

# Tolerance of Amphibians in Slovakian People: A Comparison of Pond Owners and Non-Owners

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**ABSTRACT** Amphibians are vulnerable to extinction due to their need for both terrestrial and aquatic habitats to complete their life cycles. Some of them occupy urban areas, thus human tolerance of amphibians is likely to have a significant impact on their survival. Here we investigated tolerance of amphibians by interviewing a convenience sample of 201 pond owners and non-owners of various ages in Slovakia. Tolerance of tadpoles was higher than tolerance of adult amphibians. About 26% of pond owners reported that they kill adult amphibians, as did 31% of non-owners. We found that tolerance of amphibians was positively correlated with perceived importance of amphibians and negatively correlated with a disgust reaction to amphibians. Disgust and importance of amphibians negatively correlated, suggesting that people who perceived amphibians as disgusting underestimated their importance in nature. These correlations were statistically significant. Owning a pond, gender, age, education level, and mean amphibian identification scores were not significant predictors of tolerance, but older and better educated people had higher amphibian identification scores. These results highlight the role of disgust sensitivity and education in the protection of unpopular animals such as amphibians.

**Keywords:** amphibians, disgust, identification, tolerance



Habitat loss and fragmentation are primary causes of species extinction in many regions (Wilcox and Murphy 1985; Stuart et al. 2004). Among vertebrate groups, amphibians, currently comprising over 5,500 described living species, seem particularly vulnerable to extinction due to their need for both terrestrial and aquatic ecosystems to complete their life cycle (Houlahan et al. 2000; Hamer and McDonnell 2008; Becker et al. 2009). Intense urbanization may be the cause of a dramatic decrease in amphibian populations worldwide, for example,

through climate change, emergent diseases, competition with invasive species (Blaustein and Kiesecker 2002; Pounds et al. 2006; Bickford et al. 2010), deliberate killing, traffic mortality (Ashley and Robinson 1996; Hels and Buchwald 2001; Sutherland, Dunning and Baker 2010), pond isolation (Vos and Stumpel 1995), and chemical contamination (Reeder et al. 2005). Indeed, urbanized landscapes generally contain fewer species or lower abundances of frogs, toads, and salamanders (Willson and Dorcas 2003; Pellet, Guisan and Perrin 2004; Pillsbury and Miller 2008).

Despite the negative impact of humans on the habitat of amphibians, urban areas still have the potential to save at least some amphibian species (Pellet, Guisan and Perrin 2004; Brand and Snodgrass 2009; Recuero et al. 2010). Amphibians occupy a wide range of habitats, from artificial streams to forests. Both juveniles and adults are important food sources for many predators, and adults are predators of a variety of invertebrates and small vertebrates. Despite their ecological importance and adaptability, populations continue to be lost and many species are at risk (Blaustein, Wake and Sousa 1994; Stuart et al. 2004). The role of humans in active protection of amphibians is therefore more important than ever, and the survival of many species depends on tolerance of amphibians by humans.

#### ***Attitudes toward Amphibians***

So how do humans perceive amphibians? Despite a number of research studies examining human attitudes and preferences for wild animals (e.g., Kellert 1985, 1993; Driscoll 1995; Røskaft et al. 2003; Bjerke and Østdahl 2004; Kaltenborn, Bjerke and Nyahongo 2006; Prokop and Tunnicliffe 2008, 2010; Prokop, Özel and Usak 2009), there are few empirical studies that examine human attitudes and behaviors toward amphibians. Theoretically (Herzog and Burghardt 1988; Serpell 2004), we hypothesize that one reason for amphibians being unpopular is that amphibians do not influence human survival and are not phylogenetically close to humans. Knight et al. (2004) determined that when animals were perceived as more similar physically to humans (e.g., apes), this led to beliefs that they were more similar mentally to humans. Furthermore, people have more positive attitudes toward pets (Plous 1993) and toward animals that are believed to have “higher” mental abilities, and less positive attitudes toward animals with lower mental abilities (Herzog and Galvin 1997; Knight et al. 2003, 2004, 2009).

Amphibians are not key sources of food for contemporary or ancestral humans (Ungar and Teaford 2002), and physical and behavioral characteristics of amphibians may be responsible for a lack of interest in these species among children (Prokop, Prokop and Tunnicliffe 2008; Prokop and Tunnicliffe 2010): Unlike many higher vertebrates, amphibians can be slimy, unfamiliar, and cannot be domesticated. This may be one reason why frogs are commonly targets of animal abuse or killing (Pagani, Robustelli and Ascione 2007). In a survey of attitudes toward various invertebrates and vertebrates in Swiss school children, amphibians were more disliked than butterflies, birds, and mammals (Schlegel and Rupf 2010), and out of the four amphibian species examined, three species were disliked (especially the common toad (*Bufo bufo*)). Only the tree frog (*Hyla arborea*) was rated neither very positively nor very negatively.

#### ***Disgust Reaction to Amphibians***

The slimy bodies of some amphibians are said to resemble primary disgust-evoking stimuli such as mucus or feces (Davey et al. 1998). Thus, the emotion of disgust may be associated with a dislike of these animals by humans. Also, smaller animals seem to provoke a disgust

reaction greater than bigger animals (Prokop, Usak and Fančovičová 2010a). Recent research shows that the emotion of disgust significantly influences human–animal interaction (see review by Curtis, de Barra and Aunger 2011). For example, people with high disgust sensitivity avoid petting companion animals and wash their hands more frequently than people with low sensitivity to disgust (Prokop and Fančovičová 2010b; Prokop, Fančovičová and Fedor 2010). Yet surprisingly, there is no research that examines how disgust of animals might influence tolerance or intolerance of certain species.

### ***The Effect of Age and Gender on Attitudes toward, and Treatment of, Amphibians***

Findings from previous research indicate that age and gender are likely to influence the way amphibians are viewed and treated. For example, older people show greater fear of dangerous animals (Kellert 1985; Ericsson and Heberlein 2003; Røskaft et al. 2003; Kleiven, Bjerke and Kaltenborn 2004; Kaltenborn, Bjerke and Nyahongo 2006), and better educated people accept animals (Kellert 1980, 1993; but see Signal and Taylor 2006) and conservation activities (Kaltenborn, Bjerke and Vittersø 1999; McClanahan, Davies and Maina 2005; Kideghesho, Røskaft and Kaltenborn 2007; Røskaft et al. 2007) more than less educated people. Furthermore, females tend to have more pro-animal attitudes (e.g., Herzog, Betchart and Pittman 1991; Matthews and Herzog 1997), especially toward “cute,” non-harmful animals (Bjerke, Østdahl and Kleiven 2003; Prokop and Tunnicliffe 2010; Schlegel and Rupf 2010; Prokop et al. 2011). Also, disgust sensitivity has been found to be higher in females compared with males (Oaten, Stevenson and Case 2009; Curtis et al. 2011).

### ***The Present Study***

In the present study, we compared tolerance of amphibians and identification skills of pond owners and non-owners in Slovakia. In contrast to certain industrialized countries, where ponds serve for cultivating commercial plants thus increasing the family income (Trinh et al. 2003), garden ponds in Slovakia have mainly an aesthetic value (P. Prokop, unpublished data). We are, unfortunately, not aware of any national or international study examining the motives of Slovak people when creating ponds. However, we anticipated that pond owners might have greater impact on survival of amphibians compared with non-owners, because many frogs and newts reproduce in urban areas and depend on ponds as their habitat. Furthermore, we examined whether disgust of amphibians influences tolerance of amphibians. We included age, education, and gender as further independent variables known to influence human attitudes toward animals. Therefore we predicted that: (1) pond owners would be more tolerant of amphibians compared with non-owners; (2) pond owners would be better at identifying amphibians compared with non-owners; (3) females would show higher disgust sensitivity toward amphibians than males; (4) tolerance of amphibians would be inversely related to disgust sensitivity and positively related to education level and to identification skills; and (5) education level and age would be positively associated with identification skills.

## **Methods**

### ***Participants***

The participants in this study comprised a convenience sample of 205 people recruited by the authors. Participants were recruited from Trnava’s train station between October and November 2010.

### Questionnaire Design

The questionnaire included three closed- and five open-ended questions and took 5–10 minutes to complete. The interview began with basic demographic questions (gender, age, permanent address, and education level [three levels]) and a question to determine whether the participant owned a pond (“yes” or “no”). Four participants reported having a natural stream on their property: these were excluded from analyses due to the sample size being insufficient for comparison with the rest of the group. The final sample comprised 77 males and 124 females, with a mean age of 34.2 years ( $SE = 1.15$ ; range: 10–82 years). Nine of the participants were below the age of 18 years, and analyses indicated that removal of their data did not influence the results.

*Measuring Identification Skills:* In Slovakia, there are 18 known species of amphibians. Due to a decline in amphibian populations, the Slovakian government decided to protect all species by law. Each participant was asked to identify eight of the most common adult amphibians in Slovakia from color pictures selected by the researchers (see Figure 1). All pictures were of high quality, the same size, and presented on one A4 sheet of paper. We first asked the participants which amphibians were familiar to them (“Have you ever seen any of these animals?”). When the participants were able to identify the correct genus (e.g., “It’s a frog”), the response was coded as correct. We did not seek information at the species level because it is not possible to identify many amphibians (especially some frogs *Rana* spp.) from a photograph alone. The mean number of recognized amphibians was 2.91 ( $SE = 0.13$ , range: 0–8) and the mean number of correctly identified amphibians was 2.46 ( $SE = 0.13$ , range: 0–8). The partial correlation (controlled for effect of gender, age, and having a pond) between recognized and identified amphibians was strong ( $r = 0.62$ ,  $p < 0.001$ ). We used the combined mean score of recognized and identified species in later analyses (hereafter referred to as “amphibian identification”).

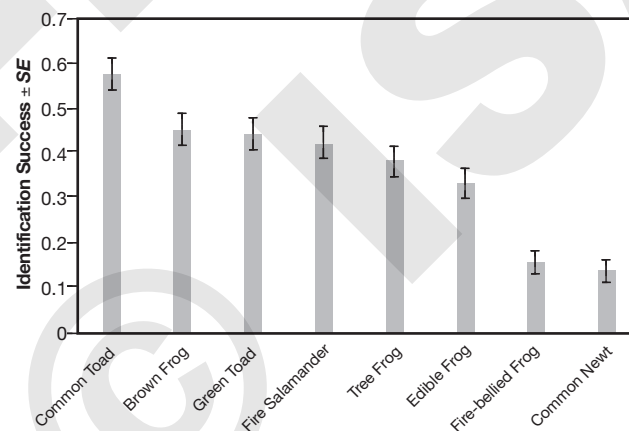


Figure 1. Proportion of correctly identified amphibians from pictures.

*Measuring Disgust Reactions to Amphibians:* Disgust of amphibians was measured by two Likert-scale items, rated from 1 (not at all) to 10 (extremely disgusting), focused on both adult amphibians and tadpoles (“Try to rate how disgusting adult amphibians/tadpoles are to you”). Participants were encouraged to base their ratings on the physical appearance of the amphibians. After controlling for the effect of gender, age, and having a pond, disgust of

tadpoles and adults were found to be significantly correlated (partial  $r = 0.55$ ,  $p < 0.001$ ,  $n = 201$ ). We combined the mean score for each of these variables into a single measure for use in later analyses (hereafter referred to as “disgust of amphibians”).

*Measuring Tolerance of Amphibians:* Tolerance of amphibians by pond owners was measured by two questions (“What do you do with adult amphibians/tadpoles in your pond?”). A modified version of the same question was used to measure potential behavior of non-pond owners toward amphibians (“Imagine that you own a garden with pond. What would you like to do with adult amphibians/tadpoles if you find them in your pond?”). Responses were categorized into three groups: “Low tolerance” (kill amphibians), “Intermediate tolerance” (remove and transport amphibians out of garden), and “High tolerance” (allow amphibians to remain in garden). Participants’ responses suggest that adult amphibians were usually killed by placing them in holes or the sewage, from where they could not return, and/or by emptying the water with tadpoles on to the ground. The correlation between tolerance of tadpoles and toads was significant (partial  $r = 0.40$ ,  $p < 0.001$ ,  $n = 201$ ). We combined the mean scores of each of these variables into a single measure (referred to as “tolerance of amphibians”) to use in subsequent analyses.

*Measuring the Perceived Importance of Amphibians:* The importance of amphibians was examined by asking “How important are amphibians in nature?”; responses were rated on a 10-point Likert scale, from 1 (absolutely unimportant) to 10 (extremely important). Furthermore, an open-ended question (“What is the importance of amphibians in nature?”) was included to validate the responses to the aforementioned question. Responses were coded on three levels (Level 1 = unable to explain importance of amphibians, Level 2 = participant considered amphibians as predators, Level 3 = amphibians were considered as part of food chains, i.e., both predators and prey). A Spearman rank correlation showed that the results of the open-ended question correlated with the Likert-scale responses ( $r = 0.23$ ,  $p = 0.001$ ,  $n = 201$ ). Because these two items were related, we performed residual analysis in which the Likert-scale responses were controlled for responses to the open-ended question, and residuals of regression were used in linear regression (hereafter referred to as “importance of amphibians”).

## Results

### *Disgust of Amphibians*

An ANCOVA, with disgust of amphibians as the dependent variable and age as a covariate, showed that owning a pond and gender (categorical predictors) had no effect on disgust sensitivity scores ( $F_{(1,196)} = 1.35$  and  $0.78$ ,  $p = 0.25$  and  $0.38$ , respectively, Figure 2). There was no interaction between the variables ( $F_{(1,196)} = 0.28$ ,  $p = 0.60$ ). Disgust sensitivity decreased as age increased, but this was non-significant ( $F_{(1,196)} = 3.65$ ,  $p = 0.06$ ). Tadpoles were rated as less disgusting than adult amphibians.

### *Tolerance of Amphibians*

An ANCOVA, with tolerance of amphibians as the dependent variable and age as a covariate, showed that owning a pond and gender (categorical predictors) had no effect on tolerance of amphibians ( $F_{(1,196)} = 0.01$  and  $1.16$ ,  $p = 0.91$  and  $0.28$ , respectively). The age of the participants had no effect on the tolerance of the amphibians ( $F_{(1,196)} = 1.01$ ,  $p = 0.32$ ). Tolerance of tadpoles was higher than tolerance of adult amphibians (Figure 2).

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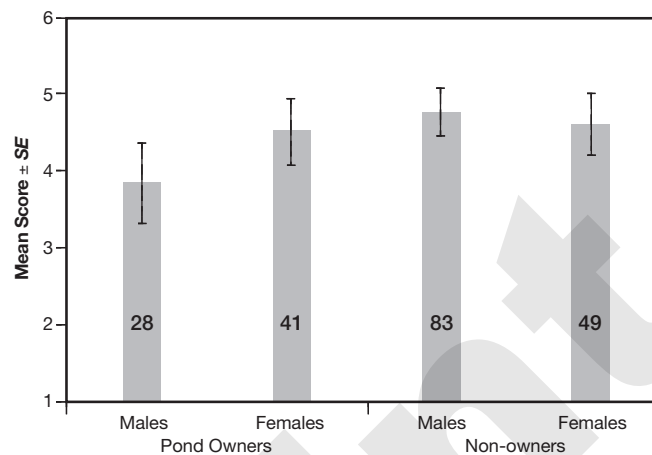


Figure 2. Comparison of mean disgust scores between pond owners and non-owners. Numbers in bars are sample sizes.

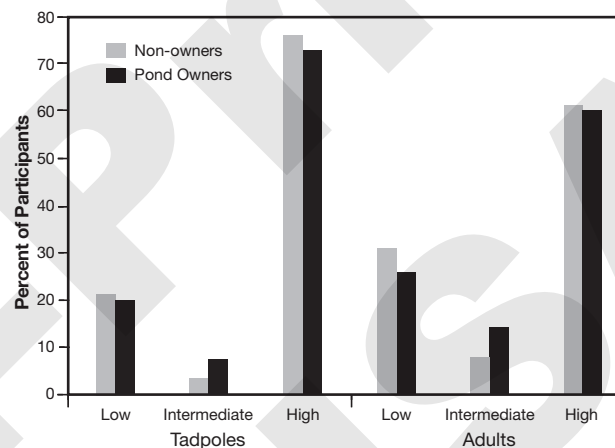


Figure 3. Levels of tolerance of tadpoles and adults between pond owners and non-owners. No significant differences.

A detailed comparison revealed that 20% of pond owners acknowledged that they killed tadpoles and 26% reported killing adult amphibians (Figure 3). About 31% of non-owners responded they would kill adult amphibians, suggesting that tolerance of amphibians does not depend upon owning a pond.

#### *Perceived Importance of Amphibians*

An ANCOVA was conducted, with perceived importance of amphibians as the dependent variable and age as a covariate; owning a pond and gender were categorical predictors. The age of participants had no effect on the tolerance of amphibians ( $F_{(1,196)} = 1.28, p = 0.26$ ). Although owning a pond did not influence the perceived importance of amphibians, males rated amphibians more highly than did females ( $F_{(1,196)} = 0.12$  and  $7.60, p = 0.73$  and  $0.006$ , respectively). There was no interaction between the variables ( $F_{(1,196)} = 1.04, p = 0.31$ ). When data were pooled irrespective of age, owning a pond, and gender, the responses to the

open-ended question revealed that 13% of participants were unable to explain the importance of amphibians in nature. These responses were coded as Level 1 (see Methods). The majority of participants (72%) considered amphibians as predators (“They eat insects”), while 2% considered amphibians to be the prey of other animals, especially snakes and storks. These responses were coded as Level 2 (see Methods). The remaining 13% of participants correctly thought of amphibians as being both predator and prey. These responses were coded as Level 3 (see Methods).

### ***Factors Associated with the Correct Identification of Amphibians***

The most identified amphibian from the pictures was the common toad and the least identified was the common newt (Figure 1). Overall, correct identification scores were low.

Multiple linear regression (forward stepwise method) was employed to examine which factors were associated with amphibian identification skills (dependent variable). Independent variables were age, gender, owning a pond, education level, and importance, disgust, and tolerance of amphibians. The model was significant ( $R^2 = 0.097$ ,  $F_{(3,197)} = 7.09$ ,  $p < 0.0002$ ). Three independent variables remained in the model: disgust of amphibians, age, and education level ( $\beta = -0.21$ ,  $0.16$ , and  $0.13$ ,  $t_{(197)} = -3.01$ ,  $2.41$ , and  $1.98$ ,  $p = 0.003$ ,  $0.02$ , and  $0.048$ , respectively). People with a higher disgust reaction to amphibians had lower amphibian identification scores. Older and better educated people had higher amphibian identification scores.

### ***Factors Associated with Tolerance of Amphibians***

Multiple linear regression (forward stepwise method) was also employed to examine which factors were associated with tolerance of amphibians (dependent variable). Age, gender, having a pond or not, education level, amphibian identification skill, and importance and disgust of amphibians were the independent variables. Only two variables entered the multiple regression model (overall model:  $R^2 = 0.11$ ,  $F_{(2,198)} = 12.82$ ,  $p < 0.0001$ ): disgust and perceived importance of amphibians ( $\beta = -0.25$  and  $0.17$ ,  $t_{(198)} = -3.65$  and  $2.44$ ,  $p = 0.0003$  and  $0.02$ , respectively). This suggests that people who had a heightened disgust reaction to amphibians were less tolerant of amphibians, and people who perceived amphibians as important in nature were more tolerant. Other variables were removed from the model. Additional analysis (partial correlation controlled for effect of gender, age, and having a pond) revealed that disgust and importance of amphibians negatively correlated ( $r = -0.25$ ,  $p < 0.001$ ,  $n = 201$ ), suggesting that people who perceived amphibians as disgusting underestimated their importance in nature.

## **Discussion**

This study shows that pond owners do not accept amphibians more than do non-owners and that there is no gender effect. As predicted, disgust of amphibians had a significant effect on tolerance of amphibians.

Our first prediction, that pond owners would be more tolerant and identify amphibians better compared with non-owners, was not supported. In fact, nearly one-third of pond owners admitted killing amphibians (both tadpoles and adults). As far as we are aware, this is the first empirical study that has identified this phenomenon. We believe that pond owners are especially important for the survival of amphibians because the reproduction of amphibians is dependent on water reservoirs to complete their life cycle (e.g., Hamer and McDonnell 2008; Becker et al. 2009). However, tadpoles in ponds are vulnerable to human behavior, such as the manual cleaning of ponds and the use of chemicals (Reeder et al. 2005). Our result that having a pond is not associated with more positive attitudes toward nature, at least in terms

of how amphibians are viewed, indicates that perhaps there are other motives (e.g., aesthetic value of ponds) for having a pond. Some pond owners (“intermediate tolerance” group) reported that they remove adult amphibians and transport them to appropriate habitats outside of their garden. The same responses were obtained from non-owners, in that they would move adults to water ecosystems. Although this practice is better than killing, it is still an example of human unwillingness to accept amphibians near their dwellings. Moreover, the reliability of these responses and the reports of killing of amphibians may be questioned, because many pond owners simply move adult amphibians to neighboring gardens or, especially when they return, throw them into the sewer where there is no way back and where the animals in all probability die (P. Prokop, unpublished data). Additional research based on personal surveys of pond owners in their homes as well as of their neighbors is required, to obtain more detailed information about tolerance of amphibians.

We also predicted that females would show a higher disgust sensitivity toward amphibians than males. We did not, however, find any significant differences in perceived disgust of amphibians between males and females, therefore this hypothesis was rejected. This contributes to the body of literature on gender differences, for which there are mixed results regarding the effect of gender on disgust reactions to animals (e.g., Eagles and Muffitt 1990; Schlegel and Rupf 2010; Tomažič 2011). Also, a cross-cultural survey examining fear of animals showed that scores representing fear of frogs loaded strongly with a group fearful of non-amphibians (such as sheep, rabbit, squirrel) and with a group with disgust-relevant animals (such as cockroach, lizard, spider) (Davey et al. 1998). This indicates that whilst amphibians might be perceived as disgusting, they are not perceived as harmful to people. Greater disgust of animals is expected especially if presented animals are harmful to humans like predators (e.g., Kellert 1985; Bjerke, Reitan and Kellert 1998; Davey et al. 1998; Røskaft et al. 2003; Prokop, Özel and Usak 2009; Prokop et al. 2010; Prokop and Tunnicliffe 2010; Prokop and Fančovičová 2010a) or parasites (Prokop and Fančovičová 2010b; Prokop, Fančovičová and Fedor 2010; Prokop, Usak and Fančovičová 2010a, b).

We also predicted that tolerance of amphibians would be inversely related to disgust sensitivity and positively related to education level and amphibian identification skills. When the importance of amphibians was perceived to be high, tolerance of amphibians was significantly higher. The association between disgust and tolerance of amphibians was supported. This suggests that people who perceive amphibians as more disgusting are less willing to tolerate them. However, disgust of amphibians was a stronger predictor of tolerance than amphibian identification skills, suggesting that actual knowledge itself does not influence the complex relationship between humans and unpopular animals (Prokop and Tunnicliffe 2008; Prokop, Özel and Usak 2009). These findings imply that human emotions play an important role in animal conservation decisions. Indeed, Prokop and Fančovičová (2010a) found that people with a higher level of fear of bears report wanting to exterminate bears, more than those with lower levels of fear. It is possible that the poor physical similarity of amphibians to humans is associated with beliefs that these animals are not capable of thinking and as a result, support from humans is low (see Knight et al. 2003, 2004; Knight and Herzog 2009). Future management strategies might therefore focus on the reduction of disgust of amphibians as a primary predictor of tolerance of amphibians. More research examining beliefs in amphibian cognition and sentience (e.g., the ability to experience pain, see Herzog and Galvin 1997) is required. Furthermore, people should be better educated specifically on the importance of amphibians, because greater awareness of the important role of amphibians in nature seems to be



associated with tolerance for these species. Education level has been found previously to be a predictor of attitudes toward animals (Kellert 1980, 1993), but we found no evidence for an association between general levels of education and tolerance of amphibians. In fact, our results better support research by Signal and Taylor (2006), who found no correlation between attitudes toward animals and education level in a large sample of adults from Australia.

Finally, we also predicted that education level and age would be positively associated with amphibian identification skills. This prediction was supported, as older and better educated participants had higher amphibian identification scores. Randler, Hollwarth and Schaal (2007) interviewed park visitors and non-visitors in Germany and found that species knowledge increased with age and with educational level. Bjerke and Østdahl (2004) also found that as people age, residential animal-related activities increase in frequency. Notably, perceived disgust of amphibians was more strongly associated with identification skills compared with age and education level, suggesting that educational strategies focused on emotional affinity with animals are relatively more important than gathering factual knowledge in traditional lessons.

### Conclusion and Future Directions

In the present study, about 26% of pond owners reported killing amphibians, and tolerance of amphibians was found to be significantly influenced by a disgust reaction to amphibians. Understanding the role of amphibians in nature was also positively associated with tolerance. Further research is now needed in order to establish causal relationships between the factors examined here, for example, via animal conservation programs. Also future research needs to examine the effect of exposure to amphibians, or other animals that evoke disgust, on the attitudes toward, and treatment of, amphibians, as it has been found that practical work with unpopular animals (e.g., amphibians, mice, or snails) can significantly reduce disgust of these animals (Randler, Ilg and Kern 2005; Tomažič 2008, 2011; Randler, Hummel and Prokop 2012). Cross-cultural research is also required to understand the effect of social norms on attitudes and behavior (e.g., what do my friends/neighbors think I should do with amphibians). Tolerance of amphibians in adults might be influenced, for example, by workshops, leaflets, or newsletters prepared by conservation organizations informing people about the current decline in, and importance of, amphibians in nature. How or whether these issues influence tolerance of amphibians in people is a challenge for further research.

### Acknowledgements

We are extremely grateful to two anonymous referees for improvements and helpful comments on an earlier version of the manuscript. This research was partly supported by projects VEGA No. 1/0124/11 and KEGA No. 175-006TVU-4/2010.

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