

Using Social Science to Improve Outreach to Protect Endangered Aquatic Animals: The Case of Freshwater Mussels in Indiana

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Abstract: Freshwater mussel populations in North America have been declining over the past two centuries due to a variety of land-use changes and anthropogenic water quality degradation. The Tippecanoe River, located in northcentral Indiana, was once home to the world's largest population of clubshell mussels. Currently, the river supports six federally listed species. The Indiana Department of Natural Resources (IDNR) partnered with Purdue University to design and implement an outreach and education campaign to raise awareness about and promote protection of these imperiled species. This article details how researchers used the principles of community-based social marketing to create and evaluate the campaign. Lessons learned and recommendations for future campaigns are provided.

Keywords: *endangered species, campaign, community-based, conservation, social marketing, survey*

Water quality in North America has been declining due to human activities for the past 200 years. As a result of this decline along with overharvesting in the 19th and 20th centuries, habitat alteration, effects of invasive species, and other factors, an estimated 70% of North American freshwater mussel species are extinct or currently imperiled (USFWS 2018). Mussels survive by taking in water, keeping microorganisms and nutrients for food, and releasing water back to the river cleaner than it was. Because mussels filter water for food and oxygen, they are highly vulnerable to water quality issues. Elevated concentrations of pollutants, bacteria, and sediment can have highly detrimental effects on mussel populations. A river that supports healthy populations of mussels usually has good water quality.

Today, freshwater mussels are among the Midwestern U.S.'s most imperiled animals, with around half of Indiana's native species extirpated

or listed as endangered or of special concern (IDNR 2018). More than half of the remaining species are federally listed as endangered, threatened, or as state species of special concern. The eight states of the Midwest (Iowa, Michigan, Minnesota, Wisconsin, Illinois, Ohio, Indiana, and Missouri) each have between three and eleven federally listed species of freshwater mussels. Indiana is home to ten federally listed freshwater mussel species.

The Charge

Once home to the world's largest population of clubshell mussels (USFWS 2001), the Tippecanoe River in northcentral Indiana (Figure 1) now supports six federally listed species of freshwater mussels: the clubshell, fanshell, rayed bean, sheepsnose, snuffbox, and rabbitsfoot. The Indiana Department of Natural Resources (IDNR) has been working to conserve the Tippecanoe River and its endangered mussels but is concerned about human impacts that are beyond the IDNR's



Figure 1. The Tippecanoe River in the North Central portion of Indiana.

control. This includes intentional and accidental take (as defined by the Endangered Species Act § 1532 (19)), activities that lead to poor water quality, and possible mussel habitat destruction by recreationists engaging in behaviors such as dragging canoes across shallow water and disturbing the substrate. The IDNR asked the Purdue University Natural Resources Social Science Lab to develop and evaluate a community-based social marketing campaign to help (1) raise awareness among riparian landowners and recreational users of the Tippecanoe River about the endangered status of mussels in the river, and (2) inform these stakeholders of actions they could take to protect and conserve mussels and their habitat.

Community-based Social Marketing

Marketing is frequently used to inspire consumers to purchase particular products, ranging from toothpaste to shoes to cars. Community-

based social marketing (CBSM), conversely, can be used to “sell” environmentally-desirable behaviors to consumers. CBSM has been applied to specific practices such as recycling, turning off cars instead of idling, and drinking tap water instead of bottled water (McKenzie-Mohr 2011; Saylor et al. 2011). Principles of CBSM have also been used in targeted campaigns for wildlife conservation (Boss 2008; Mullendore et al. 2014) and in more general environmental campaigns dealing with issues such as water quality (Jacobson et al. 2006; Kotler and Lee 2008). The effective use of CBSM requires an in-depth understanding of the target audience – what are their current behaviors? What barriers are preventing them from making more environmentally-desirable choices? How can they benefit from adopting the suggested behavior changes? CBSM relies on many strategies including prompts, social norms, and effective communication to encourage behavioral change (Kotler and Lee 2008; McKenzie-Mohr 2011).

For the mussels campaign, we followed standard social science practices by conducting baseline surveys of current conditions to determine barriers to adoption of desirable behaviors and subsequently developed an outreach program using CBSM tools. Finally, we evaluated the effectiveness of our outreach program through post-campaign surveys. We document this process in this article and illustrate learnings from each stage of campaign development and evaluation.

Pre-campaign Surveys

During the summer and fall months of 2014, surveys were mailed to riparian landowners along the Tippecanoe River. Survey mailing followed Dillman et al.’s Tailored Design Method (2009) and consisted of an advance letter, a survey, a postcard reminder, and two subsequent survey mailings. Respondents were given the chance in each mailing to go online to complete the survey or they could complete the paper survey and return it through the mail (envelopes were pre-stamped and pre-addressed for convenience). Surveys contained questions to ascertain awareness of mussels, behavioral intentions towards mussels, attitudes toward the mussels, local water quality, and wildlife in general. Out of 1,804 total surveys

distributed, 628 completed surveys were returned by mail or online (48 % response rate).

An in-person survey of visitors of the Tippecanoe River was also conducted from June to August 2014. Five state public access sites, two canoe liveries, one city park, and one state park were used as sampling locations. Times of day, days of the week, and locations to sample were all randomly selected. Two interviewers visited the sites together and interviewed as many people as were available at the sites. These surveys were designed to last for about five minutes and questions focused on recreational activities, personal interactions with, and awareness about the six endangered/threatened mussel species. A total of 387 surveys were completed.

Baseline survey results from 2014 indicated that outreach efforts should focus on raising awareness about the existence of the mussels and about their federally endangered status. Overall, our surveys showed that visitors to and landowners along the river were largely unaware that the mussels lived in the Tippecanoe River and that it is illegal to remove live mussels and empty mussel shells from the waters of Indiana. Survey data also showed that despite a lack of awareness, public attitudes toward the mussels and their conservation were generally very positive. Therefore, campaign materials needed to focus on raising awareness about the existence of the mussels and what to do when mussels are found. The campaign did not need to focus on mitigating negative attitudes toward the mussels. Four main audiences for the campaign were identified through this baseline data collection: landowners, anglers, children, and visitors to the river.

Developing the Campaign

We coupled our survey findings with the principles of CBSM to develop our outreach and education campaign. The CBSM tools we used included getting people to commit to enhancing water quality and protecting the mussels, prompting them about the appropriate behaviors, normalizing these behaviors, rewarding those who engaged in the specified behaviors, and removing barriers to information and action. Four undergraduate students, as part of a spring

semester class, synthesized these tools with our survey information to draft outreach and education materials (Figure 2).

Draft materials were presented in February 2015 at a public meeting of interested partners and stakeholders including representatives from the U.S. Fish & Wildlife Service, Indiana Department of Natural Resources, Natural Resources Conservation Service, county extension offices, soil & water conservation districts, Grace College Center for Lakes & Streams, local liveries, and landowners. Feedback was collected on the presented designs and materials, plus any new ideas that were shared. Comments were used to further develop materials.

Further testing took place at Purdue's SpringFest (an annual university festival) to gauge how well the materials and ideas worked with children and parents. Pilot testing for a lesson plan to be used in local elementary schools occurred at a local church to make sure the lesson plan met objectives. Using the feedback, the team at Purdue hired a graphic design artist to finalize the materials. Staff members in the Natural Resources Social Science Lab at Purdue University also created, revised, and finalized campaign components.

Final outreach materials were produced and distributed at several local community festivals throughout the summers of 2015 and 2016. The campaign was named "Heart of the Tippy." For a complete list of outreach materials developed, see Figure 3. Informational packets containing brochures, pledge forms, and prizes were distributed to canoe rental businesses and bait shops to help increase awareness and participation in the campaign.

Post-campaign Surveys

Post-campaign surveys to evaluate the success of the campaign included a five-wave mail survey and in-person interview surveys conducted in 2016. Survey methodologies for both the 2016 mail survey and in-person survey were similar to those in 2014. Mail surveys contained the same questions in both years, although the 2016 survey included additional questions about the Heart of the Tippy campaign. The 2016 surveys were mailed to riparian landowners that received a survey in 2014.

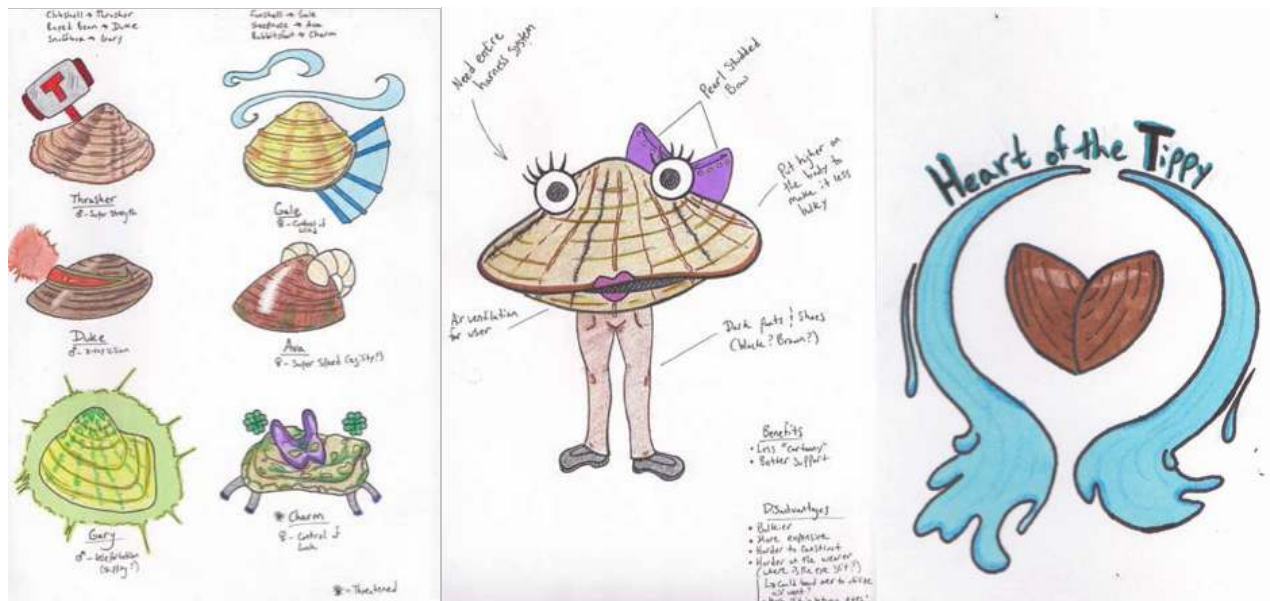


Figure 2. Original designs for Mighty Mussels, costume/mascot, and campaign logo (l to r). Illustrations by Jaclyn O'Connor.

Addresses that resulted in undeliverable surveys in 2014 were removed from the mailing list in 2016. Out of 1,276 total surveys distributed, 449 completed surveys were returned by mail or online (41% response rate).

In-person survey methodology differed slightly in sampling timeframe, sites sampled, and questions asked. Surveys were conducted from June to August in 2014 and from July to August in 2016. Four public access sites, three canoe liveries, and two parks were used as sampling locations in 2016. The northernmost public access site sampled in 2014 was not used in 2016 due to low numbers of visitors. Instead, a canoe rental location was added as a sampling site in 2016 and was chosen because of the location's high volume of visitors and its involvement with the Heart of the Tippy outreach and education campaign. Similar to the mail survey, in 2016 visitors were asked about their familiarity with the Heart of the Tippy campaign. A total of 180 surveys were completed.

Results


Visitors

Finalized Heart of the Tippy materials were distributed throughout 2015 and 2016 and results from the 2016 surveys show the success of the campaign. In 2016, while only 10 % of

respondents said they had heard of the campaign by name, 33 % had seen at least one outreach item. This demonstrates that although the campaign name was not necessarily familiar to visitors of the Tippecanoe River, Heart of the Tippy campaign materials were reaching one in three visitors during the summer months.


For visitors to the river, the most visible outreach items were the interpretive signs (installed in three sampling locations), yard signs (numerous posted in yards and at local businesses throughout the watershed), and canoe stickers (on canoes and kayaks at all three canoe livery sampling sites). A plurality of respondents said they saw outreach materials at Winamac Town Park, Tippecanoe River State Park, from their neighbors/neighborhood, or Oakdale Dam.

In terms of mussel awareness, comparisons between 2014 and 2016 in-person survey data suggest that the education campaign was also successful. When 2016 visitors to the Tippecanoe River were shown a picture of four of the endangered mussel species, a significantly higher percentage of them knew what kind of animal the mussels were compared to visitors in 2014 (p -value < 0.01). Additionally, a higher percentage of 2016 visitors said they had heard of the endangered mussels (p -value < 0.1) and had seen a mussel in the Tippecanoe River (p -value < 0.1) compared




Audience: Anglers

- Informational brochure
- Prizes (floating keychains and bobbers)
- Bilingual signs for fishing location, targeting angler messaging and defining violations




Audience: Kids

- Mighty Mussel Mania seek-and-find game
- Placemats for local restaurants
- Lesson plan




Audience: Recreationists and Visitors

- Interpretive signs for parks and public access sites
- Flyers for canoe rental transport vehicles



Audience: Riparian Residents

- Yard signs encouraging people to take pledge
- Postcards



Audience: All

- Web site (<http://www.HeartoftheTippy.org>)
- Messages (Don't Pick Me Up, Don't Litter, Babies Go Back, Forget the Fertilizer, and Carry Your Canoe/Kayak)
- Stickers (logo, Mighty Mussels, Carry Your Canoe/Kayak)
- Mascot/mussel costume
- String bag
- Informational brochure for general public
- H2-WOW! Protecting our Water Resources Exhibit

Figure 3. Examples of outreach materials developed.

with visitors in 2014. When asked whether or not it is legal to remove native, live mussels from the waters of Indiana, visitors in 2016 were less likely to say they did not know and more likely to say removing mussels is illegal compared to visitors in 2014 (p-value < 0.05). However, when asked the same question about dead mussels and empty mussel shells, visitors in both years largely did not know. Overall, it appears that visitors were more aware of the mussels in 2016 than before the outreach campaign.

Landowners

Riparian landowners seemed to be more aware of the Heart of the Tippy campaign than visitors to the river. At least one outreach item was seen by 41 % of riparian landowners. The most viewed outreach items among mail survey respondents were yard signs, pledge forms calling for the protection of the mussels, brochures with information about the mussels, and postcards with pledge information. Although postcards were one of the most seen items, only 12 % of respondents reported seeing one. This is a curious result because every address that received a survey during the summer and fall of 2016 also received a postcard in the spring of 2016. Such a low percentage indicates that postcards may not be an effective method for similar outreach campaigns in the future. However, about one in five riverside residents had spotted a yard sign, indicating that this method should continue in future campaigns.

Awareness of the mussels and information related to their conservation among riparian landowners increased between 2014 and 2016. A significantly higher percentage of landowners in 2016 (64%) said they had heard of the endangered mussels in the Tippecanoe River than in 2014 (49%) (p-value < 0.01). Landowners, unlike visitors, were also asked whether or not they were aware that the Lake Freeman water level had been lowered to protect the mussels. A significantly higher percentage of landowners had heard of this in 2016 compared to 2014 (p-value < 0.05). As with visitors, the proportion of landowners who reported seeing live mussels or empty mussel shells was higher in 2016 than in 2014. When asked, “*Have you seen a live freshwater mussel in a river?*,” 50 % of landowners in 2016

said, “*Yes, in the Tippecanoe River*” compared to 42 % in 2014. Although that difference is not statistically significant, the question “*Have you seen a dead freshwater mussel or an empty mussel shell in a river?*” did elicit significant differences. A significantly higher percentage of landowners in 2016 compared to 2014 also answered the question “*Have you seen a live freshwater mussel on the banks of the Tippecanoe River before?*” with “*No, but I’ve seen a dead freshwater mussel or an empty mussel shell on the banks of the Tippecanoe River.*”

When it comes to the legality of taking mussels, landowners were more likely in 2016 than in 2014 to say that removing live mussels and empty mussel shells from the waters of Indiana is illegal. Over half of landowners (55 %) in 2016 said removing native, live mussels is illegal compared to only 33 % in 2014. Just under one third of landowners in 2016 (32 %) said removing dead mussels or empty mussel shells is illegal compared to one fifth (20 %) of landowners in 2014. Additionally, lower percentages of “*Don’t know*” responses were recorded in 2016 than in 2014.

To summarize, from 2014 to 2016, landowner awareness about the existence of endangered mussels in the Tippecanoe River increased, as did reported sightings of the mussels, knowledge about the illegality of removing mussels, and awareness that Lake Freeman was lowered to protect the mussels.

Although awareness of the mussels increased after the launch of Heart of the Tippy campaign, attitudes toward the mussels and efforts related to their conservation did not always shift in a more positive direction among landowners. Landowners were presented with pictures of the mussels and asked to circle the number that best fit their opinion of the mussels. Numbers corresponded to 11 different semantic differential pairs (e.g., Good:Bad) and ranged from 1 to 7, where 1 indicates a more positive evaluation, 7 indicates a more negative evaluation, and 4 indicates neutrality. Of the 11 pairs, 4 pairs resulted in means that significantly shifted toward more negative evaluations (Table 1). While means for all 11 pairs were under 4, indicating overall positive evaluation, it is important to note that attitudes toward the mussels may be trending negatively over time or that these are not effective measures.

Table 1. Answers to the prompt: “Please check the number (1-7) in each row that best describes your opinion of the mussels pictured above.” Bolded rows signify statistically significant results (significance level $p < 0.05$).

Semantic Differential Pair	-----2014-----		-----2016-----		p-value
	n	Mean	n	Mean	
Good (1) to Bad (7)	526	2.32	388	2.41	0.375737
Important (1) to Unimportant (7)	536	2.63	397	2.72	0.482134
Beautiful (1) to Ugly (7)	521	2.85	398	3.18	0.005138
Friendly (1) to Unfriendly (7)	507	2.75	391	2.93	0.118727
Active (1) to Passive (7)	502	3.71	396	3.52	0.127431
Pleasant (1) to Unpleasant (7)	514	2.83	396	3.03	0.072632
Valuable (1) to Worthless (7)	524	2.79	400	3.09	0.020772
Clean (1) to Dirty (7)	519	2.69	397	2.78	0.421493
Hardy (1) to Fragile (7)	508	3.31	396	3.30	0.957454
Harmless (1) to Dangerous (7)	526	1.90	399	2.12	0.026636
Dry (1) to Slimy (7)	506	3.56	389	3.88	0.003651

Landowners received various prompts throughout the survey and were asked to mark the option that best fit their opinion on a scale from Strongly Disagree (1) to Strongly Agree (5). Therefore, a lower mean for each prompt indicates that landowners largely disagree/strongly disagree with that statement, while higher means indicate agreement/strong agreement. Results from the prompts (Table 2) give us insight as to why the attitudes above became more negative over time. Landowners in 2016 disagreed more strongly with the statement “*I would be willing to pay more to improve water quality (e.g., recreational fees, local taxes, etc.)*” than in 2014.

Perhaps a more positive result is that landowners more strongly disagreed with the statement “*These mussels are valuable for their shells*” in 2016 than in 2014. This could indicate that attitudes toward the mussels are becoming potentially more negative in some aspects as seen in Table 1, but could also indicate that landowners have learned that removing mussels from the waters of Indiana is illegal and therefore harvesting mussels for their shells is not an acceptable behavior. Another

indication of potentially pro-conservation behavior is the fact that landowners strongly disagreed with the statement “*I think we as a nation should repeal the Endangered Species Act*” more often in 2016 than in 2014. Based on the results from various survey prompts, it seems landowners do not oppose larger conservation efforts.

Behaviors of Both Visitors and Landowners

Reported behaviors toward the mussels were resoundingly positive. Less than 1 % of landowners in both 2014 and 2016 reported that they would take or harm a mussel if they found one while recreating in/along the Tippecanoe River. An overwhelming majority of landowners in both years, 80 % in 2014 and 84 % in 2016, said they would put a mussel back if they found one.

In both years and for both in-person and mailed surveys, canoeing/kayaking was one of the most popular recreational activities. As such, one focus of the Heart of the Tippy campaign was to promote carrying canoes and kayaks over areas of low water in the Tippecanoe River. Unfortunately,

Table 2. Responses to statements about mussels and related conservation efforts. Response options ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). Bolded rows signify statistically significant results (significance level $p < 0.05$).

Prompt	-----2014-----		-----2016-----		p-value
	n	Mean	n	Mean	
If I saw one of these mussels, I would catch or touch them.	574	2.01	419	1.76	0.000178
I would like to keep one of these mussels.	574	1.40	418	1.39	0.749400
These mussels are valuable for their shells.	571	2.07	418	1.89	0.006960
I think these mussels are good bait to use while fishing.	571	1.80	419	1.73	0.261967
These mussels help to improve water quality.	576	3.77	419	3.83	0.460613
These mussels harm local ecosystems.	570	1.85	419	1.85	0.962206
Government money should be used to protect these mussels.	573	3.06	420	2.99	0.387796
I would try to find/hunt more of these mussels.	574	1.53	421	1.51	0.738795
These mussels are important to the Tippecanoe River ecosystems.	581	3.82	423	3.82	0.997518
Nature will take care of the mussels, therefore we don't need to protect them.	239	2.62	421	2.63	0.907203
Mussels in the Tippecanoe River indicate that the river is healthy.	240	3.80	420	3.87	0.377505
I would be willing to pay more to improve water quality (e.g., recreational fees, local taxes, etc.)	597	2.93	420	2.77	0.039190
I think we as a nation should repeal the Endangered Species Act.	237	2.49	420	2.27	0.019437

Table 3. Answers to the question: "When canoeing/kayaking, how often to do you carry your canoe/kayak over shallow water areas?"

	Mail Survey Comparison		In-person Survey Comparison	
	2014 (n=351)	2016 (n=418)	2014 (n=102)	2016 (n=55)
I do not canoe/kayak	47%	53%	NA	NA
Never	15%	13%	27%	38%
Rarely	NA	NA	13%	16%
Sometimes	30%	30%	31%	26%
Always	8%	4%	29%	20%

lower percentages of visitors and landowners in 2016 reported that they “*sometimes*” or “*always*” carry their canoe or kayak over low water (Table 3). However, this decrease may have more to do with the weather than with the campaign. High temperatures and low levels of precipitation in 2014 resulted in extremely low water levels in parts of the Tippecanoe River. The next year was drastically different. Canoe liveries along the river had to close and cancel trips in 2015 due to dangerously high river levels resulting from more precipitation and milder temperatures. Weather in 2016 was more or less average for the area. Therefore, visitors and landowners in 2014 may have experienced areas of low water more frequently than visitors and landowners in 2016, who might have answered the question thinking that they did not need to carry their canoes and kayaks across areas of low water because there were not as many opportunities to do so.

Conclusion

Success of the Heart of the Tippy campaign is evidenced by the number of people living along or visiting the river who saw and interacted with outreach items and education efforts. Analysis of in-person and mail surveys showed that the Heart of the Tippy campaign reached about one in three visitors during the summer recreational season. Due to campaign efforts, awareness of the mussels increased over time, as did awareness about the illegality of removing native mussels from the waters of Indiana. Campaign efforts and materials that were most often seen by visitors and landowners included yard signs, interpretive signs along the river, stickers, and brochures. Post-campaign data showed that both visitors and landowners were more aware of the endangered mussels in the Tippecanoe River. The use of baseline social science data helped to design an effective community-based social marketing campaign and provided data to quantify the impacts of the conservation interventions.

Summary of Lessons Learned

- Before launching a CBSM campaign, conduct baseline assessments of your

target audience to determine their attitudes, behaviors, and perceived barriers to adopting behavior changes.

- Based on your findings, design outreach strategies and materials that best fit your target audience and the goals of your campaign.
- Assess the effectiveness of your efforts and adjust as necessary. We found that some activities (e.g., placing yard signs throughout the community) might be more effective than others (e.g., mailing postcards).

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