GREAT LAKES FISHERY COMMISSION

2022 Project Completion Report[1]

Economic Aspects of the Great Lakes Recreational Fisheries and Factors Driving Change

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by:

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ABSTRACT:

Fisheries management in the Laurentian Great Lakes operates under a transboundary governance structure that is increasingly integrating the biological and social sciences. With 20% of the world's surface fresh water, a large human population that is dependent on its water resources, and a recreational and commercial fishery, these integrations are critical. These valuable fisheries are also susceptible to a multitude of anthropogenic factors (e.g., aquatic invasive species, agricultural runoff, climate change), which will ultimately influence regional economies and quality of life. Our study sought to determine the use and non-use value of this globally important resource. We used human dimensions surveys of, 1) adult US anglers from the eight Great Lakes states to determine fishing participation and effort, expenditures related to fishing the Great Lakes, and their willingness to pay for a Great Lakes Fishing trip, and 2) a general public survey to determine the non-use value of the Great Lakes, including respondent's attitudes toward impacts and willingness to pay (WTP) for a Great Lakes fisheries management plan. We also compiled economic information from commercial harvesters to ascertain economic value within that sector and examine future population projections and how they might influence angler behavior in the future. For the 2020 recreational angler survey, between March 15 – April 20, 2021, we emailed 209,645 adult anglers with an invitation to complete an online survey. We also distributed an abbreviated survey (via mail and email) to 16,000 non-respondents. Overall, we received 19,993 replies, of which 10,595 people indicated they fished at least one of the Great Lakes during the 2020 fishing season. Using our survey results and data obtained by state fisheries managers, we estimated 1.1 million individuals fished at least one of the Great Lakes or their tributaries in 2020. Accounting for individuals who fished more than one lake (e.g., 37% in Michigan), we derived an overall estimate of 1.4 million anglers who fished 34.1 million days. Overall, we estimated that US anglers spent $3.8 billion dollars fishing the Great Lakes in 2020. Using data provided from a 2020 survey of Ontario anglers, they estimated Canadian anglers spend $285 million dollars, also in 2020 ($4.1 billion dollars combined). We also estimated on average, anglers were willing to pay $81.50 for a Great Lakes trip; however, the WTP varied based on a variety of factors, including income, how they fished, and where they lived. Using input-output models and applying multipliers, we estimated the spending contributed to $1.9 billion in household income supporting 25,900 jobs, $2.8 billion dollars to Gross Domestic Product and $770.8 million dollars in overall tax revenue. Using data from NOAA and the Ontario Commercial Fisheries' Association, we estimate the commercial fishery created $151.4 million dollars of economic activity in the U.S., contributing $78.5 million to GDP. These industries supported more than 1,920 US jobs, which provided $55.4 million in household incomes in 2020. For the same time period, Ontario harvest and revenues were twice that of the U.S. Collectively, the commercial fishing industry in both countries contributed $130.5 million dollars to their county's GDP, supported almost 3,000 jobs generating $93.3 million dollars in household income. Combined, the US and Canadian recreational and commercial fisheries generated $1.94 billion dollars of income, contributed $2.88 billion dollars to North America's GDP, and sustained almost 39,000 full and part-time jobs. Our study also found that residents of the Great Lakes were evenly split as to whether the fisheries were improving, staying the same, or declining. However, there was strong agreement among public that anthropogenic factors would negatively impact the Great Lakes environment. Respondents also believed government has the ability to manage the recreational fisheries, and their beliefs would be shared with decision-makers, and their responses would affect those decisions. Finally, the Great Lakes population is expected to increase slightly over the next 20 years; consequently, the angling population may also grow slightly. However, any measurable increase in angler spending may be dependent on people between 25 and 64 years old, as they represent the highest percentage of anglers and spend the most money.

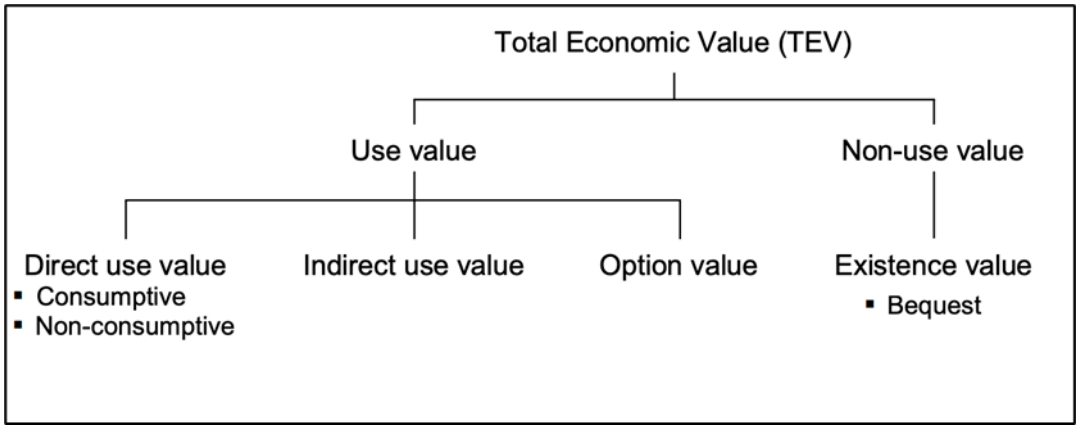
INTRODUCTION:

This project is a direct response to the Call for Proposals in the theme area, "Human Dimensions of Great Lakes Fishery Management". The intersection of human social systems and fisheries management is a complex relationship that must be considered if fisheries policies are to receive wide acceptance among the populations who utilize, value, and support the resource. However, the human dimension does not always receive the attention required to generate the information that should be part of management decisions. Regarding economic considerations, Heck, Stedman and Gaden (2015) outline several reasons as to why that is the case including the lack of formal training in the application of economic information by decision-makers, managers' distrust of social sciences, and a lack of actionable economic information on which to base decisions. This study addresses the lack of current economic information and proposes a framework to help managers incorporate demographic trends to understand how the economics of the Great Lakes system may change in the coming years.

The management of fisheries systems is complex, dynamic, and often contested. Fisheries resources and the anthropogenic activities that rely on them, whether free or at a cost, contain significant economic values. However, at the core of fisheries management lies economic issues of valuation, incentives and user-rights. Understanding the economic role that recreational fisheries play is crucial to shaping successful international, national, regional, and local fisheries policies (Bjørndal et al., 2007; Hanna, 2011; NOAA, 2004; Nunes & van den Bergh, 2001; Pagiola et al., 2004; Pearce, 2002). However, different policy contexts require the application of different approaches.

Measuring the socio-economic contributions of fisheries has taken the form of a variety of frameworks dependent on the type of aspects being explored. These methods generally fit into the categories of market valuation, non-market valuation, or a combination of the two. In fact, the total economic value of resources (TEV) is the net social benefit that comprises both consumer surplus and producer surplus. Producer surplus relates to the real market economy and represents market value, while consumer surplus refers to the non-market benefits derived from activities and is measured by the additional amount an individual would be willing to pay over and above their market expenditures (Charbonneau & Hay, 1978). Market and non-market values can be further deconstructed into use and non-use values (Figure 1). Use value is typically comprised of direct use values, which involve the economic or social values of tangible goods or benefits used directly by a consumer; indirect use values which relate to tangible benefits provided indirectly by resources; and option values which refer to the value of resource preservation and their future availability for use (Grafton et al., 2001). Non-use values are established by existence value and bequest value. Existence value is like option value; however, it is based on the idea that although individuals will not use the resource in the future, they would feel a 'loss' if the resource were to disappear (Ressurreição and Giacomello, 2013).

Figure 1. Components of Total Economic Value (TEV).



Generally, the values relating to direct use value are easiest to estimate, since they usually involve measured quantities of products which have observable market prices. For instance, we can look at transactional data of recreational fishing gear or license sales to understand certain components of direct values. However, assessing the benefits received by recreational anglers from direct use require a slightly more complex assessment. Nevertheless, a large literature has been developed to tackle this problem. The most common ways to assess these values has been through the use of surveys that measure fishery participants revealed and/or stated preferences.

This study provides two different types of economic information: 1) economic value as it relates to willingness to pay and non-use valuation, and 2) economic contributions specifically related to direct consumptive use. Economic value and economic contributions studies provide information which can seem similar in form, particularly when both are monetized, and are often confused and/or poorly understand. Both types of economic information are important for management of the Great Lakes fishery, and both have been produced at different times, by different researchers, and for different portions (or whole) of the Great Lakes (e.g., Liesch and Graziano, 2021, Melmstrom & Lupi, 2013). The measures have different uses but are equally important and should be produced consistently and accurately to provide the most benefit for fisheries managers.

Economic value is a measure of the benefit provided by a good or service. In the context of the Great Lakes, it is a measure of how much people value the Great Lakes. When stated in dollar terms, it can be defined as the maximum amount of money that someone (or some entity) is willing to pay for a specific good or service. (Subtracting from this the amount a person actually pays for the good or service yields the "net economic benefit" or "consumer surplus".) This study estimated the economic value held by the general public (i.e., non-use value) as well the value held by anglers who fish the Great Lakes (i.e., use value).

The Great Lakes are a finite resource with multiple uses and multiple users. Policy makers at various levels must make allocation decisions regarding the Great Lakes (e.g., providing water for agricultural, industrial, or recreational uses). Economic value is of particular importance to these policy makers as it provides a clear measure of the broader societal effects of resource allocation. Maximizing social welfare requires the efficient allocation of public resources, and an efficient allocation is possible only if we clearly understand the values that society places on its resources. Specific to the Great Lakes fisheries, managers are faced with allocating specific fisheries to recreational versus commercial uses. Such decisions require estimates of economic value of the fisheries that are as accurate and timely as possible.

Allocation of public resources is best done on the basis of economic value. Deciding how fisheries resources should be utilized and/or distributed without understanding how society values the Great Lakes potentially leads to an inefficient and squandered use of the resource. While economic contributions (i.e., jobs, incomes) measures alone are not an appropriate basis for fisheries managers to make allocation decisions, they are not without merit.

Economic contributions are the result of activity associated with some specific economic stimulus within a defined regional economy. For example, purchases of goods and services by anglers related to their fishing stimulates activity directly in the businesses from which they make their purchases. There are also indirect stimuli as those businesses and their employees that serve the anglers re-spend the dollars received from selling goods and services to the anglers. The economic contributions can be stated in several different ways including total dollar output, number of jobs, value-added, employee earnings, and state and local tax revenues.

Measuring the economic contributions of the Great Lakes in this way provides a sense of the importance of the Great Lakes to local and regional economies. For example, fisheries managers can point to the numbers of jobs and related income supported by fishing in the Great Lakes (recreational or commercial) to argue for maintaining or increasing public financial support of fisheries management and all of the costs required for effective management.

Managing fisheries requires expenditures of public tax dollars for research, staff, facilities, etc. In a political climate that closely scrutinizes public spending and produces calls for cuts wherever possible, it is important that public agencies are able to justify any investment of tax dollars. Quantifying the economic contributions attributable to fishing (jobs, income, GDP, tax revenues) provides managers with easily understood metrics that

convey the magnitude of economic losses that would result if fisheries are allowed to decline. Measures of economic contribution also provide a common basis (apples-to-apples) for comparing the contributions of the Great Lakes fishery to other better-known industries. These types of comparisons are used as a way of raising the profile of the fisheries in the public consciousness and to help people begin to understand the fisheries as an economic force (industry) in much the same way that they might view other industries (e.g., auto industry) as an economic force.

Economic information (contributions or use and non-use values) reflects the choices and preferences of anglers, consumers and the general public. Changes within specific demographic segments collectively impact fisheries' economic contributions and benefits. Understanding how changes within key segments of the community impact the economics of the region's fisheries can help managers adapt fisheries policies to better serve the community. Likewise, when factors beyond the control of fisheries managers change (e.g., demographic changes, economic forces, public beliefs and attitudes), sound economic information will help fisheries managers understand when they need to adapt their approaches to better serve a changing world. This study builds on previous GLFC research and examines the economic contributions and values held by specific U.S. demographic segments to project future changes based on expected shifts in the angler and general U.S. populations.

For economists, the valuation of natural resources is most commonly done to serve purposes beyond fisheries management, such as informing policy decisions in which trade-offs are considered among competing uses, providing damage estimates for illegal kills, or estimating resource values for incorporation into national economic accounts (National Research Council, 2005). Interviews with fishery managers found frequent reference to economic information as "a common currency for communicating value and benefit" of fisheries to justify management decision and money spent (Heck et al., 2014). However, Heck et al. also found economic information traditionally has been developed and presented in ways that are difficult for fisheries managers to understand or apply. This likely has limited the application of economic insights into fishery-level management decisions. Therefore, this study will include input from fisheries managers throughout the project and present the results in a way that is easily digestible by non-economists to improve the application of economic data into decision-making processes.

While a host of studies have been undertaken to value the output of goods and services provided by the Great Lakes fisheries within certain contexts, there is a paucity of research valuing the Great Lakes fisheries in their entirety. Additionally, studies that have explored the Great Lakes as a whole entity, have not captured crucial human dimensions data that can inform beyond economic value. This study aims to assess the economics and social dimensions of Great Lakes fisheries in a manner that can yield beneficial data for the continued management and coordination of these important resources.

OBJECTIVES:

1. To identify the extent of the sales, jobs, taxes and other economic contributions generated by the Great Lakes recreational and commercial fisheries in the U.S. and Canada.
    a. Recreational Fishing
        i. Nearly 1.1 million licensed US anglers fished the Great Lakes during the 2020 season. Because anglers fished multiple lakes, an estimated 1.4 million people went fishing on the Great Lakes and their tributaries. Overall, they fished an estimated 41.3 million days.
        ii. Nearly 250,000 people fished the Great Lakes in Ontario.
        iii. Anglers spent $4.1 billion in direct expenditures on the Great Lakes in 2020. Spending was distributed as $3.8 billion in the United States and $285.1 million in Canada.
        iv. That level of spending resulted in $1.0 billion of direct income and 20,300 full and part time jobs. Applying multipliers shows the $4.1 billion of spending resulted in $1.9 billion dollars of income, 35,800 full and part time jobs, $2.8 billion contribution to GDP and $5.1 billion in economic output.
    b. Commercial Fishing. We estimate the commercial fishery created $151.4 million dollars of economic activity in the U.S., contributing $78.5 million to GDP. These industries supported more than 1,920 jobs in the U.S., which provided $55.4 million to household incomes in 2020. Canadian harvest and revenues were twice that of the U.S. Collectively, the industry in both countries contributed $130.5 million dollars to North America's GDP, supported almost 3,100 jobs and generated $93.3 million in household income.
2. To determine the economic value held by the U.S. and Canadian publics for the Great Lakes fisheries, including use and non-use values as well as the values held for the fisheries role in the ecosystem.
    a. Willingness to Pay
        i. The average willingness to pay for a Great Lakes trip was $82; however, anglers would pay more or less, depending on their income, how they fished (e.g., charter, short), the species they fished, and where they lived.
        ii. More than half of survey respondents (63%) supported a one-time tax increase to pay for a management plan. Median willingness to pay for a Great Lakes management plan varied by age and income, with older, low income respondents (65+, <$50,000 = $48) willing to pay less than younger, higher income respondents (25 – 44, >$50,000 = $308).
3. To understand how values and management preferences vary across socio-demographic sectors and project how public values and demands may change, by matching with projections of the region's future population.
    a. General Public survey: Public values and a Great Lakes Fisheries Management Plan
        i. There were few differences between males and females; however, there were differences among age classes. Respondents were equally split as to whether the quality of fisheries were increasing, staying the same or decreasing. There was strong agreement among public that anthropogenic factors would negatively impact the Great Lakes environment. Respondents believed government has the ability to manage the recreational fisheries, and their beliefs would be shared with decision-makers and would affect those decisions.
        ii. Respondents were supportive of a Great Lakes management plan and the regulation/policy components that should be included in the plan. Nearly two-thirds (63%) supported a one-time tax increase to pay for the plan.
    b. Future Populations
        i. The Great Lakes population is expected to increase slightly over the next 20 years; consequently, the angling population may also grow slightly. However, any measurable increase in angler spending may be dependent on people between 25 and 64 years old, as they represent the highest percentage of anglers and they spend the most money.
        ii. Any projections on future participation rates are predicated on several assumptions, including regulatory consistency, fish populations, environmental conditions, economic conditions, social norms, or other factors. Changes to any variable can potentially positively or negatively affect future angler numbers.

4. To maximize public awareness and understanding of the results by communicating major findings.

METHODS

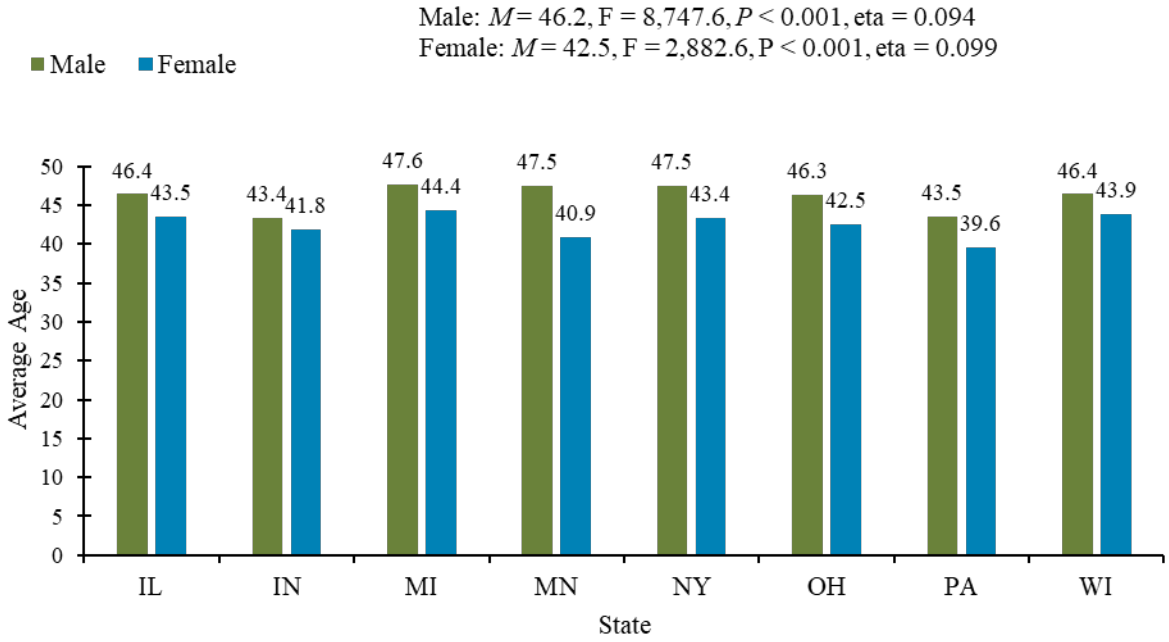
Objective 1. Economic contributions of the recreational and commercial fisheries.

Recreational Survey

Sampling Frame

Our sampling frameχ was all individuals aged 18 and older who were licensed to fish in at least one Great Lake state. In total, we identified 8,884,895 individuals; however, we recognize this is an imperfect number given our data request fell while the 2020 fishing season was still open. Overall, we observed slight demographic differences among the states for both age and gender. Average age of license holders was 45.4 (males = 46.2, females = 42.5; Figure 2) and 77% male ($\chi 2 = 14{,}291.1$, $P < 0.001$, Cramer's $V = 0.040$). Although the differences were statistically significant (likely due to a large sample size; N = 8.8 million), the effect sizes were minimal; thus, we did not weight the sampling frame at the population level.

Figure 2. Average age of male and female fishing license holders among the 8 Great Lakes states.



Survey Distribution

The survey was designed to collect demographic information, fishing behavior, expenditures, and stated preferences of Great Lakes anglers during the 2020 fishing season (Appendix A). The expenditure portion of the survey replicated the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) survey conducted by the Census Bureau every 5 years. We divided our sample into three treatment groups: 1) email, 2) advance email notification (recipient received a postcard notifying them of a future email survey), and web push (recipient was given an access code and directed to the website).

Our intent was to compile state license data at one time and stratify the sample to include 25,000 anglers from each state aged 18 and over; half the sample was comprised of individuals with zip codes within 25 miles of a Great Lake and half from outside that area. Although we successfully obtained data from all 8 Great Lakes states[1], we encountered several delays and database issues that resulted in uneven survey timelines and variable outgoing sample sizes. In brief, Indiana (IN), Michigan (MI), Minnesota (MN), Ohio (OH),

[1] Indiana and Wisconsin data privacy laws precluded us from obtaining a complete license dataset. Instead, we worked closely with both states to obtain data sufficient to complete the project.

Pennsylvania (PA), and Wisconsin (WI) sent us data by mid-December, 2020. Concurrently, we were in discussion with Illinois (IL) and New York (NY) and hoped to obtain those data in time to field one survey in mid-January. Unfortunately, NY and IL confirmed they would not meet our survey timelines and we adjusted survey delivery. We received NY data on February 4, 2021 and IL on March 4, 2021. Consequently, survey campaigns began on January 18th (IN, MI, MN, OH, PA, WI), February 4th (NY), and March 8th (IL). In total, we attempted to contact recipients 4 times and concluded primary data collection in mid-April 2021 (Table 1).

Regarding the datasets, we discovered the emails the Agencies had on file were of varying quality. For IN, MI, MN, OH, PA, and WI, an email was not required at the point of sale. However, the emails appeared to be of generally good quality, which was confirmed through independent data validation[2] (3.7% potentially invalid). New York requires an email at the time of purchase, but we observed a substantially higher percentage of invalid email addresses, as compared to the first 6 states we received. We spent significant time removing false emails (e.g., asdf@asdf, noone@dec.com) prior to selecting a sample. Independent data validation suggested up to 29% as potentially invalid, so we ultimately decided to oversample by 3,000 per strata. Illinois was the final state to provide data and while they do not require an email to purchase a license, their email field was of comparative quality as New York. We ultimately removed 110,000 invalid emails (out of nearly 500,000) and independent data validation subsequently estimated up to 61% of the emails could be invalid. We chose to oversample Illinois by 6,500 per strata to account for a potentially high proportion of invalid email addresses.

In total, we emailed 209,645 survey invitations across the 8 Great Lakes states. Of those, 17,482 invitations either bounced or were undeliverable. This yielded 186,074 surveys that were presumably delivered to recipients. For the web push component, we mailed 4,750 postcards and 397 were returned as undeliverable.

We subsequently developed an abbreviated 17 question non-response survey to demographically weight the main dataset, or ideally, obtain information that could be incorporated into the final dataset (Appendix B). To enhance response, we opted to implement the survey via both paper (mail) and email delivery. In total, we mailed 6,400 paper surveys (400 per state/strata) and sent 28,000 email invitations (2,000 per state/strata) to non-respondents. Abbreviated survey data collection started in late March and concluded at the end of April 2021.

We analyzed data using the Statistical Program for the Social Sciences (SPSS 22) and Program R. We analyzed our data using Analysis of Variance (ANOVA), Chi-square, and T-tests. We used eta (ANOVA), Cramer's V (Chi-square), and Cohen's D (t-test) to measure effect size. Values of 0.1 were interpreted as minimal, 0.3 as typical, and 0.5 or greater as substantial effect sizes. We analyzed expenditure data using Program R (R Core Team, 2022; Wickham and RStudio, 2022; Wickham et al., 2022; Wickham et al. 2019), using the methods described in that section.

Data weighting

Because we had population-level license age and gender data from all 8 states and sample-level data for our five contact modes, we examined multiple strategies to determine optimal dataset weighting. We also grouped ages based on the USFWS national survey age categories[3]. As noted previously, we observed no meaningful differences among the license datasets for the states and did not weight at the population level. For the sample, we also observed no meaningful differences among the three primary survey modes (eta = 0.081) or the primary survey and both types of abbreviated surveys (eta = 0.081). However, we observed a slight difference between the population and sample for age and gender; thus, we applied a rake-weighting strategy using those sample variables weighted against the population.

[2] https://www.datavalidation.com/
[3] USFWS age categories are 18-24, 25-34, 35-44, 45-54, 55-64, and 65+

Table 1. Distribution schedule for email-based survey of Great Lakes anglers.

State	Date license data acquired	Email contacts (weekly x 4)	Non-response emails (two contacts)
Illinois	3/4/2021	3/8 - 3/29/2021	4/15 - 4/20/2021
Indiana	12/29/2020	1/18 - 2/16/2021	3/15 - 3/24/2021
Michigan	12/10/2020	1/18 - 2/16/2021	3/15 - 3/24/2021
Minnesota	11/12/2020	1/18 - 2/16/2021	3/15 - 3/24/2021
New York	2/4/2021	2/8 - 3/2/2021	3/15 - 3/24/2021
Ohio	12/18/2020	1/18 - 2/16/2021	3/15 - 3/24/2021
Pennsylvania	11/24/2020	1/18 - 2/16/2021	3/15 - 3/24/2021
Wisconsin	12/15/2020	1/18 - 2/16/2021	3/15 - 3/24/2021

Estimating Angler Numbers

The U.S. Fish and Wildlife Service conducts a national survey of recreational anglers approximately every five years (National Survey of Fishing, Hunting and Wildlife Associated Recreation - FHWAR). The most recent FHWAR survey was conducted in 2016 and the widely reported number of Great Lakes anglers is 1.8 million. However, that estimate was derived from only 154 respondents who indicated they fished one of the five Great Lakes (including Lake St. Clair and the St. Lawrence River). In addition, 2016 FHWAR sample sizes were insufficient to estimate angler numbers on Lakes Huron, Michigan, Superior, Lake St. Clair, or the St. Lawrence River. Consequently, we did not use angler estimates generated by the 2016 FHWAR survey.

For this project, estimating the number of recreational anglers is foundational to estimating economic value of the system. This proved challenging because each Great Lake state has different requirements for licensing (e.g., age, military status) and permitting (e.g., stamp requirement). Four states (IN, MI, NY, OH) had no special requirement to fish the Great Lakes or their tributaries. We used a variety of data sources to create our estimates, recognizing that different methods must be applied, depending on the state. Where applicable, we used estimates derived by Winkler as a foundation; however, that project was constrained to resident, trout/salmon anglers in the Upper Great Lakes (Huron, Michigan, Superior). In other cases, we used a combination of stamp sales, creel data, proportion of survey respondents not fishing for trout/salmon, or other state-derived research (Table 2). Simply, it was not possible to estimate the number of Great Lakes anglers using a standardized process; thus, the estimate derived from this project is the best number we could generate given the inherent regulatory differences among the states.

In addition to the regulatory differences noted in Table 2, we acknowledge the uncertainty surrounding our angler estimates, and the fact they could be biased both low and high. Specifically,

- State requirements vary as to who is required to have a fishing license. These variations can be based on age, veteran status, or disabled status.
- COVID-19 altered both the number and distribution of sales in that states saw an increase in residents, but a decrease in non-residents. Canada was also closed to international travel in Spring 2020, so the data on individuals fishing in Canada proved of little utility[4].
- In Michigan, there was no foundation for Lake Erie or Lake St. Clair angler numbers and our estimates are likely low, as compared to other data provided by the MI DNR (Lupi, 2020). The MI DNR study estimated 46% of all Michigan anglers fished on a Great Lake. Use of that data would have increased our

[4] Canada conducted an study in Ontario during 2020 (Hunt et al., 2022) and we were provided with their data in this report; consequently, the effect of not including Canada in our results is likely negligible.

overall estimate by 50%. In discussions with MI DNR staff, they were comfortable with the estimates we generated for Lakes Huron, Michigan, and Superior. However, they believed the Lake Erie and Lake St. Clair estimates were low. Ultimately, we agreed to use our lower number, with the caveat that the actual number likely falls between our estimates and Lupi (2020).

Table 2. Legal requirements for Great Lakes fishing, by state, and data used to generate angler estimates.

State	Legal Requirement	Data Used
Illinois	Lake Michigan salmon stamp	Winkler data, salmon stamp sale, proportion of survey respondents not fishing trout/salmon
Indiana	No special requirement	Winkler data, creel, state-derived research data, proportion of survey respondents not fishing trout/salmon
Michigan	No special requirement	Winkler data (not available for Lake Erie or Lake St. Clair), creel, Lupi data, proportion of survey respondents not fishing trout/salmon
Minnesota	Trout stamp. Not specific to Great Lakes. No stamp requirement if fishing for non-salmonid species	Winkler data, creel, proportion of survey respondents not fishing trout/salmon
New York	No special requirement	Recent research (Responsive Management 2017), creel
Ohio	No special requirement	State-derived research
Pennsylvania	Lake Erie stamp. Required up to the first barrier, regardless of species	Stamp sales
Wisconsin	Great Lakes trout/salmon stamp. No stamp requirement if fishing for non-salmonid species	Winkler data, stamp sales, proportion of survey respondents not fishing trout/salmon

Estimating Lake Level Participation and Effort

To estimate lake level participation and effort, we only used individuals who fished one lake within that respective state. To drill down into lake level activity, respondents were asked:

1) If they fished a Great Lake,
2) The state they fished,
3) The Great Lake(s) they fished,
4) The species and days they fished, and
5) The number of days they fished from that state/lake (e.g., Michigan-Lake Superior, Michigan-Lake St. Clair).

Anglers fished multiple Great Lakes both within and outside their own state (Table 3), so we generated species participation results using respondents who only fished one lake. Aggregating overall participation and effort would have inflated species pursued in some cases. Using the state of Michigan as an example (up to 5 locations), if an individual fished for salmon in Lake Superior and bass in Lake St. Clair, salmon effort would be included with Lake St. Clair (where salmon fishing is limited). Thus, we would produce misleading lake-level results, especially for Lake St. Clair and the St. Lawrence River. Consequently, we decided to constrain the results to individuals who only fished one lake, recognizing sample sizes would be smaller. In the case of large lakes with multiple species, the results did not vary among people who fished one lake or more than one lake. However, for Lake St. Clair and the St. Lawrence River, results indicated significant effort for species that are otherwise lightly fished.

Table 3. Great Lakes fished by resident survey respondents, 2020.

	Great Lake						
State Licensed	Erie	Huron	Michigan	Ontario	Superior	Lake St. Clair	St. Lawrence River
Illinois	9%	2%	86%	1%	8%	3%	1%
Indiana	15%	3%	86%	0%	4%	5%	1%
Michigan	26%	33%	60%	0%	13%	23%	0%
Minnesota	0%	1%	11%	0%	91%	0%	2%
New York	33%	1%	1%	68%	1%	1%	16%
Ohio	90%	2%	6%	3%	1%	3%	0%
Pennsylvania	90%	1%	1%	9%	0%	0%	1%
Wisconsin	3%	1%	81%	1%	20%	1%	1%

Economic Contributions Overview

Economic benefits can be estimated by two types of economic measures: economic contributions and economic values. Economic value is a non-business measure that estimates the value people receive from an activity after subtracting for their costs and expenditures. This concept is also known as consumer surplus. An economic contribution, on the other hand, addresses the business and financial activity resulting from the use of a resource.

There are three types of economic contribution: direct, indirect and induced. A direct contribution is defined as the economic contribution of the initial purchase made by the consumer (the original retail sale). Indirect contributions are the secondary effects generated from a direct contribution, such as the retailer buying additional inventory, and the wholesaler and manufacturers buying additional materials. Indirect contributions affect not only the industry being studied, but also the industries that supply the first industry. An induced contribution results from the salaries and wages paid by the directly and indirectly effected industries. The employees of these industries spend their income on various goods and services. These expenditures are induced contributions, which, in turn, create a continual cycle of indirect and induced effects.

The direct, indirect and induced contribution effects sum together to provide the overall economic contribution of the activity under study. As the original retail purchase (direct contribution) goes through round after round of indirect and induced effects, the economic contribution of the original purchase is multiplied, benefiting many industries and individuals. Likewise, the reverse is true. If a particular item or industry is removed from the economy, the economic loss is greater than the original lost retail sale. Once the original retail purchase is made, each successive round of spending is smaller than the previous round. When the economic benefits are no longer measurable, the economic examination ends.

This study presents several important measures:

- **Output**: Total volume of economic activity within the local economy that is related to recreational fishing on the Great Lakes. Because it does not discount the value of raw materials as they move through the production of goods or services, this measure double-counts a portion of the output of the industries in the value chain.
- **GDP:** This represents the total "value added" contribution of economic output made by the industries involved in the production of outdoor recreation goods and services. For a given industry, value added equals the difference between gross output (sales and other income) and intermediate inputs (goods and services imported or purchased from other industries). It represents the contribution to GDP in a given industry for production related to outdoor recreation. Unlike the measure of output, this metric accounts for the flow of materials though the value chain to avoid the potential for double-counting.

- **Jobs**: Total jobs in all sectors of the economy supported as a result of recreational Great Lakes fishing and includes both full-time and part-time jobs. These are not just the employees directly serving anglers or manufacturing their goods but can also include employees of industries impacted by the direct, indirect and induced effects.
- **Wages**: Total salaries and wages paid in all sectors of the regional economy as a result of recreational Great Lakes fishing. These are not just the paychecks of those employees directly serving recreators or manufacturing their goods, it also includes portions of the paychecks of all employees affected by the direct, indirect and induced effects. For example, it would include a portion of the dollars earned by the truck driver who delivers food to the restaurants serving anglers and the accountants who manage the books for companies down the supply chain, etc.
- **Tax Revenue**: Including all forms of personal, business and excise taxes, the IMPLAN model estimates the tax revenues collected by the local, state and federal governments as a result of the initial expenditures by outdoor recreators.

Spending Estimation and Projections

State-level modeling

We calculated trip, equipment, and real estate spending arrays that included population level total spending projections for 42 categories across all eight states. Creating these projections involved six steps:

1. Outlier removal
2. Filtering to state samples and determining residency
3. Classifying spending anglers
4. Calculating state averages
5. Projection based on estimated total anglers
6. Running IMPLAN Models

Outlier Removal

Prior to determining each state's sample, we removed outlier observations based on reported total categorical expenditures. Respondents *i* were asked to approximate their total expenditure per category (x_{ic}^{T}). The aggregated responses approximated a zero inflated log-normal distribution for every category, i.e., individuals either spent nothing or something, and those who spent something did so according to a log normal distribution. As such, we calculated outliers by ignoring those who spent nothing in a category and classified the remaining logged total expenditure responses as outliers if they were greater than 1.5 * IQR (interquartile range) the third quartile boundary, or less than 1.5 * IQR the first quartile boundary. If any of a respondent's reported expenditures were classified as an outlier across the 42 categories, their entire response was removed from the sample.

Filtering to state sample and identifying residents

If respondents indicated that they spent time on a Great Lake in a state, they were grouped into that state's sample (n_s). On a per state basis, we also separated respondents into residents and non-residents based on the home state they provided in the survey. Some participants indicated that they fished in more than one state, so these individuals will be included in the sample for multiple states but may only have residency in one.

Determining proportion of spending anglers

In addition to total expenditures per category, respondents were asked which states they spent each category in and how many days were spent fishing per state. Since respondents were not asked how much of their total spending took place in each state, we assume that their per state spending was proportional to the relative number of days spent there. This yields the percentage of each expenditure category that an

individual spent in each state (p_{isc}), which is multiplied by their total expenditures to estimate state level spending on a given category (x_{isc}):

$$x_{isc} = p_{isc} * x_{ic}^{T}$$

We then classify an angler as a spending angler in a state if the sum of their estimated expenditures across all categories is greater than 0. Once we have classified anglers, we note the proportion of spending resident anglers (π_s^R) andspending non-resident anglers (π_s^{NR}) and remove non-spending (non)residents from the state sample.

Average Expenditures

We estimated the state level weighted average expenditure ($\bar{x}_{sc}$) for each category as the sum of the weighted state level expenditures across all individuals (even if they spent nothing in a particular category in that state) divided by the state sample n_s:

$$\bar{x}_{sc} = \frac{\sum_{i=1}^{n_s}(x_{isc} * w_i)}{n_s}$$

where w_i is the respondent's previously determined sample weight. We calculated means for residents and non-residents separately, denoted as $\bar{x}_{sc}^{R}$ & $\bar{x}_{sc}^{NR}$ respectively.

State Projections

Resident spending projections (R_{sc}) and non-resident spending projections (NR_{sc}) were produced by multiplying the respective sample average estimate $\bar{x}_{sc}$ by the estimated population of (non)resident angers for the state ($\hat{N}_s^R$) and the estimated proportion of spenders π_s:

$$R_{sc} = \bar{x}_{sc}^{R} * \hat{N}_s^R * \pi_s^R$$

$$NR_{sc} = \bar{x}_{sc}^{NR} * \hat{N}_{sc}^{NR} * \pi_s^{NR}$$

The total spending projection is then the sum of R_{sc} and NR_{sc}. States' total spending models are then fed into an IMPLAN model.

Lake Level Models

Lake-specific spending projections were developed by calculating the proportion of a state's spending that was attributable to each lake and combining those portions on a per lake basis. For example, the impact of Lake Erie is equal to the amount spent on Lake Erie as estimated from Michigan, New York, Ohio, and Pennsylvania respondents. The portion of spending attributable to a lake within a state is estimated based off responses about the days spent fishing each lake from that state. We assume that spending occurred proportional to the relative number of days spent on each lake across all respondents in a state.

Canadian Economic Data

We obtained a summary of angler numbers and estimated expenditures[5] from a 2020 survey conducted by the Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry (Hunt et al., 2022; MNDMNR; August 8, 2022; L. Hunt). There were differences in classifications of Great Lakes; in the US, we separated Lake St. Clair and the St. Lawrence River. In Canada, those two systems were included in Lake Erie and Lake Ontario, respectively (Table 4). Consequently, presentation of tabular results for those lakes should consider the differences in data collection methods.

[5] Canadian estimates are estimates and have not been officially published by MNDMNR. Consequently, values may be different from final Canadian publications and reports.

Of note, the Canadian estimates were for Fisheries Management Zones (FMZ), and not the Great Lakes proper; almost all tributaries and rivers that flow into the Great Lakes were excluded. As provided by L. Hunt with much of this description from Hunt et al. (2022), Canadian estimates were derived as follows:

1. The survey design used a stratified sample with 22 sub populations that varied by residency, license type, and for Ontario residences origins. The basic approach for analysis was to estimate averages for each stratum and multiply these averages by the population for that stratum. This approach assumes that any missing data are well represented by the non-missing data.
2. Expenditures are provided for all fishing activity in Ontario in 2020. These expenditures are attributed to the Fisheries Management Zone (FMZ) scale using the following steps.
    a. We estimated the amount of fishing activity for each individual associated with each FMZ.
    b. We multiplied the expenditures for each individual by the proportion of their fishing activity in each FMZ.
    c. For angling packages, we used the reported waterbodies for these packages and angling package expenditures to each FMZ using steps 1 and 2 if more than one waterbody with an angling package is provided. If the individual reported angling package expenditures, but they did not provide a waterbody for the package, we allocated angling package expenditures using the general fishing activity reports using steps 1 and 2.
3. All expenditures were reported for the household, while fishing activity was reported for an individual. Thus, we accounted for this scale mismatch (and missing data) in the following way:
    a. We had valid expenditure data from four different types of respondents: (i) active anglers who provided location information about fishing activity; (ii) active anglers who did not provide location information about fishing activity; (iii) non-active anglers who reported someone in their household fished in 2020; and (iv) non-active anglers.
    b. We culled group (iv) from the totals to isolate expenditures on households who fished in Ontario in 2020.
    c. We estimated average expenditures for group (i) for all FMZs - this is the only group that has sufficient information to link expenditures to FMZs. We next scaled these expenditures, so that when combined with expenditures from group (iv) they would balance to the known provincial estimated expenditures reported in Hunt et al. (2022). In other words, we assumed that the distribution of expenditures for group (i) was representative of expenditures for groups (ii) and (iii).

Expenditure categories between the US and Canadian data collection varied slightly. Consequently, we created a crosswalk table to categorize US trip and equipment similarly and subsequently collapsed several categories to align with Canadian categories (Table 5). We converted Canadian dollars to 2020 USD equivalent (1 USD = 0. 7457 CAD) and all tables report these values.

To align with Canadian expenditures, summary data are presented in the body of the report. Individual expenditure reports, where applicable, are presented in Appendix D**.**

Table 4. Lakes and rivers included in the analysis of individual Canadian Great Lakes, 2020.

Lake Superior	**Lake Huron**	**Lake Erie**	**Lake Ontario**
	Georgian Bay	Lake St. Clair	Bay of Quinte / Hay Bay
	North Channel	Niagara River	Lake St. Francis
	St. Mary's River	Detroit River	St. Lawrence River
	Lake Wolsey	St. Clair River	Trent Canal
	Lake George	Canard River	Consecon Lake
	Little Lake George	Cedar Creek	Roblin Lake
	Lafontaine Creek		West Lake
			East Lake
			Lake of Mountains
			Butlers Creek

Table 5. US and Canadian expenditure definitions, Canadian categories, and crosswalk determination used to estimate the economic value of the Great Lakes.

US Expenditures	Canadian Expenditures	Canadian Category	Crosswalk
Public land use or access fees (including fees for any land owned by local, state/provincial, or national government	Access fees (e.g., park fees, boat launch fees, fish derby fees)	ACCESS	Combined ACCESS and CAMPING
		ACCESS	
Private land use or access fees (including entrance, privileges, pr admittance fees for fishing on private lands or fishing preserves (Not including leases)	Campsite fees (e.g., private, provincial, national)	CAMPING	
Lodging at hotels, motels, cabins, lodges, campgrounds	Overnight accommodation (e.g., hotels, motels, cottage)	ACCOM	ACCOM
Trip packages (including fees for charters, parties, guides, party boats, outfitters)	Purchases made for fishing from or through a lodge, outfitter, or their agent that includes services such as lodging, food, transportation, and guiding	ANGLING PACKAGE	ANGLING PACKAGE
Boating launching fees	Household-owned boat/watercraft costs (e.g., gas, repairs, moorage, storage, insurance)	BOAT_EQ	BOAT_EQ
Boat fuel		BOAT_EQ	
Boat mooring/storage, maintenance, pump-out, or insurance		BOAT_EQ	
Bass boats	New and used boating equipment (e.g., boats/watercraft, motors, trailers)	BOAT	BOAT
Any type of motor boat (not including bass boat)		BOAT	
Canoes, kayaks, or any other non-motor boat		BOAT	
Boat motors, boat trailers/hitches, or any other boat accessories		BOAT	
Cabins	Land-buildings (e.g., cabins, cottages, land)	BUILD_EQ	BUILD_EQ
Land ownership (in part or whole)		BUILD_EQ	
Land leases (in part or Land leases (in part or whole)		BUILD_EQ	
Heating or cooking fuels such as propane, charcoal, firewood	Camping equipment (e.g., tents, camper trailers)	CAMP_EQ	CAMP_EQ
Camping equipment (such as backpacks, sleeping bags, duffel bags, tents)		CAMP_EQ	
Special fishing clothing (such as foul weather gear, boots, waders, fishing vests)	Fishing-related clothing (e.g., vests, waders)	CLOTH	CLOTH
Rods, reels, poles, and rod making components	Fishing equipment (e.g., rods, reels, fish finders, ice huts)	FISH_EQUIP	FISH_EQUIP
Tackle boxes		FISH_EQUIP	
Creels, stringers, fish bags, landing nets, scales, knives, and gaff hooks		FISH_EQUIP	
Depth finders, fish finders, GPS, and other electronic devices		FISH_EQUIP	
Ice-fishing equipment (such as tip-ups and tilts, ice-fishing houses)		FISH_EQUIP	
Binoculars, field glasses, telescopes		FISH_EQUIP	
Any other gear or equipment primarily used for Great Lakes fishing (such as equipment repair/maintenance, freezers, drones, or airplane rental)		FISH_EQUIP	
Food, drinks, or refreshments	Food (e.g., groceries, restaurant meals, alcoholic beverages)	FOOD	FOOD
Ice		FOOD	
Processing or taxidermy	Other investments (please specify)	OT_EQ	OT_EQ*
Books & magazines		OT_EQ	

Table 5 (Cont.)

Dues or contributions to national, state/provincial, or local Great Lakes oriented conservation or wildlife related organizations		OT_EQ	
Other misc. fishing expenditures		OT_EQ	
Equipment rentals such as boats, fishing or camping equipment	Rentals for fishing (e.g. boats, gear, snowmobiles)	RENT	RENT
Minnow traps, seines, and bait containers	Fishing supplies (e.g., lures, line, tackle, bait)	SUPPL	SUPPL
Bait (live, cut, prepared), not including lures		SUPPL	
Lines & leaders		SUPPL	
Artificial lures, flies, baits, and dressing for flies or lines		SUPPL	
Hooks, sinkers, swivels, and other items attached to a line (except lures and baits)		SUPPL	
Public transportation by airplane	Travel costs within Ontario for recreational fishing (e.g., vehicle expenses including gas and repairs, car rentals, air fares)	TRAVEL	TRAVEL
Public transportation by trains, taxis/rideshare, buses, car rental		TRAVEL	
Private vehicle expenses including gas, tolls, border crossings		TRAVEL	
Pick-ups, campers, motor homes, etc.	New and used special vehicles (e.g., 4x4s, camper, ATV, snowmobiles)	VEH_EQ	VEH_EQ
Off-road vehicles such as a snowmobile, 4-wheeler, 4x4 vehicle, trail bike, or dune buggy		VEH_EQ	

*The other equipment category (OT_EQ) in the United States and Canada are likely not directly comparable.

Estimating Economic Contributions

The interpretation of the results of the economic models depends on the changes that drive the model. The term "economic impact" is normally reserved to describe some level of economic activity that would not occur except for the initial economic activity. In the case of recreational activities like sportfishing, it is generally agreed that economic impact comes from spending by visitors to the region. If not for their presence, their spending would never occur. If quality sportfishing was no longer available in the Great Lakes, for example, non-resident anglers may choose to fish elsewhere, and their spending would not occur in the region and thus not generate additional economic effects in the regional economy. Most resident anglers, on the other hand, choose fishing as an activity on which to spend their recreational dollars locally. If quality sportfishing was no longer available some residents would likely choose some other local recreational activity on which to spend their money in place of fishing and their spending would remain in the regional economy.

It is generally acknowledged that retained economic activity can also represent a real economic impact. For example, the quality of fishing opportunities in the Great Lakes is such that some anglers choose to fish them rather than go elsewhere. If the quality of fishing were to decline, then some dedicated resident anglers may choose to travel outside of the region for sportfishing and their dollars would be lost to the regional economy. It is unclear what portion of resident anglers would fall into that category. In another retention scenario, it may be the case in the Great Lakes region that there are few recreational alternatives to fishing, so that if the quality of fishing as a recreational activity declined, some portion of anglers may choose to travel outside of the state to pursue an alternative recreational activity (e.g., a Caribbean vacation). It was beyond the scope of this study to investigate either of those scenarios.

The focus of Objective 1 was on the total economic activity associated with sportfishing as a measure of its overall contribution to the region's economy. In that case, it was appropriate to include all spending for sportfishing, including both resident and non-resident anglers. That measure is alternately called "economic contribution" or "economic significance", among others. This study was concerned with measuring the economic significance of sportfishing and therefore includes resident spending as part of the direct effect.

An assessment of the economic impacts and significance of the Great Lakes fishery requires estimates of all sportfishing activity and the spending by anglers that is associated with that activity as discussed above. Total angler expenditures are then analyzed with a model of the Great Lakes regional economies to determine the total contribution that angler spending has on the respective economies, including the multiplier effect. The extent of the economic contributions associated with spending for outdoor recreation can be estimated in two ways:

- **Direct effects**: These include the jobs, income and tax revenues that are tied directly to the spending by outdoor recreationists without including multiplier effects.

- **Total effects**: These include the jobs, income and tax revenues that are tied directly to the spending by outdoor recreationists plus the jobs, income and tax revenues that result from the multiplier effects of outdoor recreation spending. The multiplier effect occurs when a direct purchase from a business leads to increased demand for goods and services from other businesses along their supply chain. Also included is economic activity associated with household spending of incomes earned in the affected businesses.

The economic contributions from recreational fishing activities, both direct effects and total effects, were estimated with input-output (I/O) models for the state/Provincial, regional, and lake-level economies of the Great Lakes. IMPLAN models specific to the region were utilized to generate the economic contributions of U.S. anglers. IMPLAN was developed by MIG, Inc. originally for use by the U.S. Forest Service. Inherent in each IMPLAN model is the relationship between the economic output of each industry (e.g., sales) and the jobs, income and taxes associated with a given level of output. Through those models, it is possible to determine the jobs, income and taxes supported directly by outdoor recreationists with and without the multiplier effects. Similarly, an I/O model specific to Ontario Province was utilized to generate the economic contributions of Canadian anglers.

Input-output models describe how sales in one industry affect other industries. For example, once a consumer makes a purchase, the retailer buys more merchandise from wholesalers, who buy more from manufacturers, who, in turn, purchase new inputs and supplies. In addition, the salaries and wages paid by these businesses stimulate more benefits. Simply, the first purchase creates numerous rounds of purchasing. Input-output analysis tracks the flow of dollars from the consumer through all the businesses that are affected, either directly or indirectly.

To apply the I/O models, each specific expenditure for recreational fishing activities was matched to the appropriate industry sector affected by the initial purchase. The spending was estimated with models of Great Lake state economies; therefore, all of the resulting contributions represent salaries and wages, total economic effects, jobs and tax revenues that occur within each state. Likewise, models based on specific regions or counties represent the economic effects within the selected region or county. The results do not include any economic activity or indirect contributions that leak out of the state or region of interest. As a result of this leakage, economic contributions at the state level are larger than the sum of corresponding regional contributions. This occurs because a portion spending in a particular region (or lake) leak to other regions (or lakes) within the state, and this within-state leakage is captured in the overall model.

Commercial Fishing

Commercial Landings and Revenue

Commercial revenue is defined as the direct estimated revenue earned from the sale of fish by commercial vessels, which is a function of commercial landings measured in pounds and the average wholesale price per pound for the sale of that fish. For the U.S., commercial species landings and ex-vessel price data were obtained through NOAA Fisheries online commercial fisheries statistics queries. We used 2018 NOAA commercial landings data for the Great Lakes to derive our estimates[6]. These same data were obtained from the Ontario Commercial Fisheries' Association for the Province[7]. For commercial harvest, or landings, revenues, category-level spending breakouts are not needed as the revenues received by commercial fishermen were applied as-is in the economic modeling process, which is standard procedure for commercial fishing economic impact analyses.

Commercial Impacts

The commercial landings revenue does not include the additional revenues generated as that harvest moves from fish houses to processors, distributors, retail and restaurants. However, the additional economic impacts associated with moving the harvested fish through the entire value chain (i.e., the processors, distributors, retailers) to the final consumer is included in the estimated impacts of the commercial fishery.
The 2020 U.S. commercial fisheries impacts were generated using an online economic modeling tool available from NOAA Fisheries based on the 2019 Fisheries Economics of the United States. This model, built using the IMPLAN modeling system, which was also employed for the recreational impacts, allows the generation of economic contributions for seafood in general and not for Great Lake fisheries landings, specifically. Ratios were calculated for the commercially landed harvest of all species combined from the Great Lakes and effects from imported fish were excluded. The assumption is made that the multiplier effects, or the ratio of impacts created per pound of product, is equivalent to the multiplier effects for all seafood, finfish and shellfish. To the extent that this approach under- or over-estimates the impacts unique to the Great Lakes fisheries, the results reported here are similarly affected.

Similar to recreational contributions, Stats Canada provided support to model the Ontario commercial fisheries economic contributions. Similar to the NOAA fisheries model, the Stats Canada model relies on supply and use tables, which track the linkages across the Provincial economy. Economic contributions were mapped and quantified as the harvested fish move through the entire value chain.

[6] Dr. J. Dettmers indicated 2018 is the most current year available and it was sufficient to complete the objective of this project (April 27, 2022).
[7] https://www.ocfa.ca/fisheries-industry/fisheries-statistics

Objective 2. To determine the economic value held by the U.S. and Canadian publics for the Great Lakes fishery, including use and non-use values, and including the values held for the fishery's role in the ecosystem.

Willingness to Pay for Great Lakes Fishing Trips

We included several questions in the angler survey related to the anglers' most recent trip to fish the Great Lakes (Table 6). We used the contingent valuation method (CVM) to estimate the willingness to pay for a fishing trip (Boyle, 2017; Haab et al. 2020). Our survey design builds on the traditional dichotomous choice CVM approach to valuing a recreation trip. The first such study with a trip cost payment vehicle may be Cameron and James (1987), who presented two simple questions to British Columbian saltwater anglers. In this question format, survey respondents who had already taken a trip were asked about their trip costs and then a counterfactual about higher trip costs. A large number of studies have since used this approach to value outdoor recreation trips. For example, Neher et al. (2017) asked river rafting participants four separate questions with changes in trip costs at different river flow levels.

For this section, we describe the data from the CVM component of the survey of Great Lakes anglers. We then conducted an analysis that resulted in an estimated willingness to pay for the most recent Great Lakes fishing trip. The willingness to pay estimate is appropriate for benefit-cost analyses of policies that might change the number of trips taken. We use the willingness to pay estimates to estimate the aggregate economic value of Great Lakes fishing trips in the U.S.

Most recent trip variable descriptions

We focused this analysis on a sample size of n = 8,425 anglers who answered the willingness to pay and the related follow-up questions. Most of the open-ended response variables are top-coded at the 99th percentile of the distribution to minimize the impact of outliers and careless responses. For example, the number of nights stayed away from home is top-coded at the 80th percentile. Other responses were recoded to be consistent with previous answers. For example, if the reported number of people in the travel party is 0 then this is recoded to 1 since the question asked the respondent to include themselves. The item nonresponse rate for variables in the CVM component of the survey ranges from 2.4% (miles traveled) to 22% (cost of the most recent trip) (Table 6).

Respondents were first asked about the distance traveled on their most recent Great Lakes fishing trip (excluding distance traveled on the water). The average distance was 118 miles with a minimum of zero and a maximum of 980. The most recent trip was a day trip for 69% of the respondents who answered the question. Of those who took an overnight trip, the average number of nights spent away from home is 6.7 with a minimum of 1 and a maximum of 80.

The average number of people in the travel party was 3.07 with a minimum of 1 and a maximum of 84. The average number of people in the fishing party was 3.13 with a minimum of 1 and a maximum of 69. Sixty-two percent of respondents fished with members of their immediate family, 21% fished with their extended family, 57% fished with friends and colleagues, 6% fished with pets, and 1% fished with an organized group (such as a club or church group). Forty-six percent of respondents fished from a private boat and 12% fished from a charter boat. Twenty-five percent fished from the shore and 8% fished from a pier. Six percent took an ice fishing trip. September was the most common month of the most recent fishing trip (21%) with 17% in August and 16% in October. The average amount of time spent fishing on the trip is 599 minutes with a minimum of 30 and a maximum of 3,599. Overall, 88% of respondents stated that the most recent trip was a typical trip.

Table 6. Variables and descriptive statistics for the angler willingness to pay model.

Variable	Label	N	Mean	Std Dev	Min	Max
Miles	one way distance traveled (miles)	8,227	118.2	168.75	0	980
Day trip	day trip (nights = 0)	8,129	0.69	0.46	0	1
Nights	nights spent away from home	2,582	7.06	11.39	1	80
Travel party	travel party size	8,158	3.06	2.79	0	84
Fishing party	fishing party size	5,743	3.13	2.23	0	69
Immediate family	fished with immediate family	5,456	0.62	0.48	0	1
Extended family	fished with extended family	5,456	0.21	0.41	0	1
Friends	fished with friends and colleagues	5,456	0.57	0.50	0	1
Pets	fished with pets	5,456	0.06	0.23	0	1
Groups	fished with organized group	5,456	0.01	0.11	0	1
Private boat mode	mode: private boat	8,275	0.46	0.50	0	1
Charter boat mode	mode: charter boat	8,275	0.12	0.32	0	1
Shore mode	mode: shore	8,275	0.25	0.43	0	1
Pier mode	mode: pier	8,275	0.08	0.26	0	1
Ice fishing mode	mode: ice	8,275	0.06	0.23	0	1
January	most recent fishing trip month	6,906	0.06	0.23	0	1
February	most recent fishing trip month	6,906	0.03	0.16	0	1
March	most recent fishing trip month	6,906	0.01	0.12	0	1
April	most recent fishing trip month	6,906	0.02	0.13	0	1
May	most recent fishing trip month	6,906	0.03	0.18	0	1
June	most recent fishing trip month	6,906	0.08	0.27	0	1
July	most recent fishing trip month	6,906	0.11	0.31	0	1
August	most recent fishing trip month	6,906	0.17	0.37	0	1
September	most recent fishing trip month	6,906	0.21	0.40	0	1
October	most recent fishing trip month	6,906	0.16	0.36	0	1
November	most recent fishing trip month	6,906	0.08	0.27	0	1
December	most recent fishing trip month	6,906	0.06	0.23	0	1
Time	time spent fishing (minutes)	6,872	599.04	654.68	30	3,599
Typical	typical fishing trip	6,732	0.88	0.32	0	1
Trip cost	most recent fishing trip cost	6,590	$278	$496	$0	$3,000

Willingness to pay variable descriptions

The willingness to pay question section began by asking respondents for the cost of the most recent fishing trip to help frame the willingness to pay question. The average reported most recent trip cost is $278[8] with a minimum of $0 and a maximum of $3,000. Two-hundred seventy-nine respondents answered 0 and 1,835 respondents did not answer the question. Since this is a large fraction of the respondents who answered the willingness to pay question (22%), we investigated the differences in willingness to pay responses between those who answered the trip cost question and those who did not below.

Next, respondents are presented with a hypothetical situation: “Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $A more than the amount

[8] This amount is different than average per angler spending because the question was framed differently (spending on last trip, includes all spending), as part of the willingness to pay section of the survey. Also, overall sample size was smaller for this portion, likely because of survey fatigue.

you just reported?" Respondents could answer "yes", "no" or "I don't know". The randomly assigned cost amounts, $A, were developed from a review of the literature conducted by Poe et al. (2013). Poe et al. review 22 studies that estimate the economic value (i.e., willingness to pay) of a Great Lakes fishing trip. The average value is $53.9 with a standard deviation of 23.4. The values range from 24.9 to 123.2. We use 6 values from this distribution including the mean, the mean minus 1 and 2 standard deviations and the mean plus 1, 2, and 3 standard deviations (rounded to the first digit). The randomly assigned additional cost amounts are $7, $31, $54, $77, $101, and $124. The ave,rage additional cost amount presented to respondents is $66. For those respondents who answered the trip cost question, the average randomly assigned additional cost amount is $65 which is 23% of the stated cost of the most recent trip.

Overall, 56% of the respondents answered "yes" to the willingness to pay question, 20% answered" no" and 23% answered "I don't know". The willingness to pay responses broken down by the cost amount are presented in Table 7. The percentage of respondents who state that they would still have taken the fishing trip with the higher cost amount is 81% at the lowest additional cost amount and declines monotonically to 40% at the highest cost amount. The differences in proportions are statistically significant when each of the response categories is considered separately and when the "no" and "I don't know" responses are combined according to the chi-square statistic ($p<0.05$).

Table 7. "Yes" response of anglers for willingness to pay question related to whether they would take their trip, based on increased cost.

	Survey Response				
Cost	No	Maybe	Yes	Total	% Yes
$7	70	187	1,089	1,346	81%
$31	176	332	931	1,439	65%
$54	261	347	828	1,436	58%
$77	351	384	681	1,416	48%
$101	412	344	669	1,425	47%
$124	435	380	548	1,363	40%
Total	1,705	1,974	4,746	8,425	56%

χ^2 [yes vs. no, I don't know] (df) = 606.60 (5)

χ^2 [yes vs. no vs I don't know] (df) = 695.90 (10)

Respondents who answered "yes" were asked a qualitative certainty question: "How sure are you that you would still have taken this trip?" The answer options were 1-very sure, 2-somewhat sure, and 3 -not very sure. Eighty-four percent of respondents who answered "yes" stated that they were "very sure" that they would still take the trip. Fourteen percent stated that they were somewhat sure and less than 1% stated that they were not very sure. The proportion of those who were very sure about still taking the trip is 90% at a cost of $7 and decreases monotonically to 82% at $124.

Hypothetical bias exists when responses to hypothetical behavior questions in surveys does not match actual behavior. There is much past research to suggest that respondents who answer "very sure" in willingness to pay follow-up questions are more likely to actually behave that way in a real situation (Penn and Hu, 2018). A common technique to mitigate hypothetical bias is to recode "yes" responses to responses if the respondent is not "very sure" about their answer. Following this recode, 48% of the respondents would still take the trip. The percentage of respondents who state that they are very sure that they would still have taken the fishing trip with the higher cost amount is 73% at $7 and declines non-monotonically to 33% at $124. The proportion is 39.7% at $77 and 39.9% at $101. The differences in proportions are statistically significant when the "no" and "I don't know" responses are combined and considered separately, as above.

Respondents who answered "no" to the willingness to pay question were asked: "What do you think you would you have done instead of taking this trip?" Twenty-six percent state that they would have stayed home, 37% would have fished in another location, 34% would have done something outdoors other than fishing and

3% said that they would do something else. Respondents who answered that they would do something else are provided with an open-ended response box and many of these responses suggest the hypothetical situation is not realistic or that they could have answered one of the other categories. Many of these responses could be described as a "protest no".

Willingness to pay model

The economic theory behind the willingness to pay estimation begins with the utility function, $v(y \mid x)$, where y is income, $x = 1$ indicates the trip was taken and $x = 0$ indicates the trip was not taken.[9] Each respondent in the sample indicates by revealed preference that taking the most recent fishing trip would yield expected utility greater with the trip than without:

(1) $$v(y - c \mid x = 1) > v(y \mid x = 0)$$

where c is the cost of the trip.

Each respondent in the sample is put in the counterfactual situation of considering whether they would have still taken the most recent trip if the cost was higher, where A is the additional cost amount. The respondent would have taken the trip if utility with the additional costs and a fishing trip is greater than utility with no trip and no trip cost:

(2) $$v(y - c - A \mid x = 1) \geq v(y \mid x = 0)$$

If the utility with the trip is less than the utility without the trip the respondent would not have taken the trip:

(3) $$(y - c - A \mid x = 1) < v(y \mid x = 0)$$

Willingness to pay (WTP) for the trip is the dollar amount that equates utility with and without the fishing trip

(4) $$v(y - c - WTP \mid x = 1) = v(y \mid x = 0)$$

To estimate WTP with a dichotomous choice regression model (e.g., logit, probit) first suppose that respondents have a linear in parameters utility function, $v = \alpha + \beta y$, where α is the utility from a fishing trip and β is the marginal utility of income (Hanemann 1984). Since $\alpha = 0$ when $x = 0$The change in utility for which we observe trips is

(5) $$\Delta v = \big(\alpha + \beta(y - c - A)\big) - (\beta_0 y)$$

and

$$\Delta v = \alpha + (\beta - \beta_0)y - \beta c - \beta A$$

The probability that the respondent would take the trip is

(6) $$\Pr(\Delta v \geq 0) = \Pr(\alpha + (\beta - \beta_0)y - \beta c - \beta A + e)$$

[9] Note that we assume that the only alternative to taking a trip is not taking a trip. As described above, this is counterfactual as some respondents would have taken a trip to other locations and some respondents would have done something else. Since the survey questions are limited by survey space, we did not collect enough information to model this more complex choice situation. We investigate the sensitivity of our results to the expanded list of alternatives in the empirical results section.

where e is an error term. The model can be simplified by assuming that the marginal utility of income is constant across utilities with and without the fishing trip so that $\beta - \beta_0 = 0$. Theoretically the coefficients on cost per trip and the change in the cost per trip should be equal. But, the actual cost per trip is endogenous (and measured with error) so its inclusion in the model is econometrically difficult. If c is omitted from the model it will not affect estimation of the marginal utility of income since the randomly assigned cost amount, A, is exogenous and not correlated with c, which is captured by the error term.

With these two assumptions, we estimate a simple model

(7) $\Pr(\Delta v \geq 0) = \Pr(\alpha - \beta A + e)$

The probability function is operationalized with the logistic regression model:

(8) $\Pr(\Delta v \geq 0) = \frac{1}{1+\exp(-\Delta v)}$

With a linear functional form for utility the mean (and median) WTP estimate is the cost amount that makes the probability that the change in utility is equal to 0.50 (Hanemann, 1984). In other words, the angler is indifferent between paying more and taking the trip and not taking the trip (and paying nothing). Setting $Pr(\cdot) = 0.5$ yields

(9) $WTP = -\frac{\alpha}{\beta}$

The standard errors of WTP are estimated with the Delta function (Cameron 1991). Another welfare measure described in Hanemann (1984) is the truncated WTP. The WTP estimate in (9) allows for negative WTP when the probability of a "yes" response at a cost amount of zero is less than one. The truncated WTP welfare measure is:

(10) $WTP' = -\frac{1}{\beta}\ln(1 + \exp(\alpha))$

Hanemann (1987) shows that WTP'/WTP increases from close to 1 when the probability of a "yes" response when the cost amount is zero is 0.95 to almost 4 when the probability is 0.55. Note that the probability of a "yes" response should be equal to one when the cost amount is zero unless the object of valuation is a bad (instead of a good).[10]

General Population Valuation Survey

The purpose of the valuation survey was to determine the economic value held by the U.S. and Canadian publics for Great Lakes fisheries, including values held by recreational anglers and others. Stated preference methods are employed to understand how values and management preferences vary across socio-demographic sectors (age, gender, race/ethnicity, income, etc.). A referendum discrete choice experiment (Boyle et al. 2016; Giguere, Moore and Whitehead, 2020) was designed to estimate the value of various management measures that affect Great Lakes fisheries catch rates.

The sample of the general public included users (e.g., anglers) and non-users of the Great Lakes fisheries. Stated preference demand models were employed to quantify the economic values that these two groups hold for Great Lakes fisheries management. A number of stated preference studies have been conducted for Great Lakes resources (e.g., Knoche and Lupi, 2016; Zhang and Sohngen, 2018; Howard et al. 2017; Hunt et al., 2021; Lauber et al., 2020; Raynor and Phaneuf, 2020; Ready et al. 2018). Only Whitehead et al. (2009) have

[10] When the probability of a yes response is less than 0.50 ($\alpha < 0$) equation (9) will be negative. In this case, a common solution is to estimate the log functional form of equation (7). With our data the linear and log forms provide similar statistical fit so we proceed with the linear form.

considered the preferences of non-users. A consideration of non-users is important since this demographic may have significant economic values relative to users and non-users are a major portion of the voting public. Online surveys can use either probability-based or non-probability (i.e., opt-in, convenience) based samples of respondents. Internet surveys with opt-in panel samples are less expensive than probability-based samples and likely the least expensive of all survey modes. The drawback of opt-in panel data is that it may be of relatively low quality as some lowly compensated opt-in panel respondents pay little attention to the details of the valuation questions. Johnston et al. (2017) assert that high quality samples use probability-based sampling and the Dillman method, with repeated contacts, for internet surveys. Probability-based internet panels are more expensive, but respondents may pay more attention to the surveys and may generate higher quality data.

We developed the general population survey using the Qualtrics platform (Appendix C) and purchased a sample of Great Lakes and Ontario residents from Dynata[11], a market research company that was formed by merger between Research Now and Survey Sampling International in 2017. Dynata provides opt-in survey samples for academic and marketing research. Online survey responses have been found to yield similar results to more traditional survey modes (Lindhjem, 2011).

We estimated the distribution of benefits and costs for the fishery attributes. Alternative measures of the benefits are segmented on age and income groups for which we find important differences (Loomis 2011). Geographic distribution of benefits and costs can be determined considering the "distance-decay" literature (e.g., Hanley, et al. 2003, Bateman et al. 2006). These studies have found that economic values for a natural resource diminish with distance from a resource. This is due to several reasons. First, the farther away the resource the fewer on-site visits the household will take to the resource. Second, the farther away the greater the cost of obtaining information about the resource. These are reasons that drive use and non-uses, respectively. Instead of employing travel distance to fishing sites we stratify the sample to include approximately 50% coastal counties and 50% of residents of other counties. We consider differences in coastal and non-coastal willingness to pay values and find that the distance-decay relationship is inverted.

We also investigated two other important valuation issues. First, we consider survey respondent choice strategies that have been shown to significantly affect economic values. Stated preference studies have demonstrated attribute non-attendance, where survey respondents ignore certain attributes in an attempt to simplify complex choice tasks (Hensher, Rose and Greene 2005). Attribute non-attendance can lead to biased willingness to pay estimates. Approaches have been developed to identify and mitigate attribute non-attendance (Lew and Whitehead 2020). Stated attribute non-attendance models use respondents' own admissions of ignoring attributes. Inferred attribute non-attendance models use results from preference heterogeneity models to estimate those who ignore attributes. Several empirical strategies have been developed to incorporate these methods into valuation models. We test a number of these models and find that a simple inferred model generates superior results.

All stated preference data are prone to hypothetical bias due to incentive incompatibility, yea-saying and other common survey maladies. Hypothetical bias is a general term that describes differences between stated and revealed preferences. Hypothetical bias is pervasive in contingent valuation (Hausman 2012, Haab et al. 2013) but has also been identified in discrete choice experiments (Taylor, Morrison, and Boyle 2010; Fifer, Rose and Greaves 2014). Several approaches have been developed to mitigate hypothetical bias in contingent valuation (Loomis 2014, Penn and Hu 2018). Vossler and Watson (2013) and Carson, Groves, and List (2014) find that consequential surveys can lead to unbiased valuation estimates. There is a growing choice experiment literature that applies hypothetical bias mitigation approaches from the stated preference literature (Broadbent 2014; List, Sinha and Taylor, 2006; Ladenburg and Olsen 2014; Bosworth and Taylor 2012; Ready, Champ, and Lawton 2010, Howard et al. 2017). In this study we tested the effects of consequentiality, cheap talk, honesty priming and certainty scales on the magnitude and variance (e.g., scale) of economic values in a pilot survey.

[11] www.dynata.com

Recently, Whitehead, et al. (2021), in a single-bound referendum question, found that opt-in survey responses do not pass validity tests while probability-based responses do in a single-bound contingent valuation survey. Giguere, Moore, and Whitehead (2020) found that opt-in data does not pass validity tests when only the first question is used in the analysis, but the multiple question data does pass validity tests when considering attribute non-attendance. Sandstrom et al. (2021) compare two opt-in panels, MTurk and Qualtrics, with a mixed mode mail/internet sample and repeated referendum questions. They found that each sample produces valid results but there are differences in the survey responses to the program cost and scope variables across samples. Following this literature, we developed our survey using repeated referendum questions and employ ANA methods when validity issues arise.

Survey pretest

Following a review of the literature and other Great Lakes recreation studies, a valuation survey was developed during 2021.[12] Respondents are asked questions about their knowledge of the Great Lakes and Great Lakes fisheries. Respondents are asked if they participated in water-based recreational activities during the past 12 months. Anglers are then asked for the water bodies visited and the number of trips to each water body.

The survey introduces a hypothetical "Great Lakes Fishery Management Plan". The first screen states that the "plan would develop and implement policies to control aquatic invasive species, reduce industrial water pollution, reduce agricultural water pollution, restore coastal wetlands and support fisheries management activities". Each of these policies are briefly described followed by a question asking whether the respondent supports the policy.

Respondents are introduced to the 8 target species that are important from the GLFC angler survey. These are described as warm water (perch, black bass, walleye, and pike) and cold water (salmon, steelhead, lake trout and other trout) species (sauger was targeted by only 3% of anglers in the angler survey and is not mentioned). Respondents are then asked how much they know about each fish. Following this knowledge question is a question that asks about support for the goal of the plan and the sustainable harvest is defined. The payment vehicle is described as a one-time tax increase and respondents are asked if they would support a tax increase to fund the plan. Then, respondents are asked several questions that are designed to allow them to become familiar with the stated preference referendum questions. Then the referendum is described, and respondents are told they will be asked for their referendum vote.

The next section of the questionnaire considers various hypothetical bias mitigation approaches. There are five treatments, and each respondent is randomly assigned one of these. Two of these treatments include a perceived consequentiality question which is paired with the cheap talk (will you vote like it is real?) and oath (will you answer honestly?) questions. Two of the treatments include the cheap talk and oath questions without the consequentiality question. The final treatment includes the consequentiality question by itself. We test whether cheap talk and honesty priming influence the hypothetical votes and whether cheap talk and oath answers are influenced by the consequentiality question.

Each stated preference question is framed as a referendum with a tradeoff between decreases in the sustainable harvest (at a cost of $0) and maintaining the sustainable harvest at a positive cost amount. There are 11 sets of referendum scenarios with each respondent answering 6. There are 8 single species questions, each respondent answers 4 randomly assigned questions. One purpose of these questions is to determine if respondents differentiate among the species and if this depends on their prior knowledge. It is expected that single species harvest declines have many substitutes so that the willingness to pay to avoid the decline will be lower than when there is harvest declines with other species in the warm or cold water groups. The range of cost amounts is randomly selected from the $10 to $100 range and is different for each single species.

[12] The pretest survey, raw data, and data summaries can be accessed here: http://bit.ly/GLFC2022.

Respondents then answer 1 of 2 species group questions and one referendum question with all species considered. The range of cost amounts for the species group questions is $10 to $500. The pattern of the questions is for respondents to answer the single species questions first, followed by the warm or cold water question and then the warm and cold water species questions. The range of cost amounts for the all species question is $10 to $1000.

Debriefing questions are presented next. Respondents are asked how much they considered each of the attributes when they voted. These responses could be used in sensitivity analysis (attribute non-attendance models). Respondents who state that they will vote in favor of the policy are presented with a budget reminder and asked how certain they are that they would do so. Recoding responses other than "very certain" to a vote against the policy is an ex-post hypothetical bias mitigation approach. Other debriefing questions provide information about whether the respondent understood the information presented in the survey, their confidence in government, if they believe the results will be shared with government, if they believe the results could affect decisions, if they answered the questions honestly, if they answered as if it were a real referendum, if they believed their own taxes would rise and if the survey was biased. If respondents feel the survey is biased, they are asked to explain why.

The final section of the questionnaire contains demographic questions: birth year (which is used to validate the earlier age question), marital status, education, race, employment status, voting behavior, political party and income.

The survey was pretested with 432 U.S. Great Lakes residents in July 2021. We made three major revisions to the final survey based on the results. We found no differences in responses based on the ex-ante hypothetical bias treatments so focused the final survey on achieving consequentiality. We did not find significant effects of the harvest reduction variables so we simplified these questions so that respondents could more easily focus on the differences. We developed a range of cost amounts based on a model with the pretest data. In particular, we truncated the range of cost amounts based on the amount that drove the probability of a yes amount to zero in a linear probability model.

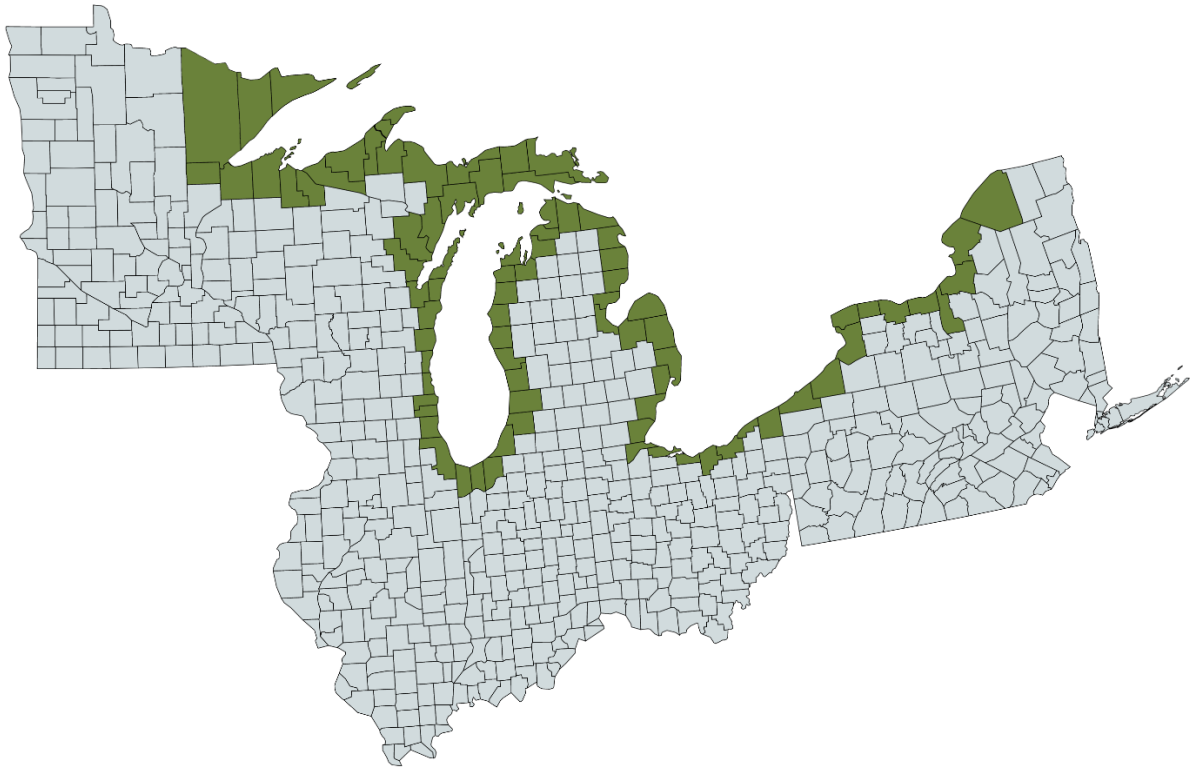
Final Survey Sampling

The sample was composed of the eight Great Lakes states and Ontario, Canada. The target sample for these two regions was based on overall population. The Great Lakes states with 85 million people comprise about 85% of the total sample and Ontario, with 15 million people, comprised 15% of the total sample.

Minnesota, Michigan, and Wisconsin have over 50% of the state population in the coastal counties. For these states the goal was to achieve a 50/50 split in sample between coastal and non-coastal counties (Figure 3). The other Great Lakes states have coastal populations that range from 3% to 35% of the state population. For these we tried to achieve as much sample in the coastal counties as possible, but no more than 50%.

The target sample size for each state (within the 85% of the total sample for the U.S.) is roughly based on the midpoint of, 1) the percentage of the overall sample in coastal counties, and 2) the percentage of the overall sample within the states. States that might have less than a sample size of 100 in this scheme are increased to 100. The remaining state targets are reduced accordingly. The targets for state samples were Illinois – 20%, Indiana – 8%, Michigan – 20%, Minnesota – 8%, New York – 12%, Ohio – 12%, Pennsylvania – 8%, Wisconsin – 12%. The sample was balanced on gender and age categories at the state level.

Figure 3. Great Lake coastal counties used for general population valuation survey, 2020. Ontario residents represented 15% of the sample, not pictured.



Final Survey Questions and Data Description

The general population survey was fielded in November 2021.[13] Dynata survey participants initially saw the informed consent screen. The survey was determined to be exempt from Appalachian State University Institutional Review Board oversight due to the lack of sensitive or risky questions. Researcher contact information was provided but no questions about the research were received.

Respondents are initially asked about their state of residence, categorical age (e.g., between 18 and 24) and zip code. Respondents who indicated that they lived in a U.S. state other than one of the Great Lakes states or a province of Canada other than Ontario are sent to the termination page. One-thousand seven-hundred twelve Dynata panelists were Great Lakes region residents and completed the survey. In order to increase data quality, we deleted any respondent who provided an age that was not +/- one year away from 2021 minus their birth year (which was asked at the end of the survey) and provided an income category that was inconsistent with the income screener question (n=17 and n=93, respectfully). One respondent provided a zip code that was outside the range of state zip codes, 7 respondents did not answer the income question and 1 respondent did not answer the political ideology question. Once these responses were deleted from the data, 1593 Great Lakes state and Ontario residents remain for the analysis.

Fifteen percent of the sample is from Ontario (n=240). Sixteen percent of the sample is from Illinois (n=222), 8% from Indiana (n=114), 17% from Michigan (n=234), 9% from Minnesota (n=121), 10% from New York (n=138), 12% from Ohio (n=158), 11% from Pennsylvania (n=143) and 16% from Wisconsin (n=223). Forty-seven percent of U.S. residents are from coastal counties. Stratification weights are developed so that the weighted population is representative in terms of coastal and state residence.

[13] The final survey, raw data, and data summaries can be accessed here: http://bit.ly/GLFC2022.

Introduction and Recreational Use

The introductory section of the survey began with a statement that the study was funded by the GLFC and a list of the duties of the GLFC could be obtained from http://glfc.org/about. The GLFC logo was placed at the top of this page. The next page also contained the GLFC logo and described the objective of the survey, its policy relevance and how results will be disseminated. The purpose of this information was to establish that the survey is consequential (Johnston et al. 2017).

Respondents were then told that the Great Lakes consist of Lake Erie, Lake Huron, Lake Michigan, Lake Ontario and Lake Superior, their tributaries and connecting waters. Respondents were then asked questions about their knowledge of the Great Lakes. Respondents who knew more than nothing about the Great Lakes were asked how much they know about Great Lakes recreational fisheries and whether the recreational fisheries are improving, deteriorating, or staying the same. Respondents who had an opinion about the health of Great Lakes recreational fisheries were asked whether different economic sectors and human activities had negative, positive, or no impact on fisheries.

To decompose total values into use and non-use values, respondents were asked questions about recreational use of the Great Lakes. Respondents were asked if they participated in water-based recreational activities during the past 12 months.

A "Great Lakes Fisheries Management Plan"

The next section of the survey introduced a hypothetical "Great Lakes Fisheries Management Plan" that would be developed by the Great Lakes states and Ontario. The first screen stated that the "plan would implement policies to control aquatic invasive species, reduce industrial water pollution, reduce agricultural water pollution, restore coastal wetlands and support fisheries management activities". Each of these policies were briefly described. Respondents were then asked if they support various government activities to implement the policies.

This was followed by a section that described the fish species that would be affected by the fishery management plan. These were described as warm water (perch, black bass, walleye, and pike) and cold water (salmon, steelhead, lake trout and other trout) species. Respondents were able to click on links that took them to web pages that contained information about each fish from the Michigan Department of Natural Resources. Respondents were then asked how much they know about each fish.

The specifics of the fishery management plan were then described. First is a question that asked about support for the goal of the plan: "achieve well-balanced and productive fish populations in the Great Lakes in order to maintain the sustainable harvest of warm water and cold water species." The sustainable harvest was defined for the respondent as "the amount of fish that can be caught and kept each year without resulting in a decline in the fish population".

Respondents were told that the plan would be costly, and the payment vehicle was described as a one-time increase in state and Provincial taxes. Respondents were asked if they would support a tax increase to fund the plan. We chose a one-time payment schedule because a one-time tax increase is easier for respondents to understand and avoids complications associated with discounting future values (Howard, Whitehead and Hochard, 2021). A one-time payment is likely to lead to conservative willingness to pay estimates.

Then, respondents were asked several questions that are designed to allow them to become familiar with the stated preference referendum questions. Respondents were told that bag limits and size limits would be used to reduce catch rates if the sustainable harvest could not be maintained. Sixty-five percent of respondents said that they read this instruction page very closely, 30% said they read it somewhat closely and 5% said they read it not very closely.

Respondents are presented with a table to illustrate the referendum scenario: without the fishery management plan there would be a 50% reduction in the recreational catch of, in this case, cold water species. With the plan there would be no change in the catch. Sixty percent of respondents said that they read this instruction page very closely, 35% said they read it somewhat closely and 5% said they read it not very closely.

To help respondents understand a percentage decrease, they were presented with a bar chart that shows 10%, 20%, 30%, 40% and 50% reductions in catch rates relative to 10 fish. We then asked respondents a question about how many fish would be caught, relative to 10, if a randomly assigned percentage decrease in catch rates due to a combination of catch limits. Each respondent received one of the five randomly assigned reductions. Sixty-five percent of respondents answered this question correctly. For example, they answered 9 fish if they were given a 10% decrease in catch rates.

Respondents were told that the cost of the plan was uncertain based on the decrease in recreational catch to be avoided and the number of policies and regulations used. The survey stated that the one-time tax increase would range from $10 to $250. The example table from the previous question is repeated with the cost amount ($100) displayed in the bottom row. Fifty-seven percent of respondents said that they read this instruction page very closely, 36% said they read it somewhat closely, and 7% said they read it not very closely.

The referendum was than described, and respondents were told they will be asked for their referendum vote. Sixty-four percent of respondents said that they read this instruction page very closely, 30% said they read it somewhat closely and 6% said they read it not very closely. The pairwise correlation coefficients for each of the "closely" variables range from $r = 0.65$ to $r = 0.75$, suggesting there was a minority of respondents who did not read any of the instructions closely.

Following the pretest results, we focused our ex-ante hypothetical bias mitigation strategy on "cheap talk" and "honesty priming" (Jacquemet, et al., 2011). We included a short cheap talk script: "In studies like this it is often the case that more people say they would vote in favor of the policy than actually do when in a real referendum." Then we added an honesty priming statement: "While the voting questions are hypothetical, we ask that you answer them just like you would if there were real referendum votes." We followed this with an "oath" question. Eighty-four percent of respondents said that they will try to answer the hypothetical voting questions just like if they were real referenda.

Referenda

Each stated preference question was framed as a referendum with a tradeoff between decreases in the sustainable harvest (at a cost of $0) and maintaining the sustainable harvest at a positive cost amount. For each type of fish (warm vs. cold water species), there varied two attributes; 1) The size of the catch reduction, which had 5 levels (10, 20, 30, 40, 50 percent reduction in the absence of the program), and 2) The one-time household cost, which had 7 levels ($10, 50, 90, 130, 170, 210, 250). From this, we created an efficient design of 15 choices, which we blocked into 5 blocks of 3 choices each. Thus, the total design consists of 30 choices (15 with reductions to warm water species and 15 with reductions to cold water species). Each respondent is presented with 6 total choices, 3 that involve warm water species reductions and 3 with cold water species reductions. Choice order within each block was randomized, as was which species type was presented first.

Following each of the six scenarios, respondents were asked "How would you vote in this situation?" Answer categories were "I would vote in favor of the plan", "I would vote against the plan", and "I don't know how I would vote". If respondents stated that they would vote in favor of the plan they are presented with a budget reminder and asked a follow-up certainty question that allows for an ex-post hypothetical bias mitigation approach: "How certain are you that you would actually vote in favor in this situation if it were a real referendum?" Answer categories were "very certain", "somewhat certain" and "not certain at all."

Debriefing questions

Attribute non-attendance is an issue in stated preference studies where survey respondents do not pay complete attention to the variation in the level of choice attributes presented (Lew and Whitehead 2020). We asked respondents to state how much attention they paid to each of the attributes. Fifty-seven percent of respondents paid a lot of attention to the amount of the one-time tax increase, 28% paid some attention, and 15% said they did not pay much attention to the attribute (i.e., not much, none). Thirty-one percent paid a lot of attention to the decrease in warmwater recreational fish catch, 43% paid some attention and 26% did not pay much attention. Thirty-two percent paid a lot of attention to the decrease in cold water recreational catch, 41% paid some attention, and 27% did not pay much attention.

Respondents are then asked standard stated preference debriefing questions. Eighty-four percent state that they strongly agree or somewhat agree with a statement that they understood all of the information presented to them about the hypothetical situations. Fifty-eight percent strongly or somewhat agree with the statement that they have confidence in the ability of the government to manage Great Lakes recreational fisheries. Eighty-one percent strongly or somewhat agree with the statement "I believe the results of this survey will be shared with the Great Lakes Fisheries Commission …" and 78% strongly agree or somewhat agree with the statement "I believe the results of this survey could affect decisions …". Seventy-three percent agree that the survey will be shared and will affect decisions and believe that the survey is consequential (Carson and Groves, 2007; Mohr et al., 2021).

Two other debriefing questions were designed to investigate the extent of potential hypothetical bias. Eighty-nine percent of respondents "answered the hypothetical questions just like [they] would if they were real referenda" and 69% "think that my own taxes would actually increase …".

Finally, we asked respondents whether they agree or disagree that "this survey is biased." Nineteen percent agree that the survey is biased, 36% neither agree nor disagree, 37% disagree and 8% do not know.

Empirical Model

The economic theory behind the willingness to pay estimation for the total economic value analysis parallels the analysis for anglers with several differences. First, since we are estimating the willingness to pay for a broader good, we extend the utility model beyond the utility for a single fishing trip. Second, we make a distinction between use and passive use value. Passive use values are those held by households who do not enjoy the resource on-site (i.e., do not take fishing trips).

Again, we begin with the utility function, $v(c, y, q)$, where c is the cost of a fishing trip, y is income, and q is the sustainable harvest of warm and coldwater species. The willingness to pay to avoid decreases in the sustainable harvest is the total economic value, TEV:

(1) $$v(c, y - TEV, q) = v(c, y, q')$$

where $q > q'$. Passive use value, PUV, is that portion of TEV that is not associated with on-site use. One way to define this is by imposing the choke price in equation (1) (Madariaga and McConnell 1987):

(2) $$v(c^*, y - PUV, q) = v(c^*, y, q')$$

Since $TEV = UV + PUV$, where UV is use value, use value is the willingness to pay for access as defined in the angler analysis. This definition excludes the possibility that resource users hold passive use values. So, we distinguish differences in values held by resource users and nonusers with split-sample models in the empirical analysis (Whitehead et al. 1995).

Each respondent is presented with a randomly assigned tax amount and compares utility with and without the policy when considering their referendum votes:

(3) $v(c, y - t, q) \gtrless v(c, y, q')$

Similar to the angler analysis, in order to estimate TEV with a dichotomous choice regression model (e.g., logit, probit) first suppose that respondents have a linear in parameters utility function, $v = \alpha + \beta c + \delta y + \gamma q$. The change in utility

(4) $\Delta v = v(c, y - t, q) - v(c, y, q')$

and

$\Delta v = \alpha + \beta c + \delta(y - t) + \gamma q - (\alpha + \beta c + \delta y + \gamma q')$

Assuming constant marginal utility across states of the world equation (4) simplifies to:

(5) $\Delta v = -\delta t + \gamma(q - q')$

The probability of a vote in favor of the policy is

(6) $\Pr(\Delta v \geq 0) = \Pr(-\delta t + \gamma(q - q') + e)$

where e is an error term. Increases in the tax amount has a negative effect on the change in utility and the probability of a vote in favor of the policy. Decreases in the sustainable harvest without the policy have a negative effect on the change in utility.

The probability function is operationalized with the logistic regression model:

(7) $\Pr(\Delta v \geq 0) = \frac{1}{1+\exp(-\Delta v)}$

With a linear functional form for utility the mean (and median) TEV estimate is the tax amount that makes the probability that the change in utility is equal to 0.50 (Hanemann, 1984). Setting $Pr(\cdot) = 0.5$ yields the marginal value for a change in the sustainable harvest

(8) $\frac{dTEV}{dq\prime} = -\frac{\gamma}{\delta}$

The standard errors of WTP are estimated with the Delta function (Cameron, 1991).

The linear utility function and the assumption of constant marginal utility impose a functional form without a constant term. This implies that a linear total economic value function that is increasing in scope with a zero intercept. However, this functional from may be too restrictive in that it may impose a steeper slope on the total value function than is observed in the data. Adding a constant, α, to (6) provides a statistical test about whether the total value function is linear with zero intercept. If the constant is statistically significant then:

(9) $TEV = -\left(\frac{\alpha+\gamma(q-q')}{\delta}\right)$

Due to improved statistical fit we focus the empirical analysis on the log-linear approximation of the utility difference:

$$(10) \quad \Delta v = \alpha - \delta lnt + \gamma ln(q - q')$$

The mean total economic value is undefined in a logistic regression. The median total economic value estimate is

$$(11) \quad TEV = exp\left(-\left(\frac{\alpha+\gamma ln(q-q')}{\delta}\right)\right)$$

The median is the amount for which 50% of respondents would vote in favor. The log-linear model also facilitates the estimation of scope elasticity as the negative ratio of the scope and tax coefficients, $\varepsilon_q = -\frac{\gamma}{\delta}$ (Whitehead, 2016).

Objective 3. To understand how values and management preferences vary across socio-demographic sectors and project how public values and demands, including fisheries funding preferences, may change, by matching with projections of the region's future population.

We used the US respondents from the Objective 2 general population survey (n = 1,450) to complete this objective. Age, race/ethnicity, income, and zip code were collected, so we used those data to establish a baseline of regional values and management preferences across the socio-demographic sectors. To determine percent urban residents, we applied the zip codes to the USDA-Rural Urban Commuting Area Codes[14] and consolidated classifications to, 1) Urban, 2) Suburban, and 3) Small Town/Rural.

We used 2010 demographic information as a surrogate for 2020 (most recent year available) and created regional values projections over the next 20 years, using Census data and the National Population Projections from the Weldon Cooper Center for Public Service at the University of Virginia[15].

We used 2020 fishing license sales data (n = 8.8 million) to generate age, gender, and % urban to determine regional demographic statistics[16]. In that dataset, ethnicity and income were not available. To create regional expenditure projections, we used a baseline angler estimate of 1.1 million unique anglers because spending across gender and age classes were combined across the eight Great Lakes states.

Finally, state level samples were recombined to determine average expenditure by age and sex. Respondents were grouped into age ranges, and each expenditure category was consolidated as, 1) Trip, 2) Equipment, and 3) Real estate. We then determined the total mean expenditure for these expenditure groupings, their mean expenditure by gender, and their mean expenditure by gender and age range. These were then used to project future spending based on anticipated demographic trends.

[14] Rural-Urban Commuting Area Codes, updated 2019.
[15] Weldon Cooper Center for Public Service, National Population Projections.
[16] Wisconsin's data privacy laws precluded us from obtaining zip code information for the entire license population, so we used the survey sample (n=25,000) as a surrogate.

RESULTS:

Objective 1. Economic contributions of the recreational and commercial fisheries.

Overall Recreational Fishing

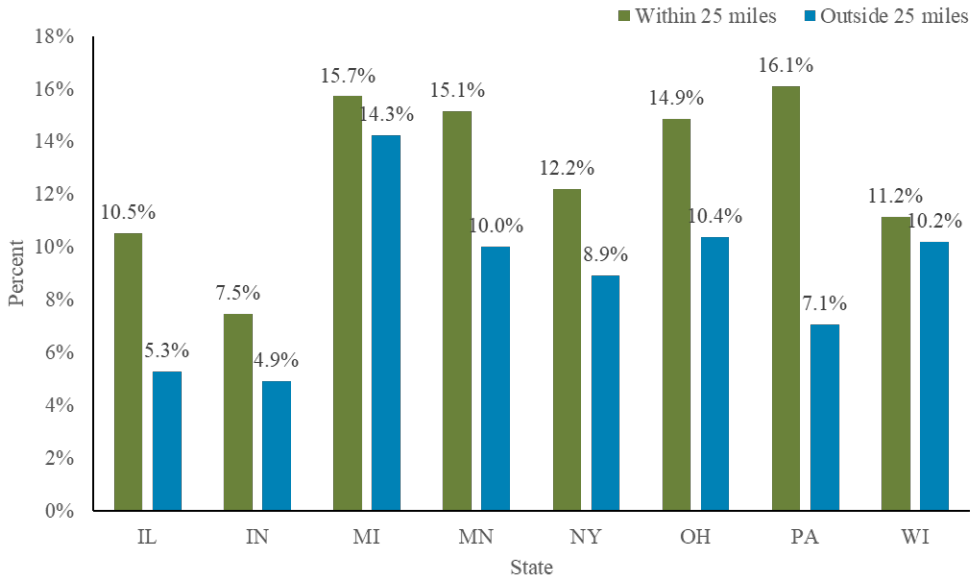
Response Rate

We emailed 209,645 survey invitations to 2020 fishing licensees (18 years of age and older) across the eight Great Lakes states and received 18,514 completed replies. Response rate varied depending on mode of contact, state, and strata (Table 8). In most cases, recipients who lived within 25 miles of a Great Lake and received an advance notification postcard responded at slightly higher rates. We received an additional 1,479 responses (979 email, 500 paper) from the abbreviated survey, which resulted in an adjusted response rate of 10.6% (12.7% inside 25 miles, 8.7% outside 25 miles). We found no meaningful differences among the five modes of contact, so we combined the primary and abbreviated survey samples into one dataset (n = 19,993; Figure 4).

Table 8. Response rates by state and strata for the three modes of survey distribution.

	Advanced Email (n = 4,800)		Email (n = 209,645)		Web Push (n = 4,750)	
State	Outside 25 miles	Within 25 miles	Outside 25 miles	Within 25 miles	Outside 25 miles	Within 25 miles
Illinois	8.0%	13.0%	4.7%	10.3%	3.0%	4.3%
Indiana	8.2%	4.8%	4.2%	6.7%	3.0%	4.7%
Michigan	12.8%	29.4%	12.7%	12.6%	5.7%	5.7%
Minnesota	12.0%	13.1%	8.6%	11.7%	4.7%	7.3%
New York	13.3%	18.6%	7.8%	10.3%	4.7%	5.0%
Ohio	9.7%	9.6%	9.3%	13.3%	3.3%	3.3%
Pennsylvania	5.3%	22.3%	6.5%	13.6%	2.7%	4.0%
Wisconsin	11.0%	11.7%	8.7%	9.5%	6.7%	6.0%
Total	10.1%	15.2%	7.6%	10.9%	4.2%	5.0%

Figure 4. Overall response rates (all survey modes combined), state and strata.



Angler Demographics

Our sample was comprised of 82% male and 18% female respondents, which was skewed slightly towards males as compared to the population (77%M/23%F). Average age of respondents was 49.9 years (males = 51.1, females = 44.4), which was slightly older than the population (46.2M/42.5F). Consequently, we applied a rake weighting procedure to reflect those differences. Overall, 53% (n = 10,595) indicated they fished at least one of the Great Lakes during the 2020 season. Of those, 78% had a resident annual license, 2% resident daily, and 9.9% each had a non-resident annual or non-resident daily license. These proportions were not different from the license population ($\chi 2 = 0.998$, $P = 0.802$).

The average angler started fishing at 9.7 years old, has fished for 31.4 years, and fished for 38.5 days in 2020. Great Lakes-specific anglers started at a slightly younger age (9.2), have fished for 32.9 years, and spent 45 days fishing in 2020. A majority of Great Lakes anglers indicated they had intermediate (34%) or fairly advanced (44%) fishing skills. Only 3.4% of respondents self-identified as beginners.

Angler Estimates

Overall, we estimated that 1.1 million unique US-licensed anglers fished at least one of the Great Lakes (or their tributaries) in 2020 (Table 9). Because individuals fished multiple lakes within a state, we estimated that during the 2020 fishing season, just over 1.4 million licensed anglers fished a Great Lake or tributary (Table 10). The most popular lake was Erie (566,511), followed by Michigan (353,790), and Ontario (228,488) (Table 11).

Table 9. Estimated number of unique licensed anglers in the Great Lakes, 2020.

	Unique Anglers		
State	Resident	Non-Resident	Total
Illinois	53,055	5,155	58,210
Indiana	16,870	7,830	24,700
Michigan	228,511	7,312	235,824
Minnesota	30,289	2,923	33,211
New York	102,735	68,269	171,004
Ohio	242,780	78,808	321,587
Pennsylvania	106,478	10,254	116,731
Wisconsin	105,794	27,808	133,602
Total	886,511	208,359	1,094,869

Table 10. Estimated number of total licensed anglers in the Great Lakes (or their tributaries), 2020.

	Total Anglers		
Great Lake	Resident	Non-Resident	Total
Erie	466,099	100,412	566,511
Huron	75,866	2,504	78,369
Michigan	310,199	43,592	353,790
Ontario	129,963	98,525	228,488
Superior	83,677	10,490	94,167
Lake St. Clair	52,558	9,618	62,176
St. Lawrence River	32,859	12,779	45,638
Total	1,151,220	277,919	1,429,139

Table 11. Estimated number of total licensed anglers by state of launch and Great Lake, 2020.

	Great Lake						
State of Launch	Huron	Erie	Michigan	Ontario	Superior	Lake St. Clair	St. Lawrence River
Illinois			58,210				
Indiana			24,700				
Michigan	78,369	61,131	145,669		31,968	62,176	
Minnesota					33,211		
New York		67,061		228,488			45,638
Ohio		321,587					
Pennsylvania		116,731					
Wisconsin			125,212		28,988		
Total	78,369	566,511	353,790	228,488	94,167	62,176	45,638

Overall Great Lakes Fishing Participation

The average time that individuals fished the Great Lakes ranged from 15.9 to 27.2 days, which yielded a lake-adjusted estimate (Lake*mean N days) of 34.1 million angler days. St. Lawrence River (15.9) and Lake St. Clair (16.3) anglers fished the fewest number of days, and Lake Erie anglers the most (27.2), followed by Lake Michigan (25.3) (Table 12). For species targeted, apart from bass on the St. Lawrence River (72%), anglers most often fished for either walleye/sauger or salmon (Table 13). Anglers also indicated they spent the most days fishing for 'anything that bites', regardless of location (Table 14). Other species were infrequently fished and generally included sturgeon, catfish, and rough fish. There was also some variation in the number of days fished for the lakes that included more than one state (Table 15).

Table 12. Average number of days fished by Great Lake anglers, 2020.

*Great Lake / Tributary**	*Sample n*	Avg. Days Fished	Std. Dev.	Std. Error	95% LCLM	95% UCLM
Lake Erie	2,964	27.1	36.61	0.69	25.8	28.4
Lake Huron	189	20.3	24.74	1.97	16.8	23.8
Lake Michigan	2,557	24.4	35.97	0.73	23.0	25.8
Lake Ontario	600	21.1	35.79	1.53	18.2	24.0
Lake Superior	979	17.5	25.90	0.84	15.9	19.1
Lake St. Clair	98	19.2	25.34	2.61	14.2	24.2
St. Lawrence River	77	19.2	26.02	3.24	13.4	25.0
Overall	10,595	28.9	39.47	0.42	28.1	29.7

*We used anglers who only fished one water body to generate these percentages.

Table 13. Fish species targeted by Great Lakes anglers, by lake, 2020.

	Great Lake*						
Species	Erie	Huron	Michigan	Ontario	Superior	Lake St. Clair	St. Lawrence River
Perch	51%	49%	36%	30%	13%	43%	53%
Black Bass	28%	31%	31%	37%	13%	36%	65%
Walleye/Sauger	63%	59%	27%	21%	39%	53%	37%
Salmon	4%	16%	48%	44%	40%	4%	4%
Steelhead	30%	12%	34%	33%	29%	5%	1%
Lake Trout	11%	17%	34%	26%	50%	4%	7%
Other Trout	15%	15%	27%	32%	32%	3%	13%
Pike	11%	31%	20%	19%	23%	25%	51%
Any Fish	7%	11%	8%	4%	8%	6%	9%
Other Fish	6%	6%	8%	11%	6%	11%	13%

*We used anglers who only fished one water body to generate these percentages.

Table 14. Average number of days fished by species and lake, 2020.

	Great Lake						
Species	Huron	Ontario	Michigan	Erie	Superior	Lake St. Clair	St. Lawrence River
Perch	13.6	17.5	12.0	12.8	11.0	10.7	12.6
Black Bass	12.2	17.6	17.9	18.1	15.0	19.0	15.6
Walleye/Sauger	16.3	14.5	14.9	15.8	12.5	14.1	19.9
Salmon	12.3	9.7	12.0	13.9	11.0	*	2.2
Steelhead	18.8	12.9	14.7	15.9	10.8	3.3	3.0
Lake Trout	10.1	10.1	11.5	16.5	11.5	1.0	9.7
Other Trout	13.9	14.6	14.6	18.0	11.8	5.0	8.2
Pike	12.4	16.9	16.1	17.2	12.7	9.6	16.9
Any Fish	26.0	19.4	11.6	17.1	11.1	29.5	2.4
Other Fish	12.4	18.6	17.9	19.7	14.6	16.4	14.8
Overall	20.3	21.1	24.4	27.1	17.5	21.9	19.2

*No data, likely indicates minimal fishing activity.

Table 15. Average number of days fished, by state of launch, 2020.

	Great Lake						
State of launch*	Huron	Ontario	Michigan	Erie	Superior	Lake St. Clair	St. Lawrence River
Illinois			20.9				
Indiana			30.2				
Michigan	20.3		23.7	17.2	15.5	19.2	
Minnesota					16.1		
New York		21.1		23.4			19.2
Ohio				24.5			
Pennsylvania				30.9			
Wisconsin			18.5		17.8		

*Average number of days fished is higher than Table 14 because days were added for individual respondents in each state. For example, if a person fished on Lake Erie in Ohio for 2 days and in Pennsylvania for 5 days, they fished a total of 7 days on Lake Erie.

Expenditures

In 2020, the estimated 1.1 million unique US anglers spent $3.8 billion on sportfishing activities, including trip spending, fishing-related equipment, and real estate purchase and leases. Almost two-thirds (65%, $2.4 billion) of the total was for equipment. Of the remaining $1.4 billion, $679 million was spent on trip-related expenditures, and $693 million was spent on real estate purchases or leases (Table 16). Individual expenditures varied based on state of launch, with Michigan anglers spending the most ($1.27 billion) and Indiana anglers the least ($83.7 million, Table 16). Among trip expenditures, the most money was spent on boat-related fees ($206.8 million), food ($149.6 million), and travel ($110.3 million). Equipment expenses, which are viewed as more durable and used on multiple trips, were dominated by boat purchases ($1.2 billion), vehicles ($682.5 million), and fishing equipment ($265.9 million, Table 17).

Using data provided by the Ministry of Natural Resources, Ontario anglers in 2020 spent $286 million fishing the Great Lakes. Combined spending for the United States and Canada during 2020 was $4.1 billion dollars (Table 16). Although the overall amounts were lower, the patterns of spending were similar for Canadian residents, as boat fees ($37.7 million), food ($15.6 million), and transportation ($21.5 million) were the top 3 spending categories. Similarly, boat purchases ($81.3 million), fishing equipment ($21.3 million), and vehicles ($20.7 million) comprised the top three expenditure categories (Table 17).

Overall, $726.8 million was spent on real estate in both countries with most ($704.3 million) spent in the United States. Real estate expenditures in 2020 were particularly high for Michigan ($446.5 million), which skewed average per angler spending to $5,371.47 for that state. As a smaller percentage of individuals purchase real estate, their overall impact within the model is limited.[17] As current real estate prices are inflated, we opted to highlight trip and equipment expenditures from the regional perspective.

On average, US anglers spent $2,792.87 (range = $1,636.20 (IL) to $3,478 (MI)) fishing the Great Lakes in 2020, not including real estate expenditures. Canadian anglers spent an average of $1,059.82 pursuing fish in the Great Lakes. Daily expenditures for trip and equipment (no real estate) also varied (mean = $96.64), with New York anglers spending the least ($73.17) and Minnesota anglers the most ($153.65) (Table 18).

[17] Purchases of existing structures or land are mostly a transfer of assets and generate little economic contributions except for the fees paid to real estate agents, leasing agents and financial institutions. Appropriate adjustments were applied to total annual spending on real estate prior to the IMPLAN modeling to isolate only the portion of the spending that generates economic activity.

Table 16. Total spending (in millions), by state/Province and expenditure category for Great Lakes anglers, 2020.

	Expenditure (millions)			
State/Province	Trip	Equipment	Real Estate	Total
Illinois	$19.16	$76.08	$.22	$95.47
Indiana	$8.05	$65.50	$10.12	$83.67
Michigan	$165.64	$654.55	$446.53	$1,266.72
Minnesota	$13.33	$72.45	$41.0	$126.78
New York	$88.82	$208.96	$67.57	$365.34
Ohio	$205.01	$877.08	$103.81	$1,185.90
Pennsylvania	$51.45	$214.95	$18.55	$284.95
Wisconsin	$71.16	$265.63	$16.53	$353.32
Ontario	$107.18	$155.87	$22.45	$285.51
US Total	$622.62	$2,435.21	$704.32	$3,762.15
Canadian Total	$107.18	$155.87	$22.45	$285.51
Grand Total	$729.80	$2,591.09	$726.77	$4,047.66

Table 17. Great Lakes angler expenditures (in millions) by category and state/Province, 2020.

	State										
Trip Expenditures (millions)	IL	IN	MI	MN	NY	OH	PA	WI	US Total	Ontario	Grand Total
Food, Ice	$5.74	$2.35	$41.38	$4.04	$22.84	$41.84	$13.79	$17.60	$149.57	$15.55	$165.11
Lodging	$1.46	$.47	$27.13	$1.52	$19.01	$24.26	$3.35	$13.80	$90.98	$9.52	$100.50
Airfare, Public and private transportation	$4.23	$1.68	$31.86	$2.79	$17.23	$29.81	$10.48	$12.23	$110.29	$21.45	$131.74
Guides	$2.27	$.42	$12.20	$.81	$9.63	$19.32	$3.31	$9.0	$56.97	$9.80	$66.77
Public and private land use fees	$.38	$.18	$2.84	$.18	$1.71	$1.35	$.31	$1.10	$8.05	$13.10	$21.15
Boat launching, boat fuel, boat mooring	$5.08	$2.96	$50.24	$4.0	$18.40	$88.44	$20.21	$17.43	$206.76	$37.74	$244.50
Other trip (Canada only)										$.03	$.03
Subtotal	$19.16	$8.05	$165.64	$13.33	$88.82	$205.01	$51.45	$71.16	$622.62	$107.18	$729.80

	State										
Equipment Expenditures (millions)	IL	IN	MI	MN	NY	OH	PA	WI	US Total	Ontario	Grand Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$11.47	$5.55	$67.89	$7.90	$29.22	$76.82	$26.66	$40.39	$265.90	$21.26	$287.16
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$5.56	$2.92	$32.55	$2.98	$16.59	$39.98	$15.87	$17.32	$133.76	$15.39	$149.15
Camping gear, Heating & cooking fuel	$1.26	$.38	$7.65	$1.01	$2.78	$5.33	$2.06	$2.49	$22.95	$10.21	$33.15
Special fishing clothing, foul weather gear	$1.67	$.86	$10.11	$1.18	$5.32	$10.23	$5.30	$5.23	$39.91	$5.16	$45.07
Equipment rental	$.88	$.10	$3.08	$.37	$2.71	$4.51	$1.48	$1.58	$14.70	$1.78	$16.48
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$1.59	$.57	$8.47	$1.58	$2.66	$8.17	$3.66	$2.96	$29.66	$.11	$29.77
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$32.93	$27.67	$303.67	$36.99	$98.88	$538.34	$100.15	$107.18	$1245.80	$81.25	$1327.05
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$20.74	$27.46	$221.12	$20.45	$50.81	$193.70	$59.79	$88.48	$682.53	$20.73	$703.26
Cabins, Land purchased for fishing, Land leased for fishing	$.22	$10.12	$446.53	$41.0	$67.57	$103.81	$18.55	$16.53	$704.32	$22.45	$726.77
Equipment Subtotal	$76.08	$65.50	$654.55	$72.45	$208.96	$877.08	$214.95	$265.63	$2,435.21	$155.87	$2,591.09
Real Estate Subtotal	$.22	$10.12	$446.53	$41.0	$67.57	$103.81	$18.55	$16.53	$704.32	$22.45	$726.77
Grand Total	$95.47	$83.67	$1266.72	$126.78	$365.34	$1185.90	$284.95	$353.32	$3,762.15	$285.51	$4,047.66

Table 18. Average annual and per day spending for US and Canadian Great Lakes anglers during the 2020 fishing season. Canadian effort data was not available to create a per day spending estimate.

		Mean expenditure/person (mean / per day)				
State	Est. Anglers	Trip	Equipment	Real Estate	Overall	Trip and Equipment
Illinois	58,210	$329.17 ($15.67)	$1,307.03 ($62.24)	$3.84 ($0.18)	$1,640.04 ($78.10)	$1,636.20 ($77.91)
Indiana	24,700	$325.77 ($13.52)	$2,651.90 ($110.04)	$409.71 ($17.00)	$3,387.38 ($140.56)	$2,977.67 ($123.55)
Michigan	235,824	$702.40 ($27.76)	$2,775.58 ($109.71)	$1,893.49 ($74.84)	$5,371.47 ($212.31)	$3,477.98 ($137.47)
Minnesota	33,211	$401.48 ($25.09)	$2,181.58 ($136.35)	$1,234.42 ($77.15)	$3,817.48 ($238.59)	$2,583.06 ($161.44)
New York	171,004	$519.39 ($21.82)	$1,221.96 ($51.34)	$395.11 ($16.60)	$2,136.46 ($89.77)	$1,741.35 ($73.17)
Ohio	321,587	$637.48 ($29.11)	$2,727.36 ($124.54)	$322.79 ($14.74)	$3,687.64 ($168.39)	$3,364.85 ($153.65)
Pennsylvania	116,731	$440.72 ($14.94)	$1,841.43 ($62.42)	$158.92 ($5.39)	$2,441.07 ($82.75)	$2,282.15 ($77.36)
Wisconsin	133,602	$532.65 ($28.79)	$1,988.23 ($107.47)	$123.70 ($6.69)	$2,644.58 ($142.95)	$2,520.88 ($136.26)
US Total	1,094,869	$568.67 ($19.68)	$2,224.20 ($76.96)	$643.29 ($22.26)	$3,436.16 ($118.90)	$2,792.87 ($96.64)
Ontario	248,211	$431.83 (no data)	$627.99 (no data)	$90.46 (no data)	$1,150.27 (no data)	$1,059.82 (no data)

Economic contributions

In addition to the economic activity directly attributable to the initial stimulus, spending by anglers, there are the multiplier effects (indirect and induced effects) of that consumer spending. The indirect effect results from the increased economic activity among businesses that supply those businesses selling directly to the anglers. For example, the charter that sells directly to anglers, in turn, stimulates additional activity among the businesses that supply the charter's operations. The induced effect is the economic activity produced by household spending of income earned by workers in those businesses that are impacted by both the direct and indirect effects. The total economic contributions reflect the collective effect of the direct retail spending as well as the multiplier effect.

In the strictest sense, the direct effect does not always equate with angler spending due to economic leakages. In certain cases, the amount of angler spending is the direct effect. For example, spending for lodging and restaurant meals represents purchases of goods and services that are produced entirely where they are bought, and the entire purchase is captured in the direct effect on the regional economy. Because a portion of the equipment purchased by anglers is manufactured outside of the state, some of the dollars spent by anglers in the region leak immediately beyond the state's borders and do not have a direct effect on the regional economy. In that case, angler spending may not equal direct effect in the language of input-output models.

Table 19 shows five types of economic contributions associated with retail spending by recreational Great Lakes anglers, which are replicated at the state and lake levels in their respective sections. Again, economic contributions include:

- **Output**: Total volume of economic activity within the local economy that is related to recreational fishing on the Great Lakes. Because it does not discount the value of raw materials as they move through the production of goods or services, this measure double-counts a portion of the output of the industries in the value chain.
- **GDP:** This represents the total "value added" contribution of economic output made by the industries involved in the production of outdoor recreation goods and services. For a given industry, value added equals the difference between gross output (sales and other income) and intermediate inputs (goods and services imported or purchased from other industries). It represents the contribution to GDP in a given industry for production related to outdoor recreation. Unlike the measure of output, this metric accounts for the flow of materials though the value chain to avoid the potential for double-counting.
- **Jobs**: Total jobs in all sectors of the economy supported as a result of recreational Great Lakes fishing and includes both full-time and part-time jobs. These are not just the employees directly serving anglers or manufacturing their goods but can also include employees of industries impacted by the direct, indirect and induced effects.
- **Wages**: Total salaries and wages paid in all sectors of the regional economy as a result of recreational Great Lakes fishing. These are not just the paychecks of those employees directly serving recreators or manufacturing their goods, it also includes portions of the paychecks of all employees affected by the direct, indirect and induced effects. For example, it would include a portion of the dollars earned by the truck driver who delivers food to the restaurants serving anglers and the accountants who manage the books for companies down the supply chain, etc.
- **Tax Revenue**: Including all forms of personal, business and excise taxes, the IMPLAN model estimates the tax revenues collected by the local, state and federal governments as a result of the initial expenditures by outdoor recreators.

Great Lakes Regional Economic Contribution

The $4.1 billion of direct spending by Great Lakes anglers in the United States and Canada generated $1.06 billion of household income to 20,300 full- and part-time employees and proprietors who worked in the Great Lakes businesses whose products were purchased by anglers. Spending in the US accounted for 18,900 jobs and $1.0 billion of income. Spending by Canadian anglers accounted for 1,400 jobs and $51.7 million of income.

This spending contributed $491.1 million in Federal and State/Local tax revenues, $1.5 billion to GDP, and $2.8 billion to direct economic output. For US anglers, spending was highest in Michigan and accounted for 9,900 of the jobs and $588.4 million of income.

Including both direct and multiplier effects, that same $4.1 billion of spending by Great Lake anglers produced $1.9 billion of household income supporting 35,800 full and part time jobs and contributed $2.8 billion to GDP and $770.8 million in tax revenue (Table 19).

Table 19. Economic contributions of all spending for recreational fishing on the Great Lakes in 2020, by state/Province.

	Illinois	Indiana	Michigan	Minnesota	New York	Ohio	Pennsylvania	Wisconsin	U.S. Region Total	Ontario Province	Grand Total
Direct effects											
Output (millions)	$45.7	$41.6	$1,445.2	$56.3	$147.7	$524.8	$148.7	$198.3	$2,608.3	$148.6	$2,756.9
GDP (millions)	$26.5	$21.6	$725.8	$29.9	$94.6	$297.7	$85.9	$107.6	$1,389.6	$75.7	$1,465.3
Income (millions)	$15.6	$11.2	$588.4	$18.1	$61.5	$181.1	$57.1	$72.9	$1,005.9	$51.7	$1,057.6
Employment (thsds)	0.3	0.2	9.9	0.4	1.2	3.9	1.3	1.7	18.9	1.4	20.3
Federal taxes (millions)	$3.7	$2.9	$108.6	$4.1	$13.3	$41.4	$12.4	$15.2	$201.6	$13.3	$214.9
State/Provincial & local taxes (millions)	$5.4	$4.2	$119.5	$5.6	$19.3	$61.2	$15.5	$18.0	$248.7	$27.5	$276.2
Multiplier effects											
Output (millions)	$39.4	$30.1	$1,258.8	$48.7	$109.3	$467.7	$134.4	$155.9	$2,244.3	$127.4	$2,371.7
GDP (millions)	$22.7	$16.0	$666.0	$26.8	$68.9	$256.2	$77.6	$84,8	$1,219.0	$70.4	$1,289.4
Income (millions)	$12.8	$8.4	$475.5	$16.3	$41.1	$138.7	$48.7	$52.8	$794.3	$38.1	$832.4
Employment (thsds)	0.2	0.2	8.8	0.3	0.6	2.6	0.8	1	14.5	0.9	15.4
Federal taxes (millions)	$2.9	$2.0	$88.7	$3.5	$8.7	$30.8	$10.1	$10.8	$157.5	$3.8	$161.3
State/Provincial & local taxes (millions)	$2.2	$1.4	$56.4	$2.8	$7.1	$23.8	$7.0	$8.2	$108.9	$7.9	$116.8
Total effects											
Output (millions)	$85.1	$71.6	$2,704.0	$104.9	$257.0	$992.5	$283.1	$354.2	$4,852.4	$276.1	$5,128.5
GDP (millions)	$49.2	$37.5	$1,390.8	$56.7	$163.5	$554.1	$163.5	$192.4	$2,607.8	$146.1	$2,753.9
Income (millions)	$28.4	$19.6	$1,063.9	$34.5	$102.6	$319.9	$105.8	$125.7	$1,800.4	$89.8	$1,890.2
Employment (thsds)	0.5	0.4	18.7	0.7	1.8	6.6	2.1	2.7	33.5	2.3	35.8
Federal taxes (millions)	$6.6	$4.9	$197.5	$7.6	$22.0	$72.3	$22.5	$25.9	$359.3	$17.1	$376.4
State/Provincial & local taxes (millions)	$7.6	$5.6	$177.2	$8.3	$26.2	$85.5	$22.5	$26.2	$359.1	$35.3	$394.4

Lake Erie

Participation

In 2020, we estimated over 550,000 US anglers fished Lake Erie and its tributaries[18], with more than half (57%) launching from Ohio (Figure 5). Overall, 18% of Lake Erie anglers fished with a non-resident license, with the lowest percentage fishing in Michigan (4%) and the highest percentage in Ohio (25%) (Figure 6). In total, anglers spent an average of 27 days fishing on Lake Erie, which equated to 15.4 million total days. Walleye/sauger were pursued by the highest percentage of anglers (65%, 6.4 million days), followed by yellow perch (52%, 3.9 million days), and steelhead (35%, 3.3 million days) (Table 20).

By state, walleye/sauger were pursued most often by anglers who launch from Michigan (74%, 923,000 days) and Ohio (73%, 4 million days), while Pennsylvania anglers pursued steelhead at higher rates, as compared to the other states (48%, 928,000 days). Nearly half of Lake Erie anglers who launched from New York pursued bass (47%, 713,000 days) (Table 21).

Figure 5. Lake Erie angler numbers and percent of total, 2020.

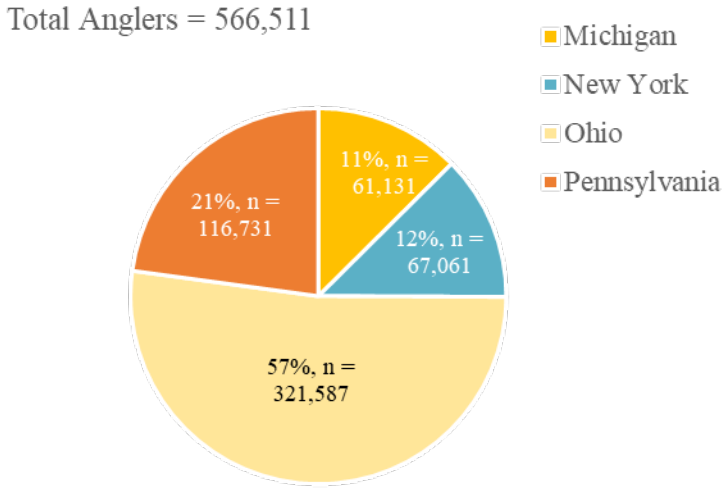
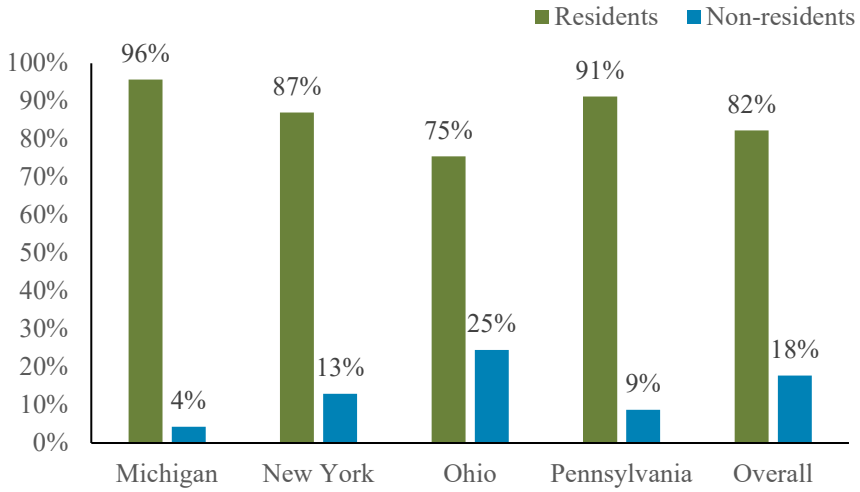


Figure 6. Percentage of resident and non-resident anglers on Lake Erie, by state, 2020.



[18] Per Dr. Len Hunt, an estimated 83,516 individuals fished Lake Erie in Canadian waters. This includes Lake St. Clair and the St. Clair River.

Table 20. Lake Erie species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

	Residents				Non-Residents				Overall			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Yellow perch	52%	244,236	13.2	3,223,915	37%	37,454	6.9	258,429	51%	289,487	12.8	3,705,434
Black bass	29%	133,770	18.5	2,474,754	24%	23,998	12.2	292,780	28%	160,323	18.1	2,901,838
Walleye/Sauger	63%	292,244	16.2	4,734,356	68%	67,778	11.7	793,000	63%	357,468	15.8	5,647,999
Salmon	4%	18,644	14.6	272,202	5%	5,121	9.0	46,089	4%	23,227	13.9	322,855
Steelhead	30%	141,228	15.7	2,217,281	22%	21,588	18.5	399,387	30%	167,687	15.9	2,666,226
Lake trout	12%	53,601	16.9	905,864	5%	5,121	6.0	30,726	11%	62,316	16.5	1,028,217
Other trout	15%	71,779	17.6	1,263,315	7%	7,029	27.6	193,995	15%	83,277	18.0	1,498,988
Pike	11%	51,271	17.4	892,114	5%	5,121	11.6	59,403	11%	59,484	17.2	1,023,119
Anything	7%	32,627	17.4	567,709	3%	3,414	4.3	14,680	7%	37,956	17.1	649,051
Other	7%	31,229	20.2	630,819	2%	1,908	11.0	20,986	6%	35,690	19.7	703,097
Overall		466,099	28.1	13,097,389		100,412	16.3	1,636,708		566,511	27.1	15,352,443

Table 21. Lake Erie species pursued, number of anglers, average days fished, and total fishing days, by state, 2020.

	State															
	Michigan				New York				Ohio				Pennsylvania			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Perch	57%	34,723	9.0	312,504	39%	26,221	15.5	406,423	54%	172,692	10.5	1,813,268	51%	59,300	15.4	913,213
Black Bass	26%	15,588	22.1	344,506	43%	28,970	16.3	472,217	25%	80,397	19.7	1,583,816	30%	35,253	17.1	602,825
Walleye/Sauger	71%	43,587	14.7	640,724	46%	30,781	22.9	704,885	70%	226,397	14.9	3,373,319	56%	65,837	16.6	1,092,886
Salmon	3%	1,834	2.1	3,851	7%	4,963	7.3	36,226	2%	7,075	21.0	148,573	6%	6,537	11.8	77,136
Steelhead	8%	4,952	40.4	200,046	25%	16,966	21.9	371,565	20%	65,604	14.1	925,013	44%	51,245	15.8	809,673
Lake Trout	2%	1,345	2.8	3,766	13%	8,517	21	178,852	5%	14,793	22.4	331,363	19%	22,296	14.8	329,976
Other Trout	5%	2,751	50.6	139,196	20%	13,345	26.7	356,315	4%	12,863	13.1	168,512	27%	31,751	17.0	539,766
Pike	15%	8,925	10.9	97,284	17%	11,199	19.7	220,624	6%	18,652	16.9	315,220	14%	16,809	17.6	295,844
Fished Anything	7%	4,524	11.0	49,761	3%	2,280	14.6	33,289	7%	23,476	12.0	281,710	7%	7,821	22.2	173,626
Fished Other	8%	4,585	14.6	66,939	10%	6,840	27.2	186,054	5%	16,401	17.2	282,096	7%	8,288	23.4	193,938
Overall		61,131	17.2	1,051,459		67,061	23.4	1,569,227		321,587	24.5	7,878,882		116,731	30.9	3,607,001

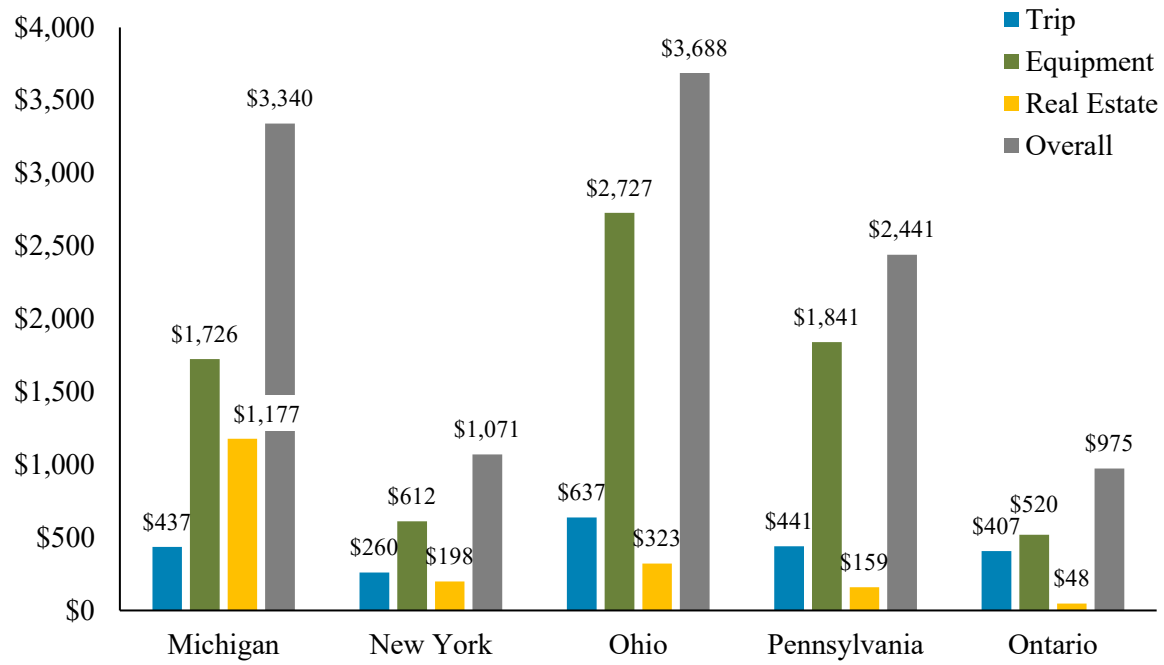
Expenditures

In total, Lake Erie anglers spent $1.83 billion pursuing fish in the United States ($1.75 billion) and Canada ($81 million[19]). Within the United States, Ohio anglers represented nearly half of all estimated anglers and as expected, they spend the most money in 2020 ($1.2 billion). This was followed by Pennsylvania ($233.5 million), Michigan ($177.5 million), and New York ($71.8 million). Equipment-related expenditures accounted for 71% of total US expenditures ($1.2 billion), followed by trip (17%, $300 million) and real estate (12%, $207.6 million) (Table 22).

For Canadian anglers, only 5% of total spending was on real estate ($4 million). Conversely equipment-related expenses comprised slightly more than half of expenditures (53%; $43.4 million), while trip-related expenses comprised the rest (42%, $34 million). The highest expenditure category was boats ($21.9 million) and boat-related trip expenses ($13.1 million) (Table 22).

On average, anglers spent $2,813 each fishing Lake Erie in 2020. Average annual expenditures varied, with Ohio anglers spending the most ($3,688) and Ontario anglers the least ($975) (Figure 7). Table 23 presents a summary of the average state (and Province) spending for major expenditure categories. Within the trip expenditure category, anglers spent the most money on boat launching, fuel, and mooring ($205.37), followed by food ($110.11), and transportation ($85.31). Money spent on equipment averaged $1,972.24 per year, which was led by boats ($1,097.15), vehicles ($469.86), and property ($325.54). On average, anglers spent $194.37 on fishing equipment, $99.00 on bait, and $30.14 on clothing.

Figure 7. Average trip, equipment, and real estate expenditures for 2020 Lake Erie anglers, by state and Province.



[19] Canadian expenditure data for Lake Erie includes Lake St. Clair and the St. Clair River.

Table 22. Detailed 2020 spending (in millions) for recreational fishing on Lake Erie, by state/Province.

	State						
Trip Expenditures (in millions)	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Food, Ice	$6.67	$4.49	$41.84	$13.79	$66.78	$4.79	$71.58
Lodging	$4.37	$3.74	$24.26	$3.35	$35.71	$2.52	$38.24
Airfare, Public and private transportation	$5.13	$3.39	$29.81	$10.48	$48.80	$6.65	$55.45
Guides	$1.97	$1.89	$19.32	$3.31	$26.49	$2.41	$28.90
Public and private land use fees	$.46	$.34	$1.35	$.31	$2.45	$4.47	$6.92
Boat launching, boat fuel, boat mooring	$8.10	$3.62	$88.44	$20.21	$120.37	$13.13	$133.50
Other trip expenses (Canada only)						$.02	$.02
Subtotal	$26.70	$17.46	$205.01	$51.45	$300.60	$33.99	$334.60

	State						
Equipment Expenditures (in millions)	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$10.94	$5.74	$76.82	$26.66	$120.17	$6.18	$126.34
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$5.25	$3.26	$39.98	$15.87	$64.36	$4.79	$69.15
Camping gear, Heating & cooking fuel	$1.23	$.55	$5.33	$2.06	$9.16	$2.48	$11.64
Special fishing clothing, foul weather gear	$1.63	$1.05	$10.23	$5.30	$18.21	$1.39	$19.59
Equipment rental	$.50	$.53	$4.51	$1.48	$7.02	$.39	$7.40
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$1.37	$.52	$8.17	$3.66	$13.72	$.01	$13.73
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$48.94	$19.44	$538.34	$100.15	$706.86	$21.87	$728.73
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$35.64	$9.99	$193.70	$59.79	$299.11	$6.32	$305.42
Cabins, Land purchased for fishing, Land leased for fishing	$71.96	$13.28	$103.81	$18.55	$207.60	$4.01	$211.61
Equipment Subtotal	$105.49	$41.07	$877.08	$214.95	$1238.60	$43.41	$1282.01
Real Estate Subtotal	$71.96	$13.28	$103.81	$18.55	$207.60	$4.01	$211.61
Grand Total	$204.15	$71.81	$1185.90	$284.95	$1746.80	$81.41	$1828.22

Table 23. Average 2020 per angler spending (in dollars) for recreational fishing on Lake Erie, by state/Province.

	State						
Trip Expenditures (in dollars)	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Food, Ice	$109.09	$66.95	$130.09	$118.11	$117.88	$57.39	$110.11
Lodging	$71.51	$55.71	$75.44	$28.67	$63.04	$30.18	$58.82
Airfare, Public and private transportation	$83.98	$50.50	$92.69	$89.75	$86.15	$79.62	$85.31
Guides	$32.17	$28.22	$60.07	$28.36	$46.75	$28.88	$44.46
Public and private land use fees	$7.50	$5.00	$4.19	$2.65	$4.32	$53.55	$10.65
Boat launching, boat fuel, boat mooring	$132.45	$53.94	$275.01	$173.17	$212.47	$157.22	$205.37
Other trip expenses (Canada only)						$0.20	$0.20
Subtotal	$436.69	$260.32	$637.48	$440.72	$530.62	$407.04	$514.75

	State						
Equipment Expenditures (in dollars)	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$178.99	$85.65	$238.89	$228.36	$212.11	$73.98	$194.37
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$85.81	$48.62	$124.33	$135.92	$113.60	$57.37	$99.00
Camping gear, Heating & cooking fuel	$20.17	$8.14	$16.56	$17.62	$16.17	$29.68	$17.91
Special fishing clothing, foul weather gear	$26.66	$15.60	$31.81	$45.41	$32.14	$16.59	$30.14
Equipment rental	$8.12	$7.94	$14.02	$12.68	$12.39	$4.61	$11.39
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$22.34	$7.78	$25.42	$31.34	$24.22	$0.07	$21.12
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$800.57	$289.81	$1,674.00	$857.93	$1,247.74	$261.86	$1,097.15
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$582.96	$148.91	$602.32	$512.17	$527.98	$75.63	$469.86
Cabins, Land purchased for fishing, Land leased for fishing	$1,177.21	$198.03	$322.79	$158.92	$366.45	$47.97	$325.54
Equipment Subtotal	$1,725.62	$612.45	$2,727.36	$1,841.43	$2,186.36	$519.80	$1,972.24
Real Estate Subtotal	$1,177.21	$198.03	$322.79	$158.92	$366.45	$47.97	$325.54
Grand Total	$3,339.53	$1,070.80	$3,687.64	$2,441.07	$3,083.44	$974.82	$2,812.52

Economic contributions

Anglers' $1.83 billion of direct spending on Lake Erie in 2020 generated $355.3 million of household income to 7,400 full- and part-time employees and proprietors who worked for and owned Lake Erie businesses. This direct spending contributed $184.9 million in tax revenues, $536.4 million to GDP, and $963.7 million to direct economic output. Spending by anglers was highest in Ohio and accounted for 3,900 of the jobs and $181.2 million of income (Table 24). Including both direct and multiplier effects, the $1.83 billion of spending by Lake Erie anglers produced $632.5 million in household income and supported 12,600 full and part time jobs. This level of spending also resulted in a contribution of $1,004.2 million to GDP along with $134.3 million and $151.3 million in Federal and State/Provincial and local taxes, respectively (Table 24).

Table 24. Economic contributions of all spending for recreational fishing on Lake Erie in 2020, by state/Province.

	Lake Erie Total	Michigan	New York	Ohio	Pennsylvania	Ontario Province
Direct effects						
Output (millions)	$963.7	$203.5	$44.7	$524.8	$148.7	$42.0
GDP (millions)	$536.4	$102.7	$28.8	$297.7	$85.9	$21.3
Income (millions)	$355.3	$83.8	$18.9	$181.2	$57.1	$14.3
Employment (thsds)	7.4	1.4	0.4	3.9	1.3	0.4
Federal taxes (millions)	$77.3	$15.5	$4.1	$41.4	$12.4	$3.9
State/Provincial & local taxes (millions)	$107.6	$17.1	$6.0	$61.2	$15.5	$7.8
Multiplier effects						
Output (millions)	$847.1	$176.0	$33.0	$467.7	$134.4	$36.0
GDP (millions)	$467.8	$93.2	$20.8	$256.2	$77.6	$20.0
Income (millions)	$277.2	$66.6	$12.4	$138.7	$48.7	$10.8
Employment (thsds)	5.1	1.2	0.2	2.6	0.8	0.3
Federal taxes (millions)	$57.0	$12.4	$2.6	$30.8	$10.1	$1.1
State/Provincial & local taxes (millions)	$43.0	$7.9	$2.2	$23.8	$7.0	$2.1
Total effects						
Output (millions)	$1,810.8	$379.5	$77.7	$992.5	$283.1	$78.0
GDP (millions)	$1,004.2	$195.8	$49.6	$554.1	$163.5	$41.2
Income (millions)	$632.5	$150.4	$31.3	$319.9	$105.8	$25.1
Employment (thsds)	12.6	2.6	0.6	6.6	2.1	0.7
Federal taxes (millions)	$134.3	$27.9	$6.7	$72.3	$22.5	$4.9
State/Provincial & local taxes (millions)	$151.3	$25.2	$8.1	$85.5	$22.5	$10.0

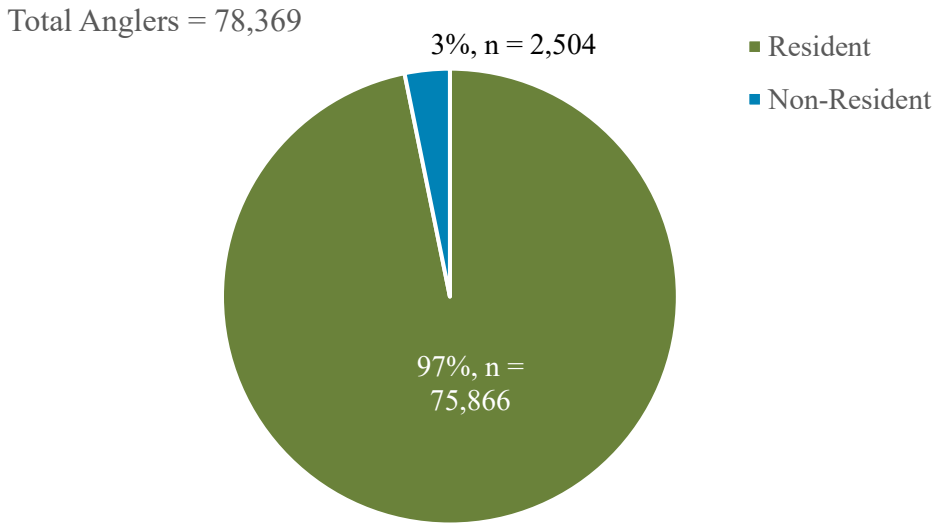
Lake Huron

Participation

In 2020, an estimated 78,000 US anglers fished on Lake Huron and its tributaries[20]. Of those, 97% (n = 75,866) were residents (Figure 8). Resident anglers were more likely than non-residents to pursue yellow perch (56% vs. 46%), salmon (39% vs. 29%), lake trout (35% vs. 23%), and other trout (27% vs. 21%). For all other species, there was less than a 10% difference between residents and non-residents.

Overall, Lake Huron anglers averaged 18.4 days fishing for all species combined, which equated to 1.4 million total days. The most frequently fished species was walleye/sauger (64%, 1 million days), followed by yellow perch (53%, 600,000 days), pike (37%, 460,000 days) and salmon (37%, 321,000 days). Overall, 500,000 days were spent bass fishing by over 27,000 people (Table 25).

Figure 8. Number of Lake Huron anglers, by residency status, 2020.



[20] Per Dr. Len Hunt, an estimated 78,078 individuals fished Lake Huron in Canadian waters.

Table 25. Lake Huron species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

	Resident			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	48%	36,264	13.6	493,188
Black Bass	31%	23,291	13.5	314,426
Walleye/Sauger	58%	43,775	17.0	744,167
Salmon	16%	12,442	13.5	167,967
Steelhead	13%	9,711	14.7	142,749
Lake Trout	18%	13,352	10.9	145,541
Other Trout	16%	12,214	14.2	173,444
Pike	26%	20,029	13.1	262,374
Fished Anything	12%	9,180	26.0	238,674
Fished Other	7%	5,159	13.4	69,129
Overall		75,866	21.8	1,653,874

	Non-Resident			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	52%	1,307	13.4	17,512
Black Bass	35%	869	5.1	4,431
Walleye/Sauger	66%	1,645	12.9	21,219
Salmon	13%	323	4.8	1,550
Steelhead	7%	165	55.0	9,088
Lake Trout	12%	298	3.9	1,162
Other Trout	9%	235	11.7	2,753
Pike	59%	1,477	10.8	15,953
Fished Anything	*	*	*	*
Fished Other	*	*	*	*
Overall		2,504	12.9	32,296

	Overall			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	49%	38,009	13.6	516,924
Black Bass	31%	24,530	12.2	299,261
Walleye/Sauger	59%	46,160	16.3	752,401
Salmon	16%	12,382	12.3	152,303
Steelhead	12%	9,326	18.8	175,328
Lake Trout	17%	13,088	10.1	132,186
Other Trout	15%	11,834	13.9	164,489
Pike	31%	24,608	12.4	305,139
Fished Anything	11%	8,777	26.0	228,212
Fished Other	6%	4,467	12.4	55,391
Overall		78,369	20.3	1,590,898

*No data, likely indicates minimal fishing activity

Expenditures

In total, Lake Huron anglers spent $348.8 million fishing during 2020 in the US (Michigan, $261.7 million) and Canada ($87.1 million). Total trip-related direct spending was nearly identical (US: $34.2 million, Canada: $31.7 million), which aligned with the nearly identical angler estimates (US = 78,369, Canada = 78,078). Within the trip category, direct expenditures by US anglers were highest for boat expenses ($10.4 million), food ($8.55 million), and transportation ($6.58 million). For Canadian anglers, they spent the most on boat expenses ($12.1 million), transportation ($6.01 million), and food ($4.60 million). Overall, US anglers spent significantly more on equipment ($135.2 vs. $48.3 million) and real estate ($92.3 vs. $7.14 million) than Canadian anglers (Table 26).

The highest US expenditure category on Lake Huron was for real estate ($92.3 million), followed by boats ($62.7 million), and vehicles ($45.7 million). Fishing equipment ($14.0 million) and bait/terminal tackle ($6.72 million) comprised a comparatively lower level of spending. Canadian anglers spent the most on boats ($24.8 million), real estate ($7.14 million), and vehicles ($7.06 million). Expenditures for fishing equipment ($5.82 million) and bait/terminal tackle ($4.75 million) were also comparatively less (Table 26).

On average, US anglers spent an average of $3,339.53 fishing Lake Huron in 2020; conversely, Canadian anglers spent an estimated $1,115.83 each (Figure 9). Table 27 presents a summary of the spending for major expenditure categories. Within the trip expenditure category, anglers spent the most money on boat expenses ($143.48), followed by food/ice ($84.05), and transportation ($80.46). For equipment, US anglers spent nearly three times as much money as Canadian anglers ($1,725.62 vs. $618.68) and nearly 13 times as much on real estate ($1,177.21 vs. $91.45).

Figure 9. Average trip, equipment, and real estate expenditures for 2020 Lake Huron anglers, by state and Province.

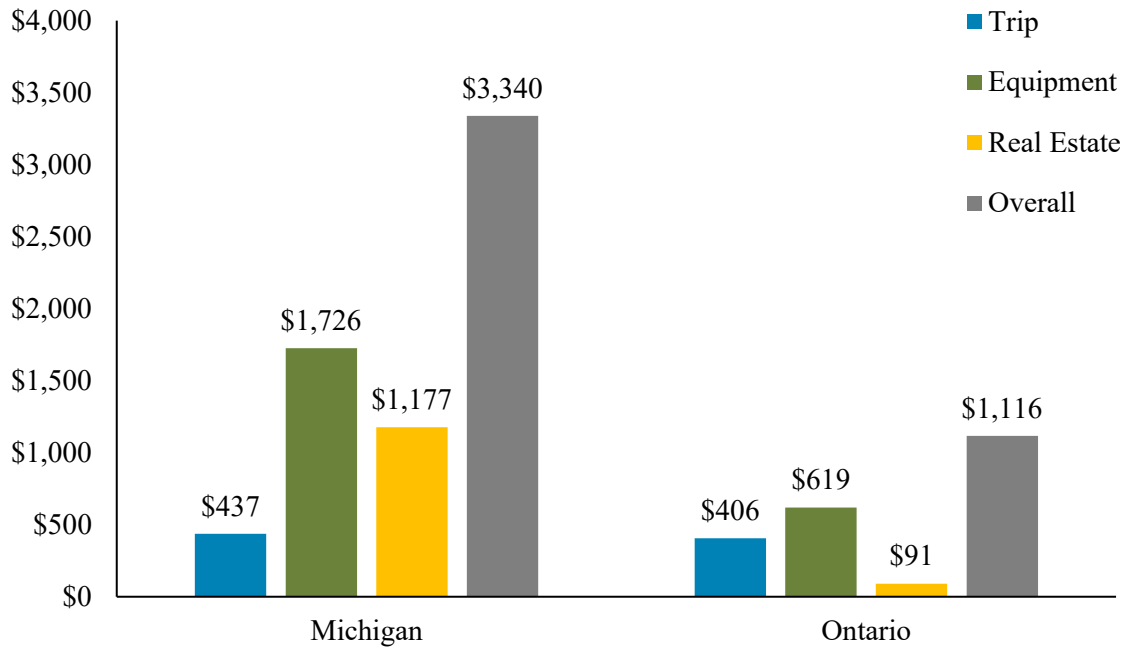


Table 26. Detailed spending for recreational fishing on Lake Huron, by state/Province.

Trip Expenditures (in millions)	Michigan	Ontario	Total
Food, Ice	$8.55	$4.60	$13.15
Lodging	$5.60	$3.02	$8.62
Airfare, Public and private transportation	$6.58	$6.01	$12.59
Guides	$2.52	$2.36	$4.88
Public and private land use fees	$.59	$3.63	$4.21
Boat launching, boat fuel, boat mooring	$10.38	$12.07	$22.45
Other trip expenditures (Canada only)		$.002	$.002
Subtotal	$34.22	$31.68	$65.90

Equipment Expenditures (in millions)	Michigan	Ontario	Total
Rods, reels & components, Tackle boxes, Depth and fish finders, other electronics, Creels, stringers, landing nets, Ice fishing equipment, Binoculars, Other fishing equipment	$14.03	$5.82	$19.85
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$6.72	$4.75	$11.47
Camping gear, Heating & cooking fuel	$1.58	$3.97	$5.55
Special fishing clothing, foul weather gear	$2.09	$1.41	$3.50
Equipment rental	$.64	$.40	$1.04
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$1.75	$.08	$1.83
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$62.74	$24.81	$87.55
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$45.69	$7.06	$52.75
Cabins, Land purchased for fishing, Land leased for fishing	$92.26	$7.14	$99.40
Equipment Subtotal	$135.24	$48.31	$183.54
Real Estate Subtotal	$92.26	$7.14	$99.40
Grand Total	$261.72	$87.12	$348.84

Table 27. Average per angler spending for recreational fishing on Lake Huron, by state/Province.

Trip Expenditures (in dollars)	Michigan	Ontario	Total
Food, Ice	$109.09	$58.92	$84.05
Lodging	$71.51	$38.66	$55.12
Airfare, Public and private transportation	$83.98	$76.93	$80.46
Guides	$32.17	$30.17	$31.17
Public and private land use fees	$7.50	$46.45	$26.94
Boat launching, boat fuel, boat mooring	$132.45	$154.55	$143.48
Other trip expenditures (Canada only)		$0.03	$0.01
Subtotal	$436.69	$405.70	$421.23

Equipment Expenditures (in dollars)	Michigan	Ontario	Total
Rods, reels & components, Tackle boxes, Depth and fish finders, other electronics, Creels, stringers, landing nets, Ice fishing equipment, Binoculars, Other fishing equipment	$178.99	$74.58	$126.88
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$85.81	$60.80	$73.33
Camping gear, Heating & cooking fuel	$20.17	$50.90	$35.51
Special fishing clothing, foul weather gear	$26.66	$18.05	$22.36
Equipment rental	$8.12	$5.15	$6.64
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$22.34	$0.98	$11.68
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$800.57	$317.75	$559.61
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$582.96	$90.48	$337.18
Cabins, Land purchased for fishing, Land leased for fishing	$1,177.21	$91.45	$635.34
Equipment Subtotal	$1,725.62	$618.68	$1,173.18
Real Estate Subtotal	$1,177.21	$91.45	$635.34
Grand Total	$3,339.53	$1,115.83	$2,229.75

Economic contributions

The $348 million of direct spending by anglers on Lake Huron in 2020 generated $115.8 million of household income to 2,100 full- and part-time employees and proprietors who worked for and owned Lake Huron businesses. This spending contributed $51.3 million in tax revenues, $145.5 million to GDP, and $288.0 million to direct economic output. Spending by anglers was highest in Michigan and accounted for 1,700 of the jobs and $100.0 million of income (Table 28).

Including both direct and multiplier effects, the $348 million of spending by Lake Huron anglers produced $206.7 million of household income and supported 3,800 full and part time jobs. This level of spending also resulted in a contribution of $278.0 million to GDP along with $38.5 million and $40.8 million in Federal and State/Provincial and local taxes, respectively (Table 28).

Table 28. Economic contributions of all spending for recreational fishing on Lake Huron in 2020, by state/Province.

	Lake Huron Total	Michigan	Ontario Province
Direct effects			
Output (millions)	$288.0	$243.0	$45.0
GDP (millions)	$145.5	$122.6	$22.9
Income (millions)	$115.8	$100.1	$15.7
Employment (thsds)	2.1	1.7	0.4
Federal taxes (millions)	$22.5	$18.4	$4.1
State/Provincial & local taxes (millions)	$28.8	$20.4	$8.4
Multiplier effects			
Output (millions)	$248.8	$210.2	$38.6
GDP (millions)	$132.7	$111.4	$21.3
Income (millions)	$91.1	$79.5	$11.6
Employment (thsds)	1.8	1.5	0.3
Federal taxes (millions)	$16.0	$14.8	$1.2
State & local taxes (millions)	$11.8	$9.4	$2.4
Total effects			
Output (millions)	$536.8	$453.3	$83.5
GDP (millions)	$278.0	$233.8	$44.2
Income (millions)	$206.7	$179.6	$27.1
Employment (thsds)	3.8	3.1	0.7
Federal taxes (millions)	$38.5	$33.3	$5.2
State & local taxes (millions)	$40.8	$30.0	$10.8

Lake Michigan

Participation

In 2020, an estimated 350,000 US anglers fished Lake Michigan and its tributaries, with most launching from Michigan (41%) or Wisconsin (35%) (Figure 10). Overall, 12% of Lake Michigan anglers fished with a non-resident license, with the lowest percentage launching from Michigan (6%) and the highest percentage from Indiana (32%) (Figure 11). Overall, anglers spent an average of 25 days fishing on Lake Michigan, which equated to nearly 10 million total fishing days (Table 29). Lake Michigan provides an array of fishing opportunities for both warm and cold water species. Overall, 67% of anglers pursued a salmonid species, with salmon pursued by the highest percentage (50%, 2.2 million days), followed by steelhead (39%, 2.1 million days) and lake trout (37%, 1.6 million days). Nearly equal percentages of anglers fished for yellow perch (41%, 1.8 million days) and walleye (40%, 2.3 million days) (Table 29).

By state, walleye/sauger were pursued most often by those from Michigan (49%, 1.2 million days) and Wisconsin (54%, 806,000 days). Though anglers spent relatively fewer days fishing for salmon and steelhead on average, Michigan and Wisconsin anglers still spent between 750,000 to 970,000 days pursuing those species. Illinois (39%, 456,000 days) and Indiana anglers (36%, 197,000 days) spent the most time bass fishing (Table 30).

Figure 10. Lake Michigan angler numbers and percent of total, 2020.

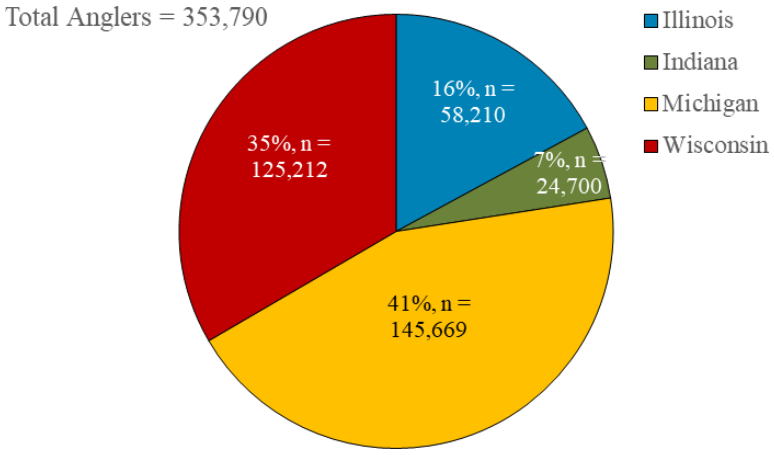


Figure 11. Percentage of resident and non-resident anglers on Lake Michigan, by state, 2020.

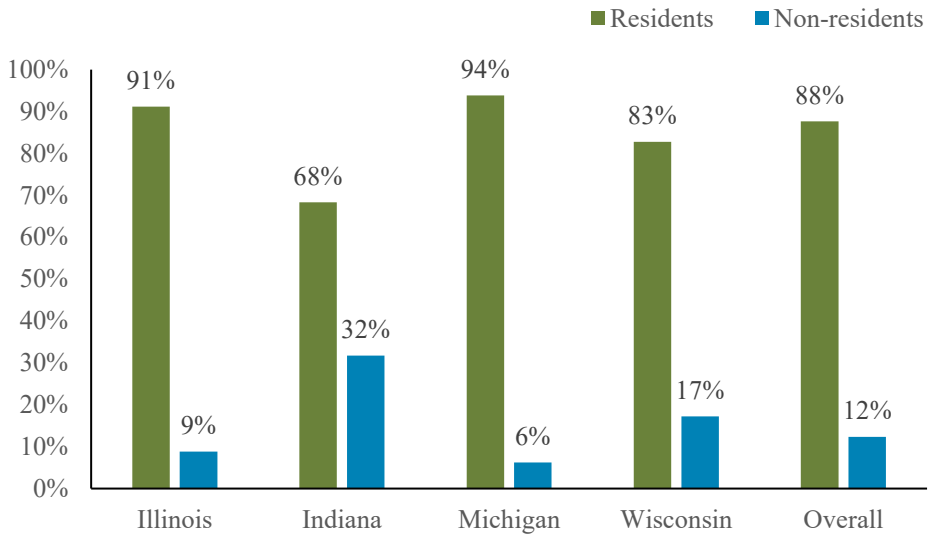


Table 29. Lake Michigan species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

	Residents				Non-Residents				Overall			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Yellow perch	36%	112,292	11.9	1,336,274	32%	13,906	12.7	176,604	36%	125,596	12.0	1,507,147
Black bass	31%	97,402	18.2	1,772,723	29%	12,816	16.2	207,619	31%	110,029	17.9	1,969,516
Walleye/Sauger	28%	85,925	15.1	1,297,468	26%	11,290	13.7	154,677	27%	96,939	14.9	1,444,385
Salmon	48%	147,655	12.0	1,771,854	48%	20,750	12.2	253,147	48%	168,404	12.0	2,020,851
Steelhead	34%	104,537	14.2	1,484,424	35%	15,257	16.8	256,320	34%	119,935	14.7	1,763,044
Lake trout	34%	105,778	11.4	1,205,866	34%	14,908	11.8	175,919	34%	120,643	11.5	1,387,389
Other trout	27%	83,443	14.9	1,243,307	27%	11,683	13.2	154,211	27%	95,170	14.6	1,389,477
Pike	21%	63,591	16.7	1,061,965	15%	6,321	11.5	72,689	20%	68,989	16.1	1,110,725
Fished Anything	8%	25,126	12.4	311,563	6%	2,746	3.6	9,887	8%	27,596	11.6	320,110
Fished Other	9%	26,677	18.0	480,187	5%	2,049	17.4	35,649	8%	27,949	17.9	500,295
Overall		310,199	24.9	7,723,946		43,592	22.1	963,380		353,790	24.4	8,632,488

Table 30. Lake Michigan species pursued, number of anglers, average days fished, and total fishing days by state, 2020. Residents and non-residents combined. Due to rounding, results do not perfectly equal Table 13.

	Illinois				Indiana				Michigan				Wisconsin			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Yellow perch	33%	19,209	10.0	192,092	41%	10,201	12.9	131,594	37%	54,480	12.3	670,105	34%	42,071	13.1	551,134
Black bass	36%	20,955	16.6	347,861	32%	8,003	23.3	186,465	30%	43,264	18.5	800,377	27%	33,807	15.4	520,632
Walleye/Sauger	21%	11,933	13.9	165,868	21%	5,138	21.0	107,890	31%	44,866	15.5	695,422	36%	44,701	13.4	598,990
Salmon	45%	25,903	9.6	248,671	48%	11,831	17.7	209,414	48%	69,921	13.5	943,933	51%	64,359	9.7	624,283
Steelhead	26%	15,367	11.7	179,798	43%	10,572	21.2	224,118	38%	55,354	14.5	802,634	32%	40,193	12.2	490,356
Lake trout	34%	20,024	8.4	168,203	34%	8,275	18.6	153,906	33%	48,362	13.1	633,542	34%	42,697	9.0	384,276
Other trout	23%	13,446	10.9	146,566	22%	5,311	26.9	142,852	28%	40,496	16.5	668,182	34%	43,073	11.0	473,803
Pike	19%	11,234	14.0	157,282	14%	3,359	25.6	85,996	20%	29,571	19.0	561,844	24%	29,550	12.5	369,376
Fished anything	8%	4,715	11.5	54,222	9%	2,223	11.9	26,454	7%	10,488	15.6	163,615	8%	10,142	8.1	82,152
Fished Other	11%	6,578	16.4	107,874	9%	2,223	25.8	57,353	6%	9,031	14.6	131,859	6%	6,887	17.0	117,073
Overall		58,210	20.9	1,216,581		24,700	30.2	745,940		145,669	23.7	3,452,348		125,212	18.5	2,316,425

Expenditures

Overall, Lake Michigan anglers spent $757.3 million fishing during 2020. Michigan anglers (41% of total) spent the most money ($315 million), followed by Wisconsin (35%, $233.5 million), Illinois (16%; $95.2 million), and Indiana (7%; $73.6 million). Equipment-related expenditures accounted for 64% of total expenditures ($608.7 million), followed by real estate (21%, $195.3 million) and trip (16%, $148.6 million).

Within the trip category, direct expenditures by anglers were highest for boat fees and fuel ($14.5 million), food/ice ($38.3 million), and transportation ($28.1 million). For equipment, the most money was spent on boats ($264.2 million), vehicles ($204.9 million), and fishing equipment ($75.9 million). Real estate expenditures during 2020 were estimated at $195.2 million (Table 31).

On average, anglers spent $2,692.27 each fishing Lake Michigan in 2020. State level average annual expenditures varied, with Indiana anglers spending the most ($3,387.38), followed closely by Michigan anglers ($3,339.51); Illinois anglers spent the least ($1,640.04) (Figure 12). The large annual spending by Indiana anglers was largely driven by the $25.8 million that was estimated to be spent on vehicles.

Table 32 presents a summary of the average state spending for major expenditure categories. Within the trip expenditure category, anglers spent the most money on boat launching, fuel, and mooring ($117.24), followed by food ($108.16), and transportation ($79.34). Money spent on equipment averaged $1,720.36 per year, which was led by boats ($746.90), vehicles ($579.32). On average, anglers spent $214.51 on fishing equipment, $99.05 on bait/terminal tackle, and $30.14 on clothing. Average real estate expenditure contributed the least to the total with $551.87.

Figure 12. Average trip, equipment, and real estate expenditures for 2020 Lake Michigan anglers, by state.

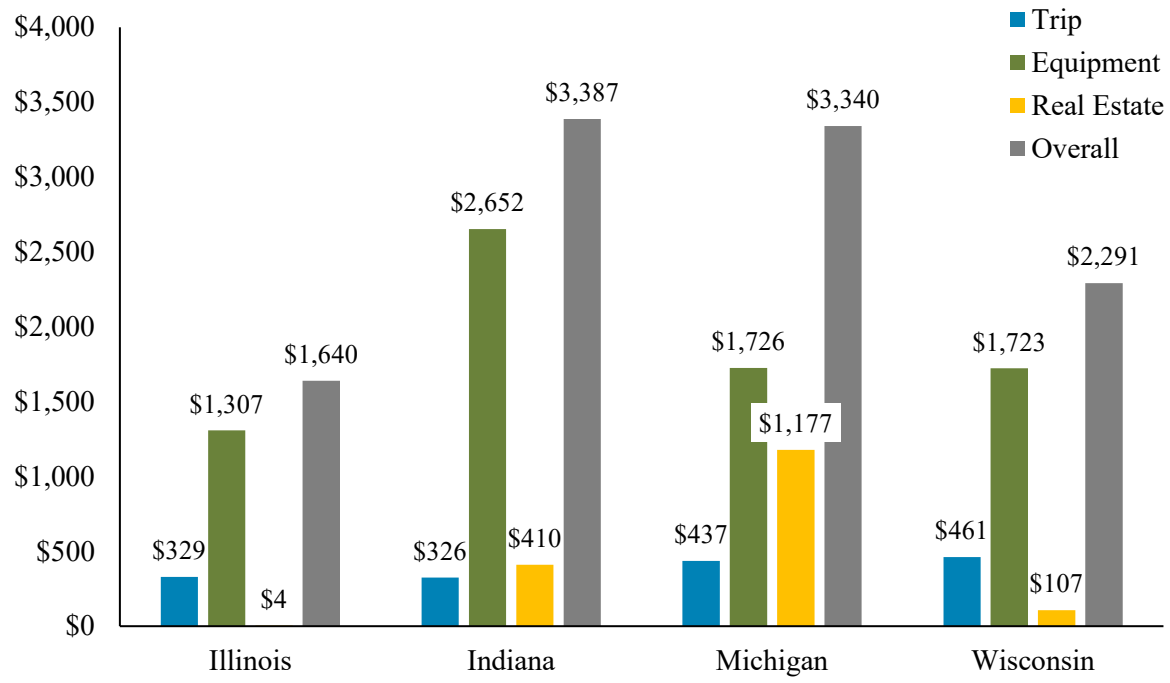


Table 31. Detailed spending (in millions) for recreational fishing on Lake Michigan, by state.

	State				
Trip Expenditures (in millions)	Illinois	Indiana	Michigan	Wisconsin	Total
Food	$5.29	$2.12	$14.70	$13.25	$35.36
Ice	$.44	$.23	$1.19	$1.04	$2.90
Lodging	$1.46	$.47	$10.42	$11.20	$23.55
Airfare	$.04	*	$.02	$.07	$.13
Public transportation	$.22	$.02	$.04	$.19	$.46
Private transportation	$3.97	$1.65	$12.17	$9.68	$27.48
Guides	$2.27	$.42	$4.69	$7.31	$14.69
Public land use fees	$.33	$.15	$.91	$.70	$2.09
Private land use fees	$.06	$.03	$.18	$.20	$.46
Boat launching	$.57	$.31	$1.24	$2.41	$4.54
Boat fuel	$1.64	$1.19	$8.87	$7.71	$19.42
Boat mooring	$2.88	$1.45	$9.18	$4.03	$17.53
Subtotal	$19.16	$8.05	$63.61	$57.79	$148.60

	State				
Equipment Expenditures (in millions)	Illinois	Indiana	Michigan	Wisconsin	Total
Rods, reels & components	$6.68	$3.10	$11.59	$13.90	$35.27
Tackle boxes	$.43	$.18	$.88	$.71	$2.20
Creels, strings, landing nets	$.31	$.16	$.78	$1.08	$2.33
Depth finder, fish finders, other electronics	$3.02	$1.59	$7.84	$12.08	$24.54
Ice fishing equipment	$.68	$.28	$3.29	$3.30	$7.55
Binoculars	$.22	$.18	$1.01	$.31	$1.72
Other fishing equipment	$.13	$.06	$.68	$1.42	$2.27
Bait (live, cut, prepared)	$1.38	$.67	$3.12	$2.85	$8.02
Lines & leaders	$1.09	$.53	$2.23	$2.37	$6.22
Lures, flies & artificial bait	$2.29	$1.26	$5.32	$6.97	$15.83
Hooks, sinkers, other terminal tackle	$.69	$.38	$1.60	$1.65	$4.32
Bait buckets, minnow traps	$.11	$.08	$.24	$.23	$.66
Camping gear	$1.01	$.28	$1.92	$1.37	$4.58
Heating & cooking fuel	$.25	$.09	$1.02	$.65	$2.01
Special fishing clothing, foul weather gear	$1.67	$.86	$3.88	$4.25	$10.66
Equipment rental	$.88	$.10	$1.18	$1.28	$3.44
Taxidermy & processing	$.16	$.09	$.33	$.32	$.89
Books & magazines	$.32	$.10	$.49	$.56	$1.47
Dues and contributions	$.44	$.19	$.94	$.73	$2.29
Other misc. fishing expenditures	$.66	$.20	$1.50	$.79	$3.16
Bass boats	$8.08	$13.66	$15.03	$32.23	$69.01
Other motorized boats	$18.81	$10.57	$85.30	$24.03	$138.71
Canoes, non-motorized boats	$1.74	$.82	$3.46	$4.32	$10.34
Boat motors, trailers, hitches, etc.	$4.29	$2.62	$12.83	$26.45	$46.19
Pick-ups, campers, motor homes	$17.88	$25.79	$64.95	$57.51	$166.14
4x4 and off-road vehicles	$2.85	$1.67	$19.96	$14.34	$38.82
Cabins	$.07	$.05	$1.63	$.66	$2.40
Land purchased for fishing	$.03	$9.95	$169.50	$12.01	$191.49
Land leased for fishing	$.12	$.13	$.35	$.75	$1.35
Equipment Subtotal	$76.08	$65.50	$251.37	$215.70	$608.65
Real Estate Subtotal	$.22	$10.12	$171.48	$13.42	$195.25
Grand Total	$95.47	$83.67	$486.46	$286.90	$952.50

*No expenditures reported by respondents.

Table 32. Average per angler spending (in dollars) for recreational fishing on Lake Michigan, by state.

Trip Expenditures (in dollars)	State				
	Illinois	Indiana	Michigan	Wisconsin	Total
Food	$90.94	$85.72	$100.94	$105.81	$99.96
Ice	$7.63	$9.24	$8.15	$8.34	$8.21
Lodging	$25.13	$18.96	$71.51	$89.47	$66.57
Airfare	$0.66	$0.00	$0.15	$0.56	$0.37
Public transportation	$3.71	$0.93	$0.26	$1.49	$1.31
Private transportation	$68.22	$66.94	$83.57	$77.28	$77.66
Guides	$39.03	$17.12	$32.17	$58.37	$41.52
Public land use fees	$5.60	$5.99	$6.27	$5.59	$5.90
Private land use fees	$0.99	$1.14	$1.23	$1.58	$1.31
Boat launching	$9.73	$12.68	$8.54	$19.26	$12.82
Boat fuel	$28.13	$48.34	$60.91	$61.60	$54.88
Boat mooring	$49.39	$58.70	$62.99	$32.15	$49.54
Subtotal	$329.17	$325.77	$436.69	$461.50	$420.04

Equipment Expenditures (in dollars)	State				
	Illinois	Indiana	Michigan	Wisconsin	Total
Rods, reels & components	$114.71	$125.53	$79.55	$111.02	$99.68
Tackle boxes	$7.41	$7.39	$6.02	$5.67	$6.22
Creels, strings, landing nets	$5.39	$6.35	$5.37	$8.63	$6.60
Depth finder, fish finders, other electronics	$51.96	$64.43	$53.84	$96.50	$69.37
Ice fishing equipment	$11.60	$11.52	$22.62	$26.34	$21.35
Binoculars	$3.85	$7.16	$6.94	$2.48	$4.87
Other fishing equipment	$2.17	$2.25	$4.65	$11.30	$6.43
Bait (live, cut, prepared)	$23.78	$27.28	$21.39	$22.73	$22.67
Lines & leaders	$18.66	$21.40	$15.28	$18.97	$17.57
Lures, flies & artificial bait	$39.29	$50.88	$36.51	$55.63	$44.74
Hooks, sinkers, other terminal tackle	$11.80	$15.50	$10.97	$13.18	$12.21
Bait buckets, minnow traps	$1.92	$3.10	$1.65	$1.84	$1.87
Camping gear	$17.35	$11.45	$13.20	$10.93	$12.96
Heating & cooking fuel	$4.26	$3.79	$6.98	$5.19	$5.68
Special fishing clothing, foul weather gear	$28.65	$34.93	$26.66	$33.93	$30.14
Equipment rental	$15.09	$3.89	$8.12	$10.24	$9.72
Taxidermy & processing	$2.80	$3.50	$2.25	$2.53	$2.53
Books & magazines	$5.54	$4.00	$3.35	$4.51	$4.17
Dues and contributions	$7.49	$7.57	$6.45	$5.82	$6.48
Other misc. fishing expenditures	$11.42	$8.02	$10.29	$6.34	$8.92
Bass boats	$138.88	$552.97	$103.17	$257.44	$195.05
Other motorized boats	$323.13	$427.82	$585.57	$191.92	$392.06
Canoes, non-motorized boats	$29.95	$33.30	$23.72	$34.49	$29.23
Boat motors, trailers, hitches, etc.	$73.70	$106.25	$88.10	$211.20	$130.56
Pick-ups, campers, motor homes	$307.24	$1,044.05	$445.90	$459.30	$469.59
4x4 and off-road vehicles	$48.99	$67.59	$137.05	$114.49	$109.73
Cabins	$1.17	$1.86	$11.16	$5.31	$6.79
Land purchased for fishing	$0.55	$402.72	$1,163.63	$95.92	$541.26
Land leased for fishing	$2.12	$5.14	$2.42	$5.95	$3.81
Equipment Subtotal	$1,307.03	$2,651.90	$1,725.61	$1,722.64	$1,720.36
Real Estate Subtotal	$3.84	$409.71	$1,177.21	$107.18	$551.87
Grand Total	$1,640.04	$3,387.38	$3,339.51	$2,291.32	$2,692.27

Economic contributions

The $952.5 million in direct spending by anglers on Lake Michigan in 2020 generated $371.8 million of household income to 6,700 full- and part-time employees and proprietors who worked for or owned Lake Michigan businesses. This spending contributed $153.9 million in tax revenues, $485.3 million to GDP and $942.0 million to direct economic output. Spending by anglers was highest in Michigan and accounted for 4,800 of the jobs and $287.3 million of income (Table 33).

Including direct and multiplier effects, the $952.5 million of spending by Lake Michigan anglers produced $663.2 million of household income and supported 12,100 full and part time jobs. This level of spending also resulted in a contribution of $910.4 million to GDP along with $127.7 million and $120.2 million in Federal and State/Provincial and local taxes, respectively (Table 33).

Table 33. Economic contributions of all spending for recreational fishing on Lake Michigan in 2020, by state.

	Lake Michigan Total	Illinois	Indiana	Michigan	Wisconsin
Direct effects					
Output (millions)	$942.0	$45.7	$41.6	$697.7	$157.0
GDP (millions)	$485.3	$26.5	$21.6	$352.0	$85.2
Income (millions)	$371.8	$15.6	$11.2	$287.3	$57.7
Employment (thsds)	6.7	0.3	0.2	4.8	1.4
Federal taxes (millions)	$71.6	$3.7	$2.9	$53.0	$12.0
State & local taxes (millions)	$82.3	$5.4	$4.2	$58.5	$14.2
Multiplier effects					
Output (millions)	$796.4	$39.4	$30.1	$603.6	$123.4
GDP (millions)	$425.5	$22.7	$16.0	$319.7	$67.1
Income (millions)	$291.3	$12.8	$8.4	$228.4	$41.8
Employment (thsds)	5.4	0.2	0.2	4.2	0.8
Federal taxes (millions)	$56.0	$2.9	$2.0	$42.6	$8.5
State & local taxes (millions)	$37.3	$2.2	$1.4	$27.1	$6.5
Total effects					
Output (millions)	$1,738.5	$85.1	$71.6	$1,301.4	$280.4
GDP (millions)	$910.4	$49.2	$37.5	$671.4	$152.3
Income (millions)	$663.2	$28.4	$19.6	$515.7	$99.5
Employment (thsds)	12.1	0.5	0.4	9.0	2.2
Federal taxes (millions)	$127.7	$6.6	$4.9	$95.7	$20.5
State & local taxes (millions)	$120.2	$7.6	$5.6	$86.2	$20.7

Lake Ontario

Participation

In 2020, an estimated 228,000 licensed US anglers fished on Lake Ontario and its tributaries[21]. Of those, 57% (n = 98,525) were residents (Figure 13). Resident anglers were more likely to pursue yellow perch (44% vs. 22%), pike (29% vs. 13%), and bass (45% vs. 26%), lake trout (35% vs. 23%). Non-resident anglers were more likely to pursue salmon (65% vs. 45%) and steelhead (57% vs. 45%) (Figure 14).

Overall, Lake Ontario anglers averaged 20.9 days fishing for all species combined, which equated to 4.8 million total days. The most frequently fished species was salmon (49%, 1.1 million days), steelhead (44%, 1.7 million days), bass (41%, 2.0 million days), and perch (40%, 1.5 million days) (Table 34).

Figure 13. Number of Lake Ontario anglers, by residency status, 2020.

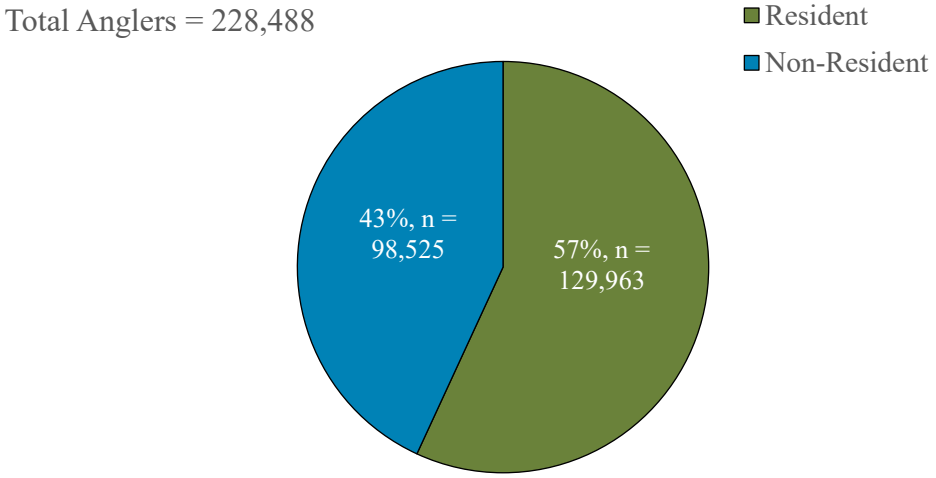
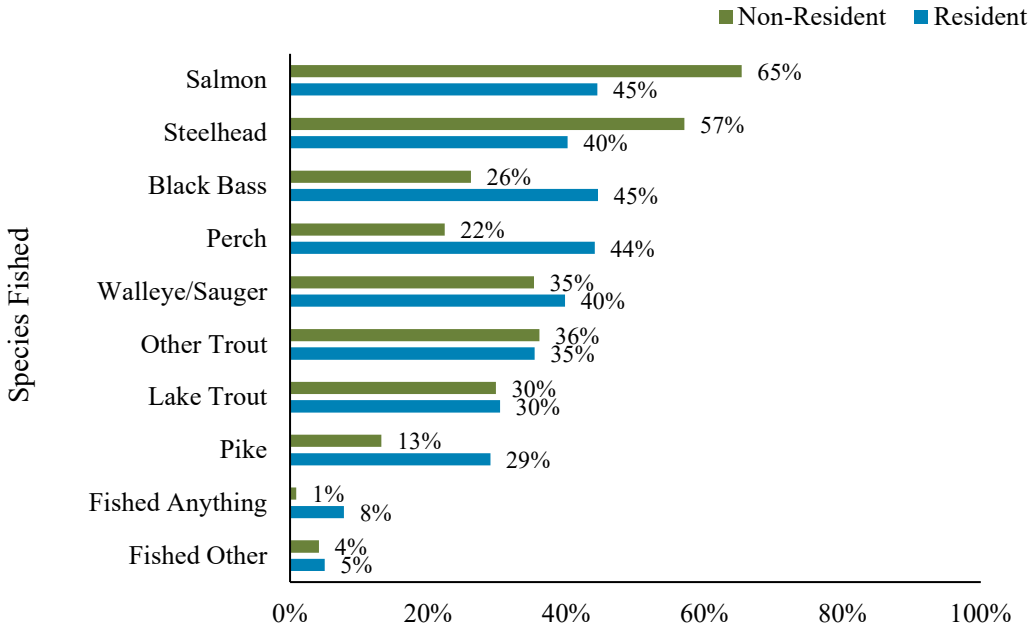


Figure 14. Species fished by Lake Ontario anglers, by residency status, 2020.



[21] Per Dr. Len Hunt, an estimated 116,684 individuals fished Lake Ontario in Canadian waters. This includes the St. Lawrence River.

Table 34. Lake Ontario species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

	Resident			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	36%	46,657	18.0	839,818
Black Bass	42%	54,974	18.6	1,022,520
Walleye/Sauger	23%	30,151	15.6	470,361
Salmon	38%	48,866	12.1	591,278
Steelhead	28%	36,909	16.5	609,005
Lake Trout	25%	31,841	12.3	391,642
Other Trout	31%	40,808	17.0	693,740
Pike	23%	29,761	17.2	511,897
Fished Anything	4%	5,069	19.9	100,864
Fished Other	14%	17,805	20.5	365,000
Overall		129,963	24.5	3,184,083

	Non-Resident			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	7%	6,897	6.5	44,829
Black Bass	17%	16,749	8.1	135,670
Walleye/Sauger	10%	9,951	5.3	52,741
Salmon	67%	66,406	4.5	298,828
Steelhead	49%	48,179	5.3	255,348
Lake Trout	30%	29,755	3.4	101,166
Other Trout	34%	33,893	6.4	216,914
Pike	4%	3,941	10.6	41,775
Fished Anything	2%	1,872	5.0	9,360
Fished Other	2%	1,675	4.4	7,370
Overall		98,525	6.9	679,825

	Overall			
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	30%	69,003	17.5	1,207,559
Black Bass	37%	85,226	17.6	1,499,978
Walleye/Sauger	21%	47,069	14.5	682,494
Salmon	44%	99,392	9.7	964,105
Steelhead	33%	74,259	12.9	957,936
Lake Trout	26%	58,493	10.1	590,779
Other Trout	32%	73,116	14.6	1,067,496
Pike	19%	43,641	16.9	737,536
Fished Anything	4%	7,997	19.4	155,143
Fished Other	11%	25,819	18.6	480,236
Overall		228,488	21.1	4,821,097

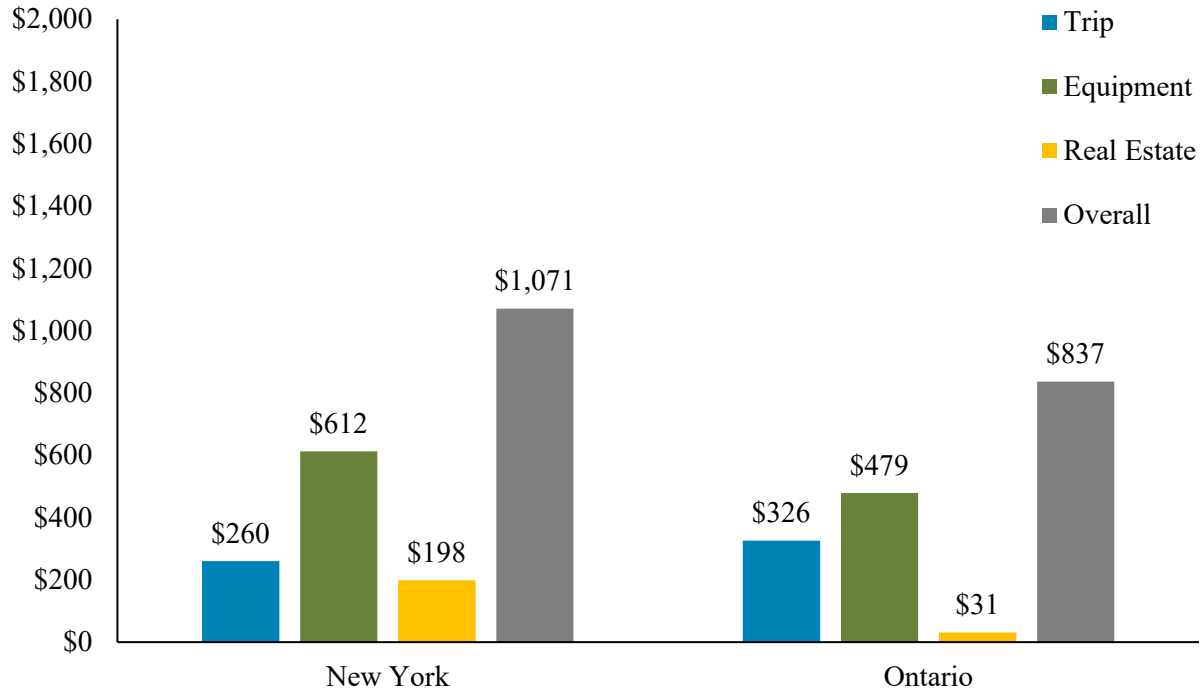
Expenditures

In total, Lake Ontario anglers spent $342.3 million during 2020 in the US (New York, $185.2 million) and Canada[22] ($55.5 million). Trip-related direct spending was slightly higher for US anglers ($59.5 million), as compared to Canadian anglers ($38.1 million). Within this category, direct expenditures by US anglers were highest for food ($14.3 million), lodging ($12.7 million), and boat expenses ($12.3 million). For Canadian anglers, they spent the most on boat expenses ($11.6 million), transportation ($7.69 million), and food ($5.35 million).

Overall, US anglers spent significantly more on equipment ($139.9 vs. $55.9 million) and real estate ($45.3 vs. $3.67 million) than Canadian anglers (Table 35). The highest US expenditure category on Lake Ontario was for boats ($66.2 million), followed by real estate ($45.3 million), and vehicles ($34.0 million). Fishing equipment ($19.6 million) and bait/terminal tackle ($11.1 million) comprised a comparatively lower level of spending. Canadian anglers spent the most on boats ($30.4 million), vehicles ($6.05 million), real estate ($3.67 million), Expenditures for fishing equipment ($8.42 million) and bait/terminal tackle ($5.28 million) were also comparatively less (Table 35).

On average, US anglers spent an average of $1,070.80 fishing Lake Ontario in 2020 while Canadian anglers spent $836.70 (Figure 15). Table 36 presents a summary of the spending for major expenditure categories. Within the trip expenditure category, anglers spent the most money on food ($59.83) boat launching, fuel, and mooring ($69.26), followed by, and transportation ($55.71). For equipment, US anglers spent slightly more money than Canadian anglers ($612.45 vs. $478.99) and six times as much on real estate ($198.03 vs. $31.45).

Figure 15. Average trip, equipment, and real estate expenditures for 2020 Lake Ontario anglers, by state and Province.



[22] Lake Ontario in Canada includes the St. Lawrence River.

Table 35. Detailed spending (in millions) for recreational fishing on Lake Ontario, by state/Province.

Trip Expenditures (in millions)	New York	Ontario	Total
Food, Ice	$15.30	$5.35	$20.65
Lodging	$12.73	$3.82	$16.55
Airfare, Public and private transportation	$11.54	$7.69	$19.23
Guides	$6.45	$4.89	$11.34
Public and private land use fees	$1.14	$4.72	$5.86
Boat launching, boat fuel, boat mooring	$12.32	$11.58	$23.91
Other trip expenditures (Canada only)		$.01	$.01
Subtotal	$59.48	$38.07	$97.55

Equipment Expenditures (in millions)	New York	Ontario	Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$19.57	$8.42	$27.99
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$11.11	$5.28	$16.39
Camping gear, Heating & cooking fuel	$1.86	$2.62	$4.48
Special fishing clothing, foul weather gear	$3.56	$2.17	$5.73
Equipment rental	$1.81	$.97	$2.79
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$1.78	$.0	$1.78
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$66.22	$30.37	$96.59
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$34.02	$6.05	$40.07
Cabins, Land purchased for fishing, Land leased for fishing	$45.25	$3.67	$48.92
Equipment Subtotal	$139.94	$55.89	$195.83
Real Estate Subtotal	$45.25	$3.67	$48.92
Grand Total	$244.67	$97.63	$342.30

Table 36. Average per angler spending (in dollars) for recreational fishing on Lake Ontario, by state/Province.

Trip Expenditures (in dollars)	New York	Ontario	Total
Food, Ice	$66.95	$45.88	$59.83
Lodging	$55.71	$32.76	$47.95
Airfare, Public and private transportation	$50.50	$65.91	$55.71
Guides	$28.22	$41.94	$32.86
Public and private land use fees	$5.00	$40.44	$16.98
Boat launching, boat fuel, boat mooring	$53.94	$99.26	$69.26
Other trip expenditures (Canada only)		$0.07	$0.02
Subtotal	$260.32	$326.26	$282.61

Equipment Expenditures (in dollars)	New York	Ontario	Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$85.65	$72.20	$81.10
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$48.62	$45.26	$47.48
Camping gear, Heating & cooking fuel	$8.14	$22.45	$12.98
Special fishing clothing, foul weather gear	$15.60	$18.60	$16.61
Equipment rental	$7.94	$8.35	$8.08
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$7.78	$0.03	$5.16
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$289.81	$260.26	$279.82
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$148.91	$51.85	$116.10
Cabins, Land purchased for fishing, Land leased for fishing	$198.03	$31.45	$141.72
Equipment Subtotal	$612.45	$478.99	$567.34
Real Estate Subtotal	$198.03	$31.45	$141.72
Grand Total	$1,070.80	$836.70	$991.67

Economic contributions

The $342.3 million of direct spending by anglers on Lake Ontario in 2020 generated $53.6 million of household income to 1,200 full- and part-time employees and proprietors who worked for or owned Lake Ontario businesses. Direct spending also contributed $32.9 million in tax revenues, $80.4 million to GPD and $134.7 million to direct economic output. Spending by anglers was higher in New York than Ontario and accounted for 700 of the jobs and $35.9 million of income (Table 37).

Including both direct and multiplier effects, the $342.3 million of spending by Lake Ontario anglers produced $90.0 million of household income and supported 1,800 full and part time jobs. This level of spending also resulted in a contribution of $143.7 million to GDP, $18.6 million in Federal taxes, and $26.9 million (Table 37).

Table 37. Economic contributions of all spending for recreational fishing on Lake Ontario in 2020, by state/Province.

	Lake Ontario Total	New York	Ontario Province
Direct effects			
Output (millions)	$134.7	$85.0	$49.7
GDP (millions)	$80.4	$54.8	$25.6
Income (millions)	$53.6	$35.9	$17.7
Employment (thsds)	1.2	0.7	0.5
Federal taxes (millions)	$12.4	$7.8	$4.6
State/Province & local taxes (millions)	$20.5	$11.3	$9.2
Multiplier effects			
Output (millions)	$105.6	$62.6	$43.0
GDP (millions)	$63.3	$39.5	$23.8
Income (millions)	$36.4	$23.6	$12.8
Employment (thsds)	0.6	0.3	0.3
Federal taxes (millions)	$6.2	$5.0	$1.2
State/Province & local taxes (millions)	$6.6	$4.1	$2.5
Total effects			
Output (millions)	$240.2	$147.6	$92.6
GDP (millions)	$143.7	$94.3	$49.4
Income (millions)	$90.0	$59.5	$30.5
Employment (thsds)	1.8	1.0	0.8
Federal taxes (millions)	$18.6	$12.8	$5.8
State/Province & local taxes (millions)	$26.9	$15.3	$11.6

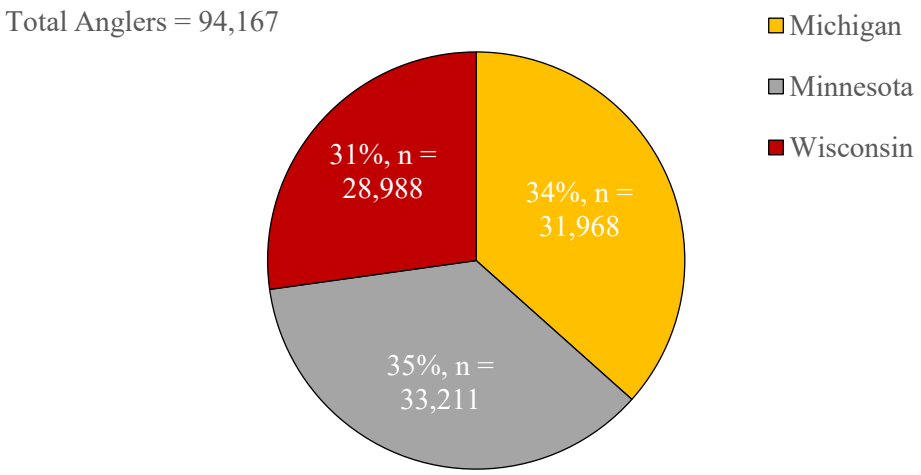
Lake Superior

Participation

In 2020, an estimated 94,000 US anglers fished Lake Superior and its tributaries[23], with anglers proportioned nearly equally across the three states (Figure 16). Overall, 11% of Lake Superior anglers fished with a non-resident license, with the lowest percentage launching from Michigan (4%) and the highest from Wisconsin (21%) (Figure 17). Overall, anglers spent an average of 18 days fishing on Lake Superior, which equated to nearly 1.7 million total fishing days (Table 38). Salmonid species were pursued most often (70%), with the highest percentage targeting lake trout (50%, 582,000 days), salmon (45%, 530,000 days), other trout (37%, 456,000 days), and steelhead (36%, 453,000 days). For non-salmonids, nearly half of all anglers fished for walleye/sauger (46%, 632,000 days), followed by followed by pike (29%, 476,000 days), yellow perch (24%, 309,000 days), and bass (22%, 395,000 days) (Table 38).

By state, a higher percentage of Michigan anglers pursued yellow perch (42%, 156,000 days), pike (40%, 210,00 days), and bass (36%, 228,000 days), as compared to Minnesota and Wisconsin (Figure 18, Table 39). The highest number of days overall came from Michigan walleye anglers (51%, 259,000 days). For Minnesota, anglers targeting lake trout made up the highest number of days (53%, 230,000 days), and in Wisconsin, anglers mostly pursued other trout (50%, 234,000 days) (Figure 18, Table 39).

Figure 16. Lake Superior angler numbers and percent of total, 2020.



[23] Per Dr. Len Hunt, an estimated 12,913 individual fished Lake Superior in Canadian waters.

Figure 17. Percentage of resident and non-resident anglers on Lake Superior, by state, 2020.

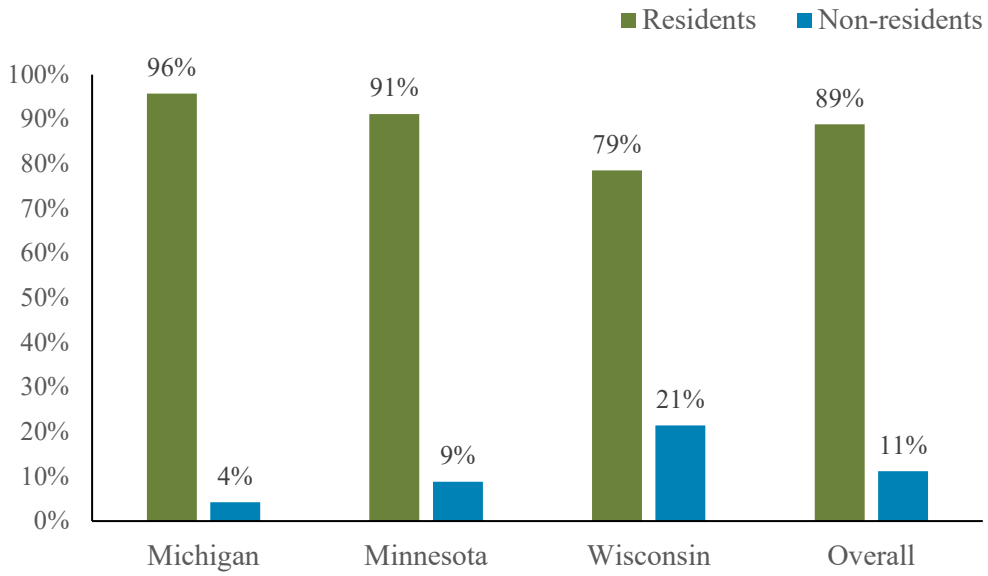


Figure 18. Percentage of anglers who pursued fish species, by state of launch, 2020.

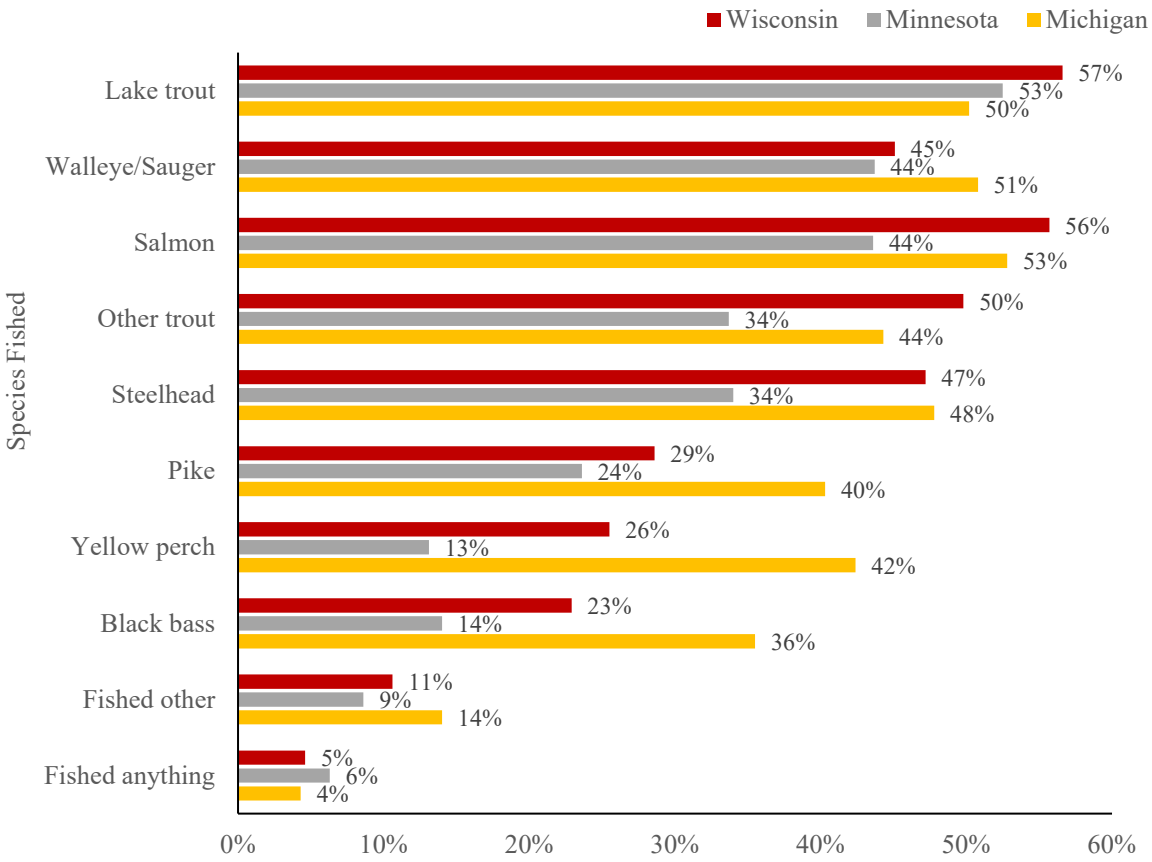


Table 38. Lake Superior species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

	Residents				Non-Residents				Total			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Yellow perch	12%	10,209	11.7	119,441	17%	1,804	7.4	13,352	13%	12,053	11.0	132,587
Black bass	12%	9,874	16.4	161,932	20%	2,046	8.1	16,569	13%	11,959	15.0	179,388
Walleye/Sauger	40%	33,722	13.2	445,128	32%	3,378	5.9	19,929	39%	37,102	12.5	463,773
Salmon	41%	34,140	10.9	372,128	32%	3,325	11.3	37,577	40%	37,384	11.0	411,228
Steelhead	30%	24,685	10.7	264,126	24%	2,465	11.1	27,364	29%	27,120	10.8	292,898
Lake trout	51%	42,843	10.9	466,985	38%	3,955	17.7	70,000	50%	46,707	11.5	537,130
Other trout	33%	27,362	12.2	333,821	27%	2,843	8.3	23,596	32%	30,133	11.8	355,575
Pike	22%	18,493	13.8	255,198	30%	3,179	7.1	22,568	23%	21,658	12.7	275,062
Fished Anything	9%	7,196	11.5	82,757	6%	619	1.6	990	8%	7,816	11.1	86,756
Fished Other	7%	5,606	15.0	84,095	2%	241	11.0	2,654	6%	5,838	14.6	85,240
Overall		83,677	17.7	1,481,083		10,490	16.4	172,039		94,167	17.5	1,647,926

Table 39. Lake Superior species pursued, number of anglers, average days fished, and total fishing days by state, 2020. Residents and non-residents combined.

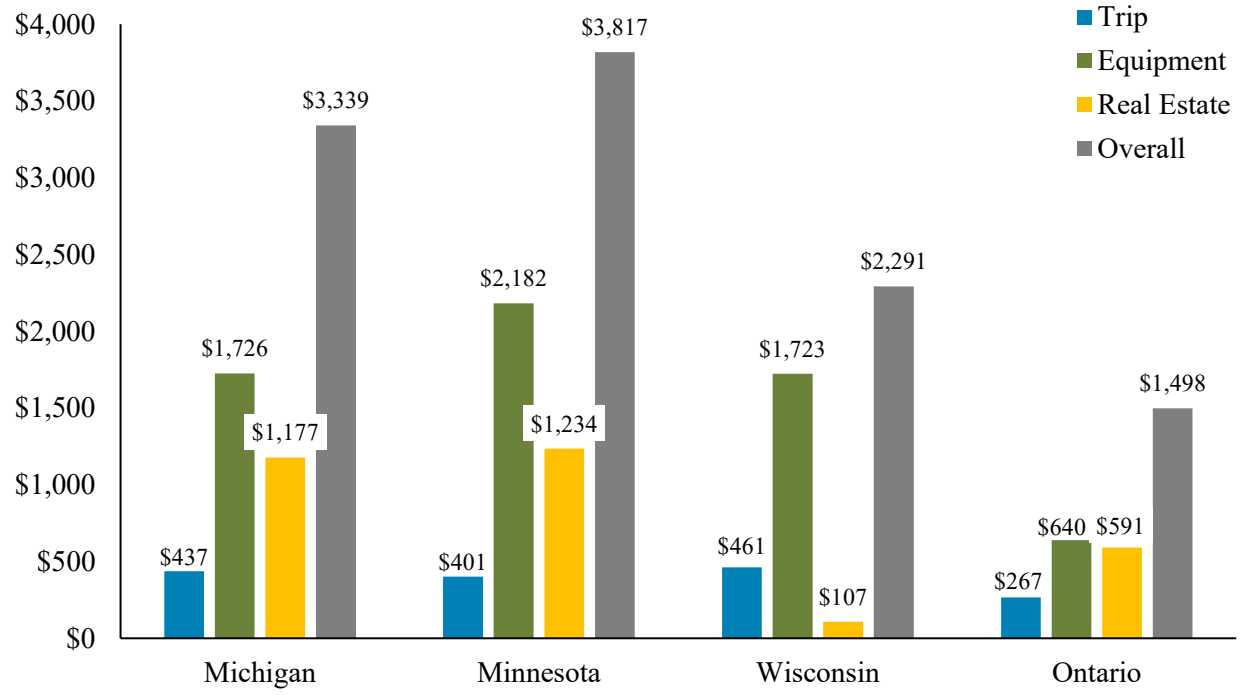
	Michigan				Minnesota				Wisconsin			
Species	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days	% Fished	N Anglers	Avg Days	Total Days
Yellow perch	23%	7,480	7.7	57,600	10%	3,421	9.2	31,471	19%	5,421	23.8	129,014
Black bass	18%	5,690	10.4	59,179	11%	3,653	12.9	47,127	15%	4,377	23.9	104,615
Walleye/Sauger	28%	8,855	15.9	140,796	42%	13,816	12.1	167,172	36%	10,291	12.3	126,576
Salmon	42%	13,395	13.3	178,147	40%	13,285	10.9	144,801	42%	12,262	9.9	121,393
Steelhead	37%	11,924	12.0	143,088	28%	9,366	10.8	101,148	31%	8,986	8.3	74,586
Lake trout	50%	15,984	19.8	316,481	51%	16,971	10.7	181,589	46%	13,392	7.9	105,801
Other trout	37%	11,764	9.5	111,760	31%	10,129	12.1	122,566	44%	12,639	13.1	165,568
Pike	29%	9,111	8.7	79,264	21%	6,941	13.1	90,929	32%	9,218	15.3	141,039
Fished Anything	5%	1,598	1.6	2,557	8%	2,790	13.0	36,267	9%	2,667	5.3	14,135
Fished Other	2%	703	4.1	2,883	7%	2,159	13.1	28,279	5%	1,333	24.6	32,803
Overall		30,621	15.5	495,501		33,211	16.1	534,702		28,988	17.8	515,988

Expenditures

In total, Lake Superior anglers spent $319.3 million across the United States ($300.0 million) and Canada ($19.3 million[24]). WAs with the proportion of anglers, US trip expenditures followed a similar pattern of near equality across all three states. Within the trip category (14% of all expenditures), direct expenditures by US anglers were highest for boat fees and fuel ($11.5 million), food/ice ($10.8 million), and transportation ($7.77 million). Canadian anglers also spent the most on boat fees and fuel ($12.5 million), followed by food/ice ($11.6 million), and transportation ($8.88 million). Overall, US anglers spent more on equipment ($177.6 vs. $8.27 million) and real estate ($81.7 vs. $7.64 million) than Canadian anglers (Table 40).

Anglers spent an average of $2,981.94 fishing Lake Superior in 2020. State level averages varied, with Minnesota anglers spending the most ($3,817.48) and Ontario anglers the least ($1,498.17) (Figure 19). Table 41 summarizes average state (and Provincial) spending for major expenditure categories. Within the trip expenditure category, anglers spent the most money on boat launching, fuel, and mooring ($116.45), followed by food ($108.65), and transportation ($82.30). Money spent on equipment averaged $1,735.32 per year, due mostly to boat ($811.88) and vehicle ($532.41) purchases. On average, anglers spent $205.84 on fishing equipment, $89.13 on bait/terminal tackle, and $30.00 on clothing (Table 41).

Figure 19. Average trip, equipment, and real estate expenditures for 2020 Lake Superior anglers, by state and Province.



[24] Canadian expenditure data for Lake Erie includes Lake St. Clair and the St. Clair River.

Table 40. Detailed spending (in millions) for recreational fishing on Lake Superior, by state/Province.

Trip Expenditures (in millions)	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Food, Ice	$3.49	$4.04	$3.31	$.80	$10.83	$11.63
Lodging	$2.29	$1.52	$2.59	$.16	$6.40	$6.55
Airfare, Public and private transportation	$2.68	$2.79	$2.30	$1.10	$7.77	$8.88
Guides	$1.03	$.81	$1.69	$.14	$3.53	$3.67
Public and private land use fees	$.24	$.18	$.21	$.28	$.63	$.91
Boat launching, boat fuel, boat mooring	$4.23	$4.0	$3.28	$.96	$11.51	$12.47
Other trip expenditures (Canada only)				$0		$.0
Subtotal	$13.96	$13.33	$13.38	$3.44	$40.67	$44.12

Equipment Expenditures (in millions)	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$5.72	$7.90	$7.59	$.83	$21.21	$22.04
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$2.74	$2.98	$3.26	$.57	$8.98	$9.54
Camping gear, Heating & cooking fuel	$.64	$1.01	$.47	$1.13	$2.13	$3.26
Special fishing clothing, foul weather gear	$.85	$1.18	$.98	$.19	$3.02	$3.21
Equipment rental	$.26	$.37	$.30	$.02	$.92	$.94
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$.71	$1.58	$.56	$.03	$2.85	$2.88
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$25.59	$36.99	$20.15	$4.20	$82.73	$86.94
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$18.64	$20.45	$16.63	$1.29	$55.72	$57.01
Cabins, Land purchased for fishing, Land leased for fishing	$37.63	$41.0	$3.11	$7.64	$81.74	$89.37
Equipment Subtotal	$55.16	$72.45	$49.94	$8.27	$177.55	$185.82
Real Estate Subtotal	$37.63	$41.0	$3.11	$7.64	$81.74	$89.37
Grand Total	$106.76	$126.78	$66.42	$19.35	$299.96	$319.31

Table 41. Average per angler spending (in dollars) for recreational fishing on Lake Superior, by state/Province.

Trip Expenditures (in dollars)	Michigan	Minnesota	Wisconsin	US Total	Ontario	Grand Total
Food, Ice	$109.08	$121.54	$114.15	$115.04	$62.05	$108.65
Lodging	$71.51	$45.64	$89.47	$67.91	$12.25	$61.20
Airfare, Public and private transportation	$83.98	$83.97	$79.33	$82.54	$85.45	$82.90
Guides	$32.17	$24.48	$58.37	$37.52	$10.81	$34.30
Public and private land use fees	$7.50	$5.48	$7.17	$6.68	$21.65	$8.49
Boat launching, boat fuel, boat mooring	$132.44	$120.39	$113.01	$122.21	$74.47	$116.45
Other trip expenditures (Canada only)					$0.00	$0.00
Subtotal	$436.69	$401.48	$461.50	$431.91	$266.69	$411.99

Equipment Expenditures (in dollars)	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Rods, reels & components, Tackle boxes, Creels, stringers, landing nets, Depth and fish finders, other electronics, Ice fishing equipment, Binoculars, Other fishing equipment	$178.99	$237.79	$261.94	$225.26	$64.22	$205.84
Bait (live, cut, prepared), Lines & leaders, Lures, flies & artificial bait, Hooks, sinkers, other terminal tackle, Bait buckets, minnow traps	$85.81	$89.67	$112.35	$95.34	$43.84	$89.13
Camping gear, Heating & cooking fuel	$20.17	$30.50	$16.12	$22.57	$87.76	$30.43
Special fishing clothing, foul weather gear	$26.66	$35.56	$33.93	$32.04	$15.10	$30.00
Equipment rental	$8.12	$11.02	$10.24	$9.80	$1.26	$8.77
Taxidermy & processing, Books & magazines, Dues and contributions, Other misc. fishing expenditures	$22.34	$47.56	$19.20	$30.27	$2.06	$26.87
Bass boats, Other motorized boats, Canoes, non-motorized boats, Boat motors, trailers, hitches	$800.56	$1,113.81	$695.05	$878.56	$325.62	$811.88
Pick-ups, campers, motor homes, 4x4 and off-road vehicles	$582.95	$615.67	$573.79	$591.67	$100.27	$532.41
Cabins, Land purchased for fishing, Land leased for fishing	$1,177.20	$1,234.42	$107.18	$867.99	$591.36	$834.63
Equipment Subtotal	$1,725.60	$2,181.58	$1,722.64	$1,885.51	$640.12	$1,735.32
Real Estate Subtotal	$1,177.20	$1,234.42	$107.18	$867.99	$591.36	$834.63
Grand Total	$3,339.50	$3,817.48	$2,291.32	$3,185.41	$1,498.17	$2,981.94

Economic contributions

The $319.3 million of direct spending by anglers on Lake Superior in 2020 generated $76.7 million in household income to 1,600 full- and part-time employees and proprietors who worked for and owned Lake Superior businesses. This spending contributed $34.9 million in tax revenues, $106.6 million to GDP and $205.3 million to direct economic output. Spending by anglers was highest in Michigan and accounted for 700 of the jobs and $39.4 million of income (Table 42).

Including both direct and multiplier effects, the $319.3 million of spending by Lake Superior anglers produced $138.3 million in household income and supported 2,700 full and part time jobs. This level of spending also resulted in $200.1 million in GDP, $27.2 million in Federal taxes, and $28.5 million in State/Provincial and local taxes (Table 42).

Table 42. Economic contributions of all spending for recreational fishing on Lake Superior in 2020, by state/Province.

	Lake Superior Total	Michigan	Minnesota	Wisconsin	Ontario Province
Direct effects					
Output (millions)	$205.3	$95.7	$56.3	$41.3	$12.0
GDP (millions)	$106.6	$48.3	$29.9	$22.4	$6.0
Income (millions)	$76.7	$39.4	$18.1	$15.2	$4.0
Employment (thsds)	1.6	0.7	0.4	0.4	0.1
Federal taxes (millions)	$15.4	$7.3	$4.1	$3.2	$0.8
State/Provincial & local taxes (millions)	$19.5	$8.0	$5.6	$3.8	$2.1
Multiplier effects					
Output (millions)	$173.7	$82.7	$48.7	$32.5	$9.8
GDP (millions)	$93.6	$43.8	$26.8	$17.7	$5.3
Income (millions)	$61.6	$31.3	$16.3	$11.0	$3.0
Employment (thsds)	1.2	0.6	0.3	0.2	0.1
Federal taxes (millions)	$11.8	$5.8	$3.5	$2.2	$0.3
State/Provincial & local taxes (millions)	$9.1	$3.7	$2.8	$1.7	$0.9
Total effects					
Output (millions)	$378.9	$178.4	$104.9	$73.8	$21.8
GDP (millions)	$200.1	$92.0	$56.7	$40.1	$11.3
Income (millions)	$138.3	$70.7	$34.5	$26.2	$6.9
Employment (thsds)	2.7	1.2	0.7	0.6	0.2
Federal taxes (millions)	$27.2	$13.1	$7.6	$5.4	$1.1
State/Provincial & local taxes (millions)	$28.5	$11.8	$8.3	$5.5	$2.9

Lake St. Clair

Participation

In 2020, an estimated 62,000 licensed US anglers fished on Lake St. Clair. Of those, 85% (n = 52,588) were residents (Figure 20), who were more likely to pursue walleye/sauger (57% vs. 31%) and yellow perch (43% vs. 27%) compared to non-residents. In contrast, non-resident anglers were more likely to pursue bass (72% vs. 30%), though pike were similarly pursued (25 - 26%). As expected, salmonid species were infrequently fished (Figure 21).

Overall, Lake St. Clair anglers averaged 19.2 days fishing for all species combined, amounting to 1.2 million total days. Walleye/sauger were fished most frequently (53%, 436,000 days), followed by yellow perch (43%, 267,000 days) and bass (36%, 328,000 days) (Table 43).

Figure 20. Number of Lake St. Clair anglers, by residency status, 2020.

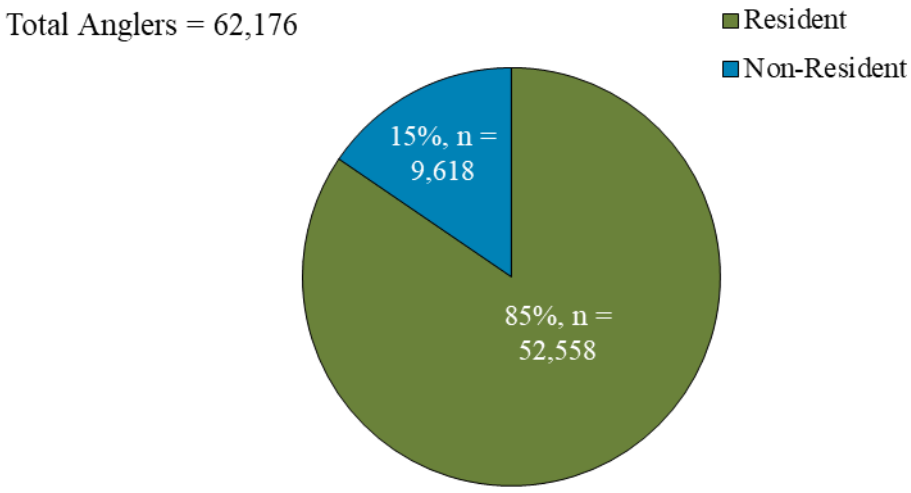


Figure 21. Species fished by Lake St. Clair anglers, 2020.

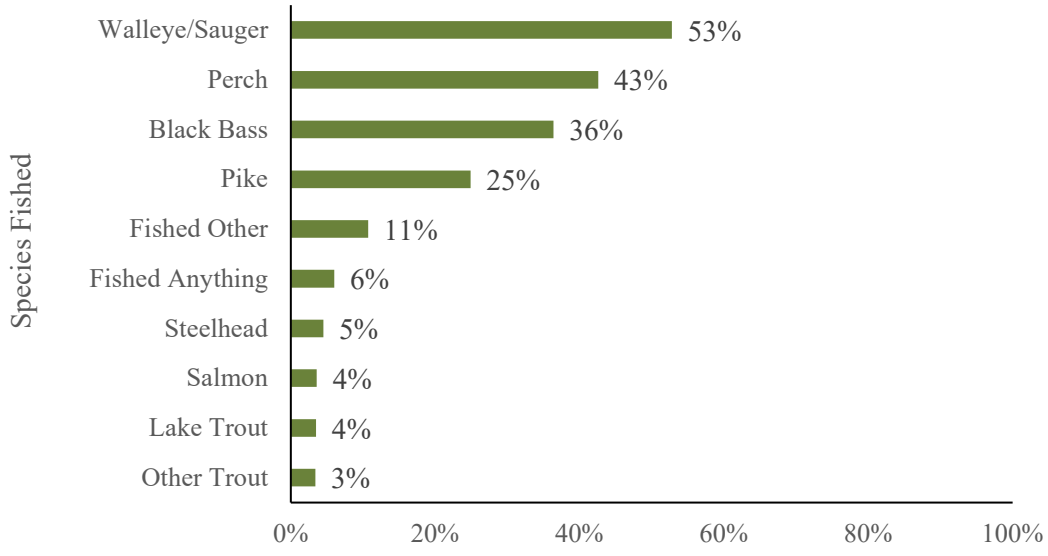


Table 43. Lake St. Clair species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

Resident				
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	46%	23,966	10.7	256,439
Black Bass	30%	15,767	19.0	299,578
Walleye/Sauger	57%	29,905	14.1	421,664
Salmon	4%	2,260	22.5	50,849
Steelhead	5%	2,786	3.3	9,192
Lake Trout	4%	2,207	1.0	2,207
Other Trout	4%	2,102	5.0	10,512
Pike	25%	13,034	9.6	125,129
Fished Anything	6%	3,259	29.5	96,128
Fished Other	12%	6,517	16.4	106,881
Overall		52,558	21.9	1,151,012

Non-Resident				
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	27%	2,568	3.6	9,245
Black Bass	72%	6,896	4.1	28,274
Walleye/Sauger	31%	2,943	6.3	18,542
Salmon	0%	*	*	*
Steelhead	0%	*	*	*
Lake Trout	0%	*	*	*
Other Trout	0%	*	*	*
Pike	26%	2,481	4.2	10,422
Fished Anything	5%	*	*	*
Fished Other	0%	*	*	*
Overall		9,618	4.2	40,396

Overall				
Species	% Fished	N Anglers	Avg Days	Total Days
Perch	43%	26,487	10.1	267,517
Black Bass	36%	22,632	14.5	328,163
Walleye/Sauger	53%	32,829	13.3	436,622
Salmon	4%	2,238	22.5	50,362
Steelhead	5%	2,798	3.3	9,233
Lake Trout	4%	2,176	1.0	2,176
Other Trout	3%	2,114	5.0	10,570
Pike	25%	15,482	8.8	136,239
Fished Anything	6%	3,731	29.5	110,051
Fished Other	11%	6,653	14.6	97,131
Overall		62,176	19.2	1,193,773

*No data, likely indicates minimal fishing activity

Expenditures

Overall, the estimated 62,176 US Lake St. Clair anglers[25] spent $207.4 million fishing in 2020. Of that amount, $27.2 million was attributable to trip expenditures, $107.3 million to equipment, and $73.2 million to real estate. Anglers spent an average of $3,339.50 each, with trips comprising 13% ($436.69), equipment represented 52% ($1,725.60), and real estate 35% ($1,177.20) (Table 44).

Table 44. Detailed spending (in millions) and average angler spending per day (in dollars) for recreational fishing on Lake St. Clair, Michigan only.

Trip Expenditures	Total (millions)	Per angler (dollars)
Food	$6.28	$100.94
Ice	$.51	$8.15
Lodging	$4.45	$71.51
Airfare	$.01	$0.15
Public transportation	$.02	$0.26
Private transportation	$5.20	$83.57
Guides	$2.0	$32.17
Public land use fees	$.39	$6.27
Private land use fees	$.08	$1.23
Boat launching	$.53	$8.54
Boat fuel	$3.79	$60.91
Boat mooring	$3.92	$62.99
Subtotal	$27.15	$436.69

Equipment Expenditures	Total (millions)	Per angler (dollars)
Rods, reels & components	$4.95	$79.55
Tackle boxes	$.37	$6.02
Creels, strings, landing nets	$.33	$5.37
Depth finder, fish finders, other electronics	$3.35	$53.84
Ice fishing equipment	$1.41	$22.62
Binoculars	$.43	$6.94
Other fishing equipment	$.29	$4.65
Bait (live, cut, prepared)	$1.33	$21.39
Lines & leaders	$.95	$15.28
Lures, flies & artificial bait	$2.27	$36.51
Hooks, sinkers, other terminal tackle	$.68	$10.97
Bait buckets, minnow traps	$.10	$1.65
Camping gear	$.82	$13.20
Heating & cooking fuel	$.43	$6.98
Special fishing clothing, foul weather gear	$1.66	$26.66
Equipment rental	$.51	$8.12
Taxidermy & processing	$.14	$2.25
Books & magazines	$.21	$3.35
Dues and contributions	$.40	$6.45
Other misc. fishing expenditures	$.64	$10.29
Bass boats	$6.41	$103.17
Other motorized boats	$36.41	$585.57
Canoes, non-motorized boats	$1.47	$23.72
Boat motors, trailers, hitches, etc.	$5.48	$88.10
Pick-ups, campers, motor homes	$27.72	$445.90
4x4 and off-road vehicles	$8.52	$137.05
Cabins	$.69	$11.16
Land purchased for fishing	$72.35	$1,163.62
Land leased for fishing	$.15	$2.42
Equipment Subtotal	$107.29	$1,725.60
Real Estate Subtotal	$73.19	$1,177.20
Grand Total	$207.64	$3,339.50

[25] Canadian Lake St. Clair anglers were included in the Lake Erie tables.

Economic contributions

The $207.6 million in direct spending by anglers on Lake St. Clair in 2020 generated $77.9 million in household income to 1,400 full- and part-time employees and proprietors who worked for or owned businesses on Lake St. Clair. This spending contributed $30.1 million in tax revenues, $100.3 million in GDP and $205.3 million in direct economic output (Table 45).

Including both direct and multiplier effects, the $207.6 million of spending by Lake St. Clair anglers produced $147.4 million in household income and supported 2,700 full and part time jobs. This level of spending also resulted in a contribution of $197.8 million to GDP along with $27.5 million and $23.9 million in Federal and State/Provincial and local taxes, respectively (Table 45).

Table 45. Economic contributions of all spending for recreational fishing on Lake St. Clair, Michigan, in 2020.

	Lake St. Clair
Direct effects	
Output (millions)	$205.3
GDP (millions)	$100.3
Income (millions)	$77.9
Employment (thsds)	1.4
Federal taxes (millions)	$14.5
State & local taxes (millions)	$15.6
Multiplier effects	
Output (millions)	$186.3
GDP (millions)	$97.8
Income (millions)	$69.7
Employment (thsds)	1.3
Federal taxes (millions)	$13.0
State & local taxes (millions)	$8.2
Total effects	
Output (millions)	$391.3
GDP (millions)	$197.8
Income (millions)	$147.4
Employment (thsds)	2.7
Federal taxes (millions)	$27.5
State & local taxes (millions)	$23.9

St. Lawrence River

Participation

In 2020, an estimated 45,638 licensed US anglers fished on the St. Lawrence River, 72% (n = 32,859) of whom were residents (Figure 22). Resident anglers were more likely to pursue yellow perch (65% vs. 22%) and walleye/sauger (40% vs. 30%), and Non-resident anglers were more likely to pursue pie (61% vs. 47%) and bass (71% vs. 63%). As expected, salmonid species were infrequently fished (Figure 23).

Overall, St. Lawrence River anglers averaged 19.2 days fishing for all species combined, which equated to 730,000 total days. The most frequently fished species were bass (65%, 464,000 days), pike (51%, 393,000 days), and yellow perch (53%, 304,000 days) (Table 46).

Figure 22. Number of St. Lawrence River anglers, by residency status, 2020.

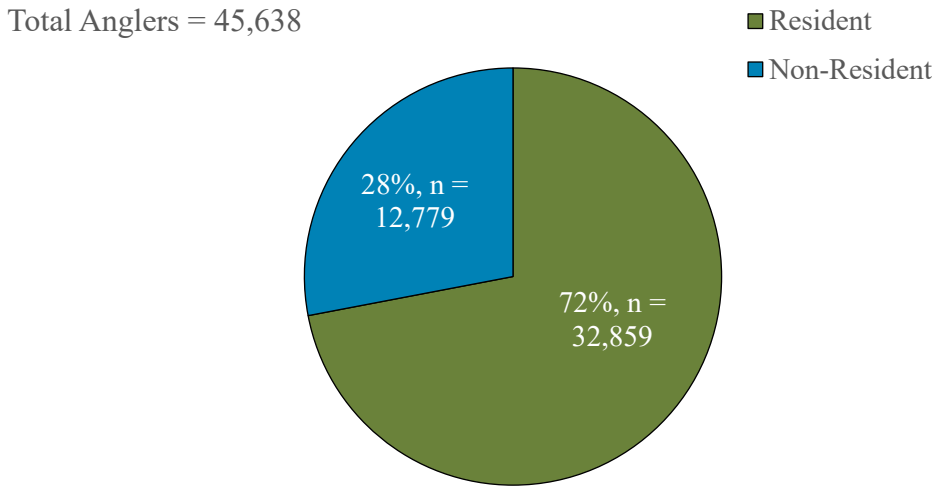


Figure 23. Species fished by St. Lawrence River anglers, 2020.

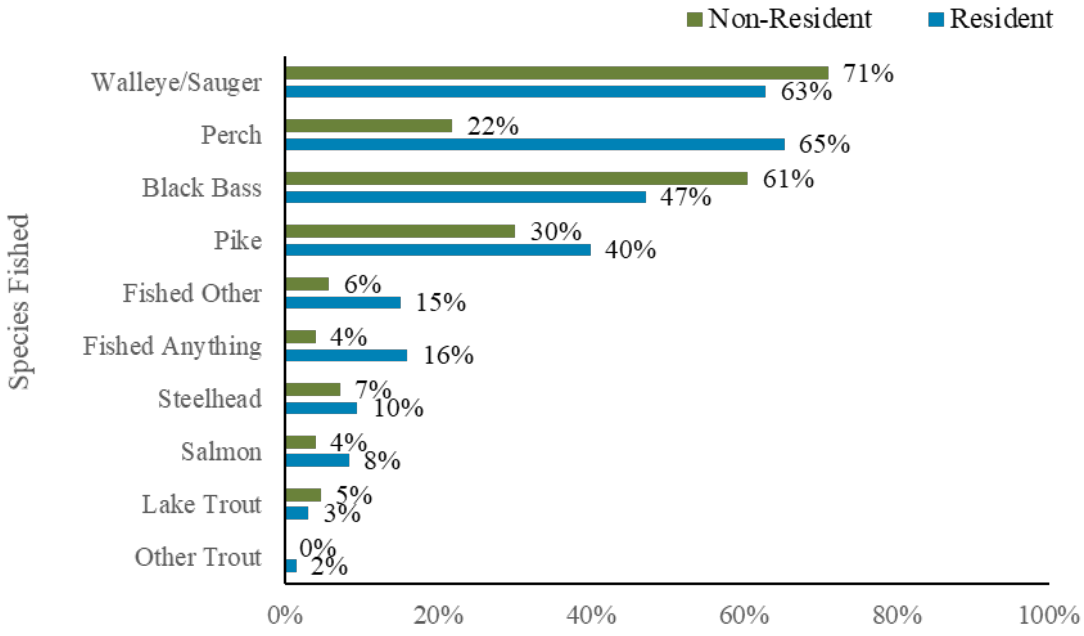


Table 46. St. Lawrence River species pursued, number of anglers, average days fished, and total fishing days by residency, 2020.

Resident

Species	% Fished	N Anglers	Avg Days	Total Days
Perch	65%	21,490	12.9	277,221
Black Bass	63%	20,669	18.3	378,234
Walleye/Sauger	40%	13,144	24.4	320,707
Salmon	3%	1,019	3.0	3,056
Steelhead	2%	493	3.0	1,479
Lake Trout	8%	2,760	7.7	21,253
Other Trout	16%	5,257	6.7	35,225
Pike	47%	15,510	20.2	313,294
Fished Anything	10%	3,122	2.1	6,555
Fished Other	15%	4,962	17.2	85,342
Overall		32,859	22.2	729,478

Non-Resident

Species	% Fished	N Anglers	Avg Days	Total Days
Perch	22%	2,799	10.2	28,545
Black Bass	71%	9,086	10.0	90,856
Walleye/Sauger	30%	3,846	5.8	22,309
Salmon	5%	601	1.0	601
Steelhead	0%	*	*	*
Lake Trout	4%	511	20.0	10,223
Other Trout	4%	511	20.0	10,223
Pike	61%	7,744	11.1	85,957
Fished Anything	7%	920	4.0	3,680
Fished Other	6%	741	7.0	5,188
Overall		12,779	11.3	144,399

Overall

Species	% Fished	N Anglers	Avg Days	Total Days
Perch	53%	24,188	12.6	304,771
Black Bass	65%	29,756	15.6	464,193
Walleye/Sauger	37%	16,977	19.9	337,849
Salmon	4%	1,597	2.2	3,514
Steelhead	1%	502	3.0	1,506
Lake Trout	7%	3,240	9.7	31,431
Other Trout	13%	5,750	8.2	47,153
Pike	51%	23,275	16.9	393,354
Fished Anything	9%	4,062	2.4	9,748
Fished Other	13%	5,796	14.8	85,781
Overall		45,638	19.2	876,250

*No data, likely indicates minimal fishing activity

Expenditures

Overall, the estimated 45,638 US St. Lawrence River anglers[26] spent $48.9 million fishing in 2020. Of that amount, $11.9 million was attributable to trip expenditures, $28.0 million to equipment, and $9.04 million to real estate. Anglers spent an average of $1,070.80 each, with trip costs comprising 24% ($260.32), equipment represented 57% ($612.45), and real estate 18% ($198.03) (Table 47).

Table 47. Detailed spending (in millions) and average angler spending per day (in dollars) for recreational fishing on the St. Lawrence River, New York only.

Trip Expenditures	Total (millions)	Per angler (dollars)
Food	$2.86	$62.73
Ice	$.19	$4.22
Lodging	$2.54	$55.71
Airfare	$.05	$1.10
Public transportation	$.03	$0.55
Private transportation	$2.23	$48.84
Guides	$1.29	$28.22
Public land use fees	$.10	$2.15
Private land use fees	$.13	$2.85
Boat launching	$.25	$5.42
Boat fuel	$1.26	$27.66
Boat mooring	$.95	$20.85
Subtotal	$11.88	$260.32
Equipment Expenditures	Total (millions)	Per angler (dollars)
Rods, reels & components	$2.40	$52.56
Tackle boxes	$.12	$2.63
Creels, strings, landing nets	$.09	$1.91
Depth finder, fish finders, other electronics	$.75	$16.50
Ice fishing equipment	$.40	$8.72
Binoculars	$.10	$2.12
Other fishing equipment	$.06	$1.21
Bait (live, cut, prepared)	$.56	$12.27
Lines & leaders	$.36	$7.93
Lures, flies & artificial bait	$.95	$20.79
Hooks, sinkers, other terminal tackle	$.31	$6.87
Bait buckets, minnow traps	$.03	$0.76
Camping gear	$.24	$5.32
Heating & cooking fuel	$.13	$2.82
Special fishing clothing, foul weather gear	$.71	$15.60
Equipment rental	$.36	$7.94
Taxidermy & processing	$.06	$1.24
Books & magazines	$.06	$1.42
Dues and contributions	$.08	$1.67
Other misc. fishing expenditures	$.16	$3.46
Bass boats	$1.08	$23.61
Other motorized boats	$7.61	$166.83
Canoes, non-motorized boats	$.98	$21.57
Boat motors, trailers, hitches, etc.	$3.55	$77.81
Pick-ups, campers, motor homes	$4.74	$103.81
4x4 and off-road vehicles	$2.06	$45.10
Cabins	$.25	$5.42
Land purchased for fishing	$8.67	$189.91
Land leased for fishing	$.12	$2.70
Equipment Subtotal	$27.95	$612.45
Real Estate Subtotal	$9.04	$198.03
Grand Total	$48.87	$1,070.80

[26] St. Lawrence River anglers in Canada were included in the Lake Ontario tables.

Economic contributions

The $48.9 million of direct spending by anglers on the St. Lawrence River in 2020 generated $6.7 million of household income to 100 full- and part-time employees and proprietors who worked for or owned businesses on the St. Lawrence River. This spending contributed $3.5 million in tax revenues, $11.0 million to GDP, and $18.0 million to direct economic output (Table 48).

Including direct and multiplier effects, the $48.9 million of spending by St. Lawrence River anglers produced $11.8 million in household income and supported 200 full and part time jobs. This level of spending also resulted in a $19.6 million contribution to GDP as well as $2.5 (Table 48).

Table 48. Economic contributions of all spending for recreational fishing on the St. Lawrence River, New York, in 2020.

	St. Lawrence River
Direct effects	
Output (millions)	$18.0
GDP (millions)	$11.0
Income (millions)	$6.7
Employment (thsds)	0.1
Federal taxes (millions)	$1.5
State & local taxes (millions)	$2.0
Multiplier effects	
Output (millions)	$13.8
GDP (millions)	$8.6
Income (millions)	$5.1
Employment (thsds)	0.1
Federal taxes (millions)	$1.1
State & local taxes (millions)	$0.9
Total effects	
Output (millions)	$31.7
GDP (millions)	$19.6
Income (millions)	$11.8
Employment (thsds)	0.2
Federal taxes (millions)	$2.5
State & local taxes (millions)	$2.9

Commercial Fishing

Commercial Landings & Revenue

Commercial fisheries effort associated with the major waterbodies of Great Lakes centers largely around three states: Michigan, Ohio, and Wisconsin, with smaller contributions made by Minnesota and New York. Illinois and Indiana do not have commercial fisheries. Commonly harvested species in the United States were lake whitefish, yellow perch, lake trout, lake herring/cisco, and white perch. By state, the highest percentage of whitefish and lake trout were harvested in Michigan and Wisconsin; conversely, Ohio commercial harvesters took the vast majority of yellow and white perch (Figure 24, Table 49).

In Canada, walleye were the most common species, followed by yellow perch, lake whitefish, white bass, and white perch (Table 49). Combined, these species account for more than a third of the total landed pounds and more than 90% of total landings revenue. While comparatively small relative to the entire North American commercial marine fisheries industry, it has substantial contributions to the region as a whole and the livelihoods of those employed within the industry.

Figure 24. Percent of fish harvested commercially in US Great Lakes, by state, 2018.

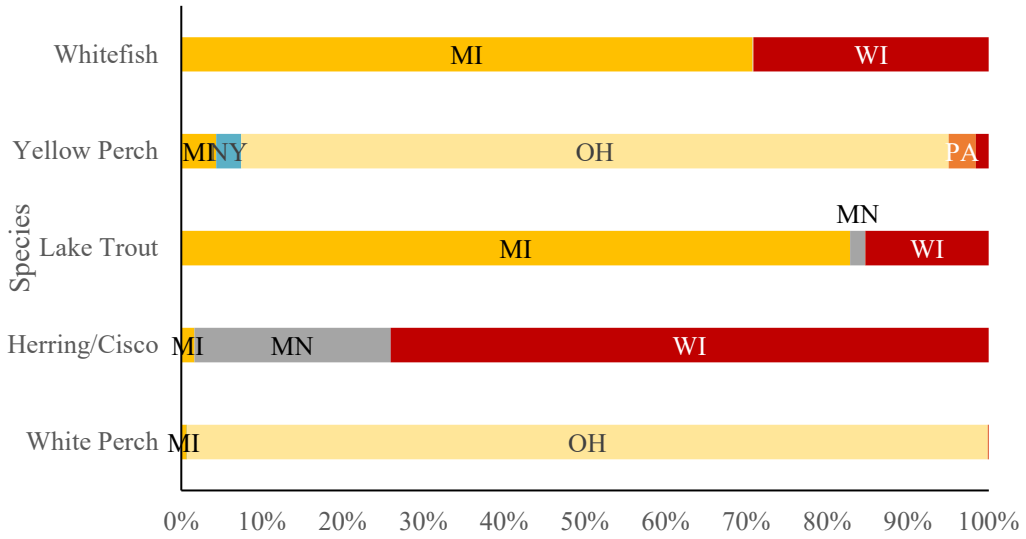


Table 49. Top five commercially harvested species in the United States and Ontario Province from the Great Lakes in 2018 (Inflation adjusted 2020 U.S. dollars).

United States			Ontario Province		
Species	Million Pounds	Total Revenue (millions)	Species	Million Pounds	Total Revenue (millions)
Whitefish	5.2	$8.7	Walleye	7.2	$16.1
Yellow Perch	1.6	$3.2	Yellow Perch	4.9	$9.6
Lake Trout	1.0	$0.8	Whitefish	1.8	$2.3
Lake Herring/Cisco	0.9	$0.5	White Bass	2.0	$1.6
White Perch	0.8	$0.4	White Perch	3.5	$1.7
All others	2.2	$1.4	All others	3.7	$1.0
Grand total	11.7	$15.0	Grand total	23.2	$32.4

Note: The most recent NOAA Fisheries commercial fisheries landing data available for the Great Lakes region reflects 2018 harvest and revenue. For the purposes of this effort, we assume the same level of harvest and adjust revenue to 2020 dollars. For consistency purposes only, the 2018 data for harvest and inflation adjusted revenue for the Ontario Province are reflected in these data.

Commercial Impacts

Including the multiplier effects of all industries involved in harvesting, processing, distributing, and retailing to consumers, Table 50 shows that commercially harvested fish from the Great Lakes created $151.4 million of economic activity in the U.S., contributing $78.5 million to GDP. These industries supported more than 1,920 jobs in both the US, which provided $55.4 million to household incomes in 2020. The majority of those impacts were felt in Michigan, Ohio, and Wisconsin.

For the same time period, Canadian harvest and revenues were twice that of the U.S., totaling 23.2 million pounds and $32.4 million dollars (2020 U.S. dollars). Collectively, the commercial fishing industry in both countries contributed $130 million dollars to North American GDP, supported almost 3,000 jobs, and generated $93.3 million dollars in household income.

Table 50. Estimated commercial Great Lakes fisheries harvest economic contributions in 2018 (Inflation adjusted 2020 U.S. dollars).

	Michigan	Minnesota	New York	Ohio	Wisconsin	U.S. Total	Ontario Province	Grand total
Total revenue (millions)	$8.0	$0.2	$0.1	$3.8	$2.9	$15.0	$32.4	$47.8
Total pounds (million)	5.2	0.2	0.1	3.8	2.4	11.7	23.2	34.9
Total economic contributions								
Output (millions)	$81.0	$2.3	$1.0	$38.1	$29.0	$151.4	$141.4	$292.8
GDP (millions)	$42.0	$1.2	$0.5	$19.8	$15.0	$78.5	$52.0	$130.5
Income (millions)	$29.6	$0.8	$0.3	$14.0	$10.6	$55.4	$38.0	$93.3
Employment	1,027	29	13	484	368	1,920	1,146	3,066

Note: Every attempt was made to develop landings, revenue, and economic contributions that were comparable between the U.S. and Ontario. This proved challenging given the different data sources and modeling approaches used by the United States and Canada.

Combined Economic Contributions of the Great Lakes Fisheries

Combined, the US and Canadian recreational and commercial fisheries generated $1.94 billion dollars of income, contributed $2.88 billion dollars to North America's GDP, and sustained almost 39,000 full and part-time jobs.

Table 51. Total economic contributions of the US and Canadian recreational and commercial fisheries, 2020.

	Recreational			Commercial			
Total effects	US	Ontario Province	Rec. Total	US	Ontario Province	Comm. Total	Grand Total
Output (millions)	$4,852.4	$276.1	$5,128.5	$151.4	$141.4	$292.8	$5,421.3
GDP (millions)	$2,607.8	$146.1	$2,753.9	$78.5	$52.0	$130.5	$2,884.4
Income (millions)	$1,800.4	$89.8	$1,890.2	$55.4	$38.0	$93.3	$1,938.0
Employment	33,500	2,300	35,800	1,920	1,146	3,066	38,866

Objective 2. To determine the economic value held by the U.S. and Canadian publics for the Great Lakes fishery, including use and non-use values, and including the values held for the fishery's role in the ecosystem.

Willingness to Pay for Great Lakes Fishing Trips

We first considered the effect of item nonresponse on the cost of the most recent trip variable on willingness to pay responses. In a logit model analyzing the factors that explain item nonresponse we find that males, those with higher incomes, those who hold nonresident licenses and who fish with more people are more likely to report their cost per trip. Beginner skill level anglers are less likely to report the cost for the most recent trip. It is tempting to conduct a complete case analysis with these data, dropping willingness to pay responses with missing cost per trip information assuming that those who consider and report their costs per trip provide better answers. But, complete case analysis would impose a sample selection rule and potentially bias the WTP estimates due to an unrepresentative sample. The percentage of "yes" responses is 57% for those who report their cost per trip and 53% for those who do not. The difference is seemingly small but statistically significant ($\chi^2 = 12.5(1\ df)$). In split sample logit models, we find that both models are statistically reliable and there are differences in both the constant (α) and slope (β) coefficients. But, there is no statistically significant difference in the WTP estimates. Considering these results, we proceed with analysis of the full data (n = 8,425).

Simple willingness to pay binary logit models with "I don't know" responses recoded to no responses are estimated (Table 52).[27] We present four models. One set is with the two dependent variables: the raw willingness to pay responses (yes1) and the yes1 responses recoded for respondent certainty (yes2). For each of these we estimate unweighted and weighted models.

In each of the logit models the constant (α) is positive and the slope (β) coefficient is negative and statistically significant. The weighted models provide an improved statistical fit with higher model chi-squared values. The raw yes1 models provide a greater statistical fit relative to the recoded yes2 responses. This is a typical result since the dependent variable in the recoded yes2 models contains an additional source of variation.

The willingness to pay estimates are also presented in Table 52. We focus our discussion on the weighted models due to their greater statistical fit. The weighted models produce willingness to pay estimates that are 93% to 96% that of the unweighted estimates. The mean willingness to pay estimate without hypothetical bias mitigation is $82 with a tight 95% confidence interval of [78, 85]. The probability of a yes1 response when the cost amount is zero is 76% and the truncated willingness to pay is $101 [96, 105], 1.2 times greater than that the willingness to pay estimate that allows negative values. The mean willingness to pay estimate with hypothetical bias mitigation is $54 [51, 58]. The probability of a yes response when the cost amount is zero is 68% and the truncated willingness to pay is $85 [80, 89], 1.6 times greater than that which allows negative values.

[27] We also estimated multinomial and ordered logit models to test whether the "I don't know" and "no" responses are statistically equal (Groothuis and Whitehead, 2002). In both models we find statistically significant differences, suggesting that "I don't know" is a middle response between a "yes" and a "no" (these results are available upon request). By estimating the logit with the "I don't know" combined with no responses we provide conservative willingness to pay estimates. Note also that it is not clear what to do with "I don't know" responses in benefit-cost analysis when they are clearly middle responses. Dropping "I don't know" responses from the analysis will lead to upward biased willingness to pay estimates.

Table 52. Simple willingness to pay logit models.

	Dependent variable is Yes[1]					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.176	0.046	25.35	1.163	0.046	25.16
Cost	-0.014	0.00059	-23.22	-0.014	0.00059	-24.08
Sample size	8,425			8,425		
Model $\chi 2$ (df)	574.35 (1)			620.53 (1)		
	WTP	SE	t-value	WTP	SE	t-value
Base	$85.57	1.81	47.21	$81.50	1.69	48.21
Truncated	$105.12	2.60	40.36	$100.56	2.36	42.56

	Dependent variable is Yes[2]					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	0.743	0.044	16.90	0.710	0.044	16.20
Cost	-0.013	0.00058	-21.79	-0.013	0.00058	-22.40
Sample size	8,425			8,425		
Model χ^2 (df)	501.02 (1)			531.53 (1)		
	WTP	SE	t-value	WTP	SE	t-value
Base	$58.52	1.79	32.60	$54.18	1.78	30.46
Truncated	$89.20	2.40	37.19	$84.71	2.19	38.72

Note: Yes[1] is yes vs. no/I don't know
Yes[2] is certain yes vs. no/I don't know/uncertain yes

Next, we examined the other factors that explain the willingness to pay responses. In doing this we relax the assumption that the marginal utility of income is constant across states of the word (trip vs no trip) include measures that are related to the cost per trip and include other variables to parameterize the constant. In choosing these variables we focus on those that have a sample size greater than 8,000 to avoid significant sample attrition and that produce statistically significant coefficient estimates.[28]

The average income is $96.8 thousand and suffers from significant, 23%, item nonresponse. We include the income variable and avoid a reduced sample size by setting the income for those who do not report income equal to zero and include a dummy variable for income item non-response. The coefficient on the income variable is no different than the coefficient on income with the sample reduced by income item non-response. Two variables are related to the cost for the most recent trip, whether the respondent took a day trip and the miles driven to the fishing location. In an ordinary least squares regression a day trip lowers the baseline cost per trip by 84% and the cost increases by $1.19 for each mile driven. In order to parameterize the constant,

[28] This sort of pre-testing of an econometric model is generally frowned upon but is common. Since the variables that we exclude from the model are not theoretically important and our model is only used for descriptive purposes, we consider the benefits of the more parsimonious model to be greater than the costs.

we include angler age, dummy variables for angler skill, dummy variables for fishing mode, dummy variables for target species and angler age and state of residence.

There were significant differences in willingness to pay between the complete case sample (n = 7,761) and those who have item non-response on this set of variables (n = 664). The mean willingness to pay estimated from a simple logit model is $88 with the complete case sample and $48 estimated with those from the item non-response sample. Since there may be many reasons for non-response we proceed with welfare analysis below with the full sample in order to avoid an upward bias in the willingness to pay estimates. But, we discuss the potential effects of covariates on willingness to pay here.

The full models are presented in Table 53. Again, we present unweighted and weighted model; however, there are few differences, so our discussion focuses on the weighted model results. The marginal effect of each independent variable is equal to the coefficient on the variable divided by the negative of the coefficient on the cost amount. As before, the cost amount increases the respondent is less likely to take the most recent trip. As income increases the respondent is more likely to continue taking the most recent trip. Each $10,000 increase in income leads to an increase of $2.83 in willingness to pay. For the variables that capture the baseline trip cost, as the miles traveled increases willingness to pay increases. The willingness to pay for a day trip is $53 lower than the willingness to pay for an overnight night trip.

Table 53. Angler willingness to pay logit models with covariates.

	Dependent variable is Yes[1] ("yes" vs "no"/"I don't know")					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Intercept	1.299	0.145	8.98	1.353	0.137	9.89
Cost	-0.016	0.001	-23.95	-0.016	0.001	-24.55
Income	0.005	0.001	8.07	0.005	0.001	7.89
Missing income	0.025	0.084	0.30	0.010	0.083	0.12
Miles	0.001	0.000	5.95	0.001	0.000	5.96
Day trip	-0.890	0.073	-12.17	-0.862	0.073	-11.82
Age	0.006	0.002	3.69	0.006	0.002	3.28
Target perch	-0.105	0.055	-1.91	-0.092	0.055	-1.67
Target pike	0.205	0.067	3.08	0.201	0.066	3.04
No target	-0.115	0.061	-1.90	-0.096	0.059	-1.63
Advanced	0.097	0.055	1.76	0.121	0.055	2.21
Expert	0.239	0.093	2.56	0.223	0.094	2.37
Charter boat mode	0.220	0.087	2.52	0.231	0.089	2.60
Shore mode	-0.354	0.063	-5.60	-0.375	0.063	-6.00
Pier mode	-0.375	0.100	-3.75	-0.387	0.097	-3.99
Ice fishing mode	-0.279	0.112	-2.48	-0.242	0.109	-2.22
MN	-0.175	0.090	-1.95	-0.183	0.088	-2.08
PA	-0.173	0.073	-2.37	-0.137	0.072	-1.90
WI	-0.167	0.090	-1.85	-0.167	0.091	-1.83
Sample size	7,761			7,761		
Model χ^2 (df)	1461.15 (18)			1474.93 (18)		

Anglers who target perch and do not target any specific species are willing to pay $6 less per trip than the baseline. Anglers who target Northern pike, pickerel, and muskie are willing to pay $12 more per trip than the baseline. Anglers with advanced skill level are willing to pay $7 more for the most recent trip. Anglers with expert skill level are willing to pay $14 more. Relative to the private boat mode, charter boat anglers are willing to pay $14 more, shore and pier anglers would pay $23 less and ice fishing anglers would pay $15 less. Minnesota, Pennsylvania, and Wisconsin resident anglers are willing to pay $11, $8, and $10 less per trip than residents of other Great Lakes states.

Several variables are not included in the full model because of significant item nonresponse. Adding these variables to those included in the full model in Table 53 lowers the sample size to n=6,033. In this model the typical trip variable has a statistically insignificant coefficient estimate. Therefore, we concluded that the most recent trip is equivalent to the typical trip for welfare analysis purposes. The trip cost variable has a positive and statistically significant effect on the probability of a "yes" response. This is contrary to that described by the economic theory described above but can be explained behaviorally: as the trip cost increases the percentage increase represented by the cost amount decreases so that the increase seems less important. As time spent fishing increases the willingness to pay for the trip increases. The willingness to pay is greater for most recent trips taken in September relative to other months.

Finally, we investigated the role that substitute activities play. We estimate a multinomial logit model with the follow up question to the "no" response and estimate the probability of these against a yes response.[29] We dropped the "I don't know" responses since we did not ask a follow-up question and the "I don't know" responses cannot be easily modeled in this framework. In the multinomial logit model as the cost amount increases the probability of not taking the most recent trip increases for each response category. The willingness to pay for a trip for those respondents who would stay home is largest and statistically different than the others. The willingness to pay for those who would take a fishing trip to another location and those who would take another type of outdoor recreation trip are not statistically different. For those who state they would do something else the willingness to pay is largest, 168% higher than for those who would stay home. This large value may reflect protest responses which were described above.

The Aggregate Economic Value of Great Lakes fishing Trips

The total economic value of Great Lakes fishing trips can be estimated by aggregating the willingness to pay for the most recent trip over the number of trips. Recall that 88% of the survey respondents stated that the most recent trip was a typical trip. Therefore, we assume that the willingness to pay estimates are unbiased estimates of the value of a typical trip. The aggregate economic value of Great Lakes fishing trips is:

(11) $$AEV = \sum_{i=1}^{n} \sum_{t=1}^{m} WTP'$$

where n is the number of anglers and m is the number of fishing trips.

As our base case estimate of the willingness to pay for a fishing trip we use the truncated willingness to pay, WTP', from the weighted model with the hypothetical bias adjustment, $85. The truncated willingness to pay may be most appropriate since it is difficult to imagine an angler trip being a bad (instead of a good) since it is a choice variable.

Since the additional cost of a fishing trip could potentially be spread out over the entire travel party, we divide the willingness to pay by the average travel party size, 3.06, from angler survey. Note that this is a conservative adjustment since the average size of the fishing party may be lower than the average size of the travel party.

We used the 1.1 million Great Lakes anglers estimate developed at the end of this report for aggregation. To estimate the number of trips we used the estimate of total Great Lakes fishing days from the angler survey

[29] These results are available upon request.

data and divide this by the number of days fished on each trip. Our estimate of the number of days fished on each trip is the number of nights way on each trip plus 1 (assuming conservatively that the angler fishes on both travel days). With these estimates, the mean and median number of trips per unique angler is 33 and 20, respectively.[30]

The product of the number of anglers and the median number of angler trips is 22 million angler trips. The product of the number of angler trips and willingness to pay per trip per angler is $611 million ($2019). A number of assumptions were made to develop the aggregate benefit estimate so we conduct sensitivity analysis to develop a more rigorous estimate of the aggregate economic value and its 90% confidence interval.

Earlier we presented a range of willingness to pay estimates and above we chose one of these for welfare analysis. However, it is clear from the economics literature that the true willingness to pay can be found over a wide range of estimates. So, we assume a triangular distribution of willingness to pay and use a lower bound estimate, $54, from the weighted model that employs the hypothetical bias adjustment but does not exclude negative willingness to pay values. The upper bound is the truncated willingness to pay from the model without the hypothetical bias adjustment, $101. The mode of the distribution is the base case estimate of willingness to pay and $WTP \sim T(54, 101, 85)$.

We employ a normal distribution of travel party size with a standard deviation of 2.79 and random draws from this distribution truncated below at 1. For the number of trips by each angler we use a triangular distribution with the minimum equal to the 25% percentile of the distribution (6.67 trips) and a maximum equal to the 75th percentile, 40 trips.

We took 100,000 random draws from each distribution and take the products implied by equation (11): $AEV = Anglers \times Trips \times WTP\ per\ angler$. The mean aggregate economic value from the Monte Carlo simulation is $623.2 million and the median is $490.6 million. The 90% confidence interval around the mean is ($182.5, $1,533) million.

General Population Valuation Survey

Demographics

Respondent ages ranged from 18 to 91 with a mean age of 49. Overall, 38% of the sample were male, 61% were female, and 1% identified as non-binary or preferred not to say. Respondents were predominantly white (83%), followed by Black/African-American (8%), and Asian (5%). More than half (60%) had household incomes below $70,000; 34% were above, and 6% preferred not to say. Forty-seven percent of respondents were married, 6% widowed, 12% divorced, 2% separated and 32% never married.

With respect to education, 25% were high school graduates, 25% hold a four-year college degree, 22% had some college but no degree, 13% have a two-year college degree, 11% had a masters degree, 3% had less than a high school degree, 2% had a professional degree (e.g., JD, MD) and 1% had a doctoral degree. Overall, 43% worked as a paid employee and 7% were self-employed. The rest of the sample was not working. Thirty-percent were retired, 7% were looking for work, 6% were disabled, 1% are on a temporary layoff, and 7% were not working for some other reason.

Politically, 81% of all respondents voted in the last election. Sixteen percent of respondents consider themselves to be very liberal, 20% are somewhat liberal, 33% are neither liberal nor conservative, 20% are somewhat conservative and 11% are very conservative. Thirty-five respondents described their political

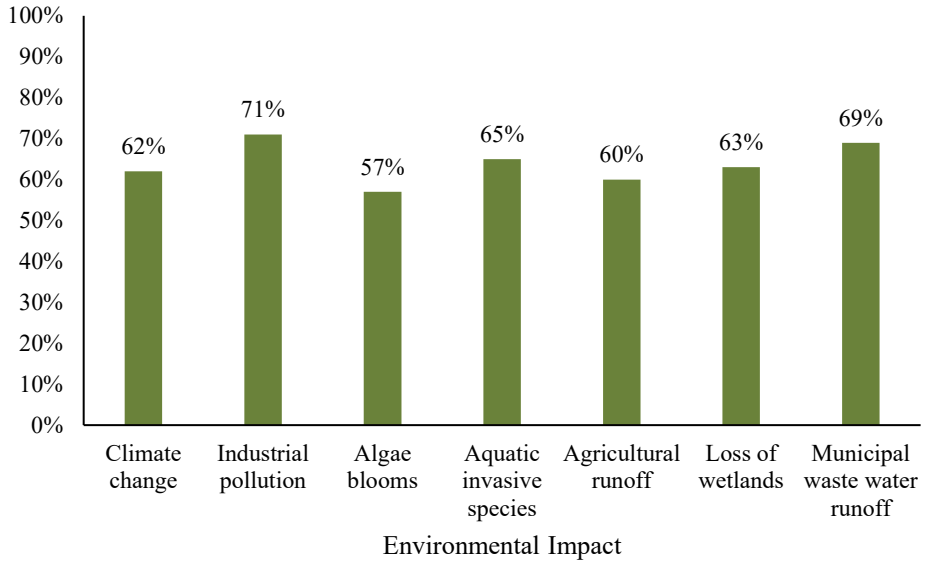
[30] In a simple regression with miles traveled as the independent variable, trips is a decreasing function of miles travelled which conforms to economic theory. We believe that this result provides evidence that our estimate of fishing trips is valid for the respondents in our survey data.

ideology in some other way.

Overall, 13% of respondents indicated they knew a lot about the Great Lakes, 35% knew some, 32% knew a little, and 20% knew nothing. Of the 80% who knew something about the Great Lakes, 10% knew a lot about the Great Lakes recreational fisheries, 32% knew some, 33% knew a little and 25% knew nothing. Of that same 80%, one-quarter (26%) said recreational fisheries are improving, 32% said it was deteriorating, 28% indicated the same, and 15% did not know. Twenty-three percent of all respondents said that they had been recreational fishing in the last 12 months at any of the Great Lakes. The most visited lakes were Lake Michigan (11% of the full sample), Lake Erie (10%) and Lake Superior (7%). The average number of fishing trips to each lake ranged from 4 to 5. Forty-three percent say that they have friends or family members who have fished the Great Lakes in the past year and 54% were in the "neither" category.

A majority of respondents also believed an array of environmental impacts had potentially negative effects on the recreational fisheries (Figure 25).

Figure 25. Beliefs about potential negative environmental impacts on the Great Lakes recreational fisheries.



Variable Coding

A summary of the socioeconomic variables with the complete case demographic data is presented in Table 54. Twelve percent of the sample had missing data on at least one socioeconomic variable. Thirty-eight percent of the sample was male, with an average age of 49. Forty-seven percent were married and 83% were white. Fifty percent of respondents were working and 81% voted in the last election.

The years schooling variable is coded as 10 if the respondent did not finish high school, 12 for high school graduates, 13 for some college but no degree, 14 for a two-year college degree, 16 for a four-year college degree, 18 for a master's degree, 19 for a profession degree and 21 for a PhD degree. The average number of years in school was 14.

The household income variable is coded at the midpoint of the interval in thousands (e.g., $35 if household income is between $30,000 and $39,999) with a top code at $175 if income is greater than $150,000. The mean income is $63.5.

If the respondent was very or somewhat liberal, then the binary liberal variable was equal to 1 and zero otherwise. If the respondent was very or somewhat conservative, then the binary conservative variable was equal to 1 and zero otherwise. Thirty-six percent of respondents were liberal and 32% were conservative.

Table 54. Variables and descriptive statistics for the general population valuation model.

Variable	Label	Mean	Std. Dev.	Min.	Max.
Male	1 if male gender, 0 otherwise	0.39	0.49	0	1
Age	age in years	50.04	18.76	18	91
Married	1 if married, 0 otherwise	0.49	0.50	0	1
School	years schooling	14.32	2.28	10	21
White	1 if white, 0 otherwise	0.83	0.37	0	1
Working	1 if working, 0 otherwise	0.51	0.50	0	1
Income	household income in 2020 before taxes (midpoint $1,000)	63.47	45.32	5	175
Vote	1 if voted in last election, 0 otherwise	0.82	0.39	0	1
Liberal	1 if politically liberal, 0 otherwise	0.36	0.48	0	1
Conservative	1 if politically conservative, 0 otherwise	0.32	0.47	0	1
Angler	1 if is a Great Lakes Angler				
Know anglers	1 if knows a Great Lakes Angler				

Sample size = 1,403

Framework for a Great Lakes Management Plan

Conceptual support for a Great Lakes management plan was high, as 87% supported water quality regulations, 80% supported policies to reduce invasive species, 84% supported wetlands restoration, and 86% supported fisheries management. With respect to knowledge about specific fish species, 13%, 9%, 16% and 14% of respondents know a lot about yellow perch, black bass, walleye, and pike, respectively. For cold water fish, 20%, 8%, 15% and 9% know a lot about salmon, steelhead, lake trout and other trout, respectively.

The referendum vote responses by cost amount are presented in Table 55 (n = 1,593 * 6 = 9,558). The percentage of votes in favor was 71% at a cost of $10 and decreases monotonically to 29% when the cost amount was $250. The don't know responses are relatively uniform as the cost rises. Sixteen percent of respondents did not know how they would vote when the cost was $10 and between 23% and 29% at higher cost amounts. The differences in the cell probabilities are statistically significant when the votes in favor are assessed against votes against and don't know responses ($P < 0.01$) and when don't know and against votes are combined ($P < 0.01$).

Table 55. How respondents voted on cost of proposed Great Lakes referendum, based on cost.

Cost	Against	I don't know	In Favor	Total	% In Favor
$10	158	199	882	1,239	71%
$50	250	290	739	1,279	58%
$90	310	333	634	1,277	50%
$130	429	332	568	1,329	43%
$170	481	378	430	1,289	33%
$210	514	334	390	1,238	32%
$250	819	529	559	1,907	29%
Total	2,961	2,395	4,202	9,558	44%

For the six referendum questions, 44% would vote in favor, 31% would vote against, and 25% did not know how they would vote for the plan. Of those in favor of the plan, 70% were very certain that they would vote in favor, 27% were somewhat certain, and 3% were not certain at all. Recoding all the uncertain responses in favor of the plan, 31% of respondents were very certain that they would vote in favor.

The referendum vote responses by scope amount (i.e., decreased catch) are presented in Table 56 (n=1,593 x 6 = 9,558). The percentage of votes in favor is 29% when scope is 10 and increases non-monotonically to 51% when the scope amount is 50. Similar to cost, the don't know responses are relatively uniform as the scope rises. Those respondents who do not know how they would vote is between 24% and 28% at different scope amounts. The differences in the cell probabilities are statistically significant when the votes in favor are assessed against votes against and don't know responses ($p < 0.01$) and when don't know and against votes are combined ($p < 0.01$).

Table 56. How respondents voted on cost of proposed Great Lakes referendum, based on scope.

Scope	Against	I don't know	In Favor	Total	% In Favor
10	552	364	373	1,289	29%
20	548	454	895	1,897	47%
30	592	445	820	1,857	44%
40	608	523	816	1,947	42%
50	661	609	1,298	2,568	51%
Total	2,961	2,395	4,202	9,558	44%

χ^2 [in favor vs against, I don't know] (df) = 174.62 (4)

χ^2 [in favor vs against vs I don't know] (df) = 193.61 (8)

Note: Sample size = 1593, votes per respondent = 6

Model Analysis

The median willingness to pay models are presented in Table 57, Table 58, and Table 59. We initially estimated the determinants of the referendum votes from the stated preference scenarios (tax, scope) in Table 57 and then include additional covariates in Table 58. In Table 59, we estimated inferred attribute non-attendance models. In Table 58 and Table 59 we estimate models with the raw votes and the votes recoded for respondent certainty. We estimated separate coefficients for decreases in the sustainable harvest of warmwater and cold water species even though a statistical test fails to reject equality of coefficients in most all models estimated. In these models we focus exclusively on the natural log functional form since the linear scope coefficients are almost always statistically insignificant (the exceptions are described below) and the log form has better overall statistical fit. We also estimated unweighted and population weighted models for comparison, although there were very few differences. All models are estimated with clustered standard errors except for the latent class model which accounts for correlation within respondents differently.

Table 57. Median general population willingness to pay logit models.

	Dependent variable is For1					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	2.006	0.188	10.66	1.893	0.186	10.20
LN(Tax)	-0.568	0.028	-20.07	-0.528	0.028	-18.97
LN(Warm)	0.101	0.036	2.83	0.090	0.035	2.57
LN(Cold)	0.110	0.035	3.13	0.103	0.035	2.97
Sample size	9,558			9,558		
Cross-section	1,593			1,593		
Time-series	6			6		
Model χ^2 (df)	770.03 (3)			667.01 (3)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$80.43	8.34	9.65	$83.46	9.16	9.11
25%	$113.00	23.27	4.86	$116.59	25.40	4.59
50%	$146.15	42.47	3.44	$150.14	46.13	3.25

	Dependent variable is For2					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.273	0.176	7.24	1.114	0.173	6.44
LN(Tax)	-0.545	0.027	-20.38	-0.499	0.026	-18.95
LN(Warm)	0.101	0.035	2.89	0.093	0.034	2.75
LN(Cold)	0.114	0.034	3.31	0.106	0.034	3.15
Sample size	9,558			9,558		
Cross-section	1,593			1,593		
Time-series	6			6		
Model χ^2 (df)	702.46 (3)			589.41(3)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$25.57	2.96	8.63	$23.28	2.96	7.87
25%	$36.68	7.58	4.84	$33.53	7.42	4.52
50%	$48.19	13.94	3.46	$44.19	13.62	3.24

Table 58. Median general population willingness to pay logit models with covariates.

	Dependent variable is For1 (for vs against/I don't know)					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Intercept	2.731	0.791	3.45	2.885	0.793	3.64
LN(Tax)	-0.654	0.033	-19.59	-0.611	0.033	-18.53
LN(Warm)	0.104	0.041	2.53	0.100	0.040	2.47
LN(Cold)	0.118	0.041	2.90	0.115	0.040	2.88
LN(Age)	-0.439	0.120	-3.64	-0.389	0.124	-3.14
Male	0.085	0.087	0.97	0.134	0.085	1.59
White	0.010	0.110	0.09	-0.030	0.098	-0.30
Working	-0.044	0.096	-0.45	-0.077	0.096	-0.80
LN(School)	0.116	0.293	0.40	-0.129	0.292	-0.44
Liberal	0.781	0.101	7.75	0.749	0.099	7.59
Conservative	0.063	0.104	0.60	0.085	0.105	0.81
Ln(Income)	0.117	0.054	2.16	0.160	0.055	2.93
Angler	0.390	0.108	3.62	0.448	0.109	4.11
Know anglers	0.503	0.092	5.47	0.495	0.093	5.35
Sample size	8,418			8,418		
Cross-section	1,403			1,403		
Time-series	6			6		
Model χ^2 (df)	1,393.70 (13)			1,302.83 (13)		

Table 59. Median general population willingness to pay inferred attribute non-attendance latent class logit models.

	Dependent variable is For1					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.967	0.089	22.11	2.020	0.091	22.25
LN(Tax)	-0.855	0.024	-35.35	-0.815	0.024	-34.59
LN(Warm)	0.207	0.039	5.37	0.152	0.038	4.00
LN(Cold)	0.212	0.038	5.57	0.163	0.038	4.33
Class probability	0.702	0.014	49.13	0.698	0.014	48.69
Sample size	9,558			9,558		
Cross-section	1,593			1,593		
Time-series	6			6		
Model χ^2 (df)	2,113.04 (6)			2,121.77 (6)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$30.82	2.42	12.74	$28.96	2.41	12.03
25%	$48.26	6.70	7.20	$41.23	6.10	6.76
50%	$67.75	12.80	5.29	$53.87	10.86	4.96

	Dependent variable is For2					
	Unweighted			Weighted		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.590	0.078	20.51	1.665	0.081	20.49
LN(Tax)	-0.963	0.028	-34.51	-0.910	0.027	-33.23
LN(Warm)	0.192	0.039	4.98	0.107	0.039	2.75
LN(Cold)	0.202	0.039	5.22	0.117	0.039	3.01
Class probability	0.764	0.012	63.56	0.761	0.01	62.64
Sample size	9,558			9,558		
Cross-section	1,593			1,593		
Time-series	6			6		
Model χ^2 (df)	2,598.03 (6)			2,722.89 (6)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$13.37	1.12	11.94	$10.97	1.02	10.71
25%	$19.46	2.71	7.19	$13.75	2.15	6.40
50%	$25.84	4.75	5.44	$16.31	3.37	4.84

Full Sample Results

Each of the four models in Table 57 are statistically significant according to the model chi-square statistic. In each of the four models the coefficients on the tax and scope variables have the expected signs. In other words, as the required tax amount increases the probability that the respondent will vote in favor falls. As the potential reduction in the sustainable harvest increases the probability that the respondent will vote in favor of the policy increases. Scope elasticity is the percentage change in median willingness to pay divided by the percentage change in scope. The scope elasticity estimates range from 0.17 to 0.21 suggesting that the results are plausible (Whitehead, 2016). In total, these results lend validity to the data (Bishop and Boyle, 2019).

We estimate median willingness to pay to avoid 10%, 25% and 50% decreases in the sustainable harvest for both warm and cold water species. The median is the amount for which 50% of respondents would vote in favor of the policy. The willingness to pay estimates indicate that respondents hold substantial economic value for maintaining recreational fishing harvests. Focusing on the weighted models, willingness to pay to avoid a 10%, 25% and 50% reduction in harvest is $83, $117, and $150. Each of these estimates are statistically different from zero and statistically different from each other. The willingness to pay estimates with the certainty recoded votes are substantially smaller. Willingness to pay to avoid a 10%, 25% and 50% reduction in harvest is $23, $34, and $44. The difference in the raw willingness to pay and recoded willingness to pay is an estimate of the potential for hypothetical bias in the stated preference data.

In Table 58 we present models with the unrecoded vote responses as the dependent variable with additional independent variables. We do not present willingness to pay estimates for these models since the sample size is reduced due to item nonresponse (n=1,403). In addition to the statistically significant coefficients on the tax and scope variables, the votes are related to respondent age, political ideology, income and angler status. Willingness to pay declines with age with an elasticity of 0.67. As age increases by 10%, willingness to pay decreases by 6.7% in the weighted model. Respondents who characterize themselves as very or somewhat liberal are 2.1 times more likely to be in favor of the policy.[31] The marginal willingness to pay for a liberal is $3 more than independents and conservatives. The probability of a vote in favor of the policy increases with income. The income elasticity is 0.26 indicating that a 10% increase in income leads to a 2.6% increase in willingness to pay. Anglers are 1.56 times more likely to vote in favor of the policy than non-anglers. The marginal willingness to pay for anglers is $1.98. Respondents who have a friend or family member who are anglers are 1.64 times more likely to vote in favor of the policy and the marginal willingness to pay is $2.13.

We present inferred attribute non-attendance (ANA) models in Table 59. These are latent class models with two classes of respondents. In the typical latent class model different coefficient vectors are estimated for each class (i.e., type) of respondent. In an equality constrained latent class model coefficients on attributes are constrained equal to zero and constrained to be equal across classes when not zero (Lew and Whitehead 2020). We estimate a simple model with two classes with the coefficients on the tax and scope variables constrained to be equal to zero in the non-attentive class (i.e., respondents who did not pay attention to the tax and scope variables) with the constants constrained to be equal across classes (Malone and Lusk 2018).

Several differences with the results in Table 59 stand out. First, the probability that a respondent will be in the attending class is 70% in the raw vote models and 76% in the certainty recoded models. This indicates that a quarter or more of all respondents ignore attribute levels when responding to the stated preference questions. This number is similar to those who stated that they did not pay any attention to the scope variables but greater than those who said they didn't pay attention to the tax variable. Second, the coefficient on the tax variables are significantly larger in absolute value, 54% to 82%, indicating the presence of hypothetical bias.[32] The willingness to pay estimates in Table 59 are 53% to 69% smaller than those in Table 57. Third, the coefficients on the scope variables increase in precision in three of the four models. The weighted, recoded model has almost identical t-statistics on the scope coefficients. The scope elasticities are similar in two of the

[31] The odds ratio is equal to $\exp(\beta)$ where β is the logit coefficient.

[32] Recall that the coefficient on the tax amount is the denominator in the willingness to pay estimate. A larger value will decrease willingness to pay.

models but larger in the unweighted, unrecoded model and smaller in the weighted, recoded model.

Several other ANA models are estimated lending validity to the data but falling short of contributing to this report in terms of willingness to pay estimates that pass the eyeball test. We estimated inferred models with more complicated patterns of ANA but none of these were statistically preferred to the models in Table 59. We also estimated models using the stated ANA survey questions. These models provided similar results in terms of statistically significant estimates of scope coefficients, including in the linear models[33]. However, the magnitude of the coefficient for respondents who stated that they paid attention to the tax amount moved in the opposite direction from expectations, inflating the willingness to pay estimates beyond the range of the tax amounts presented to respondents in the survey for the attentive class.

Split-sample Results

In this section we present results from various split-sample treatments. In Table 60 we present results for coastal and noncoastal U.S. respondents separately. All of the models are weighted with the weights rescaled so that the sum of the weights is equal to the sub-sample size. The most striking result from Table 60 is that the coastal resident model does not have statistically significant coefficients on the scope variables. This indicates that coastal resident referendum votes do not depend on the magnitude of the decreases in sustainable harvest. In a latent class model similar to those in Table 59, we find that there is a 27% probability that a coastal resident will be in the non-attending class. In the attending class, the coefficient on the reduction in sustainable harvests for coldwater species is positive and statistically different from zero with a scope elasticity of 0.16. However, the coefficient on warmwater harvests is not statistically different from zero. In a similar model for the noncoastal residents, the probability of the nonattending class is 33% and both scope coefficients are statistically different from zero. The scope elasticities are 19% for warmwater species and 17% for coldwater species.

The second striking result is that median willingness to pay for noncoastal residents is significantly greater than willingness to pay for coastal residents. Willingness to pay is $115 to avoid a 10% reduction in warmwater and cold water harvests and rises to $299 to avoid a 50% reduction in the noncoastal model. The willingness to pay estimates in the coastal model range from $57 to $65 as scope rises from 10% to 50% but the differences are not statistically significant. The median willingness to pay in the certainty recoded models are significantly lower, 71%, 67% and 62% for 10%, 25% and 50% scope levels, in the noncoastal model. Median willingness to pay in the recoded coastal model is $13 to $15. Note that these differences for coastal and noncoastal residents are not due to income effects. A combined model with income and coastal variables finds that noncoastal residents have a greater probability of voting in favor of the management policy.

One goal of this research was to estimate a distance-decay relationship for the economic value of Great Lakes recreational fisheries. This entails finding the effect of distance from the Lakes on willingness to pay. This relationship can be useful for defining the market size for economic value. Typically, this relationship is negative as distance from the resource leads to reduced on-site use of the resource and lower values. The distance-decay relationship we find is inverted, there is greater willingness to pay for respondents further from the resource. Further research is needed to determine the reasons for this unexpected relationship.

[33] A linear latent class model estimates that the probability that respondents paid attention to the scope variables is only 35%.

Table 60. Median general population willingness to pay logit models for coastal vs. non-coastal counties.

	Dependent variable is For1					
	Weighted, Coastal U.S.			Weighted, Noncoastal U.S.		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	2.006	0.286	7.01	1.691	0.280	6.05
LN(Tax)	-0.520	0.042	-12.35	-0.501	0.043	-11.74
LN(Warm)	0.005	0.054	0.10	0.151	0.052	2.89
LN(Cold)	0.038	0.053	0.72	0.148	0.052	2.85
Sample size	3,840			4,278		
Cross-section	640			713		
Time-series	6			6		
Model χ^2 (df)	256.09 (3)			278.08 (3)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$57.44	9.86	5.83	$114.68	20.20	5.68
25%	$62.00	20.64	3.00	$197.86	69.77	2.84
50%	$65.69	30.74	2.14	$298.92	148.72	2.01

	Dependent variable is For2					
	Weighted, Coastal			Weighted, Noncoastal		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.380	0.260	5.31	0.844	0.264	3.20
LN(Tax)	-0.486	0.040	-12.11	-0.491	0.040	-12.25
LN(Warm)	-0.034	0.051	-0.66	0.189	0.051	3.69
LN(Cold)	0.003	0.050	0.05	0.188	0.051	3.68
Sample size	3,840			4,278		
Cross-section	640			713		
Time-series	6			6		
Model χ^2 (df)	211.70 (3)			273.85(3)		
	WTP	SE	t-value	WTP	SE	t-value
10%	$14.75	3.27	4.50	$32.73	6.05	5.41
25%	$13.91	5.02	2.77	$66.16	22.44	2.95
50%	$13.31	6.49	2.05	$112.69	54.24	2.08

We next split the sample into three user groups. The first group is the angler group, those "users" who fished recreationally on the Great Lakes during the past year (n = 370). The second group are those "passive users" who have friends or family who fish recreationally on the Great Lakes, excluding those from the angler group (n = 351). Presumably, the willingness to pay for this group is motivated by a combination of altruism towards friends and family, bequests to future generations and those who value sustainable use of resources for their own sake. The third group are "nonusers" - those who are not anglers and do not have friends or family who are Great Lakes anglers (n=872). Motivation for willingness to pay in this group includes those described above except for altruism towards friends and family. Users, passive users and nonusers respond in favor of the referendum 59%, 47% and 36% of the time over the six questions.

We find considerable heterogeneity across angler groups in Table 61. Each of the models has a statistically significant coefficient on the tax amount but the magnitudes are different with the user group being the least responsive to tax increases. Both scope variables are statistically significant in the passive user model. Only the cold water species scope variable is statistically significant in the user and nonuser models ($p < 0.10$, one-tailed test).

Table 61. Median general population willingness to pay logit models for angler groups.

	Dependent variable is For1								
	Weighted, Users			Weighted, Passive Users			Weighted, Nonusers		
	Coefficient	SE	t-value	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.875	0.384	4.88	2.398	0.452	5.30	1.831	0.253	7.24
LN(Tax)	-0.371	0.058	-6.41	-0.702	0.071	-9.93	-0.567	0.037	-15.30
LN(Warm)	0.088	0.075	1.18	0.230	0.080	2.89	0.050	0.049	1.03
LN(Cold)	0.091	0.073	1.24	0.227	0.079	2.89	0.073	0.048	1.51
Sample size	2,220			2,106			5,232		
Cross-section	370			351			872		
Time-series	6			6			6		
Model χ^2 (df)	72.99 (3)			240.74 (3)			411.92 (3)		
	WTP	SE	t-value	WTP	SE	t-value	WTP	SE	t-value
10%	$476.06	206.40	2.31	$136.00	25.13	5.41	$41.50	5.93	7.00
25%	$739.53	563.11	1.31	$246.91	94.70	2.61	$50.62	13.86	3.65
50%	$1,031.96	1,064.43	0.97	$387.68	211.17	1.84	$58.81	22.71	2.59

	Dependent variable is For2								
	Weighted, Users			Weighted, Passive Users			Weighted, Nonusers		
	Coefficient	SE	t-value	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.061	0.320	3.32	1.634	0.421	3.88	1.029	0.247	4.17
LN(Tax)	-0.341	0.049	-6.89	-0.638	0.061	-10.48	-0.560	0.038	-14.70
LN(Warm)	0.101	0.061	1.64	0.138	0.085	1.64	0.087	0.049	1.78
LN(Cold)	0.131	0.061	2.15	0.125	0.081	1.54	0.100	0.049	2.02
Sample size	2,220			2,106			5,232		
Cross-section	370			351			872		
Time-series	6			6			6		
Model χ^2 (df)	74.83 (3)			202.07 (3)			364.90 (3)		
	WTP	SE	t-value	WTP	SE	t-value	WTP	SE	t-value
10%	$107.58	35.703	3.01	$33.52	7.12	4.71	$13.50	2.36	5.71
25%	$200.48	124.85	1.61	$48.95	20.18	2.43	$18.32	5.31	3.45
50%	$321.04	278.98	1.15	$65.18	38.23	1.71	$23.08	9.22	2.5

The source of the weakness of the scope effect is revealed in latent class models (these are available upon request). In a 2-class latent class model both scope variables have a statistically significant coefficient estimate in a class with 41% probability (but this class has a statistically insignificant cost coefficient) for the user group. Given the high percentage of responses in favor of the policy, it may be that some anglers are responding strategically and ignoring key attributes in the scenarios. However, an ANA model does not fit the user group data well. In contrast, an ANA model similar to the one presented in Table 59 improves model fit for both the passive user and nonuser groups.

The median willingness to pay estimates are significantly different across groups. Median willingness to pay is $476 to avoid a 10% reduction for the user group and 71% and 91% lower for the passive user and nonuser groups. For the user group the median willingness to pay estimates for 25% and 50% reductions are $740 and $1,032 but only the 25% reduction estimate is statistically different from zero and this is at the 10% level in a one-tailed test. For the passive user group, willingness to pay increases to $247 and $388 to avoid 25% and 50% reductions sustainable harvest. The differences in willingness to pay in the nonuser group are not statistically different from zero. The certainty recoded median willingness to pay estimates are range between

61% and 83% lower than the raw vote data estimates.

We next estimate individual models for each state and Canada. Recall that individual state dummy variables found no statistically significant coefficient estimates. This indicates that there are no direct differences in respondent residence on votes and willingness to pay. However, there may be indirect effects as respondents in different states may have different tax and scope effects. We find that residents of Illinois, New York, Pennsylvania, Wisconsin, and Canada (at the 10% level in a one-tailed test)) have statistically significant scope effects for each species group. Residents of Minnesota have a statistically significant coefficient on the cold water species at the 10% level in a one-tailed test. Models with residents of Indiana, Michigan and Ohio do not display any scope sensitivity. We also find that median willingness to pay estimates vary significantly across states and Canada. Median willingness to pay estimates range between $119 and $135 in Canada, Minnesota, and Wisconsin. The median willingness to pay estimates are greater for Illinois, New York, and Pennsylvania but the 95% confidence intervals include zero. The median willingness to pay estimates are less than $100 for Indiana, Michigan, and Ohio but the 95% confidence intervals include zero. Note that the sample sizes are small and not too much weight should be placed on these state level results.

Distributional Analysis

Finally, we estimate a model to conduct a distributional analysis. Informed by the results in Table 58, that age and income are the only socioeconomic variables that help explain referendum votes, we construct dummy variables for age categories and whether the respondent's annual household income is above or below $50,000. We estimate two models with the full sample, one with the vote variable and the other with the certainty recoded vote variable. In both models the coefficients on the tax and scope variables are statistically significant and with the expected sign. In the vote model, respondents who are aged 18-24 and 25-44 are more likely to vote in favor of the policy relative to those who are older. In the recoded for certain vote model respondents who are aged 25-44 are more likely vote in favor. In both models, respondents with incomes above $50,000 are more likely to vote in favor (Table 62).

The median willingness to pay estimates suggest substantial heterogeneity across age and income groups. Willingness to pay ranges from $48 for respondents who are 65+ with incomes below $50,000 to $308 for respondents who are 25-44 with incomes above $50,000. Respondents who are 18-44 are willing to pay more than older respondents. Respondents with higher incomes are willing to pay 137% more than those with lower incomes.

In the certainty recoded models, willingness to pay ranges from $14 for respondents who are 45-64 with incomes below $50,000 to $85 for respondents who are 25-44 with incomes above $50,000. Respondents who are 25-44 are willing to pay 80% more than those of different ages. Respondents with higher incomes are willing to pay 195% than those with lower incomes. Certainty recoded willingness to pay estimates are 75% lower for lower income respondents and 69% lower for higher income respondents.

Table 62. Median general population willingness to pay logit models for socioeconomic groups.

	Weighted, For1			Weighted, For2		
	Coefficient	SE	t-value	Coefficient	SE	t-value
Constant	1.579	0.202	7.81	0.765	0.191	4.00
LN(Tax)	-0.581	0.029	-19.77	-0.508	0.027	-18.63
LN(Warm)	0.104	0.036	2.87	0.097	0.034	2.82
LN(Cold)	0.113	0.036	3.17	0.109	0.034	3.22
Age 18-24	0.491	0.133	3.68	0.094	0.154	0.61
Age 25-44	0.555	0.094	5.91	0.280	0.103	2.72
Age 45-64	0.066	0.106	0.63	-0.105	0.123	-0.85
High income	0.439	0.078	5.64	0.550	0.089	6.19
Sample size	9,558			9,558		
Cross-section	1,593			1,593		
Time-series	6			6		
Model χ^2 (df)	988.51 (3)			765.09 (3)		
	Income below $50,000					
Age	WTP	SE	t-stat	WTP	SE	t-stat
18-24	$116.01	32.95	3.52	$19.97	6.55	3.05
25-44	$129.62	31.87	4.07	$28.78	7.60	3.78
45-64	$53.37	14.30	3.73	$13.51	4.21	3.21
65+	$48.48	11.86	4.09	$16.60	4.58	3.63
	Income above $50,000					
Age	WTP	SE	t-stat	WTP	SE	t-stat
18-24	$275.47	86.01	3.20	$58.97	20.31	2.90
25-44	$307.78	79.78	3.86	$85.00	21.88	3.88
45-64	$126.74	33.76	3.75	$39.89	11.53	3.46
65+	$115.11	28.47	4.04	$49.02	12.64	3.88

Aggregate benefits

Median willingness to pay estimates can be aggregated over the populations of the Great Lakes states and Ontario to estimate the aggregate benefit of avoiding reductions in sustainable recreational harvest. Since the tax payment is one-time, relative to annual, the aggregate benefit estimates should be considered the present value of annual benefits in perpetuity. It is more appropriate to use mean willingness to pay estimates in benefit-cost analysis. The median willingness to pay is the amount that 50% of respondents would pay. It is the amount that would lead to a 50/50 vote in an actual referendum. The mean willingness to pay is typically greater than the median since the willingness to pay distribution has a long upper tail. In simple linear models (without scope variables included), we find that the mean willingness to pay is 55% greater than the median willingness to pay. Therefore, the aggregate benefit estimate below should be considered conservative.

We base our aggregation on the willingness to pay estimates presented in Table 57 and Table 58. These are full sample estimates with and without certainty recodes (Table 59) and with attribute non-attendance (Table 59). Instead of choosing one set of estimates as a best estimate we consider all four sets of willingness to pay estimates as valid in one way or another. For example, the unrecoded vote models produce the highest willingness estimates. These are considered the upper bound in a triangular distribution of willingness to pay. Each of the other three sets of willingness to pay estimates account for hypothetical bias in two ways. One approach is to recode referendum votes for respondent certainty. These estimates are in Table 57 For2 model. The other approach is to take account of attribute non-attendance. These estimates are in the Table 59 For1 model. We consider the willingness to pay estimates combining both approaches, found in Table 59, as lower bound estimates in a triangular distribution. The mode of the triangular distribution is estimated as the

midpoint between the two willingness to pay estimates that use one of the hypothetical bias mitigation approaches, $26, $37, and $49 for avoiding 10%, 25% and 50% reductions in harvests.

Using a simulated data set with 100,000 random draws from the triangular distribution we estimate the mean and 90% confidence intervals of median willingness to pay. The mean (of the median) willingness to pay estimate is equal to the average of the lower bound, upper bound and mode estimates. The 90% confidence intervals are found by trimming the upper and lower 5% estimates. At the household level, the mean of the median willingness to pay estimates to avoid a 10% reduction in sustainable recreational harvest is $40 with a 90% confidence interval lower bound of $18 and an upper bound of $69. The mean willingness to pay estimates to avoid a 25% reduction is $56 [$25, $96]. The willingness to pay to avoid a 50% reduction is $72 [$31, $124].

We aggregate these household level estimates over the number of households in each state and Ontario with an adjustment for the proportion of households who considered the survey to be consequential. We define consequentiality as those who agree with the statements that the survey will be shared with decision makers and will affect management decisions. Overall, 73% of respondents find the survey consequential. This ranges from 71% in Illinois to 76% in Ontario. The aggregate benefit estimates are presented in Table 62. For the U.S. as a whole, the aggregate benefit estimate is $976 million to avoid a 10% reduction in sustainable recreational harvest, $1.36 billion to avoid a 25% reduction and $1.74 billion to avoid a 50% reduction. We use the November 30, 2021 U.S.-Canada exchange rate to convert Canadian dollars to U.S. dollars (one U.S. dollar is equivalent to 1.2782 Canadian dollars). The aggregate benefit estimate is $123 million to avoid a 10% reduction in sustainable recreational harvest to Ontario, $172 million to avoid a 25% reduction and $220 million to avoid a 50% reduction.

Table 63. Aggregate Household Benefit Estimates: Mean and 90% Confidence Interval ($US, millions).

	10% Reduction			25% Reduction			50% Reduction		
State	Mean	LB	UB	Mean	LB	UB	Mean	LB	UB
Illinois	138.85	63.55	238.29	193.18	85.66	332.72	248.21	107.56	428.40
Indiana	74.34	34.03	127.58	103.43	45.86	178.14	132.89	57.59	229.36
Michigan	114.89	52.59	197.17	159.84	70.88	275.30	205.37	89.00	354.47
Minnesota	65.28	29.88	112.04	90.83	40.27	156.44	116.70	50.57	201.42
New York	216.06	98.89	370.79	300.60	133.29	517.73	386.21	167.36	666.60
Ohio	142.83	65.38	245.12	198.72	88.11	342.26	255.32	110.64	440.68
Pennsylvania	153.62	70.31	263.63	213.72	94.77	368.10	274.60	118.99	473.95
Wisconsin	69.98	32.03	120.10	97.37	43.17	167.70	125.10	54.21	215.92
U.S. Total	975.85	446.66	1674.72	1,357.69	602.02	2,338.40	1,744.39	755.92	3,010.81
Ontario	123.28	56.43	211.57	171.52	76.05	295.41	220.37	95.50	380.36

Objective 3. To understand how values and management preferences vary across socio-demographic sectors and project how public values and demands, including fisheries funding preferences, may change, by matching with projections of the region's future population.

Demographic Characteristics

Regionally[34], the 2020 Census revealed an approximate even distribution of males and females, with general similarities among age classes, though there was a slightly higher percentage of older females (24% vs. 10%). In contrast, anglers were predominantly male (76%), with an age class distribution like the Census. Only 24% of license purchasers were female and older individuals were underrepresented with respect to the Census population. For the valuation study, we were overrepresented by males (specifically older males), and females 65 and over. For all three datasets, most individuals lived in an urban area (Table 64).

Overall, 84% of valuation respondents were white, 9% were Black/African American, and 2.4% were Asian. Most (97%) graduated from high school and 35% had at least a 4-year college degree. In addition, younger respondents (18 – 24) tended to identify as 'liberal' (44%), while older respondents (65 and older) were 'conservative' (44%). As expected, a higher proportion of younger respondents had incomes less than $50,000/year (71%). Finally, older individuals were much more likely to vote than younger respondents (95% vs. 53%) (Table 65).

Table 64. Regional demographic characteristics for gender, age class, and % urban, using data from the 2010 Census[35], 2020 fishing license sales, and the Objective 2 valuation study.

	Data Source		
Gender	2010 U.S. Census	2020 License data	2020 Valuation study
Male	48%	76%	62%
Female	52%	24%	38%
Age Classes (%)			
18 - 24	12M/11F	11M/15F	9M/14F
25 - 44	35M/33F	36M/42F	35M/35F
45 - 64	34M/33F	36M/33F	18M/25F
65+	19M/24F	16M/10F	37M/26F
% Urban	78%	71%	79%

Table 65. Political orientation, income, and voting behavior for general population survey respondents.

	Age Category				
Item	18 to 24	25 to 44	45 to 64	65 and older	Overall
Political Orientation					
Liberal	40%	37%	27%	26%	32%
Neither	40%	32%	40%	30%	34%
Conservative	15%	28%	31%	44%	32%
Other	5%	2%	2%	1%	2%
Income					
Less than $50K	71%	52%	44%	43%	50%
$50K or more	29%	48%	56%	57%	50%
Voted in Last Election					
Yes	53%	72%	85%	95%	80%
No	47%	28%	15%	5%	20%

[34] We defined regionally as the 8 Great Lakes states.
[35] 2020 Census data available December, 2022.

Public Values

Respondents were posed an array of questions related to the status of the Great Lakes recreational fishery, impacts from a variety of sources, support for different management options, and beliefs. We observed few statistical differences between males and females, though there were differences among the age classes (Table 66). Consequently, we combined gender and used age classes as the comparative variable for the analyses and projections.

Table 66. Statistical differences between genders and age class categories for value-based questions.

	Chi-square, P, Cramer's *V*	
Question	Gender	Age Category
Are the recreational fisheries of the Great Lakes improving, deteriorating, or staying about the same?	$\chi2$=9.47, P=.009, *V*=.115	$\chi2$=17.4, P=.008, *V*=0.110
What impact do you think each of the following have on recreational fisheries of the Great Lakes?		
Climate change	$\chi2$=.843, n.s.	$\chi2$=34.0, P<.001, V=.160
Industrial pollution	$\chi2$=8.21, n.s.	$\chi2$=61.0, P<.001, V=.211
Algae blooms	$\chi2$=1.98, n.s.	$\chi2$=113.8, P<.001, V=.298
Aquatic invasive species	$\chi2$=.778, n.s.	$\chi2$=78.1, P<.001, V=.241
Agricultural runoff	$\chi2$=.98, n.s.	$\chi2$=89.1, P<.001, V=.262
Loss of wetlands	$\chi2$=1.58, n.s.	$\chi2$=42.6, P<.001, V=.181
Municipal wastewater runoff	$\chi2$=1.15, n.s.	$\chi2$=66.0, P<.001, V=.222
Regulation/Policy		
Regulations designed to decrease industrial water pollution	$\chi2$=8.21, n.s.	$\chi2$=7.12, n.s.
Regulations designed to reduce ballast water discharge and construct permanent barriers	$\chi2$=27.3, P<.001, *V*=.139	$\chi2$=53.6, P<.001, V=.111
Regulations to reduce harmful algal blooms	$\chi2$=5.63, n.s.	$\chi2$=12.5, n.s.
Great Lakes management plan components		
Coastal wetland restoration	$\chi2$=7.11, n.s.	$\chi2$=26.0, P=.011, V=.077
Manage for well-balanced and productive fish populations	$\chi2$=13.2, P<.010, *V*=.096	$\chi2$=25.4, P=.013, V=.076
A Great Lakes recreational fisheries management plan	$\chi2$=5.37, n.s.	$\chi2$=13.4, n.s.
One-time increase in taxes	$\chi2$=12.8, P<.012, *V*=.095	$\chi2$=35.4, P<.001, V=.090
Beliefs		
I have confidence in the ability of the government to manage the Great Lakes fisheries	$\chi2$=16.5, P=.006, *V*=.107	$\chi2$=61.30, P<.001, V=.121
I believe the results of this survey will be shared with agencies that make decisions	$\chi2$=9.00, n.s.	$\chi2$=16.2, n.s.
I believe the results could affect decisions about Great Lakes fisheries	$\chi2$=4.62, n.s.	$\chi2$=7.15, n.s.
I think my own taxes would increase to pay for the Great Lakes fisheries management plan	$\chi2$=9.60, n.s.	$\chi2$=29.3, P=.006, V=.085
The survey is biased	$\chi2$=8.40, n.s.	$\chi2$=37.1, P<.001, V=.096

Overall, respondents were equally split on the status of the recreational Great Lakes fisheries; however, individuals aged 25-44 were more likely to indicate it was improving (41%). Regarding environmental issues on the fisheries, older respondents were much more likely to indicate each of the items would result in negative impacts. Interestingly, attitudes that each impact category would negatively affect fisheries increased with age on average (Table 67).

Table 67. Respondent attitudes toward the status of the Great Lakes fisheries, and possible impacts of environmental issues on the fishery.

Item	Age Category				Overall
	18 to 24	25 to 44	45 to 64	65 and older	
Status of the recreational fisheries					
Improving	26%	41%	31%	27%	33%
Deteriorating	35%	33%	32%	33%	33%
Staying the same	39%	27%	37%	40%	34%
	n = 95	n = 294	n = 145	n = 188	n = 722
Impacts to the Great Lakes recreational fisheries					
Climate change/Global warming					
Negative impact	58%	57%	63%	77%	64%
No impact	16%	20%	23%	17%	19%
Positive impact	26%	24%	14%	6%	17%
	n = 85	n = 276	n = 130	n = 176	n = 667
Industrial pollution					
Negative impact	58%	62%	78%	91%	72%
No impact	23%	18%	9%	5%	13%
Positive impact	19%	20%	13%	4%	14%
	n = 86	n = 279	n = 135	n = 182	n = 682
Algae blooms					
Negative impact	41%	45%	65%	92%	62%
No impact	27%	24%	13%	3%	17%
Positive impact	32%	30%	22%	4%	22%
	n = 73	n = 262	n = 128	n = 178	n = 641
Aquatic invasive species					
Negative impact	59%	53%	72%	91%	68%
No impact	14%	24%	13%	3%	15%
Positive impact	27%	24%	16%	6%	18%
	n = 86	n = 271	n = 134	n = 180	n = 671
Agricultural runoff					
Negative impact	52%	48%	65%	90%	64%
No impact	23%	25%	23%	6%	19%
Positive impact	25%	26%	12%	4%	17%
	n = 77	n = 262	n = 132	n = 180	n = 651
Loss of wetlands					
Negative impact	68%	57%	68%	83%	67%
No impact	14%	19%	21%	12%	17%
Positive impact	19%	24%	11%	5%	16%
	n = 80	n = 274	n = 125	n = 170	n = 649
Municipal wastewater runoff					
Negative impact	65%	58%	76%	91%	71%
No impact	20%	17%	11%	6%	13%
Positive impact	14%	25%	13%	3%	15%
	n = 83	n = 272	n = 133	n = 180	n = 668

Respondents were also posed several questions related to regulatory/policy issues, components, and funding regarding development of a Great Lakes fisheries management plan. There was strong support for all the presented regulatory/policy and plan component items (78% - 86%), but support was less strong (63%) for a one-time tax increase to implement the plan (Table 68).

Table 68. Support for regulations/policy and components of a Great Lakes fisheries management plan.

	Age Category				
Item	18 to 24	25 to 44	45 to 64	65 and older	Overall
Regulation/Policy					
Reduce industrial water pollution					
Support	86%	87%	83%	87%	86%
Neither	12%	11%	13%	10%	11%
Oppose	2%	2%	3%	3%	3%
	n = 187	n = 506	n = 299	n = 458	n = 1,450
Ballast water regulation and the construction of permanent barriers					
Support	70%	78%	78%	83%	78%
Neither	22%	18%	18%	15%	17%
Oppose	8%	4%	4%	2%	4%
	n = 186	n = 506	n = 299	n = 458	n = 1,449
Agriculture to control nutrients and reduce algal blooms					
Support	79%	83%	82%	84%	82%
Neither	15%	13%	14%	12%	13%
Oppose	6%	4%	4%	4%	4%
	n = 187	n = 506	n = 299	n = 458	n = 1,450
Great Lakes management plan components					
Restoration of coastal wetlands					
Support	72%	85%	83%	84%	82%
Neither	22%	12%	14%	13%	14%
Oppose	6%	3%	3%	3%	4%
	n = 187	n = 506	n = 299	n = 458	n = 1,450
Well-balanced and productive fish populations					
Support	76%	87%	85%	87%	85%
Neither	17%	11%	13%	11%	12%
Oppose	6%	3%	2%	2%	3%
	n = 187	n = 506	n = 299	n = 458	n = 1,450
Sustainable fisheries harvest					
Support	83%	86%	84%	88%	86%
Neither	14%	11%	15%	11%	12%
Oppose	3%	3%	2%	2%	2%
	n = 187	n = 506	n = 299	n = 458	n = 1,450
One-time tax increase to fund the plan					
Support	59%	69%	62%	57%	63%
Neither	24%	17%	25%	23%	22%
Oppose	17%	14%	13%	20%	16%
	n = 187	n = 506	n = 299	n = 458	n = 1,450

More than two-thirds (68%) indicated confidence in the government's ability to manage the Great Lakes fisheries; however, agreement declined as age increased. A high percentage of respondents believed the results would be shared by decision-makers (80%) and their survey answers could affect decisions about Great Lakes fisheries management (77%). Overall, 74% believed their taxes would be increased to pay for a plan, and that percentage also increased with age. Importantly, only 22% of respondents believed the survey was biased (Table 69).

Table 69. Beliefs about decision-making, taxes, and survey bias.

	Age Category				
I believe …	18 to 24	25 to 44	45 to 64	65 and older	Overall
I have confidence in the ability of the government to manage Great Lakes recreational fisheries					
Agree	75%	70%	68%	61%	68%
Neither	17%	21%	20%	17%	19%
Disagree	8%	8%	12%	22%	13%
	n = 181	n = 490	n = 286	n = 442	n = 1,399
The results of this survey will be shared with agencies that make decisions					
Agree	78%	78%	81%	84%	80%
Neither	17%	17%	18%	14%	16%
Disagree	4%	5%	1%	3%	3%
	n = 180	n = 483	n = 284	n = 431	n = 1,378
The results of this survey could affect decisions about Great Lakes recreational fisheries					
Agree	79%	76%	79%	76%	77%
Neither	13%	18%	16%	17%	17%
Disagree	7%	6%	5%	6%	6%
	n = 178	n = 487	n = 287	n = 430	n = 1,382
My own taxes would actually increase to pay for a plan					
Agree	67%	69%	72%	82%	74%
Neither	25%	23%	20%	13%	19%
Disagree	8%	7%	8%	5%	7%
	n = 178	n = 478	n = 278	n = 422	n = 1,356
This survey is biased					
Agree	25%	25%	22%	16%	22%
Neither	35%	38%	38%	43%	39%
Disagree	40%	37%	40%	41%	39%
	n = 169	n = 476	n = 272	n = 414	n = 1,331

Future Projections

Angler Participation and Expenditures

Using regional projections from the University of Virginia (R. Winkler, pers. comm), there is an anticipated slight increase (66.4 million to 67.8 million) in the overall regional population. That population is expected to be slightly older for both males and females (Table 70). To create projections, we used our baseline estimate of 1.1 million 2020 unique US Great Lakes anglers and the sex/age class of those anglers to estimate gender and cohort-specific angler numbers in 2030 and 2040. Using those parameters, we do not expect dramatic differences in angler participation over time (Table 71). However, any projections on future participation rates are predicated on several assumptions, including regulatory consistency, fish populations, environmental

conditions, economic conditions, social norms, or other factors. Changes to any variable can potentially positively or negatively affect angler numbers in the future.

Even if population demographics and participation rates remain stable over time, we can presume expenditures will slightly increase because anglers 45 and over spend more money than younger anglers. Using average angler expenditures by gender and age class (Table 72), we project total annual US expenditures may increase from $3.8 billion to $4.0 billion by 2040 (Table 73). However, this may be partially mitigated by decreased participation rates as individuals age (particularly for 65 and older); thus, any increase in overall expenditures may be partially tempered by an aging population overall. A key factor to stabilize or increase expenditures is to grow the number of 25 – 64-year-old anglers. Simply put, they represent the highest proportion of Great Lakes anglers, and they spend more than any other cohort.

Table 70. Regional population projections, 2020 - 2040.

	Year		
Population Composition	2020	2030	2040
Male (%)	48%	48%	48%
18 - 24	12%	12%	12%
25 - 44	35%	35%	34%
45 - 64	34%	30%	32%
65+	19%	23%	22%
Sub Total	31,927,633	32,438,235	32,334,582
Female (%)	52%	52%	52%
18 - 24	11%	11%	11%
25 - 44	33%	32%	31%
45 - 64	33%	29%	30%
65+	24%	28%	28%
Sub Total	34,470,819	35,353,737	35,483,378
Grand Total	66,398,452	67,791,972	67,817,960

Table 71. Demographic composition and 2020 participation rates of Great Lakes anglers and projections for the years 2030 and 2040.

	Year		
Angler Projections (Participation Rate %)	2020	2030	2040
Male			
18 - 24 (2.5%)	83,210	83,386	83,578
25 - 44 (2.8%)	291,235	296,537	289,023
45 - 64 (2.8%)	324,519	297,152	308,880
65+ (2.2%)	133,136	159,384	154,721
Sub Total	832,100	836,460	836,202
Female			
18 - 24 (1.7%)	39,415	39,497	39,585
25 - 44 (0.4%)	123,501	125,821	122,582
45 - 64 (1%)	84,086	76,919	79,856
65+ (1%)	15,766	18,918	18,958
Sub Total	262,769	261,156	260,982
Grand Total	1,094,869	1,097,616	1,097,184

Table 72. Average spending by gender and age class for Great Lakes angler survey respondents, 2020.

Gender/Age Class	Sample n	2020 Est. Anglers	Expenditure Category: Trip	Equipment	Real Estate	Average/Sex - Age Class[36]	Overall (millions)
Male							
18 - 24	252	83,210	$665.64	$3,134.79	$30.51	$3,577.79	$297.7
25 - 44	1,619	291,235	$754.05	$2,940.34	$369.55	$3,795.39	$1,105.4
45 - 64	2,693	324,519	$765.77	$2,835.45	$1,326.00	$4,601.63	$1,493.3
65+	1,439	133,136	$627.40	$1,741.09	$651.15	$2,820.10	$375.5
	6,003	832,100	$725.24	$2,613.97	$851.89	$3,914.15	$3,257.0
Female							
18 - 24	60	39,415	$1,191.38	$2,757.37	$15.19	$3,702.00	$145.9
25 - 44	38	123,501	$722.33	$1,963.30	$819.90	$3,273.88	$404.3
45 - 64	340	84,086	$708.04	$3,047.65	$575.01	$4,044.52	$340.1
65+	91	15,766	$488.70	$1,569.77	$1,255.78	$3,095.24	$48.8
	871	262,769	$724.66	$2,400.17	$714.41	$3,585.54	$942.2
Grand Total	8,196		$681.96	$2,287.44	$709.89	$3,436.16	$3762.15

Table 73. 2020 expenditures by gender and age class and projections for spending in 2040.

Gender/Age Class	n	2020 spending/angler (dollars)	2020 spending (millions)	Estimated 2040 anglers	2040 spending projection (millions)
Male					
18 - 24	252	$3,577.79	$297.7	83,970	$300.4
25 - 44	1,619	$3,795.39	$1,105.4	290,378	$1,102.1
45 - 64	2,693	$4,601.63	$1,493.3	310,327	$1,428.0
65+	1,439	$2,820.10	$375.5	155,446	$438.4
	6,003	$3,914.15	$3,257.0	840,121	$3,288.4
Female					
18 - 24	60	$3,702.00	$145.9	63,633	$235.6
25 - 44	38	$3,273.88	$404.3	39,305	$128.7
45 - 64	340	$4,044.52	$340.1	117,839	$476.6
65+	91	$3,095.24	$48.8	101,584	$314.4
	871	$3,585.54	$942.2	322,362	$1,155.8
Grand Total	8,196	$3,436.16	$3,762.2	1,162,482	$3,994.5

[36] Average totals in this column have been shrunk by multiplying each by 0.934. This accounts for the difference in our sample expenditure mean and the per angler expenditure estimate obtained when dividing our expenditure projection by our unique angler population estimate. Our per angler expenditure estimate is lower than our sample expenditure mean because we project more anglers than would be expected by our gross expenditure projections and sample mean alone (3.8 billion total projection / 3679.29 sample expenditure mean = 1,022,520 expected unique anglers). As such, we adjusted the sample means of all Age/Sex classes by the same factor to account for this difference.

DISCUSSION:

The Great Lakes contain 20% of the world's surface fresh water, containing a high degree of biodiversity that is managed under a transboundary governance structure that includes two federal governments, two provinces, eight states, over 120 First Nations and tribes, and thousands of local government jurisdictions and agencies (Hildebrand et al., 2002; VanNijnattena et al., 2016). Consequently, management decisions do not occur in a vacuum and nearly always have ecological and sociological information needs, considerations, and consequences (Heck et al., 2016a; Heck et al., 2016b). Our research focused on a multitude of these objectives related to how the Great Lakes ecosystem is valued and used by stakeholders. To accomplish these broad goals, we evaluated the economic value (use and non-use) of the Great Lakes fisheries, for both the recreational and commercial sectors during the 2020 fishing season[37] and the public. We also examined willingness to pay for a Great Lakes fishing trip and estimated future conditions based on regional demographic projections. The overall project goal was to take a snapshot of the Great Lakes system with the focus on describing current conditions related to participation, spending, and use/non-use values, and then apply those findings to a future regional population. Our objectives aligned with Taylor et al. (2019), who noted that a critical area of research that must be addressed is an improved valuation of fisheries, monetary and otherwise. Our research sought to answer those research questions and we believe our findings reflect a current valuation of the Great Lakes, which can help guide future decisions across this important region.

The COVID-19 pandemic, which started in 2020, brought substantial perturbations in recreational fishing across North America (Paradis et al., 2021). With stay-at-home orders in place, state fish and wildlife agencies promoted fishing and hunting opportunities as a way to connect with the outdoors and increases in both were realized (Bunt and Jacobson, 2022; Danks et al., 2022). Consistent with those increases, anglers fished more (Howarth et al. 2021; Midway et al., 2021) and boats were sold in record numbers (RBFF Annual Report, 2020). Further, the Canadian border was closed to international travel in Spring 2020, which kept people closer to home and cancelled trips to Canadian resorts. These realities created much uncertainty during our study period and beyond. Although we evaluated the 2020 fishing season during this tumultuous period, our sample size (n = 10,595) across the eight Great Lakes states, allowed us to draw meaningful conclusions about the research objectives.

States vary with respect to who must be licensed (e.g., youth, military, or senior requirements) and what stamp/permit may be required (if at all); in fact, only Pennsylvania regulates at a level where a quasi-precise estimate is possible[38]. Consequently, we relied on other research, Agency experts, supporting documentation (e.g., creel data), and our survey results to estimate angler numbers at the state and lake levels. Our study revealed the Great Lakes fisheries provided robust opportunities for an estimated 1.1 million licensed anglers in 2020 who spent at least 1 day fishing the Great Lakes and their tributaries. Accounting for anglers who fished more than one lake (e.g., 37% in Michigan), we estimated 1.4 million people spent 34.1 million days fishing.

We acknowledge our estimate is imperfect and not in alignment with the 2016 FHWAR reported 1.8 million Great Lakes anglers. However, irrespective of a point estimate, our results have implications for management of fish populations, angler distributions, and highlight the importance of recreational fishing. For example, our research showed that 36% of Lake Michigan anglers fished for yellow perch, which is a species that suffered from poor recruitment in 2019 (Bunnell et al., 2020). Declines in this fishery could have negative implications for angler numbers, or anglers may shift to different species. Future research using a discrete choice experiment could be directed at fishing effort when a preferred species either increases or decreases (see Hunt et al., 2007).

Recreational anglers made large financial contributions to National, state, and regional economies. We estimated that US anglers spent $3.8 billion dollars in 2020, while Ontario estimated their anglers spent $285 million dollars on Great Lakes fishing. The input-output models of the study region (US: IMPLAN, Canada:

[37] Ontario also conducted their angler survey in 2020.

[38] Pennsylvania anglers must have a Lake Erie permit to fish the Lake or tributary up the first barrier, regardless of species.

Stats Canada) estimated the total economic contributions using an economic multiplier effect. The $4.1 billion of angler spending supported 35,800 jobs, provided $1.9 billion dollars of income, and $5.1 billion in overall economic output from recreational fishing.

We also estimated expenditures at angler level at the trip, equipment, and real estate levels. This granularity provides Agencies with the ability to scale up (or down) overall net economic benefits for their state (or lake within a state), should new angler numbers be produced from other studies.

Recognizing there are state and species level differences in willingness to pay estimates, our overall estimates aligned with other Great Lakes studies (e.g., Poe et al., 2013). Using the contingent valuation method, we found that the annual aggregate economic value of Great Lakes recreational fishing trips is $623 million. This is the first comprehensive estimate of the total recreational value of the Great Lakes fishery. Future research with these data could provide state, lake and species-specific recreational value estimates.

From the general population survey, we found that the total value of the Great Lakes recreational fishery includes both recreational use and non-use values. Residents of Great Lakes states who do not fish themselves place economic value on maintaining sustainable recreational catch rates. We estimate that the aggregate economic value to Great Lakes states and Ontario residents of avoiding a 10% reduction in the sustainable recreational harvest is $1.1 billion and even greater for 25% and 50% reductions. Willingness to pay is greatest for recreational users but still significant for those who do not fish but value the recreational fishery for altruistic, bequest and ecological reasons. Willingness to pay is between 7% and 31% of the recreational user willingness pay for these passive and non-users of the resource. Future methodological research with these data could provide insights about the most appropriate approach for mitigating hypothetical bias (with certainty recodes or attribute non-attendance) for future valuation studies.

The Great Lakes commercial fishery is small compared to the marine sector; however, it's economic importance is no less important. The industry supports nearly 3,000 jobs and contributed $123.2 million to North America's GDP. While this is down from the peak of over 10,000 (Brenden et al., 2013), this fishery is still important as it contributed $123.2 million dollars to North America's GDP and generated $89.0 million dollars in household income.

Changing environmental conditions through anthropogenic factors, will likely have measurable effects on the fisheries. As demonstrated from this study, the public is aware of those possible negative consequences and is willing to take steps to ameliorate these problems. For example, the long-term consequences of climate change (just one stressor) will have ramifications in all portions of the system (Collingsworth et al., 2017). There was strong agreement on environmental conditions that affect ecosystem quality and conceptually, our results align with Tyner and Boyer (2020). Our results demonstrate the importance of balancing stakeholder perceptions, concerns, and preferences with public policy decisions that positively impact the system (Breffle, 2013).

This study also provided initial insights into the value system of the public throughout the Great Lakes region. Although respondents were equally split as to whether the recreational fisheries were improving, stable, or declining, they were in strong agreement that various impacts (e.g., global climate change, aquatic invasive species) would have negative impacts. For the fundamental components of Great Lakes fisheries management, support was high across gender and age categories. Support for tax increases to pay for a Great Lakes plan decreased as individuals aged; however, knowledge of the environmental perturbations related to the Great Lakes system increased with age. Thus, there is slight disconnect between knowledge (impacts) and how to address an outcome (plan funding). Additionally, political affiliation and voting behavior may also contribute to future public values towards the Great Lakes system. As the population gets older, we know they vote at higher rates and tend to identify as more conservative politically. This may be partially tempered by an increase in urban residence; however, there is uncertainty in any projection.

If a comprehensive plan is developed, effort should be directed at a more focused study on values specific to the Great Lakes ecosystem. As the US becomes more urban and values continue to shift away from

traditional orientations (Manfredo et al., 2018), the consequences of environmental decision-making will become more important. Implementation of regulatory or policy changes will require a comprehensive integration of the biological and social sciences. The governance structure of state and Provincial fish and wildlife agencies requires a strong integration of both; indeed, most decisions are made outside of strictly biological results. Although we agree with Heck et al. (2015), who noted a reluctance of biological scientists to trust social science data in decision-making, we believe there is opportunity to closely align both disciplines.

Finally, population demographic data indicates the regional population that will grow slightly and get older. However, the recreational angler population (and their expenditures) may only slightly increase. Additionally, a stability or net increase of dollars into the system may be predicated on the fishing behavior of the 45 – 64 year-old anglers. Simply, they are the highest percentage of anglers and spend the most money annually. Prior Sex-period-cohort research in the Great Lakes demonstrated decreasing participation rates commensurate with increasing age, especially for people over 65 (Burkett and Winkler, 2019). These findings underscore the importance of providing meaningful Great Lakes fishing opportunity for the angling population that participates at the highest rates. Future research could be directed at these angler cohorts to estimate how their future behavior may change as a result of economic and environmental uncertainty.

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DELIVERABLES

There are currently 3 manuscripts in preparation:

- Economic impacts from Great Lakes fishing (T. Lange lead author)
- Angler willingness to pay (J. Whitehead lead author)
- State choice from general population survey (G. Howard lead author)

RESEARCH HIGHLIGHTS

- Despite restrictions imposed by COVID-19, an estimated the Great Lakes or their tributaries were fished 1.1 million US anglers during the 2020 fishing season in the United States. An additional 285,000 people fished in Canadian waters. US anglers targeted a broad range of species and spent an average of 29 days fishing and in many cases, fished multiple lakes within a state. Anglers spent over $4 billion dollars on fishing-related expenditures and included costs associated with trips, equipment (ranging from rods and reels to boats and vehicles), and real estate, such as land or cabins. The level of spending from anglers contributed significantly to regional economies and resulted in $5 billion of economic output and 36,000 fishing-related jobs. Simply, anglers are a critical component of the Great Lakes system, from the person who owns a boat capable of fishing Lake Superior, to someone who pier fishes with a child on Lake Michigan, to someone taking a walleye charter in Ohio. All of these recreational endeavors belay the importance of fishing as both an important social construct and economic engine.

- While smaller than the commercial marine fishery, we estimated the Great Lakes commercial fishery created $151.4 million dollars of economic activity in the U.S., contributing $78.5 million dollars to GDP. These industries supported more than 1,920 jobs, which provided $55.4 million to household incomes in 2020. Canadian harvest and revenues were twice that of the U.S. Collectively, the commercial fishing industry in both countries contributed $130.5 million dollars to North American GDP, supported almost 3,100 jobs generating $93.3 million dollars in household income.

- Anglers are willing to pay, on average, $82 dollars to fish the Great Lakes for a day. Our results highlight the fact anglers are willing to pay more or less, depending on their income level, how they fish, and where they fish.

- While important, anglers are only a piece of the puzzle. The majority of Great Lake state residents do not fish one of the Great Lakes, or at all. However, they value the ecological importance of the system and recognize how environmental stressors can negatively impact the fisheries. They also have a high degree of confidence in the government to manage the fisheries and support major components of a Great Lakes management plan. More than half supported a one-time tax to fund the plan.

- Trends are important. We project that over the next 20 years, the Great Lakes population will grow slightly and will skew towards older females. Other research has projected male anglers will decline and female anglers will increase, thus making it more important to engage all stakeholders, not just the comparatively few who fish.

APPENDICES

Appendix A. Questionnaire used to survey Great Lakes anglers during the 2020 fishing season.

1) How many years have you fished recreationally? _____
2) How many days per year do you fish recreationally? _____
3) Which skill level do you consider yourself to be with regards to angling?
   ( ) Beginner - very limited experience holding a rod and casting
   ( ) Novice - some experience with rod and casting techniques and beginning to experiment with different types of tackle
   ( ) Intermediate - comfortable with the rod, casting, and tackle selection in some settings
   ( ) Fairly advanced - lots of experience and techniques in many settings
   ( ) Expert - very experienced with equipment and techniques in all settings
4) How old were you when you started fishing? _____
5) From **January 1st, 2020 to December 31st, 2020**, did you do any recreational fishing, including bait collecting, at any of the **Great Lakes or their tributaries**? This includes the lakes Huron, Superior, Michigan, Erie, and Ontario and any of their tributaries.
   ( ) Yes
   ( ) No
6) What type of license did you have when you fished the Great Lakes or their tributaries? Please check all that apply.
   [ ] Resident Annual
   [ ] Resident Daily (example: 1 to 7 day license)
   [ ] Non-resident Annual
   [ ] Non-resident Daily (example: 1 to 7 day license)
   [ ] Other - Write In: _____
7) Which of the following fish species did you target on your Great Lakes fishing trip(s)? Please check **all** that apply.
   [ ] Perch
   [ ] Black Bass (largemouth, smallmouth, spotted bass etc., -- excluding white bass, striped bass, striped bass hybrids, rock bass, etc.)
   [ ] Walleye
   [ ] Sauger
   [ ] Salmon
   [ ] Steelhead
   [ ] Lake Trout
   [ ] Other Trout (Rainbow, Brown, etc.)
   [ ] Northern Pike, Pickerel, Muskie, Muskie Hybrids
   [ ] Any fish that bites
   [ ] Other Species #1: _____
   [ ] Other Species #2: _____
   [ ] Other Species #3: _____
8) How many days did you spend fishing for these species on your Great Lakes trip(s) between Jan. 1st, 2020 and Dec. 31st, 2020? _____
9) Which of the following Great Lakes or their tributaries and connecting waters did you visit to fish from **January 1st, 2020 to December 31st, 2020**? Please check all that apply.
   [ ] Huron, including the St. Mary's River
   [ ] Ontario, including the Niagara River
   [ ] Michigan
   [ ] Erie, including the Detroit River
   [ ] Superior
   [ ] Lake St. Clair, including the St. Clair River
   [ ] St. Lawrence River, south of the bridge at Cornwall
   [ ] Other tributaries or connecting waters (please list): _____

10) For all of your trip(s) to **Lake Huron, including the St. Mary's River** in 2020, how many days did you fish, in total, from the state/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    Michigan: _____
    Ontario, Canada: _____
    For all of your trip(s) to **Lake Ontario, including the Niagara River** in 2020, how many days did you fish, in total, from the state/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    New York: _____
    Ontario, Canada: _____
    For all of your trip(s) to **Lake Michigan** in 2020, how many days did you fish, in total, from the state(s) listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state(s); leave the others blank.
    Illinois: _____
    Indiana: _____
    Michigan: _____
    Wisconsin: _____
11) For all of your trip(s) to **Lake Erie, including the Detroit River** in 2020, how many days did you fish, in total, from the state(s)/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    Michigan: _____
    New York: _____
    Ohio: _____
    Pennsylvania: _____
    Ontario, Canada: _____
12) For all of your trip(s) to **Lake Superior** in 2020, how many days did you fish, in total, from the state(s)/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    Michigan: _____
    Minnesota: _____
    Wisconsin: _____
    Ontario, Canada: _____
13) For all of your trip(s) to **Lake St. Clair, including the St. Clair River** in 2020, how many days did you fish, in total, from the state/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    Michigan: _____
    Ontario, Canada: _____
14) For all of your trip(s) to the **St. Lawrence River, south of the bridge at Cornwall**, in 2020, how many days did you fish, in total, from the state/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state(s); leave the others blank.
    New York: _____
    Ontario, Canada: _____
15) For all of your trip(s) to the other area you listed **([question('option value'), id='18', option='10048']**) in 2020, how many days did you fish, in total, from the state(s)/province listed below? Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.
    Illinois: _____
    Indiana: _____
    Michigan: _____
    Minnesota: _____
    New York: _____
    Ohio: _____
    Pennsylvania: _____
    Wisconsin: _____

Ontario, Canada: _____

16) Please check those items you bought for yourself or were bought for you between January 1st, 2020 and December 31st, 2020, with the PRIMARY PURPOSE of fishing the Great Lakes or their tributaries. If you paid for others or if someone else paid for you, **INCLUDE ONLY YOUR SHARE OF THE EXPENSES**. Do not include the amounts paid for license fees, stamps, tags or equipment. Please check **all** that apply. As a reminder, please report expenditures for **all** of your 2020 Great Lakes trips.

[ ] Food, drinks, or refreshments
[ ] Lodging at hotels, motels, cabins, lodges, campgrounds
[ ] Public transportation by airplane
[ ] Public transportation by trains, taxis/rideshare, buses, car rental
[ ] Private vehicle expenses including gas, tolls, border crossings
[ ] Trip packages (including fees for charters, parties, guides, party boats, outfitters)
[ ] Public land use or access fees (including fees for any land owned by local, state/provincial, or national government
[ ] Private land use or access fees (including entrance, privileges, pr admittance fees for fishing on private lands or fishing preserves (Not including leases)
[ ] Bait (live, cut, prepared), not including lures
[ ] Ice
[ ] Heating or cooking fuels such as propane, charcoal, firewood
[ ] Equipment rentals such as boats, fishing or camping equipment
[ ] Boating launching fees
[ ] Boat fuel
[ ] Boat mooring/storage, maintenance, pump-out, or insurance
[ ] I did not spend money on any of these items

17) Please indicate the amount of money you spent on the following items for all of your Great Lakes fishing trip(s) in 2020. **<Note: Expenditures selected in Q16 were carried down>**.

	Amount ($)

18) From what state(s)/province did you make these purchases? **<Note: Expenditures selected in Q16 were carried down>.**

Indiana	Illinois	Michigan	Minnesota	New York	Ohio	Pennsylvania	Wisconsin	Ontario, Canada

19) Using your best estimate, what percentage (from 0 to 100) of your spending in this category was **outside** one of the Great Lakes states (IN, IL, MI, MN, NY, OH, PA, WI) or Ontario? If all of your spending was in a Great Lakes state/province, please leave blank. _____.

20) Please check those items you purchased in North America, **PRIMARILY for use in fishing the Great Lakes** or their tributaries **(at least 50% of usage)** from January 1st, 2020 to December 31st, 2020. Please check all of the categories that you spent money for your trips. Include the purchase of both new items and items previously owned by others. Do NOT include gifts you purchased for others or hand me down and inherited items. As a reminder, please report expenditures for **all** of your 2020 Great Lakes trips.

[ ] Rods, reels, poles, and rod making components
[ ] Lines or Leaders
[ ] Artificial lures, flies, baits, and dressing for flies or lines
[ ] Hooks, sinkers, swivels, and other items attached to a line (except lures and baits)
[ ] Tackle boxes
[ ] Creels, stringers, fish bags, landing nets, scales, knives, and gaff hooks
[ ] Minnow traps, seines, and bait containers
[ ] Depth finders, fish finders, GPS, and other electronic devices

[ ] Ice-fishing equipment (such as tip-ups and tilts, ice-fishing houses)
[ ] Camping equipment (such as backpacks, sleeping bags, duffel bags, tents)
[ ] Binoculars, field glasses, telescopes
[ ] Special fishing clothing (such as foul weather gear, boots, waders, fishing vests)
[ ] Fish-fighting chairs, outriggers, rod holders and belts
[ ] Processing or taxidermy
[ ] Books, magazines, or digital media devoted to Great Lakes fishing
[ ] Dues or contributions to national, state/provincial, or local Great Lakes oriented conservation or wildlife related organizations
[ ] I did not spend money on any of these items

21) Please indicate the amount of money you spent on the following items that were **primarily used for all of your Great Lakes fishing trips**. **<Note: Expenditures selected in Q20 were carried down>.**

	Amount ($)

22) From which state(s)/province did you make these purchases? **<Note: Expenditures selected in Q20 were carried down>.**

Indiana	Illinois	Michigan	Minnesota	New York	Ohio	Pennsylvania	Wisconsin	Ontario, Canada

23) Using your best estimate, what percentage (from 0 to 100) of your spending from this category was **outside** one of the Great Lakes states (IN, IL, MI, MN, NY, OH, PA, WI) or Ontario? If all of your spending was in a Great Lakes state/province, please leave blank _____.

24) Please check those items you purchased in North America, **PRIMARILY for use in fishing the Great Lakes** or their tributaries **(at least 50% of usage)** from January 1st, 2020 to December 31st, 2020. Include the purchase of both new items and items previously owned by others. Do NOT include gifts you purchased for others or hand me down and inherited items. As a reminder, please report expenditures for **all** of your 2020 Great Lakes trips.
[ ] Bass boat
[ ] Any type of motor boat (not including bass boat)
[ ] Canoes, kayaks, or any other non-motor boat
[ ] Boat motors, boat trailers/hitches, or any other boat accessories
[ ] Trucks, campers, vans, travel or tent trailers, motor homes, house trailers, or RVs
[ ] Cabins
[ ] Off-road vehicles such as a snowmobile, 4-wheeler, 4x4 vehicle, trail bike, or dune buggy
[ ] Land ownership (in part or whole)
[ ] Land leases (in part or whole)
[ ] Any other gear or equipment primarily used for Great Lakes fishing (such as equipment repair/maintenance, freezers, drones, or airplane rental)
[ ] I did not spend money on any of these items

25) Please indicate the amount of money you spent on the following items that are **primarily used for all of your Great Lakes fishing trips**. **<Note: Expenditures selected in Q24 were carried down>**.

	Amount ($)

26) From what state(s)/province did you make these purchases? **<Note: Expenditures selected in Q24 were carried down>**.

Indiana	Illinois	Michigan	Minnesota	New York	Ohio	Pennsylvania	Wisconsin	Ontario, Canada

27) Using your best estimate, what percentage (from 0 to 100) of your spending in this category was **outside** one of the Great Lakes states (IN, IL, MI, MN, NY, OH, PA, WI) or Ontario? If all of your spending was in a Great Lakes state/province, please leave blank. _____
28) Approximately how far did you travel to your fishing location on your most recent Great Lakes fishing trip (do not include distance traveled on the water)? Please only consider the trip when the primary purpose was to fish. _____ miles
29) Was this a day trip or an overnight trip?
    ( ) Day trip
    ( ) Overnight trip
30) How many nights did you spend away from home? _____
31) Including yourself, how many people were in your travel party? _____
32) **I**ncluding yourself, how many of the people in your travel party went fishing with you? _____
33) You indicated you fished with others on the Great Lakes, please check who fished with you.
    [ ] Immediate family (spouse, significant other, children)
    [ ] Extended family
    [ ] Friends and colleagues
    [ ] Pets
    [ ] Organized group (such as a club, church group)
    [ ] Other - Write In: _____
34) During **your most** recent Great Lakes fishing trip, how did you fish?
    ( ) From a private boat
    ( ) From a charter boat
    ( ) From the shore
    ( ) From a pier
    ( ) Ice fishing
    ( ) Other - Write In: _____

35) During which month was your most recent Great Lakes fishing trip?
    ( ) January
    ( ) February
    ( ) March
    ( ) April
    ( ) May
    ( ) June
    ( ) July
    ( ) August
    ( ) September
    ( ) October
    ( ) November
    ( ) December
36) Approximately how much time did you spend fishing on your most recent Great Lakes fishing trip?
    Hours: _____
    Minutes: _____
37) Was your most recent trip a typical Great Lakes fishing trip for you?
    ( ) Yes
    ( ) No
38) In total, about how much money did your most recent Great Lakes fishing trip cost you from the time you left home until when you returned? _____

39) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$7** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
40) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$31** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
41) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$54** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
42) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$77** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
43) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$101** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
44) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were **$124** more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
45) How sure are you that you would have still taken this trip?
    ( ) Very sure
    ( ) Somewhat sure
    ( ) Not very sure
46) What do you think you would you have done instead of taking this trip? I would have …
    ( ) Stayed home
    ( ) Fished in another location
    ( ) Done something outdoors other than fishing
    ( ) Other - Write In: _____

47) What proportion of your annual fishing days on the Great Lakes or their tributaries in 2020 was done while staying at a cabin, camp, cottage, or other property owned by you, your family, or friends that is primarily for seasonal or recreational use? Please consider only those days where the primary purpose was to fish.
    0 _____[__]_____ 100
48) What is the zip code of the seasonal or recreational property you fished from? _____
49) What is your gender?
    ( ) Male
    ( ) Female
    ( ) Prefer not to answer
50) What year were you born? _____
51) What is the zip code of your primary residence? _____
52) What is the highest level of education you have completed?
    ( ) Less than high school degree
    ( ) High school graduate (high school diploma or equivalent)

( ) Some college but no degree
( ) Associate's degree (2-year)
( ) Bachelor's degree (4-year)
( ) Master's degree
( ) Doctoral/Professional degree (PhD, MD, JD)
( ) Other/Prefer not to share

53) Please select a choice below that best describes your 2020 household income.

( ) Less than $20,000
( ) $20,000 to $34,999
( ) $35,000 to $49,999
( ) $50,000 to $74,999
( ) $75,000 to $99,999
( ) $100,000 to $149,999
( ) $150,000 or more
( ) Prefer not to answer

Appendix B. Abbreviated questionnaire used to survey Great Lakes anglers during the 2020 fishing season.

1) We previously sent email invitations to take a longer version of this survey. Have you already completed the survey?
   ( ) Yes
   ( ) No
2) How many years have you fished recreationally? _____
3) How many days per year do you fish recreationally? _____
4) How old were you when you started fishing? _____
5) Which skill level do you consider yourself to be with regards to angling?
   ( ) Beginner - very limited experience holding a rod and casting
   ( ) Novice - some experience with rod and casting techniques and beginning to experiment with different types of tackle
   ( ) Intermediate - comfortable with the rod, casting, and tackle selection in some settings
   ( ) Fairly advanced - lots of experience and techniques in many settings
   ( ) Expert - very experienced with equipment and techniques in all settings
6) From January 1st, 2020 to December 31st, 2020, did you do any recreational fishing, including bait collecting, at any of the Great Lakes or their tributaries? This includes the lakes Huron, Superior, Michigan, Erie, and Ontario and any of their tributaries.
   ( ) Yes
   ( ) No
7) What type of license did you have when you fished the Great Lakes or their tributaries? Please check all that apply.
   [ ] Resident Annual
   [ ] Resident Daily (example: 1 to 7 day license)
   [ ] Non-Resident Annual
   [ ] Non-Resident Daily (example: 1 to 7 day license)
   [ ] Other - Write In:: _____
8) Please indicate (check the box) the Great Lakes (or their tributaries) that you fished in 2020 and note the number of days you fished at each location. Please only consider trips when the primary purpose was to fish and enter days for the relevant state/province; leave the others blank.

	Check if fished	**Days Fished**
Great Lake	**Yes**	
Huron, including the St. Mary's River	[ ]	___
Ontario, including the Niagara River	[ ]	___
Michigan	[ ]	___
Erie, including the Detroit River	[ ]	___
Superior	[ ]	___
Lake St. Clair, including the St. Clair River	[ ]	___
St. Lawrence River, south of the bridge at Cornwall	[ ]	___
Other tributaries or connecting waters	[ ]	___

9) Please indicate the amount of money you spent on the following trip-related items. Include ONLY those items used when the PRIMARY purpose was to fish the Great Lakes between January 1st, 2020 and December 31st, 2020. If you paid for others or if someone else paid for you, include only your share of the expense.

Please also indicate the locations(s) you spent the most money. Please list up to 2. If you did not spend any money in these categories, please go to the next question.

Note: Great Lakes states and provinces include Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario Province in Canada. Please enter up to two.

	Check if spent		Location where most $ spent (2 locations were offered. Table is abbreviated)									
	Yes	Amount ($) spent	IL	IN	MI	MN	NY	OH	PA	WI	Non-GL state	Ont, CA
Food, drinks, or refreshments	[ ]	___	___	___	___	___	___	___	___	___	___	___
Private vehicle expenses including gas, tolls, border crossings	[ ]	___	___	___	___	___	___	___	___	___	___	___
Lodging at motels, cabins, lodges, campgrounds	[ ]	___	___	___	___	___	___	___	___	___	___	___
Bait (live, cut, prepared), not including lures	[ ]	___	___	___	___	___	___	___	___	___	___	___
Boating costs (launch fees, boat fuel, mooring/storage, maintenance, pump-out, or insurance)	[ ]	___	___	___	___	___	___	___	___	___	___	___

10) Using your best estimate, what percentage (from 0 to 100) of the trip-related spending you just reported was outside one of the Great Lakes states? If all of your spending was in a Great Lakes state/province, please leave blank. _____

11) Please indicate the amount of money you spent on the following equipment items. Include ONLY those items used when the PRIMARY purpose (at least 50% of usage) was to fish the Great Lakes between January 1st, 2020 and December 31st, 2020. If you paid for others or if someone else paid for you, include only your share of the expense.

Please also indicate the locations(s) you spent the most money. Please list up to 2. If you did not spend any money in these categories, please go to the next question.

Note: Great Lakes states and provinces include Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario Province in Canada.

	Check if spent		Location where most $ spent (2 locations were offered. Table is abbreviated)									
	Yes	Amount ($) spent	IL	IN	MI	MN	NY	OH	PA	WI	Non-GL state	Ont, CA
Rods, reels, poles, and rod making components	[ ]	___	___	___	___	___	___	___	___	___	___	___
Terminal tackle (lures, bait, hooks, sinkers, and other items attached to a line)	[ ]	___	___	___	___	___	___	___	___	___	___	___
Depth finders, fish finders, and other electronic fishing devices	[ ]	___	___	___	___	___	___	___	___	___	___	___
Boats, boat motors, boat trailers/hitches, or any other boat accessories	[ ]	___	___	___	___	___	___	___	___	___	___	___
Trucks, campers, vans, travel or tent trailers, motor homes, house trailers, or RVs	[ ]	___	___	___	___	___	___	___	___	___	___	___

12) Using your best estimate, what percentage (from 0 to 100) of the trip-related spending you just reported was outside one of the Great Lakes states? If all of your spending was in a Great Lakes state/province, please leave blank. _____
13) Approximately how far did you travel to your fishing location on your most recent Great Lakes fishing trip (do not include distance traveled on the water)? Please only consider the trip when the primary purpose was to fish. _____
14) Was this a day trip or overnight trip?
    ( ) Day trip
    ( ) Overnight trip
15) In total, about how much money did your most recent Great Lakes fishing trip cost you from the time you left home until when you returned? _____
16) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $7 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
17) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $31 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know

18) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $54 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
19) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $77 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
20) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $101 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
21) Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken this trip if the cost were $124 more than the amount you just reported?
    ( ) Yes
    ( ) No
    ( ) I don't know
22) What is your gender?
    ( ) Male
    ( ) Female
    ( ) Prefer not to answer
23) What year were you born? _____
24) What is the zip code of your primary residence? _____
25) What is the highest level of education you have completed?
    ( ) Less than high school degree
    ( ) High school graduate (high school diploma or equivalent)
    ( ) Some college but no degree
    ( ) Associate's degree (2-year
    ( ) Bachelor's degree (4-year)
    ( ) Master's degree
    ( ) Doctoral/Professional degree (PhD, MD, JD)
    ( ) Other/Prefer not to share

Appendix C. Questionnaire used to survey the general public on use and non-use values of Great Lakes residents.

Q1.1 **Information to consider about this research**

You are invited to participate in a research study. Participating in this study is completely voluntary. Even if you decide to participate now, you may change your mind and stop at any time. You may choose to not continue with the survey for any reason.

No one will be identified in any reports coming out of the survey. No identifying information will ever be associated with your answers. All responses are confidential.

Appalachian State University's Institutional Review Board (IRB) has determined this study to be exempt from IRB oversight. If you have questions about this research project, you can contact John Whitehead at (828) 262-6121 (whiteheadjc@appstate.edu) or the Appalachian IRB Administrator at (828) 262-2692 (irb@appstate.edu) or at Appalachian State University, Office of Research Protections, IRB Administrator, Boone, North Carolina 28608.

By continuing to the questionnaire, I acknowledge that I am at least 18 years old, have read the above information, and agree to participate.

Q1.2 Do you currently live in Canada or the United States?
- ○ Canada
- ○ United States

Q2.1 What state do you currently live in?

▼ Alabama (1) ... Wyoming (50)

Display This Question: If Q2.1 = 13

Q2.2 What Illinois county do you currently live in?

▼ Adams County (1) ... Woodford County (102)

Display This Question: If Q2.1 = 14

Q2.3 What Indiana county do you currently live in?

▼ Adams County (1) ... Whitley County (92)

Display This Question: If Q2.1 = 22

Q2.4 What Michigan county do you currently live in?

▼ Alcona (1) ... Wexford (83)

Display This Question: If Q2.1 = 23

Q2.5 What Minnesota county do you currently live in?

▼ Aitkin County (1) ... Yellow Medicine County (87)

Display This Question: If Q2.1 = 32

Q2.6 What New York county do you currently live in?

▼ Adams New Purchase (1) ... Yates County (93)

Display This Question: If Q2.1 = 35

Q2.7 What Ohio county do you currently live in?

▼ Adams County (1) ... Wyandot County (88)

Display This Question: If Q2.1 = 38

Q2.8 What Pennsylvania county do you currently live in?

▼ Adams County (1) ... York County (95)

Display This Question: If Q2.1 = 49

Q2.9 What Wisconsin county do you currently live in?

▼ Adams County (1) ... Wooster (87)

Q2.10 What is your home ZIP code? _____
Q3.1 What Province or territory do you currently live in?

▼ Alberta (1) ... Yukon (15)

Display This Question: If Q3.1 = Canada

Q3.2 What is your home postal code? _____
Q4.1 To which gender do you most closely identify with?

- ○ Male
- ○ Female
- ○ Non-binary/third gender
- ○ Prefer not to say

Q4.2 Consider your entire household income in 2020 before taxes. Was it above or below $70,000?

- ○ Less than $70,000
- ○ $70,000 or more
- ○ I prefer not to answer

Q4.3 What is your current age?

- ○ Less than 18
- ○ 18 to 24
- ○ 25 to 44
- ○ 45 to 64
- ○ 65 and older

Q5.1 This study was funded by the Great Lakes Fishery Commission. The Great Lakes Fishery Commission has five major duties:

- To develop a binational research program aimed at sustaining Great Lakes fish stocks;
- To coordinate or conduct research consistent with that program;
- To recommend measures to governments that protect and improve the fishery;
- To formulate and implement a comprehensive sea lamprey control program; and
- To publish or authorize publication of scientific and other information critical to sustaining the fishery.

The purpose of this survey is to determine what the U.S. and Canadian public thinks about Great Lakes fisheries management.

You can learn more by clicking on the link to the Great Lakes Fishery Commission (glfc.org --> this opens in a new window).

Q5.2 Objective: Through this study, we aim to better understand the public's preferences about fisheries management in the Great Lakes. This survey will ask you to compare different scenarios and make choices based on your preference. The scenarios have been designed solely for the purpose of this survey and do not reflect actual decisions currently under consideration. However, they do represent the kinds of decisions the Great Lakes Fishery Commission might face in the future, and we ask that you try to make your best judgement.

Policy Relevance: The overarching goal of the study is to help the Great Lakes Fishery Commission recommend policies and decisions that reflect the public's preferences.

Information dissemination: The results generated from this study will be presented to the Great Lakes Fisheries Commission and given to others in state and local government, and non-profit organizations. We will also publicize our results online via a webpage.

Q5.3 The Great Lakes consist of Lake Erie, Lake Huron, Lake Michigan, Lake Ontario and Lake Superior. Great Lakes tributaries and connecting waters include the Detroit River, the St. Mary's River, the Niagara River, Lake St. Clair, the St. Clair River and the St. Lawrence River. How much do you know about the Great Lakes, tributaries and connecting waters?

- ○ A lot
- ○ Some
- ○ A little
- ○ Nothing

Q5.4 How much do you know about the recreational fisheries of the Great Lakes?

- ○ A lot
- ○ Some
- ○ A little
- ○ Nothing

Skip To: End of Block If Q5.4 = Nothing

Q5.5
In your opinion, are the recreational fisheries of the Great Lakes improving, deteriorating or staying the same?

- ○ Improving
- ○ Deteriorating
- ○ Staying the same
- ○ I don't know

Skip To: End of Block If Q5.5 = I don't know

Q5.6 What impact do you think each of the following have on recreational fisheries of the Great Lakes?

	Negative impact	No impact	Positive impact	I don't know
Climate change/Global warming	○	○	○	○
Loss of wetlands	○	○	○	○
Agricultural runoff	○	○	○	○
Municipal waste water runoff	○	○	○	○
Algae blooms	○	○	○	○
Aquatic invasive species	○	○	○	○
Industrial pollution	○	○	○	○

Q6.1 Have you been recreational fishing in the last 12 months at any of the Great Lakes, tributaries or connecting waters?

- Yes
- No
- I don't know

Q6.2 Have any of your friends or family members been recreational fishing in the last 12 months at any of the Great Lakes, tributaries or connecting waters?

- Yes
- No
- I don't know

Display This Question: If Q6.1 = Yes

Q6.3 Which of the following Great Lakes, tributaries or connecting waters did you visit to fish during the past 12 months?
Please check all that apply.

- Lake Erie, including the Detroit River
- Lake Huron, including the St. Mary's River
- Lake Michigan
- Lake Ontario, including the Niagara River
- Lake Superior
- Lake St. Clair, including the St. Clair River
- St. Lawrence River (south of the bridge at Cornwall)

Display This Question: If Q6.3 = Lake Erie

Q6.4 How many trips did you take to **Lake Erie** to participate in **fishing** during the past 12 months?
Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question: If Q6.3 = Lake Huron

Q6.5 How many trips did you take to **Lake Huron** to participate in **fishing** during the past 12 months?
Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question: If Q6.3 = Lake Michigan

Q6.5 How many trips did you take to **Lake Michigan** to participate in **fishing** during the past 12 months?
Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question: If Q6.3 = Lake Ontario

Q6.9 How many trips did you take to **Lake Ontario, including the Niagara River** to participate in **fishing** during the past 12 months? Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question :If Q6.3 = Lake Superior

Q6.9 How many trips did you take to **Lake Superior** to participate in **fishing** during the past 12 months? Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question: If Q6.3 = Lake St. Clair

Q6.9 How many trips did you take to **Lake St. Clair** to participate in **fishing** during the past 12 months? Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Display This Question: If Q6.3 = St. Lawrence River

Q6.10 How many trips did you take to **St. Lawrence River** to participate in **fishing** during the past 12 months? Please only consider trips when the primary purpose was to fish.

▼ 0 (1) ... More than 100 (102)

Q7.1 Suppose the U.S. Great Lakes States (Indiana, Illinois, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin) and the Province of Ontario developed a "Great Lakes Recreational Fisheries Management Plan". The plan would implement policies to:

- Control aquatic invasive species
- Reduce industrial water pollution
- Reduce agricultural water pollution
- Restore coastal wetlands
- Support fisheries management activities

Q7.2 Although the Great Lakes are large, they are sensitive to pollutants. Some of these pollutants are from industrial sources like factories. State and federal government agencies have proposed additional industrial regulations to reduce industrial water pollution in the Great Lakes.

Do you support additional regulations to reduce industrial water pollution in the Great Lakes?

- ○ Strongly support
- ○ Somewhat support
- ○ Neither
- ○ Somewhat do not support
- ○ Strongly do not support

Q7.3

- An invasive species is a plant or animal that is foreign to an ecosystem.
- At least 25 aquatic invasive species have entered the Great Lakes since the 1800s, including alewife, sea lamprey, Eurasian milfoil and zebra mussels.
- These aquatic invasive species have significantly changed the Great Lakes ecosystem.
- Aquatic invasive species can be controlled by regulating ballast water discharge and the construction of permanent barriers to prevent fish from entering the Great Lakes from connecting waterways.

Do you support ballast water regulation and the construction of permanent barriers between the Great Lakes and connecting waterways to control aquatic invasive species?

- ○ Strongly support
- ○ Somewhat support
- ○ Neither
- ○ Somewhat do not support
- ○ Strongly do not support

Q7.4 Great Lakes coastal wetlands are areas of marshes or swamps directly influenced by the waters of one of the Great Lakes. Great Lakes coastal wetlands are found throughout the basin, along shorelines, in the mouths of tributaries, and along connecting channels. More than one-half of Great Lakes coastal wetlands have been lost because of human development. State and federal government agencies have been restoring coastal wetlands in the Great Lakes. Do you support the restoration of coastal wetlands in the Great Lakes?

- Strongly support
- Somewhat support
- Neither
- Somewhat do not support
- Strongly do not support

Q7.5 Having well-balanced and productive fish populations are important for supporting recreational fisheries in the Great Lakes. Fisheries managers cooperatively manage fisheries in the Great Lakes by stocking predator fishes like salmon and trout, by regulating harvest and by enforcement of fishing regulations.

Do you support fisheries management to achieve well-balanced and productive fish populations in the Great Lakes?

- Strongly support
- Somewhat support
- Neither
- Somewhat do not support
- Strongly do not support

Q7.6 Harmful algal blooms are a frequent occurrence in the Great Lakes.

- These blooms may cause fish kills and discolored or foul-smelling water, affecting both human and ecosystem health.
- Harmful algal blooms are mostly caused by excess nutrients from agriculture entering the lake.
- Heavy rains wash soil and fertilizer containing phosphorus and nitrogen into rivers and streams that flow into lakes

Do you support the regulation of agriculture to control excess nutrients and reduce harmful algal blooms in the Great Lakes?

- Strongly support
- Somewhat support
- Neither
- Somewhat do not support
- Strongly do not support

Q8.1 Each year, almost 2 million recreational anglers fish the Great Lakes. There are a number of important recreational fish species in the Great Lakes.

Warm water species are found in the shallower bays and nearshore areas. The most important warmwater species for recreation are:
Yellow Perch, Black Bass (Largemouth, Smallmouth), Walleye, Pike (Northern Pike, Muskellunge)

Cold-water species are found in deeper, open waters. The most important coldwater species for recreation are:
Salmon (Chinook, Coho), Steelhead (Rainbow Trout), Other Trout (Brook, Brown)

Click the link for a new browser window to get more information from the Michigan Department of Natural Resources.

Q8.2 How much do you know about these fish species?

	A lot	Some	A little	Nothing
Yellow Perch	○	○	○	○
Black Bass	○	○	○	○
Walleye	○	○	○	○
Pike	○	○	○	○
Salmon	○	○	○	○
Steelhead	○	○	○	○
Lake Trout	○	○	○	○
Other Trout	○	○	○	○

Q8.3 The goals of a Great Lakes Recreational Fisheries Management Plan would be to achieve well-balanced and productive fish populations in the Great Lakes in order to maintain the sustainable harvest of warm water and cold water recreational species.

The "sustainable harvest" is the amount of fish that can be caught and kept each year without resulting in a decline in the fish population.

Would you support this goal of a Great Lakes Recreational Fisheries Management Plan?

- ○ Strongly support
- ○ Somewhat support
- ○ Neither
- ○ Somewhat do not support
- ○ Strongly do not support

Q8.4 Achieving the goals of the Great Lakes Recreational Fisheries Management Plan would be expensive. But, there are a lot of households living in the Great Lakes region and the cost would be spread around.

The funding for the management plan could come from a **one-time increase in state and Provincial taxes**.

Would you support a one-time tax increase to fund the Great Lakes Fisheries Management Plan?

- ○ Strongly support
- ○ Somewhat support
- ○ Neither
- ○ Somewhat do not support
- ○ Strongly do not support

Q8.5 You will be presented with several questions about different versions of a Great Lakes Recreational Fisheries Management Plan.

Before these questions are presented we would like you to fully understand the format of the questions.

Please consider the instructions in the next section of the questionnaire.

Q9.1 You will be presented with different scenarios for the Great Lakes Fisheries Management Plan.

The goals of the plan would be to maintain the sustainable harvest of important warmwater and coldwater recreational fish species in the Great Lakes at current levels.

Without the plan, warm water and cold water recreational fish populations will be threatened by pollution, invasive species and habitat loss. Natural resource management agencies would need to reduce the allowable amount of fish that are caught and kept.

There are several types of regulations that natural resource management agencies use to reduce the number of fish that are caught and kept by anglers:

- Bag limits - the number of fish that can be caught and kept per day (e.g., the bag limit for trout and salmon is 5 fish per day in any of the Great Lakes)
- Size limits - a minimum size of a fish that can be kept (e.g., the minimum size limit for trout and salmon in any of the Great Lakes is 10 inches)

How closely did you read these instructions?
- ○ Very closely
- ○ Somewhat closely
- ○ Not very closely

Q9.2 In the scenarios that follow, imagine that with implementation of the Great Lakes Recreational Fisheries Management Plan there would be no change in recreational catch.

Without the plan in place the fish population would not be large enough to sustain itself (i.e., the current catch and keep rates are unsustainable). So, without the plan a combination of bag and size limits would be used by natural resource management agencies to reduce the recreational catch.

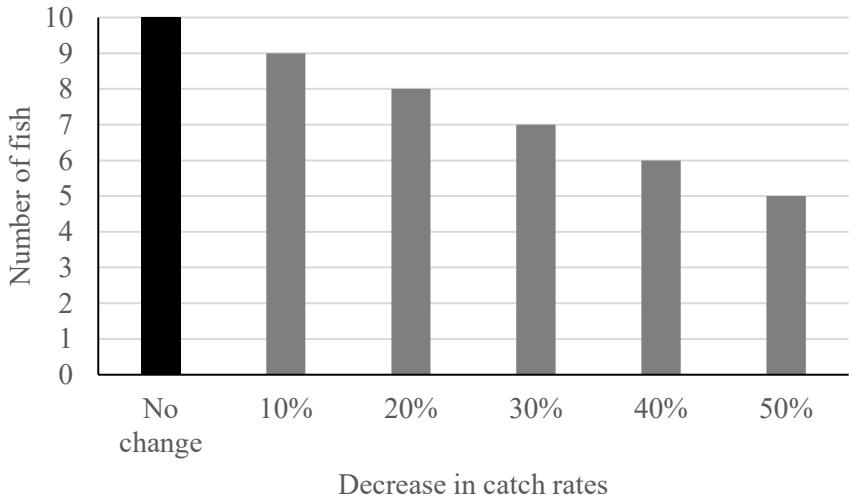
For example, the table shows that the Great Lakes Recreational Fisheries Management Plan would avoid a 50% decrease in the number of cold water species (salmon, steelhead, lake trout and other trout) that are caught and kept each year in the Great Lakes.

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">50% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
</table>

How closely did you read these instructions?
- ○ Very closely
- ○ Somewhat closely
- ○ Not very closely

Q9.3 Sometimes it is hard to understand percentages, especially when you have not experienced the situation.

The graphic below shows how large the changes in recreational catch might be without the Great Lakes Recreational Fisheries Management Plan.



Q9.4 According to the graph, if you typically catch 10 fish on each fishing trip how many would you catch if there was a combination of bag limits and size limits that led to a **${e://Field/decrease}0%** decrease in catch rates?

- 50%
- 60%
- 70%
- 80%
- 90%
- I don't know

Q9.5 You will be presented with different scenarios reflecting current uncertainties about the **cost of the plan** to Great Lakes households like yours.

The cost of the plan would depend on the:

- Size of the decrease in recreational catch to be avoided
- Number of policies and regulations used

We estimate that the one-time cost of the plan would range from about **$10** to **$250** for households with incomes like yours in the Great Lakes region. The plan would be funded by a one-time increase in state and Provincial taxes.

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
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<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$100</td></tr>
</table>

How closely did you read these instructions?
- Very closely
- Somewhat closely
- Not very closely

Q9.6 In each scenario you will be asked if you would vote in favor or against the plan in a referendum. In this referendum, if **50%** or more of the voters in the Great Lakes States and Ontario are in favor then the Great Lakes Recreational Fisheries Management Plan would be implemented.

In each of the scenarios you will be asked whether you would vote in favor or against the plan.

How closely did you read these instructions?
- Very closely
- Somewhat closely
- Not very closely

Q9.7 In studies like this it is often the case that more people say they would vote in favor of the policy than actually do when in a real referendum. While the voting questions are hypothetical, we ask that you answer them just like you would if these were real referendum votes. Will you try to answer the hypothetical voting questions just like you would if they were real referenda?
- Yes
- No
- I don't know

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">40% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$90</td></tr>
</table>

SPCold1_1: Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$90**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **40%.**

How would you vote in this situation?
- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold1_1 = Vote in Favor

CertCold1_1
Please consider that if the cost to your household was **$90**, then this is **$90** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold1_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$130**.

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$130

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **50%.**

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold1_2 = Vote in Favor

CertCold1_2
Please consider that if the cost to your household was **$130**, then this is **$130** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold1_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$50**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limitsand size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **20%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	20% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$50

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold1_3 = Vote in Favor

CertCold1_3
Please consider that if the cost to your household was **$50**, then this is **$50** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold2_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$210**.
Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **30%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	30% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$210

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold2_1 = Vote in Favor

CertCold2_1
Please consider that if the cost to your household was **$210**, then this is **$210** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold2_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **40%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	40% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$250

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question:

If SPCold2_2 = Vote in Favor

CertCold2_1
Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold2_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$90**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **20%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="9">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">20% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$90</td></tr>
</table>

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question:

If SPCold2_3 = Vote in Favor

CertCold2_3
Please consider that if the cost to your household was **$90**, then this is **$90** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold3_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$50**.
Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **50%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$50

How would you vote in this situation?
- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold3_1 = Vote in Favor

CertCold3_1
Please consider that if the cost to your household was **$50**, then this is **$50** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?
- Very certain
- Somewhat certain
- Not certain at all

SPCold3_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$210**.
Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **20%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	20% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$210

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

SPCold3_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$10**.

Display This Question: If SPCold3_2 = Vote in Favor

CertCold3_2
Please consider that if the cost to your household was **$210**, then this is **$210** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **30%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	30% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$10

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

CertCold3_3
Please consider that if the cost to your household was **$10**, then this is **$10** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold4_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.
The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **30%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	30% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$210

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold4_1 = Vote in Favor

CertCold4_1
Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold4_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$10**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **50%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	150

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold4_2 = Vote in Favor

CertCold4_2
Please consider that if the cost to your household was **$10**, then this is **$10** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold4_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$170**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **10%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	10% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$170

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question:If SPCold4_3 = 1

CertCold4_3
Please consider that if the cost to your household was **$170**, then this is **$170** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold5_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$170**.
Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **50%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$170

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold5_1 = Vote in Favor

CertCold5_1
Please consider that if the cost to your household was **$170**, then this is **$170** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPCold5_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$130**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **40%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">40% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$130</td></tr>
</table>

How would you vote in this situation?
- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPCold5_2 = Vote in Favor

CertCold5_2
Please consider that if the cost to your household was **$130**, then this is **$130** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?
- Very certain
- Somewhat certain
- Not certain at all

SPCold5_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **cold water fish species** at current levels.

The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of salmon, steelhead, lake trout, and other trout by **10%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	10% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$250

How would you vote in this situation?

- ○ I would vote in favor of the plan
- ○ I would vote against the plan
- ○ I don't know how I would vote

Display This Question: If SPCold5_3 = Vote in Favor

CertCold5_3
Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- ○ Very certain
- ○ Somewhat certain
- ○ Not certain at all

SPWarm1_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$90**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **40%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	40% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$90

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm1_1 = Vote in Favor

CertWarm1_1
Please consider that if the cost to your household was **$90**, then this is **$90** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm1_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.
The one-time cost of the plan to your household would be **$50**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **20%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	20% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$50

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm1_2 = Vote in Favor

CertWarm1_2
Please consider that if the cost to your household was **$50**, then this is **$50** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm1_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$130**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **50%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">50% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$130</td></tr>
</table>

How would you vote in this situation?
- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm1_3 = Vote in Favor

CertWarm1_3
Please consider that if the cost to your household was **$130**, then this is **$130** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?
- Very certain
- Somewhat certain
- Not certain at all

SPWarm2_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **40%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	40% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$250

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm2_1 = Vote in Favor

CertWarm2_1
Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm2_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$90**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **20%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	20% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$90

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm2_2 = Vote in Favor

CertWarm2_2
Please consider that if the cost to your household was **$90**, then this is **$90** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm2_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$210**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **30%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">30% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$210</td></tr>
</table>

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm2_3 = Vote in Favor

CertWarm2_3
Please consider that if the cost to your household was **$210**, then this is **$210** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm3_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$210**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **20%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">20% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$210</td></tr>
</table>

How would you vote in this situation?
- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm3_1 = Vote in Favor

CertWarm3_1
Please consider that if the cost to your household was **$210**, then this is **$210** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?
- Very certain
- Somewhat certain
- Not certain at all

SPWarm3_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$10**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **30%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	30% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$10

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm3_2 = Vote in Favor

CertWarm3_2
Please consider that if the cost to your household was **$10**, then this is **$10** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm3_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$50**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **50%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$50

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm3_3 = Vote in Favor

CertWarm3_3
Please consider that if the cost to your household was **$50**, then this is **$50** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm4_1
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$10**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **50%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">50% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$10</td></tr>
</table>

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm4_1 = Vote in Favor

CertWarm4_1
Please consider that if the cost to your household was **$10**, then this is **$10** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm4_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$170**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **10%.**

<table>
<tr><td></td><td colspan="2">Recreational Catch</td></tr>
<tr><td>Species</td><td>Without the Plan</td><td>With the Plan</td></tr>
<tr><td>Perch</td><td rowspan="4">No change</td><td rowspan="8">No change</td></tr>
<tr><td>Black Bass</td></tr>
<tr><td>Walleye</td></tr>
<tr><td>Pike</td></tr>
<tr><td>Salmon</td><td rowspan="4">10% decrease</td></tr>
<tr><td>Steelhead</td></tr>
<tr><td>Lake Trout</td></tr>
<tr><td>Other Trout</td></tr>
<tr><td>Cost</td><td>$0</td><td>$170</td></tr>
</table>

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm4_2 = Vote in Favor

CertWarm4_2
Please consider that if the cost to your household was **$170**, then this is **$170** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm4_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **30%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	30% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$250

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

CertWarm4_3

Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm5_1

Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$130**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **40%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	40% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$130

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm5_1 = Vote in Favor

CertWarm5_1
Please consider that if the cost to your household was **$130**, then this is **$130** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm5_2
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$250**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **10%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	40% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$250

How would you vote in this situation?

- I would vote in favor of the plan
- I would vote against the plan
- I don't know how I would vote

Display This Question: If SPWarm5_2 = Vote in Favor

CertWarm5_2
Please consider that if the cost to your household was **$250**, then this is **$250** that you would not have to spend on other things.
How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- Very certain
- Somewhat certain
- Not certain at all

SPWarm5_3
Consider the following situation

One goal of the Great Lakes Recreational Fisheries Management Plan would be to maintain the recreational catch of **warm water fish species** at current levels.

The one-time cost of the plan to your household would be **$170**.

Without the plan fish populations will be threatened by pollution, invasive species and habitat loss. Bag limits and size limits would be used to decrease the recreational catch of yellow perch, black bass, walleye and pike by **50%.**

	Recreational Catch	
Species	Without the Plan	With the Plan
Perch	No change	No change
Black Bass		
Walleye		
Pike		
Salmon	50% decrease	
Steelhead		
Lake Trout		
Other Trout		
Cost	$0	$170

How would you vote in this situation?

- ○ I would vote in favor of the plan
- ○ I would vote against the plan
- ○ I don't know how I would vote

Display This Question: If SPWarm5_3 = Vote in Favor

CertWarm5_3

Please consider that if the cost to your household was **$170**, then this is **$170** that you would not have to spend on other things.

How certain are you that you would actually vote in favor in this situation if it were a real referendum?

- ○ Very certain
- ○ Somewhat certain
- ○ Not certain at all

Q20.1 How much did you consider each of the following when making your decisions?

	A lot	Some	Not much	None
The amount of the one-time tax increase	○	○	○	○
The decrease in warm water recreational fish catch	○	○	○	○
The decrease in cold water recreational fish catch	○	○	○	○

Q20.2 – Q20.8

- I understood all of the information presented to me about the hypothetical situations.
- I have confidence in the ability of the government to manage Great Lakes recreational fisheries.
- I believe the results of this survey will be shared with the Great Lakes Fisheries Commission and other government agencies that make decisions about Great Lakes recreational fisheries.
- I believe the results of this survey could affect decisions about Great Lakes recreational fisheries.
- I answered the hypothetical questions just like I would if they were real referenda.
- I think that my own taxes would actually increase to pay for a "Great Lakes Recreational Fisheries Management Plan".
- This survey is biased.

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Display This Question:

If Q20.8 = Biased - Strongly agree

Or Q20.8 = Biased - Slightly agree

Q20.9 In what way(s) do you think this survey is biased? _____

Q21.1 What is your year of birth? _____

Q21.2 What is your current marital status?

- Married
- Widowed
- Divorced
- Separated
- Never Married
- I prefer not to answer

Q21.3 What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school graduate (high school diploma or equivalent including GED)
- Some college but no degree
- Associate degree in college (2-year)
- Bachelor's degree in college (4-year)
- Master's degree
- Doctoral degree
- Professional degree (JD, MD)
- I prefer not to answer

Q21.4 What do you consider to be your primary race or ethnic group?

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Other: _____
- I prefer not to answer

Q21.5 Which statement best describes your current employment status?

- Working (paid employee)
- Working (self-employed)
- Not working (temporary layoff from a job)
- Not working (looking for work)
- Not working (retired)
- Not working (disabled)
- Not working (other): _____
- I prefer not to answer

Q21.7 When it comes to politics, would you describe yourself as liberal, conservative, or neither liberal nor conservative?

- ○ Very liberal
- ○ Somewhat liberal
- ○ Neither liberal or conservative
- ○ Somewhat conservative
- ○ Very conservative
- ○ Other: _____

Q21.8 Information about income is very important to understand. Would you please give your best guess? Please indicate the answer that includes your entire household income in 2020 before taxes.

- ○ Less than $10,000
- ○ $10,000 to $19,999
- ○ $20,000 to $29,999
- ○ $30,000 to $39,999
- ○ $40,000 to $49,999
- ○ $50,000 to $59,999
- ○ $60,000 to $69,999
- ○ $70,000 to $79,999 (8)
- ○ $80,000 to $89,999 (9)
- ○ $90,000 to $99,999 (10)
- ○ $100,000 to $149,999 (11)
- ○ $150,000 or more
- ○ I prefer not to answer

Q21.9 If there is anything else you would like to tell us about Great Lakes fisheries or this questionnaire please use this space.

_____

If you would like to receive a summary of the results of this study please email John Whitehead at whiteheadjc@appstate.edu. You will receive an email in the summer of 2022 with a link to the project website.

Thanks!

Appendix D. Detailed expenditure tables for Great Lakes that shared a border with Canada.

Table D1. Detailed expenditures (in millions) for Great Lakes anglers, by US expenditure codes, by state/Province, 2020.

	State										
Trip Expenditures	IL	IN	MI	MN	NY	OH	PA	WI	US Total	Ontario	Grand Total
Food	$5.29	$2.12	$38.29	$3.79	$21.40	$37.46	$12.33	$16.32	$136.99	$15.55	$165.11
Ice	$.44	$.23	$3.09	$.25	$1.44	$4.38	$1.46	$1.29	$12.57		
Lodging	$1.46	$.47	$27.13	$1.52	$19.01	$24.26	$3.35	$13.80	$90.98	$9.52	$100.50
Airfare	$.04	$.0	$.06	$.0	$.37	$.16	$.0	$.09	$.72	$21.45	$174.64
Public transportation	$.22	$.02	$.10	$.02	$.19	$.30	$.01	$.23	$1.09		
Private transportation	$3.97	$1.65	$31.70	$2.77	$16.66	$29.35	$10.46	$11.92	$108.49		
Guides	$2.27	$.42	$12.20	$.81	$9.63	$19.32	$3.31	$9.0	$56.97	$9.80	$66.77
Public land use fees	$.33	$.15	$2.38	$.12	$.73	$.68	$.27	$.86	$5.52	$13.10	$21.15
Private land use fees	$.06	$.03	$.47	$.06	$.97	$.67	$.04	$.24	$2.53		
Boat launching	$.57	$.31	$3.24	$.11	$1.85	$2.77	$.36	$2.97	$12.18	$37.74	$244.50
Boat fuel	$1.64	$1.19	$23.10	$2.14	$9.44	$35.79	$9.66	$9.50	$92.47		
Boat mooring	$2.88	$1.45	$23.89	$1.75	$7.12	$49.88	$10.19	$4.96	$102.11		
Other trip expenditures (Canada only)									$.0	$.03	$.03
Sub Total	$19.16	$8.05	$165.64	$13.33	$88.82	$205.01	$51.45	$71.16	$622.62	$107.18	$729.80

	State										
Equipment Expenditures	IL	IN	MI	MN	NY	OH	PA	WI	US Total	Ontario	Grand Total
Rods, reels & components	$6.68	$3.10	$30.17	$3.18	$17.93	$40.59	$14.09	$17.12	$132.86	$21.26	$414.69
Tackle boxes	$.43	$.18	$2.28	$.22	$.90	$2.24	$1.0	$.87	$8.13		
Creels, stringers, landing nets	$.31	$.16	$2.04	$.21	$.65	$2.41	$1.07	$1.33	$8.18		
Depth and fish finders, other electronics	$3.02	$1.59	$20.42	$2.95	$5.63	$26.82	$7.16	$14.88	$82.48		
Ice fishing equipment	$.68	$.28	$8.58	$1.0	$2.98	$.78	$1.65	$4.06	$20.01		
Binoculars	$.22	$.18	$2.63	$.19	$.72	$1.61	$1.15	$.38	$7.08		
Other fishing equipment	$.13	$.06	$1.76	$.14	$.41	$2.37	$.54	$1.74	$7.15		
Bait (live, cut, prepared)	$1.38	$.67	$8.11	$.81	$4.19	$11.32	$4.36	$3.50	$34.35	$15.39	$149.15
Lines & leaders	$1.09	$.53	$5.80	$.51	$2.71	$6.30	$2.68	$2.92	$22.53		
Lures, flies & artificial bait	$2.29	$1.26	$13.85	$1.21	$7.09	$16.92	$6.46	$8.58	$57.65		
Hooks, sinkers, other terminal tackle	$.69	$.38	$4.16	$.39	$2.34	$4.75	$2.08	$2.03	$16.83		
Bait buckets, minnow traps	$.11	$.08	$.63	$.06	$.26	$.69	$.28	$.28	$2.39		
Camping gear	$1.01	$.28	$5.01	$.76	$1.82	$3.77	$1.52	$1.69	$15.85	$10.21	$33.15
Heating & cooking fuel	$.25	$.09	$2.65	$.25	$.96	$1.56	$.53	$.80	$7.10		
Special fishing clothing, foul weather gear	$1.67	$.86	$10.11	$1.18	$5.32	$10.23	$5.30	$5.23	$39.91	$5.16	$45.07
Equipment rental	$.88	$.10	$3.08	$.37	$2.71	$4.51	$1.48	$1.58	$14.70	$1.78	$16.48

Table D1 (Cont.)

Taxidermy & processing	$.16	$.09	$.85	$.09	$.42	$.97	$.29	$.39	$3.26	$.11	$29.77
Books & magazines	$.32	$.10	$1.27	$.14	$.48	$1.32	$.46	$.70	$4.79		
Dues and contributions	$.44	$.19	$2.45	$.35	$.57	$2.53	$1.14	$.90	$8.56		
Other misc. fishing expenditures	$.66	$.20	$3.90	$1.0	$1.18	$3.36	$1.77	$.98	$13.05		
Bass boats	$8.08	$13.66	$39.14	$1.32	$8.05	$91.50	$7.08	$39.70	$208.53	$81.25	$1327.05
Other motorized boats	$18.81	$10.57	$222.12	$22.26	$56.92	$378.07	$74.50	$29.59	$812.84		
Canoes, non-motorized boats	$1.74	$.82	$9.0	$1.89	$7.36	$9.11	$6.21	$5.32	$41.46		
Boat motors, trailers, hitches	$4.29	$2.62	$33.42	$11.52	$26.55	$59.65	$12.36	$32.57	$182.97		
Pick-ups, campers, motor homes	$17.88	$25.79	$169.14	$16.43	$35.42	$179.07	$54.34	$70.82	$568.89	$20.73	$703.26
4x4 and off-road vehicles	$2.85	$1.67	$51.99	$4.02	$15.39	$14.63	$5.45	$17.65	$113.65		
Cabins	$.07	$.05	$4.23	$.67	$1.85	$3.55	$.48	$.82	$11.71	$22.45	$726.77
Land purchased for fishing	$.03	$9.95	$441.38	$40.29	$64.80	$99.06	$18.05	$14.79	$688.35		
Land leased for fishing	$.12	$.13	$.92	$.03	$.92	$1.19	$.02	$.92	$4.25		
Equipment Subtotal	$76.08	$65.50	$654.55	$72.45	$208.96	$877.08	$214.95	$265.63	$2435.21	$155.87	$2591.09
Real Estate Subtotal	$.22	$10.12	$446.53	$41.0	$67.57	$103.81	$18.55	$16.53	$704.32	$22.45	$726.77
Grand Total	$95.47	$83.67	$1266.72	$126.78	$365.34	$1185.90	$284.95	$353.32	$3762.15	$285.51	$4047.66

Table D2. Detailed spending (in millions) for recreational fishing on Lake Erie, by US expenditure codes, by state/Province, 2020.

	State						
Trip Expenditures	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Food	$6.17	$4.21	$37.46	$12.33	$60.16	$4.79	$71.58
Ice	$.50	$.28	$4.38	$1.46	$6.62		
Lodging	$4.37	$3.74	$24.26	$3.35	$35.71	$2.52	$38.24
Airfare	$.01	$.07	$.16	*	$.24	$6.65	$55.45
Public transportation	$.02	$.04	$.30	$.01	$.36		
Private transportation	$5.11	$3.28	$29.35	$10.46	$48.20		
Guides	$1.97	$1.89	$19.32	$3.31	$26.49	$2.41	$28.90
Public land use fees	$.38	$.14	$.68	$.27	$1.47	$4.47	$6.92
Private land use fees	$.07	$.19	$.67	$.04	$.97		
Boat launching	$.52	$.36	$2.77	$.36	$4.01	$13.13	$133.50
Boat fuel	$3.72	$1.86	$35.79	$9.66	$51.04		
Boat mooring	$3.85	$1.40	$49.88	$10.19	$65.32		
Other trip expenditures (Canada only)						$.02	$.02
Subtotal	$26.70	$17.46	$205.01	$51.45	$300.60	$33.99	$334.60

	State						
Equipment Expenditures	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Rods, reels & components	$4.86	$3.52	$40.59	$14.09	$63.07	$6.18	$126.34
Tackle boxes	$.37	$.18	$2.24	$1.0	$3.79		
Creels, stringers, landing nets	$.33	$.13	$2.41	$1.07	$3.94		
Depth and fish finders, other electronics	$3.29	$1.11	$26.82	$7.16	$38.38		
Ice fishing equipment	$1.38	$.58	$.78	$1.65	$4.40		
Binoculars	$.42	$.14	$1.61	$1.15	$3.32		
Other fishing equipment	$.28	$.08	$2.37	$.54	$3.27		
Bait (live, cut, prepared)	$1.31	$.82	$11.32	$4.36	$17.81	$4.79	$69.15
Lines & leaders	$.93	$.53	$6.30	$2.68	$10.45		
Lures, flies & artificial bait	$2.23	$1.39	$16.92	$6.46	$27.01		
Hooks, sinkers, other terminal tackle	$.67	$.46	$4.75	$2.08	$7.96		
Bait buckets, minnow traps	$.10	$.05	$.69	$.28	$1.12		
Camping gear	$.81	$.36	$3.77	$1.52	$6.45	$2.48	$11.64
Heating & cooking fuel	$.43	$.19	$1.56	$.53	$2.71		
Special fishing clothing, foul weather gear	$1.63	$1.05	$10.23	$5.30	$18.21	$1.39	$19.59
Equipment rental	$.50	$.53	$4.51	$1.48	$7.02	$.39	$7.40
Taxidermy & processing	$.14	$.08	$.97	$.29	$1.47	$.01	$13.73
Books & magazines	$.20	$.09	$1.32	$.46	$2.08		
Dues and contributions	$.39	$.11	$2.53	$1.14	$4.18		
Other misc. fishing expenditures	$.63	$.23	$3.36	$1.77	$5.99		

Table D2 (Cont.)

Bass boats	$6.31	$1.58	$91.50	$7.08	$106.47	$21.87	$728.73
Other motorized boats	$35.80	$11.19	$378.07	$74.50	$499.56		
Canoes, non-motorized boats	$1.45	$1.45	$9.11	$6.21	$18.22		
Boat motors, trailers, hitches	$5.39	$5.22	$59.65	$12.36	$82.61	$6.32	$305.42
Pick-ups, campers, motor homes	$27.26	$6.96	$179.07	$54.34	$267.63		
4x4 and off-road vehicles	$8.38	$3.02	$14.63	$5.45	$31.48		
Cabins	$.68	$.36	$3.55	$.48	$5.08		
Land purchased for fishing	$71.13	$12.74	$99.06	$18.05	$200.98	$4.01	$211.61
Land leased for fishing	$.15	$.18	$1.19	$.02	$1.54		
Equipment Subtotal	$105.49	$41.07	$877.08	$214.95	$1238.60	$43.41	$1282.01
Real Estate Subtotal	$71.96	$13.28	$103.81	$18.55	$207.60	$4.01	$211.61
Grand Total	$204.15	$71.81	$1185.90	$284.95	$1746.80	$77.41	$1824.21

Table D3. Average spending (in dollars) for recreational fishing on Lake Erie, by US expenditure codes, by state/Province, 2020.

	State						
Trip Expenditures	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Food	$100.94	$62.73	$116.48	$105.61	$106.20	$57.39	$117.49
Ice	$8.15	$4.22	$13.61	$12.50	$11.68		
Lodging	$71.51	$55.71	$75.44	$28.67	$63.04	$30.18	$58.82
Airfare	$0.15	$1.10	$0.50	$0.00	$0.43	$79.62	$85.31
Public transportation	$0.26	$0.55	$0.93	$0.10	$0.64		
Private transportation	$83.57	$48.84	$91.26	$89.65	$85.08		
Guides	$32.17	$28.22	$60.07	$28.36	$46.75	$28.88	$44.46
Public land use fees	$6.27	$2.15	$2.12	$2.28	$2.60	$53.55	$10.65
Private land use fees	$1.23	$2.85	$2.07	$0.37	$1.72		
Boat launching	$8.54	$5.42	$8.60	$3.10	$7.08	$157.22	$205.37
Boat fuel	$60.91	$27.66	$111.30	$82.79	$90.09		
Boat mooring	$62.99	$20.85	$155.10	$87.28	$115.30		
Other trip expenditures (Canada only)						$0.20	$0.20
Subtotal	$436.69	$260.32	$637.48	$440.72	$530.62	$407.04	$514.75

	State						
Equipment Expenditures	Michigan	New York	Ohio	Pennsylvania	US Total	Ontario	Grand Total
Rods, reels & components	$79.55	$52.56	$126.22	$120.67	$111.32	$73.98	$194.37
Tackle boxes	$6.02	$2.63	$6.97	$8.57	$6.69		
Creels, stringers, landing nets	$5.37	$1.91	$7.50	$9.21	$6.96		
Depth and fish finders, other electronics	$53.84	$16.50	$83.39	$61.36	$67.74		
Ice fishing equipment	$22.62	$8.72	$2.44	$14.11	$7.76		
Binoculars	$6.94	$2.12	$4.99	$9.84	$5.86		
Other fishing equipment	$4.65	$1.21	$7.37	$4.60	$5.78		
Bait (live, cut, prepared)	$21.39	$12.27	$35.19	$37.38	$31.44	$57.37	$106.38
Lines & leaders	$15.28	$7.93	$19.60	$22.98	$18.45		
Lures, flies & artificial bait	$36.51	$20.79	$52.63	$55.32	$47.67		
Hooks, sinkers, other terminal tackle	$10.97	$6.87	$14.79	$17.80	$14.06		
Bait buckets, minnow traps	$1.65	$0.76	$2.13	$2.43	$1.98		
Camping gear	$13.20	$5.32	$11.71	$13.05	$11.39	$29.68	$17.91
Heating & cooking fuel	$6.98	$2.82	$4.85	$4.57	$4.78		
Special fishing clothing, foul weather gear	$26.66	$15.60	$31.81	$45.41	$32.14	$16.59	$30.14
Equipment rental	$8.12	$7.94	$14.02	$12.68	$12.39	$4.61	$11.39
Taxidermy & processing	$2.25	$1.24	$3.00	$2.45	$2.60	$0.07	$21.12
Books & magazines	$3.35	$1.42	$4.11	$3.93	$3.67		
Dues and contributions	$6.45	$1.67	$7.86	$9.79	$7.38		
Other misc. fishing expenditures	$10.29	$3.46	$10.44	$15.17	$10.57		

Table D3 (Cont.)

Bass boats	$103.17	$23.61	$284.52	$60.65	$187.94		
Other motorized boats	$585.58	$166.83	$1,175.65	$638.23	$881.82	$261.86	$1,121.08
Canoes, non-motorized boats	$23.72	$21.57	$28.34	$53.20	$32.16		
Boat motors, trailers, hitches	$88.10	$77.81	$185.50	$105.85	$145.83		
Pick-ups, campers, motor homes	$445.90	$103.81	$556.83	$465.52	$472.42	$75.63	$469.86
4x4 and off-road vehicles	$137.05	$45.10	$45.49	$46.65	$55.57		
Cabins	$11.16	$5.42	$11.04	$4.10	$8.96		
Land purchased for fishing	$1,163.64	$189.91	$308.04	$154.66	$354.78	$47.97	$325.54
Land leased for fishing	$2.42	$2.70	$3.71	$0.16	$2.72		
Equipment Subtotal	$1,725.62	$612.45	$2,727.36	$1,841.43	$2,186.36	$519.80	$1,972.24
Real Estate Subtotal	$1,177.21	$198.03	$322.79	$158.92	$1,856.96	$47.97	$325.54
Grand Total	$2,162.32	$872.77	$3,364.85	$2,282.15	$2,716.98	$926.84	$2,812.52

Table D4. Detailed spending (in millions) for recreational fishing on Lake Huron, by US expenditure codes, by state/Province, 2020.

Trip Expenditures	Michigan	Ontario	Total
Food	$7.91	$4.60	$13.15
Ice	$.64		
Lodging	$5.60	$3.02	$8.62
Airfare	$.01		
Public transportation	$.02	$6.01	$12.59
Private transportation	$6.55		
Guides	$2.52	$2.36	$4.88
Public land use fees	$.49	$3.63	$4.21
Private land use fees	$.10		
Boat launching	$.67		
Boat fuel	$4.77	$12.07	$22.45
Boat mooring	$4.94		
Other trip expenditures (Canada only)	$.0	$.002	$.002
Subtotal	$34.22	$31.68	$65.90

Equipment Expenditures	Michigan	Ontario	Total
Rods, reels & components	$6.23		
Tackle boxes	$.47		
Creels, stringers, landing nets	$.42		
Depth and fish finders, other electronics	$4.22	$5.82	$19.85
Ice fishing equipment	$1.77		
Binoculars	$.54		
Other fishing equipment	$.36		
Bait (live, cut, prepared)	$1.68		
Lines & leaders	$1.20		
Lures, flies & artificial bait	$2.86	$4.75	$11.47
Hooks, sinkers, other terminal tackle	$.86		
Bait buckets, minnow traps	$.13		
Camping gear	$1.03	$3.97	$5.55
Heating & cooking fuel	$.55		
Special fishing clothing, foul weather gear	$2.09	$1.41	$3.50
Equipment rental	$.64	$.40	$1.04
Taxidermy & processing	$.18		
Books & magazines	$.26	$.08	$1.83
Dues and contributions	$.51		
Other misc. fishing expenditures	$.81		
Bass boats	$8.09		
Other motorized boats	$45.89	$24.81	$87.55
Canoes, non-motorized boats	$1.86		
Boat motors, trailers, hitches	$6.90		
Pick-ups, campers, motor homes	$34.94	$7.06	$52.75
4x4 and off-road vehicles	$10.74		
Cabins	$.87		
Land purchased for fishing	$91.19	$7.14	$99.40
Land leased for fishing	$.19		
Equipment Subtotal	$135.24	$48.31	$183.54
Real Estate Subtotal	$92.26	$7.14	$99.40
Grand Total	$227.49	$55.45	$348.84

Table D 5. Average spending (in dollars) for recreational fishing on Lake Huron, by US expenditure codes, by state/Province, 2020.

Trip Expenditures	Michigan	Ontario	Total
Food	$100.94	$58.92	$84.05
Ice	$8.15		
Lodging	$71.51	$38.66	$55.12
Airfare	$0.15		
Public transportation	$0.26	$76.93	$80.46
Private transportation	$83.57		
Guides	$32.17	$30.17	$31.17
Public land use fees	$6.27	$46.45	$26.94
Private land use fees	$1.23		
Boat launching	$8.54		
Boat fuel	$60.91	$154.55	$143.48
Boat mooring	$62.99		
Other trip expenditures (Canada only)		$0.03	$0.03
Subtotal	$436.69	$405.70	421.23

Equipment Expenditures	Michigan	Ontario	Total
Rods, reels & components	$79.55		
Tackle boxes	$6.02		
Creels, stringers, landing nets	$5.37		
Depth and fish finders, other electronics	$5.37	74.58	$126.88
Ice fishing equipment	$53.84		
Binoculars	$22.62		
Other fishing equipment	$6.94		
Bait (live, cut, prepared)	$4.65		
Lines & leaders	$21.39		
Lures, flies & artificial bait	$15.28	60.80	73.33
Hooks, sinkers, other terminal tackle	$36.51		
Bait buckets, minnow traps	$10.97		
Camping gear	$1.65	50.90	35.51
Heating & cooking fuel	$13.20		
Special fishing clothing, foul weather gear	$6.98	18.05	$22.36
Equipment rental	$26.66	5.15	$6.64
Taxidermy & processing	$8.12		
Books & magazines	$2.25	0.98	11.68
Dues and contributions	$3.35		
Other misc. fishing expenditures	$6.45		
Bass boats	$10.29		
Other motorized boats	$103.17	317.75	559.61
Canoes, non-motorized boats	$585.58		
Boat motors, trailers, hitches	$23.72		
Pick-ups, campers, motor homes	$88.10	90.48	337.18
4x4 and off-road vehicles	$445.90		
Cabins	$137.05		
Land purchased for fishing	$1,163.63	91.45	635.34
Land leased for fishing	$2.42		
Equipment Subtotal	$1,725.62	$618.68	$1,173.18
Real Estate Subtotal	$1,177.21	$91.45	$635.34
Grand Total	$2,902.83	$710.16	$2,229.75

Table D 6. Detailed spending (in millions) for recreational fishing on Lake Ontario, by US expenditure codes, by state/Province, 2020.

Trip Expenditures	New York	Ontario	Total
Food	$14.33	$5.35	$20.65
Ice	$.96		
Lodging	$12.73	$3.82	$16.55
Airfare	$.25		
Public transportation	$.13	$7.69	$19.23
Private transportation	$11.16		
Guides	$6.45	$4.89	$11.34
Public land use fees	$.49	$4.72	$5.86
Private land use fees	$.65		
Boat launching	$1.24		
Boat fuel	$6.32	$11.58	$23.91
Boat mooring	$4.77		
Other trip expenditures (Canada only)	$.0	$.01	$.01
Subtotal	$59.48	$38.07	$97.55

Equipment Expenditures	New York	Ontario	Total
Rods, reels & components	$12.01		
Tackle boxes	$.60		
Creels, stringers, landing nets	$.44		
Depth and fish finders, other electronics	$3.77	$8.42	$27.99
Ice fishing equipment	$1.99		
Binoculars	$.48		
Other fishing equipment	$.28		
Bait (live, cut, prepared)	$2.80		
Lines & leaders	$1.81		
Lures, flies & artificial bait	$4.75	$5.28	$16.39
Hooks, sinkers, other terminal tackle	$1.57		
Bait buckets, minnow traps	$.17		
Camping gear	$1.22	$2.62	$4.48
Heating & cooking fuel	$.64		
Special fishing clothing, foul weather gear	$3.56	$2.17	$5.73
Equipment rental	$1.81	$.97	$2.79
Taxidermy & processing	$.28		
Books & magazines	$.32	$.0	$1.78
Dues and contributions	$.38		
Other misc. fishing expenditures	$.79		
Bass boats	$5.39		
Other motorized boats	$38.12	$30.37	$96.59
Canoes, non-motorized boats	$4.93		
Boat motors, trailers, hitches	$17.78		
Pick-ups, campers, motor homes	$23.72	$6.05	$40.07
4x4 and off-road vehicles	$10.31		
Cabins	$1.24		
Land purchased for fishing	$43.39	$3.67	$48.92
Land leased for fishing	$.62		
Equipment Subtotal	$139.94	$55.89	$195.83
Real Estate Subtotal	$45.25	$3.67	$48.92
Grand Total	$185.19	$59.57	$342.30

Table D 7. Average spending (in dollars) for recreational fishing on Lake Ontario, by US expenditure codes, by state/Province, 2020.

Trip Expenditures	New York	Ontario	Total
Food	$62.73	$45.88	$59.83
Ice	$4.22		
Lodging	$55.71	$32.76	$47.95
Airfare	$1.10		
Public transportation	$0.55	$65.91	$55.71
Private transportation	$48.84		
Guides	$28.22	$41.94	$32.86
Public land use fees	$2.15	$40.44	$16.98
Private land use fees	$2.85		
Boat launching	$5.42		
Boat fuel	$27.66	$99.26	$69.26
Boat mooring	$20.85		
Other trip expenditures (Canada only)		$0.07	$0.07
Subtotal	$260.32	$326.26	$282.66

Equipment Expenditures	New York	Ontario	Total
Rods, reels & components	$52.56		
Tackle boxes	$2.63		
Creels, stringers, landing nets	$1.91		
Depth and fish finders, other electronics	$1.91	$72.20	$81.10
Ice fishing equipment	$16.50		
Binoculars	$8.72		
Other fishing equipment	$2.12		
Bait (live, cut, prepared)	$1.21		
Lines & leaders	$12.27		
Lures, flies & artificial bait	$7.93	$45.26	$47.48
Hooks, sinkers, other terminal tackle	$20.79		
Bait buckets, minnow traps	$6.87		
Camping gear	$0.76	$22.45	$7.59
Heating & cooking fuel	$5.32		
Special fishing clothing, foul weather gear	$2.82	$18.60	$16.61
Equipment rental	$15.60	$8.35	$8.08
Taxidermy & processing	$7.94		
Books & magazines	$1.24	$0.03	$5.16
Dues and contributions	$1.42		
Other misc. fishing expenditures	$1.67		
Bass boats	$3.46		
Other motorized boats	$23.61	$51.85	$279.82
Canoes, non-motorized boats	$166.83		
Boat motors, trailers, hitches	$21.57		
Pick-ups, campers, motor homes	$77.81	$31.45	$17.53
4x4 and off-road vehicles	$103.81		
Cabins	$45.10		
Land purchased for fishing	$5.42		$10.63
Land leased for fishing	$189.91		
Equipment Subtotal	$612.45	$478.99	$567.34
Real Estate Subtotal	$198.03	$31.45	$141.72
Grand Total	$810.48	$510.51	$991.67

Table D8. Average spending (in dollars) for recreational fishing on Lake Superior, by US expenditure codes, by state/Province, 2020.

	State					
Trip Expenditures	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Food	$3.23	$3.79	$3.07	$.80	$10.08	$11.63
Ice	$.26	$.25	$.24		$.75	
Lodging	$2.29	$1.52	$2.59	$.16	$6.40	$6.55
Airfare	$.0	$.0	$.02		$.02	
Public transportation	$.01	$.02	$.04	$1.10	$.07	$8.88
Private transportation	$2.67	$2.77	$2.24		$7.68	
Guides	$1.03	$.81	$1.69	$.14	$3.53	$3.67
Public land use fees	$.20	$.12	$.16	$.28	$.49	$.91
Private land use fees	$.04	$.06	$.05		$.14	
Boat launching	$.27	$.11	$.56		$.94	
Boat fuel	$1.95	$2.14	$1.79	$.96	$5.87	$12.47
Boat mooring	$2.01	$1.75	$.93		$4.70	
Other trip expenditures (Canada only)				$.0		$.0
Subtotal	$13.96	$13.33	$13.38	$3.44	$40.67	$44.12

	State					
Equipment Expenditures	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Rods, reels & components	$2.54	$3.18	$3.22		$8.94	
Tackle boxes	$.19	$.22	$.16		$.58	
Creels, stringers, landing nets	$.17	$.21	$.25		$.63	
Depth and fish finders, other electronics	$1.72	$2.95	$2.80	$.83	$7.47	$22.04
Ice fishing equipment	$.72	$1.0	$.76		$2.49	
Binoculars	$.22	$.19	$.07		$.48	
Other fishing equipment	$.15	$.14	$.33		$.62	
Bait (live, cut, prepared)	$.68	$.81	$.66		$2.16	
Lines & leaders	$.49	$.51	$.55		$1.54	
Lures, flies & artificial bait	$1.17	$1.21	$1.61	$.57	$3.99	$9.54
Hooks, sinkers, other terminal tackle	$.35	$.39	$.38		$1.12	
Bait buckets, minnow traps	$.05	$.06	$.05		$.17	
Camping gear	$.42	$.76	$.32	$1.13	$1.50	$3.26
Heating & cooking fuel	$.22	$.25	$.15		$.63	
Special fishing clothing, foul weather gear	$.85	$1.18	$.98	$.19	$3.02	$3.21
Equipment rental	$.26	$.37	$.30	$.02	$.92	$.94
Taxidermy & processing	$.07	$.09	$.07		$.24	
Books & magazines	$.11	$.14	$.13	$.03	$.38	$2.88
Dues and contributions	$.21	$.35	$.17		$.72	
Other misc. fishing expenditures	$.33	$1.0	$.18		$1.51	
Bass boats	$3.30	$1.32	$7.46		$12.08	
Other motorized boats	$18.72	$22.26	$5.56	$4.20	$46.54	$86.94
Canoes, non-motorized boats	$.76	$1.89	$1.0		$3.65	
Boat motors, trailers, hitches	$2.82	$11.52	$6.12		$20.46	
Pick-ups, campers, motor homes	$14.25	$16.43	$13.31	$1.29	$44.0	$57.01
4x4 and off-road vehicles	$4.38	$4.02	$3.32		$11.72	
Cabins	$.36	$.67	$.15		$1.18	
Land purchased for fishing	$37.20	$40.29	$2.78	$7.64	$80.27	$89.37
Land leased for fishing	$.08	$.03	$.17		$.28	
Equipment Subtotal	$55.16	$72.45	$49.94	$8.27	$177.55	$185.82
Real Estate Subtotal	$37.63	$41.0	$3.11	$7.64	$81.74	$89.37
Grand Total	$106.76	$126.78	$66.42	$19.35	$299.96	$319.31

Table D9. Average spending (in dollars) for recreational fishing on Lake Superior, by US expenditure codes, by state/Province, 2020.

	State					
Trip Expenditures	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Food	$100.94	$114.02	$105.81	$107.05	$62.05	$108.65
Ice	$8.15	$7.52	$8.34	$7.99	$.75	
Lodging	$71.51	$45.64	$89.47	$67.91	$12.25	$61.20
Airfare	$0.15	$0.04	$0.56	$0.24	$85.45	
Public transportation	$0.26	$0.54	$1.49	$0.74	$.07	$82.90
Private transportation	$83.57	$83.38	$77.28	$81.57	$7.68	
Guides	$32.17	$24.48	$58.37	$37.52	$10.81	$34.30
Public land use fees	$6.27	$3.70	$5.59	$5.15	$21.65	$8.49
Private land use fees	$1.23	$1.78	$1.58	$1.53	$.14	
Boat launching	$8.54	$3.31	$19.26	$10.00	$.0	
Boat fuel	$60.91	$64.34	$61.60	$62.33	$5.87	$116.45
Boat mooring	$62.99	$52.73	$32.15	$49.88	$4.70	
Other trip expenditures (Canada only)					$0.00	$0.00
Subtotal	$436.69	$401.48	$461.50	$431.91	$266.69	$411.99

	State					
Equipment Expenditures	Michigan	Minnesota	Wisconsin	Ontario	US Total	Grand Total
Rods, reels & components	$79.55	$95.77	$111.02	$94.96	64.22	
Tackle boxes	$6.02	$6.69	$5.67	$6.15	$.58	
Creels, stringers, landing nets				$6.67	$.63	
Depth and fish finders, other electronics	$5.37	$6.22	$8.63	$79.34	$7.47	$205.84
Ice fishing equipment	$53.84	$88.90	$96.50	$26.44	$2.49	
Binoculars	$22.62	$30.20	$26.34	$5.11	$.48	
Other fishing equipment	$6.94	$5.64	$2.48	$6.60	$.62	
Bait (live, cut, prepared)	$4.65	$4.37	$11.30	$22.89	43.84	
Lines & leaders	$21.39	$24.48	$22.73	$16.39	$1.54	
Lures, flies & artificial bait	$15.28	$15.21	$18.97	$42.34	$3.99	89.13
Hooks, sinkers, other terminal tackle	$36.51	$36.35	$55.63	$11.95	$1.12	
Bait buckets, minnow traps	$10.97	$11.81	$13.18	$1.77	$.17	
Camping gear	$1.65	$1.82	$1.84	$15.90	87.76	
Heating & cooking fuel	$13.20	$22.83	$10.93	$6.67	$.63	30.43
Special fishing clothing, foul weather gear	$6.98	$7.66	$5.19	$32.04	15.10	$30.00
Equipment rental	$26.66	$35.56	$33.93	$9.80	1.26	$8.77
Taxidermy & processing	$8.12	$11.02	$10.24	$2.51	2.06	
Books & magazines	$2.25	$2.73	$2.53	$4.01	$.38	
Dues and contributions	$3.35	$4.22	$4.51	$7.68	$.72	26.87
Other misc. fishing expenditures	$6.45	$10.49	$5.82	$16.07	$1.51	
Bass boats	$10.29	$30.12	$6.34	$128.26	325.62	
Other motorized boats	$103.17	$39.66	$257.44	$494.26	$46.54	
Canoes, non-motorized boats	$585.57	$670.26	$191.92	$38.78	$3.65	811.88
Boat motors, trailers, hitches	$23.72	$57.03	$34.49	$217.25	$20.46	
Pick-ups, campers, motor homes	$88.10	$346.86	$211.20	$467.20	100.27	
4x4 and off-road vehicles	$445.90	$494.61	$459.30	$124.47	$11.72	532.41
Cabins	$137.05	$121.07	$114.49	$12.55	591.36	
Land purchased for fishing	$11.16	$20.21	$5.31	$852.44	$80.27	834.63
Land leased for fishing	$1,163.62	$1,213.24	$95.92	$3.00	$.28	
Equipment Subtotal	$1,725.60	$2,181.58	$1,722.64	$1,885.51	$640.12	$1,735.32
Real Estate Subtotal	$1,177.20	$1,234.42	$107.18	$867.99	$591.36	$834.63
Grand Total	$3,339.50	$3,817.48	$2,291.32	$3,185.41	$1,498.17	$2,981.94