Master's Thesis – master Sustainable Development

Attitude change of residents towards large carnivores in the Czech Beskydy Mountains

Towards coexistence with lynx, wolves and brown bears

(SPNL, 2016).

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30 ECTS

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Histories of Wildlife and People: a research project on past and present interactions between wild animals and people.

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Summary

The Eurasian lynx (*Lynx lynx*), grey wolf (*Canis lupus*) and brown bear (*Ursus arctos*) are making a comeback in Europe. Consequently, humans and large carnivores have to share landscapes, which may result in conflicts. Research of human-carnivore interactions has given extensive attention to mitigating such conflicts, thereby focusing on 'negative' interactions between humans and large carnivores. However, less research has been conducted on 'positive interactions', in other words: coexistence of humans and large carnivores. Coexistence requires peoples' attitudes to shift towards higher levels of tolerance. Attitudes towards large carnivores may change over time in accordance with changes in socio-ecological circumstances within a landscape. However, longitudinal research on this topic is scarce.

This study aimed to close this research gap on attitude change towards large carnivores, while including both negative and positive interactions. A case study was conducted in the Czech Beskydy Mountains, where local attitudes towards the Eurasian lynx, grey wolf and brown bear have been researched in the year 2000 by Friends of the Earth Czech Republic and in 2009-2010 by Kutal et al. (2018). In 2022, data on attitudes was collected again, by administering 120 questionnaires with residents in 22 municipalities. Attitudes of 2000, 2010 and 2022 were compared to discover how local attitudes towards large carnivores in this region have changed over the past 22 years. Additionally, the drivers for coexistence in Beskydy were researched, and the level of coexistence in the region was measured using a model adapted from Marchini et al. (2021).

This research found that locals' attitudes towards carnivores in Beskydy became more positive between 2000, 2010 and 2022, with emotions, existence beliefs, perceived costs and perceived benefits as drivers for tolerance. It also found that locals perceived the human-carnivore relationship in Beskydy to not have shifted towards coexistence, but instead perceived a small shift towards conflict. Locals perceived increased numbers of carnivores and carnivore-related damages, as well as human expansion and increased human disturbance in nature as reasons for this shift.

For wildlife management, it is recommended to use emotions, existence beliefs, perceived costs and perceived benefits as leverage points towards tolerance. Further research on the relations between attitudes, behaviour and coexistence is required. This research provides an example of operationalisation of the model by Marchini et al. (2021), which can be used for participatory decision-making regarding carnivores, as well as for participatory research on human-carnivore interactions.

Preface

As part of the research project 'Histories of Wildlife and People', funded by NWO, this research aimed to shed light on past and present human-carnivore interactions.

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1. Introduction

After extermination in much of Western Europe (Ripple et al., 2014), the Eurasian lynx (*Lynx lynx*), the grey wolf (*Canis lupus*) and brown bear (*Ursus arctos*) are making a comeback in Europe (Kuijper et al., 2016; Kutal et al., 2018). Their populations are stable or increasing (Chapron et al., 2014). These large carnivores require large habitats to sustain populations (Ripple et al., 2014), but simultaneously, humans are changing their manner of land exploitation as a result of population growth and overconsumption (Chapron et al., 2014; Frank & Glikman, 2019). Consequently, carnivores and humans now have to share landscapes: lynx, wolves and bears are found surviving in human-dominated landscapes and largely outside of protected areas (Chapron et al., 2014). For humans and large carnivores, this creates the challenge of living closer together and crossing each other's boundaries without causing unbearable levels of conflict (Frank & Glikman, 2019; Venumière-Lefebvre et al., 2022).

Research and management of human-carnivore interactions (HCIs) has given extensive attention to conflict mitigation (König et al., 2020), and the dominant approach towards avoiding conflict has been a strict separation of humans and carnivores (Buijs & Jacobs, 2021). However, less attention has been devoted to minimising conflict while still facilitating a shared landscape (Pooley et al., 2021). Such coexistence is key for sustainable management of these landscapes. In order to achieve coexistence, attitude change from negative perceptions towards positive perceptions is necessary (Frank & Glikman, 2019). However, more studies have focused on researching negative attitudes than positive ones (Rode et al., 2021). In addition, longitudinal studies examining how attitudes change due to the comeback of carnivores are rare ((Majic & Bath, 2010; Majic et al., 2011). This study aimed to close the research gap on attitude change towards carnivores, while focusing conflicts and negative perceptions of carnivores, as well as benefits and positive perceptions of carnivores.

Attitudes may change over time for a multitude of reasons (Majic et al., 2011), as the comeback of carnivores induces socio-ecological changes in the landscape. Carnivores influence their prey population and local vegetation (Suraci et al., 2016), they may attack livestock, ignite changes in conservation and nature management (Majic & Bath, 2010), cause fear (Røskaft et al., 2003), induce social conflicts (Chapron et al., 2014) and further influence socio-ecological dynamics. Since carnivores have been absent for decades, people have to adapt to their presence, and learn to coexist with carnivores.

Most commonly, carnivores are perceived as damaging and dangerous (Kaczensky et al., 2004; Kastelic et al., 2013; Lescureux et al., 2011; Tosi et al., 2015). In line with that, research focused predominantly on conflicts and economic impacts, neglecting positive interactions and benefits of the presence of carnivores (Bhatia et al., 2020; Lozano et al., 2019; Rode et al., 2021). This is problematic, since emphasis on conflicts could reinforce negative attitudes towards carnivores (Rode et al., 2021), lead to biases in the understanding of HCIs, and consequently lead to biases in conservation planning (Bhatia et al., 2020). As positive attitudes and perceptions of benefits are important for achieving coexistence, further research on these topics is needed (Frank & Glikman, 2019).

Most research on attitudes towards carnivores has focused on one point in time and little repetitions of studies over time showing attitude change have been done in Europe (Majic & Bath, 2010; Majic et al., 2011). The few studies that have been conducted on this topic show differing outcomes. Some studies report that in regions where the number of carnivores has grown, negative perceptions of the animals have increased (Majic et al., 2011; Tosi et al., 2015). An increase in fear (Tosi et al., 2015) or social conflict (Liukkonen et al., 2009) is reported. Zimmerman et al. (2001), suggest that after the initial increase in fear and negative attitudes, experience ensures that both fear and negative attitudes decrease again over time. Furthermore, Majic & Bath (2011) report that both negative *and* positive attitudes decreased over time. Researchers have stressed the need to start conducting longitudinal research (Majic & Bath, 2010) as it is unclear how the comeback of carnivores has already influenced people's attitudes and what attitude changes can be expected in the future. Is there a need for extra efforts towards facilitating coexistence or is it already naturally on its way? Or is coexistence even already in place?

This research is a case study of the Czech Beskydy Mountains. In this area, lynx, wolves and bears have been sighted again when official monitoring started in 2003 (Kovařík et al., 2014) after their extermination in the 1930s (Kutal et al., 2018). In the Beskydy region, sheep grazing is common (Kovařík et al., 2014). In addition, hunting, forestry and tourism occur in the area, even though the region is designated as Protected Landscape Area (PLA) (Kutal et al., 2018). Because of these circumstances, this region is especially prone to conflicts between humans and wildlife (Kutal et al., 2018). Research on conflicts has been conducted in this area in the year 2000 by Friends of the Earth Czech Republic and in 2009-2010 by Kutal et al. (2018). Both studies focused on local attitudes regarding conflict with lynx, wolves and bears in the region. Kutal et al. (2018) compared their data with the data from 2000 and found a *"decrease in negative or extreme negative attitudes of local people towards wolves and bears, and a substantial increase in neutral attitudes"* (p.181). This points towards increased coexistence of carnivores in the region. The availability of findings from 2000 and data on attitudes from 2010, combined with recent awareness campaigns in the area (Kutal et al., 2018) made Beskydy a suitable region for a longitudinal case-study on changes in attitudes towards large carnivores.

This research compared current data on attitudes towards lynx, wolves and bears in Beskydy with findings from 2000 and data from 2010, to learn how attitudes have changed in the past 22 years. In addition, this study investigated the link between attitude change and coexistence in Beskydy. Furthermore, locals' perceptions on the factors influencing the human-carnivore relationship in Beskydy were researched. The following research questions were answered:

How have locals' attitudes towards large carnivores in the Beskydy Mountains changed between the years 2000, 2010 and 2022?

Sub-question 1: How do current attitudes of locals towards lynx, wolves and brown bears in the Beskydy region compare to locals' attitudes of 2010?

Sub-question 2: What are the drivers for coexistence with lynx, wolves and brown bears in the Beskydy region?

Sub-question 3: What are locals' perceptions on changes in the human-carnivore relationship in the Beskydy region over the past 22 years?

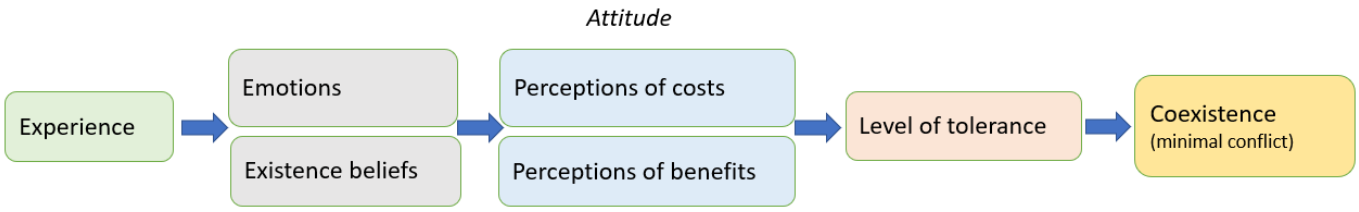
2. Theory

2.1 Theoretical framework

Figure 1 shows the theoretical framework, which provides an overview of the concepts used in this research. These concepts are elaborated on below.

Figure 1

Theoretical framework



Note. The framework shows from left to right how attitudes come about, what they consist of and how they can influence tolerance and foster coexistence.

2.2 Conflict

A multitude of definitions are being used in literature to describe conflict between humans and wildlife (Frank, 2016; Knox et al., 2021; Venumière-Lefebvre et al., 2022). Frank (2016) defines human-wildlife conflicts as *"real or perceived negative biological, economic, social, or political interactions between humans and wildlife"* (p.738) and states that this includes impacts of wildlife on humans, impacts of humans on wildlife and conflicts between humans over wildlife. This definition will also be used in this research.

Traditionally, research and management focused predominantly on impacts of wildlife on humans (Frank & Glikman, 2019). This one-way focus and neglection of the impact of humans on wildlife often drives conscious harm of humans to wildlife, such as retaliatory killing (Kansky et al., 2016). For humans, such impacts are for example threats to human safety, property, pets, livestock, game, crops, or beehives (Venumière-Lefebvre et al., 2022). Only recently have scholars begun to view conflicts between humans and wildlife as occurring within a broader system and requiring multidisciplinary and transdisciplinary solutions (Frank & Glikman, 2019). They started to view conflict between humans and wildlife as a two-way interaction, in which humans and wildlife impact each other (Frank & Glikman, 2019). For carnivores, negative impacts could be intentional killing, disease, accidental deaths and translocations (Venumière-Lefebvre et al., 2022). A third type of conflict is human-human social conflict. These conflicts between humans over wildlife are often associated with human-wildlife conflicts (Frank & Glikman, 2019; Venumière-Lefebvre et al., 2022). This may worsen the situation, for example when anger about conservation decisions is being directed at wildlife instead of at humans. Social issues are often overlooked when dealing with conflicts (Frank & Glikman, 2019).

Whether interactions between humans and carnivores are considered to have a negative impact either on humans or carnivores depends on the level of tolerance humans and carnivores have towards each other. Yurco et al. (2017) emphasise that since interactions between humans and wildlife are constantly changing, conflict is not static but is instead negotiated through daily experiences. It is therefore "*neither merely present or absent but in fact produced"* (p.1123). In their research in the Okavango Delta, Botswana, they found that locals experienced a lived contradiction, in which they admonished wildlife in one moment, but praised it in the next. This variability is important to keep in mind as it may give the researcher a skewed image of the situation in a landscape. The concept of tolerance is further explained in section 2.4, which also explains the distinction between *real* and *perceived* interactions.

2.3 Coexistence

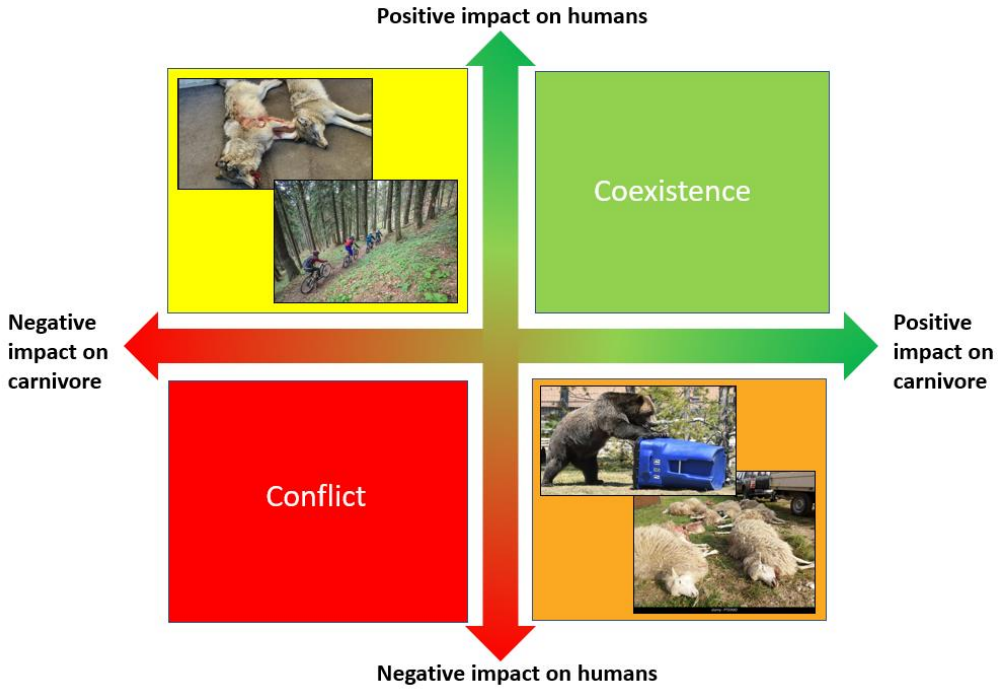
Straightforwardly, the term coexistence can be interpreted as simply the co-occurrence of humans and wildlife in a landscape. However, Knox et al. (2021) note that to prevent conflicting conservation priorities and outcomes, it is important to regard coexistence as end goal for a sustainable landscape in which conflict is minimal. What coexistence precisely entails is context-dependent, as the interplay of geography, culture and species is unique for each landscape. Moreover, people give their own meanings to coexistence (Knox et al., 2021). Also in literature, no distinct definition for the concept of coexistence exists. Instead, different definitions or no definitions at all are being used and coexistence and tolerance are being used as synonyms (Frank, 2016; Knox et al., 2021; Venumière-Lefebvre et al., 2022).

Based on a review of studies on human-wildlife coexistence, Venumière-Lefebvre et al. (2022) formulated a holistic definition of coexistence: *"Co-occurrence of sustainable carnivore populations and human endeavors with minimal human-carnivore and human-human conflict"* (p.8). According to this definition, coexistence occurs when both carnivores and humans thrive in a shared landscape. This means that carnivore populations consist of a sufficient number of individuals and have sufficient space to survive in the long-term. It also means that human populations are able to achieve their goals, such as economic prosperity or feelings of safety. As conflict impedes peaceful co-occurrence of human and carnivore populations, conflicts between carnivores and humans and conflicts between humans over carnivores need to be minimal (Venumière-Lefebvre et al., 2022).

This is illustrated in Figure 2, which is adapted from Marchini et al. (2021). The Figure shows four archetypes along two axes. The vertical axis ranges from negative to positive carnivore impacts *on humans*. The horizontal axis ranges from negative to positive human impacts *on carnivores*. As visible in the Figure, coexistence occurs when humans and carnivores positively impact each other (green). Conflict occurs when humans and carnivores negatively impact each other (red). Conflict also occurs when humans negatively impact carnivores, for example through poaching or disturbance in the forest, but carnivores do not negatively impact humans (yellow). Lastly, conflict occurs when carnivores negatively impact humans, for example through damages to property or livestock, but humans do not negatively impact carnivores (orange).

Figure 2

Human-carnivore interactions as adapted from Marchini et al. (2021).



Note. The figure shows four archetypes; conflict occurs in the red, orange and yellow archetypes, and coexistence occurs in the green archetype. Pictures are sourced from (dpa picture alliance, 2018), (Hack, 2020), (Meateater, 2021), (Romanian friend, n.d.)

2.4 Tolerance

Taking a human point of view, tolerance can be defined as a neutral point on a scale, ranging from negative to positive judgment about wildlife (Brenner & Metcalf, 2020). Bruskotter & Wilson (2014) defined tolerance as "*the passive acceptance of a wildlife population"* (p.159). As such, tolerance is a precondition for coexistence.

According to Bruskotter & Wilson (2014), one's level of tolerance towards carnivores depends on the costs, risks and benefits one associates with these animals. *Perceived* costs and benefits are not always in line with *actual* costs and benefits of the presence of carnivores in a landscape. Taking the example of risks, Bruskotter & Wilson explain that perceived risks of a hazard are more related to people's outrage over the potential effects of a hazard than to the likelihood of exposure to the risk. Likewise, costs and benefits people associate with carnivores are not a result of a logical cost-benefit analysis, but of a complicated interaction between multiple variables.

Conflict, defined as real or perceived negative interaction, can be considered as a consequence of perceived costs/risks. Therefore, conflict occurs if costs and risks of the presence of carnivores are perceived to be high, even though the actual monetary costs of damage to livestock and the actual risk of an attack on humans may be small. In short, conflict occurs regardless of whether damage and attacks actually happen. Perceived costs/risks and perceived benefits are thus important indicators for conflict. Appendix I gives further information on perceived costs and benefits towards carnivores in Europe.

2.5 Perceived benefits

Research on HCIs has mostly focused on conflicts and neglected the benefits of the presence of carnivores in a landscape (Rode et al., 2021). The presence of carnivores can garner positive emotions, strengthen social cohesion, boost tourism and contribute to cultural heritage (Rode et al., 2021) and regulate ecosystem services (Marino et al., 2021). Focusing on psychological benefits of wildlife, Buijs & Jacobs (2021) identified three pathways through which wildlife can contribute to well-being and happiness: pleasure, engagement and meaning. Wildlife can give pleasure by stimulating positive emotions and help to decrease negative emotions such as stress and isolation. Wildlife can contribute to engagement with nature through the induction of awe and fascination, known as flow experiences. Engagement can also happen through facilitation of personal growth, or virtue development, when people discover new hobbies related to wildlife. Additionally, wildlife can contribute to creating intimate relationships with other people, or with nature (Buijs & Jacobs, 2021). Research by Dorresteijn et al. (2016) on attitudes towards bears in Romania illustrates one such intimate relationship, as a respondent said to consider the bear as a neighbour. As third pathway, Buijs & Jacobs (2021) considered 'meaning', which relates to altruism and ego-transcendence. This research chose to focus on pleasure and engagement, as different methods are required for researching meaning.

2.6 Emotions and beliefs at the root of attitudes

An important way to minimise conflict is to change human behaviour towards carnivores. Attitudes are considered a proximate cause of behaviour, which means that they may influence behaviour. Understanding people's attitudes enables prediction of their behavioural response to, for example, changes in management of carnivores and conflicts with carnivores. Moreover, understanding people's attitudes may enable influencing their behavioural response. This might be useful to, for example, reduce illegal killing (Manfredo, 2008).

Attitude can be defined as *''an association, in memory, of an evaluation with an object''* (Manfredo, 2008, p.78). In this research, a person's attitude is considered to be their personal combination of perceived costs/risks and perceived benefits towards carnivores. Emotions, beliefs and behaviour are considered to be at the root of attitudes. Attitude may be based on one of these components, or on a combination of these (Manfredo, 2008). This research focuses on emotions and beliefs, and does not go into depth on behaviour.

Emotions are one's physiological and behavioural responses to a situation. Reflections of emotions influence attitudes towards carnivores. Human dimensions research has identified fear and perceived risk as important determinants of human responses to carnivores (Sponarski et al., 2015). Johansson & Karlsson (2011) mention perceived danger of wolves and bears and perceived uncontrollability of one's own response when encountering carnivores as main causes of fear. Both negative emotions, such as anger and fear, and positive emotions, such as joy, have been found to influence responses to management of carnivores (Sponarski et al., 2015). However, according to Jacobs et al. (2012), there is still a lot unknown about humans' emotions towards wildlife. Nevertheless, research on emotions can be very useful in enhancing current understanding of human behaviour towards wildlife (Jacobs et al., 2012).

Beliefs are what people take to be true, although this is not necessarily the case (Sponarski et al., 2015). Beliefs about an object are formed by associating it with other objects, events, or characteristics (Ajzen, 1991). Frank et al. (2016) researched negative attitudes towards coyotes in Newfoundland, and found that next to fear, existence beliefs and impact beliefs were strong predictors of attitude. Existence beliefs entail the importance of the existence of a large carnivore species and of preserving the species for future generations. Impact beliefs entail for example damage caused to livestock and game.

Thus, based on one's emotions and beliefs about carnivores, one forms an attitude towards them. Literature frequently uses the terms 'positive' and 'negative' attitude. In a positive overall attitude perceived benefits outweigh perceived costs/risks, whereas it is the other way around for a negative attitude. As attitude has an important influence on one's behaviour, it is likely that a positive overall attitude coincides with positive actions towards carnivores and that a negative overall attitude coincides with perceptions of conflict and resulting 'negative' behaviour.

2.7 Attitude change towards large carnivores

General attitudes can change over time, as the balance between perceived costs/risks and benefits of an object shifts. Albarracin & Shavitt (2018) reviewed psychology literature on attitude change and concluded that attitude change can occur due to personal development, social interaction, and major sociocultural changes and impactful climatic, economic or political events.

On a basic level, knowledge and experience can ignite attitude change. Knowledge of a species' behaviour and ecological function, of the risk of attack and of the cost of damage have all been found to foster positive attitudes (Bhatia et al., 2020; Bruskotter & Wilson, 2004; Glikman et al., 2012; Piédallu et al., 2016). Likewise, positive direct experiences with wildlife foster positive attitudes (Buijs & Jacobs, 2021; Kansky et al., 2021) and a lack of experience with living with carnivores is related to higher levels of fear (Zimmerman et al., 2001).

In Europe, little research has been done on the specific topic of attitude change towards carnivores (Majic & Bath, 2010; Majic et al., 2011) and existing studies provide an inconclusive view. According to Tosi et al. (2015), people living in regions where the number of carnivores is increasing often start to fear interactions with these carnivores more and their level of tolerance starts to decrease. This decrease in tolerance is confirmed by Majić et al. (2011), who found that as management of bears changed and consequently the number of brown bears increased in Croatia, locals' acceptance of the bear population decreased, even though the perceived threat remained the same. Similarly, Liukkonen et al. (2009) found that the growth of a lynx population in Finland led hunters to have a negative attitude towards the animal and illegally kill lynx. This also led to conflict

between conservationists and hunters over the suitability of killing lynx as a population management measure (Liukkonen et al., 2009).

However, in their research on bears and wolves in Norway, Zimmerman et al. (2001) found that "*the proportion of people with a negative attitude increases to a maximum with the arrival of large carnivores, and decreases with experience over time. The proportion of people afraid of large carnivores is relatively high before carnivore arrival but decreases with experience.*" (p.137). This shows how variable attitudes and levels of fear are and indicates that people are able to get used to the presence of carnivores.

A nuanced view is provided by Majić & Bath (2010), who found that both negative and positive attitudes became more neutral over time as both support for conservation and support for control of wolves in Croatia declined. The authors note that a shift towards neutrality, rather than towards positive views may be more beneficial to coexistence, as compromises can be more easily achieved.

2.8 Hypothesis

As research in Europe found shifts in overall attitude change towards more negative, more positive and more neutral attitudes due to living with carnivores (Majic et al., 2011; Majic & Bath, 2011; Tosi et al., 2015; Zimmerman et al., 2001), these are all possibilities for the Beskydy region.

According to literature, changes in experience, emotions, beliefs, perceived costs and perceived benefits all influence attitude change. Therefore, it is expected that this research finds associations between these concepts in the order that they occur in the theoretical framework (Figure 1). Additionally, it is expected that changes in these concepts between 2010 and 2022 point consistently in the same direction of attitude change, meaning that all concepts without exception indicate a negative change, positive change or shift towards neutrality. Similarly, being a measure of coexistence, it is expected that locals' perceived changes in the human-carnivore relationship in Beskydy are consistent with the found attitude change. This follows from the theoretical framework, in which it is assumed that attitude changes influence coexistence levels.

Experience is expected to have increased between 2010-2022, as the number of carnivores in Beskydy is likely to have increased (Kutal et al., 2018), along with human expansion (Chapron et al., 2014). According to Kutal et al. (2018) it is likely that the overestimations of damages in 2010 will have decreased for 2022. Therefore, fear and perceived costs are expected to have decreased. Thus, based on the theorised influence of these concepts on attitude change, an increase in tolerance and a positive attitudinal shift are expected to have occurred in Beskydy.

3. Methods

3.1 Study area

PLA Beskydy (Figure 3), is a Natura 2000 site and spans an area of 1.160 km2, and its altitude ranges between 350-1323 m. above sea level. The PLA is the largest in the Czech Republic (CZ) and is comprised of 60 different nature reserves. It has a 72% forest cover, low human density and varying land uses among which farming, hunting and tourism-attracting outdoor recreational activities (Kutal et al., 2018). The region hosts multiple protected plant and animal species, among which the lynx, grey wolf and brown bear (CHKO Beskydy, 2022). These carnivores are under strict legal protection in Europe under Annex IV of the Habitats Directive and thus may not be captured, killed or deliberately disturbed (Directive 92/43/EEC).

Carnivores in the Beskydy Mountains originate from populations in Slovakia (Kutal, 2008). Kutal mentions poaching and migration barriers, such as highways, as factors hindering the growth of populations of carnivores in the region (Kutal, 2008). The estimated number of lynx in CR has increased from 30-65 in 2012 (Kaczensky et al., 2012) to 100 in 2022 (M. Kutal, personal communication, September 27, 2022). For wolves, the estimated number in CR increased from 0-5 in 2010 (Kutal et al., 2018) to 100 in 2022 (M. Kutal, personal communication, September 27, 2022).According to Friends of the Earth Czech Republic, bears have been present in Beskydy PLA since 1970. The duration of their presence varied, with some bears staying up to several years in the region (Hnutí DUHA, 2018). Both in 2010 (Kutal et al., 2018) and 2022 (M. Kutal, personal communication, September 27, 2022), it was estimated that 0-2 bears were present in CR.

Figure 3

Map of PLA Beskydy in Czech Republic (Kovařik et al., 2014).

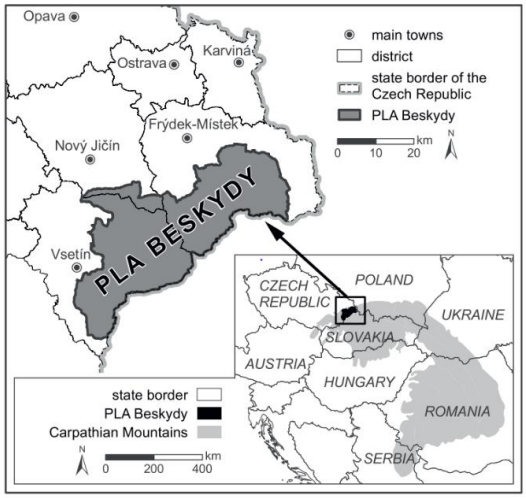


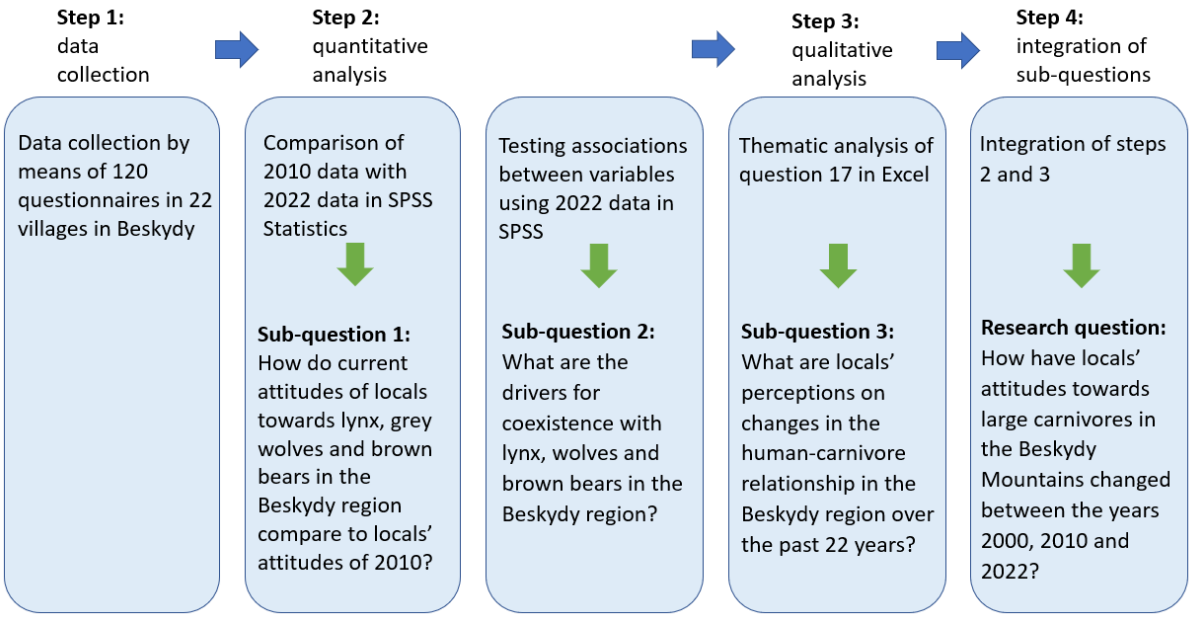
Fig. 1. Study area (PLA Beskydy).

3.2 Research Framework

This research consisted of four steps (Figure 4). First, data about current attitudes was collected via questionnaires. Second, quantitative analysis using Excel and SPSS took place in which attitudes from 2010 and 2022 were compared (sub-question 1). Additionally, associations between variables were tested (sub-question 2). Third, a qualitative analysis followed to discover locals' perceptions on the human-carnivore relationship in Beskydy (sub-question 3). Fourth, the sub-questions were integrated to formulate an answer to the research question of how attitudes towards carnivores in the Beskydy Mountains changed over time.

Figure 4

Research framework



Note. The framework shows the four research steps and how they correspond to the sub-questions.

3.3 Step 1: Data collection

3.3.1 The fieldwork

To discover current attitudes towards carnivores, data were collected similarly to Kutal et al. (2018). This ensured a valid comparison with 2010.

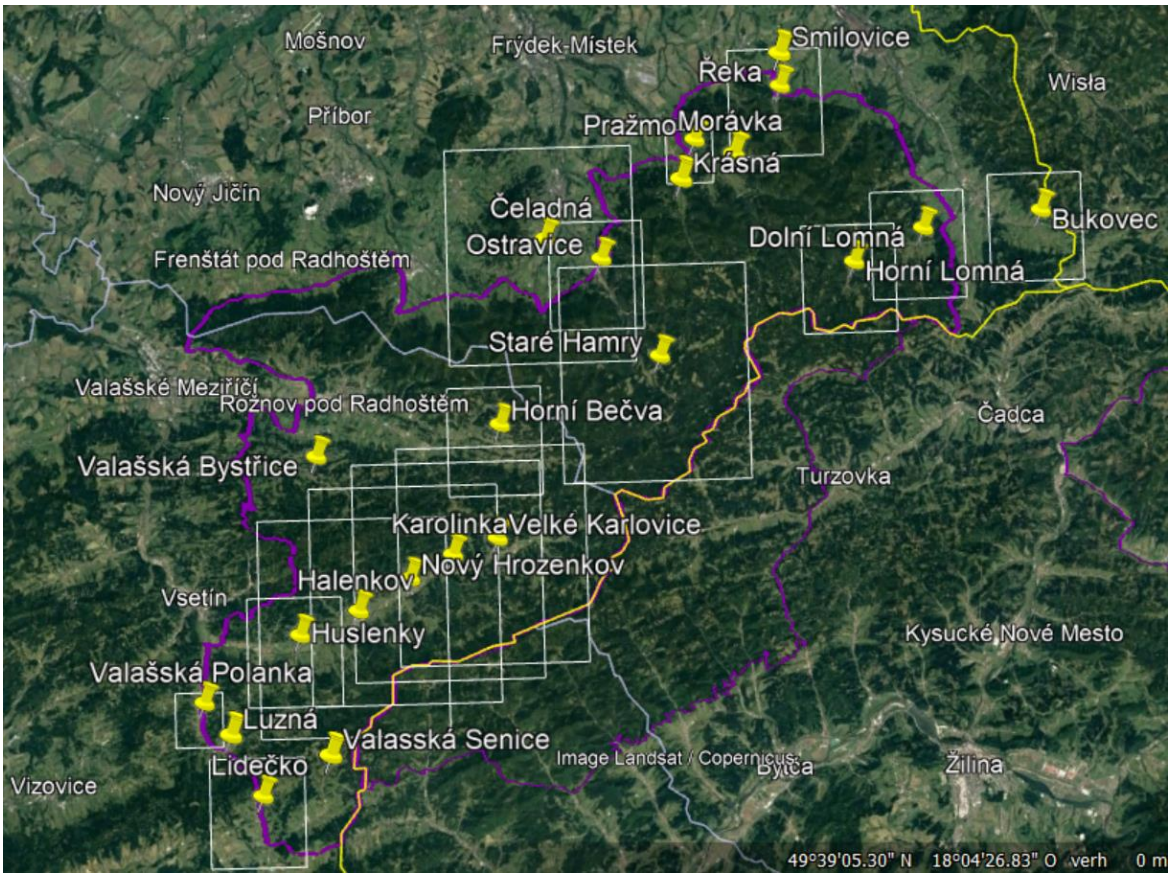
In 2010, 158 questionnaires were administered in 21 municipalities in the Beskydy region. The current research conducted 120 questionnaires in 22 municipalities during June-July 2022 in this region. Of these, 19 were the same as those visited in 2010. Moreover, the researchers aimed for a similar number of questionnaires per municipality as was obtained in 2010, to further comparison. In 2010, the number of questionnaires per municipality was based on circumstance; it was not pre-defined. The distribution of questionnaires per municipality for 2022 can be found in Appendix II. The duration of the interviews was approximately 30-60 minutes. The average number of refuses per day was 12. Most often, 4 interviews could be conducted per day, during 32 days of data collection.

In the municipalities, locals were approached by random house selection for face-to-face interviews during which a questionnaire was filled in. A Dutch researcher and a Czech translator addressed residents who were outside in their gardens and otherwise ringed doorbells. The researchers spread out the number of questionnaires roughly equally over the towns using mapy.cz, with some respondents from the city-centre and others from the outskirts. This method was similar to the random selection method of 2010. To ensure independence of observation, only one respondent per household participated. Once, a respondent mentioned to have also participated in the research in 2010. Prior to the interviews, respondents were asked if they lived in the region for at least 12 years, otherwise they were excluded from participation.

After data collection, responses were transferred to Excel sheets for analysis. To be able to quantitatively compare attitudes between 2022 and 2010, raw data collected by Kutal et al. (2018) in 2009/2010 was required. M. Kutal provided this in Excel sheets.

Figure 5

Map with the locations of the 22 municipalities in the Beskydy region where data were collected.



Note. This map was made in Google Earth Pro. The yellow points indicate the 22 visited municipalities. The purple line marks the borders of PLA Beskydy. The yellow lines indicate where Czech Republic borders with Slovakia and Poland.

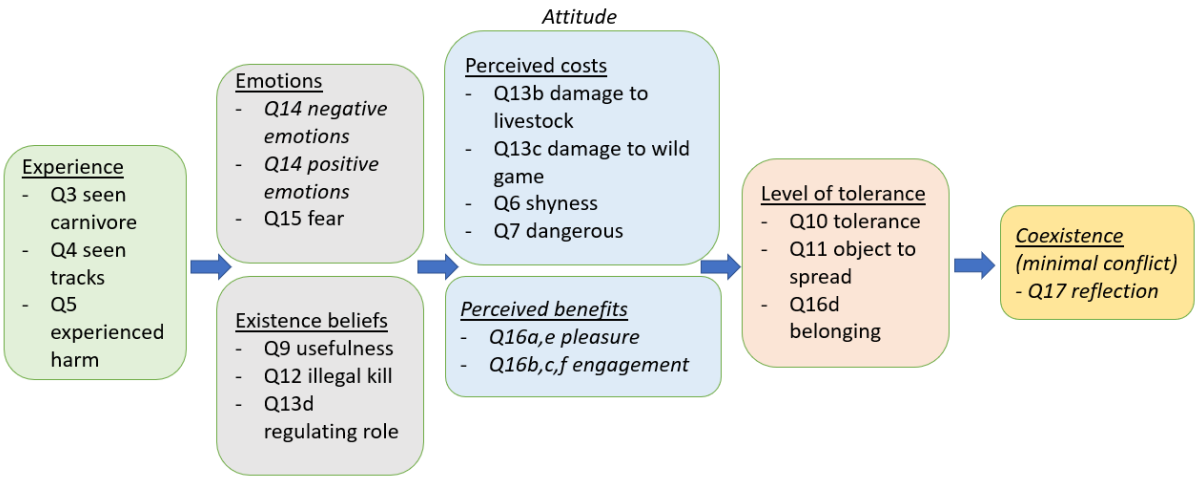
3.3.2 Structure of the questionnaire

The questionnaire was structured in four parts, so that it flowed logically for respondents. Therefore, the numbering of questions (Q) did not directly correspond to sections of the theoretical framework. This is visible in Figure 6. To ease respondents into the questionnaire, the first part (Q1-8) contained questions about their knowledge of- and experience with large carnivores. This included asking respondents to estimate the number of lynx, wolves and bears in CZ. These questions were followed with questions about the shyness and dangerousness of the carnivores, and by a question concerning information sources about carnivores. The second part was formed by Q9-15. For respondents, this part was summarized as concerning their feelings towards carnivores, with a combination of questions about emotions, existence beliefs and tolerance. Q16 formed the third part, and concerned perceptions of benefits. The researcher chose to communicate this towards the respondents as positive influences of carnivore presence on individuals. The fourth part consisted of the interactive Q17, in which respondents reflected on the human-carnivore relationship in Beskydy over the past 22 years. Last, the questionnaire contained socio-demographic questions.

To optimize comparison between 2010 and 2022, the majority of questions in the questionnaire are the same as those asked in 2010 by Kutal et al. (2018). Exceptions are the questions about emotions (Q14), perceived benefits (Q16) and reflection on the human-carnivore relationship (Q17). In Figure 6, these questions are shown cursively. The 2022 questionnaire can be found in Appendix III and IV. To ensure validity of the questionnaire items, the questionnaire was evaluated based on face validity by members of the research team (Bryman, 2016).

Figure 6

Theoretical framework with corresponding questions of questionnaire.



3.3.3 Operationalisation of the theoretical framework

Several questionnaire items were used to measure each concept belonging to the theoretical framework (Figure 6). Experience (Buijs & Jacobs, 2021; Kansky et al., 2021; Zimmerman et al., 2001) was measured by yes/no questions asking respondents whether they had ever seen a lynx, wolf or bear or seen their tracks and whether they or a family member had experienced harm by carnivores.

Emotions were measured by asking respondents to rate a range of negative and positive emotions they might feel due to the presence of each carnivore. Respondents evaluated the strength of their emotions using a five-level Likert scale ranging from very weakly to very strongly. This measurement of emotions was derived from Kansky et al. (2016). Although fear was one of the emotions respondents rated in this question, an additional question about fear was asked because fear has an important influence on HCIs (Sponarski et al., 2015). In this question, respondents were given several statements and asked for each carnivore whether these applied to them. This question provided a more detailed picture of how fear of carnivores affected respondents' daily lives, such as fear of going into the forest.

Existence beliefs (Sponarski et al., 2015) were measured using three questions. The first asked whether respondents perceived each carnivore to be useful, useless or harmful. The second question asked respondents directly whether each carnivore had an important role in regulating numbers of wild ungulates. For this question, a four-point scale ranging from certainly yes to certainly no was used. The third was a multiple-response question, which asked for each carnivore how respondents would respond in the situation that someone they knew illegally killed a lynx, wolf or bear. Possible answers were feeling glad, not caring, feeling sorry and upset, trying to explain that it was wrong, and reporting it to the PLA Administration or the police. This way, the question asked respondents about their beliefs on carnivores' right of existence.

Attitude was measured through questions concerning perceived costs and perceived benefits (Bruskotter & Wilson, 2014). Questions measuring perceived costs (Bruskotter & Wilson, 2014) asked respondents whether lynx, wolves and bears were causing a lot of damages to livestock and wild game. Additionally, respondents were asked to indicate whether lynx, wolf and bear were shy animals which usually avoided people. This question indirectly measured the perceived likelihood of attacks on humans, livestock and property. Furthermore, respondents were asked more directly whether they perceived each carnivore to be dangerous for humans. For all questions measuring perceived costs, a four-point scale ranging from certainly yes to certainly no was used.

Perceived benefits were assessed using questions regarding pleasure and engagement (Buijs & Jacobs, 2021). Respondents were asked whether they agreed with several statements, with possible

judgement on a four-point scale ranging from certainly yes to certainly no. For pleasure, the statements asked whether respondents appreciated the beauty of lynx, wolf and bear, and whether their presence gave them hope for the future. For engagement, the statements asked whether respondents felt fascination and a close connection to each carnivore, and whether due to the presence of each carnivore, respondents had started with activities that enabled them to enjoy and/or protect wildlife. These questions were inspired by Buijs & Jacobs (2021).

Tolerance levels (Bruskotter & Wilson, 2014) were measured with three questions. The first directly asked respondents about their acceptance of carnivores in Beskydy. For each carnivore, respondents could choose from the following answers: 'it makes me happy', 'I do not mind', 'it bothers me but I can accept it', 'it bothers me and I am not ready to accept it' and 'I do not have an opinion on this'. The second question asked if respondents would object to further spontaneous spread of each carnivore in CZ. For this question, answers ranged from certainly yes to certainly no on a four-point scale. The third question stated: 'The lynx/wolf/bear belongs in the Beskydy/Wallachian Mountains', with answers again on a four-point scale ranging from certainly yes to certainly no.

Lastly, coexistence (Knox et al., 2021; Marchini et al., 2021; Venumière-Lefebvre et al., 2022) was measured by asking respondents to reflect on the human-carnivore relationship in Beskydy over the past 22 years. This interactive question was based on Figure 2 as adapted from Marchini et al. (2021) and asked respondents to place images of the lynx, wolf and bear somewhere along two axes (Figure 2). The y-axis represented the impact of people on carnivores, and the x-axis represented the impact of each carnivore on people. Both axes had a scale of -5 to +5, where negative scores indicated negative impact and positive scores indicated positive impact. Respondents were asked to place each of the animals on the axes for 2022, 2010 and 2000, thereby reflecting on whether and how the human-carnivore relationship changed over time. Respondents' reasoning behind their answers was noted. In guiding this question, researchers asked respondents about each placement relative to their placements of other carnivores and other years, but their questioning did not steer respondents' reasoning in any way.

3.4 Step 2: quantitative data analysis

3.4.1 Preparing for data analysis

Quantitative questionnaire items were analysed with statistical tests in SPSS Statistics. Prior to analysis, it was ensured that questionnaire items from 2010 and 2022 were measured on the same scale. This included changing the 2022 scale for Q7 (Appendix III) from 'certainly yes – certainly no' to the 2010 scale 'very dangerous – not dangerous'. Also, for Q15 (Appendix III) respondents who did not own pets were given a separate code in 2010. This was not accounted for during data collection in 2022, therefore the 2010 code for 'no pets' was joined with the code for 'unselected'. Moreover, answers that were coded using letters were recoded into numbers. Additionally, multiple-answer questions were separated into different variables. The data for both years were then merged into one SPSS file, with each questionnaire item as variable. The variables were labelled and since all quantitative items were categorical, all variables were either ordinal or nominal in nature. The data was therefore not normally distributed and required non-parametric methods (Rumsey, 2009). Histograms of the variables were made and confirmed the non-normal distribution. The data was checked for missing cases, which were given the value 99. Answers to the questions were recoded to fit the weight system explained in section 3.4.3. A nominal variable named Year was created for distinguishing between 2010 and 2022. Descriptive statistics were used to gain insight into the data.

3.4.2 Sample comparison

The samples of 2010 and 2022 were compared based on their demographic characteristics, to gain insight into the differences between the samples. For the ordinal variables with multiple categories, the samples were compared using Mann-Whitney U (MWU) tests, which are explained in section 3.4.4.

3.4.3 Indexes

Each concept of the theoretical framework was turned into an index, in which corresponding questionnaire items were combined. Table 1 gives an overview. It shows that each index was formed by summing up the questionnaire items measuring that concept.

The possible answers for each question were given weights to enable analysis. Answers that aligned with a negative attitude were given negative weights, whereas answers aligning with a positive attitude were given positive weights. Answers that did not align with negative or positive scores were given neutral weights of 0. The stronger answers aligned with a negative or positive attitude, the higher their negative or positive weight. By adding up the weights of a set of questions corresponding to a shared index, a score for each index was obtained. Table 1 shows the range of minimum-maximum obtainable scores.

For analysis purposes, it was necessary to create separate indexes for 'negative emotions', 'positive emotions', 'fear', and 'illegal kill 2022', although these are not overarching concepts of the theoretical framework.

Table 1

Overview of indexes and sums of questionnaire questions (Q) measuring them.

Index	Sum of questions	Meaning of questions	Weight system for questions
Experience	Q3 + Q4 + Q5 Obtainable score: 0 – 3	Q3 Have you ever seen a lynx/wolf/bear in the Czech countryside? Q4 Have you ever seen lynx/wolf/bear residence signs? Q5 Have large carnivores every done harm to you or your family?	Q3 0= no 1= yes Q4 0= no/I don't know 1=yes Q5 0= no/missing 1=yes
Emotions	Negative emotions + positive emotions + fear	See below	See below
Negative emotions	Q14a + Q14b +Q14c +Q14d What emotions do you feel due to living with lynx/wolf/bear in your area? Obtainable score: -20 – 0	Q14a* Frightened Q14b* worried Q14c* annoyed Q14d* animosity	Q14a, b, c, d 0= I don't feel this at all -1= very weakly -2= weakly -3= average intensity -4= strongly -5= very strongly
Positive emotions	+ Q14e +Q14f + Q14g + Q14h	Q14e* compassionate	Q14e, f, g, h 0= I don't feel this at all

	What emotions do you feel due to living with lynx/wolf/bear in your area? Obtainable score: 0 – 20	Q14f* grateful Q14g* happy Q14h* amused	1= very weakly 2= weakly 3= average intensity 4= strongly 5= very strongly
Fear	Q15a + Q15b + Q15c + Q15d Obtainable score: -4 – 0	Q15a I am afraid to go to the forest Q15b I am afraid to walk through the forest after dark Q15c I am afraid to let the children alone in the forest Q15d I am afraid of an attack on my pets	Q15a, b, c, d 0= unticked/missing -1=ticked
Existence beliefs	Illegal kill 2022 + Q9 + Q13d Obtainable score: -7 – 8	Illegal kill 2022 Q9 Lynx/wolf/bear is… Q13d Do lynx/wolves/bears have an important role in regulating numbers of wild ungulates?	See below Q9 -2= harmful 0= useless/ I don't know 2= useful Q13d -2= certainly no -1= rather no 0= I don't know 1= rather yes 2= certainly yes
Illegal kill 2022	Q12a + Q12b + Q12c + Q12d + Q12e + Q12f If you learned that someone you know has illegally killed a lynx/wolf/bear, how would you react?	Q12a I would be glad Q12b I would feel sorry Q12c I would be upset Q12d I would try to explain to them that it was wrong Q12e I would report it to the police or PLA administration Q12f I would not care	Q12a -2= ticked 0= unticked Q12b 0= unticked 1=ticked Q12c 0= unticked 1=ticked Q12d, 0= unticked 1=ticked Q12e 0= unticked 1=ticked Q12f -1=ticked

			0= unticked
Perceived costs	Q6 + Q7 + Q13b + q13c Obtainable score: -8 – 8	Q6 Is a lynx/wolf/bear a shy animal which usually avoids people?	Q6 -2= certainly no -1= rather no 0= I don't know 1= rather yes 2= certainly yes
		Q7 Do you think that encountering a wild lynx/wolf/bear in nature is dangerous for humans?	Q7 -2= very dangerous -1= a bit dangerous 0= I don't know 2= not dangerous
		Q13b Do you think that lynx/wolves/bears are causing a lot of damage to livestock?	Q13b -2= certainly yes -1= rather yes 0= I don't know 1= rather no 2= certainly no
		Q13c Do you think that lynx/wolves/bears are causing a lot of damage to wild game?	Q13c -2= certainly yes -1= rather yes 0= I don't know 1= rather no 2= certainly no
Perceived benefits	Q16a + Q16b + Q16c + Q16e + Q16f Obtainable score: -10 – 10	Q16a* I appreciate the beauty of the lynx/wolf/bear Q16b* I feel fascination for the lynx/wolf/bear Q16c* I feel a close connection lynx/wolf/bear Q16e* The presence of lynx/wolf/bear gives me hope for the future Q16f* Because of the presence of lynx/wolf/bear I 've started activities to enjoy and/or protect wildlife	Q16a, b, c, e, f -2= certainly no -1= rather no 0= I don't know 1= rather yes 2= certainly yes
Tolerance	Q10 + Q11 + Q16d Obtainable score: -6 – 6	Q10 How do you feel about the presence of lynx/wolves/bears in the region where you live?	Q10 -2= It bothers me and I am not ready to accept it -1= It bothers me but I can accept it

		0= I do not have an opinion on this 1= I do not mind 2= It makes me happy
	Q11 Would you object to further spontaneous spread of lynx/wolves/bears in the Czech Republic?	Q11 -2= certainly yes -1= rather yes 0= I don't know 1= rather no 2= certainly no
	Q16d The lynx/wolf/bear belongs in the Beskydy/Wallachian Mountains.	Q16d -2= certainly no -1= rather no 0= I don't know 1= rather yes 2= certainly yes
Coexistence	Q17*	n.a.

Note. The meaning of the questions is also provided, along with the weight of possible answers, and the minimum – maximum obtainable score for each index. Asterisks (*) indicate which questions were asked in 2022 but not in 2010.

3.4.4 Sub-question 1

A comparative analysis was conducted to discover whether differences in attitudes between 2010 and 2022 were statistically significant, using Table 1. As 'perceived benefits' and 'emotions' were not part of the 2010 questionnaire, these indexes were omitted from comparison.

Because the dependent variables (the indexes) were ordinal and the independent variable (Year) was nominal and two independent groups were concerned, MWU tests were used to compare the indexes between 2010 and 2022. This was done for each carnivore separately. In MWU tests, the null hypothesis entails identical distributions between the samples. So, the distribution of obtained scores for each index was compared between the two independent samples. The distributions were significantly different if $p<0.05$ with an assumed confidence interval of 95%. For MWU tests in SPSS, it is required that ordinal variables are labelled as 'scale' variables, since the tests assume that the dependent variable reflects a latent continuous variable (Nussbaum, 2015). Along with the MWU tests, boxplots were made to check for differences in the mean and median and to understand the differences in distributions. Bar charts further explained these differences.

For Q12 (Appendix III), no statistical comparison could be made between 2010 and 2022, as this question was asked for all carnivores together in 2010 and for all carnivores separately in 2022. Therefore, this question was compared only descriptively and excluded from the existence beliefs index for this sub-question. For 2022, responses were similar for lynx, wolf and bear. Therefore, to compare 2010 with 2022 for this question, an average of the responses of 2022 was taken.

In addition to the comparison of indexes, respondents' estimations of the numbers of carnivores in CZ were compared to actual numbers for both 2010 and 2022, using Table 2. For 2010, actual numbers were derived from Kutal et al. (2018) for wolf and bear. For lynx, numbers of 2012 were taken from Kaczensky et al., (2012). For 2022, actual numbers were based on estimations by M. Kutal (personal communication, September 27, 2022). Table 2 shows the actual numbers of carnivores for 2010 and 2022 along with the range within which estimations of respondents were considered realistic.

Table 2

Actual numbers and realistic estimations of large carnivores in Czech Republic.

	Lynx	Wolf	Bear
2010 numbers in CZ	30-65 (in 2012)	0-5	0-2
Realistic estimations 2010	15-80	0-10	0-10
2022 numbers in CZ	100	100	0-2
Realistic estimations 2022	50-150	50-150	0-10

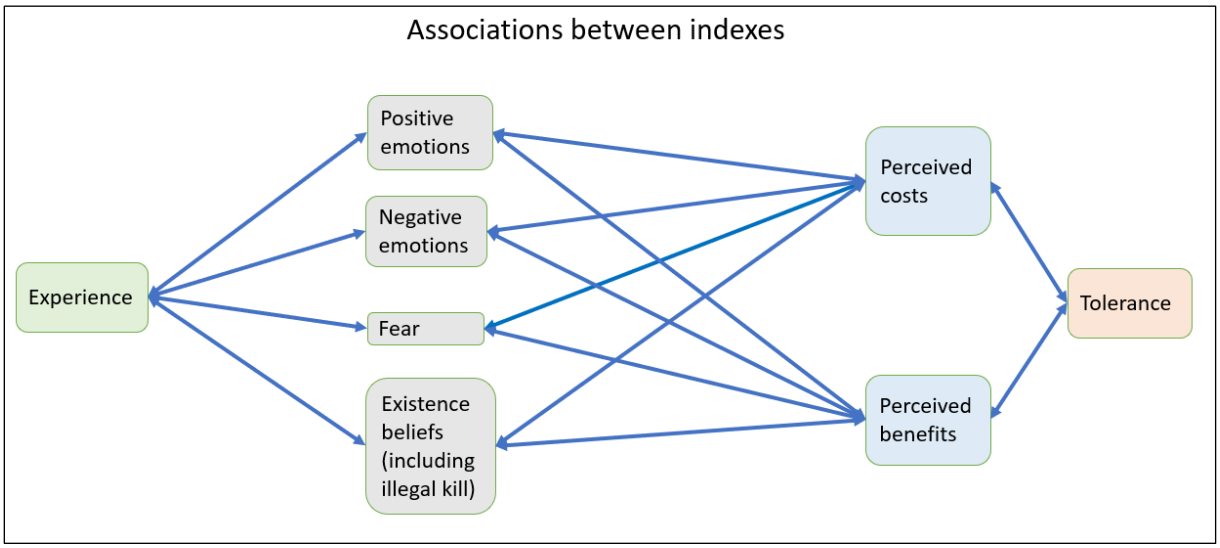
3.4.5 Sub-question 2

To discover the drivers for coexistence with carnivores in Beskydy, the associations between the indexes were tested for each carnivore. This was done following the arrows in the theoretical framework (Figure 7). To gain a more precise understanding of associations, the concept of emotions was split up in the components of 'positive emotions', 'negative emotions' and 'fear'. Associations were tested for 2022 only, therefore Q12 (reaction to illegal kill) could be included in 'existence beliefs'. Prior to conducting the association tests, responses to questions corresponding with the 'emotions' and 'perceived benefits' indexes were descriptively evaluated to gain insight into these concepts.

Since both the independent and dependent variables were ordinal and the data was non-parametric, Spearman's rank correlation test was used to test associations (Nussbaum, 2015). Scatterplots were made to check for linear relationships between the two variables, however this was not the case, as was expected for ordinal variables (Rumsey, 2009). For Spearman tests, the null hypothesis entails that the two variables are independent from each other (Rumsey, 2009). This hypothesis was rejected and associations between variables were significant if $p<0.05$ with an assumed confidence interval of 95%. Usually, Spearman's r_s is negative if variables are negatively associated and positive if variables are positively associated. However, since a weight system (Table 1) was used in this research, r_s did not accurately give the direction of associations. Therefore, this was checked using scatterplots.

Figure 7

Associations between indexes.



Note. The blue arrows indicate which associations were tested.

3.5 Step 3: qualitative data analysis

3.5.1 Sub-question 3

In their reflection on the human-carnivore relationship in Beskydy during the past 22 years, respondents were asked if, and how, they perceived this relationship to have changed.

First, for each combination of carnivore (lynx, wolf, bear) and year (2000, 2010, 2022) the number of responses in each archetype was counted. This gave an indication of the perceived level of coexistence per carnivore and year. For this analysis, placements on the axes themselves were assigned to the adjacent archetype that entailed the least conflict. Therefore, placements on the horizontal axis became part of the 'carnivore negatively impacted' or 'coexistence' archetypes. Placements on the vertical axis became part of the 'coexistence' or 'humans negatively impacted' archetypes.

Second, for each combination of carnivore and year the average and standard error were taken. These were placed as dots on the impact axes (Figure 2). This showed the overall perceived location of each of the carnivores on the axes, the distances between carnivores, and the distances between the years for each carnivore. This way, trends in the relationship with each carnivore appeared.

Third, for the vertical and horizontal axes separately, respondents were assigned to three groups depending on the trend they perceived: positive, negative, or no trend. For this purpose, for each respondent their placement of each carnivore on the axes for 2022 was compared to their placement of that same carnivore for 2010 and 2000. If their placements along one axis were completely the same for all three years, this respondent was grouped into 'no trend'. If their placement for 2022 was situated more on the plus-side or more on the minus-side of the axis than their placement for either 2010 or 2022, this respondent was grouped into respectively 'positive trend' or 'negative trend'. Some respondents believed a positive trend occurred in one time-frame (2000-2010 or 2010-2022) and a negative or no trend in the other time-frame. These respondents were placed in one group based on their reasoning behind their placements.

Fourth, an inductive thematic analysis (Bryman, 2016) was conducted on respondents' explanations accompanying their placements on the impact axes. This included also comments made in Q18, which asked whether there was anything respondents wanted to add. Each answer that brought up new information was assigned an information-specific code, so to each answer one or several codes were assigned. This created a large group of codes, many of which applied to all carnivores and some of which were carnivore-specific. The codes were then grouped into themes and used as 'meanings' of the themes to explain what these entailed. Two different sets of themes were created for 'human impact on carnivores' and 'carnivore impact on humans' (Appendix II). The themes were then matched with the three possible trends observed by respondents. This way, the themes indicated perceived influencing factors for coexistence.

3.6 Step 4: integration of sub-questions

After phase 1, 2 and 3, the results corresponding to the three sub-questions were combined in order to answer the main research question: How have locals' attitudes towards large carnivores in the Beskydy Mountains changed between the years 2000, 2010 and 2022?

3.7 Ethics

Prior to participation, participants were informed about research purposes and data usage. Participants were asked for consent to use their data and were informed that participation was voluntary, and that they could withdraw from participation at any point during the research. Participants were also informed of their anonymity. Data was handled and stored safely. The research was executed conform GDPR regulations and approved by the Ethics Review Board of the faculties of Science and Geosciences at Utrecht University (reference Geo S-21584). The researcher paid attention to local customs and behavioural norms, and tried to make participants feel at ease. The questionnaires were designed to ease respondents into the process and to build a level of trust between the researcher and participants. This encouraged participants to speak freely during the final reflection question. The researcher is aware that her own position on this topic is not neutral, but did not attempt to influence participants' responses in any way and instead maintained a neutral demeanour (Hennink et al., 2010).

4. Results

4.1 Sample comparison 2010-2022

Table 3 provides an overview of the relevant demographic characteristics of the samples from 2010 and 2022 and indicates for which characteristics significant differences were found between the samples. The differences between the samples are further described in Appendix V.

Table 3

Demographic characteristics of the samples from 2010 and 2022.

	2010	**2022**	**Statistically significant difference**
Number of respondents	158	120	-
Gender	51% males and 49% females	53% males and 47% females	-
Top 2 most prevalent age groups	36-50 (29%) 51-65 (24%)	51-65 (37%) 66-older (29%)	Yes
Lived more than 30 years in current residence	53%	73%	Yes
Most prevalent group of achieved education	Apprenticeship (42%)	Secondary (53%)	Yes
Population numbers in place of residence	less than 2,000 inhabitants: 46% 2,000-5,000 inhabitants: 54%	less than 2,000 inhabitants: 37.5% 2,000-5,000 inhabitants: 62.5%	No
Hunter	2%	4%	-
Family member is hunter	39%	26%	-
Friend/acquaintance is hunter	68%	32%	-
Farmer	39%	30%	-
Family member is livestock farmer	51%	35%	-
Friend/acquaintance is livestock farmer	84%	18%	-
Retired	27%	39%	-
Other occupation	27%	36%	-

3.2 Sub-question 1. Attitude comparison between 2010 and 2020

Bar charts illustrating the results can be found in Appendix V.

4.2.1 Estimation of large carnivores in Czech Republic.

For the lynx, wolf, and bear to a lesser extent, the percentage of respondents who realistically estimated their numbers increased from 2010 to 2022. In line with this, the number of overestimated responses declined for each of the carnivores. For the lynx however, the number of underestimated responses increased from 2010 to 2022. The results are shown in Table 4.

Table 4

Respondents' estimations of lynx, wolves and bears.

	Year	Realistically estimated responses	Underestimated responses	Overestimated responses	Missing responses
Lynx	**2022** (N=120)	49.2%	23.3%	17.5%	10.0%
	2010 (N=158)	34.8%	8.2%	54.4%	2.5%
Wolf	**2022** (N=120)	50.0%	20.8%	19.1%	10.0%
	2010 (N=158)	10.8%	n.a.	86.1%	3.2%
Bear	**2022** (N=120)	44.2%	n.a.	44.2%	11.7%
	2010 (N=158)	42.4%	n.a.	55.1%	2.5%

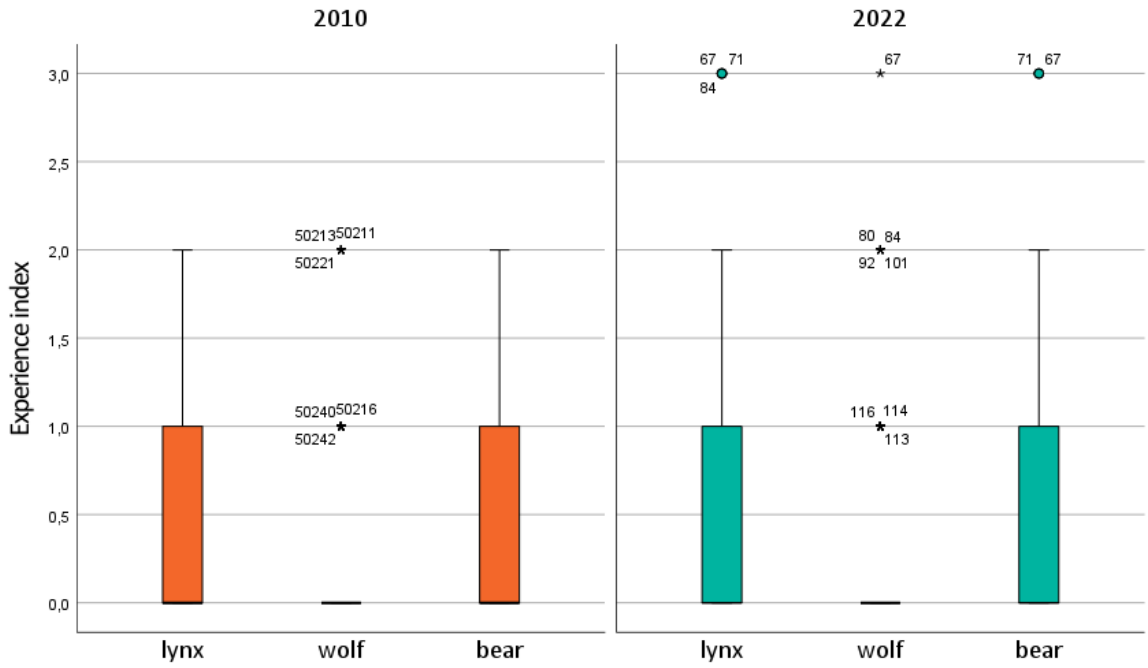
Note. The table shows percentages of realistically, underestimated and overestimated estimations of the number of lynx, wolves and bears in Czech Republic for 2010 and 2022.

4.2.2 Experience

No significant difference was found in experience between 2010 and 2022 for the lynx ($U(N_{2010}= 158, N_{2022}=120)=10353.500$, $z=1.561$, $p=.119$), wolf ($U(N_{2010}=158, N_{2022}=120)=10020.500$, $z=1.151$, $p=.250$) and bear ($U(N_{2010}=158, N_{2022}=119)=9608.000$, $z=.364$, $p=.716$). Figure 8 shows boxplots of the experience indexes of 2010 and 2022. It is noteworthy that for both years, only small portions of the samples indicated carnivores had ever done harm to the respondent or their family (2010: 3.8%, n=158, 2022: 10.8%, n=120).

Figure 8

Boxplots comparing experience indexes of 2010 and 2022 for lynx, wolf and bear.

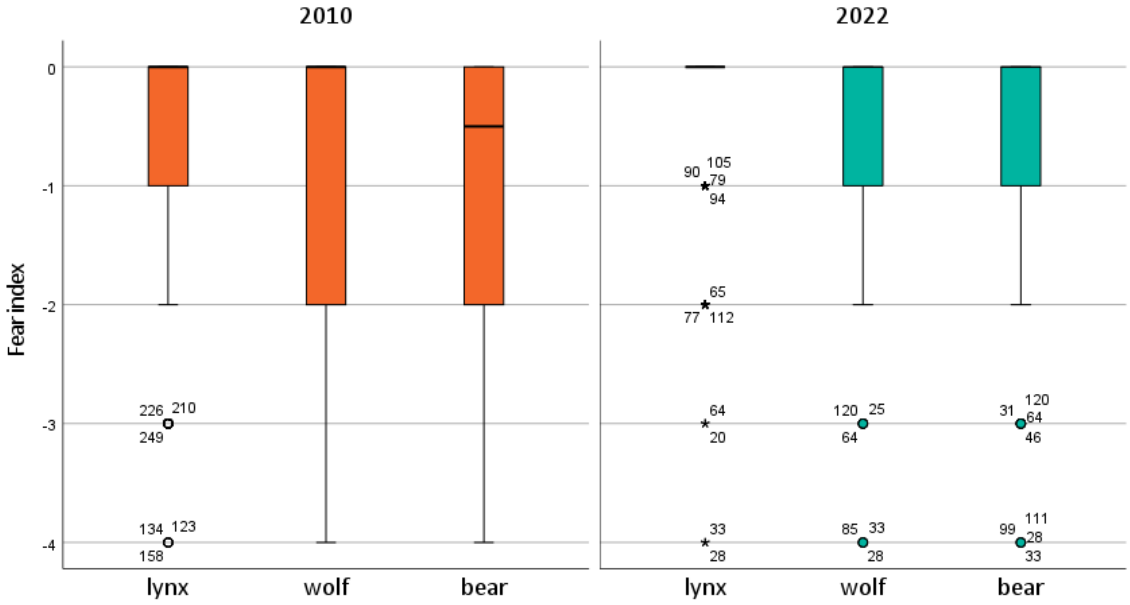


4.2.3 Fear

Fear was lower in 2022 than in 2010 for lynx ($U(N_{2010}= 153, N_{2022}=120)=11114.500$, $z=2.944$, $p=.003$), wolf ($U(N_{2010}=158, N_{2022}=120)=10896.500$, $z=2.380$, $p=.017$) and bear ($U(N_{2010}=158, N_{2022}=120)=11055.000$, $z=2.627$, $p=.009$). Figure 9 shows boxplots of the fear indexes of 2010 and 2022. It is noteworthy that for both 2010 and 2022 and for all carnivores, the majority of respondents was not afraid at all.

Figure 9

Boxplots comparing fear indexes of 2010 and 2022 for lynx, wolf and bear.



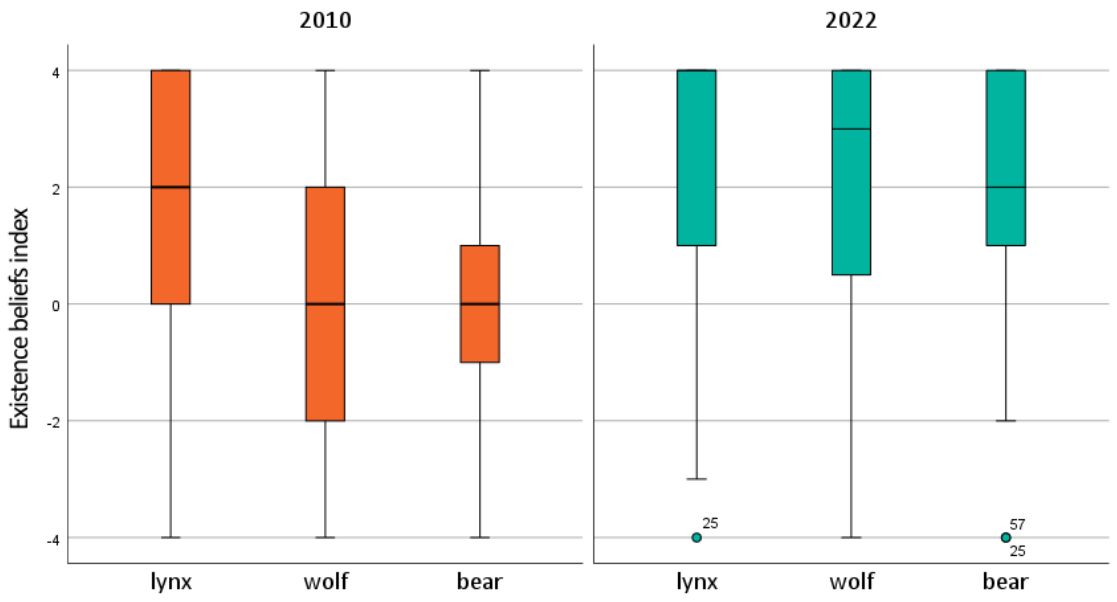
Note. A more negative boxplot indicates higher levels of fear.

4.2.4 Existence beliefs

Existence beliefs were more positive in 2022 than in 2010 for lynx ($U(N_{2010}=158, N_{2022}=119)= 12022.500$, $z=4.107$, $p<.001$), wolf ($U(N_{2010}=158, N_{2022}=119)=13498.000$, $z=6.305$, $p<.001$) and bear ($U(N_{2010}=158, N_{2022}=119)=14081.000$, $z=7.178$, $p<.001$). Figure 10 shows boxplots of the existence beliefs indexes of 2010 and 2022.

Figure 10

Boxplots comparing existence beliefs indexes of 2010 and 2022 for lynx, wolf and bear.



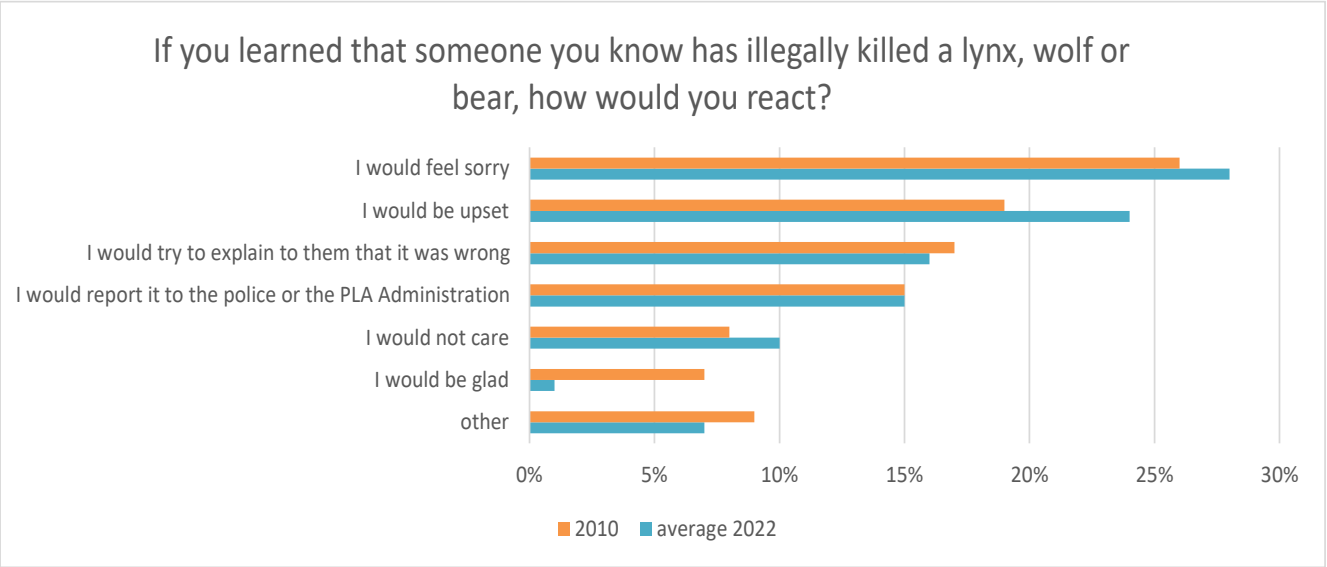
Note. A more positive boxplot indicates more positive existence beliefs. This index for existence beliefs did not include Illegal kill.

4.2.5 Illegal kill

Figure 11 shows that responses are quite similar for 2022 and 2010, with only small portions of the sample indicating that they would not care or that they would be glad. A difference is visible in the percentage of answers 'I would be glad', which made up 7% in 2010 and 1% in 2022. Table 5 provides the standard errors for the average percentages of 2022.

Figure 11

Response distribution for Illegal kill.



Note. Responses of 2010 are compared with average of responses of 2022.

Table 5

The standard errors corresponding to the average of responses for lynx, wolf and bear of 2022.

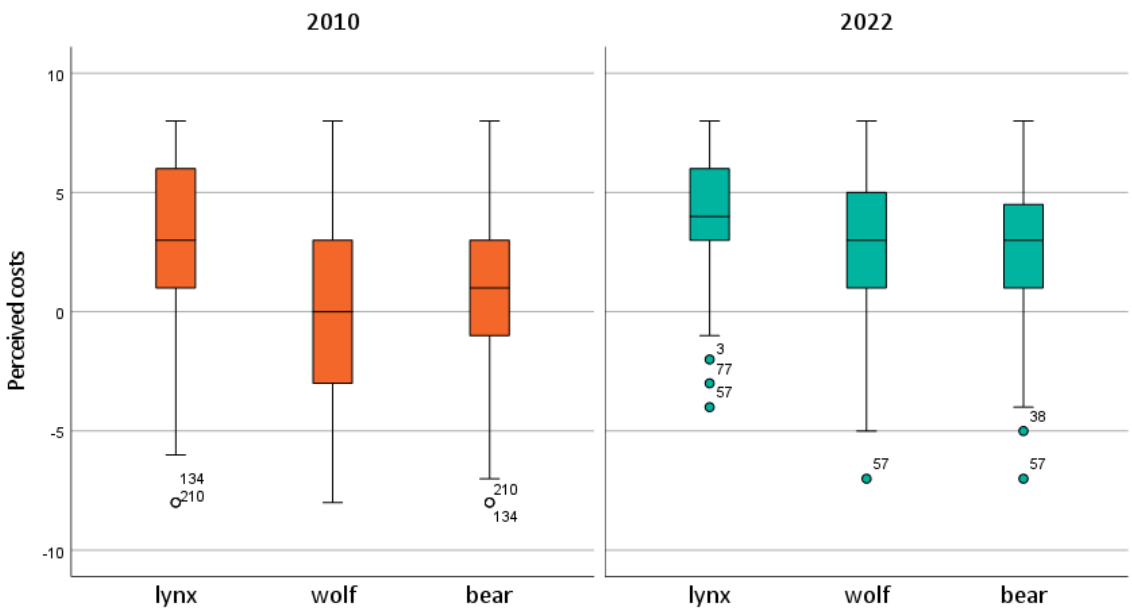
	Average 2022	St. Error 2022
I would feel sorry	28%	0.11
I would be upset	24%	-
I would try to explain to them that it was wrong	16%	0.04
I would report it to the police or the PLA Administration	15%	-
I would not care	10%	0.04
I would be glad	1%	0.07
Other	7%	-

4.2.6 Perceived costs

As is shown in Figure 12, perceived costs were lower in 2022 than in 2010 for lynx ($U(N_{2010}= 158, N_{2022}= 120)=11239.000$, $z=2.663$, $p=.008$), wolf ($U(N_{2010}=157\ N_{2022}=120)=13380.500$, $z=6.015$, $p<.001$) and bear ($U(N_{2010}=158, N_{2022}=120)=12635.000$, $z=4.776$, $p<.001$).

Figure 12

Boxplots comparing perceived costs indexes of 2010 and 2022 for lynx, wolf and bear.



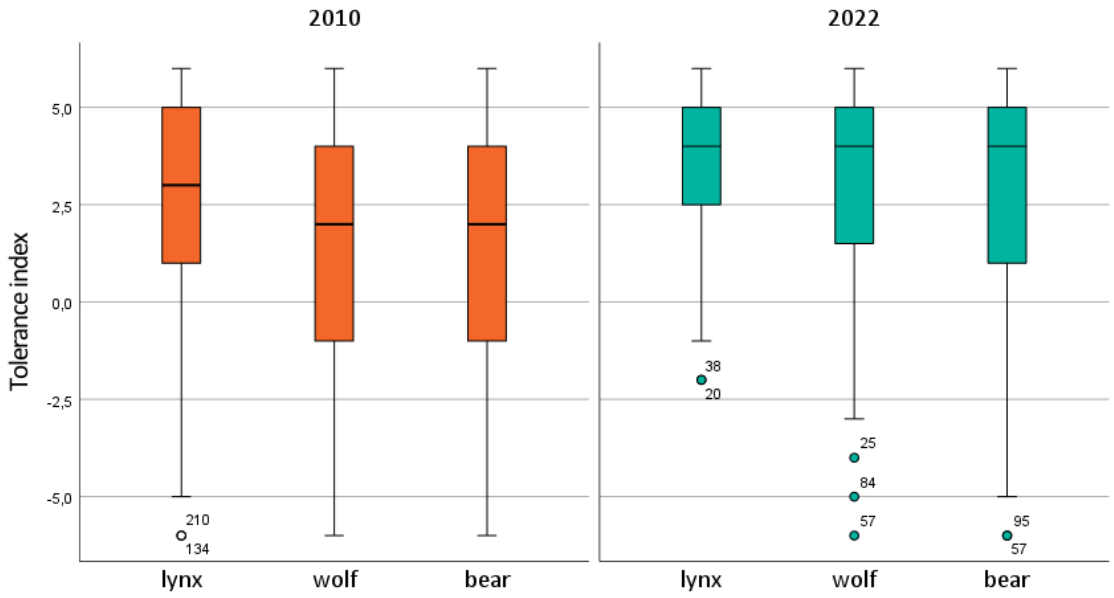
Note. A more positive boxplot indicates lower perceived costs.

4.2.7 Tolerance

As is shown in Figure 13, tolerance was higher in 2022 than in 2010 for lynx ($U(N_{2010}=158, N_{2022}= 119)=11717.500$, $z =3.555$, $p<.001$), wolf ($U(N_{2010}=158\ N_{2022}= 120)=12406.500$, $z=4.435$, $p<.001$) and bear ($U(N_{2010}=158, N_{2022}=119) =12327.500$, $z=4.460$, $p<.001$).

Figure 13

Boxplots comparing tolerance indexes of 2010 and 2022 for lynx, wolf and bear.



4.2.8 Summary sub-question 1.

Table 6 shows a summary of the findings of sub-question 1. As visible in the table, there were no differences between carnivores for the comparison of answers of 2010 and 2022.

Table 6

Summary of results of sub-question 1.

	Lynx		**Wolf**		**Bear**	
Index	**Statistically significant difference 2010 – 2022**	**Change 2010 – 2022**	**Statistically significant difference 2010 – 2022**	**Change 2010 – 2022**	**Statistically significant difference 2010 – 2022**	**Change 2010 – 2022**
Estimation of number of carnivores in CR.	-	Percentage of realistic estimations *increased*	-	Percentage of realistic estimations *increased*	-	Percentage of realistic estimations *increased*
Experience	No	-	No	-	No	-
Fear	Yes	Fear *decreased*	Yes	Fear *decreased*	Yes	Fear *decreased*
Existence beliefs	Yes	Existence beliefs became *more positive*	Yes	Existence beliefs became *more positive*	Yes	Existence beliefs became *more positive*
Illegal kill	-	Similar responses	-	Similar responses	-	Similar responses

Perceived costs	Yes	Perceived costs *decreased*	Yes	Perceived costs *decreased*	Yes	Perceived costs *decreased*
Tolerance	Yes	Tolerance *increased*	Yes	Tolerance *increased*	Yes	Tolerance *increased*

4.3 Sub-question 2. Drivers of coexistence.

Bar charts illustrating the results can be found in Appendix VI.

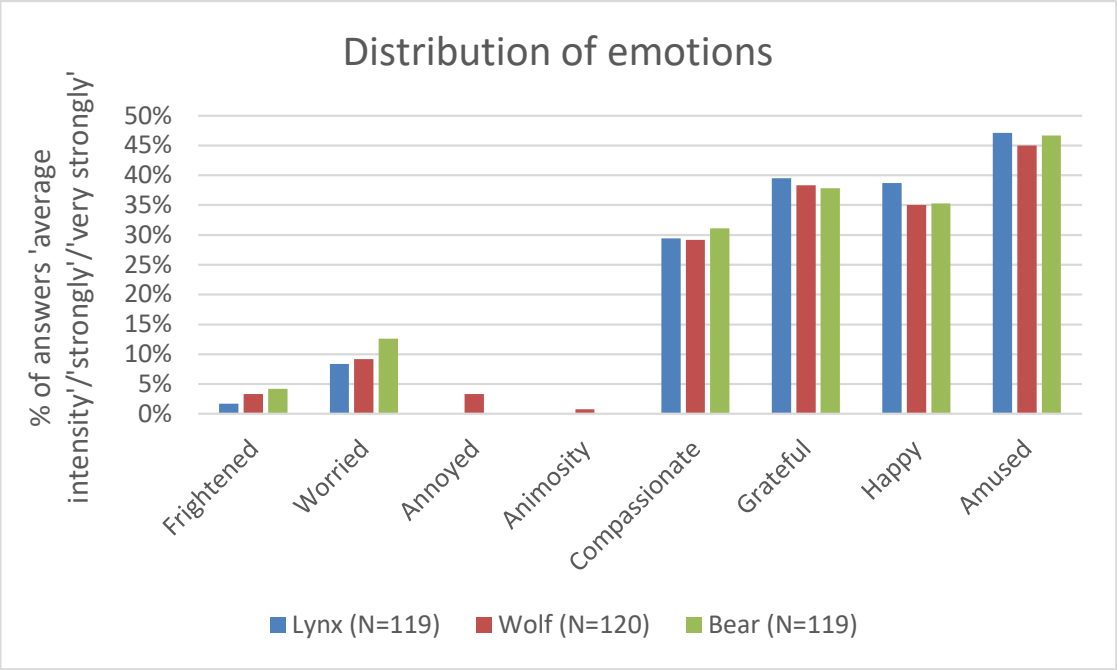
4.3.1 Current attitudes: emotions and benefits

Negative and positive emotions

Figure 14 shows that that the distribution of negative and positive emotions is similar for the three carnivores. It also clearly shows that positive emotions were felt more than negative ones. In addition, a number of respondents indicated not to feel any emotions related to carnivores at all (lynx: 15% (N=119), wolf: 15% (N=120), bear: 12.5% (N=119))

Figure 14

Overview of respondents' negative and positive emotions.



Note. Negative emotions are: frightened, worried, annoyed, animosity. Positive emotions are: compassionate, grateful, happy, amused. Percentages of the sample indicate a sum of those who felt each emotion at average intensity, strongly, or very strongly for lynx, wolf and bear.

Perceived benefits

Pleasure

A large majority of respondents (N=120) answered 'certainly yes' when asked if they appreciated the beauty of lynx (87.5%), wolf (80%) and bear (81.7%). A majority of respondents (N=120) answered 'rather yes' or 'certainly yes' when asked whether the presence of the carnivores in Beskydy gives them hope for the future (lynx: 70.8%, wolf: 68.3%, bear: 68.3%). In terms of pleasure, there were no clear differences between the lynx, wolf and bear.

Engagement

A sizeable group of respondents (N=120) is certainly fascinated by carnivores ('certainly yes'; lynx: 50%, wolf: 45%, bear: 42.5%). However, there is also a clear group who answered 'certainly no' (lynx: 25.8%, wolf: 28.3%, bear: 27.5%). A majority of respondents (N=120) indicated to not feel a close connection to carnivores ('certainly no'; lynx: 62.5%, wolf: 60.8%, bear: 61.7%). Only a small group of respondents (N=120), answered 'rather yes' or 'certainly yes' when asked whether they had started engaging in activities in order to enjoy and/or protect wildlife due to the presence of the carnivores (lynx: 9.2%, wolf: 9.2%, bear: 10%). Thus for engagement, there were no clear differences between the lynx, wolf and bear.

4.3.2 Associations between indexes for 2022.

Figures 15, 16 and 17 provide an overview of the associations between the indexes for lynx, wolf and bear. For each association, the r_s and p-values are given, along with N between brackets for each association. Due to the used score system, positive r_s -values do not automatically mean positive associations. Therefore, the arrows were given colours; blue dotted arrows indicate no association, green arrows indicate positive associations, and red arrows indicate negative associations.

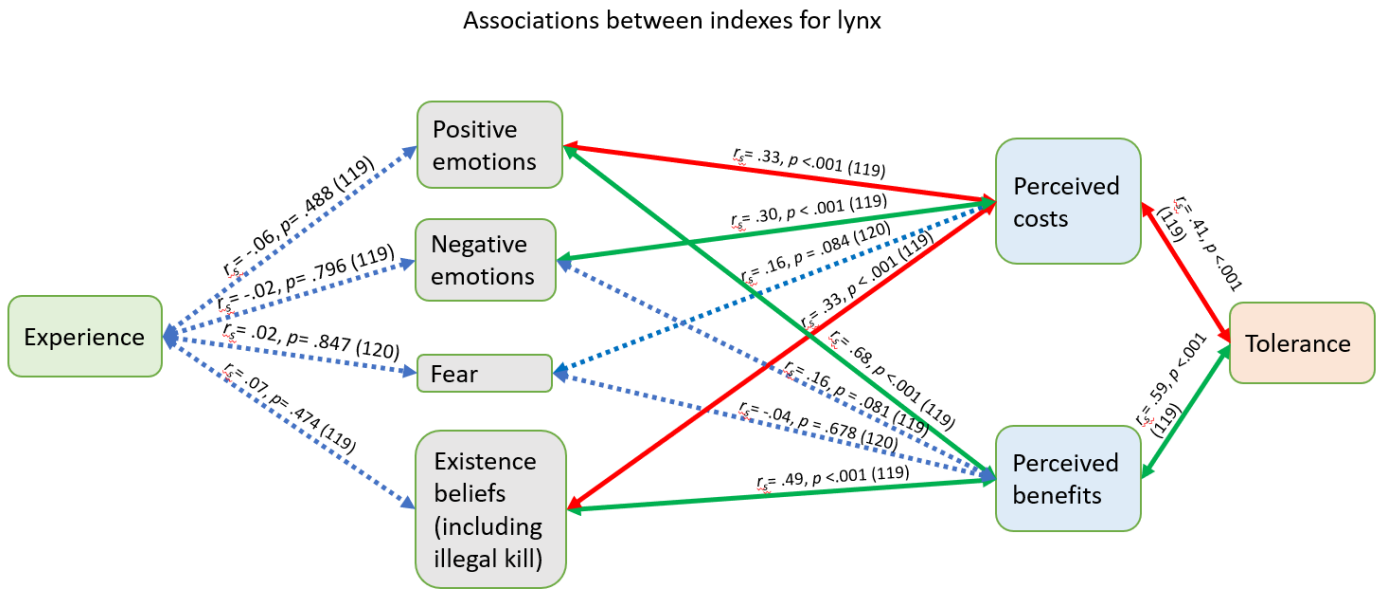
The Figures show that for none of the carnivores associations were found between experience and positive emotions, negative emotions, fear and existence beliefs. However, for all carnivores smaller perceived costs and larger perceived benefits correlate with higher tolerance levels.

Lynx

For lynx, no associations were found between negative emotions and perceived benefits. Moreover, no associations were found between fear and perceived costs and benefits. However, the Figure shows that less positive emotions, more negative emotions and more negative existence beliefs correlate with larger perceived costs. Likewise, more positive emotions and more positive existence beliefs correlate with larger perceived benefits.

Figure 15

Associations between indexes for lynx.



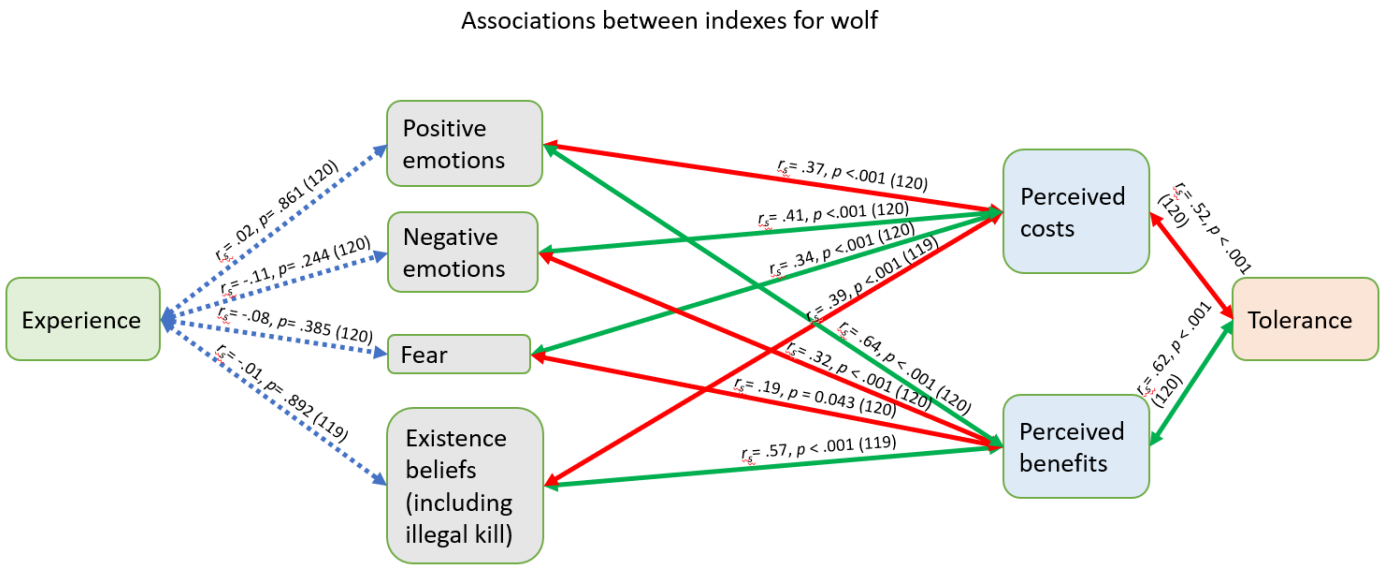
Note. Blue dotted arrows indicate no association, green arrows indicate positive associations, red arrows indicate negative associations. The number of respondents is provided between brackets for each association.

Wolf

For wolf, less positive emotions, more negative emotions, more fear and less positive existence beliefs correlate with larger perceived costs. Similarly, more positive emotions, less negative emotions, less fear and more positive existence beliefs correlate with larger perceived benefits.

Figure 16

Associations between indexes for wolf.



Note. Blue dotted arrows indicate no association, green arrows indicate positive associations, red arrows indicate negative associations. The number of respondents is provided between brackets for each association.

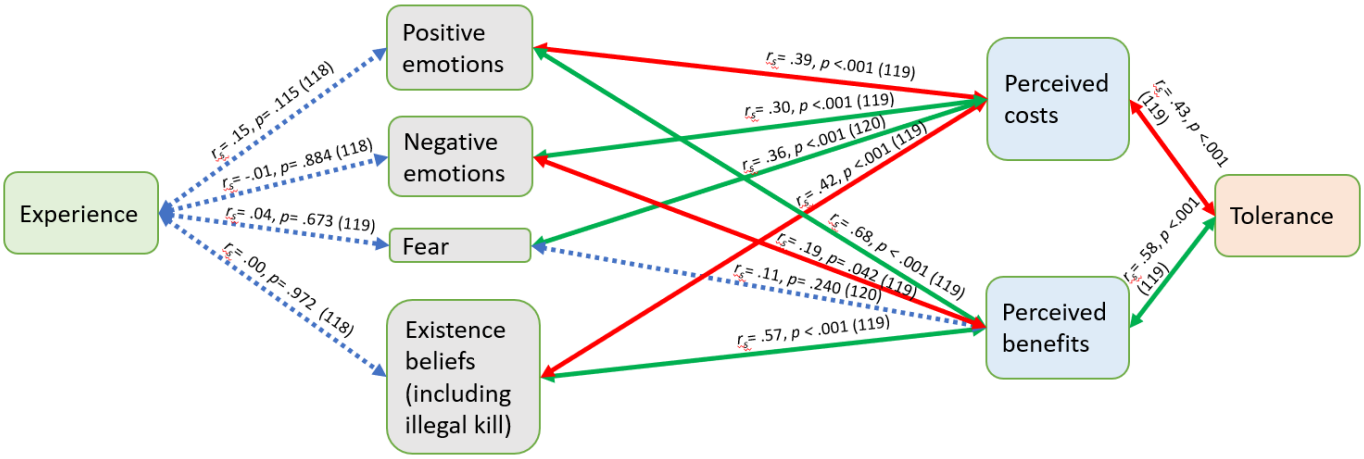
Bear

For bear, no association was found between fear and perceived benefits. However, less positive emotions, more negative emotions, more fear and less positive existence beliefs correlate with larger perceived costs. Similarly, more positive emotions, less negative emotions and more positive existence beliefs correlate with larger perceived benefits.

Figure 17

Associations between indexes for bear.

Associations between indexes for bear



Note. Blue dotted arrows indicate no association, green arrows indicate positive associations, red arrows indicate negative associations. The number of respondents is provided between brackets for each association.

4.4 Sub-question 3. Reflections on the human-carnivore relationship

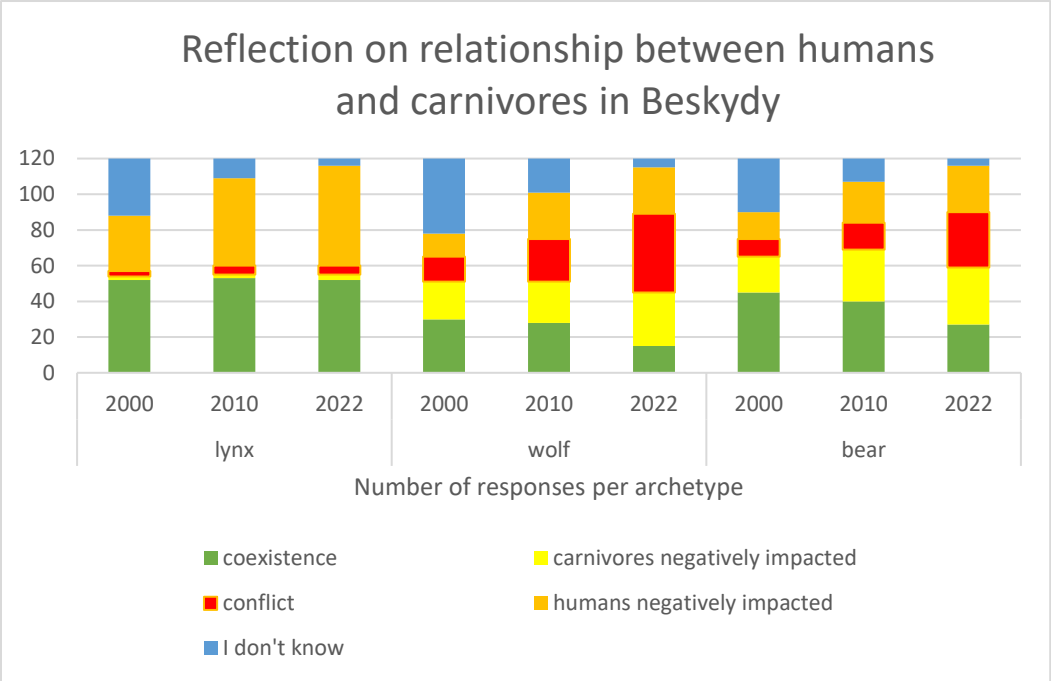
Figures illustrating the results can be found in Appendix VII.

4.4.1 Number of responses per archetype

Assigning each response for lynx, wolf and bear per year based its location on the impact axes (Figure 2) created an overview of the number of responses per archetype for each carnivore and each year. This is shown in Figure 18. For lynx, an increase in the number of responses in the archetype 'humans negatively impacted' is visible. For wolf and bear, the number of responses in the archetype 'coexistence' decreased for more recent years and the numbers for the archetypes 'conflict', 'humans negatively impacted' and 'carnivores negatively impacted' increased. Additionally, the number of 'I don't know' responses was higher for more distant years for each carnivore.

Figure 18

Number of responses per archetype for lynx, wolf and bear and for 2000, 2010 and 2022.



Note. The colours are consistent with those used for each archetype in Figure 2.

4.4.2 Perceived trends in the human-carnivore relationship

Figure 19 shows the averages along with standard errors of respondents' placement of the carnivores on the impact axes (Figure 2). Considering the scale for both axes ranges from -5 to +5, there are no large differences between the averages of different years for each carnivore. Additionally, the averages for all carnivores are relatively close to zero for both axes. Therefore, on average respondents did not believe changes in impact from 2000 to 2010 and to 2022 to be very large.

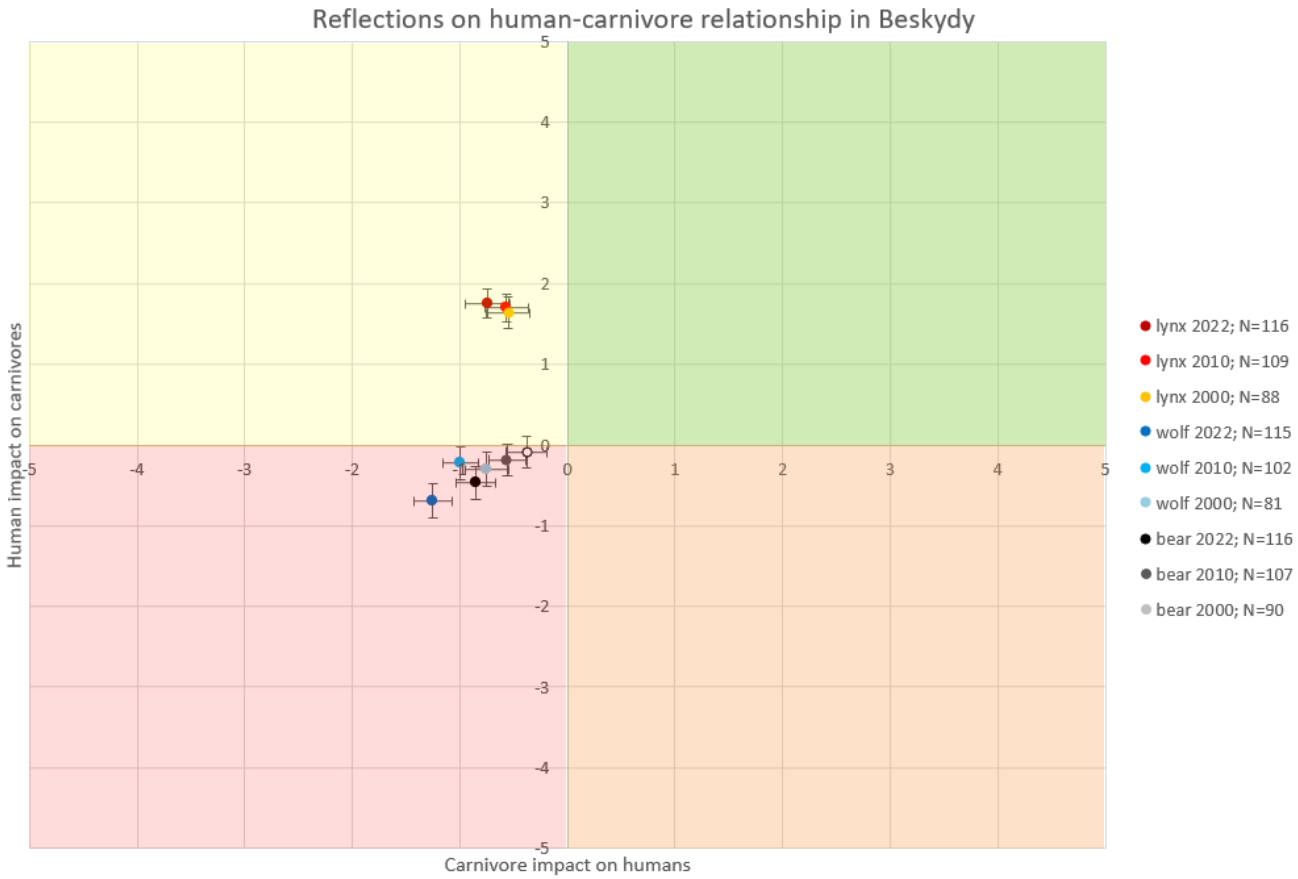
For the lynx, the averages for every year are situated in the 'carnivores negatively impacted' archetype. A small trend towards stronger negative human impacts on the lynx over time is visible from 2000 and 2010 to 2022.

For the wolf, the averages for every year are situated in the 'conflict' archetype. A slightly larger trend than for the lynx is visible going from 2000 and 2010 to 2022. This trend shows an increase in conflict, whereby both humans and carnivores are increasingly negatively impacted over time.

For the bear, the averages for every year are situated in the 'conflict' archetype as well. Similar to the wolf, the trend from 2000 and 2010 to 2022 shows an increase in conflict, whereby both humans and carnivores are increasingly negatively impacted over time. The averages for wolf and bear are very close to each other, but for the bear every year average is situated a bit closer to zero than the same year for the wolf.

Figure 19

Reflections on the human-carnivore relationship in Beskydy.



Note. The figure shows the averages with standard errors for each combination of carnivore and year. The colours indicate the four archetypes: conflict occurs in the red, orange and yellow archetypes, and coexistence occurs in the green archetype.

4.4.3 Identified reasons for perceived trends

Carnivore impact on humans

Table 7 shows the total count of responses for each carnivore per trend. For each carnivore, a large number of responses indicated no trend in carnivore impact on humans to have taken place (lynx: 98 responses (84.5%), wolf: 56 responses (48.7%), bear: 75 responses (64.7%)). The table also shows the ten themes explaining respondents' reasoning behind perceived trends regarding carnivore impact on humans that emerged from the data. The number of responses per theme is low for eight of the ten themes for all carnivores. This is in line with the large number of responses that perceived no trend to have taken place. However, 37.4% of responses (43 responses) indicated a negative trend for the wolf. This trend is largely explained by two themes; increased presence and increased damages. For the bear, 26.7% (31 responses) indicated a negative trend. Among other reasons, this trend was explain by increased presence, increased fear and increased damages. The themes are further detailed in Appendix II.

Table 7

Counts per theme and trend for carnivore impact on humans.

Carnivore impact on humans										
	Positive trend			**Negative trend**			**No trend**			
Theme *Lynx N=116* *Wolf N=115* *Bear N=116*	**Lynx.** *Total count: 15*	**Wolf.** *Total count: 16*	**Bear.** *Total count: 10*	**Lynx.** *Total count:3*	**Wolf.** *Total count: 43*	**Bear.** *Total count: 31*	**Lynx.** *Total count: 98*	**Wolf.** *Total count: 56*	**Bear.** *Total count: 75*	**Total count per theme**

increased presence	4	4	0	2	29	13	10	13	2	**77**
increased fear	0	0	0	0	10	7	0	1	0	**18**
increased damage	0	1	0	1	24	7	0	6	0	**39**
decreased ability to prevent/cope with damages	0	1	0	0	7	0	0	2	0	**10**
coming closer to settlements	0	0	0	0	2	5	0	0	4	**11**
increased appearance in media	0	0	0	0	1	2	4	3	1	**11**
increased discussion	1	1	0	0	4	2	3	1	0	**12**
increased ability to prevent/cope with damages	0	6	0	0	3	0	0	1	0	**10**
decreased damage	1	3	0	0	0	0	0	1	0	**5**
decreased fear	5	3	5	0	1	0	0	0	0	**14**

Note. The table shows total counts of positive, negative and no perceived trends for lynx, wolf and bear. The table also shows identified themes as reasons for perceived trends, and counts per theme. Highlighted numbers are noteworthy and discussed above.

Human impact on carnivores

As visible from the total counts per trend in Table 8, a large group of responses indicated no trend in human impact on carnivores to have taken place for each carnivore (lynx: 59 responses (52.2%), wolf: 56 responses (48.7%), bear: 79 responses (68.1%). However, for each carnivore a sizeable group perceived a negative trend to have occurred ((lynx: 34 responses (29.3%), wolf: 42 responses (36.5%), bear: 30 responses (25.9%). The table shows that six themes explaining respondents' reasoning behind perceived trends regarding human impact on carnivores were identified. For all carnivores, the two most mentioned themes related to perceived negative trends were increased human disturbance in the forest and human expansion. The two most mentioned themes related to perceived positive trends were increased awareness among locals and increased carnivore conservation. These themes were especially prevalent for lynx. The themes are further detailed in Appendix II.

Table 8

Counts per theme and trend for human impact on carnivores.

Human impact on carnivores										
	Positive trend			**Negative trend**			**No trend**			
Theme *Lynx N=116 Wolf N=115 Bear N=116*	**Lynx.** *Total count: 23*	**Wolf.** *Total count: 17*	**Bear.** *Total count: 7*	**Lynx.** *Total count: 34*	**Wolf.** *Total count: 42*	**Bear.** *Total count: 30*	**Lynx.** *Total count: 59*	**Wolf.** *Total count: 56*	**Bear.** *Total count: 79*	**Total count per theme**
increased awareness among locals	13	11	6	5	4	1	7	2	1	**50**
Increased human	0	1	1	21	19	20	5	3	3	**73**

disturbance in forest										
Human expansion	1	0	1	19	13	11	2	1	3	**51**
increased conservation of carnivore	16	6	5	2	1	0	2	0	0	**32**
Increased monitoring	5	4	3	1	1	2	0	0	0	**16**
For wolf only: increased tendency to shoot	0	0	0	0	6	0	0	1	0	**7**

Note. The table shows total counts of positive, negative and no perceived trends for lynx, wolf and bear. The table also shows identified themes as reasons for perceived trends, and counts per theme. Highlighted numbers are noteworthy and discussed above.

4.5 Integration

Sub-question 1 asked how current attitudes of locals towards lynx, wolves and brown bears in Beskydy compare to locals' attitudes of 2000. Contrary to expectations, this research found no differences in experience with lynx, wolf and bear between 2010 and 2022, although estimations of these carnivores were more accurate in 2022 than in 2022. Existence beliefs became more positive over this time period, although reactions to a scenario of an illegally killed carnivore remained similarly positive for 2022 as for 2010. Consistent with expectations, the level of fear and perceived costs of living with carnivores decreased and tolerance increased between 2010-2022. Thus, as hypothesised current attitudes of locals towards carnivores in Beskydy were more positive than locals' attitudes in 2010. This indicates a shift towards coexistence in Beskydy.

For sub-question 2, drivers for coexistence in Beskydy were researched. For all carnivores, decreasing perceived costs and increasing perceived benefits are drivers for coexistence through their, respectively negative and positive, associations with tolerance. Additionally, for all carnivores increasing positive emotions and the creation of more positive existence beliefs are drivers for coexistence through their negative associations with perceived costs and their positive associations with perceived benefits. For the wolf and bear, decreasing fear is a driver for coexistence through its positive association with perceived costs and, for the wolf, also its negative association with perceived benefits. Moreover, for the wolf and bear decreasing negative emotions is a driver for coexistence through its negative association with perceived benefits. Experience was not found to be a driver for coexistence for any of the carnivores, as no associations with other drivers were found. Thus, apart from experience, associations between concepts and direction of associations were as hypothesised.

Through sub-question 3, the trajectory of coexistence in Beskydy over the past 22 years was measured by asking locals' perceptions on changes in the human-carnivore relationship in Beskydy in the 2000-2022 time period. On average, locals perceived that negative trends towards increased conflict have been occurring over the past 22 years for all carnivores. However, these average trends showed small changes, since for all carnivores many respondents believed no changes to have occurred. For the wolf and bear, the average trends towards conflict were perceived to be caused by increased negative impacts of humans and carnivores on each other. Counting the number of responses in each archetype indicated this as well. For the lynx, the average trend showed only a change towards increased negative human impact on the carnivore. However, the number of responses in the 'humans negatively impacted' archetype suggested an increase in the negative impact of the lynx on humans as well. The two most prevalent reasons for a perceived increase in negative carnivore impact on humans were increased carnivore presence in Beskydy and increased damages due to carnivores, which were both expected in literature. These impacts were found especially important for the wolf. The two most prevalent reasons for a perceived increase in negative human impact on carnivores were increased human disturbance in the forest and human expansion, which was expected to be an important factor. Furthermore, the two most mentioned reasons for a perceived increase in positive impacts of humans on carnivores were increased awareness among locals, as expected in literature, and increased conservation of carnivores. These were especially important for the lynx.

The main research question asked how locals' attitudes towards carnivores in Beskydy changed between 2000, 2010 and 2022. As hypothesised, a shift towards more positive personal attitudes occurred. It was hypothesised that such a shift would have led to increased coexistence in the region. Conversely, locals' perceptions on changes in the human-carnivore relationship, as measure of coexistence, did not indicate a shift towards coexistence but instead a small shift towards conflict. Overall, decreased negative and increased positive emotions, decreased fear, increased positive existence beliefs, decreased perceived costs and increased perceived benefits were found to be drivers for increased tolerance in Beskydy. However this increased tolerance has not yet led to increased coexistence.

5. Discussion

This research found that locals' attitudes towards carnivores in Beskydy became more positive between 2000, 2010 and 2022, with emotions, existence beliefs, perceived costs and perceived benefits as drivers for tolerance. It also found that locals perceived the human-carnivore relationship in Beskydy to not have shifted towards coexistence, but instead perceived a small shift towards conflict.

5.1 Implications and recommendations for research and carnivore management

This research adds to the small number of longitudinal studies on attitude change towards carnivores (Majic & Bath, 2010; Majic et al., 2011). Attitudes towards carnivores *do* change over time as they co-evolve with changes in carnivore presence and the socio-ecological system. For carnivore management, attitudes can therefore be important indicators of levels of conflict and coexistence in landscapes and can be used to evaluate effects of management changes. Moreover, attitudes were found to change along with emotions, existence beliefs, perceived costs and perceived benefits, which were found to be drivers for tolerance. It is therefore recommended to use these as leverage points in mitigating conflicts over and with carnivores.

Special attention should be given to integrating positive emotions and perceived benefits as leverage points in carnivore management. Currently, a negativity bias exists in research on HCIs, which may prevent positive psychological associations from being recognised as leverage points in management and conservation (Buijs & Jacobs, 2021). As leverage points, positive emotions could influence responses to carnivore management (Sponarski et al., 2015) and strengthen public support for conservation strategies (Buijs & Jacobs, 2021). Emotions should therefore not be cautiously kept away from conservation debates but rather be embraced as powerful tools of understanding between opposing stakeholders (Batavia et al., 2021). Further research is necessary on how emotions and perceived benefits change over time, as these were excluded from the longitudinal part of this research.

Attitude change and the level of coexistence in Beskydy did not show similar trends. Like other studies in Europe (Dorresteijn et al., 2016; Glikman et al., 2012; Kaczensky et al., 2004; Liukkonen et al., 2009), positive attitudes in Beskydy were found despite of conflicts. Positive attitudes have not been found to coincide with coexistence, but perhaps positive attitudes precede coexistence. Further longitudinal research in Beskydy and other case studies needs to be conducted to further discover the role of attitude change in bringing about coexistence.

Additionally, further research on the relation between attitude change and individual-, as well as societal, behavioural change is necessary for the field of carnivore management. This is because an increase in positive attitudes was found simultaneously with a perceived increase in human disturbance in the forest. This raises questions regarding the relation between attitudes and behaviour of individuals, and regarding individuals' considerations of the impacts of their own behaviour on carnivores, rather than impacts of other people or society as a whole. Likewise, respondents perceived increased presence and damages of carnivores as negatively impacting humans. However, the positive attitude change in the region, together with the small portion of the sample that experienced harm by carnivores, suggest that these factors may not have impacted many respondents personally. This illustrates that people may perceive impacts of carnivores on society in one way, and impacts on themselves in another way. Two-way research on attitudes and impacts of humans and carnivores could help target interventions in HCIs.

Finally, this researched used an innovative approach towards researching human-carnivore relationships and measuring coexistence (Marchini et al., 2021). Using the impact axes (Figure 2) is an interactive way for researchers to gain insight into the level of coexistence in a landscape. For respondents the visual tool helps to make sense of how humans and carnivores co-exist within their landscape and of their attitudes regarding this situation. The axes could therefore not only be used by researchers to gain further understanding of current and past levels of coexistence in Europe, but could also be used to guide participatory decision-making in wildlife management.

5.2 Implications and recommendations for the Beskydy region

Respondents indicated human expansion as an important source of conflict. This worldwide trend is influenced by many factors and is unlikely to change in Beskydy solely based carnivore management efforts. However, respondents also mentioned damages by carnivores and human disturbance in nature as sources of conflict. These factors can be more directly traced back to individuals at the local level, and are therefore potentially more easily changed with targeted conservation policies. Thus, it is recommended for wildlife management in Beskydy to focus on these factors in their efforts towards achieving coexistence.

This research focused on documenting perceived increases in numbers of carnivores and carnivore-related damages, rather than quantitively measuring these. The perceived increases in the number of wolves and bears is in line with the findings of monitoring efforts (Table 2) (M. Kutal, personal communication, September 27, 2022; Kutal et al., 2018). For 2010, Kutal et al. (2018) found that respondents overestimated damages. However, it is unclear whether changes in the actual number of damages are aligned with perceptions of 2022. Therefore, further research is needed to understand the ratio between perceived and actual costs in Beskydy. Likewise, further research could measure the actual impact of human disturbance in the forest on carnivores, in order to inform carnivore conservation efforts.

5.3 Limitations

First, to enable comparison, questionnaire items from 2010 were reused. However, since then the research field of HCIs has gained novel insights to decrease negativity bias (Buijs & Jacobs, 2021), further incorporate human dimensions (Hovardas, 2018) and reconceptualise conservation (Cooke et al., 2022). To some extent, these new insights could not be translated into questionnaire items used in this research. Yet, new insights regarding emotions, benefits of living with carnivores and measuring coexistence were included.

Second, the questionnaire item measuring benefits (Q16) may have been biased, as it does not contain statements about costs. However, other questionnaire items focused more on costs than benefits. Therefore, the questionnaire overall gives space for both costs and benefits to be measured.

Third, it was difficult for respondents to remember the human-carnivore relationship in Beskydy 12 and 20 years ago. This rendered several respondents unable to answer part of this question. To minimise the number of respondents that would not be able to answer this question (Q17) completely, young respondents and those who recently took residence in Beskydy were excluded from taking part in the research. This research is therefore not fully representative of perceptions on the human-carnivore relationship in Beskydy. On the plus-side, the overrepresentation of older adults made the risk of a cohort effect, which was mentioned as limitation of the 2010 research (Kutal et al., 2018), unlikely.

Fourth, due to ever-changing nature of tolerance levels (Yurco et al., 2017), findings could have become outdated within weeks of data collection. Unfortunately, this limitation is unavoidable.

Last, respondents' knowledge of carnivores was not included as variable in this research, although literature indicates that knowledge potentially fosters positive attitudes (Bhatia et al., 2020; Bruskotter & Wilson, 2004; Glikman et al., 2012; Piédallu et al., 2016). In Beskydy, an awareness campaign took place in 2005-2006 (Kutal & Bláha, 2008). This may have led to increased knowledge and therefore have been a factor leading to positive attitudes in the region. Further research is required to determine the role of knowledge as driver for attitude change and coexistence.

6. Conclusion

This study aimed to close the research gap on attitude change towards large carnivores, while including both negative and positive interactions. A longitudinal case study on attitude change towards the Eurasian lynx, grey wolf and brown bear was conducted in the Czech Beskydy Mountains. Data on locals' attitudes towards these carnivores was collected by administering 120 questionnaires in 22 municipalities in the Beskydy region. This current data was compared with data on attitudes towards the lynx, wolf and bear from the same region collected in 2000 and 2010. This was used to answer the research question: *How have locals' attitudes towards large carnivores in the Beskydy Mountains changed between the years 2000, 2010 and 2022?*

The research found that a shift towards more positive personal attitudes occurred over the past 22 years. This shift did not lead to coexistence in Beskydy, but locals' perceptions on changes in the human-carnivore relationship indicated a small shift towards conflict. Locals perceived increased numbers of carnivores and carnivore-related damages, as well as human expansion and increased human disturbance in nature as reasons for this shift. Overall, decreased negative and increased positive emotions, decreased fear, increased positive existence beliefs, decreased perceived costs and increased perceived benefits were found to be drivers for increased tolerance in Beskydy. However this increased tolerance has not yet led to increased coexistence.

For wildlife management, it is recommended to use emotions, existence beliefs, perceived costs and perceived benefits as leverage points towards tolerance. Further research on the relations between attitudes, behaviour and coexistence is required. This research provided an example of operationalisation of the model by Marchini et al. (2021), which can be used for participatory decision-making regarding carnivores, as well as for participatory research on human-carnivore interactions.

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Appendices

Appendix I. Theory

1.1 Perceived costs of living with large carnivores in Europe

Perceived costs associated with carnivores in Europe seem to mostly relate to perceptions of carnivores as damaging and dangerous. According to Jakub Čejka from the Agency for Nature Conservation and Landscape Protection, only one to five percent of wolf prey consists of livestock, depending on the seasons (Čejka, 2020). However, Kastelic et al. (2013) interviewed 60 sheep farmers of which half experienced wolf attacks in the period 2008-2010 in their research on the attitudes of Southern Slovenian farmers towards wolves. This large number indicates that conflicts with wolves are common in this region. The farmers did not perceive wolves as dangerous for humans, but the majority of the farmers indicated that if a wolf were to approach humans or livestock, that wolf should be killed. Another Slovenian study on attitude towards wolves found that of livestock farmers, hunters and the public, the majority of respondents supported the conservation of wolves. However, half of the respondents found damage to livestock intolerable (Marinko & Majić Skrbinšek, 2011). Referring wolf attacks on livestock in the Czech Republic, Čejka states that farmers are not prepared for attacks on livestock (Čejka, 2020).

Tosi et al. (2015). found that brown bears in the Italian Alps mostly damaged beehives and livestock, and cited a study by Kavčič et al. (2013) which found that brown bears in Slovenia chose to attack sheep in 97% of the predation events. This shows that bears pose only a small threat to human safety, as they tend to flee or observe from a distance when encountering humans (Tosi et al., 2015). Tosi et al. (2015) found that in their research area, bears are perceived as damaging and dangerous although they are not regarded as a real threat to humans. The authors mention that a small number of 'problem bears' were responsible for most of the dangerous situations. These problem bears, together with over-exposure in the media, create a negative view of bears among the public (Tosi et al., 2015).

According to Odden et al. (2008), lynx caused a large loss of free ranging sheep in Norway. However, the study found that this livestock was mainly killed incidentally, as sheep are not a main source of food for the lynx, which usually avoids human activities. In line with this, Kaczensky et al. (2012) noted that in Czech Republic only some damages to sheep by lynx occur. Lescureux et al. (2011) researched the attitudes of Macedonian hunters and livestock breeders towards the Eurasian lynx, and found that actual interaction with lynx is rare in this region. The authors did not find any fatal attacks by lynx on humans in Europe. However, due to myths and rumours, the lynx was perceived as dangerous to humans in Macedonia. Bath et al. (2008) researched attitudes towards lynx in Poland, and found that they were generally positive, but farmers living in a lynx area were more negative, due to the perceived danger of lynx.

1.2 Perceived benefits of living with large carnivores in Europe

Several studies documented positive attitudes towards carnivores in Europe, despite the existence of conflicts (Dorresteijn et al., 2016; Glikman et al.,. 2012; Kaczensky et al., 2004; Liukkonen et al., 2009). Glikman et al. (2012) found positive attitudes towards wolves and bears in Italy, where the majority of people wished to protect the animals, although illegal killings did occur. According to the authors, feelings were the most important reason for these positive attitudes. In contrast, Dorresteijn et al. (2016) found direct interaction and beliefs of risk and population growth more decisive for positive attitudes towards bears in Romania than feelings. Kaczensky et al. (2004) researched attitudes of locals and hunters towards bears in Slovenia and documented positive attitudes towards bears, even as sheep predation in part of the country increased. The authors contributed these attitudes to perceptions of damage and danger. Lastly, Liukkonen et al. (2009) found that despite illegal killings of lynx in Finland, a majority regarded the animal as important for nature and biodiversity.

Appendix II. Methods.

2.1 Visited municipalities

Table 1

List of visited municipalities and number of respondents per municipality for 2022.

Municipality	**Number of respondents**
Bukovec	5
Čeladná	4
Dolní Lomná	3
Halenkov	8
Horní Bečva	5
Horní Lomna	1
Huslenky	17
Karolinka	2
Krásná	6
Lidečko	2
Lužná	4
Morávka	4
Nový Hrozenkov	16
Ostravice	3
Pražmo	2
Řeka	5
Smilovice	2
Staré Hamry	4
Valašská Bystřice	5
Valašská Polanka	6
Valašská Senice	3
Velké Karlovice	13

2.2 Themes for carnivore impact on humans

Table 2

Themes for carnivore impact on humans along with the different ways in which the theme was mentioned by respondents.

Carnivore impact on humans	
Theme	**Meaning**
Increased presence	Increased number of carnivores, increased appearance of carnivores.
Increased fear	Increased fear, less used to presence of carnivores, increased threat of wolf to humans/livestock, increased tension around carnivore
Increased damage	To livestock (predominantly sheep), buildings, beehives
decreased ability to prevent/cope with damages	Increased number of small (sheep) farmers, farmers are less prepared to protect themselves, increased rivalry between wolves and gamekeepers, stricter compensation for damages
Coming closer to settlements	Carnivore is coming closer to settlements, is becoming less shy
Increased appearance in media	Documentaries, news and social media spreading fear, media reports about presence of carnivores in region
Increased discussion	Increased discussion of concerns about damages and attacks, stories about attacks/damages
Increased ability to prevent/cope with damages	Increased defence/better protected, decreased number of small (sheep) farmers, better compensation for damages, decreased amount of farmland
Decreased damage	To livestock (predominantly sheep), buildings, beehives
Decreased fear	Decreased fear, more used to presence of carnivores

2.3 Themes for human impact on carnivores

Table 3

Themes for human impact on carnivores, along with the different ways in which the theme was mentioned by respondents.

Human impact on carnivores	
Theme	**Meaning**
increased awareness among locals	increased interest in wellbeing of carnivore/wildlife, increased appreciation of carnivore, increased knowledge of carnivore, decreased shooting of carnivore, increased knowledge of nature, people care more about environmental protection
increased human disturbance in forest	decreased space and peace for carnivore, increased number of people in forest, increased tourism, increased number of activities in nature, worse behaviour in forest, increased littering in forest, increased traffic in forest, increased noise in forest (bikes, motorcycles, cars), decreased knowledge of nature
Human expansion	Increased human development, increased human population, increased construction/infrastructure, increased deforestation, increased number of roadkills
increased conservation of carnivore	increased conservation and protection of carnivore, increased wildlife regulation, decreased poaching, decreased deforestation
increased monitoring	increased monitoring of carnivore, increased number of camera traps
For wolf only: increased tendency to shoot	People are more inclined to shoot and to defend against wolves, people and gamekeepers have less respect for nature, increased number of gamekeepers

Appendix III. English questionnaire 2022

Municipality/village:
Date:

Survey: changes in residents' attitudes towards large carnivores in the Beskydy Mountains

We are Marek Bock, Adéla Pohořelá and Nina Opdam, and we are students in a research project for Charles University in Prague and Utrecht University in the Netherlands. The research project is about how residents of the Beskydy region experience the presence of large carnivores in this region. In the years 2000 and 2010, similar research has been done to understand the interactions between residents and the lynx, wolf and brown bear. Now, we want to research the relationship residents have with these animals again. This way, we can see if and how peoples' attitudes have changed over 20 years' time.

For this research, we need your help! We would like to ask you about your own view of the lynx, wolves and bears in this region. This will help us understand the impact of these animals on residents in the region.

This survey consists of five parts. In the first part there are some questions about your knowledge of and experience with large carnivores in this area. In the second part we would like to learn about your feelings towards large carnivores. The third part will ask about the potential benefits that the presence of these animals can have. In the fourth part, we would like to ask you how your opinion of the lynx, wolf and bear changed over time. In the last part we ask you some questions about your age, profession and relationship to hunting and farming.

The data we collect through this survey might be used for scientific publications, in that case your identity will always be kept anonymous.

Filling out this survey will take maximum 30 minutes. There are no right or wrong answers and participation in this research is completely voluntary. We want to thank you in advance for talking to us; and we really appreciate that you take time for us.

Before we start we would like to ask you if have understood the objectives of our research and your participation in this research? Are there any other question that you would like to ask? If you have questions during the filling out of the survey you can always ask them. If you ever feel uncomfortable with the survey we can stop at any time.

Do you agree to participate in this interview? ☐ Yes ☐ No

If it is okay for you, we can now get started with some questions about your knowledge of and experience with large carnivores.

1. Do you think that there are large carnivores in the Beskydy Mountains, i.e. lynx, wolf and bear?

	Yes	No
Lynx		
Wolf		
Bear		

2. In your estimate, how many lynx, wolves and bears are there in the Beskydy Mountains/Czech Republic?

Lynx:…….

Wolf:…….

Bear:…….

3. Have you ever seen a lynx, a wolf or a bear in the Czech countryside?

	Yes	No	If yes, how did you experience it?
Lynx			
Wolf			
Bear			

4. And have you ever seen their residence signs (tracks, claws, droppings etc.)?

	Yes	No	I don't know
Lynx			
Wolf			
Bear			

5a. Have large carnivores (lynx, wolf, bear) ever done any harm to you or your family?

- Yes
- No

5b. If yes, what harm have large carnivores (lynx, wolf, bear) done to you?

……
…….

6. Would you say that a lynx/wolf/ bear is a shy animal which usually avoids people? Please select one of the following answers:

	Certainly yes	Rather yes	Rather no	Certainly no	I don't know
Lynx					
Wolf					

Bear					

7. Do you think that encountering a wild lynx, wolf or bear in nature is dangerous for humans? Please select one of the following answers:

	Certainly yes	Rather yes	Rather no	Certainly no	I don't know
Lynx					
Wolf					
Bear					

8. Where do you get information about large carnivores (at present)? + mark the 1 most important source of information

- Television
- Information materials
- Family, friends, acquaintances
- Professional literature
- Newspapers and magazines
- Discussions, lectures, exhibitions
- Internet
- Social media
- Excursions, residential events
- Radio
- Books (fiction)
- School
- Other:…….

In this second part, we are curious about your feelings towards the lynx, wolf and bear. We therefore would like to ask you questions about the usefulness of these animals, about your acceptance of their presence, and about the emotions you feel towards the lynx, wolf and bear.

9. Which of the following statements best fits your point of view? Lynx (wolf, bear) is:

	Useful	Useless	Harmful	I don't know (I don't have enough information)	Why?
Lynx					
Wolf					
Bear					

10. How do you feel about the presence of lynx, wolves and bears in the region where you live? Please select one of the following answers:

	It makes me happy	I do not mind	It bothers me but I can accept it	It bothers me and I am not ready to accept it	I do not have an opinion on this
Lynx					
Wolf					
Bear					

11a. Would you object to further spontaneous spread of large carnivores in the Czech Republic?

	Certainly yes	Rather yes	Rather no	Certainly no	I don't know (I don't have enough information)
Lynx					
Wolf					
Bear					

11b. Could you please list the most important reasons why?

……
…….

12. If you learned that someone you know has illegally killed a lynx, wolf or bear, how would you react? (More than one answer may be selected, separate answers for each species)

	Lynx	Wolf	Bear
I would be glad			
I would feel sorry			
I would be upset			
I would try to explain to them that it was wrong			
I would report it to the police or the PLA Administration			
I would not care			
Other (please specify):			

13. Please express your opinion on the following questions, using numbers where: Certainly yes = 1; Rather yes = 2; Rather no = 3; Certainly no = 4; I do not know = 0

Question	Lynx	Wolf	Bear

Is it necessary to regulate lynx/wolf/bear numbers by hunting so that they do not multiply to much?			
Do you think that lynx/wolves/ bears are causing a lot of damage to livestock?			
Do you think that lynx/wolves/ bears are causing a lot of damage to wild game?			
Do lynx/wolves/bears have an important role in regulating numbers of wild ungulates?			

14. Please describe what emotions you feel due to living with lynx/wolf/bear in your area: Please tick as many feelings as necessary and indicate the intensity of the feeling on a scale of 0 to 5. 0= I do not feel this at all, 1=very weakly, 2=weakly, 3=average intensity, 4=strongly, 5=very strongly

	Frightened	worried	annoyed	animosity	compassionate	grateful	happy	amused
Lynx								
Wolf								
Bear								

15. From the following options, please select those that apply to you (1 or more):

Due to the occurrence of this carnivore in this area	Lynx	Wolf	Bear
I am afraid to go to the forest			
I am afraid to walk through the forest after dark			
I am afraid to let the children alone into the forest			
I am afraid of an attack on my pets			
I am not afraid at all			

For the third part of this questionnaire, we would like to know whether the presence of the lynx, wolf and bear in the Beskydy region might positively influence you on a personal level.

16. Below are some statements on how people might feel about the lynx, wolf and bear. Please express your opinion in numbers where:

Certainly yes = 1; Rather yes = 2; Rather no = 3; Certainly no = 4; I do not know = 0

	Lynx	Wolf	Bear
I appreciate the beauty of the lynx/wolf/bear			
I feel fascination for the lynx/wolf/bear			
I feel a close connection to the lynx/wolf/bear			
The lynx/wolf/bear belongs in the Beskydy/Wallachian Mountains			
The presence of the lynx/wolf/bear in the Beskydy Mountains gives me hope for the future			
Because of the presence of the lynx/wolf/bear in the Beskydy Mountains, I've started to do activities which enable me to enjoy wildlife and/or protect wildlife (for example wildlife watcher, conservation activities)			

The fourth part of the questionnaire asks how your opinion of the lynx, wolf and bear has changed over the past 20 years. This is an interactive question in which we also ask you to explain the reasoning behind your answers. We therefore would like to ask you if it is okay to record this last bit of the questionnaire.

May we record this part of the questionnaire?

- o Yes o No

17. On this large sheet of paper you see **two axes**. The **vertical axis represents the impact of the lynx/wolf/bear on people** and **the horizontal axis represents the impact of people on the lynx/wolf bear**. Both axis have a scale from -5 to 5, with the negative numbers indicating a negative impact and the positive numbers indicating a positive impact. Negative impacts of lynx/wolf/bear on people are for example attacks on livestock or pets and feelings of unsafety. Positive impacts of lynx/wolf/bear on people could be increased profits of tourism or feelings of happiness. Negative impacts of people on the lynx/wolf/bear are for example poaching, roadkill, and road expansion. An example of a positive impact of people on the lynx/wolf/bear is conservation efforts.

The axes divide the paper into four areas:

1. The carnivore negatively impacts people, but people positively impact the carnivore.

2. The carnivore and the people positively impact each other. When this occurs, people and carnivores live together peacefully within the landscape.

3. The people negatively impact the carnivore, but the carnivore positively impacts the people.

4. The carnivore and the people negatively impact each other. When this occurs, people and carnivores are not able to live together peacefully within the landscape.

First, for the lynx, we would like to ask you to place these heads somewhere along these axes, based on how you currently perceive the impact of the lynx on people and peoples' impact on the lynx. Please use the **blue head** for the year **2022**, the **green head** for **2010** and the **orange head** for **2000**.

Could you do the same for the wolf and bear?

Could you explain why you placed the animal heads in these positions?

For 2010 and 2000, some context might help, as it might be difficult to remember this year and how you felt about the lynx, wolf and bear then.

- 2010 was the year in which the Central European Floods occurred. Because of these floods, a state of emergency was declared in the Moravian-Silesian Region.
- 2010 was also the year in which Jiří Paroubek, the leader of the social democratic party (ČSSD) resigned after the legislative election.
- In 2010, Martina Sáblíková was the first Czech to win two Olympic gold medals at the Winter Games in the Olympics
- In the year 2000, the Temelin nuclear power plant was launched. Many of the Czech were opposed to this, but with a narrow majority of votes the government decided to build the powerplant.

If you don't remember your opinion from back then, we can skip the year 2000.

Lynx/Rys

2022:
……

2010:
……

2000:
……

Wolf/Vlk

2022:
……

2010:
……

2000:
……

Bear/Medvěd

2022:
……

2010:
……

2000:
……

18. Do you have any other comments on the occurrence of large carnivores in the Beskydy Mountains (or in the Czech Republic) that you would like to share?

……
……

Lastly, may we ask you a few questions about your socio-demographic background?

19. What is your gender?

- Male
- Female
- Non-binary
- I prefer not to say

20. How old are you?

- 15–19
- 20–26
- 27–35
- 36–50
- 51–65
- 66–older
- I prefer not to say

21. What is your highest achieved education?

- Basic
- Apprenticeship
- Secondary – Specify:
- Further education/University – Specify:
- I prefer not to say

22. What is the size of your place of residence?

- Less than 2,000 inhabitants
- 2,000–5,000 inhabitants
- 5,001–10,000 inhabitants
- 10,001–20,000 inhabitants
- 20,001–500,000 inhabitants
- 500,001–100,000 inhabitants
- 100,001 or more
- I do not know/ I prefer not to say

23. Your occupation or the sector you work in:

- Tourism
- Forestry
- Manual worker (any sector)
- Agriculture (animal/plant production)
- Education (primary/secondary/tertiary)
- Housewife
- Student
- Retired
- Civil servant
- Self-employed/private entrepreneur
- Unemployed
- Other:
- I prefer not to say

24. How long have you been living in your current place of residence?

- Less than 5 years
- 5–15 years
- 15–30 years
- More than 30 years

25. Do you have any relationship to hunting?

- I am a hunter myself: I actively hunt/I have a hunting licence but do not hunt actively
- My family member is a hunter
- My friend/acquaintance is a hunter
- I do not know any hunters
- Other (e.g., I am interested in hunting)

26. Do you have any relationship to livestock farming (sheep, goats, cattle, etc.)?

- I am a livestock farmer myself.
  What kind and how many animals do you have?
  ……
  ……
- My family member is a livestock farmer
- My friend/acquaintance is a livestock farmer
- I have no relation to livestock farmers
  I used to farm livestock but I no longer do

Appendix IV. Czech questionnaire 2022

Město/obec/vesnice:

Datum:

Průzkum: Změny postojů obyvatel k velkým šelmám v Beskydech

Jmenujeme se Marek Bock, Adéla Pohořelá a Nina Opdam a jsme studenti spolupracující na projektu Karlovy univerzity a Utrechtské univerzity v Nizozemsku. Výzkumný projekt se zabývá tím, jak obyvatelé Beskyd vnímají přítomnost velkých šelem v tomto regionu. V letech 2000 a 2010 proběhl podobný výzkum, jehož cílem bylo porozumět interakcím mezi obyvateli a rysem, vlkem a medvědem hnědým. Nyní chceme vztah obyvatel k těmto zvířatům zkoumat znovu. Umožní nám to zjistit, zda a jak se postoje obyvatel za uplynulých 20 let změnily.

Pro tento výzkum potřebujeme vaši pomoc! Rádi bychom se vás zeptali na váš vlastní pohled na rysy, vlky a medvědy v tomto regionu. Pomůže nám to pochopit vliv těchto zvířat na zdejší obyvatele.

Průzkum se skládá z pěti částí. První část obsahuje otázky týkající se vašich znalostí a zkušeností s velkými šelmami v této oblasti. Ve druhé části bychom se rádi dozvěděli o vašich pocitech vůči velkým šelmám. Ve třetí části se budeme ptát na potenciální přínosy, plynoucí z přítomnosti těchto zvířat. Ve čtvrté části bychom se vás rádi zeptali, jak se váš názor na rysa, vlka a medvěda měnil v průběhu času. V poslední části vám položíme několik otázek týkajících se vašeho věku, profese a vztahu k myslivosti a zemědělství.

Získané údaje by mohly být použity pro vědecké publikace. V takovém případě bude vaše identita vždy zachována v anonymitě.

Vyplnění tohoto dotazníku vám zabere maximálně 30 minut. Neexistují žádné správné nebo špatné odpovědi a účast v tomto výzkumu je zcela dobrovolná. Předem vám chceme poděkovat a velmi si vážíme toho, že si na nás uděláte čas.

Rozumíte účelu tohoto výzkumu? ☐ **Ano** ☐ **Ne**

Rozumíte, že vaše identita zůstane anonymní? ☐ **Ano** ☐ **Ne**

Rozumíte, že účast na výzkumu je zcela dobrovolná? ☐ **Ano** ☐ **Ne**

Souhlasíte s vyplněním dotazníku? ☐ **Ano** ☐ **Ne**

Pokud je vše v pořádku, můžeme nyní začít s otázkami týkajícími se vašich znalostí a zkušeností s divokými šelmami.

1. Myslíte si, že se v Beskydech vyskytují velké šelmy, tzn. rys, vlk a medvěd?

	Ano	Ne
Rys		
Vlk		
Medvěd		

2. Věděl/a byste, přibližně kolik se v ČR vyskytuje:

Rysů _____

Vlků _____

Medvědů _____

3. Viděl/a jste někdy v české přírodě rysa, vlka nebo medvěda?

	Ano	Ne	Jak to probíhalo?
Rys			
Vlk			
Medvěd			

4. A viděl/a jste někdy jejich pobytové znaky (stopy, drápance, trus atd.)?

	Ano	Ne	Nevím
Rys			
Vlk			
Medvěd			

5a. Způsobily někdy vám nebo vaší rodině velké šelmy nějakou škodu?

- Ano
- Ne

5b. Pokud ano, jakou škodu vám velké šelmy způsobily?

……

……

6. Je R/V/M plachá šelma, která se lidem většinou vyhýbá? Vyberte prosím z následujících možností:

	určitě ano	*spíše ano*	*spíše ne*	*určitě ne*	*nevím*
Rys					
Vlk					
Medvěd					

7. Myslíte si, že setkání s rysem (vlkem, medvědem) ve volné přírodě v ČR je pro člověka nebezpečné? Vyberte prosím z následujících možností:

	určitě ano	*spíše ano*	*spíše ne*	*určitě ne*	*nevím*
Rys					
Vlk					
Medvěd					

8. Odkud získáváte informace o velkých šelmách (v současnosti)? Nejvýznamnější zdroj informací zvýrazněte:

- Televize
- Informační materiály
- Rodina, přátelé, známí
- Odborná literatura
- Noviny a časopisy
- Besedy, přednášky, výstavy
- Internet
- Sociální sítě
- Exkurze, pobytové akce
- Rádio
- Knihy (beletrie)
- Škola

- Jiné: ……

Ve druhé části nás zajímá, jaký je váš vztah k rysovi, vlkovi a medvědovi. Rádi bychom vám proto položili otázky týkající se užitečnosti těchto zvířat, vašeho přijetí jejich přítomnosti a emocí, které ve vás rys, vlk a medvěd vyvolává.

9. Které z následujících tvrzení nejlépe odpovídá vašemu názoru? Rys (vlk, medvěd) je v naší přírodě:

	užitečný	zbytečný	škodlivý	nevím, nemám dostatek informací	Proč?
Rys					
Vlk					
Medvěd					

10. Jaký je váš postoj k výskytu rysa, vlka a medvěda v regionu, kde žijete? Vyberte prosím z následujících možností:

	Mám z toho radost	Nevadí mi to	Vadí mi to, ale jsem schopný/á to přijmout	Vadí mi to a nejsem schopný/á to přijmout	Nemám na to názor
Rys					
Vlk					
Medvěd					

11a. Vadilo by vám další samovolné šíření velkých šelem na území ČR?

	Určitě ano	Spíše ano	Spíše ne	Určitě ne	Nevím (Nemám dost informací)
Rys					
Vlk					
Medvěd					

11b. Pokud ano, mohl/a byste prosím uvést nejdůležitější důvody proč?

……

……

……

12. Představte si, že se o někom z vašeho okolí dozvíte, že nelegálně zastřelil vlka, rysa nebo medvěda. Jak byste reagoval/a? *(Možno zaškrtnout vícero odpovědí; Pro každý druh separátní odpověď)*

	Rys	Vlk	Medvěd
Byl/a bych rád/a			
Mrzelo by mne to			
Naštvalo by mě to			
Snažil bych se mu vysvětlit, že je to špatné			
Ohlásil/a bych to na policii nebo Správě CHKO			
Bylo by mi to jedno			
Jiné (prosím rozvést):			

13. Vyjádřete prosím svůj názor na následující otázky tímto číselným ohodnocením:

Určitě ano = 1 ; Spíše ano = 2 ; Spíše ne = 3 ; Určitě ne = 4 ; Nevím = 0

Otázka	Rys	Vlk	Medvěd
Je nutné R/V/M regulovat lovem, aby se příliš nepřemnožili?			
Způsobuje R/V/M mnoho škod na hospodářských zvířatech?			
Způsobuje R/V/M mnoho škod na zvěři?			
Je R/V/M důležitý pro regulaci počtu zvěře?			

14. Popište prosím, jaké emoce pociťujete v souvislosti s životem v oblasti osídlené rysem/vlkem/medvědem: Zaškrtněte prosím tolik pocitů, kolik je třeba a uveďte jejich intenzitu na stupnici od 0 do 5.

0 = vůbec to necítím ; 1= velmi slabě ; 2 = slabě ; 3 = průměrná intenzita ; 4 = silně ; 5 = velmi silně

	Vyděšenost	Starost	Naštvanost	Nepřátelství	Soucit	Vděčnost	Štěstí	Pobavenost
Rys								
Vlk								
Medvěd								

15. Z následujících možností prosím vyberte ty, které se na vás vztahují: *(Možno vybrat vícero možností)*

Kvůli výskytu této šelmy v této oblasti	Rys	Vlk	Medvěd
mám strach chodit do lesa			
mám strach chodit lesem po setmění			
mám strach pouštět děti samotné do lesa			
mám strach z útoku na má domácí zvířata			
nemám strach vůbec			

Ve třetí části dotazníku by nás zajímalo, zda vás přítomnost rysa, vlka a medvěda v Beskydech může pozitivně ovlivnit na osobní úrovni.

16. Níže je několik výroků ohledně toho, co si lidé mohou myslet o rysovi, vlkovi a medvědovi. Vyjádřete prosím svůj názor tímto číselným ohodnocením:

Určitě ano = 1 ; Spíše ano = 2 ; Spíše ne = 3 ; Určitě ne = 4 ; Nevím = 0

	Rys	Vlk	Medvěd
Oceňuji krásu rysa/vlka/medvěda			
Cítím fascinaci rysem/vlkem/medvědem.			
Cítím k rysovi/vlkovi/medvědovi blízký vztah.			
Rys/vlk/medvěd patří do Beskyd/Valašska.			
Přítomnost rysa/vlka/medvěda v Beskydech mi dává naději do budoucna.			
Díky přítomnosti rysa/vlka/medvěda v Beskydech jsem se začal/a věnovat činnostem, které mi umožňují těšit se z divoké přírody a/nebo ji chránit (např. pozorování divoké přírody, ochranářské aktivity).			

Čtvrtá část dotazníků zjišťuje, jak se váš názor na rysa, vlka a medvěda za posledních 20 let změnil. Jedná se o interaktivní otázku, rádi bychom tedy slyšeli i zdůvodnění vaší odpovědi. Z tohoto důvodu bychom vás rádi požádali, zda je možné tuto poslední část dotazníku nahrávat.

Můžeme tuto část dotazníku nahrávat?

- Ano
- Ne

17. Na tomto velkém listu papíru vidíte **dvě osy**. **Svislá osa představuje vliv rysa/vlka/medvěda na lidi a vodorovná osa představuje vliv lidí na rysa/vlka medvěda**. Obě osy mají stupnici od -5 do 5, přičemž záporná čísla znamenají negativní vliv a kladná čísla pozitivní vliv. Mezi negativní dopady rysa/vlka/medvěda na lidi patří například útoky na hospodářská zvířata nebo domácí mazlíčky a celkový pocit ohrožení. Pozitivní dopady rysa/vlka/medvěda na lidi mohou být zvýšené zisky z cestovního ruchu nebo pocit štěstí. Negativní dopady lidí na rysa/vlka/medvěda jsou například pytláctví, zabíjení na silnicích a rozšiřování silnic. Příkladem pozitivního vlivu lidí na rysa/vlka/medvěda je snaha o ochranu přírody.

Osy rozdělují graf do čtyř oblastí:

1. Šelmy mají negativní vliv na lidi, ale lidé mají pozitivní vliv na šelmy.

2. Šelmy a lidé se navzájem pozitivně ovlivňují. Pokud dochází k interakci, lidé a šelmy spolu v krajině mohou žít v míru.

3. Lidé negativně ovlivňují šelmy, ale šelmy pozitivně ovlivňuje lidi.

4. Šelmy a lidé se navzájem ovlivňují negativně. Pokud dochází k interakci, lidé a šelmy spolu v krajině nemohou žít v míru.

Nejprve bychom vás chtěli požádat, abyste barevné hlavy rysa zařadili někam na tyto osy podle toho, jak v současné době, ale i historicky, vnímáte vliv rysa na lidi a vliv lidí na rysa. **Modrou** hlavu prosím použijte pro rok 2022, **zelenou** hlavu pro rok 2010 a **oranžovou** hlavu pro rok 2000.

Mohli byste totéž udělat i s hlavami vlka a medvěda?

Proč jste se rozhodl/a umístit zvířata právě na tato místa?

Pokud jde o roky 2010 a 2000, mohlo by vám pomoci trochu souvislostí, protože je možná těžké si vzpomenout na tato léta a na to, jak jste se tehdy cítili ohledně rysa, vlka a medvěda.

- *Rok 2010 byl rokem, kdy došlo ke středoevropským povodním. Kvůli těmto povodním byl v Moravskoslezském kraji vyhlášen stav nebezpečí.*
- *Rok 2010 byl také rokem, kdy po sněmovních volbách rezignoval předseda ČSSD Jiří Paroubek.*
- *V roce 2010 se Martina Sáblíková stala první Češkou, která získala dvě zlaté olympijské medaile na zimních olympijských hrách*
- *V roce 2000 byla spuštěna jaderná elektrárna Temelín. Mnoho Čechů bylo proti, ale těsnou většinou hlasů vláda rozhodla o výstavbě elektrárny.*

Pokud si svůj tehdejší názor nepamatujete, můžeme tuto otázku přeskočit.

Rys:

2022:

……

……

2010:

……

……

2000:

……

……

Vlk:

2022:

……

……

2010:

……

……

2000:

……

……

Medvěd:

2022:

……

……

2010:

……

……

2000:

……

……

18. Máte nějaké další připomínky k výskytu velkých šelem v Beskydech (nebo v České republice), o které byste se chtěl/a podělit?

……

……

Na závěr bychom vám rádi položili několik otázek týkajících se vašeho sociodemografického zázemí.

19. Jaké je vaše pohlaví?

- Muž
- Žena
- Nebinární
- Nechci upřesnit

20. Jaký je váš věk?

- 15–19
- 20–26
- 27–35
- 36–50
- 51–65
- 66–a vice
- Nechci upřesnit

21. Jaké je vaše nejvyšší ukončené vzdělání?

- Základní
- Vyučen/střední bez maturity
- Střední s maturitou – zaměření:
- Vysoké – zaměření:
- Nechci upřesnit

22. Velikost vaší obce/vesnice?

- Méně než 2,000 obyvatel
- 2,000–5,000 obyvatel
- 5,001–10,000 obyvatel
- 10,001–20,000 obyvatel
- 20,001–500,000 obyvatel
- 500,001–100,000 obyvatel
- 100,001 a více obyvatel
- Nevím/ Nechci upřesnit

23. Jaké je vaše zaměstnání/ pracovní sektor?

- Turismus
- Lesník
- Dělník (obecně)
- Zemědělec (živočišná/rostlinná výroba)
- Učitel ZŠ – SŠ – VŠ
- student/žák
- Důchodce
- Zaměstnanec státní správy
- Podnikatel
- Nezaměstnaný
- Jiné:
- Nechci upřesnit

24. Jak dlouho již v uvedené obci žijete?

- Méně než 5 let
- 5–15 let
- 15–30 let
- Více jak 30 let

25. Máte nějaký vztah k myslivosti?

- Sám jsem myslivec: aktivně provozuji myslivost/ jen myslivecké zkoušky
- Myslivce mám v rodině
- Myslivce mám mezi známými
- Myslivce nemám v rodině ani mezi známými
- Jiné (zajímám se o myslivost, …)

26. Máte nějaký vztah k chovu hospodářských zvířat (ovce, kozy, skot, atd.)?

- Sám chovám hospodářská zvířata – jaká a kolik:
  _____
  _____
- Rodinný příslušník chová hospodářská zvířata
- Hospodářská zvířata chová známý
- Nemám vazbu na chovatele hospodářských zvířat

Choval jsem kdysi, nyní už ne

Appendix V. Sub-question 1.

5.1 Sample comparison

The sample size for 2022 was a bit smaller than that of 2010. The proportions of males and females were approximately equally distributed for both samples. Significantly more respondents were part of older age groups for 2022 (mean rank 170.74) than for 2010 (mean rank 115.77), $U(N_{2010}= 158, N_{2022}= 120)=13229.000$, $z=5.799$, $p<.001$. Likewise, the percentage of respondents that lived at least 30 years in their current residence was significantly higher for 2022 (mean rank 155.13) than for 2010 (mean rank 127.63), $U(N_{2010}= 158, N_{2022}= 120)=11355.000$, $z=3.271$, $p=.001$. A significantly larger part of the 2022 sample (mean rank 157.88) had achieved higher education levels compared to the 2010 sample (mean rank 124.57), $U(N_{2010}= 157, N_{2022}= 120)=11685.500$, $z=3.641$, $p<.001$. The distribution of size of place of residence did not differ significantly between 2010 (mean rank 131.37) and 2022(mean rank 143.00), $U(N_{2010}= 152, N_{2022}= 120)=9900.000$, $z=1.415$, $p=.157$, as largely the same towns were visited in 2022 and 2010. Additionally, with a majority of respondents answering that they were either retired or had other occupations than those listed in the questionnaire, the distribution of occupation did not differ significantly between 2010 (mean rank 132.47) and 2022(mean rank 148.75), $U(N_{2010}= 152, N_{2022}= 120)=10590.500$, $z=1.728$, $p=.084$. It is noteworthy that the percentages of those whose family member was a hunter or farmer and those whose friend/acquaintance was a hunter or farmer were lower for 2022 than for 2010, although there seem no large differences in the percentages of hunters and farmers between 2022 and 2010.

Figure 1.

Age distribution in percentages per year for 2010 and 2022.

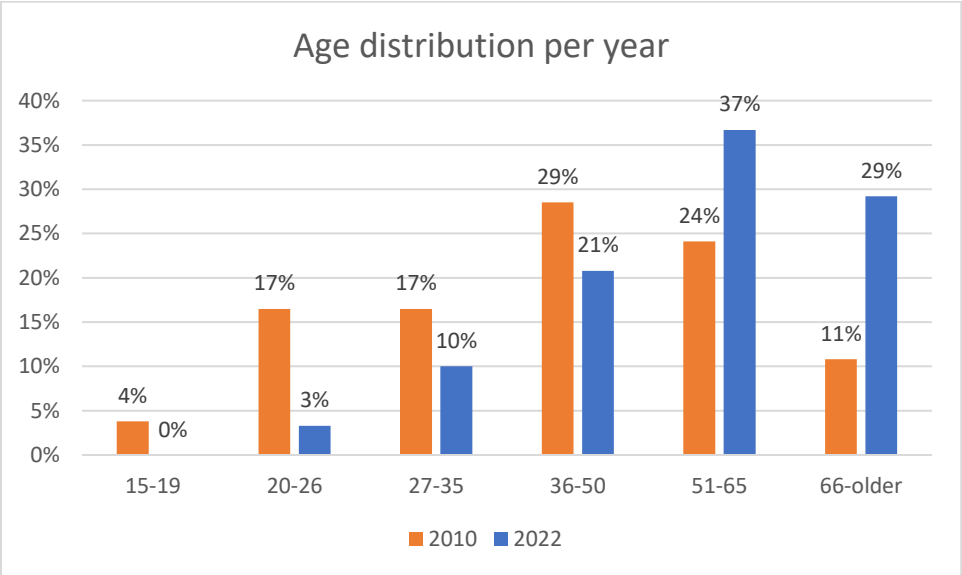


Figure 2.

Distribution of highest achieved education in percentages per year for 2010 and 2022.

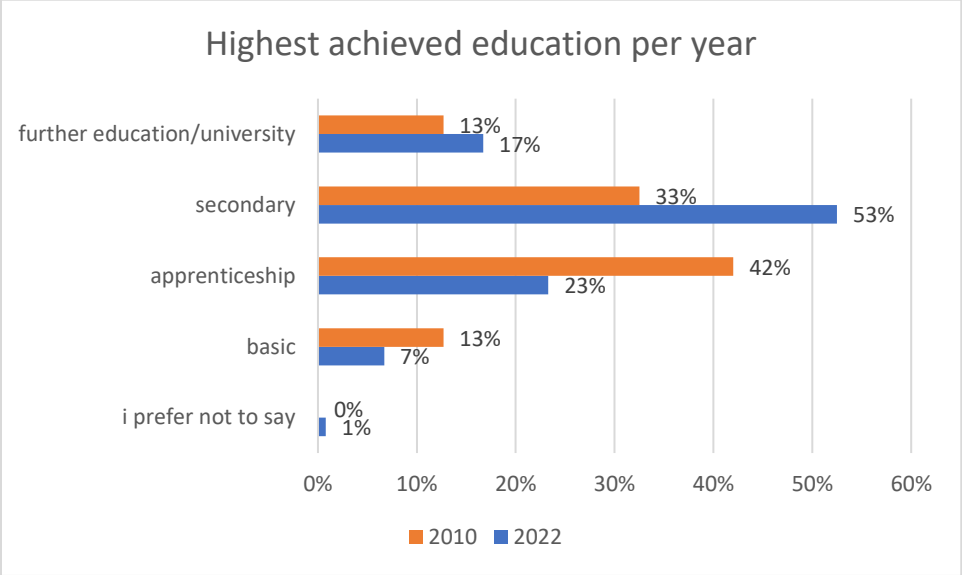
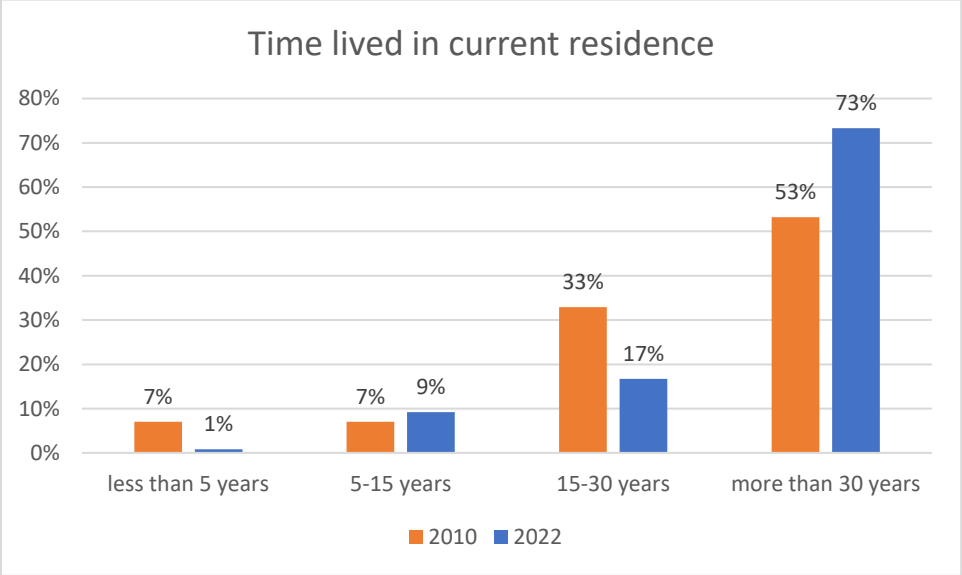


Figure 3

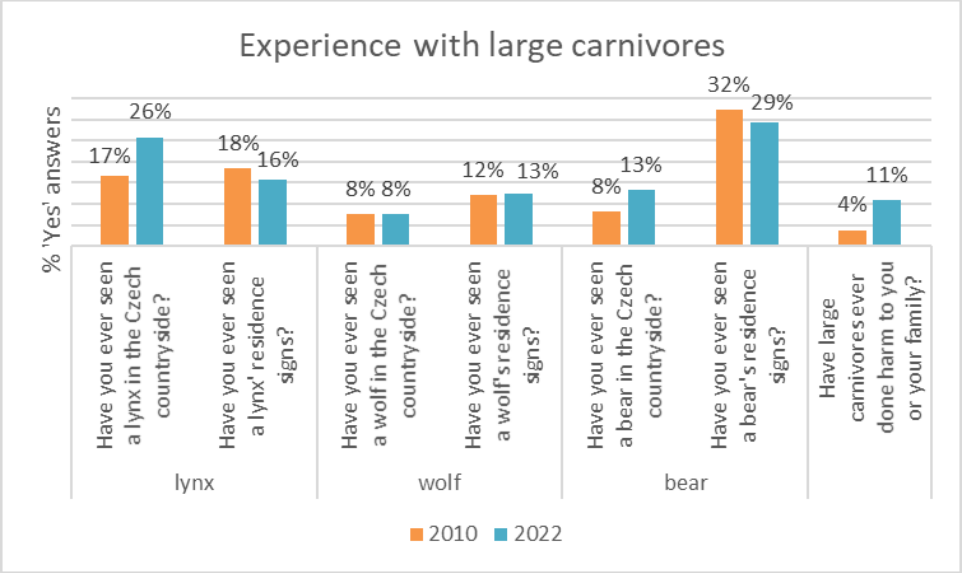
Distribution of time lived in current residence in percentages per year for 2010 and 2022.



5.2 Experience index

Figure 4

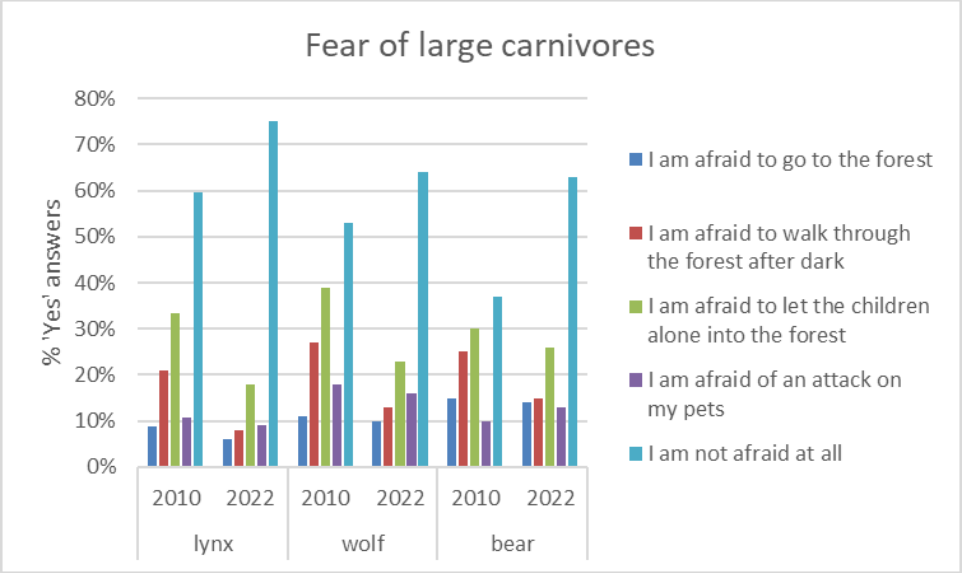
Experience with large carnivores in percentages for 2010 and 2022.



5.3 Fear index

Figure 5

Fear of large carnivores in percentages for 2010 and 2022.



Note. Those who indicated to not be afraid at all, could not also answer yes for any of the other categories.

5.4 Existence beliefs index

Figure 6

Usefulness of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

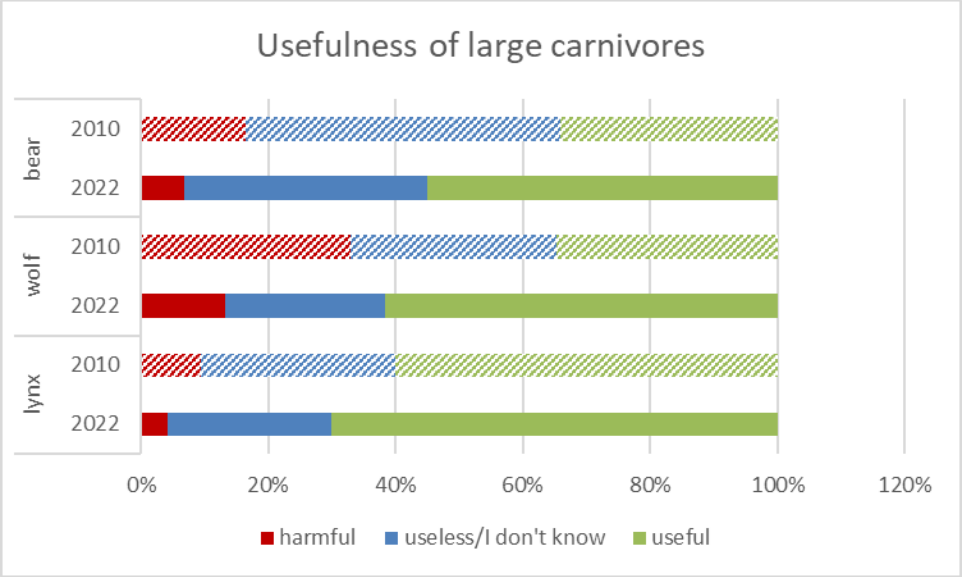


Figure 7

Distribution of answers regarding the role of lynx in regulating numbers of wild ungulates

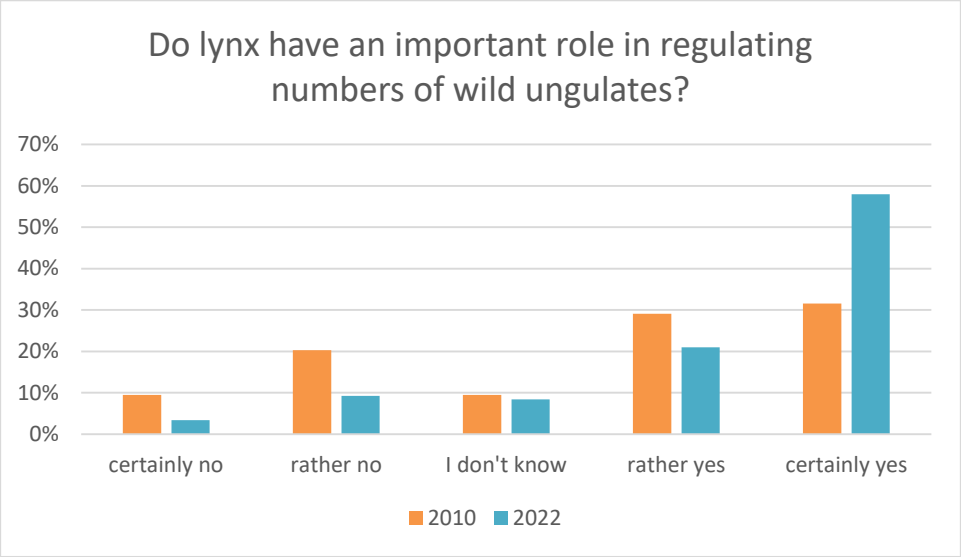


Figure 8

Distribution of answers regarding the role of wolves in regulating numbers of wild ungulates

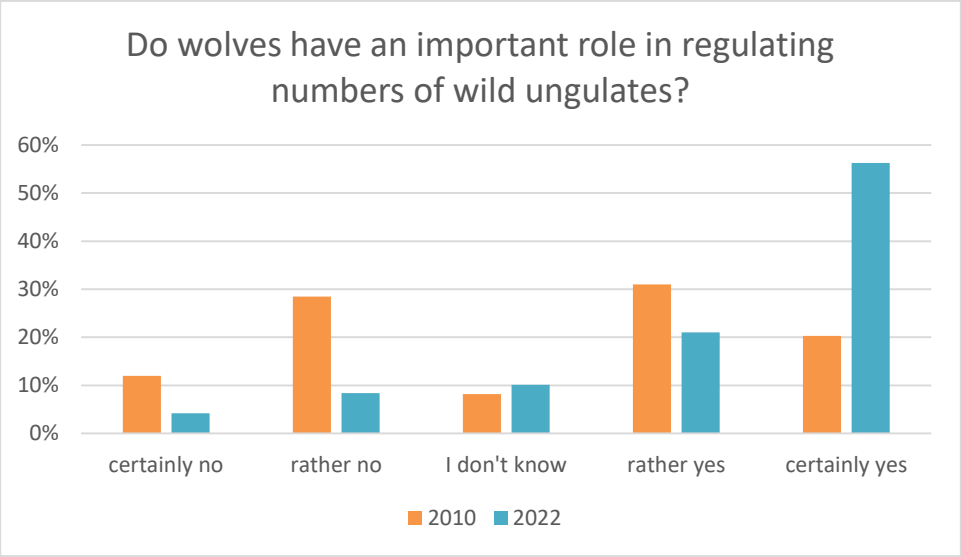
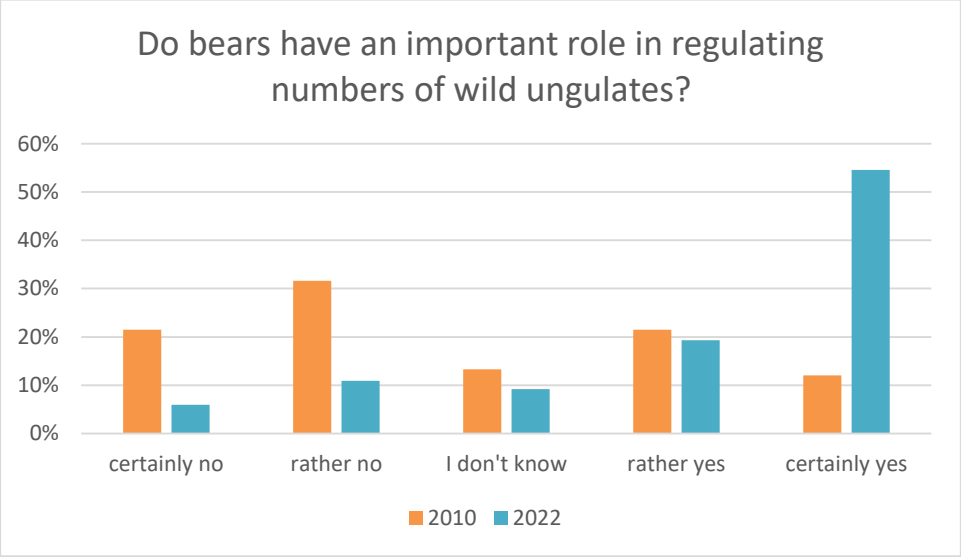


Figure 9

Distribution of answers regarding the role of bears in regulating numbers of wild ungulates



5.5 Perceived costs index

Figure 10

Dangerousness of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

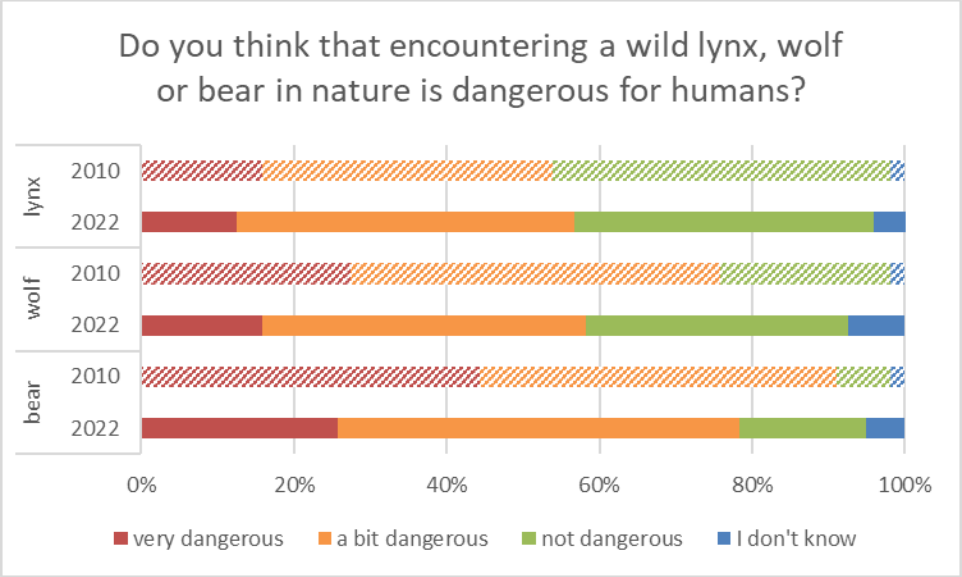


Figure 11

Shyness of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

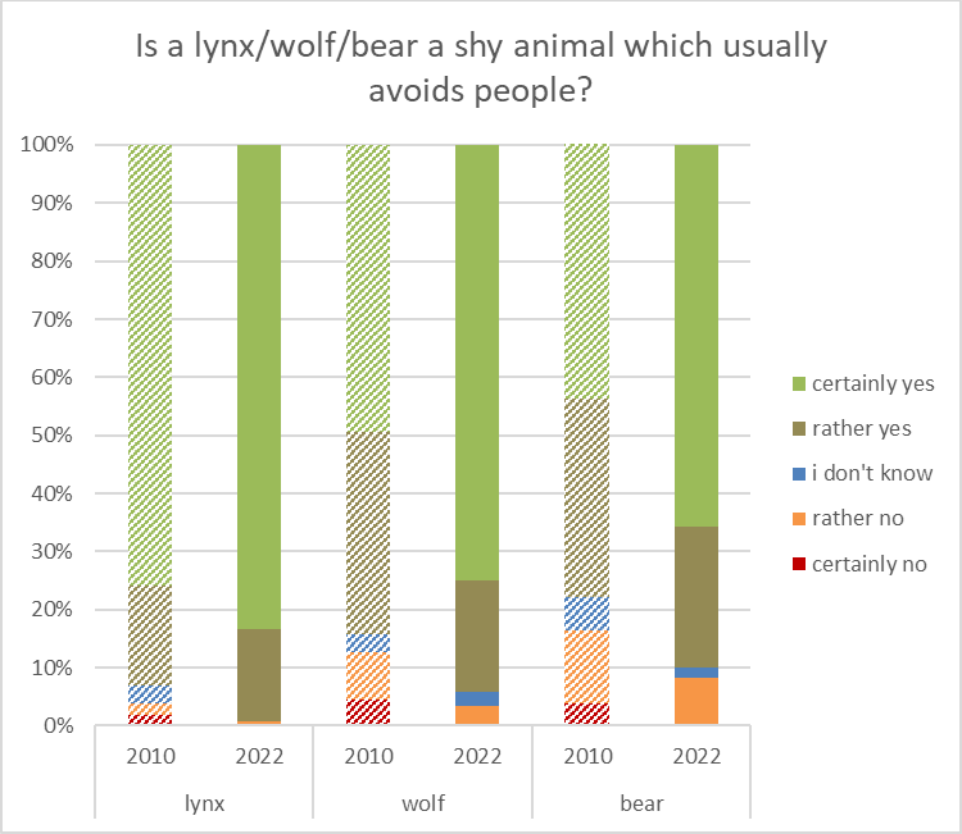


Figure 12

Perceived damages to livestock of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

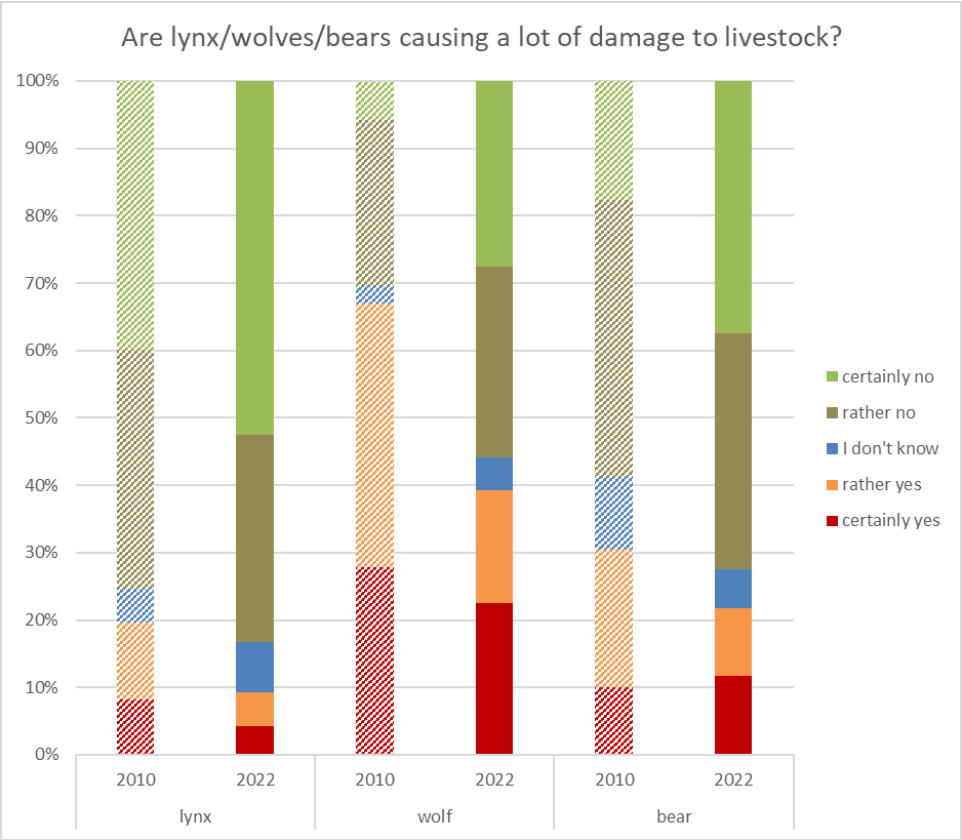
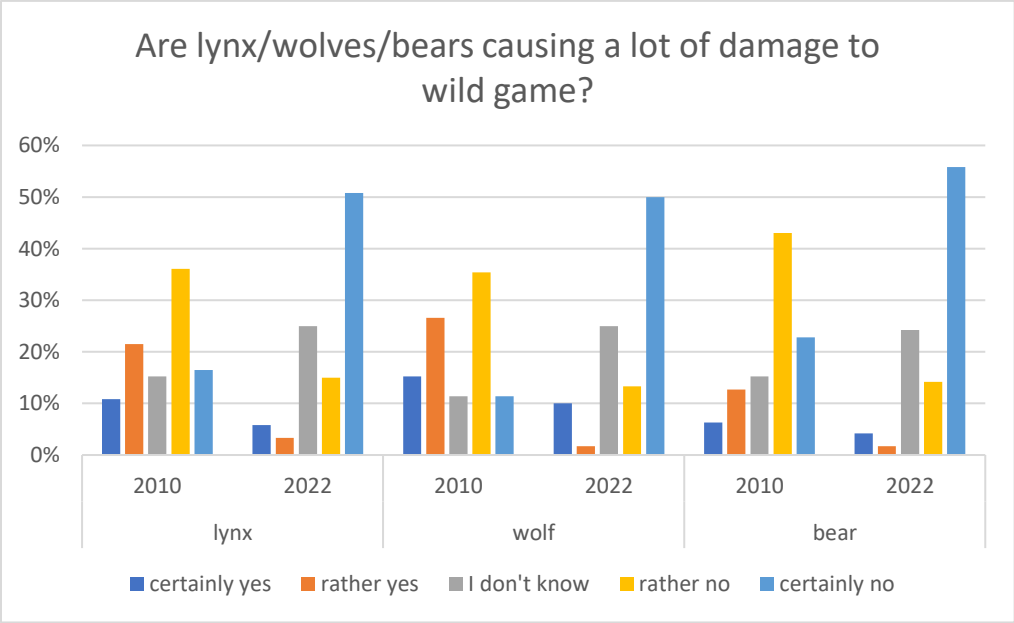


Figure 13

Perceived damages to wild game of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.



5.6 Tolerance index

Figure 14

Tolerance towards presence of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

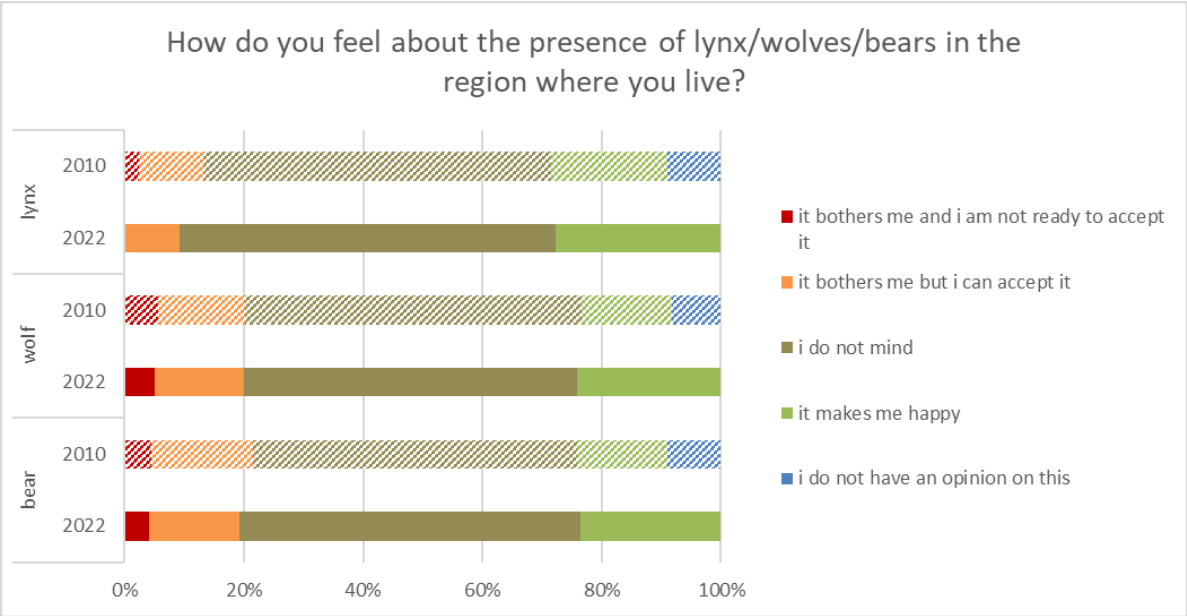


Figure 15

Objection to further spontaneous spread of large carnivores in percentages for the lynx, wolf and bear for 2010 and 2022.

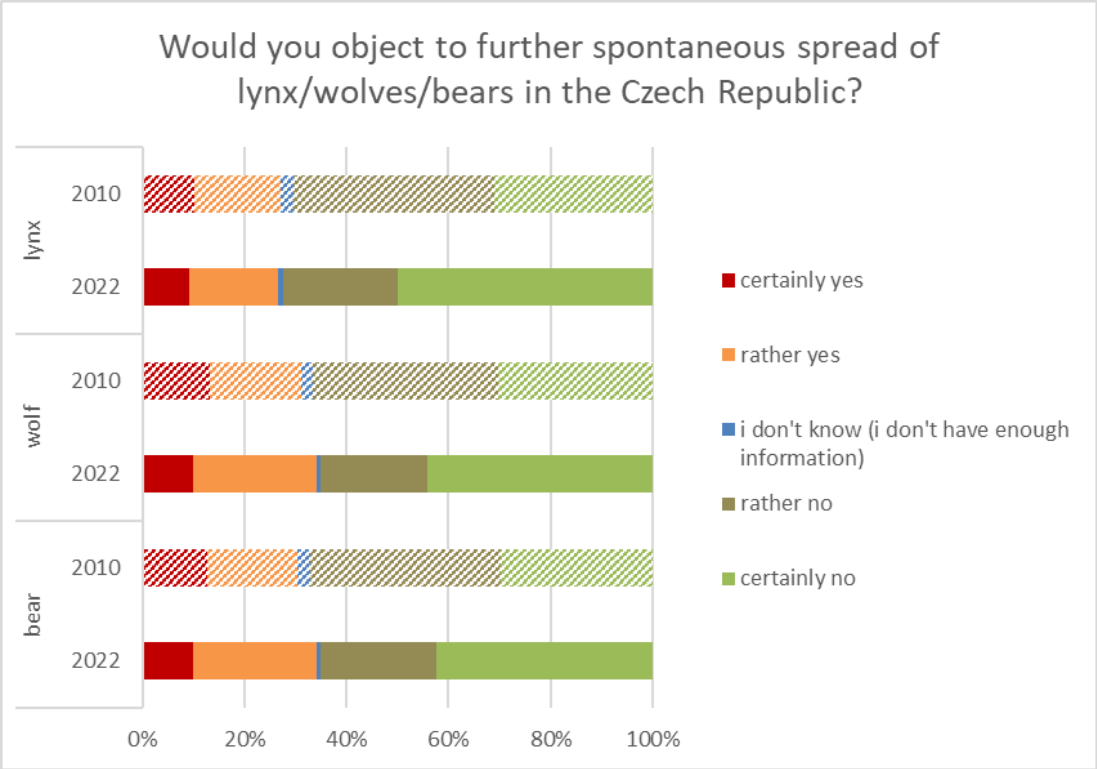
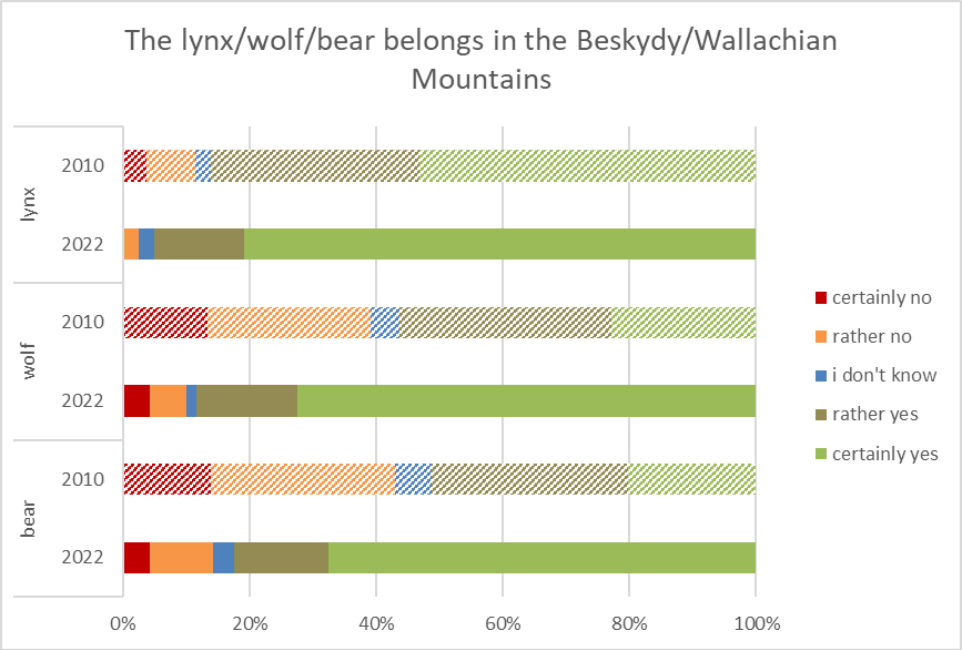


Figure 16

Belonging of large carnivores in Beskydy in percentages for the lynx, wolf and bear for 2010 and 2022.



Appendix VI. Sub-question 2

6.1 Pleasure

Figure 1

Appreciation of beauty of large carnivores in percentages for the lynx, wolf and bear for 2022.

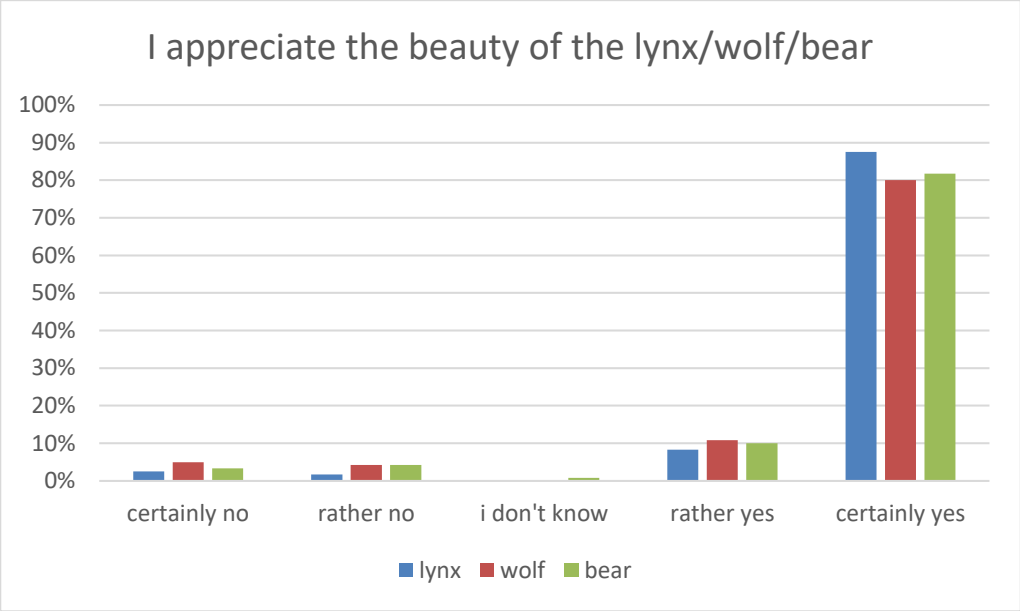
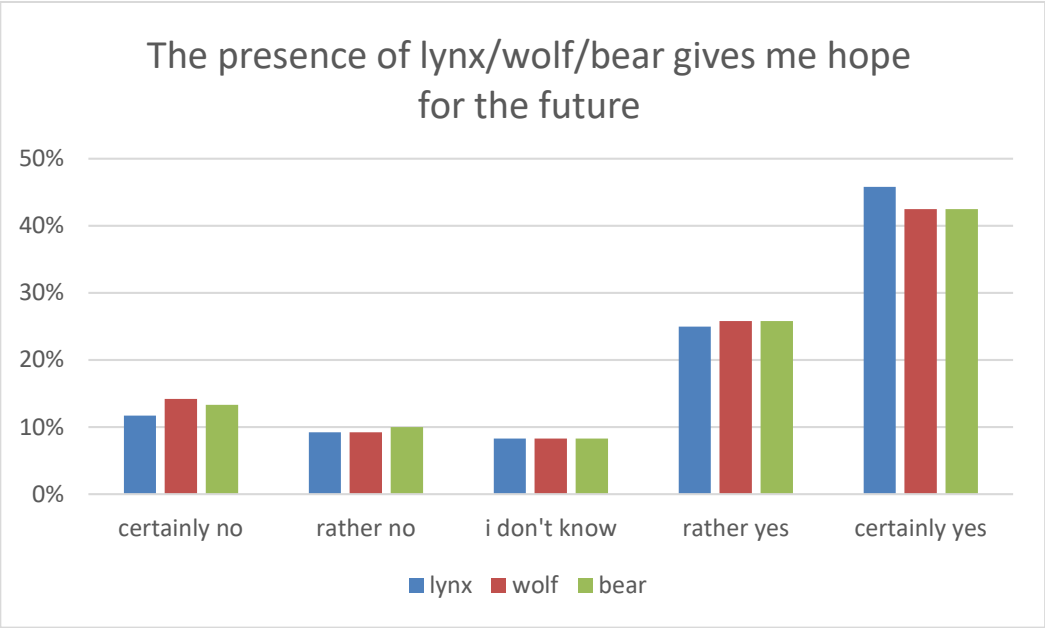


Figure 2

Hope due to presence of large carnivores in percentages for the lynx, wolf and bear for 2022.



6.2 Engagement

Figure 3

Fascination for large carnivores in percentages for the lynx, wolf and bear for 2022.

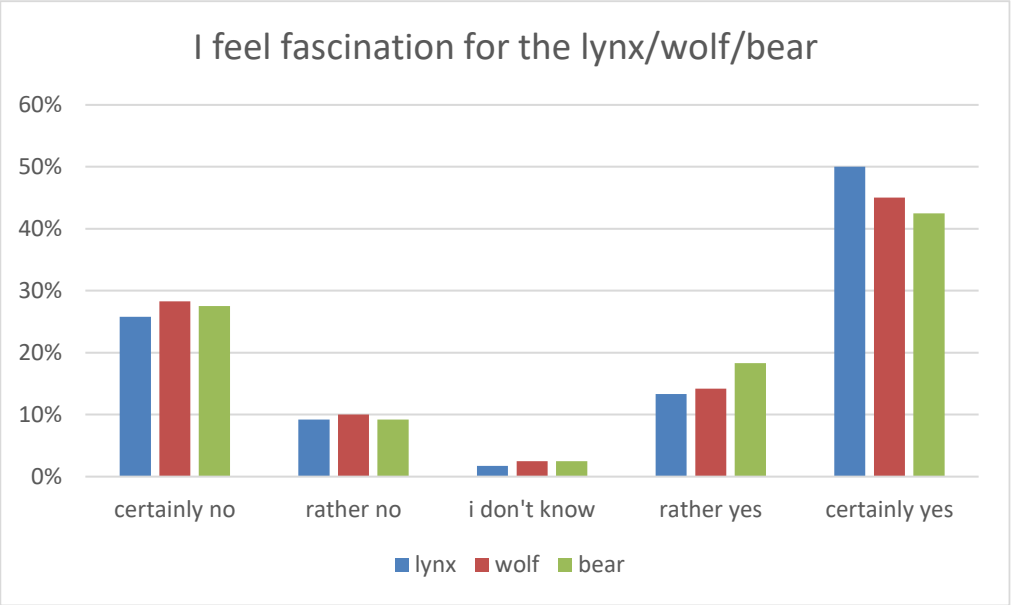


Figure 4

Close connection with large carnivores in percentages for the lynx, wolf and bear for 2022.

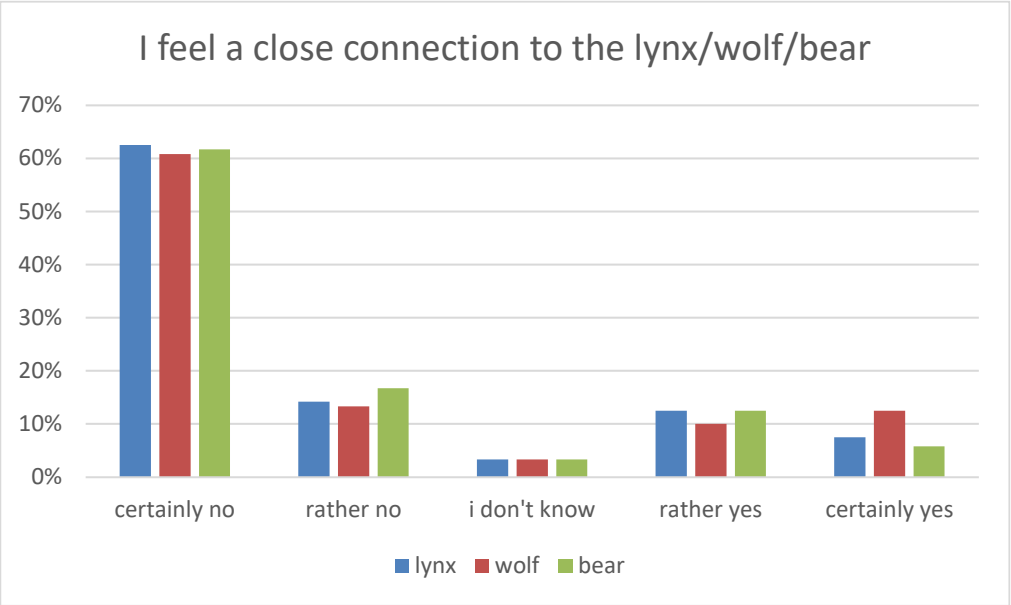
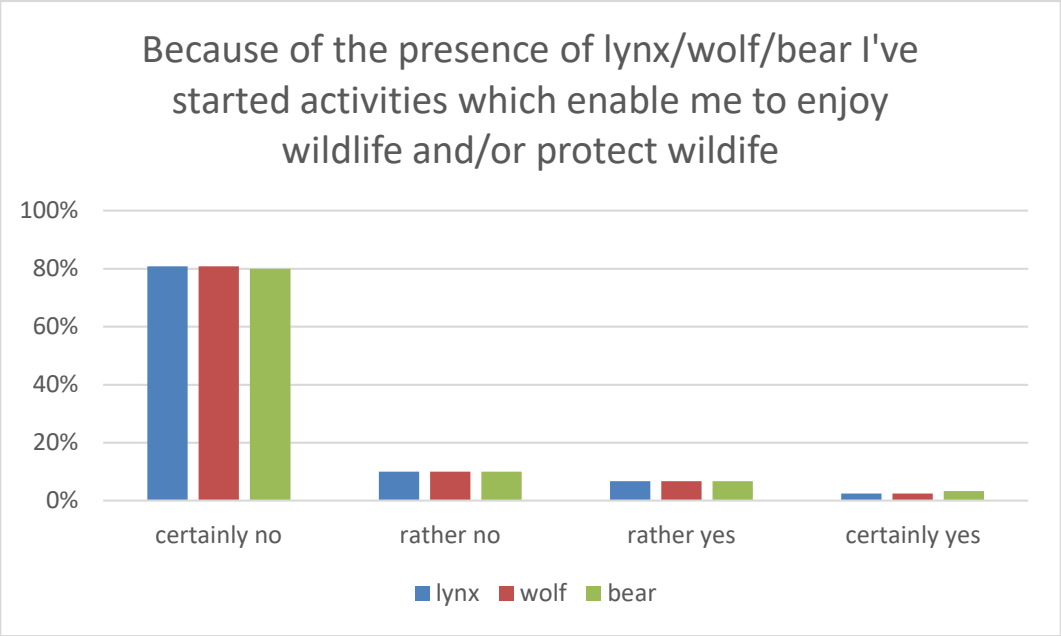


Figure 5

Activities due to presence of large carnivores in percentages for the lynx, wolf and bear for 2022.


Because of the presence of lynx/wolf/bear I've started activities which enable me to enjoy wildlife and/or protect wildife
100%
80%
60%
40%
20%
0%
certainly no
rather no
rather yes
certainly yes
lynx
wolf
bear

Appendix VII. Sub-question 3

7.1 Reflections on human-carnivore relationships

Figure 1

Zoom-in for the lynx.

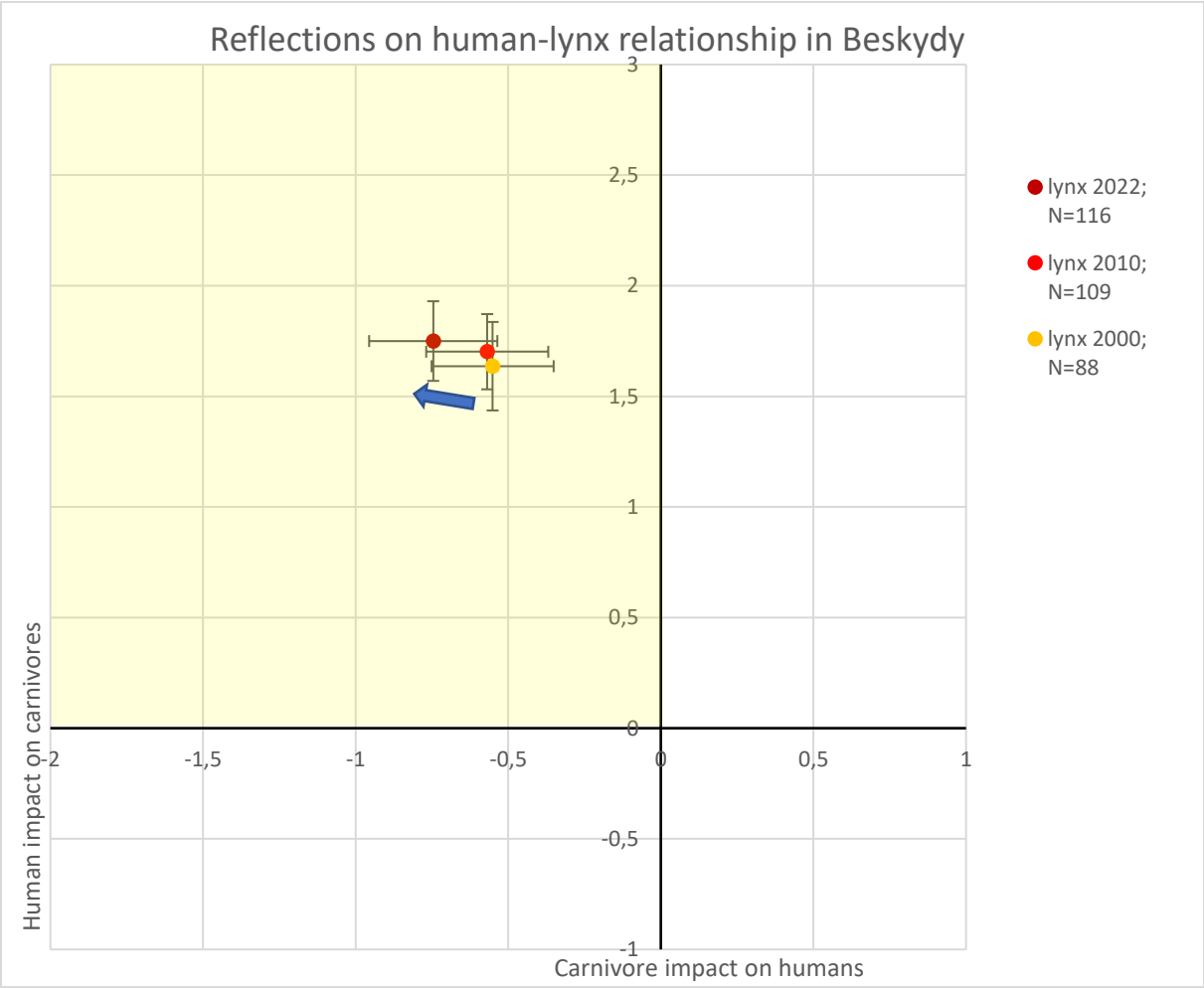


Figure 2

Zoom-in for the wolf.

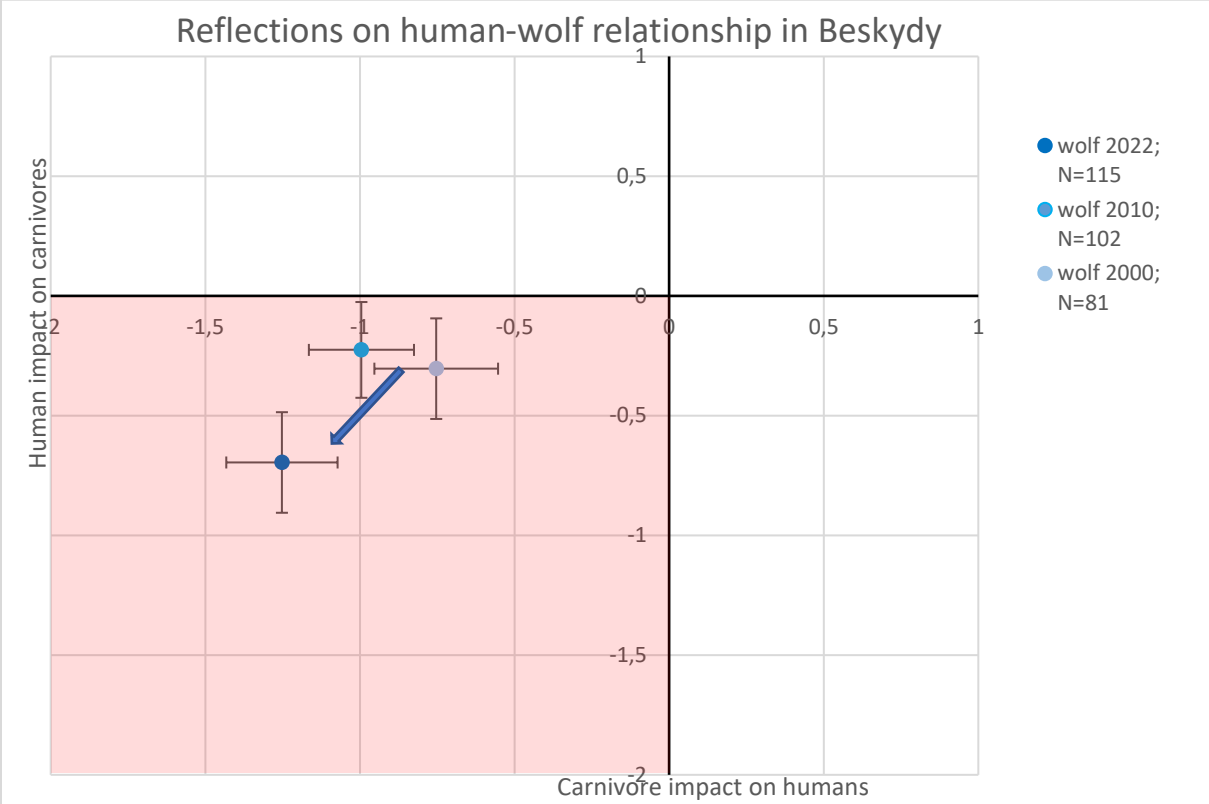
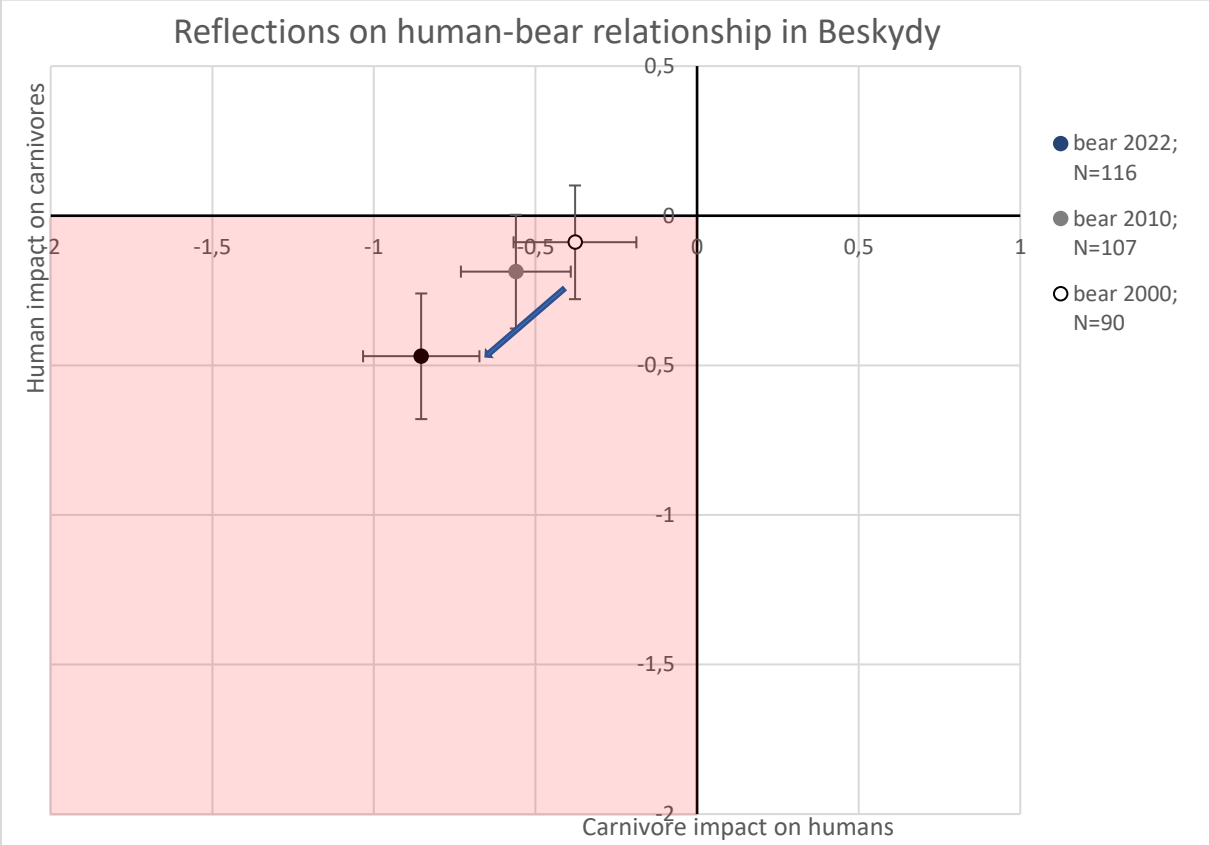


Figure 3

Zoom-in for the bear.



7.2 Carnivore impacts on humans

Figure 4

Lynx impact on humans.

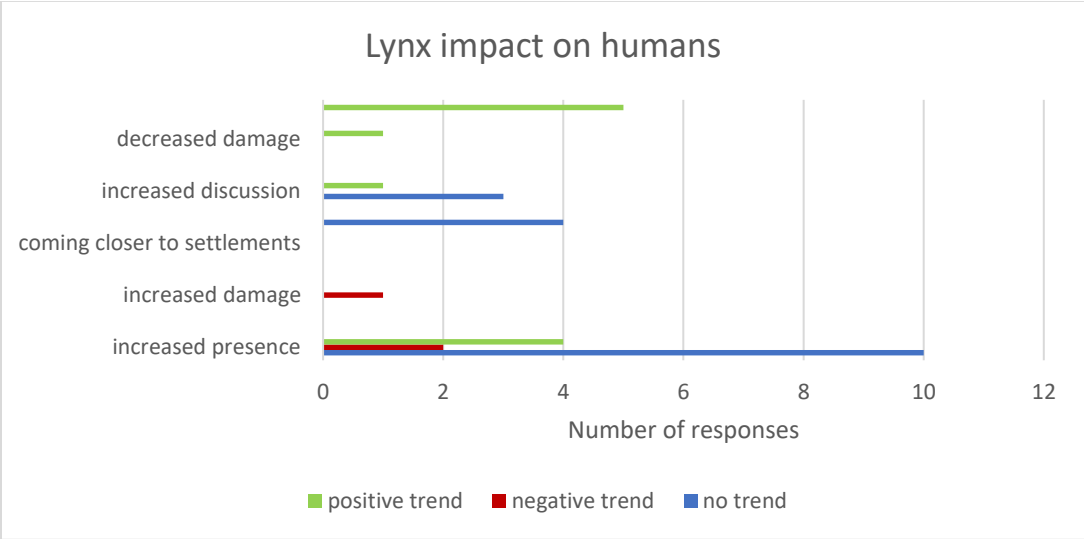


Figure 5

Wolf impact on humans.

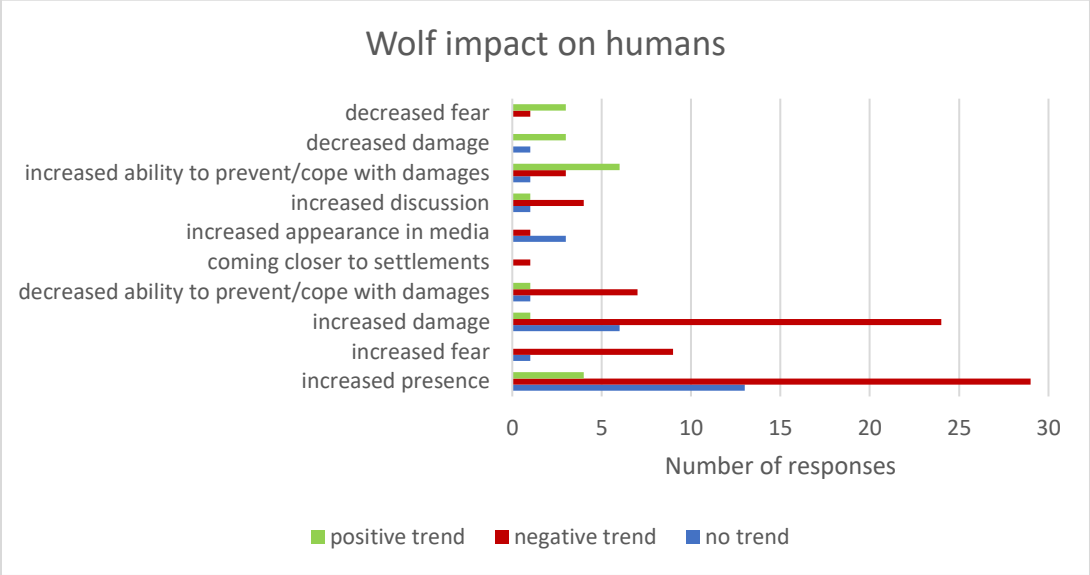
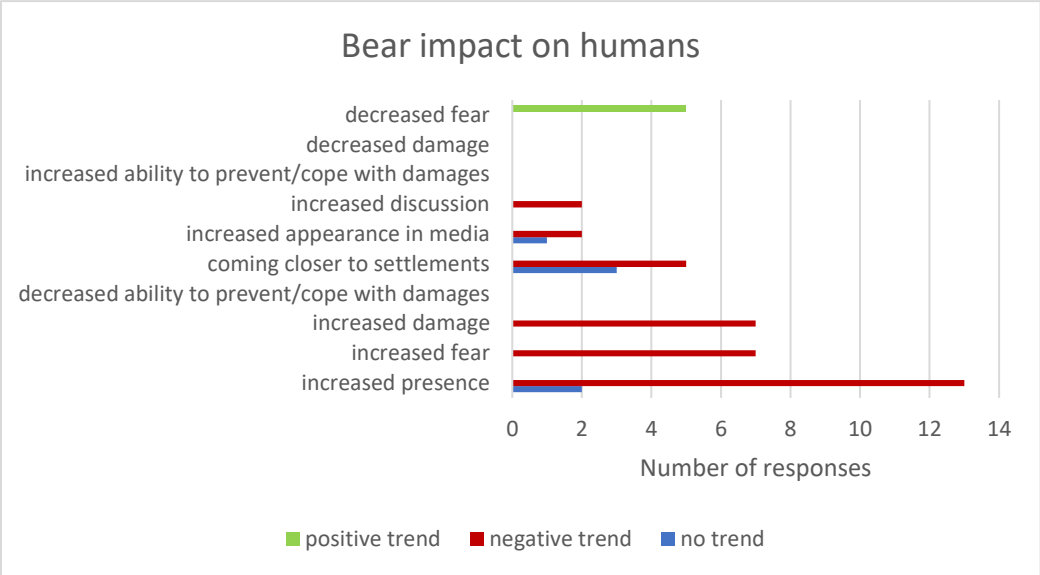


Figure 6

Bear impact on humans.



7.3 Human impact on carnivores

Figure 7

Human impact on lynx.

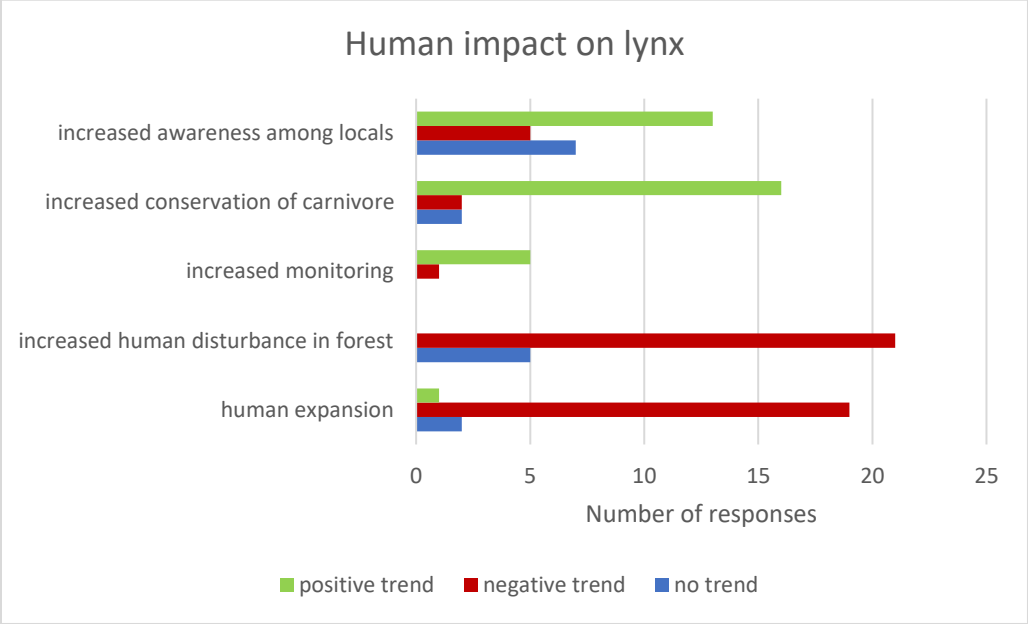


Figure 8

Human impact on wolf.

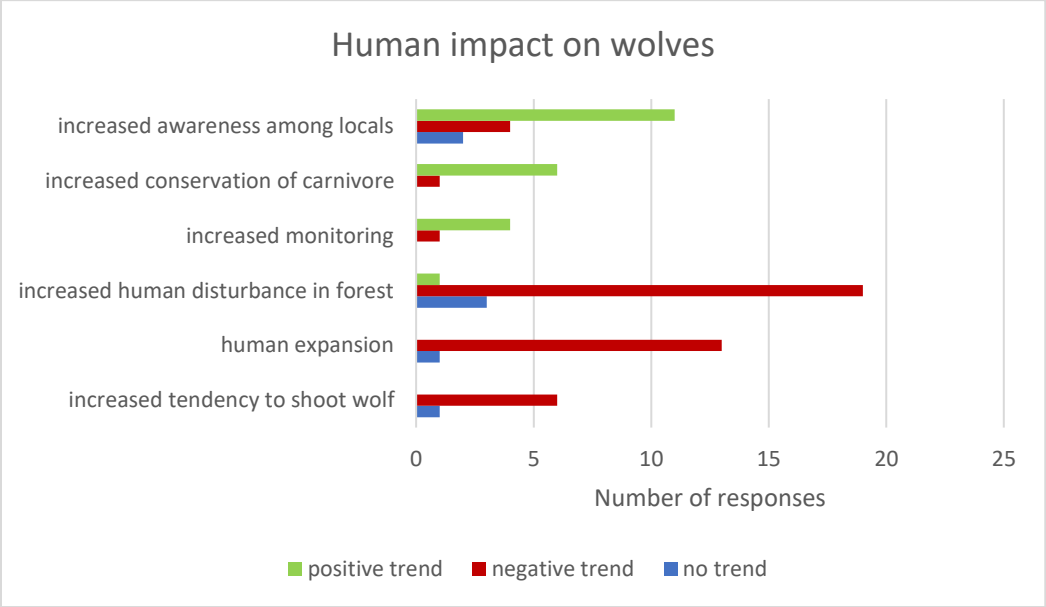
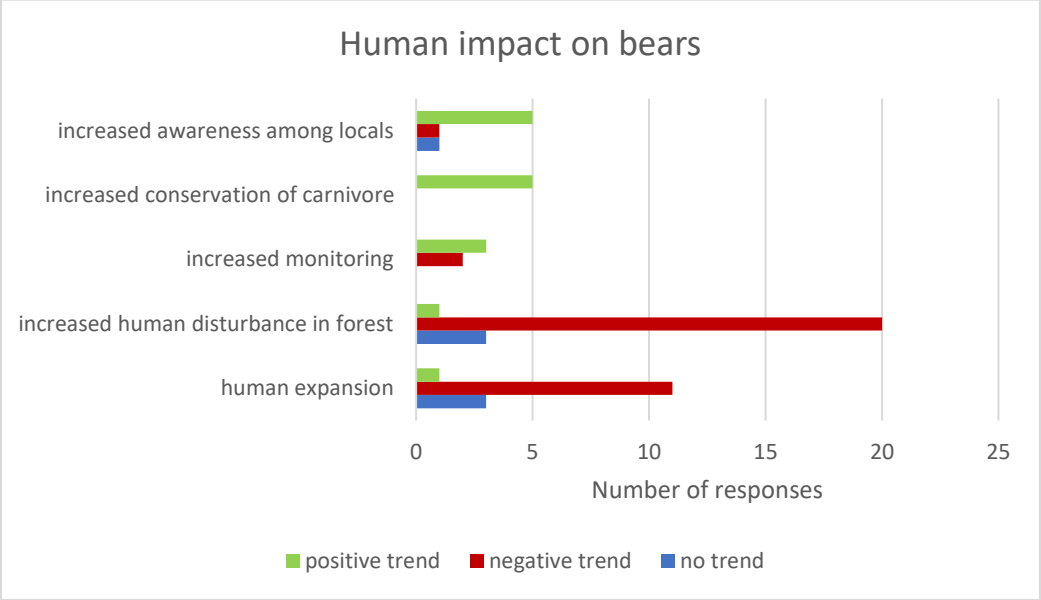


Figure 9

Human impact on bear.


Human impact on bears
increased awareness among locals
increased conservation of carnivore
increased monitoring
increased human disturbance in forest
human expansion
0
5
10
15
20
25
Number of responses
positive trend
negative trend
no trend