
Determinants of Knowledge and Awareness of Aquatic Invasive Species

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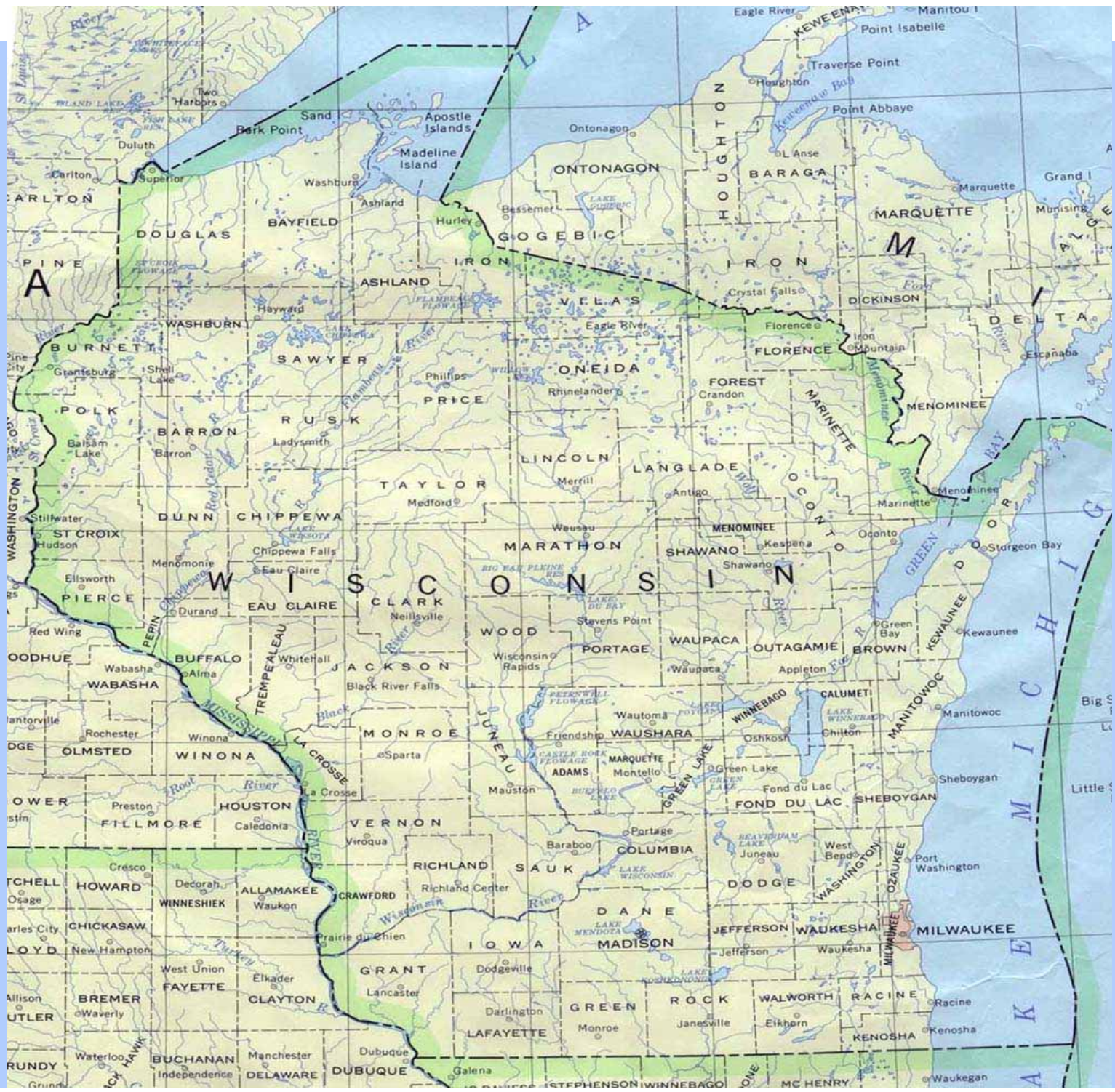
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WASHINGTON
PINE
BURNETT
POLK
BARRON
DUNN
ST CROIX
PIERCE
OODHUE
WABASHA
DGE
OLMSTED
WINONA
LOWER
FILLMORE
HOUSTON
VERNON
RICHLAND
SAUK
DANE
MADISON
GRANT
CLAYTON
LAFAYETTE
RUNDY

CARLTON
DOUGLAS
BAYFIELD
ASHLAND
WASHBURN
SAWYER
RUSK
CHIPPewa
EAU CLAIRE
WABASHA
WINONA
HOWARD
CHICKASAW
LOYD
BREMER
UTLER
BUCHANAN
DELAWARE
DUBUQUE

ASHLAND
IRON
VILLAS
ONEIDA
PRICE
WOOD
JACKSON
MONROE
CRAWFORD
GRANT
DUBUQUE

ONTONAGON
GOGEBIC
IRON
FLORENCE
MARINETTE
MENOMINEE
MARATHON
SHAWANO
WAUPACA
OUTAGAMIE
BROWN
WAUSHARA
ADAMS
COLUMBIA
DODGE
JEFFERSON
WAUKESHA
MILWAUKEE

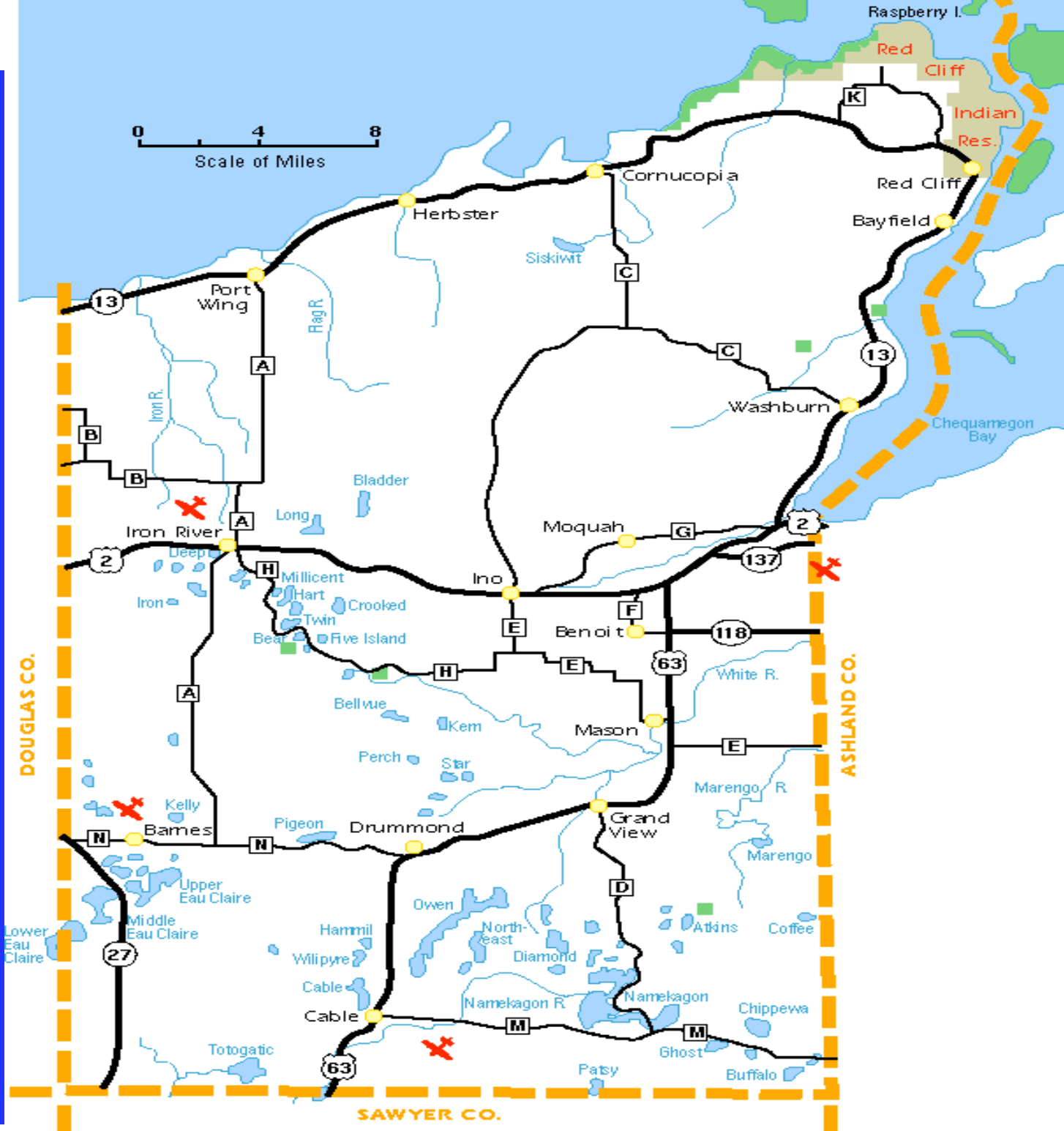
BARAGA
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DELTA
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BROWN
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MANITOWOC
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FOND DU LAC
COLUMBIA
DODGE
JEFFERSON
WAUKESHA
MILWAUKEE
WALWORTH
RACINE
KENOSHA
MC HENRY

Lakes of Interest in this Study

- Lakes in the Bayfield County Towns of Iron River and Delta
- Includes Pike Chain of Lakes



**“Poison Ivy Island – Lake Millicent”
by Sally Witz**



Some Questions of Interest

- What are property owners' attitudes/opinions on lake issues, including aquatic invasive species (AIS)?
- What is the level of awareness about AIS?
- What are some of the factors that influence a person's level of awareness?
- What is the state of knowledge about AIS?
- What factors determine a person's state of knowledge?
- How would property owners change their behavior if AIS infestations increased?

How Did We Obtain Data for the Study?

- We conducted a mail-out survey of property owners in the towns of Iron River and Delta
- Surveys were mailed to all residential property owners

The Property Owner Survey: Response Rate

- Surveys were mailed to all 1,451 property owners
- 49 undeliverables (returned with no forwarding address)
- 666 surveys were completed and returned to the team
- $666 / (1451 - 49) = 48\%$ response rate

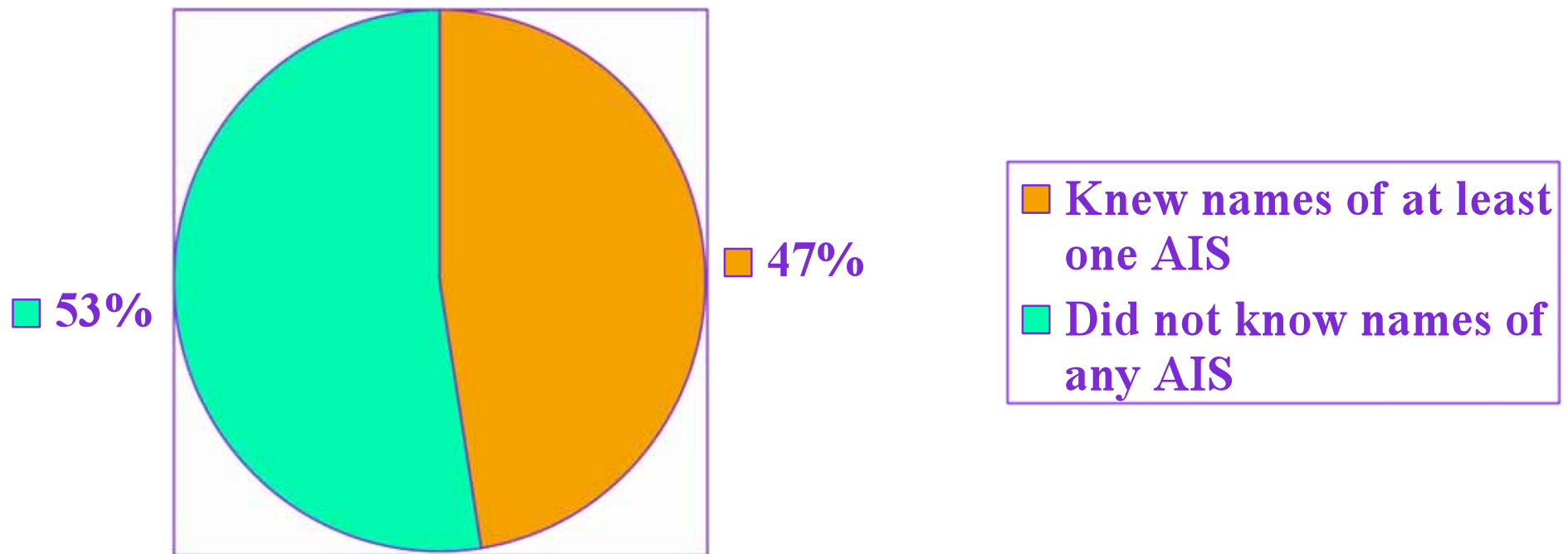
(Some) Factors Perceived as Impacting Lakes in Towns of Iron River and Delta

<i>Factors</i>	<i>No Impact</i> <i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>Great Impact</i> <i>5</i>
Aquatic invasive species Mean = 3.7 (n = 549)	4.7%	13.8%	25.1%	18.0%	38.2%
Lakeshore development Mean = 3.3 (n = 560)	10.9%	20.0%	24.6%	16.4%	28.0%
Septic tank discharge Mean = 2.9 (n = 530)	16.0%	24.7%	27.0%	16.0%	16.2%
Shoreline vegetation removal Mean = 2.9 (n = 544)	16.4%	23.2%	28.3%	16.0%	16.2%
Boat congestion Mean = 2.9 (n = 551)	14.5%	25.0%	25.8%	19.4%	15.2%

What is the Level of Awareness Regarding AIS?

- Can respondents think of the names of any aquatic invasive species they believe could be a problem for the lakes in the towns of Iron River and Delta?

Awareness: Can a Respondent Think of the Names of ANY Aquatic Invasive Species That Could be a Problem in These Lakes?



Respondent Awareness of Specific AIS that Could be a Problem in These Lakes

<i>Species</i>	<i>No. of "Aware" Respondents (Total = 291/574)</i>
Eurasian watermilfoil (some version)	244
Zebra mussels	62
Rusty crayfish / crayfish	61
Spiny water flea / water flea	26
VHS / fish virus / virus	23
Round goby	7
Other miscellaneous AIS names	33

Probit Model Regression Results: Awareness

Variable	Coefficient	Standard Errors	z-values
Constant	-1.52***	0.224	-6.78
Ownwater	0.169	0.183	0.92
Keepboat	0.210	0.175	1.20
Othlakes	0.386***	0.123	3.15
College	0.430***	0.123	3.50
Age>65	-0.256**	0.130	-1.98
Fish/Swim/Boat	0.606***	0.209	2.90
Lakemember	0.718***	0.132	5.45

^a Dependent variable is AIS awareness variable = 1 if respondent could think of the names of any AIS; otherwise = 0.

*** Denotes statistical significance at the 0.01 level.

** Denotes statistical significance at the 0.05 level.

Pseudo R² = 0.17; Number of observations = 536.

What Conclusions Emerge from the AIS Awareness Regression Analysis?

- Individuals are more likely to be aware of aquatic invasive species if they:
 - ◆ Use lakes in Iron River or Delta for fishing, swimming/wading, or motor boating
 - ◆ Are a member of a lake association
 - ◆ Visit other lakes outside the area (an indicator of recreation behavior)
 - ◆ Have completed at least a college-level education
 - ◆ Are less than 65 years of age (However: this result deserves more scrutiny)

What Implications Arise from the Regression Analysis of Awareness Factors?

- May (or may not) wish to aim public education efforts toward individuals who:
 - ✦ Do *not* use lakes in Iron River or Delta for fishing, swimming/wading, or motor boating
 - ✦ Do *not* visit other lakes outside the area
 - ✦ Are *not* members of a lake association
 - ✦ Have *not* completed at least a college-level education

General Knowledge About AIS

<i>For lakes in general:</i>	<i>Strongly disagree / somewhat disagree / neutral</i>	<i>Strongly agree / somewhat agree</i>	<i>Don't know</i>
"AIS can interfere with water-based recreation" (n=616)	8.3%	87.3%	4.4%
"AIS are easily transferred from one lake to another" (n=617)	6.5%	89.1%	4.4%
"AIS can negatively impact the health of a lake" (n=618)	5.5%	90.0%	4.5%

Knowledge About AIS Specifically for These Lakes

<i>For lakes in Iron River and Delta:</i>	<i>Strongly disagree / somewhat disagree / neutral</i>	<i>Strongly agree / somewhat agree</i>	<i>Don't know</i>
"AIS are interfering with water-based recreation" (n=612)	31.7%	41.8%	26.5%
"AIS are lowering the values of some lakefront property" (n=609)	37.4%	33.7%	28.9%
"Watercraft inspectors play an important role in preventing AIS" (n=612)	19.6%	65.9%	14.5%

Probit Model Results: Knowledge that AIS Can Interfere with Water-based Recreation

Variable	Coefficient	Standard Errors	z-values
Constant	-0.498	0.517	-0.96
Income > \$50K	0.683***	0.261	2.62
Fish/Swim/Boat	0.733	0.480	1.53
Othlakes	0.521**	0.237	2.19
Lakemember	0.474*	0.246	1.93

^a Dependent variable is AIS Knowledge Variable #1: “very good knowledge” that AIS can interfere with water-based recreation in general.

*** Denotes statistical significance at the 0.01 level.

** Denotes statistical significance at the 0.05 level.

* Denotes statistical significance at the 0.10 level.

Pseudo $R^2 = 0.14$; Number of observations = 219.

What Conclusions Emerge for General Knowledge on AIS Recreation Impacts?

- Individuals are more likely to have very good knowledge that AIS can interfere with water-based recreation if they:
 - ✦ Are a member of a lake association
 - ✦ Visit other lakes outside the area (an indicator of recreation behavior)
 - ✦ Have an annual household income greater than \$50,000

Probit Model Results: Knowledge that AIS Are Lowering Property Values on These Lakes

Variable	Coefficient	Standard Errors	z-values
Constant	-1.83***	0.555	-3.29
MA/PhD	0.391**	0.179	2.18
Fish/Swim/Boat	1.282**	0.544	2.36
Tenure	0.006	0.004	1.62
Lakemember	0.411**	0.166	2.47

^a Dependent variable is AIS Knowledge Variable #5: “good knowledge” that AIS are lowering the values of some lakefront property in Iron River and Delta specifically.

*** Denotes statistical significance at the 0.01 level.

** Denotes statistical significance at the 0.05 level.

* Denotes statistical significance at the 0.10 level.

Pseudo R² = 0.06; Number of observations = 248.

What if These Lakes Were Invaded by Aquatic Invasive Species?

- To examine this question, we asked respondents how they would change their behavior (if at all) if a particular AIS scenario were to occur
- Known as “contingent behavior analysis”

The Contingent Behavior Scenario

Suppose the following: aquatic invasive plants were spread into all the lakes in the towns of Iron River and Delta. And suppose that these aquatic plants would limit boating and swimming in half of the lakes' surface area, and that this condition was expected to persist over the foreseeable future.

The Contingent Behavior Question

IF this kind of change were to happen on the lakes in the towns of Iron River and Delta, AND these changes were not occurring in other lakes in northwest Wisconsin, how do you think you/ your family might change your activities or lifestyle, if at all? (*Please check ANY that apply, and fill in blanks as appropriate.*)

Responses to AIS Scenario

- The contingent behavior analysis indicates some people would adjust their residency patterns or recreational activities in response to an AIS invasion:
 - ✦ 17% indicate they would sell their property
 - ✦ 8% indicate they would stay, but spend less time there
 - ✦ Roughly 10-20% would recreate less on these lakes
- → AIS invasions have implications not only for quality of life but also for various economic factors...

Effects from Fewer Days Spent at Property due to AIS Scenario

- The mean respondent: about 3 fewer days/yr spent at property in response to AIS scenario
- Resulting aggregate reduction in primary spending: about \$275,000 per year

Effects from Fewer Days Spent Fishing Due to AIS Scenario

- The mean respondent: 3.3 fewer days/yr fishing in response to AIS scenario (25% decrease)
- Aggregating this to population: 4,817 fewer fishing days per yr
- $(4,817 \text{ lost angling days/yr}) * (\$52/\text{day}) = \text{about } \$250,000 \text{ in lost net economic benefits per yr due to AIS scenario}$
- **→ Decrease of ~ 24% below the baseline net economic benefits from recreational angling (\$1.1 million/yr)**

Conclusions: Knowledge and Awareness

- There is probably room for improvement in the level of awareness and knowledge about AIS
- However, many people do appear concerned about negative impacts from AIS
- This study illuminates some factors influencing individuals' awareness of and knowledge about AIS

Emerging Conclusions: Economic Effects

- AIS invasions yield several types of negative economic effects
- Even in small towns, any one effect may by itself amount to at least several hundred thousand dollars per year
- Not all of these types of economic effects can (should) be added together, but...
- Finally, some effects are sizeable in percentage terms, while others may be more modest

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How Many are Year-round Residents?

<i>Occupancy Category</i>	<i>Owns Waterfront Property</i>	<i>Does Not Own Waterfront Property</i>	<i>Total</i>
Year-round residents	130 (29.2%)	87 (49.4%)	217 (34.9%)
Not year-round residents	315 (70.8%)	89 (50.6%)	404 (65.1%)
Total	445 (100%)	176 (100%)	621 (100%)

Do You Recreate Here?

<i>Recreational Activity</i>	<i>Percent who engage in this activity on area lakes</i>	<i>Mean no. of days spent on this activity (excludes zeroes)</i>
Fishing	72.1%	19.8
Swimming/wading	67.4%	28.6
Motor boating	45.7%	28.4

What is the Average Number of Days ‘In Residence’?

- The average number of days the property is utilized by respondent's family: 195 days per year (53% of year)

Proximity of Respondent's Property to Nearest Lake (for non-Waterfront Owners)

<i>Proximity</i> (n=181)	<i>% of Respondents</i>
Less than ¼ mile	34.2%
Between ¼ and ½ mile	17.7%
Between ½ and 1 mile	17.7%
Between 1 and 2 miles	14.9%
More than 2 miles	15.5%

Got Boat?

<i>Keep a Boat on a Lake in Iron River or Delta?</i>	<i>Owns Waterfront Property</i>	<i>Does Not Own Waterfront Property</i>	<i>Total</i>
Yes, keep boat	373 (83.1%)	14 (7.9%)	387 (61.8%)
No, do not keep boat	76 (16.9%)	163 (92.1%)	239 (38.2%)
Total	449 (100%)	177 (100%)	626 (100%)

The Scenario: Part 1 (*Background*)

A Possible Future Scenario for the Lakes in the Towns of Iron River and Delta

14) Recognizing that Lake Superior contains over 80 aquatic invasive species and that significant boating traffic occurs between Lake Superior and nearby inland lakes, it is possible that species such as invasive aquatic plants, invertebrates, fish and others could enter area lakes in the future.

Possible Responses to Scenario

- Respondent would sell their property
- Would keep property, but likely spend ___ fewer days/yr there, *on average*
- Would probably go boating on these lakes ___ fewer days/yr
- Would probably go swimming/wading in these lakes ___ fewer days/yr
- Would probably go fishing on these lakes ___ fewer days/yr
- Respondent would **NOT CHANGE ANY ASPECTS** of their activities or lifestyles with regard to these lakes

Responses to Contingent Behavior Scenario

<i>Responses</i>	<i>Owns Waterfront Property</i>	<i>Does Not Own Waterfront Property</i>	<i>Total</i>
Sell property	116 (20.1%)	10 (5.6%)	126 (16.6%)
Fewer days/yr at property	48 (8.3%)	15 (8.4%)	63 (8.3%)
Boating fewer days/yr	73 (12.6%)	12 (6.7%)	85 (11.2%)
Swimming fewer days/yr	97 (16.8%)	29 (16.3%)	126 (16.7%)
Fishing fewer days/yr	89 (15.4%)	27 (15.2%)	116 (15.3%)
No changes in activities	155 (26.8%)	85 (47.8%)	240 (31.7%)
Total	578 (100%)	178 (100%)	756 (100%)

How Many Fewer Days Spent at Property in Response to Scenario?

- Among those respondents who indicated they would spend less time at their property in response to the AIS scenario, the **mean number of fewer days was 34 days/yr**
- This represents a **17% decrease** in number of days in residence below the mean baseline of 195 days/yr
- For **whole sample**: mean is 3.3 fewer days

How Much does a Typical Property Owner Spend?

- The average household spends about \$6,800 per year (conservative estimate) *in the Towns of Iron River and Delta*
- Total spending in these Towns by all property owners is estimated to be about \$9.86 million per year (conservative estimate)

AIS Scenario's Impacts on Spending via Reduced Residence Time

- Reduction in number of days spent at properties would reduce annual spending by about \$187/HH, on average
- The aggregate reduction in primary spending in these two towns would be about \$272,000 per year
- A decrease of about 3% below baseline aggregate spending of these residents
- These numbers may seem small, but...

How Many Fewer Fishing Days in Response to AIS Scenario?

- Among those who fish, the average number of days/yr spent fishing is 19.8
- Among respondents (15%) who would fish less in response to AIS scenario: 18.7 fewer days/yr fishing on these lakes, on average

What is Aggregate Effect in Terms of Reduced Fishing Days?

- Among ALL respondents (including non-anglers), the average number of days/yr spent fishing is about 13
- For ALL respondents: the mean response to the AIS scenario is 3.3 fewer fishing days per yr (a 25% decrease)
- Aggregating this to the population: we estimate 4,817 fewer fishing days per yr

Angling: Omissions and Uncertainties

- Recreators will substitute to other lakes → not all of this net economic value will be lost
- However, property owners may now incur higher travel costs to get to recreation
- Also, the **expenditures** associated with this recreation may leave the area
- Remember: none of this analysis incorporates losses due to **reduced numbers of recreational visitors from outside the area**
- Can certainly conduct the analysis for recreational activities other than angling...