Differences in Tolerance Levels Towards the Italian Wolf and Marsican Brown Bear in the Central Apennines, Italy

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Abstract

With large-scale recovery of carnivore populations in recent years, many places in Europe are inevitably facing human-wildlife conflicts and solving these has become a key issue. Tolerance toward wildlife varies greatly across areas and is influenced by many factors. Understanding these differences and drivers influencing the willingness of humans to coexist with wildlife is thus crucial to managing the human-wildlife conflict. This study investigated the difference in tolerance levels of landholders in the Abruzzo, Lazio and Molise National Park (PNALM) in Italy and the Monte Genzana Alto Gizio Regional Nature Reserve (RNRMGAG), where locals have different coexistence histories with the Marsican brown bear and the Italian wolf. By applying the Wildlife Tolerance Model (WTM), this study aims to give an insight in the different tolerance levels toward bears and wolves and which WTM variables could possibly account for these differences. Results revealed that tolerance is higher in PNALM than in RNRMGAG, although survey respondents in PNALM favored the bear over the wolf, whereas those in RNRMGAG made no difference between the species. Higher monetary benefits from tourism, emotional benefits and positive meaningful events from a longer coexistence history could potentially explain why respondents in PNALM had more positive attitudes toward bears and wolves. A lack thereof and higher emotional costs from the recolonization of bears could possibly account for lower tolerance in RNRMGAG. Higher exposure and more negative meaningful events could additionally explain why the wolf is less tolerated within PNALM. Though further analysis is needed to pinpoint which exact factor drives the differences in tolerance, this study shows that focusing on the emotional aspect of the conflict could foster more tolerance by increasing positive meaningful events and thus intangible benefits while reducing negative meaningful events and intangible costs at the same time.

Contents

1. Introduction

In recent years, Europe has seen dramatic changes in the status and conservation of large mammals (Boitani & Linnell, 2015; Chapron, et al., 2014). A variety of factors has enabled large-scale recovery of carnivore populations in various European landscapes (Chapron & López-Bao, 2016; Boitani & Linnell, 2015; Chapron, et al., 2014), with a current estimated total of 9,000 Eurasian lynx (*Lynx lynx*), 12,000 grey wolves (*Canis lupus*), and 17,000 brown bears (*Ursus arctos*) (Chapron, et al., 2014). That species return this extensively to highly modified European areas where they had previously been extinct is also referred to as the rewilding of Europe (Helmer, et al., 2015). Conservationists are putting a lot of effort into bringing back the four European large carnivores: the brown bear (*Ursus arctos*), the grey wolf (*Canis lupus*), the Eurasian lynx (*Lynx lynx*), and the wolverine (*Gulo gulo*) (Boitani & Linnell, 2015; Chapron, et al., 2014; Linnell, et al., 2008). However, in a place that is as densely populated and modified as Europe, the presence of large carnivores naturally causes conflicts with humans. Common issues associated with carnivores include livestock depredation, fear of living with the species and competition with hunters (Carter & Linnell, 2016). This can lead to human-wildlife conflicts, potentially ending in human-caused mortality like poisoning or hunting (Carter & Linnell, 2016; Bruskotter & Wilson, 2014; Chapron, et al., 2014).

Some people advocate for a "wilderness" approach, where humans and wildlife are separated and animals live in areas without any human interference (Chapron, et al., 2014). On a large scale, this is, however, not feasible for the conservation of large carnivores in Europe. For instance, large carnivores have wide-ranging territories up to 1,000 km^2 and may disperse even further (Jedrzejewski, et al., 2007; Herfindal, et al., 2005). In Europe, though, the protected areas are rather small and often not large enough to support entire populations of large carnivores (Chapron, et al., 2014; Linnell, et al., 2008). It is thus unlikely to keep large carnivore species away from areas with human interference (Carter & Linnell, 2016; Linnell & Boitani, 2012). Instead, humans need to readapt to living alongside wildlife and find ways where both sides can coexist with each other (Carter & Linnell, 2016; Boitani & Linnell, 2015; Chapron, et al., 2014; Linnell, et al., 2008; Ciucci & Boitani, 2008). Managing human-wildlife conflicts is a complex conservation issue, where there is no easy fix that applies to all situations. That is due to the different ecological contexts in which we find the species, but also due to the differences in people's relationship with wildlife and the perceptions they have of them (Kansky, et al., 2016; Bruskotter & Wilson, 2014). How humans perceive wildlife varies from one person to another and differs per region. Various factors can influence these perceptions (Kansky, et al., 2014; Bruskotter & Wilson, 2014). Understanding differences in wildlife tolerance is crucial to for the management of protected areas because they can determine which interventions will be effective (Marino, et al., 2020; Kansky, et al., 2016; Carter & Linnell, 2016; Bruskotter & Wilson, 2014).

Differences in tolerance levels and their drivers might warrant different management approaches, even for the same species or region. For instance, in comparison with other mammals, wildlife tolerance tends to be low towards large carnivores (Treves & Bruskotter, 2014; Kansky, et al., 2014; Chapron, et al., 2014; Bruskotter & Wilson, 2014) and in areas where species return after previous absence (Boitani & Linnell, 2015; Chapron, et al., 2014). Moreover, there are differences in tolerance between carnivore species: various studies have shown that the wolf is the carnivore species that humans tend to tolerate the least (Khan, et al., 2014; Wechselberger, et al., 2005).

In the Central Apennines, we can find two large carnivore species: the Italian wolf (*Canis lupus italicus*) and the Marsican brown bear (*Ursus arctos marsicanus*). Although both species suffered

substantial range contractions during eradication efforts in the 19th and 20th century all over Europe (Wolf & Ripple, 2017; Breitenmoser, 1998), in Italy, these species persisted (Boitani & Linnell, 2015). Today, the Marsican brown bear population is critically endangered (Rondinini, et al., 2013) and the Italian wolf, though more successful with its population size, is still threatened by illegal and accidental killings (Mancinelli, et al., 2018; Lovari, et al., 2007; Ciucci, et al., 2007). To reduce this human-caused mortality and other human-related threats, it is crucial to understand the locals' tolerance towards the wolf and bear.

In this study, we have investigated the tolerance levels of landholders towards the Marsican brown bear and the Italian wolf in two protected areas of the Central Apennines: the Abruzzo, Lazio and Molise National Park (PNALM) and the Monte Genzana Alto Gizio Regional Nature Reserve (RNRMGAG). Although located in the same region, the two protected areas can be distinguished according to their histories of coexistence between humans and wildlife. In the long-established PNALM, people have always had to live with bears and wolves present in the area (Marino, et al., 2020), while in the newer RNRMGAG, the bear has only recently come back after decades of absence (Di Domenico, et al., 2016). A recent study by Marino et al. (2020) surveyed the drivers of the locals' tolerance toward the Italian wolf and the Marsican brown bear across the two areas. During their research, they adopted the Wildlife Tolerance Model (WTM) proposed by Kansky et al. (2016) to identify key drivers of tolerance towards damage-causing wildlife. They found that especially increasing perceived intangible benefits and positive experiences with the species would foster tolerance among residents of the two protected areas and therefore proposed fitting management strategies.

Now, using the data from the same survey, the main aim of this study is to understand the differences in tolerance between PNALM and RNRMGAG toward the Marsican brown bear and Italian wolf and which variables could possibly explain this difference. In accordance with this, the research questions are as follows:

What is the difference in tolerance levels between residents of the PNALM and the RNRMGAG towards the Marsican brown bear and Italian wolf?

And: *Which variables could account for the differences in tolerance levels?*

The methodology of a recent study by Kansky et al. (2020) was replicated in order to have comparable results, as this was another case study belonging to their overarching research. Therefore, as in their study, the study population of interest were landholders who have already or could potentially suffer damages caused by the two carnivore species. To understand where the potential differences in tolerance levels derive from, different variables were included in the analysis. These were, on the one hand, sociodemographic variables of the residents, which include age, gender, education, and income. On the other hand, they were variables of the above-mentioned Wildlife Tolerance Model (WTM): exposure, meaningful events, perceived costs and benefits as well as empathy and perceptions of institutions responsible for wildlife management.

2. Methodology

2.1 Study area

Residents were surveyed in two protected areas of the Central Apennines in Italy (Figure 1). One is the Abruzzo, Lazio and Molise National Park (Italian: *Parco Nazionale d'Abruzzo, Lazio e Molise* or short PNALM). The other is the almost adjacent Monte Genzana Alto Gizio Natural Regional Reserve (Italian: *Riserva Naturale Regionale Monte Genzana Alto Gizio* or short RNRMGAG). The Apennines or Apennine Mountains are a mountain range stretching from the North of Italy all the way to the South. Here, typical Mediterranean montane climate manifests itself in dry summers and cold, snowy winters (Piovesan, et al., 2013). Beech (*Fagus sylvatica*) forests characteristic for the Apennines cover much of the mountain slopes, next to open hillsides and montane grasslands (Ciucci, et al., 2017). Containing some of the best-preserved ecosystems in Europe and hence, large populations of herbivores such as roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), and wild boars (*Sus scrofa*) (Mancinelli, et al., 2018), the Apennines form a refuge to European carnivores like the Marsican brown bear and the Italian wolf (Ciucci, et al., 2017). Alongside these wildlife species, local communities live dispersed in a few mountain villages. Population density for humans in the area averages 14.6 inhabitants/km^2, though locals live aggregated in their villages leaving many areas almost uninhabited (Ciucci, et al., 2015). Local farmers use the land for their livestock, which mainly comprise sheep, followed by goats, cattle, and horses (Ciucci, et al., 2020). Although local communities of farmers still practice traditional livestock management like guarding by shepherds and sheepdogs, other husbandry practices have emerged, including free-ranging, larger and unguarded herds of livestock (Marino, et al., 2020).

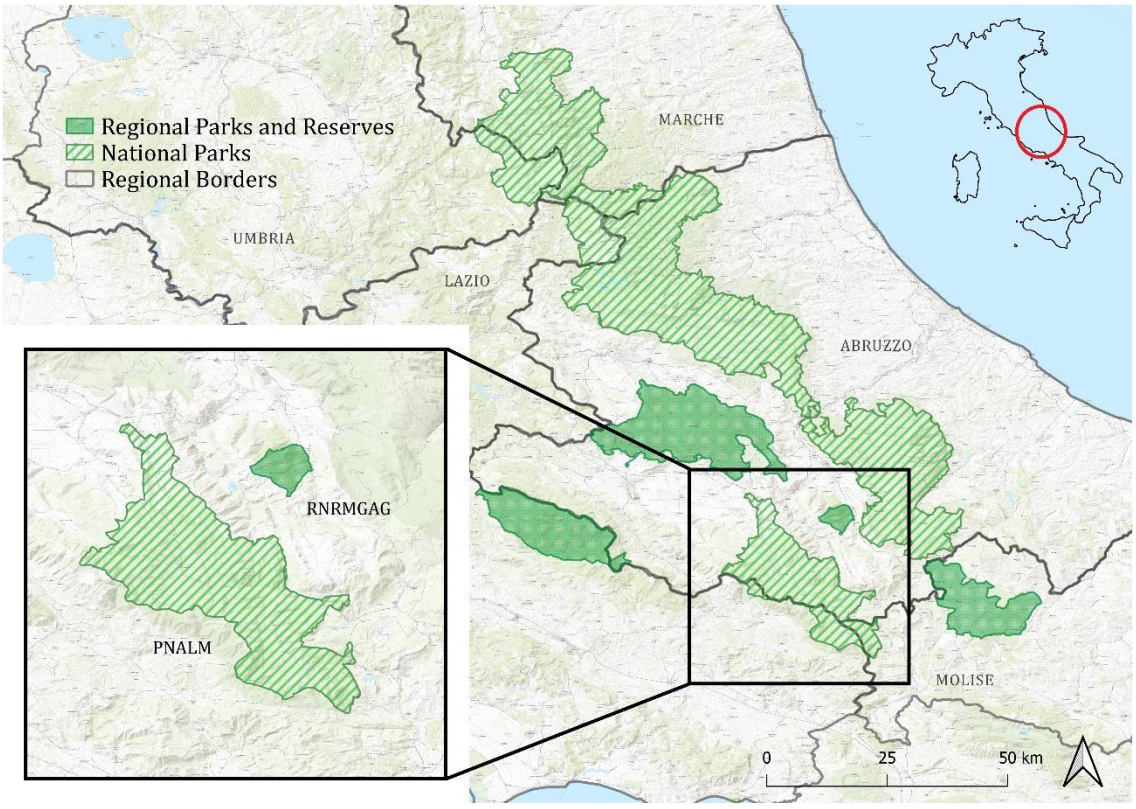

Figure 1. *Map of the two study areas Abruzzo, Lazio, and Molise National Park (PNALM) and Monte Genzana Alto Gizio Regional Natural Reserve (RNRMGAG) in the Central Apennines of Italy with surrounding national parks and regional reserves*

Abruzzo, Lazio and Molise National Park

Founded in 1922, the PNALM is the oldest national park in the Apennine Mountains and the second oldest even in all of Italy (Ente Parco Nazionale d'Abruzzo, Lazio e Molise, 2020). The park covers an area of 50,500 hectares with an elevation up to 2,249 m (Ente Parco Nazionale d'Abruzzo, Lazio e Molise, 2020). It is estimated that approximately 50 Marsican brown bears (range of 45-69) inhabit the national park (Ciucci, et al., 2015) as well as 8 packs of wolves, comprising 2-9 wolves each (Ciucci, et al., 2020).

Monte Genzana Alto Gizio Natural Regional Reserve

RNRMGAG was established in 1996 and is the largest nature reserve in Abruzzo with an area of 3,164 hectares and an elevation up to 2,170 m (Riserva Naturale Regionale Monte Genzana Alto Gizio, 2020). Located between the PNALM and the Majella National Park (PNM), the reserve acts as an ecological corridor connecting the two national parks. Signs of presence indicate at least 7 individual bears using the reserve as part of their territory (Cipollone, 2020). Although the population size has not yet been officially assessed, there is evidence from camera traps for at least 4 different wolves inhabiting the reserve and the surrounding areas (Ricci, et al., 2014).

2.2 Study population

Survey participants included residents from all municipalities of the PNALM and the RNRMGAG that had at least one trophic resource available to wolves or bears, e.g. chickens, bee hives, sheep or cattle. These landholders were, among others, farmers who depended on their farm enterprise as a source of income but also people that had other sources of income and farmed only for private use. This specific target group of farmers was chosen because variation in tolerance levels was proven to differ among different stakeholder types (Kansky & Knight, 2014) and research has emphasized the importance of studying stakeholders most directly affected by the conflict with wildlife (Ericsson & Heberlein, 2003).

Both in the PNALM and in RNRMGAG, livestock grazing is an important activity for the economy of the locals (Mancinelli, et al., 2018). So naturally, wolf and bear predation on livestock and raiding of villages by a few human-habituated and food-conditioned bears has caused social upset in the past (Ciucci & Boitani, 2008; Latini, et al., 2005). Both in the PNALM and RNRMGAG, compensation schemes have been set up by the regional government, but their effectiveness has been questioned by people in the area (Marino, et al., 2020; Ciucci, et al., 2017). These issues and compensation schemes are shared by residents of the PNALM and the RNRMGAG alike. However, unlike the PNALM, RNRMGAG provides mitigation measures for their residents, like building electric fences for farmers in need (Marino, et al., 2020). Additionally, the residents of the PNALM enjoy monetary benefits from bear-related tourism, contrary to the RNRMGAG residents, where tourism is only limited (Marino, et al., 2020).

2.3 Study species

Marsican Brown Bear

The Marsican brown bear (*Ursus arctos marsicanus*), also referred to as Apennine brown bear, is a subspecies of the Eurasian brown bear (*Ursus arctos*) that is endemic to the Central Apennines (Ciucci, et al., 2017; Ciucci & Boitani, 2008). Historically spanning most of the Apennine range, today's home range of the Marsican brown bear appears to be limited to one core area, that is mostly set around the Abruzzo, Lazio and Molise National Park and some peripheral areas in nearby reserves and national parks where they sporadically occur (Ciucci, et al., 2017). On a

national level, the subspecies is considered critically endangered (Rondinini, et al., 2013). International trade with the species is restricted by CITES Appendix II, and the species is fully protected by the Italian law (national law 157/92 and 150/92), the Habitat Directive and is included in the Bern Convention (Ciucci & Boitani, 2008). Despite this legal protection, the population of the Marsican brown bear does not seem to expand in numbers or distribution (Kaczensky, et al., 2013) with an estimated population size ranging from 45 to 69 in an area of stable presence of about 5,422 km^2 (Ciucci, et al., 2017; Large Carnivore Initiative for Europe, 2016; Ciucci, et al., 2015). Threats to the Marsican brown bear are human-caused mortality, habitat fragmentation, food availability, low viability of small populations and lack of reliable information on bear ecology (Boitani, et al., 2010; Ciucci & Boitani, 2008). Since this large carnivore is an opportunistic eater that is attracted to areas with anthropogenic food readily available to it (Elfström, et al., 2014), conflicts can arise with humans over livestock depredation, beehive destruction or loss in crops and fruit trees (Ciucci & Boitani, 2008).

Italian Wolf

Similar to the Marsican brown bear, the Italian wolf (*Canis lupus italicus*) is also known as the Apennine wolf, given that its distribution spans the entirety of the Apennine Mountains and Western Alps (Kaczensky, et al., 2013; Fabbri, et al., 2007). However, this was not always the case seeing that the Italian wolf faced dramatic reductions in population numbers leaving only approximately 100 individuals in the 1970s (Fabbri, et al., 2007; Lucchini, et al., 2004). Due to conservation efforts, wolves are expanding their territory again all over Italy, with a very rough estimate of 1,100 to 2,400 individuals (Large Carnivore Initiative for Europe, 2016). On a national level, the subspecies is considered vulnerable (Rondinini, et al., 2013). International trade with this species is restricted under CITES Appendix II and in Italy, the wolf is fully protected by national law 157/92, the Habitat Directive and the Bern Convention (Kaczensky, et al., 2013; Jdeidi, et al., 2010). Regardless of this legal protection, illegal human-caused mortality still remains one of the biggest threats to the Italian wolf (Mancinelli, et al., 2018; Lovari, et al., 2007; Ciucci, et al., 2007), next to habitat fragmentation, and the exaggerated image the public has of the wolf (Kaczensky, et al., 2013; Jdeidi, et al., 2010). The human-wolf conflict is a common issue in Europe and, as a large carnivore, the wolf naturally is a threat to the livestock and property of humans. Human tolerance in some regions is very low, especially in areas where they were previously absent (Dalmasso, et al., 2012), and, in many cases, the wolf has become a symbol for wide-ranging problems of a changing landscape (Large Carnivore Initiative for Europe, 2016).

2.4 The Wildlife Tolerance Model

To help investigate drivers behind people's tolerance toward damage-causing wildlife species such as the wolf and the bear, Kansky et al. (2016) proposed a theoretical framework: the Wildlife Tolerance Model (WTM). This model (Figure 2) comprises an outer and an inner model. The outer model is based on the idea that the degree and way in which people experience wildlife, through *recent exposure* and *meaningful event*s with the species, both positive and negative, will shape the perception of *costs* and *benefits* they associate with that species. *Exposure* in this case measures the frequency and spatial proximity somebody has been exposed to in a certain time frame. *Meaningful events* on the other hand, is not restricted by time and instead, measures strong emotionally charged experiences that could have happened anytime during a person's life. The model predicts that positive experience will lead to greater perceptions of benefits and in the same way, negative meaningful events will lead to greater perceptions of costs. Both costs and benefits can be separated into *tangible*, such as monetary benefits derived from ecotourism, and *intangible*, like the stress you might feel when living with a certain species. These perceptions of costs and benefits associated with a species will in turn determine the *tolerance* of it. In their

model, Kansky et al. define tolerance as: "The ability and willingness of an individual to absorb the extra potential or actual costs of living with wildlife" (2016, p. 138). They identified five indicators of tolerance to be used in surveys: spatial proximity to the species, damage caused by it, killing the species in different contexts, acceptable population size and tolerated costs of prevention measures.

The inner model composes 11 additional variables that can further drive the perception of costs and benefits: *wildlife value orientation, anthropomorphism, interest in animals, taxonomic group, personal norm, institutions, empathy, values, norms, habits,* and *perceived behavioral control*. Due to limitations of survey length only two inner model variables were included in the survey of 2018, which were, next to all the variables from the outer model, *empathy* and *institutions*. Both high levels of empathy and positive perceptions of institutions managing wildlife are predicted to improve the people's perception of the costs and benefits of a species (Kansky, et al., 2016) Further explanation of the variables applied in the survey can be found in Appendix I.

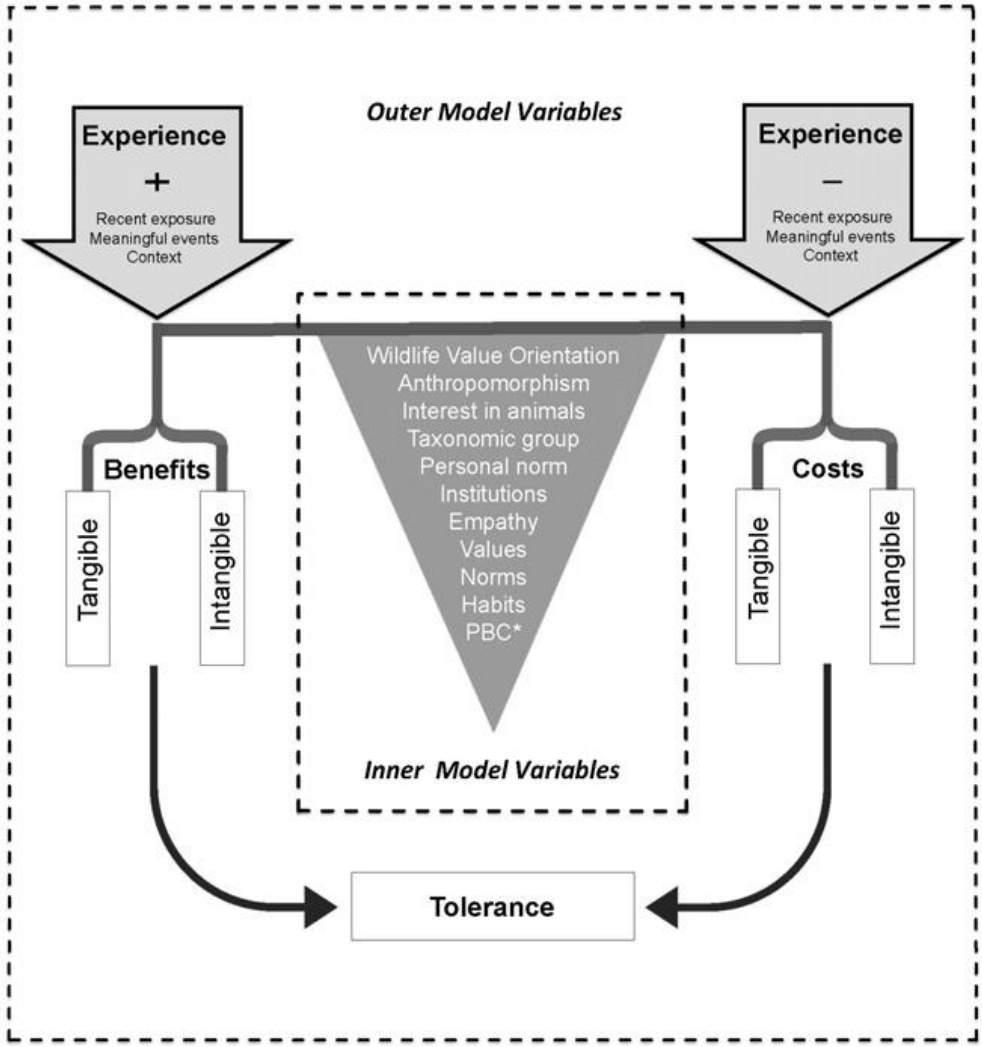

Figure 2. *Visualization of the Wildlife Tolerance Model (WTM) developed by Kansky et al. (2016) to identify key drivers affecting tolerance toward wildlife species*

2.5 Data sampling

The data for this study was collected in 2018 from April to July by the then Imperial College master students Irene Shivji and Filippo Marino, who interviewed residents of the two study areas. To fit the socioecological context of the study area, they adapted the questionnaire developed by Kansky et al. (2016). Next to sociodemographic variables from the survey participants (i.e. age, education, gender, and income), variables from the WTM were included in the questionnaire: experience, costs, benefits, tolerance, institutions, and empathy. Experience was operationalized through three additional variables: exposure, negative meaningful events, and positive meaningful events. Exposure was measured with recent spatial proximity of the species to the household, farm, and general area of the participant. Negative and positive meaningful experiences were measured with the number of their occurrences. Costs and benefits were operationalized through their tangible and intangible dimensions (e.g. monetary damage, emotions like fear, money spend on mitigation measures, money received from compensation schemes, tourism, benefits for nature). Tolerance was measured through five parameters: damage, killing, population size, prevention/mitigation, and spatial proximity. Empathy was measured through two main indicators: perspective taking and empathic concern. The last variable, institutions, was measured through a list of organizations involved in wildlife management and research in the study area where participants had to judge them according to their performance, communication, education and trust they inspired. Despite the questionnaire being mainly quantitative, participants could elaborate on different topics. This qualitative information could be used to support the interpretation of the results. More information on the variables and respective questions in the survey can be found in Appendix II.

Contact information of the residents was provided by the PNALM and RNRMGAG alike. These were telephone numbers of landholders that had received compensation payments from PNALM in the past and/or had been supported with electrical fences by RNRMGAG. Additional landholders who met the criteria were accessed through snowball sampling. The landholders were then contacted by phone and informed about the aim of the study. From each household, one individual was asked to participate in the survey. If having agreed on participating, they themselves could decide whether to be interviewed in person or fill in the questionnaire on their own. When they chose the face-to-face interview, appointments were arranged according to the requested time and place of the participants. When they chose the self-administered questionnaire, the researchers conducted weekly reminders by telephone. To ensure alignment with the context, 12 pilot interviews were conducted in April 2018, after which the questionnaire was evaluated and changed accordingly.

2.6 Data preparation

After the survey was conducted, the collected data was transferred to Excel by the same master students Irene Shivji and Filippo Marino as well as a few volunteers from the NGO Salviamo L'Orso. Using the wide format, a data set was created where the repeated responses of a subject (i.e. survey participant) were placed in a single row and each response to a question in a separate column. To fit analysis purposes, answers to the questionnaire were quantified beforehand, so that respondents had to choose on a likert scale or answer yes-no questions. The questions and the corresponding scale of possible answers can be found in Appendix II.

To fit the purposes of this study, the format of the data set was changed to the long format, where each subject was assigned two rows, one for the wolf and one for the bear. This was done to distinguish between the subjects' responses towards the two species for later analysis, thereby adding the new variable 'species', where 1=bear and 2=wolf.

After exploring the data with the software IBM SPSS Statistics Version 27 according to the protocol by Zuur et al. (2010), some variables needed to be transformed to fit the data. The validity and reliability of the latent variables had already been tested in the previous study by Marino et al. (2020) who investigated the indicator reliability, composite reliability, convergent validity, and discriminant validity of the constructs. To measure the internal consistency of the latent variables, reliability scores were computed using Cronbach's alpha. Indicators which removal improved the Cronbach's alpha values of their assigned construct were not included in the latent variable. Latent variables with different scales for their items were standardized through z-scores, as was the case for the tolerance construct. The latent variables, the final indicators that they consisted of and the corresponding Cronbach's alpha values can be found in Appendix III.

2.7 Data analysis

Using RStudio Version 1.3.1073 and the R packages "lmerTest" and "nlme" a linear mixed effects analysis (ANOVA) fit by maximum likelihood was performed to compare the tolerance levels between the two study areas per species. With tolerance as response variable, area and species were added as explanatory variables together with their interaction term. The respondent ID was added as a random within-subject factor because observations were not independent of each other considering that each respondent had to answer questions once about the bear and once about the wolf. Visual inspection of residual plots revealed an uneven spread of the residuals among the two areas. Hence, area was added as weighted factor in the new model to make up for this. Estimated marginal means (EMMs) from the package "emmeans" were used for post hoc testing to determine which groups significantly differed from each other. To make out which variable of the WTM or sociodemographic variable might possibly account for differences in tolerance it was tested how the variables differ between areas. Per species, a mixed model ANOVA was performed for each covariate. With a subset of bear or wolf, area was added to the models as the only explanatory variable, in combination with each covariate as response variable. Since all sociodemographic variables were categorical factors, their differences between areas were investigated using Chi-square.

3. Results

Of the 269 landholders willing to participate in the survey, 250 were interviewed or filled in the questionnaire on their own. The remaining 19 landholders who did not participate filled in a non-response questionnaire. 76 of the participants were residents of the RNRMGAG and 173 of the PNALM. After exclusion of missing values, the number of participants in PNALM shrank to 160.

3.1 Reliability of latent variables

Out of the 8 latent variables, 7 had Cronbach alpha (α) values above 0.7. The one variable to not reach the 0.7 threshold is tangible costs with a value of 0.63. This value was considered acceptable, however, because researchers in social studies often practice the use of 0.6 as the threshold instead (Mohamad, et al., 2015). Given the fact that this latent variable only consists of three items further explains why this was found to be sufficient, seeing that less items can decrease the α value (Taber, 2017). Nonetheless, this limitation should be kept in mind.

3.2 Differences in tolerance between PNALM and RNRMGAG

For both species, there were significant differences in tolerance levels between the two areas (Figure 3). In PNALM (n = 160), tolerance was significantly higher than in RNRMGAG (n = 76), both for the bear ($p < .001$, effect size = 2.07 [huge]) and the wolf ($p < .001$, effect size = 1.20 [huge]. The linear mixed effects model also revealed an interactive effect of species and area on tolerance (t (234) = 7.497, p <.001), which indicates that the effect of area on tolerance depends on the species, and vice-versa. Post hoc comparisons using Tukey's HSD test showed that while the species made a significant difference to the tolerance levels in PNALM, favoring the bear over the wolf ($p < .001$, effect size = 0.92 [large]), it did not in RNRMGAG ($p = 0.110$, effect size = 0.06 [negligible]) as tolerance remained low for both bear and wolf.

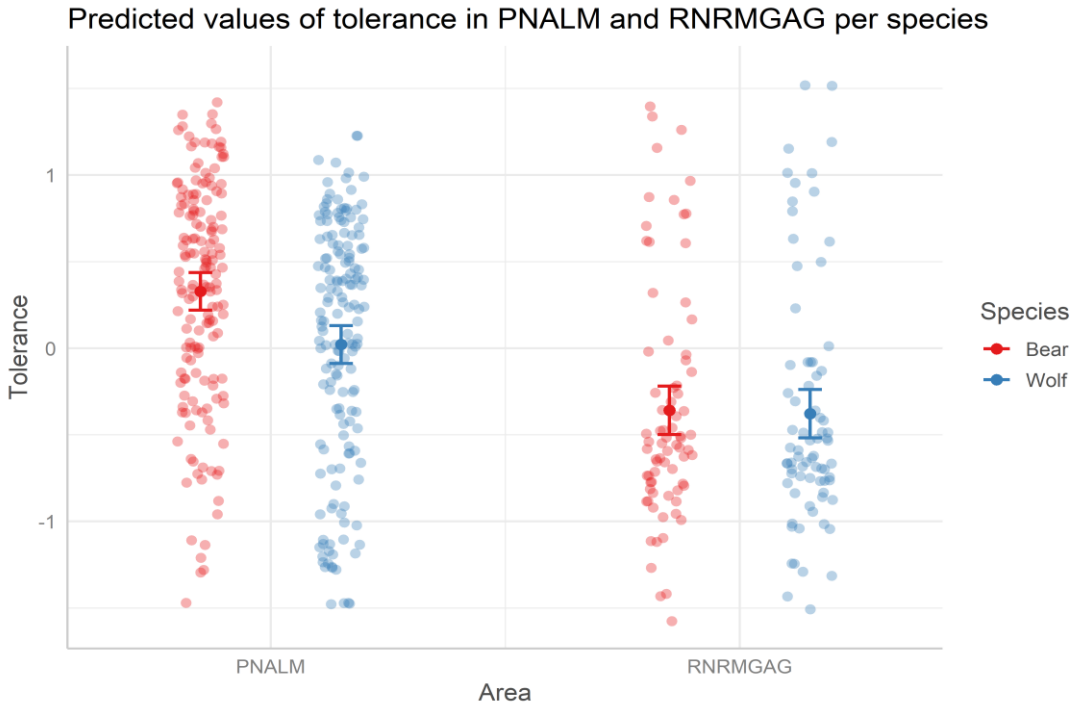

Figure 3. *Error bars of predicted values of tolerance z-scores in PNALM and RNRMGAG per species*

3.3 Differences in WTM variables between PNALM and RNRMGAG

Tangible costs

Monetary damage was not significantly different between PNALM and RNRMGAG, neither from bear nor wolf, with only slightly higher costs in PNALM (Table 1). Therefore, tangible costs could not be a driving factor for the difference in tolerance levels.

Table 1. *Descriptive comparison between PNALM and RNRMGAG for Wildlife Tolerance Model variables per species, with significantly higher means indicated in bold*

	PNALM		**RNRMGAG**			
	Mean	***SD***	**Mean**	***SD***	***p***	**Effect size**
BEAR						
Tolerance*	**0.33**	0.63	-0.36	0.70	<.001	2.07 (huge)
Tangible Costs*	0.08	0.68	-0.02	0.59	0.279 [g]	0.14 (negligible)
Intangible Costs*	-0.21	0.71	**0.19**	0.85	<.001 [g]	0.50 (medium)
Tangible Benefits	**3.19**	1.31	1.78	1.11	<.001 [g]	0.50 (medium)
Intangible Benefits*	**0.43**	0.65	-0.57	0.77	<.001	1.44 (very large)
Exposure	1.83	0.91	1.68	1.21	0.293 [g]	0.10 (negligible)
NME	0.88	4.35	0.39	0.39	0.081 [nb]	1.15 (very large)
PME	**6.46**	16.57	0.67	2.56	<.001 [nb]	2.44 (huge)
Empathy	**5.33**	1.55	4.62	1.64	0.002 [g]	0.08 (negligible)
WOLF						
Tolerance*	**0.02**	0.69	-0.38	0.71	<.001	1.20 (huge)
Tangible Costs*	0.02	0.91	-0.20	0.67	0.058 [g]	0.30 (small)
Intangible Costs*	0.04	0.90	0.17	0.89	0.292 [g]	0.12 (negligible)
Tangible Benefits	**2.65**	1.35	1.57	1.01	<.001 [g]	0.49 (medium)
Intangible Benefits*	**0.13**	0.78	-0.61	0.80	<.001	0.95 (large)
Exposure	**2.81**	1.67	1.64	1.25	<.001 [g]	0.45 (medium)
NME	**2.29**	16.51	0.62	3.50	0.033 [nb]	2.1 (huge)
PME	**3.96**	12.92	1.26	5.22	0.004 [nb]	1.37 (very large)
Empathy	4.88	1.78	4.59	1.66	0.237 [g]	0.03 (negligible)

*computed variables (z-scores), [nb] Negative binomial distribution, [g] Gamma distribution

Intangible costs

There were significant differences between the areas for intangible costs of living alongside bears (Table 1). In RNRMGAG, respondents perceived higher intangible costs for the bear than in PNALM. This difference was similar for the wolf but not significant. Consequently, it could be possible for intangible costs to explain the lower tolerance levels in RNRMGAG toward the bear, but not the wolf.

Tangible benefits

Respondents in PNALM reported significantly higher tangible benefits from both species than respondents in RNRMGAG (Table 1). This could explain why PNALM shows higher tolerance for bear and wolf.

Intangible benefits

Respondents in PNALM felt more intangible benefits from living with both species than did respondents in RNRMGAG (Table 1). The effect sizes are considerable as well, ranging from "large" for wolf to "very large" for bear. Thus, intangible benefits could explain the higher tolerance in PNALM.

Exposure

As regards the bear, no significant difference was found for exposure, although people in PNALM had slightly more exposure to the bear than in RNRMGAG (Table 1). However, for the wolf, it was significantly different between the areas, with again more exposure in PNALM than in RNRMGAG. Therefore, it is possible for exposure to explain the different tolerance levels.

Negative meaningful events

Despite having a "very large" effect size, the higher number of negative meaningful events with the bear in PNALM was not significant (Table 1). But for the wolf, it was significant and had an even larger effect size with respondents having had more negative meaningful events in PNALM than in RNRMGAG. Thus, it is possible that negative meaningful events could account for the difference in tolerance between the species in PNALM.

Positive meaningful events

In PNALM, people experienced significantly more positive events with both species than in RNRMGAG, especially with the bear (Table 1). Effect sizes are considerable: "very large" for the wolf and "huge" for the bear. Positive meaningful events with the two species could therefore explain the higher tolerance in PNALM.

Empathy

Empathy was not significantly different for wolf, although marginally higher in PNALM, but was significantly different for bear (Table 1). In PNALM, respondents felt more empathy toward the bear than respondents in RNRMGAG. This greater empathy could potentially explain the higher tolerance for this species in PNALM.

The other inner model variable institution was excluded from analysis as it had 7% missing values (n=34).

3.4 Differences in sociodemographic variables between PNALM and RNRMGAG

Age

There was a significant difference between the two areas for age (X^2 (2) = 13.37, p = 0.001). 20- to 40-year-olds made up 30% in PNALM (n=48), whereas in RNRMGAG only 12% (n=9). 40- to 60-year-olds comprised 42% in PNALM (n=67) and similarly 39% in RNRMGAG (n=30). Lastly, respondents above 60 constituted only 28% in PNALM (n=45) but 49% in RNRMGAG (n=37). This difference in demographics, with RNRMGAG leaning more to the older side and PNALM respondents' age distribution more balanced out, could potentially account for lower levels of tolerance in RNRMGAG.

Gender

For gender, there was a significant difference between the two areas (X^2 (1) = 5.18, p = 0.023). Significantly more respondents were female in RNRMGAG than in PNALM, with 21% women in RNRMGAG (n=16) and 9% in PNALM (n=15). Gender could therefore possibly account for differences in tolerance.

Education

Education level was significantly higher in PNALM (X^2 (2) = 13.95, p = <0.001) with the majority of respondents having attended high school (56%, n=89). In RNRMGAG, most respondents had attended only elementary or secondary school (61%, n=46). Therefore, education could potentially explain the higher levels of tolerance in PNALM.

Since income had 15% missing values (n=72), it was excluded from analysis.

4. Discussion

Results revealed that tolerance was higher in PNALM. Interestingly, species and area had an interactive effect on tolerance, which could be seen in the different tolerance levels for bear and wolf within the two areas. In PNALM, respondents favored the bear over the wolf, while in RNRMGAG, tolerance levels were the same for both species. Although geographically so close together, the two areas differ drastically in how their inhabitants see the Marsican brown bear and the Italian wolf. These results suggest that certain factors might be at work here that drive tolerance beyond the scope of mere locality.

Based on the analysis of sociodemographic and WTM variables, there were many that could potentially account for the differences in tolerance between area and species. In PNALM for instance, respondents perceived more benefits from coexisting with bears and wolves, both tangible and intangible. Not surprising, considering that PNALM has found ways to benefit from this coexistence, especially in the case of the bear. PNALM is famous for being the home of the endangered Marsican brown bear and attracts visitors that want to get a glimpse of this endemic species they can see nowhere else in Italy (Glikman, et al., 2019). Monetary benefits from tourism have been found in the past to increase locals' tolerance of wildlife as they associate their economic value with the species (Carter, et al., 2013). Next to tangible benefits, inhabitants also appreciate the two species for their intangible benefits. Having shared a long history of coexistence and mutual benefits (Marino, et al., 2020; Glikman, et al., 2011), the bear has become a symbol of the wild heart of Italy and a cultural heritage to be protected (Glikman, et al., 2019). This might also be one of the reasons why the respondents of PNALM showed significantly more empathy for the bear compared to RNRMGAG but not significantly more empathy for the wolf. These positive attitudes could have been shaped by the positive meaningful events with the two species, which were significantly higher in PNALM. A survey in Slovakia had shown for example, that people who had previously seen a bear thought significantly higher of it than people who had not (Wechselberger, et al., 2005).

Though single positive meaningful events can foster tolerance, exposure has been shown to negatively affect attitudes toward wildlife (Kansky & Knight, 2014; Heberlein & Ericsson, 2008). In the same study of Wechselberger et al. (2005), they found that people in the core area of carnivore abundance held more negative attitudes toward the bear and wolf than those in areas of absence. As exposure was significantly higher in PNALM than in RNRMGAG, but only for the wolf, exposure could explain why respondents of PNALM had lower tolerance of the wolf than the bear. Higher exposure to a species also increases the chance of experiencing negative events such as livestock losses (Heberlein & Ericsson, 2008). Since negative events generally have more of an impact than positive ones and are more likely to be remembered, bad impressions can form more easily and will result in lower tolerance (Kansky & Knight, 2014; Baumeister, et al., 2001; Rozin & Royzman, 2001). So, the fact that PNALM respondents reported significantly more negative meaningful events than those in RNRMGAG, but again only for the wolf, could potentially account for the difference in tolerance between the two species. Similar differences in tolerance between the two species in PNALM were documented in 2011, in a study conducted by Glikman et al. Although attitudes towards bears and wolves were generally positive, this was more so the case for bears with wolves being blamed more for monetary losses than bears (Glikman, et al., 2011). In their study, Glikman et al. (2011) suggested that knowledge of the species could potentially be part of the reason, saying that information campaigns in PNALM were more focused on bears and survey participants showed more knowledge of bears than wolves. Adding to this higher level of knowledge of the bear, participants in our study also showed more empathy for the bear.

Considering as well that PNALM has an economy partially based on the bear (Marino, et al., 2020; Glikman, et al., 2019), all these factors might ultimately make it more tolerable for people in PNALM to coexist with bears.

Against this background, it is hardly surprising that RNRMGAG respondents make no difference between bears and wolves, as all the points mentioned above only apply to PNALM. However, why then, is the tolerance in RNRMGAG so much lower in general when PNALM is significantly more exposed to the wolf and likewise faces more negative meaningful events?

While PNALM has a lot of positives to make up for the negatives (i.e. intangible and tangible benefits, positive meaningful events), it also shares a long coexistence history with both species. Unlike in most other places in Europe (Wolf & Ripple, 2017; Breitenmoser, 1998), bears and wolves were never fully eradicated from PNALM, allowing humans and carnivores to co-evolve over a long and persistent period. As the wolf and bear adapted in their ecology, so did humans in their behavior. The presence of bear and wolf became part of the local culture as well as traditional measures to prevent damages from carnivores, for instance sheepdogs guarding livestock (Carter & Linnell, 2016; Glikman, et al., 2011). Something similar can be seen in Chitwan, Nepal, where locals have been consistently exposed to the threats of tigers for hundreds of years (McLean, 1999). So much so that the risks posed by tigers have become part of their daily lives, ultimately not affecting the tolerance toward tigers anymore (Carter, et al., 2012). The same cannot be said for RNRMGAG, where the bear has only recently recolonized after decades of absence (Marino, et al., 2020; Di Domenico, et al., 2016). In RNRMGAG, intangible costs such as fear or stress due to living with bears are perceived significantly higher than in PNALM. Multiple studies have shown that people with negative or fearful perceptions of a species are less tolerant (Kansky & Knight, 2014; Wechselberger, et al., 2005; Riley & Decker, 2000). As locals in RNRMGAG are not used to living with bears anymore, they associate more of an unprecedented risk with it, which in turn might explain lower tolerance levels in RNRMGAG. In Sweden, people's tolerance for wolves decreased after reintroduction (Williams, et al., 2002) and was generally lower in areas where wolves had come back after previous absence (Ericsson & Heberlein, 2003).

Contrary to common belief, monetary losses cannot be a driving factor behind the different tolerance levels as tangible costs was not significantly different between PNALM and RNRMGAG. Previous research has shown that monetary damages do not play as big of a role in human-wildlife conflicts as emotions involved in or benefits derived from the coexistence with wildlife (Kansky, et al., 2020; Marino, et al., 2020). Even in cases where monetary damage meant major losses to livelihood, it did not significantly influence tolerance (Saif, et al., 2019). The fact that both PNALM and RNRMGAG both have compensation schemes in place might further add to this (Ciucci, et al., 2017).

Besides WTM variables, the sociodemographic variables age, gender and education could have possibly affected tolerance levels given that all three significantly differed between the two areas. Respondents of RNRMGAG were significantly older than respondents of PNALM, potentially leading to lower tolerance levels since tolerance often decreases with age (Campbell, 2013; Wechselberger, et al., 2005). For RNRMGAG, there were also significantly more female respondents than for PNALM, who have been found to be less tolerant toward carnivores than men (Campbell, 2013; Carter, et al., 2013; Czech, et al., 2001). Finally, the education level of RNRMGAG respondents was lower than of PNALM respondents. Since literature suggests a negative effect of lower education levels on tolerance this could have lowered tolerance in RNRMGAG as well (Carter, et al., 2013; Wechselberger, et al., 2005; Ericsson & Heberlein, 2003).

Before giving any suggestions based on this study, a few limitations should be mentioned. Though not the case for the tolerance model, the validation of the covariate models revealed some

problems with overdispersion and uneven spread of residuals among variables not in the model. It is also important to keep in mind that the multiple testing in this study can lead to false positives that arise because of chance. Therefore, this study is more of an exploratory nature. Lastly and most importantly, this study does not provide results indicating causality or correlation of the covariates with tolerance. It merely states which covariates differ per area and could therefore possibly account for the difference in tolerance levels. The next step will be to investigate which variable actually does drive the difference in tolerance levels between area and species, as was done by Kansky et al. (2020).

What these current results do show, however, is that RNRMGAG still has a lot of potential for improving their human-wildlife conflict with bears and wolves, as does PNALM with the wolf. Similar to what Marino et al. (2020) suggested, it is proposed to focus on the emotional aspect of the conflict by increasing intangible benefits and reducing intangible costs. Overall, management implications could involve increasing tangible benefits from tourism as well as intangible benefits by stimulating positive meaningful events with the bear and wolf through well-marked and safe hiking paths, positive educational signs, and guided tours (Marino, et al., 2020). 'Educating' the public with positive stories, presentations, workshops, and alike could cultivate a positive relationship with wildlife and bring about a better image for the bear and wolf (Bruskotter & Wilson, 2014). Facilitating discussion with stakeholders and especially people most affected by the conflict could lessen the impact of negative meaningful events and make the people feel less powerless when they themselves are affected, like the NGO Salviamo L'Orso already does (Marino, et al., 2020). Finally, preventive measures such as bear-proof bins and sheepdogs to guard livestock could reduce the appeal of human areas to bears and wolves and thus, reduce exposure, negative meaningful events, and conflict.

5. Conclusion

This study has demonstrated how tolerance toward large carnivores can differ even on a very local scale. Compared to the small reserve RNRMGAG, farmers in the national park PNALM share more positive feelings towards both carnivores, but especially the bear. Although not certain, this could very well be a result of the long coexistence history and the many positive meaningful events and benefits they associate with the species. Accordingly, a lack thereof and higher intangible costs such as fear and stress could be the reason why farmers in RNRMGAG have less tolerance for the bear and wolf. Similarly, exposure and negative events might have increased negative feelings toward the wolf in PNALM, showing the importance of decreasing intangible costs and increasing intangible benefits.

Considering that this is an exploratory study to get an insight into to the local tolerance levels in the Central Apennines and which factors could possibly play a role, a follow-up is needed to complete the picture and determine which factor does indeed drive the difference in tolerance levels toward bear and wolf in PNALM and RNRMGAG. Nevertheless, these results provide a first indication of possible variables influencing local tolerance and can therefore contribute to future research and management decisions.

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Attachments

Appendix I: List and description of the WTM variables applied in the survey

OUTER MODEL	
Variable	**Generalized description**
Exposure (EXPO)	Refers to the frequency and spatial proximity of an individual interacting with a species.
Positive Meaningful Events (PME)	Positive emotionally charged experiences which may have occurred at any time during an individual's lifetime, such as an unforgettable meaningful nature experience with wildlife.
Negative Meaningful Events (NME)	Negative emotionally charged experiences which may have occurred at any time during an individual's lifetime, such as wildlife causing the death of a family member.
Cost Tangible (CT)	Direct costs incurred from living with wildlife such as monetary loss through crop and household damage as well as, labor, time lost, injuries and fatalities.
Cost Intangible (CI)	Non-monetary values such as stress and fear which result from direct and indirect interactions with wildlife.
Benefits Tangible (BT)	These can appear in the form of compensation or NGOs/governments provisioning equipment for mitigating damages or the development of social institutions, e.g. schools.
Benefits Intangible (BI)	Non-monetary values referring to the existence value of a species for the individual, the community, mankind, and nature.
Tolerance (TOL)	Tolerance is measured through 4 main parameters; 1) tolerance to the killing of problem species under different contexts, 2) the population size of a species that person is willing to accept, 3) tolerance to live in a village where bears or wolves visit on a scale from never to numerous times in a week, 4) tolerance to varying levels of damage.
INNER MODEL	
Variable	**Generalized description**
Empathy (EMP)	High trait empathy predicts pro social behaviour towards humans and animals (Kansky, et al., 2016). Empathy is measured through 2 parameters: 1) empathic concern, 2) perspective taking.
Institutions (INS)	Institutions are defined as "durable systems of established and embedded social rules that structure social interaction and are therefore key components of social systems (Kansky, et al., 2016). In human–wildlife interactions institutions provide structure and regulate relationships between stakeholders and wildlife and between stakeholders regarding wildlife management. In the present study the variable institutions is measured through 5 parameters: 1) trust, 2) performance, 3) skills and knowledge, 4) communication, 5) education

Appendix II: Latent variables, their respective indicators and corresponding questions

OUTER MODEL			
Latent variable	**Indicators**	**Questions in survey**	**Scale**
Exposure (EXPO)	1. Expo_house_sum	How often were wildlife and/or fresh tracks SEEN on your HOUSEHOLD in the LAST SUMMER (May 2017 - Oct 2017)?	1 = Everyday 2 = 1-3 times a week 3 = 1-3 times a week - 2 times a month 4 = 2 times a month - once a month 5 = 1 time a month - 1 time every 2 months 6 = 1 time every 2 months - Once every 3 months 7 = 1 time every 3 months - Once every 6 months 8 = Never
	2. Expo_house_win	How often were wildlife and/or fresh tracks SEEN on your HOUSEHOLD in the THIS WINTER (Nov 2017 - May 2018)?	1 = Everyday 2 = 1-3 times a week 3 = 1-3 times a week - 2 times a month 4 = 2 times a month - once a month 5 = 1 time a month - 1 time every 2 months 6 = 1 time every 2 months - Once every 3 months 7 = 1 time every 3 months - Once every 6 months 8 = Never
	3. Expo_farm_sum	How often were wildlife and/or fresh tracks SEEN on your FARM in the LAST SUMMER?	As above

	4. Expo_farm_win	How often were wildlife and/or fresh tracks SEEN on your FARM in the THIS WINTER?	As above
	5. Expo_area_sum	How OFTEN were wildlife and/or fresh tracks SEEN in your AREA (neighbouring farms and roads) in LAST SUMMER?	As above
	6. Expo_area_win	How OFTEN were wildlife and/or fresh tracks SEEN in your AREA (neighbouring farms and roads) in LAST WINTER?	As above
Positive Meaningful Events (PME)	1. no_positive	Have you had any particularly POSITIVE EXPERIENCES with these WILDLIFE SPECIES? If yes HOW MANY such incidences have you experienced?.....	Number of experiences
Negative Meaningful Events (NME)	1. no_negative	Have you had any particularly NEGATIVE EXPERIENCES with these WILDLIFE SPECIES? If yes HOW MANY such incidences have you experienced?.....	Number of experiences
Cost Tangible (CT)	1. tot_mit_measures	Which of the following MEASURES HAVE YOU TRIED to prevent and reduce wildlife damage? Please mark all those you have tried by ticking the □ in the first column	Number of mitigation measures used out of a list of 13
	2. tot_mit_euro	How much have you spent in TOTAL on MITIGATION MEASURES to PREVENT WILDLIFE DAMAGE ON YOUR PROPERTY?	Euros
	3. damage	How much DAMAGE, in animals lost did your FARM EXPERIENCE due to wildlife, during the LAST SUMMER? How much DAMAGE, in animals lost did your FARM EXPERIENCE due to wildlife, during the THIS WINTER?	Number in Euros Number in Euros

Cost Intangible (CI)	1. neg_emo	Please describe EMOTIONS you feel due to LIVING WITH WILDLIFE in your area: Please tick as many feelings as necessary and indicate the intensity of the feeling on a scale of 0 to 5 Furious Irritated Worried Frustrated Stressed	0 = I do not feel this at all 1 = very weakly 2 = weakly 3 = average intensity 4 = strongly 5 = very strongly
	2. diff_time	COST1. Living with x in my area is difficult because it takes up a lot of my time to deal with them	1 = strongly disagree 2 = moderately disagree 3 = slightly disagree 4 = neither 5 = slightly agree 6 = moderately agree 7 = strongly agree
	3. diff_vigilant	COST2. Living with x in my area is difficult because I need to be vigilant at all times.	As above
	4. diff_protect	COST3. Living with x in my area is difficult because there are many things to think about to protect my farm enterprise.	As above
	5. diff_support	COST4. Living with x in my area is difficult because I don't get the support I would like from authorities.	As above
Benefit Tangible (BT)	1. comp_euro*	What type of animals, how many animals did you lose, how much money did you claim and receive for last summer (June 2017 – Nov 2017)?	Euros
		What type of animals, how many animals did you lose, how much money did you claim and receive for last winter (Dec 2017 – May 2018)?	Euros
	2. ben_you_mon	Please list how BENEFICIAL OR NOT you think wildlife are, in your general perspective, both MONETARY (benefit in euros)	1= NOT beneficial at all and 7= Very beneficial. Euros.

	3. ben_comm_mon	Please list how BENEFICIAL OR NOT you think wildlife are, in your general perspective, both MONETARY (benefit in euros)	1= NOT beneficial at all and 7= Very beneficial. Euros.
Benefit Intangible (BI)	1. pos_emo	Please describe EMOTIONS you feel due to LIVING WITH WILDLIFE in your area: Please tick as many feelings as necessary and indicate the intensity of the feeling on a scale of 0 to 5 Compassionate Grateful Safe Happy Relaxed	0 = I do not feel this at all 1 = very weakly 2 = weakly 3 = average intensity 4 = strongly 5 = very strongly
	2. ben_you_nonmon	Please list how BENEFICIAL OR NOT you think x are for YOU. If you think there are any benefits, please list them.	1= NOT beneficial at all and 7= Very beneficial
	3. ben_comm_nonmon	Please list how BENEFICIAL OR NOT you think x are for your COMMUNITY. If you think there are any benefits, please list them.	1= NOT beneficial at all and 7= Very beneficial
	4. ben_comm_nonmon	Please list how BENEFICIAL OR NOT you think x are for MANKIND. If you think there are any benefits, please list them.	1= NOT beneficial at all and 7= Very beneficial
	5. ben_nat_nonmon	Please list how BENEFICIAL OR NOT you think x are for NATURE. If you think there are any benefits, please list them.	1= NOT beneficial at all and 7= Very beneficial
Tolerance (TOL)	1. tol_killing*	Many wild animals are known to cause damage to humans and their property. Some are herbivores capable of eating agricultural crops and gardens or raiding urban households. Others are carnivores capable of killing domestic livestock as well as scaring, injuring or killing humans. Under what conditions do you think it would be justified to kill a wild animal? Please ignore for now if it is illegal or not, who would do the killing, how it would be killed or what would be done with its body.	Yes/no/unsure

		Read the scenarios listed in the table below and tick the appropriate boxes. Do you think a X should be killed if… ….it is seen far away from any village or houses or livestock or agricultural crops. …it is seen in the vicinity of where livestock are grazing or agricultural crops are growing, or on the urban fringe where they could enter people's properties. ...it has injured or killed a domestic animal or has raided some houses or agricultural crops for the first time. ...it causes repeated problems for you and your community but has never harmed a person. …..it has threatened a child or adult human. …..it has injured a child or adult human. ….it has killed a child or adult human.	
	2. tol_pop_area	Would you like the population of x IN YOUR AREA to decrease, stay the same or increase?	1= Decrease a lot 2= Decrease a little 3= Stay same 4= Increase a little 5= Increase a lot

			6=no opinion
	3. tol_pop_PNALM_RNRMGAG	Would you like the population of x in PNALM to decrease, stay the same or increase?	As above
	4. tol_pop_italy	Would you like the population of x in ITALY to decrease, stay the same or increase?	As above
	5. tol_expo_house_sum	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your HOUSEHOLD? SUMMER	Number of days
	6. tol_expo_house_win	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your HOUSEHOLD? WINTER	As above
	7. tol_expo_farm_sum	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your FARM? SUMMER	As above
	8. tol_expo_farm_win	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your FARM? WINTER	As above
	9. tol_expo_area_sum	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your AREA (neighbouring farms? SUMMER	As above
	10. tol_expo_area_win	What would be the maximum NUMBER OF DAYS PER SEASON you would be able to TOLERATE OR COPE with seeing wildlife and/or fresh tracks on your AREA (neighbouring farms? WINTER	As above

	11. tol_loss_money*	What would be the maximum AMOUNT OF DAMAGE you would be able to TOLERATE OR COPE with due to wildlife in ONE YEAR?	Euros
	12. tol_damage	Indicate how you would FEEL for the different scenarios: If x came to my land and 0% (none) of my crops/livestock were destroyed I would be… If x came to my land and 20% of my crops/livestock were destroyed I would be… If x came to my land and 40% of my crops/livestock were destroyed I would be… If x came to my land and 60% of my crops/livestock were destroyed I would be... If x came to my land and 80% of my crops/livestock were destroyed I would be…	1 = Extremely sad 2 = Very sad 3 = Sad 4 = I would not be sad or happy 5 = I would be happy 6 = I would be very happy 7 = I would be extremely happy
INNER MODEL			
Latent variable	**Indicators**	**Questions in survey**	**Scale**
Empathy (EMP)	1. emp_softhearted (Empathic concern)	When it comes to x, I would describe myself as a pretty soft-hearted person.	1 = strongly disagree 2 = moderately disagree 3 = slightly disagree 4 = neither 5 = slightly agree

			6 = moderately agree 7 = strongly agree
	2. emp_shoes (Perspective taking)	When I am upset about something x have done, I usually try to "put myself in its shoes".	As above
	3. emp_sorry (Empathic concern)	Sometimes I don't feel very sorry for x when they are having problems.	As above
	4. emp_perspect (Perspective taking)	When x are being problematic I often try to see things from their perspective as well.	As above
	5. emp_protect (Empathic concern)	When I see x being hurt or treated badly I feel kind of protective towards them.	As above
	6. emp_imagine (Perspective taking)	I sometimes try to understand x better by imagining how things look from their perspective.	As above
Organization (ORG)**	1. org_trust	There are a number of ORGANIZATIONS that have been involved in WILDLIFE MANAGEMENT, RESEARCH, in the PNALM/RNRMGAG. Please indicate if you are familiar with these organizations by typing "Y" in the first column. Then record the extent to which you think they have undertaken the various tasks listed in the remaining columns. 1) Trust in the organization 2) General Performance 3) Skills and knowledge to manage wildlife 4) Communication with farmers 5) Education of farmers Organizations listed: 1. Local Farmer's Association 2. Associazione Italiana Allevatori (AIA)	
	2. org_performance		
	3. org_skills_knowledge		
	4. org_communication		
	5. org_education		

		3. Associazione Regionale Allevatori Abruzzo (ARA Abruzzo) 4. Associazione Regionale Allevatori Lazio (ARA Lazio) 5. Parco Nazionale D'Abruzzo, Lazio e Molise 6. Riserva Naturale Monte Genzana Alto Gizio 7. Local Municipality 8. Dipartimento politiche dello sviluppo rurale della Regione Abruzzo 9. Carabinieri Forestali 10. NGO "Salviamo L'Orso" 11. NGO "Dalla parte dell'orso"	
	6. comp_sat	Overall, how would you describe your experience of the COMPENSATION SCHEME implemented in your area for wolves/bear?	1= Extremely dissatisfied 2= Very dissatisfied 3= Moderately dissatisfied 4= Neutral 5= Moderately satisfied 6= Very satisfied 7= Extremely satisfied

*excluded from construct because of their removal improved the internal consistency of their assigned construct

**excluded from analysis because of too many missing values

Appendix III: Latent variables and their Cronbach's alpha

Constructs	Construct items	Cronbach α	95% Confidence Interval
Outer Model			
Exposure	expo_house_sum	0.84	(0.81, 0.86)
	expo_house_win		
	expo_farm_sum		
	expo_farm_win		
	expo_area_sum		
	expo_area_win		
Positive Meaningful Events	no_positive	N/A	
Negative Meaningful Events	no_negative	N/A	
Tangible Costs	damage	0.63	(0.57, 0.69)
	mit_measures		
	mit_euro		
Intangible Cost	diff_time	0.89	(0.88, 0.91)
	diff_vigilant		
	diff_support		
	diff_protect		
	neg_emo		
Benefit Tangible	ben_you_mon	0.72	(0.66, 0.76)
	ben_comm_mon		
Benefit Intangible	ben_you_nonmon	0.90	(0.88, 0.91)
	ben_comm_nonmon		
	ben_man_nonmon		
	ben_nat_nonmon		
	pos_emo		
Tolerance	tol_damage	0.86	(0.84, 0.88)
	tol_expo_house_sum		
	tol_expo_house_win		
	tol_expo_farm_sum		
	tol_expo_farm_win		
	tol_expo_area_sum		
	tol_expo_farm_win		
	tol_pop_area		
	tol_pop_PNALM_RNRMGAG		
	tol_pop_italy		

Inner Model			
Empathy	emp_softhearted	0.88	(0.87, 0.90)
	emp_shoes		
	emp_sorry		
	emp_perspect		
	emp_protect		
	emp_imagine		
Organization	org_trust	0.92	(0.91, 0.93)
	org_performance		
	org_skill_knowledge		
	org_communication		
	org_education		
Sociodemographic			
Gender	gender	N/A	
Age	age_group	N/A	
Education	education	N/A	
Income	income	N/A	