Do Student Teachers' Wildlife Value Orientations impact how they judge Management Actions of Carnivore Species from different Habitat Status Groups?

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Abstract

Lethal management of carnivore species in Germany differs according to the species habitat status (i.e., for new arrivals, long-established, or re-colonizing species). Management actions are not always accepted by the public. Since prospective teachers are future multipliers of public acceptance of lethal management, and teaching is influenced by ones' value orientations, we investigated student teachers' (N = 95) decisions on lethal management of carnivore species of different habitat status groups in relation to their wildlife value orientations (WVOs). Our results show that student teachers' WVOs are more strongly associated with certain management actions for new arrivals and re-colonizing species than for long-established species. In those cases, their WVOs are more likely to affect teaching of decision-making in the context of management actions. Thus, teacher education should support student teachers in reflecting their value orientations for teaching local biodiversity protection.

Keywords: habitat status, carnivores, student teachers, wildlife value orientation.

Introduction

Environmental changes have facilitated shifts in carnivore species' distributions in the ecosystems of Central Europe (Trouwborst et al., 2015). Some autochthonous carnivore species such as the red fox (*Vulpes vulpes*) and the European badger (*Meles meles*) have been present in Germany for the last 120 years and thus are long-established. Some formerly locally eradicated autochthonous carnivore species such as the European grey wolf (*Canis lupus*) and the brown bear (*Ursus arctos)* have re-colonized spaces. Other carnivore species such as the raccoon (*Procyon lotor*) and the golden jackal (*Canis aureus*) appeared as new arrivals for the first time during this period.

Lethal control is a common tool to manage carnivore species in order to pursue goals such the promotion of local biodiversity (Treves & Karanth, 2003). In compliance with international wildlife law (for an overview see: Trouwborst et al., 2017), German law provides for different lethal management actions for different carnivore species. Long-established carnivore species such as the red fox and the European badger can be controlled by hunting, that is, for harvest or to avoid overpopulation and to protect endangered species on which they prey. In contrast, re-colonizing carnivore species such as brown bear and European grey wolf are protected by law year-round to enhance their population growth in order to recover local biodiversity. Finally, different kinds of new arrivals are treated differently by German law: Populations of invasive carnivore species such as the raccoon are legally controlled through hunting because of their negative impact on local ecosystems. In contrast, carnivore species with natural spread such as the golden jackal are protected year-round. National law in effect requires management actions according to the habitat status of carnivore species (long-established, re-colonizing, or new arrivals).

The implementation of management actions to protect local biodiversity can fail due to a lack of public acceptance (Shackleton et al., 2019). Cognitions, emotions, and values influence the acceptance of management actions (Straka et al., 2020). In particular, peoples' wildlife value orientations (WVOs) are predictors of their acceptance of distinct management actions toward carnivores, ranging from complete protection to eradication (e.g., Manfredo et al., 2009; Straka et al., 2020). Previous research distinguished between three different WVOs: domination, mutualism, and appreciation (e.g., Hermann & Menzel, 2013). The domination WVO contains the two dimensions of hunting and use of wildlife. People with domination beliefs rate human interests higher than animal rights. The mutualism WVO comprises the two dimensions of social affiliation and caring. Those with high mutualism beliefs underline equal rights of both humans and animals. Third, the appreciation WVO comprises two dimensions of sustainable co-existence and residential wildlife experience (Fulton et al., 1996;

Hermann & Menzel, 2013). High appreciation beliefs are characterized by recognizing the importance of wildlife in the environment of an individual as well as of wildlife conservation for future generations. WVOs are relatively stable and predict the acceptability of management actions (Hermann & Menzel, 2013). The domination and mutualism WVOs are especially suitable to predict the decision for certain management actions (Whittaker et al., 2006).

To allow young citizens to reach informed decisions on accepting or opposing management actions, school teaching needs to reflect the cognitions, emotions, and values related to this topic (Hermann & Menzel, 2013). Teachers' beliefs and value orientations, however, influence how they promote decision-making processes, that is, the reasoning about acceptance of management actions in their teaching (Büssing et al., 2019). Therefore, reflecting on their WVOs regarding carnivore species of different habitat status groups enables prospective teachers to teach decision-making on management actions independent of their own values (Büssing et al., 2019). Student teachers' acceptance of management actions toward long-established, re-colonizing, and new arrival carnivore species is of relevance as they are future multipliers of public acceptance of such actions due to their prospective teaching of biodiversity protection. Decision-making on sustainability-related issues includes scientific and societal dimensions and, thus, relates to several disciplines and school subjects in teaching (Garrecht et al., 2018). That being the case, opportunities for reflection on beliefs and value orientations in decision-making could be integrated into university coursework to promote adequate teaching. In this context, the question arises whether student teachers accept different management actions with respect to carnivore species with different habitat status.

The Current Research

The present study aims to clarify to what extent lethal management of carnivore species of different habitat status groups—long-established, re-colonizing, or new arrivals—are supported by student teachers and are associated with their WVOs. For this scope, we followed two research questions:

(1) Does the habitat status—long-established, re-colonizing, or new arrivals—of a carnivore species affect student teachers' decision to accept or oppose lethal management actions?

(2) How are these decisions associated with the student teachers' WVOs?

Methods

Design and Participants

Our study had a one-factorial within-subject design. The single factor was species' habitat status with three conditions, that were, new arrivals vs. long-established vs. re-colonizing species. This factor was a within-subject factor because each participant was presented with vignettes on three animal species that had the status of being either long-established, re-colonizing, or a new arrival. Participants were asked to choose between different management actions for each species. We recruited university students enrolled in a teacher education program at a German university for participation in our questionnaire. We approached the student teachers outside of the courses to secure voluntary participation from a diverse range of teaching subjects. Our study included $N = 95$ student teachers ($M_{age} = 24.3$ years, $SD = 3.10$, range: 20–37 years) who were enrolled in various teaching subjects, with half of the student teachers studying biology education (51.6%). 85 students were female. The gender distribution of the sample corresponds to that of the university. This, however, is a convenience sample as we did not randomly draw the sample from the population. The

participating student teachers gave their informed consent to participate. The study was approved by the academic examination office of the Karlsruhe University of Education.

Procedure and Materials

Participants were provided with a questionnaire that was divided into two parts: (a) items to measure WVOs, and (b) three vignettes on carnivore species with different status (long-established, re-colonizing, and new arrival) that provided information on species' ecological role with regard to their influence on the ecosystem and human-wildlife interactions (see next paragraph). After answering questions in part (a), each participant read the vignettes in part (b). The vignettes asked participants to decide on the management action for each species. Finally, the participants provided demographic data on their age, gender, and current study enrollment.

Each vignette comprised an introductory information text and two tables with management actions and possible consequences of the management actions. Table 1 provides excerpts of an exemplary vignette. The introductory information texts were based on literature of the German federal agency of nature conservation (www.bfn.de) and employed a neutral tone. These texts explained the distribution area, the feeding and hunting behavior, as well as the relationship with humans of each of the carnivore species. The introductory information also told participants they would later have to decide on appropriate lethal management actions for each carnivore species. After reading the introductory information, participants were provided with an open-ended task for decision-making on the management actions. In the open-ended task, four management actions, three of which are lethal, were described. Those were: (1) no action, (2) lethal control of problematic individuals, (3) continuous regulation of populations, and (4) local eradication. Then, possible consequences of the four management actions with regard to the respective carnivore species were listed in a table. To avoid biasing the participants concerning consequences, the vignettes reflect possible

consequences that might typically be important to individuals with a domination, mutualism, and appreciation orientation (Hermann & Menzel, 2013). For the three WVOs with their six dimensions, possible consequences of the four management actions were briefly described. This resulted in a 6 × 4 matrix of consequences of the management actions (see Table 1, Open-ended task). After reading the two tables, participants were asked for a decision on the management actions (see Table 1, bottom).

Measures

Wildlife Value Orientations

The items to measure WVOs are based on the German adaptation (Hermann & Menzel, 2013) of the domination and mutualism scale (Manfredo et al., 2009) as well as the experience and existence scale (Fulton et al., 1996). The domination scale included statements on the dimensions of hunting and use of wildlife (10 items; scale reliability: $\alpha = .80$); the mutualism scale included statements on the dimensions of social affiliation and caring (9 items; scale reliability: $\alpha = .84$); the appreciation scale included statements on the dimensions of sustainable co-existence and residential wildlife experience (6 items; scale reliability: $\alpha = .82$). Each statement was rated on a 5-point scale ranging from 1 *(strongly agree)* to 5 *(strongly disagree).*

Decision on Lethal Management Actions

For each carnivore species with different status, participants were asked to choose between four management actions, three of which are lethal: (1) no action, (2) lethal control of problematic individuals, (3) continuous regulation of populations, and (4) local eradication.

Data Analysis

First, we used a nonparametric testing procedure (nparLD package: Noguchi et al., 2012) to examine whether the decisions on management actions differed in their frequency with regard

to species habitat status. We chose a nonparametric testing procedure because participants' decision on management actions is a categorial variable that was assessed for each participant in three vignettes. Second, we used a multivariate analysis of variance (MANOVA) to estimate whether participants' WVOs were associated with their choice of management actions for each condition of the within-subject factor *status*. Due to our study design, we were able to perform comparisons based on the management action for each condition of the within-subject factor *status* separately because the repeated measure provided a sufficient sample size. However, we had to drop management action 4 (local eradication) due to the low number of participants who chose this option (see Table 2). We used simple contrast analysis in post-hoc tests to estimate how strongly participants' WVOs were associated with their choice of least strict management action 1 (i.e., no action), of stricter action 2 (i.e., lethal control of problematic individuals), and of strictest action 3 (i.e., continuous regulation of populations).

Results

Habitat Status and Decision on Lethal Management Actions

The frequency of management actions selected by participants significantly differed in relation to the habitat status of the carnivore species, with $F = 9.11$, $df = 1.99$, $p < .001$. The difference in frequency in relation to the carnivore species was not significant, with $F = 3.63$, $df = 1$, $p = .057$. Table 2 presents the absolute frequencies of management actions that were chosen by participants. Participants chose the strictest management action 3 (i.e., continuous regulation of populations) most often for long-established species and new arrivals. Participants chose the stricter management action 2 (i.e., lethal control of problematic individuals) most often for re-colonizing species. Participants chose the least strict management action 1 (i.e., no action) equally often.

Habitat Status and Wildlife Value Orientations

The participants chose management actions for three carnivore species with different habitat status (i.e., new arrivals, long-established, or re-colonizing) depending on different WVOs. Table 3 presents estimates of associations between self-reported WVOs and participants' choices of least strict management action and stricter management actions for each of the three habitat statuses.

For *new arrivals*, we observed strong associations between participants' domination beliefs and their choice of management actions, with $F(2, 80) = 3.83$, $p = .026$, $\eta_p^2 = .09$. Participants with lower *domination beliefs* tended to favor no action over lethal control of problematic individuals or continuous regulation of populations.

For *long-established carnivore species*, we observed marginal associations between participants' domination beliefs and their choice of management actions that were not significant, with $F(2, 88) = 2.88$, $p = .061$, $\eta_p^2 = .06$. However, participants with lower *domination beliefs* tended to favor no action over continuous regulation of populations.

For *re-colonizing carnivore species*, we found the strongest associations between participants' *domination beliefs* and their choice of management actions, with $F(2, 89) = 4.52$, $p = .014$, $\eta_p^2 = .09$, and *mutualism beliefs* and their choice of management actions, with $F(2, 89) = 5.31$, $p = .007$, $\eta_p^2 = .11$. Participants with lower domination beliefs tended to favor no action over lethal control of problematic individuals or continuous regulation of populations. Furthermore, participants with higher *mutualism beliefs* tended to favor no action over lethal control of problematic individuals and continuous regulation of populations. There were no other significant differences, all Fs < 1.32, all ps > .273, all $\eta_p^2 < .04$.

Discussion

This study investigated whether student teachers' decision on management actions depend on different expressions of their WVOs for new arrivals, long-established, and re-colonizing carnivore species. Student teachers' decisions in relation to their WVOs need to be examined because student teachers' WVOs influence their teaching about carnivore species (Büssing et al., 2019). First, our results indicate that whether student teachers decide in favor of stricter management actions depends on the carnivore species' habitat status. Previous research showed that the decision for management actions strongly depends on the perception of species (e.g., positive or negative emotions: Straka et al., 2020). Our results extend the previous research by showing that the decision on management actions also depends on whether the species are known to be long-established, re-colonizing, or a new arrival. Second, our results provide evidence that only for new arrivals and re-colonizing but not for long-established carnivore species stronger expressions of the domination WVO are associated with decisions for stricter management actions (but not for strictest management actions, i.e., continuous regulation). Previous research argued that the domination WVO is a predictor for the support of management actions (Whittaker et al., 2006). Our results corroborate the predictive function of the domination WVO for the support of management actions. Our findings, however, also show that the expression of the domination WVO is more pronounced for new arrivals and re-colonizing carnivore species when considering stricter management actions. This highlights that new arrivals and re-colonizing species elicit a stronger association between more pronounced domination beliefs and the acceptance of stricter management actions than long-established species. Furthermore, when student teachers had higher expressions of the mutualism WVO, stricter management actions were not supported for re-colonizing carnivore species. This shows that re-colonizing species seem elicit different decisions from student teachers, regarding lethal management.

Implications

Our results have implications for how acceptance of wildlife management should be promoted early in the training of future teachers. Domination-orientated individuals likely support stricter management options and, therefore, might decide in conflict with the protection of re-colonizing biodiversity. In contrast, individuals with high expression of mutualism might oppose stricter management actions for re-colonizing carnivore species despite the potential damages caused by these species. These findings show that the teaching of decision-making on lethal management of re-colonizing carnivore species and new arrivals is in danger of being influenced by student teachers' WVOs. Thus, there is the need to foster student teachers' competences to teach decision-making independent to their WVOs. A first step to do so is to enable student teachers to reflect on their own value orientations (Büssing et al., 2019). A second step is to connect student teachers' reflection of value orientations with ecological knowledge on carnivore species. Previous research showed that student teachers' knowledge of invasive carnivore species' effects on ecosystem impacts their attitudes towards management actions (Remmele & Lindemann-Matthies, 2020). This will likely improve their competence to reflect on management actions that may be in contrast to their WVOs and hence to teach decision-making on lethal management of carnivore species in a reflected way.

Strength, Limitations, and future Research

A strength of the study is that it examines differences in regulation decisions as a function of habitat status by forming groups of carnivore species with respect to habitat status. The present study, however, only focused on two species for each status. Moreover, the character of the species differed across the different status groups. For example, European grey wolves and brown bears are likely to be perceived as the most dangerous among the carnivore species included in this survey. Our results show that there are slight differences in the decisions for management actions depending on the carnivore species. However, these differences are

smaller than the differences depending on habitat status of carnivore species and did not quite reach significance. Thus, future research should include further carnivore species in each status group. Furthermore, our study focuses only on student teachers who are novices to the teaching of biodiversity protection; the results indicate that opportunities to reflect on one's own values should be offered during university coursework. As we do not know if our findings were also influenced by student teachers' inexperience, future research should examine the decisions of experienced teachers as well.

Conclusion

Student teachers' WVOs impact how they judge lethal management actions depending on carnivore species' habitat status. In summary, this study provides evidence that individuals who have higher domination beliefs and lower mutualism beliefs also accept stricter management actions, but only for re-colonizing carnivore species and not for new arrivals and long-established species. Hence, individuals' decision-making processes on the acceptance of lethal management actions more strongly depend on their WVOs when carnivore species' habitat status is considered.

References

Arnold, J., Humer, A., Heltai, M., Murariu, D., Spassov, N., & Hackländer, K. (2012). Current status and distribution of golden jackals Canis aureus in Europe. *Mammal Review, 42*(1), 1–11. https://doi.org/10.1111/j.1365-2907.2011.00185.x

Büssing, A., Schleper, M., & Menzel, S. (2019). Do pre-service teachers dance with wolves? Subject-specific teacher professional development in a recent biodiversity conservation issue. *Sustainability, 11*(1), 47. https://doi.org/10.3390/su11010047

Fulton, D. C., Manfredo, M. J., & Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife*, *1*(2), 24–47. https://doi.org/10.1080/10871209609359060

Garrecht, C., Bruckermann, T., & Harms, U. (2018). Students' Decision-Making in Education for Sustainability-Related Extracurricular Activities—A Systematic Review of Empirical Studies. *Sustainability*, *10*(11), 3876. https://doi.org/10.3390/su10113876

Hermann, N., & Menzel, S. (2013). Predicting the intention to support the return of wolves: A quantitative study with teenagers. *Journal of Environmental Psychology*, *36*, 153-161. https://doi.org/10.1016/j.jenvp.2013.07.017

Manfredo, M. J., Teel, T. L., & Henry, K. L. (2009). Linking Society and Environment: A Multilevel Model of Shifting Wildlife Value Orientations in the Western United States. *Social Science Quarterly*, *90*(2), 407-427. https://doi.org/10.1111/j.1540-6237.2009.00624.x

Noguchi, K., Gel, Y. R., Brunner, E., & Konietschke, F. (2012). nparLD: An R Software Package for the Nonparametric Analysis of Longitudinal Data in Factorial Experiments. *Journal of Statistical Software*, *50*(12), 1–23. https://doi.org/10.18637/jss.v050.i12

Remmele, M. & Lindemann-Matthies, P. (2020). Dead or alive? Teacher students' perception of invasive alien animal species and attitudes towards their management. *Eurasia Journal of Mathematics, Science and Technology Education*, 16(5):em1840. https://doi.org/10.29333/ejmste/115105

Shackleton, R. T., Richardson, D. M., Shackleton, C. M., Bennett, B., Crowley, S. L., Dehnen-Schmutz, K., ... Marchante, E. (2019). Explaining people's perceptions of invasive alien species: a conceptual framework. *Journal of Environmental Management, 229*, 10-26. https://doi.org/10.1016/j.jenvman. 2018.04.045

Straka, T. M., Miller, K. K., & Jacobs, M. H. (2020). Understanding the acceptability of wolf management actions: Roles of cognition and emotion. *Human Dimensions of Wildlife*, *25*(1), 33–46. https://doi.org/10.1080/10871209.2019.1680774

Treves, A., & Karanth, K. U. (2003). Human carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology*. (17), 1291–1587. https://doi.org/10.1111/j.1523-1739.2003.00059.x

Trouwborst, A., Krofel, M., & Linnell, J. D. C. (2015). Legal implications of range expansions in a terrestrial carnivore: The case of the golden jackal (Canis aureus) in Europe. *Biodiversity and Conservation*, *24*(10), 2593–2610. https://doi.org/10.1007/s10531-015-0948-y

Trouwborst, A., Blackmore, A., Boitani, L., Bowman, M., Caddell, R., Chapron, G., Cliquet, A., Couzens, S., Epstein, Y., Fernández-Galiano, E., Fleurke, F., Gardner, R., Hunter, L., Jacobsen, K., Krofel, M., Lewis, M., López-Bao, J., Macdonald, D., Redpath, S., … Linnell, J. (2017). International Wildlife Law: Understanding and Enhancing Its Role in Conservation. *BioScience*, 67(9), 784–790. https://doi.org/10.1093/biosci/bix086

Whittaker, D., Vaske, J. J., & Manfredo, M. J. (2006). Specificity and the cognitive hierarchy: Value orientations and the acceptability of urban wildlife management actions. *Society & Natural Resources*, *19*(6), 515–530. https://doi.org/10.1080/08941920600663912

Tables

Table 1

Excerpts of an Exemplary Vignette on the Red Fox (*Vulpes vulpes*) Containing the Possible Consequences of Four Management Actions According to the six Dimensions of WVOs.

Vignette introductory information text

The red fox is widespread throughout Germany and has always been part of our native fauna. [...] Foxes are considered food opportunists, which means that they feed with the least effort. [...] Foxes have adapted to the changed environmental conditions and are increasingly losing their shyness towards humans. [...]

Open-ended task

There are several actions to regulate populations: (1) no action, (2) lethal control of problematic individuals, (3) continuous regulation of populations, and (4) local eradication.

Suppose you had to decide on one of the four possible actions for wildlife management. Which would it be? The following information will help you decide:

actions/ dimensions	**1. no action**	**2. lethal control of problematic individuals**	**3. continuous regulation of populations**	**4. local eradication**
Hunting	Hunters kill less small game (e.g., hares).	Hunters kill less small game (e.g., hares).	Hunters have only slight constraints on hunting small game.	Hunters kill more small game (e.g., hares).
[…]	[…]	[…]	[…]	[…]
residential wildlife experience	Foxes can be spotted more frequently in Germany.	Foxes can be spotted regularly in Germany.	Foxes can be sighted less frequently in Germany.	Foxes cannot be sighted in Germany.

Based on the information above, which of the aforementioned actions (1, 2, 3, and 4) for wildlife management would you prefer? **Justify your answer in as much detail as possible.**

Table 2

Number of Student Teachers That Accept the Respective Management Actions Related to Carnivore Species' Habitat Status (Within-subject Factor).

	new arrivals[1]	long-established	re-colonizing
no action	16	16	16
lethal control of problematic individuals	36	34	65
continuous regulation of populations	31	41	11
local eradication	—[2]	—	—

Note. [1]This category includes species that are invasive or at least perceived to be invasive (such as the Golden jackal: Arnold et al., 2012).

[2]Option excluded because of low number of respondents.

Table 3

Differences Between Means M_{diff}, Standard Errors (SE), p-value, Confidence Interval [Lower 95% CI; Upper 95% CI] for the Comparison Between Least Strict and Stricter (1 vs. 2) or Least Strict and Strictest Management Actions (1 vs. 3) for the Three Wildlife Value Orientations.

	new arrivals		long-established		re-colonizing	
	1 vs. 2	1 vs. 3	1 vs. 2	1 vs. 3	1 vs. 2	1 vs. 3
WVOs						
dom.	**.38 (.17), *p* = .026, [0.05; 0.71]**	**.46 (.17), *p* = .008, [0.12; 0.80]**	.27 (.18), *p* = .126, [−0.08; 0.62]	**.41 (.17), *p* = .019, [0.07; 0.75]**	**.44 (.16), *p* = .007, [0.13; 0.75]**	**.56 (.22), *p* = .013, [0.12; 1.00]**
mut.	−.22 (.21), *p* = .302, [−0.64; 0.20]	−.16 (.22), *p* = .456, [−0.60; 0.27]	−.28 (.21), *p* = .180, [−0.69; 0.13]	−.06 (.20), *p* = .764, [−0.46; 0.34]	**−.58 (.19), *p* = .002, [−0.95; −0.22]**	**−.64 (.26), *p* = .016, [−1.16; −0.12]**
app.	−.11 (.22), *p* = .614, [−0.55; 0.32]	−.11 (.22), *p* = .617, [−0.56; 0.27]	.13 (.21), *p* = .552, [−0.30; 0.55]	.10 (.21), *p* = .623, [−0.31; 0.51]	−.24 (.20), *p* = .214, [−0.63; 0.14]	.01 (.27), *p* = .982, [−0.54; 0.55]

Note. WVOs: wildlife value orientations; dom.: domination; mut.: mutualism; app.: appreciation; 1: no action; 2: lethal control of problematic individuals; 3: continuous regulation of populations