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The Recreational Ice Fishing and Ancillary Retail Communities on a Northern Latitude Lake: Yet-to-be-served Extension Audiences?

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Cover Page Footnote

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The Recreational Ice Fishing and Ancillary Retail Communities on a Northern Latitude Lake: Yet-to-Be-Served Extension Audiences?

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Abstract. Ice fishing communities appear to be poorly described in Sea Grant Extension programming and planning documents. An intercept survey (N=52) of L. Champlain anglers revealed a broad age range and decades of participation. Opinions about spatial and temporal declines in ice cover were unrelated to state residency or age. Anglers expressing agreement with perceived declines in ice cover reported reductions in avidity and choice of fishing locations, while indicating little impact on species preference or fishing methods. Programming ideas to support this audience include distribution of economic data, ice forecasting, contaminant advisories for subsistence anglers, invasive species, and biodiversity conservation outreach.

INTRODUCTION

Ice fishing is a popular recreational activity on many north-eastern U.S. lakes, including Lake Champlain (Kanas, 2022; Sutkoski, 2012). The 120-mile (193-km) lake lies on the border between New York (NY), Vermont (VT), and Quebec, Canada (<https://www.lcbp.org/about-the-basin/facts/>). More than 12,000 anglers annually fish atop the frozen surface in the VT portion of the lake (Duda et al., 2020). Participation rates in NY waters are currently pending (https://www.dec.ny.gov/docs/fish_marine_pdf/lkchamplaincreelplan.pdf). The frozen surfaces of Great Lakes embayments (e.g., Green Bay, Wisconsin; Traverse Bay and Saginaw Bay, Michigan; and Sodus Bay and Chaumont Bay, New York) also support major winter fisheries, although participation rates are not readily available.

Participants in these fisheries are an underserved audience for Sea Grant Extension programs. The National Sea Grant Library and the National Sea Grant College Program Office websites were searched (January 27, 2020), and no publications, proposals, stories, or press releases connected to Extension programming targeting ice-fishing audiences or communities were found (although state Sea Grant omnibus proposals were not examined). The broader recreational fishing community and coastal tourism audiences do represent important audiences for Extension programming in Healthy

Coastal Ecosystems (HCE) and Resilient Communities and Economies (RCE) focus areas. Helping with sport-fish habitat restoration efforts and assisting coastal communities in their response to climate change are activities supported by research and Extension work. The development of work plans (under HCE and RCE) that expand to include ice-fishing audiences seems like a worthy goal, if gathered information (i.e., surveys, needs assessment) warrants such programming.

Efforts to characterize the winter (ice-based) fishery on Lake Champlain and other water bodies are fitting. Ice-fishing safety issues (and related educational opportunities) have long been noted by outdoor enthusiasts, writers, educators, and state natural resource agencies (Anonymous, n.d.; Howard & Greene, 1989/1985; New York State Department of Environmental Conservation, n.d.; Witsil, 2022). Recent declines in temporal and spatial ice cover are now well documented in northern-latitude lakes (Filazzola et al., 2020; Mason et al., 2016). Although Lake Champlain has many shallow embayments that continue to freeze over annually, ice cover is becoming temporally compressed (Stager & Thill, 2010). This observation parallels an average decline in VT's freeze-free period of nearly 3 weeks since 1960 (Hoag et al., 2021). Complete absence of ice cover on the main lake is now observed regularly, with documented main-lake freeze-over occurring only twice (in 2015 and 2019) since 2009 (National

Weather Service, 2021). Consequently, anglers may need to modify fishing locations, timing, or angling techniques for reasons of safety and changes in species availability patterns (Marsden et al., 2010; Stager & Thill, 2010; Sutkoski, 2012).

Changes in timing and extent of ice cover have potential to significantly affect local economies. Expenditures of resident and visiting anglers engaging in recreational fishing opportunities have been estimated to be as high \$147 million per year within VT alone (Hoag et al., 2021). These expenditures, which include bait and tackle purchases and food and beverage sales, likely represent important economic contributions to small towns along the lakeshore.

Some available research suggests that participation in ice fishing (i.e., avidity) on the Lake Champlain fishery is in measured decline. Angler survey information collected between 2009 and 2019 revealed that the percentage of nonresident VT fishing license buyers who ice fished declined from 16% to 12% (Duda et al., 2020). Similar (although not statistically significant) declines were observed in resident license holder participation in ice fishing, with steady declines in the number of anglers and the number of mean days fished over a period of 30 years. In contrast, fishing license sales increased during the COVID-19 pandemic, yet questions remain as to whether or for how long this increase in outdoor recreation will be sustained (Hoag et al., 2021).

In theory, existing and pending state agency creel and mail surveys should be useful in characterizing the lake's ice-fishing participants and their socioeconomic patterns. However, traditional state natural resource agency surveys are typically limited to the collection of fishing effort and stock data, although some surveys do include angler satisfaction content (Duda et al., 2020). Nieman et al. (2021, p. 741) suggested that surveys with more human dimension content could "increase our understanding of interactions between and within the social-ecological recreational fisheries system." A small pilot survey of ice-fishing enthusiasts could address these recommendations and provide a "jumping-off" point for Extension programming in HCE and RCE focus areas. Opportunities related to climate change, small business (e.g., tackle retailers) support, tourism sustainability, invasive species spread prevention, and other topics might be supported by summarizing the attitudes, opinions, and characteristics of this underserved audience.

METHODS

LOCATION

Fifty-two intercept surveys were conducted at 10 locations in VT and NY during the period of February 13–March 7, 2020 (see Appendix). Specific locations for each survey were noted at the time of interception, but to maintain the anonymity of the anglers surveyed, the location information was detached from any other identifiable information, including

each respondent's specific answers to survey questions. Intercept survey locations were chosen as representative fishing locations and, for accessibility purposes, did not require the use of mechanized vehicles (e.g., all-terrain vehicles [ATVs] and snowmobiles) to access. Sampling locations and dates were not randomized, given the objectives of the survey (i.e., opinion survey, not quantitative creel survey).

PARTICIPANTS

At each location, all identifiable anglers were approached and queried regarding their interest in participating in a voluntary survey. Each willing participant ages 18 and above was informed that their responses would be kept separate from any identifiable information and that responses would be used solely for the purposes of targeted outreach efforts. Anglers under age 18 were not interviewed in accordance with federal laws and State University of New York–Plattsburgh Campus Policies on the Use of Human Subjects (IRB #1625: Characterization of Lake Champlain's Ice-Based Winter Fishery: Current Status and Future).

SURVEY INSTRUMENT AND ANALYSIS

The survey instrument assessed avidity and angler opinions, preferences, and practices associated with perceived changes in average ice cover, thickness, and duration on Lake Champlain (see Appendix). Angler demographic information was also collected. Opinion questions related to ice cover, thickness, and duration offered respondents choices of answers arranged on a 5-point Likert scale (McLeod, 2008). Data were entered in spreadsheet software (Google Sheets, MS Excel) for summary and analysis. Graphical summaries were generated to enable response comparisons. Annual mean number of ice-fishing trips and mean per-trip angler expenditures were calculated by midpoint coding and weighting (by percentage response) of estimates. Tests of independence (i.e., state vs. ice cover opinion, age vs. ice cover opinion) were examined with chi-square tests (Sokal & Rohlf, 1969) conducted in Excel.

RESULTS AND DISCUSSION

We conducted 52 intercept surveys. Nearly all participants completed the entire survey, although some participants declined to respond to one or more demographic questions (figures compiled from fewer than 52 observations include sample-size labels).

AVIDITY AND GENERAL QUESTIONS

Age and years-of-participation data suggested early entry to the sport, decades of participation, and few age-related limitations (see Figures 1 and 2). This information is in general agreement with VT fishing license sales data, which showed the largest group of VT license buyers to be ages 55 and older

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(Duda et al., 2019). The largest percentage of anglers (38%) made three or fewer ice fishing trips to Lake Champlain in an average year, although trip numbers varied widely, with almost one in five fishers making more than 21 trips per year, and 13% making more than 40 trips per year. The estimated average of 13.6 ice-fishing trips to Lake Champlain each year was similar to, although slightly higher than, the average of 10 trips per year reported by Duda et al. (2020). The average reported here was much higher than the 4.5 trips per year calculated by a University of Vermont Rural Studies project (Center for Rural Studies at the University of Vermont, 2014).

The estimated annual mean number of ice-fishing trips per angler was 13.7 (assuming a maximum of 45 possible trips per winter). About one-half of the anglers reported spending less than \$30 per trip on daily travel and ancillary expenditures (e.g., bait, food, gas), but excluding permanent equipment (see Figure 3). Comparable expenditure data for this fishery or related northern U.S. through-the-ice fisher-

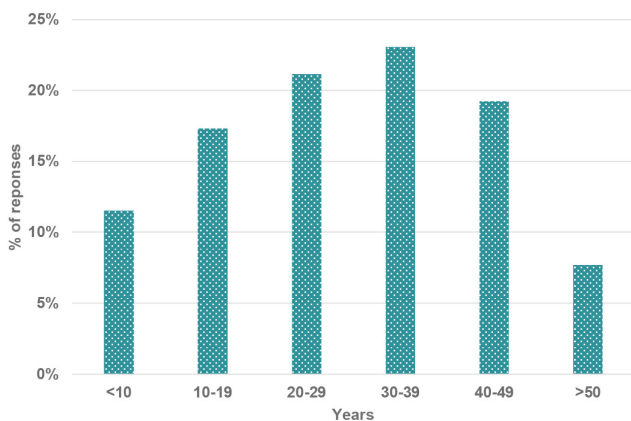


Figure 1. Number of years ice fishing on Lake Champlain.

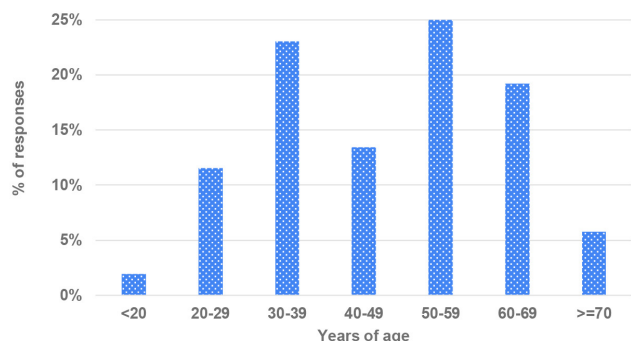


Figure 2. Angler age group.

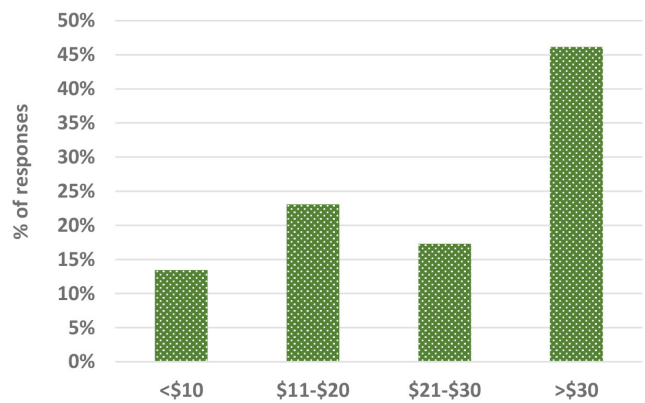


Figure 3. Average daily ice-fishing trip expenditures (not including permanent equipment).

ies are lacking. Several reports provided angling expenditure data at the lake, regional, statewide, or national scale (Duda et al., 2019, 2020; Center for Rural Studies at the University of Vermont, 2014; USFWS and U.S. Census Bureau, 2016). However, none of these reports provided daily ice-fishing expenditure estimates. NY Inland/Great Lakes and Lake Champlain daily angling expenditure (ice fishing not specified) estimates ranged from \$33–\$34 to \$68–\$138 (Poe et al., 2013; Center for Rural Studies at the University of Vermont, 2014). Crude daily expenditure estimates (i.e., expenditures for those from the Eastern Adirondacks and Lake Champlain regions, divided by Lake Champlain angler days) were calculated to be \$74, based on tabular data from the 2017 NY Statewide Angler Survey (Duda et al., 2019).

Most anglers (94%) fished primarily for recreation. Twenty-one percent and 13 percent (respectively) of anglers noted “additional food source” and “supplemental income” as additional choices. (Multiple responses were allowed; therefore, percentages do not add to 100.)

ICE-COVER OPINIONS

Responses were mixed when participants were asked whether *average ice cover*, thickness, and duration on Lake Champlain had decreased since they had started ice fishing. Answers of *strongly agree*, *agree*, *neutral*, *disagree*, and *strongly disagree* were chosen by 25%, 23%, 27%, 25%, and 0% of respondents, respectively. A breakdown of these responses by age group did not indicate a significant difference across variables (see Figure 4; chi-square $p > 0.90$). A similar classification (not graphed) failed to indicate that opinions about ice cover were predicated on state residency (chi-square $p > 0.39$). Those anglers who responded *strongly agree* or *agree* ($n = 25$) were further queried about angling avidity, choice of fishing areas, species preferences, and methods. As a group, these anglers reported reductions in avidity and choice of fishing locations,

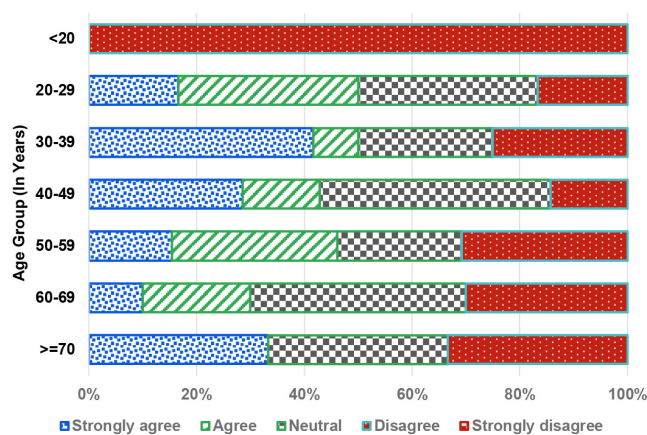


Figure 4. Lake Champlain ice anglers' reported level of agreement with statement "Average ice cover, thickness, and duration on Lake Champlain have decreased since I started ice fishing."

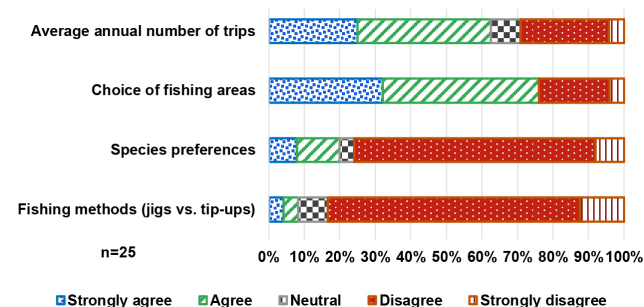


Figure 5. L. Champlain ice anglers' reported level of agreement with four statements related to the influence (on each) of changes in average ice cover, thickness, and duration on their ice-fishing practices over time.

while indicating little or no impact on their species preference or fishing methods (see Figure 5).

These self-reported behaviors were logical responses to a changing ice-cover regime—thinner/spatially reduced lake ice would constrain fishing opportunities and locales, but not necessarily target species or gear choices. Such adaptations agree with models that predict changes in tourism destinations based on climactic factors (Scott & Lemieux, 2010). Additional information about these behaviors is clearly important to tackle retailers and tourism promotional organizations, and a larger (and more robust) study of this fishery is deserved.

METHODS AND GEAR

Winter anglers on Lake Champlain used jigging and tip-ups while pursuing their sport, although panfish (typically targeted via jigging) anglers slightly outnumbered gamefish anglers (i.e., those using tip-ups). All respondents used a variety of ancillary gear, including live bait, artificial lures, and powered and hand augers (see Table 1).

About 75% of anglers owned an ice-fishing shelter, the majority (73%) of which were soft-sided/portable. Six percent of respondents owned traditional "shanties" (i.e., hard-sided shelters). Ownership of portable ice-fishing shelters was a common although relatively new phenomenon for most anglers, with about 73% of owners having purchased this gear within the past 8 years. Attributes of mobility, cost, and cold-weather/wind protection all ranked equally among owners when citing reasons for purchasing a portable-shelter. More than 70% of shelter owners indicated that their shelter was either very important or somewhat important to their ice-fishing avidity.

These results support the conclusion that the portable-shelter market is still in the growth phase. Portable shelters (in tandem with ATVs) have enabled greater angler mobility relative to the use of hard-sided shelters, which traditionally have been associated with thick ice and prolonged ice cover. Such flexibility enables ice anglers to move quickly and easily if fishing reports suggest better fishing conditions elsewhere. These behaviors are also consistent with patterns of climate change, in that portable shelters can be quickly deployed, retrieved, and redeployed without the need for thick, stable ice sheets to support the ice shanty as common in previous decades.

DEMOGRAPHICS

Survey respondents overwhelmingly (90%) self-identified as male, and 63% of surveyed anglers originated from the two Lake Champlain border states (VT and NY). The balance of respondents originated from Massachusetts (23%) and other states (4%). Annual household income of survey anglers ranged from less than \$20,000 per year to more than \$79,000 per year, and 40% of respondents reported their achieved education levels above that of high school (see Table 2). Previous studies used different income categories, making direct comparisons difficult. A national survey of fishing, hunting, and wildlife recreation used 11 income bins, with a participation rate in fishing peaking (22% of U.S. population who fished) at \$35,000–\$39,999. (U.S. Fish and Wildlife Service, 2018). A previous Lake Champlain study used seven different income categories, ranging from less than \$35,000 to \$200,000 or more (Center for Rural Studies at the University of Vermont, 2014). However, 62% of its respondents reported household income (before taxes) of less than \$74,999, while the present study had 60% of respondents reporting values ranging from less than \$20,000 to \$79,000. Education lev-

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Table 1. Reported Percentages of Angling Methods and Gear Used by Lake Champlain Anglers

Angling methods (only one response allowed; totals 100%)	% of Responses
Strictly used jigging techniques	29.4%
Mostly used tip-ups, but occasionally used jigging techniques	25.5%
Mostly used jigging techniques	19.6%
Usually used both tip-ups and jigging	17.6%
Strictly used tip-ups	7.8%
Angling Gear (multiple responses allowed; totals > 100%)	% of Responses
Bait	80.8%
Lures	78.8%
Powered auger	76.9%
Ice-fishing shelter	75.0%
Hand auger	46.2%
ATV or other vehicle	30.8%
Echosounder/depth finder	17.3%
Underwater camera	11.5%
Other	11.5%

els achieved among survey respondents paralleled those of U.S. Census data for VT and NY. Comparable Census data for VT/NY were associate degree (8.7%/8.8%), bachelor's degree (22.7%/21.2%), and advanced degree (16.0%/16.6%). Fifty-eight percent of surveyed anglers reported membership in hunting/angling clubs.

CONCLUSIONS

A variety of anglers are using ice to facilitate their access to a fishery jointly managed by Vermont, New York, and Quebec. Their pastime has clear cultural and socioeconomic importance to the region, and climate-change coping behaviors are becoming evident. This shift affords programming opportu-

nities that can be leveraged by Extension professionals, state/local governments, and tourism organizations. Opportunities (by Sea Grant focus-area headings) are discussed below.

RESILIENT COMMUNITIES AND ECONOMIES

Coastal Tourism

This and previous studies have documented the economic contributions of resident and nonresident winter anglers. During the course of this survey, members of a Massachusetts fishing club revealed that their location of an annual 2-day tournament on Lake Champlain was predicated on the loss of reliable lake ice “back home.” Such information should be useful to tourism and visitor bureaus and retail tourism-sector audiences. Such information could help inform marketing efforts, especially to anglers outside the basin. Such marketing could build upon climate-driven behavioral trends exhibited by resident and nonresident winter anglers, thereby strengthening community resilience and sustainability efforts. Because reported membership in hunting and angling clubs was high (58% of anglers surveyed), a possible avenue for future Extension programming may be to reach this audience through club interactions.

Local bait and tackle businesses might similarly benefit from information learned from this survey about fishing-gear patterns and trends. New/improved gear-type practices would be useful market information, and future, more rigorous surveys might uncover additional market trends or needs on which local retailers could capitalize.

Ice Forecasting

Forecasting of detailed ice parameters presents opportunities dealing with safety and fishery resilience from research and Extension perspectives. Continued advances in the application of remote sensing could enable (or underpin) the development of a program that would directly serve the ice-fishing community. No-cost, high-resolution satellite imagery (see <https://www.sentinel-hub.com/explore/eobrowser/>) is now being adopted by recreationists who frequent Lake Champlain (and presumably other northern regions). Ice skaters regularly access this imagery to locate newly formed, smooth

Table 2. Respondent Demographics

Highest education level achieved	Responses (n = 50)	Approx. total household income before taxes in 2019	Responses
Less than high school	8%	<\$20K	8.5%
High school	52%	\$20K to \$39K	8.5%
Associate degree	12%	\$40K to \$59K	23.4%
Bachelor's degree	20%	\$60K to \$79K	19.1%
Advanced degree	8%	>\$79K	40.4%

ice (D. Spada, personal communication, January 13, 2022). A real-time, repeating verification system with direct observation and research-derived metrics could lead to something akin to a Lake Champlain Ice Forecast Center, providing daily updates on ice thickness and safety. Such a system could improve angler experiences and support winter tourism–industry development, if ice thickness (and ice type) could be accurately assessed and modeled remotely. At least two analogous models are known: the CoastWatch Program and the Utah Avalanche Center. The CoastWatch node at the Great Lakes Environmental Research Lab “provides users with access to near real-time satellite observations and in-situ data for the Great Lakes. In addition, satellite-derived surface temperature imagery is contoured and made available via Michigan State Sea Grant’s web site. Great Lakes CoastWatch data and products benefit riparian as well as commercial and recreational users” (see <https://coastwatch.glerl.noaa.gov/overview/cw-overview.html>). Similarly, the Utah Avalanche Center brings together National Weather Service, U.S. Forest Service, and Utah Department of Transportation professionals to issue daily avalanche forecast conditions throughout the Wasatch Mountains. It was created in 1980 in response to sharp increases in the number of avalanche accidents and fatalities spawned by the fast-growing popularity of back-country skiing and snowmobiling. Each winter morning, the Avalanche Center issues detailed analyses of snowpack stability, weather conditions, risk probabilities, and warnings (see <https://utahavalanchecenter.org/forecast/salt-lake>).

SUSTAINABLE FISHERIES AND AQUACULTURE

Support of Traditional and Subsistence Fisheries

This study produced information about subsistence and supplemental-income uses for angled fish in Lake Champlain. Such documentation is presumably useful to those agencies serving traditional middle-income as well as low-income Native peoples (e.g., Abenaki) and others. Educational programs dealing with nutrition and fish-contaminant mitigation could be directed to all these audiences.

HEALTHY COASTAL ECOSYSTEMS

Aquatic Invasive Species Outreach

As with other anglers, those transiting frozen lakes risk moving aquatic invasive species. An abundance of Sea Grant Extension materials and resources have been developed in response to this issue, and many could be adapted for ice-fishing audiences.

Biodiversity Conservation

Discarded bycatch (unwanted species or size classes) has long been a management and education issue in marine commercial fisheries, but it has also plagued the recreational

ice-fishing community. Education/Extension programming opportunities could be developed to help protect declining aquatic biodiversity in Lake Champlain, the Great Lakes, and inland waterbody fisheries across the northern United States.

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APPENDIX: SURVEY INSTRUMENT

AVIDITY AND SETTING

1. When did you begin ice fishing on Lake Champlain?

- ☐ Prior to 1970
- ☐ 1971–1980
- ☐ 1981–1990
- ☐ 1991–2000
- ☐ 2001–2010
- ☐ After 2010

2. How many ice fishing trips have you made on Lake Champlain this year?

- ☐ 1–3
- ☐ 4–8
- ☐ 9–12
- ☐ 13–20
- ☐ 21–40
- ☐ > 40

3. On average how many ice fishing trips do you make to Lake Champlain each year?

- ☐ 1–3
- ☐ 4–8
- ☐ 9–12
- ☐ 13–20
- ☐ 21–40
- ☐ > 40

4. My average trip expenditures (bait, food, gas, etc., but not permanent equipment) are:

- ☐ < \$10
- ☐ \$11–\$20
- ☐ \$21–\$30
- ☐ > \$30

5. I fish primarily for:

- ☐ Recreation
- ☐ Additional food source
- ☐ Supplemental income
- ☐ Other (please describe _____)

Note: The next five questions refer to annual average ice cover. This current winter's (i.e., 2013–2014) ice cover should be included but be given extra “weight” or importance.

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6. Average ice cover, thickness, and duration on Lake Champlain has decreased since I started ice fishing.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

If neutral, skip 7–10.

7. Changes in average ice cover, thickness, and duration on Lake Champlain have influenced my average annual number of trips since I started ice fishing.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

8. Changes in average ice cover, thickness, and duration on Lake Champlain have influenced my choice of fishing areas since I started ice fishing.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

9. Changes in average ice cover, thickness, and duration on Lake Champlain have influenced my species preferences since I started ice fishing.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

10. Changes in average ice cover, thickness, and duration on Lake Champlain have influenced my fishing methods (i.e., jigs vs. tip-ups) since I started ice fishing.

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

11. Both NY and VT regulate bait species (i.e., “green list”), and transport (“only certified bait may be transported over-land”). These regulations directly impact the number or frequency of my ice fishing trips each year on Lake Champlain.
- ☐ Strongly agree
 - ☐ Agree
 - ☐ Neutral
 - ☐ Disagree
 - ☐ Strongly disagree

GEAR QUESTIONS

1. My gear preferences are...
- ☐ Strictly use tip-ups
 - ☐ Mostly use tip-ups, but occasionally use jigging techniques
 - ☐ Usually use both tip-ups and jigging techniques
 - ☐ Mostly use jigging techniques
 - ☐ Strictly use jigging techniques
2. My gear includes the following (check all that apply):
- ☐ ATV or other vehicle
 - ☐ Electronic echosounder/depth finder
 - ☐ Powered auger
 - ☐ Hand auger
 - ☐ Underwater camera
 - ☐ Lures
 - ☐ Bait
 - ☐ Other (please describe)_____
3. Do you own or use an ice fishing shelter?
- ☐ Yes
 - ☐ No
4. How would you describe the shelter?
- ☐ Hard-sided and relatively “fixed”
 - ☐ Soft-sided and relatively mobile or “portable”
 - ☐ other (describe_____)
5. If portable, how many years have you owned a portable shelter?
- ☐ 1–3
 - ☐ 4–8
 - ☐ 9–12
 - ☐ 13+

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6. If portable, did you previously own/use a “fixed” shelter?

- ☐ Yes
- ☐ No

7. If portable, rank the reasons for your purchase of the shelter.

- ☐ ___ Mobility
- ☐ ___ Cost
- ☐ ___ Cold-weather/wind protection

8. If portable, how important is the shelter in regards to the number of ice fishing trips you take?

- ☐ Very Important
- ☐ Somewhat Important
- ☐ Neutral
- ☐ Not Very Important
- ☐ Not At All Important

DEMOGRAPHIC QUESTIONS

1. What is the zip code of your primary residence? _____

2. Birth year? _____

3. Gender?

- ☐ Male
- ☐ Female

4. What was your approximate total household income before taxes in 2013?

- ☐ < \$20K
- ☐ \$20K to \$39K
- ☐ \$40K to \$59K

5. Please indicate highest education level achieved:

- ☐ Less than high school
- ☐ High School
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Advanced degree (MS/Ph.D.)

6. Do you belong to any fishing/hunting related clubs?

- ☐ Yes
- ☐ No

Thank you very much for taking the time to provide this information.