Received: 6 June 2023 | Revised: 13 June 2024 | Accepted: 24 June 2024

DOI: 10.1111/csp2.13184

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access
WILEY

CONTRIBUTED PAPER

Friend or foe? Engaging public can save the critically endangered common hamster (*Cricetus cricetus*)

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Funding information
LIFE IP GRASSLAND-HU, Grant/Award Number: LIFE17 IPE/HU/000018

Abstract

The common hamster (*Cricetus cricetus*) occupies a controversial position among mammals inhabiting agricultural areas, as it is possibly the only critically endangered species that is legally targeted by lethal control methods, making it a conflict-generating pest. We surveyed various stakeholders, agrarian consultants, wildlife rangers, and residents for the first time in Hungary, with two interrelated questionnaires to obtain accurate information about hamster populations, and to learn about the participants knowledge of, and attitude toward hamsters in order to provide fundamental information for planning and strengthening social embeddedness. Additionally, we prepared the current distribution map of the hamster. Based on the relatively wide distribution and locally high abundance of the species, Hungary has a key role in hamster conservation. We identified several factors, which can contribute to successful species protection. The results indicated that more than 60% of the respondent's liked hamsters. In contrast, only a few residents considered hamsters in their settlement to be beneficial. Our results suggest that the hamster's reputation is disproportionately negative due to vaguely known perceptions of harm as compared with actual reported damage. This imbalance could be rectified through enhanced communication efforts. Improving the species' reputation is integral to effective species conservation initiatives. Current pest control practices (poisons and snap traps) kill the hamsters, even though 82% of the residents would prefer to keep the hamsters alive, conforming to conservation efforts. The results also indicated that the hamster could be a flagship species in Hungary. Knowledge of the protected status of the hamster predicted a positive attitude toward the species and related to nature conservation consciousness. We conclude that requirements of residents should be included in the

species action plan along with the experts' knowledge, as this could contribute to successful, long-term conservation of the hamster.

KEYWORDS

agricultural pest management, conflict-generating species, keystone burrow-dweller species, Pannonian ecoregion, questionnaire, threatened species conservation

1 | INTRODUCTION

1.1 | The global and Hungarian status of the common hamster

In recent decades, common hamster (*Cricetus cricetus*; hereafter hamster) populations have been drastically reduced or declining; this trend is even more characteristic in the western margin of its Eurasian distribution, for example, in Belgium, France, and The Netherlands (Horváth et al., 2018; La Haye et al., 2012; Reiners et al., 2014). Some countries spend a substantial amount of money to conserve the almost collapsed hamster populations (Kletty et al., 2020; La Haye et al., 2010). The reduction of hamster populations can be traced back to many factors (Weinhold, 2008). Arable habitats, in particular, are becoming less suitable for hamsters due to agricultural practices such as large monoculture, narrow crop rotation, deep soil tillage, and the cultivation of unfavorable crops like maize (Kirschke et al., 2021; Tissier et al., 2016). Additionally, industrial developments exacerbate this issue (Weinhold, 2008). Furthermore, the expansion of road networks leads to habitat fragmentation, isolating individual hamster populations from each other (Kletty et al., 2020; Surov et al., 2016). It is hypothesized that climate change (Tissier et al., 2016) and light pollution (Surov et al., 2016) also negatively impact hamsters. Moreover, targeted poisoning not only affects hamsters directly but also their predators through secondary poisoning, where toxic substances transfer into nontarget species through the food chain (Alomar et al., 2018; Cserkész, Kiss et al., 2020; Millesi et al., 2008). Furthermore, trapping of the hamster for the fur industry also contributes to its decline in Central and Eastern European countries (Nechay, 2000). As a consequence, the species was listed by the IUCN as Critically Endangered (CR) in 2019 (Banaszek et al., 2020). Additionally, it was included to Annex IV of the Habitats Directive in all countries of its European distribution, which lists species in need of strict protection so it is prohibited to kill hamster, except Hungary, where the largest hamster population exists, and the species is listed in Annex V, which means that member countries may decide for themselves how to manage the population, so hamster populations can be reduced. This means that, although the hamster is protected in Hungary, it does not have the greater conservation benefit provided by Annex IV of the Habitats Directive. There is evident and unique conflict in this situation, as every spring, the hamster population can be reduced as an agrarian pest without any specific permission due to damage the hamster causes in crop fields and gardens (KöM decree 13/2001. [V. 9.]). Financial damage and the anticipation of such losses can escalate conflicts and result in direct extermination of hamsters through targeted methods such as anticoagulant rodenticides and snap traps (Cserkész, Kiss et al., 2020), aimed at protecting crops from hamster damage. Thus, in contrast to the global situation, the hamster is considered one of the main conflict-generating species in Hungary and the situation is similar in Romania (Hegyeli & Fülöp, 2018).

The hamster diet consists of 80% plant-based and 20% animal origin foods (O'Brien, 2015). It digs burrows and can store food; the cached food ranges between 0.05 and 15 kg in its winter hibernation burrow (Hędrzak et al., 2021). In the spring, it moves to summer burrows where the hamsters reproduce and find shelter (Weinhold, 2008). Nowadays, climate change has adverse effects on hibernation, for example, causing body mass decrease, which influences reproductive success, which indirectly affects the survival of the species (Tissier et al., 2016). The hamster is a polygamous species (Weinhold, 2008), in which the reproduction period lasts from April to August. The female hamster can produce 1–3 litters annually, containing 3–8 offspring per litter (rarely up to 15) (O'Brien, 2015).

The distribution area of the hamster in Hungary has narrowed considerably in recent decades (Cserkész, 2016). The hamster's original habitat is grassland steppe (Górecki, 1977; Weinhold, 2008), but now it occurs almost exclusively in the agricultural areas of Hungary. For the hamster, the most favourable areas contain crops such as alfalfa, sugar beet, and winter cereals (O'Brien, 2015; Weinhold, 2008). Rarely, it also occurs in grasslands (typically in areas of national parks) and roadside verges. Lately, it also appears more often within settlements (Cserkész, 2016). Currently, the hamster population in Hungary is fluctuating and has sudden increases about every 10 years (Bihari, 2004;

Cserkész, 2016). Species protection can only be successful where there are enough individuals and stable populations according to minimum viable population models (Shaffer, 1981). In some locations, the hamster is still abundant, which provides a solid starting point for its conservation and the maintenance of its ecological functions (Delibes-Mateos et al., 2011; Hędrzak et al., 2021; Shaffer, 1981). Overall, Hungary has a key role in the conservation of the hamster globally.

1.2 | Conflict-generating keystone burrow-dweller species

Despite the existing conflict, the hamster is a keystone burrow-dweller species in its habitats. Similar to hamsters, other conflict-generating small mammals, such as the plateau pika (*Ochotona curzoniae*), black-tailed prairie dog (*Cynomys ludovicianus*), and European rabbit (*Oryctolagus cuniculus*), are also abundant in some places of their original distribution areas, thus they are also often considered as pests (Delibes-Mateos et al., 2011; Lai & Smith, 2003; Miller & Cully, 2001). Labeling a species as a pest is mainly based on social perception, rather than scientific results, which culminates in a discrepancy between perceived and real risk (Delibes-Mateos et al., 2011). Research demonstrates that these native small mammals play essential and irreplaceable roles in the ecosystem (Delibes-Mateos et al., 2011), for example, creating microhabitats and improving soil structure, which in turn improves precipitation absorption and ventilation, which facilitates nutrient circulation (Hędrzak et al., 2021). Keystone species such as burrow dwellers further contribute to ecosystem health by improving food quality, restoring natural plant cover, and increasing species richness. The positive association between these mammals and vertebrate abundance extends to hundreds of species, as evidenced by findings from studies on black-tailed prairie dogs (*Cynomys ludovicianus*), where 247 vertebrates were detected (Delibes-Mateos et al., 2011). Additionally, these mammals serve as primary consumers in the food chain, further underscoring their significance (Gedeon et al., 2011; Millesi et al., 2008; Ramos-Lara et al., 2014).

With the disappearance of the hamster as a keystone burrow-dweller species, the positive ecological effects that burrowing may provide (Delibes-Mateos et al., 2011; Gedeon et al., 2011; Godó et al., 2022; Hędrzak et al., 2021; Millesi et al., 2008; Ramos-Lara et al., 2014) are also lost. The presence of hamsters also yields direct benefits for farmers while providing essential ecosystem services such as soil scarification, aeration, and organic carbon sequestration. Through bioturbation, they contribute to the formation of chernozem, enriching agricultural soils and, ultimately, enhancing crop production (Altermann et al., 2005; Hędrzak et al., 2021).

1.3 | Residents' inclusion

Cooperation with residents is one of the key aspects for long-term conservation of conflict-generating species (Grossmann et al., 2020). Their inclusion has proven to be successful with such species as the Himalayan brown bear (*Ursus arctos isabellinus*) (Nawaz et al., 2008), and the snow leopard (*Panthera uncia*) (Jackson & Wangchuk, 2001; Schofield, 2019). According to Arnstein's theory (1969), the more we treat residents as partners in mapping a problem and finding solutions in a project, the more likely they will feel included and contribute to finding the best solutions and cooperating in the implementation of the goals and plans. In the case of the hamster, conflict resolution via a species action plan requires solutions that are acceptable to the agricultural sector, as well as the residents. A species action plan has to increase the social embeddedness of the hamster and give adequate solutions to coexistence, where there is conflict between hamster and residents.

1.4 | Our goals

Our long-term plan is to find the best way to conserve the CR hamster; therefore, our main goal was to collect the necessary information, which can form a basis for the elaboration of a complex species action plan, which helps in effective hamster conservation.

To achieve our goals, we chose the questionnaire method. We first asked for information, experiences, and social perceptions regarding hamsters from professionals. In another questionnaire, we inquired about residents' experiences with, opinions about, and attitudes toward hamsters. Through this questionnaire, we aimed to identify gaps in residents' knowledge, enabling us to strategize targeted educational activities. For management plan development, collecting accurate information about the stakeholders' knowledge of, attitude toward, and characteristic interactions with the hamster is essential. Although questionnaire surveys are known in other conflict-generating species (e.g., Bjurlin & Cypher, 2005; Ericsson & Heberlein, 2003; Hanson, 2022; Heberlein & Ericsson, 2008; Rigg et al., 2011), to our knowledge, our research stands as the first of its kind for a nonpredator conflict-generating species, particularly in the case of hamsters, where the opinions of nonprofessional citizens were elicited and population distributions were mapped.

Moreover, prior to our study, professionals were never asked about their experiences and opinions about hamsters. While a questionnaire survey similar to our professional questionnaire had been conducted about the status and distribution of hamster populations in Poland (Ziomek & Banaszek, 2007), Hungary was an unmapped area with this method until now.

2 | METHODS

2.1 | Respondents

We prepared two interrelated questionnaires for data collection. The questionnaire created for the professional group (Appendix A) was sent to The Hungarian Chamber of Agriculture (HCA) and the National Park Directorates (NPD) in 2020, who forwarded it to two different groups of stakeholders, the agrarian consultants and rangers, to gather reliable first-hand information on hamster populations. Agrarian consultants serve as intermediaries between the HCA and farmers, offering crucial support and advice. Their primary responsibility is assisting farmers in accessing European Union (EU) subsidies by providing information and guidance. They also handle tasks such as issuing farming certificates, gathering and reporting crop data, assessing agricultural damages, and conducting cross-compliance checks to ensure farmers meet EU standards in areas such as human health, plant, and animal health and animal welfare. In short, rangers are tasked with overseeing adherence to legislation and official regulations concerning the safeguarding of both protected and non-protected natural resources and areas, as well as the preservation of archeological heritage. Agrarian consultants and rangers were asked due to the hamster's presence in agricultural areas in Hungary, potentially leading to conflicts with farmers. Rangers were specifically included as hamster is a protected species, with many habitats falling within national park areas. A total of 198 professionals completed the form, 126 agrarian consultants and 72 rangers.

Another questionnaire was prepared for the inclusion of the broadest possible range of residents to discover their opinion regarding, attitude toward, and interactions with hamsters (Appendix B). This questionnaire was circulated in 2021. As in the first questionnaire, collecting knowledge about the hamster's urbanization and control measures was also among our goals. The questionnaire was shared on different online platforms and thematic Facebook groups related to conservation, biology, animals, and education, as well as the personal profile of the authors, which yielded most of the responses ($N = 303$). We also aimed to sample those residents who may not have internet access or do not use it regularly, and also those who live in the countryside areas inhabited by hamsters, by offering the opportunity to complete the questionnaire through personal meetings, which was accepted by 47 participants.

2.2 | The questionnaires

In the professionals questionnaire, we asked about the respondent's knowledge of the protected status of the species, the opinion on the hamster in the respondents' settlement, the distribution and abundance of the local hamster population, the interactions with residents, for example, the damage caused by the hamster, and the control measures used against them (Appendix A). The residents questionnaire included the relevant questions of the professionals questionnaire, so it was possible to compare the opinions of the different groups. Where it was necessary, we modified the questions, for example, we added the answer option "I do not know." In addition, we added questions that specifically measured attitudes toward the species (e.g., whether they liked hamsters; whether they agreed that there should be species protection activities related to hamsters; whether and how they would control the hamster population). In addition to descriptive statistics, we asked basic demographic information (Table 1) to conduct a dependency analysis. Another difference was that the residents questionnaire was divided into several parts; thus, we could ask for information about the occurrence, abundance, and opinion of hamsters from only those who marked that they had information about the occurrence of hamsters in any settlement (Appendix B).

2.3 | Geospatial visualization

The responses from the professionals questionnaire group, regarding the abundance of the hamsters, were divided into four groups (0 = does not occur, 1 = rare/very few, 2 = frequent, and 3 = abundant). The response data were then displayed on a map using Quantum GIS 3.10 software. The display unit was the administrative border of the settlement. Urban hamster populations were also illustrated on the map.

2.4 | Statistical analysis

In the case of those questionnaire items where the case numbers (N) of the variable groups were too few or

unequal, we merged these into functionally meaningful clusters. The steps of how the variables were derived from the questionnaire are shown in Appendix C (Tables C1–C4). Table C1 contains "opinion" as a dependent variable from professionals questionnaire. Table C2 presents independent variables from the professionals questionnaire such as "position," knowledge about the hamster ("protected," "CR endangered"), information about the hamster ("presence info," "presence location," "abundance," "change," "damage causing") and interaction with hamster ("meeting," "control"). Table C3 shows the dependent variables of resident's questionnaire: "species protection," "can be reduced," "2ndpoisoning exists," "2ndpoisoning serious," "opinion," and "control opinion." Table C4 lists the independent variables from residents questionnaire: demographic data (Table 1), the same variables as in professionals questionnaire (see Table C2), excluding "position" and "damage causing," and we put plus variables besides the variables originated from professionals questionnaire: "viewpoint," "settlement," and "green area."

First, we compared the answers to the overlapping questions from the two questionnaires with a Chi-square test. Where the only difference between the questions of the two questionnaires was that one of them included the "I do not know" response option, these responses were left out of the analysis. A particular answer was considered significantly characteristic of a particular group if the adjusted residual value was more than 1.96 in absolute value (Beasley & Schumacker, 1995; Sorice et al., 2014). The sign and size of the adjusted residuals relative to each other were also considered, while we evaluated the difference between groups. The higher the adjusted residual value was, the more often a particular answer option was marked compared with the expected group average. The lower the adjusted residual value was, the less characteristic a particular answer was within a group. Those questions that were only included in the residents questionnaire were evaluated with descriptive statistics.

In the residents questionnaire, we were looking for those factors that could be associated with the respondents' attitude toward the hamsters. Most of their answers on protection and control were considered dependent variables (Appendix C), and dependence analysis was performed. We also included the interactions of the independent variables in the models (Appendix C). In those models where the dependent variables were in the facultative part of the questionnaire, we only included respondents who had information about hamster occurrence in any settlement. The "I do not know" responses for the dependent variable in the particular model were not evaluated.

The dependency of the variables was analyzed with generalized linear model (GzLM) with ordinal logistics. In the "secondary poisoning exists" model, the dependent variable was binary, thus, GzLM with binary logistic was used. We examined each main effect and two-way interaction and performed backward model selection until only the significant interactions (if any) and main effects remained. Here, we always report the final models. An association was considered significant if $p \leq .05$. In any given model, we excluded those respondents who did not enter all the requested answers. The "opinion" was the only dependent variable in the professional questionnaire, which we could compare with the result of the residents questionnaire.

Statistical analyses were performed in SPSS 28.

TABLE 1 The collected demographic information in the resident's questionnaire.

	Final groups used for analysis			Original categories		
Demographic information	**Group**	**Name of group**	***N***	**Group**	**Name of group**	***N***
Education	1	Primary school	37			
	2	High school	133			
	3	College or university	180			
Age	1	≤49 years	291	1	≤18 years	24
				2	19–49 years	267
	2	≥50 years	59	3	50–70 years	47
				4	≥71 years	12
Sex[a]	1	Male	75			
	2	Female	151			

[a]Sex is the only derived variable: we categorized respondents during personal survey and on the respondents' name in online cases.

2.5 | Ethics approval statement and declarations

The survey was performed with the respondents' knowledge and consent, while respecting their privacy rights (Appendix B). During this research, we complied with all relevant legislation.

3 | RESULTS

3.1 | Hamster abundance and occurrence based on the professionals questionnaire

Based on the data of the survey sent to the agrarian consultants and rangers in 2020, the species was frequent or abundant in several counties in Eastern Hungary (see detailed results summarized in Figure 1). The hamster was known to be rare in the central part of the country, and nearly absent in the entire Transdanubian region. Urban hamster populations were also reported from 44 settlements mainly along the Tisza River (Figure 1).

3.2 | Comparison of the residents and professionals questionnaire

The questionnaire data indicated that 62% of residents liked hamsters, 6% did not like them, while 32% were neutral. There was significant knowledge difference regarding the protection of the hamster in Hungary (Figure 2a) between the agrarian consultants, rangers, and residents ($\chi^2(2) = 63.73$, $p < .001$). Most of the rangers knew that the hamster is a protected species, and the agrarian consultants were also typically aware of this. On the other hand, the public respondents were the least informed about the issue. There was also a significant difference in the knowledge of the CR status of the hamster (Figure 2b) between rangers and residents ($\chi^2(2) = 69.91$, $p < .001$). Most of the rangers knew that the hamster had CR status, however; it was not typical knowledge for the residents.

The majority (91%) of residents agreed that hamster protection measures are needed; while, 31% also wanted the farmers' interests to be taken into account. Only 3% of respondents did not consider species protection measures necessary, while 6% answered with "I do not know." Most residents (75%)

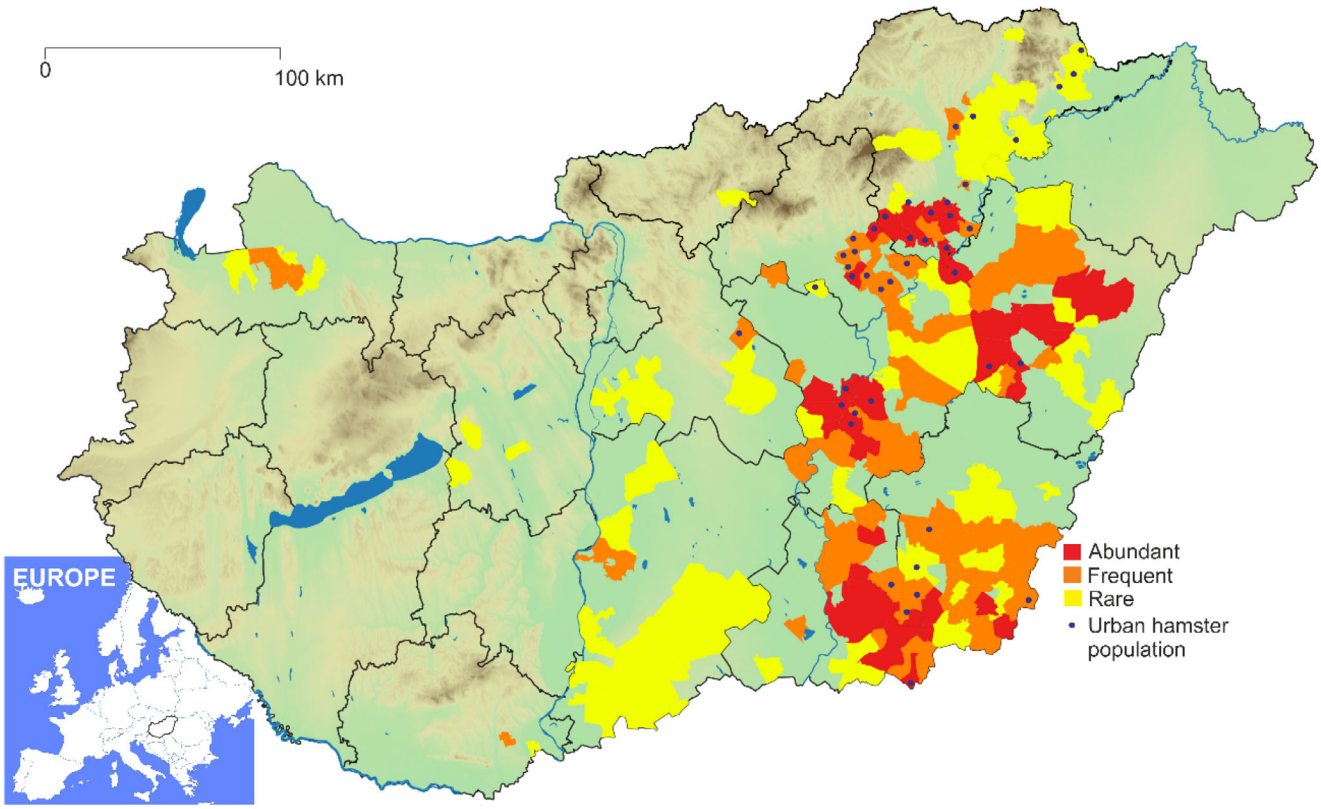

FIGURE 1 The distribution and abundance of the common hamster in Hungary, based on the professionals questionnaire survey in 2020.

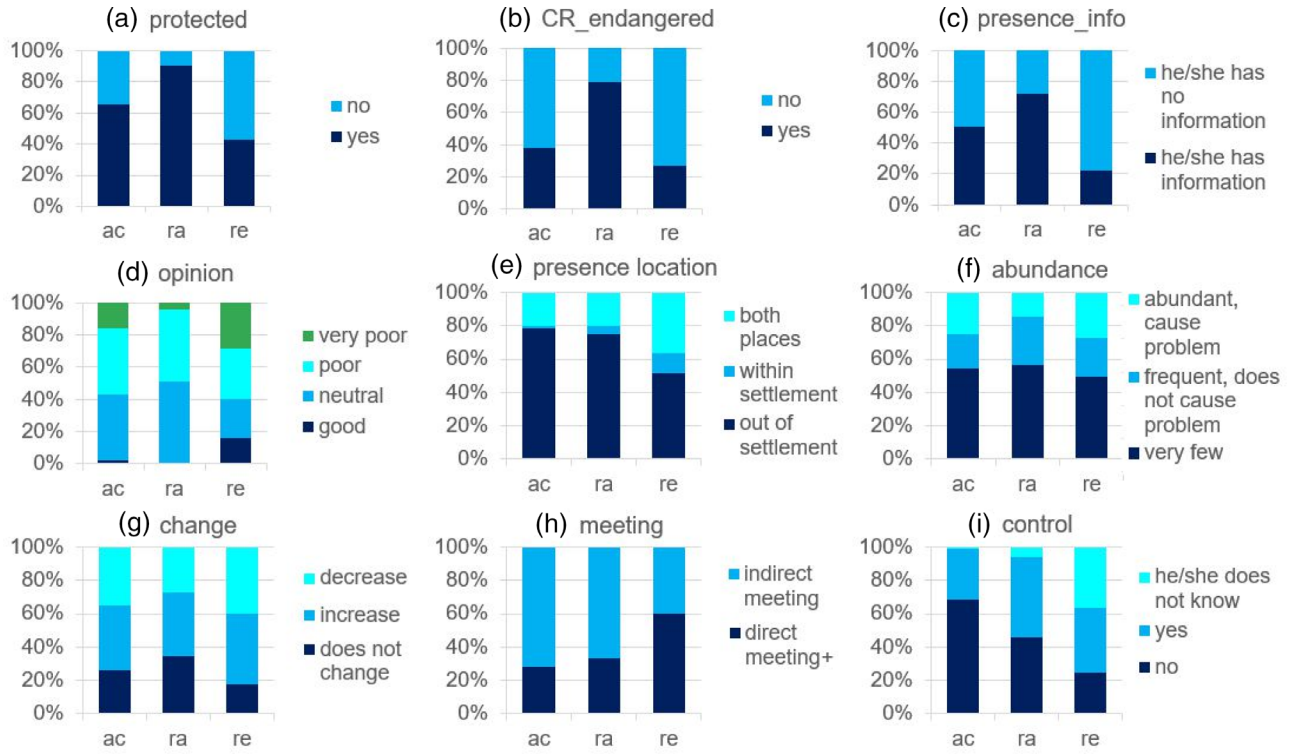

FIGURE 2 Percentage distribution of responses to the overlapping questions of the professionals and residents questionnaires within groups of respondents. In (h), + means that if somebody marked direct meeting in any answer combination (as this question type was multiple choice), we clustered the response in this category even if marked other options besides, which belongs to indirect meeting. Detailed results of the models can be viewed in Appendix D (Tables D1–D9). Abbreviations: ac, agrarian consultant; ra, ranger; re, residents.

disagreed with the killing of hamsters, and 40% considered farmer hamster-damage compensation important. Only 9% of residents agreed that the hamster population could be reduced, while 16% answered with "I do not know."

Most residents (81%) knew that secondary poisoning happens, with 74% considered the death of animals due to secondary poisoning to be a very serious problem, 16% indicated that it was a serious problem and 10% considered it only moderately serious at most.

There was significant difference in the information provided by respondent groups regarding the occurrence of hamsters in a given settlement ($\chi^2(2) = 83.41$, $p < .001$) (Figure 2c). Rangers and agrarian consultants were able to name actual settlements where hamsters occur in high numbers. In contrast, the residents typically did not have up-to-date knowledge on the occurrence of hamsters. There was also a significant difference between the agrarian consultants and residents regarding hamster's presence locations ($\chi^2(4) = 17.89$, $p = .001$) (Figure 2e). It was mostly the agrarian consultants who knew if hamsters occurred out of settlements. Only residents knew significantly when hamsters occurred within the settlements and in both places.

Significant difference was found among the residents and rangers regarding opinions on the hamster in those settlements where they coexist ($\chi^2(6) = 38.81$, $p < .001$) (Figure 2d). Basically, only the residents thought that the opinion of the species was "good." In contrast, rangers considered the species as mostly "neutral," and this choice was the least characteristic of the residents. The response category of "poor" opinion represents approximately the same proportion in each respondent group. It was the residents who principally thought that the opinion of the hamster was "very poor," while the rangers chose this option the least.

No significant difference between the three groups was revealed regarding the abundance of the hamster ($\chi^2(4) = 4.03$, $p = .402$) (Figure 2f). In each group, about half of the respondents thought that hamsters were rare, and only half of the remaining respondents thought that hamsters caused problems. There was no significant difference in the change of the abundance of the hamster in the last 10 years according to the respondents ($\chi^2(4) = 3.98$, $p = .409$) (Figure 2g), as all three groups marked the individual answer options in nearly the same proportion.

Significant difference was seen between the agrarian consultants and the residents in their frequency of

hamster encounters ($\chi^2(4) = 19.59$, $p < .001$) (Figure 2h). The residents saw hamsters in the highest proportions, while the agrarian consultants met them in other, more indirect ways.

There was also a significant difference between the agrarian consultants and the residents responses regarding the occurrence of hamster control ($\chi^2(4) = 62.53$, $p < .001$) (Figure 2i). Most of the agrarian consultants indicated there was no hamster control, while the rangers indicated population control existed in settlements in the highest proportion. However, the adjusted residual of this cell was just below the significance level. The "I do not know" answer was typical of residents as compared with the agrarian consultants. Of the residents, 36% would not control hamster populations at all, 46% would control exclusively by nonlethal measures, and 18% of the respondents would control by lethal methods.

3.3 | Dependency analysis

Respondents with primary school education who did not like hamsters generally oppose species protection measures. Conversely, respondents with high school education, regardless of their preference for hamsters, tend to recognize the importance of such measures. Furthermore, younger respondents (under 49 years old) are more inclined to view species protection measures favorably if they are aware of the hamster's protected status, whereas older respondents do not necessarily show increased support for these measures even with knowledge of the hamster's protected status (Tables 2, E1.1, and E1.2 and Figures E1.1–E1.3).

Elder respondents who held negative attitudes toward hamsters were more likely to indicate that the hamster population could be reduced. Similarly, among male participants with an aversion to hamsters, there was a tendency to think that the hamster population should be reduced. Those individuals who were informed about hamster occurrences but lacked awareness of their protected status were more inclined to choose that the population could be reduced (Tables 2, E2.1, and E2.2 and Figures E2.1–E2.3).

Those respondents who knew that the hamster was protected heard more about secondary poisoning. People with only primary school education heard about the existence of secondary poisonings the least (Tables 2, E3.1, and E3.2). These people indicated that they consider secondary poisoning as a moderately serious problem at most. With higher levels of education, this problem was considered to be much more serious. Older respondents (50+ years) considered secondary poisonings to be a more serious problem. The perception of secondary poisoning severity appears to be consistent among men irrespective of their viewpoint on hamsters. Conversely, women's perspectives on the seriousness of secondary poisoning seem to be influenced by their attitudes toward hamsters: those with a positive bias for hamsters tend to view this issue with greater concern, whereas those with a dislike for hamsters perceive secondary poisonings as

TABLE 2 The result of the dependency analysis with the final models.

Model	The number of responses included in the model	Significant main effects and interactions	GzLM with ordinal logistic (†)
Species protection	209	Education * viewpoint	$\chi^2(4) = 12.97$, $p = .011$
		Age * protected	$\chi^2(1) = 4.36$, $p = .037$
Can be reduced	191	Age * viewpoint	$\chi^2(2) = 8.12$, $p = .017$
		Sex * viewpoint	$\chi^2(2) = 6.99$, $p = .030$
		Protected * presence_info	$\chi^2(1) = 9.73$, $p = .002$
2ndpoisoning_exists	226	Education	$\chi^2(2) = 25.05$, $p < .001$ †GzLM with binary logistic
		Protected	$\chi^2(1) = 15.93$, $p < .001$ *GzLM with binary logistic

TABLE 2 (Continued)

Model	The number of responses included in the model	Significant main effects and interactions	GzLM with ordinal logistic (†)
2ndpoisoning_serious	226	Education	$\chi^2(2) = 6.73$, $p = .035$
		Age	$\chi^2(1) = 4.48$, $p = .034$
		Sex * viewpoint	$\chi^2(2) = 12.85$, $p = .002$
		Sex * protected	$\chi^2(1) = 4.55$, $p = .033$
Opinion	44	Education	$\chi^2(2) = 8.81$, $p = .012$
		Presence_location	$\chi^2(2) = 6.50$, $p = .039$
		Abundance	$\chi^2(2) = 9.36$, $p = .009$
		Meeting	$\chi^2(1) = 6.69$, $p = .010$
		Control	$\chi^2(2) = 9.05$, $p = .011$
		Sex * viewpoint	$\chi^2(2) = 9.42$, $p = .009$
Opinion according to professionals	117	Protected_ac, r	$\chi^2(1) = 9.43$, $p = .002$
		Damage_causing * abundance_ac, r	$\chi^2(4) = 10.92$, $p = .027$
Control_opinion	60	Control	$\chi^2(2) = 11.08$, $p = .004$
		Education * age	$\chi^2(2) = 8.78$, $p = .012$

Note: Detailed results of the models can be viewed in Appendix E (Tables E1.1–E7.2 and Figures E1.1–E7). The ac, r abbreviation at the end of a variable name means agrarian consultants and rangers and shows that the variable was derived from the professionals questionnaire.
Abbreviation: GzLM, generalized linear model.

less severe. Those men who knew that the hamster is a protected species considered secondary poisoning as a more serious issue (Tables 2, E4.1 and E4.2 and Figures E4.1–E4.2).

It was mostly residents with a high school education who thought that the opinion of hamsters in the settlement was "good," compared with those with higher levels of education. Where the hamster occurred only out of settlement, the opinion was worse than where it occurred both within and out of settlement. The opinion was better where the hamster was frequent but did not cause problems than where it was abundant and caused problems. Those who had already seen a live hamster had a poorer opinion. Those who knew that there was hamster control in the settlement thought the opinion was harsher than the respondents who did not know of control. The opinion of women who liked hamsters or held a neutral stance toward them was more positive (Tables 2, E5.1, and E5.2 and Figure E5).

Those agrarian consultants and rangers who knew that the hamster is protected considered the opinion of hamsters to be better. The professionals' opinion was most negative when hamsters were abundant and caused damage in several crop types (Tables 2, E6.1, and E6.2 and Figure E6).

In the settlements where the hamsters were controlled, the residents mostly marked that they would use lethal control. In those settlements where the hamster was uncontrolled, the residents did not want any control measures. Most of those under 50 years of age, with

primary school education, marked that they would not control the hamsters at all (Tables 2, E7.1, and E7.2 and Figure E7).

4 | DISCUSSION

4.1 | Abundance and occurrence data from the professionals questionnaire

Our results based on the professionals questionnaire provide the most recent and accurate distribution data regarding the hamster population in Hungary. This information represents one of the cornerstones of successful species protection (e.g., Farhadinia et al., 2019). Up-to-date abundance and occurrence information is crucial for planning effective conservation measures. According to our survey in 2020, the presence of the hamster was reported from considerably fewer administrative areas of Hungary ($N = 288$) than was found in an earlier survey ($N = 505$, Cserkész, 2016). In 2015, the population entered a period of significant growth, reaching its peak in 2018, followed by a subsequent decline. This pattern aligns with the natural population fluctuation observed in Hungary, which typically follows a cycle of approximately 10 years (Bihari, 2004; Cserkész, 2016). However, compared with the situation in 2015, urbanization of hamsters was more frequent. This is in line with international trends (Wallimann-Helmer & Schübel, 2021).

Despite the overall decline in numbers and distribution, the status of the species in Hungary is still favorable, especially when compared with some Western European countries where self-sustaining populations of the species no longer exist (Surov et al., 2016). Therefore, the Hungarian populations are particularly important to the survival of the species.

4.2 | Comparing the results of the residents and the professionals questionnaires

The reported knowledge about the hamster's CR status followed nearly the same pattern previously seen regarding the knowledge of the protected status of the hamster. The difference was that the ratio of agrarian consultants with and without knowledge changed. In all three groups, fewer people knew that the hamster was CR compared with protected status. Almost all of the residents agreed that there should be species protection activities (as in the case of the San Joaquin kit fox [*Vulpes macrotis mutica*] [Bjurlin & Cypher, 2005]), and that, the hamster population should not be reduced, which is in line with the aims of nature conservation and species protection. It should also be noted that many respondents thought it was important to consider farmers' interests, for example, compensation for the caused damage (Rigg et al., 2011), or presence (Hötte & Bereznuk, 2007) of hamsters. The financial compensation could be part of the species action plan. The most common approach used in Hungary for hamster control is performed through lethal methods, which is in direct contrast with the intentions of most residents. The majority of residents (82%) wanted population control methods that kept the animals alive, which is consistent with conservation efforts (Surov et al., 2016; Weinhold, 2008). Therefore, current hamster management solutions should be changed to methods that take animal welfare into consideration, for example, translocation of individuals.

Additionally, as the majority of survey respondents knew about secondary poisonings and considered this to be a very serious problem, this knowledge can offer another protection approach for hamsters. It is worth considering the conservation of hamsters not only in terms of species preservation but also as protection of an entire trophic system (Deák et al., 2020; Horváth et al., 2018; Lanszki & Heltai, 2007). This means that health of humans, animals, and ecosystems is interconnected (Zinsstag et al., 2011; van Bruggen et al., 2019).

As the hamster was liked by approximately two-thirds of the residents, this offers a promising starting point for effective, long-term species protection. This will allow us to draw attention to the hamster and the related challenges with nature conservation by affecting the residents' emotions. Interestingly, the same ratio of residents "liking" a species was found in the case of conflict-generating wolves as well (Ericsson & Heberlein, 2003). However, it is important to deal with the fact that a few respondents disliked the hamsters, because their attitude can make the mitigation of human–hamster conflict more difficult. The regular, objective communication about the hamster, and communicating the benefits of their presence can increase the local residents' tolerance level. We can further this effort by giving practical information to avoid or reduce damage caused by hamsters. Moreover, the communication of the common goals of the stakeholders can promote the successful cooperation between farmers and conservationists (Bruskotter & Wilson, 2014).

The opinion model gave controversial results. Most professionals thought that the opinion of the hamster was either "neutral" or "poor," and although the residents also marked these two answers frequently, the "good" and the "very poor" opinions were more commonly indicated. This difference may be due to the fact that we asked professionals primarily about farmers (Appendix A vs. Appendix B), and they are thought to have a poorer opinion of this species than other people have. The lower frequency of indicating the "good"

opinion is particularly interesting because most of the respondents liked hamsters. However, the results were far more positive when asking for personal viewpoint than during metarepresentation (i.e., when we asked participants to consider other people's thoughts). This could be a decision-making factor, for example, when settlement leaders make decisions regarding hamster control based on a preconceived negative public opinion (Burstein, 2003), which is actually against the wishes of individual viewpoint and opinion. It is also possible that some respondents wanted to present themselves in a favorable light (Gonyea, 2005), and therefore attributed "poor" opinions to others. The framing of the questions about species conservation and personal preferences regarding animal species significantly influences respondents' answers. When asked about their own practices or preferences regarding the hamsters and their management, respondents tend to provide more accurate and knowledgeable answers compared with their perspectives about general ongoing practices, legislative issues, or other's opinion. Therefore, comparing the two results, the personal viewpoint of respondents could provide a more reliable basis for hamster protection, as participants are likely to better assess their own feelings about the hamster compared with the assumptions about others' attitudes.

Abundance data showed an interesting contrast with the data of people's "poor" opinions. This result showed that the hamster's reputation is worse than the actual reported damage would justify, since the hamster is present in small numbers and does not cause problems for the majority of those farming or living in these areas. One significant practical implication is that effective communication regarding the minimal damage caused by hamsters can greatly enhance the species' reputation, a crucial factor in its conservation efforts. This is identical to what was reported about other native small mammals considered as pests: the actual damage is rarely documented and, even in recorded cases, only minimal damage was reported (Delibes-Mateos et al., 2011). Within settlements, it is possible that opinion leaders with bad experiences are followed by the majority (Office for Coordinating Local Governments of the Ministry of the Interior, 2018). It is also possible that if someone's entire garden was destroyed by hamsters, they will be more inclined to develop the opinion that hamsters are harmful in general. The long lasting cultural heritage of past gradation damages (Cserkész, 2016; Nechay et al., 1977) can also contribute, and is strengthened by the imprint of an egocentric attitude toward pests. The 10-year change could not be evaluated properly, which could be due to hamster population fluctuation. Moreover, it appeared difficult for nonprofessionals to decide on this issue. On the contrary, the residents' responses proved to be valuable regarding the within settlement occurrences, which were known only to a lesser extent by the professionals. In the personal survey, the precise location of the occurrence was shown in some cases and was recorded with GPS. This illustrates why it is worthy to ask residents in the case of urbanizing species.

4.3 | Dependency analysis

Raising awareness and popularity of hamsters among people with primary education would be particularly important to garner their support for active species conservation efforts. We found that among the respondents with high school education, those who did not like hamsters still considered species protection measures important. This may indicate that those who reject kill trapping are not necessarily motivated by their emotions, but they understand the importance of nature conservation. The younger respondents who also knew that the hamster is protected may have received more education about responsibility toward protected species (Heberlein & Ericsson, 2008); this could explain why they considered protection measures to be important. Negative perceptions stemming from memories of past instances of economical damages can lead older individuals to perceive species protection measures as less important. Those who coexisted with hamsters, and knew that it is a protected species, did not consider lethal control to be an adequate solution, although the actual practice of hamster control did fit to the residents' expectations. However, there is another explanation for these findings: those who became accustomed to the control practice used within a settlement for a longer period may have found it difficult to separate from it when asked to express their own opinion. Therefore, wider application of nonlethal practices (e.g., nonlethal curiosity traps) should be a recommended control method for use in protection programs. It would be important to draw residents' attention to the harmful and dangerous consequences of the use of poisons as a hamster control method. Additionally, even greater importance should be put on pest management steps before control: prevention and monitoring (Meerburg et al., 2008).

The knowledge about secondary poisonings was more common in those groups whose respondents were thought to have higher natural science knowledge based on their education level or knowledge about the hamster's protected status. This draws attention to the importance of general education and targeted dissemination (Doughty et al., 2020; Ericsson & Heberlein, 2003; Trombulak et al., 2004) in nature conservation. The level of education was not only

associated with the knowledge of secondary poisonings but also with the correct assessment of their seriousness. This also supports the idea that education helps to decide the accuracy, importance, and significance of certain information (Bellaera et al., 2021). The positive association between respondents' age and their opinion about the seriousness of secondary poisoning may have originated from the fact that younger people tend to underestimate the severity of situations more than their elders do (Tränkle et al., 1990). Men are usually under-represented among respondents of questionnaires (Pongrácz & Szapu, 2018; Vékony et al., 2022), but we assume based on our result and personal experiences that they will be more likely to participate if the topic is important to them. We believe that men with knowledge about the hamster's protected status were more inclined to complete our questionnaire.

A strong effect of location is probably due to the heavier impact of hamsters on crops. Where the hamsters were more abundant and caused problems, their opinion was worse. This could also happen because people living in areas with many hamsters are more likely to meet with them (Ericsson & Heberlein, 2003). An apparent abundance of the species can reinforce public awareness that the hamster is a common pest (Weinhold, 2008), which can lead to an incorrect assumption of their range-wide abundance (Bjurlin & Cypher, 2005). Behind this association, a reverse conclusion can also be hypothesized: residents may consider the hamster problematic because it must be controlled. In the case of residents, nonexperimental factors (such as gender, viewpoint) proved to be the basis for conclusions during metarepresentation on the opinions of others. Knowledge about the protected status of the hamster could also encourage professionals to have a favorable opinion of the species. Their opinion is rather based on objective knowledge (Ericsson & Heberlein, 2003), while more subjective factors contributed to the creation of an overall picture for the residents.

4.4 | The relationship of natural and social science in nature conservation

The questionnaire reached each agrarian consultant and ranger who worked in areas that can be considered as hamster habitats, thus this survey is highly representative of the professionals in Hungary. During internet-based and personal surveying, we managed to reach and involve a wide range of residents, including those who encounter hamsters on a regular basis. Only certain social groups can be reached properly through the internet (Andrews et al., 2007). Moreover, the potential overrepresentation of certain cohorts of the population, such as higher-educated individuals and women, as well as likely overrepresentation of animal lovers and those prioritizing nature conservation due to the survey's topic and methodology, made it crucial to conduct surveys in those areas of Hungary where hamsters are abundant to ensure comprehensive coverage. This is especially important for the hamster's and the topic's social embeddedness and acceptance, even to those who have suffered economic damage due to the hamsters' activity (Ericsson et al., 2006). The long-term protection of the species can only be successful if the people living and working in hamster populated areas are adequately informed and cooperate as management partners. Communication about the protected status of hamsters seems to have fundamental importance (Bjurlin & Cypher, 2005), because knowledge of this fact was associated with more questions, which influenced the attitude toward the species in a positive way. It would also be important for all stakeholders to be aware that the hamster is CR globally. The species action plan should raise each stakeholders' tolerance level and find solutions to the coexistence between humans and hamsters. This should contain direct connection and cross-references with Agri-Environmental Schemes (AES), which contributes to the positive changes in agricultural practices for effective nature conservation (Bartkowski et al., 2023). These AES can enhance the protection and coexistence of hamsters through measures such as establishing protection belts with wildflowers or roadside verges adjacent to agricultural areas, and implementing long-term financial support schemes for farmers. An additional solution could involve relocating problematic hamsters from settlements to designated Natura 2000 sites within national parks.

It is a significant result that many residents express a favorable attitude toward hamsters, despite their potential for causing damage. This suggests that there is no unresolvable conflict between hamster protection and societal requirements and it is worth solving this paradoxical situation as soon as possible (La Haye et al., 2010). This result also indicates that the hamster could be a flagship species of agroecosystems in Hungary. In connection with this, we should not only be able to find solutions to the problems affecting the species but we could also deal with the related global and more complex nature conservation issues. By protecting the hamster, we could help other endangered species that are connected to it (Bowen-Jones & Entwistle, 2002). Also by considering the hamster as an umbrella species (Hędrzak et al., 2021), through the protection of its habitat, we can contribute to the survival of other species (e.g., corn bunting [*Emberiza calandra*] [Báldi et al., 2005]), that are also declining elsewhere in agricultural areas, and to the sustainability of diverse, mosaic, grassland agroecosystems.

5 | CONCLUSION

This is the first complex survey regarding the common hamster, which examined the situation of the species from an ecological and social point of view and also allowed us to create the most accurate distribution map of the hamster in Hungary. Our survey, which targeted residents, was adapted to the locality and could serve as a model for other countries where the hamster occurs. This is to account for countries that have different conservation status such as Germany or Poland (Weinhold, 2008). Furthermore, our methods can be transferable and adaptable to other conflict-generating species to aid in their preservation.

Due to the significant and, in some regions, abundant hamster populations in Hungary, which exhibit extreme fluctuations, the country has an important role in both local and global conservation efforts for this species. We propose regular species monitoring on a national scale, which can be supported by the wider inclusion of all stakeholders (Grossmann et al., 2020). We identified several factors, which can also contribute toward the species conservation. One of the most important factors is the preference of residents and professionals, that hamsters should not be destroyed, despite their stigma as a pest, which is a good starting point for hamster conservation. It would also be advantageous if the hamster was listed in Annex IV, by the Habitats Directive in Hungary, as well. Our results indicate that it would be worthy to develop a species action plan, as well as other conservation measures that integrate the experts' knowledge, as well as the requirements of the residents. All of these factors and considerations will contribute to the successful, long-term preservation of a conflict species, such as the common hamster. Additionally, protecting the hamster as a keystone burrow-dweller species, umbrella species, and a potential flagship species, would help to sustain the unique grassland agroecosystems of the Pannonian ecoregion.

AUTHOR CONTRIBUTIONS

Julianna Szulamit Szapu: Conceptualization; methodology; formal analysis; investigation; writing—original draft; writing—review and editing; visualization; supervision; project administration. **József Lanszki:** Writing—review and editing; supervision. **Péter Pongrácz:** Methodology, writing—review and editing; supervision. **Tamás Cserkész:** Conceptualization; methodology; investigation; writing—review and editing; visualization; supervision; project administration; funding acquisition.

ACKNOWLEDGMENTS

We would like to express our gratitude to those who completed the questionnaire, to The Hungarian Chamber of Agriculture and the National Park Directorates who helped with the dissemination of the questionnaire. We also thank Gábor Csorba and Mátyás Prommer for their help in composing the questionnaires and reviewing the first draft of the manuscript, Borbála Turcsán, Judit T. Nagy, and Tamás Faragó for help with statistical analysis, Csaba Kiss for help with figures in Appendix E, Kitti Tóth for correcting the English manuscript and Celeste R. Pongrácz for proofreading the manuscript. The financial background for the implementation of the survey was provided by the LIFE IP GRASSLAND-HU (LIFE17 IPE/HU/000018) project.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the first author on reasonable request.

ETHICS STATEMENT

The survey was performed with the respondents' knowledge and consent, while respecting their privacy rights (Appendix B). During this research, we complied with all relevant legislation.

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APPENDIX A: HAMSTER QUESTIONNAIRE 2020 FOR EXPERTS IN HUNGARY

The filling of fields marked with asterisk is minimum required to submit the form. Sending of the questionnaire is only successful if after pressing the submit button you can see "Thank you for completing our questionnaire!" subtitle.

The questionnaire is being conducted under GRASSLAND-HU LIFE. The title of the project is: Long term conservation of Pannonian grasslands and related habitats through the implementation of Prioritized Action Framework (PAF) strategic measures.

1. Name_____

2. Position

3. Did you know that the common hamster is a protected species in Hungary since 2008 and its nature conservation value is HUF 25,000? (*Select one option*.)*

☐ Yes

☐ No

4. Have you ever heard that the common hamster is considered as critically endangered species by the International Union for Conservation of Nature? (*Select one option*.)*

☐ Yes

☐ No

Questions concerning the rangers' and agrarian consultants' operating areas

In the following, questions will be concerned to the ranger district and agrarian consultant areas. It is enough to fill in a single questionnaire if the status of the hamster is the same in the whole area. If there is a settlement within the area where the status of the hamster substantially differs from the others, e.g. the hamster colonised the settlement, please fill a separate questionnaire.

5. Name of the settlement, to which the data applies (more can be given)*

_____

_____

6. Does the hamster occur within the administrative boundaries of your settlement? In case of "No" answer the questionnaire ends, and enters to the "submit" line (*Select one option*.)*

☐ Yes

☐ No

☐ I do not know, probably not

7. What is the opinion about the hamster among the residents, primarily among the farmers in the settlement? (*Select one option*.)*

☐ Good

☐ Poor

☐ Very poor

☐ Neutral

8. Where does the hamster occur? (*Select one option*.)*

☐ Out of settlement

☐ Within settlement

☐ Both places

☐ Other

9. What is the abundance of the hamster population? (*Select one option*.)

☐ Low

☐ Frequent, but does not cause problem

☐ Abundant and cause problem

10. Considering a ten-year interval, how does the abundance of hamster population change? (*Select one option*.)

☐ Does not change

☐ Increase

☐ Decrease

11. How do you spot the presence of hamsters? (*Multiple choice*)

☐ I see road killed animals

☐ I find burrows in the gardens or plough fields

☐ Pets (dog or cat) capture them

☐ I see the living animals

☐ Other:

12. Where does the hamster cause damage? (*Multiple choice*)

☐ Nowhere

☐ In gardens

☐ In grain

☐ In alfalfa

☐ In sunflower

☐ In corn

☐ In rape

☐ Other:

13. Is there hamster control within your operational area? (*Multiple choice*) *Select all that valid.*

☐ No

☐ With trapping

☐ With chemicals

☐ With gassers, gas cartridges

☐ Other

14. What is the size of the area where the hamster control is executed in 2020? (in hectare, estimate is also appropriate)

_____

_____

15. How much economic damage caused by the hamster in 2019? (in HUF, estimate is also appropriate)

_____

16. Can you list concrete hamster occurrences? (geographical names, parcel number, street, coordinate, where the hamster can be found on the site)

_____

17. Share other information or your opinion with the authors of the questionnaire.

_____

_____

_____

_____

_____

_____

APPENDIX B: HAMSTER QUESTIONNAIRE 2021 FOR RESIDENTS IN HUNGARY

B.1 | Information for participants

The filling of fields marked with asterisk is minimum required to submit the form. Sending of the questionnaire is only successful if after pressing the submit button you can see "Thank you for completing our questionnaire!" subtitle. If you are ranger or agrarian consultant, please do not fill this form, instead of it choose which is for specialists in these positions (if you have not completed it before): https://forms.gle/MV9Fb6rFWMVq2DfS9.

The questionnaire consists more parts:

- demographic questions
- questions about common hamster and the opinion about the actual situation of the hamster
- if you have information about common hamster occurrence in concrete settlements, then about concrete occurrence information

Filling of the questionnaire requires 2–10 min. There are not good or bad answers, nor expectations, so we ask, that fill the survey as honestly as you can according to your knowledge and real emotions.

The participation in the research is voluntary and anonymous, the data contained in it are used for scientific purposes only. Your data will be handled confidentially in strict compliance with applicable data protection laws. The data are treated as part of a large database and it will be processed statistically. Only those working in the research have access to the raw data. The analyzed results of the research will be published in the form of scientific and educational publications.

If you experience any discomfort while participating in the research, you can interrupt it at any time without consequences (if you close the questionnaire before clicking the "send" button at the end, your details will not be recorded).

By clicking on the "Next" button, you declare that you have read and understood the information, voluntarily participate in the study and agree to the terms.

The questionnaire is being conducted under GRASSLAND-HU LIFE. The title of the project is: Long term conservation of Pannonian grasslands and related habitats through the implementation of Prioritized Action Framework (PAF) strategic measures.

Questions about your personal opinion and demographic data

1. Name_____

2. Highest education (*Select one option*.)*

☐ Primary school

☐ High school

☐ College/University

3. Age (*Select one option*.)*

☐ 0-18 years

☐ 19-49 years

☐ 50-70 years

☐ over 70 years

4. What is your opinion about the common hamster? (*Select one option*.)*

☐ He/she likes[1] it

☐ He/she does not like it

☐ neutral

5. Did you know that the common hamster is a protected species in Hungary since 2008 and its nature conservation value is HUF 25,000? (*Select one option*.)*

☐ Yes

☐ No

6. Have you ever heard that the common hamster is considered as critically endangered species by the International Union for Conservation of Nature? (*Select one option*.)*

☐ Yes

☐ No

7. Do you agree that there are species protection activities related to common hamster (e.g. sustaining habitats, monitoring of hamster populations, preparation of species action plan etc.)? (*Select one option*.)*

☐ Yes

☐ Yes, but the species protection measures should be in line with the farmers interests

☐ No

☐ I do not know

[1] In Hungarian, the English noun "like" has two meanings: it can imply "szeretni," which reflects your feelings toward another person and how you feel about your pet. This sense is a very strong, definite like for which no English word exists, but it is clearly distinguished from the slighter like (in Hungarian: "kedvelni"). We used the word "szeretni" in the Hungarian questionnaire.

8. Do you agree that the common hamster populations can be reduced? (*Select one option*.)*

☐ Yes

☐ No, but farmers should be compensated for the damage caused by hamsters

☐ No

☐ I do not know

9. Have you ever heard about secondary poisonings (e.g. the rodenticides accumulates in the organs of predator consuming poisoned hamster)? (*Select one option*.)*

☐ Yes

☐ No

10. To what extent do you consider it a serious problem that birds of prey, ungulates and other animals die regularly as a result of secondary poisoning? (1- I do not think it is a problem; 5- I consider it very serious problem) (*Select one option*.)*

○	○	○	○	○
1	2	3	4	5

11. What type of settlement do you live? (*Select one option*.)*

☐ Capital

☐ City

☐ Village

☐ Farm

☐ Other:

12. Name of the settlement, where you live*

_____

13. Is there a continuous, larger green space (including agricultural fields) within 10 minutes of your residence on foot? (*Select one option*.)*

☐ Yes

☐ No

14. Do you have information about the occurrence of the common hamster regarding any settlement? (*Select one option*.)*

☐ Yes -> *Jump to question #15*

☐ No -> *Jump to question #27*

Questions concerning the hamsters' occurrence

15. Name that settlement where you have the most information about the occurrence of the common hamster (it can also be that settlement where you live). Please fill the questions in the next section for this selected settlement! If you have information about more settlements, you can list them at the end of the questionnaire.*

_____

16. What is the opinion about the hamster among the residents in the settlement? (*Select one option*.)*

☐ Good

☐ Poor

☐ Very poor

☐ Neutral

☐ I do not know

17. Where does the hamster occur? (*Select one option*.)*

☐ Out of settlement

☐ Within settlement

☐ Both places

18. Can you list concrete hamster occurrences? If yes, please write down the location as accurately as possible (geographical names, parcel number, street, coordinate) where the hamster can be found on the site.

_____

19. What is the abundance of the hamster population? (*Select one option*.)*

☐ Low

☐ Frequent, but does not cause problem

☐ Abundant and cause problem

20. Considering a ten-year interval, how does the abundance of hamster population change? (*Select one option*.)*

☐ Does not change

☐ Increased

☐ Decreased

☐ I do not know

21. How do you spot the presence of hamsters? (*Multiple choice*)*

☐ I have never seen hamster in the nature

☐ I see the living animals

☐ Pets (dog or cat) capture them

☐ I see road killed animals

☐ I find burrows in the gardens or plough fields

☐ I can hear them

☐ Other, e.g. I heard about them from my neighbour

22. If in the previous question you chose “Other” please explain!

_____

23. Do you know about if there is hamster control in your region and if so, what is the applied method? (*Multiple choice*)*

☐ No

☐ With trapping

☐ With chemicals

☐ With gassers, gas cartridges

☐ I do not know

☐ Other

24. If it were up to you, there would be control measures against the hamster? (*Select one option*.)*

☐ No, if it were up to me, no animal could be killed by anyone

☐ No, I consider this unacceptable against protected, endangered animals

☐ No, for other reason

☐ Yes, but exclusively by methods that do not involve the destruction of the animals (e.g. translocation, alarm, arable land/granary completely separated from the common hamster by any method)

☐ Yes, using snap traps

☐ Yes, using chemicals, even if it cause the death of other species

☐ Yes, using gassers

☐ Yes, using alternative methods

25. If you selected "No, for other reason" or "Yes, using alternative methods" in the previous question, please explain.

26. Please also list other settlements where you have information about the occurrence of the common hamster (with the related data considered important – e.g. where does the hamster occur, in what amount and form did you meet with them). You can fill new questionnaire to each settlement as well (we propose this if there are abundant hamster populations in these too).

_____

_____

_____

_____

_____

_____

Other things to report

27. Share other information or your opinion with the authors of the questionnaire.

_____

_____

_____

_____

_____

_____

APPENDIX C: THE VARIABLES

This appendix shows those demographic and other factors that we used as dependent and independent variables in the GzLM analyses. In those cases, where the original categories of a factor resulted in very uneven Ns, we performed clustering among particular categories. In some cases, clustering was also necessary because of the multiple combinations of answers within a given question. The last three columns of appendix show the process of the clustering (if there was any), the resulting Ns (used for the analysis) and the exact guidelines for clustering.

+ denotes the 'stronger' answer—independently of the other answers in a combination, the "stronger answer" decided the cluster. If a participant marked the 'stronger answer' in any answer combination (when this question type was multiple choice), we clustered the response according to the chosen 'stronger' category.

We named the variables in both questionnaires almost the same. The difference was the "ac, r" abbreviation at the end of a variable name, which means "agrarian consultants and rangers". This shows that the given variable was derived from the professionals questionnaire.

TABLE C1 Professionals questionnaire.

	Final groups used for analysis			Original categories			
Dependent variable	**Group**	**Name of group**	***N***	**Group**	**Name of group**	***N***	**Guidelines for category clustering**
Opinion_ac, r	1	Good	3				
	2	Neutral	88				
	3	Poor	84				
	4	Very poor	23				

TABLE C2 Professionals questionnaire.

	Final groups used for analysis			Original categories			
Independent variables	**Group**	**Name of group**	***N***	**Group**	**Name of group**	***N***	**Guidelines for category clustering**
Position	1	Agrarian consultant	126				
	2	Ranger	72				
Protected_ac, r	1	Yes	148				
	2	No	50				
CR endangered_ac, r	1	Yes	105				
	2	No	93				
Presence info_ac, r	1	Yes	116	1	Yes	116	
	2	2 + 3 → 2; no	82	2	No	52	
				3	He/she does not know	30	
Presence location_ac, r	1	Out of settlement	127				
	2	Within settlement	5				
	3	Both places	33				
Abundance_ac, r	1	Very few	85				
	2	Frequent, does not cause problem	36				
	3	Abundant, cause problem	33				
Change_ac, r	1	Does not change	44				
	2	Increase	59				
	3	Decrease	49				
Meeting_ac, r	1	Direct meeting+	47				Each combination where "he/she saw hamster" was included
	2	Indirect meeting	110				All the other combinations
Damage causing	1	In one type of crop	35				
	2	In several (2 or 3) crops	60				
	3	In many (≥4) crops	26				
Control_ac, r	1	No control	93				There are no control measures in the settlement
	2	Control	56				Any combination where there is any type of control measures in the settlement
	3	He/she does not know	4				

TABLE C3 Residents questionnaire.

Dependent variables	Final groups used for analysis			Original categories			Guidelines for category clustering
	Group	Name of group	*N*	Group	Name of group	*N*	
Species Protection	1	Yes	211				
	2	Yes, but the species protection measures should be in line with the farmers interests	109				
	3	No	11				
	4	He/she does not know	19				
Can be reduced	1	Yes	31				
	2	No, but farmers should be compensated	139				
	3	No	122				
	4	He/she does not know	58				
2ndpoisoning exists	1	He/she knows	285				
	2	He/she does not know	65				
2ndpoisoning serious	1	$1 + 2 + 3 \rightarrow 1$	37	1	No problem	4	
	2	$4 \rightarrow 2$	55	2	Little problem	2	
	3	$5 \rightarrow 3$	258	3	Moderately problem	31	
				4	Serious problem	55	
				5	Very serious problem	258	
Opinion	1	Good	9				
	2	Neutral	14				
	3	Poor	18				
	4	Very poor	16				
	5	He/she does not know	20				
Control opinion	1	$1 + 2 + 3 \rightarrow 1$; would not control	28	1	No, no animal could be killed by anyone	11	
	2	$4 \rightarrow 2$; he/she would defend so that the animal would survive	35	2	No, he/she considers this unacceptable against protected animals	14	
	3	$5 + 6 + 7 \rightarrow 3$; he/she would defend so that the animal would die	14	3	No, for other reason	3	
				4	He/she would defend so that the animal would survive	34	
				5	Yes, using snap traps	6	
				6	Yes, using chemicals	2	
				7	Yes, using gassers	2	
				8	Yes, using alternative methods	5	Answers 8 were categorized one by one to 3 groups based on their content

TABLE C4 Residents questionnaire.

Independent variables	Final groups used for analysis			Original categories			Guidelines for category clustering
	Group	Name of group	*N*	Group	Name of group	*N*	
Education	1	Primary school	37				
	2	High school	133				
	3	College or university	180				
Age	1	≤49 years	291	1	≤18 years	24	
				2	19–49 years	267	
	2	≥50 years	59	3	50–70 years	47	
				4	≥71 years	12	
Sex[a]	1	Male	75				
	2	Female	151				
Viewpoint	1	Likes	216				
	2	He/she does not like	23				
	3	Neutral	111				
Protected	1	Yes	149				
	2	No	201				
CR Endangered	1	Yes	95				
	2	No	255				
Settlement	1	Capital	114	1	Capital	114	
	2	City	143	2	City	143	
	3	Village	93	3	Village	91	
				4	Farm	2	
Green area	1	Yes	277				
	2	No	73				
Presence info	1	Yes	77				
	2	No	273				
Presence location	1	Out of settlement	40				
	2	Within settlement	9				
	3	Both places	28				
Abundance	1	Very few	38				
	2	Frequent, does not cause problem	18				
	3	Abundant, cause problem	21				
Change	1	Does not change	8				
	2	Increase	19				
	3	Decrease	18				
	4	He/she does not know	32				
Meeting	1	Direct meeting+	46				Each combination where "he/she saw hamster" was included
	2	Indirect meeting	31				All the other combinations

TABLE C4 (Continued)

Independent variables	Final groups used for analysis: Group	Name of group	N	Original categories: Group	Name of group	N	Guidelines for category clustering
Control	1	No control	19				There are no control measures in the settlement
	2	Control	30				Any combination where there is any type of control measures in the settlement
	3	He/she does not know	28				

[a]Sex is the only derived variable: we categorized respondents during personal survey and based on the respondents' name in online cases.

APPENDIX D: RESULTS OF CHI-SQUARE TEST WITH ADJUSTED RESIDUALS

TABLE D1 Protected * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Protected	Yes	Count	83	65	149	297
		% within position	65.9%	90.3%	42.6%	54.2%
		Adjusted residual	3.00	6.59	−7.26	
	No	Count	43	7	201	251
		% within position	34.1%	9.7%	57.4%	45.8%
		Adjusted residual	−3.00	−6.59	7.26	
Total		Count	126	72	350	548
		% within position	100.0%	100.0%	100.0%	100.0%

TABLE D2 CR endangered * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
CR endangered	Yes	Count	48	57	95	200
		% within position	38.1%	79.2%	27.1%	36.5%
		Adjusted residual	0.42	8.07	−6.05	
	No	Count	78	15	255	348
		% within position	61.9%	20.8%	72.9%	63.5%
		Adjusted residual	−0.42	−8.07	6.05	
Total		Count	126	72	350	548
		% within position	100.0%	100.0%	100.0%	100.0%

Abbreviation: CR, critically endangered.

TABLE D3 Presence info * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Presence info	Yes	Count	64	52	77	193
		% within position	50.8%	72.2%	22.0%	35.2%
		Adjusted residual	4.17	7.05	−8.61	
	No	Count	62	20	273	355
		% within position	49.2%	27.8%	78.0%	64.8%
		Adjusted residual	−4.17	−7.05	8.61	
Total		Count	126	72	350	548
		% within position	100.0%	100.0%	100.0%	100.0%

TABLE D4 Opinion * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Opinion	Good	Count	3	0	9	12
		% within position	2.4%	0.0%	15.8%	4.7%
		Adjusted residual	−1.73	−2.23	4.48	
	Neutral	Count	51	37	14	102
		% within position	40.5%	51.4%	24.6%	40.0%
		Adjusted residual	0.15	2.33	−2.70	
	Poor	Count	52	32	18	102
		% within position	41.3%	44.4%	31.6%	40.0%
		Adjusted residual	0.41	0.91	−1.47	
	Very poor	Count	20	3	16	39
		% within position	15.9%	4.2%	28.1%	15.3%
		Adjusted residual	0.25	−3.10	3.04	
Total		Count	126	72	57	255
		% within position_opinion	100.0%	100.0%	100.0%	100.0%

TABLE D5 Presence location * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Presence location	Out of settlement	Count	83	44	40	167
		% within position	78.3%	74.6%	51.9%	69.0%
		Adjusted residual	2.76	1.06	−3.92	
	Within settlement	Count	2	3	9	14
		% within position	1.9%	5.1%	11.7%	5.8%
		Adjusted residual	−2.29	−0.26	2.69	
	Both places	Count	21	12	28	61
		% within position	19.8%	20.3%	36.4%	25.2%
		Adjusted residual	−1.71	−0.99	2.73	
Total		Count	106	59	77	242
		% within position_presence location	100.0%	100.0%	100.0%	100.0%

TABLE D6 Abundance * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Abundance	Very few	Count	54	31	38	123
		% within position	54.5%	56.4%	49.4%	53.2%
		Adjusted residual	0.34	0.53	−0.84	
	Frequent. Does not cause problem	Count	20	16	18	54
		% within position	20.2%	29.1%	23.4%	23.4%
		Adjusted residual	−0.99	1.15	0.00	
	Abundant. Cause problem	Count	25	8	21	54
		% within position	25.3%	14.5%	27.3%	23.4%
		Adjusted residual	0.58	−1.77	0.99	
Total		Count	99	55	77	231
		% within position_abundance	100.0%	100.0%	100.0%	100.0%

TABLE D7 Change * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Change	Does not change	Count	26	18	8	52
		% within position	26.0%	34.6%	17.8%	26.4%
		Adjusted residual	−0.13	1.57	−1.49	
	Increase	Count	39	20	19	78
		% within position	39.0%	38.5%	42.2%	39.6%
		Adjusted residual	−0.17	−0.19	0.41	
	Decrease	Count	35	14	18	67
		% within position	35.0%	26.9%	40.0%	34.0%
		Adjusted residual	0.30	−1.26	0.97	
Total		Count	100	52	45	197
		% within position_change	100.0%	100.0%	100.0%	100.0%

TABLE D8 Meeting * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Meeting	Direct meeting+	Count	28	19	46	93
		% within position	28.0%	33.3%	59.7%	39.7%
		Adjusted residual	−3.17	−1.14	4.38	
	Indirect meeting	Count	72	38	31	141
		% within position	72.0%	66.7%	40.3%	60.3%
		Adjusted residual	3.17	1.14	−4.38	
Total		Count	100	57	77	234
		% within position_meeting	100.0%	100.0%	100.0%	100.0%

TABLE D9 Control * position.

			Position			
			Agrarian consultant	Ranger	Residents	Total
Control	No control	Count	69	24	19	112
		% within position	68.3%	46.2%	24.7%	48.7%
−0.42	−5.17	adjusted residual	5.27	−0.42	−5.17	
	Control	Count	31	25	30	86
		% within position	30.7%	48.1%	39.0%	37.4%
		Adjusted residual	−1.86	1.81	0.35	
	He/she does not know	Count	1	3	28	32
		% within position	1.0%	5.8%	36.4%	13.9%
		Adjusted residual	−5.01	−1.93	6.98	
Total		Count	101	52	77	230
		% within position_cotrol	100.0%	100.0%	100.0%	100.0%

APPENDIX E: RESULTS OF GzLMS, PARAMETER ESTIMATES, AND GRAPHS OF INTERACTIONS

E.1 | Species protection

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, presence info + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 209 answers

TABLE E1.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Education	1.756	2	0.416
Age	0.234	1	0.628
Viewpoint	11.103	2	0.004
Protected	1.784	1	0.182
Education * viewpoint	12.972	4	0.011
Age * protected	4.357	1	0.037

Note: * means the reference category within the groups of a particular variable.

TABLE E1.2 Parameter estimates.

Parameter		*B*	Std. error	95% Wald confidence interval		Hypothesis test		
				Lower	Upper	Wald chi-square	df	Sig.
Threshold	[Species protection = 1]	0.997	0.6716	−0.319	2.313	2.204	1	0.138
	[Species protection = 2]	3.924	0.7782	2.399	5.450	25.429	1	<0.001
[Education = 1]		−1.876	1.1363	−4.103	0.351	2.727	1	0.099
[Education = 2]		0.454	0.5777	−0.678	1.586	0.618	1	0.432
[Education = 3]		0*	-	-	-	-	-	-
[Age = 1]		1.097	0.6102	−0.099	2.293	3.229	1	0.072
[Age = 2]		0*	-	-	-	-	-	-
[Viewpoint = 1]		−1.069	0.4485	−1.948	−0.190	5.680	1	0.017
[Viewpoint = 2]		1.835	1.1231	−0.367	4.036	2.668	1	0.102
[Viewpoint = 3]		0*	-	-	-	-	-	-
[Protected = 1]		1.456	0.7807	−0.074	2.986	3.479	1	0.062
[Protected = 2]		0*	-	-	-	-	-	-
[Education = 1] * [viewpoint = 1]		2.260	1.3271	−0.341	4.861	2.901	1	0.089
[Education = 1] * [viewpoint = 2]		3.193	1.8289	−0.391	6.778	3.049	1	0.081
[Education = 1] * [viewpoint = 3]		0*	-	-	-	-	-	-
[Education = 2] * [viewpoint = 1]		−0.110	0.7151	−1.512	1.291	0.024	1	0.877
[Education = 2] * [viewpoint = 2]		−3.175	1.5396	−6.193	−0.157	4.253	1	0.039
[Education = 2] * [viewpoint = 3]		0*	-	-	-	-	-	-
[Education = 3] * [viewpoint = 1]		0*	-	-	-	-	-	-
[Education = 3] * [viewpoint = 2]		0*	-	-	-	-	-	-
[Education = 3] * [viewpoint = 3]		0*	-	-	-	-	-	-
[Age = 1] * [protected = 1]		−1.770	0.8478	−3.431	−0.108	4.357	1	0.037
[Age = 1] * [protected = 1]		0*	-	-	-	-	-	-
[Age = 1] * [protected = 1]		0*	-	-	-	-	-	-
[Age = 1] * [protected = 1]		0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graphs of interactions

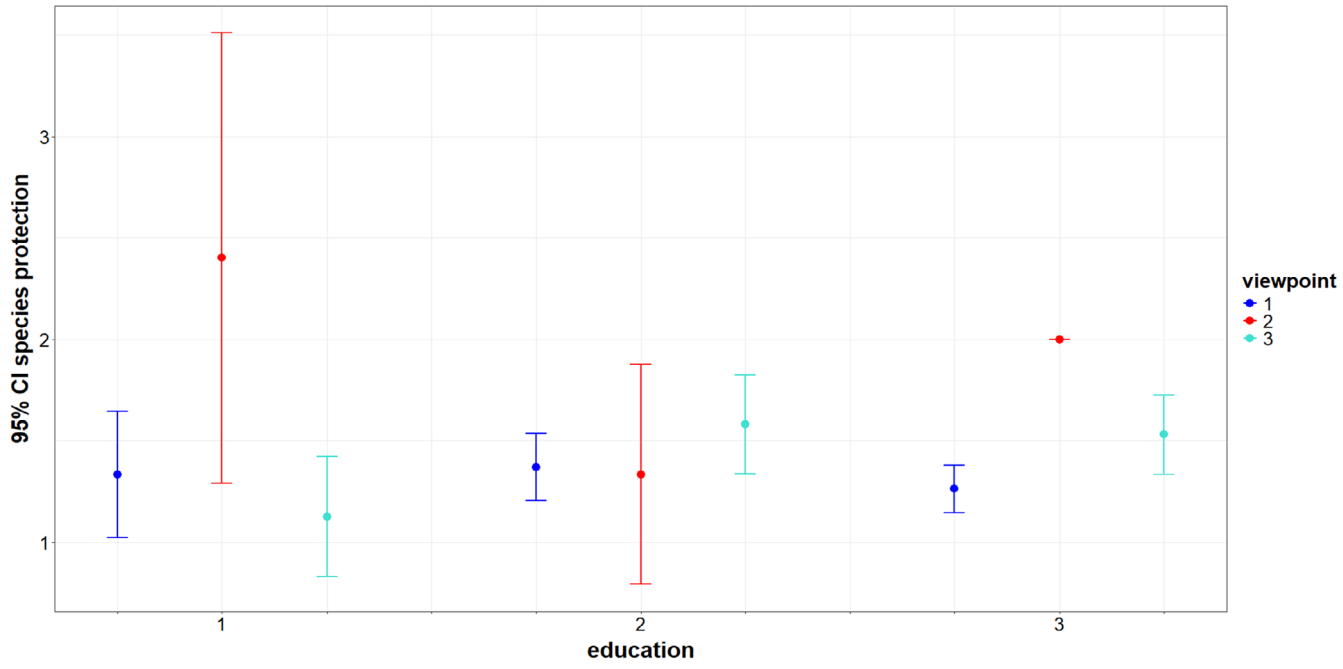

FIGURE E1.1 The effect of education * viewpoint interaction on species protection.

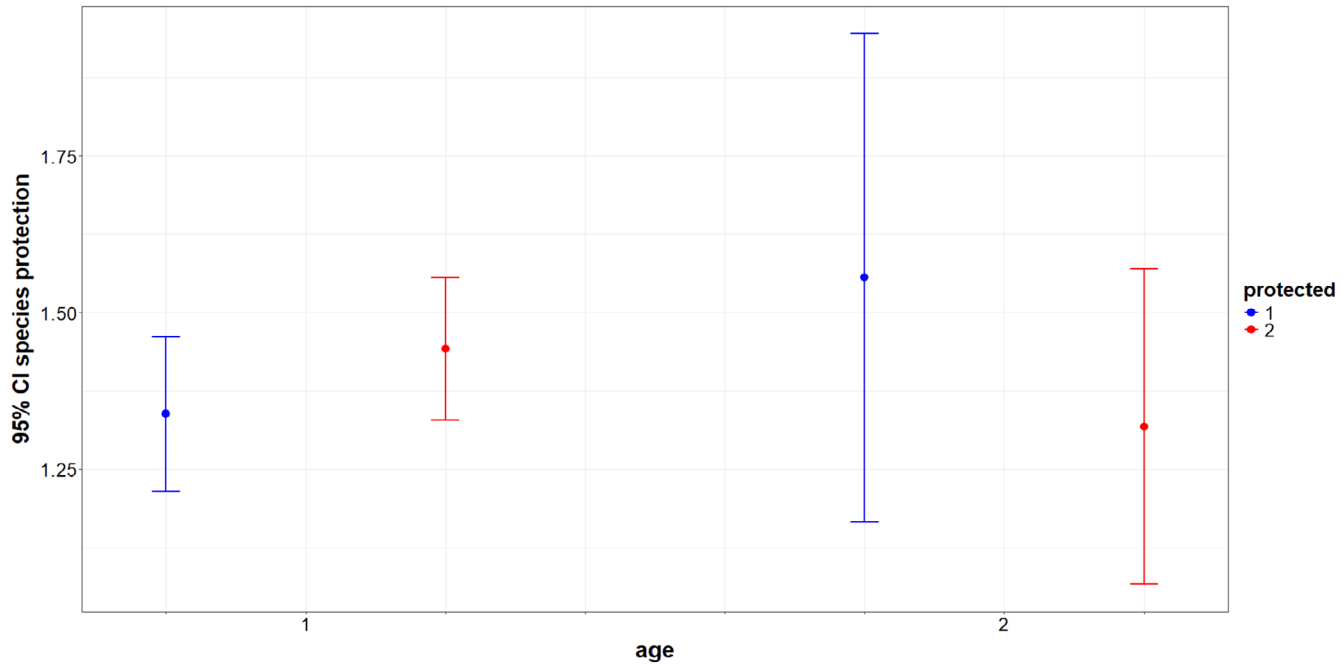

FIGURE E1.2 The effect of age * protected interaction on species protection.

E.2 | Can be reduced

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, presence info + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 191 answers

TABLE E2.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Age	2.144	1	0.143
Sex	8.090	1	0.004
Viewpoint	9.892	2	0.007
Protected	6.414	1	0.011
Presence_info	2.011	1	0.156
Age * viewpoint	8.121	2	0.017
Age * viewpoint	6.985	2	0.030
Protected * presence_info	9.731	1	0.002

Note: * means the reference category within the groups of a particular variable.

TABLE E2.2 Parameter estimates.

				95% Wald confidence interval		Hypothesis test		
Parameter		***B***	**Std. error**	**Lower**	**Upper**	**Wald chi-square**	**df**	**Sig.**
Threshold	[Can be reduced = 1]	−1.708	0.7604	−3.198	−0.217	5.043	1	0.025
	[Can be reduced = 2]	1.206	0.7513	−0.267	2.678	2.575	1	0.109
[Age = 1]		0.762	0.7734	−0.754	2.278	0.970	1	0.325
[Age = 2]		0*	-	-	-	-	-	-
[Sex = 1]		0.190	0.5964	−0.979	1.359	0.102	1	0.749
[Sex = 2]		0*	-	-	-	-	-	-
[Viewpoint = 1]		2.540	0.9496	0.678	4.401	7.152	1	0.007
[Viewpoint = 2]		−0.181	1.1200	−2.376	2.014	0.026	1	0.872
[Viewpoint = 3]		0*	-	-	-	-	-	-
[Protected = 1]		−0.242	0.3537	−0.935	0.451	0.467	1	0.494
[Protected = 2]		0*	-	-	-	-	-	-
[Presence_info = 1]		−1.712	0.5869	−2.863	−0.562	8.511	1	0.004
[Presence_info = 2]		0*	-	-	-	-	-	-
[Age = 1] * [viewpoint = 1]		−1.782	0.9649	−3.673	0.109	3.410	1	0.065
[Age = 1] * [viewpoint = 2]		1.725	1.4264	−1.071	4.521	1.463	1	0.227
[Age = 1] * [viewpoint = 3]		0*	-	-	-	-	-	-

(Continues)

TABLE E2.2 (Continued)

Parameter	B	Std. error	95% Wald confidence interval		Hypothesis test		
			Lower	Upper	Wald chi-square	df	Sig.
[Age = 2] * [viewpoint = 1]	0*	-	-	-	-	-	-
[Age = 2] * [viewpoint = 2]	0*	-	-	-	-	-	-
[Age = 2] * [viewpoint = 3]	0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]	−1.215	0.7129	−2.612	0.182	2.905	1	0.088
[Sex = 1] * [viewpoint = 2]	−3.308	1.3081	−5.872	−0.744	6.396	1	0.011
[Sex = 1] * [viewpoint = 3]	0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 1]	0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 2]	0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 3]	0*	-	-	-	-	-	-
[Protected = 1] * [presence_info = 1]	2.325	0.7453	0.864	3.786	9.731	1	0.002
[Protected = 1] * [presence_info = 2]	0*	-	-	-	-	-	-
[Protected = 2] * [presence_info = 1]	0*	-	-	-	-	-	-
[Protected = 2] * [presence_info = 2]	0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graphs of interactions

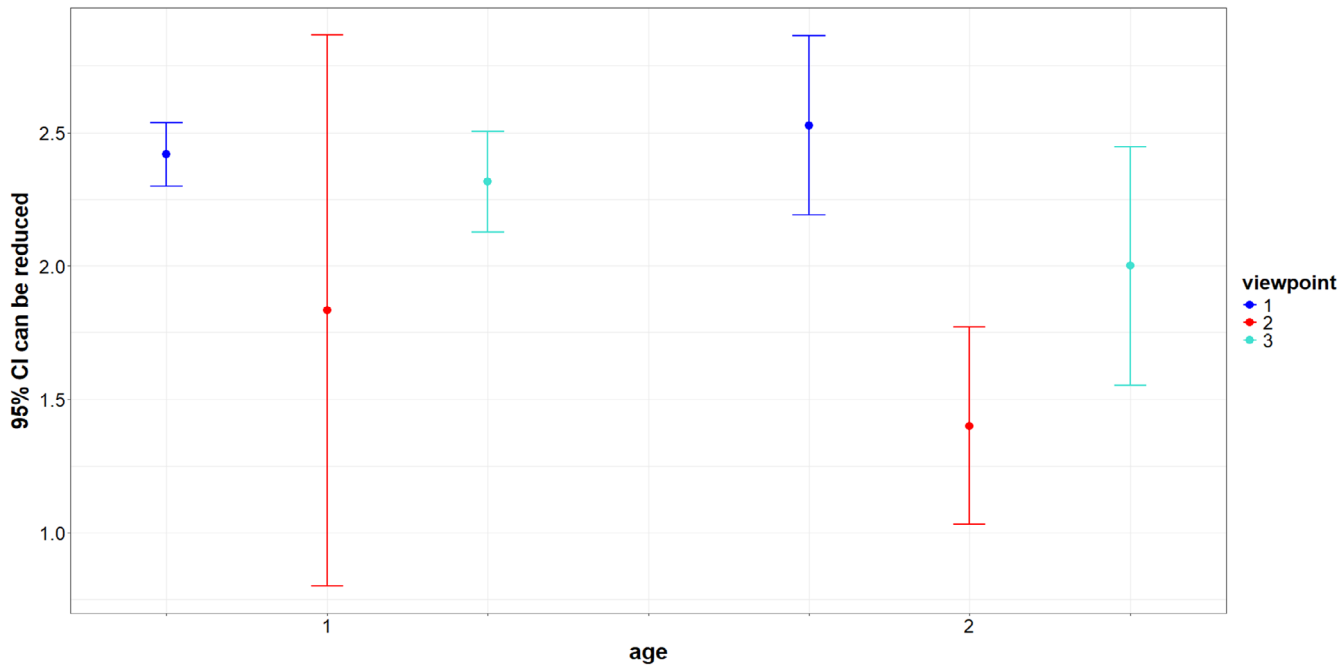

FIGURE E2.1 The effect of age * viewpoint interaction on can be reduced.

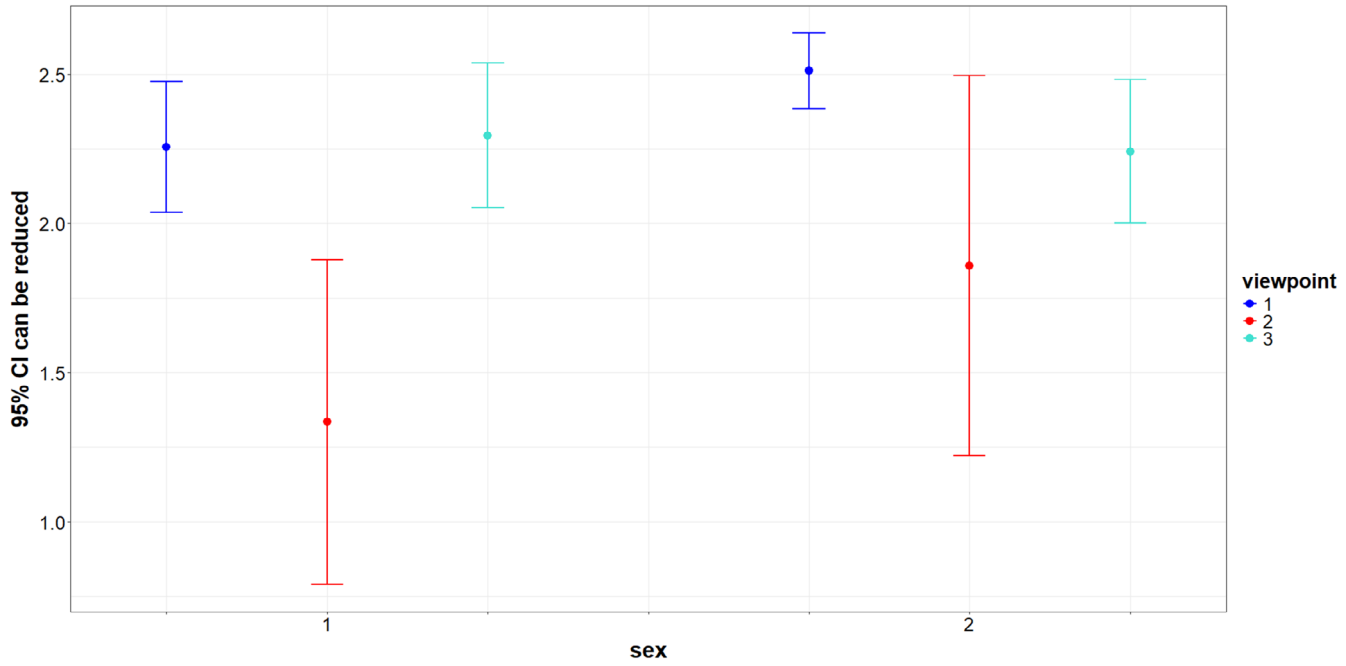

FIGURE E2.2 The effect of age * viewpoint interaction on can be reduced.

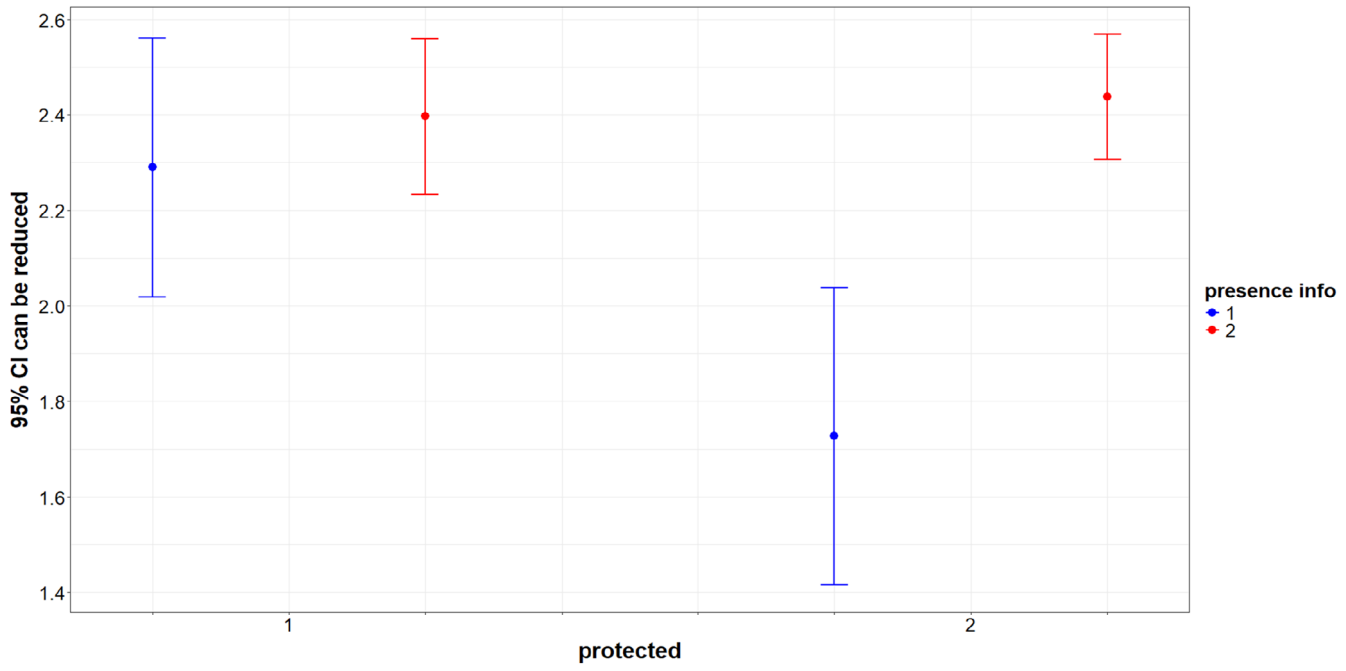

FIGURE E2.3 The effect of protected * presence_info interaction on can be reduced.

E.3 | 2ndpoisoning exist

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, presence info + all two-ways interactions

Statistics: Generalized linear model with binary logistic

Involved: 226 answers

TABLE E3.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Education	25.050	2	<0.001
Protected	15.933	1	<0.001

TABLE E3.2 Parameter estimates.

				95% Wald confidence interval		Hypothesis test		
Parameter		***B***	**Std. error**	**Lower**	**Upper**	**Wald chi-square**	**df**	**Sig.**
Threshold	[2ndpoisoning_exist = 1]	1.714	0.3485	1.031	2.397	24.185	1	<0.001
[Education = 1]		2.656	0.5323	1.612	3.699	24.883	1	<0.001
[Education = 2]		1.234	0.4228	0.406	2.063	8.523	1	0.004
[Education = 3]		0*	-	-	-	-	-	-
[Protected = 1]		−1.735	0.4347	−2.587	−0.883	15.933	1	<0.001
[Protected = 2]		0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

E.4 | 2ndpoisoning serious

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, presence info + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 226 answers

TABLE E4.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Education	6.733	2	0.035
Age	4.483	1	0.034
Sex	6.968	1	0.008
Viewpoint	6.703	2	0.035
Protected	2.001	1	0.157
Sex * viewpoint	12.847	2	0.002
Sex * protected	4.548	1	0.033

Note: * means the reference category within the groups of a particular variable.

TABLE E4.2 Parameter estimates.

Parameter		*B*	Std. error	95% Wald confidence interval		Hypothesis test		
				Lower	Upper	Wald chi-square	df	Sig.
Threshold	[2ndpoisoning_serious = 1]	−3.038	0.6336	−4.280	−1.796	22.984	1	<0.001
	[2ndpoisoning_serious = 2]	−1.660	0.5995	−2.835	−0.485	7.665	1	0.006
[Education = 1]		−1.227	0.4779	−2.163	−0.290	6.586	1	0.010
[Education = 2]		−0.530	0.3729	−1.261	0.201	2.023	1	0.155
[Education = 3]		0*	-	-	-	-	-	-
[Age = 1]		−1.092	0.5156	−2.102	−0.081	4.483	1	0.034
[Age = 2]		0*	-	-	-	-	-	-
[Sex = 1]		0.358	0.6448	−0.906	1.621	0.308	1	0.579
[Sex = 2]		0*	-	-	-	-	-	-
[Viewpoint = 1]		1.472	0.4292	0.631	2.313	11.764	1	<0.001
[Viewpoint = 2]		−2.288	0.8686	−3.990	−0.585	6.936	1	0.008
[Viewpoint = 3]		0*	-	-	-	-	-	-
[Protected = 1]		−0.265	0.4152	−1.079	0.549	0.408	1	0.523
[Protected = 2]		0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]		−1.891	0.7940	−3.447	−0.335	5.673	1	0.017
[Sex = 1] * [viewpoint = 2]		2.217	1.3169	−0.364	4.798	2.835	1	0.092
[Sex = 1] * [viewpoint = 3]		0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 1]		0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 2]		0*	-	-	-	-	-	-
[Sex = 2] * [viewpoint = 3]		0*	-	-	-	-	-	-
[Sex = 1] * [protected = 1]		1.581	0.7412	0.128	3.033	4.548	1	0.033
[Sex = 1] * [protected = 2]		0*	-	-	-	-	-	-
[Sex = 2] * [protected = 1]		0*	-	-	-	-	-	-
[Sex = 2] * [protected = 2]		0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graphs of interactions

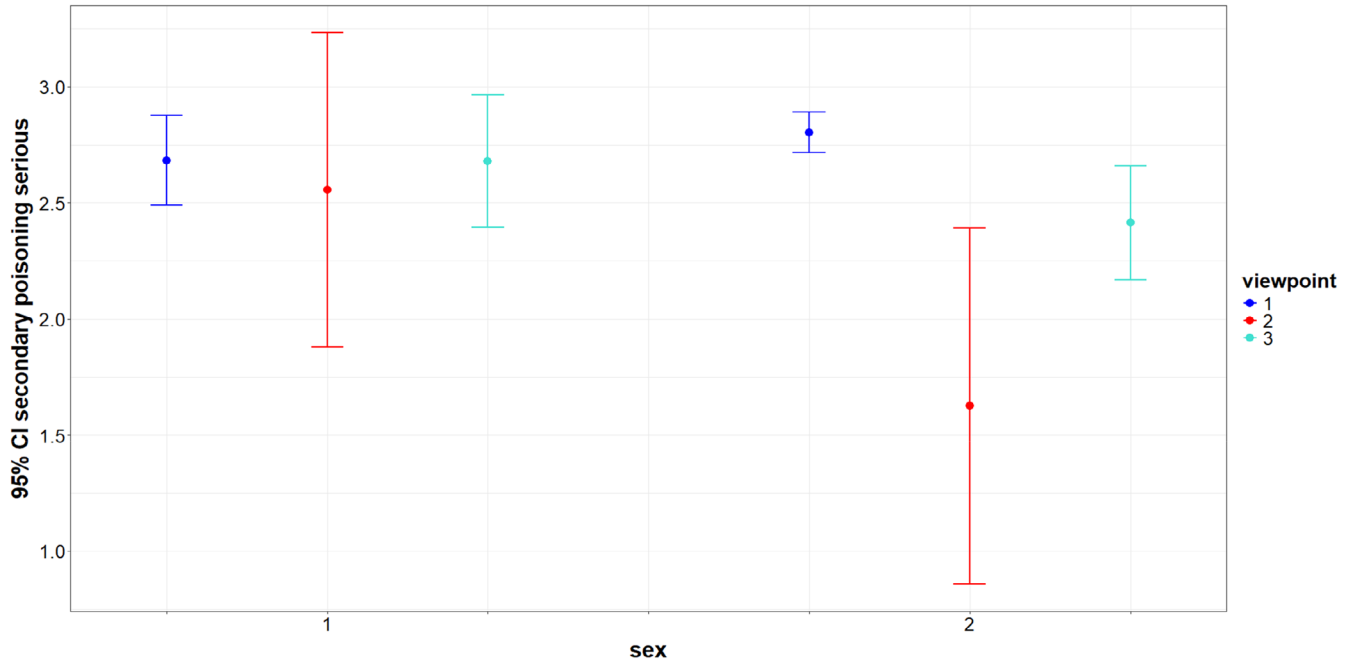

FIGURE E4.1 The effect of sex * viewpoint interaction on secondary poisoning serious.

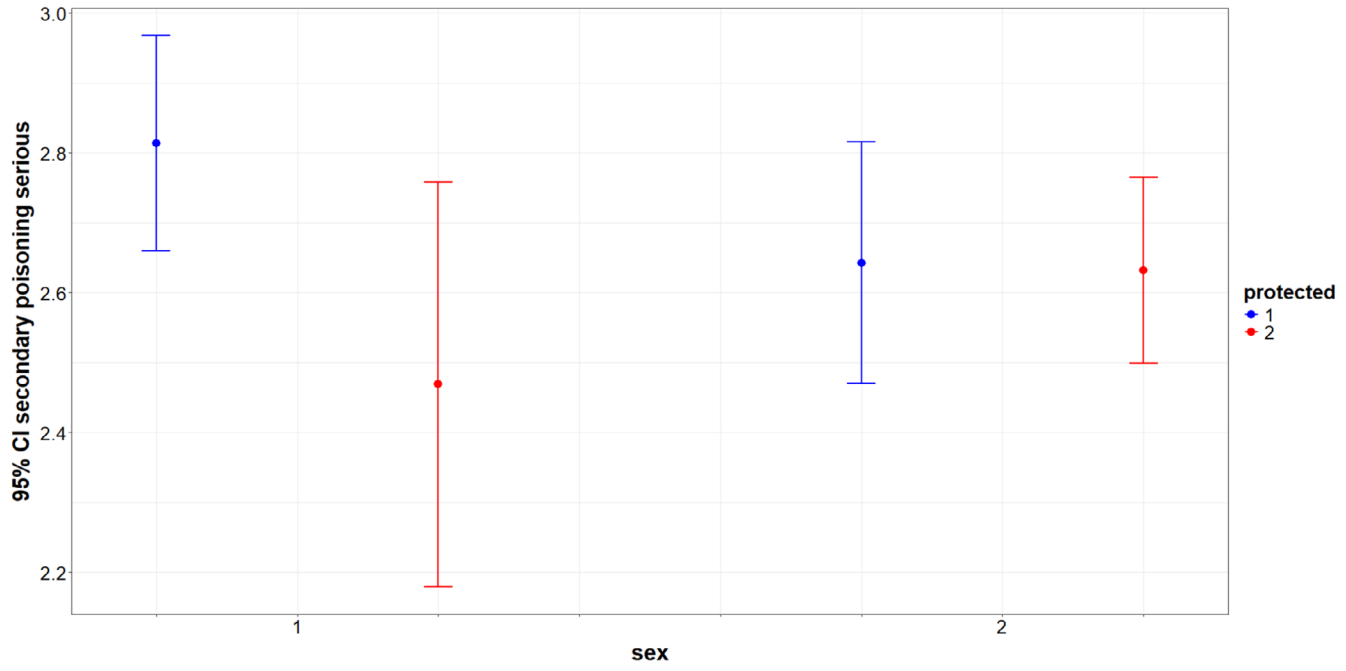

FIGURE E4.2 The effect of sex * protected interaction on secondary poisoning serious.

E.5 | Opinion

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, presence location, abundance, meeting, control + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 44 answers

TABLE E5.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Education	8.812	2	0.012
Sex	0.061	1	0.805
Viewpoint	1.377	2	0.502
Presence_location	6.499	2	0.039
Abundance	9.361	2	0.009
Meeting	6.686	1	0.010
Control	9.054	2	0.011
Sex * viewpoint	9.420	2	0.009

Note: * means the reference category within the groups of a particular variable.

TABLE E5.2 Parameter estimates.

				95% Wald confidence interval		Hypothesis test		
Parameter		***B***	**Std. error**	**Lower**	**Upper**	**Wald chi-square**	**df**	**Sig.**
Threshold	[Opinion = 1]	1.690	1.9981	−2.227	5.606	0.715	1	0.398
	[Opinion = 2]	4.347	2.2969	−0.155	8.849	3.582	1	0.058
	[Opinion = 3]	7.187	2.4096	2.464	11.910	8.896	1	0.003
[Education = 1]		−0.553	1.0747	−2.659	1.554	0.264	1	0.607
[Education = 2]		−4.410	1.5140	−7.378	−1.443	8.485	1	0.004
[Education = 3]		0*	-	-	-	-	-	-
[Sex = 1]		2.443	1.4907	−0.478	5.365	2.686	1	0.101
[Sex = 2]		0*	-	-	-	-	-	-
[Viewpoint = 1]		4.653	1.8312	1.064	8.242	6.456	1	0.011
[Viewpoint = 2]		−0.112	1.5935	−3.235	3.011	0.005	1	0.944
[Viewpoint = 3]		0*	-	-	-	-	-	-
[Presence_location = 1]		2.556	1.0228	0.551	4.560	6.245	1	0.012
[Presence_location = 2]		3.069	1.7195	−0.302	6.439	3.185	1	0.074
[Presence_location = 3]		0*	-	-	-	-	-	-
[Abundance = 1]		−0.761	1.2608	−3.232	1.710	0.364	1	0.546
[Abundance = 2]		−3.659	1.4105	−6.424	−0.895	6.730	1	0.009
[Abundance = 3]		0*	-	-	-	-	-	-
[Meeting = 1]		2.975	1.1504	0.720	5.229	6.686	1	0.010
[Meeting = 2]		0*	-	-	-	-	-	-
[Control = 1]		1.051	1.0412	−0.990	3.092	1.019	1	0.313
[Control = 2]		4.732	1.5843	1.627	7.838	8.923	1	0.003
[Control = 3]		0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]		−7.153	2.4926	−12.038	−2.267	8.235	1	0.004

(Continues)

TABLE E5.2 (Continued)

Parameter	B	Std. error	95% Wald confidence interval		Hypothesis test		
			Lower	Upper	Wald chi-square	df	Sig.
[Sex = 1] * [viewpoint = 1]	0.370	2.1105	−3.767	4.506	0.031	1	0.861
[Sex = 1] * [viewpoint = 1]	0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]	0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]	0*	-	-	-	-	-	-
[Sex = 1] * [viewpoint = 1]	0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graph of interaction

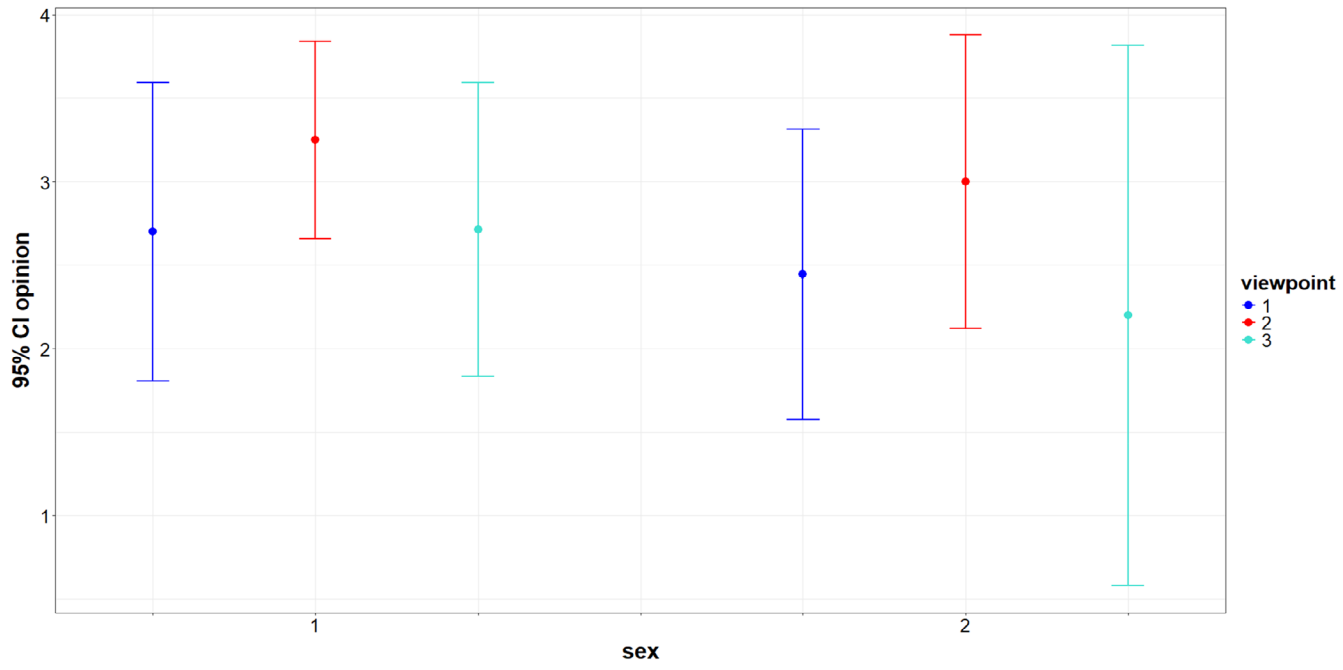

FIGURE E5 The effect of sex * viewpoint interaction on opinion.

E.6 | Opinion_ac, r

Independent variables of original model: position, protected_ac, r, presence location_ac, r, abundance_ac, r, meeting_ac, r, damage causing, control_ac, r + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 117 answers

TABLE E6.1 Results.

Type III			
Source	Wald Chi-square	df	Sig.
Protected_ac, r	9.431	1	0.002
Abundance_ac, r	26.125	2	<0.001
Damage_causing_ac, r	5.569	2	0.062
Abundance_ac, r * damage_causing_ac, r	10.921	4	0.027

Note: * means the reference category within the groups of a particular variable.

TABLE E6.2 Parameter estimates.

Parameter	*B*	Std. error	95% Wald confidence interval		Hypothesis test		
			Lower	Upper	Wald Chi-square	df	Sig.
Threshold [opinion_ac, r = 1]	−11.107	1.5064	−14.060	−8.155	54.363	1	<0.001
[Opinion_ac, r = 2]	−7.062	1.0893	−9.197	−4.927	42.032	1	<0.001
[Opinion_ac, r = 3]	−2.805	0.8459	−4.463	−1.147	10.995	1	<0.001
[Protected_ac, r = 1]	−1.737	0.5657	−2.846	−0.629	9.431	1	0.002
[Protected_ac, r = 2]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1]	−6.406	1.3058	−8.966	−3.847	24.072	1	<0.001
[Abundance_ac, r = 2]	−2.246	1.1759	−4.551	0.059	3.648	1	0.056
[Abundance_ac, r = 3]	0*	-	-	-	-	-	-
[Damage_causing = 1]	−4.357	1.3286	−6.961	−1.753	10.753	1	0.001
[Damage_causing = 1]	−2.715	0.9043	−4.488	−0.943	9.017	1	0.003
[Damage_causing = 1]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1] * [damage_causing = 1]	5.103	1.6954	1.780	8.426	9.060	1	0.003
[Abundance_ac, r = 1] * [damage_causing = 1]	4.059	1.4098	1.296	6.822	8.288	1	0.004
[Abundance_ac, r = 1] * [damage_causing = 1]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1] * [damage_causing = 1]	2.806	1.8326	−0.785	6.398	2.345	1	0.126
[Abundance_ac, r = 1] * [damage_causing = 1]	1.349	1.4302	−1.454	4.152	0.890	1	0.346
[Abundance_ac, r = 1] * [damage_causing = 1]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1] * [damage_causing = 1]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1] * [damage_causing = 1]	0*	-	-	-	-	-	-
[Abundance_ac, r = 1] * [damage_causing = 1]	0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graph of interaction

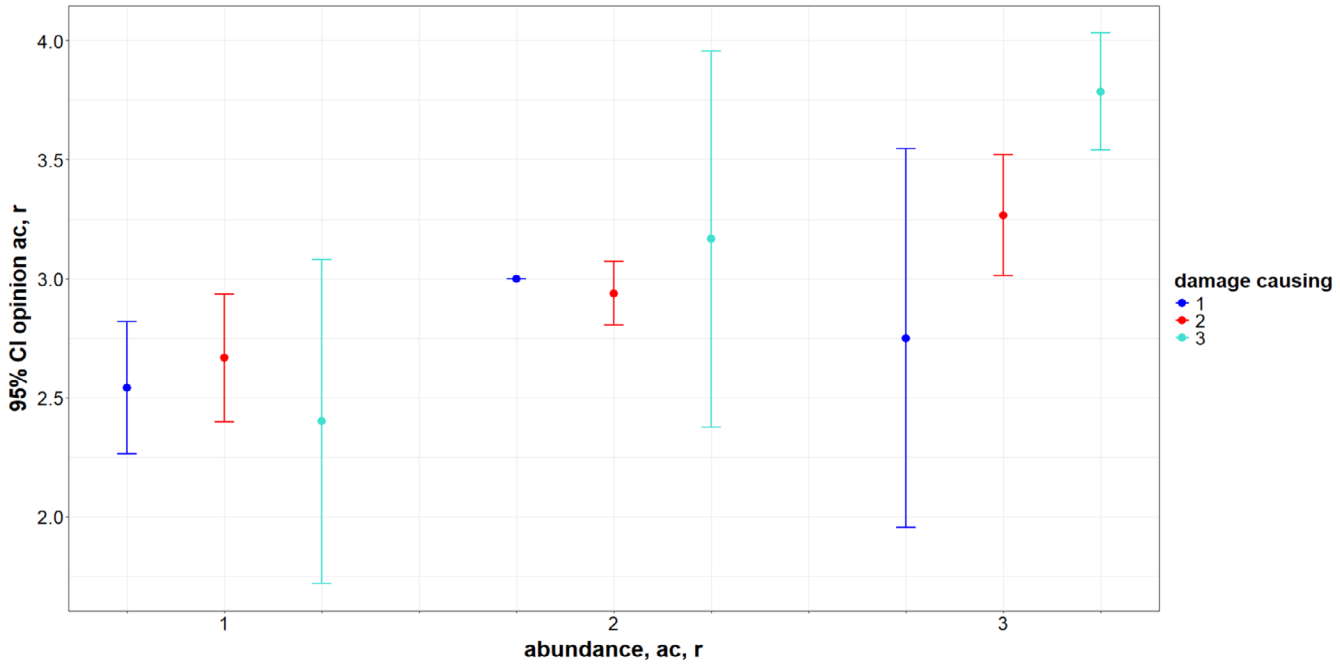

FIGURE E6 The effect of abundance_ac, r * damage causing interaction on opinion_ac, r.

E.7 | Control opinion

Independent variables of original model: education, age, sex, viewpoint, protected, settlement, meeting, control + all two-ways interactions

Statistics: Generalized linear model with ordinal logistic

Involved: 60 answers

TABLE E7.1 Results.

Type III			
Source	**Wald Chi-square**	**df**	**Sig.**
Education	3.512	2	0.173
Age	9.197	1	0.002
Control	11.083	2	0.004
Education * age	8.777	2	0.012

Note: * means the reference category within the groups of a particular variable.

TABLE E7.2 Parameter estimates.

Parameter		*B*	Std. error	95% Wald confidence interval		Hypothesis test		
				Lower	Upper	Wald Chi-square	df	Sig.
Threshold	[Control opinion = 1]	−0.162	0.9181	−1.962	1.637	0.031	1	0.860
	[Control opinion = 2]	3.671	1.1625	1.393	5.950	9.973	1	0.002
[Education = 1]		4.190	1.3800	1.485	6.895	9.218	1	0.002
[Education = 2]		0.579	1.2078	−1.788	2.946	0.230	1	0.632
[Education = 3]		0*	-	-	-	-	-	-
[Age = 1]		−0.220	0.9515	−2.085	1.645	0.054	1	0.817
[Age = 2]		0*	-	-	-	-	-	-
[Control = 1]		−0.051	0.7069	−1.437	1.334	0.005	1	0.942
[Control = 2]		2.763	0.8898	1.019	4.507	9.645	1	0.002
[Control = 3]		0*	-	-	-	-	-	-
[Education = 1] * [age = 1]		−5.161	1.7923	−8.674	−1.648	8.292	1	0.004
[Education = 1] * [age = 2]		0*	-	-	-	-	-	-
[Education = 2] * [age = 1]		−0.604	1.4077	−3.363	2.155	.184	1	0.668
[Education = 2] * [age = 2]		0*	-	-	-	-	-	-
[Education = 3] * [age = 1]		0*	-	-	-	-	-	-
[Education = 3] * [age = 2]		0*	-	-	-	-	-	-

Note: * means the reference category within the groups of a particular variable.

Graph of interaction

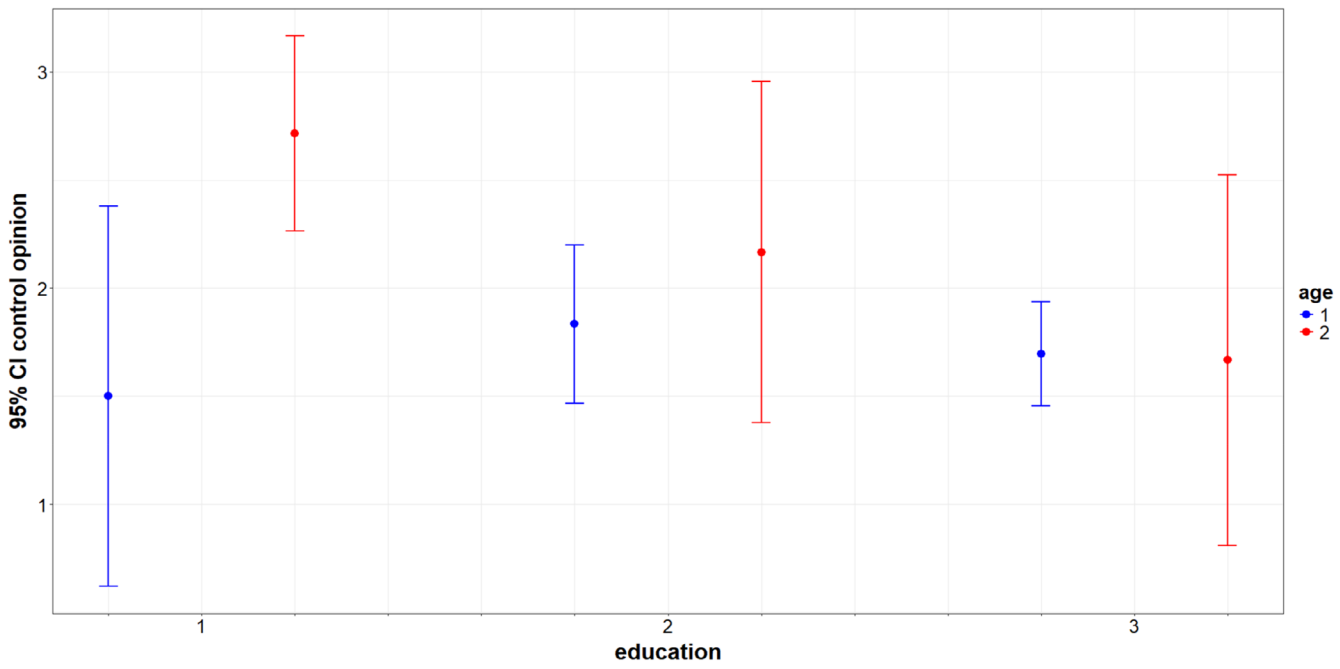

FIGURE E7 The effect of education * age interaction on control opinion.