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A Study of Angler Behavior and the Spread of Aquatic Invasive Species in the Great Lakes Region

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EXECUTIVE SUMMARY

Mounting evidence suggests the unintentional spread of aquatic invasive species (AIS) stemming from human behavior is degrading aquatic ecosystems in the Great Lakes region. Understanding the reasons why anglers make decisions and express preferences for future management scenarios is fundamentally important for effectively communicating with public audiences and developing strategies to encourage behavior that minimizes human impact on the environment. Effective fisheries management therefore requires knowledge of the factors that shape how anglers make decisions and engage in behaviors related to the spread of AIS. This research was designed to support evidence-based decisions about angler concerns, beliefs, and preferences for the future of the Great Lakes region, particularly among individuals who live adjacent to Lake Michigan and Lake Ontario.

We designed this study to generate information that will help agencies address fishery management goals for effectively communicating with and engaging recreational anglers. Through a mailback survey conducted in four US states, an on-site survey in one US state and an online survey in the Canadian province of Ontario, we collected data on the three topics listed below. Three objectives guided this work. Specifically, we quantified the effects of psychological processes on angler behaviors relevant to the spread of invasive species, determined angler preferences for tradeoffs among fishing scenarios, and compared anglers' psychological processes and preferences across anglers in Lake Michigan and Lake Ontario.

This report is organized into these three sections to share our key findings relevant to closing the knowledge-action gap and stopping the spread of AIS, in the general context of the pooled sample of Great Lakes anglers, as well as subcategories of respondents living adjacent to Lake Michigan and to the US side of Lake Ontario.

1. Descriptive Information about Recreational Anglers
    - History of fishing participation
    - Location of fishing activities
    - Species targeted
    - Primary information sources
    - Socio-demographic characteristics

2. Environmental Behavior and Drivers of Change
    - "Short-term" drivers of behavior including knowledge, norms, self-efficacy, risk perceptions, and trust
    - "Long-term" drivers of behavior including individual and cultural values
    - Integration of short- and long-term drivers of angler behavior

3. Evaluations of Fishing Scenarios
    - Angler preferences for the future
    - Economic value of fishery characteristics

Summary of Descriptive Information about Recreational Anglers

- This report draws on findings generated through a mixed mode survey of 1,981 license holding anglers contacted in five US states and the Canadian province of Ontario.
- Survey respondents were experienced given an average of 40 years of previous fishing experience and nearly one month out of the year (2018) spent fishing. Above average fishing skills were also reported.
- Anglers were not extremely familiar with "certified bait (free of exotic species or diseases)" yet frequency of using live baitfish occurred "sometimes." Also, live baitfish was "sometimes" kept for later use. On the US side of Lake Ontario, there was higher reported familiarity with certified bait than around Lake Michigan, yet more respondents near Lake Ontario disposed of live baitfish on the ground and fewer disposed of live baitfish in trashcans. Anglers around the two study lakes require different strategies for communication and management of live bait use.
- The fishing locations of anglers were organized into three categories to guide future engagement and understanding of these groups:
    1) Great Lakes and tributary anglers
    2) Inland waterway anglers
    3) Mixed-site anglers
- Half of the survey respondents included in this study were classified as "mixed site anglers" that moved between inland waterways and the Great Lakes or its tributaries. These individuals are a key subgroup given their movement and therefore risk of spreading AIS across aquatic ecosystems.
- More respondents on the US side of Lake Ontario fished in the Great Lakes and its tributaries whereas more respondents around Lake Michigan fished in inland waterways.
- Anglers were asked about their time spent fishing from a boat versus the shoreline, and our results showed that 60% spent more time fishing from a boat.
    - For the individuals who owned a boat, questions were asked to determine their mobility and, therefore, risk of spreading AIS. Just over half in the pooled sample trailered their boat between fishing sites and approximately one quarter kept their boat docked at one location. More respondents around Lake Michigan trailered their boat between fishing sites.
- The species targeted by anglers were highly variable and differed between Lake Michigan and Lake Ontario. Among the 21 different fish species evaluated in this study, the species targeted by more than half of respondents included bluegill (58.1%), walleye (56.0%), yellow perch (53.7%), and largemouth bass (53.2%).
- An analysis of the primary species targeted resulted in the identification of three primary subgroups that should be considered and further analyzed by agencies, including:
    1) <u>Salmon and/or trout</u> targeted by two out of ten respondents
    2) <u>Walleye, bass, pike, and/or perch</u> targeted by just over half of respondents
    3) <u>Other fish species</u> targeted by approximately three out of ten respondents

- Anglers learn about AIS through a variety of information sources; key sources are the same for anglers in Lake Michigan and US Lake Ontario.
    - The most common sources included print newspapers, other anglers, friends and family, environmental groups, and social media.
    - The least common sources were scholarly articles, government websites and public meetings
    - The results from this study concerning information sources can be used as a guide for engagement and communication with anglers living around Lake Michigan and Lake Ontario.
- A variety of socio-demographic characteristics were reported. The most striking results indicated anglers were mostly male, White, and over 50 years of age.

Summary of Environmental Behavior and Drivers of Change

- Engagement in behaviors that minimized the spread of aquatic invasive species was markedly low. Most anglers either never or only sometimes took action at the individual level and few took actions that involved either other people or the broader public.
- Our analysis of short-term drivers of behavior showed there were high feelings of moral obligation to take action that would minimize the spread of AIS. To positively influence environmental behavior, agencies should consider strategies for invoking feelings of pride, guilt, and/or worry (i.e. emphasize the relationship between anglers and their fishing environment). Activating norms through these feelings is a powerful tool for behavior change.
- There were strong beliefs that people had the capabilities to take actions that would minimize the spread of AIS. Agencies should strive to maintain these levels of self-efficacy among recreational anglers through four pathways:

    1) Highlight the wins of environmental protection to establish 'mastery' over the way anglers think about their influence on AIS

    2) Share success stories among everyday people so other anglers can live vicariously through these experiences

    3) Identify and showcase the actions, principles and achievements of role models that are minimizing the spread of AIS

    4) Create opportunities that facilitate the emotional and mental well-being of anglers to positively influence self-efficacy.
- Respondents had high knowledge of aquatic invasive species in the Great Lakes region according to a four-question quiz that was developed to gauge understanding of invasive species, resource management, and the role of anglers in spreading AIS. This finding aligns with previous research indicating that knowledge of AIS is on the rise among recreational anglers.
- Results showed that anglers were concerned with the hazards related to AIS, particularly the threat that would be imposed on communities rather than individuals. When communicating about AIS, agencies should aim to develop policy options that lessen these concerns. Strategies should be designed to cope with the uncertainty

people hold concerning the spread of AIS, particularly if the spread will influence entire communities rather than individuals.

- Respondents were largely neutral with respect to how much they trusted their state government to manage the Great Lakes fishery. We observed that skepticism was higher than general trust.
- Long-term drivers of behavior were examined to determine the deeply held, core beliefs that influence angler decision-making and behavior.
- Biospheric (i.e., concern for non-human species) and eudaimonic values (i.e., concern for long-term care for oneself) were the most important whereas egoistic value (i.e., self-interest) was the least important guiding principle in life. Biospheric and eudaimonic values positively correlated with AIS prevention behavior (Shin & van Riper, in prep).
    - Value-based messages should emphasize goals such as environmental protection and unity with nature, alongside the long-term gains that people can receive for 'living a good life' through AIS reduction. This strategy will be more likely to motivate action, whereas messaging about fisheries management that relates to equality, social justice, and peace will be less likely to resonate.
- Cultural values were examined to understand how anglers saw their roles in society. When asked about statements that represented individualism or communitarianism, respondents indicated stronger agreement with individualism, indicating that government intervention should be de-emphasized when communicating about the process around AIS management. With respect to differences in egalitarian versus hierarchical cultural values, anglers indicated ambivalence in their responses.
    - Result from an assessment of cultural values indicates that anglers will respond equally well to message frames that emphasize the equality of effects of AIS on different groups in society *and* the importance of designated roles and top-down decision-making to sustain aquatic ecosystems.
- Future research should focus on the integration of short- and long-term drivers of behavior to better understand how and why anglers make decisions that influence the spread of AIS.
    - Results from an assessment of respondents from IL, MI and NY showed that angler behavior could be better understood and predicted by risk perceptions and values. This is useful because behavior is complex, difficult to change, and influenced by both short-term (e.g., risk perceptions) and long-term (i.e., values) factors that are rarely considered concurrently.
    - Cultural values help explain how people perceive risks from the spread of AIS.
        - Egalitarian values positively correlated with core beliefs for environmental protection (i.e., biospheric values), which positively influenced anglers' perceptions of AIS-related risk. Therefore, outreach messages should aim to activate biospheric values by emphasizing how AIS threaten the beauty of nature.
        - Communitarian cultural values predicted egoistic individual values, which also led to higher personal risk perceptions. These relationships suggest another messaging approach that aims to activate communitarian and

egoistic values by highlighting opportunities to be a leader in the angling community by participating in AIS prevention.

- Social risk perceptions are greater than personal risk perceptions; however, personal risk perceptions are the primary drivers of behavior. Thus, decision-makers should encourage anglers to envision how AIS will affect themselves through strategies such as personal anecdotes about how AIS have destroyed the environmental quality of a favorite fishing site.

Summary of Anglers' Evaluations of Future Fishing Scenarios

- Angler preferences for hypothetical fishing scenarios were examined to understand tradeoffs related to AIS impacts and management. In response to informal discussions with Lake Committee managers and pilot testing, we developed the following five features:
    1. Wash stations: Locations near boat ramps where anglers can disinfect and pressure-wash boats to stop AIS from spreading.
    2. Willingness to pay: Cost that could be voluntarily added to each fishing trip for invasive species control and prevention efforts in the Great Lakes.
    3. Amount of native fish: Total population of native fish species found in the Great Lakes
    4. Impact from invasive species: Degradation caused by organisms that are outside of their historic range and harming the environment
    5. Fish habitat: The quality of the environment for supporting fish species
- In a series of questions, anglers were asked to choose between two scenarios that included varying levels of the five features listed above.
    - We observed that all five features significantly influenced respondent preferences for the future. Our model accounted for a moderate degree of variation.
    - The probability of choosing a scenario increased with the presence of voluntary or mandatory wash stations, lower costs per fishing trip, a greater amount of native fish species, less impact from invasive species, and increased quality of fish habitat.
- The discrete choice experiment included a "willingness to pay" feature that was presented to anglers as the cost they would be willing to add to each of their fishing trips in the future.
    - In an analysis of cost in relation to the other four features assessed in the experiment, we observed the quality of fish habitat was most valuable, followed by minimizing impacts from invasive species and then availability of wash stations at boat ramps. Conversely, the amount of native fish species was not of great value according to survey respondents.

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BACKGROUND

Recreational anglers are instrumental in the unintentional spread of invasive species that are threatening aquatic ecosystems across the Great Lakes region. Communication and engagement with anglers will be more effective if informed by social science research on why people make decisions to engage in behavior. A variety of factors influence people's decisions, particularly descriptive information about angling experiences, the short- and long-term drivers of behavior, and preferences for future fishing scenarios. This information can be shared with numerous agencies and organizations that interface with recreational anglers. **Therefore, we studied how and why anglers make decisions that influence management of AIS with an eye toward supporting the development of effective, consistent, and relevant communication strategies to prevent the spread of AIS.**

METHODS

Data Collection and Sampling

During June – August 2019 questionnaires were distributed to license-holding anglers (see Figure 1). We applied three different sampling strategies to engage anglers in **the counties that bordered Lake Michigan and Lake Ontario in the US and anglers in Ontario, CA (N = 1,981)** While our survey instrument remained largely the same across all three samples, some questions were excluded at the request of select state-based agencies.

Sample 1: Mixed mode survey: The first sample included anglers in the US states of Illinois, New York, Michigan, and Wisconsin. Within each state, we used management records to draw random independent samples of 1,200 individuals who purchased a non-commercial fishing license during 2017 and lived in a county directly adjacent to Lake Michigan or Lake Ontario (see Appendix 1 for included counties). From our initial sample of 4,800, we excluded 576 points due to outdated addresses, deceased respondents and individuals who indicated they were sick and unwilling to participate. **A total of 1,120 questionnaires were returned resulting in a 27% response rate.** Following the Tailored Design Method (Dillman et al., 2014), each potential respondent was contacted on multiple occasions. Our contact protocol consisted of an

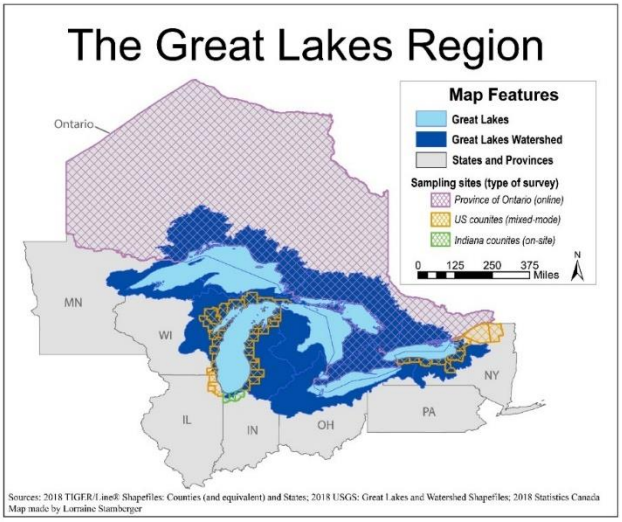

Figure 1. Study context for the three samples of anglers engaged in the research

Figure 2. Data collection for the on-site survey along the Lake Michigan shoreline in Indiana

introductory letter, three survey waves of the questionnaire and cover letter, and two reminder postcards. A $1 incentive was included in the first mailing and respondents were given the opportunity to complete the survey online.

Sample 2: On-site survey: The second sample included recreational anglers who were contacted at boat ramps along the Indiana shoreline of Lake Michigan. Trained survey administrators wearing University of Illinois uniforms approached all individuals who were fishing or possessed fishing gear and invited them to participate in the study (see Figure 2). The survey administrator completed an on-site log for the contact, noting reason for refusal if offered. Individuals who accepted were provided a postage paid envelope, questionnaire and cover letter. The survey administrator assured the respondent that the information provided would be kept completely confidential. Individual respondents who were 18 years or older were selected at random, and for groups, the individual with the most recent birthday was invited. **A total of 363 people agreed to participate (on-site response rate = 85%) and 60 people returned the questionnaire (mailback response rate = 17%).** Surveys were conducted at five sampling locations selected in consultation with the Indiana Department of Natural Resources: 1) Marina Shores, 2) Portage Public Marina, 3) Riverwalk Pier, 4) Trail Creek, and 5) Washington Park. Survey administration occurred on different days of the week (weekend vs weekday) and time of day (a.m. vs. p.m) (see Appendix 2 for sampling stratifications). Although the sampling strategy was designed to provide a reliable estimate of anglers, the results are representative only of the people during the sample periods and do not necessarily apply to people during other times of the year. Thus, the findings should be considered a "snapshot" in time.

Sample 3: Online survey: The third sample included anglers from the Canadian province of Ontario, where an online version of the questionnaire was distributed to all registered users of the fishing application called, "Anglers Atlas" (https://www.anglersatlas.com/). Data collection occurred online, and a two-contact protocol was adopted consisting of an introductory email that included a link to an online version of the questionnaire and one follow-up reminder email. The population of anglers subscribed to Anglers Atlas included 31,299 individuals, all of whom were contacted for this study. A total of 24,357 individuals never opened their emails and were therefore excluded from the sample. Therefore, 6,942 respondents were invited to participate in the study, **801 of whom agreed to participate resulting in a response rate of 12%.** After data cleaning, 760 respondents were entered into the analysis.

Sampling Bias Assessment

Analyses were performed to test how well the data collected represented the target population of anglers in the Great Lakes through our three modes of data collection, including 1) a mixed mode survey with mailback and online options presented to license holding anglers in four US states, 2) an on-site survey administered to anglers in Indiana, and 3) an online survey of Canadians subscribed to Anglers Atlas. Each sample was compared with samples collected in past research that studied similar populations to identify bias that may have emerged from our sampling methods.

Sampling bias from mixed mode survey

Comparisons were performed between our sample and previous studies about AIS and angler behavior in the Great Lakes to identify differences in gender and days fished between samples. A comparison of our sample with anglers from Michigan, New York, Wisconsin, and Illinois in a prior study (Connelly et al., 2014) revealed no significant differences in gender (χ^2 = 0.1674; p = 0.682). We also assessed days fished between our sample and a study of anglers in the broader Great Lakes region (Ready et al., 2012); no significant difference in days fished was found (t-stat(df=2636)=.2602; p=.795).

Sampling bias from on-site survey

Non-response bias was assessed for the on-site survey of anglers conducted along the Lake Michigan shoreline of Indiana. Results revealed that the average group size for the population of respondents contacted on-site was 2.07 people (*SD* = 1.31) and the majority (92.82%) were males. In a comparison between the people who refused to participate and those who agreed, no bias was detected on the basis of group size (F = 1.498; df = 411; p = 0.222) and gender (χ^2 = 0.725; p = 0.395) across the five sampling locations. We also tested for differences between the total number of people who returned their questionnaires by mail and those who did not return the survey and found that no bias existed on the basis of group size (F = 1.488; df = 351; p = 0.223) and gender (χ^2 = 0.001; p = 0.969).

Non-response bias for on-line survey

Respondents to the online Canadian survey were compared with respondents from previous research conducted with Ontario anglers (OMNRF, 2015, 2017). One sample t-tests (continuous variables) and chi-square tests (categorical variables) were performed to compare age, gender, license type, days fished, and years fished. We found significant differences in years fished between the OMNF (2017) sample (*M* = 31.96, *SD* = 17.05) and our sample (*M* = 36.89, *SD* = 16.15) (t-stat=7.007; df = 4363; p < 0.001). Gender differences existed as well, in that OMNF (2015) respondents were 78% male whereas our respondents were 92% male (χ^2 = 11.203, p < 0.001). No significant difference was found in our comparisons between the license type purchased (χ^2 = 0.0202; p = .887).

Pilot Test

To prepare for data collection and analysis, the survey questionnaire underwent two rounds of pilot testing and adjustments. First, a focus group with graduate students from the Illinois Natural History Survey and the American Fisheries Society (AFS) chapter at the University of Illinois (n = 6) was held in in May, 2018. To collect feedback, a verbal protocol assessment was used to walk students through the survey on an individual basis and ask them to think out loud while taking the survey. This methodology is often applied to prepare for data collection involving stated choice experiments to minimize cognitive burden and complexity of the exercise (Cahill et al., 2007). Second, an online pilot test occurred in June 2018 with AFS chapter members from both Illinois (n = 45) and New York (n = 76). A total of 695 people were contacted on two occasions, 102 of whom agreed to participate in the study, resulting in a response rate of 14%. The data generated from this online survey were analyzed and referenced to modify the questionnaire. These various forms of feedback enabled us to: a) tune the wording of survey items; b) diagnose any methodological potential problems with our survey (e.g., completion rates); c) generate prior estimates for an efficiency analysis used to refine the experimental design of the stated choice experiment; and d) increase the likelihood of science transfer at the conclusion of the project in response to stakeholder needs and management concerns.

Data Analysis and Entry

All mailback survey questionnaires were coded manually by a team of five students over the course of a three-month period with 2% being double coded to ensure intercoder reliability. Surveys were returned from June through September 2019 (see Figure 3). Data cleaning, descriptive statistics and mean value comparisons were performed in Stata 15, SPSS 24, and R Studio packages. Analysis for the stated choice experiment was performed in Nlogit, while structural equation modeling techniques were performed in MPlus and R Studio.

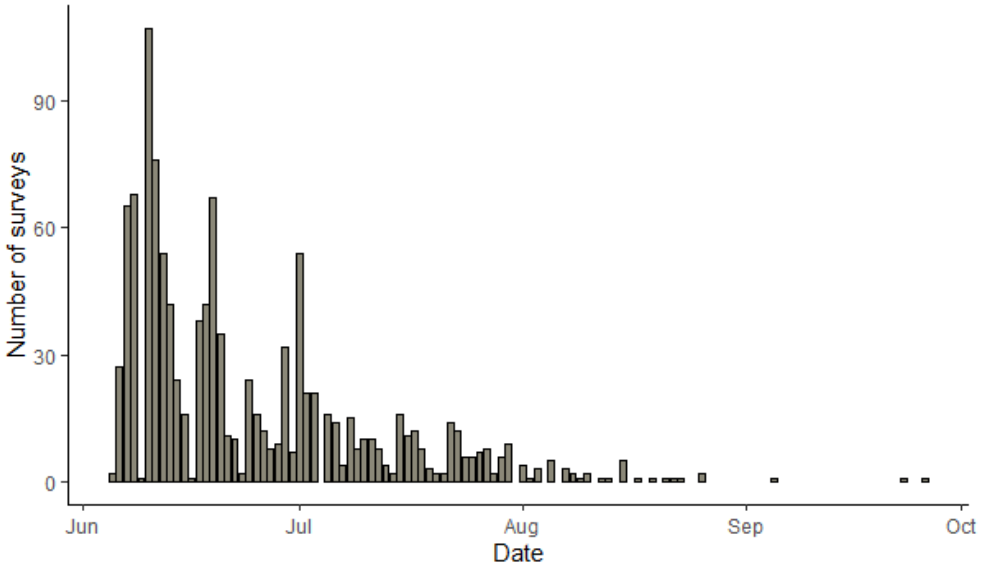

Figure 3. Arrival date for all surveys returned from US anglers engaged in this research

Respondent Locations

Respondents to the mail survey were distributed across Wisconsin (N = 298), Illinois (N = 270), Michigan (N = 289), and New York (N = 229). Given that respondents were selected based on the county in which they purchased their fishing license, most were clustered around Lake Michigan and Lake Ontario, but several were outside of these ranges, showing where anglers who fish in the Great Lakes live albeit at a distance (see Figure 4). The distribution of Indiana anglers (N = 60) reflects where they were sampled along the Lake Michigan shoreline. Canadian respondents recruited through Angler's Atlas (N = 760) were clustered around higher population regions (i.e., Toronto).

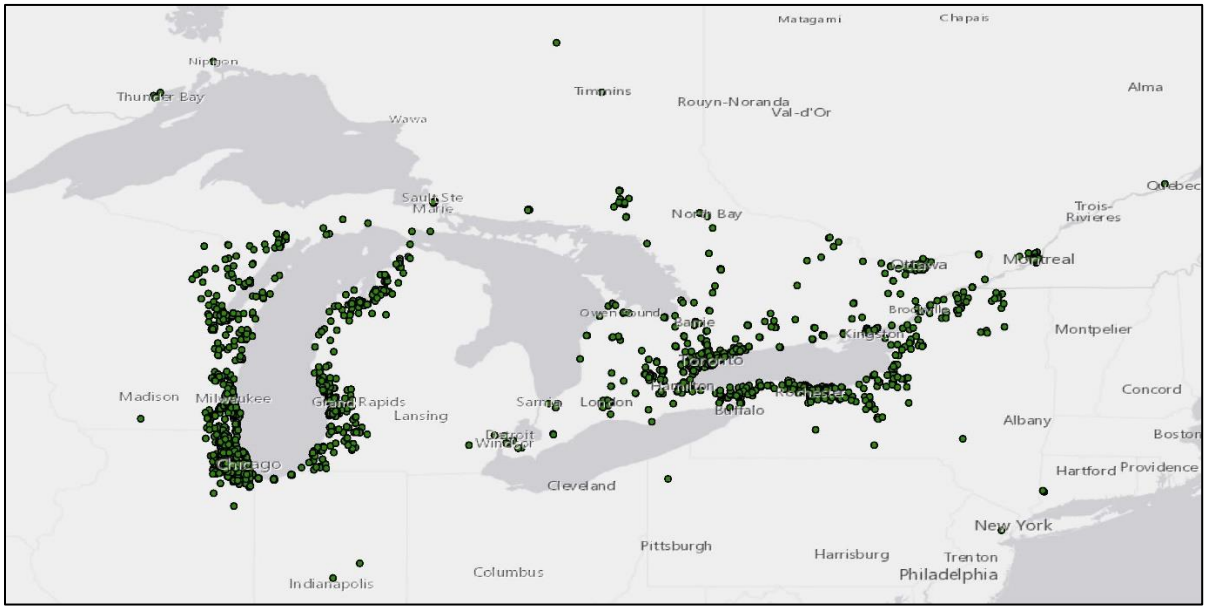

Figure 4. Graphical representation of the approximate locations of survey respondents. Each point represents the approximate mailing address of a respondent who returned a survey, or, in the case of online respondents, their approximate location according to their IP address.

RESEARCH RESULTS

This section presents results using a series of tables and figures, particularly frequency distributions for each individual 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. Results are divided into three samples that reflect the scope of work funded by the Great Lakes Fishery Commission, including the pooled sample, respondents in states bordering Lake Michigan and the US state bordering Lake Ontario (New York). Individual state reports and a report on findings from anglers on the Canadian side of Lake Ontario are presented in the Appendix.

Descriptive Information about Recreational Anglers

History of fishing participation

Survey respondents were asked to share their history of participation in fishing activities (see Table 1). On average, nearly one month out of the year was spent fishing according to the pooled sample (M = 28.66, SD = 36.85) and similar patterns emerged for the two subgroups defined by their proximities to Lake Michigan (M = 29.23, SD = 37.83) and Lake Ontario (M = 26.36, SD = 32.46). Given the large variation in responses for these two experience-use-history questions, further examination of the data indicated a distribution that was right skewed (skewness=4.027; see Figure 5). The total number of years of fishing experience was also similar across the pooled sample (M = 40.49, SD = 17.93), Lake Michigan respondents (M = 40.66, SD = 17.99) and Lake Ontario respondents in the US (M = 39.75, SD = 17.78). Total years spent fishing showed a distribution closer to normal (skewness = -0.277; see Figure 6).

Table 1. Previous experiences and self-reported skill levels among recreational anglers

Previous experience	**Pooled sample** M (SD)	**Lake Michigan** M (SD)	**Lake Ontario in US** M (SD)
Total number of days fishing in 2018	28.68 Mo[1] = 20.00 (36.85)	29.23 Mo = 20.00 (37.81)	26.36 Mo = 20.00 (32.46)
Total number of years fishing[2]	40.49 Mo = 50.00 (17.94)	40.68 Mo = 50.00 (17.98)	39.75 Mo = 50.00 (17.78)
Fishing skills in comparison to other anglers[3]	3.72 (1.44)	3.74 (1.42)	3.66 (1.53)

[1]Mode number of days fished based on the sample data

[2]Estimate included fishing activities in 2018

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

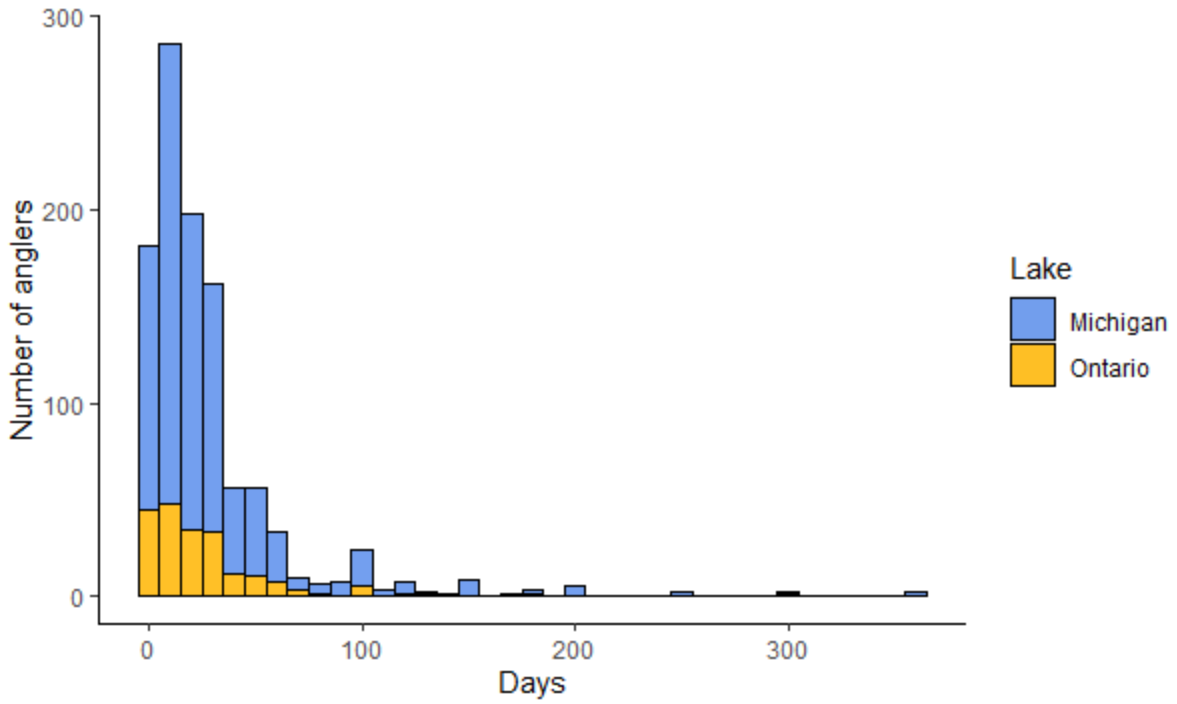

Figure 5. Total days fished in 2018 for respondents living near Lake Michigan and Lake Ontario

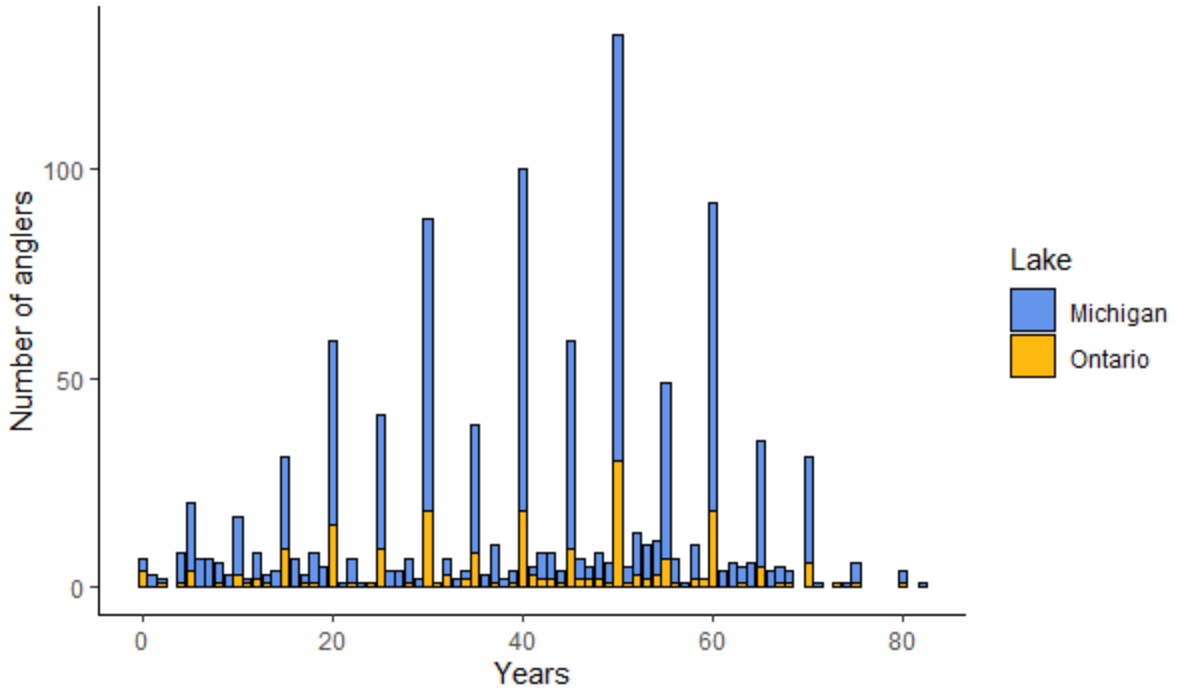

Figure 6. Total years fished including 2018 for respondents living near Lake Michigan and Lake Ontario

Reported skill levels were also evaluated to better understand the history and specialization of recreational anglers engaged in this study (see Table 1). Skill levels were slightly above average.

Respondents in the pooled sample indicated their fishing skills in relation to other anglers were 3.72 (*SD* = 1.44) on a scale from 1 – 5. Respondents living around Lake Michigan reported an above average skill level at 3.74 (*SD* = 1.42), as did Lake Ontario respondents in the US with a value of 3.66 (*SD* = 1.53).

Questions about familiarity and use of live bait showed familiarity with "certified bait (free of exotic species or diseases)" was low (see Table 2). However, results from an Independent-Sample t-test indicated there were significant differences between subgroups. Respondents in the Lake Ontario subgroup had more familiarity with certified bait than did Lake Michigan respondents (t-stat (df = 1,112) = 4.95, $p < 0.001$). Frequency of using live baitfish occurred "sometimes," in that the pooled sample reported an average score of 2.95 (*SD* = 1.19) on a scale from 1 – 5. Three behaviors related to baitfish disposal were examined, two of which differed between subgroups. Despite having higher reported familiarity with certified bait, more respondents near Lake Ontario disposed of live baitfish on the ground (t-stat (df = 214) = 4.52, $p < 0.001$) with equal variances not assumed according to results from the Levene's test for equality of variances. Analyses also showed fewer respondents near Lake Ontario disposed of baitfish in trash cans as compared to anglers living near Lake Michigan (t-stat (df = 860) = 5.27, $p < 0.001$). An equal number of respondents in the two subgroups reported "often" keeping baitfish for later use (t-stat (df = 873) = 1.20, $p < 0.229$).

Table 2. Familiarity and use of live bait

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario (US)** M (SD)
Familiarity with "certified" bait (free of exotic species or diseases)[1]	2.24 (1.24)	2.15 (1.20)*	2.60 (1.32)*
Frequency of using live baitfish while fishing[2]	3.13 (1.14)	2.98 (1.19)	2.86 (1.18)
Disposal of extra baitfish when you are done fishing[2]	-	-	-
Dispose of them in the water where you fish	1.71 (1.23)	1.78 (1.26)*	2.36 (1.54)*
Dispose of them on the ground or in trash cans	2.87 (1.59)	3.18 (1.56)*	2.45 (1.57)*
Keep them to use later	3.17 (1.47)	3.31 (1.43)	3.16 (1.59)

[1]Measured on a Likert scale ranging from 1 (Not at all familiar) to 5 (Extremely familiar)
[2]Measured on a Likert scale ranging from 1 (Never) to 5 (Very often)
*Statistically significant difference between the two survey subgroups

Location of fishing activities

The primary locations of fishing activities were identified by asking respondents to indicate the places where they spent the most time fishing (see Table 3). Results showed differences between subgroups across locations including the five Great Lakes, other inland lakes, and rivers and/or streams that either were or were not connected to the Great Lakes. Nearly two thirds (67.8%) in the pooled sample reported fishing in other inland lakes compared to three quarters (73.8%) around Lake Michigan and under half (43.7%) around Lake Ontario.

Table 3. Location of fishing activities

Location	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario in US N (%)
Lake Ontario	126 (11.0)	3 (0.3)	123 (53.7)
Lake Michigan	462 (40.3)	460 (50.2)	2 (0.9)
Lake Superior	20 (1.7)	19 (2.1)	1 (0.4)
Lake Erie	57 (5.0)	41 (4.5)	16 (7.0)
Lake Huron	16 (1.4)	16 (1.7)	0 (0.0)
Other inland lakes	776 (67.8)	676 (73.8)	100 (43.7)
Rivers and/or streams connected to the Great Lakes	520 (45.4)	394 (43.0)	126 (55.0)
Rivers and/or streams not connected to the Great Lakes	357 (31.2)	285 (31.1)	72 (31.4)

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

All fishing location responses were collapsed into three variables for ease of interpretation (see Table 4). First, anglers who selected "Lake Ontario," "Lake Michigan," "Lake Superior" "Lake Erie," "Lake Huron," and/or "Rivers and/or streams connected to the Great Lakes" were categorized as "Great Lakes & Tributary anglers." Second, anglers who selected "other inland lakes" and/or "rivers and/or streams not connected to the Great Lakes" were categorized as "inland waterways anglers." Third, anglers who selected at least one of the Great Lakes and/or Tributary options and at least one of the inland options were categorized as "mixed-site" anglers.

Results showed that half (50%) of the sample was classified as a "mixed site angler." These individuals will be a key subgroup of interest given their movement between the Great Lakes and inland waterways. Three out of ten respondents (30%) fished in inland waterways and two out of ten (20%) fished only in the Great Lakes and/or its tributaries. There were more Lake Ontario respondents classified as "Great Lakes and tributary anglers" and more Lake Michigan respondents that were part of the "inland waterways" category.

Table 4. Collapsed categories of fishing location

Location	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario in US N (%)
Great Lakes and tributary anglers			
Lake Ontario, Lake Michigan, Lake Superior, Lake Erie, Lake Huron, and/or tributaries (but no inland sites)	220 (19.8)	141 (15.8)	79 (36.4)
Inland waterway anglers			
Other inland lakes and/or inland rivers/streams	333 (30.0)	285 (31.9)	48 (22.1)

(but no Great Lakes and/or Tributary fishing sites)			
Mixed-site anglers			
At least one Great Lakes and/or Tributary site and at least one inland waterway site	557 (50.2)	467 (52.3)	90 (41.5)

Respondents were asked to report the percent time spent fishing from a boat versus the shoreline so that their two response options totaled 100% (see Table 5). In the pooled sample, respondents spent more time fishing from a boat (59.4%). The same pattern held for Lake Michigan (62.1%) but Lake Ontario respondents spent more time fishing from the shoreline (58.1%).

For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, risk of spreading AIS. Just over half of respondents in the pooled sample (57.5%) trailered their boat between fishing sites and approximately one quarter (23.2%) kept their boat docked at one location. In Lake Michigan six out of ten (60.3%) anglers trailered their boats, greater than the five out of ten (46.3%) Lake Ontario anglers who did so. Similar to the pooled sample, approximately one quarter around Lake Michigan (22.9%) and Lake Ontario (24.5%) kept their boats in one location. The most common responses shared under the "other" response option included respondents who used kayaks or canoes (3.7%), rental equipment (1%) or both (1%).

Table 5. Time spent fishing from a boat versus the shoreline

	Pooled sample N (%)	**Lake Michigan** N (%)	**Lake Ontario in US** N (%)
Shoreline[1] [M, SD]	[45.78, 36.96]	[42.73, 36.45]	[58.10, 36.52]
Boat[1] [M, SD]	[59.43, 36.55]	[62.09, 35.85]	[48.25, 37.40]
Type of boat use[2]			
A boat trailered between fishing sites	658 (57.5)	552 (60.3)	106 (46.3)
A boat docked at one location for a season	266 (23.2)	210 (22.9)	56 (24.5)
Not sure	9 (0.8)	5 (0.5)	4 (1.7)
Other	70 (6.1)	47 (5.1)	23 (10.0)

[1]Percent of fishing time spent from a boat and from shore, ranging from 0-100%

[2]If respondents indicated they spent any time fishing from a boat, they were asked to select a description of the boat they used more often

Species targeted

The species targeted by survey respondents were highly variable and differed between Lake Michigan and Lake Ontario (see Table 6). The species targeted by more than 50% of respondents included bluegill (58.1%), walleye (56.0%), yellow perch (53.7), and largemouth

bass (53.2%). Among these species, more anglers in the Lake Michigan sample targeted bluegill (64.0%) whereas more anglers in the Lake Ontario sample targeted largemouth bass (59.0%). In addition to these species, eight others differed to statistically significant degrees according to results from chi square difference tests. Specifically, targeting Atlantic salmon (χ^2=13.663; df=1; p<.001), Brown trout (χ^2=5.254; df=1; p=0.022), Smallmouth bass (χ^2=28.007; df=1; p<.001), Carp (χ^2=5.052; df=1; p=.025), and Brook trout (χ^2=14.721; df=1; p<.001), was more common in the Lake Ontario sample. More anglers in the Lake Michigan sample targeted Chinook salmon (χ^2=5.160; df=1; p=.023), Whitefish (χ^2=7.821; df=1; p=.005), Bluegill (χ^2=65.375; df=1; p<.001), Coho Salmon (χ^2=17.400; df=1; p<.001), Walleye (χ^2=12.973; df=1; p<.001), and Crappie (χ^2=45.037; df=1; p<.001).

Table 6. All species targeted by survey respondents

Species	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario in the US N (%)
Bluegill*	665 (58.1)	586 (64.0)	79 (34.5)
Walleye*	641 (56.0)	537 (58.6)	104 (45.4)
Yellow perch	615 (53.7)	492 (53.7)	123 (53.7)
Largemouth bass	609 (53.2)	474 (51.7)	135 (59.0)
Northern pike	534 (46.6)	423 (46.2)	111 (48.5)
Smallmouth bass*	556 (48.6)	409 (44.7)	147 (64.2)
Crappie*	557 (48.6)	491 (53.6)	66 (28.8)
Rainbow trout / steelhead	401 (35.0)	312 (34.1)	89 (38.9)
Chinook / king salmon*	372 (32.5)	312 (34.1)	60 (26.2)
Brown trout*	311 (27.2)	235 (25.7)	76 (33.2)
Coho salmon*	229 (26.1)	264 (28.8)	35 (15.3)
Lake trout	276 (24.1)	224 (24.5)	52 (22.7)
Catfish	228 (19.9)	173 (18.9)	55 (24.0)
Muskie	214 (18.7)	179 (19.5)	35 (15.3)
Brook trout*	197 (17.2)	138 (15.1)	59 (25.8)
White bass	191 (16.7)	162 (17.7)	29 (12.7)
Whitefish*	111 (9.7)	100 (10.9)	11 (4.8)
Atlantic salmon*	92 (8.0)	60 (6.6)	32 (14.0)
Carp	81 (7.1)	57 (6.2)	24 (10.5)
Drum / sheepshead	55 (4.8)	43 (4.7)	12 (5.2)
Other*	48 (4.2)	25 (2.7)	23 (10.0)

Note. Column totals may not equal 100% because respondents were asked to check all that applied
*Significantly different at $p < 0.05$

After reporting all species targeted, survey respondents were asked to identify their primary species of interest (see Table 7). The same primary species emerged, though notable differences were observed in that a larger proportion of Lake Michigan respondents targeted bluegill (15.2%) and Walleye (13.1%) as compared to Lake Ontario (bluegill = 3.5%; walleye =

9.5%). Also, more respondents in the Lake Ontario sample targeted yellow perch (14.5%), all types of bass (12.5%) and smallmouth bass (8.0%) as compared to Lake Michigan respondents (yellow perch = 7.9%; general bass = 5.8%; smallmouth bass = 4.5%). To simplify the range of species targeted, respondents were divided into three categories including 1) Salmon / trout, 2) Walleye / bass / pike / perch; and 3) panfish & other (see Table 8). Results showed that more anglers in both subgroups targeted walleye / bass / pike / perch, and more living near Lake Ontario (60.5%) as compared to Lake Michigan (49.3%) prioritized these specific species.

Table 7. Valid percentages for the primary species targeted by survey respondents

Species	**Pooled sample** (%)	**Lake Michigan** (%)	**Lake Ontario in the US** (%)
Bluegill	12.9	15.2	3.5
Walleye	12.4	13.1	9.5
Largemouth bass	10.8	11.0	10.0
Yellow perch	9.2	7.9	14.5
All types of bass	7.1	5.8	12.5
Chinook / king salmon	5.6	5.6	5.5
Smallmouth bass	5.5	4.9	8.0
Crappie	4.9	5.9	1.0
Northern pike	4.7	4.5	5.5
Rainbow trout / steelhead	4.1	3.6	6.5
White bass	3.7	3.9	3.0
General salmon / trout	3.5	3.3	4.5
Catfish	2.3	2.5	1.5
Brook trout	2.2	2.0	3.0
Coho salmon	2.2	2.7	0.0
Brown trout	1.9	1.7	2.5
Muskie	1.8	2.1	0.5
No target	1.6	1.0	4.0
Lake trout	1.1	1.2	0.5
Whitefish	0.8	0.7	1.0
Bull head	0.5	0.1	2.0
Panfish	0.3	0.4	-
Drum / sheepshead	0.3	0.2	0.5
Nightcrawlers	0.1	0.1	-
Carp	0.1	0.1	-
Suckers	0.1	0.1	-
Sunnies	0.1	-	0.5
Other	0.2	0.2	-
Total	100%	100%	100%

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

Table 8. Proportion of respondents in three subgroups defined by the primary species targeted

Species	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario in the US N (%)
Salmon / trout	209 (20.6)	164 (20.1)	45 (22.5)
Walleye / bass / pike / perch	523 (51.5)	402 (49.3)	121 (60.5)
Bluegill / crappie / other	283 (27.9)	249 (30.6)	34 (17.0)

Primary information sources

A variety of information sources provided anglers included in this study with information about AIS (see Table 9). A strikingly high proportion of anglers had heard about AIS through print newspapers (67.5%). The other primary information sources for the pooled sample included other anglers (54.4%), friends and family (42.3%), environmental groups (37.9%), social media (33.0%), public agencies (27.6%), and webinars (25.2%). In comparing the Lake Michigan and Lake Ontario subgroups, results revealed similarities across all information outlets except public agencies. Respondents near Lake Ontario had heard about AIS from public agencies less than respondents around Lake Michigan (χ^2=6.268; df=1; p=.012).

Table 9. Primary source of information where respondents heard about aquatic invasive species

Source	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario (US) N (%)
Print newspapers	774 (67.5)	624 (68.0)	150 (65.5)
Other anglers	623 (54.4)	504 (55.0)	119 (52.0)
Friends and family	485 (42.3)	387 (42.2)	98 (42.8)
Environmental groups	434 (37.9)	349 (38.1)	85 (37.1)
Social media (e.g., Facebook)	378 (33.0)	297 (32.4)	81 (35.4)
Public agencies*	316 (27.6)	268 (29.2)	48 (21.01)
Webinars	289 (25.2)	235 (25.6)	54 (23.6)
Online angling forums	278 (24.3)	231 (25.2)	47 (20.5)
Online newspapers	238 (20.8))	199 (21.7)	39 (17.0)
Government officials	237 (20.7)	189 (20.6)	48 (21.0)
Professional societies	199 (17.4)	161 (17.6)	38 (16.6)
Charter captains	170 (14.8)	131 (14.3)	39 (17.0)
Public meetings	112 (9.8)	95 (10.4)	17 (7.4)
Government websites	81 (7.1)	66 (7.2)	15 (6.6)
Scholarly articles	104 (9.1)	80 (8.7)	24 (10.5)

Note. Column totals may not equal 100% because respondents were asked to check all that applied
*Significantly different at $p < 0.01$

Socio-demographic characteristics

Survey respondents were mostly male (86.2%), White (84.9%), and the average age was 56.13 (*SD* = 15.51) for the pooled sample (see Table 10, Figure 7 and 8). A total of 32.2% reported earning a two-year college degree (32.2%), while 27.2% held a Bachelor's degree or higher. Approximately one third (36.6%) reported earning less than $79,999 each year before taxes.

Table 10. Socio-demographic profile of survey respondents

Variables	Pooled sample N (%)	Lake Michigan N (%)	Lake Ontario N (%)
Gender			
Male	962 (86.2)	773 (86.6)	189 (84.8)
Female	153 (13.7)	119 (13.3)	34 (15.2)
Other	1 (0.1)	1 (0.1)	0 (0.0)
Age [M, SD]	[56.13, 15.51]	[56.06, 15.44]	[56.46, 15.84]
18-34 years	134 (12.0)	108 (12.1)	26 (19.4)
35-50 years	218 (19.6)	173 (19.4)	45 (20.0)
51-60 years	260 (23.3)	214 (24.0)	46 (20.4)
61-70 years	304 (27.3)	236 (26.5)	68 (30.2)
71 years or more	199 (17.8)	159 (17.9)	40 (17.8)
Education			
Some high school	260 (24.6)	221 (26.0)	39 (18.8)
High school graduate or GED	170 (16.1)	145 (17.1)	25 (12.0)
Two-year college degree	341 (32.2)	261 (30.7)	80 (38.5)
Bachelor's degree	99 (9.4)	80 (9.4)	19 (9.1)
Professional certificate	27 (2.6)	18 (2.1)	9 (4.3)
Graduate degree	161 (15.2)	125 (14.7)	36 (17.3)
Income			
Less than $20,000	55 (5.3)	42 (5.0)	13 (6.4)
$20,000 to $39,999	127 (12.2)	107 (12.8)	20 (9.9)
$40,000 to $59,999	130 (12.5)	109 (13.0)	21 (10.3)
$60,000 to $79,999	65 (6.3)	53 (6.3)	12 (5.9)
$80,000 to $99,999	129 (12.4)	105 (12.5)	24 (11.8)
$100,000 to $124,999	140 (13.5)	119 (14.2)	21 (10.3)
$125,000 to $149,999	152 (14.6)	117 (14.0)	35 (17.2)
$150,000 or more	126 (12.1)	97 (11.6)	29 (14.3)
Prefer not to answer	116 (11.2)	88 (10.5)	28 (13.8)
Race[1]			
White	973 (84.9)	779 (85.0)	194 (84.7)
Asian	16 (1.4)	16 (1.7)	0 (0.0)
Black or African American	22 (1.9)	17 (1.9)	5 (2.2)
Native Hawaiian or other Pacific Islander	5 (0.4)	4 (0.4)	1 (0.4)
American Indian or Alaska Native	34 (3.0)	28 (3.1)	6 (2.6)

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

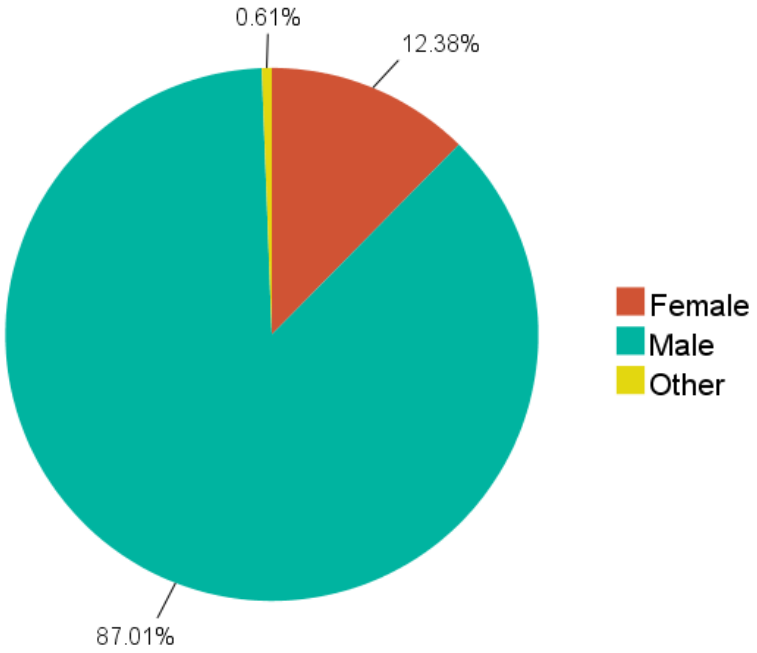

Figure 7. Gender of the pooled sample of survey respondents included in this research

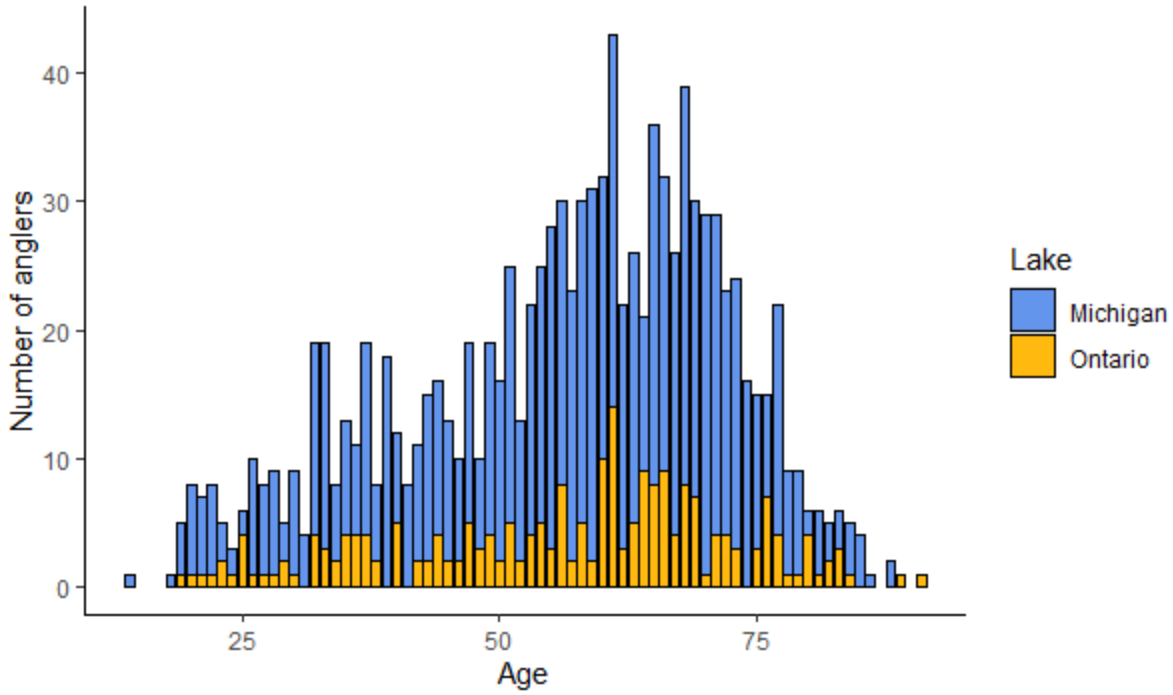

Figure 8. Age of survey respondents included in this research

Environmental Behavior and Drivers of Change

Respondents were asked to report how frequently they engaged in a variety of environmental behaviors related to aquatic invasive species over the past year (see Table 11). Drawing from previous research and exploratory analysis (Larson et al., 2015), we found there were two primary dimensions of behavior that existed in the private and public spheres. Participation in both types of behavior was low, in that respondents reported rarely engaging in private sphere behaviors that occurred at an individual level (*M* = 2.55, *SD* = 1.02) and even fewer (*M* = 1.50, *SD* = 0.75) reported engaging in behaviors that minimized the spread of AIS through interaction with other people and the public realm. Respondents near Lake Michigan and Lake Ontario did not statistically differ in their reported behavior in either private (t-stat (df = 1,098) = -.430 p =.667) or public (t-stat (df = 1089) = 1.451 p =.147) spheres of behavior.

Table 11. Reported environmental behavior that was performed over the past 12 months

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
Private sphere behaviors (α = .627)[1]	***2.55 (1.02)***	***2.54 (1.01)***	***2.57 (1.06)***
Looked up information about AIS	2.03 (1.08)	2.04 (1.08)	1.99 (1.07)
Avoided purchasing products that contribute to the spread of AIS	2.80 (1.78)	2.75 (1.77)	2.98 (1.83)
Took measures (e.g., washed boat or equipment) to personally reduce the spread of AIS	3.21 (1.66)	3.23 (1.66)	3.12 (1.67)
Talked to other people in my community about AIS	2.23 (1.25)	2.21 (1.26)	2.32 (1.21)
Public sphere behaviors (α = .740)[1]	***1.50 (0.75)***	***1.51 (0.76)***	***1.43 (0.68)***
Participated in a policy process (e.g., voting) related to AIS	1.72 (1.26)	1.75 (1.28)	1.60 (1.12)
Donated money with the intention of reducing impacts from AIS	1.61 (1.04)	1.63 (1.07)	1.50 (0.88)
Wrote a letter, sent an email, or signed a petition about AIS	1.29 (0.77)	1.29 (0.77)	1.29 (0.77)
Encouraged other people to attend an event related to AIS	1.35 (0.83)	1.36 (0.84)	1.33 (0.81)

Note. Measured on a Likert scale where 1 = "Never" and 5 = "Very Often".
Note. Respondents were presented with a "Not Applicable" option
[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

Short-term drivers of change

Personal norms (i.e., feelings of moral obligation) regarding the spread of AIS were measured using three questions (see Table 12). This scale was derived from past work (Steg et al., 2004) and found to be reliable (α = 0.851). Personal norms were very high across survey respondents

(*M* = 4.50; *SD* = 0.80), and did not differ statistically between respondents near Lake Michigan and Lake Ontario (t-stat (df = 1,093) = 1.957 p = 0.051).

This study assessed **self-efficacy** (i.e., beliefs that one has the ability to take a particular action). Two items were adapted from past work (Bandura, 1977; Landon et al., 2018) and found to be reliable (Spearman-Brown coefficient = .801). Self-efficacy was high across anglers (*M* = 4.18, *SD* = 0.96) and did not differ statistically between respondents near Lake Michigan and Lake Ontario (t-stat (df = 1,092) = 1.467 p = 0.143).

Table 12. Personal norms and self-efficacy

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
Personal norms (α = .851)[1]	***4.50 (0.80)***	***4.52 (0.78)***	***4.40 (0.88)***
I feel guilty if I spread aquatic invasive species	4.41 (1.02)	4.43 (0.99)	4.31 (1.11)
I am morally obligated to minimize the spread of aquatic invasive species when fishing	4.55 (0.86)	4.58 (0.84)	4.45 (0.92)
People like me should feel personally obligated to limit the spread of aquatic invasive species	4.54 (0.85)	4.56 (0.84)	4.54 (0.85)
Self-efficacy (r = .801)[2]	***4.18 (0.96)***	***4.20 (0.96)***	***4.09 (0.98)***
I have the ability to limit the spread of aquatic invasive species	4.28 (1.03)	4.31 (1.01)	4.14 (1.10)
There are many ways I can help stop the spread of aquatic invasive species	4.09 (1.05)	4.10 (1.05)	4.04 (1.03)

Note. Measured on a Likert scale where 1= "Strongly disagree" and 5= "Strongly agree"
[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.
[2]r represents Spearman-Brown coefficient, which is used to assess scale reliability when only two items are included. Values above 0.6 reflect acceptable reliability.

Survey respondents had high **knowledge** of the research topic according to a four-question quiz that was developed to gauge understanding of invasive species, resource management, and the role of anglers in spreading AIS. The valid percent of people who answered each question correctly is shown in Table 13. According to an Independent-Samples t-test, respondents who lived around Lake Michigan (*M* = 3.50) were more knowledgeable about aquatic invasive species than respondents near Lake Ontario (M = 3.32) (t-stat (df = 1,111) = 2.58 p < 0.01).

Table 13. Knowledge of recreational anglers

	Pooled sample N (%)	**Lake Michigan** N (%)	**Lake Ontario** N (%)
Overall knowledge score[1] (*M* = 3.47, *SD* = 0.92)			
Number of non-native species (including fish, plants, and other organisms) currently present	680 (66.7)	541 (66.1)	139 (69.5)

in the Great Lakes[2]			
Agency primarily responsible for managing the Great Lakes fishery is the Fish Authority[3]	343 (31.2)	284 (32.2)	59 (27.2)
Sea lamprey are considered "invasive," meaning they are both unintentionally introduced and causing harm[3]	797 (73.9)	656 (75.6)	141 (66.8)
Aquatic invasive species can be spread through dumping of bait buckets by recreational anglers[3]	926 (84.6)	758 (86.1)	168 (78.5)

Note. "Do not know" was presented as a response option to ease respondent burden
[1]Score was created by adding the number of correct responses where 1 = no correct responses and 5 = all correct responses
[2]Response options: 1) None, 2) Around 20 species, 3) Around 200 species, and 4) Around 2,000 species
[3]Response option was true or false

Perceptions of the risk posed by AIS were assessed, including personal risk perceptions (i.e., the level of threat posed to individuals), and social risk perceptions (i.e., the level of threat posed to communities) (see Table 14). Both scales were reliable (α = .720, 0.887). Social risk perceptions (*M* = 4.24, *SD* = 0.95) were higher than personal risk perceptions (*M* = 3.39, *SD* = 1.01). There were no statistical differences between Lake Michigan and Lake Ontario respondents for personal (t-stat (df = 1,094) = -.237 p =.813) or social (t-stat (df = 1,089) = 1.592 p =.112) risk perceptions.

Table 14. Risk perceptions reported by survey respondents

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
Personal risk perceptions (α = .720)[1]	***3.39 (1.01)***	***3.39 (1.00)***	***3.40 (1.02)***
Your fishing experience	3.93 (1.22)	3.96 (1.22)	3.83 (1.24)
Your financial well-being	2.27 (1.33)	2.25 (1.33)	2.34 (1.37)
The environment where you fish	3.95 (1.21)	3.94 (1.22)	4.02 (1.13)
Social risk perceptions (α = .887)[1]	***4.24 (0.95)***	***4.26 (0.93)***	***4.14 (1.00)***
The Great Lakes fishery	4.39 (0.99)	4.41 (0.97)	4.28 (1.04)
The economy in the Great Lakes region	4.09 (1.11)	4.11 (1.10)	4.00 (1.14)
The environment in the Great Lakes region	4.25 (1.02)	4.27 (1.01)	4.17 (1.06)

Note. Measured on a Likert scale where 1 = "Low threat" and 5 = "High threat"
[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

Respondents were asked about how much ***trust*** they instilled in their state government with respect to managing the Great Lakes fisheries (see Table 15). Items were adapted from past work (Parkins et al., 2017) that assessed two dimensions of trust: *General trust*, which includes beliefs that the government is fair and effective, and *Skepticism*, which includes beliefs that the government is unfair and biased. Both scales were reliable (α = .855, r = .654). Skepticism (*M* =

3.16, *SD* = 0.86) was stronger than general trust (*M* = 3.01, *SD* = 0.87) across survey respondents (t-stat(df=1287) = -5.918 p<.001). Anglers near Lake Ontario had lower general trust than anglers near Lake Michigan (t-stat (df = 768) = 2.537 p =.011), but there was no difference between the two groups in skepticism (t-stat (df = 768) = -1.176 p = 0.240).

Table 15. Trust in state government decision-making

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
General Trust (α = .855)[1]	***3.01 (0.87)***	***3.06 (0.86)***	***2.87 (0.89)***
My state government has the necessary expertise to manage my state's Great Lakes fishery effectively	3.07 (1.15)	3.13 (1.14)	2.90 (1.14)
In managing my state's Great Lakes fishery, decision-makers consider all relevant points of view	2.99 (1.09)	3.03 (1.08)	2.86 (1.10)
My state government is open to new ideas and alternative points of view on Great Lakes fisheries	2.92 (0.98)	2.97 (0.95)	2.78 (1.04)
My state government makes credible decisions about my state's Great Lakes fishery	3.06 (0.94)	3.10 (0.94)	2.95 (0.93)
Skepticism (r = .654)[2]	***3.16 (0.86)***	***3.13 (0.87)***	***3.22 (0.85)***
My state government's information about Great Lakes management tends to be biased and one-sided	3.01 (0.97)	2.97 (0.96)	3.10 (0.98)
My state government is too influenced by private industries in my state's Great Lakes fishery	3.31 (1.01)	3.30 (1.03)	3.33 (0.97)

Note. Measured on a Likert scale where 1 = "Strongly Disagree" and 5 = "Strongly Agree"
Note. Anglers in the Wisconsin sample were not presented with these questions.
[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.
[2]r represents Spearman-Brown coefficient, which is used to assess scale reliability when only two items are included. Values above 0.6 reflect acceptable reliability.

Long-term drivers of change

In contrast to the "short-term" drivers of behavior reviewed above, this study also measured two types of "long-term" drivers of behavior including individual and cultural values. These types of values are unlikely to change over the course of a person's life and are a useful basis for framing messages to facilitate communication among stakeholder groups and between stakeholders and agencies (see Figure 9).

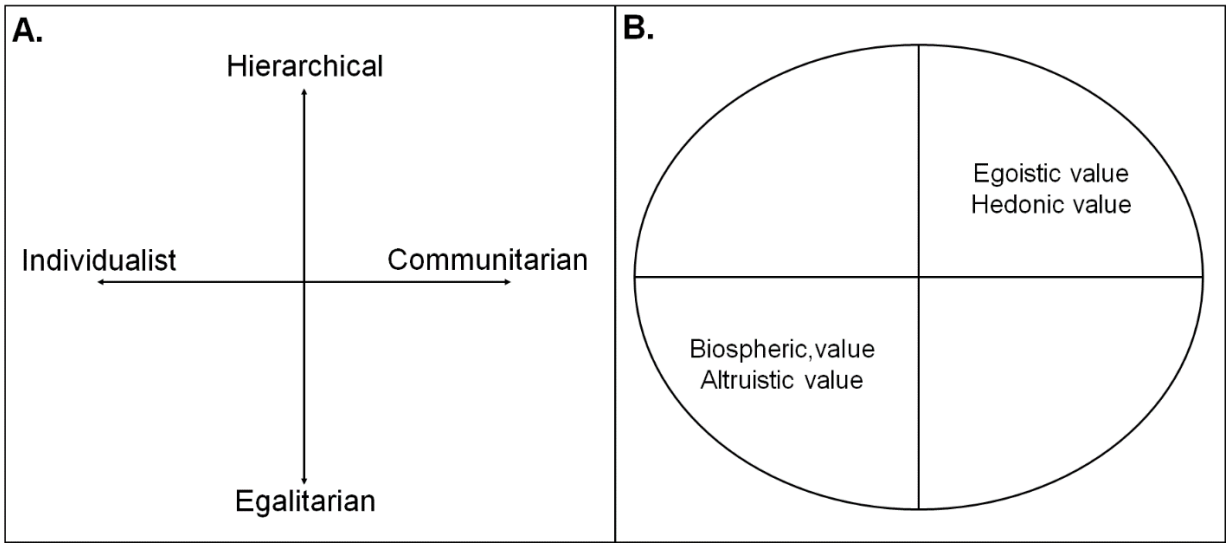

Figure 9. Anglers can identify with two types of cultural values (A) situated on axes ranging from hierarchical to egalitarian and individualist to communitarian (adapted from Kahan (2011)). Two types of individual values (B) are situated on a value wheel as polar opposites ranging from self-transcendence to self-enhancement (adapted from Schwartz (2006)).

A total of five types of **individual values**, defined as guiding principles in life, were assessed (see Table 16). Biospheric values represented concern for the environment, altruistic values represented concern for other people, egoistic values represented a desire for control and power, hedonic values represented short-term pleasures, and eudaimonic values represented priorities placed on achieving long-term personal goals. Survey items were drawn from past research (Stern, 2000) and resulted in five reliable scales (α = .883, .856, .711, .865, .875). Among survey respondents, biospheric (*M* = 7.23, *SD* = 1.59) and eudaimonic (*M* = 7.22, *SD* = 1.48) values were the strongest, followed by altruistic (*M* = 7.02, *SD* = 1.85) and hedonic (*M* = 6.97, *SD* = 1.59) values. Egoistic values were comparatively lower (*M* = 4.90, *SD* = 1.69). There were no statistical differences between respondents near Lake Michigan and Lake Ontario in individual values, including biospheric (t-stat (df = 1,085) = -1.440 p =.150), altruistic (t-stat (df = 1,078) = -1.179 p =.239), egoistic (t-stat (df = 1,072) = -.641 p =.552), hedonic (t-stat (df = 1,072) = -1.520 p =.129), and eudaimonic (t-stat (df = 1,072) = -1.035 p =.301).

Table 16. Average individual values among anglers

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
Biospheric values (α = .883)[1]	***7.23 (1.59)***	***7.20 (1.57)***	***7.37 (1.63)***
Protecting the environment: preserving nature	7.55 (1.60)	7.53 (1.60)	7.66 (1.60)
Unity with nature: fitting into nature	7.02 (1.82)	6.96 (1.83)	7.27 (1.76)
A world of beauty: beauty of nature and the arts	7.13 (1.85)	7.11 (1.82)	7.20 (1.97)
Altruistic values (α = .856)[1]	***7.02 (1.85)***	***6.98 (1.87)***	***7.15 (1.77)***
Equality: equal opportunity for all	7.09 (2.02)	7.03 (2.04)	7.33 (1.94)

Social justice: correcting injustice, care for others	6.87 (2.13)	6.83 (2.14)	7.02 (2.08)
A world at peace: free of war and conflict	7.10 (2.14)	7.10 (2.15)	7.08 (2.11)
Egoistic values (α = .711)1	***4.90 (1.69)***	***4.89 (1.67)***	***4.97 (1.80)***
Authority: the right to lead or command	5.91 (2.04)	5.88 (2.02)	6.05 (2.11)
Social power: control over others, dominance	3.38 (2.24)	3.35 (2.21)	3.48 (2.40)
Influential: having an impact on people and events	5.40 (2.06)	5.40 (2.05)	5.40 (2.14)
Hedonic values (α = .865)[1]	***6.97 (1.59)***	***6.94 (1.59)***	***7.12 (1.57)***
Fulfilment of desire: food, fun, pleasure	6.52 (1.90)	6.47 (1.90)	6.72 (1.86)
Enjoying life: pursuing hobbies, leisure, socializing	7.29 (1.70)	7.26 (1.71)	7.43 (1.66)
Reducing worries: seeking comfort and relaxation	7.10 (1.77)	7.07 (1.75)	7.22 (1.82)
Eudaimonic values (α = .875)[1]	***7.22 (1.48)***	***7.20 (1.46)***	***7.32 (1.56)***
Personal growth: development of new skills, learning, or gaining insight into something	7.16 (1.73)	7.13 (1.69)	7.26 (1.88)
Pursuit of excellence: attaining a personal ideal in life	6.93 (1.84)	6.90 (1.83)	7.08 (1.88)
Autonomy: deciding your own future and doing what you believe in	7.44 (1.69)	7.41 (1.70)	7.59 (1.64)
Satisfaction with life: finding meaning, value, and relevance to a broader context	7.36 (1.67)	7.37 (1.64)	7.33 (1.77)

Note: Measured on a Likert scale where 1 = "Opposed to my values" and 9 = "Of supreme importance"
α = Cronbach's alpha
[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

This study assessed **cultural values**, which situates people on two axes according to the worldviews that they believe define their society (see Figure 9A). The "group" axis ranges from individualist to communitarian, representing the degree to which individual freedoms are sacrificed for the good of the group, whereas the "grid" axis ranges from hierarchical to egalitarian, representing the degree to which a society is structured with designated roles and responsibilities. Thus, four types of cultural values were measured, using items developed in past work (Kahan et al., 2011; see Table 17).

After one communitarian item was dropped, all scales were reliable (α = .766, .822, .734, r = .747). Individualist values (*M* = 3.48, *SD* = 0.93) were stronger than communitarian values (*M* = 2.16, *SD* = 1.04), whereas hierarchical values (*M* = 3.14, *SD* = 1.13) and egalitarian values (*M* = 3.18, *SD* = 1.16) reflected similar distributions. Anglers near Lake Ontario had stronger hierarchical values than anglers near Lake Michigan (t-stat (df = 770) = -2.007 p =.045). No significant differences in egalitarian values (t-stat (df = 766) = -.935 p =.350), individualist values (t-stat (df = 767) = -1.269 p =.205), or communitarian values (t-stat (df = 765) = .815 p =.416) were found between anglers near Lake Michigan and Lake Ontario.

Table 17. Agreement with survey items measuring cultural values

	Pooled sample M (SD)	**Lake Michigan** M (SD)	**Lake Ontario** M (SD)
Hierarchical (α = .766)[1]	***3.14 (1.13)***	***3.09 (1.14)***	***3.28 (1.10)***
We have gone too far in pushing equal rights in this country	2.93 (1.34)	2.88 (1.36)	3.07 (1.28)
It seems like blacks, women, homosexuals and other groups don't want equal rights, they want special rights just for them	3.22 (1.41)	3.18 (1.41)	3.31 (1.40)
Society as a whole has become too soft and feminine	3.26 (1.36)	3.19 (1.36)	3.43 (1.35)
Egalitarian (α = .822)[1]	***3.18 (1.16)***	***3.16 (1.15)***	***3.24 (1.19)***
Our society would be better off if the distribution of wealth was more equal	3.00 (1.40)	2.99 (1.40)	3.04 (1.40)
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women	3.18 (1.37)	3.14 (1.37)	3.29 (1.35)
Discrimination against minorities is still a very serious problem in our society	3.35 (1.27)	3.34 (1.27)	3.39 (1.29)
Individualist (α = .734)[1]	***3.48 (0.93)***	***3.45 (0.93)***	***3.55 (0.92)***
The government interferes far too much in our everyday lives	3.65 (1.09)	3.60 (1.08)	3.79 (1.10)
It's not the governments business to try to protect people from themselves	3.13 (1.21)	3.14 (1.20)	3.11 (1.21)
The government should stop telling people how to live their lives	3.65 (1.14)	3.62 (1.13)	3.74 (1.16)
Communitarian (r = .747)[2]	***2.16 (1.04)***	***2.18 (1.03)***	***2.11 (1.06)***
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals	2.13 (1.16)	2.15 (1.14)	2.08 (1.19)
Government should put limits on the choices individuals can make so they don't get in the way of what's good for society	2.20 (1.15)	2.22 (1.14)	2.15 (1.18)

Note: Measured along a Likert scale where 1 = "Strongly Disagree" and 5 = "Strongly Agree."

Note: Anglers in the Wisconsin sample were not presented with these survey items.

[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

[2]r represents Spearman-Brown coefficient, which is used to assess scale reliability when only two items are included. Values above 0.6 reflect acceptable reliability.

Integrating Short- and Long-term Drivers of Behavior

This study used structural regression modeling to understand relationships between short-term (i.e., risk perceptions) and long-term (i.e., cultural and individual values) drivers of behavior in the context of AIS prevention (see Figure 10). The model below shows the relationships among multiple predictors of behavior. Starting on the left-hand side of the model, four cultural values (i.e., hierarchical, egalitarian, individualist, and communitarian) predicted three individual values (i.e., biospheric, altruistic, and egoistic). Next in line, two of these individual values, including biospheric and egoistic values, predicted two different types of risk perceptions that can be expressed by anglers (i.e., social and personal risk). Of these risk perceptions, personal risk was observed to predict two different types of behaviors that can be performed to minimize the spread of AIS. This model tested the theoretical relationships among multiple drivers of behavior to represent the suite of factors that anglers think about when making decisions that influence the environment.

In Figure 10, the black lines indicate a positive relationship, whereas red lines indicate a negative relationship between variables. One of the results from this model was that hierarchical cultural values negatively predicted biospheric and altruistic individual values, whereas egalitarian cultural values were positively related with these individual values. As hypothesized, anglers who believe that society should be organized hierarchically are less likely to espouse principles that prioritize the well-being of nature and other people. In other words, as concerns for equality among social roles in society increase, so too does the importance of ideals related to the well-being of issues outside of the self. Additionally, as resistance to government intervention in everyday life increases, a sense of altruism decreases. However, government intervention to support communal wellbeing was positively associated with the importance of achievement and the influence of individuals. These insights are useful to understand the fundamental, core beliefs of anglers and how they are positioned to respond to potential interactions with management agencies.

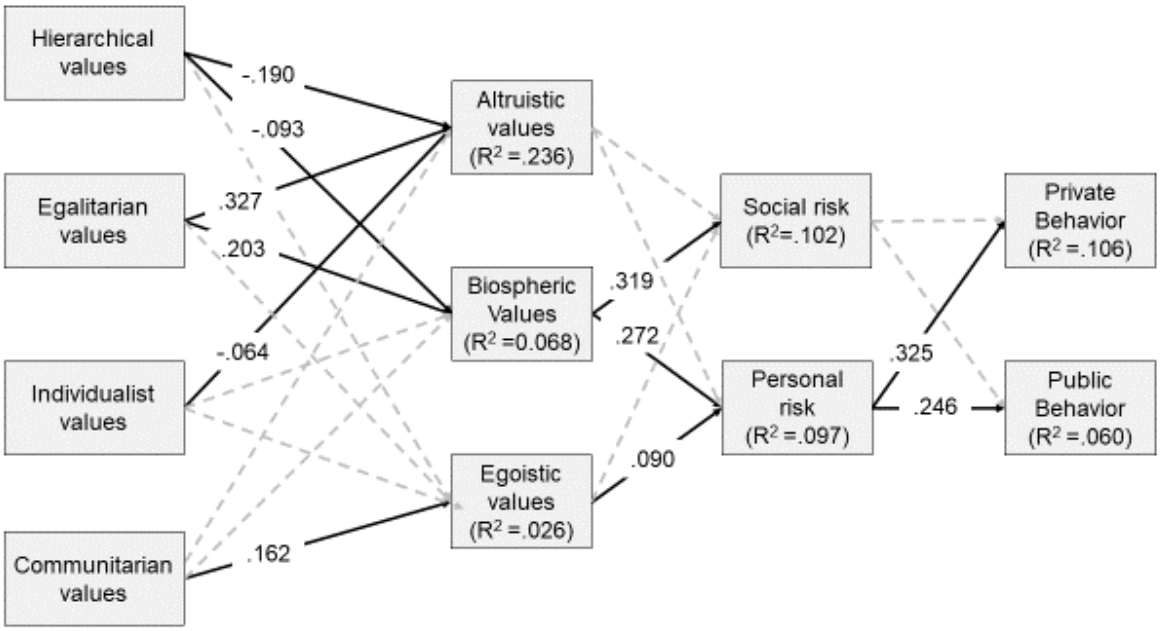

Figure 10. Drivers of pro-environmental behavior of anglers residing in Illinois, Michigan, and New York counties bordering Lake Michigan or Lake Ontario (N=757). Fit statistics: χ2=52.905, df=28, p=0.003; CFI=0.982; TLI = 0.969; RMSEA=0.036; SRMR=0.032. Non-significant relationships are shown in grey dotted lines.

We observed that values and principles for environmental protection positively influenced risk perceptions, indicating these are primary drivers of behavior and can be "activated" to stimulate behavior change. To activate a value, the language adopted and message frames used should align with the things that people care about most. Framing in line with values is most likely to be understood and processed, and thus result in more effective communication. The relationships found in this model have multiple implications for communication and behavior change interventions among recreational anglers.

Next, the pathway from communitarian values to egoistic values, and in turn, personal risk perceptions provides support for another messaging approach that highlights the opportunity to be a leader in the angling community by participating in invasive species prevention. Finally, given that personal risk perceptions were a strong predictor of behavior, outreach messages should speak to ways that anglers may be personally impacted by aquatic invasive species, rather than highlighting broader regional impacts. For instance, messages may reference anecdotes such as being unable to access a waterway due to overgrowth of aquatic weeds, or being unable to catch a favorite species that has been outcompeted by an invasive.

Evaluations of Future Fishing Scenarios

Angler preferences for the future

This study evaluated anglers' preferences for hypothetical changes they may experience while fishing in the Great Lakes region. Given that decision-makers weigh many factors when

developing policies and regulations, a research approach was adopted to account for the tradeoffs inherently made when evaluating multiple features of an environment. Specifically, a "discrete choice experiment" was developed through pilot testing and informal discussions with the Lake Committee managers for Lake Michigan and Lake Ontario to provide insight on the *relative* rather than *absolute* value of a collection of competing conditions. Respondents were asked to evaluate six hypothetical scenarios that represented current and future conditions (Louviere et al., 2000). An information sheet was included in the questionnaire to provide the necessary background for the respondent (see Appendix 1). An example scenario is presented below (see Figure 11).

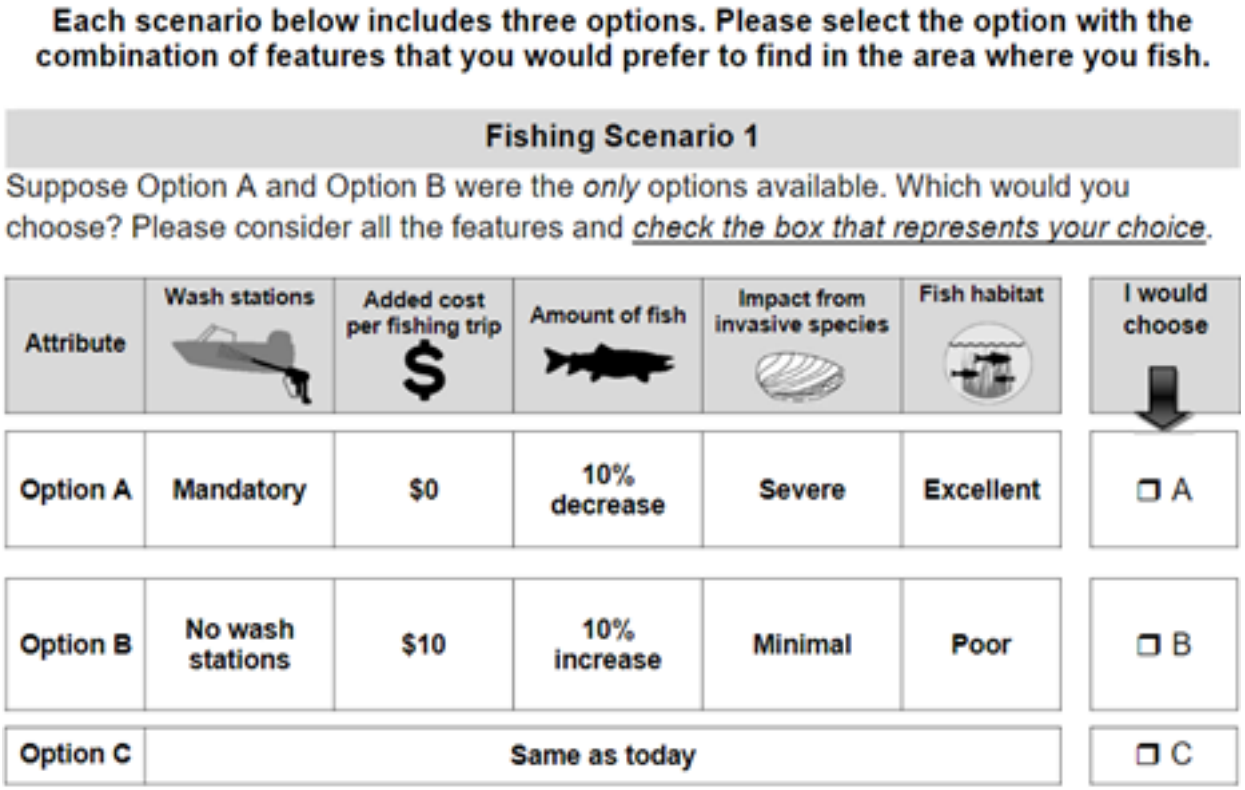

Figure 11. Example paired comparison included in the survey of license holding anglers in the Great Lakes region

The experimental design that was developed for our discrete choice experiment allowed us to evaluate the relative influence of five features of a fishery on anglers' stated choices for what they desire in the future. The five features, and levels that were used to represent changes in these features, were evaluated simultaneously by respondents in their assessments of the hypothetical scenarios. Table 18 describes each feature and its associated levels.

Table 18. Definitions and levels for all attributes estimated in the discrete choice experiment

Feature	Definition	Levels
Wash stations	Locations near boat ramps where anglers can disinfect and pressure-wash boats to stop AIS from spreading.	1. No wash stations 2. Voluntary wash stations 3. Mandatory wash station
Added cost per fishing trip	Cost per fishing trip that could be voluntarily added for invasive species control and prevention efforts in the Great Lakes.	$0 - $20
Amount of fish	Total amount of native fish species found in the Great Lakes	1. 20% decrease 2. No change 3. 20% increase
Impact from invasive species	Degradation caused by organisms that are outside of their historic range and harming the environment	1. Minimal impact 2. Moderate impact 3. Severe impact
Fish habitat	The quality of the environment for supporting fish species	1. Poor 2. Good 3. Excellent

To analyze these data, we drew on 9,192 sets of observations (i.e., the total number of alternatives chosen) and tested a mixed multinomial logistic regression model. We observed that all five features from the hypothetical fishing scenarios influenced the choices made by survey respondents to a statistically significant degree (see Table 18). We accounted for a moderate degree of variation in our dependent variable of "choice" given the McFadden's pseudo R^2 value of 31.5% (Hensher & Johnson, 1981). Specifically, we found that the probability of choosing an alternative increased with greater intensity of management infrastructure (e.g., wash stations) at boat ramps (β = 0.506), fewer costs per fishing trip (β = -0.048), a greater amount of native fish species (β = 0.035), less impact from invasive species (β = 0.690), and increased quality of fish habitat (β = 0.864) (see Table 19). We observed significant standard deviations of the random parameter distributions, indicating preference heterogeneity across all study parameters.

Table 19. The mean and spread of the five random parameters from the mixed multinomial logit model, including coefficients, standard deviations, and standard errors (SE) (N=1,532)

Attributes	Coefficients (SE)	Std. Deviation (SE)
Wash stations	0.506* (0.040)	0.628* (0.070)
Added cost per fishing trip	-0.048* (0.004)	0.072* (0.006)
Amount of native fish	0.035* (0.002)	0.008* (0.005)
Impact from invasive species	-0.690* (0.039)	0.774* (0.056)
Fish habitat	0.864* (0.036)	0.521* (0.055)
Constant	-1.601* (0.113)	2.535* (0.112)

Log-likelihood = -6,363; Akaike information criterion (AIC) = 1,2749; No. of observations = 9,192; Pseudo R^2 = 0.315; * = p<0.0001

Economic value of fishery characteristics

Our discrete choice experiment included a "willingness to pay" feature that was presented to anglers as the cost they would be willing to add to each of their fishing trips in the future (see Table 20). We analyzed this cost in relation to the other four features included in the experiment to estimate the relative cost of each feature for all survey respondents included in the study from the US and Canada. The values presented in the Canadian survey were converted from US dollar values to Canadian dollars. Our results showed that anglers were willing to pay the most for good quality of fish habitat, followed by minimizing impacts from invasive species and the availability and enforcement of boat wash stations. Conversely, the amount of native fish species was not of great economic value. That is, respondents were only willing to add $0.15 to the cost of each fishing trip for native fish populations to move from 0% (no change) to a 20% increase. This cost was in contrast to the values greater than $2 that anglers indicated they would add to each fishing trip for the sake of the other key variables analyzed in our study.

Table 20. Marginal willingness-to-pay for each feature included in the discrete choice experiment

Variable	Willingness to Pay
Wash stations	$10.54
Added cost per fishing trip	-
Amount of native fish	$0.73
Impact from invasive species	$14.37
Fish habitat	$18.00

Open-ended Comments

Respondents had the opportunity to provide additional thoughts at the end of the questionnaire. Comments were shared by 430 respondents. A selection of representative comments is below:

- A total of 37 respondents requested results from the survey.
    - "Would be interested in the study and results."
- Many anglers reported a need for more information about invasive species:
    - "I think that government agencies associated with wildlife organizations should make all relevant information about invasive species in our area transparent and available to all"
    - "I wish I had more information about aquatic invasive species. What's the progress on keeping Asian carp our of the great lakes?"
    - "We need more post information on the places where we fish on the shore (signs) so we can read while we are fishing."
    - "I understand the invasive species exist, but I am not knowledgeable of what they are, where they are, and how they can be prevented."
- Asian carp were the species most frequently mentioned; 33 people expressed concern about the threat of Asian Carp to the Great Lakes:

    - "I strongly believe if Asian Carp get into Great Lakes. My grandchildren will never have the good fishing I had."
    - "The Asian carp are a serious threat to Lake Michigan if more isn't done to stop their encroachment it will change this wonderful fishery at Chicago's doorstep forever."
- In response to the idea of boat wash stations presented in the survey, 14 people expressed support:
    - "I think it's a great idea to add wash stations at boat ramps. I think if you increased boat launch fees by a couple dollars, you could use that extra income to help funding."
- Concern for habitat conservation was shared by 16 respondents:
    - "Habitat is the key to fishing the future. And controlling invasive species"
    - "Always, improve habitat. So we can always pass down Michigan traditions of hunting and fishing in our great state."
- Anglers expressed concern about the role of industry in the spread of invasive species:
    - "It is my understanding that their ballasts should be emptied before they reach our waters and I know that is not the case."
    - "With the amount of shipping on the Great Lakes I.e. Big tankers we're losing the war on invasive species"
    - "I do not like the idea that industry can use (and pollute) Great Lakes water for their own profit"

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APPENDIX A: SURVEY QUESTIONNAIRE

Aquatic Invasive Species in the Great Lakes Region

Understanding your angling experiences and preferences for invasive species management

Image: Great Lakes Hydrography Dataset

The University of Illinois at Urbana-Champaign and Cornell University are conducting research to learn more about the opinions of recreational anglers in the US and Canada and the spread of aquatic invasive species, which are organisms that move into areas beyond their natural, historic range. You are one of a small number of people chosen for this study, because you have previously purchased a fishing license. Your response is important to us. All information will be kept confidential and your response is voluntary. Results from this research will be shared with managers across the Great Lakes states. Please answer each question carefully and save any additional comments for the final page. This survey will take about 20 minutes to complete.

www.AISresearch.org

Section 1 of 5: Background Information

In this section, we ask you to provide information about your fishing experiences in 2018.

1. **About how many days did you go fishing?** _____Days

2. **About how many years, including this one, have you been fishing?** _____Years

3. **Where do you spend most of your time fishing?** (Please ✓ all that apply)

- ❑ Lake Ontario
- ❑ Lake Michigan
- ❑ Lake Superior
- ❑ Lake Erie
- ❑ Lake Huron
- ❑ Other inland lakes
- ❑ Rivers and/or streams connected to the Great Lakes
- ❑ Rivers and/or streams not connected to the Great Lakes

4. **About what percent of your fishing time is from a boat and from shore?**

Boat: _____% **Shore:** _____%

4b. If you fish from a boat, please ✓ the description of the boat you use most often.

- ❑ A boat that is trailered between fishing sites
- ❑ A boat that is docked at one location for a season
- ❑ Not sure
- ❑ Other: _____

5. **Which species do you frequently fish for?** (Please ✓all that apply)

- ❑ Atlantic salmon
- ❑ Bluegill
- ❑ Brook trout
- ❑ Brown trout
- ❑ Carp
- ❑ Catfish
- ❑ Chinook / king salmon
- ❑ Coho salmon
- ❑ Crappie
- ❑ Drum / sheepshead
- ❑ Lake trout
- ❑ Largemouth bass
- ❑ Muskie
- ❑ Northern pike
- ❑ Rainbow trout / steelhead
- ❑ Smallmouth bass
- ❑ Walleye
- ❑ White bass
- ❑ Whitefish
- ❑ Yellow perch
- ❑ Other: _____

5b. Of these species, which ONE do you target most often? _____

6. **How familiar are you with "certified" bait (free of exotic species or diseases)?**

❑	❑	❑	❑	❑
Not at all familiar	Slightly familiar	Somewhat familiar	Very familiar	Extremely familiar

7. How often do you use live baitfish while fishing?

❑ Never ❑ Rarely ❑ Sometimes ❑ Often ❑ Very Often

8. How often do you do each of the following with extra baitfish when you are done fishing?

	Never	Sometimes	Very Often	N/A
a. Dispose of them in the water where you fish	○ ○	○ ○	○ ○	○
b. Dispose of them on the ground or in trash cans	○ ○	○ ○	○ ○	○
c. Keep them to use later	○ ○	○ ○	○ ○	○

9. How would you rate your fishing skills in comparison to other anglers?

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

10. About how many non-native species (including fish, plants, and other organisms) are currently present in the Great Lakes?

❑ None ❑ Around 20 species ❑ Don't know

❑ Around 200 species ❑ Around 2000 species

11. The agency primarily responsible for managing the Great Lakes fishery is the Fish Authority. ❑ True ❑ False ❑ Don't know

12. Sea lamprey are considered "invasive," meaning they are <u>both</u> unintentionally introduced and causing harm. ❑ True ❑ False ❑ Don't know

13. Aquatic invasive species can be spread through dumping of bait buckets by recreational anglers. ❑ True ❑ False ❑ Don't know

14. Where have you heard about aquatic invasive species? (Please ✓all that apply)

❑ Print newspapers ❑ Online angling forums ❑ Online newspapers
❑ Government officials ❑ Government websites ❑ Webinars
❑ Social media (e.g., Facebook) ❑ Scholarly articles ❑ Public meetings
❑ Professional societies ❑ Public agencies ❑ Charter captains
❑ Friends and family ❑ Environmental groups ❑ Other anglers

Section 2 of 5: Environmental Behavior and Values

In this section, we ask you to think about your personal values and behavior related to fishing, aquatic invasive species, and the environment. This information will help decision makers understand what you care about most.

15. There are many ways that people can minimize the impacts of invasive species on the environment. How frequently have you engaged in the following activities over the <u>past 12 months?</u>

	Never		Sometimes		Very Often	N/A
a. Looked up information about aquatic invasive species	○	○	○	○	○	○
b. Avoided purchasing products that contribute to the spread of aquatic invasive species	○	○	○	○	○	○
c. Took measures (e.g., washed boat or equipment) to personally reduce the spread of aquatic invasive species	○	○	○	○	○	○
d. Participated in a policy process (e.g., voting) related to aquatic invasive species	○	○	○	○	○	○
e. Donated money with the intention of reducing impacts from aquatic invasive species	○	○	○	○	○	○
f. Wrote a letter, sent an email, or signed a petition about aquatic invasive species	○	○	○	○	○	○
g. Encouraged other people to attend an event related to aquatic invasive species	○	○	○	○	○	○
h. Talked to other people in my community about aquatic invasive species	○	○	○	○	○	○
i. Worked with others to minimize impacts from aquatic invasive species	○	○	○	○	○	○

16. We would like to understand your beliefs about environmental impacts from invasive species. How strongly do you agree or disagree with these statements?

	Strongly Disagree		Neutral		Strongly Agree
a. I feel guilty if I spread aquatic invasive species	○	○	○	○	○
b. I am morally obligated to minimize the spread of aquatic invasive species when fishing	○	○	○	○	○
c. People like me should feel personally obligated to limit the spread of aquatic invasive species	○	○	○	○	○
d. My own actions while fishing influence the spread of aquatic invasive species	○	○	○	○	○
e. I have the ability to limit the spread of aquatic invasive species	○	○	○	○	○
f. There are many ways I can help stop the spread of aquatic invasive species	○	○	○	○	○

17. People have different beliefs about aquatic invasive species and the risks they present. How serious of a threat do you think invasive species are to:

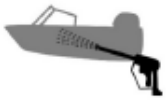
	Low threat	Moderate Threat	High Threat
a. Your fishing experience	○	○ ○ ○	○
b. Your financial well-being	○	○ ○ ○	○
c. The environment where you fish	○	○ ○ ○	○
d. The Great Lakes fishery	○	○ ○ ○	○
e. The economy in the Great Lakes region	○	○ ○ ○	○
f. The environment in the Great Lakes region	○	○ ○ ○	○

18. 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.

	Opposed to my Values				Important				Of Supreme Importance
	1	2	3	4	5	6	7	8	9
a. **Protecting the environment**: preserving nature	○	○	○	○	○	○	○	○	○
b. **Unity with nature**: fitting into nature	○	○	○	○	○	○	○	○	○
c. **A world of beauty**: beauty of nature and the arts	○	○	○	○	○	○	○	○	○
d. **Equality**: equal opportunity for all	○	○	○	○	○	○	○	○	○
e. **Social justice**: correcting injustice, care for others	○	○	○	○	○	○	○	○	○
f. **A world at peace**: free of war and conflict	○	○	○	○	○	○	○	○	○
g. **Authority**: the right to lead or command	○	○	○	○	○	○	○	○	○
h. **Social power**: control over others, dominance	○	○	○	○	○	○	○	○	○
i. **Influential**: having an impact on people and events	○	○	○	○	○	○	○	○	○
j. **Fulfilment of desire**: food, fun, pleasure	○	○	○	○	○	○	○	○	○
k. **Enjoying life**: pursuing hobbies, leisure, socializing	○	○	○	○	○	○	○	○	○
l. **Reducing worries**: seeking comfort and relaxation	○	○	○	○	○	○	○	○	○
m. **Personal growth**: development of new skills, learning, or gaining insight into something	○	○	○	○	○	○	○	○	○
n. **Pursuit of excellence**: attaining a personal ideal in life	○	○	○	○	○	○	○	○	○
o. **Autonomy**: deciding your own future and doing what you believe in	○	○	○	○	○	○	○	○	○
p. **Satisfaction with life:** finding meaning, value, and relevance to a broader context	○	○	○	○	○	○	○	○	○

Section 3 of 5: Future Fishing Scenarios

On the next few pages, we ask you six questions related to possible changes in the conditions of fishing sites in the Great Lakes region. In each of these questions, you need to choose between two hypothetical future scenarios and current conditions. Each future scenario includes multiple features representing environmental characteristics that can only be partially controlled by management. The features are described below. *Please read this material carefully.*

Wash Stations 	Wash stations can be used to disinfect and pressure-wash boats to stop invasive species from spreading. At some US boat launch sites that border the Great Lakes, people are required to drain boats and remove visible plant and animal material before leaving to prevent species from spreading to other waterbodies. Wash station availability is set at three levels: 1. **No wash stations** 2. **Voluntary wash stations** 3. **Mandatory wash stations** (monitored by an official)
Added Cost per Fishing Trip 	Invasive species control and prevention efforts in the Great Lakes are mostly federally funded, and could be enhanced by voluntary contributions. "Added cost per fishing trip" is the extra amount you would be willing to pay each time you go fishing for better invasive species management. 1. Added cost per fishing trip ranges from **$0 to $20 (USD)**
Amount of Native Fish 	Native fish include lake trout, yellow perch and walleye. In recent years, these species have been fairly stable in the Great Lakes, but population levels are lower than they have been historically. 1. Amount of native fish ranges from a **20% decrease** to a **20% increase** from current levels
Impact from Invasive Species 	Invasive species are organisms outside of their historic range that harm the environment. Species such as zebra mussels and sea lamprey have dramatically changed nutrients, water clarity, and habitat in the Great Lakes. Impact from invasive species is set at three levels: 1. **Minimal impacts** 2. **Moderate impacts** 3. **Severe impacts**
Fish Habitat 	Fish habitat refers to the quality of the environment that supports fish. These habitats are critical for successful reproduction and growth of sportfish communities such as salmon and yellow perch, and for prey fish such as smelt and alewife. The quality of fish habitat ranges from: 1. **Poor** 2. **Good** 3. **Excellent**

Each scenario below includes three options. Please select the option with the combination of features that you would prefer to find in the area where you fish.

Fishing Scenario 1

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	Mandatory	$0	10% decrease	Severe	Excellent	❒ A
Option B	No wash stations	$10	10% increase	Minimal	Poor	❒ B
Option C	Same as today					❒ C

Fishing Scenario 2

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	No wash stations	$10	No change	Minimal	Good	❒ A
Option B	Voluntary	$0	20% increase	Moderate	Excellent	❒ B
Option C	Same as today					❒ C

Fishing Scenario 3

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	Mandatory	$15	10% decrease	Minimal	Poor	❒ A
Option B	Mandatory	$5	20% decrease	Minimal	Excellent	❒ B
Option C	Same as today					❒ C

Fishing Scenario 4

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	Mandatory	$10	20% increase	Severe	Good	❒ A
Option B	Voluntary	$20	10% increase	Minimal	Excellent	❒ B
Option C	Same as today					❒ C

Fishing Scenario 5

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	Voluntary	$15	20% decrease	Moderate	Good	❒ A
Option B	No wash stations	$5	No change	Severe	Poor	❒ B
Option C	Same as today					❒ C

Fishing Scenario 6

Suppose Option A and Option B were the *only* options available. Which would you choose? Please consider all the features and *check the box that represents your choice*.

Attribute	Wash stations 	Added cost per fishing trip $	Amount of fish 	Impact from invasive species 	Fish habitat 	I would choose
Option A	No wash stations	$0	No change	Moderate	Poor	❒ A
Option B	Voluntary	$10	20% decrease	Severe	Good	❒ B
Option C	Same as today					❒ C

19. Did you ignore any of the features while reviewing the fishing scenarios listed above? ❒Yes ❒ No

Section 4 of 5: Cultural Values and Beliefs

In this section, we ask you to reflect on your values as they relate to society as a whole. These kinds of values will help us understand why you make decisions and engage in behaviors that relate to aquatic invasive species.

20. There are many different perspectives on how society should be organized. How strongly do you agree or disagree with these statements?

	Strongly Disagree		Neutral		Strongly Agree
a. We have gone too far in pushing equal rights in this country	○	○	○	○	○
b. Our society would be better off if the distribution of wealth was more equal	○	○	○	○	○
c. We need to dramatically reduce inequalities between the rich and poor, whites and people of color, and men and women	○	○	○	○	○
d. Discrimination against minorities is still a very serious problem in our society	○	○	○	○	○
e. It seems like blacks, women, homosexuals, and other groups don't want equal rights, they want special rights just for them	○	○	○	○	○
f. Society as a whole has become too soft and feminine	○	○	○	○	○

21. There are many different perspectives on the role of government. How strongly do you agree or disagree with these statements?

	Strongly Disagree		Neutral		Strongly Agree
a. The government interferes far too much in our everyday lives	○	○	○	○	○
b. Sometimes government needs to make laws that keep people from hurting themselves	○	○	○	○	○
c. It's not the government's business to try to protect people from themselves	○	○	○	○	○
d. The government should stop telling people how to live their lives	○	○	○	○	○
e. The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals	○	○	○	○	○
f. Government should put limits on the choices individuals can make so they don't get in the way of what's good for society	○	○	○	○	○

22. We next ask about your views on management of the Great Lakes fishery in your state. Please rate your level of agreement with the statements below.

	Strongly Disagree		Neutral		Strongly Agree
a. My state government has the necessary expertise to manage my state's Great Lakes fishery effectively	○	○	○	○	○
b. In managing my state's Great Lakes fishery, decision-makers consider all relevant points of view	○	○	○	○	○
c. My state government is open to new ideas and alternative points of view on Great Lakes fisheries	○	○	○	○	○
d. My state government's information about Great Lakes management tends to be biased and one-sided	○	○	○	○	○
e. My state government is too influenced by private industries in my state's Great Lakes fishery	○	○	○	○	○
f. My state government makes credible decisions about my state's Great Lakes fishery	○	○	○	○	○

Section 5 of 5: About You

23. What is your gender? ❑ Male ❑ Female ❑ Other

24. In what year were you born? _____

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

❑ Less than $20,000
❑ $20,000 - $39,999
❑ $40,000 - $59,999
❑ $60,000-$79,999
❑ $80,000 - $99,999
❑ $100,000 - $124,999
❑ $125,000 - $149,999
❑ $150,000 or more
❑ Prefer not to answer

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

❑ Some high school
❑ High school graduate or GED
❑ Two-year degree
❑ Bachelor's degree
❑ Professional certificate
❑ Graduate degree

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

❑ White
❑ Asian
❑ Black or African American
❑ American Indian
❑ Native Hawaiian or other Pacific Islander
❑ Other: _____

Please check the box below if you read the introductory letter (enclosed with this survey)

❑ Yes, I read the introductory letter.

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.

If you have any questions or would like to see the results please let us know.

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APPENDIX B: RESEARCH RESULTS FROM RECREATIONAL ANGLERS SAMPLED IN THE CANADIAN PROVINCE OF ONTARIO

This section presents descriptive information about anglers from the Canadian province of Ontario (n=760) who were included in this research. Results are presented using a series of tables and figures, particularly frequency distributions. 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 data.

History of fishing participation

Survey respondents were asked to share their history of participation in fishing activities (see Table 20). On average, Ontario respondents spent approximately one month out of the year fishing (*M* = 32.53 days fished, *SD* = 36.69). Given the large variation in responses for these two experience-use-history questions, further examination of the data indicated the distribution was right skewed (skewness=4.035; see Figure 12). Total years of fishing experience (*M* = 36.89, *SD* = 16.21) showed a distribution closer to normal (skewness = -0.385; see Figure 13).

Table 21. Previous experiences and self-reported skill levels among recreational anglers

Previous experience	U.S. Respondents M (SD)	Ontario M (SD)
Total number of days fishing in 2018	28.68 Mo[1] = 20.00 (36.85)	32.53 Mo = 20.00 (36.69)
Total number of years fishing[2]	40.49 Mo = 50.00 (17.94)	36.89 Mo = 50.00 (16.21)
Fishing skills in comparison to other anglers[3]	3.72 (1.44)	3.77 (1.25)

[1]Mode number of days fished based on the sample data
[2]Estimate included fishing activities in 2018
[3]Measured on a Likert scale ranging from 1 (Much lower than average) to 5 (Much higher than average)

Reported skill levels were also evaluated to better understand the history and specialization of recreational anglers engaged in this study (see Table 20). The mean skill levels were slightly above average. Respondents in the Ontario sample reported their fishing skills in comparison to other anglers were higher than average (*M* = 3.77, *SD* = 1.25).

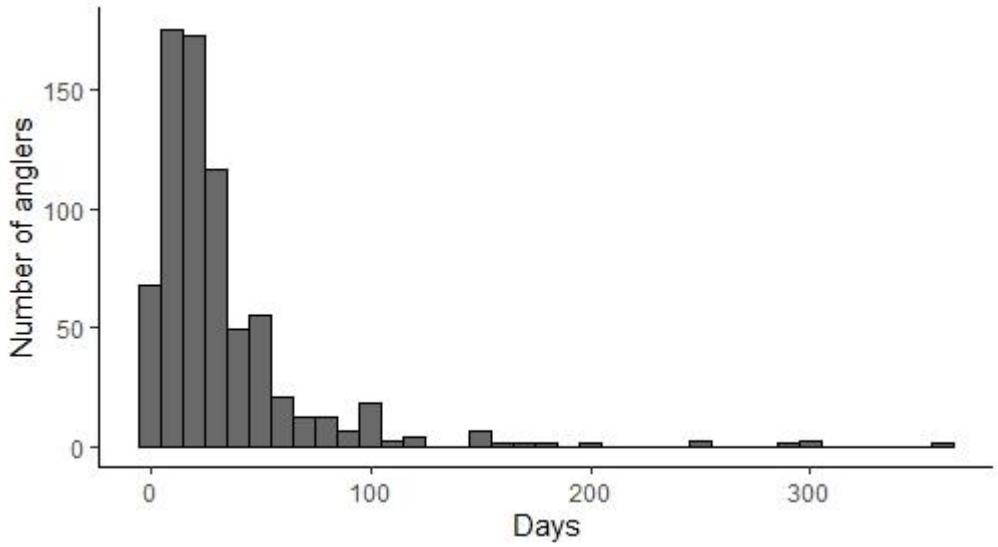

Figure 12. Total days fished in 2018 for Ontario anglers

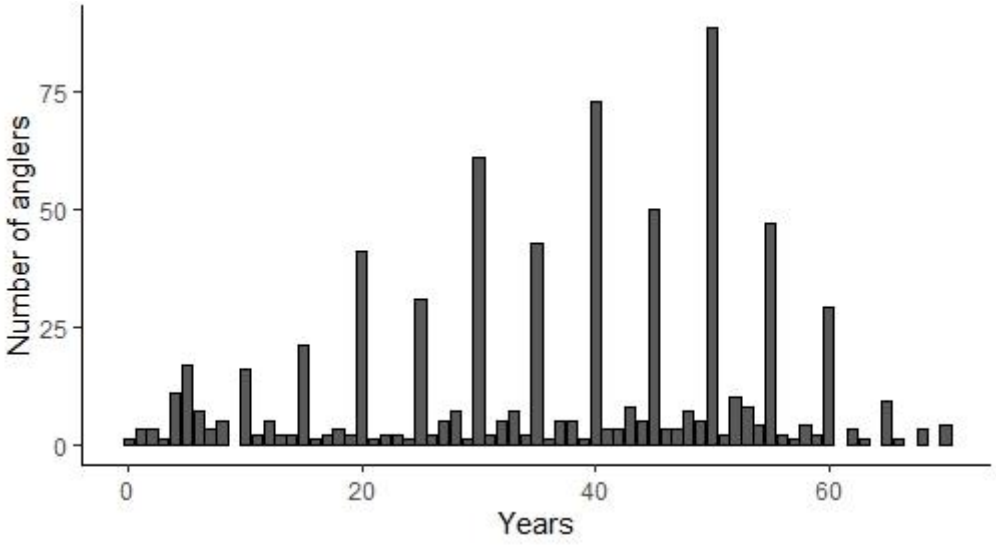

Figure 13. Total years fished of fishing experience including 2018 for Ontario anglers

Location of fishing activities

The primary locations of fishing activities were identified in this study by asking respondents to indicate the places where they spent the most time fishing (see Table 21). A majority of Ontario

respondents fished inland lakes (69%), with smaller proportions of anglers fishing Great Lakes tributaries (46%), Lake Ontario (28%), and inland rivers and streams (27%).

Table 22. Location of fishing activities

Location	U.S. Respondents N (%)	Ontario N (%)
Lake Ontario	126 (11.0)	209 (27.5)
Lake Michigan	462 (40.3)	20 (2.6)
Lake Superior	20 (1.7)	27 (3.6)
Lake Erie	57 (5.0)	124 (16.3)
Lake Huron	16 (1.4)	121 (15.9)
Other inland lakes	776 (67.8)	522 (68.7)
Rivers and/or streams connected to the Great Lakes	520 (45.4)	351 (46.2)
Rivers and/or streams not connected to the Great Lakes	357 (31.2)	203 (26.7)

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

All fishing location responses were collapsed into three variables for ease of interpretation (see Table 22). First, anglers who selected "Lake Ontario," "Lake Michigan," "Lake Superior" "Lake Erie," "Lake Huron," and/or "Rivers and/or streams connected to the Great Lakes" were categorized as "Great Lakes & Tributary anglers." Second, anglers who selected "other inland lakes" and/or "rivers and/or streams not connected to the Great Lakes" were categorized as "inland waterways anglers." Third, anglers who selected at least one of the Great Lakes and/or Tributary options and at least one of the inland options were categorized as "mixed-site" anglers.

Results showed that half (50%) of the Ontario sample was classified as a "mixed site angler." These individuals will be a key subgroup of interest given their movement between the Great Lakes and inland waterways. Three out of ten respondents (30%) fished in inland waterways and two out of ten (20%) fished only in the Great Lakes and/or its tributaries.

Table 23. Collapsed categories of fishing location

Location	U.S. Respondents N (%)	Ontario N (%)
Great Lakes and tributary anglers Lake Ontario, Lake Michigan, Lake Superior, Lake Erie, Lake Huron, and/or tributaries (but no inland sites)	220 (19.8)	140 (19.6)
Inland waterways Other inland lakes and/or inland rivers/streams	333 (30.0)	217 (30.3)

(but no Great Lakes and/or Tributary fishing sites)		
Mixed-site anglers	557 (50.2)	358 (50.1)
At least one Great Lakes and/or Tributary site and at least one inland waterway site		

Respondents were asked to report the percent time spent fishing from a boat versus the shoreline so that their two response options totaled 100% (see Table 23). On average, Ontario anglers reported that they spent 69% of their fishing time on the shoreline and 31% of their fishing time on boats.

For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, risk of spreading AIS. Just over half of Ontario respondents (58.7%) trailered their boat between fishing sites and approximately one quarter (24.5%) kept their boat docked at one location.

Table 24. Time spent fishing from a boat versus the shoreline

	U.S. Respondents	**Ontario**
	N (%)	N (%)
Shoreline[1] [M, SD]	[45.78, 36.96]	[69.41, 32.01]
Boat[1] [M, SD]	[59.43, 36.55]	[30.59, 32.01]
Type of boat use[2]		
A boat trailered between fishing sites	658 (57.5)	446 (58.7)
A boat docked at one location for a season	266 (23.2)	186 (24.5)
Not sure	9 (0.8)	11 (1.4)
Other	70 (6.1)	99 (13.0)

[1]Percent of fishing time spent from a boat and from shore, ranging from 0-100%
[2]If respondents indicated they spent any time fishing from a boat, they were asked to select a description of the boat they used more often

Species targeted

The species targeted by survey respondents were highly variable (see Table 24). The species targeted by more than 50% of Ontario respondents included walleye (77%), smallmouth bass (77%), largemouth bass (69%), northern pike (67%), and yellow perch (53%). After reporting all species targeted, survey respondents were asked to identify their primary species of interest (see Table 25). The same primary species emerged, in 30% of Ontario anglers selected walleye, 19% selected smallmouth bass, and 17% selected largemouth bass. To simplify the range of species targeted, respondents were divided into three categories including 1) Salmon / trout, 2)

Walleye / bass / pike / perch; and 3) panfish & other (see Table 26). A vast majority of Ontario anglers (80%) targeted walleye / bass / pike / perch.

Table 25. All species targeted by survey respondents

Species	U.S. Respondents N (%)	Ontario N (%)
Bluegill	665 (58.1)	120 (15.8)
Walleye	641 (56.0)	588 (77.4)
Yellow perch	615 (53.7)	401 (52.8)
Largemouth bass	609 (53.2)	527 (69.3)
Northern pike	534 (46.6)	511 (67.2)
Smallmouth bass	556 (48.6)	586 (77.1)
Crappie	557 (48.6)	202 (26.6)
Rainbow trout / steelhead	401 (35.0)	263 (34.6)
Chinook / king salmon	372 (32.5)	143 (18.8)
Brown trout	311 (27.2)	130 (17.1)
Coho salmon	229 (26.1)	86 (11.3)
Lake trout	276 (24.1)	295 (38.8)
Catfish	228 (19.9)	107 (14.1)
Muskie	214 (18.7)	226 (29.7)
Brook trout	197 (17.2)	184 (24.2)
White bass	191 (16.7)	59 (7.8)
Whitefish	111 (9.7)	124 (16.3)
Atlantic salmon	92 (8.0)	50 (6.6)
Carp	81 (7.1)	62 (8.2)
Drum / sheepshead	55 (4.8)	30 (3.9)
Other	48 (4.2)	22 (2.9)

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

Table 26. Valid percentages for the primary species targeted by survey respondents

Species	U.S. Respondents (%)	Ontario (%)
Bluegill	12.9	0.1
Walleye	12.4	30.2
Largemouth bass	10.8	17.3
Yellow perch	9.2	3.6
All types of bass	7.1	0.1

Chinook / king salmon	5.6	2.6
Smallmouth bass	5.5	18.7
Crappie	4.9	1.0
Northern pike	4.7	7.8
Rainbow trout / steelhead	4.1	4.9
White bass	3.7	1.2
General salmon / trout	3.5	-
Catfish	2.3	0.3
Brook trout	2.2	2.9
Coho salmon	2.2	0.6
Brown trout	1.9	0.3
Muskie	1.8	1.9
No target	1.6	-
Lake trout	1.1	4.2
Whitefish	0.8	0.6
Bull head	0.5	-
Panfish	0.3	-
Drum / sheepshead	0.3	0.1
Nightcrawlers	0.1	-
Carp	0.1	0.7
Suckers	0.1	-
Sunies	0.1	-
Other	0.2	0.6
Total	100%	100%

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

Table 27. Proportion of respondents in three subgroups defined by the primary species targeted

Species	**U.S. Respondents** N (%)	**Ontario** N (%)
Salmon / trout	209 (20.6)	113 (15.6)
Walleye / bass / pike / perch	523 (51.5)	575 (79.5)
Bluegill / crappie / other	283 (27.9)	33 (4.60)

Primary information sources

A variety of information sources provided anglers with information about AIS (see Table 27). More than 50% of Ontario anglers heard about AIS from online angling forums (69%), other anglers (58%), and government websites (53%).

Table 28. Primary source of information where respondents heard about aquatic invasive species

Source	U.S. Respondents N (%)	Ontario N (%)
Print newspapers	774 (67.5)	359 (47.3)
Other anglers	623 (54.4)	443 (58.4)
Friends and family	485 (42.3)	296 (39.0)
Environmental groups	434 (37.9)	277 (36.5)
Social media (e.g., Facebook)	378 (33.0)	279 (36.8)
Public agencies	316 (27.6)	132 (17.4)
Webinars	289 (25.2)	29 (3.8)
Online angling forums	278 (24.3)	520 (68.5)
Online newspapers	238 (20.8)	235 (31.0)
Government officials	237 (20.7)	135 (17.8)
Professional societies	199 (17.4)	97 (12.8)
Charter captains	170 (14.8)	58 (7.6)
Public meetings	112 (9.8)	69 (9.1)
Government websites	81 (7.1)	405 (53.4)
Scholarly articles	104 (9.1)	89 (11.7)

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

Socio-demographic characteristics

Ontario respondents were mostly male (89%), White (62%), and the average age was 50.36 (*SD* = 13.30; see Table 28, Figure 14 and 15). The most frequently cited level of education was a graduate degree (33%), while 21% reported holding a two-year college degree. Approximately 28% of respondents reported earning less than $79,999 each year before taxes.

Table 29. Socio-demographic profile of survey respondents

Variables	U.S. Respondents N (%)	Ontario N (%)
Gender		
Male	962 (86.2)	472 (88.7)

Female	153 (13.7)	51 (9.6)
Other	1 (0.1)	9 (1.7)
Age [M, SD]	[56.13, 15.51]	[50.36, 13.30]
18-34 years	134 (12.0)	71 (14.7)
35-50 years	218 (19.6)	151 (31.3)
51-60 years	260 (23.3)	143 (29.6)
61-70 years	304 (27.3)	99 (20.5)
71 years or more	199 (17.8)	19 (3.9)
Education		
Some high school	260 (24.6)	95 (18.3)
High school graduate or GED	170 (16.1)	49 (9.5)
Two-year college degree	341 (32.2)	109 (21.0)
Bachelor's degree	99 (9.4)	71 (13.7)
Professional certificate	27 (2.6)	23 (4.4)
Graduate degree	161 (15.2)	171 (33.0)
Income		
Less than $20,000	55 (5.3)	13 (2.4)
$20,000 to $39,999	127 (12.2)	34 (6.4)
$40,000 to $59,999	130 (12.5)	43 (8.1)
$60,000 to $79,999	65 (6.3)	61 (11.5)
$80,000 to $99,999	129 (12.4)	72 (13.6)
$100,000 to $124,999	140 (13.5)	79 (14.9)
$125,000 to $149,999	152 (14.6)	43 (8.1)
$150,000 or more	126 (12.1)	87 (16.4)
Prefer not to answer	116 (11.2)	99 (18.6)
Race[1]		
White	973 (84.9)	475 (62.5)
Asian	16 (1.4)	26 (3.4)
Black or African American	22 (1.9)	7 (0.9)
Native Hawaiian or other Pacific Islander	5 (0.4)	3 (0.4)
American Indian or Alaska Native	34 (3.0)	26 (3.4)

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

Environmental behavior

Respondents were asked to report how frequently they engaged in a variety of environmental behaviors related to aquatic invasive species over the past year (see Table 29). Drawing from previous research and exploratory analysis, we found there were two primary dimensions of behavior that existed in the private and public spheres. Participation in both types of behavior was low, in that Ontario respondents reported sometimes (M = 2.81, SD = 0.97) engaging in private sphere behaviors that occurred at an individual level and rarely (M = 1.41, SD = 0.68) engaging in behaviors that minimized the spread of AIS through interaction with other people and the public realm.

Table 30. Reported environmental behavior that was performed over the past 12 months

	U.S. Respondents M (SD)	Ontario M (SD)
Private sphere behaviors (α = .627)[1]	***2.55 (1.02)***	***2.81 (0.97)***
Looked up information about AIS	2.03 (1.08)	2.36 (1.04)
Avoided purchasing products that contribute to the spread of AIS	2.80 (1.78)	3.09 (1.73)
Took measures (e.g., washed boat or equipment) to personally reduce the spread of AIS	3.21 (1.66)	3.35 (1.55)
Talked to other people in my community about AIS	2.23 (1.25)	2.11 (1.13)
Public sphere behaviors (α = .740)[1]	***1.50 (0.75)***	***1.41 (0.68)***
Participated in a policy process (e.g., voting) related to AIS	1.72 (1.26)	1.47 (1.04)
Donated money with the intention of reducing impacts from AIS	1.61 (1.04)	1.44 (0.84)
Wrote a letter, sent an email, or signed a petition about AIS	1.29 (0.77)	1.33 (0.77)
Encouraged other people to attend an event related to AIS	1.35 (0.83)	1.42 (0.92)

Note. Measured on a Likert scale where 1 = "Never" and 5 = "Very Often".

Note. Respondents were presented with a "Not Applicable" option

[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

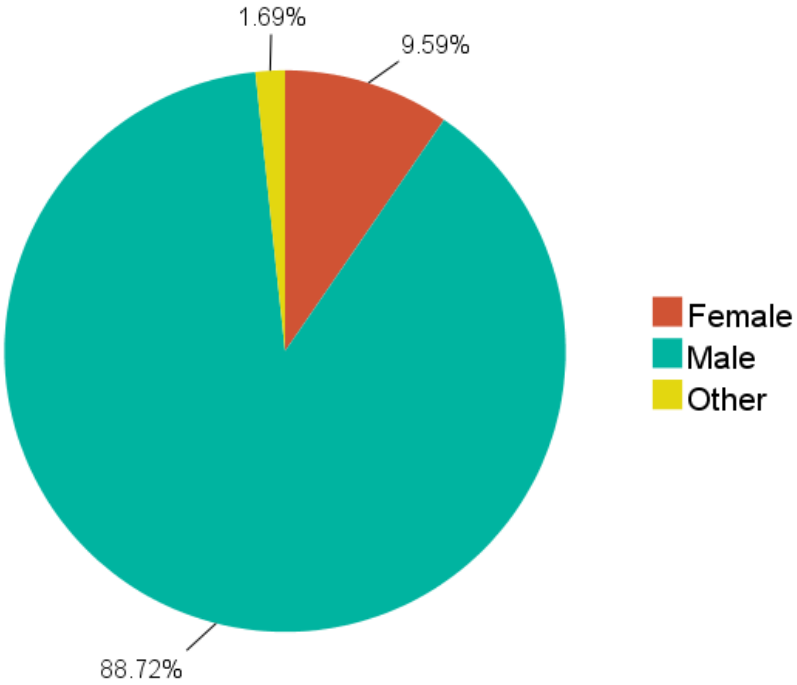

Figure 14. Gender of survey respondents included in the Ontario sample

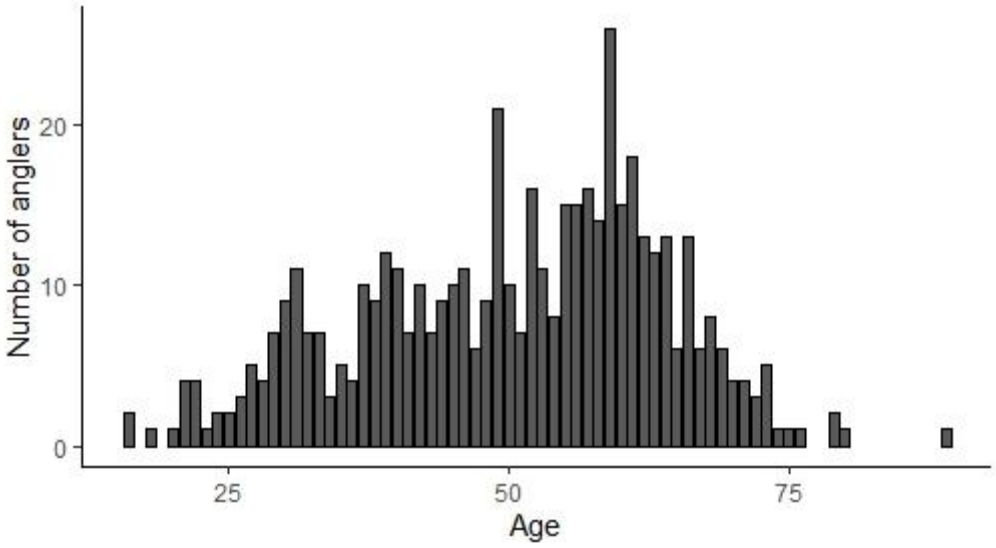

Figure 15. Age of Ontario respondents to this survey

APPENDIX C: RESEARCH RESULTS FROM RECREATIONAL ANGLERS SAMPLED IN ILLINOIS

This section presents descriptive information about anglers from Illinois (n=270) who were included in this research. Results are presented using a series of tables and figures, particularly frequency distributions. 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 data.

History of fishing participation

Survey respondents were asked to share their history of participation in fishing activities (see Table 30). On average, Illinois anglers spent nearly one month out of the year fishing (*M* = 27.22 days, *SD* = 37.13). Given the large variation in responses for these two experience-use-history questions, further examination of the data indicated the distribution was right skewed (skewness = 4.975; see Figure 16). Total years of fishing experience (*M* = 37.74, *SD* = 19.00) showed a distribution closer to normal (skewness = -0.196; see Figure 17).

Table 31. Previous experiences and self-reported skill levels among recreational anglers

Previous experience	Pooled sample M (SD)	Illinois M (SD)
Total number of days fishing in 2018	28.68 Mo[1] = 20.00 (36.85)	27.22 Mo = 20.00 (37.13)
Total number of years fishing[2]	40.49 Mo = 50.00 (17.94)	37.74 Mo = 40.00 (19.00)
Fishing skills in comparison to other anglers[3]	3.72 (1.44)	3.70 (1.36)

[1]Mode number of days fished based on the sample data
[2]Estimate included fishing activities in 2018
[3]Measured on a Likert scale ranging from 1 (Much lower than average) to 5 (Much higher than average)

Reported skill levels were also evaluated to better understand the history and specialization of recreational anglers engaged in this study (see Table 30). The mean skill levels were slightly above average. Illinois respondents reported that their fishing skills in comparison to other anglers were higher than average (*M* = 3.70, *SD* = 1.36).

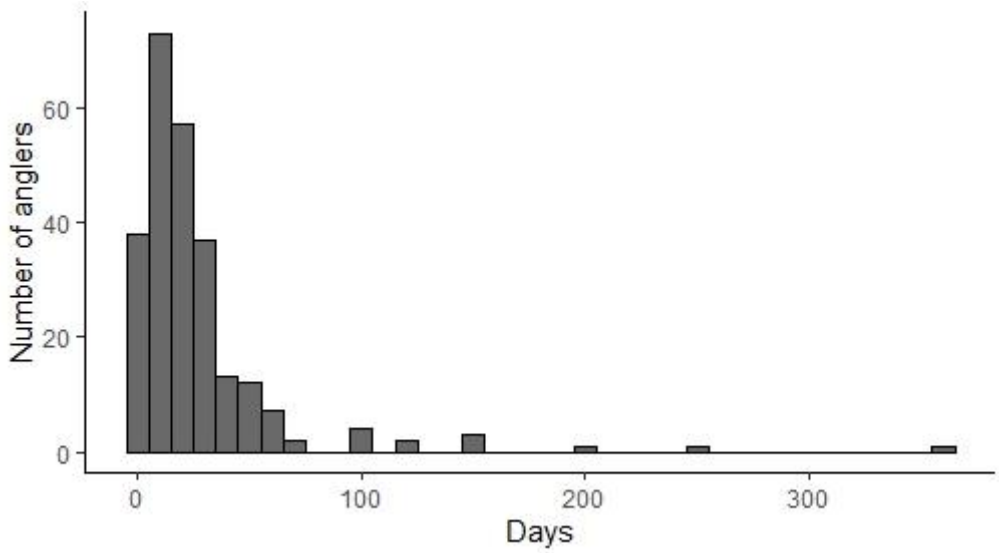

Figure 16. Total days fished in 2018 for Illinois anglers

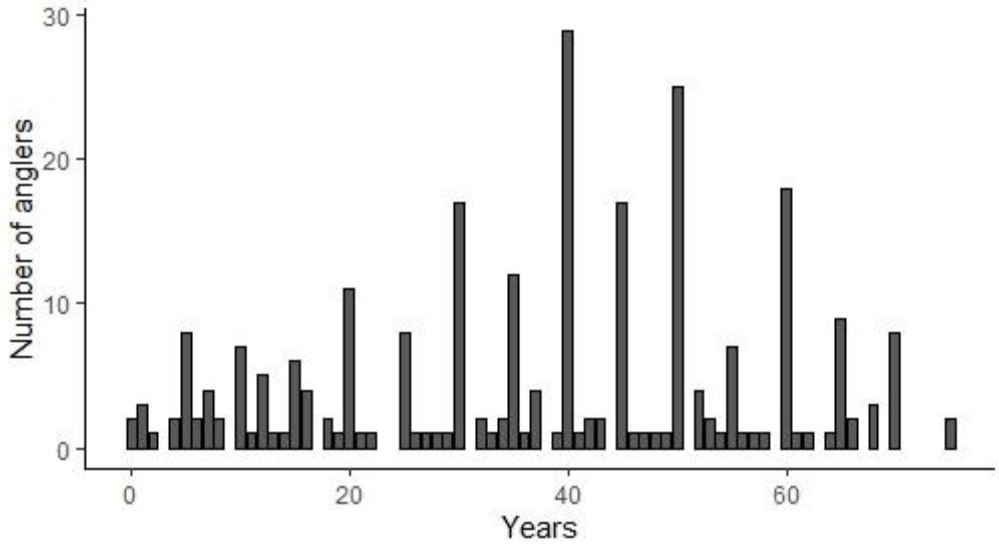

Figure 17. Total years fished of fishing experience including 2018 for Illinois anglers

Questions about familiarity and use of live bait showed familiarity with "certified bait (free of exotic species or diseases)" was low (*M* = 1.95, *SD* = 1.13; see Table 31. Frequency of using live baitfish occurred "sometimes," in that Illinois anglers reported an average score of 2.95 (*SD* = 1.21) on a scale from 1 – 5. Three behaviors related to baitfish disposal were examined. Illinois anglers most frequently kept bait to use later (*M* = 3.16, *SD* = 1.48) and disposed of them on the ground (*M* = 3.18, *SD* = 1.58). Respondents disposed of baitfish less frequently in the water where fishing (*M* = 1.98, *SD* = 1.44).

Table 32. Familiarity and use of live bait

	Pooled sample	Illinois
	M (SD)	M (SD)
Familiarity with "certified" bait (free of exotic species or diseases)[1]	2.34 (1.25)	1.95 (1.13)
Frequency of using live baitfish while fishing[2]	2.95 (1.19)	2.95 (1.21)
Disposal of extra baitfish when you are done fishing[2]	-	-
Dispose of them in the water where you fish	1.88 (1.34)	1.98 (1.44)
Dispose of them on the ground or in trash cans	3.06 (1.59)	3.18 (1.58)
Keep them to use later	3.28 (1.46)	3.16 (1.48)

[1]Measured on a Likert scale ranging from 1 (Not at all familiar) to 5 (Extremely familiar)
[2]Measured on a Likert scale ranging from 1 (Never) to 5 (Very often)

Location of fishing activities

The primary locations of fishing activities were identified in this study by asking respondents to indicate the places where they spent the most time fishing (see Table 32). A majority of Illinois respondents primarily fished inland lakes (72%), while smaller proportions fished inland rivers and streams (44%), Lake Michigan (47%), and Great Lakes tributaries (30%).

Table 33. Location of fishing activities

Location	Pooled sample	Illinois
	N (%)	N (%)
Lake Ontario	126 (11.0)	2 (0.7)
Lake Michigan	462 (40.3)	126 (46.8)
Lake Superior	20 (1.7)	3 (1.1)
Lake Erie	57 (5.0)	15 (5.6)
Lake Huron	16 (1.4)	-
Other inland lakes	776 (67.8)	193 (71.7)
Rivers and/or streams connected to the Great Lakes	520 (45.4)	80 (29.7)
Rivers and/or streams not connected to the Great Lakes	357 (31.2)	119 (44.2)

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

All fishing location responses were collapsed into three variables for ease of interpretation (see Table 33). First, anglers who selected "Lake Ontario," "Lake Michigan," "Lake Superior," "Lake Erie," "Lake Huron," and/or "Rivers and/or streams connected to the Great Lakes" were categorized as "Great Lakes & Tributary anglers." Second, anglers who selected "other inland lakes" and/or "rivers and/or streams not connected to the Great Lakes" were categorized as

"inland waterways anglers." Third, anglers who selected at least one of the Great Lakes and/or Tributary options and at least one of the inland options were categorized as "mixed-site" anglers.

Results showed that approximately half (46%) of Illinois respondents were classified as "mixed site anglers." These individuals will be a key subgroup of interest given their movement between the Great Lakes and inland waterways. A similar proportion of Illinois anglers (42%) fished in only inland waterways and one out of ten (12%) fished only in the Great Lakes and/or its tributaries.

Table 34. Collapsed categories of fishing location

Location	Pooled sample N (%)	Illinois N (%)
Great Lakes and tributary anglers Lake Ontario, Lake Michigan, Lake Superior, Lake Erie, Lake Huron, and/or tributaries (but no inland sites)	220 (19.8)	31 (11.9)
Inland waterways Other inland lakes and/or inland rivers/stream (but no Great Lakes and/or Tributary fishing sites)	333 (30.0)	110 (42.1)
Mixed-site anglers At least one Great Lakes and/or Tributary site and at least one inland waterway site	557 (50.2)	120 (46.0)

Respondents were asked to report the percent time spent fishing from a boat versus the shoreline so that their two response options totaled 100% (see Table 34). On average, Illinois anglers reported that they spent slightly more than half (54%) of their time fishing from the shoreline and 49% of their fishing time from a boat.

For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, risk of spreading AIS. Approximately half of Illinois respondents (46%) trailered their boat between fishing sites and just over one quarter (28.6%) kept their boat docked at one location.

Table 35. Time spent fishing from a boat versus the shoreline

	Pooled sample N (%)	Illinois N (%)
Shoreline[1] [M, SD]	[45.78, 36.96]	[54.26, 38.11]
Boat[1] [M, SD]	[59.43,	[49.20,

	36.55]	38.34]
Type of boat use[2]		
A boat trailered between fishing sites	658 (57.5)	124 (46.1)
A boat docked at one location for a season	266 (23.2)	77 (28.6)
Not sure	9 (0.8)	3 (1.1)
Other	70 (6.1)	16 (5.9)

[1]Percent of fishing time spent from a boat and from shore, ranging from 0-100%
[2]If respondents indicated they spent any time fishing from a boat, they were asked to select a description of the boat they used more often

Species targeted

The species targeted by survey respondents were highly variable (see Table 35). The species targeted by more than 50% of respondents included largemouth bass (61%), crappie (56%), walleye (54%), and bluegill (53%). After reporting all species targeted, survey respondents were asked to identify their primary species of interest (see Table 36), revealing that largemouth bass were most commonly targeted (17.2%). To simplify the range of species targeted, respondents were divided into three categories including 1) Salmon / trout, 2) Walleye / bass / pike / perch; and 3) panfish & other (see Table 37). Results showed that more anglers (51%) targeted walleye / bass / pike / perch.

Table 36. All species targeted by survey respondents

Species	Pooled sample N (%)	Illinois N (%)
Bluegill	665 (58.1)	143 (53.2)
Walleye	641 (56.0)	145 (53.9)
Yellow perch	615 (53.7)	100 (37.2)
Largemouth bass	609 (53.2)	163 (60.6)
Northern pike	534 (46.6)	127 (47.2)
Smallmouth bass	556 (48.6)	133 (49.4)
Crappie	557 (48.6)	150 (55.8)
Rainbow trout / steelhead	401 (35.0)	89 (33.1)
Chinook / king salmon	372 (32.5)	92 (34.2)
Brown trout	311 (27.2)	59 (21.9)
Coho salmon	229 (26.1)	69 (25.7)
Lake trout	276 (24.1)	69 (25.7)
Catfish	228 (19.9)	81 (30.1)
Muskie	214 (18.7)	75 (27.9)
Brook trout	197 (17.2)	24 (8.9)

White bass	191 (16.7)	79 (29.4)
Whitefish	111 (9.7)	28 (10.4)
Atlantic salmon	92 (8.0)	13 (4.8)
Carp	81 (7.1)	24 (8.9)
Drum / sheepshead	55 (4.8)	15 (5.6)
Other	48 (4.2)	5 (1.9)

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

Table 37. Valid percentages for the primary species targeted by survey respondents

Species	Pooled sample (%)	Illinois (%)
Bluegill	12.9	7.1
Walleye	12.4	7.9
Largemouth bass	10.8	17.2
Yellow perch	9.2	2.5
All types of bass	7.1	7.5
Chinook / king salmon	5.6	4.2
Smallmouth bass	5.5	5.9
Crappie	4.9	5.4
Northern pike	4.7	6.3
Rainbow trout / steelhead	4.1	1.3
White bass	3.7	9.2
General salmon / trout	3.5	2.1
Catfish	2.3	5.0
Brook trout	2.2	1.3
Coho salmon	2.2	5.4
Brown trout	1.9	1.3
Muskie	1.8	3.8
No target	1.6	1.3
Lake trout	1.1	2.5
Whitefish	0.8	1.3
Bull head	0.5	-
Panfish	0.3	-
Drum / sheepshead	0.3	0.4
Nightcrawlers	0.1	-
Carp	0.1	0.4
Suckers	0.1	-

Sunies	0.1	-
Other	0.2	0.8
Total	100%	100%

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

Table 38. Proportion of respondents in three subgroups defined by the primary species targeted

Species	Pooled sample N (%)	Illinois N (%)
Salmon / trout	209 (20.6)	43 (18.0)
Walleye / bass / pike / perch	523 (51.5)	122 (51.0)
Bluegill / crappie / other	283 (27.9)	74 (31.0)

Primary information sources

A variety of information sources provided anglers with information about AIS (see Table 38). A strikingly high proportion of anglers had heard about AIS through print newspapers (71%). The other primary information sources for Illinois anglers were other anglers (57%), friends and family (36%), environmental groups (35%), social media (33%), public agencies (32%), webinars (32%), and online angling forums (32%).

Table 39. Primary source of information where respondents heard about aquatic invasive species

Source	Pooled sample N (%)	Illinois N (%)
Print newspapers	774 (67.5)	191 (70.7)
Other anglers	623 (54.4)	154 (57.0)
Friends and family	485 (42.3)	96 (35.6)
Environmental groups	434 (37.9)	94 (34.8)
Social media (e.g., Facebook)	378 (33.0)	89 (33.0)
Public agencies	316 (27.6)	86 (31.9)
Webinars	289 (25.2)	87 (32.2)
Online angling forums	278 (24.3)	87 (32.2)
Online newspapers	238 (20.8)	69 (25.6)
Government officials	237 (20.7)	45 (16.7)
Professional societies	199 (17.4)	54 (20.0)
Charter captains	170 (14.8)	41 (15.2)
Public meetings	112 (9.8)	22 (8.1)

Government websites	81 (7.1)	39 (14.4)
Scholarly articles	104 (9.1)	28 (10.4)

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

Socio-demographic characteristics

Illinois respondents were mostly male (94%), White (82%), and the average age was 54.33 (*SD* = 15.99; see Table 39, Figure 18 and 19). The most frequently cited level of education was some high school (31%), while 26% reported having graduated high school or holding a GED. Approximately half (51%) of respondents reported earning less than $79,999 each year before taxes.

Table 40. Socio-demographic profile of survey respondents

Variables	Pooled sample N (%)	Illinois N (%)
Gender		
Male	962 (86.2)	244 (93.8)
Female	153 (13.7)	16 (6.2)
Other	1 (0.1)	0 (0.0)
Age [M, SD]	[56.13, 15.51]	[54.33, 15.99]
18-34 years	134 (12.0)	35 (13.5)
35-50 years	218 (19.6)	64 (24.7)
51-60 years	260 (23.3)	60 (23.2)
61-70 years	304 (27.3)	58 (22.4)
71 years or more	199 (17.8)	42 (16.2)
Education		
Some high school	260 (24.6)	77 (31.0)
High school graduate or GED	170 (16.1)	65 (26.2)
Two-year college degree	341 (32.2)	53 (21.4)
Bachelor's degree	99 (9.4)	25 (10.1)
Professional certificate	27 (2.6)	7 (2.8)
Graduate degree	161 (15.2)	21 (8.5)
Income		
Less than $20,000	55 (5.3)	15 (6.0)
$20,000 to $39,999	127 (12.2)	56 (22.6)
$40,000 to $59,999	130 (12.5)	32 (12.9)
$60,000 to $79,999	65 (6.3)	24 (9.7)
$80,000 to $99,999	129 (12.4)	30 (12.1)
$100,000 to $124,999	140 (13.5)	22 (8.9)
$125,000 to $149,999	152 (14.6)	28 (11.3)
$150,000 or more	126 (12.1)	31 (12.5)
Prefer not to answer	116 (11.2)	10 (4.0)

Race[1]		
White	973 (84.9)	221 (81.9)
Asian	16 (1.4)	6 (2.2)
Black or African American	22 (1.9)	6 (2.2)
Native Hawaiian or other Pacific Islander	5 (0.4)	0 (0.0)
American Indian or Alaska Native	34 (3.0)	8 (3.0)

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

Environmental behavior

Respondents were asked to report how frequently they engaged in a variety of environmental behaviors related to aquatic invasive species over the past year (see Table 40). Drawing from previous research and exploratory analysis, we found there were two primary dimensions of behavior that existed in the private and public spheres. Participation in both types of behavior was low, in that Illinois respondents reported rarely (*M* = 2.48, *SD* = 1.03) engaging in private sphere behaviors that occurred at an individual level and even less often (*M* = 1.49, *SD* = 0.72) engaging in behaviors that minimized the spread of AIS through interaction with other people and the public realm.

Table 41. Reported environmental behavior that was performed over the past 12 months

	Pooled sample M (SD)	**Illinois** M (SD)
Private sphere behaviors (α = .627)[1]	***2.55 (1.02)***	***2.48 (1.03)***
Looked up information about AIS	2.03 (1.08)	2.06 (1.00)
Avoided purchasing products that contribute to the spread of AIS	2.80 (1.78)	2.83 (1.78)
Took measures (e.g., washed boat or equipment) to personally reduce the spread of AIS	3.21 (1.66)	2.99 (1.67)
Talked to other people in my community about AIS	2.23 (1.25)	2.16 (1.25)
Public sphere behaviors (α = .740)[1]	***1.50 (0.75)***	***1.49 (0.72)***
Participated in a policy process (e.g., voting) related to AIS	1.72 (1.26)	1.59 (1.12)
Donated money with the intention of reducing impacts from AIS	1.61 (1.04)	1.72 (1.09)
Wrote a letter, sent an email, or signed a petition about AIS	1.29 (0.77)	1.29 (0.76)
Encouraged other people to attend an event related to AIS	1.35 (0.83)	1.34 (0.78)

Note. Measured on a Likert scale where 1 = "Never" and 5 = "Very Often".

Note. Respondents were presented with a "Not Applicable" option

[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

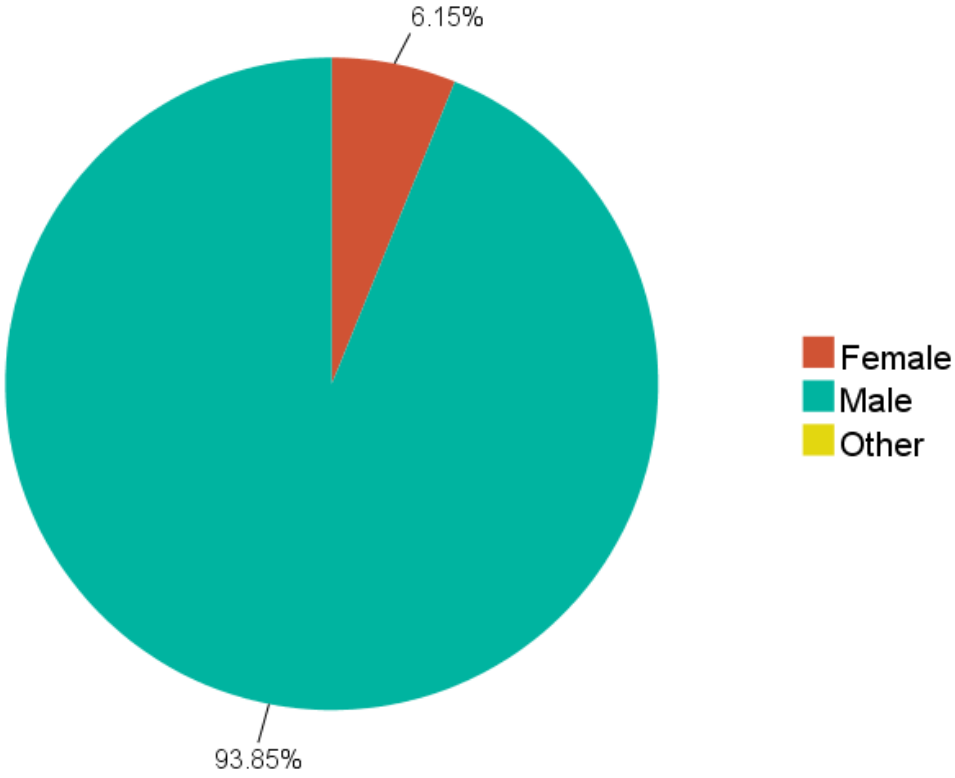

Figure 18. Gender of survey respondents included in the Illinois sample

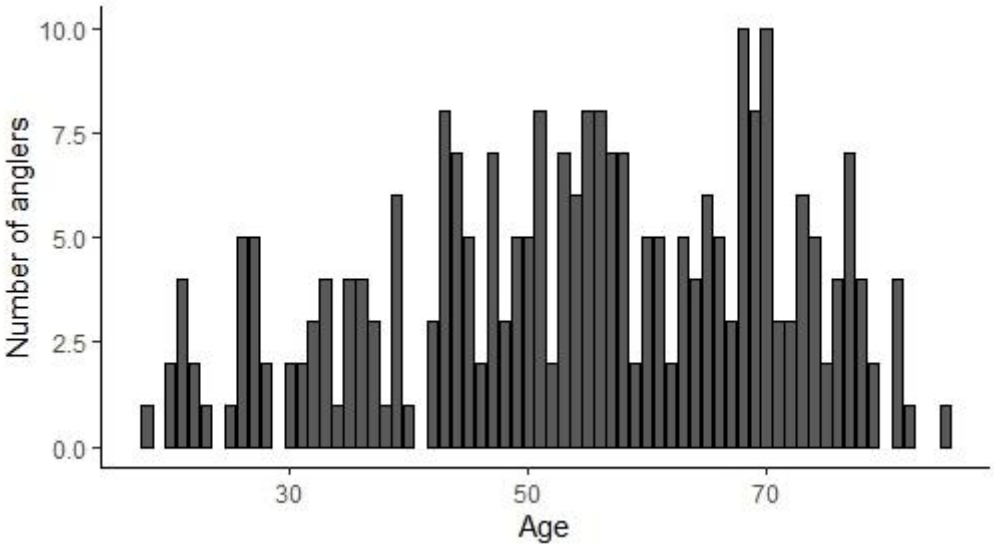

Figure 19. Age of Illinois respondents to this survey

APPENDIX D: RESEARCH RESULTS FROM RECREATIONAL ANGLERS SAMPLED IN WISCONSIN

This section presents descriptive information about anglers from Wisconsin (n=298) who were included in this research. Results are presented using a series of tables and figures, particularly frequency distributions. 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 data.

History of fishing participation

Survey respondents were asked to share their history of participation in fishing activities (see Table 41). On average, Wisconsin anglers spent 25 days a year fishing (*M* = 24.73, *SD* = 28.20). Given the large variation in responses for these two experience-use-history questions, further examination of the data indicated the distribution was right skewed (skewness=3.271; see Figure 20). Total years of fishing experience (*M* = 40.51, *SD* = 17.67) showed a distribution closer to normal (skewness = -0.290; see Figure 21).

Table 42. Previous experiences and self-reported skill levels among recreational anglers

Previous experience	Pooled sample M (SD)	Wisconsin M (SD)
Total number of days fishing in 2018	28.68 Mo[1] = 20.00 (36.85)	24.73 Mo = 20.00 (28.20)
Total number of years fishing[2]	40.49 Mo = 50.00 (17.94)	40.51 Mo = 50.00 (17.67)
Fishing skills in comparison to other anglers[3]	3.72 (1.44)	3.72 (1.50)

[1]Mode number of days fished based on the sample data
[2]Estimate included fishing activities in 2018
[3]Measured on a Likert scale ranging from 1 (Much lower than average) to 5 (Much higher than average)

Reported skill levels were also evaluated to better understand the history and specialization of recreational anglers engaged in this study (see Table 41). The mean skill levels were slightly above average. Respondents in the Wisconsin sample reported their fishing skills in comparison to other anglers were higher than average (*M* = 3.72, *SD* = 1.50).

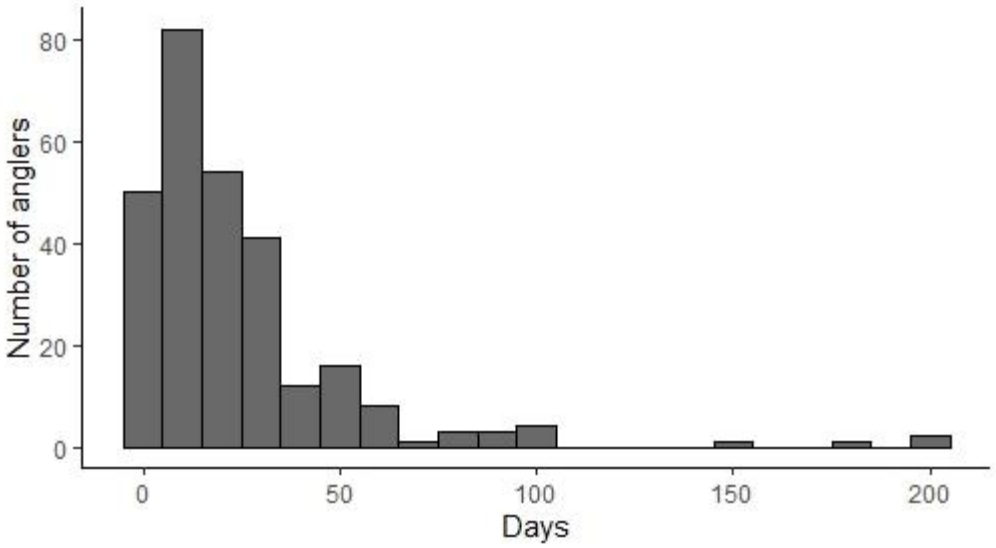

Figure 20. Total days fished in 2018 for Wisconsin anglers

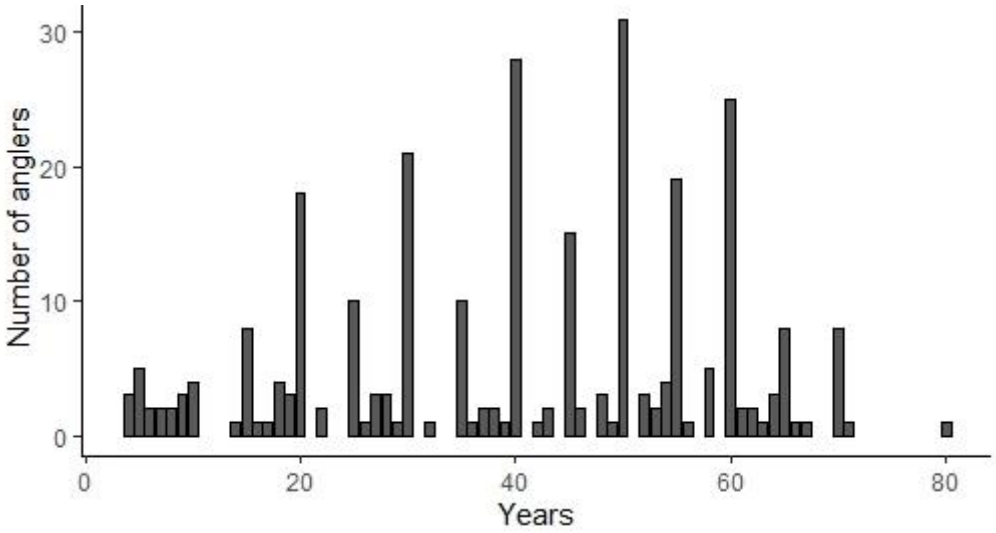

Figure 21. Total years fished of fishing experience including 2018 for Wisconsin anglers

Questions about familiarity and use of live bait showed familiarity with "certified bait (free of exotic species or diseases)" was low (*M* = 2.13, *SD* = 1.18; see Table 42. Frequency of using live baitfish occurred "sometimes," in that the sample reported an average score of 3.10 (*SD* = 1.10) on a scale from 1 – 5. Three behaviors related to baitfish disposal were examined. Wisconsin respondents most frequently kept bait to use later (*M* = 3.33, *SD* = 1.39) and/or disposed of them on the ground (*M* = 3.34, *SD* = 1.55). Wisconsin respondents rarely disposed of baitfish in the water where fishing (*M* = 1.53, *SD* = 1.02).

Table 43. Familiarity and use of live bait

	Pooled sample	Wisconsin
	M (SD)	M (SD)
Familiarity with "certified" bait (free of exotic species or diseases)[1]	2.34 (1.25)	2.13 (1.18)
Frequency of using live baitfish while fishing[2]	2.95 (1.19)	3.10 (1.10)
Disposal of extra baitfish when you are done fishing[2]	-	-
Dispose of them in the water where you fish	1.88 (1.34)	1.53 (1.02)
Dispose of them on the ground or in trash cans	3.06 (1.59)	3.34 (1.55)
Keep them to use later	3.28 (1.46)	3.33 (1.39)

[1]Measured on a Likert scale ranging from 1 (Not at all familiar) to 5 (Extremely familiar)
[2]Measured on a Likert scale ranging from 1 (Never) to 5 (Very often)

Location of fishing activities

The primary locations of fishing activities were identified in this study by asking respondents to indicate the places where they spent the most time fishing (see Table 43). A majority of Wisconsin respondents fished inland lakes (79%), with smaller proportions fishing Lake Michigan (41%), Great Lakes tributaries (39%), and inland rivers and streams (34%).

Table 44. Location of fishing activities

Location	Pooled sample	Wisconsin
	N (%)	N (%)
Lake Ontario	126 (11.0)	1 (0.3)
Lake Michigan	462 (40.3)	123 (41.3)
Lake Superior	20 (1.7)	6 (2.0)
Lake Erie	57 (5.0)	6 (2.0)
Lake Huron	16 (1.4)	2 (0.7)
Other inland lakes	776 (67.8)	234 (78.5)
Rivers and/or streams connected to the Great Lakes	520 (45.4)	115 (38.6)
Rivers and/or streams not connected to the Great Lakes	357 (31.2)	102 (34.2)

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

All fishing location responses were collapsed into three variables for ease of interpretation (see Table 44). First, anglers who selected "Lake Ontario," "Lake Michigan," "Lake Superior" "Lake Erie," "Lake Huron," and/or "Rivers and/or streams connected to the Great Lakes" were categorized as "Great Lakes & Tributary anglers." Second, anglers who selected "other inland lakes" and/or "rivers and/or streams not connected to the Great Lakes" were categorized as

"inland waterways anglers." Third, anglers who selected at least one of the Great Lakes and/or Tributary options and at least one of the inland options were categorized as "mixed-site" anglers.

Results showed that half (48%) of the Wisconsin anglers were classified as "mixed site anglers." These individuals will be a key subgroup of interest given their movement between the Great Lakes and inland waterways. Four out of ten respondents (41%) fished only in inland waterways and one out of ten (1%) fished only in the Great Lakes and/or its tributaries.

Table 45. Collapsed categories of fishing location

Location	Pooled sample N (%)	Wisconsin N (%)
Great Lakes and tributary anglers Lake Ontario, Lake Michigan, Lake Superior, Lake Erie, Lake Huron, and/or tributaries (but no inland sites)	220 (19.8)	32 (10.9)
Inland waterways Other inland lakes and/or inland rivers/streams (but no Great Lakes and/or Tributary fishing sites)	333 (30.0)	121 (41.2)
Mixed-site anglers At least one Great Lakes and/or Tributary site and at least one inland waterway site	557 (50.2)	141 (48.0)

Respondents were asked to report the percent time spent fishing from a boat versus the shoreline so that their two response options totaled 100% (see Table 45). On average, Wisconsin respondents reported they spent 67% of their fishing time from a boat and 35% from shore.

For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, risk of spreading AIS. A majority of Wisconsin anglers (69%) trailered their boat between fishing sites, whereas 21% kept their boat docked at one location.

Table 46. Time spent fishing from a boat versus the shoreline

	Pooled sample N (%)	Wisconsin N (%)
Shoreline[1] [M, SD]	[45.78, 36.96]	[35.34, 33.84]
Boat[1] [M, SD]	[59.43, 36.55]	[67.33, 33.56]
Type of boat use[2]		

A boat trailered between fishing sites	658 (57.5)	205 (68.8)
A boat docked at one location for a season	266 (23.2)	62 (20.8)
Not sure	9 (0.8)	-
Other	70 (6.1)	11 (3.7)

[1]Percent of fishing time spent from a boat and from shore, ranging from 0-100%
[2]If respondents indicated they spent any time fishing from a boat, they were asked to select a description of the boat they used more often

Species targeted

The species targeted by survey respondents were highly variable (see Table 46). The species targeted by more than 50% of respondents included bluegill (58.1%), walleye (56.0%), yellow perch (53.7), and largemouth bass (53.2%). After reporting all species targeted, survey respondents were asked to identify their primary species of interest (see Table 47). Wisconsin anglers reported bluegill (19%) and walleye (20%) to be their primary target species. To simplify the range of species targeted, respondents were divided into three categories including 1) Salmon / trout (13%), 2) Walleye / bass / pike / perch (53%); and 3) panfish & other (34%; see Table 48).

Table 47. All species targeted by survey respondents

Species	Pooled sample N (%)	Wisconsin N (%)
Bluegill	665 (58.1)	213 (71.5)
Walleye	641 (56.0)	204 (68.5)
Yellow perch	615 (53.7)	187 (62.8)
Largemouth bass	609 (53.2)	148 (49.7)
Northern pike	534 (46.6)	147 (49.3)
Smallmouth bass	556 (48.6)	133 (44.6)
Crappie	557 (48.6)	202 (67.8)
Rainbow trout / steelhead	401 (35.0)	78 (26.2)
Chinook / king salmon	372 (32.5)	90 (30.2)
Brown trout	311 (27.2)	73 (24.5)
Coho salmon	229 (26.1)	68 (22.8)
Lake trout	276 (24.1)	53 (17.8)
Catfish	228 (19.9)	43 (14.4)
Muskie	214 (18.7)	71 (23.8)
Brook trout	197 (17.2)	44 (14.8)
White bass	191 (16.7)	45 (15.1)
Whitefish	111 (9.7)	36 (12.1)

Atlantic salmon	92 (8.0)	14 (4.7)
Carp	81 (7.1)	11 (3.7)
Drum / sheepshead	55 (4.8)	9 (3.0)
Other	48 (4.2)	9 (3.0)

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

Table 48. Valid percentages for the primary species targeted by survey respondents

Species	Pooled sample (%)	Wisconsin (%)
Bluegill	12.9	19.0
Walleye	12.4	20.1
Largemouth bass	10.8	8.6
Yellow perch	9.2	9.7
All types of bass	7.1	5.2
Chinook / king salmon	5.6	6.7
Smallmouth bass	5.5	3.3
Crappie	4.9	8.6
Northern pike	4.7	3.7
Rainbow trout / steelhead	4.1	1.1
White bass	3.7	2.6
General salmon / trout	3.5	3.0
Catfish	2.3	2.2
Brook trout	2.2	1.5
Coho salmon	2.2	-
Brown trout	1.9	0.4
Muskie	1.8	2.6
No target	1.6	0.7
Lake trout	1.1	-
Whitefish	0.8	-
Bull head	0.5	0.4
Panfish	0.3	0.7
Drum / sheepshead	0.3	-
Nightcrawlers	0.1	-
Carp	0.1	-
Suckers	0.1	-
Sunies	0.1	-
Other	0.2	-

Total	100%	100%

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

Table 49. Proportion of respondents in three subgroups defined by the primary species targeted

Species	Pooled sample N (%)	Wisconsin N (%)
Salmon / trout	209 (20.6)	34 (12.6)
Walleye / bass / pike / perch	523 (51.5)	143 (53.2)
Bluegill / crappie / other	283 (27.9)	92 (34.2)

Primary information sources

A variety of information sources provided anglers with information about AIS (see Table 49). A strikingly high proportion of anglers had heard about AIS through print newspapers (67.8%). The other primary information sources for the Wisconsin sample included other anglers (54.0%), friends and family (45%), and environmental groups (40.9%).

Table 50. Primary source of information where respondents heard about aquatic invasive species

Source	Pooled sample N (%)	Wisconsin N (%)
Print newspapers	774 (67.5)	202 (67.8)
Other anglers	623 (54.4)	161 (54.0)
Friends and family	485 (42.3)	134 (45.0)
Environmental groups	434 (37.9)	122 (40.9)
Social media (e.g., Facebook)	378 (33.0)	88 (29.5)
Public agencies	316 (27.6)	92 (30.9)
Webinars	289 (25.2)	63 (21.1)
Online angling forums	278 (24.3)	62 (20.8)
Online newspapers	238 (20.8))	60 (20.1)
Government officials	237 (20.7)	61 (20.5)
Professional societies	199 (17.4)	42 (14.1)
Charter captains	170 (14.8)	31 (10.4)
Public meetings	112 (9.8)	36 (12.1)
Government websites	81 (7.1)	9 (3.0)
Scholarly articles	104 (9.1)	26 (8.7)

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

Socio-demographic characteristics

Wisconsin respondents were mostly male (80%), White (90%), and the average age was 55.56 (*SD* = 15.42; see Table 50, Figure 22 and 23). The most frequently cited level of education was a two-year college degree (38%). Approximately one third (32%) or respondents reported earning less than $79,999 each year before taxes.

Table 51. Socio-demographic profile of survey respondents

Variables	Pooled sample N (%)	Wisconsin N (%)
Gender		
Male	962 (86.2)	232 (79.7)
Female	153 (13.7)	58 (19.9)
Other	1 (0.1)	1 (0.3)
Age [M, SD]	[56.13, 15.51]	[55.56, 15.42]
18-34 years	134 (12.0)	36 (12.2)
35-50 years	218 (19.6)	59 (20.0)
51-60 years	260 (23.3)	67 (22.7)
61-70 years	304 (27.3)	85 (28.8)
71 years or more	199 (17.8)	48 (16.3)
Education		
Some high school	260 (24.6)	69 (24.2)
High school graduate or GED	170 (16.1)	30 (10.5)
Two-year college degree	341 (32.2)	107 (37.5)
Bachelor's degree	99 (9.4)	16 (5.6)
Professional certificate	27 (2.6)	5 (1.8)
Graduate degree	161 (15.2)	58 (20.4)
Income		
Less than $20,000	55 (5.3)	9 (3.2)
$20,000 to $39,999	127 (12.2)	31 (11.1)
$40,000 to $59,999	130 (12.5)	31 (11.1)
$60,000 to $79,999	65 (6.3)	17 (6.1)
$80,000 to $99,999	129 (12.4)	37 (13.2)
$100,000 to $124,999	140 (13.5)	47 (16.8)
$125,000 to $149,999	152 (14.6)	43 (15.4)
$150,000 or more	126 (12.1)	30 (10.7)
Prefer not to answer	116 (11.2)	35 (12.5)
Race[1]		
White	973 (84.9)	269 (90.3)
Asian	16 (1.4)	2 (0.7)
Black or African American	22 (1.9)	2 (0.7)
Native Hawaiian or other Pacific Islander	5 (0.4)	1 (0.3)
American Indian or Alaska Native	34 (3.0)	3 (1.0)

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

Environmental behavior

Respondents were asked to report how frequently they engaged in a variety of environmental behaviors related to aquatic invasive species over the past year (see Table 51). Drawing from previous research and exploratory analysis, we found there were two primary dimensions of behavior that existed in the private and public spheres. Participation in both types of behavior was low, in that Wisconsin respondents reported sometimes (*M* = 2.67, *SD* = 0.97) engaging in private sphere behaviors that occurred at an individual level and rarely (*M* = 1.54, *SD* = 0.80) engaging in behaviors that minimized the spread of AIS through interaction with other people and the public realm.

Table 52. Reported environmental behavior that was performed over the past 12 months

	Pooled sample M (SD)	**Wisconsin** M (SD)
Private sphere behaviors (α = .627)[1]	***2.55 (1.02)***	***2.67 (0.97)***
Looked up information about AIS	2.03 (1.08)	2.00 (1.11)
Avoided purchasing products that contribute to the spread of AIS	2.80 (1.78)	2.68 (1.73)
Took measures (e.g., washed boat or equipment) to personally reduce the spread of AIS	3.21 (1.66)	3.83 (1.51)
Talked to other people in my community about AIS	2.23 (1.25)	2.18 (1.19)
Public sphere behaviors (α = .740)[1]	***1.50 (0.75)***	***1.54 (0.80)***
Participated in a policy process (e.g., voting) related to AIS	1.72 (1.26)	1.83 (1.36)
Donated money with the intention of reducing impacts from AIS	1.61 (1.04)	1.69 (1.09)
Wrote a letter, sent an email, or signed a petition about AIS	1.29 (0.77)	1.25 (0.71)
Encouraged other people to attend an event related to AIS	1.35 (0.83)	1.40 (0.88)

Note. Measured on a Likert scale where 1 = "Never" and 5 = "Very Often".

Note. Respondents were presented with a "Not Applicable" option

[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

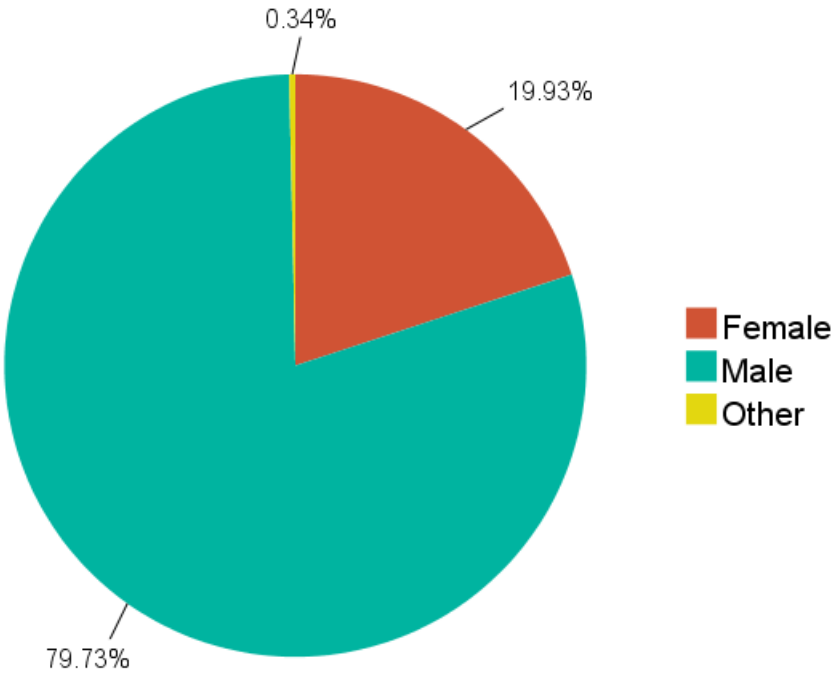

Figure 22. Gender of survey respondents included in the Wisconsin sample

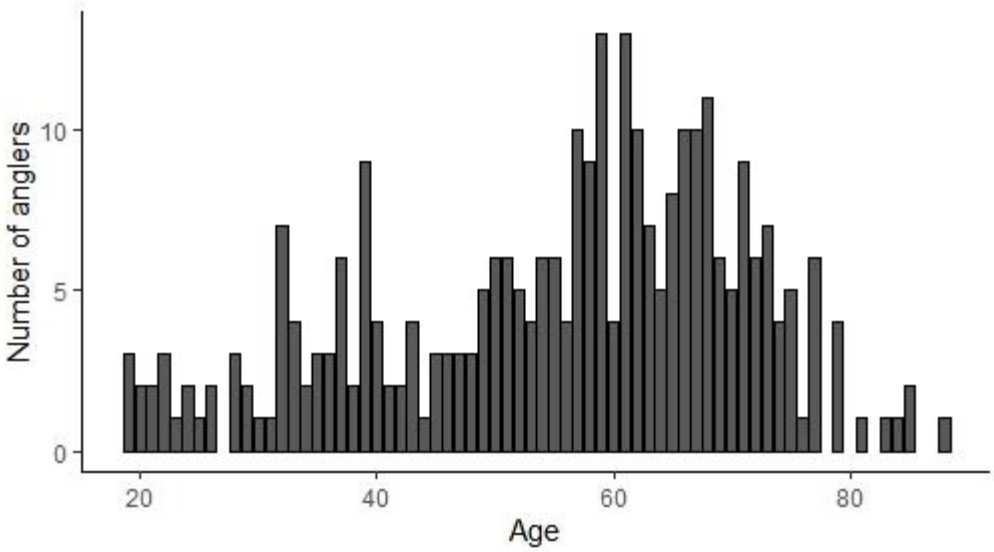

Figure 23. Age of Wisconsin respondents to this survey

APPENDIX E: RESEARCH RESULTS FROM RECREATIONAL ANGLERS SAMPLED IN MICHIGAN

This section presents descriptive information about anglers from Michigan (n = 289) who were included in this research. Results are presented using a series of tables and figures, particularly frequency distributions. 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 data.

History of fishing participation

Survey respondents were asked to share their history of participation in fishing activities (see Table 52). On average, Michigan anglers spent about one month out of the year fishing (*M* = 32.23 days, *SD* = 43.91). Given the large variation in responses for these two experience-use-history questions, further examination of the data indicated the distribution was right skewed (skewness=3.847; see Figure 24). Total years of fishing experience (*M* = 43.78, *SD* = 17.39) showed a distribution closer to normal (skewness = -0.392; see Figure 25).

Table 53. Previous experiences and self-reported skill levels among recreational anglers

Previous experience	Pooled sample M (SD)	Michigan M (SD)
Total number of days fishing in 2018	28.68 Mo[1] = 20.00 (36.85)	32.23 Mo = 10.00 (43.91)
Total number of years fishing[2]	40.49 Mo = 50.00 (17.94)	43.78 Mo = 50.00 (17.39)
Fishing skills in comparison to other anglers[3]	3.72 (1.44)	3.77 (1.45)

[1]Mode number of days fished based on the sample data

[2]Estimate included fishing activities in 2018

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

Reported skill levels were also evaluated to better understand the history and specialization of recreational anglers engaged in this study (see Table 1). The mean skill levels for Michigan anglers were higher than average (*M*= 3.77, *SD* = 1.45).

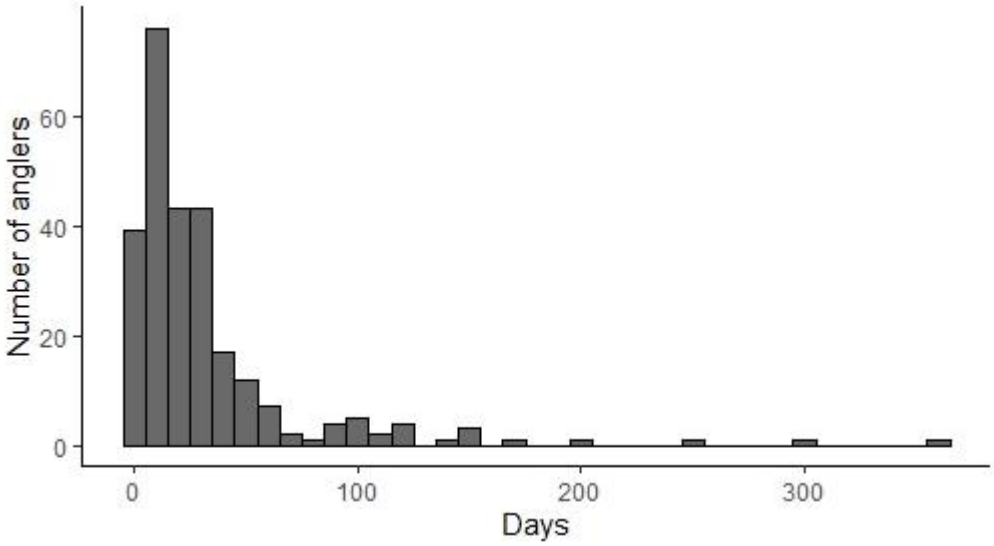

Figure 24. Total days fished in 2018 for Michigan anglers

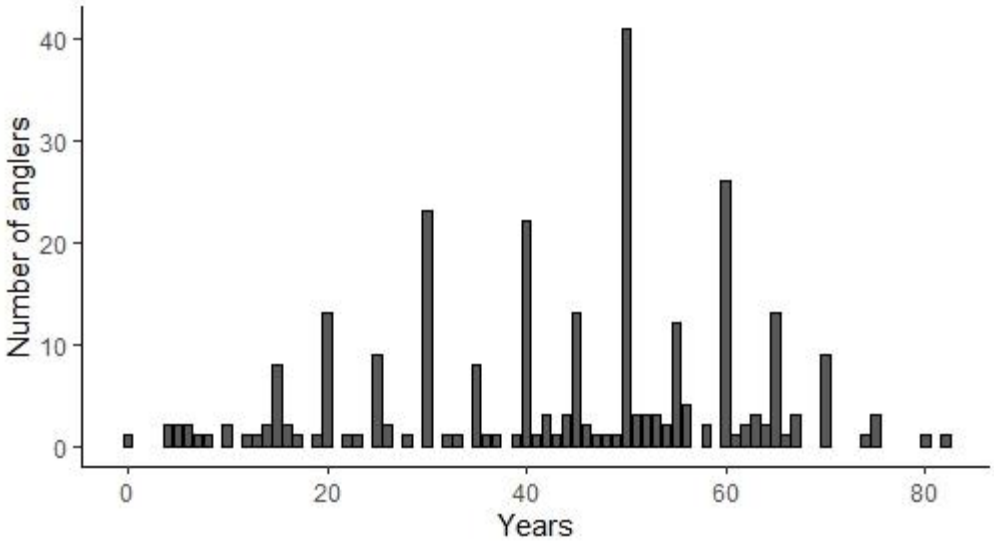

Figure 25. Total years fished of fishing experience including 2018 for Michigan anglers

Questions about familiarity and use of live bait showed familiarity with "certified bait (free of exotic species or diseases)" was low (*M* = 2.36, *SD* = 1.28; see Table 53. Frequency of using live baitfish occurred "sometimes," in that Michigan anglers reported an average score of 2.84 (*SD* = 1.25) on a scale from 1 – 5. Three behaviors related to baitfish disposal were examined. Michigan anglers most frequently kept bait to use later (*M* = 3.43, *SD* = 1.42), but also disposed of them on the ground (*M* = 3.09, *SD* = 1.54). Michigan anglers only sometimes disposed of baitfish in the water where fishing (*M* = 1.75, *SD* = 1.20).

Table 54. Familiarity and use of live bait

	Pooled sample	Michigan
	M (SD)	M (SD)
Familiarity with "certified" bait (free of exotic species or diseases)[1]	2.34 (1.25)	2.36 (1.28)
Frequency of using live baitfish while fishing[2]	2.95 (1.19)	2.84 (1.25)
Disposal of extra baitfish when you are done fishing[2]	-	-
Dispose of them in the water where you fish	1.88 (1.34)	1.75 (1.20)
Dispose of them on the ground or in trash cans	3.06 (1.59)	3.09 (1.54)
Keep them to use later	3.28 (1.46)	3.43 (1.42)

[1]Measured on a Likert scale ranging from 1 (Not at all familiar) to 5 (Extremely familiar)
[2]Measured on a Likert scale ranging from 1 (Never) to 5 (Very often)

Location of fishing activities

The primary locations of fishing activities were identified in this study by asking respondents to indicate the places where they spent the most time fishing (see Table 54). A majority of Michigan respondents fished inland lakes (72%), Great Lakes tributaries (60%), and Lake Michigan (57%).

Table 55. Location of fishing activities

Location	Pooled sample	Michigan
	N (%)	N (%)
Lake Ontario	126 (11.0)	-
Lake Michigan	462 (40.3)	165 (57.1)
Lake Superior	20 (1.7)	10 (3.5)
Lake Erie	57 (5.0)	11 (3.8)
Lake Huron	16 (1.4)	11 (3.8)
Other inland lakes	776 (67.8)	209 (72.3)
Rivers and/or streams connected to the Great Lakes	520 (45.4)	174 (60.2)
Rivers and/or streams not connected to the Great Lakes	357 (31.2)	53 (18.3)

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

All fishing location responses were collapsed into three variables for ease of interpretation (see Table 55). First, anglers who selected "Lake Ontario," "Lake Michigan," "Lake Superior" "Lake Erie," "Lake Huron," and/or "Rivers and/or streams connected to the Great Lakes" were categorized as "Great Lakes & Tributary anglers." Second, anglers who selected "other inland lakes" and/or "rivers and/or streams not connected to the Great Lakes" were categorized as

"inland waterways anglers." Third, anglers who selected at least one of the Great Lakes and/or Tributary options and at least one of the inland options were categorized as "mixed-site" anglers.

Results showed that a majority (62%) of the Michigan respondents were classified as "mixed site anglers." These individuals will be a key subgroup of interest given their movement between the Great Lakes and inland waterways. Smaller proportions of Michigan anglers fished only in the Great Lakes and/or its tributaries (22%) or only in inland waterways (16%).

Table 56. Collapsed categories of fishing location

Location	Pooled sample N (%)	Michigan N (%)
Great Lakes and tributary anglers Lake Ontario, Lake Michigan, Lake Superior, Lake Erie, Lake Huron, and/or tributaries (but no inland sites)	220 (19.8)	62 (22.2)
Inland waterways Other inland lakes and/or inland rivers/streams (but no Great Lakes and/or Tributary fishing sites)	333 (30.0)	45 (16.1)
Mixed-site anglers At least one Great Lakes and/or Tributary site and at least one inland waterway site	557 (50.2)	172 (61.6)

Respondents were asked to report the percent time spent fishing from a boat versus the shoreline so that their two response options totaled 100% (see Table 56). On average, Michigan anglers reported that they spent 68% of their fishing time on a boat and 39% of their fishing time on the shoreline.

For respondents who reported some boating activity, questions were asked to determine respondents' mobility and, therefore, risk of spreading AIS. A majority of Michigan respondents (65%) trailered their boat between fishing sites, while a smaller proportion (20%) kept their boat docked at one location.

Table 57. Time spent fishing from a boat versus the shoreline

	Pooled sample N (%)	Michigan N (%)
Shoreline[1] [M, SD]	[45.78, 36.96]	[38.69, 33.41]

Boat[1] [M, SD]	[59.43, 36.55]	[67.98, 31.77]
Type of boat use[2]		
A boat trailered between fishing sites	658 (57.5)	189 (65.4)
A boat docked at one location for a season	266 (23.2)	59 (20.4)
Not sure	9 (0.8)	2 (0.7)
Other	70 (6.1)	15 (5.2)

[1]Percent of fishing time spent from a boat and from shore, ranging from 0-100%
[2]If respondents indicated they spent any time fishing from a boat, they were asked to select a description of the boat they used more often

Species targeted

The species targeted by survey respondents were highly variable (see Table 57). The species targeted by more than 50% of Michigan respondents included bluegill (67%), yellow perch (57%), and walleye (54%). After reporting all species targeted, survey respondents were asked to identify their primary species of interest (see Table 58). The same three species, bluegill (21%), yellow perch (10%), and walleye (10%) were the most frequently selected by Michigan anglers. To simplify the range of species targeted, respondents were divided into three categories including 1) Salmon / trout (26%), 2) Walleye / bass / pike / perch (44%); and 3) panfish & other (30%; see Table 59).

Table 58. All species targeted by survey respondents

Species	Pooled sample N (%)	Michigan N (%)
Bluegill	665 (58.1)	193 (66.8)
Walleye	641 (56.0)	157 (54.3)
Yellow perch	615 (53.7)	164 (56.7)
Largemouth bass	609 (53.2)	134 (46.4)
Northern pike	534 (46.6)	127 (43.9)
Smallmouth bass	556 (48.6)	122 (42.2)
Crappie	557 (48.6)	107 (37.0)
Rainbow trout / steelhead	401 (35.0)	113 (39.1)
Chinook / king salmon	372 (32.5)	98 (33.9)
Brown trout	311 (27.2)	86 (29.8)
Coho salmon	229 (26.1)	89 (30.8)
Lake trout	276 (24.1)	81 (28.0)
Catfish	228 (19.9)	32 (11.1)
Muskie	214 (18.7)	26 (9.0)

Brook trout	197 (17.2)	67 (23.2)
White bass	191 (16.7)	30 (10.4)
Whitefish	111 (9.7)	31 (10.7)
Atlantic salmon	92 (8.0)	26 (9.0)
Carp	81 (7.1)	19 (6.6)
Drum / sheepshead	55 (4.8)	14 (4.8)
Other	48 (4.2)	9 (3.1)

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

Table 59. Valid percentages for the primary species targeted by survey respondents

Species	Pooled sample (%)	Michigan (%)
Bluegill	12.9	20.9
Walleye	12.4	10.3
Largemouth bass	10.8	7.9
Yellow perch	9.2	9.5
All types of bass	7.1	5.1
Chinook / king salmon	5.6	5.9
Smallmouth bass	5.5	6.7
Crappie	4.9	4.0
Northern pike	4.7	4.0
Rainbow trout / steelhead	4.1	6.7
White bass	3.7	1.2
General salmon / trout	3.5	4.3
Catfish	2.3	-
Brook trout	2.2	3.6
Coho salmon	2.2	0.8
Brown trout	1.9	3.6
Muskie	1.8	0.4
No target	1.6	1.2
Lake trout	1.1	1.2
Whitefish	0.8	1.2
Bull head	0.5	-
Panfish	0.3	0.4
Drum / sheepshead	0.3	0.4
Nightcrawlers	0.1	0.4
Carp	0.1	-

Suckers	0.1	0.4
Sunies	0.1	-
Other	0.2	-
Total	100%	100%

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

Table 60. Proportion of respondents in three subgroups defined by the primary species targeted

Species	Pooled sample N (%)	Michigan N (%)
Salmon / trout	209 (20.6)	66 (26.1)
Walleye / bass / pike / perch	523 (51.5)	111 (43.9)
Bluegill / crappie / other	283 (27.9)	76 (30.0)

Primary information sources

A variety of information sources provided anglers with information about AIS (see Table 60). A strikingly high proportion of Michigan anglers had heard about AIS through print newspapers (67%). The other primary information sources for Michigan anglers included other anglers (52%), friends and family (43%), and environmental groups (40%).

Table 61. Primary source of information where respondents heard about aquatic invasive species

Source	Pooled sample N (%)	Michigan N (%)
Print newspapers	774 (67.5)	194 (67.1)
Other anglers	623 (54.4)	150 (51.9)
Friends and family	485 (42.3)	125 (43.3)
Environmental groups	434 (37.9)	116 (40.1)
Social media (e.g., Facebook)	378 (33.0)	93 (32.2)
Public agencies	316 (27.6)	73 (25.3)
Webinars	289 (25.2)	66 (22.8)
Online angling forums	278 (24.3)	56 (19.4)
Online newspapers	238 (20.8)	55 (19.0)
Government officials	237 (20.7)	67 (23.2)
Professional societies	199 (17.4)	50 (17.3)
Charter captains	170 (14.8)	43 (14.9)
Public meetings	112 (9.8)	28 (9.7)

Government websites	81 (7.1)	15 (5.2)
Scholarly articles	104 (9.1)	22 (7.6)

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

Socio-demographic characteristics

Michigan survey respondents were mostly male (86.2%), White (83.4%), and the average age was 58.91 (*SD* = 14.85; see Table 61, Figure 26 and 27). The most frequently cited level of education was a two-year college degree (34.1%). Approximately one quarter (26.7%) of respondents reported earning less than $79,999 each year before taxes.

Table 62. Socio-demographic profile of survey respondents

Variables	Pooled sample N (%)	Michigan N (%)
Gender		
Male	962 (86.2)	244 (86.2)
Female	153 (13.7)	39 (13.8)
Other	1 (0.1)	0 (0.0)
Age [M, SD]	[56.13, 15.51]	[58.91, 14.85]
18-34 years	134 (12.0)	30 (10.7)
35-50 years	218 (19.6)	37 (13.2)
51-60 years	260 (23.3)	66 (23.5)
61-70 years	304 (27.3)	83 (29.5)
71 years or more	199 (17.8)	65 (23.1)
Education		
Some high school	260 (24.6)	58 (22.2)
High school graduate or GED	170 (16.1)	40 (15.3)
Two-year college degree	341 (32.2)	89 (34.1)
Bachelor's degree	99 (9.4)	31 (11.9)
Professional certificate	27 (2.6)	6 (2.3)
Graduate degree	161 (15.2)	37 (14.2)
Income		
Less than $20,000	55 (5.3)	13 (5.1)
$20,000 to $39,999	127 (12.2)	11 (4.3)
$40,000 to $59,999	130 (12.5)	36 (14.2)
$60,000 to $79,999	65 (6.3)	8 (3.1)
$80,000 to $99,999	129 (12.4)	31 (12.2)
$100,000 to $124,999	140 (13.5)	44 (17.3)
$125,000 to $149,999	152 (14.6)	42 (16.5)
$150,000 or more	126 (12.1)	30 (11.8)
Prefer not to answer	116 (11.2)	39 (15.4)
Race[1]		
White	973 (84.9)	241 (83.4)

Asian	16 (1.4)	2 (0.7)
Black or African American	22 (1.9)	5 (1.7)
Native Hawaiian or other Pacific Islander	5 (0.4)	2 (0.7)
American Indian or Alaska Native	34 (3.0)	14 (4.8)

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

Environmental behavior

Respondents were asked to report how frequently they engaged in a variety of environmental behaviors related to aquatic invasive species over the past year (see Table 62). Drawing from previous research and exploratory analysis, we found there were two primary dimensions of behavior that existed in the private and public spheres. Participation in both types of behavior was low, in that Michigan respondents reported sometimes (*M* = 2.49, *SD* = 1.02) engaging in private sphere behaviors that occurred at an individual level and rarely (*M* = 1.48, *SD* = 0.75) engaging in behaviors that minimized the spread of AIS through interaction with other people and the public realm.

Table 63. Reported environmental behavior that was performed over the past 12 months

	Pooled sample M (SD)	**Michigan** M (SD)
Private sphere behaviors (α = .627)[1]	***2.55 (1.02)***	***2.49 (1.02)***
Looked up information about AIS	2.03 (1.08)	2.03 (1.09)
Avoided purchasing products that contribute to the spread of AIS	2.80 (1.78)	2.91 (1.81)
Took measures (e.g., washed boat or equipment) to personally reduce the spread of AIS	3.21 (1.66)	2.89 (1.64)
Talked to other people in my community about AIS	2.23 (1.25)	2.22 (1.30)
Public sphere behaviors (α = .740)[1]	***1.50 (0.75)***	***1.48 (0.75)***
Participated in a policy process (e.g., voting) related to AIS	1.72 (1.26)	1.81 (1.32)
Donated money with the intention of reducing impacts from AIS	1.61 (1.04)	1.49 (0.96)
Wrote a letter, sent an email, or signed a petition about AIS	1.29 (0.77)	1.29 (0.82)
Encouraged other people to attend an event related to AIS	1.35 (0.83)	1.31 (0.81)

Note. Measured on a Likert scale where 1 = "Never" and 5 = "Very Often".

Note. Respondents were presented with a "Not Applicable" option

[1]α represents Cronbach's Alpha which reflects scale reliability and ranges from 0-1. Values above 0.6 reflect acceptable reliability.

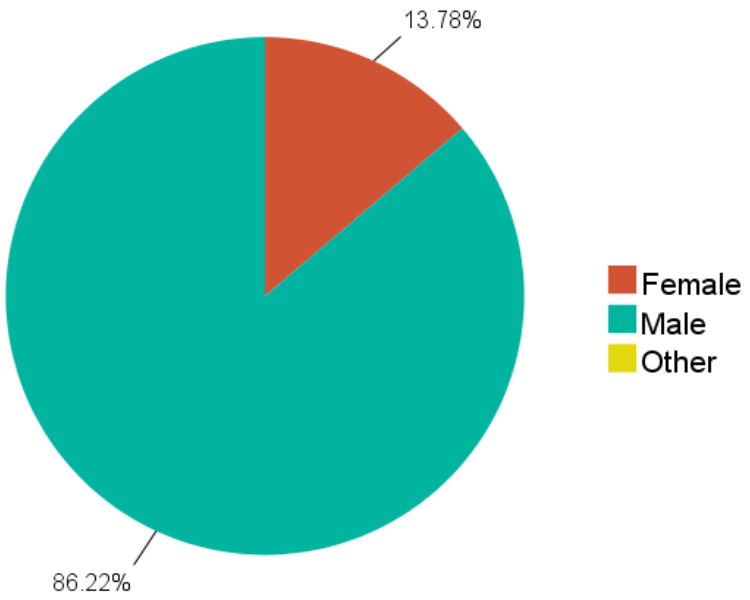

Figure 26. Gender of survey respondents included in the Michigan sample

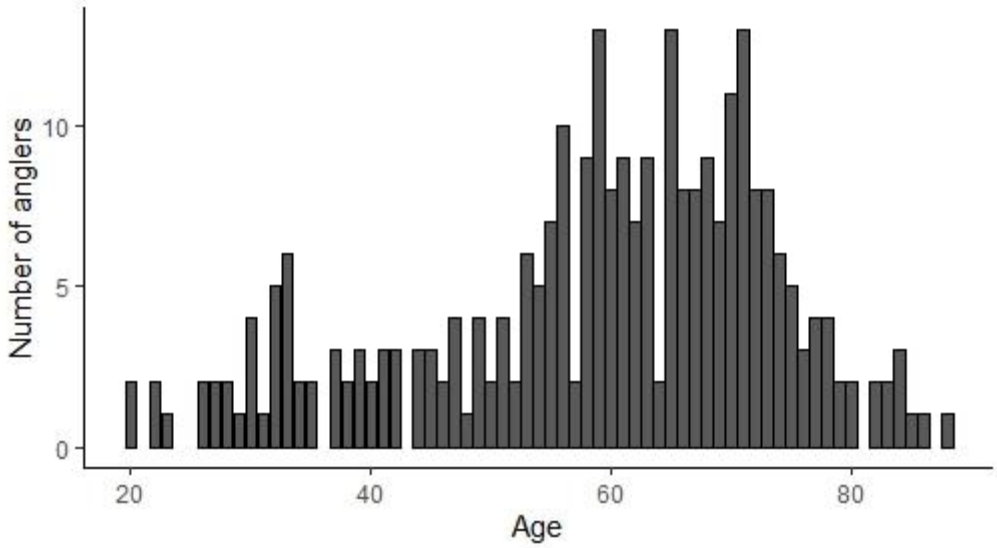

Figure 27. Age of Michigan respondents to this survey