Assessment of the Keweenaw Bay Indian Community's Fish Consumption

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Portions of this report and the earlier QAPP were developed from similar reports and plans developed by the Seldovia Village Tribe and Wampanoag Tribe of Gay Head, and final reports from similar studies of the Tulalip and Squaxin Island Tribes of Puget Sound, and the Columbia River Inter-Tribal Fish Commission. We also referred to the *EPA Guidance for Conducting Fish and Wildlife Consumption Surveys* (1996).

We are also especially grateful to KBIC tribal members living on or near the L'Anse Reservation, including those who reside in Baraga, Houghton, Keweenaw, Ontonagon, Gogebic, and Marquette counties who contributed their time to participate in the assessment. This assessment would not have been possible without their support and participation.

Executive Summary

The Keweenaw Bay Indian Community (KBIC) is a federally-recognized Native American tribe, located in the Upper Peninsula of Michigan, along the shores of Lake Superior. Historically, Lake Superior has provided KBIC members fisheries subsistence for generations, and continues to support an important commercial fishery and economic livelihood for tribal members. KBIC's fishing rights have been retained through the Treaty of 1842 and continue to be utilized to this day.

Many studies point to the health benefits of consuming fish as a source of omega-3 nutrients and lean protein. At the same time, fish contain contaminants such as polychlorinated biphenyls (PCBs), mercury, and dioxin. KBIC members may be at a higher risk of the negative impacts of these contaminants because of their higher consumption of fish due to traditional and commercial lifestyles. Furthermore, because fish are important to KBIC's culture, eliminating or reducing fish as a food source would provide an undue burden on traditional lifestyles.

The objective of this assessment was to determine a credible and legally-defensible fish consumption rate by KBIC tribal members on and near the L'Anse Reservation.

Results found that KBIC tribal member respondents consume 29.9 grams/day of fish averaged across the year (32.1 grams/day if those who do not eat fish are excluded). This rate is lower than that of other recent fish consumption studies. Consumption rates at the 95th and 99th percentile for all respondents were found to be 121 and 222 grams/day, respectively. When those who do not eat fish are excluded, these numbers were 126 grams/day at the 95th percentile and 222 grams/day at the 99th percentile.

It appears that men (ages 16-40 years), and older adults (ages 41-54 years) consume higher amounts of fish than women of child-bearing age (ages 16-40 years) and children (ages 0-15 years). At least one reason for lower fish consumption rates among women of child-bearing age has to do with contaminants and pollutants (e.g., mercury).

Nearly two out of three members (63 percent) would consume fish more frequently, increasing their desired consumption rate to 85.9 grams/day (87.5 grams/day if those who do not eat fish are excluded). Desired consumption rates at the 95th and 99th percentile for all respondents were found to be 242 and 565 grams/day, respectively. When those who do not eat fish are excluded, these numbers were 260 grams/day at the 95th percentile and 565 grams/day at the 99th percentile.

These findings are consistent with the proportion of households that report fishing from local waterways (72 percent) and a general expression of importance placed on harvesting and consuming traditional foods; fish consumption is viewed as good for health, important to family, important to the community, a way to save money, and important in preserving treaty rights.

Barriers to harvesting include time, physical/health issues, age, and cost. Other concerns about consuming or harvesting traditional foods include contaminant/pollutants, depleting resources, invasive species, and lack of knowledge about traditional practices. These concerns are at odds with the cultural and traditional significance of fish consumption among KBIC tribal members.

I. Introduction

Between May 29, 2015 and December 22, 2015, the Keweenaw Bay Indian Community (KBIC) Natural Resources Department conducted in-person interviews based on a survey instrument to determine fish consumption rates and practices by members of the KBIC. We analyzed results from these interviews to determine the consumption of fish across several demographic variables, such as age and gender, as well as species of fish, source of fish, methods of preparation, and parts of fish consumed. Results from this assessment will enable KBIC to make informed risk-based and regulatory decisions that are protective of the health of its members.

Background

The Keweenaw Bay Indian Community (KBIC) is a federally-recognized Native American tribe located in the Upper Peninsula of Michigan, along the shores of Lake Superior. Historically, Lake Superior has provided KBIC members with fisheries subsistence for generations, and continues to support an important commercial fishery and economic livelihood for tribal members. KBIC's fishing rights have been retained through the Treaty of 1842 and continue to be utilized to this day.

Many studies point to the health benefits of consuming fish as a source of omega-3 nutrients and lean proteins. At the same time fish contain contaminants such as polychlorinated biphenyls (PCBs), mercury, and dioxin. KBIC members may be at a higher risk of the negative impacts of these contaminants because of their higher consumption of fish due to traditional and commercial lifestyles. Furthermore, because fish are important to KBIC's culture, eliminating or reducing fish as a food source would provide an undue burden on traditional lifestyles.

Regulatory decisions regarding environmental standards (e.g., water quality criteria and standards, surface water, and sediment cleanup levels), as well as whether to issue fish consumption advisories, are typically based on fish consumption data reflective of the general population. Therefore, tribal populations and those populations that consume a higher rate of fish are not protected by these standards. In order to establish environmental standards that protect KBIC human health and the environment, a fish consumption survey of tribal members is required to determine a relevant, scientifically defensible fish consumption rate. Relevant and quantifiable fish consumption data will also help KBIC to improve risk communication by targeting health education and awareness programs.

Assessment Objective

The objective of this assessment was to determine a credible and legally-defensible fish consumption rate by KBIC tribal members on and near the L'Anse Reservation. Specifically, this objective involved collecting data and information on overall community fish consumption, including fish food products obtained from subsistence and recreational harvests, fish markets, and grocery stores by:

- ✓ Designing a survey that provided highly accurate, legally-defensible fish consumption data for KBIC
- ✓ Creating a survey questionnaire that provided a credible and legally-defensible description of KBIC's current fish consumption habits
- ✓ Developing survey visual aids (fish portion size, maps) that ensured reliability of consumption data collected during interviews

- ✓ Statistically identifying the number of community members who consume fish
- ✓ Determining each species of fish that is being consumed by tribal households and what quantities of fish are being consumed
- ✓ Identifying the most frequented specific locations where fish species are harvested, purchased, or otherwise obtained
- ✓ Determining what methods of fish preparation are being used by tribal households and the quantities of fish being consumed for each preparation method
- ✓ Estimating mean per capita amounts of fish consumed by tribal members, and the number that are freshly caught and amounts consumed that are obtained commercially.
- ✓ Estimating mean per capita amounts of fish consumed by tribal elders (ages 55 years and older).
- ✓ Estimating mean per capita amounts of fish consumed by children (under the age of 16).
- ✓ Estimating mean per capita amounts of fish consumed by women of childbearing age (ages 16 – 40 years).

The survey results will be published and presented to the community through various means and outreach materials will be prepared to educate the community on how to reduce exposure to contaminated fish and better communicate risk. Additionally, the survey data will enable KBIC to make informed risk-based and regulatory decisions that are more protective of the health of its members.

II. Literature Review

A literature review revealed a number of prior surveys and interviews that addressed fish consumption among tribal and non-tribal populations. In total, we identified 26 studies; 14 involved tribal populations and 12 involved non-tribal populations (mostly conducted among fishermen and women). The varied methodologies of these studies and their findings provide a good comparison for the current study of the KBIC population. In this section, we review these published study methodologies and findings. Finally, we compare the methods used in these studies to those used in the *Assessment of the KBIC's Fish Consumption*. (Please see Appendix A for the complete literature review.)

Results of Fish Consumption Surveys among Tribal Groups

Studies evaluating fish consumption in Native American populations provide evidence of higher consumption than in the general population as well as differences in consumption practices across tribal populations and between men and women (e.g., Foran et al., 2010; Toy et al., 1996; Seldovia Village Tribe, 2012). Furthermore, fish consumption by tribal populations tends to be significantly higher than levels recommended by the EPA (Tsuchiya, 2009; Toy et al., 1996; Seldovia Village Tribe, 2012). Several studies in both tribal and non-tribal populations have found that higher fish consumption is associated with higher blood levels of contaminants such as lead, methyl mercury, PCBs, and DDE (Gerstenberger, 1997; Peterson et al., 1994; Dolbec, 2000). Finally, studies that evaluated consumers' awareness of governmental and tribal fish advisories found mixed levels of awareness of these advisories (Kuntz, 2007; Johnston & Snow, 2007; Anderson, 2004).

Methodological Choices among Fish Consumption Studies

Many of the 26 studies identified did not conduct a traditional fish consumption survey (i.e., one in which the average rate of fish consumption is calculated based on appropriate samples, survey

methods, and statistics). After reviewing these studies, we selected seven studies for a methodological evaluation because they included criteria and/or methodologies that were relevant to a high-quality fish consumption survey. Some studies did not describe a detailed research approach; only those studies that positively identified the research methodology were included. Table 1 presents a list of the study criteria included in the fish consumption studies and compares these criteria to those used in the *Assessment of the KBIC's Fish Consumption*. The comparison criteria include: technical advisory panels, representative samples, response rates, child data, recall bias, physical fish models, survey instruments, in-person interviews, average consumption rates for individuals and subgroups, significance testing between groups, and power analyses. These criteria are discussed below:

- *Technical Advisory Panels* – The majority of these studies included an advisory panel that provided cultural guidance for developing the survey instrument and identifying how the survey might be deployed.

- *Representative Sample* –These studies selected representative populations for inclusion. Several studies oversampled some tribal members by location in order to ensure that their numbers were representative of a geographical area or county (e.g., Seldovia Village Tribe, 2012; Toy et al., 1996). The current study oversampled certain subgroups to achieve a representative sample of subgroups.

- *Response Rates* – All studies reported the number of individuals who were surveyed or interviewed. Two studies used mailed surveys that were completed by respondents, which resulted in large numbers of respondents (822 - 2,236 respondents). However, for studies that relied on in-person interviews, the sample size ranged from 65 to 1,325 respondents. With a response rate of 256 individuals (obtained through 219 interviews; some households included more than one individual/respondent), the current study had the second highest response rate of fish consumption surveys presented here.

- *Child Data* – The current study asked a single household member to report the fish consumption patterns of all children residing in that home. This approach was similar to four other studies that also collected child fish consumption data.

- *Recall Bias* – One of the first tasks of the interview was to identify all foods and beverages consumed within the last 24 hours. This recall task helps to start the interview and probes respondents' memory of fish consumption while also providing a comparison for other reported fish consumption patterns. Three fish consumption studies used a 24-hour recall item in their surveys.

- *Physical Fish Models* – To help respondents identify the amount of fish they consumed, the interviewers used physical models of portion size. This was an approach used by three fish consumption studies.

- *Survey Instrument* – In the published studies, a survey instrument was designed to collect statistical data on fish consumption patterns. However, the current study was also designed to collect qualitative data on topics such as the importance of harvesting and consuming fish, concerns about fish, barriers to eating more fish, and interesting stories regarding fishing.

- *In-Person Interviews* – Donatuto (2010) highlighted the importance of conducting in-person interviews. The current study used in-person interviews to collect accurate data on tribal members' consumption patterns. Six out of seven studies relied on in-person interviews to collect data.

- *Average Consumption Rates* –Only four of the seven studies calculated the average number of grams of fish respondents ate on a daily basis. The current study calculated the average fish consumption of KBIC members, which was one of the cornerstones of this study.

- *Average Consumption Rates of Subgroups* – Only three studies reported the average consumption rates of subgroups (e.g., children, women). The current study examined the rates of fish consumption for several important groups – children (ages 0-15 years), women of child-bearing years (ages 16-40 years), men of child-bearing years (ages 16-40 years), older adults (ages 41-54 years), and tribal elders (ages 55 years and older).

- *Significance Testing between Groups* – Two studies used statistical significance testing to determine whether there were important differences in the amount of fish consumed by subgroups of interest (e.g., children, women of child-bearing years, tribal elders). The current study also used significance testing, where appropriate, to determine whether consumption patterns among subgroups varied significantly.

- *Power Analyses* –Statistical power is the probability that a significance test correctly rejects the null hypothesis when the alternative hypothesis is true. For example, if the outcome of a statistical test indicates that the null hypothesis should be rejected (e.g., $p < .05$), statistical power indicates how confident we are about this finding. If the test is sufficiently powered (i.e., enough data has been collected), the decision to reject the null hypothesis is well supported. If it is underpowered, the interpretation of the outcome questionable. Many scientific studies that report statistical significance do not also report power analyses. Among the fish studies reviewed here, the current study is the only one that utilized power analysis to determine sample sizes.

Thus, the current study builds upon several of the established research methodologies of previous fish consumption surveys while also introducing new criteria for performing fish consumption surveys.

Table 1: Criteria necessary for a strong assessment of fish consumption

Study	Year	Study Group	Technical Advisory Panel	Representative Sample	Response Rates	Child Data (n)	Recall Bias (24-hr recall)	Physical Fish Models
Toy et al.	1996	Tulalip & Squaxin Is.	✓	✓	190	59		✓
Duncan	2000	Suquamish Tribe	✓	✓	92	31	✓	✓
Seldovia Village Tribe	2012	Seldovia Village	✓	✓	76	35	✓	✓
Westat	2012	Colville Tribe	✓	✓	2,236	409	✓	
Kuntz	2007	NW Tribes (women)	✓		65			
Dellinger	2004	Ojibwe		✓	822			
Gerstenberger	2004	Ojibwe		✓	89			
KBIC	2016	KBIC	✓	✓	256	51	✓	✓

Table 1: Criteria necessary for a strong assessment of fish consumption (cont'd)

Study	Year	Study Group	Survey Instrument	In Person Interviews	Avg. Consumption Rates	Avg. Consumption Rates of Subgroups	Significance Testing between Groups	Power Analysis
Toy et al.	1996	Tulalip & Squaxin Is.	✓	✓	✓	✓	✓	
Duncan	2000	Suquamish Tribe	✓	✓	✓	✓		
Seldovia Village Tribe	2012	Seldovia Village	✓	✓	✓	✓	✓	
Westat	2012	Colville Tribe	✓	✓				
Kuntz	2007	NW Tribes (women)	✓	✓				
Dellinger	2004	Ojibwe	✓		✓			
Gerstenberger	2004	Ojibwe	✓	✓				
KBIC	2016	KBIC	✓	✓	✓	✓	✓	✓

III. Survey Methodology

The survey methodology involved identifying the appropriate sample design, developing the survey instrument, and incorporating on-site in person interview research protocols that increased the quality of the data collected.

Sample Design

The data for this assessment was obtained by interviewing a stratified sample of KBIC members about their fish consumption. The initial sample size chosen for this study met two important requirements. First, the sample size was large enough to ensure that the fish consumption numbers reported in this study represent the average KBIC member and the subpopulation strata identified. Second, the sample size was large enough to ensure sufficient statistical power to examine differences between subpopulations (e.g., do children eat more fish than elders?).

The following sections describe the survey population and sample sizes needed to obtain legally defensible estimates of fish consumption rates.

Survey Population

The survey population included individually-enrolled KBIC tribal members living on or near the L'Anse Reservation, including those who reside in Baraga, Houghton, Keweenaw, Ontonagon, Gogebic, and Marquette counties. Certain subpopulations were targeted, including children (under age 16 years), women of child-bearing age (ages 16-40 years), and elders (ages 55 years and older). Table 2 presents the breakdown of the KBIC membership database into the following strata: children, women of child-bearing age, men ages 16-40 years, older adults, and tribal elders. Please note that the KBIC membership database did not identify members by their gender; therefore, the actual proportion of male and female KBIC members was unknown at the start of this study. In order to arrive at these estimates, we estimated the female membership in KBIC as 51 percent, a figure consistent with the distribution of women across the United States (U.S. Census Bureau, 2014).

Sample Size Needed to Calculate Mean Consumption Rates

In order to identify the sample size necessary for estimating average fish consumption of KBIC members, we performed several calculations before the interviews were conducted. We calculated minimum sample sizes for each of the subpopulations of interest (i.e., children, women of childbearing age, elders) and the remaining subgroups (men, ages 16-40 years; older adults) using criteria from past fish consumption studies; we also performed one calculation based on power analysis (described in a later section). These calculations resulted in different estimated sample sizes, depending on a number of assumptions and approaches. These sample size estimates appear in Table 2.

Table 2: Sample size comparisons

			Sample Size			
Strata	Age	Population	Susquamish	Cook Inlet	Power	Wampanoag
Children	0 - 15	261	**	37	51	91
Women of child bearing age*	16 - 40	286	**	38	51	93
Men	16 - 40	275	**	37	51	93
Older adults	41 - 54	375	**	39	51	102
Elders	55+	375	**	39	51	102
Total	--	1572	158	190	255	481

* Population assumed to be 51% for all members of this subgroup

** Susquamish calculation method estimates total sample size only

The following formula was used in the Cook Inlet study and the Wampanoag Project Planning and Development Plan (PPDP) (Merrill & Opheim, 2013; Wampanoag Tribe of Gay Head, 2002).

$$n = \sigma^2 / ((B^2/z^2) + (\sigma^2/N))$$

n = required sample size
N = population size
z = z-score for $(1 - \alpha)$% confidence
B = the bound within which you want to estimate mu
σ = standard deviation

This formula produced two different estimates for the sample size needed for the current study. Using the assumptions for the Cook Inlet study (B = 9 grams, σ = 30 grams) for each KBIC strata, the total estimated sample size for KBIC was 190 completed interviews. Using the assumptions for the Wampanoag PPDP (B = 5 grams, σ = 30 grams), the total estimated sample size for KBIC was 481.[1]

A second formula used in past studies and more recently in the *Fish Consumption Survey of the Susquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region* (Duncan, 2000) is as follows:

$$n = [1.96 \times SD / \log (1.2)]^2$$

n = required sample size
SD = standard deviation on the logarithmic scale

There are at least two important differences between the use of the first and second formulas. First, the second formula has been used to estimate total sample size, rather than the sample size for different strata. In the case of the Susquamish study, using an SD of 1.17 (derived from the logarithmic scale of five previous fish studies), the total sample size was calculated to be 158 completed surveys. The second important difference is that this estimate stays the same no matter how large or small the population.

Using the two formulas and associated assumptions, the estimated sample size needed for the current study ranged between 158 and 481 completed surveys.

[1] Although the Wampanoag Tribe of Gay Head (Aquinnah) developed a QAPP, it does not appear that this study was ever completed. Therefore, the standards used to determine the sample size formula should be considered with caution.

Sample Size for Defensible Sub-group Comparisons

A sample size large enough to allow for meaningful statistical tests for subpopulations of interest requires statistical power analysis. One application of power analysis is determining the minimum sample size needed to reasonably detect a significant difference, if one exists, between two groups. That is, if an analysis does not include a large enough sample (i.e., the statistical test is under-powered), a statistically significant finding may not actually indicate a true difference between groups. One way to safeguard against this possibility is to conduct a power analysis before data collection begins in order to calculate a minimum sample size. This calculation depends upon a number of factors, including the statistic to be calculated, the desired level of power, and assumptions (e.g., standard deviation) about the data.

For this assessment, comparisons of interest involve average (mean) fish consumption amounts (as measured in grams) between subgroups (e.g., between children and elders). The appropriate statistical analysis for the comparison of two groups is the independent samples t-test (Field, 2005). If we assume a power of 0.80 (the generally accepted value in the social sciences), set alpha to 0.05 (the normal level for a statistical test), and anticipate a medium effect size (**d** = 0.5), the minimum sample size for each subgroup of interest is 51 (Faul, Erdfelder, Lang, & Buchner, 2007).

This means that the total number of completed surveys for individuals needs to be at least 255, with 51 surveys reported for each subgroup of interest (Table 3).[2] This number exceeds the calculations used for the Susquamish and Cook Inlet fish consumption studies, but falls short of the calculations presented in the Wampanoag QAPP. As can be seen in Table 3, this study was able to collect the recommended number of surveys for every subgroup except for men ages 16-40 years. Accordingly, any comparison between women of child-bearing years and their male counterparts must be made carefully and may need to encompass a wider comparison group.

Table 3: Final sample size

			Sample Size	
Strata	Age	Population	Power	Final
Children	0 - 15	261	51	51
Women of child bearing age*	16 - 40	286	51	57
Men	16 - 40	275	51	46
Older adults	41 - 54	375	51	51
Elders	55+	375	51	51
Total	--	1572	255	256

* Population assumed to be 51% for all members of this subgroup

Survey Development

[2] Since this is a household survey in which parents answered fish consumption questions for their children, the total number of household surveys needed is 204, and from these surveys we need survey responses for 51 children.

Interviewers collected fish consumption data for individuals through in-person interviews. Below we discuss the development of the survey instruments, the target fish species list, and the visual aids used during the in-person interviews.

The Assessment Questionnaire

The Survey Consultants drafted the questionnaire with significant input and guidance from the Survey Workgroup. The questionnaire was designed to only collect information deemed essential to the project goals and objectives described earlier. Specifically, the closed-ended survey items asked about the fish consumption patterns of KBIC tribal members related to the following topics:

- How often fish is consumed
- How fish consumption changes by season
- Where fish are obtained (e.g., caught, purchased)
- What types of fish are consumed
- How fish are prepared
- What parts of fish are consumed
- Desired fish consumption

In addition, the survey instrument asks for or verifies respondent demographic information, including age, gender, weight, and exposure duration. These survey items were necessary to determine the proportional effect fish consumption may have upon the respondents as well as different fish consumption patterns by age and gender.

The general format of the survey and specific wording of closed-ended items came primarily from the *Assessment of Cook Inlet Tribes Subsistence Consumption* report (Merrill & Opheim, 2013). We selected this source for several reasons. The primary consideration was that this survey design was approved by the EPA as part of a QAPP in 2012. A secondary consideration was the comprehensive scope of the survey and its compatibility with the project objectives and goals. Furthermore, the survey was based on an earlier fish consumption study developed by the Columbia River Inter-Tribal Fish Commission for the Umatilla, Nez Perce, Yakama, and Warm Spring tribes of the Columbia River Basin. Prior EPA approval of the general design and usage in two prior fish consumption projects contributed to quality assurance and quality control considerations for the current project.

24-Hour Recall

The inclusion of a 24-hour dietary recall served three purposes. First, prior studies (e.g., Merrill & Opheim, 2013) indicate that asking interviewees to list all food and beverages consumed in the past 24 hours provides a point of comparison against overall fish consumption rates. That is, the reported information from the 24-hour recall exercise should be consistent with the typical fish consumption patterns reported by the interviewee. Second, the 24-hour recall exercise acts as a "warm-up" to the interview, giving respondents a simple recall task at the start and prompting them to think about meals and portion sizes. Third, this was the first opportunity to familiarize the interviewee with the fish portion size visual aids.

Where Fish are Obtained

An important aspect of understanding fish consumption patterns is learning how fish are obtained. Consumed fish species may be caught directly by respondents (spear, net, rod and reel), bought

from Tribal fisherman, or purchased at a grocery store. Knowing which fish species are sourced from local waterways provided information on the relative exposure of KBIC tribal members to environmental toxins. According to the 2013 *KBIC Wildlife and Natural Resources' Survey Report* (Gagnon, Nankervis, & Johnston, 2013), many respondents (59%) purchase fish from local tribal fishermen and report eating local fish at least once per month (66%). The presentation and wording of closed-ended survey items related to where fish are obtained came from the *Assessment of Cook Inlet Tribes Subsistence Consumption* report (Merrill & Opheim, 2013).

Fish Species Consumed

The local fish species that might be caught and/or bought for consumption were identified and included in this assessment. Sources of information on local fish species specific to KBIC members included the *Michigan Fishing Guide* (Michigan Department of Natural Resources, 2014c) and the *Eat Safe Fish Guide, Upper Peninsula, 2014-2015* (Michigan Department of Community Health, 2014). These sources were used to identify fish species common to the state of Michigan and specific to the areas and counties where KBIC tribal members reside.

The initial list of fish species the Survey Consultants developed was an exhaustive catalog of Michigan fish species common to Lake Superior, the waterways of the Michigan Upper Peninsula, and the KBIC fisheries. This list was included in an initial draft of the survey instrument and was reviewed and edited/amended by the Survey Workgroup. In the interest of keeping the survey instrument (and the in-person interview) to a minimum length, only the most common or familiar species were listed, with space for additional write-ins.

Fish Parts Consumed

In addition to fish species consumed, respondents were asked to identify the fish parts that were most commonly eaten. Fish parts listed on the survey included: fillet, skin, head, eggs, bones, belly, and other organs. The list of fish parts included in the survey and their presentation came from the *Assessment of Cook Inlet Tribes Subsistence Consumption* report (Merrill & Opheim, 2013).

Fish Preparation Methods

The method of preparing fish may affect certain toxin levels that remain after preparation (Michigan Department of Community Health, 2014). Because of this, understanding the fish preparation methods used contributes to our understanding of toxin exposure as a result of fish consumption for this population. The survey questionnaire had an open space that asked respondents to list the different fish preparation methods they commonly used for each type of fish they consumed.

Visual Aids

Several visual aids were used during the in-person interviews to help respondents answer questions accurately. Visual aids provided quality control by allowing respondents the ability to specify the portion size of fish typically consumed during a fish meal, verify which fish species they did/did not consume, and identify specific waterways from which they obtained caught fish, if any. The visual aids used in the current project are described in more detail below.

Portion Size

To help survey respondents estimate the amount of fish typically consumed in a meal, full-size physical models of six salmon fillets of various sizes were presented during the in-person interview. The use of physical models in fish consumption surveys has been conducted previously with success (Duncan, 2000). The physical models were marked on the bottom with the weight (in grams) of comparably sized actual salmon fillets. These markings assisted interviewers in documenting the typical portion sizes of fish meals as indicated by respondents (e.g., a single best model, combination of models, fraction of a specific model, or multiples of a specific model). The physical models used for the study were obtained from Fake Foods Online (www.fakefoodsonline.com), a distributor of food models for the food displays used in the restaurant industry.

Fish Species

To help respondents identify the fish species listed in the survey instrument, black and white scientific drawings from an atlas of Michigan fishes (Michigan Department of Natural Resources, 2014a) were presented during the in-person interview as needed (see Appendix H for the Fish Species Catalog).

Maps of Local Waterways

To assist respondents in identifying where fish are caught locally, interviewers used a KBIC Territory Atlas, including waterway maps, during the in-person interviews. The Territory Atlases were produced by the KBIC Natural Resources Department. The atlases including plat maps developed by the Western Upper Peninsula Planning & Development Region (WUPPDR) and covered the entire geographic area where KBIC tribal members retain and exercise Treaty rights within the portion of the 1842 Ceded Territory in the State of Michigan.

Survey Administration

Research Interviewers collected fish consumption data through in-person interviews; they manually completed the interview form and handwrote the responses to the open-ended questions during the interview. In addition, Research Interviewers audio recorded the entire interview using a digital recorder. They received training on how to fill out the questionnaire completely and accurately. They also received training on how to record the interviews using the digital recorder. Part of this training included the proper completion of the Comments section, where the Research Interviewers reported any additional comments, problems, or abnormalities with the survey procedures or data collection devices.

After receiving a letter from the KBIC Natural Resources Department (see Letter of Invitation in Appendix C), interview subjects were contacted by phone by one of the Research Interviewers and asked to participate in the Fish Consumption Survey. Up to four attempts to contact participants were made. If all four telephone attempts failed, we attempted to contact participants by visiting their homes. Only after the door-to-door attempts failed were individuals closed out of the study. (Please see the Contact Activity Log in Appendix E).

Prior to the scheduled interview, the Research Interviewer completed the first portion (pre-interview) of the Pre/Post Interview Checklist (see Appendix J). This ensured that the interviewer had the appropriate materials (e.g., forms, visual aids, digital audio recorder) for the scheduled interview. At the time of the interview, each Research Interviewer signed an informed consent form (see Appendix D for the Informed Consent Form), enabling the Project Manager and/or

Environmental Specialist to analyze each interviewer's performance. Closed-ended questions regarding consumption indicated that weights or meal size represented cooked fish (rather than raw fish). Visual aids – including full-size physical models of salmon fillets depicting portion size, black and white scientific drawings for species identification, and local waterway maps – were shown during interviews to increase accuracy of consumption estimation and aid in memory recall (See Appendix H for the Fish Species Catalog).

Once the interview was complete, the Research Interviewer double-checked the interview form for completeness. The Research Interviewer then completed the final section (post-interview) of the Pre/Post Interview Checklist to ensure that all remaining forms were completed and that all materials were collected. At the end of each interview day, all completed questionnaires and digital files were provided to the Project Manager, who also reviewed the forms for completeness and missing data.

Cultural Bias

To reduce cultural bias, the survey questionnaire (e.g., item inclusion, wording of items/questions, choice of response options) and interview process (e.g., steps, wording of instructions) were developed with input from KBIC. This input was provided by the Survey Workgroup throughout the project and by the Tribal Council as appropriate. Furthermore, local KBIC tribal members familiar with the topic of the survey and target population were hired to conduct the interviews to help minimize response bias.

IV: Methodology

The fish consumption survey generated a considerable amount of quantitative and qualitative data.

Quantitative Data Analyses

The following discussion identifies the statistical methods used in the analysis of the quantitative survey data gathered from tribal members during the in-person interviews.

Statistical Methods

Statistical analysis of the fish consumption data included two classes of statistics: descriptive and inferential.

Descriptive Statistics

Descriptive statistics of fish consumption patterns, as summarized in tables and graphs, are presented in this assessment. These descriptive statistics include means and standard deviations. Descriptive statistics were used to examine a number of topics including: demographic information, dietary recall of fish consumed, average season consumption patterns, average fish consumption rates, average consumption rates by fish species, summary statistics on fish parts typically consumed, frequency of fish preparation methods, types of fish by location where obtained, changes in rates of fish consumption by season, and ceremonial fish consumption.

Inferential Statistics

The assessment also used inferential statistics to estimate whether fish consumption varied by subpopulation. Specifically, this assessment examined three sets of subgroups: (1) tribal elders (ages 55 years and older) vs. adults (ages 16-54 years), (2) children (younger than 16 years) vs. adults (ages 16-54 years), and (3) women of child-bearing age (16-40 years) vs. men of child-bearing age (16-40 years). This important step determined whether any reported group differences in fish consumption were meaningful.

In order to test whether group differences between two groups exist, we used *independent sample t-tests*. The null hypothesis was that there were no differences between the two groups. With independent sample t-tests, it is important to address two considerations. First, we needed to establish that the outcome variables were normally distributed (Fields, 2005). In cases where the outcome variable was not normally distributed, a comparable non-parametric t-test was used. Second, the two groups should have equal variances. The Levene's statistic was used to test for the equality of variances of the two groups. Depending on the outcome of this statistic, the appropriate t-statistic was reported.

Questions Answered Using Statistical Analyses

This section presents the different questions that were answered using statistical analyses.

<u>Demographic Information</u>
This assessment began by examining the demographic information of survey respondents, including the following three areas:

(1) *Characteristics of Respondents*: Descriptive statistics including county location, gender, and age of the respondents (e.g., elder, child) are presented to ensure that the number of respondents is sufficient to represent any subgroups.

(2) *Non-response Rates*: Non-response rates are presented to identify the percentage of tribal members who were contacted but refused to participate or who were unable to be successfully contacted for inclusion in the study. These response rates were also examined by age to ensure that the non-response rates were not overly represented by one group, potentially causing a bias in the data collected. Unfortunately, gender was not available for examination.

(3) *24-hour Dietary Recall*: Many fish consumption surveys ask respondents to list the food and beverages that they consumed in a recent 24-hour period (Merrill & Opheim, 2013). This dietary recall is helpful for determining whether people who reported recent fish consumption also reported higher levels of fish consumption over the past year (Merrill & Opheim, 2013; Duncan, 2000).

Consumption Rates by Tribal Members Seasonally, Monthly and Weekly

The average fish consumption rate was calculated for respondents throughout the year. This consumption pattern was examined for both the entire KBIC tribal population as well as for specified subgroups of interest (e.g., tribal elders, women of child-bearing age, children). The proper checks for normality and outliers were performed to ensure that these fish consumption rates reflected real patterns of fish consumption among these groups. In addition, statistical tests determined whether there were significant differences in fish consumption patterns between groups.

Fish consumption rates were calculated in grams per day (g/d) using portion sizes that were reported in ounces of weight as represented by salmon fillet models. Six different sizes were presented to respondents to indicate which single model, combination of models, fraction of a specific model, or multiples of a specific model best represented a typical fish meal. Measured as ounces per meal, the following formulas were used for the remaining calculations by timeframe:

Data collected by season:
- Ounces eaten per meal * 28.35 grams per ounce = Grams eaten per meal
- Grams eaten per meal * number of meals per season = Grams per season
- Grams per season / 91.25 days per season = Grams per day

Data collected by month:
- Ounces eaten per meal * 28.35 grams per ounce = Grams eaten per meal
- Grams eaten per meal * number of meals per month = Grams per month
- Grams per month / 30.4 days per month = Grams per day

Data collected by week:
- Ounces eaten per meal * 28.35 grams per ounce = Grams eaten per meal
- Grams eaten per meal * number of meals per week = Grams per week
- Grams per week / 7 days per week = Grams per day

Consumption Rates by Fish Species Type

The survey asked about fish species that are common to the Michigan waterways. These included: bass (largemouth, rock, smallmouth), bluegill, bullhead, burbot, carp, cisco (lake herring), black crappie, lake sturgeon, northern pike, yellow perch, pumkinseed, salmon, smelt, splake, sucker, trout (brook, brown, lake, rainbow), walleye, and lake whitefish. In addition, the questionnaire provided space to note fish species not covered in the above list.

The average consumption rates for these fish are presented for the entire tribal population as well as for certain subgroups of interest (e.g., tribal elders, women of child-bearing age, children). In addition, the proper significance tests were performed to identify whether there were significant differences in consumption of the most commonly eaten fish species by subgroups of interest (e.g., children vs. adults, elders vs. adults, women of child-bearing age vs. men of child-bearing age).

Consumption of Specific Fish Parts

The survey asked respondents to identify the different parts of the fish that they regularly consume – fillet, skin, head, eggs, bones, belly, and other organs. The average consumption rates for these specific parts of fish are presented for the all respondents as well as for certain subgroups of interest (e.g., tribal elders, women of child-bearing age, children). Additional analyses examined subgroup differences in fish parts consumed.

Consumption Patterns by Fish Preparation Technique

The survey respondents were asked to identify how the fish was prepared in open-ended responses. These responses were recoded into the most common categories of responses (e.g., pan-fried, grilled, and steamed). These preparation categories are then presented for the average tribal member and subgroups of interest (e.g., tribal elders, women of child-bearing age, and children). Unfortunately, since tribal members often reported multiple types of preparation for a single fish it was not possible to report the average consumption rates for the fish preparation type.

Origins of Fish Consumed

The survey asked respondents to identify where fish were most commonly obtained. For those who locally harvested fish, the interviewer presented local waterway maps and asked respondents to identify where they most commonly obtained different species of fish. The results from this series of questions are presented in a tabular format and also in a series of 11 maps depicting the density of fishing for certain species of fish by fishing location.

Ceremonial Consumption of Fish

The survey also captured fish consumption that occurs during ceremonies and community events. Summaries of how often tribal members attended ceremonies and how often fish was eaten during these ceremonies is presented.

Qualitative Data Analyses

In addition to providing statistical analyses of data from the fish consumption survey, this assessment also examined responses to open-ended questions. The open-ended questions ask for comments on topics such as:

- Importance of harvesting and consuming fish
- Concerns about harvesting or consuming traditional foods
- Interesting stories, personal experiences, or family traditions regarding fish

Analysis of the Interviews

Qualitative analysis of the open-ended items involved theme identification and theme treatment.

Theme Identification

Theme identification consisted of an examination of the open-ended responses from the in-person interviews. QSR International's NVivo 10 Qualitative Data Analysis Software program was used to store, code, query, and organize the open-ended data. A conventional approach (Hsieh and Shannon, 2005) to qualitative content analysis was used to code and analyze participants' open-ended responses. The responses for each question were analyzed separately. Using a line-by-line technique (Glaser & Strauss, 1967), each response was reviewed. Data was inductively coded to identify the categories and themes that emerged from the data. Participants' words were used to establish the inductive codes for each question. Deductive codes based on the questions were added as needed. Codes were added and/or modified as necessary as new meanings emerged. Using a constant comparison technique (Glaser & Strauss, 1967), the text that related to the purpose of the research was systematically compared and assigned to one or more codes. To assess coding consistency, codes and their assignment to text were checked and rechecked.

Once the data was coded, codes were constantly compared (Glaser & Strauss, 1967) to each other, and queried to identify the main themes that emerged from the data for each question. The themes for each question were compared to the corresponding quantitative data. The themes for each question are reported below. Representative quotes that support the themes and subthemes are presented as well. To ensure the trustworthiness of the data, confirmability was performed by two researchers, who audited the data and ensured internal consistency of the codes, themes, and subthemes (Lincoln & Guba, 1985).

Theme Treatment

The themes extracted from the interviews were used to better understand or supplement the information collected from the statistical analyses and helped assess fish consumption patterns and decisions in terms of triangulation of methods and findings. Specifically, convergence of themes derived from the open-ended questions along with findings from statistical data analysis allowed a more complete description of fish consumption patterns and decisions and served to confirm findings from multiple sources.

V: Quality Assurance

In order to ensure that a study is conducted with high quality, it is necessary to develop and follow quality assurance and control procedures throughout the study. Below is a discussion of the quality assurance measures we followed for three components of this study: (1) interviewing, (2) data entry, data management, and data storage, and (3) the confidentiality of study participants.

Quality Assurance for Interviewing

In order to ensure that the interviews were conducted with high quality, five steps were taken: (1) training for Research Interviewers, (2) pilot testing of the interview protocol, (3) incorporation of field audits by the project manager and environmental specialist, (4) confirmation of the quality of the open-ended responses, and (5) use of additional forms to track and verify that procedures were followed (e.g., Contact Activity Log, Appendix E; Pre/Post Interview Checklist, Appendix J).

Training for Research Interviewers

One tribal member and one descendant were hired as Research Interviewers to conduct the in-person interviews. Two staff members from the Natural Resources Department also conducted some interviews. The interviewers were familiar with the topic of the survey as well as the sample population. To prepare for their role, Research Interviewers were required to complete a 2.5 day Research Interviewing Workshop/ Special Topics Course through the Keweenaw Bay Ojibwa Community College, as well as complete "Protecting Human Research Participants" certification through the National Institutes of Health.

The content of workshop/course included the following topics:

- Research within and for Tribal Communities
- Types of Research
- Types of Interviews
- Advantages and Disadvantages of Using Interviewing in Research
- Memory and Truth
- Legal, Ethical, and Genuine Conduct
- Everything You Need To Know Before, During, and After the Interview
- Conversations with Experienced Interviewers and Narrators
- Mock Interviews and Discussion
- National Institutes of Health Certification

Pilot-testing the Interview Protocol

Before the interviews were conducted, pilot interviews were conducted with members of the Survey Workgroup. These interviews helped to test and tailor the questionnaire to the target population. Members of the Survey Workgroup were selected and interviewed in order to determine the time required to administer the survey and to identify potential problems with the delivery or interpretation of questions.

The pilot interviews were monitored for question consistency and the presence of any bias. Scripted answers to the open-ended questions were prepared prior to the interviews to identify how well the Research Interviewers were at recording open-ended responses. Then, by comparing what the Research Interviewer recorded on the interview form with the scripted response, we were able to assess how well the Research Interviewer captured the verbal response. Results from these pilot interviews were then used to modify and update the survey instrument.

Field Audits by the Project Manager/Environmental Specialist

The Project Manager and Environmental Specialist also performed quality control monitoring of the interviews. Indeed, 89.5 percent of survey instruments were selected and examined for completeness. The monitors suggested improvements to interviewers' interviewing techniques of the Research Interviewers and corrected mistakes on the survey instruments. The monitors also ensured that all of the survey questions had been asked during the interview.

Confirming the Quality of Open-ended Responses

Interviewers asked open-ended questions, and interviewee responded verbally. Interviewers handwrote responses to the open-ended questions on an approved survey questionnaire form and recorded them using a digital recorder. Digital recordings of the interviews were used as a backup

in the event that the handwritten response was unclear, incomplete, or illegible, to ensure the quality of data collection.

The Survey Consultants entered the open-ended responses into the database. In order to ensure fidelity between the handwritten notes and the digital recordings, recorded interviews were randomly selected, reviewed, and compared to the notes.

Additional Tracking and Verification Forms

To ensure that interview subjects were only contacted up to four times for participation in the study, a Contact Activity Log (Appendix E) was used to document these attempts. This form safeguarded participants from being contacted an unreasonable number of times, and had the additional benefit of making recruitment attempts uniform across the sample, such that each candidate was treated uniformly.

Interviewers also used the Pre/Post Interview Checklist (Appendix J). This form ensured that all necessary materials (e.g., forms, visual aids, digital recorder) were brought to and retrieved from each interview.

Quality Assurance for Data Entry, Management and Storage

Data entry, data maintenance, and data storage processes were followed to ensure high data quality.

Data Entry

After the Project Manager checked and proofread the completed interview forms, the forms were collected, copied (scanned or photocopied as a safeguard against loss of original data through the mail), and shipped to the Survey Consultants. In addition, the Project Manager uploaded the digital recordings of the interviews onto a password-protected computer. The Survey Consultants renamed the files with unique interview identification (ID) numbers. These surveys and digital files did not contain any identifiable information (e.g., respondent name, address) -- only the ID number.

The Survey Consultants entered the closed-ended responses from these interview forms into a SPSS database. This program controlled for inadmissible entries (e.g., text where only numeric values are allowed). Data was then keyed and verified to minimize data entry errors. After the data was entered, checks were performed to detect out-of-range values and logical inconsistencies (e.g., presence of data for a variable when that field should have been skipped due to an earlier response).

All of the handwritten open-ended responses were transcribed in SPSS and then exported into an Excel spreadsheet for the Qualitative Analyst. When handwritten responses were unclear, incomplete, or illegible, a Survey Consultant transcribed the digitally-recorded response. The Excel spreadsheet was imported into QSR International's NVivo 10 Qualitative Data Analysis Software program. During this data entry stage, the Survey Consultants asked the Project Manager for missing data and explanations as needed.

The Survey Consultant who entered this data has an extensive background working with data entry and database management systems. This experience and training helped minimize data entry errors. The Survey Consultant also randomly selected 10 percent of the interviews entered into the

database and compared those against the paper interview forms for accuracy using a second error checker. If more than 0.1 percent of data entry errors (14 errors) had been detected, then the Survey Consultants would have double-checked every record entered for data entry errors against the original interview form. However, the Survey Consultants identified only 11 errors; therefore, the data was judged to have been entered with accuracy.

Data Management

The databases created in the data entry stage were used to conduct the analyses necessary for the study. In order to analyze the closed-ended data, we created a new analytic dataset from the data entry dataset (by saving it under a new name). A syntax file was saved with all data steps so that any changes can be replicated with the original dataset.

Data Storage

The completed surveys, informed consent forms, and digital recordings (which contain personally identifiable information) reside with the KBIC Natural Resources Department in a locked file cabinet. The Survey Consultants completed data entry from the completed surveys and the resulting databases include only information from the surveys and the relevant ID number. All records and documents are maintained at the KBIC Natural Resources Department office and are available for EPA inspection at any time.

Quality Assurance for Confidentiality

The KBIC Natural Resources Department sent tribal members selected for the study a letter of invitation to participate (See Appendix C). This letter introduced the study and described the level of confidentiality provided to participants. At the start of each interview, the interviewers provided participants with two copies of the informed consent letter, which discusses participant confidentiality the types of data to be collected. During interviews, only the respondent, interviewer, and in some cases, the interview auditor were present in the room.

Two types of data were collected during interviews: identifying information and interview information. All identifying information collected during interviews (e.g., name, address, phone number) was recorded on the informed consent form. This information is maintained separately from interview information. A randomly generated ID number was added to the identifying information and was the only connection to the interview information and digital recordings collected from that household.

Interview information included a randomly generated ID number that only KBIC Natural Resources Department staff will be able to link to the identifying information. This purpose of this link was to allow follow-up with specific respondents in the event that their interview information was incomplete or incorrectly recorded.

These procedures allow for confidentiality of individual responses throughout the life of the project. Anonymity of interview information has been ensured for the remainder of the project life cycle and afterward to include the final report, presentation to KBIC, and any future publications or presentations. This anonymity is possible since quantitative data will only be reported in the aggregate. When specific quotes from the open-ended responses from an individual respondent were used, no identifying information was associated with it (as this information was not be accessible to the Survey Consultants). All hard copy files and records (including both identifying

and interview information) and digital recordings will be securely stored at the KBIC Natural Resources Department.

VI: Quantitative Data Analyses

24-Hour Recall

As described earlier, one purpose of the 24-hour recall exercise at the beginning of each interview was to serve as a point of comparison against overall consumption rates. However, only 11 of the 219 interview sessions (5 percent) reported fish consumption in the previous 24 hours. Given the relatively low number of respondents who consumed fish in the previous 24 hours, it is unclear whether any conclusion can be drawn about this data. Indeed, when overall fish consumption (grams/day) was examined, no discernible pattern was noticed in the distribution of these 11 records. At the very least, reported fish consumption in the previous 24 hours does not contradict the study's overall findings.

Number of Fish Meals

The average number of fish meals consumed per year (from all sources) for all respondents was 54. This number ranged from a low of 47 per year for children (ages 0-15 years) to a high of 63 per year for older adults (ages 41-54 years). Table 4a shows this breakdown of fish meals by year and by season. Table 4b provides the same analysis, but excludes those who do not eat fish. Here, we find that the average number of fish meals consumed per year to be 58.

Table 4a.

Average (mean) number of fish meals consumed per season by group

Group (ages)	Spring	Summer	Fall	Winter	Year
Children (0-15)	14	12	10	10	47
Women (16-40)	14	13	10	10	48
Men (16-40)	20	16	12	14	60
Older adults (41-54)	18	16	14	14	63
Elders (55+)	19	13	12	12	56
All groups	17	14	12	12	54

Table 4b.
Average (mean) number of fish meals consumed per season by group excluding those who do not eat fish

Group (ages)	Spring	Summer	Fall	Winter	Year
Children (0-15)	14	13	11	11	48
Women (16-40)	16	15	12	12	53
Men (16-40)	21	17	12	15	65
Older adults (41-54)	19	17	15	15	67
Elders (55+)	20	14	13	13	61
All groups	18	15	13	13	58

Portion Size

A necessary component of calculating fish consumption in addition to frequency of fish meals is typical portion size. Using physical models of fish fillets of various sizes, interviewers were able to determine the typical portion size for each survey participant. Table 5 shows the average portion size (ounces) for respondents by age group.

Table 5.
Average portion size (ounces) of a meal of fish based on inclusion or exclusion of those that do not eat fish

	Includes			Excludes		
Group (ages)	n	**Mean**	*SD*	n	**Mean**	*SD*
Children (0-15)	51	**5.7**	*3.6*	50	**5.8**	*3.5*
Women (16-40)	57	**4.8**	*3.1*	51	**5.3**	*2.7*
Men (16-40)	46	**8.2**	*4.9*	43	**8.7**	*4.5*
Older adults (41-54)	51	**5.9**	*3.2*	48	**6.3**	*2.9*
Elders (55+)	51	**6.1**	*3.6*	47	**6.6**	*3.3*
All groups	256	**6.1**	*3.8*	239	**6.5**	*3.6*

Fish Consumption Rates

Table 6a shows the average amount of fish consumed in grams/day for the entire year and by season. Men (ages 16-40 years) consume the greatest amount of fish at 49 grams/day. The smallest amount is for women of child-bearing age (ages 16-40 years), at 20 grams/day.

We conducted several analyses to determine whether differences in fish consumption by age group were statistically significant. We used the t-test to compare means between two groups. When the t-test is not appropriate (i.e., one or more assumptions are violated), we used the non-parametric alternative, Mann-Whitney U.

We performed Levene's test to determine equality of variance, an assumption of the t-test. For this analysis, Levene's test was significant (p <0.001), indicating heteroscedasticity (a lack of homogeneity of variance). However, some researchers have argued that heteroscedasticity is not critical (i.e., Field, 2005). Accordingly, we conducted both t-tests and the Mann-Whitney U.

T-tests indicated that men (ages 16-40 years) consume more fish per year than children (p = 0.03) and women of child-bearing age (p =.01). All other comparisons were not statistically significant.

Mann-Whitney U tests also showed that men (ages 16-40 years) consumed more fish than children (p = 0.029) and women of child-bearing age (p = 0.014). Furthermore, this non-parametric test indicated that older adults consumed more fish than children (p = 0.019) and women of child-bearing age (p = 0.009).

A final consideration when interpreting tests of statistical significance has to do with power. That is, was sufficient data collected to support the statistical analysis? The issue of collecting sufficient data is one of resources and time. With unlimited resources, one could attempt to collect data from an entire population rather than a sample. Instead, taking a random sample of sufficient size for statistical analysis (to include power considerations) provides the desired balance of resources and time spent on data collection and response burden of those asked to participate. It has been shown that a considerable portion of the research literature contain tests of statistical significance that are under-powered (i.e., too little data was collected), calling into question the confidence of these findings (Cohen, 1988). To safeguard against this possibility, an a priori power analysis was conducted during the planning stages of the study to determine the sample needed for appropriate interpretation of statistical significance (see QAPP, Appendix B, p. 16); approximately 51 completed surveys per subgroup of interest was required. The a priori power analysis was calculated using information reported in earlier fish studies. Once the data were entered and assessed for power, it was found that the planned tests for statistical significance were underpowered (**d** = 0.3, rather than the expected 0.8). It should be noted that few fish studies report statistical significance and the current fish consumption study is the only one known to assess power.

Taken together, these findings suggest that men (ages 16-40 years) and older adults likely consume more fish than children and women of child-bearing age. However, these differences are not necessarily statistically significant.

Table 6a.

Average amount of fish consumed (grams/day) by season and group

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*51*	28	24	20	19	23
Women (16-40)	*57*	26	21	17	16	20
Men (16-40)	*46*	65	50	37	45	49
Older adults (41-54)	*51*	38	35	33	32	34
Elders (55+)	*51*	33	26	24	22	26
All groups	*256*	37	31	26	26	30

Table 6b provides fish consumption rates at the 95th percentile among all respondents. This calculation provides a sense of high consumption rates among all respondents. When considering all subgroups, the consumption rate at the 95th percentile is 121 grams/day for the year. This value goes from a low of 68 grams/day for women (ages 16-40 years) to a high of 191 grams/day for men (ages 16-40 years).

Table 6b.
Fish consumption (grams/day) by season and group
95th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*51*	121	121	105	105	110
Women (16-40)	*57*	70	84	63	63	68
Men (16-40)	*46*	323	303	145	323	191
Older adults (41-54)	*51*	121	121	121	121	121
Elders (55+)	*51*	129	113	63	63	81
All groups	*256*	129	121	105	121	121

Table 6c provides fish consumption rates at the 99th percentile among all respondents. This calculation provides a sense of very high consumption rates among all respondents. When considering all subgroups, the consumption rate at the 99th percentile is 222 grams/day for the year. This value goes from a low of 143 grams/day for women (ages 16-40 years) to a high of 339 grams/day for men (ages 16-40 years).

Table 6c.
Fish consumption (grams/day) by season and group
99th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*51*	194	145	194	145	170
Women (16-40)	*57*	339	97	67	67	143
Men (16-40)	*46*	388	323	323	339	339
Older adults (41-54)	*51*	202	161	161	161	172
Elders (55+)	*51*	452	202	161	161	222
All groups	*256*	363	303	194	323	222

Table 6d provides fish consumption rates similar to Table 6a, but excludes from calculations those who do not eat fish. When considering all subgroups, the fish consumption rate is 32 grams/day for the year. This value goes from a low of 22 grams/day for women (ages 16-40 years) to a high of 53 grams/day for men (ages 16-40 years).

Table 6d.
Average amount of fish consumed (grams/day) by season and group
excluding those who do not eat fish

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*50*	28	25	20	19	23
Women (16-40)	*51*	29	24	19	18	22
Men (16-40)	*43*	69	54	39	48	53
Older adults (41-54)	*48*	40	37	35	34	36
Elders (55+)	*47*	36	29	26	24	29
All groups	*239*	40	33	27	28	32

Table 6e provides fish consumption rates similar to Table 6b, at the 95th percentile. This calculation provides a sense of high consumption rates among just those who eat fish. When considering all subgroups, the consumption rate at the 95th percentile is 126 grams/day for the year. This value goes from a low of 68 grams/day for women (ages 16-40 years) to a high of 191 grams/day for men (ages 16-40 years).

Table 6e.
Average amount of fish consumed (grams/day) by season and group
excluding those who do not eat fish
95th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*50*	121	121	105	105	110
Women (16-40)	*51*	70	84	63	63	68
Men (16-40)	*43*	323	303	145	323	191
Older adults (41-54)	*48*	121	121	121	121	121
Elders (55+)	*47*	129	113	63	63	81
All groups	*239*	145	123	121	121	126

Table 6f provides fish consumption rates similar to Table 6c, at the 99th percentile. This calculation provides a sense of very high consumption rates among just those who eat fish. When considering all subgroups, the consumption rate at the 99th percentile is 222 grams/day for the year. This value goes from a low of 143 grams/day for women (ages 16-40 years) to a high of 339 grams/day for men (ages 16-40 years).

Table 6f.
Average amount of fish consumed (grams/day) by season and group
excluding those who do not eat fish
99th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*50*	194	145	194	145	170
Women (16-40)	*51*	339	97	67	67	143
Men (16-40)	*43*	388	323	323	339	339
Older adults (41-54)	*48*	202	161	161	161	172
Elders (55+)	*47*	452	202	161	161	222
All groups	*239*	363	303	194	323	222

Fish Species Consumed

Table 7a reports average fish consumption (grams/day) of locally-obtained fish sources, by species. Averaged over the entire year, the highest average amounts of fish consumed included lake white fish (4.9 grams/day), lake trout (3.5 grams/day), and walleye (3.4 grams/day). The lowest averages included carp (less than 0.1 grams/day), bullhead, burbot, and rock bass (about 0.1 grams/day each).

In spring, the highest average amounts of fish consumed were 7.5 grams/day of walleye, followed by 4.9 grams/day of lake whitefish and 4.2 grams/day of rainbow trout. In summer, the highest average amounts of fish consumed included lake whitefish (5.2 grams/day), lake trout (4.6 grams/day), and salmon (2.6 grams/day). The highest amounts of fish consumed in fall were lake whitefish (4.7 grams/day), followed by lake trout (3.4 grams/day) and salmon (2.8 grams/day). In winter, the highest average amounts of fish consumed included lake whitefish (4.9 grams/day), lake trout (3.5 grams/day), and walleye (3.4 grams/day). Carp (less than 0.1 grams/day) and burbot (between 0.0 and 0.2 grams/day) accounted for the lowest levels of locally-obtained fish consumed throughout the year.

Table 7a.
Average (mean) grams per day of locally obtained fish by season and species
all respondents

Species	Spring	Summer	Fall	Winter	Year
Bass, large & smallmouth	0.23	0.49	0.13	0.04	0.22
Bass, rock	0.13	0.34	0.08	0.00	0.14
Bluegill	0.52	0.88	0.28	0.13	0.45
Bullhead	0.07	0.12	0.07	0.00	0.07
Burbot	0.02	0.07	0.02	0.15	0.07
Carp	0.01	0.01	0.01	0.01	0.01
Cisco (L. Herring)	0.48	0.50	0.58	0.82	0.60
Crappie, Black	0.13	0.66	0.13	0.09	0.25
Lake Sturgeon	0.06	0.23	0.04	0.00	0.09
Northern Pike	0.29	0.44	0.15	0.16	0.26
Perch, Yellow	0.62	1.71	0.93	0.30	0.89
Pumpkinseed	0.40	0.60	0.26	0.19	0.36
Salmon	2.99	2.58	2.09	2.81	2.62
Smelt	3.44	0.06	0.05	1.76	1.32
Splake	0.18	0.24	0.02	0.06	0.13
Sucker	0.09	0.01	0.01	0.01	0.03
Trout, Brook	1.04	1.36	0.64	0.09	0.78
Trout, Brown	0.40	0.31	0.10	0.02	0.21
Trout, Lake	3.05	4.61	3.10	3.37	3.53
Trout, Rainbow	4.15	0.71	0.60	0.19	1.41
Walleye	7.45	2.50	2.00	1.48	3.35
Whitefish, Lake	4.86	5.20	4.68	4.73	4.87

Table 7b shows the same calculations, but limited to only those who eat fish. As a result, these numbers are slightly higher. For example, lake whitefish consumption increased from 4.9 grams/day (all respondents) to 5.2 grams/day when those who do not eat fish are excluded.

Table 7b.
Average (mean) grams per day of locally obtained fish by season and species excluding those who do not eat fish

Species	Spring	Summer	Fall	Winter	Year
Bass, large & smallmouth	0.25	0.53	0.14	0.04	0.24
Bass, rock	0.14	0.37	0.08	0.00	0.15
Bluegill	0.56	0.95	0.30	0.14	0.49
Bullhead	0.08	0.13	0.08	0.00	0.07
Burbot	0.02	0.08	0.02	0.16	0.07
Carp	0.01	0.01	0.01	0.01	0.01
Cisco (L. Herring)	0.52	0.54	0.62	0.88	0.64
Crappie, Black	0.14	0.70	0.14	0.10	0.27
Lake Sturgeon	0.07	0.25	0.05	0.00	0.09
Northern Pike	0.31	0.47	0.16	0.17	0.28
Perch, Yellow	0.66	1.83	1.00	0.32	0.95
Pumpkinseed	0.43	0.64	0.28	0.20	0.39
Salmon	3.21	2.76	2.24	3.02	2.81
Smelt	3.68	0.06	0.05	1.88	1.42
Splake	0.20	0.26	0.02	0.07	0.14
Sucker	0.10	0.01	0.01	0.01	0.03
Trout, Brook	1.11	1.46	0.69	0.10	0.84
Trout, Brown	0.43	0.33	0.11	0.03	0.22
Trout, Lake	3.26	4.94	3.32	3.61	3.78
Trout, Rainbow	4.44	0.76	0.64	0.20	1.51
Walleye	7.98	2.68	2.14	1.58	3.59
Whitefish, Lake	5.21	5.57	5.02	5.07	5.22

Fish Parts Consumed

Table 8 shows the proportion of respondents who typically eat specific parts of locally-obtained fish. The *fillet* was the predominant fish part consumed, at 100 percent or nearly so for all species. Percentages below 100 percent are assumed to be the result of missing data. In general, *belly* (meat) is the next highest reported fish part consumed across species, with a low of 1 percent for lake whitefish and a high of 89 percent for smelt. Other fish parts with reported consumption include *skin* (between 1 percent for lake whitefish and 95 percent for smelt), and *bones* (1 percent for lake whitefish, rainbow trout, lake trout, and salmon; 83 percent for smelt). Less frequently indicated fish parts included *head*, *eggs*, and *other*.

Table 8.
Percentage of respondents that eat specific parts of locally obtained fish by species
all respondents

Species	n	Fillet	Skin	Head	Eggs	Bones	Belly	Other
Bass, large & smallmouth	21	100	5	-	-	-	-	-
Bass, rock	10	100	10	-	-	-	10	-
Bluegill	28	96	7	-	-	-	14	-
Bullhead	2	100	-	-	-	-	-	-
Burbot	6	100	-	-	-	-	-	-
Carp	2	100	-	-	-	-	-	-
Cisco (L. Herring)	35	100	9	-	-	-	9	-
Crappie, Black	21	100	5	-	-	-	5	-
Lake Sturgeon	18	100	39	-	-	17	56	6
Northern Pike	32	100	-	-	-	-	6	-
Perch, Yellow	53	100	6	-	-	2	8	-
Pumpkinseed	16	94	13	-	-	-	19	-
Salmon	110	100	-	-	-	1	4	-
Smelt	92	100	95	7	8	83	89	1
Splake	15	93	-	-	-	-	-	-
Sucker	8	88	-	-	-	-	25	-
Trout, Brook	61	100	16	-	-	-	30	-
Trout, Brown	29	100	10	-	-	-	7	-
Trout, Lake	151	99	2	-	-	1	3	-
Trout, Rainbow	93	97	2	-	-	1	2	2
Walleye	131	98	-	-	-	-	2	-
Whitefish, Lake	154	99	1	-	-	1	1	1

n = number of respondents that indicated at least one fish part for that species

Fish Preparation Methods

For each locally obtained fish species, respondents were asked to list all methods of fish preparation. This information was recoded to the specific categories found in Table 9. For each category of fish preparation, the percentage of respondents who listed that method for that species is reported. When interpreting these results, it is important to consider the number of respondents who reported preparation methods for that species, as low frequencies (e.g., n=2) could result in apparently high percentages (e.g., 100 percent) based on just these two responses.

As the table shows, there is considerable variety in preparation methods by species. For some, *pan-fried* is the predominantly reported method (e.g., large and smallmouth bass at 48 percent, bluegill at 64 percent). For some of the most frequently prepared fish species from local waterways, *baked* is the preferred preparation method (e.g., lake whitefish at 51 percent, lake trout at 45 percent), while for others, *deep fried* is the preferred choice (e.g., smelt at 72 percent, walleye at 44 percent).

Table 9.

Percentage of respondents that eat locally obtained fish by preparation method by species

all respondents

Species	n	Baked	Boiled	Broiled	Deep Fried	Fried	Grilled	Pan Fried	Pickled	Smoked
Bass, large & smallmouth	21	19	-	5	33	10	14	48	-	5
Bass, rock	10	10	-	10	20	10	10	80	-	10
Bluegill	28	21	-	-	29	11	4	64	-	4
Bullhead	2	50	-	-	100	50	-	-	-	-
Burbot	5	-	20	-	40	40	-	20	20	-
Carp	2	50	-	-	-	-	-	-	-	50
Cisco (L. Herring)	35	11	-	-	26	9	-	17	49	23
Crappie, Black	21	10	-	10	43	5	5	43	-	-
Lake Sturgeon	15	7	-	-	-	7	-	-	-	93
Northern Pike	32	28	3	-	28	9	22	19	22	13
Perch, Yellow	51	25	-	4	31	12	14	47	-	-
Pumpkinseed	16	25	-	-	38	6	6	56	-	6
Salmon	105	49	-	7	9	6	30	34	1	13
Smelt	93	-	-	-	72	18	1	10	-	2
Splake	14	43	-	14	14	-	29	57	-	14
Sucker	7	14	-	-	-	-	43	-	29	29
Trout, Brook	61	16	2	-	10	5	15	59	-	2
Trout, Brown	29	52	-	7	17	-	7	48	-	10
Trout, Lake	146	45	2	8	25	8	27	32	1	10
Trout, Rainbow	88	43	1	8	13	9	25	42	-	14
Walleye	131	24	-	6	44	10	19	29	-	4
Whitefish, Lake	150	51	7	9	25	9	23	30	1	14

n = number of respondents that indicated at least one fish part for that species

Other Foods Consumed

In addition to fish, respondents were asked about the consumption of other foods, including traditional foods (e.g., wild rice, cranberries, waterfowl), store-bought fish (canned, frozen, not frozen), and restaurant fish/seafood. As with fish, consumption rates were calculated for these other foods. The most consumed item from this list was *store-bought fish (canned)* at 10.5 grams/day over the course of the year. Although this food was consumed at a fairly consistent rate across seasons, other food items varied throughout the year. For example, *duck*, *other waterfowl*, and *other game birds* were not consumed during the summer months, but peaked in fall (0.2, 0.1, and 2.5 grams/day, respectively), with lower amounts in winter and spring.

Table 10.
Average (mean) grams per day of other foods consumed by season and species
all respondents

Species	Spring	Summer	Fall	Winter	Year
Wild rice	6.8	7.2	7.9	8.0	7.5
Cranberries	2.1	2.1	2.5	2.3	2.3
Duck	0.0	0.0	0.2	0.0	0.1
Other waterfowl	0.0	0.0	0.1	0.0	0.0
Other game birds (e.g., partridge)	0.1	0.0	2.5	0.3	0.7
Store bought fish (canned)	10.2	11.1	10.4	10.4	10.5
Store bought fish (frozen) (e.g., fish sticks)	2.9	2.8	2.7	2.8	2.8
Store bought fish (not frozen)	0.7	0.7	0.5	0.6	0.6
Other store bought fish (e.g., shrimp)	2.3	2.5	2.3	2.6	2.4
Restaurant fish (except L. Trout or L. Whitefish)	1.5	1.5	1.6	1.7	1.6
Restaurant, other seafood	1.0	1.1	1.0	1.0	1.0

Where Fish are Obtained

Respondents were asked, for all the fish consumed in a year, the percentage that comes from a list of possible sources. Table 11 tabulates the average percentage for each listed source for all respondents as well as by age group. Overall, the largest percentage was for *fish caught yourself or by family members* (40 percent); note that the 45 percent reported for *other* is excluded as this category only contains three responses. The next most common sources include *grocery stores* (37 percent), *restaurants* (29 percent), *fish caught by friends* (28 percent), and *tribal commercial fishermen* (27 percent). *Community events* (18 percent) was the lowest indicated source of fish.

Table 11.
Sources of all fish eaten in a year (average percent) by age group

	Children (0-15)	Women (16-40)	Men (16-40)	Older adults (41-54)	Elders (55+)	All respondents	
Sources	%	%	%	%	%	%	n
Fish caught yourself or by family members	51	48	49	42	40	40	173
Fish caught by friends	17	27	20	25	28	28	96
Tribal Commercial Fishermen	57	38	34	34	27	27	91
Events (ceremonies, powwows, feasts)	13	13	9	14	18	18	133
Grocery stores	43	36	25	23	37	37	172
Restaurants	16	25	18	26	29	29	138
Other	-	-	-	10	45	45	3

Community Events

Interviewees were asked about community event attendance (e.g., ceremonies, powwows, feasts) by season. Table 12 tabulates the average number of events attended per season by group. Season to season, the average number of events attended stayed relatively stable, from 2.1 in spring to 1.7 in winter. However, the number of those attending at least one community event changed considerably throughout the year. That is, just over half (n=129; 50.4 percent) of respondents attended one or more events in spring, while a majority (n=235; 91.8 percent) attended in summer. In fall and winter, more than half (n=155, 60.5 percent; n=165, 64.5 percent, respectively) of respondents attended one or more events.

Table 12.
Average (mean) number of community events* attended per season by age group

	Spring	Summer	Fall	Winter
Group (ages)	(n=129)	(n=235)	(n=155)	(n=165)
Children (0-15)	2.3	2.1	1.9	1.6
Women (16-40)	1.7	1.8	1.6	1.4
Men (16-40)	2.3	1.9	1.9	1.8
Older adults (41-54)	2.0	1.8	1.9	1.8
Elders (55+)	2.6	2.0	2.0	2.2
All groups	2.1	1.9	1.9	1.7

* ceremonies, powwows, feasts, etc.

Among those attending events, respondents were asked to indicate the relative frequency with which they consume fish (Table 13). Across seasons, between 60 and 63 percent of respondents eat

fish at *more than half* of community events. About 20 percent eat fish at *about half* of these events. The smallest proportion (between 16 and 21 percent) consume fish at *less than half* of these events.

Table 13.
Frequency (percent) of eating fish at community events* per season
all respondents

Frequency	Spring	Summer	Fall	Winter
More than half	61	60	63	62
About half	21	19	20	22
Less than half	18	21	17	16

* ceremonies, powwows, feasts, etc.

The final question about community events asked for the number of meals of fish consumed at events per season (Table 14). Overall, respondents averaged between 1.5 and 1.7 meals per season. In spring, these averages ranged from 1.3 meals for women of child-bearing age to 2.3 meals for children. In summer, the range again went from a low for women of child-bearing age (1.4 meals) to a high for children (2.1 meals). Fall provided roughly the same numbers (1.3 meals for women of child-bearing age and 1.9 meals for children). Winter differed slightly, with a low of 1.3 meals over the season for women of child-bearing age and a high of 1.8 meals for elders (ages 55 years or older).

Table 14.
Average (mean) number of meals of fish eaten at community events* per season by age group

Group (ages)	Spring	Summer	Fall	Winter
Children (0-15)	2.3	2.1	1.9	1.6
Women (16-40)	1.3	1.4	1.3	1.3
Men (16-40)	1.5	1.5	1.3	1.3
Older adults (41-54)	1.7	1.6	1.6	1.6
Elders (55+)	1.9	1.6	1.7	1.8
All groups	1.7	1.7	1.6	1.5

* ceremonies, powwows, feasts, etc.

Age at Which Children Begin Eating Meals That Include Fish

Of the 51 survey responses that included information on children, 47 (92.1 percent) provided information on the age at which the child began eating meals that include fish. The average (mean) age was 26.5 months (*SD* = 25.0), with responses ranging from one to 120 months. However, the most frequently reported age (mode) was 12 months.

Ideal Fish Harvesting/Consumption

Interviewees were asked a series of questions about their ideal amount of fish harvesting and consumption. First, respondents were given a number of options for what would change if they could harvest and consume as much traditional foods as they wanted. Specifically, would they harvest more fish, consume larger amounts per meal, eat fish more often, or none of the above?

Respondents had the ability to select more than one option. Table 15 provides the outcome of this initial set of questions.

Overall, the most frequently endorsed option was *consume fish more frequently* (63 percent). Thirty-four percent said *none of the above*, 16 percent indicated *harvest more fish*, and 11 percent said *consume more fish per meal*. As respondents could choose more than one option, there was some degree of overlap in the different ways one could harvest or consume more fish.

Among those who indicated the wish to *consume more fish per meal* (n=28), the average (mean) increase reported was 9.65 ounces (*SD* = 6.0), with individual responses ranging anywhere from one to 20 ounces.

Table 15.
Percentage response to each option by age group

Response options	Children (0-15) (n = 51)	Women (16-40) (n = 57)	Men (16-40) (n = 46)	Older adults (41-54) (n = 51)	Elders (55+) (n = 51)	All respondents (n = 256)
Harvest more fish	n/a*	21	24	18	18	16
Consume more fish per meal	12	4	13	14	14	11
Consume fish more frequently	71	54	70	67	57	63
None of the above	24	44	30	29	43	34

* this response option was not available for data collection on children

The second part of the question about ideal harvesting and consumption of fish concerned an increase in the total number of desired meals, by season. A larger proportion of respondents (63 percent; see Table 15) indicated this response option. Table 16a illustrates the average number of desired fish meals per week among this subset. The average desired number of fish meals per week across all subgroups was 3.1. This ranged from a low of 1.8 for women (ages 16-40 years) to a high of 4.2 desired meals per week for elders (ages 55 and higher).

Table 16a.
Desired number of fish meals (average) consumed per week

Group (ages)	n	Spring	Summer	Fall	Winter
Children (0-15)	36	3.5	3.5	3.5	3.5
Women (16-40)	31	1.9	1.8	1.9	1.8
Men (16-40)	32	3.4	3.4	3.4	3.4
Older adults (41-54)	34	2.6	2.6	2.6	2.6
Elders (55+)	29	4.2	4.2	4.2	4.2
All groups	162	3.1	3.1	3.1	3.1

As a point of comparison, Table 16b presents the number of meals currently eaten per week by the same cohort of people above.

Table 16b.
Number of fish meals (average) currently consumed per week

Group (ages)	n	Spring	Summer	Fall	Winter
Children (0-15)	36	1.3	1.1	0.9	0.9
Women (16-40)	31	1.1	1.0	0.8	0.8
Men (16-40)	32	1.4	1.1	0.9	0.9
Older adults (41-54)	34	1.4	1.3	1.3	1.3
Elders (55+)	29	1.9	1.2	1.2	1.2
All groups	162	1.4	1.2	1.0	1.0

Table 16c shows the average (mean) rate of desired fish consumption (grams/day) for this subset. Here, we see that the mean rate is 86 grams/day across all subgroups. Among subgroups, this ranges from a low of 49 grams/day for women (ages 16-40 years) to a high of 122 grams/day for men (ages 16-40 years). The difference in highest subgroup between desired number of meals (elders) and desired consumption in grams/day (men, ages 16-40 years) is explained by larger meal size.

Table 16c.
Desired fish consumption (grams/day) by season and group

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	86	87	86	86	86
Women (16-40)	*31*	50	49	50	47	49
Men (16-40)	*32*	122	122	122	122	122
Older adults (41-54)	*34*	78	78	76	76	77
Elders (55+)	*29*	95	95	95	94	95
All groups	*162*	86	86	86	85	86

Table 16d presents desired fish consumption at the 95th percentile. This illustrates relatively high fish consumption patterns. Across all subgroups, the 95th percentile rate is 242 grams/day. This ranges from a low of 157 grams/day for women (ages 16-40 years) to a high of 520 grams/day for men (ages 16-40 years).

Table 16d.
Desired fish consumption (grams/day) by season and group
95th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	283	283	283	283	283
Women (16-40)	*31*	194	145	145	145	157
Men (16-40)	*32*	520	520	520	520	520
Older adults (41-54)	*34*	210	210	210	210	210
Elders (55+)	*29*	242	242	242	242	242
All groups	*162*	242	242	242	242	242

Table 16e shows desired fish consumption at the 99th percentile. This illustrates very high fish consumption patterns. Across all subgroups, the 99th percentile rate is 565 grams/day. This ranges from a low of 202 grams/day for women (ages 16-40 years) to a high of 1356 grams/day for men (ages 16-40 years).

Table 16e.
Desired fish consumption (grams/day) by season and group
99th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	441	441	441	441	441
Women (16-40)	*31*	202	202	202	202	202
Men (16-40)	*32*	1356	1356	1356	1356	1356
Older adults (41-54)	*34*	260	260	260	260	260
Elders (55+)	*29*	565	565	565	565	565
All groups	*162*	565	565	565	565	565

Table 16f provides fish consumption rates similar to Table 16c, but excludes from calculations those who do not eat fish. When considering all subgroups, the desired fish consumption rate is 88 grams/day for the year. This value goes from a low of 52 grams/day for women (ages 16-40 years) to a high of 126 grams/day for men (ages 16-40 years).

Table 16f.
Desired fish consumption (grams/day) by season and group
excluding those who do not eat fish

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	86	87	86	86	86
Women (16-40)	*29*	53	52	53	51	52
Men (16-40)	*31*	126	126	126	126	126
Older adults (41-54)	*34*	78	78	76	76	77
Elders (55+)	*29*	95	95	95	94	95
All groups	*159*	88	88	87	87	88

Table 16g provides fish consumption rates similar to Table 16d, at the 95th percentile. This calculation provides a sense of high desired consumption rates among just those who eat fish. When considering all subgroups, the desired consumption rate at the 95th percentile is 260 grams/day for the year. This value goes from a low of 157 grams/day for women (ages 16-40 years) to a high of 520 grams/day for men (ages 16-40 years).

Table 16g.
Desired fish consumption (grams/day) by season and group
excluding those who do not eat fish
95th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	283	283	283	283	283
Women (16-40)	*29*	194	145	145	145	157
Men (16-40)	*31*	520	520	520	520	520
Older adults (41-54)	*34*	210	210	210	210	210
Elders (55+)	*29*	242	242	242	242	242
All groups	*159*	260	260	260	260	260

Table 16h provides fish consumption rates similar to Table 16e, at the 99th percentile. This calculation provides a sense of very high desired consumption rates among just those who eat fish. When considering all subgroups, the consumption rate at the 99th percentile is 565 grams/day for the year. This value goes from a low of 202 grams/day for women (ages 16-40 years) to a high of 1356 grams/day for men (ages 16-40 years).

Table 16h.
Desired fish consumption (grams/day) by season and group
excluding those who do not eat fish
99th percentile

Group (ages)	*n*	Spring	Summer	Fall	Winter	Year
Children (0-15)	*36*	441	441	441	441	441
Women (16-40)	*29*	202	202	202	202	202
Men (16-40)	*31*	1356	1356	1356	1356	1356
Older adults (41-54)	*34*	260	260	260	260	260
Elders (55+)	*29*	565	565	565	565	565
All groups	*159*	565	565	565	565	565

Fishing from Local Waterways

Most (72.3 percent) households indicated that they catch or have caught fish from local waterways.

Households were also asked to specify the location(s) where they usually catch fish and to list these by species. Table 17 lists the most common locations for local waterway fishing among all species. A full tabulation of fishing locations, by species, is provided in Appendix K.

Table 17.
Most frequent locations (top 20) for local waterway fishing

Location	Map identfier	n	%
Keweenaw Bay	1323	140	16.4
Baraga County	B12	65	7.6
Baraga County	B14	58	6.8
Baraga County	B9	53	6.2
	1423	32	3.8
Houghton County	H24	31	3.6
Baraga County	B7	30	3.5
Houghton County	H14	30	3.5
Baraga County	B25	29	3.4
Baraga County	B8	29	3.4
Huron Bay	1325	24	2.8
	MI-4	20	2.3
Baraga County	B15	15	1.8
Baraga County	B20	15	1.8
Baraga County	B3	13	1.5
Keweenaw Bay	1324	11	1.3
Baraga County	B10	11	1.3
Baraga County	B22	11	1.3
Houghton County	H22	11	1.3
Baraga County	B13	10	1.2

Table 18 lists the number and percentage of reported fishing locations by fish species. Of all the fishing locations documented in the interviews, the greatest proportion of locations were for walleye at 13.7 percent (n=117). This was followed closely by locations for rainbow trout (13.3 percent, n=113) and lake trout (12.4 percent, n=106). The least frequently mentioned species, each with just one listed location, included black bullhead, burbot, and carp.

Table 18.
Frequency of identified local waterway fishing locations by species

Species	n	%
Bass, Large and Smallmouth	51	6.0
Bass, Rock	14	1.6
Bluegill	48	5.6
Bullhead, Black	1	0.1
Burbot	1	0.1
Carp	1	0.1
Cisco	5	0.6
Crappie	29	3.4
Sturgeon	10	1.2
Pike	36	4.2
Perch	59	6.9
Salmon	50	5.9
Smelt	41	4.8
Splake	3	0.4
Sucker, Long	5	0.6
Sucker, White	4	0.5
Pumpkin	17	2.0
Trout, Brook	80	9.4
Trout, Brown	16	1.9
Trout, Lake	106	12.4
Trout, Rainbow	113	13.3
Walleye	117	13.7
Whitefish	45	5.3

In addition to fishing locations and species of fish caught, interviewees were asked to indicate the longest distance (one-way) usually travelled to fish by season, including land and water travel. Table 19 indicates the percentage of responses for each range of distance for each season. In the spring, the most frequently reported distance was 26-50 miles (24.8 percent), followed by 16-20 miles (17.5 percent). In summer, 26-50 miles (23.4 percent) and 16-20 miles (17.5 percent), were also the most frequently indicated distances. However, in fall, the largest proportion of responses were for 0-5 miles (19.5%), followed by 26-50 miles (18.6%). In winter, distances were shorter, with most fishing (51.3%) occurring within five miles or 6-10 miles (15.8%).

Table 19.
Longest distance (one-way) usually traveled to fish by season
percent of households by category

Distances (miles)	Spring	Summer	Fall	Winter
0-5	11.7	14.9	19.5	51.3
6-10	10.9	13.0	15.9	15.8
11-15	6.6	5.2	8.0	7.9
16-20	17.5	17.5	15.9	10.5
21-25	10.2	9.1	6.2	0.0
26-50	24.8	23.4	18.6	9.2
51-75	2.2	4.5	1.8	0.0
75-100	10.9	7.1	8.8	2.6
101 or more	5.1	5.2	5.3	2.6

VII: Qualitative Data Analyses

The responses for each open-ended question were analyzed and reported separately. The themes and subthemes for each question are presented below.

Question: Please describe the importance of harvesting and consuming fish to you and your family.

Five main themes and eight subthemes (see Table 20) emerged from the responses to this question. These themes included: culture and tradition, fish consumption, family importance, economic importance, and treaty rights.

Table 20: Themes and subthemes

Theme	Subtheme
Culture and tradition	
Fish consumption	• Subsistence • Good for health • Enjoy fishing • Consume fish • Not consume fish
Family importance	
Economic importance	• Importance to the community • Saving money • Commercial fishing
Treaty rights	

Culture and Tradition

Participants believed that it was important to their culture to maintain the traditions of harvesting and consuming fish. One participant stated, "Really important for family and traditional, ancestors grew up on it." Another participant added, "I think it is important because it is part of Native American tradition." A third participant noted, "It's tradition. I can't imagine not fishing. How she was brought up and how she eats. Ability to catch own food is extremely important."

A few participants specifically mentioned the importance of maintaining the tradition of spear fishing. As one participant stated, "Extremely important, I enjoy it but it's not needed to feed my family. It is more about keeping the traditions going such as spearing." Another added, "My uncle is very traditional and does a lot of spearing, etc. He likes to keep the traditions alive. Fishing is a big and important part of our culture."

Participants also discussed the importance of fish as part of traditional events and feasts. "Local fish very important. Feasts. Large part of tribal family meals," stated one participant. Another participant stated, "We have a feast every year for my grandpa. So it is extremely important to us to consume fish, as a practice of our tradition and as part of our culture."

For some participants, fishing was important for spiritual reasons. One participant said, "It is more on a spiritual level for us." Another participant added, "Would be distraught, always been a part of our culture and tradition. And our connection to the earth and our creator."

Fish Consumption

Subsistence

Harvesting fish provided subsistence for families. Participants noted, "It's important for subsistence, and learning cultural responsibilities" and "Harvesting your own fish is important as a means of subsistence to provide meals for family."

Other participants noted the importance of fish in their diet. One participant noted, "It's important, does not eat meat so it is very important to interviewee's diet." Another participant stated, "Growing up, my parents were commercial fishermen. So it is very important for subsistence and having fresh fish to eat." A third participant added, "If we could not receive fish it would change our eating habits."

Good for Health

Participants discussed how fish is a healthy food choice. Some participants made general statements about fish being healthy, such as: "Good for your health," "Good nutritional value," and "Consumption is important because of the health benefits."

Other participants compared the health benefits of eating fish to consuming other meats. Participant comments included: "It is healthier than red meats to eat," "Healthier than beef or pork," and "We like to eat it because its fresh, very healthy. Not full of farm raised pesticides and steroids. It is more of an organic resource."

Some participants discussed specific health benefits of consuming fish. One participant said, "Not

only is it delicious, but it's healthy and we need the oils from the fish." Another participant who spoke about a personal health benefit stated, "It is important to my diet because I am diabetic." A third participant added, "Good source of protein, good way to show people how to manage their food on their own."

Enjoy Fishing

Other participants noted that fishing was important because they enjoyed the sport. Participant statements included: "We enjoy it a lot. I love fishing," "Catching fish can be very rewarding," and "It is a fun hobby and I believe it is important not waste what I catch."

Consume Fish

Some participants said that harvesting and consuming fish was important simply for the reason that they like eating fish. Comments included: "I like the taste of fish," "We all like to eat fish, although we are not heavily into harvesting," and "I often get cravings for fish, and need to satisfy it."

Not Consume Fish

Although nearly all of the participants felt that harvesting and consuming fish was important, some participants stated that it was not important or was of low importance to them personally or to their direct family. Some of those participants ate very little fish. One participant said, "Not very important, we do not eat fish very often." Other participants did not eat fish at all: "Not that important to me. I do not eat fish." In addition, some participants did not provide a reason, but simply made statements such as, "I myself have never had a taste for fish."

Family Importance

Participants expressed the importance of harvesting fish for their family and family members. One participant mentioned, "It is important to my uncles and family tradition. My uncles bring fish to my grandma often." Another added, "Really important for family and traditional, ancestors grew up on it." A third participant noted, "Would mean a lot to my whole family if we could harvest and have the stuff that we used to have, we lived on wild meat including lots of fish."

Other participants discussed how harvesting and consuming fish was not important to them or their immediate family, but that it was important to one or more members of their extended family and the community. One participant said, "For my family, my mother loves fish. For them it's very important." Another participant stated, "I don't eat fish, but my husband enjoys." A third participant added, "It is not important directly because we do not harvest it ourselves. But it is very important to people that are close to me. And very important to the community."

Fishing was also seen as a way for families to spend quality time together. Participants discussed the role of fishing in their family life. Comments included the following: "I think it is important to harvest fish with your family because it brings you closer," "I guess it is more of a sport or fun activity for the children and spend quality time with their dad," and "The enjoyment of spending time together is important to us."

Many participants discussed their desire to pass these traditions on to their children. One

participant said, "I feel it is important to pass on the tradition onto the children for their own needs." Another participant stated, "Very important to pass on the tradition to my children, teaching them how to harvest food." A third participant added, "I would like for my children to eat it more and I like them being involved in our traditions. It is important to our culture to keep the traditions alive."

Economic Importance

Participants described how harvesting and consuming fish is important economically. Sub-themes included: importance to the community, saving money, and commercial fishing.

Importance to the Community

Participants discussed the economic importance of harvesting fish to the community. In general, participants noted the economic importance of harvesting fish as a resource for the community. Comments included the following: "I think if people were able to have the opportunity to harvest more it would help them financially. So it is an important part of our community if people take advantage of it," "I think it is an important resource for our community," and "We consume fish regularly even though some of my kids do not like it. And it is important to our community."

Participants also discussed communities' dependence on fish for survival. Sample comments included: "People are very dependent on fish, some folks don't have a choice but to fish in order to eat" and "It is really important to us. That is what we live off of," and "Mother gathered fish for survival. Money is an issue - fish is source of income."

Saving Money

Many participants indicated that harvesting fish was of economic importance in terms of saving money. One participant discussed saving money on groceries: "helps cut down the cost of groceries." Other participants added, "It puts food on the table and saves money," "Cost less to get food," "Very important, especially if times get rough," and "It's feeding my family, it helps economically if I am able to catch fish for my family."

Commercial Fishing

Many participants discussed the importance of harvesting fish to commercial fishermen. One participant stated, "Harvesting fish through commercial fishermen is part of our tradition and our connection to the community." Participants also discussed how someone in their immediate or extended family was a commercial fisherman. Some of their comments were: "Many of my family members commercial fish. So the more we harvest, the more we have to eat," "My uncle used to be a commercial fisherman so my family depended on it to eat and for my uncle to survive," and "My dad was a commercial fisherman so it was part of our livelihood." Some participants described their experiences with commercial fishing: "I used to fish commercially, so it is very important to us."

Participants also specifically commented on the importance of commercial fishing as a source of income: "I am not a pole fisherman. I spear fish, and commercial fish now so it is more important to me as it is my source of income," "As a commercial fisherman, it is our livelihood, for my family," and "It is important to my family for both subsistence and income. My dad was a commercial fisherman." For one family, commercial fishing was a second job, as indicated by the statement,

"Supplemented dad's income, he would work all day and go pull nets at night."

Treaty Rights

Participants discussed the high importance of Treaty Rights. One participant noted the importance of Treaty Rights to maintain their tradition: "The importance for me is keeping the tradition alive. And to maintain treaty rights. If we don't fish, we won't have our rights." Another participant added, "It is important to maintain our treaty rights, so by exercising our traditions we are maintaining those rights for future generations." A third participant stated, "Important that we keep our rights for fishing. It has always been a part of our traditions." Treaty Rights were also especially important for commercial fishermen: "Very important, would impact commercial fishermen if treaty rights were changed."

Several participants felt it was important to maintain their Treaty Rights. One participant stated, "It should be a more important issue among our community. As part of our culture. If we should lose our harvest rights it would make it harder to be able to get fresh fish to consume." Another participant reflected on the historical importance of obtaining Treaty Rights:

> Important to keep rights, too many people fought hard to get those rights. I remember when I was a kid, one of the key tribal members that was crucial to getting our treaty rights granted got arrested intentionally, as a means to spread the word. And started a protest which ultimately lead to the treaty rights being approved.

Question: Please describe any concerns that you may have about consuming or harvesting traditional foods.

Six main themes and three subthemes (see Table 21) emerged from the responses to this question. These themes included: contaminants, pollutants; depleting resources; invasive species; non-natives; lack of knowledge about traditional practices; no concerns.

Table 21: Themes and subthemes

Theme	Subtheme
Contaminants, pollutants	• Mercury • Mining • Power plants
Depleting resources	
Invasive species	
Non-natives	
Lack of knowledge about traditional practices	
No concerns	

Contaminants, Pollutants

Contaminants and pollutants that compromise the health of the fish was the concern that participants mentioned most. They discussed contaminants and pollutants such as mercury, mining, and the power plants.

Mercury

Mercury was the specific contaminant discussed most by the participants. One participant noted, "Concerned about high level of toxicity/mercury in fish. Consuming less fish than like." Another mentioned, "Mercury levels in Deer Lake and Portage Lake. Not being able to eat the fish I catch."

Contamination from mercury was of the biggest concern to pregnant women. One participant commented, "I never really know that there was mercury in the fish until I was pregnant. I was surprised when the doctor told me I needed to cut back on fish." Another participant mentioned,

> Personally, I try to keep my food as natural as I can to avoid contaminants. When I was pregnant with my four kids I was told by my doctor not to eat the fish in this area due to the mercury levels.

Participants also shared some of their other health concerns regarding ingesting mercury in fish. One participant stated, "Mercury. My dad died of ALS. Heavy metals are a huge issue for my family." Another participant said, "I blame mercury for autism in my kids."

Several participants described how they were regularly advised of mercury contamination. Comments included the following: "Mercury is pounded into our heads, fish consumption advisories, affected how our tribal people eat fish," "Worry about mercury in fish. GLIFWC reports about what lakes not to eat from - concerned about is in fish," and "Mercury in the fish, pay close attention to fish advisories."

Participants were also concerned about the health of the fish. One participant mentioned, "Worried about health of fish and contaminants, i.e., mercury, copper, overall health. Worried about population of fish declining." Another added, "Fishing - pollution from mercury, etc. and decline in fish population."

Mining

Participants were concerned about the pollution and contamination associated with mining. Some of the comments included, "Poisons, chemicals being dumped. Mining problem - how this will affect fish?" and "…mining in the area - what is going into our lake."

Other participants voiced specific concerns about mining. One participant referenced heavy metals: "Heavy metals deposited over the years from mining." Another participant discussed acid: "Acid mining concerns me."

Power Plants

Another source of contamination that concerned the participants was the power plants. Most of the comments were about a particular power plant in the area. One participant said, "[name of power plant] power plant, can't be good for the lake." Another stated, "Dead fish by [name of power plant]

power station." A third participant discussed plants in other areas: "Had to quit when lived in South - nuclear power plants."

Depleting Resources

Participants shared their concerns about depleting fish. In addition to pollution and containments, over-harvesting affected the depletion of fish. One participant commented, "Over-harvesting by other tribes that were given rights to our water." Another participant said, "Talk to a lot of people that catch 100 fish and keep them all which is greedy." A third participant stated, "The possibility that someday there will not be any fish."

Invasive Species

Another concern among the participants was invasive species, particularly lamprey. One participant stated, "There has been a few times my husband caught fish with lamprey attached to it. It scared me." Another participant said, "Noticed the other day in [name of river] river, there were lamprey, two of them. A health concern, I am currently pregnant." A third participant added, "…Asian carp coming into Lake [name of lake]."

Non-Natives

Participants discussed their concerns about non-natives. They specifically mentioned problems with non-native attitudes toward native people. One participant said, "Mining in the area makes me apprehensive, as well as racism." Another participant commented, "Non-natives harassing Natives."

Another concern was non-natives' lack of knowledge about native rights. One participant stated, "White people need to become more educated on Native Rights." Another participant added, "Dealing with non-native peoples attitudes on harvest rights. Would like to see more environmental issues brought up and solved with water. Would like to see more responsible fishing, and less pollution."

Lack of Knowledge about Traditional Practices

Participants shared that they did not have adequate knowledge of traditional practices concerning when, where, and how to harvest resources, as demonstrated by one participant's comment: "Lack of knowledge. Where it is, what's the season. When is the correct time." Other comments included: "We as a family are not knowledgeable enough in traditional practices and would like to learn more" and "Not enough knowledge about traditional foods."

No Concerns

Many participants stated that they did not have any concerns about consuming or harvesting traditional foods. Only a few participants gave detailed responses. These include: "None. But, I feel I need to look into areas of concern," "No. Ate a lot of fish and never got sick. Mother ate fish all through pregnancy," "None, as long as it is cooked right," "None. Just exercise common sense. If the fish look unhealthy, do not eat them," and "Not really. People talk about mercury and stuff, but I don't eat enough fish for it to be a concern to me."

Question: Please describe any barriers that you may face that prevent you from harvesting or consuming traditional foods as much as you'd like.

Six themes (see Table 22) emerged from the responses to this question. These themes included: time; physical, health issues; age; cost; lack of knowledge; and none.

Table 22: Themes

Theme
Time
Physical, health issues
Age
Cost
Lack of knowledge

Time

The barrier to harvesting resources mentioned most often by the participants is time. Many of the participants simply said "time" and did not provide any further details. Some participants mentioned having children and attending to their needs as a time constraint that prevented them from harvesting fish. One participant said, "Young kids make it difficult to find the time to be able to harvest as much as we would like." Work was another constraint on time that was often mentioned, as stated by one participant: "no time, working a lot." Other participants echoed this comment: "Work schedule, kids" and "Time, too busy, both me and my wife work full time. So between work and activities for our kids we do not have enough time to harvest as much as we would like."

Physical, Health Issues

Participants described various physical and health issues as a barrier to harvesting resources. Some participants had physical issues that impacted their mobility: "Handicapped, I do not move very well anymore" and "Too heavy, can't walk around like I used to."

Other participants described other health issues that impacted their ability to fish. These comments included: "Back problems, diabetes, heart trouble, two artificial knees," "I had a stroke in 2010; I have neuropathy so I cannot walk like I could before," and "Physical health problems, kidney and heart disease, osteoporosis. Sometimes even bending or kneeling is too difficult."

Age

Older participants commented on age-related limitations as a reason why they do not harvest fish. One participant said, "Age, cannot do as much as I used to" and another said, "Age, bad legs. Can't walk far enough, anymore." For one participant, age was the only barrier: "The only barrier I have is age."

Cost

Participants discussed cost as a barrier to harvesting and consuming traditional foods. In regards to harvesting fish, one participant stated, "Economic costs to gather." Another mentioned, "Finances, not enough money to go." In addition, some participants specifically mentioned the cost of fishing. One participant commented on the costs of fishing gear: "Fishing gear is expensive." Another

mentioned needing money in order to fish: "Gotta have money to fish"

Participants also mentioned the cost of purchasing fish as a barrier. Comments included the following: "Cost of purchasing traditional foods," "Financial barriers; fish is expensive," and the "Cost for white fish."

Lack of Knowledge

Participants shared that their lack of knowledge regarding when, where, and how to harvest fish as a barrier to harvesting fish. Some of the comments included: "Lack of knowledge/skill to catch fish," "Lack of knowledge about where and when harvesting takes place," and "Biggest barrier is unfamiliarity with methods, otherwise I would go."

Question: Would you like to share any interesting stories, such as personal experiences, legends, or family traditions regarding fish and/or fishing?

Six main themes and two subthemes (see Table 23) emerged from the responses to this question. Some of the themes were interconnected but were discussed separately often enough to qualify as individual themes. These themes include: no, none; commercial fishing; tradition; spearing; and smelting.

Table 23: Themes and subthemes

Theme	Subtheme
No, none	
Commercial fishing	• Family • Personal
Tradition	
Spearing	
Smelting	

No, None

A majority of participants responded "no" or "none" and almost none of these responses contained further context. However, one participant said, "No. Family tradition is to not discuss fishing stories outside the family."

Commercial Fishing

Many participants shared stories that involved commercial fishing. Most of those stories either referenced a family member who was a commercial fisherman or their own personal experience. The personal experiences often involved a family member who was also a commercial fisherman.

<u>Family Member</u>

Participants recounted stories about their family members involved in commercial fishing. One participant said, "My grandfather was a well-known commercial fisherman and was also tribal chief." Another story told was, "My dad used to commercial fish in late 1940's and 1950's. In (city) they would meet the boats, and come to get the fish out of the nets and clean them."

Personal Stories

Participants told personal stories about their commercial fishing experiences. Participants explained that they learned how to commercially fish through a family member. One participant learned how to commercially fish by accompanying his grandfather: "My grandpa did commercial and subsistence fishing. When I was young he would bring me with to help tie nets and set nets and taught me the trade." Other participants learned how to commercially fish from their parents. One participant stated, "I understand how tough commercial fishing can be. I used to help my dad, it is very hard work having to tighten the net using a row boat." Another participant noted,

> My parents taught me and my sister how to fish commercially. So if my parents were sick, my sister and I would go out and set nets or pull nets. There was one time we pulled up a net with a sturgeon in it so big it was longer than our 16 foot aluminum boat.

Tradition

Many of the participants told stories about family traditions regarding harvesting fish. One participant stated, "The elders and older boys try to get the kids out and involved in fishing and other traditions." Another participant mentioned, "Family traditions including spring spearing and fish camp. I had a lot of good times on the water with my family." A third participant discussed the importance of passing down family traditions from generation to generation.

> Grandfather taught me from a young age to not take more than needed. And to pass traditions on to next generation. And to make use of what you harvest. Teach kids what it means to have something for their own kids when they grow up. Our chiefs had the foresight to put these things into the treaty. I believe heavily in conservation. The greater generations theory.

Spearing

Participants told stories about spear fishing. Several participants discussed spear fishing with their family members: comments included "We walleye spear every year and enjoy it as a family" and "Family traditions including spring spearing and fish camp. I had a lot of good times on the water with my family." Other participants discussed their experiences with spear fishing as children. One participant discussed,

> In Chassell Bay fishing as kids we were often called 'spear chuckers'. So we would through our spears at the walleye to shut them up. Once they see you spear a walleye from 20 feet away, they stop disrespecting you.

Another participant mentioned,

> My first time spearing, a rainbow went through the tunnel and I had to chase it through the tunnel. And I remember slipping and falling as I tried to get it out. Then my friend came and helped me get it out of the river.

A third participant added,

> When we were kids spearing on the Carp river, we did it mostly for subsistence. My friend put his spear right through his big toe. We pulled the barb and the tine of the spear out, and

had him put his foot back into the cold water.

Smelting

Another popular story subject was smelting. Participants discussed the traditional and social aspects of smelting. One participant expressed, "I had my kid bite the head off the first smelt he ever got just like I did. It is a tradition." Other participants shared stories about smelting from when they were children. One participant stated, "Exciting to smelt at night when I was a kid. Smelting was a social event. I liked sharing stories and people are relaxed and happy." Another mentioned, "I remember when I was young, my dad went fishing a lot, and in the spring he would harvest smelt. I remember him cleaning the smelt and cooking them and they were delicious."

Question: Is there anything else you would like to share that I haven't already asked you about?

Two themes (see Table 24) emerged from the responses to this question. These themes also appeared under other questions. These themes are commercial fishing and contaminants, pollutants.

Table 24: Themes

Theme
Commercial fishing
Contaminants, pollutants

Commercial Fishing

Commercial fishing was discussed in two previous questions and participants made additional comments here. Some of the comments regarded commercial fishermen supplying the community with fish. One participant said, "It would be great if commercial fishermen or family members gave fish to the elders and those who cannot fish." Another participant stated, "I wish fish was more readily available to the community, if the commercial fishermen were able to provide more for the community."

Contaminants, Pollutants

Some of the participants reiterated their concerns about contaminants as indicated by this response: "My main concern is the mercury in the fish." Some of the other comments included, "Quit poisoning our water!!" and "I no longer eat locally obtained fish because of the contaminants. My cousin passed away from cancer, and I am concerned it was due to his heavy fish consumption."

VIII: Conclusions

Triangulation of the Data

Quantitatively we found that men (ages 16-40 years) and older adults likely consume more fish than children and women of child-bearing age. The qualitative finding that women are being told by their doctors to consume less fish while pregnant is consistent with the quantitative findings. However, it is important to note that considerable variation exists in reported amounts of fish

consumption by respondents, limiting our ability to make definitive statements about statistically significant differences by age group.

Table 25 lists the overall fish consumption rate (grams/day) found in the current study, compared with average overall rates (including those who do not consume fish) from other recent fish studies. It is important to note that the overall fish consumption rate reported here for KBIC members does not reflect the seasonal variation that exists within this group (see Table 6a for seasonal rates).

Table 25.
Comparison of fish consumption rates by study

Study	Year	Group	Rate
Toy et al.	1996	Tulalip & Squaxin Ise.	48.8 grams/day
Duncan	2000	Susquamish	81.1 grams/day
Seldovia Village	2012	Cook Inlet	94.8 grams/day
Dellinger	2004	Ojibwe	60 grams/day
KBIC	2016	KBIC	29.9 grams/day

References

Back, R. C., Hurley, J. P., & Rolfhus, K. R. (2002). Watershed influences on the transport, fate and bioavailability of mercury in Lake Superior: Field measurements and modelling approaches. *Lakes and Reservoirs: Research and Management, 7*(3), 201-206. doi: 10.1046/j.1440-1770.2002.00188.x

Beehler, G. P., McGuinness, B. M., & Vena, J. E. (2003). Characterizing Latino anglers' environmental risk perceptions, sport fish consumption, and advisory awareness. *Medical Anthropology Quarterly, 17*(1), 99-116.

Buck, G. M., Tee, G. P., Fitzgerald, E. F., Vena, J. E., Weiner, J. M., Swanson, M., & Msall, M. E. (2003). Maternal fish consumption and infant birth size and gestation: New York State Angler Cohort Study. *Environmental Health: A Global Access Science Source, 2*, 1-9. doi: 10.1186/1476-069x-2-1

Dellinger, J. A. (2004). Exposure assessment and initial intervention regarding fish consumption of tribal members of the Upper Great Lakes Region in the United States. *Environmental Research, 95*(3), 325-340. doi: 10.1016/j.envres.2003.07.012

Dellinger, J. A., Moths, M. D., Dellinger, M. J., & Ripley, M. P. (2014). Contaminant trends in freshwater fish from the Laurentian Great Lakes: A 20-year analysis. *Human and Ecological Risk Assessment, 20*(2), 461-478. doi: 10.1080/10807039.2012.759475

Dolbec, J., Mergler, D., Larribe, F., Roulet, M., Lebel, J., & Lucotte, M. (2001). Sequential analysis of hair mercury levels in relation to fish diet of an Amazonian population, Brazil. *Science of the Total Environment, 271*(1-3), 87-97. doi: 10.1016/s0048-9697(00)00835-4

Donatuto, J. (2008). *When seafood feeds the spirit yet poisons the body: Developing health indicators for risk assessment in a Native American fishing community.* Vancouver, British Columbia: University of British Columbia. Retrieved from: http://hdl.handle.net/2429/2523.

Donatuto, J., & Harper, B. L. (2008). Issues in evaluating fish consumption rates for Native American tribes. *Risk Analysis, 28*(6), 1497-1506. doi: 10.1111/j.1539-6924.2008.01113.x

Duncan, M. (2000). *Fish consumption survey of the Suquamish Indian tribe of the Port Madison Indian Reservation, Puget Sound Region.* Prepared for the Suquamish Tribe, Port Madison Indian Reservation Fisheries Department. Published August 2000.

Environmental Protection Agency. (1998). *Guidance for conducting fish and wildlife consumption surveys* (EPA-823-B-98-007). Washington, DC: United States Environmental Protection Agency.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Fields, A. (2005). *Discovering Statistics Using SPSS*, 2nd ed. Sage Publications, London, UK.

Fish consumption survey of people fishing and harvesting fish from the Saginaw Bay watershed

(2007). Retrieved from WorldCat Fish consumption survey of people fishing and harvesting fish from the Saginaw Bay Watershed, Michigan. Department of Community Health; Saginaw Bay Watershed Initiative Network. 2007 English Internet Resource Computer File v, 76 p.: digital, PDF file. Lansing, MI: Michigan Dept. of Community Health WorldCat database. Retrieved from http://www.michigan.gov/documents/mdch/FCS_Final_rpt_061407_199288_7.pdf

Fish consumption survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region. (2000). Suquamish, WA: The Suquamish Tribe (15838 Sandy Hook Road, P.O. Box 498, Suquamish, WA 98392).

Foran, J. A., DeWeese, A. D., Hudson, M. J., & Kmiecik, N. E. (2010). Evaluation of mercury exposure reduction through a fish consumption advisory program for Anishinaabe tribal members in Northern Wisconsin, Michigan, and Minnesota. *Journal of Environmental and Public Health, 2010*. doi: 10.1155/2010/802584

Gagnon, V. S., Nankervis, P., & Johnston, E. (2013). *Keweenaw Bay Indian Community Wildlife and Natural Resources' Survey Report: 2013.* Prepared for Keweenaw Bay Indian Community – Natural Resources Department & Hatchery. Published on November 17, 2013. Retrieved from http://nrd.kbic-nsn.gov/PDF/KBIC WILDLIFE and NR REPORT 11_2013 (hyperlinked TABLE of CONTENTS).pdf

Gerstenberger, S. L., Tavris, D. R., Hansen, L. K., Pratt-Shelley, J., & Dellinger, J. A. (1997). Concentrations of blood and hair mercury and serum PCBs in an Ojibwa population that consumes Great Lakes Region fish. *Journal of Toxicology - Clinical Toxicology, 35*(4), 377-386.

Glaser, B.G., & Strauss, A.L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York, NY: Aldine.

Hanrahan, L. P., Falk, C., Anderson, H. A., Draheim, L., Kanarek, M. S., Olson, J., . . . Steenport, D. (1999). Serum PCB and DDE levels of frequent Great Lakes sport fish consumers - A first look. *Environmental Research, 80*(2 II), S26-S37. doi: 10.1006/enrs.1998.3914

Harper, B. L., & Harris, S. G. (2008). A possible approach for setting a mercury risk-based action level based on tribal fish ingestion rates. *Environmental Research, 107*(1), 60-68. doi: 10.1016/j.envres.2007.05.008

Holloman, E. L., & Newman, M. C. (2012). Expanding perceptions of subsistence fish consumption: Evidence of high commercial fish consumption and dietary mercury exposure in an urban coastal community. *Science of the Total Environment, 416*, 111-120. doi: 10.1016/j.scitotenv.2011.10.003

Hsieh, H.-F., & Shannon, S.E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288.

Judd, N. L., Griffith, W. C., & Faustman, E. M. (2004). Consideration of cultural and lifestyle factors in defining susceptible populations for environmental disease. *Toxicology, 198*(1-3), 121-133. doi: 10.1016/j.tox.2004.01.023

Judd, N. L., Griffith, W. C., Kalman, D. A., & Faustman, E. M. (2003). Assessment of PCB congener analytical methods: Do they meet risk assessment needs? *Archives of Environmental Contamination and Toxicology, 44*(1), 132-139. doi: 10.1007/s00244-002-2001-x

Knuth, B. A., Connelly, N. A., Sheeshka, J., & Patterson, J. (2003). Weighing health benefit and health risk information when consuming sport-caught fish. *Risk Analysis, 23*(6), 1185-1197. doi: 10.1111/j.0272-4332.2003.00392.x

Kuntz, S. W., Hill, W. G., Linkenbach, J. W., Lande, G., & Larsson, L. (2009). Methylmercury risk and awareness among American Indian women of childbearing age living on an inland northwest reservation. *Environmental Research, 109*(6), 753-759. doi: 10.1016/j.envres.2009.04.007

Lake Whatcom residential and angler fish consumption survey. (2001). Olympia, WA: Washington State Dept of Health, Office of Environmental Health Assessments.

Merrill, T., & Opheim, M. (2013). *Assessment of Cook Inlet tribes subsistence consumption. Prepared for Seldovia Village Tribe Council.* Published on September 30, 2013.

Michigan Department of Community Health (2014). *Eat Safe Fish Guide, Upper Peninsula, 2014-2015*. Retrieved from www.michigan.gov/eatsafefish

Michigan Department of Natural Resources (2014a). *An Atlas of Michigan Fishes.* Retrieved from https://www.michigan.gov/dnr/1,1607,7-153-10371_14793-30538--,00.html

Michigan Department of Natural Resources (2014a). *Inland Trout and Salmon Regulations and Maps.* Retrieved from http://www.michigan.gov/dnr/0,4570,7-153-10364_63235-211883--,00.html

Michigan Department of Natural Resources (2014c). *Michigan Fishing Guide*. Retrieved from www.michigan.gov/fishingguide

Moya, J., Itkin, C., Selevan, S. G., Rogers, J. W., & Clickner, R. P. (2008). Estimates of fish consumption rates for consumers of bought and self-caught fish in Connecticut, Florida, Minnesota, and North Dakota. *Science of the Total Environment, 403*(1-3), 89-98. doi: 10.1016/j.scitotenv.2008.05.023

NVivo qualitative data analysis software; QSR International Pty Ltd. Version 10, 2012.

Oklahoma Department of Environmental Quality, Customer Services*. Fish tissue metals analysis in the tri-state mining area. FY 2006 Final Report (Technical Reports).* Oklahoma Department of Environmental Quality.

O'Neill, C. A. (2007). Protecting the tribal harvest: The right to catch and consume fish. *Journal of Environmental Law and Litigation, 22*(1), 131-151.

Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods*. Thousand Oaks, CA: Sage Publications.

Peterson, D. E., Kanarek, M. S., Kuykendall, M. A., Diedrich, J. M., Anderson, H. A., Remington, P. L., &

Sheffy, T. B. (1994). Fish consumption patterns and blood mercury levels in Wisconsin Chippewa Indians. *Archives of Environmental Health, 49*(1), 53-58.

Rayburn, T. (2005). *Integrating data, resources, and capabilities in the Great Lakes: Impacting federal, state, tribal, local, and private partnerships through the area committee.* Paper presented at the 2005 International Oil Spill Conference, IOSC 2005, Miami Beach, FL.

Schantz, S. L., Sweeney, A. M., Gardiner, J. C., Humphrey, H. E. B., McCaffrey, R. J., Gasior, D. M., . . . Budd, M. L. (1996). Neuropsychological assessment of an aging population of Great Lakes fisheaters. *Toxicology and Industrial Health, 12*(3-4), 403-417.

Toy, K. A., Polissar, N. L., Liao, S., & Mittelstaedt, G. D. (1996). *A fish consumption survey of the Tulalip and Squaxin Island tribes of the Puget Sound region.* Marysville, WA: Tulalip Tribes, Department of Environment.

Tsuchiya, A., Hinners, T. A., Krogstad, F., White, J. W., Burbacher, T. M., Faustman, E. M., & Mariën, K. (2009). Longitudinal mercury monitoring within the Japanese and Korean communities (United States): Implications for exposure determination and public health protection. *Environmental Health Perspectives, 117*(11), 1760-1766. doi: 10.1289/ehp.0900801

U.S. Bureau of the Census. (2014). *Population Estimates Program (PEP).* Updated annually. Retrieved from http://www.census.gov/popest/estimates.html

Wampanoag Tribe of Gay Head (Aquinnah). (2002). *Fish & Shellfish Consumption Survey Project Planning and Development Plan.*

Westat, Inc. (2012). *Upper Columbia River Site remedial investigation and feasibility study tribal consumption and resource use study final report.* Rockville, MD: Westat, Inc.

Xue, J., Zartarian, V. G., Liu, S. V., & Geller, A. M. (2012). Methyl mercury exposure from fish consumption in vulnerable racial/ethnic populations: Probabilistic sheds-dietary model analyses using 1999-2006 NHANES and 1990-2002 TDS data. *Science of the Total Environment, 414*, 373-379. doi: 10.1016/j.scitotenv.2011.10.010