LIFE DINALP BEAR

Population level management and conservation of brown bears in northern Dinaric Mountains and the Alps

LIFE13 NAT/SI/000550

Project visibility and public acceptance of bears and bear management

Technical report

Action D3: Project visibility and public acceptance of bears and bear management

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September, 2019

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Special acknowledgements:
We thank all our respondents who without offering their opinions about bears we would have no data.

Suggested citation:
Majić Skrbinšek, A. et al. (2019) Public attitudes, perceptions, and beliefs about bears and bear management and LIFE DINALP BEAR project visibility in media. Final report of the Action D3, project LIFE DINALP BEAR. University of Ljubljana. 71 pgs. Retrieved from www.dinalpbear.eu

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Introduction

Public awareness campaigns are often used as tools to raise awareness about conservation issues, improve human attitudes toward wildlife and wildlife management decisions and subsequently also influence public behaviours. One of the main expected results of many large carnivore conservation projects, including LIFE DINALP BEAR, is improved public acceptance of the large carnivore(s) in question in their regions. Especially in areas that are being recolonized by large carnivores, there is often a debate how these large carnivores should be managed. This debate occurs because different stakeholder groups hold different values and subsequently have different or even opposing management goals. Because of that, it is important that decision-makers and all those involved in large carnivore conservation understand those values and how values influence attitudes and consequently also support or oppose the conservation goals. This report presents the comparative results of two surveys of public attitudes carried out within the LIFE DINALP BEAR project. The data in the first survey were collected during 2015 (in Austria, Slovenia and Croatia) and 2016 (in Italy). The data in the second survey were collected in late 2018 and beginning of 2019.

Mass media are globally an important source of information about nature conservation, especially for an increasingly urban population. During the project we've collected media clips about bears in the project area. We have carried out a content analysis of these clips to assess how media is portraying the project LIFE DINALP BEAR. This provides important insights for evaluation of the projects' achievements, while the analysis of how media is portraying brown bears can provide insights into potential strategies for improvement of human-bear coexistence.

Attitude Survey

Methods

Study area

Study area for the public attitude survey includes the entire LIFE DINALP BEAR project area (Figure 1). The sampling has been geographically stratified based on the hypotheses that political boundaries (national borders) and status of the bear population (Alpine vs. Dinaric region) will also define the results. Thus sampling was independently carried out in Croatia, Slovenia- Dinaric part, Slovenia – Alpine part, Italy and Austria. Furthermore, our goal was to target local rural public, thus only communities with fewer than 10 000 inhabitants were included in the sampling.

Figure 1: LIFE DINALP BEAR project area represents also the study area of the public attitude survey.

Questionnaires

In surveys, answers are of interest not intrinsically but because they are in relationship to something they are supposed to measure. In that sense designing a question for a questionnaire is designing a measure, not a conversational inquiry. For the purpose of this study, a questionnaire was designed by the project group based on the results of the focus group carried out earlier in the project area (Majić et al, 2015). The questionnaire was designed in English, translated to local languages – Croatian, Slovenian, Italian and German. Then it was tested locally and adjusted both locally (translations) and overall (additional questions designed) (see Questionnaires, available upon request to almajic@gmail.com). The questionnaire was implemented two times. First in 2015/16 and secondly in 2019 as a part of evaluation survey. In the second round an additional question was added – “Have you answered to such a questionnaire in 2015?”. Following answers were offered: a) No; b) Yes; and c) Not sure.

Following topics were included in the questionnaire:

- Questions aiming to explore general attitudes toward bears and bear management.
- Questions aiming to explore tolerance limits, including acceptable perceived bear population size and support for bear conservation
- Beliefs about bears and a knowledge section made up of factual questions.

- Perceptions about human-bear conflicts and beliefs about potential solutions.
- Personal experience with bears.
- Familiarity with the LIFE DINALP BEAR project.
- Socio-demographic information about each respondent, including association with key stakeholder groups (hunter, farmer, and beekeeper).

The development of the questionnaires was partly based on the questionnaires previously used in Croatia and Slovenia. There are two main reasons for that:

- The questions used in the previous surveys were already tested and therefore we could largely omit additional pretesting of these questions.
- Similar questionnaires would allow direct comparisons of the results from before the start of the LIFE DINALPB BEAR project with our data, thus we have also directed our study towards more longitudinal monitoring of the attitudes and beliefs.

Sampling and data collection

The same approach to sampling was taken in all countries. The target group was local general public in (more) rural areas, thus only communities with fewer than 10 000 inhabitants were included in the sampling frame. Targeted sample sizes were 400 of adult (18 years of age or more) respondents per stratum, thus we planned to obtain sample of 2000 completed questionnaires in total.

The general public was randomly sampled proportional to the number of inhabitants in each community within the study area. In Croatia and Slovenia the questionnaires were implemented using postal services. In Slovenia the sample (name, surname and address of potential respondent) was obtained from the national register of inhabitants. In Croatia sample was obtained by randomly selecting potential respondents from an electronic telephone book (in 2015) and by using “smart post” services where questionnaires are delivered to households according to specific instructions (in 2019). We’ve considered a minimal expected response rate using mail to be 20%, thus number of sent questionnaires was adjusted accordingly. The questionnaires were mailed together with additional envelope with prepaid postage for returning the filled questionnaire. In Slovenia seven to ten days after the mailing of the questionnaires, a reminder / thank you card (Figure 2) was sent in order to increase the response rate.

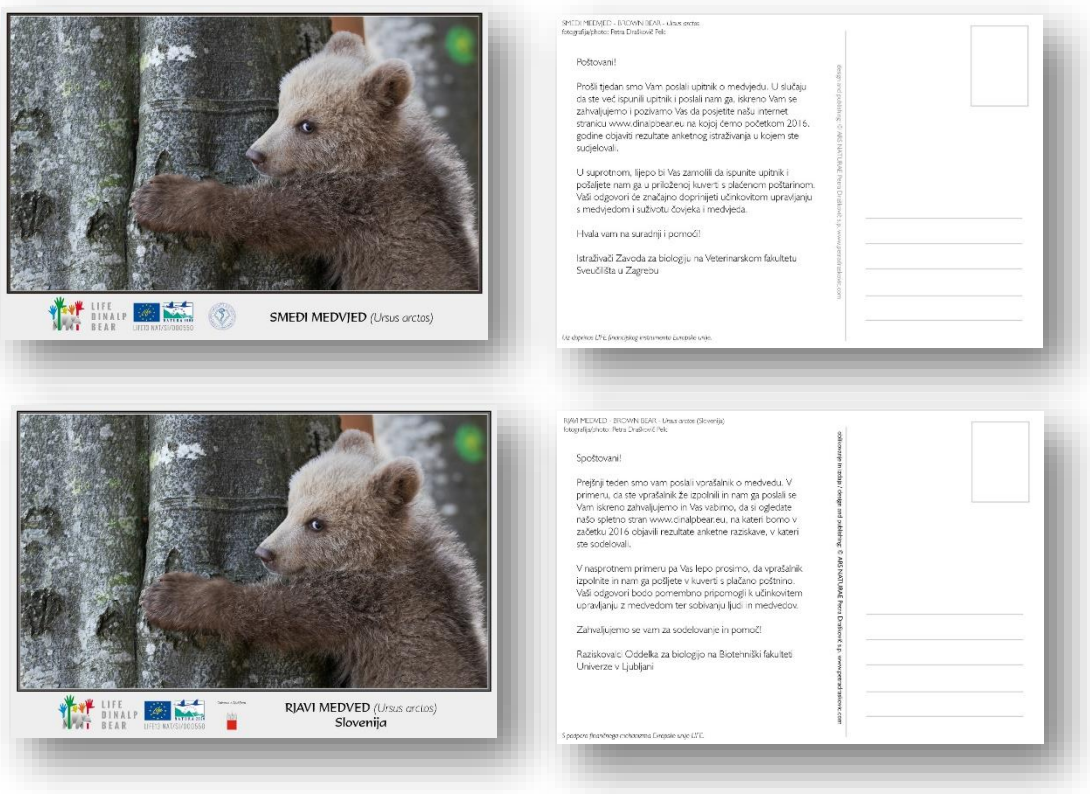

Figure 2: Reminder / Thank you! cards was sent to potential respondents in Croatia and Slovenia in order to increase the response rate.

In Austria and Italy, it was practically impossible to obtain data needed to create a representative sample of the targeted population, thus pre-existing panel samples owned by market research companies were used and questionnaire was implemented as on-line survey. In Austria the same company was used both times. In Italy two different companies were used.

Data preparation

The questionnaire data was recorded in the pre-agreed table format in each country, and merged into a single database when the data collection was completed. We maintained the index key structure to preserve traceability of each physical questionnaire with its record in the database. We checked the data for consistency, data-entry errors and missing data. The records with unacceptable amount of missing data, missing data in key columns or inconsistencies we were not able to solve were removed and stored in a different database.

Some variables needed to be constructed by aggregation of data from several columns (has_livestock, big_livestock). We also calculated knowledge score as the number of correct answers to the four questions about bear biology included in the questionnaire. The question

about bear number had too many missing data and was not asked in Italy at all, and was excluded from this score.

The questions for seeing bear in nature have been recoded to a new variable seennatureyesno - all people that reported seeing the bear in nature have been aggregated to "yes" since apart from Dinarics there has been only a small number of cases in the "yes, >10 times" category. This issue could be explored independently at a later stage.

Statistical analysis

All statistical analyses were done in R analytical environment within RStudio IDE. We followed the reproducible research paradigm by ensuring data consistency throughout analysis and documenting each analytical step (R code, comments, data and output) with RMarkdown.

Reduction of dimensionality using Principal Component Analysis (PCA)

There were three batches of questions that needed to have dimensionality reduced to enable interpretation. Since responses were collected using the Likert scale, we could assume ordinality and linearity of the responses and include them in Principal Component Analysis (PCA). We used R package psych to do this part of the analysis. We determined the number of meaningful components to extract using scree plot analysis, Kaiser-Guttman rule (eigenvalue > 1), Parallel Analysis, Optimal Coordinates, and Accelleration Factor. The components were rotated using the Varimax rotation to extract the interpretable components. Cases with unacceptable amount of missing data were excluded in the data preparation phase, and the remaining missing values were set to the mean of the variable to prevent unacceptable data loss. The extracted components were interpreted and included in the database table for downstream analysis.

Factors were normalized from -2 to 2, with 0 as neutral, direction has been checked to be logical with the interpretation of the variable. Original questions that were used for PCA were retained in the downstream dataset.

Attitudinal items (Q1-Q18)

There were 18 questions regarding the general attitudes towards bears and their conservation. Missing data was 1-3%, which is acceptable. We extracted three components:

bear_conservation - support for bear conservation. *bear_control* - support for bear control. *bear_value* - percieved value of bears.

Conflict items (Q19-Q27)

We extracted only one component: *conflict_tolerance* - how ready a person is to tolerate conflicts caused by bears.

Support of different solutions to bear problems (Q28-Q36)

There were three clear components:

sol_mitigation - preference for 'mitigation measures' solutions for bear problems *sol_culling* - preference for culling as a solution for bear problems *sol_feeding* - preference of a person for supplemental feeding as a solution for bear problems.

Q37 (other solutions), which is descriptive, is not usable in this type of analysis and was omitted.

Statistical modelling

We used Generalized Linear Models and information-theoretic approach to model selection and inference to model these highly complex data and enable interpretation of effects of otherwise confounded explanatory variables. We used the scores obtained by PCA variably as response or predictor variables, and explored their relation to other characteristics of the sample (Region, gender, education, etc.).

The general approach was as follows:

First, we checked the distribution of the response variables. Since they were PCA scores, we didn't expect a specific functional form, and we tried different probability distributions and transformations to select the correct distribution family and link function for GLM and ensure model fit.

We explored the missing data in the dataset. When meaningful (for some scalar variables) we replaced the missing values with the mean value of the variable, which shouldn't have much effect on fitting of models but prevented unacceptable data loss. At the model selection stage the remaining records with missing data were discarded to enable comparison of the fitted models, but the final (optimal) models were fitted with the entire dataset so that only the records that had missing data in the variables retained in the model were lost.

We constructed a global model with the selected distribution family and link function for each response variable where we fitted all variables we a-priori hypothesized (according to previous understanding of the problem) that they affect the response variable. We didn't fit any interactions between variables at this stage. We checked model fit by plotting standardised residuals against predicted values, checking for non-linearity, bias and heteroscedasticity. We checked for multicollinearity using Variance Inflation Factors (VIF).

We explored the model space of each global model by fitting all sub-models without interactions using R package MuMIn. We determined the importance of each variable as the proportion of models where it appears weighted by the Akaike's weight of each model. We constructed the optimal model without interactions by including all highly important variables (Importance > 0.9), and tested the effect of removal of each variable by comparing the second-order Akaike's information criterion (AICc) with the full model. We used dAICc > 3 as the threshold to retain a variable.

We fitted different two-way interactions between variables, selected a-priori using prior knowledge and hypotheses about the problem, and checked support of each model by the data using AICc. We also used dAICc > 3 as the criteria to retain a model. If the dAICc was between 0 and 3, we retained the model with lower number of parameters.

To fit the final optimal (most parsimonious) model with as much data as possible, we used the entire dataset and excluded the records that had missing data just in the variables retained in the model. We checked the data for high-leverage data points by calculating Cook's distances, and we excluded the records with Cook's distances larger than 4/N (model outliers), where N is the number of records included in the model. We re-fitted the optimal model with this dataset without outliers, re-checked linearity and homoscedasticity, and used the fitted model for interpretation.

Data exploration and interpretation of modelling results

We plotted different aspects of the dataset to visually examine the raw data for the effects of different explanatory variables on the response variables. Since the explanatory variables are in many cases highly confounded and in practically all cases non-orthogonal, we used the most parsimonious models fitted in the statistical modelling exercise to directly explore the effect of single explanatory variables or their pre-determined interactions when the other parameters in the model are being controlled for. In other words, we examined the "pure" effect of a specific explanatory variable (e.g. age, education, etc.) on the response (e.g. support for bear conservation) controlling for the effect of other explanatory variables (e.g. Region, gender, etc.). In this manner we could provide an understanding of the actual effect of a certain explanatory variable even in the face of the high complexity and non-orthogonality of the data. The effects were explored using the R package *effects*.

For more information about the analysis please refer to the – Analysis Notes, available by request to almajic@gmail.com.

Results

Data set description

Following a data quality screening and exclusion of questionnaires with high ratio of missing data (n=24) and those filled out by persons younger than 18 years (n=12 in 2015 and 12 in 2019), 2306 from 2015 and 2297 questionnaires from 2019 were included in the analysis. Response rates for questionnaires sent via post were 24.6% in Croatia, and 33.6% and 27% for the Dinaric and Alpine parts of Slovenia, respectively.

Overall, half of our respondents were females. Nevertheless, there were some variations at the country level. In Croatia, for example, in 2015 over 60% of respondents were males, probably due to the sampling from the telephone book as traditionally males are considered heads of the households and their names are listed in the telephone books. In Italy, on the other hand, close to 56% of the respondents were females.

On average respondents to our questionnaire were close to 48 years old in both surveys. The overall oldest respondents were from Slovenia (median = 51) followed by Croatia and Austria (median = 47). The sample from Italy (median = 44) was most likely somewhat biased towards younger generations, probably due to the online implementation of the questionnaire. Distribution by age is presented in Figure 3.

Majority of respondents had secondary (high school) education (52% overall). University degree or other form of higher education was reported by 22% (in Austria) to up to 37% (in the Slovenian Dinarics).

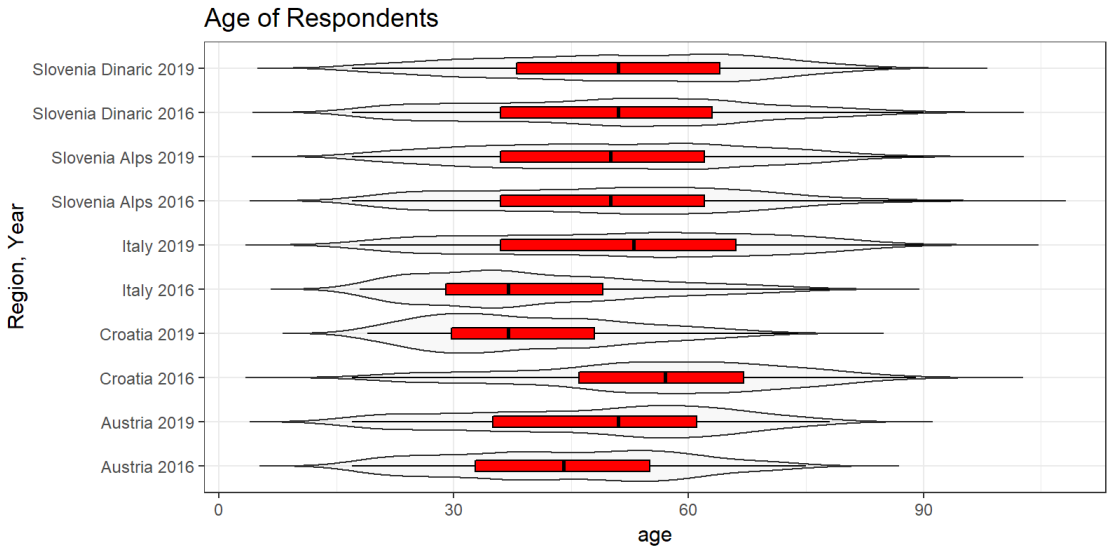

Figure 3: Distribution of respondents' age per study area and year of survey.

Respondents from the Dinarics (Croatia and Slovenia – Dinarics) overall had the most direct experiences with bears. Over 10% of them experienced damage caused by bears to their property. In the Alpine area only few respondents claimed experiencing damage by bears - 4% in Slovenia and around 2% in each Austria and Italy.

Majority of Croatian and Slovenia-Dinarics respondents reported seeing a bear in nature Respondents from the Alpine regions mostly did not see a bear in nature (78%, 88% and 89% for Slovenia, Italy and Austria, respectively, Figure 4). Large majority all of the respondents from reported seeing a captive bear (for example in a ZOO).

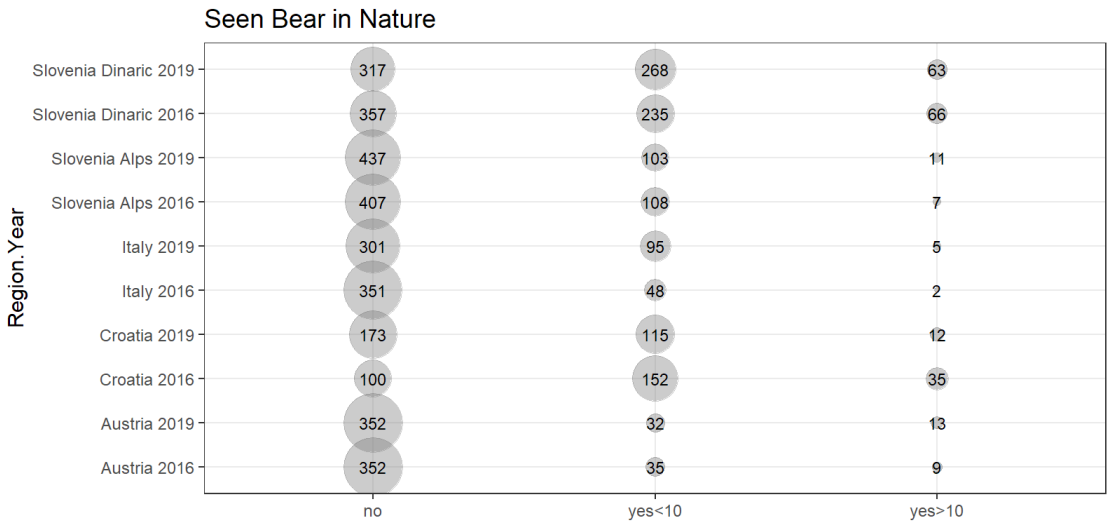

Figure 4: Number of respondents reporting either not seeing a bear in nature or seeing it fewer than or 10 or more times in their life.

Overall, there were 5.1% of hunters among our respondents, 5.6% in 2015 and 4.7% in 2019.

Beekeepers are another important stakeholder group in bear management. Just under 5% of our respondents reported having bees. Overall the highest percentage was in Croatia (7%) and lowest in Italy (4.1%).

Livestock farmers as one of the key stakeholder group in bear management were also specifically recognized within the survey (Figure 6). The highest share of livestock farmers was among Slovenian respondents, followed by Croatia. Among Austrian respondents there were close to 10% of livestock farmers, while the lowest share of farmers was recorded in the Italian sample (just under 8%).

Dog owners are an important target group for communicating ways of safe behavior in bear habitat. Share of dog owners in our sample is presented in Figure 5.

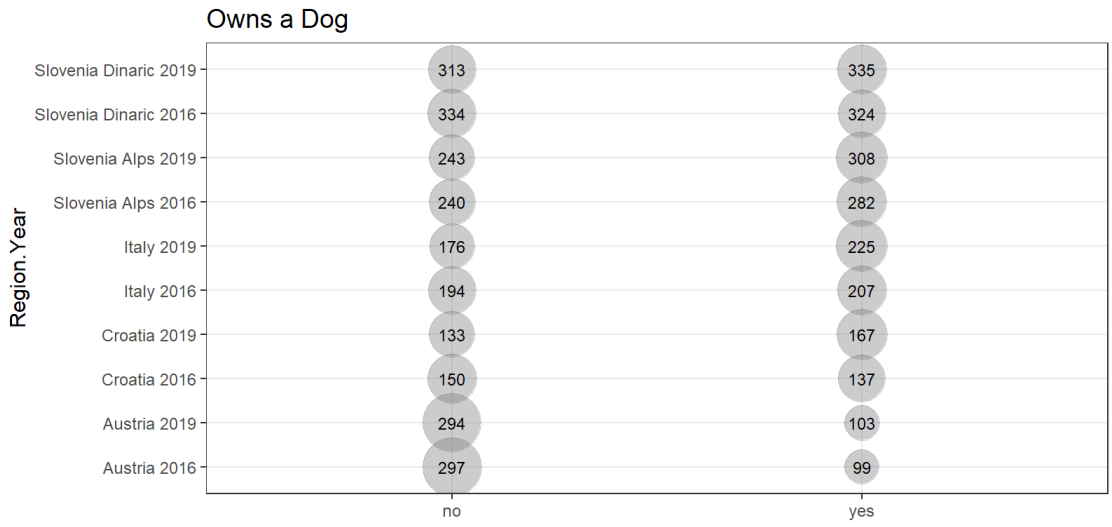

Figure 5: Respondents reported (not) owning a dog in their family.

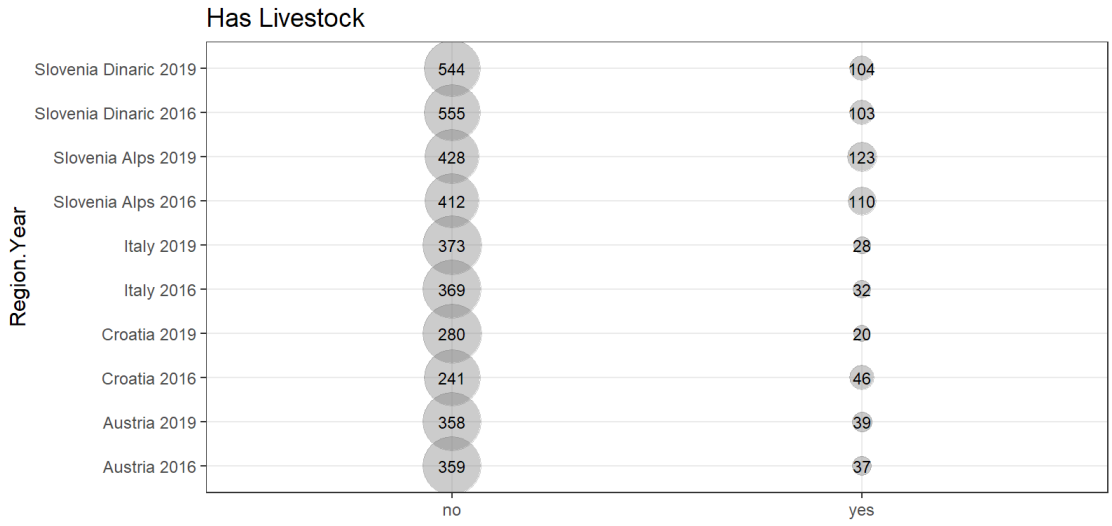

Figure 6: Respondents reported having livestock (sheep, goats, cattle and/or horses).

Project visibility

Overall 15.7% of our respondents have reported hearing about our project before, in comparison to 15.6% in 2015 (during the first year of project implementation). The highest share was recorded in Slovenia, close to 23% and Croatia (around 15%). In Italy and Austria 8% and 4% of respondents heard of the project, respectively (Figure 7).

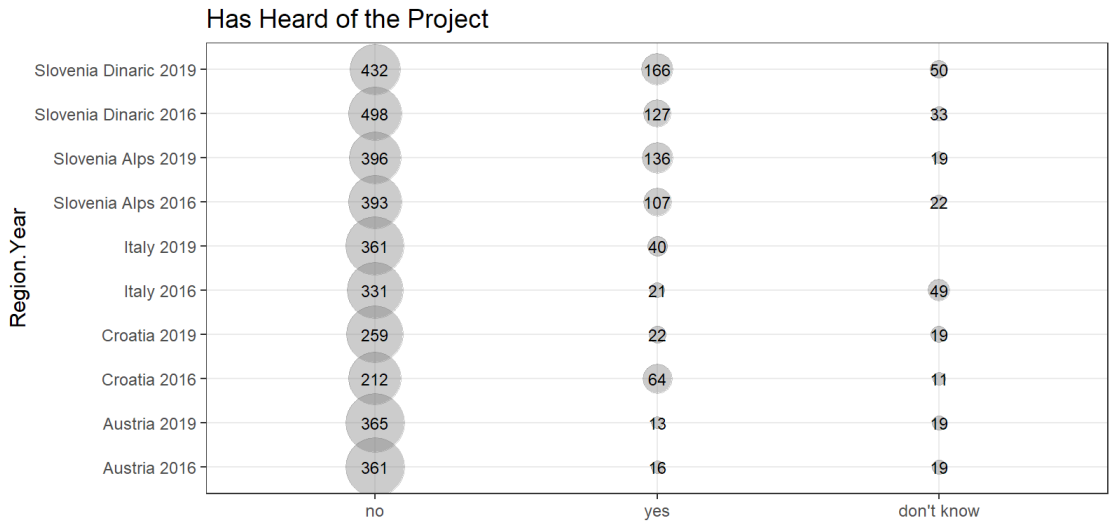

Figure 7: Number of respondents that did (not) hear about our project before receiving the questionnaire.

Knowledge about bears

General bear biology and bear behaviour questions presented in Table 1 were used to assess respondents' general familiarity with bears as a species. Respondents in general demonstrated good knowledge about bears. The only question where we documented considerable misconceptions was the one related to the species diet as majority of respondents overestimated the share of animal food origin in bear's diet. Results for the knowledge items are presented in detail in Figure 8 to Figure 11.

These questions were also used to calculate "knowledge score" which ranged from 0 (none of the questions were correctly answered) to 4 (all of the questions were correctly answered). Overall, the highest level of knowledge was documented among Croatian respondents, followed by Slovenia Dinaric, Austria, and Slovenia Alps. Somewhat lower levels of knowledge were documented among Italian respondents (Figure 12).

Respondents in Slovenia, Croatia and Austria were also asked to write down the number of bears in their respective countries. In Italy this question was not asked in 2015. In 2019 median value for Italian Alps was 100 bears. Median value for Slovenia was 450 bears in 2015 and 550 in 2019, for Croatia 775 bears in 2015 and 500 in 2019 and for Austria 15 bears in 2015 and 20 in 2019. Due to a high number of missing data and many outliers, this questions was not used in calculating knowledge score.

Table 1: Knowledge questions used to calculate "knowledge score".

Question	Possible answers
Bears in SI/HR/IT/AT feed on:	a) Only food of animal origin. b) Mostly food of animal origin. c) Mostly food of plant origin.

	d) Food of animal and plant origin in approximately same ration. e) Don't know.
How many cubs are there in a litter most often?	a) One. b) Two. c) Three. d) Four. e) Don't know.
Bears in SI/HR/IT/AT are in general afraid of people.	a) No. b) Yes. c) Don't know.
Bear cubs in SI/HR/IT/AT usually leave their mothers:	a) As soon as they leave the den where they were born. b) During the first year of their life. c) During the second year of their life. d) During the third year of their life. e) During the fourth year of their life. f) Don't know.

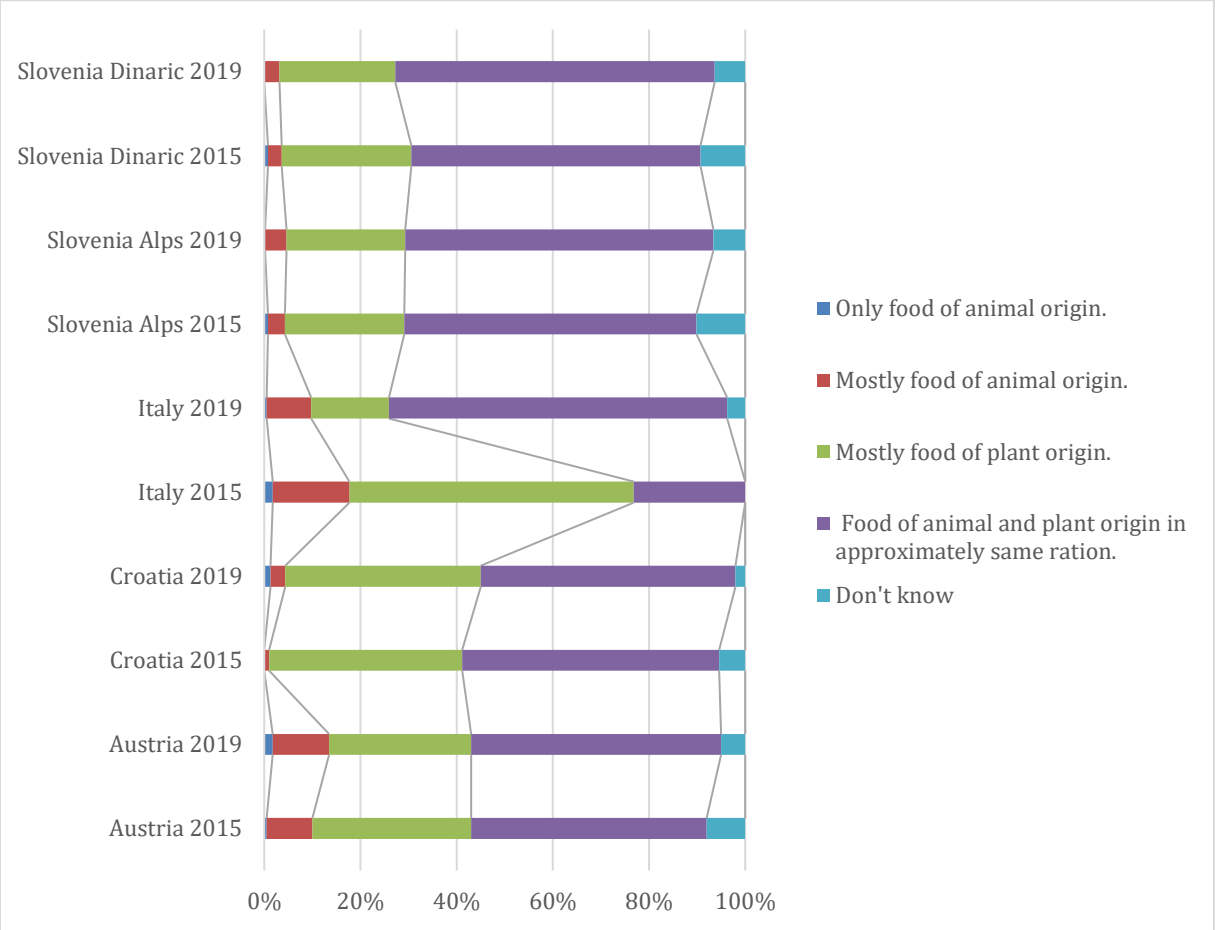

Figure 8: Answers to the question "Bears in SI/HR/IT/AT feed on:…". Correct answer is "Mostly food of plant origin", coloured green in the chart.

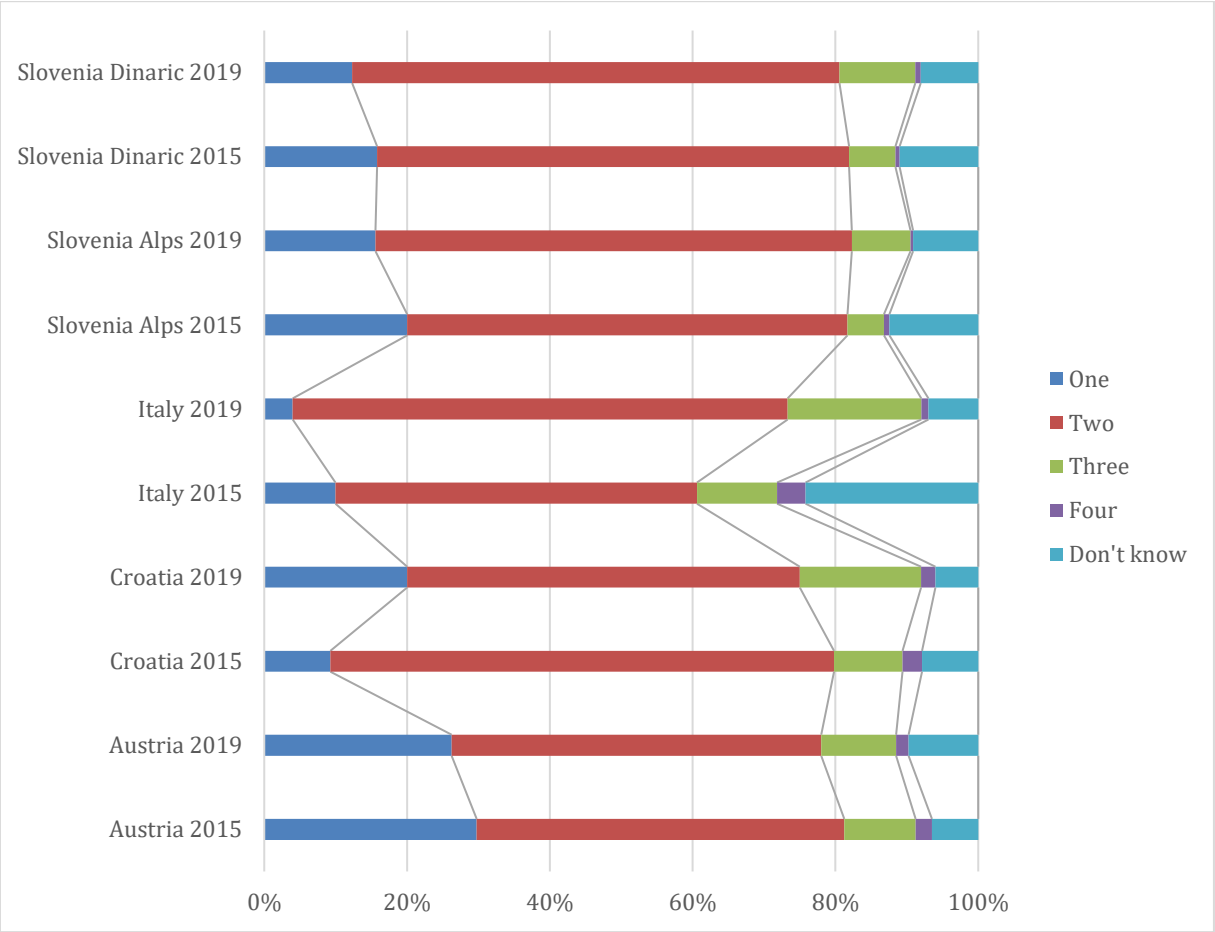

Figure 9: Answers to the question "How many cubs are there in a litter most often?". Two and three were considered as correct answers in further analysis (coloured red and green in the chart).

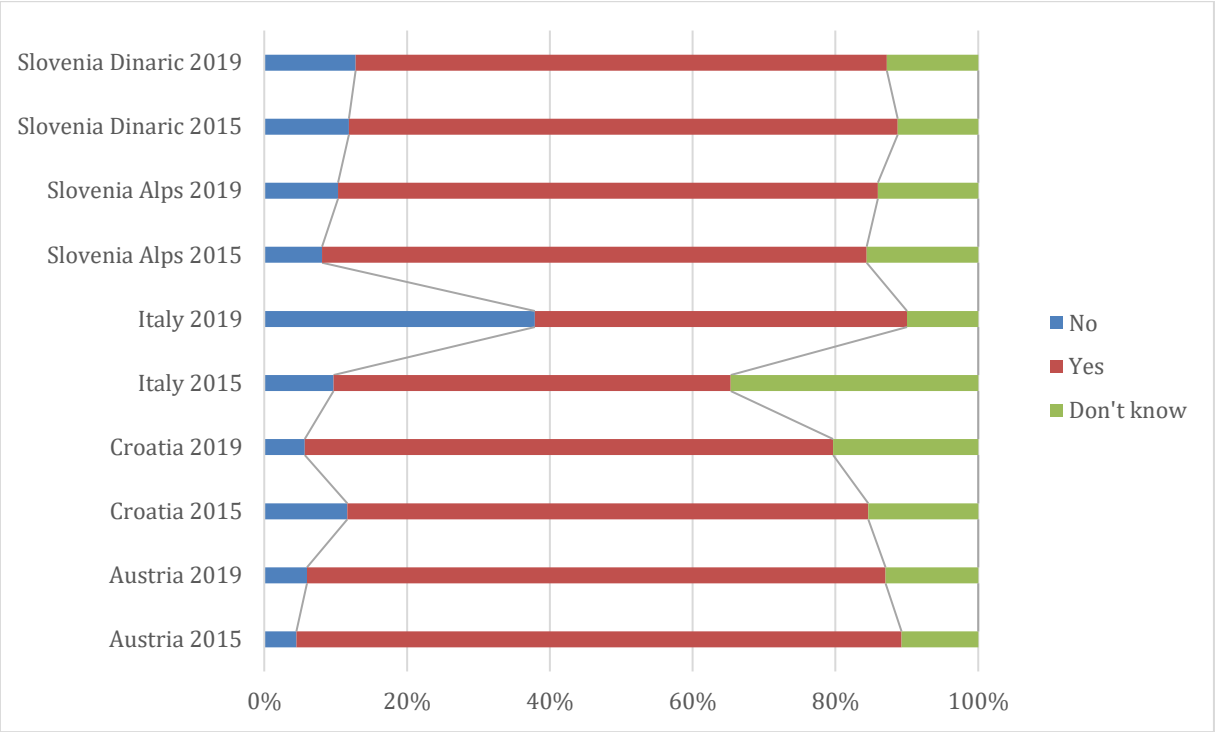

Figure 10: Answers to the question "Bears in SI/HR/IT/AT are in general afraid of people." Correct answer was "Yes" (coloured red in the chart).

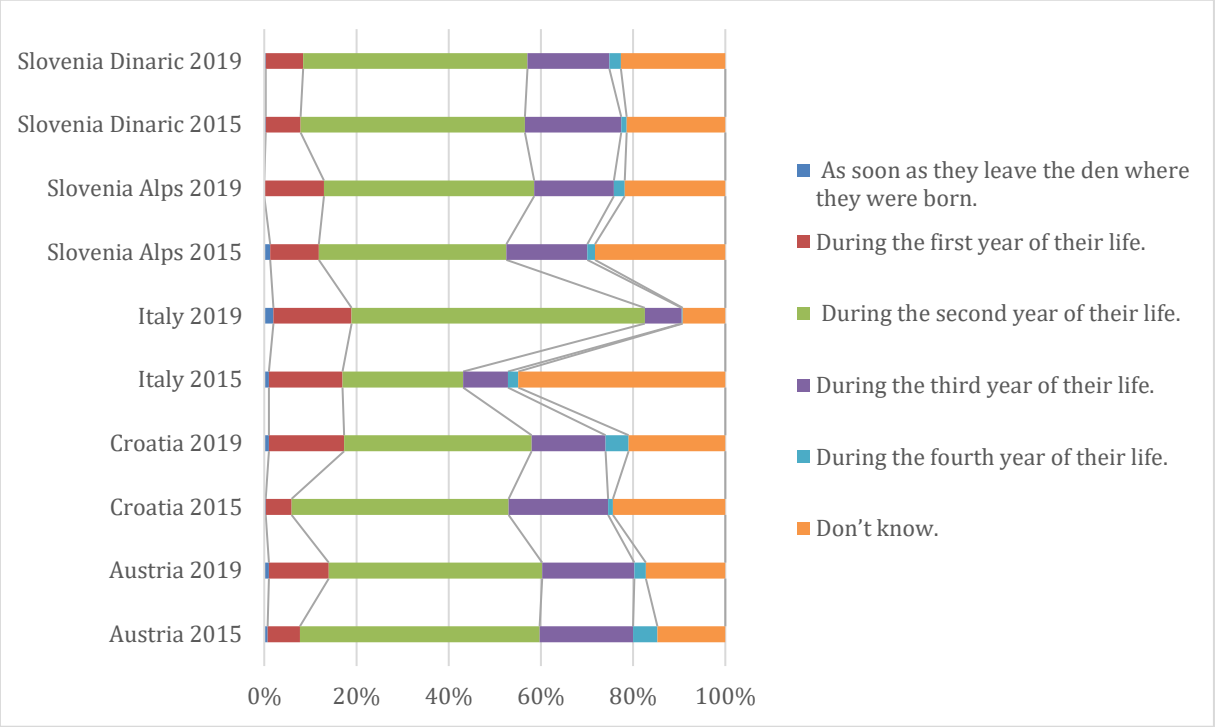

Figure 11: Answers to the question: "Bear cubs in SI/HR/IT/AT usually leave their mothers:…". Correct answer was "During the second year of their life" (coloured green in the chart).

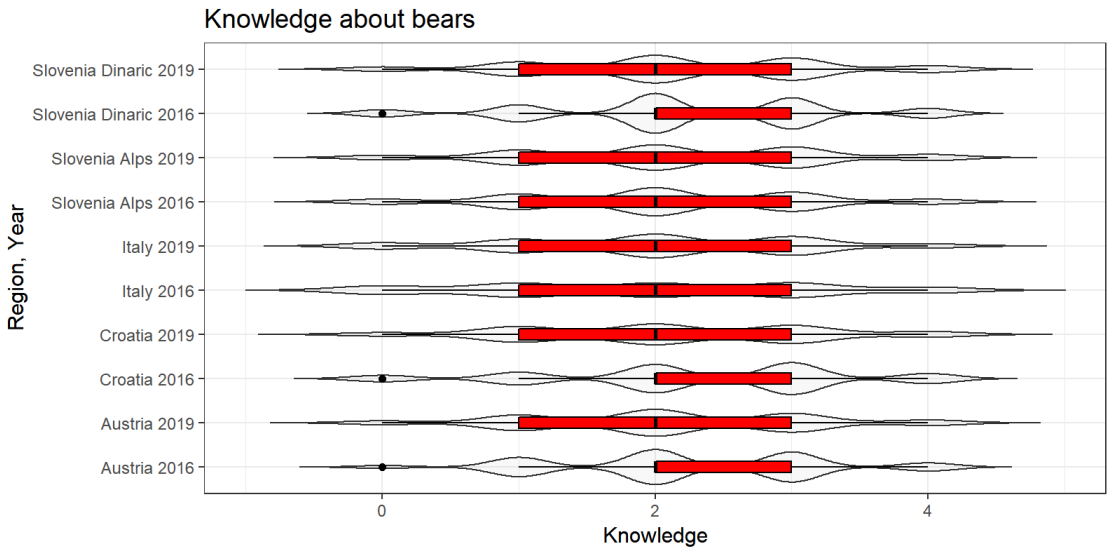

Figure 12: Distribution of knowledge score (0-4) across the study areas.

Exploring human tolerance of bears

Perceptions about acceptable bear population size

Perceptions and beliefs about population size are probably one of the most important components shaping public expectations from the population management. If predominant belief among the constituency is that there are too few bears, they will oppose any interventions into the population which could reduce the population size and they would expect measures to better conserve the population. The same is for the opposite example – beliefs that there are too many bears will result with expectations of population size control. It is important that decision-makers have access to the information on public opinions and expectations, so that they can predict and manage public support for management decisions that need to be taken.

In the questionnaire we have asked two complementing questions regarding the respondents' opinion on local (national) bear population size: "In my opinion, there are too many bears in SI/HR/IT/AT" (Figure 13) and "I would agree with increasing bear numbers in SI/HR/IT/AT" (Figure 14). Italian, Austrian and Croatian respondents would agree with increasing number of bears in their respective countries, while Slovenian respondents mainly opposed this statement. Many of the Slovenian respondents from the Dinaric region also agreed that there are too many bears in Slovenia. These results would suggest that social carrying capacity has been reached among the interested inhabitants of Slovenia, especially those in the Dinarics, while in other countries people would be willing to tolerate more bears. It is however important to note that many respondents in all countries but Austria in 2015 did not have a concrete opinion about the bear population size in their country and choose "neither agree or disagree" (shown as "Neutral" in the graphs).

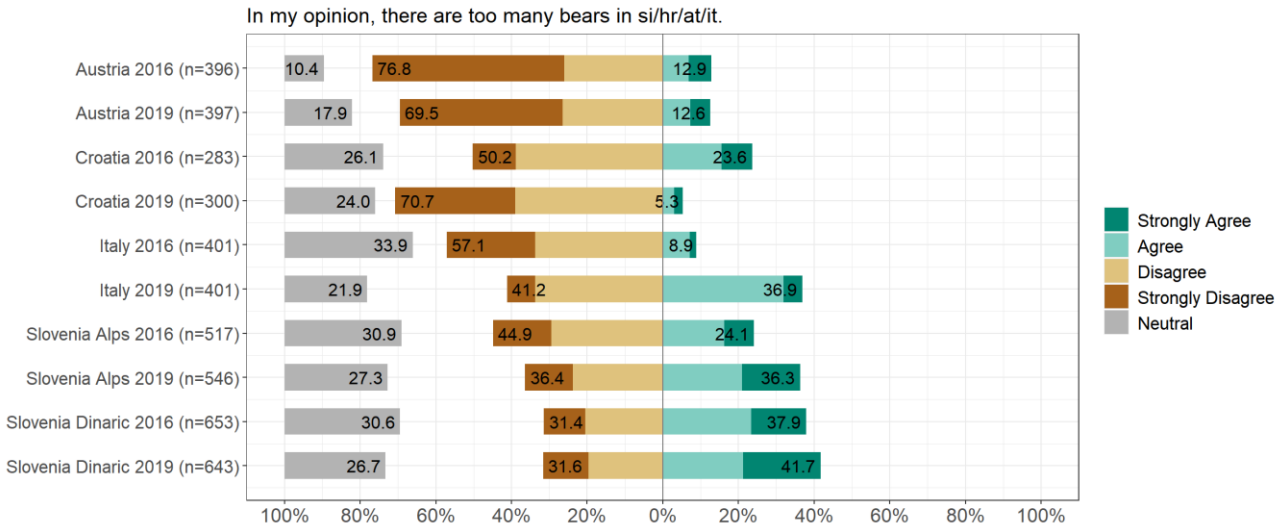

Figure 13: Results for the item "In my opinion, there are too many bears in SI/HR/IT/AT."

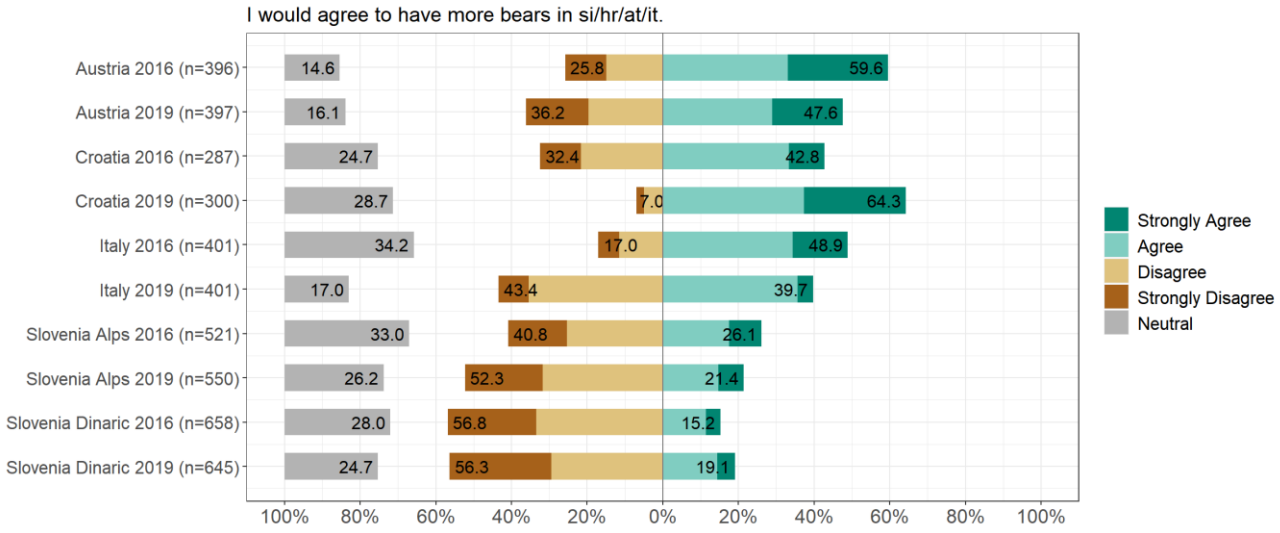

Figure 14: Results for the item "I would agree with increase in bear numbers in SI/HR/IT/AT."

Public support for bear conservation

Principal Components Analysis (PCA) presented in detail in Analysis Notes (available by request to almajic@gmail.com) allowed us to aggregate general attitudinal items into three interpretable scores. First one, explaining 51% of the variance was interpreted as "Support for bear conservation" (Figure 20). Raw results of the main items contributing to this component are presented in Figure 15 to Figure 19. The question presented in Figure 13 (In my opinion, there are too many bears in SI/HR/IT/AT" also contributed to this score with a standardized loading based upon a correlation matrix of -0.73.

By looking at the raw data, it is important to note a discrepancy in responses among the Austrian respondents. While less than 10% assessed their own attitudes toward bears as negative, over 20% disagreed that it is important to have bears in Austria for future generations and also agreed that it is not necessary to have bears in Austria since large populations already exist in other European countries.

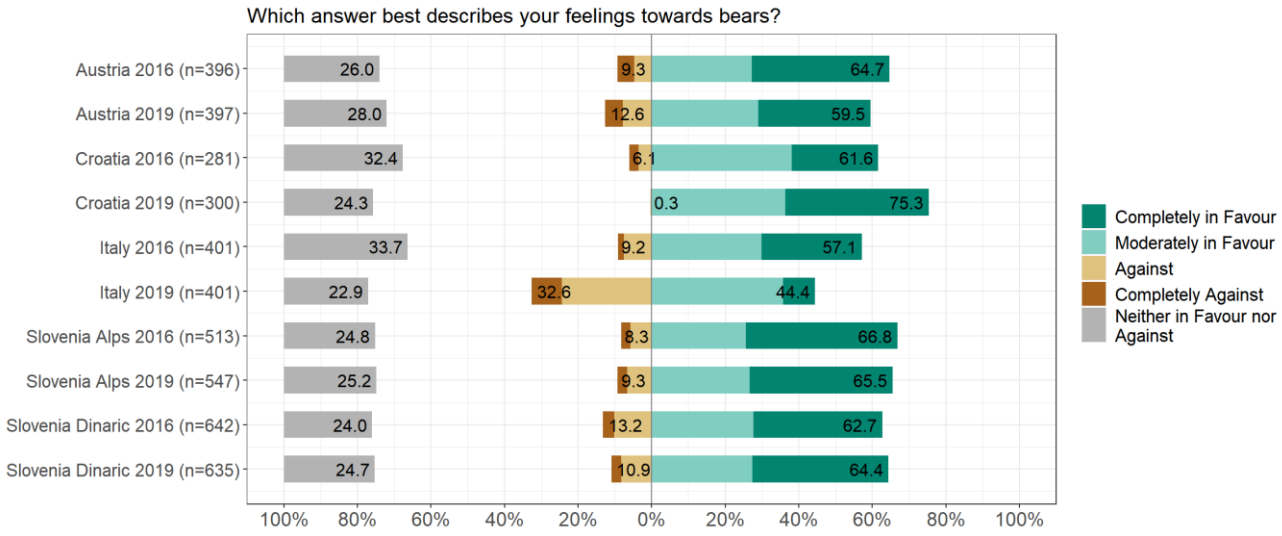

Figure 15: Results of the item: "Which answer best describes your feelings toward bears?". This item contributed to the PCA score "support for bear conservation" with a standardized loading of 0.82.

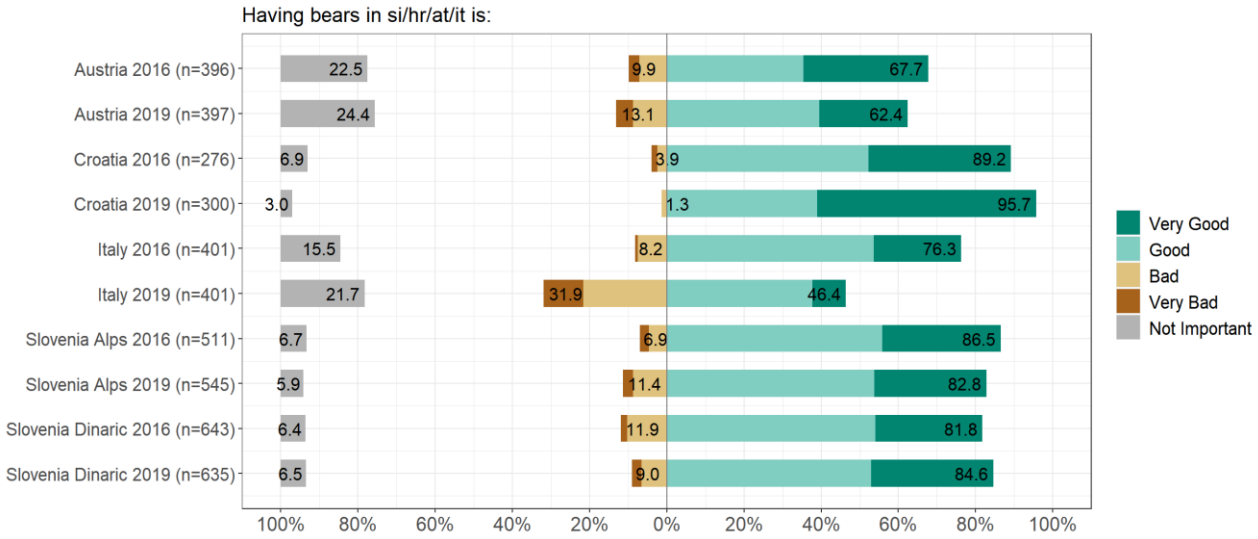

Figure 16: Results of the item: "Having bears in SI/HR/IT/AT is:…". This item contributed to the PCA score "support for bear conservation" with a standardized loading of 0.84.

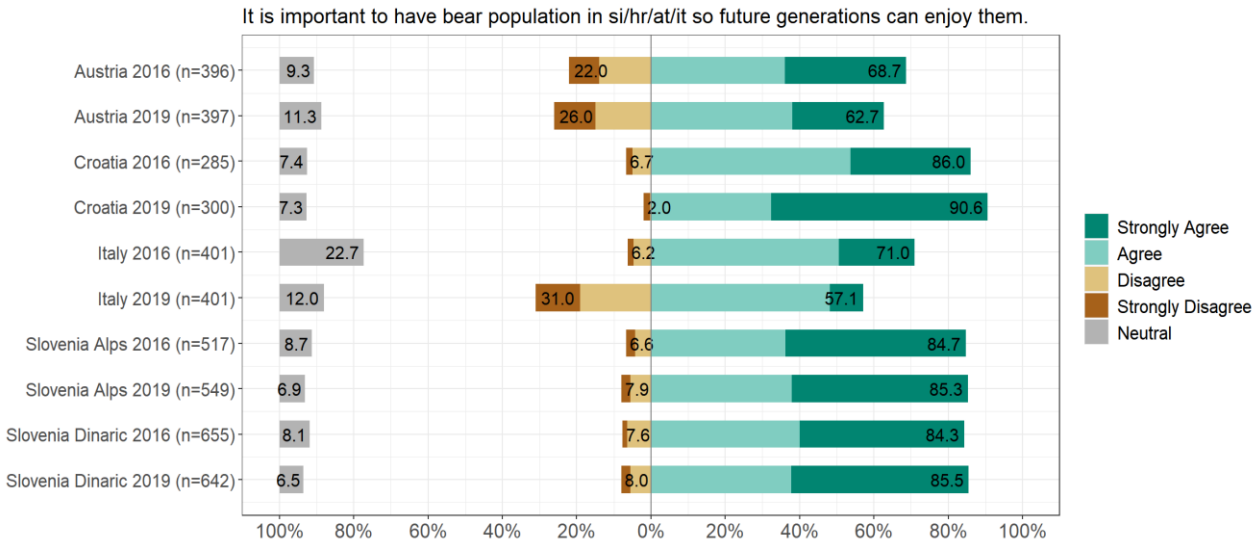

Figure 17: Results of the item "It is important to have bear population in SI/HR/IT/AT for the future generations.". This item contributed to the PCA score "support for bear conservation" with a standardized loading of 0.76.

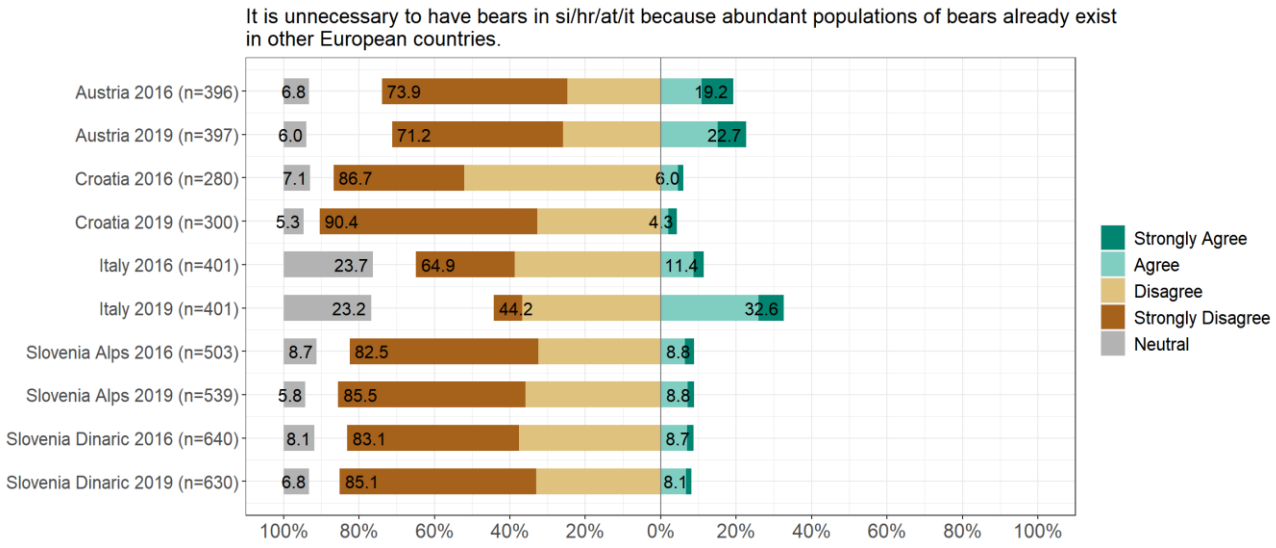

Figure 18: Results of the item "It is unnecessary to have bears in SI/HR/IT/AT because abundant populations of bears already exist in other European countries.". This item contributed to the PCA score "support for bear conservation" with a standardized loading of -0.74.

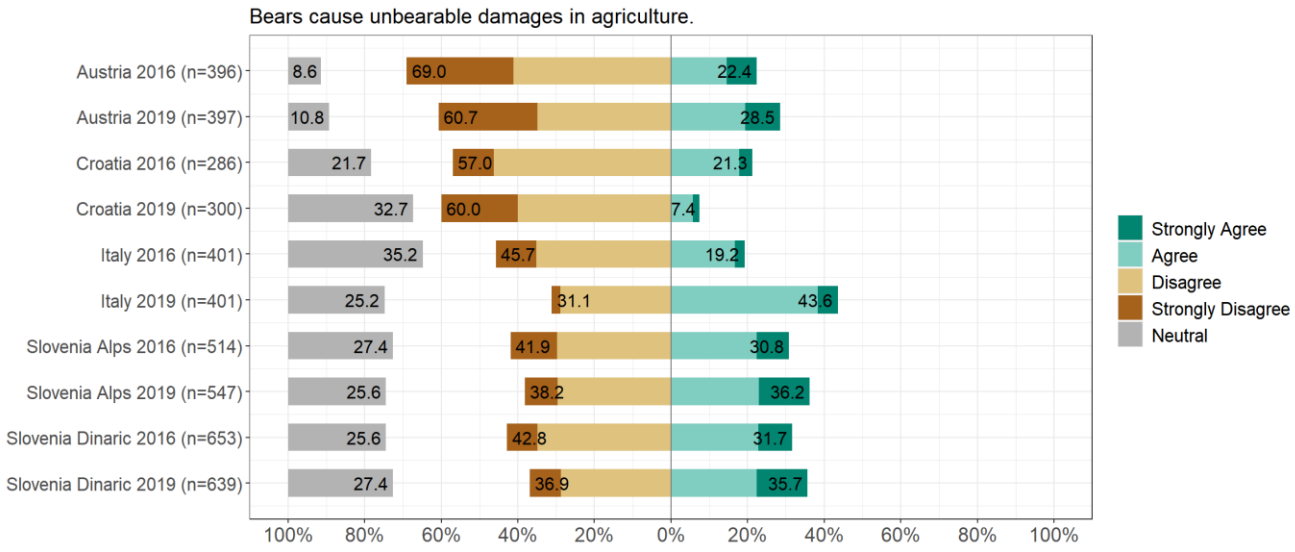

Figure 19: Results of the item "Bears cause unbearable damages in agriculture" This item contributed to the PCA score "support for bear conservation" with a standardized loading of -0.73.

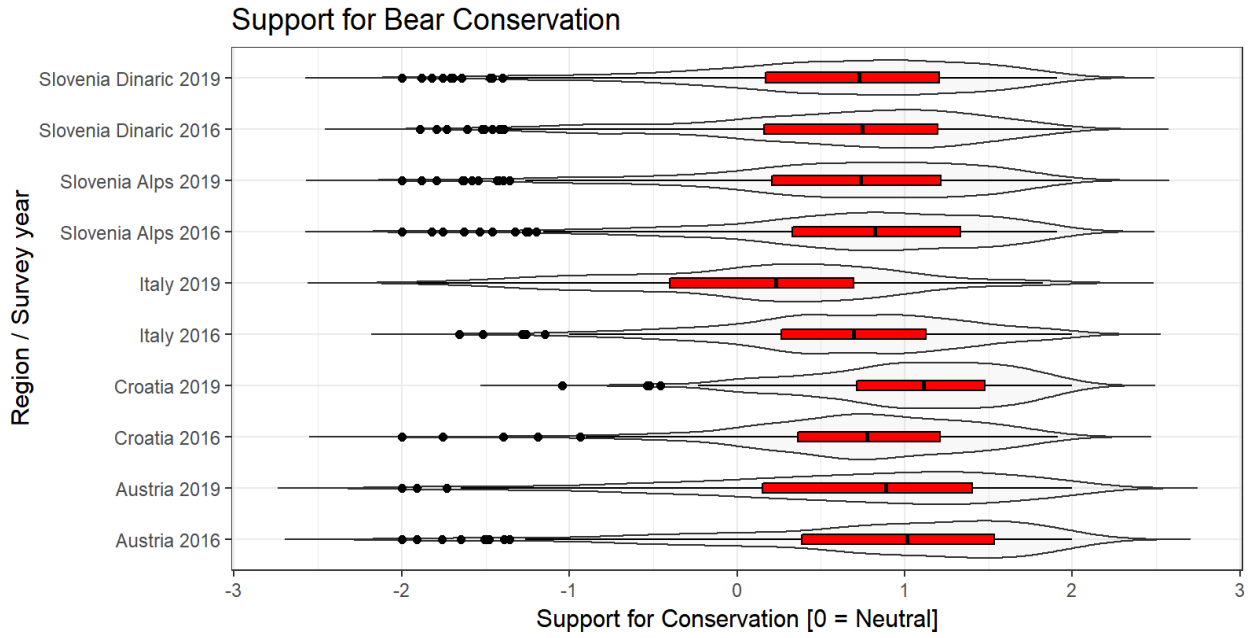

Figure 20: Distribution of the extracted PCA score "Support for bear conservation".

The final model for "Support for Conservation" had following structure: I((**bear_conservation***-1) + 3)~Region + Year + age + education + seennatureyesno + dogowner + knowledge + has_livestock + Region:age + education:seennatureyesno + Region:Year + Region:knowledge + dogowner:Region

Overall, all groups were supportive of bear conservation, but there were regional differences (Figure 21), with noticeable drop in support in the Alpine regions, especially in Italy. The highest general support for bear conservation was documented in Austria, while in other countries it was somewhat lower. Younger generations support bear conservation more than the older ones (Figure 22). Respondents that have higher formal education (Figure 23) and especially those that have better knowledge of bear biology (Figure 24) also scored higher on the "Support for bear conservation". Effect of seeing a bear in nature on support for bear conservation seems to be important according to the education of the respondent. It might be that people with different education levels encounter bears under different circumstances, such as nuisance during work vs. as an interesting attraction while hiking or even bear watching (Figure 26), while owning livestock was a negative predictor for support for bear conservation (Figure 25). Nevertheless, livestock breeders overall still support bear conservation (except those from Italy and those that know little about bears).

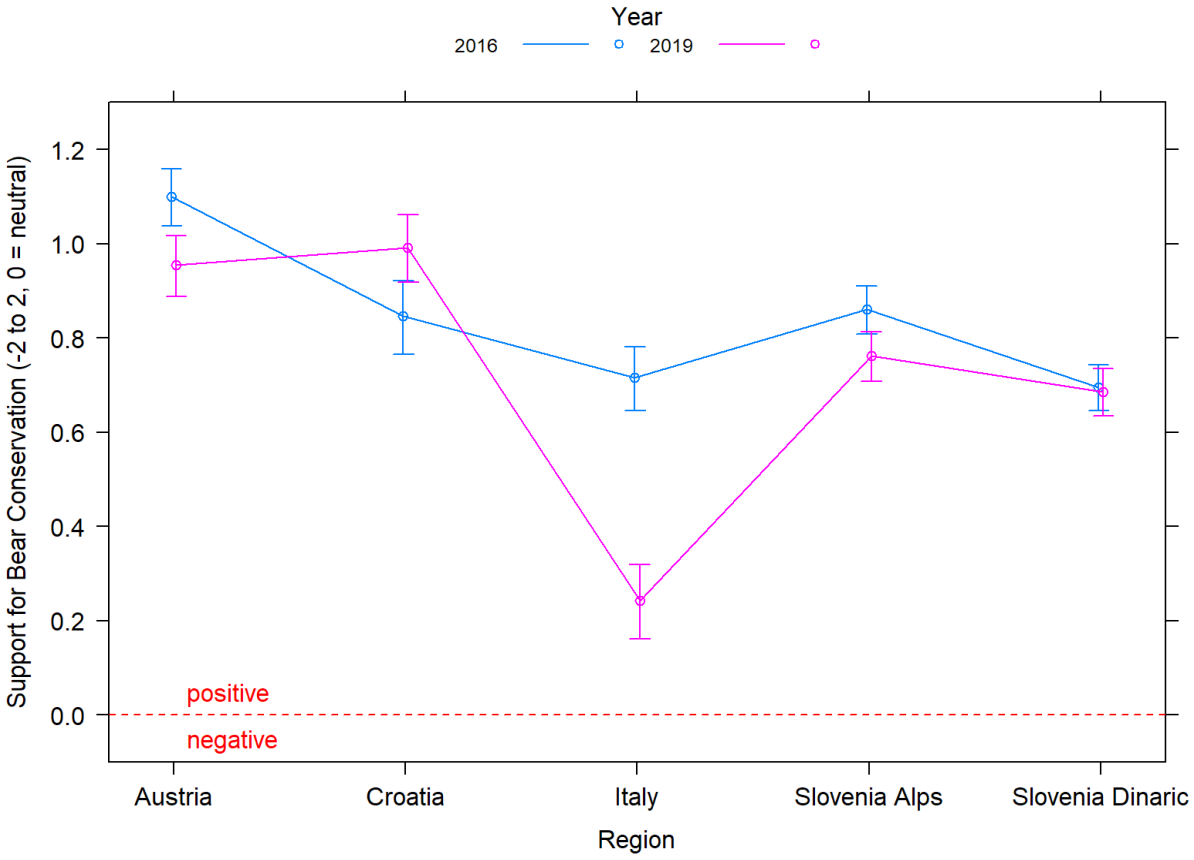

Figure 21: Effects of "region" and "survey year" to "Bear Conservation Support".

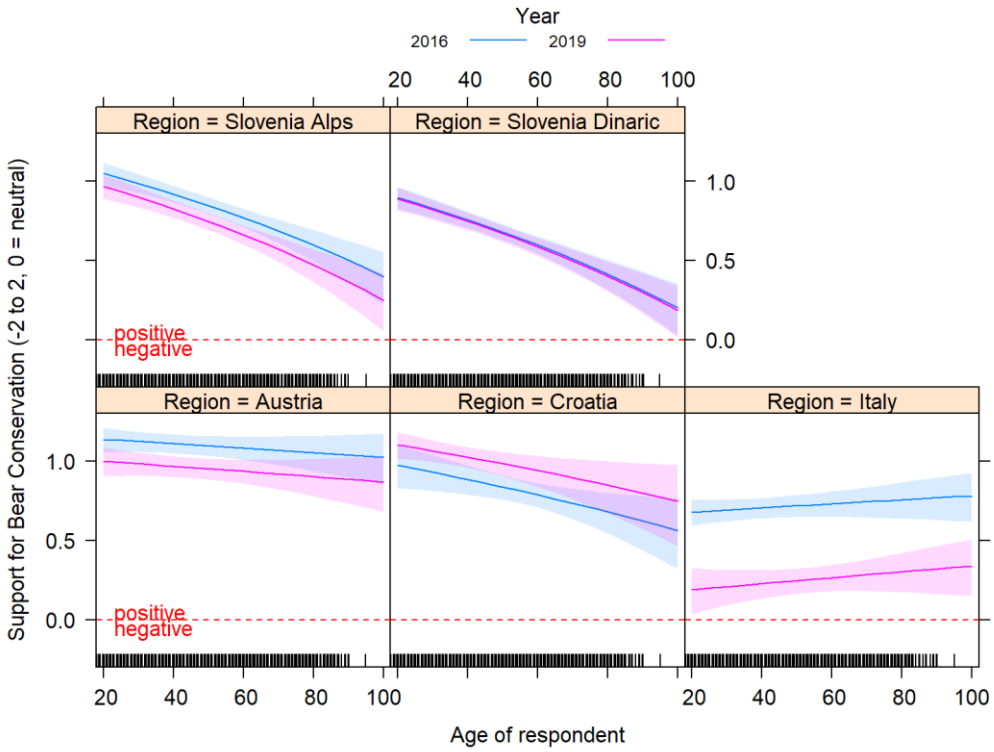

Figure 22: Effects of respondents' age on Support for conservation.

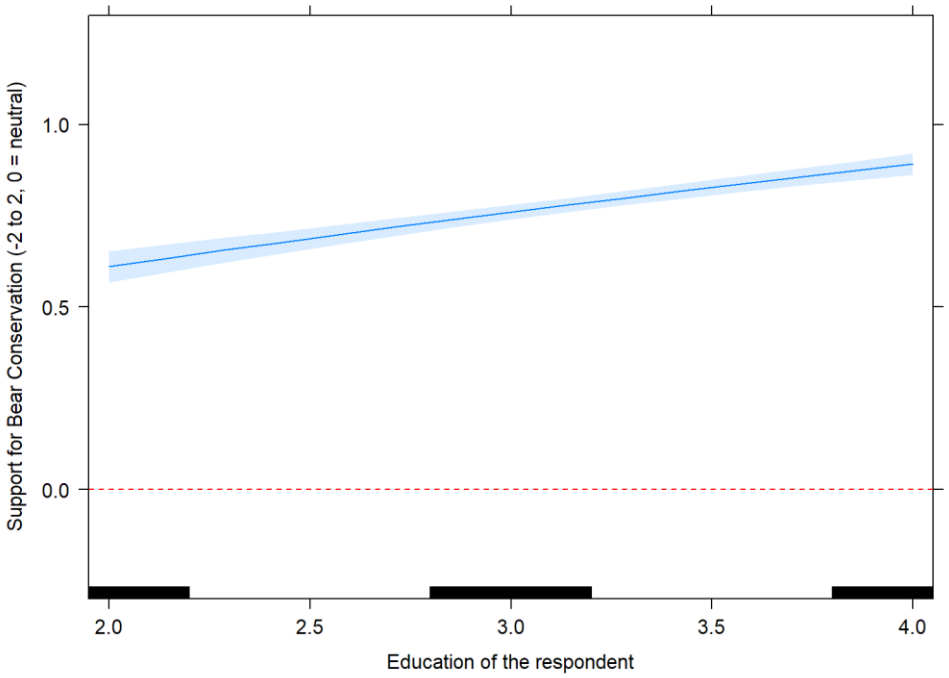

Figure 23: Effects of respondent's education on Support for Conservation.

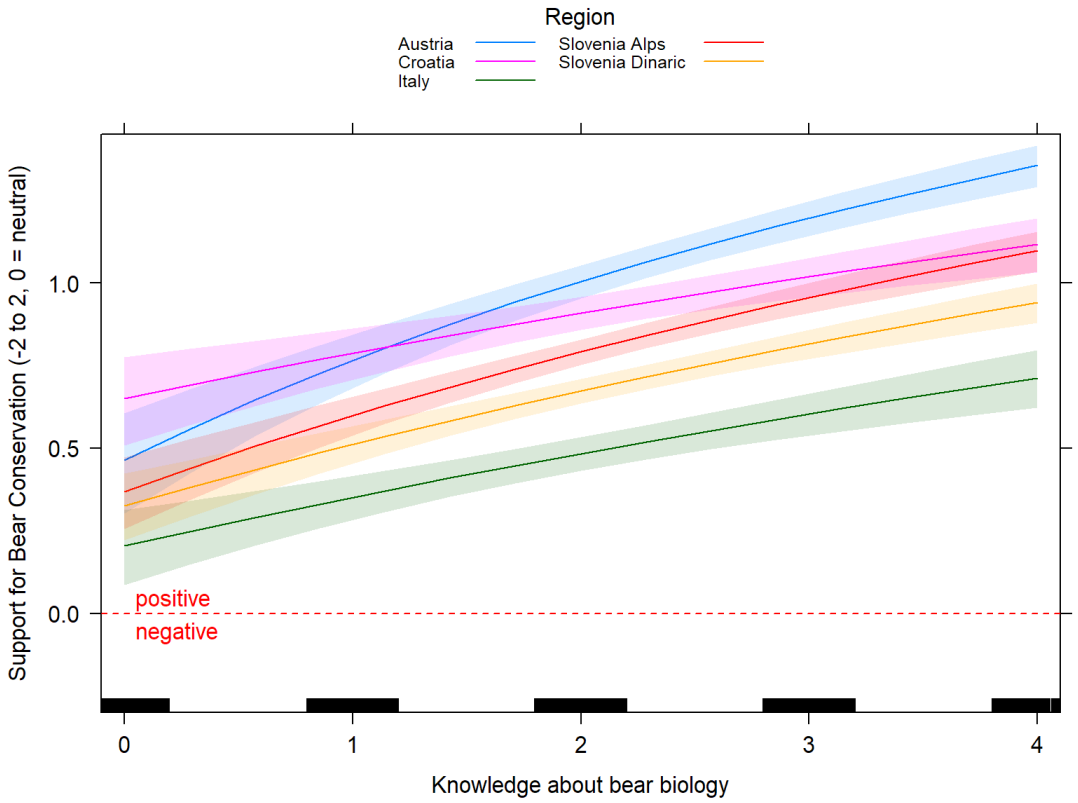

Figure 24: Effects of respondents' knowledge about bears on the Support for conservation.

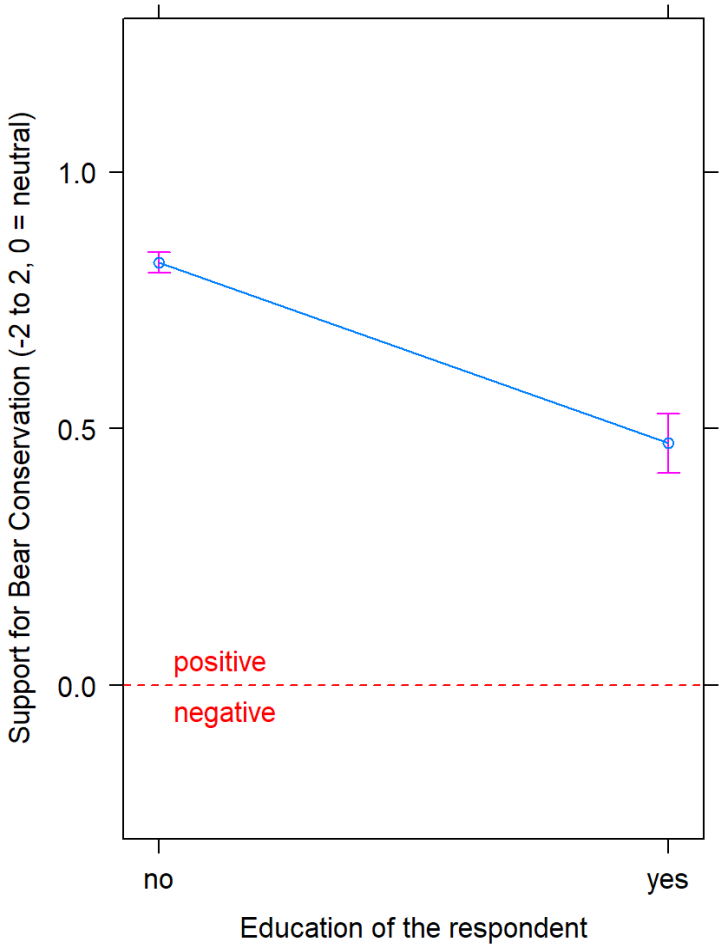

Figure 25: Effects of respondents' owning livestock on Support for conservation.

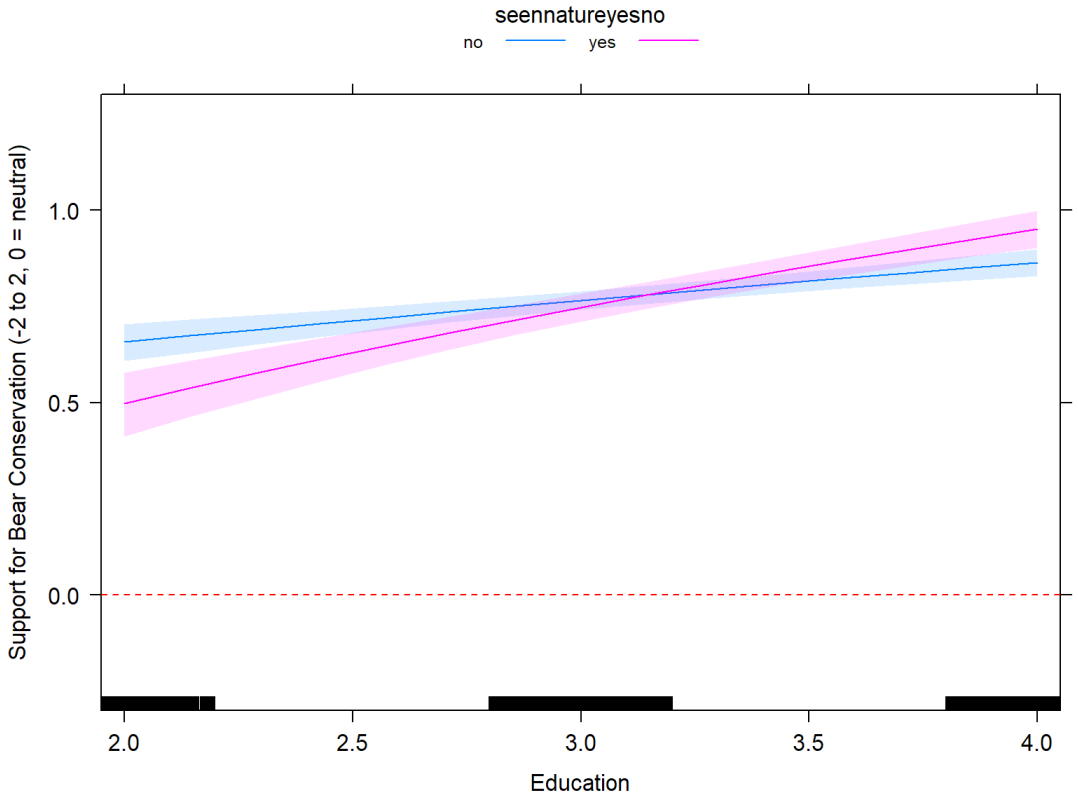

Figure 26: Combined effects of seeing a bear in nature on support for bear conservation, according to the education of the respondent.

Public support for lethal control of bear population

The second extracted PCA score was interpreted as “Support for lethal control of bears”. It explained 60% of the variance. Raw results of the items contributing to this score are presented in: Figure 13 (with standardized loading of 0.85), Figure 14 (standardize loading of -0.80), Figure 27, Figure 28, and Figure 29. The results suggest that hunting of bears could be more or less acceptable to all studied groups except for Italian respondents which mainly disagreed with the statement. That it is necessary to shoot bears in order to control the population size was agreed to by Slovenian and Croatian respondents.

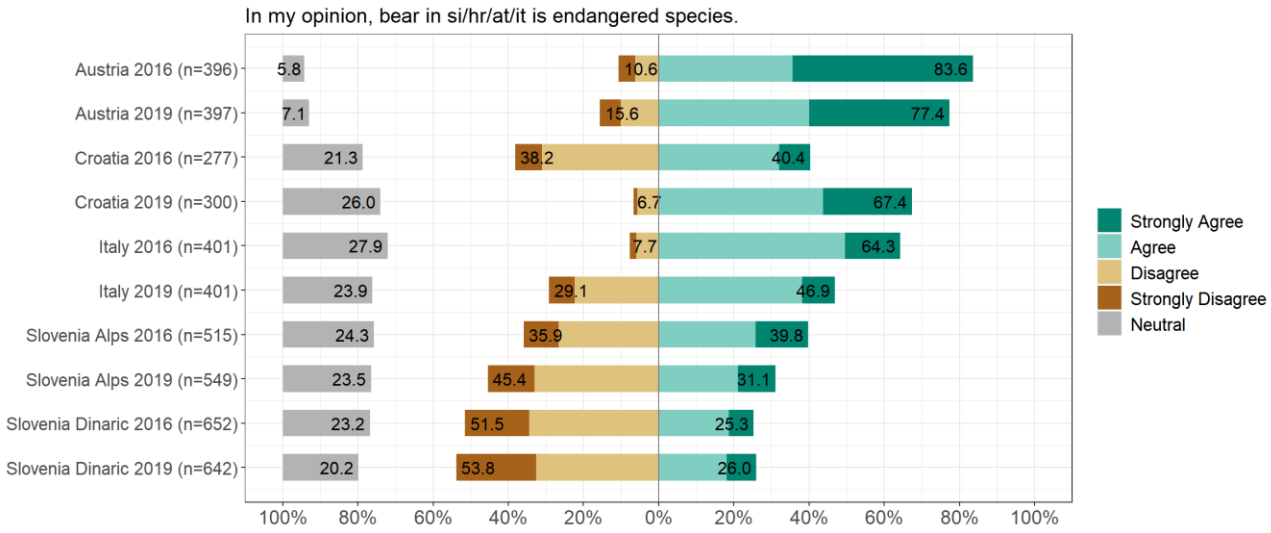

Figure 27: Results of the item "In my opinion, bear in SI/HR/IT/AT is an endangered species" This item contributed to the PCA score "support for lethal control" with a standardized loading of -0.75.

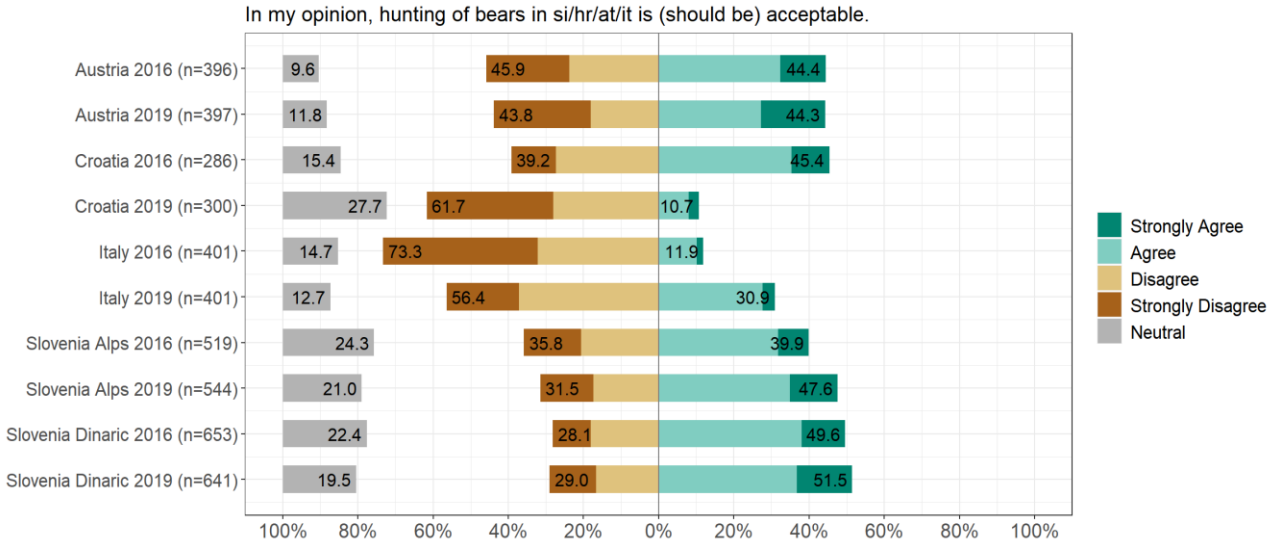

Figure 28: Results of the item "In my opinion, hunting of bears in SI/HR/IT/AT is (should be) acceptable" This item contributed to the PCA score "support for lethal control" with a standardized loading of 0.73.

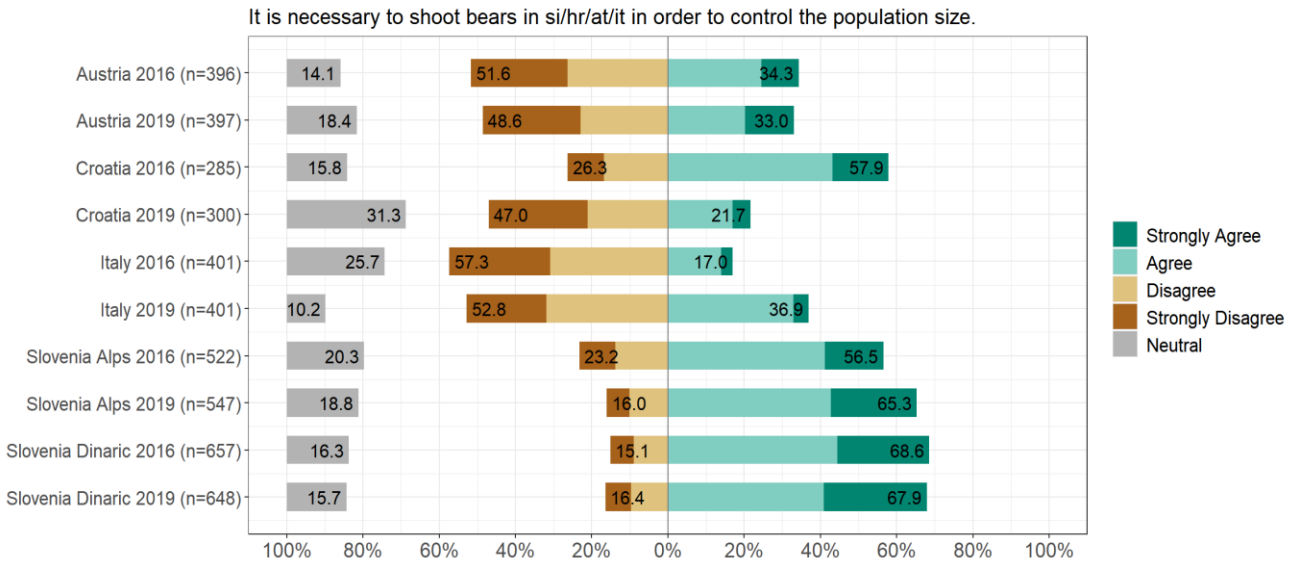

Figure 29: Results of the item "It is necessary to shoot bears in SI/HR/IT/AT in order to control the population size" This item contributed to the PCA score "support for lethal control" with a standardized loading of 0.80.

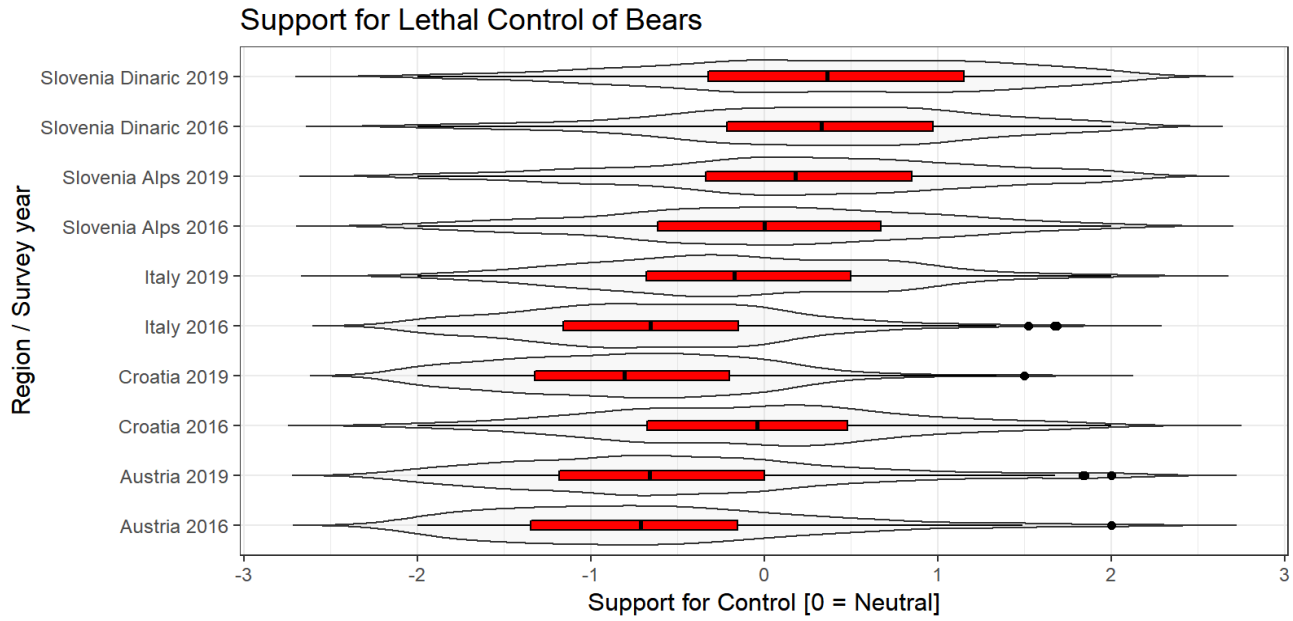

Figure 30: Distribution of the PCA score "Support for lethal control of bears".

Using the constructed model of population control support we can explore the effect of a single variable or a combination of variables while controlling for the effect of other variables. In this manner we can understand the effect of i.e. Region where the respondent lives (or any other parameter we wish to explore) without the confounding effects of other characteristics of the respondent (e.g. education, having livestock etc.)

The final model for "Support of lethal control" was structured as follows:

I((**bear_control***-1) + 3)~Region + Year + gender + age + education + knowledge + has_livestock + seennatureyesno + Region:knowledge + Region:age + gender:knowledge + education:Region + Region:Year.

According to our model, Austrian and to some degree Italian and Croatian respondents do not support lethal control of bears.The Slovenians from the Dinarics consistently recognized the need for lethal control of bear population size and support for lethal control has increased in the Alpine areas during the LIFE DINALP BEAR project implementation (Figure 31). The support for lethal control of bear population was shaped also by the age of the respondents, but only in Slovenia (and marginally Croatia), where older generations (>60 years old) expressed considerably higher support for lethal control (Figure 32). Influence of gender was also documented and men were more likely to support lethal control than women (Figure 33). Also, knowledge about bears has a stronger effect for women than it does for men. The same was for respondents with lower achieved formal education (Figure 34), less knowledge about bear biology (Figure 35), as well as those that own livestock (Figure 36). In areas with high densities of bear there is less difference in support for lethal population control explained by education of the respondent.

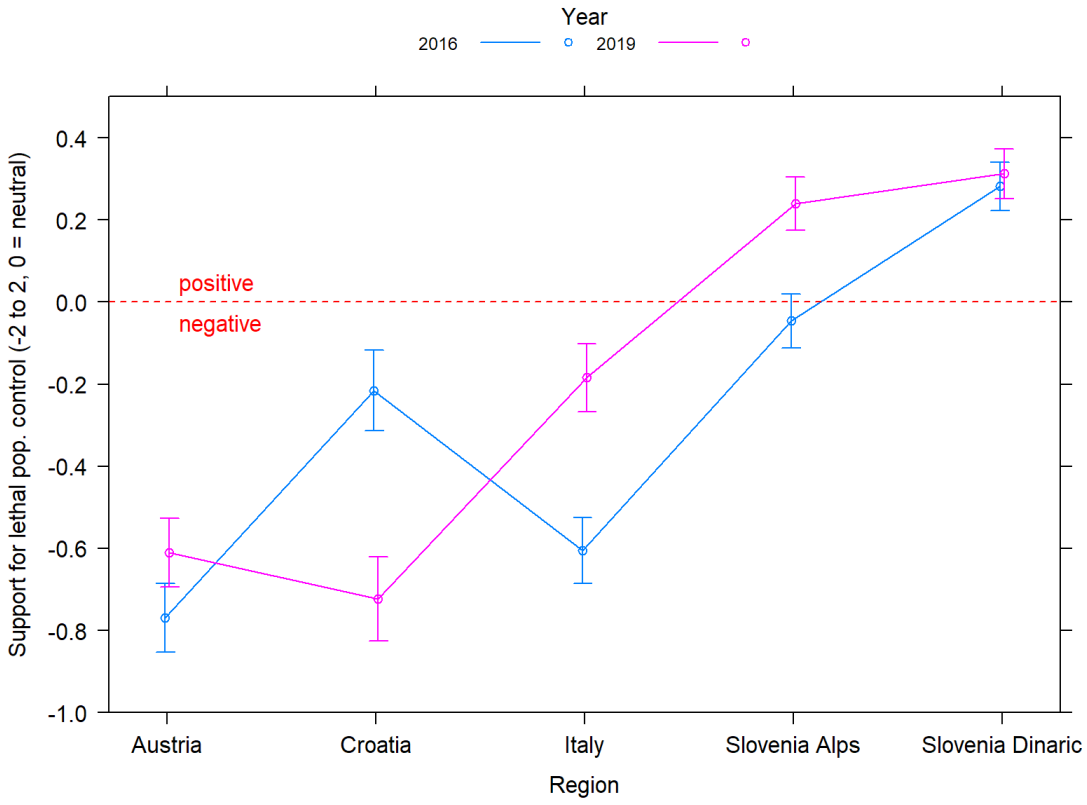

Figure 31: Effects of "region" and "year of survey" on "Support for lethal control".

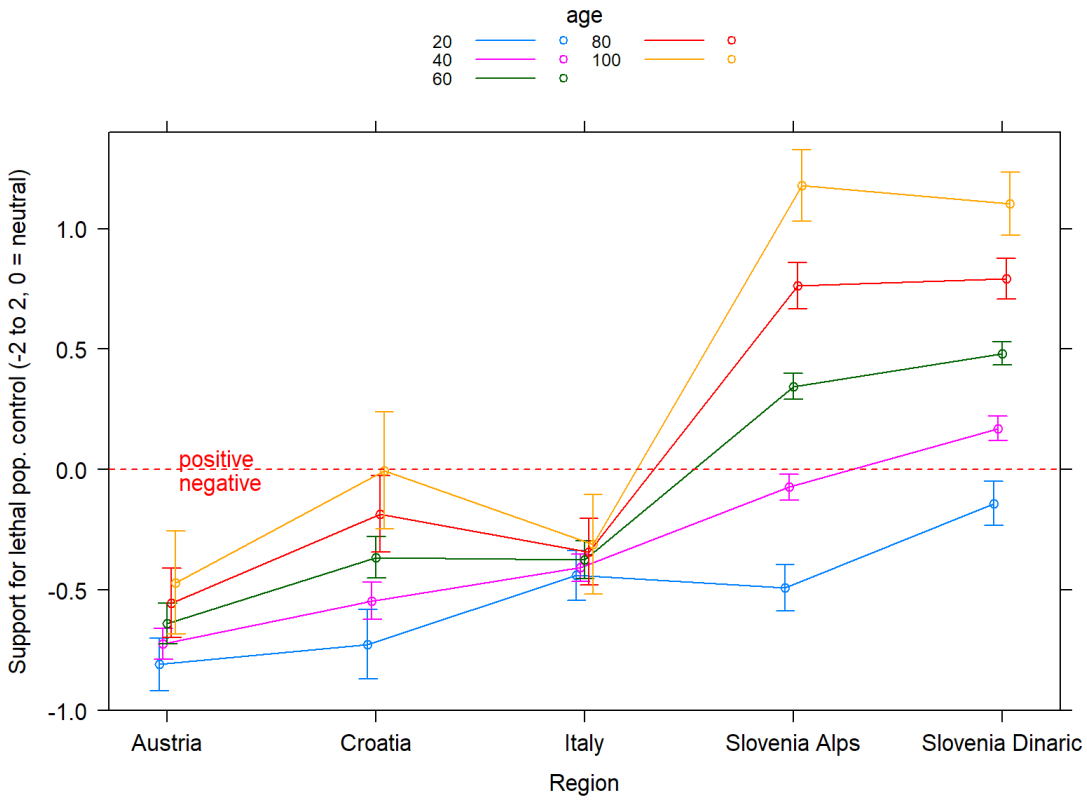

Figure 32: Combined effects of age and region on the Support for lethal population control.

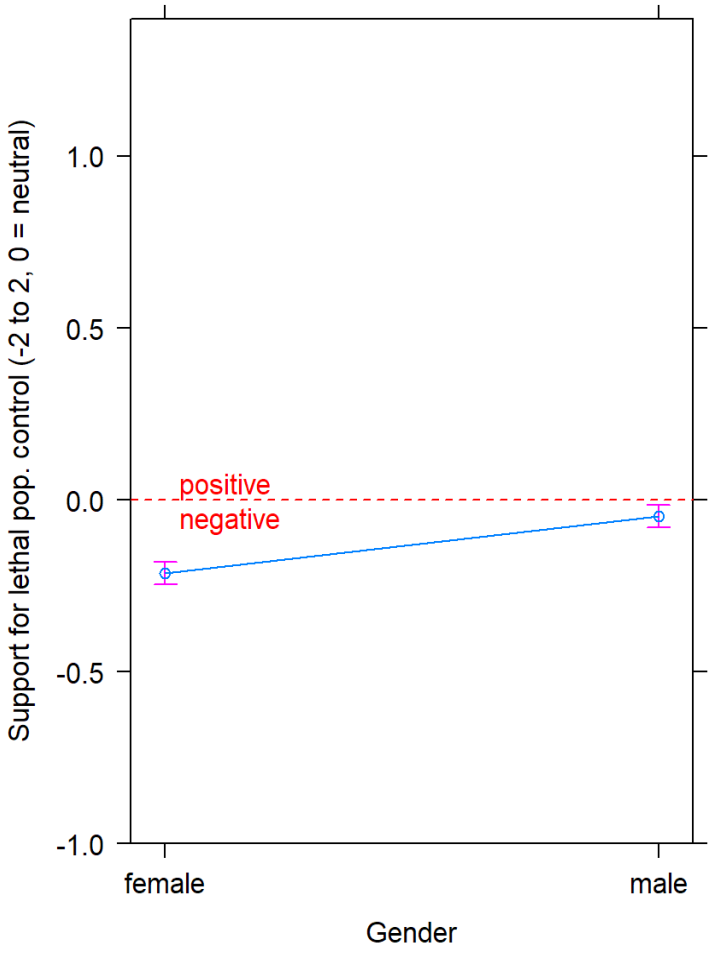

Figure 33: Effects of gender on the Support for lethal population control.

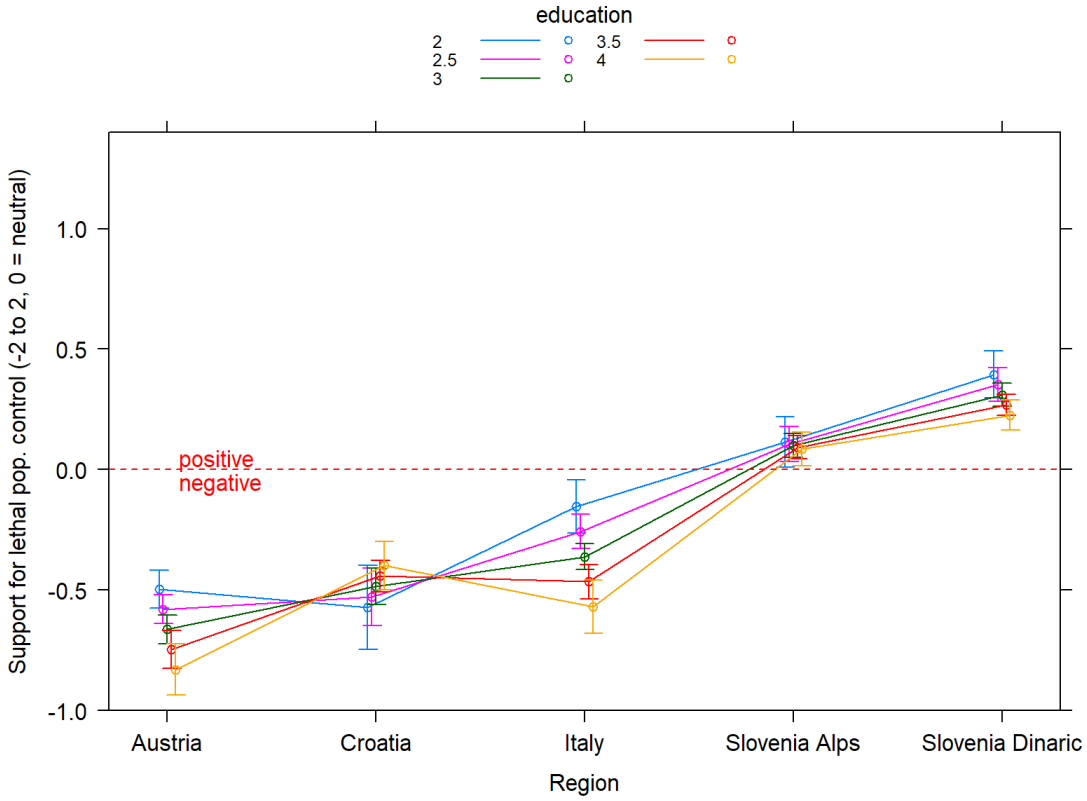

Figure 34: Effects of education on Support for lethal control.

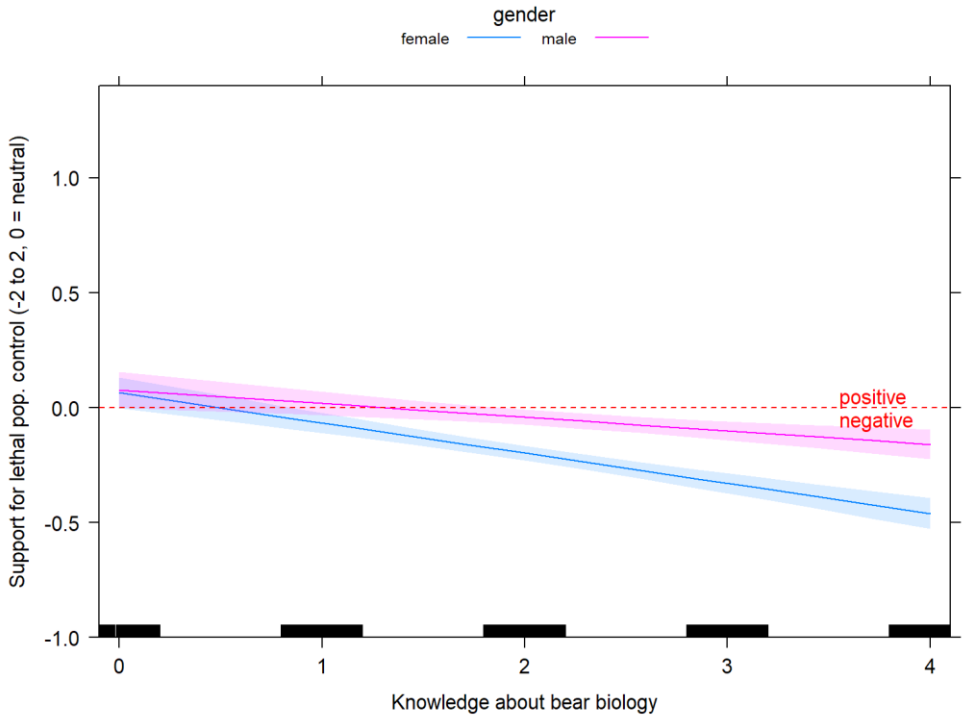

Figure 35: Effects of knowledge about bear biology on Support for lethal control.

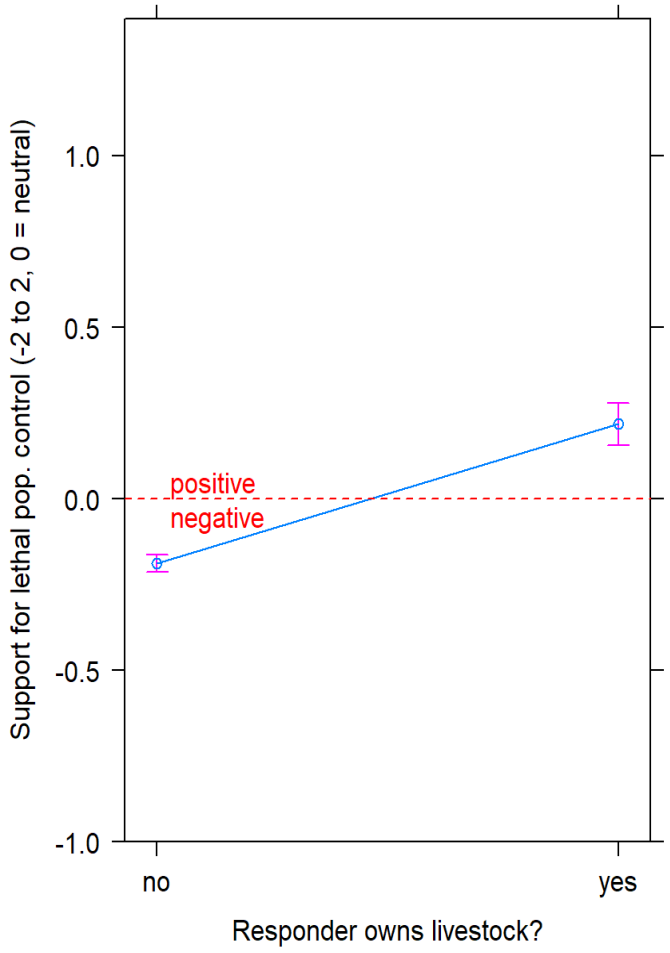

Figure 36: Effect of livestock ownership to Support for lethal control.

Value of bears

The third extracted PCA score was interpreted and labelled as "Value of bears" (Figure 39). Proportion of explained variance was 58%. This component describes the benefits of having bears, but it is important to note that question related to bears increasing value of a hunting ground and question related to consuming bear meat, did not load to this component, thus the score describes the benefits related to the non-consumptive use of bears.

Among the main items to contribute to this component were some that were already presented above:

- Figure 16: "Having bears in SI/HR/IT/AT is…". This item contributed to the PCA score "value of bears" with a standardized loading of 0.82.
- Figure 17: "It is important to have bear population in SI/HR/IT/AT for the future generations". This item contributed to the PCA score "value of bears" with a standardized loading of 0.81.

- Figure 14: " I would agree with increasing bear numbers in SI/HR/IT/AT". This item contributed to the PCA score "value of bears" with a standardized loading of 0.70.

Other contributing items were related to assessing the potential of organized bear watching (Figure 37) and assessing the effects of bear presence to local economy (Figure 38).

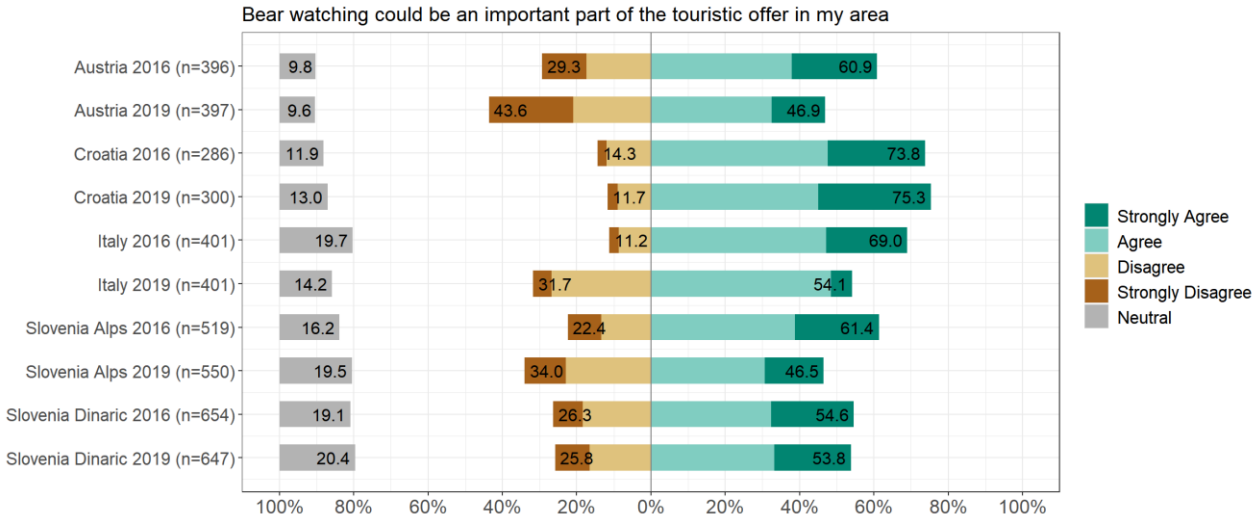

Figure 37: Results of the item "Bear watching could be an important part of touristic offer in my area" This item contributed to the PCA score "value of bears" with a standardized loading of 0.71.

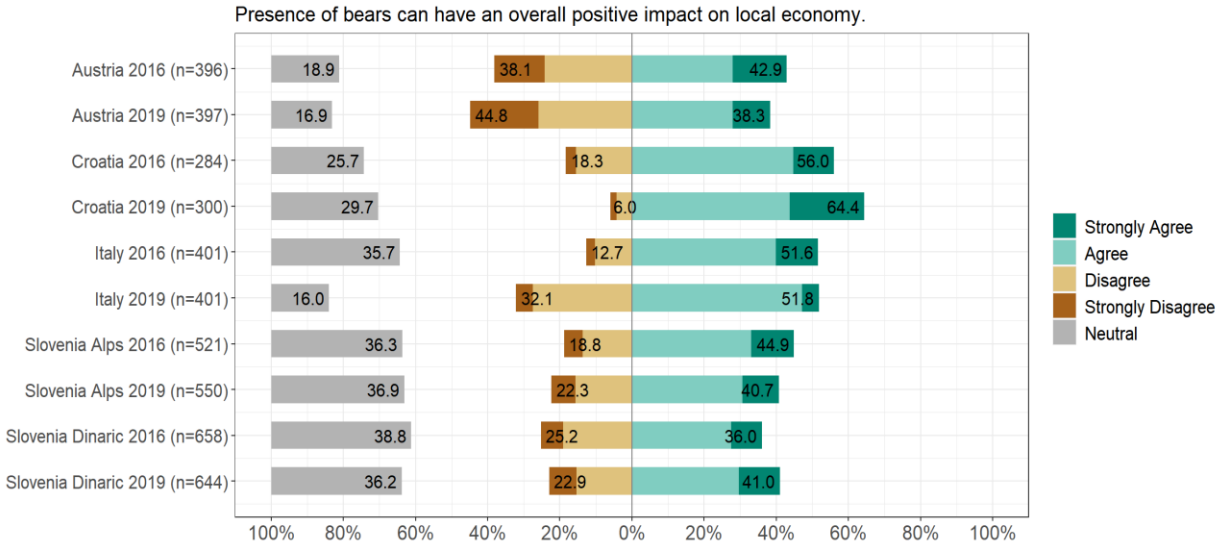

Figure 38: Results of the item "Presence of bears can have an overall positive impact on local economy" This item contributed to the PCA score "value of bears" with a standardized loading of 0.80.

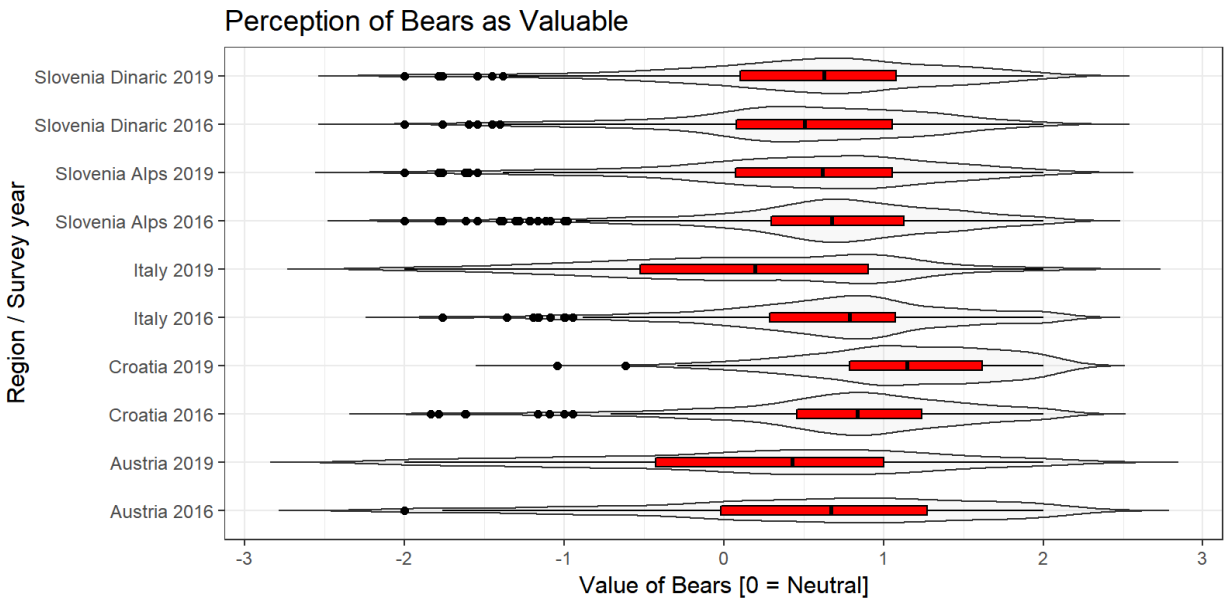

Figure 39: Distribution of the PCA score "Value of bears".

The final model for Value of bears had this structure: I((**bear_value***-1) + 3)~Region + Year + age + education + dogowner + knowledge + has_livestock + Region:age + Region:Year + dogowner:Region + education:Year

According to our model, in all regions respondent perceived bears as beneficial for the local communities and in the Dinarics (Croatia and Slovenia Dinarics) the support was higher in 2019 in comparison to 2016 (Figure 40). Among other factors contributing to this component, knowledge of bear biology had the weightiest effect (Figure 43). Younger (Figure 41) and better educated (Figure 42) respondents tend to perceive bears as beneficial for local communities more than the older ones. The results also suggest that between 2016 and 2019 people with lower education started attributing less value to bears.

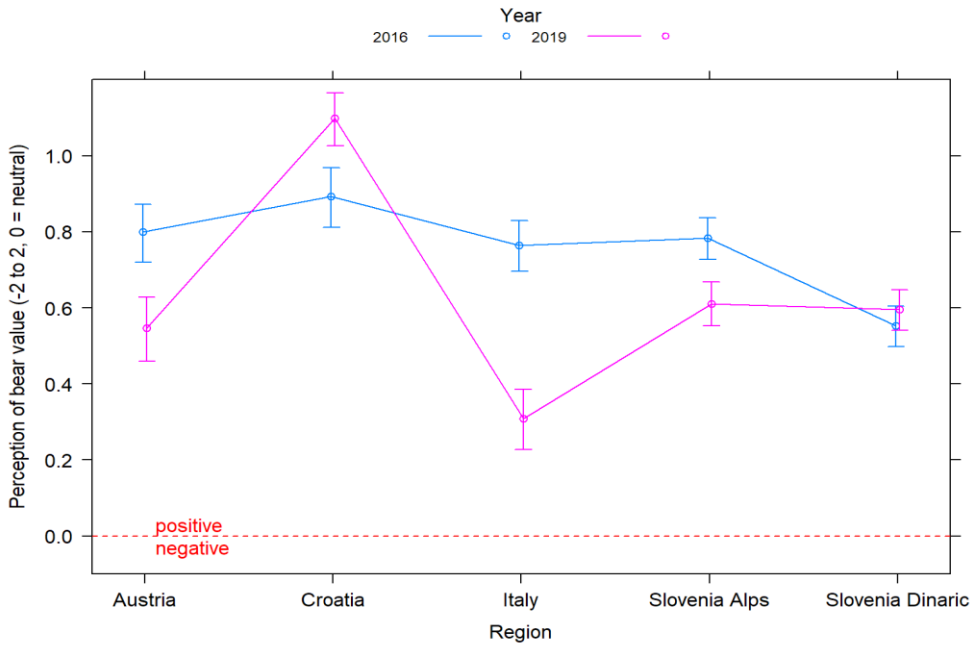

Figure 40: Effects of region and year of survey on perception of bear value.

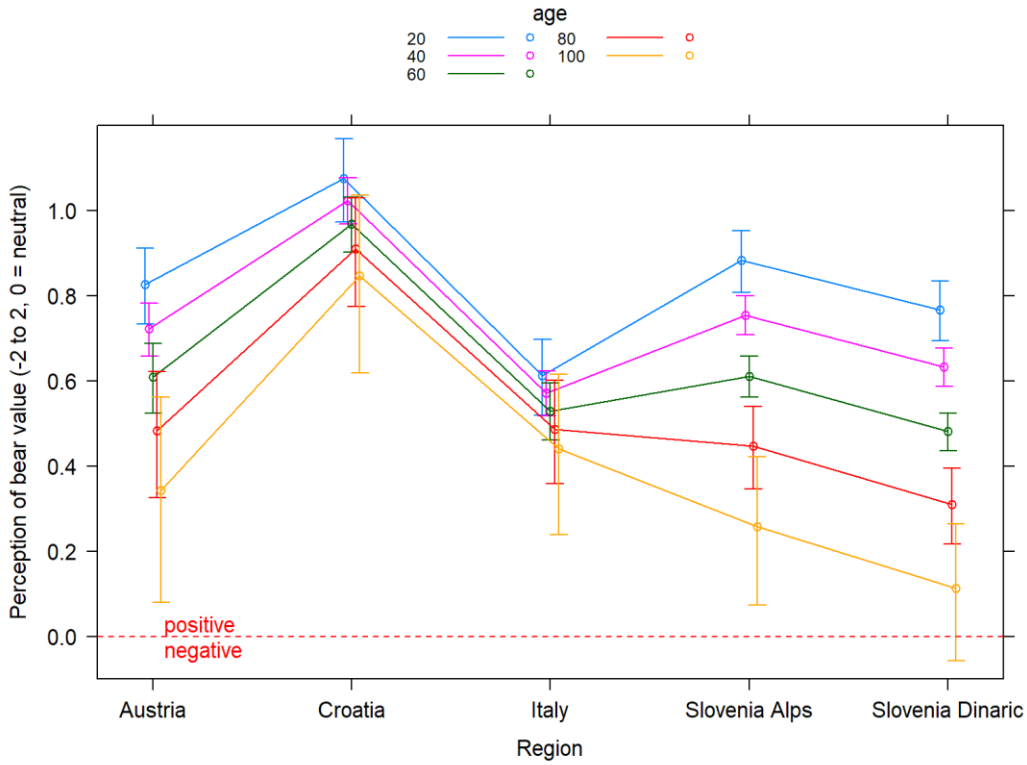

Figure 41: Effects of respondents' age on perception of bear value.

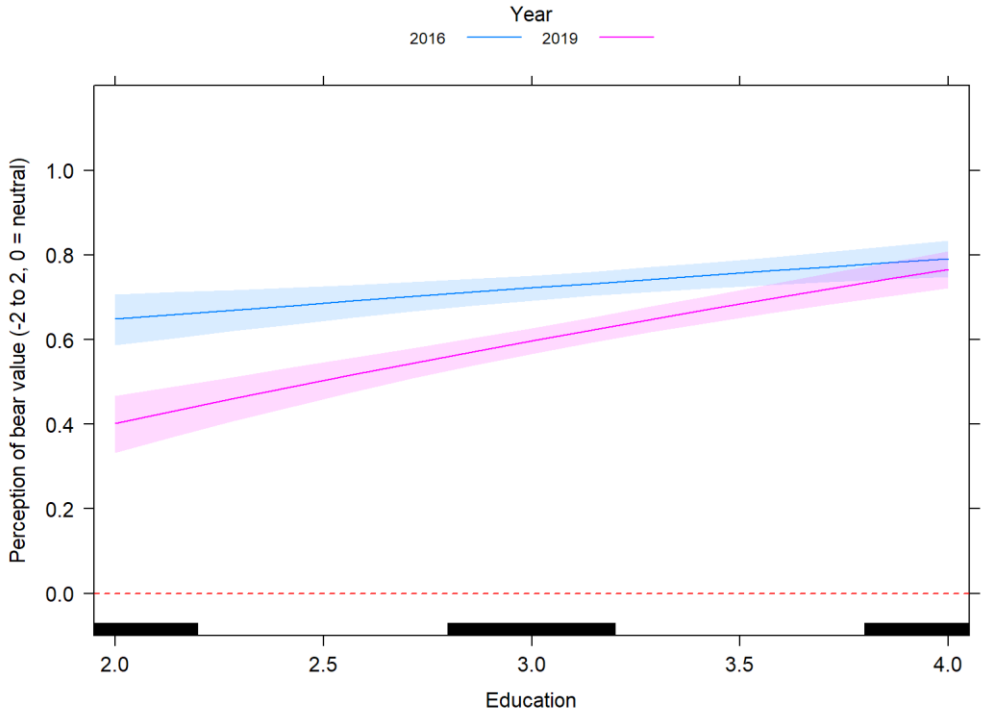

Figure 42: Effects of education on perception of bear value.

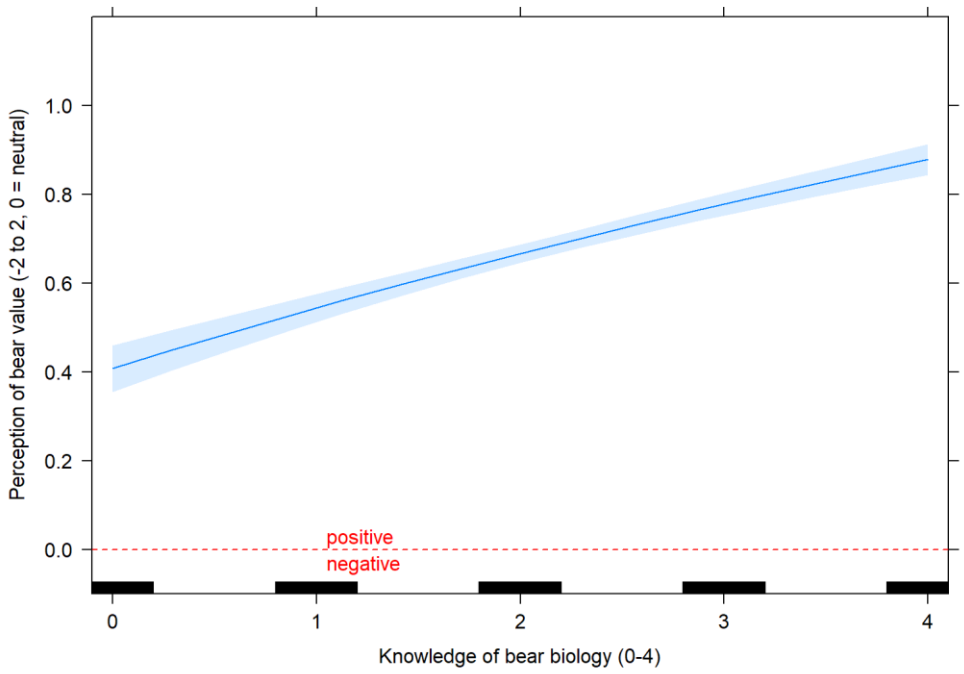

Figure 43: Effects of knowledge of bear biology on perception of value of bears.

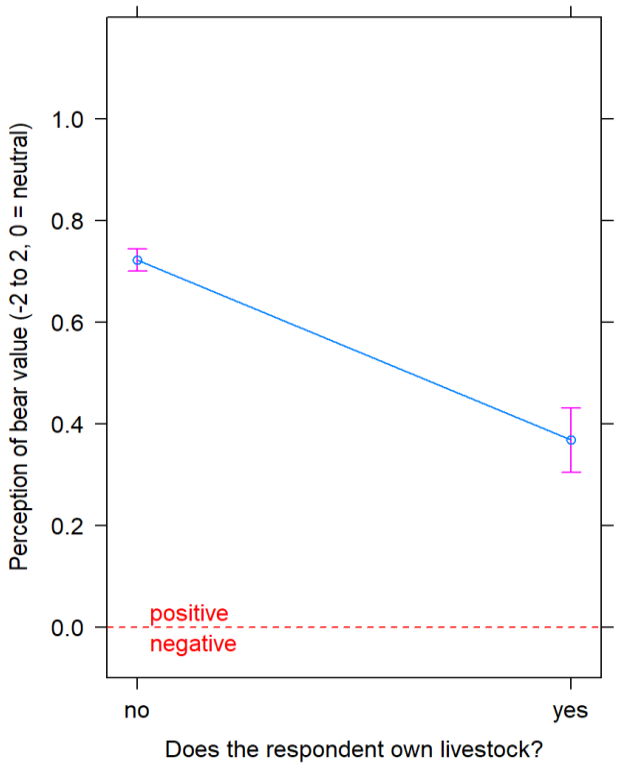

Figure 44: Effects of having livestock on perception of value of bears.

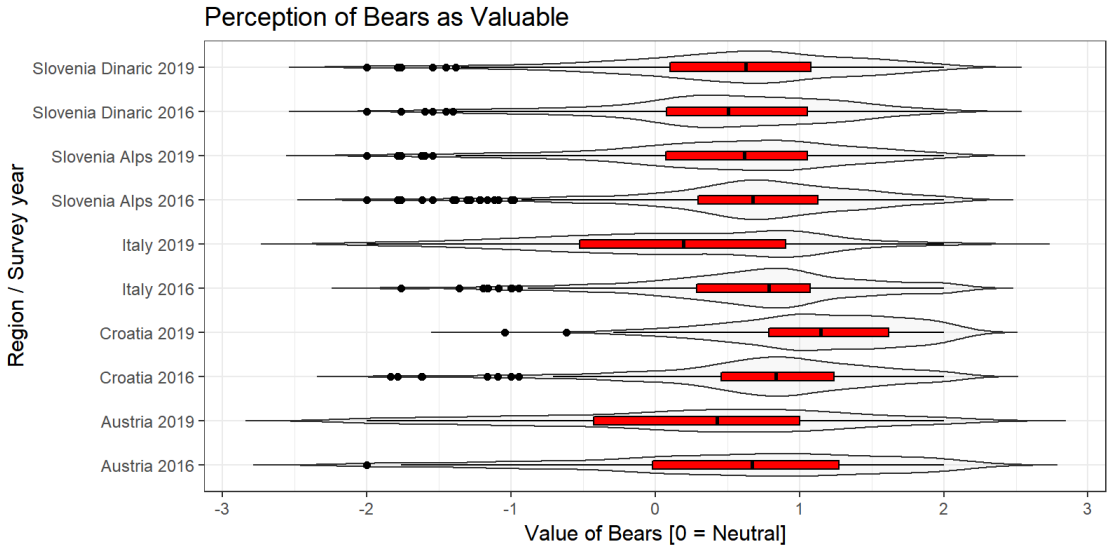

Figure 45: Distribution of Value of bears score per region and year of survey.

Perceptions about human-bear conflicts

Eight items were designed in the questionnaire with a purpose to explore respondents' perceptions about human bear conflict. The respondents were asked to assess how problematic (if at all) different situations with bears were for them personally. The scale ranges from "very problematic" to "I like the idea". The raw results for these items are presented in the Figure 46 to Figure 54. To varying degrees all of the presented situations were found problematic by our respondents. PCA analysis has not identified any significant structure, so one PCA score was extracted (Table 2) and interpreted as "tolerance of bear conflicts" (Figure 55).

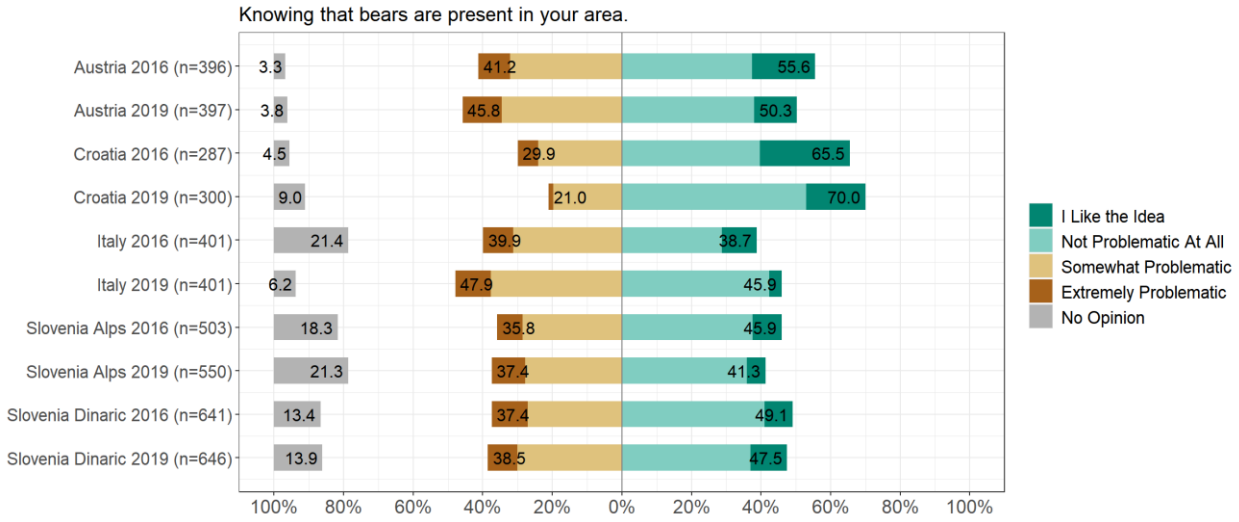

Figure 46: Results for the item "How problematic is for you knowing that bears are present in your area?".

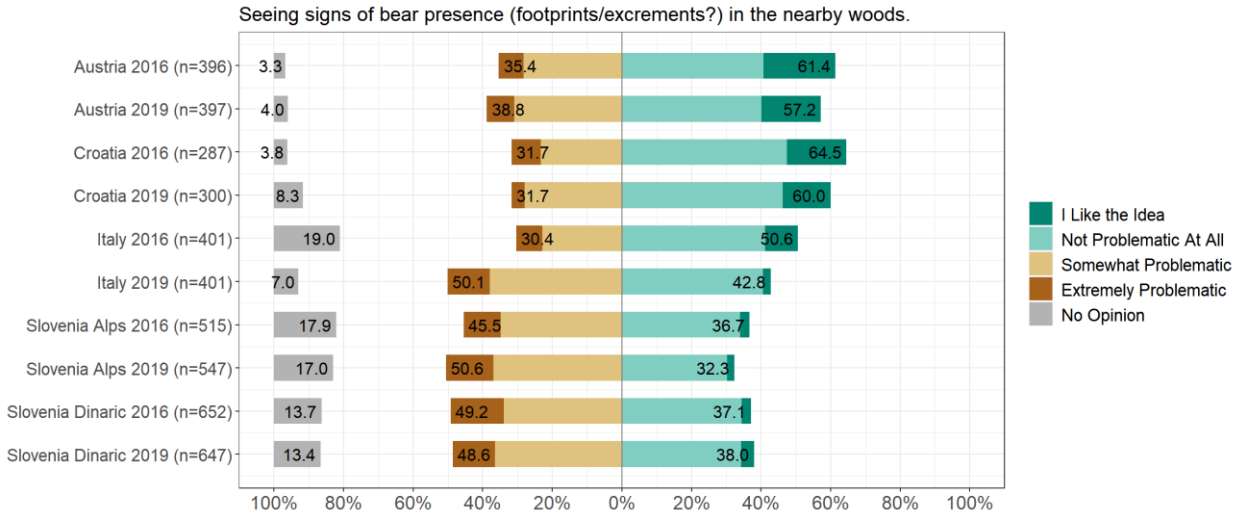

Figure 47: Results for the item "How problematic is for you seeing signs of bear presence (footprints, excrements…) in the nearby woods?".

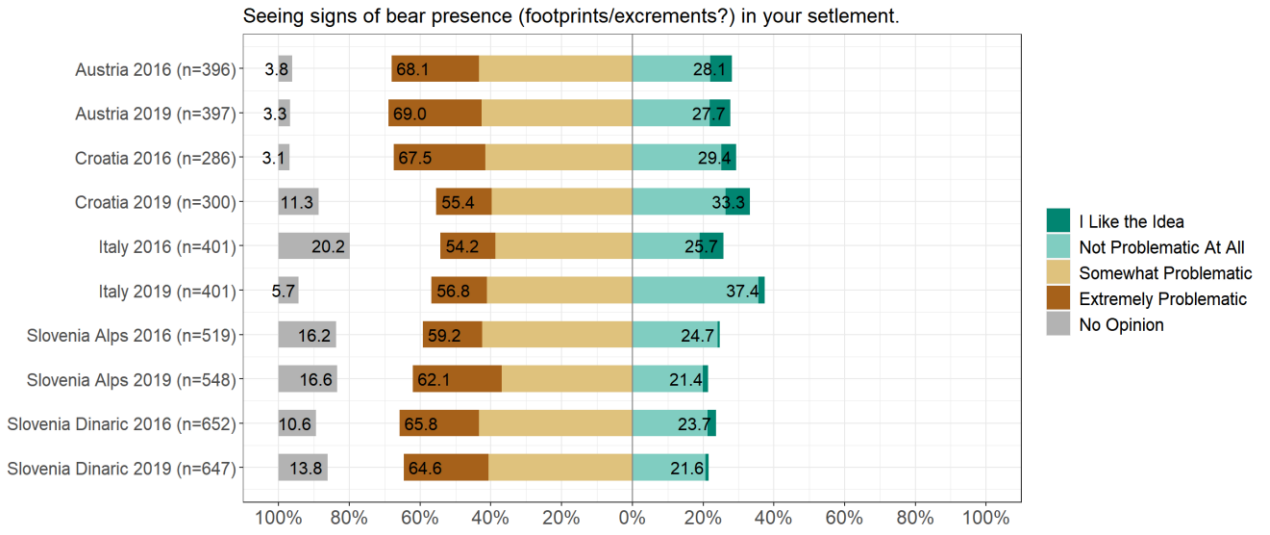

Figure 48: Results for the item "How problematic is for you seeing signs of bear presence (footprints, excrements…) in your settlement?".

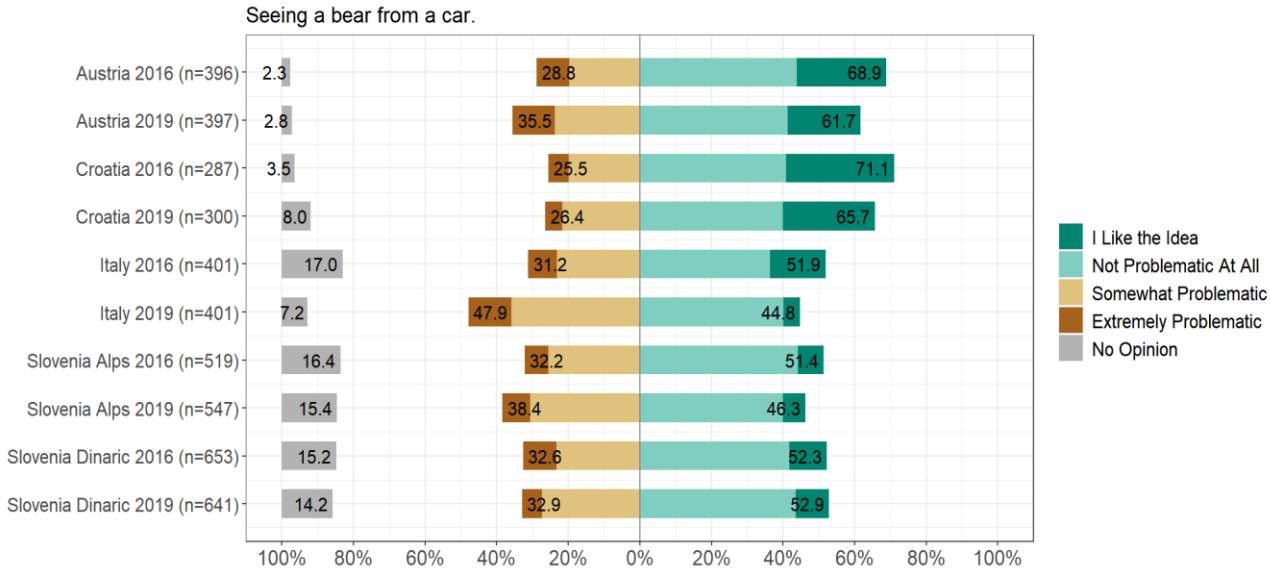

Figure 49: Results for the item "How problematic is for you seeing a bear from a car?".

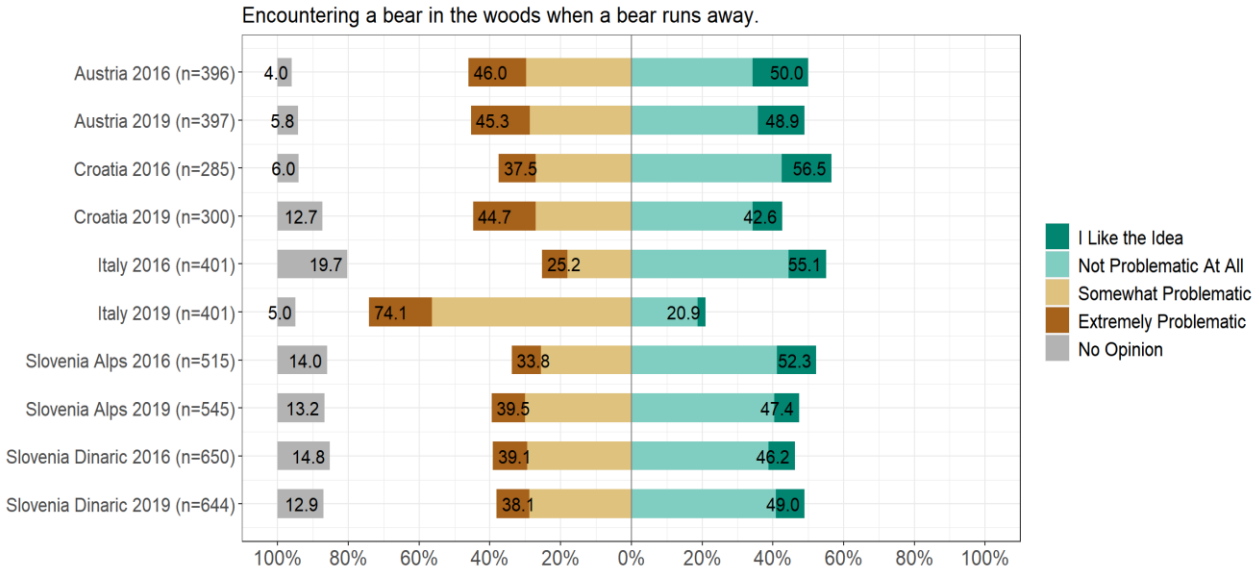

Figure 50: Results for the item "How problematic is for you encountering a bear in the woods when a bear runs away.

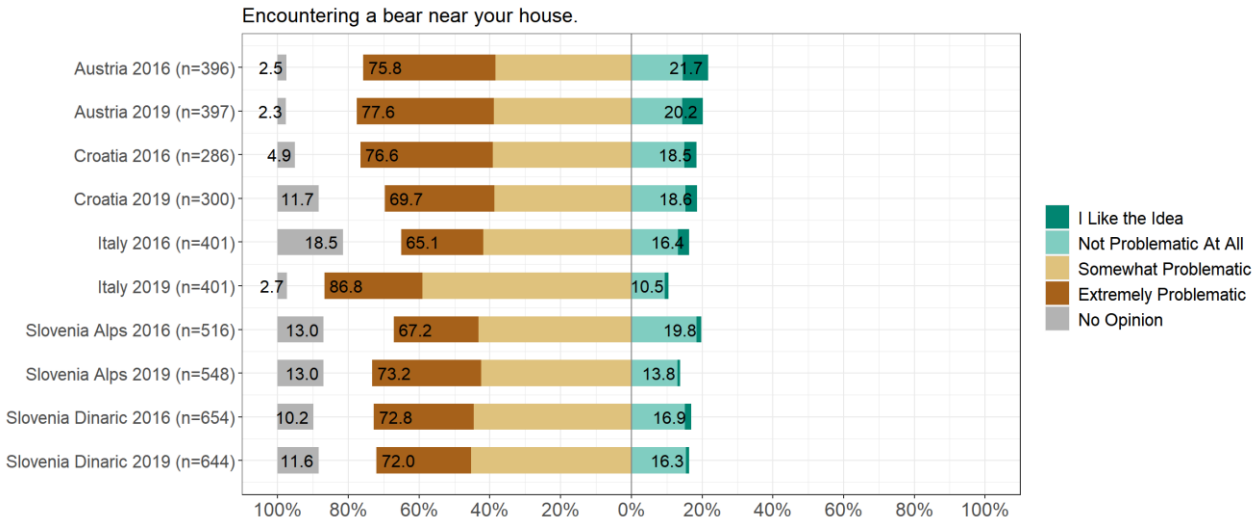

Figure 51: Results for the item "How problematic is for you encountering a bear near your house.

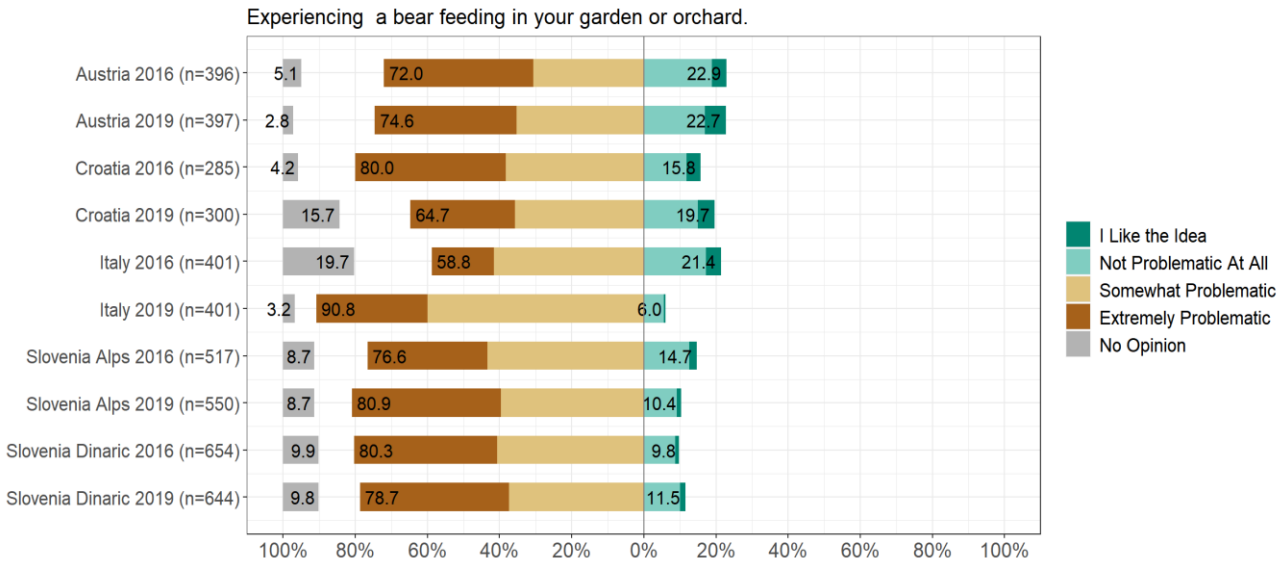

Figure 52: Results for the item "How problematic is for you experiencing a bear feeding in your garden or orchard.

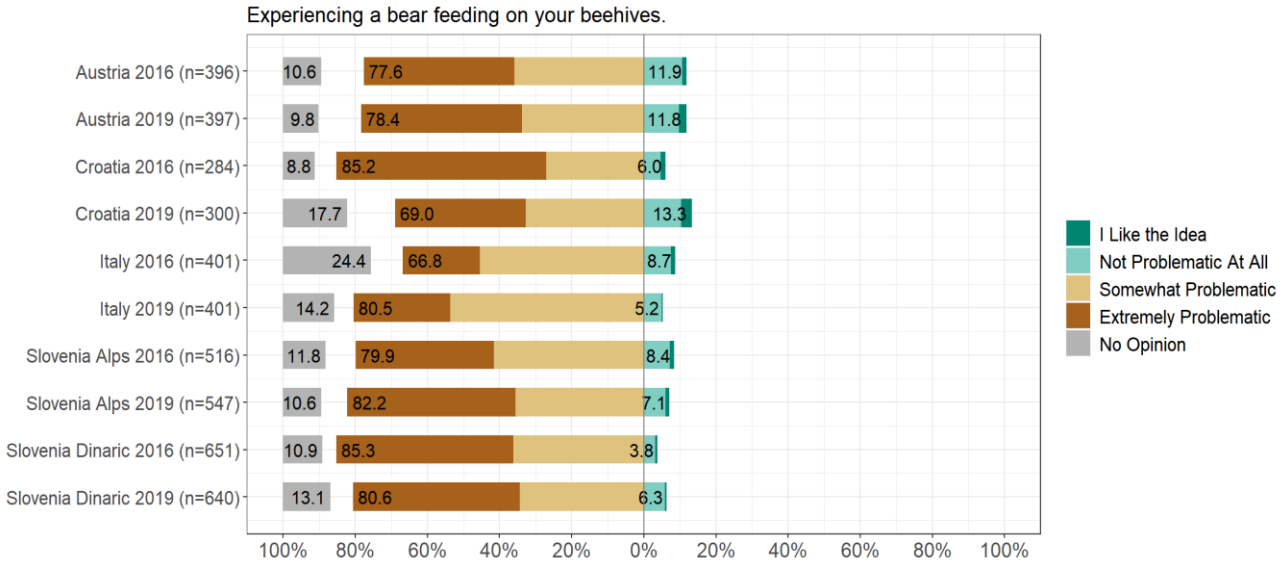

Figure 53: Results for the item "How problematic is for you experiencing a bear feeding on your beehives.

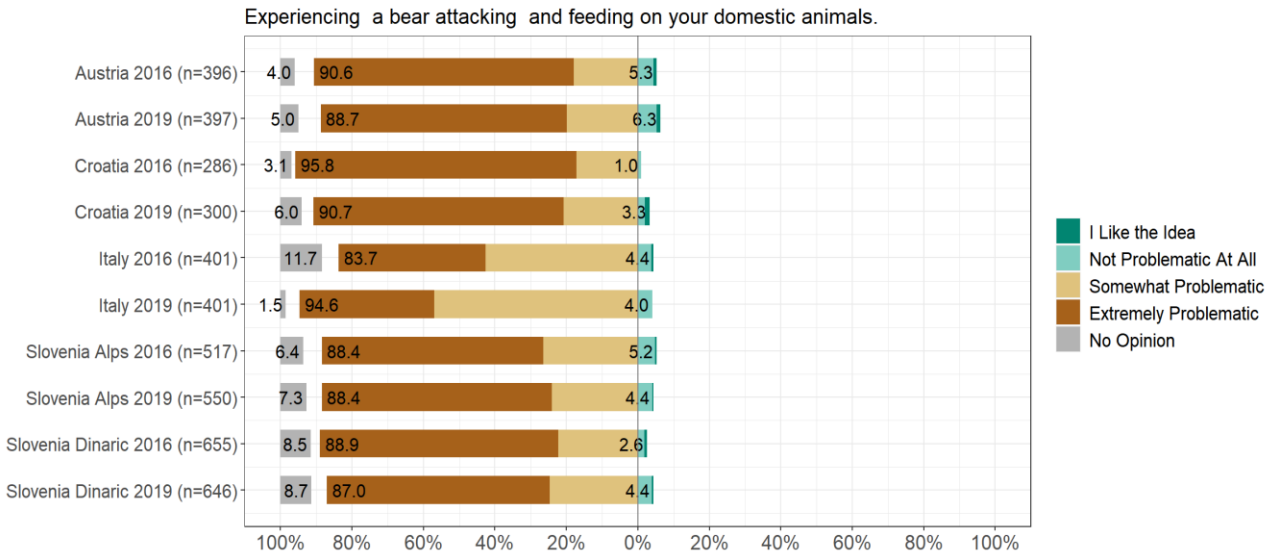

Figure 54: Results for the item "How problematic is for you experiencing a bear attacking and feeding on your domestic animals."

Table 2: Standardized PCA loadings of the items for the PCA score "Tolerance of bear conflicts".

How problematic is for you…	Standardized PCA loading
… knowing that bears are present in your area	0.73
…seeing signs of bear presence (footprints, excrements…) in the nearby woods	0.77
… seeing signs of bear presence (footprints, excrements…) in your settlement	0.82
… seeing a bear from a car	0.68
… encountering a bear in the woods when a bear runs away.	0.70
… encountering a bear near your house.	0.84
… experiencing a bear feeding in your garden or orchard.	0.81
… experiencing a bear feeding on your beehives.	0.67
…experiencing a bear attacking and feeding on your domestic animals	0.58

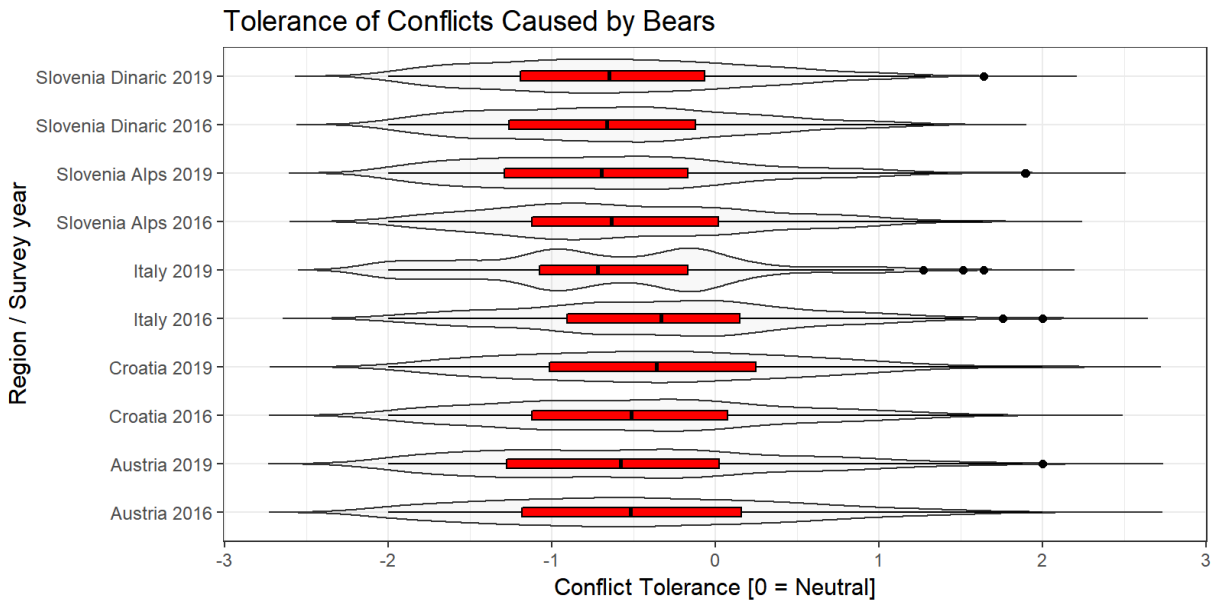

Figure 55: Distribution of "tolerance of conflicts" score.

The final model for "conflict tolerance" was structured as follows: I(**conflict_tolerance** + 3)~georegion + Year + gender + education + has_livestock + knowledge + dogowner + georegion:Year + has_livestock:Year + knowledge:Year

According to our model, Croatians can tolerate the most conflict situations although all groups loaded negative on the "conflict tolerance" score (Figure 56). In the Alpine regions the tolerance of conflicts has decreased between the two measurements. Younger generations, those that do not own livestock, dog owners and knowledgeable about bear biology were more tolerant of conflicts with bears (Figure 57, Figure 58, Figure 59, Figure 60). Tolerance of bear conflicts has dropped considerably among livestock owners between the two measurements.

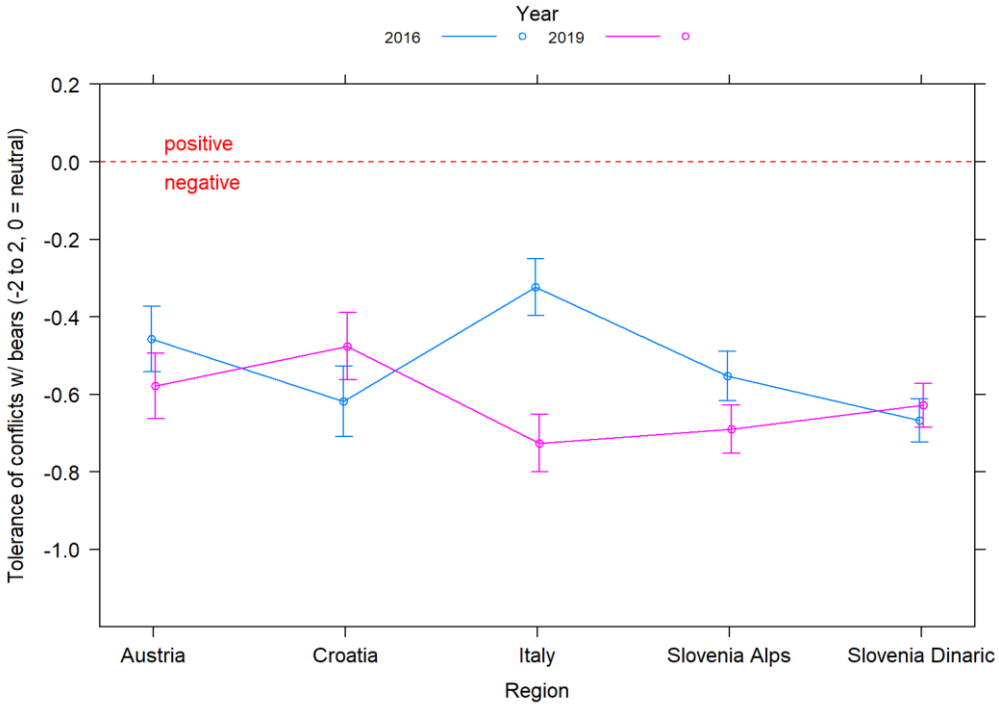

Figure 56: Effects of region and year of survey on "bear conflict tolerance".

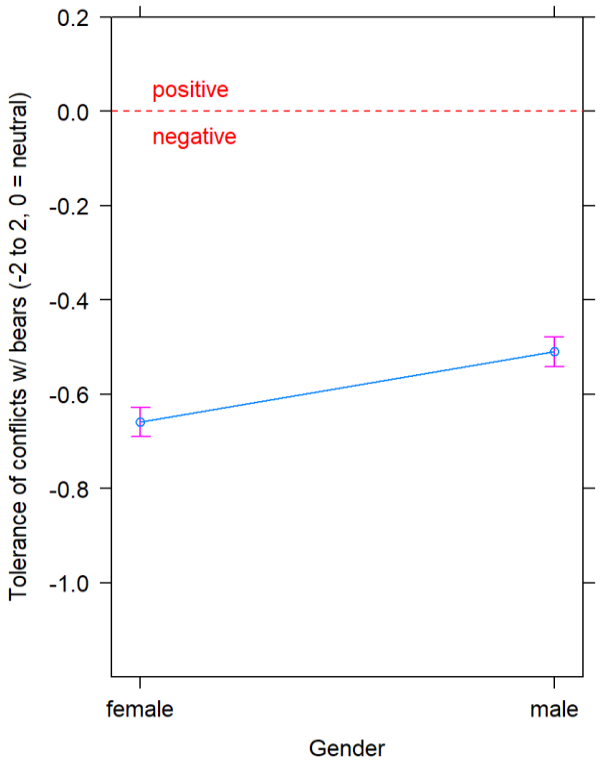

Figure 57: Effects of gender on "bear conflict tolerance".

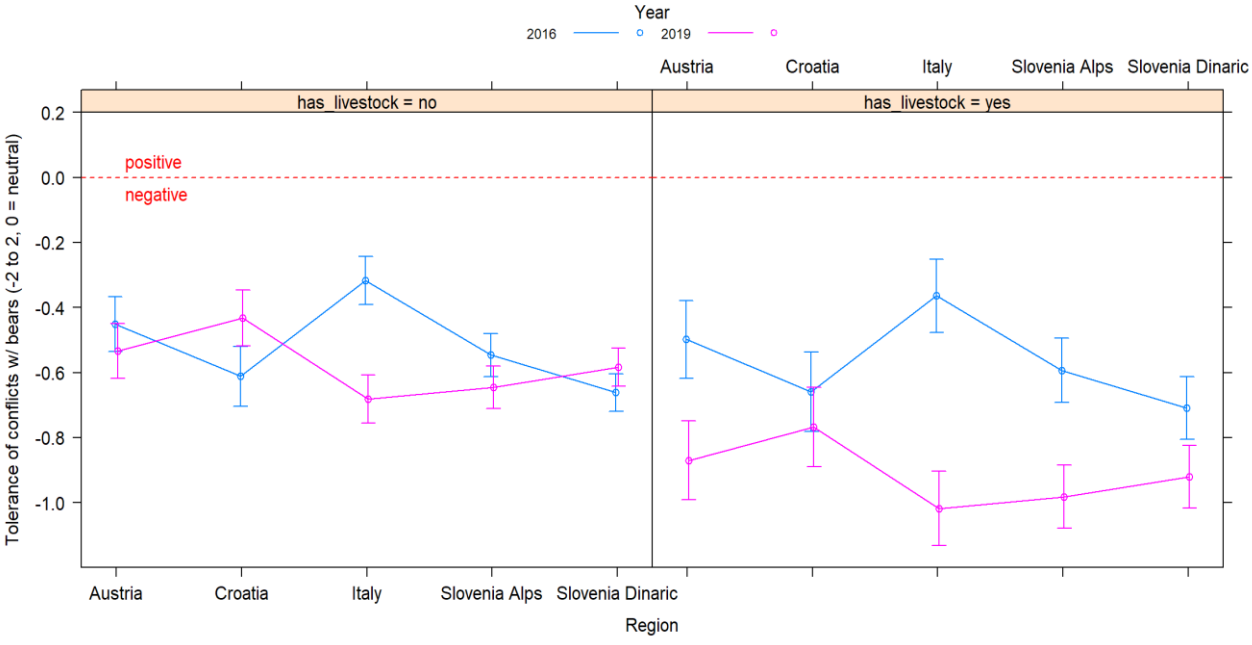

Figure 58: Differences in tolerance of bear conflicts depending on livestock ownership and year of survey, by Region.

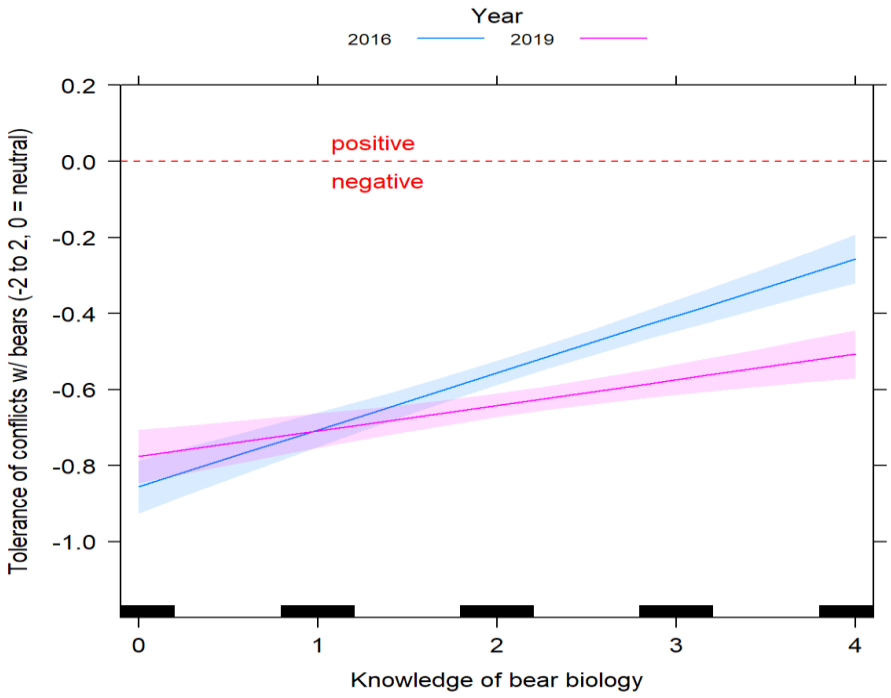

Figure 59: Effects of knowledge of bear biology on "bear conflict tolerance".

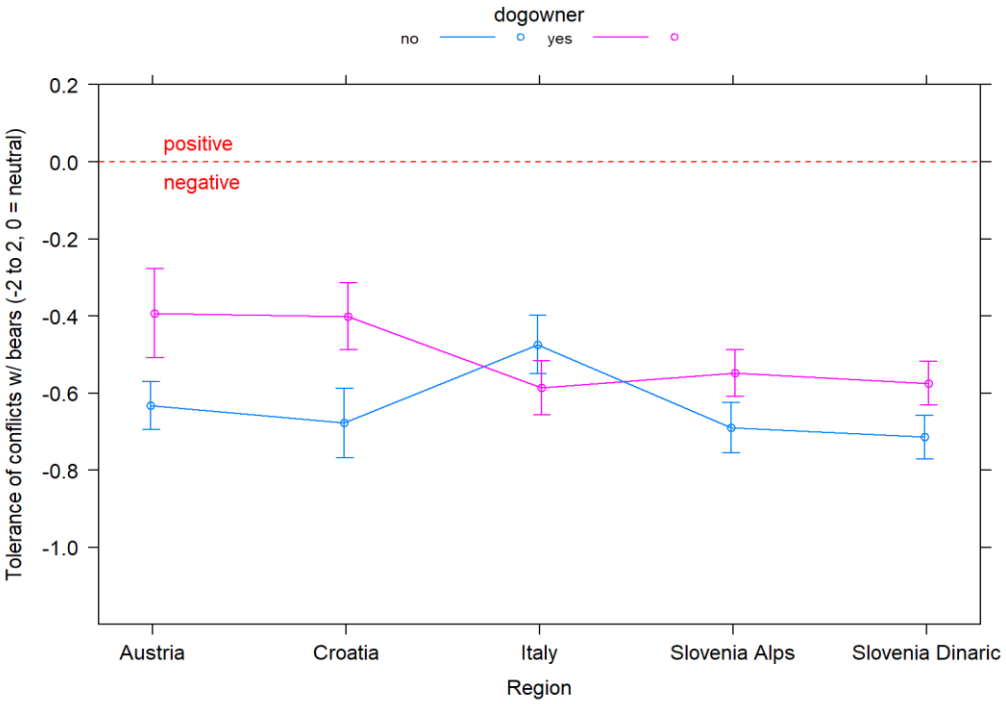

Figure 60: Effects of owning a dog on "bear conflict tolerance".

Beliefs about solutions to human-bear conflicts

Nine items were designed in the questionnaire with a purpose to investigate respondents' perceptions about the effectiveness of possible solutions to human-bear conflicts. The respondents were asked to assess how (if) effective different solutions to bear conflict were according to their personal opinion. The scale ranged from "measure is actually increasing the problem" to "very effective". Raw data for the nine items are presented in Figure 61 to Figure 69.

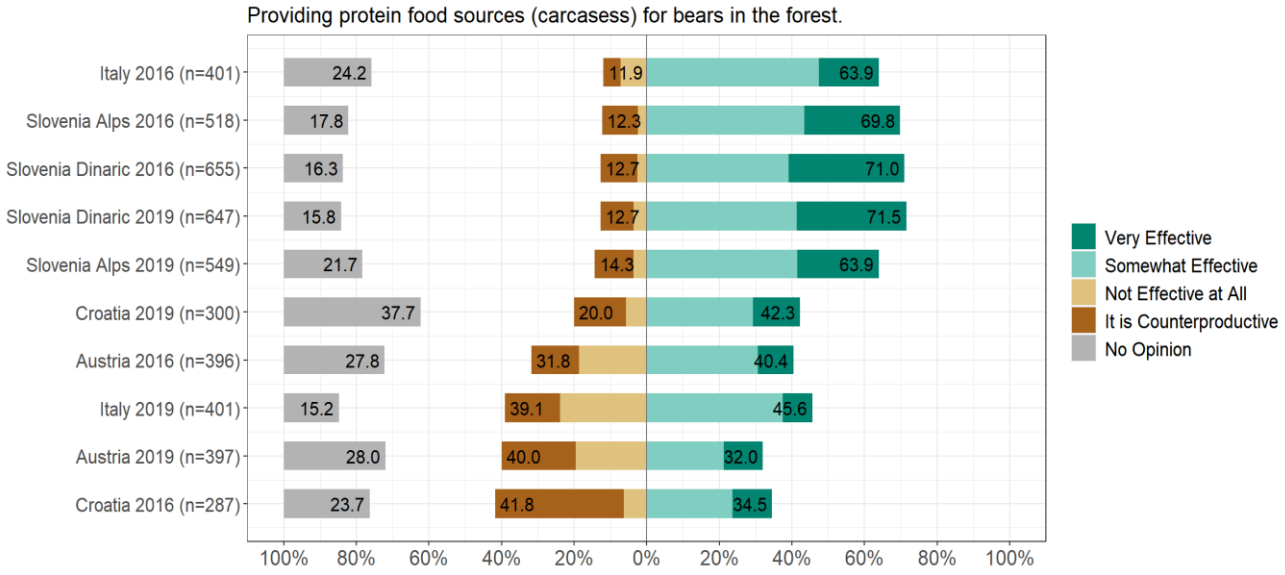

Figure 61: Results for the item "How effective in mitigating human-bear conflicts is providing protein food sources (carcasses) for bears in the forest".

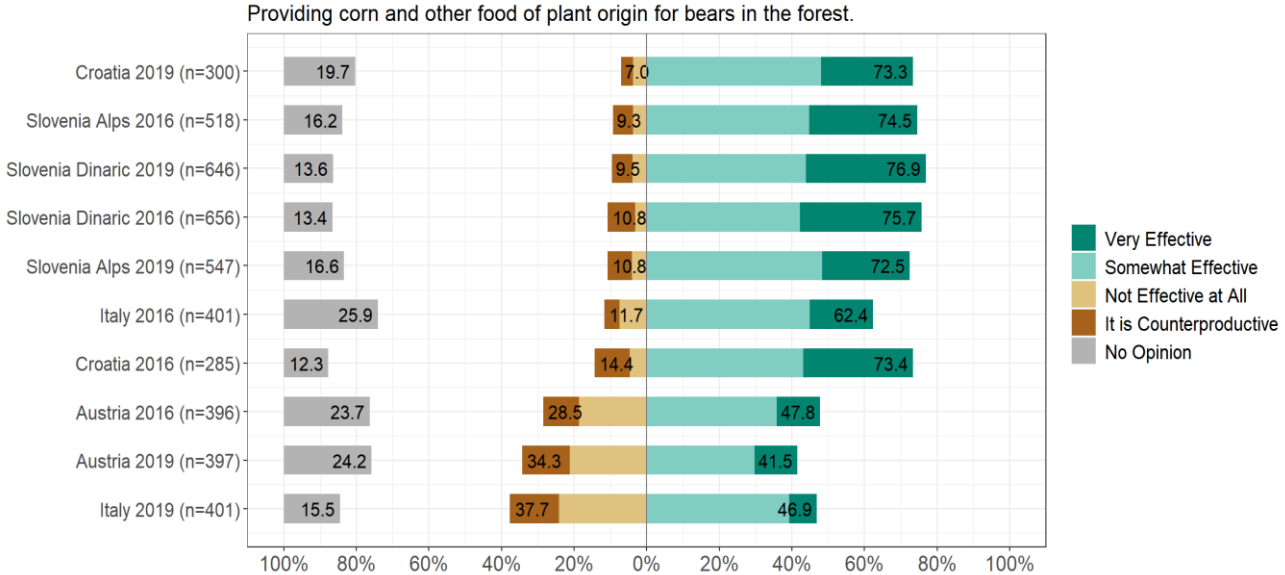

Figure 62: Results for the item "How effective in mitigating human-bear conflicts is providing corn and other food of plant origin for bears in the forest".

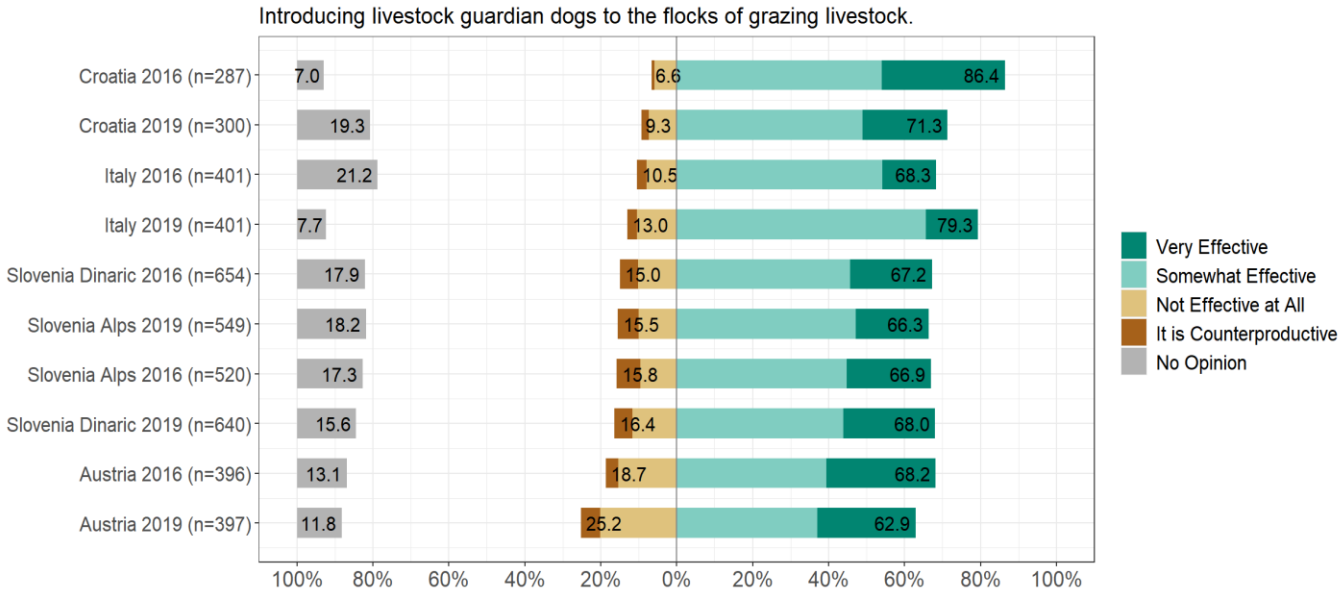

Figure 63: Results for the item "How effective in mitigating human-bear conflicts is introducing livestock guarding dogs to the flocks of grazing livestock."

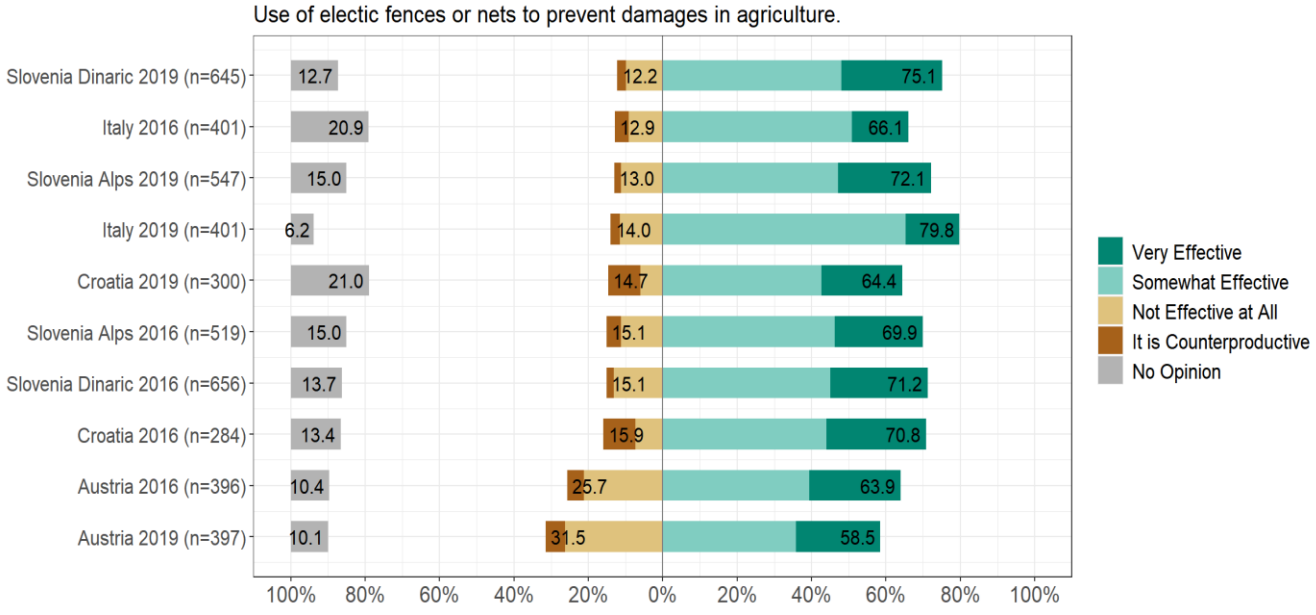

Figure 64: Results for the item "How effective in mitigating human-bear conflicts is use of electric fences or nets to prevent damages in agriculture."

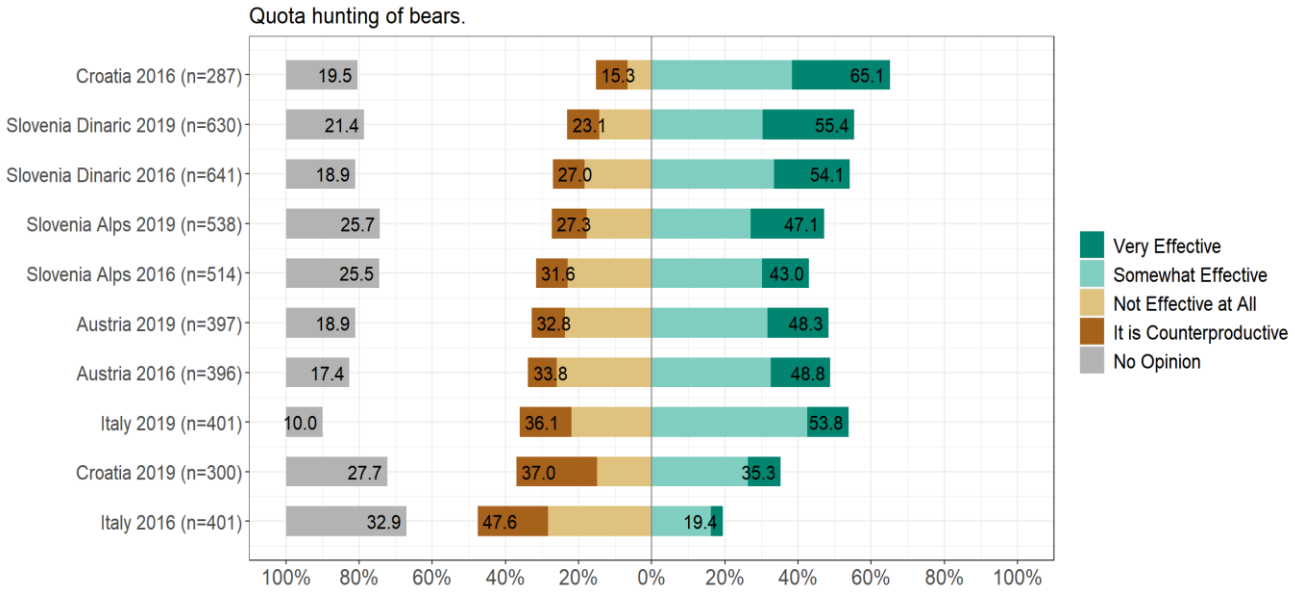

Figure 65: Results for the item "How effective in mitigating human-bear conflicts is a regular quota for hunting of bears."

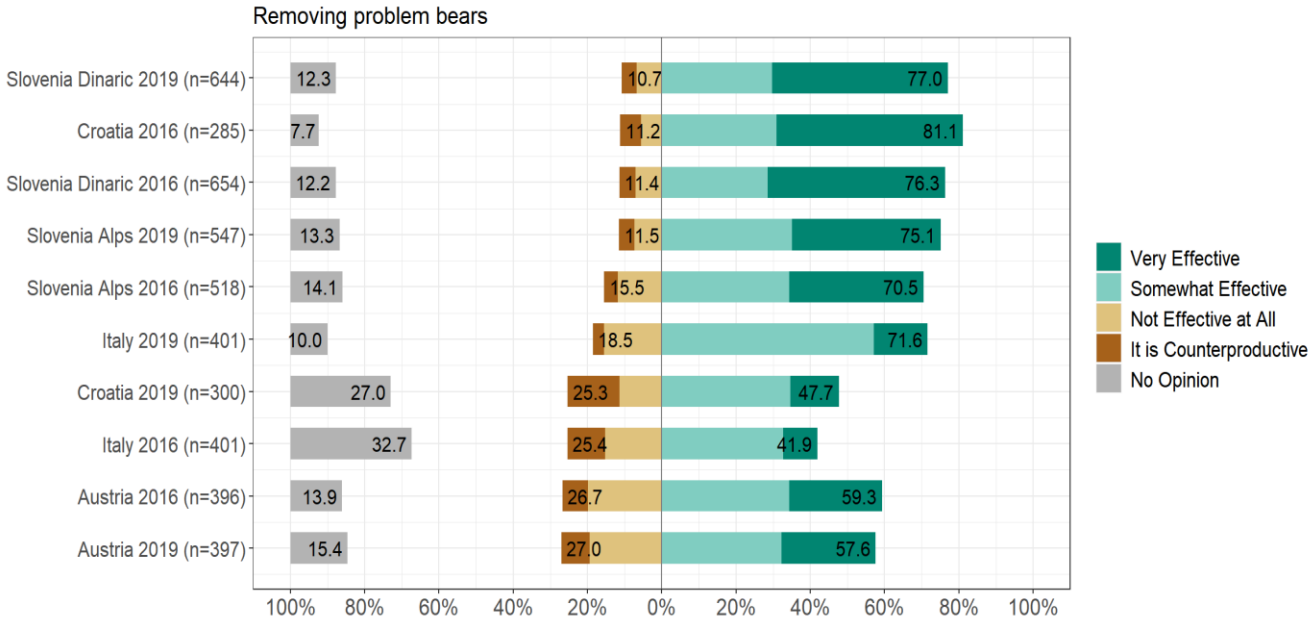

Figure 66: Results for the item "How effective in mitigating human-bear conflicts is removal of problem bears".

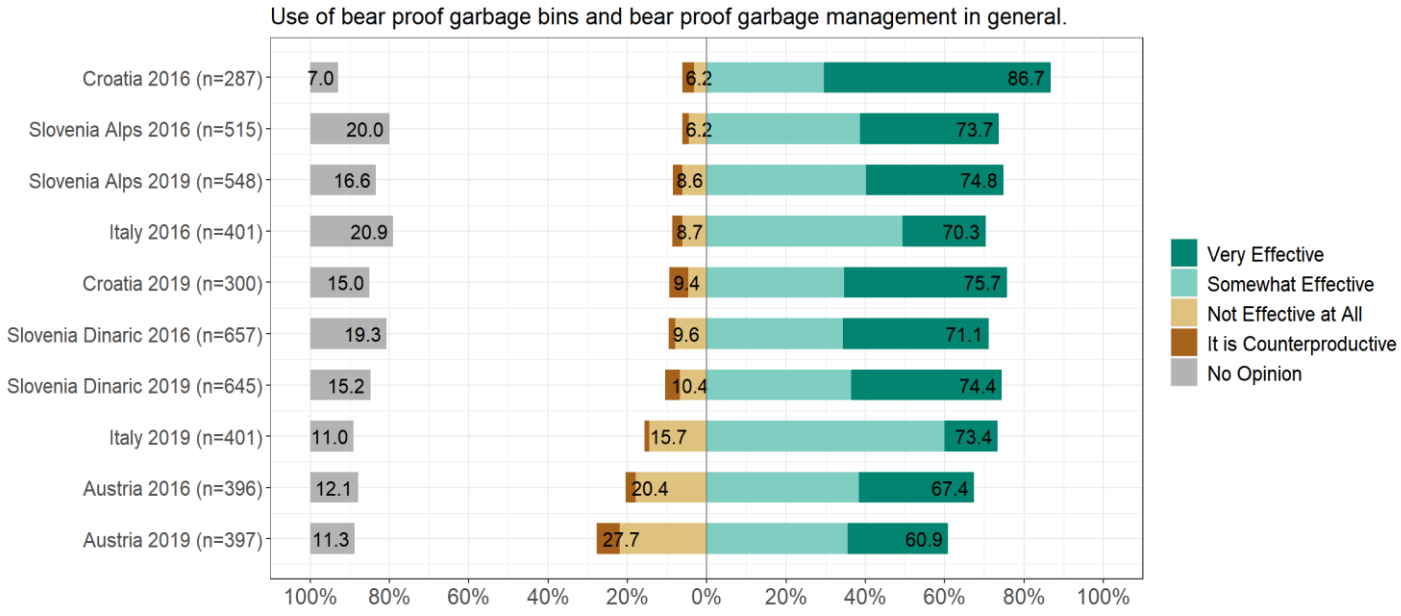

Figure 67: Results for the item "How effective in mitigating human-bear conflicts is use of bear proof garbage bins and bear proof garbage management in general".

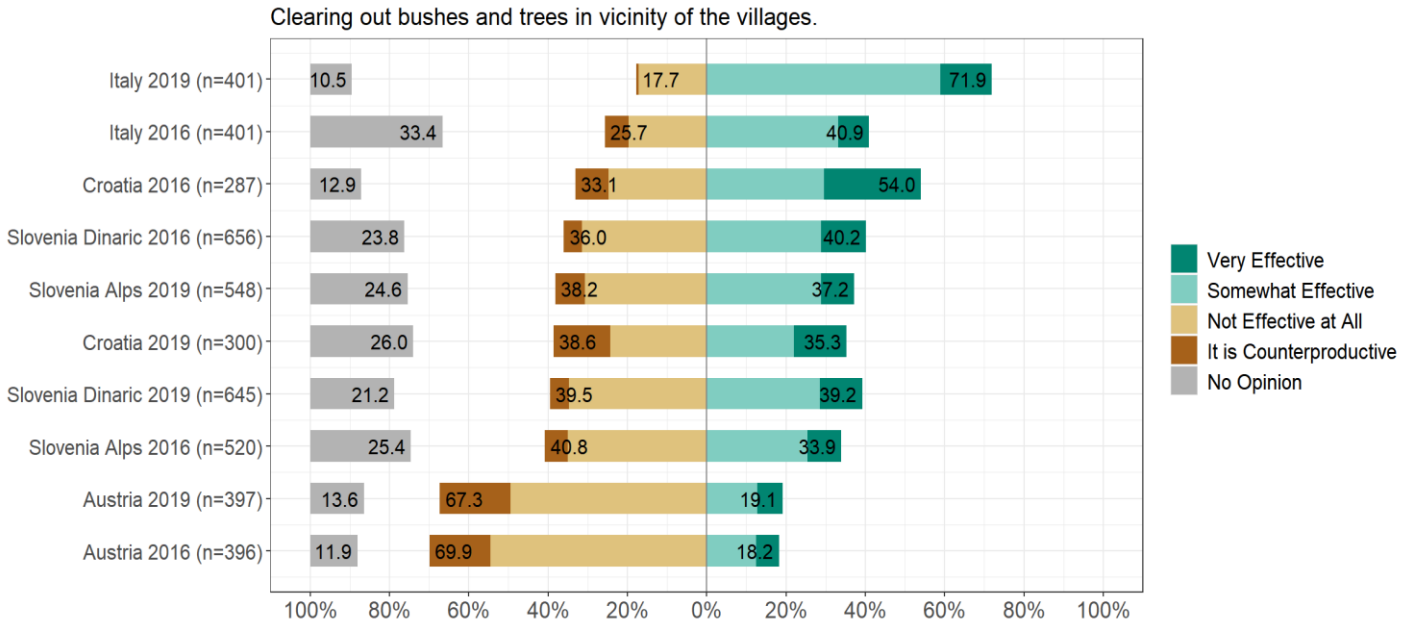

Figure 68: Results for the item "How effective in mitigating human-bear conflicts is clearing out bushes and trees in near vicinity of the villages".

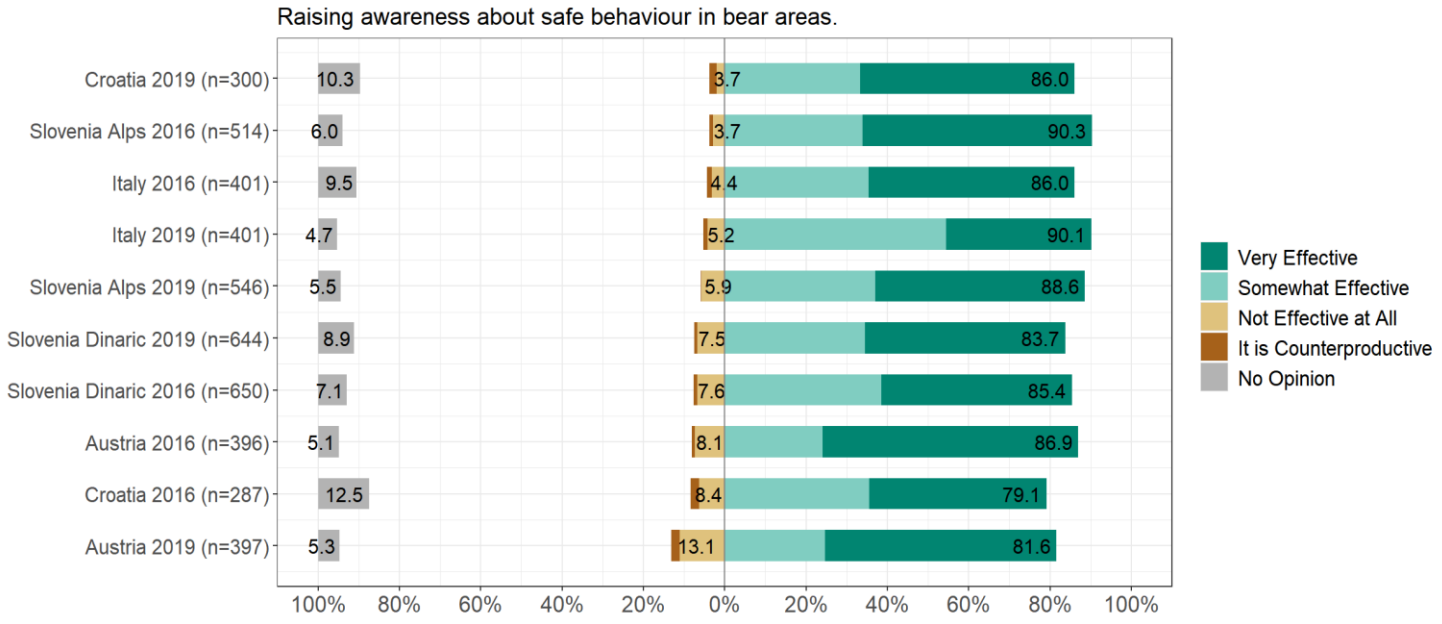

Figure 69: Results for the item "How effective in mitigating human-bear conflicts is educating people about safe behaviour in bear areas."

PCA analysis of the nine solutions items has clearly structured the data into three logical and interpretable components. Structure of the three components is presented in Table 3. First one was interpreted as "conflict mitigation and education" as the main items contributing to this component included use prevention measures in agriculture (guarding dogs, electric fences, responsible waste management and educating people). The second component was defined by solutions that are invasive towards bears: regular culling of bears and removal of problem bears. The third component was defined by the two questions related to supplemental feeding of bears. Distributions of the three factors are shown in Figure 70 (conflict mitigation), Figure 71 (culling), and Figure 72 (supplemental feeding). Already by looking at the distributions it is possible to conclude that there are considerable differences among the regions in the latter two factors.

Table 3: Standardized PCA loadings for the three components within the conflict resolution cluster.

How effective in mitigating human-bear conflicts is	Conflict mitigation score – PCA loadings	Culling score – PCA loadings	Supplemental feeding score – PCA loadings
… providing protein food sources (carcasses) for bears in the forest	-	-	0.90
… providing corn and other food of plant origin for bears in the forest	-	-	0.90
…introducing livestock guarding dogs to the flocks of grazing livestock.	0.72	-	-

… use of electric fences or nets to prevent damages in agriculture	0.69	-	-
…a regular quota for hunting of bears	-	0.90	-
… removal of problem bears	-	0.90	-
… use of “bear proof” garbage bins and responsible organic waste management	0.69	-	-
…cutting bushes and trees in near vicinity of villages	-	-	-
…educating people about the proper ways of behavior in the bear area	0.64	-	-

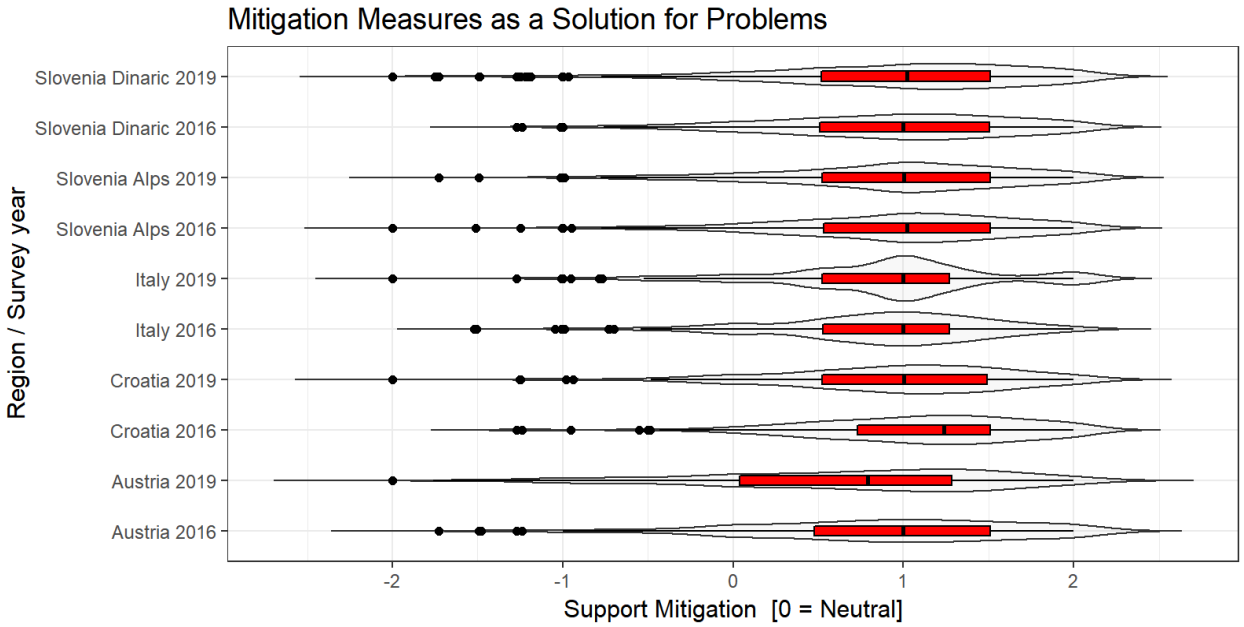

Figure 70: Distribution of “mitigation measures” PCA score.

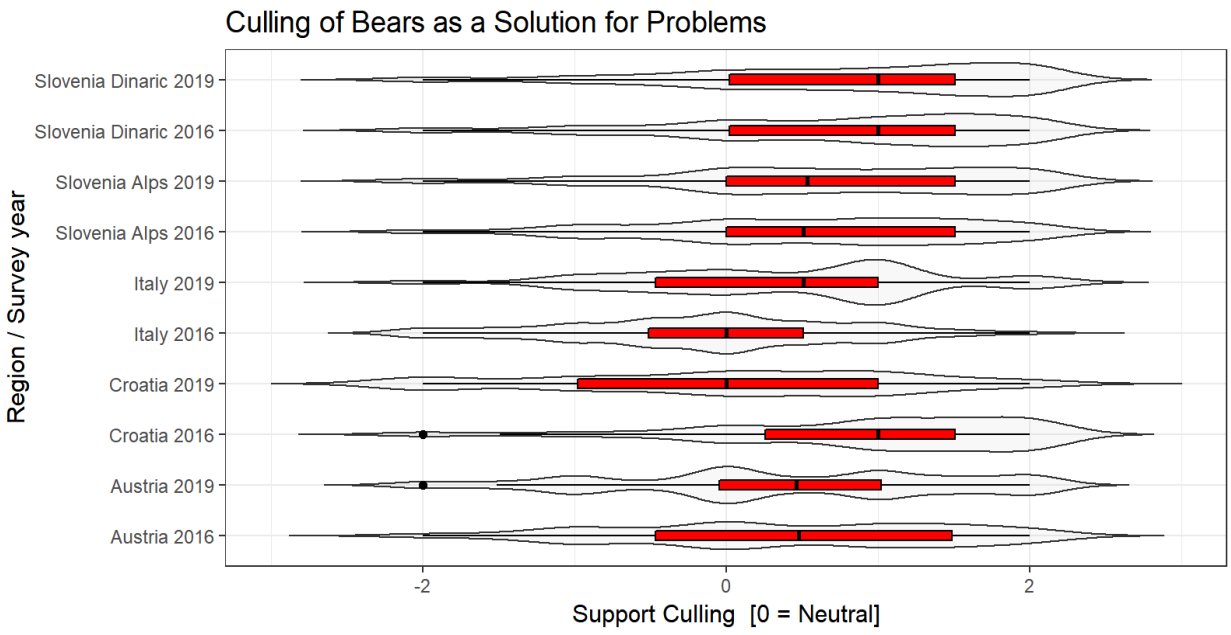

Figure 71: Distribution of "culling of bears" PCA score.

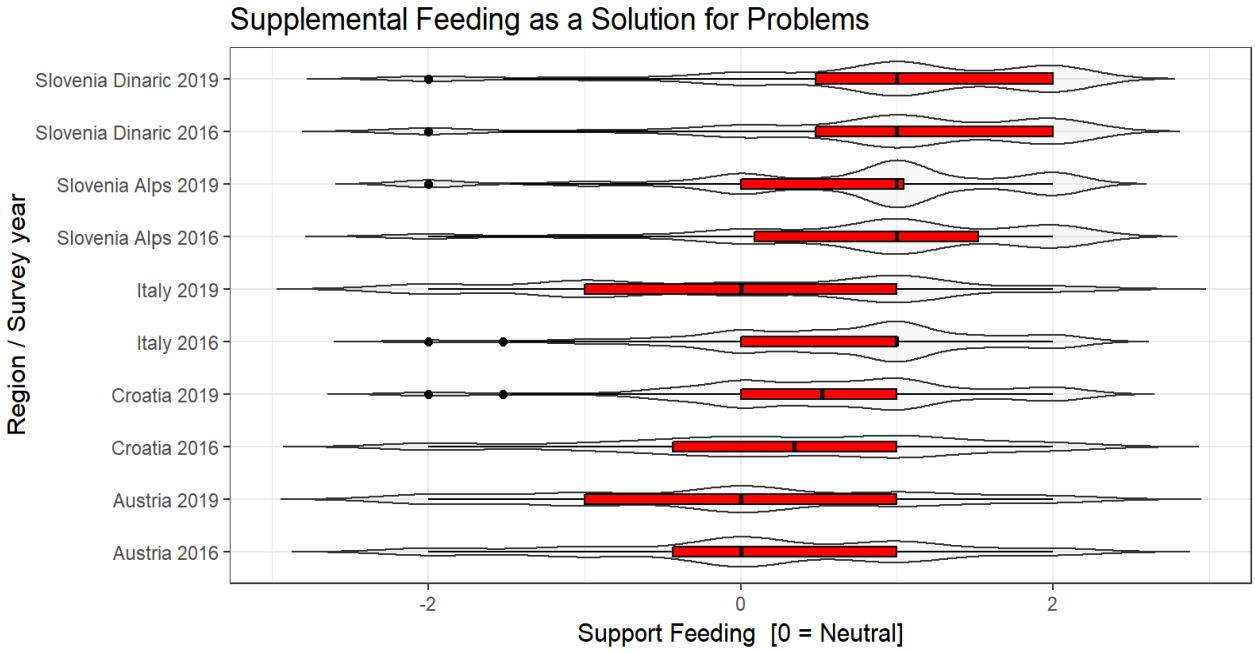

Figure 72: Distribution of "supplemental feeding" PCA score.

When modelling "mitigation measures" we can see that respondents in all regions acknowledged the effectiveness of mitigation measures (Figure 73). Owners of livestock were less inclined to supporting mitigation measures as the effective solution, especially those from Slovenia (Figure

74). Knowledge of bear biology proved to be important in predicting support for mitigation measures, especially among the livestock owners (Figure 76). Besides that also dog owners and better educated respondents seemed to acknowledge the effectiveness of mitigation measures for resolving human-bear conflicts.

Final model selection for mitigation measures was: I((**sol_mitigation***-1) + 3)~Region + Year + education + knowledge + dogowner + has_livestock + Region:education + knowledge:has_livestock + Region:Year + has_livestock:Region + education:Year

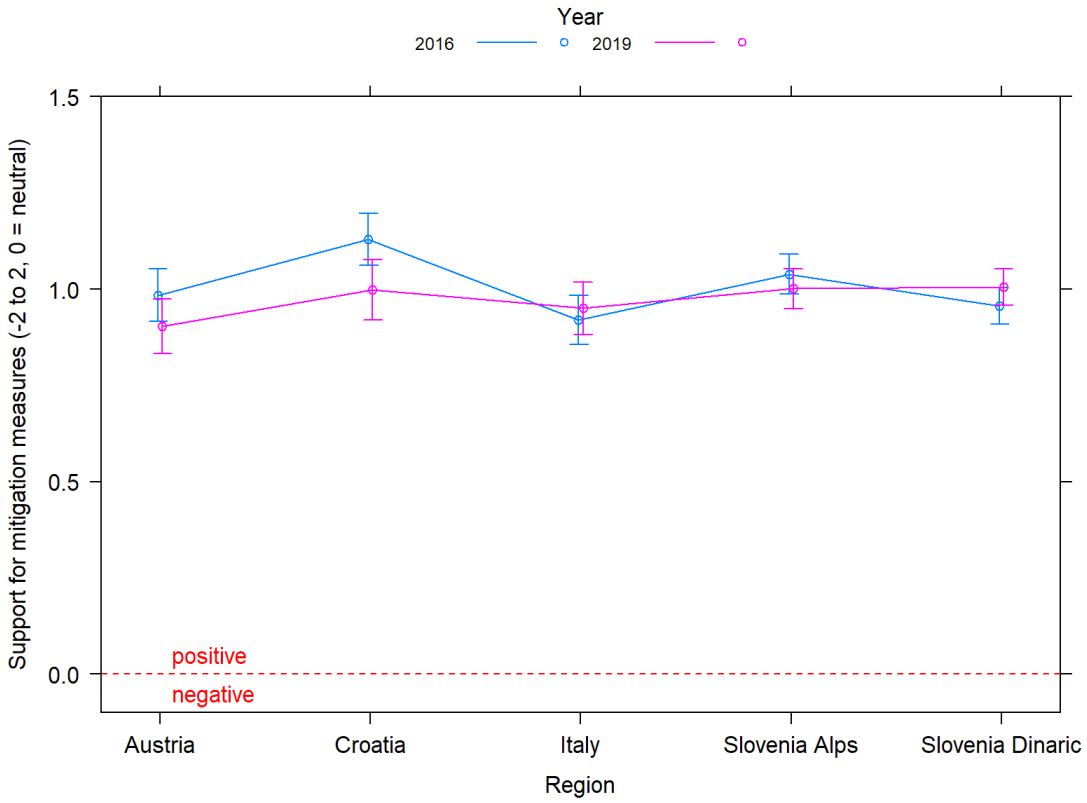

Figure 73: Effects of region on public support of mitigation measures for resolving human-bear conflicts.

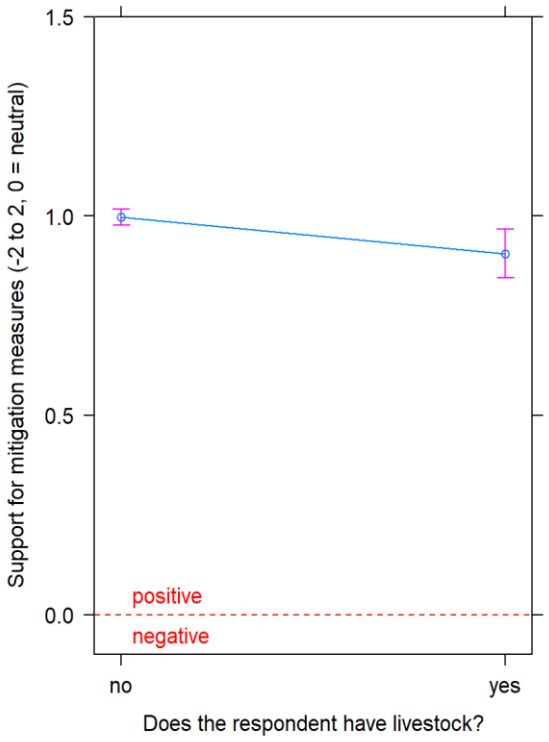

Figure 74: Effects of livestock ownership on support of mitigation measures for resolving human-bear conflicts.

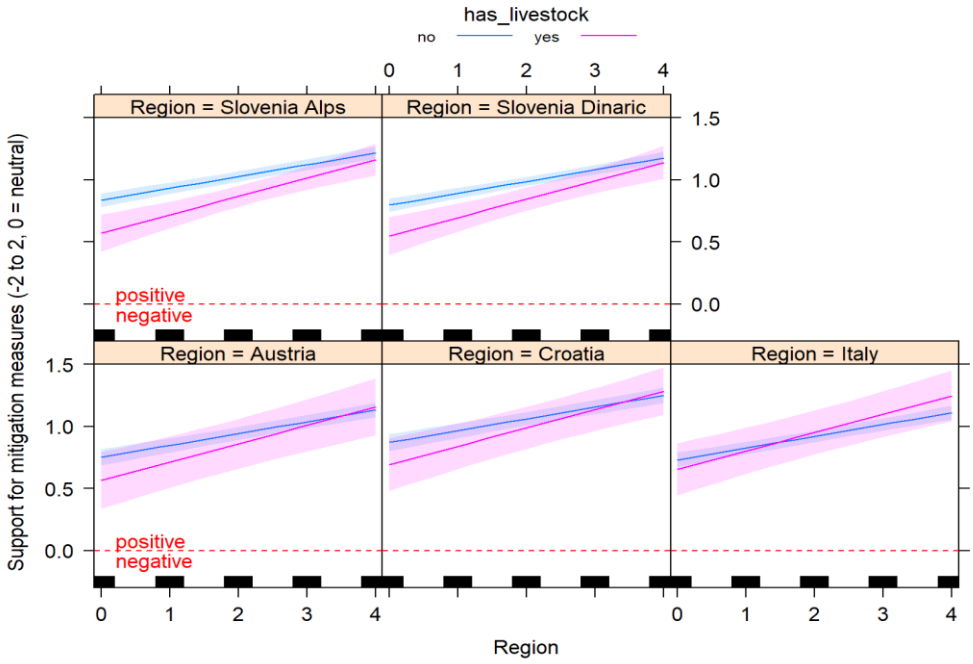

Figure 75: Effect of having livestock and knowledge about bear biology on support for mitigation measures, by region.

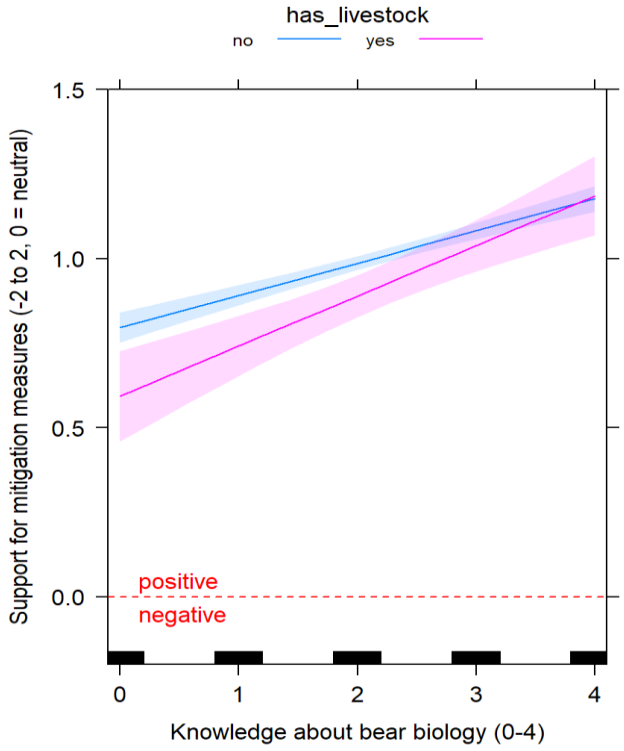

Figure 76: Combined effects on livestock ownership and knowledge of bear biology on support of mitigation measures for resolving human-bear conflicts.

Model for “culling” revealed considerable differences in respondents’ perceptions among the regions. While all groups scored positive on this factor, meaning that all groups acknowledge effectiveness of culling in resolving human problems with bears, respondents from Croatia and Slovenia scored much higher than those from Austria and Italy (Figure 77). Also livestock owners (Figure 78) and males and those with lower completed formal education (Figure 79) were more likely to support culling as a conflict resolution tool. There was no difference in support for culling in the data from 2016 and 2019.

Model for support for culling: I((**sol_culling***-1) + 3)~Region + gender + has_livestock + dogowner + education + Region:gender + Region:education + dogowner:gender

Supplemental feeding of bears as a conflict resolution measure was also recognized as effective, especially among Slovenian respondents, nevertheless the results suggest an overall drop in support for supplemental feeding between the two measurements (Figure 80). Respondents that were more knowledgeable about bears and have seen a bear in nature tend to support more supplemental feeding as management tool.

Model for support for supplemental feeding: I((**sol_feeding***-1) + 3)~Region + Year + dogowner + knowledge + seennatureyesno + Region:Year + knowledge:seennatureyesno + knowledge:Region + dogowner:Region

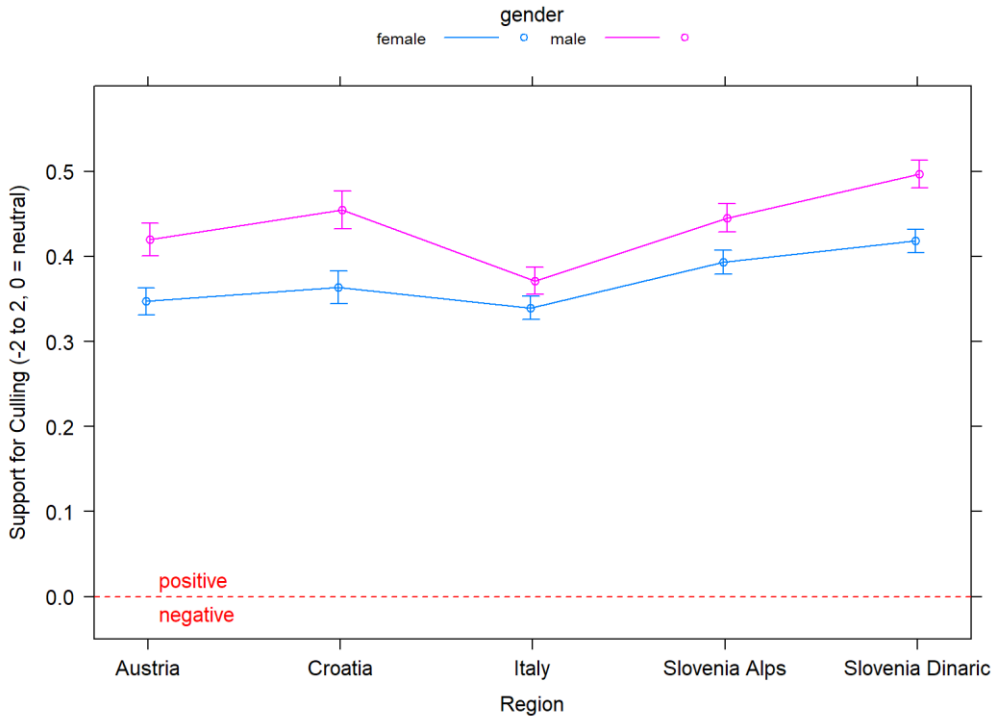

Figure 77: Effects of region and gender on predicting support for culling as a conflict resolution measure.

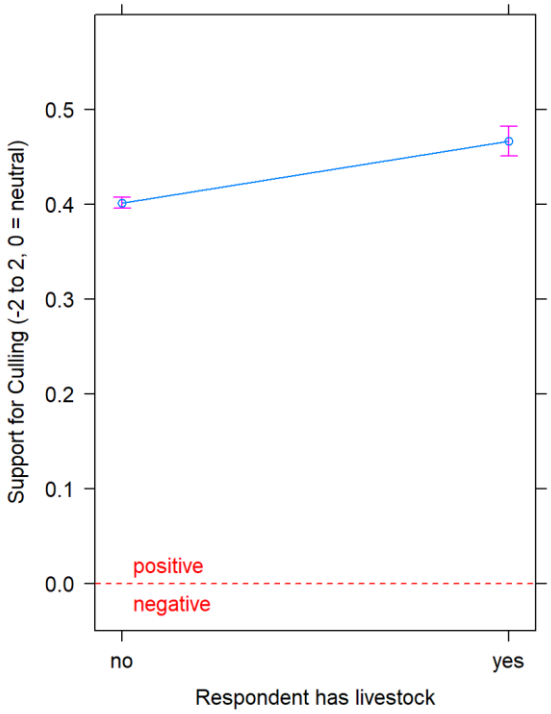

Figure 78: Effects of livestock ownership on "support for culling" in conflict resolution.

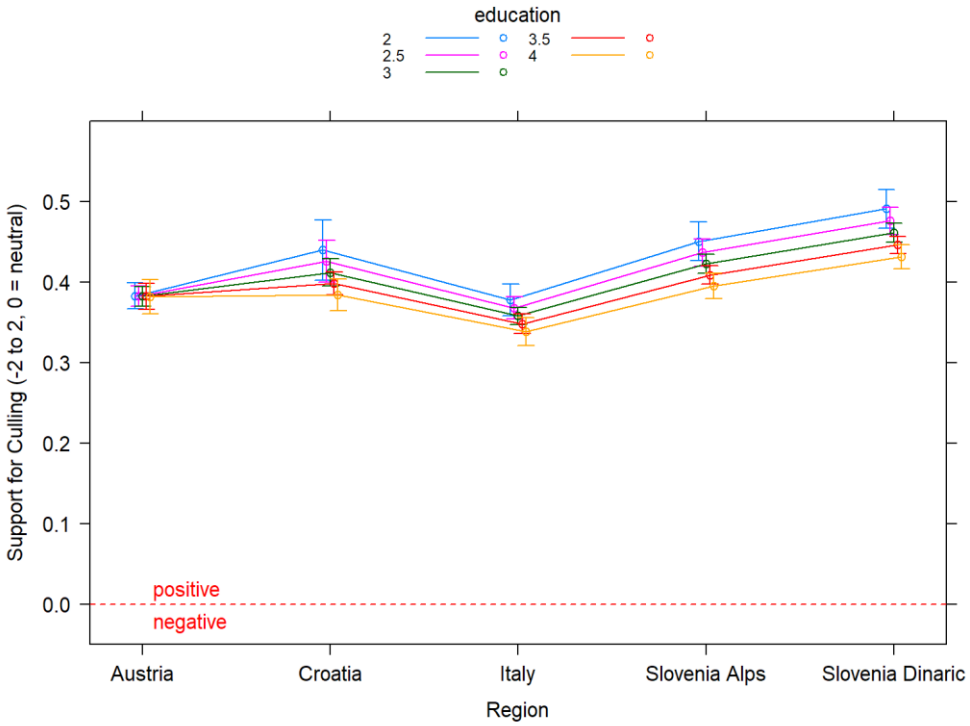

Figure 79: Support for culling of bears, by education level of the respondent and region.

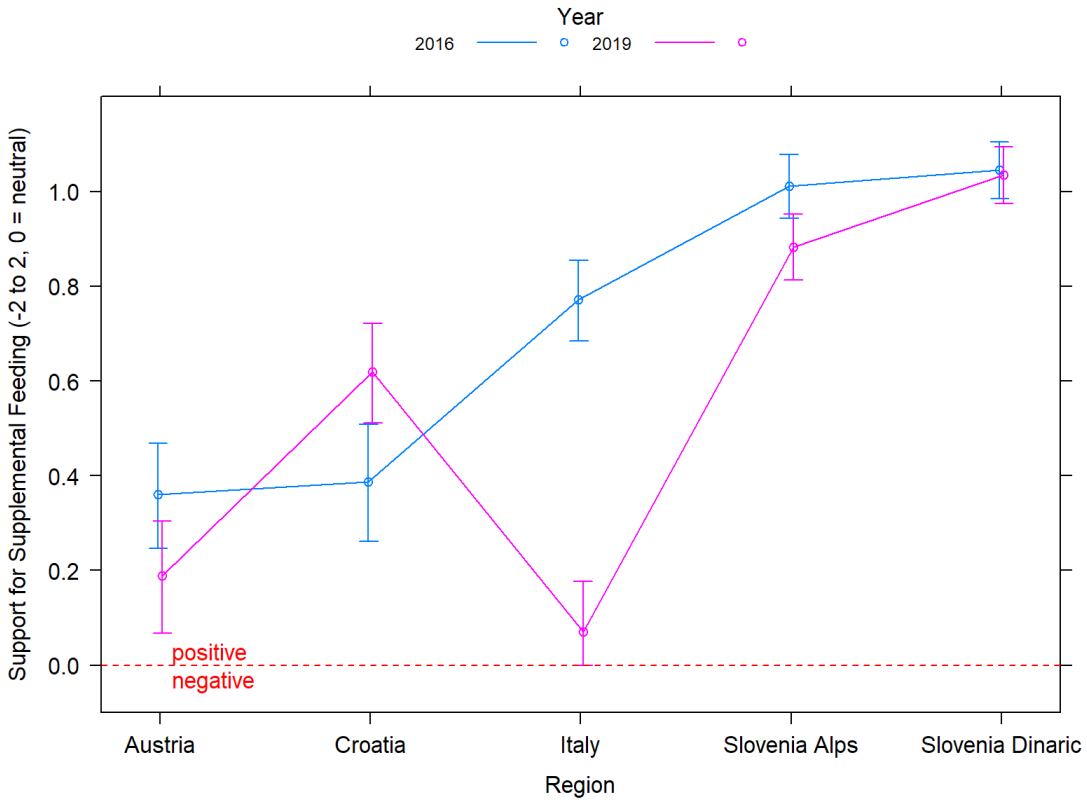

Figure 80: Effects of region and year of survey on support of "supplemental feeding" as a human-bear conflict resolution tool.

Content analysis of media articles about bears

Methods

Project partners in all four participating countries were collecting media pieces about bears published during the project life time. Information about the collected media pieces were collected in a joint spreadsheet. The collected data included: assigned unique ID, media type (print, internet, TV, radio), date, month and year of publication/broadcasting, title, source, description, author(s), http link, country and weather it mentions LIFE DINALP BEAR project or not. In addition each media piece was assessed with regards to its predominant sentiment about bear (conservation) and about the LIFE DINALP BEAR project (when the project was mentioned). This assessment was done by systematic evaluations of all collected pieces. The evaluators assessed the two topics (sentiments bear; sentiments project) on an 11 point scale (-5 to +5 where -5 =extremely negative, 0=neutral and +5=extremely positive). When possible (time and resource allowing) single media piece was assessed by second independent evaluator and average values were used in further analysis.

Results

In total we've collected and assessed 3702 media pieces about bears. More than half of the analysed media articles come from Italy, one third from Slovenia and 7% and 8% from Austria and Croatia, respectively (Figure 81). Majority of analysed media pieces were internet or print articles (Figure 82).

Approximately 10% of all media pieces about bears have mentioned the project (Figure 83), the highest number in years 2015-2017. Those were also the most active years of project implementation. Overall sentiment about bears in the assessed media pieces was on the positive side, more so in the articles that were mentioning the project (Figure 84). Overall sentiment about the project remained on average positive throughout the project lifetime

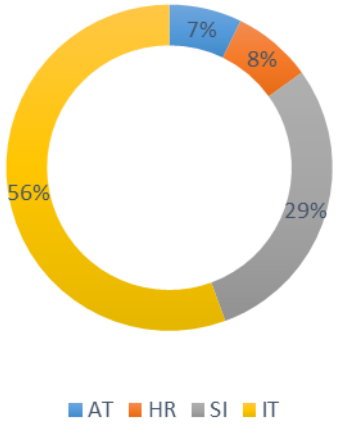

Figure 81: Share of media pieces collected and analyzed per country.

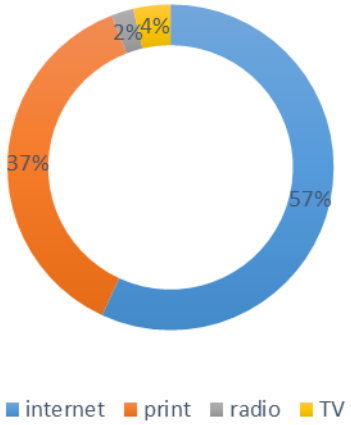

Figure 82: Type of analyzed media (internet, print, radio, TV).

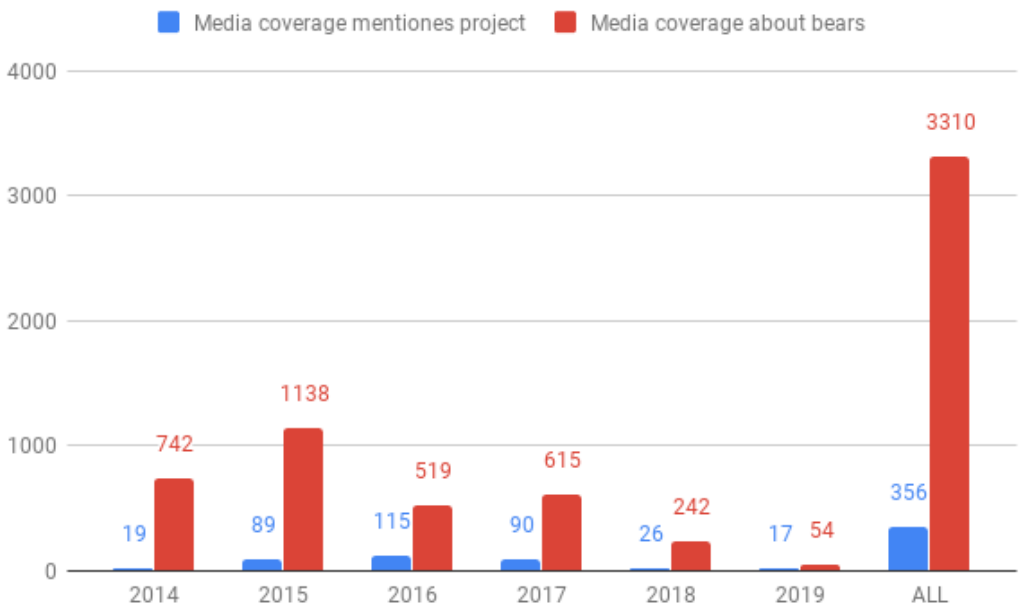

Figure 83: Project mentions in media compared to all reviewed media coverage about bears during the project in the project area.

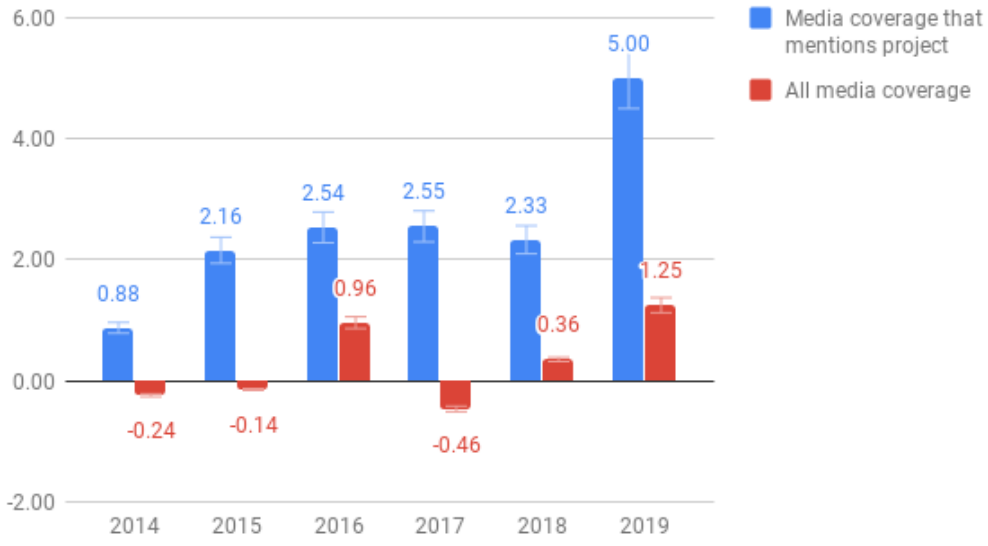

Figure 84: Average sentiment about bears assessed on a 11-point scale where -5 was extremely negative towards bears and bear conservation, 0 was neutral and +5 was extremely positive towards bears and their conservation.

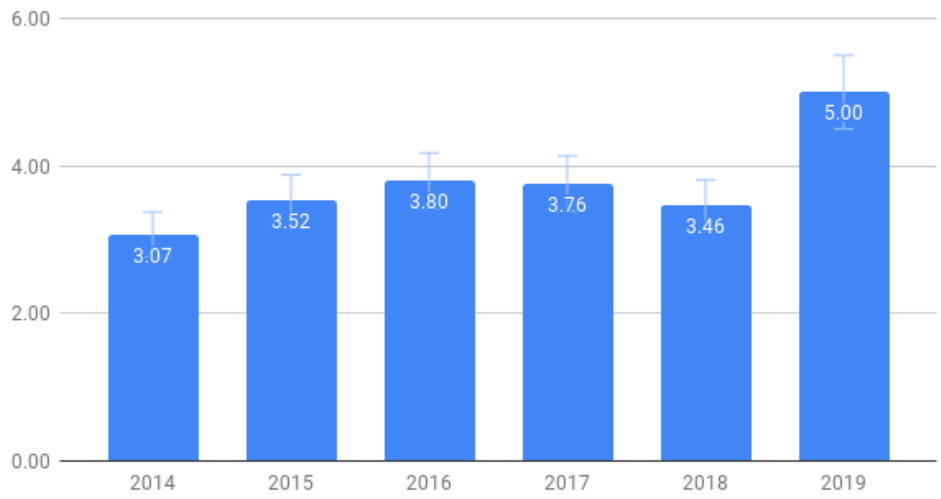

Figure 85: Average sentiment about the project in the media, assessed on a 11-point scale where -5 was extremely negative towards the project, 0 was neutral and +5 was extremely positive towards the project.

Conclusions

Opinions and beliefs of local general public are most likely the best indicator of society's mood about bears. We've documented high support for long-term bear conservation in all countries participating in the project LIFE DINALP BEAR. The effects of project dissemination activities were clearly seen as many of our respondents, especially in Slovenia and Croatia were familiar with the project and also understood quite well project objectives. Good media relations were certainly partly responsible for the good reach of the targeted local public as over 10% of media reportings about bears in the project area had mentions of the LIFE DINALP BEAR project. The overall sentiments of those mentions were positive.

Future informational and educational activities planned in the project should be adjusted in a way which will enable addressing directly specific segments of the society with carefully designed key messages. For example, it seems that older generations are much less likely to accept damage prevention measures as a human-bear conflict resolution approach, thus in order to maximize the project's effects, the focus should be on younger generations of farmers and other stakeholder groups that have problems with bears. Overall the tolerance of human-bear conflicts has dropped considerably among livestock owners during the project and no such change was documented among the other (non-livestock owners) public in the project area. Part of this change might be contributed to the increase in actual human-bear conflict but those were not recorded in all countries / regions of the project areas. Therefore, it is safe to hypothesise that the change is a result of a recent more pro-active anti-large carnivore campaign led predominantly by the European livestock farming organizations. Furthermore, understanding of bear biology and behaviour proved to be one of the most important predictors when exploring values that are generally also core values of our project (coexistence, long-term conservation, prevention of conflicts). While in general our respondents demonstrated good knowledge about

bears, it seems important to prepare and communicate basic key messages with information on bear biology, especially those related to bear diet, where highest level of misconceptions was documented, also to the stakeholder groups that usually are not that interested in such knowledge (livestock farmers, bee keepers). To those groups we traditionally focus on delivering information related to damage prevention and compensation approaches and processes, nevertheless it seems that carefully delivered information about bear biology has the potential to create cognitive dissonance resulting in improved coexistence.

Perceptions and beliefs about population size are probably one of the most important components shaping public expectations from the population management. If predominant belief among the constituency is that there are too few bears, they will oppose any interventions into the population which could reduce the population size and they would expect measures to better conserve the population. The same is for the opposite example – beliefs that there are too many bears will result with expectations of population size control. It is important that decision-makers have access to the information on public opinions and expectations, so that they can predict and manage public support for management decisions that need to be taken. Results of our study would suggest that there is an opposition to further increase in bear population size among the interested inhabitants of Slovenia, while in other countries people would be willing to tolerate more bears. This opposition was even more pronounced in 2019 in comparison to the 2016 results. It is however important to note that still many respondents in all countries did not have a concrete opinion about the bear population size in their country and choose “neither agree nor disagree” and even in Slovenia approximately 20% of respondents agreed with potential increase in bear population size.

Closely related to perceptions about bear population size is public support for lethal control of bears. Our data suggest that Italian and Austrian (and to some degree Croatian) respondents do not support lethal control of bears but less so than in 2016. In Slovenia, many respondents (approx. 20%) were undecided, many, especially in the Dinarics and more so in 2019 supported hunting of bears. Still one third of the respondents clearly opposed hunting of bears. These results where public opinions are clearly divided evidently confirms the controversial nature of the topic. Lethal control of bears was also on average acceptable to the older generations (respondents >60 years old), those with lower achieved formal education, less knowledge about bear biology, and those owning livestock.

(Potential) benefits of having bears for local communities were recognized in responses in all participating countries and more so in 2019. Important to note is that in the Dinaric region of Slovenia and in Croatia there has been an increase in supporting the notion that having bears is beneficial to local economies. These are also regions were LIFE DINALP BEAR project has implemented a series of activities related to promoting responsible non-consumptive use of bears in tourism and promoting responsible co-existence practices through “Bear-friendly” labelling system (for more info look at results of Action C.6 of the project).

On the other hand respondents in all participating countries do not like to tolerate conflict situations with bears. According to our data, Croatians are willing to tolerate the most conflict

situations as well as those that are younger, and more knowledgeable about bears. The tolerance of conflicts has decreased in comparison to 2016 in the Alpine regions and especially among livestock owners. Respondents in all four countries acknowledged that damage prevention, correct organic waste management and public awareness are the most effective approaches in dealing with human-bear conflicts and overall support to this approach has remained stable over the project implementation period. Neverhteless, the livestock owners, especially those from Slovenia were less inclined to supporting mitigation measures as an effective solution. This was defined partly also by their knowledge of bear biology. Invasive measures such as culling and removal of problems bears were also recognized as efficient, however much more among the respondents from Croatia and Slovenia, than those from Italy and Austria. There was no change in support for culling the data from 2016 and 2019. Livestock owners and those with lower completed formal education were more in favour of culling as a solution to human-bear conflicts than others. Supplemental feeding of bears as a conflict resolution measure was also recognized as effective, especially among Slovenian respondents, but overall less so than in 2016.