# Are wildlife value orientations useful tools to explain tolerance and illegal killing of wildlife by farmers in response to crop damage?

**Article** *in* European Journal of Wildlife Research · August 2017

DOI: 10.1007/s10344-017-1127-0

CITATIONS
4

READS
661

**4 authors**, including:

Jacopo Cerri
Institute for Environmental Protection and Research (ISPRA)
**21** PUBLICATIONS **18** CITATIONS

SEE PROFILE

Emiliano Mori
Università degli Studi di Siena
**158** PUBLICATIONS **669** CITATIONS

SEE PROFILE

Marco Zaccaroni
University of Florence
**47** PUBLICATIONS **197** CITATIONS

SEE PROFILE

**Title**: “Are wildlife value orientations useful tools to explain tolerance and illegal killing of wildlife by farmers in response to crop damage?”

**Authors**:

1. Jacopo Cerri, Scuola Superiore Sant’Anna, Piazza Martiri della Libertà, 33, 56127 Pisa, Italy. Email: j.cerri@sssup.it
2. Emiliano Mori, Research Unit of Behavioural Ecology, Ethology and Wildlife Management, Department of Life Sciences, University of Siena, Via P.A. Mattioli 4, 53100 Siena, Italy. Email: moriemiliano@tiscali.it
3. Mattia Vivarelli, Dipartimento di Scienze delle Produzioni AgroAlimentari (DISPAA), Università degli Studi di Firenze, Piazzale delle Cascine 18, 50100 Florence, Italy. Email: mattia.vivarelli@stud.unifi.it
4. Marco Zaccaroni, Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano 6, 50019, Sesto Fiorentino, Florence, Italy. Email: marco.zaccaroni@unifi.it

**Keywords**: Wildlife value orientations, Human dimensions of, wildlife . Values . Randomized response technique, Sensitive, Crop/poultry damage.

## Abstract

Understanding human-wildlife conflicts and monitoring their consequences, such as wildlife persecution, is crucial for biological conservation. Although most theoretical models suggest that the influence of value orientations on behavior is mediated by higher order constructs such as attitudes and norms, wildlife value orientations are widely used to assess human-wildlife relationships and to predict human behavior towards wildlife. We have no evidence of studies which have measured them in Mediterranean countries, where the highest biodiversity level in temperate

Western countries is present. In spring 2016, we administered a questionnaire to local farmers in Central Italy to measure the association be tween wildlife value orientations and illegal killing of wildlife, in response to crop or poultry damages (n = 352). We obtained the prevalence of illegal killing with the Randomized Response Technique, ensuring complete individual protection to respondents. We modeled the effect of wildlife value orientations over illegal wildlife killing with a Bayesian logistic regression for three taxa: the red fox, the crested porcupine, and birds, as most of persecution by farmers in our study site is exerted towards them. We found that domination predicted illegal killing for the red fox only. On the other hand, mutualism predicted tolerance towards all the study taxa. Combining wildlife value orientations and the Randomized Response Technique can be a promising approach to explore human-wildlife conflicts and their consequences. Furthermore, the Mediterranean setting of our study filled existing geographical gaps about wildlife value orientations in Europe. We encourage future research on the application of wildlife value orientations to conflicts involving wildlife and extensive farmers, i.e., at large scale, as well as future large-scale research on wildlife value orientations in Europe

## Introduction

Human-wildlife conflicts are a topic of growing interest for contemporary wildlife managers (Woodroffe et al. 2005). Human and some wildlife populations grew in the last decades, and negative interactions between human activities and wildlife have become more frequent, with substantial social costs (Woodroffe et al. 2005; Barua et al. 2013) and receiving growing attention from media (Gore et al. 2005). This has reinforced or created new conflicts among stakeholders (Dickman 2010; Redpath et al. 2013), altered social tolerance towards problematic wildlife (Liu et al. 2011; Treves and Bruskotter 2014), or generated discussions about general topics such as equity for land use and access to private properties (Patterson et al. 2003). Wildlife managers need to develop new tools to frame human-wildlife conflicts, as well as to monitor and forecast their

consequences, to develop longstanding management strategies (Messmer 2009). Psychology provides valuable theoretical frames to explain human-wildlife interactions. For instance, the cognitive hierarchy has been adopted since the late 1990s to explain how values, value orientations, attitudes, and norms affect human behavior towards wildlife (Jacobs et al. 2012). Values are desirable end states and conduct modes reflecting our basic desires and goals of our life (Rockeach 1973; Schwartz 2006). Values are indirect drivers of human behavior and receive contextual meaning from schematic networks of basic beliefs, i.e., value orientations (Kluckhohn 1951). Wildlife value orientations show individual thoughts about wildlife or wildlife-related issues (e.g., disease transmission, crop raiding), and they provide general values with a meaning in the context of wildlife (Fulton et al. 1996). For instance, two farmers may hold similar general values (e.g., recognition of the importance of well-being), but yet hold different wildlife value orientations (positive vs. negative): thus they may react differently in response to wildlife damaging crops or poultries. Two wildlife value orientations have been identified: domination and mutualism (Manfredo et al. 2009; Teel and Manfredo 2009; Teel et al. 2007, 2009). These orientations are made of a network of four basic beliefs towards wildlife: appropriate use, hunting, social affiliation, and caring. People whose wildlife value orientation is mainly domination-oriented claim that society should manage wildlife to maximize their own wellness. They are more likely to treat wildlife in a utilitarian way and to accept drastic management actions (e.g., lethal control). On the other hand, those who hold a mutualistic perspective tend to consider animals in a non-utilitarian way. In the most extreme cases, mutualism can lead people to pose animals at the same level of humans, considering them part of the society and extending them human rights (Manfredo 2008). Those with a mutualistic value orientation oppose actions which can harm or kill animals and promotes caring behavior and welfare-enhancing actions (Clergeau and Vergnes 2015). Many studies on wildlife value orientations have been conducted in North America (Fulton et al. 1996; Teel et al. 2010). Other research has been carried out in Central and Northern Europe (Gamborg and

Jensen 2016a, b; Herrmann et al. 2013; Jacobs 2007; Jacobs et al. 2014a; Raadik and Cottrell 2007; Vaske et al. 2011), Asia (Jafarpour and Manohar 2014; Kaczensky 2007; Tanakanjana and Saranet 2007; Zainal Abidin and Jacobs 2016; Zinn and Shen 2007), and Oceania (Miller 2003). Wildlife value orientations are appealing for wildlife managers, as they can predict public support towards wildlife management policies (Jacobs et al. 2014b) and towards conservation of iconic wildlife (Herrmann et al. 2013). In Western countries, current research on wildlife value orientations suggests that social changes in education, economic income, and urbanization are influencing a value shift towards mutualism (Manfredo 2008). This will certainly affect biological conservation (Manfredo et al. 2016), e.g., by reshaping human-wildlife conflicts, like those between agriculture and wildlife. As the society changes, so the public support for lethal control of wildlife will do (Jacobs et al. 2014b; Sijtsma et al. 2012); changes in the social features of young farmers (e.g., higher levels of education, different economic incomes) may also lead to changes in the levels of wildlife acceptance and persecution.

Monitoring the consequences of human-wildlife conflicts is crucial to achieve conservation goals, because persecution and illegal killing are typically the quickest reaction of human communities to wildlife damaging. The persecution of problematic wildlife seriously undermines conservation efforts worldwide, it is seldom effective in limiting future damages and it may triggers serious cascade effects on ecological communities, worsening the original conflict (Prugh et al. 2009; Wallach et al. 2010; Ripple et al. 2014). Surveys can be a valuable approach to detect where human-wildlife conflicts arise and which stakeholders they affect (Vaske 2008; White et al. 2005). Unfortunately, monitoring their consequences, e.g., wildlife persecution, is often complex: respondents are generally unwilling to report their real behavior if they perceived it as socially undesirable or sanctionable (Krumpal 2013; Nuno and St. John 2015). Farmers who experienced crop damaging will hardly reveal whether they reacted against problematic wildlife, because they are afraid of being fined or convicted. Conventional direct-answer questionnaires are unsuitable to

measure wildlife persecution, because they can suffer from a high non-response rate or biased answers. Various specialized questioning techniques have been developed to conduct surveys about sensitive topics (Nuno and St. John 2015). These techniques assume that guaranteeing respondents' privacy will increase data validity. Privacy protection is based on logical mechanisms that do not enable surveyors to track individual answers, ensuring complete individual protection to respondents. Specialized questioning techniques allow researchers to obtain estimates of the target behavior at the population level, and some of them even to model the effect of covariates. The Randomized Response Technique is arguably the most applied of these techniques (Krumpal 2013; Blair et al. 2015). Its main advantages are its high statistical power, allowing for relatively small sample sizes, altogether with the possibility to use modified logistic regressions or mixture models to investigate the effect of covariates over the likelihood of engaging in the sensitive behavior (Van den Hout et al. 2007). Provided respondents comply with the instructions, the Randomized Response Technique provides prevalence estimates with a lower bias than direct-questions and it has a great potential to monitor wildlife persecution arising from follow human-wildlife conflicts.

In Europe, the numerical recovery experienced by many wildlife populations in the last decades is colliding with human activities (Deinet et al. 2013; Massei et al. 2015; Fox and Abraham 2017). Therefore, wildlife managers need proper tools to forecast these conflicts and to monitor their consequences, such as wildlife persecution, at the continental scale. Wildlife value orientations might provide a sound theoretical frame to accomplish these tasks, but various research gaps still exist. Firstly, no study is available for Mediterranean Europe, hampering their application at the European scale. Available research about the predictive power of wildlife value orientations considered hypothetical scenarios only (Jacobs et al. 2012) and never measured self-reported behavior about human-wildlife conflicts. This study aims to address all these gaps, testing two hypotheses about the predictive value of wildlife value orientations towards wildlife persecution by farmers, in case of crop damages in a Mediterranean context. We predicted that, in response to crop

damages: (i) a domination-oriented value orientation lead farmers to kill problematic wildlife and (ii) a mutualism-oriented value orientation prevents farmers from killing problematic wildlife. This paper will also show how the Randomized Response Technique, generally neglected in Europe (Cross et al. 2013), can be a valuable tool to measure wildlife persecution.

## Materials and methods

Questionnaire structure and administration The study area was located in Tuscany, a region of Central Italy (Fig. 1). Between March and April 2016, we administered questionnaires to a sample of residents who practiced leisure farming in the provinces of Pistoia, Lucca, Grosseto, and Siena. We selected three taxa, exerting the main crop damages excluding ungulates. Birds (especially the European starling *Sturnus vulgaris*) are, after wild boar, the main cause of crop loss in our study area (Santilli et al. 2012; Laurenzi et al. 2016). Among mammals, the crested porcupine *Hystrix cristata* may exert heavy damage to vegetable gardens (Laurenzi et al. 2016; Lovari et al. 2017) and the red fox *Vulpes vulpes* may cause severe losses in poultries (Poole 2002). These species, very abundant in Tuscany, might therefore be subjected to a considerable persecution by farmers (Serafini and Lovari 1993; Laurenzi et al. 2016; Lovari et al. 2017).

Prior to the survey, we identified and mapped vegetable gardens with QuantumGIS (QuantumGIS Development Team 2009). We identified the nearest houses to vegetable gardens, then we obtained phone numbers and we took contacts with farmers. Our sampling was purposive: random sampling was impossible because of the absence of registers of Bamateur^ farmers (i.e., those having only private vegetables gardens). Two authors (MV and EM) administered the questionnaire, following a fixed protocol. At the beginning of the questionnaire, interviewers explained how to use the randomizing device (i.e., a dice), to answer to the questions with the Randomized Response Technique (hereafter, RRT), and explained how the technique ensured privacy protection. Then they administered the questionnaires, and left respondents alone 10 min to fill the module. At the end,

interviewers came back to respondents and asked them to put the questionnaire in a ballot box. The questionnaire included three RRT questions asking respondents whether they had ever killed wildlife after crop/poultry damages. We asked respondents to roll the dice before answering to each question, then to answer “Yes” if the outcome was 1 or 2 and “No” if it was 5 or 6, but to provide an honest answer if the outcome was 4 or 5. This was a forced-response design of the RRT (Blair et al. 2015). Two questions asked respondents whether they illegally killed two iconic mammals: the red fox and the crested porcupine. Furthermore, another question asked respondents whether they illegally killed “birds” as a consequence of crop damaging: we used this general expression, because in the study area those bird species causing crop damaging are not iconic taxa and we preferred to avoid misclassification bias from respondents.

In the second section of the questionnaire, we asked respondents about the type of amateur farming they practiced, about crop/poultry damaging by wildlife, and whether they reported such damage to local authorities. In the third section, we adopted a four-item construct based on a seven-point scale, to measure the importance they assigned to farming. In the last section of the survey, we measured the wildlife value orientations of respondents by adopting the 19 items set with a seven-point scale used in previous works (Jacobs et al. 2014A; Manfredo et al. 2009). At the end of the questionnaire, we asked respondents their demographic characteristics. A complete version of the questionnaire is available in the Supplementary Material (S1). Local crop/poultry damage was assessed and verified by technicians working for Hunting Agencies for the same areas of our social survey, through addressed surveys on damaged rural areas (cf. Laurenzi et al. 2016). Technicians identified different impacts by porcupines and foxes by presence signs (i.e., quills, digs, hair, footprints, and excrements) on the ground (cf. Laurenzi et al. 2017).

**Statistical analyses**

We calculated the Cronbach's alpha to measure (i) the reliability of wildlife value orientations and (ii) the reliability of perceived importance of farming, and the Harman's Single Factor, to control for common method variance.

Our sample was smaller than samples from previous research about wildlife value orientations adopting frequentist Confirmatory Factor Analysis (Manfredo et al. 2009; Teel and Manfredo 2009; Whittaker et al. 2006) and our study was the first where wildlife value orientations, notably domination and mutualism, were estimated in a Mediterranean context. Therefore, we were interested in a latent variable model allowing for a small sample size and for the possibility to measure its goodness-of-fit to the data. The Bayesian Confirmatory Factor Analysis (BCFA) met these requirements, enabling us to incorporate existing information about wildlife value orientations through constrained priors and allowing us to see whether our two latent variables were correctly estimated, by inspecting MCMC diagnostics and convergence metrics (Merkle and Rosseel 2015).

Existing literature about wildlife value orientations indicates that the various items well reflect their respective latent variables: each observed variable (item) is positively correlated with the latent variable it represents and uncorrelated with the other latent variable. Therefore, we constrained the prior distribution of factor loadings to positive values and we set at zero the factor loadings representing a relationship between a specific item and the uncorrelated latent variable. We used a standard Gibbs sampler with 10,000 iterations and a burn-in of 1000 observations to simulate from the posterior distribution. After we run the BCFA and we obtained convergence of the estimates, we estimated factor scores for domination and mutualism. We adopted a Bayesian logistic regression with known misclassification probabilities to test for the effect of domination and mutualism over illegal killing (Blair et al. 2015).

We used the Gelman-Rubin statistics and graphical exploration to examine the MCMC outputs of the BCFA and the logistic regressions. We also adopted Gelman plots to check the convergence of logistic regressions.

## Results

We administered 352 questionnaires and the proportion of missing answers was low (Supplementary Material S2), therefore we retained all of them for data analysis. Vegetable gardens were the most widespread activity (89.2%), followed by orchards (21.9%) and poultries (18.2%). The majority of respondents (61.9%) suffered wildlife damaging, but only few (5.7%) reported damaging to local authorities. Wildlife value orientations were reliable, as their Cronbach's alpha was above the traditional cutoff of 0.65 (Table 1: cf. Doi et al. 2000) and Harman's single factor test did not reveal any common method variance bias. We removed one item from the set measuring mutualism (item n.11), as it strongly increased the Cronbach's alpha of the construct (Table 1). The BCFA provided a satisfactory fit to our data, as shown by MCMC graphical diagnostics. In the Bayesian logistic regressions, the acceptance ratios of the Metropolis algorithm were 0.4, MCMC diagnostics were good, and the Gelman-Rubin statistics were all below 1.1, indicating convergence (Table 2). Domination was positively and strongly related to the likelihood of having killed red foxes, but such relationship was weak for the illegal killing of crested porcupines and birds. Mutualism was always strongly negatively related to illegal wildlife killing, both for the red fox, the crested porcupine, and birds (Table 2). The prevalence of illegal wildlife killing differed between the various species. According to the RRT, birds were the most persecuted because of crop damaging (27.9%), followed by the crested porcupine (20.4%) and by the red fox (13.8%).

## Discussion

Our results show how wildlife value orientations can help understanding human tolerance towards problematic wildlife in Europe, and how the RRT can be an effective tool to monitor the negative consequences human-wildlife conflicts, like wildlife persecution.

Farmers with mutualistic wildlife value orientations are tolerant towards wildlife, even if they suffer crop/poultry. On the other hand, famers with a domination wildlife value orientation were not likely to kill wildlife, in response to crop damage. The low predictive power of domination can underlie the existence of other important drivers of wildlife killing by farmers, e.g., emotions towards wildlife (Manfredo 2008; Jacobs 2012; Jacobs et al. 2012, 2014a; Frank et al. 2016; Prokop et al. 2016). In our study, the majority of respondents (c. 62%) had suffered crop damaging prior to the questionnaire and we believe that the existence, the extent, and the frequency of previous crop damaging can be other important factors guiding decision-making. Future studies should address this issue. To sum up, our results verified our prediction (ii), but rejected (i). Interestingly, they also contradicted findings of previous research showing that mutualism drives evaluations on rare wildlife, whereas domination drives evaluations on common species (Hermann et al. 2013; Jacobs et al. 2014b). Our results denied this hypothesis, since we investigated the occurrence of an evaluative behavior involving common species, finding no predictive potential of domination.

Two criticisms may be advanced against our approach. Firstly, by asking respondents about a behavior that could have occurred long ago, memory recall bias could occur. We believe that memory recall bias is unlikely to have affected our estimates, because killing wildlife is likely to awake strong emotions, which reinforce and strengthen memories (Manfredo 2008). Then, a second critic can notice that the wildlife value orientations of respondents could have changed from the time when they engaged in the reported behavior, to the time of the interview, especially if such time span was long. We believe that this is unlikely to be a major problem too, because changes in individual values may occur (Majic and Bath 2010) but they are not common, given that values are a stable and central trait of human personality (Jacobs et al. 2012). Our results also show that the classic quantitative scale adopted to measure wildlife value orientations (Manfredo et al. 2009) can be adopted in Mediterranean countries. The validity of wildlife value orientations for Mediterranean countries extends the geographical scale where they have been applied and discloses new research

possibilities (Jacobs 2007; Raadik and Cottrel 2007; Herrmann et al. 2013; Gamborg and Jensen 2016a, b). Large-scale studies (Manfredo 2008; Manfredo et al. 2009) may have deep implications for cross-cultural validity of wildlife value orientations and their theoretical structure (Dayer et al. 2007), as well as for trans-boundary wildlife policies (Marzano et al. 2013; Langhammer et al. 2017), and their interplay with national regulations.

## Conclusions

Wildlife value orientations can be regarded as a robust theoretical framework to explain wildlife persecution by farmers, in response to crop damages. The RRT should be used instead of conventional direct-answers questionnaires, as shown by other works on problematic wildlife (Fairbrass et al. 2016; St. John et al. 2010, 2016). Recently, substantial advances were achieved in RRT modeling, leading to more accurate and efficient estimators and allowing to tests for respondents' compliance with the instructions (Cruyff et al. 2016): we recommend future studies testing this new RRT approach to measure wildlife persecution.

Mutualism predicts that farmers suffering crop damaging may tolerate the presence of wildlife, but domination does not predict illegal killing. Future research addressing the role of domination and mutualism as moderators for the effect of crop damaging and other drivers over illegal wildlife killing are needed. Mutualism might have a greater moderating power than domination, because engaging in rule violation not only requires the willingness to do so but a favorable social context, perceived benefits exceeding costs, altogether with practical skills. If true, this assumption may have practical implications understanding and managing human-wildlife conflicts. The combination of studies on wildlife value orientations with data on demographic changes in the farmer community may constitute a fertile approach to model the potential evolution of agriculture-wildlife conflicts. Young farmers often have a valuable education level and, mainly if graduated, most of them do not have a degree in agricultural sciences, suggesting the occurrence of part-time and

leisure farming (Albani et al. 2013). As wildlife value orientations are influenced by the educational background (Zinn et al. 2002; Manfredo et al. 2009), at least part of the European farming community may increase its tolerance towards wildlife (Rovný 2016). This may also result in a decreasing acceptance of lethal control of wildlife. We enabled future studies at the European level about this topic by providing evidence for wildlife value orientations in a Mediterranean country.

**Acknowledgments**

Dr. Vasco Sfondrini kindly took the time to revise the English grammar and syntax of our manuscript. Two anonymous reviewers and the Associate Editor provided us with useful comments on an early draft.

**References**

Albani C, Ascione E, Henke R, Li Vecchi D, Pesce A, Pierangeli F, Pierri F (2013) I giovani e il ricambio generazionale nell'agricoltura italiana. Ministero delle Politiche Agricole, Alimentari e Forestali, INEA (Eds.), Rome, Italy

Barua M, Bhagwat SA, Jadhav S (2013) The hidden dimensions of hu-man–wildlife conflict: health impacts, opportunity and transaction costs. *Biol Conserv* 157:309–316

Blair G, Zhou YY, Imai K (2015) rr: Statistical methods for the random- ized response. Available at the Comprehensive R Archive Network, http://CRAN. R-project. org/package= rr. Accessed on 28th July 2016

Clergeau P, Vergnes P (2015) Bird feeders may sustain feral rose-ringed parakeets *Psittacula krameri* in temperate Europe. *Wildl Biol* 17: 248–252

Cross P, St. John FAS, Khan S, Petroczi A (2013) Innovative techniques for estimating illegal activities in a human-wildlife-management conflict. *PLoS One* 8:e53681

Cruyff MJ, Böckenholt U, Van der Heijden PG (2016) The multidimensional randomized response design: estimating different aspects of the same sensitive behavior. *Behav Res Methods* 48:390–399

Dayer AA, Stinchfield HM, Manfredo MJ (2007) Stories about wildlife: developing an instrument for identifying wildlife value orientations cross-culturally. *Hum Dim Wildl* 12:307–315

Deinet S, Ieronymidou C, McRae L, Burfield IJ, Foppen RP, Collen B, Böhm M (2013) Wildlife comeback in Europe: the recovery of selected mammal and bird species. *Final report to Rewilding Europe* by ZSL, BirdLife International and the European Bird Census Council, Zoological Society of London London

Dickman AJ (2010) Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. *Anim Conserv* 13:458–466

Doi Y, Minowa M, Uchiyama M, Okawa M, Kim K, Shibui K, Kamei Y (2000) Psychometric assessment of subjective sleep quality using the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) in psychiatric disordered and control subjects. *Psych Res* 97:165–172

Fairbrass A, Nuno A, Bunnefeld N, Milner-Gulland EJ (2016) Investigating determinants of compliance with wildlife protection laws: bird persecution in Portugal. *Eur J Wildl Res* 62:93–101

Fox AD, Abraham KF (2017) Why geese benefit from the transition from natural vegetation to agriculture. *Ambio* 46:188–197

Frank B, Glikman JA, Sutherland M, Bath AJ (2016) Predictors of extreme negative feelings toward coyote in Newfoundland. *Human Dim Wildl* 21:297–310

Fulton DC, Manfredo MJ, Lipscomb J (1996) Wildlife value orientations: a conceptual and measurement approach. *Human Dim Wildl* 1:24–47

Gamborg C, Jensen FS (2016a) Wildlife value orientations: a quantitative study of the general public in Denmark. *Human Dim Wildl* 21:34–46

Gamborg C, Jensen FS (2016b) Wildlife value orientations among hunters, landowners, and the general public: a Danish comparative quantitative study. *Human Dim Wildl* 21:328–344

Gore ML, Siemer WF, Shanahan JE, Schuefele D, Decker DJ (2005) Effects on risk perception of media coverage of a black bear related human fatality. *Wildl Soc Bull* 33:507–516

Herrmann N, Voß C, Menzel S (2013) Wildlife value orientations as predicting factors in support of reintroducing bison and of wolves migrating to Germany. *J Nat Cons* 21:125–132

Jacobs MH (2007) Wildlife value orientations in the Netherlands. *Human Dim Wildl* 21:359–365

Jacobs MH (2012) Human emotions toward wildlife. *Human Dim Wildl* 17:1–3

Jacobs MH, Vaske JJ, Roemer JM (2012) Toward a mental systems approach to human relationships with wildlife: the role of emotional dispositions. *Human Dim Wildl* 17:4–15

Jacobs MH, Vaske JJ, Dubois S, Fehres P (2014a) More than fear: role of emotions in acceptability of lethal control of wolves. *Eur J Wildl Res* 60:589–598

Jacobs MH, Vaske JJ, Sijtsma MT (2014b) Predictive potential of wildlife value orientations for acceptability of management interventions. *J Nat Cons* 22:377–383

Jafarpour M, Manohar M (2014) Wildlife value orientations based on age, gender and education in Malaysia. *Life Sci J* 11:194–201

Kaczensky P (2007) Wildlife value orientations of rural Mongolians. *Human Dim Wildl* 12:317–329

Kluckhohn C (1951) Values and value-orientations in the theory of action: an exploration in definition and classification. In: Parsons T, Shils E (eds) *Toward a general theory of action*. Harper and Row Editions, New York, USA, pp 388–433

Krumpal I (2013) Determinants of social desirability bias in sensitive surveys: a literature review. *Qual Quant* 47:2025–2047

Langhammer M, Grimm V, Pütz S, Topping CJ (2017) A modelling approach to evaluating the effectiveness of ecological focus areas: the case of the European brown hare. *Land Use Policy* 61:63–79

Laurenzi A, Bodino N, Mori E (2016) Much ado about nothing: assessing the impact of a problematic rodent on agriculture and native trees. *Mammal Res* 61:65–72

Liu F, McShea WJ, Garshelis DL, Zhu X, Wang D, Shao L (2011) Human-wildlife conflicts influence attitudes but not necessarily behaviors: factors driving the poaching of bears in China. *Biol Conserv* 144:538–547

Lovari S, Corsini MT, Guazzini B, Romeo G, Mori E (2017) Suburban ecology of the crested porcupine in a heavily poached area: a global approach. *Eur J Wildl Res* 63:10

Majić A, Bath AJ (2010) Changes in attitudes toward wolves in Croatia. *Biol Conserv* 143:255–260

Manfredo MJ (2008) Who cares about wildlife? Springer US (Eds), New York, USA

Manfredo MJ, Teel TL, Henry KL (2009) Linking society and environment: a multilevel model of shifting wildlife value orientations in the western United States. *Soc Sci Quart* 90:407–427

Manfredo MJ, Teel TL, Dietsch AM (2016) Implications of human value shift and persistence for biodiversity conservation. *Cons Biol* 30: 287–296

Marzano M, Carss DN, Cheyne I (2013) Managing European cormorant-fisheries conflicts: problems, practicalities and policy. *Fish Manag Ecol* 20:401–413

Massei G, Kindberg J, Licoppe A, Gačić D, Šprem N, Kamler J, Baubet E, Hohmann U, Monaco A, Ozoliņš CS, Podogórski T, Fonseca C, Markov N, Pokorny B, Rosell C, Nàhlik A (2015) Wild boar populations up, numbers of hunters down? A review of trends and implications for Europe. *Pest Manag Sci* 71:492–500

Merkle EC, Rosseel Y (2015). Blavaan: Bayesian structural equation models via parameter expansion. arXiv preprint arXiv:1511.05604

Messmer TA (2009) Human-wildlife conflicts: emerging challenges and opportunities. *Human-Wildl Confl* 3:10–17

Miller KK (2003) Public and stakeholder values of wildlife in Victoria, Australia. *Wildl Res* 30:465–476

Nuno ANA, St. John FA (2015) How to ask sensitive questions in conservation: a review of specialized questioning techniques. *Biol Conserv* 189:5–15

Patterson ME, Montag JM, Williams DR (2003) The urbanization of wildlife management: social science, conflict, and decision making. *Urban For Urban Green* 1:171–183

Poole DW (2002) Effectiveness of two types of electric fence for excluding the red fox (Vulpes vulpes). *Mamm Rev* 32:51–57

Prokop P, Medina-Jerez W, Coleman J, Fančovičová J, Özel M, Fedor P (2016) Tolerance of frogs among high school students: influences of disgust and culture. *Eur J Math Sci Tech Educ* 12:1499–1505

Prugh LR, Stoner CJ, Epps CW, Bean WT, Ripple WJ, Laliberte AS, Brashares JS (2009) The rise of the mesopredator. *Bioscience* 59: 779–791

Quantum GIS Development Team (2009) Quantum GIS geographic information system. Open Source Geospatial Foundation Project. http://grass.geo.org

Raadik J, Cottrell S (2007) Wildlife value orientations: an Estonian case study. *Hum Dim Wildl* 12:347–357

Redpath SM, Young J, Evely A, Adams WM, Sutherland WJ, Whitehouse A, Amar A, Lambert LA, Linnell JDC, Watt A, Gutiérrez RJ (2013) Understanding and managing conservation conflicts. *Trends Ecol Evol* 28:100–109

Ripple WJ, Estes JA, Beschta RL, Wilmers CC, Ritchie EG, Hebblewhite M, Berger J, Elmhagen B, Letnic M, Nelson PM, Schmitz OJ, Smith DW, Wallach AD, Wirsing AJ (2014) Status and ecological effects of the world's largest carnivores. *Sci* 343:1241484

Rockeach M (1973) The nature of human values. Free Press (Eds.), New York, USA

Rovný P (2016) The analysis of farm population with respect to young farmers in the European Union. *Procedia-Soc Behav Sci* 220:391–398

Santilli F, Azara S, Galardi L, Gorreri L, Perfetti A, Bagliacca M (2012) Evaluation of an aerial scaring device for birds damage prevention to agricultural crops. *Riv It Orn* 82:144–146

Schwartz SH (2006) A theory of cultural value orientations: explication and applications. *Comp Sociol* 5:137–182

Serafini P, Lovari S (1993) Food habits and trophic niche overlap of the red fox and the stone marten in a Mediterranean rural area. *Acta Theriol* 38:233–244

Sijtsma MT, Vaske JJ, Jacobs MH (2012) Acceptability of lethal control of wildlife that damage agriculture in the Netherlands. *Soc Nat Res* 25:1308–1323

St. John FA, Edwards-Jones G, Gibbons JM, Jones JP (2010) Testing novel methods for assessing rule breaking in conservation. *Biol Conserv* 143:1025–1030

St. John FA, Brockington D, Bunnefeld N, Duffy R, Homewood K, Jones JP, Keane AK, Milner-Gulland EJ, Nuno A, Razafimanahaka JH (2016) Research ethics: assuring anonymity at the individual level may not be sufficient to protect research participants from harm. *Biol Conserv* 196:208–209

Tanakanjana N, Saranet S (2007) Wildlife value orientations in Thailand: preliminary findings. *Hum Dim Wildl* 12:339–345

Teel TL, Manfredo MJ (2009) Understanding the diversity of public interests in wildlife conservation. *Cons Biol* 24:128–139

Teel TL, Manfredo MJ, Stinchfield HM (2007) The need and theoretical basis for exploring wildlife value orientations cross-culturally. *Hum Dim Wildl* 12:297–305

Teel TL, Manfredo MJ, Jensen FS, Buijs AE, Fischer A, Riepe C, Arlinghaus R, Jacobs MH (2010) Understanding the cognitive basis for human-wildlife relationships as a key to successful protected area management. *Intern J Sociol* 40:104–123

Treves A, Bruskotter J (2014) Tolerance for predatory wildlife. *Sci* 344: 476–477

Van den Hout A, van der Heijden PG, Gilchrist R (2007) The logistic regression model with response variables subject to randomized response. *Comp Stat Data Anal* 51:6060–6069

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

Vaske JJ, Jacobs MH, Sijtsma MT (2011) Wildlife value orientations and demographics in The Netherlands. *Eur J Wildl Res* 57:1179–1187

Wallach AD, Johnson CN, Ritchie EG, O'Neill AJ (2010) Predator control promotes invasive dominated ecological states. *Ecol Lett* 13: 1008–1018

White PC, Jennings NV, Renwick AR, Barker NH (2005) Review: questionnaires in ecology: a review of past use and recommendations for best practice. *J Appl Ecol* 42:421–430

Whittaker D, Vaske JJ, Manfredo MJ (2006) Specificity and the cognitive hierarchy: value orientations and the acceptability of urban wildlife management actions. *Soc Nat Resour* 19:515–530

Woodroffe R, Thirgood S, Rabinowitz A (2005) People and wildlife, conflict or co-existence? (No. 9). Cambridge University Press, Cambridge

Zainal Abidin ZA, Jacobs MH (2016) The applicability of wildlife value orientations scales to a Muslim student sample in Malaysia. *Hum Dim Wildl* 21:1–12

Zinn HC, Shen XS (2007) Wildlife value orientations in China. *Hum Dim Wildl* 12:331–338

Zinn HC, Manfredo MJ, Barro SC (2002) Patterns of wildlife value orientations in hunters' families. *Hum Dim Wildl* 7:147–162

**Figures**

Fig. 1. The provinces surveyed in the study area

**Tables**

Table 1. Wildlife value orientations, reliability of constructs

| Value Orientation<br>Basic belief dimension<br>Survey item[a] | Reliability analysis | | |
|---|---|---|---|
| | Alpha if item deleted | Cronbach's alpha | |
| Domination | | | 0.94 |
| Appropriate use beliefs | | 0.94 | |
| Humans should manage fish and wildlife populations so that human benefit | 0.92 | | |
| The needs of humans should take priority over fish and wildlife protection | 0.93 | | |
| It is acceptable for people to kill wildlife if they think it poses a threat to their life | 0.92 | | |
| It is acceptable for people to kill wildlife if they think it poses a threat to their property | 0.91 | | |
| It is acceptable to use fish and wildlife in research even if it may harm or kill some animals | 0.92 | | |
| Fish and wildlife are on earth primarily for people to use | 0.92 | | |
| Hunting beliefs | | 0.83 | |
| We should strive for a world where there is an abundance of fish and wildlife for hunting and fishing | 0.81 | | |
| Hunting is cruel and inhumane to the animals[b] | 0.74 | | |
| Hunting does not respect the lives of animals[b] | 0.72 | | |
| People who want to hunt should be provided the opportunity to do so | 0.84 | | |
| Mutualism | | | 0.90 |
| Social affiliation beliefs | | 0.80 | |
| We should strive for a world where humans and fish and wildlife can live side by side without fear | 0.92 | | |
| I view all living things as part of one big family | 0.65 | | |
| Animals should have rights similar to the rights of humans | 0.66 | | |
| Wildlife are like my family and I want to protect them | 0.69 | | |
| Caring beliefs | | 0.89 | |
| I care about animals as much as I do other people | 0.87 | | |
| It would be more rewarding to me to help animals rather than people | 0.90 | | |
| I take great comfort in the relationships I have with animals | 0.84 | | |
| I feel a strong emotional bond with animals | 0.84 | | |

| | | | |
|---|---|---|---|
| I value the sense of companionship I receive from animals | 0.87 | | |
| [a] Variables coded on a seven-point Likert scale, ranging from −3 (strongly disagree) to +3 (strongly agree) | | | |
| [b]Reverse coded | | | |

Table 2. Illegal killing of wildlife: effect of domination and mutualism over wildlife killing. The Gelman-Rubin statistic, if smaller than 1.1, indicates that the logistic regression correctly estimated the coefficients. Estimated coefficients are odds ratio and Bayesian credibility intervals are at the 95% level

| Species | Wildlife Value Orientations | Estimated coefficients | Credibility interval (95%) | Gelma-Rubin statistic |
|---|---|---|---|---|
| Fox | Domination | 3.19 | 3.69 | 1.00 |
| | Mutualism | -3.39 | 3.89 | 1.00 |
| Crested porcupine | Domination | -0.48 | 3.59 | 1.00 |
| | Mutualism | -4.86 | 3.41 | 1.00 |
| Birds | Domination | 0.34 | 2.23 | 1.01 |
| | Mutualism | -1.09 | 2.50 | 1.02 |