Natural and Social Science Work Better Together **for Managing AIS**

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When talking about people in a natural resource management context, many of us have likely heard a variation of the joke "That's why I study (insert physical or biological thing that can be studied). That thing is easy. People are hard!" As with every good joke, part of the humor comes from the vein of truth in the statement. When you know what a fish needs to find food, not become food, or to reproduce, you can start to guess where they are going to be (even if they're still hard to catch). The impact of a new physical or chemical element to a lake can be predicted thanks to the wealth of data that exist on lake ecosystems. When we introduce a lake management program or tweak an existing one, we have an idea of what is going to happen because of past experiences with similar programs.

But people? People are hard to predict. They can make decisions that can harm the ecological health of their lake even though they care for their lake. They may say one thing and do another. They think they're good environmental stewards even though some of their behaviors suggest otherwise. They may tell you what they think you want to hear as opposed to what they believe or do. People can hold conflicting values and views. What motivates one person to do something doesn't motivate others. All of these things, and many other quirks of human behavior, can make working with people difficult. Yet, it's necessary to understand people and work with them because many of us aren't exclusively responsible for whatever natural science we were trained in. We work with communities of people who care for and use lakes and reservoirs, and we need their support and behavioral compliance to improve and protect these waters.

While all aspects of lake and reservoir management benefit from a social component, aquatic invasive species (AIS) management– which for the purposes of this article includes all aspects of working with AIS, including but not limited to outreach, prevention, and control – is a clear example where it is impossible to make meaningful progress without also addressing human behavior. Human behaviors move invasive species, so only by working with people can we reduce their spread. The application of social science approaches can help us understand the attitudes and behaviors of people intentionally and unintentionally moving invasive species and how to develop interventions to reduce the number of invasive species in transport. Without the human and social science component, invasive species management would be limited to addressing ever worsening and new impacts of invasion.

Luckily, there are rigorous social science methods that help us understand and influence the behaviors of people to prevent the spread of aquatic invasive species. These methods can help us understand how people think and behave, while providing insights on what messages are most effective in encouraging people to perform AIS prevention behaviors. These methods are also important for program evaluation and can be used to both identify opportunities for program improvement while also providing data on the effectiveness of our AIS-prevention programs. If you haven't thought much about how social science approaches could improve your AIS management program, we encourage you to follow along as we highlight some social science projects that have helped improve aquatic invasive species management across the country. Specifically, we highlight how these approaches can help us better understand our target audiences, help us craft better messages to communicate with our audiences, and how these approaches can remove barriers to people performing invasive species prevention behaviors.

Understanding your target audiences

There are several approaches that can be used to understand a target audience. Surveying a randomly selected sample of a larger population can provide information that is representative of the population as a whole. This can be an efficient way to collect quantitative data to help understand the broader knowledge, behaviors, and beliefs of that group. Targeted interviews and focus groups with an audience can generate qualitative data that bring new insights to light and can help uncover additional details that are difficult to get through a quantitative survey alone. Informal conversations with people can even be useful if care is taken to not overinterpret what was learned. All these approaches, used in combination or on their own, can help AIS managers learn more about their target audiences and have been used to improve AIS management.

In Wisconsin, qualitative approaches have been used to better understand the specific beliefs of water users. For example, focus groups were used to talk with boaters more about their behaviors relating to draining water from their boats. Through these conversations, AIS staff learned that boaters generally knew the rules about draining water prior to leaving the landing, but for anglers, if fish were in the livewell, they believed that water was needed to transport their fish and it didn't occur to them to drain it. Interviews with waterfront property owners have been

used to understand detailed beliefs about aquatic plant management, which often can be a contentious topic. Interviews with waterfront property owners uncovered that there was a disconnect between what managers and waterfront property owners believe to be a management action. Managers considered monitoring a management action while waterfront property owners did not mention monitoring a population as an action they would take in response to finding a new AIS. It's easy to see how this difference in beliefs could cause discontent and improved communication on how monitoring can help manage AIS could overcome this.

Quantitative efforts are also used to set baseline information for how many people are performing prevention behaviors and how they feel about AIS issues. The data can be used to identify gaps in prevention behaviors that can inform new outreach programs. If the surveys are repeated, they can be used to evaluate outreach programs that were implemented between the survey periods. Wisconsin has regularly surveyed registered boaters in the state to set benchmarks for how often they report performing AIS prevention behaviors and how knowledgeable they are about AIS. This information has also been used to segment recreational boaters into different audiences, such as boaters that don't travel and boaters that travel frequently, or that have different levels of knowledge and different trusted information sources. Prevention messages and sources can then be tailored to the boaters that have the riskiest boating behaviors.

Crafting better messages

Social science doesn't just help us broadly define and understand audiences. It can be used to develop better messaging that helps our audiences feel and act in desirable ways. Using the survey methods discussed earlier, researchers can test different models of human behavior with different messaging to better understand which models and concepts from those models best explain a target audience's reactions and their intention to implement AIS prevention behaviors. Understanding which aspects of those constructs best motivate people can then allow us to create messages that operate on those beliefs or feelings. Perhaps feelings of self-efficacy – I can perform the action – help people perform certain AIS prevention steps. If that is the case, we can lean heavily on messages that emphasize what people need to do and that the prevention steps are things they can do. Another common construct that is influential is response efficacy, or that the suggested actions will make a difference in protecting the waters they use. Many people feel as if the spread of AIS is inevitable and our actions don't matter, so they don't perform prevention behaviors. Our messaging can help overcome those feelings by including information on how prevention behaviors can make a difference.

Social science can be used more explicitly to test messages that might improve outreach. To test the impacts of and reactions to different types of messages, the specific text of an outreach campaign can be changed while the visual aids remain the same, allowing researchers to directly compare messages. Work done by researchers at the University of Arkansas at Monticello and Texas A&M University suggests that regulation-framed messages were most effective for increasing boater intention to perform AIS prevention behaviors. Key messaging strategies can be operationalized into specific text and visual aids and then placed in a setting where people are likely to respond to the message with actions – like at a boat ramp. Message testing can also take place in a digital setting. Facebook has been used to test different messages and how they impact people's desire to click on a link to learn more about invasive species information. In this instance, the research found that an informational, scientific message frame can achieve the same communication outcomes as commonly used nativist or militaristic frames (e.g., "alien species aren't welcome" or "the war against invasive species"), which are associated with ethical questions and can have unintended consequences that may ultimately undermine ecologically sound lake and reservoir management (Figure 1). For example, there are some preliminary data to suggest that fear campaigns targeted at transient boaters can have "spillover" effects such that lakeshore property owners can overreact to a new

Figure 1. Message testing approaches allow researchers to compare the effectiveness of different messaging approaches. In this example, invasive species social media posts with (a) a militaristic frame did not outperform (b) a science and fact-based frame. This suggests that we can achieve communication goals without the potential ethical concerns or unintended consequences of militaristic messaging (photo: Brooke Alexander).

AIS with aggressive treatments that may harm native plants or animals when more methodical and ecologically informed options may be available as an initial course of action. Using social science to help us understand how messages are impacting people can tell us what to change about an outreach program to get the desired impact.

Addressing barriers to behavior change

For most of us, the ultimate goal for our AIS-prevention outreach efforts is to help water users adopt behaviors that prevent the spread of AIS, and there are a number of examples that have translated social science research into effective outreach programs. A lot of this has been done in the context of community-based social marketing (CBSM), which is a form of social marketing that emphasizes direct contact with community members and the removal of barriers to action. It embraces the psychology of behavior change and staying focused on behavioral outcomes vs other forms of education that focus on filling knowledge gaps. Both Stop Aquatic Hitchhikers! (https://stopaquatichitchhikers.org/) and Habitattitude (https://www.habitattitude.net/), which are national AIS prevention campaigns, are based on CBSM principles and encourage people to perform AIS prevention behaviors. In a more recent example, the Minnesota DNR has used a CBSM approach as part of a small grants pilot program for county-level AIS programs and local groups to implement programs that remove barriers to AIS prevention activities. This program has funded projects that target specific AIS prevention behaviors including encouraging waterfront property owners to dry docks, lifts, and equipment for 21 or more days before installing them to a new body of water and working with anglers to properly dispose of unwanted bait in the trash. Each of these small projects included an evaluative component that allowed for the larger Minnesota AIS program to learn from each of these local projects. Efforts like this can apply the lessons learned from social science research with the help of local partners.

Another example can be drawn from the previously mentioned example of Wisconsin boaters and their disconnect with the requirement to drain water from livewells and their need to transport harvested fish. Out of this misunderstanding came the Drain Campaign, which was developed to educate boaters specifically on this behavior. The outreach efforts included an ice pack as a giveaway (Figure 2), which served as a reminder to boaters to drain livewells and provided the ice they needed to keep their fish fresh until they returned home. A follow-up statewide survey completed in 2018 indicated a slight improvement in these behaviors, indicating the program had a positive effect.

Figure 2. To help boaters and anglers engage in AIS prevention behaviors, it can be helpful to provide reminders to action and to remove barriers to any desired behaviors. Branded towels and ice packs that are handed out by watercraft inspectors in Wisconsin remind boaters and anglers on behaviors they need to engage in while providing the tools they need to complete the actions. Towels can help dry watercraft and gear, while the ice pack can be used to keep fresh during transport. Both behaviors help reduce AIS transport risk (photo: Ellen Voss).

A relatively easy to implement opportunity for lake and reservoir managers may be placement of boat cleaning tools at landings. Many surveys of recreational boaters indicate that the lack of tools to clean their boats at water access points is a common reason why they do not perform AIS-prevention behaviors. Providing these tools, whether they be tools purchased from a hardware store or an all-in-one cleaning station solution, can remove that barrier to action.

In all these instances, the key to getting people to perform the desired action was to remove barriers that made it easier for them to do the right thing.

Doing more social science for AIS management

We hope you are now motivated to try more social science approaches to inform your lake management outreach programs. Below are a few ideas that can help anyone incorporate more of these approaches within their work:

- *Have social scientists or people familiar with social science working on teams.* They can help make connections to where these approaches can help. These people may be researchers or extension staff at a university, natural resource managers with this background, or simply someone with an interest in the subject that is looking at a problem through that lens. Having someone on your team with some social science experience can provide valuable insights to pursue this work and can

help make connections that get this work done.

- *Direct funding to this work.* While social science work might not require field work or capital expenses like a lot of natural resource management projects, it does still cost something. It often costs money to compensate participants or find a sample of people to survey. Even "free" information from willing participants still requires time or financial resources in the sense that someone needs to collect the data, process it, and report the results. Investing in this kind of work will help you realize more applicable and useful results. It's important to budget for social science to understand your audience and evaluate your outreach just like you would fund other aspects of an AIS management program.
- *Consider social science a tool for evaluation.* Even if you might not be interested in some of the theoretical information that social science approaches can provide, many of these approaches are needed to understand the impacts of management programs since these programs involve people. We all can benefit from knowing if our programs are having the intended effects within communities and using social science approaches help us understand whether our outreach programs are working and where they can be improved.
- *Apply an actionable science lens to these projects to help ensure results are applicable to AIS-prevention and management programs.* One question we've heard at the end of research projects about natural resource management is "How am I supposed to use this information?" Somewhere in the process of conceiving of the study and analyzing and communicating the research findings, the original need of the natural resource manager was lost. Ensuring that throughout the process someone is continually thinking about how this work can be used and how it can improve the management of AIS will help us all complete more applicable social science projects.

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