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Conserving the Eastern Hellbender Salamander

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Conserving the Eastern Hellbender Salamander

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*Through a mail survey of 541 residents and riparian landowners in the area surrounding the Blue River watershed of southern Indiana, we examined perceptions and intended behaviors toward the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), an aquatic salamander experiencing drastic population declines due to anthropogenic causes. While anecdotal reports attribute hellbender mortality and removal to anglers and pet collectors, only 5% of respondents reported these negative behaviors. Misconceptions among anglers and the general public about the eastern hellbender were less prevalent than anticipated. Anglers, recreational boaters, riparian landowners, and respondents who were previously familiar with the hellbender displayed more positive attitudes toward the animal than other groupings of individuals. Data collected in this article shaped a detailed education and outreach campaign based on the principles of community-based social marketing.*

Keywords nongame wildlife, education, behavior change, threatened species, public support

Introduction

Conservation efforts targeting small, unattractive, or otherwise “uncharismatic” fauna are constrained by a relative lack of research and funding compared to large mammals, birds, and other more charismatic animals (Gratwicke, Lovejoy, & Wildt, 2012; Trimble & Van Aarde, 2010). These imbalances are especially concerning when human–wildlife interactions pose a threat to uncharismatic conservation targets, a common situation that weakens global efforts to preserve biodiversity (McCleery, Ditton, Sell, & Lopez, 2006). While a small number of programs such as RARE Pride (Boss, 2008) work to address the human dimensions of conserving non-charismatic animals, empirical research exploring this area is lacking.

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One uncharismatic animal affected by human–wildlife interaction is the eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*), an aquatic salamander endemic to the eastern United States. Once found in rivers from Missouri to New York, eastern hellbenders are believed to have been extirpated from large parts of their historical range. Data suggest recent declines in about 70% of the streams where population trends can be projected (J. Applegate, personal communication, August 6, 2012), with an average population decline of 77% in individual river systems (Wheeler, Prosen, Mathis, & Wilkinson, 2003). Eastern hellbenders have been banned from international pet trade through the Convention of International Trade in Endangered Species (Inclusion of the Hellbender, 2011) and have retained limited protections on a state-by-state basis, typically as a non-game species with no legal harvest. The U.S. Fish and Wildlife Service (USFWS) and its partners are currently assessing the eastern hellbender for potential listing under the Endangered Species Act.

The 2003 Status Assessment Report prepared for the USFWS attributes eastern hellbender declines to causes ranging from habitat alteration and water quality degradation to direct persecution from anglers and other recreational users (USFWS, 2003). While nearly all of these concerns are anthropogenic, managers have focused on problems arising from *direct* human–hellbender interactions, including mortality following angler by catch (Humphries, 2005; Lipps, 2009), intentional recreational catch through giggering or spearing (Nickerson & Briggler, 2007), capture for human consumption (Minton, 1972; Swanson, 1948), and even concerted eradication efforts (Green, 1934; Nickerson & Mays, 1973). Human–hellbender interactions are numerous and distributed across the salamander’s native range. Such reports, however, are generally anecdotal and are often decades old, making them difficult to cumulatively quantify. Researchers and managers alike have noted several instances of antagonistic behavior from recreational users in the last decade (J. Applegate, personal communication, August 6, 2012).

The stories accompanying accounts of hellbender persecution, combined with general psychological studies of people toward animals, do lend some insight into why human persecution of hellbenders might be occurring. Some anglers believe hellbenders eat sport fish (Green, 1934; Nickerson & Mays, 1973) and are poisonous or venomous (Gentry, 1955; Green & Pauley, 1987; Reese, 1903). Hellbenders display characteristics that others find unappealing, such as sharp teeth, beady eyes, and slimy skin. Relative to other salamanders, they are also large in size, with full-grown adults reaching lengths up to 29 inches (Fitch, 1947). Studies have suggested that humans are evolutionarily predisposed against slimy, snake-like creatures, especially when compared to mammals with human-like faces or other creatures with anthropomorphic qualities (Estren, 2012; Gunnthorsdottir, 2001). This predisposition, combined with misconceptions about the animal’s ability to inflict harm, may engender negative attitudes that ultimately manifest in overtly antagonistic behavior. Past hellbender outreach efforts have focused on addressing these beliefs without first assessing their prevalence in target audiences.

Eastern Hellbenders in the Blue River of Southern Indiana

Indiana’s only known population of eastern hellbenders is found in one of the state’s most popular recreational waterways—the Blue River (Figure 1). Without significant intervention, the Blue River hellbender population could be extirpated within 25 years, even with as few as 10 animals removed or killed by humans per year (Unger, Sutton, & Williams, 2013). Accounts of human–hellbender interaction specific to the study area are limited, although some research (Kern, 1984; Minton, 1972; Nickerson & Mays, 1973) reports encounters



Figure 1. Map of the Blue River watershed study area in southern Indiana, USA.

with Blue River anglers who had caught hellbenders. Minton (2001) also recounts the story of a 1973 fish fry near the Blue River in which hellbenders were served as part of the meal. This evidence notwithstanding, the impact of human–hellbender interactions has yet to be fully explored.

The Blue River was recognized as Indiana’s first designated Scenic River in 1975, and is regionally known for its natural resource–based amenities, which include two commercial canoe liveries and a state park. A 1999 recreational use survey found that during the primary annual fishing period (May 1–September 30), an estimated 1,362 anglers spent 4,260 total hours in fishing effort on the river (Carnahan, 1999). Given the concerns raised in other studies regarding human–hellbender interaction, this combination of popular recreation use and a major decline in the local hellbender population has prompted the state’s natural resource agencies and other resource managers to investigate the human dimensions of hellbender conservation.

Prior to our research, Indiana's primary hellbender outreach effort consisted of a notice in the Indiana Department of Natural Resources' (IDNR) annual fishing guide that included a photo of the hellbender with basic life history information. This notice also advised anglers to cut the line if they catch a hellbender rather than trying to remove the hook, since the latter often causes fatal damage to the animal. IDNR and its partners sought to expand on this effort with a coordinated outreach campaign intended to minimize the effects of negative direct human–hellbender interactions while promoting equally important household and land management behaviors that affect water quality.

A variety of strategies have been used in other states with hellbender populations (e.g., Missouri, Ohio, North Carolina) to promote hellbender conservation. These efforts vary in scope and purpose, but generally focus on basic life history, the extent of population declines, and the message that “this animal is harmless.” Our review of these materials, combined with conversations with managers and other researchers, suggests that few (if any) of these education efforts have been formally evaluated or coordinated across state boundaries. The materials rarely promote specific behaviors that would help hellbenders, such as household water conservation practices or cutting the fishing line to release an animal in the event of angler by catch. Regional efforts to promote hellbender conservation can likely be improved by incorporating concepts from communications theory, community-based social marketing (CBSM), and past conservation efforts directed toward locally distinct wildlife species.

Research in communication and behavior change theory provides some ideas for conducting outreach that addresses behaviors related to wildlife conservation. Ajzen (2002) proposes four factors for planning outreach: source (who is delivering the information); receiver (demographics of intended audience); channel (mode of communication); and message (content and how it is delivered). Vaske, Needham, Stafford, Green, and Petchenik (2007) used this structure in a wildlife-specific context to evaluate education efforts regarding Chronic Wasting Disease. Community-based social marketing (Kotler & Lee, 2008; McKenzie-Mohr, 2011) builds on these ideas by incorporating tools such as prompts, norms, and commitments to target barriers and to explicitly encourage behavior change. This framework has been applied to specific wildlife conservation efforts by the RARE Pride program (Boss, 2008) and to broader environmental concerns such as water quality (e.g., Jacobson, McDuff, & Monroe, 2006; Kotler & Lee, 2008). Combined, these studies provide a helpful structure for planning and evaluating outreach campaigns.

Project partners have determined that public support for hellbender conservation is ultimately needed at four levels: (a) public and private funding for research and management efforts; (b) support for regulation on resource uses negatively affecting the animal; (c) voluntary land management changes made by private landowners, particularly agricultural producers; and (d) changes in how paddlers and other recreational users respond to the animal during a direct encounter. To build this support, education and outreach efforts must be targeted to specific audiences (i.e., anglers and riparian landowners) who trust the source.

This article sought to understand awareness, attitudes, and behavioral intentions regarding the eastern hellbender salamander in a specific area surrounding the Blue River watershed of Indiana. In this setting, conservation professionals believed that negative misconceptions about the hellbender were widely held, thereby resulting in antagonistic human–hellbender interactions. Specific research questions included: What level of familiarity and experience do Blue River area residents and riparian landowners have with the hellbender? What are the general attitudes, beliefs (including misconceptions), and intended behaviors of Blue River area residents and riparian landowners toward the hellbender? How do different groups of individuals (i.e., anglers vs. non-anglers, riparian

landowners vs. other Blue River area residents) differ in regard to intended behavior and attitudes toward hellbenders? What are the most commonly used and trusted sources of wildlife information in the Blue River area?

Study Area

We defined the “Blue River Area” as the region comprised of all 5-digit zip codes within 10 miles of the Blue River watershed boundary (Figure 1). This area contains a population of 140,062 individuals living in 60,141 households (2010 U.S. Census). The Blue River itself drains a watershed of approximately 125,000 acres in southern Indiana consisting primarily of cultivated land in its upper reaches (Washington, Floyd, and Clark Counties) and forested land near its confluence with the Ohio River (Harrison and Crawford Counties) (Carnahan, 1999).

Methods

To empirically measure awareness, attitudes, and intended behavior regarding the hellbender, a survey was conducted among residents and riparian property owners in the Blue River Area (Figure 1) in the summer of 2011. The survey was designed to assess the validity of resource managers’ assumptions about human behaviors, help develop conservation outreach materials, and provide a baseline against which future outreach efforts can be evaluated. Two methods were used for selecting survey recipients. First, addresses for 1,096 randomly selected Blue River Area head of households were purchased from Survey Sampling International (hereafter referred to as the “Blue River Area residents”). Second, we surveyed all 281 riparian landowners along the lower reach of the Blue River. The address information for these riparian landowners was collected from county property tax records available online. Combined, the two survey populations totaled 1,377 potential respondents.

Multiple waves of survey mailings were sent using stationery listing Purdue University’s Natural Resources Social Science Lab as the return address. Recipients were informed that if they returned the survey they would be entered into a drawing for a \$30 cash prize with a better than 1 in 100 chance of winning. Respondents could choose to complete the survey online using the Qualtrics survey system, or to submit an equivalent paper survey through the mail. A greater proportion of respondents completed the paper survey (81%) as compared to the online survey (19%).

The survey instrument focused on wildlife concerns in the Blue River, with several questions specific to the eastern hellbender. We anticipated that many respondents would be either unfamiliar with the animal or unaware of its proper name, so we included two full-color pictures accompanied by a short verbal description. Two slightly different versions of the survey were used to assess the impact of differing verbal descriptions. Using random assignment, half of all surveys included the statement “This animal is a hellbender,” while the other half included a longer description emphasizing the threatened status of the animal: “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.” Because the implications of this difference are discussed in detail by Reimer et al. (in press), we do not further address the issue in this article.

Several questions investigated familiarity with the hellbender and related attitudes and beliefs. We first asked if the respondent had heard of or seen the animal. We then asked what the respondent would do if he/she caught or encountered one in the wild. To further

explore behavioral intentions, attitudes, and beliefs, including the prevalence of misconceptions about the animal, we asked respondents to indicate their level of agreement to eight statements specific to the hellbender (Table 1) on a five-point scale. To compare these items to general wildlife concerns, we included one additional statement: “Government money should be used to support the variety of wildlife in the Blue River.” For ease of interpretation, we report and analyze responses to most scale items as a collapsed binary of “agree” or “disagree/neutral.”

To assess how these measures differed among different types of recreational users, we asked respondents to indicate their participation in a number of outdoor activities including fishing and boating during the past 12 months in the Blue River. Any respondent who reported fishing in the Blue River at least once during this time period is hereafter referred to as an “active Blue River Angler.” Chi-squared tests of independence were used to analyze differences between respondent groupings such as recreational participation, familiarity with the hellbender, and riparian land ownership. In cases where the expected cell counts were less than five, Fisher’s Exact Test (Conover, 1999) was used. Finally, to address our fourth research question we asked respondents to indicate their level of trust in various

Table 1
 Comparison between active Blue River anglers and non-anglers regarding misconceptions, attitudes, and beliefs about the hellbender salamander in 2011

	Anglers (n)	Non-anglers (n)	Significance
Misconceptions			
I think this animal eats sport fish	16% (148)	11% (326)	$\chi^2 (1, 474) = 2.464, p = .116$
This animal could make me sick if I touched it	5% (148)	8% (320)	$\chi^2 (1, 478) = .946, p = .331$
This animal is poisonous or venomous	7% (147)	2% (325)	$\chi^2 (1, 472) = 7.593, p = .011$
I think this animal could electrocute me	4% (148)	5% (332)	$\chi^2 (1, 480) = .255, p = .613$
Attitudes and beliefs			
I would be scared if I saw one of these animals in the river	16% (149)	23% (332)	$\chi^2 (1, 481) = 2.874, p = .090$
Government money should be used to protect this animal	33% (148)	22% (333)	$\chi^2 (1, 481) = 7.180, p = .007$
I think this animal is important to the Blue River ecosystem	64% (149)	43% (333)	$\chi^2 (1, 482) = 17.844, p < .001$
This animal has as much right to live as any other	83% (150)	74% (332)	$\chi^2 (1, 482) = 4.973, p = .026$

Responses were assessed using a 5-point scale ranging from *strongly disagree* to *strongly agree*. Percentages shown represent respondents who indicated that they agreed or strongly agreed with each statement.

sources of wildlife information, as well as their membership in different wildlife organizations. Basic demographic information including gender, age, and education was also collected.

Results

In total, 541 individuals responded to the survey, yielding a response rate of 40% after accounting for bad addresses. Response rates differed between the two survey populations, with 35% of Blue River Area residents ($n = 1,047$) participating compared to 58% of riparian landowners ($n = 271$). The majority of all respondents were male (63%). The mean age was 59 ($n = 513$). Slightly more than a quarter of the respondents (29%) had obtained a 4-year college or graduate degree.

In terms of basic awareness of the hellbender, about a third (38%) of the Blue River Area residents reported that they had heard of the animal prior to receiving the survey. By comparison, 63% of riparian landowners were familiar with the hellbender. Less than one-fifth (17%) of Blue River Area residents said that they had seen one in the wild, compared to nearly half (45%) of riparian landowners. The difference between these two groups was statistically significant, $\chi^2(1, 408) = 43.59, p < .001$.

The percentage of individuals who indicated that they would pursue a negative behavior (killing a hellbender, throwing one on the bank, or keeping one as a pet) was below 5% for each action, regardless of familiarity with the animal (Table 2). At least 70% of respondents said they would “put it back” if they caught a hellbender, regardless of demographic grouping.

Table 2
Percentages of Blue River Area residents and riparian landowners reporting specific behavioral intentions in response to a hellbender encounter: Comparison between individuals who were previously familiar or unfamiliar with the hellbender

Responses	Comparison: prior familiarity	
	Familiar ($n = 227$)	Not familiar ($n = 264$)
Put it back	85%*	72%
Remove the hook	75%*	61%
Cut the line	25%*	39%
Call a resource professional	12%	12%
Throw it on the bank	3%	3%
Take it home alive	1%	1%
Kill it	1%	2%

*significant at the $p \leq .01$ level Survey Version and Prior Familiarity are separate and non-exclusive categorizations. Column percentages sum to greater than 100 because intended responses are non-exclusive.

One quarter (25%) of Blue River Area residents reported that they were active Blue River anglers (fishing at least once in the past 12 months). A very small percentage of active Blue River anglers said they would kill a hellbender or throw one on the bank if caught (<1% and 2%, respectively). More than twice as many active Blue River anglers (53%) reported that they would remove the hook compared to cutting the line (25%). Only 13% of these resource users would report a hellbender sighting or capture to a natural resource professional.

Low numbers of active Blue River anglers expressed misconceptions about hellbenders (Table 1). Only 4% of active Blue River anglers thought that the animal could electrocute them or that it was poisonous or venomous. One-fifth of active Blue River anglers (22%) believed that the hellbender would bite them. In response to the prompt “I think this animal eats sport fish,” 15% agreed or strongly agreed, with an additional 41% reporting a neutral position, likely indicating a lack of knowledge regarding this potential concern. Active Blue River anglers were significantly more likely than other respondents to believe that the hellbender “has as much right to live as any other” (80% compared to 69%; $\chi^2 (1, 482) = 4.973, p = .027$). Blue River anglers were nearly twice as likely as other respondents to agree that the animal “is important to the Blue River ecosystem” (61% compared to 31%), a difference that was also significant, $\chi^2 (1, 482) = 17.84, p < .001$. While nearly half of respondents (48%) agreed that government money should be used to support the variety of wildlife in the Blue River, only 25% agreed that these funds should be spent to protect the hellbender specifically (Figure 2). Respondents who were familiar with the hellbender prior to receiving the survey were significantly more likely to agree that government money should be spent to protect the hellbender, $\chi^2 (1, 510) = 22.34, p < .001$.

In general, survey respondents trusted natural resource agencies and conservation organizations as providers of information about wildlife. The Indiana Department of Natural Resources (IDNR) and Purdue University Extension were “moderately” or “very

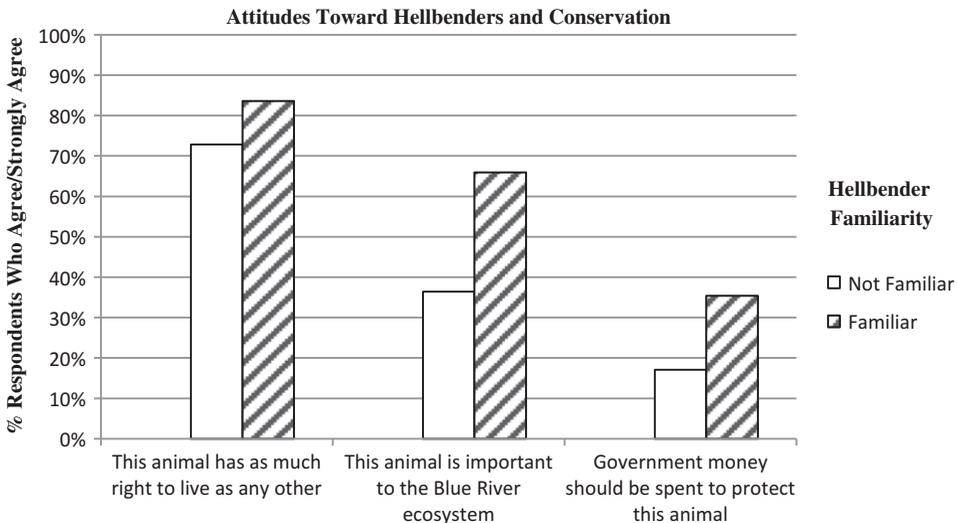


Figure 2. Attitudes toward hellbenders and government funding for hellbender conservation, sorted by prior familiarity with the animal. Responses were assessed using a 5-point scale ranging from *strongly disagree* to *strongly agree*. Percentages shown represent respondents who indicated that they agreed or strongly agreed with each statement.

much” trusted by 88% and 89% of respondents. Conversely, the two major regulatory agencies—the United States Environmental Protection Agency and Indiana Department of Environmental Management—were less trusted, with 54% and 57% of respondents indicating that they trust these agencies “moderately” or “very much.” The Nature Conservancy, another organization involved with hellbender protection in the area, was trusted “moderately” or “very much” by 71% of respondents familiar with the organization. However, 27% of respondents had not heard of The Nature Conservancy.

Respondents preferred to receive information about wildlife primarily from displays at state parks (54%), the Internet (52%), newspapers/magazines (51%), and newsletters, brochures, or fact sheets (43%). Blue River area residents also used interpersonal communication to learn about wildlife and water quality, with 50% reporting that they were likely to seek information from conversation with others. Only 5% of respondents reported that they were not interested in information about wildlife.

Discussion

Human pursuit of hellbenders has a long and complex history in Indiana and throughout the animal’s range. Achieving a better understanding of sociocultural factors underlying modern day human–hellbender interactions will enhance resource managers’ efforts to conserve the species by informing education and outreach efforts. This research represents one of the few studies analyzing a local population’s interaction with an imperiled and uncharismatic animal, and is the first known attempt to investigate the human dimensions of hellbender conservation specifically.

Natural resources managers should be encouraged by several findings regarding the intended behaviors of people who live or own property in the Blue River area. Very few individuals (<5%) of any categorization reported that they would kill or otherwise harm a hellbender if caught. However, it is important to note the possibility of social desirability bias, or the tendency of respondents to under-report behavior perceived as undesirable in surveys (Berinsky, 1998; Streb, Burrell, Frederick, & Genovese, 2008). A strong majority (>70%) from every respondent group said they would return the animal back to the water. While 90% of survey respondents said they would not deliberately seek out hellbenders, 5% agreed or strongly agreed that they would like to keep the animal as a pet. Managers should continue to monitor these numbers, as heightened awareness of the hellbender may increase the desire to keep one in captivity.

While only a low percentage of respondents reported deliberately negative intentions, many anglers indicated behavior that can have negative consequences. Although IDNR recommends that anglers cut the line on accidentally captured hellbenders, more than twice as many active Blue River anglers reported that they would remove the hook rather than cut the line. This could be because they believe that the animal would be better off if the hook was removed or simply because they do not want to lose their fishing tackle. In the case of the former concern, outreach is needed to correct this misperception in order to encourage the desired behavior.

Managers would like hellbender encounters to be reported to either IDNR or to university professionals. At the time of this survey, roughly one in ten respondents (13%) said they would contact a resource professional if they caught or saw a hellbender. This low number suggests two things: (a) in general, people are currently unlikely to report their hellbender encounters to resource professionals and (b) the instances in which resource managers hear about a hellbender from a citizen likely represent only a small fraction of the actual encounters. In other words, the stories of human–hellbender interactions reported

to managers are likely not representative of all such contacts in the wild. Outreach efforts will be needed to increase citizen reporting to better understand the frequency and nature of human–hellbender interactions.

The hellbender literature suggests that a variety of negative misconceptions about the animal are commonly held, particularly among anglers (e.g., Green & Pauley, 1987; Nickerson & Mays, 1973; Pflingsten, 1988). Our survey results indicated a scarcity of negative misconceptions about the animal, although “neutral” responses on items such as “this animal eats sport fish” likely indicate some degree of uncertainty. Further reducing the prevalence of these negative misconceptions may decrease the number of instances where anglers kill or maim the animal. Given the survey results, however, we feel this should not be the dominant focus of the outreach campaign. Instead, efforts targeting anglers would be better focused on correcting the misconception that removing the hook from an accidentally caught animal is better than cutting the line.

For hellbender recovery efforts to be successful in the Blue River watershed, it is critical that local residents develop and maintain positive attitudes toward the animal while supporting government conservation efforts. While three quarters (77%) agreed or strongly agreed that hellbenders “have as much right to live as any other (animal),” only 25% agreed or strongly agreed that government money should be spent to protect them. Those that were familiar with the hellbender prior to receiving the survey were significantly more likely to agree that protection efforts deserved government money. Based on these findings, we believe that increased community awareness of the animal and its presence will increase support for publicly funded conservation efforts. These findings also underscore the importance of involving nongovernmental groups in order to show that the project has diverse funding and support.

We asked questions regarding recreational habits and about landownership to better understand if distinct groups of individuals (i.e., anglers vs. non-anglers, riparian landowners vs. Blue River Area residents who are not riparian landowners) express different behavioral intentions and attitudes toward hellbenders. Riparian landowners were much more likely than general watershed residents to have been familiar with the animal prior to the survey and to have seen one in the wild. Active Blue River anglers were significantly more likely than other respondents to believe that hellbender has the same right to live as any other animal and that it is an important part of the river ecosystem. We believe that outreach targeted directly to riparian landowners and anglers can accomplish dual goals of minimizing negative interactions while also strengthening conservation support from two key stakeholder groups. Since a majority of riparian landowners and active Blue River anglers are already familiar with the animal, the messages they receive should focus on actions they can take to help hellbenders rather than simply raising awareness about the hellbender.

Using the results from this study, university researchers are working with partners including IDNR, The Nature Conservancy, and local natural resource agencies to pursue a targeted education and outreach campaign regarding the hellbender and the impact of household and land management practices on water quality. A central theme in the campaign materials is the use of CBSM strategies, which begin with the recognition that simply distributing information is rarely sufficient to change behaviors (Kotler & Lee, 2008; McKenzie-Mohr, 2011). Several techniques are recommended in the CBSM literature, including the use of prompts, norms, commitments, and effective communication. Furthermore, the use of these techniques needs to be informed by an understanding of the benefits and barriers to specific behaviors in a particular context. This approach has been demonstrated in at least 40 countries by the nonprofit organization RARE through its Rare Pride program (Boss, 2008; see also <http://www.rareconservation.org>). In their

project sites, RARE trains community leaders to implement these strategies for locally distinct wildlife, ranging from well-known conservation flagships like parrots and sea turtles to obscure species like the Turks and Caicos rock iguana.

Our planned outreach work employs this model specifically for eastern hellbenders in the Blue River. Specific elements of the campaign being developed include: a “Help the Hellbender” website and Facebook page; informational postcards distributed to all riparian landowners in the target area; promotional booths featuring a human-sized hellbender mascot at community events; a bobber and fish measuring sticker giveaway program featuring “cut the line” prompts targeted to anglers; a yard sign recognition program for adopters of conservation practices that improve water quality; and interpretive displays posted at local outdoor recreation retailers, a state park nature center, river access sites, and local schools. The choices for media outlets and program venues deliberately reflect the respondents’ preferences for sources of wildlife information.

The overall outreach strategy will promote desired behaviors for both direct interactions with the hellbender and indirect interactions including household or land management practices that affect water quality. For the “indirect” behaviors, interested individuals encountered during presentations and other community events will be referred to local watershed projects and other agency staff who already operate programs that promote and facilitate adoption of conservation practices. For the direct interactions, relevant items (e.g., bobbers) with prompts, such as “Be Kind, Cut the Line,” will be distributed to anglers, the group of resource users most likely to encounter a hellbender in the wild. Unlike previous education efforts to protect the hellbender in other states, this campaign will not focus heavily on correcting misconceptions, as our survey results suggest these are less prevalent than previously believed. A community-wide public relations campaign will be targeted to local residents with the goal of improving attitudes regarding issues such as the willingness to pay for wildlife conservation. The hellbender outreach program will be formally evaluated with a follow-up survey to test for changes in awareness, attitudes, and behavioral intentions.

Conclusions

This research highlights the importance of integrating social science into wildlife management and conservation programs. Without this intensive survey work in the Blue River watershed, an outreach campaign might have erroneously focused on correcting misconceptions about the hellbender that are actually uncommon among watershed residents and riparian landowners. Outreach and communication efforts should directly guide the public toward specific conservation behaviors that will protect remaining hellbender populations, including household and land management practices that protect water quality. For example, the survey illustrated the need to inform anglers about desired behaviors (i.e., cut the line not remove the hook) to minimize hellbender injuries from angler by catch. Wildlife managers should consult with trained social scientists when seeking to protect rare or endangered species like the eastern hellbender to ensure that they truly understand their target audience before designing conservation outreach efforts.

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References

- Ajzen, I. (1992). Persuasive communication theory in social psychology: A historical perspective. In M. J. Manfredi (Ed.), *Influencing human behavior: Theory and applications in recreation, tourism, and natural resource manage* (pp. 1–27). Champaign, IL: Sagamore.
- Berinsky, A. (1998). “The two faces of public opinion.” Chicago, IL: Annual Meeting of the Midwest Political Science Association.
- Boss, S. (2008). The cultural touch: Environmental nonprofit RARE tailors its programs to local cultures and needs. *Stanford Social Innovation Review*, 6, 75–79.
- Carnahan, D. P. (1999). *Evaluation of Blue River game fish populations in Crawford, Harrison, and Washington Counties. 1998 Fish management report*. Indianapolis, IN: Indiana Department of Natural Resources.
- Conover, W. J. (1999). *Practical nonparametric statistics* (3rd ed.). New York, NY: Wiley.
- Estren, M. J. (2012). The neoteny barrier: Seeking respect for the non-cute. *Journal of Animal Ethics*, 2, 6–11.
- Fitch, F. W. (1947). A record *Cryptobranchus alleganiensis*. *Copeia*, 210.
- Gentry, G. (1955). An annotated checklist of the amphibians and reptiles of Tennessee. *Journal of the Tennessee Academy of Science*, 30, 168–176.
- Gratwicke, B., Lovejoy, T. E., & Wildt, D. E. (2012). Will amphibians croak under the Endangered Species Act? *BioScience*, 62, 197–202.
- Green, N. B. (1934). *Cryptobranchus alleganiensis* in West Virginia. *Proceedings of the West Virginia Academy of Science*, 7, 28–30.
- Green, N. B., & Pauley, T. K. (1987). *Amphibians and reptiles in West Virginia*. Pittsburgh, PA: University of Pittsburgh Press.
- Gunthorsdottir, A. (2001). Physical attractiveness of an animal species as a decision factor for its preservation. *Anthrozoös*, 14, 204–215.
- Humphries, W. J. (2005). *Georgia Hellbender status assessment: Historic and current distribution, habitat associations, and the influence of land use an abundance*. Final report to Georgia Department of Natural Resources.
- Inclusion of the Hellbender; Including the Eastern Hellbender and the Ozark Hellbender, in Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*, 76 Fed. Reg. 61978 (2011)-(to be codified at 50 C.F.R. pt. 23).
- Jacobson, S. K., McDuff, M. D., & Monroe, M. C. (2006). *Conservation Education and Outreach Techniques*. Oxford, UK: Oxford University Press.
- Kern, W. H. (1984). *The hellbender, C. alleganiensis, in Indiana*. (Unpublished MS thesis). Indiana State University, Terre Haute, Indiana.
- Kotler, P., & Lee, N. R. (2008). *Social marketing: Influencing behaviors for good* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Lipps, G. (2009). *A survey of the Eastern Hellbender in the Licking and Kentucky River watersheds* (Unpublished report). Frankfurt, KY: Kentucky Department of Fish and Wildlife Resources.
- McCleery, R. A., Ditton, R. B., Sell, J., & Lopez, R. R. (2006). Understanding and improving attitudinal research in wildlife sciences. *Wildlife Society Bulletin*, 34, 537–541.
- McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: An introduction to community-based social marketing*. Gabriola Island, Canada: New Society Publishers.
- Minton, S. A., Jr. (1972). Amphibians and reptiles of Indiana. *Indiana Academy of Science Monograph*, 3, 24–27.
- Minton, S.A., Jr. (2001). *Amphibians & Reptiles of Indiana* (Revised 2nd ed.). Bloomington, IN: Indiana University Press.
- Nickerson, M. A., & Briggler, J. T. (2007). Harvesting as a factor in population decline of a long-lived salamander; the Ozark Hellbender, *Cryptobranchus alleganiensis bishopi* Grobman. *Applied Herpetology*, 4, 207–216.
- Nickerson, M. A., & Mays, C. E. (1973). *The Hellbenders: North American giant salamanders*. Milwaukee, WI: Milwaukee Public Museum Publications in Biology and Geology.

- Pfingsten, R. A. (1988). *The status and distribution of the Hellbender, Cryptobranchus alleganiensis, in Ohio*. (Unpublished report). Columbus, OH: Ohio Department of Natural Resources.
- Reese, A. M. (1903). The habits of the giant salamander. *Popular Science Monthly*, 62, 526–531.
- Reimer, A., Mase, A. S., Mulvaney, K., Perry-Hill, R., Mullendore, N., & Prokopy, L. S. (in press). The impact of information and familiarity on attitudes toward a rare salamander. *Animal Conservation* (Accepted manuscript).
- Streb, M. J., Burrell, B., Frederick, B., & Genovese, M. A. (2008). Social desirability effects and support for a female presidential candidate. *Public Opinion Quarterly*, 72(1), 76–89.
- Swanson, P. L. (1948). Notes on the amphibians and reptiles of Venango County, Pennsylvania. *The American Midland Naturalist*, 40, 362–371.
- Trimble, M. J., & Van Aarde, R. J. (2010). Species inequality in scientific study. *Conservation Biology*, 24, 886–890.
- Unger, S. D., Sutton, T. M., Williams, R. N. (2013). Projected population persistence of eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) using a stage-structured life-history model and population viability analysis. *Journal for Nature Conservation*, 21, 423–432.
- USFWS. (2003). *Eastern Hellbender status assessment report* (NRRI/TR-2003/09). Fort Snelling, MN: U.S. Fish and Wildlife Service.
- Vaske, J. J., Needham, M. D., Stafford, N. T., Green, K., & Petchenik, J. (2007). Information sources and knowledge about Chronic Wasting Disease in Colorado and Wisconsin. *Human Dimensions of Wildlife*, 11, 191–202.
- Wheeler, B. A., Prosen, E., Mathis, A., & Wilkinson, R. F. (2003). Population declines of a long-lived salamander: A 20+-year study of hellbenders, *Cryptobranchus alleganiensis*. *Biological Conservation*, 109, 151–156.