Factor Influencing Public Preference for Raccoon Eradication Plan in Kanagawa, Japan

HARUMI AKIBA,[1] CRAIG A. MILLER,[2]
AND HIROYUKI MATSUDA[3]

[1]Graduate School of Environment and Information Sciences, Yokohama National University, Yokohama, Japan
[2]Illinois Natural History Survey, University of Illinois at Urbana-Champaign, Illinois, USA
[3]Department of Risk Management & Environment Sciences, Yokohama National University, Yokohama, Japan

*Efforts to eradicate Invasive Alien Species (IAS) often become controversial, yet public support is essential for the success of eradication projects. Issues regarding IAS often require immediate action, but information about public attitudes toward and support for IAS management in Japan is lacking. This study examined public preferences for eradication of raccoons (*Procyon lotor*) (classified as an IAS in Japan) and identified factors affecting preference. Data were obtained from residents of Kanagawa prefecture in Japan via a Web survey. Logistic regression models revealed that preference for eradication of raccoons was relatively low (31%), and that the public lacked knowledge regarding raccoon management. Attitudes toward raccoons, attitudes toward damage, knowledge of raccoon issues, age, gender, and duration of residence were predictors of public preference for eradication. Preference for eradication was not related to having seen the once popular "Raccoon Rascal" cartoon.*

Keywords attitudes, eradication, raccoons, invasive alien species, Japan

Introduction

Increased mobility of human populations and expanding global trade has led to both purposeful and inadvertent introductions of invasive species in many nations. Invasive species pose threats to ecosystems including extinction of native species. Such species can also negatively impact socioeconomic activities such as human health, losses in agriculture crops, fisheries, and forestry (McNeely, 2001; Mooney & Hobbs, 2000; Nelson, 2005). The Convention on Biological Diversity (1992) termed these species "Invasive Alien Species (IAS)" and recommended eradicating and controlling IASs to conserve native ecosystems, habitats, and species. Wildlife eradication and control, however, often are controversial. In Japan, for example, a project to eradicate the Formosan rock macaque (*Macaca cyclopis*)

Address correspondence to Harumi Akiba, Graduate School of Environment and Information Sciences, Yokohama National University, Room 106, Environmental Information Building No.4, 79-7 Tokiwa-dai, Hodogaya-ku, Yokohama, Kanagawa, 240-8501, Japan. E-mail: akiba-harumi-bj@ynu.jp

introduced from the People's Republic of China faced stiff opposition from animal welfare groups and the general public. The project was temporarily halted and then took three additional years to reach stakeholder consensus necessary to re-start the program (Murakami & Oi, 2007). Similar cases of public resistance to eradicate or control IAS include American grey squirrels (*Sciurus carolinensis*) in Italy (Bertolino & Genovesi, 2003), feral cats in Illinois (Loyd & Miller, 2010a), mountain goats (*Oreamnos americanus*) in Olympic National Park, and sheep (*Ovis aries)* on Santa Cruz Island (McNeely, 2001).

Public support is important for the success of nuisance species eradication projects (Bertolino & Genovesi, 2003; Bomford & O'Brien, 1995; Bremner & Park, 2007). An understanding of public attitudes toward IAS eradication can be useful for management decisions including developing outreach programs, identifying optimal areas for implementing management programs, or considering alternative management options. Most studies have been conducted in the United States and Europe for management of various species and in New Zealand and Australia for IAS management. Little research, however, has been conducted regarding IAS management in Japan. Attitudes toward IAS also have extensive social–cultural contexts, and results from one country may not be valid for others (Fitzgerald, Fitzgerald, & Davidson, 2007). Ikeda (2006) conducted a survey of attitudes of the Japanese public toward raccoons (*Procyon lotor)* and identified high public acceptance for raccoon control and public perception of raccoon issues. His study, however, was limited to a descriptive assessment (cross-tabulation without statistical analysis) of the affecting factors. The objectives of this study are to: (a) examine public preference for eradication of raccoons and (b) identify factors affecting preferences.

Although attitudes toward IAS eradication are important for implementing management programs, understanding attitudes toward species in general or behaviors attributed to them may provide greater understanding of differences in public support for eradication programs. Attitudes are defined as the evaluations, either favorable or unfavorable, of a specific phenomenon and directly influence behaviors (Vaske, 2008). Understanding attitudes toward wildlife is essential to examine behavior such as public support for management programs, as differences in attitudes may result in different behaviors, even if individuals share the same beliefs (Pierce, Manfredo, & Vaske, 2001; Vaske, 2008).

Attitudes toward a species have been recognized as strong predictors of preference for wildlife management plans (Fulton, Skerl, Shank, & Lime, 2004; Riley & Decker, 2000). For example, Georgia residents reporting positive attitudes toward bears were more supportive of trapping and transferring bears causing property damage or found in urban areas than for euthanizing problem bears (Agee & Miller, 2009).

Tolerance for wildlife problems can depend on individual concerns related to type and extent of the damage incurred. Acceptance of lethal management was more strongly related to concern about nuisance and economic damage issues than about health and safety issues (Reiter, Brunson, & Schmidt, 1999). Extent of stakeholder concerns about damage may affect the preference for the management actions (Loker, Decker, & Schwager, 1999).

Knowledge is associated with acceptability of specific management actions (Vaske & Donnelly, 2007). People who have knowledge of issues and related management plans are more likely to support management if the purpose of the management is acceptable based on existing values and beliefs (Bremner & Park, 2007; Kakoyannis, Shindler, & Stankey, 2001). Hawley (2007) showed how survey results of public knowledge about issues could be applied to develop an effective public awareness campaign related to brown tree snakes (*Boiga irregularis*), an IAS in the Northern Mariana Islands.

Past experiences such as hearing or reading media reports of human–wildlife conflicts, observing the species in the wild, and experiencing property damage may affect perception of the species' densities and promote specific attitudes toward the species (Riley & Decker, 2000). People who have had negative experiences are more likely to support some aspect of management, as long as the proposed management does not interfere with deeply held values and beliefs (Loyd & Miller, 2010a).

In general, public acceptability of wildlife management plans are influenced by demographics, most notably gender, age, and place of residence (i.e., rural vs. urban). For example, males, older people and rural residents were more likely to accept reducing wildlife population (Bremner & Park, 2007; Loyd & Miller, 2010b; Sanborn & Schmidt, 1995). Generally speaking, demographics are not strong predictors of acceptance of wildlife management programs; however, in certain issues, especially those involving euthanasia (e.g., feral cats and gender), key demographic characteristics have been found to be significant predictors of support for such programs (Loyd & Miller, 2010b).

Based on published research, we hypothesize that preference for raccoon eradication is affected by:

H_1: general attitudes toward raccoons,
H_2: attitudes regarding damage by raccoons,
H_3: knowledge of issues surrounding raccoon management,
H_4: past experience related to raccoons, and
H_5: demographics (e.g., age, gender, place and duration of residence).

Study Area

Kanagawa prefecture has the second-largest human population (approximately 8,900,000) in Japan. The raccoon is classified as an IAS designated by the Japanese government under the Invasive Alien Species Act of 2004. During the 1970s, a television cartoon, "Raccoon Rascal," portrayed raccoons as cute and intelligent animals; they subsequently became popular pets and many were imported from the United States (Agetsuma-Yanagihara, 2004; Ikeda, Asano, Matoba, & Abe, 2004; Koike, 2006). After the fad for pet raccoons ended in the early 1980s, abandoned or escaped raccoons survived in the wild (Makino & Hashii, 2002). Raccoons cause agriculture loss, attack pets, and damage property including important cultural assets such as shrines and temples. Damage to native ecosystems includes preying on native species such as Japanese crayfish (*Cambaroides japoneicus*), Ezo salamander (*Hynobius retardatus*), and Tokyo salamander (*Hynobius tokyoensis*), which is a threatened species (Ikeda et al., 2004). Kanagawa prefecture has one of the widest distributions of raccoons within Japan (Biodiversity Center of Japan, 2007) and suffered one of the highest losses to agriculture caused by raccoons in 2005 (Agricultural Production Bureau, 2008). Strong opposition by animal welfare groups and individuals led the Kamakura city government to postpone research trapping in order to develop effective population control strategies in 2004 (Kamakura City Government, 2004). When the Kanagawa prefectural government announced the raccoon eradication plan in 2005, comments from the public revealed a wide range of opinions, including preference for control over eradication, negative response to lethal methods, skepticism of success, and opposition toward using great amounts of tax revenue for the plan. Such situations hindered implementation of the management plan as well as development of more effective trapping strategies.

Methods

Questionnaire Design

Our questionnaire was developed in consultation with academic social scientists and ecologists as well as with a local resident actively working on issues surrounding the raccoon population. The instrument was pretested on students, faculty members of Yokohama National University, and a subsample of members of the general public in Kanagawa. The first page of the questionnaire explained briefly that the raccoon is not a native species and that it causes damage impacting the local society. We deliberately chose the wording "not a native species" instead of "Invasive Alien Species" to help respondents easily understand the intended meaning of the questions.

We collected data from Kanagawa residents via a Web survey during October 2008. Computer Planning Co., Ltd., a survey company in Tokyo, sent questionnaires to 7,100 randomly selected individuals from among their list of 13,105 registered computer users. These users register their email addresses to be available for marketing and other Internet surveys, and in turn receive incentives (e.g., prizes, special offers). The registered computer users we sampled were Kanagawa residents over 15 years of age. We received 2,622 completed responses (response rate = 37%, CI = ±1.71%, $\alpha = .05$). As this study employed an Internet survey, we were limited to drawing our sample from the existing sample frame of email addresses provided by Computer Planning Co. LTD., which was the only sample frame available for the Internet survey. We weighted the data received from respondents by demographic data on the general Kanagawa population to account for potential response bias by dividing the percentage of the Kanagawa population for a particular variable (e.g., percent male) by the percent in our response. We weighted our sample by the Kanagawa census data (Kanagawa Prefectural Government, n.d.) to reflect the actual population characteristics for the following demographic variables: (a) age (age 15 to 29, 30s, 40s, 50s, and 60s+), (b) gender, and (c) place of residence (towns of <50,000 people, small city of 50,000 to <150,000, middle city of 150,000 to <1,000,000, and major city of >1,000,000 people). Ideally, the weighted number of cases should equal the un-weighted number and the mean of the weights should be 1 (Glynn, 2004); however, because this was not the case we adjusted our weights proportionally. For example, the proportion of people aged 60 and over in our sample was considerably lower than the general population (sample = 11%, Kanagawa = 30%) and those aged in 30s and 40s were relatively greater (sample = 27% for 30s and 28% for 40s, Kanagawa = 19% for 30s and 16% for 40s).

Dependent Variable

Participants were asked to select their preference for the raccoon population over the next 5 years. Choices were "zero," "decrease more," "decrease somewhat," "stable," "increase somewhat," "increase more" and "don't know." Based on the definition of "zero" as extirpation of the entire population of an alien species in a managed area (Secretariat of the Convention on Biological Diversity, 2001), respondents who chose "zero" were classified as "prefer eradication" (coded as 1). All other responses were combined into the category "not prefer eradication" (coded as 0).

Independent Variables

Five topic areas were treated as independent variables: (a) attitudes toward raccoons, (b) attitudes toward damage to property and ecosystems, (c) knowledge of issues

surrounding raccoon management, (d) experiences related to raccoons, and (e) demographic information.

Six psychological statements measuring attitudes toward raccoons and damage caused by raccoons were presented to survey subjects, each using a 5-point scale ($-2 =$ "strongly disagree" to $+2 =$ "strongly agree"). Attitudes toward raccoons were based on three statements: (a) raccoons are cute, (b) seeing them gives comfort, and (c) raccoons should not be killed. Attitudes toward damage were based on three statements about the perceived importance of eliminating damage to: (a) agricultural crops, (b) personal property, and (c) ecosystems. Responses for the three variables for attitudes toward raccoons and attitudes toward raccoon damage were combined into two single index variables by summing responses to each variable and dividing by three to create an index variable on the same scale as the original variables.

In the knowledge section, we first asked respondents about their prior knowledge of raccoons before taking this survey including the first page of the questionnaire explained brief information about raccoon issues. Nine questions related to issues involving raccoons were presented (No $= 0$, Yes $= 1$) and the number of "Yes" answers was summed into a single index: "knowledge level" (continuous). Prior knowledge statements included that raccoons were a non-native species; existence of naturalized raccoons; damage to agriculture, home property, and natural ecosystems; attacking domestic pets; and awareness of eradication and of local or national raccoon management policies.

Experience was measured by five statements (No $= 0$, Yes $= 1$). Statements asked survey participants if they had observed raccoons, watched the "Raccoon Rascal" cartoon, heard or read news stories of damage caused by raccoons, learned of raccoon issues at symposia or school, or experienced raccoon damage first- or second-hand.

Demographic variables included age ($\leq 29 = 1$, 30–39 $= 2$, 40–49 $= 3$, 50–59 $= 4$, $\geq 60 = 5$), gender (male $= 0$, female $= 1$), duration of residence (5-point scale ranging from less than one year to more than 16 years) and place of residence (towns of $<50,000$ people $= 1$, small city of 50,000 to $< 150,000 = 2$, medium city of 150,000 to $<1,000,000 = 3$, and major city of $>1,000,000$ people $= 4$).

Statistical Analyses

The two attitudinal indices (attitudes toward raccoons and raccoon damage) were tested for reliability using Cronbach's alpha and then combined to construct single scale variables representing the respective domains. To assess differences among respondents, we conducted chi-square bivariate analyses of preference for eradication versus knowledge (categorical), past experience, demographics, and one-way ANOVA of preference for eradication versus knowledge level (continuous) and the two attitude scale variables respectively. Four separate binary logistic regression models were then constructed to predict factors affecting preference for eradication of raccoons: (a) psychological model, (b) knowledge model, (c) experience model, and (d) demographics model. Finally, the full model was constructed by including only the significant independent variables from each of the four partial models.

Results

Descriptive Findings

Cronbach's alpha for attitude toward raccoons (.70) and toward damage by raccoons (.90) indicated relatively "good internal consistency" (Vaske, 2008). The mean of attitude

Table 1
Bivariate analysis of knowledge by preference for raccoon eradication ($N = 2,622$)

| Variables | Eradication | | χ^2 or F-value | p-value | Effect size |
	Yes (%)	No (%)			Φ or Eta
Knowledge (% Yes)					
I knew that:					
Naturalized raccoons exist (56%)	37	63	73.31	<.001	.167
Raccoons are Invasive Alien Species (34%)	42	58	88.72	<.001	.184
Raccoons cause damage to agriculture (47%)	37	63	51.48	<.001	.140
Raccoons cause damage to home property (35%)	40	60	62.89	<.001	.155
Raccoons cause damage to native ecosystems (25%)	43	57	60.61	<.001	.152
Raccoons cause damage to pets (18%)	38	62	15.89	<.001	.078
Raccoons are trapped and euthanized (5%)	37	63	2.68	.102	.032
Kanagawa prefecture planed for raccoon management (7%)	41	59	8.95	.003	.058
Japanese government enforced Invasive Alien Species Acts (9%)	47	54	31.95	<.001	.110
Knowledge level* (mean)	3.05	2.04	112.23	<.001	.203

*Total number of Yes of the statements (0 to 9).

single index toward raccoons was −.38 and that of attitude toward damage was 1.16. Although 56% of respondents knew that naturalized raccoons existed, only 34% were aware that raccoons were an alien species (Table 1). The most well-known damage was to agricultural crops (47%). About one-third (35%) knew of damage to home property, and less than one quarter knew of damage to native ecosystems (25%), or pets (18%).

A majority (54%) of respondents had watched "Raccoon Rascal" and 37% had heard or read reports about damage through the media. Few respondents had observed naturalized raccoons (9%), experienced damage personally, or knew someone who had experienced damage by raccoons (6%). Still fewer (1%) had the opportunity to learn about raccoons at school or other educational forums (Table 2).

Less than 10% of respondents knew that raccoons were trapped and euthanized, of the existence of the raccoon eradication plan for Kanagawa prefecture, or of the Japanese IAS Act. Thirty-one percent of respondents preferred a zero raccoon population level within the 5 years following the study.

Table 2
Bivariate analysis of past experience by preference for raccoon
eradication ($N = 2,622$)

Variables	Eradication		χ^2	p-value	Effect size
	Yes (%)	No (%)			Φ
Past experience (% Yes)					
I have:					
Watched TV cartoon "Raccoon Rascal" (54%)	31	69	.24	.622	.010
Heard/read about damage in the media (37%)	39	61	46.66	<.001	.133
Observed naturalized raccoons (9%)	29	71	.19	.663	.009
Experienced damage (6%)	26	74	1.84	.174	.027
Learned about raccoons at symposia/school (1%)	17	83	2.74	.098	.032

Bivariate Analysis

We examined preference for eradication related to attitudes toward raccoons, attitudes toward damage, prior knowledge, past experience, and demographics. The knowledge variable was significantly related to preference for eradication. Mean knowledge level of respondents who preferred eradication ($M = 3.05$) was statistically higher than that of those who did not ($M = 2.04$). Effect size for knowledge level (Eta $= .203$) suggested a "minimal" to "typical" relationship (Vaske, 2008) (Table 1). Among the five variables measuring past experience, one ("I have heard or read stories about damage through the media") was significantly associated with preference for eradication ($\chi^2 = 46.66$, $p < .001$), albeit with a "minimal" effect size ($\Phi = .133$) (Vaske, 2008) (Table 2).

Significant demographic variables associated with public preference for eradication were age, gender, place of residence, and duration of residence (Table 3). A greater percentage of respondents 60 years old and over (44%) preferred eradication, compared to 33% or fewer respondents in all other age categories. Males (35%) were more likely to prefer eradication than females (26%). Among the four places of residence categories, the greatest percentage (43%) that preferred eradication was in the town category and the least (21%) was in the small city category. For duration of residence, those respondents residing longer in Kanagawa preferred eradication. There was a significant difference ($\chi^2 = 68.05$, $p < .001$) between respondents with less than one year of residence (9%) and those living there at least 16 years (35%). Effect sizes of all demographic variables (.066 to .228) was "minimal" to "typical" (Vaske, 2008).

Comparisons of attitudes toward raccoons and raccoon damage with preference for eradication were significant in each test (Table 4). Higher percentages of individuals who responded positively in regard to attitudes toward raccoons expressed that they did not prefer eradication compared to those who had less positive attitudes. Effect sizes for each of the individual variable comparisons were "minimal" to "typical." Preference for eradication differed significantly by the attitude scale item measuring combined attitudes toward raccoons ($F = 251.94$, $p < .001$, Eta $= .296$). Differences between attitudes toward raccoon

Table 3
Bivariate analysis of demographic variables with preference for raccoon
eradication ($N = 2,622$)

| Variables | Eradication | | χ^2 | *p*-value | Effect size |
	Yes (%)	No (%)			Cramer's *V* or Φ
Age			136.49	<.001	.228
15–20s	16	84			
30s	23	77			
40s	30	70			
50s	33	67			
60s+	44	56			
Gender			21.11	<.001	.090
Male	35	65			
Female	26	74			
City size			11.57	.009	.066
Town	43	57			
Small city	21	79			
Middle city	30	70			
Major city	31	69			
Duration of residence			68.05	<.001	.161
<1 year	9	91			
1–5 years	21	79			
6–10 years	22	78			
11–15 years	22	78			
16 years+	35	65			

damage and preference for eradication were significant across all comparisons, with effect sizes "minimal" to "typical" for all tests. Attitudes toward damage scale was significant ($F = 211.31$, $p < .001$) and had a typical effect size (Eta = .273).

Logistic Regression Model

Although both attitude variable scale items were significant in the psychological model (Table 5), the model itself was not significant based on the Hosmer and Lemeshow test (predicted 71% correct; Hosmer & Lemeshow test $p = .001$; Nagelkerke $R^2 = .18$). The model correctly classified 27% of cases for support for eradication and 91% for not supporting eradication. This difference may be attributed to differing sample sizes for the two categories. In the knowledge model, knowledge was significantly associated with public preference for eradication (predicted 70% correct; Hosmer & Lemeshow test $p = .374$; Nagelkerke $R^2 = .06$). Respondents with greater knowledge of issues related to raccoons were more likely to prefer eradication (Table 5). Of the five variables in the experience model only "I have heard or read stories about damage by raccoons through the media" was a significant predictor of preference for eradication (predicted 70% correct; Hosmer & Lemeshow test $p = .909$; Nagelkerke $R^2 = .03$). Respondents who had heard or

Table 4

Bivariate comparison of attitudes with preference for raccoon eradication ($N = 2,622$)

	Eradication				Effect size
	Yes	No	*F*-value	*p*-value	Eta
I think that raccoons are cute animals.	−.67	−.26	96.74	<.001	.189
Seeing raccoons gives me comfort (enjoyment, pleasure).	−.60	−.14	120.26	<.001	.209
I do think that raccoons should not be killed no matter what they do.	−.92	−.27	264.19	<.001	.303
Attitudes toward raccoons scale ($\alpha = .70$)	−.73	−.22	251.94	<.001	.296
Eliminating agricultural damage is important to me.	1.44	1.06	163.02	<.001	.242
Eliminating damage to home property is important to me.	1.43	1.03	159.93	<.001	.240
Eliminating damage to ecosystems is important to me.	1.44	1.02	198.02	<.001	.265
Attitudes toward damage scale ($\alpha = .90$)	1.44	1.04	211.31	<.001	.273

Table 5

Logistic regression model of public preference for raccoon eradication

	Partial models				Full model[1]			
Variables	β	Wald	Odds ratio	*p*-value	β	Wald	Odds ratio	*p*-value
Psychological								
Attitudes toward raccoons	−.68	127.12	.51	<.001	−.59	91.31	.55	<.001
Attitudes toward damage	.84	108.03	2.31	<.001	.70	71.88	2.01	<.001
Knowledge level	.19	103.34	1.20	<.001	.08	10.83	1.08	.001
Experiences								
Heard/read about damage in the media	.64	50.55	1.91	<.001				
Demographics								
Age	.30	88.90	1.36	<.001	.20	33.87	1.22	<.001
Gender	−.47	27.58	.63	<.001	−.36	14.49	.70	<.001
Duration of residence	.17	14.96	1.19	<.001	.13	7.98	1.14	.005

[1]Final Model Solution: Predicted 74% correct; Hosmer and Lemeshow test *p* = .404; Nagelkerke R^2 = .23.

read stories about damage through the media were more likely to prefer eradication. The demographics model showed that all variables except place of residence were significant predictors of preference for eradication (predicted 71% correct; Hosmer & Lemeshow test $p = .264$; Nagelkerke $R^2 = .10$). Respondents who are older, male, and had resided longer in Kanagawa were more likely to prefer eradication.

Six of seven variables used in the full model were significant predictors affecting public preference (predicted 74% correct; Hosmer and Lemeshow test $p = .404$; Nagelkerke $R^2 = .23$ "heard/read stories about damage though the media" was the only variable not significant in the final model).

Attitudes toward raccoons, attitudes toward damage, and knowledge were strongly associated with public preference for eradication in the full model. Respondents having more positive attitudes toward raccoons were less likely to prefer eradication, whereas those with negative attitudes toward damage were more likely to support eradication. These results supported hypotheses H_1, H_2, and H_3, which means that psychological and knowledge factors affected public preference for eradicating raccoons. There was no significant predictor among the experience variables in the full model. Our hypothesis H_4 that past experience influenced preference must, therefore, be rejected, although it was not rejected in the partial model of experience only. Age, gender, and duration of residence were significantly associated with public preference for eradicating raccoons, therefore we were unable to reject hypothesis H_5. Among these significant factors, attitudes toward raccoons and attitudes toward damage had the largest impact on public preference. According to the odds ratios, the probability of preference for eradication changed by a factor of .55 or 2.01, given a unit change in each factor, respectively.

Discussion

In our survey, preference level for eradication of raccoons was relatively low (31%). In a similar study for IAS in New Zealand, 72% of respondents preferred eradication of possum (*Trichosurus vulpecula*) (Fraser, 2001). Johnston and Marks (1997) found that more than half of the respondents in an Australian study believed it necessary to eradicate IAS such as feral cats (84%), wild dogs (63%) and rabbits (56%). All of these animals are small IAS mammals that may hold appeal for the general public similar to how raccoons once did in Japan. Cats, dogs, and rabbits are popular as a pet among the residents of both countries. Compared to those studies, our survey found far less preference for eradication of one small IAS mammal.

Not all management actions that decision makers and scientists judge to be most effective and reasonable actually earn public support (Fulton et al., 2004). Our results reveal a gap between local government and public perceptions of raccoons in Kanagawa prefecture. Local governments within Kanagawa prefecture currently take actions based on reports from public observations of raccoons. They must obtain the permission of property owners to set traps on private lands, and successful local eradication requires great amounts of funding from local government budgets given the rapidly expanding raccoon population. Without more public support for its management plan, the government of Kanagawa prefecture will find it difficult to eradicate raccoons. Our analysis suggests that the general public lacks knowledge related to, and opportunities to learn about, issues surrounding raccoon populations. More effective public education and outreach programs will be needed to increase knowledge and awareness of problems associated with raccoons.

Although this study initially focused on investigating potential influences or the "Raccoon Rascal" cartoon on attitudes toward raccoons in Kanagawa prefecture and more

than half of the respondents had watched the "Raccoon Rascal" cartoon, it was not statistically significant in the bivariate analysis or in the logistic regression models. This finding countered our hypothesis that "Raccoon Rascal" negatively influenced preference for eradication of raccoons. We proposed that the positive image of the cartoon character was related to lack of support for eradication. That this was not the case suggests other factors may be influencing public attitudes toward raccoons. Place of residence was not a significant factor predicting public preference for raccoon eradication, but our bivariate analysis of demographic variables showed that residents of small city areas were least likely to prefer eradication, which suggests that people in these areas may be least supportive when an eradication project is proposed or implemented. The effect size for all demographic variables were small; consistent with past research (for example, Miller & Vaske, 2003; Donnelly & Vaske, 1995), demographics variables had weak relationship with acceptability of management.

Management Implications

Very few respondents had learned about raccoon issues in school or other educational programs, and only 17% of respondents who had been exposed to such programs supported eradication. In our experience model, respondents who had heard or read reports of damage through broadcast media were 1.9 times more likely to prefer eradication than those who had not. This finding suggests that the broadcast media could be a more effective tool to increase support than educational programs. To be effective, educational and informational programs should be designed to target specific stakeholders (Hawley, 2007). Based on our results, we suggest that younger people, females, and people residing in Kanagawa less than a year should be target audiences. Attitude regarding damage was a strong predictor of preference for eradication; however, few respondents knew about damage caused by raccoons. Publicizing information about damage, such as direct or indirect damage to personal property, economic activity or ecosystems would likely increase awareness of raccoon issues.

Future Research

In Kanagawa prefecture, most of the methods employed for eradication are lethal. Some public comments proposed non-lethal methods such as trap-neuter-and-release or sheltering. Reiter et al. (1999) found nine lethal methods employed in wildlife damage management were rated as inhumane and animal suffering was one of the most important factors to be considered in selecting management methods. Levels of public support differ for various methods (Agee & Miller, 2009; Bremner & Park, 2007) and the chosen methods differ with the demographic composition of stakeholders (Agee & Miller, 2009). Studying public preference for different methods and identifying affecting factors should yield valuable information for decision-makers considering raccoon management methods. Further studies to identify priority topics for particular stakeholders should also be included in developing management options. Few studies (e.g., Hawley, 2007) have quantitatively evaluated the effectiveness of applying factors identified by studies such as presented here for developing outreach and education strategies in IAS management. A follow-up study to assess the effectiveness of our findings for developing management strategies would contribute to future management of both IAS and other wildlife in Japan.

References

Agee, J. D., & Miller, C. A. (2009). Factors contributing toward acceptance of lethal control of black bears in Central Georgia, USA. *Human Dimensions of Wildlife*, *14*(3), 198–205.

Agetsuma-Yanagihara, Y. (2004). Process of establishing an introduced raccoon (*Procyon loter*) population in Aichi and Gifu Prefectures, Japan: Policy for managing threats posed by introduced raccoons. *Mammalian Science*, *44*(2), 147–160. (In Japanese)

Agricultural Production Bureau. (2008). *Manual of Wildlife Damage Prevention: Raccoon, nutria, reeves's muntjac, mongoose, Taiwan squirrel*. Retrieved from http://www.maff.go.jp/j/seisan/tyozyu/higai/h_manual/pdf/data9.pdf (In Japanese)

Bertolino, S., & Genovesi, P. (2003). Spread and attempted eradication of the grey squirrel (*Sciurus carolinensis*) in Italy, and consequences for the red squirrel (*Sciurus vulgaris*) in Eurasia. *Biological Conservation*, *109*(3), 351–358.

Biodiversity Center of Japan. (2007). *Nature environment baseline survey 2007: Report for biodiversity survey of raccoon habitat*. Retrieved from http://www.biodic.go.jp/reports2/7th/araiguma/araiguma.pdf (In Japanese)

Bomford, M., & O'Brien, P. (1995). Eradication or control for vertebrate pests. *Wildlife Society Bulletin*, *23*(2), 249–255.

Bremner, A., & Park, K. (2007). Public attitudes to the management of invasive non-native species in Scotland. *Biological Conservation*, *139*(3–4), 306–314.

Convention on Biological Diversity. (1992). *Convention on biological diversity*. Retrieved from http://www.cbd.int/doc/legal/cbd-en.pdf

Donnelly, M. P., & Vaske, J. J. (1995). Predicting attitudes toward a proposed moose hunt. *Society and Natural Resources*, *8*, 307–319.

Fitzgerald, G., Fitzgerald, N., & Davidson, C. (2007). *Public attitudes towards invasive animals and their impacts*. Retrieved from http://www.feral.org.au/wp-content/uploads/2010/03/Social_Literature_Review-report.pdf

Fraser, K. W. (2001). Introduced wildlife in New Zealand: A survey of general public views. *Landcare Research Science Series* (23). Lincoln, NZ: Manaaki Whenua Press.

Fulton, D. C., Skerl, K., Shank, E. M., & Lime, D. W. (2004). Beliefs and attitudes toward lethal management of deer in Cuyahoga Valley National Park. *Wildlife Society Bulletin*, *32*(4), 1166–1176.

Glynn, P. (2004). *Adjusting or normalizing weights "on the fly" in SPSS*. Retrieved from http://staff.washington.edu/glynn/adjspss.pdf

Hawley, N. B. (2007). Custom trucks, radio snake jingles, and temporary tattoos: An overview of a successful public awareness campaign related to brown treesnakes in the Commonwealth of the Northern Mariana Islands. In G. W. Witmer, W. C. Pitt, and K. A. Featherstone (Eds.), *Managing vertebrate invasive species: Proceedings of an international symposium* (pp. 53–56). Fort Collins, CO: National Wildlife Research Center.

Ikeda, T. (2006). *Study of consensus building for countermeasure against invasive alien raccoons: Report for FY2004-2005 Grant-in-Aid for Scientific Research (C)*. Sapporo, Hokkaido: Hokkaido University.

Ikeda, T., Asano, M., Matoba, Y., & Abe, G. (2004). Present status of invasive alien raccoon and its impact in Japan. *Global Environmental Research*, *8*(2), 125–131.

Johnston, M. J., & Marks, C.A. (1997). *Attitudinal survey on vertebrate pest management in Victoria*. Frankston, Victoria: Department of Natural Resources and Environment.

Kakoyannis, C., Shindler, B., & Stankey, G. (2001). *Understanding the social acceptability of natural resource decision making processes by using a knowledge base modeling approach*. Retrieved from http://www.fs.fed.us/pnw/pubs/pnw_gtr518.pdf

Kamakura City Government. (2004). *Postponement of investigation for inhabiting situation of raccoon and masked musang* [Press release]. (In Japanese)

Kanagawa Prefectural Government. (n.d.). Community Census as of 1, Feb. 2010. Retrieved from http://www.pref.kanagawa.jp/cnt/p20883.html (In Japanese)

Koike, F. (2006). Prediction of range expansion and optimum strategy for spatial control of feral raccoon using a metapopulation model. In F. Koike, M. N. Clout, M. Kawamichi, M. De Poorter, & K. Iwatsuki (Eds.), *Assessment and control of biological invasion risks* (pp. 148–156). Kyoto, Japan and Gland, Switzerland: SHOUKADOH Book Sellers and the World Conservation Union.

Loker, C. A., Decker, D. J., & Schwager, S. J. (1999). Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. *Wildlife Society Bulletin*, *27*(1), 152–159.

Loyd, K. A., & Miller, C. A. (2010a). Factors related to preferences for trap-neuter-release management of feral cats among Illinois homeowners. *Journal of Wildlife Management*, *74*(1), 160–165.

Loyd, K. A. T., & Miller, C. A. (2010b). Influence of demographics, experience and value orientations on preferences for lethal management of feral cats. *Human Dimensions of Wildlife*, *15*(4), 262–273.

Makino, T., & Hashii, H. (2002). A note of raccoons transported to Kanagawa-ken Shizenkankyo Hozen Center. *Kanagawa-ken Shizenkankyo Hozen Center Shizen Jyoho*, *1*, 1–6. (In Japanese)

McNeely, J. A. (2001). An introduction to human dimensions of invasive alien species. In J. A. McNeely & International Union for Conservation of Nature and Natural Resources. (Eds.), *The great reshuffling: human dimensions of invasive alien species* (pp. 5–20). Gland, Switzerland and Cambridge, England: IUCN.

Miller, A. C., & Vaske, J. J. (2003). Individual and situational influences on declining hunter effort in Illinois. *Human Dimensions of Wildlife*, *8*, 263–276.

Mooney, H. A., & Hobbs, R. J. (2000). Introduction. In H. A. Mooney & R. J. Hobbs (Eds.), *Invasive species in a changing world* (pp. xiii–xv). Washington, DC: Island Press.

Murakami, O., & Oi, T. (2007).The present status of and perspectives on the Specified Wildlife Conservation and Management Plans: A report on the public symposium part 2 at the 2006 annual meeting of the Mammalogical Society of Japan. *Mammalian Science*, *47*(1), 127–130. (In Japanese)

Nelson, G. C. (2005). Drivers of ecosystem change: Summary chapter. In R. M. Hassan, R. Scholes, & N. Ash (Eds.), *Ecosystems and human well-being: Current state and trends: Findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment* (pp. 73–76). Washington, DC: Island Press.

Pierce, C. L., Manfredo, M. J., & Vaske, J. J. (2001). Social science theories in wildlife management. In D. J. Decker, T. L. Brown, & W. F. Siemer (Eds.), *Human dimensions of wildlife management in North America* (pp. 39–56). Bethesda, MD: The Wildlife Society.

Reiter, D. K., Brunson, M. W., & Schmidt, R. H. (1999). Public attitudes toward wildlife damage management and policy. *Wildlife Society Bulletin*, *27*(3), 746–758.

Riley, S. J., & Decker, D. J. (2000). Wildlife stakeholder acceptance capacity for cougars in Montana. *Wildlife Society Bulletin*, *28*(4), 931–939.

Sanborn, W. A., & Schmidt, R. H. (1995). Gender effects on views of wildlife professionals about wildlife management. *Wildlife Society Bulletin*, *23*(4), 583–587.

Secretariat of the Convention on Biological Diversity. (2001). *Invasive alien species: Review of the efficacy of existing legal instruments applicable to invasive alien species* (*CBD Technical Series No. 2*). Montreal, Québec, Canada: Author.

Vaske, J. J. (2008). *Survey research and analysis: Applications in parks, recreation and human dimensions*. State College, PA: Venture Publishing.

Vaske, J. J., & Donnelly, M. P. (2007). Public knowledge and perceptions of the desert tortoise (HDNRU Report No. 81). Report for the National Park Service. Fort Collins, CO: Colorado State University, Human Dimensions in Natural Resources Unit.