Supplementary Information for**:**

The Impact of Free-ranging Domestic Cats on Wildlife of the United States

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Supplementary Table S1 | Estimates of cat predation rates on wildlife (per cat per yr) from temperate zone studies.

		Estimated predation rate (per cat per yr)					Study	
		Bird	Mammal	Reptile	Amphibian	Method[6]	location	Study citation
Owned cats	*United States*	31.06	124.25[1]			st	Pennsylvania, US	*58*
		4.20				pr	Kansas, US	*40*
		1.64	17.32			pr	New York, US	*31*
		33.18				st	Oklahoma, US	*59*
	Europe	5.57	15.43			pr	Bristol, UK	*60*
		1.14	3.75			pr	Bristol, UK	*9*
		3.81	6.87			pr	Felmersham, UK	*8*
		21.92				st	Revinge, Sweden	*35*
		12.44	31.94			pr	throughout UK	*61*
		1.70	22.08			pr	Finsterstee, Switzerland	*39*
		6.74	27.15	0.40	1.63	pr	Great Britain	*57*
	Other temperate	2.47	5.95	0.61	0.10	pr	Canberra, Australia	*33*
		2.60	6.90	0.60	0.10	pr	Canberra, Australia	*34*
		2.83	6.59	1.59	0.01	pr	Auckland, NZ	*62*
		2.96	26.80	0.31		pr	Christchurch, NZ	*63*
		2.30	4.37	2.07		pr	Christchurch, NZ	*64*
		77.92[1]	110.73[1]	4.10		sc	southern Chile	*65*
		4.83	4.45	1.04	0.03	pr	Dunedin, NZ	*7*
	Excluded	20.78	32.50			pr	Perth, Australia	*66*[2]
		16.00		0.25		pr	northern Scotland	*67*[3]
		15.00	24.00	17.00		su	California, US	*5*[4]
		13.12	19.12	0.53	0.06	pr	Lower Hutt, NZ	*68*[3]
		35.52				su	Michigan, US	*47*[4]
		12.93	26.38	16.79	4.94	pr	Virginia, US	*69*[3]
		11.73	52.95		3.49	pr	Lancashire, UK	*70*[2]
Un-owned cats	*United States*	45.95				lit	Wisconsin, US	*18*
		51.17	296.78			st	Pennsylvania, US	*58*
		43.80	416.10[1]			st	Wisconsin, US	*30*
		14.60	237.25			sc	California, US	*6*

	186.47[1]	749.84[1]			st	California, US	*28*
	50.37	26.65			sc	Maryland, US	*29*
	63.88	355.88			st	Maryland, US	*26*
	9.87				st	Oklahoma, US	*59*
	110.35[1]	305.58			st	Oregon, US	*25*
	23.55	329.68	58.87		st	Texas, US	*27*
Europe	45.63	584.83[1]	4.15		sc, st	Hungary	*71*
	27.61				sc	Revinge, Sweden	*35*
	4.93	86.32			sc	western Switzerland	*72*
Other temperate	131.93[1]				sc	Otago Peninsula, NZ	*73*
	77.38	293.83	109.87[1]		st	New S. Wales, AUST	*74*
	27.38	244.55			st	Victoria, Australia	*75*
	43.80				sc	Wellington, NZ	*76*
	34.43	291.54	2.30		sc	Victoria, Australia	*77*
	100.28[1]	394.15[1]	45.48	4.67	st	southeastern, Australia	*78*
	15.33		12.41		sc	New S. Wales, AUST	*79*
	51.10	255.50	64.24	1.87	st	N. Territories, AUST	*80*
	46.72	42.71	122.28[1]	3.29	st	southern Australia	*81*
	59.77	332.98	42.69		st	Heirisson Prong, AUST	*82*
	98.55[1]		83.95[1]		sc	Victoria, Australia	*83*
Excluded	162.22	283.89			st	north Island, NZ	*37*[3]
		149.50			pr	Illinois, US	*48*[3]
	199.84	313.51			sc, st	Macquarie Is. AUST	*36*[5]
	84.23				st	north Island, NZ	*84*[3]
	43.80	403.93	4.87		sc	Majorca Island, Spain	*85*[5]
	195.06	59.78			st	Marion Is. S. Africa	*86*[5]

[1]Study excluded for documenting abnormally high predation rate
[2]Study excluded because cats experimentally manipulated and the study's sampling duration is <1 month
[3]Study excluded because of a small sample of cats (< 10)
[4]Study excluded for using questionnaire asking participants to recall previous predation events
[5]Study excluded because it was conducted on a small island.
[6]Method of predation rate estimation used in study: lit – estimated based on literature summary; pr – collection of data on prey returns to cat owners; sc – scat contents; st – stomach contents; su – survey asking cat owners to recall previous predation events.

Supplementary Table S2 | Values of model parameters (other than predation rate) used to develop probability distributions in the cat predation model.

	Cats (millions)	Proportion outdoors	Proportion hunting	Correction factor	Geographic origin	Study
Owned cats	86.4	-	-	-	Nationwide	*41*
	81.7	-	-	-	Nationwide	*42*
	-	0.66	-	-	Nationwide	*43*
	-	0.5	-	-	Nationwide	*44*
	-	0.65	-	-	Nationwide	*45*
	-	0.40	0.51	3.30	New York	*31*
	-	0.43	0.83	1.20	Kansas	*40*
	-	0.77	0.84	-	California	*5*
	-	0.36	-	-	Michigan	*47*
	-	0.56	-	-	Florida	*46*
	-	-	-	2.0	Illinois	*48*
Un-owned cats	60-120	-	-	-	Nationwide	*87*
	60-100	-	-	-	Nationwide	*49, 50*
	25-40	-	-	-	Nationwide	*88*
	40-60	-	-	-	Nationwide	*89*
	10-50	-	-	-	Nationwide	*1*
	-	-	1.00	-	Illinois	*51*
	-	-	0.90	-	Wisconsin	*53*

Supplementary Table S3 | Average proportion of total bird mortality caused by cat predation for individual species.

Species	Average proportion[1]	Number of Studies[2]
Ring-necked Pheasant (*Phasianus colchicus*)	0.160	1
House Sparrow (*Passer domesticus*)	0.107	2
American Robin (*Turdus migratorius*)	0.085	5
Red-winged Blackbird (*Agelaius phoeniceus*)	0.056	1
Northern Bobwhite (*Colinus virginianus*)	0.050	1
Gray Catbird (*Dumetella carolinensis*)	0.048	1
American Goldfinch (*Spinus tristis*)	0.036	5
Northern Cardinal (*Cardinalis cardinalis*)	0.035	2
Rock Pigeon (*Columba livia*)	0.034	1
House Wren (*Troglodytes aedon*)	0.030	1
European Starling (*Sturnus vulgaris*)	0.029	2
Blue Jay (*Cyanocitta cristata*)	0.027	3
Carolina Wren (*Thryothorus ludovicianus*)	0.026	1
Mourning Dove (*Zenaida macroura*)	0.025	2
Brewer's Blackbird (*Euphagus cyanocephalus*)	0.020	3
Horned Lark (*Eremophila alpestris*)	0.017	2
Red-bellied Woodpecker (*Melanerpes carolinus*)	0.017	2
Northern Flicker (*Colaptes auratus*)	0.017	1
Dark-eyed Junco (*Junco hyemalis*)	0.016	2
American Coot (*Fulica americana*)	0.015	5
White-throated Sparrow (*Zonotrichia albicollis*)	0.015	1
Ovenbird (*Seiurus aurocapilla*)	0.014	2
Common Grackle (*Quiscalus quiscula*)	0.013	2
Tufted Titmouse (*Baeolophus bicolor*)	0.013	1
Black-capped Chickadee (*Poecile atricapillus*)	0.011	3
Eastern Bluebird (*Sialia sialis*)	0.008	1
Barn Swallow (*Hirundo rustica*)	0.006	3
Carolina Chickadee (*Poecile carolinensis*)	0.006	1
Song Sparrow (*Melospiza melodia*)	0.004	1
Lincoln's Sparrow (*Melospiza lincolnii*)	0.004	1
Ruby-throated Hummingbird (*Archilochus colubris*)	0.004	1
Western Meadowlark (*Sturnella neglecta*)	0.004	1
White-crowned Sparrow (*Zonotrichia leucophrys*)	0.004	1
Brown-headed Cowbird (*Molothrus ater*)	0.003	3
Wood Thrush (*Hylocichla mustelina*)	0.003	1
House Finch (*Carpodacus mexicanus*)	0.003	1
Mallard (*Anas platyrhynchos*)	0.003	1
Ruby-crowned Kinglet (*Regulus calendula*)	0.003	1
Swainson's Thrush (*Catharus ustulatus*)	0.003	1
Purple Finch (*Carpodacus purpureus*)	0.003	1
Brown Thrasher (*Toxostoma rufum*)	0.002	4
California Quail (*Callipepla californica*)	0.002	3
Green Heron (*Butorides virescens*)	0.002	3
Eastern Screech-Owl (*Megascops asio*)	0.002	3

American Crow (*Corvus brachyrhynchos*)	0.002	2
Golden-crowned Sparrow (*Zonotrichia atricapilla*)	0.002	2
Dickcissel (*Spiza americana*)	0.001	3
Eastern Towhee (*Pipilo erythrophthalmus*)	0.001	3
Cedar Waxwing (*Bombycilla cedrorum*)	0.001	3
Savannah Sparrow (*Passerculus sandwichensis*)	0.002	1
Winter Wren (*Troglodytes hiemalis*)	0.002	1
Chipping Sparrow (*Spizella passerina*)	0.001	1
Wood Duck (*Aix sponsa*)	0.001	1
Lapland Longspur (*Calcarius lapponicus*)	0.001	1
Red-eyed Vireo (*Vireo olivaceus*)	0.001	1
Yellow-billed Cuckoo (*Coccyzus americanus*)	0.001	1
Northern Mockingbird (*Mimus polyglottos*)	0.001	1
White-eyed Vireo (*Vireo griseus*)	0.001	1

[1]Proportions are based on 10 U.S. studies that report species-by-species mortality counts[27,28,30,31,40,47,58,59,69,89].

[2]Number of studies documenting predation on each bird species

Supplementary Methods | Development of probability distributions for model parameters.

For all model parameters except predation rates, we used the same probability distribution for both mammals and birds. Literature estimates of parameters other than predation rates are in Supplementary Table S2, and the specific probability distributions we defined for all parameters are in Table 1.

Number of owned cats in the contiguous U.S. (*npc*). Two recent estimates of the number of owned cats are based on nationwide pet-owner surveys: 86.4 million[41] and 81.7 million[42]. We defined this parameter as a normal distribution with mean of 84 million, the average of the two estimates, and standard deviation of 2.5 million, which represents a 95% confidence interval of 79-89 million cats. The standard deviation reflects estimate uncertainty, potential changes in the number of owned cats, and the likelihood that cat population size for the contiguous U.S. may be slightly smaller than the above estimates, which include Alaska and Hawaii (i.e., no separate estimates of cat population size exist for the contiguous U.S). This population estimate range is likely conservative given a trend for increasing cat ownership[12].

Proportion of owned cats with outdoor access (pod). We found eight U.S. estimates for this parameter, with three based on nationwide pet-owner surveys[43,44,45] and five based on research in individual study areas[5, 31,40,46,47]. We defined *pod* as a uniform distribution with minimum and maximum of 0.4 and 0.7, respectively. The *pod* distribution is centered on the range of values from nationwide studies. For this parameter and the following parameters, we defined uniform probability distributions because there is not sufficient data to ascribe greater likelihood to any particular value.

Proportion of owned cats hunting (pph). We found three U.S. estimates for this parameter: 0.51[31], 0.83[40], and 0.84[5]. We defined pph as a uniform distribution with minimum and maximum of 0.5 and 0.8, respectively, which is slightly conservative relative to published data.

Correction factor to account for owned cats not returning all prey (*cor*). Three studies compare the number of prey returned to owners to the number of prey killed. Twice as many predation events were observed when cats were monitored continuously compared to average monitoring effort in Illinois[48]. Compared to prey returns, 3.3 times more kills were directly observed in New York[31]. Based on assessment of scat samples, 21% of prey captures were not detected in a study in Kansas[40]. We defined this parameter to reflect these detection estimates using a uniform distribution with minimum and maximum of 1.2 and 3.3, respectively.

Number of un-owned cats in the contiguous United States (*nfc*). No empirically-derived estimate of un-owned cat abundance exists for the contiguous U.S. Studies report rough estimates between 20-120 million cats, with 60-100 million cats the most frequently cited value[49,50]. Reflecting this uncertainty, we defined a uniform distribution with minimum and maximum of 30 and 80 million, respectively. We defined a uniform distribution rather than a normal distribution because the lack of rigorously derived estimates of un-owned cat population size precludes assignment of greater probability to a particular value. This range of abundance is conservative, given local U.S. studies that estimate densities of 0.06-0.16 un-owned cats per ha[51,52,53], which extrapolates to 46-123 million un-owned cats across the land area of the contiguous U.S. The validity of extrapolating three density values to a national-scale abundance estimate is questionable. Local studies are often conducted in areas with above average density[54], and density estimates often depend on the area sampled[55,56]. Little evidence exists to quantitatively test whether the above limitations apply to these density estimates.

Proportion of un-owned cats hunting (*pfh*). Predation on wildlife was observed to be universal among 326 farm cats in Illinois[51], and several studies were summarized as finding that <10% of rural cats do not kill wildlife[53]. We therefore defined this parameter as a uniform distribution with minimum and maximum of 0.8 and 1, respectively.

Annual predation rates (*ppr* and *fpr*). For owned and un-owned cats, and for both birds and mammals, we compiled predation rate estimates and used box plots to identify and remove high predation rate values. These removed values are not strictly statistical outliers because the values were measured in separate study areas and for different prey communities. However, we still removed high values to increase the conservatism of our mortality estimates. In addition, we also visually inspected each set of predation rates (combined across all geographic locations) to remove those that were not statistical outliers but were much greater than other estimates (Supplementary Table S1). From remaining estimates, we used the 95% confidence interval bounds to specify minimum and maximum values of uniform distributions (Table 1). Because there was only one U.S. value that was not an outlier for owned cat predation on mammals, we only estimated predation on mammals using data from: (1) the U.S. and Europe, and (2) all temperate zone studies. For the first approximation of reptile and amphibian mortality, there were few U.S. *or* European studies of predation on reptiles and amphibians. Therefore, we only estimated predation on these taxa using all temperate zone studies. For amphibians, there were only five and three predation rate estimates for owned and un-owned cats, respectively. For un-owned cats, we used minimum and maximum values to define the uniform distribution, and for owned cats, we defined a uniform distribution with minimum and maximum of 0.05 and 0.50, respectively. The latter distribution falls within the observed range of estimates and may be conservative given an annual estimate of 1.6 amphibians killed per cat in Great Britain[57].

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