Factors Affecting Zoo Visitors’ Conservation Beliefs and Knowledge of Large Carnivores in 2009 and a Dozen Years Later

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Abstract: Teaching in a formal learning environment mainly focuses on gaining knowledge, and scarcely on the development of pro-environmental attitudes. Knowledge can also be gained in informal learning institutions, such as zoos, and their potential use in general public education should not be neglected. This paper explores factors influencing the conservation beliefs of zoo visitors about brown bears, grey wolves, and Eurasian lynx. The study undertaken in Zoo Ljubljana (Slovenia) consisted of surveys performed in 2009 (n = 613) and in 2021 (n = 257). The levels of knowledge and education influenced both supporting and opposing beliefs about the three large carnivore species. The gender factor was less uniform: both supporting and opposing beliefs about lynx were demonstrated, but only opposing beliefs about brown bear and wolf. The study indicates that knowledge has the most significant influence on conservation beliefs, thus highlighting the importance of educational and communication activities in management and conservation actions regarding large carnivore species. The varied gender influence suggests that species-specific educational activities should be encouraged.

Keywords: large carnivores; conservation beliefs; knowledge; zoo visitors

1. Introduction

Three legally protected species of large carnivores—brown bear (Ursus arctos L.), grey wolf (Canis lupus L.) and Eurasian lynx (Lynx lynx L.)—are broadly present in Slovenia [1–3]. The presence of these species leads to potential and even real human–wildlife conflicts. So, there are natural and human factors by which the species are endangered. The need to find ways and solutions for their conservation has been recognized as a priority [4] (p. 1). There are three approaches to be introduced into large carnivore wildlife management: the cognitive approach (education), the technological approach (fences, deterrent devices, hunting) and the structural approach (legislation) [5]. The cognitive approach is the only way to change human attitudes as predictors of potential or actual behavior toward wildlife conservation. Education is a lifelong process that is not confined to a formal educational system: many formal and informal institutions also contribute. Education is one of the most important factors for the formation of pro-environmental attitudes [6]. In conservation biology, it is recognized as an important part of the field [7]. Schools and informal learning environments such as zoos or natural history museums are crucial to informing the general public about the conservation of species and ecosystems [8].

The conservation and management of animals requires a basis of public policies, research, and scientific values [9]: wildlife management efforts that do not include public opinions are destined to be unsuccessful [10]. Frequently, management measures for large carnivores are poorly understood, and therefore unaccepted by the public, especially if the animals are recognized as a potential hazard to humans and domestic animals [11]. Individuals may formulate judgments about the acceptability of carnivore populations...
based on willingness to accept a hazard. Perception of hazard is largely a function of the perceived risks and perceived benefits associated with that hazard [11]. The subjective experience of an individual’s fear is primarily linked to the perceived danger or harm that the animal represents and the perceived uncontrollability of the person’s own response when encountering the animal [12,13].

Public attitudes and acceptance of animals, in particular carnivores, can strongly influence their conservation [14]: attitudes often change if animals are perceived to behave “problematically” [15]. Several articles investigating attitudes and knowledge in the general public in relation to large carnivores have been published [14,16–19] in the past decade. Perceptions of large carnivore species are based on species phylogeny in relation to humans, animal characteristics (such as aesthetic value), the perception of their intelligence, size, morphology, type of locomotion, potential dangerousness and damage to property, and even on cultural or historical background [20,21]. One of the findings was that large carnivores generate fear in humans mainly because of possible physical injuries [22].

Various factors may affect attitudes toward animals, among which are gender [23], culture, and even possession of pets [24,25]. Gender may be the most important factor, with females usually reporting greater fear than males [15,22]. This can be explained by the lesser physical ability of females to avoid attacks by predators [23]. On the other hand, such gender-based differences in attitude can also arise from religious beliefs [26]. Beside the mentioned factors, direct experience with animals was determined as a predictor of strength of positive attitude [10,27]—it was found that, generally, direct contact changes people’s attitudes in a positive direction [28]. For example, males and females differ in positive attitudes toward different species. Males are known to like wild indigenous species (e.g., squirrel (*Sciurus* sp.), deer (*Cervus elaphus*), fox (*Vulpes vulpes*)) and exotic animals (e.g., dolphin (*Cetacea*), tiger (*Panthera tigris*), lion (*Panthera leo*)), while females like pets (e.g., cat (*Felis catus*), dog (*Canis lupus familiaris*), horse (*Equus ferus caballus*)) [29]. Preferences toward species are influenced by evolution, genetics, and psychosocial and cultural factors [30].

Because large carnivores are relatively rare, attitudes are not formed from first-hand experience, but are usually a result of secondary and selected information, if not prejudices and stereotypes [31]. To plan and execute the most effective measures for large carnivore conservation, knowledge of public opinion toward these animals is needed. Public opinion can be influenced by the general public’s attitudes toward flagship (charismatic and popular) animal species and the experiences with them, and by the general acceptance of animals [15]. According to a previous study [9], knowledge of a species involves ecological and factual knowledge, or conservation awareness. For effective conservation and management actions, besides general public opinion, knowledge of species ecology and biology, as well as of socioeconomic and other factors, needs to be considered.

Before now, attitudes toward large carnivores have been analyzed among different groups, i.e., the general public [14,18,32–36], rural and urban residents [19,37], hunters [16,38], farmers and foresters [16], and students [16,31,39–43]. Recently, research has also arisen in a zoo setting [44–47]. However, more attention is usually paid to other (more charismatic) species, such as elephants [48], dolphins [49], gorillas and chimpanzees [50,51], reptiles and amphibians [52], and penguins [53,54].

Zoos, nature centers, museums and other similar institutions provide various educational programs classified as informal education. Since education is one of the main missions of modern zoos [55], they should not be regarded only as entertainment parks, research institutions, or ex situ keepers of rare species, but as educational institutions as well. Conservation goals in zoos are usually included in leisure activities, educational programs, and animal protection and research [56,57]. When comparing zoo education to formal education, the former promotes the education of the general public regardless of personal status and age, and fosters conservation awareness as part of lifelong education [55]. Formal education, on the other hand, is oriented mainly towards the younger population. Zoos are believed to have a positive impact on attitude development [58]. Visitors of zoos express more humanistic attitudes toward animal species than individuals who do not visit
zoos [6]. A more humanistic attitude refers to the formation of an emotional bond between humans and animals, although the connection between experiences of animals in a zoo and the attitudes that favor conservation is not as simple as it seems [45]. For example, viewing an animal in a zoo does not necessarily equate to pro-conservation action [59]. When people see animals at the zoo, different feelings and cognitions arise. Thus, it is important to find out whether these feelings and cognitions are linked with animal conservation [45].

Worldwide, around 700 million people visit zoos annually [60], providing an ample basis for conservation education [61]. People of different backgrounds, ages, education levels, and other characteristics can be invited into surveys to try to assess their pro-environmental knowledge, attitudes and actions [62]. However, not all people visit zoos primarily to learn [63]: recreation may be the main goal, even if they think education is important [64]. Nevertheless, education in zoos is intended to inform visitors about ecological concepts and animal–habitat relationships [65], so as to raise environmental awareness [66]. Support for the conservation of animal species and wildlife increases with exposure to experts providing well-structured information about, along with experiences of, wildlife [67].

Each year, more than 250,000 people visit the largest zoo in Slovenia, Ljubljana Zoo [62]. Besides regular self-guided visits by the public, a number of activities and events are offered, for example, guided tours, zoo adventures (hands-on activities), petting zoos, zookeeper-for-a-day activities, camping at the zoo, photo safaris and birthday parties. Furthermore, the zoo organizes guided tours and activities for schools and other educational institutions. Each year, more than 10% of visitors, ranging from kindergarten children to university students, are enrolled in guided activities, as part of organized out-of-school activities [62]. At the time of the study, the zoo housed around 120 species of vertebrates, among them the three large carnivore species brown bear, grey wolf and Eurasian lynx. At every animal enclosure, information boards present biological and conservation-related information about the species [62]. Since Ljubljana Zoo is rather small, it is anticipated that visitors will stop by the enclosures with large carnivore species [68].

This paper explores how different factors influence the attitudes of zoo visitors toward brown bear, grey wolf, and Eurasian lynx, and their acceptance thereof. The results of the study will be used in the preparation of more effective educational efforts at Ljubljana Zoo concerning large carnivore conservation. Hopefully, the study will also be informative for a broader audience, especially in the field of large carnivore management and conservation.

The Purpose of the Study

The present study used a questionnaire modified from previous research [19] to analyze the supporting and opposing beliefs of zoo visitors regarding the three large carnivore species (brown bear, grey wolf and Eurasian lynx). The authors of previous research analyzed the differences in conservation beliefs related to large carnivores between rural and urban residents. They found small differences between the two groups in arguments supporting conservation. On the other hand, the analysis of arguments that oppose the conservation of large carnivores showed greater differences between the two groups. Differences in opinions opposing conservation were also found in relation to different species of large carnivores (brown bear, wolverine, grey wolf and Eurasian lynx). In general, low levels of support for direct use values (e.g., ecotourism and hunting) were found.

Additionally, we used multiple choice questions to assess visitors’ knowledge about large carnivores. Via the modification and supplementation of arguments, the present study sought to find out:

- whether participants’ opposing or supporting beliefs differ for individual large carnivore species;
- whether age, gender, education level, yearly number of zoo visits, place of residence, knowledge and beliefs before and after the visit, and the year of study affect the opposing/supporting beliefs of zoo visitors in relation to a selection of carnivore species;
• whether this varies between species;
• whether there are correlations between visitors’ opposing/supporting beliefs and their knowledge.

2. Materials and Methods

2.1. Study Design and Participant Information

The present study investigates differences in zoo visitors’ knowledge and conservation beliefs about large carnivores. It was performed as a repeated cross-sectional study [69]. Data were collected during four consecutive weekends in April and May 2009. The interviews were conducted near the entrance to the zoo. To assess the differences in knowledge and beliefs, participants were invited either when entering or exiting the zoo. Daily alternations between interviewing outgoing and incoming visitors were performed to homogenize the study sample. A total of 640 zoo visitors participated in the first part of the study. From this sample, 17 surveys were excluded as incomplete. In addition, 10 surveys were excluded as participants were not residents of Slovenia. The final size of the sample included in the statistical analysis was 613. The second run was performed twelve years later, in June 2021. Due to COVID-19 restrictions, the survey could only be performed during one weekend. The second sample consisted of 257 participants. Altogether, 870 respondents were included in the present study (Table 1).

Table 1. Sample structure by independent variables (gender, education level, frequency of visits and delivery of the questionnaire).

| Variable                        | N   | N (%) |
|---------------------------------|-----|-------|
|                                |     |       |
| Gender                         |     |       |
| male                           | 341 | 39.2  |
| female                         | 526 | 60.5  |
| not specified                  | 3   | 0.3   |
| Education level                |     |       |
| primary school                 | 59  | 6.8   |
| high school                    | 377 | 43.3  |
| university                     | 430 | 49.4  |
| missing                         | 4   | 0.5   |
| Frequency of visits            |     |       |
| every two months               | 161 | 18.5  |
| twice a year                   | 190 | 21.8  |
| once per year                  | 452 | 52.8  |
| less than once per year        | 265 | 30.5  |
| missing                         | 9   | 1.0   |
| Questionnaire delivery—visit   |     |       |
| before the visit               | 303 | 34.8  |
| after the visit                | 567 | 65.2  |
| Questionnaire delivery—year    |     |       |
| 2009                            | 613 | 70.5  |
| 2021                            | 257 | 29.5  |

Note: N = 870.

2.2. Questionnaire

The questionnaire consisted of three parts (Appendix A). The first part included questions about the respondent’s socio-demographics: age, gender, education level, and the yearly number of zoo visits. The second part of the questionnaire consisted of seven multiple choice questions about large carnivores. Two general questions were about the protection of large carnivores ("All large carnivores are protected by law—Yes/No/Not sure") and compensations for damages inflicted by animals ("Damages that are caused by large
carnivores are covered by the state—Yes/No/Not sure”). Two questions asked participants about the lynx: “Lynx live in (a) pairs, (b) solitary, (c) groups, (d) not sure” and “Lynx became extinct in the near past but was reintroduced—Yes/No/Not sure”. One question was about bears: “Bears eat mainly (a) food of animal origin, (b) food of plant origin, (c) equal amounts of food that is of plant and animal origin, (d) not sure”. Two questions were about wolves: “How much does an adult wolf male weight? (a) 10–20 kg, (b) 21–40 kg, (c) 41–60 kg, (d) more than 60 kg, (e) not sure”, and “How big are wolf packs in Slovenia? (a) 1–10, (b) 11–20, (d) more than 30 individuals, (e) not sure”. Only one option was correct and was graded as one point for every question.

For statistical analysis, we used summed scores. The “not sure” option was introduced for each question to minimize participants’ guessing. The third part of the questionnaire was constructed after a previous study [19], wherein the authors used statements linked with supporting and opposing conservation beliefs for four large carnivore species found in Sweden. The respondents in their study were asked to only state whether the arguments were valid or not, and not to state the strength of the arguments. The 12 statements used in this study were based on a 5-point Likert-type scale (1—strongly disagree, to 5—strongly agree). Consequently, data analysis was also different. All respondents were asked to report their supporting and opposing conservation beliefs in relation to all three large carnivore species.

The attitudinal items consisted of positive (e.g., “As a society, we have a shared responsibility to protect these animals.”) and negative statements (e.g., “These animals could have a serious negative impact on the livestock breeding.”). Negative wording was used to reduce response bias (e.g., “There is no need for conservation in Slovenia because there are populations in other countries.”). However, some authors have argued that second source variances can influence the unidimensionality of the test: they stress the importance of well-structured wording given the different linguistic skills of the respondents, e.g., [70]. The questionnaire consisted of unambiguous, concise sentences, which several experts had previously checked. These attitudinal items are comparable to those in other questionnaires used in similar surveys [31,42,43].

2.3. Data Analysis
First, a panel of experts from the zoo and the university reviewed the content of the questionnaire. Data analysis was undertaken using SPSS 25.0 software (SPSS, IBM, Germany, Ehningen). For each species, the participant belief ratings were first subjected to principal component analysis (PCA) with Direct Oblimin rotation (Table 2). According to Oblimin rotation, The Kaiser–Meyer–Olkin (KMO) measures of sampling adequacy (KMObear = 0.84, KMOWolf = 0.85 and KMOlynx = 0.84) and the Bartlett’s values for sphericity (bear: $\chi^2 = 1866.8, df = 66, p < 0.001$; wolf: $\chi^2 = 1934.6, df = 66, p < 0.001$; lynx: $\chi^2 = 1929.7, df = 66, p < 0.001$) suggest that the analysis was appropriate for these data sets [71]. An eigenvalue above 1.0 and loadings of at least 0.40 were used for a final solution. In order to test the reliability of the extracted PCs, Cronbach’s $\alpha$ coefficients were calculated; the values were all above 0.7, showing that the internal consistency of the components is reliable [71].

The results of the analysis are presented in Table 2. Eleven out of twelve statements were categorized in a similar way for every animal species, with seven of them opposing conservation (PC 1) and four supporting conservation (PC 2). The item “It is hard to predict the effects of their extermination.” did not load to any of the principal components, and was therefore eliminated from further analysis. The two components explained 42.3% of the total variance for bears, 42.7% for wolves, and 42.8% for lynx.

For each extracted principal component, means and standard deviations were calculated (see Table 2), on which a series of GLM univariate and multivariate tests were applied. The effects of the independent variables of individual species on the ratings of supporting and opposing beliefs were assessed with univariate tests. Multivariate tests were conducted to find the effects of independent variables on supporting and opposing beliefs jointly for all three species. Gender, education level, frequency of visits and survey delivery by year
and pre/post-visit were treated as fixed factors, while age and knowledge were treated as covariates in the multi- and univariate statistics. Partial eta-squared was used as a measure of effect size, where 0.01 was considered small, 0.04 moderate, and 0.1 large [72].

Table 2. Factor analyses of attitude statements for individual large carnivore species.

| ITEM                                                                 | Principal Component 1 (PC 1) | Principal Component 2 (PC 2) |
|----------------------------------------------------------------------|------------------------------|------------------------------|
|                                                                     | Lynx            | Wolf           | Bear           | Lynx            | Wolf           | Bear           |
| These animals compete with hunters over game such as deer and roe deer. (R) | 0.662           | 0.646          | 0.672          |                 |                 |                 |
| These animals may have serious negative impact on deer and roe deer numbers. (R) | 0.633           | 0.630          | 0.617          |                 |                 |                 |
| They may have serious negative impact on livestock farming. (R)       | 0.677           | 0.634          | 0.647          |                 |                 |                 |
| Costs of compensation, research and monitoring are too high. (R)      | 0.658           | 0.666          | 0.641          |                 |                 |                 |
| There is a high risk of human injuries. (R)                          | 0.578           | 0.540          | 0.584          |                 |                 |                 |
| We may use these animals as a valuable game species. (R)              | 0.589           | 0.598          | 0.548          |                 |                 |                 |
| There is no need for conservation in Slovenia because there are populations in other countries. (R) | 0.511           | 0.501          | 0.470          |                 |                 |                 |
| We need to preserve these animals for future generations.            |                 | 0.762          | 0.783          | 0.759          |                 |                 |
| We should share the responsibility for conserving these animals.      |                 | 0.663          | 0.688          | 0.674          |                 |                 |
| I want them to exist in Slovenia, even though I may never see any of them in the wild. |                 | 0.690          | 0.699          | 0.705          |                 |                 |
| These animals can have positive impact on balance of organisms.       |                 | 0.700          | 0.722          | 0.699          |                 |                 |
| Cronbach alpha                                                       | 0.748           | 0.734          | 0.736          | 0.726           | 0.749          | 0.733          |
| Explained variance                                                   | 3.51            | 3.50           | 3.46           | 1.63            | 1.63           | 1.62           |
| M                                                                    | 3.68            | 3.56           | 3.55           | 4.43            | 4.41           | 4.41           |
| SD                                                                   | 0.776           | 0.768          | 0.751          | 0.627           | 0.642          | 0.640          |

It is hard to predict the effects of extermination (did not fit in any principal component).

Note: (R)—reversed items.

For variables that produced a statistically significant effect on participants’ belief ratings, as assessed through GLMs, descriptive (means and standard deviations) and inferential (Mann–Whitney and Kruskal–Wallis test) statistics were applied. Bonferroni-corrected post-hoc Mann–Whitney tests were used to determine differences, following the Kruskal–Wallis test.

For knowledge, the total score was used to calculate the partial correlations with beliefs. Partial correlations for gender, education level, frequency of visits and survey delivery (comparison between years and pre–post-visit) were extracted.

3. Results

The first part presents the results of multivariate and univariate tests. In the second part, the following correlations are given: (a) supporting beliefs between individual species, (b) opposing beliefs between individual species, (c) between supporting and opposing beliefs for individual species, (d) between supporting beliefs and knowledge for each species, and (e) between opposing beliefs and knowledge for each species. The third part of the results shows participant ratings according to the individual independent variable that produced the highest effects in the multivariate and univariate statistics.
3.1. The Results of Multivariate Statistics

In Table 3, the results of multivariate statistical analysis of supporting beliefs for all three species are presented. The main factors affecting beliefs are knowledge and gender, whereby the size of the effects is measured by partial eta-squared. It shows that knowledge has a moderate effect, while gender has a small effect on participants’ beliefs.

Table 3. General Linear Model (GLM) analysis of the effects of independent variables on supporting beliefs (PC 2) for all three large carnivore species.

| Effect               | Wilks’ Λ | F         | Hypothesis df | Error df | p       | Partial η² |
|----------------------|----------|-----------|---------------|----------|---------|------------|
| Knowledge            | 0.945    | 14.931    | 3             | 769.0    | <0.001  | 0.055      |
| Gender               | 0.977    | 6.084     | 3             | 769.0    | <0.001  | 0.023      |
| Education level      | 0.987    | 1.621     | 6             | 1538.0   | 0.137   | 0.006      |
| Age                  | 0.993    | 1.679     | 3             | 769.0    | 0.170   | 0.007      |
| Survey delivery—visit| 0.997    | 0.892     | 3             | 769.0    | 0.445   | 0.003      |
| Survey delivery—year | 0.998    | 0.410     | 3             | 769.0    | 0.746   | 0.002      |
| Freq. of visits      | 0.984    | 1.406     | 9             | 1871.7   | 0.180   | 0.005      |

On the other hand, the results of multivariate test on opposing beliefs for all three species (Table 4) show the significant influence of knowledge, gender and education level. Again, knowledge has a moderate, but the strongest, effect on participants’ beliefs.

Table 4. General Linear Model (GLM) analysis of the effects of independent variables on opposing beliefs (PC 1) for all three large carnivore species.

| Effect               | Wilks’ Λ | F         | Hypothesis df | Error df | p       | Partial η² |
|----------------------|----------|-----------|---------------|----------|---------|------------|
| Knowledge            | 0.941    | 15.931    | 3             | 769.0    | <0.001  | 0.059      |
| Gender               | 0.985    | 3.965     | 3             | 769.0    | 0.008   | 0.015      |
| Education level      | 0.969    | 4.011     | 6             | 1538.0   | 0.001   | 0.015      |
| Freq. of visits      | 0.988    | 1.059     | 9             | 1871.7   | 0.390   | 0.004      |
| Survey delivery—visit| 0.995    | 1.186     | 3             | 769.0    | 0.314   | 0.005      |
| Survey delivery—year | 0.998    | 0.421     | 3             | 769.0    | 0.738   | 0.002      |
| Age                  | 0.996    | 1.010     | 3             | 769.0    | 0.388   | 0.004      |

3.2. The Results of Univariate Statistics

When we analyzed the data for individual species, we found that, for all three species, supporting beliefs (PC 2) are influenced by knowledge and education level (Table 5). Respondents’ ratings were influenced by gender only for lynx, but strongly enough to produce significant effects in the multivariate statistics (Table 3). Still, the highest effect on supporting beliefs can be attributed to the knowledge of participants, which was evaluated as moderate.

Table 5. GLM univariate analysis of the effects of independent variables on supporting beliefs (PC 2) for individual species.

| Source               | Type III Sum of Squares | df | Mean Square | F       | p       | Partial η² |
|----------------------|-------------------------|----|-------------|---------|---------|------------|
| BEAR                 |                         |    |             |         |         |            |
| Knowledge            | 13.630                  | 1  | 13.630      | 36.512  | <0.001  | 0.045      |
| Education level      | 3.343                   | 2  | 1.672       | 4.478   | 0.012   | 0.011      |
| Gender               | 0.414                   | 1  | 0.414       | 1.108   | 0.293   | 0.001      |
| Survey delivery—visit| 0.086                   | 1  | 0.086       | 0.229   | 0.632   | 0.000      |
| Survey delivery—year | 0.111                   | 1  | 0.111       | 0.297   | 0.586   | 0.000      |
| Age                  | 0.108                   | 1  | 0.108       | 0.289   | 0.591   | 0.000      |
| Freq. of visits      | 0.592                   | 3  | 0.197       | 0.528   | 0.663   | 0.002      |
Opposing beliefs (PC 1) are, in the same way as supporting beliefs, influenced by knowledge, education level (Table 6) and also gender. The highest effect on opposing beliefs can be attributed to the knowledge of participants, similarly to supporting beliefs (Table 5).

### Table 5. Cont.

| Source                      | Type III Sum of Squares | df | Mean Square | F    | p      | Partial $\eta^2$ |
|-----------------------------|-------------------------|----|-------------|------|--------|-----------------|
| **WOLF**                    |                         |    |             |      |        |                 |
| Knowledge                   | 13.728                  | 1  | 13.728      | 36.735 | <0.001 | 0.045           |
| Education level             | 3.372                   | 2  | 1.686       | 4.511 | 0.011  | 0.012           |
| Gender                      | 0.663                   | 1  | 0.663       | 1.773 | 0.183  | 0.002           |
| Age                         | 0.515                   | 1  | 0.515       | 1.378 | 0.241  | 0.002           |
| Survey delivery—visit       | 0.169                   | 1  | 0.169       | 0.452 | 0.502  | 0.001           |
| Survey delivery—year        | 0.097                   | 1  | 0.097       | 0.259 | 0.611  | 0.000           |
| Freq. of visits             | 0.515                   | 3  | 0.172       | 0.459 | 0.711  | 0.002           |
| **LYNX**                    |                         |    |             |      |        |                 |
| Knowledge                   | 15.422                  | 1  | 15.422      | 44.361 | <0.001 | 0.054           |
| Gender                      | 2.373                   | 1  | 2.373       | 6.826 | 0.009  | 0.009           |
| Education level             | 3.297                   | 2  | 1.649       | 4.743 | 0.009  | 0.012           |
| Age                         | 0.603                   | 1  | 0.603       | 1.733 | 0.188  | 0.002           |
| Freq. of visits             | 0.900                   | 3  | 0.300       | 0.863 | 0.460  | 0.003           |
| Survey delivery—visit       | 0.419                   | 1  | 0.419       | 1.206 | 0.272  | 0.002           |
| Survey delivery—year        | 0.008                   | 1  | 0.008       | 0.023 | 0.881  | 0.000           |

### Table 6. GLM univariate analysis of the effects of independent variables on opposing beliefs (PC 1) for individual species.

| Source                      | Type III Sum of Squares | df | Mean Square | F    | p      | Partial $\eta^2$ |
|-----------------------------|-------------------------|----|-------------|------|--------|-----------------|
| **BEAR**                    |                         |    |             |      |        |                 |
| Knowledge                   | 17.392                  | 1  | 17.392      | 35.454 | <0.001 | 0.044           |
| Education level             | 5.644                   | 2  | 2.822       | 5.753 | 0.003  | 0.015           |
| Gender                      | 3.997                   | 1  | 3.997       | 8.148 | 0.004  | 0.010           |
| Freq. of visits             | 1.860                   | 3  | 0.620       | 1.264 | 0.286  | 0.005           |
| Survey delivery—visit       | 1.310                   | 1  | 1.310       | 2.671 | 0.103  | 0.003           |
| Survey delivery—year        | 0.357                   | 1  | 0.357       | 0.728 | 0.394  | 0.001           |
| Age                         | 0.040                   | 1  | 0.040       | 0.082 | 0.775  | 0.000           |
| **WOLF**                    |                         |    |             |      |        |                 |
| Knowledge                   | 16.292                  | 1  | 16.292      | 31.977 | <0.001 | 0.040           |
| Education level             | 5.949                   | 2  | 2.974       | 5.838 | 0.003  | 0.015           |
| Gender                      | 2.734                   | 1  | 2.734       | 5.367 | 0.021  | 0.007           |
| Survey delivery—visit       | 1.634                   | 1  | 1.634       | 3.206 | 0.074  | 0.004           |
| Survey delivery—year        | 0.555                   | 1  | 0.555       | 1.090 | 0.297  | 0.001           |
| Age                         | 0.296                   | 1  | 0.296       | 0.581 | 0.446  | 0.001           |
| Freq. of visits             | 1.267                   | 3  | 0.422       | 0.829 | 0.478  | 0.003           |
| **LYNX**                    |                         |    |             |      |        |                 |
| Knowledge                   | 22.042                  | 1  | 22.042      | 44.167 | <0.001 | 0.054           |
| Education level             | 8.838                   | 2  | 4.419       | 8.855 | <0.001 | 0.022           |
| Gender                      | 3.998                   | 1  | 3.998       | 8.011 | 0.005  | 0.010           |
| Freq. of visits             | 2.271                   | 3  | 0.757       | 1.517 | 0.209  | 0.006           |
| Survey delivery—visit       | 1.039                   | 1  | 1.039       | 2.081 | 0.130  | 0.003           |
| Survey delivery—year        | 0.487                   | 1  | 0.487       | 0.977 | 0.323  | 0.001           |
| Age                         | 0.055                   | 1  | 0.055       | 0.110 | 0.740  | 0.000           |
3.3. Correlations between Beliefs and Knowledge

When controlled for the effect of gender, education level, reported number of visits to the zoo and survey delivery, strong correlations emerged between supporting ratings and between opposing ratings for all species (Table 7). Low and negative correlations were found between supporting and opposing dimensions for each species: the respondents agreed with supporting statements when they agreed less with opposing statements. Still lower correlations were found between knowledge scores and supporting/opposing belief ratings for individual species.

Table 7. Partial correlations between visitors’ beliefs and knowledge.

| Partial Correlations                        | Correlation Value |
|--------------------------------------------|-------------------|
| Wolf vs. lynx supporting beliefs           | 0.936             |
| Wolf vs. bear supporting beliefs           | 0.943             |
| Lynx vs. bear supporting beliefs           | 0.904             |
| Wolf vs. lynx opposing beliefs             | 0.932             |
| Wolf vs. bear opposing beliefs             | 0.948             |
| Lynx vs. bear opposing beliefs             | 0.904             |
| Lynx supporting vs. opposing beliefs       | −0.340            |
| Wolf supporting vs. opposing beliefs       | −0.345            |
| Bear supporting vs. opposing beliefs       | −0.353            |
| Lynx supporting beliefs vs. knowledge      | 0.237             |
| Wolf supporting beliefs vs. knowledge      | 0.217             |
| Bear supporting beliefs vs. knowledge      | 0.211             |
| Lynx opposing beliefs vs. knowledge        | −0.231            |
| Wolf opposing beliefs vs. knowledge        | −0.202            |
| Bear opposing beliefs vs. knowledge        | −0.202            |

Note—all p < 0.001; control variables: gender, education level, freq. of visits and survey delivery; supporting belief (PC 2); opposing belief (PC 1).

3.4. Differences in Participants’ Belief Ratings and Knowledge Scores According to Independent Variables

In general, the mean scores of supportive statements were high: for all three species, they were between 4.41 and 4.43 on the 5-point scale. The mean scores for opposing belief ranged between 3.54 and 3.68 on the same scale. Independent variables that did not show significant effects in the multivariate and univariate statistics were excluded from this section. Only gender and education level effects are described (Tables 8 and 9).

Table 8. Effect of gender on ratings of belief statements and knowledge score.

| Belief/Knowledge | Female | Male | Mann–Whitney U |
|------------------|--------|------|----------------|
|                  | M      | SD   | M   | SD   | Z   | p   |
| Lynx—sup        | 4.39   | 0.64 | 4.48| 0.60 | −2.037 | 0.042 |
| Wolf—sup        | 4.39   | 0.64 | 4.44| 0.65 | −1.406 | 0.160 |
| Bear—sup        | 4.40   | 0.63 | 4.43| 0.66 | −0.990 | 0.322 |
| Lynx—opp        | 3.59   | 0.78 | 3.82| 0.75 | −4.424 | <0.001 |
| Wolf—opp        | 3.49   | 0.77 | 3.67| 0.75 | −3.650 | <0.001 |
| Bear—opp        | 3.47   | 0.75 | 3.65| 0.74 | −3.646 | <0.001 |
| Knowledge       | 3.46   | 1.54 | 4.08| 1.43 | −5.873 | <0.001 |

Note: M = mean; SD = standard deviation; sup = supporting belief (PC 2); opp = opposing belief (PC 1); lower values in PC 1 indicate more opposing belief.
Table 9. Effect of education level on ratings of belief statements and knowledge score.

| Belief/Knowledge | Primary School or Less | High School | University or More | Kruskal–Wallis χ² | df | p | Post-hoc Bonferroni-Corrected p-Values |
|------------------|------------------------|-------------|--------------------|-------------------|----|---|-------------------------------------|
| Lynx—sup         | 4.11 0.64              | 4.38 0.66   | 4.52 0.55          | 26.627            | 2  | <0.001 | 0.001 | <0.001 | 0.019 |
| Wolf—sup         | 4.09 0.56              | 4.36 0.69   | 4.50 0.57          | 30.584            | 2  | <0.001 | <0.001 | <0.001 | 0.018 |
| Bear—sup         | 4.10 0.59              | 4.37 0.69   | 4.50 0.56          | 28.333            | 2  | <0.001 | 0.001 | <0.001 | 0.023 |
| Lynx—opp         | 3.20 0.85              | 3.57 0.79   | 3.84 0.71          | 43.958            | 2  | <0.001 | 0.006 | <0.001 | <0.001 |
| Wolf—opp         | 3.09 0.80              | 3.46 0.77   | 3.71 0.73          | 41.289            | 2  | <0.001 | 0.005 | <0.001 | <0.001 |
| Bear—opp         | 3.12 0.82              | 3.45 0.75   | 3.68 0.71          | 38.764            | 2  | <0.001 | 0.011 | <0.001 | <0.001 |
| Knowledge        | 3.02 1.56              | 3.66 1.49   | 3.83 1.52          | 12.185            | 2  | 0.002  | 0.026 | 0.002  | 0.396 |

Note—M = mean; SD = standard deviation; sup = supporting belief (PC 2); opp = opposing belief (PC 1); Bonferroni-corrected post-hoc Mann–Whitney tests’ p-values: P/H—primary school or less vs. high school, P/U—primary school or less vs. university or more, and H/U—high school vs. university or more; lower values in PC 1 indicate more opposing belief.

3.4.1. Effect of Gender on Belief Statements and Knowledge Score

We found statistically significant differences in participants’ ratings of opposing beliefs for all species (Table 8: females agreed less than males with statements that oppose large carnivore conservation than males). As for supporting beliefs, males supported lynx conservation more than females. Yet the difference, although statistically significant, was small. Male participants also scored higher in knowledge than females.

3.4.2. Effect of Education Level on Belief Statements and Knowledge Score

Participants who are formally educated to a higher level display greater support for and less opposition to conservation of large carnivores (Kruskal–Wallis: all p < 0.001) (Table 9). On the other hand, we found smaller, but still statistically significant, differences in participants’ knowledge according to education level (Kruskal–Wallis: p = 0.002). Post-hoc comparisons revealed the significant differences between primary school- vs. high school-level educated participants and primary school- vs. university-level educated participants. High school- and university-level educated participants did not significantly differ in knowledge.

4. Discussion

Our results show that the greatest impact on supporting and opposing beliefs related to all three large carnivore species can be attributed to knowledge and education level. Gender is also recognized to play a role in participants’ ratings. All other independent variables produced no significant effects on participants’ ratings.

4.1. The Effect of Knowledge on Conservation Beliefs

Knowledge has been identified as an important factor in the process of the formation of attitudes toward conservation action [9], although some authors have argued that the attitudes are probably predisposed [73]. Knowledge has been recognized as one of the most important factors among children, with attitudes just developing [74]. Beside theoretical knowledge, direct experiences with animals are, or can be, an effective precursor in forming positive attitudes towards animals [27]. In the case of large carnivores, direct experiences of animals in nature are rare. Therefore, seeing species in a zoo setting can also be effective in forming positive attitudes [24]. Among all factors taken into account in the present study, knowledge had the greatest impact on both supporting and opposing conservation beliefs regarding large carnivores. Knowledge induced the formation of conservation-supporting beliefs for all three large carnivore species, but, even more importantly, it reduced the formation of conservation-opposing beliefs. People with less knowledge about the species expressed opposing beliefs more often than more knowledgeable people. The results suggest that teaching biological facts about large carnivores can improve overall public
support for large carnivore conservation, most likely through demystifying the species and also through reducing fear.

Leisure time activities, such as zoo visits involving connection with animals, correlate with more knowledge of those animal species [75]. Human perceptions of animals depend not only on the amount of knowledge (factual knowledge), but also on its type (e.g., factual, conceptual or procedural) [76]. Therefore, it has been concluded that human perception correlates with the type of knowledge transfer (e.g., egocentric or anthropocentric) [77]. While attitudes are formed at a very young age, education plays an important role in the perception of animals and nature in general persisting into adulthood [78].

4.2. The Effect of Gender on Conservation Beliefs and Knowledge

The influence of gender was found to be less uniform. Gender had an impact on belief ratings, but this was smaller than the impact of knowledge. Namely, it was found that gender had more influence on the opposing than supporting beliefs; it affected respondents’ ratings of supporting and opposing beliefs related to lynx, and also opposing beliefs related to bears and wolves. Females displayed more opposition to all three large carnivore species’ conservation than males. The results are in line with previous research that also reported gender differences in attitudes, where females expressed greater fear of large carnivores than males [13,23]. Consequently, gender was proposed as one of the most predictive factors in attitude formation [15]. The reason for the small but statistically significant difference in supportive beliefs between males and females in relation to lynx should be further explored.

Furthermore, males in the present study achieved higher knowledge scores than females, and reported less conservation-opposing beliefs. Other studies also showed that more knowledge about the species was not necessarily related to more positive attitudes in females [39]. Attitudes towards animals and knowledge about them are closely related to the amount of fear one experiences—they depend on individuals’ perceptions of potential dangerousness [24,41,74]. Consequently, environmental knowledge was set as an important factor to be controlled [28].

The present study’s results suggest that gender-specific educational strategies should also be considered.

4.3. The Effect of Education Level on Conservation Beliefs and Knowledge

Education level influenced supporting and opposing beliefs related to all three species. In other studies [41,75], it was found that a higher education level correlated with more positive attitudes towards animals. In the present study, the results show that a higher education level induced the formation of less opposing beliefs, representing the main concern of conservation actions.

Although the respondents’ degree of knowledge was significantly affected by education level, there was no difference between high school- and university-level participants. Significant differences in knowledge were found in comparison with the primary school educated group. In other research [41], a correlation between respondents’ knowledge and type of education institution was found. If, as shown in the present study, knowledge does not necessarily correlate with education level, then education in formal institutions does not address the topic sufficiently. As already proposed for primary school teachers, higher-level educators should engage students in activities that promote close contact with living organisms [29]. Again, this emphasizes the great educational potential of zoos as an informal learning environment, supplementing the instructions carried out in formal learning institutions. As promoters of species conservation, zoos have a great opportunity, and also responsibility, to provide quality information and experiences for the visitors. As already pointed out, the mission of zoos is not just to provide information, but they must aim to form positive attitudes toward nature among the visitors as well [47], using large carnivores as ambassador species of biodiversity conservation [79].
5. Conclusions

This study indicates that knowledge is an important factor that significantly shapes the attitudes of visitors towards all three large carnivore species.

The authors of the baseline study proposed separate designs of conservation and management plans for different species of large carnivores, following the differences in participants’ ratings of individual species [19]. However, in contrast to our study, theirs was conducted on the general public. Because in our case, the differences in participants’ conservation belief ratings between individual species were almost non-existent, we can conclude that zoo conservation education needs to focus more on females and visitors of lower education levels than on individual species.

Visiting a zoo without engaging in any guided educational activities does not change attitudes and beliefs regarding large carnivores. At our zoo, casual visitors can learn about the biology of large carnivores, mainly from information tables. Information about human–animal conflicts and their management is usually gained only through guided tours or workshops.

In the present study, only casual visitors participated. In order to obtain data on the efficiency of pedagogical activities, participants from guided tours and workshops should be included in future research. Since previous studies also stressed the effectiveness of educational activities in zoos [52] and other out-of-school settings [43], the evaluation of such educational activities regarding large carnivores is encouraged.

By determining the factors influencing an individual’s knowledge about large carnivores and beliefs about their conservation, the results of this study contribute to existing knowledge, as they serve as a theoretical basis for planning educational activities in conservation biology.

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Appendix A

QUESTIONNAIRE ON ATTITUDE TO AND KNOWLEDGE OF THE LARGE CARNIVORE ISSUES

Dear visitors of the Ljubljana Zoo. We ask you to take part in an anonymous survey, which assess the attitudes towards and knowledge of the issues regarding large carnivores. Your cooperation will help to improve pedagogical work and will influence the development and improvement of our nature conservation activities.

I. For the purposes of statistical data analysis, please fill in the sections below.

1. Gender: [ ] Female [ ] Male
2. Age: _______ years.
3. Place of residence: ___________________________
4. Education level:
   a. Uncompleted primary and secondary school
   b. Completed primary and secondary school
   c. Completed upper secondary school
   d. Higher education
5. How many times you visit the zoo?
   a) every two months  b) twice a year  c) once a year  d) less than once per year
6. Do you have a pet?
   a. Dog [ ]  b. Cat [ ]  c. I am not a pet owner [ ]

II. Please answer the questions that test your knowledge of large carnivores living in Slovenia. Circle only one answer that you think is correct, or the answer that best describes your opinion.

1) All large carnivore species (brown bear, grey wolf and Eurasian lynx) are protected in Slovenia due to their endangerment.
   a. Yes.
   b. No.
   c. Not sure.

2) Compensation for damage caused by large carnivores to farmers is paid by the state.
   a. Yes.
   b. No.
   c. Not sure.

3) How do Eurasian lynx live?
   a. In couple.
   b. Solitary.
   c. In social group.
   d. Not sure.

4) The Eurasian lynx became extinct in Slovenia in the past, but then it was reintroduced.
   a. Yes.
   b. No.
   c. Not sure.

5) Brown bears in Slovenia diet mainly consists of:
   a. food of animal origin (game, carrion ...),
   b. food of plant origin (plants and their fruits),
   c. food of animal and plant origin in approximately equal quantities,
   d. not sure.

Questionnaire design: mag. Aleksandra Majič Skrbišek and doc. dr. Iztok Tomazič
6) The weight of an average adult male grey wolf in Slovenia is:
   a. 1-20 kilos,
   b. 21-40 kilos,
   c. 41-60 kilos,
   d. more than 60 kilos,
   e. Not sure.

7) Of how many members consists an average wolf pack in Slovenia?
   a. 1-10 wolves.
   b. 11-20 wolves.
   c. 21-30 wolves.
   d. More than 30 wolves.
   e. Not sure.

III. The table below lists the claims that relate to your support for the protection of a particular large carnivore species. Please rate your agreement with each statement FOR EACH ANIMAL SEPARATELY on a scale of 1 to 5.

| N | STATEMENT                                                                 | LYNX | WOLF | BEAR |
|---|---------------------------------------------------------------------------|------|------|------|
|   | We should share the responsibility for conserving these animals.          | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 2 | There is a high risk of human injuries.                                   | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 3 | There is no need for conservation in Slovenia because there are populations in other countries. | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 4 | I want these animals to be present in Slovenia, even though I may never see them in the wild. | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 5 | We may use these animals as a valuable game species.                      | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 6 | Costs of compensation, research and monitoring are too high.             | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 7 | They may have serious negative impact on livestock farming.              | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 8 | These animals can have positive impact on balance of organisms.          | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 9 | We need to preserve these animals for future generations.                | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 10| These animals compete with hunters over game such as deer and roe deer.  | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 11| It is hard to predict the effects of extermination.                      | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| 12| These animals may have serious negative impact on deer and roe deer numbers. | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |

Thank you for cooperation!

*** Protection of potential personal data: all obtained personal data will be used exclusively for one-time communication and statistical data processing. The survey authors undertake to protect any personal data collected in the survey following the Personal Data Protection Act and not pass it on to third parties.

Questionnaire design: mag. Aleksandra Mjukić Skrinški and dr. Istok Tomažič

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