Received: 19 August 2021 | Accepted: 24 May 2022

DOI: 10.1002/pan3.10379

PEOPLE AND NATURE
BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICLE

Knowledge of returning wildlife species and willingness to participate in citizen science projects among wildlife park visitors in Germany

Emu-Felicitas Ostermann-Miyashita[1,2] | Hannes J. König[1] | Nadja Pernat[3,4] | Sonoko Dorothea Bellingrath-Kimura[2,3] | Sophia Hibler[1,5] | Christian Kiffner[1]

[1]Junior Research Group Human-Wildlife Conflict and Coexistence, Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany

[2]Faculty of Life Sciences, Thaer-Institute of Agricultural and Horticultural Sciences, Humboldt Universität zu Berlin, Berlin, Germany

[3]Research Area 2: Land Use and Governance, Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany

[4]Institute of Landscape Ecology, Animal Ecology Research Group, University of Münster, Münster, Germany

[5]Department of Plant Ecology and Nature Conservation, University of Potsdam, Potsdam, Germany

Correspondence
Emu-Felicitas Ostermann-Miyashita
Email: emu-felicitas.ostermann@zalf.de; emufelicitasostermann@gmail.com

Funding information
Japan Student Services Organization; Marianne und Dr. Fritz Walter Fischer foundation; the EU InterReg project INT144 "LosBonasus - Crossing! Improving transboundary wildlife management for European bison and moose"

Handling Editor: Sarah Crowley

Abstract

1. Successful conservation efforts have led to recent increases of large mammals such as European bison *Bison bonasus*, moose *Alces alces* and grey wolf *Canis lupus* and their return to former habitats in central Europe. While embraced by some, the recovery of these species is a controversial topic and holds potential for human-wildlife conflicts. Involving the public has been suggested to be an effective method for monitoring wildlife and mitigating associated conflicts.
2. To assess two interrelated prerequisites for engaging people in Citizen Science (CS)—knowledge of returning species and respondents' readiness to participate in CS activities for monitoring and managing these species—we conducted a survey (questionnaire) in two wildlife parks located in different states of Germany. Based on 472 complete questionnaires, we developed generalized linear models to understand how sociodemographic variables and exposure to the species affected visitors' knowledge of each species, and to investigate if sociodemographic variables and knowledge influenced the likelihood of visitors to participate in CS activities.
3. Almost all visitors were aware of the returning wolf population, while knowledge and awareness about bison and moose were significantly lower. Knowledge of the two herbivores differed geographically (higher knowledge of moose in the north-eastern state), possibly indicating a positive association between exposure to the species and knowledge. However, models generally performed poorly in predicting knowledge about wildlife, suggesting that such specific knowledge is insufficiently explained by sociodemographic variables.
4. Our model, which explained stated willingness in CS indicated that younger participants and those with higher knowledge scores in the survey were more willing to engage in CS activities.

5. Overall, our analyses highlight how exposure to large mammals, knowledge about wildlife and human demographics are interrelated—insights that are helpful for effectively recruiting citizen scientists for wildlife conservation.

Read the free Plain Language Summary for this article on the Journal blog.

KEYWORDS
environmental awareness, human-animal relationships, human-wildlife conflicts, social-ecological system, wildlife conservation, wildlife knowledge

1 | INTRODUCTION

Citizen science (CS), the voluntary engagement of citizens in scientific research (Follett & Strezov, 2015), is increasingly gaining attention as a valuable tool for monitoring (Frigerio et al., 2018; Jordt et al., 2016; Kauffman et al., 2016; Liebenberg et al., 2017) and management (Ceausu et al., 2018; Todd, 2002) of wildlife. While one of the main goals of CS is to contribute to science by generating new knowledge, the process of CS also affects other fields: participants enhance their knowledge status (field of education), and communication between scientists and the public (field of communication) improves. In turn, these processes could lead to changes in the society (field of society; Ostermann-Miyashita et al., 2021). This interdisciplinary and reciprocal characteristic of CS enables a holistic approach to societal challenges, which is especially crucial when tackling complex and multifaceted environmental challenges such as human-wildlife conflicts (Echeverri et al., 2018; Liordos et al., 2017).

As citizen scientists collect data voluntarily, CS projects can theoretically gather considerable amounts of data across large spatio-temporal scales at a low budget compared to professional wildlife monitoring carried out by research institutions (Commodore et al., 2017; Farhadinia et al., 2018; MacPhail & Colla, 2020; Pédarros et al., 2020). For example in Botswana, trained rangers produced valid wildlife monitoring data at 60% of the budget required by wildlife researchers for the same task (Keeping et al., 2018). In contrast, due to limitations of common funding schemes, wildlife research activities carried out by research institutions are frequently spatially and temporally constrained to a few years and selected study sites. Although CS projects also require funds for organization, equipment, and data management, voluntary participation greatly reduces the cost for data collection (Dickinson et al., 2010; Kelling et al., 2019). CS projects not only enable gathering data at larger spatial scales, for example nationwide or even globally (Bonney et al., 2009; Brown et al., 2016), but also in locations that are usually difficult to access for researchers, such as private homes and gardens (Pernat et al., 2021).

Despite these advantages of CS projects, parts of academia are sceptical about the reliability and utility of citizen-generated data (Lewandowski & Specht, 2015). Multiple studies which addressed these concerns (Anhalt-Depies et al., 2019; Galloway et al., 2011; Swanson et al., 2016) showed that data collected by citizens, even by children under the age of 12 years (Ecoclub Amphibian Group, Pope, et al., 2016; Frigerio et al., 2018), can be as accurate as data collected by scientists if clear instructions and the necessary training are provided (Bonney et al., 2009). However, CS data collection tends to be biased, for example due to heterogeneous spatial distribution of the sampling or lower detection probability compared to scientists (Brown et al., 2018; Pédarros et al., 2020). During data vetting or analysis, it is therefore crucial to apply methods that reduce errors and remove potential biases (Bird et al., 2014; Isaac et al., 2014; Kelling et al., 2019). A pre-collection approach in more structured CS projects could minimize such possible biases through rigorous protocols (Kelling et al., 2019), but also through targeted recruitment of citizen scientists based on their motivation, skills or time capacity (Ostermann-Miyashita et al., 2019).

CS methods are especially effective for monitoring rare (Tiralongo et al., 2020) and invasive species (Jordt et al., 2016; Pocock et al., 2017) which are typically difficult and costly to monitor (Putman et al., 2021) due to their low abundance or cryptic behaviour (Pernat et al., 2021). CS approaches can also contribute to informing time-sensitive policy decisions for wildlife conservation. An example is the use of eBird—a global CS online database for bird observations—for the Species Status Assessment (SSA) in 2015. Monitoring records of eBird were applied to fill the missing data gap and provided the necessary information for assessing the conservation status of a migratory songbird species *Anthus spragueii* within a limited timespan (Long et al., 2019).

In addition to being a potentially effective wildlife monitoring tool, CS enables the general public to participate in scientific research on environmental challenges (Ravetz, 2004). In some cases, this will increase the scientific knowledge of the participating citizens and enhance the transparency of science (Haywood & Besley, 2014). For example, involving South African citizens in baboon monitoring activities not only delivered scientifically valuable data in a fast, non-invasive and low-cost manner but also provided insights into local stakeholder knowledge on tackling this conflict situation (Pédarros et al., 2020). Through the reciprocal communication between citizens and scientists, local and scientific knowledge can be combined to better understand complex socio-ecological challenges (Beach & Clark, 2015; Forrester et al., 2017; Reed, 2008) and to find pathways for facilitating coexistence between humans and wildlife (Reed et al., 2009; Soulsbury & White, 2015).

In a recent review, Echeverri et al. (2018) highlighted the diversity of scientific fields conducting research on human-animal relationships, ranging from natural sciences, social sciences, humanities to arts. Given the complexity of different cultural backgrounds globally (Camill et al., 2013) and the dynamic relationships between humans and nature (which comprises animals; Kaltenborn & Linnell, 2022), the importance of approaching these challenges from an interdisciplinary lens is stressed (Jiren et al., 2021). This is also true on a bigger scale; not only for the preservation of single species but also for the conservation of biodiversity as a whole. Although we are living in the Anthropocene (Kremen & Merenlender, 2018), where humans exert strong influences on the environment (Cepic et al., 2022; Isbell et al., 2017), there is still a strong bias towards natural science approaches in the field of biodiversity conservation (Lozano et al., 2019). To contribute to the interdisciplinary development of the field and to account for the human dimension of wildlife conservation, sociological approaches are needed. Such studies could help improving our understanding of human-nature relationships and could contribute to mitigating human-wildlife conflicts, and thus to address a key driver of biodiversity loss (Ferreira et al., 2022). CS is an effective tool for a bottom-up approach to this challenge; not only does it include multiple (concerned) parts of the human population, it also provides a chance for individuals to deepen or restore their connection to nature and gain a first-hand experience of wildlife research (Clayton et al., 2017; Kaplan & Kaplan, 1989).

As interactions with large carnivores (Lozano et al., 2019; Pooley et al., 2017) and with reintroduced or recolonizing species (Corlett, 2016) are particularly challenging, we here focus on three large mammal species: European bison *Bison bonasus*, moose *Alces alces* and grey wolf *Canis lupus*. A detailed description of the historical background of the three target species in Germany is found in the material and methods section. Although the return of these three species is welcomed by some parts of society (Arbieu et al., 2019; Carpio et al., 2020; Schwerk et al., 2021), bison, moose and wolf also pose a high potential for human-wildlife conflicts (Arbieu et al., 2021; Darimont et al., 2018; Jung, 2020). Collisions with vehicles and trains are major concerns for the two large herbivores (Borowik et al., 2021; Jasińska et al., 2019), while the growing number of wolves and livestock depredation are at the core of an emotional and political debate (Kiffner et al., 2019; Reinhardt et al., 2019; Ronnenberg et al., 2017; Trouwborst, 2018). Involving citizens in monitoring and management activities could improve the public's understanding and support for these species and contribute to effectively addressing the multiple potential conflicts associated with these species (Kansky et al., 2021; Schuttler et al., 2018).

For citizens to effectively participate in wildlife monitoring and management, a certain level of scientific and environmental knowledge is necessary. Knowledge is mediated by sociodemographic variables such as formal education, profession, residential context (hereafter referred to as 'degree of urbanisation'), gender, and age (Crall et al., 2013). Particularly age and gender were shown to be influencing factors for environmental knowledge (Imbulana Arachchi & Managi, 2021; Shafiei & Maleksaeidi, 2020). For example, several studies suggest that today's youth (school and university students) are more knowledgeable and motivated to address environmental issues (Haugestad et al., 2021; Randler et al., 2020; Shafiei & Maleksaeidi, 2020). With regards to gender, investigations showed mixed results depending on the specific topic and regional context (Cruz-Garcia et al., 2019; Imbulana Arachchi & Managi, 2021; Vicente-Molina et al., 2018). In addition, the level of exposure of people to wildlife species can affect their knowledge about these species (König et al., 2020). In this study, we were thus particularly interested how the predominant sociodemographic context, including 'age', 'gender' and 'degree of urbanization' influenced knowledge about wildlife, as this information could contribute to designing and applying CS approaches in wildlife management for specific target groups, adjusting to their different knowledge levels. Further, the geographical location in which people live may affect the potential exposure to different wildlife species (Arbieu et al., 2019). For species which are heterogeneously distributed in Germany (moose), we expected knowledge to differ between localities, while for species that are rather homogenously distributed (wolf) or currently not present in the research area (bison), we expected no spatial differences in knowledge.

Environmentally informed citizens are more likely to participate in conservation-oriented actions, with greater awareness of anthropogenic impact on local ecosystems (Haywood et al., 2016). Therefore, we expected to see positive correlations between visitors' knowledge about the species and their readiness to participate in CS activities. Sociodemographic variables also affect individual attitudes towards wildlife species (Arbieu et al., 2019; Bencin et al., 2016; Boulet et al., 2021; Hermann et al., 2013; Koziarski et al., 2016), which is one of the deciding factors regarding if and how individuals participate in conservation activities. Based on these backgrounds (Bonney et al., 2016; Decker et al., 2010; Maund et al., 2020), we analysed the effect of the visitors' knowledge about the three target species on their willingness to participate in CS activities, in addition to the four sociodemographic variables (gender, age, degree of urbanization and park location). We hypothesized that people with greater overall knowledge about the three target species (bison, moose and wolf) were more likely to participate in CS projects.

The study was conducted in two wildlife parks located in the federal states of Brandenburg and Lower Saxony in Germany. Wildlife parks are '*an enclosed area of land where uncaged wild animals roam, fairly freely, in conditions designed to mimic their natural habitat as closely as possible*' (Collins English Dictionary, 2022). We expected sufficient interest of visitors towards the three returning wildlife species (bison, moose and wolf) to take some time for participating in a survey, as well as a wide range in knowledge and sociodemographic background. Due to the assumption that wildlife park visitors tend to have higher interest in wildlife, we would like to point out that the results of this study are not necessarily representative of the general public. Research also suggests the positive effects of facilities accommodating wildlife on environmental learning (Botha et al., 2021) and behavioural changes of visitors (Ballantyne et al., 2018; Fukano et al., 2020; Hacker & Miller, 2016), which suggest that these are may be suitable locations for recruiting participants for CS projects on wildlife monitoring and management.

The aims of this study were to (1) evaluate which sociodemographic variables mediated visitors' knowledge of three selected wildlife species (bison, moose and wolf) and (2) to test if sociodemographic variables, exposure to the wildlife species and knowledge of the three wildlife species were associated with the stated willingness to participate in CS activities.

2 | MATERIALS AND METHODS

2.1 | Historical background of the target species

Free-ranging European bison were driven to extinction in the wild in the early 20th century through a combination of unregulated hunting, habitat loss and other environmental factors (Decker et al., 2010; Pucek, 2004). After World War II, a reintroduction program was started, facilitated by few individual bison that had survived in captivity (Bleyhl et al., 2015). Population increase in western Poland due to rigorous conservation efforts (Churski et al., 2021; König et al., 2021) led to one bison crossing the border to Germany in 2017. This bison was shot dead in Germany by a local hunter, as a result of ineffective communication and uninformed decision making among authorities (MLUK, 2020). Currently, the only free-living population in Germany is in the 'Rothaar Gebirge' (a low mountain range in the states of North Rhine-Westphalia and Hesse) these bison were reintroduced in 2013.

While the moose (we are aware, that in UK English, the European population of *Alces alces* is normally referred to as 'elk', but to avoid being mistaken for *Cervus canadensis*, we will consistently apply 'moose' in this article) population in central Europe dropped to a low point in the early 20th century, moose persisted in Poland (Niedziałkowska, 2017). In Germany, moose disappeared around the 17th century, and repeated attempts to re-establish a population failed in the 20th century (Schönfeld, 2009). When the Polish moose population further decreased in the 1990s, Poland imposed a hunting ban across the country (Borowik et al., 2021). After the population started to increase due to effective enforcement of the hunting ban (Borowik et al., 2018), there have been repeated moose sightings in the eastern part of Germany (Janik et al., 2021; Martin, 2013). Notably, the moose 'Bert' which had crossed over from the Polish border in 2018 and ever since has stayed in the north-eastern part of Germany, is regularly covered by the local media of Brandenburg (Gandl, 2020).

During the Middle Ages, the grey wolf was widespread across the European continent. Persecution led to large-scale eradication in many parts of Europe (Hindrikson et al., 2017) until the population reached an all-time low in the 1960s (Reinhardt et al., 2019). This trend has been reversed through several European legal instruments for the protection of large carnivores, which were agreed upon in the 1980s and 1990s (Trouwborst, 2018). From the 1990s, wolves entered Germany from western Poland and the first reproduction within Germany was documented in 2000 (Arbieu et al., 2019). Since then, the wolf population in Germany has been increasing at an astounding rate of about 36% per year (Hindrikson et al., 2017; Reinhardt et al., 2019).

2.2 | Survey background and design

In October 2020, we conducted a survey in two wildlife parks located in two states of Germany. 'Wildpark Schorfheide' (hereafter: Schorfheide) is located in Brandenburg state (Northeast Germany), a state that is bordering with Poland and currently hosts the highest wolf density of Germany and Europe (König et al., 2020). This state also holds a small moose population. The other park, 'Wisentgehege Springe' (hereafter: Springe) is located in Lower Saxony (Northwest Germany), which also has an established wolf population but currently does not host a moose population (Figure 1). As its name (Wisentgehege = Bison park) indicates, Springe has a strong focus on bison. Both wildlife parks host most wildlife species common in Germany, including the three target species of our study (bison, moose, and wolf). Nevertheless, the two wildlife parks differ: Schorfheide is a private organization, while Springe is supported by the State Forest Administration of Lower Saxony. Both wildlife parks offer guided tours, and Schorfheide has a 'Wolf information centre'

FIGURE 1 The location of the two wildlife parks Schorfheide in Brandenburg state and springe in Lower Saxony state.

which specifically caters for visitors who want to learn historical and ecological facts about the wolf. We hypothesized, that the cumulative effect of different locations of the wildlife park (a coarse proxy for exposure to different wildlife species) and differences in visitor engagement contributed to varying knowledge of the species as well as different interest levels to engaging in CS activities.

In each wildlife park, the survey was carried out for 4 consecutive days during the autumn school holidays. We handed out the questionnaires at the entrance of the park, and asked visitors to complete the form on the spot or during their visit and return them before leaving the park. It was not possible to keep count of how many participants initially took the questionnaire with them, because some had asked for a second or third copy, when the paper-based questionnaires became unidentifiable due to the rainy weather condition. The questionnaire was designed based on the EU General Data Protection Regulation and was approved by the institutes' review board for data protection and research ethics after detailed examination on October 2nd 2020 (no reference number applied). All participants were informed about the content of the survey and the purpose for which the data would be used through an explanatory paragraph at the beginning of the questionnaire and also verbally. Only the questionnaires where the participants had given their written consent to the usage of the data were analysed.

We defined empty, unclear and multiple selected (for a single answer question) answers as 'invalid'. Questionnaires with less than 10% of complete answers (9 and less question answered out of 97 questions) were omitted from the analyses (Schorfheide = 0%, Springe = 1.8%), resulting in a total of 589 surveys (Schorfheide: $n = 321$; Springe: $n = 268$).

The survey consisted of 97 multiple choice questions and we analysed the following three parts for this study. The first section focussed on knowledge about the three target species and was presented as an animal quiz. The quiz attempted to gauge conventional knowledge regarding the ecology and population status of the species in Germany. For brevity, we refer to the aggregated quiz results as 'knowledge' yet acknowledge that this is a very narrow scope for defining 'knowledge' of a species. The second section addressed issues pertaining to knowledge about and interest in participating in CS projects. In this part, a small explanation box for the term CS ('Bürgerwissenschaften' in German) was provided at the bottom of the section for participants who were not familiar with the term. Participants were then asked to answer the following questions (e.g. whether they were interested to participate in CS activities) based on this information. The third section focused on the sociodemographic background (residential state, degree of urbanization, gender, age, income, education and current occupation) of the participants. For more details on the survey, please refer to Appendix Table A1.

2.3 | Statistical analysis

We conducted all statistical analyses in R ver.3.6.3 (R Core Team, 2020). To gauge overall knowledge about the species, we included 7 questions for each species (Figure A1), and each correct answer was scored as 1 point, while wrong, invalid, and 'do not know' answers were scored as 0 points for the specific answer. To assess if visitors' knowledge about the three species differed, we used Kruskal-Wallis-Anova and tested if the knowledge points scored for each species (max. of 7 points) differed between bison, moose, and wolf. For evaluating the hypothesized associations between knowledge of the three target species and the sociodemographic variables, we used generalized linear models. Prior to modelling, we applied case-wise deletion for incomplete questionnaires, resulting in $n = 472$ complete questionnaires. As explanatory variables, we categorized the degree of urbanization as a four-level variable (rural, rather rural, rather urban and urban), gender as a two-level categorical variable (female and male; in total 2 participants identified as non-binary and due to this small sample size in this category we omitted these cases), and age of the participants, defined as categorical variables with six-levels (under 24, 25 to 29, 30 to 39, 40 to 49, 50 to 59 and over 60 years of age). We considered the wildlife park as a two-level variable (Schorfheide and Springe) reflecting differences in the presentation of the three target species in each wildlife park, and possible differences in exposure of visitors to free ranging target species (Table A2; the location of the park was strongly correlated with the participants' residence, see 3.1).

Prior to model fitting, we assessed collinearity among the explanatory categories using Cramer's *V* index for categorical variables and epsilon square statistics for associations between numerical and categorical variables. For this, we used the packages 'vcd', and 'rcompanion' (Mangiafico, 2021; Meyer et al., 2022; Wei et al., 2021). As there were no strong associations among the variables (Table A3), we included all explanatory variables for initial model fitting.

For addressing our first objective – assessing participants' knowledge of returning wildlife species – we used a generalized linear model with a Poisson error structure because of the discrete nature of the response variable (i.e. the knowledge points which could range from 0 to 7 points). For each target species, we first fitted a global model with all 4 hypothesized variables and then used backward selection to iteratively remove the least contributing predictors based on the Akaike Information Criterion (AIC). This was done using the stepAIC function of the MASS package (Venables & Ripley, 2002). For the final model, we estimated robust standard errors and 95% confidence intervals of the regression coefficients using the SANDWICH package (Zeileis et al., 2020) and ran a goodness of fit test.

For our second objective—to test if the sociodemographic variables, the respective wildlife park, and knowledge about the three target species were associated with the stated willingness to participate in citizen science projects (yes = 1, no = 0)—we fitted a logistic regression model. Sociodemographic variables included degree of urbanization, gender, age, (defined exactly as in the models exploring knowledge), and the wildlife park. Knowledge about the three target species was calculated as the sum of all species (3 species × 7 questions = max. of 21 points). We first parameterized the most complex model and then used backward model selection to derive our final model applying the same packages as above. To predict relative effects of the explanatory variables we computed the odds ratios (exponent of regression coefficients), associated 95% confidence intervals. For the final model, we also ran a goodness of fit test.

3 | RESULTS

3.1 | Sociodemographic background

Selected variables of the sociodemographic background (state of residence, degree of urbanization, gender and age) of the participants in both wildlife parks are summarized in Table 1. On average, 85.7% of the participants lived in the state (or in case of Schorfheide either in the state or the adjacent city-state of Berlin) where the wildlife park is located in (Schorfheide: 81.3%, $n = 261$ from Berlin Brandenburg and Springe: 91.0%, $n = 244$ from Lower Saxony). While the majority of participants in Schorfheide reportedly lived in urban (48.6%, $n = 156$) and rather urban (16.2%, $n = 52$) areas, the majority of participants in Springe lived in rural (34.3%, $n = 92$) and rather rural (27.2%, $n = 73$) areas. In both wildlife parks, more women participated compared to men (female participants: 53.6%, $n = 172$ in Schorfheide and 55.6%, $n = 149$ in Springe). While the majority of participants were between 30 and 49 years of age in both parks (Schorfheide: 49.9%, $n = 160$ and Springe 42.1%, $n = 113$), the number of very young participants under the age of 24 was higher in Springe (14.6%, $n = 39$) than in Schorfheide (5.0%, $n = 16$). The percentages of invalid answers in all categories were between 7.1 and 10.4%.

3.2 | Knowledge of returning wildlife species

The answers to the 7 questions for each target species (total of 21 questions) are shown in Figure A1. On average, participants got 3 answers correct for bison, 2 for moose and 4 for wolf. Over 98% of participants in both wildlife parks knew that there are free living wolves in Germany, yet only 33% knew that there were free-living moose and only 26% knew that there are free living bison in the country. Knowledge about the status of the three species in Germany also

TABLE 1 The sociodemographic background of the participants in the wildlife parks Schorfheide and Springe

	Schorfheide		Springe		Total[a]	
Number of participants	**321**		**268**		**589**	
Number of visitors from the states in which the wildlife park is located in (Berlin and Brandenburg state for Schorfheide and Lower Saxony for Springe)	261	81.3%	244	91.0%	505	85.7%
Degree of urbanization						
Urban	156	48.6%	50	18.6%	206	35.0%
Rather urban	52	16.2%	32	11.9%	84	14.3%
Rather rural	54	16.8%	73	27.2%	127	21.6%
Rural	36	11.2%	92	34.3%	128	21.7%
Invalid	23	7.1%	21	7.8%	44	7.5%
Gender						
Female	172	53.6%	149	55.6%	321	54.4%
Male	120	37.4%	92	34.3%	212	36.0%
Diverse	1	0.3%	1	0.4%	2	0.3%
Invalid	28	8.7%	26	9.7%	54	9.2%
Age						
Under 24	16	5.0%	39	14.6%	55	9.3%
25–29	25	7.8%	19	7.1%	44	7.5%
30–39	79	24.6%	47	17.5%	126	21.4%
40–49	81	25.3%	66	24.6%	147	25.0%
50–59	62	19.3%	34	12.7%	96	16.3%
Over 60	34	10.6%	35	13.6%	69	11.7%
Invalid	24	7.5%	28	10.4%	52	8.8%

[a]For the column 'Schorfheide' and 'Springe' the numbers in the brackets show the percentage within the respective wildlife parks and for the column 'Total' the percentage of the total participants of both the wildlife parks.

differed by location. For example, 44.5% ($n = 143$) of participants in Schorfheide knew that moose are present in Germany while only 19.4% ($n = 52$) of participants in Springe thought so. The only question where the correct answer differed between the two wildlife parks was the one regarding the current distribution status of moose in the state where each wildlife park is located in. As there is a small moose population in Berlin Brandenburg currently, the correct answer to this question (Are there currently any free living moose in Berlin and Brandenburg?) for participants in Schorfheide is 'yes', while for the participants in Springe the correct answer to the question (Are there currently any free living moose in Lower Saxony?) is 'no', as there are currently no free living moose in Lower Saxony. In Schorfheide, 28.7% ($n = 92$) chose the correct answer 'yes', while in Springe 72.0% ($n = 193$) chose the correct answer 'no'.

A high percentage of participants left the remaining questions of the knowledge section unanswered for bison and moose, which contributed to an overall lower score for these species. The majority of participants in both wildlife parks (Schorfheide: 58.9%, $n = 189$; Springe: 53.7%, $n = 144$) thought that the wolf had recently returned to Germany (within the last 10 years), while the correct answer was more than 10 years ago (Schorfheide: 38.3%, $n = 123$; Springe: 40.3%, $n = 108$). Only 9.3% ($n = 30$) of the participants in Schorfheide and 13.8% ($n = 37$) in Springe answered correctly that there are more than 600 wolves in Germany at present. Most of the people assumed that there were fewer than 300 wolves in Germany (Schorfheide: 52.3%, $n = 168$; Springe: 42.5%, $n = 114$). The majority of participants (Schorfheide: 69.8%, $n = 224$; Springe: 65.7%, $n = 176$) knew correctly that the wolves have immigrated naturally into Germany from neighbouring countries. A similar share of participants in both wildlife parks (Schorfheide: 26.5%, $n = 85$; Springe: 28.0%, $n = 75$), knew that the bison currently residing in Germany were actively reintroduced by humans. While 38.9% ($n = 125$) of participants in Schorfheide knew that moose immigrated naturally into Germany from neighbouring countries, only 13.4% ($n = 36$) in Springe answered this question correctly. The majority of participants assumed that there were currently no moose in Germany. More than 60% of participants in both wildlife parks knew that bison (Schorfheide: 61.7%, $n = 198$; Springe: 68.3%, $n = 183$) and moose (Schorfheide: 61.1%, $n = 196$; Springe: 65.7%, $n = 176$) mainly feed on wild plants. The majority of participants assumed that wolves mainly feed on smaller wild animals (Schorfheide: 29.3%, $n = 94$; Springe: 32.1% $n = 86$), and some participants responded that wolves feed on domestic animals (Schorfheide: 15.3%, $n = 49$; Springe: 18.7%, $n = 50$), while the correct answer was larger wild animals (Schorfheide: 27.1%, $n = 87$; Springe: 25.4%, $n = 68$) such as wild boar *Sus scrofa* or deer (mostly *Capreolus capreolus*, *Cervus elaphus*, and *Dama dama*). Overall, the participants in Springe knew more about bison, while the participants in Schorfheide scored more points with regard to moose (Figure 2). The participants in both wildlife parks had significantly greater knowledge about wolves compared to the other two species (Kruskal-Wallis Test: $W = 439.9$; df = 2; $p < 0.001$).

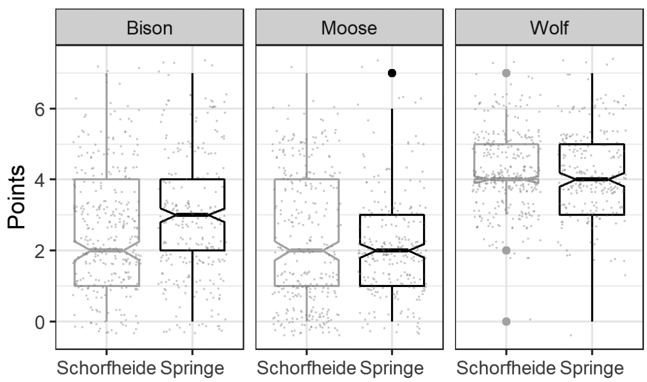

FIGURE 2 Boxplots showing the distribution of knowledge points (number of correct answers in the animal quiz: Maximum of 7 points for each species) for bison, moose, and wolf achieved by participants in the two wildlife parks Schorfheide and springe. The small, jittered points depict the raw data.

The backward selection approach indicated that the best model to explain knowledge of bison included the location of the wildlife park only (Table 2). Compared to participants in Schorfheide, participants in Springe had greater knowledge of bison. The next ranked model (ΔAIC = 1.8) additionally included gender. Based on a goodness of fit test with the residual deviance, the selected model did not fit observed data well ($p < 0.001$). To explain the knowledge of moose, model selection indicated that the park location and the degree of urbanization were influential (Table 2).

TABLE 2 Regression coefficient estimates, associated 95% confidence intervals (LL = lower limit; UL = upper limit), standard errors (*SE*) and *p*-values of generalized linear models explaining variation in knowledge of bison, moose and wolf among participants in the wildlife parks Schorfheide and Springe

	Estimate	LL	UL	*SE*	*p*-value
Bison					
Intercept	0.946	0.868	1.023	0.040	<0.001
Springe (vs. Schorfheide)	0.109	−0.004	0.222	0.058	0.059
Moose					
Intercept	0.923	0.740	1.107	0.094	<0.001
Springe (vs. Schorfheide)	−0.112	−0.263	0.040	0.077	0.150
Rather rural (vs. rural)	−0.021	−0.208	0.165	0.095	0.823
Rather urban (vs. rural)	0.025	−0.203	0.253	0.116	0.830
Urban (vs. rural)	−0.244	−0.447	−0.041	0.103	0.018
Wolf					
Intercept	1.453	1.430	1.476	0.012	<0.001

Participants in Schorfheide had greater knowledge of moose than those in Springe and participants who lived in urban settings scored significantly fewer knowledge points than those who reportedly lived in a rural setting. Similar to the bison knowledge model, the next best competing model (ΔAIC = 0.4) additionally included gender. Goodness of fit test also suggested poor fit to the data ($p < 0.001$). With regards to knowledge of wolves, none of the tested variables produced a significant signal (Table 2). Like the models for bison and moose, the second most supported model to explain participants' knowledge of wolves (ΔAIC = 1.6) contained gender as an additional variable.

3.3 | Participation interest in citizen science and attractive activities

More participants in Schorfheide (22.1% = 71) had previously heard of the term 'citizen science' than in Springe (16.4% = 44; Figure 3a).

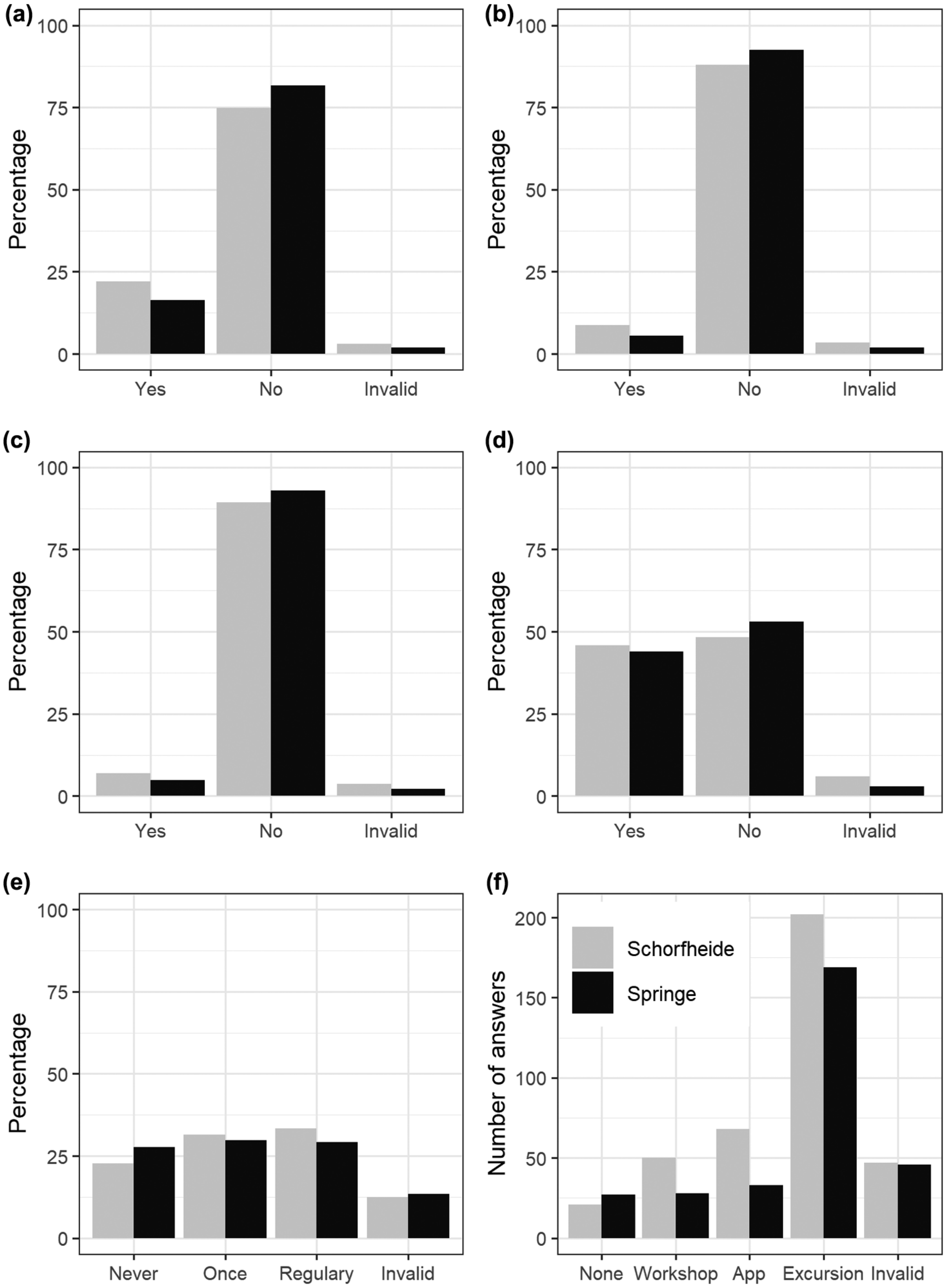

FIGURE 3 Knowledge and interest of wildlife park visitors in citizen science: (a) Have you ever heard the term 'citizen science' before? (b) have you ever participated in a CS project? (c) are you currently taking part in CS projects? (d) would you be interested to take part in a CS project? (e) how often would you want to take part in CS projects? (f) which format is the most interesting for you? Responses to (a)–(e) are on a percentage scale; due to multiple possible answers, we provide the absolute number of responses for (f).

TABLE 3 Regression coefficient estimates, associated 95% confidence intervals (LL = lower limit; UL = upper limit), standard errors (*SE*) and *p*-values of a logistic regression model, testing the likelihood of willingness among participants in the wildlife parks springe and Schorfheide to participate in a citizen science project. To predict effect sizes, we converted regression coefficients to odds ratios (OR)

	Estimate	LL	UL	*SE*	*z*-value	*p*-value	OR	OR LL	OR UL
Intercept	−0.01	−0.78	0.77	0.39	−0.03	0.98			
Age 25 to 29 (vs. under 24)	−0.75	−1.62	0.10	0.44	−1.72	0.09	0.47	0.20	1.10
Age 30 to 39 (vs. under 24)	−0.38	−1.06	0.29	0.34	−1.10	0.27	0.68	0.35	1.34
Age 40 to 49 (vs. under 24)	−0.44	−1.11	0.21	0.34	−1.31	0.19	0.64	0.33	1.23
Age 50 to 59 (vs. under 24)	−0.50	−1.22	0.20	0.36	−1.39	0.16	0.61	0.30	1.22
Age 60+ (vs. under 24)	−1.47	−2.30	−0.68	0.41	−3.56	0.00	0.23	0.10	0.51
Knowledge of wildlife	0.05	−0.01	0.12	0.03	1.76	0.08	1.06	0.99	1.12

Similarly, more participants in Schorfheide reported having taken part in (Figure 3b) or to currently participate (Figure 3c) in a CS project than participants in Springe. A little fewer than half of the participants in both parks answered that they were interested in participating in a CS project (Figure 3d), and more than half could imagine participating if one-time occasions were included (Figure 3e). Participants in both parks considered a field trip with a group, followed by a smartphone app and workshops (Figure 3f) as the most interesting format.

As we were particularly interested in the willingness of visitors to participate in CS projects, we further analysed if sociodemographic variables and knowledge about wildlife were associated with such willingness. The backward selection approach indicated that the model which only included the age and the knowledge level of the participants explained their willingness to participate in CS activities best (Table 3). The next best competing model ($\Delta AIC = 1.4$) additionally included wildlife park location. The chi-square value of 18.33 with 6 degrees of freedom and an associated *p*-value of 0.005 indicates that this model fits significantly better than an intercept only model. When looking at the age variable, participants above 60 years of age were four times less likely to participate in a CS project than participants younger than 24 years of age (odds ratio 0.23; 95% CI: 0.10–0.51). Participants in other age groups were also less likely to participate in CS projects than those below 24 years of age but not significantly so. For each additional point that participants scored in the animal quiz, they were about 6% more likely (odds ratio 1.06; 95% CI: 0.99–1.12) to participate in a CS project (Table 3).

4 | DISCUSSION

The questionnaire was designed to evaluate the visitors' level of knowledge about the three target species (bison, moose and wolf). In addition, a section specifically addressing CS was included to evaluate respondents' willingness to participate in CS projects, as well as which formats would be preferred. Not only was the questionnaire carried out in wildlife parks, where a potential positive bias towards a greater interest for wildlife was expected, but visitors were also informed that the entire questionnaire would take more than 10 min. Thus, the participants were likely to be people who had a strong enough motivation to dedicate their leisure time to wildlife-related topics.

4.1 | State of knowledge regarding returning wildlife species

Our results showed that knowledge about wolves was particularly high among participants (Figure 2), likely reflecting not only the relatively high abundance and longer residence time of wolves (Reinhardt et al., 2019) but possibly also their perceived presence in people's minds, relative to bison and moose in this case (Arbieu et al., 2019; Hermann et al., 2013; Hermann & Menzel, 2013; Randler et al., 2020; Treves et al., 2013). As a 'livestock killer' and competitor for game (Gosling et al., 2019; Mech, 2012), wolves have been in the spotlight of human history. This is underlined by numerous reports on wolf attacks that have accumulated for centuries in many parts of the world (Linnell et al., 2002). In addition to human-carnivore conflicts being reported more frequently and dramatically (Bombieri et al., 2018; Bornatowski et al., 2019; Penteriani et al., 2016; Rode et al., 2021), the high cultural salience of wolves leads to increased media exposure (Delibes-Mateos, 2020). Although this has not been a focus of our study, we acknowledge that media—or more precisely the way how species are represented in media—plays an important role in how the species are perceived by the public (Pernat et al., 2022; Schakner et al., 2019).

The higher score of moose knowledge among visitors to Schorfheide (compared to Springe; Figure 2) could indicate that the wildlife parks also reflect the local context in the presentation of their animals and potential exposure of visitors to the species: moose are occasionally sighted in Eastern Germany (Brandenburg state)—in areas relatively close to potential source populations of moose in western Poland. In contrast, moose are basically absent in states further west (Janik et al., 2021). Visitors in Springe scored higher in the bison part of the quiz, potentially because the bison was one of the highlighted species in this park. Also, visitors residing in rural or rather rural areas scored significantly higher for the moose part of the animal quiz compared to visitors living in urban or rather urban areas, which also supports the hypothesis that greater exposure to the species can result in higher knowledge (Arbieu et al., 2019; Tomaselli et al., 2018; Wojciechowski et al., 2021). Indicated by the goodness of fit tests, the models to explain knowledge about moose and bison did not fit the data well. This suggests that there could be other influential factors that were not either not included in the questionnaire or could not be included for the analysis. For example, we were not able to include variables such as 'formal education', 'occupation' and 'income', due to low response rates. In addition, we suspect that knowledge in specific wildlife species may be difficult to predict with coarse variables (such as age or gender) and may rather reflect individual interests.

4.2 | Willingness to participate in citizen science

Except for the age group between 25 and 29 years, the younger the participants the more they were motivated to take part in CS activities related to the conservation of the three target species. Overall, this matches other findings showing that the young generation has high interest in wildlife conservation, natural resource management and other environmental issues such as climate change (George et al., 2016; Giachino et al., 2021), as well as generally more positive environmental attitudes (Salman et al., 2020). With this emerging trend of higher environmental awareness in the younger generation and youth environmental activism such as #FridaysForFuture, multiple studies have tried to determine what triggers the motivation of youth to engage in these activities (Haugestad et al., 2021; Shafiei & Maleksaeidi, 2020). A study in Thailand on youth's motivation for voluntary participation in water onion (*Crinum thaianum* J. Schulze) conservation examined several factors such as demographic background, intrinsic and extrinsic motivation and ideal effort (conservation effort of closely related person), and found that pro-nature intrinsic motivation had the largest effect on participation (Athihirunwong et al., 2018). Other studies listed self-motivation, influence by peers and social expectations (Leyshon et al., 2021) as well as responsibility for climate change, necessity for shared action to mitigate it and collective identity (Haugestad et al., 2021) as factors that motivated the youth to engage in conservation and environmental actions.

The integration of environmental and biological conservation subjects in formal education continues to be of importance (Grace & Ratcliffe, 2002) as the students will be the generation that has to deal with the environmental challenges including the severe loss of biodiversity (Soanes et al., 2020). CS can be a promising additional approach, as youth-focused CS activities not only increase pupils' understanding of the subject but also improves scientific thinking (Trumbull et al., 1999) and positively affects their families and communities (Maund et al., 2020), sometimes even leading to improved local habitat management (Ballard et al., 2017). As participation in CS activities enhances youth engagement in current conservation actions, integrating it into the current educational system could lead to a positive feedback loop increasing the environmental awareness of the young people.

However, the interest in citizen science demonstrated by younger age groups contrasts with findings on the demographic background of the participants of environmental citizen science projects. Many studies find participants to be over 50 years old independent of the structure of the project (Larson et al., 2020; Merenlender et al., 2016; Pateman et al., 2021). The contrasting result here may be due to the response options provided in the questionnaire on citizen science activities: excursions, smartphone app or workshops. All three options might present barriers for senior age groups, e.g. a (possibly) strenuous field trip, a time-consuming workshop or the handling of an unknown technology (Vasiliades et al., 2021), especially when specific information on the future design of the programme is lacking. The possible enthusiasm about the wildlife park visit that prevailed when filling out the questionnaire, as well as the leisure time capacity of the younger respondents might also have led to a positive attitude towards CS activities.

The results of this study broadly confirmed the hypothesis that citizens who have a higher species knowledge level are more likely to participate in conservation-oriented actions. This is in line with a study conducted prior to the restoration project of free-ranging bison in North Rhine-Westphalia, Germany, where residents with a higher knowledge level of the species were more willing to support the project (Decker et al., 2010). Broadening the scope, general environmental knowledge also plays an important role, specifically in increasing the readiness to participate in CS activities (Bonney et al., 2016; Haywood et al., 2016) and some scholars have analysed the type of knowledge which had direct effects on individual conservation behaviour (Frick et al., 2004). Again, these effects were seen at early stages of education, such as a case in Slovenia, which showed that children with better general knowledge of ecology placed more importance on conservation issues (Torkar & Krašovec, 2019). It should also be noted, that citizens repeatedly named 'knowledge improvement' as their motivation to participate in CS projects (Land-Zandstra et al., 2016; Larson et al., 2020; Merenlender et al., 2016), indicating that 'positive attitude' and 'knowledge' are interlinked. While this can be seen as a positive feedback loop (higher knowledge leading to more willingness to participate, and participation in CS projects leading to knowledge gain), this knowledge—CS relationship could possibly also be a barrier for people to engage in CS projects. Therefore it is important to work on both ends: increase the integration of environmental studies into formal education and increase the knowledge level of the wide public, and at the same time design conservation-oriented CS projects attractive to a wider audience. In other words, it is important to make the step of transforming motivation into action as easy as possible (Nolan, 2010). CS projects designed to have low barriers and a variety of activities may be most effective at bridging the intent-action gap (Ostermann-Miyashita et al., 2019).

5 | CONCLUSION

The results of this study suggest that wildlife park visitors in Germany are better informed about the wolf compared to the bison or moose. Perhaps, this is not only due to longer residence time of the species but may also reflect the fact that carnivore-human conflicts are more frequently reported than human-herbivore conflicts. As the 'returning wolf' is often a highly emotional and political issue causing polarization in most debates, it is crucial to communicate research-based evidence and facts transparently to the public. For the two herbivores, this could be achieved by informing and preparing the public about both the positive effects as well as the negative interactions. Overall, CS could complement the toolbox to mitigate the consequences of wildlife restoration efforts on human-wildlife conflicts by raising awareness and actively including citizens in wildlife research and management.

Since higher exposure typically leads to a higher knowledge about a species, CS could reverse the trend of urban residents losing their connection to nature (Clayton et al., 2017), by providing opportunities for citizens to get involved in conservation activities. For the recruitment of citizen scientists, this study indicates a high potential for doing so at wildlife parks. Thus, we recommend research institutes and CS initiatives utilize these wildlife facilities and their networks to enhance cooperation for conservation activities.

In our study, the young generation had the highest motivation to participate in CS activities, reflecting their genuine interest and engagement in environmental activities. As educational programs have shown to increase interest and promote participation in environmental and conservation activities, this can lead to a positive feedback loop. While this can and should be utilized to foster an environmentally aware generation, CS is open to all generations and encourages interactions between different social groups. Therefore, it is important to regard an inclusive and user-friendly format while designing a CS project, in order to fulfil this promise.

ACKNOWLEDGEMENTS

This study was financially supported by the Marianne und Dr Fritz Walter Fischer foundation, Japanese Student Services Organization (JASSO) and the Leibniz Centre for Agricultural Landscape Research. This paper has also been supported by the EU InterReg project INT144 'LosBonasus – Crossing! Improving transboundary wildlife management for European bison and moose'. We express our thanks to the staff of Wildpark Schorfheide led by Ms. Imke Heyter and of Wisentgehege Springe led by Mr Thomas Hennig for their cooperation and assistance in conducting the survey. We express special thanks to Dr Stephan Wirth for reviewing and approving the questionnaire protocol and to Mr Azby Brown for language revision. We also express our thanks to the reviewers and editors who invested their professional knowledge and supplied many constructive advice and suggestions to add a holistic view and greatly improved the manuscript. Open Access funding enabled and organized by Projekt DEAL. WOA Institution: N/A Consortia Name : Projekt DEAL

CONFLICT OF INTEREST

None to declare: There have been no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

The date are archived on dryad as an Excel file and can be found at 10.5061/dryad.bvq83bkc2.

AUTHORS' CONTRIBUTIONS

E.-F.O.-M. Conceptualization, methodology, formal analysis, investigation, writing—original draft and visualization; H.J.K. Conceptualization, methodology, resources, writing—review and editing, supervision, project administration and funding acquisition; N.P. Methodology and writing—review and editing; S.D.B.-K. Writing—review and editing and supervision; S.H. Writing—review and editing; C.K. Methodology, formal analysis, writing—original draft, writing—review and editing and supervision.

ORCID

Emu-Felicitas Ostermann-Miyashita https://orcid.org/0000-0002-5270-5737
Hannes J. König https://orcid.org/0000-0002-4980-7388
Nadja Pernat https://orcid.org/0000-0003-2244-1002
Sonoko Dorothea Bellingrath-Kimura https://orcid.org/0000-0001-7392-7796
Sophia Hibler https://orcid.org/0000-0003-0704-0729
Christian Kiffner https://orcid.org/0000-0002-7475-9023

REFERENCES

Anhalt-Depies, C., Stenglein, J. L., Zuckerberg, B., Townsend, P. A., & Rissman, A. R. (2019). Tradeoffs and tools for data quality, privacy, transparency, and trust in citizen science. *Biological Conservation*, *238*, 108195.

Arbieu, U., Helsper, K., Dadvar, M., Mueller, T., & Niamir, A. (2021). Natural language processing as a tool to evaluate emotions in conservation conflicts. *Biological Conservation*, *256*, 109030.

Arbieu, U., Mehring, M., Bunnefeld, N., Kaczensky, P., Reinhardt, I., Ansorge, H., Böhning-Gaese, K., Glikman, J. A., Kluth, G., Nowak, C., & Müller, T. (2019). Attitudes towards returning wolves (*Canis lupus*) in Germany: Exposure, information sources and trust matter. *Biological Conservation*, *234*, 202–210.

Athihirunwong, N., Janekarnkij, P., & Sanglestsawai, S. (2018). Understanding youth motivation for water onion (*Crinum thaianum* J. Schulze) conservation in Thailand. *Kasetsart Journal of Social Sciences*, *39*(1), 42–50.

Ballantyne, R., Hughes, K., Lee, J., Packer, J., & Sneddon, J. (2018). Visitors' values and environmental learning outcomes at wildlife attractions: Implications for interpretive practice. *Tourism Management*, *64*, 190–201.

Ballard, H. L., Dixon, C. G. H., & Harris, E. M. (2017). Youth-focused citizen science: Examining the role of environmental science learning and agency for conservation. *Biological Conservation*, *208*, 65–75.

Beach, D. M., & Clark, D. A. (2015). Scenario planning during rapid ecological change: Lessons and perspectives from workshops with Southwest Yukon wildlife managers. *Ecology and Society*, *20*(1), 26269748.

Bencin, H., Kioko, J., & Kiffner, C. (2016). Local people's perceptions of wildlife species in two distinct landscapes of northern Tanzania. *Journal for Nature Conservation*, *34*, 82–92.

Bird, T. J., Bates, A. E., Lefcheck, J. S., Hill, N. A., Thomson, R. J., Edgar, G. J., Stuart-Smith, R. D., Wotherspoon, S., Krkosek, M., Stuart-Smith, J. F., Pecl, G. T., Barrett, N., & Frusher, S. (2014). Statistical solutions for error and bias in global citizen science datasets. *Biological Conservation*, *173*, 144–154.

Bleyhl, B., Sipko, T., Trepet, S., Bragina, E., Leitão, P. J., Radeloff, V. C., & Kuemmerle, T. (2015). Mapping seasonal European bison habitat in the Caucasus Mountains to identify potential reintroduction sites. *Biological Conservation*, *191*, 83–92.

Bombieri, G., Nanni, V., Delgado, M. d. M., Fedriani, J. M., López-Bao, J. V., Pedrini, P., & Penteriani, V. (2018). Content analysis of media reports on predator attacks on humans: Toward an understanding of human risk perception and predator acceptance. *Bioscience*, *68*(8), 577–584.

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: A developing tool for expanding science knowledge and scientific literacy. *Bioscience*, *59*(11), 977–984.

Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science*, *25*(1), 2–16.

Bornatowski, H., Hussey, N. E., Sampaio, C. L. S., & Barreto, R. R. P. (2019). Geographic bias in the media reporting of aquatic versus terrestrial human predator conflicts and its conservation implications. *Perspectives in Ecology and Conservation*, *17*(1), 32–35.

Borowik, T., Ratkiewicz, M., Maślanko, W., Duda, N., Rode, P., & Kowalczyk, R. (2018). Living on the edge – The predicted impact of renewed hunting on moose in national parks in Poland. *Basic and Applied Ecology*, *30*, 87–95.

Borowik, T., Ratkiewicz, M., Maślanko, W., Kowalczyk, R., Duda, N., & Żmihorski, M. (2021). Temporal pattern of moose-vehicle collisions. *Transportation Research Part D: Transport and Environment*, *92*(92), 102715.

Botha, E., Kruger, M., & Viljoen, A. (2021). Enhancing the interpretation at the National Zoological Gardens in South Africa. *Journal of Outdoor Recreation and Tourism*, *33*, 100362.

Boulet, M., Borg, K., Faulkner, N., & Smith, L. (2021). Evenly split: Exploring the highly polarized public response to the use of lethal methods to manage overabundant native wildlife in Australia. *Journal for Nature Conservation*, *61*, 125995.

Brown, A., Pieter, F., Bonner, S., Dolezal, N., & Moross, J. (2016). Safecast: Successful citizen-science for radiation measurement and communication after Fukushima. *Society for Radiological Protection*, *36*, S82–S101.

Brown, G., McAlpine, C., Rhodes, J., Lunney, D., Goldingay, R., Fielding, K., Hetherington, S., Hopkins, M., Manning, C., Wood, M., Brace, A., & Vass, L. (2018). Assessing the validity of crowdsourced wildlife observations for conservation using public participatory mapping methods. *Biological Conservation*, *227*, 141–151.

Camill, P., Kothari, A., & Brown, J. (2013). Conservation as if people also mattered: Policy and practice of community-based conservation. *Conservation and Society*, *11*(1), 1.

Carpio, A. J., Apollonio, M., & Acevedo, P. (2020). Wild ungulate overabundance in Europe: Contexts, causes, monitoring and management recommendations. *Mammal Review*, *51*(1), 95–108.

Ceausu, S., Graves, R. A., Killion, A. K., Svenning, J. C., & Carter, N. H. (2018). Governing trade-offs in ecosystem services and disservices to achieve human-wildlife coexistence. *Conservation Biology*, *33*(3), 543–553.

Cepic, M., Bechtold, U., & Wilfing, H. (2022). Modelling human influences on biodiversity at a global scale – A human ecology perspective. *Ecological Modelling*, *465*, 465.

Churski, M., Spitzer, R., Coissac, E., Taberlet, P., Lescinskaite, J., van Ginkel, H. A. L., Kuijper, D. P. J., & Cromsigt, J. P. G. M. (2021). How do forest management and wolf space-use affect diet composition of the wolf's main prey, the red deer versus a non-prey species, the European bison? *Forest Ecology and Management*, *479*, 118620.

Clayton, S., Colléony, A., Conversy, P., Maclouf, E., Martin, L., Torres, A.-C., Truong, M.-X., & Prévot, A.-C. (2017). Transformation of experience: Toward a new relationship with nature. *Conservation Letters*, *10*(5), 645–651.

Commodore, A., Wilson, S., Muhammad, O., Svendsen, E., & Pearce, J. (2017). Community-based participatory research for the study of air pollution: A review of motivations, approaches, and outcomes. *Environmental Monitoring and Assessment*, *189*(8), 378.

Corlett, R. T. (2016). Restoration, reintroduction, and rewilding in a changing world. *Trends in Ecology & Evolution*, *31*(6), 453–462.

Crall, A. W., Jordan, R., Holfelder, K., Newman, G. J., Graham, J., & Waller, D. M. (2013). The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy. *Public Understanding of Science*, *22*(6), 745–764.

Cruz-Garcia, G. S., Vanegas Cubillos, M., Torres-Vitolas, C., Harvey, C. A., Shackleton, C. M., Schreckenberg, K., Willcock, S., Navarrete-Frías, C., & Sachet, E. (2019). He says, she says: Ecosystem services and gender among indigenous communities in the Colombian Amazon. *Ecosystem Services*, *37*, 100921.

Darimont, C. T., Paquet, P. C., Treves, A., Artelle, K. A., & Chapron, G. (2018). Political populations of large carnivores. *Conservation Biology*, *32*(3), 747–749.

Decker, S. E., Bath, A. J., Simms, A., Lindner, U., & Reisinger, E. (2010). The return of the king or bringing snails to the garden? The human dimensions of a proposed restoration of European bison (*Bison bonasus*) in Germany. *Restoration Ecology*, *18*(1), 41–51.

Delibes-Mateos, M. (2020). Wolf Media coverage in the region of Castilla y Leon (Spain): Variations over time and in two contrasting socio-ecological settings. *Animals (Basel)*, *10*(4), 736.

Dickinson, J. L., Zuckerberg, B., & Bonter, D. N. (2010). Citizen science as an ecological research tool: Challenges and benefits. *Annual Review of Ecology, Evolution, and Systematics*, *41*(1), 149–172.

Dictionary, C. E. (2022). *Definition of 'wildlife park'*. Collins English Dictionary, HarperCollins Publishers.

Echeverri, A., Karp, D. S., Naidoo, R., Zhao, J., & Chan, K. M. A. (2018). Approaching human-animal relationships from multiple angles: A synthetic perspective. *Biological Conservation*, *224*, 50–62.

Ecoclub Amphibian Group, Pope, K. L., Wengert, G. M., Foley, J. E., Ashton, D. T., & Botzler, R. G. (2016). Citizen scientists monitor a deadly fungus threatening amphibian communities in northern coastal California, USA. *Journal of Wildlife Diseases*, *52*(3), 516–523.

Farhadinia, M. S., Moll, R. J., Montgomery, R. A., Ashrafi, S., Johnson, P. J., Hunter, L. T. B., & Macdonald, D. W. (2018). Citizen science data facilitate monitoring of rare large carnivores in remote montane landscapes. *Ecological Indicators*, *94*, 283–291.

Ferreira, M. A., Barrio Froján, C., Gunn, V., & Johnson, D. E. (2022). A role for UNEP's regional seas Programme under the post-2020 global biodiversity framework. *Marine Policy*, *136*, 104930.

Follett, R., & Strezov, V. (2015). An analysis of citizen science based research: Usage and publication patterns. *PLoS ONE*, *10*(11), e0143687.

Forrester, T. D., Baker, M., Costello, R., Kays, R., Parsons, A. W., & McShea, W. J. (2017). Creating advocates for mammal conservation through citizen science. *Biological Conservation*, *208*, 98–105.

Frick, J., Kaiser, F. G., & Wilson, M. (2004). Environmental knowledge and conservation behavior: Exploring prevalence and structure in a representative sample. *Personality and Individual Differences*, *37*(8), 1597–1613.

Frigerio, D., Pipek, P., Kimmig, S., Winter, S., Melzheimer, J., Diblíková, L., Wachter, B., Richter, A., & Bshary, R. (2018). Citizen science and wildlife biology: Synergies and challenges. *Ethology*, *124*(6), 365–377.

Fukano, Y., Tanaka, Y., & Soga, M. (2020). Zoos and animated animals increase public interest in and support for threatened animals. *Sci Total Environ*, *704*, 135352.

Galloway, A. W. E., Hickey, R. J., & Koehler, G. M. (2011). A survey of ungulates by students along rural school bus routes. *Society & Natural Resources*, *24*(2), 201–204.

Gandl, N. (2020). *Der Elch ist zurück in Deutschland*. W. Germany.

George, K. A., Slagle, K. M., Wilson, R. S., Moeller, S. J., & Bruskotter, J. T. (2016). Changes in attitudes toward animals in the United States from 1978 to 2014. *Biological Conservation*, *201*, 237–242.

Giachino, C., Pattanaro, G., Bertoldi, B., Bollani, L., & Bonadonna, A. (2021). Nature-based solutions and their potential to attract the young generations. *Land Use Policy*, *101*, 105176.

Gosling, E., Bojarska, K., Gula, R., & Kuehn, R. (2019). Recent arrivals or established tenants? History of wolf presence influences attitudes toward the carnivore. *Wildlife Society Bulletin*, *43*(4), 639–650.

Grace, M. M., & Ratcliffe, M. (2002). The science and values that young people draw upon to make decisions about biological conservation issues. *International Journal of Science Education*, *24*(11), 1157–1169.

Hacker, C. E., & Miller, L. J. (2016). Zoo visitor perceptions, attitudes, and conservation intent after viewing African elephants at the San Diego Zoo Safari Park. *Zoo Biology*, *35*(4), 355–361.

Haugestad, C. A. P., Skauge, A. D., Kunst, J. R., & Power, S. A. (2021). Why do youth participate in climate activism? A mixed-methods investigation of the #FridaysForFuture climate protests. *Journal of Environmental Psychology*, *76*, 101647.

Haywood, B. K., & Besley, J. C. (2014). Education, outreach, and inclusive engagement: Towards integrated indicators of successful program outcomes in participatory science. *Public Understanding of Science*, *23*(1), 92–106.

Haywood, B. K., Parrish, J. K., & Dolliver, J. (2016). Place-based and data-rich citizen science as a precursor for conservation action. *Conservation Biology*, *30*(3), 476–486.

Hermann, N., & Menzel, S. (2013). Threat perception and attitudes of adolescents towards re-introduced wild animals: A qualitative study of young learners from affected regions in Germany. *International Journal of Science Education*, *35*(18), 3062–3094.

Hermann, N., Voß, C., & Menzel, S. (2013). Wildlife value orientations as predicting factors in support of reintroducing bison and of wolves migrating to Germany. *Journal for Nature Conservation*, *21*(3), 125–132.

Hindrikson, M., Remm, J., Pilot, M., Godinho, R., Stronen, A. V., Baltrunaite, L., Czarnomska, S. D., Leonard, J. A., Randi, E., Nowak, C., Akesson, M., Lopez-Bao, J. V., Alvares, F., Llaneza, L., Echegaray, J., Vila, C., Ozolins, J., Rungis, D., Aspi, J., … Saarma, U. (2017). Wolf population genetics in Europe: A systematic review, meta-analysis and suggestions for conservation and management. *Biological Reviews of the Cambridge Philosophical Society*, *92*(3), 1601–1629.

Imbulana Arachchi, J., & Managi, S. (2021). Preferences for energy sustainability: Different effects of gender on knowledge and importance. *Renewable and Sustainable Energy Reviews*, *141*, 110767.

Isaac, N. J. B., Strien, A. J., August, T. A., Zeeuw, M. P., Roy, D. B., & Anderson, B. (2014). Statistics for citizen science: Extracting signals of change from noisy ecological data. *Methods in Ecology and Evolution*, *5*(10), 1052–1060.

Isbell, F., Gonzalez, A., Loreau, M., Cowles, J., Diaz, S., Hector, A., Mace, G. M., Wardle, D. A., O'Connor, M. I., Duffy, J. E., Turnbull, L. A., Thompson, P. L., & Larigauderie, A. (2017). Linking the influence and dependence of people on biodiversity across scales. *Nature*, *546*(7656), 65–72.

Janik, T., Peters, W., Salek, M., Romportl, D., Jirku, M., Engleder, T., Ernst, M., Neudert, J., & Heurich, M. (2021). The declining occurrence of moose (*Alces alces*) at the southernmost edge of its range raise conservation concerns. *Ecology and Evolution*, *11*(10), 5468–5483.

Jasińska, K. D., Żmihorski, M., Krauze-Gryz, D., Kotowska, D., Werka, J., Piotrowska, D., Pärt, T., & Cadotte, M. (2019). Linking habitat composition, local population densities and traffic characteristics to spatial patterns of ungulate-train collisions. *Journal of Applied Ecology*, *56*(12), 2630–2640.

Jiren, T. S., Riechers, M., Kansky, R., & Fischer, J. (2021). Participatory scenario planning to facilitate human-wildlife coexistence. *Conservation Biology*, *35*(6), 1957–1965.

Jordt, A. M., Lange, M., Kramer-Schadt, S., Nielsen, L. H., Nielsen, S. S., Thulke, H. H., Vejre, H., & Alban, L. (2016). Spatio-temporal modeling of the invasive potential of wild boar – A conflict-prone species-using multi-source citizen science data. *Preventive Veterinary Medicine*, *124*, 34–44.

Jung, T. S. (2020). Investigating local concerns regarding large mammal restoration: Group size in a growing population of reintroduced bison (*Bison bison*). *Global Ecology and Conservation*, *24*, e01303.

Kaltenborn, B. P., & Linnell, J. D. C. (2022). The coexistence potential of different wildlife conservation frameworks in a historical perspective. *Frontiers in Conservation Science*, *2*, 2.

Kansky, R., Kidd, M., & Fischer, J. (2021). Understanding drivers of human tolerance towards mammals in a mixed-use transfrontier conservation area in southern Africa. *Biological Conservation*, *254*, 108947.

Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge University Press.

Kauffman, M., Peck, D., Scurlock, B., Logan, J., Robinson, T., Cook, W., Boroff, K., & Schumaker, B. (2016). Risk assessment and management of brucellosis in the southern greater Yellowstone area (I): A citizen-science based risk model for bovine brucellosis transmission from elk to cattle. *Preventive Veterinary Medicine*, *132*, 88–97.

Keeping, D., Burger, J. H., Keitsile, A. O., Gielen, M.-C., Mudongo, E., Wallgren, M., Skarpe, C., & Foote, A. L. (2018). Can trackers count free-ranging wildlife as effectively and efficiently as conventional aerial survey and distance sampling? Implications for citizen science in the Kalahari, Botswana. *Biological Conservation*, *223*, 156–169.

Kelling, S., Johnston, A., Bonn, A., Fink, D., Ruiz-Gutierrez, V., Bonney, R., Fernandez, M., Hochachka, W. M., Julliard, R., Kraemer, R., & Guralnick, R. (2019). Using Semistructured surveys to improve citizen science data for monitoring biodiversity. *Bioscience*, *69*(3), 170–179.

Kiffner, C., Chapron, G., & König, H. J. (2019). Germany's wolves in the crosshairs. *Science*, *365*(6458), 1089.

König, H. J., Ceaușu, S., Reed, M., Kendall, H., Hemminger, K., Reinke, H., Ostermann-Miyashita, E. F., Wenz, E., Eufemia, L., Hermanns, T., Klose, M., Spyra, M., Kuemmerle, T., & Ford, A. T. (2021). Integrated framework for stakeholder participation: Methods and tools for identifying and addressing human–wildlife conflicts. *Conservation Science and Practice*, *3*(3), e399.

König, H. J., Kiffner, C., Kramer-Schadt, S., Furst, C., Keuling, O., & Ford, A. T. (2020). Human-wildlife coexistence in a changing world. *Conservation Biology*, *34*(4), 786–794.

Koziarski, A., Kissui, B., & Kiffner, C. (2016). Patterns and correlates of perceived conflict between humans and large carnivores in northern Tanzania. *Biological Conservation*, *199*, 41–50.

Kremen, C., & Merenlender, A. M. (2018). Landscapes that work for biodiversity and people. *Science*, *362*(6412), eaau6020. https://doi.org/10.1126/science.aau6020

Land-Zandstra, A. M., Devilee, J. L., Snik, F., Buurmeijer, F., & van den Broek, J. M. (2016). Citizen science on a smartphone: Participants' motivations and learning. *Public Understanding of Science*, *25*(1), 45–60.

Larson, L. R., Cooper, C. B., Futch, S., Singh, D., Shipley, N. J., Dale, K., LeBaron, G. S., & Takekawa, J. Y. (2020). The diverse motivations of citizen scientists: Does conservation emphasis grow as volunteer participation progresses? *Biological Conservation*, *242*, 108428.

Lewandowski, E., & Specht, H. (2015). Influence of volunteer and project characteristics on data quality of biological surveys. *Conservation Biology*, *29*(3), 713–723.

Leyshon, M., Leyshon, C., Walker, T., & Fish, R. (2021). More than sweat equity: Young people as volunteers in conservation work. *Journal of Rural Studies*, *81*, 78–88.

Liebenberg, L., Steventon, J., Brahman, N., Benadie, K., Minye, J., Langwane, H., & Xhukwe, Q. (2017). Smartphone icon user Interface design for non-literate trackers and its implications for an inclusive citizen science. *Biological Conservation*, *208*, 155–162.

Linnell, J. D., Andersen, R., Andersone, Ž., Balčiauskas, L., Blanco, J. C., Boitani, L., Brainerd, S. M., Breitenmoser, U., Kojola, I., Liberg, O., Loe, J., Okarma, H., Pedersen, H. C., Sand, H., Solberg, E. J., Valdmann, H., & Wabakken, P. (2002). The fear of wolves: A review of wolf attacks on humans. *NINA Publications*, *731*, 1–65.

Liordos, V., Kontsiotis, V. J., Georgari, M., Baltzi, K., & Baltzi, I. (2017). Public acceptance of management methods under different human-wildlife conflict scenarios. *Science of The Total Environment*, *579*, 685–693.

Long, A. M., Pierce, B. L., Anderson, A. D., Skow, K. L., Smith, A., & Lopez, R. R. (2019). Integrating citizen science and remotely sensed data to help inform time-sensitive policy decisions for species of conservation concern. *Biological Conservation*, *237*, 463–469.

Lozano, J., Olszańska, A., Morales-Reyes, Z., Castro, A. A., Malo, A. F., Moleón, M., Sánchez-Zapata, J. A., Cortés-Avizanda, A., von Wehrden, H., Dorresteijn, I., Kansky, R., Fischer, J., & Martín-López, B. (2019). Human-carnivore relations: A systematic review. *Biological Conservation*, *237*, 480–492.

MacPhail, V. J., & Colla, S. R. (2020). Power of the people: A review of citizen science programs for conservation. *Biological Conservation*, *249*, 108739.

Mangiafico, S. (2021). Rcompanion: Functions to support extension education program evaluation. https://CRAN.R-project.org/package=rcompanion

Martin, I. (2013). Elch-Managementplan für Brandenburg. *Ministerium für Infrastruktur und Landwirtschaft des Landes Brandenburg*. 1–72.

Maund, P. R., Irvine, K. N., Lawson, B., Steadman, J., Risely, K., Cunningham, A. A., & Davies, Z. G. (2020). What motivates the masses: Understanding why people contribute to conservation citizen science projects. *Biological Conservation*, *246*, 108587.

Mech, L. D. (2012). Is science in danger of sanctifying the wolf? *Biological Conservation*, *150*(1), 143–149.

Merenlender, A. M., Crall, A. W., Drill, S., Prysby, M., & Ballard, H. (2016). Evaluating environmental education, citizen science, and stewardship through naturalist programs. *Conservation Biology*, *30*(6), 1255–1265.

Meyer, D., Zeileis, A., & Hornik, K. (2022). vcd: Visualizing categorical data. https://cran.r-project.org/web/packages/vcd/vcd.pdf

MLUK. (2020). *Wisent auf Wanderschaft*. Ministerium für Landwirtschaft, Umwelt und Klimaschutz des Landes Brandenburg.

Niedziałkowska, M. (2017). Phylogeography of European moose (*Alces alces*) based on contemporary mtDNA data and archaeological records. *Mammalian Biology*, *84*, 35–43.

Nolan, J. M. (2010). 'An inconvenient truth' increases knowledge, concern, and willingness to reduce greenhouse gases. *Environment and Behavior*, *42*(5), 643–658.

Ostermann-Miyashita, E. F., Bellingrath-Kimura, S. D., Pernat, N., Watanabe, I., Ozaki, H., Kampen, H., & Werner, D. (2019). Analysis of the current state of citizen science in Germany, based on 96 projects registered on the official website of the Federal Ministry for Education and Research. The Open ScienceFramework. https://doi.org/10.17605/OSF.IO/8P96M

Ostermann-Miyashita, E. F., Pernat, N., & König, H. J. (2021). Citizen science as a bottom-up approach to address human–wildlife conflicts: From theories and methods to practical implications. *Conservation Science and Practice*, *3*(3), e385.

Pateman, R., Dyke, A., & West, S. (2021). The diversity of participants in environmental citizen science. *Citizen Science: Theory and Practice*, *6*(1), 9. https://doi.org/10.5334/cstp.369

Pédarros, É., Coetzee, T., Fritz, H., & Guerbois, C. (2020). Rallying citizen knowledge to assess wildlife occurrence and habitat suitability in anthropogenic landscapes. *Biological Conservation*, *242*, 108407.

Penteriani, V., Delgado, M. D. M., Pinchera, F., Naves, J., Fernandez-Gil, A., Kojola, I., Harkonen, S., Norberg, H., Frank, J., Fedriani, J. M., Sahlen, V., Stoen, O. G., Swenson, J. E., Wabakken, P., Pellegrini, M., Herrero, S., & Lopez-Bao, J. V. (2016). Human behaviour can trigger large carnivore attacks in developed countries. *Scientific Reports*, *6*, 20552.

Pernat, N., Kampen, H., Jeschke, J. M., & Werner, D. (2021). Buzzing homes: Using citizen science data to explore the effects of urbanization on indoor mosquito communities. *Insects*, *12*(5), 378.

Pernat, N., Zscheischler, J., Kampen, H., Ostermann-Miyashita, E. F., Jeschke, J. M., & Werner, D. (2022). How media presence triggers participation in citizen science-the case of the mosquito monitoring project 'Muckenatlas'. *PLoS ONE*, *17*(2), e0262850.

Pocock, M. J. O., Roy, H. E., Fox, R., Ellis, W. N., & Botham, M. (2017). Citizen science and invasive alien species: Predicting the detection of the oak processionary moth *Thaumetopoea processionea* by moth recorders. *Biological Conservation*, *208*, 146–154.

Pooley, S., Barua, M., Beinart, W., Dickman, A., Holmes, G., Lorimer, J., Loveridge, A. J., Macdonald, D. W., Marvin, G., Redpath, S., Sillero-Zubiri, C., Zimmermann, A., & Milner-Gulland, E. J. (2017). An interdisciplinary review of current and future approaches to improving human-predator relations. *Conservation Biology*, *31*(3), 513–523.

Pucek, Z. (2004). *Status survey and conservation action plan: European Bison*. IUCN/SSC Bison Specialist Group.

Putman, B. J., Williams, R., Li, E., & Pauly, G. B. (2021). The power of community science to quantify ecological interactions in cities. *Scientific Reports*, *11*(1), 3069.

R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.r-project.org/index.html

Randler, C., Wagner, A., Rogele, A., Hummel, E., & Tomazic, I. (2020). Attitudes toward and knowledge about wolves in SW German secondary school pupils from within and outside an area occupied by wolves (Canis lupus). *Animals (Basel)*, *10*(4), 607.

Ravetz, J. (2004). The post-normal science of precaution. *Futures*, *36*(3), 347–357.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, *141*(10), 2417–2431.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933–1949.

Reinhardt, I., Kluth, G., Nowak, C., Szentiks, C. A., Krone, O., Ansorge, H., & Mueller, T. (2019). Military training areas facilitate the recolonization of wolves in Germany. *Conservation Letters*, *12*(3), e12635.

Rode, J., Flinzberger, L., Karutz, R., Berghöfer, A., & Schröter-Schlaack, C. (2021). Why so negative? Exploring the socio-economic impacts of large carnivores from a European perspective. *Biological Conservation*, *255*, 255.

Ronnenberg, K., Habbe, B., Gräber, R., Strauß, E., & Siebert, U. (2017). Coexistence of wolves and humans in a densely populated region (Lower Saxony, Germany). *Basic and Applied Ecology*, *25*, 1–14.

Salman, M. M., Kharroubi, S., Itani, M., & Talhouk, S. N. (2020). Using IUCN protected areas management categories as a tool to assess youth preferences for local management of an important plant area (IPA) in Lebanon. *Land Use Policy*, *99*, 105035.

Schakner, Z., Purdy, C., & Blumstein, D. T. (2019). Contrasting attitudes and perceptions of California Sea lions by recreational anglers and the media. *Marine Policy*, *109*, 103710.

Schönfeld, F. (2009). Presence of moose (*Alces alces*) in southeastern Germany. *European Journal of Wildlife Research*, *55*(4), 449–453.

Schuttler, S. G., Sorensen, A. E., Jordan, R. C., Cooper, C., & Shwartz, A. (2018). Bridging the nature gap: Can citizen science reverse the extinction of experience? *Frontiers in Ecology and the Environment*, *16*(7), 405–411.

Schwerk, A., Klich, D., Wojtowicz, E., & Olech, W. (2021). Impact of European bison grazing (*Bison bonasus* [L.]) on species and functional traits of carabid beetle assemblages in selected habitats in Poland. *Biology (Basel)*, *10*(2), 123.

Shafiei, A., & Maleksaeidi, H. (2020). Pro-environmental behavior of university students: Application of protection motivation theory. *Global Ecology and Conservation*, *22*, e00908.

Soanes, K., Cranney, K., Dade, M. C., Edwards, A. M., Palavalli-Nettimi, R., & Doherty, T. S. (2020). How to work with children and animals: A guide for school-based citizen science in wildlife research. *Austral Ecology*, *45*(1), 3–14.

Soulsbury, C. D., & White, P. C. L. (2015). Human–wildlife interactions in urban areas: A review of conflicts, benefits and opportunities. *Wildlife Research*, *42*(7), 541.

Swanson, A., Kosmala, M., Lintott, C., & Packer, C. (2016). A generalized approach for producing, quantifying, and validating citizen science data from wildlife images. *Conservation Biology*, *30*(3), 520–531.

Tiralongo, F., Crocetta, F., Riginella, E., Lillo, A. O., Tondo, E., Macali, A., Mancini, E., Russo, F., Coco, S., Paolillo, G., & Azzurro, E. (2020). Snapshot of rare, exotic and overlooked fish species in the Italian seas: A citizen science survey. *Journal of Sea Research*, *164*, 101930.

Todd, S. (2002). Building consensus on divisive issues; a casestudy of the Yukon wolf management team. *Environmental Impact Assessment Review*, *22*, 655–684.

Tomaselli, M., Kutz, S., Gerlach, C., & Checkley, S. (2018). Local knowledge to enhance wildlife population health surveillance: Conserving muskoxen and caribou in the Canadian Arctic. *Biological Conservation*, *217*, 337–348.

Torkar, G., & Krašovec, U. (2019). Students' attitudes toward forest ecosystem services, knowledge about ecology, and direct experience with forests. *Ecosystem Services*, *37*, 100916.

Treves, A., Naughton-Treves, L., & Shelley, V. (2013). Longitudinal analysis of attitudes toward wolves. *Conservation Biology*, *27*(2), 315–323.

Trouwborst, A. (2018). Wolves not welcome? Zoning for large carnivore conservation and management under the Bern convention and EU habitats directive. *Review of European, Comparative & International Environmental Law*, *27*(3), 306–319.

Trumbull, D. J., Bonney, R., Bascom, D., & Cabaral, A. (1999). Thinking scientifically during participation in a citizen-science project. *Informal Science*, *84*(2), 265–275.

Vasiliades, M. A., Hadjichambis, A. C., Paraskeva-Hadjichambi, D., Adamou, A., & Georgiou, Y. (2021). A systematic literature review on the participation aspects of environmental and nature-based citizen science initiatives. *Sustainability*, *13*(13), 7457.

Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with S*. Springer.

Vicente-Molina, M. A., Fernández-Sainz, A., & Izagirre-Olaizola, J. (2018). Does gender make a difference in pro-environmental behavior? The case of the Basque Country university students. *Journal of Cleaner Production*, *176*, 89–98.

Wei, T., Simko, V., Levy, M., Xie, Y., Jin, Y., Zemla, J., Freidank, M., Cai, J., & Protivinsky, T. (2021). R package 'corrplot': Visualization of a correlation matrix. https://cran.r-project.org/web/packages/corrplot/corrplot.pdf

Wojciechowski, F. J., Kaszycka, K. A., & Otadoy, J. B. (2021). Utilizing local community knowledge of the Philippine tarsier in assessing the Bilar population endangerment risk, and implications for conservation. *Journal for Nature Conservation*, *62*, 126028.

Zeileis, A., Köll, S., & Graham, N. (2020). Various versatile variances: An object-oriented implementation of clustered covariances in R. *Journal of Statistical Software*, *95*(1), 1–36.

SUPPORTING INFORMATION

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

How to cite this article: Ostermann-Miyashita, E-F, König, H. J., Pernat, N., Bellingrath-Kimura, S. D., Hibler, S., & Kiffner, C. (2022). Knowledge of returning wildlife species and willingness to participate in citizen science projects among wildlife park visitors in Germany. *People and Nature*, *4*, 1201–1215. https://doi.org/10.1002/pan3.10379