

## Original Research Article

## Factors affecting attitudes toward reintroduction of wolves in Japan



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## ABSTRACT

Japanese wolves (*Canis lupus hodophilax*) became extinct in the early 1900s. Because the country is experiencing growth in populations of ungulates, the potential of reintroducing wolves to promote self-regulating biodiverse ecosystems has been discussed by various Japanese and international researchers. However, limited research exists regarding public attitudes toward the reintroduction of wolves, which is indispensable to the success of such projects. We conducted a survey of 360 undergraduate students at a university in Japan and found that while most respondents believed that government officials and local residents should be responsible for the decision-making, a majority felt that this responsibility should not rest with the general citizens. Multiple regression analysis revealed that respondents disagreed with the reintroduction of exotic species generally, while those who thought wolves are necessary to a healthy ecosystem were supportive. Text mining analysis revealed that those who disagreed with the reintroduction were thinking about "people" while those who agreed emphasized the need to control an increasing deer population and to prevent related damage. In contrast to previous research, our survey revealed that it is not people's propensity for wolves (*i.e.*, whether they like or hate wolves), but their understanding of the ecological impact of reintroduced wolves, that influences their support. In summary, our findings suggest that public attitudes toward the reintroduction of wolves may become more favorable if people were informed of the scientific findings that Japanese and continental wolves are the same species and that their presence will positively impact the ecosystem.

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## 1. Introduction

Reintroducing extirpated species, especially those that play a vital role in the ecosystem, is an important approach to restore trophic interactions and promote self-regulating biodiverse ecosystems (Vander Zanden et al., 2006; Svenning et al., 2016). The concept of decreasing interference by humans and restoring natural ecological processes, known as Ecological Rewilding is widely researched and implemented in Europe (Pettorelli et al., 2018). In the US, since the reintroduction of wolves to Yellowstone National Park in 1995, studies have shown revived ecological function and biodiversity through top-

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down effects caused by wolves (Hollenbeck and Ripple, 2008; Ripple and Beschta, 2012). Reintroduction, one approach for rewilding, could take different modes including releasing and managing wolves in controlled enclosures to be released in larger national park areas. Many reintroduction projects aim to ultimately let wolves disperse beyond a certain region as the goal of rewilding generally is to restore ecosystem function sufficiently so that management by humans is unnecessary. Nevertheless, such programs cannot be successful nor sustainable without public understanding and support, especially where top-predators are concerned (Decker et al., 2001 p.312, 314–315). In the US, multiple studies have been conducted to understand stakeholders' (e.g., national park visitors, ranchers, local residents) perceptions of the reintroduction of wolves (Bath, 1989; Enck and Brown, 2002; Nie, 2003); these findings were utilized to select a target audience for public communications to increase tolerance toward this policy (Jacobson, 1999, p. 293–317).

Japan has rich biodiversity with more than 90,000 confirmed species (Ministry of the Environment, 2008). However, rapid economic development since World War II has reduced biodiversity; more than 20% of mammal species are currently endangered (The Nature Conservation Society of Japan, 2010). Species such as the Japanese wolves (*Canis lupus hodophilax*) and oriental stork (*Ciconia boyciana*) went extinct in the 20th century. To tackle the issues of decreasing wildlife population and to conserve and revive the ecosystem, the Act on Conservation of Endangered Species of Wild Fauna and Flora was enacted in 1993. Based on this law, the critically endangered crested ibis (*Nipponia nippon*) was reintroduced to Japan from China. Despite this, the law does not specify if already extinct species such as wolves should be reintroduced as well (Kato, 2005). The potential and significance of reintroducing a top-predator, wolves, to revive the ecosystem and control herbivores such as Sika deer (*Cervus nippon*) and boars (*Sus scrofa*), have been discussed among researchers (Knight, 2006; Yamanaka and Kaji, 2006; Maruyama et al., 2007; Kaji, 2017) for decades.

Japan is also currently facing human depopulation, from 120 million residents in 2013 to an estimated 100 million residents by 2050 (Cabinet Office Japan, 2014). In rural mountainous regions, aging and depopulation is an even more serious problem; abandoned fields become brush and ultimately forests, leading to an expansion of habitats for species such as Sika deer (Sakurai, 2019; Tsunoda and Enari, 2020). This has resulted in a high population density of deer (Kaji and Iijima, 2017), leading to frequent and substantial crop damage; agricultural damage by deer more than doubled after the 1980s (Ministry of the Environment, 2010).

While reintroduction of wolves to Japan is controversial—issues include biological/ecological and political matters—information on public opinion on the reintroduction of wolves in Japan is lacking. As Japan is a democratic country where public needs and requests affect decisions and policies, information on public opinion regarding the topic is indispensable.

To address the dearth of human-dimension studies on this topic in Japan, we aim to understand attitudes toward the reintroduction of wolves and the factors influencing these attitudes by conducting surveys of university students as potential future decision-makers.

## 2. Previous studies on attitudes toward wolf reintroduction

One of the classic studies (Bath and Buchanan, 1989) on public attitudes toward wolf reintroduction found diversity among stakeholders in Wyoming (U.S.A.); stock growers were more opposed than the conservation association, Defenders of Wildlife. Using the same data, Bath (1989) conducted a multiple regression analysis and revealed that attitudes toward wolves significantly influenced their support toward reintroduction, explaining 72% of the total variance. In New York, a survey of the residents within the boundary of Adirondack Park as well as statewide residents found that public opinion was divided; in the Adirondack Park area, 42% were supportive and 41% opposed, whereas the majority of statewide residents (60%) supported the reintroduction (Enck and Brown, 2002). Further, this research found that the following factors influenced support: 1) attitudes toward wolves, 2) beliefs that reintroduced wolves would reduce deer population and restore important missing elements of the wilderness, and 3) knowledge of wildlife.

In Europe, studies were conducted to gauge public opinion toward restored or increasing number of wolves (e.g. Glikman et al., 2012 study in Italy). A series of studies has been conducted in Sweden to understand public attitudes toward wolves as well as wolf policy. Findings of these research projects include: (1) having knowledge about wolves does not necessarily increase positive attitudes toward wolves (e.g., the most knowledgeable local hunters had least favorable attitudes toward wolves) (Eriksson and Heberlein, 2003), (2) multigenerational urbanities had more negative attitudes toward wolves than those with rural experience (Heberlein and Ericsson, 2005), and (3) public level of acceptance of wolves has decreased as the wolf population and people's direct experience of wolves has increased (Eriksson et al., 2015). A survey of university students ( $n = 364$ ) in Germany revealed that wildlife value orientation (Fulton et al., 1996) predicated respondents' support; people with a domination ideology (a view of human mastery over wildlife) were more opposed compared to those with a mutualism ideology (a view that wildlife have rights like humans), and that there was a difference in wildlife value orientation depending on the students' major (for example, agriculture majors tend to have domination way of thinking) (Hermann et al., 2013).

## 3. Situation regarding potential wolf reintroduction in Japan

An anthropological study in Japan explored how the idea of reintroduction of wolves in the country might be reflected by people's nostalgia for the pre-industrial past where Japanese co-existed with nature as well as their repentance hoping to

atone for past mistakes of driving wolves to extinction (Knight, 2006). As wolves were traditionally seen as a benign animal or the mountain spirit protecting agricultural fields from boars or deer, Knight (2006) proclaimed that wolf reintroduction in Japan is expected to achieve both ecological and symbolic restoration (p. 247).

Recently in Japan, researchers have examined this topic from multiple perspectives, including the impact on reconstructing healthy ecosystems (Maruyama et al., 2007; Kaji, 2017), legislative imperatives (Kato, 2005), as well as the potential risk of human casualties (Kawata, 2014). Based on the premise that an ecosystem lacking top-predators cannot self-sustain ecological dynamics, many researchers assert that the determining factor ultimately lies in the public's willingness to support reintroduction (Yamanaka and Kaji, 2006 p. 314; Maruyama et al., 2007 p. 185; Kawata, 2014; Kaji, 2017 p. 118). However, limited studies focus on public opinion toward the reintroduction of wolves in Japan. The Japan Wolf Association (JWA), has been conducting surveys regarding public opinion toward the reintroduction of wolves. A study conducted with citizens nationwide in 1996 ( $n = 1,176$ ) found that public attitudes were divided; 28.5% supported and 27.7% opposed while 43.8% were undecided (Angeli et al., 1998). The same study found that supporters tend to like wolves and were significantly more knowledgeable about wolves than opponents (Angeli et al., 1998). A similar survey conducted in 2016 showed that of 11,586 people surveyed, 45.5% were supportive and only 11.0% were opposed, while 43.3% were ambivalent (Japan Wolf Association, 2017). Compared to their survey conducted in 1996, the ratio of those supporting reintroduction increased while that of those opposing decreased substantially. Unfortunately, the respondents in these surveys were not selected randomly: questionnaires were distributed by the members of JWA to their acquaintances and friends, resulting in selection bias in the samples. We therefore cannot conclusively say that attitudes changed over time.

When considering wolf reintroduction in Japan, there are critical issues that need to be addressed. First, the potentially exotic breed of reintroduced wolves might affect public opinion. While there has been debate on whether Japanese wolves were endemic or a sub-species of gray wolves (Nakamura, 2008; Ishiguro, 2012), recent DNA analyses revealed that the Japanese wolf is a sub-species of gray wolves (*C. lupus*) and therefore, the same species as continental wolves (Matsumura et al., 2014). Second, public awareness of the massive agricultural damage caused by wildlife might also affect their attitudes toward wolves in Japan. Currently, agricultural damage caused by wildlife totals around 200 million US dollars annually (Ministry of Agriculture, Forestry and Fisheries, 2014). Media has been reporting wolf reintroduction as a potential solution to mitigate agricultural damage by wildlife (e.g., Nihon Keizai Shimbun, 1998; The Sankei Shimbun and SANKEI DIGITAL, 2017). Third, the locus of decision-making could be a critical factor that affects not only public attitudes but also the feasibility of this policy. Many Asian countries including Japan are collectivistic societies where people are influenced by what others think or the decisions that others (such as government) make (Abrams et al., 1998; Gudykanst and Nishida, 1999/2000). In addition, previous research in Japan found that social trust affects public opinion regarding wildlife management, for example, whether local residents trusted government affected their willingness to engage in damage preventative interventions (Sakurai et al., 2013). Similar findings come from Sweden; whether individual support the wolf policy is affected by how much they felt politically alienated (partly measured by their trust toward politicians) (Eriksson, 2017).

Finally, most surveys on wolf reintroduction were conducted as questions with scaled answers, such as the Likert scale from 1 to 5, enabling subsequent quantitative analyses. However, people's perception toward the reintroduction of extinct species is complex (Nie, 2003), and it is difficult to thoroughly evaluate factors that influence attitudes with pre-determined items and fixed scales. There were several studies that used qualitative methods such as interviews to understand the variance of people's opinion (Beeland, 2008; Hermann and Menzel, 2013). However, limited research utilizes both quantitative and qualitative methods.

For our research, instead of testing certain socio-psychological theories, we utilized an exploratory approach to identify factors among various potential variables that could explain public opinion toward the reintroduction of wolves in Japan. We also included open-ended questions to determine the variance of opinions and identify the reasons behind their attitudes.

#### 4. Questionnaire items

We developed questionnaire items based on previous studies and discussions among co-researchers on potential factors that would be important and appropriate in the Japanese context. Items were divided into eleven categories (Appendices 1 and 2): 1. Knowledge about wolves in Japan, 2. Attitudes toward wildlife and wolves, 3. Knowledge about wildlife issues in Japan, 4. Attitudes toward reintroduction of wolves in Japan, 5. Trust toward different stakeholders, 6. Risk perceptions, 7. Stakeholders to be entrusted with decision-making responsibilities on wolf reintroduction, 8. Knowledge about general biology and ecology, 9. Outdoor experiences, 10. Information sources about wildlife, and 11. Socio-demographic attributes. While some questions within categories 1, 2, 3, 5 and 6 were similar to those in previous studies (e.g., Enck and Brown, 2002; Glikman et al., 2012) to facilitate comparative analyses, other questions (i.e., the species of reintroduced wolves; exotic or native) were specifically designed for this study. We tested several hypotheses that are new to Japan including; "The more knowledge about wolves students have, the more they support reintroduction", "Students with positive attitudes toward wolves (e.g., like wolves) more likely support reintroduction", and "Students' trust level is different for different stakeholders, and affects their support for reintroduction differently".

Since perceived responsibility for decision making has been associated with decisions (Ikeda et al., 2010 p. 180), we devised a category listing stakeholders to whom the responsibility of decision-making should rest. Further, the necessity of increasing public knowledge of wolves and the ecology to make informed decisions on wolf reintroduction have been discussed by researchers including Yamanaka and Kaji (2006, p. 314) and Kawata (2014). Therefore, we included questions

regarding biology and ecology; general knowledge gained during a science course at junior high school through textbooks (Okamura and Fujishima, 2016), and those learned in high school, such as the definition of keystone species, ecosystem function, and endangered species in Japan (Asajima et al., 2018).

Two response scales were implemented (Appendices 1 and 2). In categories 1 and 3 (knowledge about wolves and wildlife issues), a three-scale answer was provided (I do not know, know a little bit, and know very well). A five-point scale was provided (disagree, slightly disagree, neither disagree nor agree, slightly agree, and agree) for the following question categories: attitudes toward wolves (2); reintroduction of wolves (4); trust (5); risk perceptions (6); stakeholders responsible for decision-making (7); outdoor experience (9); and resources (10). For general knowledge on biology and ecology, respondents selected one answer among five choices. We also prepared an open-ended question to solicit personalized reasons regarding respondents' opinions on the reintroduction of wolves in Japan.

## 5. Study design

We surveyed students at Ritsumeikan University, a private university in Japan. There are more than 30,000 undergraduate and approximately 4,000 graduate students at this university, making Ritsumeikan University one of the biggest universities in the country. We surveyed students of the College of Policy Science at the Osaka campus, where approximately 1,600 undergraduate students enrolled in the four-year Bachelor of Policy Science degree study interdisciplinary subjects related to policy. The survey was distributed to students undertaking the compulsory freshman course, "Introduction to Social Survey".

University students are future decision-makers (Torkar et al., 2010; Hermann et al., 2013), and therefore, their perceptions could be indicators of future public opinion. In addition, the College of Policy Science accept students with varying interests and offer seminars in multiple fields. Therefore, we postulate that students of the College of Policy Science better represent the general population of the future than students enrolled in one specific field such as ecology or wildlife management.

## 6. Analysis

First, we undertook a descriptive analysis of each questionnaire item, presenting the key results below (the remainder are shown in Appendices 3 to 5). Second, we conducted multiple regression analyses to identify the factors that affect public attitudes toward the reintroduction of wolves in Japan (an item of category 4 as a dependent variable). We used all 61 items as independent variables. Further, the mean score of the five knowledge items about general biology and ecology were combined into one variable. A stepwise method was used to identify the best fit model in terms of F-value at a significance level of 5%. All statistical analyses were conducted using SPSS version 20 (IBM, Tokyo). Third, we conducted text mining (morphological) analyses to characterize the differences in words found in answers for the open-ended questions. Word frequencies were tabulated to show quantitative differences of the three responses (those who disagreed or slightly disagreed, those who neither disagreed nor agreed, and those who agreed or slightly agreed). Words with high Jaccard coefficients (degree of co-occurrence between certain words and responses) were listed in Appendix 6. To visualize the association of words and responses, correspondence analysis was conducted and 35 words with high Jaccard indices are shown. All text mining analysis was conducted in KH Coder (Higuchi, 2016).

## 7. Results

### 7.1. Descriptive analysis

Students ( $n = 360$ ) who attended the class for "Introduction to Social Survey" on May 9th, 2019 participated in the survey; 56.8% of respondents were male while 43.2% were female. The majority of respondents (65.0%) were 18 years old, while 27.1% were 19 years old and the rest were more than 20 years old. Most are currently urbanites (69.1%) and a majority grew up in urban areas (56.6%).

While most respondents knew that wolves once lived in Japan (85.0%), more than half of them (52.6%) did not know that they went extinct by the beginning of the 1900s (Appendix 4). A majority of them neither knew the reason for wolf extinction in Japan (71.0%) nor about wolf reintroduction in the US (85.2%).

While more than half of respondents (56.4%) felt that wolves are scary, nearly half (47.5%) thought that wolves are beautiful (Table 1). A majority of respondents (63.8%) disagreed with the statement: "we could not help extirpating wolves in Japan because wolves only have negative impacts". While 40.8% of respondents agreed that a balance of the ecosystem collapsed without wolves, 38.3% were unsure. Nearly half of the respondents (43.0%) thought that reintroduced wolves from other countries are exotic species and have negative impacts.

A majority of respondents (>60%) were unaware that the population of deer is increasing and negatively impacting the ecosystem. Also, a considerable number of students (36.9%) did not know that deer frequently cause agricultural damage. Further, most respondents knew what exotic species are (90.1%) and how they could cause extinction of native species (88.7%).

About half the respondents were able to correctly answer questions regarding basic biology (Appendix 4). While many (56.2%) were aware of the basic principles of the ecosystem, a majority of respondents (57.1%) were not able to define "keystone species". On average, students were able to answer less than half (44.6%) of the five biology and ecology questions.

**Table 1**  
Students' responses to Category 2: attitudes toward wolves.

	Respondents who either disagreed or slightly disagreed (%)	Respondents who neither agreed nor disagreed (%)	Respondents who either agreed or slightly agreed (%)	Mean score	Standard deviation
Wolves are scary (n = 360)	22.5	21.1	56.4	3.51	1.22
Wolves are beautiful (n = 360)	29.7	22.8	47.5	3.24	1.31
We could not help extirpating wolves in Japan because wolves only have negative impacts (n = 359)	63.8	31.2	5.0	2.04	0.97
Wolves are necessary for healthy forest/ecosystem (n = 360)	15.0	45.8	39.2	3.37	1.04
Balance of ecosystem collapse without wolves (n = 360)	20.9	38.3	40.8	3.28	1.13
There is a causal relationship between increase of deer and extinction of wolves (n = 359)	28.4	29.2	42.3	3.24	1.26
Wolves can control population of deer (n = 360)	35.5	26.4	38.1	3.02	1.23
I am worried about safety, such as when walking outside, if wolves are reintroduced in Japan (n = 360)	25.8	11.1	63.0	3.59	1.29
I worry that kids will be attacked if wolves are reintroduced in Japan (n = 360)	21.9	15.0	63.1	3.60	1.19
Reintroduced wolves are exotic species and have negative impacts (n = 360)	20.5	36.4	43.0	3.30	1.09

A majority of respondents trusted local and central government, and researchers at research institutes, in terms of information provided by those stakeholders (Appendix 5). About 10% fewer respondents trusted professors than trusted researchers.

A majority of students supported central and local government, researchers at research institute, and local residents as stakeholders who should be entrusted with the responsibility to make decisions regarding the reintroduction of wolves to Japan (Table 2). In contrast, the ratio of students who entrusted this responsibility to professors compared to researchers was 1:2. A majority of respondents (54.1%) disagreed or were not sure if the general citizen should be entrusted with this responsibility.

Regarding support for the reintroduction of wolves in Japan, students' opinions were divided. While 42.8% disagreed or slightly disagreed, 31.1% agreed or slightly agreed whereas 26.1% neither disagreed nor agreed (n = 360, mean = 2.80, standard deviation = 1.17).

## 7.2. Stepwise multiple regression analysis

Using a stepwise multiple regression analysis, four independent variables were identified as the best-fit model to explain attitudes towards wolf reintroduction (Table 3). While "wolves reintroduced from other country are exotic species and have negative impacts" had significantly negative effects ( $B = -0.450$ ), "wolves are necessary for healthy forest/ecosystem" ( $B = 0.158$ ), "trust information provided by close friends" ( $B = 0.148$ ), and "professors at universities should have responsibility to decide whether or not to reintroduce wolves in Japan" ( $B = 0.114$ ) had significantly positive effects on attitudes towards reintroduction. The VIF (Variance Inflation Factor) for these four independent variables was less than 2.0 for all, and

**Table 2**  
Students' responses to Category 7: stakeholders to be entrusted with decision-making responsibilities on wolf reintroduction.

	Respondents who either disagreed or slightly disagreed (%)	Respondents who neither agreed nor disagreed (%)	Respondents who either agreed or slightly agreed (%)	Mean score	Standard deviation
Central government (e.g., cabinet, Ministry of Environment) (n = 360)	15.6	12.8	71.6	3.92	1.25
Local government (e.g., city office, prefectural government) (n = 360)	19.1	15.6	65.2	3.71	1.29
Researchers at research institutes (n = 359)	19.8	14.8	65.4	3.67	1.24
Professors at universities (n = 359)	44.9	23.7	31.5	2.76	1.29
NGO, NPO (n = 360)	37.2	30.8	32.0	2.85	1.20
General citizen (including urban residents) (n = 360)	36.9	17.2	45.8	3.10	1.44
Local residents (those living near forest and mountain where wolves are reintroduced) (n = 359)	18.7	15.6	65.7	3.79	1.30

**Table 3**

Multiple regression analysis with students' attitudes toward the reintroduction of wolves in Japan as a dependent variable ( $B$  = Standardized coefficient,  $n = 296$ ).

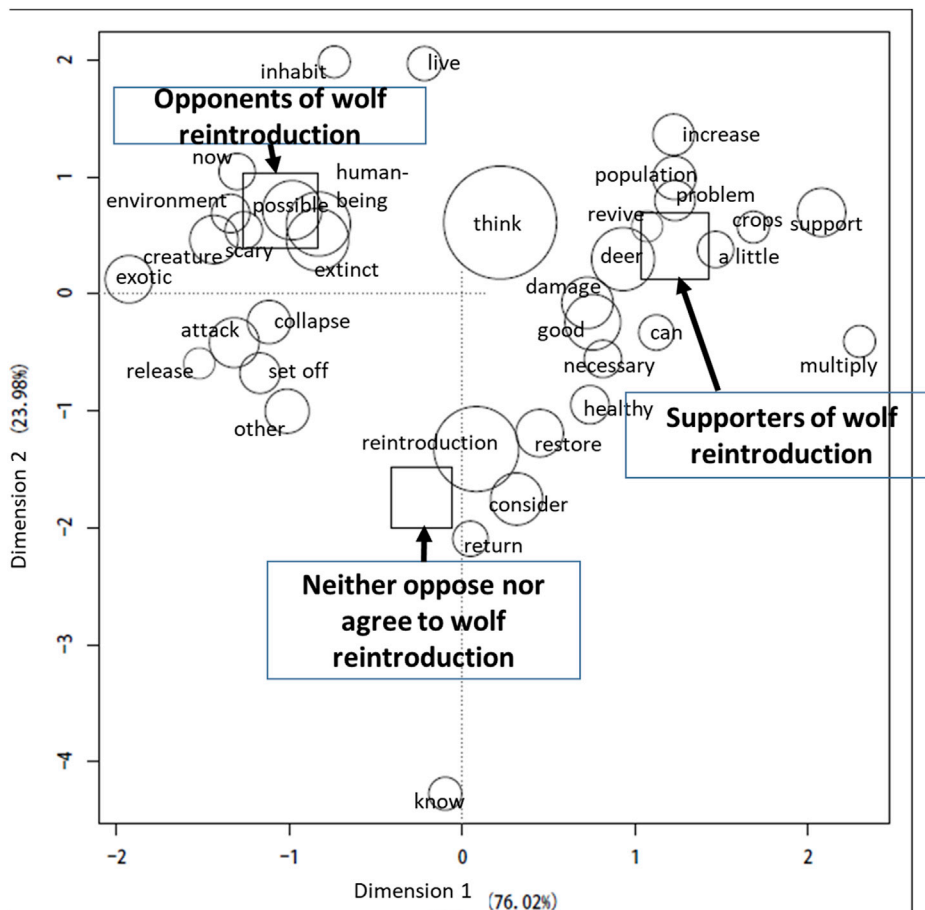
	$B$	$p$	VIF	$R^2$	Adjusted $R^2$
Wolves reintroduced from other country are exotic species and have negative impacts	-0.445	<0.001	1.010	0.263	0.253
Wolves are necessary for healthy forest/ecosystem	0.158	0.002	1.042		
Trust information provided by familiar friends	0.148	0.004	1.040		
Professors at universities should have responsibility to decide whether or not to reintroduce wolves in Japan	0.114	0.027	1.048		

multicollinearity was insignificant (Vaske, 2008). The identified model had an adjusted  $R^2 = 0.253$  indicating that about one fourth of the variance in attitudes toward the reintroduction of wolves, was explained by these four variables.

### 7.3. Text mining analysis

A morphological text-mining analysis revealed a total of 10,180 words with 435 sentences in students' answers for the open-ended question regarding the reason for their attitudes toward wolf reintroduction in Japan. Most frequently mentioned words by respondents who opposed (including those who slightly disagreed) reintroduction of wolves included "human being", "exotic", "attack", and "collapse" while words mentioned by respondents who supported (including those who slightly agreed) reintroduction included "deer", "population", "problem", "damage", and "increase" (Appendix 6). Further, respondents who were ambivalent used words such as "wolf," "ecology," "reintroduction," and "restore".

We created Fig. 1 based on correspondence analysis using words that have a minimum of 10 occurrences and showed the top 35 words that had a significant difference in frequency used among respondents according to their attitudes (disagreed including slightly disagreed, neither disagreed nor agreed, or agreed including slightly agreed) regarding the reintroduction



**Fig. 1.** Results of correspondence analysis showing words with strong association with respondents' attitudes toward reintroduction of wolves in Japan. Squares show the location of each attitude. The larger bubbles indicate words mentioned more frequently, and the closer the bubble is located to the attitudes, the more likely respondents with that attitude used that word.

of wolves. Respondents who opposed reintroduction are located on the left side (with negative scores) of Dimension 1 while those who supported are located on the right side (with positive scores). A score of 76.02% indicates that the majority of differences of words used by respondents could be explained as differences between those who disagreed and agreed with the reintroduction. Those who neither disagreed nor agreed with reintroduction are indicated lower than other positions showing negative scores in Dimension 2. A score of 23.98% indicates the difference of words used that can be explained by the difference between those who neither disagreed nor agreed and those who disagreed/agreed with the reintroduction. Such words as “exotic,” “attack,” and “scary” are more likely mentioned by those who disagreed with the reintroduction. On the other hand, words such as “increase,” “crops,” “population,” and “deer” were more likely used by those who agreed with the reintroduction. Words such as “know,” “consider,” and “return” were more likely used by those who neither disagreed nor agreed with the reintroduction.

## 8. Discussion

### 8.1. Knowledge of wolves and ecology

While a majority of students knew that wolves once lived in Japan, many of them neither knew that they are now extirpated nor the reason for their extirpation. Further, most students knew what exotic species are and their potential impact on the ecosystem, as well as basic ecological principles. The fact that most students disagreed with the statement “we could not help extirpating wolves in Japan because wolves only have negative impacts” suggests that extinction of species should be prevented. Students in junior and senior high schools learn about the importance of conserving biodiversity as well as basic ecological concepts in their mandatory biology/science course.

### 8.2. Decision-makers as influencers

Most students (>65%) agreed that central and local government should be entrusted with the responsibility to make decisions regarding the reintroduction of wolves while less than half (<32%) thought that professors or NGO/NPOs should be entrusted with this responsibility. Currently in Japan, certain NGOs and academics are proposing the reintroduction of wolves while government have vetoed this program ([Secretariat of House of Representatives, 2014](#)). While a majority of students agreed that local residents living near to potential reintroduction sites should be entrusted with decision-making responsibilities, fewer thought that general citizens should be included in this process. This suggests that although Japan is a democratic country where citizens can directly or indirectly participate in the decision-making process, respondents are not motivated to be involved in this process in relation to wildlife-related issues. This might be explained by the collectivistic nature of Japan where meeting public expectations, especially decisions made by government, is paramount ([Abrams et al., 1998](#); [Gudykanst and Nishida, 1999/2000](#)). Our results suggest that it could be difficult to gain public support unless the program is promoted by Government.

### 8.3. Perception of ecological role of wolves

The factor that had the strongest effect on students' position was their perception that reintroduced wolves would be an exotic species and thus have negative impacts on the ecosystem. This could be attributed to specific characteristics of Japan; an island country where many species are endemic and vulnerable to the negative effects of exotic species ([Ministry of the Environment, 2008](#)). As reintroduction projects should make sure that same or similar and related species are substituted as ecological replacements ([IUCN/SSC, 2013](#)), much time and effort was invested in scientifically explaining the genetic origin of both species when reintroducing wolves from Canada to Yellowstone National Park ([Fritts et al., 1997](#) p. 12–13). In Florida, when Texas cougars were reintroduced to revitalize the population of Florida's panthers, researchers questioned the disparity in genetic origin; this debate is still ongoing ([Gross, 2005](#)). Because respondents were much more likely to think of reintroduced wolves are an exotic species, our findings suggest that the public are unaware of recent scientific findings, which show that Japanese wolves are the same species as continental wolves ([Matsumura et al., 2014](#); [Asahi Shimbun, 2018](#)).

Our study revealed that, net of other variables, attitudes toward wolves did not significantly influence students' position toward reintroduction, which contradicts previous studies ([Bath, 1989](#); [Enck and Brown, 2002](#)). Our results suggest that in Japan (at least, with university students), it is not affect but ecological understanding and perception of the ecological role of wolves that potentially affect attitudes toward reintroduction. This contradicts the widely-held belief that emotions and fear caused by the media and fairy tales—the “Little Red Riding Hood Syndrome”—is a major influencing factor on public opinion ([Angeli et al., 1998](#); [The Sankei Shimbun and SANKEI DIGITAL, 2017](#)). This also contradicts cultural comparison studies which concluded that Japanese appreciation of wildlife and nature is largely emotional with little biological and ecological considerations, when compared with people in countries such as the U.S.A. and Germany ([Kellert, 1993](#)).

Our findings revealed that students have abundant knowledge of ecology and their position toward reintroduction is affected by their perception and understanding of the ecological significance of wolves. Thus, it is imperative that more research be conducted from evolutionary and ecological perspectives. While data are available on the ecological impact of reintroduced wolves in North America and Europe ([Ripple and Beschta, 2012](#); [Callan et al., 2013](#); [Ripple et al., 2014](#)), only a few studies were conducted on the potential ecological impact of restoring wolves in Japan ([Tsunoda and Enari, 2012](#); [Sakurai](#)

et al., 2018) and further studies will also be based on hypothetical scenarios as wolves are absent in Japan. However, as restoration of the ecosystem remain a national policy goal (e.g., Nature Restoration Act), and as issues related to increasing ungulate populations prevail, such ecological research will be important.

Research shows that those who trust other people are positive thinkers and open to new ideas (Uslaner, 2002), which explains why in our survey, those who trust close friends were supportive of wolf reintroduction. Therefore, besides ecological knowledge, researchers should consider factors such as social trust (items that were not tested in previous studies) in order to fully understand variables affecting public opinion.

A willingness to satisfy the interviewer, the “social desirability effect” (Groves et al., 2004), might bias the results. If students thought the professors who distributed this survey promoted wolf reintroduction in Japan, then students may also support this idea. To determine the extent of bias from the social desirability effect, we conducted an additional short survey ( $n = 192$ ) two months later, on July 18th (authors’ unpublished data). The number of students who thought that professors who distributed the survey on May 9th support reintroduction of wolves were 44.7% while 37.2% were not sure (the rest of students, 18.1%, thought professors oppose reintroduction). Based on a regression analysis, whether students thought professors supported reintroduction did not affect their attitudes on this topic ( $p > 0.05$ ); there was no social desirability effect in our sample.

#### 8.4. Reasons behind students’ attitudes

Text mining analyses of open-ended questions revealed that those who opposed reintroduction used words such as “people”, “attack”, and “dangerous”, derived from phrases like “wolves will be dangerous for people”. This suggests that opponents are human-centered with anthropocentric ethics in which the benefits and threats of the natural environment to human beings are important considerations (Groom et al., 2006, p. 114). In contrast, those who support reintroduction used words like “deer”, “increase”, and “population”, derived from phrases like “population of deer increased and needs to be controlled”. Therefore, supporters possibly have ecocentric views, where wolves and people are considered members of a biotic community (Groom et al., 2006, p.128).

Those who neither support nor oppose reintroduction used words such as “wolf”, “ecology”, and “know”, derived from sentences like “I first need to know about ecology and wolf to decide whether to support or oppose reintroduction”. Consequently, those who were ambivalent seemed to be careful thinkers emphasizing science and evidence. Previous studies on education programs found that while most students with limited knowledge initially opposed restarting nuclear power plants, their position shifted, when informed, to a neutral one (neither disagree nor agree) (Takano et al., 2018). A similar trend might be observed; those who were ambivalent were eager to know about “ecology” and “wolf”.

#### 8.5. Policy implication: researchers’ and citizens’ roles

The importance of restoring a healthy ecosystem has been promoted by the enactment of laws such as Act on Conservation of Endangered Species of Wild Fauna and Flora, and projects that reintroduce species such as the crested ibis. However, the Ministry of the Environment has not prepared a roadmap with targets for restoration projects. Ecosystems lacking top-predators, especially keystone species such as wolves, are incomplete and cannot fully generate dynamics such as cascade effects (Ripple et al., 2014). In asserting the significance of reintroducing top-predators, several researchers deferred to citizens by saying that reintroduction will depend on citizen understanding and acceptance (Yamanaka and Kaji, 2006, p. 314; Kaji, 2017, p. 118). Our survey revealed that public opinions were divided among those who oppose (42.8%) and support (31.1%) wolf reintroduction in Japan; the remainder were ambivalent. This is not necessarily because respondents lack basic knowledge of ecology or biology, but that this knowledge could be derived from textbooks as a key source of knowledge in their educational training. While these textbooks explain the increasing deer population as well as its impact on the ecosystem, they do not delve into the sustainable and effective management of this population without a predator-prey relationship. Further, in explaining the significance of reintroducing crested ibis, the ultimate goal of such restoration projects was not explained: the species for reintroduction. The latest high school textbook published in 2018 (Asajima et al., 2018) describes the extinction of wolves but it does not explain nor introduce the current scientific finding that Japanese and continental wolves are the same species.

Wildlife management, including the decision to reintroduce extirpated species, is a public concern in which decisions affect all citizens (e.g., through recreation, and agriculture). Fewer than half (45.8%) of respondents agreed that the general population should be responsible for deciding whether wolves should be reintroduced, suggesting that government and educational institutions could foster a public sense of ownership in relation to wildlife issues. Further, the goal of a school curriculum is to train students to be conscious of and responsible for social issues (including environmental problems) and to be independent thinkers (Ministry of Education, Culture, Sports, Science and Technology Japan, 2009). Irrespective of the public’s position on the reintroduction of wolves, they should first acknowledge wildlife issues in Japan and be able to critically think about how these issues could be solved; in other words, they should gain autonomy to make decisions for the democratic management of their society (Chawla and Cushing, 2007). Previous research showed that direct experience and understanding of local issues and promoting participation by youths in the decision-making process are necessary to fostering youths’ ownership of environmental issues (Hermann and Menzel, 2013). In Japan, for example, taking students to local mountainous regions where damage by wildlife frequently occur and observing farmers protecting their crops might not



only increase students' awareness of wildlife issues but also foster their sense of responsibility and autonomy (Sakurai, 2019 p. 121–130).

### 8.6. Limitations and potential direction of future research

There are several limitations of this research which imply potential direction of future research. First, surveys with a greater sample size, which do not focus exclusively on college students, should be conducted to determine if our findings are representative of the general population. We understand the limitation of our study as undergraduate students are only "potential future decision-makers" and not representative of the current general population. In addition, research could be conducted with specific stakeholder groups (e.g., hunters, environmentalists, and others). The wolf-hunter relationship tends to be negative as they compete in pursuing ungulates, and in Japan, there has not been any research conducted, as far as the authors know, on how Japanese hunters' views on wolf reintroduction. Second, there is a limitation in using one statistical analysis to analyze data. To begin to address this, we conducted a post-hoc cross validation on stepwise multiple regression analysis, using 75% randomly selected data among a whole samples, to test if the same results could be obtained. While the cross validation identified three same independent variables as the factors that significantly affected the dependent variable, one independent variable; "trust information provided by familiar friends" was not selected in the final model. Additional analyses could further explore these data. Finally, more exploratory research including qualitative studies (e.g., in-depth interview) would be necessary to identify other factors, besides those tested in this survey, that influence public opinion toward the reintroduction of wolves, as only 25% of variation in attitudes was explained by our suite of predictor variables.

### Declaration of competing interest

The authors have no conflict of interest.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.gecco.2020.e01036>.

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