A FISH CONSUMPTION SURVEY OF THE NEZ PERCE TRIBE

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Nez Perce Tribe — Treaty of 1855

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A Fish Consumption Survey of the Nez Perce Tribe

Final Report

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Nayak L Polissar, PhD[a]
Anthony Salisbury[b]
Callie Ridolfi, MS, MBA[c]
Kristin Callahan, MS[c]
Moni Neradilek, MS[a]
Daniel S Hippe, MS[a]
William H Beckley, MS[c]

[a]The Mountain-Whisper-Light Statistics
[b]Pacific Market Research
[c]Ridolfi Inc.

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PREFACE TO VOLUMES I-III

This report culminates two years of work—preceded by years of discussion—to characterize the current and heritage fish consumption rates and fishing-related activities of the Nez Perce Tribe. The report contains three volumes in one document. Volume I is concerned with heritage rates and the methods used to estimate the rates; Volume II describes the methods and results of a current fish consumption survey; Volume III is a technical appendix to Volume II. Each volume has its own page numbering and Table of Contents. The foreword to Volumes I-III has been authored by the Nez Perce Tribe and EPA. All other sections of this report have been authored by the members of the contractor team listed on the title page.

Foreword to Volumes I-III: Background and Context for the Nez Perce Tribal Fish Consumption Survey (Authored by the Nez Perce Tribe and EPA)

The Native American tribal governments in the State of Idaho collaborated with the U.S. Environmental Protection Agency (EPA) Region 10, and tribal consortia to gather data on tribal fish consumption rates (FCRs) in Idaho. One objective of this effort was to support the effort to assess risks posed by contaminants in fish for populations who consume large quantities of fish. More generally, this effort was intended to enhance tribal environmental capacity in the area of water quality. The tribes and EPA met with the State of Idaho to develop tribal surveys that supported Idaho's efforts to develop ambient water quality criteria (AWQC) protective of high fish consumers.

This report presents survey methodology and results, specifically FCRs, for the Nez Perce Tribe. The survey is focused on both current and heritage rates. Heritage rates are tribal FCRs that existed prior to modern environmental and social interferences with historic tribal fishing and fish consumption practices. Within this report, current rates are discussed in Volume II, with supporting material provided in Volume III. Heritage rates are discussed in Volume I.

For tribes and tribal members, fish are an important food and economic resource. The harvest and consumption of fish also figure significantly in tribal culture and spirituality. The Nez Perce have many concerns about water quality. However, the effect of water quality on fish and fisheries resources is of particular importance to the Nez Perce Tribe. Water quality affects the health of fish populations, the level of contaminants in fish and the consequent health risks posed by these contaminants to tribal members when they consume fish. Water quality also impacts fishing and fish consumption aspects of tribal culture and spirituality.

This report shows that a substantial portion of the diet of the Nez Perce Tribe consists of fish and shellfish[1], which research has shown acquire contaminants from water. This report's results are consistent with findings that Puget Sound and Columbia River Basin tribes have much higher FCRs than the general U.S. population. (CRITFC 1994, Toy et al. 1996, Suquamish Tribe 2000, Polissar et al. 2014). As a result of higher tribal fish consumption relative to the general population, tribal people suffer disproportionate exposure and risks associated with contaminants in fish. As the FCRs for populations consuming fish increase, the water must become cleaner in order to keep human exposures to toxic chemicals in fish at acceptable levels, with consequences for target water quality. EPA Region 10 is supporting Idaho's tribal governments in identifying appropriate FCRs to use in protecting the health of the Idaho tribes. Current FCR statistics (i.e., averages and percentiles) included in Volume II of this report are reported in terms of usual consumption: the average daily grams of the edible mass of uncooked fish and shellfish consumed by a tribal member.

A fish consumption study fits into a larger context. There are three eras of importance for such a study: the past, the present, and the future. Considering the past, over an extended period of time the Nez Perce Tribe has experienced environmental and social changes that have reduced fish abundance, access to fish, safety of fish consumption, and fish consumption itself. During the design phase of the current study, the Tribe expressed its goals to increase fish availability, reduce

[1] Hereafter, "fish" will refer to fish and shellfish.

contamination of fish, and increase 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.

A complete understanding of tribal fish consumption issues thus requires not only consideration of current fish consumption rates, but also tribal goals and heritage fish consumption. Assessing past consumption involves review of historical materials and, potentially, interviews with some older individuals whose memories span a long lifetime (and whose memories may carry stories passed down from earlier generations).[2] Assessment of past consumption is likely not as precise as current surveys because derivation of heritage rates does not employ the same methodology as modern surveys of current fish consumption, and involves longer-term recall and unknown quality and completeness of past documentation. Further, heritage surveys can only provide average estimates of fish consumption as opposed to distributions of fish consumption that can be obtained by current fish consumption survey methodologies. Nonetheless, heritage rates are valid data that have been developed with defensible, rational, and accepted research methods (e.g. ethnographic observation, caloric intake, etc.). There have been many studies of historic rates and suppression of fish consumption in the past, but their isolation from a report on current rates may have denied them the attention they deserve.

Multiple studies using different methods have demonstrated that heritage FCRs exceeded current FCRs. Nez Perce heritage and current FCRs documented in Volumes I and II of this report are consistent with these findings. In other words, current FCRs are reduced or suppressed relative to heritage FCRs. The Tribe is concerned that development of water quality criteria based on suppressed fish consumption rates may not allow restoration of water quality to support safe consumption of fish at the higher rates the Tribe desires and that are of cultural importance, rates informed by treaties between the Tribe and the U.S. government that guaranteed tribal rights to practice subsistence fishing.

The concept of suppression was discussed in depth in a publication by the National Environmental Justice Advisory Council (NEJAC, 2002)[3]. Specifically, 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. Suppression effects can arise from at least the following three factors:

- 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 causes, including an aquatic environment that is contaminated, altered (due,

[2] It should be noted that suppressed fish consumption has likely occurred prior to the birth of almost all tribal elders alive today, and hence no firsthand accounts of unsuppressed consumption are possible.

[3] National Environmental Justice Advisory Council (NEJAC). Fish Consumption and Environmental Justice: A Report Developed from the National Environmental Justice Advisory Council Meeting of December 3–6, 2001. 2002. https://www.epa.gov/sites/production/files/2015-02/documents/fish-consump-report_1102.pdf

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.

Another concern in assessing suppression is how to define the more robust "baseline" level for the particular group affected. In some cases, 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.

The strength of the current rates is that they are derived by a technically defensible methodology, and 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. The website of the Nez Perce Department of Fisheries Resource management states, "Our vision is to recover and restore all species and populations of anadromous and resident fish within the traditional lands of the Nez Perce Tribe."[4]

Development of the survey design involved informational visits to the Nez Perce Tribe, 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.

The survey was implemented largely consistent with the Nez Perce final survey design report (Appendix H in Volume III). Some design modifications were made while the survey for current rates was underway to improve response rates without introducing bias. The final survey design report also includes a description of the Nez Perce Tribe's story about 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, as well as causes of decline in the fish populations, and goals for the future.

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[4] http://www.nptfisheries.org, accessed September 17, 2015.

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Volume I:
Heritage Fish Consumption Rates of the Nez Perce Tribe

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LIST OF ABBREVIATIONS AND ACRONYMS

EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FCR	Fish Consumption Rate
ICC	Indian Claims Commission
IDFG	Idaho Department of Fish and Game
NPT	Nez Perce Tribe

LIST OF UNITS

%	percent
cal/d	calories per day
g/d	grams per day
kCal	kilocalories
km	kilometers
lb/d	pounds per day
lb/yr	pounds per year

1.0 INTRODUCTION

A study of heritage Fish Consumption Rates (FCRs) was conducted for the Nez Perce Tribe. The study was done as part of a larger fish consumption survey of federally recognized Tribes in Idaho, which was initiated by the U.S. Environmental Protection Agency in 2013. This report presents the results of the Nez Perce Tribe's heritage rate research, which was based upon an evaluation of available ethnographic literature on aboriginal fish consumption by Columbia Basin Tribes and other influential studies that have supported previous estimates of heritage rates.

1.1 Purpose and Objectives

Tribal Governments in the State of Idaho are working closely with the U.S. Environmental Protection Agency (EPA) Region 10, the State of Idaho, and other stakeholders to gather data on FCRs. The overarching goal of this process is to obtain information on fish consumption to enable Tribal governments to set water quality standards for tribal waters, and to allow Tribes to meaningfully participate as informed partners in Idaho DEQ's ambient water quality criteria review process that impacts tribal interests. A Tribal heritage rate study was conducted as part of this effort.

Recognizing that current Tribal fish consumption is suppressed due to a number of factors (e.g. decreased fish populations due to physical habitat modifications and adverse effects of chemical contamination, loss of Tribal access to fisheries resources, fears of exposure to contaminants in fish, and changes in fish harvesting by Tribal members associated adaptation to economic and cultural shifts), this study compiled and evaluated available data to determine heritage FCRs for the Nez Perce Tribe (NPT). Knowledge of past rates may help determine how current FCRs might increase in the future if current fisheries resources are improved and fish consumption is restored to past, higher levels. Information about FCRs may be used to support development of water quality standards that protect human health.

Water quality is of great importance to the Nez Perce Tribe, since a substantial portion of their diet is derived from aquatic sources, and water and aquatic resources are of great cultural and spiritual significance. As part of the survey effort, discussions with the Tribe highlighted the issue of suppression of current fish consumption and its causes. Therefore, the survey team agreed to review and evaluate heritage rates available in the literature, which may be more relevant than current suppressed rates to the long-term restoration goals of the Tribe.

The Nez Perce Tribe has treaty reserved fishing rights within the Columbia Basin and Snake River basins. In the Snake River 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 NPT has usual and accustomed fishing places throughout 13 million+ acres that have been found to been 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 River 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. Increased fisheries resources will support higher fish consumption.

1.2 Study Approach

The approach for estimating heritage rates was based on a comprehensive review and evaluation of literature that is relevant to heritage rates, including historical accounts and modern studies of heritage consumption. For Tribes that harvest fish from the Columbia Basin, there is a significant volume of literature to form the basis for a range of quantitative estimates of fish consumption. Information includes ethnographic studies, personal interviews, historical harvest records, archaeological and ecological information, and nutritional and dietary information. The quantitative assessment includes compilation and analysis of historic and heritage information across the region of the Columbia Basin.

The survey team compiled and evaluated available information regarding heritage consumption rates relevant to the Nez Perce Tribe. The development of estimates of heritage rates presented here includes a discussion of the available information, including methodologies used to develop the fish consumption estimates and factors affecting the uncertainty associated with the estimates. Based on available information, a quantitative range of heritage FCRs is presented for the Tribe.

Certain key geographic features referred to in the following discussion are mapped in Figure 1.

2.0 BACKGROUND

The Nez Perce Tribe has relied extensively on fish resources and fishing activities throughout time. A summary of the fish harvest and extensive use and consumption of fish historically, as well as the causes of decline in fish availability over time, is provided for context.

2.1 Summary of 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 Perces, 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, 1999). The decline of salmon productivity since the mid-1800s 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.

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[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.

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 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, Coho, and Sockeye varieties of salmon; Dolly Varden, Cutthroat, Brook, Lake, and Rainbow varieties of trout; several species of suckers, white fish, sturgeon, squawfish (Northern pikeminnow), 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).

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 (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.

2.2 Summary of 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 (Landeen 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 dams 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- 1800s. 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), 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 (Matthews 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.

2.3 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."

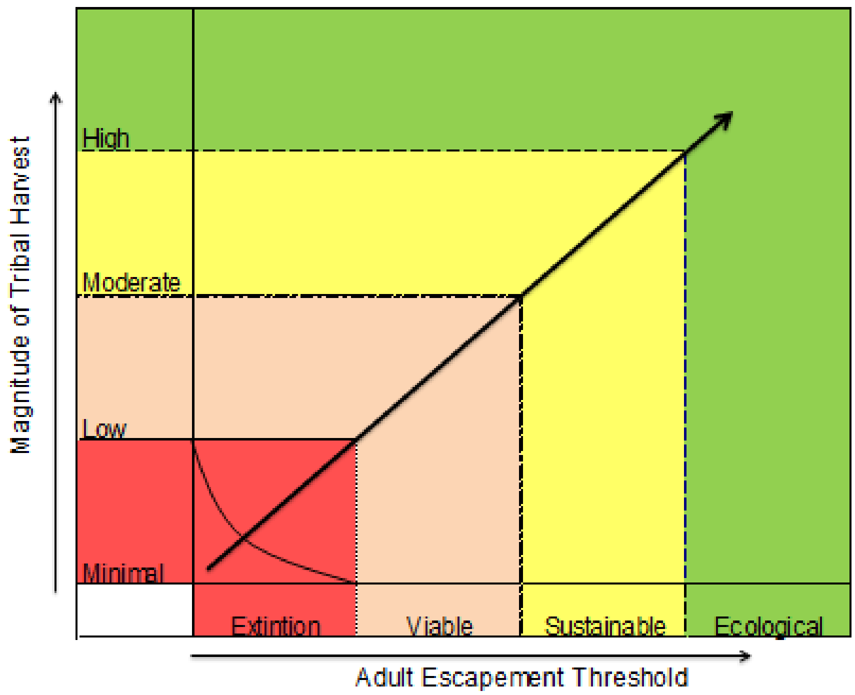
The following table depicts the aggregated abundance thresholds for certain fish species.

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	120,000
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.

3.0 HERITAGE FISH CONSUMPTION RATES (FCRs)

A summary of the primary source literature reviewed for this heritage rate study is provided here, including a definition of "fish consumption," as used differently by various authors, and certain factors and other assumptions that have been used to adjust and/or calculate consumption rates. Also presented below are the average aboriginal per capita FCRs estimated for the Columbia Basin Tribes (summarized in Table 1) and rates for the Nez Perce Tribe specifically (summarized in Table 2).

3.1 Defining Fish Consumption

The focus of this effort is to compile, summarize, and evaluate estimates of Tribal fish consumption during the period when Tribes had full access to their traditional fisheries, which we refer to here as "heritage rates." This effort is intended to provide Tribes with information that may be useful in establishing water quality criteria for the protection of human health. The information supporting heritage rates is on a per capita basis that can be used to estimate average FCRs, however this information is not suitable for development of FCR distributions or percentiles of fish consumption.

As evident in review of the documentary record, the definition of fish consumption as fish *ingestion* is not necessarily shared by the various researchers who have attempted to estimate aboriginal FCRs for various Tribal groups. Several researchers include all uses of fish in what they describe as a "total consumption rate." For example, one researcher (Schalk, 1986), suggested that a previously calculated consumption estimate was too low because it "only considers human dietary demands." Another (Griswold, 1954) stated that "[t]he tribes here required salmon for fuel as well as for food. Consequently, it may be inferred that their per capita consumption was considerably greater than that of the tribes [downstream] below." Still another, (Walker, 1967) discussed "exceptional areas of unusually high consumption, up to 1000 lbs. per capita, per year" which are "caused not only by the high calorie demands typical of colder climates, but also by the use of fish for dog food or for fuel."

Estimates by various researchers, therefore, may include as part of a total FCR that portion of the overall fish harvest that was used for trade, for fuel, for animal feed, or may include the inedible portion of fish not actually ingested. To the extent that it is discussed in the literature, this report attempts to describe the assumptions involved in estimating a consumption rate, and, where possible and appropriate, identify that portion that was actually ingested.

3.2 Defining Factors Influencing Consumption Rates

Many sources of information providing estimates of heritage FCRs for Tribal groups in the Columbia Basin tend to refer to or build upon previous work, in some cases revising or adjusting rates from previous reports based on new knowledge, new data, or new approaches for interpreting consumption information. Some authors have attempted to revise earlier estimates of fish consumption, particularly those estimates based on caloric intake, to account for the caloric losses that occur as a result of salmon spawning migration ("migration calorie loss factor") and to account for the fact that not all of an individual fish is consumed ("waste loss factor"). Each of these factors and their effect on consumption estimates, as well as other variables that influence the calculation of consumption rates, are discussed below.

3.2.1 Migration Calorie Loss Factor

Eugene Hunn (1981) appears to be the first author to suggest modifying the calorie-based fish consumption estimates originally developed by Gordon Hewes (1947, 1973). While Hunn considered Hewes' estimates of salmon consumption to be "the most comprehensive attempted to date for the region" he contends that "his interpretation of the nutritional factors is misleading." Specifically, Hewes's caloric calculations did not account for the calories that salmon lose during spawning migration (since migrating salmon no longer feed once they re-enter freshwater).

Citing a study by Idler and Clemens (1959), who determined that sockeye salmon lose 75% of their caloric potential during spawning migration in the Fraser River watershed, Hunn proposed the following approach, as transferred to the Columbia River watershed: the "migration calorie loss factor" is computed as a ratio of (a) the distance in river-kilometers (km) from the mouth of the Columbia River to the approximate middle of each group's territory, to (b) the entire length of the Columbia River (1,936 km). This ratio was then multiplied by the average value for calorie loss during salmon migration, 75% (0.75), and the product was subtracted from one. For example, a salmon harvested halfway to the headwaters of the Columbia River is assumed to have lost half of 75%, or 37.5% (0.375) of its beginning caloric potential, and, therefore, would retain 62.5% of its beginning caloric potential (1 – 0.375 = 0.625), which is considered the migration calorie loss factor. Based in part on this adjustment, Hunn suggested that Hewes likely overestimated the calories provided by salmon, and therefore salmon's contribution to the overall diet, and that "vegetable resources" likely played a larger dietary role than assumed by other authors. In fact, he concluded that the food collecting societies of the southern half of the Columbia-Fraser Plateau "obtained in the neighborhood of 70% of their food energy needs from plant foods harvested by women."

Other authors (e.g., Scholz et al., 1985; Schalk, 1986) have taken a different approach and assumed that Hewes was correct about the proportion of the diet supplied by salmon (on average 50%, or about 1,000 calories), but by not accounting for migration calorie loss, Hewes likely underestimated salmon consumption rates, particularly for upriver Tribes (as Schalk, 1986, stated, "some adjustment should have been made for distance traveled upstream"). To account for this, Schalk divided the consumption estimates developed by Hewes by a specific migration calorie loss factor determined for each Tribal group, following the approach described above.

Again using the example of a salmon harvested halfway to the headwaters of the Columbia River, Hewes's estimate for average per capita consumption for the Columbia Basin tribes of 365 pounds per year would be revised in the following manner: assuming a salmon has lost 37.5% of its initial caloric potential during spawning migration, 62.5% of its caloric potential would remain (the migration calorie loss factor). Dividing 365 pounds per year by 62.5% (0.625) gives a revised estimate of 584 pounds per year – a 60% increase. In other words, a person harvesting salmon halfway up the Columbia River would need to consume 584 pounds of salmon to get the same amount of calories as someone consuming 365 pounds of salmon harvested at the mouth of the Columbia. As Schalk (1986) noted, "the total annual per capita estimate for fish consumed rises significantly when a migration calorie loss factor is included."

3.2.2 Waste Loss Factor

In addition to considering calorie loss from migration, Hunn (1981) also appears to be the first author to suggest modifying the calorie-based fish consumption estimates originally developed by Hewes (1947, 1973) based upon the fact that some portion of a fish is not edible. Hunn (1981) stated that Hewes "does not allow for the fact that the edible fraction of whole salmon is generally considered to be approximately 80% of the total weight." Since many authors providing estimates of historical Tribal fish consumption did so for the purpose of estimating historical harvest rates, this factor (if accurate) was likely an important consideration. For example, if only 80% of each salmon harvested is edible (i.e., 20% is "waste"), then a person consuming 100 pounds of salmon per year would need to harvest 125 pounds of salmon to support that consumption rate.

Schalk (1986) incorporated this "waste loss factor" into his estimates of annual salmonid catch in the Columbia Basin by revising Hewes's consumption estimates for various Tribes and Tribal groups. Schalk stated that "the revised estimate involves dividing the per capita consumption estimate by a waste loss factor of 0.8 to get the gross weight of fish utilized. This figure is also derived from Hunn's (1981) suggestion that 80% of the total weight of a salmon is edible." While it appears that the main objective in using this factor is in estimating total catch ("the gross weight of fish utilized"), the terms "total catch" and "total consumption" are sometimes used interchangeably. Some subsequent authors have incorporated this waste loss factor into their estimates of actual fish *ingestion* when estimating aboriginal FCRs.

3.2.3 Other Assumptions used to Develop Consumption Rates

In addition to the rate adjustment factors discussed above, there are a number of other assumptions that various authors have made to develop consumption rate estimates, including the following (discussed in more detail in Section 4.1.3).

- Fish ingestion versus harvest and other uses (i.e., definition of "consumption")
- Percent of diet (calories) provided by fish (versus other food items)
- Salmon (anadromous) and/or resident fish consumption
- Historical Tribal population estimates
- Number of fishing sites, fishing methods, and fishing efficiency

3.3 Columbia Basin-Wide Heritage Rates

Below is a summary of the primary source information reviewed on aboriginal FCRs of Columbia Basin Tribes. Relevant information is presented from each of the following publications, including fish consumption estimates and associated assumptions (and summarized in Table 1).

- Craig and Hacker, 1940
- Swindell, 1942
- Hewes, 1947
- Griswold, 1954
- Walker, 1967
- Boldt, 1974
- Hunn, 1981

3.3.1 Craig and Hacker, 1940

In 1940, Joseph Craig and Robert Hacker of the U.S. Bureau of Fisheries estimated an aboriginal per capita salmon consumption rate of 1 pound per day (lb/d), which equates to 365 pounds per year (lb/yr) (or 454 grams per day [g/d][6]) for Columbia Basin Tribes (Table 1). This estimate is based on historical ethnographic observations of extensive salmon harvest and use. The authors stated that, based on accounts of early explorers:

> *"Without doubt salmon, either fresh or dried, was the chief single factor in the diet of the Indians of the Columbia Basin in their native state."* (p. 140)

Other species were identified as consumed as well, including sturgeon, trout, and other fish; however, salmon was the primary species consumed. While the authors noted that it was "not possible to make an accurate estimate of the amount of salmon used by the Indians," at the time, an approximation could serve "to illustrate the possible magnitude" of fish caught and consumed, with a wide margin of error (p. 141).

The authors stated that since significant quantities of salmon were available in the Columbia River and its tributaries during at least 6 months of the year, the Indians likely harvested and consumed large quantities of fresh salmon during this period and then consumed dried salmon for the remainder of the year. Therefore, "it appears to be well within the realms of probability that these Indians had an average per capita consumption of salmon of 1 pound per day during the entire year" (p. 142).

3.3.2 Swindell, 1942

In 1942, Edward Swindell of the U.S. Department of the Interior's Office of Indian Affairs estimated an aboriginal per capita salmon consumption rate of 322 lb/yr (or 401 g/d) for Columbia Basin Tribes, specifically in the Celilo region prior to the installation of the Dalles Dam and flooding of Celilo Falls (Table 1). This estimate is based on field survey interviews (and published affidavits) with local Indian families.

Swindell agreed that the estimate reported by Craig and Hacker (1940) of per capita salmon consumption of 1 pound per day was "not unreasonable" (p. 13) and that while "the poundage of the fish used for subsistence purposes cannot be definitely ascertained… the importance of this article of food as shown by a survey of 55 representative families is shown…" in his report (p. 147). As part of this study, the author presented and compared results obtained from interviews conducted with the heads of the 55 selected families, which represented a total of 795 Indian families present "under the jurisdiction of the Yakima, Umatilla, and Warm Springs" (p. 13-14). These interviews determined an average consumption rate of 1,611 lb/yr per family. Assuming a family unit was comprised of 5 members, Swindell calculated this to be a per capita rate of 322 lb/yr. This value accounted for both fresh and cured salmon, where the dried weights were converted to wet (fresh) weights. The affidavits given by participants of the survey supported Swindell's aboriginal fish consumption estimates.

6 Most sources present rates in pounds per day; this report applies a conversion to grams per day (1 pound = 454 grams) for the reader and for applicability to water quality standards.

An affidavit provided by Tommy Thompson (age 79), of the Wyam Tribe of Indians residing at Celilo, Oregon, stated that "each family of Indians, when he was a boy,[7] would dry and put away for their own future use, about 30 sacks of fish…each sack would contain about 10 or 12 fish which weighed almost 100 pounds [total]… each fish after it had been cleaned, the head and tail removed, and then dried, would only weigh between 6 and 8 pounds" (p. 153). Another affidavit provided by Chief William Yallup (age 75), a Klickitat Indian of Rock Creek, stated that "when he was a boy… during the [fish] runs, they would eat fresh fish three times daily and the surplus they caught would be dried for use when no fresh ones were available" and "that in those days each family would dry for its own personal use approximately 30 sacks of fish, each of which contained about six large salmon weighing, after they had been cleaned for drying, about six pounds; that for purposes of trading, each family would put away about 10 sacks of fish" (p. 165). Further, the affidavit noted that fishing rights "have a value to the Indians which cannot be measured in the terms of dollars and cents of the white man; that the subsistence value to the Indians as a whole is enormous…" (p. 167).

3.3.3 Hewes, 1947

In 1947, as part of his dissertation required for a Ph.D. in Anthropology, Gordon Hewes developed an estimate reflective of Craig and Hacker's (1940) per capita salmon consumption estimate of 1 lb/d (365 lb/yr or 454 g/d) for aboriginal Columbia Basin Tribes (Table 1). The justification for this estimate was based on the average human caloric requirements of 2,000 calories per day (cal/d), the assumption that nearly 50% of the Indian diet was salmon, and that the caloric value of salmon was approximately 1,000 calories per pound[8] (p. 213-215). This assumed that salmon provided nearly all dietary protein (primary source of energy) and that other food sources (such as plants) contributed minimal caloric value to the diet.

Hewes presented various consumption rate estimates for Tribal groups in different regions of Alaska and the Pacific Northwest compiled from various sources, stating that "while we have very few quantitative hints for the regions south of Alaska, it is reasonable to suppose that per capita consumption among intensive fishing peoples in parts of the Plateau…reached amounts equivalent to at least the lower estimates…" provided for Alaska and the Pacific Northwest by other authors (p. 223), including the estimate of 365 lb/d for the Columbia Basin presented by Craig and Hacker (1940). Acknowledging the guesswork involved, the author made every effort to develop reasonable rates, based on available ethnographic data for the various Tribes in the Pacific Northwest and Alaska, weighing salmon consumption by group or area accordingly. Tribe-specific rates are further discussed in Hewes, 1973 (Section 3.4.1).

[7] Based on the year of the publication (1942) and the age of Tommy Thompson at the time of the affidavit (79 years), the period discussed here equates to the mid to late 1800s.

[8] Calculation: 2000 cal/d * 0.5 * 1 lb/1000 cal = 1 lb/d

3.3.4 Griswold, 1954

In 1954, as part of his dissertation required for a Master of Arts, Gillett Griswold cited Swindell's survey of Indian families in the Celilo region of the Columbia Basin, specifically noting the input factors that, when applied together, would result in an aboriginal per capita salmon consumption rate of 800 lb/yr (or 995 g/d). This rate was not presented in his publication *per se* (and, therefore, not listed in Table 1), only the factors used to calculate the rate.

Referring to affidavits presented in Swindell's study, Griswold assumed that each family cured and stored 30 sacks of salmon for their own use and an additional 10 sacks of salmon for trade each year, with each sack weighing 100 pounds. This equates to 4,000 lb/yr per family harvested. Assuming 5 individuals per family (as stated by Swindell), this equates to a per capita rate of 800 lb/yr. It should be noted that this rate considers all salmon that was harvested for both ingestion as well as trade (i.e., not eaten). While this consumption rate was not presented by Griswold in his dissertation, his input factors (4,000 lb/yr per family of 5 individuals) were used in the rate calculation by another author (Walker, 1967, discussed below) to estimate a range of consumption rates.

3.3.5 Walker, 1967

In 1967, Deward Walker conducted research on behalf of the Nez Perce Tribe and estimated an average per capita salmon consumption rate of 583 lb/yr (or 725 g/d) for aboriginal Tribes of the Columbia Plateau in general (Table 1). This estimate was based on the median value of two previously reported estimates: 365 lb/yr (estimated by Craig and Hacker, 1940) and 800 lb/yr (calculated from assumptions in Griswold, 1954). Walker also estimated a rate specifically for the Nez Perce Tribe, which is discussed in Section 3.4.1 below.

Walker stated that "in light of the known annual dietary dependence on fish among aboriginal societies of the Plateau, it seems safe to conclude that the range was between 365 and 800 lbs. per capita with the average probably close to the median, i.e., 583 lbs." (p. 19). It should be noted that the higher value of this range was calculated from Griswold, which, as discussed above, includes salmon harvested for ingestion as well as other uses such as trade. Walker noted that a typical use of fish in the Celilo region was for fuel. He also noted that determining a rate for particular groups in the Plateau would "require substantial, additional research" (p. 19).

3.3.6 Boldt, 1974

In the 1974 decision, Senior District Judge George H. Boldt ruled in the case regarding Treaty fishing rights in Washington State. The Judge stated that salmon "both fresh and cured, was a staple in the food supply" of the Columbia River Tribal fishers, and that salmon was consumed annually "in the neighborhood of 500 pounds per capita" (or 622 g/d) (p. 72) (Table 1). This case decision reaffirmed the reserved right of Native Americans in Washington State to harvest fish from their traditional use areas.

3.3.7 Hunn, 1981

In 1981, Eugene Hunn from the University of Washington, Department of Anthropology, re-evaluated the assumptions associated with Hewes' (1947 and 1973) salmon consumption estimates for Columbia Basin Tribes, suggesting that salmon likely did not provide as many calories as originally estimated in the aboriginal diet. Although Hunn did not present FCRs in his publication (and, therefore, no estimate is included in Table 1), he first introduced the concept of migration calorie loss and waste loss factors, as discussed in Section 3.2 above, and as later applied to fish consumption estimates by other authors (e.g., Scholz, et al., 1985, and Schalk, 1986).

While Hunn considered Hewes' estimates to be the most comprehensive to date, Hunn contended that the caloric calculations were based on commercial fish, which are generally the fattest species, and which are typically harvested prior to upstream migration. Hunn cited Idler and Clemens (1959), which concluded that migrating salmon in the Fraser River "lose on average 75% of their caloric potential during this migration" (p. 127). It may be assumed that fewer calories per pound of salmon upstream results in people consuming more salmon to meet their daily caloric requirements. However, Hunn stated that other foods, such as roots and bulbs, likely provided a large caloric percentage of traditional diets. In addition to migration loss, Hunn determined that only about 80% of the total weight of salmon was edible, therefore introducing the concept of the "waste loss" factor, later applied by other authors to adjust consumption rates.

3.4 Nez Perce Tribe Heritage Rates

Below is a summary of the primary source information reviewed on heritage FCRs specific to the Nez Perce Tribe. Relevant information is presented from each of the following publications (and summarized in Table 2), including fish consumption estimates and associated assumptions.

- Walker, 1967
- Hewes, 1973
- Marshall, 1977
- Walker, 1985
- Schalk, 1986
- Hunn and Bruneau, 1989

3.4.1 Walker, 1967

In 1967, Deward Walker, in the same publication discussed above, estimated an average per capita salmon consumption rate of 300 lb/yr (or 373 g/d) for the Nez Perce Tribe (Table 2). This estimate was based on the following assumptions: a minimum of 300 fish harvested on a peak day, a minimum of 10 peak days per year, a minimal average fish weight of 10 pounds per fish, and a total of 50 historical fishing sites or villages (this last assumption was made from Spalding in 1936, as noted in Walker, 1967).[9] Multiplied together, this value was divided by the total estimated population at the time of 5,000 people, yielding a total of 300 lb/yr.

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[9] Calculation: (300 fish/site x 10 peak days/year x 10 lb/fish x 50 fishing sites) ÷ 5,000 people

Walker's (1967) assumptions were identified as minimum estimates. His informants, for example, estimated 10 to 20 peak days of fish harvest, and Hewes (1947) reported a total population of 4,000 (which would increase the per capita consumption estimate).

3.4.2 Hewes, 1973

In 1973, continuing on his previous dissertation work, Gordon Hewes presented updated aboriginal per capita salmon consumption rates for specific Tribes in Alaska, British Columbia, and the Pacific Northwest, including a rate of 300 lb/yr (or 373 g/d) for the Nez Perce Tribe (Table 2). This rate is based on caloric content and daily requirements, population estimates, and ethnographic accounts of the importance of salmon; it is also based on human dietary demands only, not including other non-ingestion uses.

Hewes initially published a general rate for salmon consumption by Columbia Basin Tribes based on assumptions about dietary caloric requirements and the contribution of salmon to aboriginal diets (see discussion of Hewes, 1947, in Section 3.3.3 above). In this report, Hewes again presents an average per capita estimate of 365 lb/yr (or 454 g/d) for the Columbia Basin Tribes as well as rates for individual Tribes. The Tribe-specific rates account for variability in salmon dependence between regions and population groups, and they reflect population numbers available at the time for each Tribe.

3.4.3 Marshall, 1977

In 1977, working on his dissertation for the Washington State University Department of Anthropology, Alan Marshall estimated an aboriginal per capita salmon consumption rate of 560 lb/yr (or 697 g/d) for the Nez Perce, based on total fish harvest (Table 2).

Marshall (1977) estimated the Nez Perce rate based on the following assumptions, the majority which originated from Walker's "informants" (1967): a minimum of 300 fish harvested on a peak day, a minimum of 10 peak days per year, a minimal average fish weight of 10 pounds per fish, and a total of 94 historical fishing sites or villages. This last assumption (fishing sites) was increased from Walker's estimate of 50 (according to information from Schwede, 1966, as cited in Marshall, 1977).[10] Multiplied together, this value was divided by the total estimated population at the time of 5,000 people, yielding a total of 564 lb/yr, which the author presents as "roughly 560 pounds" that "reasonably approximates the figure" from Walker (1967) for Columbia Basin Tribes.

3.4.4 Walker, 1985

In 1985, Deward Walker conducted ethnographic research that included information about the Nez Perce Tribe; however, the report was never published and remains unavailable due to the sensitivity of the information it contained. The data presented here is based upon citations in Scholz, et al. (1985), in which the author included estimates and quotes and, therefore, apparently had access to Walker's (1985) report. Walker calculated an average per capita total (anadromous

[10] Calculation: (300 fish/site x 10 peak days/year x 10 lb/fish x 94 fishing sites) ÷ 5,000 people

and resident) FCR of 1,000 lb/yr (or 1,244 g/d) for the Nez Perce Tribe (Table 2). Note that this rate intended to include both salmon and resident fish consumption combined in the estimate.

According to Scholz (1985), Hewes "checked Walker's new figures for populations and per capita consumption and agrees with Walker's revisions" (Scholz, 1985, p. 73). Scholz also stated that Walker's (1985) estimates were significantly different from those of Schalk (1986), discussed below, primarily because Walker assumed higher Tribal population totals (and also includes resident fish with salmon consumption). Without the original document, however, it is unclear if Walker's estimates represent fish ingestion only or include fish used for other purposes, such as trade and fuel.

3.4.5 Schalk, 1986

In 1986, Randall Schalk calculated salmon consumption estimates for specific Tribes based on Hewes' (1947 and 1973) original estimates, including a rate of 647 lb/yr (or 804 g/d) for the Nez Perce Tribe (Table 2). This rate includes migration and waste loss factors applied to Hewes' Tribe-specific values. Schalk contended that many of Hewes' original estimates were biased low because they were based on:

- A caloric content of fish representing salmon as they enter freshwater in prime condition (i.e., having more calories than upstream salmon). Schalk stated that "since salmonids lose an average of 75% of their caloric content during migration (Idler and Clemens 1959), some adjustment should have been made for distance traveled upstream" (i.e., applying a migration loss factor).
- The assumption that salmon were eaten in their entirety. Schalk states that assuming the entire fish was consumed was "unrealistic" and cited Hunn (1981) to state that only "about 80% of the weight of a salmon is edible" (p.17).

Schalk, therefore, adjusted (increased) Hewes' consumption rates by applying a migration loss factor (variable by Tribe depending on how far upstream they harvested salmon) of 58% (0.58) for the Nez Perce Tribe. Schalk also applied a waste loss factor of 80% (0.80), citing Hunn (1981), therefore, including inedible fish parts in the fish consumption estimate.

3.4.6 Hunn and Bruneau, 1989

In 1989, Eugene Hunn and C. Bruneau of Pacific Northwest Laboratory (on behalf of the U.S. Department of Energy at the Hanford Site) estimated an anadromous fish (including salmon, steelhead, and lamprey) consumption rate of 320 lb/yr (or 398 g/d) for the Nez Perce Tribe (Table 2).

Based on the "educated guesses" of previous authors, including Craig and Hacker (1940), Hewes (1947, 1973), and Walker (1967), Hunn and Bruneau (1989) estimate 400 pounds per person per year as a "reasonable traditional gross harvest rate" for the Nez Perce. Assuming that the actual consumption was only 80% of the total harvest, the authors adjusted (reduced) this value (i.e., multiplied by 0.80) to account for the edible fraction only.

4.0 RATE EVALUATION AND DISCUSSION

This section further evaluates and discusses the information presented above, including the uncertainty associated with the rate adjustment factors and other assumptions influencing rate calculations.

4.1 Factors Influencing Consumption Rates

The migration calorie loss factor and waste loss factor are considered here, particularly regarding the uncertainty associated with applying these adjustment factors to heritage rates. Other factors that influence the calculation of heritage rates and that may also increase uncertainty of the estimates include population size estimated at the time, number of fishing sites, and reliability of ethnographic data in general.

4.1.1 Migration Calorie Loss Factor

For a number of reasons, the application of the migration calorie loss factor as described above introduces a high degree of uncertainty into the revised estimates of tribal fish consumption. The study that forms the basis of this adjustment (Idler and Clemens, 1959) is based on one year's run of one species of salmon (sockeye) in one watershed (the Fraser River). The conclusions of this study are then broadly applied to all salmon species within a different watershed (the Columbia River), even though it is estimated that sockeye accounted for only 7% of the Upper Columbia salmon harvest (Beiningen, 1976 as cited in Scholz, et al., 1986). The degree to which different salmon species lose calories at different rates or in different proportions during spawning migration, and the degree to which the Columbia River and Fraser River watersheds differ (in length, elevation change, etc.) all affect the degree of uncertainty associated with the calculation and application of a migration calorie loss factor.

The migration calorie loss factor is based on a gross percentage of calories lost by a sockeye salmon during spawning migration in the Fraser River (i.e., ending calories compared to beginning calories). However, the factor is applied in revising consumption rates as though it represents the amount of calories lost *per pound consumed*, which is not the same; salmon not only lose calories during migration, they also lose weight. Based on measurements collected by Idler and Clemens (1959), the average overall weight loss during spawning migration was 25%, and the loss in caloric density (calories per gram) was therefore about 65%, as opposed to 75%. Table 3 provides the total calories, total weight (in grams), and caloric density (in calories per gram) of sockeye salmon measured at various stages in the Fraser River (from Idler and Clemens, 1959).

Further, the overall decrease in caloric potential was based on measurements of sockeye salmon that have spawned *and died* in headwater streams. Michael Kew (1986) describes the results of the Idler and Clemens study as follows:

> *"As a general rule, the further from the sea a salmon is, the less fat and protein it carries. The loss is considerable. Total caloric value of a sockeye, measured at the river mouth, will be reduced to nearly one-half when it reaches the Upper Stuart spawning grounds, one thousand kilometers from the sea. After the enriched gonads have been expended in spawning and the fish die on these upper streams, they will have lost over 90 percent of their fat and one-half to two-thirds of their protein (Idler and Clemens, 1959; reviewed in Foerster, 1968: 74-6)."*

As Kew notes, there is a significant difference in caloric potential between the time a salmon reaches its spawning grounds and the time it has spawned and died. Based on measurements collected by Idler and Clemens (1959), the average sockeye loses almost 15% of its caloric density (calories per pound) between the time it reaches its spawning grounds and the time it has spawned and died. At the time a sockeye salmon reaches its spawning grounds in the upper Fraser River watershed, it has lost about 50% of its caloric density (Table 3).

Still further, the derivation of the migration calorie loss factor relies on the assumption that the salmon harvest location is at “the approximate middle of each group's territory” (Hunn, 1981). To the extent that a majority of salmon harvest occurs either downstream or upstream of this point, the migration calorie loss factor would either overestimate or underestimate, respectively, the effect on the consumption rate.

Mullan, et al. (1992) note that caloric losses in salmon are generally related to mileage of migration, but not directly. “Idler and Clemens (1959) show much higher energy expenditures by sockeye in some river reaches than others, and higher rates for females than males. In other words, caloric content is not linear in relation to distance.” Further, Mullan notes that in migration and maturation the fish tend to mobilize fat reserves and resorb organs (e.g., gastro-intestinal tract), and “[t]hus they lose weight, but not necessarily caloric content, between cessation of ocean feeding and nominal freshwater capture.”

While the idea of adjusting calorie-based consumption estimates to account for migration calorie loss does not seem unreasonable, based on the uncertainty described above, it most likely tends to overestimate salmon consumption relative to Hewes’ original estimates (because it likely overestimates calorie loss per pound). Since sockeye salmon lose approximately 50% of their caloric density upon reaching their spawning grounds, a maximum migration calorie loss factor of 50%, as opposed to 75%, may be more consistent with the supporting research (although the existing research is limited to a single species of salmon). Hewes’s diet and calorie-based consumption estimate for the Columbia Plateau Tribes is identical to that proposed by Craig and Hacker (1940), which is not based on caloric intake but on observation and review of the ethno-historical literature (although it is “admittedly liable to a wide margin of error”).

4.1.2 Waste Loss Factor

Incorporating a waste loss factor to revise Hewes’s fish consumption estimates has the effect of increasing the consumption rate (relative to Hewes’s estimate) by 25%. If the interest is in understanding how much individuals consumed (ingested), as opposed to “used,” then the use of a waste loss factor is not appropriate. Essentially, this factor adjusts a consumption rate, increasing it by 25%, to account for the portion of fish NOT consumed. Consumption estimates that have been revised to account for a waste loss factor (as in Scholz et al., 1985, and Schalk, 1986) would tend to overestimate consumption (ingestion) by 25%, relative to the “unrevised” rates.

Some estimates of consumption by Tribal groups are based on an estimate of total harvest and total population. For example, some authors estimate a total harvest (in pounds) based on the number of fishing sites, number of fishing days, efficiency of fishing techniques, average weight of fish, etc., and simply divide the total estimated harvest by the total estimated tribal population to arrive at an annual per capita consumption rate. However, this type of estimate does not account for the fact that only a portion of each fish may be edible (i.e., 80%), and may tend to overestimate the amount that people are actually consuming.

Mullan, et al. (1992) suggested that, because many Tribal groups prepared and consumed most parts of the salmon, including organs, eyes, eggs, etc., the inedible waste was much less than 20%, arguing that "waste factor of a salmon amounted to bones only, under 10% of body weight."

4.1.3 Other Assumptions used to Develop Consumption Rates

In addition to the rate adjustment factors discussed above, other assumptions that various authors have made in developing consumption rates introduce varying degrees of uncertainty to the estimates, including those discussed below.

Ingestion, Harvest, and Consumption

As discussed in Section 3.1, the effort here is to summarize estimates of fish ingestion which may be relevant to the development of Tribal water quality standards. The degree to which estimates of Tribal fish consumption in the various studies include uses in addition to ingestion may affect their applicability to Tribal regulatory or policy development.

Percent of Diet Supplied by Fish

The calorie-based consumption estimates developed by Hewes, which form the basis for a number of subsequent estimates, are based on the assumption that salmon account for about 50% of the average Columbia Basin aboriginal diet. Many authors have made similar estimates, while others have assumed either higher or lower dietary estimates. While 50% of the diet (i.e., 50% of total calories) is among the most common estimates, the degree to which a specific Tribe has a higher or lower percentage of diet supplied by fish can affect the accuracy of the calculated consumption rate.

Salmon and Resident Fish Consumption

Because of the importance of salmon to the Columbia Basin Tribes, and because many studies have attempted to evaluate the impact of the hydroelectric system on anadromous fisheries, a majority of the studies evaluated focused exclusively or primarily on the harvest and consumption of salmon. The degree to which individual Tribal groups relied on resident fish, either to supplement or to substitute for salmon consumption, will affect the accuracy of consumption estimates included in these studies relative to total fish consumption.

Tribal Population Estimates

Some authors have estimated total fish consumption for various Tribal groups by estimating an overall harvest rate and dividing that rate by the total Tribal population to develop an average per capita estimate. Therefore, the accuracy of population estimates may directly affect the accuracy of consumption estimates developed using this approach.

Number of Fishing Sites, Fishing Methods, and Fishing Efficiency

Some authors have developed consumption estimates based on assumptions about the type and effectiveness of Tribal fishing methods and the number of harvest locations utilized by individual Tribes or Tribal groups. The degree to which these assumptions are accurate will directly affect the accuracy of consumption estimates using this approach.

4.2 Heritage Fish Consumption Rates (FCRs)

The heritage rates estimated for the Columbia Basin Tribes and, specifically, the Nez Perce Tribe, introduced in Sections 3.3 and 3.4 above, are evaluated in more detail below, including discussion of the assumptions and uncertainty associated with the estimates.

4.2.1 Columbia Basin-Wide Heritage Rates

Craig and Hacker (1940) presented the first estimate of per capita salmon consumption for aboriginal Tribes of the Columbia Basin of 365 lb/yr (or 454 g/d), which was based on historical ethnographic observations, although acknowledged by the authors as likely having a wide margin of error. Hewes (1947) validated this rate with additional assumptions related to average dietary caloric requirements, the contribution of salmon to the aboriginal diet, and a caloric value for salmon. These assumptions (a 2,000 calorie diet, 50% of the diet was salmon, and salmon contained 1,000 calories per pound), while generalized, provided additional justification for this rate. Hunn (1981) later re-evaluated Hewes' assumptions by suggesting that migration calorie loss and inedible waste loss factors should be considered. While variability exists in how many calories each salmon contained and how much of each salmon was eaten, the method for developing and applying such "adjustment factors" (discussed in Section 4.1 above), as done to aboriginal rates by other authors (Scholz, et al., 1985, and Schalk, 1986), may have added a level of uncertainty to those estimates.

Shortly after Craig and Hacker (1940) published the first aboriginal salmon consumption estimate, Swindell (1942) published a very similar estimate of per capita salmon consumption of 322 lb/yr (or 401 g/d) for the Tribes of the Celilo Falls region. This value was based on interviews with Indian families, including affidavits of extensive salmon consumption and use, and total harvest (according to sacks of fish and average weights per fish). Griswold (1954) later cited Swindell's work, referring to these affidavits, to calculate a total annual harvest of 4,000 pounds per family. Although Griswold did not calculate a *per capita* consumption rate in his publication, Walker (1967), by assuming 5 individuals per family, calculated a per capita rate of 800 lb/yr (or 995 g/d) for an upper range of fish consumption. Based on per capita FCRs ranging from 365 lb/yr (presented in Craig and Hacker, 1940, and Hewes, 1947) to 800 lb/yr (calculated from Griswold, 1954), Walker (1967) calculated an average (median) per capita salmon consumption rate of 583 lb/yr (or 725 g/d). A few years later, Boldt (1974) stated that Columbia River Tribes consumed (as food supply) a comparable rate of about 500 lb/yr (or 622 g/d) of salmon.

It is important to remember that the rate calculated from Griswold's (1954) information reflects salmon that was harvested for both consumption as well as trade (i.e., salmon not ingested). If all other assumptions hold true, based on Swindell's (1942) information (3,000 lb/yr harvested per family for consumption, 5 individuals per family[11]), a more accurate per capita upper range for fish consumption as defined for this report would be 600 lb/yr (or 746 g/d). If this alternate value is used from Griswold (1954), calculating an average rate similar to Walker's approach would result in an average rate of 483 lb/yr (or 600 g/d). See Table 1.

[11] If the10 sacks of salmon that were harvested for trade are removed from the equation, the 30 sacks of fish consumed at 100 pounds = 3,000 pounds (per family).

4.2.2 Nez Perce Tribe Heritage Rates

In addition to estimating an average consumption rate for aboriginal Tribes of the Columbia Basin in general, Walker (1967) also estimated a rate specific to the Nez Perce Tribe. He estimated an average per capita salmon consumption rate of 300 lb/yr (373 g/d) based on estimates of fish harvest on peak days, number of fishing sites, average fish weight, and total population. Hewes (1973), continuing his earlier dissertation research from 1947, published his estimates for various Tribes, including the Nez Perce, based on fish caloric content and daily requirements, population estimates, and ethnographic accounts of the importance of salmon among different Tribes. He estimated an average per capita salmon consumption rate identical to Walker (1967) of 300 lb/yr (or 373 g/d) for the Nez Perce Tribe. Marshall (1977) believed Hewes' rate to be a minimum estimate; he calculated an average per capita salmon consumption rate of 560 lb/yr (or 697 g/d) based on the same assumptions as Walker (1967), but assuming nearly twice the number of fishing sites.

Schalk (1986) later applied migration and waste loss factors to Hewes' estimate (dividing Hewes' rate of 300 lb/yr by 0.58 and 0.80), yielding a higher salmon consumption rate of 647 lb/yr (or 804 g/d) for the Nez Perce Tribe. Taking a slightly different approach, Hunn and Bruneau (1989) removed the inedible fraction from a total harvest estimate (multiplying a harvest rate of 400 lb/yr by the 0.80 waste loss factor), yielding a lower anadromous FCR (including consumption of salmon, steelhead, and lamprey) of 320 lb/yr (or 398 g/d).

In 1985, Walker expanded upon his previous work from 1967 and calculated Tribe-specific per capita total FCRs for individual tribes, including 1,000 lb/yr (or 1,244 g/d) for the Nez Perce Tribe. Although this study remains unpublished, the estimates were presented (with supporting information) by Scholz (1985). Walker's estimates appear to be the only rates (of those presented here) that reflect use of both anadromous and resident fish; however, since the report is unavailable, it cannot be verified if these estimates account for only fish ingested or include fish used for other purposes (such as trade). See Table 2.

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6.0 TABLES

Notes/Footnotes for Tables:

[1] Includes a migration calorie loss factor (based on Hunn, 1981, citing Idler and Clemens, 1959) to adjust estimates based on caloric intake.

[2] Waste loss may be accounted for either in direct observation (i.e. the author is citing consumption of fish that had been prepared for consumption, as was done by Craig and Hacker and Swindell) or by adjusting the amount of fish harvested by a waste loss factor loss factor (0.8, based on Hunn, 1981) to translate from amount consumed to amount harvested. For consumption rates derived using caloric analysis, waste loss is inherently accounted for, as calories consumed are converted into edible fish mass consumed.

Estimates based on ethno-graphic observation sometimes appear to be based on amounts actually consumed (e.g. Craig and Hacker; Swindell) and sometimes based on amounts harvested (e.g. Walker; Marshall). Those based on the amount harvested would include the inedible (waste loss) portion, and would likely overestimate consumption. They may also include harvest for other uses, although that is not specifically stated in most studies.

Different studies address "waste loss" differently. Most that use the "waste loss factor", like Schalk and Scholz, use the factor to translate from a consumption rate to a harvest rate, so they tend to inflate the consumption rate (by dividing by 0.8). Other studies (e.g. Hunn and Bruneau, 1989) use the same factor to translate from a harvest rate to a consumption rate (by multiplying by 0.8). So both studies "account" for waste loss, but they do so to opposite effect.

Here is an excerpt from Hunn and Bruneau:

> *"Based on these educated guesses, I use 500 pounds per person per year as a reasonable traditional gross harvest rate for "River Yakima" and 400 pounds for the Nez Perce (cf. Walker 1973:56) and the Colville. Actual consumption is estimated at 80% for the edible fraction (thus 400 and 320 pounds respectively)."*

Table 1: Average Heritage Fish Consumption Rates for the Columbia Basin Tribes

Reference	Methodology	Species Evaluated	Rate in g/day	Rate Derivation	Includes (Note: +/-/U indicates whether the way in which a particular factor was addressed causes an increase, decrease, or unknown impact on the FCR)		
					Uses Besides Consumption	Migratory Caloric Loss Factor [1]	Accounting for inedible portion [2]
Craig & Hacker 1940	Ethnographic Observation	Salmon, sturgeon, trout	454	Not presented	No (+)	No (-)	Yes (U)
Swindell 1942	Ethnographic Observation	Salmon	401	1611 lb salmon/year ÷ 5 people/family x 454 g salmon/lb salmon ÷ 365 days/year	No (+)	No (-)	Yes (U)
Hewes 1947	Caloric Analysis	Salmon	454	2000 calories/day x 50% of diet as salmon x 1000 calories/lb salmon x lb salmon/454 g salmon	Yes (-)	No (-)	Yes (U)
Griswold 1954	Ethnographic Observation	Salmon	746	30 sacks salmon/year/family x 10 lb salmon/sack x family/5 people x 454 g salmon/lb salmon x year/365 days Griswald cited 40 sacks of salmon per family were obtained with 30 retained for family use and 10 used for other purposes.	No (+)	No (-)	No (U)
Walker 1967	Evaluation of Craig & Hacker 1940 and Griswold 1954	Salmon	725	Average of 454 g/day (from Craig and Hacker, 1940) and 995 g/day (from Griswold 1954). The Griswold value was based on families obtaining 40 bags of salmon, 30 for consumption and 10 for trade. 995 g/day = 40 sacks salmon/year/family x 100 lb salmon/sack x family/5 people x 454 g salmon/lb salmon x year/365 days	Yes (+)	No (-)	No (U)
Boldt 1974	Undocumented, (United States v. Washington, 384 F. Supp. 312	Salmon	622	500 lb salmon/person/year x 454 g salmon/lb salmon x year/365 days	Unknown (U)	No (-)	Unknown (U)

Table 2. Average Heritage Fish Consumption Rates for the Nez Perce Tribe

Reference	Methodology	Species Evaluated	Rate in g/day	Rate Derivation	Includes (Note: +/-/U indicates whether the way in which a particular factor was addressed causes an increase, decrease, or unknown impact on the FCR)		
					Uses Besides Consumption	Migratory Caloric Loss Factor [1]	Accounting for inedible portion [2]
Walker 1967	Ethnographic observation citing Spalding 1936	Salmon	373[a] 466[b]	300 fish/peak day/fishing site x 10 peak days/year x 10 lb tissue/fish x 50 fishing sites ÷ 5000 total population (from Spalding 1936) a: assumes population of 5000 b: assumes population of 4000 (Hewes 1947)	Unknown (U)	No (-)	Unknown (U)
Hewes 1973	Caloric Analysis/Ethnographic Observation	Salmon	373		No (+)	No (-)	No (U)
Marshall 1977	Ethnographic Observation citing Walker	Salmon	701	300 fish/peak day/fishing site x 10 peak days/year x 10 lb salmon/fish x 94 fishing sites x 454 g salmon/lb salmon ÷ 5000 total population Note: fishing sites increased from 50 to 94 based on Schwede 1966	Unknown (U)	No (-)	No (U)
Walker 1985	Ethnographic Observation, unpublished by cited by Scholz 1985	Salmon & Resident	1,244	Methodology not presented	Unknown (U)	Unknown (U)	Unknown (U)
Schalk 1986	Ethnographic Observation citing Hewes 1947 and 1973	Salmon	804	300 lb salmon/year/person x 454 g salmon/lb salmon x year/365 days ÷ 0.58 caloric loss factor ÷ 0.8 edible fraction. Modified consumption rates of Hewes 1947 and 1973. Hewes (1973) assumed a consumption rate of 300 lb/year. Assumed that caloric content of fish was reduced during migration. For the Nez Perce, there was a 58% reduction in caloric value. Further, not all parts of the salmon are edible. Schalk assumed 80% of the fish was consumed.	Unknown (U)	Yes (+)	Yes (+)
Hunn and Bruneau 1989	Ethnographic Observation, derived from: Craig and Hacker 1950; Hewes 1947 & 1973; Walker 1967	Salmon, Steelhead, Lamprey	398	400 lb salmon/year/person x 454 g salmon/pound of salmon x year/365 days x 0.8 edible fraction Based on review of references cited in the methodology column, Hunn and Bruneau estimated the annual salmon harvest per person at 400 lb/year	Unknown (U)	No (-)	Yes (-)

Table 3. Spawning Migration and Calorie Loss (Fraser River)

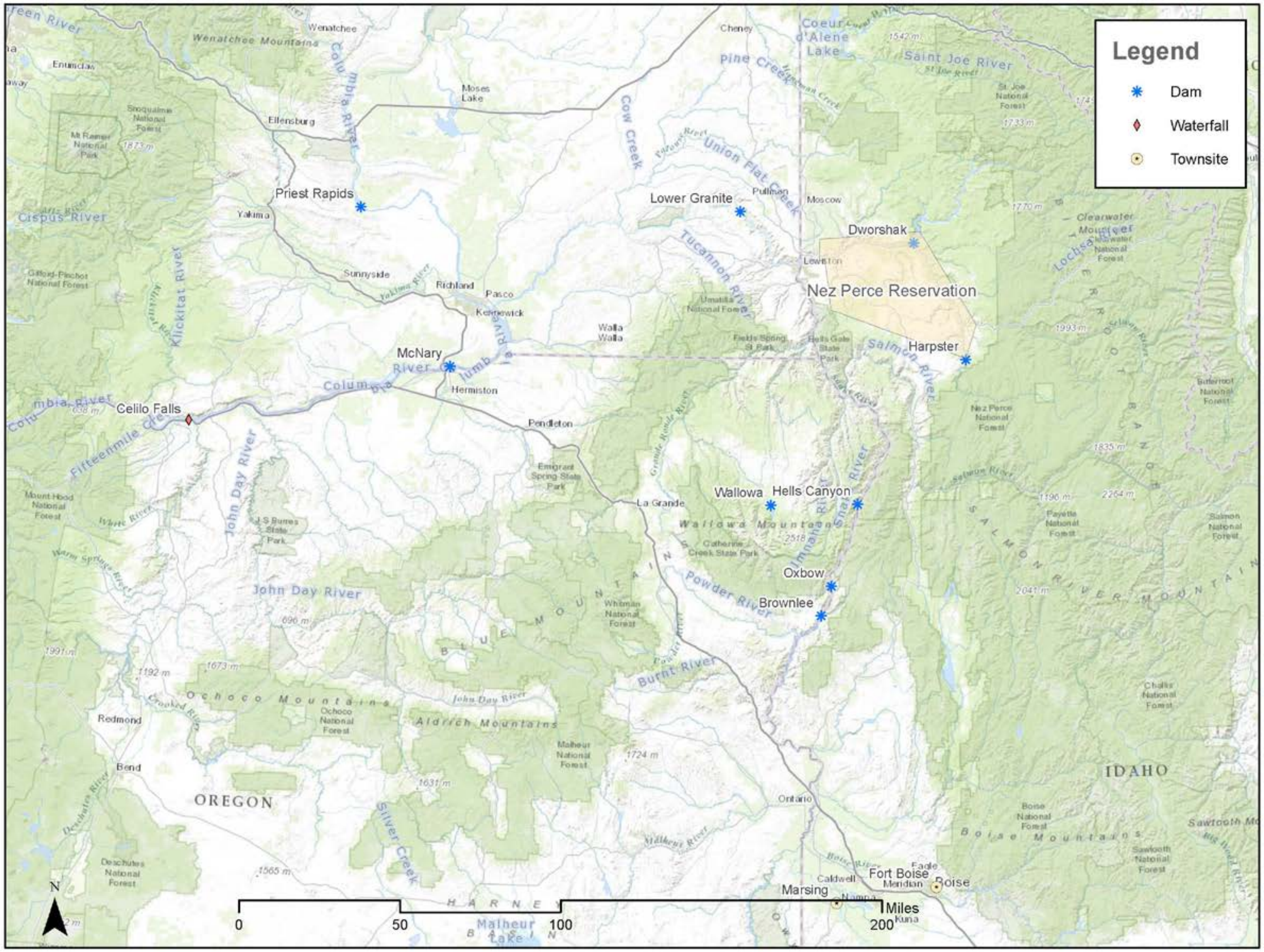
Fraser River Location	Total Calories[1] (kCal)	Total Weight[1] (grams)	Caloric Density (calories/ gram)
At River Mouth	5,173	2,585	2.00
At Spawning Grounds	2,248	2,363	0.95
After Spawning and Death	1,334	1,917	0.70
Percent Loss at Spawning Grounds	57%	9%	52%
Percent Loss After Spawning and Death	74%	26%	65%

Notes for table 3:

All values are based on Idler and Clemens, 1959.

[1]Based on average of male and female values.

Figure 1: Key geographic features referred to in this report.



Volume II:
Current Fish Consumption Survey-
Nez Perce Tribe

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1.0 Preface to Volume II

This report of current fish consumption rates (FCRs), which includes both finfish and shellfish, among the Nez Perce Tribe is a step toward quantitatively documenting the role of fish in the life of the Tribe. The FCRs from this survey can be used by the Tribe, by the State of Idaho and by other bodies to inform and guide the effort to assess risks posed by contaminants in fish for populations with a high level of fish consumption. The foreword to Volumes I-III provides much more comprehensive material on development of this report and the context for use of the information included within the report.

While the results of this report are numeric, the numbers are only a companion to the Nez Perce culture, heritage and vision for their future. It may help the reader to know more about the Nez Perce Tribe, the role of fish in the lives of its members and the activities of the Tribe in relation to fish and fishing. Volume I of this report on heritage FCRs includes material that provides a better understanding of the Tribe's longstanding relationship and dependence on fish and fishing.

The Nez Perce Tribe Final Survey Design document (included in Volume III of this report as an appendix) provides additional information on the Nez Perce Tribe. The design report covers a number of topics, including the background and purpose of the survey, the survey objectives for the Tribe, the importance of heritage FCRs to the Tribe, the suppression of fish consumption over time, the role of the current survey and a historic assessment. The Nez Perce Tribe Final Survey Design document was written prior to implementation of the survey. The document covers issues, concepts and planning that were developed or considered in preparation for implementation. Some aspects of the design were changed after the Nez Perce design document was completed (document date: February 2014). Changes in design that might have statistical implications are covered in Volume II of this report (with related material in Volume III, as needed).

About this volume. Volume II of this report includes the main numeric findings from the survey data. At various places in the report there are references to Volume III, which is a series of appendices intended to provide more detail or additional relevant material.

2.0 Acronyms and Abbreviations

AMPM	Automated Multiple Pass Method
AWQC	Ambient Water Quality Criteria
CAPI	Computer-Assisted Personal Interviews
CRITFC	Columbia River Inter-Tribal Fish Commission
EPA	Environmental Protection Agency
FCR	Fish Consumption Rate(s)
FFQ	Food Frequency Questionnaire
g	Grams, as in g/day
HSSRO	Human Subjects Research Review Official
ID DEQ	Idaho Department of Environmental Quality
IRB	Institutional Review Board
NCI	National Cancer Institute
NHANES	National Health and Nutrition Examination Survey
NPT	Nez Perce Tribe
SBT	Shoshone-Bannock Tribes
USRTF	Upper Snake River Tribes Foundation

3.0 Executive Summary

3.1 Introduction and Purpose

This is a report on fish consumption by the Nez Perce Tribe (NPT). The numeric FCRs (edible mass of uncooked finfish and/or shellfish in grams per day) presented here are based on two statistical methods and two types of data used to estimate FCRs. One method uses a food frequency questionnaire (FFQ), wherein survey respondents directly provide estimates per species of frequency of consumption, portion sizes and duration of their consumption seasons during the past year. The analysis results provide means and percentiles of FCRs for the Nez Perce Tribe. The second statistical method uses responses to questions asked on two separate days about fish consumption "yesterday" (a 24-hour recall period). The 24-hour data along with additional data from the survey and some accepted and plausible statistical modeling yields, again, means and percentiles of FCRs. The purpose of the report is to quantitatively describe current fish consumption and related activities of the Nez Perce Tribe. The FCRs from this survey can be used by the Tribe, by the State of Idaho and by other bodies to inform and guide the effort to assess risks posed by contaminants in fish for populations with a high level of fish consumption, including development of ambient water quality criteria to protect human health.

The data analyzed in this report are based on interviews conducted from May 2014 to May 2015. The earliest in-person interview (including the FFQ and first 24-hour recall) that supplied useable data for this report occurred on May 10, 2014. The last in-person interview occurred on April 24, 2015. Telephone interviews continued through May 4, 2015 to complete the second 24-hour dietary recall interview.

3.2 Survey Methods

Every aspect of this survey was designed in an extensive, time-consuming and transparent collaborative process beginning in the Fall of 2012 and lasting until the Fall of 2016 between the Nez Perce Tribe, the Environmental Protection Agency, tribal consortia and a highly skilled and experienced team of expert consultants. Efforts were made to incorporate state-of-the-art survey and analytical methods and tribal cultural and governmental concerns in a study that was designed to contribute to understanding fish consumption by members of the Nez Perce Tribe who were surveyed.

This study is unique among tribal surveys in that it included all of the following features: the interviews covered an entire year; the survey included a FFQ (food frequency questionnaire) which yielded data to support fish consumption estimates; and the survey simultaneously included up to two 24-hour recall interviews which were used to calculate fish consumption estimates using the statistical modeling of the NCI method. The FFQ method has been used frequently in the past. The NCI method was included in the survey as a more state-of-the-art method that was designed to improve accuracy in fish consumption estimates.

The survey covered adult tribal members (age 18 and over) residing in ZIP codes falling within approximately 50 miles of two major tribal centers, Lapwai and Kamiah, which are 60 miles apart by road. Children and teenagers were not included in the survey due to the additional time and resources that would have been needed for development of appropriate methodology, interviewing and analyses for this age group. The geographic scope was selected in consideration of the logistics of interviewers needing to reach respondents as well as to select a sample that would represent Nez Perce fish consumers specific to Idaho. A stratified random sample was drawn from tribal enrollment files, where the strata were defined by gender and age. The sample size of each stratum was chosen to be in proportion to the size of the stratum in the tribal enrollment file. Within each stratum, members were drawn randomly. Tribal fishers ("Tribal members who fish") were identified from a roster maintained by the Tribe; a number of fishers were included in the sample and were interviewed. A fish consumption rate is reported for the fishers as a distinct population.

Tribal interviewers were employed and trained by an EPA sub-contractor in charge of administering the questionnaire. Tribal interviewers (rather than non-tribal interviewers) were selected, because both tribal representatives and EPA contractors thought that tribal members would be more likely to accept an interview from and convey more accurate information a fellow tribal member (and also be more likely to accept a home interview) than from someone outside the Tribe. In addition, tribal member interviewers have a very wide network of relatives and friends within the tribal community—which proved to be very helpful in locating members to be sampled (sometimes the most difficult step) and gaining their cooperation for an interview. The tribal leadership and staff also expressed, in advance, the importance of using tribal interviewers for cultural reasons, for tribal capacity-building, to improve the likelihood that tribal members would participate in the survey, and also to provide income for tribal members. Tribal interviewers were also used in other Pacific Northwest fish consumption surveys of Native Americans (CRITFC, 1994, Toy et al., 1996, Suquamish Tribe, 2000). As noted later (Section 5.14, Design Changes), non-tribal interviewers conducted some interviewers under special circumstances. In order to facilitate coordination and maintain data quality, interviewers worked under close supervision of the staff of the survey research firm charged with implementing the survey. Respondents were offered an incentive for participation in the survey, financed entirely by the Tribe. Incentives included entering respondents who completed interviews into a raffle drawing (approximately $3,000 worth of prizes were available), t-shirts and paid time off for tribal employees for participating in the interviews. Tribal officials, EPA staff and contractor staff met in conference calls several times each month to review progress and resolve evolving challenges of fieldwork. Meetings were held each week during the summer of 2014 to address issues of respondent recruitment. Survey progress was reviewed with State of Idaho officials on a regular basis paralleling the State's own survey effort.

Respondents to the survey answered questions about species consumed (frequency and quantity), covering consumption over the past year, as well as answering questions about fish consumption "yesterday" (the 24-hour recall). The questions on 24-hour recall were repeated in a separate interview (usually by telephone) administered on a later day, chosen with enough lag after the first interview (at least 3 days) to provide an independent assessment of the respondent's consumption. More closely spaced interviews might have caused second interview results to be affected by consumption events covered by the first interview, as, for example, leftovers from a first interview fish meal might be consumed over the next few days. An attempt was made to match the first and second interview timing during the seven days of the week so that the two interviews would both either be on a weekday or a weekend day.

The questions about consumption over the past year followed the format of a food frequency questionnaire (FFQ), which is common in dietary studies. The analysis of the FFQ data provides an estimated average daily fish consumption rate in grams/day for each respondent and for any species or species group referenced in the survey. Data from the two 24-hour recall interviews were analyzed using the "NCI method"—a methodology developed by the National Cancer Institute and other researchers. (The NCI method can—and did in this study—also use other survey data to improve the estimates of fish consumption rates.) The NCI method yields a distribution of the usual fish consumption rate in grams/day. The results of the NCI method are also presented here. Both FFQ and 24-hour recall questionnaires can be found in Appendix A.

The statistical analysis included development of appropriate statistical weights in an effort to provide unbiased estimates of fish consumption for the Tribe. These weights are expected to correct for some or all of the potential response bias due to differential response rates across demographic groups of the Tribe. Specifically, the respondents in demographic groups with a smaller response rate (relative to other groups) needed to be given a greater statistical weight so that all demographic groups would be appropriately represented in the analysis. The mean, median and percentiles of fish consumption are reported for all species combined (species Group 1), for near coastal, estuarine, freshwater and anadromous species (species Group 2), and for other species groups. Additional fish consumption statistics are provided for demographic sub-groups of the Tribe.

This survey project includes an analysis of heritage rates—the FCRs of the Tribe that were in place prior to modern environmental and social interference with its fishing practices. The current consumption rates presented here, combined with the heritage rates (see Volume I), provide a range of potential future fish-consuming populations (and associated FCRs) to be considered in the effort to protect people with a high level of fish consumption, including development of ambient water quality criteria to protect human health.

3.3 Results

A sample of 1,250 adult tribal members (age 18 or older) was drawn from tribal enrollment files, representing 46% of the 2,727 adult members recorded in the files. Over the course of the interview period, 460 members were interviewed and provided sufficient information to classify them as fish consumers or non-consumers and to calculate an FFQ consumption rate for the consumers. The response rate for the survey is 38%. Only 9 of the respondents were non-consumers, and, using appropriate survey weighting, this count leads to an estimate of 3% non-consumers in the Tribe. The FCRs for the Tribe are summarized briefly in Tables S1 and S2. Additional FCRs are provided in the body of this report.

The Tribe's estimated current total fish and shellfish consumption rates are high relative to the U.S. general population (Table S3), and the rates for the population of fishers in the Tribe is substantially higher (Table S2). The consumption rates include some relatively high rates for each of the population and species groups presented in Tables S1 and S2; the 95th percentile is several-fold larger than the median, typically an indication of the presence of relatively high rates. The mean and percentiles of consumption by the NCI method are smaller than those calculated by the FFQ method. For example, among the consumption estimates for Group 1 species (all species combined), the mean consumption rate from the NCI method is 39% lower than the mean rate from the FFQ method. The NCI method median is 30% lower than the FFQ median, and the NCI method 95th percentile is 47% lower than the corresponding FFQ value. For

Group 2 species, the mean, median and 95th percentile of consumption rates calculated by the NCI method range from 29% to 41% lower than the corresponding FFQ rates.

The smaller rates from the NCI method than from the FFQ method arise, in part, from the smaller values of fish consumption frequencies and portion sizes reported in the 24-hour data than in the FFQ data. For Group 1 species (all species combined), the mean frequency calculated from the 24-hour data was 85% as large as the mean frequency from the FFQ data. The corresponding value for Group 2 species was 86%. The Group 1 and Group 2 mean portion sizes from the 24-hour data were 87% and 89% as large as the mean portion sizes from the FFQ data, respectively. The relative difference in frequencies and portion sizes was larger for the high consumers. Among the 10% of consumers with the highest FFQ consumption rate (all species combined) the 24-hour mean frequency for Group 1 and Group 2 was 64% and 57% of the FFQ mean frequency, respectively. Again, for these high consumers, the 24-hour data's mean portion size for Group 1 and Group 2 species was 61% and 64% of the FFQ mean portion size, respectively.

Table S1. Nez Perce Tribe. Mean, median and selected percentiles of FFQ and NCI method FCRs (g/day, raw weight, edible portion); consumers only. Estimates are weighted.

			Percentiles		
Species Group*	No. of Consumers	Mean	50%	90%	95%
Group 1 - FFQ	451	123.4	70.5	270.1	437.4
Group 1 - NCI Method	451	75.0	49.5	173.2	232.1
Group 2 - FFQ	446	104.0	61.3	231.4	327.9
Group 2 - NCI Method	446	66.5	36.0	159.4	233.9

*Group 1 includes all finfish and shellfish. Group 2 includes near coastal, estuarine, freshwater, and anadromous finfish and shellfish.

Table S2. Nez Perce Tribe. Mean, median and selected percentiles of FFQ and NCI method FCRs (g/day, raw weight, edible portion) for fishers and non-fishers; consumers only. Estimates are weighted.

				Percentiles		
Species Group*	Group	No. of Consumers	Mean	50%	90%	95%
Group 1	Fishers - FFQ	138	171.8	98.0	436.8	543.5
Group 1	Fishers - NCI Method	138	98.2	64.7	229.2	305.0
Group 1	Non-fishers - FFQ	313	107.9	65.5	232.9	337.7
Group 1	Non-fishers - NCI Method	313	67.6	45.6	155.1	206.0
Group 2	Fishers - FFQ	138	156.7	83.5	360.7	507.8
Group 2	Fishers - NCI Method	138	98.4	55.2	238.6	345.0
Group 2	Non-fishers - FFQ	308	86.9	51.0	186.2	261.1
Group 2	Non-fishers - NCI Method	308	55.6	32.0	132.0	189.5

*Group 1 includes all finfish and shellfish. Group 2 includes near coastal, estuarine, freshwater, and anadromous finfish and shellfish.

Table S3. Nez Perce Tribe. Total FCRs (g/day, raw weight, edible portion, all species combined) of adults in Pacific Northwest Tribes (with consumption rates available) and the U.S. general population. Consumers only.

Population	No. of Consumers	Mean	Percentiles	
			50%	95%
Nez Perce Tribe - FFQ	451	123.4	70.5	437.4
Nez Perce Tribe – NCI Method	451	75.0	49.5	232.1
Shoshone-Bannock Tribes - FFQ	226	158.5	74.6	603.4
Shoshone-Bannock Tribes – NCI Method	226	34.9	14.9	140.9
Tulalip Tribes (Toy, et al, 1996)	73	82.2	44.5	267.6
Squaxin Island Tribe (Toy, et al, 1996)	117	83.7	44.5	280.2

Population	No. of Consumers	Mean	Percentiles	
			50%	95%
Suquamish Tribe (The Suquamish Tribe, 2000)	92	213.9	132.1	796.9
Columbia River Tribes (CRITFC, 1994)	464	63.2	40.5	194.0
USA – NCI Method (U.S. EPA., 2014)	*16,363	23.8	17.6	68.1

*Adults ≥ 21 years old; includes both consumers and non-consumers.

The rates for Columbia River Tribes are from CRITFC, 1994, Table 10. The rates for the Suquamish Tribe are from Suquamish Tribe, 2000, Table T-3 and Liao, 2002. These rates were converted from g/kg/day to g/day by multiplying by the mean body weight of 79.0 kg, found in Table T-2 of Suquamish, 2000. The rates for the Tulalip and Squaxin Island Tribes are from Polissar, 2014, Table 2 and Table 3, respectively. The national rates are from U.S. EPA, 2014, Appendix E, Table E-1. The rates for the Nez Perce and Shoshone-Bannock Tribes are from this report and the other report released at the same time as this report with virtually the same format, in Table 8 (FFQ rates) and Table 12 (NCI method rates).

3.4 Discussion

The NPT's fish consumption rates are high compared to the rates of other populations. The NPT rates can be compared to the rates for other populations, carrying out the comparison among rates based on a similar survey and analysis methodology (either the FFQ method or the NCI method). The NPT's NCI-method rates (which are probably more accurate than the FFQ rates) are several-fold higher than the NCI-method FCRs for the U.S. general population and the Shoshone-Bannock Tribes. (See Table S3.)

The FCRs of the Nez Perce Tribe—based on the FFQ methodology—are generally higher than those observed in other Pacific Northwest tribal fish consumption surveys, such as the Columbia River Inter-Tribal Fish Consumption survey (which included the Nez Perce Tribe—see CRITFC, 1994), with an exception being the survey of the Suquamish Tribe. The FFQ mean and 95th percentile rates of the Shoshone-Bannock Tribes are numerically larger than those of the Nez Perce Tribe, but the uncertainty renders the FFQ rates for these two tribes comparable. For example, the margin of error (95% confidence intervals) for both the SBT's mean and its 95th percentile consumption rates include the NPT's values for the mean and 95th percentile, respectively (see Table 8). The level of uncertainty is such that it is difficult to designate either tribe's actual adult FFQ rates as higher or lower than that of the other tribe. The NPT's FFQ mean consumption rate is from 50% to 100% larger and the 95th percentile of consumption is from 56% to 125% larger than the FFQ mean consumption rate of the pooled Columbia River Tribes (CRITFC survey), the Squaxin Island Tribe and the Tulalip Tribes.

The estimated mean consumption rates (Groups 1 and 2) differed between the FFQ-based rates and the rates based on the 24-hour recalls (which are used in the NCI method), with the 24-hour mean rates being lower. The survey-weighted 24-hour mean consumption rates of Group 1 and Group 2 species were 76% and 78% as large as the FFQ means for Groups 1 and 2, respectively. The other species groups assessed (Groups 3–7) also had lower survey-weighted 24-hour means than the FFQ means.

It is likely that—compared with the FFQ approach—the rates based on the NCI method are closer to the actual[1] FCRs of the adult Nez Perce population, because the challenge to a respondent's memory is less than that involved in collecting the type of data used by the FFQ method. The NCI method, however, contains strong assumptions about the shape[2] of the distribution of usual consumption, and the fitted shape used to provide the NCI estimates may or may not fit well in the tails of the distribution, including the important and often-cited 90th and 95th percentiles. At this point in the history of fish consumption surveys, there is no definitive scientific evidence that the NCI method yields rates that are closer than FFQ rates to the actual distribution of fish consumption of the adult Nez Perce population. Invoking the memory issue in favor of the NCI method provides a type of common-sense piece of evidence, but that evidence alone is not sufficient to eliminate FFQ rates from serious consideration. It is likely that FFQ surveys will need to continue into the future in certain situations, such as for small surveys, for surveys with limited resources, or for surveys assessing fish species (or other foods) with a relatively low frequency of consumption. Such surveys will address the need for estimates of fish consumption.

The NCI method, using 24-hour recall data, and the FFQ method, using respondents' perceptions about the past year of consumption, yield a range of estimates, and this range seems highly likely to include the actual FCR values. It seems likely that the actual consumption rates are closer to the NCI estimates, since they are based on memory of consumption "yesterday" rather than memory of the past year of consumption. Both the FFQ and NCI method approaches are, currently, accepted survey methodologies.

Some factors—including those just discussed—that may help to explain the difference between the FFQ consumption rates and the rates from the NCI method include the following. *Chance*: The days on which the respondents were interviewed about their consumption "yesterday" (24-hour recall) happened to selectively miss their days of actual fish consumption. *Memory and interpretation:* Both the FFQ and 24-hour recall responses require the respondents to exercise their memory and interpret their fish consumption behavior. The 24-hour recall is less challenging to memory than the FFQ. *Differences in frequency or portion-size reporting:* Both frequency and portion size appear to be either over-reported in the FFQ data or under-reported in the 24-hour recall data, or both. *Modeling: tails of the distribution:* As noted earlier in this section, the rates based on the 24-hour recall and the NCI method may be more accurate in the middle of the distribution of usual consumption rates than in the upper or lower tails, including the important 95th percentile of consumption rates.

In summary, the NCI method's rates based on the 24-hour recall interviews are likely to be closer to the actual rates than the rates from the FFQ analysis, due to the lighter demand on memory required by the 24-hour recall approach. The NCI method's and the FFQ method's rates provide a

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[1] Throughout this report, the familiar term "actual" (e.g., "actual adult FFQ rates") is usually used in place of the more statistical term "true" (e.g., "true adult FFQ rates") to indicate the rates that apply to the population under study. If, for example a rate such as the 95th percentile of fish consumption were known for the entire target population, such as the population of adults in the defined ZIP code area, it would be referred to as the "true 95th percentile" or "the population 95th percentile" for a statistical audience.
[2] The NCI method assumes a certain family of shapes derived from the normal distribution by a Box-Cox power transformation.

plausible range of consumption rates. Additionally, the FFQ approach may be the only feasible method for development of FCRs for narrowly defined fish groups or for small surveys, for which the data needed to implement the NCI approach would usually not be available. Future fish consumption surveys utilizing the NCI vs. FFQ methodologies will, hopefully, clarify the precision and accuracy of these approaches. Unfortunately, the resources required to run surveys, in particular for the NCI method, will likely result in relatively slow acquisition of new information that can shed light on the reasons for differences in rates from these two methodologies.

This study is unique in that it used both the FFQ (food frequency questionnaire) and the 24-hour recall (NCI) methods simultaneously in a survey of tribal consumption of fish over an entire year. The survey included the two methods in a manner such that both methods could be used to provide quantitative estimates of fish consumption. No other studies have included all of these elements. The strength of the current rates is that they are derived by technically defensible methodologies, and these rates can be compared to those of other populations. The use of two distinct methods to estimate fish consumption—FFQ and 24-hour recall (combined with the NCI method)—had multiple benefits, and, taken together, provided a very comprehensive study on fish consumption. This study is also unique in the length of time over which it was conducted. No other study of tribal fish consumption has run both the FFQ method and NCI method and also conducted interviews for a full year, covering multiple periods of fish runs and seasons and a full annual cycle of cultural activities. The span of the survey allowed evaluation of seasonal and temporal impacts on FCRs (although the evaluation of the role of time was limited by a relatively small number of respondents for some months of the survey, particularly during some months with strong fish runs).

The design and implementation of this study involved a collaborative effort of tribal governments, the U.S. Environmental Protection Agency, and a team of highly qualified and experienced cross-disciplinary consultants. Significant financial and in-kind resources, as well as technical and cultural expertise, were combined to create a unique and comprehensive survey. The expert contractor team consisted of firms with considerable relevant experience in: survey fieldwork (Pacific Market Research), conducting surveys of other Native American tribes and minority ethnic groups (The Mountain-Whisper-Light and Pacific Market Research), conducting statistical analysis and reporting results of Native American fish consumption surveys (The Mountain-Whisper-Light) and working with Native Americans on environmental issues (Ridolfi). This contributed to the rigor of the study design and provided ongoing review and adaptation as challenges were encountered in the field.

One advantage of the collaboration with the tribal government is that the contractor team was allowed access to a unique frame for drawing the sample: tribal enrollment records. The use of the enrollment records avoided a costly effort to develop an alternative frame for sampling. The random sampling (as opposed to, for example, a convenience sample) conducted from this complete population listing added to the precision of the survey by using survey resources to increase the sample size rather than using some of the resources for an alternative and costlier means of identifying respondents with, inevitably, a reduced sample size. The availability of a population roster from which to draw the sample along with the availability of a list of fishers also permitted characterization of population demographics, which supported statistical weighting of respondent results to ensure that the results represented the target population as much as possible. Developing the statistical weights would have been far less successful without access to a population roster.

The use of in-person interviews is a strength of the study. That form of data collection was expected to generally lead to more accurate and complete responses in this population, due to the expected better acceptance of a personal approach to potential respondents by tribal interviewers and because in-person interviews readily allowed the use of physical display models for species identification and portion sizes. Many of the interviews were conducted in respondents' homes, which may have provided a more comfortable environment to participate in a long, detailed personal interview. Advance scheduling of interviews also ensured that interviews were conducted during times that were convenient for respondents, allowing collection of information without competing demands. The interviewers could ensure completeness of responses (e.g., ensuring topics and questions were not skipped), could question inconsistent responses, and could clarify questions for respondents. In-person interviews also allowed interviewers to use portion model displays and photographs of relevant fish species. These visual aids enhanced the ability of respondents to accurately identify the species consumed, specify portion size, and correctly identify preparation methods.

Interviews were conducted by using unobtrusive electronic tablets to collect raw interview data; the data were uploaded frequently and subsequently reviewed by the survey team. The electronic CAPI system also immediately checked key entry to permit only valid codes. Automated data uploading eliminated errors associated with manual data entry. The CAPI[3] interview model likely made the data more accurate and complete by assisting the interviewers in following skip patterns (avoiding inapplicable questions or topics, for example, questions on breast-feeding for male respondents) and ensured that relevant questions were not missed or left unanswered. The CAPI also facilitated interview administration and accuracy by including prompts for the interviewer to use visual aids (i.e., portion size models and species photographs) at relevant points in the interview. In summary, use of a CAPI allowed for far more accurate administration of a complex interview than would have been possible using a typical manual approach (e.g., paper and pencil).

A minor limitation of the survey is that some respondents could not remember and supply answers to some questions, such as the typical portion size consumed for a particular species. The missing data had to be imputed in order to retain the respondent's other related responses for inclusion in the survey. A sensitivity analysis suggests that the imputations had little impact on the final results. Another potential limitation of this interview-guided survey (and of any dietary survey) is the possibility of social desirability bias, where some individuals may have the tendency to over- or under-report consumption due to perceived social norms (Herbert, et al., 1995, Tooze et al., 2004).

The survey had a modest response rate of 38%. The four other fish consumption surveys of Pacific Northwest Indian Tribes have had response rates over 60% (i.e., CRITFC, Suquamish, Squaxin Island and Tulalip surveys). While the statistical weighting may have addressed the potential selection bias that may occur when there is a response rate of this magnitude, it is possible that those in the sample who were not reached and interviewed do have a different

[3] See Section 5.8 for a description of the CAPI method of interviewing. CAPI: computer-assisted personal interviewing. In this survey the CAPI software was installed on electronic tablets.

consumption rate, on the average, than those included. That is an unknown at this time, and the response rate of 38%, by itself, does not discredit this survey. The 95% confidence intervals (showing the "margin of error" presented later in this report) allow for interpretation of uncertainty (due to sample size) in the FCRs presented. However, the confidence intervals do not show uncertainty due to undetected bias. The range of values in the confidence interval represent plausible alternatives for the actual FCR, based on the degree of uncertainty. However, a reported mean FCR or FCR percentile is itself the single best estimate of consumption, because these estimates are derived through methodologic principles designed to avoid bias.

Because of the small populations of the Tribe, achieving the ideal response rate posed a challenge that was not easily overcome. The Tribe is scattered over a large, primarily rural geographic area. Obtaining contact information for many people was difficult and time-consuming due to the rural nature of the sample. In-person interviews required significant resources for travel time and costs and may have resulted in fewer interviews than would have been possible in a more densely populated area. Also, the early period of interviewing coincided with a time of strong fish runs. During this period interviews were accrued at quite a low rate and some high fish consumers may have been unavailable due to their absence while out fishing. Additional advance consideration of these issues might have increased response rates during the early phase of the interviewing.

This study could not have been designed or completed without the full collaboration of tribal officials. In order to meet interview quotas, the Tribe had to be creative in encouraging the participation of its members through various public statements, promotional activities and, importantly, offering incentives (financed entirely by the Tribe) in the form of a raffle as well as in-kind services. Tribal enrollment data in itself, while an excellent and helpful source from which to draw the sample, did not always provide contact information (e.g., phone numbers, physical addresses) that the interviewers could use to make contact with the respondents. Much time was spent developing additional methods to reach respondents and arrange interviews. Tribal cooperation and willingness to think creatively about how to connect a respondent's name to a contact point was critical to increasing the response rate. Additional time spent up-front in testing the survey implementation might have discovered faster or less time-consuming ways of contacting respondents prior to initiation of the field data collection. The frequent status discussions with all parties involved in the survey enabled creative responses to the challenges of locating tribal members and providing encouragement and incentives (financed entirely from tribal resources) for tribal members to participate. These and the aforementioned experiences should be considered in the design of and preparation for future fish consumption surveys of Native American tribes.

3.5 Conclusion

The Nez Perce Tribe has FFQ FCRs that are among the highest in the Pacific Northwest, and both the FFQ and NCI-method means and percentiles are several-fold higher than consumption rates of the U.S. general population (See Table S3.) FCRs determined using the NCI method were lower than those determined using the FFQ approach. Mean FCRs for Group 1 species (all finfish and shellfish) and Group 2 species (near coastal, estuarine, freshwater, and anadromous finfish and shellfish), based on the NCI method, were, respectively, 39% and 36% lower than means obtained via the FFQ approach.

4.0 Introduction

4.1 Purpose of the Overall Fish Consumption Survey Effort

The Nez Perce Tribe collaborated with the U.S. Environmental Protection Agency (EPA) Region 10, tribal consortia and the State of Idaho to gather data on tribal FCRs (FCR) in Idaho. One objective of this effort was to support the effort to assess risks posed by contaminants in fish for populations who consume fish at high levels. More generally, this effort was intended to enhance tribal environmental capacity in preserving and improving water quality. This report presents survey methodology and results, specifically FCRs, for the Nez Perce Tribe.

4.2 Putting the Survey of Current Fish Consumption in Context

A fish consumption study fits into a larger context. There are three eras of importance for such a study: the past, the present, and the future. Assessing consumption through a current cross-sectional survey will provide relatively precise information about current consumption only. The strength of the current rates is that they are derived by a technically defensible methodology, and these rates can be compared to those of other populations.

The reader is directed to the foreword of this three volume report for a discussion of the background and purpose of volume II, which discusses current fish consumption rates. The foreword places the information in volume II in context of the overall survey effort. Specifically, the foreword discusses how historic fish consumption rates, suppression in historic fish consumption rates, current fish consumption rates, and tribal treaty rights should be considered in developing water quality criteria to protect human health.

The survey was implemented largely consistent with the Nez Perce final survey design report (Appendix H in Volume III).

4.3 A Brief Description of the Nez Perce Tribe

The Nez Perce Tribe of today is a self-governing, Federally Recognized Tribe located on a reservation in North Central Idaho, which lies primarily in the Camas Prairie region south of the Clearwater River, covering parts of Nez Perce, Lewis, Idaho, and Clearwater Counties. The tribal government seat is at Lapwai, which also contains the largest population of Nez Perce, and the community with the largest population within the reservation boundary is the City of Orofino. Additional material about the Nez Perce Tribe can be found in Volume I of this report (Heritage Rates) and in Volume III, Appendix H, "Design of a Survey on Fish Consumption by the Nez Perce Tribe".

4.4 Populations

The tribal populations described quantitatively in this report are the Nez Perce Tribe as a whole (adult members) and the population of adult, "documented" fishers within the Tribe. Identification of tribal members was obtained from confidential tribal enrollment records in close consultation with tribal officials.

Identification of the fisher group was achieved using a list derived from the Nez Perce Department of Fisheries Resources Management (DFRM) records of sampling activities that are conducted annually for certain fisheries. Information is collected and compiled for specific individual tribal members who fish in certain rivers/areas. Tribal members were observed or interviewed for their fishing activities at a certain area during a certain fishery season. This fisher data was either collected during the actual fishery season or collected post-season. This list represents only those tribal members who provided in-season and/or post-season catch/harvest data to DFRM staff. Some tribal members who are, in fact, fishers, do not appear on the fishers list. Thus, the fishers list is not a comprehensive representation of all “fishers” of the Tribe, but, rather, a “fisher indicator” (i.e., includes a subset) of the actual fisher population. When the term “fisher” is used in this report, it refers to persons appearing on this fishers list. When there is reference to a non-fisher, it means a person not on the fishers list. A certain fraction of those not on the fishers list do, in fact, harvest fish, as discovered through answers to survey questions regarding fishing activity, cross-referenced to the fishers list. Despite any inaccuracies in designation of fishers and non-fishers, the fishers list is a useful roster of persons, most of whom are engaged in fishing and harvesting activities. Those on the fishers list constitute one of the populations identified in this report, with a presentation of their consumption rates. As noted, some active fishers are not on the fishers list and will, thus, fall into the category labeled as “non-fishers.” The comparison of consumption rates between persons labeled as fishers or as non-fishers has some uncertainty because some of the active fishers (and the complement, non-fishers) among the respondents have not been assigned to the correct fisher/non-fisher category.

4.5 Guide to Report Sections

This document follows the commonly used IMRD format for scientific articles and reports: **I**ntroduction, **M**ethods, **R**esults and **D**iscussion. After this introduction, the methods used to prepare for and then execute the survey in the field are described, as are the methods used to analyze the data obtained from the survey. The Results section contains demographic statistics about the population, the selected sample and the survey respondents, survey response rates, quantitative fish consumption rates (overall and by demographic subgroups) and other statistics related to tribal fishing and fish consumption. The Discussion section recaps the main findings and discusses the strengths and limitations of the survey and its analysis. Appendices include supporting technical material.

5.0 Methods

5.1 Overview

This section describes the basis for choosing the survey sample, including sample size, inclusion/exclusion eligibility criteria, and the definition of the geographic area from which survey-eligible tribal members were selected. It discusses the review and approval process, by both tribal and external sources, for determining the survey's approach and procedures.

This section also reviews the development of the questionnaire, the methods used to draw the sample from tribal enrollment records, identification of fishers[4] to be used in calculating fisher consumption rates, allocation of selected tribal members to sample waves of interviewing in order to provide interviewing throughout the one-year survey period, reinterviewing of initial respondents, and the relevance to this survey of computer-assisted personal interviewing (CAPI).

Selection and training of interviewers is discussed, along with methods for calculating survey response rates, methods for weighting the sample to adjust for differential response rates in different sample strata and for differentials in the probability of response related to demographic factors. Finally, this section covers methods to convert respondent data on frequency and portion sizes of consumed species to quantitative consumption rates, and methods to obtain means and percentiles of fish consumption and their confidence intervals using two different analysis methodologies. One methodology uses data collected from a food frequency questionnaire (FFQ). A separate methodology, the "NCI method," uses data collected from the respondents' recall of fish consumption during one or two 24-hour periods and also uses FFQ data and other variables as covariates.

The two methods were used in tandem in order to be able to compare consumption estimates from two very different methodologies. Under the assumption of perfect accuracy of responses by the interviewed tribal members (and additional assumptions described later), the distribution of usual consumption (means and percentiles) would have the same expected values. The two sets of results would differ only by the element of chance that enters through, for example, the random selection of days on which people were interviewed. An additional reason for using both methods was the challenge of obtaining the required dataset for the NCI method. The modeling used in the NCI method may not succeed if there are fewer than 50 respondents who report having consumed fish on both of the 24-hour recall days.[5] At the outset of planning for this survey, it was not certain that the consumption frequency in the population (and the yet-unknown total number of successful interviews) would be sufficient to offer adequate assurance of reaching the 50 double hits. The FFQ method always yields data that can be used to develop FCRs, though, ideally, FCR estimates from the FFQ method would be accompanied by an evaluation of uncertainty in the rates. In this survey the NCI method was favored as a methodology, because its use of recall data from "yesterday" was expected to be more accurate than the recall of average consumption over the past year. The often-used and previously accepted FFQ method was run in parallel with the newer NCI method, since the FFQ method can

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[4] See Section 4.4 for a definition of "fisher" as used in this document.

[5] Based on discussions with key developers of the NCI method, Dr. Janet Tooze and Dr. Kevin Dodd, the NCI method may work (produce a distribution of usual consumption rates) with fewer than 50 double hits. In the contractors' work with the NCI method, covering this and other projects, the NCI method has sometimes worked and sometimes failed with fewer than 50 double hits. For planning purposes it is safest to aim for at least 50 double hits.

succeed in yielding a consumption rate distribution even with a quite limited dataset. It also allows more direct comparison with previous tribal fish consumption surveys. Further, the FFQ method can provide consumption estimates for species groups with smaller numbers of consumers, whereas small sample sizes and the associated small number of double hits usually cannot meet the NCI method's data requirements.

5.2 Sample Selection

The planned sample size was developed to fulfill two goals: (a) a sufficient sample size so that means and percentiles of FCRs calculated from the FFQ portion of the questionnaire would be reasonably precise; and, (b) a sufficient sample size to provide reasonable assurance of an adequate number of respondents with two separate 24-hour recall interviews, both of which reported some fish consumption during the preceding 24-hour day ("yesterday").

The second goal was considerably more challenging to plan than the first. The criterion of at least 50 "double hits" from the survey—two separate, independent interviews wherein a respondent recalled eating fish on the preceding day—is a requirement[6] of one of the methods used to calculate a distribution of usual fish consumption. The "NCI method" refers to a statistical procedure for calculating the distribution of usual consumption of episodically consumed foods (Dodd, KW, et al. 2006; Tooze, JA, et al. 2006; Kipnis V, et al. 2009). Fish consumption would fall into the "episodically consumed" category, since most people do not eat fish every day. This technical method was designed to exploit data collected about consumption (or non-consumption) of a food item on two or more independent days. The NCI method has been used to analyze the data of this survey and the results of the analysis are provided in this final report.

Part of the challenge in planning the sample size was the lack of relevant data or tabulations on frequency of fish consumption (expressed in days with fish consumption per week, days per month, or days per year) for this population. Data of this type were needed in order to estimate what percentage of respondents who reported about their fish consumption on two independent days would have fish consumption on both days. A count of 50 of the respondents having these "double-hits" (two different days with fish consumption) is needed to provide strong assurance that the NCI method can provide a distribution of consumption rates for a population. Among the fish consumption survey reports about Native American tribes in the Pacific Northwest, there is no survey that includes tabulations specifically on the frequency of consumption of fish (all species combined), with frequency reported as consumption days per week, per month, per year or per other time unit. The tabulations closest to this framework are in a Columbia River Inter-Tribal Fish Commission survey report (CRITFC Technical Report 94-3, 1994), which reports on the frequency of fish meals (not days with fish meals). In order to properly plan use of the NCI method of estimating fish consumption rates, an estimate of the fraction of days with positive fish consumption (or the average number of such days per week) is needed. The count of number of meals per week with fish consumption would not suffice, in case there is a sizeable fraction of tribal members who consume fish during two or more meals per day, for some days of the week.

[6] While analysis by the NCI method might be possible with fewer than 50 double hits, the 50 count provides reasonable assurance that models used in the analysis will converge on the necessary parameter estimates. The contractors have carried out NCI method analyses for this and other projects. The analyses with fewer than 50 double hits would sometimes be successful (resulting in a distribution of fish consumption rates with means and percentiles of consumption) and would sometimes fail.

For example, a tribal member who eats three fish meals per week, on average, might typically eat two fish meals on one day and one fish meal on another day. The respondent would have three fish meals per week but only two days with fish consumption per week. Thus, the number of meals per week is 50% larger than the number of days per week with fish consumption.

The CRITFC survey was carried out among four Columbia Basin tribes—the Warm Springs Confederated Tribes, Yakama Indian Nation, Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe of Idaho. The Nez Perce Tribe was the only one of the four tribe included in the current survey[7].

Calculations were carried out on the expected number of double hits with various assumed sample sizes, and assumptions were made which allowed for the conversion of fish meals per week, as tabulated in the CRITFC report, to days with fish meals per week. Using these planning assumptions and the CRITFC input tabular data, it was estimated that a sample of approximately 1,800 tribal members would provide good confidence that those completing the interviews of the survey would include at least 50 individuals who would report eating fish on both of the two independent days targeted by a 24-hour recall questionnaire (i.e., 50 double hits). Some notes and calculations on the methods used to estimate the expected number of double hits under various scenarios can be found at the end of Appendix D.

During the survey planning phase, five tribes of Idaho (the Kootenai, Shoshone-Paiute, Coeur d'Alene, Shoshone-Bannock, and Nez Perce) were considering participation in the survey. To employ the NCI method for each tribe individually, 50 double hits would have been needed for each tribe. This was not possible given the resources available, the sample size that would be needed per tribe, and, for the Kootenai, the small population size[8]. Consequently, the 1,800 interviews were to be distributed over the five participating tribes with the intention of finding 50 double hits from the pooled results of all participating tribes. Thus, the authors decided to report separate FCR distributions per participating tribe, using the NCI method, although the data from multiple tribes would need to be pooled as input to the NCI method. The rates for individual tribes would be obtained through the use of covariates in the NCI modeling process. The NCI method includes provisions for the use of covariates (see Section 5.23.2). The covariates can be used to indicate sub-populations. Thus, the combined tribal samples would represent a "population" that is created for computational purposes only, and this pseudo-population is needed in order to reach (or surpass) the 50 double hits collectively. A covariate indicating tribal membership (with one category per tribe) would then allow for the computation of fish consumption rates per tribe; each tribe would be a sub-population for computational purposes.

[7] See CRITFC, 1994, Appendix 1, pp. 106-107. In the CRITFC survey each of the four tribes received a statistical weight used in the weighted estimates presented in the report, such as consumption rates. The Nez Perce had a weight of 19%. The value of 19% statistical weight for the Nez Perce Tribe is calculated as the Nez Perce population divided by the total population of all four tribes as listed in the CRITFC report, p. 106. The listed population of the four tribes (which determines the statistical weight of each tribe in calculating the combined CRITFC rates) are as follows: Umatilla, 818; Nez Perce, 1440; Warm Springs, 1531; Yakama, 3872. Total of the four tribes: 7661

[8] The Kootenai Tribe reported an adult population of 85 individuals (data received on October 2, 2013 from the Tribe). It may have been technically feasible to achieve enough multiple hits to run the NCI method for this tribe analyzed separately, perhaps using more than two 24-hour recall interviews per fish consumer. However, there was the uncertainty of reaching sufficient multiple hits, and, further, the analysis would need to statistically accommodate the correlation of consumption among members of a household—sure to be a feature of a 100% sample of this small population. The available software code for the NCI method does not currently include an option for analyzing this type of correlation. These issues were a considerable barrier to implementing an NCI-method data collection and analysis for this Tribe considered by itself.

This computational convenience has no cultural implication and it does not assume that the distribution of usual consumption is the same for each of the tribes involved.

After further deliberation by the Idaho tribes, the Nez Perce and Shoshone-Bannock Tribes chose to participate in surveying current fish consumption. Based on discussions with staff of these Tribes, the planned approximate sample size of 1,800 was allocated as a sample of approximately 1,200 from the Nez Perce Tribe and 600 from the Shoshone-Bannock Tribes. Based on available information regarding fisheries and harvest levels, it was thought that the Nez Perce Tribe had higher FCRs than the Shoshone-Bannock Tribes and, consequently, would consume fish more frequently. Allocating more interviews to the Nez Perce Tribe improved the chances of obtaining 50 double hits. The two tribes recognized that they both needed to achieve the necessary number of "double hits" and that this part of the survey would require a joint effort to do so—with a greater allocation of available sample size to the tribe expected to have more frequent consumption. Within each tribe, of course, the sample would be selected by a random process, and every effort would be made to obtain unbiased responses about consumption. None of the respondents were aware of the goal of 50 double hits to support the NCI method.

The anticipated percentage of sampled members providing two 24-hour interviews was calculated as: (a) an anticipated 60% response rate for the first 24-hour interview (and FFQ-based interview), followed by (b) an anticipated 80% response rate for the second interview among those participating in the first interview. The 60% for the first interview response rate was selected as a conservative value given that response rates above 60% have been obtained for other Northwest tribal fish consumption surveys (see Toy, et al, 1996 and Suquamish Tribe, 2000). The 80% continuation rate for those completing the first interview was simply an assumed reasonable value for continuation among those who had participated in the first interview. The net response rate for completion of both interviews would thus be 48%—approximately half of the sampled members. The method for computing response rates is covered in Section 5.13 ("Response rates" in the "Methods" section) and the achieved response rates upon completion of the survey are covered in Section 6.1 ("Response rates" in the "Results" section).

5.3 Inclusion/Exclusion Criteria

The survey was designed to assess the consumption rate of adults, defined as individuals age 18 and over. Specifically excluded from the survey were any members who were living in an institutional setting (e.g., a nursing home). The reason for this exclusion is that a person in the institutional setting would typically not be in control of their diet and might not be living a tribal lifestyle in terms of diet. The enrollment files did not indicate this status, and such members were identified during the initial contacts or attempts at contact with potential respondents.

During the interview process, an additional exclusion was incorporated: tribal members who could not participate in the interview process due to physical, mental or other reasons were excluded as they were encountered.[9] This exclusion was based on practical considerations; in particular, extra time would be needed to locate a person familiar with the tribal member's fish consumption, both for a first interview (in person) and for a second interview (by phone). The interviewers identified eight tribal members whom they encountered as falling in this category.

The tribal interviewers were also excluded from the sample. Their training and their extensive contact with the contractors had made them very familiar with the potential use of the survey data in the State of Idaho's deliberations on water quality and health. Even though the interviewers were well aware of the need for unbiased responses, the contractors chose to remove them from the pool of potential respondents and avoid any possibility or challenge that their exceptional knowledge of the purpose of the survey might put them in a meaningfully different category than the rest of the tribal population. While this may have been excessive caution, the number of interviewers was small and the exclusion has presumably had a very minor impact on the final fish consumption estimates. (There was a total of six interviewers from the Nez Perce Tribe.)

There were no exclusions based on language issues. In advance of the survey, the contractor team was informed by the tribal authorities that there would be no need to prepare for interviews in any other language than English. No instances of non-response due to language issues were reported to the contractors.

[9] The specific disposition code that could be used by the interviewers for this status was labeled as "Impairment: hearing, mental health, other."

5.4 Geographic Sample Selection Criteria

Initial exploration showed that this survey could not use the entire population of enrolled adult tribal members as a target population for interviews. Data (not containing any personally identifying information) from the tribal enrollment office showed that tribal members live throughout the United States, with the greatest concentration on and near the reservation. There would clearly be a limitation on the travel resources available for interviewing people in person; persons living very far from the reservation would need to be excluded. Secondly, there was a concern that members living very far from the reservation and far from the fisheries used by tribal members might be different in some way from those living close; fish consumption habits, lifestyle, and other known or unknown factors might substantially differ from those living closer to or on the reservation. The travel limitations were the deciding factor in limiting the geographic scope of the survey. A fifty-mile travel limit was considered acceptable for practical survey operation. The selection of geographic areas was based on ZIP codes, and the selected ZIP codes for the survey were approved by the Tribe. The selected ZIP codes are shown in Table 1 and displayed in Figure 1. Areas on the map falling within the 50-mile limit but with no (zero) population are not color-coded as included in the survey area. Not all ZIP codes shown in the table and map provided respondents who were interviewed for the fish consumption survey. Any adult tribal members residing in the noted ZIP codes were eligible to be selected into the survey sample.

Figure 1. Nez Perce Tribe. Nez Perce reservation and surrounding eligible ZIP codes for inclusion in the Nez Perce Tribe fish consumption survey.

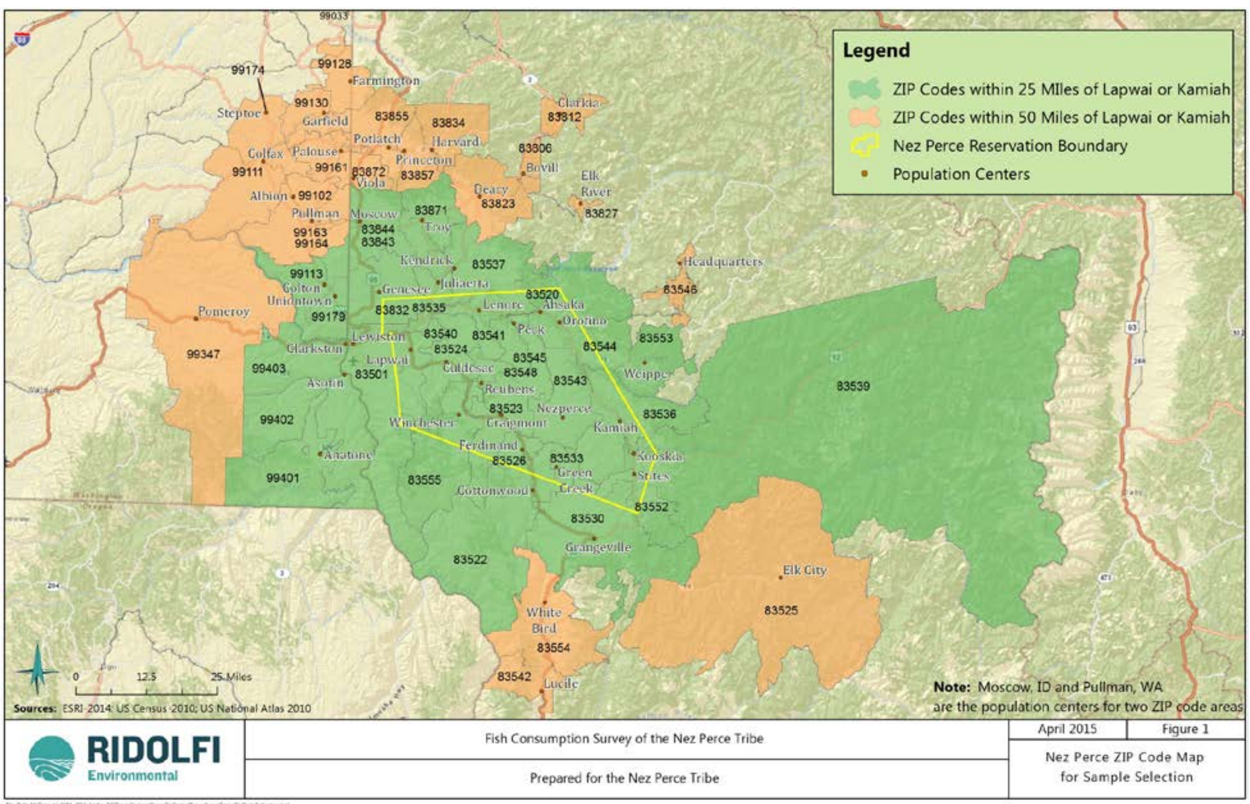

Table 1. Nez Perce Tribe. ZIP codes included for sampling members of the Nez Perce Tribe.

ZIP Code	Population Center
83501	Lewiston
83520	Ahsaka
83522	Cottonwood
83523	Craigmont
83524	Culdesac
83525	Elk City
83526	Ferdinand
83530	Grangeville
83533	Green Creek
83535	Juliaetta
83536	Kamiah
83537	Kendrick
83539	Kooskia
83540	Lapwai
83541	Lenore
83542	Lucile
83543	Nezperce
83544	Orofino
83545	Peck
83546	Headquarters
83548	Reubens
83552	Stites
83553	Weippe
83554	White Bird
83555	Winchester
83806	Bovill
83812	Clarkia
83823	Deary
83827	Elk River
83832	Genesee
83834	Harvard
83843	Moscow
83844	Moscow
83855	Potlatch
83857	Princeton
83871	Troy
83872	Viola
99102	Albion
99111	Colfax
99174	Steptoe
99113	Colton
99128	Farmington
99130	Garfield
99161	Palouse
99163	Pullman
99164	Pullman
99179	Uniontown
99347	Pomeroy
99401	Anatone
99402	Asotin
99403	Clarkston

5.5 Stratification and Drawing the Sample

The survey statistical team visited the Nez Perce Tribe on April 3, 2014 to draw the sample for interviewing, which was carried out on-site in the tribal offices. The Tribe provided the contractors with a tribal enrollment list of 2,727 adult members. The list contained gender, age, physical address and mailing address for each tribal member (though a physical address was not always available).

Members eligible for sampling were determined by first restricting the list to those 18 years or older and with a physical address ZIP code on the eligible ZIP code list (see Section 5.4.) For records without a physical address, the ZIP code of the mailing address was used instead. For records in which both addresses were available, the ZIP codes of the physical and mailing addresses matched in 2,011 of 2,061 cases, or 98% of them. This close matching supported the use of mailing address ZIP codes as a surrogate for physical address ZIP codes when needed. Of the original list of 2,727 adult members eligible for sampling, 68 were missing both physical and mailing addresses and 1,085 were located outside of the eligible ZIP codes, leaving 1,574 eligible for the sample.

Each eligible member was assigned a unique PMRID (Pacific Market Research Identification Number). A stratified random sample size of 1,250 was drawn from the 1,574 eligible members, with strata defined by each combination of gender and age group (18–29, 30–39, 40–49, 50–59, 60+). No other demographic variables were available in the tribal enrollment list. In particular, fisher status was not stratified on because the fishers list (see Section 4.4) was not available at the time of the sample draw. Fisher status was determined after members were sampled using the fishers list. The percentage of each stratum in the population of the 1,574 eligible members was then determined. The sample size allocated per stratum was determined by multiplying 1,250 by the population percentage computed for each stratum, thus creating a stratified sample with strata sizes proportional to the corresponding strata in the original population of interest. The sampled members were then randomly partitioned into four waves (to be successively allocated to interviewers approximately every three months) within each stratum. Once a wave of respondents was released to the interviewers, they could interview any sample member from the current or any preceding wave. While this expanded access to the waves of respondents may have introduced a greater possibility of selection bias from interviewer choice of respondents to approach, it was a necessary step due to the difficulty of locating respondents (Section 5.14, “Design Changes”).

Personally identifying information (PII) was utilized to draw the sample, but all such information was left with the Nez Perce Tribe after generating the list of sampled members. The Tribe retained full control of PII and its use for locating respondents

5.6 Questionnaire Development

Every aspect of this survey was designed in an extensive, time-consuming and transparent collaborative process beginning in the Fall of 2012 and lasting until the Fall of 2016 among the five tribes in Idaho, the Environmental Protection Agency, two tribal consortia, the State of Idaho, and a highly skilled and experienced team of expert EPA contractors and sub-contractors. Efforts were made to incorporate state-of-the-art survey and analytical methods and tribal cultural and governmental concerns in a study that was designed to contribute to understanding fish consumption by members of the two tribes surveyed.

This study is unique in that it conducted both the FFQ (food frequency questionnaire) and the 24-hour recall (NCI) method simultaneously in a survey of tribal consumption of fish over an entire year. (See Section 5.1, “Overview,” for a discussion of the merit of using the NCI method and the FFQ method together.)

The survey team, in close collaboration with tribal officials and EPA staff, developed an interview questionnaire to gather information from tribal members to help determine current tribal FCRs. Questionnaires from several other surveys were reviewed, specifically other Pacific Northwest regional fish consumption surveys employing a Food Frequency Questionnaire (FFQ) approach (Suquamish 2000, Toy et al. 1996, Sechena et al. 1999, CRITFC 1994). A draft questionnaire drew on components of these questionnaires. After several iterations and refinements, the final FFQ became the critical survey instrument used to ask respondents about their dietary patterns and activities related to fish consumption over the preceding 12 months. The questionnaire also covered several other topics, such as demographic characteristics and changes in fish consumption and access to fishing over time.

Drawing primarily from U.S. national dietary surveys (Johnson, 2013), additional questions were included in the questionnaire to assess fish consumption during the preceding 24 hours (“yesterday”). These 24-hour recall questions were needed in order to enable use of the NCI method of determining the distribution of usual fish consumption. At least two independent days of fish consumption (or non-consumption) need to be assessed for the NCI method. This requirement was met by conducting two 24-hour dietary recall interviews in addition to the FFQ. An attempt was made to match the timing of the first and second interview so that the two interviews would either both be on a weekday or on a weekend day. The reason for matching the interviews on the period of the week (weekdays or weekend days) was that the matching for some participants would then yield an estimate of within-person variation in consumption—the natural day-to-day variation in consumption amount that is independent of the weekday-weekend. This variation (technical term: within-person variance) is a component that is essential to and is estimated by the NCI method. Such variation would not generally be affected by other fixed factors (fixed within an individual), such as age, gender, or whether the two 24-hour periods are matched, and would also not depend on the specific aspect of fish consumption that is unique to and differs between weekends and weekdays.

The NCI methodology does provide for (and does include in the modeling) a possible weekend vs. weekday difference in daily consumption, and the methodology does appropriately handle data from respondents who have any combination of a weekend and weekday in their two 24-hour interviews. In the execution of this survey, there was some mixing of weekends and weekdays for the two interviews. As noted, this mixture is addressed as part of the NCI method of analysis.

Survey design provided that after first contacting potential respondents through a telephone screening process, interviewers administered the first 24-hour dietary recall interview and the FFQ in person to willing participants. The second 24-hour dietary recall interview was intended for telephone administration from three days up to 4 weeks after the first interview, though a longer interval was permitted during the later part of the field work. The longer interval was permitted in order to achieve an increased number of completed second 24-hour interviews and, thereby, increase the chances of reaching at least 50 double hits to use in the NCI method of analysis.

Data collected via the questionnaire included fish species consumed, frequency of consumption and portion size, with additional information gathered about fish parts eaten, preparation methods and special events and gatherings. Special events and gatherings include ceremonies or other community events but it was left up to the respondent to decide which events qualified. Examples of special events include longhouse meals, “Wahlusut” funeral meals, memorials, potlatches, name-givings and First Fish feast.

With regard to typical portion size and frequency of consumption of a species over the past year, respondents were allowed to provide this information for a respondent-identified period of higher fish consumption (along with the respondent’s estimate of the period’s duration) and for the balance of the year, a period of lower fish consumption. Alternatively, the respondent could simply describe a consumption pattern that was relatively constant throughout the year. If two periods (of higher vs. lower fish consumption) were chosen, the periods may or may not have coincided with periods of higher vs. lower fish runs and harvest.

Qualitative data were collected regarding both changes in fish consumption patterns as compared to the past and expectations for future consumption in order to provide additional context around the quantitative consumption rates. Demographic information was also collected, such as height and weight (to calculate and check FCRs) and education and income ranges (to determine FCRs for various population groups). A subset of respondents was reinterviewed by telephone, which involved asking a subset of the same questions (from the FFQ) a second time. The purpose of the reinterview was to assess reproducibility.

The FFQ survey questionnaire is presented in Appendix A. The survey team developed this questionnaire with substantial collaboration, review and input from the Tribe, tribal consortia, the EPA, discussion with the State of Idaho and review by two Institutional Review Boards (discussed below in Section 5.16). In addition, the questionnaire was subject to pilot testing, during which the interviewers tried out the questionnaire on tribal members and provided feedback to the survey team on any problems with the questionnaire. These pilot interviews were not used in the analysis for this report. The questionnaire was ultimately transferred to a CAPI software program on tablets, as described in Section 5.8, to facilitate more efficient and accurate reporting during the interviews in comparison to the use of a paper questionnaire. The questionnaire was then used to conduct interviews via CAPI, along with other visual instruments such as portion models and species identification photographs, as discussed in Appendix B.

5.7 Portion Models, Photos, Portion-to-Mass Conversions

To facilitate questionnaire administration during the survey, interviewers used portion model displays and species identification photographs (presented in Appendix B). The survey team selected species and developed these visual representations in collaboration with tribal technical and cultural staff to reflect the appropriateness of the fish species and preparation methods most commonly consumed by tribal members.

To aid in accurate determination of portion sizes, three-dimensional (3-D) and two-dimensional (2-D) model displays were used during the in-person interviews. These models can be broadly grouped into three types: realistic depictions of the part of an organism consumed (e.g., a fillet), measures of volume (e.g., bowls of various volumes), or photos of numbers of selected shellfish species (i.e., crayfish, mussels, and shrimp) consumed. Each interviewer had one full set of models to bring to the interviews. A set of photographs depicting those same models, printed at full scale, were left behind with each respondent after the first interview for use during the follow-up (second 24-hour dietary recall) telephone interview. This allowed respondents to report portion sizes using the same models consistently throughout the survey.

The survey team developed the following portion model displays for this survey, each of which included pre-determined serving sizes (as described in Appendix B):

1. A urethane rubber replica of a cooked whole salmon fillet, cut into multiple servings.
2. A flexible plastic replica of a single-serving, cooked trout-like (white fish) fillet.
3. A gray PVC pipe to represent lamprey, marked with portion sizes.
4. A package of salmon jerky to represent dried (or similarly shaped) fish tissue.
5. A set of measuring bowls for different portions of fish soup or volume of fish tissue.
6. Photograph displays of selected shellfish (crayfish, mussels, and shrimp).

Interviewers displayed portion models to respondents in familiar cooked forms (e.g., baked or dried); however, associated uncooked weights (edible mass) were calculated for application during data analysis. Each portion model had a specific (unique) code attached to it, and a separate table was created to show the volume and/or weight per species corresponding to each portion identified on a display. To maintain interview efficiency, respondents answered the questions in terms of simple portion marks or codes on each display, saving the interviewer from having to refer to a look-up table for the species-specific weight of the noted portion. Mass conversions of each model serving, corrected according to appropriate published moisture loss factors, were tabulated and used following the interviews to analyze the data and determine FCRs (see Section 5.10 for FFQ calculations and Section 5.23 for the NCI method, based on the 24-hour recalls). Details of the portion-to-mass calculations are provided in Appendix B.

In addition to the portion models (and the photographs of them which were left with each respondent), each interviewer had a laminated sheet with illustrations or photographs of each species to facilitate identification by the respondents, if necessary, during the interviews. The species identification photographs used to help respondents identify unfamiliar species during the interviews are also provided in Appendix B.

5.8 CAPI (Computer-Assisted Personal Interviewing)

The survey implementation team explored many modes for data collection. After careful consideration, the team identified CAPI as the most efficient and best data-collection process for this survey.

With a CAPI system, the respondent or interviewer uses a computer to answer survey questions. This is the preferred mode when a questionnaire is long and complex (Groves, Fowler, et al., 2009) such as in this case, when the in-person portion of the first interview (FFQ plus first 24-hour recall) lasted over an hour. This is due to the way that computer-assisted interviewing improves data quality; the computer script increases interviewer efficiency and decreases the likelihood of human error related to skip-pattern problems (i.e. moving to different sections of the survey based on the answers to previous questions) or misprinted questionnaires. Additionally, the CAPI system provides help screens and error checking and messages at the time of input. This ensures that surveys are completely filled out and enhances the accuracy of the entered data, decreasing backend data cleaning and processing tasks. Finally, there is no need to transcribe results.

The survey team selected Confirmit, a globally-recognized leader among online and CAPI software developers, as the CAPI application because it provides both on-demand resources, via Software as a Service (SaaS), and on-premises software, two critical requirements for this project: the survey team used both SaaS and an on-premises product for the interviews. When interviews were conducted in remote locations without internet or telephone access, the on-premises application, loaded on the tablets, was integral to the data collection process, allowing interviewers to conduct interviews and data entry, then synchronizing their data files the next time their tablets were connected to Wi-Fi.

After the questionnaire was finalized, a programming team built and scripted the computer version (to be used by the interviewers) within the Confirmit environment. This task, including thousands of lines of code, was substantial and was reviewed on a daily basis during the initial programming. All programming reviews were conducted by a programmer who was not directly involved in this project. After the programmed version was approved by the Lead Programmer and vetted by the programming review team, it was delivered to the Quality Assurance Department and the Project Manager for independent review and validation, prior to distribution to a larger team.

Each interviewer received a Windows 8 tablet for this study. These tablets were selected based on their reliability, durability, and especially their small and unobtrusive form factor. Not only was it important that the tablets were easily portable, but also that the technological "footprint" and the sometimes off-putting nature of a physical barrier between the interviewer and the respondent were minimized.

Interviewers brought the tablets with them to each in-person interview where the interviewer, not the respondent, would enter the data. The tablets included detachable screens and keyboards, as well as touchpad mice and power adapters for AC outlets and car lighters—a necessity in some rural areas where power was not always guaranteed.

The tablets were password-protected. Survey responses were encrypted and transmitted via HTTPS to central servers each time a WiFi connection was available and all data files were automatically removed from the tablets after synchronization with the master database. No personally identifiable information from respondents was stored either on the tablets or in the master database.

Confirmit stores data in an optimized database format. Using the Extensible Markup Language protocol or XML, its database is accessible with many popular software applications. Using Confirmit's built-in "Export" feature, the data were transferred from the Confirmit database into a standard SPSS file format (IBM SPSS Statistics, Armonk, NY) in an automated manner. To do this, Confirmit uses the metadata assigned to all fields when the questionnaire was programmed. The only configuration needed was to specify certain administrative variables (used internally by Confirmit—not from the questionnaire itself) to be filtered out of the data file supplied for statistical analysis. The generated SPSS data file is readable by the statistical software used (see Section 5.31). This data file contains a row for each respondent or attempted contact and has a unique ID. Responses to each question in the interview are stored in columns. The testing of CAPI and verification that data input matches the output is described in the next section.

5.9 Interviewer Recruitment and Training, Pilot Tests

In February 2014, prior to the start of data collection, a widespread recruitment campaign was initiated by the survey implementation firm to search for local candidates to hire as interviewers. The contractors worked closely with the Tribes to publicize the survey effort, advertising online, in the newspaper, on tribal bulletin boards, and using word-of-mouth among the tribal council and the fisheries and water quality personnel.

Interviewers were required to be currently enrolled members of the Tribes. Tribal interviewers (rather than non-tribal interviewers) were selected, because it was thought that tribal member respondents were more likely to accept and open up to an interview from a fellow member of the Tribe (including accepting a home interview) than from someone outside the Tribe. In addition, tribal member interviewers would have a very wide network of relatives and friends within the tribal community—something that it was thought might prove very helpful in locating sampled members (sometimes the most difficult step) and gaining their cooperation for an interview. The tribal leadership and staff also expressed, in advance, the importance of using tribal interviewers, for cultural, capacity-building and economic reasons ((i.e. providing income and new or additional job skills for tribal members).). That choice was also made in other Pacific Northwest fish consumption surveys of Native Americans (CRITFC, 1994, Toy et al., 1996, Suquamish Tribe, 2000).

Applicants were screened on paper and by telephone. Following a successful initial vetting, acceptable candidates were interviewed in person, after which non-qualified candidates were culled and a short list of qualified candidates was provided to the tribal councils for review and approval. As a professional courtesy, the Tribe had "first right of refusal." Candidates who passed the screening process, the in-person interview, and tribal approval were offered year-long positions on the project. Qualified and approved applicants were hired by the survey administration firm (Pacific Market Research) as part-time employees. An experienced Idaho project administrator was retained to provide supervision, problem-solving and quality assurance for interviewers, to act as liaison with tribal officials, and to provide general coordination with the rest of the contractor and governmental team members. The presence of a local project administrator was key to coordinating all of the efforts and establishing relationships with tribal staff and officials.

After hiring, the contractor team conducted an extensive training and mentoring process. The initial training was a full-day session during which the interviewers were presented with the background of the survey, its purpose, and the development of the questionnaire. The interviewers were also taught about the project objectives. The contractors briefed the interviewers on the history of survey research, the guidelines and principles of in-person and telephone interviews, and the Belmont Report (a document which explains the importance of human subject protections). The interviewers were also trained to use the technology (i.e., computer tablets and associated software) associated with the survey, as well as the various display models.

Interviewers were taught how to properly screen respondents, how to conduct in-person interviews, and how to conduct telephone interviews. It was explained that the first (typically hour-long) interviews would be conducted in person, while the second (20-minute or less) follow-up interviews would be administered over the phone. The interviewers were taught to read all questions verbatim without influencing the respondents' answers. They were also taught how to record all answers exactly as presented to them. The contractors stressed the importance of maintaining objectivity throughout the entire process, from respondent recruitment and screening through the final question of the second interview. There was also instruction and an emphasis on careful and accurate key entry of interview responses into the correct fields in the CAPI tablets.

The final part of the training included mock interviews with the interviewers and trainers. The mock interviews required the use of the tablets, interviewing software, and fish models and photographs. Interviewers were required to complete a mock hour-long interview as well as a mock follow-up telephone interview before completion of their training.

After the initial, day-long training session, interviewers were required to conduct practice interviews, either with family and friends or independently. In this way, they familiarized themselves with the questionnaire, the computer tablet and the CAPI software. After these practice interviews, the survey team contacted each interviewer to solicit feedback. The contractors evaluated the data entered to ensure that the interviewers completed the fields appropriately. Next, the survey team provided "dummy" responses to the interviewers. This consisted of providing interviewers paper questionnaires with pre-populated data for them to enter into CAPI as well as conducting in-person meetings with a member of the survey team who behaved as a sample respondent, answering with the same dummy data. The pre-populated data in the paper questionnaires included answers specifically developed to support establishing personas: high consumers and low consumers of fish. The dummy data from the paper questionnaires and from the mock interviews were entered into CAPI in May 2014.

In June 2014, the Project Manager at Pacific Market Research checked all dummy data entered against the master file, a key version of the dummy data. If discrepancies were found between the key and the data entry by any interviewer, that interviewer was notified and required to correct the errors. Any interviewers who made such errors were required to conduct additional data entry exercises prior to receiving authorization to "go live."

All of the dummy data output was double-checked to make sure that the values entered in the CAPI system matched the values produced by the CAPI system. Concurrent with successful testing, the live interviews with tribal members began. The first live interview was completed on May 10, 2014 and the last in-person interview included in this report was completed on April 24,

2015. Telephone interviews continued through May 4, 2015 to complete the second 24-hour dietary recall.

Numbers of completed interviews were tabulated weekly against expected completion rates and hours expended. At the beginning of the study, interview numbers were low as the survey administration contractor and interviewers worked through difficulties in obtaining contact information for selected sample respondents. Weekly calls between all contractors, tribal staff and EPA staff were initiated to resolve in-the-field challenges in obtaining interviews.

5.10 Calculation of FFQ Consumption Rates

Annual FCRs, which included consumption at special events and gatherings, were computed based on responses to the FFQ portion of the first interview. Rates were also computed from the 24-hour recalls using the NCI method, described later in Section 5.23. Respondents described their consumption using portion models to indicate portion size (converted to grams as described in Section 5.7) and portion frequency (e.g., once per week or two times per month). For each separate species, respondents were permitted to describe their consumption in two ways: over the whole year using a single portion size and frequency (constant throughout the year) or over two different periods of higher and lower fish consumption, which may or may not correspond to when the specific species was in or out of season. In the case of consumption varying between a high and low season, respondents would provide portion size and frequency for each of the two periods separately, as well as the duration of the higher consumption period in days, weeks, or months. The low consumption season was then calculated as one year minus the fraction-of-a-year duration of the high consumption season. Stated again for clarity, the duration of high and low seasons (or designation of only one regimen of portion size and frequency throughout the entire year) was reported for each individual species consumed.

Note that the higher consumption period duration was entirely up to the respondent to provide for each species as he or she wished. It was also optional for the respondent to a) mentally average over the whole year rather than using two periods; or, b) use a single (full-year) period, if the respondent felt that that was a better approximation to the respondent's consumption pattern than two periods. For the two-period responses, the duration of the higher consumption period provided by the respondent may have been shorter than the biological season of the species or the period may have been longer, for example by preserving fish caught in season and consuming it over an extended period or a different period based on cultural events. We have not compared the respondent-reported and the biological season lengths in this report. This difference may be evaluated in the future. Most responses (80% of the 2,810 per-species responses from all respondents combined) were provided using a single, one-year period rather than a pair of higher and lower consumption periods.

The FFQ asked separately about consumption at and outside of special events and gatherings. The notation for rates in this section is descriptive of the quantity entering into or the result of a calculation. The total consumption rate in grams/day (*Rate_Total* in the equations here) was calculated as the sum of the rate which excluded special events and gatherings (*Rate_Nonevents*) and the rate for special events and gatherings only (*Rate_Events*). *Rate_Nonevents* was calculated either based on consumption information provided to represent an entire year as a single period, (*Rate_Nonevents_Whole*) or by combining annualized rates of consumption during a higher consumption period (*Rate_Nonevents_Higher*) and the consumption rate in the remaining lower period (*Rate_Nonevents_Lower*). Each of these rates were calculated per species first, then species-specific rates were summed together to produce species-group rates (see Section 5.11 for definitions of species groups).

If the respondent reported consumption over the whole year as a single period (rather than varying during the year), the FCR (g/day), excluding consumption at special events, was determined by the following equation:

$$Rate\_Nonevents\_Whole = SIZE\_Nonevents \times FREQ\_Nonevents, \quad (1)$$

where:

> *SIZE_Nonevents* = total portion size in grams (determined based on the portion model used by the respondent, the portion-to-mass conversion factor for the combination of the portion model and species, and the number of portion units consumed; see Q19 in the questionnaire in Appendix A)
>
> and:
>
> *FREQ_Nonevents* = number of portions consumed per day, which may be converted to a daily amount from the number of portions reported per week, per month or per year (Q18 in the questionnaire).

Any frequency per week was converted to frequency per day using 7 days/week. Any frequency per month was converted to frequency per day by dividing by the factor 365/12 days/month. Any frequency per year was converted to frequency per day by dividing by the factor 365 days/year. Of note, the year preceding any interview in the survey did not overlap a leap year.

If the respondent reported consumption over two periods (higher and lower consumption), the rates (non-annualized) for each period were computed in the same way as equation (1), above. The two rates were then annualized and combined using the following equation:

$$Rate\_Nonevents = \%HIGH \times Rate\_Nonevents\_Higher + \%LOW \times Rate\_Nonevents\_Lower, \quad (2)$$

where:

> *%HIGH* = the length of the higher consumption period expressed as a proportion of the year (Q22 in the questionnaire);
>
> *%LOW* = the length of the lower consumption period expressed as a proportion of the year (*%HIGH* + *%LOW* = 1);
>
> *Rate_Nonevents_Higher* = consumption rate in g/day during the higher consumption period (portion frequency and size came from Q20 and Q21, respectively);
>
> and,
>
> *Rate_Nonevents_Lower* = consumption rate in g/day during the lower consumption period (portion frequency and size came from Q23 and Q24, respectively).

The higher-period duration was reported in either weeks or months. Weeks' duration of a high-consumption season were converted to a proportion of a year by multiplying by the factor 7/365. Months' duration of a season were converted to a proportion of a year by multiplying by the factor 1/12.

For special events and gatherings, respondents were asked only about suckers and whitefish (as a single group), salmon and steelhead (all species combined), resident trout (all species combined) and sturgeon. This selection of species and groups was done through consultation with both the Nez Perce and Shoshone-Bannock Tribes, who noted that a more limited set of species were consumed at special events, and was further motivated by the desire to reduce respondent burden. For each of these four species/groups, the corresponding FCR (g/day) was computed as

$$Rate\_Events = EFREQ \times \%EVENTS \times SIZE\_Events, \quad (3)$$

where:

EFREQ = number of events per day (converted from the number of events per week, month, or year; Q31 in the questionnaire in Appendix A);

%EVENTS = proportion of events where the given species is consumed (Q34);

and,

SIZE_Events = total portion size in grams (based on the model and units chosen in Q33 and the standard portion-to-mass conversion routine described in Section 5.7).

The final individual FCR (g/day), which also includes consumption both at and outside of special events and gatherings, is determined using the following equation:

$$Rate\_Total = Rate\_Nonevents + Rate\_Events. \quad (4)$$

As *Rate_Nonevents* was calculated for each individual species (e.g. chinook, coho or sockeye salmon) while *Rate_Events* was calculated at the group level (e.g. all salmon and steelhead combined), *Rate_Nonevents* in equation (4) was first aggregated to the group level by summing individual species rates as appropriate before the summation with *Rate_Events*.

5.11 Species Groups

The species groups included in this report (Table 2) were determined jointly by the Nez Perce Tribe[10] and EPA staff, with the Tribe making the final decision. EPA staff provided guidance on EPA policy as to what species might be included in developing FCRs that are relevant for ambient water quality criteria to protect human health.

The Nez Perce Tribe decided that from a water quality standard development perspective, the appropriate grouping of fish to focus on in this report should include near coastal, estuarine, freshwater and, in particular, anadromous species (Group 2). Inclusion of anadromous species in the FCR used to develop AWQC is a policy option that the EPA has made available to states and tribes (US EPA, 2013). In Oregon, anadromous species are included in the FCR used for that state's AWQC (Oregon DEQ, 2011). Anadromous species are also currently included in the FCR

[10] Email from Joe Oatman to Nayak Polissar (and others) on June 26, 2015, conveying an email from Marlene Trumbo documenting the Nez Perce Tribal Executive Committee (NPTEC) decision on species groups to be reported.

used for Washington's proposed AWQC (Washington Department of Ecology, 2015). The Nez Perce Tribe wished to report on total fish consumption (Group 1).

The species included in the groups used for reporting FCRs are described in detail in Table 2. Group 2 contains Groups 3-5 and part of Group 6. Groups 3-7 are mutually exclusive groups which completely cover Group 1. During interviews, individual species consumed were named by the respondent based on their personal knowledge, species photographs (Appendix B) and discussion with the interviewer; the respondent's final identification was accepted. In particular, respondents differentiated between freshwater clams and mussels and marine clams and mussels. In the case of freshwater clams and mussels, some respondents harvested the shellfish themselves or knew the difference based on appearance. Only 4% of respondents reported consuming freshwater clams or mussels while 31% reported consuming marine clams and mussels. Of note, Groups 1 and 2 contain all shellfish species, so this distinction between freshwater and marine does not affect those groups.

Table 2. Nez Perce Tribe. Species groups.

Species Group	Description	Species and Species Groups Included
Group 1	All finfish and shellfish	All species in groups 3-7 (these groups are mutually exclusive)
Group 2	Near coastal, estuarine, freshwater and anadromous finfish and shell fish	All species in groups 3, 4 and 5; lobster, crab, shrimp, octopus, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels
Group 3	Salmon and steelhead	Chinook, coho, sockeye, kokanee, steelhead, chum, pink, Atlantic and any unspecified salmon species
Group 4	Resident trout	Rainbow, cutthroat, cutbow, bull, brook, lake, brown, bottoms, golden and any unspecified trout species.
Group 5	Other freshwater finfish and shellfish	Lamprey, sturgeon, whitefish, sucker, bass, bluegill, carp, catfish, crappie, sunfish, tilapia, walleye, yellow perch, crayfish, freshwater clams or mussels and any unspecified freshwater species
Group 6	Marine finfish and shellfish	Marine finfish (cod, halibut, pollock, tuna, herring, sardines, mackerel, mahi, orange roughy, red snapper, seabass, kipper, wahoo, yellowtail and shark), marine shellfish (lobster, crab, shrimp, octopus, squid, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels) and any unspecified marine finfish or shellfish
Group 7	Unspecified finfish and shellfish	Any response where the species was not specified sufficiently to be placed into groups 3, 4, 5 or 6

Note: There is overlap between the species in Group 2 and Groups 3-6. Group 2 used in this report has been revised from the Group 2 species list presented in a draft interim report of this survey. Species selection for group 2, as presented in this report, was informed in part by the habitat proportions listed per species in U.S. EPA, 2014, Table 1. In particular, the marine species in Group 2 were considered likely to be near coastal or estuarine.

5.12 Demographic Groups

Group 1 (all fish) consumption rates were computed by population demographic groups defined by variables available from the enrollment file and the survey questionnaire The enrollment file was used to define groups based on gender, age, and whether or not the respondent was a documented fisher as determined from the Nez Perce Tribe fishers list (see Section 4.4). The questionnaire was used to define groups based on whether the respondent lived on- or off-reservation, the number of persons resident in the respondent's household, and the respondent's education and income levels.

5.13 Response Rates

Response rates were calculated according to standard definitions of response rate (AAPOR, 2011). The following specific form of the response rate was calculated**:**

$$RR1 = I / [(I + P) + (R + NC + O) + U]$$

where:

I = The number of complete interviews

P = The number of partial interviews

R = The number of refusals and break-offs

NC = The number of eligible sampled members not contacted

O = The number of other eligible non-respondents

U = The number of non-respondents with unknown eligibility

For this survey the use of the RR1 equation is equivalent to the following formulation:

$$RR1 = I / (N - X)$$

where N = the size of the originally selected sample and X = the number of members found to be ineligible after contacting or attempting contact. A completed interview, which contributes to the numerator of the response rate calculation, was defined as one where the respondent either: 1) responded to the screening interview or the FFQ items sufficiently to be classified as a non-consumer (Q3-Q6 of the questionnaire), or 2) completed the full first interview (after the screening interview) with the FFQ items completed and provided enough information to support calculation of an FFQ consumption rate. To satisfy the second condition, a respondent did not need to answer every question but needed to reach the end of the questionnaire. Note that this definition allows for respondents who sufficiently answered the screening interview to be classified as consumers (Q3-Q6) but who did not go on to complete the full interview. This means that the number of known consumers in the survey is higher than the number of respondents with known FFQ consumption rates.

An ineligible member, who reduces the denominator of the response rate calculation, was defined as a sampled member who was: 1) found to live outside of the eligible ZIP codes, 2) found to be employed as a tribal interviewer involved in the survey, or 3) deceased, institutionalized or impaired. The term "institutionalized" included prospective adult respondents who, at the time of the survey, lived in a setting where they had little or no control over their diets. For example, residents of long-term care facilities, hospice (not in-home), and prison would be classified as institutionalized.

Not all sampled members were contacted, and therefore the eligibility or ineligibility of every sample member could not be determined. This measure of response rate is thus conservative (too low) in the sense that its value is reduced by the presence of sampled members who are ineligible but presently unknown to be ineligible. Ineligible members whose ineligibility was unknown to the survey team would include, for example, deceased members whose enrollment records had not yet been updated or members who recently moved out of the eligible ZIP code area and whose residence address differed from the address of record at the time the enrollment files were used to draw the sample. A count that is unknown to the survey staff is the number of sampled tribal members who were ineligible but were not known to be ineligible. If this number was known, it could be included in the response rate calculations, and the response rate would be higher than that reported here.

5.14 Design Changes

As the survey progressed, a number of issues became evident. It was found that the contact information found in tribal enrollment records was not as accurate as had been hoped, requiring sometimes significant and creative research to locate potential respondents. The time required for interviewers to travel to respondents' homes and conduct interviews was also much greater than expected, and some interviewers encountered difficulty in conducting interviews at tribal members' homes. Finally, the fraction of individuals agreeing to be interviewed was also lower than expected. All of these factors led to a lower-than-expected rate of interview acquisition and concerns about attaining an appropriate number of interviews to assure a credible result.

To address these issues, several design changes were adopted partway through the interviewing period to increase the number of interviews completed and improve the chances of meeting the sample size goals for the NCI method. The first of these design changes was to permit the interviewers to attend special events[11] (e.g., tribal meetings and powwows) and recruit and interview attendees for interviews during the events—still drawing potential respondents only from the list of tribal members selected into the sample. As part of this design change, interviewers were permitted to draw respondents from any of the four sample waves of members. Ultimately, this did lead to the interviews not being spread evenly across the year, as originally designed. However, during the analysis phase of this project, the wave structure was considered to be less important, because seasonality was not found to be a factor that was present in reported consumption rates in a manner that could be included in the analysis. (See the analyses of seasonality presented in Section 5.23.2.1.) The ability to detect seasonality may have been limited by the small number of interviews conducted during the peak harvesting period. Due to the limited number of interviews during the peak season, the finding of no compelling seasonality during the data analysis does not constitute a demonstration that there is no seasonal variation in fish consumption.

[11] The Nez Perce culture and traditional practices involve regular and time-specific ceremonies. Today, these "special events" are a continuation of tribal customs and cultural practices, and provide an opportunity to maintain those traditional values and teachings. These gatherings often have a large attendance, and such occasions served as an opportunity to make contacts and complete interviews.

As part of their activity at these events, the interviewers were also permitted to schedule interviews at a later time (after the special event). Thus, the special events provided an opportunity not only for on-site interviewing, but also to arrange additional interviews later on. After the special event, the criteria reverted to respondent recruitment only from the wave of members assigned to the specific calendar period. However, interviewers were also permitted to conduct interviews of members from the sample list (any wave) whom they might encounter by chance.

As expected, the design change noted above greatly increased the acquisition of completed interviews. Any adult willing to be interviewed at a special event was likely part of the sample roster, as approximately 80% of the eligible adults in the Tribe were included in the sample.

A second design change occurred after the EPA and the contractor team received limited, conditional approval from the Tribe to expand the interview team to include non-Nez Perce interviewers, which allowed interviewers from the EPA and other tribal organizations to assist the Nez Perce interview team. These individuals received the same training and instructions that the Nez Perce interview team received. The non-Nez Perce interviewers were also permitted to draw respondents from any wave of members. Non-tribal interviewers visited the Tribe in December, 2014 and March-April, 2015 and interviewed eligible members from the sample list that were tribal government employees. During the December 2014 visit, non-tribal interviewers also attended a tribal holiday event and interviewed additional sampled members (not necessarily Tribal employees). The interviews by the non-tribal interviewers were conducted in the respondents' offices or other Tribal or commercial venues, rather than respondents' homes. Tribal employees were offered paid time off, by the Tribe, to participate in the survey. In rare cases, the interviewing supervisor, a non-tribal member, scheduled or completed interviews with tribal members who were not also tribal employees, but these instances were rare, and all were pre-approved by the Nez Perce Tribe. Nearly all first contacts with prospective respondents were made by tribal interviewers or the interviewers' supervisor, who had developed exceptional rapport with tribal members. While non-tribal interviewers assisted in interviewing some of the easier-to-contact tribal members (i.e. employees whose work phones and work addresses were known), tribal interviewers were freed up to pursue many more of the hard-to-reach respondents, people who a non-tribal interviewer would have difficulty finding, contacting and convincing to complete the interview. The scope of work for the non-tribal interviewers was limited, but their overall efforts were crucial to the success of the project.

An additional change—though not a design change—was increased coordination in scheduling of interviews. The interviewers' supervisor (from the contractor team) worked more closely with the interviewers to assist them in arranging interviews. In addition, tribal staff and tribal leaders played a more prominent role in establishing the framework to coordinate between interviewers, supervisor, and tribal staff to schedule interviews at special events and on tribal property.

5.15 Reinterviews

A sample of respondents who completed the first interview were sampled to be re-interviewed using a short list of questions related to fish consumption. The goal of the reinterview was to compare the original and reinterview responses to assess reproducibility.

The reinterview questionnaire is contained in Appendix A. The questions cover the frequency of consumption of Chinook salmon, the species with the largest number of consumers among the survey respondents. Additional species were not specified to limit the total burden on respondents and the duration of the reinterviews. Additional questions in the reinterview cover changes in overall fish consumption and the number of people living in the respondent's household. Responses to corresponding questions in the original and reinterview were compared descriptively using means, standard deviations and Spearman's correlation coefficient.

The reinterviews were conducted from April 3 to June 12, 2015 by the Pacific Market Research interview supervisor, a non-tribal interviewer. The survey statistical team provided the interviewer with a list of respondents who were originally interviewed within the last 2 months to help select respondents. The list was refreshed every two or three weeks with recent interviews. To help ensure a balanced sample, the list was partitioned into 6 groups, defined by gender and Chinook consumption. For each gender, Chinook consumption was divided into three equal-sized groups using tertiles. The target was 30 reinterviews total, with 5 from each group. The interviewer was aware of the groups but was not aware that the groups were defined by previously reported consumption levels. The interviewer was instructed to carry out reinterviews from each group (e.g., high-consumption females) until five reinterviews in the group were completed.

Over the course of 2 months, 81 respondents were identified for possible contact for a reinterview, of which 67 (83%) had at least one contact attempt. (There was no requirement to contact or attempt to contact all respondents on the list.) Thirty-one reinterviews were completed. The target was 30 but an extra interview was performed (and used in the reinterview analysis), because—on the first interview—one respondent did not provide a complete response regarding Chinook consumption (the duration of the high consumption period was missing), necessitating imputation. The imputed value was retained for comparison to the reinterview value, since such imputations have been used to present the results of this survey. Of the 36 respondents with a reinterview attempt but no completion, there were no (zero) refusals, 22 respondents did not have a valid phone number recorded, five did not respond after the maximum number of contact attempts was reached and 9 had 1-6 contact attempts (median: 2) before the reinterview quota was reached and no further attempts to contact these respondents were needed.

5.16 Reviews and Approvals

The survey team developed a Survey Design Report in 2014 in extensive discussions and collaboration with the Nez Perce Tribe and the EPA that outlined the approach and procedures for implementing the fish consumption survey. The Coeur d'Alene, Kootenai and Shoshone-Bannock Tribes of Idaho, the Columbia River Inter-Tribal Fish Commission (CRITFC) and the Upper Snake River Tribes Foundation (USRTF) also reviewed and provided input to the survey design based on similar design reports that were submitted to them. Staff from the State of Idaho

Department of Environmental Quality also participated in design discussions that paralleled their own survey development efforts. The coordination with DEQ was implemented in order to ensure that data collected by the tribal surveys would be of utility in Idaho's efforts to revise State ambient water quality criteria. Progress on the survey was reported on a regular basis to the Negotiated Rulemaking process run by the State of Idaho.

In order to meet accepted standards of protection for survey respondents, the Survey Design Report was submitted for review and approval to two Institutional Review Boards (IRBs) and the EPA Human Subjects Research Review Official (HSRRO), the latter of which has the final authority for all human subjects research supported by the EPA.

First, the Northwest Indian College (NWIC) IRB reviewed the design protocol, suggested modifications to the survey questionnaire to ensure protection of tribal respondents, and gave "consultative approval" for the survey to proceed on March 14, 2014. The design team felt that it was important to include an IRB associated with Native American tribes in order to fully assess any issues the research might pose for unique Native American cultures. Subsequently, Quorum Review IRB reviewed the design protocol, including revisions made according to the NWIC IRB recommendations, and issued a "notice of exemption determination" on March 26, 2014 acknowledging that the survey met the criteria for protection of human subjects' personally identifiable information and did not require further review or restrictions. Quorum IRB was the official IRB on record for the survey, since the NWIC IRB played a consultative role. Finally, the EPA HSRRO reviewed the design protocol and supporting documentation, including the IRB letters, and approved the survey design. Ultimately, the Nez Perce Tribe gave final approval for the survey to proceed.

The survey was implemented largely consistent with the methods as described in the final survey design document. Some modifications to the design—in a manner that would not bias the survey—were implemented during the field work to increase the response rate, as described above in Section 5.14.

A version of this report was submitted to a four-person peer review committee on July 30, 2015 for a letter peer review. The four reviewers included: a statistician who co-developed the NCI method and who had extensive experience in dietary surveys; a dietician and nutritionist involved in monitoring and assessing food consumption and related behavior of the U.S. population; a professor of nutrition involved in designing and evaluating dietary surveys; and a researcher in food sciences involved in methodological aspects of dietary intake assessment. The four reviewers each evaluated the report independently and submitted their reviews to the peer review contractor, who summarized the reviews and also included them verbatim in the peer review report. The charge to the reviewers asked them to consider all major aspects of the design, analysis and reporting of the survey. The peer reviewers' comments were returned at the end of August, 2015. The current version of the report includes the contractors' revisions in response to the peer reviews and in response to additional internal reviews from the EPA, from the two tribes participating in the current fish consumption survey, and from two tribal consortia. (see Section 5.17.1).

5.17 Internal Reviews

5.17.1 Review by the Tribe and Other Organizations

A design report containing planned procedures was prepared for review by the Tribe, as well as by two affiliated tribal organizations (Columbia River Inter-Tribal Fish Commission—CRITFC—and the Upper Snake River Tribes Foundation—USRTF), the EPA, SRA (the contracting organization managing multiple related contracts for the EPA), and Ross Strategic. These Tribe and organizations provided feedback or approval, and their suggestions were addressed or considered in preparation of a final design document.

A draft interim report was provided on April 27, 2015 to and was reviewed by the two Tribes participating in the current fish consumption survey—the Nez Perce and Shoshone-Bannock Tribes. The draft interim report included analysis only from the FFQ data collected during part of the survey year. The report was also provided to and reviewed by the CRITFC and USRTF tribal organizations, as well as the EPA and two organizations closely involved in the work effort: SRA and Ross Strategic. The feedback from these reviews played a role in the version of the draft interim report, dated May 12, 2015, and the benefits of those reviews have carried forward into the current analysis and report. The May 12, 2015 report was submitted specifically to aid the State of Idaho in its rulemaking effort.

A revised draft report was issued on July 15, 2015 for internal review by the Tribes, tribal organizations, EPA and the contractors. The July 15, 2015 report included analysis of both FFQ data and data from the 24-hour dietary recalls—analyzed by the NCI method. The various parties offered comments, which the contractors used to prepare the next major version of the report. That version was submitted to a peer review committee on July 30, 2015 (see Section 5.16), and the same version was reviewed by the Tribes, tribal organizations, EPA and the contractors, who also reviewed versions issued on September 21, 2015, and September 25, 2015. The contractors considered the feedback from each wave of reviews in producing each subsequent version of the report, including the present version.

5.17.2 Review of Statistical Computing

Two statisticians separately implemented the calculation of the FCRs per respondent, for all species combined (total consumption rate), all reported species groups (see Section 5.11) and also for each of the 45 pre-specified species and species group used in the survey questionnaire. The calculations include the consumption rate formulas described in Section 5.10 and the imputation of missing values as described in Section 5.28. All of these consumption rate values were compared between the two statisticians' implementations of the rate calculation methodology. Any differences found were discussed (without comparing codes), after which each statistician modified their code independently until there was complete agreement for all respondents and all species.

5.18 Overview of Statistical Analysis

The description of the statistical analysis methods in the following sections is extensive and covers a number of topics, including:

- definition of fish consumers vs. non-consumers (which may vary across the more frequently to less frequently consumed species groups);

- handling of missing values in the FFQ responses about consumption—a methodology which avoided excluding some respondents' consumption records, which were nearly but not entirely complete;
- sampling probabilities and their adjustment for non-response for use in statistical weighting with the intent of providing estimates for the target tribal population;
- evaluation of the impact of design changes, including interviewing at special events and non-tribal interviewers, as well as home vs. non-home interviews;
- confidence interval calculations based on the non-parametric bootstrap using replicate weights, which provided robust estimates of the precision of consumption rate means and percentiles; and
- the NCI method, a complex and flexible modeling approach that was applied to the 24-hour recall responses to estimate consumption rate distributions—in addition to those provided from the FFQ data on estimated consumption over the preceding year

Consumption rates in this report are generally presented to one decimal place, e.g., 70.1 g/day. While the true level of precision of a particular rate may not warrant the one decimal place, that format has been used for four reasons. First, in some cases, for very low consumption rates, e.g., 1.6 g/day, rounding to an integer (which would be 2 g/day, in the example) would sometimes be an unacceptable loss of information. Second, users of this report may sometimes carry out calculations based on the rates reported here, and the one decimal place may sometimes improve the precision of those derived calculations. Third, stylistically, tables with internally varying numerical formats are more difficult for some users to read and scan than a table with a consistent numeric format. Finally, if the format of the rates is intended to truly and consistently represent precision for every rate presented, then, onerously, each and every rate would need to be considered separately for possible rounding, and that rounding could extend to the unit, tens or hundreds digits, as well as being differential rounding for each individual rate. For example, in one case 43.6 g/day might need to be rounded to 40, while in another case it might be rounded to 44 g/day, and in yet another case, it might need to be preserved in all its specific digits: 43.6 g/day. Thus, though the format of a particular rate might be more precise than warranted in some cases, the magnitude of the rate is apparent and meaningful, and it would be rare in this study to have the numeric format interfere with any comparison among rates.

5.19 Sampling Probabilities

The sampling probabilities (or sampling fraction) for each stratum were calculated as the number of the sampled tribal members in a stratum divided by the number of tribal members in the same stratum. Section 5.20 describes how the sampling probabilities were modified to produce statistical weights used in calculating most results presented in this report.

5.20 Non-Response Adjustments to Weights

Completed interviews with useable responses for consumption rate calculations (or with a determination that the respondents never consumed fish) were not available for all sampled tribal members. If it could be assumed that non-response to the survey was completely random—for example, not dependent on sampled members' gender, age or other characteristic—then the original sampling weights (based on strata only, and calculate as the inverse of the sampling fraction per stratum) could be used without leading to any bias. However, that assumption is often not valid and was not made here. The sampling weights were therefore adjusted for non-response using characteristics available from the enrollment file and fisher list.

The terms “responder” and “non-responder” are used in this section and at other locations in this report. Responders were defined as sampled tribal members who were interviewed and were determined to be either fish consumers or fish non-consumers. In contrast, sampled tribal members that were either not interviewed or were interviewed but could not be determined to be either fish consumers or fish non-consumers, were designated as non-responders. Both terms “responder” or “non-responder” are not to be confused with the generic term “respondent” that simply means a survey participant who may be referred to in the particular topic being discussed or whose data were used in the analysis being presented.

The non-response adjustment is used to adjust the probability of being sampled from the tribal population—i.e., to adjust the “sampling probability.” The sampling probability (Section 5.19) is the starting point—a quantity used in creating appropriate statistical weights. It is adjusted by taking account of the probability of a sampled tribal member actually becoming a responder to the survey. That probability of survey response, in turn, is calculated in relation to demographics of the sampled tribal members. The goal is to adjust for potential bias due to differences among responders and non-responders and to yield better (usually less biased) estimates of the population value of a statistic, such as a mean. A respondent’s sampling weight W (used for statistical analysis) was calculated as the inverse of the product of: (a) the sampling fraction in the respondent’s stratum F_s, and (b) the estimated probability P_R of being a respondent (“response probability”) for a tribal member with the respondent’s specific characteristics (e.g., age, gender, etc.):

$$W = 1/(F_s * P_R)$$

Response probabilities (P_R) were calculated using multivariate logistic regression (Hosmer and Lemeshow, 2000) for survey response among sampled tribal members, using available demographic characteristics. The response probabilities are, thus, a multivariate function of a number of demographic characteristics. Available demographic characteristics from the enrollment files used to draw the sample or from other sources included:

age group, gender, ZIP code group (83540, 83536, 83501, Other ZIP codes), and fisher indicator (on vs. not on the fisher list).

Logistic regression models for response were selected using the Hosmer-Lemeshow goodness of fit statistic (Hosmer and Lemeshow, 2000). The selected models included:

age group, ZIP code group (83540, 83536, 83501, Other), and fisher indicator.

The same weights that were developed per respondent were applied to all weighted analyses (including the analysis of the FFQ and 24-hour recall consumption data).

Replicate weights from bootstrap re-sampling (1,000 resamples) were used to calculate the variance estimators (standard errors, confidence intervals, p-values). See the section on replicate weight calculations, below, for more detail.

5.21 Consumer/Non-Consumer Determination (Overall and per Species)

The analysis included a determination of whether respondents were either fish consumers or fish non-consumers using screening questions in the CAPI (screening interview questions 3–6, see Appendix A). These questions asked the respondents sequentially whether they consumed fish yesterday, last week, last month, or in the past year. Only respondents who reported consuming fish in response to the screening questions were further interviewed using the FFQ. Any respondent who did not report consuming fish on the FFQ, despite reporting consumption in response to the screening questions, was categorized as a non-consumer. Consumers of any other designated species group (see Section 5.11) were identified using only the FFQ responses; respondents were considered consumers of the species group if they reported consuming any of the applicable species during the preceding year, including consumption at special events and gatherings. All analyses (FFQ analysis, naïve and NCI methods for the 24-hour recalls) were limited to the consumers of the relevant species group according to this designation.

5.22 Mean, Variance and Percentile Methods for non-NCI analyses

Estimates of means, variances and percentiles were carried out using standard survey estimate methods implemented in the R survey package (Lumley, 2014 and Lumley, 2004). For the estimates of the percentiles, the package uses a method described in Francisco and Fuller's 1986 (Iowa State University) technical report, *Estimation of the Distribution Function With a Complex Survey*. The survey package also enables inference (estimation of means, variances, percentiles, percentages) in specific groups. When estimating quantities in sub-populations the methodology accounts for the uncertainty in the weights derived for a specific sub-population. The methodology is further described in Lumley, 2010.

The survey estimate method applied to the 24-hour recall data is referred to as the "naïve" method. For each respondent providing data for a naïve method calculation, the respondent's one or two 24-hour recall consumption rates were averaged and the naïve method was applied to the per-respondent averages. (For a respondent with only one 24-hour recall, the "average" is the single consumption rate itself—for the species or species group considered.) The method is "naïve" in that it does not account for the variability of recalls within a respondent or other complexities of the 24-hour recall data (such as the weekend effect, the effect of the interview number—first vs. second interview—or the impact of other variables that may cause a difference between fish consumption during the first vs. second 24-hour period). The naïve method was utilized primarily for a methodologic comparison of the differences between the FFQ and 24-hour recall consumption rates and it was limited to the estimation of means.[12] The percentile estimates for the upper and lower tails of the distribution of fish consumption, if they are calculated from the naïve method, do not account for the within-person, day-to-day variation in fish consumption. Those tail percentile estimates tend to be biased, with overestimated percentiles in the upper tail and underestimated percentiles in the lower tail (see Dodd, 2006). The NCI method, which is based on the 24-hour recall data, could not be used for the analysis of species Groups 3-7 due to the smaller number consumers of each of these species groups (than for Groups 1 and 2) and the associated insufficient number of "double-hits" needed for the NCI

[12] A more extensive comparison of FFQ and 24-hour recall data was carried out and the methods and results are described in Section 6.11.

method. Thus, the naïve method was carried out to estimate mean fish consumption rates for species Groups 3-7—to be compared the means calculated by the FFQ method.

5.23 NCI Method

5.23.1 Overview

The NCI method (Dodd, KW, et al. 2006; Tooze, JA, et al. 2006; Kipnis V, et al. 2009) was used to estimate the distribution of usual fish consumption from the 24-hour recall data. Compared to the consumption reported on the FFQ, 24-hour consumption would be expected to have a smaller recall bias. The 24-hour assessment refers to consumption "yesterday" while the FFQ asks about typical values of consumption for the preceding year. For this survey, the grams consumed "yesterday" were calculated from the responses to Q10 from the questionnaire (the question number is the same for both recalls; see Appendix A) using the standardized portion-to-mass conversion described in Section 5.7. The analysis of reported 24-hour consumption, however, presents analytical challenges. The main analytical features of the NCI method for analysis of fish consumption are described in Polissar et al., 2014. Points (1) to (8), below are adapted (and extended for application in the present context) from that document.

The NCI method involves fitting a model for usual intake (grams/day) of a commodity, such as fish, based on data from a survey with reported consumption on two or more days. The mean and percentiles of consumption are estimated from a derived distribution of usual intake, which is part of the fitted model. The model assumes:

(1) There is an underlying distribution of true usual intake for the population being studied. The true intake for a given person might be thought of as their average daily intake—averaged over the course of a year, often reported as grams per day. The usual intake for a person does not have the ups and downs that occur with intake for any given day; the usual intake is a single number for each person. This usual, average or "true" intake would typically vary from person to person in the population. The set of values of usual intake would typically have relatively few people at very low or very high values of intake and relatively more people in between.

The set of usual intake values for a population do not have to form a "bell-shaped curve," but the true distribution, it is assumed in the NCI methodology, can be transformed to the normal (bell curve) distribution in a fairly flexible manner, specified by the methodology. (It is noted that fish consumption distributions tend to be skewed toward large consumption values and can often be approximated by the lognormal distribution; this phenomenon is consistent with the "transformation-to-the-bell-shape" assumption here.)

(2) There is day-to-day variation in how much a person consumes of a commodity—on days when they do consume. The daily consumption varies around their usual intake.

The estimate of the day-to-day variation is a critical part of the NCI model and requires a substantial number of respondents that report consumption on two days ("double-hits"). The ability to run the NCI model is directly impacted by the number of available double-hits, with considerations for this study noted as follows.

> The numbers of double-hits for species Group 1 (all finfish and shellfish species) and for species Group 2 (near coastal, estuarine, freshwater and anadromous species) were small in the two tribes involved in the fish consumption survey: 43 double-hits for the Nez Perce Tribe and 8 for the Shoshone-Bannock Tribes for Group 1 consumption, and 28 for the Nez Perce Tribe and 3 for the Shoshone-Bannock Tribes for species Group 2 consumption. Thus, an NCI-method model for each species group was fit to data from both tribes combined[13]. The NCI method allows the use of covariates, which are factors (or "variables") influencing consumption—more specifically, influencing the distribution of usual consumption. (See items 6-8 below for a more extensive description of the covariates and their role.) Covariates were introduced into the models in order to capture differences between the two tribes in the likelihood to consume fish on a given day and in the amount consumed on a day when fish consumption occurred. Use of these covariates allowed estimation of tribe-specific distributions of usual fish consumption. A substantial number of respondents with Group 1 consumption on at least one of two 24-recall days were available to enable the inclusion of covariates into the model (179 NPT respondents and 56 SBT respondents with fish consumption on at least one of the two 24-hour recall days). The number of respondents was smaller for Group 2 species: 145 NPT and 31 SBT respondents with at least one fish-positive 24-hour recall for Group 2.
>
> As a sensitivity analysis to the primary NCI models that used data for the two tribes together, NCI models were also run for the NPT only. The small number of double-hits for the SBT did not allow fitting an NCI model for the SBT only. The combined-tribes model results are presented in this report, since, under certain assumptions, they are expected to be more precise than results from a model based on only one of the Tribes.

(3) Returning to an overview of the NCI method, there is a certain probability that a person will consume on any given day, and this probability can vary from person to person. For example, there can be frequent and infrequent consumers of fish.

(4) There may be a correlation between the amount consumed on a consumption day and the frequency of consumption. For many foods, those people who consume the food more frequently also consume more of it on the actual consumption day (Tooze et al., 2006).

(5) All survey respondents who are included in the analysis are assumed to be fish consumers. This includes the possibility that the consumption rate of some

[13] This analysis with 31 double hits is an example of the possibility of successfully fitting an NCI model with fewer than 50 double hits. However, as noted previously, it is wise to plan a sample size that is very likely to yield at least 50 double hits in order to provide stronger assurance of being able to fit and estimate the parameters for the NCI model.

consumers may be very low. The FFQ data were used to determine if a respondent was a consumer of fish (or a specific species group) in this study.

(6) The distribution of usual fish consumption may be influenced by factors with values specific to each individual. In order to accommodate this realistic feature, the NCI method has the option of including respondent-specific covariates in the modeling (e.g., FFQ consumption rate, gender, age). The individual-level covariates can be used to modify the distribution based on the values of the covariate. For example, respondents with higher FFQ consumption can have a different distribution of FCRs than respondents with lower FFQ consumption, and use of gender as a binary covariate can produce a different distribution for each gender. The selection of covariates into the NCI model is further described in Section 5.23.2. Another reason for including covariates into the NCI model is to estimate the distribution for specific groups. Inclusion of a covariate in the model states that the consumption frequency or amount (or both) vary across the groups (or values) of the covariate. After the NCI model is fit the estimation of the distribution in the overall population as well as in specific groups defined by the model covariates is available.

Consumption may vary depending on the day of the week. Continuing development of the key points described above, in addition to the respondent-specific covariates, the NCI method can also adjust for weekday-weekend differences in consumption and over- or under-representation of weekend or weekday interviews in the completed pool of 24-hour recall interviews. For the purpose of this study, the “weekend” was defined as Friday, Saturday and Sunday and weekdays as Monday through Thursday. Friday has been included in the definition of the weekend for this analysis, since consumption on Friday has been found to be more similar to consumption on the traditional two-day weekend than to consumption on other weekdays (Haines et al., 2003, in a study of the U.S. general population). The weekday/weekend adjustment accounts for: (a) the difference in the consumption rate between weekdays and weekends, (b) the weekday/weekend mix among each respondent’s first and second 24-hour recall interviews, and (c) The noted potential over- or under-representation of weekdays or weekends in the pool of completed interviews.

(7) The NCI method can also adjust for differences in consumption between the first and subsequent interviews (“sequence effect”). The sequence effect adjustment in this study introduces into the model an indicator variable for the second vs. first interview. In the analysis of this survey’s 24-hour recall data by the NCI method, the fitted model used in calculating the mean and percentiles of the distribution of usual consumption (the main end product of the NCI method) have keyed the estimates to the mean consumption rate found in the first interview, though the data from both interviews are used. In this analysis, both the weekday-weekend and the sequence effect adjustments have been applied. This choice was recommended by NCI staff who frequently use the NCI method in dietary

studies[14]. The NCI staff found these two adjustments to be important in past application of the NCI method to the NHANES study. Consistent with this recommendation, the first interview was used as the reference interview. While there are no formal guidelines dictating this choice, the contractors considered this to be the most reasonable choice for this survey for two reasons. First, differences in mean FCRs based on the first and second interviews separately were observed, indicating that an adjustment for interview sequence was needed (either the first or the second would be considered as the reference interview). Second, the first interview was conducted in-person with physical models available in a more controlled environment than the second interview, which was conducted by phone using model photos left behind by the interviewer. The contractors also carried out a sensitivity analysis to assess the impact of these two adjustments on the estimated distributions. The results of the sensitivity analysis are available in Appendix E, Section 4.

(8) The model-fitting process leads, in steps, to the estimated distribution of usual fish consumption. The NCI model is fit by the maximum likelihood method, using SAS macros available from the following NCI website: (http://riskfactor.cancer.gov/diet/usualintakes/macros_single.html). All model parameters, including the Box-Cox transformation parameter (the parameter that dictates the shape of the distribution of mean consumption per respondent on days with consumption), are estimated jointly by the likelihood maximization procedure. The model-fitting by the maximum likelihood method is iterative, converging on the final parameter estimates. The fitted model describes the daily fish consumption as a function of covariates and random effects. (The random effects in the model represent person-to-person differences that are not explained by the covariates.) The model is used to calculate the distribution of usual fish consumption. The distribution cannot be determined by a closed form equation, and it is calculated using simulation.

Specifically, the estimated model parameters are utilized to generate (by simulation) a population of persons with the same composition of covariates and between-person variability as has been observed among the respondents. As the simulation calculates the distribution of usual consumptions rather than consumptions on specific days, the within-person variation in the amount consumed day-to-day (also estimated by the model) is not included in the generating process. The usual consumption for each generated individual is the product of a) the individual’s proportion of days with positive consumption and b) the individual’s mean consumption amount on days with positive consumption. The two parts (the proportion and the mean amount) are generated by the model from that individual’s covariates and the model parameters. The simulation also includes generation of a random effect for each person that is added to the fixed effects of the covariates. As the random effects are model-based but unobservable, the generated data represent “pseudo-persons” drawn from a

[14] Personal communication from Kevin Dodd to Moni Neradilek on June 22, 2015 and to Nayak Polissar on September 14, 2015.

population with characteristics derived from the survey's respondents; these generated pseudo-persons (and their fish consumption) are not specific respondents in this survey. The random effects for the proportion and the mean amount consumed on positive days are generated from a bivariate normal distribution with zero mean and variances estimated from the NCI model. Because the average amount for a specific pseudo-person generated from the amount equation in the NCI model is on the Box-Cox transformed scale, it needs to be back-transformed to the original scale. The back-transformation (the "9-point approximation" method) adjusts the values to ensure that the mean fish consumption rate of the estimated usual intake distribution on the original scale is approximately[15] equal to the overall mean of the original 24-hour recall data (see Tooze, JA, et al. 2010 for more details).

Finally, the probabilities and the average amounts on the original scale are multiplied for each pseudo-person to yield the usual consumption rate for the pseudo-person, and the distribution of the usual consumptions is calculated. The precision of the estimated usual intake distribution is improved by independently drawing 100 pseudo-persons per each individual in the sample. When the sequence or the weekend effect(s) is (are) present in the model, the calculations of the probabilities and the mean consumption amounts are slightly modified. When the sequence effect is present, the probabilities and the average amounts are generated with the interview number covariate set to the reference interview. The first interview is the reference interview in the analysis presented in this report). When the weekend effect is included, separate probabilities and mean amounts are generated for the weekdays and for the weekend and are then averaged using a weighted mean, with weights of 4 and 3, respectively, to yield a single overall probability and a single overall average amount per pseudo-person.

The simulation method of creating a distribution of usual fish consumption also applies to the calculation of distributions of usual consumption for specific subpopulations. The subpopulation calculations are, in fact, a by-product of the calculation for the entire distribution, when the simulated pseudo-persons are separated into the desired subpopulations (e.g., the two genders) and subpopulation-specific distributions are calculated from the pseudo-person data. In addition to presenting the means and percentiles of usual consumption for subpopulations of interest, the estimated subpopulation distributions were also utilized in the process of covariate selection and quality checking of the model (described in more detail in sections 5.23.2 and 5.23.3, respectively.)

This section and subsequent sections present specific methodology relevant to the analysis by the NCI method. Readers who are particularly interested in this approach to estimating the distribution of usual consumption may wish to also review Appendix E, which has important additional information on the use of the NCI method for this report.

[15] The mean based on the distribution of usual intake estimated from the NCI model can differ from the mean estimated by the naïve method (from the input 24-hour recall fish consumption rates) due to options chosen for the model-fitting process, such as the choice between the first or second interview as the reference interview for the fitting process.

Additional notes on the NCI methodology are available in Tooze et al., 2006. An instructive webinar series featuring Dr. Tooze and others is available online at:

http://riskfactor.cancer.gov/measurementerror. The SAS statistical programming language code for carrying out the calculations using the NCI methodology (version 2.1) is also available online at: http://riskfactor.cancer.gov/diet/usualintakes/macros_single.html.

5.23.2 Covariate Selection and Assessment of Seasonality

The use of covariates, if properly selected, can improve the consistency between the NCI-method model and the survey's 24-hour recall data and provide better estimates of the mean and percentiles of consumption for the population or sub-population being considered. The inclusion of covariates does not change the mean of the overall distribution of usual fish consumption, but the use of covariates can change the shape of the distribution. If there are differences in distributions across different subpopulations, the model is able to accommodate these differences by introducing these characteristics as covariates in the NCI model. The overall distribution estimated by the NCI model with specific covariates included is then a result of combining the different distributions across the subpopulations, leading to a potentially different shape of the overall distribution compared to the NCI model without covariates. As noted, the model is improved if covariates that affect the distribution of usual fish consumption are included. The covariates considered for inclusion in the NCI model were:

- FCR per respondent from the FFQ for the same species group for which the distribution of usual intake was desired (i.e., the Group 1 FFQ consumption rate was used as a covariate for analysis of the Group 1 24-hour recall consumption data and Group 2 FFQ rates were used as a covariate for the 24-hour recall data from Group 2)
- presence vs. absence on the fishers list
- gender
- ZIP code groups (83540, 83536, 83501 and combined other ZIP codes for the Nez Perce Tribe and 83203 and combined other ZIP codes for the Shoshone-Bannock Tribes)
- age (grouped as 18-29, 30-39, 40-49, 50-59 and 60+)
- the respondent's body weight (in pounds)

A dichotomous tribe indicator (NPT or SBT) was included as a covariate in all models.

The FFQ consumption rate is an especially important covariate, as it is highly predictive of the 24-hour recall data. By including the FFQ as a covariate in the NCI method modeling, the implication is that a distribution of usual consumption derived from the 24-hour recall data of tribal members with lower FFQ rates would itself be shifted toward lower rates than such a distribution derived from tribal members with higher FFQ. As there are different ways in which FFQ rates can be related to the 24-hour recall data, the analysis path in this study explored several possible relationships between the two set of rates and chose, among them, the best-fitting one. (More detail on the choice is provided later in this section.)

Among the candidate covariates listed above, the covariates that were selected into the NCI-method model had a demonstrable impact on the NCI-estimated consumption rate distribution. The selection of covariates involved a model-building process that started with a simple NCI model (including tribe as the only covariate) and that subsequently added other covariates that had an impact on the NCI-model distribution of usual consumption rates. Specifically, the model-building process added a candidate covariate (and its statistical interaction with the tribe covariate) into the model, and then there was a visual comparison of the differences in the NCI-estimated means and percentiles of usual consumption rates within subpopulations defined by categories of the covariate.

For example, when considering the fishers list covariate, the contractors compared the NCI-estimated statistics (mean and percentiles) between fishers and non-fishers within each tribe. Large differences between different levels or categories of the covariate suggested inclusion of the covariate in the NCI model. To arrive at the best fit for continuous covariates (FFQ rates and the respondent's body weight), different transformations of the covariate were considered: the original (untransformed) value, 3rd root, log and ordered decile number (a variable with integer values from 1 to 10, depending on which decile of the distribution of the covariate included the untransformed value for a respondent).

The selection of covariates for the NCI model was carried out in two steps: 1.) choosing the best functional form for the FFQ covariate (choices: no transformation, 3rd root, log or ordered decile number), and 2.) selecting other covariates. The FFQ consumption rate covariate was considered first (and was added to the model first, with other candidate covariates considered afterward), because it was expected that the FFQ rates would be strongly related to the 24-hour recall consumption rates. Thus, the contractors first considered the FFQ rates as a covariate in the model and attempted to find the best transformation of FFQ rates that predict the 24-hour recall rates as analyzed through the NCI method.

When considering a continuous covariate, such as the FFQ rates, for inclusion into the NCI model, one needs to ensure that the specific form of the continuous covariate correctly reflects the trend of the 24-hour recall rates in relation to the FFQ rates. As noted, continuous effects of the FFQ were considered in four forms: the original (untransformed) value, the 3rd root value, the $\log_{10}$ value and the numerical decile of FFQ (coded as 1–10[16]). To choose the best among these four models the contractors compared them to a fifth NCI model that used the FFQ covariate as a categorical decile. The overall population was then broken down into ten approximately equal-sized subpopulations (bins) according to the FFQ decile. The NCI-model estimated means and percentiles (medians, 90th percentiles and 95th percentiles) in each bin from the four competing continuous FFQ NCI models were then compared to the means and percentiles from the categorical NCI model (reference model).

The categorical FFQ model is the most complex one; it uses nine degrees of freedom per tribe, compared to one degree of freedom per tribe for each of the four continuous FFQ models. The median and percentiles of the categorical FFQ model may be "noisy" within each decile bin (due to the small number of respondents in each bin), but the categorical FFQ model is a useful reference for choosing the best continuous FFQ model. The categorical FFQ model is a useful reference because it can reveal important features in the possible curvilinear or nonlinear relationship of FFQ rates to the 24-hour recall rates, after the latter are processed through the NCI method. A simplistic model-fitting with the various continuous FFQ models can miss such non-linear relationships.

[16] The deciles were defined separately within each tribe.

In choosing among the four continuous FFQ models the contractors sought a model that captured important features that are present in the categorical FFQ model (see Appendix E, Section 1 and Figures E1 and E7 for more detail). On visual inspection, the 3rd root and the $\log_{10}$ transformations best followed the trend in the categorical decile (true for species Group 1 and for species Group 2 models). As the lambda (λ) parameter[17] for both species group models was relatively close to the 3rd root (lambda = 1/3), the 3rd root FFQ was chosen as the primary model choice. Analysis by the NCI method with $\log_{10}$ FFQ was carried out as a sensitivity analysis. The sensitivity analysis is presented in Appendix E, Section 4 and further details regarding the choice between FFQ transformations are presented in Appendix E, Section 1. Finally, the contractors discovered that the 24-hour recall consumption in the 10th FFQ decile among the SBT respondents was considerably lower than expected by the trend in the continuous FFQ variable and a binary indicator for this group was added into the model to improve the model fit.

The second step involved considering the inclusion of the remaining covariates into the model. The candidate variables available included presence/absence on the fishers list, gender, ZIP code group (83540, 83536, 83501 and combined other ZIP codes for the Nez Perce Tribe, and 83203 and combined other ZIP codes for the Shoshone-Bannock Tribes), and age (grouped as 18–29, 30–39, 40–49, 50–59 and 60+). All of these variables had an impact on the estimated distribution of usual fish consumption distribution from the NCI method and were included in the NCI models. Respondents' body weight (tried in the modeling as untransformed, 3rd root, $\log_{10}$ and the decile rank) had no or only a weak relationship with the estimated consumption distribution and was therefore not included as a covariate. The selected covariates were used in two model components of the NCI method: the model for the probability of consuming from the designated species group on a randomly selected day and the model for the amount of the species group eaten during the day, given that consumption occurred on the specific day.

The 3rd root of FFQ was also selected as the covariate for the Group 2 model. However, due to the small number of single- and double-hits of Group 2 in the SBT, a model with several covariates was found to be statistically unstable and the remaining covariates (presence on the fishers list, gender, ZIP code and age) were not included in the final Group 2 model for the combined Tribes. The final model for Group 2 consumption thus consisted of tribe (dichotomous), and the 3rd root of FFQ rates and its interaction with the dichotomous tribe variable. When the distribution of the Group 2 consumption rates was to be estimated within subgroups (e.g., by gender) the corresponding covariate (e.g., gender) was added into the final Group 2 model for the specific subgroup analysis only.

Seasonality as a potential factor influencing fish consumption was explored, as described in the next section. More details on covariate selection can be found Appendix E, Section 1.

[17] Lambda (λ) is the power exponent used to transform a normal distribution to a distribution appropriate as one component of a model consistent with the dietary recall data being analyzed.

5.23.2.1 *Assessment of Seasonality*

Prior to selecting the covariates, potential seasonal variation in 24-hour recall consumption rates was explored for Group 1, Group 2 and salmon. For each tribe, the mean consumption by month was plotted (see Figures E22, E23 and E24 in Appendix E for the Group 1, Group 2 and salmon displays, respectively). As the consumption values differed between the 1st and 2nd interviews, the means per month were calculated separately for the 1st and 2nd interview data for a more direct comparison across months. While some variability across the months exists, no difference or pattern was discerned indicating a clear seasonal differences vs. empirical noise; this null finding may be due to the small sample size for each month. The findings were further corroborated in the 24-hour recall data by examining seasonal patterns in mean Group 1 FFQ consumption rates (Appendix E, Figure E25). Also, there might be seasonal variation in access to fishers for interviews due to their seasonal absence from home. Such absence might affect the mix of interviewees by month and induce a time pattern of consumption, particularly consumption of salmon. A plot of the monthly percentage of respondents that were fishers (Appendix E, Figure E26) shows no clear indication of seasonal differences.

May–July 2014 was the peak salmonid harvest period [18], which coincided with the first three months of the survey. Further analysis of the Nez Perce respondents was conducted to explore the possibility that different types of respondents were interviewed during the peak harvest period compared with the remainder of the survey. For instance, if respondents who fish heavily (potentially respondents with more seasonality in their consumption patterns) tended to be too busy or otherwise unavailable for interviewing during the peak harvest period, some true seasonality may be masked.

The findings of the seasonality analysis did not provide a basis for adjusting consumption rate estimates for seasonal variation, but the sample sizes used in these analysis and the findings do not show that there is not a true, underlying seasonal component. Of the 451 Nez Perce respondents (138 on the fishers list), 30 (11 fishers) were interviewed during the peak harvest period. The unweighted percentages of fishers did not vary significantly between the peak harvest period (May-July, 2014) and the remaining period (37% vs. 30%, Chi-squared test $p = 0.6$). Appendix Table E18 shows mean FCRs calculated using the 24-hour recalls (naïve mean) and the FFQ means for Group 1 (all fish), Group 3 (salmon or steelhead) and Chinook salmon. There were no significant differences between the early and later respondents in naïve mean FCRs, when considering the early-late comparison among all respondents or among fishers only (all $p > 0.6$; see Appendix Table E18 for details on calculations). Mean Group 1 12-month consumption rates by the FFQ method were significantly higher in respondents interviewed during the peak harvest period (170 vs. 120 g/day, $p = 0.015$), indicating that consumers with relatively high annual consumption were interviewed during the peak period. There were no other significant differences in mean FFQ rates between periods (Appendix Table E18). Appendix Table E19 shows self-reported frequencies of fishing (times per month) from respondents interviewed during the two periods. There were no significant differences in fishing rates between periods ($p > 0.2$ for all comparisons). Taken together, there is no evidence that fishers, high consumers, or potentially seasonal consumers were under-represented during the

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[18] Personal communications from Joe Oatman, Nez Perce Department of Fisheries, to Nayak Polissar during August 28-30, 2015.

peak harvest period, though with the small sample size, there may be such an effect that was not detected.

Appendix Table E20 summarizes how often respondents reported species-specific consumption as two separate periods (higher and lower consumption periods, presumably related to seasonality of the species) as opposed to averaging consumption over the whole year (presumably indicating no seasonality). For respondents interviewed during the peak salmonid harvest period (May–July, 2014), 45% of responses involving salmon or steelhead were reported using two periods, compared with 27% of such responses for respondents interviewed during the remainder of the survey period. This ratio was similar among fishers and non-fishers, as well. While not conclusive, this suggests that during the peak harvest period, respondents were more apt (though still <50% of the time) to report consumption of these species in two periods to explicitly acknowledge the seasonality of consumption. In contrast, during the remaining survey period, respondents most often mentally averaged consumption over the entire year as one period. Note that according to Appendix Table E18, this did not seem to have notably impacted annual salmon and steelhead consumption rates. Again, the small sample size during the peak harvest period makes detecting seasonal effects, if there are seasonal effects, more difficult.

5.23.3 Quality Checking of the Model

The NCI method is a powerful yet complex method to estimate the distribution of the usual consumption from the 24-hour recall data. A few simple analyses were therefore conducted to assess the validity of the NCI model estimates.

In the first quality check the contractors examined the distribution of the consumed amounts. An important assumption of the NCI method is that the transformed positive consumption amounts (fish consumption on days when consumption occurred) are normally distributed. To verify this assumption the contractors examined the (survey-weighted) histograms of the transformed (3^{rd} root) respondent-specific mean consumption (for the respondents' one or two days which included fish consumption) and the within-person residuals (for respondents with double-hits) for the data from the two tribes combined.

The second quality check consisted of comparison of demographic subgroup means between (a) the NCI method (considering only the consumption amount part of the NCI model), and (b) means from a "naïve" approach: traditional weighted survey means, calculated directly from the 24-hour recall consumption data (including only days with non-zero consumption). The demographic subgroups considered were defined by the following covariates, each analyzed separately for this purpose: the fisher indicator, gender, ZIP code group, age group and the FFQ decile. The two parameters that the contractors compared for each demographic subgroup were the mean per-respondent probability of consuming fish on a given day and the mean per-respondent consumption on days with fish consumption. (Note that the mean consumption per day, on the average, is the product of these two parameters.)

The naïve approach was carried out in three alternative forms, depending on which interviews were used in the calculations: 1) all interviews, 2) interviews for respondents with two interviews and 3) only first interviews. Choices 1 and 2 are more comparable to the NCI method in that they also utilize both interviews and allow examination of the covariate effects on the consumption rates in both interviews. Choices 1 and 2, however, do not account for the sequence effect (second vs. first interview) and the results could therefore be systematically lower or higher compared to the results from the NCI model (as the NCI model adjusts for the sequence effect). The results from choice 3 (first interview only) should be more comparable to the NCI model estimates with regard to the adjustment for the sequence effect, as the NCI model adjusts for the sequence number and calculates the consumption rate distribution keyed to the mean of the first interview. Some differences between all three choices of the naïve approach and the NCI model estimates are still possible because the NCI model adjusts for differences between weekdays and weekends while the naïve approach does not. The estimates that were compared between the naïve and the NCI methods were consumption probabilities and means of positive consumption days for groups defined by covariates included in the NCI model. The naïve and NCI-method means were compared within categories of the following variables: presence/absence on the fishers list, gender, ZIP code group, age and the FFQ rate (categorized in deciles). The comparison of the NCI and naïve approaches was carried out for consumption of Group 1 species only.

A final check of the NCI method estimates involved re-computing the estimates by an independent statistician. The estimates (mean and percentiles) of the Group 1 consumption distribution from the NCI method were checked by a member of the NCI staff who deals regularly with the NCI method (personal communication from Kevin Dodd to Moni Neradilek on July 2, 2015). The staff member's Group 1 means and percentiles were all within 0.4% of the contractors' estimates for the Nez Perce Tribe and within 0.9% for the Shoshone-Bannock Tribes.

5.23.4 Sensitivity Analyses

While building the NCI model several choices were made. These choices included: 1) using the third root transformation for the FFQ covariate; 2) using the weekend adjustment and the sequence effect adjustment; and 3) including a number of other covariates in the final model for the distribution of usual consumption of Group 1 species. To quantify the impact of these choices on the estimated distributions, a sensitivity analysis was run with alternative choices. (All sensitivity analyses were carried out for Groups 1 and 2 species unless otherwise noted.) Specifically, the log transformation for the FFQ covariate was considered instead of the third root transformation. A model without the weekend/weekday adjustment was also considered, as was a model without the sequence effect adjustment. For each of these three alternatives, only the specific item (e.g., weekend/weekday) was changed or omitted in the model and all other covariates from the final model were unchanged.

Three additional sensitivity analyses were carried out: (a) a model based on the NPT data only; (b) a simpler model (for Group 1 species only) than the final model (certain covariates were not included in the model); and (c) a model assuming zero correlation between the daily probability of consuming fish and the amount of fish consumed on an actual consumption day.

The model based on the NPT data alone was created to compare the means and percentiles from the final model—using both Tribes' data—to means and percentiles from a model using just one Tribe's data (NPT). The relatively small number of single- and double-hits in the SBT data required that the final models be fitted to data from both Tribes combined, and that covariates be introduced into the model to capture differences between the Tribes[19]. As the number of hits in

[19] As noted previously, the NCI model based on combined data from the two Tribes was used for the final estimates of means and percentiles of fish consumption for each Tribe. These estimates are expected to be more precise, under certain assumptions, than estimates based on a model using data from a single Tribe.

NPT was sufficient to run certain models without problems, a sensitivity analysis was carried out by running the NCI models with the NPT data only and then comparing the results to the final estimates from the two-Tribe model.

To examine the impact of combining numerous covariates in the NCI model, a sensitivity analysis was run in which only a single covariate was added to a model that initially included Tribe (dichotomous), FFQ consumption rate, the Tribe-FFQ interaction and an indicator variable for the 10^{th} decile of the FFQ consumption rate in the SBT.

Finally, an important methodological feature of the NCI method is that it can include a non-zero correlation between the probability of consumption on a random day and the consumption amount on an actual consumption day. In order to investigate the impact of the correlation assumption, a sensitivity analysis was run forcing the correlation to be zero (no correlation) in the NCI models.

5.24 Effect of Changes in Study Design on FFQ Rates

An assessment was conducted to determine the impact of two study design changes on overall fish consumption. The first impact was that of interviews conducted at special events. All interviews conducted on September 25–27, 2014 and October 17–19, 2014 were considered interviews at special events. The second consideration was the impact of non-tribal interviewers compared to tribal interviewers.

Another assessment was also conducted to determine whether interviews conducted at a respondent's home differed in fish consumption from interviews not conducted at their home. Although this is not a design change, the comparison was of interest because this variable might have had an effect on the reported consumption. The results of the home/not home analysis are presented along with the results on design changes for convenience.

The impact of the design variables on fish consumption was calculated both without and with an adjustment for respondent characteristics. The unadjusted analysis consisted of the calculation of FFQ means and medians of fish consumption in the two groups and the estimation of the difference of the two means. The latter was estimated from linear regression (with the same statistical weighting of respondents as in the calculation of means and percentiles). Linear regression was also used in the adjusted analysis and included respondent characteristics in addition to the tested design variable. The characteristics included ZIP code (categorized as 83536, 83501 or others combined), age category (<30, 30–39, 40–49, 50–59 and 60+), gender, on/off reservation residence, fishing (questions 35 and 36) and the respondent's body weight (as a continuous predictor). Including the respondent characteristics in the regression controls for differences in the fish consumption that may be due to the respondent's personal characteristics and not to the tested design variables. The results of this analysis are presented in Section 6.7 "Effect of Changes in Study Design on FFQ Rates."

5.25 Confidence Intervals

Confidence intervals express the uncertainty of the estimated population means and percentiles of fish consumption. The confidence intervals in this report were calculated using the bootstrap replicate weight method (Lumley, 2010), which is a standard statistical methodology for calculating confidence intervals and incorporates relevant sources of uncertainty. In this method, 1,000 replicate weights (random perturbations of the adjusted sampling weights) are first calculated (see Section 5.26 for more detail). The replicated weights are then saved for use in all subsequent confidence interval calculations (see Section 5.26 for more detail). The bootstrap method for confidence intervals was applied to all weighted analyses (including the analysis of the FFQ and 24-hour consumption rates). Running the NCI model for 1,000 replicate weight sets in the bootstrap procedure took over 3 days of computation for species Group 1; therefore, the confidence intervals were calculated only for the Group 1 mean and percentiles.

These confidence intervals do not account for any clustering of respondents by household. For example, people who live together may tend to consume more similarly than randomly selected individuals from different households. This correlation between individuals within the same cluster would tend to decrease the precision of the mean and percentile estimates (widen the confidence intervals). The contractors investigated the potential impact of not accounting for clustering with the help of the Tribe. The Tribe reviewed the list of respondents and their contact information, as maintained by the tribal enrollment offices at the time the sample was drawn, to determine which respondents did live together around the time the survey was conducted. The review was based on address and the reviewer's knowledge of the population.

Based on this review by the Tribe, there were 35 household clusters that comprised 81 members of the 451 respondents with a completed FFQ interview and calculable consumption rate (see Appendix D, Table D4 for a complete list of respondents' survey ID codes). Of the 35 clusters, 27 had a pair of respondents, seven had three respondents and one had five respondents.

If, very conservatively, only one respondent per cluster had been included in the analysis, the effective sample would have been reduced by 46, to a net of 405 respondents, implying that consumption information from additional respondents within the same household is completely "redundant"—a highly conservative and unrealistic assumption. This reduction in effective sample size would lead to only a 5.5% increase in the confidence interval widths of the mean Group 1 consumption rate, under a simple random sampling scenario. As this impact is quite small and would only occur under a very extreme and unlikely scenario, the confidence interval methodology was not modified to account for clustering.

5.26 Replicate Weight Calculations

A total of 1,000 bootstrap replicates was utilized in the calculation of confidence interval and other measures or uncertainty or inference. In the calculations, each replicate bootstrap accounted for two sources of uncertainty: the random sampling of members from the population in each stratum and the non-response model.

The sampling uncertainty was addressed by drawing 1,000 non-parametric bootstrap resamples. Each non-parametric bootstrap resample consisted of a stratified random sample from the original sample, sampling with replacement. Specifically, the strata were the strata used in drawing the random sample for the study and the sample was the sample of the participants drawn for this study (see Section 5.5). Each random draw was selected from all sampled tribal members (both non-responders and responders) in each sample stratum. Logistically, the recorded information from the non-parametric bootstrap procedure was the number of times (N_i) each respondent was drawn in each bootstrap resample *i*. Note that for observations not being drawn into a given resample, $N_i = 0$.

The uncertainty in the non-response model was also addressed by the non-parametric bootstrap. For each of the 1,000 bootstrap resamples the response probabilities predicted by the logistic response model (described in Section 5.20) were recalculated after the model was refitted to each bootstrap resample. The response probabilities from bootstrap i are denoted by P_{Ri}. The non-response adjusted replicate weights were then calculated for all responders in the bootstrap resample. Replicate weights W_i (*i* denotes the bootstrap index) were calculated as the inverse of the product of: (a) the sampling fraction per stratum (F_s) and (b) the parametric bootstrap response probabilities (P_{Ri}), and then multiplied by the number of bootstrap resamples for a given observation:

$$W_i = N_i / (F_s * P_{Ri})$$

The 1,000 sets of bootstrap replicate weights were saved and used for all confidence interval calculations.

5.27 Confidence Interval Calculations for a Specific Statistic

Calculations for specific statistics were carried out on the subset of responders that were relevant for that statistic (e.g., consumers of Group 2 fish species would be included for Group 2 calculations of the mean, median and other percentiles).

The statistic of interest (a mean, percentiles or a regression coefficient) were than calculated on the relevant subset of responders (e.g., Group 2 fish consumers) for each bootstrap realization. Issues with item-specific missing values in this step were automatically handled by the subset function in the R software (by excluding the observations with missing values and adjusting the weights to accommodate the actual number of observations used in the analysis). The 95% confidence interval limits for a statistic (when a confidence interval was calculated) were defined as the 2.5th and the 97.5th percentiles of the bootstrap distribution of the specific statistic across the 1,000 bootstrap realizations.

In a small fraction of the bootstrap replicates, the NCI model did not converge. The NCI model estimation is a complex iterative procedure for a non-linear mathematical problem that occasionally does not arrive at a best solution (non-convergence). The fraction of bootstrap models that did not converge are reported.

5.28 Handling Missing Values

As with all surveys, the interviewers strove to obtain complete responses from all respondents and to avoid any missing values. However, in a survey of this size and complexity, missing values are unavoidable and a concerted effort was made to handle the missing values in an appropriate manner.

During an interview, the respondents usually had the option of indicating "don't know or refused" to avoid responding to a specific question, but could continue on to the subsequent question. In those situations, missing values were dealt with in multiple ways, depending on the type of variable with missing data or its importance. If a *non-consumption-related* response or variable was missing (e.g., respondent weight in pounds or household income), the respondent was simply excluded from any analysis involving that variable.

In contrast, if the missing variable *was* a consumption rate component, then a value was imputed. The consumption rate components that were imputed in the case of "missingness" were portion frequency (e.g., portions per week), portion size (based on portion models) and, if the respondent reported consumption in two periods (e.g., higher/lower or in season/out of season), the length of the higher consumption period as a percentage of the year (see Section 5.10 on consumption rate calculations). The imputation procedure was based on the specific rate component missing and the corresponding species and was always derived from observed, similar responses without missingness, as described below.

In the sample, respondents reported consuming 6.2 species on average and 13% of respondents had at least one missing component among any species reported. In total, there were 2,810 species-specific consumption responses (across all combinations of species and respondents), of which 3.2% had a missing component. This rate of missingness is relatively low, given the large number of combinations of respondents and species, but the missingness needed to be addressed due to the total number of respondents with some missingness.

The guiding principle to the imputation procedure was to impute only individual consumption rate components rather than the final consumption rate itself, which can vary many-fold between individuals. In general, the value imputed was a mean calculated from similar responses that had no missing values, where "similar" means that the species or species group was the same as for the given respondent's record with a missing value. For example, if a respondent reported consuming Chinook salmon by describing consumption during higher and lower consumption periods, but did not provide the portion size for the lower-period rate, other responses for Chinook consumption during the lower consumption period, without missingness, would be selected for imputation. The mean portion size from those similar responses would then be calculated and used in place of the missing portion size. If there were less than five other similar records to use for imputing a missing value, related species were grouped to increase the sample size. All groupings used are fully specified in Appendix C (Table C1).

Imputation of missing values was performed according to the following rules:

1. **Both portion frequency and portion size are missing.**
   If a respondent provided neither how often he or she consumed a species nor in what portion size, both frequency and portion size were imputed to 0, which resulted in a consumption rate of 0 grams/day for that specific species.

2. **Portion frequency is missing but portion size is not**

   If the respondent reported how much he or she consumed per portion but not the frequency, the frequency was imputed using the mean value computed using records from the same species and from the same period type, where period type was the whole year, higher consumption period, or lower consumption period. If fewer than five such records were available, similar species were grouped together to provide a larger sample size. Details on how species were grouped is described in Appendix C.

3. **Portion size is missing but portion frequency is not**

   If the respondent reported how frequently he or she consumed but not how much, the portion size was imputed in an analogous way as Case 2 above, using similar records without missing values.

4. **Higher consumption period length is missing**

   If the respondent provided consumption detail for higher and lower consumption periods but did not provide the length of the higher consumption period, this value was imputed using the mean calculated from similar responses for higher consumption periods. As for Cases 2 and 3 above, the imputation was species-specific unless the sample size was less than 5, in which case similar species were grouped. Appendix C describes this process in more detail.

Once a value was imputed for the missing consumption rate component, the consumption rate was calculated according to Section 5.10 as if the imputed value was the actual value provided by the respondent. Appendix C, Tables C2-C7 shows that the final mean and percentiles of consumption rates were similar under a range of possible imputed values, demonstrating that the impact of missingness and imputation on the final results was minimal.

There was one exception to the above rules on handling missing values, leading to the exclusion of a respondent for some analyses. The respondent reported consuming Chinook, cod, and crab outside of special events and gatherings, and consuming salmon, steelhead, and sturgeon at special events and gatherings. However, for all species consumed, this respondent did not provide a portion size or a frequency of consumption. Instead of imputing all of these species as 0 g/day as the above rule #1 would prescribe, the rates were considered incalculable and the respondent was excluded from the analysis of consumption rates. The reason for treating this respondent differently than rule #1 states, above, is that the pattern of response strongly indicated that the respondent was, indeed, a consumer of salmon (included in Group 2), because salmon was reported as a consumed species both at special events and at gatherings and outside of them. As a rate of zero for both Group 1 and Group 2 would clearly be incorrect in this case and there was no basis for imputation, it was deemed best to exclude the respondent.

5.29 Limited Percentiles for Small Sample Sizes

Some percentiles may be quite imprecise due to the small sample size of respondents used for the percentile calculation. Such percentiles have generally been indicated using a rule of thumb borrowed from random sampling; a percentile was designated as potentially very imprecise if—treating the sample as a simple random sample—there would have been two or fewer respondents with a consumption rate equal to or greater than the noted percentile. Due to the statistical weighting used in the calculation of percentiles, it is possible that in a specific case there may actually be more than two respondents (in the sample used to calculate the percentile) with a rate at or exceeding the noted percentile value. Nevertheless, this approximate method does provide a helpful flag of caution attached to some percentiles. This rule was applied to analyses estimated from traditional survey-weighted techniques (Section 5.22), but not to NCI method analyses (Section 5.23). The latter set of analyses relies on the entire data set, rather than only on the observations in the tail of the distribution to estimate the percentiles.

Confidence intervals for percentiles (described in Section 5.25) may also become less reliable (inappropriately wide or narrow) when the sample size is small. Such intervals have been indicated in cases where there were less than five observations greater than or equal to the corresponding percentile. This rule was applied only to the analyses estimated from traditional survey-weighted techniques, but not to the analyses using the NCI method.

5.30 Large Consumption Values

Histograms (Figure 2) were examined of total consumption based on the FFQ, and three respondents were found with values noticeably higher (1124–1372 g/day) than the other respondents. The weight and gender of each respondent and the details of the species consumed were further examined and the consumption rates were determined to be plausible. Accordingly, the respondents were retained in the analysis without modification of any data.

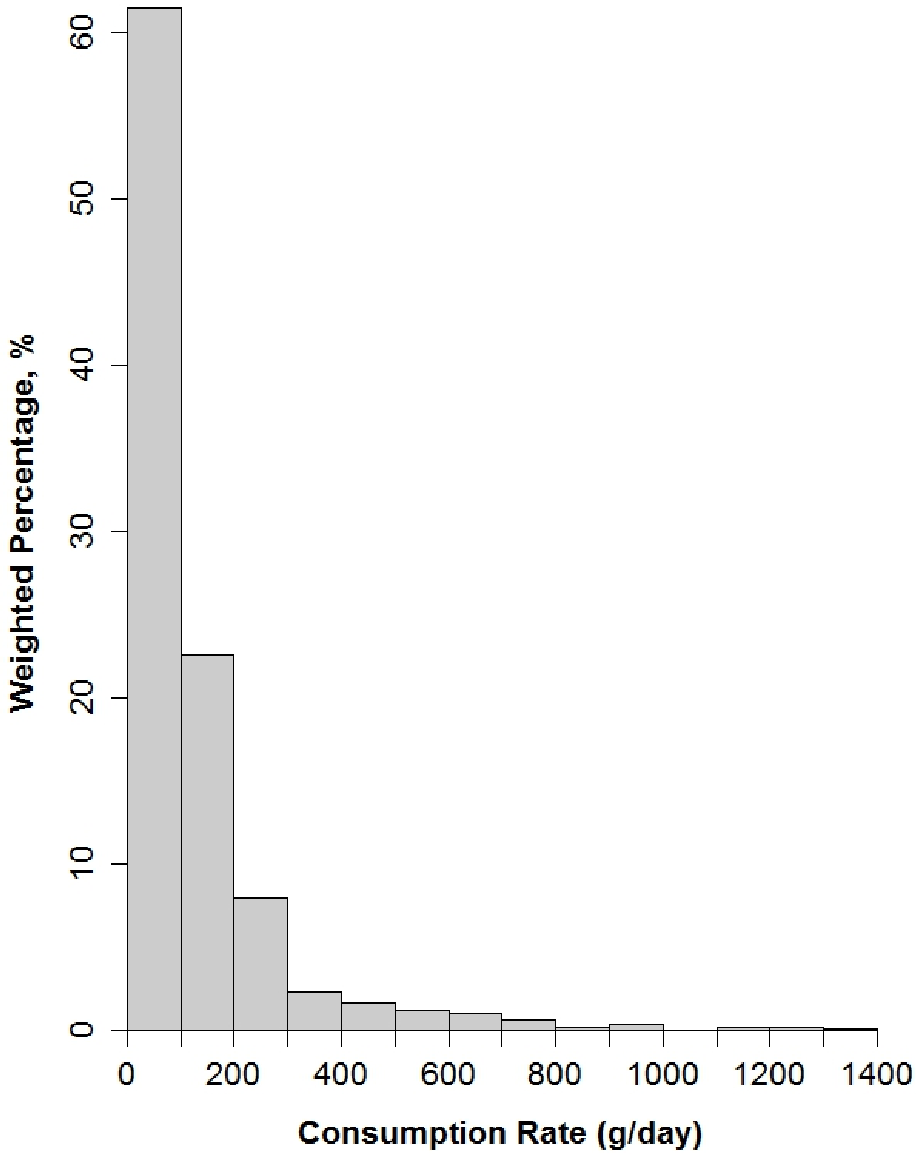

Figure 2. Nez Perce Tribe. Histogram of Group 1 (all fish) FCRs (g/day, raw weight, edible portion).

The bin width is 100 g/day. The percentages (y-axis), corresponding to the frequency of consumers within each bin, are weighted to correspond to the percentage among consumers in the eligible population. The sum of all bars equals 100%.

5.31 Software and Software Modules

Calculations were carried out in R (R Core Team, 2015) versions 3.1.1–3.1.3 and SAS 9.4 (for NCI method analysis only). The weighted survey analyses performed in R used the *survey* package for analysis of complex surveys. (Lumley, 2014 and Lumley, 2004). The NCI method was performed using a SAS macro (version 2.1) that was obtained directly from the NCI team.

6.0 Results

6.1 Response Rates

Table 3 summarizes the overall survey response rate, calculated to be 38.0%. Of the 1250 Nez Perce tribal members originally sampled, 40 were found to be ineligible during the contact attempts by interviewers (e.g., the sampled member lived out of the eligible area, were employed as Tribal interviewers involved in the survey, or were deceased, institutionalized or impaired). Of these, 8 were classified as impaired. For the purpose of overall response rate calculations, the remaining 1210 members after excluding the 40 ineligible members were used as the denominator (using the RR1 standard—see AAPOR, 2011).

Of these 1210 members, 472 members adequately responded to the screening interview questions used to distinguish between consumers (n=464) and non-consumers (n=8). One respondent who reported being a consumer on screening reported not consuming on the FFQ, so this respondent was re-classified as a non-consumer, for a total of 9 non-consumers. Of the remaining 463 consumers, 452 completed the first interview and 451 had a calculable FFQ consumption rate. The respondent without a calculable rate is described in Section 5.28 (last paragraph). The total number of responders with a complete and usable interview was 460, including the 451 consumers with an FFQ rate plus the 9 non-consumers. The overall RR1 response rate was thus 460 of 1210 (38.0%) (Table 3). The number of responders corresponds to 29% of the original population size of 1574. During the planning phase (see Section 5.13, “Response Rates”) it was anticipated that approximately 60% of sampled members would provide a first interview and 48% would provide two interviews. It was also anticipated that these response rates would provide sufficient assurance of reaching the 50 double-hit interviews (in combination with the double hits from the SBT interviews) needed to support the NCI method of analysis. While the achieved response rate was lower than anticipated, the required number of double hits for the two Tribes combined was achieved.

The 451 consumers with calculable FFQ consumption rates form the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents, depending on analysis-specific inclusion/exclusion criteria.

Table 3. Nez Perce Tribe. Survey response rate.

	No. or %
Responders*	460
Total sample size**	1210
Response rate (RR1)	38.0%

*Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;

**Excludes 40 tribal members found to be ineligible during contact attempts.

6.2 Factors Affecting Response Rates

This section uses a slightly different definition of response to the survey where ineligible members are *not* excluded from the denominator; thus the response rate is somewhat underestimated relative to the primary definition used in Section 6.1. The sample size and population size are defined and meaningful numerical counts, whereas the number of ineligibles detected in the survey depends on various survey-specific factors, such as total survey effort. The contractors did not wish to use a survey-influenced denominator for response rates in this section; hence, the entire sample or population is used in the denominators here. Due to the small number of sampled members found to be ineligible to be interviewed, as noted in Section 6.1, the inclusion of the ineligibles in the denominators of response rates in this section results in a small underestimate of those response rates[20]. That underestimation is unlikely to have much impact on the difference in response rates between sample or population subgroups.

The response rate did vary quite substantially by demographic characteristics of the selected sample. Tables 4 and 5 summarize the details. The response rate among males was higher than among females (41% vs. 33%), those on the fishers list ("documented fisher")[21] had a substantially higher response rate than non-fishers (48% versus 33%), and those in the most tribally populated ZIP code, 83540, had a substantially higher response rate than those in other ZIP codes (46% vs. 22–26%).

Age was an important factor in determining response; among females and males, the youngest members of the selected sample had the lowest response rate (the age range of 18–29 had a response rate of 16% for females and 28% for males vs. 34–43% for other ages among females and 29–58% for other ages among males). Unweighted demographics of the tribal population, sampled members, and consumers who responded are summarized in Appendix, D, Table D1.

[20] The rate of ineligibility in the entire sample is likely to be between 3% and 9%, based on 40 known ineligibles among those contacted within a sample size of 1210, from which 460 became respondents. Calculations: 40/1210 = 3%, 40/460 = 9%

[21] NPT staff have noted that the fisher list was derived from the Department of Fisheries Resources Management (DFRM) information on specific individual tribal members who were sampled during their fishing activity at a certain river/area during a certain fishery season, and is not a comprehensive representation of all "fishers" of the Tribe. They serve as a "fisher indicator" for purpose of this survey. This will allow comparison their rates to other Tribal members who were not "documented" as fishers through the Tribe's sampling program and monitoring activities.

Table 4. Nez Perce Tribe. Response rates by sampling strata. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded** No.	% of Sample	% of Pop.
All	1574	1250	460	36.8%	29.2%
Sampling Strata					
Female Age 18-29	191	152	25	16.4%	13.1%
Age 30-39	145	115	40	34.8%	27.6%
Age 40-49	152	121	52	43.0%	34.2%
Age 50-59	153	122	42	34.4%	27.5%
Age 60 or older	175	139	57	41.0%	32.6%
Male Age 18-29	178	141	39	27.7%	21.9%
Age 30-39	160	127	56	44.1%	35.0%
Age 40-49	144	114	66	57.9%	45.8%
Age 50-59	130	103	49	47.6%	37.7%
Age 60 or older	146	116	34	29.3%	23.3%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;

**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate.

Table 5. Nez Perce Tribe. Response rates by demographic factors. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded ** No.	Responded ** % of Sample	Responded ** % of Pop.
All	1574	1250	460	36.8%	29.2%
Gender					
Male	758	601	244	40.6%	32.2%
Female	816	649	216	33.3%	26.5%
Documented Fisher***					
Yes	371	288	139	48.3%	37.5%
No	1203	962	321	33.4%	26.7%
Zip Code					
Lapwai – 83540	906	729	336	46.1%	37.1%
Kamiah – 83536	196	151	39	25.8%	19.9%
Lewiston – 83501	172	136	30	22.1%	17.4%
Other	300	234	55	23.5%	18.3%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;

**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;

***Refer to Section 4.4 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

6.3 Consumers, Non-Consumers and Frequency of Consumption

Non-consumption of fish was rare among the Nez Perce Tribe, as shown in Table 6. An estimated 2.6% of the adult tribal members do not consume fish. The single most common reason for non-consumption reported was not liking fish at 87% of non-consumers. Other common reasons included too busy (36%), do not know how to prepare (28%) and allergy or health concern (25%). The vast majority (87%) of consumers reported eating fish once per week or less often, while about 10% eat fish 1-2 times per week (Table 6). This frequency information was determined during the relatively short screening interview and did not involve detailed probing of consumption frequency, species by species, of the type that occurred later in the interview.

Of the 463 consumers who responded, 452 completed the first interview which collected detailed consumption information. One respondent did not provide enough information to calculate an FFQ consumption rate (described in more detail in Section 5.28, last paragraph), so the remaining 451 respondents with calculable FFQ rates formed the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents depending on analysis-specific inclusion/exclusion criteria.

Table 6. Nez Perce Tribe. Frequency of fish consumption based on 472 responders to the screening questionnaire. Estimates are weighted.

		Unweighted %	No.	Weighted %
Consumer*	Yes	98.1%	463	97.4%
	No	1.9%	9	2.6%
If consumer, how many days per week?**	≤ 1	86.3%	314	87.3%
	1-2	10.4%	38	9.6%
	2-3	2.8%	10	2.5%
	3-4	0.0%	0	0.0%
	4-5	0.6%	2	0.6%
	5-6	0.0%	0	0.0%
	6-7	0.0%	0	0.0%
If non-consumer, why?***	Contamination	0.0%	0	0.0%
(multiple reasons allowed)	Availability	0.0%	0	0.0%
	Access to fishing	12.5%	1	7.3%
	Do not like fish	75.0%	6	87.0%
	Too busy to catch or prepare	25.0%	2	35.6%
	Do not know how to prepare	12.5%	1	28.4%
	Cannot afford fish	12.5%	1	7.3%
	Allergies or health concerns	25.0%	2	34.0%
	Vegetarian or vegan	0.0%	0	0.0%
	Religious customs	0.0%	0	0.0%

*Consumer status was determined primary from the screening interview. Only respondents who sufficiently completed the interview to determine consumer status were considered responders. One respondent claimed to be a consumer during screening but then denied being a consumer during the first interview. This respondent was classified as a non-consumer;

**364 consumers responded to this question;

***8 non-consumers responded to this question.

6.4 Demographic Characteristics

The tribe is diverse in demographic composition. Table 7 shows that in addition to the expected diversity of gender and age, most of the respondents live in households with three or more persons, about a quarter of the population are fishers, almost all of the population has finished high school or obtained a GED (99%) and nearly half of members have attended some college (45%). Household income is also diverse but with the majority of Tribal member respondents falling into the range of $15,000–$45,000 per year annual household income. Of the consumers included on the fishers list, 87% were male while 38% of non-fishers were male. More than half of the fishers (56%) were between 18 and 39 years old.

Among female consumers, 82% reported giving birth. Of these women, 75% reported breast-feeding or providing breast milk to their babies. Of those women who have finished breast-feeding their youngest child, the median reported age at which they stopped was 6 months (range: 1 to 46 months). Table D2 in Appendix D summarizes the same demographic variables as Table 7, but without statistical weighting.

Table 7. Nez Perce Tribe. Demographic characteristics of consumers. Estimates are weighted.

		% or Mean ± SD	No. who Responded
Gender*	Male	49.9%	451
	Female	50.1%	
Age*	18-29 years	21.5%	451
	30-39 years	19.6%	
	40-49 years	19.2%	
	50-59 years	17.8%	
	60 years or older	21.8%	
Weight, kgs		89.4 ± 19.9	434
Weight, kgs (males only)		96.6 ± 19.4	239
Weight, kgs (females only)		81.7 ± 17.5	195
No. in household	1	8.8%	451
	2	19.4%	
	3-4	42.8%	
	5 or more	29.0%	
Documented fisher*	Yes	24.2%	451
	No	75.8%	
Live on reservation	Yes	82.7%	449
	No	17.3%	

		% or Mean ± SD	No. who Responded
Highest education	Middle school	1.2%	448
	High School / GED	54.0%	
	Associates degree	26.4%	
	Bachelor's degree	12.4%	
	Master's degree	5.2%	
	Doctorate	0.8%	
Annual household income	≤ $15K	20.5%	410
	$15K – $25K	20.8%	
	$25K – $35K	20.0%	
	$35K – $45K	12.6%	
	$45K – $55K	8.1%	
	$55K – $65K	5.6%	
	>$65K	12.3%	

*From the Tribal enrollment file or the fishers list; other demographics were determined from the questionnaire. Refer to Section 4.4 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

6.5 FFQ Rates for Species and Groups of Species

FFQ consumption rate statistics for the Nez Perce Tribe, which include special event consumption, are shown in Table 8. The Group 1 (all fish) consumption distribution is skewed toward large values due to a number of consumers with high consumption rates. The mean of 123.4 grams per day among the 451 consumers with a calculable consumption rate is accompanied by a standard deviation of 159.4, larger than the mean, indicating skewness toward large values. In addition, the mean (123.4 g/day) is larger than the median (70.5 g/day), another indication of skewness.

The 90th percentile of consumption, 270.1 grams per day, is more than twice the mean and approximately four times the median, and the 95th percentile of consumption, 437.4 grams per day, is approximately triple the mean and over six times as large as the median. The maximum observed consumption rate was 1,371.9 grams per day.

Confidence intervals are presented for the means and percentiles of consumption. The width of a confidence interval is a measure of the uncertainty in the specific estimated value. Regardless of the width of the confidence interval, the estimated rate (statistically referred to as the "point estimate") is a useful value and is methodologically superior to any other choice within the confidence interval as an estimate of the percentile, because it has been derived by an unbiased method. It is wrong to assume for these survey results that the range of a confidence interval—from lower bound to upper bound—are all equally appropriate consumption rates to use as a measure of the true population value. The choice of the "point estimate," for example, of 437.4

grams per day for the 95th percentile (FFQ method, Group 1 species), is the only estimate within the interval that is derived by an unbiased procedure. It is the preferred value to use as the 95th percentile.

In Group 2, the mean consumption rate is somewhat lower at 104.0 grams per day, and the median consumption rate for Group 2, 61.3 grams per day, is approximately 85% as large as the median for Group 1, Once again, this species group's consumption rate has values skewed toward high consumption rates, weighting to a 90th percentile of 231.4 grams per day and a 95th percentile of 327.9 grams per day. The maximum Group 2 consumption rate of 1323.8 grams per day is, again, large but plausible. The consumption rates are presented in a graphic format in Figures 2 and 3.

Groups 3 through 7 are mutually exclusive and completely subdivide Group 1. Among Groups 3-7 the most consumed group is Group 3 (salmon and steelhead), with 446 consumers and a mean consumption rate of 79.0 grams per day, followed by Group 6 (marine finfish and shellfish), with 308 consumers and a mean rate of 51.0 grams per day. Groups 4 (resident trout) and 5 (other freshwater finfish and shellfish) had similar consumption with 136 and 150 consumers, respectively, and mean rates of 13.5 grams per day and 14.3 grams per day. There were only 2 consumers of Group 7 (species not specified sufficiently well to place in one of the aforementioned groups), with a mean rate of 8.1 grams per day.

Table 8. Nez Perce Tribe. Mean, median and selected percentiles of FCRs (g/day, raw weight, edible portion) in the Nez Perce Tribe, based on the FFQ; consumers only. Estimates are weighted.

	No. of				Percentiles											
Species Group*	Consumers	Mean	SD	Min	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	***99%	Max
Group 1 (all finfish and shellfish)	451	123.4	159.4	0.4	70.5	79.1	91.2	109.5	124.5	137.6	163.9	207.4	270.1	437.4	795.9	1371.9
(95% CI)		(108.7-146.5)			(63.6-80.8)	(69.4-94.8)	(76.8-109.8)	(88.6-126.7)	(106.4-147.4)	(123.9-166.6)	(143.9-206.3)	(174.8-264.7)	(221.0-340.3)	(309.5-522.6)	(562.1-1172.0)	
Group 2 (near coastal/estuarine/freshwater/anadromous finfish and shellfish)	446	104.0	144.2	0.2	61.3	69.0	77.7	91.5	103.6	123.3	145.1	175.2	231.4	327.9	764.5	1323.8
(95% CI)		(92.0-125.9)			(52.2-69.5)	(59.7-80.3)	(66.7-94.2)	(76.8-105.6)	(88.9-128.2)	(104.1-146.9)	(127.6-176.3)	(151.1-222.9)	(195.8-288.6)	(250.9-489.9)	(500.9-1150.2)	
Group 3 (salmon and steelhead)	446	79.0	119.7	0.2	45.2	49.5	58.0	65.6	75.7	89.4	107.1	131.7	166.1	247.3	706.7	949.8
(95% CI)		(68.9-96.0)			(38.4-55.3)	(45.9-61.9)	(51.0-70.0)	(58.8-79.3)	(67.5-96.6)	(78.3-110.9)	(97.7-135.4)	(114.1-163.1)	(145.9-205.5)	(200.7-438.1)	(431.1-798.1)	
Group 4 (resident trout)	136	13.5	42.5	0.03	3.8	5.3	5.8	7.3	7.9	9.0	13.0	19.9	26.3	56.8	**129.3	544.2
(95% CI)		(8.2-28.0)			(1.9-6.2)	(2.8-7.5)	(3.7-8.1)	(5.1-10.4)	(5.7-13.9)	(7.5-19.3)	(8.1-22.0)	(11.0-32.4)	(18.8-56.5)	(28.6-89.9)	(56.3-428.3)	
Group 5 (other freshwater finfish and shellfish)	150	14.3	32.1	0.02	3.7	5.0	6.2	7.5	8.6	11.2	14.9	20.4	34.2	75.9	**109.2	309.5
(95% CI)		(9.4-21.9)			(2.0-5.7)	(2.7-7.2)	(3.4-8.4)	(4.2-11.1)	(5.3-14.6)	(7.2-20.5)	(8.7-29.3)	(12.1-45.1)	(19.0-75.0)	(34.7-103.2)	(77.6-237.5)	
Group 6 (marine finfish and shellfish)	308	51.0	77.6	0.1	29.8	33.8	37.9	44.9	52.8	57.7	70.0	74.9	93.3	155.4	363.0	731.8
(95% CI)		(42.3-63.5)			(25.1-34.4)	(28.4-40.6)	(30.6-46.7)	(34.5-53.0)	(42.0-58.1)	(48.6-70.3)	(56.3-80.0)	(68.4-105.5)	(80.1-151.2)	(124.4-288.9)	(255.6-521.6)	
Group 7**** (unspecified finfish and shellfish)	2	8.1	4.9	-	-	-	-	-	-	-	-	-	-	-	-	-

*See Table 2 for definitions of species groups;
**Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously;
***Confidence intervals for the 99th percentile are less reliable because there are less than 5 respondents equal to or greater than the reported percentile (approximately); interpret these intervals more cautiously;
****There were only 2 consumers of unspecified species so only the mean and SD are presented.

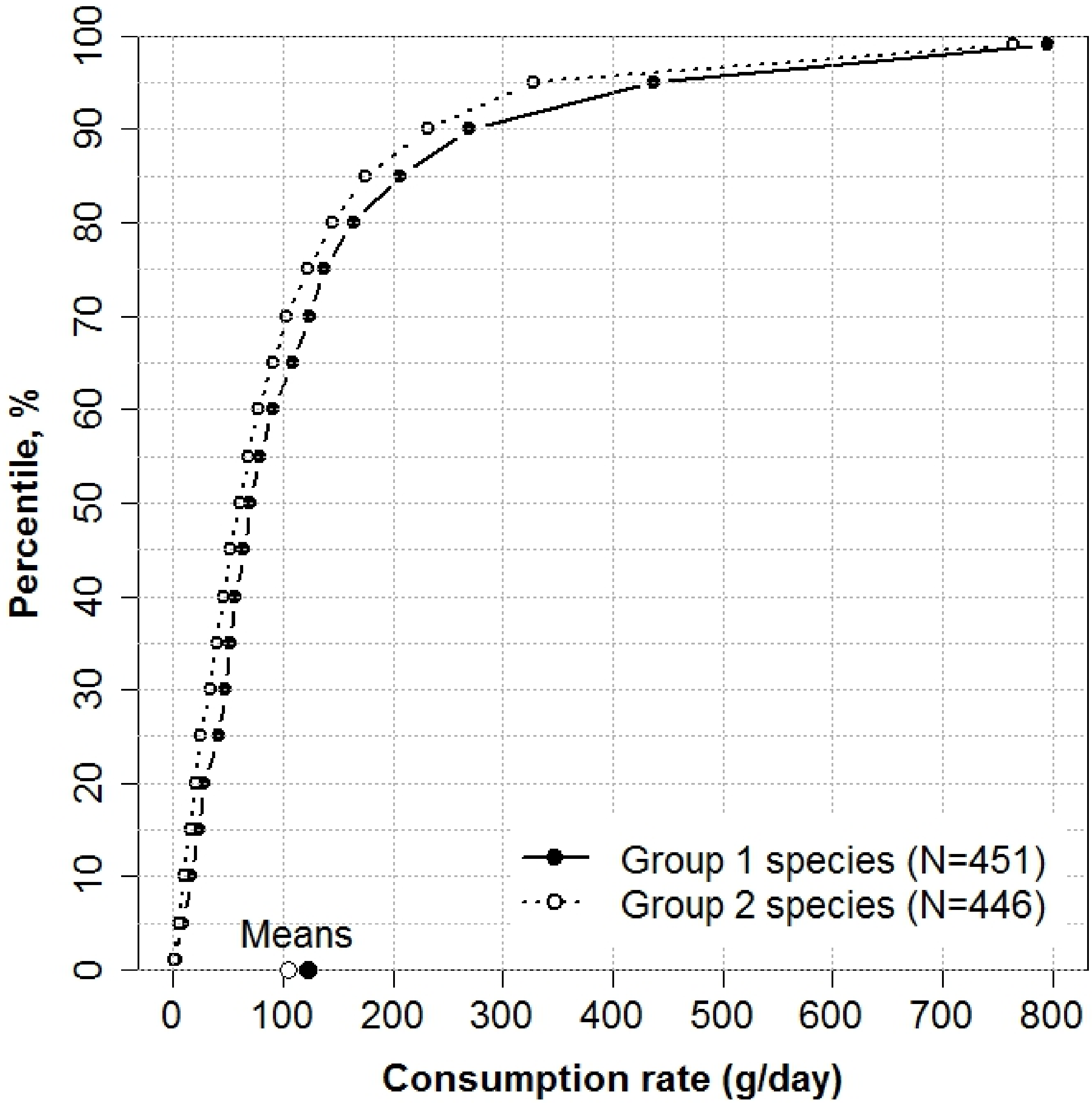

Figure 3. Nez Perce Tribe. Estimated cumulative distribution of FFQ FCRs (g/day, raw weight, edible portion). Group 1 includes all finfish and shellfish. Group 2 includes near coastal, estuarine, freshwater, and anadromous finfish and shellfish. The percentiles are spaced every 5% on the vertical axis, with the 1st percentile and 99th percentiles also included. Estimates are weighted. The points are the original estimates and the lines (solid and dotted) are linear interpolations between those estimates. The mean consumption rates for both species groups are indicated with points on the horizontal axis.

6.6 FFQ Consumption Rates by Demographic Groups

As shown in Table 9, FFQ consumption rates for Group 1 (all fish) did vary substantially across some of the demographic factors. See Table D3 in Appendix D for an expanded set of consumption rate percentiles in addition to the 50th, 90th, and 95th percentiles. The documented fishers (based on the fisher list) had a substantially higher consumption rate than the non-fishers (or those tribal members who were not documented as fishing recently through the Tribe's sampling program and monitoring activities). The mean of 171.8 g/day for fishers is 60% larger than the mean for non-fishers at 107.9 g/day. The medians and higher percentiles for fishers are also substantially higher than the corresponding values for non-fishers. As noted in Section 4.4 (Populations), some active fishers who were not on the fishers list may have been incorrectly classified as non-fishers. Thus, it is possible that the difference in population consumption rates between actual fishers and non-fishers is not correctly estimated by the difference between labeled fishers and non-fishers presented in Table 9.

The survey included questions for respondents on their frequency of fishing (see questions #35 and #36 in Appendix A for question wording). A comparison of responses to these questions and presence or absence on the fishers list shows that of 93% of those on the fishers list did report fishing during the preceding 12 months. In the same group, 79% reported fishing more frequently—at least 12 times in the preceding 12 months (a calculated average of once per month or more). Among those not on the fishers list, 50% reported fishing during the last year but only 22% reported fishing at least once per month, on the average. Thus, those on the fishers list include a much higher fraction of people who fish and a much higher fraction of more frequent fishers than is found among those respondents not on the list. The fishers list contains about two-thirds of the respondents who fish more frequently, defined as those fishing once per month or more, on the average. (These calculations are based on 138 respondents on the fishers list and 313 respondents not on the fishers list, limited to those completing questions #35 and #36 of the questionnaire.)

The mean consumption rate for males was higher than the female rate by 46%: a mean of 146.6 g/day versus 100.2 g/day, respectively.

Age had less of an impact on consumption rates, being relatively consistent (mean and median) across all age groups except the oldest age group (60 years or older) which had the lowest mean rate at 105.8 g/day.

Those living on the reservation had a higher mean consumption than those not living on the reservation; higher percentiles of consumption were also larger for those living on the reservation.

Household size did not show a consistent relationship with consumption rates. Nor did education, with those completing high school (or GED) or less having about the same consumption rate as those who reported some college education. There was also no consistent pattern of consumption rates in relation to household income.

Table 9: Nez Perce Tribe. Estimated distribution of FFQ consumption rates (g/day, raw weight, edible portion) of consumers within demographic groups. All rates are for total consumption (Group 1). Estimates are weighted.

Group	No. of Consumers*	Mean	SD	Percentiles		
				50%	90%	95%
Gender**						
Male	241	146.6	179.3	87.4	285.1	488.3
Female	210	100.2	133.1	54.7	244.0	341.4
Age**						
18-29 years	61	126.7	175.4	74.7	225.2	522.4
30-39 years	94	140.9	161.1	74.0	298.9	448.6
40-49 years	116	115.4	126.1	68.5	241.2	463.3
50-59 years	89	130.3	193.4	67.4	253.8	308.2
60 years or older	91	105.8	136.8	62.3	264.8	332.0
Documented Fisher**						
Yes	138	171.8	207.2	98.0	436.8	543.5
No	313	107.9	137.5	65.5	232.9	337.7
Live on reservation						
Yes	391	127.3	164.4	70.6	284.6	451.0
No	58	106.5	134.4	65.6	202.8	237.5
Number who live in household						
1	37	133.9	179.3	82.0	288.3	***423
2	84	119.0	144.1	57.2	285.3	451.5
3-4	193	119.3	163.7	71.0	224.3	441.0
5 or more	137	129.2	158.0	74.0	284.0	381.1
Highest education						
High school / GED or less	242	126.6	176.5	70.4	253.9	492.0
Associates degree or higher	206	120.4	136.5	70.7	275.0	409.0
Annual household income						
≤ $15K	79	122.9	168.7	69.7	282.4	324.9
$15K – $45K	219	126.6	165.9	71.1	250.8	488.7
>$45K	112	117.7	113.5	72.4	244.8	339.6

*Consumers with unknown or missing subgroup status were excluded for the analysis of that subgroup;
**From the enrollment list or fisher indicator list; other subgroups were determined from the questionnaire;
***Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously.

6.7 Effect of Changes in Study Design on FFQ Rates

The estimated mean and medians of FFQ fish consumption classified by two variables that reflect mid-survey changes in design are shown in Table 10. The table compares FFQ rates of consumption of Group 1 (all fish) species for interviewing at special events vs. regular interviewing and for tribal vs. non-tribal interviewers. The table also compares FFQ rates for home vs. non-home interviews, which is included here for convenience, though it does not reflect a design change. The corresponding differences in means (comparing interviews with vs. without a given characteristic), unadjusted or adjusted for other respondent characteristics, are shown in Table 11.

The mean consumption for respondents interviewed at special events was 0.3 grams/day lower compared to respondents not interviewed at special events. This difference reversed and was still small (5.4 grams/day) once respondent characteristics were adjusted for. These differences were not statistically significant (p = 0.8-1.0).

The mean FFQ consumption for respondents with tribal interviewers was 31.7 grams/day lower compared to respondents with non-tribal interviewers. This difference was similar (30.7 grams/day) once respondent characteristics were adjusted for using a multivariate linear regression model (Table 11). Both the unadjusted and adjusted difference were not statistically significant (p = 0.3).

Finally, the mean consumption for respondents interviewed at home was 29.1 grams/day lower compared to respondents interviewed elsewhere. This difference changed very little (23.0 grams/day) once respondent characteristics were adjusted for. Neither the unadjusted nor the adjusted differences were statistically significant (p = 0.2-0.3).

While there are some small numeric effects of the variables considered, they are not statistically significant and there is no need to adjust for them in presenting consumption rates for this population. The effect of these variables on other species groups was not assessed because the main part of this report focuses on Group 1 species and the assessment for the other groups would be more limited due to the smaller sample sizes of data sets limited to the consumers of the other (and more specific) species groups.

Table 10. Nez Perce Tribe. Mean and median of Group 1 (all fish) FFQ consumption rates (g/day, raw weight, edible portion) by groups according to design variables. Weighted results.

Group	No.	Mean	Median
Not special event	393	123.4	72.2
Special event	67	123.1	60.7
Non-tribal interviewer	93	147.9	78.6
Tribal interviewer	365	116.2	68.9
Non-home interview	380	128.0	72.9
Home interview	77	98.9	65.4

Table 11. Nez Perce Tribe. Unadjusted and adjusted differences in mean Group 1 (all fish) FFQ FCRs (g/day, raw weight, edible portion) by the design variables. Linear regression. Weighted results.

	Unadjusted			Adjusted For Respondent Characteristics*		
Difference	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*
Special event	-0.3	27.0	1.0	5.4	27.1	0.8
Tribal interviewer	-31.7	29.8	0.3	-30.6	28.1	0.3
Home interview	-29.1	20.3	0.2	-23.0	20.2	0.3

*Adjusted for ZIP code (83536, 83501 and others), age category (<30, 30-39, 40-49, 50-59 and 60+), gender, on/off reservation, fishing (questions 35 and 36) and the respondent's physical weight (as a continuous predictor).

6.8 Consumption Rates from the NCI Method

The 24-hour recall data consisted of 850 interviews (single and paired interviews) from 451 respondents. Of the 850 interviews, 29.8% were conducted on the weekend (Friday, Saturday or Sunday). A total of 399 respondents had two interviews, for which the average interval between the interviews was 21 days (median: 11 days). The intervals were 21 days or less in 76% of those with both interviews, between 21 and 90 days in 21%, and between 90 and 180 days in 3.2%. One respondent had an interval of 205 days. Of the 399 respondents with two interviews, 43 had two days with Group 1 positive fish consumption and 122 had one day with Group 1 positive fish consumption. The remaining 52 respondents had only one interview. Of these 52, 14 respondents had Group 1 positive fish consumption.

There were 446 Group 2 consumers, with a total of 840 interviews, among which 29.9% were on the weekend. Among the respondents in this group, 394 had two interviews. Of the 394 respondents, 33 had two days with Group 2 positive fish consumption and 108 had one day with Group 2 positive fish consumption. The remaining 52 respondents had only one interview. Of these 52, 9 respondents had Group 2 positive fish consumption.

The mean and selected percentiles of the distribution of the fish consumption rates calculated from the 24-hour recall data by the NCI method are presented in Tables 12, 13 and 14 and in Figure 4.[22] Table 12 presents statistics for overall fish consumption (species Group 1) and Table

[22] The NCI method as implemented in SAS software provides integer percentiles of usual consumption rates up to the 99th percentile. However, an analysis of species Group 1 and species Group 2 consumption for the NPT (all respondents) showed a lower calculated 99th percentile consumption rate for Group 1 (373.2 g/day) than for Group 2 (409.6 g/day), even though the nearby 95th percentile values were in the order expected (232.1 g/day and 221.8 g/day, respectively). The number of respondents in the two analyses was very similar (though small for the NCI method), and Group 2 is a subset of the species in Group 1 and would be expected to have a smaller actual 99th percentile in the population. However, it is not an error for these two estimated values of the 99th percentiles to be in an unexpected order. These are both estimates—not population values—for the 99th percentile for each group of species, and—as indicated by the width of the confidence interval for the 99th percentile for Group 1 (276.2–692.7 g/day)—there is a range of plausible values for these kinds of estimates. Among the plausible estimates for each of the two 99th percentiles, some of the plausible choices will have the 99th in the expected order (Group 2 having a smaller 99th percentile than Group 1). In

14 for species Group 2 consumption. Table 13 shows the 95% confidence intervals for the species Group 1 statistics among all NPT respondents and among NPT respondents on the fishers list. The bootstrap distributions that were used to derive these distributions are shown in the Appendix: Figure E20 (all respondents) and Figure E21 (fisher list only). Only 22 out of the 1,000 bootstrap models (2.2%) did not converge. The 22 resamples were excluded from the confidence interval calculations.

The mean fish consumption in Groups 1 and 2 among all NPT respondents were 75.0 (95% CI, 57.3-104.6) g/day and 66.5 g/day, respectively. The 95th percentile of the distribution of fish consumption in Groups 1 and 2 among all NPT respondents were 232.1 (95% CI, 165.0-379.7) g/day and 233.9 g/day, respectively.

Fishers consumed more Group 1 fish than non-fishers (mean 98.2 g/day vs. 67.6 g/day) and men consumed more than women (mean 87.7 g/day vs. 62.3 g/day). The means in the four ZIP code groups (83540, 83536, 83501, and "Other" ZIP codes) were between 63.6 and 84.5 g/day. The means ranged from 58.1 to 92.5 g/day across the five age groups, with the 60+ age group consuming the least and the 30–39 age group consuming the most. Similar trends were observed for Group 2 species.

More extensive tables that include lower percentiles of the Group 1 distributions, Group 2 distributions and confidence intervals for Group 1 for the additional percentiles reported are available in Appendix Tables E1-E3, respectively.

order to avoid confusion in presentation of results, all NCI-method percentiles for Group 1 and Group 2 have been reported only up to the 95th percentile.

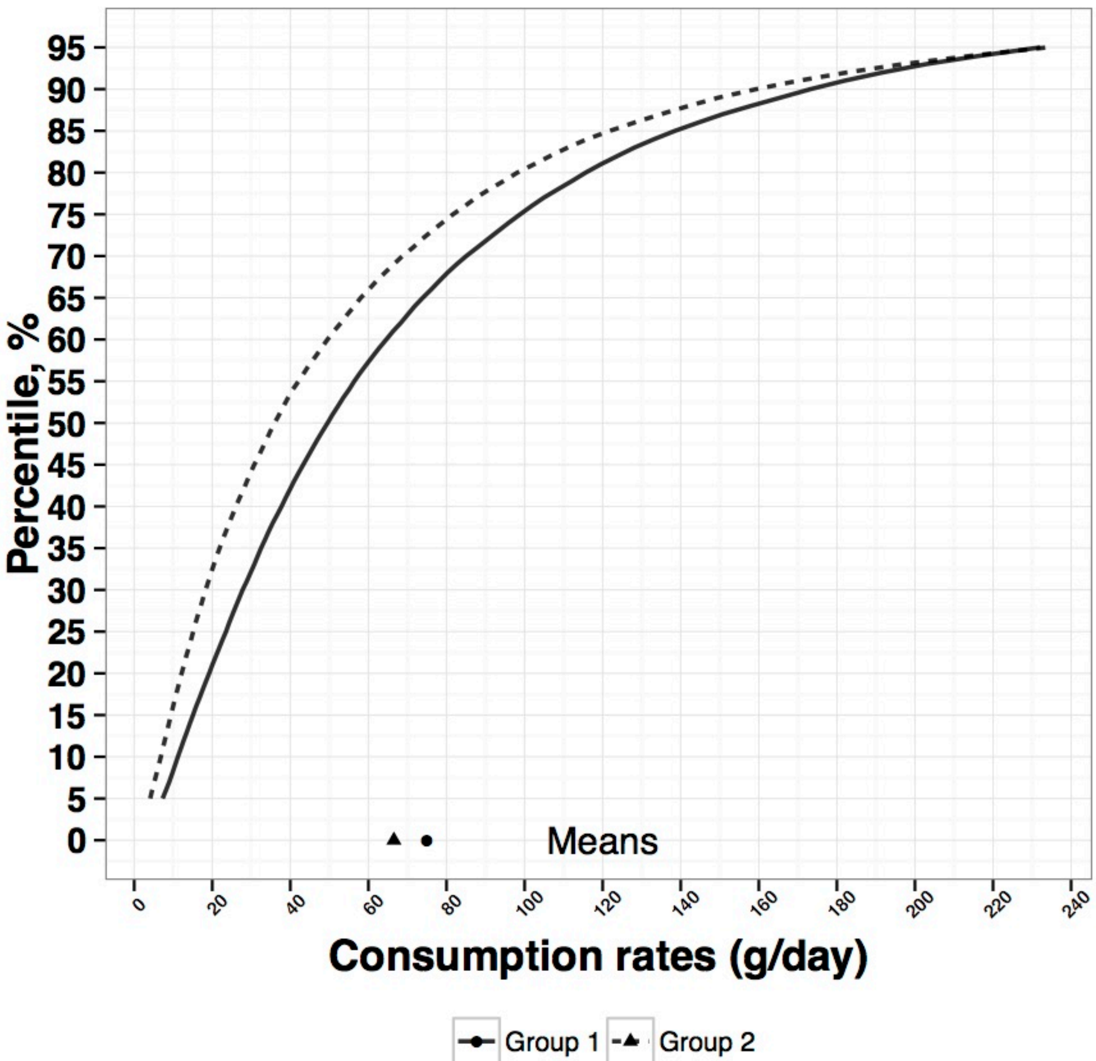

Figure 4. Nez Perce Tribe. Distribution of the usual fish consumption (g/day, raw weight, edible portion) based on the 24-hour recalls. Estimated by the NCI method. Group 1 includes all finfish and shellfish. Group 2 includes near coastal, estuarine, freshwater, and anadromous finfish and shellfish.

Table 12. Nez Perce Tribe. Distribution of the usual fish consumption of species Group 1 (g/day, raw weight, edible portion) based on the 24-hour recalls. Estimated by the NCI method.

Group	No. of Consumers	Mean	Percentiles									
			50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall	451	75.0	49.5	56.4	64.6	73.9	85.1	98.9	115.7	138.5	173.2	232.1
Documented fisher												
Fisher	138	98.2	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305.0
Non-fisher	313	67.6	45.6	52.0	59.2	67.9	77.6	90.0	104.9	124.6	155.1	206.0
Gender												
Men	241	87.7	58.4	66.7	76.3	87.2	99.8	115.3	134.1	161.9	199.8	268.1
Women	210	62.3	41.8	47.7	54.4	62.4	71.6	82.8	97.7	116.0	145.1	194.4
ZIP Code												
83540	329	73.6	48.2	55.1	62.7	72.1	83.2	96.4	113.1	135.5	168.1	227.2
83536	39	84.5	58.1	67.4	77.4	88.9	101.5	117.6	136.2	164.2	197.9	246.9
83501	28	63.6	48.4	54.5	60.8	67.9	75.2	85.6	98.4	115.8	139.4	177.7
Other	55	79.8	49.2	56.8	65.9	76.5	88.8	102.7	120.7	148.8	193.8	264.2
Age												
18-29	61	75.3	52.0	58.6	66.1	74.7	85.5	97.8	114.3	137.0	170.1	232.5
30-39	94	92.5	64.5	73.1	83.1	94.9	108.5	124.4	143.7	171.2	207.7	274.2
40-49	116	83.8	56.6	64.0	73.1	83.6	97.4	112.5	129.9	157.0	192.6	256.3
50-59	89	66.8	41.2	46.8	54.0	62.0	71.4	83.3	98.0	118.4	151.4	212.7
60+	91	58.1	37.7	43.0	49.6	57.3	67.6	77.7	92.9	110.5	136.5	182.5

Table 13. Nez Perce Tribe. Distribution of the usual fish consumption of species Group 1 (g/day, raw weight, edible portion) and their 95% confidence intervals based on the 24-hour recalls. Estimated by the NCI method.

	No. of Consumers	Mean	Percentiles									
			50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall												
	451	75.0	49.5	56.4	64.6	73.9	85.1	98.9	115.7	138.5	173.2	232.1
(95% CI)		(57.3-104.6)	(27.8-67.8)	(33.8-76.1)	(41.0-86.5)	(49.5-97.5)	(59.0-111.6)	(69.9-133.5)	(82.9-161.2)	(97.8-200.1)	(120.9-262.3)	(165.0-379.7)
Fisher												
	138	98.2	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305
(95% CI)		(66.3-158.3)	(32.8-106.5)	(38.6-121.0)	(45.9-137.9)	(54.8-159.1)	(65.1-184.2)	(78.2-218.7)	(91.1-257.7)	(112.9-316.1)	(141.4-401.6)	(196.7-540.3)

Table 14. Nez Perce Tribe. Distribution of the usual fish consumption of species Group 2 (g/day, raw weight, edible portion) based on the 24-hour recalls. Estimated by the NCI method.

Group	No. of Consumers	Mean	Percentiles									
			50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall	446	66.5	36.0	42.1	49.5	58.0	68.7	81.7	98.2	121.8	159.4	233.9
Documented fisher												
Fisher	138	98.4	55.2	64.8	75.4	86.3	101.8	121.9	146.9	181.5	238.6	345.0
Non-fisher	308	55.6	32.0	37.0	43.2	50.8	59.4	70.6	84.1	102.2	132.0	189.5
Gender												
Men	240	79.4	44.0	51.4	60.1	70.3	81.8	96.4	116.7	144.6	190.4	277.1
Women	206	55.0	29.0	34.0	39.8	47.5	56.3	67.9	82.7	102.8	135.6	198.0
ZIP Code												
83540	326	65.5	34.7	40.6	48.2	56.7	67.0	80.2	97.0	120.7	158.4	232.3
83536	38	83.7	46.6	54.8	63.8	74.8	88.9	104.3	129.6	162.4	219.2	301.5
83501	27	64.0	41.6	48.0	54.3	64.6	75.6	87.6	104.8	123.3	150.6	197.4
Other	55	63.0	30.2	36.4	43.0	51.3	60.0	72.2	87.9	112.8	150.0	231.3
Age												
18-29	61	76.9	49.4	56.6	64.2	72.5	82.5	93.7	108.4	130.3	167.0	249.4
30-39	94	83.7	53.1	61.0	69.2	79.0	90.4	104.0	122.5	147.6	189.0	262.8
40-49	115	65.1	43.6	48.9	54.9	62.5	71.1	81.7	95.0	114.2	142.8	196.6
50-59	88	55.2	33.8	38.3	43.6	49.9	57.7	67.5	80.4	96.9	122.1	173.0
60+	88	50.4	31.7	36.1	41.0	47.0	54.4	63.4	73.5	89.3	111.6	153.9

6.9 Quality Checking—NCI Method

Some quality checks were carried out to determine if certain assumptions of the NCI method were met (see Section 5.23.3).

In order to check the NCI model results, certain distributions were examined to determine if they were similar to a normal ("bell-shaped") distribution—a requirement of the NCI methodology. The daily consumption rates were raised to an exponent power lambda(λ) prior to this particular assessment. The contractors examined the distribution of person-means (the mean for a respondent using only their power-transformed consumption on their one or two 24-hour recall days with non-zero fish consumption—if they had any such days). The contractors also examined the distribution of within-person residuals. These residuals are the difference of a respondent's power-transformed consumption on a 24-hour recall day from the mean of the two power-transformed values for respondents with two non-zero fish consumption days. These distributions of power-transformed values or residuals should appear approximately normal.

For several demographic subgroups the naïve mean (calculated without the NCI method but using survey weighting) was compared to the mean calculated from the NCI method. The naïve mean was compared to the NCI-method mean of: 1) the probability of consuming on a random day, and 2) the mean consumption amount, conditional on a day having some fish consumption.

The first quality check examined the distribution of the person-means and within-person residuals. The NCI models for species Groups 1 and 2 estimated a model lambda of 0.29 and 0.41, respectively, as powers for transformations that result in a distribution closest to the normal distribution. As both powers are close to the third root (lambda = 0.33), the contractors transformed the positive amounts of these consumptions of these species groups by taking the third (cubic) root of the amounts. The distributions of the transformed person-means and the within-person residuals were then examined. The histograms of these distributions are shown in Appendix E, Figure E13 (Group 1) and Figure E14 (Group 2) and are, upon visual inspection, relatively close to the normal distribution.

In the second quality check, naïve and NCI method estimated consumption probabilities and means of positive consumption were compared. The comparisons were carried out within groups defined by the NCI model covariates are shown in Appendix Figures E15-E19. The covariates included the presence on the fishers list (Figure E15), gender (Figure E16), ZIP code (Figure E17), age (Figure E18) and the FFQ decile (Figure E19).

For all covariates, the naïve and NCI approaches revealed similar patterns of the consumption probability and mean consumption amount across the different groups (e.g., the fishers and male consumption are estimated to be higher than their complementary population groups by all approaches). The means and probabilities from the naïve approach that utilized both interviews, however, tended to be higher than the NCI probabilities and means. This difference can be attributed to the difference between the first and second interview.[23] This difference between the

[23] See Appendix E, Table E5 for the second interview coefficients in the NCI model, A23_SECINT (a coefficient for the second vs. first interview mean in the amount portion of the NCI model) and P23_SECINT (a coefficient for the dally probability of consumption in the probability portion of the NCI model). The positive values of these coefficient indicate that the mean amount consumed on a consumption day and the probability of consumption on a randomly chosen day are higher in the second interview than in the first interview.

naive and NCI method means was expected, because the second 24-hour recall mean consumption (from a naïve, survey-weighted analysis) was somewhat higher than the first 24-hour recall mean (again, naïve). This systematic difference was addressed during the NCI analysis by using the mean from the first 24-hour interview recall as an unbiased estimate of the population mean of usual intake, as described in Section 5.23.1. Thus, the naïve mean that averaged both the first (lower mean consumption) and second (higher mean consumption) interviews was higher than the NCI mean, which used the mean from the first interview as an unbiased estimate of the population mean.

An additional reason that the naïve means differed somewhat from the NCI method means is that the naïve approach does not account for the weekday-weekend differences. Specifically, the consumption amounts tended to be lower on the weekend than the weekdays and the weekend interviews were under-represented in the sample compared to equal representation of the seven days of the week (this is not unexpected as the interviewers were not instructed to achieve a specific ratio of weekday and weekend interviews). About 30% of the 24-hour recall interviews represented a weekend day versus 43% expected ([3 days]/[7 days] = 43%). The excess of higher-consumption weekdays in the 24-hour interview data was addressed and adjusted in the NCI method analysis, yielding a lower NCI mean than the naïve mean.

As an additional quality check, the calculations of the estimates of the species Group 1 distribution (mean and percentiles) from the NCI method were also recomputed by NCI staff (personal communication from Kevin Dodd to Moni Neradilek on July 2, 2015). The recomputed mean and percentiles for species Group 1 were all within 0.4% of the contractors' estimates for the Nez Perce Tribe and within 0.9% for the Shoshone-Bannock Tribes.

6.10 Sensitivity Analyses—NCI Model

We carried out a number of sensitivity analyses to understand the impact of various modeling choices on the estimated means and percentiles. Detailed results of the sensitivity analyses are presented in Appendix E, Tables E7-E17. All of the analyses in this section refer to comparisons of means and percentiles when models with different specifications are run using the NCI method.

Model with $\log_{10}$ FFQ replacing the 3^{rd} root of the FFQ consumption rate. Compared to the final model, the change in this one FFQ variable as a covariate in the model had the following effect. The means for Group 1 species for NPT and SBT were 0.8% higher and 2.6% lower, respectively, when adjusted for $\log_{10}$ FFQ rather than the cube root of FFQ (Table E7). The corresponding 95^{th} percentiles were 8.3% higher and 0.4% lower, respectively. The differences in means and the 95^{th} percentiles between the two models were mostly small (<5%) for specific subgroups. Somewhat larger differences (10–30%) were present for some of the 95^{th} percentiles, for the SBT mean for males, for the 18–29 age group and for the 60+ age group. Differences in Group 2 means and 95^{th} percentiles from the two different FFQ specifications were even smaller than the differences for Group 1. Compared to the final model, the overall Group 2 means for NPT and SBT were 0.2% and 1.2% higher, respectively, when adjusted for $\log_{10}$ FFQ (Table E8). The corresponding 95^{th} percentiles were 3.3% lower and 1.9% higher, respectively. All Group 2 differences in mean and percentile estimates for population subgroups were less than 13% of the estimate from the final model using the cube root of FFQ.

Model with no weekend adjustment. Estimated means and 95th percentiles for Groups 1 and 2 were only slightly affected by presence or absence of the weekend adjustment (Tables E9 and E10). Most of the estimates tended to increase when the weekend adjustment was not made, but the differences were small (<7%, except for Group 2 estimates for the SBT age group 50–59, which had approximately a 10% difference).

Model with no sequence effect adjustment. The final NCI models adjusted the estimated consumption for the sequence of the interviews, calibrating the second interview consumption amounts to correspond to the first interview consumption amounts. To investigate the impact of this adjustment on the estimated distribution of fish consumption NCI models *without* this adjustment were considered. Estimated means and 95th percentiles for Groups 1 and 2 increased by 10–40% when the interview sequence was not addressed (Tables E11 and E12). Compared to the final model, the overall Group 1 means for NPT and SBT were 22.5% and 26.1% higher, respectively. The corresponding 95th percentiles were 13.8% and 22.3% higher, respectively. The overall Group 2 means for NPT and SBT were 24.4% and 30.1% higher, respectively. The corresponding 95th percentiles were 19.2% and 25.3% higher, respectively. This increase can be attributed to the higher mean consumption rate reported on the second interview. Section 5.23.1 further explains the choice to use the first interview as the reference interview.

Model with no correlation between consumption probability and consumed amount. Estimated means and 95th percentiles for Group 1 and 2 were almost identical when the NCI model ignored the correlation between the probability of consuming on a random day and consumption amount (Tables E13 and E14). All estimates of means and 95th percentiles were within 0.2% of the final model estimates for Group 1 species consumption and within 3.9% for Group 2 consumption.

Model fit only to the NPT data. Compared to the NPT mean and percentile estimates from the final model (using both NPT and SBT data), the Group 1 species mean and 95th percentile from the model using only NPT data were 5.4% lower and 9.6% higher, respectively (Table E15). In estimates for population subgroups, species Group 1 means from the NPT-only model were 3.0–8.4% lower and the 95th percentiles were 3.8–19.3% higher. The species Group 2 estimated mean and 95th percentile for the NPT population were 12.7% and 19.3% lower, respectively, when the model was fitted only to the NPT data (Table E16). In population subgroups, Group 2 means from the NPT-only model were 9.9–16.8% lower and the 95th percentiles were 5.6–23.6% lower.

Simpler model for Group 1. The simpler model for Group 1 consumption—a model which included only the covariates for tribe, the 3rd root of the FFQ rate and the tribe by the 3rd root of the FFQ interaction—had a relatively small effect on the estimated means and 95th percentiles compared to the final model (Table E17). In most cases the estimates from the simpler model differed from the final model estimates by <5%, and all of them differed by <15%.

In summary, the different sensitivity analyses showed the impact of the different modeling choices on the NCI model estimates. For most estimates of mean and the 95th percentile 1.) the use of log FFQ as covariate, 2.) the absence of the weekend adjustment, 3.) the use of no correlation between consumption probability and consumed amount and 4.) a simpler model for Group 1 resulted in <5% difference in the estimates (compared to the final model). The estimated means and 95th percentiles for NPT changed up to 23.6% when the model was fit only to the NPT data. When the model did not adjust for the interview sequence the estimates of the mean and the 95th percentile increased by 10-40% (compared to the final model).

6.11 Comparison of FFQ Rates to 24-Hour and NCI-Method Rates

The estimated distributions of the 24-hour rates from the NCI method were limited to Group 1 and Group 2 species due to the very low number of double-hits for the other species groups considered. The naïve (survey-weighted) means for these two species groups have been calculated.[24] These means can be compared to the corresponding means from the FFQ rate analysis. Under certain assumptions, the naïve means have the same expected value as the FFQ means. The assumptions include a steady state of consumption rates over time (including the assumption of a steady state of the probability of consuming fish on a randomly chosen day), accurate recall by all respondents when reporting fish consumption, and the assumption that the underlying NCI model used to calculate the distribution of rates of consumption is the correct model for the population and species groups being considered. Since the various assumptions would usually be only approximately correct, it is appropriate to look for approximate agreement of means. The estimates presented in this report also include the means for 24-hour rates for a larger series of species groups using the standard, survey-weighted, "naïve" method. Some estimated means, 95th percentiles and ratios are presented in Table 15. Because the naïve approach does not adjust for the interview sequence (first vs. second interview) and weekend vs. weekday effects on consumption, the naïve 24-hour means for Groups 1 and 2 were, as expected, larger than their NCI method counterparts. The higher naïve 24-hour means were expected because of the higher rates for the second interview and, to a smaller extent, because of smaller mean consumption rates on the three days designated as the "weekend" (Friday-Sunday), accompanied by fewer than 3/7^{ths} of the 24-hour recall interviews occurring on the three days designated as the weekend.

The mean for Group 1 (estimated by the NCI method from 24-hour data) was 61% of the corresponding mean estimated from the FFQ while the 95th percentile estimated from the NCI method was 53% of the FFQ estimate. The NCI-estimated Group 2 mean and the 95th percentile were 64% and 71% of the FFQ values, respectively. The naïve means from the 24-hour data were lower than the corresponding FFQ means for all species groups, as shown by the ratios (the 24-hour value divided by the corresponding FFQ value) in Table 15. Most of the species had ratios between 0.33 and 0.88 (the mean of the Group 7 species consumption was 0.0, but it was based on only two consumers of this species). It is obvious that the two survey methodologies are not in agreement in their estimates of the consumption rate distributions. These findings are addressed with additional analyses in this section and are considered further in the discussion section.

[24] As noted in Section 6.9, the naïve mean is calculated from the 24-hour recall data—without using the NCI method but using the statistical survey weights.

Table 15. Nez Perce Tribe. Estimated means and 95th percentiles of consumption (g/day, raw weight, edible portion) by species group and estimation method.

Species group	No. of Consumers	Mean								95th percentile		
		24h					FFQ	Ratio		24h	FFQ	Ratio
		Mean (naïve method)	*Mean (NCI method)*	*#>0*	*# 1 hit*	*# 2 hit*	*Mean*	*24h (naïve) /FFQ*	*24h (NCI) /FFQ*	*Perc. (NCI method)*	*Perc.*	*NCI /FFQ*
Group 1: All Finfish and Shellfish	451	94.0	75.0	179	136	43	123.4	0.76	0.61	232.1	437.0	0.53
Group 2: Near Coastal/Estuarine/Freshwater/Anadromous Finfish and Shellfish	446	81.5	66.5	150	117	33	104.0	0.78	0.64	233.9	327.5	0.71
Group 3: All Salmon and Steelhead	446	69.2		126	99	27	79.0	0.88			247.3	
Group 4: Resident Trout	136	4.8		2	2	0	13.5	0.36			56.9	
Group 5: Other Freshwater Finfish and Shellfish	150	4.7		4	4	0	14.3	0.33			75.9	
Group 6: Marine Finfish and Shellfish	308	31.4		65	62	3	51.0	0.61			155.4	
Group 7: Unspecified Finfish and Shellfish Species	2	0.0		0	0	0	8.1	0.00			12.2	

#>0 = number of consumers with at least one positive 24h recall,

 # 1 hit = number of consumers with one positive 24h recall

 # 2 hit = number of consumers with two positive 24h recalls

naïve method = standard (weighted) survey estimate methods applied to the per-respondent averages of the 24-hour recalls

In order to better elucidate the difference in consumption rates calculated from the 24-hour recall data and the rates calculated from the FFQ data, the analyses presented here show the difference in rates for respondents classified into ten different ordered groups. The ten groups were defined by deciles of the respondents' FFQ Group 1 consumption rates. Using these groupings of respondents, this section also compares the FFQ and 24-hour rates for several species groups as a function of Group 1 deciles. All means were calculated as weighted means using the survey weights. This section also compares the FFQ-derived and 24-hour recall-derived frequencies of consumption and typical portion sizes as a function of Group 1 deciles.

Finally, also reported here is an analysis of the relation between a.) the difference (gap) between a respondent's FFQ and 24-hour recall consumption rates and b.) the respondent's uncertainty in their FFQ responses. This analysis explores the possibility that the respondents who were less certain in some of their responses might have larger differences in FFQ vs. 24-hour consumption than those who were more certain in their responses. The first measure of respondent uncertainty was the extent to which a respondent reported consumption of non-specific species groups rather than individual species; for example, the respondent might report generic salmon consumption (coded as "…salmon and steelhead / species not identified"), an indication of uncertainty, rather than reporting consumption of specific species, such as coho or Chinook. The second measure of uncertainty used in this analysis was the extent to which the respondent did not specify certain aspects of consumption, such as the frequency of consumption of a species or the portion size typically consumed.

Each respondent's Group 1 FFQ FCR was used to rank order the respondents from lowest to highest FCR. Respondents in each tribe were then divided into deciles (ten approximately equally sized groups[25]) according to their FFQ consumption rates from Group 1 species. These decile groups defined by FFQ consumption of Group 1 species are used for all of the decile analyses in this section. For each respondent and for each species group, such as Group 1, the consumption rate from the 24-hour data was the mean consumption of the one or two days of consumption that were assessed. Days with zero or positive consumption were included in the calculation of the per-respondent mean. The number of responses with non-zero consumption in the FFQ data and in the 24-hour recall data are shown in Table 16. These counts of respondents also help in interpreting the tables that follow Table 16—in particular, Table 19, where these numbers correspond to the number of consumers of the species group used to calculate the means and ratios in the table.

Within each decile group, the average across the respondents of their mean daily consumption (g/day) was calculated from their 24-hour recall responses. Similarly, in the same decile group, the average daily consumption based on the FFQ responses was calculated. The decile group averages from the FFQ data and from the 24-hour data were compared in the form of the ratio of the 24-hour mean consumption rate to the FFQ mean consumption rate. As described later in this section, similar ratios were calculated comparing 24-hour recall responses and FFQ responses on frequencies of consumption and on typical portion sizes.[26] The deciles were numbered in an

[25] Decile groups are of exactly equal size only if the total sample size being divided into groups is a multiple of 10. If the total is not a multiple of 10, some decile groups will have one additional respondent.

[26] It can be easily shown that the 24-hour/FFQ ratios for consumption rates (presented later in Table 17) and frequencies of consumption (Table 18) are equal to the ratios that would be calculated by including only consumers of the species group in calculations of the mean FFQ consumption rate (the denominator of each ratio presented) and the mean 24-hour recall consumption rate (the numerator of the ratio). That equivalence does not hold for the ratios for portion sizes (Table 19).

increasing order, with the first decile corresponding to the 10% of the respondents with the lowest Group 1 FFQ consumption rate and the 10th decile corresponding to the 10% of the respondents with the highest Group 1 FFQ consumption rate. The means of Group 1 consumption and Group 2 consumption from the 24-hour recall data and FFQ data for the ten deciles are shown in Figures 5 and 6, respectively.

The NPT respondents in the lowest seven deciles had relatively similar mean Group 1 consumption rates between the 24-hour recall data and the FFQ data. Starting from the eighth decile, the 24-hour recall means are progressively smaller compared to the FFQ means. In the 10th decile, the 24-hour recall mean was half the FFQ mean. These patterns were similar for Group 2 consumption. More numeric details for this comparison can be found in the Appendix F, Tables F1 (Group 1) and F2 (Group 2).

The analysis of the difference between consumption rates derived from the FFQ and the 24-hour recall data includes consideration of the contribution of specific species groups to the Group 1 consumption rate. The specific species groups include Group 2 species (near coastal/estuarine/freshwater/anadromous finfish and shellfish), non-Group 2 species, Group 3 species (salmon and steelhead), Group 4 species (resident trout) and Group 6 species (all marine species); see Table 2 for the definitions of species groups. For this decile analysis (and only for the decile analysis), the mean consumption rate for a decile or for all deciles combined has been calculated including the non-consumer respondents of the species group considered. These non-consumers of a species group have a zero consumption rate for the species group.

While not presented in the tabular results of this section, the means calculated including non-consumers can be used to calculate the percentage of the Group 1 (all species) mean consumption rate that is contributed by a smaller, embedded species group. For example, using the Group 1 FFQ mean (all deciles combined) of 123.4 g/day and the corresponding Group 2 mean of 102.8 g/day, both from Table 17, the Group 2 species contribute 83% of the total amount consumed of Group 1 species (all species combined). The analogous percentage based on the 24-hour recall means was 86%, calculated as 100% x 80.6 g/day (Group 2 mean) / 94.0 g/day (Group 1 mean) using values from Table 17. As another example using the same table, it can be calculated that the Group 2 species contribute 84% of the consumption of all species in the 10th decile group, based on either the FFQ or 24-hour recall means. Throughout, the decile-specific results should be interpreted more cautiously as each decile contains only one tenth of the total sample size.

The comparison statistic of particular interest is the ratio of the 24-hour mean consumption rate to the FFQ mean consumption rate—per decile and overall. A value of 1.0 indicates that the FFQ mean and the 24-hour mean are in perfect agreement. Ratios smaller than 1.0 indicate that consumption reported in the 24-hour recall interview is smaller than expected compared to consumption reported in the FFQ interview. Ratios larger than 1.0 indicate larger consumption reported in the 24-hour interviews than would be expected from the FFQ interviews.

Table 17 shows the mean consumption rates from the FFQ and 24-hour recall and their ratio. More detailed versions of these tables can be found in Tables F3–F6 in Appendix F. Although some differences among the species groups were observed in the ratios of 24-hour-to-FFQ means or percentiles of consumption, the FFQ means were higher than the 24-hour recall means for all species groups. The 24-hour/FFQ ratio of means ranged from 0.33 (Group 4) to 0.88 (Group 3). For each species group, the comparison of the FFQ-based and 24-hour-based mean consumption rates within each decile showed, generally, greater discrepancies at the lowest (1st and 2nd) and highest (9th and 10th) deciles, with the 24-hour mean being greater than the FFQ mean at the lower deciles and running the opposite direction at the higher deciles.

The usual daily consumption rate depends on the frequency of consumption and the portion size typically consumed. Thus, it is important to consider the role of each—frequency and portion size—as they may affect the observed differences between consumption rates calculated using the two different sources of data: FFQ and 24-hour recall. The consumption rate estimate for a respondent and for a particular species is the product of frequency of consumption multiplied by the portion size. This product calculation, per respondent, then becomes a numerical component of the consumption rate calculated "downstream" for a group of species and for a group of respondents. In order to understand whether the differences between the FFQ and 24-hour recall means were driven by the reported consumption frequency or by the reported portion size (or both), this section includes a comparison of the FFQ-derived and 24-hour recall-derived mean frequencies and portion sizes by decile and overall, presented by species group (Tables 18, 19 and Appendix Tables F7 and F8.)

<u>Comparison of frequencies and portion sizes between the FFQ and 24-hour recall data</u>. For each respondent and for each species group considered, the following four values were calculated, describing frequency of consumption or portion sizes.

a.) <u>FFQ-based expected frequency of consumption</u>. For a given species group, the expected frequency of consumption was calculated as the sum of the individual FFQ-reported frequencies (portions per day) for all species included in the species group. This approximation is most accurate if no more than one species is eaten per day; the approximation overestimate the daily frequency of consumption as the incidence of eating multiple species in a day increases. In this section the frequency for each species is expressed as the probability of that species being consumed on a randomly selected day. Thus, for example, if a respondent noted eating Chinook salmon three times per week (interpreted as three days per week), the daily probability would be 3/7 = 0.43. If a respondent reported two periods of consumption for the species (a higher and a lower consumption period during the year—an option permitted in the questionnaire), the daily probabilities for each period were combined in a weighted average: the two probabilities were weighted by the duration of each period. The sum across species of these daily probabilities would equal the probability of consumption of fish—from the species group considered—on a randomly selected day of the year.[27] (The sum of probabilities was capped at 1.0, a value that indicates consumption of fish from the species group every day.) As mentioned above, calculation of this daily probability assumes that, at most, only one species is eaten on any given day. That assumption appears to be approximately correct. Among the 222 days with fish consumption reported on the 24-hour recall interviews (counting all respondents and all of their 24-hour recall days), only ten days (4.5%) showed two or more species consumed. The following is offered in support of the assumption that, approximately, only one species is eaten per day. Among the survey respondents and among the adult members of the tribal population, it seems likely that the percentage of consumption days with two or more species consumed is lower than the percentage value just noted. The reason is that the survey consumption days with "hits" are

[27] The probability is readily converted to the more familiar frequency designation by multiplying the probability by a period of time, such as a week. For example, a probability of 0.25 is the same as 0.25 x 7 days = 1.75 days per week (or 7 days out of 28), on the average.

more likely to come from the more frequent fish consumers among the respondents. The balance of the respondents (who had no days with hits in this survey) are likely to consume fish less frequently. It also seems likely that the more frequent consumers would more often consume two species or more on one of their consumption days than would be found among the less frequent consumers. If that is the case, then the days with hits in the survey would find the "two-or-more species" consumers over-represented relative to the entire sample of respondents or the entire adult population. Thus, the 4.5% of consumption days with two or more species consumed would be biased upward relative to what would be found in the long-term experience of the sample of respondents or the population.

b.) Expected frequency of consumption based on the 24-hour recall data. This empirical frequency is simply the number of days that a respondent had a "hit" divided by the number of days for which the respondent provided a 24-hour recall interview for fish consumption. The possible values of this ratio are very limited: 0 (zero), 0.5 or 1.0, depending on whether the respondent reported zero hits or one hit on one 24-hour interview, or zero, one or two hits on two interviews. This very limited selection of frequencies is obviously too coarse to be accurate for an individual, and therefore these probabilities are used only in aggregate form (by taking a mean) for groups of respondents.

c.) FFQ-based expected portion size on days of consumption. For each species group, a weighted mean of the respondent's reported portion size for each of the group's constituent species was calculated. The per-species statistical weights (used in the weighted mean portion size for a specific respondent) were calculated as the reported frequency of consumption of that species (from the FFQ) divided by the sum of the respondent's reported frequencies for all species within the group.[28] This sum—in the denominator of the statistical weight calculations—is the FFQ-based expected frequency of consumption (of any species in the group) described in a.) above. Division of the consumption frequency of a single species by this sum then yields a statistical weight for that species to be used in the calculation of mean portion size. For example, considering Group 1 (all species), if a respondent reported consuming Chinook salmon six times a month, tuna three times a month and shrimp once a month (and no other species were consumed), the sum of the frequencies would be ten. The corresponding statistical weights to be applied to Chinook salmon, tuna and shrimp typical portion sizes (as offered by the respondent) would be 6/10, 3/10 and 1/10, respectively. This weighted mean of portion sizes represents the average amount in grams consumed, averaged over occasions when fish was eaten. In this example, Chinook was consumed twice as often as tuna, so it would have twice the weight in the mean calculation.

d.) Expected portion size based on the 24-hour recall data. This quantity was calculated in three steps: 1.) for each respondent, calculate an unweighted mean of non-zero portion sizes over each species consumed and across all eating occasions (e.g., lunch, dinner, etc.) reported on the first 24-hour recall interview, if there was any positive fish consumption reported on the first interview. (See the example, below, for the calculation of the unweighted mean.) 2.) Calculate an analogous unweighted mean of non-zero portion sizes reported on the second 24-hour recall interview, if there was any positive fish consumption reported on the second interview. 3.)

[28] Note that if a respondent did not consume a particular species within the group, the frequency would be zero, and, thus, all of the respondent's non-consumed species would have no influence on the statistical weights or the respondent's mean portion size for the species group.

Determine an unweighted average of the results of steps 1 and 2, if both days had hits. If there was a hit on only one 24-hour recall interview, then the unweighted mean from the particular interview was used as the mean 24-hour recall portion size for the respondent. If there were no hits, then the expected portion size was undefined/unknown for that respondent. Such respondents were not included and were not intended to be included in the calculation of the mean portion sizes from 24-hour recall data. The portion size calculations were performed separately for each species group. The following is an example of the calculation of the unweighted mean portion size for a given day of consumption. If a respondent reported on one 24-hour recall interview that he or she ate 200 grams of Chinook salmon for lunch, 100 grams of tuna for a snack and 300 grams of Chinook salmon for dinner (and did not report eating any other fish that day), then the mean portion size for Group 1 (all species) would be 200 grams (600 grams total divided by three eating occasions). As in the computation of frequencies, these per-respondent average portion sizes may not be very precise for each respondent, but they can be used for calculation of a more precise mean portion size for a group of respondents, such as the respondents in a decile group.

Survey-weighted means for the frequencies and portions (described in a–d above) were calculated for each decile's group of respondents, and also for all deciles combined. For the portion calculations (c and d), a decile's survey-weighted mean portion size from FFQ data (item c) was calculated including only respondents with positive consumption rates for the particular species group. Similarly, a decile's survey-weighted mean calculated from 24-hour recall data (item d) included only respondents who reported positive fish consumption on at least one of the 24-hour recall days.

As shown in Tables 18 (mean frequency) and 19 (mean portion size), the lower consumption rate from the 24-hour recall relative to the FFQ came from both lower estimated frequency of consumption and lower estimated portion size. For Group 1 mean consumption (all deciles combined) the 24-hour recall's lower consumption, relative to the FFQ, was in about the same proportion for frequency (24-hour/FFQ ratio: 0.85) and portion size (ratio: 0.87). The smallest ratios (smallest 24-hour frequency or portion size relative to FFQ) occurred primarily at the higher deciles of consumption. There were similar patterns for Group 2 consumption, with a frequency ratio of 0.86 (comparing means) and portion size ratio of 0.89 (24-hour/FFQ). More detailed summaries of the other species groups are summarized in Tables F7 (mean frequency) and F8 (mean portion size) in Appendix F.

An additional analysis assesses the relation of a respondent's uncertainty in his or her FFQ responses to the difference between their FFQ and 24-hour recall means. A small proportion of the respondents (9%) reported some of their fish consumption without designating the specific species consumed (e.g., a response coded as "All salmon and steelhead/species not identified", see Figure F1 and Table F9 in Appendix F). Some respondents also had missing data (frequencies, portion sizes or both) for one or more species (Figure F2). The relationship of uncertainty and the FFQ–24-hour difference was analyzed using regression analysis. The FFQ-minus-24-hour difference in consumption rates (per respondent) was the dependent variable and the number of unspecified species was the independent variable (Table F10). In a second regression analysis, the number of species with missing data was the independent variable (Table F11). The analysis showed no compelling evidence to support an impact of these two uncertainty factors on the FFQ–24-hour difference, but the confidence intervals for the impact of each of the two uncertainty measures on the FFQ–24-hour consumption rate difference were so wide that the analysis is inconclusive. The methods and the results are included for methodologic interest in Appendix F as referenced above (see Figures F1F2 and Tables F9–F11 for more details.)

In summary, the larger reported consumption rates from the FFQ method than from the NCI method based on 24-hour recall data were present for the several species groups considered. Underlying this difference is a corresponding difference in the calculated frequency and portion size of consumption. These differences were most pronounced among the 10%–20% of respondents with the largest (Group 1, all species) FFQ consumption rates.

Table 16. Nez Perce Tribe. Number of respondents with consumption on the FFQ and 24-hour recall by species group and decile of FFQ consumption rate. These show the number of non-zero values included in the calculations for Tables 17 and 18, and the sample sizes for each cell in Table 19.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
Group 1											
Respondents with >0 consumption on the FFQ	451	46	45	45	45	45	45	45	45	45	45
Respondents with >0 consumption on the 24h recall	179	8	15	11	13	16	20	17	24	26	29
Group 2											
Respondents with >0 consumption on the FFQ	446	41	45	45	45	45	45	45	45	45	45
Respondents with >0 consumption on the 24h recall	150	6	10	7	11	12	17	16	21	25	25
Group 3											
Respondents with >0 consumption on the FFQ	446	41	45	45	45	45	45	45	45	45	45
Respondents with >0 consumption on the 24h recall	126	5	9	5	10	12	13	12	19	21	20
Group 4											
Respondents with >0 consumption on the FFQ	136	1	11	6	11	6	16	9	20	24	32
Respondents with >0 consumption on the 24h recall	2	0	0	0	0	0	0	0	0	1	1
Group 5											
Respondents with >0 consumption on the FFQ	150	2	11	14	10	10	20	12	20	26	25
Respondents with >0 consumption on the 24h recall	4	0	0	0	0	0	1	0	1	1	1
Group 6											
Respondents with >0 consumption on the FFQ	308	29	33	32	28	24	33	28	28	35	38
Respondents with >0 consumption on the 24h recall	65	3	7	8	3	5	9	8	7	6	9
Group 7											
Respondents with >0 consumption on the FFQ	2	0	0	0	0	0	0	0	1	0	1
Respondents with >0 consumption on the 24h recall	0	0	0	0	0	0	0	0	0	0	0

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table 17. Nez Perce Tribe. Weighted mean consumption (g/day) from the 24-hour recall and FFQ interviews for each species group, overall and by decile of FFQ consumption rate. Deciles are calculated from the group 1 FFQ consumption rate. All rows are based on all group 1 consumers. Ratios were not calculated when a species group was not consumed by the FFQ.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean consumption, g/day	123.4	8.6	24.2	43.2	52.8	64.7	79.8	110.2	144.4	215.8	516.1
24h mean consumption, g/day	94.0	22.2	46.9	37.2	48.3	74.2	96.3	100.7	106.9	162.6	254.4
24h/FFQ consumption	0.76	2.59	1.94	0.86	0.92	1.15	1.21	0.91	0.74	0.75	0.49
Group 2											
FFQ mean consumption, g/day	102.8	5.9	19.4	31.5	41.5	51.7	63.9	93.7	120.1	187.2	434.1
24h mean consumption, g/day	80.6	17.4	35.3	26.6	41.6	52.8	86.1	88.7	99.5	152.8	213.4
24h/FFQ consumption	0.78	2.96	1.82	0.84	1.00	1.02	1.35	0.95	0.83	0.82	0.49
Group 3: 24h/FFQ consumption	0.88	3.43	1.50	0.80	1.11	1.18	1.48	1.08	0.90	1.01	0.55
Group 4: 24h/FFQ consumption	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.47
Group 5: 24h/FFQ consumption	0.33	0.00	0.00	0.00	0.00	0.00	2.93	0.00	0.66	0.12	0.17
Group 6: 24h/FFQ consumption	0.62	1.76	3.08	1.02	0.52	1.15	0.63	0.70	0.38	0.48	0.41
Group 7: 24h/FFQ consumption	0.00	-	-	-	-	-	-	-	0.00	-	0.00

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table 18. Nez Perce Tribe. Weighted mean expected frequency (percentage of days) with fish consumption from the 24-hour recall and FFQ interviews for each species group, overall and by decile of FFQ consumption rate. Deciles are calculated from the group 1 FFQ consumption rate. All rows are based on all group 1 consumers. Ratios were not calculated when a species group was not consumed, based on the FFQ responses.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean frequency, %	31%	5%	11%	19%	21%	23%	24%	35%	42%	58%	78%
24h mean frequency, %	26%	10%	22%	14%	16%	22%	31%	30%	32%	39%	50%
24h/FFQ frequency	0.85	1.98	2.02	0.73	0.75	0.94	1.27	0.86	0.77	0.68	0.64
Group 2											
FFQ mean frequency, %	25%	4%	8%	12%	15%	17%	19%	27%	34%	47%	68%
24h mean frequency, %	21%	8%	15%	7%	14%	14%	27%	26%	29%	36%	39%
24h/FFQ frequency	0.86	2.20	1.81	0.60	0.89	0.81	1.45	0.97	0.84	0.78	0.57
Group 3: 24h/FFQ frequency	1.00	2.48	1.55	0.60	1.00	1.06	1.45	1.16	1.00	1.05	0.65
Group 4: 24h/FFQ frequency	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.12
Group 5: 24h/FFQ frequency	0.45	0.00	0.00	0.00	0.00	0.00	3.08	0.00	0.99	0.13	0.28
Group 6: 24h/FFQ frequency	0.71	1.39	3.16	0.92	0.37	0.87	0.94	0.55	0.59	0.39	0.56
Group 7: 24h/FFQ frequency	0.00	-	-	-	-	-	-	-	0.00	-	0.00

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table 19. Nez Perce Tribe. Weighted mean portion size (grams) from the 24-hour recall and FFQ for each species group, overall and by decile of FFQ consumption rate. Deciles are the deciles of the group 1 FFQ consumption rate. Each individual's portions sizes were averaged across species with a weight according to the species consumption frequency. All calculations are limited to positive portion sizes. Ratios were not calculated when a species group was not consumed based on the FFQ or 24-hour recall.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean portion size, grams	356	198	259	271	298	335	380	374	404	445	618
24h mean portion size, grams	310	220	232	264	308	329	293	284	302	372	376
24h/FFQ portion size	0.87	1.11	0.90	0.98	1.03	0.98	0.77	0.76	0.75	0.84	0.61
Group 2											
FFQ mean portion size, grams	373	190	285	296	293	340	394	393	406	492	638
24h mean portion size, grams	333	225	259	370	313	392	295	284	322	379	405
24h/FFQ portion size	0.89	1.18	0.91	1.25	1.07	1.15	0.75	0.72	0.79	0.77	0.64
Group 3: 24h/FFQ portion size	0.89	1.23	0.82	1.23	1.08	1.13	0.85	0.69	0.77	0.76	0.64
Group 4: 24h/FFQ portion size	2.10	-	-	-	-	-	-	-	-	1.23	2.32
Group 5: 24h/FFQ portion size	0.86	-	-	-	-	-	0.81	-	0.68	1.08	0.67
Group 6: 24h/FFQ portion size	0.90	0.96	0.96	1.01	0.95	1.17	0.61	1.14	0.61	0.95	0.80
Group 7: 24h/FFQ portion size	-	-	-	-	-	-	-	-	-	-	-

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

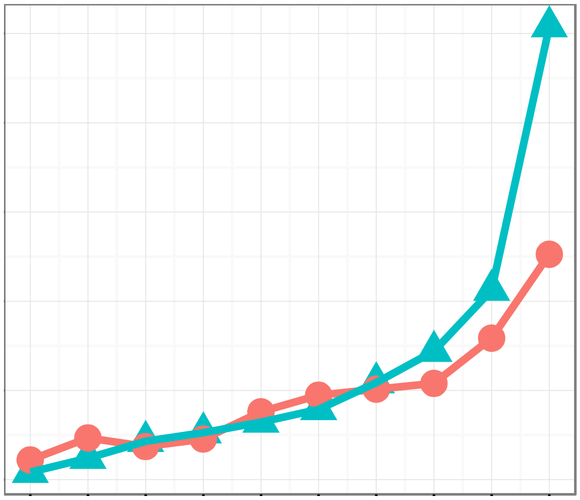

Figure 5. Nez Perce Tribe. Weighted Group 1 means (g/day) of the 24-hour recall and of the FFQ consumption rates by Group 1 FFQ deciles. The numerical values for the means are tabulated in Appendix Table F1.

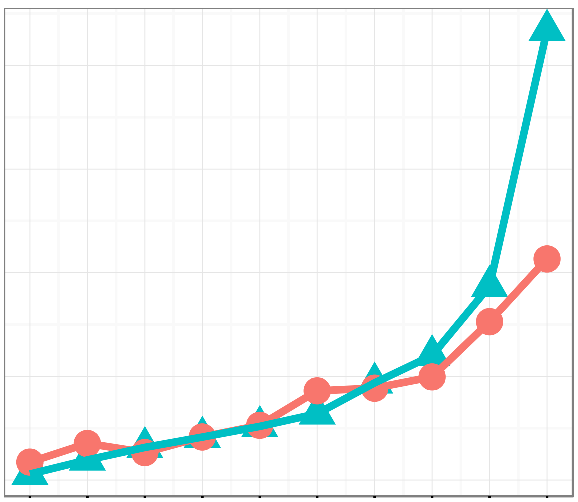

Figure 6. Nez Perce Tribe. Weighted Group 2 means (g/day) of the 24-hour recall and of the FFQ consumption rates by Group 1 FFQ deciles. The numerical values for the means are tabulated in Appendix Table F2.

6.12 Consumption at Special Events and Gatherings

The FFQ rates presented throughout this report include consumption at special events and gatherings, while this section summarizes, specifically, annual consumption at special events only. Consumers reported attending an average of 11.3 ± 15.1 special events or gatherings per year (median: 6). Of those who consumed at special events, their consumption at events was, on average, 11.5 ± 13.8% of their total consumption (median: 6.7%). Table 20 summarizes how often selected species and groups were consumed at special events and gatherings. Salmon and steelhead were the most common species group consumed, with 96% of salmon/steelhead consumers eating from this species group at an average of 10.4 events per year. The large mean number of events per year where suckers and whitefish are consumed (19.3 events per year) is due to the fact that the seven members who consumed these two species at special events attended more than twice the number events per year than the overall average for all consumers (28.9 vs. 11.3 events per year).

Table 20. Nez Perce Tribe. Frequency of consumption at special events and gatherings for selected species and groups. Does not include consumption outside of special events and gatherings. Estimates are weighted[29].

	Species or Species Group			
	Salmon and/or Steelhead	Resident Trout	Sturgeon	Suckers and/or Whitefish
No. of consumers (based on the FFQ)	446	136	51	28
% who consume from the species or species group at special events	95.6%	17.5%	45.2%	29.4%
Events per year where species or species group is consumed*	10.4 ± 14.5	6.8 ± 9.1	8.1 ± 10.7	19.3 ± 17.4

*Values are mean ± SD from those who consume at special events.

6.13 Fish Parts Eaten, Preparation Methods and Sources

The percent of the time skin, eggs and the head, bones and/or other organs were consumed are summarized in Table 21. The skin was commonly consumed for salmon/steelhead and resident trout while the other parts were much less frequently consumed for any species group.

[29] As described in Section 5.20, unless noted otherwise, "weighted" estimates indicate that the survey statistical weights were used in calculating the statistics presented.

Table 21. Nez Perce Tribe. Percent of the time other fish parts were consumed for selected species and species groups. Consumers only*. Estimates are weighted.

Item	Species or Species Group			
	Salmon and/or Steelhead	Resident Trout	Sturgeon	Suckers and/or Whitefish
Skin	44.8 ± 47.7% (418)	36.3 ± 46.1% (122)	12.1 ± 29.8% (44)	7.8 ± 25.6% (24)
Eggs	2.2 ± 12.3% (309)**	2.2 ± 14.4% (117)	6.9 ± 22.1% (42)	0.4 ± 2.1% (20)
Head, bone and/or organs	3.9 ± 14.9% (309)**	6.4 ± 22.2% (117)	1.8 ± 11.9% (42)	10.0 ± 29.2% (20)

Values are mean ± SD; (sample size). Those who did not did not report a percentage value are excluded from calculation of the statistics in the given cell, e.g., consumption of sturgeon eggs.
Note: Missing values for eggs and head/bones/organs were interpreted as 0% if the respondent did not choose "Not applicable" or "Don't know or refused."
*Consumer status determined based on annual consumption reported in the FFQ;
**One interviewer frequently entered "Not applicable" to the question about consuming salmon and steelhead eggs, head, bone and other organs, contributing to a large number of missing values for these cells.

Table 22 shows the percentage of the time different preparation methods were used. Baked or broiled was a common preparation for all listed species (mean: 45.5–62.8% of the time, depending on the species). Smoking was also common for salmon/steelhead (mean: 19.6% of the time) and sturgeon (mean: 28.8% of the time). Dried or use in soups were uncommon (mean <5% for each listed species).

Table 22. Nez Perce Tribe. Percent of the time different preparation methods were used for selected species and species groups. Consumers only*. Estimates are weighted.

Method	Species or Species Group			
	Salmon and Steelhead (N=445)	Resident Trout (N=131)	Sturgeon (N=50)	Suckers and Whitefish (N=24)
Baked or broiled	62.8 ± 27.8%	45.5 ± 45.2%	45.6 ± 45.0%	46.2 ± 47.0%
Smoked	19.6 ± 19.8%	4.0 ± 13.5%	28.8 ± 38.8%	0.0 ± 0.0%
Dried	3.9 ± 8.2%	0.2 ± 1.8%	0.9 ± 3.9%	0.7 ± 4.1%
In a soup	2.0 ± 5.8%	0.5 ± 4.3%	2.2 ± 5.6%	4.5 ± 13.2%
Other	11.7 ± 22.7%	49.8 ± 47.1%	22.4 ± 38.2%	48.6 ± 46.8%

Values are mean ± SD;
Note: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;
*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column;
**Grilled was the most common "Other" preparation method for salmon and steelhead while fried was the most common method for resident trout, sturgeon, suckers and whitefish.

The percentage of the time consumed fish were obtained from different sources is summarized in Table 23. Salmon/steelhead and resident trout were most often caught in Idaho waters at 74.4% and 89.6% of the time on average, respectively.

Table 23. Nez Perce Tribe. Percent of the time selected species and species groups were consumed from different sources. Consumers only*. Estimates are weighted.

Variable	Species or Species Group			
	Salmon and/or Steelhead (N=442)	Resident Trout (N=130)	Sturgeon (N=51)	Suckers and/or Whitefish (N=24)
Bought from a store (grocery or market)	1.9 ± 9.5%	1.0 ± 9.7%	0.1 ± 0.7%	20.1 ± 31.4%
From a restaurant	1.3 ± 5.9%	1.7 ± 11.2%	4.7 ± 20.6%	18.4 ± 29.9%
Caught by you or someone else (in Idaho waters)	74.4 ± 31.3%	89.6 ± 26.8%	25.6 ± 40.1%	58.2 ± 46.3%
Caught by you or someone else (outside of Idaho)	21.8 ± 29.2%	6.9 ± 21.7%	64.4 ± 44.3%	3.3 ± 12.0%
Other	0.6 ± 5.9%	0.8 ± 9.0%	5.2 ± 22.5%	0.0 ± 0.0%

Values are mean ± SD;
Note: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;
*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column.

6.14 Fishing Activities

Based on the questionnaire responses, it is estimated that 61% of consumers took part in fishing activities over the past year. Figure 7 shows the mean number of times respondents went fishing each month. June had the highest fishing frequency, followed by July and then May. January and December had the lowest fishing frequencies. Table 24 summarizes overall fishing frequency and respondents' access to fishing gear and boats.

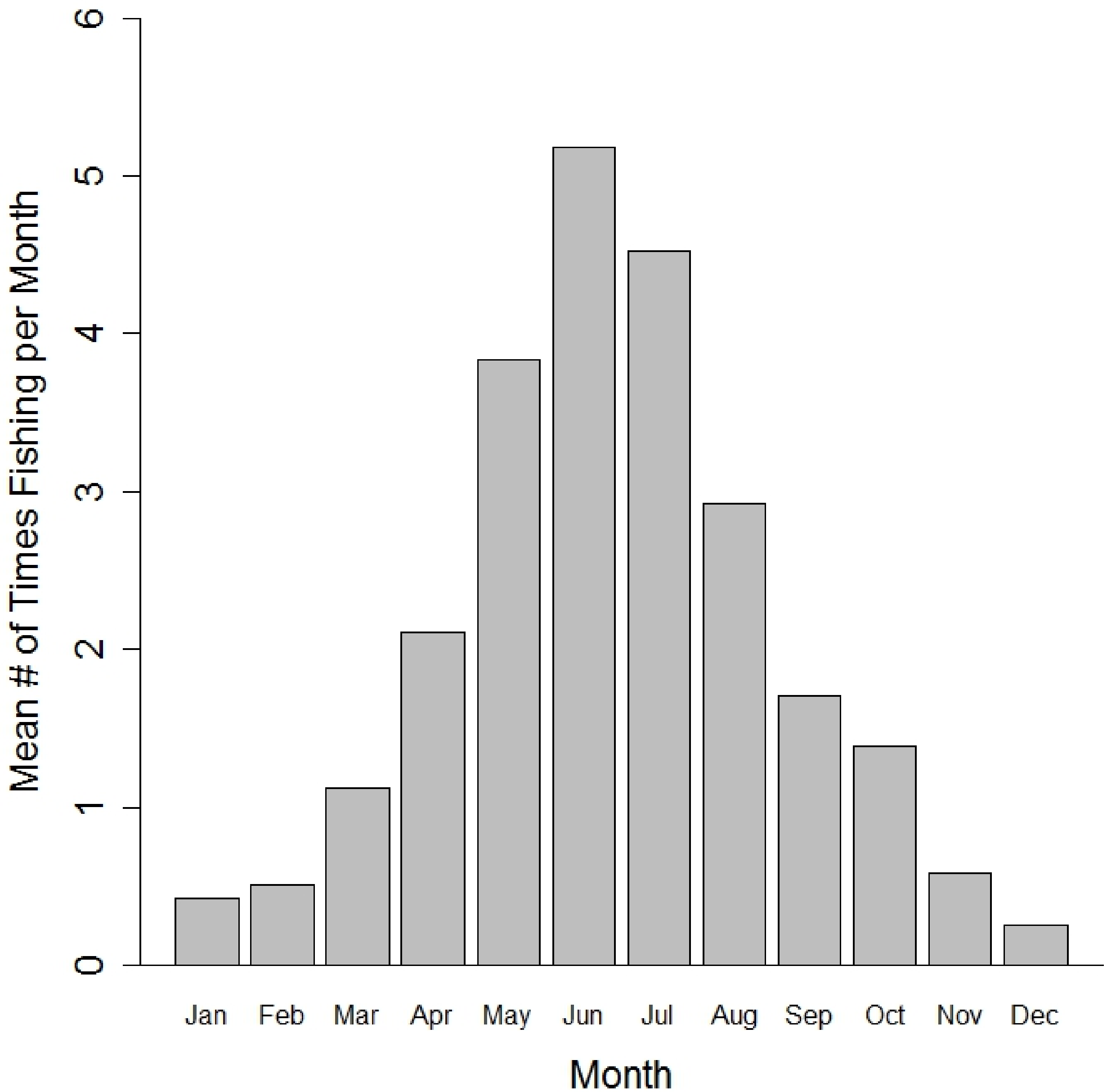

Figure 7. Nez Perce Tribe. Mean number of times respondents went fishing each month among the 283 respondents who reported fishing at least once. Estimates are weighted.

Table 24. Nez Perce Tribe. Fishing activities during the preceding year as reported by the 283 respondents who reported fishing at least once. Estimates are weighted.

Variable		% or Mean ± SD	No. who Responded
Number of times went fishing		24.6 ± 35.1	283
Percent of fish harvested which were--	Kept	60.0 ± 24.7%	277
	Given to others	34.5 ± 22.2%	
	Sold	5.5 ± 16.5%	
Own or have access to fishing gear	Yes	97.1%	283
	No	2.9%	
Own or have access to a boat	Yes	34.3%	283
	No	65.7%	

6.15 Changes in Consumption and Reasons

Table 25 summarizes reported changes in consumption and access to fish and fishing. Nearly all consumers believe that fish were/are very important in the Tribe's heritage and culture in the past (97.9%) and present (96.4%).

An estimated 39% of the consumers have experienced a change in fish consumption over time, and among those who have experienced the change, 49% experienced increased consumption and 47% experienced a decrease. A large proportion of the consumers (48%) have experienced a change in fishing access and, among those experiencing a change, less access to fishing (71%) far outweighed more access (25%). Similarly, 38% of consumers reported a change in fishing frequency, of which 30% reported an increase and 67% reported a decrease. Nearly all consumers want to increase consumption (45%) or maintain current levels of consumption of fish (55%).

Table 25. Nez Perce Tribe. Changes in consumption and access to fishing in the eligible consumer population. Estimates are weighted.

Variable		%	No. who responded to the question
Importance of fish in Tribe's heritage and culture, in the past	Very important	97.9%	451
	Somewhat important	2.0%	
	Not important	0.1%	
Importance of fish in Tribe's heritage and culture, in the present	Very important	96.4%	450
	Somewhat important	3.6%	
	Not important	0.0%	
Change in fish consumption over time	Yes	39.2%	451
	No	60.8%	
If so, how has consumption changed	Increased	48.9%	171
	Decreased	47.4%	
	Other	3.8%	
Change in access to fish and fishing over time	Yes	48.4%	427
	No	51.6%	
If so, how has access changed	More access	25.4%	201
	Less access	70.7%	
	Other change	3.9%	
Change in frequency of fishing	Yes	38.3%	441
	No	61.7%	
If so, how has fishing frequency changed	Increased	30.4%	164
	Decreased	67.1%	
	Other	2.5%	
Desired fish consumption in the future compared to now	Increase amount	45.2%	451
	Maintain amount	54.7%	
	Decrease amount	0.1%	

6.16 Reinterviews

Thirty-one reinterviews were conducted between April 3 and June 12, 2015. The time between the first interview and the reinterview ranged from 28 days to 85 days (median 55 days). There were 17 female respondents and 14 male respondents. Of the 31 respondents, 29 (94%) reported consuming Chinook during the reinterview. Of the 2 who did not report consuming Chinook during the reinterview, one did report consuming Chinook on the first interview (3 days per year). Of the 29 who reported consuming Chinook on the reinterview, on the first interview 23 also reported Chinook, three reported an unspecified salmon species only and three reported Coho salmon as the only salmon species. As the respondents were not always sure of the specific salmon species they consumed, these six instances of unspecified salmon species or Coho salmon reported on the first interview were assumed to be Chinook salmon for the purposes of comparing consumption frequencies between the first interview and the reinterview.

Table 26 summarizes the responses to the first interview and reinterview. The mean (± SD) frequency of Chinook consumption on the first interview and reinterview was 30.7 ± 30.8 and 30.9 ± 38.9 portions/year, respectively, with an average difference of 0.2 ± 36 portions/year. The correlation in the number of portions per day between the first interview and reinterview was r = 0.57 (Spearman's correlation coefficient). The results were little changed when the one respondent with an imputed duration of their high consumption period was omitted (Spearman's r=0.60).

Respondents were asked in both interviews whether their overall fish consumption had changed. Of the 31 respondents, 20 (65%) gave the same response on both. Nine others reported a change in consumption (5 increased and 4 decreased) on the first interview but no change on the reinterview. Of the 9 respondents who reported a change in consumption on both interviews, 7 (78%) agreed on the direction of change. The number living in the household of the respondent was reported to be 4.1 ± 2.4 on the first interview and 4.5 ± 2.5 on the second (Spearman's r = 0.92).

Overall, the first and reinterview responses were consistent, particularly in the summary means and percentages, though there were disagreements at the individual level. These results support the use of aggregate summaries of consumption. The reinterview questionnaire is in Appendix A.

Table 26. Nez Perce Tribe. Summary of FFQ interview and reinterview responses. All rows are based on all 31 respondents who completed both interviews. Summaries are unweighted.

	Interview	
Questionnaire Item	FFQ Interview	Reinterview
Consumed Chinook salmon	96.8%	93.5%
Frequency of Chinook consumption*, portions/year	30.7 ± 30.8	30.9 ± 38.9
Overall fish consumption has changed over time	58.1%	35.5%
Overall fish consumption increased	32.3%	22.6%
Overall fish consumption decreased	25.8%	12.9%
Number living in respondent's household	4.1 ± 2.4	4.5 ± 2.5

Values are percentages or mean ± SD;
*Includes non-consumers as 0.

6.17 Reliability and Cooperation of Respondents—Interviewer's Assessment

Of the 452 completed first interviews, the duration ranged from 15 minutes to 131 minutes (mean ± SD: 59 ± 28 minutes). This excludes two implausible duration values. Sixteen percent were conducted at the respondent's home and 70% were conducted in private, without others present.

Table 27 shows that the interviewers found only a very small fraction of respondents to be less than "highly reliable" or "generally reliable." Similarly, the interviewers found only a small fraction of respondents to be less than "very good" or "good" in their cooperation. No interviewers thought any respondents had questionable reliability or were unreliable. Thus overall the interviewers appeared to trust the information they were obtaining.

Table 27. Nez Perce Tribe. Descriptive summary of interviewers' ratings of respondents' cooperation and reliability during the first interview. Summaries are unweighted.

Variable		%	No.
Respondent's cooperation	Very good	88.2%	398
	Good	10.9%	49
	Fair	0.9%	4
	Poor	0.0%	0
Respondent's reliability	Highly reliable	80.7%	364
	Generally reliable	19.3%	87
	Questionable	0.0%	0
	Unreliable	0.0%	0

7.0 Discussion

7.1 Overview

This fish consumption survey provides unique information about fish consumption and fish harvesting by a Tribe residing in the Columbia River Basin. Two different sets of FCR estimates are presented, each developed by quite different methodologies.

One set of rates is based on a food frequency questionnaire (FFQ), through which respondents provided information on their fish consumption over the past year. The information on frequency of consumption, portion sizes and the duration of certain consumption seasons has been combined to yield a consumption rate (g/day) for each respondent for each of the species they have consumed—the FFQ rates. Means and percentiles of the FFQ rate distribution for seven groups of species have been presented in this report.

The second method of estimation of rates uses the respondents' answers about fish consumption during a 24-hour period ("yesterday") along with some plausible modeling assumptions (the NCI method) to come up with estimates (means and percentiles) that can be directly compared to those provided by the FFQ method[30]. The NCI method does not provide estimates of rates for the individual respondents encountered in the survey. Rates from the NCI method have also been presented in this report. NCI rates could only be computed for two of the seven species groups for which FFQ rates were determined. The other species groups, for which the NCI method could not be used, had an insufficient number of respondents with double hits[31].

The FFQ and NCI methods' estimates of means and percentiles differ. This issue is discussed in Section 7.2. Because the NCI and FFQ methods are quite different, a specific summary statistic from this population, such as a mean or a percentile, should be compared to a statistic computed with a similar methodology from another population in order to draw a valid comparative conclusion. For reasons discussed later, the NCI method statistics would usually be preferable when available (and if the sample size is sufficiently large to support the method). However, the NCI method analysis may not be possible for consumption of narrowly defined species groups or small sample sizes, since the planning goal of achieving approximately 50 double hits would usually not be fulfilled. The FFQ approach is feasible for surveys with a much smaller sample size than that needed for the NCI method. While larger sample sizes provide more precise estimates from any method, the minimum size for assurance of feasibility of using the NCI method would usually start in the hundreds. The data needs and the resources (including statistical expertise) required for the NCI method's estimates of FCRs are much greater than those necessary to develop FCRs from FFQ data.

The fish consumption survey of the Nez Perce Tribe, based on a modest response rate (38%) to the survey—and one that has likely been addressed by use of survey weighting techniques—has a substantial FCR, with quite high consumption rates for a notable fraction of the population,

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[30] The NCI model for the distribution of usual consumption can be developed using only the 24-hour recall data. However, the FFQ rates can be used as a covariate in fitting the NCI model. The FFQ rates provide a covariate in the same sense that gender, age, and other variables are covariates which may be helpful in improving the NCI model. Only the relative value of the FFQ rates is important and not their absolute magnitudes. If the FFQ rates were multiplied by or divided by 10,000 or any other non-zero number, the fitted NCI model using the re-scaled FFQ rates would be unchanged.

[31] A double hit refers to the occurrence of a respondent reporting consumption of fish from a given species group for both of the 24-hour recall interviews. An adequate number of double hits is needed to support the NCI method.

whether the FFQ or NCI method rates are considered. For example, based on the calculated consumption rates (Tables 8 and 12, all species), one-quarter of the Nez Perce adults consume at least 99 g/day (NCI method) or 137 g/day, if the FFQ data are used.

Very few non-consumers of fish were encountered in the survey. Only 9 out of 472 respondents reported non-consumption of fish, for a weighted non-consumption percentage of 2.6%. The non-consumption percentage is based on respondents who adequately completed questions 3 through 6 of the screening interview (Appendix A, Section 1.0). The subsequent analysis of the percentage of non-consumers used appropriate statistical survey weights for each of the 9 non-consuming respondents and 463 consuming respondents.

The Nez Perce Tribe has experienced changes in FCRs and fishing activities, as documented by the survey. Changes in the distribution and abundance of fish (compared to the Tribe's history) as well as changes in access to fishing across the treaty territory may all be factors. Among those who reported a change in access to fishing, many more reported less access (71%) than more access (25%) compared to an earlier time. It is of interest that more fish are available (compared to the 1990s, see above) and yet the respondents report less access to fishing. One possible explanation, among others, is an increase in competition for harvesting of fish from non-Indians, especially at the more productive fisheries where tribal and state fisheries occur at same time and area.

The Tribal members and staff and Nez Perce Tribal Executive Committee contributed very significantly to the execution of this survey. Through advertising, offering of incentives[32] (entirely at the Tribe's own expense), assisting the supervisor with issues involving survey implementation (coordination with tribal interviewers and scheduling of interviews with tribal members), opening special events and powwows to interviewing opportunities, conducting mailings to tribal members, and other forms of information and advertising, the Nez Perce came forward to substantially reverse what was a very challenging and difficult slow start to the survey. Thus, in addition to the quantitative findings in this report, the role of the Tribe and its governing body and staff should be considered a critical component in the planning of future tribal surveys. In addition, the development of individual rapport and mutual trust between individuals from the contractor's staff and those from the tribal staff was a critical component of the survey. The Tribe is a separate and distinct nation, and collaboration with this unique nation is something that involved mutual learning, for both the contractor's staff and the Tribe.

[32] Of particular note was the Nez Perce Tribe's offering of an attractive t-shirt to interviewees on certain interviewing occasions. The t-shirts were very popular and undoubtedly helped recruitment of respondents. The Tribe also utilized a raffle to reward individuals for participating in the survey.

7.2 Comparison of FFQ Rates to NCI-Method Rates

The estimated mean consumption rates (Groups 1 and 2) differed between the FFQ-based rates and the rates based on the 24-hour recalls, with the 24-hour mean rates being lower (Table 15). A simple mean was initially used for this comparison: the "naïve" mean was calculated as the survey-weighted mean of the observations. The naïve 24-hour mean consumption rates of Group 1 and Group 2 species were 76% and 78% as large as the FFQ means for Groups 1 and 2, respectively (Table 15). The difference was statistically significant for Group 1 species ($p < 0.01$, based on a bootstrap CI for the difference between the FFQ and naïve 24-recall mean) and marginally significant for Group 2 species ($p = 0.053$). When the 24-hour data were analyzed (with covariates) using the NCI method, the NCI method's mean and 95th percentile estimates for Group 1 species consumption were, respectively, 61% and 53% as large as the corresponding mean and 95th percentile from the FFQ data and methods (Table 15). For Group 2 species, the NCI method mean and 95th percentile estimates were, respectively, 64% and 71% as large as the FFQ values. The other species groups assessed (Groups 3–7) also had lower naïve 24-hour means than the FFQ means, but the NCI method could not be used to provide a mean or percentiles of consumption for these groups due to the smaller sample size of "double hits."

It is likely that—compared with the FFQ approach—the rates based on the NCI method may be closer to the actual population values because the challenge to a respondent's memory is less than that involved in collecting the type of data used by the FFQ method. The 24-hour recall data used by the NCI method are based on the respondent recalling consumption "yesterday," a memory task that is easier than recalling and averaging consumption during the preceding 12 months, as required by the FFQ portion of the interview. Secondly, a study by Subar et al. (2003) found that the 24-hour recall method was more accurate than the FFQ method in reproducing protein and energy intake as measured by accepted biomarker methods.[33] Results from the Subar study suggest a preference for the 24-hour recall data over FFQ data, but extrapolation from protein and energy intake to fish consumption may be an issue. In addition, the specific format of the questions used for data collection in any given survey can be expected to have an impact on the rates calculated from the survey.

The NCI method, however, contains strong assumptions about the shape[34] of the distribution of usual consumption, and the fitted shape used to provide the NCI estimates may or may not fit well in the tails of the distribution. Specifically, the upper tail of the NCI method distribution may not fit the actual distribution for high-level consumers very well. Diagnostics and quality checks suggest that the NCI model fits the tribal data well overall, but there is no definitive methodology to check segments of the NCI method distributions, such as the upper tails of FCRs, including the important 90th and 95th percentiles, which are used in making regulatory and risk assessment determinations.

The NCI method, using 24-hour recall data, and the FFQ method, using respondents' perception about the past year of consumption, yield a range of estimates, and this range seems likely to include the actual FCR values. It seems likely that the actual consumption rates are closer to the NCI estimates, since they are based on memory of consumption "yesterday" rather than memory

[33] Protein intake was measured using an indicator chemical while energy production was measured using doubly labeled water.
[34] The NCI method assumes a certain family of shapes of the distribution of usual consumption, and the distribution must be derived from the normal distribution by a Box-Cox power transformation.

of the past year of consumption. Both the FFQ and NCI method approaches are accepted survey methodologies. Further research is needed to compare usual consumption distributions from the two methods and determine what gives rise to their differences. The current Idaho tribal fish consumption surveys are the only surveys known that have collected data using the NCI method and a comprehensive form of the FFQ method simultaneously. Given the resources required to conduct surveys supporting NCI data analysis, acquisition of data comparing NCI and FFQ approaches will likely be slow. Also, it is important to note that an FFQ survey is the only method—using limited resources—for deriving the distribution of usual consumption (e.g., "usual" refers to mean daily consumption over the course of a year) in cases where the survey results cannot support use of the NCI method. That can happen, for example, when estimation is needed for species groups that do not have sufficient double hits; generally, the analysis needs 50 or more respondents who report consumption of the fish species group of interest for at least two 24-hour recall periods to provide confidence, in advance of data collection, that the resulting data can be used with the NCI method.[35] The FFQ approach is also the only method available for a fish consumption survey of limited sample size, for which only a handful of double hits—not 50—may be expected.

Some factors—including those just discussed—that may help to explain the difference between the FFQ consumption rates and the rates from the NCI method include the following.

- **Chance**. The FFQ rates per respondent may correctly reflect their consumption over the past year, but, by chance, the days on which they were interviewed about their consumption "yesterday" happened to selectively miss their days of actual fish consumption. Chance may, indeed, explain part of the difference, but the difference in means and 95th percentiles between the two methodologies is statistically significant ($p < 0.05$), so it is very likely that only a part of the difference might be explained this way. Chance may provide a partial explanation of the differences, but, due to the wide gap between means and percentiles by the two methods, the role of chance is likely to be small.
- **Memory and interpretation.** Both the FFQ and 24-hour recall responses require the respondents to exercise their memory and interpret their fish consumption behavior. The 24-hour recall is less challenging to memory than the FFQ. The 24-hour recall questions ask about what happened "yesterday"; the FFQ asks about what happened over the course of 12 months before the present moment. The fish consumption occasions addressed by the 24-hour recall can be at most 48 hours old; e.g., consider a Monday 11:55 p.m. interview response of a person who ate fish at 12:05 a.m. on Sunday.

The FFQ respondent is referring to an average that may not correspond to any events; e.g., a person who eats fish twice per week during every second week would need to report an average frequency of once per week, a frequency which never happens during any single week. Whereas the 24-hour recall asks for an inventory of fish-eating occasions on the preceding day—no averaging is involved. Similarly, the 24-hour recall asks for the portion size per eating occasion yesterday rather than for the FFQ's typical portion size during a year. Finally, the FFQ handles variation in consumption during the course of a year by allowing up to two periods of

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[35] At the completion of data collection a dataset with fewer than 50 double hits may well be usable with the NCI method. However, when planning a survey, the 50-double-hit goal is precautionary.

consumption—a high and low consumption period—if needed. The 24-hour recall simply records what happened throughout a single day.

The 24-hour recall also may include memory error, including error in: a.) determining when "yesterday" began and ended; b.) forgetting items consumed yesterday; c.) moving consumption from another day into "yesterday"; and d.) errors in portions sizes or species consumed "yesterday." There is evidence that the 24-hour recall data may, on the average, be underreporting fish consumption, which would imply that the NCI-based estimates may correspondingly underreport fish consumption rates. A relevant study by Moshfegh et al. compared a.) energy intake (EI) calculated from 24-hour dietary recall interviews to b.) total energy expenditure (TEE) calculated using the doubly labeled water technique. The analysis was based on 524 volunteers from the Washington, D.C. area. The ratio of energy intake to expenditure expressed as a percentage (100*EI/TEE) can be considered a measure of the extent to which the dietary recall interview captured energy intake. The study found underreporting of EI by 11%, on the average, and underreporting depended on the BMI[36] (body-mass index) of the subjects. Using a common BMI classification (WHO, 2015), the underreporting of EI in the Moshfegh study was as follows: normal weight (BMI less than 25) males had 0% underreporting, 6% for females; overweight (BMI = 25 to less than 30) males had 14% underreporting, 15% for females; obese (BMI = 30 or greater) males had 20% underreporting, 21% for females. While energy intake is not equivalent to mass of food items consumed, fish are a higher source of energy per unit mass than some other foods, such as vegetables. It is likely that percentage energy underreporting would be relevant in understanding underreporting of high-energy foods, such as fish. Given the greater underreporting for individuals with greater values of BMI, the BMI distribution of the surveyed tribal members is relevant.

The 434 Nez Perce respondents' BMI distribution (excluding those with missing height or weight) was 18% normal weight, 26% overweight and 56% obese (unweighted percentages). While the Moshfegh findings about energy intake among a largely non-Hispanic white population cannot be directly applied to this survey of fish consumption among Native Americans, there is a possibility of underreporting of fish consumption from this survey's 24-hour interviews, especially given the presence of large BMI values in this surveyed population. (The Moshfegh study did not collect FFQ consumption rates, and, thus, did not consider accuracy of respondents' reports on FFQ rates.) A related study by Subar et al. (2003) also found underreporting of protein and energy intake from both the FFQ and 24-hour recall methods, but the underreporting was larger for the FFQ method.

Concerning memory, the differential demand on memory of the two approaches is a plausible but not a proven factor in the observed difference in rates between the two methods. The results presented in Section 6.11 (Comparison of FFQ Rates to 24-Hour and NCI Method Rates) show that the frequency of consumption days in the 24-hour data is too low to be consistent with the frequencies of consumption reported by the FFQ method. It would be tempting to conclude, therefore, that the respondents' reported 24-hour incidence of hits (a day with fish consumption) is more accurate than the reported FFQ consumption frequencies, because the 24-hour method requires less use of memory and interpretation than the FFQ method. It is also possible that the

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[36] BMI is a commonly used index, based on weight and height, that is used to classify people along a spectrum from normal weight up to obese. BMI = $wt(kg)/ht^2$ (m).

extensive list of species included in the questionnaire (45 species had explicit consumption questions for the respondents) may have led to double-counting of some species in the FFQ. A respondent unsure of a species eaten may have reported it under two or more species. The analysis in this document of respondent uncertainty in reporting in relation to the difference between FFQ and 24-hour recall consumption did not show any trend of an increasing FFQ/24-hour consumption difference with increasing uncertainty. That analysis was not at all definitive given the relatively small number of respondents showing some aspect of uncertainty (see Section 6.11 and Appendix F, Figures F1–F2 and Tables F9–F11.) It will take more surveys with these paired methodologies to definitively address the issue of greater or lesser accuracy of the 24-hour data vs. the FFQ data.

Differences in frequency or portion size reporting. Both frequency and portion size appear to be either overreported in the FFQ data or underreported in the 24-hour recall data, or both.[37] For all species combined (Group 1), for example, the mean frequency of fish consumption calculated from the 24-hour recall data (all respondents combined) was 85% as large as the mean frequency from the FFQ data. The 24-hour recall mean portion size was 87% as large as the FFQ mean portion size. This pattern was similar for Group 2 species, with the mean frequency of consumption from the 24-hour recall data being 86% as large as that from the FFQ data and the mean portion size from the 24-hour recall being 89% of that from the FFQ. These factors are directly observable and quantitatively appear to explain much of the difference between FFQ and 24-hour recall rates. (See Section 6.11 for a comparison between the 24-hour and FFQ data on portion sizes and frequencies.)

As an additional methodologic note, the description of portion size is handled differently in the FFQ and in the 24-hour recall interviews, and the difference may have some effect on the difference in average portion sizes determined by the two methods (see Section 6.11). In the 24-hour recall interview's data, the portion size for a species consumed is identified for each eating occasion during the 24-hour period. In the FFQ interview, a single portion size (or, at most, two different portion sizes for two different seasons) is identified to describe typical consumption of a species for an entire year. For a given species, the average across respondents of the FFQ's typical portion size would agree with the average across respondents of the 24-hour recall's portion sizes under some specific assumptions, two of which are: a.) the FFQ typical size is a faithful average, per respondent, of the individual portion sizes occurring during the preceding year; and b.) the 24-hour recall portion sizes are accurate.

Reference period. The collection of "yesterdays" reported by the pool of respondents in the survey spans a period of approximately one year (12 months) corresponding to the duration of interviewing activity in the survey. The reference period for the fish consumption during the FFQ's *preceding year* spans almost two years (24 months), corresponding to the *beginning* of the preceding year for the first-interviewed respondent to the *end* of the *preceding year* (ending on the interview day) for the last respondent to complete the FFQ segment of the interview. Thus, collectively for the pool of respondents, the two reference periods do not match. This appears not to be an important factor in influencing FFQ rates. In the analysis of seasonality described in Section 5.23.2.1, the calculated mean FFQ consumption rate did not appear to vary

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[37] The frequency of consumption of a species (e.g., number of times per week) is not directly reported by the respondents during the 24-hour recall interviews, but the average frequency for a group of respondents can be estimated. See Section 6.11 for methods and results.

systematically month by month across the 12 months during which FFQ interviews occurred, which is consistent with (but does not prove) a consumption regimen that was not highly variable during the entire two-year reference period. Thus, the reference period appears not to be a definite contributor to the difference in consumption rates (24-hour vs. FFQ), based on the lack of identifiable seasonal variation observed in the FFQ and 24-hour time series for species Groups 1 and 2 and, surprisingly, the salmon species.[38] As noted elsewhere, the number of interviews completed during the peak harvesting period was low, perhaps preventing detection of true seasonal variation.

Modeling: tails of the distribution. As noted earlier in this section, the rates based on the 24-hour recall and the NCI method may be more accurate in the middle of the distribution of usual consumption rates than in the upper or lower tails, including the important 95th percentile of consumption rates. Currently, there is no way to verify the accuracy of different segments of the distribution of usual consumption rates provided by the NCI method. It is good to bear in mind that the NCI model is fitted using all of the 24-hour data to determine one model, and the tails of the distribution of usual consumption are determined by and consistent with the entire fitted distribution, including the central hump of the unimodal distribution. Every part of the distribution is affected by the data from every respondent, including those with low, medium or high consumption. With the FFQ data, however, the upper and lower tail are determined by those with very high or very low consumption. Although the NCI method does allow for certain skewed distributions, the shape of the entire distribution is restricted to a specific family of distributions. The shape of the distribution derived by the NCI method from the 24-hour recall data is affected by the data from every respondent. The distribution of usual consumption derived from the FFQ data has more independence of the tails from the balance of the distribution. For example, one can have two FFQ distributions with exactly the same shape (percentile values) up to, say, the 90th percentile, but then one of the two distributions can continue with a long tail of very high consumption rates and the other distribution can continue with, say, consumption rates arbitrarily close to the 90th percentile value. That kind of "independence" of the upper or lower tail cannot happen with the NCI model. The upper tail has to conform to the functional form determined by the entire dataset. Thus, the important upper tail of the NCI-modeled distribution may or may not adequately represent the actual upper tail of the population distribution of consumption. Nevertheless, it is likely that the NCI-based distribution of consumption is, overall, closer to the actual distribution than the distribution based on the FFQ data.

In summary, the NCI method's rates based on the 24-hour recall interviews are likely to be closer to the actual rates than the rates from the FFQ analysis, due to the lighter demand on memory required by the 24-hour recall approach. In this analysis, memory is the primary candidate to lean on in favor of the NCI method; memory and its imperfections are involved in producing both the FFQ data and the 24-hour data. However, recall and interpretation of fish consumption during the 24-hour interviews is less difficult for the respondent than that during the FFQ segment of the first interview. Given these factors, the NCI method can be favored, while the FFQ method provides an additional valid estimate of FCRs. In some cases, the FFQ may be the only viable option to estimate FCRs given the cost of collecting data for and conducting the analysis for the NCI method. Additionally, the FFQ approach may be the only

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[38] See the seasonality material at the end of the section on covariate selection (5.23.2), and related material in Appendix E, Section 5.

feasible method for development of FCRs for narrowly defined species groups or for small surveys. The difficulty in implementing the NCI method in these cases relates to the need to accrue a sufficient number of respondents who report some fish consumption on two (or more) 24-hour recall interviews—i.e., a sufficient number of double hits. A low probability of fish consumption may result in too few double hits to estimate the distribution of consumption rates even for all species combined (total fish consumption). And, even if the NCI model is successfully developed for total fish consumption, the separate models attempted for groups of species or for individual species may not succeed due to the limited number of double hits encountered. The FFQ method can handle these cases where the NCI method does not succeed. The FFQ is well established as a method to assess food consumption, and Pacific Northwest FFQ FCRs have been broadly used by EPA and state environmental agencies for regulatory actions involving assessment of risks posed to Native Americans exposed to contaminants in seafood.

7.3 Comparison of This Survey's Rates to Other Surveys' Rates

Table 28 compares the Nez Perce rates for Group 1 species from the current consumption survey (based on the FFQ method and the NCI method) to other similarly targeted tribal surveys, and also presents results of a survey of the U.S. national population (NCI method). Rates can be validly compared among surveys when the rates have been calculated using the same methodology—either the NCI method or the FFQ method. The Nez Perce Tribe has a high rate of fish consumption. Its mean total fish consumption rate for adults (based on the NCI method) is 75.0 g/day and the 95th percentile of consumption is 232.1 g/day. Compared to the NCI method rates for the U.S.A, the Nez Perce mean, median and 95th percentile rates are from 2.8-fold to 3.4-fold larger. The FFQ method mean, median and 90th and 95th percentiles of consumption for the Nez Perce Tribe are also high and larger than the corresponding FFQ rates for some other Pacific Northwest tribes, including the four pooled CRITFC survey tribes. (The NPT was one of the four tribes include in the CRITFC survey.) In comparison to tribes with access to Puget Sound fisheries resources, the Nez Perce FFQ rates are also higher than the FFQ rates of the Tulalip and Squaxin Island Tribes, but lower than those of the Suquamish Tribe. The only other Pacific Northwest inland tribes with documented fish consumption rates available are the Shoshone-Bannock Tribes, who participated in the current survey using the same methodology and survey management as the Nez Perce Tribe. The Nez Perce FFQ rates are lower than but comparable to the Shoshone-Bannock rates (NPT mean, 123.4 g/day, SBT mean, 158.5 g/day; NPT 95th percentile, 437.0 g/day, SBT 95th percentile, 603.4 g/day.) The notes under Table 28 provide references for consumption rates of the tribes.

A contributing factor to the high FFQ FCRs as compared to the CRITFC survey may be the difference in the abundance of anadromous fish particularly, and other fish species more generally, that were at lower levels in the 1990s and have been increasing to higher levels in the past decade or more, based on yearly counts of fish passages at Lower Granite Dam from the website of the Fish Passage Center (see www.fpc.org). The fish runs in recent years are larger, which would support more harvest opportunities, and therefore would be expected to support increased current consumption by tribal members compared to the time of the CRITFC survey (conducted from late 1991 through early 1992). The 2013–2014 counts at Lower Granite Dam of adult Chinook salmon, for example, are several-fold larger than those during 1991–1992.[39]

Differences in survey methodology in assessing total fish consumption may also contribute to the higher FFQ FCRs for the current survey relative to the CRITFC study. While the CRITFC survey did question respondents in detail about consumption of the species primarily harvested in the Columbia River Basin (e.g., salmon, steelhead, lamprey, etc.), its estimates of total fish consumption (from all sources, not only the Columbia River Basin) were derived from questions which referred to all species combined, without enumerating species or allowing the respondent to provide different portion sizes for each species consumed. In contrast, the questionnaire from this survey enumerated 45 species and gave respondents an opportunity to consider each species individually, potentially increasing their recall of consumption.

The NCI method rates, which are likely closer to the actual rates than the FFQ rates—for reasons discussed elsewhere in this report—show greater fish consumption rates for the Nez Perce than for the Shoshone-Bannock Tribes (all species combined). Likely reasons for the difference in rates between the two tribes include the greater access of the Nez Perce to fish available for harvest in its fisheries, and Nez Perce country having more productive fish runs and fisheries than the other four Idaho tribes (including the SBT). Furthermore, while the NPT fishing areas are affected by multiple dams that affect survival of anadromous fish or prevent their passage to spawning grounds during migration, the SBT fishing areas are further upriver and are affected by additional dams. However, this rationale does not explain why SBT FFQ rates exceed NPT FFQ rates, in contrast to the NCI method rates, which show the opposite order. Differences in reported portion size and frequency of consumption between the 24-hour data and the FFQ data for each tribe seem to be an important factor underlying differences in NCI vs. FFQ rates for each tribe, and, possibly, for the difference in rates between tribes. (See Section 6.11).

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[39] Based on data available at www.fpc.org (accessed September 24, 2015), the passage count for adult Chinook salmon at Lower Granite Dam was 11,000 and 25,000 (rounded) during 1991 and 1992, respectively; the passage count was 100,000 and 155,000 during 2013 and 2014, respectively. (Table of passages obtained by starting from the web site http://www.fpc.org/adultsalmon/adultqueries/Adult_Annual_Totals_Query_form.html and selecting “Lower Granite Dam” and “Chinook”.)

Table 28. Nez Perce Tribe. Total FCRs (g/day) of adults in Pacific Northwest Tribes (with consumption rates available) and the U.S. general population. Consumers only.

Population	No. of Consumers*		Percentiles		
		Mean	50%	90%	95%
Nez Perce Tribe, FFQ rates, Group 1	451	123.4	70.5	270.1	437.4
Nez Perce Tribe, NCI method, Group 1	451	75.0	49.5	173.2	232.1
Shoshone-Bannock Tribes, FFQ rates, Group 1	226	158.5	74.6	392.5	603.4
Shoshone-Bannock Tribes, NCI method, Group 1	226	34.9	14.9	94.5	140.9
Tulalip Tribes, FFQ rates	73	82.2	44.5	193.4	267.6
Squaxin Island Tribe, FFQ rates	117	83.7	44.5	205.8	280.2
Suquamish Tribe, FFQ rates	92	213.9	132.1	489.0	796.9
Columbia River Tribes, FFQ rates	464	63.2	40.5	130.0	194.0
USA, NCI method[40]	*16,363	23.8	17.6	52.8	68.1

*Adults ≥ 21 years old; includes both consumers and non-consumers.

Notes. The rates for Columbia River Tribes are from CRITFC, 1994, Table 10. The rates for the Suquamish Tribe are from Suquamish Tribe, 2000, Table T-3 and Liao, 2002. These rates were converted from g/kg/day to g/day by multiplying by the mean body weight of 79.0 kg, found in Table T-2 of Suquamish, 2000. The rates for the Tulalip and Squaxin Island Tribes are from Polissar, 2014, Table 2 and Table 3, respectively. The national rates are from U.S. EPA, 2014, Appendix E, Table E-1. The rates for the Nez Perce and Shoshone-Bannock Tribes are from this report and the other report released at the same time as this report with virtually the same format, in Table 8 (FFQ rates) and Table 12 (NCI method rates).

[40] In Table 28, the quoted U.S. national rate includes non-consumers. An analysis of data from an NHANES survey period (2003–2006) overlapping the reference period (2003–2010) for the NHANES-based rates quoted in Table 28 indicated that only a small fraction of the U.S. population are non-consumers of fish. (See Polissar et al., 2014, Table 8 and text following it.) An analysis of 7,145 NHANES respondents from the 2003–2006 survey period, including respondents who supplied 24-hour recall data and completed the FFQ portion of the questionnaire, showed that 680 (9.5%) of the respondents could be labeled as fish "non-consumers" based on their FFQ responses. Some of these "non-consumers," however, would be "consumers" based on the foods they reported eating on the 24-hour recalls. Some of the respondents with inconsistent consumer/non-consumer status between the 24-hour recall and FFQ fish consumption reports may have eaten very small, undetected quantities of fish in the foods they reported consuming on the 24-hour recall and then reported no fish consumption in response to the FFQ questions on consumption during the preceding year. Trace quantities of fish, such as that found in Caesar salad and certain cheese spreads, were captured in the NHANES survey methodology by use of standard recipes applied to foods reported as eaten during the 24-hour recall periods. Thus, it appears that less than 10% of the U.S. population are non-consumers of fish, and a smaller percentage may hold if undetected, trace quantities of fish are excluded.

7.4 Strengths and Limitations

Strengths and limitations of the survey are noted below.

Strengths

Uniqueness. This study is unique in that it conducted both the FFQ (food frequency questionnaire, including amount consumed) and the 24-hour recall (NCI) method simultaneously in a survey of tribal consumption of fish. This study is also unique in the length of time over which it was conducted. Other than a survey of the Colville Tribe (SRC 2015), no other study of tribal fish consumption in the United States has run for a whole year, covering multiple periods of fish runs and seasons as well as cultural activities. The span of the survey allowed some evaluation of seasonal and temporal impacts on FCRs (although the evaluation was limited by a relatively small number of respondents for some months of the survey).

Collaborative development. Every aspect of this survey was designed in a research-intensive, time-consuming and transparent collaborative process beginning in the Fall of 2012 and lasting until the Fall of 2016 between the five tribes in Idaho, the Environmental Protection Agency, two tribal collaboratives [the Upper Snake River Tribes Foundation (USRTF) and the Columbia River Inter-Tribal Fish Commission (CRITFC)], the State of Idaho and a highly skilled and expert cross-disciplinary team of experienced consultants. Efforts were made to incorporate state-of-the-art survey and analytical methods and tribal cultural and governmental concerns in a study that was designed to contribute to an understanding of fish consumption by members of the two tribes surveyed. The survey questionnaire drew extensively on questionnaire content that had been used previously (for FFQ and 24-hour recall interviews). The approach that was used to quantify current fish consumption is consistent with the way food consumption surveys at the population level are currently performed worldwide. (See, for example, the review of food consumption surveys in De Keyser, et al., 2015.) The intensive collaboration extended over two years, beginning with design and continuing through the implementation of the study in the field and the analyses of the data.

The areas of expertise held by the involved parties included tribal culture, fisheries and fishing practices, environmental issues, survey design (including CAPI), survey administration, statistics and government policy. Using a team that included considerable prior survey design experience likely reduced or eliminated bias and increased precision of the resulting estimates. The team's considerable experience with survey fieldwork was also essential in providing thorough training for the field staff, conducting the monitoring needed and providing practical and swift solutions to address the unexpected events that inevitably arise in complex survey efforts. In addition to the core technical staff working on the project, the project consulted with and utilized outside experts, through means which included several teleconferences and a number of e-mail exchanges with experts in dietary surveys from the National Cancer Institute.[41] Experts were involved in both the IRB consultations at the beginning and in the peer review at the conclusion. The diversity of expertise provided was essential given the broad range of areas and activities that needed support under each of the areas noted. Lastly, the extensive experience of working with Native American tribes among this team created an initial rapport with the tribes and fostered the cooperation that continued to grow as the survey progressed.

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[41] Drs. Amy Subar and Kevin Dodd of the National Cancer Institute provided valuable input and support.

Tribal contributions. The Tribe made many important contributions to the success of the survey. Just a few of the many contributions include: the designation of species consumed, the identification of fishers within the Tribe, the assistance in locating hard-to-find respondents, regular participation in review and monitoring of progress, tribal governmental encouragement of participation, publicity to promote participation in the survey and monetary or other incentives (entirely from tribal resources) to recognize participation.

Tribal enrollment records. One advantage of this collaboration with the tribal government is that the contractor team was allowed access to a unique frame for drawing the sample: tribal enrollment records. The use of the enrollment records avoided a costly effort to develop an alternative frame for sampling. The random sampling (as opposed to, for example, a convenience sample) conducted from this complete population listing added to the precision of the survey by using survey resources to increase the sample size rather than using an alternative and costlier means of identifying respondents and, inevitably, a reduced sample size. In addition, by having demographic information available in advance of sample selection, the random sample could be selected from defined demographic strata of the population. This method of stratification almost always leads to a sample that is more representative of the population than a sample drawn by other means that are used when a population roster is not available. Finally, the availability of a population roster from which to draw the sample also allowed an adjustment to reduce or eliminate bias in the reported results. By comparison of the sample demographic composition to the population demographic composition (from the enrollment records), each respondent could be statistically weighted in a manner that reduced (or eliminated) bias due to different success rates in obtaining interviews among the various demographic groups.

In-person interviews. The use of in-person interviews is a strength of the study because that form of data collection was expected to generally lead to more accurate and complete responses in this population, for cultural reasons and because of the use of physical display models that could be and were used in in-person interviews. Many of the interviews were conducted in respondents' homes, which may have provided a more comfortable environment to participate in a long, detailed personal interview. Personal interviews allowed for question clarification. This included use of non-verbal cues (e.g. facial expressions, etc.) to further determine when some aspect of the survey was not understood and to clarify as appropriate. Other advantages of a personal interview approach included ensuring completeness of responses (e.g., ensuring topics and questions were not skipped) and correction of potentially inconsistent responses. Clarification, verification, and completeness are much more difficult to address using other interview approaches (e.g. telephone or mail surveys). In-person interviews also allowed the interviewers to use portion model displays—which could be picked up and examined closely—and photographs of multiple species of fish, which added to the ability of the respondents to more accurately identify the species consumed and characterize the size of their portions. Also, because some portion models were more closely related to certain preparation methods, the in-person interviews with portion models aided in identifying the methods used to prepare fish for consumption; e.g., the fillet model would be commonly linked to methods such as frying or grilling, and the jerky portion model would be commonly linked to smoking of fish.

It is possible that social desirability bias might enter into a live interview. In this setting, social desirability is the tendency of an individual to over- or under-report consumption (overall or for particular species) to avoid anticipated verbal or nonverbal negative feedback related to the perceived social norms (Herbert, et al., 1995). This type of bias is common in dietary surveys, including both those based on FFQs or based on 24-hour recalls (Tooze, et al., 2004). This phenomenon might be more likely with an interviewer than with a privately-offered response. But, the strengths of interviewer-collected data as described above are likely to outweigh this potential bias.

The survey contractors found that use of outside interviewers was acceptable in limited circumstances and effective in increasing the total number of interviews, due to their activities being shepherded and supported by the Tribe. First contacts for interviews were usually made by tribal members or by a non-tribal interview supervisor who had developed exceptional rapport with the Tribe. In addition, the outside interviewers were directed only to potential respondents who were staff members of the Tribe, except for a single visit to a tribal holiday event where other sampled members were interviewed. This practice made finding the potential respondents easier and, also, put the interviewers in touch with a group of tribal members who usually had substantive interaction with the people outside the Tribe. As described in Section 6.7, the potential impact of non-tribal interviewers on responses was examined and no significant differences in overall consumption rates were found between respondents with a tribal or non-tribal interviewer.

Electronic capture of interviews (CAPI). Another strength of the survey was the use of the CAPI interview model, which, as noted previously, greatly enhances survey accuracy and completeness. The interview results were usually available very shortly after the interview based on synchronizing the CAPI tablets online with the contractor's website.

Survey accuracy and completeness is increased by CAPI, compared to other modes, because:

- There are fewer "touches" on the data. With a paper and pencil questionnaire, the interviewer records the respondent's answer, and later a data entry clerk enters the data in a tabulation program. CAPI needs only one data recording source: the interviewer.
- Computer programming and skip logic conditions are automated, allowing the interviewer to focus on the respondent. A paper questionnaire, whether self-administered or administered by an interviewer, relies on the sometimes fallible human to check and administer real-time skip patterns during the interview.
- Out-of-range values and logic checks are evaluated immediately by the computer. Paper and pencil questionnaires cannot offer this degree of quality assurance.
- Data from the CAPI system is uploaded as soon as an Internet connection is available. This provides both a backup (in case a computer tablet is lost or stolen) and a means for statisticians to check the integrity of the data.
- CAPI data collection is transportable. Interviewers can bring the computer tablets to far-flung areas, even households without landlines or cell phone coverage. Telephone interviews and online interviews only work where there is phone or Internet access, respectively.
- CAPI technology requires no technical knowledge or ability from the respondents. Interviewers are trained to use the computer tablets unobtrusively and without respondent assistance, other than asking for answers to survey questions. Online surveys dictate that each respondent has at least basic computer experience and knows how to navigate the internet.

Detailed inventory of species. An additional strength of the survey was the level of detail obtained on consumption by species. The consumption of approximately 45 individual species was specifically inquired about, and additional species could be reported by respondents and entered into the database using a text field. All such entries were used in preparing this report. The inquiries on consumption of numerous species may have stimulated memory and comprehensively evaluated consumption. However, there may have been some double-counting of consumption if respondents who were unsure of a specific species consumed may have reported such consumption under more than one species.

Interviews spanned one year. Yet another strength of the survey was the span of time during which the survey was carried out, covering multiple periods of fish runs and seasons. While this was a strong design feature, the full strength of this design feature (a full year of interviews) was not fully realized. The interviews did, indeed, cover one year, but they started during a peak fishing season and the accrual of completed interviews was slow relative to later periods of the survey year. The peak fishing season was relatively sparsely covered by interviews. Nevertheless, all seasons were represented by some interviews. The representation of all seasons in the survey allowed an assessment of seasonal effect on FFQ consumption responses. Analysis did not show that a seasonal adjustment was needed to provide valid consumption rates. The number of interviews per season did vary substantially, but the coverage of seasons during a year of interviewing is some insurance against bias. While ideally a retrospective FCR covering the past year and drawn from the respondent's memory (i.e., the food frequency approach) should be fairly constant over time, in fact the consumption of the preceding year reported during interviews at the beginning of the survey year could be quite different than the consumption in the preceding year reported at the end of the survey year. Thus, spreading the surveys over 12 months covered, potentially, the full annual cycle of harvesting and consuming fish. Relative to extant fish consumption surveys in EPA Region 10,[42] this is one of the first to collect FFQ information during 12 months. Among published reports, the FFQ surveys of the Squaxin Island and Tulalip Tribes (February 25 through May 15, 1994), Suquamish (July through September, 1998) and the four tribes included in the CRITFC survey (fall and winter of 1991–1992) were all carried out in less than a year.

NCI method combined with FFQ method. The use of the NCI method to estimate the distribution of usual fish consumption is another strength. It involves less reliance on memory (but more reliance on modeling) than the FFQ approach. The results of the NCI method were thoroughly vetted through additional quality assurance methods, sensitivity analyses and parallel and independent calculations by two statisticians for many of the consumption rate analyses presented—both for the FFQ and NCI methods. The use of the two methods in the survey also provided the opportunity to compare consumption rates between methodologies and explore potential factors that might explain the differences.

This survey used a quantitative FFQ interview combined with interviews yielding 24-hour recall of fish consumption to support the NCI method. The FFQ interviews provided data which, by itself, led to estimates of fish consumption rates. In addition, even though the NCI method could provide fish consumption estimates from the 24-hour recall data alone, the FFQ data (along with other covariates) were used in the NCI modeling to provide fish consumption estimates that are

[42] EPA Region 10 includes Alaska, Idaho, Oregon, Washington and Native American Tribes in these states.

very likely to be more accurate than estimates that would be derived from the 24-hour data alone. The use of two distinct methods to assess dietary intake—FFQ and 24-hour recall—combined with two distinct analyses to estimate usual consumption of fish provided a very comprehensive study on fish consumption.

Independent replication and verification of key statistics. The calculation of consumption rates (a rate for each species for each respondent) by two statisticians working independently (and agreeing on the computed rates) strongly supports an assertion that there are likely to be zero or very few computational errors in the many calculated quantities presented in this report. The double computing was an essential measure of quality assurance. In addition, a number of the summary estimated fish consumption rates (means and percentiles) and other quantities in this report were also computed twice, independently, by two of the contractors' statisticians, in the pathway to preparing results for different sections of this report. Lastly, calculations of the estimates of the species Group 1 distribution (mean and percentiles) from the NCI method were also recomputed by NCI staff. The recomputed mean and percentiles for species Group 1 were all within 0.4% of the contractors' estimates.

Reinterviews. The reinterview analysis shows that while individual responses to the same questions vary over time, the summary means and percentages are reasonably similar to each other from interview to reinterview. (See Section 6.16.) As this survey is intended to provide summary consumption statistics such as means and percentiles, the reinterview analysis supports the achievement of that goal with these interviews, though significant variation by individuals in their responses (to identical questions) over time is evident. However, reproducibility of interview results may potentially be affected by the species selected for re-evaluation of consumption. This analysis selected Chinook salmon, a commonly consumed species of considerable cultural relevance. Future studies may wish to evaluate consistency using a broader range of species.

Limitations

Response rates. The response rate for the survey was lower than expected at 38%. The four other fish consumption surveys of Pacific Northwest Indian tribes have had response rates of over 60% (i.e., CRITFC, Squaxin Island, Suquamish and Tulalip surveys). It is often difficult to know the reasons for non-response; typically, these individuals do not divulge rationales for their lack of participation. To no small effect, limitations on resources and time (to adequately find and contact some respondents) contributed to a lower response rate. Contributing to the difficulty of contacting prospective respondents was the incomplete, outdated, incorrect or missing contact information. Enrollment offices provided membership lists, but sometimes without accurate phone numbers or addresses. The survey team employed supplemental methods to search for tribal members, including checking property records, utility records, commercial databases and online searches. Some tribal members lived "off the grid," in areas without physical mailing addresses. Others had addresses which were merely "Rural Route." Even tribal interviewers, who had direct and in-depth knowledge about tribal members, experienced significant difficulty locating some members. Because of this difficulty, resources intended for the interviewing task were necessarily diverted to locating contact information for prospective respondents. The team also experienced challenges with missed appointments. Some tribal members scheduled interviews in their homes, but then decided not to participate, or postponed them for another time and location—a postponement which did not always have a successful ending. The challenges of home interviews that affected response rate included the time and distances travelled to reach widely dispersed rural residents and difficulties in trying to group willing respondents into convenient interview trips. This posed both a financial challenge (i.e., time and gas expense of interviewers) and the resultant reduced numbers of interviews able to be conducted within the calendar time and budget of the study.

The weighting method used to estimate the population distribution of consumption rates mitigated some of the potential selection bias stemming from the modest response rate. Specifically, the non-response adjustment to the weights accounted for differences between responders and non-responders in their age, gender, ZIP code of residence, fisher indicator (presence/absence on a list of fishers) and combinations (two-way statistical interactions) of these characteristics. Biases related to other (unknown) characteristics may potentially persist.

Limited imputation of missing values. A minor limitation of the survey is that some cases had missing data which had to be imputed to be able to retain the respondent's other related responses for inclusion in the survey. For example, a respondent might not remember a typical portion size of consumption for a species but would remember the frequency of consumption of the species. In this example, the CAPI system would capture the portion size response as a "don't know" code, and, if there was no intervention, the consumption rate for that species would end up being missing for the planned statistical analysis. As a result, the respondent's fish consumption rate would be underreported. Instead, an imputed value of portion size was supplied for the missing value for the analyses presented in this report. Usually the much less frequently consumed species had such missing values, though this was not exclusively the case. (See Section 5.28, "Handling Missing Values," for imputation methods.) A sensitivity analysis reported in Appendix C suggests that such imputations had little impact on the final results.

7.5 Characterizing Uncertainty

The confidence intervals for percentiles of consumption rates in the study describe the uncertainty in various FCR statistics—the "margin of error." The width of these confidence intervals should be taken as advisory, without a specific cutoff of widths considered to be desirable or undesirable among the confidence intervals presented in this report. Again, the data are valuable and, as a practice, the estimated means and percentiles are the best choice to use for practical purposes as opposed to other values in the confidence interval. Based on methodologic principles used to avoid bias, the point estimate (the estimated value lying within the confidence interval) is the preferred estimate to use in practice rather than other values in the confidence interval.

The statistical weights were adjusted for non-response to correct for any selection bias. It cannot be guaranteed that selection bias has been completely addressed, as not all non-response can be predicted, but all available demographic variables were considered in making the nonresponse adjustment. Furthermore, the additional uncertainty in consumption rates due to imputation of missing fields in a limited number of cases is not fully represented in the confidence intervals. However, the ultimate impact of imputation was found to be small based on a sensitivity analysis encompassing a wide range of imputation scenarios. In summary, the use of imputation was important to avoid deletion of a number of respondents' data from the analysis, but the different choices for imputation, varying around the parameter values chosen, had little effect on means and percentiles of consumption rates.

The findings on seasonality—actually, a possible lack of seasonality—were unexpected (see Section 5.23.2.1. This finding was unexpected because fishing activity, as reported in this survey, did vary by season, as shown in Figure 7. Interviewers also sometimes reported difficulty reaching sampled members because they were away, fishing. The CRITFC report also showed strong variation across the 12 calendar months in the percentage of respondents identifying a month as one of high consumption, and, separately, identifying low consumption months (CRITFC, 1994, Figures 3 and 4). (The Nez Perce Tribe was one of the four tribes included in the CRITFC survey.) Analysis of data from the current survey showed no discernible seasonal patterns—that differed from "noise"—in consumption rates for the species groups analyzed, including salmon (all salmon and steelhead species combined). The sample sizes were too small to rule out seasonal variation, but there was no pattern that could be used to create a method for seasonal adjustment of the consumption rate distributions. It is possible that a large fraction of the Tribal members tend to be fairly steady over time in their FCR. A fairly steady consumption rate could be managed if tribal members alternate species according to availability (by harvest or purchase), and, also, draw on preserved or otherwise stored fish harvested from peak periods of availability.

An additional source of uncertainty about the results of the NCI method of analysis is the role of the question wording and question sequence used to gather the 24-hour recall data used for the NCI method (and also used for calculation of mean consumption rates using the naïve method, described in Section 5.22). The 24-hour recall portion of the questionnaire was adapted (and shortened) from the AMPM method (Automated Multiple Pass Method), a thorough and probing method to elicit all foods consumed during a 24-hour period (Raper et al., 2004, Moshfegh et al., 2008). Similar to the AMPM system, the present survey questionnaire included an inventory of occasions with fish consumption, but, in order to avoid problems from an overly long interview (e.g., fatigue, dropout, inaccurate answers) there was only one pass through the eating occasions rather than the multiple passes of the AMPM system. In the current survey a lead-in question (Appendix A, question #9) could filter out any respondent who reported eating no fish "yesterday." Such a respondent would be assigned zero fish consumption, would not answer subsequent questions about specific eating occasions, and would skip to questions on other topics. It is possible that some of the respondents who may have been recorded as having zero fish consumption on the 24-hour recall—due to their response on the lead-in question—would have reported non-zero fish consumption if they had proceeded to a more detailed questioning about eating occasions. The impact of this phenomenon is unknown but is expected to be small, since the lead-in question is thorough in asking about potential types and occasions of consumption, and the interviewers would commonly probe for fish consumption "yesterday."

7.6 Next Steps, Lessons Learned

Many lessons were learned in the process of developing and implementing the survey, analyzing survey data, and drafting these reports. A "Lessons Learned" memorandum reflecting the experience of the Tribes, contractors, and EPA will be forthcoming.

7.7 Conclusions

The Nez Perce Tribe is a high fish-consuming population. The mean adult consumption rate for all fish species (Group 1) is 75.0 g/day and the 95th percentile of consumption is 232.1 g/day—estimates based on the survey data as analyzed by the NCI method. The consumption rates based on the data from the food frequency questionnaires (FFQ) in this survey are also high: mean consumption, 123.4 g/day, 95th percentile, 437.4 g/day.

The Nez Perce NCI method mean fish consumption rate of 75.0 g/day is high relative to the general U.S. population (NCI-method mean, 23.8 g/day). The FFQ fish consumption rate is also high relative to some other Pacific Northwest tribes—tribes that can only be compared using an FFQ rate (Table 28). The Nez Perce mean FFQ consumption rate of 123.4 g/day can be compared to the pooled CRITFC survey Tribes (FFQ mean, 63.2 g/day), Squaxin Island Tribe (FFQ mean, 83.7 g/day) and Tulalip Tribes (FFQ mean, 82.2 g/day). The Nez Perce mean FFQ rate of 123.4 g/day is lower than the FFQ rate for the Suquamish Tribe, 213.9 g/day. The Nez Perce NCI method rates can be compared to and are higher than those of the Shoshone-Bannock Tribes, the second tribal population included in the current consumption survey. The NCI method mean rates for the NPT and SBT are 75.0 g/day and 34.9 g/day, respectively. The NPT and SBT 95th percentile rates are 232.1 g/day and 140.9 g/day, respectively.

Nez Perce consumption rates were also high when restricted to Group 2 species (near coastal, estuarine, freshwater, and anadromous finfish and shellfish) with a mean of 66.5 g/day and 95th percentile of 233.9 g/day by the NCI method. The mean Group 2 consumption rate based on the FFQ was 104.0 g/day and the 95th percentile was 327.9 g/day.

The population of documented fishers within the Nez Perce Tribe has even higher FCRs than the overall tribal population (Tables 9, 12). There has been a substantial reported change in access to fish and fishing according to tribal respondents, and the greatest change is that a much larger proportion of the population has experienced a decrease in access to fishing than the proportion of those experiencing an increase in access (Table 25).

Consumption rates obtained via the NCI method are likely closer to the actual rates than rates obtained using the FFQ method. However, the FFQ approach is a well-documented and accepted method for conducting dietary intake surveys, and may be used to produce credible results when sample size or resources cannot support the NCI method. The resources required to collect data for and implement the NCI method are considerable and are likely not often available to tribes with limited resources. The current surveys of fish consumption among two tribes in Idaho, the Nez Perce and the Shoshone-Bannock Tribes, show differing levels of agreement between NCI and FFQ method FCRs. The source of these differences in rates between NCI and FFQ methods appears to be associated with reported fish consumption frequency, and, to a lesser degree, reported portion size for the FFQ vs. the 24-hour recall data. The current Idaho tribal surveys are the first to conduct both methods simultaneously. Future surveys will be needed to elucidate differences between the two methods. Given the resources required to conduct these surveys, acquisition of further data will not occur rapidly.

Multiple studies using different methodologies (e.g., ethnographic observation, caloric intake, etc.) demonstrate that heritage FCRs exceeded current FCRs, as is shown in Volume I.

A lesson learned from the survey activity is the importance of strong support from the tribal leadership and staff in order to achieve acceptance of the survey and higher response rates and the need for significant advance time and preparation prior to field work.

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Appendix A—
Idaho Tribes Fish Consumption Survey: Questionnaire

Appendix A—Questionnaire[1]

IDAHO TRIBES FISH CONSUMPTION SURVEY

APPENDIX A

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[1] This hardcopy version of the questionnaire was used from time to time as needed. The vast majority of interviews were carried out with the questionnaire embedded in a CAPI system (computer-assisted personal interviewing) on a tablet. See the main body of this report for a description of the CAPI system used in this survey.

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LIST OF ACRONYMS

CDC	Center for Disease Control and Prevention
FFQ	food frequency questionnaire
NCI	National Cancer Institute

*(**NOTE:** The original Preface and Telephone Screen introductory narrative were repetitive of the main design document and, therefore, removed from this appendix.*

1.0 TELEPHONE SCREENING

1. **"Hello, I'm calling on behalf of the** *(name of Tribe and department)* **. May I please speak with** *(name of respondent)* **?"** (Enter contact information into Table A-1; refer to Table A-2 for response entry codes)

    ______ Yes

    ______ No

If YES and respondent is speaking or when the respondent comes to the telephone, continue to Question #2.

If NO, probe if he/she lives there, and if so, ask "**When is the best time to reach him/her?** (Record on log) "**Okay, thank you for your time. Good bye."**

If NO, not living there, ask "**What is the best way to reach him/her?** (Record new number on log) "**Okay, thank you for your time. Good bye."**

2. **"Hello, my name is** *(your name)* **.** Reintroduce Tribe if necessary**. We are conducting a survey to determine the fish consumption rates within our Tribe. The survey is endorsed and supported by the** *(name council / other).* **Your information, plus the information of other Tribal members, will help us protect our environment and promote the health of our Tribal members and families. You are free to not answer any of the questions. Today's survey takes about 5 minutes and we would like to include your input, if now is a good time?"**

    ______ Yes

    ______ No

If YES, **"thank you for agreeing to participate,"** check box below and continue to Question #3.

☐ *INTERVIEWER CHECK THIS BOX IF RESPONDENT AGREES TO PARTICIPATE IN THE TELEPHONE SCREENING.*

If NO, ask "**When is a good time to call back?** (Record on log) "**Okay, thank you for your time. Good bye.**"

3. **"I'd like to ask you about what you ate yesterday. Did you eat any fish yesterday? This includes ANY amount of fish, shellfish, or seafood eaten for breakfast, lunch, dinner, or snacks, by itself or within a dish such as soup."** (Record on log)

______ Yes

______ No

______ Don't know / Prefer not to answer

If YES, skip to Question #8.

If NO or other, continue to Question #4.

4. **"Did you eat any fish in the past week (**or if not, **in the past month)?"** (Record on log)

   ______ Yes

   ______ No

   ______ Don't know / Prefer not to answer

If YES, skip to Question #7.

If NO or other, continue to Question #5.

5. **"Did you eat any fish in the past year?"** (Record on log)

   ______ Yes

   ______ No

   ______ Don't know / Prefer not to answer

If YES, skip to Question #7.

If NO or other, continue to Question #6.

6. **"Thank you. Just to be thorough, is it possible that during the past year you ate fish at a restaurant, a friend's house or another place, or someone brought fish to you?"** (Record on log)

   ______ Yes

   ______ No

   ______ Don't know / Prefer not to answer

If YES, continue to Question #7.

If NO or other, skip to Question #9.

7. **"How many days did you eat fish in the past week (or month or year –** depending on previous answers**)?"** (This information will determine applicability of the NCI Method; Record on log as number per week, month, or year)

7a. **"Now considering your eating habits in general, on average how many days do you eat fish – this can be number of times each week, each month, or each year?"** (Record on log as number per week, month, or year)

8. **Thank you. We are also conducting survey interviews that have been endorsed by** ______*(endorsing authority)*__. **The information that you provide will remain strictly confidential and it will help to protect the health of our Tribe. We will conduct in-person interviews in a convenient location. Your participation is very important. If you do agree to participate, you may withdraw at any time and there would be no consequence for you. May we meet with you for the survey interview?** (Record on log)

    ______ Yes

    ______ No

If YES, **"Great, thank you for your willingness to participate in this important survey. Let's schedule a time and place. We have Tribal interviewers available to meet 7 days a week from 8:00 am until 7:00 pm; which day in the next two weeks is best for you?"** If don't know, schedule a call-back time to set interview. Record on log, skip to #10.

If NO, **"I understand. This survey is very important. We don't have to do it immediately, we have several months to schedule it. I'd like to call you back at a later date. We want to make sure we represent the whole Tribe."**

If ACCEPT or SOFT REFUSAL, schedule re-call and skip to #10.

If HARD REFUSAL, "**Okay, thank you for your time today. Good bye."**

9. **"Can you please tell me the main reasons why you haven't eaten fish?"** Allow respondent to answer question unaided, then state **"now I will list some other reasons people do not eat fish; please let know if any of these apply to you."** List the following items (of those not already noted by the respondent). Check left and right columns, then continue to #10:

Contamination:

A. "Do you not eat fish because of fish advisories?"

______ Yes ______ Answered unaided

______ No ______ Answered by prompt

B. "Do you not eat fish because of pollution?"

______ Yes ______ Answered unaided

______ No ______ Answered by prompt

C. "Do you not eat fish because of other environmental concerns (for example, eating fish is not sustainable)?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Fish Availability:

D. "Do you not eat fish because there is not enough fish available to catch?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

E. "Do you not eat fish because it is hard to find fresh fish and seafood"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Access to Fishing:

F. "Do you not eat fish because of limited access to fishing areas?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

G. "Do you not eat fish because you used to have access to a boat or fishing gear, but don't anymore?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Other Reasons:

H. "Do you not eat fish because you do not like fish or you prefer other foods?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

I. "Do you not eat fish because you are <u>too busy</u> to catch and/or prepare fish?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

J. "Do you not eat fish because you <u>do not know how to prepare fish</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

K. "Do you not eat fish because you <u>cannot afford it</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

L. "Do you not eat fish because of <u>allergies or other health concerns</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

M. "Do you not eat fish because you are a <u>vegetarian or vegan</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

N. "Do you not eat fish because you <u>observe religious customs</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Table A-1. Telephone Screening Contact Log

Respondent Name:						**Respondent ID #:**		
Respondent Telephone Number *(strike-out incorrect numbers, record new)***:**								
Scheduled Call-Back Time for Telephone Screen *(if necessary to re-schedule):*								
When Called					**Who Contacted**		**Results (of call & questions)**	
Attempt	**Date**	**Day**	**Time**	***Circle***	**Caller Name**	**Caller ID**	**Codes**	**Notes**
1				AM PM				
2				AM PM				
3				AM PM				
4				AM PM				
5				AM PM				
6				AM PM				
7				AM PM				
8				AM PM				
9				AM PM				
When Called					**Who Contacted**		**Results**	
Attempt	**Date**	**Day**	**Time**	**AM/PM**	**Caller Name**	**Caller ID**	**Code**	**Notes**
10				AM PM				
11				AM PM				
12				AM PM				
13				AM PM				
14				AM PM				
15				AM PM				
Reported eating fish <u>yesterday</u> *(circle)*: YES / NO / No Answer								
Reported eating fish during past <u>week</u> *(circle)*: YES / NO / No Answer / Not Applicable								
Reported eating fish during past <u>month</u> *(circle)*: YES / NO / No Answer / Not Applicable								
Reported eating fish during past <u>year</u> *(circle)*: YES / NO / No Answer / Not Applicable								
Number of <u>days ate fish</u> *(enter number, circle unit)***:** __________ in past Week / Month / Year								
Number of <u>days generally eat fish</u> *(enter number, circle unit)***:** __________ times per Week / Month / Year								
Schedule in-person interview? *(circle, enter):* YES / NO (If NO, enter call-back time at top of form) Date: ______________ (mm/dd/yyyy) Day: _____________ Time: ___________ am / pm Location: ________________								

Table A-2. Disposition Codes for Respondent Contact

01	Completed interview
02	Mid-termination
03	Hard Refusal
04	Invalid number: out of service, disconnected, fast busy
05	No answer
06	Busy signal
07	Answering machine
08	Appointment set
09	Language barrier: non-English
10	Impairment: hearing, mental health, other
11	Deceased respondent
12	Institutionalized
13	Other (Please Specify)
14	Soft Refusal
15	Email attempt
16	Enrollment office lookup
17	Acquaintance / family lookup
18	Online lookup
19	Household visit

Note: Interviewers will be trained on how to respond to telephone inquiries (leaving a message, handling refusals, calling back, etc.)

10. **Finally, for the survey, we need to note the general location where you live. The zip code we have listed for your residence is** *(zip code from enrollment)*; **is that correct?** (Check)

    ______ Yes

    ______ No

If NO, **"Can you please provide your correct RESIDENCE zip code (or if you don't know the zip code, community name)? ____________________**[2]

Final zip code of residence: _____________

This concludes the interview. Thank you very much for your cooperation. We really appreciate your time today. That is all. Good bye."

[2] **NOTE**: Individuals may have a different zip code for mail versus residence; be sure to inquire about residence. Prior to an in-person interview, the supervisor will need to check that the corrected zip code (or community name) supplied by the respondent is included in the list of eligible zip codes. If the reported residence zip code is not eligible, but the enrollment zip code used to locate the respondent is eligible, then a call-back may be made to clarify the location of the current residence address. An interview can still be scheduled pending the final determination. The final residence zip code for the respondent should be noted here.

2.0 INTERVIEW INTRODUCTION

Basic information about the interview (e.g., location) will be recorded by the interviewer prior to the in-person interview. The interviewer will then provide a brief introduction to the respondent about the project. Words to be spoken by the interviewer are identified in bold. Answers are written, checked, and/or circled, as indicated.

2.1 Administrative Information

General administrative information will be completed by the interviewer at the time of the interview, but prior to questioning the respondent.

1. Interviewer Identification

1. Interviewer Name ______________________________________
2. Interviewer ID: _________________________

2. Respondent Identification

3. Respondent ID: _________________________

3. Interview Date, Time, and Location

4. Date: ______/_____/______ (mm/dd/yyyy)
5. Day (of the week): ___________________
6. Start time: ___________________ AM / PM *(circle)*
7. City, State: ____
8. Location/Venue (check):
   ______ Home ______ Central Location
   ______ Tribal Office ______ Other (coffee shop, etc.)

Respondent ID: ____________

2.2 Introduction to Interview

To begin the in-person interview, the interviewer will introduce the purpose of the survey and provide a brief overview of its structure.

"Hello, my name is ________, and we're conducting a survey on behalf of the ________. We appreciate your willingness to participate in our fish consumption survey. The survey is endorsed by the __________.

The information you provide as part of this survey will help us understand the rates of fish consumption, how fish is prepared, and the species or types of fish regularly eaten by members of the ________ Tribe. Your information, plus the information of other Tribal members, will help us protect our environment and promote the health of our Tribal members and families.

We do not intend to collect ANY culturally-sensitive information during this interview. The information that you provide during this interview is confidential. Your responses to the questions will be combined with those of others so that your answers cannot be identified. In the meantime, if you have any questions, here is an information and contact sheet for you to keep. (Provide Information Sheet)

This interview will take about an hour. The questionnaire has 3 parts. In the first part, I will ask you to tell me how much fish you ate yesterday. The second part focuses on the past 12 months: the types of fish you ate, how often you ate it, where you got it, and how it was prepared, as well as fishing activities and special events. Finally, in the third part, I will ask you for some general information about yourself.

Your participation in this study is voluntary and you may withdraw at any time without any consequence to you. If at any time during the interview, you do not know an answer or do not feel comfortable answering a question, we can skip to the next question. You are free to not answer any of the questions. May we start the interview now?"

☐ *INTERVIEWER CHECK THIS BOX IF RESPONDENT AGREES TO PARTICIPATE IN THE IN-PERSON INTERVIEW.*

3.0 24-HOUR DIETARY RECALL

The first part of the in-person interview is a 24-hour dietary recall. Words to be spoken by the interviewer are identified in bold. Each question will be asked in numeric order. Photographic and portion model displays will be available for use during questioning.

3.1 Fish Consumption

9. **"The first questions are about your fish consumption yesterday. Please consider what you ate yesterday. I am going to ask you about EACH time you ate. That would include meals, snacks, eating at home, eating at a friend's or relative's house or a purchase somewhere. It includes eating fish anywhere or at any time and in any amount. Did you eat any fish yesterday?"**

   ______ Yes

   ______ No

   ______ Don't know / Prefer not to answer

   If YES, continue to next Question #9a
   If NO or other, skip to next Section (4.0).

9a. "**Please think about the first time you ate yesterday Please enter a description (name, time, or number) for the first occasion where you ate fish yesterday (which includes finfish, shellfish, and seafood). Consider all meals and snacks, including fish within dishes such as soups. Include fish bought from a store, from a restaurant, or caught by you or someone else."** (Enter description or occasion number in Table A-3)

10. **"What type of fish did you eat?"** (Refer to species display, if needed, enter species type in Table A-3; see Table A-4 for list of species).

10a. **"How much of the** *(species type mentioned)* **did you eat?** (See quantity displays according to species type; enter portion size according to Table A-3a).

10b. **"How was the** *(species type mentioned)* **prepared or cooked?** (Unprompted, check box in Table A-3).

10c. **"Where did the** *(species type mentioned)* **come from? Was it from a market or store? Was it from a restaurant? Or was it caught by you or someone else (this includes Tribal distributions)?**

10d. **"Was it from Idaho waters or outside of Idaho?"** (Check box in Table A-3).

10e. "**Did you eat this species prepared in any other way or did you eat any other species of fish for** *(eating occasion mentioned)* **?"**

Repeat Question #9a for first/second/third species type or preparation method mentioned for that eating occasion and complete Table A-3.

______ Yes

______ No

If YES, repeat Question #10b above.
If NO, continue to next Question #11.

11. "**Please think about the NEXT time you ate yesterday; when was that (name the eating occasion)? Did you eat fish?** (Check)

______ Yes

______ No

______ Did not eat fish rest of day

If YES, repeat Question #9a above for up to 6 eating occasions.
If NO, repeat Question #11 for all eating occasions yesterday.
If "Did not eat fish rest of day," skip ahead to next section, Question #12.

Respondent ID: ____________

Table A-3. 24-Hr Recall: Types, Quantities, Methods, and Sources of Fish Eaten Yesterday

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
1		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
2		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*		Source *Check box*
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
3		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*		Source *Check box*
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
4		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
5		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught _______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught _______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught _______________ ☐ In Idaho ☐ Outside of Idaho
6		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught _______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*		Source *Check box*
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

1. “Description” refers to a distinct fish-eating occasion defined by the respondent (breakfast, lunch, dinner, snack, or a time or number).
2. See Table A-4 for species list; will be coded later as anadromous, freshwater resident, or marine fish and shellfish.

Table A-3a. Portion Size Model Displays: Description and Use

Display Type[1]	Display Numbers[2]	Display Description	What Display Represents	How Respondents Report Portion Size	Associated Mass of Real Fish
Salmon	S1 to S9	Large rubber salmon fillet, cut into 24 servings	Cooked salmon and other fish species with thick fillets	Identify multiples and/or fractions for sections 1 to 24 in 0.25 increments	Serving sections range from 1.5 oz. (42 g) to 6.8 oz. (192 g) of uncooked fish
Trout	T1 to T9	Small plastic trout fillet, single serving	Cooked trout and other fish species with thin fillets	Identify multiples and/or fractions of the fillet in 0.25 increments	One fillet is 3.0 oz. (85 g) of baked fish, or 4.0 oz. (113 g) of uncooked fish
Lamprey	L1 to L9	Gray PVC pipe, 2" diameter, 14" long, notched every 2" for 7 servings	Cooked adult lamprey (eel)	Identify multiples and/or fractions of the 2" servings in 0.25 increments	Each 2" serving is calculated to be 4.0 ounces (113 grams) of uncooked fish
Jerky	J1 to J9	Package of real "salmon candy" (dried fish pieces)	Dried pieces of salmon and other fish species	Identify multiples and/or fractions of the package in 0.25 increments	Packages range from 2.4 oz. (68 g) to 3.0 oz. (84 g) of dried fish, or 5.6 oz. (159 g) to 6.5 oz. (187 g) raw fish
Bowls	B1 to B9 (each is set of 5)	Empty plastic bowls (¼, ½, 1, 1½, and 2 cups) of different colors	Containers to hold fish soup, composite dishes	Identify multiples and/or fractions of a cup in 0.25 increments	1 cup of fish soup is estimated to include 0.25 cup of cooked fish (2 oz. or 57 g) or 2.5 oz. (72 g) raw fish
Crayfish	C1 to C9	Color photograph (laminated) of whole crayfish	Cooked crayfish	Identify number of organisms	1 crayfish contains 0.26 oz. (7.2 g) of uncooked edible meat
Mussels	M1 to M9	Color photograph (laminated) of plate with 6 half-shell mussels	Cooked mussels and other bivalve shellfish	Identify number of organisms	1 mussel contains 0.4 oz. (10 g) of uncooked edible tissue
Shrimp	S1 to S9	Color photograph (laminated) of plate with 6 shrimp	Cooked shrimp	Identify number of organisms	1 shrimp contains 1.6 oz. (44 g) of uncooked edible tissue
Other	N/A	Can or jar of fish (no display provided)	Fish (tuna, salmon) in a can or jar	Identify multiples and/or fractions of cans or jars in 0.25 increments	Standard tuna can is 5 oz. (142 g); mason jar is 8 oz (227 g)

Notes

1. A total of nine identical copies of each model display type will be available for use during interviews (five for NPT and four for SBT).
2. Display numbers are written in permanent marker on every model display, as well as contact information for Kristin Callahan, RIDOLFI, 206-436-2774, in the event there are questions or need for replacements.

" = inches

g = grams

oz. = ounces

3.2 Other Dietary Information

"Now I will ask you general questions about your diet."

12. "**Was the amount of fish you ate yesterday more, less, or about the same as usual?"** (Check)

    ______ More than usual

    ______ Less than usual

    ______ About the same as usual

13. "**Are you currently on any kind of diet, either to lose weight or for some other reason?"** (Check)

    ______ Yes

    ______ No

    ______ Prefer not to answer

4.0 FOOD FREQUENCY QUESTIONNAIRE

The second part of the in-person interview is a food frequency questionnaire (FFQ) based on the past year (12 months), and includes questions on dietary patterns and related activities that may affect fish consumption.

4.1 Fish Consumption

"Thank you for the information about fish you may have eaten yesterday. The next questions are about your fish consumption (and activities involving fish) over the past year."

1. Species, Frequency, Quantities

14. "**Did you eat fish in the past 12 months? That includes finfish, shellfish, and seafood. Consider all meals and snacks, including fish within dishes such as soups. Include fish bought from a store, from a restaurant, or caught by you or someone else. Did you eat fish in the past 12 months?"** (Check)

    ______ Yes

    ______ No

    If YES, continue to Question #15.
    If NO, ask **"Please consider ANY amount of fish you may have eaten in the past year."** If still NO, terminate interview (skip to Section 5.2, Interview End).

15. "**Please tell me which types of fish you ate in the past 12 months (including the fillet and any parts). For each fish type you say you have eaten, I will ask you how often you ate it and how much you usually ate. You will be able to respond according to two periods: when the fish is in-season and the rest of the year. Remember to consider breakfast, lunch, dinner, and snacks, and include fillets, stews, and other dishes. Do NOT include special events, such as feasts and ceremonies; I will ask about that later."**

    Substitute each species name listed in Table A-4 for each of the questions below, and complete the table accordingly. Be prepared to show species photographs, if necessary, and portion size displays. Ask all questions for each species one-by-one, and record frequency according to "in season" and the rest of the year and record portion sizes according to Table A-3a.

16. "**In the past 12 months, did you eat _____*(Species X)*___?"**

    If YES, check box in Table A-4 and continue to Question #17.
    If NO, repeat question for next species on list.

17. "**Did you eat about the same amount of** *(Species X)* **throughout the year or did you eat more during certain periods and less during other periods of the year?"**

If SAME, ask Questions #18-19 and complete Table A-4 for one period; enter length of period as 12 months. If contradiction occurs (e.g., reports only 3 months), ask "**what about the rest of the year?"** (and consider as NOT SAME below).

If NOT SAME, skip to Question #20 and complete Table A-4 for both high and low fish-eating periods.

18. "**In the past 12 months, how often did you eat** *(Species X)* **in any form (e.g. cooked or smoked fillets, dried, or soups)?"** Enter value and check the units (number of portions per day, per week, per month, or per year).

19. **Please tell me what your typical portion size was when you ate** (*Species X)*. **You may only choose ONE type of measurement, either enter the section numbers or one of the measurements below."** Refer to portion displays.

REPEAT Question #16 for each species type listed on Table A-4.

20. "**In the past 12 months, how often did you eat** *(Species X)* **in any form (e.g. cooked or smoked fillets, dried, or soups) when it was in season?"** Enter value and check the units (number of portions per day, per week, per month, or per year).

21. **Please tell me what your typical portion size was when you ate** (*Species X)* **when it was in season. You may only choose ONE type of measurement, either enter the section numbers or one of the measurements below."** Refer to portion displays.

22. "**Recognizing that past years may be different, how long was** *(Species X)* **in season (total in weeks or months)?**" Enter value in weeks or months.

23. "**In the past 12 months, how often did you eat** *(Species X)* **in any form (e.g. cooked or smoked fillets, dried, or soups) during the rest of the year ?** Enter value and check the units (number of portions per day, per week, per month, or per year).

24. **Please tell me what your typical portion size was when you ate** (*Species X)* **during the rest of the year. You may only choose ONE type of measurement, either enter the section numbers or one of the measurements below"** Refer to portion displays.

25. REPEAT Question #16 for each species type listed on Table A-4.

26. **"Are there any other fish or shellfish species that you ate in the past 12 months that we have not mentioned here?**"
REPEAT this question and Question #17 (series of questions).

Respondent ID: ____________

Table A-4. FFQ: Types, Frequency, and Quantity of Species Eaten in Past 12 Months

Fish Species[1]	Check if eaten	Consumption When Fish are In Season[2] Or Same Consumption Year Round				Consumption Rest of the Year (Blank if Same Consumption Year Round)			
		Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (weeks or months)	Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (auto-calculated)
SALMON AND STEELHEAD									
Chinook (King) Salmon			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Coho (Silver) Salmon			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Sockeye (Red) Salmon			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Kokanee (resident form of sockeye)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Steelhead (migratory form of rainbow trout)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other salmon species (specify, e.g., Chum, Pink, Atlantic salmon)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
All salmon and steelhead / species not identified			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
RESIDENT TROUT									
Rainbow Trout			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Cutthroat Trout			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Cutbow Trout (hybrid of Rainbow and Cutthroat Trout)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Bull Trout (Dolly Varden)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Brook Trout			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Lake Trout			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Brown Trout			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other trout species (specify)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
All resident trout / species not identified			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.

Respondent ID: ____________

Fish Species[1]	Check if eaten	Consumption When Fish are In Season[2] Or Same Consumption Year Round				Consumption Rest of the Year (Blank if Same Consumption Year Round)			
		Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (weeks or months)	Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (auto-calculated)
OTHER FRESHWATER FISH AND SHELLFISH									
Sturgeon			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Lamprey			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Whitefish			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Sucker			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Burbot			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Northern Pikeminnow (Squawfish)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Bass			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Bluegill			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Carp			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Catfish			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Crappie			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Sunfish			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Tilapia			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Walleye			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Yellow Perch			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other freshwater finfish (specify)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Crayfish			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Freshwater Clams or Mussels			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Unspecified freshwater fish			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
SEAFOOD / MARINE FISH AND SHELLFISH									

Fish Species[1]	Check if eaten	Consumption When Fish are In Season[2] Or Same Consumption Year Round				Consumption Rest of the Year (Blank if Same Consumption Year Round)			
		Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (weeks or months)	Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)[3]	Length of period (auto-calculated)
Cod			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Halibut			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Pollock			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Tuna			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Lobster			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Crab			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Marine Clams or Mussels			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Shrimp			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other marine fish or shellfish (Specify)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other marine fish or shellfish (Specify)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
Other marine fish or shellfish (Specify)			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
UNSPECIFIED FISH OR SHELLFISH SPECIES			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.

Notes

1. Species are listed and grouped according to the most commonly eaten types of fish and shellfish.
2. Fish consumption “in season” is based on respondents perception or experience related to harvest and assumed higher consumption (compared to the rest of the year); biological seasons (e.g., fish runs) will be evaluated during data analysis and do not have to correspond to the duration of seasons noted by the respondent.
3. See 24-hour dietary recall (Table A-3) for examples of portion size data to enter according to species type (e.g., salmon, trout, lamprey, shellfish) or preparation method (jerky, bowls of soup). A description of the portion displays is provided in Table A-3a above.

2. Parts of Fish Consumed, Preparation Methods, and Sources

The next questions are about the parts of fish you eat, methods of preparation, and sources (where acquired) according to species groups. Those groups are 1) salmon and steelhead, 2) trout species, 3) sturgeon, and 4) suckers and whitefish." Complete Table A-5 for the following questions.

27. "**When you eat a fish fillet, what percent of the time do you eat the following species of fish with skin?"**

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Record answers in percent (including zero) or leave blank if that species type is not consumed at all. Complete Table A-5.

28. "**When you eat** _(species group)_ **, what percent of the time do you eat the eggs and what percent of the time do you eat other organs (including head and bones)?"**

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Record answers in percent (including zero) or select "Not Applicable" if that species type is not consumed at all. Complete Table A-5.

29. **"Thinking about how the fish that you eat is prepared, what percent of the time that you eat** _(species group)_ **is it: baked or broiled? smoked? dried? in a soup? or other method (specify)? Your answers should total 100%."**

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Complete Table A-5.

30. "**Thinking about where the fish comes from that you eat, what percent of the time do you get** _(species type)_ **from the following sources? Your answers should total 100%.**"
    - **Bought from a store (grocery or market)?**
    - **From a restaurant?**
    - **Caught by you or someone else in Idaho waters, including Tribal distributions?**
    - **Caught by you or someone else outside of Idaho waters, including Tribal distributions?**

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Complete Table A-5.

Table A-5. FFQ: Fish Parts Eaten, Preparation Methods, and Sources

Species Group:	Salmon and Steelhead	Trout	Sturgeon	Suckers and Whitefish
Percent of Time Typically Eat:				
Skin				
Eggs				
Head, bone, and/or organs				
Percent of Time Typically Prepare (total 100%):				
Baked or broiled				
Smoked				
Dried				
In a soup				
Other:				
Don’t know				
Percent of Time Typically Obtained (total 100%):				
Bought from a store (grocery or market)				
From a restaurant				
Caught by you or someone else (in Idaho waters)				
Caught by you or someone else (outside of Idaho)				
Other:				
Don’t know				

4.2 Special Events and Gatherings

"I will now ask questions related to your fish consumption during special events and gatherings, including ceremonies or other community events." Complete Table A-6 for the following questions.

31. **"In the past 12 months, how many special events and gatherings did you attend (either per week, month or year)?"** (Enter number and circle one unit)
    ____________ Events per Week / Month / Year

    If zero, skip to next section (4.3), Question #35.

32. "**Did you eat fish in any form (e.g. cooked or smoked fillets, dried, or soups) at these special events and gatherings, such as 1) salmon and steelhead, 2) trout, 3) sturgeon, 4) suckers or whitefish?"** (Circle answer in Table A-6)

    ______ Yes

    ______ No

    ______ Don't know / Prefer not to answer

    If YES continue to next question
    If NO or other, skip to next section (4.3), Question #35.

33. **"What was your typical portion size for the following species at the special events and gatherings? You may only choose ONE type of measurement, either enter the section numbers or one of the measurements below."**

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Complete Table A-6. (See portion models.)

34. "**At what percent of the special events and gatherings did you eat** *(species group)* **?**"

    ASK question for 1) salmon and steelhead, 2) trout, 3) sturgeon, and 4) suckers and whitefish. Complete Table A-6.

Table A-6. FFQ: Fish Consumption at Gatherings

Species Group	**Consumed** (circle)	**Typical Portion Size** *(enter sections, fillets, packages, cups– see Table A-4a for model list)*	**Percent of time eat fish at gatherings**
Salmon and Steelhead	YES NO		%
Trout	YES NO		%
Sturgeon	YES NO		%
Suckers and Whitefish	YES NO		%

4.3 Fishing Activities

"I am now going to ask you some questions about fishing."

35. "**Over the past 12 months, did you take part in any fishing-related activities?**" (Check)

    ______ Yes

    ______ No

    ______ Prefer not to answer

    If YES, continue to next question.

35a. If NO, ask **"Why not"**? (Check and skip to next section)
    If prefer not to answer, skip to next section.

    ______ Fish advisories

    ______ Pollution

    ______ Other environmental concerns

    ______ Not enough fish available to catch

    ______ Limited access to fishing areas

    ______ Used to access to boat/fishing gear, not anymore

    ______ Too far from fishing areas

    ______ Too busy, no time

______ No longer custom, prefer other activities

______ Prefer other foods

______ Don't know how to fish

______ Prefer not to answer

______ Other ____

36. "**Now I'm going to ask you the approximate number of times you went fishing (for fish and shellfish) each month. How many times did you go fishing during each of the following months?"** (List and enter value for each)

______ Times in January

______ Times in February

______ Times in March

______ Times in April

______ Times in May

______ Times in June

______ Times in July

______ Times in August

______ Times in September

______ Times in October

______ Times in November

______ Times in December

37. "**What percent of the fish that you harvest do you keep for you and your household, what percent do you give/distribute to others outside your household, and what percent do you sell (your answers should total 100%)?**" (Enter)

______ Percent Keep

______ Percent Give to others

______ Percent Sell

100% Total

38. "**Do you own or have access to fishing gear?**" (Check)

______ Yes

______ No

______ Prefer not to answer

39. "**Do you own or have access to a boat?**" (Check)

______ Yes

______ No

______ Prefer not to answer

4.4 Changes in Fish Consumption

"I am now going to ask you questions about changes in fish consumption and availability. Some of these may be open-ended questions. We do not intend to collect ANY culturally-sensitive information."

40. "**Has there been a change over time in your fish consumption?**" (Check)

______ Yes

______ No

______ Don't know / Prefer not to answer

If YES, continue to next question.

If NO or other, skip to Question #41.

40a. "**How has it changed most recently?"** (Check)

______ Increased consumption

______ Decreased consumption

______ Other change (e.g., available species)____________________________________

40b. “**When did it change?”**

______ Within past 5 years
______ In the 2000s (or 5 to 15 years ago)
______ In the 1990s (or 15 to 25 years ago)
______ In the 1980s (or 25 to 35 years ago)
______ In the 1970s (or 35-45 years ago)
______ In the 1960s or earlier (more than 45 years ago)

40c. “**Why did it change?”** (Multiple choice options may be developed in Pilot Test)

____

____

41. “**In the past, how important was fish to your Tribe’s heritage and culture?**”

______ Very important
______ Somewhat important
______ Not important
______ Don’t know / Prefer not to answer

41a. “**Currently, how important is fish to your Tribe’s heritage and culture?**”

______ Very important
______ Somewhat important
______ Not important
______ Don’t know / Prefer not to answer /

42. “**Has there been a change in access to fish and fishing (for you or others) over time?**” (Check)

______ Yes

______ No

______ Don’t know / Prefer not to answer /

If YES, continue to next question.

If NO or other, skip to Question #43.

42a. “**How has it changed?”** (Check)

______ More access to fishing

______ Less access to fishing

______ Other change____

42b. “**When did it change?”**

______ Within past 5 years

______ In the 2000s (or 5 to 15 years ago)

______ In the 1990s (or 15 to 25 years ago)

______ In the 1980s (or 25 to 35 years ago)

______ In the 1970s (or 35-45 years ago)

______ In the 1960s or earlier (more than 45 years ago)

42c. “**Why did it change?”** (Multiple choice options may be developed in Pilot Test)

____

____

43. "**Has there been a change in how often you fish (for you or others)?**" (Check)

______ Yes
______ No
______ Don't know / Prefer not to answer

If YES, continue to next question.
If NO or other, skip to Question #44.

43a. "**How has it changed most recently?**" (Check)

______ Increased frequency
______ Decreased frequency
______ Other change ____

43b. "**When did it change?**"

______ Within past 5 years
______ In the 2000s (or 5 to 15 years ago)
______ In the 1990s (or 15 to 25 years ago)
______ In the 1980s (or 25 to 35 years ago)
______ In the 1970s (or 35-45 years ago)
______ In the 1960s or earlier (more than 45 years ago)

43c. "**Why did it change?**" (Multiple choice options may be developed in Pilot Test)

____

____

44. “**Has there been a change in the way you prepare or use fish?**” (Check)

______ Yes

______ No

______ Don’t know / Prefer not to answer /

If YES, continue to next question.

If NO or other, skip to Question #45.

44a. “**How has it changed most recently?”**

______ Different cooking method

______ Different use

______ Don’t know / Prefer not to answer /

44b. “**When did it change?”**

______ Within past 5 years

______ In the 2000s (or 5 to 15 years ago)

______ In the 1990s (or 15 to 25 years ago)

______ In the 1980s (or 25 to 35 years ago)

______ In the 1970s (or 35-45 years ago)

______ In the 1960s or earlier (more than 45 years ago)

44c. “**Why did it change?”** (Multiple choice options may be developed in Pilot Test)

____

____

45. "**Compared to your fish consumption now, how much/how frequently would you like to consume fish in the future?**" (Check)

______ Increase consumption

______ Decrease consumption

______ Maintain same consumption

______ Don't know / Prefer not to answer

If INCREASED, continue to next question.

If DECREASED or other, skip to next section.

46. "**If you prefer to eat more fish or seafood than you're currently eating, what would have to occur for you to eat that amount in the future?**"

____

____

____

____

5.0 GENERAL INFORMATION

The third and final part of the in-person interview involves collecting general information from the respondent and recording final administrative data.

5.1 Respondent Information

Respondents will be asked demographic questions as well as (for female respondents) questions related to breastfeeding history.

1. Demographic Information

"This is the final part of the interview. I have a few general questions and then we will be done. These include reporting your height and weight, which will help us to calculate and check fish consumption rates, and reporting education and income ranges, which will help us determine fish consumption rates for various population groups." (Check or enter – if respondent prefers not to say, enter 999)

47. Gender (check):

______ Male

______ Female

48. **"What is your age?"** ____________ (years)

49. **"What is your height?"** ____________ feet ____________ inches

50. **"How much do you weigh?"** ____________ pounds

51. "**How many people live in your household, including yourself?**" ____________

52. "**Do you live on your Tribe's Reservation?**" (Check)

______ Yes

______ No

______ Prefer not to answer

53. "**What is the highest level of education that you've completed?**" (Check)

______ Elementary School

______ Middle School

______ High School / GED

______ Associates Degree

______ Bachelor's Degree

______ Master's Degree

______ Doctorate

______ Prefer not to answer

54. "**What is your approximate household income per year?**" (List all options below, except "prefer not to say" and check)

______ $15,000 or less

______ More than $15,000 up to $25,000

______ More than $25,000 up to $35,000

______ More than $35,000 up to $45,000

______ More than $45,000 up to $55,000

______ More than $55,000 up to $65,000

______ More than $65,000

______ Prefer not to answer

2. Breastfeeding History

The following questions are for female respondents only; if male, skip to next section.

55. "**Have you ever given birth?** (Check)

______ Yes

______ No

______ Prefer not to answer

If YES, continue to next question.

Otherwise, skip to next section.

56. "**When did you most recently give birth?** _/_____ (MM, YYYY)

57. "**Was this baby ever breastfed or fed breast milk**? (Check)

______ Yes

______ No

______ Prefer not to answer

If YES, continue to next question.

Otherwise, skip to next section.

58. "**If the youngest child is no longer breastfeeding, at what age did you stop feeding breast milk to this child?"** (Provide in months or check other option)

______ Stopped at ________ (months old)

______ Still breastfeeding

______ Prefer not to answer

______ Not applicable (not biological mother, etc.)

5.2 Interview End

Upon completing the interview, the interviewer will offer appreciation and complete the remaining administrative information, including signing a form verifying participation.

"This concludes the interview. If any of your answers included culturally-sensitive information, please tell me.

______ Yes, included culturally sensitive information

______ No culturally sensitive information included

______ Don't know / Prefer not to answer

If YES, this questionnaire will be reviewed by a Tribal official and culturally sensitive information may be edited or redacted prior to further analysis and review.

Thank you SO very much for your time and cooperation today. Your participation will contribute significantly to the overall success of this survey and help protect the health of our Tribe. It would also benefit the survey if you could participate in a second, follow-up interview over the phone in the next one to four weeks. This second interview will be much shorter and should only take about 15 minutes."

59. **"Is it okay if I contact you again for a follow-up call?"**

______ Yes

______ No

59a. If YES, "**what is the best phone number to reach you?**" ____________

59b. If YES, "**Thank you. I am going to leave photographs of the portion display models with you so that you will have them for reference when I call.**" Leave actual-size photographs of models with the respondent.

59c. If NO, remind respondent of the importance of this study and ask again.

60. "**Thank you again for your time today, that is all**." Complete information below.

Record interview end time and calculate interview length.

61. End time: __________________ AM / PM (circle)

62. Length of interview: ________________________ (hours and/or minutes)

63. Was the interview conducted in private or were others present? (Check)

______ In private

______ Others were present

5.3 Post-Interview

Following the interview, the interviewer will assess and record the respondent's level of participation and the interviewer will acknowledge that he/she recorded the information truthfully and to the best of his/her ability by signing the following guarantee of authenticity.

1. Interview Quality

64. Respondents cooperation: (Check)

______ Very good

______ Good

______ Fair

______ Poor

65. Respondent's reliability: (Check)

______ Highly reliable

______ Generally reliable

______ Questionable

______ Unreliable

Notes / Reasons for opinions:

____

____

____

66. Note any topics or specific questions that appeared confusing or particularly challenging for the respondent to answer.

____

____

____

____

____

____

2. Interviewer Guarantee of Authenticity

67. I, ________________________________ (printed name of interviewer) hereby affirm that the answers recorded on this questionnaire reflect a complete and accurate accounting of my interview with the respondent.

____

Signature of Interviewer

____

Date

6.0 SECOND 24-HOUR DIETARY RECALL

Based on the results of the first interview, which includes a 24-hour dietary recall, food frequency questionnaire, and general demographic information, a subset of individuals will be selected as "high" fish consumers for participation in a second 24-hour dietary recall by telephone. Words to be spoken by the interviewer are identified in bold. Questions will be asked in numeric order.

6.1 Administrative Information

Since this telephone interview will be conducted at a later date, general administrative information will be completed similar to the first interview (prior to questioning the respondent).

1. Interviewer Identification

1. Interviewer Name ________________________________
2. Interviewer ID: ______________________

2. Respondent Identification

3. Respondent ID: ______________________
4. Phone number: ______________________

3. Interview Date, Time, and Location

5. Date: ______/_____/______ (MM/DD/YYYY)
6. Day (of the week): ________________
7. Start time: ________________ AM / PM (circle)
8. City, State: ______________________________________

6.2 Introduction

"Hello, my name is _____, and I am calling on behalf of the _______ Tribe. We appreciate your continued willingness to participate in our fish consumption survey.

The information you provide during this follow-up interview, as well as your previous answers, plus the information of other Tribal members, will help us understand the rates of fish consumption, how fish is prepared, and the species or types of fish regularly eaten by members of the _______ Tribe.

The information that you provide during this interview is confidential. Your responses to the questions will be combined with those of others so that your answers cannot be identified. If you have any questions, please refer to the information sheet I gave you previously.

This follow-up survey is much shorter and should only take about 15 minutes. I will ask you to tell me how much fish you ate in the last 24 hours. Please refer to the photographs I left with you previously. If you do not know an answer or do not feel comfortable answering, we can skip that question. You are free to not answer any of the questions. May we start the interview now?"

☐ *INTERVIEWER CHECK THIS BOX IF RESPONDENT AGREES TO PARTICIPATE IN THE FOLLOW-UP TELEPHONE INTERVIEW.*

6.3 Fish Consumption

9. **"The first questions are about your fish consumption yesterday. Please consider what you ate yesterday. I am going to ask you about EACH time you ate. That would include meals, snacks, eating at home, eating at a friend's or relative's house or a purchase somewhere. It includes eating fish anywhere or at any time and in any amount. Did you eat any fish yesterday?"**

   ______ Yes

   ______ No

   ______ Don't know / Prefer not to answer

   If YES, continue to next Question #9a
   If NO or Other, skip to next Section (6.5), Question #14.

9a. "**Please think about the first time you ate yesterday Please enter a description (name, time, or number) for the first occasion where you ate fish yesterday (which includes finfish, shellfish, and seafood). Consider all meals and snacks, including fish within dishes such as soups. Include fish bought from a store, from a restaurant, or caught by you or someone else."** (Enter description or occasion number in Table A-7)

10. **"What type of fish did you eat?"** (Refer to species display, if needed, enter species type in Table A-7; see Table A-4 above for list of species).

10a. **"How much of the** *(species type mentioned)* **did you eat?** (See quantity displays according to species type; enter portion size according to Table A-7a).

10b. **"How was the** *(species type mentioned)* **prepared or cooked?** (Unprompted, check box in Table A-7).

10c. **"Where did the** *(species type mentioned)* **come from? Was it from a market or store? Was it from a restaurant? Or was it caught by you or someone else (this includes Tribal distributions)?**

10d. **"Was it from Idaho waters or outside of Idaho?"** (Check box in Table A-7).

10e. "**Did you eat this species prepared in any other way or did you eat any other species of fish for** *(eating occasion mentioned) ?"*

11. "**Please think about the NEXT time you ate yesterday; when was that (name the eating occasion)? Did you eat fish?** (Check)

______ Yes

______ No

______ Did not eat fish rest of day

If YES, repeat Question #10 above for up to 6 eating occasions.
If NO, repeat Question #11 for all eating occasions yesterday.
If "Did not eat fish rest of day," skip ahead to next section, Question #12

Respondent ID: ____________

Table A-7. 24-Hr Recall: Types, Quantities, Methods, and Sources of Fish Eaten Yesterday

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
1		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
2		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
3		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
4		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*	Source *Check box*
5		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
6		Species 1:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Stew, Soup ☐ Baked / Roasted ☐ Canned, Pickled ☐ Broiled / Grilled ☐ Microwaved ☐ Poached / Boiled ☐ Raw / Uncooked ☐ Dried, Smoked, Salted ☐ Other, Unknown ☐ Casserole, Mixed Dish	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

Respondent ID: ____________

Occasion # & Description[1]		Species Type[2]	Portion Size / Quantity *See Displays (enter display #)*	Preparation / Cooking Method *Check box*		Source *Check box*
		Species 2:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho
		Species 3:	Salmon sections #s ________ Trout (thin) fillets: __________ Lamprey sections: _________ Jerky packages: ___________ Soup bowls: __________ cups Shellfish (organisms): __________	☐ Fried / Sauteed ☐ Baked / Roasted ☐ Broiled / Grilled ☐ Poached / Boiled ☐ Dried, Smoked, Salted ☐ Casserole, Mixed Dish	☐ Stew, Soup ☐ Canned, Pickled ☐ Microwaved ☐ Raw / Uncooked ☐ Other, Unknown	☐ Market / Store ☐ Restaurant ☐ Caught ______________ ☐ In Idaho ☐ Outside of Idaho

1. "Description" refers to a distinct fish-eating occasion defined by the respondent (breakfast, lunch, dinner, snack, or a time or number).
2. See Table A-4 for species list; will be coded later as anadromous, freshwater resident, or marine fish and shellfish.

Table A-7a. Portion Size Model Displays: Description and Use

Display Type[1]	Display Numbers[2]	Display Description	What Display Represents	How Respondents Report Portion Size	Associated Mass of Real Fish
Salmon	S1 to S9	Large rubber salmon fillet, cut into 24 servings	Cooked salmon and other fish species with thick fillets	Identify multiples and/or fractions for sections 1 to 24 in 0.25 increments	Serving sections range from 1.5 oz. (42 g) to 6.8 oz. (192 g) of uncooked fish
Trout	T1 to T9	Small plastic trout fillet, single serving	Cooked trout and other fish species with thin fillets	Identify multiples and/or fractions of the fillet in 0.25 increments	One fillet is 3.0 oz. (85 g) of baked fish, or 4.0 oz. (113 g) of uncooked fish
Lamprey	L1 to L9	Gray PVC pipe, 2" diameter, 14" long, notched every 2" for 7 servings	Cooked adult lamprey (eel)	Identify multiples and/or fractions of the 2" servings in 0.25 increments	Each 2" serving is calculated to be 4.0 ounces (113 grams) of uncooked fish
Jerky	J1 to J9	Package of real "salmon candy" (dried fish pieces)	Dried pieces of salmon and other fish species	Identify multiples and/or fractions of the package in 0.25 increments	Packages range from 2.4 oz. (68 g) to 3.0 oz. (84 g) of dried fish, or 5.6 oz. (159 g) to 6.5 oz. (187 g) raw fish
Bowls	B1 to B9 (each is set of 5)	Empty plastic bowls (¼, ½, 1, 1½, and 2 cups) of different colors	Containers to hold fish soup, composite dishes	Identify multiples and/or fractions of a cup in 0.25 increments	1 cup of fish soup is estimated to include 0.25 cup of cooked fish (2 oz. or 57 g) or 2.5 oz. (72 g) raw fish
Crayfish	C1 to C9	Color photograph (laminated) of whole crayfish	Cooked crayfish	Identify number of organisms	1 crayfish contains 0.26 oz. (7.2 g) of uncooked edible meat
Mussels	M1 to M9	Color photograph (laminated) of plate with 6 half-shell mussels	Cooked mussels and other bivalve shellfish	Identify number of organisms	1 mussel contains 0.4 oz. (10 g) of uncooked edible tissue
Shrimp	S1 to S9	Color photograph (laminated) of plate with 6 shrimp	Cooked shrimp	Identify number of organisms	1 shrimp contains 1.6 oz. (44 g) of uncooked edible tissue
Other	N/A	Can or jar of fish (no display provided)	Fish (tuna, salmon) in a can or jar	Identify multiples and/or fractions of cans or jars in 0.25 increments	Standard tuna can is 5 oz. (142 g); mason jar is 8 oz (227 g)

Notes

1. A total of nine identical copies of each model display type will be available for use during interviews (five for NPT and four for SBT).
2. Display numbers are written in permanent marker on every model display, as well as contact information for Kristin Callahan, RIDOLFI, 206-436-2774, in the event there are questions or need for replacements.

" = inches
g = grams
oz. = ounces

6.4 Other Dietary Information

"Now I will ask you general questions about your diet."

12. "**Was the amount of fish you ate yesterday more, less, or about the same as usual?"** (Check)

    ______ More than usual

    ______ Less than usual

    ______ About the same as usual

13. "**Are you currently on any kind of diet, either to lose weight or for some other reason?"** (Check)

    ______ Yes

    ______ No

    ______ Prefer not to answer

"This concludes the interview. Thank you SO very much for your time and cooperation today. Your participation will contribute significantly to the overall success of this survey and help protect the health of our Tribe. We will be calling a few people back just as a quality control measure. Thanks again for your time; that is all."

6.5 Post-Interview

Following the interview, the interviewer will record the telephone interview end time and length and acknowledge that he/she recorded the information truthfully and to the best of his/her ability by signing the following guarantee of authenticity.

Respondent ID: ____________

Record interview end time and calculate interview length.

14. End time: __________________ AM / PM (circle)

15. Length of interview: ________________________ (hours and/or minutes)

16. I, __________________________________ (printed name of interviewer) hereby affirm that the answers recorded on this questionnaire reflect a complete and accurate accounting of my interview with the respondent.

____

Signature of Interviewer

____

Date

RE-INTERVIEW QUESTIONNAIRE

7.0 INTERVIEW INTRODUCTION

Contact attempts (up to 7 attempts) will be made at varying days of the week and times of day. If no contact is made before the maximum number of attempts or by the end of the permitted one-month period (whichever comes first), contact attempts will be terminated. Upon contact by phone, the interviewer will record answers to re-interview questions.

0. Note outcome of contact attempts here:

______ No reinterview, maximum no. of attempts reached

______ No reinterview, respondent refused

______ Reinterview commenced, responses below.

11. **"Hello, I'm calling on behalf of** ___*(name of Tribe and department)*__. **May I please speak with** __*(name of respondent)*__**?"**

    ______ Yes

    ______ No

    If YES and respondent is speaking or when the respondent comes to the telephone, continue to Question #2.

    If NO, probe if he/she lives there, and if so, ask "**When is the best time to reach him/her?** (Record on log) "**Okay, thank you for your time. Good bye."**

    If NO, not living there, ask "**What is the best way to reach him/her?** (Record new number on log) "**Okay, thank you for your time. Good bye."**

12. **"Hello, my name is** *(your name)* **."** Reintroduce Tribe if necessary**. "I am calling to thank you for your participation in our fish consumption survey. Can you please confirm that you participated in the first interview for this survey?** (Check)

    ______ Yes, did participate

    ______ No

    ______ Do not remember

    If YES, continue to Question #3.

    If NO or Do not remember, probe by reminding him/her of the interview date, if he/she has a relative of the same name, etc.; otherwise, record on log, "**Okay, thank you for your time. Good bye."**

13. **Great, I am calling to ask just a couple of the same questions for verification purposes. We do this to make sure we recorded it correctly the first time. The**

information that you provide is confidential. Today's survey takes less than 5 minutes. May we begin?"

If YES, **"Thank you for agreeing to participate,"** check box below and continue to Question #4.

☐ Interviewer: check this box if respondent agrees to participate in the telephone verification interview.

If NO, ask "**When is a good time to call back?** (Record notes for re-contact as needed) "**Okay, thank you for your time. Good bye.**"

14. When starting interview, record re-interview call information:

Date: ______/_____/______ (mm/dd/yyyy)

Day (of the week): ___________________

Start time: ___________________ AM / PM *(circle)*

15. The number of contact attempts needed to reach and re-interview this respondent, including the successful re-interview, was ______. (note number)

8.0 INTERVIEW QUESTIONS

Questions from the original FFQ will be asked again for quality control purposes. Words to be spoken by the interviewer are identified in bold. Each question will be asked in numeric order. No photographic or portion model displays will be necessary.

"Thinking about your fish consumption in the past year,"

8.1 Chinook Salmon Consumption

68. "**In the past 12 months, did you eat Chinook salmon?"**

    If YES, check box in Table 1 and continue to Question #3.
    If NO, continue with Question #2.

69. **"Thank you. Just to be thorough, is it possible that during the past year you ate Chinook Salmon at a restaurant, a friend's house or another place, or someone brought fish to you?"**

    ______ Yes

    ______ No

    If YES, continue to QUESTION EXPLANATION below, then Question #3.

    If NO, skip to Question #8.

    QUESTION EXPLANATION

    "Please tell me about how much Chinook salmon you ate in the past 12 months (including the fillet and any parts). I will ask you how often you ate it. You will be able to respond according to two periods: when Chinook salmon is in-season and the rest of the year. Remember to consider breakfast, lunch, dinner, and snacks, and include fillets, stews, and other dishes. Do NOT include special events, such as feasts and ceremonies.

70. "**Did you eat about the same amount of Chinook salmon throughout the year, or did you eat more during certain periods and less during other periods of the year?"**

    _____Same

    _____Not same

    _____Don't know.refused

If SAME, ask Question #4 (but not Questions #5, #6 and #7), and complete Table 1 for one period; enter length of period as 12 months. If contradiction occurs (e.g., reports only 3 months), ask "**what about the rest of the year?"** (and consider as NOT SAME below).

If NOT SAME, skip to Questions #5, #6 and #7 and complete Table 1 for both high and low fish-eating periods.

71. "**In the past 12 months, how often did you eat Chinook salmon in any form (e.g., cooked or smoked fillets, dried, or soups)?"** Enter value and check the units (number of portions per day, per week, per month, or per year).

    Skip to Question #8.

72. "**In the past 12 months, how often did you eat Chinook salmon in any form (e.g., cooked or smoked fillets, dried, or soups) when it was in season?"** Enter value and check the units (number of portions per day, per week, per month, or per year). Record in Table 1.

73. "**Recognizing that past years may be different, how long was Chinook salmon in season (total in weeks or months)?**" Enter value in weeks or months.

74. "**In the past 12 months, how often did you eat Chinook salmon <u>in any form</u> (e.g., cooked or smoked fillets, dried, or soups) during the rest of the year?** Enter value and check the units (number of portions per day, per week, per month, or per year).

Table 1. FFQ: Frequency and Quantity of Chinook Salmon Eaten in Past 12 Months

Fish Species	Check if eaten	Consumption When Fish are In Season[1] Or Same Consumption Year Round				Consumption Rest of the Year (Blank if Same Consumption Year Round)			
		Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)	Length of period (weeks or months)	Number of Portions	Portions per day, week, month, or year (circle)	Typical Portion Size (& display #)	Length of period (auto-calculated)
Chinook (King) Salmon			Day Wk. Mo. Yr.	NOT ASKED	Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.

Notes

1. Fish consumption "in season" is based on respondent's perception or experience related to harvest and assumed higher consumption (compared to the rest of the year); biological seasons (e.g., fish runs) will be evaluated during data analysis and do not have to correspond to the duration of seasons noted by the respondent.

8.2 Changes in Fish Consumption.

"The next two questions refer to your consumption of any species of fish, not just Chinook Salmon." Note, this interviewer's introductory sentence does not appear in the original questionnaire or in the CAPI software (see section 5.8 of Volume II). It is added here because the theme just prior to this has been about consumption of Chinook salmon.

75. "**Has there been a change over time in your fish consumption?**" (Check)

______ Yes

______ No

______ Prefer not to answer / Don't know

If YES, continue to Question #9.

If NO or PREFER NOT TO ANSWER/DON'T KNOW, skip to Question #10.

76. **"How has it changed most recently?"** (Check)

______ Increased consumption

______ Decreased consumption

______ Other change (simply note if there has been a change that is not either 'increased' or 'decreased')

Technical note: The responses to this question have been modified from the original question in the full questionnaire by dropping the 'specify' entry for what 'other change' represents.

8.3 Demographic Information

(Check or enter – if respondent prefers not to say, enter 999)

77. "**How many people live in your household, including yourself?**"______

9.0 INTERVIEW END

Upon completing the interview, the interviewer will offer appreciation and complete the remaining information, including signing a form verifying participation.

78. **“Thank you SO much for your time and cooperation.”** Complete information below.

Record telephone verification interview end time.

79. End time: __________________ AM / PM (circle)

80. Record the circumstances of the re-interview.

81. The interview was conducted (check one)

_______By phone

_______In person

Following the interview, the interviewer will acknowledge that he/she recorded the information truthfully and to the best of his/her ability by signing the following guarantee of authenticity.

I, __________________________________ (printed name of interviewer) hereby affirm that the answers recorded on this questionnaire reflect a complete and accurate accounting of my verification interview with the respondent.

____

Signature of Interviewer

____

Date

Appendix B—
Portion-to-Mass Conversion

Appendix B—Portion-to-Mass Conversion

Fish Consumption Survey

Portion Model Displays and Mass Calculations

For dietary assessments where food items are not weighed, portion sizes must be used (with frequency of consumption) to calculate consumption rates (Wrieden, et al., 2003). The U.S. Department of Agriculture (USDA), in partnership with the Centers for Disease Control and Prevention (CDC), uses 3-D food models for in-person interviews and 2-D photographs for follow-up telephone interviews to collect dietary information as part of the National Health and Nutrition Examination Survey (NHANES) (USDA, 2013). A similar approach has been successfully used for Tribal fish consumption surveys in California where University of California Davis researchers use 3-D fish fillet models of varying pre-determined masses to estimate Tribal fish consumption rates (Shilling, 2014). The USDA recommends that models represent foods “as consumed” as much as possible (for most accurate reporting); i.e., familiar in appearance and preparation method (Moshfegh, 2014). Broadly, the models used in this survey can be grouped into three types: life size depictions of fish portions (e.g. fillets), depictions of numbers of organisms consumed per serving (e.g. shellfish), or volumes of tissue or composite dishes consumed (e.g. bowls for fish meat or soup containing fish). The U.S. Environmental Protection Agency (USEPA) recommends reporting the portions in uncooked weights, however, since contaminant concentrations are measured in raw fish tissue (Kissinger, 2014). Recognizing that fish is eaten in various forms, bowls may be used as a measuring guide for fish stews and other composite dishes; although a standard recipe must be determined in advance to equate the bowl quantity to fish mass. Some respondents to this survey also reported consumption of fish tissue in volumetric terms. For example, consumption of crab meat might be reported in terms of cups of crab meat consumed. Once respondents are familiar with the models, photographs of the models can be given to respondents for the follow-up telephone interviews (CDC, 2010).

The list of common species used during the interviews to determine fish consumption is provided in Table B1 below. The fish model displays used to determine portion sizes consumed of those species are described in Table B2, followed by photographs and a discussion of the models and the mass calculations. There were nine to 11 copies of each display type, depending on the number of interviewers and whether replacements were necessary during the survey. The model displays, which represent common species and preparation methods, included the following:

1. Large cooked salmon fillet replica, cut into servings
2. Small cooked trout fillet replica, single serving
3. PVC pipe to represent lamprey
4. Fish jerky pieces (real, packaged) to represent dried fish
5. Measuring bowls for soups and composite dishes
6. Photographs of shellfish, including mussels, crayfish, and shrimp

Table B1. Survey Species List

SALMON AND STEELHEAD
Chinook (King) Salmon
Coho (Silver) Salmon
Sockeye (Red) Salmon
Kokanee (resident form of sockeye)
Steelhead (migratory form of rainbow trout)
Other salmon species (specify, e.g., Chum, Pink, Atlantic salmon)
RESIDENT TROUT
Rainbow Trout
Cutthroat Trout
Cutbow Trout (hybrid of Rainbow and Cutthroat Trout)
Bull Trout (Dolly Varden)
Brook Trout
Lake Trout
Brown Trout
Other trout species (specify)
OTHER FRESHWATER FISH AND SHELLFISH
Sturgeon
Lamprey
Whitefish
Sucker
Burbot
Northern Pikeminnow (Squawfish)
Bass
Bluegill
Carp
Catfish
Crappie
Sunfish
Tilapia
Walleye
Yellow Perch
Other freshwater finfish (specify)
Crayfish
Freshwater Clams or Mussels
SEAFOOD / MARINE FISH AND SHELLFISH
Cod
Halibut
Pollock
Tuna
Lobster
Crab
Marine Clams or Mussels
Shrimp
Other marine fish or shellfish (specify)

Table B2. Description of Portion Size Model Displays

Display Type[1]	Display Numbers[2]	Display Description	What Display Represents	How Respondents Report Portion	Associated Mass of Uncooked Fish
Salmon	S1 to S9	Large rubber salmon fillet, cut into 24 servings	Cooked salmon and other fish species with thick fillets	Identify multiples and/or fractions for sections 1 to 24 in 0.25 increments	Servings range from 1.5 oz. (42 g) to 6.8 oz. (192 g) uncooked fish
Trout	T1 to T9	Small plastic trout fillet, single serving	Cooked trout and other fish species with thin fillets	Identify multiples and/or fractions of the fillet in 0.25 increments	One fillet is 3.0 oz. (85 g) of baked fish, or 4.0 oz. (113 g) of uncooked fish
Lamprey	L1 to L10	Gray 14" PVC pipe, 2" diameter notched every 2" for 7 servings	Cooked adult lamprey (eel)	Identify multiples and/or fractions of the 2" servings in 0.25 increments	Each 2" serving is calculated to be 4.0 oz. (or 113 g) of uncooked fish
Jerky	J1 to J11	Package of real "salmon candy" (dried fish pieces)	Dried pieces of salmon and other fish species; also crab or similar-shape tissue	Identify multiples and/or fractions of the package in 0.25 increments	Packages range from 2.4 oz. (68 g) to 3.0 oz. (84 g) of dried fish, or 5.6 oz. (159 g) to 6.5 oz. (187 g) uncooked fish
Bowls	B1 to B9 (each is set of 5)	Empty plastic bowls (¼, ½, 1, 1½, and 2 cups) of different colors	Containers to hold fish soup, composite dishes	Identify multiples and/or fractions of a cup in 0.25 increments	1 cup of fish soup includes 0.25 cup of cooked fish (2 oz. or 57 g) or 2.5 oz. (72 g) uncooked fish; If not soup, 1 cup of fish (8 oz or 227 g) or 10.7 oz (302.4 g) uncooked fish
Crayfish	C1 to C10	Color laminated photograph of whole crayfish	Cooked crayfish	Identify number of organisms	1 crayfish contains 0.26 oz. (7.2 g) of uncooked edible tissue
Mussels	M1 to M10	Color laminated photograph of plate with 6 half-shell mussels	Cooked mussels and other bivalve shellfish	Identify number of organisms	1 mussel contains 0.4 oz. (10 g) of uncooked edible tissue
Shrimp	Sh1 to Sh10	Color laminated photograph of plate with 6 shrimp	Cooked shrimp	Identify number of organisms	1 shrimp contains 1.6 oz. (44 g) of uncooked edible tissue

Notes: " = inches, g = grams, oz. = ounces

1.0 Salmon Fillet Model Display

A 3-D replica of a Chinook salmon fillet was obtained from a local Seattle artist (Figure B1). The fillet (with skin and tail) was made of a flexible and durable urethane rubber, which was poured into a latex mold built based on a fresh (brined) ocean-caught Chinook salmon fillet. The rubber model was painted the color of cooked salmon muscle (fillet) and other tissues (skin and tail). The rubber model weighed 6.8 pounds; the fillet part of the model, which was used to report portion sizes (without skin or tail), had a total length of 29 inches, a width ranging from 3 inches (at the tail end) to 7.5 inches (in the middle), and a depth up to approximately 1 inch.

The salmon replica was used as a model display to indicate portion sizes of all species of baked or smoked salmon, including Chinook, coho, and sockeye salmon, and also other large fish with thick fillets, such as sturgeon or halibut, assuming the respondents could associate the model cross-species. The fillet was cut into 24 servings, each of which was labeled with a number (1 through 24). During the interviews, respondents indicated which serving pieces represented their average portion size, and the interviewers recorded those numbers for each species type (translated to mass during data analysis). The display number (S1 to S9) of the specific model used during the interview was also recorded.

Figure B1. Salmon Fillet Replica (24 Servings)

To equate fish model servings to mass of fresh fish, a Chinook salmon of comparable size was obtained from the Pike's Place Market in Seattle, Washington. Professional staff at the fish market filleted and skinned an ocean-caught Chinook salmon and cut it into servings as equal to the model servings as possible. The whole raw fish (with skin, but no tail) weighed approximately 7 pounds; 6.8 pounds without the skin. Each serving was later weighed (in ounces and grams) on a scale (precision of +/- 2 grams), both uncooked and cooked (after oven-baking for 30 minutes). There was an average 12% loss of mass from the light baking process. Due to the amorphousness of fresh fish (and, therefore, the model), servings nearest the head and tail were found to have less mass (about half) than those in the middle of the fillet. Uncooked fish mass of each of the 24 servings of fresh fish (representing the 24 servings of the portion model) is presented in Table B4 in section 11.

2.0 Trout-Like Fillet Model Display

A 3-D replica of a baked tilapia fillet from Barnard, Ltd. (made of flexible plastic resin, latex- and lead-free, 3.5 x 5-inches, and weighing 2.6 ounces), was used as a model display to indicate portion sizes of baked or smoked trout and other fish species with lighter-colored tissue and thinner fillets as compared to salmon (Figure B2). The trout-like replica represented a 3-ounce (or 85-gram) fillet of baked fish, and was versatile enough to represent a variety of freshwater and marine species. Respondents reported fractions (0.25, 0.5, and 0.75) and/or multiples (1, 2, 3, etc.) of the fillet to indicate their portion size, and interviewers recorded that number (translated into total mass during data analysis). The display number (T1 through T9) of the specific model used during the interview was also recorded.

Figure B2. Trout-Like Fillet Replica (Single Serving)

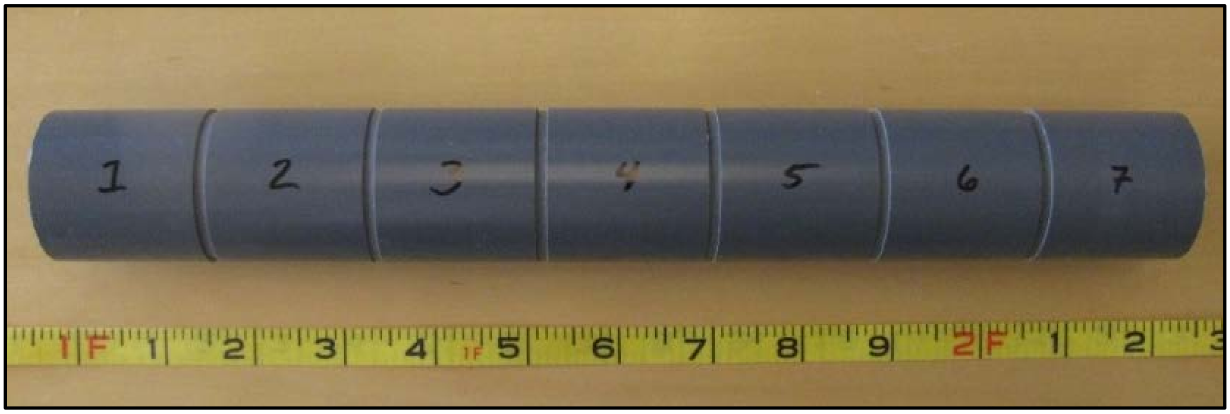
Based on the replica representing a 3-ounce baked fish fillet, and assuming a 25% moisture loss during the baking process (see Attachment 1; USEPA, 2014), Table B5 in section 11 presents various portion sizes converted into uncooked fish mass (based on fractions or multiples of 1). One serving (one whole trout fillet) that is 3 ounces (85 grams) baked equates to 4 ounces (113 grams) uncooked.[3] Additional multiples and/or fractions reported by respondents were calculated during data analysis.

[3] Values shown in ounces and grams reflect the direct mass conversions from cooked to uncooked weights (according to the equation in Attachment 1).

3.0 Lamprey (PVC Pipe) Display

Lamprey (eel) is a unique anadromous species type consumed by Tribal members. As recommended by Tribal Representatives, a 14-inch long, 2-inch diameter gray PVC pipe was used as a model display to indicate portion sizes of lamprey (Figure B3). The length was an approximate average size of an adult lamprey post-migration, preparing to spawn up-river (Kostow, 2002). The PVC pipe had section marks notched every 2 inches to indicate servings. Each 2-inch serving was labeled with a number (1 through 7). Respondents reported fractions (0.25, 0.5, or 0.75) and/or multiples (1, 2, 3, etc.) of a serving to represent their average portion size, and the interviewers recorded that number (translated into total mass during data analysis). The display number (L1 to L10) of the specific pipe used during the interview was also recorded.

Figure B3. PVC "Lamprey" Pipe (7 Servings)



Assuming a density as least as great as other fresh (raw) fish muscle, approximately 1.1 g/cm3 (UNFAO, 2014a), and a calculated volume of a cylinder section (102.9 cm^3), the mass of each 2-inch serving was estimated to be 4.0 ounces (113 grams). Table B5 in in section 11 presents portion sizes as fractions and multiples of one (1) serving. Additional multiples and/or fractions of these servings reported by respondents were calculated during data analysis.

4.0 Jerky / Dried Fish Display

In cases where respondents reported eating any species of fish (salmonid or other) in a dried form, real fish jerky (known as "salmon candy"), protected in a sealed package, was used to indicate portion sizes (Figure B4). Respondents reported fractions (0.25, 0.5, or 0.75) and/or multiples (1, 2, 3, etc.) of the approximately 3-ounce (85-gram) package of dried salmon to indicate their portion size, and the interviewers recorded that number (translated into total mass during data analysis). The display number (J1 to J11) of the specific package used during the interview was also recorded.

In this case, recording the specific display number was particularly important because, although the label stated that there were 3 ounces (85 grams) in every package, the true mass was found to vary between packages (and was generally less). Two extra packages were purchased and opened, and the contents were weighed (in ounces and grams) on a scale (precision of +/- 2 grams). The dried salmon within each of these packages was measured at 2.6 ounces (72 grams), and the package alone weighed 0.2 ounces (5.7 grams). Without opening the display packages to be used during the survey (to maintain the integrity of the contents), each whole package was weighed and, subtracting the weight of the bag (0.2 ounces), total mass of dried fish was calculated. That mass, without a moisture loss conversion, was used for reporting fresh tissue such as crab.

Figure B4. Package of Real Jerky/Dried Fish ("Salmon Candy")

To represent dried fish, assuming a 57% moisture loss during the desiccation process (Attachment 1; USEPA, 2014), Table B6 in section 11 presents the mass of salmon jerky measured in each display package converted to uncooked mass (based on fractions or multiples of 1). One serving (one whole package of display J1) that was 2.5 ounces (70 grams) dried, for example, converted to 5.8 ounces (163 grams) uncooked. Fractions and/or multiples of one serving (one package) were calculated based upon one (1) serving of the particular display package during data analysis.

5.0 Soup Bowl Display

For fish soups and composite dishes, portion sizes were determined using empty hard-plastic bowls of different quantities (and colors) within a ¼-cup (red), ½-cup (yellow), 1-cup (purple), 1½-cup (blue), or 2-cup (green) bowl (Figure B5). Respondents reported the fractions (0.25 or 0.5 cup) or multiples (1, 1.5, 2 cups, etc.) of one cup to indicate their portion size, and the interviewers recorded that number (translated into mass of fish during data analysis). The display number (B1 to B9) of the measuring bowl set used during the interview was also recorded.

Figure B5. Measuring Bowls for Fish Soups

As suggested by Tribal representatives (Holt, et al., 2014), it was estimated that 1 cup of soup contained approximately 0.25 cup (or 2 ounces or 57 grams) of cooked fish (i.e., soup was 25% fish). Based on the assumption that a one (1)-cup serving of soup contained 2 ounces (57 grams) of cooked fish, and assuming a moisture loss of 21% from cooking in soup ("wet cooked in moist heat"), Table B5 in section 11 presents the mass of uncooked fish according to number of cups (servings) of soup (based on fractions or multiples of 1) (Attachment 1; USEPA, 2014). Additional multiples and/or fractions that were reported by respondents were calculated during data analysis. Note that the measuring bowls were intended to represent soups, stews, chowders, or other composite dishes such as casseroles, applying the same general assumption of 1 cup composite dish: 0.25 cup cooked fish ratio. As has been noted, some respondents reported consumption of fish or shellfish tissue in volumetric terms. When the bowls were used to describe fish volume rather than soup, it was assumed that one cup corresponded to 8 ounces (227 g) of cooked fish (assumes an overall density of 1) and 10.7 ounces (302.4 g) of uncooked fish, assuming a 25% moisture loss, as from canning or a dry heat method (Table B3).

6.0 Shellfish Photograph Displays

For shellfish, portion sizes were determined using laminated color photograph displays (photo-displays), printed to 100% scale (actual size). There was a photo-display of a single, whole crayfish (tail tucked under); a photo-display of mussels (six half shells on a plate) to represent marine and freshwater bivalves (clams and mussels); and a photo-display of shrimp (six on a plate), as shown on Figures B6 through B8, respectively. Respondents reported numbers of organisms (e.g., number of crayfish, mussels, or shrimp) to indicate their portion size, and the interviewers recorded that number (translated into mass of shellfish during data analysis). The photo-display number (C1 to C10 for crayfish; M1 to M10 for mussels; or SH1 to SH10 for shrimp) of the specific photo-display used during the interview was also recorded.

Figure B6 illustrates a native crayfish, *Pacifastacus leniusculus,* the most widely distributed species in the Pacific Northwest (Johnsen and Taugbøl, 2010; Larson and Olden, 2011), which was obtained from the Columbia River watershed and purchased at the Pikes Place Market in Seattle, Washington. Weight of the whole uncooked organism was measured at 1.3 ounces (36 grams). The primary edible tissue of crayfish is the tail (abdominal muscle), the percent (to whole body) of which depends on size and maturity. The edible portion of *P. leniusculus* has been estimated to be 15 to 25% of total body weight (Lee and Wickins, 1992, as cited in Harlioğlu, 1996). Assuming that an average 20% of body mass is edible tissue, the mass consumed per single organism (of a size organism shown in the figure) is 0.26 ounces (7.2 grams). Total numbers of crayfish reported by respondents as the portion size consumed were recorded and the associated mass was calculated during data analysis.

Figure B6. Crayfish Photo-Display

Figure B7 illustrates a common intertidal zone bivalve, *Mytilus edulis* or Blue Mussel, which is found on the Pacific coast of the U.S. and is domestically farmed (NOAA, 2014). Freshwater mussels are in a different subclass of bivalves than the marine species, but are superficially similar in appearance. The figure is intended to represent all types of marine and freshwater bivalves that may be consumed by participants. The shell (half) is included with cooked mussel meat in the photograph to display a familiar preparation method, but it is the edible soft tissue that is of interest. Soft tissue can be nearly 50% of total live (wet) weight when the organism is in best condition (UNFAO, 2014b). One study reported that organisms investing energy in shell growth may actually limit soft tissue growth (Gimin et al., 2004). For this study, average tissue weights, which vary by species, age, gender, density, season, food availability, and other environmental conditions, were used for portion size calculations.

Multiple sources of information were investigated to determine the average mass of soft tissue consumed per bivalve organism. The mean wet weight of edible soft tissue of a single mussel consumed by California Indians was reported (in an archeological study) as 1.065 grams, but with no supporting documentation (Heizer and Whipple, 1971). A more recent study of *Mytilus edulis* in Quebéc, Canada, collected 4,224 juvenile mussels and measured an average soft tissue dry weight (ash free) of 0.037 grams (Alunno-Bruscia et al., 2001), which equates to 0.42 grams wet weight (likely a juvenile that is too small to be edible). Finally, a reference documenting the life history of mussels suggested that average large adult mussel soft tissue weighs 1 g dry weight (Newell and Moran, 1989), which (assuming 10% solids) equates to 10 g. This value was used to represent the mass of a single bivalve organisms. Total numbers of mussels or clams reported by respondents as the portion size consumed were recorded, and the associated mass was calculated during data analysis.

Figure B7. Mussels Photo-Display

Figure B8 illustrates a large shrimp, likely *Pandalus borealis*, northern prawn or pink shrimp. Large males commonly reach 170 millimeters (mm) (6.69 inches), which (when including head) approximates the organism sizes in the photograph. Based on a total length to weight conversion cited by the U.S. Fish and Wildlife Service (Nichols, 1982 as cited in Bielsa, et al., 1983), a length of 170 mm equates to 44 grams (1.6 ounces). This value was used to represent the mass of a single shrimp organism, based upon fractions and multiples of 1. Total numbers of shrimp reported by respondents as the portion size consumed were recorded, and the associated mass was calculated during data analysis.

Figure B8. Shrimp Photo-Display

7.0 Fish in Cans or Jars

For fish reported as eaten from cans or jars, the following assumptions were made: 1 standard can of tuna (or other commercially canned fish) contains 5 ounces of cooked fish and 1 standard Mason jar of salmon (or other fish, home-canned) contains 8 ounces of cooked fish. Based on a moisture loss of 25% during the canning process (Attachment 1; USEPA, 2014), a single can or jar equates to 6.7 ounces (189 grams) and 10.7 ounces (302 grams) of uncooked fish, respectively. Table B5 in section 11 presents the uncooked fish mass associated with fractions and multiples of 1 can or 1 jar, respectively, of cooked fish.

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COOKING LOSS FACTORS

Similar to the Idaho Tribal Fish Consumption Survey, NHANES participants report the amount of fish consumed “as prepared,” which is converted to a raw wet weight in grams. Since the process of cooking changes the moisture content of fish, a weight conversion based on the estimated moisture loss due to cooking is required to calculate the grams of raw fish consumed (USEPA, 2014). Adjustment factors for cooking loss used by NHANES, and reported by EPA, are provided in Table B3 (with values in bold associated with key preparation methods presented in this study; notes in italics have been added by the authors).

The following equation is used to convert cooked mass to uncooked (raw) mass:

$$\text{Weight of raw fish} = \frac{\text{Weight of cooked fish}}{1 - (\%\ \text{Moisture Loss}/100)}$$

Table B3. Estimated Fish Moisture Loss Due to Cooking

Cooking / Preparation Method	Percent moisture loss
Dried *(e.g. jerky)*	**57**
Kippered	46
Smoked, (other than salmon)	36
Salted	33
Canned	**25**
Cooked, dry heat *(e.g., baked)*	**25**
Restructured	25
Cooked, moist heat *(e.g., soup)*	**21**
Smoked salmon	17
Pickled	16
Fried	12
Raw	0

Source: USEPA, 2014

Figure B9. Species Identification Photographs

The species identification photographs (image resolution reduced for inclusion into this report) used by the interviewers to facilitate the administration of the questionnaire (4 pages). Sources: Columbia River Inter-Tribal Fish Commission, Idaho Fish and Game, Washington Department of Fish and Wildlife, Montana Field Guide, Freshwater Mollusks Guide, U.S. Fish and Wildlife Service, U.S. Geological Survey.

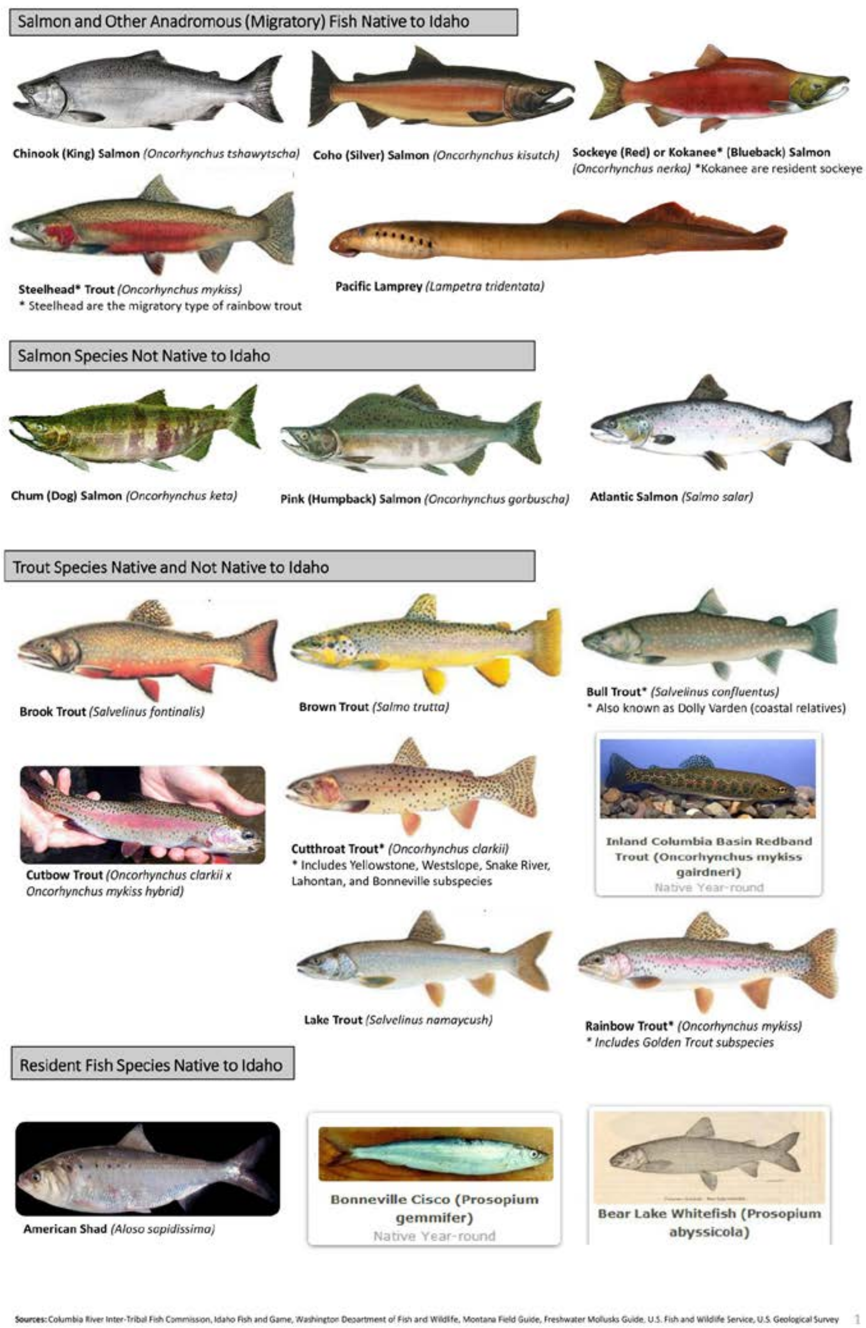

Figure B9. Species Identification Photographs (continued, page 2 of 4)

Sources: Columbia River Inter-Tribal Fish Commission, Idaho Fish and Game, Washington Department of Fish and Wildlife, Montana Field Guide, Freshwater Mollusks Guide, U.S. Fish and Wildlife Service, U.S. Geological Survey.

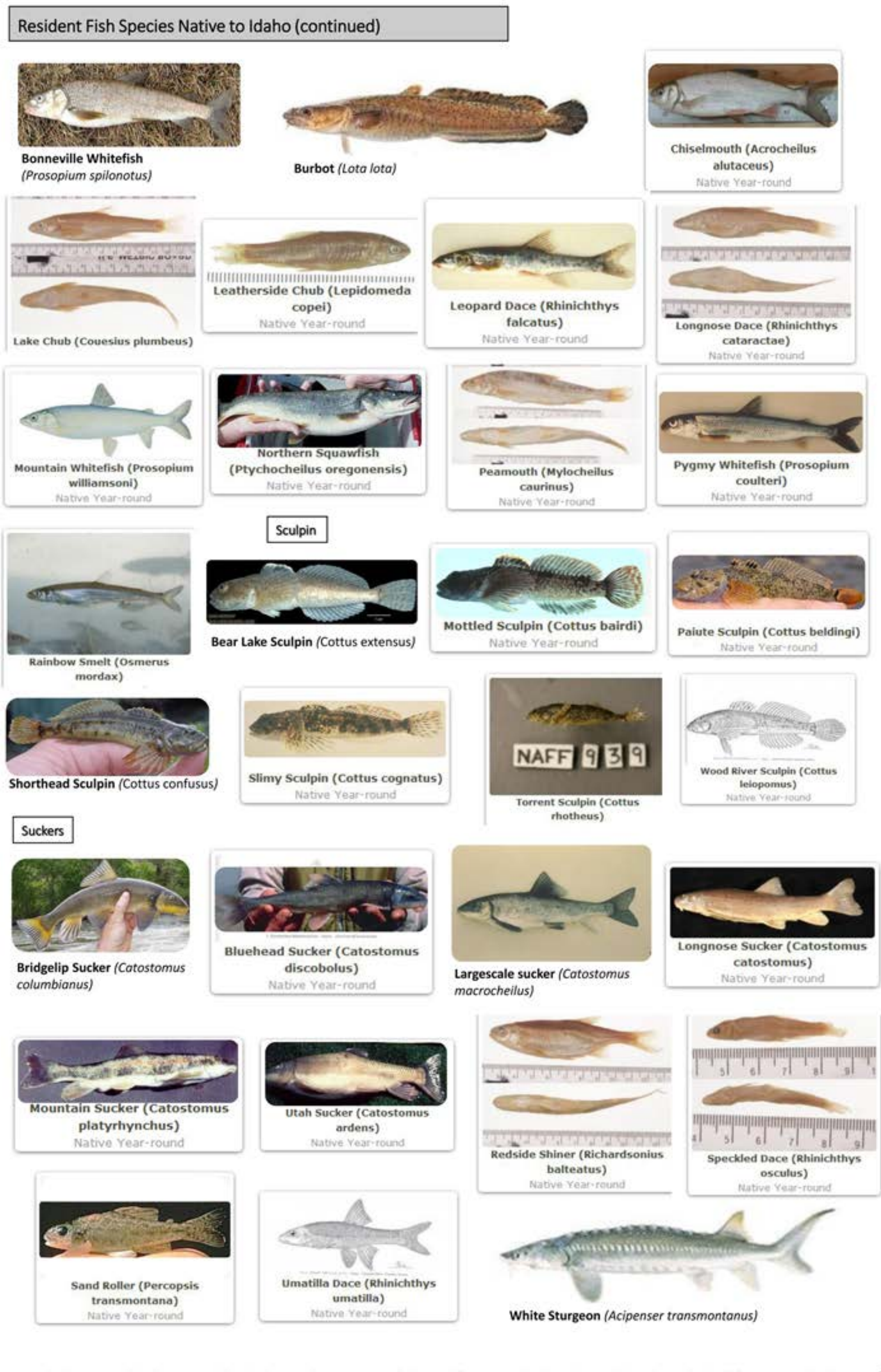

Figure B9. Species Identification Photographs (continued, page 3 of 4)

Sources: Columbia River Inter-Tribal Fish Commission, Idaho Fish and Game, Washington Department of Fish and Wildlife, Montana Field Guide, Freshwater Mollusks Guide, U.S. Fish and Wildlife Service, U.S. Geological Survey.

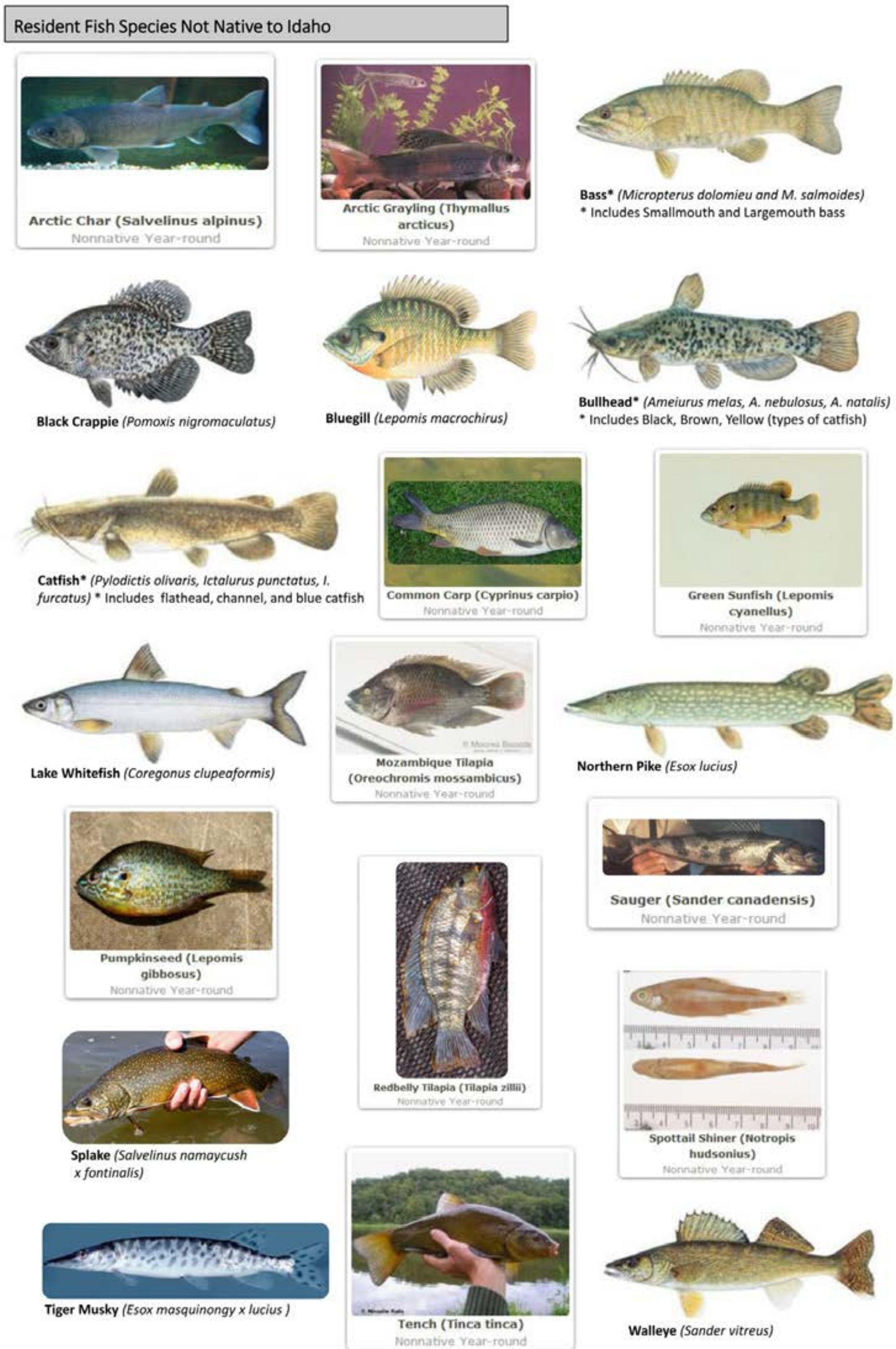

Figure B9. Species Identification Photographs (continued, page 4 of 4)

Sources: Columbia River Inter-Tribal Fish Commission, Idaho Fish and Game, Washington Department of Fish and Wildlife, Montana Field Guide, Freshwater Mollusks Guide, U.S. Fish and Wildlife Service, U.S. Geological Survey.

Resident Fish Species Not Native to Idaho (Continued)

White Crappie (Pomoxis annularis)
Nonnative Year-round

Yellow Perch *(Perca flavescens)*

Clams, Mussels, and Crayfish

Asian Clams *(Corbicula spp.)*

Bay Mussel (Mytilus trossulus)
Nonnative Year-round

Floaters *(Anodonta spp.)*

Western Pearlshell *(Margaritifera falcata)*

Western Ridgemussel *(Gonidea angulata)*

Zebra/quagga mussels *(Dreissena spp.)*

Crawfish (Pacifastacus)
Native Year-round

9.0 Portion-to-Mass Calculations

More specific details of the portion-to-mass conversion procedure are described below, including the specific factors used for each portion model, how write-in species were handled, how can and jar portion sizes were determined, how shellfish portion sizes were determined, and special-case exceptions to the overall procedure.

10.0 Portion-to-Mass Conversion Tables

The portion-to-mass conversion factors for each model are shown in Tables A (salmon fillet sections), B (trout, soup bowl, lamprey, shellfish, can and jar models), and C (jerky models). Two different conversion factors were determined for bowls, depending on whether the respondent likely intended the bowl to refer to the total volume of a composite dish of which fish was only one component or whether the bowl referred to the actual volume of fish. The most common example of the latter would be canned tuna, as used, for example, in a tuna fish sandwich. The bowl conversions are described in detail in section 13 of this appendix.

Lastly, two conversion factors were used for each jerky model, with and without adjustment for moisture loss due to drying. The moisture-loss-adjusted conversion was used for most species. However, for certain species (noted in Table B6) it was assumed that the respondent utilized the jerky model to describe consumption due to the visual appearance of the model rather than to imply it was consumed in a dried form. In those cases, the conversion without moisture loss adjustment was used.

Table B4. Portion-to-mass (raw weight, edible portion) conversions for the salmon replica with fillet divided into sections

Fillet Section Number	Portion-to-Mass (grams)	Fillet Section Number	Portion-to-Mass (grams)
1	50	13	192
2	80	14	180
3	92	15	178
4	112	16	162
5	124	17	170
6	132	18	138
7	176	19	124
8	190	20	110
9	174	21	88
10	170	22	88
11	178	23	66
12	176	24	42

Table B5. Portion-to-mass (raw weight, edible portion) conversions for other models

Model	Unit	Portion-to-Mass (grams)*
Trout replica	1 fillet	113.4
Measuring bowls (for soup, stew, etc.)**	1 cup	72.2
Measuring bowls (for fish volume)**	1 cup	302.4
Lamprey	1 serving	113.2
Crayfish	1 organism	7.2
Mussel	1 organism	10.0
Shrimp	1 organism	44.0
Can	1 5 oz can***	302.4
Jar	1 8 oz jar***	189.0

*Values rounded to 1 decimal digit for display although 4 decimal digits were used for calculations to avoid accumulating rounding errors;

**The 72.2 grams conversion factor was used when the respondent described consumption using the measuring bowl and either 1) specified the preparation as soup or stew (24-hour recall only) or 2) the species being described was clams, mussels or lamprey (FFQ only); this factor assumed only a portion of the volume was fish; otherwise, the 302.4 grams factor was used, which assumed the entire volume was fish (see section 13 of this appendix);

The conversion factor was adjusted proportionally if a non-standard size was specified (i.e., not 5 oz. or 8 oz.) as described in the ***Portion-to-mass conversions for cans and jars section below.

Table B6. Portion-to-mass (raw weight, edible portion) conversions for jerky, depending on the jerky model and species

Jerky Model	Portion-to-Mass (grams)*	
	With Moisture Loss Adjustment (Species Group A)	Without Moisture Loss Adjustment (Species Group B)
J1	163.5	70.3
J2	172.8	74.3
J3	168.1	72.3
J4	163.5	70.3
J5	163.5	70.3
J6	158.8	68.3
J7	168.1	72.3
J8	163.5	70.3
J9	186.7	80.3
J10	196.0	84.3
J11	191.4	82.3

Group A contains all salmon, steelhead, freshwater finfish, cod, halibut, pollock, and other marine finfish not in group B;

Group B contains all freshwater and marine shellfish, tuna and sardines;

See Table B3 for moisture loss adjustment factors;

*Values rounded to 1 decimal digit for display although 4 decimal digits were used for calculations to avoid accumulating rounding errors.

11.0 Write-In Species Corrections and Mapping

In CAPI, several general species categories allowed the respondent to describe consumption of specific but unlisted species, such as pink salmon or oysters. These species categories include other salmon, other trout, other freshwater finfish, other marine fish or shellfish, and other fish or shellfish. In each case, the interviewer was able to write in the name of the specific species.

Because these write-in fields allowed unrestricted free text, there were occasional spelling variations and instances where a listed species (e.g., tuna) was written in or a write-in species belonged in a more specific species category. For example, marine clams or mussels would be a more specific category for a write-in of butter clams rather than “other marine fish and shellfish.” All write-in text instances were examined manually to correct for spelling variation and remap to a more specific CAPI species category when needed. These changes, which were made in consultation with Ridolfi staff, facilitated species-specific portion-to-mass conversions and species grouping for reporting.

12.0 Portion-to-Mass Conversions for Soup Bowls

The soup bowls were originally intended to be used only for specifying soups, stews, or other composite dishes where the fish was only a component of the total volume; however, during the course of interviewing it was found that respondents more often used this model to describe the volume of fish they consumed, not including other non-fish components. This was particularly common for tuna, crab and lobster meat and small shrimp, the latter being difficult to count individually, as would be required to utilize the shrimp model. In contrast, clams or mussels were most often consumed and described as soups.

Whether the respondent intended the soup bowl to refer to A) the total volume of a composite dish or B) only to the volume of fish contained in the dish was not recorded by the interviewer. However, through discussions with the interviewer supervisor (who performed and observed a number of interviews) and some of the interviewers who performed a large number of interviews, it was determined which species were most commonly described as type A or type B. The type A species (fish was a component of soup or stew) were determined to be freshwater clams or mussels, marine clams or mussels and lamprey. All other species were type B.

When performing the mass conversions for the FFQ interviews, where a preparation method was not recorded, type A species described using bowls were converted using 72.2 grams per 1 cup bowl (see Figure B5 of this appendix). Type B species were converted using 302.4 grams per 1 cup bowl. This conversion assumed a 25% moisture loss, the same factor assumed for canned fish or fish cooked with a dry heat (Table B3).

However, when performing the mass conversions for the 24-hour recall, the 72.2 grams per 1 cup bowl conversion (type A) was used only when the preparation was noted as soup or stew, regardless of species. The 302.4 grams per 1 cup bowl conversion (type B) was used for all other preparations, including casserole or mixed dish (a single category). This preparation was most often used to refer to the final form of the dish rather than how the respondent described the portion size. For example, a tuna fish sandwich or shrimp salad would be described as a mixed dish, but the soup bowl model was used to describe the amount of tuna or shrimp included instead of the total volume of the final dish. This is the only aspect of the portion-to-mass conversions which differed between the 24-hour recall and FFQ.

13.0 Portion-to-Mass Conversions for Cans and Jars

When respondents provided portion sizes in terms of cans or jars, the interviewer had a text field in which to capture specific descriptions. Unless otherwise specified, cans were assumed to be 5-oz. and jars 8-oz. In consultation with Ridolfi, an algorithm was developed which utilizes the species and text description field to determine the most appropriate portion-to-mass conversion. The steps of the algorithm are as follows:

1. If an unambiguous container size could be determined from the text field (e.g., 6 oz., 1 qt., 1 cup), this size was used for the conversion.
2. Otherwise, if the text field contained the string “can” and did not contain “jar” (which would create an ambiguity), then 5 oz. was assumed.
3. If the text field contained the string “jar” but not “can,” then 8 oz. was assumed.
4. Finally, if a size could not be determined by steps 1–3, a default was assumed based on the species. For all freshwater species, cod, halibut, and pollock, 8 oz. was assumed. For the remaining marine species, 5 oz. was assumed.

14.0 Portion-to-Mass Conversions for Number of Shellfish

When reporting consumption of shellfish, the respondent had the option of specifying the number of organisms. There were three portion models for this purpose: crayfish, mussels, and shrimp, each with different portion-to-mass conversion factors. In November 2014, a field was added to CAPI to allow the interviewer to record which model was used. Due to restrictions in CAPI, this was implemented as a text field and the interviewer was instructed to use "C" for crayfish, "M" for mussels, and "S" for shrimp. However, the text field also allowed other text, and an algorithm was developed in consultation with Ridolfi staff to examine the model text field and the species field to determine the most appropriate model for mass conversion. The procedure used is:

1. For any clams or mussels species, "mussels" was chosen regardless of the shellfish model recorded.
2. For other species, if a valid shellfish model code (C, M, S) could be determined from the text field, that model was chosen.
3. If a valid shellfish model could not be determined, Table B7 was used to choose the likely model used:

Table B7. Choice of shellfish model *when not specified by the interviewer*

Species in CAPI	Chosen Shellfish Model
Crayfish, lobster, crab	Crayfish
Freshwater clams or mussels, marine clams or mussels, oysters, scallops	Mussels
Shrimp, prawns, squid, octopus	Shrimp

15.0 Exceptions to the Portion-to-Mass Conversion Procedure

Two records that did not follow the expected protocol were manually modified to perform the mass conversion. These are described below:

1. One respondent reported shark consumption in a higher consumption period and a lower consumption period. The respondent reported consuming shark once per year in the higher period and 0 times per year in the lower period, but did not provide the duration of the higher period. This was manually converted into once per year as a single period instead of a higher and lower period. The standard portion-to-mass conversion procedure was then applied to the modified record.
2. One respondent reported consuming alligator as 2 soup bowls per year. This response was excluded because the alligator is neither a finfish nor a shellfish.

Appendix C—
Additional Detail on Imputations

Appendix C—Additional Detail on Imputations

1.0 Grouping of Species for Imputation of Uncommon Responses

As described in Section 5.28 of the main body of this report, when there was a component missing which was needed to calculate a species-specific consumption rate (portion frequency, portion size or higher consumption period percentage of the year), similar non-missing responses were used to estimate a mean value for imputation. To be considered similar, a response needed to be for the same species and have the same period type (the types were: whole year, higher consumption period or lower consumption period). This rule was used when the number of similar responses was at least 5. When the number was less than 5, species were grouped to expand the number of similar responses on a case-by-case basis, as described in Table C1. In general, the choice of groupings was restrictive and based on consultation with Ridolfi staff. When high-consumption period percentage was being imputed, the grouping was less restrictive than for size and frequency because the number of available responses was smaller and because the majority of responses were in the range of 8%–33% (1–4 months) across all species. As the sensitivity analysis in the next section shows, the final results are similar under a wide range of imputed values, so the precise value used for the imputation is not critical.

Table C1. Nez Perce Tribe. Species groupings used to impute missing values for uncommon species (less than 5 non-missing responses)

Species in CAPI	Missing Field	No. Imputed	Species group used for Imputation
Other salmon*	Portion frequency	1	Other salmon,* Kokanee, Sockeye, which are less commonly consumed salmon species
Other salmon*	Higher period percentage	1	Other salmon,* Kokanee, Sockeye, which are less commonly consumed salmon species
All trout or unspecified	Higher period percentage	1	All resident trout species/groups
Freshwater clams or mussels	Higher period percentage	2	All freshwater or marine shellfish species
Lobster	Higher period percentage	3	All freshwater or marine shellfish species

*Other salmon is a species category in CAPI that allowed for a specific salmon species not listed to be written in, most commonly pink or Atlantic salmon.

2.0 Sensitivity Analysis on Imputations

The impact of imputing missing values in calculating consumption rates was explored by recomputing rates under two extreme approaches: imputing 0 for all missing values, which would systematically underestimate consumption, and imputing twice the mean value (based on the same species), which in many cases would overestimate consumption. Consumption rates based on alternative imputations for Groups 1-6 are shown in Tables C2-C7, respectively. There was usually little or no difference in the estimates based on the extreme imputation approaches compared to the imputation approach used in the report (imputing the mean value from the same species), with the differences ranging from 0.0-2.6% except for the 90th percentile of Group 5 (Table C6) had a difference of 18.4% between the mean approach and the twice the mean approach. The mean approach is likely to be much more accurate than twice the mean and the difference of 18.4% is not very large compared to the upper bound of the 95% CI (120% higher than the point estimate). These results show that imputation of missing values had a minimal impact on the final consumption rates presented in this report.

Table C2. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 1 FCRs (g/day, raw weight, edible portion). Estimates are weighted

	Imputation Method		
	Zero*	Mean** (used in report)	High***
No. of consumers	451	451	451
Mean	122.1	123.4	123.9
50th percentile	70.2	70.5	71.2
90th percentile	263.8	270.1	270.9
95th percentile	437.3	437.4	437.6
Max	1371.9	1371.9	1371.9

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Table C3. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 2 FCRs (g/day, raw weight, edible portion). Estimates are weighted.

	Imputation Method		
	Zero*	**Mean** (used in report)**	**High*****
No. of consumers	446	446	446
Mean	102.8	104.0	104.5
50th percentile	60.1	61.3	62.9
90th percentile	229.5	231.4	233.7
95th percentile	321.8	327.9	326.9
Max	1323.8	1323.8	1323.8

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Table C4. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 3 FCRs (g/day, raw weight, edible portion). Estimates are weighted.

	Imputation Method		
	Zero*	**Mean** (used in report)**	**High*****
No. of consumers	446	446	446
Mean	77.9	79.0	79.4
50th percentile	45.2	45.2	45.8
90th percentile	166.1	166.1	167.1
95th percentile	244.8	247.3	247.3
Max	949.8	949.8	949.8

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Table C5. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 4 FCRs (g/day, raw weight, edible portion). Estimates are weighted.

	Imputation Method		
	Zero*	**Mean** (used in report)**	**High*****
No. of consumers	136	136	136
Mean	13.5	13.5	13.5
50th percentile	3.8	3.8	3.8
90th percentile	26.3	26.3	26.3
95th percentile	56.8	56.8	56.8
Max	544.2	544.2	544.2

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Table C6. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 5 FCRs (g/day, raw weight, edible portion). Estimates are weighted.

	Imputation Method		
	Zero*	**Mean** (used in report)**	**High*****
No. of consumers	150	150	150
Mean	14.0	14.3	14.6
50th percentile	3.7	3.7	3.7
90th percentile	34.2	34.2	40.5
95th percentile	75.9	75.9	75.9
Max	309.5	309.5	309.5

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Table C7. Nez Perce Tribe. Sensitivity analysis of imputation method on the Group 6 FCRs (g/day, raw weight, edible portion). Estimates are weighted.

	Imputation Method		
	Zero*	**Mean** (used in report)**	**High*****
No. of consumers	308	308	308
Mean	50.8	51.0	51.1
50^{th} percentile	29.8	29.8	29.8
90^{th} percentile	93.3	93.3	93.3
95^{th} percentile	155.4	155.4	155.4
Max	731.8	731.8	731.8

*All missing values were assigned the value 0;

**All missing values were assigned the mean value from the same species;

***All missing values were assigned twice the mean value from the same species.

Appendix D—
Additional Detailed Tables and Methodologic Notes

Appendix D—Additional Detailed Tables and Methodologic Notes

The tables in this appendix supplement tables included in Volume II. Table D1 summarizes demographics in the original population of eligible Tribal members based on the enrollment records, in the sample drawn from that population, and the final sample of consumers based on the responses to the FFQ portion of the questionnaire. All of these estimates are unweighted. There were some differences in demographic distributions between the original population, the list of tribal members designated to be included in the sample and the consumers about whom various analyses are presented in the report tables. This illustrates why the survey weights were used throughout the analyses presented in this report, as the weights are designed to account for these differences and produce estimates which are representative of the tribal population from which the sample was drawn. Weighting is discussed.in Section 5.20 of Volume II.

Table D1. Nez Perce Tribe. Demographics of the population, selected sample and first interview consumers with known consumption rates. Estimates are unweighted.

		Population (N=1574)		Sample (N=1250)		FFQ Consumer* (N=451)	
Variable		**%**	**No.**	**%**	**No.**	**%**	**No.**
Gender	Male	48.2%	758	48.1%	601	53.4%	241
	Female	51.8%	816	51.9%	649	46.6%	210
Age	18-29 years	23.4%	369	23.4%	293	13.5%	61
	30-39 years	19.4%	305	19.4%	242	20.8%	94
	40-49 years	18.8%	296	18.8%	235	25.7%	116
	50-59 years	18.0%	283	18.0%	225	19.7%	89
	60 years or older	20.4%	321	20.4%	255	20.2%	91
Documented fisher	Yes	23.6%	371	23.0%	288	30.6%	138
	No	76.4%	1203	77.0%	962	69.4%	313
Zip code	83540	57.6%	906	58.3%	729	73.0%	329
	83536	12.4%	196	12.1%	151	8.6%	39
	83501	10.9%	172	10.9%	136	6.2%	28
	Other	19.1%	300	18.7%	234	12.2%	55

*Includes those who completed the first interview and have a calculable non-zero FFQ consumption rate.

Table D2 presents unweighted estimates of demographics among consumers, analogous to Table 7 in Volume II, which presents weighted estimates.

Table D2. Nez Perce Tribe. Demographics of the FFQ consumers with known consumption rates. Estimates are unweighted.

		% or Mean ± SD	No. who Responded
Gender*	Male	53.4%	451
	Female	46.6%	
Age*	18-29 years	13.5%	451
	30-39 years	20.8%	
	40-49 years	25.7%	
	50-59 years	19.7%	
	60 years or older	20.2%	
Weight, kgs		89.9 ± 19.5	434
Weight, kgs (males only)		95.9 ± 18.8	239
Weight, kgs (females only)		82.6 ± 17.8	195
No. in household	1	8.2%	451
	2	18.6%	
	3-4	42.8%	
	5 or more	30.4%	
Documented fisher*	Yes	30.6%	451
	No	69.4%	
Live on reservation	Yes	87.1%	449
	No	12.9%	
Highest education	Middle school	1.6%	448
	High School / GED	52.5%	
	Associates degree	25.7%	
	Bachelor's degree	14.1%	
	Master's degree	5.6%	
	Doctorate	0.7%	
Annual household income	≤ $15K	19.3%	410
	$15K – $25K	20.7%	
	$25K – $35K	19.8%	
	$35K – $45K	12.9%	
	$45K – $55K	8.3%	
	$55K – $65K	5.6%	
	>$65K	13.4%	

*From the enrollment list or fisher indicator list; other demographics were determined from the questionnaire.

Annual fish consumption rates based on the FFQ for various demographic groups are summarized in detail in Table D3. This expanded version of Table 9 in Volume II shows more percentiles.

Table D3. Nez Perce Tribe. Estimated distribution of FCRs (g/day, raw weight, edible portion) of consumers within demographic groups. All rates are for total consumption (Group 1). Estimates are weighted. Mean, SD, median ('50%') and percentiles.

Group	No. of Consumers*	Mean	SD	Percentiles 50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Gender**													
Male	241	146.6	179.3	87.4	101.0	119.7	133.3	148.8	168.7	191.3	223.6	285.1	488.3
Female	210	100.2	133.1	54.7	64.1	70.9	81.8	105.3	116.3	133.1	155.1	244.0	341.4
Age**													
18-29 years	61	126.7	175.4	74.7	84.2	102.0	109.5	123.1	126.2	148.3	190.7	225.2	522.4
30-39 years	94	140.9	161.1	74.0	84.9	112.8	132.7	148.1	164.8	185.9	243.2	298.9	448.6
40-49 years	116	115.4	126.1	68.5	78.2	85.9	95.5	114.8	130.8	150.4	194.5	241.2	463.3
50-59 years	89	130.3	193.4	67.4	76.6	88.6	107.2	136.1	150.0	184.6	212.8	253.8	308.2
60 years or older	91	105.8	136.8	62.3	71.0	76.4	101.9	113.2	129.4	143.9	207.5	264.8	332.0
Documented Fisher**													
Yes	138	171.8	207.2	98.0	108.6	125.7	156.1	177.5	203.2	228.5	283.9	436.8	543.5
No	313	107.9	137.5	65.5	70.6	81.1	98.8	113.4	132.5	147.7	178.1	232.9	337.7
Live on reservation													
Yes	391	127.3	164.4	70.6	77.9	88.9	112.4	131.4	148.4	177.6	222.5	284.6	451.0
No	58	106.5	134.4	65.6	95.0	106.2	108.9	110.8	123.2	128.1	152.7	202.8	237.5
Number who live in household													
1	37	133.9	179.3	82.0	93.0	108.9	113.8	131.8	135.9	147.9	243.1	288.3	***423.0
2	84	119.0	144.1	57.2	65.5	82.1	103.5	136.3	179.1	202.4	240.0	285.3	451.5
3-4	193	119.3	163.7	71.0	78.4	88.0	105.7	117.1	125.9	144.9	175.8	224.3	441.0
5 or more	137	129.2	158.0	74.0	83.1	100.0	113.7	133.1	155.8	176.3	201.1	284.0	381.1
Highest education													
High school / GED or less	242	126.6	176.5	70.4	79.5	96.9	109.1	123.0	134.8	156.2	190.8	253.9	492.0
Associates degree or higher	206	120.4	136.5	70.7	78.6	89.8	113.3	134.3	151.9	185.3	211.0	275.0	409.0
Annual household income													
≤ $15K	79	122.9	168.7	69.7	74.0	97.2	105.8	125.8	135.4	159.9	204.0	282.4	324.9
$15K – $45K	219	126.6	165.9	71.1	79.3	89.4	107.1	121.2	136.4	156.7	208.5	250.8	488.7
>$45K	112	117.7	113.5	72.4	78.9	97.1	122.8	135.9	155.7	174.1	215.5	244.8	339.6

*Consumers with unknown or missing subgroup status were excluded for the analysis of that subgroup;

**From the enrollment list or fisher indicator list; other subgroups were determined from the questionnaire;

***Two or fewer expected respondents with rates equal or greater than the reported percentile (approximately); interpret this percentile more cautiously.

Some sampled respondents lived together in the same household (a statistical cluster). As described in Section 5.25 of Volume II on confidence interval calculations, this clustering was ignored in the calculations, as the number of clusters was small and likely to have minimal impact on estimates and the precision of estimates. All known clusters are enumerated in Table D4 to facilitate future analyses which may utilize the clustering information.

Table D4. Nez Perce Tribe. Enumeration of household clusters. Respondent IDs within each cluster are comma separated. See section 5.25 on confidence intervals for a discussion on impact.

Cluster ID	PMR IDs
1	E1AIO, EAIT1
2	E1P63, ESFBV
3	E33P9, EM176
4	E3P73, EO63E
5	E3XBE, EJ9K1
6	E4NEO, EREES
7	E58XO, EEMQQ
8	E5RHK, EQ8BI
9	E65IH, EB452
10	E6CQ2, E6P1W
11	E6PAI, ET8FX
12	E6YG0, EC0DT
13	E7EJ6, EC0UR
14	E8AMB, ESM4S
15	E8HEK, EXY46
16	E8RLC, EDPQA
17	EA4VL, EIOXT
18	EB478, EVD86
19	EBT5B, EGRJP
20	EC8V1, EFQQ4
21	EESW7, EYSWS
22	EFE4A, EWQB2
23	EH21Q, ESDK7
24	EHAK0, EMWSN

Cluster ID	PMR IDs
25	EOIID, EV2MI
26	EPULA, EZRSR
27	ETTSY, EWQ7T
28	E11X9, E6HY0, EOL5S
29	E1Q8I, ETWDT, EX2ND
30	E2OJH, E5LMF, EJ2V7
31	E4OTM, E6URJ, EQBA2
32	EB3TX, EQ3Y5, EZE8V
33	EDKUW, EDVWP, EIDIO
34	EQGKA, ER9Y3, EY40I
35	E389E, E4WM7, ELXWI, EPIWP, EU22B

Sample size and expected number of double hits. A planning exercise to support the NCI method.

In this section, the expected counts of fish consumption in two 24-hour recall periods ("double hits") are calculated using various assumptions on the frequency of fish consumption. Of particular interest is the expected number of individuals who consume fish in each of two 24-hour recall interviews. The fish consumption rates from the CRITFC report are used (see reference below the second table, below), which gives the fraction of the population that consumes various numbers of fish meals per week.

Table 5, on page 77 of the CRITFC report, gives the estimated number of fish meals per week. However, the probability of fish consumption on a randomly chosen day is required in order to calculate the expected number of double hits. To account for the possibility of multiple meals being consumed on the same day (e.g., a person who consumes two fish meals in one week may consume both on the same day), several alternative methods were used to calculate the probability of fish consumption:

1) **Method 1:** Assume each meal was consumed on a separate day. That is, estimate the probability of fish consumption as "number of fish meals per week"/7. Those who consumed 7 or more meals per week were assumed to consume fish every day.
2) **Method 2:** Divide the number of meals per week by 2, for those who eat 1 or more fish meals per week, and then implement Method 1 on the modified (weighted) percentages. Using this method, someone who consumes 2 fish meals per week would have a 1 in 7 chance of consuming fish on a particular day, while someone who consumes fish once every 2 weeks (i.e., less than one fish meal per week) would still have a 1/14 chance of fish consumption on a randomly chosen day, as in Method 1.
3) **Method 3:** Divide the number of meals for those who eat 2 or more fish meals per week by two, and then implement Method 1 on the modified counts.
4) **Method 4:** Divide the number of meals for those who eat 4 or more fish meals per week by two, and then implement Method 1 on the modified counts.

For a given consumption category (e.g., those who consume 1 meal per week), the probability of fish consumption on two separate days can be calculated, assuming consumption is independent between the days. If this probability is labeled p_j, the probability that a randomly sampled person from the population consumes fish in each of two independent 24-hour recall periods is then a weighted average of these p_j, where the p_j is weighted by the fraction of the population which they represent.

Two methods of sampling individuals were considered:

a) **No over-sampling:** Take a random sample of fish consumers.
b) **Over-sampling:** Sample those who consume fish 2 or more times per week at twice the rate of the rest of the population.

Over-sampling is intended to increase the number of respondents who report eating fish during each of two 24-hour recall periods.

In summary, four methods are presented for estimating the probability of fish consumption on a particular day for individuals in the population, and two ways of sampling individuals from the population are presented. For a given sample size, this gives us 8 estimates of the expected number of individuals who eat fish in both 24-hour recall periods ("double hits"). These estimates are given in the following table, along with a 95% lower bound on the expected number in parentheses.

Table D5. Expected number of "double-hits" for two independent interviews based on the noted sample size of respondents and two different sampling methods.

	Method1		Method2		Method3		Method 4	
Sample Size	random sample	over sample	random sample	over sample	random sample	over sample	random sample	over sample
100	10 (4)	13 (6)	4 (0)	5 (1)	6 (1)	7 (2)	7 (2)	9 (3)
200	20 (11)	27 (17)	7 (2)	10 (4)	11 (5)	15 (7)	13 (6)	17 (9)
300	30 (19)	40 (28)	11 (4)	15 (7)	17 (9)	22 (13)	20 (11)	26 (16)
400	40 (27)	54 (40)	14 (7)	20 (11)	23 (13)	30 (19)	26 (16)	34 (23)
500	49 (36)	67 (51)	18 (9)	24 (15)	28 (18)	37 (25)	33 (21)	43 (30)
600	59 (44)	81 (63)	21 (12)	29 (19)	34 (23)	45 (32)	39 (27)	52 (38)
700	69 (53)	94 (75)	25 (15)	34 (23)	40 (28)	52 (38)	46 (32)	60 (45)
800	79 (62)	108 (87)	28 (18)	39 (27)	46 (32)	60 (44)	52 (38)	69 (53)
900	89 (70)	121 (100)	32 (21)	44 (31)	51 (37)	67 (51)	59 (44)	77 (60)
1000	99 (79)	135 (112)	35 (24)	49 (35)	57 (42)	75 (58)	65 (49)	86 (68)
1100	109 (88)	148 (124)	39 (27)	54 (39)	63 (47)	82 (64)	72 (55)	95 (76)
1200	119 (97)	162 (137)	42 (30)	59 (44)	68 (52)	89 (71)	78 (61)	103 (83)
1300	128 (106)	175 (149)	46 (33)	63 (48)	74 (57)	97 (78)	85 (67)	112 (91)
1400	138 (115)	189 (162)	49 (36)	68 (52)	80 (62)	104 (84)	91 (72)	121 (99)
1500	148 (124)	202 (174)	53 (39)	73 (56)	85 (67)	112 (91)	98 (78)	129 (107)
1600	158 (134)	216 (187)	57 (42)	78 (61)	91 (72)	119 (98)	104 (84)	138 (115)
1700	168 (143)	229 (199)	60 (45)	83 (65)	97 (78)	127 (105)	111 (90)	146 (123)
1800	178 (152)	243 (212)	64 (48)	88 (69)	103 (83)	134 (111)	117 (96)	155 (131)
1900	188 (161)	256 (225)	67 (51)	93 (74)	108 (88)	142 (118)	124 (102)	164 (138)
2000	198 (170)	270 (237)	71 (54)	98 (78)	114 (93)	149 (125)	130 (108)	172 (146)

Technical Notes

In this report, self-reported survey data collected in 1994 were used from the Yakama, Warm Springs, Umatilla or Nez Perce Tribes. It is implicitly assumed that: i.) the fish consumption rates in this historical population are similar to those in our target population; and ii.) the respondents accurately reported consumption frequencies. Fish consumption patterns may vary both by population and over time. Also, the survey suggests significant recall bias. For example, consumption once every week was much more common than once every 6 days or once every 8 days. It is also possible that fish consumption varies widely by season, and that the rates in the CRITFC report may be averaged over several seasons.

In obtaining the lower bound for counts of "double-hits", it was assumed that the counts were Poisson-distributed. With this approximation, the standard deviation (SD) of a count is the square-root of the count. The 95% lower confidence bound was then estimated, using a normal approximation, as "count – 1.96*SD." In reality, heterogeneity in the fish consumption categories may make this assumption unrealistic, making the reported lower bound approximate to some degree.

Table D6. Number of fish meals consumed by all adult respondents (fish consumers and non-fish consumers) per week – throughout the year.

Number of Meals per week	Unweighted Frequency	Weighted Percent	Weighted Cumulative Percent	Number of Meals per week	Unweighted Frequency	Weighted Percent	Weighted Cumulative Percent
0.0	46	8.9%	8.9%	4	16	4.8%	95.5%
0.1	5	0.5%	9.4%	5	4	0.8%	96.2%
0.2	24	3.0%	12.4%	6	3	0.5%	96.7%
0.3	3	0.3%	12.7%	7	2	0.8%	97.6%
0.4	24	2.6%	15.3%	8	2	0.2%	97.8%
0.5	28	3.9%	19.2%	9	1	0.1%	97.9%
0.6	9	1.0%	20.2%	10	4	0.9%	98.8%
0.8	1	0.1%	20.3%	12	2	0.3%	99.1%
1.0	203	43.8%	64.1%	15	3	0.4%	99.6%
1.2	1	0.1%	64.2%	20	1	0.1%	99.7%
1.9	1	0.1%	64.3%	24	1	0.1%	99.9%
2.0	90	21.0%	85.4%	30	1	0.1%	100%
3.0	25	5.3%	90.7%	Total	500	100%	

From Table 5, page 77, CRITFC report (Columbia River Inter-Tribal Fish Commission, “A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin.” Technical Report 94-3. Portland, Oregon. 1994). Used with permission.

Appendix E—
Expanded Tables and Additional Notes on the NCI Method

Appendix E—Expanded Tables and Additional Notes on the NCI Method

The tables in this section provide additional percentiles and other statistics of fish consumption rates based on the NCI method. Selected values in these tables have been presented in the Results section of Volume II, in particular Sections 6.8 – 6.10.

Table E1. Nez Perce Tribe. Distribution of the usual fish Group 1 (all fish) consumption (g/day, raw weight, edible portion) based on the 24 hour recalls. Estimated by the NCI method.

	No. of Consumers	Mean	Percentiles																		
			5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall	451	75.0	7.3	11.2	15.1	19.2	23.5	27.8	32.5	37.7	43.3	49.5	56.4	64.6	73.9	85.1	98.9	115.7	138.5	173.2	232.1
Documented fisher																					
Fisher	138	98.2	9.4	14.8	20.1	25.2	30.9	36.7	42.7	49.3	56.3	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305.0
Non-fisher	313	67.6	6.8	10.5	14.0	17.7	21.7	25.8	30.2	34.6	39.9	45.6	52.0	59.2	67.9	77.6	90.0	104.9	124.6	155.1	206.0
Gender																					
Men	241	87.7	9.1	14.0	18.8	23.6	28.4	33.4	39.1	44.8	51.3	58.4	66.7	76.3	87.2	99.8	115.3	134.1	161.9	199.8	268.1
Women	210	62.3	6.1	9.5	12.5	15.9	19.5	23.5	27.3	31.7	36.5	41.8	47.7	54.4	62.4	71.6	82.8	97.7	116.0	145.1	194.4
ZIP Code																					
83540	329	73.6	7.0	10.9	14.7	18.7	22.8	27.2	31.8	36.9	42.3	48.2	55.1	62.7	72.1	83.2	96.4	113.1	135.5	168.1	227.2
83536	39	84.5	8.7	13.1	17.6	23.0	27.8	32.8	38.5	44.2	50.8	58.1	67.4	77.4	88.9	101.5	117.6	136.2	164.2	197.9	246.9
83501	28	63.6	7.4	11.2	14.8	19.3	23.7	27.7	32.4	37.0	42.3	48.4	54.5	60.8	67.9	75.2	85.6	98.4	115.8	139.4	177.7
NP Other	55	79.8	7.2	11.0	15.0	19.0	23.2	26.9	31.7	36.8	42.6	49.2	56.8	65.9	76.5	88.8	102.7	120.7	148.8	193.8	264.2
Age																					
18-29	61	75.3	8.4	12.4	17.0	21.4	25.8	30.7	35.1	40.5	46.5	52.0	58.6	66.1	74.7	85.5	97.8	114.3	137.0	170.1	232.5
30-39	94	92.5	10.8	16.5	21.8	27.2	31.8	37.2	43.0	49.4	56.2	64.5	73.1	83.1	94.9	108.5	124.4	143.7	171.2	207.7	274.2
40-49	116	83.8	9.3	13.7	18.1	22.9	27.2	32.2	37.9	43.5	49.9	56.6	64.0	73.1	83.6	97.4	112.5	129.9	157.0	192.6	256.3
50-59	89	66.8	5.8	9.1	12.3	15.4	19.0	22.6	26.5	30.8	35.8	41.2	46.8	54.0	62.0	71.4	83.3	98.0	118.4	151.4	212.7
60+	91	58.1	5.4	8.2	11.0	13.8	16.9	20.5	24.1	28.3	33.0	37.7	43.0	49.6	57.3	67.6	77.7	92.9	110.5	136.5	182.5

Table E2. Nez Perce Tribe. Distribution of the usual fish Group 2 consumption (g/day, raw weight, edible portion) based on the 24 hour recalls. Estimated by the NCI method.

	No. of Consumers	Mean	Percentiles																		
			5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall	446	66.5	4.1	6.8	9.4	12.2	15.1	18.3	21.9	26.1	30.8	36.0	42.1	49.5	58.0	68.7	81.7	98.2	121.8	159.4	233.9
Documented fisher																					
Fisher	138	98.4	7.3	11.6	15.8	20.0	24.6	29.8	35.1	40.8	47.7	55.2	64.8	75.4	86.3	101.8	121.9	146.9	181.5	238.6	345.0
Non-fisher	308	55.6	3.9	6.4	8.8	11.2	13.8	16.6	19.7	23.2	27.4	32.0	37.0	43.2	50.8	59.4	70.6	84.1	102.2	132.0	189.5
Gender																					
Men	240	79.4	5.3	8.7	11.8	15.2	18.7	22.7	27.2	32.2	37.5	44.0	51.4	60.1	70.3	81.8	96.4	116.7	144.6	190.4	277.1
Women	206	55.0	3.0	5.1	7.2	9.4	11.8	14.4	17.4	20.5	24.5	29.0	34.0	39.8	47.5	56.3	67.9	82.7	102.8	135.6	198.0
ZIP Code																					
83540	326	65.5	3.8	6.3	8.8	11.4	14.3	17.4	20.8	24.8	29.6	34.7	40.6	48.2	56.7	67.0	80.2	97.0	120.7	158.4	232.3
83536	38	83.7	4.8	8.0	11.0	14.6	18.2	22.7	27.9	33.3	39.7	46.6	54.8	63.8	74.8	88.9	104.3	129.6	162.4	219.2	301.5
83501	27	64.0	5.1	8.4	11.7	15.0	18.6	22.5	26.5	31.0	36.0	41.6	48.0	54.3	64.6	75.6	87.6	104.8	123.3	150.6	197.4
NP Other	55	63.0	3.8	6.3	8.5	10.8	13.1	15.9	19.2	22.4	26.1	30.2	36.4	43.0	51.3	60.0	72.2	87.9	112.8	150.0	231.3
Age																					
18-29	61	76.9	9.1	13.4	17.6	21.2	25.1	29.4	33.2	38.5	43.4	49.4	56.6	64.2	72.5	82.5	93.7	108.4	130.3	167.0	249.4
30-39	94	83.7	10.5	15.1	19.5	23.2	27.4	31.7	36.6	41.6	46.9	53.1	61.0	69.2	79.0	90.4	104.0	122.5	147.6	189.0	262.8
40-49	115	65.1	8.8	12.8	16.2	19.7	23.1	26.6	30.2	34.7	38.8	43.6	48.9	54.9	62.5	71.1	81.7	95.0	114.2	142.8	196.6
50-59	88	55.2	5.3	8.0	10.5	13.0	15.5	18.5	21.8	25.3	29.4	33.8	38.3	43.6	49.9	57.7	67.5	80.4	96.9	122.1	173.0
60+	88	50.4	5.5	8.2	10.6	13.1	15.6	18.3	21.0	24.4	28.0	31.7	36.1	41.0	47.0	54.4	63.4	73.5	89.3	111.6	153.9

Table E3. Nez Perce Tribe. Distribution of the usual fish Group 1 (all fish) consumption (g/day, raw weight, edible portion) and their 95% confidence intervals based on the 24 hour recalls. Estimated by the NCI method.

	No. of Consumers	Mean	Percentiles								
			5%	10%	15%	20%	25%	30%	35%	40%	45%
Overall											
	451	75.0	7.3	11.2	15.1	19.2	23.5	27.8	32.5	37.7	43.3
(95% CI)		(57.3-104.6)	(1.5-18.5)	(3.0-24.0)	(4.7-29.3)	(6.7-34.4)	(9.1-38.8)	(11.8-44.0)	(14.8-48.6)	(18.5-54.0)	(22.6-60.7)
Fisher											
	138	98.2	9.4	14.8	20.1	25.2	30.9	36.7	42.7	49.3	56.3
(95% CI)		(66.3-158.3)	(1.8-32.2)	(3.8-39.9)	(6.1-47.9)	(8.4-55.8)	(11.1-62.6)	(14.4-69.9)	(18.5-77.6)	(23.1-86.4)	(28.0-96.0)

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			Percentiles							
	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall										
	49.5	56.4	64.6	73.9	85.1	98.9	115.7	138.5	173.2	232.1
(95% CI)	(27.8-67.8)	(33.8-76.1)	(41.0-86.5)	(49.5-97.5)	(59.0-111.6)	(69.9-133.5)	(82.9-161.2)	(97.8-200.1)	(120.9-262.3)	(165.0-379.7)
Fisher										
	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305
(95% CI)	(32.8-106.5)	(38.6-121.0)	(45.9-137.9)	(54.8-159.1)	(65.1-184.2)	(78.2-218.7)	(91.1-257.7)	(112.9-316.1)	(141.4-401.6)	(196.7-540.3)

1.0 NCI Method—Covariate Selection

This section expands on the selection of covariates into the NCI models described in section 5.23.2 “The NCI Method—Covariate Selection.” That section described two steps for selecting the covariates into the NCI models: (1) the choice of the FFQ covariate adjustment; and (2) the inclusion of other covariates. The other candidate covariates included: presence on the fishers list, gender, ZIP code groups (83540, 83536, 83501 and Other for the Nez Perce Tribe; 83203 and Other for the Shoshone-Bannock Tribes), age (grouped as 18–29, 30–39, 40–49, 50–59 and 60+) and the responder’s weight (in pounds). Prior to these two steps we also assessed potential seasonality in the 24-hour recall data.

We first present covariate selection for the species Group 1 NCI model. We first considered four forms of continuous FFQ covariate adjustment: the original (untransformed) FFQ rate value, the 3rd root value, the $\log_{10}$ value and the numerical decile of FFQ (coded as 1-10[4]). Each of these forms was accompanied in the model by its interaction with the tribe to allow different effects in the two tribes. The goodness-of-fit of the four FFQ forms was compared to the model with the categorical FFQ decile by calculating statistics for respondents divided into the ten decile groups per tribe[5]. Specifically, the mean, median, 90th percentile and 95th percentile of consumption were calculated by the NCI method within each decile of FFQ for each of the four forms, and were compared to the same statistics (means and percentiles) calculated by a fifth NCI model that used the FFQ decile as a categorical variable. The NCI model with the categorical FFQ decile regresses the likelihood of consuming fish on a given day and the amount consumed on days with positive consumption on the indicators of the FFQ deciles. The model estimates one average probability and one average amount for each FFQ decile. As a result, the estimated relationship between the FFQ and the 24-hour recall from this model is a step function (step = one estimated value per decile). The model allows for any shape of the FFQ-24-hour-recall trend line across the ten FFQ deciles (but constant values within each decile). The four forms of continuous FFQ covariate adjustment, in contrast, assume specific curve-linear trends, constraining the estimated trends to specific shapes. Although the categorical decile model need not necessarily reveal the “best” relationship between FFQ and 24-hour recalls (due to noise in the data and other possible relationships), the categorical model is a useful reference because it can reveal potential non-linear trends in the relationship. In choosing between the four continuous FFQ adjustments we sought to find a transformation of FFQ that would reasonably follow the trend suggested by the categorical decile model and lead to a good, simple characterization of the relationship between FFQ and the 24-hour recalls. The categorical decile model also suggested another adjustment that we previously did not expect. We discovered that the 24h recall consumption in the 10th FFQ decile among the SBT respondents was considerably

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[4] The decile cut points were defined separately within each tribe.

[5] The categorical FFQ model, representing 10 decile categories, is defined by indicator variables (often called ‘dummy’ variables). These indicator variables are dichotomous and are usually coded as either 1 (one) or 0 (zero) for each particular observation being used in the analysis (e.g., a consumption rate for a particular respondent). A value of ‘1’ for an indicator variable (e.g., the indicator variable for the 3rd decile) indicates that the observation falls in the particular decile group represented by that variable (e.g., the 3rd decile). For the 10 deciles, nine indicator variables are needed to define the categorical variable. One of the decile groups serves as a reference group and is not represented by an indicator variable. Thus, if the 10th decile is the reference group, an observation in the 3rd decile would be represented by the following values for the nine indicator variables: 0,0,1,0,0,0,0,0,0. An observation in the 10th decile group would be represented by the following values for the nine indicator variables: 0,0,0,0,0,0,0,0,0. That collection of nine zeroes tells us that the observation is not in any of the first nine deciles, so it must be in the 10th decile. In the context of this study, the categorical FFQ variable probably is the best representation of the FFQ data for a regression analysis. However, it uses nine variables and is not a parsimonious representation of the data; thus, to avoid problems in fitting the NCI models, a more parsimonious form of the FFQ consumption rate is sought, which is the topic considered here.

lower than expected by the trend in any of the four forms of FFQ. We therefore added an indicator for this group into each model, which greatly improved the fit. The impact of the 10^{th} SBT decile is further described in the following paragraph.

The comparison of the four FFQ forms of covariate adjustments to the categorical FFQ adjustment is shown in Figure E2. The eight panels of the figure show the fit for the two tribes (the first four panels for NPT and the second four panels for SBT), all calculated from an NCI model based on data combined form the two Tribes. The four panels for each tribe show the estimated mean, the 50^{th}, 90^{th} and 95^{th} percentiles (in that order). The estimates from the reference categorical decile model are shown as black bars and the estimates from the four considered FFQ forms are superimposed as colored lines. The categorical estimates show that in the NPT, the NCI-estimated usual intake estimated from the 24-hour recalls increased with higher FFQ deciles. This, however, was not the case in the SBT, where the estimated intake decreased after the 8^{th} decile. While the decrease from the 8^{th} decile to the 9^{th} decile was relative moderate, the decrease from the 8^{th} decile to the 10^{th} decile was pronounced. We therefore introduced an indicator for the 10^{th} SBT decile (but not for the 9^{th} SBT decile) into the model. The impact of this indicator is also illustrated in Table E4, which shows the NCI model coefficients for 10 different models: (1) the four continuous forms of FFQ with the indicator for SBT decile 10; (2) the four continuous forms of FFQ without the indicator for SBT decile 10; (3) the model with the categorical FFQ decile; and (4) the model without FFQ. The coefficient A_VAR_U2 shows the between-person variance, in the transformed positive amount, not explained by the covariates. The similar values of the coefficients lambda (A_LAMBDA) across the models suggests that the transformations of the amount consumed are similar across the 10 models (ranging from 0.25 to 0.32) and, thus, the variances are approximately comparable (larger differences would suggest different amount scales and a lack of comparability of the other model coefficients). The model without FFQ (the last column) has A_VAR_U2 equal to 6.09. As this model has no FFQ adjustment, the unexplained between-person variance is large. Importantly, the models with the SBT decile 10 indicator variable have A_VAR_U2 values between 0.91 and 2.55 whereas the models without it have much larger A_VAR_U2 values (ranging between 2.78 and 6.12). The difference in A_VAR_U2 shows the ability of the SBT decile 10 to explain differences in the amount variation across respondents.

Figure E1 and Table E4 help us to choose between the four forms of continuous FFQ adjustment. The untransformed FFQ and numerical FFQ decile models have much larger A_VAR_U2 than the 3^{rd} root and $\log_{10}$ FFQ models. Visually, the untransformed FFQ model tends to overestimate the intake for the bottom two FFQ deciles and the 10^{th} decile, and to underestimate the intake for the FFQ deciles 5-9 in SBT (with the exception of decile 10). The model with numerical FFQ deciles tends to overestimate the intake for FFQ deciles 7 and 8 in NPT. The fits for the 3^{rd} root and $\log_{10}$ FFQ models are similar visually as well as in terms of their A_VAR_U2 values. The choice between these two models was therefore arbitrary. We used the 3^{rd} root of FFQ as our primary choice because the 3^{rd} root transformation is numerically very close to the transformation of the positive 24-hour recalls in this model (lambda of 0.33 corresponds to the third root). With the 3^{rd} root of FFQ, the FFQ predictor and the transformed 24-hour recall values are approximately on the same scale. To investigate the impact of this choice, we ran a sensitivity analysis with $\log_{10}$ FFQ as the form for the FFQ variable and compared the results to the primary choice of the 3^{rd} root of FFQ. The results of this sensitivity analysis are presented in this appendix.

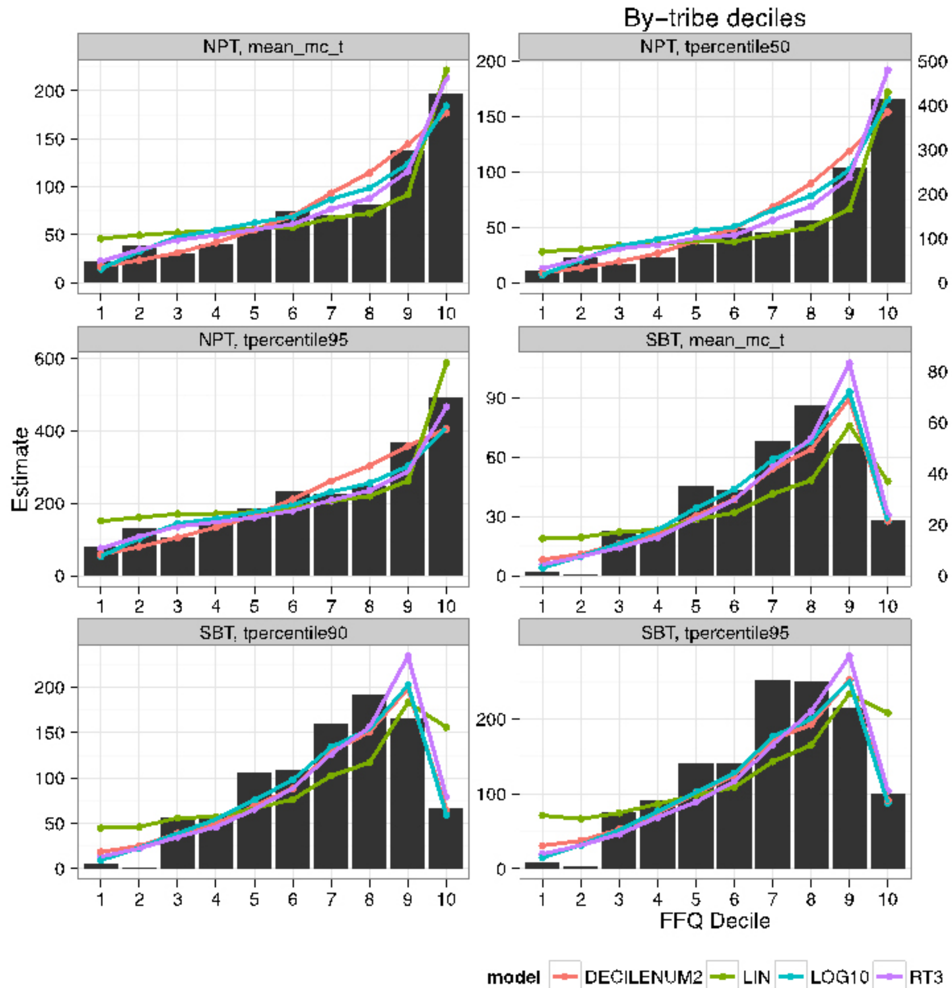

Figure E1. Comparison of *four forms of FFQ adjustment* (colored lines) to the categorical decile FFQ adjustment (black bars). Model for *Group 1 species*. DECILENUM2 = the numerical decile of FFQ (coded as 1-10), LIN = the original (untransformed) FFQ, LOG10 = the $\log_{10}$ FFQ, RT3 = the 3rd root FFQ. All models included an addition adjustment for the 10th decile in the SBT. mean_mc_t = mean, tpercentile50, 90 and 95 = the 50th, 90th and 95th percentiles, respectively. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

Table E4. Coefficients for the NCI models considered in the selection of the FFQ covariate form. Model for Group 1 species. Only selected coefficients are presented for the reference model with categorical decile of FFQ ("Cat. FFQ") and for the model with no FFQ (i.e., model with tribe only).

	Models with indicator for 10th decile in SBT				Models without indicator for 10th decile in SBT					
	FFQ model as linear function of				*FFQ model as linear function of*					
	Orig. FFQ	*3rd root of FFQ*	*Log FFQ*	*FFQ Decile*	*Orig. FFQ*	*3rd root of FFQ*	*Log FFQ*	*FFQ Decile*	*Cat. FFQ*	*No FFQ*
A01_INTERCEPT	13.9559	10.3166	8.0985	10.7239	13.0141	10.2516	8.0091	11.1414		
A02_TRIBE	-1.5858	-3.7307	-3.3414	-0.2963	-0.485	-0.0059	-1.0845	-0.5927		
<A03_FFQ variable>	0.006336	0.6543	0.8374	0.5618	0.007474	0.8504	1.1147	0.5113		
<A04_Tribe*FFQ interaction>	0.007179	0.6377	0.6002	-0.02219	-0.00503	-0.286	-0.03819	-0.05807		
A05_SBT_DEC10	-9.0943	-6.6204	-4.1483	-4.0528						
A06_WEEKEND	-0.9247	-0.7346	-0.4761	-0.9493	-1.2819	-1.2208	-0.8656	-1.0534		
A07_SECINT	0.8183	0.846	0.5661	1.0871	1.2293	1.3213	1.0724	1.2909		
A_LAMBDA	**0.3117**	**0.283**	**0.2467**	**0.3**	**0.3163**	**0.3156**	**0.2864**	**0.3074**	**0.2504**	**0.2956**
A_LOGSDE	1.3783	1.2269	1.006	1.3037	1.3682	1.3839	1.2245	1.3473		
A_LOGSDU2	0.407	0.02313	-0.04887	0.4687	0.9056	0.7576	0.5107	0.6819		
P01_INTERCEPT	-1.9953	-3.4115	-4.2844	-3.0236	-1.9964	-3.4485	-4.3217	-2.7742		
P02_TRIBE	-0.8803	-1.2198	-1.0185	-0.615	-0.6906	-0.2404	-0.155	-0.77		
<P03_FFQ variable>	0.003719	0.4265	0.6466	0.2804	0.003724	0.4326	0.6516	0.2413		
<P04_Tribe*FFQ interaction>	0.000153	0.08232	0.03917	-0.01308	-0.0024	-0.1727	-0.1923	-0.01529		
P05_ SBT _DEC10	-2.1493	-2.0507	-1.3541	-1.1575						
P06_WEEKEND	-0.1348	-0.07827	-0.04341	-0.04868	-0.1743	-0.1089	-0.09914	-0.1101		
P07_SECINT	0.5072	0.4915	0.4825	0.4907	0.5132	0.484	0.4936	0.4897		
P_LOGSDU1	0.179	0.07796	0.03015	0.07674	0.1934	0.1392	0.1122	0.1205		
Z_U	0.5427	0.5503	0.5118	0.5889	1.1695	1.1138	1.02	1.1021		
P_VAR_U1	1.4304	1.1687	1.0622	1.1659	1.4721	1.3211	1.2515	1.2726	1.0642	1.625
A_VAR_U2	**2.2571**	**1.0473**	**0.9069**	**2.5533**	**6.1181**	**4.5502**	**2.7772**	**3.9107**	**1.8615**	**6.0925**

	Models with indicator for 10th decile in SBT				Models without indicator for 10th decile in SBT					
	FFQ model as linear function of				*FFQ model as linear function of*					
	Orig. FFQ	*3rd root of FFQ*	*Log FFQ*	*FFQ Decile*	*Orig. FFQ*	*3rd root of FFQ*	*Log FFQ*	*FFQ Decile*	*Cat. FFQ*	*No FFQ*
A_VAR_E	15.7464	11.6335	7.4788	13.565	15.4315	15.9229	11.5756	14.8004	6.7362	12.0332
cov_u1u2	0.8895	0.554	0.4626	0.9129	2.4733	1.9746	1.4353	1.7875	1.3851	2.7027
RHO	0.4951	0.5008	0.4713	0.5291	0.8241	0.8054	0.7699	0.8012	0.9841	0.859

Estimated parameters: Parameters starting with the letters “A” and “P” refer to the amount and probability models, respectively.
A01_INTERCEPT and P01_INTERCEPT= intercept;
A02_TRIBE and P02_TRIBE = tribe (NPT=0, SBT=1);
<A03_FFQ variable> and <P03_FFQ variable>= the (untransformed or transformed) FFQ;
<A04_Tribe*FFQ interaction> and <P04_Tribe*FFQ interaction> = the tribe-FFQ interaction;
A05_SBT_DEC10 and P05_ SBT_DEC10 = indicator of 10th decile in SBT (0=no,1= yes);
A06_WEEKEND and P06_WEEKEND = weekend indicator (0=no,1= yes);
A07_SECINT and P07_SECINT= 2^{nd} interview (0=no,1= yes);
A_LAMBDA = lambda for the Box-Cox transformation of the consumed amount;
A_LOGSDE = log SD of the residual variance;
A_LOGSDU2 and P_LOGSDU1= log SD of the between-subject variance;
Z_U = the Fisher’s transformation of the correlation parameter;
P_VAR_U1 = the between-subject variance for the probability model (U1);
A_VAR_U2 = the between-subject variance for the amount model (U1);
A_VAR_E = the residual variance for the amount model;
cov_u1u2 = covariance between U1 and U2;
RHO = the correlation parameter between U1 and U2.

After adding the 3rd root of FFQ and its interaction with the dichotomous tribe variable and the indicator for SBT decile 10 into the model, the next step considered inclusion of the remaining covariates into the model. These candidate covariates included the presence on the fishers list, gender, ZIP code groups (83540, 83536, 83501 and Other for the Nez Perce Tribe and 83203 and Other for the Shoshone-Bannock Tribes), age (grouped as 18–29, 30–39, 40–49, 50–59 and 60+) and the responders' weight (attempted as untransformed, 3rd root, $\log_{10}$ and the numerical decile, coded 1-10). These covariates were included in the model along with their interactions with the tribe.

For the categorical covariates (all covariates except the responders' weight), we calculated the NCI-estimated mean and percentiles and compared them across the groups of the covariate. The results are shown in Figures E2–E5. All four covariates showed an impact on the Group 1 consumption. Specifically, fishers tended to consume more (Figure E2), women less (Figure E3), and respondents in the other SBT ZIP codes more than in the ZIP code 83203 and respondents in the NPT ZIP code 83501 less than in the remaining three NPT ZIP codes (Figure E4). We also observed differences in age for both tribes. Going from younger age groups (left) to older groups (right), consumption first increased and then decreased (Figure E5).

Respondents' weight (attempted as untransformed, 3rd root, $\log_{10}$ and the numerical decile) was analyzed in a fashion similar to the FFQ covariate (Figure E6). There seems to be no or, at best, a weak relationship between the respondents' weight and the 24-hour recall. Respondents' weight was therefore not included in the final model.

The selected covariates were used as covariates in both the probability and the amount equations of the NCI model. The coefficients for the final model for Group 1 are presented in Table E5. In addition to the coefficients for the selected covariates, the output shows coefficients for the weekend adjustment, the sequence effect adjustment and the variance components. Documentation of the parameters can be found in the user's guide for the NCI model macros (Ruth Parsons, Stella S. Munuo, Dennis W. Buckman, Janet A. Tooze, Kevin W. Dodd. User's Guide for Analysis of Usual Intakes. 2009. http://appliedresearch.cancer.gov/diet/usualintakes/Users_Guide_Mixtran_Distrib_Indivint_1.1.pdf)

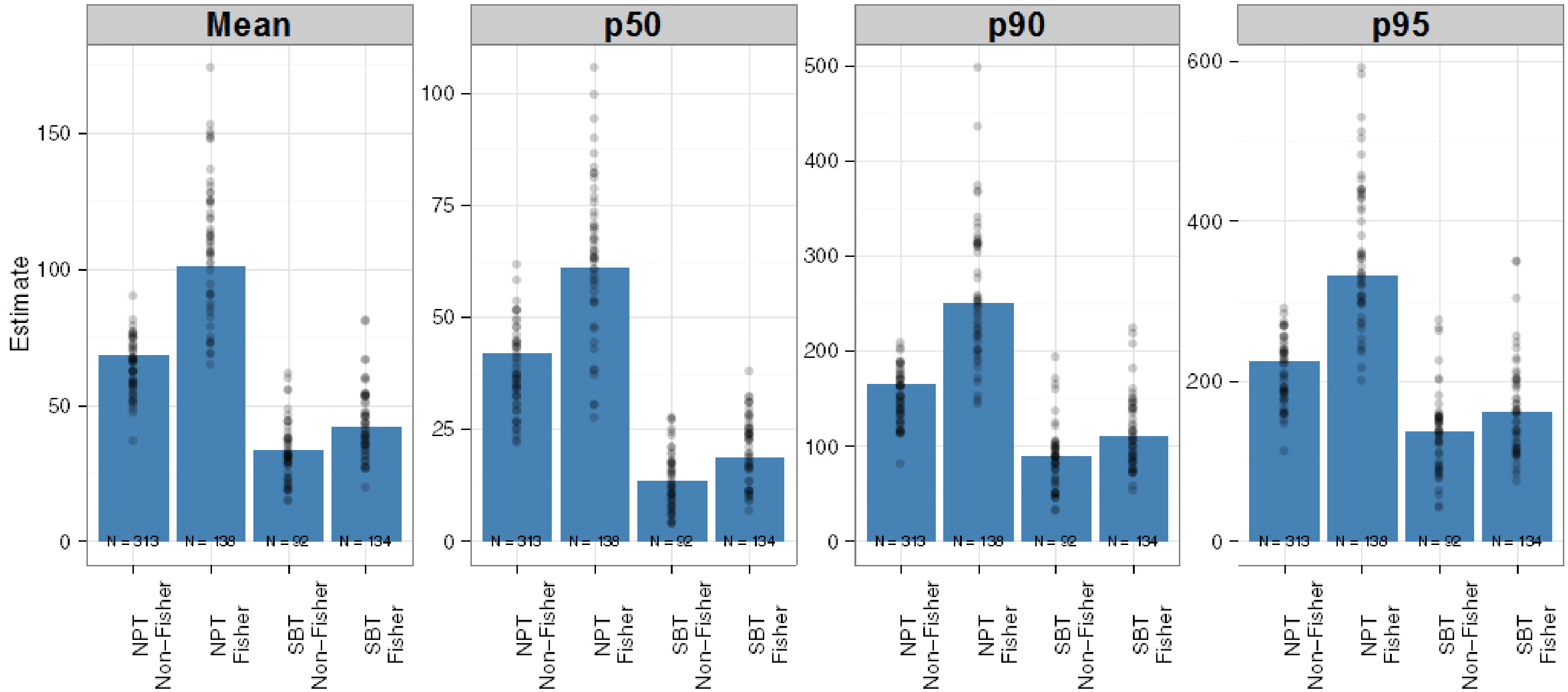

Figure E2. NCI-estimated mean and the 50th, 90th and 95th percentiles by *__the presence on the fishers list__* and tribe. Model for *__Group 1 species__*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

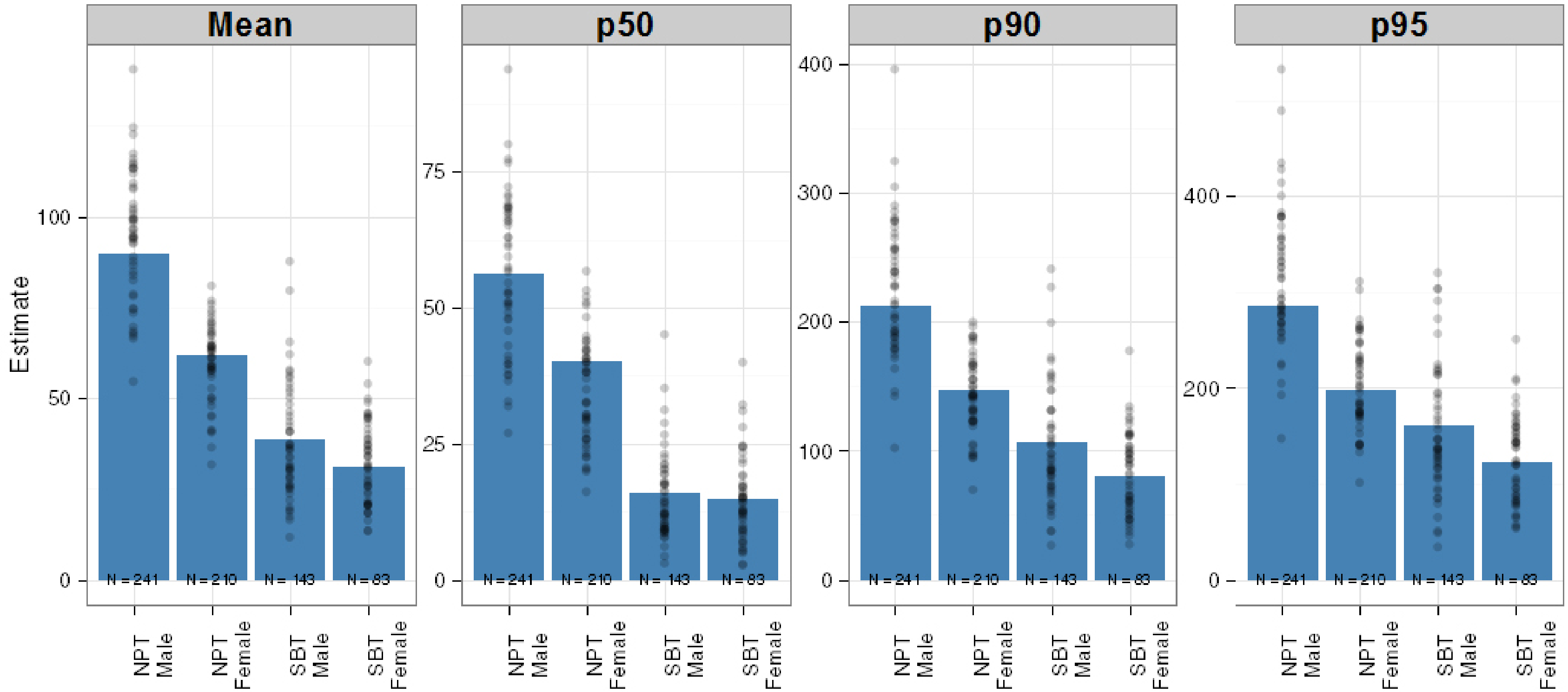

Figure E3. NCI-estimated mean and the 50th, 90th and 95th percentiles by _gender_ and tribe. Model for _Group 1 species_. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

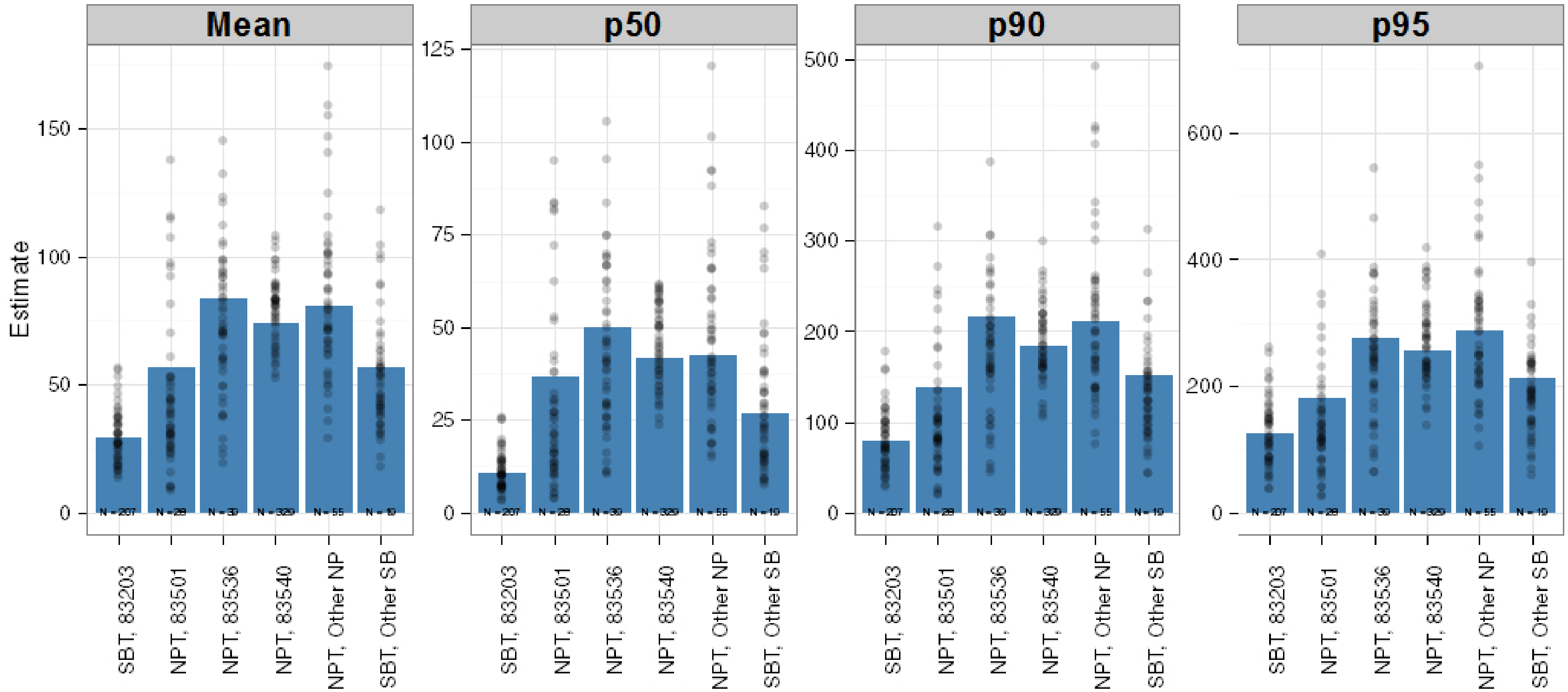

Figure E4. NCI-estimated mean and the 50th, 90th and 95th percentiles by *ZIP code*. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

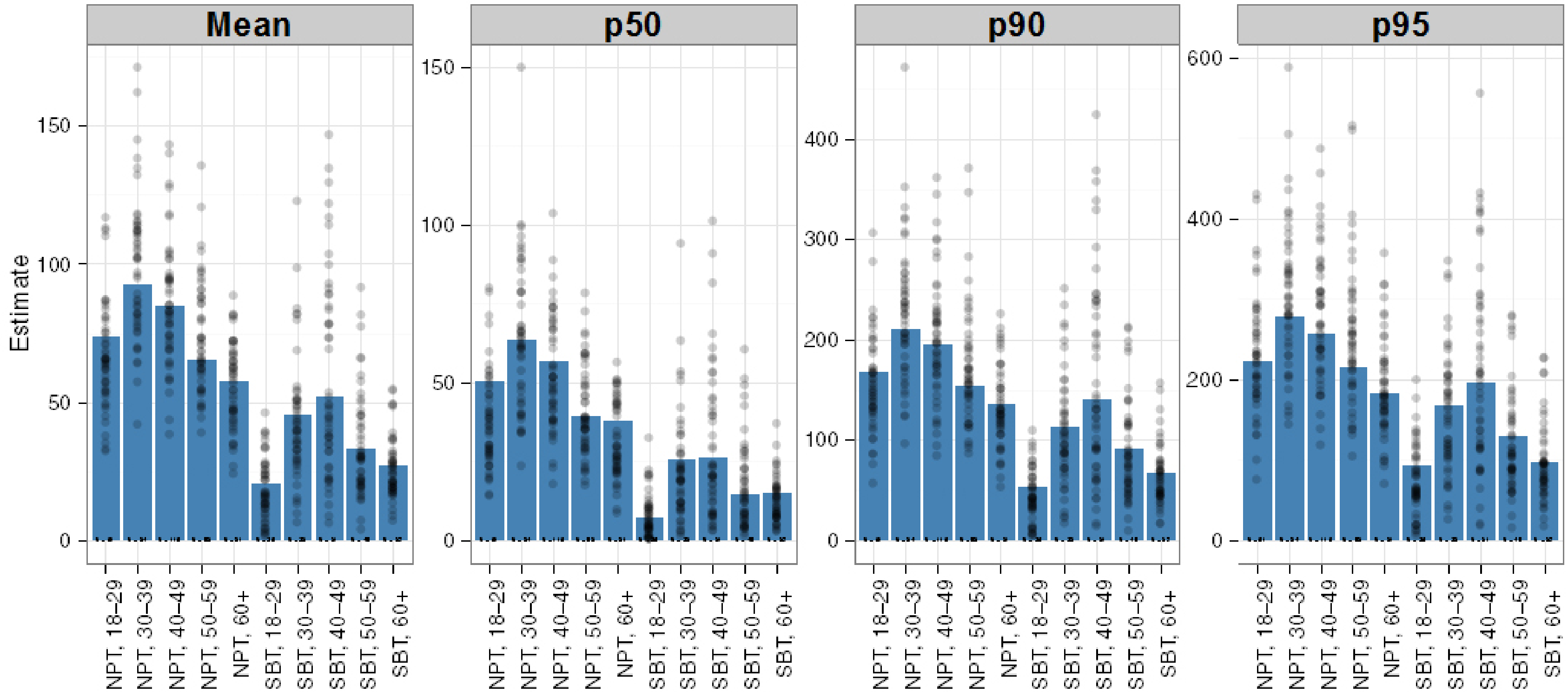

Figure E5. NCI-estimated mean and the 50th, 90th and 95th percentiles by *age* and tribe. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

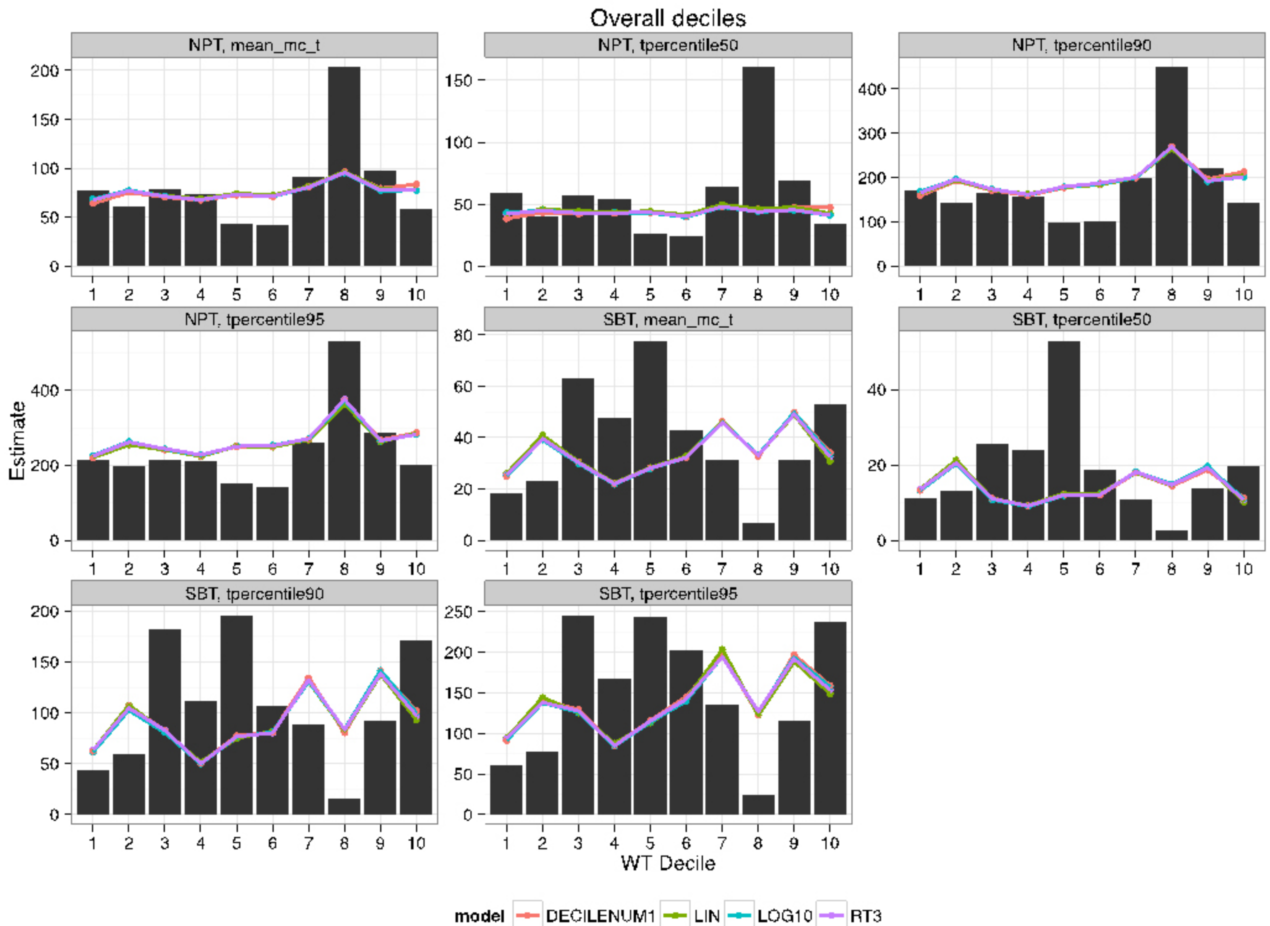

Figure E6. Comparison of *four forms of respondent weight adjustment* (color lines) to the categorical decile respondent weight adjustment (black bars). Model for *Group 1 species*. DECILENUM2 = the numerical decile of respondent weight (coded as 1-10), LIN = the original (untransformed) respondent weight, LOG10 = the $\log_{10}$ respondent weight, RT3 = the 3rd root respondent weight. Models include an adjustment for FFQ. mean_mc_t = mean, tpercentile50, 90 and 95 = the 50th, 90th and 95th percentiles, respectively. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

Table E5. Final model NCI for Group 1.

Term	Estimate	Term	Estimate
A01_INTERCEPT	11.3909	P01_INTERCEPT	-3.3335
A02_TRIBE	-3.76	P02_TRIBE	-2.2826
A03_ROOT3FFQ	0.5626	P03_ROOT3FFQ	0.4529
A04_TRIBEROOT3FFQ	0.8751	P04_TRIBEROOT3FFQ	0.07145
A05_TRIBEFFQ_GROUP_ALL_GPD_DECX10	-7.9413	P05_TRIBEFFQ_GROUP_ALL_GPD_DECX10	-2.1986
A06_FISHER	0.4883	P06_FISHER	-0.2079
A07_FISHERTRIBE	0.7557	P07_FISHERTRIBE	0.2321
A08_FEMALE	-1.5451	P08_FEMALE	0.2951
A09_FEMALETRIBE	1.5025	P09_FEMALETRIBE	-0.08841
A10_ZIPGROUP83536	-0.2356	P10_ZIPGROUP83536	0.2814
A11_ZIPGROUP83501	0.01798	P11_ZIPGROUP83501	0.06362
A12_ZIPGROUPNPOTHER	0.04987	P12_ZIPGROUPNPOTHER	-0.3446
A13_ZIPGROUPSBOTHER	1.6268	P13_ZIPGROUPSBOTHER	0.7921
A14_AGEGROUP1	1.185	P14_AGEGROUP1	-0.138
A15_AGEGROUP2	1.9248	P15_AGEGROUP2	-0.3214
A16_AGEGROUP3	0.7249	P16_AGEGROUP3	-0.4385
A17_AGEGROUP4	0.3805	P17_AGEGROUP4	-0.3371
A18_AGEGROUP1TRIBE	-3.4037	P18_AGEGROUP1TRIBE	1.3651
A19_AGEGROUP2TRIBE	-2.0021	P19_AGEGROUP2TRIBE	1.0734
A20_AGEGROUP3TRIBE	-2.8827	P20_AGEGROUP3TRIBE	0.8447
A21_AGEGROUP4TRIBE	-1.9345	P21_AGEGROUP4TRIBE	1.3002
A22_WEEKEND	-0.9696	P22_WEEKEND	-0.05227
A23_SECINT	0.7675	P23_SECINT	0.48
A_LAMBDA	0.289	P_LOGSDU1	-0.03087
A_LOGSDE	1.2507	Z_U	0.5493
A_LOGSDU2	-4.669	P_VAR_U1	0.9401
		A_VAR_U2	0.000088
		A_VAR_E	12.1995
		cov_u1u2	0.004549
		RHO	0.5

Estimated parameters: Parameters starting with the letters “A” and “P” refer to the amount and probability models, respectively.

A01_INTERCEPT and P01_INTERCEPT= intercept;

A02_TRIBE and P02_TRIBE = tribe (NPT=0, SBT=1);

A03_ROOT3FFQ and P03_ROOT3FFQ = the (untransformed or transformed) FFQ;

A04_TRIBEROOT3FFQ and P04_TRIBEROOT3FFQ = the tribe-FFQ interaction;

A05_TRIBEFFQ_GROUP_ALL_GPD_DECX10 and P05_TRIBEFFQ_GROUP_ALL_GPD_DECX10 = indicator of 10th decile in SBT (0=no,1= yes);

A06_FISHER and P06_FISHER = on the fishers list (0=no,1= yes);

A07_FISHERTRIBE and P07_FISHERTRIBE = on the fishers list and SBT (0=no,1= yes);

A08_FEMALE and P08_FEMALE = female (0=no,1= yes);

A09_FEMALETRIBE and P09_FEMALETRIBE = SBT female (0=no,1= yes);

A10_ZIPGROUP83536 and P10_ZIPGROUP83536 = ZIP = 83538 (0=no,1= yes);

A11_ZIPGROUP83501 and P11_ZIPGROUP83501 = ZIP = 83501 (0=no,1= yes);

A12_ZIPGROUPNPOTHER and P12_ZIPGROUPNPOTHER = NPT but not ZIP 83538 or 83501 (0=no,1= yes);

A13_ZIPGROUPSBOTHER and P13_ZIPGROUPSBOTHER = SBT but not ZIP 83203 (0=no,1= yes);

A14_AGEGROUP1 and P14_AGEGROUP1 = age 30-39 (0=no,1= yes);

A15_AGEGROUP2 and P15_AGEGROUP2 = age 40-49(0=no,1= yes);

A16_AGEGROUP3 and P16_AGEGROUP3 = age 50-59 (0=no,1= yes);

A17_AGEGROUP4 and P17_AGEGROUP4 = age 60+ (0=no,1= yes);

A18_AGEGROUP1TRIBE and P18_AGEGROUP1TRIBE = age 30-39 and SBT (0=no,1= yes);

A19_AGEGROUP2TRIBE and P19_AGEGROUP2TRIBE = age 40-49 and SBT(0=no,1= yes);

A20_AGEGROUP3TRIBE and P20_AGEGROUP3TRIBE = age 50-59 and SBT (0=no,1= yes);

A21_AGEGROUP4TRIBE and P21_AGEGROUP4TRIBE = age 60+ and SBT (0=no,1= yes);

A22_WEEKEND and P22_WEEKEND = weekend indicator (0=no,1= yes);

A23_SECINT and P23_SECINT= 2nd interview (0=no,1= yes);

A_LAMBDA = lambda for the Box-Cox transformation of the consumed amount;

A_LOGSDE = log SD of the residual variance;

A_LOGSDU2 and P_LOGSDU1= log SD of the between-subject variance;

Z_U = the Fisher's transformation of the correlation parameter;

P_VAR_U1 = the between-subject variance for the probability model (U1);

A_VAR_U2 = the between-subject variance for the amount model (U1);

A_VAR_E = the residual variance for the amount model; cov_u1u2 = covariance between U1 and U2;

RHO = the correlation parameter between U1 and U2.

We ran a similar covariate selection for the Group 2 NCI model.

Figure E7 shows comparison of the four forms of FFQ adjustment (the original (untransformed) value, the 3rd root value, the $\log_{10}$ value and the numerical decile of FFQ). In this case, the FFQ was the FFQ for the Group 2 species to correspond to the Group 2 outcome. As in the group 1 model addition of the indicator for the SBT decile 10 improved the model greatly and the 3rd root and $\log_{10}$ transformations lead to the best fit among the four forms of continuous FFQ. The 3rd root transformation more closely corresponded to the lambda from the NCI model and was thus used as the primary choice while the $\log_{10}$ transformation was used in the sensitivity analysis.

Similar to group 1, the presence on the fishers list (Figure E8), gender (Figure E9), ZIP code (Figure E10) and age (Figure E11) had an important impact on the group 2 consumption while the impact of the respondents' weight was weak (Figure E12). We attempted to add all of the important covariates into the final NCI model for group 2 consumption. However, the model coefficients were unstable. The instability was a consequence of a small number of "hits" in the SBT data, and the model could not clearly separate the independent effects of some of the covariates. To obtain a more stable model we used the model FFQ and tribe adjustments only as the final NCI model for group 2 (Table E6). The additional covariates (such as the presence on the fishers list) were introduced into the model only when needed (i.e. when specific subgroup estimates of consumption were needed). For example, the gender covariate was added when gender-specific distributions were estimated.

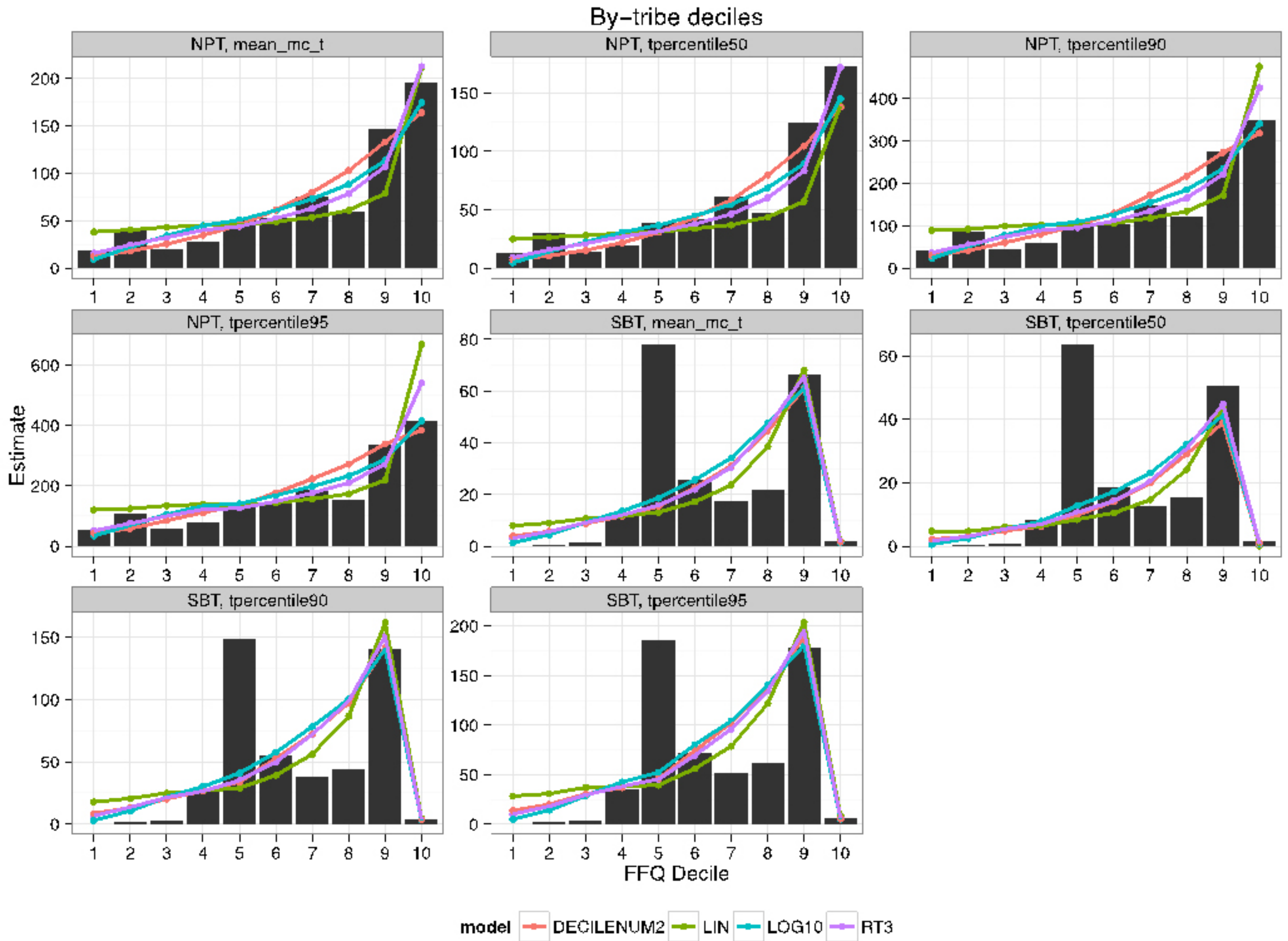

Figure E7. Comparison of *<u>four forms of FFQ adjustment</u>* (colored lines) to the categorical decile FFQ adjustment (black bars). Model for *<u>Group 2 species</u>*. DECILENUM2 = the numerical decile of FFQ (coded as 1-10), LIN = linear—the original (untransformed) FFQ, LOG10 = the $\log_{10}$ FFQ, RT3 = the 3^{rd} root FFQ. All models included an addition adjustment for the 10^{th} decile in SBT. mean_mc_t = mean, tpercentile50, 90 and 95 = the 50^{th}, 90^{th} and 95^{th} percentiles, respectively. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

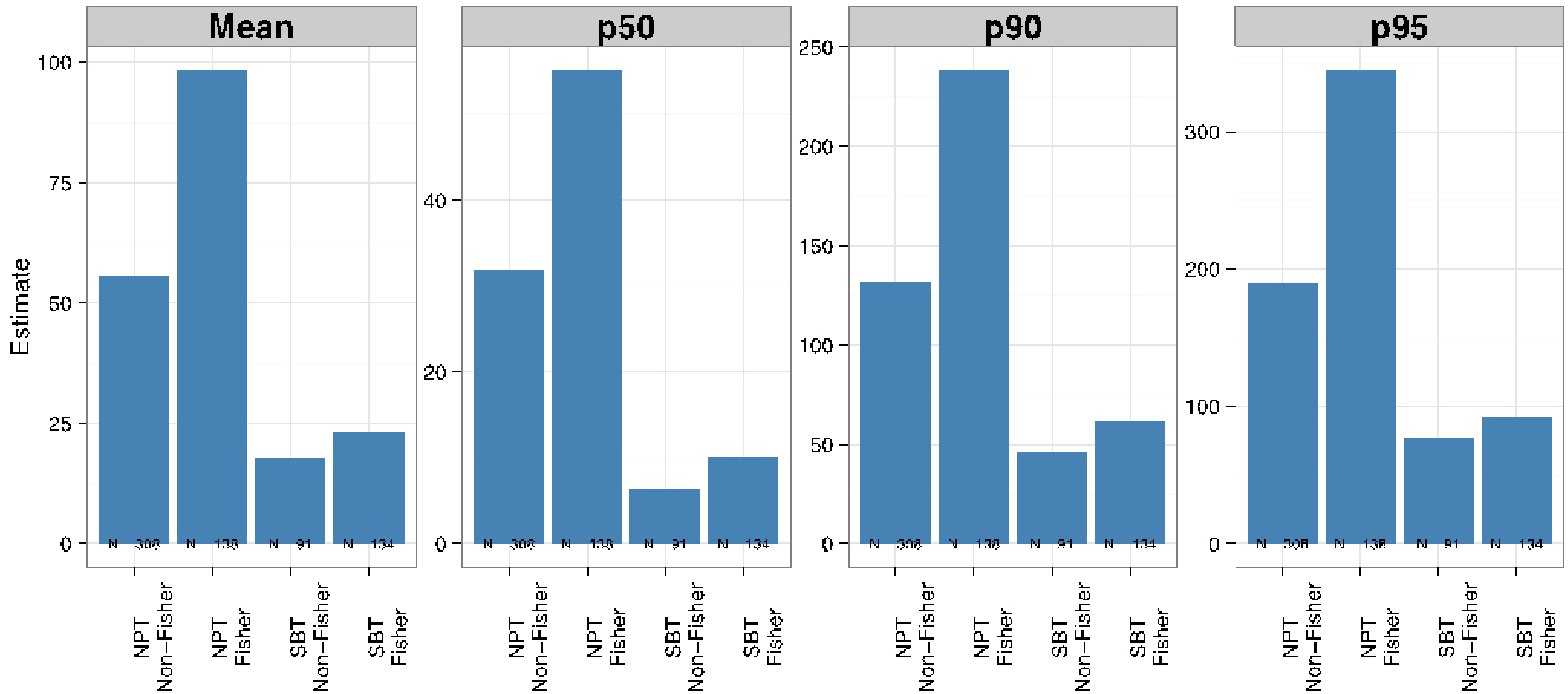

Figure E8. NCI-estimated mean and the 50th, 90th and 95th percentiles by *__the presence on the fishers list__* and tribe. Model for *__Group 2 species__*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for the SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

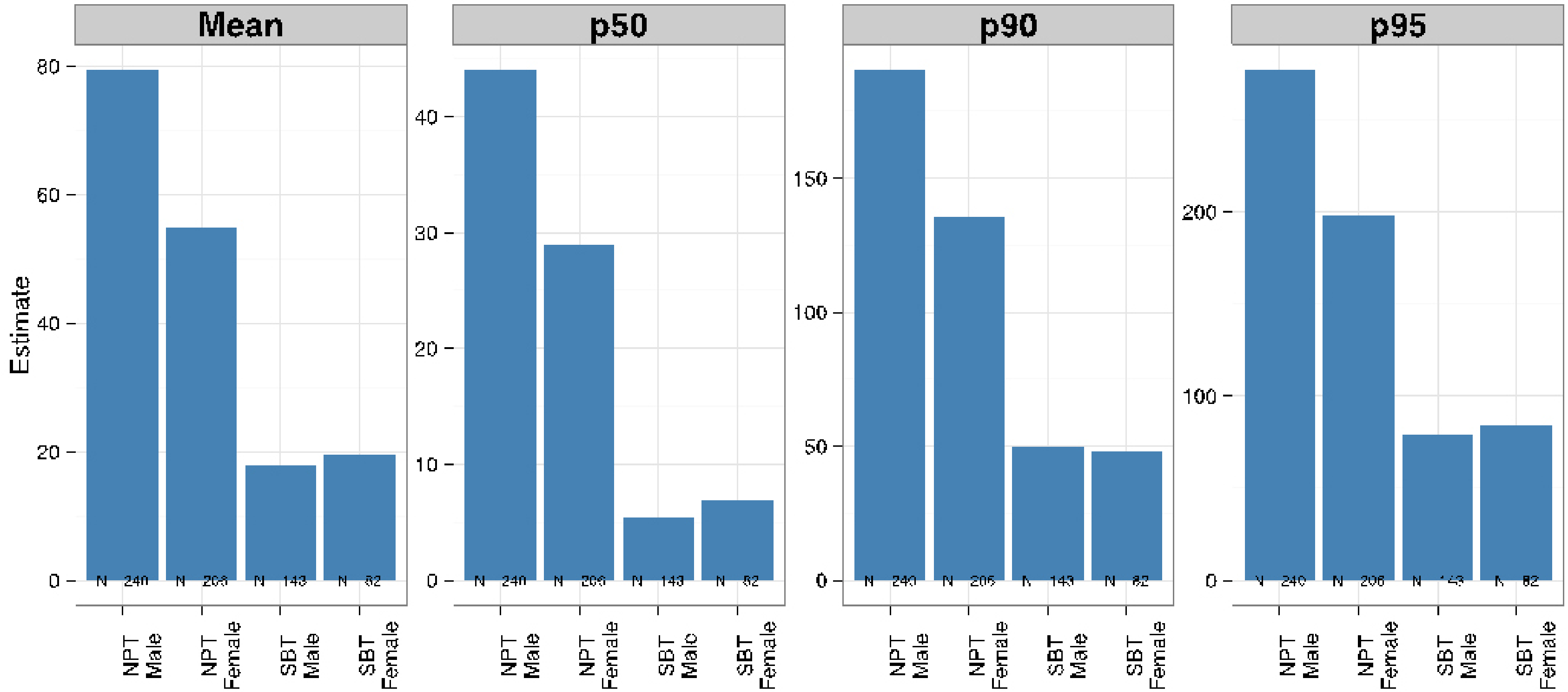

Figure E9. NCI-estimated mean and the 50th, 90th and 95th percentiles by *gender* and tribe. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

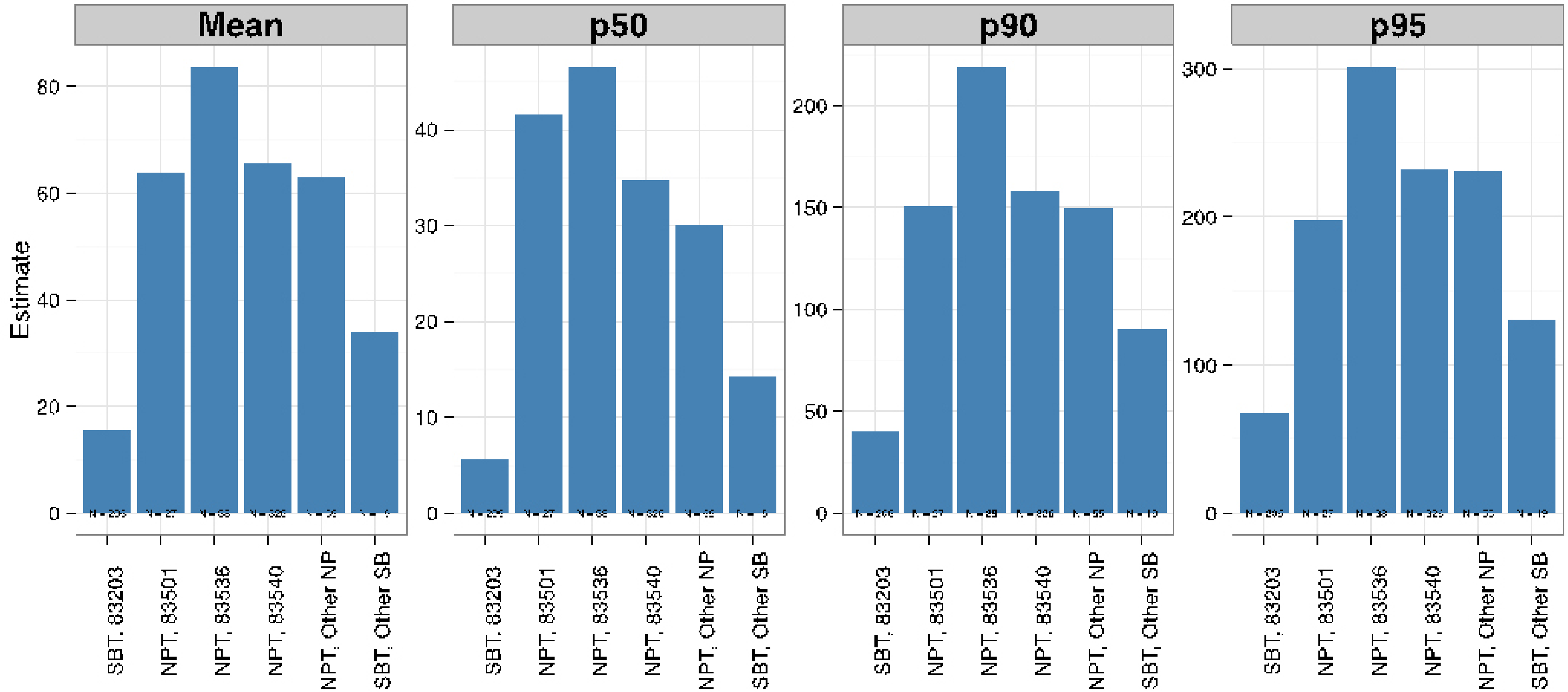

Figure E10. NCI-estimated mean and the 50th, 90th and 95th percentiles by *ZIP code*. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for the SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

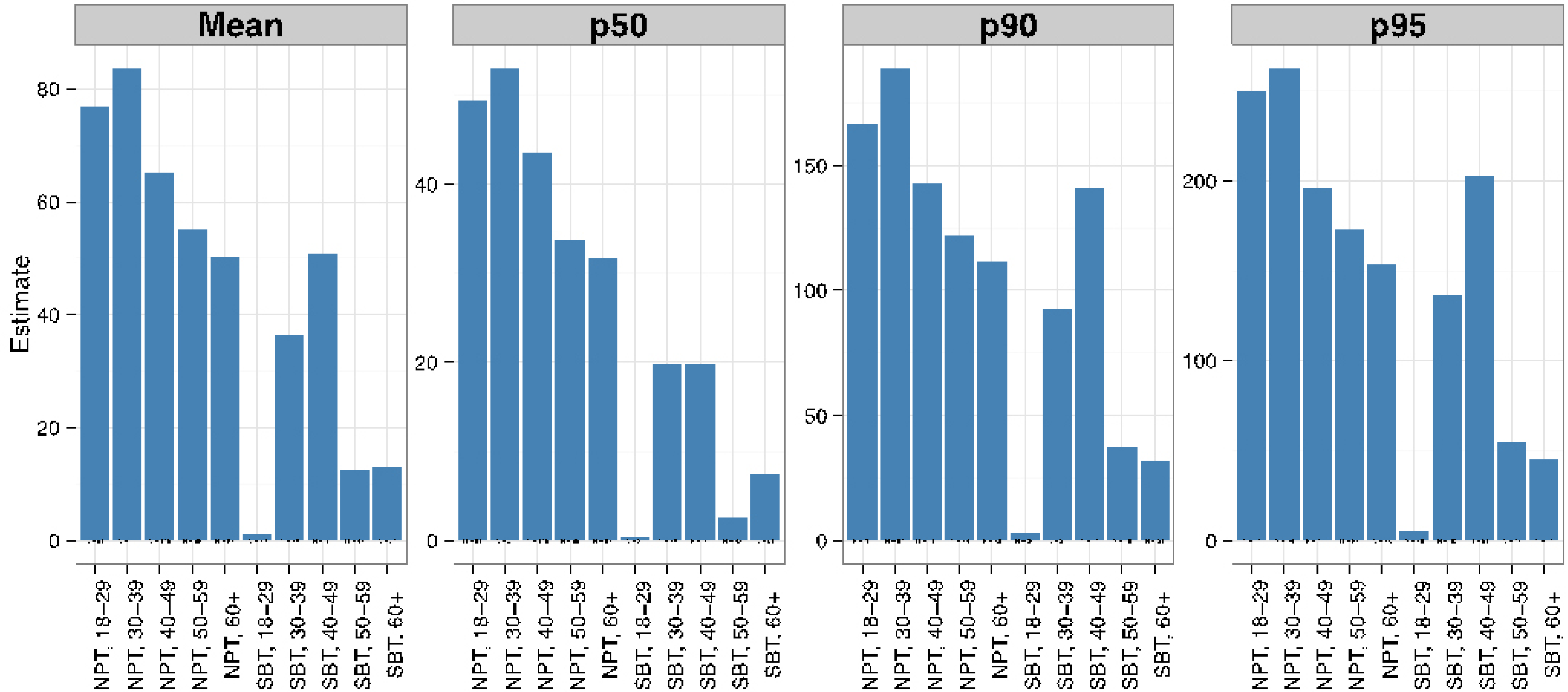

Figure E11. NCI-estimated mean and the 50th, 90th and 95th percentiles by *age* and tribe. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

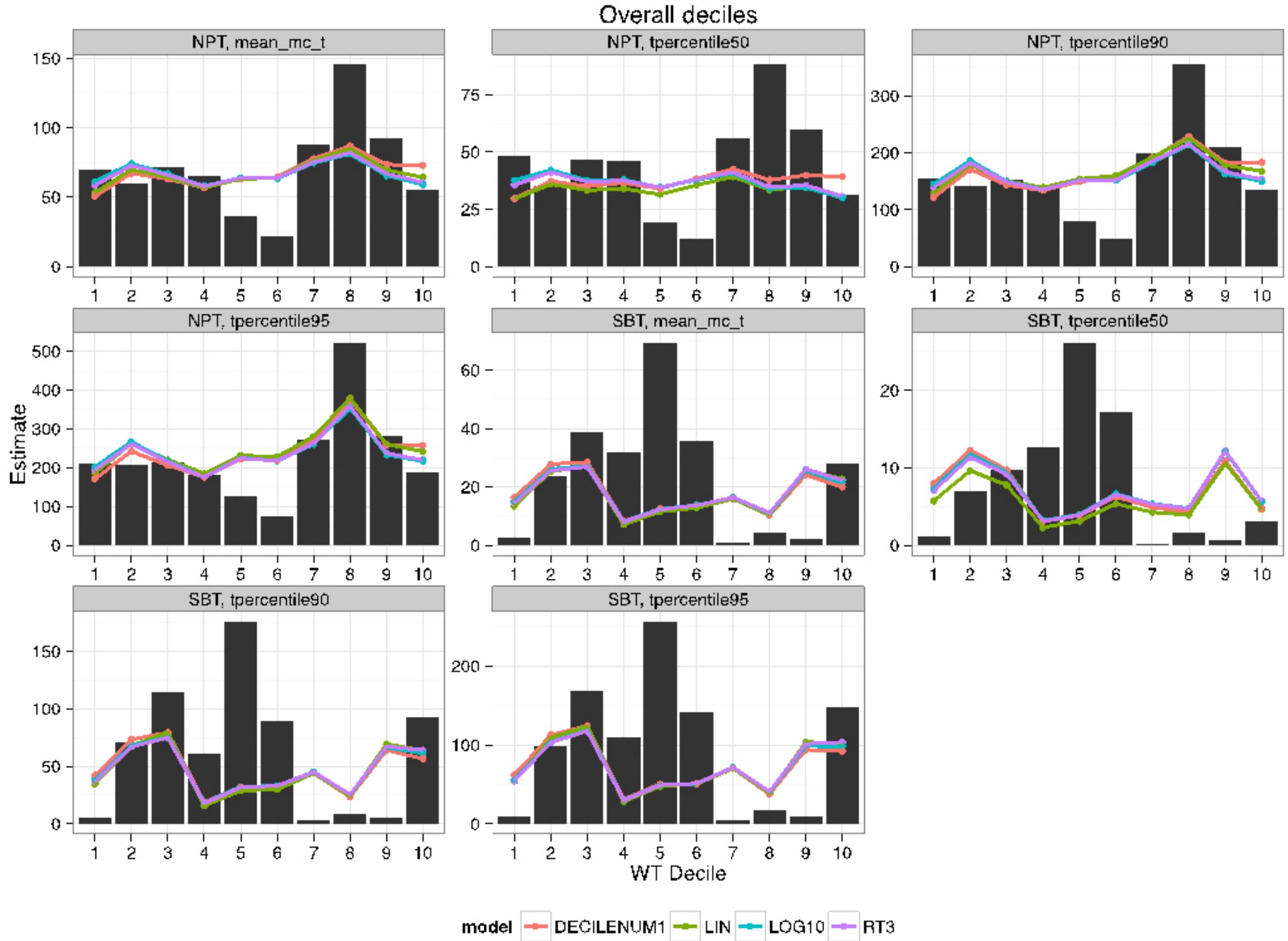

Figure E12. Comparison of *four forms of respondent body weight adjustment* (colored lines) to the categorical decile of respondent weight adjustment (black bars). Model for *Group 2 species*. DECILENUM2 = the numerical decile of respondent weight (coded as 1-10), LIN = the original (untransformed) respondent weight, LOG10 = the $\log_{10}$ respondent weight, RT3 = the 3^{rd} root respondent weight. Models include an adjustment for FFQ. mean_mc_t = mean, tpercentile50, 90 and 95 = the 50^{th}, 90^{th} and 95^{th} percentiles, respectively. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

Table E6. Final model NCI for Group 2.

Term	Estimate	Term	Estimate
A01_INTERCEPT	16.2626	P01_INTERCEPT	-3.6988
A02_TRIBE	8.6578	P02_TRIBE	-2.6738
A03_ROOT3FFQ	1.5434	P03_ROOT3FFQ	0.4562
A04_TRIBEROOT3FFQ	-1.8424	P04_TRIBEROOT3FFQ	0.3336
A05_SBT_DEC10	0.546	P05_ SBT_DEC10	-6.0168
A06_WEEKEND	-2.0663	P06_WEEKEND	-0.1213
A07_SECINT	1.2819	P07_SECINT	0.5122
A_LAMBDA	0.4074	P_LOGSDU1	-0.01034
A_LOGSDE	1.6965	Z_U	-0.09476
A_LOGSDU2	1.663	P_VAR_U1	0.9795
		A_VAR_U2	27.8251
		A_VAR_E	29.7566
		cov_u1u2	-0.4932
		RHO	-0.09448

Estimated parameters: Parameters starting with the letters “A” and “P” refer to the amount and probability models, respectively.

A01_INTERCEPT and P01_INTERCEPT= intercept;

A02_TRIBE and P02_TRIBE = tribe (NPT=0, SBT=1);

A03_ROOT3FFQ and P03_ROOT3FFQ = the (untransformed or transformed) FFQ;

A04_TRIBEROOT3FFQ and P04_ TRIBEROOT3FFQ = the tribe-FFQ interaction;

A05_SBT_DEC10 and P05_ SBT_DEC10 = indicator of 10th decile in SBT (0=no,1= yes);

A06_WEEKEND and P06_WEEKEND = weekend indicator (0=no,1= yes);

A07_SECINT and P07_SECINT= 2nd interview (0=no,1= yes);

A_LAMBDA = lambda for the Box-Cox transformation of the consumed amount;

A_LOGSDE = log SD of the residual variance;

A_LOGSDU2 and P_LOGSDU1= log SD of the between-subject variance;

Z_U = the Fisher's transformation of the correlation parameter;

P_VAR_U1 = the between-subject variance for the probability model (U1);

A_VAR_U2 = the between-subject variance for the amount model (U1);

A_VAR_E = the residual variance for the amount model;

cov_u1u2 = covariance between U1 and U2;

RHO = the correlation parameter between U1 and U2

2.0 NCI Method—Quality Checking

This appendix section contains displays concerning various quality checks for the NCI model. These displays are discussed and referenced in section 6.9 “Quality Checking—NCI Method“ in Volume II.

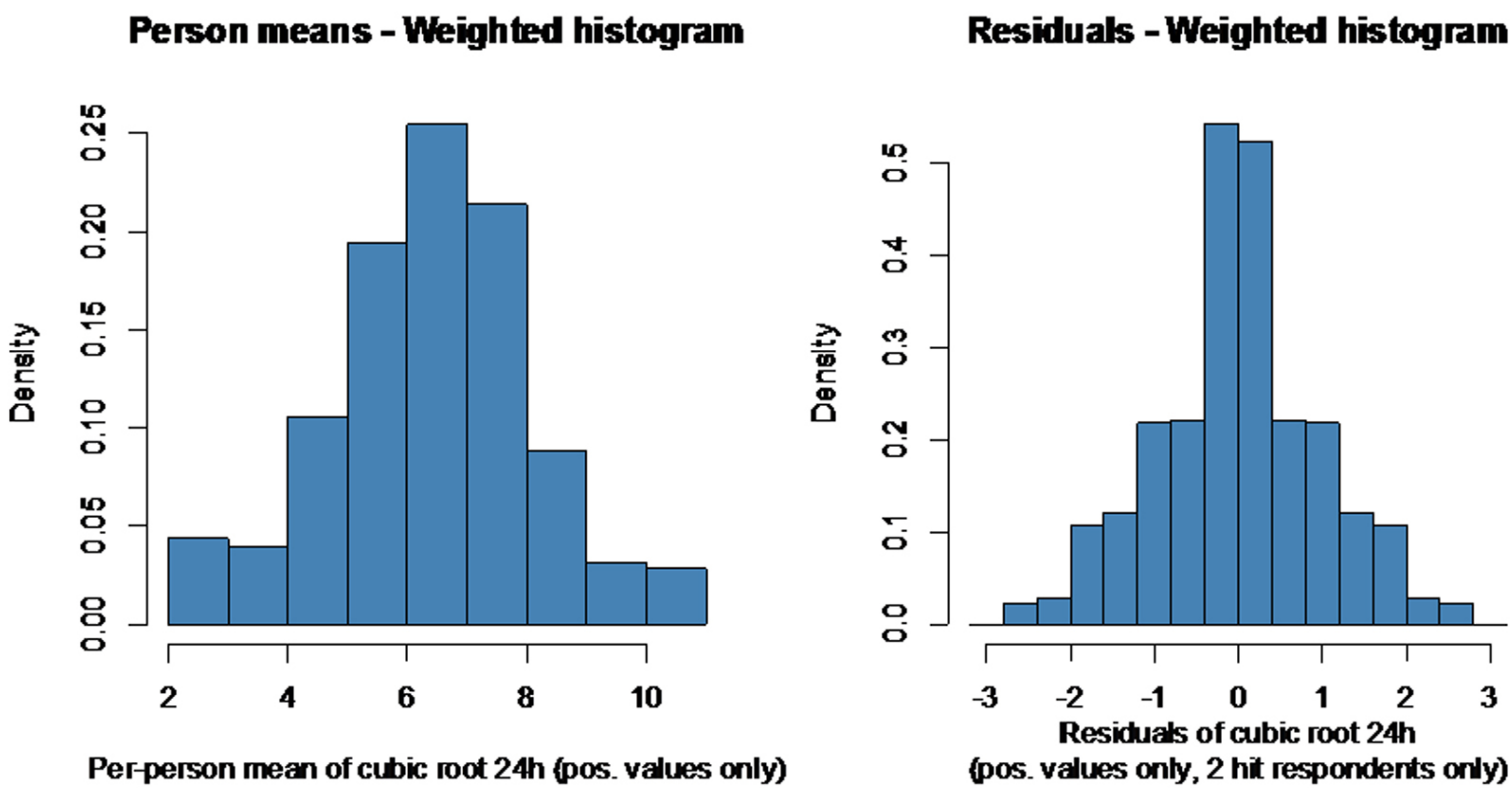

Figure E13. The (survey-weighted) distribution of the person-means and within-person residuals of the third root of the positive Group 1 consumption amounts. Both tribes combined. The units of the original values were g/day (raw weight, edible portion).

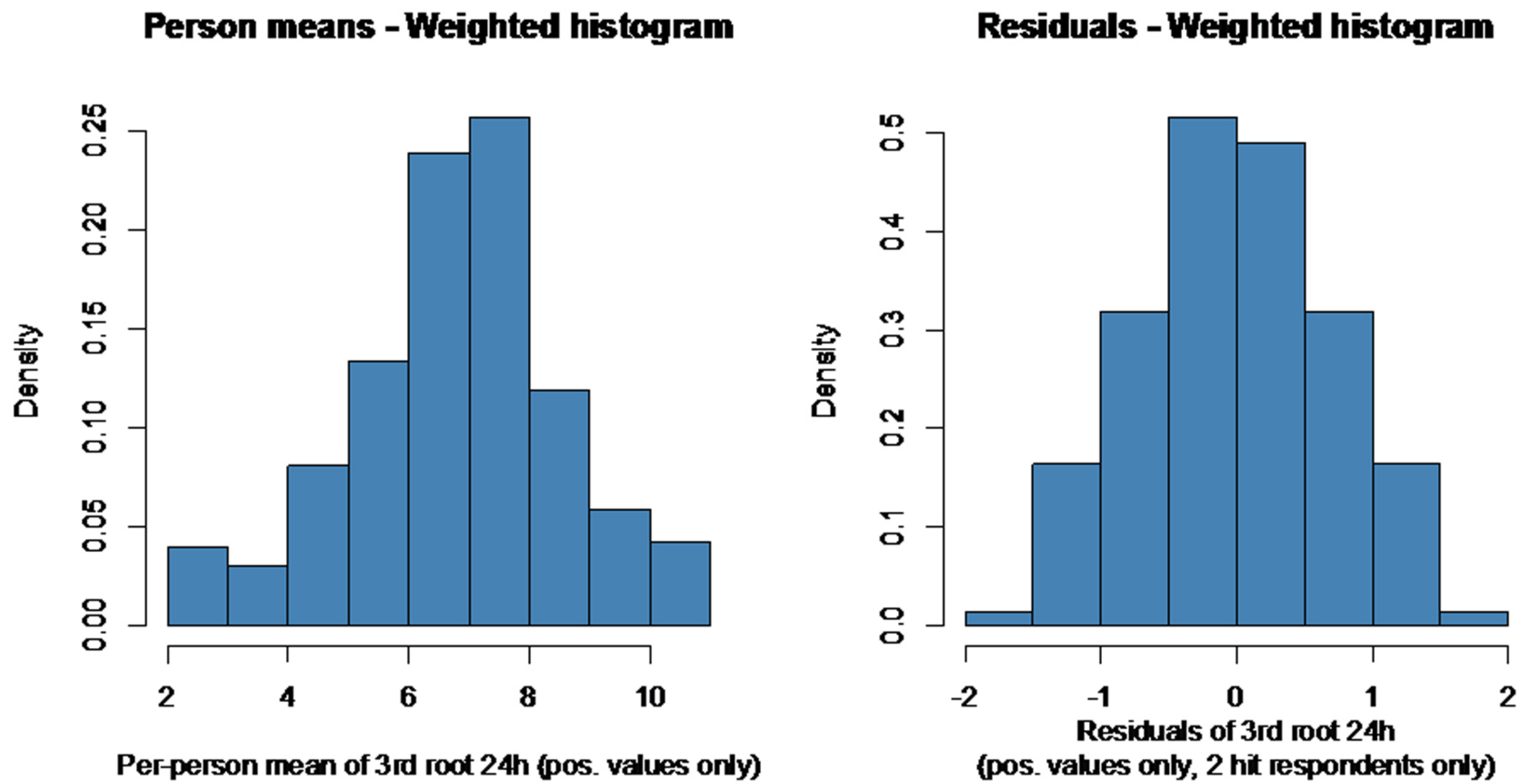

Figure E14. The (survey-weighted) distribution of the person-means and within-person residuals of the third root of the positive Group 2 consumption amounts. Both tribes combined. The units of the original values were g/day (raw weight, edible portion).

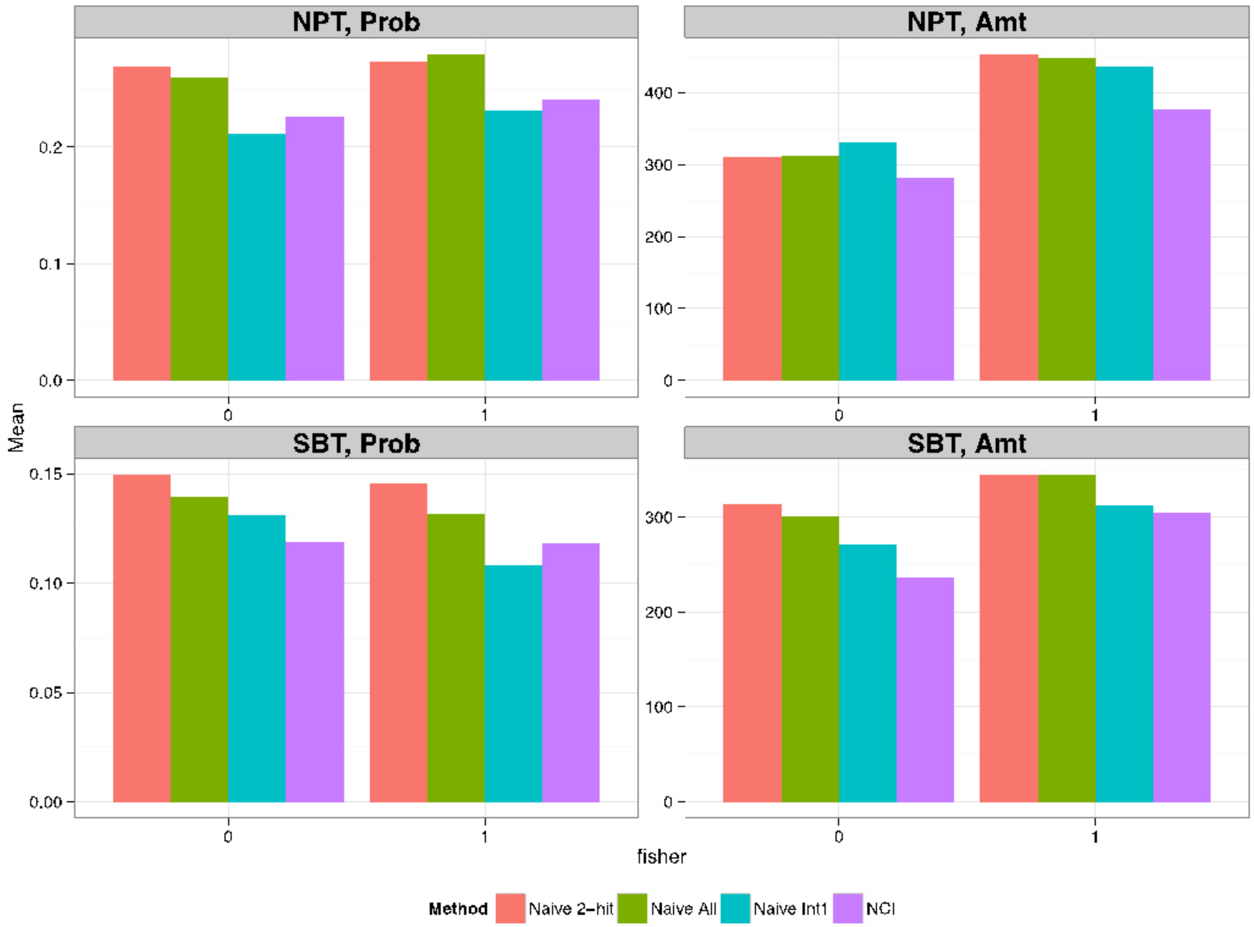

Figure E15. Quality checking of NCI model for _Group 1 species_. Consumption probability and mean amount on consumption days by _the respondent's presence on the fishers list_. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). 0 = not on the fishers list. 1= on the fishers list. The y-axis shows either the consumption probability (between 0 and 1) or the mean amount on consumption days. Naïve 2-hit = naïve approach limited to respondents with 2 interviews, naïve all = naïve approach with all respondents, naïve int1 = naïve approach limited to 1st interviews, NCI = the NCI model estimate.

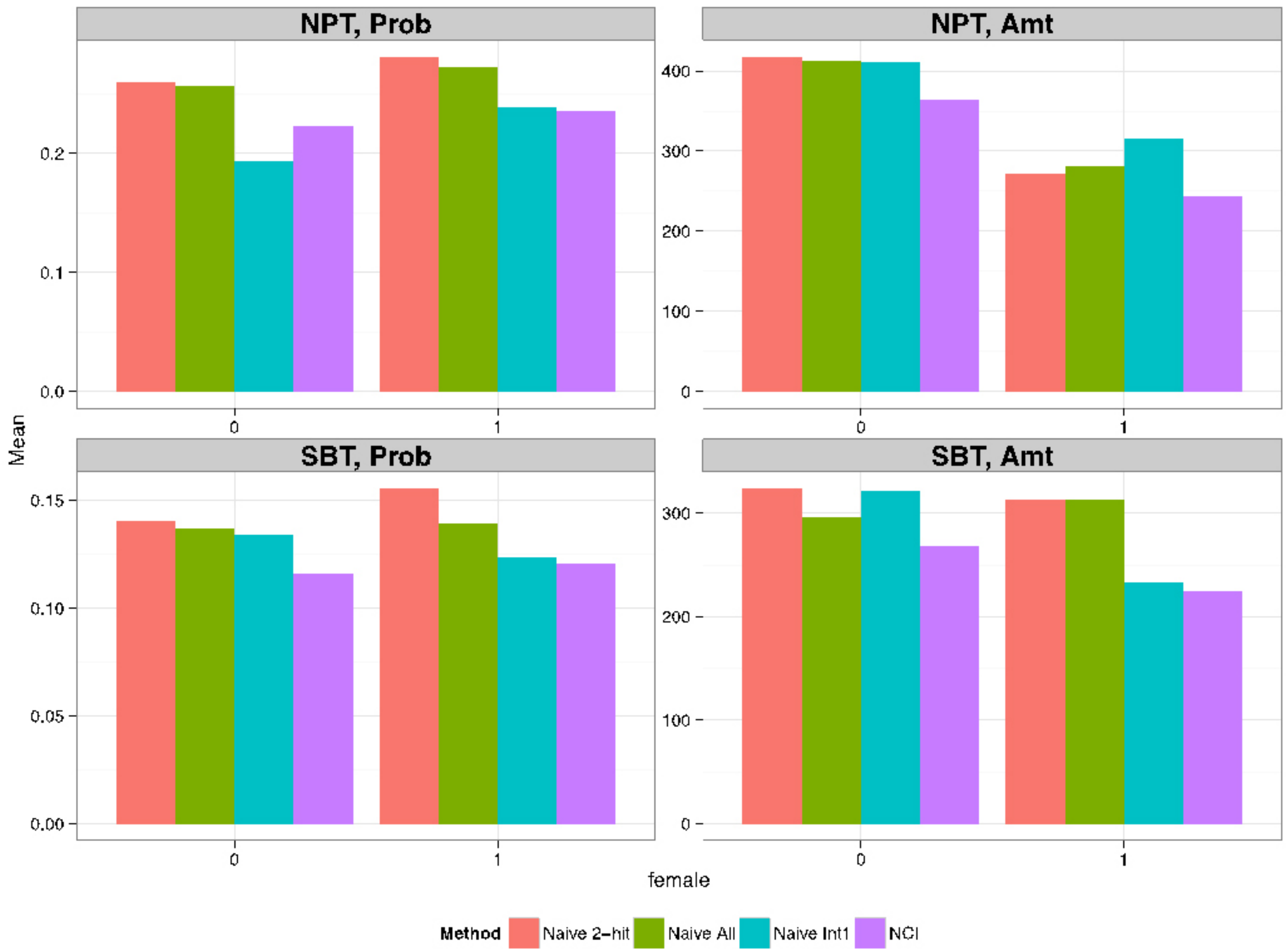

Figure E16. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's gender*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). 0 = men. 1= women. The y-axis shows either the consumption probability (between 0 and 1) or the mean amount on consumption days. Naïve 2-hit = naïve approach limited to respondents with 2 interviews, naïve all = naïve approach with all respondents, naïve int1 = naïve approach limited to 1st interviews, NCI = the NCI model estimate.

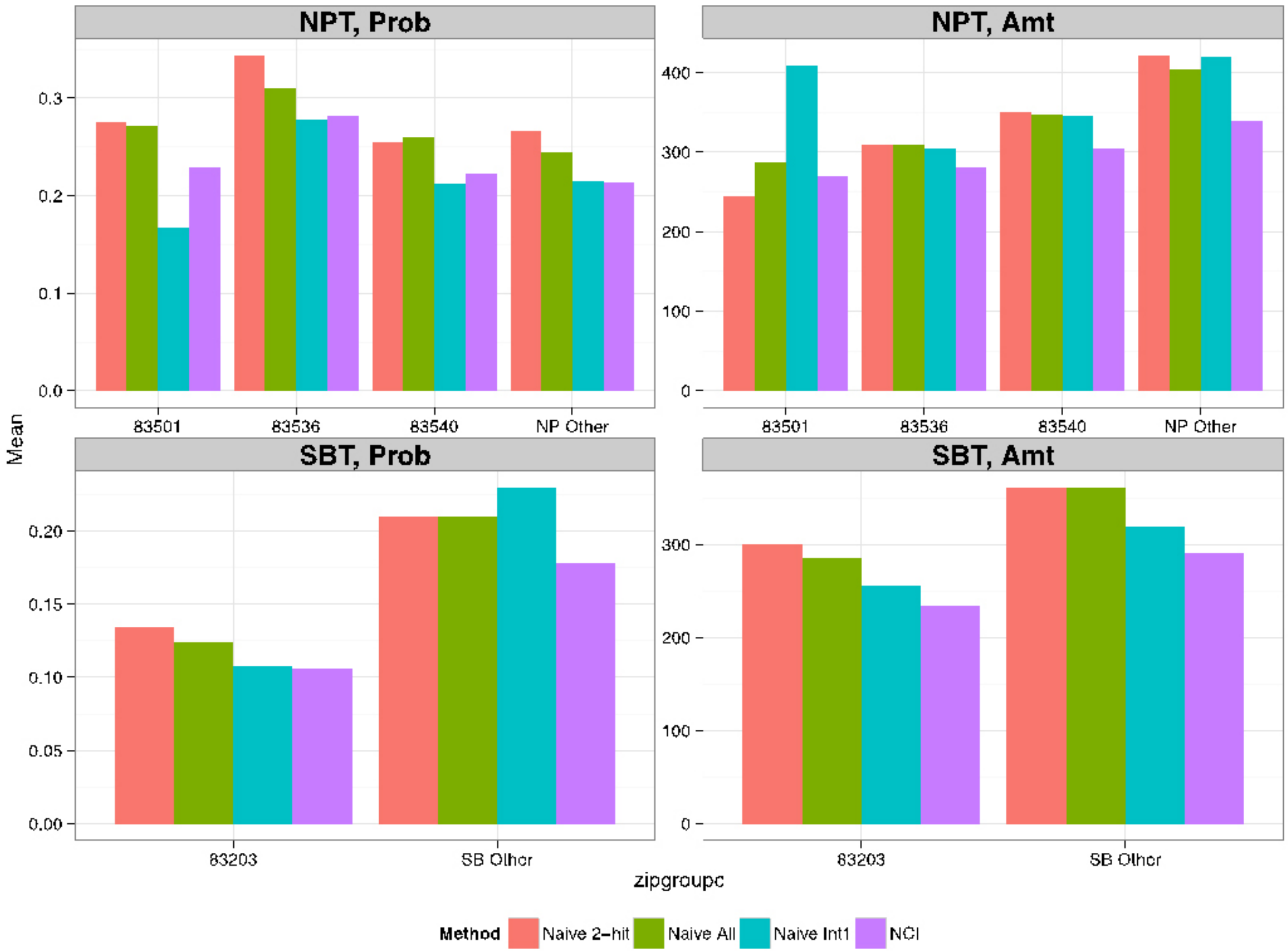

Figure E17. Quality checking of NCI model for *__Group 1 species__*. Consumption probability and mean amount on consumption days by *__the respondent's ZIP code__*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the consumption probability (between 0 and 1) or the mean amount on consumption days. Naïve 2-hit = naïve approach limited to respondents with 2 interviews, naïve all = naïve approach with all respondents, naïve int1 = naïve approach limited to 1st interviews, NCI = the NCI model estimate.

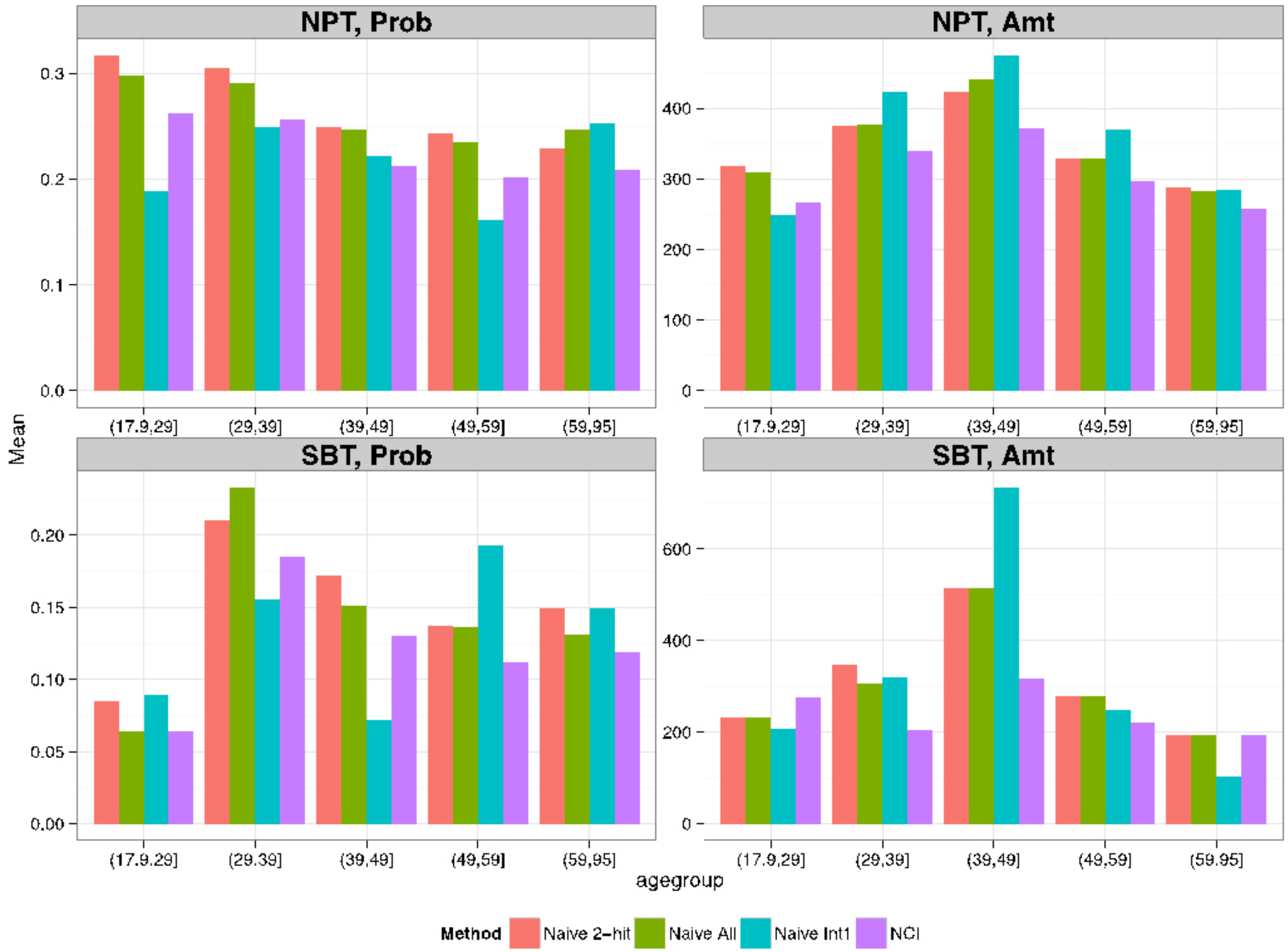

Figure E18. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's age*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the consumption probability (between 0 and 1) or the mean amount on consumption days. Naïve 2-hit = naïve approach limited to respondents with 2 interviews, naïve all = naïve approach with all respondents, naïve int1 = naïve approach limited to 1st interviews, NCI = the NCI model estimate.

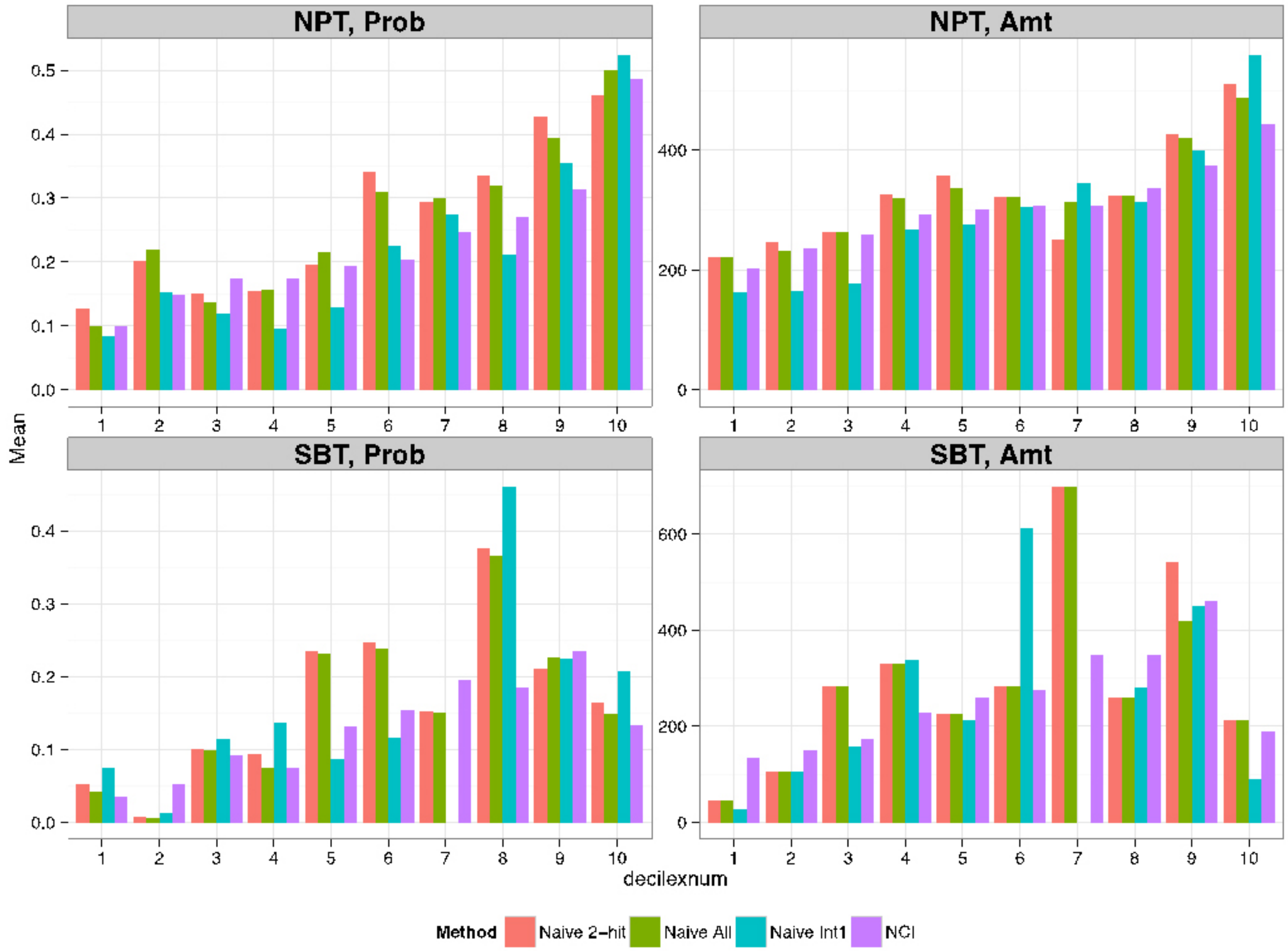

Figure E19. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's decile of group 1 FFQ consumption*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the consumption probability (between 0 and 1) or the mean amount on consumption days. Naïve 2-hit = naïve approach limited to respondents with 2 interviews, naïve all = naïve approach with all respondents, naïve int1 = naïve approach limited to 1st interviews, NCI = the NCI model estimate.

3.0 NCI Method—Confidence Intervals

The bootstrap distributions which were used to compute confidence intervals are shown in Figures E20 and E21 below. These are discussed in Section 6.8 of Volume II.

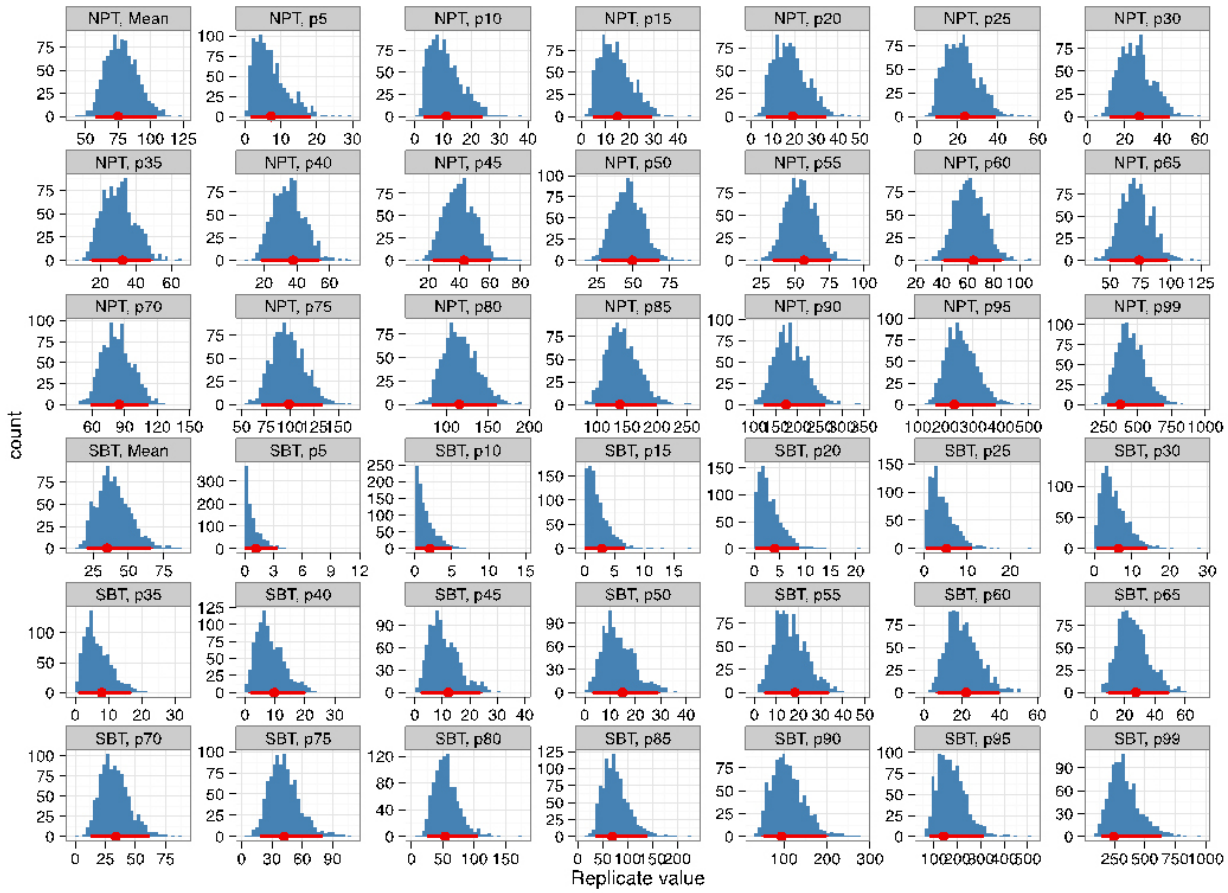

Figure E20. *Bootstrap distribution* of the NCI method estimated means and selected percentiles for all NPT and SBT respondents. N=978 bootstraps (22 of the 1000 bootstraps did not converge). *Group 1 consumption* (in g/day, raw weight, edible portion). Red dot shows the point estimate and the red bar around it shows the 95% confidence interval.

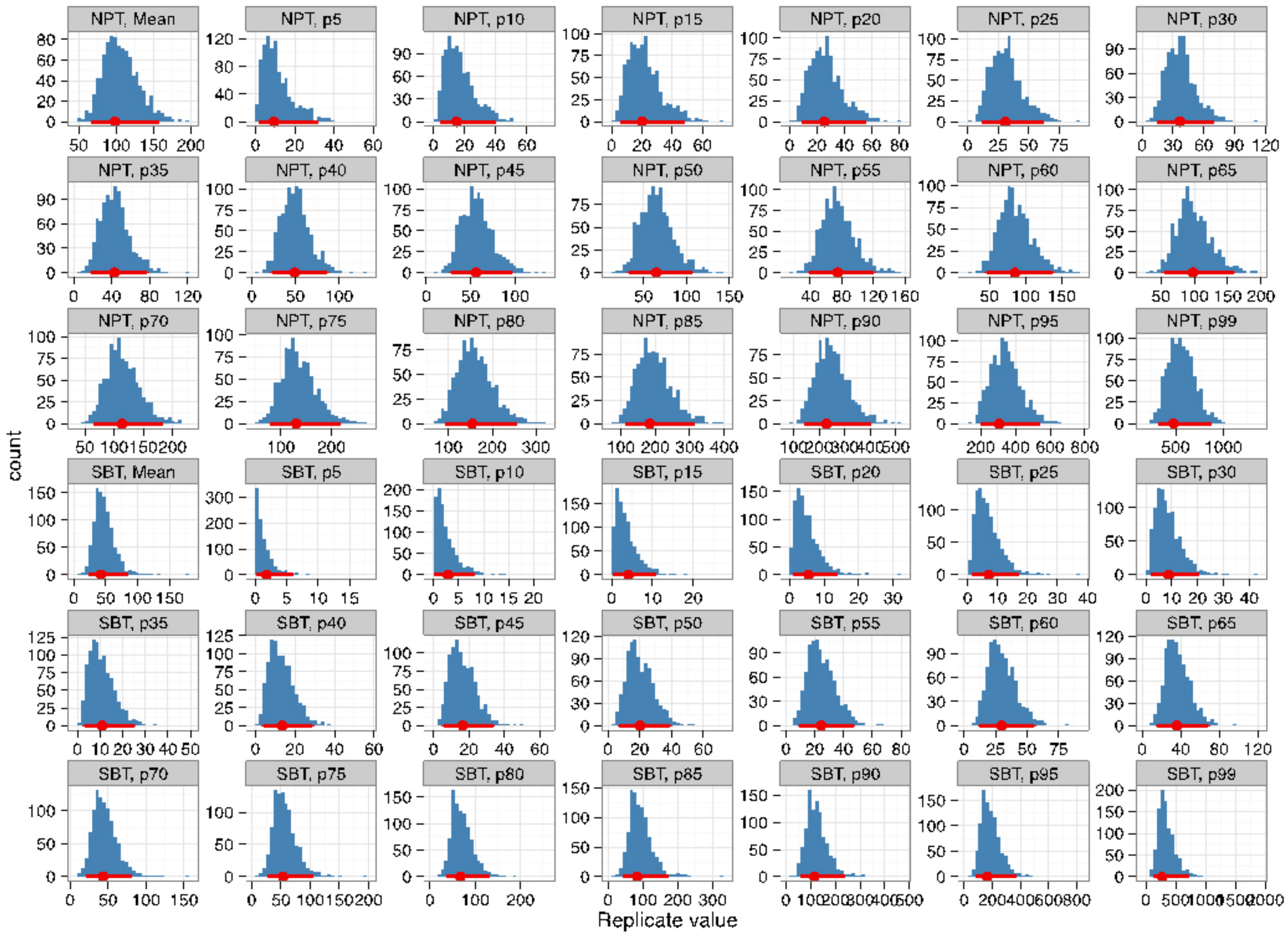

Figure E21. *Bootstrap distribution* of the NCI method estimated means and selected percentiles for NPT and SBT respondents on the fishers list. N=978 bootstraps (22 of the 1000 bootstraps did not converge). *Group 1 consumption* (in g/day, raw weight, edible portion). Red dot shows the point estimate and the red bar around it shows the 95% confidence interval.

4.0 NCI Method—Sensitivity Analyses

This section of the appendix shows the numerical results of the sensitivity analyses described in Sections 5.23.4 and 6.10 of Volume II (Sensitivity analyses). Each table in this section compares the Group 1 and Group 2 consumption results from two different models: a.) the final model (used to derive the means and percentiles of consumption presented in Volume II) vs. b.) a variation on the final model, as noted in the table title. The variations considered are 3rd root vs. $\log_{10}$ transformation of FFQ consumption (Tables E7 and E8), with and without weekend adjustment (Tables E9 and E10), with and without interview sequence effect adjustment (Tables E11 and E12), with and without correlation between probability of consumption and consumed amount (Tables E13 and E14), NPT and SBT data combined vs. NPT data only (Tables E15 and E16), and final model vs. simplified model with three covariates (Table E17). The mean consumption rate and the 95th percentile of consumption are compared between the final model and the alternative model in each table.

Table E7. NCI estimates (g/day, raw weight, edible portion) from the final model vs. model with log_{10} FFQ replacing 3^{rd} root of FFQ. Group 1 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) Log10 FFQ model		% difference (B-A)/A *100%	
				Mean	95^{th} Percentile	Mean	95^{th} Percentile	Mean	95^{th} Percentile
NPT	Overall	Overall	451	75.0	232.1	75.6	251.4	0.8%	8.3%
NPT	Fisher	Fisher	138	98.2	305.0	95.5	304.5	-2.7%	-0.2%
NPT	Fisher	Non-fisher	313	67.6	206.0	69.3	232.4	2.5%	12.8%
NPT	Gender	Male	241	87.7	268.1	88.0	283.8	0.3%	5.9%
NPT	Gender	Female	210	62.3	194.4	63.3	216.1	1.6%	11.2%
NPT	ZIP	83501	28	63.6	177.7	66.4	222.1	4.4%	25.0%
NPT	ZIP	83536	39	84.5	246.9	86.4	267.6	2.2%	8.4%
NPT	ZIP	83540	329	73.6	227.2	74.9	251.2	1.7%	10.6%
NPT	ZIP	Other	55	79.8	264.2	76.4	257.6	-4.2%	-2.5%
NPT	Age	18-29	61	75.3	232.5	75.2	241.7	-0.1%	4.0%
NPT	Age	30-39	94	92.5	274.2	92.8	293.9	0.4%	7.2%
NPT	Age	40-49	116	83.8	256.3	84.8	279.2	1.3%	8.9%
NPT	Age	50-59	89	66.8	212.7	68.1	236.0	1.9%	11.0%
NPT	Age	60+	91	58.1	182.5	58.7	204.6	1.1%	12.1%
SBT	Overall	Overall	226	34.9	140.9	34.0	140.3	-2.6%	-0.4%
SBT	Fisher	Fisher	134	42.4	163.6	40.4	158.1	-4.6%	-3.4%
SBT	Fisher	Non-fisher	92	33.9	138.3	33.2	138.1	-2.3%	-0.2%
SBT	Gender	Male	143	38.1	158.3	33.9	144.3	-11.0%	-8.8%
SBT	Gender	Female	83	32.2	126.8	34.1	138.4	5.7%	9.1%
SBT	ZIP	83203	207	29.9	121.1	29.1	120.1	-2.5%	-0.8%
SBT	ZIP	Other	19	59.2	209.7	57.5	217.3	-2.9%	3.6%
SBT	Age	18-29	36	24.3	110.2	21.1	89.2	-13.1%	-19.1%
SBT	Age	30-39	39	44.6	159.0	41.6	155.4	-6.8%	-2.2%
SBT	Age	40-49	51	51.7	202.5	51.0	203.3	-1.2%	0.4%
SBT	Age	50-59	48	31.8	125.8	31.3	126.3	-1.7%	0.4%
SBT	Age	60+	52	26.8	90.7	31.4	116.6	17.1%	28.4%

Table E8. NCI estimates (g/day, raw weight, edible portion) from the final model vs. model with log_{10} FFQ replacing 3^{rd} root of FFQ. Group 2 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) Log10 FFQ model		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	446	66.5	233.9	66.6	226.2	0.2%	-3.3%
NPT	Fisher	Fisher	138	98.4	345.0	95.1	302.0	-3.4%	-12.5%
NPT	Fisher	Non-fisher	308	55.6	189.5	56.7	189.0	1.9%	-0.2%
NPT	Gender	Male	240	79.4	277.1	79.0	261.9	-0.6%	-5.5%
NPT	Gender	Female	206	55.0	198.0	55.3	196.5	0.7%	-0.7%
NPT	ZIP	83501	27	64.0	197.4	66.6	204.4	4.0%	3.5%
NPT	ZIP	83536	38	83.7	301.5	84.1	282.9	0.4%	-6.2%
NPT	ZIP	83540	326	65.5	232.3	65.1	224.8	-0.7%	-3.2%
NPT	ZIP	Other	55	63.0	231.3	61.1	208.0	-2.9%	-10.1%
NPT	Age	18-29	61	76.9	249.4	74.8	222.4	-2.7%	-10.8%
NPT	Age	30-39	94	83.7	262.8	82.1	241.5	-1.9%	-8.1%
NPT	Age	40-49	115	65.1	196.6	65.0	193.8	-0.1%	-1.4%
NPT	Age	50-59	88	55.2	173.0	54.0	169.6	-2.2%	-2.0%
NPT	Age	60+	88	50.4	153.9	51.9	162.8	3.0%	5.8%
SBT	Overall	Overall	225	18.6	80.0	18.9	81.5	1.2%	1.9%
SBT	Fisher	Fisher	134	23.3	92.6	23.4	91.3	0.2%	-1.4%
SBT	Fisher	Non-fisher	91	17.8	76.8	18.1	78.6	1.6%	2.2%
SBT	Gender	Male	143	18.0	79.4	18.1	82.0	0.8%	3.3%
SBT	Gender	Female	82	19.5	84.3	19.6	85.2	0.9%	1.1%
SBT	ZIP	83203	206	15.8	67.2	16.0	68.4	1.3%	1.8%
SBT	ZIP	Other	19	34.1	130.7	34.0	127.5	-0.4%	-2.4%
SBT	Age	18-29	36	1.3	5.4	1.4	5.8	7.1%	8.9%
SBT	Age	30-39	39	36.5	136.3	36.5	138.1	0.0%	1.4%
SBT	Age	40-49	51	50.9	203.0	51.0	197.9	0.1%	-2.5%
SBT	Age	50-59	48	12.6	55.2	12.8	55.6	1.6%	0.8%
SBT	Age	60+	51	13.1	45.1	12.8	45.2	-2.8%	0.3%

Table E9. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without the weekend adjustment. Group 1 consumption.

				(A) Final model		(B) No weekend adjustment		% difference (B-A)/A *100%	
Tribe	Grouping variable	Group	No. of Consumers	Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	451	75.0	232.1	78.0	240.2	4.0%	3.5%
NPT	Fisher	Fisher	138	98.2	305.0	100.0	309.3	1.8%	1.4%
NPT	Fisher	Non-fisher	313	67.6	206.0	71.0	215.3	5.1%	4.5%
NPT	Gender	Male	241	87.7	268.1	90.8	276.9	3.5%	3.3%
NPT	Gender	Female	210	62.3	194.4	65.4	203.4	4.9%	4.6%
NPT	ZIP	83501	28	63.6	177.7	67.3	188.9	5.8%	6.3%
NPT	ZIP	83536	39	84.5	246.9	87.4	254.2	3.4%	3.0%
NPT	ZIP	83540	329	73.6	227.2	77.0	237.3	4.6%	4.5%
NPT	ZIP	Other	55	79.8	264.2	81.4	268.6	2.1%	1.7%
NPT	Age	18-29	61	75.3	232.5	77.2	236.8	2.6%	1.8%
NPT	Age	30-39	94	92.5	274.2	97.2	286.7	5.1%	4.6%
NPT	Age	40-49	116	83.8	256.3	86.7	262.4	3.5%	2.4%
NPT	Age	50-59	89	66.8	212.7	69.2	219.8	3.5%	3.4%
NPT	Age	60+	91	58.1	182.5	61.3	192.4	5.5%	5.4%
SBT	Overall	Overall	226	34.9	140.9	35.0	142.2	0.3%	0.9%
SBT	Fisher	Fisher	134	42.4	163.6	44.5	170.9	5.1%	4.5%
SBT	Fisher	Non-fisher	92	33.9	138.3	33.8	138.0	-0.4%	-0.3%
SBT	Gender	Male	143	38.1	158.3	38.8	160.6	1.9%	1.5%
SBT	Gender	Female	83	32.2	126.8	31.8	124.6	-1.2%	-1.8%
SBT	ZIP	83203	207	29.9	121.1	30.3	123.6	1.4%	2.1%
SBT	ZIP	Other	19	59.2	209.7	57.9	205.7	-2.2%	-1.9%
SBT	Age	18-29	36	24.3	110.2	23.8	108.0	-2.1%	-2.0%
SBT	Age	30-39	39	44.6	159.0	46.7	166.0	4.6%	4.4%
SBT	Age	40-49	51	51.7	202.5	50.1	195.0	-3.1%	-3.7%
SBT	Age	50-59	48	31.8	125.8	33.4	133.1	4.8%	5.8%
SBT	Age	60+	52	26.8	90.7	25.9	88.0	-3.3%	-3.1%

Table E10. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without the weekend adjustment. Group 2 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) No weekend adjustment		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	446	66.5	233.9	68.9	243.1	3.5%	3.9%
NPT	Fisher	Fisher	138	98.4	345.0	99.7	350.8	1.3%	1.7%
NPT	Fisher	Non-fisher	308	55.6	189.5	58.4	200.6	5.0%	5.9%
NPT	Gender	Male	240	79.4	277.1	81.9	288.8	3.1%	4.2%
NPT	Gender	Female	206	55.0	198.0	57.5	209.3	4.6%	5.7%
NPT	ZIP	83501	27	64.0	197.4	67.2	209.8	4.9%	6.3%
NPT	ZIP	83536	38	83.7	301.5	86.3	313.7	3.1%	4.1%
NPT	ZIP	83540	326	65.5	232.3	68.4	244.9	4.4%	5.4%
NPT	ZIP	Other	55	63.0	231.3	64.0	238.0	1.6%	2.9%
NPT	Age	18-29	61	76.9	249.4	77.2	254.9	0.5%	2.2%
NPT	Age	30-39	94	83.7	262.8	86.9	272.7	3.8%	3.7%
NPT	Age	40-49	115	65.1	196.6	66.6	201.2	2.3%	2.4%
NPT	Age	50-59	88	55.2	173.0	55.7	175.3	0.9%	1.3%
NPT	Age	60+	88	50.4	153.9	52.0	159.2	3.2%	3.5%
SBT	Overall	Overall	225	18.6	80.0	18.8	81.5	1.0%	1.9%
SBT	Fisher	Fisher	134	23.3	92.6	23.8	95.7	1.9%	3.3%
SBT	Fisher	Non-fisher	91	17.8	76.8	17.9	77.9	0.4%	1.3%
SBT	Gender	Male	143	18.0	79.4	18.0	80.2	0.5%	1.0%
SBT	Gender	Female	82	19.5	84.3	20.1	88.1	3.2%	4.6%
SBT	ZIP	83203	206	15.8	67.2	15.4	67.0	-2.2%	-0.4%
SBT	ZIP	Other	19	34.1	130.7	35.9	140.2	5.4%	7.3%
SBT	Age	18-29	36	1.3	5.4	1.3	5.5	4.0%	2.6%
SBT	Age	30-39	39	36.5	136.3	37.7	139.4	3.0%	2.3%
SBT	Age	40-49	51	50.9	203.0	50.7	199.8	-0.4%	-1.5%
SBT	Age	50-59	48	12.6	55.2	13.8	60.1	9.6%	8.9%
SBT	Age	60+	51	13.1	45.1	12.8	43.1	-2.6%	-4.4%

Table E11. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without the sequence effect adjustment. Group 1 consumption

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) No sequence effect adjustment		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	451	75.0	232.1	91.9	264.1	22.5%	13.8%
NPT	Fisher	Fisher	138	98.2	305.0	119.4	343.2	21.6%	12.5%
NPT	Fisher	Non-fisher	313	67.6	206.0	83.1	236.2	22.9%	14.6%
NPT	Gender	Male	241	87.7	268.1	107.9	306.7	23.0%	14.4%
NPT	Gender	Female	210	62.3	194.4	75.9	219.2	21.7%	12.7%
NPT	ZIP	83501	28	63.6	177.7	80.3	209.4	26.2%	17.8%
NPT	ZIP	83536	39	84.5	246.9	102.6	277.1	21.4%	12.2%
NPT	ZIP	83540	329	73.6	227.2	90.0	258.9	22.3%	14.0%
NPT	ZIP	Other	55	79.8	264.2	97.3	302.1	22.0%	14.3%
NPT	Age	18-29	61	75.3	232.5	92.9	265.4	23.5%	14.1%
NPT	Age	30-39	94	92.5	274.2	112.1	305.5	21.3%	11.4%
NPT	Age	40-49	116	83.8	256.3	102.8	290.4	22.7%	13.3%
NPT	Age	50-59	89	66.8	212.7	83.4	250.7	24.7%	17.9%
NPT	Age	60+	91	58.1	182.5	70.0	205.4	20.5%	12.5%
SBT	Overall	Overall	226	34.9	140.9	44.0	172.3	26.1%	22.3%
SBT	Fisher	Fisher	134	42.4	163.6	54.3	199.2	28.1%	21.7%
SBT	Fisher	Non-fisher	92	33.9	138.3	42.7	168.2	25.8%	21.6%
SBT	Gender	Male	143	38.1	158.3	47.0	187.8	23.4%	18.6%
SBT	Gender	Female	83	32.2	126.8	41.5	153.7	28.8%	21.2%
SBT	ZIP	83203	207	29.9	121.1	38.1	148.7	27.6%	22.8%
SBT	ZIP	Other	19	59.2	209.7	72.5	246.1	22.4%	17.4%
SBT	Age	18-29	36	24.3	110.2	29.6	134.3	21.9%	21.8%
SBT	Age	30-39	39	44.6	159.0	56.2	190.0	25.9%	19.5%
SBT	Age	40-49	51	51.7	202.5	66.9	250.0	29.5%	23.5%
SBT	Age	50-59	48	31.8	125.8	38.8	144.5	21.9%	14.9%
SBT	Age	60+	52	26.8	90.7	35.1	113.5	31.1%	25.0%

Table E12. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without the sequence effect adjustment. Group 2 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) No sequence effect adjustment		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	446	66.5	233.9	82.7	278.8	24.4%	19.2%
NPT	Fisher	Fisher	138	98.4	345.0	122.0	396.6	23.9%	15.0%
NPT	Fisher	Non-fisher	308	55.6	189.5	69.8	221.8	25.5%	17.0%
NPT	Gender	Male	240	79.4	277.1	98.6	323.8	24.1%	16.9%
NPT	Gender	Female	206	55.0	198.0	67.3	231.2	22.5%	16.8%
NPT	ZIP	83501	27	64.0	197.4	79.6	232.5	24.4%	17.8%
NPT	ZIP	83536	38	83.7	301.5	100.7	343.6	20.2%	14.0%
NPT	ZIP	83540	326	65.5	232.3	80.9	275.3	23.5%	18.5%
NPT	ZIP	Other	55	63.0	231.3	78.4	278.6	24.4%	20.4%
NPT	Age	18-29	61	76.9	249.4	92.0	283.3	19.7%	13.6%
NPT	Age	30-39	94	83.7	262.8	100.2	297.6	19.7%	13.2%
NPT	Age	40-49	115	65.1	196.6	78.9	227.4	21.2%	15.7%
NPT	Age	50-59	88	55.2	173.0	67.3	202.6	21.9%	17.1%
NPT	Age	60+	88	50.4	153.9	61.4	179.7	21.8%	16.8%
SBT	Overall	Overall	225	18.6	80.0	24.2	100.1	30.1%	25.3%
SBT	Fisher	Fisher	134	23.3	92.6	29.5	110.8	26.4%	19.6%
SBT	Fisher	Non-fisher	91	17.8	76.8	23.4	96.5	31.0%	25.6%
SBT	Gender	Male	143	18.0	79.4	23.3	98.5	29.9%	24.0%
SBT	Gender	Female	82	19.5	84.3	25.4	106.3	30.3%	26.2%
SBT	ZIP	83203	206	15.8	67.2	20.7	86.5	31.2%	28.7%
SBT	ZIP	Other	19	34.1	130.7	42.5	157.6	24.7%	20.6%
SBT	Age	18-29	36	1.3	5.4	1.7	7.2	36.5%	33.6%
SBT	Age	30-39	39	36.5	136.3	45.9	161.2	25.6%	18.3%
SBT	Age	40-49	51	50.9	203.0	63.0	240.9	23.7%	18.7%
SBT	Age	50-59	48	12.6	55.2	16.2	69.2	29.0%	25.4%
SBT	Age	60+	51	13.1	45.1	16.6	54.1	26.5%	20.0%

Table E13. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without correlation between the probability and consumed amount. Group 1 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) Without Prob-amt. Correlation		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	451	75.0	232.1	75.0	232.1	0.0%	0.0%
NPT	Fisher	Fisher	138	98.2	305.0	98.3	305.0	0.0%	0.0%
NPT	Fisher	Non-fisher	313	67.6	206.0	67.6	205.9	0.0%	-0.1%
NPT	Gender	Male	241	87.7	268.1	87.7	268.1	0.0%	0.0%
NPT	Gender	Female	210	62.3	194.4	62.3	194.4	0.0%	0.0%
NPT	ZIP	83501	28	63.6	177.7	63.6	177.6	0.0%	-0.1%
NPT	ZIP	83536	39	84.5	246.9	84.5	246.9	0.0%	0.0%
NPT	ZIP	83540	329	73.6	227.2	73.6	227.1	0.0%	0.0%
NPT	ZIP	Other	55	79.8	264.2	79.8	264.4	0.0%	0.1%
NPT	Age	18-29	61	75.3	232.5	75.3	232.5	0.0%	0.0%
NPT	Age	30-39	94	92.5	274.2	92.5	274.2	0.0%	0.0%
NPT	Age	40-49	116	83.8	256.3	83.8	256.4	0.0%	0.0%
NPT	Age	50-59	89	66.8	212.7	66.9	212.9	0.0%	0.1%
NPT	Age	60+	91	58.1	182.5	58.1	182.3	0.0%	-0.1%
SBT	Overall	Overall	226	34.9	140.9	34.9	140.9	0.1%	0.0%
SBT	Fisher	Fisher	134	42.4	163.6	42.4	163.6	0.1%	0.0%
SBT	Fisher	Non-fisher	92	33.9	138.3	34.0	138.4	0.1%	0.0%
SBT	Gender	Male	143	38.1	158.3	38.1	158.5	0.1%	0.1%
SBT	Gender	Female	83	32.2	126.8	32.2	126.7	0.1%	-0.1%
SBT	ZIP	83203	207	29.9	121.1	29.9	121.2	0.1%	0.1%
SBT	ZIP	Other	19	59.2	209.7	59.3	209.6	0.1%	0.0%
SBT	Age	18-29	36	24.3	110.2	24.3	110.4	0.1%	0.1%
SBT	Age	30-39	39	44.6	159.0	44.6	158.7	0.1%	-0.1%
SBT	Age	40-49	51	51.7	202.5	51.7	202.7	0.1%	0.1%
SBT	Age	50-59	48	31.8	125.8	31.9	125.9	0.1%	0.1%
SBT	Age	60+	52	26.8	90.7	26.8	90.8	0.0%	0.1%

Table E14. NCI estimates (g/day, raw weight, edible portion) from the final model vs. final model without correlation between the probability and consumed amount. Group 2 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) Without Prob-amt. Correlation		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	446	66.5	233.9	66.9	238.8	0.6%	2.1%
NPT	Fisher	Fisher	138	98.4	345.0	97.9	347.5	-0.5%	0.7%
NPT	Fisher	Non-fisher	308	55.6	189.5	56.4	196.9	1.4%	3.9%
NPT	Gender	Male	240	79.4	277.1	79.3	274.0	-0.1%	-1.1%
NPT	Gender	Female	206	55.0	198.0	54.8	196.5	-0.4%	-0.8%
NPT	ZIP	83501	27	64.0	197.4	63.6	193.6	-0.7%	-1.9%
NPT	ZIP	83536	38	83.7	301.5	83.5	300.0	-0.3%	-0.5%
NPT	ZIP	83540	326	65.5	232.3	65.2	229.5	-0.4%	-1.2%
NPT	ZIP	Other	55	63.0	231.3	62.9	230.5	-0.1%	-0.4%
NPT	Age	18-29	61	76.9	249.4	76.7	251.8	-0.2%	1.0%
NPT	Age	30-39	94	83.7	262.8	83.9	264.9	0.3%	0.8%
NPT	Age	40-49	115	65.1	196.6	64.0	195.9	-1.6%	-0.3%
NPT	Age	50-59	88	55.2	173.0	54.6	173.9	-1.0%	0.5%
NPT	Age	60+	88	50.4	153.9	50.7	156.5	0.6%	1.7%
SBT	Overall	Overall	225	18.6	80.0	18.8	81.6	0.9%	2.0%
SBT	Fisher	Fisher	134	23.3	92.6	23.5	95.8	0.9%	3.5%
SBT	Fisher	Non-fisher	91	17.8	76.8	18.1	79.5	1.5%	3.5%
SBT	Gender	Male	143	18.0	79.4	17.9	78.9	-0.3%	-0.6%
SBT	Gender	Female	82	19.5	84.3	19.4	83.5	-0.2%	-0.9%
SBT	ZIP	83203	206	15.8	67.2	15.7	66.4	-0.5%	-1.2%
SBT	ZIP	Other	19	34.1	130.7	33.7	128.1	-1.1%	-2.0%
SBT	Age	18-29	36	1.3	5.4	1.2	5.2	-2.2%	-2.6%
SBT	Age	30-39	39	36.5	136.3	36.3	137.3	-0.7%	0.8%
SBT	Age	40-49	51	50.9	203.0	50.5	206.8	-0.7%	1.9%
SBT	Age	50-59	48	12.6	55.2	12.5	55.4	-0.6%	0.4%
SBT	Age	60+	51	13.1	45.1	12.9	45.0	-1.5%	-0.2%

Table E15. NCI estimates (g/day, raw weight, edible portion) for the NPT from the final model fit to data from NPT + SBT vs. final model fit only to the NPT data. Group 1 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) NPT data only		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	451	75.0	232.1	70.9	254.3	-5.4%	9.6%
NPT	Fisher	Fisher	138	98.2	305.0	92.0	327.2	-6.3%	7.3%
NPT	Fisher	Non-fisher	313	67.6	206.0	64.2	231.5	-5.0%	12.4%
NPT	Gender	Male	241	87.7	268.1	84.0	300.9	-4.2%	12.3%
NPT	Gender	Female	210	62.3	194.4	57.9	212.5	-7.0%	9.3%
NPT	ZIP	83501	28	63.6	177.7	61.7	212.1	-3.0%	19.3%
NPT	ZIP	83536	39	84.5	246.9	79.8	265.9	-5.6%	7.7%
NPT	ZIP	83540	329	73.6	227.2	70.1	253.5	-4.7%	11.6%
NPT	ZIP	Other	55	79.8	264.2	73.1	274.3	-8.4%	3.8%
NPT	Age	18-29	61	75.3	232.5	71.7	247.0	-4.8%	6.2%
NPT	Age	30-39	94	92.5	274.2	88.6	305.5	-4.2%	11.4%
NPT	Age	40-49	116	83.8	256.3	78.6	280.1	-6.2%	9.3%
NPT	Age	50-59	89	66.8	212.7	62.8	238.3	-6.1%	12.1%
NPT	Age	60+	91	58.1	182.5	54.4	202.7	-6.4%	11.0%

Table E16. NCI estimates (g/day, raw weight, edible portion) for the NPT from the final model fit to data from NPT + SBT vs. final model fit only to the NPT data Group 2 consumption

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) NPTT data only		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	446	66.5	233.9	58.1	188.9	-12.7%	-19.3%
NPT	Fisher	Fisher	138	98.4	345.0	88.5	296.9	-10.0%	-13.9%
NPT	Fisher	Non-fisher	308	55.6	189.5	48.0	147.5	-13.7%	-22.1%
NPT	Gender	Male	240	79.4	277.1	71.6	233.8	-9.9%	-15.6%
NPT	Gender	Female	206	55.0	198.0	46.7	158.2	-15.1%	-20.1%
NPT	ZIP	83501	27	64.0	197.4	55.5	150.9	-13.3%	-23.6%
NPT	ZIP	83536	38	83.7	301.5	74.7	268.1	-10.8%	-11.1%
NPT	ZIP	83540	326	65.5	232.3	56.0	184.9	-14.5%	-20.4%
NPT	ZIP	Other	55	63.0	231.3	54.9	202.2	-12.8%	-12.6%
NPT	Age	18-29	61	76.9	249.4	67.0	235.4	-12.9%	-5.6%
NPT	Age	30-39	94	83.7	262.8	73.5	242.9	-12.2%	-7.6%
NPT	Age	40-49	115	65.1	196.6	54.8	174.6	-15.9%	-11.2%
NPT	Age	50-59	88	55.2	173.0	45.9	149.7	-16.8%	-13.5%
NPT	Age	60+	88	50.4	153.9	43.1	137.7	-14.4%	-10.5%

Table E17. NCI estimates (g/day, raw weight, edible portion) from the final model vs. simpler model (tribe, 3rd root of FFQ, tribe by 3rd root of FFQ interaction and a single covariate for groups as needed). Group 1 consumption.

Tribe	Grouping variable	Group	No. of Consumers	(A) Final model		(B) Simpler model		% difference (B-A)/A *100%	
				Mean	95th Percentile	Mean	95th Percentile	Mean	95th Percentile
NPT	Overall	Overall	451	75.0	232.1	75.2	252.3	0.3%	8.7%
NPT	Fisher	Fisher	138	98.2	305.0	101.4	333.7	3.2%	9.4%
NPT	Fisher	Non-fisher	313	67.6	206.0	68.3	226.8	1.1%	10.1%
NPT	Gender	Male	241	87.7	268.1	89.8	286.3	2.4%	6.8%
NPT	Gender	Female	210	62.3	194.4	62.3	198.7	-0.1%	2.2%
NPT	ZIP	83501	28	63.6	177.7	57.2	182.7	-10.1%	2.8%
NPT	ZIP	83536	39	84.5	246.9	84.0	276.2	-0.6%	11.8%
NPT	ZIP	83540	329	73.6	227.2	74.3	256.6	1.0%	13.0%
NPT	ZIP	Other	55	79.8	264.2	80.9	287.9	1.4%	9.0%
NPT	Age	18-29	61	75.3	232.5	74.2	224.2	-1.5%	-3.6%
NPT	Age	30-39	94	92.5	274.2	92.8	278.8	0.4%	1.7%
NPT	Age	40-49	116	83.8	256.3	84.8	258.5	1.2%	0.8%
NPT	Age	50-59	89	66.8	212.7	65.5	215.3	-2.1%	1.2%
NPT	Age	60+	91	58.1	182.5	58.1	182.6	0.0%	0.1%
SBT	Overall	Overall	226	34.9	140.9	34.5	142.8	-1.1%	1.3%
SBT	Fisher	Fisher	134	42.4	163.6	42.1	161.9	-0.8%	-1.0%
SBT	Fisher	Non-fisher	92	33.9	138.3	33.5	138.6	-1.4%	0.2%
SBT	Gender	Male	143	38.1	158.3	38.7	161.7	1.7%	2.2%
SBT	Gender	Female	83	32.2	126.8	31.3	123.3	-3.0%	-2.8%
SBT	ZIP	83203	207	29.9	121.1	29.3	126.9	-1.8%	4.8%
SBT	ZIP	Other	19	59.2	209.7	56.8	212.6	-4.1%	1.4%
SBT	Age	18-29	36	24.3	110.2	21.0	94.3	-13.7%	-14.4%
SBT	Age	30-39	39	44.6	159.0	45.9	169.2	2.9%	6.4%
SBT	Age	40-49	51	51.7	202.5	52.3	196.2	1.3%	-3.1%
SBT	Age	50-59	48	31.8	125.8	33.5	131.1	5.2%	4.2%
SBT	Age	60+	52	26.8	90.7	27.2	97.1	1.6%	7.0%

5.0 NCI Method—Covariate Selection: Assessment of Seasonality

Figure E22 shows the survey-weighted mean[6] of the 24-hour recall of the Group 1 species consumption by tribe, month and interview number (1st vs. 2nd interview). The 1st and 2nd interviews are separated because we found important differences between them (the 2nd interview tended to be higher, on average, than those in the first interview). Means for some of the months have very small sample sizes (the sample size is shown within each dot). The sample sizes are limited and there is large variability of the 24-hour recall data across time: no clear seasonal trend is apparent. We do not claim that such a trend does not exist, but that a trend was not empirically evident from the data. With fewer single and double hits than the NPT, the trend lines for the SBT do not suggest a trend. Although some of the months appear to have lower consumption rates, on the average (e.g., July and August 2014 for NPT), this could be an artifact of the small sample size. And, while other months seem to be high in a specific group (e.g., November for 1st interviews in NPT), these trends are not strongly supported by the other interviews (e.g., the 2nd interview for the NPT November mean) or across tribes. Because of the lack of empirical evidence for seasonal differences in the 24-hour recalls for Group 1, species seasonality was ignored in the NCI models for Group 1.

Figure E23 shows the survey-weighted mean of the 24-hour recall of the Group 2 species consumption by tribe, month and interview number (1st vs. 2nd interview). The conclusions for the seasonal effects in Group 2 consumption are similar to those for Group 1 (Figure E1) in that no clear seasonal trends were identified.

The remaining figures (E24–E26) and tables (E18–E20) presented in this section provide additional summaries and analysis of the data regarding possible seasonality in consumption. These materials are described and interpreted in section 5.23.2.1 of Volume II of this report.

[6] The means were calculated standard survey estimate methods described in section 5.22 using the same weights as in all other analyses (see in sections 5.19 and 5.20).

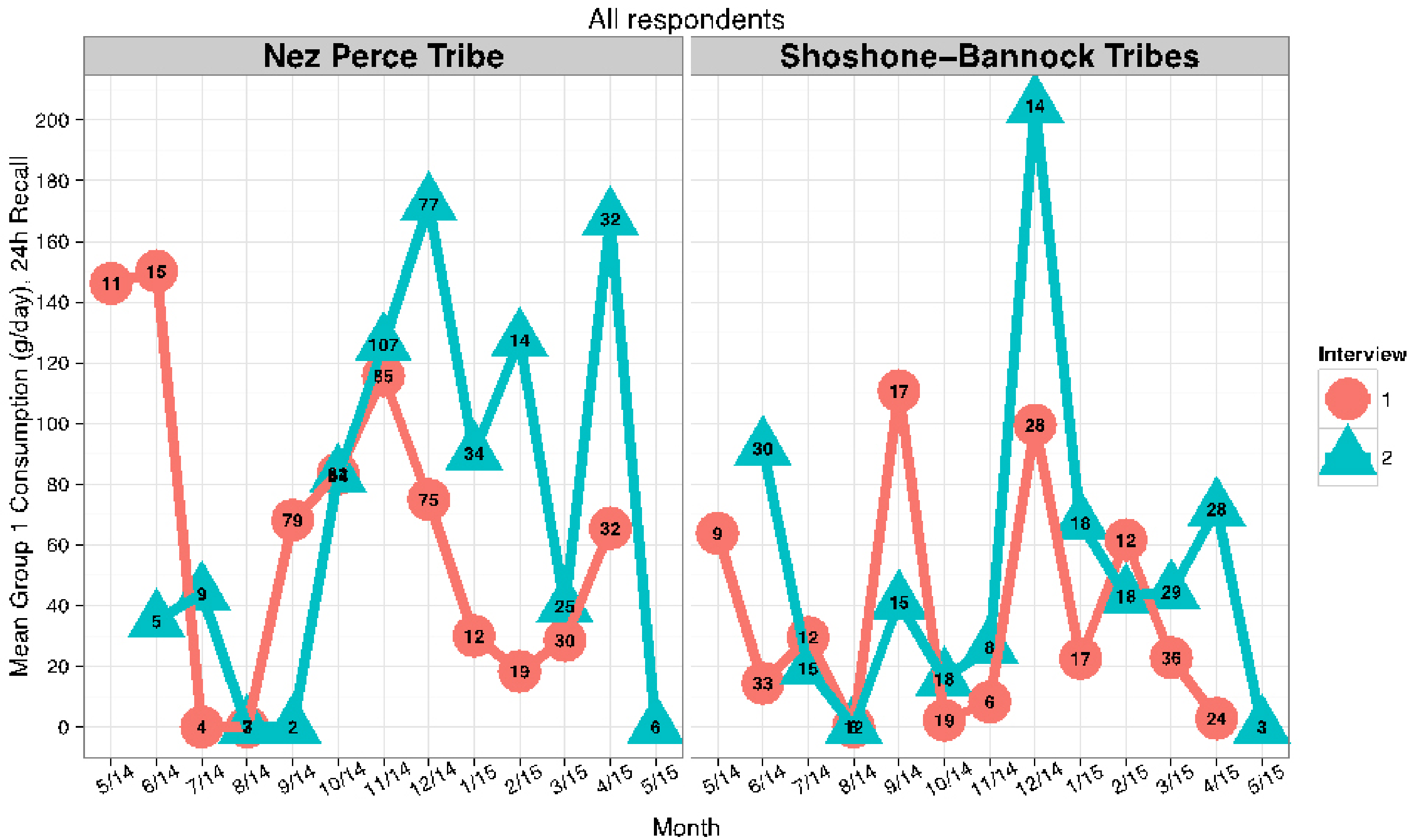

Figure E22. ***Seasonality for Group 1 species consumption on the 24-hour recall.*** **Mean 24-hour recall for species Group 1 consumption (g/day, raw weight, edible portion) by tribe, month and interview number (1st or 2nd 24-hour recall interview). Numbers within each month's dot are the sample size. One very large data point for a single NPT second interview during May (5/14) was excluded from this seasonal analysis**

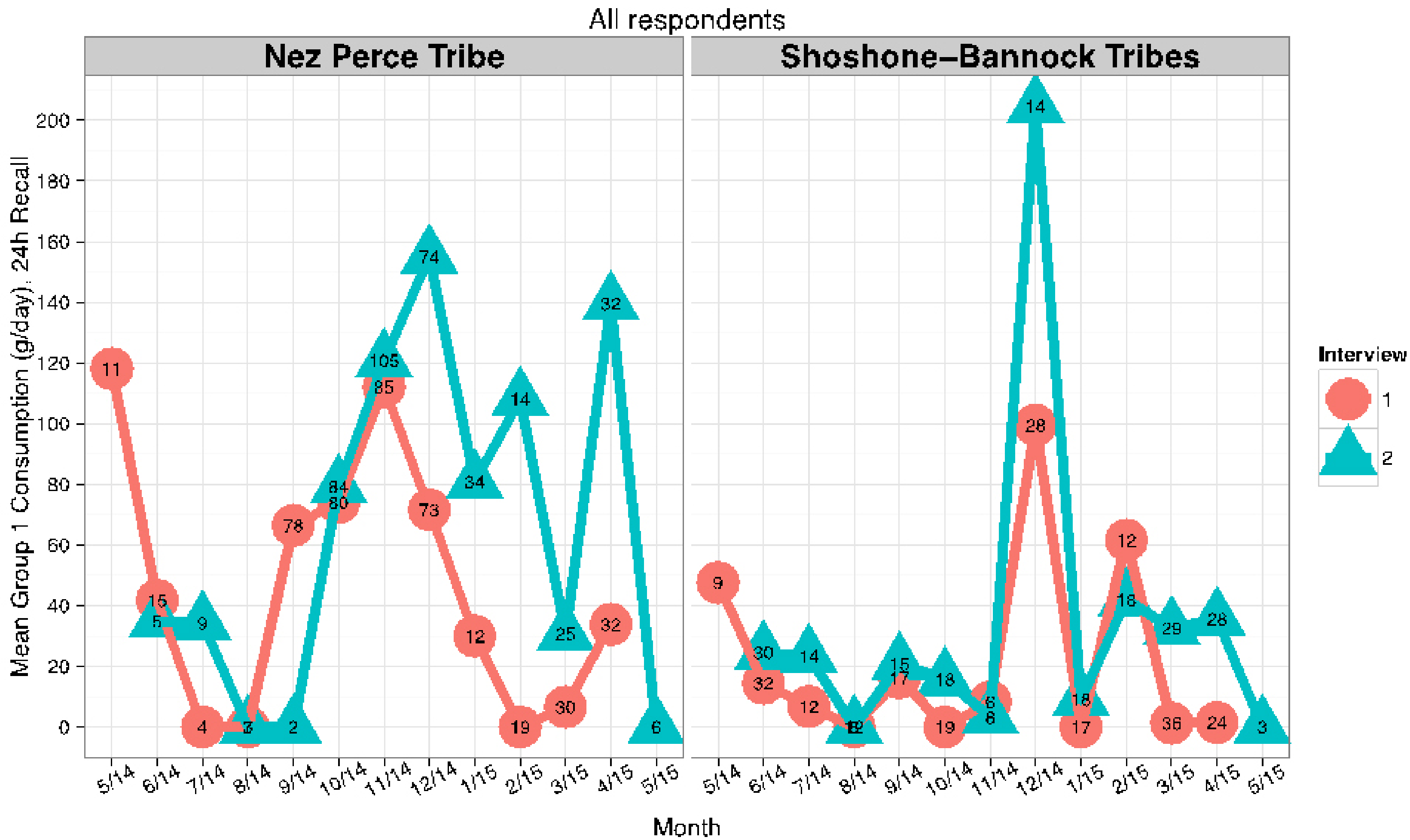

Figure E23. ***Seasonality for Group 2 species consumption on the 24-hour recall.*** **Mean 24-hour recall for species Group 2 consumption (g/day, raw weight, edible portion) by tribe, month and interview number. Numbers within each month's dot are the sample size. One outlier data point for a single NPT second interview during May (5/14) was excluded.**

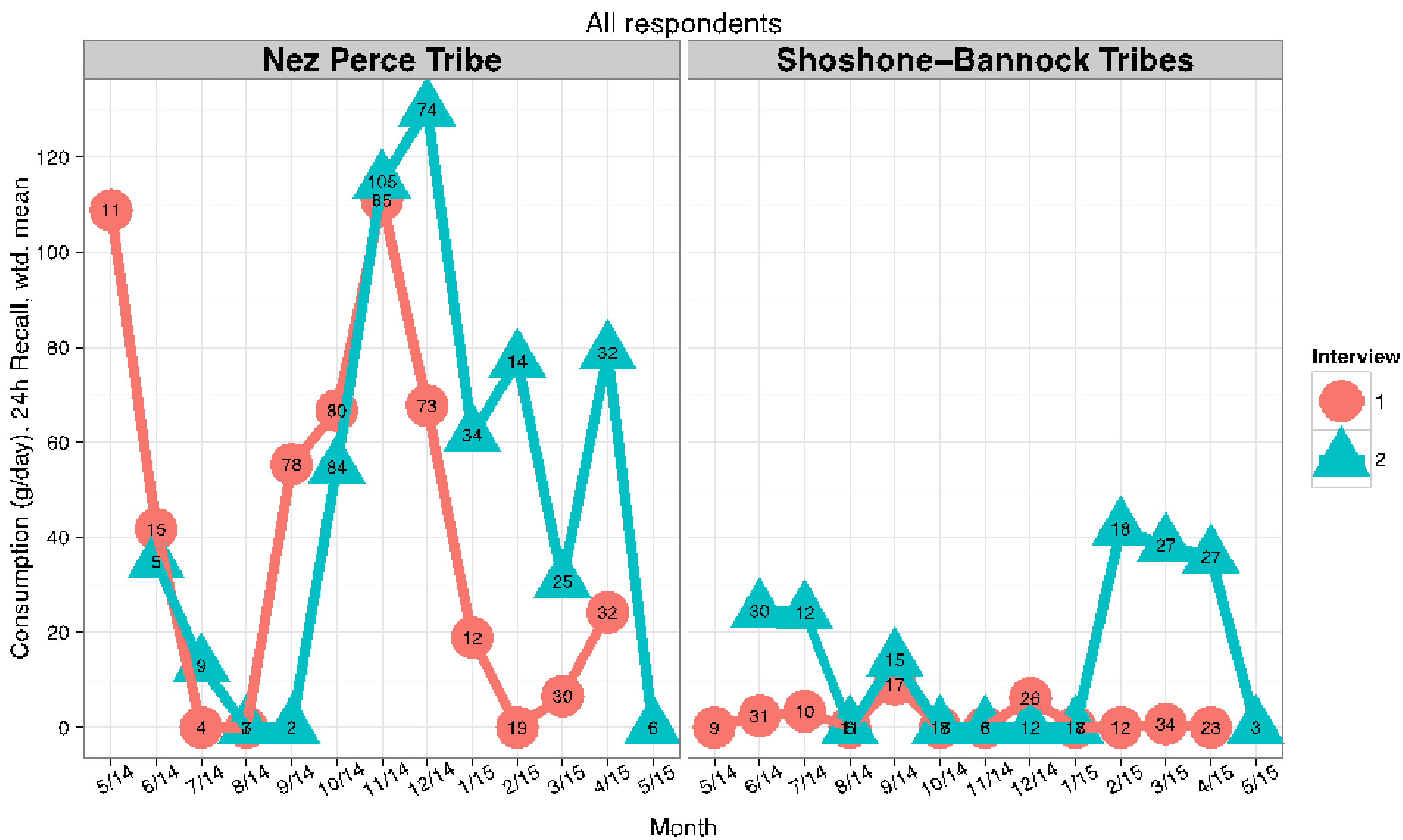

Figure E24. ***Seasonality for salmon and steelhead consumption on the 24-hour recall.*** **Mean 24-hour recall consumption rate (g/day, raw weight, edible portion) for all salmon and steelhead species (combined) by tribe, interview month and interview number (1st and 2nd interview). Numbers within each month's dot are the sample size. One outlier data point for a single NPT second interview during May (5/14) was excluded.**

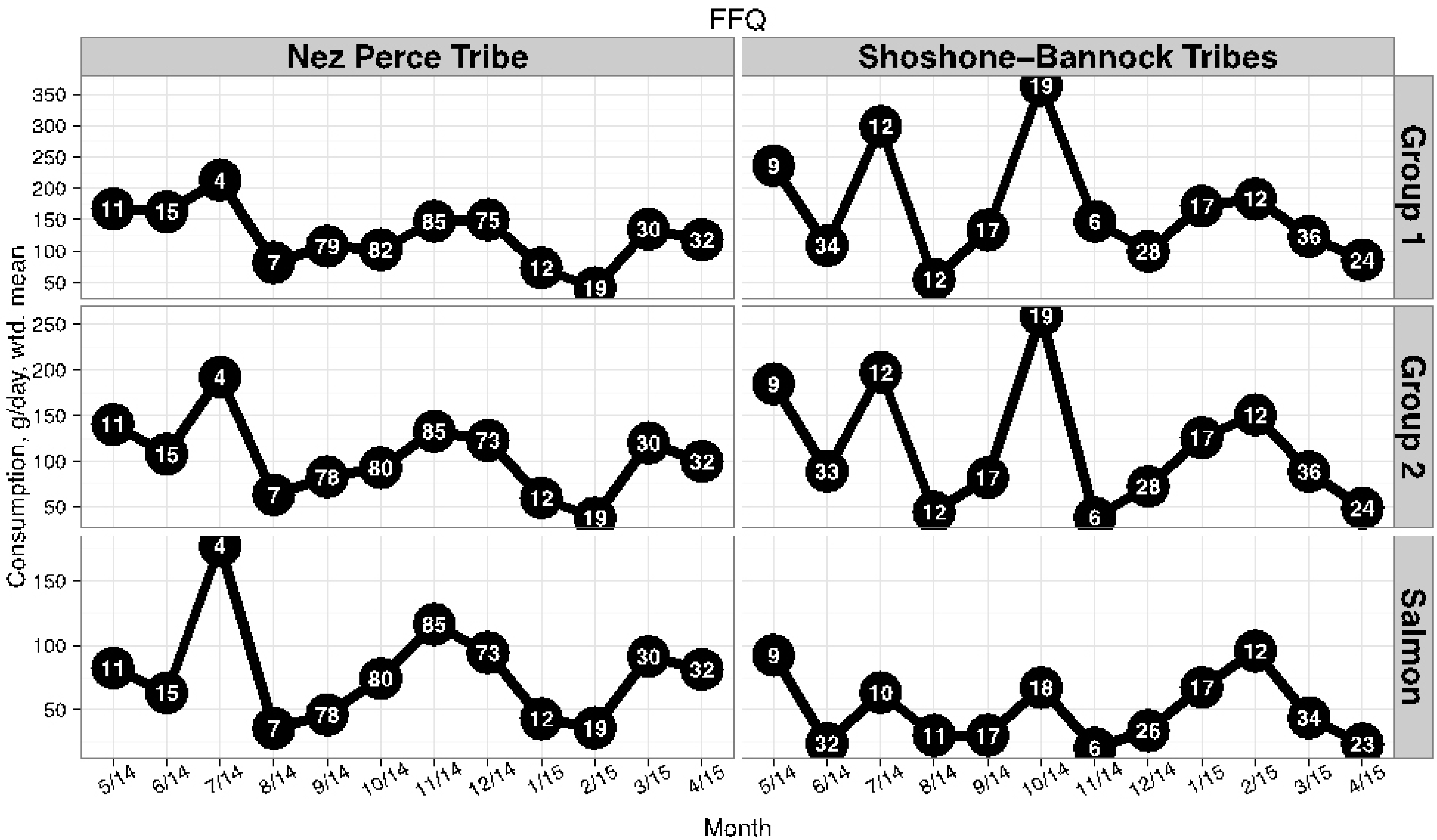

Figure E25. ***Seasonality for Group 1 species, Group 2 species and salmon+steelhead consumption on the FFQ.*** **Mean Group 1 FFQ consumption rate (g/day, raw weight, edible portion) by tribe, species group and interview month. Numbers within each month's dot are the sample size. Salmon: all salmon and steelhead species combined.**

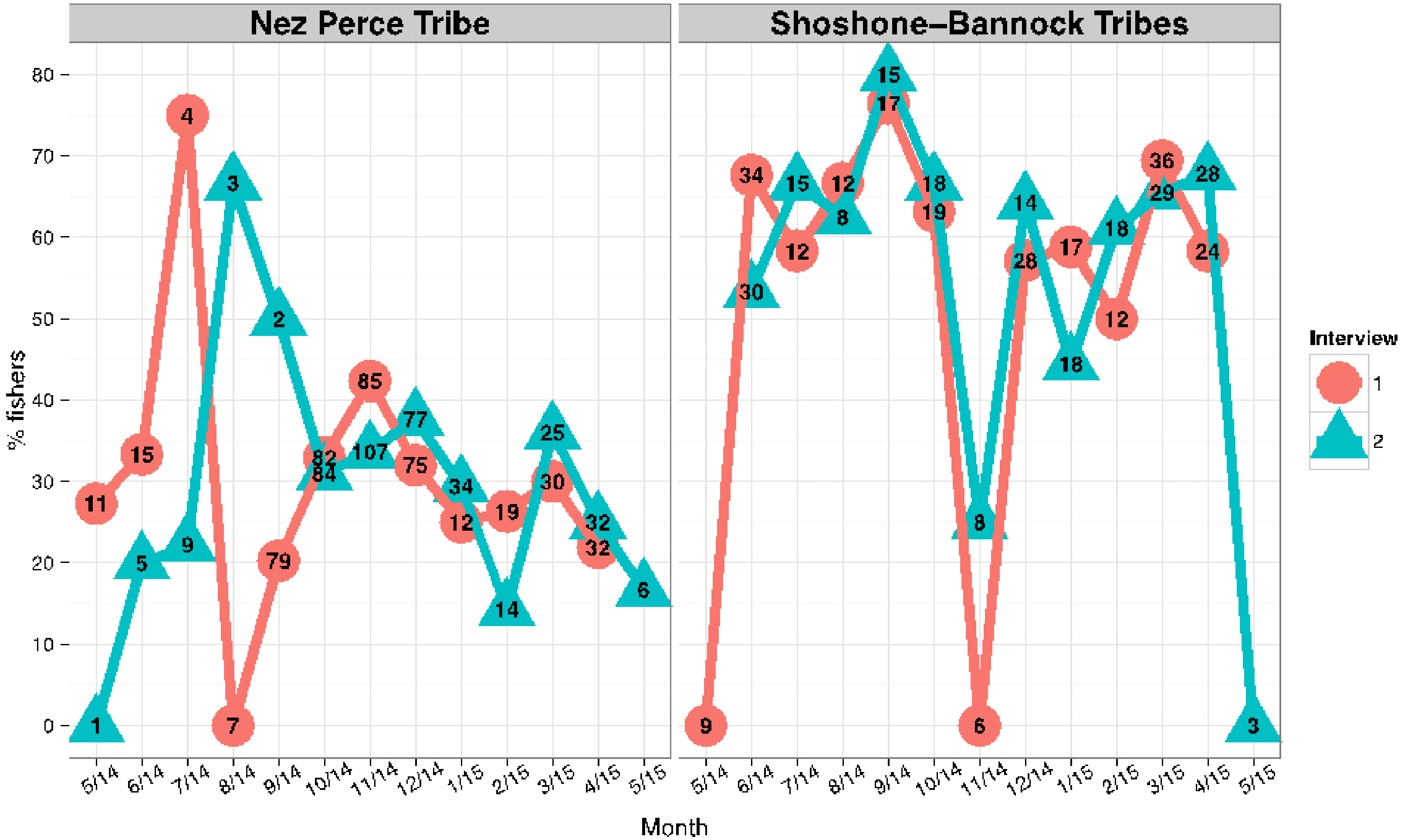

Figure E26. *Seasonality in the % fisher respondents.* **Percentages of fishers among respondents by tribe, interview month and interview number (1st and 2nd interviews). Numbers within each month's dot are the sample size.**

Table E18. Comparison of FCRs (g/day, raw weight, edible portion, based on 24-hour recall data) between 24-hour recall interviews conducted during the peak salmon harvest period (May 2014 through July 2014) vs. the remainder of the survey period (August 2014 through May 2015). Nez Perce Tribe. Consumers only*. Estimates are weighted.

		All Respondents (451 consumers)			Fishers (138 consumers)		
		Interviews During Peak Harvest			Interviews During Peak Harvest		
		Yes	No	P-value***	Yes	No	P-value***
Naïve 24-hour mean*	Group 1 (all fish)	108.3 (40.7)	93.6 (8.4)	0.81	124.7 (56.0)	129.0 (18.9)	0.96
	Group 3 (Salmon or steelhead)	64.9 (22.7)	70.2 (7.8)	0.80	113.8 (56.3)	108.9 (18.0)	0.93
	Chinook salmon	56.3 (21.7)	46.7 (7.2)	0.65	82.2 (49.7)	61.4 (13.9)	0.61
FFQ Mean	Group 1 (all fish)	170.0 (31.6)	119.8 (8.7)	0.015	304.4 (91.1)	161.2 (18.7)	0.041
	Group 3 (Salmon or steelhead)	82.5 (19.7)	78.7 (6.9)	0.68	189.2 (62.1)	121.9 (15.1)	0.31
	Chinook salmon	46.3 (14.0)	48.2 (5.4)	0.61	119.3 (43.3)	73.9 (12.5)	0.24

Note: see Section 5.23.2.1 (Assessment of Seasonality) in Volume II for a more detailed explanation and interpretation of this table.

Values are mean (standard error) unless otherwise specified;

*The number of consumers (based on the FFQ) were 451, 446 and 389 (138, 138 and 128 for fishers only) for Group 1, Group 2 and Chinook salmon, respectively; within the peak harvest period, the number of consumers were 30, 30 and 29 (11, 11 and 11 for fishers only) for Group 1, Group 2 and Chinook salmon, respectively;

**The naïve mean was calculated in two steps: 1) for each respondent, the mean of the consumption on up to two 24 hour recalls and 2) mean of these means. In this table only, this calculation was adjusted to *exclude* the second 24-hour recall if the first recall occurred during the peak harvest period and the second occurred after the peak harvest period;

***Survey weighted t-test of the cube root of the FCR values.

Table E19. Comparison of reported fishing rates (mean times per month) between first interviews conducted during the peak salmon harvest period (May 2014 through July 2014) vs. FFQ interviews conducted during the remainder of the survey period (August 2014 through April 2015). Nez Perce Tribe. Consumers only. Estimates are weighted.

	All Respondents (451 consumers)			Fishers (138 consumers)		
	Interviews During Peak Harvest			Interviews During Peak Harvest		
	Yes	No	P-value*	Yes	No	P-value*
Went fishing at least once (%)						
Over the whole year	73%	61%	0.22	92%	91%	0.88
In May, June and July	71%	59%	0.26	92%	91%	0.88
No. of times fishing, everyone (times/month)						
Over the whole year	1.1 (0.3)	1.3 (0.1)	0.51	2.7 (0.8)	2.3 (0.2)	0.65
In May, June and July	2.5 (0.5)	2.8 (0.3)	0.48	5.3 (1.6)	5.3 (0.5)	0.94
No. of times fishing, if > 0 times (times/month)**						
Over the whole year	1.5 (0.4)	2.1 (0.2)	0.20	2.9 (0.8)	2.6 (0.2)	0.65
In May, June and July	3.5 (0.7)	4.7 (0.4)	0.22	5.7 (1.7)	5.8 (0.5)	0.81

Values are percentages or mean (standard error) unless otherwise specified;

*Survey weighted chi-squared test for went fishing at least once and t-test of the cube root of the fishing rate values;

**Only including those who went fishing at least once.

Table E20. Frequencies of two-period FFQ responses (consumption information provided for higher and lower consumption periods separately) out of all responses*, compared between FFQ interviews conducted during the peak salmon harvest period (May 2014 through July 2014) vs. the remainder of the survey period (August 2014 through April 2015). Nez Perce Tribe. Estimates are unweighted.

	All Respondents (451 consumers)			Fishers (138 consumers)		
	Interviews During Peak Harvest			Interviews During Peak Harvest		
	Yes	No	Ratio of %'s	Yes	No	Ratio of %'s
Group 1 (all fish)	30% (80/267)	19% (475/2543)	1.6	20% (18/90)	22% (171/761)	0.9
Group 3 (Salmon or steelhead)	45% (32/71)	27% (238/893)	1.7	39% (9/23)	24% (71/298)	1.6
Chinook salmon	48% (14/29)	27% (98/361)	1.8	36% (4/11)	24% (28/117)	1.5

Values are percentages (numerator / denominator) unless otherwise specified;

*For the purposes of this table, a "response" is a record of the consumption of an individual species on the FFQ. That is, if a respondent reports eating Chinook, rainbow trout and sturgeon, this counts as three responses. For each response, the respondent may report consumption for a higher and lower period separately (a two-period response). This counts as a single response. Therefore, the total number of responses is the total number of individual species mentioned by all respondents on the FFQ. For simplicity, this analysis includes all responses, without making any exclusions for missing values.

Appendix F—
Comparison of FFQ Rates to 24-Hour Recall Rates

Appendix F—Comparison of FFQ Rates to 24-Hour Recall Rates

This section presents additional description of the differences between the FFQ fish consumption rates and the 24-hour recall rates. It examines the differences in the consumption (g/day), frequency of consumption and portion size by deciles of the Group 1 FFQ rate and for other species groups. It also examines the relationship of these rate differences to two indices that describe the level of uncertainty of the respondents in their answers to FFQ questions on fish consumption. These tables supplement the material in Section 6.11 of Volume II, where more background and definitions are provided. Note that these tables are based on Group 1 consumers, even when consumption rates of other species groups are examined. Non-consumers of a given species group contribute a consumption rate of zero to the calculations.

Tables F1 and F2 shows the mean of FFQ and 24-hour recall rates for Group 1 and Group 2, respectively, grouped by the decile of the Group 1 FFQ rate. The identical partitioning of the respondents into ten deciles by the Group 1 FFQ rate is also used in the subsequent tables.

Table F1. Nez Perce Tribe. Weighted group 1 means and other statistics from the 24-hour recall and the FFQ consumption rates (g/day) by Group 1 FFQ consumption rate deciles.

Group 1 FFQ Decile	FFQ range in decile	N	Sum of weights	# respondents with a 24h hit	Mean FFQ (MF)	Mean, naive 24h (M24)	M24-MF	M24/MF
1	0.41-16.98	46	156	8	8.6	22.2	13.6	2.59
2	17.03-33.53	45	167	15	24.2	46.9	22.8	1.94
3	33.84-48.65	45	146	11	43.2	37.2	-6.0	0.86
4	48.82-57.52	45	129	13	52.8	48.3	-4.5	0.92
5	57.53-70.60	45	147	16	64.7	74.2	9.5	1.15
6	70.79-89.94	45	140	20	79.8	96.3	16.6	1.21
7	91.06-124.94	45	159	17	110.2	100.7	-9.5	0.91
8	126.54-166.77	45	150	24	144.4	106.9	-37.5	0.74
9	167.39-281.18	45	150	26	215.8	162.6	-53.2	0.75
10	281.75-1372	45	140	29	516.1	254.4	-261.7	0.49
All		451	1485	179	123.4	94.0	-29.4	0.76

Table F2. Nez Perce Tribe. Weighted group 2 means and other statistics from the 24-hour recall and the FFQ consumption rates (g/day) by Group 1 FFQ consumption rate deciles.

Group 1 FFQ Decile	FFQ range in decile	N	Sum of weights	# respondents with a 24h hit	Mean FFQ (MF)	Mean, naive 24h (M24)	M24-MF	M24/MF
1	0.00-16.39	46	156	6	5.9	17.4	11.5	2.96
2	5.52-33.53	45	167	10	19.4	35.3	15.9	1.82
3	5.45-48.44	45	146	7	31.5	26.6	-5.0	0.84
4	0.79-57.21	45	129	11	41.5	41.6	0.1	1.00
5	18.94-70.53	45	147	12	51.7	52.8	1.1	1.02
6	3.55-88.61	45	140	17	63.9	86.1	22.2	1.35
7	52.50-124.41	45	159	16	93.7	88.7	-5.0	0.95
8	54.78-162.81	45	150	21	120.1	99.5	-20.5	0.83
9	126.85-272.81	45	150	25	187.2	152.8	-34.4	0.82
10	104.13-1324	45	140	25	434.1	213.4	-220.8	0.49
All		451	1485	150	102.8	80.6	-22.2	0.78

Table F3 shows the differences in the mean FFQ and 24-hour recall rates for all species and for other species groups. The table illustrates that the differences between the FFQ and 24-hour rates were present in all species groups.

Table F3. Nez Perce Tribe. Weighted means of the 24-hour recall and of the FFQ consumption rates (g/day) by species group. All Group 1 consumers.

	N	# respondents with a 24h hit	Mean FFQ (MF)	Mean, naive 24h (M24)	M24-MF	M24/MF
Group 1	451	179	123.4	94.0	-29.4	0.76
Group 2	451	150	102.8	80.6	-22.2	0.78
Non-Group 2	451	41	20.6	13.4	-7.2	0.65
Group 3	451	126	78.1	68.4	-9.7	0.88
Group 4	451	2	4.3	1.5	-2.7	0.36
Group 6	451	65	36.2	22.5	-13.7	0.62

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 6 = marine finfish and shell fish (see Table 2).

Tables F4 and F5 are analogous to Table F3 but are limited only to the respondents in the 10th decile and the 9th decile, respectively. The table illustrates that the differences between the FFQ and 24-hour recall rates were largely driven by differences for the respondents in these two deciles and these differences were present for all species groups.

Table F4. Nez Perce Tribe. Weighted means of the 24-hour recall and of the FFQ consumption rates (g/day) by species group. Group 1 consumers in the 10th decile.

	N	# respondents with a 24h hit	Mean FFQ (MF)	Mean, naive 24h (M24)	M24-MF	M24/MF
Group 1	45	29	516.1	254.4	-261.7	0.49
Group 2	45	25	434.1	213.4	-220.8	0.49
Non-Group 2	45	5	82.0	41.0	-40.9	0.50
Group 3	45	20	331.7	181.3	-150.4	0.55
Group 4	45	1	27.4	12.9	-14.5	0.47
Group 6	45	9	137.1	56.7	-80.4	0.41

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 6 = marine finfish and shell fish (see Table 2).

Table F5. Nez Perce Tribe. Weighted means of the 24-hour recall and of the FFQ consumption rates (g/day) by species group. Group 1 consumers in the 9th decile.

	N	# respondents with a 24h hit	Mean FFQ (MF)	Mean, naive 24h (M24)	M24-MF	M24/MF
Group 1	45	26	215.8	162.6	-53.2	0.75
Group 2	45	25	187.2	152.8	-34.4	0.82
Non-Group 2	45	3	28.6	9.8	-18.8	0.34
Group 3	45	21	125.4	126.1	0.7	1.01
Group 4	45	1	7.6	3.0	-4.6	0.39
Group 6	45	6	64.4	31.2	-33.2	0.48

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 6 = marine finfish and shell fish (see Table 2).

Table F6 shows the consumption rates from the FFQ and 24-hour recall by species group and decile. This table is formatted in the same way as Tables F7 and F8, which summarized mean frequencies and portion size. The consumption rate is a product of frequency and portion size, so by examining these components separately more insight into the source of the disagreement between the FFQ and 24-hour recall can be gained (also see Section 6.11 of Volume II).

Table F6. Nez Perce Tribe. Weighted mean consumption from the 24-hour recall and FFQ for each species group, overall and by decile. Deciles are the deciles of the Group 1 FFQ consumption rate. All rows are based on all Group 1 consumers. Ratios were not calculated when a species group was not consumed by the FFQ.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean consumption, g/day	123.4	8.6	24.2	43.2	52.8	64.7	79.8	110.2	144.4	215.8	516.1
24h mean consumption, g/day	94.0	22.2	46.9	37.2	48.3	74.2	96.3	100.7	106.9	162.6	254.4
24h/FFQ mean consumption	0.76	2.59	1.94	0.86	0.92	1.15	1.21	0.91	0.74	0.75	0.49
Group 2											
FFQ mean consumption, g/day	102.8	5.9	19.4	31.5	41.5	51.7	63.9	93.7	120.1	187.2	434.1
24h mean consumption, g/day	80.6	17.4	35.3	26.6	41.6	52.8	86.1	88.7	99.5	152.8	213.4
24h/FFQ mean consumption	0.78	2.96	1.82	0.84	1.00	1.02	1.35	0.95	0.83	0.82	0.49
Group 3											
FFQ mean consumption, g/day	78.1	4.3	15.0	22.9	36.3	44.8	47.9	69.6	99.7	125.4	331.7
24h mean consumption, g/day	68.4	14.8	22.6	18.4	40.4	52.8	70.7	75.2	89.9	126.1	181.3
24h/FFQ mean consumption	0.88	3.43	1.50	0.80	1.11	1.18	1.48	1.08	0.90	1.01	0.55
Group 4											
FFQ mean consumption, g/day	4.3	0.0	0.8	0.3	0.7	0.2	2.4	2.1	2.5	7.6	27.4
24h mean consumption, g/day	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	12.9
24h/FFQ mean consumption	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.47
Group 5											
FFQ mean consumption, g/day	4.8	0.0	0.5	1.4	0.5	1.1	3.1	2.0	2.8	18.3	19.7
24h mean consumption, g/day	1.6	0.0	0.0	0.0	0.0	0.0	9.0	0.0	1.8	2.3	3.4
24h/FFQ mean consumption	0.33	0.00	0.00	0.00	0.00	0.00	2.93	0.00	0.66	0.12	0.17
Group 6											
FFQ mean consumption, g/day	36.2	4.2	7.9	18.6	15.3	18.6	26.4	36.5	39.4	64.4	137.1
24h mean consumption, g/day	22.5	7.3	24.3	18.9	7.9	21.4	16.6	25.5	15.2	31.2	56.7
24h/FFQ mean consumption	0.62	1.76	3.08	1.02	0.52	1.15	0.63	0.70	0.38	0.48	0.41
Group 7											
FFQ mean consumption, g/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2
24h mean consumption, g/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24h/FFQ mean consumption	0.00	-	-	-	-	-	-	-	0.00	-	0.00

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table F7 examines the differences in the FFQ and 24-hour recall consumption frequencies. Frequencies are defined as the expected percentage of days of the year with consumption (see Section 6.11 of Volume II). The 9th and 10th deciles feature the biggest differences, and these differences are found for the majority of species groups.

Table F7. Nez Perce Tribe. Weighted mean frequency of positive daily consumption from the 24-hour recall and FFQ for each species group, overall and by decile. Deciles are the deciles of the Group 1 FFQ consumption rate. All rows are based on all Group 1 consumers. Ratios were not calculated when a species group was not consumed by the FFQ.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean frequency, %	31%	5%	11%	19%	21%	23%	24%	35%	42%	58%	78%
24h mean frequency, %	26%	10%	22%	14%	16%	22%	31%	30%	32%	39%	50%
24h/FFQ mean frequency	0.85	1.98	2.02	0.73	0.75	0.94	1.27	0.86	0.77	0.68	0.64
Group 2											
FFQ mean frequency, %	25%	4%	8%	12%	15%	17%	19%	27%	34%	47%	68%
24h mean frequency, %	21%	8%	15%	7%	14%	14%	27%	26%	29%	36%	39%
24h/FFQ mean frequency	0.86	2.20	1.81	0.60	0.89	0.81	1.45	0.97	0.84	0.78	0.57
Group 3											
FFQ mean frequency, %	18%	3%	6%	8%	13%	13%	13%	19%	27%	29%	50%
24h mean frequency, %	18%	7%	10%	5%	13%	14%	18%	22%	27%	31%	32%
24h/FFQ mean frequency	1.00	2.48	1.55	0.60	1.00	1.06	1.45	1.16	1.00	1.05	0.65
Group 4											
FFQ mean frequency, %	2%	0%	1%	0%	0%	0%	1%	1%	1%	2%	9%
24h mean frequency, %	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
24h/FFQ mean frequency	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.12
Group 5											
FFQ mean frequency, %	2%	0%	0%	1%	0%	1%	1%	1%	1%	5%	5%
24h mean frequency, %	1%	0%	0%	0%	0%	0%	4%	0%	1%	1%	1%
24h/FFQ mean frequency	0.45	0.00	0.00	0.00	0.00	0.00	3.08	0.00	0.99	0.13	0.28
Group 6											
FFQ mean frequency, %	12%	2%	4%	10%	7%	9%	9%	14%	12%	23%	29%
24h mean frequency, %	8%	3%	12%	9%	3%	7%	9%	8%	7%	9%	16%
24h/FFQ mean frequency	0.71	1.39	3.16	0.92	0.37	0.87	0.94	0.55	0.59	0.39	0.56
Group 7											
FFQ mean frequency, %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24h mean frequency, %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24h/FFQ mean frequency	0.00	-	-	-	-	-	-	-	0.00	-	0.00

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table F8 examines the differences in the FFQ and 24-hour recall portion sizes. The 9th and 10th decile feature the biggest differences. These differences are found for Group 2 and salmon species but not for trout, other freshwater species and all marine species.

Table F8. Nez Perce Tribe. Weighted mean portion size (grams) from the 24-hour recall and FFQ for each species group, overall and by decile. Deciles are the deciles of the Group 1 FFQ consumption rate. Each individual's portions sizes were averaged across species with a weight according to the species frequency. All calculations are limited to positive (non-zero) portion sizes. Ratios were not calculated when a species group was not consumed, as noted on the FFQ or 24-hour recall.

	ALL	DECILE									
		1	2	3	4	5	6	7	8	9	10
No. of respondents	451	46	45	45	45	45	45	45	45	45	45
Group 1											
FFQ mean portion size, grams	356	198	259	271	298	335	380	374	404	445	618
24h mean portion size, grams	310	220	232	264	308	329	293	284	302	372	376
24h/FFQ mean portion size	0.87	1.11	0.90	0.98	1.03	0.98	0.77	0.76	0.75	0.84	0.61
Group 2											
FFQ mean portion size, grams	373	190	285	296	293	340	394	393	406	492	638
24h mean portion size, grams	333	225	259	370	313	392	295	284	322	379	405
24h/FFQ mean portion size	0.89	1.18	0.91	1.25	1.07	1.15	0.75	0.72	0.79	0.77	0.64
Group 3											
FFQ mean portion size, grams	383	175	288	314	300	348	408	402	423	501	673
24h mean portion size, grams	342	215	235	387	325	392	346	278	326	383	431
24h/FFQ mean portion size	0.89	1.23	0.82	1.23	1.08	1.13	0.85	0.69	0.77	0.76	0.64
Group 4											
FFQ mean portion size, grams	229	227	143	123	175	145	306	237	195	277	261
24h mean portion size, grams	481	NA	NA	NA	NA	NA	NA	NA	NA	340	605
24h/FFQ mean portion size	2.10	-	-	-	-	-	-	-	-	1.23	2.32
Group 5											
FFQ mean portion size, grams	254	233	281	168	248	204	281	192	191	309	339
24h mean portion size, grams	218	NA	NA	NA	NA	NA	227	NA	130	334	227
24h/FFQ mean portion size	0.86	-	-	-	-	-	0.81	-	0.68	1.08	0.67
Group 6											
FFQ mean portion size, grams	288	240	221	209	248	248	294	290	355	325	426
24h mean portion size, grams	259	231	213	211	236	290	179	329	217	310	342
24h/FFQ mean portion size	0.90	0.96	0.96	1.01	0.95	1.17	0.61	1.14	0.61	0.95	0.80
Group 7											
FFQ mean portion size, grams	1297	NA	NA	NA	NA	NA	NA	NA	340	NA	2419
24h mean portion size, grams	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
24h/FFQ mean portion size	-	-	-	-	-	-	-	-	-	-	-

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 =

other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Figure F1 and Table F9 describe the distribution of the number of "not otherwise specified" species (NOS) on the FFQ, per respondent, for different species groups.

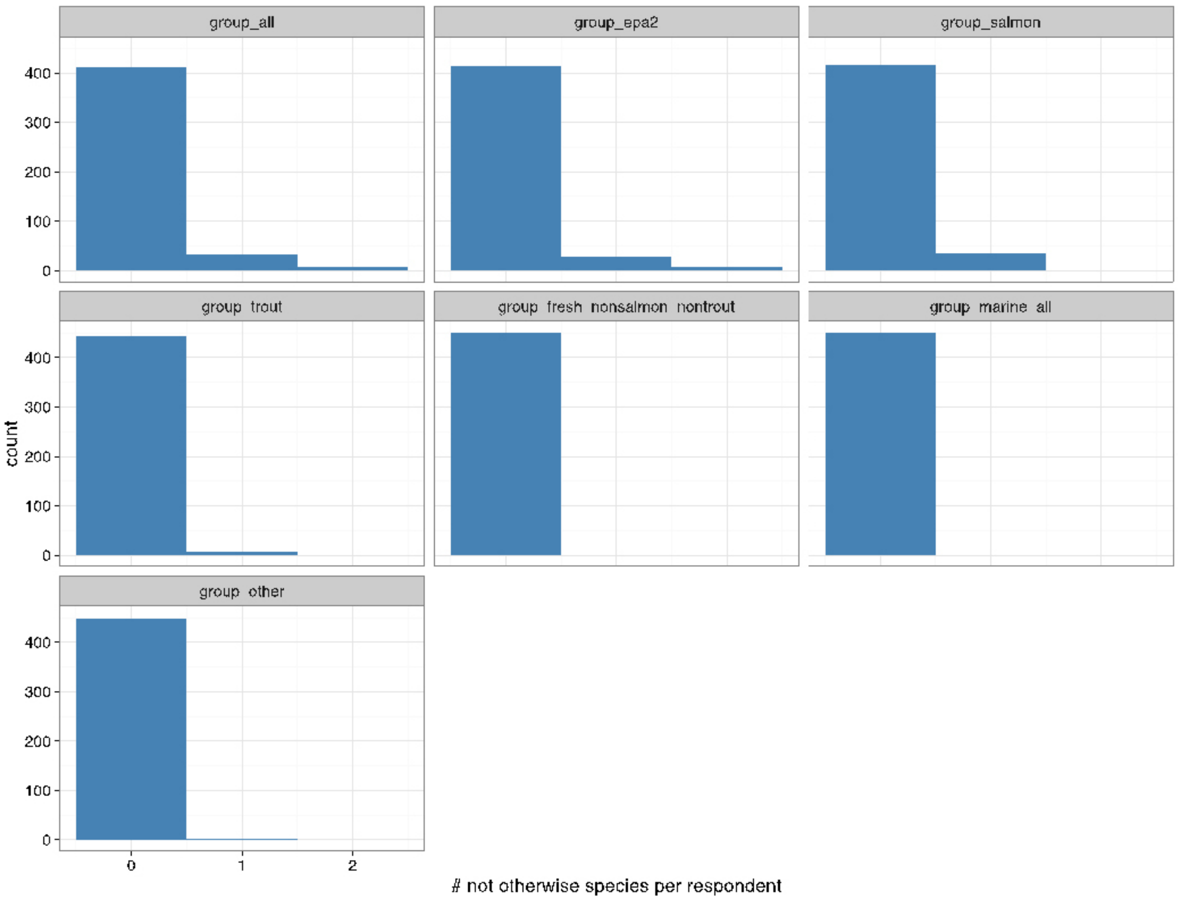

Figure F1. Nez Perce Tribe. Distribution of the # "not otherwise specified" species (NOS) on FFQ per respondent.

group_all = Group 1 (all finfish and shellfish); group_epa2 = Group 2 (near coastal/estuarine/freshwater/anadromous finfish and shellfish); group_salmon = Group 3 (all salmon and steelhead), group_trout = Group 4 (resident trout); group_fresh_nonsalmon_nontrout = Group 5 (other freshwater finfish and shellfish); group_marine = Group 6 (marine finfish and shell fish); group_other = Group 7 (unspecified finfish and shellfish species).

Table F9. Nez Perce Tribe. Number and % respondents with any "not otherwise specified" species designation (NOS) on the FFQ. Overall and by species group.

Species Group	N	%
Group 1	39	9%
Group 2	36	8%
Group 3	35	8%
Group 4	7	2%
Group 5	0	0%
Group 6	0	0%
Group 7	3	1%

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Table F10 presents linear regression results that analyze the relationship between # "not otherwise specified" species (NOS) and the FFQ–24-hour difference in consumption rates.

Table F10. Nez Perce Tribe. Unweighted simple linear regressions of the FFQ–24-hour difference on the number of "not otherwise specified" species (NOS) in the FFQ data per respondent. Overall and by species. Slope per 1 NOS species. 95% confidence intervals are approximate (assuming asymptotic normality).

Species Group	Intercept	Slope	95% CI	
Group 1	26.8	**-7.6**	-56.1	41.0
Group 2	21.9	**-17.8**	-63.7	28.2
Group 3	7.5	**-7.2**	-60.1	45.6
Group 4	2.9	**2.7**	-21.9	27.4
Group 5	-	**-**	-	-
Group 6	-	**-**	-	-
Group 7	0.0	**5.7**	5.1	6.2

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Figure F2 describes the distribution of the number of species with missing data on FFQ for different species groups.

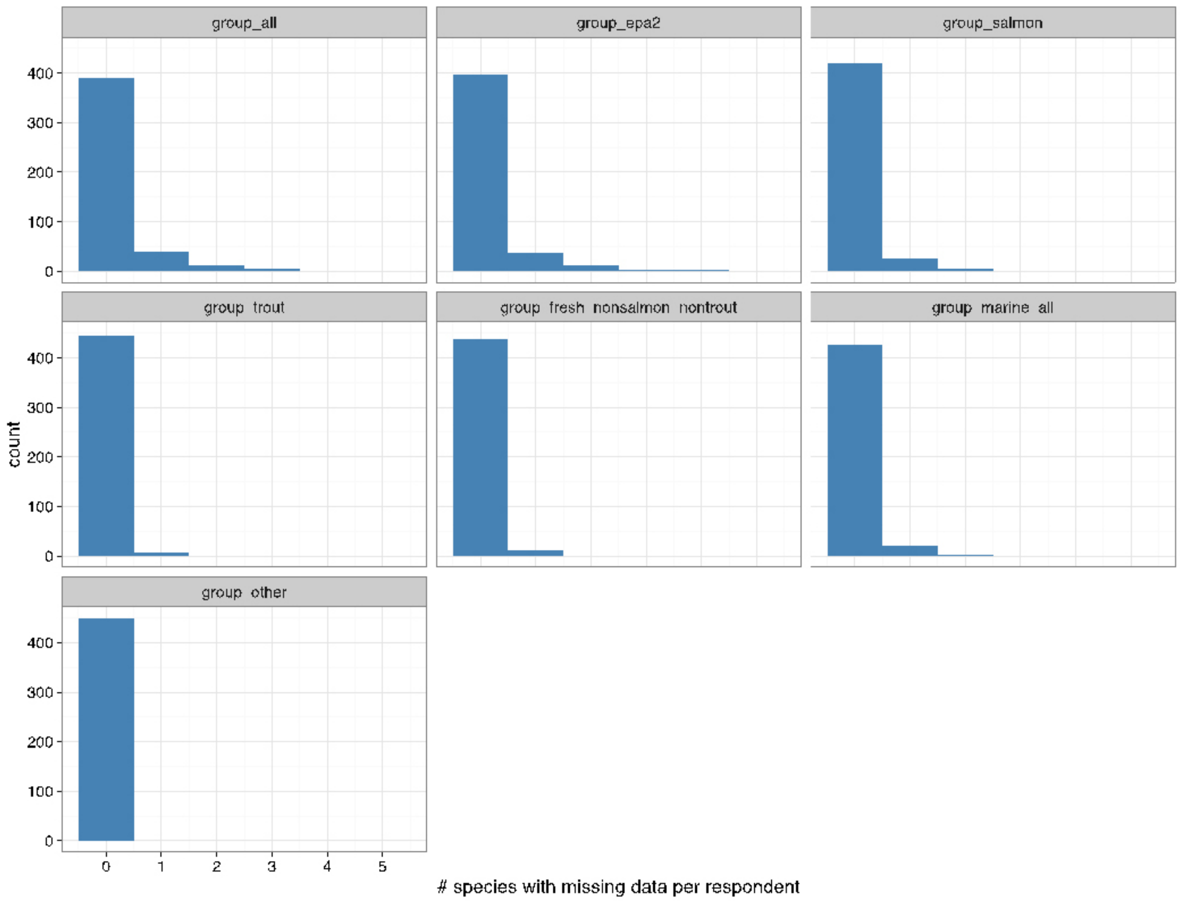

Figure F2. Nez Perce Tribe. Histogram of the number of species with missing data on the FFQ per respondent.

group_all = Group 1 (all finfish and shellfish); group_epa2 = Group 2 (near coastal/estuarine/freshwater/anadromous finfish and shellfish); group_salmon = Group 3 (all salmon and steelhead), group_trout = Group 4 (resident trout); group_fresh_nonsalmon_nontrout = Group 5 (other freshwater finfish and shellfish); group_marine = Group 6 (marine finfish and shell fish); group_other = Group 7 (unspecified finfish and shellfish species).

Table F11 presents linear regression results that analyze the relationship between the number of species with missing data and the FFQ–24-hour difference in consumption rates.

Table F11. Nez Perce Tribe. Unweighted simple linear regressions of the FFQ–24-hour difference on the number of species with missing data per respondent. Overall and by species. Slope per 1 missing-data species. 95% confidence intervals are approximate (assuming asymptotic normality).

Species Group	Intercept	Slope	95% CI	
Group 1	24.5	**7.3**	-21.3	35.8
Group 2	20.0	**1.0**	-28.3	30.3
Group 3	6.9	**-0.6**	-44.5	43.4
Group 4	2.9	**4.0**	-20.7	28.6
Group 5	3.5	**8.0**	-3.0	18.9
Group 6	12.9	**-7.5**	-30.6	15.6
Group 7	0.0	**0.0**	-1.3	1.2

Group 1 = all finfish and shellfish; Group 2 = near coastal/estuarine/freshwater/anadromous finfish and shellfish; Group 3 = all salmon and steelhead; Group 4 = resident trout; Group 5 = other freshwater finfish and shellfish; Group 6 = marine finfish and shell fish; Group 7 = unspecified finfish and shellfish species (see Table 2).

Appendix G—
Geographic Inclusion Criteria—
Additional Information

Appendix G—Geographic Inclusion Criteria—Additional Information

The process for selecting a geographic area for sampling members of the Nez Perce Tribe was based on ZIP code boundaries for zip codes in and around the Nez Perce reservation. The Zip code boundaries were delineated using a Geographic Information System (GIS)—specifically, the ArcGIS software program. ZIP code boundaries were downloaded from the U.S. Census Bureau, circa 2010. To subset the ZIP codes from national to local scale, buffers of 25 and 50 miles (called sampling “hubs”) were created around the primary population centers of Lapwai and Kamiah using ArcGIS. Any ZIP code boundary that included any portion of the land area within either buffer was then selected for inclusion in the first iteration of the ZIP code subset.

Using this ZIP code subset, a population center for each ZIP code was identified using the U.S. Postal Service ZIP code lookup tool. These population centers were then selected in ArcGIS from the “Cities and Towns” dataset available from the National Atlas of the United States (NAUS). If the population center was not present in the NAUS dataset, it was instead digitized in ArcGIS through aerial interpretation of high-resolution basemaps. Once the population centers were assigned to every ZIP code, a second iteration of the ZIP code subset was created. For this second iteration, any ZIP code whose population center was not included within the 25- or 50-mile buffer from either sampling hub was removed from the ZIP code subset.

Using this second iteration of the ZIP code subset, each code was first assigned to a sampling hub (either Lapwai or Kamiah) based on the closest aerial distance of the ZIP code population center to the sampling hub. Once each ZIP code was assigned to a sampling hub, it was then assigned to a buffer zone of either 25 or 50 miles (depending on the distance from the ZIP code’s population center to the sampling hub). The ZIP codes were then plotted on a map, symbolizing each ZIP code as either 25 or 50 miles from either sampling hub, as shown in Figure G1.

The distances between each ZIP code population center and the sampling hubs were calculated in ArcGIS using an automatic straight-line distance-calculation tool. Since the geographical coordinates of the population centers were provided in feet according to the Idaho State Plane Coordinate System, the distances were measured in feet and then converted to miles. The distances calculated from each population center to Lapwai and Kamiah, according to ZIP code, are provided in Table G1.

Figure G1. Nez Perce reservation and surrounding eligible ZIP codes for inclusion in the Nez Perce Tribe fish consumption survey.

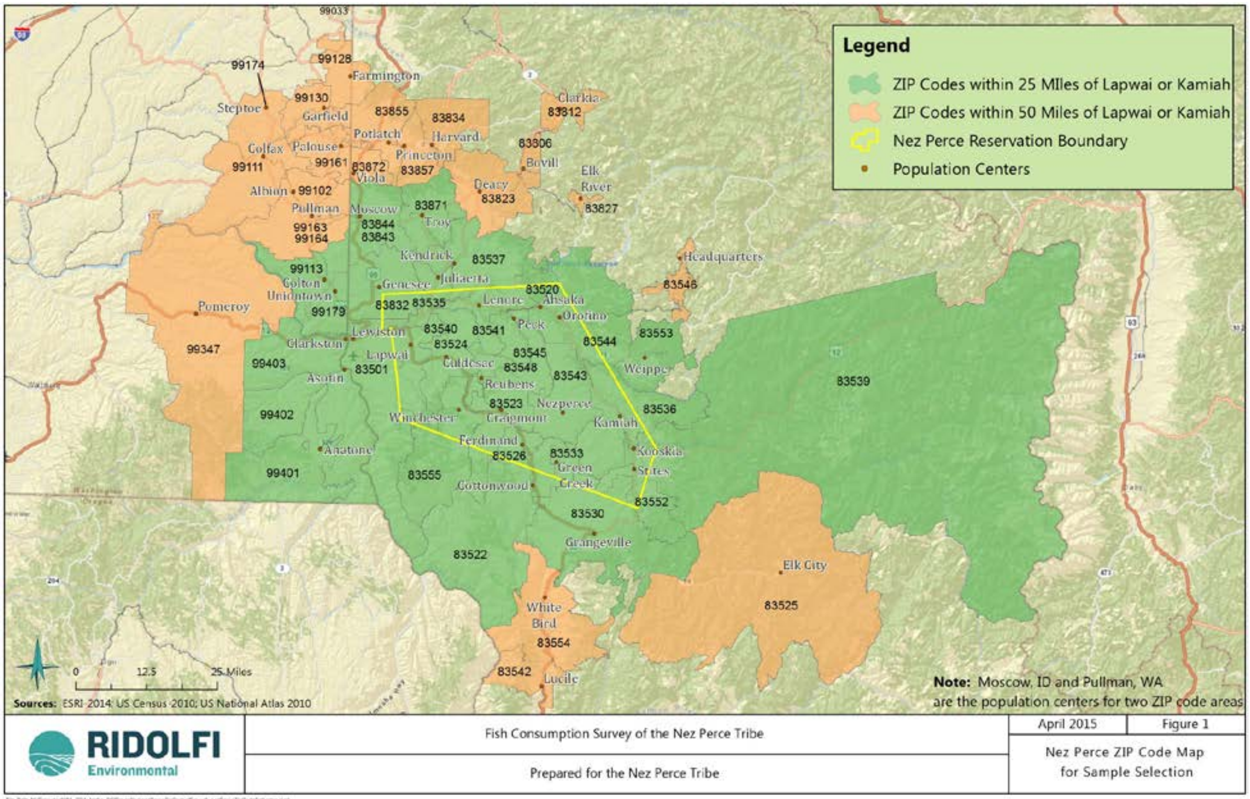

Table G1. Nez Perce reservation ZIP codes, corresponding population centers, and distances to sampling hubs for the Nez Perce Tribe survey.

ZIP Code	Population Center	Distance to Lapwai (Miles)	Distance to Kamiah (Miles)	Buffer Distance	Closest Sampling Hub
83501	Lewiston	10.21	49.14	25	Lapwai
83520	Ahsaka	23.93	23.91	25	Kamiah
83522	Cottonwood	32.94	19.74	25	Kamiah
83523	Craigmont	19.75	21.03	25	Lapwai
83524	Culdesac	6.64	32.50	25	Lapwai
83525	Elk City	76.90	39.69	50	Kamiah
83526	Ferdinand	26.50	18.04	25	Kamiah
83530	Grangeville	46.58	21.26	25	Kamiah
83533	Green Creek	33.15	13.88	25	Kamiah
83535	Juliaetta	12.92	40.49	25	Lapwai
83536	Kamiah	39.15	0.00	25	Kamiah
83537	Kendrick	16.33	39.84	25	Lapwai
83539	Kooskia	43.54	6.20	25	Kamiah
83540	Lapwai	0.00	39.14	25	Lapwai
83541	Lenore	14.01	31.71	25	Lapwai
83542	Lucile	64.69	49.77	50	Kamiah
83543	Nezperce	29.48	10.16	25	Kamiah
83544	Orofino	26.78	20.52	25	Kamiah
83545	Peck	18.84	25.53	25	Lapwai
83546	Headquarters	50.03	29.80	50	Kamiah
83548	Reubens	13.80	25.48	25	Lapwai
83552	Stites	45.28	9.71	25	Kamiah
83553	Weippe	41.52	11.18	25	Kamiah
83554	White Bird	50.68	34.75	50	Kamiah
83555	Winchester	14.32	28.57	25	Lapwai
83806	Bovill	37.01	47.01	50	Lapwai
83812	Clarkia	49.39	55.32	50	Lapwai
83823	Deary	29.75	46.88	50	Lapwai
83827	Elk River	39.67	39.14	50	Kamiah
83832	Genesee	11.62	48.37	25	Lapwai
83834	Harvard	35.61	58.43	50	Lapwai
83843	Moscow	24.50	58.08	25	Lapwai
83844	Moscow	24.50	58.08	25	Lapwai
83855	Potlatch	36.02	63.44	50	Lapwai
83857	Princeton	35.24	61.21	50	Lapwai
83871	Troy	23.02	49.93	25	Lapwai
83872	Viola	32.06	63.84	50	Lapwai
99102	Albion	34.13	70.16	50	Lapwai
99111	Colfax	42.33	78.09	50	Lapwai
99174	Steptoe	49.21	83.14	50	Lapwai
99113	Colton	19.14	57.64	25	Lapwai
99128	Farmington	48.70	76.76	50	Lapwai
99130	Garfield	44.68	75.66	50	Lapwai

ZIP Code	Population Center	Distance to Lapwai (Miles)	Distance to Kamiah (Miles)	Buffer Distance	Closest Sampling Hub
99161	Palouse	37.26	68.73	50	Lapwai
99163	Pullman	28.80	65.09	50	Lapwai
99164	Pullman	28.80	65.09	50	Lapwai
99179	Uniontown	16.41	55.07	25	Lapwai
99347	Pomeroy	38.47	77.29	50	Lapwai
99401	Anatone	24.47	53.46	25	Lapwai
99402	Asotin	12.50	49.47	25	Lapwai
99403	Clarkston	11.52	50.40	25	Lapwai

Appendix H—
Survey Design Document—
Nez Perce Tribe

Appendix H—Survey Design Document, Nez Perce Tribe

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

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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,[7] 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.[8]

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 inquires 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

[7] See subsections "FFQ Sample Size" and "24-Hour Dietary Recall Sample size" for details on sample size methodology.
[8] 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.

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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 rates[9] 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.[10]

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.

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[9] 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.

[10] 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 been 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 Perces, 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."[11]

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

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[11] 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 (Landeen 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.

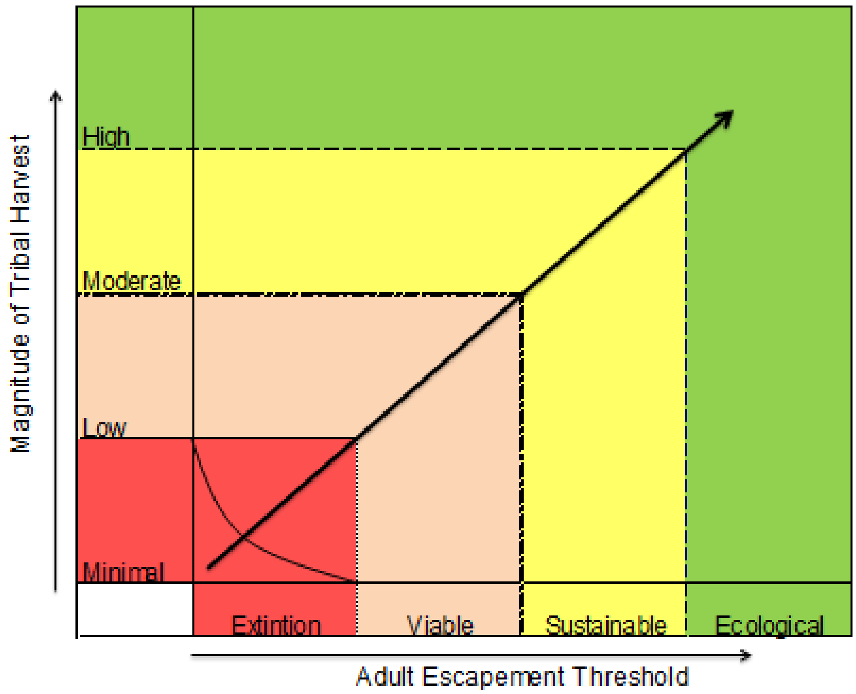

Figure 2-1. Abundance-Based Tribal Harvest Goals

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 distribution[12] 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

[12] 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.[13]

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,

[13] 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 consumers[14] 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.[15] 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.[16] 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.

[14] 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.

[15] 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 ± 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%.

[16] 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.

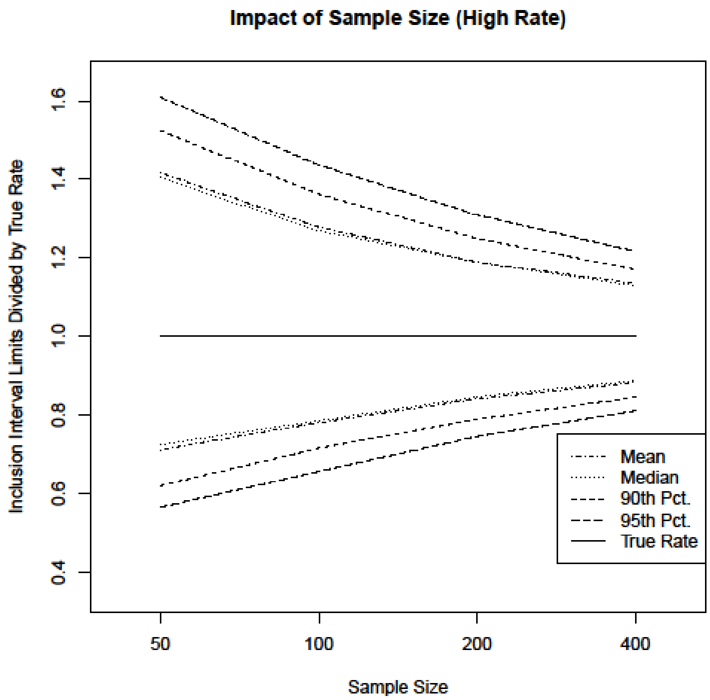

Figure 4-1. Precision of mean and selected percentile estimates vs. sample size The upper and lower bounds for each estimate are expressed as a ratio to the true value. In 95% of surveys drawn from a population with a lognormal distribution of consumption rates, the estimated value of the statistic is 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.[17]

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,

[17] 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.

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.

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 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 complied 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),[18] 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.

[18] 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 sub-divided 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
- Nakia 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.

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