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# What If Everything You Thought You Knew About “Feral” Cats Was Wrong?

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**ABSTRACT:** Among the many topics discussed under the broad category of urban ecology, few are as contentious as the management of unowned free-roaming cats. Like any public policy, the policies intended to effectively manage the population of these cats must, in addition to meeting other criteria (e.g., reflect broad public interest, economic feasibility, etc.), be based on sound science. Although many communities across the country have implemented programs based on the trap-neuter-return (TNR) method of managing “feral” cats, such efforts are often met with significant opposition by those claiming to have science on their side. However, this review of one of the most-often cited research papers on the subject reveals a number of significant shortcomings that undermine such claims. Public policy justified by such work is likely to prove costly and ineffective, and will very likely increase any legitimate threats unowned free-roaming cats pose to wildlife, the environment, and public health.

**KEY WORDS:** birds, computer modeling, feral cats, non-lethal control, predation, Trap-Neuter-Return

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## INTRODUCTION

In a 2014 article published in *The Condor*, researchers from the Smithsonian Conservation Biology Institute and U.S. Fish and Wildlife Service estimated that 365-988 million birds “are killed annually by building collisions in the U.S.” (Loss et al. 2014). One year earlier, *Nature Communications* published “The impact of free-ranging domestic cats (*Felis catus*) on wildlife of the United States,” in which three of four authors estimated – using computer modeling and inputs they describe as “conservative” – that “free-ranging domestic cats kill 1.3-4.0 billion birds” (Loss et al. 2013a) annually in the contiguous U.S.

Combining the high-end estimates, one is left with the impression that these two causes alone are responsible for up to 5.0 billion bird mortalities in the U.S. – year in and year out. According to the Partners in Flight Population Estimates Database, however, the total number of land-birds in all of North America was then estimated to be only 4.7 billion (Rich et al. 2004, Blancher 2007). Referring to the Guide to the Partners in Flight Population Estimates Database, Loss et al. claim that “existing estimates range from 10–20 billion individuals in North America.” The Guide itself, however, suggests otherwise: “The total of all estimates for North America is approximately 5 billion breeding birds.” How are we to reconcile these three estimates? Indeed, the mortalities attributed to domestic cats alone warrant careful scrutiny, in light of the implication: free-roaming cats in the Lower 48 are responsible for killing up to 85% of North America’s land birds each year.

In fact, remarkably little scrutiny was forthcoming (but see Matthews 2013, Wolf 2013). Comments I submitted (focusing on the key points made in the present review) were rejected by *Nature Communications*’ senior editor: “We do not feel that they challenge key data or conclusions of the paper by Dr. Loss and colleagues.” On the contrary, “The impact of free-ranging domestic cats” was an immediate hit with the mainstream media. On the day the paper was published online, January 29, for example, online

stories appeared via *The New York Times* (“That Cuddly Kitty Is Deadlier than You Think”), the BBC (“Cats killing billions of animals in the US”), and National Public Radio (“Killer Kitties? Cats Kill Billions Of Creatures Every Year”). And it wasn’t long before the paper was being used to justify policies opposing the use of trap-neuter-return (TNR) for the management of unowned, free-roaming cats, with op-eds in *The Baltimore Sun* (Fenwick 2013) and *San Francisco Chronicle* (Lynes 2013) appearing within weeks. And in 2015, Washington D.C.’s Department of Energy and Environment relied solely on “The impact of free-ranging domestic cats” to justify the agency’s position on free-ranging cats, as articulated in its Draft 2015 District of Columbia Wildlife Plan:

“Government-sanctioned Trap-Neuter-Return (TNR) programs in the District should be revisited... Captured free-ranging cats can be taken in by several adoption facilities operating in the District” (Ossi et al. 2015).

And “The impact of free-ranging domestic cats” was featured prominently in the 2014 State of the Birds report. Among “best ways to reduce bird mortality,” explain the report’s authors, are “keeping pet cats indoors and implementing policies to eliminate feral cat colonies” (NABCI 2014). Curiously, though, the report’s authors are unambiguous in their big-picture assessment: “Habitat loss is by far the greatest cause of bird population declines.” Such statements obviously raise serious questions about the alleged role of free-roaming cats.

A February 5, 2016, review of various metrics compiled on the *Nature Communications* website reveal the paper’s popularity: it’s ranked 27<sup>th</sup> among “the 286,927 tracked articles of a similar age in all journals” and 1<sup>st</sup> “of the 279 tracked articles of a similar age in *Nature Communications*.” “The impact of free-ranging domestic cats” has been mentioned in 33 “scientific blogs” and 41 news stories, and cited in dozens of journal articles: 63 according to Web of Science, 77 according to Scopus (Nature Communications 2016). The potential influence

of such a widely cited paper can be considerable, providing both policy makers and their constituents with the justification necessary to implement unpalatable policies: lethal methods for managing the most popular (by overall number, if not by ownership rate) companion animal in the U.S. (APPA 2014b). Indeed, Loss et al. (2013a) acknowledge the policy implications: “Our estimates should alert policy makers and the general public about the large magnitude of wildlife mortality caused by free-ranging cats.” But what if the mortality estimates are grossly exaggerated – what role should flawed research play in shaping public policy?

#### **NO EVIDENCE OF POPULATION DECLINES**

“The magnitude of our mortality estimates,” explain Loss et al. (2013a), “suggest that cats are likely causing population declines for some species and in some regions.” However, the authors cite no examples of such impacts. And, although Loss et al. (2013a) acknowledge that the “conservation importance of a mortality source requires identification of which species are being killed (for example, native versus non-native invasive species and rare versus common species),” the evidence they compile suggests that domestic cats are, in fact, of little “conservation importance.” Based on their collection of 10 studies, documenting 438 bird specimens across 58 species, for example, the authors claim that 67% of the birds preyed upon by cats are from 54 native species (Loss et al. 2013a). However, the vast majority of these native species are healthy as populations; indeed, all but one of the 54 are considered species of Least Concern by the International Union for Conservation of Nature. The single exception, the northern bobwhite, is considered Near Threatened due largely to “widespread habitat fragmentation” and extensive hunting (IUCN 2012). Moreover, the populations of at least 25 of those 54 species (46%) are, as indicated by North America Breeding Bird Survey data (Sauer et al. 2012), stable or increasing. And just 10 of the 54 species have been assigned breeding or non-breeding threat assessment scores of 3 or higher (on a scale of 1-5; 1 = low vulnerability, 5 = high vulnerability) in the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004). If the estimates generated by Loss et al. are even remotely accurate, one would expect to see some evidence of the population declines to which they refer – especially if their estimates are, as the authors repeatedly suggest, truly conservative.

Any claim of population declines attributable to free-roaming cats challenges a previous review of more than 80 predation studies from around the world in which researchers found “there are few, if any studies apart from island ones, that actually demonstrate that cats have reduced bird populations” (Fitzgerald and Turner 2000). This is hardly surprising in light of the compensatory (as opposed to additive) nature of predation by domestic cats in contexts other than islands. At least two studies (Møller and Erritzøe 2000, Baker et al. 2008) have investigated this in detail, revealing that birds killed by cats are, on average, significantly less healthy than birds killed through non-predatory events (e.g., collisions with windows or cars). As the Royal Society for the Protection of Birds explains, “It is likely that most of the birds killed by cats would have

died anyway from other causes before the next breeding season, so cats are unlikely to have a major impact on populations” (RSPB 2011).

Unable to provide evidence of population declines, Loss et al. (2013a) rely solely on “the magnitude of [their] mortality estimates” to support the claim that “cats are likely causing population declines for some species and in some regions.” As I will demonstrate, however, the assumptions underlying the computer modeling at the heart of “The impact of free-ranging domestic cats” are badly flawed, thereby undermining the authors’ estimates – and, in turn, their influence with “policy makers and the general public.”

#### **FLAWED MODEL INPUTS**

There is an expression that originated in the early days of computers: “Garbage in, garbage out” (Shapiro 2006, Lidwell et al. 2010). The value of computer modeling, however simple or complex, depends largely on the accuracy of its input values. A review of the input variables used by Loss et al. (some of which are pulled directly from the literature, while others are derived from data found in the literature) reveals a number of questionable assumptions, contradictory information, and mischaracterizations – often inflating the input values, and thereby the overall mortality estimates. The detailed analysis that follows will likely appear tedious to some – perhaps *many* – readers. However, such analysis is necessary to understand the flaws underlying the mortality estimates that attracted so much media attention. In any case, research published in a peer-reviewed journal – and especially work with such obvious policy implications – should be able to withstand careful scrutiny.

#### **Un-owned Cats**

As Loss et al. (2013a) explain, their model inputs corresponding to the “un-owned cat population size and predation rate explained the greatest variation in mortality estimates,” contributing roughly 42% and 24%, respectively. These figures refer to estimates for bird mortalities; the corresponding figures for mammals are 51% and 40%. These two factors will therefore be discussed before addressing factors contributing to a lesser degree. Again, Loss et al. generated predation estimates for both birds and small mammals; however, the present discussion will be limited to those associated with birds, as these estimates attracted considerable media attention (Angier 2013, Eilperin 2013, LaCapra 2013, Raasch 2013), and leveraged by some in the conservation community to rationalize their ongoing opposition to the TNR method of managing un-owned free-roaming cats (Fenwick 2013, Lynes 2013, Williams 2013, Yarnold 2013) and support for lethal control methods (Fenwick 2013, Williams 2013).

#### **Number of Un-owned Cats**

Although it’s true, as Loss et al. note, that there are no empirically-derived estimates of the un-owned cat population at a national level, at least three studies (Johnson et al. 1993, Johnson and Lewellen 1995, Levy et al. 2003) have attempted to estimate the population of un-owned cats at a *local* level, using telephone surveys to determine the proportion of residents feeding cats they didn’t own and the

average number of such cats being fed by these residents. Were the findings of these studies (i.e., the estimated population of presumably un-owned cats as a fraction of the overall population of cats in a community) to be extrapolated nationally, the resulting estimate for the population of un-owned cats would range from approximately 47 to 66 million, somewhat lower than the 50-80 million figure used by Loss et al. (2013a). However, several factors suggest that this extrapolated estimate is likely to be exaggerated, perhaps considerably—in which case, an estimate of 50-80 million must also be too high (perhaps considerably).

To begin with, the survey method used assumes that respondents are able to determine if a particular cat is owned or not. But because most cats don't wear collars (Lord et al. 2007, Lord 2008, Gibson 2012, Lisnik 2012), such determinations can be quite difficult. And recent research using collar-mounted video cameras on pet cats has revealed “secret lives” in which some cats regularly visited neighboring homes, “basically cheating on their original owners” (Block 2012, Diep 2013). Such behavior obviously hinders attempts to identify free-roaming cats as either owned or un-owned. These challenges likely lead to over-counting, thereby inflating any subsequent population estimates.

Further contributing to these inflated population estimates are factors specific to the three examples cited here, which refer to surveys conducted in California (Johnson et al. 1993, Johnson and Lewellen 1995) and Florida (Levy et al. 2003), where temperate climates allow for larger populations of un-owned cats than in other parts of the country. And both states are, according to a recent AVMA report (AVMA 2012), among the lowest in the country for cat ownership (CA = 28.3%, FL = 27.3%, as compared to the national average of 30.4%). The ratio of un-owned cats to owned cats in these parts of the country will, as a result, likely be higher than in other parts of the country. (By contrast, consider Vermont: with an estimated cat ownership rate of 49.5%, the estimated population of pet cats exceeds 500,000 (Lisnik 2012, AVMA 2012), but the un-owned cat population is estimated to be only about 30,000 (Lisnik 2012).)

It should be clear, then, that an estimated nationwide population of 47-66 million un-owned cats, derived from the three surveys cited previously, is exaggerated, perhaps by a wide margin. In which case, it should be equally clear that the 50-80 million figure used by Loss et al. (lacking any empirical basis) is also inflated. (And again, this one factor accounts for 44% of the variation in the authors' overall mortality estimates.)

### ***Bird Predation Rate (Un-owned Cats)***

To account for bird mortalities attributable to un-owned cats, Loss et al. (2013b) draw upon 10 studies from the U.S. (two of which were excluded for their “abnormally high” predation rates) and three from Europe, settling on a range of 23.2-46.2 birds/cat/year, represented as a uniform distribution. However, six of the eight U.S. studies the authors included in their analysis (Errington 1936, McMurry and Sperry 1941, Jackson 1951, Llewellyn and Uhler 1952, Parmalee 1953, Eberhard 1954) were con-

ducted at a time when it was typical for researchers studying the diet of cats to simply shoot whatever cats could be found apparently hunting along roadsides or picked up dead, having been killed by a passing vehicle (Errington 1936, McMurry and Sperry 1941, Hubbs 1951, Parmalee 1953, Eberhard 1954). Hubbs (1951), for example, reported, “Shooting or capture by dogs seems to be a better method than trapping for obtaining animals for use in food studies, because the stomachs of nearly one-half of the trapped animals contained nothing or so little that they could not be used.” In another of the papers cited by Loss et al., McMurry and Sperry (1941) explain that 21.5% of the stomachs collected (as a result of both shooting and trapping) were empty or “contained only traces of food,” and were therefore not included in their calculations of prey consumed (thereby inflating the predation rate estimates generated by Loss et al.). While such “collecting” methods may be useful for determining *which* prey cats were hunting at the time, they almost certainly exaggerate the *frequency* and *success* of their hunting efforts and, by extension, the mortality estimates generated by Loss et al.

Another of the questionable U.S. estimates cited by Loss et al. (2013b) is “based on [a] literature summary.” In fact, this estimate (Coleman and Temple 1996) is based upon four studies, three of which (Errington 1936, Parmalee 1953, Eberhard 1954) were already included among the eight U.S. studies used to generate the authors' estimated predation rate (questionable for the reasons described above) and another (Mitchell and Beck 1992) excluded due to its small sample size. Including this estimate is at best redundant and raises additional questions about the care with which Loss et al. compiled the values for their model inputs.

### ***Proportion of Un-owned Cats that Hunt***

Although Loss et al. assume that 80-100% of un-owned cats kill wildlife, the two studies they cite (Warner 1985, Coleman et al. 1997) involve only rural cats. But research conducted in more densely populated areas, or areas where un-owned cats aren't entirely reliant on prey for their meals, suggests hunting success rates far lower than 80% (Calhoun and Haspel 1989), especially for birds (Hawkins 1998, Castillo and Clarke 2003, Arnold 2015). Over the course of approximately 300 hours of observation (this, in addition to what the researchers described as “several months identifying, describing, and photographing each of the cats living in the colonies” prior to beginning their research) in two Miami-Dade County (FL) parks, for example, Castillo and Clarke (2003) “saw cats kill a juvenile common yellowthroat and a blue jay. Cats also caught and ate green anoles, bark anoles, and brown anoles... [and researchers] found the carcasses of a gray catbird and a juvenile opossum in the feeding area.” There were, at any one time, 85-95 cats across the two study sites, raising serious doubts about the claim that at least 80% of un-owned cats are successful hunters of birds (or any wildlife). Similar doubts arise from a review of Hawkins' research (cited by Loss et al.). Of the 120 scat samples Hawkins collected by searching the “cat area” of his study site (where 22 cats were fed regularly), “65% were found to contain rodent hair and 4% feathers” (Hawkins 1998).

### **Scat and Stomach Analysis (Un-owned Cats)**

Nearly all of the 11 studies Loss et al. use to estimate the bird predation rate for un-owned cats involved the analysis of scats and/or stomach contents. The authors then convert the results of these studies to annual predation rates using methods not found in the literature, thereby raising questions about their validity. And, although Loss et al. claim their methods are conservative, a careful examination of the very work they cite suggests otherwise.

As Loss et al. (2013a) explain, they assumed that “one stomach or scat sample represented a cat’s average daily prey intake” in part based on the work of Hubbs (1951), who observed, “It appears that after about 12 hours most of the contents of a cat’s stomach have been passed.” It’s not clear, however, how Hubbs arrived at such a conclusion. Moreover, laboratory studies conducted by Jackson, whose work is also cited by Loss et al., showed that rodent remains “are passed through the digestive tract within two days after feeding, and that after this time any remains generally will occur in small quantities” (Jackson 1951). If the same can be said of bird remains, then the “daily prey intake” assumption employed by Loss et al. would exaggerate corresponding predation rates by a factor of two or more (in addition to the biases associated with “collecting” cats while they are hunting).

“For studies reporting occurrence frequencies of prey items,” Loss et al. (2013a) “assumed this proportion represented a cat’s average daily prey intake (for example, a 10% bird occurrence rate = 0.1 bird per stomach or scat = 36.5 birds per cat per year).” Again, if this method were widely accepted, one would expect the authors to include citations, yet none is provided. Indeed, it’s easy to imagine why such a method would be avoided, as it ignores completely the *amount* and *size* of prey consumed. Eberhard, for example (whose work is among the eight U.S. studies used by Loss et al.), documented a 28-36% occurrence of “table foods and garbage” among “field cats,” compared to 21-26% among “non-field cats” (presumed to be pets). When measured as the proportion of diet *by volume*, however, a very different story emerges: the contribution of “table foods and garbage” to the diet of non-field cats was nearly three times its contribution to the diet of field cats. Using the method devised by Loss et al., one would conclude, incorrectly, that the un-owned cats described in Eberhard’s work consumed approximately 30% more of this food category compared to owned cats. Studies using occurrence frequencies to document dietary intake routinely report “totals” exceeding 100% or even 200% (or less than 100%), which is to be expected given what is being measured (Eberhard 1954, Liberg 1984, Fitzgerald et al. 1991). Converting such data to average daily prey intake, as Loss et al. have done, implies that a cat’s daily intake may well exceed its capacity.

As the examples above illustrate, estimated annual predation rates derived from the analysis of scat and stomach contents are, contrary to the authors’ claims, not conservative at all. Moreover, the errors associated with this method are compounded when multiplied by other inflated factors (e.g., population of un-owned cats, proportion of cats hunting birds, etc.) to estimate overall mortality levels.

### **Owned Cats**

Again, model inputs corresponding to the “un-owned cat population size and predation rate explained the greatest variation in mortality estimates,” contributing roughly 42% and 24%, respectively (Loss et al. 2013a). Nevertheless, several model inputs associated with predation by *owned* cats contributed to inflated predation estimates as well, and therefore also warrant careful examination.

### **Outdoor Access (Owned Cats)**

As Loss et al. (2013a) acknowledge, “the amount of time [owned] cats spend outdoors is a major determinant of predation rates.” However, an examination of 18 studies (Johnson et al. 1993, Johnson and Lewellen 1995, Patronek et al. 1996, Crooks and Soulé 1999, Fiore 2000, Clancy et al. 2003, Lepczyk et al. 2003, Levy et al. 2003, ABC 2004, Kays and DeWan 2004, Dabritz et al. 2006, Lord 2008, APPA 2010, Gibson 2012, Lisnik 2012, Loyd and Hernandez 2012, Freiwald et al. 2014), just seven of which (Crooks and Soulé 1999, Clancy et al. 2003, ABC 2004, Kays and DeWan 2004, Dabritz et al. 2006, Lord 2008, APPA 2010) are cited by Loss et al., is revealing. Contrary to the authors’ assertion that 40-70% of pet cats are allowed access to the outdoors, a compilation of surveys suggest that the figure is, on average, probably closer to 20-50%. Also revealing are surveys asking respondents how many hours per day their cats spend outdoors: approximately half of these cats are allowed outdoors for no more than two to four hours each day (Clancy et al. 2003, Kays and DeWan 2004, Lord 2008). This is an especially important consideration in light of recent research demonstrating that just 13% of 24 pet cats monitored by way of collar-mounted video cameras exhibited “hunting behavior (stalking, chasing, or capture)” within their first five hours outdoors (Loyd 2012). For the purposes of their modeling, Loss et al. assume that a cat with any outdoor access at all is no different from a cat that lives outdoors all day, every day.

Whereas Loss et al. (2013a) suggest that approximately 34-59 million of the estimated 84 million owned cats in the U.S. are outdoors and possibly hunting, the factors described above suggest that this estimate is inflated two or three times. The authors also suggest, based on three U.S. studies (Crooks and Soulé 1999, Fiore 2000, Kays and DeWan 2004), that 50-80% of owned cats hunt; however, two U.K. studies cited by Loss et al. document much lower rates of 26-44% (Baker et al. 2005) and 36% (Baker et al. 2008). Surveys suggest that cat owners living in rural communities are more likely than their urban and suburban counterparts to allow their cats outdoor access (Lepczyk et al. 2003, Lord 2008, Gibson 2012, Freiwald et al. 2014) and generally own more cats per household (Lepczyk et al. 2003). And less than a third of U.S. cat owners “live in more rural areas” (APPA 2014a). Taken together, this research suggests that the number of owned cats in rural areas is roughly 30% of the total number of pet cats in the U.S. And, as was mentioned previously, the urban cats that outnumber them (perhaps by a significant margin) are more likely to rely on human provisions than on their hunting skills. Although such findings have important

implications for any research regarding the possible impacts of owned cats permitted outdoors, Loss et al. failed to account for them in their computer modeling.

### **Bird Return Rate (Owned Cats)**

To account for bird mortalities attributable to owned cats, Loss et al. (2013a) draw upon four studies from the U.S. and 7 from Europe, settling on a range (again represented as a uniform distribution) of 1.0-34.1 birds/cat/year. However, the two estimates contributing most significantly to the maximum, both of which are from U.S. studies, are roughly eight times the next highest U.S. estimates cited, and more than four times the average of the European studies cited, thereby raising some question as to their validity. In fact, it's clear from the studies (McMurry and Sperry 1941, Eberhard 1954) that their authors are unable to distinguish with any certainty owned cats from un-owned cats. And, because commercial cat litter was unavailable until the late 1940s (Sterba 2012, Grimm 2014), it's quite likely that even cats kept as pets were kept largely outdoors. Even if the researchers involved were able to clearly distinguish pets from un-owned cats, therefore, the associated predation rates are simply not applicable to pet cats 60 or more years later.

More troubling than the range of predation rates, however, is its representation by Loss et al. as a uniform distribution. It's widely recognized – and documented in studies cited by the authors (Churcher and Lawton 1987, Barratt 1998, Woods et al. 2003) – that the distribution of prey items killed by pet cats is not uniform at all but positively skewed. A brief example will illustrate the consequences of overlooking this fact. In using a uniform distribution to describe the range of bird mortalities documented in the seven European studies cited (4.2-18.3 birds/cat/year), Loss et al. are suggesting (in terms of model inputs) that the odds of a cat killing four birds annually are the same as the odds of a cat killing 18 birds annually. Results reported by Woods et al. (2003), whose work Loss et al. cite, suggest that the former case is, in fact, more than 25 times more likely than the latter. By using a uniform distribution to represent the annual predation rate of pet cats, then, Loss et al. greatly exaggerate overall predation levels, perhaps even more so for birds than for small mammals (Woods et al. 2003, but see Barratt 1998). Using an Excel model to approximate the model created by Loss et al., and adjusting for this one factor alone results in a 20-25% reduction in the median annual bird mortality estimate.

### **Prey Return Correction Factors (Owned Cats)**

As a “correction factor to account for owned cats not returning all prey to owners,” Loss et al. (2013a) use a range of 2.0-3.3. In fact, the low-end estimate is attributable to the common misreading (Fitzgerald and Turner 2000) of a paper in which George (1974) “double[d] the number of observed captured specimens,” not to account for the cats' behavior but his own: he was simply attempting to correct for discrepancies between periods “when the delivery area was under continuous day-and-night scrutiny” and periods “when [it was] continuously scrutinized for lesser amounts of time.” The upper-end estimate was derived from research based on the observations of 12 cats'

hunting behavior (including failed attempts), in which the researchers concluded that monthly predation rates during the summer were “3.3 times greater than the rate estimated from prey brought home” (Kays and DeWan 2004). Of the “31 attempted hunts” documented, birds were targeted seven times – but none was captured; all of the eight successful attempts involved small mammals (Kays and DeWan 2004). Strictly speaking, then, the correction factor for birds documented in this study was not 3.3, but 1.0. And this doesn't account for scavenging prey items or killing birds injured in window collisions, poisoned by pesticides, etc.

### **CONCLUSIONS**

“When considering the magnitude and effects of cat predation on their prey populations,” cautions Turner (2014) in the third edition of *The Domestic Cat: The Biology of its Behaviour*, it is important to recognize that “estimates of total predation (e.g., number of prey items taken by all cats over a one-year period) are meaningless from an ecological point of view unless put into relation to the entire population of that prey species and its annual production rate.” Loss et al. (2013a) made no attempt to do so, relying instead solely on “the magnitude of [their] mortality estimates” to conclude that “cats are likely causing population declines for some species and in some regions.” As this review has demonstrated, however, the authors' estimates are greatly exaggerated, and therefore any such conclusions unjustified.

In 2012, Loss et al. (2012) published a paper in which they complained that “national mortality estimates are often based on extrapolation from a limited sample of small-scale studies, and estimates of uncertainty are ignored or only superficially assessed.” One year later, the authors included some of these very studies in “The impact of free-ranging domestic cats.” And, more troubling, the numerous missteps made in their attempt to estimate annual mortality levels (many of which have been discussed in the present review) actually *add* to the uncertainty Loss et al. lamented previously.

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