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Public attitudes and intentions toward engaging in reintroduction of wolves to Japan

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Abstract

Reintroducing apex predators is an important approach in ecosystem restoration; however, it is challenging. Wolves (*Canis lupus*) were exterminated in Japan around 1900, and since then, there has been a lack of top predators throughout the country. Currently, the wild ungulate population is increasing, causing agricultural and forest damage. This has triggered an ongoing debate among researchers and nongovernmental organizations on whether wolves should be reintroduced to promote self-regulating biodiverse ecosystems. We conducted a nationwide survey to examine public attitudes toward wolf reintroduction (WR) in Japan. We sent online questionnaires to 88,318 citizens across the country. Among the 12,028 respondents, excluding those with invalid or incomplete answers and unqualified respondents, we obtained and analyzed 7500 responses that were representative of Japanese citizens in terms of some key sociodemographic attributes. More respondents disagreed with WR (39.9%) than agreed (17.1%), and many respondents (43.0%) were undecided. Structural equation modeling revealed that risk perceptions affected public attitudes, implying that the greater the perceived threat of wolf attacks, the less likely people are to support WR. In contrast, attitudes toward wolves (e.g., "I like wolves.") influenced by wildlife value orientation and beliefs about the ecological role of wolves (e.g., controlling deer populations) positively affected public attitudes toward WR. Those who had a positive attitude toward WR showed intentions to engage in behaviors that support WR. Our results suggest that the dissemination of information related to the ecological role of wolves and the development of a more mutualistic mindset in people could positively influence public support for WR in Japan.

KEYWORDS
behavioral intentions, caring beliefs, ecological restoration, Japanese, nationwide survey, risk perception, structural equational modeling, top predators

Actitudes e intenciones públicas respecto a la reintroducción de lobos en Japón

Resumen: La reintroducción de superdepredadores es una estrategia importante para la restauración de los ecosistemas; sin embargo, representa muchos retos. Los lobos (*Canis lupus*) fueron exterminados en Japón alrededor de 1900 y desde entonces no ha habido superdepredadores en el país. Hoy en día, la población silvestre de ungulados está incrementando y ocasionando daño agrícola y forestal. Esto ha detonado un debate entre los investigadores y las organizaciones no gubernamentales sobre si se debiesen reintroducir lobos para promover ecosistemas biodiversos autorregulados. Realizamos una encuesta nacional para analizar las actitudes públicas respecto a la reintroducción de lobos (RL) en Japón. Enviamos 88,318 cuestionarios virtuales a ciudadanos de todo el país. De los

12,028 respondientes, excluyendo a aquellos con respuestas inválidas o incompletas y a los respondientes no calificados, obtuvimos y analizamos 7500 respuestas representativas del ciudadano japonés en términos de algunas características sociodemográficas importantes. Hubo más respondientes en contra (39.9%) que a favor (17.1%) de la RL y todavía más respondientes (43.0%) no estaban decididos. El modelo de ecuación estructural reveló que las percepciones de riesgo impactaron sobre las actitudes públicas, lo que implica que entre mayor sea la amenaza percibida de los ataques de lobos, es menos probable que la gente apoye la RL. Como contraste, la orientación del valor de la fauna que influyó sobre las actitudes (p. ej.: "me gustan los lobos") y las creencias sobre el papel ecológico de los lobos (p. ej.: controlar las poblaciones de venados) tuvieron un impacto positivo en las actitudes respecto a la RL. Quienes tuvieron una actitud positiva respecto a la RL mostraron intenciones de apoyarla. Nuestros resultados sugieren que la divulgación de información relacionada con el papel ecológico de los lobos y el desarrollo de una mentalidad más mutualista en las personas podrían influir positivamente en el apoyo público para la RL en Japón.

【摘要】

重引入顶级捕食者是生态系统恢复的重要方法, 同时也是一项挑战。灰狼 (*Canis lupus*) 在1900年左右在日本灭绝, 此后, 日本一直缺少顶级捕食者。目前, 野生有蹄类动物的数量正在增加, 对农业和森林造成了破坏。这引发了研究者和非政府组织持续争论是否应重引入灰狼, 以促进高生物多样性的生态系统进行自我调节。我们在全国范围内进行了一次调查, 分析了日本公众对灰狼重引入的态度。我们向全国88,318名公民发出了在线调查问卷。在12,028名受访者中, 除去那些回答无效、不完整或不具有资格的受访者, 我们获得了7,500份回答并进行了分析, 这些受访者在日本公民重要的社会人口属性方面具有代表性。不同意重引入灰狼的受访者 (39.9%) 多于同意的受访者 (17.1%), 还有许多受访者 (43.0%) 不能下定论。结构方程模型显示, 风险认知影响了公众态度, 意味着人们对灰狼袭击的威胁感知越明显, 就越不可能支持灰狼重引入。相反, 因野生动物价值观而对灰狼产生的态度 (如"我喜欢狼"), 以及对灰狼生态作用的信念 (如控制鹿的数量) 积极影响着公众对于灰狼重引入的态度。那些对灰狼重引入持积极态度的人表现出参与支持灰狼重引入行动的意向。我们的结果表明, 传播与灰狼生态作用有关的信息并培养人们更多的互助心态有助于积极推动日本公众对灰狼重引入的支持。

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INTRODUCTION

The critical role of top predators in driving trophic cascades in ecosystems is well documented (Callan et al., 2013; Smith & Bangs, 2009; Svenning et al., 2016). Historically, people worldwide have viewed top predators as pests. In some cases, the predators were persecuted until they were exterminated from the region (Bangs et al., 2005; Ripple et al., 2014). Research in different ecosystems shows that the loss of top predators can lead to an ecological release of prey species, which in turn constrains species on lower trophic levels, resulting in secondary extinctions and changes in biological communities (Groom et al., 2006; Ripple et al., 2014). Additionally, evidence exists that reintroducing top predators into ecosystems helps in the recovery of ecosystems and improves biodiversity richness (e.g., wolf [*Canis lupus*] reintroduction in Yellowstone National Park, USA [Beschta & Ripple, 2016; Smith & Bangs, 2009]). The results of such predator-reintroduction efforts, in which top predators have aided in ecosystem restoration, have led to exterminated predators either being reintroduced or considered for reintroduction worldwide, for example, potential reintroduction of wolves in Scotland (Nilsen et al., 2007) and Colorado (USA) (Niemiec et al., 2020) and potential reintroduction of lynx (*Lynx lynx*) to the United Kingdom (Drouilly & O'Rian, 2021).

Two subspecies of wolves inhabited Japan: the Ezo wolf (*C. lupus hattai*) in Hokkaido and the Japanese wolf (*C. l. hodophilax*) in Honshu, Shikoku, and Kyushu (Endo, 2015). Traditionally, cultivation of crops, such as rice, was the major source of

food production in Japan; it was more common than ranching except in Hokkaido (Knight, 2006). Wolves were traditionally considered benign animals. They were worshiped as gods because they helped protect fields from crop-raiding pests, such as deer (*Cervus nippon*), boars (*Sus scrofa*), and monkeys (*Macaca fuscata*) (Knight, 2006). However, the positive image of wolves as guardians of agricultural fields changed with the spread of rabies in the 1700s, which led to several cases of wolf attacks on people (Knight, 2006). Furthermore, deforestation for the creation of agricultural lands and urbanization over the years led to the destruction of wolf habitat, which in turn led to a decrease in wolf prey populations (such as deer), which further led to a reduction in the number of wolves (Endo, 2015). Wolves in Japan consequently decreased in number. The last Ezo wolf was killed in Hokkaido in the 1890s, and the last Japanese wolf was hunted and killed in 1905.

Japan is currently facing various wildlife-related problems, including an increase in the number of wild ungulates (i.e., deer and boar), which are causing more agricultural damage than any other mammals (Sakurai, 2019; Tsunoda & Enari, 2020). In several regions of Japan, the population density of deer has increased to more than 40 deer/km^2 (Ueno et al., 2022). The number of deer harvested by hunting has increased 12-fold from 42,000 in 1990 to 725,000 in 2021 (Ministry of the Environment, 2022a). Despite this increase in hunting-related harvest, populations continue to increase. Terrestrial mammals, mainly deer and boar, cause agricultural damage costing approximately 13 billion yen (approximately US$82 million) annually (Ministry of Agriculture, Forestry & Fisheries, 2021a).

The human population in Japan is decreasing; the resident population of 120 million in 2013 is projected to decline to approximately 100 million by 2050 (Cabinet Office Japan, 2014). Depopulation and aging of the population is severe, especially in the rural mountainous areas. Abandoned fields in these areas ultimately become brush and forests, leading to the expansion of habitats for wild animals (Sakurai, 2019; Tsunoda & Enari, 2020). Although the government aims to mitigate wildlife damage by promoting hunting and culling (Ministry of Agriculture, Forestry & Fishery, 2021b), the number of hunters has also declined to approximately 200,000 as of 2018. This is less than half the number of hunters in the 1970s (Kaji et al., 2013; Ministry of the Environment, 2022b).

To help resolve these problems, researchers suggest wolf reintroduction to Japan (WR) to promote the self-regulation of ecosystems (Kaji, 2017; Knight, 2006; Sakurai et al., 2018; Yamanaka & Kaji, 2006). However, because Japan is democratic, the government needs to consider public opinion and implement policies that reflect the needs and demands of citizens. As in Colorado, where WR was determined based on ballot results (NPR News, 2020), WR in Japan would depend on the majority opinion of the public (Kaji, 2017; Yamanaka & Kaji, 2006). However, few studies have been conducted in Japan to determine nationwide public attitudes toward WR. Therefore, we analyzed public perceptions of WR in Japan through a representative sampling of Japanese citizens.

Previous studies

Public perceptions of WR have been well-studied in the United States. A series of studies of stakeholders in and around Yellowstone National Park were some of the first attempts to understand public attitudes toward WR. The research findings included differences in support based on respondent attributes (positive attitude among the statewide public toward WR vs. negative attitude among nearby residents). People with more knowledge about wolves tended to support WR (Bath, 1989; Bath & Buchanan, 1989). Similar results were found in Europe. In Poland, rural residents in regions with a long history of wolf presence had less positive attitudes toward wolves than those in regions with a short history whose knowledge of wolves positively affected their attitudes (Gosling et al., 2019). A review of public attitudes toward WR and conservation mostly in the United States and Europe (Williams et al., 2002) showed that public attitudes toward WR should become more positive as education and urbanization increase. An increase in human−wolf tensions was recorded in countries where wolf populations recovered naturally. In Sweden, an increase in wolf populations led to a decrease in public acceptance as people experienced direct encounters with wolves (Eriksson et al., 2015). Other factors, such as attitudes toward wolves and risk perceptions, seem to affect public attitudes toward WR as well (Appendix S1; see "Conceptual Framework" for details).

Human dimension studies are also being conducted in places where WR projects have not yet taken place. In Colorado, where WR is expected to take place by 2024, a study revealed that a majority of residents across different regions of the state and different age groups are in favor of WR (Niemiec et al., 2020). In Scotland, where wolves were eradicated in the 1700s, rural and urban communities are generally positive about the idea of WR, although they are concerned about the loss of livestock or human casualties due to wolves (Nilsen et al., 2007).

In Japan, studies have been conducted to understand the public attitudes toward WR. The Japan Wolf Association (JWA) (a general incorporated association) has been continuously conducting public surveys on this subject. A nationwide survey (*n* = 1176) conducted in 1996 showed that public attitudes toward WR were divided: 28.5% supported WR and 27.7% opposed the idea, and 43.8% were undecided (Angeli et al., 1998). The results of a more recent survey (*n* = 12,114) conducted in 2019 showed that 41.2% supported and 14.5% opposed WR, whereas 43.9% were unsure about WR (JWA, 2020). This implies that potentially there has been an increase in the ratio of respondents supporting WR in the past two decades. However, because the survey was conducted mainly by members of the JWA collecting opinions from gatherings in parks and festivals, sampling was not systematic (JWA, 2020). Thus, it is unclear on how well the respondents represented the perceptions of the larger citizenry. Sampling bias can occur when some members of the sampling frame are unlikely to be selected (Groves et al., 2004). The JWA was established to promote and realize WR in Japan; therefore, it is understood that most of its members are supporters of WR. Another study conducted with a targeted sample (students at

a private university in Japan [$n = 360$]) showed that their attitudes were divided: 42.8% disagreed, 31.1% agreed, and 26.1% were neutral to WR (Sakurai et al., 2020). Students who thought wolves were necessary for a functioning ecosystem were more likely to support reintroduction, whereas those who thought reintroduced wolves would become invasive species were more likely to disagree (Sakurai et al., 2020).

Conceptual framework

Based on the findings of previous studies on public acceptance of large carnivores (Bruskotter & Wilson, 2014; Zajac et al., 2012), we developed a hypothesized model (Appendix S2) of the factors that affect public attitudes and intentions toward engaging in WR in Japan. Following the hazard-acceptance model modified for use with large carnivores (Bruskotter & Wilson, 2014), we hypothesized that public attitudes toward WR (acceptance of a newly developed wolf population) are affected by risk perceptions. People are prone to misjudging risk levels. They overestimate infrequent risks with catastrophic consequences and underestimate more frequent but less consequential risks (Jaeger et al., 2001; Slovic, 1987). In the United States, risk perceptions related to cougars (*Felis concolor*) (e.g., fear of being attacked) affect their attitude toward the species (Riley & Decker, 2000). In Japan, local residents with a greater perceived risk of bear (*Ursus thibetanus*) attacks are less accepting of the species (Sakurai et al., 2013a).

Previous studies show that social trust affects risk perceptions (Bruskotter & Wilson, 2014; Zajac et al., 2012). Social trust is a degree of trust people have in agencies or individuals responsible for the management of technology, the environment, or other realms of public health and safety (Siegrist et al., 2000, 2005). People in the United States who trust agencies participate more in wildlife-related interventions promoted by governments than those who lack trust in agencies (Vaske et al., 2004) and Japan (Sakurai et al., 2013a). Public trust in researchers and governments who propose management policies could affect public attitudes toward WR. A study in Japan showed that university students who trust researchers are more likely to support WR (Sakurai et al., 2020).

Attitudes toward wolves could influence attitudes toward WR and risk perceptions (Bruskotter & Wilson, 2014) and are potentially affected by wildlife value orientation (WVO). This cognitive concept was developed specifically to examine public beliefs regarding wildlife (Manfredo, 2008). Two key value orientations possibly affect the public's relationship with wildlife: mutualism, measured by social affiliation and caring beliefs, and domination, measured by appropriate use and hunting beliefs (Manfredo, 2008; Manfredo et al., 2020). WVO appears to affect public attitudes toward wolves; those with mutualistic values are more likely to support wolf conservation than those with hunting beliefs (Gosling et al., 2019; Manfredo et al., 2020). Few, if any, studies have been conducted in Asian countries to determine the influence of WVO on public perception of WR.

Knowledge systems formed through education, experiences, and media affect how people shape attitudes (Ajzen, 1985;

Hines et al., 1987). The public's science-based knowledge of wolves affects support toward WR (Angeli et al., 1998; Enck & Brown, 2002; Gosling et al., 2019). A previous study in Japan showed that people are more supportive of the reintroduction of familiar species, which could be the result of the social psychological phenomenon mere-exposure effect (Sakurai et al., 2022). Based on the findings of previous studies, we speculated that beliefs regarding the ecological role of wolves affect attitudes toward wolves (Williams et al., 2002) and that knowledge of deer-related problems affects attitudes toward WR (Angeli et al., 1998).

As one of the first nationwide surveys to have been conducted in Japan, we aimed to explore potential factors affecting public attitudes toward WR. Because Japan is an island country, whether the public perceives reintroduction of wolves as an introduction of an invasive species could affect their attitudes toward WR. In Japan, the introduction of invasive predators, such as the mongoose (*Herpestes javanicus*) and raccoon (*Procyon lotor*), has led to the loss of indigenous species and conflicts with humans (Ikeda, 2015; Yamada & Sugimura, 2004). However, few studies have focused on whether the public perception of invasive species affects their attitudes toward WR. We assumed that people would perceive WR as a risk if they believe wolves are a non-native species that could become invasive.

Because most researchers have investigated public attitudes and beliefs about WR (Enck & Brown, 2002; Williams et al., 2002; Eriksson et al., 2015) without associating these attitudes and beliefs with an action, their results have no direct influence on policy. In contrast, action predicted based on behavioral intention (Ajzen & Fishbein, 1980) could directly affect policies and legislation, especially in democratic countries. Moreover, few sociological studies of WR have focused on the relationships among cognitive factors, attitudes, and behavioral intentions in a model.

METHODS

Questionnaire items

Survey items were developed based on discussions among the authors, who included two researchers specializing in human dimensions of wildlife management (one from Japan and one from the United States) and two ecologists from Japan.

Although the survey included 84 items, for this study, we focused on 45 items associated with our hypotheses. These were asked mostly according to the 5-point Likert scale. The items were divided into eight categories: knowledge of problems with deer; beliefs about the ecological role of wolves; attitudes toward wolves; risk perceptions; social trust; WVO; attitudes toward WR in Japan; and behavioral intentions to engage in actions that support WR (Appendices S3 & S4). We identified these items from a survey conducted in Japan (Sakurai et al., 2020) created based on previous studies conducted worldwide on public attitudes toward WR (e.g., Bath, 1989; Enck & Brown, 2002). Although the use of the Likert scale is occasionally criticized because the assumption of equidistance between categories is

not necessarily verified (e.g., Lionello et al., 2021), it is a widely accepted approach in questionnaire surveys. Thus, we used this scale to compare our results with those of previous studies that utilized similar scales.

Sampling procedure

We conducted a web-based survey of residents in Japan. Respondents were sampled with an aim to represent the entire population (following the distribution of citizens in the country publicized in the Basic Resident Register by the Ministry of Internal Affairs & Communication, 2020) in terms of gender ratio (categories male and female), age (six categories: 20−29, 30−39, 40−49, 50−59, 60−69, and 70−99 years old), and region of residence (eight categories: Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu). Questionnaires were distributed to residents who were registered in the website system Research Panel (Research Panel, 2020). Over 2.2 million residents in Japan were registered in this system at the time of our survey. Registrants gain from the system, for example, useful information related to shopping and points that are worth actual money to be used for other purposes. Although those who are more comfortable with using technology may be more likely to have answered our online survey (Ranchhod & Zhou, 2001), the respondents were recruited independent of their interest in the topic. In addition, respondents were sampled following the ratio of the Japanese population in terms of sociodemographics. Therefore, consistent with a previous study in which a similar online survey was used (Niemiec et al., 2020), we believe that our stratified sampling enabled a better representation of the Japanese population.

Web surveys conducted using registered monitors have been criticized because they involve some respondents who answer the questions rather informally because their focus is only to obtain rewards (Liu & Wronski, 2018). However, these approaches could overcome declining response rates to surveys distributed to random samples of general populations (Stedman et al., 2019). To ensure the reliability of the samples, we inserted two trap questions in the survey in which respondents were asked to choose a particular answer (e.g., "Please choose 2: Slightly disagree with this question."). Respondents who did not answer "slightly disagree with this question" (i.e., those who were potentially not reading the question) were excluded from the sample. In addition, we excluded those respondents who answered the survey in <2 min because this implied they were not reading the questions carefully. This was based on our pilot survey with a few individuals, which showed that it was impossible for the respondents to answer 84 questions in <2 min.

In August 2020, we randomly distributed questionnaires to 88,793 people registered in Research Panel. Overall, we received 12,028 responses (response rate = 13.5%). Among them, 3096 failed in either of the two trap questions. We excluded 1310 respondents because they answered all questions in <2 min. In addition, 38 respondents did not answer all the questions, and 84 respondents did not qualify as respondents (e.g., teenagers).

Following sample exclusions, we reached a sample size of 7500 respondents in <1 week of distribution of questionnaires. Because the population of Japan is approximately 120 million, a sample size of more than 1067 is considered suitable to allow for population estimates within a 3% margin of error at the 95% confidence level (Vaske, 2008). Therefore, we considered our sample size sufficient for achieving our research objectives.

The final survey and all administrative procedures were approved by the Research Ethics Committee involving Living Human Participants, Ritsumeikan University (protocol Kinugasa-Hito-2019-10).

Analyses

We first analyzed the descriptive results of the items to identify the characteristics of our samples. To validate our hypotheses, we used a multivariate technique, namely, a structural equation model (SEM) because our model contained both measured variables (e.g., "I like wolves.") and latent variables (concepts composed of multiple observed items that cannot be measured directly; e.g., attitudes toward wolves). An SEM, which combines factor analysis and multiple regression, was appropriate for examining the causal relationships among the measured and latent variables. We conducted exploratory factor analysis (EFA) to determine whether each item was loaded on the hypothesized latent variables (knowledge, beliefs, attitudes, risk perceptions, social trust, and behavioral intention) because these categories were not based on established theories. Factor analysis for WVO items was conducted to confirm that items were loaded in the expected variables because these scales have been validated in previous studies (e.g., Manfredo, 2008). Items considered construct latent variables (factor loading >0.4 based on Gosling et al., 2019) with sufficient internal reliability (Cronbach $\alpha \geq 0.70$ according to Vaske, 2008:518) were used in the SEM. To refine and explore the model with the best fit, we conducted an exploratory specification search analysis of SEM in which all possible associations and covariances between latent constructs were tested. We considered the fit of SEM acceptable if the root mean square error of approximation (RMSEA) was <0.08 (Diamantopoulos & Siguar, 2000) and goodness-of-fit index (GFI) and comparative fit index (CFI) were ≥ 0.9 (Toyoda, 2010:18). We performed all statistical analyses with SPSS 22 (IBM) and AMOS 16 (IBM) with significance levels set at $p < 0.05$.

RESULTS

Descriptive results

Our samples were divided equally in terms of gender, and age was evenly split in each age category. Individuals over 70 years old accounted for the highest percentage (23.4%) of respondents. Most respondents (33.5%) were from Kanto, and Shikoku the fewest respondents (3.3%). Respondents represented the actual ratio of the Japanese population in terms of gender, age, and region (Appendix S5). Regarding their

knowledge of wolves, a majority were aware that wolves once inhabited Japan (89.8%) and that they were extirpated in the 1900s (63.0%), although a majority (69.0%) did not know the reasons for their extirpation.

The proportion of respondents who agreed that wolves were necessary for ecosystems; ecosystems would collapse without wolves; and wolves can control the population of deer was more than double that of respondents disagreeing with these statements. However, over half agreed that reintroduced wolves would become invasive and have negative effects on ecosystems (53.3%). Although a majority of respondents were afraid of wolves (72.5%), approximately one-half had a neutral attitude regarding whether they liked or disliked wolves. A majority of respondents worried about safety while walking outdoors (57.5%) and that children would be attacked (59.3%) if wolves were reintroduced. As for attitudes toward WR in Japan, 39.9% disagreed, 17.1% agreed, and the remaining (43.0%) neither agreed nor disagreed to WR. Those who agreed to engage in actions to support WR were limited (15.9% agreed to vote and 12.7% agreed to affix their signatures) (Table 1).

Results of statistical analyses

The EFA verified that items were loaded into seven hypothesized latent variables (knowledge, beliefs, attitudes, risk perceptions, social trust [two categories], and behavioral intentions) (Table 2) Factor analysis revealed that WVO items fell into four categories in line with previous studies: appropriate use, hunting, social affiliation, and caring beliefs. However, contrary to the results of previous studies, the item "Wildlife is like my family and I want to protect them." (originally part of social affiliation beliefs) was associated with caring beliefs. Three items were not loaded in any latent variables and were deleted from the SEM (Appendix S6).

The exploratory specification searches of the SEM revealed the finalized model with the best GFI (RMSEA = 0.070, GFI = 0.808, CFI = 0.843) (Figure 1), and fit indexes slightly improved from the original hypothesized model (Appendix S7). The general assumptions of the SEM, including normality of item response distributions, were met because skewness ranged from −0.766 to 0.835 and kurtosis from −1.011 to 0.028, indicating no signs of major departure from normality (Toyoda, 2010). The final model showed all factors with significant relationships ($p<0.001$) in the dependent variables. Risk perceptions were associated with a more negative attitude toward WR ($B = -0.34$), which mediated social trust. However, attitudes toward wolves had positive effects on public attitudes toward WR ($B = 0.20$) and negative effects on risk perceptions ($B = -0.32$) and mediated the effects of beliefs regarding the ecological role of wolves and four WVO variables. Attitudes toward WR had a strong effect on behavioral intentions to engage in actions to support WR ($B = 0.72$). The explanatory power (R^2) of attitudes toward WR was 0.20, indicating that one-fifth of variances in attitudes toward WR were explained by risk perceptions and attitudes toward wolves. The R^2 of behavioral intentions was 0.51, implying that the majority of

the variance in behavioral intentions were explained by attitude. Although the overall model had a satisfactory level of fitness with an RMSEA of <0.08, the fact that both GFI and CFI were below 0.9 demonstrates the necessity of interpreting the results with caution (see "Discussion").

DISCUSSION

Japanese attitudes toward WR and their behavioral intentions to support WR

Our study is the first systematic sampling survey addressing Japan residents views on wolves. The results showed that the highest percentage of public attitudes toward WR was undecided (i.e., "neither agreed nor disagreed" with WR). A previous survey conducted with Japanese students showed that those who were unsure about their attitudes felt they did not have enough knowledge to express their opinion about WR (Sakurai et al., 2020). It is possible that our sampled respondents felt the same way.

Based on the SEM, we found that greater perceived risk negatively affected public attitudes toward WR in Japan, similar to a previous study (Enck & Brown, 2002). This implies that even in a country where wolves were extirpated more than 100 years ago, with a low possibility of a direct interaction, people expressed fear toward the species. Some researchers argue that images of Japanese wolves mostly originated from nonscientific literature, such as fairy tales (e.g., "Little Red Riding Hood"), that mostly originated from outside the country (Angeli et al., 1998; Nambu, 2007). Considering the fact that human casualties in wolf attacks are rare worldwide (e.g., two fatal cases in 18 years from 2002 to 2020 in North America [Linnell et al., 2021]), our results suggest that people might be overestimating the risk of attack.

We found that positive attitudes toward wolves that mediate people's beliefs in the ecological role of wolves have increased people's support of WR. Cascading effects caused by top predators in ecosystems, which have both direct and indirect effects on prey species, have been observed worldwide (Beschta & Ripple, 2016; Ripple et al., 2014). Therefore, awareness of these ecological dynamics could encourage people to gain positive beliefs about the ecological role of wolves. The relationship between public knowledge and attitude toward WR is complex. A previous study pointed out that knowledge of the recent increase in deer populations and agricultural damage caused by the species could increase public support for WR (Angeli et al., 1998); however, we did not observe such relationships in our study.

However, we found that perceptions that reintroduced wolves would have negative impacts on the ecosystem as invasive species, together with other risk perception items, reduced public support for WR, which is in line with the results of a previous study (Sakurai et al., 2020). Japan has a large number of endemic species (>60% of reptiles and >80% of amphibians are endemic to Japan) (Conservation International, 2022), which have recently been threatened by invasive species, such

TABLE 1 Public attitude, beliefs, and behavioral intentions regarding wolf reintroduction in Japan.[a]

		Respondents who either disagreed or slightly disagreed (%)	Respondents who neither agreed nor disagreed (%)	Respondents who either agreed or slightly agreed (%)
Beliefs about ecological role of wolves	Wolves are necessary for healthy forest or ecosystem.	13.2	49.8	37.0
	The balance of an ecosystem collapses without wolves.	14.0	50.9	36.1
	There is a causal relationship between increases in deer and extinction of wolves.	20.7	42.0	37.2
	Wolves can control the deer population.	18.3	41.6	40.2
Attitudes toward wolves	Wolves are scary.	10.0	17.5	72.5
	Wolves are beautiful.	25.9	37.9	36.2
	I like wolves.	38.6	42.7	18.8
	I hate wolves.	31.4	47.6	21.1
	I am interested in wolves.	45.9	34.3	19.8
Risk perceptions	I am worried about safety, such as when walking outside, if wolves are reintroduced in Japan.	20.9	21.6	57.5
	Pets will be attacked if wolves are reintroduced in Japan.	20.1	28.6	51.2
	I worry that kids will be attacked if wolves are reintroduced in Japan.	16.9	23.8	59.5
	Reintroduced wolves would become invasive species and have negative impacts in Japan.	11.4	35.2	53.3
Attitudes toward WR in Japan	Do you agree or disagree with the reintroduction of wolves from another country to recover healthy ecosystem in Japan?	39.9	43.0	17.1
Behavioral intentions to engage in activities to support the reintroduction of wolves	I would collect donations for reintroduction of wolves.	67.5	28.0	4.5
	I would support reintroduction of wolves in a vote.	52.0	32.0	15.9
	I would affix my signature for reintroduction of wolves.	55.7	31.6	12.7

[a]Number of respondents 7500.

as mongoose and raccoon. Negative impacts of invasive species are frequently reported in the media (Fukano & Soga, 2019) and are taught in schools (Asajima et al., 2018), resulting in increased public knowledge about the risks posed by invasive species. If wolves are perceived as non-native, this may further contribute to opposition to WR.

We observed that caring beliefs had the strongest (positive) effect on attitude among four WVO variables. This is consistent with the findings of previous studies (Gosling et al., 2019). People have become more mutualistic as society has modernized and urbanized (Manfredo et al., 2020). More Japanese would become mutualistic with the progression of modernization, and more people are expected to support WR.

Our SEM explained one-fifth (20.0%) of public attitudes toward WR, which is comparable to that found in previous studies (Gosling et al., 2019; Sakurai et al., 2020). Future research should focus on the remaining factors that affect public

attitudes toward WR in Japan. Different methods, such as interviewing people and analysis of open-ended questions on the reasons for their support or opposition to WR, would provide additional information.

Study limitations

Previous researchers (e.g., Hu & Bentler, 1999) have proposed that the cutoff point of model selection when using RMSEA should be <0.065 and that CFI should be >0.95. Our final model (RMSEA = 0.070, CFI = 0.843) did not fulfill these requirements. This implies that other factors that contribute to public attitudes toward WR in Japan should be explored. Although studies on the validity of WVO scale have been conducted, a majority of them are from North America and Europe. There has been limited research done to test model validity

TABLE 2 Results of factor analysis of items used as latent constructs in the structural equation model (SEM) related to a survey of Japanese citizens on wolf reintroduction.

Factor[a]	Item	Mean (SD)	Factor loadings	Cronbach α
Knowledge about deer issues	KD1. I know that in Japan, the deer population is increasing.	1.87 (0.67)	0.88	0.907
	KD2. I know that agricultural damage by deer frequently occurs all over Japan.	2.04 (0.64)	0.88	
	KD3. I know that an increase in deer affects the forest ecosystem in Japan.	1.84 (0.71)	0.87	
Beliefs about ecological role of wolves	BW1. Wolves are necessary for healthy forests and ecosystems.	3.31 (0.93)	0.83	0.826
	BW2. Balance of ecosystem collapses without wolves.	3.27 (0.92)	0.94	
	BW3. Wolves can control population of deer.	3.27 (1.00)	0.51	
	BW4. There is a causal relationship between increase of deer and extinction of wolves.	3.22 (1.03)	0.50	
Attitudes toward wolves	AW1. Wolves are beautiful.	3.14 (1.07)	0.74	0.853
	AW2. I like wolves.	2.72 (1.04)	0.95	
	AW3. I am interested in wolves.	2.58 (1.09)	0.69	
	AW4. I hate wolves [reversed coded].	3.14 (1.04)	0.68	
Risk perceptions	RP1. I worry about safety such as when walking outside if wolves are reintroduced in Japan.	3.49 (1.10)	0.87	0.880
	RP2. Pets will be attacked if wolves are reintroduced in Japan.	3.39 (1.06)	0.87	
	RP3. I worry that kids will be attacked if wolves are reintroduced in Japan.	3.57 (1.06)	0.95	
	RP4. Reintroduced wolves would become invasive species and have negative impacts in Japan.	3.60 (1.00)	0.48	
Trust in information provided by government and researchers	TI1. I trust information provided by central government.	2.95 (1.02)	0.89	0.871
	TI2. I trust information provided by local government.	3.18 (0.95)	0.95	
	TI3. I trust information provided by researchers.	3.42 (0.89)	0.68	
	TI4. I trust information provided by professors at university.	3.27 (0.87)	0.60	
Trust in government and researchers to take responsibility for decision-making	TD1. Central government should have responsibility to decide whether to reintroduce wolves in Japan.	3.78 (1.19)	0.47	0.822
	TD2. Local government should have the responsibility to decide whether to reintroduce wolves in Japan.	3.55 (1.16)	0.61	
	TD3. Researchers should have the responsibility to decide whether to reintroduce wolves in Japan.	3.41 (1.11)	0.94	
	TD4. Professors at university should have the responsibility to decide whether to reintroduce wolves in Japan.	2.98 (1.06)	0.83	
Appropriate use beliefs	AU1. Human should manage fish and wildlife populations so that humans benefit.	2.65 (1.11)	0.53	0.846
	AU2. The needs of humans should take priority over fish and wildlife protection.	2.47 (1.00)	0.62	
	AU3. It is acceptable for people to kill wildlife if they think it poses a threat to their life.	2.86 (1.15)	0.88	
	AU4. It is acceptable for people to kill wildlife if they think it poses a threat to their property.	2.89 (1.12)	0.90	
	AU5. It is acceptable to use fish and wildlife in research even if it may harm or kill some animals.	2.51 (1.02)	0.66	
	AU6. Fish and wildlife are on earth primarily for people to use.	1.91 (0.95)	0.42	

(Continues)

TABLE 2 (Continued)

Factor[a]	Item	Mean (SD)	Factor loadings	Cronbach α
Hunting beliefs	HB1. Hunting is cruel and inhumane to the animals [reverse coded].	3.18 (1.05)	0.91	0.885
	HB2. Hunting does not respect the lives of animals [reverse coded].	3.21 (1.07)	0.88	
Social affiliation beliefs	SB1. We should strive for a world where humans and wildlife can live side by side without fear.	3.80 (1.03)	0.70	0.758
	SB2. I view all living things as part of one big family.	3.22 (1.06)	0.55	
	SB3. Animals should have rights similar to the rights of humans.	3.67 (1.04)	0.73	
Caring beliefs	CB1. I care about animals as much as I do other people.	3.00 (1.00)	0.61	0.896
	CB2. It would be more rewarding to me to help animals rather than people.	2.70 (0.98)	0.61	
	CB3. I take great comfort in the relationships I have with animals.	3.16 (1.04)	0.84	
	CB4. I feel a strong emotional bond with animals.	2.69 (1.05)	0.99	
	CB5. I value the sense of companionship I receive from animals.	3.12 (1.07)	0.83	
	CB6. Wildlife are like my family and I want to protect them.[b]	3.01 (0.98)	0.46	
Behavioral intentions to engage in actions to support WR	BI1. I would collect donations for WR.	2.02 (0.92)	0.76	0.923
	BI2. I would support WR in a vote.	2.40 (1.13)	0.91	
	BI3. I would affix my signature for WR.	2.30 (1.10)	0.98	

[a]All factors except "behavioral intentions to engage in actions to support WR" were used as independent variables in SEM. Codes, such as KD1, match items shown in the model in Figure 1.
[b]Originally part of social affiliation beliefs; however, based on the factor analysis, it was categorized as a caring belief item.
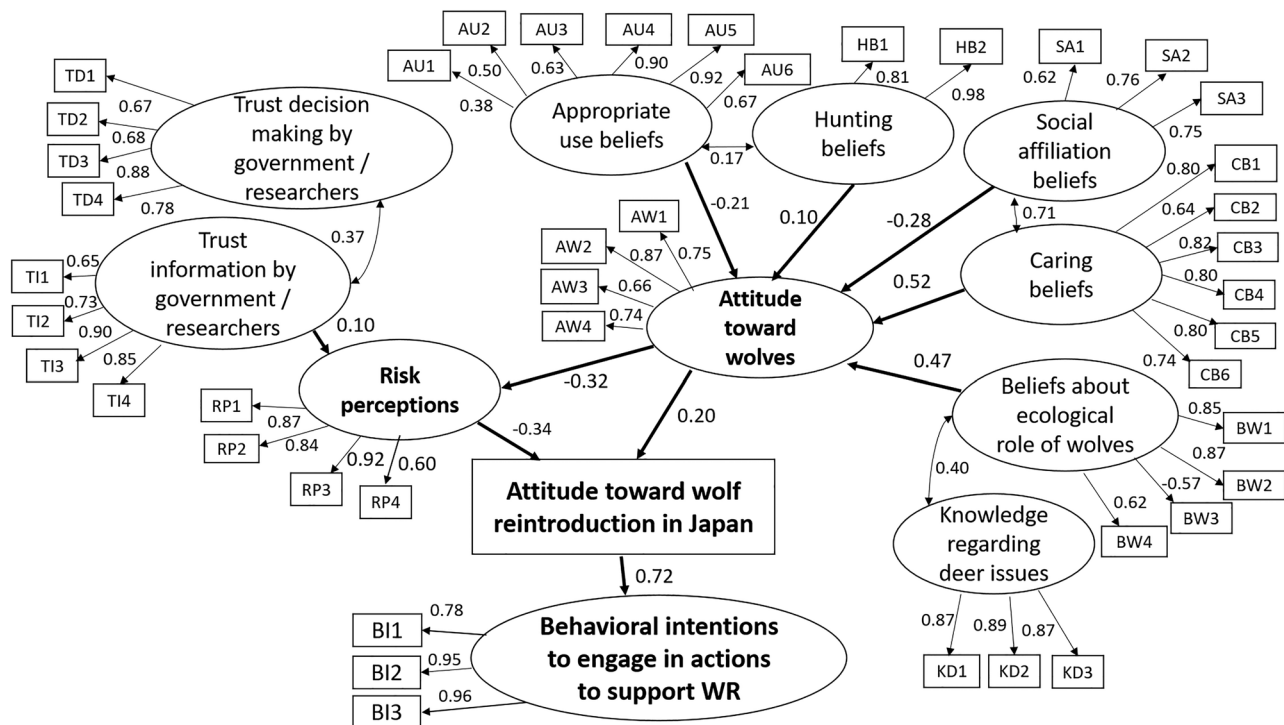

FIGURE 1 Finalized model of public attitudes toward and their behavioral intentions to support wolf reintroduction (WR) in Japan ($n = 7500$, root mean square error of approximation 0.070, goodness-of-fit index 0.808, comparative fit index 0.843, $\chi^2 = 33{,}490.906$). All scores represent standardized coefficients (all relationships were significant at 0.1%). Abbreviations of items that comprise each factor are defined in Table 2.

outside of Western countries, where people might perceive wildlife differently. In fact, our results showed that some WVO items did not represent the expected latent variables, which resulted in only two items remaining for a particular construct. This potentially weakened the model. Additionally, the relationship between several factors contrasted with our expectations (e.g., trust toward the government and researchers increased risk perceptions), which differs from the findings of previous studies (e.g., Bruskotter & Wilson, 2014). Further research should be conducted to explore factors that best describe the cognitive framework of how people perceive wildlife in countries with cultural and social backgrounds different from those in North America and Europe.

Although we sampled respondents to represent gender, age, and region, there are other factors that could affect public attitudes toward WR, such as level of education. In future research, additional criteria should be included to obtain samples that better represent the population, and the use of other survey methods (e.g., mail and telephone survey) should be considered to overcome problems associated with online surveys (e.g., only those who were registered with the site were contacted), but see Stedman et al. (2019) for a statement on limitations of these methods as well. Conducting additional surveys with nonrespondents could also reveal potential gaps between attitudes of those who responded to this survey and those who did not (e.g., whether respondents were more likely interested in the topics of wolves and WR than nonrespondents).

Finally, the quality of measurement (e.g., content of items and response options) could be modified in future research. For example, the question of attitudes toward WR included statements on the case of WR in North America and how that could restore the ecosystem. Therefore, respondents who disagreed with this statement might not oppose the reintroduction itself but instead oppose the assumption that reintroducing wolves would improve ecosystem functioning. Additionally, the fact that there was no "do not know" option for attitude questions implies that some respondents who selected "neither disagree nor agree" may simply have not understood the question. In addition, knowledge about deer problems was asked via self-assessment and should be calibrated with questions that answer actual knowledge (that said, perceived knowledge is very commonly used in survey research).

Policy implications and potential outreach

As one of the first studies to explore the relationships among public cognitive components, attitudes toward WR, and their behavioral intentions, our model revealed that a relatively small percentage of the public (>10%) possessed behavioral intentions to support WR. These intentions were strongly affected by attitude toward WR. Based on our results, we could quantitatively predict that once people begin to understand the scientific evidence for the role played by wolves in ecosystem management, they will be more likely to take action and support WR. It is not our intention to lead the discussion toward a certain side (e.g., how to increase or decrease the number of people who support WR). However, we believe that decision-making should be based on updated scientific knowledge. Public misunderstandings, based on a lack of certain information, can be corrected with the dissemination of solid scientific research findings.

Risks could be amplified via media and anecdotes, which may not necessarily reflect the true nature of the risks (Jaeger et al., 2001). When the media resorts to repeated sensational reporting of casualties caused by bear attacks (for example), it potentially makes people believe that such incidents occur frequently, leading to overestimation of actual risks (e.g., cases in New York [USA] [Gore et al., 2009] and in Japan [Sakurai et al., 2013b]). Media and agencies need to provide more information on the actual risk of casualties caused by wildlife (not only by wolves but also by species that currently exist in the country, such as bears and boar) so that people can shape their risk perceptions based on more accurate risk frequencies.

A majority of respondents thought that reintroduced wolves would become invasive. Holding this belief was associated with less support for WR. However, wolves that once lived in Japan could be classified as the same species currently seen in Asian continents based on DNA typing (Ishiguro, 2012; Matsumura et al., 2014). Therefore, schools, media, and agencies should include the results of such recent research when referring to WR. Internationally, the goal of reintroduction projects is clear in that the same, similar, or a related species could be used as ecological replacements (IUCN/SSC, 2013). Full-scale restoration of ecosystems targeting species at all tropic levels (Carver et al., 2021) would help fulfill biodiversity conservation goals. However, people have a more positive attitude toward species that have already been reintroduced (e.g., oriental stork [*Ciconia boyciana*]) than toward species that are yet to be reintroduced (e.g., river otters [*Lutra lutra*]) (Sakurai et al., 2022). Such bias in public perception would affect reintroduction projects worldwide; people are supportive of the reintroduction of species that they favor, whereas species that are not favored by citizens are not reintroduced (Seddon et al., 2005).

Although the potential of WR has been proposed and analyzed in Japan (Yamanaka & Kaji, 2006), there have been very few discussions based on the International Union for the Conservation of Nature Guidelines (IUCN/SSC, 2013) on whether such projects should include the restoration of similar species (such as different subspecies) that could play the ecological role of the lost species. Although some species, such as the oriental stork and crested ibis (*Nipponia nippon*), have been reintroduced in Japan, no concrete goals have been set up by the Ministry of Environment or prefectural governments clarifying whether the reintroduction of these carnivorous species and rewilding should be attempted in Japan. This needs further research and debate in Japan.

Finally, while gaining public trust is one of the primary goals of government agencies because their service is directed to improve the lives of citizens, our results showed that a majority of respondents were not sure if they could trust the government. Similarly, a majority of people were unsure about whether they could trust researchers. In terms of human–wildlife conflicts,

agencies could increase trust by disseminating facts and providing opportunities for residents to discuss issues with agency staff and help generate solutions to problems (Needham & Vaske, 2008; Sakurai et al., 2013a). In addition to agency personnel, researchers could also participate in decision-making and interact with citizens so that people would be aware of current research results. Although there is no right answer on whether wolves should be reintroduced in Japan, our results suggest that by disseminating information related to the ecological role of wolves and as people develop a more mutualistic mindset, public attitudes will likely shift toward the idea of WR in the country.

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REFERENCES

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl, & J. Beckmann (Eds.), _Action control, from cognition to behavior_ (pp. 11–39). Springer Berlin.

Ajzen, I., & Fishbein, M. (1980). _Understanding attitudes and predicting social behavior_. Prentice-Hall.

Angeli, C. B., Maruyama, N., Koganezawa, M., Takahashi, M., & Chinen, S. (1998). Japanese people's attitudes towards wolves and their reintroduction into Japan. _Biosphere Conservation_, _1_, 63–71.

Asajima, M., et al. (2018). _Biology (Revised version)_. Tokyoshoseki (in Japanese).

Bangs, E. E., Fontaine, J. A., Jimenez, M. D., Meier, T. J., Bradley, E. H., Niemeyer, C. C., Smith, D. W., Mack, C. M., Asher, V., & Oakleaf, J. K. (2005). Managing wolf–human conflict in the northwestern United States. In R. Woodroffe, S. Thirgood, & A. Rabinowitz (Eds.), _People and wildlife: Conflict or coexistence?_ (pp. 340–356). Cambridge University Press.

Bath, A. J. (1989). The public and wolf reintroduction in Yellowstone National Park. _Society and Natural Resources_, _2_, 297–306.

Bath, A. J., & Buchanan, T. (1989). Attitudes of interest groups in Wyoming towards wolf restoration in Yellowstone National Park. _Wildlife Society Bulletin_, _17_, 519–525.

Beschta, R. L., & Ripple, W. J. (2016). Riparian vegetation recovery in Yellowstone: The first two decades after wolf reintroduction. _Biological Conservation_, _198_, 93–103.

Bruskotter, J. T., & Wilson, R. S. (2014). Determining where the wild things will be: Using psychological theory to find tolerance for large carnivores. _Conservation Letters_, _7_(3), 158–165.

Cabinet Office Japan. (2014). Annual report on the aging society. Tokyo, Japan (in Japanese). http://www8.cao.go.jp/kourei/english/annualreport/2014/2014pdf_e.html

Callan, R., Nibbelink, N. P., Rooney, T. P., Wiedenhoeft, J. E., & Wydeven, A. P. (2013). Recolonizing wolves trigger a trophic cascade in Wisconsin (USA). _Journal of Ecology_, _101_, 837–845.

Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., Van Maanen, E., Cao, Y., Fisher, M., Edwards, S. R., & Nelson, C. (2021). Guiding principles for rewilding. _Conservation Biology_, _35_, 1882–1893.

Conservation International. (2022). Japan – Species. https://www.cepf.net/our-work/biodiversity-hotspots/japan/species

Diamantopoulos, A., & Siguaw, J. A. (2000). _Introducing LISREL_. Sage Publications.

Drouilly, M., & O'Riain, M. J. (2021). Rewilding the world's large carnivores without neglecting the human dimension. _Biodiversity and Conservation_, _30_, 917–923. https://doi.org/10.1007/s10531-021-02112-y

Enck, J. W., & Brown, T. L. (2002). New Yorkers' attitudes towards restoring wolves to the Adirondack Park. _Wildlife Society Bulletin_, _30_, 16–28.

Endo, H. (2015). _Canis lupus_ (Linnaeus, 1758). In S. D. Ohdachi, Y. Ishibashi, M. A. Iwasa, D. Fukui, & T. Saitoh (Eds.), _The wild mammals of Japan_ (2nd ed., pp. 226–227). Shoukadoh.

Eriksson, M. (2017). Political alienation, rurality and the symbolic role of Swedish wolf policy. _Society & Natural Resources_, _30_, 1374–388.

Eriksson, M., Sandstrom, C., & Ericsson, G. (2015). Direct experience and attitude change towards bears and wolves. _Wildlife Biology_, _21_, 131–137.

Fukano, Y., & Soga, M. (2019). Spatio-temporal dynamics and drivers of public interest in invasive alien species. _Biological Invasions_, _21_, 3521–3532.

Gore, M. L., Wilson, R. S., Siemer, W. F., Hudenko, H. W., Clarke, C. E., Slohart, P., Maguire, L. A., & Muter, B. A. (2009). Application of risk concepts to wildlife management: Special issue introduction. _Human Dimensions of Wildlife_, _14_, 301–313.

Gosling, E., Bojarska, K., Gula, R., & Kuehn, R. (2019). Recent arrivals or established tenants? History of wolf presence influences attitudes towards the carnivore. _Wildlife Society Bulletin_, _43_, 639–650.

Groom, M. J., Meffe, G. K., & Carroll, R. (2006). _Principles of conservation biology_ (3rd ed.). Sinauer Associates.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangean, R. (2004). _Survey methodology_. John Wiley & Sons.

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. _Journal of Environmental Education_, _18_, 1–8.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. _Structural Equation Modeling_, _6_, 1–55.

Ikeda, T. (2015). Invasive alien mammal problems in Japan. In S. D. Ohdachi, Y. Ishibashi, M. A. Iwasa, D. Fukui, & T. Saitoh (Eds.), _The wild mammals of Japan_ (2nd ed., p. 277). Shoukadoh.

Ishiguro, N. (2012). Phylogenetic analysis of extinct wolves in Japan. _Journal of Japanese Veterinary Medicinal Association_, _65_, 225–231. (in Japanese).

IUCN/SSC. (2013). _Guidelines for reintroductions and other conservation translocations. Version 1.0_. IUCN Species Survival Commission.

Jaeger, C. C., Renn, O., Rosa, E. A., & Webler, T. (2001). _Risk, uncertainty, and rational action_. Earthscan Publications.

JWA (Japan Wolf Association). (2020). Results of ninth nation-wide survey on wolf conducted in 2019. (in Japanese). https://japan-wolf.org/2020/11/26/%e7%ac%ac9%e5%9b%9e%e5%85%a8%e5%9b%bd%e3%82%aa%e3%82%aa%e3%82%ab%e3%83%9f%e3%82%a2%e3%83%b3%e3%82%b1%e3%83%bc%e3%83%88%e8%aa%bf%e6%9f%bb2019%e5%a0%b1%e5%91%8a/

Kaji, K. (2017). Discussion regarding reintroduction of carnivores. In K. Kaji & H. Iijima (Eds.), _Sika deer in Japan: The science and management of overabundant populations_ (pp. 102–121). University of Tokyo Press (in Japanese).

Kaji, K., Igota, M., & Suzuki, M. (2013). _Science of hunting: For wildlife management in Japan_. Asakura (in Japanese).

Knight, J. (2006). _Waiting for wolves in Japan: An anthropological study of people–wildlife relations_. University of Hawaii Press.

Linnell, J. D. C., Kovtun, E., & Rouart, I. (2021). _Wolf attacks on humans: An update for 2002–2020. Report 1994_. Norwegian Institute for Nature Research.

Lionello, M., Aletta, F., Mitchell, A. M., & Kang, J. (2021). Introducing a method for intervals correction on multiple Likert scales: Soundscape data collection instrument. _Frontiers in Psychology_, _11_, 602831.

Liu, M., & Wronski, L. (2018). Examining completion rates in web surveys via over 25,000 real-world surveys. _Social Science Computer Review_, _36_, 116–124.

Manfredo, M. J. (2008). _Who cares about wildlife? Social science concepts for exploring human–wildlife relationships and conservation issues_. Springer.

Manfredo, M. J., Teel, T. L., Carlos, D., A, W., Sullivan, L., Bright, A. D., Dietsch, A. M., Bruskotter, J., & Fulton, D. (2020). The changing sociocultural context of wildlife conservation. _Conservation Biology_, _34_, 1549–1559.

Matsumura, S., Inoshima, Y., & Ishiguro, N. (2014). Reconstructing the colonization history of lost wolf lineages by the analysis of the mitochondrial genome. _Molecular Phylogenetics and Evolution_, _80_, 105–112.

Ministry of Agriculture, Forestry and Fisheries. (2021a). Change of agricultural damage caused by wildlife. (in Japanese). https://www.maff.go.jp/j/seisan/tyozyu/higai_zyoukyou/index.html

Ministry of Agriculture, Forestry and Fisheries. (2021b). Current situation of wildlife damage and interventions. (in Japanese). https://www.maff.go.jp/j/seisan/tyozyu/higai/attach/pdf/index-393.pdf

Ministry of Internal Affairs and Communication. (2020). Population, population dynamics, and number of households based on the Basic Resident Register. (in Japanese). https://www.soumu.go.jp/main_sosiki/jichi_gyousei/daityo/jinkou_jinkoudoutai-setaisuu.html

Ministry of the Environment. (2022a). Preliminary results of number of deer and boars hunted and culled in 2021. (in Japanese). https://www.env.go.jp/nature/choju/docs/docs4/sokuhou.pdf

Ministry of the Environment. (2022b). Statistical record related to wildlife of 2018. (in Japanese). https://www.env.go.jp/nature/choju/docs/docs2/h30/06h30tou.html

Nambu, N. (2007). Japanese perceptions of wolves. In N. Maruyama, K. Suda, & M. Koganezawa (Eds.), *Releasing wolves* (pp. 152–162). Hakusuisha. (in Japanese).

Needham, M. D., & Vaske, J. J. (2008). Hunter perceptions of similarity and trust in wildlife agencies and personal risk associated with chronic wasting disease. *Society and Natural Resources*, 21, 197–214.

Niemiec, R., Berl, R. E. W., Gonzalez, M., Teel, T., Camara, C., Collins, M., Salerno, J., Crooks, K., Schultz, C., Breck, S., & Hoag, D. (2020). Public perspectives and media reporting of wolf reintroduction in Colorado. *PeerJ*, 8, e9074. https://doi.org/10.7717/peerj.9074

Nilsen, E. B., Milner-Gulland, E., Schofield, L., Mysterud, A., Stenseth, N. C., & Coulson, T. (2007). Wolf reintroduction to Scotland: Public attitudes and consequences for red deer management. *Proceedings of the Royal Society Bulletin*, 274, 995–1002.

NPR News. (2020). Historic move, Colorado voters decide to reintroduce gray wolves. https://www.npr.org/2020/11/06/931472376/in-historic-move-colorado-voters-decide-to-reintroduce-gray-wolves

Ranchhod, A., & Zhou, F. (2001). Comparing respondents of e-mail and mail surveys: Understanding the implications of technology. *Marketing Intelligence & Planning*, 19, 254–262.

Research Panel. (2020). Research Panel. (in Japanese). https://research-panel.jp/

Riley, S. J., & Decker, D. J. (2000). Risk perception as a factor in wildlife stakeholder acceptance capacity for cougars in Montana. *Human Dimensions of Wildlife*, 5, 50–62.

Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P., Schmitz, O. J., Smith, D. W., Wallach, A. D., & Wirsing, A. J. (2014). Status and ecological effects of the world's largest carnivores. *Science*, 343, 1241484. https://doi.org/10.1126/science.1241484

Sakurai, R. (2019). *Human dimensions of wildlife management in Japan: From Asia to the world*. Springer.

Sakurai, R., Jacobson, S. K., & Carlton, J. S. (2013b). Media coverage of management of the black bear *Ursus thibetanus* in Japan. *Oryx*, 47, 519–525.

Sakurai, R., Jacobson, S. K., & Ueda, G. (2013a). Public perceptions of risk and government performance regarding bear management in Japan. *Ursus*, 24, 70–82.

Sakurai, R., Stedman, R. C., Tsunoda, H., Enari, H., & Uehara, T. (2022). Comparison of perceptions regarding the reintroduction of river otters and oriental storks in Japan. *Cogent Social Science*, 8, 2115656. https://doi.org/10.1080/23311886.2022.2115656

Sakurai, R., Tidball, K. G., Stedman, R. C., & Tsunoda, H. (2018). Exploring social-ecological resilience via three megafauna in Japan: An exercise in integrating ideas of human dimensions of wildlife management, Satoyama, and SES thinking. *Policy Science*, 25, 1–12.

Sakurai, R., Tsunoda, H., Enari, H., Siemer, W. F., Uehara, T., & Stedman, R. C. (2020). Factors affecting attitudes towards reintroduction of wolves in Japan. *Global Ecology and Conservation*, 22, e01036. https://doi.org/10.1016/j.gecco.2020.e01036

Seddon, P. J., Soorae, P. S., & Launay, F. (2005). Taxonomic bias in reintroduction projects. *Animal Conservation*, 8, 51–58.

Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis*, 20, 713–719.

Siegrist, M., Gutscher, H., & Earle, T. C. (2005). Perception of risk: The influence of general trust, and general confidence. *Journal of Risk Research*, 8, 145–156.

Slovic, P. (1987). Perception of risk. *Science*, 236, 280–285.

Smith, D. W., & Bangs, E. E. (2009). Reintroduction of wolves to Yellowstone National Park: History, values and ecosystem restoration. In M. W. Hayward & M. J. Somers (Eds.), *Reintroduction of top-order predators* (pp. 92–125). Blackwell Publishing.

Stedman, R. C., Connelly, N. A., Heberlein, T. A., Decker, D. J., & Allred, S. B. (2019). The end of the (research) world as we know it? Understanding and coping with declining response rates to mail surveys. *Society and Natural Resources*, 32, 1139–1154.

Svenning, J., Pedersen, P. B. M., Donlan, C. J., Ejrnaes, R., Faurby, S., Galetti, M., Hansen, D. M., Sandel, B., Sandom, C. J., Terborgh, J. W., & Vera, F. W. M. (2016). Science for a wilder Anthropocene: Synthesis and future directions for trophic rewilding research. *Proceedings of the National Academy of Sciences*, 113, 898–906.

Toyoda, H. (2010). *Structural equation modeling using Amos*. Tokyo-tosho (in Japanese).

Tsunoda, H., & Enari, H. (2020). A strategy for wildlife management in depopulating rural areas of Japan. *Conservation Biology*, 34(4), 819–828. https://doi.org/10.1111/cobi.13470

Ueno, M., Iijima, H., Asada, M., & Watanabe, D. (2022). Variation in the local sika deer density between three areas of Japan with diverse climatic conditions. In K. Kaji, H. Uno, & H. Iijima (Eds.), *Sika deer: Life history plasticity and management* (pp. 61–81). Springer Singapore.

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

Vaske, J. J., Timmons, N. R., Beaman, J., & Petchenik, J. (2004). Chronic wasting disease in Wisconsin: Hunter behaviors, perceived risk, and agency trust. *Human Dimensions of Wildlife*, 9, 193–209.

Williams, C. K., Ericsson, G., & Heberlein, T. A. (2002). A quantitative summary of attitudes towards wolves and their reintroduction (1972–2000). *Wildlife Society Bulletin*, 30, 575–584.

Yamada, F., & Sugimura, K. (2004). Negative impact of an invasive small Indian Mongoose *Herpestes javanicus* on native wildlife species and evaluation of a control project in Amami-Ohshima and Okinawa Islands, Japan. *Global Environmental Research*, 8, 117–124.

Yamanaka, M., & Kaji, K. (2006). Future of Shiretoko: A response to the Yellowstone researchers. In D. R. McCullough, K. Kaji, & M. Yamanaka (Eds.), *Wildlife in Shiretoko and Yellowstone National Parks: Lessons in wildlife conservation from two world heritage sites* (pp. 310–315). Shiretoko Nature Foundation.

Zajac, R., Bruskotter, J. T., Wilson, R. S., & Prange, S. (2012). Learning to live with black bears: A psychological model of acceptance. *Journal of Wildlife Management*, 76(7), 1331–1340.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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