# LIFE CONNECT CARPATHIANS

**Enhancing landscape connectivity for brown bear and wolf through a regional network of NATURA 2000 sites in Romania**

# Knowledge, Attitudes and Perceptions (KAP) survey in the Apuseni-Meridionali Carpathian Corridor

Imperial College London

# Large Carnivore Conservation Conflict in the Carpathian Mountains, Western Romania


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## Declaration of Own Work

I declare that this thesis "Large Carnivore Conservation Conflict in the Carpathian Mountains, Western Romania" is all my own work, except for collection of the data, and that where material could be credited as the work of others, it is fully cited and referenced, with appropriate acknowledgement provided. Data collection (interviews with rural households in the project area) was performed by Claudia Câmpeanu, Liviu Chelcea and Câlin Cotoi from the University of Bucharest, and Marius Cosmeanu from the "Tempo Giusto" Association.

**Signed**……..

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# Abstract

I examined and compared attitudes towards and tolerance to Eurasian brown bears (*Ursus arctos*) and gray wolves (*Canis lupus*) across the Carpathian Mountains in Western Romania. Face-to-face surveys of 602 rural households indicated that 33% have experienced damage caused by wolves and 21% by bear. Sixty percent of participants hold negative attitudes of wolves and 40% of bears. If a wolf were to cause damage to property or agriculture, 34% of participants would shoot it, compared to 13% for bear. Attitudes towards and tolerance of large carnivores was compared to other wildlife found in the area. Gender, experience of damage, level of education and village size affected attitudes towards these large carnivores, while only experience of damage affected tolerance towards them. Spatial analysis of attitudes and reports of damage indicated the presence of three regions within the study area: 1) Southern Carpathians where attitudes tend to be positive and reports of damage are low, 2) Western Carpathians where attitudes are negative and reports of damage are high, and 3) lowland linking the mountain ranges, where reports of damage are lower but attitudes are very mixed. Identification of these regions allows targeted conservation action. Attitudes towards large carnivores are largely affected by perceived risks of damage to both people and property, although actual risks are relatively low. Support from local residents is important for large carnivore conservation schemes to be successful, therefore understanding the underlying attitudes and tolerance of participants to large carnivores is crucial.

# 1 Introduction

Since the 18th century, large carnivore populations have declined in Europe due to the combined effects of habitat loss and fragmentation, and hunting (Breitenmoser, 1998; Kaczensky, 1999). Over the last 50 years, attempts to restore large carnivore populations in parts of Europe have intensified, with varying degrees of success (Chapron et al., 2014). Local improvements in habitat quality, the return of prey species, public support and favourable legislation have contributed to the recovery of some populations (Kacensky et al., 2012). Currently, Europe hosts several large and robust populations of large carnivores, comprising thousands of individuals, medium-sized and increasing populations that number in the hundreds of individuals, and several small, critically endangered and declining populations comprising of tens of individuals (Chapron et al., 2014; Kaczensky et al., 2012). Nevertheless, large carnivore species remain vulnerable to extinction due to their relatively small population sizes, large habitat requirements and slow growth rates (Purvis et al., 2000; Bruskotter and Wilson, 2013). Where large carnivore populations are increasing and/or expanding, conservation conflict may increase or intensify (Kansky and Knight, 2014; Redpath et al., 2013; Balmford et al., 2001), therefore conservation approaches need to be carefully managed.

Conservation conflict can be partitioned into two components: (i) impacts that deal with direct interactions between humans and other species; and (ii) conflicts that centre on human interactions between those seeking to conserve species and those with other goals (Young et al., 2010). Large carnivores can incur significant costs to people, particularly those associated with predation of livestock and game, attacks on humans, disease transmission, and opportunity costs (Dickman, 2010; Woodroffe et al. 2005). Those people who are directly impacted tend to be more opposed to large carnivore recovery, whereas recovery is more likely to be supported by those not living in close proximity (Kellert et al., 1996) and where human-carnivore co-existence has been unbroken (Bath and Maijie, 2001; Kaczensky et al., 2004). Where large carnivores become absent from an area, locals often abandon traditional farming and herding methods and lose knowledge of large carnivores (Chapron et al., 2014; Kaczensky et al., 1999). The reappearance of large carnivores may result in locally high levels of damage (Kaczensky et al., 1999) and higher levels of fear (Zimmermann et al., 2001). The human response to damage caused by wild animals, or in response to a perceived risk of damage, is often lethal control (Dickham, 2010; Liu et al., 2011). Consequently, lethal control could contribute to the decline of vulnerable populations of large carnivores unless conflict is managed effectively (Kellert et al., 1996).

While understanding the biology of a species and its habitat is important for reducing conservation conflict, there is also a need to understand public attitudes towards species and possible management approaches (Kansky and Knight, 2014). Social factors strongly influence perceptions of conservation conflict and can modulate conflict intensity (Kansky et al. 2014). Effective conflict management requires a cross-disciplinary approach, through integration of the underlying social context with material impacts (Redpath et al. 2013). Human attitudes can be shaped by a number of factors, for example, previous experience with wild animals (Zimmermann et al., 2005), perceived economic loss and socioeconomic factors (Farhadinia et al., 2017; Babrgir et al., 2017; Dar et al., 2009), age, gender and education (Kellert and Berry, 1987; Suryawanshi et al., 2014) and risk to human life (Behdarvand and Kaboli, 2015), as well as people's knowledge and understanding of a species (Kellert et al., 1996). Individuals with positive attitudes are more likely to support conservation programmes and an increase in population numbers (Kaczensky et al., 2004). Therefore, it is important to understand and address the underlying attitudes towards large carnivores when designing interventions to ensure conservation initiatives are successful (Kansky and Knight, 2014).

Historic extirpations and extinctions caused by the actions of human populations worldwide have shown that human tolerance for large carnivores can play an important role in defining their distributions and densities (Bruskotter and Wilson, 2013), highlighting the need to understand the factors which promote tolerance. Research has shown that an individuals' willingness to accept a hazard is based upon perceived risks and benefits associated with that hazard (Siegrist et al., 2000). Often the perceived risk of damage may far outweigh the actual risk of damage, meaning tolerance of large carnivores is low despite the small risk of damage occurring (Bruskotter and Wilson, 2013). Studies have shown that the strongest predictor of acceptance of large carnivores are the perceived benefits associated with the species (Carter et al., 2012; Slagle et al., 2012, 2013). Slagle et al. (2013) showed that presenting information to individuals about how to avoid or reduce risks associated with black bears (without information about benefits) lowered tolerance, while tolerance was increased the most when participants were given information about both the benefits of living with black bears and how to reduce risks (Buskotter and Wilson, 2013). Human dimensions, such as attitude and tolerance, have been shown to influence the success of large carnivore conservation schemes (Woodroffe, 2000), therefore, it is important to understand them and how they contribute to the complexity of conflict issues.

In Romania, public opinions towards large carnivores have not been extensively studied, particularly in Western Romania where this study is based. In rural communities of Romania, agriculture has a high economic and social importance but suffers from wildlife-induced damage. Losses may cause increasingly negative attitudes of local people towards species responsible for damage (Babrgir et al., 2017; Zimmerman et al., 2001; Naughton-Treves et al., 2003; Liu et al., 2011), and even affect attitudes

towards and tolerance of other species associated with damage (Farhadinia et al., 2017). The Romanian landscape provides globally important habitats for brown bears (*Ursus arctos)*, gray wolves *(Canis lupus*) and Eurasian lynx (*Lynx lynx)* (Chapron et al., 2014; Mertens and Promberger, 2001). However, populations are at risk from habitat loss and fragmentation (Feranec et al., 2010). For example, the Carpathian Mountains in Western Romania have become increasingly isolated, due to the growth of human settlements and agriculture in lowland separating the Western and Southern Carpathians. To prevent genetic, ecological or demographic isolation of large carnivore populations, the Life Connect Carpathian (hereafter referred to as LCC) project has created ecological corridors to increase connectivity for large carnivores between the mountain ranges (Goldthorpe, in press). This is likely to increase large carnivore presence in areas of human settlement.

To guarantee long-term success of the project, it is important to ensure local residents are supportive of large carnivore populations and that they accept population increases. Therefore, in this study I aim to:
1) understand local attitudes towards, and knowledge and tolerance of large carnivores, and 2) understand how attitudes towards large carnivores vary spatially. This study will focus on two large carnivore species in Romania, the Eurasian brown bear and gray wolf. Wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus)* and beaver (*Castor fiber)* are also native to Romania and will be included in the initial analysis to provide a comparison between species. Study aims will be addressed through analysis of survey data conducted through personal interviews. Understanding the human dimensions associated with conservation conflict in Romania will help guide conservation management approaches.

# 2 Methods

## 2.1 Study Area

The LCC project area covers 4,300km$^2$ of the Carpathian Mountains in western Romania, and consists of three zones: the Western Carpathian Mountains to the north; Southern Carpathians to the south; and a lower-lying area linking the two mountain ranges, where human use is higher and there are more permanent settlements (Figure 1). The region is characterised by extensive forests and mountainous areas, interspersed with villages and agricultural areas. The main agricultural activities are livestock grazing, orchards, crops and beehives, with seasonal movement of livestock occurring between summer and winter pastures. Sheep are the main form of livestock and hay the most widely grown crop. Most conflict involving livestock concerns wolves and wild boar are reported as the main cause of damage to crops. A small number of bear attacks on livestock and orchards also occur.

There are approximately 218,300 residents of the LCC project area, living in 63 territorial administrative units, within 6 counties. Each administrative unit contains at least one village, with 312 villages in total. Twenty Natura 2000 sites (nature protection areas) have been established in the LCC project area to provide ecological corridors between the two mountain regions, specifically to increase connectivity for large carnivores (Figure 1). Approximately 31% of residents live in administrative units inside of Natura 2000 sites. Commercial and subsistence hunting occurs throughout Romania and is regulated by Game Management Units (Goldthrope, in press).

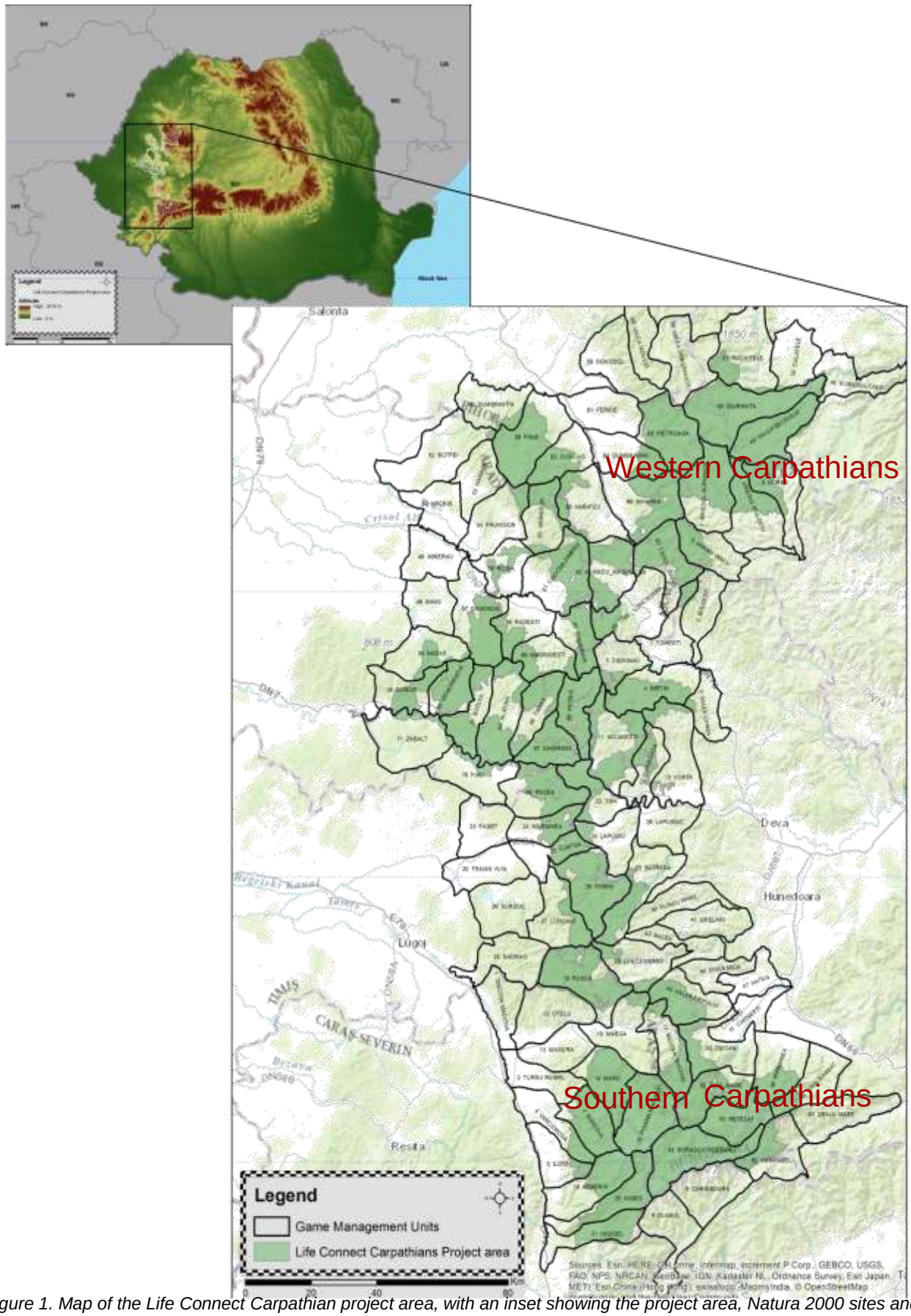


*Figure 1. Map of the Life Connect Carpathian project area, with an inset showing the project area, Natura 2000 sites and Game Management Units*

## 2.2 Data collection

Face-to-face interviews were conducted in 2015 with 602 households selected from 100 villages in the project area, to obtain data on people's knowledge, attitudes and perceptions of large carnivores (bears and wolves) and other species in the area (wild boar, beaver and roe deer). Sampling was stratified according to village size and proximity to Natura 2000 sites, and residents living both within and outside of Natura 2000 sites were surveyed. The number of interviews conducted in each village was relative to the size of the village, and varied from 0.5% of the number of residents in the larger villages to 3% in some smaller villages (Appendix 1). Adult male and female participants were approached and asked a combination of structured and open-ended questions.

Topics covered included: perceived and preferred changes in wild animal populations, interactions with wild animals, first or second-hand experience of wildlife-caused damage, human responses to wild animal damage, attitudes towards wild animals and knowledge of wild animals (see Appendix 2). Sociodemographic data were also recorded (gender, age, occupation, education, income, proportion of income from agriculture) for each participant. Responses to attitudinal questions were on a 5-point in the Likert scale (very positive to very negative). Participants were asked a total of nine questions testing their knowledge of wolves, bears and roe deer reproductive and social behaviour. These three species were chosen to test if levels of knowledge about species harbouring more positive attitudes (e.g. roe deer) were different to levels of knowledge about species who tend to harbour more negative attitudes (wolf and bear). Three questions were asked about each species, with questions such as "What do you think is the main food of wolves?" and "How often does the female bear give birth?"

## 2.3 Data analysis

Responses to attitudinal questions ranged from very positive to very negative, these were coded from 2 to -2 for data analysis. Responses to Question 22 ("How would you respond if a wild animal were to attack your property, crops or livestock?") were used as a measure of tolerance towards wild animals. Answers were categorised on a scale of 1 to 5, with 1 being the most tolerant and 5 the least tolerant, where possible answers were: (1) educate neighbours about mitigation measures to prevent damage, (2) leave the wild animal alone, (3) scare the wild animal away, (4) relocate the animal, and (5) shoot. Knowledge questions were compiled to give a total knowledge score (maximum score of nine) and knowledge scores for each of the species (maximum score three).

Sociodemographic data were used as potential explanatory factors for attitudes and tolerance towards wild animals, and were grouped as follows: four income categories (RON 0-500, 501-1000, 1001-2000, 2000+), gender (male and female), education level (Class 2 (8-9 years old), 4 (10-11 years), and 8 (14-

15 years), vocational, high school, post-secondary school, university, post-graduate), residents' age (18-26, 27-51, 52-71, 72-95), proportion of income from agriculture (0%, 25%, 50%, 75% and 100%) and a total of 17 occupations were recorded. Village size was coded into 5 categories according to number of people: 10-99, 100-199, 200-499, 500-1000, 1000-1999.

To determine if sociodemographic and spatial variables were significant in explaining attitudes and tolerance towards wild animals, analysis was performed using Kruskal-Wallis and Mann-Whitney U tests. These tests were used due to the ordinal nature of the Likert scale data because the median rather than the mean should be used as a measure of central tendency. Correlation tests were also performed using Cramer's V. When testing level of knowledge with sociodemographic and spatial variables, ANOVA and t-tests were used as the data is parametric. Further analysis was performed using ordinal logistic regression to find which explanatory variables caused the most variance in attitudes and tolerance. Models with the lowest AIC were selected. Occupation could not be included in the model because the responses are unordered, but separate analysis indicated that the occupation of participants had a significant impact on their attitude towards bears, wolves and wild boar. This analysis was performed using Kruskal-Wallis tests (Appendix 3). Regression analysis was only performed on questions regarding bear, wolf and wild boar because roe deer and beaver are viewed relatively positively and cause small amounts of damage, therefore attitudes do not need to be improved. Wild boar cause large amounts of damage to crops, and negative attitudes towards boar may be transferred to large carnivores (Farhadinia et al., 2017). Furthermore, resolving conflict between local residents and wild boar, as well as large carnivore, may encourage residents to be more supportive of the LCC project and recovery of large carnivore populations.

Not all questions were answered by participants, therefore the sample size (n) refers to how many participants answered the question rather than the number of people who were asked the question. All analysis was performed using Microsoft Excel and R Core Team (2016).

## 2.4 Spatial analysis

Spatial analysis was used to test how attitudes towards bear and wolf vary across the project area. Maps were created using ESRI (2012) ArcMap software 10.5. Bear and wolf estimated abundance data was supplied by GMUs. Hotspot analysis was performed in ArcMap on attitudinal data. This was compared to reports of damage taken from the interviews. To find the proportional amount of damage for each village, the total number of participants who had experienced first or second-hand damage was divided by the total number of interviews conducted in that village.

# 3 Results

## 3.1 Sociodemographic and spatial characteristics of the surveyed population

Sixty-percent of participants were men, and the mean age of participants was 50 (range 18-95, n=597). Fifty-percent of participants have completed high school or higher education (n=587). The proportion of participants totally reliant on agriculture as their main form of income is only 5%, whereas 81% of participants receive 0 or 25% of their income from agriculture (n=552). The lowest income category contains the largest number of participants (31.7%), while the highest income category contains the fewest (14.4%, n = 450). The most common occupation within participants were retirees (26%) followed by "other" (23%), housewives (19%) and livestock owners (8.6%). Forty-three percent of participants were between 28 to 51 years old, while 32% were between 52 to 71 years old (n=597). Occupation and gender were highly correlated ($X^2$ = 166, $p$ <0.001, Cramer's V = 0.53). A large proportion of females are housewives (42%) or retired (23%). Twenty-nine percent of males are retired, 25% answered "other" and 13% livestock owners. Participants were spread equally between living inside and outside of Natura 2000 sites. Village size ranged from 10 to 2000 people, with 36% living in villages ranging from 200-499. Forty-five percent lived in villages with more than 500 people and 19% lived in villages with fewer than 200.

## 3.2 Attitudes towards, and knowledge and tolerance of wild animals

### *3.2.1 Attitudes towards wild animals*

Overall, participants were most positive towards roe deer and least positive towards wolves (Figure 3). Roe deer are the species most commonly seen by participants (39% see them frequently and 54% occasionally, frequency is based on the participants' perception). When asked if they would like numbers of roe deer to change, 65% of females (n=213) and 75% of males (n=352) stated they would like to see an increase in numbers. Attitudes towards beavers were mainly neutral and 85% of participants have never seen one or any of their tracks or signs. As attitudes towards roe deer were mainly positive and only small numbers of beavers exist in the LCC project area, these species were excluded from regression analyses of attitudes.

Gender, whether participants had experienced first or second-hand damage and education level were retained in the best models for attitudes towards all three species, with attitudes being more negative among women, those who have experienced damage and among those who have completed lower levels of education (Table 1). There was also a strong correlation between gender and fear of wild animals, with females significantly more fearful of bears ($X^2$ = 76, $p$ <0.001, Cramer's V = 0.36), boar ($X^2$ = 116,

$p$ <0.001, Cramer's V = 0.44) and wolves ($X^2$=77, $p$ <0.001, Cramer's V = 0.36) which may partially explain their negative attitudes. Participants were slightly more afraid of bears than wolves. Approximately half the surveyed population were afraid of wild boar, and a small number were afraid of beaver and deer (Figure 2).

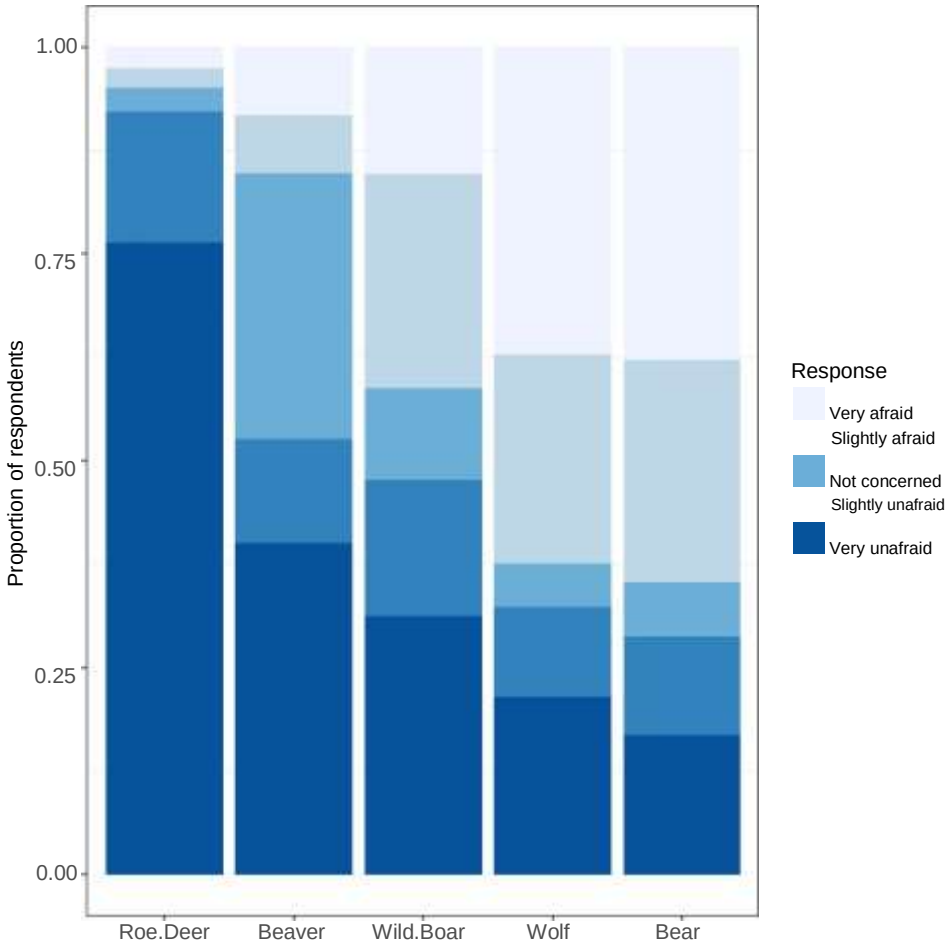


*Figure 2. Comparing how fear of respondents changes between five species of wildlife: bear, roe deer, wild boar, beaver and wolf (Number of responses: bear=596; roe deer=594; wild boar= 595; beaver=558; wolf=593)*

The most negative attitudes were towards wolves (67% of females (n=233) and 56% of males (n=353)), followed by wild boar (49% of females (n=234) and 41% of males (n=356)) and bears (45% of females (n=233) and 36% of males (n=358)) (Figure 3). Most participants have never seen a wolf or bear (60% of females (n=236) and 41% of males (n=360), and 77% of females (n=235) and 56% of males (n=361), respectively), whereas wild boar are the second most common species in the LCC project area and the majority of participants' report seeing them frequently (54% of females, n=236 and 57% of males, n=360).

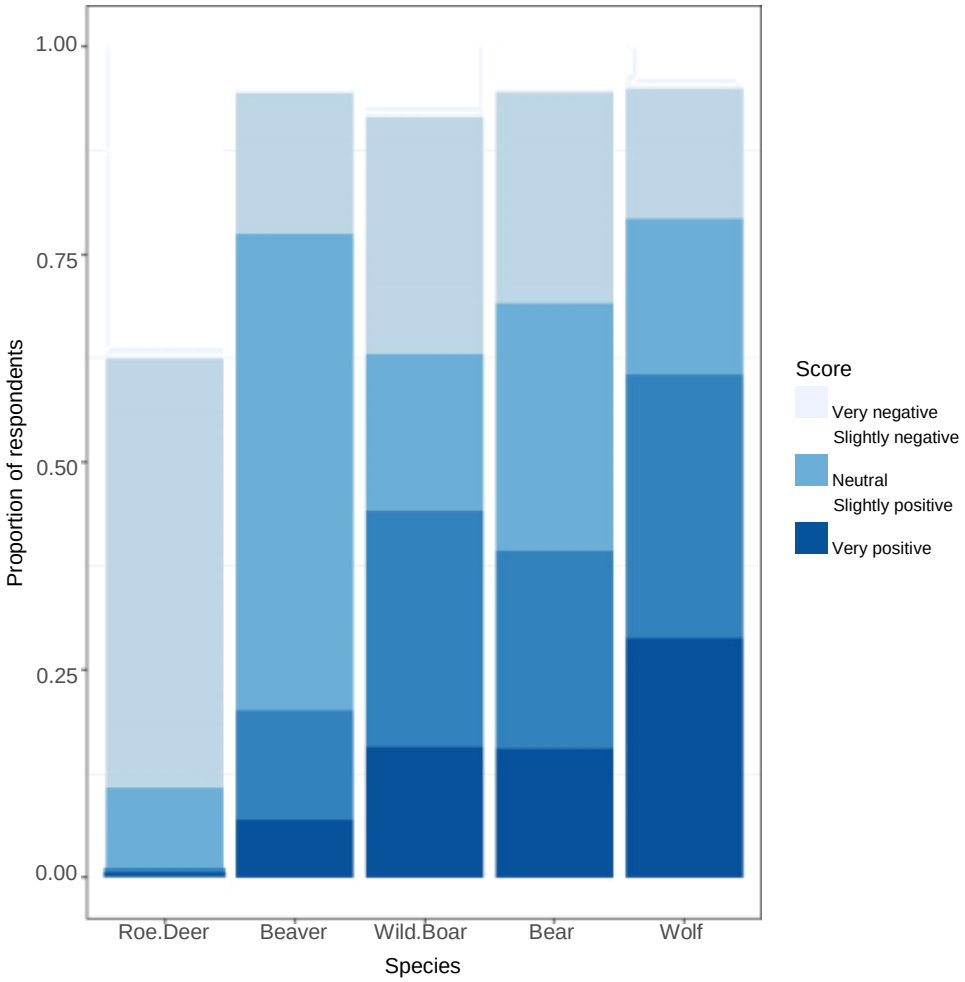


*Figure 3: Comparing attitudes of participants to five species of wild animals found in Romania (bears, roe deer, wild boar, beavers and wolves). (Number of responses: Bear =591; Roe Deer =590; Wild Boar =590; Beaver =556; Wolf =586)*

While the majority of participants want to see wolf numbers decrease (63% of females and 51% of males, n=514)), 63% of participants would like bear numbers to increase or stay the same over the next ten years (59% of females and 65% of males, n=438), and 60% would like wild boar numbers to increase or stay the same (55% of females and 63% of males, n=561).

*Table 1. Results of ordinal logistic regression of factors affecting attitude towards bear, wolf and wild boar in Romania.*

| | Explanatory variable | Model AIC | Proportional odds ratio | SE | *t* | *p* |
|---|---|---|---|---|---|---|
| **Bear** | | 1107.6 | | | | |
| | Gender | | 1.84 | 0.19 | 3.16 | **0.002** |
| | Damage | | 0.52 | 0.25 | -2.63 | **0.009** |
| | Education | | 1.15 | 0.07 | 2.04 | **0.04** |
| | % income from agriculture | | 0.90 | 0.09 | -1.17 | 0.24 |
| | Income | | 1.05 | 0.09 | 0.50 | 0.62 |
| | Village Size | | 1.32 | 0.09 | 2.81 | **0.005** |
| | Frequency of contact | | 0.88 | 0.18 | -0.74 | 0.46 |
| **Wolf** | | 1160.0 | | | | |
| | Gender | | 1.47 | 0.19 | 2.09 | **0.04** |
| | Damage | | 0.62 | 0.20 | -2.44 | **0.01** |
| | Education | | 1.21 | 0.07 | 2.85 | **0.004** |
| | % income from agriculture | | 0.88 | 0.09 | -1.51 | 0.13 |
| | Income | | 1.11 | 0.08 | 1.25 | 0.21 |
| | Village size | | 0.99 | 0.08 | -0.17 | 0.87 |
| **Boar** | | 1235.9 | | | | |
| | Gender | | 1.98 | 0.18 | 3.76 | **<0.001** |
| | Damage | | 0.54 | 0.18 | -3.39 | **<0.001** |
| | Education | | 1.23 | 0.07 | 3.02 | **0.003** |
| | % income from agriculture | | 0.89 | 0.07 | -1.82 | 0.07 |
| | Income | | 1.23 | 0.08 | 2.55 | **0.01** |
| | Age | | 1.31 | 0.11 | 2.45 | **0.01** |
| | Village size | | 0.98 | 0.08 | -0.32 | 0.75 |

Sixty-three percent of participants have reported damage from wild boar, one third of participants have experienced damage by wolves and 21% by bear (Figure 4). A small number of reports of damage were documented for roe deer (10%) and beaver (6%). Average support for wolves and an increase in wolf numbers was higher among people who had not experienced damage (17% vs 8%, Kruskal-Wallis: $X^2$ = 19, $p$ = <0.001) and the same for bears (27% vs 9%, Kruskal-Wallis: $X^2$ = 37, $p$ = <0.001). Participants

appear to be significantly more concerned about wild animals causing them damage in the future if they have already experienced damage (Appendix 3).

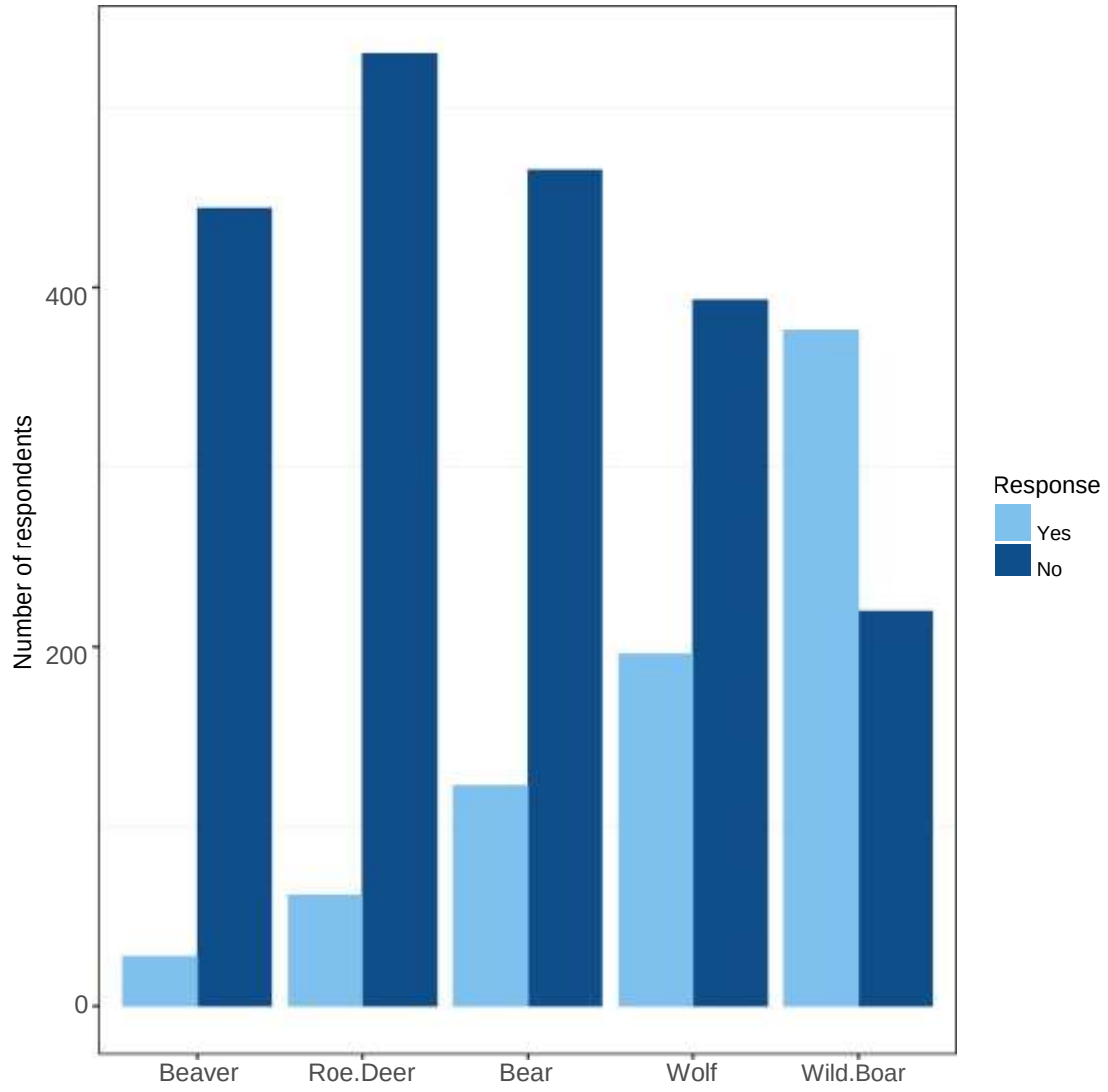


*Figure 4: Comparing the number of participants who have experienced either first or second-hand damage between species in Romania (Number of responses: Bear=588; Roe Deer=592; Wild Boar=596; Beaver=472; Wolf=589)*

Experience of damage is strongly correlated with occupation for bear ($X^2$=71, $p$ <0.001, Cramer's V = 0.35) and moderately for boar ($X^2$ = 28.4, $p$ = 0.03, Cramer's V = 0.22) and wolf ($X^2$ = 31, $p$ =0.02, Cramer's V = 0.23). For bear, 57% of participants who own/manage livestock have experienced damage (n=54) compared to 55% for wolves (n=55). Ninety percent of participants who grow fruit or crops have experienced damage from wild boar (n=10).

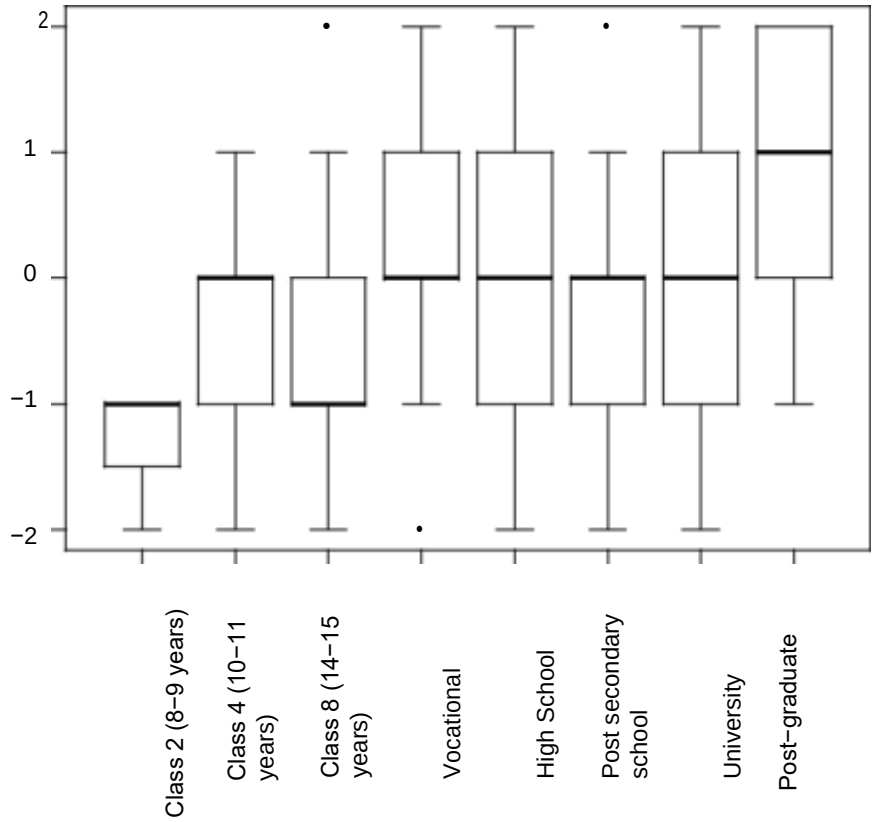


*Figure 5: Distribution of responses for bear according to education level for Question 8:" How do you feel about bears existing in this area?". The score ranges from -2 (very negative) to 2 (very positive), with 0 neutral.*

Village size was only retained in the model of attitudes towards bears, with participants from larger villages having more positive attitudes (Table 1)

Income and age were retained only in the model of attitudes towards wild boar, with those receiving higher incomes and in the younger age categories having more positive attitudes (Table 1).

Nature-related occupations such as protected area staff, foresters and hunters tended to have more positive attitudes towards wild animals, as well as police and drivers (Appendix 3). Agricultural occupations, such as herders, livestock owners, fruit growers and cereal farmers, and education-related jobs (teachers and students) tended to have more negative views, as well as housewives and retirees (Appendix 3).

### *3.2.2 Knowledge of bear, wolf and roe deer*

Knowledge about bear, wolf and deer was not significant in explaining attitudes towards these species. Participants were most knowledgeable about wolves, with 4.3% answering all questions concerning wolves correctly and 46.4% answering two out of three correctly, followed by bears (3.8% answered

all questions correctly and 35.9% answered two correctly) and deer (0.7% could answer all questions correctly and 11.8% answered two correctly) (Figure 6). When all knowledge questions were combined, no participant answered all questions correctly, and the average total score was 3.4 out of 9 (range: 0 to 8).

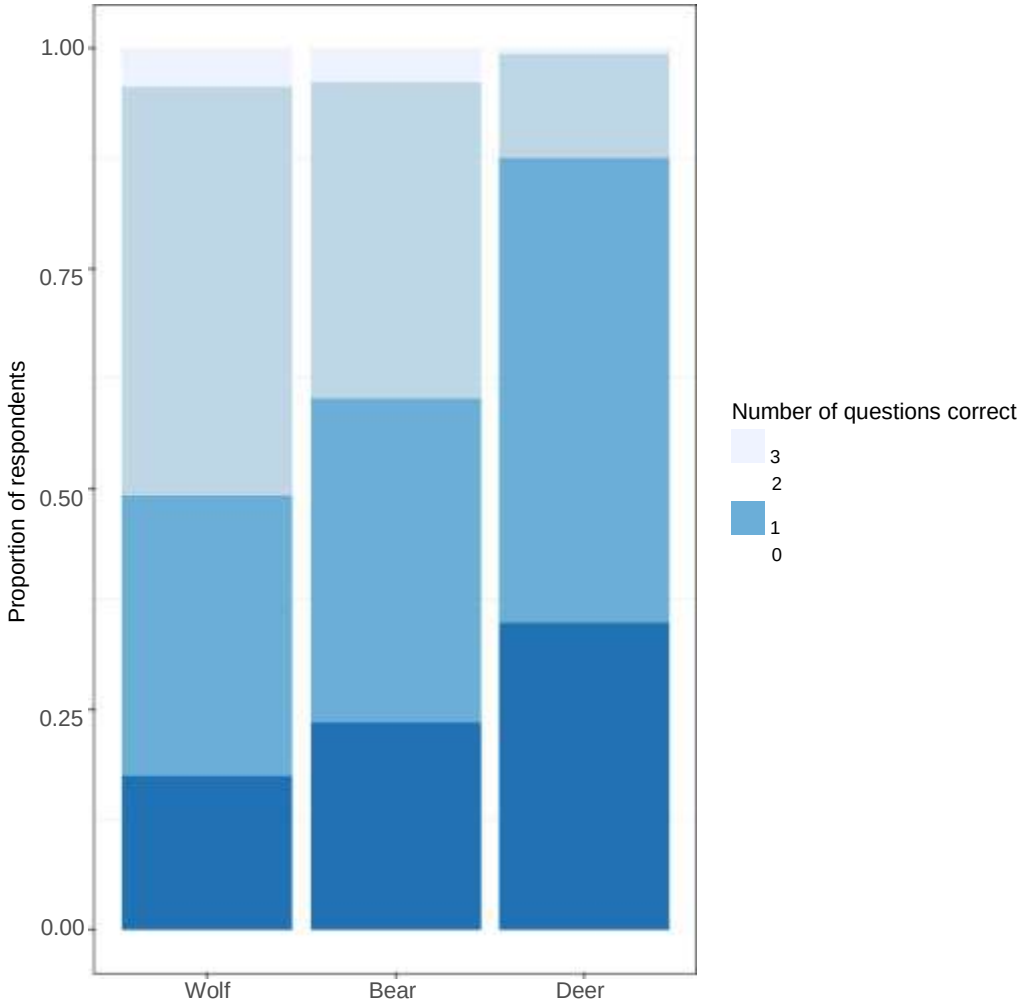


*Figure 6. Comparing how the knowledge level of participants differs between each species (bear, wolf and roe deer, n = 602)*

Females had significantly lower knowledge of wild animals compared to males, with a mean knowledge score of 3.0 (maximum 9) for all knowledge questions, compared to a mean score of 3.6 for males (Table 2). Hunters and cereal farmers were least knowledgeable about wild animals, with average knowledge scores of 2.1 and 2.8 respectively. Police and unemployed participants were significantly more knowledgeable with average scores of 4 and 3.9. Knowledge of wild animals did not significantly differ between participants of different incomes, education, ages or those from villages of different sizes (Table 2). Participants living inside Natura 2000 sites had a significantly higher mean total knowledge score of 3.5 compared to those living outside, who had a mean score of 3.2 (Table 2).

*Table 2. Results of ANOVAs and t-tests comparing the factors which affect levels of knowledge about all three species (bear, wolf and bear)*

| Variable | *F* | *df* | *p* |
|---|---|---|---|
| **Occupation** | 5.0 | 1 | **0.03** |
| **Income** | 0.06 | 1 | 0.81 |
| **Education** | <0.01 | 1 | 0.99 |
| **Age** | 0.12 | 1 | 0.73 |
| **Village size** | 0.04 | 1 | 0.84 |
| | ***t*** | ***df*** | ***p*** |
| **Gender** | -4.5 | 511 | **<0.001** |
| **Position relative to N2K site** | 2.6 | 600 | **0.01** |

### *3.2.3 Tolerance of wild animals*

Participants were most tolerant to roe deer (Table 3), 71.1% stated they would leave them alone if roe deer caused them damage. Participants were least tolerant of wolves (34.2% said they would shoot them if they were causing damage to property), followed by wild boar (31.2%). The most common response for bear was to capture and relocate it to a new location (29.4%).

*Table 3. A participants most likely response if they experienced damage to agriculture or property by bear, roe deer, wild boar, beaver or wolf, in Romania. Tolerance ranges from most tolerant (Educate neighbours about preventative measures) to least tolerant (shoot the animal).*

| Response | Bear % | Roe Deer % | Wild Boar % | Beaver % | Wolf % |
|---|---|---|---|---|---|
| Educate neighbours about preventative measures | 12.8 | 6.8 | 7.6 | 13.0 | 8.5 |
| Leave the animal alone | 17.3 | 71.1 | 20.3 | 35.4 | 14.5 |
| Frighten the animal away | 23.3 | 11.6 | 25.6 | 18.3 | 22.8 |
| Capture and relocate the animal | 29.4 | 5.5 | 13.1 | 10.0 | 16.5 |
| Shoot the animal | 13.1 | 1.5 | 31.2 | 8.5 | 34.2 |
| No response | 4.2 | 3.5 | 2.2 | 15.0 | 3.7 |

If a participant has previously experienced damage by bear, wolf or wild boar, they are less tolerant and more likely to attempt to stop future damage by shooting the animal than those who have never experienced damage (Table 4). These were the only significant variables affecting tolerance to bear and

wild boar, but for wolf, age of participants and knowledge of wolves were also significant in affecting tolerance, with younger participants and those more knowledgeable showing higher tolerance (Table 4).

*Table 4. Results of ordinal logistic regression of factors affecting tolerance to bear, wolf and boar in Romania.*

| Species | Predictor | AIC | Proportional odds ratio | SE | *t* | *p* |
|---|---|---|---|---|---|---|
| **Bear** | | | | | | |
| | Damage | 1816.7 | 1.70 | 0.18 | 2.88 | **0.004** |
| | Village size | | 1.09 | 0.07 | 1.33 | 0.18 |
| **Wolf** | | 1820.3 | | | | |
| | Damage | | 1.46 | 0.16 | 2.39 | **0.02** |
| | Age | | 1.23 | 0.09 | 2.36 | **0.02** |
| | Knowledge | | -0.83 | 0.09 | -2.09 | **0.04** |
| | Proximity to Nature 2000 site | | 1.33 | 015 | 1.95 | 0.06 |
| **Boar** | | 1795.8 | | | | |
| | Damage | | 1.37 | 0.15 | 2.05 | **0.04** |
| | Gender | | 1.18 | 0.15 | 1.06 | 0.29 |
| | Education | | 0.94 | 0.05 | -1.28 | 0.20 |
| | Proximity to Natura 2000 site | | 1.22 | 0.15 | 1.31 | 0.19 |
| | Village size | | 0.97 | 0.07 | -0.50 | 0.62 |

Tolerance tended to be higher among residents who had positive attitudes towards wolf, bear and wild boar. Five percent of participants who had a positive attitude would shoot a bear if it were to cause them damage (n=177), compared to 50% of participants with a negative attitude (n=231). Of participants who had a positive attitude towards wolves (n=119), 28% would shoot a wolf, compared to 39% of participants reported to have a negative attitude (n=347).

### 3.3 Spatial mapping of attitudes towards wild animals and reports of damage

Attitudes towards bears appeared to be spatially correlated, with more positive attitudes in the Southern Carpathians where reported bear numbers are actually higher (Figure 7, inset 3), negative in the Western Carpathians (inset 1) and mixed in the lowlands where the Natura 2000 sites are situated (inset 2). This was confirmed by hotspot analysis of attitudes towards bears. Negative attitudes correlated with high amounts of damage reported in the Western Carpathians (Figure 8).

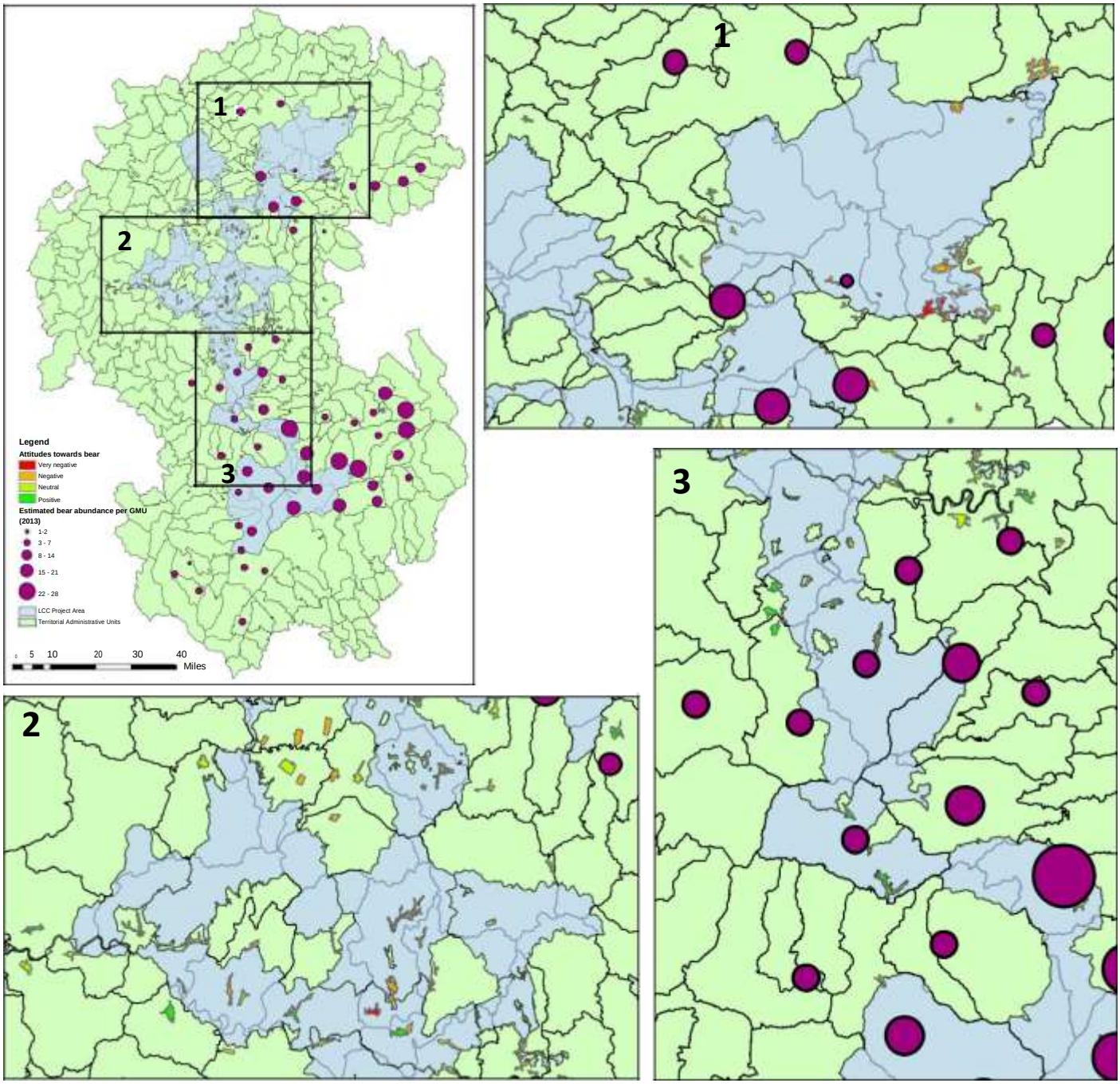


*Figure 7. Attitudes towards bears in surveyed villages and estimated bear populations within each Game Management Unit in Romania*

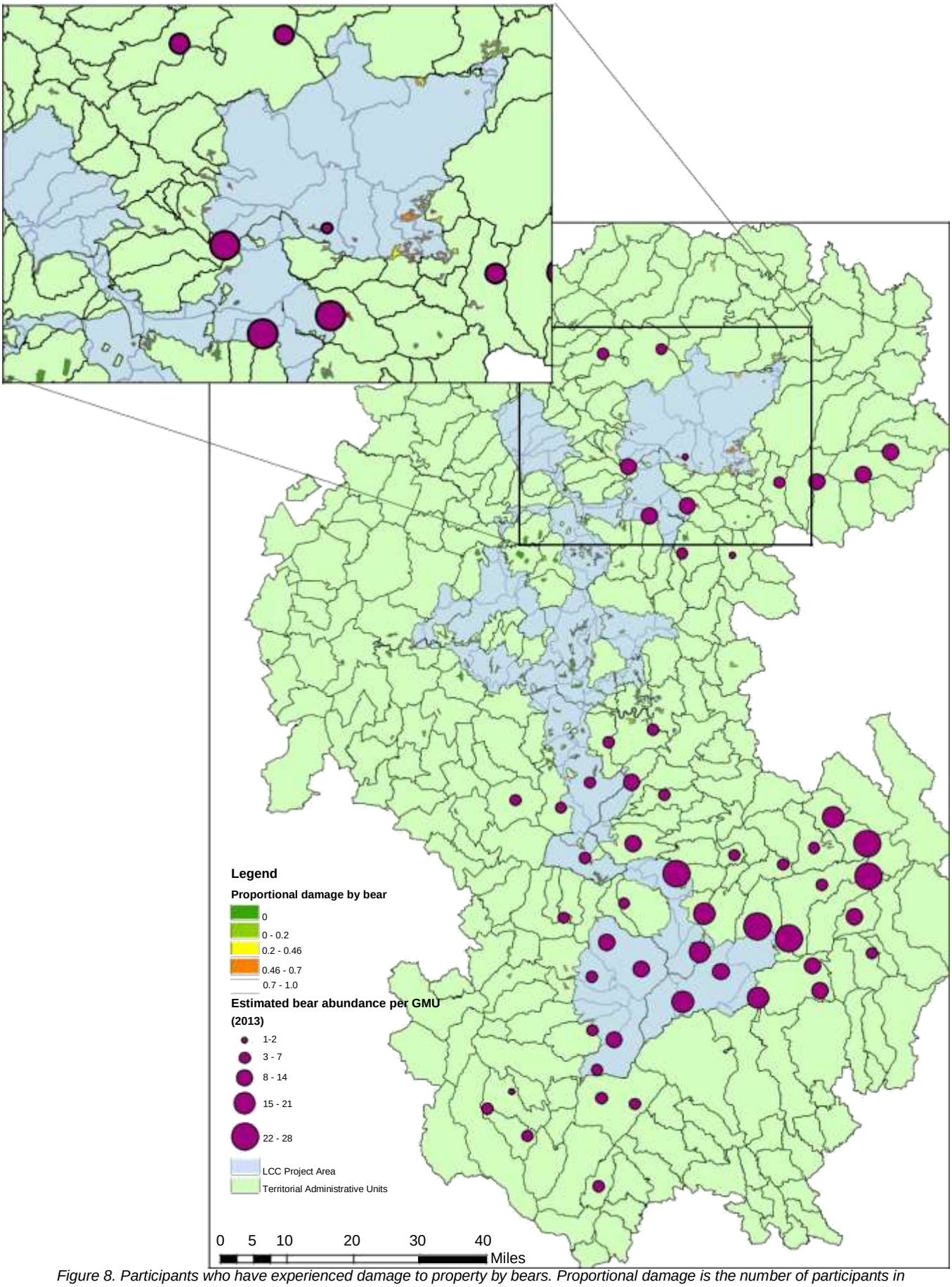


*Figure 8. Participants who have experienced damage to property by bears. Proportional damage is the number of participants in each village who have experienced damage divided by the total number of participants from the village, in Romania.*

Attitudes towards wolves are less clearly spatially correlated and negative attitudes appear to be more widespread. Attitudes become increasingly positive moving south towards the Southern Carpathians, with the most positive attitudes occurring near to Natura 2000 sites connecting lowland to the Southern Carpathians, where wolf abundance is highest (Figure 9, inset 3). Attitudes are most negative in the Western Carpathians (inset 1) and lowlands near to this mountain range (inset 2). This somewhat correlated with reports of damage (Figure 10). The proportion of participants that have experienced damage in each village increases towards the Western Carpathians and decreases towards the Southern Carpathians.

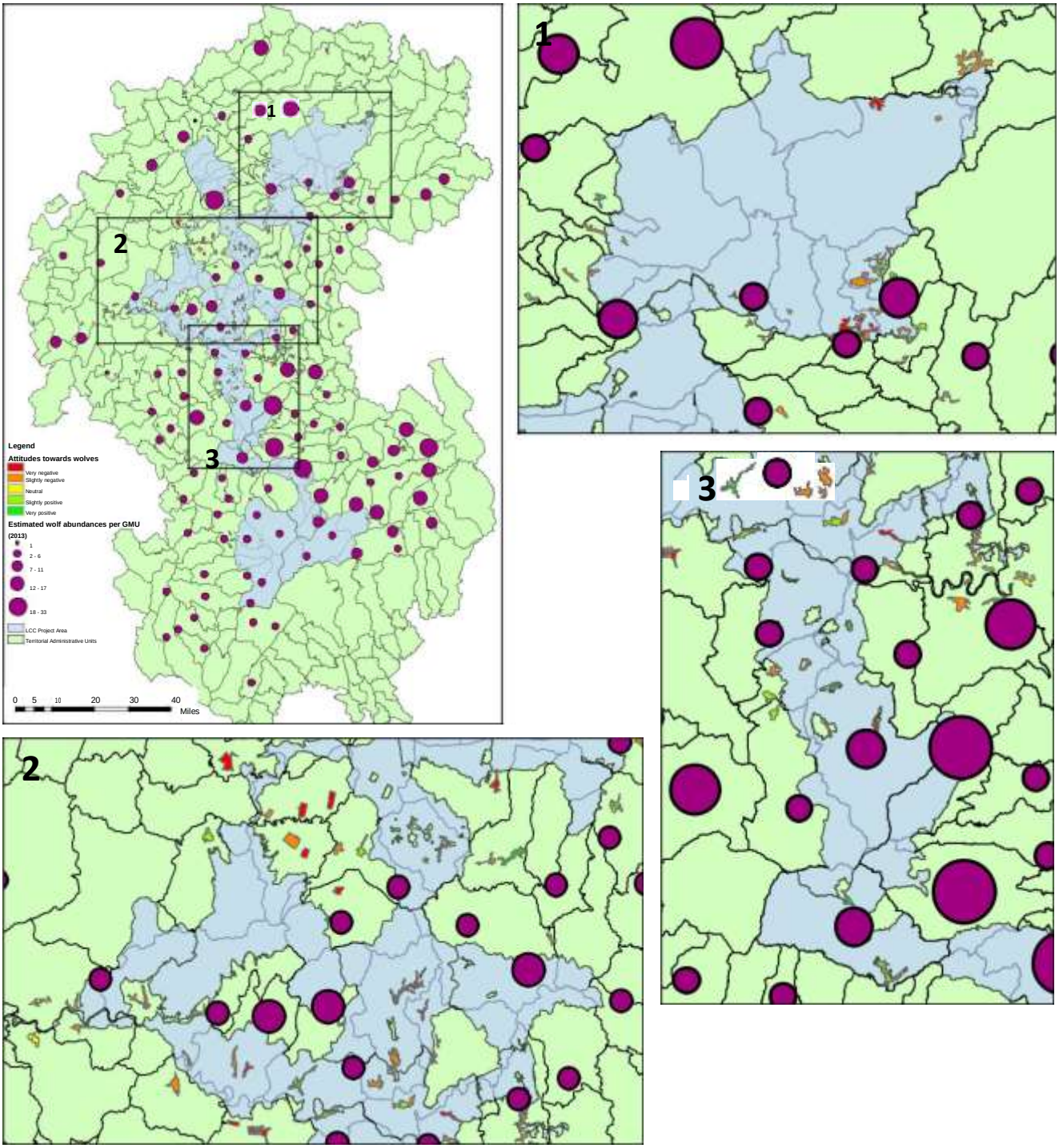


*Figure 9. Attitudes towards wolves in surveyed villages and estimated wolf populations within each Game Management Unit in Romania*

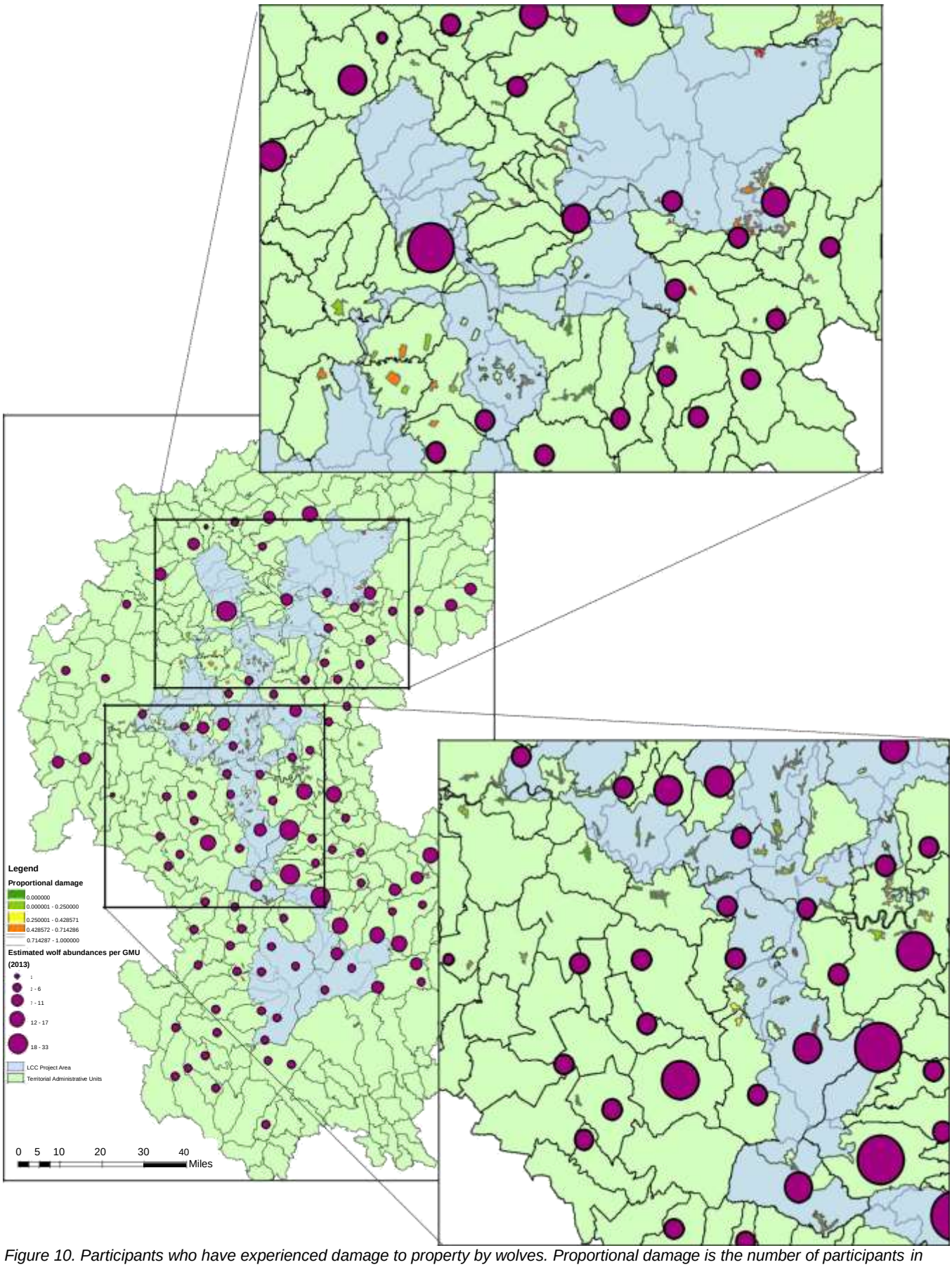


*Figure 10. Participants who have experienced damage to property by wolves. Proportional damage is the number of participants in each village who have experienced damage divided by the total number of participants from the village, in Romania.*

# 4 Discussion

## 4.1 Attitudes towards, knowledge of and tolerance to wild animals

Among sociodemographic groups, those educated to a lower level and females had the most negative attitudes towards bears, wolves and wild boar, as well as those with prior experience of damage. The elderly and those earning a lower income were also significantly more negative towards wild boar compared to their counterparts, and those living in smaller villages were more negative towards bears. Experience of damage affected tolerance to all species, although younger participants and those more knowledgeable about wolves were also more tolerant. These results are similar to those from other studies (e.g. Kellert et al., 1996; Kellert and Berry, 1987; Kleiven et al., 2004; Williams et al., 2002).

Females are very afraid of large carnivores and generally unsupportive of an increase in population numbers. The majority are either housewives or retired (65%) which might explain their lower levels of interaction with wild animals. Or they may be relatively unconcerned about unfamiliar and remote wild animals, this could explain their lower knowledge levels (Kellert and Berry, 1987). The moral development of females is largely defined by interpersonal responsibility, nonaggressiveness and caring for others, and females tend to take on the role of nurturer and caretaker (Giligan, 1983; Kellert and Berry, 1987). Fear of wild animal attacks to either themselves or family could explain their more negative attitudes. This is opposed to males who emphasise work, competition and assertiveness. Males are characterised by "more cognitive and logically abstract perceptions of animals, reflected in substantially greater knowledge of animals and ecological concern for the relationship of wildlife to natural habitats" (Kellert and Berry, 1987). This is reflected by their increased knowledge, lower fear and improved attitude towards large carnivores. Gender of participants had a stronger impact on attitudes towards wild animals than experience of damage, indicating this is an important area for the project to target to improve attitudes.

Higher education is associated with more knowledge and appreciation of the environment, higher protectionist value of wildlife (Kellert and Berry, 1996), and recognition that they need not be afraid of them. Despite level of education affecting the attitude of participants, knowledge of wildlife did not. However, the low importance of knowledge about wildlife in this analysis does not necessarily mean there is no relation with attitude, because knowledge is hard to quantify (Kaczensky et al., 2004). This may have been a limitation of the study, the survey questionnaire only focused on knowledge questions relating to social and reproductive behaviour. It would be interesting to ask participants about their knowledge of the ecological value of wildlife, whether they think it is important for these animals to be present etc., to gain a broader understanding of their knowledge about wildlife. Wolves have substantial,

widespread negative attitudes and low tolerance, yet a high level of knowledge about wolves was associated with higher tolerance among participants. Individuals living inside of Natura 2000 sites were also more knowledgeable about wild animals than those living outside, suggesting the presence of education schemes operating within Natura sites and/or a higher awareness of large carnivores. A link between knowledge and personal experience has been suggested in other studies, with the most knowledgeable people often those who frequently come into contact with wildlife (i.e. hunters). However, these people may be more likely to have had negative experiences (e.g. killing of hunting dogs) (Dickham and Hazzah, 2016).

Hunters were, in fact, the least knowledgeable about wildlife and were among the most positive towards them. Although, a hunters' perception of large carnivores differs across Europe depending on whether they see large carnivores as the prize or as competition for ungulates (e.g. Kaczensky et al., 2004). This survey did not distinguish between commercial and subsistence hunters, which may affect results because presumably the latter would be more knowledgeable about wildlife than the former. Participants with nature-related jobs (i.e. protected area staff and foresters), police and drivers were more positive towards and supportive of large carnivores. Police and drivers probably have less exposure to wildlife and are not reliant on agriculture for income, which has been shown to elevate attitudes (Williams et al., 2002). Police were, surprisingly, the most knowledgeable about wildlife, followed by unemployed individuals. The majority of unemployed participants were in the youngest age category and tended to be more positive than other occupations, such as those in education-related professions (teachers and students). Participants with agricultural professions are likely to have experienced damage by bears, wolves and/or wild boar, consequently, they have the most negative attitudes. The large majority of participants were retirees who tended to have more negative attitudes. This may be linked to a historically ingrained negative perception of wild animals (Kellert, 1984). A limitation to this study was that participants were only assigned to one occupation when they likely to have several. For example, individuals may partake in hunting and also have several forms of agriculture.

## 4.2 Spatial variation of attitudes towards large carnivores

Spatial analysis of attitudes towards bear and wolves indicated the project area could be split into three approximate regions according to attitude and reports of damage: 1) The Southern Carpathians contained the highest abundances of bears and wolves and tend to have the most positive attitudes. Coexistence between humans and large carnivores is likely to have remained unbroken here. They will have retained their knowledge of large carnivores and traditional herding methods (Chapron et al., 2014), resulting in lower levels of damage and fear. This was further indicated by lower levels of

damage in this area. 2) The Western Carpathians have retained lower densities of large carnivore populations (Goldthorpe, in press), yet reports of damage are higher and attitudes are more negative. It would be interesting to assess the types of protection used here and compare it to the Southern Carpathians to determine the reasons for the differences in damage and attitudes. This is an important area to target in terms of improving protection measures to reduce damage. 3) Lowland linking the two mountain ranges has relatively low levels of damage and mixed attitudes. This area tends to have low densities of bear and wolf, most are just passing through, and this is unlikely to have changed dramatically in recent history. The creation of Natura 2000 sites in this area might have raised publicity of large carnivores, thereby increasing the perceived risk and fear of bears and wolves. This might be an important area to target in terms of educating local residents about the benefits of bear, as well as how to prevent damage, to reduce fear and build on positive attitudes.

## 4.3 Conclusion

Human attitudes were significantly more negative towards wolves than bears (60% vs 40%), and tolerance was higher for bears than wolves. This is probably because wolves inflict more damage to agriculture than bears, although participants were slightly more afraid of bears. Wild boars inflict more damage than both bears and wolves, but, surprisingly, attitudes towards them are more positive than towards large carnivores, and tolerance of wild boar is higher than for that of wolves. Participants were considerably more afraid of large carnivores causing them personal harm than wild boar, which might explain the disparities seen here. The perceived risk of damage to self, family or property far outweighs the actual risk of damage, but significantly impacts on attitudes and tolerance towards large carnivores. This was also seen in relation to gender, where females have an elevated perceived risk compared to males, and in the lowlands between the mountain ranges, where the actual risk of damage is low but some villages have negative attitudes.

Despite these findings, the risk of an attack on agriculture is relatively small (33% of participants have experienced damage by wolves and 21% by bear), and the risk of an attack on humans by bear and wolves throughout Europe is very low. In the last 50 years, only 9 records of people being killed by wolves have been found in Europe (Linnell et al., 2002). Wolves are among the least dangerous species of both large carnivores and other wildlife for their size and predatory potential (Linnell et al., 2002). Brown bear pose a greater potential hazard to human safety although documented attacks remain relatively rare (Trouwborst, 2010). Since the beginning of the 20$^{th}$ century, there are 36 records people being killed by European brown bears. Although fatalities are very rare and the risk of attack is low, incidents with bears and wolves are widely publicised in the media which reinforces cultural fear (Bruskotter and Wilson, 2013).

If the perceived risk is higher than the actual risk, this presents an opportunity to educate participants about the ecological value of large carnivores, as well as how to reduce damage (Needham and Vaske, 2007). It is important to educate individuals about both the benefits of the species along with prevention measures and defence mechanisms because people's tolerance for large carnivores partly depends upon their perception of benefits (Bruskotter and Wilson, 2013; Slagle et al., 2013). Participants that have experienced damage hold the most negative views, therefore support should be provided to implement mitigation measures to prevent and reduce damage. In turn, this might increase support of conservation initiatives. Complex factors affect conflict and attitudes towards and tolerance of wildlife. Conservationists need a broad, interdisciplinary approach for effective conflict mitigation if humans and large carnivores are to coexist.

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# Appendices

Appendix 1. Distribution of respondents according to county, TAU, village, population range, location relative to N2k site and the number of questionnaires conducted in each village.

| County | Local community (territorial administrative unit) | Village | Population range | Location relative to N2K site | Number of questionnaires |
|---|---|---|---|---|---|
| ALBA | Albac | Albac | 500-999 | inside | 8 |
| ALBA | Albac | Fata | 200-499 | inside | 6 |
| ALBA | Albac | Rogoz | 100-199 | adjacent | 5 |
| ALBA | Albac | Rosesti | 10-99 | inside | 3 |
| ALBA | Arieseni | Casa de Piatra | 10-99 | inside | 3 |
| ALBA | Arieseni | Cobles | 200-499 | inside | 6 |
| ALBA | Arieseni | Dealu Bajului | 100-199 | adjacent | 5 |
| ALBA | Arieseni | Stei-Arieseni | 10-99 | adjacent | 3 |
| ALBA | Avram Iancu | Tarsa | 200-499 | adjacent | 5 |
| ALBA | Garda de Sus | Garda de Sus | 200-499 | inside | 6 |
| ALBA | Garda de Sus | Garda Seaca | 100-199 | inside | 5 |
| ALBA | Horea | Butesti | 10-99 | adjacent | 3 |
| ALBA | Horea | Darlesti | 200-499 | inside | 6 |
| ALBA | Horea | Fericet | 100-199 | inside | 5 |
| ALBA | Horea | Horea | 200-499 | inside | 6 |
| ALBA | Horea | Matisesti | 200-499 | inside | 6 |
| ALBA | Horea | Trifesti | 10-99 | inside | 3 |
| ALBA | Scarisoara | Floresti | 10-99 | inside | 3 |
| ALBA | Scarisoara | Lespezea | 10-99 | inside | 3 |
| ALBA | Scarisoara | Negesti | 100-199 | inside | 5 |
| ALBA | Scarisoara | Scarisoara | 500-999 | inside | 8 |
| ALBA | Scarisoara | Stiuleti | 100-199 | inside | 5 |
| ARAD | Almas | Almas | 1.000-1.999 | adjacent | 10 |
| ARAD | Almas | Radesti | 200-499 | adjacent | 6 |
| ARAD | Barzava | Barzava | 500-999 | adjacent | 8 |
| ARAD | Barzava | Batuta | 10-99 | inside | 4 |
| ARAD | Barzava | Dumbravita | 200-499 | adjacent | 6 |
| ARAD | Bata | Bata | 200-499 | adjacent | 5 |
| ARAD | Birchis | Ostrov | 200-499 | adjacent | 5 |
| ARAD | Brazii | Secas | 200-499 | adjacent | 6 |
| ARAD | Chisindia | Chisindia | 500-999 | adjacent | 8 |
| ARAD | Conop | Chelmac | 200-499 | adjacent | 5 |
| ARAD | Conop | Odvos | 200-499 | adjacent | 5 |
| ARAD | Dieci | Crocna | 200-499 | adjacent | 5 |

| | | | | | |
|---|---|---|---|---|---|
| ARAD | Dieci | Dieci | 500-999 | adjacent | 9 |
| ARAD | Dieci | Revetis | 200-499 | adjacent | 5 |
| ARAD | Gurahont | Bontesti | 500-999 | adjacent | 8 |
| ARAD | Gurahont | Gurahont | 1.000-1.999 | adjacent | 11 |
| ARAD | Halmagiu | Tisa | 200-499 | adjacent | 5 |
| ARAD | Moneasa | Moneasa | 500-999 | adjacent | 7 |
| ARAD | Petris | Ilteu | 200-499 | inside | 5 |
| ARAD | Petris | Petris | 500-999 | inside | 5 |
| ARAD | Petris | Rosia Noua | 200-499 | inside | 5 |
| ARAD | Petris | Seliste | 100-199 | inside | 3 |
| ARAD | Plescuta | Aciuta | 200-499 | inside | 5 |
| ARAD | Plescuta | Budesti | 10-99 | inside | 3 |
| ARAD | Plescuta | Plescuta | 200-499 | inside | 5 |
| ARAD | Plescuta | Talagiu | 200-499 | inside | 5 |
| ARAD | Savarsin | Caprioara | 200-499 | inside | 5 |
| ARAD | Savarsin | Savarsin | 1.000-1.999 | inside | 17 |
| ARAD | Savarsin | Troas | 100-199 | adjacent | 3 |
| ARAD | Ususau | Ususau | 500-999 | adjacent | 9 |
| ARAD | Varadia de Mures | Baia | 100-199 | adjacent | 5 |
| ARAD | Varadia de Mures | Julita | 200-499 | inside | 5 |
| ARAD | Varadia de Mures | Stejar | 100-199 | inside | 5 |
| ARAD | Varadia de Mures | Varadia de Mures | 500-999 | inside | 7 |
| ARAD | Varfurile | Lazuri | 200-499 | adjacent | 5 |
| ARAD | Varfurile | Poiana | 100-199 | inside | 5 |
| ARAD | Sebis | Salajeni | 100-199 | adjacent | 5 |
| BIHOR | Campani | Campani | 500-999 | adjacent | 7 |
| BIHOR | Campani | Fanate | 500-999 | adjacent | 7 |
| BIHOR | Campani | Sighistel | 200-499 | inside | 6 |
| BIHOR | Cristioru de Jos | Poiana | 200-499 | inside | 6 |
| BIHOR | Finis | Ioanis | 500-999 | adjacent | 7 |
| BIHOR | Finis | Suncuis | 500-999 | adjacent | 7 |
| BIHOR | Lunca | Briheni | 200-499 | adjacent | 6 |
| BIHOR | Lunca | Sustiu | 200-499 | adjacent | 6 |
| BIHOR | Pietroasa | Chiscau | 500-999 | inside | 8 |
| BIHOR | Pietroasa | Giulesti | 100-199 | inside | 5 |
| BIHOR | Pietroasa | Pietroasa | 500-999 | adjacent | 7 |
| BIHOR | Nucet | Baita | 500-999 | inside | 8 |
| CARAS-SEVERIN | Cornereva | Hora Mica | 10-99 | inside | 3 |
| CARAS-SEVERIN | Rusca Montana | Rusca Montana | 1.000-1.999 | inside | 18 |
| CARAS-SEVERIN | Rusca Montana | Ruschita | 200-499 | inside | 5 |
| CARAS-SEVERIN | Turnu Ruieni | Borlova | 1.000-1.999 | adjacent | 10 |

| | | | | | |
|---|---|---|---|---|---|
| CARAS-SEVERIN | Zavoi | Maru | 1.000-1.999 | inside | 13 |
| CARAS-SEVERIN | Bolvasnita | Varciorova | 500-999 | adjacent | 7 |
| CLUJ | Belis | Belis | 500-999 | inside | 8 |
| CLUJ | Belis | Dealu Botii | 10-99 | inside | 3 |
| CLUJ | Calatele | Dealu Negru | 200-499 | adjacent | 5 |
| HUNEDOARA | Bulzestii de Sus | Giurgesti | 10-99 | adjacent | 3 |
| HUNEDOARA | Burjuc | Glodghilesti | 200-499 | inside | 5 |
| HUNEDOARA | Dobra | Dobra | 1.000-1.999 | adjacent | 10 |
| HUNEDOARA | Dobra | Lapusnic | 500-999 | adjacent | 9 |
| HUNEDOARA | Dobra | Stretea | 10-99 | adjacent | 4 |
| HUNEDOARA | Gurasada | Gothatea | 200-499 | adjacent | 5 |
| HUNEDOARA | Gurasada | Gurasada | 200-499 | adjacent | 5 |
| HUNEDOARA | Ilia | Ilia | 1.000-1.999 | adjacent | 10 |
| HUNEDOARA | Lapugiu de Jos | Cosesti | 10-99 | inside | 3 |
| HUNEDOARA | Lapugiu de Jos | Lapugiu de Sus | 200-499 | adjacent | 5 |
| HUNEDOARA | Vata de Jos | Birtin | 200-499 | adjacent | 5 |
| HUNEDOARA | Zam | Almasel | 10-99 | inside | 3 |
| HUNEDOARA | Zam | Cerbia | 100-199 | adjacent | 3 |
| HUNEDOARA | Zam | Poganesti | 10-99 | adjacent | 3 |
| HUNEDOARA | Zam | Pojoga | 200-499 | inside | 5 |
| HUNEDOARA | Zam | Salciva | 200-499 | inside | 5 |
| TIMIS | Curtea | Cosava | 200-499 | inside | 5 |
| TIMIS | Curtea | Curtea | 500-999 | adjacent | 7 |
| TIMIS | Curtea | Homojdia | 100-199 | inside | 5 |
| TIMIS | Pietroasa | Farasesti | 200-499 | inside | 5 |
| TIMIS | Pietroasa | Poieni | 200-499 | inside | 5 |
| TIMIS | Tomesti | Romanesti | 500-999 | adjacent | 7 |
| Total | | | | | 602 |

Appendix 2. English translation of the questionnaire

**Written questionnaire to quantify public opinion and knowledge**

*[#: _____ ]*

Hello,

My name is _____. I am part of a research team trying to understand the relationship between people and nature in the area between the Apuseni Mountains and the Southern Carpathians. This study is conducted as part of the LIFE Connect Carpathians project which aims to facilitate coexistence between people and nature in this region. I am a student at the University of Bucharest and we work with Fauna & Flora International and Asociația Zarand who are implementing the project.

We value local people's opinions very much and we greatly appreciate your time in answering our questions. There are no correct or incorrect answers. Whether positive, neutral or negative your views are very important to us, since we are trying to understand the range of people's attitudes towards nature and wild animals.

You were selected randomly from amongst the adults living in this area. Your participation in this survey is voluntary. Your individual answers will be confidential and we do not need to know your name, so the answers you give us can never be associated with you.

*(Please fill out this information when starting an interview)*

**Name of interviewer**:_____

Date**: _____** Time**: _____**

This questionnaire will take approximately 30 minutes. May we proceed with the questions? Thank you.

**I. Basic information** *(Fill out the first 2 points – do not ask the respondent)*

1. **Community**: _____

2. **Gender**: ☐ Female ☐ Male (*tick the appropriate box*)

## II. We would like to know about your experience with wild animals in your area

3. **How long have you lived in this community for?** (*specify years and/or months*)_____

4. **How often do you go to places with wild animals?** _____

(*if no direct answer use the following to prompt the respondent; circle the appropriate answer)*

Almost daily At least once a week Once a month Seldom Never

5. **What do you usually do there?**

sheep/cattle herding hunting forestry work fishing

berry/mushroom picking  crop tending  hay making  excursions

other (specify): _____

6. **What wild animals are found in this area?** (*do not read out options to the respondent; as they answer tick the appropriate boxes)*

☐bear ☐wolf ☐wild cat ☐otter ☐ red deer ☐roe deer ☐ fox

☐wild boar ☐badger ☐marten ☐beaver

☐other

(*specify*)_____

| 7. **In this area have you ever seen any of the following animals or their tracks and signs:** | No, never | Yes, occasionally | Yes, frequently |
|---|---|---|---|
| **bear?** | 1 | 2 | 3 |
| **roe deer?** | 1 | 2 | 3 |
| **wild boar?** | 1 | 2 | 3 |
| **beaver?** | 1 | 2 | 3 |
| **wolf?** | 1 | 2 | 3 |

8. **The fact that the following animals exist in this area is for you:**

| | very bad | bad | neither bad nor good | good | very good | There aren't any in this area |
|---|---|---|---|---|---|---|
| **bears** | -2 | -1 | 0 | 1 | 2 | 9 |
| **roe deer** | -2 | -1 | 0 | 1 | 2 | 9 |
| **wild boars** | -2 | -1 | 0 | 1 | 2 | 9 |
| **beavers** | -2 | -1 | 0 | 1 | 2 | 9 |
| **wolves** | -2 | -1 | 0 | 1 | 2 | 9 |

(*if all wild animals are present in their area proceed to question 10; if they state that any of the wild animals is not currently present ask question 9)*

9. **If any of the animals that are not currently found in this area would appear would be for you:**

| very bad | bad | neither bad nor good | good | very good |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **bears** | -2 | -1 | 0 | 1 | 2 |
| **roe deer** | -2 | -1 | 0 | 1 | 2 |
| **wild boars** | -2 | -1 | 0 | 1 | 2 |
| **beavers** | -2 | -1 | 0 | 1 | 2 |
| **wolves** | -2 | -1 | 0 | 1 | 2 |

| 10. **Which answer best describes your attitude / opinion towards these animals?** | very bad | bad | neither bad nor good | good | very good |
|---|---|---|---|---|---|
| **Bears** | -2 | -1 | 0 | 1 | 2 |
| **Roe deer** | -2 | -1 | 0 | 1 | 2 |
| **Wild boars** | -2 | -1 | 0 | 1 | 2 |
| **Beavers** | -2 | -1 | 0 | 1 | 2 |
| **Wolves** | -2 | -1 | 0 | 1 | 2 |

| **To what extent do you agree or disagree with the following statements:** | | strongly disagree | disagree | neither disagree nor agree | agree | strongly agree |
|---|---|---|---|---|---|---|
| 11. | | | | | | |
| I would be afraid to go to places with | **bears** | -2 | -1 | 0 | 1 | 2 |
| | **roe deer** | -2 | -1 | 0 | 1 | 2 |
| | **wild boars** | -2 | -1 | 0 | 1 | 2 |
| | **beavers** | -2 | -1 | 0 | 1 | 2 |
| | **wolves** | -2 | -1 | 0 | 1 | 2 |

12. **a) Do you talk about wild animals with others?**

☐ **1.** Yes ☐ **2.** No (*skip to question 14*) ☐ **99.** No answer

**b) If yes, with whom do you talk about wild animals?**

_____

_____

___

**c) Which wild animals do you talk about?**

_____

_____

___

**d) Why?**

_____

_____

___

13. **a) Over the past ten years have the numbers of these animals changed in this area?**

| | Decreased greatly | Decreased somewhat | Remained the same | Increased somewhat | Increased greatly | Don't know |
|---|---|---|---|---|---|---|
| **Bears** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Roe deer** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Wild boars** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Beavers** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Wolves** | -2 | -1 | 0 | 1 | 2 | 98 |

**b) Why do you think those changes happened?**

_____

_____

_____

_____

14. **a) How would you like the numbers of these animals to change in this area over the next ten years?**

| | Decrease greatly | Decrease somewhat | Remain the same | Increase somewhat | Increase greatly | Don't know |
|---|---|---|---|---|---|---|
| **Bears** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Roe deer** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Wild boars** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Beavers** | -2 | -1 | 0 | 1 | 2 | 98 |
| **Wolves** | -2 | -1 | 0 | 1 | 2 | 98 |

**b) Why do you want these changes to**

**happen?__**_____

_____

_____

_____

_____

| **To what extent do you agree or disagree with the following statements:** | strongly disagree | disagree | neither disagree nor agree | agree | strongly agree | don't know |
|---|---|---|---|---|---|---|
| 15. **There are benefits to living in an area with wild animals** | -2 | -1 | 0 | 1 | 2 | 98 |
| 16. **Damages are an accepted fact of life when coexisting with wild animals** | -2 | -1 | 0 | 1 | 2 | 98 |
| 17. **Compensation paid for damage caused by wild animals are adequate and make up for the loss incurred** | -2 | -1 | 0 | 1 | 2 | 98 |
| 18. **The procedure for obtaining compensation is clear and easy** | -2 | -1 | 0 | 1 | 2 | 98 |

| 19. **How concerned are you that these animals will cause you annoyance or damage?** | Not at all concerned | A little concerned | Fair amount concerned | Much concerned | Very much concerned |
|---|---|---|---|---|---|
| **Bear** | 1 | 2 | 3 | 4 | 5 |
| **Roe deer** | 1 | 2 | 3 | 4 | 5 |
| **Wild boar** | 1 | 2 | 3 | 4 | 5 |
| **Beaver** | 1 | 2 | 3 | 4 | 5 |
| **Wolf** | 1 | 2 | 3 | 4 | 5 |

| 20. **Have you or anyone close to you ever experienced damage caused by** | Yes | No | No answer |
|---|---|---|---|
| **Bears?** | 1 | 2 | 99 |
| **Roe deer?** | 1 | 2 | 99 |
| **Wild boars?** | 1 | 2 | 99 |
| **Beavers?** | 1 | 2 | 99 |
| **Wolves?** | 1 | 2 | 99 |

21. **Who do you first go to in case of an attack or damage caused by wild animals?**

_____

_____

_____

_____

_____

_____

In cases where wild animals cause damage to property, crops or livestock please indicate to what extent you agree or disagree with the following measures for the five species listed:

| | strongly disagree | disagree | neither disagree nor agree | agree | strongly agree |
|---|---|---|---|---|---|
| (*enter the appropriate number as indicated by the respondent's choice)* | -2 | -1 | 0 | 1 | 2 |

| | **Bears** | **Wild boars** | **Roe deer** | **Beaver** | **Wolves** |
|---|---|---|---|---|---|
| 22. **Leave the wild animal alone** | | | | | |
| 23. **Frighten the wild animal away** | | | | | |
| 24. **Capture and relocate the wild animal to a new location in the hope that it will not return** | | | | | |
| 25. **Shoot the animal** | | | | | |
| 26. **Educate the people who live near wild animal habitat on how to avoid problems by taking preventative measures** | | | | | |

**III. Now we would like to ask you a few questions about wild animals and their behaviours**

33. **What do you think is the <u>main</u> food of wolves?** (*circle the correct answer*)

| | | | |
|---|---|---|---|
| 1. Fruits, berries, grass | 2. Deer, wild boars and other wild species | 3. Carrion | 98. Don't know |

34. **Generally wolves live:** (*circle the correct answer*)

| | | | |
|---|---|---|---|
| 1. In packs made up of related individuals | 2. Alone | 3. In separate groups - females with pups and males | 98. Don't know |

35. **Wolf packs are led by:** (*circle the correct answer*)

| | | | |
|---|---|---|---|
| 1. A dominant pair | 2. The oldest male | 3. The dominant female | 98. Don't know |

36. **The Brown bear feeds on:** (*circle the correct answer*)

| | | | |
|---|---|---|---|
| 1. Only meat | 2. Plants, fruits, insects, ants, meat | 3. Only plants and fruits | 98. Don't know |

37. **The Brown bear live**: (*circle the correct answer*)

| | | | |
|---|---|---|---|
| 1. In pairs | 2. In groups of females with cubs, and males are alone | 3. Alone | 98. Don't know |

38. **How many times does the female bear give birth?**

| | | | |
|---|---|---|---|
| 1. Once a year | 2. Twice a year | 3. Once every 2-4 years | 98. Don't know |

39. **Roe deer live:**

| | | | |
|---|---|---|---|
| 1. In pairs | 2. Alone | 3. In family groups | 98. Don't know |

40. **Generally the roe deer female gives birth to:**

| | | | |
|---|---|---|---|
| 1. 1-2 fawn every 2 years | 2. 1-2 fawn every year | 3. 3-4 fawn every year | 98. Don't know |

41. **Roe deer mate in:**

| | | | |
|---|---|---|---|
| 1. March – April | 2. July – August | 3. September – October | 98. Don't know |

**IV. In this short section we would like to ask you about your sources of information about wild animals**

42. **Please tell us where your knowledge of wild animals has come from.** *(Circle all that apply)*

| | | | | | | |
|---|---|---|---|---|---|---|
| newspapers / magazines | books/ leaflets | fairy tales / legends | hunters | radio | television | internet |
| school | family | farmers / herders | protected area staff | own experience | foresters | |

other (specify): _____

43. **Are you interested in learning more about wild animals?** *(Circle the appropriate answer)*

1. Yes 2. Partly 3. no 98. Don't know / no answer

44. **In what form would you like to obtain information?**

| | | | | |
|---|---|---|---|---|
| television/radio | internet | excursions | from hunters | from protected area staff |
| from foresters | books | leaflets | presentations | newspapers / magazines |

other (specify): _____

**V. This final section will help us to learn more about the respondents of this survey. Your answers will be confidential.** (*Please circle or fill in the correct information.*)

55. **How old are you?** _____

56. **What is your occupation?** (*please circle all that apply*):

| | | | | | |
|---|---|---|---|---|---|
| livestock owner | herder | protected area staff | forester | police | hunter |
| tourism industry | teacher | student | High school student | housewife | retired |
| currently unemployed | driver | fruit grower / wine maker | cereal farmer | | |

other (specify): _____

57. **What is the approximate total monthly income for your household?** (*Tick the appropriate box*)

☐ RON0-500 ☐ RON501-1000 ☐ RON1001-2000 ☐ RON2001-3000

☐ RON3001-4000 ☐ RON4001-5000 ☐ RON5000+

58. **What proportion of your household income comes from agriculture (including crops, livestock and bee-keeping)?** (*Tick the appropriate box*)

☐ Zero ☐ A quarter ☐ Half ☐ Three quarters ☐ 100%

58. **What level of education have you completed?**

1. Primary 2. Secondary 3. High school 4. University 5. Postgraduate

**Thank you very much!**

Appendix 3. Statistical analysis of Question 8, 9, 10, 11, 14 and 19 with sociodemographic variables (Kruskal Wallis)

| Species | Time lived in area | | Age | | Occupation | | Income | | % Income from agriculture | | Education | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $X^2$ | *p* | $X^2$ | *p* | $X^2$ | *p* | $X^2$ | *p* | $X^2$ | *p* | $X^2$ | *p* |
| **Q8: How do you feel about the following animals living here?** | | | | | | | | | | | | |
| Bear | 74.0 | 0.67 | 2.45 | 0.48 | 28.8 | **0.02** | 19.5 | **0.003** | 9.67 | **0.046** | 22.1 | **0.002** |
| Roe Deer | 73.4 | 0.77 | 2.35 | 0.50 | 34.9 | **0.004** | 11.6 | 0.071 | 2.37 | 0.67 | 19.7 | **0.006** |
| Wild Boar | 105.09 | 0.05 | 10.4 | **0.015** | 60.4 | **<0.001** | 23.5 | **<0.001** | 2.84 | 0.58 | 28.5 | **<0.001** |
| Beaver | 54.6 | 0.77 | 2.12 | 0.55 | 9.91 | 0.83 | 7.87 | 0.25 | 2.55 | 0.64 | 10.5 | 0.10 |
| Wolf | 87.2 | 0.33 | 0.43 | 0.93 | 23.9 | **0.093** | 2.83 | 0.83 | 1.36 | 0.85 | 17.3 | **0.016** |
| **Q9: How would you feel about the following animals appearing here? (If not already present)** | | | | | | | | | | | | |
| Bear | 101 | 0.062 | 1.21 | 0.75 | 18.5 | 0.30 | 2.67 | 0.85 | 1.71 | 0.79 | 11.1 | 0.13 |
| Roe Deer | 89.5 | 0.22 | 9.67 | **0.022** | 15.7 | 0.48 | 6.48 | 0.37 | 2.43 | 0.66 | 9.45 | 0.22 |
| Wild Boar | 96.5 | 0.10 | 6.66 | 0.084 | 38.2 | **0.001** | 9.87 | 0.13 | 5.34 | 0.25 | 11.3 | 0.13 |
| Beaver | 86.5 | 0.32 | 2.31 | 0.51 | 17.1 | 0.38 | 1.41 | 0.97 | 3.23 | 0.52 | 16.8 | **0.019** |
| Wolf | 70.7 | 0.79 | 0.50 | 0.92 | 24.1 | 0.087 | 7.74 | 0.26 | 2.55 | 0.63 | 10.6 | 0.16 |
| **Q10: How would you describe your attitude towards these animals?** | | | | | | | | | | | | |
| Bear | 84.2 | 0.44 | 1.37 | 0.71 | 34.7 | **0.004** | 18.2 | **0.006** | 4.44 | 0.35 | 27.6 | **<0.001** |
| Roe Deer | 86.7 | 0.37 | 3.62 | 0.31 | 28.8 | **0.025** | 5.25 | 0.51 | 8.49 | 0.078 | 14.2 | **0.047** |
| Wild Boar | 100 | 0.096 | 9.83 | **0.020** | 63.2 | **<0.001** | 21.4 | **0.002** | 1.92 | 0.75 | 39.3 | **<0.001** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beaver | 79.1 | 0.60 | 0.55 | 0.91 | 15.2 | 0.51 | 7.66 | 0.26 | 1.73 | 0.79 | 11.5 | 0.12 |
| Wolf | 84.8 | 0.42 | 0.045 | 1.00 | 21.4 | 0.17 | 10.4 | 0.11 | 5.11 | 0.28 | 28.4 | **<0.001** |
| **Q11: Would you be afraid to go to places with the following animals?** | | | | | | | | | | | | |
| Bear | 84.5 | 0.43 | 4.58 | 0.21 | 59.5 | **<0.001** | 15.8 | **0.015** | 4.99 | 0.29 | 13.3 | 0.065 |
| Roe Deer | 103 | 0.071 | 2.48 | 0.48 | 19.6 | 0.24 | 3.6 | 0.73 | 6.87 | 0.14 | 8.70 | 0.28 |
| Wild Boar | 78.0 | 0.57 | 2.94 | 0.40 | 68.8 | **<0.001** | 11.0 | 0.090 | 6.46 | 0.17 | 22.4 | **0.002** |
| Beaver | 72.7 | 0.78 | 5.77 | 0.12 | 55.0 | **<0.001** | 14.1 | **0.028** | 2.24 | 0.69 | 13.6 | 0.059 |
| Wolf | 72.2 | 0.80 | 4.48 | 0.21 | 53.0 | **<0.001** | 14.7 | **0.023** | 3.68 | 0.45 | 18.3 | **0.011** |
| **Q14: How would you like numbers of these animals to change over the next 10 years?** | | | | | | | | | | | | |
| Bear | 92.6 | 0.18 | 2.72 | 0.44 | 34.4 | **0.003** | 24.7 | **<0.001** | 9.40 | 0.052 | 17.3 | **0.015** |
| Roe Deer | 67.9 | 0.89 | 1.81 | 0.61 | 27.7 | **0.034** | 12.3 | 0.056 | 4.33 | 0.36 | 17.2 | **0.016** |
| Wild Boar | 91.3 | 0.25 | 9.19 | **0.027** | 54.6 | **<0.001** | 16.4 | **0.012** | 10.6 | **0.032** | 28.9 | **<0.001** |
| Beaver | 80.2 | 0.41 | 5.51 | 0.14 | 19.8 | 0.23 | 5.53 | 0.48 | 7.61 | 0.11 | 2.77 | 0.91 |
| Wolf | 93.5 | 0.20 | 0.26 | 0.97 | 19.4 | 0.25 | 7.78 | 0.25 | 3.62 | 0.46 | 14.1 | **0.050** |
| **Q19: How worried are you that these animals might bother you or cause you damage?** | | | | | | | | | | | | |
| Bear | 89.8 | 0.29 | 2.97 | 0.40 | 49.1 | **<0.001** | 29.5 | **<0.001** | 14.5 | **0.006** | 17.4 | **0.015** |
| Roe Deer | 85.2 | 0.41 | 4.55 | 0.21 | 16.7 | 0.41 | 3.49 | 0.75 | 10.9 | **0.028** | 8.84 | 0.26 |
| Wild Boar | 95.9 | 0.16 | 1.79 | 0.62 | 41.9 | **<0.001** | 13.9 | **0.031** | 14.7 | **0.005** | 23.9 | **0.001** |
| Beaver | 82.1 | 0.51 | 2.80 | 0.42 | 29.3 | **0.022** | 14.4 | **0.025** | 3.74 | 0.44 | 11.2 | 0.13 |
| Wolf | 110.6 | 0.023 | 4.09 | 0.25 | 23.9 | 0.091 | 16.7 | **0.011** | 19.7 | **<0.001** | 14.1 | **0.050** |

Appendix 4. Statistical analysis of Questions 8, 9, 10, 11, 14 and 19 for gender and respondents' experience of damage (Mann-Whitney U tests, gender: n1 (female) = 241, n2 (male) = 361, two-tailed; experience of damage: n1 (no damage) =

| **Species – need u values** | **Gender** | | **Experienced damage** |
|---|---|---|---|
| | *U* | *P* | *p* |
| **Q8: How do you feel about the following animals living here?** | | | |
| Bear | | 0.062 | **<0.001** |
| Roe Deer | | **<0.001** | 0.17 |
| Wild Boar | | **0.001** | **<0.001** |
| Beaver | | 0.23 | **0.01** |
| Wolf | | **0.007** | **0.002** |
| **Q9: How would you feel about the following animals appearing here? (If not already present)** | | | |
| Bear | **1**9218 | **<0.001** | **0.004** |
| Roe Deer | | 0.20 | **0.024** |
| Wild Boar | | **0.002** | **<0.001** |
| Beaver | | **0.001** | 0.29 |
| Wolf | | **0.008** | **<0.001** |
| **Q10: How would you describe your attitude towards these animals?** | | | |
| Bear | 33968 | **<0.001** | **<0.001** |
| Roe Deer | | **0.028** | **0.017** |
| Wild Boar | | **<0.001** | **<0.001** |
| Beaver | | **0.012** | **<0.001** |
| Wolf | | **0.014** | **0.003** |
| **Q11: Would you be afraid to go to places with the following animals?** | | | |
| Bear | | **<0.001** | 0.31 |
| Roe Deer | | **0.007** | 0.31 |
| Wild Boar | | **<0.001** | **<0.001** |
| Beaver | | **<0.001** | 0.37 |
| Wolf | | **<0.001** | 0.61 |
| **Q14: How would you like numbers of these animals to change over the next 10 years?** | | | |
| Bear | 19176 | **0.018** | **<0.001** |
| Roe Deer | | **0.012** | **0.003** |
| Wild Boar | | **<0.001** | 0.97 |
| Beaver | | **0.003** | **<0.001** |
| Wolf | | **0.001** | **<0.001** |
| **Q19: How worried are you that these animals might bother you or cause you damage?** | | | |
| Bear | | 0.09 | **<0.001** |
| Roe Deer | | **0.033** | **<0.001** |
| Wild Boar | | **0.004** | **<0.001** |
| Beaver | | **0.031** | **<0.001** |
| Wolf | | **0.011** | **<0.001** |

*Table 1. Male and female attitudes towards bear, wild boar and wolf depending on whether they see them frequently, occasionally or have never seen one. (Bear: Female n=235, Male n=361; Boar: Female n=236, Male n=360; Wolf: Female n=236, Male n=360)*

| | | Negative | Neutral | Positive |
|---|---|---|---|---|
| **Bear** | | **Never seen one** | | |
| | Female (77%) | 42 | 37 | 21 |
| | Male (56%) | 28 | 28 | 44 |
| | | **Occasionally** | | |
| | Female (21%) | 53 | 29 | 18 |
| | Male (42%) | 46 | 25 | 29 |
| | | **Frequently** | | |
| | Female (2%) | 50 | 50 | 0 |
| | Male (2%) | 43 | 14 | 43 |
| **Boar** | | **Never seen one** | | |
| | Female (27% | 51 | 35 | 14 |
| | Male (8%) | 31 | 33 | 36 |
| | | **Occasionally** | | |
| | Female (54%) | 45 | 35 | 30 |
| | Male (57%) | 40 | 17 | 43 |
| | | **Frequently** | | |
| | Female (19%) | 51 | 25 | 24 |
| | Male (34%) | 42 | 14 | 44 |
| **Wolf** | | **Never seen one** | | |
| | Female (60%) | 55 | 22 | 23 |
| | Male (41%) | 53 | 6 | 41 |
| | | **Occasionally** | | |
| | Female (38%) | 68 | 18 | 14 |
| | Male (55%) | 59 | 4 | 37 |
| | | **Frequently** | | |
| | Female (3%) | 67 | 33 | 0 |
| | Male (4%) | 43 | 21 | 36 |