

The impact of information and familiarity on public attitudes toward the eastern hellbender

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Abstract

Despite their ecological significance, rare and uncharismatic but threatened species are less often the focus of research and conservation efforts than more familiar and charismatic threatened species. The eastern hellbender, a salamander threatened by human activities, is believed to be negatively perceived by or unknown to the general public. Through a survey of 541 (response rate 40.1%) residents in southern Indiana, this study assessed public familiarity and attitudes toward the hellbender. Overall attitudes were found to be relatively neutral. There were significant differences between the attitudes of respondents who were familiar with hellbenders compared to those who were not familiar, with familiar respondents reporting more positive attitudes overall. Providing survey respondents with just a small amount of additional information about the rarity and locality of the hellbender resulted in more positive attitudes toward this species. Respondents who were unfamiliar with the hellbender expressed significantly more positive attitudes when given the additional information, while the attitudes of respondents familiar with hellbenders were more established and remained stable despite the additional information. The measurement instruments and findings from this study could inform future efforts to protect little-known and threatened species by identifying attitudes and beliefs for social interventions to address.

Introduction

Conservation efforts, and the research that accompanies them, are often directed toward species that are charismatic or well-known by the public. However, conservation efforts are equally important for threatened species that are uncharismatic or less familiar (Estren, 2012). Human activities, ranging from habitat degradation and destruction (Brooks *et al.*, 2002) to direct mortality (Owens & Bennett, 2000), frequently threaten already rare species. Due to the impacts from human behavior on animals and their habitats, as well as the need for public support for conservation policies, social science research is a necessary component of successful conservation efforts. Theory-based social science research that examines attitudes and other precursors of behavior is particularly important given the complex and frequently unobservable nature of human actions.

Unfortunately, theory-based explorations of conservation behavior are also largely lacking from the conservation literature, although theories of individual behavior are commonly used in other fields (McCleery *et al.*, 2006). Many of these frameworks, including the Reasoned Action

Approach (Fishbein & Ajzen, 2010), the Motivation and Opportunity as Determinants model (Fazio, 1990) and Vertical Structure diagram (Bem, 1970), help explain behaviors with attitudes, beliefs and values. In these models, the term attitude refers to the positive or negative evaluation of a psychological object by an individual person (Fazio, 1990; Fishbein & Ajzen, 2010). Beliefs are 'cognitive components' (Heberlein, 2012) or facts in an individual's mind, things they believe to be true about the attitude object. Values are broader, not specific to an object, and more stable than attitudes (Fishbein & Ajzen, 2010; Heberlein, 2012). These frameworks emphasize that attitudes are related to behavior but are not entirely predictive on their own. It is important to understand attitudes, however, as they can predict support for management or conservation efforts (Heberlein, 2012).

Many researchers have found that accurate measures of attitudes can be useful tools for understanding how people make decisions about conservation, how they view policies and conservation approaches, and how they interact with wildlife (Manfredo, 2008; Heberlein, 2012). Most research in this area has indirectly assessed attitudes toward a particular species by focusing on more general attitudes toward

the acceptability of wildlife management strategies (Zinn & Pierce, 2002; Dougherty, Fulton & Anderson, 2003; Whittaker, Vaske & Manfredi, 2006) or support for generic protection efforts (Tarrant, Bright & Cordell, 1997; Teel *et al.*, 2010). However, none of the studies cited above explores species-specific attitudes; studies in this area could improve understanding of how individuals form attitudes toward animals and how outreach strategies might generate more positive attitudes, especially toward rare or uncharismatic species.

To examine how attitudes change and relate to conservation behaviors, it is important to consider attitude strength, stability and consistency. In this context, stability refers to the likelihood that an attitude will change over time; some scholars view attitudes as stable entities that are stored in memory, while others consider them to be transient expressions that are formed spontaneously (Bohner & Dickel, 2011). Heberlein (2012) suggests that individuals confronted with new attitude objects (such as an unfamiliar wildlife species in a survey) develop unstable attitudes that are more likely to be influenced by the presentation of information, especially if that object prompts an emotional response. Conversely, attitudes formed in response to direct experience are less likely to change.

Attitude strength refers to the intensity of the attitude being expressed. Researchers commonly measure attitude strength with 'Likert-type' scales, wherein subjects indicate whether they 'strongly', 'moderately' or 'slightly' agree (or disagree) with a given statement. Attitude strength can play a moderating role in attitude-behavior stability, with stronger attitudes being more stable over time (Petty, Wegener & Fabrigar, 1997), and thus better predictors of behavior (Holland, Verplanken & Van Knippenberg, 2002).

Research regarding attitude consistency examines this connection between attitudes and behaviors, as well as the connection between attitudes toward different but related objects (Festinger, 1957; Heberlein, 2012). Studies have shown that individuals prefer to appear consistent in their thoughts, words and actions; the term cognitive dissonance refers to the discomfort people experience when these elements diverge (Festinger, 1957). Persuasive communication efforts aimed at behavior change tap into human's innate resistance to cognitive dissonance by pointing out behavior that is discordant with an individual's attitudes or past actions. However, studies have shown that these efforts often fail because people find ways to justify their inconsistencies (Heberlein, 2012).

The role of information in attitude formation, and how the characteristics of the attitude object influence attitudes, remains unclear (Serpell, 2004). Positive attitudes are more likely to be evoked by animals that are aesthetically appealing or that are more similar to humans (physically, phylogenetically or cognitively), likely because of perceived familiarity with the characteristics rather than the species itself (Serpell, 2004). Gunnthorsdottir (2001) found that more attractive animals were more likely to receive increased support for protection. In addition to these findings, Gunnthorsdottir (2001) found that research

participants would rate an animal more attractive when told that the animal was endangered. This is consistent with the work of Kellert & Berry (1980), who found that less knowledgeable individuals and groups tended to show predominantly negative or indifferent affective responses toward wildlife. However, increased knowledge does not inherently lead to more favorable attitudes toward a given species (Fishbein & Ajzen, 2010; Heberlein, 2012). As Heberlein (2012) points out, a study of attitudes toward wolf reintroduction in Michigan found that many individuals with a high level of knowledge of wolves had less positive attitudes toward reintroduction. Unlike wolves, which are well known to the public through literature and popular media, hellbenders are known by a select few and thus unlikely to evoke strong emotional reactions. The research presented here investigates the impact of such information on the attitudes of watershed residents toward the eastern hellbender, *Cryptobranchus alleganiensis alleganiensis*, a rare species found within the Blue River in southern Indiana.

Eastern hellbender salamanders are a long-lived, rare amphibian found in rivers throughout the eastern and mid-western United States. These salamanders face serious population declines throughout their range stemming from a number of anthropogenic threats including habitat alteration, loss and degradation, and collection (Wheeler *et al.*, 2003). Anecdotal information from hellbender researchers and wildlife managers also indicates concern about human persecution of eastern hellbenders (i.e. killing the hellbenders intentionally). In southern Indiana, the study site for this research, hellbenders show a particularly significant decline in overall numbers, with only one remaining population in the entire state (Burgmeier *et al.*, 2011).

Conservation of rare and elusive species like the hellbender depends to some degree on changing human behaviors, whether by preventing direct mortality to the animals or changing land-use practices to improve habitat. Although some progress has been made toward understanding the biological needs of hellbenders for conservation, the attitudes of the general public toward hellbenders remain unknown. Based on our examination of the literature on attitudes toward animals and the relative lack of research on attitudes toward rare uncharismatic species, this study addresses the following research questions:

RQ1: Are Blue River watershed residents' attitudes toward this rare and uncharismatic species primarily positive, neutral or negative?

H1: Residents' attitudes toward the hellbender are expected to be neutral to negative, due to perceived negative characteristics of the species.

RQ2: Does providing survey respondents with basic information about the local rarity of a species lead to more positive attitudes toward that species?

H2: Knowledge of the hellbender's rarity is expected to lead to more positive attitudes among respondents.

RQ3: Are respondents who are unfamiliar with a threatened species (the hellbender) more influenced by information about the rareness/endemism of that species than respondents who had previously heard of that species?

H3: Individuals who have never heard of the hellbender will be more likely to be influenced by additional information than those who had already heard of this species.

Methods

In the summer of 2011, we conducted a survey of heads of households and riparian landowners in the Blue River watershed of southern Indiana (Fig. 1). Two methods were

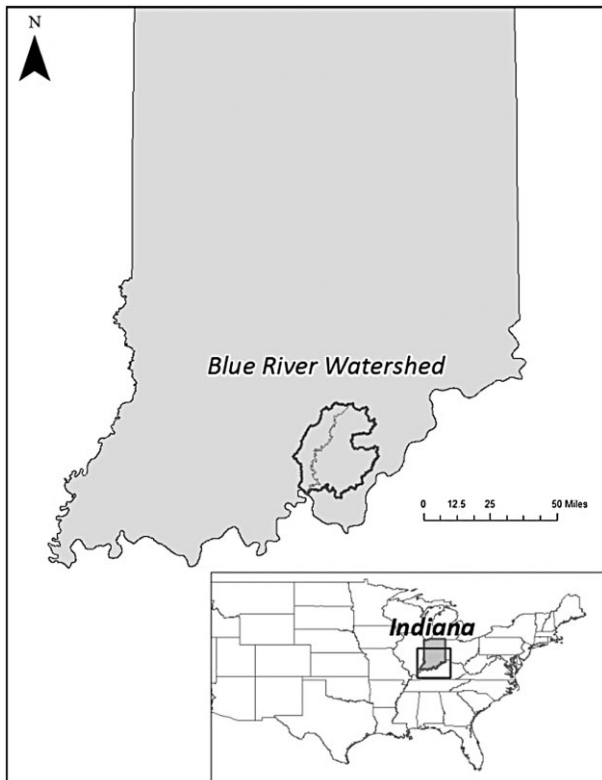


Figure 1 The Blue River watershed and its location in Indiana, USA.

used for selecting the sample population. First, we took a random sample of 1096 households from the watershed using addresses purchased from Survey Sampling International (Shelton, CT, USA). Second, we administered a census to 281 riparian landowners whose contact information was collected from county property tax records available online. Combined, the two survey populations totaled 1377 potential respondents (there was no overlap). The survey procedures followed the Tailored Design Method (Dillman, Smyth & Christian, 2009), with several waves of survey mailings to each member of the survey population. Respondents could choose to complete the survey online through Qualtrics survey software or return the completed paper survey through the mail. In total, 541 responses were received (226 online, 315 by mail), with 58 surveys returned as undeliverable, yielding a response rate of 40.1%.

The survey instrument contained multiple sections of questions related to the hellbender and the Blue River watershed; only a subset of the questions was used in the research presented here. To test the impact of information on attitudes, we administered two versions of the survey randomly among the survey population. Both versions included two pictures of hellbender salamanders along with a simple description that read: 'This animal is a Hellbender' (Fig 2). Version two included a longer description: 'This animal is a Hellbender. It is only found in one place in Indiana: the waters of the Blue River. Without new efforts to protect it, the Hellbender may disappear from Indiana.'

Independent variables: familiarity and information provided about hellbenders

Two independent variables were used in this study: information provided and pre-existing familiarity with the species. Familiarity with the hellbender was assessed by asking the respondent 'Have you heard of this animal before?' Respondents were categorized based on whether they were familiar with the hellbender and the survey version they received (i.e. the amount of information they

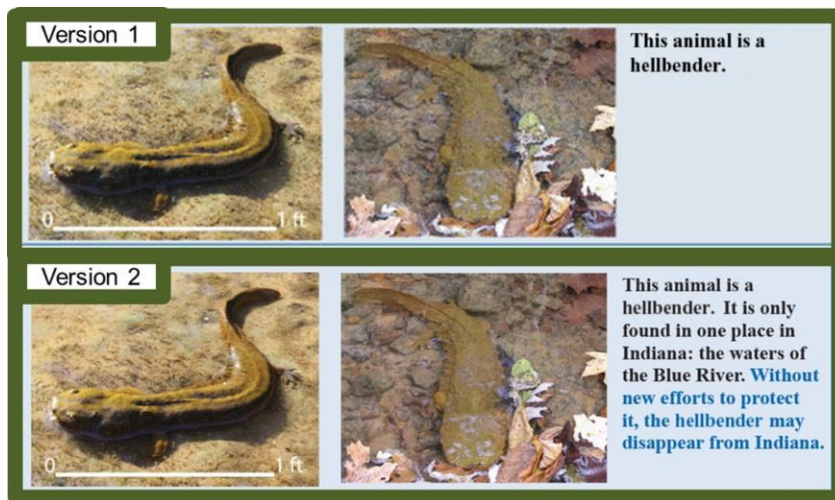


Figure 2 Two separate versions of the survey were administered, with different amounts of information given about the eastern hellbender.

Table 1 Percentage of respondents agreeing with belief statements and combined attitude scale means, presented by familiarity and information

Statement ^a	Means			
	No information	Additional information	Unfamiliar	Familiar
I would be scared if I saw one of these animals in the river	21.8%	19.8%	31.0% ^b	9.1% ^b
I think this animal would electrocute me	3.1%	6.2%	6.5% ^b	2.6% ^b
I think this animal would bite me	23.0%	17.9%	25.6% ^b	14.8% ^b
This animal could make me sick if I touched it	7.4%	6.6%	10.1% ^b	3.5% ^b
This animal is poisonous or venomous	3.1%	3.1%	3.2%	3.0%
I think this animal eats sport fish	14.0% ^b	10.1% ^b	14.1% ^b	10.0% ^b
I would try to touch this animal if I saw one	6.6%	5.8%	4.3% ^b	8.7% ^b
I would try to feed this animal if I saw one	1.9% ^b	3.1% ^b	2.5%	2.6%
If I saw one of these animals, I would try to catch it	3.5%	5.8%	5.1%	4.3%
I would like to keep one of these animals as a pet	5.1%	3.9%	3.6%	5.7%
I would try to find/hunt this animal	1.9%	1.6%	0.7%	3.0%
This animal has as much right to live as any other	73.2% ^b	82.5% ^b	73.6% ^b	84.3% ^b
Government money should be spent to protect this animal	21.4% ^b	29.3% ^b	17.3% ^b	35.2% ^b
This animal is important to the Blue River ecosystem	40.9% ^b	58.4% ^b	36.8% ^b	65.7% ^b
Combined attitude scale	31.50 ^c	33.97 ^c	29.79 ^c	35.94 ^c

^aStatement responses are measured on a scale from 1 (strongly disagree) to 5 (strongly agree), with a mean of 3 indicating a neutral response.

^bSignificant difference ($\alpha = 0.05$) in means, Kruskal–Wallis test.

^cSignificant difference ($\alpha = 0.05$) in means, t-test.

were provided). Therefore, there were four possible groups of respondents: group (1) unfamiliar, no additional information provided; group (2) familiar, no additional information; group (3) unfamiliar, additional information; and group (4) familiar, additional information.

Dependent variables: attitude scale and beliefs about the hellbender

We utilized a semantic differential (SD) scale to assess attitudes toward the hellbender. Despite being a commonly used method of assessing attitudes (Fishbein & Ajzen, 2010), SD scales have rarely been used in wildlife research. Respondents were expected to have low awareness and knowledge of the species and have weakly formed cognitive attitudes. Since people may have strong affective attitudes toward animals that they are not familiar with (Gunnthorsdottir, 2001; Estren, 2012), an SD scale, which measures primarily affective attitudes, makes for an effective measurement tool (Poresky *et al.*, 1988). An SD scale has respondents rate an object along a multipoint scale between antonym pairs of adjectives. When multiple antonym pairs are used, responses can produce a reliable and valid scale of direct attitudes toward an object (Fishbein & Ajzen, 2010). For this study, we modified an existing scale that assessed attitudes toward pet animals (Poresky *et al.*, 1988). Respondents identified the number between 1 (most negative) and 7 (most positive) that best described their opinion about the animal pictured. The antonyms were arranged on the survey based on *a priori* expectation of what dimension of attitude (positive or negative) they would represent (e.g. Unimportant 1.2.3.4.5.6.7 Important).

In addition to attitude questions, we asked a series of knowledge and opinion questions concerning the hellbender on a 5-point strongly disagree to strongly agree Likert-type

scale. These questions addressed perceptions that Indiana conservation professionals believed residents may hold about hellbenders, such as harmful characteristics and behaviors of the animal that might not necessarily be scientifically accurate, as well as general beliefs and its importance to the local ecosystem (Table 1). Conservation professionals with Purdue Extension, the Indiana Department of Natural Resources and Indiana Nature Conservancy were consulted during design of the instrument to provide guidance on misperceptions among Blue River watershed residents and resource users. Familiarity with the hellbender was predicted to result in lower agreement with scientifically false statements.

Data analysis

To assess the ability of each scale item to measure the attitude construct, we conducted a factor analysis (principle component analysis) using all 11 items. We assessed fit with the attitude construct using the criterion of 0.7 for standardized factor loadings. Standardized factor loadings (also known as component loadings) run from 0 to 1 and indicate the strength with which an item loads on a latent factor (Hair *et al.*, 2010). To ensure that the attitude measure is valid for the target species, we eliminated scale items that fell below the 0.7 threshold from the final attitude measurement scale. Three antonym pairs were removed from the final scale (*warm : cold*, *hardy : fragile*, *dry : slimy*). These pairs may not have loaded strongly because they do not necessarily correspond with positive or negative attitudes.

We conducted validity tests on the remaining attitude scale items using IBM SPSS Statistics 19 (Armonk, NY, USA). We evaluated two different components of construct validity: reliability and convergent validity, both of which were assessed in multiple ways. To assess the reliability of

Table 2 Descriptive and scale statistics of semantic differential attitude items, arranged from most positive to most negative responses

Antonym pair item	Descriptives				Scale tests	
	Mean ^a	SD	Skewness	Kurtosis	Standardized factor loadings ^c	Cronbach's α if item deleted from scale
Harmless/dangerous ^b	4.90	1.77	-0.417	-0.651	0.698	0.899
Important/unimportant ^b	4.70	1.88	-0.355	-0.757	0.792	0.891
Good/bad ^b	4.67	1.77	-0.281	-0.577	0.834	0.887
Valuable/worthless ^b	4.54	1.87	-0.282	-0.846	0.796	0.891
Clean/dirty ^b	3.81	1.81	0.157	-0.745	0.757	0.896
Friendly/not friendly ^b	3.54	1.70	0.273	-0.446	0.757	0.896
Pleasant/unpleasant ^b	3.36	1.72	0.361	-0.493	0.831	0.889
Beautiful/ugly ^b	2.79	1.85	0.784	-0.416	0.718	0.900
Excluded scale items						
Hardy/fragile	4.26	1.77	-0.096	-0.732	0.077	-
Warm/cold ^b	3.00	1.60	0.402	-0.390	0.605	-
Dry/slimy	2.34	1.45	0.982	0.449	0.375	-

^aMean response, ranging from 1 (most negative) to 7 (most positive), with neutral response of 3.5.

^bPoresky *et al.* (1988)

^cFactor loadings indicate the strength with which the item loads with the primary latent factor, ranging from 0 to 1, with a larger score indicating a stronger relationship.

Table 3 Demographics of treatment groups

Demographic measure	2010 census data for counties	Respondent group			
		Group 1	Group 2	Group 3	Group 4
Gender (% female)	50%	49% ^a	25%	39%	29%
Age	39.9	58.6	57.6	60.1	58.0
Education - At least high school Diploma	84%	93% ^b	95% ^b	93% ^b	97% ^b
Education - At least bachelor's degree	14%	29% ^b	34% ^b	21% ^b	31% ^b
Years of residence in area	-	37.40	37.01	36.47	38.48

^aSignificant difference at $\alpha = 0.05$ in one-way analysis of variance test for differences in means.

^bSignificant difference from county average at $\alpha = 0.05$ in t-test.

the measures, each scale item was first vetted for acceptable distributions through skewness and kurtosis measures. All items fall within acceptable levels of ± 2 for both measures (Nunnally & Bernstein, 1994) and are presented in Table 2. The Cronbach's alpha (α) measure of reliability was also calculated for the attitude scale and is presented in the results section, with a recommended level of 0.7 used for acceptability (Nunnally & Bernstein, 1994). Convergent validity was measured in two ways: adequate factor loadings and acceptable model fit. Standardized factor loadings are presented in Table 2. Model fit was assessed in two ways: percentage of variance explained by the attitude factor and through a confirmatory factor analysis (maximum likelihood estimation) with the χ^2 fit statistic. These measures are presented below in the results section.

We tested the impact of information and familiarity with the hellbender through a one-way analysis of variance (ANOVA) comparing the attitude measures for each of the four treatment groups described earlier, which represent the different combinations of the two independent variables (e.g. additional information on the survey and familiarity with the hellbender). The distribution statistics (skewness and kurtosis) indicated that the attitude measures fit the normal distribution, an assumption of the ANOVA test.

In addition, we tested the impact of information and familiarity on the general belief and false statement questions about the hellbender. Due to the ordinal form of these questions (and the resulting non-parametric distribution of the data), we used the Kruskal-Wallis test to assess differences in mean responses to these items between the treatment groups.

The survey versions were randomly assigned to the respondents, leading to the expectation of similar respondents for each survey version. To test this assumption, we assessed the demographics (gender, age, education and length of residence in the area) of each respondent group (outlined in Table 3). Group 1 was more likely to be female than the other groups; all other demographics were consistent across survey versions. The largely similar demographics of each group indicate that the surveys versions represent the same general population. We also compared our sample respondents to area residents by comparing gender, age and education with US Census statistics (Table 3). Our respondents were more likely to be male and had higher educational attainment than the study area as a whole (Scott, Floyd, Harrison, Crawford and Washington counties). A more complete description of the survey respondents can be found in Mullendore *et al.* (forthcoming).

These differences are likely due to obtaining our addresses from county records and a sampling company, which pulls names predominantly from housing records. Housing records may be more likely to list the male heads of household, so surveys may have been addressed to more men than women. Additionally, it seems likely that landowners (the sample frame in our study) are more likely to have higher educational attainment than the general population or non-homeowners. Given our adequate response rate (40%), we do not have concerns that our sample is biased from the larger population of homeowners in this area.

Results

As expected in H1, familiarity with this rare and uncharismatic species was low among Blue River residents, with less than half of survey respondents familiar with the hellbender (only 44% had heard of the species prior to the survey). Familiarity did not vary significantly between survey types: 42% of survey version one and 46% of survey version two respondents were familiar with the species (groups 2 and 4, respectively). Lack of familiarity may have impacted the survey response rate, as low awareness may impact interest in taking a survey about the topic.

Eight of the 11 antonym pairs loaded with a standardized coefficient of 0.70 or higher on the primary factor (Table 2). Attitudes toward the hellbender tended toward neutral on several items and all items had means between 2 and 5, on a scale of 1 to 7. Reliability test results for the remaining eight items are shown in Table 2. The Cronbach's alpha for the attitude scale was 0.908, indicating a high degree of internal consistency between scale items (Nunnally & Bernstein, 1994). Removing any item from the scale produced a lower alpha. These measures of reliability indicate a high likelihood that these items are all measuring the same underlying construct of evaluative attitude for the species in question. The model fit statistics also indicated a high level of fit for the attitude model. The combined scale factor accounted for 61.3% of the variance. In addition, the model χ^2 value was 394.964 (2 d.f., $P < 0.000$), indicating a statistically significant fit for the attitude scale with the underlying attitude construct. A single attitude measure was created through summation of the semantic differential scales (Poresky *et al.*, 1988) with scores ranging from 8 to 56.

The mean attitude score for the entire population was 32.3, just above the midpoint between the least and most positive attitude score. When broken down by survey type, survey one respondents had more negative attitudes, with a mean score of 31.5 compared to 34.0 for survey two respondents. An independent-samples t-test indicated a significant difference between these two mean values ($t = 2.273$, d.f. = 397, $P = 0.024$). A one-way ANOVA indicated significant differences between the four group means ($F = 14.340$, $P < 0.000$). Group 1, representing individuals with no pre-existing knowledge of the hellbender and no additional information given in the survey, had the most negative attitudes toward the hellbender (Table 4). Attitudes were more

Table 4 Attitude scale means by treatment group

	Unfamiliar	Familiar
Survey version 1 ^a	Group 1 27.79 ^b	Group 2 35.95
Survey version 2 ^a	Group 3 32.02 ^b	Group 4 35.93

^aSurvey version 1 = just picture, survey version 2 = rare and unique statement

^bSignificant difference at $\alpha = 0.05$ in one-way analysis of variance test for differences in means

positive when unfamiliar individuals were given an additional statement about the rarity of the animal locally (group 3). Attitudes were the most positive among those who were already familiar with the hellbender (groups 2 and 4), meeting our expectation in H2. For these groups, the additional statement did not lead to any significant differences in attitudes.

Kruskal–Wallis tests revealed there were significant differences between the treatment groups' responses to the belief questions about the hellbender (Table 1). Those familiar with the species were significantly less likely to hold beliefs that the hellbender has dangerous characteristics, including that they could electrocute, bite or poison humans. Overall, individuals familiar with the hellbender were less likely to be scared of the hellbender than those who had not heard of the species before. Familiar individuals (regardless of survey type) were more likely to agree with the statement 'This animal has as much right to live as any other', were more supportive of the use of government money to protect the species, and were more likely to agree that the animal is important to the Blue River. Information also impacted some of these belief statements; for those unfamiliar with the species, receiving additional information resulted in stronger support for government money being spent to protect the species and the importance of the hellbender to the local ecosystem.

Discussion

This study explored public familiarity and attitudes toward an uncharismatic and rare species of salamander. Public attitudes toward the hellbender were more positive than expected in H1, although they were relatively neutral for all groups evaluated. Previous research (Gunnthorsdottir, 2001; Estren, 2012) has shown that people are more likely to positively evaluate animals with certain characteristics, such as attractiveness or neoteny (the retention of juvenile characteristics in adulthood). Mean attitudes for the overall population were just above the halfway mark between positive and negative. Survey respondents who were familiar with the hellbender prior to receiving the survey had significantly more positive attitudes and were less likely to believe false statements about the animal, including belief that the hellbender is venomous or could electrocute people. The relationship between beliefs and attitudes was beyond the scope of this research, but it seems likely that as individuals'

knowledge of the hellbender's importance increases, their attitudes toward this particular species are likely to become more positive.

Information about local rarity had a significant impact on respondent attitudes toward the hellbender. As expected in H3, those who had never heard of the species before had significantly more positive attitudes when given just one additional statement about the rarity of the animal. In contrast, this information had no impact on those who were already familiar with the animal. It seems likely that individuals familiar with the hellbender already knew that the species was found in the Blue River watershed and that it was locally rare, and so providing them with this information would not result in a change in attitude. These findings are similar to those of Gunnthorsdottir (2001) who also found that changes in description of a species can influence attitudes toward wildlife. These differences in attitudes suggest that accompanying descriptions in surveys and other social science research methods can impact responses. This emphasizes the need for carefully constructed survey questionnaires and instruments that consider effects of included text on responses collected. Additionally, this discrepancy in attitudes could inform future studies by highlighting the significance of how attitudes are measured and what information about an animal is provided – particularly for rare and uncharismatic species such as the hellbender. It should be noted that attitudes reported on a survey, particularly among those with little previous knowledge of the species, may not reflect long-term, stable attitudes, but rather quickly formed, and quickly lost, affective judgments. Future research should evaluate the temporal aspects of information on survey participants' attitudes toward wildlife.

The findings do reveal some important insights into affective attitude formation. On average, individuals who are unfamiliar with the animal indicate neutral attitudes toward the hellbender. This supports previous research that when individuals first assess a new attitude object (such as a new and unfamiliar animal), they do not have a strong tendency to evaluate the object one way or another, and do not form particularly strong attitudes (Heberlein, 2012). This study found that attitudes toward the hellbender became more positive as familiarity or information increased, but the direction of the attitude change may depend on the animal and the situation in which attitudes are being evaluated. However, even those familiar with hellbenders or who were given additional information had relatively neutral attitudes. This is important for conservation professionals to note, since these weak or neutral attitudes potentially impact public support for management efforts by moderating interest (e.g. Alwitt & Berger, 1993; Petty *et al.*, 1997; and Holland *et al.*, 2002). Further research is needed to identify how attitudes change for individuals over time, across situations, and, more importantly, how attitudes and attitude change impact both behavior and support for conservation efforts.

These findings have potential ramifications for conservation efforts. Respondents familiar with the hellbender

indicated more support for government action to protect the hellbender. Attitudes were significantly impacted by providing one statement about the local rarity of the species, indicating that small changes in knowledge about a species can result in more positive affective attitudes toward the species. It is not clear, however, how long this effect lasted, and whether making others familiar will result in similar shifts in attitudes.

The significant impact of information on attitudes points to the potential for using the rarity and endemism of an animal to foster more positive attitudes through outreach and education campaigns. Initiatives such as Rare Pride have successfully capitalized on these characteristics to heighten support for other wildlife conservation efforts (Boss, 2008). This emphasis on broader values – such as preserving biodiversity for future generations – could result in more positive attitudes toward these salamanders, which have the potential to foster changes in behaviors that impact water quality and thus hellbenders and other aquatic species (Fishbein & Ajzen, 2010). Additional research is needed to investigate the long-term impact of particular outreach interventions on individual attitudes toward threatened species.

This research is a first step in the exploration of the formation of attitudes toward an unfamiliar threatened animal species. The connections between attitudes toward hellbenders and critical behaviors for the conservation of hellbenders (such as direct mortality during angling or harvesting for the pet trade) have not been explored here. The exact impacts of specific outreach methods also require further study, but there is reason to believe that public attitudes toward the hellbender could be made more positive through emphasis on their local rarity and uniqueness. In addition, our findings support the idea that positive attitudes toward a species and support for government conservation efforts are correlated. Additionally, this research has focused on one species of conservation interest in one location in the United States. The semantic differential measurement tool modified for this research proved effective, but needs to be further tested in other contexts and with other animal conservation targets. There are many situations globally where less-charismatic species are of conservation concern and little is known about human behaviors or attitudes toward those species.

While ecological and biophysical research are vital for understanding the conservation threats facing species, the impact of human behavior on species cannot be understated (Brooks *et al.*, 2002). Consequently, comprehensive conservation efforts should be informed by social science theory and science-based investigation of relevant human beliefs, attitudes and behaviors, particularly when direct human-wildlife conflict is present. Following McCleery *et al.*'s (2006) suggestion, future research in this arena should be theory-based to ensure that psychosocial constructs that precede behaviors are properly measured. When combined with an understanding of the ecological factors contributing to population declines, social science research will likely improve conservation outcomes.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix S1. Your views on Blue River resources (survey).