



# A moral panic over cats

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**Abstract:** *Some conservationists believe that free-ranging cats pose an enormous risk to biodiversity and public health and therefore should be eliminated from the landscape by any means necessary. They further claim that those who question the science or ethics behind their arguments are science deniers (merchants of doubt) seeking to mislead the public. As much as we share a commitment to conservation of biodiversity and wild nature, we believe these ideas are wrong and fuel an unwarranted moral panic over cats. Those who question the ecological or epidemiological status of cats are not science deniers, and it is a false analogy to compare them with corporate and right-wing special interests that perpetrate disinformation campaigns over issues, such as smoking and climate change. There are good conservation and public-health reasons and evidence to be skeptical that free-ranging cats constitute a disaster for biodiversity and human health in all circumstances. Further, there are significant and largely unaddressed ethical and policy issues (e.g., the ethics and efficacy of lethal management) relative to how people ought to value and coexist with cats and native wildlife. Society is better served by a collaborative approach to produce better scientific and ethical knowledge about free-ranging cats.*

**Keywords:** biodiversity, ethics, free-ranging cats, Merchants of Doubt, methodological rigor, moral panic, public health, public policy, science denialism

Pánico Moral por los Gatos

**Resumen:** *Algunos conservacionistas creen que los gatos sueltos representan un riesgo enorme para la biodiversidad y la salud pública, por lo que deberían ser eliminados del paisaje a como dé lugar. Los conservacionistas además alegan que quienes cuestionan la ciencia o la ética detrás de estos argumentos son negadores de la ciencia (mercaderes de la duda) que buscan desinformar al público. Por mucho que compartamos un compromiso con la conservación de la biodiversidad y la fauna silvestre, creemos que estas ideas están equivocadas y alimentan un pánico moral injustificado por los gatos. Aquellos que cuestionan el estado ecológico o epidemiológico de los gatos no son negadores de la ciencia y es una analogía falsa compararlos con los intereses especiales de los corporativos y de la derecha política, los cuales perpetúan las campañas de desinformación de temas como el cigarro y el cambio climático. Existen razones y evidencias de conservación y salud pública para ser escépticos sobre el argumento de que los gatos sueltos constituyen un desastre para la biodiversidad y la salud humana bajo todas las circunstancias. Además, hay temas éticos y políticos que no reciben atención (p. ej.: la ética y la eficacia del manejo letal) relativos a cómo las personas deberían valorar y coexistir con los gatos y la fauna nativa. La sociedad se beneficia más con una estrategia colaborativa para producir un mejor conocimiento científico y ético sobre los gatos que viven sueltos.*

**Article impact statement:** *The moral panic over free-ranging cats is unwarranted and hampers conservation ethics, science, and policy. Paper submitted August 20, 2018; revised manuscript accepted March 28, 2019.*

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**Palabras Clave:** biodiversidad, ética, gatos sueltos, Mercaderes de la Duda, negación de la ciencia, pánico moral, política pública, rigor metodológico, salud pública

**摘要:** 一些保护主义者认为流浪猫对生物多样性和公共健康造成了巨大威胁, 因此应该不择手段地消灭它们。他们还进一步声称, 那些质疑他们论点背后的科学性或伦理道德的人, 是企图误导公众的科学否认者(贩卖怀疑的商人)。虽然我们同样地致力于保护生物多样性和野生自然, 但我们认为这些想法是错误的, 并助长了对猫不必要的道德恐慌。那些质疑猫的生态学问题或流行病学状况的人并不是科学否认者, 将他们与在吸烟和气候变化等问题上进行虚假宣传的企业和右翼特殊利益集团进行比较是不恰当的。我们有充分的保护和公共卫生方面的理由和证据来质疑流浪猫一律对生物多样性和人类健康造成了灾难。此外, 还有一些重大的道德和政策问题(如处死流浪猫的道德问题和效率)没有得到解决, 这些问题涉及到人们应该如何看待猫和其它当地野生动物的价值, 以及如何与之共存。只有通过合作的方式更好地理解流浪猫的科学和伦理知识, 才能更好地为社会服务。【翻译: 胡怡思; 审校: 聂永刚】

**关键词:** 流浪猫, 道德恐慌, 生物多样性, 公众健康, 《贩卖怀疑的商人》, 否定科学主义, 方法严格, 伦理学, 国家政策

## Introduction

In “Merchants of Doubt in the Free-Ranging Cat Conflict,” Loss and Marra (2018) equate citizens, nongovernmental organizations, ethicists, and scientists concerned about the well-being of free-ranging cats (*Felis catus*) (hereafter cats) with science deniers, a term used to describe those who mislead the public over the harms of smoking, ozone depletion, and climate change. We believe this analogy is false because it mischaracterizes and stigmatizes parties to the debate and fuels an unnecessary moral panic that cats are a looming global threat to biodiversity and public health (Loss & Marra 2018).

## Merchants of Doubt

To understand why the analogy is false, one needs to start with the book from which Loss and Marra (2018) draw their analogy: *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Written by science historians Naomi Oreskes and Erik Conway (2010), it explores how major policy disputes over smoking, acid rain, and global warming were driven by corporate disinformation campaigns. These campaigns sought to mislead the general public by casting doubt on the science of responsive public policies designed to mitigate demonstrably harmful activities.

According to Oreskes and Conway (2010), such efforts are carried out by a cabal of industry-beholden experts (so-called), who produce intentionally misleading research and propaganda and are supported by a well-funded infrastructure of corporate donors, nonprofit organizations, foundations, think tanks, media outlets, and conservative politicians. Individual participants in this cabal are often motivated by libertarian ideology and suspicious of government regulation. Corporate participants seek to prevent or delay policies governing environmental or public health that will negatively affect their current

or future profitability. This ongoing strategy to impede progressive policies on environmental and public health has also been well documented by others (Lakoff 2004; Rich 2005).

## A False Analogy

Loss and Marra (2018) claim that those questioning whether or how much cats threaten biodiversity or undermine public health are in the same league as the merchants of doubt discussed by Oreskes and Conway (2010). They assert “campaigns to fabricate doubt” about the “threats posed by cats” exist and are based on specific tactics, such as smearing research as “junk science,” disinformation through biased reports, bad-faith diminishment of the impacts of cats on biodiversity, and exaggerated claims about the success of the trap-neuter-return (TNR) approach in limiting urban cat densities. As a set of what they regard as factual presuppositions, they restate several previously published assertions about the wildlife mortality attributed to cats and the role of cats as hosts for zoonotic diseases (Loss et al. 2012; Marra & Santella 2016a).

Yet, the strength of any argument based on analogy rests on the similarities of the entities being compared (Toulmin et al. 1984; Lakoff & Johnson 2003). In this respect, we argue the merchants-of-doubt analogy is fatally weak. Equating the resources and power of global corporations and economic elites (e.g., Exxon Mobil) with the reach and advocacy of comparatively small nonprofit organizations and university academics strains the argument past the breaking point. Those advocating for cats or questioning the rigor and ethics of anticat science bear little to no resemblance to the corporate, conservative, and private entities denying science in the service of their vested political and economic interests.

Loss and Marra (2018) appear to have made this mistake because they elide all nonprofit organizations, global corporations, and economic elites under the

single heading of “special interests.” They sidestep a crucial and common-place policy distinction between pressure groups seeking the common good and those promoting special interests or seeking private gain at the community’s expense. The animal-protection movement simply does not manifest any of the vested material self-interests or the level of public agency capture that this analogy presumes (Treves et al. 2017). In fact, animal-advocacy organizations and public environmental agencies are often in conflict, rather than collusion, over the treatment of nonhuman animals (Perry & Perry 2008). The fact that animal advocates usually have to go through courts to protect nonhumans from harmful interventions established by public agencies and that they have little to gain economically from this advocacy speaks to the brittleness of Loss and Marra’s (2018) analogy.

It is true that people may legitimately disagree about what constitutes the common good, such as emphasizing the well-being of cats versus the protection of biodiversity. And, one or all may be in error in part or in whole. But this fact cannot be used to claim that those seeking the well-being of cats have the nefarious motives of those entities seeking to mislead political decision makers and civil society on climate change and its consequences (Union of Concerned Scientists 2018). Scientists and conservationists should instead strive to engage with those concerned with the well-being of cats because they are often also concerned with the well-being of wildlife (Nisbet et al. 2009; Toukhsati et al. 2012; Twardek et al. 2017).

### Conservation Reasons for Skepticism

Contrary to Loss and Marra’s (2018) claims that the scientific consensus is consistent with their views that cats are a global threat to biodiversity, the actual scientific consensus is that cats can, in certain contexts, have suppressive population-level effects on some other species (Twardek et al. 2017). This is something that is true of all predators, native or not (Wallach et al. 2010). Thus, cats should not be profiled as a general threat a priori and without reference to important factors of ecological context, situational factors, clear definition of harms, and evidence thereof.

Despite the scientific documentation of negative population or biodiversity impacts in certain ecological contexts (Doherty et al. 2016; Twardek et al. 2017), there is also scientific evidence providing a more nuanced perspective on potential impacts that cautions against assuming the presence or number of cats is divorced from context. Examples include notable downward revisions of wild cat numbers in Australia (Legge et al. 2017; Doherty et al. 2019); applying assumptions about specific case studies to the world at large (Tantillo 2006; Schaffner 2018); low numbers of species that are threatened or

endangered by free-ranging cats on mainlands (Doherty et al. 2016); potential disconnects between lethal population management and conservation best practices and outcomes (Littin et al. 2004; Doherty et al. 2019); distractions from larger threats to biodiversity, such as habitat loss (Ferreira et al. 2011; Doherty et al. 2019); a failure to address spatial, temporal, and ecological dynamics, such as proximity to human structures, predator guilds, predator-prey relations, and compensatory versus additive predation (Crooks & Soulé 1999; Ferreira et al. 2011; Gehrt et al. 2013; Oro 2013); unsatisfactory and counter-productive outcomes to the removal of cats and their predators in some disturbed island and mainland ecosystems (Rayner et al. 2007; Bergstrom et al. 2009; Wallach et al. 2010; Lazenby et al. 2015; Marlow et al. 2015; Fulton 2018); reappraisals of the positive roles non-native species may play in disturbed or novel ecosystems (Wallach et al. 2010; Schlaepfer 2018); appreciation for the role companion animals, such as cats, play in nature protection (Twardek et al. 2017); bickering over a useful but not miraculous tool like TNR (Longcore et al. 2009; Spehar & Wolf 2017); perceived cruelty on the part of some involved conservationists (Animal Legal & Historical Center 2013; Dell’Amore 2013); and challenges to the rigor and program of invasion biology itself (Chew & Hamilton 2011; Chew 2015; Munro et al. 2019).

Loss and Marra (2017) acknowledge the difficulty of determining whether, despite their own data, cats are actually exerting population-level impacts on their prey species. Yet, instead of endorsing further studies to ascertain these impacts, or adjusting their policy recommendations about cats in light of the methodological challenges, they sound the clarion call to “remove [cats]—once and for all—from the landscape” by “any means necessary” (Marra & Santella 2016a). This underscores their problematic claim of a “scientific consensus” allegedly supporting categorical statements, such as cats “unquestionably threaten humans” or that they may “threaten biodiversity by causing tremendous wildlife mortality” (Loss & Marra 2018) in any context and introduces an unnecessarily invidious bias against cats. We sought to highlight that these and other quotes from Loss and Marra clearly reference and normalize the lethal management so common in traditional conservation. It is not a distortion of its meaning to point that out and think through what it implies.

### Public Health Reasons for Skepticism

Problems of overgeneralizations and misinterpretation also plague Loss and Marra’s (2018) statement that “free-ranging cats unquestionably threaten humans as hosts of zoonotic disease.” Painting cats as a looming public health crisis has been one strategy that Marra and colleagues have pursued at length (Marra & Santella 2016b).

In “Merchants of Doubt,” Loss and Marra (2018) ground this claim in the Centers for Disease Control and Prevention’s (CDC) “Healthy Pets, Healthy People” webpage that discusses feline, human, and public health (CDC 2016). It is misleading to portray this educational material as an urgent warning in order to generate a public health crisis over cats. This is not to say that diseases, such as toxoplasmosis or rabies, are not serious concerns; rather, all claims about zoonoses need to be set in context and based on real and comparative risks.

For example, Marra and colleagues’ claims about toxoplasmosis and mental health (e.g., “one of the least understood but most critical public-health challenges of our time”) (Marra & Santella 2016b) are being challenged (Solmi et al. 2017) due to the lack of control for confounding variables and small sample sizes. In fact, the authors of the study they cite arguing for harmful *Toxoplasma gondii* effects to pregnant mothers caution against any interpretation of causality or generalizations (Pedersen et al. 2012). Although toxoplasmosis can threaten the pregnancies of previously unexposed mothers, for people with immunosuppressive conditions and diseases, such as HIV/AIDS, and people being treated with immune-suppressive therapies for cancer and autoimmune diseases, direct contact with cats is not thought to be a primary risk factor for human infection because cats are fastidious by nature, oocysts are not infective when passed, and the duration of oocyst shedding is short (Elmore et al. 2010). Risk factors of greater importance for human infection include ingestion of tissue cysts in contaminated meat and oocyst-contaminated soil and water (Jones et al. 2007).

This is not a cause for alarmism, but for rational measures to manage risk—keeping cats of those at risk indoors to reduce exposure, washing hands after handling cats, proper litter-box management, avoiding consumption of undercooked meat, wearing gloves when gardening, continuing efforts to develop vaccines, and other preventative health care measures (CDC 2016). Perhaps due to greater adherence to these recommendations, the rate of *T. gondii* seroprevalence in the United States appears to be decreasing (Jones et al. 2007).

Similar issues attend rabies. Cats are not reservoirs for the rabies virus, but they can serve as vectors for rabies virus variants (RVVs) that circulate in wild animals. Considering contributions to total cases, rabies is significantly less prevalent in cats than in bats and other wildlife, such as skunks, raccoons, and foxes (CDC 2017) (Ma et al. 2018a). How great a risk they pose is a separate question.

The assessment of rabies risk is based on the observation that cats, because of their nocturnal habits, are more likely to have physical contact with nocturnal wildlife populations that are reservoirs for RVV. In 2016 and 2017, most rabid cats were reported from 5 eastern U.S. states (Virginia, West Virginia, Pennsylvania, New York, and

New Jersey), where the raccoon RVV was considered enzootic (Ma et al. 2018a, 2018b) and where human activity in the early 1990s is believed to have been responsible for introducing rabies to raccoon populations (Rupprecht & Smith 1994).

Public health measures to prevent human rabies from cat exposures have been highly successful. Recent estimates indicate that 16% of national postexposure prophylaxis (PEP) administration is attributable to cat exposures (Christian et al. 2009), and this may be higher in regions where raccoon rabies is enzootic. From February 2003 to July 2018, not one of 42 human rabies cases among people living in the United States and Puerto Rico was determined to be caused by exposure to a cat (Ma et al. 2018a), although in one 2011 case a child’s exposure to a rabid cat was possible but not confirmed (Roebbling et al. 2014). These findings indicate that public health professionals and the public are highly aware of the potential risk of rabies from domestic animals, the need to submit cat rabies suspects for testing, and the need to seek PEP if exposure to cats of absent or unknown rabies vaccination status is confirmed or suspected.

The dramatic decline in dog rabies within the past century was accomplished through state and local policies that promote mass vaccination coverage and control of strays by removal to shelters, testing for rabies where indicated, sterilization, and adoption (CDC 2008). Although adherence to these policies appears limited for cats, current national recommendations focus on greater attention to existing policies (Brown et al. 2016). This is particularly important to apply in states where the majority of rabid cats are found.

The crux of the matter here is that neither the costs of testing rabies-suspect cats and PEP administration nor the number of human rabies cases attributable to exposure to rabid cats justifies a panic over cats. Indeed, globally dogs pose a far greater risk for rabies than cats, but the World Health Organization, the World Organization for Animal Health, and the Food and Agriculture Organization of the United Nations jointly note that the systematic killing of stray dogs is neither effective in controlling stray dog populations nor in reducing cases of rabies in dogs and recommend against the systematic killing of stray dogs in favor of public health measures to control the virus in dogs. The latter is more cost-effective than indefinite PEP of humans, which does not change disease ecology or break the cycle of transmission to humans (WHO 2014).

In the United States in 2017, U.S. Department of Agriculture Wildlife Services, state agencies, and the CDC cooperated on a large-scale program to control the spread and ultimately eliminate the raccoon RVV, and plans are underway to expand this program to other wildlife reservoirs (Ma et al. 2018a). This builds on previously successful statewide programs (Robbins et al. 1998) and is consistent with international efforts to control and eliminate the virus and not the vectors or the reservoirs.



For these reasons, society should not be stampeded by fear-mongering into making poor policy choices. Attention to prevention and control of zoonotic diseases is better focused on the development and distribution of vaccines and continuing current recommendations and interventions with respect to rabies and other zoonotic diseases. After all, if society were to respond to the risk of zoonotic diseases by simply killing or removing from the landscape the entirety of its reservoirs and vectors, billions of wild and domestic animals, including humans, would likely be subject to harmful or deadly interventions annually. That is not an ethically or scientifically reasonable course of action.

### Beyond Moral Panic

As ethicists and scientists who value the lives of individual animals as well as the preservation of biodiversity, we recognize that non-native species may, in specific circumstances, pose a threat to native wildlife and human health. This does not excuse, however, conservationists overgeneralizing their science and losing their moral compass by profiling cats as a threat in all ecological or public health circumstances. The nuanced scientific evidence we do have—and the ethical dialogue that has just begun—cautions against a moral panic over cats. Nor are there grounds for dismissing those seeking greater scientific and ethical insight on this issue as peddling antiscience disinformation. It is quite the opposite because the harming of sentient, sapient, and social individuals, such as cats, that Loss and Marra (2018) and others (e.g., Marra & Santella 2016a) countenance requires strict ethical and scientific scrutiny.

To eschew both a moral panic and a deadlocked dispute over free-ranging cats, we offer several suggestions for both the conservation and animal protection communities to consider. First, one should frankly acknowledge the substantial reasons for skepticism about claims that free-ranging cats pose a clear and present danger to global biodiversity or that they pose an immediate threat to public health. Such skepticism is not the result of science denialism or a campaign by “merchants of doubt” to mislead the public and policy makers. It speaks instead to an earnest dispute about both the facts and values, that is, the scientific and ethical dimensions of the debate swirling around cats. This should come as no surprise because it reflects a growing debate within invasion biology itself (Chew & Hamilton 2011; Munro et al. 2019).

Second, this skepticism should not be used to deny the impact cats may have when rigorously documented for specific contexts. Rather, it opens an opportunity for researchers to develop better evidence and theoretical understanding. This will help citizens, scientists, and decision makers avoid overgeneralizing or underdeter-

mining how cats may impact nature and society. It is also an opportunity to develop a protocol with non- or the least harmful measures to be used first and foremost as an ethical prerequisite. If any harmful measures are invoked, these require rigorous and ongoing evaluation of their need and monitoring of their efficacy (Littin & Mellor 2005; Littin 2010; Hadidian 2012; Hadidian 2015; Doherty et al. 2019).

Third, the ecological and public-health issues do not touch on the ethics and policy problems that are core to understanding the dispute over cats—grappling with the intrinsic value of all animals (wild and domestic) in conservation (Midgley 1998; Santiago-Ávila et al. 2018); balancing moral obligations to both native and non-native species (Lynn 1998; Lynn 2018); learning how to coexist with wild and domestic animals across a range of urban to wild landscapes (Hadidian et al. 2006; Hadidian 2015); changing paradigms of conservation that encourage non-lethal methods of management (Ramp & Bekoff 2015; Wallach et al. 2018; Treves et al. 2019); making questionable or missing moral justifications for introducing disease (Berthier et al. 2000) and indiscriminate poisons (Doherty & Algar 2015) to control cats; considering the role of values and ethics as drivers of policy disputes, such as those over cats (Shrader-Frechette & McCoy 1994; Lynn 2006); and considering the serious theoretical and ethical debate within invasion biology over its presuppositions and value judgments about introduced species (Chew & Hamilton 2011; Wallach et al. 2015; Munro et al. 2019). Both conservation and animal protection communities must be willing to grapple with these value-laden issues directly.

Fourth, it may be tempting to appeal to a precautionary approach that would argue that even if the impact of free-ranging cats on nature and society is not settled science, we should take action to reduce or eliminate outdoor cats as a matter of precaution. Before we accept this argument at face value, it is important to understand that precaution is not simply a rationale for action in the face of scientific uncertainty (Tickner 2002). In its original German formulation, *vorsorgeprinzip* is “the principle of forecaring” (O’Riordan & Cameron 1994). In this sense, it is an ethical principle for public policy that has implications for the use of science in undertaking action for the common good (Myers & Raffensperger 2006; Bernard 2016). It seeks to foresee, forewarn, and forestall harm to the well-being of individuals and communities, something that applies to individual humans, nonhuman animals, and ecological and social communities (Raffensperger & Tickner 1999; Lynn 2018). The principle of precaution is not a way to sidestep complex questions of science or ethics and thereby resolve the debate over cats one way or the other. It is instead a powerful tool for thinking through and weighing how one ought to respond to cats in varying ecological and social circumstances in light of the ethical and scientific complexities at hand.

We welcome calls for the adoption of a precautionary approach, when it involves the implementation of mitigation measures that are not harmful, and monitoring and adaptive management (Calver et al. 2011). We caution against instrumentalizing such a principle, which focuses on harm reduction, precisely to categorically justify harmful interventions against cats, especially in the face of evidenced social, ecological, ethical, and effectiveness concerns (Littin & Mellor 2005; Littin 2010; Hadidian 2012; Hadidian 2015; Doherty & Ritchie 2017).

Finally, we urge everyone concerned with free-ranging cats to reject framing this debate as a matter of us versus them. A more fruitful and collaborative approach was demonstrated in 2012 during a conference in Los Angeles, California (U.S.A.), entitled *The Outdoor Cat: Science and Policy from a Global Perspective*. The conference brought together citizens, ethicists, and scientists, who as a group cared about both cats, biodiversity, and public health. The conference consensus statement reads, in part:

It is important to develop a scientifically . . . [and] ethically well-founded consensus on how to manage conflicts with outdoors cats, explicitly bearing in mind the diversity of contexts within which management needs to occur. Strategies built on this consensus are most likely to be developed through constructive, collaborative engagement between those with expertise in animal welfare and wildlife conservation. While cats continue to suffer, and wildlife species continue to decline in the face of multiple threats, all stakeholders share a duty of care to work together in solving these problems. (HSUS 2013)

We believe the spirit of respectful engagement embodied by this statement is a better path to travel and offers the best opportunity to resolving the complex issues surrounding free-ranging cats.

## Literature Cited

- Animal Legal & Historical Center. 2013. Nico Dauphine, Appellant v. United States, Appellee, 73 A.3d 1029 (D.C. Cir. 2013). Available from <https://www.animallaw.info/case/dauphine-v-us> (accessed February 2019).
- Bergstrom DM, Lucieer A, Kiefer K, Wasley J, Belbin L, Pedersen TK, Chown SL. 2009. Indirect effects of invasive species removal devastate World Heritage Island. *Journal of Applied Ecology* 46:73–81.
- Bernard R. 2016. Precautionary principle, pluralism and deliberation. John Wiley & Sons, Hoboken, New Jersey.
- Berthier K, Langlais M, Auger P, Pontier D. 2000. Dynamics of a feline virus with two transmission modes within exponentially growing host populations. *Proceedings of the Royal Society of London, Series B. Biological Sciences* 267:2049–2056.
- Brown CM, Slavinski S, Ettestad P, Sidwa TJ, Sorhage FE. 2016. Compendium of animal rabies prevention and control, 2016. *Journal of the American Veterinary Medical Association* 248:505–517.
- Calver MC, Grayson J, Lilith M, Dickman CR. 2011. Applying the precautionary principle to the issue of impacts by pet cats on urban wildlife. *Biological Conservation* 144:1895–1901.
- CDC (Centers for Disease Control and Prevention). 2008. Human rabies prevention — United States, 2008: recommendations of the Advisory Committee on Immunization Practices. *Morbidity and Mortality Weekly Report* 57. Available from <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5703a1.htm> (accessed February 2019).
- CDC (Centers for Disease Control and Prevention). 2016. Healthy pets, healthy people. CDC, Atlanta, Georgia. Available from <https://www.cdc.gov/healthypets/pets/cats.html> (accessed June 2018).
- CDC (Centers for Disease Control and Prevention). 2017. Rabies. CDC, Atlanta, Georgia. Available from <https://www.cdc.gov/rabies/> (accessed June 2018).
- Chew MK. 2015. Ecologists, environmentalists, experts, and the invasion of the second greatest threat. *International Review of Environmental History* 1:7–40.
- Chew MK, Hamilton AL. 2011. The rise and fall of biotic nativeness: a historical perspective. Pages 35–48 in Richardson DM, editor. *Fifty years of invasion ecology: the legacy of Charles Elton*. Wiley-Blackwell, Chichester, United Kingdom.
- Christian KA, Blanton JD, Auslander M, Rupprecht CE. 2009. Epidemiology of rabies post-exposure prophylaxis—United States of America, 2006–2008. *Vaccine* 27:7156–7161.
- Crooks KR, Soulé ME. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. *Nature* 400:563.
- Dell'Amore C. 2013. Writer's call to kill feral cats sparks outcry. *National Geographic News*. Available from <https://news.nationalgeographic.com/news/2013/03/130320-feral-cats-euthanize-ted-williams-audubon-science/> (accessed February 2019).
- Doherty TS, Algar D. 2015. Response of feral cats to a track-based baiting programme using Eradicat® baits. *Ecological Management & Restoration* 16:124–130.
- Doherty TS, Driscoll DA, Nimmo DG, Ritchie EG, Spencer RJ. 2019. Conservation or politics? Australia's target to kill 2 million cats. *Conservation Letters* <https://doi.org/10.1111/conl.12633>.
- Doherty TS, Glen AS, Nimmo DG, Ritchie EG, Dickman CR. 2016. Invasive predators and global biodiversity loss. *Proceedings of the National Academy of Sciences of the United States of America* 113:11261–11265.
- Doherty TS, Ritchie EG. 2017. Stop jumping the gun: a call for evidence-based invasive predator management. *Conservation Letters* 10: 15–22.
- Elmore SA, Jones JL, Conrad PA, Patton S, Lindsay DS, Dubey JP. 2010. *Toxoplasma gondii*: epidemiology, feline clinical aspects, and prevention. *Trends in Parasitology* 26:190–196.
- Ferreira JP, Leitão I, Santos-Reis M, Revilla E. 2011. Human-related factors regulate the spatial ecology of domestic cats in sensitive areas for conservation. *PLOS ONE* (e25970) <https://doi.org/10.1371/journal.pone.0025970>.
- Fulton GR. 2018. Avian nest predation in Australian temperate forest and woodland: a review. *Pacific Conservation Biology* 24:122–133.
- Gehrt SD, Wilson EC, Brown JL, Anchor C. 2013. Population ecology of free-roaming cats and interference competition by coyotes in urban parks. *PLOS ONE* 8 (e75718) <https://doi.org/10.1371/journal.pone.0075718>.
- Hadidian J. 2012. Taking the “pest” out of pest control: humaneness and wildlife damage management. Pages 7–11 in Frey SN, editor. *Proceedings of the 14th wildlife damage management conference*. University of California, Davis, Davis, California.
- Hadidian J. 2015. Wildlife in US cities: managing unwanted animals. *Animals (Basel)* 5:1092–1113.
- Hadidian J, Fox C, Lynn WS. 2006. The ethics of wildlife control in humanized landscapes. Pages 500–504 in Timm RM, O'Brien JM, editors. *Proceedings of the twenty-second vertebrate pest conference*. University of California, Davis, Davis, California.
- HSUS (Humane Society of the United States). 2013. Results of the outdoor cat conference. Available from <http://www.humanesociety.org/news/publications/whitepapers/presentations-outdoor-cat-conference.html> (accessed June 2018).
- Jones JL, Kruszon-Moran D, Sanders-Lewis K, Wilson M. 2007. *Toxoplasma gondii* infection in the United States, 1999–2004, decline

- from the prior decade. *American Journal of Tropical Medicine and Hygiene* **77**:405–410.
- Lakoff G. 2004. Don't think of an elephant! Know your values and frame the debate. Chelsea Green Publishing, New York, New York.
- Lakoff G, Johnson M. 2003. *Metaphors we live by*. 2nd edition. University of Chicago Press, Chicago, Illinois.
- Lazenby BT, Mooney NJ, Dickman CR. 2015. Effects of low-level culling of feral cats in open populations: a case study from the forests of southern Tasmania. *Wildlife Research* **41**:407–420.
- Legge S, Murphy BP, McGregor H, Woinarski JCZ, Augusteyn J, Ballard G, Baseier M, Buckmaster T. 2017. Enumerating a continental-scale threat: how many feral cats are in Australia. *Biological Conservation* **206**:293–303.
- Littin KE. 2010. Animal welfare and pest control: meeting both conservation and animal welfare goals. *Animal Welfare* **19**:171–176.
- Littin KE, Mellor DJ. 2005. Strategic animal welfare issues: ethical and animal welfare issues arising from the killing of wildlife for disease control and environmental reasons. *Review Science and Technology* **24**:767–782.
- Littin KE, Mellor DJ, Warburton B, Eason CT. 2004. Animal welfare and ethical issues relevant to the humane control of vertebrate pests. *New Zealand Veterinary Journal* **52**:1–10.
- Longcore T, Rich C, Sullivan LM. 2009. Critical assessment of claims regarding management of feral cats by trap–neuter–return. *Conservation Biology* **23**:887–894.
- Loss SR, Marra PP. 2017. Population impacts of free-ranging domestic cats on mainland vertebrates. *Frontiers of Ecology and Environment* **15**:502–509.
- Loss SR, Marra PP. 2018. Merchants of doubt in the free-ranging cat conflict. *Conservation Biology* **32**:265–266.
- Loss SR, Will T, Marra PP. 2012. The impact of free-ranging domestic cats on wildlife of the United States. *Nature Communications* **4**:1–8.
- Lynn WS. 1998. Contested moralities: animals and moral value in the Dear/Symanski debate. *Ethics, Place and Environment* **1**:223–242.
- Lynn WS. 2006. Between science and ethics: what science and the scientific method can and cannot contribute to conservation and sustainability. Pages 191–205 in Lavigne D, editor. *Gaining ground: in pursuit of ecological sustainability*. University of Limerick, Limerick.
- Lynn WS. 2018. Bringing ethics to wild lives: public policy for barred and northern spotted owls. *Society & Animals: Special Issue on Wildlife* **26**:217–238.
- Ma X, et al. 2018a. Rabies surveillance in the United States during 2017. *Journal of the American Veterinary Medical Association* **253**:1555–1568.
- Ma X, et al. 2018b. Rabies surveillance in the United States during 2016. *Journal of the American Veterinary Medical Association* **252**:945–957.
- Marlow NJ, Thomas ND, Williams AAE, Macmahon B, Lawson J, Hitchen Y, Angus J, Berry O. 2015. Cats (*Felis catus*) are more abundant and are the dominant predator of woylies (*Bettongia penicillata*) after sustained fox (*Vulpes vulpes*) control. *Australian Journal of Zoology* **63**:18–27.
- Marra PP, Santella C. 2016a. *Cat wars: the devastating consequences of a cuddly killer*. Princeton University Press, Princeton, New Jersey.
- Marra PP, Santella C. 2016b. The zombie maker: cats as agents of disease. Pages 75–94 in *Cat wars: the devastating consequences of a cuddly killer*. Princeton University Press, Princeton, New Jersey.
- Midgley M. 1998. *Animals and why they matter*. Reissue edition. University of Georgia Press, Athens, Georgia.
- Munro D, Steer J, Linklatter W. 2019. On allegations of invasive species denialism. *Conservation Biology* <https://doi.org/10.1111/cobi.13278>.
- Myers NJ, Raffensperger C. 2006. *Precautionary tools for reshaping environmental policy*. MIT Press, Cambridge, Massachusetts.
- Nisbet EK, Zelenski JM, Murphy SA. 2009. The nature relatedness scale. *Environment and Behavior* **41**:715–740.
- O'Riordan T, Cameron J, editors. 1994. *Interpreting the precautionary principle*. Earthscan, London, United Kingdom.
- Oreskes N, Conway EM. 2010. *Merchants of doubt: how a handful of scientists obscured the truth on issues from tobacco smoke to global warming*. 1st U.S. edition. Bloomsbury Press, New York, New York.
- Oro D. 2013. Grand challenges in population dynamics. *Frontiers in Ecology and Evolution* **1**:2.
- Pedersen MG, Mortensen PB, Norgaard-Pedersen B, Postolache TT. 2012. *Toxoplasma gondii* infection and self-directed violence in mothers. *Archives of General Psychiatry* **69**:1123–1130.
- Perry D, Perry G. 2008. Improving interactions between animal rights groups and conservation biologists. *Conservation Biology* **22**:27–35.
- Raffensperger C, Tickner J, editors. 1999. *Protecting public health and the environment: implementing the precautionary principle*. Island Press, Washington, D.C.
- Ramp D, Bekoff M. 2015. Compassion as a practical and evolved ethic for conservation. *BioScience* **65**:323–327.
- Rayner MJ, Hauber ME, Imber MJ, Stamp RK, Clout MN. 2007. Spatial heterogeneity of mesopredator release within an oceanic island system. *Proceedings of the National Academy of Sciences of the United States America* **104**:20862–20865.
- Rich A. 2005. War of ideas: why mainstream and liberal foundations and the think tanks they support are losing in the war of ideas in American politics. *Stanford Social Innovation Review*, Spring, 18–25.
- Robbins AH, et al. 1998. Prevention of the spread of rabies to wildlife by oral vaccination of raccoons in Massachusetts. *Journal of the American Veterinary Medical Association* **213**:1407–1412.
- Roebing AD, Johnson, D, Blanton JD, Levin M, Slate D, Fenwick G, Rupprecht CE. 2014. Rabies prevention and management of cats in the context of trap–neuter–vaccinate–release programmes. *Zoonoses Public Health* **61**:290–296.
- Rupprecht CE, Smith JS. 1994. Raccoon rabies: the re-emergence of an epizootic in a densely populated area. *Seminars in Virology* **5**:155–164.
- Santiago-Ávila FJ, Lynn WS, Treves A. 2018. Inappropriate consideration of animal interests in predator management: towards a comprehensive moral code. Pages 227–251 in Hovardos T, editor. *Large carnivore conservation and management: human dimensions and governance*. Routledge, New York, New York.
- Schaffner JE. 2018. Cat wars: the devastating consequences of a dangerous book. *Journal of Animal Ethics* **8**:236–248.
- Schlaepfer MA. 2018. Do non-native species contribute to biodiversity. *PLoS Biology* **16**:e2005568.
- Shrader-Frechette KS, McCoy ED. 1994. How the tail wags the dog: how value judgments determine ecological science. *Environmental Values* **3**:107–120.
- Solmi F, Hayes JF, Lewis G, Kirkbride JB. 2017. Curiosity killed the cat: no evidence of an association between cat ownership and psychotic symptoms at ages 13 and 18 years in a UK general population cohort. *Psychological Medicine* **47**:1659–1667.
- Spehar DD, Wolf PJ. 2017. An examination of an iconic trap–neuter–return program: The Newburyport, Massachusetts case study. *Animals (Basel)* **7**. <https://doi.org/10.3390/ani7110081>.
- Tantillo, JA. 2006. Killing Cats and Killing Birds: philosophical Issues Pertaining to Feral Cats. Pages 701–708 in JR August, editor. *Consultations in Feline Internal Medicine*. Elsevier Saunders, St. Louis, Missouri.
- Tickner J, editor. 2002. *Precaution, environmental science and preventive public policy*. Island Press, Washington, D.C.
- Toukhsati SR, Young E, Bennett PC, Coleman GJ. 2012. Wandering cats: attitudes and behaviors towards cat containment in Australia. *Anthrozoös* **25**:61–74.
- Toulmin SE, Rieke RD, Janik A. 1984. *An introduction to reasoning*. Prentice Hall, New York, New York.



- Treves A, Chapron G, López-Bao JV, Shoemaker C, Goeckner AR, Bruskotter JT. 2017. Predators and the public trust. *Biological Reviews* **92**:248–270.
- Treves A, Santiago-Ávila FJ, Lynn WS. 2019. Just preservation. *Biological Conservation* **229**:134–141.
- Twardek WM, Peiman KS, Gallagher AJ, Cooke S. 2017. Fido, Fluffy, and wildlife conservation: the environmental consequences of domesticated animals. *Environmental Reviews* **25**:381–395.
- Union of Concerned Scientists (UCS). 2018. Global warming skeptic organizations. UCS, Washington, D.C. Available from <https://www.ucsusa.org/global-warming/solutions/fight-misinformation/global-warming-skeptic.html#.WwbqWS8ZNgc> (accessed May 2018).
- Wallach AD, Bekoff M, Batavia C, Nelson MP, Ramp D. 2018. Summoning compassion to address the challenges of conservation. *Conservation Biology* **32**:1255–1265.
- Wallach AD, Johnson CN, Ritchie EG, O'Neill AJ. 2010. Predator control promotes invasive dominated ecological states. *Ecology Letters* **13**:1008–1018.
- Wallach AD, Ripple WJ, Carroll SP. 2015. Novel trophic cascades: apex predators enable coexistence. *Trends in Ecology & Evolution* **30**:146–153.
- WHO (World Health Organization). 2014. Rabies - bulletin - Europe. Rabies is a tripartite priority. WHO, Geneva, Switzerland. Available from <https://www.oie.int/doc/ged/D14101.PDF> (accessed January 2019).

