

DESIGN OF A SURVEY ON FISH CONSUMPTION BY THE NEZ PERCE TRIBE

Prepared for
The Nez Perce Tribe
The U.S. Environmental Protection Agency
SRA International, Inc.

Prepared by
The Mountain-Whisper-Light Statistics and RIDOLFI Inc.

February 2014

This report was prepared under EPA Contract EP-W09-011, Task Order 125, with SRA International, Inc.

Design of a Survey
on Fish Consumption
by the Nez Perce Tribe

Prepared for
The Nez Perce Tribe
The U.S. Environmental Protection Agency
SRA International, Inc.

Prepared by
The Mountain-Whisper-Light Statistics and RIDOLFI Inc.

February 2014

EXECUTIVE SUMMARY

Survey Purpose and Approach

The Tribal Governments in the State of Idaho are collaborating with the U.S. Environmental Protection Agency (EPA) Region 10, the State of Idaho, and other stakeholders to develop methods for gathering data on fish consumption rates (FCRs), which includes all freshwater and marine finfish and shellfish. A survey is being designed to obtain data necessary for determining fish consumption rates for the Tribes in Idaho, exploring both current and heritage rates. An additional objective of the survey is to determine how current fish consumption rates might increase if fisheries resources are improved. This information will be useful for developing water quality standards that are protective of the current and future health of the Tribes and of other Idaho residents. Water quality is of great importance to the Native American Tribes in Idaho, since a substantial portion of their diet is derived from aquatic sources, and water and aquatic resources play an important cultural and spiritual role for them. It has been documented elsewhere in the Pacific Northwest (e.g., Puget Sound and the Columbia River) that Tribes consume far more fish and shellfish than the general U.S. population. In addition, reported historic fish consumption rates are very high. EPA is therefore interested in investigating FCRs for Idaho Tribes to support development of Tribal ambient water quality criteria (AWQC) to protect high fish consuming populations.

Development of the survey design involved informational visits to the Idaho Tribes, including an open exchange of interests, concerns, and ideas; collection of relevant information on culture, history, fisheries, environment, and Tribal objectives; investigation of statistical methods and issues; development of an appropriate statistical methodology for the current fish consumption survey and an approach for documentation of heritage rates; preparation of a multi-part survey questionnaire, including screening, two 24-hour dietary recalls, and food frequency questionnaire; calculations to support a statistically valid design; and coordination with involved agencies, tribes, consortia, and consultants. This report describes the proposed survey design for the Nez Perce Tribe (NPT).

Current Survey and Historic Assessment

There are three eras of importance for a fish consumption study: the past, present, and future. Over an extended period of time, the Tribes have experienced environmental and social changes that have reduced fish abundance, access to fish, safety of fish consumption, and fish consumption itself. The Tribes are seeking to increase fish availability, fish safety (i.e., free from contamination), and fish consumption in the future. Thus, current consumption rates do not reflect the Tribe's past nor its future goals. Assessing consumption through a current, cross-sectional survey will provide relatively precise information about current consumption only. For the overall goals of this survey project, the current consumption rates should not be considered in isolation. Assessing past consumption through an assessment of historical materials and, potentially, interviews with some older individuals whose history reaches back a long lifetime may be highly informative, but rates so derived are likely not as precise because they involve longer-term recall and unknown quality and completeness of past documentation.

Since the results of the survey may be used for water quality regulation, it is intended that rates and ancillary materials will support that use. The strength of the current rates is the methodology and the ability to compare them to contemporary rates for other populations. The strength of the historical rates is their relevance to the goals of the Tribe, which is to restore fish consumption to

past, higher levels. Future rates may be projected based on anticipated increases in fish populations resulting from planned or ongoing habitat restoration and supplementation efforts, and associated increases in fish consumption.

The draft survey design includes a description of the Nez Perce Tribe's story about suppression, based primarily on existing literature and supplemented with input directly from the Tribes. Historical fish harvest and fish consumption by Tribal members is presented, as well as causes of decline in the fish populations, and goals for the future. Additional research and discussion with Tribal representatives and experts will take place to implement the survey design. During the survey implementation phase, a more in-depth study of suppression will take place and its implications for future fish consumption will be considered.

Suppression Effects and Their Implications

According to the National Environmental Justice Advisory Council (NEJAC), a “suppression effect” occurs when a fish consumption rate for a given population, group, or tribe reflects a current level of consumption that is artificially diminished from an appropriate baseline level of consumption for that population, group, or tribe. The baseline level of consumption is suppressed, and cannot be characterized via a survey of current consumption.

There are circumstances in which suppression effects have implications for an environmental justice policy that seeks to sustain healthy aquatic ecosystems and to protect the health and safety of people consuming fish, shellfish, aquatic plants, and wildlife for subsistence, traditional, cultural, or spiritual purposes. First, a suppression effect may arise when an aquatic environment and the fish it supports have become contaminated to the point that humans refrain from consuming fish caught from particular waters. Were the fish not contaminated, these people would consume fish at more robust baseline levels. Second, a suppression effect may arise when fish upon which humans rely are no longer available in historical quantities (and kinds), such that humans are unable to catch and consume as much fish as they had or would. Such depleted fisheries may result from a variety of affronts, including an aquatic environment that is contaminated, altered (due, among other things, to the presence of dams), overdrawn, and/or overfished. Were the fish not depleted, these people would consume fish at more robust baseline levels. Third, a suppression effect may occur from loss of access to fisheries resources and changes in social structure such that individuals no longer harvest fish to the same extent as before, or do not harvest at all.

When environmental agencies employ a FCR that does not capture fully the consumption that is suppressed – under any scenario in which suppression effects occur – they may set in motion a sort of downward spiral whereby the resulting environmental standards permit further and further contamination or depletion of the fish and so diminished health and safety of people consuming fish, shellfish, aquatic plants, and wildlife for subsistence, traditional, cultural, or spiritual purposes. This survey is intended to develop the most precise FCRs possible while taking into consideration historical rates as they relate to restored future rates. An approach is presented for determining the Tribe's heritage rates based on a critical evaluation of existing historical literature.

Survey Design and Questionnaire

The target population for the current survey is adult (18+) enrolled Nez Perce Tribal members, a population which will be geographically defined (e.g., by zip codes within the reservation and within a reasonable travel distance of the reservation). Sampling will occur with the use of stratification; strata will be defined by the combination of age, gender, and frequency of consumption (determined through an initial phone screening process). Potential respondents will be selected randomly from each stratum and this screening list will include 3 to 5 times as many individuals as the ultimate effective sample size,¹ which was statistically derived to achieve acceptably precise rates and support the use of modern survey methodology based on 24-hour dietary recall interviews. The proposed sample size is expected, conservatively, to provide an estimated mean consumption rate (all species combined, calculated from responses to the food frequency questionnaire) that has 95% probability of falling within 25% of the population mean, and to provide an estimated 95th percentile of consumption that has 95% probability of falling within 40% of the population 95th percentile of consumption. The sample size is also likely to provide an acceptable number of respondents with fish consumption on both days of the 24-hour dietary recall interview, enabling use of the methodology for analyzing the recall data.²

Trained Tribal representatives will conduct in-person interviews. Each individual surveyed will complete a food frequency questionnaire and a 24-hour dietary recall interview focused on fish consumption behavior. A subsample of individuals will subsequently be contacted by phone for a second 24-hour recall interview after several days. The food frequency questionnaire will ascertain species-specific frequency of consumption, typical quantities consumed by fish-eating period, sources of fish consumed, and preparation methods. Portion size characterization will be facilitated through use of models. Species identification will be facilitated by use of photographs. Hard copy and electronic data will be handled under strict confidentiality and quality assurance/quality control protocols.

In addition to the approach presented for critically reviewing existing literature to determine the Tribe's heritage rates and future aspirations for consumption, the survey questionnaire will include qualitative questions related to changes in fish consumption over time. The survey questionnaire presented to respondents during the in-person interviews will include questions related to changes in fish consumption and fishing activities compared to the past, reasons for changed fish consumption, and future consumption goals. These inquiries will provide additional lines of evidence regarding heritage rates.

Survey Data Analysis and Reporting

In addition to data collection activities, the draft survey design includes a description of methods for data management, confidentiality, analysis, and reporting. The results of the suppression study for each Tribe (including fish consumption rates and supporting materials) will be presented in a final report along with the results of the current consumption survey. Reported fish consumption rates from the implementation of the current consumption survey will include the mean (average) and various percentiles of consumption up to the 95th percentile—and beyond, if warranted. The precision (margin-of-error) for certain rates (e.g., mean, median, 90th and 95th

¹ See subsections "FFQ Sample Size" and "24-Hour Dietary Recall Sample size" for details on sample size methodology.

² The "NCI method", described later, will be used to analyze the 24-hour dietary recall data. The NCI method may be used only if there is a sufficient number of respondents with fish consumption on both days of the 24-hour recall interviews.

percentiles) will also be presented. Rates based on the food frequency questionnaire will be presented for population sub-groups defined by age, gender, and other characteristics in grams per day (and for some analyses, in grams per kilogram of body weight per day). Rates for fish species groups (e.g., anadromous, resident freshwater, and marine species) will also be presented. Data from the 24-hour recalls will be used (and assessed by the 'NCI method' where possible) to provide rates for all species combined and, if supported by the data, for population sub-groups and for some species groups. The report of findings will include a description of the survey operations performed and statistical analyses, results of both the current survey and heritage rate study, a discussion of the data, including a comparison of the fish consumption rates derived from both the FFQ and the 24-hr recall surveys, and supporting materials.

TABLE OF CONTENTS
SURVEY DESIGN REPORT

EXECUTIVE SUMMARY i

1.0 INTRODUCTION AND BACKGROUND 1

1.1 Survey Background and Purpose 1

1.2 Procedures Used to Develop Design Document 2

1.3 Survey Objectives for the Nez Perce Tribe 2

1.4 Role of Current Survey and Historic Assessment 3

2.0 TRIBAL PERSPECTIVE ON SUPPRESSION 4

2.1 Suppression Effects and Their Implications 4

2.2 Historical Fish Harvest and Consumption 5

2.3 Causes of Decline in Fish Populations 7

2.4 Vision for the Future 9

2.5 Estimating Heritage Fish Consumption Rates 13

3.0 SURVEY DESIGN: TARGET POPULATION 15

3.1 Target Population to be Sampled 15

3.2 Phasing-in of the Survey 15

3.3 Sampling the Population 16

1. Sample Stratification 16

2. Sample Selection 17

4.0 SURVEY DESIGN: DATA COLLECTION 20

4.1 Survey Methods 20

1. Selection of In-Person Interviews vs. Other Methods 20

2. Use of Photographs and Portion Size Models 21

3. Use of Tribal Interviewers 21

4.2 Measurement Method 21

4.3 Sample Size 23

1. Screening of Participants 23

2. FFQ Sample Size 23

3. 24-Hour Dietary Recall Sample Size 25

4.4	Questionnaire Development.....	26
1.	Telephone Screening.....	27
2.	Interview Introduction	27
3.	24-Hour Dietary Recall.....	27
4.	Food Frequency Questionnaire	28
5.	General Information.....	28
6.	Photographs and Portion Models.....	29
7.	In-House Testing and Revisions of Questionnaire	29
8.	Pilot Testing of Questionnaire and Field Operations.....	30
4.5	IRB Approval.....	30
4.6	EPA Human Subjects Review	31
5.0	SURVEY OPERATIONS.....	32
5.1	Interviewing	32
1.	Interviewer Selection	32
2.	Interviewer Training	32
3.	Procedure Manual and Training for Interviewers and Supervisors	33
4.	Scheduling and Monitoring Interviewers and Activities	34
5.	Recording Interviewer Responses.....	34
6.	Integrity and Handling of Questionnaire Hardcopy.....	35
5.2	Contact with Respondents.....	35
1.	Initial Contact by Mail and Telephone	35
2.	In-Person Interviews	35
3.	Follow-up Call and Re-Interview	36
5.3	Tribal Collaboration in Field Operations.....	36
5.4	Key Entry of Questionnaire, Validity Checks, and Storage	36
1.	Field Validity Checks and Re-interview.....	37
2.	Handling Missing Values.....	37
3.	Naming and storage of electronic files	37
4.	Back-up and Transfer Protocols.....	38
5.5	Sensitive Information.....	38
5.6	Confidentiality and Data Management	38
1.	Confidentiality of Hardcopy and Electronic Files	38
2.	Communicating Confidentiality to Participants.....	38

6.0	ANALYSIS, REPORTING, CLOSE-OUT OF STUDY	40
6.1	Analysis of FFQ results	40
6.2	Analysis of 24-hour Recalls.....	41
6.3	Reporting of Results	41
6.4	Peer Review	43
6.5	Archiving, Ownership, Sharing of Data	43
7.0	DESIGN TEAM, ACKNOWLEDGEMENTS, AND RESOURCES	44
7.1	Names and affiliation.....	44
7.2	Acknowledgements.....	44
7.3	Resources	45
1.	Guidance, Regulations, and Other Agency Reports	45
2.	Fish Consumption Surveys and Survey Methodology	46
3.	Traditional Lifeways and Suppression Studies.....	48
8.0	REFERENCES CITED.....	51

LIST OF FIGURES

- Figure 2-1 Abundance-Based Tribal Harvest Goals
Figure 4-1. Precision of mean and selected percentile estimates vs. sample size

LIST OF TABLES

- Table 2-1 Abundance Thresholds for Certain Snake River Anadromous Fish
Table 3-1. Number of adult Tribal members by distance from Tribal Reference point defined by zip code of residence
Table 3-2. Hypothetical strata based on three stratifying factors: age, gender and frequency of fish consumption

LIST OF APPENDICES

- Appendix A. Survey Questionnaire

Note: In the Nez Perce design document as originally issued, Appendix A referred to the survey questionnaire, contained in a separate file. References to Appendix A in this design report now refer to the latest version of the questionnaire, found in Appendix A of Volume III.

LIST OF ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
CDC	Center for Disease Control and Prevention
CV	Curriculum vitae
CWA	Clean Water Act
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FCR	fish consumption rate
FFQ	food frequency questionnaire
FOIA	Freedom of Information Act
HSRRO	Human Subjects Research Review Official
ICC	Indian Claims Commission
IRB	Institutional Review Board
NCI	National Cancer Institute
NEJAC	National Environmental Justice Advisory Council
NHANES	National Health and Nutrition Examination Survey
NPDES	National Pollutant Discharge Elimination System
NPT	Nez Perce Tribe
NPTEC	Nez Perce Tribal Executive Committee
PHI	Protected Health Information
PI	Principal Investigator
PII	Personally Identifiable Information
SFTP	Secure File Transfer Protocol
USDA	U.S. Department of Agriculture

LIST OF UNITS

g/day	grams per day
g/kg-day	grams per kilogram of body weight per day

1.0 INTRODUCTION AND BACKGROUND

The Tribal Governments in the State of Idaho are collaborating with the U.S. Environmental Protection Agency (EPA) Region 10, the State of Idaho, and other stakeholders to develop methods for gathering data on fish consumption rates (FCRs) in Idaho. This effort is underway to support development of water quality standards. This survey has been designed to obtain data necessary for determining fish consumption rates for the Nez Perce Tribe (NPT). The survey is focused on both current and heritage rates. This information will be useful in developing water quality standards that are protective of the health of Tribal members as well as of other residents of Idaho.

1.1 Survey Background and Purpose

Water quality is of great importance to the Native American Tribes in Idaho, since a substantial portion of their diet is derived from aquatic sources, and water and aquatic resources play an important cultural and spiritual role for them. EPA Region 10 is conducting fact finding to assist Tribal governments in Idaho to identify fish consumption rates³ that are appropriate for use in setting Tribal ambient water quality criteria (AWQC) to protect human health. Idaho Tribal FCRs may also be of use to the State of Idaho as Idaho AWQC undergo revision.

The numeric value for a particular AWQC is inversely dependent on the FCR used to derive it. As the FCR increases, the AWQC becomes lower, or more stringent (and, therefore, more protective of human health). This is particularly true for bioaccumulative chemicals (i.e., chemicals that dissolve in fat and increase in concentration at higher levels of the food chain).

It has been documented elsewhere in the Pacific Northwest (e.g., Puget Sound and the Columbia River) that tribes consume far more fish and shellfish than the general U.S. population. EPA is thus interested in investigating FCRs for Idaho Tribes to support development of AWQC to protect high Tribal fish consuming populations.⁴

EPA has a national goal, established by the Clean Water Act (CWA), to protect water quality so that fish and shellfish thrive and can be safely eaten by humans. AWQC serve as an important tool in these efforts. AWQC are used by the CWA National Pollutant Discharge Elimination System (NPDES) to establish permits for allowable levels of contaminant discharge to the Nation's waters as well as other water quality management tools to reduce toxics and protect human health. Protection of tribal health is an important consideration for these regulatory efforts.

The purpose of this report is to provide a survey design for collecting Tribal fish consumption information for the Nez Perce Tribe. The information resulting from implementation of the survey can be used to set AWQC for Tribal waters. This survey effort will help Tribes build capacity for measuring FCRs, inform tribal fisheries management, and document the importance of fish in tribal culture and lifeways. The survey results may also be useful for the State of Idaho in its decision-making process for development of water quality standards.

³ A fish consumption rate (FCR) is the amount of fish and shellfish (by weight) that is consumed by a person on a daily or annual basis.

⁴ EPA is also interested in protecting the health of other high fish consuming populations (e.g., recreational anglers or ethnic minorities). The State of Idaho is currently preparing a survey to determine FCRs for recreational anglers.

1.2 Procedures Used to Develop Design Document

The development of this survey design included informative visits with the five Idaho Tribes on their reservations, including an open exchange of interests, concerns, and ideas; collection and review of relevant information on culture, history, fisheries, environment, and Tribal objectives; investigation of statistical methods and development of an appropriate approach for the fish consumption survey; drafting a multi-part survey questionnaire, including questions on past, current, and future consumption patterns; calculations to support a statistically valid design for each of the Tribal surveys; and coordination with involved agencies, tribes, consortia, and consultants.

The Tribal visits helped the survey team develop a working relationship with each of the Tribes and provided critical information for the survey design. The type of information gathered included the Tribes' objectives for the survey; the type of data compiled in their tribal registers (to be used for sample selection); existence of and content of historical records on fisheries resources; issues on language, travel and communication; planning for tribal hosting of and publicity around the surveys; issues of confidentiality of Tribal data and future survey records; and discussion of tribal capabilities for carrying out duties during the implementation phase.

Historical reports, past questionnaires, guidance documents, literature articles, and study methodologies were reviewed. Specific topics of interest relevant to this work included fish species, preparation methods, ceremonial uses, and suppressed consumption. As available, ethnographic information for each Tribe was reviewed. A list of additional resources related to this effort are provided in Section 7 of this report.

Design development included the evaluation of appropriate methodologies for a fish consumption survey; defining the population of interest; drafting a questionnaire based on survey objectives; performing calculations to support a statistically valid design for each of the Tribal surveys; incorporating methods to account for the effect of suppressed consumption; and specifying key elements of the survey operation.

The State of Idaho is also planning to implement fish consumption surveys. Coordination with the State of Idaho survey involved periodic conference calls with the survey design teams, agencies, Tribes and consultants to discuss technical topics related to the survey design. For example, methods of accessing survey participants, sampling frames, sharing of questionnaires and documentation from past surveys, defining consumers and non-consumers, species lists, and identification of survey components were discussed and may promote comparison of the final results from multiple surveys.

1.3 Survey Objectives for the Nez Perce Tribe

The Nez Perce Tribe has treaty reserved fishing rights within the Columbia Basin and Snake River basins. In the Snake Basin, the Nez Perce Tribe has quite possibly the largest number of tributary salmon and steelhead fisheries which can often occur year-round across the states of Washington, Oregon and Idaho. The Nez Perce Tribe has usual and accustomed fishing places throughout 13 million+ acres that have been found to be exclusively used and occupied by the Tribe (including the major portions of the Snake, Tucannon, Imnaha, Grande Ronde, Salmon and Clearwater Rivers and their drainages); the mainstem Columbia River; and other locations in the Columbia/Snake Basin.

The Nez Perce Tribe's primary objective for the fish consumption survey is to support development of more stringent water quality standards that are protective of tribal members' consumption of fish. The Tribe's culture is and always has been intimately tied to fish, which is a staple of their diet and an integral part of their society; poor water quality impedes fish survival and can affect both the quantity and availability of fish that can be harvested and safely consumed by tribal members. The NPT has a vision of restoring fish species native to the Nez Perce Treaty Territory. To accomplish this vision, the Tribe has engaged in managing the resident and anadromous fish species in the streams, lakes, and watersheds within their management authority in an effort to rebuild habitat and restore opportunities for fish harvest. Their goal is that fish will be found in all available habitats and will provide fishing opportunities for present and future generations. An objective of the Tribe is that results of this survey and the resulting water quality standards should support the Tribe's expectation of an enhanced fishery and should be adequately protective of fish consumption by the Tribe in the future.

1.4 Role of Current Survey and Historic Assessment

There are three eras of importance for a fish consumption study: the past, present, and the future. Considering the past, over an extended period of time the NPT has experienced environmental and social changes that have reduced fish abundance, access to fish, safety of fish consumption, and fish consumption itself. The Tribe is seeking to increase fish availability, fish safety (i.e., free from contamination), and fish consumption in the future. Thus, current consumption does not reflect the Tribe's past nor its goals. Assessing consumption through a current, cross-sectional survey will provide relatively precise information about current consumption only. For the overall goals of this survey, the current consumption rates should not be considered in isolation. Assessing past consumption through an assessment of historical materials and, potentially, interviews with some older individuals whose history reaches back a long lifetime may be highly informative, but rates so derived are likely not as precise because they involve longer-term recall and unknown quality and completeness of past documentation.

The rates and supporting materials generated by this study will be used in water quality regulation. The strength of the current rates is that they are derived via a technically defensible methodology and that these rates can be compared to those of other populations. The strength of the heritage rates is their relevance to the goals of the Tribe. Future rates may be projected based on anticipated increases in fish populations resulting from planned or ongoing habitat restoration and supplementation efforts, and associated increases in fish consumption.

2.0 TRIBAL PERSPECTIVE ON SUPPRESSION

This section describes the Nez Perce Tribe's perspective on suppression, based primarily on existing literature and supplemented with input directly from the Tribe. Historical fish harvest and fish consumption by Tribal members is presented, followed by causes of decline in the fish populations, and vision for the future. Additional research and Tribal input will be required during the survey implementation phase to account for suppression and the implications for future fish consumption.

2.1 Suppression Effects and Their Implications

According to the National Environmental Justice Advisory Council (NEJAC, 2002), a “suppression effect” occurs when a fish consumption rate for a given population, group, or tribe reflects a current level of consumption that is artificially diminished from an appropriate baseline level of consumption for that population, group, or tribe. The more robust baseline level of consumption is suppressed, inasmuch as it does not get captured by the current FCR.

There are circumstances in which suppression effects have implications for an environmental justice policy that seeks to sustain healthy aquatic ecosystems and to protect the health and safety of people consuming fish, shellfish, aquatic plants, and wildlife for subsistence, traditional, cultural, or spiritual purposes. First, a suppression effect may arise when an aquatic environment and the fish it supports have become contaminated to the point that humans refrain from consuming fish caught from particular waters. Were the fish not contaminated, these people would consume fish at more robust baseline levels. Second, a suppression effect may arise when fish upon which humans rely are no longer available in historical quantities (and kinds), such that humans are unable to catch and consume as much fish as they had or would. Such depleted fisheries may result from a variety of affronts, including an aquatic environment that is contaminated, altered (due, among other things, to the presence of dams), overdrawn, and/or overfished. Were the fish not depleted, these people would consume fish at more robust baseline levels. Third, a suppression effect may occur from loss of access to fisheries resources and changes in social structure such that individuals no longer harvest fish to the same extent as before, or do not harvest at all.

The implications for environmental justice policy will depend in part upon which of these scenarios accounts for the suppression effect observed. They will also depend upon how the more robust “baseline” level is defined – an exercise that itself raises important environmental justice issues. This question of an appropriate “baseline” will in turn be related to the particular group affected. In some cases, for example, a tribe will be able to cite a historical “point of reference” that would describe an appropriate baseline in terms of environmental quality, geographic delineation, and treaty rights. In each case, there may be important questions of history, culture, and aspiration to be considered in determining an appropriate baseline; that is to say, an appropriate baseline might mean examination of what people had consumed as well as aspiration for what people would consume were there “fair access for all to a full range of resources,” (NEJAC, 2002) or were the conditions fulfilled for full exercise of treaty- and trust-protected rights and purposes.

When environmental agencies employ a suppressed FCR – under any scenario in which suppression effects occur – they may set in motion a downward spiral where inappropriately lax environmental standards permit further and further contamination or depletion of the fish and so diminish health and safety of people consuming fish, shellfish, aquatic plants, and wildlife for

subsistence, traditional, cultural, or spiritual purposes. This survey is intended to develop the most precise FCRs as possible while taking into consideration heritage rates as they relate to aspired future rates. An approach is presented for determining the Tribe's heritage rates based on a critical evaluation of existing historical literature. Results of the heritage rate study will be presented with supporting materials in the final survey results report.

2.2 Historical Fish Harvest and Consumption

The Nez Perce are a large Northwest tribe with a culture tied closely to fish. Since time immemorial, the Tribe occupied a territory covering more than 13 million acres that included what is today north central Idaho, southeastern Washington, and northeastern Oregon. The Nez Perce subsistence cycle involved traveling year to year on the same well-traveled routes through the canyons of the Snake, Tucannon, Clearwater, Grande Ronde, Imnaha and Salmon Rivers, primarily to follow the salmon runs. In addition to those rivers and their tributaries, the Nez Perce historically took part in the fishing and trading that occurred between several of the region's tribes at Celilo Falls on the Columbia River, among other locations of the Columbia Basin.

The Tribe has always fished. Their economy and culture evolved around Northwest fish runs. Their persistence can be attributed in large part to the abundance of fish, which has served as a primary food source, trade item and cultural resource for thousands of years. Settlement by others in the last 150 years has disrupted people of the Tribe and the natural resources (NPT, 2005). The degree to which the Tribe is culturally coupled to fish was recognized in treaties signed between the Tribe and the United States Government. The same treaties that confined the Tribe to a fraction of their former territory also guaranteed their access to fishery resources. Article III of the Treaty of 1855 guarantees to the Tribe:

“The exclusive right of taking fish in all the streams running through or bordering said reservation ... as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory.” Treaty with the Nez Percés, 12 Stat. 957 (1859).

The 1855 Treaty Council at Walla Walla and the Treaty negotiations reflect the Tribe's inherent tribal sovereignty and its “aboriginal title” to land. At the Treaty Council, the United States sought to clear title to lands; the Nez Perce sought to reserve and maintain a homeland (“Reservation”) and reserve its aboriginal rights and way of life. The Nez Perce would not have signed this treaty without first receiving assurances that these rights, including the right to fish, would be protected into the future. Additional treaties between the two sovereigns have been made, but the reserved fishing right has remained unchanged since 1855.

In its 1855 Treaty, the Nez Perce reserved a significant portion of their aboriginal land (about 8 million acres). And, this Nez Perce homeland contained, as the United States recognized, many of the best fisheries:

Gov. Stevens said: “Here (showing a draft on a large scale) is a map of the Reservation. There is the Snake River. There is the Clear Water river. Here is the Salmon river. Here is the Grande Ronde river. There is the Palouse river. There is the El-pow-wow-wee. This is a large Reservation. The best fisheries on the Snake River are on it... ”.

Moreover, in addition to this homeland, Nez Perce leaders insisted on reserving off-reservation hunting, fishing, gathering, and pasturing rights. The minutes of the treaty negotiations reflect

Governor Stevens' repeated assurances, on behalf of the United States, that the treaty would reserve these off-reservation rights to the Nez Perce Tribe:

You will be allowed to pasture your animals on land not claimed or occupied by settlers, white men. You will be allowed to go on the roads, to take your things to market, your horses and cattle. You will be allowed to go to the usual and accustomed fishing places and fish in common with the whites, and to get roots and berries and to kill game on land not occupied by the whites; all this outside the Reservation:"

Gov. Stevens said: "I will ask of Looking Glass whether he has been told of our council. Looking Glass knows that in this reservation settlers cannot go, that he can graze his cattle outside of the reservation on lands not claimed by settlers, that he can catch fish at any of the fishing stations, that he can kill game and can go to Buffalo when he pleases, that he can get roots and berries on any of the lands not occupied by settlers..."

Fish, as a staple of the Nez Perce diet, have always been an integral part of the Nez Perce society. Principal to the Nez Perce diet were the anadromous fish species that inhabit the rivers of the inland northwest. This is corroborated by other existing information such as those from federal court proceedings.

For example, in its 1967 decision concerning the Nez Perce Tribe, the Indian Claims Commission (ICC) made comprehensive findings based on detailed anthropological evidence from both the United States and the Nez Perce Tribe, of the Tribe's area of "exclusive use and occupancy" and "aboriginal ownership". The ICC determined that the Nez Perce had "exclusive use" and occupancy of 13,204,000 acres of land and "that salmon fishing was one of the major sources of subsistence since the main rivers through the area, which include the Snake, the Clearwater, the Salmon, and their branches, were well supplied with this fish in aboriginal times." It also concluded that their seasonal "cycle consists of specific times of the year for fishing for salmon, digging camas and other roots, hunting the game"; this "economic cycle can generally be summarized as ten months salmon fishing and two months berry picking, with hunting most of the year."⁵

During the time that the treaty was negotiated, the salmon resource reserved by the Nez Perce came from "...river systems that were biologically functional and fully productive..." (Meyer Resources, Inc., 1999). The decline of salmon productivity since the mid-1800's to present, does not alter, change, or abrogate the Nez Perce treaty right to take fish. This right to take fish represents an inherent right that the Nez Perce have held since time immemorial. The fishing right is as important to the Nez Perce today as it was before contact with non-Indians.

The Nez Perce governed where fishing occurred, how many fish were to be harvested, who could participate, how to use the resource, and ways to honor and perpetuate the resource. They developed ways to harvest large amounts of fish. These were documented as proven methods to catch the substantial numbers of salmon and steelhead (as well as other species of fish). The complex, elaborate, and efficient Nez Perce fishing techniques described below document the

⁵ The ICC was created by Congress in 1946 to hear claims by Indian tribes for, among other things, compensation for the taking of aboriginal lands by the United States without fair payment. Compensable aboriginal title was required to be based on "actual and exclusive use and occupancy 'for a long time' prior to the cession, transfer, or loss of the property." It provided historical information regarding Nez Perce village sites, uses of natural resources, and range and extent of natural resource use.

extent of their reliance on this valuable resource and the importance of fish to its society and cultural identity.

Whenever possible, the Nez Perce historically and contemporarily have regularly fished for the following species: Chinook, Silver, Coho, and Sockeye varieties of salmon; Dolly Varden, Cut Throat, Brook, Lake, and Rainbow varieties of trout; several species of suckers, white fish, sturgeon, squaw fish, lampreys, and some shellfish (freshwater clams). In order to harvest these fish species, the Nez Perce developed a number of fishing techniques and methods: weirs and traps; dipping platforms (either natural or man-made); fish walls and dams; canoes; spears; hook and line; gaffs; and variety of nets (dipnets, set nets and throw nets).

The expansive territory of the Nez Perce people was rich in rivers and streams abundant in fish life. Bands fished from the Snake, Salmon, Clearwater, Imnaha, Grand Ronde, Selway, Tucannon, Rapid River and many other rivers within and outside its homeland and territory. As with other tribes, the Nez Perce did not limit their fishing to salmon. Research has been conducted by a number of people in an effort to determine how many fish were historically harvested by the Nez Perce. There are a number of methods to estimate amount of fish harvested and consumed by the Nez Perce (commonly expressed in numbers of fish harvested and annual per capita consumption). Anthropologist Deward Walker, Jr. estimated that each Nez Perce consumed over 500 pounds of fish each year (CCRH, 2013).

Others (as cited in Scholz et al., 1985) have estimated an annual per capita fish consumption for the Nez Perce Tribe of 1,000 pounds per year. This range of rates is equivalent to fish consumption rates of about 620 to about 1,240 grams per day. These values are represented as “pounds per capita”. While estimates, this illustrates the general magnitude of harvest that occurred.

In addition to salmon and steelhead, the Tribe has traditionally harvested Snake River white sturgeon for subsistence purposes. Tribal elders confirm the historical presence of white sturgeon throughout the Snake River, mainstem Salmon River, the Clearwater River from its mouth to above Orofino, Idaho, as well as seasonal migrations into the Grande Ronde River (Elmer Crow, Nez Perce Tribe Department of Fisheries Resources Management, Personal Communication, 2014). In addition to being an important food source, white sturgeon served many purposes in the culture of the Tribe. White sturgeon blood was used to make glue; the hides were used for bow cases and quivers, and for water proofing footwear. However, subsistence fishing has been severely limited as a result of low white sturgeon numbers between Hells Canyon and Lower Granite dams (all as cited in NPT, 2005).

The traditional way of life for the Nez Perce (e.g. gathering, harvesting, ceremonies, and traditions) depends on continuance of the circle of life for all native species (plants and animals). To the Nez Perce the rights reserved under the Treaty of 1855 must be protected such that the enjoyment of these rights resembles that envisioned by the treaty signers and Nez Perce leaders.

2.3 Causes of Decline in Fish Populations

Nez Perce tribal elders believe that one of the greatest tragedies of this century is the loss of traditional fishing sites and Chinook salmon runs on the Columbia River and its tributaries. They believe the circle of life has been broken and ask us to consider what the consequences of breaking that circle may mean for future generations. In many ways the loss of the salmon mirrors the plight of the Nez Perce people. The elders remind us that the fates of humans and

salmon are linked (Landeem and Pinkham, 1999). This dependence on fish to meet dietary, spiritual, and basic subsistence needs is still a prevailing necessity of Nez Perce life. To this day, the right to a “fair share” of the salmon harvest by the Nez Perce Tribe does not occur because of the impacts to these fish by non-Indian activities and development in the Columbia and Snake basins.

The Nez Perce lived in the heart of salmon country – along the Salmon, Snake, Grande Ronde, Imnaha, Clearwater and Tucannon rivers; which historically were major salmon and steelhead producers. The Nez Perce have lived through and experienced the extirpation of entire populations of fish by blocking and altering of thousands of miles of rivers and streams as result of dams. The Hells Canyon, Oxbow and Brownlee on the Snake River, Wallowa Lake Dam on the Wallowa River, Dworshak Dam on the North Fork Clearwater, the eight major dams on the Columbia and Snake rivers, and the many other smaller projects, have individually and collectively impacted fish, and thus the Nez Perce ability to fish for them.

The environment and water that support fish has been altered due to human development and enterprise over the past century and a half. This human progress has come at a cost to the fish species and “salmon people.” Current productivity of salmon- producing streams is much lower than it was historically. Many of the fish species either face extinction or are in seriously depressed conditions. As a result, tribal harvest in the present day is only a very small fraction of what the Nez Perce harvested in the mid- 1800’s. Although hard to quantify, it is probable that until recently harvest has been less than 1% of historic harvest levels prior to 1855.

Causes contributing to salmon and steelhead decline encompass a variety of human activities and anthropogenic and natural phenomena. These include the following: commercial, recreational and subsistence fishing; freshwater and estuarine habitat alteration due to urbanizing, farming, logging, and ranching; dams built and operated for electricity generation and flood control; water withdrawals for agricultural, municipal, or commercial needs; stream and river channel alterations; hatchery production; predation by marine mammals, birds, and other fish species; competition with other fish species; diseases and parasites; and reduction in annual nutrient distribution from spawned-out salmon to the local ecosystem. These activities continue to affect fish.

Salmon and steelhead runs in the Snake Basin are not as abundant or productive as they were historically. Snake River Chinook salmon (spring, summer and fall runs, and sockeye) and steelhead are listed under the Endangered Species Act (ESA). Coho and Chinook salmon were extirpated in the Clearwater River subbasin in the 1990s, and steelhead were at very depressed levels.

Snake River spring/summer Chinook salmon were historically found spawning in the Snake River tributaries of the Clearwater, Salmon, Weiser, Payette, and Boise Rivers. A review of run size for Snake River of spring/summer Chinook salmon is provided by Matthews and Waples (1991). Their summary of research on run size reports historic runs in the Snake River probably exceeded one million fish annually in the late 1800s. By the mid–1900s, the abundance of adult spring and summer Chinook salmon had greatly declined to near 100,000 adults per year in the 1950s. Since the 1960s, counts of spring and summer Chinook salmon adults have declined considerably at the lower Snake River dams (IDFG, 2013).

The construction of hydroelectric dams on the main stem Snake and Columbia Rivers blocked access to nearly half of the historic spawning habitat and reduced survival of juveniles and adults

migrating to and from the ocean. Additional effects from hydroelectric dams and water storage projects have resulted in altered hydrographs and water temperature regimes affecting run timing of juveniles and adults. Diversions in spawning and rearing streams have caused direct mortality, loss of habitat and migration barriers. Land management activities have resulted in degraded habitat with the loss of riparian cover, sedimentation and artificial barriers to passage. The addition of hatchery programs to mitigate for lost habitat and survival of fish have introduced genetic concerns about effects to wild stocks. Declining water quality from increasing development in and along river and tributary streams can affect fish populations. Introductions of non-native fish in some waters can increase predation and competition with juvenile fish (IDFG, 2013).

Salmon runs in the Clearwater River Subbasin were virtually eliminated by the construction of hydroelectric dams (Mathews and Waples, 1991). In 1910, the Harpster Dam, constructed on the lower South Fork Clearwater River, prevented all fishes from returning upstream of Harpster, ID, and eliminated access to over 95% of the watershed and its high quality spawning grounds (Schoning, 1940). In 1927, the Washington Water Power Diversion Dam constructed just above the mouth of the Clearwater River eliminated all upriver salmon runs (Parkhurst, 1950; USFWS, 1962). A crude fish ladder was built on the lower Clearwater River dam, which allowed steelhead passage during higher flow periods, but proved almost impassible during lower flows when salmon arrived (Parkhurst, 1950). The ladder was not modified for a period of 12 to 14 years; eliminating all late returning fish, like coho and fall Chinook salmon (all as cited in Everett et al, 2006).

The cumulative loss of anadromous fish to the Nez Perce Tribe as a result of these two dams was substantial (Cramer et al., 1993). The Harpster Dam was removed in 1963 and the lower Clearwater River dam was removed in 1972, making available most of the salmon production areas in the drainage. However in 1971, Dworshak Dam was built just upstream of the mouth of the North Fork Clearwater River. Dworshak Dam lacks fish passage, resulting in the permanent loss of productive salmonid spawning aggregates and high quality habitat. The lower Clearwater River temperature regime continues to be altered by Dworshak Dam, resulting in warmer water in the winter and cooler water in the summer (Arnsberg et al., 1992, Arnsberg and Statler, 1995; all as cited in Everett et al., 2006).

Currently, a majority of the fisheries that occur in the Snake River basin are supported by hatchery programs. All of the anadromous fish hatcheries in the Snake River basin are mitigation hatcheries for the development of hydroelectric dams. All of the returns from these hatcheries pass through or return to the Nez Perce Tribe's usual and accustomed fishing places.

2.4 Vision for the Future

The Nez Perce Tribe has a vision of restoring all fish species native to the Nez Perce Treaty Territory. To that end, the Tribe has engaged in management of all fish species- both resident and anadromous - for all streams, lakes and watersheds within their management authority. The Tribe is involved in these efforts to protect implementation of treaty rights, to restore species and conditions consistent with the treaty, and to protect the long-term productivity of their natural resources.

Today, maintaining a healthy 13-plus million acre watershed and improving survival of salmon and steelhead under the auspices of the 1855 Treaty, rests with the Tribe's Department of Fisheries Resources Management program and policy direction from the Nez Perce Tribal

Executive Committee (NPTEC), the governing body of the Nez Perce Tribe. Native fish within the Nez Perce Country depend on healthy habitats, healthy watersheds, and healthy ecosystems. Sound fisheries and habitat management actions will be implemented to improve survival, production, recovery and restoration of all populations of native anadromous and resident fish species and their habitats throughout the Nez Perce Tribe's usual and accustomed fishing places. It is the Tribe's desire that all species and populations of anadromous and resident fish and their habitats will be healthy and harvestable throughout the Nez Perce Tribe's usual and accustomed fishing places.

As described in the Department's Strategic Management Plan (NPT, 2013), Tribal member use of and access to all treaty rights and resources guaranteed under the Treaty of 1855 guide's the department's restoration program and actions:

- All native anadromous fish and resident fish have had long-standing cultural significance to the Nimiipúu, including: subsistence value, ceremonial and spiritual value, medicinal value, economic or commercial value, and intrinsic value.
- Native fish populations thrive best under natural or normative conditions to which they are best adapted.
- Natural ecosystems have been and will continue to be increasingly stressed and altered by human activities and population levels.
- When historic natural conditions are not achievable, altered ecosystems should function adequately enough to maintain harvest opportunities.
- The entire life cycle of a species must be successfully carried out (from egg through adulthood) for that species or population to persist.
- Failure to serve a species' needs, at any life history stage, can lead to extirpation of populations.
- Federal governmental agencies have treaty trust responsibilities; their actions must recognize the treaties as federal commitments and their actions must be taken in support of a tribe's ability to exercise rights guaranteed in the treaties.

The following goals seek to secure the integrity of populations and habitat features essential to anadromous and resident fish:

- Achieve and maintain fish abundance in tributary-specific areas at levels sufficient to support: 1) population persistence, 2) harvest, and 3) ecological processes.
- Achieve and maintain diverse and productive ecosystems with species composition and productivity consistent with historic conditions.
- Achieve and maintain adult spawner distribution consistent with historically utilized tributaries (includes within and across tributary spatial scales).
- Achieve and maintain fish population genetic diversity at levels adequate for population persistence and consistent with historic conditions.
- Ridge top to ridge top watershed protection and restoration for rearing and spawning habitats and protection of water quality.
- Supplementation approach "putting fish in the rivers" with hatchery tool.
- Protection and providing flows, water quality and passage for upstream and downstream migrants.
- Participate in Pacific Salmon Treaty and US v Oregon for ocean and in-river harvest management.

- Allow an abundance of spawners to protect the resource for future generations.
- Monitor our activities and the runs to determine how things are faring.
- Harvest opportunities currently available will be protected and enhanced.

The Nez Perce Tribe continues to protect and enhance abundance of fish through natural production and artificial production in the form of hatcheries. Hatcheries for salmon and steelhead in the Columbia Basin were developed as a necessary mitigation tool to compensate for the fishery losses that resulted from the impacts of increased human settlement that began soon after ratification of the Treaty of 1855.

Accordingly, hatcheries represent a promise to those who have always depended on the salmon for culture, sustenance, and livelihood to replace the fish that are and were diminished as a result of human development of salmon habitats. In the Snake River Basin, all but one of the hatcheries (Kooskia), were built specifically to mitigate for the impacts of the development and operation of hydroelectric dams (Dworshak, Brownlee, Hells Canyon, Oxbow, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville dams). These hatchery programs play a very important role in meeting congressionally mandated mitigation obligations and treaty trust responsibility to protect and maintain tribal treaty reserved fisheries.

The Department has been a leader in implementing supplementation programs and hatchery reform. Tribal goals for supplementation programs are: increased abundance (both total and natural origin) and spatial structure; maintenance of culturally and economically important tribal salmon fisheries; contribution to non-Indian fisheries; and restored ecosystem processes and health.

The Fisheries program has over 150 employees and operates on a budget derived from more than 50 contracts. There are 7 divisions within the program: Administration, Conservation Enforcement, Harvest, Production, Research, Resident Fish and Watershed. The Fisheries program works throughout the ceded lands and has offices in Powell, Red River, Grangeville, Orofino, McCall, Sweetwater, Lapwai and Joseph, OR. Tribal staff coordinate and interact with State, Federal and Tribal agencies and committees and private entities in assessing and implementing fish recovery and restoration plans and actions.

The Department has engaged in a significant body of work throughout its U&A areas – implementing more restoration actions within the Snake River basin than perhaps any other single entity or agency. The aquatic habitat is subject to a diverse array of natural and anthropogenic influences and impacts and given the synergistic effect of watershed health on aquatic habitat quality, the Department employs a “ridge-top to ridge-top” approach to restoration.

The Department adopted abundance-based reference points (thresholds) for certain anadromous fish to assist in development of long-term management strategies and to guide the implementation of short-term management actions to achieve both broad and population-specific salmon rebuilding goals. Adult salmon abundance (or escapement) objectives are our primary measure for quantifying goals and are generally defined as the number of adults and jacks in each population that return to their river of origin.

These identified abundance thresholds serve as useful decision criteria that trigger specific actions (e.g. harvest rates or initiation and other management actions). Populations at very depressed to critically low levels require “more aggressive actions and demand a more rapid

population response than populations fluctuating at higher, less risky levels of abundance.” Reference abundances or population designations specified in this section include the designated escapement objective, and the ecological escapement objective for four focal species, spring/summer Chinook, steelhead, and fall Chinook (see Table below). The following are descriptions for each threshold type.

- Viable abundance thresholds are considered the size at which a population maintains essential genetic diversity, and at which there is negligible risk of long-term extinction given contemporary levels of environmental variability. They are the minimum abundance for a healthy population.
- Sustainable Escapement Objectives describe the numbers of returning adults that would annually sustain substantial spawning as well as harvest for tribal and non-tribal fisheries. It is assumed that escapement sizes reflecting these values would also encompass healthy tribal and non-tribal fisheries downriver.
- Ecological Escapement Objectives refer to the escapement level at which sustainable spawning abundance is maximized within a population, the full utilization of available spawning and rearing habitat is promoted, and the ecosystem-level processes (e.g., nutrient redistribution) for multiple species are fostered. Historical salmon and steelhead escapement to the Columbia and Snake river basins was 8-16 million and 500,000 - 2 million, respectively (NPPC, 1986; CBFWA, 1990; Chapman, 1986; Fulton, 1968). According to tribal knowledge, escapement at those historic levels to tributary-specific areas resulted in “fish so thick you could walk across their backs.”

The following table depicts these abundance thresholds for certain fish species.

Table 2-1. Abundance Thresholds for Certain Snake River Anadromous Fish

Species	# Major Population Group	# Population(s)	Viable Abundance	Sustainable Harvest Goal	Ecological Escapement Goal
Spring/Summer Chinook	7	41	31,500	215,900	669,000
Fall Chinook	1	1	3,000	39,110	86,300
Steelhead	6	25	25,500	330,200	602,000

The Nez Perce Tribe intends to increase and expand the level of harvest or fishing areas for salmon and steelhead at all Nez Perce usual and accustomed places, including those in the Snake Basin, in a way that balances conservation needs of the fish with the right to take fish. This can be achieved through a biologically-sound harvest management philosophy and harvest rate schedules keyed to the status and trends in abundance and productivity of fish resources. Generally, abundance-based tribal harvest strategies can be designed to account for annual variation in total fish run size and run composition. This is illustrated in the Figure below.

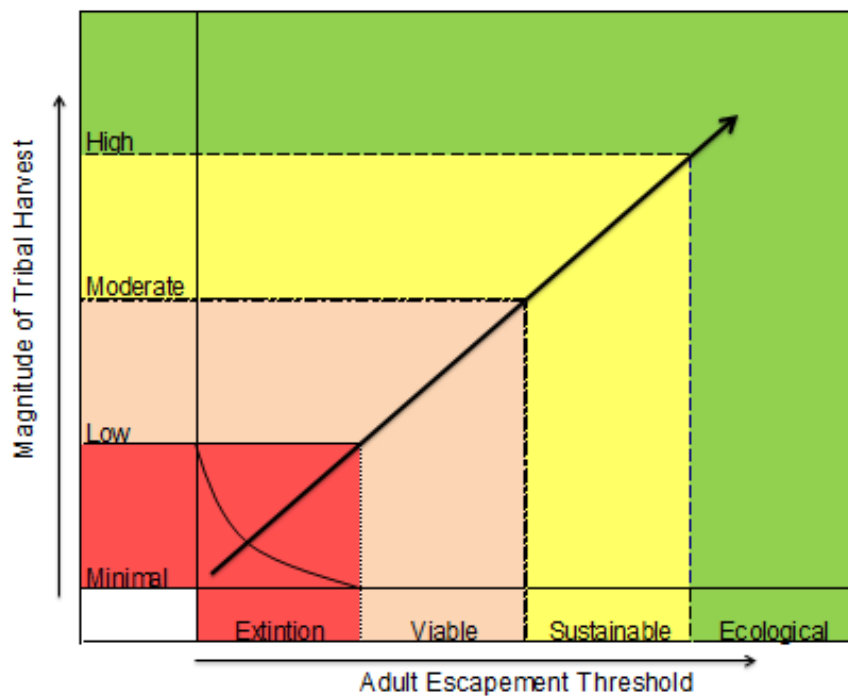


Figure 2-1. Abundance-Based Tribal Harvest Goals

As returns increase, the Nez Perce Tribe expects to increase the relative magnitude of tribal harvest and fishing effort and fish consumption.

When restoration efforts result in sustainable returns, the Tribe anticipates that Tribal harvest will increase and fish consumption rates will rise when fish populations attain “sustainable abundance” and “ecological abundance” levels of adult escapement. Ultimately, the goal is to achieve a harvest consistent with pre-Treaty harvest levels. Simply put, the Tribe’s goal is to rebuild the Snake River fishery to healthy, self-sustaining levels that will in turn support sustainable treaty fisheries.

2.5 Estimating Heritage Fish Consumption Rates

Based on discussions with Tribal representatives and other experts on the issues of suppression and heritage fish consumption rates, the survey design team recommends that, as part of the survey implementation phase, heritage fish consumption rates be estimated for each of the individual Tribes. The design team believes that current survey respondents may provide useful information and context regarding heritage consumption rates, but that the approach to estimating heritage rates should be primarily based on a comprehensive review and evaluation of literature that is relevant to heritage rates, including historical accounts and modern studies of heritage consumption rates.

For Tribes that harvest fish from the Columbia River basin, there is a significant volume of literature to form the basis for quantitative estimates of fish consumption rates, or ranges of rates. Information includes ethnographic studies, personal interviews, historical harvest records, archaeological and ecological information, and nutritional and dietary information.

During project implementation, the survey team will compile and evaluate relevant available information regarding heritage consumption rates specific to the NPT. The development of estimates of heritage rates should include a thorough discussion of the types of information available regarding consumption, a discussion of the methodologies used to develop the estimates, and a discussion of factors affecting the uncertainty associated with the estimates. Finally, the implementation team should develop a quantitative estimate of a heritage fish consumption rate or range of rates for the Tribe.

One aspect of the quantitative assessment will be a compilation and analysis of historic and heritage information across the region (primarily for the Idaho Tribes). The purpose of this compilation and analysis will be, to the extent possible, to reduce the uncertainty associated with individual heritage rates or update the rate calculations by a statistical methodology that uses data for multiple Tribes, locations, and times. An analysis which shows consistency in relationships among these variables will support the individual heritage rates. Further, it may be possible to estimate a range of rates for the Tribe based on a joint (multivariate) analysis of heritage, including tabular and graphical displays and numeric estimates of a plausible range.

3.0 SURVEY DESIGN: TARGET POPULATION

This section describes the survey design approach as it relates to the target sample population and sampling frame, including phasing in of multiple surveys.

3.1 Target Population to be Sampled

The target population for the survey is enrolled adult members of the NPT, age 18 and over. The population to be sampled in this survey can be tentatively defined as enrolled adults (age 18+) who live within a specified geographic area around the NPT Reservation, e.g., a distance reflecting up to a reasonable drive time, such as 1-2 hours. While a distance cut-off may appear arbitrary for a population definition, some kind of practical cut-off is needed, since some tribal members may reside at great distances from the reservation. Distance will be defined by zip code or location of residence in relation to a central site for interviewing. The site or sites will be identified in cooperation with the Tribes. Due to the expected high correlation of diets and the substantial time per interview, the survey will be limited to enrolled tribal members and will not include non-tribal spouses or other non-tribal adults. The residential location of all members will be checked with the Tribes just prior to the sample selection. The specific tribal members in the population to be sampled will be identified from the Tribal enrollment roster in cooperation with the Tribal authorities.

Among the adult population, there will be a sub-population of non-consumers of fish, and these people would be detected in an initial telephone screening (described in Section 4.4.1). For the non-consumers, defined as those who have not eaten fish in the last year, the screening will determine the reasons for non-consumption, such as taste (dislike of fish), concern about advisories or pollution, or other reasons. No further information will be collected for non-consumers (some demographic information will be available from the tribal enrolment roster), and the main focus of the effort on the fish consumption survey will be confined to fish consumers only.

An exclusion from the sample, if they should be selected in the sampling process, is persons living in an institutional setting (e.g., nursing homes). The reason for the exclusion is that in this special population, expected to be small, a totally different questionnaire and data collection method would be needed. Secondly, an institutionalized person is usually not free to make decisions about their fish consumption, and it is not clear to what extent that consumption represents the tribal way of life.

Another exclusion is the tribal sub-population of children and young adults (age <18 years). This demographic group has been excluded at this time to avoid a potential insufficient sample size in an effort to shorten an already detailed and lengthy interview process for each adult interviewed and collectively ensure an adequate number of adult interviews within the resources available.

3.2 Phasing-in of the Survey

The design team recommends that the survey implementation be carried out in phases, with one or two Tribes selected initially to start. It is likely that a great deal will be learned about what works well and what does not work during the early part of the survey. While the survey design is certainly intended to provide an excellent framework for all of the Tribes, it is inevitable that important working points will be learned as the implementation team proceeds, collaborating with these unique populations. Thus, the survey might start with one or two Tribes and then proceed to a second and a third, etc., at short intervals. Alternatively, the survey may start with

one Tribe but then proceed with the other Idaho Tribes with a modest delay after that. This is a decision that is best made closer to initiation of the survey. The survey team will communicate with tribal fishery staff to determine the several seasons of fishing and fish consumption. The survey will be scheduled to overlap significant seasonal periods.

3.3 Sampling the Population

The enrollment roster of the NPT will be the sampling frame and basis for sample selection. The roster is expected to be reasonably complete and up to date, since tribal membership includes benefits that motivate enrollment. The enrollment roster is expected to include age, birth date, gender, address (including zip code) and other fields.

The population to be sampled will be limited to specified zip codes or other location indicators. As noted earlier, the locations will be selected in order to accommodate a reasonable amount of travel time for members to attend a central site for interviewing. It may be possible for some interviews to be conducted closer to or at a respondent’s home when there are issues of health and ability to travel.

The Nez Perce Tribe has supplied the data on their adult population counts by zip code of residence. The design team will use the data to fill in Table 3-1 for the NPT. The table will help the design team and the Tribes to decide on the geographic area from which survey participants will be selected.

Table 3-1. Number of adult Tribal members by distance from Tribal reference point defined by zip code of residence

Distance (miles)	No. of members	Zip codes included
<5	N	11111, 22222, 33333, etc.
5 to <10	N	44444, 55555, etc.
....
40 to <50	N	88888, 99999, etc.
Etc.		

1. Sample Stratification

The eligible adult population (defined by age 18+ and an eligible zip code of residence) will be sampled using stratification. “Strata” are simply population groups defined by some characteristic. For example, six strata might be defined by age and gender to include young adults, the middle aged, and Tribal elders, classified separately by each of the two genders. One use of stratification is to insure that the sample will represent the population faithfully. For example, if six strata (not necessarily age-related) cover the whole population and have about one-sixth of the population each, then one-sixth of the sample can be drawn from each stratum.

An ideal stratifying factor for this survey would be defined by an *a priori* indication of level and frequency of fish consumption. High-level consumers are needed since there is particular interest in the higher percentiles of fish consumption, which the high consumers would tend to define.

Secondly, as explained later, frequent consumers (who also tend to be high-level consumers) are needed for the survey’s planned use of a particular method (National Cancer Institute or NCI method) to estimate the fish consumption distribution from two or more 24-hour dietary recall interviews. In the use of the methodology to analyze the 24-hour recall interview data, it is important to have enough respondents with two days of fish consumption. Currently, age, gender, and location (defined by zip code) are the only candidates in the roster for the NPT that might define higher vs. lower level consumers. Fish consumption rates in relation to age show mixed results for the Native American surveys in the Pacific Northwest. Thus, the phone screening process (Section 4.4.1) is needed to identify frequent consumers who may, then, have a higher probability of consuming fish on the second of the two days of 24-hour dietary recall. The second interview will occur within a time window (yet to be specified) probably of one to four weeks after the initial interview. The time window will be selected to yield an independent eating occasion but not so long that seasonal effects (e.g., associated with fish availability) will influence fish consumption.

Strata will be defined by the combination of age, gender, and frequency of consumption, with frequency determined from the phone screening process. The age-by-gender composition of the NPT has already been provided by the Tribe. The age group breakdown will be helpful in forming initial strata, which will then be sub-divided by at least two frequency categories, such as consumption of fish ‘two or more times/week’ vs. ‘less than twice per week.’ Again, these strata will both insure that the population can be well represented by the sample selected, and in addition, allow over-sampling of the high-frequency strata. An oversimplified stratification is shown in the table below.

Table 3-2. Hypothetical strata based on three stratifying factors: age, gender and frequency of fish consumption

Stratum	Gender	Age group	Consumption frequency
A	Male	18-44	< 2x per week
B	Male	18-44	≥ 2x per week
C	Male	45+	< 2x per week
D	Male	45+	≥ 2x per week
E	Female	18-44	< 2x per week
F	Female	18-44	≥ 2x per week
G	Female	45+	< 2x per week
H	Female	45+	≥ 2x per week

2. Sample Selection

Once the strata are defined in terms of age, gender and frequency of consumption, potential respondents for screening will be selected randomly from each age-gender stratum (combining the frequency strata). If there are appropriate non-disclosure agreements and adequate security and confidentiality procedures in place, and if the NPT agrees, a copy of the enrollment file with fields needed for sample selection can be transferred to the implementation team and then

deleted (including derived files) after there is no further need for the file or after a mutually agreed period has expired.

If the NPT does not wish to “loan” the enrollment file for sample selection purposes, an alternate procedure of sample selection can be used. In order to preserve the confidentiality of Tribal members listed in the electronic enrollment file, the enrollment office will be asked to take the following steps.

1. Apply any member exclusions (such as non-eligible zip codes and persons less than 18 years of age) and save a copy of the resulting file.
2. Add a field defining age and gender for each person. These strata labels will appear for each person in the file.
3. Sort the file in random order. Almost any random sort software can be used here.
4. Starting with the randomly sorted file from the previous step, add a field with a new sequential survey identification number (“surveyID”), which should be a sequential number, e.g., 1, 2, 3, The correspondence between this unique survey ID number and the Tribes’ unique ID number will allow communication between the survey implementation team and the enrollment office, as needed. Due to the random sort prior to this step, the assigned survey ID number will be non-informative about any member characteristics—a helpful step in preserving confidentiality.
5. Save a file which contains only the new survey ID number, and selected demographic data (e.g., gender, age in grouped categories). Transfer this file to the implementation team.
6. The implementation team will select the sample from the file provided by the Tribe and return the file of the selected sample to the Tribe. The implementation team will work with the Tribe to generate a list of the sample suitable for phone screening (including names and contact information).

The implementation team will select the specified respondent count for screening from each stratum by random selection. This process should be carried out under the supervision of the statistician working with the implementation team. See the section on sample size for the specified sample count for the NPT.

The random selection process will generate a list of potential respondents for the screening step. This screening list will include 3 to 5 times as many individuals as the ultimate effective sample size, since a number of individuals may need to be screened to identify each frequent consumer. The screening list will be divided into 4 to 5 sections corresponding to waves of screening. Within each section, the age-by-gender composition of the list will be similar to the composition of the Tribe.

By screening in several waves, the implementation team can examine initial results to better understand the population as well as determine what screening methods will yield a higher percentage of frequent consumers from the first or early waves. This allows the team to refine a sampling plan so that resources are allocated most effectively. For the 24-hour recall component of the interviews, it is especially important to obtain a large enough number of people who consume fish on both recalls. The implementation team will need to focus the selection effort on identifying people who are likely to meet this condition in order to provide the best chance of

obtaining data suitable for use with the NCI method. After the initial full interview, frequent consumers can be given a higher probability of selection for the additional second 24-hour recall interview. All initially interviewed respondents (supplying food frequency interview and an initial 24-hour dietary recall report) will have a positive probability of selection for the second 24-hour recall. However, frequent consumers will be assigned a higher probability of selection. While all respondents supplying an initial 24-hour dietary recall will have some probability of selection for the second 24-hour recall, not all of them will be selected. Nevertheless, all of those selected for the second 24-hour-recall will be selected on a probability basis from the first recall and not by a categorical selection that absolutely excludes some first-recall respondents.

A list of respondents to be interviewed in person (in waves, corresponding to the sections of the screening list) will be generated by the screening process. The initial screening list will be turned over to Tribal members hired to help with the survey, and they will carry out the screening process under the direction of the implementation team.

4.0 SURVEY DESIGN: DATA COLLECTION

This section describes the survey design approach as it relates to the survey method, measurement method, sample size, and questionnaire development.

4.1 Survey Methods

Based on our experience, in-person interviews are superior to many other survey research modes for many reasons; however, for most studies, in-person interviews are cost prohibitive and a compromise must be achieved between “best practices” and budget constraints. In-person interviews allow the respondent to see survey aids (in the case of this study, photographs and models) and to establish a face-to-face connection with the interviewer. In addition, respondents generally tolerate longer in-person interviews than telephone or other interview modes (Doyle, 2005).

1. Selection of In-Person Interviews vs. Other Methods

Based on a review of the literature and decades of experience, we have identified several possible modes for this study. Below is an examination of various modes but, in a summary, we recommend in-person interviews for this survey. They are a superior solution for this project due to their inherent cultural advantages and the expected length of the interview for this survey.

Although mail surveys are generally less expensive than other modes (in-person, telephone, online), they suffer from poor response rates. Without a staff member prompting the potential respondent to complete the interview, it is very easy for recipients to discard the questionnaire without opening it. Further, self-administered mail questionnaires are rife with opportunities for respondents to provide incorrect, improper, or no answers to questions that they do not understand or do not care to answer. A telephone interview, an in-person interview, and online interview can all be structured in a way to alert the respondent when they’ve failed to answer a question or gone outside the choice parameters—a mail questionnaire cannot do that. Based on our research, mail questionnaires are insufficient for high-quality data collection, especially for long interviews. (The anticipated length of this interview is approximately one hour.) Finally, mail surveys exclude members of the target population who are not literate.

Telephone studies are a popular mode of survey research, allowing for centralized management of the sample frame, the interviewers, and project administration. Telephone surveys, when programmed with computer-assisted telephone interviewing software, can include complex skip patterns and other calculations which are less feasible with mail surveys and in-person interviews. Telephone studies allow convenient monitoring and supervision of the interviewing staff, ensuring consistent administration of the questionnaire. However, telephone studies lend themselves to social desirability bias, the notion that a respondent seeks to provide answers which will increase the likelihood that the interviewer “likes” the respondent (Maguire, 2009). Further, telephone studies are limited to respondents with telephones, obviously; it is difficult to ensure 100% coverage within the sampling frame if it is based on the telephone alone.

The telephone approach also has another disadvantage for dietary surveys. With a telephone interview it is more challenging to use visual aids for identifying species and quantifying portions. While materials might be mailed or emailed in advance of the interview, that is another level of complexity for the survey and the respondent, and it may be difficult to have the proper conjunction of pre-sent materials and the specified interview appointment. Further, the planned

interview goes into some detail on a number of topics and the hour or hour-plus duration of a phone interview may lose cooperation and accuracy of reporting.

2. Use of Photographs and Portion Size Models

There are different ways to measure respondent food consumption, including administering questions verbally, with or without visual aids. The use of aids such as photographs and portion size models is a well-accepted measurement device when collecting respondent-reported data. This is consistent with other, large-scale, ongoing survey research projects, such as the National Health and Nutrition Examination Survey (NHANES), which uses portion size models for its initial in-person 24-hour dietary recall. The portion model representation will include composite dishes, such as stews, chowders and other mixtures.

In order to ensure the most accurate self-reported data about past food consumption, we strongly recommend the use of either photographs, portion size models, or a combination of both for this survey. Although photographs lack the tactile and 3-dimensional visual appeal of portion size models, they have been shown to be equally as effective (providing accurate measurement) as portion size models (Thompson and Subar, 2013). During the pilot test, portion models should be used to verify their efficacy.

The design team is collecting displays to use as species and portion-size choices for use in the interviews. See Section 4.4.6 for more information about development of these portion size models and other visual displays that will be useful tools for respondents to indicate fish consumption types and quantities during survey implementation.

3. Use of Tribal Interviewers

This project represents an important step in the evaluation of fish consumption among native populations in Idaho. To encourage participation from respondents, professional interviewers will administer the questionnaire to each respondent. The interviewing staff will be selected, hired, and trained from among NPT members. Tribal representatives reported that Tribal interviewers are necessary to gain and maintain respondent trust. Further, Tribal interviewers are familiar with the local area.

Complementary goals during the survey include decreasing respondent burden and increasing respondent comfort. We expect that an interviewer who shares heritage with the respondent can more easily identify and adhere to cultural norms and sensitivities. The interviewer may be more attuned to the respondent's background, living situation, and local conventions and events. In short, we expect greater affinity between respondents and interviewers who are from the same Tribe than between respondents and interviewers who are not Tribal members. Additionally, this study covers a broad geography in rural Idaho. In addition to our efforts to match interviewers to anticipated socio-demographic characteristics of respondents, by using local Tribal interviewers, study and travel costs may be reduced.

4.2 Measurement Method

The survey will use two methods to measure current fish consumption. The first method will be based a food frequency questionnaire (FFQ) which ascertains species-specific frequency of consumption and typical quantities eaten per eating occasion. The questionnaire will also allow these quantities to vary by 'season' with up to two periods per species. A 'season', as the term is used here, is one or more periods when the respondent reports consuming fish at a rate different

than that of other periods during the year. Some species may be consumed by a particular respondent year-round at about the same rate, and that respondent would have one season (over one year) for that species. Consumption on ceremonial occasions and other special events will be covered by separate questions. See the questionnaire section of this document for the questions and wording of the FFQ (Appendix A).

The principle behind the FFQ is as follows. Briefly, a respondent's frequency of occasions of consumption of fish (per day, week, or month) multiplied by the typical quantity eaten per occasion will give the total quantity eaten per day, week, or month. This quantity is easily converted to total annual consumption, which, divided by 365 days, will yield an average quantity of the given fish species eaten per day. A straightforward extension of this basic method, described later, can include seasonal variation and consumption at special events.

The strength of the FFQ is that average frequency and quantities of fish consumption are reported directly by the respondent. The weakness of the FFQ is that the respondent is relying on memory and must internally average their varying frequencies and varying quantities of consumption to come up with 'typical' values.

The second method is based on the respondent's recall of fish consumption during two or more specified 24-hour periods. Each period is the day before an in-person or telephone contact. The second (and later) interviews will be matched on the weekday vs. weekend occurrence of the initial 24-hour recall interview for a given respondent. The reason for this day-matching is to hold other variables relatively constant so that the variation between days of consumption is random variation in consumption *per se* and is not influenced by other weekly cycles of eating. For example, the difference between weekday and weekend fish consumption may be a fixed average difference and not simply random variation. (With a substantially larger sample size than will be used in this survey, the NCI method, by using certain information collected about each eating occasion, could accommodate a mixture of weekday and weekend fish consumption per respondent.)

The second step in working with the 24-hour recall surveys is use of the 'NCI method' to analyze the data collected (Tooze, et al., 2006). The NCI method uses some assumptions and statistical models to generate a fish consumption distribution⁶ that is consistent with the observed data in the two 24-hour dietary recalls.

A strength of the NCI method is that the respondent is having to remember only items and quantities consumed on the previous day. A weakness of the NCI method is that some strong (but reasonable) assumptions are needed to generate the distribution of average daily intake for a population. An additional weakness of the NCI method in the context of a fish consumption study is that it may be able to supply consumption estimates only for all fish species combined and for one or two frequently consumed species. For the less frequently consumed species there may be too few consumption 'hits' on the sampled recall days to support a meaningful analysis. The design team recommends that the questions on the 24-hour recall be constructed to support estimates of frequency of consumption for a) all species combined, b) anadromous species, c) freshwater resident species, and d) marine species. The ability to make the consumption estimates for each of the individual species groups *a*, *b*, *c*, and *d* using the NCI method depends

⁶ By 'distribution' in this report we are referring to values of the mean, median, and higher percentiles of the population's fish consumption rates. 'Distribution' has a more technical definition in the statistical literature.

on having an adequate number of respondents who report eating from the species group on both of the two 24-hour recall interviews. However, even if the NCI method cannot be used, the FFQ will be designed to allow calculation of the consumption rate distribution for each of the major species, for all species combined, and for various groups of species.

The FFQ and the 24-hour questionnaires that will be used to support the fish consumption estimates can be viewed in Appendix A of this document.

4.3 Sample Size

Multiple sample sizes are considered here, corresponding to the following survey components:

- Initial telephone screening operation to identify non-consumers and high consumers
- Food frequency questionnaire (FFQ)
- 24-hour recalls (1st and 2nd recall days)

Some strata (or groups) of respondents will be sampled at a higher rate than others. For example, when characteristics of more frequent consumers or high consumers of fish are identified, a stratum of these tribal members will be sampled at a higher rate than members not in this stratum. Currently, the design team recommends that the high or frequent consumers be identified by the initial telephone screen. If one-quarter of the consumer population consists of high consumers, they may be sampled at four times the rate as the lower-level consumers, resulting in more than 50% of the sample consisting of high consumers. In the statistical analysis following data collection, each sampled high consumer would carry one-quarter of the weight compared to a low-end consumer in order to represent the entire population in an unbiased way. However, despite their quarter-weight, the extra sampling of high-end consumers will provide greater precision in estimation of the higher percentiles of fish consumption—percentiles of great importance in water quality regulation. Also, the over-sampling of high consumers will provide a better basis for carrying out the NCI method of analyzing the 24-hour recall data.⁷

For each sampling operation considered, the driving factor in selection of a sample size is the trade-off between precision of an estimate—which improves with increasing sample size—and the mounting cost of a survey as sample size increases

1. Screening of Participants

An initial telephone screening call will be carried out to identify any non-consumers of fish and note reasons for non-consumption (described in more detail in Section 4.4.1). Non-consumers will not receive a personal interview.

2. FFQ Sample Size

Prior to presenting notes on sample size for this survey, a caveat is that the final sample size will depend on results from the survey pilot testing and telephone screening as well a critical dependence on resources available to this project to carry out the surveys for the Idaho Tribes.

The desired effective sample size for the FFQ will be approximately 140 fish-consuming individuals. The “effective” sample size is smaller than the number of individuals sampled,

⁷ One of the assumptions of the NCI method is that the within-person variance of the logarithm of the quantity consumed on a day with fish consumption is constant across all levels of consumption. If the assumption is true, there is no disadvantage to over-sampling high consumers. It may be possible to check this assumption if there is a sufficient number of respondents with two days of consumption.

because high consumers will be over-sampled in proportion to their numbers in the population. The effective sample size here takes into account the statistical weight given to each individual. A speculative guess is that 25% of consumers⁸ in the Tribe will be high consumers and if the high consumers are sampled at a fourfold rate compared to the low-consuming balance of the consuming population, then approximately 245 individual respondents will be included in the sample. The 245 individuals would include approximately 105 low consumers and 140 high consumers. The 140 high consumers would each have one-quarter statistical weight, yielding an effective sample size of 35 high consumers. (The full 140 high consumer respondents would be included in the analysis, but four high consumers carry the same statistical weight as one low consumer, thus the effective sample size of $140/4 = 35$ for high consumers.) The 105 low consumers plus the effective sample size of 35 high consumers yields a total effective sample size of 140.

Based on some preliminary simulation analyses, 140 completed FFQ questionnaires from randomly selected Tribal members would yield a mean consumption rate with a 95% probability of falling within +/- 25% of the true population value.⁹ This is a conservative estimate of precision (i.e., precision would likely be better), because the effective sample size of $n = 140$ stems from a much larger sample size of individuals, due to over-sampling of high-consumers. Under the same conservative assumptions, the 90th and 95th percentiles will have 95% probability of falling within about 40% of the true population value. Figure 4-1 shows the relationship between sample size and precision. It is apparent from the diagram that achieving high precision for the higher percentiles requires quite large sample sizes.

In order to yield approximately 140 high consumers and based on 25% high consumers and 30% refusals or no contact, the screening list will need to include approximately 800 individuals.¹⁰ The proportion of the population who are high consumers and the survey non-participation rate are speculative. For that reason, a phased start to the survey, as described in Section 3.2, is important with the implementation team learning from each wave of screening and then adjusting methods for the next wave.

⁸ The Columbia River Inter-Tribal Fish Commission survey results (CRITFC, 1994) reported that 38% of adult fish consumers had two or more fish meals per week (Table 8). Given that some respondents may have consumed two or more of their weekly fish meals on a single day, the value of 25% of respondents consuming fish on two or more days per week (i.e., high consumers) may be a reasonable value to assume for this work.

⁹ The simulations were samples of size $n = 100, 200$ and higher from hypothetical surveys of populations with a lognormal distribution of fish consumption rates for consumers only. Different populations were considered to have mean consumption rates varying from low to medium to high (mean \pm SD of 19 ± 21 g/day, 82 ± 128 g/day and 214 ± 273 g/day, respectively). For each population and sample size 10,000 simulated 'surveys' of the given sample size were drawn and the sample mean, median and 90th and 95th percentiles were calculated. From the simulation distribution of a descriptive statistic, such as the mean, the 2.5th and 97.5th percentiles of the descriptive statistic were calculated. This range, though not a confidence interval, shows estimated limits within which 95% of survey results for the specific statistic would be expected to fall for the given population and sample size. Across the low, medium and high fish consumption populations the maximum percentage difference of the limits from the true mean was 25% for a sample size of 140 (using linear interpolation between sample sizes of $n = 100$ and 200). For the 95th percentile of consumption the corresponding maximum percentage deviation from the true 95th percentile was 39%.

¹⁰ Approximately 200 high consumers would need to have contact attempts in order to yield 140 net high consumers after a 30% loss rate. If 25% of Tribal members are high consumers, 800 Tribal members (of any consumption rate) would need to be contacted to find the 200 net high consumers. The low consumers can be selected from the remaining 600 Tribal members—the balance of the 800 who are not high consumers.

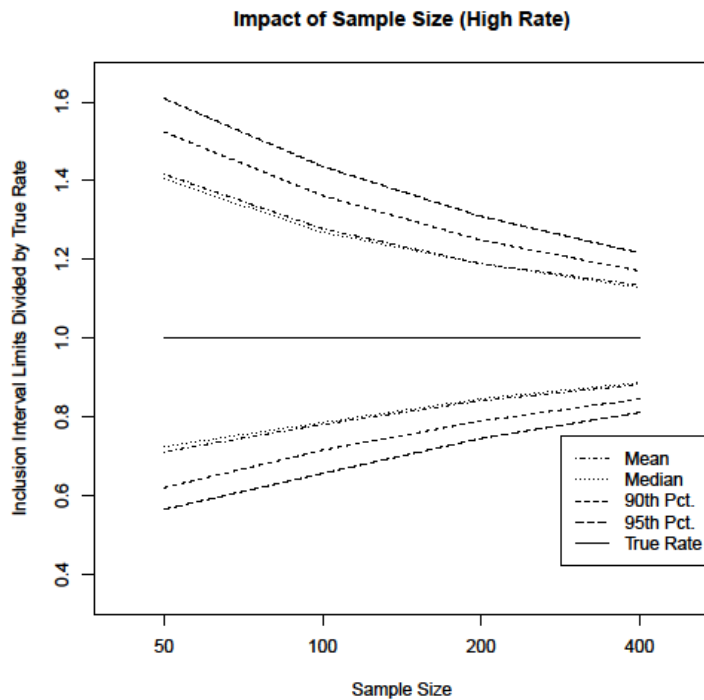


Figure 4-1. Precision of mean and selected percentile estimates vs. sample size The upper and lower bounds for each estimate are expressed as a ratio to the true value. In 95% of surveys drawn from a population with a lognormal distribution of consumption rates, the estimated value of the statistic is expected to fall between the bounds corresponding to the survey’s sample size (bounds are approximate from simulation).

3. 24-Hour Dietary Recall Sample Size

All of the expected 245 individual respondents will complete the first 24-hour dietary recall assessment. All of these 245 respondents will have the possibility of selection for the 2nd 24-hour recall interview, but the probability of selection will increase with increasing (grouped) quantity and frequency of consumption as determined from the FFQ. The goal is to adjust the net number sampled on day 2 of the recall to yield at least 50 respondents with fish consumption on both days of the 24-hour recall.¹¹

The implementation team will need to: a) choose a cut-off that defines frequent consumers in terms of the frequency of consumption (and possibly the quantity eaten on day 1 of the recall), and b) determine selection probabilities for day 2 of the 24-hour recall in order to have at least an expected 50 individuals with fish consumption on both days 1 and 2 of the 24-hour dietary recall. The key parameters in this calculation will be an estimated survey non-participation rate (refusal, no contact, etc.) projected to the day 2 attempted contact, the percentages of day 1 recall respondents who consume at various frequencies, and the day 1 quantity of fish consumed.

¹¹ The minimum number of respondents—50—who consume fish on both days of the 24-hour recall has been suggested by Dr. Kevin Dodd, one of the developers of the NCI method. This minimum sample size is based on the precision of a variance estimate. To put the $n = 50$ in perspective, standard deviations (SD) based on 25, 50, or 75 degrees of freedom for samples drawn from a normal distribution would have 95% confidence limits that differ from the estimated SD by no more than 39%, 25% or 19%, respectively. Thus, $n = 50$ has an associated 25% level of precision, which is fair (not excellent) precision.

As a side note, it is possible that the number of sampled individuals with two recall days of fish consumption will not be sufficient to yield a meaningful estimate of the fish consumption distribution using the NCI method. In that case, the data from multiple Tribes may be pooled and used with the NCI method, introducing the Tribe as a categorical covariate or as the person-specific fish consumption rate for the species group being evaluated. That procedure will yield a distribution for each Tribe. However, some assumptions about commonality among the Tribes of certain statistics of the distributions will need to be tested and noted.

4.4 Questionnaire Development

A survey questionnaire, provided in Appendix A, was developed to help determine the fish consumption rate of the NPT. The purpose of the questionnaire is to ask Tribal members about their dietary patterns and activities related to fish consumption in the past 24 hours as well as in the preceding 12 months to determine current fish consumption rates. This will be accomplished by conducting two 24-hour dietary recall interviews (the second of which will be administered after a week, but within four weeks after the first recall interview) and a food frequency questionnaire, as discussed above. The second 24-hour recall will be administered to a randomly selected sample of the first-interview respondents, weighted toward those determined to consume fish more frequently, based on the first interview. Data will be collected regarding fish species consumed, frequency of consumption, and portion size, with additional information gathered about parts eaten, preparation methods, and special events. Data will also be collected regarding changes in fish consumption patterns from the past and expectations for future consumption to develop a more accurate FCR that is not restricted by current-day suppression factors.

The questionnaire is written such that the trained interviewer can clearly follow the line of questioning, read each question verbatim, and record (in written form, by check box or circling) the information given by each respondent in the space provided in a consistent manner. Words to be spoken by the interviewer are identified in bold text on the questionnaire, and each question will be asked in numeric order. Written information will only be recorded on the questionnaire form by the interviewer. Entry codes, species displays, and portion displays will be used during the interviews.

Past fish consumption surveys were reviewed, in addition to recent survey questionnaires developed by the Center for Disease Control and Prevention (CDC), for guidance in selecting wording for the current questionnaire. These resources are listed in Section 7. The questionnaire will be pre-tested (during a pilot survey) and revised as necessary prior to implementation. The questionnaire is organized according to the following sections, which are discussed in more detail below:

1. Telephone Screening
2. Interview Introduction
3. 24-Hour Dietary Recall
4. Food Frequency Questionnaire
5. General Information
6. Second 24-Hour Dietary Recall

1. Telephone Screening

Potential respondents will first be contacted by telephone. The initial phone contact will provide an opportunity to screen for fish consumers versus non-fish consumers and to discern why fish is not being eaten by the non-consumers. For those who do eat fish, an in-person interview will be scheduled with the respondent for a later date, if they are willing. The selection (or non-selection) of a tribal member reached through a screening call will be based on the survey's progress in filling in the required sample counts for each population stratum.

Each respondent will have his or her own Telephone Screening Contact Log. The Telephone Screening Contact Log will be maintained separate from the interview forms, as the contact log will provide the only documentation linking the respondent's name with the respondent's randomly assigned identification number. Subsequent interview forms will only include the respondent identification number to maintain confidentiality of the respondent.

This section of the questionnaire provides statements for the caller (interviewer) to make over the telephone and a log to record every contact attempt. If multiple attempts are made, the interviewer placing the call may vary (and may be different from the person who ultimately conducts the interview). The Telephone Screening Contact Log will include the date, day of the week, and time of the call, name and identification number of the interviewer making the call, results of the call according to the entry codes provided, and whether or not the respondent consumes fish. If an in-person interview is scheduled over the telephone, the date and location of the interview will be recorded on the contact log.

2. Interview Introduction

The primary in-person interview will begin by documenting basic identifying information about the interview (who, when, where) and introducing the respondent to the project and the purpose of the interview. Administrative information will be recorded before (or as) the interview begins and will include the interviewer's name and assigned identification number, the respondent's assigned identification number (no name), and the date, day, start time, and location (city, state, and venue) of the interview. After the administrative information is recorded, the interviewer will read the introductory narrative to the respondent to formally begin the interview. The respondent will be reminded that their information will remain confidential. The primary in-person interview includes three parts, the 24-hour dietary recall, the FFQ, and general information. A second 24-hour dietary recall survey will be conducted for a subset of respondents by telephone.

3. 24-Hour Dietary Recall

Following the introduction, a 24-hour dietary recall questionnaire will be administered to collect information on fish dietary patterns during the previous day. The objective of this component of the survey is to estimate total intake of fish that was consumed during the 24-hour period prior to the interview from midnight to midnight. The interviewer will read the questions in numeric order and complete the table, entering and circling answers as provided by the respondent.

The primary series of questions relate to the types of fish eaten over the past 24 hours, the quantity, preparation method, and source of the fish eaten. Once the interviewer has verified whether the respondent ate fish during the previous 24 hours, the interviewer will inquire about fish eaten during each occasion over those 24 hours, including species type (to be coded later),

portion size (quantity), preparation method, and source of each fish meal or snack consumed by the respondent. Species and portion displays will be used.

A representative selection of respondents, weighted toward those identified as being high fish consumers, will be contacted for a second (separate) 24-hour dietary recall survey by telephone after a week, but within four weeks after the first interview. The second 24-hour dietary recall questionnaire will mimic the first, repeating the same inquiries as administered during the primary 24-hour dietary recall interview. The method of identifying species and sizing portions on the second 24-hour interview (by phone) is still being determined, but it is likely that it will use either displays left with the respondent at the initial interview or else delivered to the respondent.

4. Food Frequency Questionnaire

Following the 24-hour dietary recall, an FFQ will be administered to collect information on fish dietary patterns and associated activities over the past year. The objective of this component of the survey is to estimate total intake of fish that was consumed over the previous 12 months as well as to gather information about fishing activities and other factors that may affect consumption. The interviewer will read the questions in numeric order and complete the table in the questionnaire.

The first series of questions relate to the species, frequency, and quantities of fish eaten. If consumption varies with high and low-eating periods, questions will be asked for each period. Once the interviewer has verified whether the respondent ate fish during the previous 12 months, the interviewer will inquire about which type of species were eaten, the number of portions or frequency that each type was eaten, and typical portion sizes. Species and portion displays will be used.

Information will be gathered regarding parts of fish consumed, methods of preparation, and sources of fish consumed over the past 12 months. Information will also be gathered about activities associated with fish consumption, including special events, such as feasts and ceremonies, as well as fishing activities. Finally, several questions will attempt to gather more qualitative data on changes in fish consumption compared to the past and about intentions for fish-consumption in the future.

5. General Information

General information will be collected at the end of the primary in-person interview. Demographic information will be recorded, including the respondent's gender, date of birth, age, height, weight, residence on or off reservation, education level, and household income. These items are being collected to provide sub-groups for rate-reporting, to support calculations of rates in other formats (e.g., g/kg-day), or to attempt to identify characteristics of high vs. low consumers of fish. After the demographic information is recorded, the interviewer will ask female respondents about their breastfeeding history (linkage to child health).

The interviewer will conclude the interview by reading the statements of appreciation, inquiring about future contact. At that point, the interviewer will record the end time (and calculated length) of the interview. Following the interview, the interviewer will record their opinion of the respondent's level of participation (cooperation and reliability) and acknowledge that they recorded the information truthfully and to the best of their ability by signing an attestation of authenticity.

6. Photographs and Portion Models

Portion models and graphics (photographs or other representations) will be used during the 24-hour recall and food frequency questionnaires and will be comparable to the U.S. Department of Agriculture (USDA) portion size booklet (and accompanying measuring implements) that is used by NHANES for national dietary surveys. These models will provide a visual display of quantities of fish consumed during each meal. These models will be reviewed and tested by the implementation team prior to survey interviews, and they will be evaluated for usefulness and appropriateness by the Tribes (and modified, if needed) during pilot testing of the questionnaire. The portion displays have not been fully evaluated by the survey team yet, but following are some general considerations in the selection and use of the final portion displays.

There may be a need to calibrate the portion displays to physical weights of the species represented and for each specific portion size shown in the display. Any portion displays should show the portions as actual (100%) size. If possible, the display should be shown to the respondent at a distance similar to the distance between a person and their meal, without being intrusive of personal space. This could usually be accomplished by handing the display to the respondent and asking them to indicate the particular portion mark within the display that corresponds to their consumption in response to a question.

All portion displays will have a specific code attached to them, and a separate table (to be used during data analysis) will show the volume and/or weight-per-species corresponding to each portion mark in the display. To maintain efficiency of the interview, the respondent will answer questions in terms of simple portion marks or codes on each display, saving the interviewer a table look-up for the species-specific weight of the noted portion.

Dishes such as stews, chowders, casseroles, and special composite dishes unique to the NPT will have their own portion models to indicate serving sizes. For example, measuring bowls will be used for respondents to identify portions of liquid dishes (with a fish ingredient list pre-determined). The survey team will identify the tribal-specific dishes (only those which include fish as a component) and obtain approximate recipes for conversion of visual portion sizes to weight of fish by species. Other composite dishes that are reported will be handled using standard recipes (such as that compiled by the EPA) to convert respondent-reported quantities consumed to weight of fish consumed.

7. In-House Testing and Revisions of Questionnaire

In order to create the most effective questionnaire, the research design team identified the information of interest and crafted an initial design that was modeled after other questionnaires from recent, similar studies. Survey research experts from Pacific Market Research reviewed the questionnaire, along with statistical and subject matter experts.

Prior to widespread implementation, the questionnaire will be administered and tested among team members for content and length. After passage of that test, the questionnaire will be administered to a small subset of the target population. Following this “pilot test,” sample respondents will be interviewed about their experience with the questionnaire, including:

- Was your overall impression of your interview experience positive or negative, and why?
- Which questions were challenging? If any were challenging, what might make them easier?

- Keeping in mind that the study topic is fish consumption, are there any questions that ought to have been asked but weren't?
- Are there any questions which seemed unnecessary?

Each step of the process allows for questionnaire revisions as appropriate. Significant revisions and/or additions to the questionnaire deserve further testing.

8. Pilot Testing of Questionnaire and Field Operations

The pilot test will cover most of the survey procedures, including screening, invitation and first contact, interview using the questionnaires (FFQ and 24-hour recall), field review and key entry. The persons selected for the pilot test will exercise all dimensions of the questionnaire. It is likely that 15-20 persons, at least, will be needed for an adequate pilot test.

Questionnaires may be revised continuously while the pilot test is underway, but substantial revisions may require additional pilot interviews to test new questions or new wording and formats. The following characteristics of pilot test respondents (who will not be eligible for inclusion in subsequent sample selection) will be covered.

- Age: elders and younger members
- Gender: males and females
- Lifestyle: modern and traditional
- Fishing: fishers and non-fishers
- Source of fish: primarily eat at home vs. eat out frequently
- Income: low-income and high-income
- Food preparation: respondents who do and do not usually prepare food for the household

A pilot test respondent may cover more than one dimension. For example, elder fishers may contribute to understanding the questionnaire performance on both elders and fishers. However, other combinations of characteristics with an elder and with a fisher should also be tested. Additional pilot test participants may be added until the various dimensions have been fully covered. During the pilot test it is important to interview different types of respondents so that all iterations of the questionnaire can be addressed. The pilot test should include the anticipated final questionnaire as well as other tools related to it, such as portion size models and photographs.

4.5 IRB Approval

In order to meet accepted standards of protection for survey respondents, we will seek Institutional Review Board (IRB) approval of the survey design. We have identified Quorum Review IRB, a commercial IRB service, as a vendor for this purpose. The process consists of preparing a set of documents (see list below), working with the IRB for pre-review of the application, revising the application based on the pre-review, and then submitting the revised application for full review.

The following list provides an example of the documents needed for the IRB application; many forms and examples are available on the Quorum Review IRB website, at <http://www.quorumreview.com/forms/>.

- Submission forms, which include administrative details about the study, study locations, and study team.

- Study Protocol, including discussion of the purpose and benefits of the study, potential risks to the respondents, description of the study methods, selection criteria for respondents, and procedures to protect confidentiality.
- Curriculum vitae (CV) and other credentials of the Principal Investigator (PI). Only one PI is needed for the IRB application if that PI will be responsible for the protection of human subjects.
- Survey documents, including survey forms, consent forms, and any other written material which will be provided to respondents.

The goal of pre-review with the IRB prior to full submission is to improve the quality and completeness of the submission. Quorum Review provides a pre-review service for this purpose. The expected timeline for IRB approval is about 1 week from submission of all documents, depending on whether the pre-review identifies any issues. Since this survey is purely behavioral and risk to the study participants is minimal, we expect that it will qualify for expedited review.

4.6 EPA Human Subjects Review

In addition to IRB review and approval, the survey will need review and approval from the EPA Human Subjects Research Review Official (HSRRO). The process consists of submitting an application and supporting documents to the HSRRO. The IRB review and approval is one input to the HSRRO review process. The HSRRO has final authority for review of human subjects research supported by the EPA. The following documents are needed for submission to the HSRRO; additional documents may also be requested:

- Application memorandum using a template provided by the HSRRO, which includes a brief discussion of the value of the research, any risk to the subjects from the research, and the approach for subject selection and informed consent.
- Documents submitted to the IRB, including the study design and survey documents such as consent forms, survey forms, and recruitment material.
- Documents received from the IRB, such as review comments and letters of approval or exemption.

The HSRRO review process takes place after IRB approval and prior to commencement of the survey.

The EPA provides educational resources for investigators to clarify human subjects research policies, such as the online tutorial “Human Subjects Research at the Environmental Protection Agency: Ethical Standards and Regulatory Requirements” at http://www.epa.gov/osa/phre/phre_course/index.htm. The survey team will pursue and manage the human subjects approval process with EPA.

5.0 SURVEY OPERATIONS

This section describes the field operations, including interviewing and contacting participants, as well as pilot testing and key entry of the questionnaire.

5.1 Interviewing

This section describes the selection and training of individuals who will administer the survey interviews; procedures for conducting the interviews; scheduling, monitoring, and recording interviews; and proper handling of the questionnaires.

1. Interviewer Selection

Interviewing positions will be filled in collaboration with the Tribal authorities with agreement on selection by both parties. Once hired, the interviewers will report to the survey team. Ideally, the Tribes will recruit or propose two to three individuals for each interviewer position.

Additionally, the survey team hopes that the NPT will promote participation in this study, both for respondents and interviewers. For those who apply for the interviewing position, a survey team staff member will explain the job duties; those whose qualifications appear promising will be invited to complete various skills and aptitude tests that cover:

- Education
 - High school diploma or GED
 - 9th grade reading level
 - Reading sample survey script: silently and aloud
 - Comprehension and clarity
- Clerical skills
 - Legible hand-writing
 - Spelling
 - Grammar
- Employment availability: part-time work for 9-12 months
- Transportation
- 18+ years old
- Courtesy and professionalism
- Ability to think “on one’s feet” and to adapt to changing conditions
- Good communication skills
- Reliability
- Ability to follow directions, as it is important that surveys be administered using a common, scripted approach to maximize objectivity and to enhance comparability of answers.

2. Interviewer Training

Interviewers will be trained to follow “best practices” when it comes to in-person interviews. This classroom component of the training is expected to last approximately 4-8 hours. It will begin with an overview of survey research, including a brief history of its utility and the importance of its role. The training will include general and specific interviewing techniques and skills. In addition to an explanation of the origin of this survey, interviewers will receive survey-related materials and information about the critical nature of the project. As part of the training,

the survey staff will themselves need some instruction in practices that are acceptable to or unacceptable to Tribal respondents. These important cultural points will be included in the training.

Interviewers will be exposed to general survey research principles related to interviewing. Objective data collection will be emphasized, as will the need to listen closely to what the respondent says and record it accurately. Interviewers will learn how to probe, clarify and check open-ended answers to ensure that they've elicited and captured all relevant information from the respondent. Most importantly, interviewers will participate in a lengthy and in-depth mock interview session during which the interviewer works directly with a supervisor or another co-worker to try out the questionnaire and what they've learned. The supervisor will provide the interviewer with challenging but realistic answers to the questions.

Special attention will be devoted to cultural aspects which might prove challenging during verbatim administration of the questionnaire. For example, if a respondent does not understand a question, a typical interviewing technique is to repeat the question and to answer the respondent's inquiries with, "I can't interpret the question for you. It is whatever the question means to you." If the pilot test uncovers survey items which are unclear, additional probes and prompts will be developed in order to minimize interviewer interpretations while in the field.

3. Procedure Manual and Training for Interviewers and Supervisors

All interviewers and supervisors will undergo a comprehensive training prior to beginning work on this project. The training will include basic and advanced topics necessary to successfully conduct in-person survey research. Below is an example agenda for the training sessions which would be required for all interviewing staff.

- Introduction of survey staff and implementation team
- Project background
- Overview of survey research
- Confidentiality requirements
 - Dealing with Personally Identifiable Information (PII)
 - What to do if you know the respondent
- Exploration of question types
 - Close-ended items
 - Numeric items
 - Scale items
 - Open-ended items
- Importance of precision and accuracy when recording answers
- Objective research: non-bias by interviewer
- Techniques to probe and clarify
- Building rapport with respondents
 - Being courteous and respectful
 - Addressing challenging respondents
 - Older
 - Hard-of-hearing
 - Angry
- Review of questionnaire

- Quality control measures
 - Self-monitoring
 - Supervisor/data entry controls
 - Call-backs and verification
 - Statistical tests
- Productivity targets
- Logistics related to appointments, survey administration, etc.
 - Reimbursement for expenses
 - Contact information for all staff

4. Scheduling and Monitoring Interviewers and Activities

The process for assigning in-person interviews will be administered by the survey team’s scheduler, who, initially, will be an employee of Pacific Market Research—one of the three firms which will be carrying out the survey implementation work. The scheduler will work closely with the interviewers to ensure that the in-person interviews are scheduled only during hours when the interviewers are available. Over time, some or all of the scheduling responsibility might be transferred to the interviewers with continued monitoring by the survey staff. Based on the estimated interview length, we anticipate that it will be possible for an interviewer to complete two interviews per day. This is expected to be the target quota for the interviewers, given the length of the interviews and activities associated with each interview. This depends on many factors, including the distance that the interviewer must travel, road conditions, and whether the respondents show up when agreed. We recommend setting a target of at least one half of all interviews being conducted at a central location on each reservation.

Consideration will be extended for respondents with mobility problems, ensuring that their responses are gathered even if they are homebound. Accounting for respondent availability and interviewer workload, interviews will be scheduled seven days a week starting as early as 8:00 a.m. with no interview beginning later than 8:00 p.m. To the extent possible, a primary goal is to minimize respondent burden; one way to do this is to offer an assortment of times and convenient locations for the interviews.

Any issues of calendar sensitivity (such as avoiding or minimizing interviews on Sundays or special occasions) will be addressed in conjunction with the Tribes prior to the commencement of interviewing. The survey implementation team will work with the Tribes to jointly design an initial approach to respondents that is consistent with the Tribes’ way of carrying out activities and is also consistent with accepted scientific survey practice.

5. Recording Interviewer Responses

Interviewers will record interview answers on the hardcopy questionnaire. They will also record start date, the start time, the completion date, and the end time. Writing will be tidy and easily readable. Stray marks or mistakes will be corrected as necessary prior to handing off the completed questionnaire for data entry.

During data entry, the entry staff will review the questionnaires as they enter them. If the supervisor or the data entry personnel observe missing data or other problematic aspects with the questionnaire, it will be referred to the original interviewer for review and correction as appropriate.

6. Integrity and Handling of Questionnaire Hardcopy

The completed questionnaires will be protected by interviewers until the questionnaires have been delivered to the data entry staff or a secure holding area. Questionnaires must not be left out where non-survey staff might gain access to them. Instead the questionnaires should be kept with the interviewer, within his/her physical control, or in a locked area prior to handing off to data entry.

5.2 Contact with Respondents

Respondents will first be contacted by mail and/or Tribal newsletter to introduce the project in general. Respondents will then be contacted by telephone, followed by a selection of those respondents who are willing to participate in the in-person interview(s).

1. Initial Contact by Mail and Telephone

Initial contact with respondents will be by letter or postcard, alerting respondents that the survey is forthcoming and that their opinions are important. Follow-up contact will occur via telephone (up to 15 call attempts before assigning a record as deceased or otherwise ineligible). During the telephone call, respondents will be screened for fish consumers versus non-fish consumers, and an attempt will be made to schedule an appointment for an in-person interview with fish consumers.

The implementer will coordinate with individual Tribes to identify motivating factors such as incentives or other valuable rewards for prospective respondents. EPA funds cannot be used for remuneration but we strongly recommend providing a token of gratitude in order to establish good will and boost the response rate. Without incentives there is danger of survey failure due to a low response rate. If the main motivation for the respondents in this project is a sense of altruism, it is all the more important that the interviewers are extremely assertive and persuasive in convincing prospective respondents to participate. In order for the survey to be successful, the Tribal leadership will need to play a central role in informing the Tribe about the survey and promoting cooperation with the survey.

When contacting respondents by telephone, some individuals are expected to refuse to participate. The initial counterpoint to a respondent refusal is to explain the importance of the respondent's opinions and experiences in the study, sharing with him/her how the results will benefit the Tribes and community. If he/she still refuses, the interviewer will put the number back in the system, allowing several days to pass before attempting the number again. Call-back conversion attempts are often handled by "conversion experts," different from the original interviewer, which may be applied as necessary. Interviewers will use standard survey research practices to try to convert initial refusals to cooperative participants.

2. In-Person Interviews

Data collection will take place either in the respondent's home or in a central, public location. Part of the goal of the research is to promote a feeling of confidence and good will among the prospective respondents in order to conduct as many completed interviews as possible. To this end, we recommend conducting the interview in a location where the respondent feels comfortable and safe. The interviewer will either meet the respondent in a mutually agreed location or go to the respondent's home. Background materials relevant to the survey will also be provided to the respondent in advance.

At each interview's conclusion, the interviewer will graciously thank the respondent for his/her time, reiterate the importance of the study results, and quickly review the questionnaire so that the interviewer may administer follow-up questions for any items which have missing information. To the extent possible, interviewers will record interview feedback from respondents. This includes praise and complaints from respondents. Feedback will be provided to the scheduler or the supervisor at the end of each day. Interviewers are required to provide the outcome or disposition of each interview attempt as soon as possible after the attempt or at the conclusion of each day, whichever comes first. The disposition will be recorded in a master database so that the result is available for immediate and later analysis.

3. Follow-up Call and Re-Interview

For quality control purposes, we recommend a follow-up call to every respondent. The follow-up call or verification call is intended to provide a double-check of the interview. Some respondents who receive a follow-up call will merely be asked whether they participated in the survey. But a sub-sample of the entire group will be asked to validate their data. By asking some of the same questions again, the researchers can test the reproducibility of the data. The questions will be selected to represent major sections of the questionnaire and will avoid questions with complex or long lead-in development.

5.3 Tribal Collaboration in Field Operations

It is recommended that a primary technical contact for survey operations be identified by the Tribes. This contact person will be responsible for collaborating with the survey implementation team, providing access to the Tribal facilities for conducting interviews, assisting with the logistics of contacting and following-up with survey participants, and keeping the Tribal leadership and membership informed of the status of the survey.

To create and roll out a successful survey, it is critical to obtain Tribal support initially, particularly Tribal leadership, and to develop and maintain the relationship and support throughout the project. From the implementation team this requires familiarity with quantitative survey research as well as cultural sensitivity. The implementation team must be available to the Tribal representatives to address any outstanding survey issues. Two-way communication is crucial.

5.4 Key Entry of Questionnaire, Validity Checks, and Storage

Data collection will be conducted with hard copies of the questionnaire. After the data have been recorded on the questionnaire, information will be keypunched or entered onto digital media. This provides an extra level of redundancy as well as, and more importantly, an automated method of organizing and eventually analyzing the data.

Many data entry software packages are available and they allow quick, efficient, reliable and secure data entry. Some of these include: SPSS Data Collection Data Entry, Voxco Interviewer Suite/Command Center, EpiData Software, SurveyAnalytics iPad Survey Tool, snap Surveys, Confirmit and even Excel. Pricing varies depending on the vendor and the type of solution, from many thousands of dollars to a nominal (or even no) fee for open source applications. Each software package has its benefits and drawbacks, but for this project we recommend SPSS Data Collection. For security purposes, sample files and data files shall be encrypted.

Best practices demand that data entry is verified. This can be accomplished by spot-checking randomly selected data points in every n^{th} interview or entering all responses for every n^{th} interview twice. The most reliable way to check the accuracy of the data entry is to perform 100% verification. This means that *all* data points for *every* interview are entered twice. We strongly recommend 100% verification.

To effect reliable data verification, two or more parties will be involved in the process. An initial keypunch operator enters the data for one interview; it is verified (re-entered) by a different keypunch operator. Each record or line of data related to the questionnaire is checked against its respective original record. If discrepancies are found, a supervisor or other staff member will review both of the electronic records and the hard copy of the questionnaire to determine which data entry point is correct.

Error rates will be tracked among survey responses in general and also by cross-tabulating responses by various demographic or other information, and looking for anomalies or statistically significant differences.

1. Field Validity Checks and Re-interview

Of the many places where an error can be introduced into the data, the collection point is among the first. A typical way to test for interviewer errors is to re-contact some respondents and re-ask several questions. Due to the additional burden on respondents during this follow-up process, it's unrealistic to administer the entire interview again; instead a subset of questions may be asked to validate the data recorded by the interviewer. Not all respondents will be re-contacted. In the event that significant differences are found (between the originally recorded answers and the validation answers), the interview for that respondent will either be discarded or a new interviewer will be sent to administer the full questionnaire again. Each interviewer's work will be evaluated for consistency and accuracy. Selected questions will be re-asked of a selected sub sample.

2. Handling Missing Values

Missing survey data, whether because of survey design problems, interviewer error, respondent misunderstanding or simply refusal to answer questions, can be problematic for any project. Ideally there will be no missing data. In the event that a record is missing some of its data—and it is due to respondent-caused factors—there are several acceptable steps for adjusting the data to accommodate missing values. By using data analysis software we can impute new values where once the data were missing. That is, based on the values in other, similar cases, data can be pushed into the records which had missing data. The replacement data might be based on copying a value from a random case, mean substitution, regression, or multiple imputation. Generally, the most robust method is with multiple imputation; we recommend using multiple imputation for this project. This will be implemented during analysis.

3. Naming and storage of electronic files

Data files will be stored and named according to the specifications of the selected data entry software. Generally the file name suffix should be a concise but descriptive annotation of the file's contents and the date of last revision. For example, a data file created in Excel which holds information about the NPT should be named *fish_consumption_NPT_2014_04_23.xls*, where "fish_consumption" describes the study, "NPT" identifies the Tribe and "2014_04_23" is the date that the file was last modified. In most cases the file extension will depend on the data entry

software. Some systems do not allow long file names. In this case, the file name will be shortened to convey as much information as possible without exceeding file-naming rules for the respective operating system.

4. Back-up and Transfer Protocols

Data back-ups shall be completed on a basic grandfather-father-son rotation schedule. Backups will be completed daily, weekly, and monthly. Media for daily back-ups are rotated daily, weekly back-ups are rotated weekly, and monthly back-ups are rotated monthly. For example, a back-up is completed each day. After the initial back-up, additional back-ups will be incremental (i.e., backing up only the files which have changed since the previous back-up).

The transfer of files which contain Personally Identifiable Information (PII) or Protected Health Information (PHI) shall be conducted via secure messaging or via a Secure File Transfer Protocol (SFTP) site. Sensitive data must not be transmitted via “regular” e-mail or other unsecured means.

5.5 Sensitive Information

During the administration of this survey, the Tribe will provide information about their membership. Some of this information is considered “sensitive information” and must be protected from disclosure. Sensitive information includes PII and PHI. Various laws and regulations affect the handling of PII and PHI.

5.6 Confidentiality and Data Management

Tribal Committees and the Tribal Office of Legal Council will be included in discussions and plans to maintain the confidentiality of the data during the survey operation. All survey staff will be required to sign a Proprietary Information Agreement and a Non-Disclosure form prior to gaining access to private or sensitive information and certainly before beginning work on the data collection. The agreement will include confidentiality during the interviews and confidentiality of the survey results.

1. Confidentiality of Hardcopy and Electronic Files

Hardcopy questionnaires, with data on them, whether completed or not, must be stored in a secure location if they include PHI or PII. A secure location is an area that cannot be easily breached by the public or by non-authorized personnel. An example of a secure location is within a safe, a locked filing drawer or sometimes a locked office. However, a locked office is often insufficient as custodial staff or other workers might have access to the area.

Data files which contain PII or PHI shall be stored on secure password-protected devices. In this case a password-protected device is an electronic medium which requires a unique username (not shared among users) and a strong password in order to access the file. The strong password should include a combination of alphanumeric characters, with uppercase and lowercase letters and numbers. The file should be encrypted using at least AES 256-bit security.

2. Communicating Confidentiality to Participants

Respondents will be informed in advance and again at the beginning of the interview that their survey responses will remain confidential and that all research results will be reported in an aggregate manner. No individually-identifiable data or answers will be shared with anybody outside of the survey staff. The respondents will be assured that they can safely and honestly

answer the questions, since they will remain anonymous after completion of the interview. Respondents will be advised that a Freedom of Information Act (FOIA) request might nullify the study sponsor's promise of confidentiality. However, the usefulness of the data, on an individual level is dubious: a FOIA request is unlikely to affect divulgence of individual information.

The EPA and the NPT have yet to agree on and sign confidentiality agreements; communication to the respondents will be specified (and reviewed by the Tribes) after such agreements are in place. The survey will not proceed on administering any interviews with tribal members until confidentiality agreements are in place between the NPT and EPA and the survey has received both IRB and EPA Human Subjects approval.

6.0 ANALYSIS, REPORTING, CLOSE-OUT OF STUDY

This section discusses the methods for analyzing data collected from the FFQ and 24-hour dietary recall surveys, as well as final reporting and completion of the study.

6.1 Analysis of FFQ results

The data collected from the FFQ will enable a fish consumption rate (g/day) to be determined for each sampled individual. For an individual, the rate can be determined for each species or species group (anadromous, resident freshwater, and marine). Briefly, an annual amount consumed arising from consumption in a particular season can be calculated per species from the typical portion size (grams) consumed for that species multiplied by the frequency of consumption, then multiplied by the duration of the season (or period). The sum of this total seasonal quantity for the two seasons yields an annual quantity. Secondly, the amount consumed (grams) in ceremonial or special events can be calculated from the typical consumption amount at those events multiplied by the number of such events attended per year by the individual. This can be added to the total amount for two seasons to yield a total consumption for a year. Division by 365.24 days (taking into account leap years) will yield a daily amount in grams per day for the given species. The daily consumption rate for a species group can be calculated for an individual by summing the daily rates for the individual species included in the group. Some selected analyses can be carried out to express consumption rates in grams per kilogram of body weight per day (g/kg-day),¹² since some consumption studies report rates in these units.

The computation of means, medians and other percentiles will need to take into account the stratification and weighting used in the sampling, as well as any correlation among respondents' data introduced by the occurrence of two sampled adults in the same household.

Quantities reported for the NPT should be accompanied by appropriate indications of uncertainty and, where applicable, an estimate of variation across individuals. All means reported for fish consumption rates or for other variables should be accompanied by standard deviations along with a notation of the weighted and unweighted sample size underlying the calculation. Other estimated quantities (aside from means), such as percentiles of the fish consumption distribution, should be reported with standard errors and, for rates that are likely to be considered for setting water quality standards or other regulatory actions, the estimate should be accompanied by 95% confidence intervals. Again, for percentiles and other quantitative estimates, the underlying weighted and unweighted sample size should be noted.

There are several methods available for computing percentiles of an empirical distribution. See Hyndman and Fan (1996), for a discussion of the different methods. The design team recommends the calculation of type 7 percentiles, as noted in the Hyndman article.

A number of other quantities and responses are collected in relation to the FFQ. These quantities will consist of continuous variables (such as age) and categorical variables (such as gender or education). The continuous variables can be summarized by means (and medians if there are highly skewed distributions), standard deviations, minimum and maximum values and, if appropriate, standard errors. Categorical variables can be summarized by percentages per category. The total sample size underlying each set of summary statistics for variables should also be shown.

¹² Body weight data will be collected with general demographic information during the in-person interviews

Confidence intervals (95% level) for the various statistics can be calculated by several methods. The choice of method depends heavily on the distribution of the values used to calculate the statistics and on the sample size. For the larger sample sizes (e.g., over 100), the nonparametric Bootstrap will usually work well for the mean, median and percentiles near the median, but other methods may be needed for the higher percentiles. (The Bootstrap method will need to be adapted to the particular weighting and stratification scheme used for the NPT.) Experiments with the Bootstrap for 95% confidence intervals for various percentiles or the mean from random samples from a lognormal distribution show less than 95% coverage for samples sizes of the magnitude discussed in this report. For the 90th and 95th percentiles (and possibly other nearby percentiles), non-parametric confidence intervals can be based on the ranking method described by Hollander and Wolfe (1999).

Alternatively, if the distribution appears close to the lognormal or another distribution that can be specified in closed form, the parametric bootstrap can be used. For example, a lognormal distribution can be fitted to the data (taking account of weighting) and the bootstrap algorithm can be applied to calculate percentiles for samples drawn from the fitted distribution, again taking account of weighting and stratification. In fitting a distribution to the data, another method that may be useful is to fit a broken-stick spline to the Q-Q plot (using normal distribution quantiles). The parametric bootstrap can then be carried out with the fitted distribution.

6.2 Analysis of 24-hour Recalls

The 24-hour recall data will be analyzed using the “NCI method.” An example of analysis of fish consumption data using the NCI method, along with a heuristic description of the method can be found in Polissar, et al., 2012. Dr. Kevin Dodd of the NCI, one of the developers of the method, has offered to assist in implementation of the method for the Idaho Tribes. The implementation team statistician will be in touch with Dr. Dodd to carry out this work. Helpful references for this method can be found in Tooze, et al., 2006; Dodd, et al., 2006; and Kipnis, et al., 2009. An excellent series of webinars, including a talk and materials by Dr. Janet Tooze on the NCI method, are available at <http://riskfactor.cancer.gov/measurementerror/>. The SAS software for the method is available from Dr. Dodd at NCI and it will need to be adapted to this specific survey methodology. Confidence intervals are not provided by the methodology, but they may be computed by some potentially computationally extensive methods.

As noted previously, there may not be a sufficient sample size of respondents with two fish consumption days from the two 24-hour recall interviews to support the NCI method for the NPT considered alone. In that case it may be possible to estimate fish consumption rates for the NPT by pooling data with other Tribes (for this purpose alone) and then using a covariate or covariates to generate a unique NPT distribution of consumption rates. The covariate might be either a tribal indicator variable or else the respondent-specific consumption rate from the food frequency questionnaire.

6.3 Reporting of Results

The results of this survey are likely to be used for years ahead, if not decades, therefore a very complete report should be prepared. Some of the tribal fish consumption surveys in the Pacific Northwest continue to be used for environmental regulation more than 20 years after their completion. This survey will likely also have that long-term utility.

In addition to the report describing the methods and results of the survey, the implementation team may also prepare a short procedural history of the survey, including lessons learned and changes in design made during the survey operation. Such a report will help users of the results to understand the context of data collection more thoroughly.

The suggested format for the report on suppression and quantitative rates is the commonly used sequence of:

- Executive summary
- Introduction (including background and motivation)
- Methods (including methods for survey design, survey operations and statistical methods for data analysis—for both the suppression study and the current consumption survey)
- Results (extensive tables and displays along with textual commentary) on the suppression study and the current consumption survey
- Discussion (including main findings, comparison of the rates from the FFQ and the NCI method, strengths, weaknesses, remaining uncertainty, potential applications of the results in water quality regulation and conclusions)
- References
- Appendices (including more detailed tables than presented in the body of the report, technical notes, and other supporting material)
- Acknowledgments (thanking, in particular, tribal council, tribal respondents and tribal staff)

The suppression study will fit into this framework as well, as part and parcel of the report. There have been many studies of historic rates and suppression in the past, but their isolation from a report on current rates may have denied them the attention they deserve. The primary quantitative results from the suppression study are likely to be mean (average) consumption per day with a plausible range bracketing the mean. To the extent possible, the rates will be categorized by broad species groups.

The methods section of the report can include plain-language description of methods, but highly technical material should be placed in the appendices. This should be a report whose main body is very readable by Tribal leaders and managers, environmental scientists, political leaders, regulatory staff, and by anyone with previous exposure to the topic.

The main results such as the mean, median, and percentiles of fish consumption for all species combined and for various species groups can be presented in tabular and graphical format in the main body of the report. The various rates can be presented for age, gender, income and educational attainment groups, but more detailed tables (e.g., with more percentiles, more subdivided groups, and with confidence intervals) can be presented in the appendices. The implementation team should keep in touch with the team conducting the surveys for the State of Idaho and attempt to include tables in the report that have comparable species and demographic groups as the main tables of the State surveys.

The State of Idaho will be surveying anglers (in addition to their survey of the general population) and the NPT's report can also report on Tribal anglers who are sampled within the survey process. The anglers may be defined by, for example, having fished at least a certain number of times during a defined period (using questions included in the in-person interview). The extent of results reported for anglers will depend on the number of anglers encountered.

6.4 Peer Review

The design team recommends that a technical peer review panel be convened. The topic of fish consumption rates is controversial, and there are always opportunities for mistakes in a survey as large and complex as this one. The panel may consist of an environmental scientist familiar with issues in fisheries and fish consumption, a PhD-level statistician familiar with surveys, a scientist familiar with reconstruction of heritage consumption rates, and a support or reference person who is familiar with the use of FCRs for environmental regulation.

6.5 Archiving, Ownership, Sharing of Data

The EPA management staff for this project will be communicating with the Idaho Tribes, with this design team, and with other EPA staff to develop a globally satisfactory policy for confidentiality and ownership of, access to, and potential sharing of the data developed from this survey. The design team has provided input on this process and various issues related to this topic. The formal agreement on ownership of current and future access to the survey electronic and hardcopy data will be an agreement between EPA and the Tribes, it is anticipated. A survey team representative(s) may also be a signer – in the role of one implementing parts of the agreement. The survey team will request to review and comment on any proposed agreements to ensure that there is compatibility between the agreements and survey operations, planned data analysis, and final reporting.

Undoubtedly the results of this survey will be a precious resource for the Tribe and others, documenting the status of fish consumption and factors affecting it both historically and at this time. Future aspirations for fish consumption are also covered.

Given the present and future importance of the survey results, it will be important to archive the material carefully. The quantitative data should be saved in electronic system and text files, accompanied by data dictionaries, including the name of each variable (field), its definition and meaning, file position and width, and codes used with a definition of each code. At least two copies of the files should be kept on external media and the two or more sets of files should be maintained in widely separate locations to avoid common loss in case of a disaster. At least annually (signaled by a tickler file) a copy should be made of each set of files (and verified) to avoid loss through physical deterioration of media. As storage modes change over time (e.g., the past transition from tape to disc), the storage mode of the survey files should be kept up to date.

7.0 DESIGN TEAM, ACKNOWLEDGEMENTS, AND RESOURCES

The survey design team coordinated with the Idaho Tribes, EPA, and the State of Idaho to develop this survey design. Various resources were compiled and reviewed as much as possible to support design development.

7.1 Names and affiliation

The survey design was conducted as a collaboration between The Mountain-Whisper-Light Statistics (TMWL) and RIDOLFI Inc., with support from Pacific Market Research (PMR), and consisted of the following key team members:

- Dr. Nayak Polissar of TMWL
- Dr. Derek Stanford of TMWL
- Callie Ridolfi of RIDOLFI Inc.
- William Beckley of RIDOLFI Inc.
- Kristin Callahan of RIDOLFI Inc.
- Anthony Salisbury of PMR

7.2 Acknowledgements

The survey design team would like to thank the following Tribal representatives for their support and input during the design phase:

- Silas Whitman, Nez Perce Tribal Executive Committee (NPTEC) Chairman
- Joel Moffett, NPTEC Vice-Chairman
- McCoy Oatman, NPTEC Treasurer
- Anthony Johnson, NPTEC Secretary
- Daniel Kane, NPTEC Asst. Sec./Treasurer
- Leotis McCormack, NPTEC Chaplain
- Samuel Penney, NPTEC Member
- Albert Barros, NPTEC Member
- Brooklyn Baptiste, NPTEC Member
- Julie Kane, Managing Attorney, Office of Legal Counsel
- Michael Lopez, Staff Attorney, Office of Legal Counsel
- David Cummings, Staff Attorney, Office of Legal Counsel
- Carla Timentwa, Enrollment and Chair of General Council
- James Holt, Director of Water Resources Division
- Ken Clark, Water Quality Program Coordinator
- Joseph Oatman, Deputy Program Manager, Department of Fisheries Resource Management
- Patrick Baird, Tribal Historic Preservation Officer, Cultural Resources
- Nafia Williamson, Tribal Ethnographer, Cultural Resources

7.3 Resources

A list of resources pertinent to developing and implementing a FCR survey is presented below, including agency guidance documents, existing surveys and methodology reports, and traditional lifeways and suppression studies. These resources, in addition to the references cited within this design report (Section 8), will provide additional guidance, background information, and research to support implementation of the survey.

1. Guidance, Regulations, and Other Agency Reports

- Idaho Department of Health and Welfare (IDHW). 2013. *Eat Fish, Be Smart, Choose Wisely, A guide to Safe Fish Consumption for Fish Caught in Idaho Waters*. Bureau of Community and Environmental Health.
- U.S. Environmental Protection Agency (EPA). 1998. *Guidance for Conducting Fish and Wildlife Consumption Surveys*. Office of Water. EPA-823-B-98-007. November.
- U.S. Environmental Protection Agency (EPA). 2000a. *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health*. Office of Water, Office of Science and Technology. EPA-822-B-00-004. October.
- U.S. Environmental Protection Agency (EPA). 2000b. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*. Volumes 1-4. Office of Water. EPA-823-B-00-007. November.
- U.S. Environmental Protection Agency (EPA). 2002. *Columbia River Basin Fish Contaminant Survey, 1996-1998*. EPA Region 10. EPA 910-R-02-006.
- U.S. Environmental Protection Agency (EPA). 2006. *Paper on Tribal Issues Related to Tribal Traditional Lifeways, Risk Assessment, and Health & Well Being: Documenting What We've Heard*. The National EPA-Tribal Science Council. April.
- U.S. Environmental Protection Agency (EPA). 2007. *Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia*. EPA Region 10. August.
- U.S. Environmental Protection Agency (EPA). 2013a. Human Health Ambient water Quality Criteria and Fish Consumption Rates Frequently Asked Questions. January. Available online:
<http://water.epa.gov/scitech/swguidance/standards/criteria/health/methodology/index.cfm>.
- U.S. Environmental Protection Agency (EPA). 2013b. *National Rivers and Streams Assessment 2008-2009, A collaborative Survey, DRAFT*. Office of Wetlands, Oceans and Watersheds, Office of Research and Development. EPA/841/D-13/001. February 28.
- U.S. Environmental Protection Agency (EPA). 2013c. *Fish Consumption in Connecticut, Florida, Minnesota, and North Dakota*. Office of Research and Development. EPA/600/R-13-098F. August.
- U.S. Environmental Protection Agency (EPA) and Toxicology Excellence for Risk Assessment (TERA). 1999. *Comparative Dietary Risks: Balancing the Risks and Benefits of Fish Consumption*. Results of a Cooperative Agreement between EPA and TERA. August 6.

2. Fish Consumption Surveys and Survey Methodology

- Columbia River Inter-Tribal Fish Commission (CRITFC). 1994. *A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin*. Technical Report 94-3. October.
- Freimund, J., M. Lange, and C. Dolphin. 2012. *Lummi Nation Seafood Consumption Survey*. Water Resource Division, Lummi Natural Resources Department. Prepared for Lummi Indian Business Council. August, 31.
- Groves, R.M., F.J. Fowler, Jr., M.P. Couper, J.M. Lepkowski, E. Singer, and R. Tourangeau. 2013. *Survey Methodology*, 2nd Edition.
- Harper, B.L, B. Flett, S. Harris, C. Abeyta, and F. Kirschner. 2002. “*The Spokane Tribe’s multipathway subsistence exposure scenario and screening level RME.*” In: *Risk Analysis*. 22: 3, 513 - 526.
- IDM Consulting. 1997. *Establishing Alaska Subsistence Exposure Scenarios*. ASPS #97-0165. Prepared for Alaska Department of Environmental Conservation. September 1.
- Kissinger, L., 2010. “*Development of a computer-assisted personal interview software system for collection of tribal fish consumption data.*” In: *Risk Analysis*. 30: 12, 1833-1841.
- Landolt, M.L, F.R. Hafer, A. Nevissi, G. van Belle, K. Van Ness, and C. Rockwell. 1985. *Potential Toxicant Exposure Among Consumers of Recreationally Caught Fish from Urban Embayments of Puget Sound*. Memorandum to Pacific Office, Coastal and Estuarine Assessment Branch, Ocean Assessments Division, Office of Oceanography and Marine Assessment, National Ocean Service, National Oceanic and Atmospheric Administration (NOAA). November.
- Landolt, M.L, D. Kalman , A. Nevissi, G. van Belle, K. Van Ness, and F. Hafer. 1987. *Potential Toxicant Exposure Among Consumers of Recreationally Caught Fish from Urban Embayments of Puget Sound: Final Report*. Memorandum to Pacific Office, Coastal and Estuarine Assessment Branch, Ocean Assessments Division, Office of Oceanography and Marine Assessment, National Ocean Service, National Oceanic and Atmospheric Administration (NOAA). April.
- Mayfield, D.B., S. Robinson, and J. Simmonds. 2007. “*Survey of Fish Consumption Patterns of King county (Washington) Recreational Anglers.*” In: *Journal of Exposure Analysis and Environmental Epidemiology*. Natural Publishing Group. 17: 7, 604-612. February.
- McCallum, M. 1985. *Seafood Catch and Consumption in Urban Bays of Puget Sound*. Washington State Department of Social and Health Services. January.
- Merrill, T. and M. Opheim. 2013. *Assessment of Cook Inlet Tribes Subsistence Consumption*. Revised. Seldovia Village Tribe, Environmental Department. Prepared for the SVT Council. May 20.
- Murray, D.M. and D.E. Burmaster. 1994. “*Estimated Distributions for Average Daily Consumption of Total and Self-Caught Fish for Adults in Michigan Angler Households.*” Revised. In: *Risk Analysis*. 14: 4, 513-519. February.

- Ochsner, Jean. 1996. *Technical Memorandum on the results of the 1995 Fish Consumption and Recreational Use Surveys – Amendment No. 1*. Memorandum to Chee Choy. Adolfson Associates, Inc. April 19.
- Patterson, R.E., A.R. Kristal, L.F. Tinker, R.A. Carter, M.P. Bolton, and T. Agurs-Collins. 1999. *Measurement Characteristics of the Women’s Health Initiative Food Frequency Questionnaire*. *Ann Epidemiol*.1999;9(3):178–187.
- Pierce, D. 1981. *Commencement Bay Seafood Consumption Study*. Preliminary Report. Tacoma-Pierce County Health Department. December.
- Polissar, N., M. Neradilek, A.Y. Aravkin, P. Danaher, and J. Kalat. 2012. *Statistical Analysis of National and Washington State Fish Consumption Data, DRAFT*. The Mountain-Whisper-Light Statistics. September 18.
- Prentice, R.L., Y. Mossavar-Rahmani, Y. Huang, L. Van Horn, S.A.A. Beresford, B. Caan, L. Tinker, D. Schoeller, S. Binghamy, C.B. Eaton, C. Thomson, K.C. Johnson, J. Ockene, G. Sarto, G. Heiss, and M.L. Neuhouser. 2011. *Evaluation and Comparison of Food Records, Recalls, and Frequencies for Energy and Protein Assessment by Using Recovery Biomarkers*. *Am J Epidemiol*. 2011;174(5):591–603.
- RIDOLFI Inc. (Ridolfi). 2007. *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*. Prepared for the Yakama Nation ERWM Program. September.
- Ruffle, B., D.E. Burmaster, P.D. Anderson, and H.D. Gordon. 1994. “*Lognormal distributions for fish consumption by the general U.S. population.*” In: *Risk Analysis*. 14: 4, 395-404. January 3.
- Sechena, R., C. Nakano, S. Liao, N. Polissar, R. Lorenzana, S. Truong, and R. Fenske. 1999. *Asian and Pacific Islander Seafood Consumption Study*. EPA Environmental Justice Community/University. EPA 910/R-99-003. May 27.
- Singer, E. and C. Ye. 2013. “*The use and effects of incentives in surveys.*” In: *The ANNALS of the American Academy of Political and Social Science*. 645: 112.
- Spokane Regional Health District. 1998. *1998 Fish Consumption Survey*. Assessment/Epidemiology Center. Prepared for the Washington State Attorney General’s office and the Department of Ecology.
- Sun Rhodes, N.A. 2006. *Fish Consumption, Nutrition, and Potential Exposure to Contaminants Among Columbia River Basin Tribes, A Thesis*. Prepared for Department of Public Health and Preventive Medicine, Oregon Health and Science University. April.
- Suquamish Tribe. 2000. *Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region*. Port Madison Indian Reservation, Fisheries Department. August.
- Towksjhea, A., S. Iwenofu, L. Kissinger, and A.H. Williams. *RARE Project Tribal Seafood Consumption Survey Software*. Quinault Indian Nation.
- Toy, K.A., N.L. Polissar, S. Liao, and G.D. Mittelstaedt. 1996. *A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region*. Department of Environment, Tulalip Tribes and Mountain-Whisper-Light Statistical Consulting. October.

- Tran, N.L., L.M. Barraaj, X. Bi, L.C. Schuda, and J. Moya. 2012. “*Estimated long-term fish and shellfish intake—national health and nutrition examination survey.*” In: *Journal of Exposure Science and Environmental Epidemiology*. Nature America. 23, 128-136. October 10.
- U.S. Department of Health and Human Services. 1989. *The Relationship of Human Levels of Lead and Cadmium to the Consumption of Fish Caught in and Around Lake Coeur D’Alene, Idaho*. Final Report. Agency for Toxic Substances and Disease Registry, Division of Health Studies. Technical Assistance to the Idaho State Health Department and the Indian Health Service. September.
- U.S. Environmental Protection Agency (EPA). 2002. *Estimated Per Capita Fish Consumption in the United States*. August.
- Washington State Department of Health (WADOH). 1997. *Anglers Who Frequently Fish Lake Roosevelt*. September.
- Washington State Department of Health (WADOH). 2001. *Lake Whatcom Residential and Angler Fish Consumption Survey*. April.
- Westat. 2012. *Upper Columbia River Site Remedial Investigation and Feasibility Study Tribal Consumption and Resource Use Survey*. Final Report. Prepared for the U.S. Environmental Protection Agency. June 22.
- Western Institutional Review Board (WIRB). 2013. *A Guide for Researchers*.

3. Traditional Lifeways and Suppression Studies

- Baumhoff, M.A. 1963. “Ecological determinants of aboriginal California populations.” In: *University of California Publications in American Archaeology and Ethnology*. Cambridge University Press. Vol. 49, No. 2, pp.155 - 236. May 28.
- Burger, J. 1999. *American Indians, Hunting and Fishing Rates, Risk, and the Idaho National Engineering and Environmental Laboratory*. Environmental Research, Section A, 80, 317-329.
- Craig, J.A. and R.L. Hacker. 1938. *The History and Development of the Fisheries of the Columbia River*. United States Bureau of Fisheries. Bulletin No. 32.
- Dall, W.H. 1897. “Alaska and Its Resources.” Boston Lee and Shepard Publishers. Digitized by Google.
- Donatuto, J. and B.L. Harper. 2008. “*Issues in evaluating fish consumption rate for native American tribes.*” In: *Risk Analysis*. 28: 6, 1497-1506.
- Dunn, L. and W.S. White. 2013. *The Incidence of Disease in the Lower Elwha Klallam Tribe as Related to the Decrease in Fish Consumption, Specifically Salmon and Shellfish*. Lower Elwha Klallam Tribe.
- Environmental Health Perspectives (EHP). 2013. *Meeting the Needs of the People, Fish Consumption Rates in the Pacific Northwest*. Vol. 121, No. 11-12, p. A335-339. November-December.

- Harper, B.L. 2007. *Traditional Tribal Subsistence Exposure Scenario and Risk Assessment Guidance Manual*. EPA-STAR-J1-R831046. August.
- Harper, B. and D. Ranco. 2009. *Wabanaki Traditional Cultural Lifeways Exposure Scenario*. Prepared for EPA. July, 9.
- Harper, B., A. Harding, S. Harris, and P. Berger. 2012. *Exposure Assessment Articles: Subsistence Exposure Scenarios for Tribal Applications*. Human and Ecological Risk Assessment, 18:810-831.
- Harris, S.G., and B.L. Harper. 1997. "A native American exposure scenario." Revised. In: Risk Analysis. 17: 6, 789-795. April 29.
- Harris, S.G., and B.L. Harper. 2000. "Using eco-cultural dependency webs in risk assessment and characterization of risks to tribal health and cultures." In: Environmental Science and Pollution Research (ESPR). Ecomed Publishers. Special Issue 2, 91-100.
- Harris, S.G. and B.L. Harper. 2004. *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*. Department of Science & Engineering, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.
- Hewes, G.W. 1947. *Aboriginal use of fishery resources in northwestern North America*. Doctoral dissertation, University of California, Berkeley.
- Hewes, G.W. 1973. *Indian fisheries productivity in precontact times in the Pacific salmon area*. Northwest Anthropological Research Notes 7:133–155.
- HistoryLink.org. 2013. *Northwest Indian Fisheries Commission*. HistoryLink File #9786. Accessed May 2013. Available: http://www.historylink.org/index.cfm?DisplayPage=output.cfm&file_id=9786.
- Hunn E.S. 1990. *Nch"i-Wana, The Big River: Mid-Columbians and Their Land*. University of Washington Press, Seattle, Washington.
- Hunn, E.S. and C.L. Bruneau. 1989. *Estimates of Traditional Native American Diets in the Columbia Plateau*. Work supported by the U.S. Department of Energy and Pacific Northwest Laboratory. August.
- O'Neill, C.A. 2000. *Variable Justice: Environmental Standards, Contaminated Fish, and "Acceptable" risk to Native Peoples*. Sanford Environmental Law Journal. 19 stan. Env'tl. L.J.3. January.
- O'Neill, C.A. 2007. *Protecting the Tribal Harvest: The Right to Catch and Consume Fish*. J. Env'tl. Law and Litigation. Vol. 22, 131.
- O'Neill, C.A. 2008. *Environmental Justice in the Tribal Context: A Madness to EPA's Method*. Environmental Law, Lewis & Clark Law School. Issue 38:2.
- O'Neill, C.A. 2013. "Fishable Waters." In: *American Indian Law Journal*. Vol. 1, Issue 2, pp. 181-284.
- Ray, V.F. 1977. *Ethnic Impact of the Events Incident to Federal Power Development on the Colville and Spokane Indian Reservations*.

- Riley, D.M., C.A. Newby, and T.O. Leal-Almeraz. 2006. "Incorporating ethnographic methods in multidisciplinary approaches to risk assessment and communication: cultural and religious uses of mercury in Latino and Caribbean communities." In: *Risk Analysis*. 26: 5, 1205-1221.
- Sanger, D. 1988. "Maritime adaptations in the gulf of Maine." In: *Archaeology of Eastern North America*. Eastern States Archeological Federation. 16, 81-99.
- Schalk, R.F. 1986. *Estimating salmon and steelhead usage in the Columbia basin before 1850: the anthropological perspective*. Northwest Environmental Journal. Vol. 2 (2), p. 1-26.
- Sullivan, R.J. 1942. "The Ten'a food quest." In: *The Catholic University of America Anthropological Series*. Dissertation. The Catholic University of America Press. No. 11.
- Swindell, E.G. 1942. *Report on source, nature and extent of the fishing, hunting and miscellaneous related rights of certain Indian tribes in Washington and Oregon together with affidavits showing location of a number of usual and accustomed fishing grounds and stations*. United States Department of the Interior, Office of Indian Affairs, Division of Forestry and Grazing. Los Angeles, California. July.
- Tiller, V.E.V. 2005. *Tiller's Guide to Indian Country, Economic Profiles of American Indian Reservations*.
- Walker, D.E. 1967. "Mutual cross-utilization of economic resources in the plateau: an example from aboriginal Nez Perce fishing practices." In: *Washington State University Laboratory of Anthropology Report of Investigations*. No. 41, p. 1-70.
- Walker, D.E. 1992. "Productivity of tribal dipnet fishermen at celilo falls: analysis of the Joe Pinkham fish buying records." In: *Northwest Anthropological Research Notes*. Vol. 26: No. 2, pp. 123 - 135.
- Walker, D.E. (ed). 1998. *Handbook of North American Indians, Volume 12: Plateau*. Washington, DC: Smithsonian Institution.
- Wolfe, R.J. and R.J. Walker. 1987. "Subsistence economics in Alaska: productivity, geography, and development impacts." In: *Arctic Anthropology*. Vol. 24, No. 2, pp. 56-81.

8.0 REFERENCES CITED

- Center for Columbia River History (CCRH). 2013. *Nez Perce, Nee-Me-Poo*. Available: <http://www.ccrh.org/comm/river/profile/nezperce.php>. Accessed September 19.
- Coulston, A.M., C.J. Boushey, and M.G. Ferruzzi. 2001. *Nutrition in the Prevention and Treatment of Disease*. Third Edition, p. 12. Available: http://appliedresearch.cancer.gov/diet/adi/thompson_subar_dietary_assessment_methodology.pdf.
- Dodd, K.W., P.M. Guenther, L.S. Freedman, A.F. Subar, V. Kipnis, D. Midthune, J.A. Tooze, and S.M. Krebs-Smith. 2006. "Statistical methods for estimating usual intake of nutrients and foods: a review of the theory." *J Am Diet Assoc* 2006; 106(10):1640-50.
- Doyle, J.K. 2005. *Face-to-Face Surveys*. Available: http://www.wpi.edu/Images/CMS/SSPS/Doyle_-_Face-to-Face_Surveys.pdf.
- Everett, S., C. Beasley, R. Johnson, C. Davenport, and R. Larson. 2006. *"Nez Perce Tribal Hatchery Project; Coho Salmon Master Plan, Clearwater River Basin", 2003-2004 Annual Report*, Project No. 198335000, 134 electronic pages, (BPA Report DOE/BP-00004035-1). FishPro Division of HDR Engineering.
- Hollander, M. and D.A. Wolfe. 1999. *Non-parametric Statistical Methods*, Second Edition, Wiley.
- Hyndman, R.J. and Y. Fan. 1996. "Sample Quantiles in Statistical Packages". *American Statistician* (American Statistical Association); 50 (4): 361–365. November.
- Idaho Department of Fish and Game (IDFG) *Chinook Salmon (Snake River Spring/Summer Run) Conservation Status*. Available: http://fishandgame.idaho.gov/ifwis/cwcs/pdf/Chinook%20Salmon%20%28Snake%20River%20spring_summer%20run%29.pdf. Accessed September 13,
- Kipnis V., D. Midthune, D.W. Buckman, K.W. Dodd, P.M. Guenther, S.M. Krebs-Smith, A.F. Subar, J.A. Tooze, R.J. Carroll, and L.S. Freedman. 2009. "Modeling data with excess zeros and measurement error: application to evaluating relationships between episodically consumed foods and health outcomes." *Biometrics* 65, 2009, pp. 1003-1010.
- Landeem, D. and A. Pinkham. 1999. *Salmon and His People: Fish and Fishing in Nez Perce Culture*.
- Maguire, K.B.. 2009. *Does mode matter? A comparison of telephone, mail, and in-person treatments in contingent valuation surveys*. *J Environ Manage*. Aug;90(11):3528-33. Available: <http://www.ncbi.nlm.nih.gov/pubmed/19647362>.
- Meyer Resources, Inc. 1999. *Tribal Circumstances and Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes*. Prepared for CRITFC, funded by USACE.
- National Environmental Justice Advisory Council (NEJAC). 2002. *Fish Consumption and Environmental Justice*. Report developed from NEJAC Meeting of December 3-6, 2001 (Federal Advisory Committee to the EPA). November.

- Nez Perce Tribe (NPT). 2005. *White Sturgeon Management Plan in the Snake River Between Lower Granite and Hell's Canyon Dams*. Department of Fisheries Resource Management. Lapwai, ID. September.
- Polissar, N., M. Neradilek, A.Y. Aravkin, P. Danaher, and J. Kalat. 2012. *Statistical Analysis of National and Washington State Fish Consumption Data, DRAFT*. The Mountain-Whisper-Light Statistics. September 18.
- Scholz, A., K. O'Laughlin, D. Geist, D. Peone, J. Uehara, L. Fields, T. Kleist, I. Zozaya, T. Peone, and K. Teesatuskie. 1985. *Compilation of Information on Salmon and Steelhead Total Run Size, Catch and Hydropower Related Losses in the Upper Columbia River Basin, above Grand Coulee Dam*. Fisheries Technical Report No. 2. Upper Columbia United Tribes Fisheries Center, Eastern Washington University, Department of Biology. Cheney, Washington 99004. December.
- Smithsonian Institution. 1907. *Handbook of American Indians North of Mexico*. Bureau of American Ethnology, Bulletin 30. Ed. F.W. Hodge. Washington Government Printing Office. Tooze, J., et. al. 2006. A new statistical method for estimating the usual intake of episodically consumed foods with application to their distribution. *Journal of the American Dietetic Association* 106:10, 2006, pp. 1575-1587.