

Risk Perceptions about Outdoor Pet Cats in a Small City in the Interior of British Columbia

Denise S. King¹, Panagiotis Tsigaris²

Abstract: This research aims to analyze and understand the perception of the risks pet cats impose on the environment and incur while outdoors in Kamloops, British Columbia. An online survey, influenced by past studies and tailored to the local circumstances, collected 584 valid responses, of which 155 were outdoor cat owners, 221 indoor cat owners, and 208 non-cat owners. It provides insight into the perceptions of 16 bidirectional risks for outdoor and indoor cat owners and non-cat owners. Two hypotheses—one comparing risk perceptions between cat owners and non-cat owners and the other between outdoor and indoor cat owners—drive this study. The study used Wilcoxon-rank and Mann-Whitney U tests to analyze risk perceptions from cat and non-cat owners. Gender, education, and freely roaming neighborhood cats were examined in ordered logistic regression models to detect the influence these may have on the various risks. The results demonstrate for the risks deemed as the highest that cats impose on the environment includes predation on mice/rats for owners of outdoor pet cats and property damages for indoor cat owners and non-cat owners. The risks cats incur includes getting hit by a car, going missing, and predation from coyotes for both cat and non-cat owners. The level of risk perception for the diseases cats imposes and incur continues to rate low. Female respondents perceive larger cat hazards, especially predation from coyotes, lynx, and cougars, than males. Respondents with post-secondary education see an increase in risk of cats' decreasing bird populations and an increased risk of wildlife illness susceptibility. Increased cats in a neighborhood impact bird populations and disease transmission. The study emphasizes the need for region-specific rules that balance animal conservation and pet safety and satisfy all stakeholders' concerns. Wildlife conservationists, animal welfare organizations, and municipal governments should work together to promote risk-mitigating behaviors and community improvements for outdoor pet cats, according to the findings.



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HIGHLIGHTS

- Pets provide support to their owners during times of grief by improving their emotional wellbeing and sense of connection, as well as regulating their emotions.
- High engagement activities, such as cuddling and exercising with the pet, have been found to be particularly beneficial during times of grief.
- Even incidental interactions with pets, such as simply being in their presence, have a positive effect.
- The bond between pet and owner is perceived to be important and offers low-effort, non-judgmental support, which is often preferred over human companionship.

INTRODUCTION

Momentum surrounding the global issue of outdoor domestic cats (*Felis catus*) and their impact on wildlife, especially birds, is gaining the attention of experts working in the fields of wildlife conservation and animal welfare (van Heezik et al., 2010; Blancher, 2013; Loss et al., 2013; Wald et al., 2016; Marra and Santella, 2016; Loss and Marra, 2017; Flockhart and Coe, 2018; Cove et al., 2018; Roetman et al., 2018). Wildlife conservationists, especially ornithologists, are alarmed by research results that estimates bird mortality in North America, due to cats, in the range of 1.4 billion to 4.0 billion per year (Blancher, 2013; Marra and Santella, 2016; The Stewardship Centre for BC, 2016). Despite the years of domestication, cats remain skilled hunters and are praised for their ability to kill and manage rodent populations (Figure 1), but chastised for preying on birds and other small mammals in our ecosystem (McDonald et al., 2015). Wildlife conservationists want to remove outdoor cats from the landscape (Marra and Santella, 2016) because they deem the problem persists, not only because of stray and feral cat populations, but because cat owners allow their cats to go outdoors unsupervised.



Figure 1. Before 1924. Reproduction of a painting of a cat waiting to capture a rodent. Author: Walter Heubach (1865–1923). https://commons.wikimedia.org/wiki/File:Heubach_cat.jpg

Henceforth, there is a need to further to explore cat owners' attitudes and motivations for allowing their pets outside to design policies that reduce the risks of their pet dying prematurely and to decrease the risks their cat imposes on others. Research across various regions has highlighted a spectrum of reasons why owners might choose this practice, ranging from beliefs about natural behavior and well-being, cultural norms, to issues of convenience and space constraints (Loss and Marra, 2017; Loss and Marra, 2017; Mameno et al., 2017; Hall, et al., 2017; Walker et al., 2017; Crowley et al., 2019). In Canada, a substantial number of households – estimated between 8.5 to 9.3 million – own cats, and about 28 percent of these allow their cats to roam outdoors unsupervised (Canadian Federation of Humane Societies, 2017). Of those households, 28 percent allow their cats outdoors unsupervised (Canadian Federation of Humane Societies, 2017). This means that there are



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approximately 2.3 to 2.6 million outdoor owned cats who may be preying on wildlife, spreading disease, and damaging neighbours' property.

The risks cats impose on wildlife include predation, spreading diseases, and anthropogenic concerns, such as property damage and harm to small farm animals (Gramza, et al., 2016). Notably, these risks extend beyond predation, as outdoor cats can also contribute to the stray and feral cat populations, increasing the number of cats in shelters (Canadian Federation of Humane Societies, 2017). On the other hand, the risks outdoor cats face is significant, including threats from predators like coyotes, wildcats, and large birds, disease, and anthropogenic dangers, such as vehicular accidents and getting lost (Gramza, et al., 2016). It's challenging to gather accurate data on cat fatalities due to predators, as lost cats might end up in various scenarios, including joining the stray population or being euthanized in shelters. Research in England (O'Neill et al., 2015) indicates that 60% of premature cat deaths are caused by road traffic accidents, especially in cats under five years old. A study by Kent et al. (2022) on 3,108 cats from 1989-2019 found that cancer was the leading cause of death, with renal abnormalities also prevalent. Spaying and neutering were associated with longer lifespans. They also found that outdoor only cats live an average lifespan of two years shorter than indoor/outdoor or indoor only cats who had an average lifespan of approximately 9 years.

Conservation social science (Bennett, et al., 2016) could offer deeper insights into outdoor cats and their owners' behaviors. Given the unique ecosystems of individual communities, localized surveys are vital to assess risks and resident perceptions (Kikillus et al., 2016; Mameno et al., 2017; Walker et al., 2017). This growing area of cat ownership research emphasizes the need for effective conservation initiatives and risk mitigation strategies, acknowledging the high risks facing both wildlife and cats in outdoor, unsupervised settings. Consequently, this research seeks to understand the perception of risks that outdoor pet cats incur and impose on the environment in Kamloops, a small city in the interior of British Columbia, and the factors that influence those perceptions. Results will identify the differences in those perceptions between cat owners and non-cat owners; and cat owners who allow their cats outdoors versus those with indoor cats. Risk perceptions are analyzed from the perspective of outdoor cat owners, indoor cat owners, and non-cat owners. Based on prior work, it is anticipated that those residents, who perceived the risks, both for imposing and/or incurring, to be high, would keep their cats indoors or implement some form of risk mitigation while their cat is outdoors, such as a harness, or a cat enclosure. Cat owners can thus reduce the risks outdoor pet cats impose and incur on the environment; however, that would require a change in behavior or regulations.

Questions this research investigates includes: What are the differences in the risk perceptions of the non-cat owners from the cat owners? What are the differences in the risk perceptions between the cat owners who allow their cats outdoors compared to those who keep their cats indoors? Understanding the factors that influence the risk perceptions will help guide the next steps for risk mitigation. The next section describes the methodology, followed by results, discussion and concluding remarks.



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METHODOLOGY

Survey design

The methodology for data collection on risk perception was an online survey modelled after the survey used in similar research in Colorado, USA with permission granted by the lead researcher, Ashley Gramza (Gramza et al., 2016). The first section was general questions about wildlife. The second section attempted to extract information about their views on outdoor pet cats in general such as being informed about the issues, their interest, and about their feeling in terms of pet cats living happier and healthier lives outside or not, and if they approve overall allowing people to let their cats outdoors. The third section requests their opinions regarding the possible risks associated with pet cats spending time outdoors in their neighborhood. These include risks that pet cats may pose to wildlife, people, and other pets, as well as risks that pet cats may encounter while they are outdoors. The next section explores their view about certain actions to address possible risks associated with pet cats spending time outdoors in their neighborhood. The final section relevant to this paper provided demographic information such as where they grew up, which subdivision of Kamloops they live, gender, age, education, and income.

Before answering the main question of survey (S3Q1) to collect risk perceptions, the participants were told the following:

"We are now interested in learning more about your opinions regarding the possible risks associated with pet cats spending time outdoors in your neighborhood. These could include risks that pet cats may pose to wildlife, people, and other pets, as well as risks that pet cats may encounter while they are outdoors. How unlikely or likely do you think it is that the following would occur because of pet cats spending time outdoors in your neighborhood?"

The questions were answered on the Likert scale with 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely. The survey is available in a supplementary file.

Risk perception categories for outdoor pet cats were split into two: risks to wildlife and risks to the cats themselves (Gramza et al., 2016). The risks to wildlife include predation (leading to reduced populations of rodents, birds, and small mammals like squirrels and gophers), disease transmission to other pets, wildlife, and humans, and anthropogenic risks such as property damage (e.g., cats using yards as litter boxes, damaging gardens) and harming small farm animals like chickens (Figure 2).

The risks to outdoor cats include predation by wildlife (e.g., coyotes, lynx, cougars), diseases from other animals (wildlife, pets like cats and dogs), and anthropogenic dangers such as vehicle accidents, getting lost or stolen, and injury from other pets (Figure 3).



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Statistical analysis

In order to explore differences in the risk perceptions of the non-cat owners from the cat owners and differences in the risk perceptions between the cat owners who allow their cats outdoors compared to those who keep their cats indoors and the factors that influence the risk perceptions data were recorded in Excel, and statistical analyses were conducted using Stata version 18 from the Stata Corporation, College Station Texas, USA.

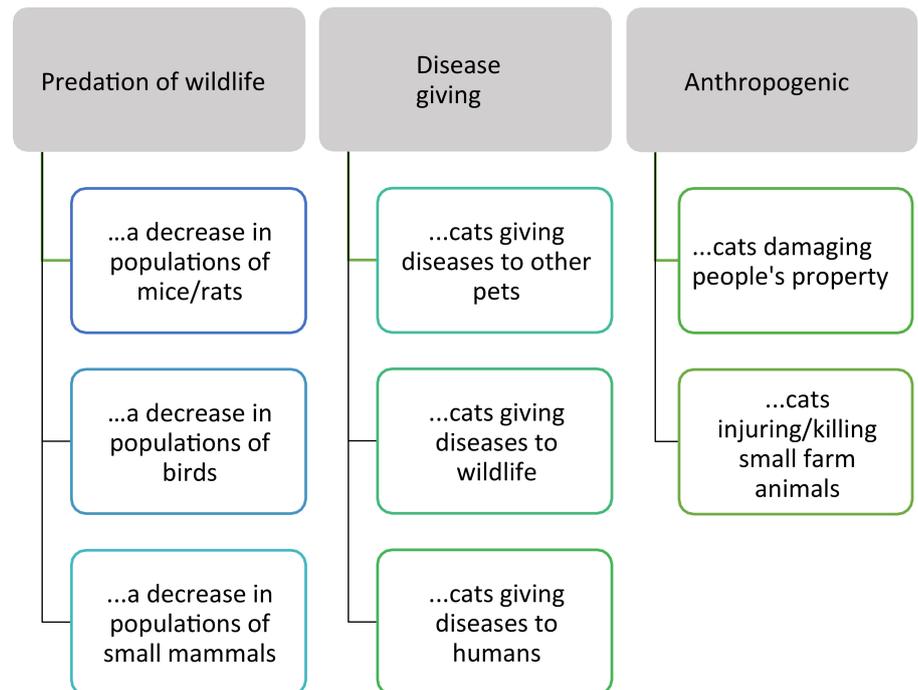


Figure 2. Risks Outdoor Cats Impose on the Environment

First, descriptive statistics were performed to estimate means and medians. Since the data are on a 5 Likert scale the Wilcoxon-rank test was used to test for risk neutrality. For many of the questions the neutral responses [mean = 3] suggested indifference, lack of comfort with personal level of knowledge, or a perceived lack of information on the topic. A greater than 3 response indicates the probability of the risk is likely or very likely, while less than 3 indicates the probability of the risk is unlikely or very unlikely.

To test the first hypothesis of differences in risk perceptions between cat owners and non-cat owners the Mann-Whitney U test was applied. The same approach was used to test the second hypothesis if outdoor cat owners and indoor cat owners perceive risks differently.

Finally, to estimate the factors that influence each of the risks cats are exposed to and those they incur, ordered logistic regressions were estimated controlling gender (=1 if female, 0 male or other), education (=1 if post-secondary education otherwise zero) and how many cats do the respondents see roaming freely in



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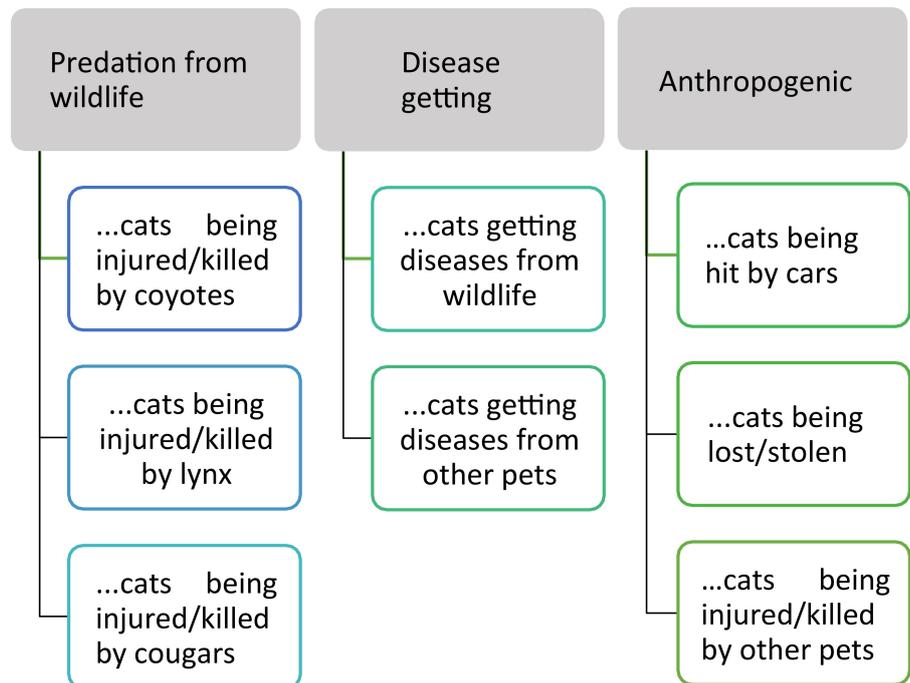


Figure 3. Risks Outdoor Cats Incur From the Environment

their neighborhood on average a day (numerical) for both of the hypotheses. Namely, controlling also for cat ownership or not and separately that of outdoor versus indoor cat ownership. In this model, the risks (both imposed by and incurred by cats) are categorized into an ordinal scale (i.e., Very unlikely = 1, unlikely = 2, Neutral = 3, Likely = 4, and Very likely = 5). The model then estimates the odds of falling into these risk categories based on the independent variables, under the assumption that the odds' relationship between categories is constant. For instance, a positive coefficient for cat ownership in the model would suggest an increased likelihood of higher risk levels associated with owning a cat. This approach is valuable for understanding the multifaceted impacts of cat ownership and the demographic factors influencing these risks, aiding in effective policy-making and community management strategies related to domestic cats.



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Target population and methods of engagement

The target population was the community of Kamloops in the interior of British Columbia with population of 100,000. The survey was created using Fluid Survey, an online survey tool, and ethics approval was received from the Thompson Rivers University Research Ethics Committee. Participation in this research was voluntary and the distribution of the survey was as widespread throughout the community as possible. Respondents were solicited through three methods of engagement. First, interviews took place with local media outlets such as the Kamloops This Week newspaper, Kamloops CBC Radio morning show, and the CFJC TV and website blog. Second, the survey was sent

to Thompson Rivers University's 1,543 employees via email distribution (Thompson Rivers University, 2019). Third, through community collaboration and relationships building such as the Kamloops Naturalist Club, Kamloops SPCA, the provincial SPCA office in Vancouver, and the local North Shore newsletter, The Echo. Despite all these attempts, the number of female respondents outweighed the male respondents. This is not uncommon and previous research has demonstrated that females are more likely to participate in online surveys than males (Smith, 2008). Non-response error is the final error that is to be considered and that was accommodated for by posting the survey online, which helps alleviate such an error.

RESULTS

The representative sample size required, at a 95 percent confidence level and +/- 5 percent margin for error, with the number of households listed for Kamloops as 55,722 (BC Statistics, 2018), is 382. In total, 729 surveys were submitted, however, after removing those respondents who lived outside of the Kamloops area, and thus ineligible to be part of the survey, 584 survey responses were utilized for this analysis. Of those 584 responses, 376 were cat owners (155 outdoor cat owners and 221 indoor cat owners) and 208 non-cat owners. Cat and non-cat owner responses were more from females in the age of 25-64 with at least a high school diploma, owning a house with a backyard and household income more than \$40,000. Also, over 40% if cat and non-cat owners have a dog. For further details of the demographics see Table 1.

Cat Owners versus Non-Cat Owners

This section provides findings about the attitudes of cat owners and non-cat owners, regarding the threats that cats represent to wildlife, such as mice, rats, birds, and small mammals. It also examines the potential for cats to spread diseases to other pets, wildlife, and people, as well as the impact of cats on human-made structures and farm animals. Furthermore, there are potential hazards that arise, such as being preyed upon by wildlife such as coyotes, lynx, and cougars, contracting diseases from both wildlife and domesticated animals, and experiencing negative effects from human activities, such as being struck by vehicles, becoming lost or stolen, and being harmed or killed by other pets. There were 376 cat owners responding and 208 non-cat owners.

Cat Owners and Non-Cat Owners: Wilcoxon-rank test for risk levels.

Cats as Predators

Survey results shown in Table 2 indicate that cat owners perceive the highest risk outdoor pet cats impose on the environment is a decrease in the populations of mice or rats (avg. 3.93), followed by cats damaging people's property (avg. 3.88) and finally a decrease in the population of birds (avg 3.76). Non-cat owners deemed cats damaging people's property (avg. 4.34), followed by a decrease in population of birds (avg 3.96) and finally a decrease in the



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	Cat Owners		Non-Cat Owners	
	#	%	#	%
Gender:				
Female	310	83	136	66.3
Male	59	16	67	32.7
Other	3	1	2	1.0
Age:				
18 - 24 years old	25	7	8	3.9
25 - 39 years old	122	33	50	24.2
40 - 64 years old	179	48	116	56.0
65 - 79 years old	42	11	32	15.5
80 years or older	2	1	1	0.5
Education:				
Less than high school diploma	2	1	3	1.5
High school diploma or equivalent	44	12	18	8.8
Certificate, diploma, or trade	145	39	68	33.2
4-year university degree	114	31	64	31.2
Post-graduate degree	65	17	52	25.4
Homeowner	104	72	172	83.1
Have a backyard	322	87	184	89.3
Have a dog	152	41	92	44.7
Income:				
Less than \$40,000	72	22	24	14.0
\$40,001 to \$80,000	98	30	56	32.6
\$80,001 to \$120,000	83	25	50	29.1
\$120,001 or more	71	22	41	23.8

Figure 1: Illustration of a child/dog pairing

population of mice/rats (avg. 3.67). Disease giving was not a major concern for these two groups.

Cats as Victims

Cat owners perceived cats being hit by cars as the greatest risk (avg. 4.27), followed by cats being injured or killed by coyotes (avg. 4.17) and then cats being lost or stolen (avg. 3.94). For non-cat owners, similar ranking was observed.

Risk Neutrality

For cat owners, risk neutrality was rejected for all levels of risk perceptions. For cat owners, risk was perceived as likely or very likely for all categories except for cats giving diseases to humans and cats injuring/killing small farm animals which were unlikely and very unlikely. For non-cat owners, neutrality was not rejected for three risk perceptions. For non-cat owners risk neutrality was not rejected for cats giving diseases to wildlife, cats injuring or killing small farm animals and cats being injured or killed by lynx. All other categories were perceived as of higher risk of occurring.

Cat and Non-Cat Owners: Mann-Whitney U difference test

There were significant differences between the means of cat owners and non-cat owners for the majority of the risks' cats impose on the environment (Table 3). The non-cat owners were more concerned with cats damaging people's property compared to cat owners (p < 0.001). The next largest difference in the



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means lies with cats injuring or killing small farm animals again non-cat owners are more concerned than cat owners ($p < 0.001$) and same with cats giving diseases to humans ($p < 0.001$) which were both deemed unlikely. The only results that did not have significant differences between cat and non-cat owners were the likelihood that cats would decrease the populations of small mammals ($p = 0.971$) and cats giving diseases to other pets ($p = 0.775$). With respect to the risks outdoor pet cats incur, most results had little difference in the means. The most significant difference was with cats being hit by a car and cats getting diseases from other pets with cat owners perceiving the risk to be higher than the non-cat owners ($p = 0.022$ and $p = 0.003$ respectively).

Cat Owners and non-cat owners: Ordered logistic regressions.

The ordered logistic regression model results are presented in this section to determine the risks associated with cats, considering variables such as cat

		Cat Owner (N = 376)			
	S3Q1: Pet cats spending time outdoors in my neighborhood would result in...	Risk Categories	Mean	Median	p-value to reject neutrality
IMPOSE	... a decrease in populations of mice/rats	Predation of wildlife	3.93	4.00	< 0.0001
	... a decrease in populations of birds		3.76	4.00	< 0.0001
	... a decrease in populations of small Mammals		3.34	4.00	< 0.0001
	... cats giving diseases to other pets	Disease giving	3.20	3.00	0.0004
	... cats giving diseases to wildlife		2.74	3.00	< 0.0001
	... cats giving diseases to humans		2.41	2.00	< 0.0001
	... cats damaging people's property	Anthropogenic impact from cats	3.88	4.00	< 0.0001
	... cats injuring/killing small farm animals		2.63	2.00	< 0.0001
INCUR	... cats being injured/killed by coyotes	Predation from wildlife	4.17	4.00	< 0.0001
	... cats being injured/killed by lynx		3.13	3.00	0.0324
	... cats being injured/killed by cougars		3.20	3.00	0.0017
	... cats getting diseases from wildlife	Disease getting	3.35	4.00	< 0.0001
	... cats getting diseases from other pets		3.49	4.00	< 0.0001
	... cats being hit by cars	Anthropogenic impact on cats	4.27	4.00	< 0.0001
	... cats being lost/stolen		3.94	4.00	< 0.0001
	... cats being injured/killed by other pets		3.61	4.00	< 0.0001

Table 2a. Risk Perceptions of Cat Owners: 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely



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ownership, gender, level of post-secondary education, and the prevalence of cats roaming in a neighborhood.

Cats as Predators

Responders cat pet owners have a higher likelihood of perceiving a decrease in the populations of mice/rats ($p = 0.001$), and a lower likelihood of perceiving a decrease in the population of birds ($p = 0.102$) relative to those that don't have a cat. Pet cat owners also believe that there is a lower risk from cats giving diseases to wildlife ($p = 0.013$) and humans (0.002). Outdoor cat owners also perceive a lower likelihood with their pets causing property damage ($p < 0.001$) and a lower probability of cats injuring/killing small farm animals ($p < 0.001$).

			Non-Cat Owners (N = 208)		
	S3Q1: Pet cats spending time outdoors in my neighborhood would result in...	Risk Categories	Mean	Median	p-value to reject neutrality
IMPOSE	... a decrease in populations of mice/rats	Predation of wildlife	3.67	4.00	< 0.0001
	... a decrease in populations of birds		3.96	4.00	< 0.0001
	... a decrease in populations of small Mammals		3.33	4.00	< 0.0001
	... cats giving diseases to other pets	Disease giving	3.23	3.00	0.0008
	... cats giving diseases to wildlife		3.00	3.00	0.7785
	... cats giving diseases to humans		2.73	3.00	0.0001
	... cats damaging people's property	Anthropogenic impact from cats	4.34	5.00	<0.0001
	... cats injuring/killing small farm animals		3.06	2.00	0.5814
URINE	... cats being injured/killed by coyotes	Predation from wildlife	4.13	4.00	< 0.0001
	... cats being injured/killed by lynx		3.13	3.00	0.1059
	... cats being injured/killed by cougars		3.25	3.00	0.0019
	... cats getting diseases from wildlife	Disease getting	3.19	3.00	0.0074
	... cats getting diseases from other pets		3.26	3.00	0.0002
	... cats being hit by cars	Anthropogenic impact on cats	4.13	4.00	< 0.0001
	... cats being lost/stolen		3.86	4.00	< 0.0001
	... cats being injured/killed by other pets		3.43	4.00	< 0.0001

Table 2b. Risk Perceptions of Non-Cat Owners: 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely



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		Cat Owners (N = 376)	Non-Cat Owners (N=208)	Mann-Whitney U test for differences
	Risk Categories	Mean	Mean	p
IMPOSE	S3Q1: Pet cats spending time outdoors in my neighborhood would result in...			
	...a decrease in populations of mice/rats	3.93	3.67	0.001
	...a decrease in populations of birds	3.76	3.96	0.004
	...a decrease in populations of small mammals	3.34	3.33	0.986
	...cats giving diseases to other pets	3.20	3.23	0.891
	...cats giving diseases to wildlife	2.74	3.00	0.002
	...cats giving diseases to humans	2.41	2.73	< 0.001
	...cats damaging people's property	3.88	4.34	< 0.001
	...cats injuring/killing small farm animals	2.63	3.06	< 0.001
INCUR	...cats being injured/killed by coyotes	4.17	4.13	0.332
	...cats being injured/killed by lynx	3.13	3.13	0.968
	...cats being injured/killed by cougars	3.20	3.25	0.585
	...cats getting diseases from wildlife	3.35	3.19	0.047
	...cats getting diseases from other pets	3.49	3.26	0.003
	...cats being hit by cars	4.27	4.13	0.022
	...cats being lost/stolen	3.94	3.86	0.197
	...cats being injured/killed by other pets	3.61	3.43	0.050

Table 3. Risk Perceptions of Cat and Non-Cat Owners – Difference in Means, 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely.

Cats as Victims

Individuals with cats show a perception of higher risk of cats contracting diseases from wildlife (p = 0.021) and from other pets (p = 0.002) relative to those that don't have cats. Risks such as being lost/stolen are higher for cat owners than those without a pet cat (p = 0.057). All other risks are not statistically significant.

Other control variables

For female respondents, relative to males, the significance varies across different risks, with some being more pronounced. Female respondents, relative to males, perceive lower risks with respect to cats being predators although these risks are not statistically significant. As for risks cats incur, female respondents perceive a high risk in most categories. However, the most significant results are for female respondents to perceive risks of outdoor pet cats to be higher for predation from coyotes (p = 0.004), lynx (p < 0.001) and cougars (p < 0.001). Also female respondents believe that there is a higher risk from anthropogenic impacts on cats such as cats being hit by cars (p = 0.073), cats being lost/stolen (p = 0.035) and cats being injured/killed by other pet (p = 0.021).



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For respondents with post-secondary education, relative to those with less education, some risks have a positive others negative impact, but many associations are not statistically significant. The statistically significant coefficient is that a respondent with post-secondary education perceive a higher risk associated with a decrease in populations of mice/rats ($p = 0.047$) and the decrease in the population of birds ($p = 0.005$) relative to those with a lower education. Also, respondents with a post-secondary education perceive a lower risk of cats being injured/killed by lynx ($p = 0.065$) and cats being injured/killed by cougars (0.086).

An increase in the presence of roaming cats in a neighborhood increases the risk of a decrease in populations of birds ($p = 0.044$). An increase presence of roaming cats in the neighborhood also increases the risk perception of disease giving in other pets ($p = 0.060$), wildlife ($p = 0.012$) and humans ($p < 0.001$). There is also a significant positive association with the risk of anthropogenic impact from cats such as cats damaging people's property ($p < 0.000$) and cats injuring/killing small farm animals ($p < 0.001$). Table 4 summarizes all the results.

Outdoor vs Indoor Cat Owners

This section presents results about outdoor and indoor cat owners' perceptions of risks cats impose on wildlife (i.e., mice/rats, birds, and small mammals), giving disease (i.e., to pets, wildlife and humans), and anthropogenic impacts from cats (i.e., property, farm animals). Also risks incur such as predation from wildlife (i.e., coyotes, lynx, and cougars), disease getting (i.e., from wildlife and pets) and anthropogenic impact on cats (i.e., hit by cars, lost/stolen and injured/killed by other pets). There are 155 outdoor cat owners and 221 indoor cat owners.

Outdoor and indoor cat owners: Wilcoxon-rank test for risk levels.

Cats as Predators

When just comparing the means for the risks outdoor pet cats impose on the environment, the greatest likelihood of risks for cat owners who allow their cats outdoors were a decrease in the populations of mice or rats (predation of wildlife), then cats damaging people's property (anthropogenic) and then a decrease in the populations of birds ((predation of wildlife). For indoor cat owners the greatest risks cats impose on the environment while outdoors was cats damaging people's property (anthropogenic), then a decrease in the populations of birds (predation of wildlife) and then a decrease in populations of mice or rats (predation of wildlife).

Cats as Victims

When it comes to the risks incurred by cats spending time outdoors, the outdoor cat owners rated the risks as follows. The most likely risk was cats being hit by cars (anthropogenic) then cats being injured or killed by coyotes (predation from wildlife) and then cats being lost or stolen (anthropogenic). For



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Dependent Variable	Risk categories	Owner	P-value	Female	P-value	Schooling	p-value	Roaming	p-value
IMPOSE									
A decrease in populations of mice/rats	Predation of wildlife	0.560	0.001	-0.603	0.740	0.316	0.047	-0.058	0.309
A decrease in populations of birds		-0.290	0.102	-0.542	0.005	0.454	0.005	0.112	0.044
A decrease in populations of small mammals		0.046	0.780	-0.168	0.365	0.078	0.617	0.007	0.884
Cats giving diseases to other pets	Disease giving	0.034	0.822	-0.164	0.316	-0.015	0.924	0.106	0.060
Cats giving diseases to wildlife		-0.393	0.013	-0.190	0.271	-0.024	0.877	0.139	0.012
Cats giving diseases to humans		-0.470	0.002	-0.110	0.542	0.096	0.525	0.190	0.000
Cats damaging people's property	Anthropogenic impact from cats	-0.972	0.000	-0.013	0.948	-0.195	0.225	0.282	0.000
Cats injuring/killing small farm animals		-0.608	0.000	-0.075	0.676	-0.002	0.992	0.221	0.000
Cats being injured/killed by coyotes	Predation from wildlife	0.094	0.567	0.533	0.004	0.003	0.987	-0.018	0.754
Cats being injured/killed by lynx		-0.114	0.472	0.726	0.000	-0.287	0.065	0.014	0.797
Cats being injured/killed by cougars		-0.179	0.252	0.687	0.000	-0.264	0.086	0.001	0.983
INCUR									
Cats getting diseases from wildlife	Disease getting	0.354	0.021	0.080	0.640	0.188	0.229	0.076	0.175
Cats getting diseases from other pets		0.501	0.002	-0.143	0.381	-0.013	0.933	0.051	0.385
Cats being hit by cars	Anthropogenic impact on cats	0.244	0.139	0.307	0.073	-0.223	0.162	0.011	0.841
Cats being lost/stolen		0.321	0.057	0.402	0.035	-0.711	0.661	0.069	0.186
Cats being injured/killed by other pets		0.141	0.376	0.397	0.021	0.121	0.443	0.039	0.480

Note: Ordered logistic regression model. Bold p-values show significance at less than 10%.

Table 4. Risk perceptions impacted by Cat owner or not, gender, post-secondary schooling and cats roaming.

indoor cat owners' similar risks were perceived. The greatest perceived risk was cats being hit by cars (anthropogenic), then cats being injured or killed by coyotes (predation from wildlife) and then cats being lost or stolen (anthropogenic).

Risk neutrality

For the outdoor cat owners, risk neutrality was not rejected for cats being injured/killed by lynx, cats being injured/killed by cougars, cats getting diseases from wildlife. For all other categories risk perceptions was greater than 3 except for cats giving disease which was less likely to occur. For the indoor cat owner's neutrality almost all the risks were more likely to occur except for cats giving diseases to wildlife and cats injuring/killing small farm animals which were less likely to occur.

Outdoor and Indoor Cat Owners: Mann-Whitney U difference test

There were significant differences between the means of outdoor cat owners and indoor cat owners for the majority of the risks' cats impose on the environment (Table 6). The indoor cat owners were more concerned with the risks' outdoor cats face in terms of predation of wildlife, disease giving and anthropogenic impacts especially when it comes to cats damaging people's property ($p = 0.0001$). The only results that did not have significant differences between outdoor cat and indoor cat owners were the likelihood that cats would decrease the populations of small mammals ($p = 0.148$). With respect to the risks outdoor pet cats incur, most results shows again that indoor cat owners have more risks concerns with respect to predation from wildlife and getting disease. In terms of anthropogenic indoor cat owners worry more about cats being hit by cars than by cats being lost/stolen and cats being injured/killed by other pets.

Outdoor and Indoor Cat Owners: Ordered logistic regressions.

This section presents the results of the ordered logistic regression model, which aims to ascertain the risks associated with cats. The analysis considers variables such as the ownership of cats (indoor versus outdoor), gender, level of post-secondary education, and the prevalence of cats roaming in a neighborhood. The study focuses on a specific group of cat owners and non-cat owners.

Cats as Predators

Individuals who have outdoor pet cats are more likely to observe a decrease in the populations of mice/rats ($p < 0.001$). However, they are less likely to observe a decrease in the population of birds ($p = 0.011$) and small mammals ($p = 0.15$) due to predation, compared to those who have an indoor cat. Those who let their cats go outside believe that there is a reduced chance of their pets spreading illnesses to other animals ($p < 0.001$), wildlife ($p = 0.005$), and people ($p < 0.001$) compared to those who keep their cats indoors. Owners of cats that spend time outdoors also believe there is a greater chance of their pets causing harm to property ($p < 0.001$), but a reduced possibility of cats hurting or killing small farm animals ($p < 0.001$).



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S3Q1: Pet cats spending time outdoors in my neighborhood would result in...	Risk Categories	Outdoor Cat Owner (N = 155)			Indoor Cat Owners (N = 221)		
		Mean	Median	p-value to reject neutrality	Mean	Median	p-value to reject neutrality
... a decrease in populations of mice/rats	Predation of wildlife	4.19	4.00	< 0.0001	3.74	4.00	< 0.0001
... a decrease in populations of birds		3.63	4.00	< 0.0001	3.85	4.00	< 0.0001
... a decrease in populations of small Mammals		3.25	3.00	0.0041	3.39	4.00	< 0.0001
... cats giving diseases to other pets	Disease giving	2.86	3.00	0.0404	3.44	4.00	0.0562
... cats giving diseases to wildlife		2.55	2.00	< 0.0001	2.87	3.00	< 0.0001
... cats giving diseases to humans		2.17	2.00	< 0.0001	2.58	2.00	< 0.0001
... cats damaging people's property	Anthropogenic impact from cats	3.66	4.00	< 0.0001	4.03	4.00	< 0.0001
... cats injuring/killing small farm animals		2.38	2.00	< 0.0001	2.80	3.00	0.0063
... cats being injured/killed by coyotes	Predation from wildlife	3.85	4.00	< 0.0001	4.40	5.00	< 0.0001
... cats being injured/killed by lynx		2.85	3.00	0.1034	3.33	4.00	< 0.0001
... cats being injured/killed by cougars		2.89	3.00	0.2294	3.42	4.00	< 0.0001
... cats getting diseases from wildlife	Disease getting	2.99	3.00	0.8654	3.60	4.00	< 0.0001
... cats getting diseases from other pets		3.17	3.00	0.0343	3.72	4.00	< 0.0001
... cats being hit by cars	Anthropogenic impact on cats	3.96	4.00	< 0.0001	4.49	5.00	< 0.0001
... cats being lost/stolen		3.59	4.00	< 0.0001	4.19	4.00	< 0.0001
... cats being injured/killed by other pets		3.37	4.00	< 0.0001	3.77	4.00	< 0.0001

Table 5. Risk Perceptions of Outdoor Versus Indoor Cat Owners, 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely.

		Outdoor Cat Owners (N = 155)	Indoor Cat Owners (N=221)	Mann Whitney U test for differences
	S3Q1: Pet cats spending time outdoors in my neighborhood would result in...	Mean	Mean	p
IMPOSE	...a decrease in populations of mice/rats	4.19	3.67	0.0001
	...a decrease in populations of birds	3.63	3.96	0.0148
	...a decrease in populations of small mammals	3.25	3.33	0.1483
	...cats giving diseases to other pets	2.86	3.23	< 0.0001
	...cats giving diseases to wildlife	2.55	3.00	0.0065
	...cats giving diseases to humans	2.17	2.73	0.0002
	...cats damaging people's property	3.66	4.34	0.0001
	...cats injuring/killing small farm animals	2.38	3.06	0.0001
INCUR	...cats being injured/killed by coyotes	3.85	4.13	< 0.0001
	...cats being injured/killed by lynx	2.85	3.13	0.0001
	...cats being injured/killed by cougars	2.89	3.25	< 0.0001
	...cats getting diseases from wildlife	2.99	3.19	< 0.0001
	...cats getting diseases from other pets	3.17	3.26	< 0.0001
	...cats being hit by cars	3.96	4.13	0.0001
	...cats being lost/stolen	3.94	3.86	0.0001
	...cats being injured/killed by other pets	3.61	3.43	0.0002

Table 6. Risk Perceptions of outdoor Cat and indoor Cat Owners – Difference in means, 1 = very unlikely, 2 = unlikely, 3 = Neutral, 4 = Likely, 5 = very likely.

Cats as Victims

People who have outdoor pet cats believe that the chances of their cats being attacked by coyotes ($p < 0.001$), lynx ($p < 0.001$), and cougars ($p < 0.001$) are lower compared to those who keep their cats indoors. There is a significantly decreased perceived risk of cats catching infections from nature ($p < 0.001$) and from other pets ($p < 0.001$) for people who keep their cats indoors. The odds of outdoor pet cats being struck by vehicles, becoming lost or stolen, or being wounded or killed by other animals are lower for outdoor pet cats owned by individuals with ($p < 0.001$ for all three risks).

Additional independent variables

Significance levels varied among female responders compared to males, with certain hazards exhibiting more substantial differences. Female participants, in comparison to males, have a perception of lesser risks seeing cats as predators, however these risks do not reach statistical significance. Regarding the threats that cats face, female respondents estimate a significant level of risk in most categories. Nevertheless, the most notable findings indicate that female



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participants have a greater perception of the hazards posed by outdoor pet cats in terms of predation by coyotes ($p = 0.021$), lynx ($p = 0.012$), and cougars ($p < 0.006$).

Among individuals with post-secondary education, certain hazards exhibit a favorable influence while others have a detrimental impact. However, it is worth noting that many of these connections lack statistical significance. The coefficient that is statistically significant indicates that individuals with post-secondary education have a greater perception of the risk associated with the decline in bird populations compared to those with lower education levels ($p = 0.008$). Additionally, there is a slightly significant association between higher education and the perception of cats contracting diseases from wildlife ($p = 0.07$).

The increase of wandering cats in an area has several effects. It is worth mentioning that there is a strong positive correlation between the risk of human-caused effect and cats, specifically in terms of cats causing damage to people's property ($p = 0.018$) and cats harming or killing small farm animals (p -value = 0.015). Moreover, a rise in the prevalence of wandering felines in the vicinity leads to a reduced probability of a decline in populations of mice/rats ($p = 0.052$) and a drop in populations of small animals ($p = 0.035$).

DISCUSSION

This study and Gramza et al. (2016) focus on the risks associated with outdoor domestic cats, but the approach is from a different perspective and methodology. The Gramza et al. (2016) study, conducted in Colorado, U.S.A., emphasizes public risk perceptions towards outdoor cats in varied urbanization levels, highlighting concerns over cat predation on wildlife and wildlife predation on cats. Our study identifies similar concerns related to predation from wildlife especially from female respondents, but also neighborhood disturbances. Our results are consistent with Gramza et al. (2016) who found that owners of outdoor freely roaming pet cats showed lower risk perceptions than indoor-only cat owners and those who apply limitations such outdoor cat cages or permitting cats outside only during daytime hours. Both studies underline the significance of public perception in managing outdoor cat-related risks and the need for targeted educational campaigns, yet they highlight different aspects of the community's attitudes and experiences in distinct geographical contexts.

Furthermore, the findings of this study are consistent with Loyd et al. (2013) research on typical risky behaviors shown by male and younger free-roaming cats, such as crossing roads. Our study also highlighted this as a significant worry amongst all stakeholders but especially cat owners as it relates to the anthropogenic risks on cats such a being hit by cars, lost/stolen and injured/killed by other pets.

The disparity in viewpoints between those who own cats and those who do not, as shown in our study, has resemblance to the conclusions obtained by Wald et al. (2013, 2016) on contrasting beliefs held by different stakeholders. Wald et al.



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Dependent Variable	Risk categories	Outdoor	p	Female	p	Schooling	p	Roaming	p
IMPOSE	A decrease in populations of mice/rats	0.789	0.000	-0.081	0.760	0.301	0.133	-0.183	0.035
	A decrease in populations of birds	-0.494	0.011	-0.267	0.314	0.521	0.008	0.010	0.898
	A decrease in populations of small mammals	-0.273	0.150	-0.167	0.492	0.220	0.260	-0.137	0.052
IMPOSE	Cats giving diseases to other pets	-1.079	0.000	-0.171	0.426	-0.049	0.801	0.066	0.356
	Cats giving diseases to wildlife	-0.528	0.005	-0.094	0.686	0.023	0.907	0.113	0.141
	Cats giving diseases to humans	-0.734	0.000	-0.053	0.813	0.163	0.397	0.103	0.153
IMPOSE	Cats damaging people's property	0.761	0.000	0.152	0.573	-0.646	0.746	0.182	0.018
	Cats injuring/killing small farm animals	-0.699	0.000	-0.297	0.230	0.008	0.966	0.174	0.015
	Cats being injured/killed by coyotes	-1.372	0.000	0.588	0.021	0.295	0.144	-0.064	0.416
INCUR	Cats being injured/killed by lynx	-0.735	0.000	0.549	0.012	-0.254	0.183	-0.066	0.345
	Cats being injured/killed by cougars	-0.788	0.000	0.620	0.006	-0.236	0.217	-0.081	0.262
	Cats getting diseases from wildlife	-1.099	0.000	0.070	0.752	0.361	0.070	0.065	0.403
INCUR	Cats getting diseases from other pets	-1.089	0.000	-0.126	0.560	-0.023	0.907	0.073	0.341
	Cats being hit by cars	-0.746	0.000	0.308	0.152	-0.127	0.520	-0.003	0.967
	Cats being lost/stolen	-1.457	0.000	0.420	0.120	-0.010	0.959	0.046	0.523
INCUR	Cats being injured/killed by other pets	-1.221	0.000	0.327	0.181	0.051	0.795	0.053	0.458

Note: Bold p-values show significance at less than 10%

Table 6. Risk perceptions impacted by outdoor cat owners, gender, post-secondary schooling, and cats roaming.

(2016) highlights that Florida respondents were significantly more tolerant of outdoor cats and less concerned about cat-related risks than Hawaii respondents. In contrast, the concerns stated by Kamloops residents, especially those who have indoor only cats and those who do not own cats, worry about the impact on bird populations and property damage. This indicates the need for targeted communication strategies that address these local nuances in attitudes, particularly for conservation efforts.

In line with the research conducted by Foreman-Worsley et al. (2021), our study likewise revealed that cat owners expressed a notable worry over road traffic accidents. This indicates a prevalent acknowledgement of this hazard among cat owners, irrespective of whether their cats are exclusively indoors or outside. In addition, Chalkowski's et al. (2019) research on the susceptibility to parasite infection highlights the health hazards linked to cats having outside access. Although this worry was not the main emphasis among our survey participants, it remains significant in the wider scope of managing outdoor cats.

The study done by Tan et al. (2020, 2021) on the risks and benefits of influencing unrestricted outdoor access for cats provides the framework for our findings. Tan's suggested elements, including owner viewpoints and cat features, may impact the impression of outdoor cats as effective in rodent control in our study. This indicates a complex interaction between the characteristics of cat owners, their attitudes, and the choice to grant cats the freedom to go outside.

The study also employed ordered logistic regression models to understand better the factors that influence perceptions of risks (Foreman-Worsley et al., 2021, Hirsch et al., 2022). It finds that cat owners, particularly those with outdoor cats, are more attuned to the impact their pets have on local rodent populations, with less concern for birds and small mammals. These owners also perceive a lower risk of their cats' transmitting diseases to wildlife and humans. Interestingly, outdoor cat owners recognize a higher likelihood of property damage than indoor cat owners, whereas indoor cat owners note lesser risks from external threats. Gender differences are significant in risk perception, with females generally viewing higher risks for cats, especially from predation than male respondents. Educational background plays a role also in risk perceptions. Those more educated individuals are more conscious of the effects cats have on bird populations and the risk of contracting wildlife diseases. The presence of roaming cats in neighborhoods additionally shifts perceptions, raising concerns about bird populations and disease transmission. This is consistent with the study by Walker et al. (2017) who provide valuable insights into public opinion on cat predation and the future direction of cat management in New Zealand highlighting the influence of demographic variables such as knowledge, experience, employment status, beliefs, values, and gender on public opinion regarding cat predation and management techniques.

Perception of risks versus actual risks of outdoor cats may vary. McDonald et al. (2015) found that cat owners often underestimate the predatory behavior of their pets. Part of the online survey included a question about the actual risks outdoor cats incur. Results show that, in the past, 24% have been injured or



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killed by other pets, 13.7% of cats have been injured or killed by predators such as coyotes, lynx, and cougars, 11% have been lost or stolen, 6.7% were hit by a car, and only 1.3% of cats have gotten a disease from wildlife. However, owners of outdoor pet cats did not highly rank risk of their cat being injured or killed by other pets. Furthermore, indoor cat owners placed higher risk in all the above categories than outdoor pet cats. This indicates that outdoor pet owners also underestimate the risks their cats face in the outdoor environment.

The results of this research, together with the other studies, emphasize the need of implementing detailed rules that are tailored to certain regions. These policies should consider the diverse viewpoints and worries of both cat owners and non-owners. Implementing policies that encompass both animal conservation and pet safety, in conjunction with community education initiatives, might successfully tackle the varied attitudes and behaviors documented in our study and the wider body of literature.

CONCLUSION

Outdoor cat management requires wildlife conservationists, animal welfare activists, and city governments to collaborate on risk-mitigating behavior and community reforms. This research summarizes and interprets the results to give evidence and baseline data for stakeholders to establish a long-term plan for communities and outdoor pet cats.

Outdoor pet cats' bidirectional dangers affect wildlife/environment and cat welfare. Understanding Kamloops citizens' views of such dangers is crucial to developing effective risk reduction methods. This study grouped risk perceptions into three primary categories: animal predation, disease giving/getting, and anthropogenic, for both impose and incur, to investigate how cat owners and non-cat owners perceive risk. Cat owners' replies were divided into outdoor and indoor-only categories.

Outdoor cat owners saw the biggest environmental danger as a drop in mouse populations, whereas indoor cat owners saw cats hit by cars as the highest risk. This is intriguing because it may explain why outdoor cat owners let their cats outside: they regard them as rodent control. Research shows that Great Horned and Barn Owls can reduce mice and rat populations. Non-cat owners are concerned with property damage, cats hit by cars, attacked by coyotes, and threatening bird populations (Figure 2).

Ordered logistic regression demonstrates that cat owners, especially outdoor cat owners, prioritize mouse/rat management over bird and small animal effect. Owners feel their cats infect people and wildlife less. Outdoor cat owners report more property damage in the face of external hazards. Men think cats are less preyed on than women. Educational background affects risk perception. Education raises awareness of cats' impact on birds and wildlife illnesses. Cats roaming the area harm bird populations and disease spread.



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In summary cat owners can lessen the environmental dangers of outdoor pet cats by changing their behavior. The best technique to improve cat owner behavior needs further research. Community campaigns might use that knowledge and collaborate with wildlife conservationists and animal welfare activists to develop risk-mitigating behavior change management strategies.

The study has limitations. First, its concentration on Kamloops restricts its applicability to other ecological and cultural environments. The comments, mostly from middle-aged females with high school diplomas, may not reflect the community's beliefs. Online survey tools and distribution channels like local environmental groups and universities may generate response bias. The Likert scale used to measure risk perceptions may oversimplify complicated attitudes, and the lack of longitudinal data limits understanding how these views change over time. Ordered logistic regressions may have omitted crucial covariates, biasing coefficient estimates. Future exploration should compare actual relative to perceived risks to determine if perceptions of risk are within the realm of actual risks of outdoor pet cats.



Figure 4. Cat stalking birds, 1916, The domestic cat, known for its predatory nature and ability to hunt birds and mice, is a threat to wildlife. However, there are ways to harness and manage its behavior. Author Forbush, Edward Howe, (1858-1929) (Source: https://commons.wikimedia.org/wiki/File:Cat_stalking_birds.png)

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