

INCORPORATING SOCIAL SCIENCE INTO FISHERIES MANAGEMENT TO ADDRESS
CHALLENGES FROM AQUATIC INVASIVE SPECIES

BY

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THESIS

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ABSTRACT

Governance of freshwater resources amidst degradation from invasive species requires a sophisticated understanding of the water using constituency. This requires the continued integration of social science into fisheries research to understand preferences for management in the midst of multiple competing demands, as well as theoretically informed research on user behavior and its antecedents. My research addresses this necessity with two objectives: (1) assess recreational anglers' preference for future management scenarios characterized by the spread of AIS in both the US and Canada, and (2) determine the effects of trust instilled in regulatory and scientific communities on pro-environmental behavior among anglers and boaters in Illinois. To address objective 1, a stated choice experiment was conducted to determine the relative palatability of five attributes among recreational anglers: impact from invasives, amount of native fish, quality of fish habitat, added cost per fishing trip, and the availability of equipment and boat wash stations. To reflect the regional scale of resource management, this experiment solicited Great Lakes anglers across the US-Canada border, allowing me to examine preference heterogeneity across an international border. Results showed consistency among US and Canadian anglers, suggesting that a unified management approach would be well received. To address objective 2, personal values were used to understand how trust in the regulatory community moderated respondents' intention to engage in behavior that mitigated the spread of invasive species among boaters in Illinois. Results from a structural equation model showed that higher levels of trust clarified paths from personal values to intended behavior, suggesting that increasing trust in regulators among water users will make their behavior easier to predict. Trust research is rendered urgent by increasingly polarized attitudes regarding government and the

scientific community, thus underscoring the importance of social science to inform fisheries research and management.

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CHAPTER 1: INTRODUCTION

1.1 Fisheries and the Social Sciences

Freshwater fisheries are a social-ecological system that are at risk from the spread of aquatic invasive species (AIS) (Dudgeon et al., 2006; Reid et al., 2019; Ricciardi, 2006; Williams et al., 1993). The Laurentian Great Lakes represent one of the largest of said ecosystems with myriad stakeholders spanning the US-Canada border relying on these waterbodies for their livelihoods and quality of life. This creates significant challenges for resource management agencies that are responsible for balancing competing ecological objectives alongside the needs of stakeholders, as well as coordinating decisions and policy implementation at geopolitical scales (Gaden et al., 2008; Minns, 2014a). Because fishery managers are tasked with finding policy solutions that are both effective and palatable to a diversity of interests, there is a strong need for understanding the behavior, preferences, and attitudes of their constituents (Hunt et al., 2013). The human dimensions of fisheries, as it's known, was established in the 1960s to help solve these problems and has become increasingly interdisciplinary, drawing from fields like economics and psychology to more pragmatically understand the socio-political dynamics of a fishery beyond fish biology and ecology (Arlinghaus, 2004). Although there is increasing recognition that knowledge from the human dimensions – encompassing a range of environmental social science fields – is instrumental in guiding decisions about fisheries management, there has been limited progress on integrating social-ecological data in part due to limited training in the social sciences among many scientists employed in resource management agencies (Heck et al., 2015).

There are multiple values of recreational fisheries that have been empirically studied in past research, with increasingly salient issues like the spread of invasive species, bringing their

importance into focus. Indeed, recreational fishing represents a substantial portion of the Great Lakes' total economic value, with an estimated 174 million fishing trips taken in 2011 (Lauber et al., 2020). This utilization of the Great Lakes fishery illustrates not only economic importance, but also reflects personal values (i.e., guiding principles in life; (Rokeach, 1973; Schwartz, 1992)) that influence both the behaviors and capacity for user groups that perpetuate the spread of harmful AIS. The accidental release of bait and overland transport of boats and equipment are examples of behaviors that pose threats that exist at a regional scale (Johnson et al., 2001); however, unilateral policies are being designed and implemented by management agencies that face different constraints on either side of an international border between the US and Canada. Internationally situated evidence of the Great Lakes fishery is needed to facilitate co-management yet no human dimensions research in the Great Lakes region to date has spanned the two countries (Gaden, O. Brant, et al., 2021). Further complicating the translation of research and decision-making across an international border is the dearth of social science data regarding angler behavior. A systematic literature review examining AIS literature in the United States found that studies drawing from environmental social sciences accounted for just 12.6% of the total (Golebie et al, 2022). Specifically, there is a lack of knowledge surrounding the role of trust in shaping stakeholder reactions to resource management decisions (Glenn et al., 2012) and pro-environmental behavior defined as actions intended to benefit the environment (Steg & Vlek, 2009; Stern et al., 1999). Management agencies and scientific institutions that generate information and therefore shape policy outcomes may hold values that differ from their constituencies and have a history of decision-making that ignites negative reactions to their authority (Acheson, 1975). To encourage compliance with fishery regulations (Raakjær Nielsen, 2003) and minimize social conflicts that may ensue from challenges around co-management

(Pomeroy et al., 2001; Sen & Raakjaer Nielsen, 1996), there is a strong need to understand how stakeholders do or do not trust in government agencies. Therefore, my thesis research is structured around the two objectives listed below and is guided by the following central research question: *How do the preferences and belief systems of recreational anglers influence their responses to resource management decisions that govern the spread of aquatic invasive species in the Great Lakes region?*

1.2 Research Aims & Objectives

Aim 1: Assess recreational anglers' preferences for future management scenarios characterized by the spread of AIS in both the US and Canada.

Objective 1a: Evaluate the importance of competing conditions that characterize a fishery through a stated choice experiment.

Objective 1b: Understand angler preference for management schemes in both the US and Canada

Objective 1c: Provide empirical evidence for decision makers about the economic valuation of fisheries through the estimation of Willingness to Pay values.

Aim 2: Determine the effects of trust instilled in regulatory and scientific community on pro-environmental behavior (PEB) among anglers and boaters in Illinois.

Objective 2a: Evaluate the individual environmental values amongst recreational anglers in Illinois.

Objective 2b: Assess potential links between values and PEB among anglers.

Objective 2c: Examine trust as a moderating factor between values and pro-environmental behavior.

CHAPTER 2: ASSESSING ANGLER PREFERENCE

Abstract: Aquatic invasive species (AIS) management in the Great Lakes region of North America requires coordination between multiple agencies and stakeholder groups. Because the Great Lakes are an internationally managed entity, an understanding of policy preferences among stakeholders across that international boundary is integral for making evidence-based decisions about fishery resources. We evaluated angler preference for management factors that characterize how future fishing scenarios are affected by aquatic invasive species in the Great Lakes region. Using a mixed-mode survey of anglers in Illinois, Michigan, Wisconsin, New York, and the Canadian province of Ontario, we conducted a stated choice experiment to understand angler preferences for the future and compare preferences between US and Canadian anglers. Results from a mixed multinomial logit model suggested fish habitat quality, amount of native fish species, impact of invasive species, availability of wash stations, and cost all significantly influenced hypothetical scenarios chosen by survey respondents. The most impactful attributes were improvements to fish habitat and increased availability of boat wash stations, indicating that changes of this kind were most likely to predict that the scenario was chosen by a respondent. Using country of residence as interaction terms, we tested for significant differences between US and Canadian anglers and found that Canadian anglers had stronger preferences for limiting AIS impacts ($p < .001$) and improving habitat quality ($p < .0001$), but overall that recreational anglers across the international border shared preferences for management characterized by the spread of AIS. Thus, an internationally consistent management approach would likely be well received.

Key words: recreational angling; stated choice model; aquatic invasive species; fisheries management

2.1 Introduction

The impact of aquatic invasive species (AIS) costs billions each year in the United States (Pimentel et al., 2005; Lovell et al., 2006) and causes substantial alterations to freshwater ecosystems that are exacerbated by pollution and channelization, creating a host of resource management challenges (Williams et al., 1993; Ricciardi et al., 1998). The Great Lakes region, in particular, presents a complex challenge for fisheries managers due to its combined commercial and recreational uses. In addition to costly invasions from commonly known species such as sea lamprey (*Petromyzon marinus*) (Christie & Goddard, 2003), zebra mussel (*Dreissena polymorpha*) (Griffiths et al., 2011), and varieties of bigheaded carp (*Hypophthalmichthys* spp., *Mylopharyngodon* spp.) (Cuddington et al., 2014), the Great Lakes are also subject to novel AIS invasions, with a new alien aquatic species being discovered every 28 weeks, on average (Ricciardi, 2006). Recreational anglers are an important stakeholder group for fishery managers to consider when addressing the topic of aquatic invaders because anglers experience the effects of AIS damage firsthand, and likewise can be partially responsible for the spread of AIS through inadvertent transmission in bilge water, fishing gear, and live bait disposal (Drake et al., 2015; Johnson et al., 2001; Kemp et al., 2017; Kilian et al., 2012; A. Pradhananga et al., 2015; Seekamp et al., 2016). Effective mitigation of biological invasions therefore requires an understanding of angler behavior and preferences for resource management (Arlinghaus, 2004; Arlinghaus et al., 2017; Beardmore et al., 2015; Hunt et al., 2013), yet there has been a lack of corresponding urgency in incorporating evidence generated from a human dimensions perspective into decision-making at the management level (Heck et al., 2015). An emphasis on understanding recreational angler preference is needed because their motivations transcend simple economic considerations and venture into more complex, leisure-based drivers of

behavior. Knowing how anglers are likely to react to regulations will help managers to tailor policies to best attain desired impacts on aquatic ecosystems and angler experience (Aas et al., 2000; Hunt et al., 2019).

Due to the rise in human utilization of the Great Lakes (Hunt et al., 2021; Ricciardi, 2006) AIS challenges have become more politically complex (Escobar et al., 2018), thus necessitating research on angler preferences to inform consensus-based decision making across multiple state, Tribal and international boundaries. Although human dimensions of fisheries management have received some attention (Haapasaari et al., 2012; Kaplan & McCay, 2004), there is a need for more social science research particularly to inform management decisions (Heck et al., 2015), regarding AIS in an internationally managed entity like the Great Lakes. Addressing the evolution of threats from AIS while striving for the collective approval of stakeholders in two different countries necessitates the integration of disciplines within the human dimensions of natural resources (Hunt et al., 2013), but also research that reflects the international and multi-jurisdictional scale of the Great Lakes Region (Gaden, Brant, et al., 2021).

Managers have some mitigative tools and initiatives at their disposal, but limited resources necessitate prioritization regarding methods and objectives. Boat ramps are an important node for the overland transport of AIS (Rothlisberger et al., 2010), and research has been done showing that risk remains high for further spread from this vector (Cole et al., 2019). Increasing resources to these sites in the form of wash station infrastructure, use of which could be either voluntary or mandatory, would add an effective mitigative measure but would also represent a substantial cost. Managers could also choose to prioritize combating AIS that no longer rely on human vectors, such as the sea lamprey, control of which has been largely

successful since being implemented in the late 1950s – though some researchers worry that this has led to lower issue salience which could, in turn, lower social acceptance for lampricide applications (Gaden, Brant, et al., 2021). Of course, financial resources are likely to be a limiting factor for most management agencies, and understanding the willingness of anglers to accept added costs to fishing trips is integral in designing a mitigation strategy. An accounting for the kinds of management regimes anglers would like to see in the midst of AIS across the US-Canada border will allow for prioritization by managers while ensuring an adequate level of buy-in stakeholders.

Stated choice modeling has ample potential in fisheries, as it can elucidate the kinds of management factors anglers would be most willing to accept in their fishing locales. First used in environmental research to test preferences for recreation sites in Canada (Adamowicz et al., 1994), choice models have since been used test preferences for moose hunting sites (Boxall et al., 1996; Hunt et al., 2005), soil-erosion mitigation programs (Colombo et al., 2006), and environmental planning in exurban areas (Foelske et al., 2019). Use of stated choice models in fisheries social science emerged from inquiries into how anglers select potential fishing sites, and research on that behavior remains the most studied (Hunt et al., 2019). Other work has used choice modeling to understand how regulations affect and are received by anglers (Aas et al., 2000; Oh et al., 2005; Dorow et al., 2010), aiding managers in a pursuit of tenable policy. Despite this wealth of fisheries choice data, there has been an absence in use of this method that accounts for the effects of AIS. While prior studies have addressed invasive species generally (Rolfe & Windle, 2014; Adams et al., 2011; Adams et al., 2020), the ecological, economic, and political precarity of fisheries render the absence of research into management preferences in the context of AIS as especially conspicuous (Levers & Pradhananga, 2021). Research in this vein

thus has potential to provide managers with new assessments of how anglers see AIS and what kinds of approaches to mitigation they find most palatable relative to other options.

Our stated choice experiment served two functions. First, by having respondents select between differing sets of hypothetical conditions, we weighed the relative importance of five management attributes that characterized a future impacted by AIS, which generated information that could be easily communicated to managers. Secondly, by situating our research design across the US-Canada border, we estimated separate models for both countries which allowed us to assess how preference among anglers differed across that boundary. Research of this kind will facilitate multi-national coordination in the face of growing threats from AIS, as well as helping to ameliorate the kinds of resource-based conflicts that characterize fisheries relations worldwide.

2.2 Methods

Study Site

Fisheries management in the Great Lakes region is complicated by a menagerie of entities with decision-making authority. Comprised of both lakes and tributaries, the region historically struggled to address problems due to a lack of coordination across multiple states, provincial, tribal, and national governments (Gaden et al., 2008). Coordination improved slightly with the establishment of the Great Lakes Fisheries Commission (GLFC) in 1956, but especially so with the GLFC's subsequent ratification of the *Joint Strategic Plan for Management of Great Lakes Fisheries* in 1981. This policy document developed and revised a series of strategic management plans that outline challenges and mandate solutions guided by scientific evidence, in addition to validation by consensus (Gaden et al., 2008; *StrategicVision2021.Pdf*, n.d.). In addition to supporting research and management, the GLFC was largely designed to implement a program to control sea lamprey, which had wrought havoc on already declining fish populations

and was previously emblematic of broad concerns surrounding AIS management (Minns, 2014b).

Data Collection

Data were collected through a mixed mode survey administered to anglers in 2019. Different sampling methods were used to optimize data collection across state and national borders. In the US, anglers from New York, Illinois, Michigan, and Wisconsin were invited to participate in the study through a mail back survey that included a \$1 incentive and an online option. Within each state, fishing license data were used to draw an independent random sample of 1200 among anglers who had purchased a non-commercial license in 2017 and lived in a county adjacent to Lake Michigan or Lake Ontario. Mail-back surveys were administered from June through August 2019, relying on a standard survey methodology with six points of protocol consisting of an introductory letter, two reminders, and three survey waves (Dillman et al., 2014).

We could not access a database of licensed anglers for the Canadian sample given the challenges sharing information across an international border, and therefore sampled Canadian anglers by soliciting all registered users of the smartphone app “Anglers Atlas” (anglersatlas.com) in the province of Ontario in 2019. A two-contact protocol was used, consisting of an introductory email and reminder. As incentives, those who completed the survey were offered to be part of a raffle to win one of ten \$50 CAD gift cards to Canadian Tire. While the same survey instrument was used, it was adapted, with cover letters and survey items such as socio-demographic characteristics being tailored to local standards in the US and CA. Also, some items were excluded to accommodate participating state agencies. Our survey instrument underwent two rounds of pilot testing to ensure conceptual and empirical validity (Johnston et

al., 2017; Rose & Bliemer, 2013). A focus group of graduate students at the University of Illinois at Urbana Champaign campus was conducted to collect feedback on the survey ($n = 6$), followed by a pilot test using an online sample of 121 members of American Fisheries Society chapters of New York and Illinois. Data collected through mail-back surveys were manually coded, with 5% of the coded data being quality controlled to ensure inter-coder reliability.

Stated choice experimental design

We measured angler preferences for future fishing scenarios using a statistical technique called stated choice modeling (Dabrowksa et al., 2017; Pröbstl-Haider et al., 2020). This method first arose in the field of transportation planning to discern individual preference for travel types (McFadden, 1974) and has since burgeoned into a widely used tool that is applicable in a diverse array of fields (Louviere et al., 2000). Typically designed as a series of choices between two or more scenarios, stated choice models elucidate preferences by varying the intensities of factors used to comprise choices options. Depending on the design, researchers characterize the factor intensities to simulate a range of conditions that characterize realistic, hypothetical scenarios. In choice model designs in which one of the factors is represented in monetary units, the marginal rate of substitution derived from a ratio of two factors can be considered a willingness-to-pay (WTP) value (Louviere et al., 2000). Data from respondent selections are aggregated across multiple respondents to collectively portray the relative impact each factor and its intensity on the scenario chosen under the theoretical assumption that respondents seek to maximize their utility amidst budget constraints (Lancaster, 1966). Data are then analyzed using a type of logit model, with the multinomial logit having become the most relied upon method given its sophistication compared to earlier and simpler models (Hensher & Greene, 2003). Further, the

random parameters logit has increased in popularity on account of its ability to assess preference heterogeneity (Colombo et al., 2009; Hensher et al., 2005; Hunt et al., 2019).

Anglers' preferences for management regimes were elucidated by using five attributes derived from consultation with members of the Lake Michigan and Lake Ontario Lake Committees through the Great Lakes Fishery Commission. First, we measured preferences for availability of *wash stations*, which are areas where anglers can clean their boating and fishing equipment to minimize the unintentional spread of AIS. Second, we measured preferences for *added cost per fishing trip* to understand the amount of money anglers would be willing to accept as a cost to improve management attributes. This factor ranged from \$0 to \$20 in increments of 5, with Canadian dollar figures adjusted to equal US dollars. Third, we measured preferences for *amount of native fish species* present in the Great Lakes. This factor had five levels ranging from 20% decrease to 20% increase, in increments of 10%. Fourth, we measured preference for *impact from invasive species*, which were defined as organisms such as zebra mussels and sea lamprey that are outside of their historic range and harming the environment by changing nutrients, water clarity, and habitat in the Great Lakes. There were three levels spanning minimal impact, moderate impact, and severe impact. Our fifth factor was *quality of fish habitat*, which referred to the quality of the environment that supported fish species, including support for successful reproduction and growth of sportfish communities such as salmon and yellow perch, and for prey fish such as smelt and alewife. Respondents were asked to choose their preferred scenario out of three total options in six total sets, meaning each respondent evaluated six total scenarios. Two of the options in each choice set were scenarios comprised of attributes, and the third was a "same as today" option. Each attribute of either three or five levels reflected a realistic range of potential changes in this attribute over time (see Table 1).

Table 1. *The definitions and levels for all attributes estimated in the stated choice experiment*

Attribute	Definition	Levels
<i>Wash stations</i>	Locations near boat ramps where anglers can disinfect and pressure-wash boats to stop invasive species from spreading.	1. No wash stations 2. Voluntary wash stations 3. Mandatory wash station
<i>Added cost per fishing trip</i>	Cost per fishing trip that could be voluntarily added for invasive species control and prevention efforts in the Great Lakes.	\$0 - \$20
<i>Amount of fish</i>	Total amount of native fish species found in the Great Lakes	1. 20% decrease 2. 10% decrease 3. No change 4. 10% increase 5. 20% increase
<i>Impact from invasive species</i>	Degradation caused by organisms that are outside of their historic range and harming the environment	1. Minimal impact 2. Moderate impact 3. Severe impact
<i>Fish habitat</i>	The quality of the environment for supporting fish species	1. Poor 2. Good 3. Excellent

Analysis Approach

A random parameter (mixed) multinomial logit model was estimated with individual specific variables included. Use of such a model allowed for the estimation of heterogeneity within the sample, an element missing in much of the stated choice literature, as measured by the standard deviations shown in Table 3. Three alternatives were accommodated in the model including two options that displayed a configured set of attribute levels and a third option that represented the current set of conditions and was treated as a constant. Marginal WTP was calculated for the non-cost attributes that were normally distributed whereas a triangular parameter distribution was applied to our cost attribute to ensure theoretically consistent signs in our measures (Zhang & Sohngen, 2018). First, main effects were estimated, and then main effects with interaction terms based on country of residence – United States or Canada.

Respondents who selected the “same as current condition” option for all six sets were considered

to be protest responses, and thus, were excluded from analysis (Greiner et al., 2014). Our analysis was conducted using Nlogit Version 6.

Figure 1 An example of a stated choice paired comparison included in the questionnaire

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 <i>only</i> options available. Which would you choose? Please consider all the features and <u>check the box that represents your choice</u> .						
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

2.3 Results

Descriptive results

On the US side, a total of 1,120 questionnaires were returned. After accounting for 576 samples with incorrect addresses or deceased individuals, the response rate was 27%. After removing protest respondents, a total of 940 respondents were used for analysis. On the Canadian side, 31,299 users of Anglers Atlas were contacted, 24,357 of which never opened the email and were excluded from the sample. This left 6,942 that we considered to be invited to participate in the study, 801 of whom agreed to participate, resulting in a response rate of 12%. A total of 760 were eventually entered into the analysis after data cleaning. From the pooled sample, most respondents identified as male (86.4%) and White (87.2%), with 63% holding at least a two-year college degree and 54.1% reporting a household income of \$100,000 or more (Table 2).

Respondents were mostly older with an average age of 53.95 ($SD = 14.95$). Respondents were also asked about their total years fishing ($M = 39.37$, $SD = 17.32$) and number of days fishing out of the year ($M = 30.26$, $SD = 36.93$). Respondents were highly experienced ($M = 39.37$ years, $SD = 17.32$) and avid ($M = 30.26$ days fished out of the year, $SD = 36.93$). Respondents were quizzed on their knowledge of AIS with four questions, with an average score of 3.50 out of four. Demographic information for each respective country was compared to assess the validity of each group given the differing methods of sampling (Table 2). The data from Canada largely mirrored that from the US, and both were consistent with previous studies of angler population (Ready et al. 2012; Connelly et al. 2014).

Table 2 Respondent socio-demographic characteristics of the survey sample showing separate columns based on nationality

Variable	Pooled N(%)	United States N (%)	Canada N (%)
Gender			
<i>Female</i>	184 (12.9)	134 (14.3)	50 (10.1)
<i>Male</i>	1235 (86.4)	799 (85.5)	435 (88.1)
<i>Other</i>	10 (0.7)	1 (0.1)	9 (1.8)
Education ^a			
<i>Some high school</i>	318 (22.8)	227(24.9)	91 (18.9)
<i>High school graduate or GED</i>	196 (14.0)	150 (16.4)	46 (9.5)
<i>Two-year college degree</i>	397 (28.4)	295 (32.1)	102 (21.2)
<i>Bachelor's degree</i>	147 (10.5)	79 (8.6)	68 (14.1)
<i>Professional certificate</i>	46 (3.1)	23 (2.5)	23 (4.8)
<i>Graduate degree</i>	293 (21.0)	141 (15.4)	152 (31.5)
Annual Household Income			
<i>Less than \$20,000</i>	58 (4.2)	45 (5.0)	13 (2.6)
<i>\$20,000 to \$39,999</i>	142 (10.2)	111 (12.5)	31 (6.2)
<i>\$40,000 to \$59,999</i>	152 (10.9)	114 (12.7)	38 (7.6)
<i>\$60,000 to \$79,999</i>	117 (8.4)	60 (6.7)	57 (11.4)
<i>\$80,000 to \$99,999</i>	173 (12.4)	106 (11.8)	67 (13.5)
<i>\$100,000 to \$124,999</i>	195 (14.0)	122 (13.6)	73 (14.7)
<i>\$125,000 to \$149,999</i>	176 (12.6)	134 (14.8)	42 (8.4)
<i>\$150,000 or more</i>	191 (13.7)	108 (12.0)	83 (16.7)
<i>Prefer not to answer</i>	193 (13.8)	99 (11.0)	94 (18.9)
Race ^b			
<i>White</i>	1284 (87.2)	844 (89.8)	440 (82.7)

Table 2 (Cont.) Respondent socio-demographic characteristics of the survey sample showing separate columns based on nationality

Variable	Pooled N(%)	United States N (%)	Canada N (%)
<i>Asian</i>	30 (2.1)	9 (1.0)	21 (4.2)
<i>Black or African American</i>	23 (1.6)	17 (1.8)	6 (1.1)
<i>Native Hawaiian or Pacific Islander</i>	3 (0.2)	2 (0.2)	1 (0.2)
<i>American Indian or Alaska Native</i>	48 (3.3)	26 (2.8)	22 (4.1)
<i>Other</i>	47 (3.2)	0(0)	47 (9.0)
<i>Age [M, SD]</i>	[53.95, 14.95]	[55.58, 15.44]	[50.55, 13.24]
18-34 years	180 (13.0)	115 (12.3)	65 (14.5)
35-50 years	334 (24.1)	196 (21.0)	138 (30.7)
51-60 years	351 (25.4)	215 (23.0)	136 (30.3)
61-70 years	346 (25.0)	254 (27.2)	92 (20.5)
71 years or more	173 (12.5)	155 (16.6)	18 (4.0)
Knowledge ^c	3.50	3.46	3.53
Total years fishing ^d [M,SD]	[39.37, 17.32]	[40.25, 17.88]	[37.82, 16.17]
Total days fishing/year [M,SD]	[30.26, 36.93]	[28.45, 36.46]	[33.24, 37.51]

^aDifferent educational categories were presented to respondents in the US and Canada

^bRespondents could check all that applied so column totals may not equal 100%.

^cScore was created by adding the number of correct responses where 1 = no correct responses and 5 = all correct responses

^eEstimate included fishing activities in 2018

Choice modeling results

A total of 8,862 individual scenarios were chosen by respondents, with 5,640 in the US and 3,222 in Canada. These numbers correspond to the number of respondents multiplied by the scenarios chosen in each of six sets. The relative impact of each attribute on the chosen scenario was illustrated by regression coefficients (Table 3). Each attribute had a statistically significant effect on the scenario chosen by respondents ($p < .0001$), and we observed a McFadden's R^2 value of 0.3147. Standard deviations were also statistically significant ($p < .0001$) for each factor except for *amount of native fish*, demonstrating heterogeneity within the samples for all but one attribute. The strongest predictors of the chosen scenarios were improvements to *fish habitat* ($\beta = 0.535$, $SD = 0.516$), followed by the implementation of *wash stations* ($\beta = 0.509$, $SD = 0.730$),

limiting *impact from invasive species* ($\beta = -0.437$, $SD = 0.708$), limiting *added cost* ($\beta = -0.069$, $SD = 0.187$), and increasing the *amount of native fish* ($\beta = 0.025$, $SD = 0.002$). Interaction terms were then estimated to test for differences between anglers in each respective country, with preference for *cost* ($\beta = 0.014$), and *amount of native fish* ($\beta = 0.007$) significant at $p < .01$, while *impacts from invasive species* ($\beta = -0.186$) significant at $p < 0.001$, and *fish habitat* ($\beta = 0.256$) was significant at $p < .0001$. Differences regarding preferences for *wash stations* ($\beta = -0.006$) was not significant.

Table 3 *Estimated results from random parameters logit models*

Variables	Coeff. (Std. Err)	Std. Dev. (Std. Err)
Wash Stations	0.509*** (0.119)	0.730*** (0.064)
Added cost per trip	-0.069*** (0.011)	0.187*** (0.014)
Amount of native fish	0.025*** (0.006)	0.002 (0.005)
Impact from AIS	-0.437*** (0.110)	0.708*** (0.059)
Fish habitat	0.535*** (0.100)	0.516*** (0.055)
Constant	-1.578*** (0.110)	2.353*** (0.100)
Country $\times$ wash stations	-0.006 (0.083)	
Country $\times$ cost	0.014* (0.008)	
Country $\times$ amount of native fish	0.007* (0.004)	
Country $\times$ impacts from AIS	-0.186** (0.077)	
Country $\times$ fish habitat	0.256*** (0.070)	

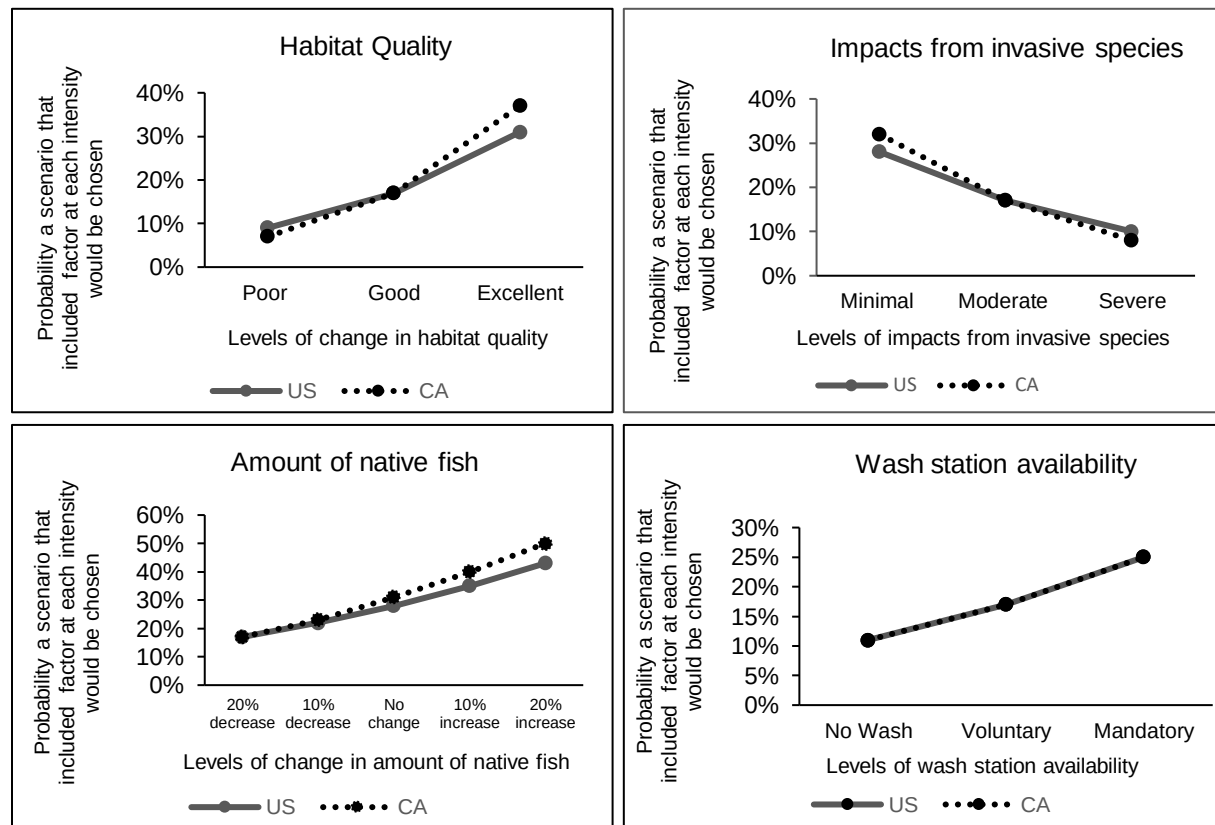
LL = -6143; AIC = 12,320.8; N = 8160; Pseudo $R^2 = 0.3147$; *** = $p < 0.0001$; ** = $p < 0.001$; * = $p < 0.01$

Coefficients and interaction effects were converted into probabilities for ease of interpretation to illustrate the impact of each attribute, excluding cost as the intensity or level increased (Figure 2). These graphs show the probability that a scenario including an attribute at each level would be chosen, as well as the rate at which higher intensities of that attribute were chosen compared to the lower levels, demonstrating how impactful each attribute was as the levels changed. Marginal willingness-to-pay (WTP) was calculated using the added cost per trip

attribute (Table 4). These figures represent the average amount of money anglers would be willing to pay per trip to upgrade from one attribute level to the next. For instance, concerning *wash stations*, anglers were willing to pay \$7.37 (USD) per trip to upgrade from *no wash stations* to *voluntary wash stations*, or from *voluntary wash stations* to *mandatory wash stations*. The highest WTP amount, which corresponds to the trends reflected in the coefficients, was for improvements to *fish habitat* (\$7.74). This was followed by implementation of *wash stations* (\$7.37), reductions in *impact from invasive species* (\$6.33) and increases in *amount of native fish* (\$0.36).

Table 4 *Marginal willingness-to-pay for changes to each study attribute contained in the stated-choice experiment*

Variable	WTP
Wash stations	\$7.37
Amount of native fish	\$0.36
Impact from invasive species	\$6.33
Fish habitat	\$7.74

Figure 2 *Rate of change in probabilities for chosen scenario*

2.4 Discussion

This study focused on the tradeoffs anglers would be willing to make to obtain their desired fishing experiences in the Great Lakes region, particularly around Lake Michigan and Lake Ontario. This research is important because of the rising urgency of AIS issues and the relevance of recreational anglers in shaping associated policy outcomes (Birdsong et al., 2021; Heck et al., 2016). Importantly, we provide a new, international perspective to advance knowledge of angler preferences across a national border that has challenged fishery management authorities in the Great Lakes region over time (Gaden, O. Brant, et al., 2021)). Given collaborative management of the Great Lakes involving US and Canadian agencies, an understanding of angler preferences across both sides of the border is important for supporting

evidence-based practices and minimizing the likelihood of fragmented co-management of a shared resource.

The interaction effects estimated by our model suggest relative uniformity in preferences for the attributes tested; however, the significant levels of standard deviation suggest that there was heterogeneity present within the sample. Because levels of heterogeneity are not strongly correlated with interaction coefficients, country of origin did not account for much of this variation, but rather, the diversity of preference spanned the international boundary. This point is further supported by the similarity in demographics, experience and knowledge among anglers in both countries, despite our differing sampling methods. Explanations for heterogeneity regarding some attributes are relevant to anglers in both countries. In the case of *wash stations*, which had a high level of deviation from the mean and low level of difference between country of residence, the difference could be attributed to whether anglers were fishing from the shore or from a boat. Differences in preference for limiting impacts from invasive species, some of which was accounted for by country of residence, call into question the differing experiences of those who fish in the Great Lakes versus tributaries as well as in the US versus Canada. This suggests a need for more research into how perceptions of AIS and preferences for mitigation are affected by the specific species anglers are likely to experience based on their fishing behavior as well as the local or regional levels of impact already present at their chosen sites (Golebie et al., 2021). Stronger preference for improving fish habitat among anglers from Canada may have resulted from our sampling method, by which anglers who used a fishing app were solicited, likely yielding a more specialized group. Strong differences in specialization were not detected in our assessment of angler knowledge or reported levels of experience. However, if Canadians did have a higher-level understanding of aquatic ecosystems on average, they may have seen

improvements to habitat as a stronger proxy for fisheries health than simply the amount of native fish, which could be a result of stocking and seasonal variation. Stronger preferences for improvements to fish habitat compared to increases in amount of native fish overall could be due to the fact that quality fish habitat entails improvement to water quality and increased flora and fauna that contribute to scenery and angler experiences (Gill et al., 2018).

Results showed that anglers were willing to pay relatively high amounts to see improvements in habitat quality, fewer AIS impacts and the implementation of wash stations. Our WTP figures were estimated relative to each fishing trip, which corresponds to the high number of fishing trips taken on average by anglers. Other studies on WTP for invasive species management have shown similar values for increases to catch rates (Cantrell et al., 2004) and relaxed harvest bans (Shideler et al., 2015). Our results reflect an interest among anglers in improving the quality of their fishing experience via the improvement of fish habitat, the mitigation of AIS and the increase in boat ramp infrastructure, specifically wash stations. Also noteworthy is that anglers were not interested in adding costs to their fishing trips to increase the amount of native fish. This may be because anglers associated increases in native fish to the practice of fish stocking, which they consider to be something they already pay for through fishing license fees. Given their relatively high values, our WTP figures may also be considered a rational investment by anglers, as the improvement of fisheries can save them money in travel costs from venturing to other fishing sites or the need to upgrade equipment (Zalejska-Jonsson, 2014). These results may also signal an ascription of responsibility among anglers in stewarding their shared resource, suggesting that managers would be well advised to connect the damage from AIS to the capacity of anglers to inadvertently assist in their spread (Levers & Pradhananga, 2021). These findings align with the recent rise of research using contingent

valuation methods to address challenges posed by AIS and provide decision support for managers seeking to rationalize consensus-based decisions with available evidence (Jones et al., 2010; Stensland et al., 2021; Smith, 2021)

2.5 Conclusion

This study reports on results from a valuation of fisheries characteristics and the associated experiences of recreational anglers at a regional scale spanning Lake Michigan and Lake Ontario. An international perspective on fisheries management is adopted in a stated choice model that includes interaction effects to compare country of residence including the US and Canada. We observe relatively similar preferences for Great Lakes fishery management across the border. This finding underscores the need for multinational cooperation to address environmental problems concerning biological invasions. Addressing the evolving nature of the Great Lakes requires continual consideration of social science research to account for the centrality of human dimensions in the inadvertent spread of AIS.

CHAPTER 3: TRUST, VALUES AND BEHAVIOR

Abstract: Illinois waters are at risk of degradation by aquatic invasive species (AIS). These water bodies represent a valuable natural resource that is utilized by a variety of stakeholders including recreationists who experience the negative effects caused by AIS and are also responsible for their inadvertent spread. Given the centrality of recreational water-users to this issue, an understanding of angler behavior and its antecedents are integral to mitigating AIS spread and managing for user satisfaction in the midst of biological invasions. However, few studies have integrated long-term, stable explanatory variables like personal values, with shorter term attitudinal variables like trust in regulatory agencies to broaden consideration of factors that explain behavioral patterns that pertain to important conservation issues. We estimated a latent variable structural equation model using data from a state-wide survey of boaters in the U.S. state of Illinois to evaluate the relationships between values and pro-environmental behavior among boaters in Illinois and determine how those relationships differed among groups based on reported levels of trust in the Illinois Department of Natural Resources and the scientific community. Our results suggested that values were a helpful long-term basis for directly predicting behavioral intentions, and that high levels of reported trust activated those values-behavior relationships, demonstrating the effect of short-term predictors. These findings offer insights into the importance of values in explaining behavioral patterns among recreational boaters, as well as the role of trust in activating values-behavior relationships. Additionally, the demographic composition of our sample raises important questions about the typology of Illinois boaters and how standard sampling methods that rely on registration data may miss a wide swathe of recreationists who are liable to inadvertently contribute to the spread of AIS.

Key words: Boaters, Illinois, environmental values, invasive species, freshwater

3.1 Introduction

Social-ecological systems that exist within freshwater ecosystems are at risk from the spread of aquatic invasive species (AIS) (Dudgeon et al., 2006; Reid et al., 2019; Ricciardi, 2006; Williams et al., 1993). Utilized by myriad stakeholders, freshwaters in the United States contain important fisheries and a variety of interconnected water bodies including the Laurentian Great Lakes. There are substantive challenges for resource management agencies responsible for balancing competing ecological objectives alongside the needs of stakeholders, all while coordinating decisions at regional and sometimes geopolitical scales (Gaden et al., 2008; Minns, 2014a). Because fishery and water resource managers are tasked with finding policy solutions that are both effective and palatable to a diversity of interests, there is a strong need for understanding the behavior, preferences, and attitudes of their constituents (Hunt et al., 2013). Empirical research on recreational water use, in particular, has brought multiple management challenges into focus. Recreational fishing, which exists in conjunction with boating, generates a substantial portion of freshwater economic value, with the Great Lakes hosting an estimated 174 million fishing trips in 2011 (Lauber et al., 2020). Because the use of freshwater ecosystems for angling and boating represent not only economic contributions, but also potential vectors for the spread of AIS, there is an urgent and persistent need to understand recreationists' capacity to take mitigative action in this regard.

The utilization of freshwater resources by recreationists is rooted in their personal values (i.e., guiding principles in life; (Rokeach, 1973; Schwartz, 1992) as well the relationship they have with governance surrounding that resource (Glenn et al., 2012). Scientific institutions and management agencies that act as knowledge brokers and interface with recreational boaters and anglers are responsible for shaping policy in ways that acknowledge and work within the

multiple values held by a constituency (Acheson, 1975). To encourage compliance with fishery regulations (Raakjær Nielsen, 2003) and minimize social conflicts that may ensue from challenges around co-management arrangements between governments and user groups (Pomeroy et al., 2001; Sen & Raakjaer Nielsen, 1996), there is a strong need to understand who the water recreationist constituency is, and particularly, how trust in the regulatory community affect the relationship between the values held by recreationists and their intention to engage in pro-environmental behavior to address pertinent issues like the spread of AIS. Addressing this lack of understanding will require research that generates knowledge of how levels of trust interact with other antecedents of behavior. Answering this call for research will provide managers with a more complete understanding of a) the values of their constituency; b) the level of trust instilled in the regulatory community, and c) how that trust interacts with values to explain why recreationists engage in behavior to the avail of management goals regarding AIS mitigation.

Environmental Values

Values research within the context of fisheries management has received limited attention but holds great potential to provide insight into the underlying psychological factors that drive recreationist behavior (van Riper et al., 2019). Increasingly, previous research has shown an appetite for recalibrating the study of human behavior given the disproportionate focus on attitudes in relation to other factors such as values (Nilsson et al., 2020; Wallen & Landon, 2020). More deeply seated antecedents to behavior like personal values bring direct relevance to the study of behaviors that benefit the environment, referred to herein as “pro-environmental behavior” (PEB). An (in)direct predictor of PEB is personal values, defined as abstract beliefs about desirable, trans-situational goals that serve as guiding principles in people’s lives

(Schwartz, 1992; Dietz et al., 2005; Stern, 1992). These value concepts are relatively stable across cultures (Schultz et al., 2005) and do not readily change throughout an individual's lifetime (Vecchione et al., 2016). Elaborating on Rokeach (1973)'s initial work that asserted the importance of human values in the social sciences, Schwartz (1992) positioned values along a motivational axis ranging from self-enhancement to self-transcendence -- the former representing a concern for personal well-being and self-interest, and the latter representing a concern for the well-being and interests of others.

Work by Schwartz (1992) was adapted to fit into an environmental context by Stern & Dietz (1994) who established the value-belief-norm (VBN) theory of environmentalism, which extended the norm activation model (Schwartz, 1973) and rests on assumptions of morality as a primary driver of behavior. An individual's behavior is directly predicted by personal norms (i.e., feelings such as pride and guilt that reflect moral obligation), while an individual's recognition of consequences to a valued entity, as well as an ascription of responsibility to prevent those consequences, work in conjunction to affect the norm-behavior relationship (De Groot & Steg, 2009). Previous research suggests that environmental worldviews (Dunlap et al., 2000) predict this chain of beliefs and norms, which is, in turn, preceded by values, particularly egoistic values (i.e., a concern for the self), altruistic values (i.e., a concern for others), and biospheric values (i.e., a concern for all living things). These values pertain to the environment yet differ insofar as the avenue by which environmental damage poses a threat in accordance with the individual's sensibilities. Egoistic values, for example, would inform a recognition of threat to individual self-worth, while altruistic values would inform decisions that recognize threats to a neighbor, or even neighboring community.

The importance of studying values is, in large part, due to their ability to provide a stable basis for understanding human behavior when considered in conjunction with less stable constructs that can be contextualized to address resource management concerns. Indeed, there is a large body of work that illustrates the role of values in underpinning environmental attitudes and beliefs (Schultz & Zelezny, 1999). Research directly linking values to environmental behavior, however, is less prevalent (Karp, 1996), as is research that examines how values interact with each other at multi-level scales (van Riper et al., 2018), illustrating a need for continued research into how values function in tandem with other predictors of behavior. The relationship between individual values and institutional trust, in particular, is worthy of further consideration given the importance of both constructs in shaping the interactions between stakeholders and decision makers (Kim & Stepchenkova, 2020; Tam & Chan, 2018; Wynveen & Sutton, 2015). Indeed, some recent studies have tested the effect of values on trust in the context of environmental issues (Witt et al. 2021; Schroeder et al. 2021)). Those studies have provided evidence that values predict attitudes yet paint conspicuous the lack of trust-related research utilizing values as conceptualized by Schwartz and Stern.

Trust

The role of trust has been recognized in a variety of contexts, from personal interactions (Cook, 2001) to economic and political organization (Levi & Stoker, 2000; Putnam et al., 1994). This topic has thus garnered much attention in literature focused on parsing out dimensions of trust and documenting its sprawling relevance in the social sciences (Poortinga & Pidgeon, 2003; Stern & Coleman, 2015). In a natural resources context, an emphasis on trust, in part, stems from the importance of securing buy-in and cooperation from constituents to achieve sustainability goals (Needham et al., 2004; Schroeder & Fulton, 2017). This alludes to a dimension known as

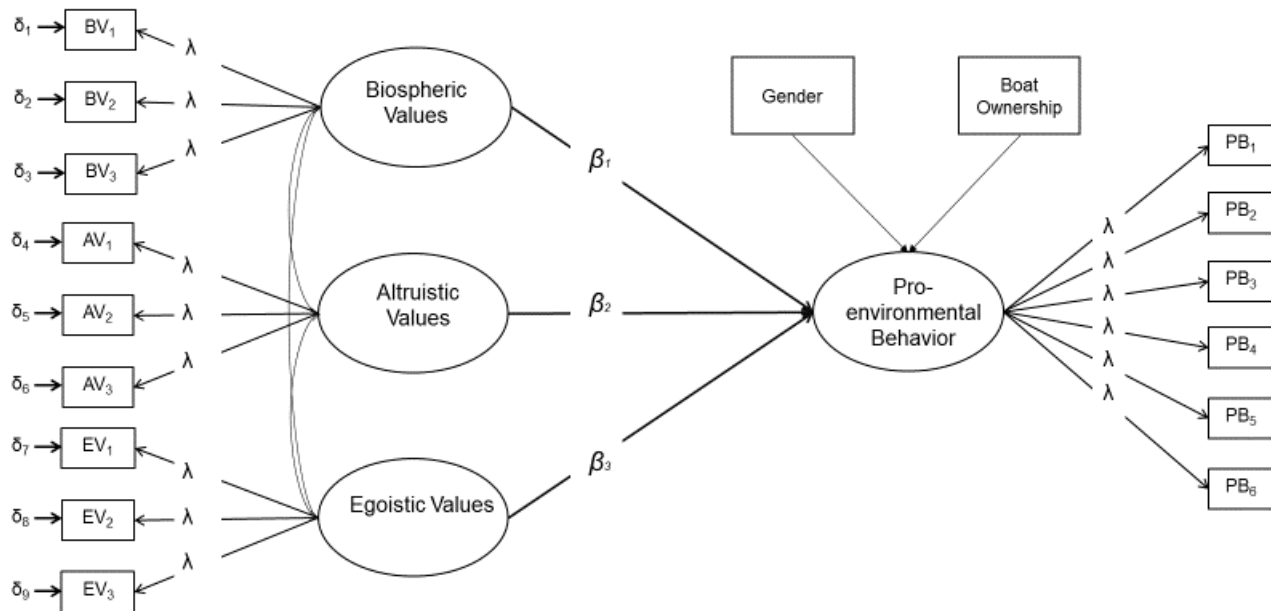
institutional trust, which refers to confidence that government agencies will responsibly and effectively manage public resources (Schroeder et al., 2021; Siegrist et al., 2000). In the case of recreational fisheries, which function amidst ongoing challenges from AIS, this type of trust is especially important but challenging to obtain because of power differentials between decision-makers and anglers, and the investments needed for agencies to interact and negotiate with diverse stakeholders in (in)formal contexts. Much consideration has been given to the factors that influence trust in natural resource institutions (Gray et al., 2012), how (dis)trust translates into public engagement (Parkins et al., 2017), as well as the effects of trust on factors such as environmental attitudes (Sponarski et al., 2014) and perceived threats from environments van Riper et al., 2016).

Institutional trust is considered an attitudinal construct (Jones, 1996) that carries relevance for resource management agencies and policymakers. It functions as a construct less stable than that of values and thus most extant research evaluates the effect of values on trust. However, managers seeking to accommodate a broad set of constituents would benefit from an understanding of how trust tempers the behavioral intentions of anglers as informed by their personal values. This necessity is rendered as especially important amidst increasing polarization of attitudes towards scientific and governmental institutions. In the case of trust in the scientific community, an Associated Press poll of Americans showed a divergence in levels of trust based on partisan affiliation (AP-NORC 2021), requiring natural resource regulators to understand a constituency with attitudes closer to the extremes. Therefore, empirical evidence of the trust levels with a stakeholder groups such as recreational anglers can be informative for guiding public participation in decision-making / determining how best to engage a constituency.

Hypotheses

To better understand antecedents of mitigative behavior among water recreationists, we predicted and tested relationships between the values and behavioral intentions of differing groups of recreational boaters in Illinois (see Figure 3). Subgroups were then compared and defined by their reported levels of trust in institutions that represented the regulatory community (i.e. the scientific community and Illinois Department of Natural Resources), boat ownership, and gender. For the pooled sample, we hypothesized that biospheric and altruistic values would predict pro-environmental behavior, while egoistic values would negatively predict such behavior (Karp, 1996) (Table 5). For the multigroup analyses based on levels of institutional trust held in the Illinois Department of Natural Resources and the scientific community, respectively, we hypothesized that higher trust would activate positive paths from biospheric, altruistic and egoistic values, while lower levels of trust would see negative relationships between altruistic and egoistic values, with little or no effect on biospheric values, although previous work has found the effects of trust to be varied and difficult to predict (Taniguchi & Marshall, 2018). Gender and boat ownership type, i.e., renter or owner, were also positioned as direct predictors of pro-environmental behavior. We expected to see a greater behavioral intentions among women than among men (Vicente-Molina et al., 2018), and greater behavioral intentions among those that own boats than among those that rent, on account of their level of specialization (Bryan, 1977).

Figure 3 Hypothesized model showing three value types, gender and boat ownership predicting pro-environmental behavior. In the model, BV refers to items used to measure biospheric values, AV to altruistic values, EV to egoistic values and PB to pro-environmental behavior



β = regression path

δ = measurement error

λ = latent variable loading score

Table 5 Hypothesized relationships between values and pro-environmental behavior. Plus signs indicate a predicted positive relationship, minus signs indicate a predicted negative relationship

Model Subgroup	β_1	β_2	β_3
Pooled sample	+	+	-
IL-DNR trust			
High trust group	+	+	+
Low trust group	+	-	-
Science trust			
High trust	+	+	+
Low trust	+	-	-

+ = positive relationship predicted

- = negative relationship predicted

3.2 Methods

Study Site

Illinois waterways are faced with a variety of resource management challenges concerning the spread of AIS given movement across its variable aquatic ecosystems including Lake Michigan and major rivers along three borders. Much attention is paid to detrimental species like varieties of the Bigheaded carp (*Hypophthalmichthys* spp.), the rusty crayfish (*Orconectes rusticus*), and zebra mussel (*Dreissena polymorpha*) for their capacity to disrupt both ecological systems and infrastructure. The Mississippi River Basin in particular hosts some of the most diverse bivalve populations in the world, which are already threatened with extinction from channelization and pollution (Ricciardi et al., 1998; Williams et al., 1993), and are now at pronounced risk from zebra mussels. Meanwhile, Bigheaded carp continue to move through the state's river systems and threaten to establish a foothold in the Great Lakes. While some AIS have a level of viability that allows them to spread without a continuing human vector, many rely on inadvertent human transport and thus present a unique challenge for managers that involve the role of human communities.

Data Collection

Data were collected through a Qualtrics survey of both anglers and boaters who reside and participate in fishing activities in Illinois. An initial pilot test was done in May 2021 and included 50 participants. In response, few modifications were made to the questionnaire in response to concerns around item interpretation, preliminary analysis of the measurement properties of key scales, and the potential for cognitive burden. The full online survey was conducted in summer 2021 among respondents that were recruited and incentivized by Qualtrics. Screening questions were asked to ensure respondents were over 18 years of age and had gone

either fishing or boating at least in the three years preceding the survey. Respondents were removed from the final database if they did not complete the entire survey, failed “attention check” questions, or showed patterns as bots or extreme disingenuity. The sample differed from previous research involving anglers in Illinois, likely as a result of differences in the sampling process (Golebie et al., 2021), in that we asked water users to self-identify through an online interface instead of relying on state angler licensing data, or boat registration data.

Measures

Our trust scale was adapted from Nisbet et al. (2015) and designed to measure trust in the Illinois Department of Natural Resources (ILDNR) and the scientific community. Initially composed of five items each, two items from each trust scale were dropped due to factor loading scores $< .04$ (Hair et al. 2010). Questions about values were drawn from Stern et al. (1999), Steg et al. (2014) and van Riper et al. (2019) to measure five dimensions, including biospheric, altruistic, egoistic, hedonic, and eudaimonic. Trust and values were evaluated on a five-point Likert scale, with 1 indicating an item was “unimportant” and 5 indicating an item was “very important.” Pro-environmental behavior was measured using scales adapted from Cole et al. (2016) and Pradhananga et al. (2015) to evaluate the actions one intended to take to prevent the spread of AIS. Respondents were asked to evaluate statements using a five-point scale with 1 indicating that they “never” took the prescribed action and 5 indicating that they did “every time I [they] go boating.” All scales included a minimum of three survey items each.

Analysis

Structural equation modeling (SEM) was employed to evaluate the properties of latent variables by fitting observed data to a hypothesized structure informed by theory (Kline, 2016). The latent variables utilized in this study were personal values and pro-environmental behavior

(PEB) (see Table 2). Trust was designed and validated as a latent variable but used as a mean score to determine high and low trust groups. In accordance with the two-step structural regression modeling approach (Anderson & Gerbing, 1988), scales were first tested for validity using a confirmatory factor analysis (CFA) to assess factor loadings, and reliability using Cronbach's alpha coefficients. Robust maximum-likelihood was used to account for non-normality in responses to the values scale, as determined by kurtosis and skewness over a score of one or under negative one. Fit of our measurement model to the sample data was judged by a chi-square test, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error approximation (RMSEA), and standardized root mean square residual (SRMR) (Kline, 2016). We then added our hypothesized regression paths to test a structural model that regressed behavioral intentions on three value dimensions, as well as dichotomous variables that measured boat ownership and gender.

A groups comparison was performed to understand how trust influenced the relationship between each predictor variable and intention to engage in PEB. A median split was used to define subgroups of respondents according to their high versus low level of trust instilled in the Illinois Department of Natural Resources and the scientific community. The multigroup analysis included steps to establish measurement invariance, starting with configural invariance, then metric invariance, and finally scalar invariance. We then conducted ANOVA comparisons to determine whether models with added constraints across groups deteriorated significantly from the model with fewer constraints. Once invariance was established, we tested for significant differences between regression coefficients among the different groups by holding those paths constant and testing for significant model deterioration. Such deterioration indicated that regressions were significantly different, while no such deterioration indicated that the difference

in regression coefficients was not significant. The function full information maximum likelihood (FIML) was used to account for missing data. The models were run in R Version 4.1.2 with the “Lavaan” package.

3.3 Results

Sociodemographic results

Respondents were asked to identify themselves along socio-demographic lines (Table 6). The average age was 44.05 years ($SD = 17.11$) and the sample was just over half female (60.1%). The majority had at least a two-year college degree, with a plurality holding a bachelor’s degree or higher. Respondents were mostly White (87.1%), with varying levels of income. Respondents were quizzed on their knowledge of AIS with five questions asking whether or not a particular species was invasive, with the average score out of 5 being 2.10 ($SD = 1.41$). Respondents were asked about their boating history and experience, whether or not they owned a boat or rented/borrowed, and what type of boat owned, if any. The average days spent boating in 2020 was 9.79 ($SD = 16.06$), with the average years of boating experience being 15.08 ($SD = 14.84$). The percentage of respondents that reported owning at least one boat was 56.3%, with the most common type of boat owned being fishing boat (26.5%), followed by canoe (17.2%), kayak (14.7%), power boat (11.1%), jetski (9.0%), pontoon boat (7.5%), and sailboat (5.4%). Those who reported they were not owners indicated that they rented or borrowed a boat (43.7%). Detailed demographics based on subgroups are available in Appendix A.

Table 6 *Respondent socio-demographic of self-described boaters in Illinois (n = 389)*

Variable	N (%)
Age [M, SD]	44.05 (17.11)
Gender	
Female	233 (60.1)
Male	155 (39.9)
Other	0 (0)
Education	
Some high school	6 (1.5)
High school graduate or GED	108 (27.8)
Two-year college degree	59 (15.2)
Bachelor's degree	115 (29.6)
Professional certificate	14 (3.6)
Graduate degree	87 (22.4)
Annual Household Income	
Less than \$24,999	52 (13.4)
\$25,000 to \$49,999	71 (18.3)
\$50,000 to \$99,999	122 (31.4)
\$100,000 to \$149,999	81 (20.8)
\$150,000 to \$199,999	22 (5.7)
\$200,000 and over	18 (4.6)
Prefer not to answer	23 (5.9)
Race	
White	339 (87.1)
Black or African American	26 (6.7)
Asian	14 (3.6)
American Indian or Alaska Native	4 (1.0)
Native Hawaiian or other Pacific Islander	0 (0.0)
Other	10 (2.6)
Knowledge^b [M, SD]	2.10 (1.41)
Total days boating/year^c [M, SD]	9.79 (16.06)
Total years of experience	15.08 (14.84)
Boat owner	219 (56.3)
Type of boat owned^a	
Fishing boat	103 (26.5)
Canoe	67 (17.2)
Kayak	57 (14.7)
Power boat	43 (11.1)
Jetski (personal watercraft)	38 (9.0)
Pontoon boat	29 (7.5)
Sailboat	21 (5.4)
Boat renter/borrower	170 (43.7)

^aRespondents could check all that applied so column totals may not equal 100%.

^bScore was created by adding the number of correct responses where 1 = no correct responses and 5 = all correct responses

^cEstimate included boating activities in 2020

Model results

The constructs utilized in our model showed good internal consistency and validity as judged by Cronbach's Alpha, McDonald's Omega and average variance extracted (AVE), including biospheric values ($\alpha = .792$, $CR = .795$, $AVE = .566$), altruistic values ($\alpha = .815$, $CR = .834$, $AVE = .635$), egoistic values ($\alpha = .797$, $CR = .801$, $AVE = .576$), trust in IL-DNR ($\alpha = .875$, $CR = .883$, $AVE = .718$), trust in scientific community ($\alpha = .845$, $CR = .850$, $AVE = .656$), and intended pro-environmental ($\alpha = .900$, $CR = .901$, $AVE = .601$). Descriptive results from survey items are shown in Table 2. Results from the measurement model indicated an acceptable model fit across all relevant indices ($\chi^2 = 399.532$, $df = 174$ $p < .000$); CFI = 0.942; TLI = .930; RMSEA = 0.062; SRMR = 0.054). More detailed descriptive results based on subgroups are available in Appendix A.

Table 7 Descriptive results showing average values from questionnaire items and results from a confirmatory factor analysis of survey items measuring values, trust and pro-environmental behavior among survey respondents

Scale items		λ	Mean (S.D.)
Individual Values^a			
Biospheric ($\alpha = .792$, $CR = .795$, $AVE = .566$)			
BV1	Protecting the environment: preserving nature	.742	4.39 (0.75)
BV2	Unity with nature: fitting into nature	.766	4.15 (0.87)
BV3	A world of beauty: beauty of nature and the arts	.744	4.37 (0.75)
Altruistic ($\alpha = .815$, $CR = .834$, $AVE = .635$)			
AV1	Equality: equal opportunity for all	.786	4.33 (0.84)
AV2	Social justice: correcting injustice, care for others	.873	4.11 (1.04)
AV3	A world at peace: free of war and conflict	.681	4.41 (0.84)
Egoistic ($\alpha = .797$, $CR = .801$, $AVE = .576$)			
EV1	Authority: the right to lead or command	.834	3.35 (1.16)
EV2	Social power: control over others, dominance	.746	2.58 (1.29)
EV3	Influential: having an impact on people and events	.687	3.43 (1.09)

Table 7 (Cont.) Descriptive results showing average values from questionnaire items and results from a confirmatory factor analysis of survey items measuring values, trust and pro-environmental behavior among survey respondents

Scale items	λ	Mean (S.D.)
Trust in the Illinois Department of Natural Resources (ILDNR)^b		
(α =.875, CR=.883, AVE=.718)		
I have very little confidence in the Illinois DNR ^d	.736	3.71 (1.06)
The Illinois DNR often does not tell the public the truth ^d	.864	3.53 (1.12)
I am suspicious of the Illinois DNR ^d	.916	3.72 (1.15)
Trust in the Scientific Community^b		
(α =.845, CR=.850, AVE=.656)		
I have very little confidence in the scientific community ^d	.753	3.88 (1.06)
The scientific community often does not tell the public the truth ^d	.797	3.41 (1.18)
I am suspicious of the scientific community ^d	.862	3.60 (1.20)
Intended pro-environmental behavior (PEB)^c		
(α =.900, CR=.901, AVE=.601)		
PB1 Drain all standing water from the boat	.743	4.01 (1.00)
PB2 Conduct visual inspections of boats for invasive species	.767	4.11 (1.22)
PB3 Remove plants, animals, and mud from the boat	.767	3.92 (1.27)
PB4 Rinse boat and trailer	.831	4.22 (1.11)
PB5 Wipe down hull with a towel	.785	4.00 (1.18)
PB6 Allow boat to dry before entering a different body of water	.765	3.8 (1.28)
	.771	4.01 (1.25)

^aMean values were coded on a Likert scale where 1 = "Unimportant" and 5 = "Very important"

^bMean values were coded on a Likert scale where 1 = "Strongly Disagree" and 5 = "Strong Agree."

^cMean values were coded on a Likert scale where 1 = "Never" and 5 = "Everytime I go boating"

^dIndicates items were reverse coded

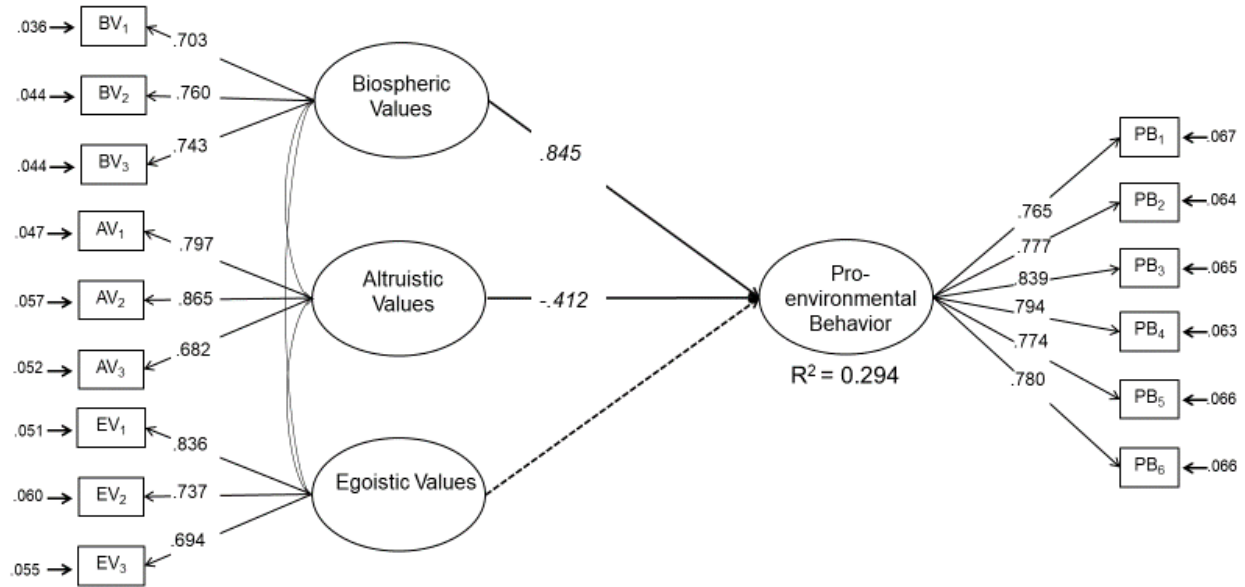
λ = factor loading score

α = Cronbach's Alpha

CR= McDonald's Omega

AVE= Average Variance Extracted

Figure 4 Structural regression modeling results from the pooled sample showing biospheric and altruistic values predicting intended pro-environmental behavior, with gender and boat ownership removed



Fit statistics: $\chi^2 = 243.224$, $df = 85$ $p < .000$; CFI = 0.934; TLI = 0.912; RMSEA = 0.076; SRMR = 0.066

Results from our pooled sample structural equation model showed acceptable model fit and all non-significant paths were removed from the model, including the variables that measured gender and boat ownership (see Figure 4). The chi-square test was significant, indicating a substantial improvement in the user model over the baseline model ($\chi^2 = 2316.784$, $df = 105$ $p < .000$), and the other statistics were within an acceptable range: CFI = 0.934; TLI = 0.918; RMSEA = 0.076; SRMR = 0.066. Two out of three value types directly predicted intended behavior, including biospheric ($\beta = .845$) and altruistic ($\beta = -.412$). This supported our hypothesis that biospheric values would positively correlate with behavior, however contradicted our hypothesis that altruistic values would do the same.

Table 8 Goodness-of-fit indices from invariance testing between subgroups defined by low and high levels of trust in the IL Department of Natural Resources (DNR) and the scientific community

Models	χ^2	df	RMSEA	SRMR	CFI	TLI
Trust in the IL-DNR						
Configural invariance model	330.469	170	0.075	0.066	0.932	0.916
Metric invariance model	341.218	181	0.073	0.069	0.932	0.921
Scalar invariance model	357.089	191	0.072	0.067	0.924	0.923
Trust in the scientific community						
Configural invariance model	338.740	170	0.077	0.063	0.931	0.915
Metric invariance model	350.574	181	0.069	0.067	0.925	0.913
Scalar invariance model	382.123	191	0.077	0.069	0.922	0.915

χ^2 = test statistic

df = degrees of freedom

RMSEA = root mean square error approximation

CFI = comparative fit index

TLI = Tucker Lewis index

After evaluating the pooled sample, two multigroup analyses were performed to understand how subgroups defined by low and high levels of trust in the IL Department of Natural Resources and the scientific community differed from each other based on that variable. This first required establishing measurement invariance (Table 8). Scalar level measurement invariance was established for the two subgroups defined by their level of trust in the Illinois Department of Natural Resources ($\chi^2 = 357.089$, df = 191 $p < .000$); (CFI = 0.924; TLI = 0.923; RMSEA = 0.072; SRMR = 0.067), while only metric invariance was established for the subgroups defined by their level of trust in the scientific community ($\chi^2 = 350.574$, df = 181 $p < .000$); CFI = 0.925; TLI = 0.913; RMSEA = 0.069; SRMR = 0.067.

Regression results from each multigroup analysis are shown in Table 9. In the first multigroup analysis that compared low and high levels of trust in the IL-DNR, the high trust subgroup had significant paths between biospheric values and intended behavior ($\beta_1 = 0.833$) and from egoistic values to intended behavior ($\beta_3 = -0.210$). The path between altruistic values and intended behavior, as well as all paths among the low trust group, were non-significant. For

the multigroup analysis that compared respondents with low versus high levels of trust in the scientific community, the high trust group had significant paths between biospheric values and behavior ($\beta_1 = 0.768$) and egoistic values and behavior ($\beta_3 = -0.215$), with no significant path between altruistic values and behavior. For the low trust group, biospheric values positively correlated with intended behavior ($\beta_1 = 1.046$).

Table 9 Beta coefficients from group analyses by subgroups based on levels of trust in the IL-DNR and scientific community

Model Subgroup	β_1	β_2	β_3	R^2
Trust in the IL-DNR				
High trust group ^a	0.833***	-0.252	-0.210*	0.418
Low trust group ^b	0.353	-0.255	-0.014	0.041
Trust in scientific community				
High trust ^a	0.768***	-0.253	-0.215*	0.320
Low trust ^b	1.067*	-0.938	0.122	0.259

ILDNR trust, Scalar invariance: ($\chi^2 = 357.089$, $df = 191$ $p < .000$); CFI = 0.924; TLI = .923; RMSEA = 0.072; SRMR = 0.067)

Science trust, Metric invariance: ($\chi^2 = 350.574$, $df = 181$ $p < .000$); CFI = 0.925; TLI = .913; RMSEA = 0.069; SRMR = 0.067)

^{ab}Differing superscript among subgroups within a single model indicates significant difference in regression coefficients between groups

$p < .05 = *$, $p < .01 = **$, $p < .001 = ***$

3.4 Discussion

We observed that altruistic values were negatively correlated with intended behavior in the pooled sample. One potential explanation for this relationship is that, in accordance with previous research on altruism (Schwartz, 1977), there is a missing link that is needed to activate this value and behavior, like an awareness of consequences or prevailing social norms to help inform an action intended to be socially beneficial. It is unlikely, however, that respondents would have an understanding of AIS related issues sufficient to activate a path from biospheric values and behavior but not recognize a social consequence, and that reasoning would not help to explain why there was a *negative* relationship, as opposed to non-significant result. A more promising explanation for this may be that individuals with high levels of altruism were less likely embellish or exaggerate the rate at which they performed the tasks listed in our PEB scale.

Some work has distinguished honesty from altruism (Khalil, 2004), yet respondents could still use honesty as a mechanism for being selflessly helpful, in this case seeking to maintain integrity in scientific research. Although we tested the direct effects of values on behavior in line with previous research involving recreational anglers (Shin et al., 2022), results from other studies (Klößner, 2013) suggest that mediating attitudinal variables could improve the predictive capacity of models.

More pronounced value-behavior paths among the higher trust groups indicate that trust is an important factor for activating those relationships, and likely function in a manner similar to that of awareness or other enabling factors that would allow values to function in a way suggested by the VBN theory (citation). The valence of the value-behavior relationship requires careful consideration, because higher trust in regulatory institutions does not change the nature of the value orientation, but rather activates the value to function as it would at a baseline level. That is to say, our findings suggest that trust is an important factor that can explain behavioral performance, because it orients the activation of both self-transcendent and self-enhancement values but does not change their valence. This implies that in an era where trust in regulatory institutions is more polarized, those with lower levels of trust will be harder to predict, while those with higher levels will behave more intuitively but not necessarily in a more pro-environmental fashion.

In line with previous work (Karp, 1996; Schultz et al., 2005; van Riper et al., 2018; Wesley schultz & Zelezny, 1999), we observed that biospheric values predicted PEB and this relationship was predominantly not affected by level of trust. The exception to this result was in the subgroup that expressed lower trust in the IL-DNR. For the lower trust IL-DNR group, this may be explained by the close link between the regime of mitigative behaviors that we used to

conceptualize PEB and the IL-DNR which may be seen as the authority that prescribes them. It follows, then, that if one does not trust or generally approve of an agency, one would also signal a disinterest in following their guidance. This finding suggests that environmental managers might benefit from broadening the justification behind their prescribed AIS behaviors beyond their own expertise and authority to one that includes other institutions such as trade or sporting groups. The strong positive relationships between biospheric values and intended pro-environmental behavior suggest that respondents were motivated primarily from a concern for ecosystem health as opposed to a concern for the resource as it pertains to the benefits it holds for the wider community or their own recreational use of a given water body. This finding is at odds with previous work that has suggested biospheric and altruistic values should be combined into a single construct because they both reflect broader ‘self-transcendent’ concerns (Pradhananga et al., 2017; van Riper & Kyle, 2014).

We observed high levels of trust instilled in state regulatory agencies, which is in contrast to previous studies of water-based recreationists and other resource management stakeholders (e.g., Goodson et al., 2021.; van Riper et al., 2017). Although higher trust can portend greater support for policy regimes, previous research has suggested that certain types of trust decreases public engagement and can lower pro-environmental behavioral intentions (Parkins et al., 2017; Taniguchi & Marshall, 2018). Although previous work has considered different types of pro-environmental behavior, it begs the question whether respondents who hold high levels of trust in science and natural resource agencies may be less likely to engage in PEB because they are confident in how those entities handle environmental issues. This potential negative relationship between trust and intended behavior aligns with Schwartz’s norm deactivation theory that posits individuals absolve themselves of responsibility if they feel that they are either unable to perform

a behavior, or the action is out of their purview (Schwartz & Clausen, 1970). Consideration of this multi-pronged effect of trust must be considered in future research, particularly in a political climate in which institutional trust is more polarized with both sides closer to the extremes.

Our results found no significant difference in intended behavior between men and women. Consideration must be given to the demographic composition of survey research samples (Rossi et al., 2013), because profiling respondents provides a basis for comparing across similar past studies and considering implications for research design (Arlinghaus et al., 2019). In previous research involving recreational water-users, respondents have been predominantly male and older. For example, two recent studies, Cole et al. (2016) and Pradhananga et al. (2015) both surveyed registered boat owners from different regions in Illinois and reported on samples that were 91% and 97% male, respectively, highlighting the limited breadth of representation garnered by reliance upon licensing data from natural resource management agencies. This demographic composition raises concerns that outreach and research may be missing a crucial segment of water users that may behave differently and therefore present a differing liability regarding further spread of AIS. Together, results from our work suggest that men and women are largely similar in the context of factors that can spread AIS.

Boat ownership was examined in this study by considering respondents who rent versus own watercraft used for recreational purposes in the state of Illinois. These recreationists use boats in different ways and therefore have different liabilities to spread AIS, as well as variable exposure to outreach messaging about mitigation efforts and best practices for water users (Connelly et al., 2018; Eiswerth et al., 2011; Seekamp et al., 2016; Wallen & Kyle, 2018). Although we found no difference in the behavioral intentions between owners and non-owners, boat renters, as well as unregistered boat owners, are a group of water users that warrant further

study, because they have been underrepresented in prior research. Moreover, the high proportion of boaters who rent or borrow their watercrafts present an opportunity to understand how they may differ from those that own as they can be considered to be less specialized.

It is important to consider how interactions with management agencies might differ based on boat ownership (Kuentzel & Heberlein, 2006; Van Doren & Lentnek, 1969). It is intuitive to think that those who own boats are more likely to be more immersed in the culture and best practices of boat ownership, although some research has shown that more specialized boaters are *less* likely to engage in conservation behavior (Jett et al., 2009). This may be in part because those who rent or borrow boats are more likely come into contact with literature or guidance from rental facilities. Given previous research that has evaluated the role of bait dealers in preventing the spread of AIS through outreach efforts (Connelly et al., 2018), future studies could be developed to understand the parallel role of boat rental companies in disseminating information to boaters. Future research is also warranted among other subgroups that may account for preference heterogeneity (Beardmore et al., 2011; Hunt et al., 2005). For example, the type and health of ecosystem experienced may influence the experiences of recreationists and their preferences for the future, especially those that depend on habitat quality more so than others, i.e. anglers versus those using personal watercraft or “jetskis” (Ferguson et al., 2018). There could also be differences between recreationists that utilize motorized versus non-motorized boats like canoes or kayaks (Miller et al., 2020; Riungu et al., 2020). The behaviors of motorized boaters that often have bilge water functions and water in the motors themselves, would be particularly important given their potential to inadvertently spread AIS (Johnson et al., 2001).

3.5 Conclusion

This study focuses on understanding how personal values, socio-demographic characteristics, and boat ownership directly culminate in pro-environmental behavior, as well as how those relationships are moderated by trust in facets of the regulatory and scientific communities in Illinois. Our findings suggest that the values held by self-identified boat owners or boat renters/borrowers provide a helpful basis for predicting behavior, and that higher levels of institutional trust are instrumental in activating those values in a way that spurs behavior. We also suggest there are important demographic differences in our sample as compared to previous human dimensions of fisheries research, indicating a need for broadening sampling approaches that have typically relied upon registration or licensing data to solicit respondents, and therefore missed a large contingent of boaters that are liable to inadvertently contribute to the spread of AIS.

CHAPTER 4: CONCLUSION

Because fisheries science and management has historically relied upon foundations of population modeling and harvest-based concepts like maximum sustained yield, the field has been left with limited tools for addressing management issues that arise from nuanced human-environment interactions. These issues are made more complex and divergent from yield-related concepts in the recreational space, as the motives for recreationists are more varied and complex than those with a commercial interest. Human dimensions research, which relies on theories from a diverse set of disciplines, has the capacity to help us understand complex issues in the context of recreational fisheries management. Economic modeling can help us understand how preferences for management and prioritization amidst financial resource constraints differs across the US-Canada border, while psychological modeling with variables such as personal values and institutional trust, show promise as ways to deepen knowledge of the range of factors that influence the kind of mitigative behavior that is critical in the struggle against biological invasions from AIS. While human dimensions based research has been adopted into the fisheries discipline, a continuing integration of social science into the field remains an important goal.

Social science techniques have the ability to inform the development of policy amidst complicated governance structures. This is highly important in North America, where freshwater ecosystems are diverse both in their ecological composition as well as their management systems. The Laurentian Great Lakes, which represents one of the biggest freshwater ecosystems in the world as well as a hotspot for invasive species research, is managed by a host of state, tribal and national governments, as well as collaborative organizations made up of multiple agencies. These organizations, like the Great Lakes Fishery Commission, have done well to foment and drive a spirit of regional and international cooperation into the ethos of Great Lakes

management, however this spirit has not been adequately adopted by the social science that informs much of the commissions' human dimensions based decision making. Research from such a perspective will allow for policy development and the informed prioritization of needs with a more decidedly powerful mandate. This research demonstrates through these techniques that priorities for AIS themed management are largely consistent across the US-Canada border, allowing for confidence in developing and implementing consistent strategies at large regional scales.

Regarding inland waterways, issues around fisheries governance mostly exist at smaller scales, particularly concerning interactions between managers and stakeholders, as well as stakeholders and the resource they utilize. In this context, human dimensions in fisheries science is able to provide managers with information regarding who their constituents are and how that relates to their propensity to participate within a given policy framework. Understanding how water recreationists behave amidst the high stakes reality of ongoing biological invasions is crucial because it can both describe how mitigation efforts, i.e. outreach campaigns like Clean, Drain, Dry, are working, as well as prescribe how they may be improved. Understanding human behavior is a difficult task, however the preceding research has demonstrated and reinforced theory finding that psychological constructs like personal values and institutional trust can help in this pursuit. Specifically, this research finds that values have a direct impact on intended behavior, and that those relationships are further activated by higher levels of trust in fisheries managers as well as the scientific community. The need for research pertaining to trust and values will only become more important as it can provide ongoing insight into how recreators are responding to the management of recreational fisheries, especially so as water resources continue to change due to AIS related alterations as well as increasingly polarized attitudes on government

and scientists. Situating research into fisheries management in a way that embraces social science knowledge is thus urgently needed to inform management that can both confront ecological challenges while addressing the needs of stakeholders.

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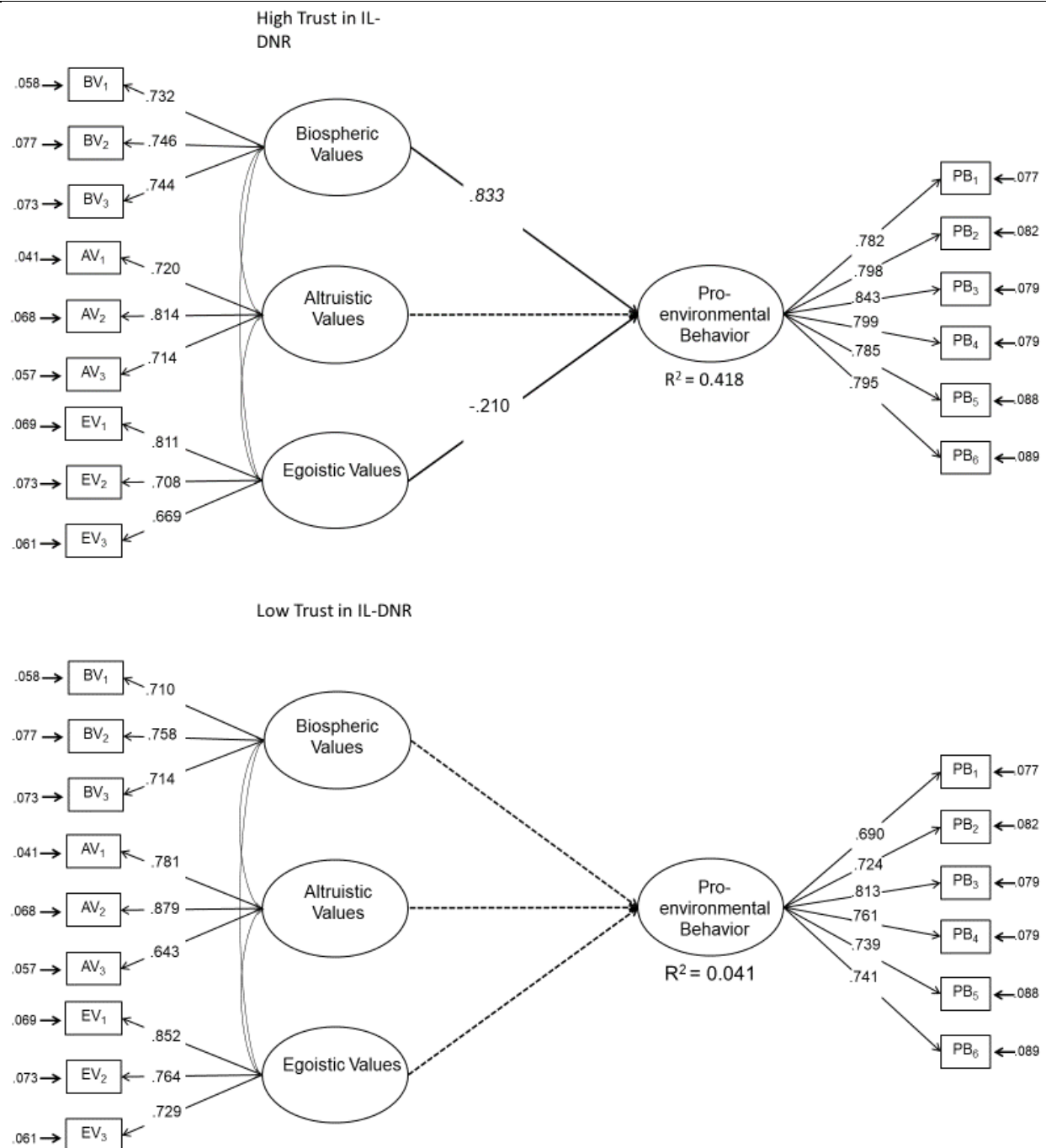
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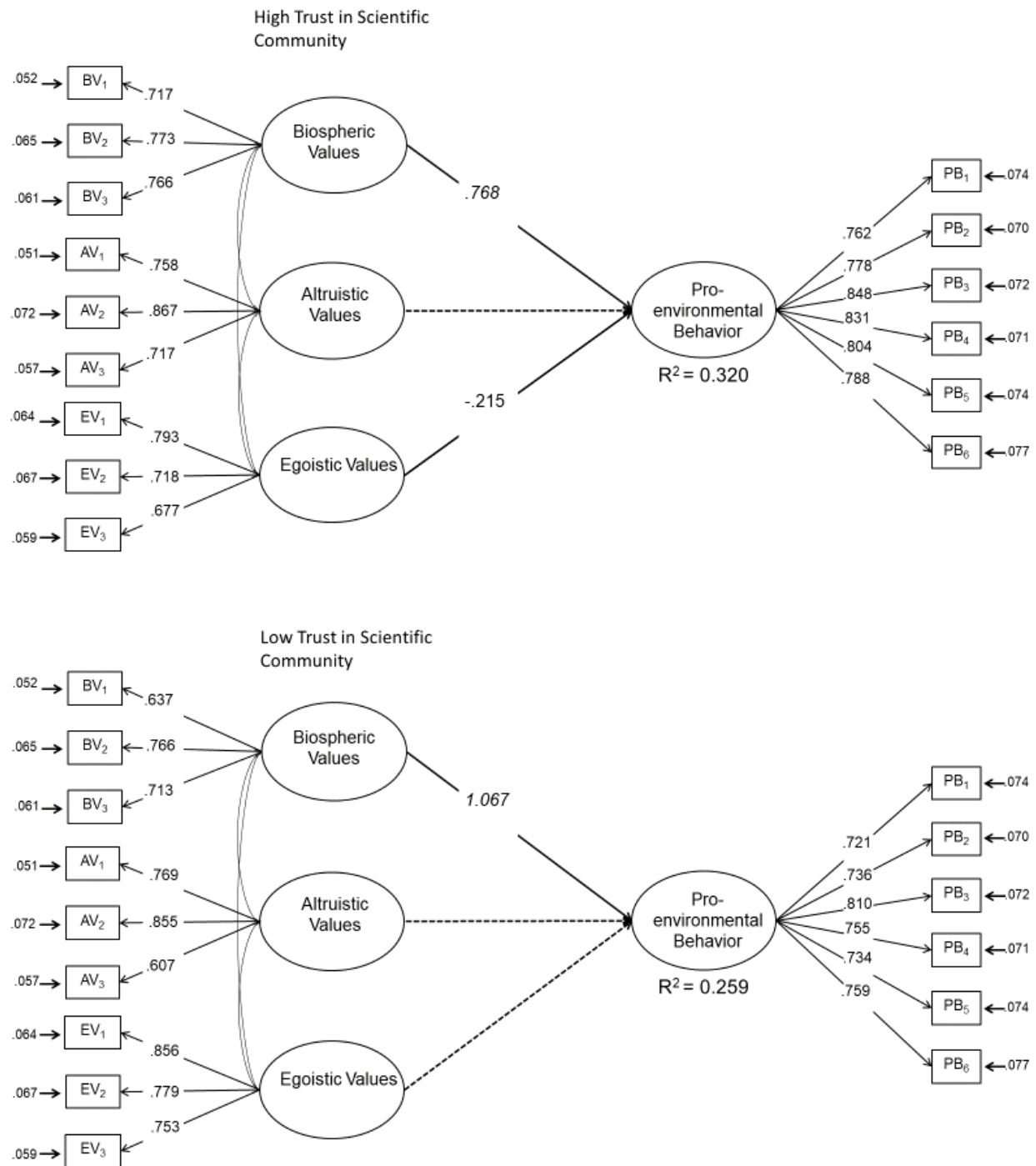
APPENDIX A: RESULTS COMPARISONS OF TRUST AND VALUES SUBGROUPS

Figure 5 Structural regression models showing multigroup comparison of those reporting higher and lower trust in the Illinois Department of Natural Resources



ILDNR trust, Scalar invariance: ($\chi^2 = 357.089$, $df = 191$ $p < .000$); CFI = 0.924; TLI = 0.923; RMSEA = 0.072; SRMR = 0.067)

Figure 6 Structural regression models showing multigroup comparison of those reporting higher and lower trust in the scientific community



Science trust, Metric invariance: ($\chi^2 = 350.574$, $df = 181$ $p < .000$); CFI = 0.925; TLI = 0.913; RMSEA = 0.069; SRMR = 0.067)

Table 10 *Demographics comparison of subgroups based on trust in Illinois Department of Natural Resources*

Variable	Total Sample N=389	Higher Trust in IL-DNR N=196	Lower Trust in IL-DNR N=193
	N(%)	N(%)	N(%)
Age [M, SD]	44.05 (17.11)	44.85 (17.09)	43.23 (17.13)
Gender			
Female	233 (60.1)	121 (61.7)	112 (58.3)
Male	155 (39.9)	75 (38.3)	80 (47.1)
Other	0 (0)	0 (0)	0 (0)
Education			
Some high school	6 (1.5)	4 (2.0)	2 (1.0)
High school graduate or GED	108 (27.8)	51 (26.0)	57 (29.5)
Two-year college degree	59 (15.2)	26 (13.3)	33 (17.1)
Bachelor's degree	115 (29.6)	60 (30.6)	55 (28.5)
Professional certificate	14 (3.6)	10 (5.1)	4 (2.1)
Graduate degree	87 (22.4)	45 (23.0)	42 (21.8)
Annual Household Income			
Less than \$24,999	52 (13.4)	23 (11.7)	29 (15.0)
\$25,000 to \$49,999	71 (18.3)	35 (17.9)	37 (19.2)
\$50,000 to \$99,999	122 (31.4)	65 (33.1)	57 (29.6)
\$100,000 to \$149,999	81 (20.8)	44 (22.5)	37 (19.2)
\$150,000 to \$199,999	22 (5.7)	10 (5.1)	12 (6.2)
\$200,000 and over	18 (4.6)	13 (6.6)	5 (2.6)
Prefer not to answer	23 (5.9)	6 (3.1)	17 (8.8)
Race^a			
White	339 (87.1)	176 (89.8)	163 (84.5)
Black or African American	26 (6.7)	9 (4.6)	17 (8.8)
Asian	14 (3.6)	8 (4.1)	6 (3.1)
American Indian or Alaska Native	4 (1.0)	3 (1.5)	1 (0.5)
Native Hawaiian or other Pacific Islander	0 (0.0)	0 (0)	0 (0)
Other	10 (2.6)	3 (1.5)	7 (3.6)
Knowledge^b [M, SD]	2.10 (1.41)	2.13 (1.41)	2.07 (1.41)
Total days boating/year [M,SD]	9.79 (16.06)	9.53 (14.38)	10.07 (17.64)
Total years of experience	15.08 (14.84)	15.85 (15.02)	14.30 (14.64)
Boat owner	219 (56.3)	109 (55.6)	110 (57.0)
Type of boat owned^a			
Fishing boat	103 (26.5)	44 (22.4)	59 (30.6)

Table 10 (Cont.) *Demographics comparison of subgroups based on trust in Illinois Department of Natural Resources*

Variable	Total Sample N=389	Higher Trust in IL-DNR N=196	Lower Trust in IL-DNR N=193
	N(%)	N(%)	N(%)
Canoe	67 (17.2)	37 (18.9)	30 (15.5)
Kayak	57 (14.7)	26 (13.3)	31 (16.1)
Power boat	43 (11.1)	24 (12.2)	19 (9.8)
Jetski (personal watercraft)	38 (9.0)	17 (8.7)	20 (10.4)
Pontoon boat	29 (7.5)	14 (7.1)	15 (7.8)
Sailboat	21 (5.4)	10 (5.1)	11 (5.7)
Boat renter/borrower	170 (43.7)	87 (44.4)	83 (43.0)

^aRespondents could check all that applied so column totals may not equal 100%.

^bScore was created by adding the number of correct responses where 1 = no correct responses and 5 = all correct responses

^cEstimate included boating activities in 2020

Table 11 *Demographics comparison of subgroups based on trust in scientific community*

Variable	Total Sample N=389	Higher Trust in Scientific community N=217	Lower Trust in Scientific community N= 172
	N(%)	N(%)	N(%)
Age [M, SD]	44.05 (17.11)	45.09 (17.50)	42.73 (16.55)
Gender			
Female	233 (60.1)	133 (61.3)	100 (58.5)
Male	155 (39.9)	84 (38.7)	71 (41.5)
Other	0 (0)	0 (0)	0 (0)
Education			
Some high school	6 (1.5)	2 (0.9)	4 (2.3)
High school graduate or GED	108 (27.8)	55 (25.3)	53 (30.8)
Two-year college degree	59 (15.2)	32 (14.7)	27 (15.7)
Bachelor's degree	115 (29.6)	66 (30.4)	49 (28.5)
Professional certificate	14 (3.6)	9 (4.1)	5 (2.9)
Graduate degree	87 (22.4)	53 (24.4)	34 (19.8)
Annual Household Income			
Less than \$24,999	52 (13.4)	23 (10.6)	29 (16.9)
\$25,000 to \$49,999	71 (18.3)	38 (17.5)	33 (19.2)
\$50,000 to \$99,999	122 (31.4)	74 (34.1)	48 (27.9)
\$100,000 to \$149,999	81 (20.8)	51 (23.5)	30 (17.4)
\$150,000 to \$199,999	22 (5.7)	9 (4.2)	13 (7.5)
\$200,000 and over	18 (4.6)	15 (6.9)	3 (1.7)
Prefer not to answer	23 (5.9)	7 (3.2)	16 (9.3)

Table 11 (Cont.) *Demographics comparison of subgroups based on trust in scientific community*

Variable	Total Sample N=389	Higher Trust in Scientific community N=217	Lower Trust in Scientific community N= 172
	N(%)	N(%)	N(%)
Race^b			
White	339 (87.1)	197 (90.8)	142 (82.6)
Black or African American	26 (6.7)	11 (5.1)	15 (8.7)
Asian	14 (3.6)	9 (4.1)	5 (2.9)
American Indian or Alaska Native	4 (1.0)	3 (1.4)	1 (0.6)
Native Hawaiian or other Pacific Islander	0 (0.0)	0 (0)	0 (0)
Other	10 (2.6)	1 (.5)	9 (5.2)
Knowledge^b [M, SD]	2.10 (1.41)	2.16 (1.47)	2.04 (1.33)
Total days boating/year^c [M,SD]	9.79 (16.06)	9.20 (14.55)	10.54 (17.79)
Total years of experience	15.08 (14.84)	15.54 (15.00)	14.50 (14.64)
Boat owner	219 (56.3)	114 (52.5)	105 (61.0)
Type of boat owned^a			
Fishing boat	103 (26.5)	50 (23.0)	53 (30.8)
Canoe	67 (17.2)	37 (17.1)	30 (17.4)
Kayak	57 (14.7)	32 (14.7)	25 (14.5)
Power boat	43 (11.1)	20 (9.2)	23 (13.4)
Jetski (personal watercraft)	38 (9.0)	20 (9.2)	17 (9.9)
Pontoon boat	29 (7.5)	15 (6.9)	14 (8.1)
Sailboat	21 (5.4)	10 (4.6)	11 (6.4)
Boat renter/borrower	170 (43.7)	103 (47.5)	67 (39.0)

^aRespondents could check all that applied so column totals may not equal 100%.

^bScore was created by adding the number of correct responses where 1 = no correct responses and 5 = all correct responses

^cEstimate included boating activities in 2020

Table 12 Survey item comparison of subgroups based on trust in Illinois Department of Natural Resources

Scale items	High Trust in IL-DNR	Low Trust in IL-DNR
	Mean (S.D.)	Mean (S.D.)
Individual Values^a		
Biospheric	4.48 (0.61)	4.12 (0.68)
Protecting the environment: preserving nature	4.62 (0.63)	4.15 (0.78)
Unity with nature: fitting into nature	4.31 (0.84)	3.98 (0.88)
A world of beauty: beauty of nature and the arts	4.51 (0.70)	4.22 (0.78)
Altruistic	4.56 (0.61)	4.01 (0.83)
Equality: equal opportunity for all	4.57 (0.68)	4.09 (0.93)
Social justice: correcting injustice, care for others	4.46 (0.84)	3.76 (1.09)
A world at peace: free of war and conflict	4.66 (0.64)	4.17 (0.94)
Egoistic	3.11 (0.98)	3.13 (1.02)
Authority: the right to lead or command	3.38 (1.15)	3.32 (1.17)
Social power: control over others, dominance	2.48 (1.30)	2.68 (1.28)
Influential: having an impact on people and events	3.48 (1.07)	3.37 (1.11)
Trust in the Illinois Department of Natural Resources (ILDNR)^b	4.45 (0.44)	3.84 (0.70)
I have very little confidence in the Illinois DNR ^d	4.44 (0.55)	2.97 (0.93)
The Illinois DNR often does not tell the public the truth ^d	4.37 (0.55)	2.68 (0.87)
I am suspicious of the Illinois DNR ^d	4.54 (0.52)	2.90 (1.02)
Trust in the Scientific Community^b	4.23 (0.74)	3.03 (0.87)
I have very little confidence in the scientific community ^d	4.36 (0.81)	3.39 (1.06)
The scientific community often does not tell the public the truth ^d	4.05 (0.96)	2.76 (1.02)
I am suspicious of the scientific community ^d	4.27 (0.85)	2.93 (1.12)
Intended pro-environmental behavior (PEB)^c	4.18 (1.00)	3.83 (0.97)
Drain all standing water from the boat	4.32 (1.12)	3.80 (1.28)
Conduct visual inspections of boats for invasive species	4.14 (1.22)	3.68 (1.29)
Remove plants, animals, and mud from the boat	4.34 (1.11)	4.09 (1.10)
Rinse boat and trailer	4.16 (1.18)	3.83 (1.16)
Wipe down hull with a towel	3.99 (1.28)	3.60 (1.26)

Table 12 (Cont.) *Survey item comparison of subgroups based on trust in Illinois Department of Natural Resources*

Scale items	High Trust in IL-DNR	Low Trust in IL-DNR
	Mean (S.D.)	Mean (S.D.)
Allow boat to dry before entering a different body of water	4.13 (1.26)	3.88 (1.23)

^aMean values were coded on a Likert scale where 1 = “Unimportant” and 5 = “Very important”

^bMean values were coded on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree.”

^cMean values were coded on a Likert scale where 1 = “Never” and 5 = “Everytime I go boating”

^dIndicates items were reverse coded

Table 13 *Survey item comparison of subgroups based on trust in scientific community*

Scale items	High Trust in scientific community	Low Trust in scientific community
	Mean (S.D.)	Mean (S.D.)
Individual Values^a		
Biospheric	4.42 (0.63)	4.14 (0.69)
Protecting the environment: preserving nature	4.58 (0.63)	4.14 (0.81)
Unity with nature: fitting into nature	4.23 (0.88)	4.04 (0.86)
A world of beauty: beauty of nature and the arts	4.46 (0.71)	4.24 (0.79)
Altruistic	4.51 (0.65)	4.00 (0.83)
Equality: equal opportunity for all	4.53 (0.71)	4.08 (0.92)
Social justice: correcting injustice, care for others	4.39 (0.89)	3.76 (1.10)
A world at peace: free of war and conflict	4.61 (0.66)	4.16 (0.97)
Egoistic	3.05 (0.97)	3.20 (1.03)
Authority: the right to lead or command	3.28 (1.16)	3.44 (1.16)
Social power: control over others, dominance	2.41 (1.27)	2.8 (1.29)
Influential: having an impact on people and events	3.47 (1.09)	3.37 (1.09)
Trust in the Illinois Department of Natural Resources (ILDNR)^b	4.18 (0.75)	3.00 (0.86)
I have very little confidence in the Illinois DNR ^d	4.16 (0.91)	3.16 (0.96)
The Illinois DNR often does not tell the public the truth ^d	4.06 (0.93)	2.87 (0.97)
I am suspicious of the Illinois DNR ^d	4.33 (0.84)	2.97 (0.87)

Table 13 (Cont.) *Survey item comparison of subgroups based on trust in scientific community*

Scale items	High Trust in scientific community	Low Trust in scientific community
	Mean (S.D.)	Mean (S.D.)
Trust in the Scientific Community^b	4.37 (0.50)	2.69 (0.62)
I have very little confidence in the scientific community ^d	4.52 (0.59)	3.07 (0.96)
The scientific community often does not tell the public the truth ^d	4.18 (0.79)	2.44 (0.82)
I am suspicious of the scientific community ^d	4.42 (0.69)	2.57 (0.87)
Intended pro-environmental behavior (PEB)^c	4.15 (0.98)	3.83 (0.99)
Drain all standing water from the boat	4.26 (1.15)	3.92 (1.29)
Conduct visual inspections of boats for invasive species	4.11 (1.20)	3.67 (1.32)
Remove plants, animals, and mud from the boat	4.34 (1.07)	4.06 (1.14)
Rinse boat and trailer	4.14 (1.15)	3.81 (1.18)
Wipe down hull with a towel	3.95 (1.23)	3.60 (1.33)
Allow boat to dry before entering a different body of water	4.11 (1.23)	3.88 (1.27)

^aMean values were coded on a Likert scale where 1 = “Unimportant” and 5 = “Very important”

^bMean values were coded on a Likert scale where 1 = “Strongly Disagree” and 5 = “Strongly Agree.”

^cMean values were coded on a Likert scale where 1 = “Never” and 5 = “Everytime I go boating”

^dIndicates items were reverse coded

APPENDIX B: QUESTIONNAIRE FROM CHAPTER 2

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.



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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 both 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 past 12 months?**

	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:

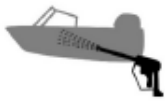
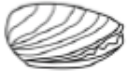
	Low threat	Moderate Threat	High Threat
a. Your fishing experience	☐	☐	☐
b. Your financial well-being	☐	☐	☐
c. The environment where you fish	☐	☐	☐
d. The Great Lakes fishery	☐	☐	☐
e. The economy in the Great Lakes region	☐	☐	☐
f. The environment in the Great Lakes region	☐	☐	☐

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.

[illegible]

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

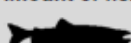
Fishing Scenario 5

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 | ☐ \$60,000-\$79,999 | ☐ \$125,000 - \$149,999 |
| ☐ \$20,000 - \$39,999 | ☐ \$80,000 - \$99,999 | ☐ \$150,000 or more |
| ☐ \$40,000 - \$59,999 | ☐ \$100,000 - \$124,999 | ☐ 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)

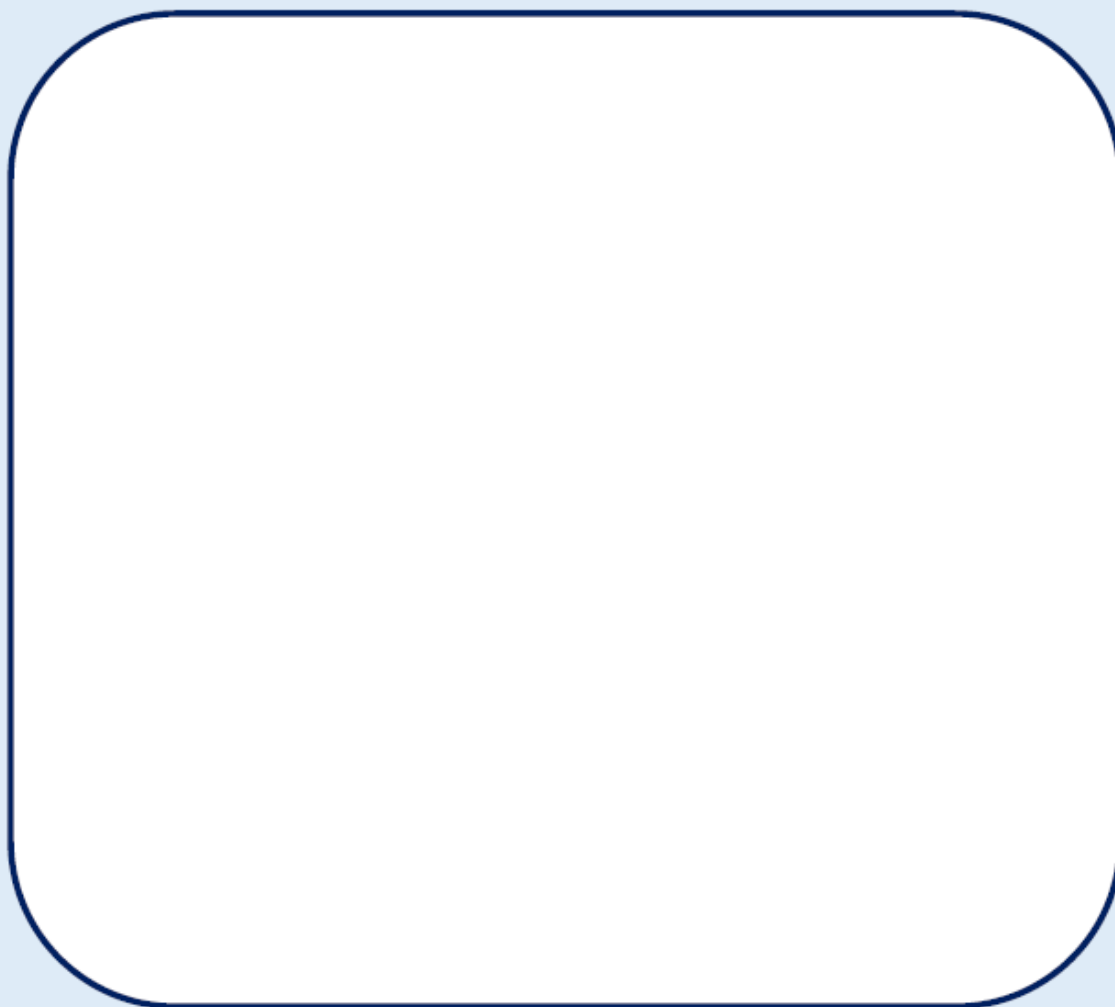
- | | |
|--|--|
| ☐ White | ☐ American Indian |
| ☐ Asian | ☐ Native Hawaiian or other Pacific Islander |
| ☐ Black or African American | ☐ Other: _____ |

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 C: QUESTIONNAIRE FROM CHAPTER 3

A survey about aquatic Invasive Species in Illinois

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

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

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

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

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

Screening questions

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

Section 1 of 6: Background Information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(select all that apply)

- ☐ Sailing ☐ Kayaking ☐ Canoeing
☐ Boating ☐ Jetskiing
☐ Other: _____

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

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

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

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

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

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

All Respondents --

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

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

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

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

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

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

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

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

Section 2 of 6: Aquatic Invasive Species Outreach Messages

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

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

BE A HERO TRANSPORT ZERO

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

REMOVE

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

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

ZEBCA MUSSELS

DRAIN

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

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

DRY

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

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

HYDRILLA

PROTECT THE ENVIRONMENT

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

Remember
Dispose of all unwanted bait and live fish in the trash, and never release captured carp from one waterbody into another.

SILVER CARP

Report new sightings!
If you suspect a new introduction of an invasive plant or animal, take a picture and report it by visiting <http://www.wa.gov/pnw/awp/ASD> or calling the Wildlife Department of British Columbia at 1-800-966-9229.

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

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

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

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

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

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

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

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

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

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

	Not at all trustworthy	Slightly trustworthy	Moderately trustworthy	Very trustworthy	Extremely trustworthy
Family members, friends, or neighbors	☐	☐	☐	☐	☐
Government employees	☐	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐	☐
Bait shop vendors	☐	☐	☐	☐	☐
Members in boating or angling clubs	☐	☐	☐	☐	☐
Sales associates at boating or fishing stores	☐	☐	☐	☐	☐
Charter captains	☐	☐	☐	☐	☐

Environmental groups	☐	☐	☐	☐	☐
Other anglers	☐	☐	☐	☐	☐

Section 3 of 6: Risks of aquatic invasive species

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

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

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

19. If invasive species spread to your most frequented waterbody, how intense would you expect the impacts to be? Please indicate the intensity of potential harm to...	No impacts	Mild impacts	Moderate impacts	Severe impacts	Very severe impacts
a. Quality of habitat and natural environments	☐	☐	☐	☐	☐
b. Environmental processes (e.g., water cycle)	☐	☐	☐	☐	☐
c. Survival of plants and animals	☐	☐	☐	☐	☐
d. Your appreciation of the beauty of the landscape	☐	☐	☐	☐	☐
e. Your own enjoyment of recreational activities	☐	☐	☐	☐	☐
f. Your own access to the waterbody	☐	☐	☐	☐	☐
g. The local economy	☐	☐	☐	☐	☐
h. The community in the region	☐	☐	☐	☐	☐
i. Recreational opportunities for future generations	☐	☐	☐	☐	☐

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

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

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

20a. There are several ways to prevent accidentally transporting invasive species on your boat. Think about your boating trips over the next 12 months. How frequently do you plan to engage in the following activities?	Never	Occasionally	About half the time	Most of the time	Every time I go boating
a. Drain all standing water from the boat	☐	☐	☐	☐	☐
b. Conduct visual inspections of boats for invasive species	☐	☐	☐	☐	☐
c. Remove plants, animals, and mud from the boat	☐	☐	☐	☐	☐
d. Rinse boat and trailer	☐	☐	☐	☐	☐
e. Wipe down hull with a towel	☐	☐	☐	☐	☐
f. Allow boat to dry before entering a different body of water	☐	☐	☐	☐	☐

20b. There are several ways to prevent accidentally transporting invasive species on your fishing equipment. Think about your fishing trips over the next 12 months. How frequently do you plan to engage in the following activities?	Never	Occasionally	About half the time	Most of the time	Every time I go fishing
a. Remove any non-bait fish, plants, and other "hitchhikers" from bait bucket	☐	☐	☐	☐	☐
b. Dispose of unused live bait in the trash	☐	☐	☐	☐	☐
c. Drain water from bait bucket before moving to another waterbody	☐	☐	☐	☐	☐
d. Conduct visual inspections of fishing equipment for invasive species	☐	☐	☐	☐	☐
e. Remove plants, animals, and mud from fishing equipment	☐	☐	☐	☐	☐
f. Rinse fishing equipment	☐	☐	☐	☐	☐
g. Wipe down fishing equipment with a towel	☐	☐	☐	☐	☐
h. Allow fishing equipment to dry before fishing in a different body of water	☐	☐	☐	☐	☐

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

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

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

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

c. I lack the necessary equipment to effectively clean my boat or equipment	☐	☐	☐	☐	☐
d. Poor weather conditions often interfere with my ability to complete the recommended cleaning tasks	☐	☐	☐	☐	☐
e. My health or physical abilities prevent me from effectively cleaning my boating or fishing equipment	☐	☐	☐	☐	☐

Section 5 of 6: Environmental Values and Trust

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

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

	Unimportant	Of Little Importance	Moderately Important	Important	Very Important
a. Protecting the environment: preserving nature	☐	☐	☐	☐	☐
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	☐	☐	☐	☐	☐

25. Scientists provide information about fisheries in lakes and rivers throughout the state of Illinois. We would like to know how much you trust the scientific community. To what extent do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. I have very little confidence in the scientific community.	☐	☐	☐	☐	☐
b. Information from the scientific community is trustworthy.	☐	☐	☐	☐	☐
c. I trust the scientific community to do what's right.	☐	☐	☐	☐	☐
d. The scientific community often does not tell the public the truth.	☐	☐	☐	☐	☐
e. I am suspicious of the scientific community.	☐	☐	☐	☐	☐

26. Fisheries and other recreational activities in Illinois are primarily managed by the Department of Natural Resources (DNR). We would like to know how much you trust this agency. To what extent do you agree or disagree with the following statements?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
f. I have very little confidence in the Illinois Department of Natural Resources.	☐	☐	☐	☐	☐
g. Information from the Illinois Department of Natural Resources is trustworthy.	☐	☐	☐	☐	☐
h. I trust the Illinois Department of Natural Resources to do what's right.	☐	☐	☐	☐	☐
i. The Illinois Department of Natural Resources often does not tell the public the truth.	☐	☐	☐	☐	☐
j. I am suspicious of the Illinois Department of Natural Resources.	☐	☐	☐	☐	☐

Section 6 of 6: About You

26. What is your gender? ☐ Male ☐ Female ☐ Other

27. In what year were you born? _____

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

- | | | |
|--|---|---|
| ☐ Less than \$24,999 | ☐ \$25,000-\$49,999 | ☐ \$50,000-\$74,999 |
| ☐ \$75,000-\$99,999 | ☐ \$100,000-\$124,999 | ☐ \$125,000-\$149,999 |
| ☐ \$150,000-\$174,999 | ☐ \$175,000-\$199,999 | ☐ \$200,000 and over |
| ☐ Prefer not to answer | | |

29. 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 |

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

- | | |
|-----------------------------|---|
| ☐ White | ☐ Black or African American |
|-----------------------------|---|

- ☐ Asian
☐ American Indian

- ☐ Native Hawaiian or other Pacific Islander
☐ Other: _____

31. With which ethnicity do you identify?

- ☐ Hispanic ☐ Non-Hispanic

32. Which language are you most comfortable reading? _____

33. What is your zip code? _____

Thanks for your help!

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

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