

RESEARCH REPORT
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*Addressing barriers to aquatic invasive
species prevention behaviors among
Illinois recreational water users*

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EXECUTIVE SUMMARY

The unintentional spread of aquatic invasive species (AIS) by Illinois anglers and boaters is of high concern in Illinois. The Be A Hero outreach campaign has successfully raised awareness of the threat of AIS and encouraged some anglers and boaters to “remove, drain, dry” after leaving a waterbody. However, Illinois anglers and boaters are highly transient, and the interconnectedness of waterways means that a small number of water users who are not performing these behaviors are creating high risks of AIS transport. This research was designed to provide information on the factors that contribute to Illinois recreational water users’ engagement in AIS prevention and to test outreach messages that may be effective for those who have not been compliant. Thus, the goal of our study was to provide information to the Illinois Department of Natural Resources, Illinois-Indiana Sea Grant and Illinois Natural History Survey about barriers to participation in AIS prevention and strategies for increasing participation rates.

This report synthesizes key findings from two phases of a project with an emphasis on take-aways for managers and lessons learned that can be translated to future research involving recreational water users in Illinois. The first phase involved qualitative, in-depth discussions with small groups of recreational water users. The second phase was a state-wide survey that generated quantitative data for modeling behavior and decision-making. This mixed-methods research approach was optimal to **combine multiple, complementary forms of knowledge and employ different strategies for engaging recreational water users**. Results from both phases are organized into three sub-sections corresponding to the objectives that guided the study.

Key findings and management recommendations from focus groups

- Objective 1: Examine perceived threats from the spread of aquatic invasive species
- Objective 2: Identify barriers to participation in remove-drain-dry behavior
- Objective 3: Explore benefits derived from completing remove-drain-dry behavior

Key findings and management recommendations from state-wide survey

- Objective 1: Develop descriptive information about recreational water users
- Objective 2: Determine the factors contributing to AIS-prevention behaviors
- Objective 3: Evaluate the efficacy of outreach messages

Key Findings and Management Recommendations from Focus Groups

Objective 1: Examine perceived threats from the spread of aquatic invasive species

- Perceived threats included impacts on **individuals, communities, and ecosystems**. Impacts on recreation (e.g., fishing, swimming) and human health are seen to be more important than factors such as socialization, skill development, and ability to escape from the pressures of everyday life. These threats should be prioritized by decision-makers.
- Ambivalence was expressed in accordance with individual experience, indicating that **not all threats were of equal concern and that some recreational water users may in fact prefer changes** caused by AIS. Decision-makers should carefully weigh public preferences alongside scientific expertise.

Objective 2: Identify barriers to participation in remove-drain-dry behavior

- **Water users need to be assured that they can make a difference.** This recommendation stems from the finding that self-efficacy – defined as the belief that individual action can effect change – is a major constraint that prevents water users from taking action.
- Concern over **lack of knowledge** and a desire for better educational outreach was expressed. Therefore, more educational outreach is needed, and decision-makers should champion the initiatives already in place to raise awareness of current efforts.
- **Low ascribed responsibility** was observed given a tendency to point to “the other” as a culprit for spreading AIS. Anglers and boaters need to take more ownership over AIS issues. Instilling trust and delegating authority through citizen-led management would encourage people to take initiative in solving problems that stem from invasive species.
- Participants expressed a need for **more infrastructure at boat ramps** for performing AIS preventative behaviors. If budgets allow, expanding the footprint of boat washing stations would increase convenience and create more inviting spaces (e.g., shelters from inclement weather). Support from boat ramp attendants would also be well-received.

Objective 3: Explore benefits derived from completing remove-drain-dry behavior

- Performing remove-drain-dry behavior was analyzed across the categories of individual, community, and ecosystem-related benefits. Results illustrated low awareness of benefits relative to threats and barriers, indicating **agencies should take action to raise visibility of the positive outcomes from behavioral performance. Benefits to the environment should receive special attention.**
- Participants identified a rich array of benefits they believed they would receive, including feelings of moral responsibility, increased knowledge, and boat maintenance.
- Supporting future generations and fishing communities were emphasized as community-based benefits, particularly among anglers as compared to boaters.

Key Findings and Management Recommendations from State-Wide Survey

Objective 1: Develop descriptive information about recreational water users

- Three predominant types of recreational water users were identified in response to a series of questions about boat ownership and fishing activities in the state: **1) Boat owners; 2) Boat renters / borrowers; 3) Non-boat users.** As such, we present results in this report for the pooled sample and these types of recreationists. **We suggest that decision-makers organize their thinking in terms of these three groups.**
- Our sample included moderately experienced anglers with an average of 21 years of fishing experience and 12 days fishing in 2020. Boat owners were most skilled at fishing and reported more time fishing in 2020 than the other two subgroups. Lower than average fishing skills were reported for boat renters and non-boat users.
- Respondents were less experienced with boating than with angling given an average of 15 years of boating experience and 10 days boating in the previous years. “Average” boating skills were reported.
- **Fishing from the shoreline was more common than fishing from a boat.** Of the respondents who reported engaging in water-based recreation in the past year, about two thirds went boating while one third went canoeing or kayaking. The most commonly targeted species across the state were catfish, bluegill, crappie, and largemouth bass.
- Nearly half of the sample transported their watercraft between sites. These **mobile anglers and boaters warrant special attention from decision-makers given their risk of transporting invasive species.**
- Basic education about invasive species should be continued, focusing particular attention on **raising awareness of how to correctly identify invasive species and understand their relationships to ecosystems, recreational activity, and management.**
 - Knowledge of aquatic invasive species was low, and boat owners were more knowledgeable than boat renters and non-boat users. Corroborating these results, familiarity with ecosystems, recreation impacts, and fisheries management was also low, but higher among boat owners than the other subgroups.
 - Anglers and boaters **rely on multiple sources of information** to learn about AIS, particularly environmental groups and boating or fishing clubs, whereas government employees and sales associates at stores are least trusted sources. Regarding information channels, **species identification cards and booths at sport or fishing shows were reported to be most useful.**
- Most respondents were White, six out of ten were women, just over half held a bachelor’s degree or higher, and over half reported an annual salary of less than \$75,000. Boat renters and borrowers reported higher levels of education and income than non-boat users.
- Descriptive results point to a need for more research that explores differences in Illinois recreational water users by management region as well as differences between users based on delineations like “licensed anglers” and “registered boat owner.”
- Respondents were recruited from an online panel purchased from Qualtrics. The panel included Illinois residents who had fished or participated in recreational water activities since 2018. This method was an **affordable alternative to on-site and mailback surveys and responsive to rapidly declining response rates in survey research.** Another strength of this approach was the inclusion of anglers who did not regularly

purchase fishing licenses, which would not have been possible using a licensed registration list. Thus, our sample represents a class of stakeholders that has been less studied in past work, and included more female respondents, residents who were younger, better educated, less experienced, and wealthier than respondents engaged in previous research.

Objective 2: Determine the factors contributing to AIS-prevention behaviors

- We observed **high levels of intended behaviors** to prevent invasive species transport via boats and fishing equipment.
- Engagement in AIS-prevention behavior was seen as beneficial for the environment, community and individual angler.
 - **Non-boat users were less likely to identify benefits to themselves than boat owners and boat renters/borrowers**
- Respondents reported **low levels of perceived barriers** to taking action that would limit the spread of AIS, such as *weather conditions* and *pressure from other recreationists*. Boat owners reported the highest levels of perceived barriers and non-boat users reported the lowest. This result suggests that **preventative behaviors associated with boat ownership are seen to be more difficult**.
- Concerns about environmental threats were highest in the pooled sample. Boat owners expressed higher levels of risk perceptions than boat renters. **Higher risk perceptions may be associated with the responsibility of owning rather than renting a boat, or with the more frequent use** that boat owners engaged in compared to non-owners.
- Boat owners were more likely to believe they could take preventative action (i.e., they had higher self-efficacy) than both boat renters and non-boat users.
- Boaters were more likely than non-boat users to believe that a given action would meaningfully prevent AIS spread (i.e., they had higher response efficacy).
- The low efficacy among non-boat users suggests that they would benefit from **the following best management practices** concerning AIS outreach:
 - Highlight the wins of environmental protection to support ‘mastery’ over the way non-boat users think about their influence on AIS.
 - Share success stories among everyday people so other anglers can live vicariously through these experiences.
 - Identify and showcase the actions, principles and achievements of role models that are minimizing the spread of AIS.
 - Create opportunities that facilitate the emotional and mental well-being of anglers to positively influence self-efficacy.
- Survey respondents reported **moderately high levels of trust in both the scientific community and the Illinois Department of Natural Resources**, with no significant differences across user groups. This finding suggests that lack of trust in regulatory institutions is not likely an impediment to effective outreach.
- We observed high levels of concern for the environment (i.e., biospheric values), concern for other people (i.e., altruistic values), an interest in maximizing personal utility (i.e., hedonic values), and motivation to seek personal fulfillment (i.e., eudaimonic values).
- Respondents reported low levels of desire for power and influence (i.e., egoistic values). This finding indicates that few anglers are driven by interests in influencing other people or leading groups such as fishing or boating clubs as compared to their interests in

environmental protection. Of the three subgroups, boat owners had the strongest values related to achievement and influencing other people.

- Value-based messages should emphasize that anglers and boaters can accomplish goals related to environmental protection, human well-being, and pleasure, alongside more abstract gains such as ‘living a good life’ through AIS reduction.
- Self-efficacy was the strongest predictor of behavior to stop the spread of AIS on boats, meaning that as **boaters were more confident in their ability to complete remove-drain-dry behaviors**, they were more likely to do so.
- Response-efficacy was the strongest predictor of remove-drain-dry of fishing equipment, meaning that as **anglers became more convinced that their behaviors would make a difference, they were more likely to take action.**

Objective 3: Evaluate the efficacy of outreach messages

- **Responses to all messages were positive, indicating the Sea Grant brochure is overall well-received.** Participants reported thinking deeply about the message and believed it to be highly effective and not manipulative.
- Respondents who viewed messages that included statements about the ease of completing remove-drain-dry (i.e., self-efficacy) and the direct link to AIS prevention (i.e., response efficacy) reported lower perceived benefits to the self and community than participants who viewed messages that instead included statements related to the legal mandates regarding AIS prevention.
- Respondents who viewed messages that included statements about laws related to AIS prevention were more likely to feel that their actions would prevent the spread of AIS – that is, these individuals had high response efficacy.
- Adopting language that appeals either to efficacy or legal mandates will likely have the same response on beliefs about barriers, risk perceptions, and self-efficacy, given there were no significant differences in these variables between groups who received efficacy or legal messages
- Respondents who received experimental messages framed in line with altruistic values or values of goal attainment did not report stronger beliefs than respondents who received a control message. This finding indicates that **adding values framing to the current brochure will not likely expand the current set of beliefs or behaviors performed by water-based recreationists to minimize the spread of AIS.**
- Many respondents expressed a desire for more information about aquatic invasive species, including:
 - Visual depictions of common AIS to help recreationists identify problematic species.
 - Resources on how to become involved with AIS mitigation.
 - More details on how individuals can prevent the spread of AIS.
 - Ways that recreationists may be personally impacted by AIS invasions.

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BACKGROUND

Numerous aquatic invasive species (AIS) threaten to spread throughout Illinois waterways by transport via recreational water users. The Be A Hero campaign encourages boaters and anglers to complete three steps upon leaving a waterway: 1) remove any visible plants or animals from the boat and equipment; 2) drain all water from the boat; 3) dry everything thoroughly with a towel or allow the boat to fully dry before entering a new waterway. Research has shown that Illinois boaters and anglers are largely compliant (~95%) with performing at least one of these recommended AIS-prevention behaviors (Williams, 2014; Hilbrich, 2015; Cole et al., 2016). However, recent work by Cole et al. (2019) reveals that a small number of non-compliant boaters and anglers can pose a disproportionately high risk of spreading AIS because of the interconnectedness of lakes caused by boater visits. It is critical that these risks be addressed to keep the waters of Illinois, including Lake Michigan, free of new biological invasions. Therefore, **we sought to identify the reasons for non-compliance of AIS preventative behaviors and evaluate outreach messages to improve efficacy in communication between resource management agencies and Illinois recreational water users** through two phases of research including focus groups and a state-wide survey.

FOCUS GROUPS

Study purpose

As a first step in the research process, focus groups were conducted to build a nuanced and in-depth understanding of how recreational water users perceived remove-drain-dry behavior. This qualitative phase of the study laid groundwork for a state-wide survey of anglers and boaters. Below is a description of the methodology for this research, along with a summary of research results. Our primary objectives were to: 1) examine the perceived threats from the spread of aquatic invasive species; 2) identify the barriers to participation in remove-drain-dry behavior; and 3) explore the benefits derived from behavioral engagement.

Methodology

Participants

Our recruitment strategy for engaging recreational water users in discussions about AIS preventative behaviors began with an opportunity for anglers to participate in focus groups in

March 2020. Attendees of the Lake Michigan Fisheries Workshops hosted by Illinois-Indiana Sea Grant were invited to attend presentations about the project and subsequently participate in a focus group. Advertisements for the workshops were distributed on social media to encourage broad attendance. In total, four focus groups with recreational anglers were held, including two on March 10th (n = 5, n = 7) and two on March 11th (n = 5, n = 9). Participants included 23 men and 3 women, with an average age of 54 years. Average years of fishing experience was 38 and median number of days fished in the past year was 20. Three of the focus groups were recorded and transcribed verbatim; the average conversation length was 28 minutes, resulting in 83 total minutes of discussion.

In July 2020, two focus groups were organized to understand the perspectives of recreational boaters. These focus groups were conducted via Zoom on July 27th (n = 2) and July 28th (n = 5). Participants included three women and four men, with an average age of 52, an average of 23 years of boating experience, and median of 33 days spent out on the water in the previous year. Participants were recruited through recreational boating and fishing organizations and received \$25 compensation for their participation. Conversations lasted approximately 85 minutes, amounting to 171 minutes of discussion that was recorded and transcribed verbatim.

Procedures

Focus group participants were provided with information about the study topic in advance to prime and prepare them for a thoughtful discussion (see Appendix A). All participants were also asked to provide written consent for their participation in accordance with requirements from the University of Illinois Institutional Review Board for conducting human subjects research (see Appendix B). During the focus groups, participants were asked to fill out a short questionnaire that evaluated their viewpoints concerning AIS and remove-drain-dry behaviors (see Appendix C). Specifically, the questionnaire included questions about the perceived impacts of invasive species, benefits of remove-drain-dry behavior, barriers to performing clean-drain dry behavior, and socio-demographic information. Beneath each of the prompts, sample responses were provided as a point of reference and inspiration for the participants to share their own thoughts. Material shared during the survey process was used as a basis for discussion.

Analysis

All recorded data collected during the focus group discussions were transcribed verbatim. After transcription, ATLAS.ti version 8 software was used for analysis. Clarke & Braun's (2014) methodology of thematic analysis was used to guide this process. A total of 50 open codes were identified and used to build a conceptual framework that showed the relationships among benefits and barriers to remove-drain-dry behavior, as well as the impacts from invasive species. These relationships were related and interpreted with guidance from the Health Belief Model (Carpenter, 2010). All codes were inductively derived and used as a basis for developing the structure and content of a state-wide survey.

Results from focus groups

Perceived threats from the spread of aquatic invasive species

Thematic analysis of participant discussions revealed multiple threats that could be classified in terms of impacts on individuals, communities, and ecosystems. On an individual basis, **personal impacts were experienced through recreation** and were the most prevalent point of discussion regarding the threat of AIS. For instance, respondents commented that: "I like to be able to catch fish and with the invasives it's a lot harder to do that" and "My nice sandy swimming area is now full of weeds." Participants also expressed concerns about **threats to human health**, including water quality with "Lake Michigan being our water source here," "personal harm from flying Asian carp" and concerns with spread of parasites that may impact humans.

Participants commented on wider reaching **impacts of AIS to a broader community**. They referenced harm to the sportfishing and tourism industry, noting that "people may be less likely to vacation in an area impacted by invasives." They also noted that there would be damage to human-nature relationships, such as decreased beauty of the environment and "damage to shipwrecks and beauty at lake bottom."

Conversations also centered around **ecological threats**, including trophic cascades and habitat changes. Participants cited specific concerns including "shifts in diet of native species" and "changing energy pathways impacting important populations." Participants who were less knowledgeable about ecological impacts still indicated invasive species were problematic:

“negative impact on an ecosystem with unknown consequences” and “not to mention that uh some of the fish are getting trapped in the weeds, and that’s also not good for the aquatic life.”

Although a range of threats were identified across individuals, communities and ecosystems, **ambivalence around perceived threats of AIS** was expressed by participants. Some reported **AIS were concerning** while others believed that nature would adapt, as evidenced by statements indicating “mussels are improving water quality and aiding the fishery” or that “Nature will change itself to do whatever it has to, you know, it will do. Moreover, beliefs tended to be **shaped by personal encounters with AIS during recreational activities or daily life** so the conclusions drawn by participants varied based on circumstance. As one participant commented,

“How much it affects you is how much you’re concerned, right? So you just, if you wanna know how much this group that uses water is concerned or that one, like how much does it affect them? Well it affects us because it affects fish. But if you’re just boating on a lake it doesn’t really affect you so you aren’t thinking about it.”

These results provided insights on how participants were thinking about threats from AIS without being prompted by pre-existing questions from the research team. From this inductive process we were better able to develop a robust questionnaire tailored to a specific group of respondents, inform our decisions about word choice in survey questions, and identify the following broad categories of threats that were most salient to recreational water users in Illinois: 1) threats to individuals, 2) threats to communities, and 3) threats to the environment.

Barriers to participation in remove-drain-dry behavior

Results suggested multiple barriers impeded participation in AIS preventative behavior. One of the most salient barriers related to the idea of “self-efficacy” that refers to an individual’s belief about his or her capacity to make change. Specifically, a common barrier related to the sheer volume of AIS that created **insurmountable hurdles that individual actions could not overcome**. Participants cited the wide-reaching impacts of industry and shared beliefs that ecosystems were “too far gone currently” for any solution to be achieved. For instance, one participant noted that “When I’ve read about the invasive species, it’s a large corporation or something who actually made the decision to allow international boats to drop their ballasts in the first place, so from a small individual thing ...it just feels like an impossibility to do

anything.” Similarly, others shared that they were doubtful they could make a difference as individuals, or that they believed a single fishing trip would be unlikely to affect the lake.

Participants shared that a **lack of knowledge** or feeling uninformed on AIS contributed to a lack of action. Some participants commented that, as anglers, they are “probably the most concerned individuals” but that less experienced recreationists may be unfamiliar or unconcerned with AIS. In other words, they believed that many recreationists just did not know that AIS were a problem or that they should be doing anything to minimize their spread. Several participants admitted that they were personally aware of AIS but “don’t understand what the process is” for completing remove-drain-dry or did not know how to tell “if you really got them all off your boat.” Others recalled seeing signage at boat ramps but questioned “when’s the last time that signage was updated?” Management of AIS was considered to be “a black hole for a general boater” and **there was a strong desire for more information.**

Another key barrier to performing remove-drain-dry behavior was **lack of boat wash infrastructure.** Recreationists expressed a need for wash-down stations and external cleaning tools to be available at boat ramps. A similar concern was a need for designated space at boat ramps to perform remove-drain-dry tasks. One participant commented that there is “Not enough space provided at launch ramp or access point to pull over and conduct remove-drain-dry” while another cited pressure from other boaters to avoid “obstructing boat ramp area” while completing cleaning tasks. Weather (“poor weather conditions at time of taking boat out”) and physical ability (“limited ability to carry materials / equipment for thorough clean drain dry”), were also mentioned, which may be addressed by building shelters and staffing attendants at boat ramps.

An additional barrier that may partially be addressed by expanding infrastructure at boat ramps related to the convenience of performing AIS preventative behaviors. The **time required to complete remove-drain-dry** was highlighted. Recreationists believed the steps involved to be time consuming, stating that “expecting people to do more than maybe a few minutes’ worth of effort I think is a futile effort.” Participants noted that “after fishing, people are tired and keen to get off to the next thing.” Likewise, “people who are recreating normally have limited time and don’t plan for this activity.” It could be that expanding the footprint of boat washing stations would increase convenience, and in turn, washing of boats and equipment at boat ramps.

Benefits derived from preventing biological invasions

Given that our analysis of perceived threats resulted in three emergent themes of impacts on individuals, communities and ecosystems, the same framework was applied to organize results around the perceived benefits of remove-drain-dry behaviors. Despite less time spent discussing benefits of remove-drain-dry, participants highlighted a variety of positive outcomes they perceived. **Management agencies should raise awareness of the positive outcomes from recreational water users performing remove-drain-dry behavior.** It could be that water users are not motivated to perform behavior because they do not understand the consequences of inaction.

Benefits to the self were highlighted, in that participants believed they would derive advantages from completing remove-drain-dry. First, participants **emphasized the morality behind their decisions**, commenting that remove-drain-dry would be “doing the right thing” and allowing them “to be a responsible angler and boater.” Second, they noted that engaging in these prevention behaviors would **improve their knowledge of AIS issues** and enable them to “adequately understand risks and outcomes from improper management.” Finally, boat owners commented that performing remove-drain-dry would **help with boat maintenance**, citing “benefits to mechanical operations of boat/engine” given that draining their bilge water, for instance is “best practice for maintaining the longevity of your boat.”

Anglers, moreso than boaters, identified benefits to the broader community. Engaging in AIS prevention was believed to help **support the fishing community** by building a “sense of community and/or comradery among anglers and water users.” Anglers highlighted the importance of stewardship in **supporting the future generation**, both in terms of conserving the ecosystem and “keeping things clean for the next generation,” as well as “teaching others, especially young anglers, about the impact of our behaviors on the environment.

Given that participants had already discussed the risks of AIS to the environment in great detail, the conversation about environmental benefits of remove-drain-dry was fairly brief. No additional environmental benefits were recognized other than reducing the previously discussed risks of AIS to the environment. Thus, the most common environmental benefit cited was **being able to prevent the spread of AIS**. For instance, participants noted that remove-drain-dry would

“keep AIS in infected lakes and keeping un-infected lakes clear of AIS.” Several respondents also talked generally about **ecosystem preservation**, stating that remove-drain-dry would help with “preserving the ecosystem” and “not disturbing what took a long time” to develop. The less nuanced discussion on environmental benefits may be because participants felt they had already commented on relationships between AIS and the environment during the risk discussion. Alternatively, there may be an opportunity for messages to highlight the environmental benefits of remove-drain-dry in more detail to further stimulate interest in taking action.

In addition to providing valuable information on recreational water users perceptions of remove-drain-dry, these results informed survey development. Based on participants’ perceived benefits of remove-drain-dry that were shared during the focus groups, we developed survey questions that asked about benefits to individuals, benefits to the community, and benefits to the environment.

STATE-WIDE SURVEY

Study purpose

In response to results generated during focus groups conducted in the first phase of this project, a state-wide survey was administered in summer 2021. In preparation for this assessment, we conducted an online pilot test in May 2021. A total of 50 participants were recruited through a Qualtrics panel. The data generated from this online pilot survey were analyzed to modify the questionnaire. This feedback enabled us to: a) tune the wording of survey questions; b) diagnose any potential methodological problems (e.g., completion rates, item interpretation); and c) increase the likelihood of science transfer at the conclusion of the project in response to stakeholder needs and management concerns. The final questionnaire is presented in Appendix D.

Methodology

Data collection and sampling

During May-June 2021, we conducted an online survey of Illinois recreational water users using the Qualtrics platform. Respondents were recruited from an online panel and compensated for their participation. All respondents were at least 18 years old and lived in the state of Illinois.

Additionally, to take the survey, potential respondents had to meet at least one of the following screening requirements:

- Had gone fishing on at least one occasion since 2018
- Had participated in a recreational water activity (sailing, kayaking, canoeing, boating, jetskiing, etc.) on at least one occasion since 2018

Responses were discarded and replaced when participants did not complete the entire survey, failed at least one of two “attention check” questions (Kung et al., 2018) or had response patterns that indicated extreme inattention or possible use of bots. This process continued until a final sample size of 500 was attained.

Sampling bias assessment

Analyses were performed to test how well the data collected in this study (Golebie et al., 2021) represented the target population of recreational boaters and anglers in Illinois. Our sample was compared against past research that studied similar populations of recreational water users in Illinois to identify potential sources of bias that may have emerged from our sampling methods.

Previous research in Illinois has adopted a variety of methods and survey modes to engage recreational water users (see Table 1). For instance, van Riper et al. (2020) used mixed methods including mail-back survey with an online option to engage Illinois anglers who resided in counties adjacent to Lake Michigan, yielding a sample that was mostly male (94%), White (82%) and middle aged (54.3). Another study by van Riper et al. (2019) involved self-administered onsite surveys of water-users at the North Point Marina on Lake Michigan and Chain O’Lakes State Park, yielding a sample that was mostly male (76%), White (91%) and middle aged (48). Cole et al. (2016) relied exclusively on mail-back survey methods to study registered boat owners in 12 counties representing the Northeastern, Northwestern and Southern regions, also yielding a highly male (94%) and older sample (59). The survey mode adopted by Pradhananga et al. (2015) involved mail-back surveys of registered boat owners drawn from 91 out of 102 Illinois counties, excluding those in the Southernmost region. These authors generated a sample that was highly male (97%), White (98%) and middle aged (54). Finally, Burkett & Winkler (2018) conducted an analysis of Illinois Department of Natural Resources angler license data

from 2006-2015 to determine prevailing demographic trends, illustrating a user group that was predominately male as of 2015 (79%).

The present study involved the use of an online panel generated by Qualtrics and was therefore not constrained to water users that have appeared on previously compiled government lists such as registered anglers or boat owners. Most notably, the sample we generated included a large portion (59%) of female survey respondents. Previous research has shown that women report stronger environmental attitudes and are more likely to engage in pro-environmental behavior (Lynn & Longhi, 2011; Blankenberg & Alhusen, 2019), which supports our findings that respondents had high levels of biocentric values, environmental risk perceptions, and trust in regulatory institutions. Moreover, it could be that water users engaged in this study have had less contact with management agencies and thus may have missed messaging about AIS and best practices to mitigate their spread.

Table 1*Comparison with studies that used different sampling methods to study recreational water-users*

Variables	Golebie et al. (2021) n=507	van Riper et al. (2020) n=260	van Riper et al. (2019) n=104	Burkett & Winkler (2018) n=596,593	Cole et al. (2016) n=515	Pradhananga et al. (2015) n=760
<i>Age (M)</i>	45.4	54.3	48	-	59 (median)	54
<i>Gender (%)</i>						
Male	41	94	76	79	91	97
Female	59	6	24	21	8	3
<i>Education (%)</i>						
High school graduate	29	26	16	-	-	-
College degree or certificate	69	64	76	-	27	-
<i>Income (%)</i>						
Less than \$49,999	35	35	16	-	-	-
\$50,000 to \$99,999	32	28	26	-	-	-
\$100,000 or more	27	46	48	-	-	-
<i>Race (%)</i>						
White	86	82	91	-	-	98
Black or African American	8	2	0	-	-	-
<i>Descriptive statistics</i>						
Days Fished	11.6	27.2	-	-	-	-
Years Fished	21.5	37.7	-	-	-	-

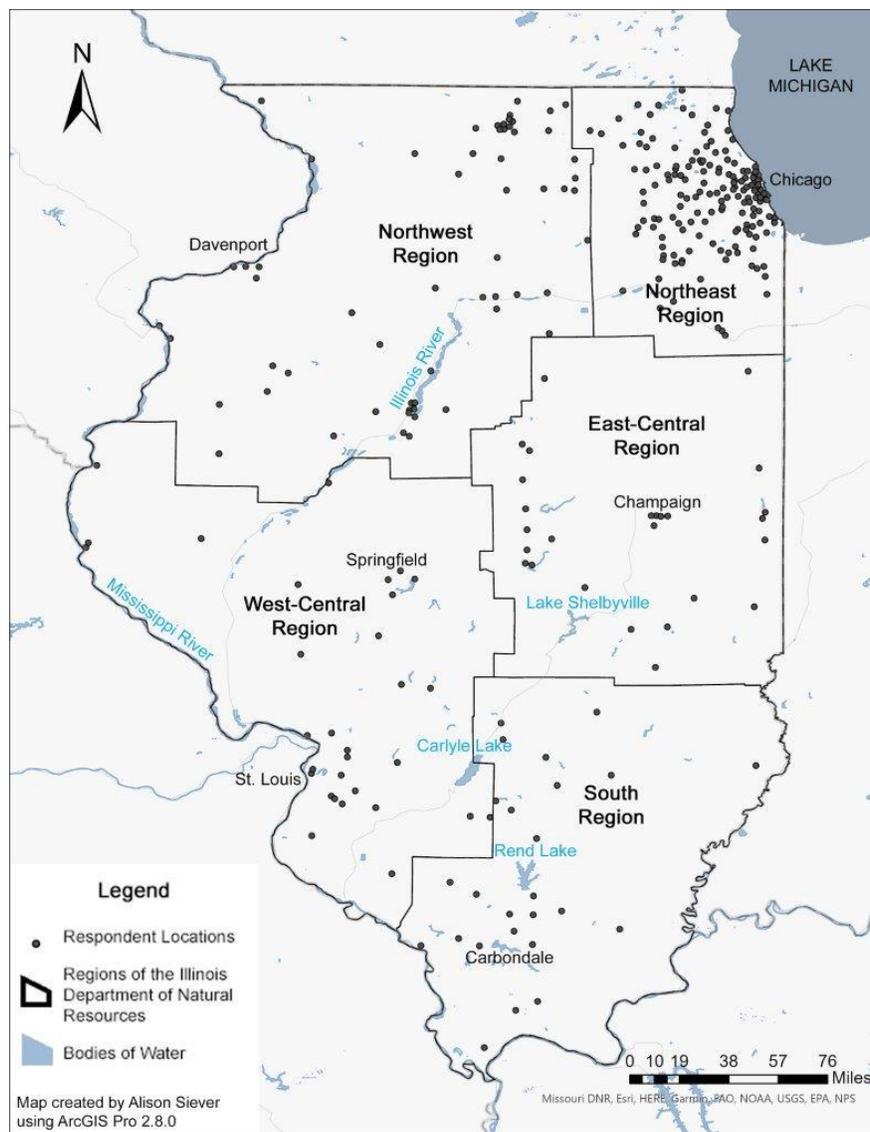
Note. Some columns may not add up to 100%*Note.* Some values are missing because of survey differences

Data entry and analysis of respondents across the state

All survey data were cleaned and analyzed by the research team following the collection facilitated by Qualtrics. Descriptive statistics and tests for normality were estimated in SPSS version 27, while more advanced modeling took place in R Studio packages. All survey data used were drawn from respondents who lived across the state of Illinois (see Figure 1).

Figure 1.

Graphical representation of the approximate locations of survey respondents



RESULTS FROM STATE-WIDE SURVEY

This section presents results using tables and figures, particularly frequency distributions for each variable included in the questionnaire. Data presented are typically valid percentages in each response category (i.e., percentages excluding missing values). Descriptive statistics, such as mean values and standard deviations are also included for appropriate variables. Per disciplinary standards within the environmental social sciences, Likert scale questions with five points or greater were treated as interval-level measures. Data are displayed for the pooled sample of survey respondents as well as subgroups defined by boat ownership.

Process for identifying subgroups and organizing research results

Boat ownership subgroups

All respondents ($N = 507$) were asked to report the type of boat or watercraft they owned (see Table 2). **Fishing boats were most common (24.5%), followed by canoes (15.4%), kayaks (13.0%), and powerboats (9.5%).** Approximately half of respondents (49.3%) did not own any type of boat; this included respondents who did not engage in any boating activities as well as respondents who engaged in boating activities but used watercraft that was borrowed or rented.

Table 2.

Boat ownership reported by recreational water users

Boat Types	Pooled sample N (%)
Does not own any type of boat	250 (49.3)
Fishing boat	124 (24.5)
Canoe	78 (15.4)
Kayak	66 (13.0)
Powerboat	48 (9.5)
Pontoon boat	34 (6.7)
Jetskiing	39 (7.7)
Sailboat	22 (4.3)
Other	6 (1.2)

Note. Respondents could check all that applied so column totals may not equal 100%.

Based on responses to the boat ownership question, we identified 258 respondents who own a boat or other watercraft. Of the remaining 250 who reported not owning a boat, we examined their responses to questions about their angling and boating activities and identified 54 respondents who were exclusively shoreline or wading anglers that did not report any boat or watercraft use, along with 195 respondents that reported borrowing or renting boats for

recreational activities. This delineation approach resulted in three subgroups: boat owners ($N=258$), boat renters / borrowers ($N=195$), and non-boat users ($N=54$). This approach to segmenting the survey sample was adopted due to the managerial relevance of these subgroups, the different strategies that would be needed to reach these groups, and empirical differences that emerged through exploratory analyses.

Descriptive Information about Recreational Water Users

History of fishing participation

All respondents who reported having gone fishing at least once from 2018 through 2020 ($N = 390$) were asked to provide information on their fishing activities (see Table 3). Respondents spent an average of 11.60 days fishing during 2020 and reported an average of 21.46 years of fishing experience. Both days fished and years fished were right skewed (skewness = 4.278, 0.828). Therefore, graphical representations of survey data were generated (see Figure 2, Figure 3). Reported fishing skill was normally distributed with anglers reporting that their fishing skills were slightly lower than “average” ($M = 2.93$, $SD = 0.96$). A majority of surveyed anglers (73.6%) reported purchasing a fishing license between 2018 and 2020.

Table 3.

Previous experiences and self-reported skill levels among recreational anglers

Previous experience	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers/ M (SD)	Non-boat users M (SD)
Total number of days fishing in 2020	11.60 (19.97)	15.73 (23.90) ^a	6.32 (11.59) ^b	7.02 (12.7) ^b
Total number of years fishing ¹	21.46 (19.09)	19.27 (17.81) ^a	23.62 (20.37) ^a	25.33 (20.2) ^a
Fishing skills in comparison to other anglers ²	2.93 (0.96)	3.24 (0.93) ^a	2.55 (0.84) ^b	2.57 (0.90) ^b

¹Estimate included fishing activities in 2020

²Measured on a Likert scale ranging from 1 (Much lower than average) to 5 (Much higher than average)
Note. Like superscript indicates no significant differences at $p < 0.05$

Results from our subgroup comparison revealed that **boat owners were more likely to spend more days fishing in 2020 than boat renters/borrowers and non-boat users** ($F(2, 387) = 10.75$, $p < .001$). **Boat owners were also more likely to rate themselves as higher skilled**

compared to their peers than were boat renters/borrowers and non-boat users ($F(2, 387) = 28.4$, $p < .001$). Boat owners had fewer years of experience on average but not to a statistically significant degree ($F(2, 387) = 3.35$, $p > .05$).

Figure 2.

Total days fished in 2020 for recreational anglers across the state of Illinois

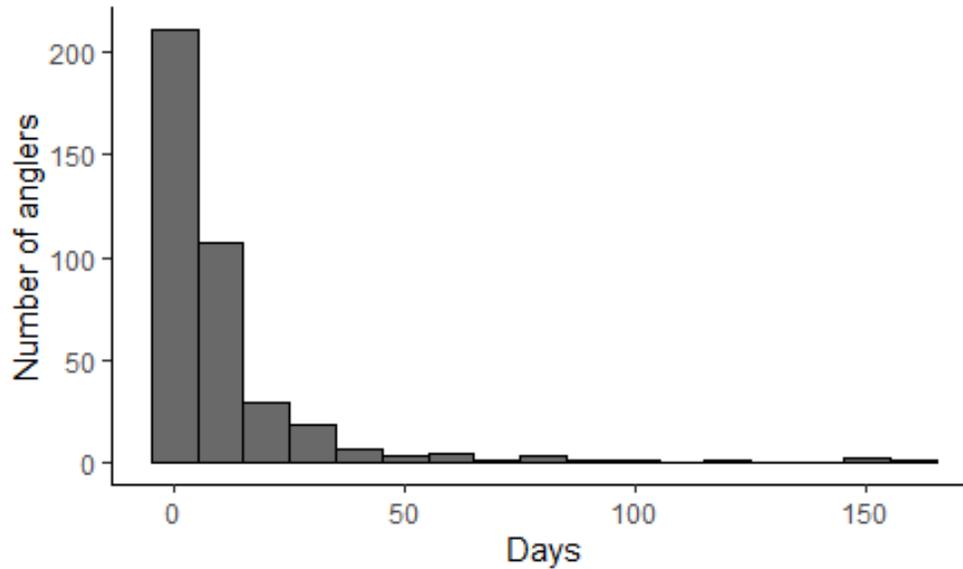
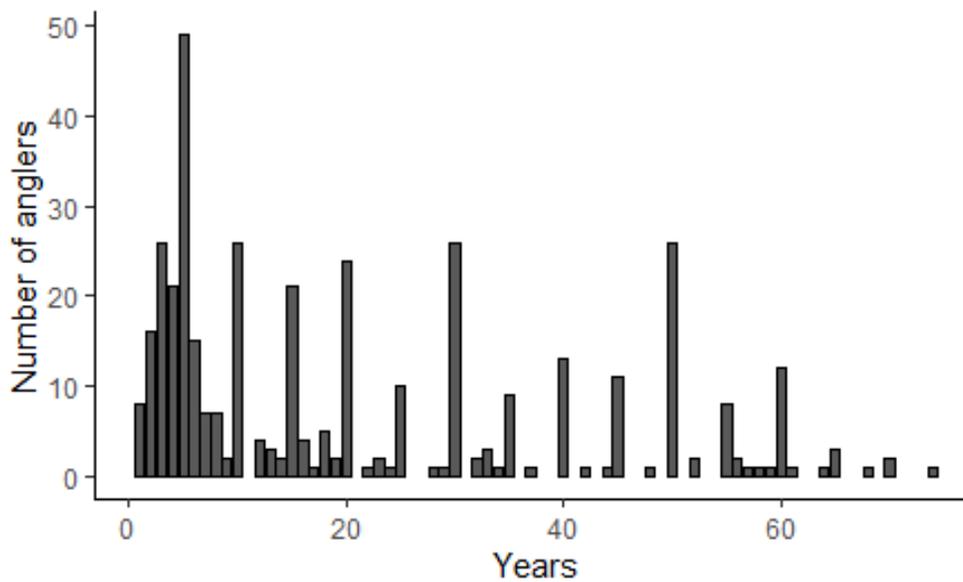


Figure 3.

Total years fished including 2021 for recreational anglers across the state of Illinois



Recreational anglers were asked to report the location where most of their fishing activities occurred, including shoreline, boat, wading, or multiple locations (see Table 4). **Fishing from the shoreline was more common (47.7%) than fishing from a boat (23.8%).** Wading was represented by a small number of respondents (2.8%). Approximately 25.6% of respondents reported fishing in multiple types of settings with equal frequency, most commonly fishing from both boats and shorelines (16.7%).

Table 4.

Primary location of fishing activities

Fishing location	Pooled sample N (%)	Boat owners N (%)	Boat renters/ borrowers N (%)	Non-boat users N (%)
Shoreline only	186 (47.7)	70 (32.6)	63 (52.1)	53 (98.1)
Boat only	93 (23.8)	70 (32.6)	23 (19.0)	0 (0.0)
Wading in shallow water (e.g., fly fishing) only	11 (2.8)	8 (3.7)	2 (1.7)	1 (1.9)
More than one location ¹				
Boat and shoreline	65 (16.7)	38 (14.7)	27 (13.8)	0 (0.0)
Boat and wading	1 (0.3)	1 (0.4)	0 (0.0)	0 (0.0)
Shoreline and wading	6 (1.5)	4 (1.6)	2 (1.0)	0 (0.0)
Boat, shoreline, and wading	28 (7.2)	24 (9.3)	4 (2.1)	0 (0.0)

¹If respondents indicated they fished in more than one location, they were asked to clarify which locations they fished at most often.

Recreational anglers **reported a wide variety of species targeted** (see Table 5). The most commonly targeted species were catfish (56.4%), bluegill (46.9%), crappie (35.9%), and largemouth bass (35.9%).

Table 5.

All species targeted by recreational water users

Species	Pooled sample N (%)	Boat owners N (%)	Boat renters/ borrowers N (%)	Non-boat users N (%)
Catfish	220 (56.4)	125 (48.4)	60 (30.8)	35 (64.8)
Bluegill	183 (46.9)	98 (38.0)	52 (26.7)	33 (61.1)
Crappie	140 (35.9)	80 (31.0)	39 (20.0)	21 (38.9)
Largemouth bass	140 (35.9)	72 (27.9)	46 (23.6)	22 (40.7)
Smallmouth bass	112 (28.7)	60 (23.3)	39 (20.0)	13 (24.1)
Lake trout	109 (27.9)	65 (25.2)	29 (14.9)	15 (27.8)
Walleye	99 (25.4)	57 (22.1)	32 (16.4)	10 (18.5)
Carp	68 (17.4)	49 (19.0)	13 (6.7)	6 (11.1)

Species	Pooled sample N (%)	Boat owners N (%)	Boat renters/ borrowers N (%)	Non-boat users N (%)
Yellow perch	65 (16.7)	32 (12.4)	24 (12.3)	9 (16.7)
Northern pike	58 (14.9)	32 (12.4)	20 (10.3)	6 (11.1)
Whitefish	54 (13.8)	42 (16.3)	9 (4.6)	3 (5.6)
White bass	53 (13.6)	39 (15.1)	9 (4.6)	5 (9.3)
Rainbow trout / steelhead	45 (11.5)	30 (11.6)	7 (3.6)	8 (14.8)
Atlantic salmon	43 (11.0)	36 (14.0)	6 (3.1)	1 (1.9)
Brook trout	36 (9.2)	29 (11.2)	3 (1.5)	4 (7.4)
Muskie	35 (9.0)	28 (10.9)	6 (3.1)	1 (1.9)
Brown trout	26 (6.7)	20 (7.8)	4 (2.1)	2 (3.7)
Chinook / king salmon	21 (5.4)	19 (7.4)	2 (1.0)	0 (0.0)
Coho salmon	23 (5.9)	22 (8.5)	1 (0.5)	0 (0.0)
Drum / sheepshead	17 (4.4)	15 (5.8)	1 (0.5)	1 (1.9)
Gar	10 (2.6)	10 (3.9)	0 (0.0)	0 (0.0)
Other	15 (3.8)	3 (1.2)	11 (5.6)	1 (1.9)

Note. Column totals may not equal 100% because respondents were asked to check all that applied

History of boating participation

All respondents who reported having gone boating at least once in the past two years ($N = 425$) were asked to provide information on their boating activities (see Table 6). Boating was defined broadly, thus respondents were asked to share what types of boating activities they had engaged in since 2018. **A majority of these respondents (69.2%) reported engaging in boating, with smaller proportions participating in canoeing (29.9%) and kayaking (29.4%).**

Table 6.

Recreational activities reported by water users

Recreation type	Pooled sample N (%)	Boat owners N (%)	Boat renters/ borrowers N (%)	Non-boat users N (%)
Boating	294 (69.2)	170 (65.9)	124 (63.6)	-
Canoeing	127 (29.9)	98 (38)	29 (14.9)	-
Kayaking	125 (29.4)	75 (29.1)	50 (25.6)	-
Jetskiing	81 (19.1)	57 (22.1)	24 (12.3)	-
Sailing	68 (16.0)	50 (19.4)	18 (9.2)	-
Other	28 (6.6)	9 (3.5)	19 (9.7)	-

Note. Respondents could check all that applied so column totals may not equal 100%.

Note. Cells with hyphens indicate data are not applicable

Respondents were also asked which activity they participated in most frequently (see Table 7).

Boating (57.0%) and kayaking (16.2%) were the most commonly identified activities for the

pooled sample, and similar patterns emerged for the relevant subgroups of survey respondents. Additional popular activities reported were canoeing, sailing, jetskiing, and “other.”

Table 7.

Most frequent recreational activities

Recreation type	Pooled sample N (%)	Boat owners N (%)	Boat renters/ borrowers N (%)	Non-boat users N (%)
Boating	225 (57.0)	117 (45.3)	108 (63.2)	-
Kayaking	64 (16.2)	37 (14.3)	27 (15.8)	-
Canoeing	38 (9.6)	29 (11.2)	9 (5.3)	-
Sailing	28 (7.1)	20 (7.8)	8 (4.7)	-
Jetskiing	17 (4.3)	15 (5.8)	2 (1.2)	-
More than one activity	3 (0.8)	1 (0.4)	2 (1.2)	-
Other	20 (5.1)	5 (1.9)	15 (8.8)	-

Note. Respondents who reported engaging in “other” activities listed floating, rafting, paddle boarding, swimming, water skiing, and tubing.

Note. Cells with hyphens indicate data are not applicable

Recreational water users spent an average of 9.71 days engaging in their preferred recreational activity during 2020 and reported an average of 14.97 years of experience with that activity (see Table 8; Figure 4; Figure 5). Both days fished and years fished were right skewed (skewness = 4.126, 1.482). Reported skill was more normally distributed (skewness = -0.179) and respondents reported their skills were “average” ($M = 3.02$, $SD = 0.94$).

Table 8.

Previous experiences and self-reported skill levels among recreational water users

Previous experience	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
Total number of days boating in 2020	9.71 (15.96)	13.72 (19.40)	4.46 (6.88)	-
Total number of years boating ¹	14.97 (14.77)	15.02 (14.55)	14.91 (15.08)	-
Boating skills in comparison to other boaters ²	3.02 (0.94)	3.36 (0.84)	2.57 (0.87)	-

¹Estimate included boating activities in 2021

²Measured on a Likert scale ranging from 1 (Much lower than average) to 5 (Much higher than average)

Note. Cells with hyphens indicate data are not applicable

Figure 4.

Total days of activity in 2020 for recreational water users across the state of Illinois

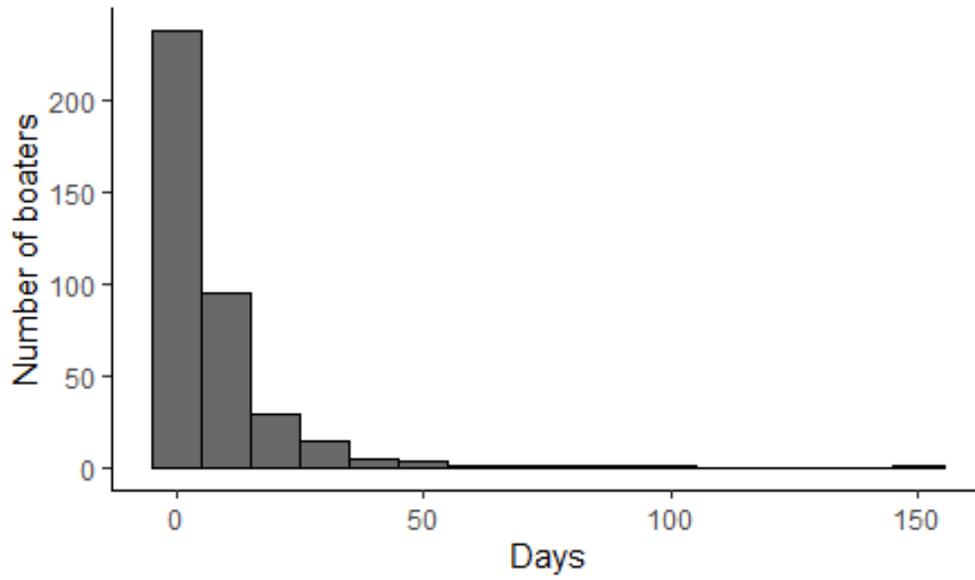
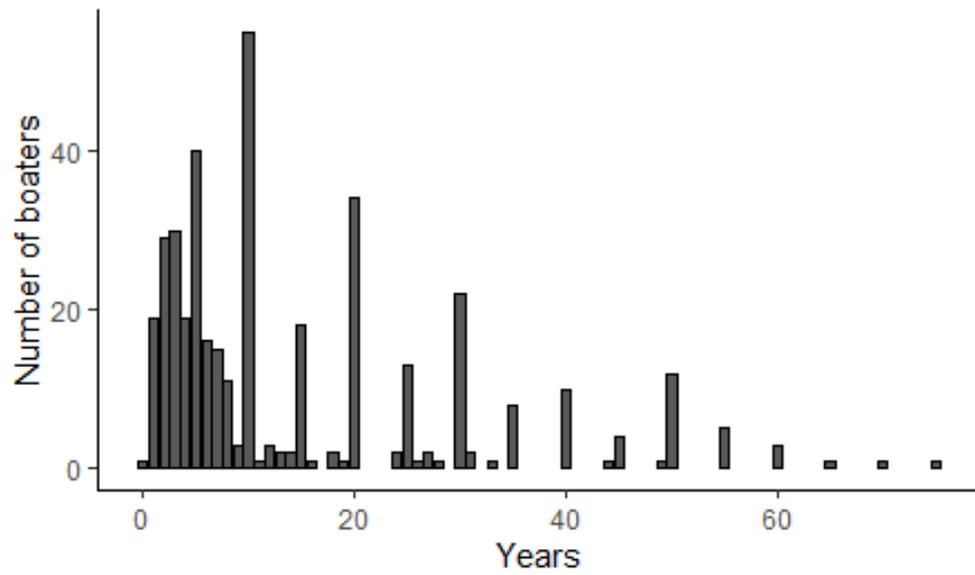


Figure 5.

Total years of experience including 2021 for recreational water users across the state of Illinois



For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, their risk of spreading AIS (Table 9). **Almost half of respondents (44.4%) transported their watercraft between sites, and a similar proportion (44.6%) kept their watercraft at one waterbody for the entire season.** An additional 12% of respondents listed “other,” most commonly reporting that they did not own their watercraft and were unaware of possible transportation activities.

Table 9.

Mobility of watercraft among fishing sites

Watercraft transportation	Pooled sample N (valid %)
Docked or moored at one location for a season	194 (44.6)
Trailer between fishing sites	189 (43.4)
Other ¹	52 (12.0)

¹The most commonly stated reason for respondents selecting “other” was that they borrowed or rented their watercraft and were unaware of possible transit activities

Knowledge, familiarity, and involvement with aquatic invasive species

A large body of previous research has focused on understanding awareness of AIS among recreational water users and used a variety of methods to do so. We evaluated the knowledge of survey respondents through a quiz that asked respondents to identify whether six organisms, referred to by their common names, were classified as invasive. Total number of correct answers for each respondent were added, resulting in a total knowledge score. Results showed that survey respondents had **relatively low knowledge of which aquatic species were invasive** (see Table 10), indicating a limited ability to recognize common names of some AIS. On average, respondents were able to correctly identify two out of six species as either invasive or not invasive. Most identified Asian carps, such as the silver carp (*Hypophthalmichthys molitrix*), as an invasive species; however, a majority were unsure whether rusty crayfish (*Orconectes rusticus*), hydrilla (*Hydrilla verticillate*), or spiny waterflea (*Bythotrephes longimanus*) were considered invasive. In a comparison across subgroups, **boat owners were more likely to correctly identify AIS in Illinois than boat renters/borrowers and non-boat users** ($F(2, 503) = 17.80, p < .001$).

Table 10.

Knowledge indicated by ability to identify AIS. Percent of respondents correctly identifying each species as invasive or native is shown.

	Pooled Sample (N=507)	Boat owners (N=258)	Boat renters/ borrowers (N=195)	Non-boat users (N=54)
Total knowledge score¹ (M, SD)	(2.11, 1.42)	(2.46, 1.48)²	(1.69, 1.26)	(2.11, 1.42)
Respondents correctly identifying each species N (%)				
Asian carps (invasive)	355 (70.0)	173 (67.1)	141 (72.7)	41 (75.9)
Spiny waterflea (invasive)	168 (33.1)	111 (43.0)	46 (23.6)	11 (20.4)
Rusty crayfish (invasive)	128 (25.2)	92 (35.7)	30 (15.4)	6 (11.1)
Hydrilla (invasive)	121 (23.9)	84 (32.6)	25 (12.8)	12 (22.2)
Channel catfish (native)	212 (41.8)	113 (43.8)	70 (35.9)	29 (53.7)
Gizzard shad (native)	82 (16.2)	61 (23.6)	15 (7.7)	6 (11.1)

¹Score was created by adding the number of correct responses; 0 = no correct responses and 6 = all correct responses

²Boat owners had significantly higher knowledge than the other two groups ($F(2, 503) = 17.80, p < .001$).

To further examine the awareness among recreational water users, respondents were asked to report their level of familiarity with ecosystems, recreational experiences, and management related to AIS (see Table 11), to align with sources of knowledge assessed in past work (van Riper et al. 2020). This approach to measuring familiarity was reliable given high internal consistency that was measured using a “Cronbach’s alpha coefficient” that ranged from 0 – 1. Values above .6 were deemed acceptable in this study, and this applied to the questions that indicated familiarity with ecosystems ($\alpha = .888$), recreational experiences ($\alpha = .913$), and management ($\alpha = .924$). We also confirmed that the relationships among these groupings of survey questions were more closely related with one another than with the broader types of familiarity we were trying to understand by estimating factor loading scores.

On average, **respondents were slightly to somewhat familiar** with ecological conditions ($M = 2.78, SD = 1.11$), ways that recreationists can cause impacts ($M = 2.66, SD = 1.21$), and the role of fishery management agencies ($M = 2.46, SD = 1.18$).

Table 10.*Familiarity with topics related to aquatic invasive species*

Familiarity¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Familiarity with ecological conditions</i>	2.78 (1.11)	3.15 (1.22)^a	2.37 (0.96)^b	2.51 (1.08)^b
The biological characteristics that make a species “invasive”	2.82 (1.25)	3.18 (1.23)	2.42 (1.16)	2.56 (1.21)
Names of species that are considered invasive	2.55 (1.18)	2.98 (1.21)	2.07 (0.93)	2.28 (1.09)
Ways that invasive species affect the environment	2.97 (1.25)	3.30 (1.22)	2.62 (1.17)	2.69 (1.23)
<i>Familiarity with impacts from recreation</i>	2.66 (1.21)	3.08 (1.30)^a	2.19 (1.07)^b	2.36 (1.08)^b
How boaters and anglers can spread invasive species	2.78 (1.32)	3.17 (1.28)	2.35 (1.26)	2.46 (1.19)
Types of actions you can take to prevent invasive species from spreading	2.67 (1.27)	3.03 (1.26)	2.25 (1.16)	2.43 (1.16)
How to complete recommended preventative actions	2.54 (1.34)	3.04 (1.35)	1.97 (1.09)	2.20 (1.20)
<i>Familiarity with management</i>	2.46 (1.18)	2.88 (1.27)^a	2.02 (1.04)^b	2.04 (1.04)^b
Agencies that are responsible for managing invasive species	2.51 (1.25)	2.91 (1.25)	2.11 (1.11)	2.09 (1.10)
Management actions that reduce invasive species impacts	2.47 (1.29)	2.89 (1.27)	2.02 (1.16)	2.07 (1.18)
The current state of invasive species management at your most frequented waterbody	2.40 (1.28)	2.85 (1.30)	1.93 (1.09)	1.96 (1.03)

Fit statistics: $\chi^2=156.421$, $df=24$, $p<.001$; $CFI=.970$; $TLI=.955$; $RMSEA=.104$, $SRMR=.029$

¹Measured on a Likert scale ranging from 1 (Not at all familiar) to 5 (Extremely familiar)

Note. Like superscript indicates no significant differences at $p < 0.05$

Boat owners expressed the most familiarity as compared to boat renters/borrowers and non-boat users in each category, including ecological conditions ($F(2, 504) = 33.02$, $p < .001$), impacts from recreation ($F(2, 504) = 36.33$, $p < .001$), and management ($F(2, 504) = 45.98$, $p < .001$). The higher knowledge and familiarity of boat owners may be related to increased exposure to the AIS messaging since they engage in boating and fishing more often than the other groups. Non-boat users exclusively participated in shoreline or wading angling, and thus likely had less exposure to AIS messaging.

Similar to the approach taken to evaluate familiarity, the involvement levels of recreational water users were examined by asking respondents four different questions. These four questions reflected the concept of involvement, which was defined as belief that the topic of AIS management is inherently important and/or consequential for an individual’s life (Quick and Stephenson, 2007). This approach was reliable given high internal consistency of the scale ($\alpha = .832$), acceptable factor loading scores and good model fit. Results showed the **pooled sample had moderate levels of involvement** (see Table 12). Boat owners were more likely to be highly involved than both boat renters/borrowers and non-boat users ($F(2, 504) = 37.76, p < .001$).

Table 11.

Levels of involvement reported by recreational water users

Involvement¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Involvement</i>	3.04 (0.89)	3.35 (0.85)^a	2.70 (0.85)^b	2.75 (0.64)^b
The spread of aquatic invasive species is a personally relevant topic for me	3.41 (0.95)	3.64 (0.94)	3.19 (0.97)	3.11 (0.63)
I think about aquatic invasive species a great deal	2.85 (1.11)	3.21 (1.12)	2.45 (1.00)	2.59 (0.84)
I find myself bringing up aquatic invasive species in casual conversation	2.54 (1.18)	2.90 (1.22)	2.14 (1.05)	2.26 (0.92)
When aquatic invasive species come up in conversation I “tune in”	3.34 (1.11)	3.65 (1.01)	3.02 (1.14)	3.04 (1.05)

Fit statistics: $\chi^2=49.624, df=2, p<.001$; CFI=.943; TLI=.829; RMSEA=.217, SRMR=.044

¹Measured on a Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree)

Note. Like superscript indicated no significant differences at $p < 0.05$

Primary information sources

Recreational water users included in this study believed that **a variety of sources provided trustworthy information** about AIS (see Table 13). Environmental groups ($M = 3.99, SD = 1.02$) and members of boating or angling clubs ($M = 3.70, SD = 0.97$) were perceived to be the most trustworthy, whereas government employees ($M = 3.10, SD = 1.07$) and sales associates at boating or fishing stores ($M = 3.18, SD = 1.07$) were perceived to be the least trustworthy. The higher perceived reliability of environmental groups ($t(503)=-15.603, p=.011$) and other anglers ($t(504)=5.617, p<.001$) versus government employees was supported by paired sample t-tests. Thus, information is more likely to be well-received if coming from environmental groups or disseminated through boating or angling clubs, rather than through official government reports.

Table 12.

Sources of information that Illinois recreational water users trust for information about aquatic invasive species

Source¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
Environmental groups	3.88 (1.02)	3.93 (1.02)	3.87 (1.02)	3.72 (1.00)
Members in boating or angling clubs	3.70 (0.97)	3.92 (0.90)	3.45 (1.04)	3.59 (0.86)
Charter captains	3.55 (1.00)	3.72 (0.98)	3.33 (1.02)	3.54 (0.91)
Bait shop vendors	3.50 (0.98)	3.65 (1.00)	3.28 (0.94)	3.59 (0.90)
Volunteers	3.45 (0.94)	3.62 (0.95)	3.33 (0.90)	3.09 (0.85)
Other anglers	3.40 (0.95)	3.56 (0.97)	3.18 (0.93)	3.43 (0.77)
Family members, friends, or neighbors	3.36 (1.00)	3.54 (0.99)	3.11 (0.98)	3.39 (0.90)
Sales associates at boating or fishing stores	3.18 (1.07)	3.41 (1.08)	2.87 (0.99)	3.17 (1.02)
Government employees	3.10 (1.07)	3.28 (1.08)	2.92 (1.09)	2.83 (1.08)

¹Measured on a Likert scale where 1 = “Not at all trustworthy” and 5 = “Extremely trustworthy”.

Recreational water users reported **many useful information channels for learning about AIS** (see Table 14). Species identification cards ($M = 4.03$, $SD = 0.98$) and booths at sport or fishing shows ($M = 4.02$, $SD = 0.96$) were reported to be the most useful. Other highly useful sources included internet websites ($M = 3.87$, $SD = 0.98$), brochures and fact sheets ($M = 3.85$, $SD = 0.98$), educational exhibits or displays ($M = 3.83$, $SD = 0.95$), and outreach activities at boat launches ($M = 3.83$, $SD = 1.02$).

Table 13.

Useful information channels for Illinois recreational water users to learn about aquatic invasive species

Channel¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
Species identification cards	4.03 (0.98)	4.04 (0.98)	4.02 (0.95)	4.06 (1.05)
Booths at a sports or fishing show	4.02 (0.96)	4.14 (0.93)	3.88 (1.02)	3.93 (0.84)
Internet websites	3.87 (0.98)	3.98 (0.96)	3.75 (1.00)	3.76 (0.95)
Brochures and fact sheets	3.85 (0.98)	3.92 (0.97)	3.78 (0.99)	3.81 (0.99)
Educational exhibits or displays	3.83 (0.95)	3.98 (0.91)	3.62 (0.99)	3.89 (0.79)
Outreach activities at boat launches	3.83 (1.02)	3.98 (1.00)	3.71 (1.00)	3.56 (1.02)
YouTube videos	3.70 (1.09)	3.87 (1.05)	3.51 (1.07)	3.54 (1.19)
Television news or programs	3.61 (1.04)	3.77 (1.07)	3.39 (0.99)	3.59 (0.92)

Channel ¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
Social media posts (Facebook, Twitter, etc.)	3.51 (1.18)	3.73 (1.14)	3.28 (1.16)	3.28 (1.28)
Television public service announcements	3.51 (1.13)	3.72 (1.11)	3.24 (1.12)	3.46 (1.06)
Newspaper, magazine, or newsletter articles	3.48 (1.08)	3.65 (1.08)	3.25 (1.07)	3.48 (1.04)
Public meetings regarding natural resources	3.35 (1.16)	3.55 (1.21)	3.10 (1.05)	3.24 (1.12)
Radio public service announcements	3.35 (1.17)	3.62 (1.13)	3.03 (1.13)	3.15 (1.14)
Radio news or programs	3.30 (1.13)	3.53 (1.11)	3.05 (1.09)	3.13 (1.12)
Workshops on aquatic invasive species prevention	3.29 (1.14)	3.51 (1.16)	3.01 (1.11)	3.30 (0.94)
Scholarly articles	3.25 (1.17)	3.45 (1.19)	3.01 (1.09)	3.13 (1.20)

¹Measured on a Likert scale where 1 = “Not at all useful” and 5 = “Extremely useful”.

Socio-demographic characteristics

Survey respondents were mostly White (86.0%), with an average age of 45.36 ($SD = 17.72$) (see Table 15, Figure 6). A total of 59.1% of respondents were women. A variety of education experiences were reported as 29.0% earned a high school diploma, another 29.0% held a two-year college degree, and an additional 19.9% earned a graduate degree. Just over half (54.2%) reported earning less than \$75,000 each year before taxes. Boat renters and borrowers reported higher levels of education and income than non-boat users.

Figure 6.

Age of survey respondents included in this research

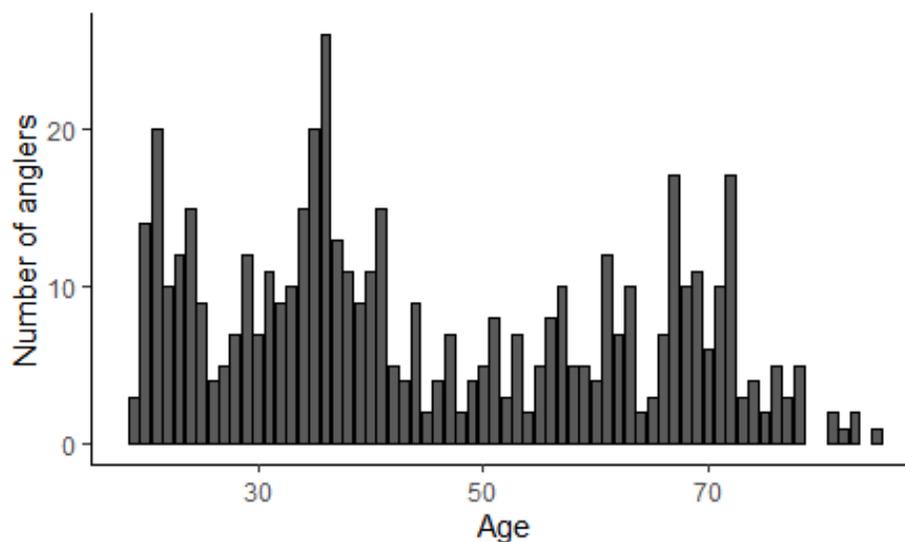


Table 145.*Socio-demographic profile of recreational water users included in this research*

Variables	Pooled sample N (%)	Boat owners N (%)	Boat renters/ Borrowers N (%)	Non-boat users N (%)
<i>Age [M, SD]</i>	[45.36, 17.72]	[41.60, 15.8]	[48.02, 19.00]	[53.72, 17.20]
<i>Gender</i>				
Male	206 (40.6)	115 (44.6)	69 (35.4)	22 (40.7)
Female	299 (59.1)	143 (55.4)	125 (64.1)	31 (57.4)
Other	1 (0.2)	0 (0.0)	0 (0.0)	1 (1.9)
<i>Education</i>				
Some high school	10 (2.0)	5 (1.9)	1 (0.5)	4 (7.4)
High school graduate or GED	147 (29.0)	70 (27.1)	57 (29.2)	20 (37.0)
Two-year college degree	81 (16.0)	36 (14.0)	33 (16.9)	12 (22.2)
Bachelor's degree	147 (29.0)	83 (32.2)	51 (26.2)	13 (24.1)
Professional certificate	21 (4.1)	9 (3.5)	9 (4.6)	3 (5.6)
Graduate degree	101 (19.9)	55 (21.3)	44 (22.6)	2 (3.7)
<i>Income</i>				
Less than \$24,999	74 (14.6)	30 (11.6)	31 (15.9)	13 (24.1)
\$25,000 to \$49,999	105 (20.7)	45 (17.4)	39 (20.0)	21 (38.9)
\$50,000 to \$74,999	96 (18.9)	46 (17.8)	42 (21.5)	8 (14.8)
\$75,000 to \$99,999	67 (13.2)	32 (12.4)	29 (14.9)	6 (11.1)
\$100,000 to \$124,999	50 (9.9)	34 (13.2)	14 (7.2)	2 (3.7)
\$125,000 to \$149,999	38 (7.5)	27 (10.5)	11 (5.6)	0 (0.0)
\$150,000 or more	50 (9.9)	19 (7.4)	14 (7.2)	2 (3.7)
Prefer not to answer	27 (5.3)	10 (3.9)	15 (7.7)	2 (3.7)
<i>Race¹</i>				
White	436 (86.0)	221 (85.7)	168 (86.2)	47 (87.0)
Asian	20 (3.9)	8 (3.1)	9 (4.6)	3 (5.6)
Black or African American	39 (7.7)	26 (10.1)	10 (5.1)	3 (5.6)
Native Hawaiian or other Pacific Islander	1 (0.2)	1 (0.4)	0 (0.0)	0 (0.0)
American Indian or Alaska Native	7 (1.4)	1 (0.4)	4 (2.1)	2 (3.7)
Other	11 (2.2)	4 (1.6)	6 (3.1)	1 (1.9)

¹Respondents could check all that applied so column totals may not equal 100%.

Factors contributing to AIS-prevention behaviors

The *Be A Hero* program encourages recreational water users to take action to prevent the spread of AIS. Survey respondents were asked how often they intend to participate in these types of behaviors over the course of the next year (see Table 16). Specifically, intended behaviors related to two transportation vectors, boats and fishing equipment, were assessed in line with past work (Cole et al. 2016). Survey questions were drawn from Pradhananga et al. (2015) and modified according to the current goals of the Be A Hero program. Only participants who

reported boating were asked about prevention of AIS via boats, and only respondents who reported fishing were asked about prevention of AIS via fishing equipment. Intentions to engage in behaviors were high for both the boating vector ($M = 3.99$, $SD = 1.00$) and fishing equipment vector ($M = 4.12$, $SD = 0.87$), meaning that most survey respondents intend to complete the recommended behaviors “most of the time.” There were no statistically significant differences between groups in the expressed intention to engage in preventative behavior related to fishing equipment ($F(2, 387) = 1.08$, $p = .339$) or boating equipment ($F(1, 445) = 3.263$, $p = .072$).

Table 16.

Behaviors that recreational water users intend to perform in the next 12 months

Intended Behavior	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Preventing transport via boats¹</i>	3.99 (1.00)	4.06 (0.90)	3.89 (1.12)	-
Drain all standing water from the boat	4.10 (1.22)	4.14 (1.15)	4.04 (1.32)	-
Conduct visual inspections of boats for invasive species	3.90 (1.28)	3.95 (1.19)	3.83 (1.40)	-
Remove plants, animals, and mud from the boat	4.18 (1.13)	4.25 (1.02)	4.10 (1.26)	-
Rinse boat and trailer	3.98 (1.19)	4.05 (1.15)	3.88 (1.23)	-
Wipe down hull with a towel	3.77 (1.28)	3.90 (1.22)	3.61 (1.34)	-
Allow boat to dry before entering a different body of water	3.99 (1.25)	4.07 (1.18)	3.88 (1.33)	-
<i>Preventing transport via fishing equipment²</i>	4.12 (0.87)	4.16 (0.87)^a	4.18 (0.84)^a	3.97 (0.96)^a
Remove any non-bait fish, plants, and other “hitchhikers” from bait bucket	4.19 (1.06)	4.15 (1.06)	4.31 (.958)	4.02 (1.26)
Dispose of unused live bait in the trash	4.11 (1.19)	4.10 (1.15)	4.21 (1.20)	3.93 (1.33)
Drain water from bait bucket before moving to another waterbody	4.12 (1.18)	4.11 (1.15)	4.25 (1.08)	3.87 (1.44)
Conduct visual inspections of fishing equipment for invasive species	4.08 (1.15)	4.08 (1.16)	4.13 (1.09)	3.94 (1.24)
Remove plants, animals, and mud from fishing equipment	4.35 (0.96)	4.33 (.97)	4.38 (.906)	4.33 (1.03)
Rinse fishing equipment	4.06 (1.10)	4.07 (1.08)	4.12 (1.08)	3.92 (1.24)
Wipe down fishing equipment with a towel	3.88 (1.25)	3.93 (1.24)	3.84 (1.21)	3.80 (1.34)
Allow fishing equipment to dry before fishing in a different body of water	4.14 (1.10)	4.14 (1.11)	4.22 (1.00)	3.96 (1.23)

Fit statistics: $\chi^2=710.805$, $df=76$, $p<.001$; $CFI=.843$; $TLI=.812$; $RMSEA=.128$, $SRMR=.064$

¹Measured on a Likert scale where 1 = “Never” and 5 = “Every time I go boating”.

²Measured on a Likert scale where 1 = “Never” and 5 = “Every time I go fishing”.

Note. Like superscript indicates no significant differences at $p < 0.05$

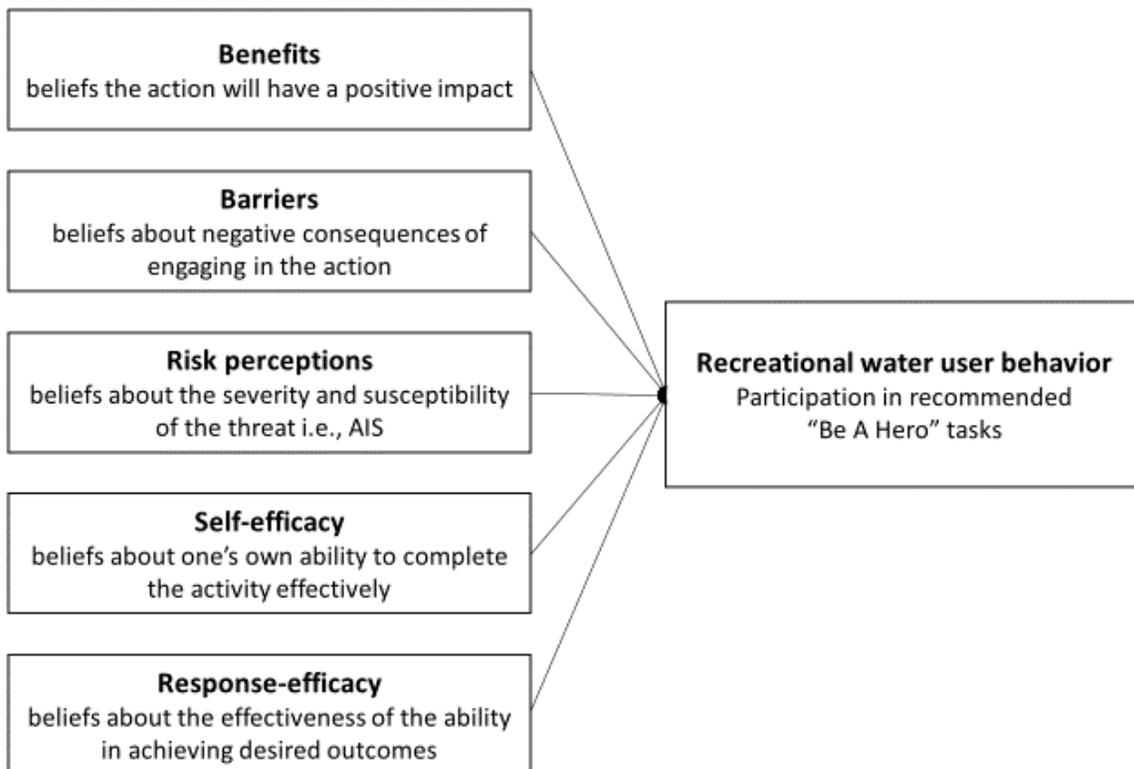
Note. Cells with hyphens indicate data are not applicable

Short-term drivers of behavior

Reasons that recreational water users participate in **AIS-prevention behaviors can be understood through The Health Belief Model** (Rosenstock, 1974). The Health Belief Model considers the role of benefits, barriers, risk perceptions, and efficacy in predicting desirable behaviors like those performed by recreational water users (see Figure 7). Therefore, this study sought to assess each of these variables among recreational water users and understand their relevance in predicting AIS-prevention behaviors in Illinois waterways.

Figure 7.

Relevant variables for predicting recreational water user participation in behaviors that minimize the spread of aquatic invasive species, according to the Health Belief Model.



The first key concept from the Health Belief Model that was tested in this study pertained to benefits, defined as beliefs about the positive outcomes resulting from AIS prevention behaviors.

The survey questions about benefits were derived from focus group data and measured using multiple questions, as is a standard practice in the environmental social sciences. Results of a confirmatory factor analysis showed good model fit and reliability across three types of benefits to the: 1) self ($\alpha = .758$); 2) community ($\alpha = .809$); and 3) environment ($\alpha = .849$).

Perceived benefits to the environment ($M = 4.37, SD = 0.63$) were slightly higher than perceived benefits to the self ($M = 4.23, SD = 0.64; t(505)=7.111, p < .001$) and community ($M = 4.25, SD = 0.641; t(505) = 6.111, p < .001$) (see Table 17). **Non-boat users were less likely to identify benefits to the self than boat owners and boat renters/borrowers** ($F(2, 503) = 3.43, p = .033$). There were no statistically significant differences between groups in identification of benefits to the community ($F(2, 503) = 1.66, p = .191$) or environment ($F(2, 503) = 2.71, p = .068$).

Table 17.

Perceived benefits of taking action to prevent the spread of aquatic invasive species

Benefits	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Benefits to the self</i>	<i>4.23 (0.64)</i>	<i>4.25 (0.64)^a</i>	<i>4.26 (0.54)^a</i>	<i>4.01 (0.79)^b</i>
Increasing my own knowledge and understanding of the ecosystem	4.06 (0.85)	4.09 (0.85)	4.09 (0.81)	3.83 (0.97)
Improved maintenance of my boat or equipment	4.24 (0.74)	4.28 (0.77)	4.26 (0.67)	3.98 (0.84)
Knowing that I have done the right thing to be a responsible water user	4.37 (0.74)	4.37 (0.75)	4.42 (0.64)	4.22 (0.97)
<i>Benefits to the community</i>	<i>4.25 (0.64)</i>	<i>4.27 (0.64)^a</i>	<i>4.28 (0.59)^a</i>	<i>4.10 (0.83)^a</i>
A sense of community among water-based recreationists	4.09 (0.83)	4.12 (0.84)	4.10 (0.79)	3.93 (0.91)
Teaching younger generations about the impact of our behaviors on the environment	4.34 (0.73)	4.31 (0.76)	4.42 (0.63)	4.20 (0.90)
Preserving aquatic resources for my community	4.33 (0.70)	4.37 (0.69)	4.31 (0.65)	4.19 (0.89)
<i>Benefits to the environment</i>	<i>4.37 (0.63)</i>	<i>4.40 (0.61)^a</i>	<i>4.38 (0.58)^a</i>	<i>4.18 (0.83)^a</i>
A healthier ecosystem	4.40 (0.70)	4.41 (0.70)	4.44 (0.63)	4.23 (0.91)
More sustainable populations of plants and animals	4.33 (0.72)	4.38 (0.72)	4.34 (0.67)	4.11 (0.86)
Better water quality	4.37 (0.74)	4.41 (0.72)	4.36 (0.72)	4.20 (0.87)

Fit statistics $\chi^2 = 110.556, df = 24, p < .001; CFI = .968; TLI = .952; RMSEA = .084, SRMR = .030$

Note. Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”.

Note. Like superscript indicates no significant differences at $p < 0.05$

The second concept from the Health Belief Model related to barriers that represented beliefs about the negative consequences of engaging in AIS-preventative behaviors. Results from focus groups were used to identify barriers. There were **low reported levels of perceived barriers across all recreational water users** ($M = 2.49$, $SD = 0.96$). There were no statistical differences in barriers between the three subgroups (see Table 18).

Table 18.

Perceived barriers to taking action to prevent the spread of aquatic invasive species

Barriers¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Barriers to taking action</i>	2.49 (0.96)	2.55 (1.08)	2.45 (0.80)	2.35 (0.86)
I do not have enough time to complete the recommended cleaning tasks that minimize the spread of invasive species	2.38 (1.14)	2.40 (1.21)	2.38 (1.03)	2.26 (1.14)
I feel pressure from other recreationists to leave the site without cleaning my boat or equipment	2.55 (1.21)	2.67 (1.31)	2.48 (1.07)	2.24 (1.10)
I lack the necessary equipment to effectively clean my boat or equipment	2.36 (1.21)	2.43 (1.30)	2.30 (1.08)	2.26 (1.14)
Poor weather conditions often interfere with my ability to complete the recommended cleaning tasks	2.78 (1.15)	2.83 (1.24)	2.75 (1.03)	2.69 (1.06)
My health or physical abilities prevent me from effectively cleaning my boating or fishing equipment	2.36 (1.20)	2.40 (1.28)	2.33 (1.10)	2.30 (1.18)

¹Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”.

The fourth key concept from the Health Belief Model included in this study was perception of the risks posed by AIS. Three types of risk perceptions were examined, including environmental (i.e., the level of threat posed to the environment) ($\alpha = .823$); personal (i.e., the level of threat posed to individuals) ($\alpha = .815$); and social (i.e., the level of threat posed to communities) ($\alpha = .823$). We found acceptable model fit and factor loading scores exceeding minimum acceptable thresholds.

Results suggested potential threats facing the environment were of greatest concern (see Table 19). Specifically, environmental risk perceptions ($M = 3.56$, $SD = 0.788$) were higher than personal ($M = 3.32$, $SD = .937$; $t(506)=7.520$, $p < .001$) and social ($M = 3.32$, $SD = .944$; $t(506)=7.221$, $p < .001$). Comparing subgroups, **boat owners were more likely to report higher risk perceptions than boat renters/borrowers**. This trend held across each type of risk perception, including environmental ($F(2, 504) = 8.19$, $p < .001$), personal ($F(2, 504) = 7.44$, $p < .001$), and social ($F(2, 504) = 5.60$, $p = .004$). There were no statistically significant differences between boat renters/borrowers and non-boat users at the .05 level.

Table 159.

Risk perceptions of recreational water users

Risk perceptions	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Environmental risk perceptions</i>	3.56 (0.79)	3.68 (0.79)^a	3.38 (0.77)^b	3.59 (0.73)^{ab}
Quality of habitat and natural environments	3.52 (.883)	3.65 (.914)	3.32 (.851)	3.59 (.714)
Environmental processes (e.g., water cycle)	3.46 (.945)	3.62 (.943)	3.22 (.924)	3.54 (.862)
Survival of plants and animals	3.69 (.921)	3.77 (.916)	3.61 (.909)	3.63 (.977)
<i>Personal risk perceptions</i>	3.32 (0.94)	3.47 (0.95)^a	3.13 (0.91)^b	3.26 (0.85)^{ab}
Your appreciation of the beauty of the landscape	3.33 (1.10)	3.48 (1.12)	3.13 (1.03)	3.35 (1.08)
Your own enjoyment of recreational activities	3.40 (1.05)	3.53 (1.10)	3.22 (.999)	3.39 (.899)
Your own access to the waterbody	3.22 (1.14)	3.38 (1.18)	3.05 (1.10)	3.04 (1.01)
<i>Social risk perceptions</i>	3.32 (0.94)	3.46 (0.98)^a	3.17 (0.89)^b	3.20 (0.87)^{ab}
The local economy	3.14 (1.12)	3.28 (1.18)	3.02 (1.04)	2.96 (1.01)
The community in the region	3.16 (1.11)	3.28 (1.18)	3.01 (1.03)	3.07 (1.01)
Recreational opportunities for future generations	3.66 (1.02)	3.81 (1.04)	3.50 (.976)	3.56 (.965)

Fit statistics: $\chi^2 = 120.209$, $df = 24$, $p < .001$; $CFI = .962$; $TLI = .943$; $RMSEA = .089$, $SRMR = .046$

Note. Measured on a Likert scale where 1 = “Low threat” and 5 = “High threat”

Note. Like superscript indicates no significant differences at $p < 0.05$

The final two variables from the Health Belief model included **self-efficacy** (i.e., beliefs that one has the ability to take a particular action) and **response-efficacy** (i.e., beliefs that a recommended action will effectively achieve a particular goal). Questions about self-efficacy were adapted from past work (Bandura, 1977). Response-efficacy questions were drawn from the focus group stage of the project and complemented with measured used in past research (Landon et al.,

2018). Both self-efficacy ($\alpha = .865$) and response-efficacy ($\alpha = .845$) were reliable and there was good model fit.

Results showed that **recreational water users believed they could take actions and that those actions would minimize the spread of AIS** (see Table 20). Specifically, both self-efficacy ($M = 4.12$, $SD = 0.746$) and response efficacy ($M = 4.35$, $SD = 0.661$) were high among survey respondents. Boat owners were more likely to report higher levels of self-efficacy than non-boat users ($F(2, 503) = 4.66$, $p = .010$), and both boat owners and boat renters/borrowers were more likely to report higher levels of response efficacy than non-boat users ($F(2, 504) = 4.11$, $p = .017$).

Table 20.

Self-efficacy and response-efficacy related to behaviors that prevent the spread of aquatic invasive species

Efficacy¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Self-efficacy</i>	4.12 (0.75)	4.21 (0.72)^a	4.07 (0.76)^{ab}	3.90 (0.78)^b
I understand what I need to do in order to remove invasive species from my boat or equipment	4.11 (0.85)	4.17 (0.88)	4.08 (0.80)	3.85 (0.86)
I am capable of performing the tasks required to remove possible invasive species from my boat and equipment	4.18 (0.84)	4.26 (0.83)	4.15 (0.83)	3.94 (0.90)
I feel confident in performing procedures necessary to prevent aquatic invasive species from spreading	4.08 (0.83)	4.20 (0.79)	3.96 (0.85)	3.91 (0.88)
<i>Response-efficacy</i>	4.35 (0.66)	4.37 (0.66)^a	4.38 (0.61)^a	4.10 (0.81)^b
Cleaning my boat and equipment helps to prevent invasive species from spreading	4.36 (0.73)	4.39 (0.74)	4.40 (0.68)	4.09 (0.83)
My own actions to remove, drain, and dry will protect fishing waters from invasive species	4.30 (0.77)	4.35 (0.76)	4.32 (0.71)	4.04 (0.95)
If everyone remembered to “remove, drain, dry”, we could significantly lower the risk of spreading invasive species	4.38 (0.77)	4.37 (0.79)	4.43 (0.69)	4.19 (0.91)

Fit statistics: $\chi^2 = 15.082$, $df = 8$, $p = .058$; $CFI = .996$; $TLI = .992$; $RMSEA = .042$, $SRMR = .013$

Note. Measured on a Likert scale where 1= “Strongly disagree” and 5= “Strongly agree”

¹Like superscript indicates no significant differences at $p < 0.05$

Health Belief Model

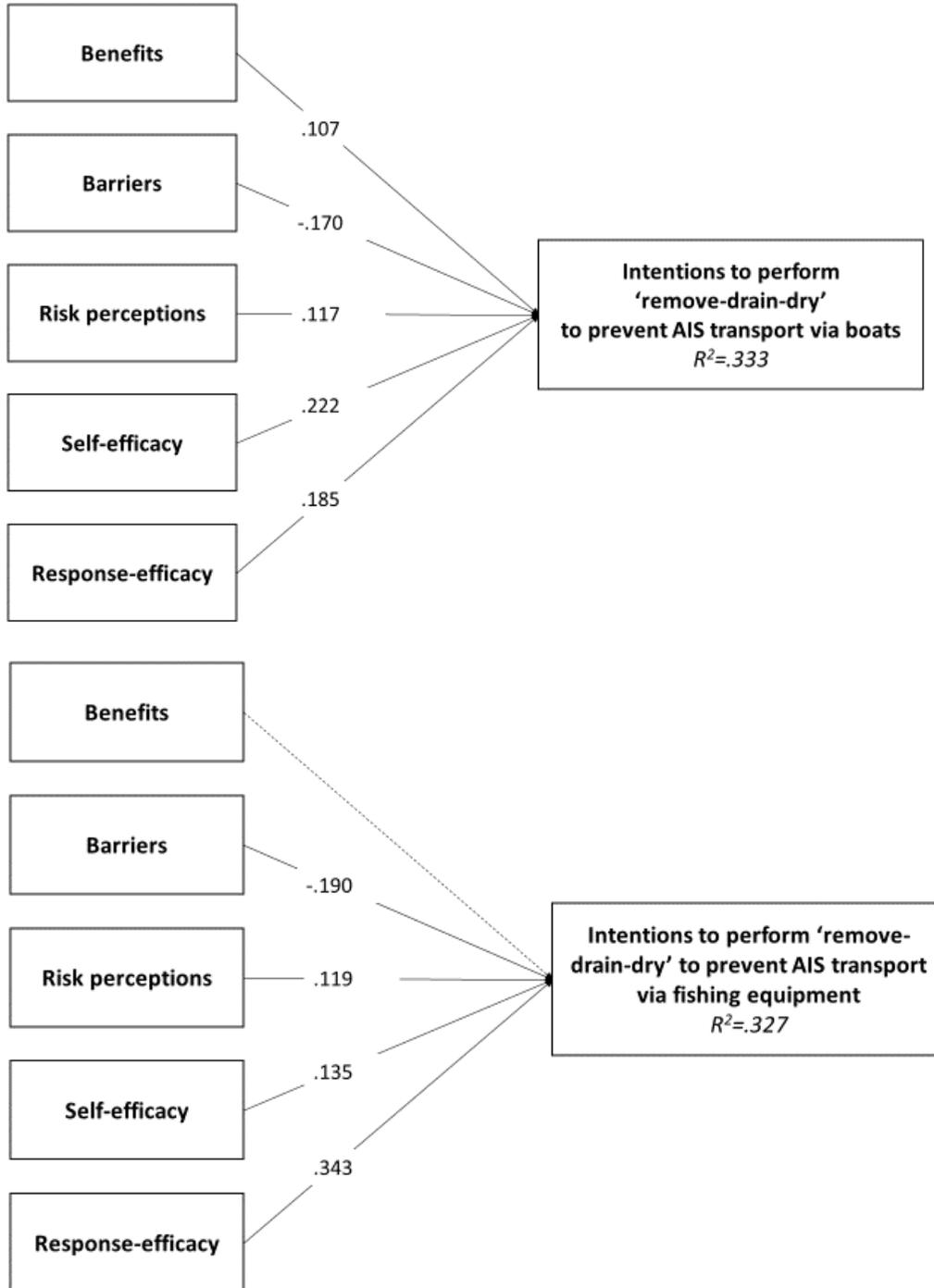
This study used multiple regression to identify the most important drivers of AIS-prevention behavior among Illinois recreational water users (see Figure 8). Both **self- and response-efficacy were useful for determining whether recreational water users intended to take action to prevent AIS spread**. For the boating vector, self-efficacy was the strongest predictor ($\beta = .22$), meaning that **as boaters were more confident in their ability to complete remove-drain-dry behaviors, they were more likely to do so**. For the fishing equipment vector, response-efficacy was the strongest predictor of intended behavior ($\beta = .343$), meaning that **as anglers became more convinced that their behaviors would make a difference, they were more likely to take action**. These results underscore the need to highlight the successes of environmental protection to promote a sense of mastery among anglers regarding their influence on AIS, as well showcase positive actions and achievements of both role-models and everyday anglers/boaters that promote a sense confidence in their ability to prevent AIS spread.

For both boaters and anglers, **barriers negatively predicted intentions to perform AIS-prevention behaviors**. A suite of five variables were reported as important barriers to recreational water users, including poor weather conditions, pressure from other recreationists, lack of equipment, lack of time, and health or physical ability. To address concerns about weather conditions, consider providing information in outreach materials regarding best practices in inclement weather conditions. To address the issue of pressure from other recreationists, managers may consider creating designated areas at boat launches where recreationists can complete remove-drain-dry without perceiving themselves to be blocking others from exiting the waterway. On a longer-term basis, cultivating a community norm around boat and equipment cleaning can also lead to respect rather than annoyance from other recreationists. Finally, providing equipment and staff at higher risk areas or areas with higher populations of older recreationists may help to negotiate constraints associated with physical ability and equipment needs.

Personal risk perceptions were significant predictors of intended behavior for both boating and angling vectors. As recreationists' beliefs that their own access to the waterbody, enjoyment of recreational activities, and appreciation of the beauty of the landscape are threatened, their likelihood of engaging in preventative behaviors increases.

Figure 8.

Drivers of prevention behavior of recreational water users in Illinois (N=507). Regression coefficients are placed on the paths leading from variables that were hypothesized to predict behavioral intentions according to the Health Belief Model. Non-significant relationships are shown in grey dotted lines



Long-term drivers of behavior

Trust and distrust with the Illinois Department of Natural Resources (IL DNR) was examined because it is an essential ingredient for effective resource management. Survey respondents were asked to report their level of trust with the scientific community, and with the Illinois Department of Natural Resources (IL DNR) (see Table 21). The questions included in the survey regarding the scientific community were drawn directly from past work and adapted to improve reliability (Nisbet et al., 2015). These same questions were used to assess trust in the Illinois Department of Natural Resources by simply changing the object of each item. Both scales were reliable ($\alpha = .848, .853$), but model fit is not reported because it showed poor ability to predict trust as a latent construct. Levels of trust in the pooled sample were similar across both objects ($M = 3.76, SD = 0.84; M = 3.78, SD = 0.80$), with IL DNR slightly higher. There were no statistically significant differences in trust levels between groups regarding either the scientific community ($F(2, 504) = 3.04, p < 0.05$), or IL DNR ($F(2, 461) = 1.07, p < 0.05$). Overall, levels of trust reported by recreational water users were higher than previous work would have predicted. This is likely due to the fact that our sample included recreational water users of any type rather than just anglers, and further, relied upon a self-identification rather than identification based on whether or not the respondent had purchased a fishing license. As shown in Table 1, this sampling difference yielded a group that is largely more female than those reported by previous studies. This difference alludes to a population of water users that are not represented in studies that rely on licensing data for sampling.

Table 16.

Trust in the scientific community and the Illinois Department of Natural Resources

Trust	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Scientific Community</i>	3.76 (0.84)	3.70 (0.85)^a	3.88 (0.79)^a	3.65 (0.95)^a
I have very little confidence in the scientific community*	3.84 (1.09)	3.67 (1.20)	4.06 (0.89)	3.81 (1.09)
Information from the scientific community is trustworthy	4.00 (0.90)	4.02 (0.94)	4.03 (0.84)	3.78 (0.88)
I trust the scientific community to do what's right	3.96 (0.91)	4.04 (0.91)	3.94 (0.86)	3.67 (1.06)
The scientific community often does not tell the public the truth*	3.42 (1.19)	3.26 (1.25)	3.62 (1.07)	3.48 (1.19)
I am suspicious of the scientific community*	3.59 (1.21)	3.50 (1.28)	3.72 (1.11)	3.52 (1.18)

Trust	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Illinois Department of Natural Resources (IL DNR)</i>	3.78 (0.80)	3.73 (0.85)^a	3.84 (0.75)^a	3.80 (0.79)^a
I have very little confidence in the Illinois DNR*	3.69 (1.06)	3.59 (1.15)	3.83 (0.94)	3.68 (1.02)
Information from the Illinois DNR is trustworthy	3.96 (0.84)	4.01 (0.86)	3.91 (0.82)	3.88 (0.77)
I trust the Illinois DNR to do what's right	3.97 (0.86)	4.01 (0.90)	3.97 (0.82)	3.80 (0.83)
The Illinois DNR often does not tell the public the truth*	3.54 (1.11)	3.42 (1.20)	3.64 (1.01)	3.70 (1.04)
I am suspicious of the Illinois DNR*	3.73 (1.15)	3.59 (1.28)	3.85 (0.99)	3.94 (1.02)

Note. Measured on a Likert scale where 1= “Strongly disagree” and 5= “Strongly agree”

* Indicates the item was reverse coded

This study assessed five types of **individual values** (see Table 22). Individual values, defined as guiding principles of life, include biospheric values (i.e., concern for the environment), altruistic values (i.e., concern for other people), egoistic values (i.e., a desire for control and power), hedonic values (i.e., short-term pleasures), and eudaimonic values (i.e., long-term personal goals). Survey questions measuring these five types of values were drawn from past research (Stern, 2000). All scales were reliable ($\alpha = .798, .815, .806, .781, .825$), and reflected high biospheric ($M = 4.27, SD = .673$), altruistic ($M = 4.25, SD = .782$), eudaimonic ($M = 4.23, SD = .683$), and hedonic ($M = 4.19, SD = .686$) values.

Survey participants had lower egoistic values ($M = 3.13, SD = 1.02$) than the other types of values. Reported values among each group were largely similar with two exceptions: boat owners were more likely to express higher egoistic values than boat renter/borrowers ($F(2, 504) = 20.37, p < .001$), and more likely to express higher levels of hedonic values than non-boat users ($F(2, 504) = 3.22, p = .041$). Thus, in contrast to other groups, boat owners may be more receptive to messaging that stressed the ways that preventing AIS can support their own ability to influence people and events and enjoy life and recreational activities. However, biospheric values were overall stronger than egoistic values ($t(506) = 24.685, p < .001$), thus a focus on the environmental risks of AIS and benefits to the ecosystem resulting from taking action are likely to resonate most with water-based recreationists, and adding information to resonate with egoistic values may confer additional benefits.

Table 17.*Average individual values among recreational water users*

Individual values¹	Pooled sample M (SD)	Boat owners M (SD)	Boat renters/ borrowers M (SD)	Non-boat users M (SD)
<i>Biospheric values</i>	4.27 (0.67)	4.35 (0.65)^a	4.21 (0.70)^a	4.17 (0.67)^a
Protecting the environment: preserving nature	4.37 (0.75)	4.43 (0.76)	4.31 (0.74)	4.33 (0.70)
Unity with nature: fitting into nature	4.12 (0.86)	4.23 (0.81)	4.01 (0.91)	3.98 (0.86)
A world of beauty: beauty of nature and the arts	4.33 (0.78)	4.38 (0.75)	4.30 (0.81)	4.19 (0.78)
<i>Altruistic values</i>	4.25 (0.78)	4.27 (0.78)^a	4.25 (0.79)^a	4.13 (0.74)^a
Equality: equal opportunity for all	4.28 (0.86)	4.33 (0.87)	4.27 (0.87)	4.15 (0.81)
Social justice: correcting injustice, care for others	4.08 (1.04)	4.13 (1.10)	4.05 (1.07)	3.96 (0.99)
A world at peace: free of war and conflict	4.38 (0.83)	4.35 (0.88)	4.45 (0.77)	4.28 (0.79)
<i>Egoistic values</i>	3.13 (1.02)	3.40 (1.01)^a	2.81 (0.91)^b	3.02 (1.07)^{ab}
Authority: the right to lead or command	3.35 (1.171)	3.62 (1.17)	3.03 (1.09)	3.26 (1.20)
Social power: control over others, dominance	2.63 (1.31)	2.95 (1.33)	2.23 (1.15)	2.54 (1.31)
Influential: having an impact on people and events	3.41 (1.11)	3.63 (.1.06)	3.17 (1.11)	3.26 (1.10)
<i>Hedonic values</i>	4.19 (0.69)	4.23 (0.68)^a	4.20 (0.67)^{ab}	3.98 (0.76)^b
Fulfilment of desire: food, fun, pleasure	3.96 (0.92)	4.03 (0.91)	3.94 (0.90)	3.69 (0.99)
Enjoying life: pursuing hobbies, leisure, socializing	4.32 (0.76)	4.33 (0.76)	4.35 (0.73)	4.17 (0.89)
Reducing worries: seeking comfort and relaxation	4.30 (0.78)	4.35 (0.76)	4.30 (0.78)	4.07 (0.89)
<i>Eudaimonic values</i>	4.23 (0.68)	4.25 (0.72)^a	4.26 (0.63)^a	4.04 (0.70)^a
Personal growth: development of new skills, learning, or gaining insight into something	4.25 (0.83)	4.28 (0.86)	4.24 (0.81)	4.17 (0.77)
Pursuit of excellence: attaining a personal ideal in life	4.04 (0.92)	4.09 (0.93)	4.06 (0.88)	3.76 (0.93)
Autonomy: deciding your own future and doing what you believe in	4.23 (0.84)	4.23 (0.87)	4.28 (0.77)	4.07 (0.89)
Satisfaction with life: finding meaning, value, and relevance to a broader context	4.40 (0.79)	4.41 (0.81)	4.45 (0.71)	4.19 (0.91)

Fit statistics: $\chi^2 = 393.373$, $df = 94$, $p = .000$; $CFI = .924$; $TLI = .903$; $RMSEA = .079$, $SRMR = .062$ ¹Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”.*Note.* Like superscript indicates no significant differences at $p < 0.05$

Efficacy of outreach messages

This project evaluated two message features that were developed in collaboration with the Illinois-Indiana Sea Grant to improve current approaches to communicating with recreational water users. A 2x3 experimental design was adopted, meaning that there were two treatments that tested the effect of efficacy vs. legality, and three treatments that included different types of values. Treatments were tested simultaneously in six different messages (see Table 23, Figure 9). Each respondent was randomly assigned to evaluate one of the six messages.

Table 18.

Experimental design used to analyze outreach messages. Two efficacy treatments and three value treatments were simultaneously tested.

	Efficacy framing	Legality framing
<i>Self-transcendent value framing</i>	Message 1	Message 2
<i>Self-enhancement value framing</i>	Message 3	Message 4
<i>Control</i>	Message 5	Message 6

Figure 9

Example outreach message that survey respondents were asked to evaluate. The displayed message is “Message 6: No values framing + legality.”



Efficacy messages

The efficacy treatment measured both self-efficacy and response efficacy. Self-efficacy, defined as beliefs that an individual is able to correctly take AIS prevention steps, was reflected through phrases such as “it’s quick” “it’s easy” and “it’s effective.” Response efficacy, defined as beliefs that taking action will result in reducing the spread of invasive species, was reflected through phrases noting that remove-drain dry “significantly decreases the spread of invaders” and is a “reliable way to kill off any potential invaders.” Thus, the **efficacy treatment** received the following three messages:

- It’s quick – a few minutes spent removing plants and animals significantly decreases the spread of invaders.
- It’s easy – by draining all water, you can easily prevent live plants and animals from traveling with you.
- It’s effective – allowing your equipment to dry is a reliable way to kill off any potential invaders.

In contrast, the **legality treatment** involved statements that were not tied to efficacy, but highlighted legal reasons for taking action:

- Be aware! It is illegal to travel on Illinois roadways with aquatic plants attached to your vehicle or trailer.
- Be aware! It is illegal to transport water-related equipment on Illinois roadways without first draining water
- Be aware! High pressure water removes and hot water kills aquatic invaders. If possible, spray your gear down with high pressure and/or hot water.

Participants were asked to evaluate the message they viewed in three ways. First, they were asked to respond to questions about their *elaboration*, meaning the depth of their thinking about the message and related ideas (Petty & Cacioppo, 1986). High elaboration (i.e., deeper thinking) tends to result in longer-term effects (O’Keefe, 2013). Elaboration while reviewing both the efficacy and legality messages was moderate to high (see Table 24). Next, respondents’ perceived *effectiveness* of the message was high for both treatments. Finally, *reactance*, defined as negative responses to perceived pressure experienced from persuasive message (Nisbet et al., 2015), was low and did not differ between the two treatments. Measurement scales ranged from good to acceptable for elaboration, ($\alpha = .745$), effectiveness ($\alpha = .908$), and reactance ($\alpha = .697$).

Table 194.*Participant evaluation of efficacy messages*

Evaluation	Efficacy M (SD)	Legality M (SD)
<i>Elaboration</i>	3.78 (0.67)	3.81 (0.69)
Deep in thought about the message	3.69 (0.89)	3.73 (0.91)
Extending a good deal of cognitive effort	3.66 (0.98)	3.62 (0.99)
Doing your best to think about what was written	3.97 (0.81)	4.01 (0.88)
Reflecting on the implications of the arguments	3.80 (0.85)	3.87 (0.91)
<i>Perceived effectiveness</i>	4.06 (0.69)	4.17 (0.64)
The message was worth remembering	4.11 (0.80)	4.23 (0.72)
The message grabbed my attention	4.03 (0.81)	4.15 (0.78)
The message was powerful	3.88 (0.88)	3.96 (0.90)
The message was meaningful to me	3.93 (0.87)	4.06 (0.84)
The message was informative	4.34 (0.75)	4.42 (0.66)
The message was convincing	4.09 (0.84)	4.22 (0.77)
<i>Reactance</i>	2.63 (0.83)	2.63 (0.91)
The message tried to pressure me to think a certain way	2.76 (1.08)	2.81 (1.15)
The message tried to manipulate me	2.02 (1.03)	2.04 (1.05)
I felt like the message was trying to persuade me	3.11 (1.09)	3.03 (1.22)

Fit statistics: $\chi^2=275.949$; $df=62$, $p<.001$; $CFI=.930$; $TLI=.912$; $RMSEA=.083$, $SRMR=.057$

Note. Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”

We tested for effects from messages about beliefs related to AIS and remove-drain-dry behaviors (see Table 25). No significant differences emerged among barriers, risk perceptions, or self-efficacy, but key differences were observed between perceived benefits and response efficacy. Specifically, those who viewed the legality message reported higher perceived benefits to the self ($F(1, 504) = 5.722$, $p = .017$) and to the community ($F(1, 504) = 4.002$, $p = .046$). Legality message recipients also reported higher response efficacy ($F(1,505) = 5.360$, $p = .021$).

Table 205.*Comparison of post-message beliefs among respondents who viewed messages framed with high or low efficacy*

Beliefs¹	Efficacy M (SD)	Legality M (SD)
<i>Benefits</i>		
To the self*	4.16 (0.68)	4.30 (0.59)
To the community*	4.20 (0.67)	4.31 (0.61)
To the environment	4.34 (0.64)	4.40 (0.62)
<i>Barriers</i>	2.56 (0.95)	2.41 (0.96)
<i>Risk perceptions</i>		
Personal	3.29 (0.93)	3.34 (0.94)
Social	3.26 (0.97)	3.39 (0.92)
Environmental	3.53 (0.80)	3.59 (0.78)

Beliefs¹	Efficacy M (SD)	Legality M (SD)
<i>Self-efficacy</i>	4.11 (0.74)	4.13 (0.77)
<i>Response efficacy*</i>	4.28 (0.68)	4.42 (0.63)

¹Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”

Asterisks (*) indicate significant differences between the two treatments ($p < .05$)

Value-framed messages

The value treatment included three different messages. First, self-transcendent messages incorporated ideas of altruism and environmentalism as guiding principles in life. Respondents assigned to the **self-transcendent treatment** group received the following message:

Aquatic invaders can dramatically change the ecosystem and harm native fish species. By completing remove-drain-dry, you can...

- *Protect the quality of habitats and natural environments*
- *Preserve recreational opportunities for future generations*
- *Build a sense of community among anglers and water users*
- *Ensure the economic benefits provided by the resource will continue to benefit the region*

Second, the self-enhancement message incorporated ideas of self-interest and goal attainment as guiding principles in life. Respondents in this treatment group received the following message:

Aquatic invaders can block access to waterbodies and prevent you from enjoying your favorite activities. By completing remove-drain-dry, you can...

- *Protect the waterbodies that you value the most*
- *Ensure you’ll be able to enjoy the resource for years to come*
- *Know you have done the right thing to be a responsible angler or boater*
- *Influence other recreationists to take responsibility for the ecosystem*

Finally, a control group received the original message contained in the current version of the brochure, which simply reads: *Don’t dump bait*. As with the efficacy treatments, we examined elaboration, perceived effectiveness, and reactance. We did not identify any significant differences between the three treatments (see Table 26). Our assessment of possible effects of the messages on respondent beliefs related to AIS and remove-drain dry did not detect any significant differences across the three treatments groups (see Table 27).

Table 216.*Participant evaluation of values-framed messages*

Evaluation¹	Self-transcendent framing	Self-enhancement framing	Control
<i>Elaboration</i>	3.79 (0.70)	3.77 (0.69)	3.82 (0.65)
Deep in thought about the message	3.81 (0.86)	3.62 (0.96)	3.70 (0.90)
Extending a good deal of cognitive effort	3.66 (0.97)	3.58 (1.03)	3.69 (0.95)
Doing your best to think about what was written	3.93 (0.91)	4.02 (0.83)	4.03 (0.78)
Reflecting on the implications of the arguments	3.78 (0.91)	3.85 (0.90)	3.87 (0.82)
<i>Perceived effectiveness</i>	4.11 (0.69)	4.10 (0.68)	4.14 (0.64)
The message was worth remembering	4.11 (0.78)	4.14 (0.79)	4.24 (0.73)
The message grabbed my attention	4.14 (0.80)	4.05 (0.81)	4.08 (0.78)
The message was powerful	3.91 (0.85)	3.88 (0.94)	3.96 (0.89)
The message was meaningful to me	3.98 (0.86)	4.02 (0.89)	3.98 (0.84)
The message was informative	4.37 (0.77)	4.34 (0.74)	4.42 (0.61)
The message was convincing	4.14 (0.87)	4.14 (0.81)	4.17 (0.75)
<i>Reactance</i>	2.61 (0.90)	2.63 (0.87)	2.64 (0.84)
The message tried to pressure me to think a certain way	2.77 (1.10)	2.76 (1.07)	2.82 (1.16)
The message tried to manipulate me	2.90 (1.06)	2.01 (1.00)	2.03 (1.07)
I felt like the message was trying to persuade me	3.06 (1.16)	3.10 (1.21)	3.06 (1.10)

Fit statistics: $\chi^2 = 275.949$; $df = 62$, $p < .001$; $CFI = .930$; $TLI = .912$; $RMSEA = .083$, $SRMR = .057$ ¹Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”**Table 227.***Comparison of post-message beliefs among respondents who viewed messages framed in line with different values*

Beliefs¹	Self-transcendent framing	Self-enhancement framing	Control
<i>Benefits</i>			
To the self	4.24 (0.62)	4.16 (0.66)	4.27 (0.63)
To the community	4.28 (0.63)	4.22 (0.69)	4.27 (0.60)
To the environment	4.38 (0.61)	4.33 (0.67)	4.39 (0.61)
<i>Barriers</i>	2.56 (0.92)	2.49 (0.93)	2.42 (1.03)
<i>Risk perceptions</i>			
Personal	3.27 (0.96)	3.36 (0.90)	3.31 (0.96)
Social	3.28 (0.95)	3.30 (0.96)	3.38 (0.92)
Environmental	3.48 (0.78)	3.60 (0.76)	3.58 (0.82)
<i>Self-efficacy</i>	4.09 (0.81)	4.09 (0.76)	4.19 (0.67)
<i>Response efficacy</i>	4.35 (0.67)	4.30 (0.71)	4.40 (0.60)

¹Measured on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree”

Open-ended responses to outreach messages

Respondents were asked to respond to the question: “What information would be helpful for you to know about aquatic invasive species? What do you think should be included in a brochure like the one you reviewed?” Out of 507 respondents, 17 chose not to respond.

The largest group of 91 respondents felt that a list of aquatic invasive species should be included, and an additional 21 wanted information about these species’ locations.

- “Besides the information provided, maybe a list of invasive species in the region.”
- “Where each species is most prevalent. Use map”

Fifty-one respondents wanted pictures or graphics to be included, while nineteen specifically wanted additional information on how to identify the species in question.

- “Pictures of the fish would be great. I have memory issues and rely heavily on visual cues.”
- “What they look like, how to identify them. Somewhere to go to see all the species that are invasive.”

There were 62 respondents who wanted to know what they could do to prevent AIS spread. An additional six respondents wanted to include what was already being done to control AIS.

- “The most important thing would be what you need to do to mitigate the problem”
- “How individuals can help on a small scale but still make a difference.”
- “What the government and conservation department is doing to help prevent the spread of invasive species in Illinois.”

Forty-six respondents felt that it was important to articulate the impacts incurred from AIS.

- “I think the negative impact on the local ecosystem should be included to more explicitly contextualize the message.”
- “How it affects everyone who enjoys being on/in the water”

There were 41 respondents who wanted more to be included about AIS; seven respondents wanted to know how these species spread, and five respondents wanted to know both what they are and how they spread.

- “More information on specific invasive species and how they spread from one area to another”
- “More information on invasive species”
- “Definition”

Nine respondents wanted to know why it was important to know about AIS and why they should help prevent the spread.

- “Why a normal average person should care”
- “More info as to how following the info will directly benefit individual fishermen and boaters”

A total of 32 respondents asked for additional resources to be included in the brochure.

- “I think a way to communicate and know more about aquatic invasive species should have been added like a link or something”
- “Workshops on aquatic invasive species prevention”
- “Where I can go locally to find out more information about the topic.”

Ten respondents offered feedback on the brochure overall.

- “Make sure it is clear and concise”
- “I missed who made the brochure. It would have been nice to notice for credibility”

There were 42 respondents who felt that the brochure was good as is, and 51 respondents who did not know what additional information should be included.

Open-ended comments on survey

At the end of the questionnaire used for the state-wide survey of recreational water-users, respondents were given the opportunity to provide additional thoughts and feedback. Out of 507 total responses, 180 respondents chose to leave a comment.

Ten respondents offered suggestions for how to reduce the spread of AIS and make the campaign better.

- “It would be great to get an email reminder of protecting waterway from invasive species after I purchase my license each year and to throw line or other damaged equipment in the trash.”
- “posted signs at lakes and waterways to help people learn how important it is to know this information about invasive species.”
- “Inspection points should be set up. A sticker of some kind would be good.”
- “Meetings with fishermen frequently”
- “Have seen some great outreaches at boat launches in WI. They give away a nice cool pack or fishing towel or similar, along with information.”

There were 45 respondents who expressed appreciation for the survey. An additional 26 respondents commented specifically on how informative the survey was or how much they learned from it.

- “This was a great and inspiring survey and I look forward to doing more like this in the future”
- “This was a very interesting survey. It gives me lots to think about this summer with boating, fishing, and doing my part to protect our waterways. Thank you.”

Eight respondents offered feedback on the contents of the survey.

- “Probably a “not applicable” choice on some of the questions would have been good for those of us that fish but do not own a boat”
- “Sometimes two options were equally true - perhaps a sliding scale would be better used on some of the questions”

Three respondents said that they did not own boats, while two respondents said that they do not fish or boat in Illinois.

- “Seeing that I rent a boat or it comes with the cabin, I'm limited in what I can do.”
- “You didn't ask where I boat, you only asked if I've boated in the past 18 months. Yes, I boat almost daily but it's at Lake of the Ozarks in Missouri. :)”

Two respondents said that they did not trust the Illinois government or politicians.

- “Generally, I (and many others) have very little trust or “faith” in the Illinois government to tell us the truth or determine what is “right” or “wrong”. For this type of campaign, I would stay away from implications that any of the suggestions are mandated by the state, illegal, etc. Instead, you should consider framing the information in such a way that it is understood that these practices are the law to protect the environment and our natural resources, and backed by independent and sound research.”

Five respondents shared general desires to stop the spread of AIS or protect the environment.

- “I am very interested in this subject I want to try to stop the spread of invasive species not only from Illinois but from the entire great lakes region.”
- “I truly believe we need to do more to safeguard our environment. I am glad to see more people letting their yards be more natural. I am not a fan of pesticides and chemicals.”

There were 70 respondents who indicated that they did not have any additional comments or added irrelevant information excluded (e.g., “none”, “thank you”, etc.).

LITERATURE CITED

- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological review*, 84(2):191.
- Blankenberg, A. K., & Alhusen, H. (2019). On the determinants of pro-environmental behavior: A literature review and guide for the empirical economist. cege Discussion Papers, No. 350, University of Göttingen, Center for European, Governance and Economic Development Research (cege), Göttingen.
- Burkett, E. M., & Winkler, R. L. (2018). Upper Great Lakes States' Angler Estimates and Map Book Documentation, 1999-2015. Houghton, MI
- Carpenter, C. J. (2010). A meta-analysis of the effectiveness of health belief model variables in predicting behavior. *Health communication*, 25(8):661-669.
- Clarke, V., & Braun, V. (2014). Thematic analysis. In *Encyclopedia of critical psychology* (pp. 1947-1952). Springer, New York, NY.
- Cole, E., Keller, R. P., & Garbach, K. (2019). Risk of invasive species spread by recreational boaters remains high despite widespread adoption of conservation behaviors. *Journal of environmental management*, 229:112-119.
- Cole, E., Keller, R. P., & Garbach, K. (2016). Assessing the success of invasive species prevention efforts at changing the behaviors of recreational boaters. *Journal of environmental management*, 184:210-218.
- Hilbrich, D.J. (2015). Determining the Effectiveness of the Clean Boats Crew: An Education and Outreach Program Aimed at Preventing the Spread of Aquatic Invasive Species in Lake County, Illinois. Unpublished Master's Thesis University of Illinois Urbana Champaign.
- Kung, F. Y., Kwok, N., & Brown, D. J. (2018). Are attention check questions a threat to scale validity?. *Applied Psychology*, 67(2):264-283.
- Landon, A. C., Kyle, G. T., van Riper, C. J., Schuett, M. A., & Park, J. (2018). Exploring the psychological dimensions of stewardship in recreational fisheries. *North American Journal of Fisheries Management*, 38(3):579-591.
- Lynn, P., & Longhi, S. (2011). Environmental attitudes and behaviour: who cares about climate change. In McFall, S. L. & Garrington, C. (Eds.). *Early findings from the first wave of the UK's household longitudinal study* (pp. 109-116). Colchester: Institute for Social and Economic Research, University of Essex.
- Nisbet, E. C., Cooper, K. E., & Garrett, R. K. (2015). The partisan brain: How dissonant science messages lead conservatives and liberals to (dis) trust science. *The ANNALS of the American Academy of Political and Social Science*, 658(1):36-66.
- O'Keefe, D. J. (2013). The elaboration likelihood model. In J. P. Dillard & L. Shen (Eds.), *The SAGE Handbook of Persuasion : Developments in Theory and Practice* (2nd ed., pp. 137-149). Los Angeles: SAGE.
- Petty, R. E., & Cacioppo, J. T. (1986). The Elaboration Likelihood Model of Persuasion. In *Communication and Persuasion: Central and Peripheral Routes to Attitude Change* (pp. 1-24). New York, NY: Springer New York.
- Pradhananga, A., Davenport, M. A., Seekamp, E., & Bundy, D. (2015). Preventing the spread of aquatic invasive species: boater concerns, habits, and future behaviors. *Human Dimensions of Wildlife*, 20(5):381-393.

- Quick, B. L., & Stephenson, M. T. (2007). Authoritative parenting and issue involvement as indicators of ad recall: An empirical investigation of anti-drug ads for parents. *Health communication, 22*(1):25-35.
- Rosenstock, I. M. (1974). Historical origins of the Health Belief Model. *Health Education & Behavior, 2*(4):328–335.
- Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3):407-424.
- van Riper, C.J., E.J. Golebie, S. Shin, M. Eriksson, A. Smith, C. Suski, & R. Stedman. (2020). A study of angler behavior and the spread of aquatic invasive species in the Great Lakes region. Series 20-7 Dept. of Nat. Resources., Coll. Agric. and Life Sci., Cornell Univ., Ithaca, NY. 94 pp.
- van Riper C.J., Browning M.H.E.M., Becker D., Stewart W., Suski C.D., Browning L., & E. Golebie. (2019). Human-nature relationships and normative beliefs influence behaviors that reduce the spread of aquatic invasive species. *Environmental Management 63*:69–79.
- Williams, B.D. (2014). Be A Hero, Transport Zero Survey Report. Unpublished INHS Report.

APPENDIX A: FOCUS GROUP AGENDA



VAN RIPER RESEARCH GROUP
Valuing nature. Changing behavior.



Sea Grant
ILLINOIS-INDIANA



Focus Group Agenda

The purpose of this meeting is to discuss how Illinois anglers characterize aquatic invasive species and identify the benefits and barriers to taking preventative action, clean-drain-dry. We will explore both individual and group-level perspectives on the relevance of these topics to Illinois anglers.

Introductions: 15 minutes

- *Project Introduction:* A research project examining angler perspectives of aquatic invasive species with a focus on understanding barriers to engaging in preventative behaviors
- *Overview of agenda:* Leaders review the scope of the conversation and timing for various activities.
- *Consent forms:* Consent forms are distributed to ask for everyone's permission to be tape recorded.
- *Participant Introductions:* Each participant introduces their name, occupation, and a brief overview of their involvement with fishing.

Subgroup discussion about aquatic invasive species: 45 minutes

- *Discussion of risks associated with invasive species*
 - Each participant shares their own experiences with invasive species and how their angling experience has been affected and/or what they are familiar with from the experiences of others
- *Discussion of preventative behaviors and benefits of clean-drain-dry*
 - Participants discuss familiarity with clean, drain, dry and related behaviors and general impressions of this topic
 - Participants read through the preliminary list of benefits.
 - The group discusses the list, modifies it, and adds to it as needed.
- *Discussion of barriers to clean-drain-dry*
 - Participants read through the preliminary list of barriers.
 - The group discusses the list, modifies it, and adds to it as needed.

Full group discussion: 30 minutes

Participants come together as a group and discuss the information they have generated.

- *Group discussion*
 - Each group will share their results with the full group. The enjoyable and challenging elements of the exercise can also be highlighted.
 - The following questions are discussed:
 - How have AIS risks changed over time?
 - Which benefits and barriers are most important and why?
 - How might the most challenging barriers be overcome?
- *Closing*
 - Each participant shares their closing remarks and any points that they would like to discuss.
 - All participants complete their exercise sheets including contact information.

Thank you for your time.

APPENDIX B: FOCUS GROUP CONSENT FORM



CONSENT FORM FOR FOCUS GROUP PARTICIPANTS

Responsible Project Investigators: This project is being conducted under the direction of Carena van Riper in the Department of Natural Resources and Environmental Sciences at the University of Illinois at Urbana-Champaign, and both Greg Hitzroth and Patricia Charlebois at the Illinois-Indiana SeaGrant.

Purpose of the Study: The purpose of this study is to understand Illinois angler viewpoints on aquatic invasive species and how best to increase participation in preventative action. We are particularly interested in barriers to participation and ways managers can help minimize those barriers.

Procedures: We will be conducting focus groups that will last up to 1 hour depending on availability and the nature of the conversation. If you agree to participate, we would like to digitally audio record the session to study this material in the future. The recording can be stopped at any time. In addition, we may photograph the focus group process as part of research documentation. You must be 18 years or older to participate.

Statement of Confidentiality: All information you share will be kept confidential and viewed only by the research staff. All digital audio recordings, interviews, transcripts, and other personal information will be stored separately from your personal information in a secure location. After completion of the study, the information will be summarized and shared with policy makers to enhance conservation programs. Short excerpts of what you say may be included in aggregate reporting; however, no names of individuals will appear. We will not be able to guarantee that confidentiality will be maintained by group members if you are involved in a focus group discussion with other people. All collected data, including notes, digital audio recordings, photographs, and transcribed documents will be kept in a locked file in the investigators' offices and in password protected computers. Project staff members are trained to respect your privacy.

When this research is discussed or published, no one will know that you were in the study. However, laws and university rules might require us to disclose information about you. For example, if required by laws or University Policy, study information which identifies you and the consent form signed by you may be seen or copied by the following people or groups: a) The university committee and office that reviews and approves research studies, the Institutional Review Board (IRB) and Office for Protection of Research Subjects; and b) University and state auditors, and Departments of the university responsible for oversight of research; and c) Federal government regulatory agencies such as the Office of Human Research Protections in the Department of Health and Human Services or our federal funding agencies.

Risks and Benefits: Subjects participating in this study will not be exposed to any physical or psychological risks beyond those that exist in daily life. Benefits from participating may include enjoyment from sharing experiences and enhanced knowledge about aquatic invasive species.

Right to Ask Questions: If you have questions or concerns about the study, contact Carena van Riper (217) 244-9317. If you feel you have not been treated according to the descriptions in this form, or if you have questions about your rights as a research subject, including questions, concerns, complaints, or to offer input, you may call the Office for the Protection of Research Subjects (OPRS) at 217-333-2670 or e-mail irb@illinois.edu.

Your participation in this research is strictly voluntary. You can end your participation at any time or choose not to answer questions. If you offer consent to participate in this study and to the terms above, please sign your name below:

Participant Printed Name _____ Address _____

Participant Signature _____ Date _____

APPENDIX C: FOCUS GROUP ACTIVITY

Name: _____

SECTION A: Risks of Aquatic Invasive Species

We are interested in your opinions and perceptions of the risks posed by aquatic invasive species. Listed below are two examples of impacts that could come from the spread of invasive species. Please read through this list and add the other impacts that you think are important for fisheries managers to take into consideration.

Impacts of Invasive Species

1. **Lower catchability:** reduced opportunity for catching sportfish
2. **Damage to infrastructure:** inaccessible fishing sites, clogged pipes

SECTION B: AIS Prevention Behaviors & Benefits

The recommended behaviors for minimizing the spread of aquatic invasive species is to clean, drain and dry recreational fishing boats. We are interested in your thoughts about these behaviors, both in terms of your own experiences and how you think other anglers feel.

There are many reasons why anglers might perform clean-drain-dry behaviors after a fishing trip. Considering your experience and what you have observed of other people, please help us expand this list of benefits using the space below. To get started, you might think of benefits to yourself, benefits to other people, and benefits to the environment.

Benefits of Clean-Drain-Dry Behavior

1. **Benefits to the self:** achieving a sense of pride
2. **Benefits to the environment:** helping to maintain healthy ecosystems
3. **Benefits to others:** preserving fishing experiences for the angling community

SECTION C: Barriers to Performing Clean-Drain-Dry

Some anglers find it difficult to perform clean-drain-dry behavior following a fishing trip. Considering your own experience and what you have observed of other people, please help us expand this list of barriers in the space below. You might think of internal barriers, which are your own abilities and perceptions, as well as external barriers, which are factors outside of your control.

Barriers to performing Clean-Drain-Dry Behavior

1. External factors

- a. **Time:** Recommended actions are time consuming and difficult to schedule within a fishing trip
- b. **Resources:** Anglers lack the necessary equipment to complete recommended actions

2. Internal factors:

- a. **Knowledge:** Anglers are unfamiliar with which actions are recommended or how to perform them
- b. **Ability:** Clean-drain-dry is physically demanding and difficult for some anglers to complete

SECTION D: Personal information

We would like to learn more about your angling experience and interests in staying in touch. Please only answer the questions that you are comfortable sharing with us.

How many years of fishing experience do you have? _____

About how many days have you gone fishing in the past year? _____

In what year were you born? _____

What is your gender? _____

- 1. Would you like to receive a copy of the transcript from our group conversation? Yes No
- 2. Would you like a copy of the report and findings from our group discussion? Yes No

If you answered "yes" to either of these questions, please provide your contact information here:

APPENDIX D: SURVEY QUESTIONNAIRE

A survey about aquatic Invasive Species in Illinois

The University of Illinois at Urbana-Champaign and Illinois-Indiana Sea Grant are conducting research to learn more about the opinions of recreational water users in Illinois and the spread of aquatic invasive species, which are organisms that move into areas beyond their natural, historic range causing ecological and economic problems.

To help decision makers understand the opinions of recreational water users and develop helpful materials for sharing information about aquatic invasive species, we are asking you to participate in this survey. Responding to survey questions about your experiences and preferences as an angler or boater will take approximately 15 minutes.

Those of us at the University of Illinois who may see your information will maintain confidentiality to the extent of laws and university policies. Personal identifiers will not be published or presented. If you have questions or concerns about your rights as a participant please contact the University of Illinois at Urbana-Champaign Office for the Protection of Research Subjects at 217-333-2670 or via email at irb@illinois.edu. If you have any questions about the study, please contact the project leader, Carena van Riper at cvanripe@illinois.edu.

Your participation in this research is voluntary. If you decide to participate, you are free to withdraw at any time. If for any reason you prefer not to participate in this study, you may exit now. If you would like to be removed from our email list, please let us know by responding to our email.

We appreciate your careful consideration of each question. Please save any comments you might have for the end of the survey.

Screening questions

- A. Have you gone fishing at least once since 2018?
- B. Have you participated in a recreational water activity (sailing, kayaking, canoeing, boating, jetskiing, etc.) at least once since 2018?
- C. What is your zip code?
- D. In what year were you born?

Section 1 of 6: Background Information

Anglers only (responded "yes" to screening question A).

In this section, we ask you to provide information about your fishing experiences.

1. About how many days did you go fishing in 2020? _____ Days
2. About how many years, including this one, have you been fishing? _____ Years
3. Where have you spent most of your time fishing?

- Fishing from the shoreline
- Fishing from a boat
- Wading in shallow water (e.g., fly fishing)
- I spend about an equal amount of time fishing from two or more of the above options

3b. Please select the statement that generally describes your experience.
(shown only to those who selected the 4th option above)

- I spend equal amounts of time fishing from a boat and the shoreline
- I spend equal amounts of time fishing from a boat and wading
- I spend equal amounts of time fishing from the shoreline and wading
- I spend equal amounts of time fishing from a boat, the shoreline, and wading

4. Which species do you frequently fish for? (Please select all that apply)

- | | | |
|--|--|--|
| <input type="checkbox"/> Atlantic salmon | <input type="checkbox"/> Bluegill | <input type="checkbox"/> Brook trout |
| <input type="checkbox"/> Brown trout | <input type="checkbox"/> Carp | <input type="checkbox"/> Catfish |
| <input type="checkbox"/> Chinook / king salmon | <input type="checkbox"/> Coho salmon | <input type="checkbox"/> Crappie |
| <input type="checkbox"/> Drum / sheepshead | <input type="checkbox"/> Gar | <input type="checkbox"/> Lake trout |
| <input type="checkbox"/> Largemouth bass | <input type="checkbox"/> Muskie | <input type="checkbox"/> Northern pike |
| <input type="checkbox"/> Rainbow trout / steelhead | <input type="checkbox"/> Smallmouth bass | <input type="checkbox"/> Walleye |
| <input type="checkbox"/> White bass | <input type="checkbox"/> Whitefish | <input type="checkbox"/> Yellow perch |
| <input type="checkbox"/> Other: _____ | | |

5. How would you rate your fishing skills compared to other anglers?

- | | | | | |
|----------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Much lower
than average | Lower than
average | Average | Higher than
average | Much higher
than average |

6. Have you purchased a fishing license between 2018 and 2020? Yes No

Boaters only (responded "yes" to screening question B)

In this section, we ask you to provide information about your recreational water experiences.

1. Which recreational activities have you participated in since 2018?

(select all that apply)

- Sailing Kayaking Canoeing
 Boating Jetskiing
 Other: _____

1b. Which activity do you participate in most frequently?

- Sailing Kayaking Canoeing
 Boating Jetskiing Other: _____
 More than one of these activities (explain): _____

2. In 2020, about how many days did you participate in the activity you selected in the previous question? _____ Days

3. About how many years, including this one, have you been participating in this activity? _____ Years

4. How would you rate your level of expertise in this activity compared to other recreationists?

- Much lower than average Lower than average Average Higher than average Much higher than average

All Respondents --

7a. Which of the following do you own? (select all that apply)

- Fishing boat Sailboat Powerboat
 Pontoon boat Jetski Canoe
 Kayak Other: _____ I do not own any type of boat or watercraft

7b. Please select the description of the boat you use most often.

(shown only to those screened in as a boater, or reported fishing from a boat (Q3))

- A boat that is trailered between fishing sites
 A boat that is docked or moored at one location for a season
 Other: _____

8. We would like to understand your familiarity with aquatic invasive species. How familiar are you with the following types of information?	Not at all familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Extremely familiar
a. The biological characteristics that make a species "invasive"	<input type="radio"/>				
b. Names of species that are considered invasive	<input type="radio"/>				
c. Ways that invasive species affect the environment	<input type="radio"/>				
d. How boaters and anglers can spread invasive species	<input type="radio"/>				
e. Types of actions you can take to prevent invasive species from spreading	<input type="radio"/>				
f. How to complete recommended preventative actions	<input type="radio"/>				
g. Agencies that are responsible for managing invasive species	<input type="radio"/>				
h. Management actions that reduce invasive species impacts	<input type="radio"/>				
i. The current state of invasive species management at your most frequented waterbody	<input type="radio"/>				

9. We would like to gauge your understanding of the species listed below. Which of the following species are considered invasive in Illinois?	Invasive	Not invasive	Not sure
a. Rusty crayfish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Channel catfish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Asian carps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Hydrilla	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Spiny waterflea	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Gizzard shad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. We would like to understand how important the issue of aquatic invasive species is to you. To what extent do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. The spread of aquatic invasive species is a personally relevant topic for me	<input type="radio"/>				
b. I think about aquatic invasive species a great deal	<input type="radio"/>				
c. I find myself bringing up aquatic invasive species in casual conversation	<input type="radio"/>				
d. When aquatic invasive species come up in conversation I "tune in"	<input type="radio"/>				
e. I don't care about aquatic invasive species	<input type="radio"/>				
f. Aquatic invasive species are never at the top of my mind	<input type="radio"/>				

Section 2 of 6: Aquatic Invasive Species Outreach Messages

We are testing outreach messages that can be used to inform anglers and boaters about how to minimize the spread of aquatic invasive species. We would like your feedback on one of these messages.

Respondents were selected at random to receive one of six experimental messages. An example of these messages is shown below.

BE A HERO TRANSPORT ZERO

Here are a few simple actions you can take to prevent aquatic invaders from spreading:

REMOVE

Remove plants, animals and mud from all equipment. Many invaders spread by attaching to boats, trailers, and other equipment. Plant fragments can create new populations and transport smaller invaders like zebra mussels.

It's quick!
A few minutes spent removing plants and animals significantly decreases the spread of invaders.

ZEBRA MUSSELS

DRAIN

Drain all water from your boat and gear. Pull drain plugs and remove water from all equipment prior to leaving a water access. Water should be drained from all water-containing equipment, such as portable bait containers, ballast tanks, motors, bilge tanks, livewells, and baitwells.

It's easy!
By draining all water, you can easily prevent live plants and animals from traveling with you.

DRY

Dry everything thoroughly with a towel. Wiping down your boat, trailer, and other equipment not only leaves you with clean gear, but also removes all the invaders you can't see, such as zebra mussel larvae and fish diseases like VHS. If possible, let your gear remain dry for at least 5 days.

It's effective!
Allowing your equipment to dry is a reliable way to kill off any potential invaders, especially smaller species you can't see.

PROTECT THE ENVIRONMENT

Aquatic invaders can dramatically change the ecosystem and harm native fish species. By completing remove-drain-dry, you can protect the quality of habitats and natural environments and build a sense of community among anglers and water users.

Remember:
Dispose of all unwanted bait and live fishers in the trash, and never release captured crabs from any voluntarily introduced.

SILVER CRAP

These tips don't just apply to boaters and anglers! Other activities can easily spread invaders, such as:

JETSKIING WINDSURFING SAILING KAYAKING WATERFOWL HUNTING BODYBOARDING
PADDLEBOARDING CANOEING SHORE AND FLY FISHING SCUBA DIVING SURFING

Report new sightings!
If you report a new sighting of an invasive plant or animal, take a picture and report it by visiting <http://www.wa.gov/dep/wsp/ASD> or calling your Wildlife Department in Pacific Northwest at 360-986-9226.

11. We are interested in everything that went through your mind while examining the infographic shown above. Please use the space below to list all thoughts, whether they were about yourself, the information, or others, as well as whether they were positive, negative, or neutral. There are no right or wrong answers.

12. We would like to understand your reactions to the message. While reading the message, were you....	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Deep in thought about the message	<input type="radio"/>				
b. Extending a good deal of cognitive effort	<input type="radio"/>				
c. Not really exerting your mind	<input type="radio"/>				
d. Doing your best to think about what was written	<input type="radio"/>				
e. Reflecting on the implications of the arguments	<input type="radio"/>				
f. Taking it easy	<input type="radio"/>				

13. We would like to know the effectiveness of the message you just evaluated. Please rate your level of agreement or disagreement with the following statements.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. The message was worth remembering	<input type="radio"/>				
b. The message grabbed my attention	<input type="radio"/>				
c. The message was powerful	<input type="radio"/>				
d. The message was meaningful to me	<input type="radio"/>				
e. The message was informative	<input type="radio"/>				
f. The message was convincing	<input type="radio"/>				

14. We would like to understand your perceptions of the message you just evaluated. Please rate your level of agreement or disagreement with the following statements.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. The message was very objective	<input type="radio"/>				
b. The message tried to pressure me to think a certain way	<input type="radio"/>				
c. The message did not try to force its opinions on me	<input type="radio"/>				
d. The message was very believable	<input type="radio"/>				
e. The message was not very credible	<input type="radio"/>				
f. The message tried to manipulate me	<input type="radio"/>				
g. I felt like the message was trying to persuade me	<input type="radio"/>				

15. What information would be helpful for you to know about aquatic invasive species? What do you think should be included in a brochure like the one you reviewed?

16. We would like your input on the best ways of disseminating information such as what you read in the brochure. How useful would the following resources be for you to learn about aquatic invasive species?

	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
Workshops on aquatic invasive species prevention	<input type="radio"/>				
Educational exhibits or displays	<input type="radio"/>				
Booths at a sports or fishing show	<input type="radio"/>				
Outreach activities at boat launches	<input type="radio"/>				
Newspaper, magazine, or newsletter articles	<input type="radio"/>				
Television news or programs	<input type="radio"/>				
Television public service announcements	<input type="radio"/>				
Radio news or programs	<input type="radio"/>				
Radio public service announcements	<input type="radio"/>				
Brochures and fact sheets	<input type="radio"/>				
Species identification cards	<input type="radio"/>				
Internet websites	<input type="radio"/>				
YouTube videos	<input type="radio"/>				
Social media posts (Facebook, Twitter, etc.)	<input type="radio"/>				
Scholarly articles	<input type="radio"/>				
Public meetings regarding natural resources	<input type="radio"/>				

17. We are also interested in the sources of information that you rely on the most. How reliable are the following sources for information about invasive species?

	Not at all trustworthy	Slightly trustworthy	Moderately trustworthy	Very trustworthy	Extremely trustworthy
Family members, friends, or neighbors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Government employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volunteers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bait shop vendors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Members in boating or angling clubs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sales associates at boating or fishing stores	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Charter captains	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Environmental groups	<input type="radio"/>				
Other anglers	<input type="radio"/>				

Section 3 of 6: Risks of aquatic invasive species

In the following questions, we would like to understand your perceptions of the risks associated with the spread of aquatic invasive species.

18. This question is about the likelihood that invasive species will spread to the waterway that you visit most often. In your opinion, what are the chances...

	0	10	20	30	40	50	60	70	80	90	100%
that invasive species will spread to your waterbody within the next year	_____										
that invasive species will spread to your waterbody within the next ten years	_____										
that humans will be able to prevent invasive species from spreading to your waterbody	_____										

19. If invasive species spread to your most frequented waterbody, how intense would you expect the impacts to be? Please indicate the intensity of potential harm to...

	No impacts	Mild impacts	Moderate impacts	Severe impacts	Very severe impacts
a. Quality of habitat and natural environments	<input type="radio"/>				
b. Environmental processes (e.g., water cycle)	<input type="radio"/>				
c. Survival of plants and animals	<input type="radio"/>				
d. Your appreciation of the beauty of the landscape	<input type="radio"/>				
e. Your own enjoyment of recreational activities	<input type="radio"/>				
f. Your own access to the waterbody	<input type="radio"/>				
g. The local economy	<input type="radio"/>				
h. The community in the region	<input type="radio"/>				
i. Recreational opportunities for future generations	<input type="radio"/>				

Section 4 of 6: Preventing the spread of aquatic invasive species

In this section, we ask you to reflect on the actions you could take to prevent aquatic invasive species from spreading.

There are two behavior questions, one reflecting transport on the boat, and one on the fishing equipment. Respondents who reported boating but not fishing receive 20a, respondents who reported fishing from the shoreline online receive 20b, respondents who boat and fish (or fish from boats) receive both batteries of questions.

20a. There are several ways to prevent accidentally transporting invasive species on your boat. Think about your boating trips over the next 12 months. How frequently do you plan to engage in the following activities?

	Never	Occasionally	About half the time	Most of the time	Every time I go boating
a. Drain all standing water from the boat	<input type="radio"/>				
b. Conduct visual inspections of boats for invasive species	<input type="radio"/>				
c. Remove plants, animals, and mud from the boat	<input type="radio"/>				
d. Rinse boat and trailer	<input type="radio"/>				
e. Wipe down hull with a towel	<input type="radio"/>				
f. Allow boat to dry before entering a different body of water	<input type="radio"/>				

20b. There are several ways to prevent accidentally transporting invasive species on your fishing equipment. Think about your fishing trips over the next 12 months. How frequently do you plan to engage in the following activities?

	Never	Occasionally	About half the time	Most of the time	Every time I go fishing
a. Remove any non-bait fish, plants, and other "hitchhikers" from bait bucket	<input type="radio"/>				
b. Dispose of unused live bait in the trash	<input type="radio"/>				
c. Drain water from bait bucket before moving to another waterbody	<input type="radio"/>				
d. Conduct visual inspections of fishing equipment for invasive species	<input type="radio"/>				
e. Remove plants, animals, and mud from fishing equipment	<input type="radio"/>				
f. Rinse fishing equipment	<input type="radio"/>				
g. Wipe down fishing equipment with a towel	<input type="radio"/>				
h. Allow fishing equipment to dry before fishing in a different body of water	<input type="radio"/>				

All respondents receive the rest of the survey; no further skip patterns or display logic.

21. We would like to understand how you view your ability to mitigate the impacts from aquatic invasive species. How strongly do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I understand what I need to do in order to remove invasive species from my boat or equipment.	<input type="radio"/>				
b. I am capable of performing the tasks required to remove possible invasive species from my boat and equipment	<input type="radio"/>				
c. I feel confident in performing procedures necessary to prevent aquatic invasive species from spreading	<input type="radio"/>				
d. Cleaning my boat and equipment helps to prevent invasive species from spreading	<input type="radio"/>				
e. My own actions to <i>remove, drain, and dry</i> will protect fishing waters from invasive species	<input type="radio"/>				
f. If everyone remembered to "remove, drain, dry", we could significantly lower the risk of spreading invasive species	<input type="radio"/>				

22. There are many reasons it may be beneficial to complete the recommended aquatic invasive species prevention tasks. Please rate your level of agreement or disagreement regarding the following reasons.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
<i>Completing "remove, drain, dry" results in...</i>					
a. Increasing my own knowledge and understanding of the ecosystem	<input type="radio"/>				
b. Improved maintenance of my boat or equipment	<input type="radio"/>				
c. Knowing that I have done the right thing to be a responsible water user	<input type="radio"/>				
d. A sense of community among water-based recreationists	<input type="radio"/>				
e. Teaching younger generations about the impact of our behaviors on the environment	<input type="radio"/>				
f. Preserving aquatic resources for my community	<input type="radio"/>				
g. A healthier ecosystem	<input type="radio"/>				
h. More sustainable populations of plants and animals	<input type="radio"/>				
i. Better water quality	<input type="radio"/>				

23. There are many reasons it may be difficult to complete the recommended aquatic invasive species prevention tasks. Please rate your level of agreement or disagreement regarding the following reasons.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I do not have enough time to complete the recommended cleaning tasks that minimize the spread of invasive species	<input type="radio"/>				
b. I feel pressure from other recreationists to leave the site without cleaning my boat or equipment	<input type="radio"/>				

c. I lack the necessary equipment to effectively clean my boat or equipment	<input type="radio"/>				
d. Poor weather conditions often interfere with my ability to complete the recommended cleaning tasks	<input type="radio"/>				
e. My health or physical abilities prevent me from effectively cleaning my boating or fishing equipment	<input type="radio"/>				

Section 5 of 6: Environmental Values and Trust

In this section, we ask you to think about your personal values. This information will help decision makers understand what you care about most.

24. These questions are about the things you value most. Please rate the extent to which you consider these general ideas to be guiding principles in your life.

	Unimportant	Of Little Importance	Moderately Important	Important	Very Important
a. Protecting the environment: preserving nature	<input type="radio"/>				
b. Unity with nature: fitting into nature	<input type="radio"/>				
c. A world of beauty: beauty of nature and the arts	<input type="radio"/>				
d. Equality: equal opportunity for all	<input type="radio"/>				
e. Social justice: correcting injustice, care for others	<input type="radio"/>				
f. A world at peace: free of war and conflict	<input type="radio"/>				
g. Authority: the right to lead or command	<input type="radio"/>				
h. Social power: control over others, dominance	<input type="radio"/>				
i. Influential: having an impact on people and events	<input type="radio"/>				
j. Fulfilment of desire: food, fun, pleasure	<input type="radio"/>				
k. Enjoying life: pursuing hobbies, leisure, socializing	<input type="radio"/>				
l. Reducing worries: seeking comfort and relaxation	<input type="radio"/>				
m. Personal growth: development of new skills, learning, or gaining insight into something	<input type="radio"/>				
n. Pursuit of excellence: attaining a personal ideal in life	<input type="radio"/>				
o. Autonomy: deciding your own future and doing what you believe in	<input type="radio"/>				
p. Satisfaction with life: finding meaning, value, and relevance to a broader context	<input type="radio"/>				

25. Scientists provide information about fisheries in lakes and rivers throughout the state of Illinois. We would like to know how much you trust the scientific community. To what extent do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I have very little confidence in the scientific community.	<input type="radio"/>				
b. Information from the scientific community is trustworthy.	<input type="radio"/>				
c. I trust the scientific community to do what's right.	<input type="radio"/>				
d. The scientific community often does not tell the public the truth.	<input type="radio"/>				
e. I am suspicious of the scientific community.	<input type="radio"/>				
26. Fisheries and other recreational activities in Illinois are primarily managed by the Department of Natural Resources (DNR). We would like to know how much you trust this agency. To what extent do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
f. I have very little confidence in the Illinois Department of Natural Resources.	<input type="radio"/>				
g. Information from the Illinois Department of Natural Resources is trustworthy.	<input type="radio"/>				
h. I trust the Illinois Department of Natural Resources to do what's right.	<input type="radio"/>				
i. The Illinois Department of Natural Resources often does not tell the public the truth.	<input type="radio"/>				
j. I am suspicious of the Illinois Department of Natural Resources.	<input type="radio"/>				

Section 6 of 6: About You

26. What is your gender? Male Female Other

27. In what year were you born? _____

28. What is your annual household income (in USD) before taxes? (Please ✓ one)

- | | | |
|--|---|---|
| <input type="radio"/> Less than \$24,999 | <input type="radio"/> \$25,000-\$49,999 | <input type="radio"/> \$50,000-\$74,999 |
| <input type="radio"/> \$75,000-\$99,999 | <input type="radio"/> \$100,000-\$124,999 | <input type="radio"/> \$125,000-\$149,999 |
| <input type="radio"/> \$150,000-\$174,999 | <input type="radio"/> \$175,000-\$199,999 | <input type="radio"/> \$200,000 and over |
| <input type="radio"/> Prefer not to answer | | |

29. What is the highest level of education you have completed? (Please ✓ one)

- | | | |
|---|---|---------------------------------------|
| <input type="radio"/> Some high school | <input type="radio"/> High school graduate or GED | <input type="radio"/> Two-year degree |
| <input type="radio"/> Bachelor's degree | <input type="radio"/> Professional certificate | <input type="radio"/> Graduate degree |

30. With which racial group(s) do you identify? (Please ✓ all that apply)

- | | |
|-----------------------------|---|
| <input type="radio"/> White | <input type="radio"/> Black or African American |
|-----------------------------|---|

- Asian Native Hawaiian or other Pacific Islander
 American Indian Other: _____

31. With which ethnicity do you identify?

- Hispanic Non-Hispanic

32. Which language are you most comfortable reading? _____

33. What is your zip code? _____

Thanks for your help!

If you have any additional thoughts about this study that were not reflected in the questions above, please share them here.

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