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Who Wants Feral Cats in the Hawaiian Islands and Why?

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ABSTRACT: Feral cats are abundant in the Hawaiian Islands and pose a threat to native wildlife through predation and the spread of disease. A combination of factors including the submission of state bills and county resolutions has created the impression that a large segment of society supports the presence of feral cats in the islands and *in-situ* management techniques. The purpose of this research was to quantify the perceptions and desires of Hawai'i residents regarding the abundance and impact of feral cats. In 2011, I disseminated a social survey to approximately 5,000 Hawai'i residents including pre-identified wildlife stakeholders and a random sample of the general public. Data were analyzed using the potential for conflict index (PCI) and Wildlife Stakeholder Acceptance Capacity models. PCI results indicate that there is a high level of consensus within every stakeholder group that the abundance of feral cats should be decreased. Despite this result, 12% of respondents would like to see populations of feral cats persist in the islands. People's desire to see the abundance of cats reduced was highly correlated (0.54) with whether or not people enjoyed seeing feral cats: 84% of survey respondents dislike seeing feral cats. We also asked survey recipients if feral cats should be removed permanently or relocated away from areas with threatened or endangered wildlife: the majority of people (78%) support the idea of permanently removing feral cats, whereas 10.1% would prefer to see feral cats relocated away from the specified area, and a small proportion of people (3%) believe that feral cats that are being fed do not kill other animals. This research reveals that a small segment of society supports the presence of feral cats, and that the majority of people would prefer to see feral cats removed from areas with threatened native fauna.

KEY WORDS: abundance, *Felis catus*, feral cats, Hawai'i, human dimensions, human-wildlife conflict, survey, wildlife stakeholder acceptance capacity

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INTRODUCTION

The "human dimensions of wildlife" is a field of study that attempts to understand and clarify people's perspectives on wildlife management programs and issues and systematically incorporate insight derived from research into decision making, replacing assumptions with knowledge (Decker and Enck 1996). Human dimensions studies are frequently instigated by human-wildlife conflict (HWC), conflict between people and wildlife, or conflict among people over wildlife. HWC occurs when the needs and behaviors of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife (Madden 2004). These conflicts may result when wildlife threatens human health and safety, or when one group of people benefits from the presence of wildlife while another group pays a cost (Stokes et al. 2006). HWC escalates when people feel that the needs or values of wildlife or other people are given priority over their own needs. If wildlife professionals fail to address HWC, people may turn to legal and legislative processes to overturn their decisions (Teel et al. 2002). Eventually, conservation initiatives suffer, the economic and social well-being of people is impaired, and support for conservation declines (Madden 2004).

A first step to mitigating HWC is to gain an understanding of public sentiment in regard to a wildlife species. Human dimensions research can illuminate whether there is public support for a management goal or objective and why people support some plans and not others (Decker and Enck 1996). Public officials need to represent their constituents, and hence political support will be more forthcoming for management goals that are supported by the public. Resources managers, outreach specialists,

and educators can greatly benefit from understanding why people support some plans and not others, as they can use the information to address underlying issues.

Feral cats (*Felis catus*) were probably introduced to the Hawaiian Islands by European sailors in the late 1700s and early 1800s (Tomich 1969, Kramer 1971). Today, feral cats can be spotted in both urban and rural areas throughout the year. Colonies of cats created or facilitated by people that feed feral cats are known to exist on all of the main islands. The University of Hawai'i at Mānoa (UHM) a state-run institution, has implemented a policy of managing feral cats by limiting food distribution to several specifically built feeding shelters within the campus boundaries (Anonymous 2012). The sheer number of cat colonies in Hawai'i, combined with the number of legislative bills/resolutions submitted that support Trap-Neuter-Release (TNR) as an appropriate method of management for feral cats, gives people the impression that a large segment of society supports the presence of feral cats in the islands and *in-situ* management techniques. However, feral cats are known to be a threat to numerous species of native animals – some of which are federally listed – in the islands via predation or disease (Smith et al. 2002, Work et al. 2009). HWC exists between conservation professionals working to remove cats from the natural environment to protect native species and those people that feed feral cats or advocate for TNR (Longcore et al. 2009). This conflict is apparent in Hawai'i during the legislative session. In the 2011 Hawai'i state legislative session, SB13 tried to designate trapping feral cats by any means a misdemeanor. In Kaua'i County, Resolution 2011-51 was introduced with the purpose of replacing euthanasia of feral cats with TNR. This resolution was met with strong op-

position and did not pass. These disputes are occurring without any quantitative knowledge regarding true public sentiment for feral cats.

The purpose of this research was to gain an understanding of the beliefs, values, and desires of Hawai'i residents regarding feral cats. I employed a social survey to collect data that could be used to assess Wildlife Stakeholder Acceptance Capacity (WSAC) for feral cats in the Hawaiian Islands. WSAC analysis measures people's perceptions of the abundance of wildlife, the perceived impact of wildlife, and people's desires for future changes in the abundance of wildlife (West and Parkhurst 2002, Lischka et al. 2008). In this case, the expected result of WSAC analysis was an improved understanding of which stakeholders want feral cats in the Hawaiian Islands and why.

METHODS

I employed a social survey to collect data, which is the standard approach for WSAC analysis (Lischka et al. 2008). The survey was disseminated to 5,407 people from 6 pre-identified stakeholder groups: hunters, conservation professionals, agriculturalists, animal welfare activists, native Hawaiians (members of a Hawaiian Civic Club), and the general public, between July and September 2011. Survey recipients were identified using a variety of approaches including direct solicitation, internet searches, and assessment of organization membership lists. A list of random mailing addresses, stratified by zip code, was used to contact the general public. The survey was emailed via SurveyMonkey™ to people identified as conservation professionals, agriculturalists, animal welfare activists, or native Hawaiians. A hard copy of the survey was mailed to the general public and hunters in accordance with the tailored design method (Dillman et al. 2009). Each survey recipient received an initial copy of the survey, a postcard/email reminding them to return the survey, followed by a second copy of the survey. Upon completion of the survey we attempted to contact 5% of non-respondents via telephone or email.

Survey recipients were initially assigned to a stakeholder group based on their affiliation with an organization (e.g., people with hunting licenses are hunters). However, some people fell into multiple stakeholder groups (e.g., conservation professional and a hunter). The number and characteristics of the stakeholder groups were modified following *post hoc* cluster analysis of socio-demographic and behavioral data (Brophy et al. 2006). I used k-means cluster analysis with the Calinski and Harabasz algorithm (Calinski and Harabasz 1974) and CAIC (Q-Analysis Software for Market Research®, Numbers International Pty Ltd 2007-2012) to identify the optimal number of clusters within a dataset that included information on survey respondents interest in wildlife; education level, home location (rural/urban); and tendency to feed wildlife; watch wildlife; hunt; hike; volunteer for conservation programs; or participate in Hawaiian cultural activities. The cluster analysis identified 6 unique *post hoc* stakeholder groups. WSAC models were built for both pre-identified and *post hoc* stakeholder groups.

WSAC models compare people's desired change in the abundance of feral cats (dependent variable) to data describing people's beliefs about the impacts of feral cats

and attitudes towards the presence of feral cats (independent variables) (Christoffel 2007, Lischka et al. 2008). Using a 5-point bipolar scale to collect responses, I asked survey recipients 10 questions about the abundance and potential impacts of feral cats in the Hawaiian Islands: Are feral cats culturally important or valuable animals to you? (CU); Are feral cats economically important or valuable animals in Hawai'i? Do they generate income or revenue? (EC); Are feral cats enjoyable to see or hear in the wild in Hawai'i? (EN); Whether or not you see a feral cat, do you benefit from knowing that they persist in Hawai'i? (intrinsic value: IN); Do feral cats damage people's property or source of income? (PR); Do feral cats pose a health or safety risk for people? (HE); Do feral cats pose a risk for native animals or plants? (AP); Do feral cats contaminate or degrade the soil or water? (CO); In the last two years has the number of feral cats has increased in your area? (TW); How frequently do you see feral cats in the area where you live? (SE: 5 point unipolar scale); and finally, In the future, would you like the number of feral cats in the wild to increase or decrease (Y)? I used linear regression (best subsets) with AICC (Anderson 2008) in Systat 13® to select the subset of questions that best explained people's desired change in the abundance of feral cats, and hence identified the beliefs and values with regards to feral cats that were commonly held by stakeholders. The best regression model or 'WSAC model' was identified for each pre-identified and *post hoc* stakeholder group. Linear regression coefficients were calculated for the best model. The disparity in people's desired abundance for feral cats was also analyzed, independently of the questions assessing beliefs and values, via the potential for conflict index (Vaske et al. 2010).

The survey also included questions unrelated to WSAC analysis, such as: Would you like populations of feral cats to continue to persist in the Hawaiian Islands? and Would you support the removal or relocation of feral cats away from areas with threatened or endangered fauna? The data collected by these questions was analyzed via Kruskal-Wallis and Mann-Whitney nonparametric tests.

RESULTS

On average, 46% ($n = 1,110$) of pre-identified stakeholders and 20% ($n = 396$) of the general public responded to the survey. Non-response survey revealed that respondents and non-respondents did not differ significantly in regards to their interest in wildlife ($K = 0.98$; 1df; $P = 0.32$), education level ($K = 0.25$; 1df; $P = 0.62$), or average age ($K = 0.13$; 1df; $P = 0.72$). The cluster analysis identified 6 unique *post hoc* stakeholder groups (Cronbach's alpha 0.5; Spearman-Brown coefficient 0.54): people with little or no interest in wildlife; people with a high interest in wildlife; people that hunt frequently (once per month or more); people that feed wildlife frequently; people whose current home is located in a rural area or small town (<25,000 people); and people with a college education (Table 1). Results from the randomized survey of the general public suggest that 25.9% of the population either donates money to or volunteers for an animal shelter, but only 7% of Hawai'i's residents feed both feral cats and wild birds frequently (Table 1). Upon further investigation, 8.6% of the population feed feral cats frequently,

Table 1. Survey response rate by pre-identified stakeholder group and the percentage of the representative sample of the general public that meet the characteristics of the pre-identified and *post hoc* stakeholder groups.

Stakeholder Group	<i>n</i> Responded	% Public within group
Pre-identified		
Agriculture	162	8.6
Animal Welfare	277	25.9
Conservation Professionals	698	55.8
Hawaiian	290	15.2
Hunter all levels	482	24.0
Public	396	100
Post hoc		
Hunt frequently	368	8.4
College education	726	41.9
Feed wildlife frequently	131	7.0
Low interest in wildlife	316	41.0
High interest in wildlife	697	22.0
Rural home	964	82.5

Figure 1. Average desired change in the abundance of feral cats in Hawaiian Islands: A) Pre-identified stakeholder groups; B) Post hoc stakeholder groups.

Table 2. Percentage of survey respondents that stated they would like to see populations of feral cats persist in the Hawaiian Islands.

Stakeholder Groups	Should populations of feral cats persist in the Hawaiian Islands?		
	% Yes	% No	% Unsure
All	12.3	76.6	11.2
Agriculture	10.8	73.9	15.4
Animal Welfare	50	36.8	13.2
Conservation	1.6	97.2	1.2
Hunter all	7.7	84	8.3
Hawaiian	10.1	77.4	12.5
Public	15.3	65.8	18.9
Low interest	12.6	68.3	19.1
High interest	11.1	83.4	5.5
College education	12.5	79.3	8.2
Active hunters	8.2	84.5	7.3
Feeders	46.3	43.8	10
Rural home	11.9	75.9	12.2
Kauai	9.6	82.5	7.8
Oahu	14.2	77.1	8.7
Maui	12.7	73.4	13.9
Molokai	14.8	71.1	14.1
Lanai	4.5	74.6	20.9
Hawaii	10.3	77.7	11.9

whereas 20.6% of people frequently feed wild birds.

Analysis of respondents' desire for the future abundance of feral cats found that every stakeholder group, including animal welfare and feeders, would like to see a moderate decrease in the abundance of feral cats in the Hawaiian Islands (Figure 1). The potential for conflict index was very small (≤ 0.1) for all stakeholder groups, which suggests that there is a high level of consensus among the public that the number of feral cats should be reduced. On average 86.9% of people would like to see a decrease in the number of cats; 12% of people would like the number of cats to remain the same; and 1% of people would like to see an increase in the number of feral cats. Even 67% of people that frequently feed cats would like to see the number of feral cats reduced (27% no change, 0% increase), and 68.3% of people involved with animal welfare organizations would like to see the abundance of cats decrease (26.7% no change, 4.95% increase). Respondents' desire for the future abundance of feral cats did not vary significantly among the main Hawaiian Islands ($p = 0.51$). Despite a common desire to see the abundance of feral cats decrease, 12% of respondents on average stated that they would like to see populations of feral cats persist in the Hawaiian Islands (76.6% do not want them to persist, 11.2% unsure; Table 2): 50% of people involved with animal welfare organizations and 46.3% of feeders would like to see cats persist. Desire to see populations of feral cats persist did vary significantly among the islands ($p = 0.017$) with significantly fewer people on Lana'i wanting

Table 3. Spearman correlation coefficients for all respondents desired future abundance of feral cats and 10 belief/value statements.

Belief/Value Variable	Correlation with desired future abundance
Enjoy to see	0.56
Cultural value	0.54
Intrinsic value	0.54
Economic value	0.42
Risk to native plants and animals	-0.41
Risk Human health and safety	-0.40
Contaminate soil and water	-0.38
Damage Income/Property	-0.37
Change in abundance over last 2 years	-0.24
Frequency cats seen	-0.12

feral cats than any of the other islands.

Spearman correlation matrix (Table 3) revealed high correlation values between people's desired abundance of feral cats and people's responses to questions that ask if feral cats were enjoyable to see (0.56), had an intrinsic value (0.54), and if feral cats had a cultural value (0.54). These same variables were assigned the dominant regression coefficients in the best WSAC models for the majority (10/12) of the pre-identified and *post hoc* stakeholder groups (Table 4). On average, 9.2% of survey respondents enjoy seeing feral cats, 6.8% neither like nor dislike seeing feral cats, and 84% dislike seeing feral cats. Similarly, the cultural and intrinsic value variables were assigned positive coefficients, with people that assigned higher cultural and intrinsic values to cats generally desiring to see more feral cats in the future. Interestingly, these three variables did not appear in the WSAC model for conservation professionals (Table 4). However, the Conservation-WSAC model was very weak (Adj. $R^2 = 0.05$) due to a lack of variation in the dependent variable.

I asked survey recipients one direct question regarding management techniques for feral cats: Would you support

the removal or relocation of feral cats away from areas with threatened or endangered fauna? The majority of people (average 78%) support the idea of permanently removing feral cats away from areas with threatened or endangered fauna (Table 5). On average, 10.1% would prefer to see feral cats relocated away from the specified area, whereas a very small proportion of people (3%) believe that feral cats that are being fed do not kill other animals. Responses varied significantly among pre-identified and *post hoc* stakeholder groups ($p < 0.001$). Significantly fewer people involved in animals welfare ($p < 0.001$) and significantly fewer people that feed wildlife ($p < 0.001$) would prefer to see cats removed permanently. People in animal welfare (14%) have a greater tendency to believe that fed cats do not kill other animals. Responses did not vary significantly among the islands ($p = 0.25$), but significantly more women than men ($p < 0.001$) would prefer to see cats relocated or believe fed cats do not kill other animals.

DISCUSSION

The results from this state-wide survey suggest that there is strong support among the residents of Hawai'i for over-arching management goals that aim to reduce the abundance of feral cats in the Hawaiian Islands. Very few people (~13%) want to see feral cat abundance remain the same or increase. However, strong support for reducing the abundance of feral cats does not mean Hawai'i's residents will support an eradication program. On average, 12% of people want populations of feral cats to persist in the Hawaiian Islands, and as many as 50% of those people involved in animal welfare in Hawai'i would like to see feral cats persist (Table 2). While we should keep in mind that the results suggest that 25.9% of Hawai'i's residents actively support animal welfare organizations (Table 1), animal welfare organizations are very effective at obtaining signatures for petitions and letters of support from a network of supporters across the nation. I recommended that management goals be very carefully worded, avoiding terms like eradication or control, replacing them with reduced abundance or density, which data suggest better

Table 4. WSAC models identified for each stakeholder group.

Stakeholder Group	Best Model	Adj R^2	p-value
Agriculture	$Y = 0.21IN + 0.11EN - 0.06SE - 1.1$	0.13	<0.001
Animal welfare	$Y = 0.33EN + 0.15EC - 1.28$	0.47	<0.001
Conservation	$Y = -0.19AP - 0.06PR + 0.05SE - 1.64$	0.05	<0.001
Hunter all	$Y = 0.21CU + 0.12EN + 0.11IN - 0.06SE - 0.06AP - 0.06TW - 0.03HE - 1.1$	0.31	<0.001
Hawaiian	$Y = 0.31CU + 0.26EN - 0.07TW - 0.06AP - 0.06HE - 0.06SE - 1.02$	0.51	<0.001
Public	$Y = 0.13EN + 0.11IN + 0.09CU - 0.08SE - 0.06CO - 0.06AP - 0.04PR - 0.98$	0.3	<0.001
Low interest	$Y = 0.34EN - 0.1TW - 0.09AP - 0.09SE - 0.74$	0.36	<0.001
High interest	$Y = 0.14CU + 0.13IN + 0.1EC - 0.04CO + 0.01EN - 1.46$	0.41	<0.001
College education	$Y = 0.14CU + 0.12IN + 0.09EN - 0.1AP - 1.33$	0.36	<0.001
Active hunters	$Y = 0.19CU + 0.1EN + 0.08IN - 0.08PR - 0.07HE - 1.3$	0.3	<0.001
Feeders	$Y = 0.26EC + 0.24EN + 0.2IN - 0.18HE - 1.32$	0.5	<0.001
Rural	$Y = 0.2EN + 0.06IN + 0.07EC - 0.03IN - 0.03CO - 0.04AP - 0.04SE - 0.05TW - 1.13$	0.33	<0.001

AP = belief that cats pose a risk to native flora and fauna

CO = belief cats may contaminate soil or water

CU = cultural value assigned to cats

EN = Enjoy seeing/hearing cats

EC = economic value assigned cats

HE = belief that cats pose a health or safety risk to people

IN = intrinsic value assigned to cats

PR = belief cats damage property or income

SE = frequency respondent sees cats

TW = perceived change in cat abundance over past two years

Table 5. Results from survey question asking, would you support the removal or relocation of feral cats away from areas with threatened or endangered fauna?

Stakeholder Group	Yes, remove cats permanently (%)	Yes, relocate cats >500m away (%)	No, fed cats don't kill other animals (%)	Unsure (%)
All respondents	78.2	10.8	3.0	8.1
Agriculture	85.6	6.8	1.5	6.1
Animal Welfare	35.5	41.1	14.0	9.4
Conservation	98.1	1.5	0	0.4
Hunter all	83.9	6.7	1.9	7.4
Hawaiian	77.9	7.6	2.4	12.1
Public	66.8	15.3	3.8	14.1
Low interest	65.5	13.9	4.5	16.1
High interest	84.4	8.9	2.7	4.0
College education	83.6	9.1	2.8	4.6
Active hunters	85.9	5.9	1.9	6.3
Feeders	43.5	35.1	9.2	12.2
Rural	77.3	11.1	2.8	8.8
Female	66.2	17.4	5.0	11.5
Male	85.9	6.3	1.8	6.0

represent the desires of the majority of the public. The public may also be more inclined to support management goals if plans explicitly state that public opinion surveys were used to help define the goals of the plan. Similarly, political support for a comprehensive management plan may be more forthcoming if public opinion is listed as a basis for a plan's goals and objectives.

Unfortunately, people's desire to see the abundance of cats decrease does not seem to be linked to scientific knowledge regarding the impacts of feral cats on the natural environment or people. Beliefs about feral cats as a potential source of contamination for soil and water (3/12 models); a health risk to people (4/12 models); or a threat to native fauna (7/12 models) did not appear in many of the best WSAC models. The WSAC models imply that many people are either unconcerned or unaware of the potential health risks associated with cats, for example, that cats are the definitive host for *Toxoplasma gondii*, a parasite that can cause health problems or death in native fauna and in humans.

Toxoplasmosis has been shown to be able to survive in and hence contaminate soil and water for several months (Ruiz et al. 1973, Lindsay et al. 2003). It has been hypothesized that monk seals (*Monachus schauinslandi*) are contracting toxoplasmosis when they enter nearshore environments contaminated with cat feces (Littnan et al. 2006). Similarly, a reintroduced population of 'alala (*Corvus hawaiiensis*) had to be recaptured when individuals died from toxoplasmosis (Work et al. 2000). Feral cats have a high seroprevalence for toxoplasmosis in Hawai'i (Danner et al. 2007). Colony cats live in higher densities and interact more often than truly feral cats, which facilitates the transmission of disease among individuals (Mendes-de-Almeida et al. 2007).

It's understandable why survey respondents may be unconcerned or unaware of the risks of toxoplasmosis, when the Centers for Disease Control and Prevention states that toxoplasmosis is one of the "neglected parasitic infections" because relatively little attention has been devoted to surveillance, prevention, and/or treatment of the disease (CDC 2012). In Hawai'i, only 10 cases per year of toxoplasmosis infection were recorded, on average, by the Hawai'i Department of Health between 2001 and 2010 (Hawai'i Department of Health 2011), but according to the CDC, more than 20% of the population of the U.S. are infected with the toxoplasma parasite (CDC 2012). Evidence is building that latent toxoplasmosis infections, which were previously thought to be asymptomatic, can effect human behavior, personality traits, and psychomotor control (Flegr 2007). If people are informed that they can contract toxoplasmosis from contaminated soil (Cook et al. 2000) or water, and colonies of cats create concentrated points of contamination (Afonso et al. 2008), then people may become more concerned about colonies of feral cats, especially if colonies are based on public recreational land. The relative weakness of the potential to contaminate soil and water (CO) data, and the risk to human health (HE) data as explanatory variables in the WSAC models, suggests that outreach specialists should consider producing educational materials on the disease risk posed by concentrated populations of feral cats.

The correlation coefficients (Table 3) imply that people are aware that feral cats pose a risk to native fauna. However, there is a small segment of society that stated they believe that cats receiving supplemental food from humans do not kill other animals (~3%: Table 5). While fecal analysis studies may be able to prove that fed cats do still prey upon other animals, it is likely that there will always be a small number of people that cannot be convinced that feral cats, especially those that will interact with people, are negatively impacting the environment. Personal conversations with several of these survey respondents actually suggest that if these people are pressured to recognize that all cats are predators, these people would react by stating that feral cats are beneficial to the natural environment as a control agent for rodent populations.

The management of any public resource is susceptible to conflict among stakeholders. Understanding public sentiment regarding a given resource is invaluable when decision makers need to defend policy. This research reveals that a small segment of society supports the presence of feral cats, and that slightly more people would prefer to see feral cats relocated rather than removed from an area in order to protect native fauna. However, the majority of people does not enjoy seeing feral cats and would prefer to see their abundance decline. Public officials are interested in representing the majority of their constituents. Therefore, it is recommended that management plans and wildlife policies should formally measure public opinion on highly contentious issues prior to public comment periods, when vocal minorities can exert undue influence on the direction of decisions.

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