A FISH CONSUMPTION SURVEY OF THE SHOSHONE-BANNOCK TRIBES

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SHOSHONE-BANNOCK TRIBES OF THE FORT HALL RESERVATION IDAHO

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A Fish Consumption Survey of the Shoshone-Bannock Tribes

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 Shoshone-Bannock Tribes. 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. A foreword to Volumes I-III has been authored by the Shoshone-Bannock Tribes and EPA. The Shoshone-Bannock Tribes have also authored a second foreword to Volumes I-III and the 'Background' section of Volume I. All other sections of this report have been authored by the members of the contractor team listed on the title page preceding Volume I.

FOREWORD TO VOLUMES I-III *(AUTHORED BY THE SHOSHONE-BANNOCK TRIBES 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 assess the risks posed by contaminants in fish for populations who consume large quantities of fish in the State of Idaho and among the Idaho tribes. 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 Shoshone-Bannock Tribes. 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[1] are an important food and economic resource. The harvest and consumption of fish also figure significantly in tribal culture and spirituality. Because of water quality's effects on fish and fisheries, water quality is of great importance to the Native American tribes in Idaho. 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 related aspects of tribal culture and spirituality.

This report shows that a substantial portion of the diet of the Shoshone-Bannock Tribes consists of fish and shellfish, which research has shown acquire contaminants (e.g. PCBs, mercury, dioxins, etc.) 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[2]). 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. Generally, contaminant levels in water and fish are linked. Therefore, 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. EPA Region 10 is supporting Idaho's tribal governments in identifying appropriate FCRs to use in protecting the health of Idaho tribal members. 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 Shoshone-Bannock Tribes have experienced a suppression of consumption due to environmental and social changes that have reduced fish abundance, access to fish, safety of fish consumption, and fish consumption itself. Suppressed fish consumption threatens tribal culture

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[1] Hereafter, "fish" will refer to fish and shellfish.
[2] References for these reports can be found in the reference section of Volume II.

and rights, as well as the health of individual tribal members. The Tribes are seeking to improve fish availability, reduce contamination of fish, and increase fish consumption in the future. (These goals were expressed to the contractors multiple times during meetings with tribal staff.) Thus, current consumption does not reflect the Tribes' past nor their 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 should also consider 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).[3] Assessment of past consumption is likely not as precise as that of 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 estimates of average fish consumption as opposed to distributions of fish consumption rates 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. Shoshone-Bannock 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[4] relative to heritage FCRs. Tribes are 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 tribes' desire, rates informed by treaties between tribes and the U.S. government that guaranteed tribal rights to practice subsistence fishing.

The rates and supporting materials generated by this study will be used to protect the health of members of the Shoshone-Bannock Tribes and other Idaho residents who consume large quantities of fish. 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 Tribes. The website of the Shoshone-Bannock Fish and Wildlife Department states, "The mission of the Shoshone-Bannock Tribes Fish & Wildlife Department is to protect, restore, and enhance fish and wildlife related resources in accordance with the Tribes' unique interests and vested rights in such resources and their habitats, including the inherent, aboriginal and treaty protected rights of Tribal members to fair process and the priority rights to harvest pursuant to the Fort Bridger Treaty of July 3, 1868."[5]

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[3] 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.
[4] For an in depth discussion of the concept of suppression, see: 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
[5] http://www.shoshonebannocktribes.com/shoshone-bannock-fish-and-wildlife.html, accessed September 17, 2015.

FOREWORD TO VOLUMES I-III *(AUTHORED BY THE SHOSHONE-BANNOCK TRIBES)*[6,7]

Significance of the Report on Current and Heritage Fish Consumption by the Shoshone-Bannock Tribes

Since a substantial portion of their diet is derived from aquatic sources, water and aquatic resources are of great importance to their subsistence lifestyle; and, these resources hold significant cultural and spiritual value to the Shoshone-Bannock Tribes. As part of the survey effort, discussions with the Tribes highlighted the issue of suppression 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 Tribes.

This study compiled and evaluated available data to determine heritage FCRs for the Shoshone-Bannock Tribes. 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 both on and off the Reservation.

Idaho's final rulemaking on Fish Consumption Rate to be submitted to EPA excludes suppression as a variable to be considered when setting a baseline for fish consumption rates. Idaho made a policy choice to exclude suppression; a choice that the Tribes disagreed with; and, a choice that will contribute to the downward spiral of water quality standards in Idaho. This choice will pull Idaho further away from the Tribes' goal of having robust, meaningful fisheries that are free of carcinogens and other pollutants that harm the health and wellbeing of their Tribal membership.

The Tribes Today

The Shoshone-Bannock Tribes of today are a self-governing, Federally Recognized Tribe with reserved off-Reservation Treaty rights secured by the Fort Bridger Treaty of July 3, 1868.[8] The Fort Hall reservation, permanent homeland of the Tribes, is located in Southeastern Idaho near the city of Pocatello. The current reservation is 97% Indian owned occupying approximately 544,000 acres and resides in four counties: Bannock, Bingham, Caribou, and Power. The Snake and Blackfoot rivers provide for the western and northern reservation boundaries; and, to the South is the Portneuf River which begins on the reservation then leaves to flow through lands ceded to the federal government in 1900 and then returns to the reservation when it ends at the confluence with the Snake River at American Falls Reservoir.

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[6] A supplement to this report or a future edition of the report will provide a discussion of the history of the Shoshone-Bannock Tribes and of the Fort Bridger Treaty and Treaty guaranteed rights to harvest fish and game.

[7] References for this foreword may be found in the reference section of Volume I.

[8] Article IV of the Fort Bridger Treaty reads: "The Indians herein named agree, when the agency house and other buildings shall be constructed on their reservations named, they will make said reservations their permanent home, and they will make no permanent settlement elsewhere; but they shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts." Quoted from: http://digital.library.okstate.edu/kappler/Vol2/treaties/sho1020.htm#mn4

Shoshone-Bannock Fisheries Resources and their Use

Anadromous and resident fish have always provided the Shoshone-Bannock peoples with an abundant and predictable supply of fish. Salmon and the Padogoa' or the Pacific lamprey were a primary aquatic food resource. Resident fish species including cutthroat trout, Bull trout, whitefish, and suckers were also an important subsistence species of the Tribes. Fluvial and adfluvial migrations of these species provided predictable opportunity for abundant harvest in areas where anadromy didn't occur. The Upper Snake River still has adfluvial spawning populations of significant and predictable size of Cutthroat, Rainbow, and their hybrid cross the Cutt-bow trout. The spring streams of the Fort Hall Bottoms still receive significant influx of trout from December to April, as well as, May – June spawning runs of native sucker. Bull trout of central Idaho are caught in adult chinook traps on the Yankee Fork where they are PIT tagged, released and relocated in other drainages such as Redfish Lake. Tribal membership continues to take advantage of these populations for the obvious reason of predictability. Traditional knowledge related to place and run timing has been passed down from generation to generation giving opportunity to harvest fish during times when anadromous fish are not in the Snake River system.

Plant resources nearly always occur in wetland or riparian areas (areas of prolonged flooding. standing water, or saturated soils). Such plants were, and continue to be, an important cultural use of the Tribes. Bannock and Shoshone names applied to groups who made major subsistence or use of wetland/riparian plants included: *Guiyuideka*' (Tobacco Root Eaters), *Sehewokinee'* (Willows Standing In A Row Like Running Water People). Although not documented by Liljeblad or Steward, there were also the *Basigodeka* (Camas Eaters) and *Yambadeka* (Yampah Eaters). The Tribes have provided cultural information on the use of wetland/riparian plants. As is the case with fish, the Tribes may be at risk from use of plants that have bioaccumulated environmental pollution. This also goes for wildlife that drink or spend extended time in and around contaminated waters.

Even though Shoshone-Bannock peoples fished at different times and places, and even though they varied in their relative reliance on specific fisheries, it can be said with total confidence that all of those who lived in Idaho during historic times procured fish as a basic part of their diet (Albers, 1998, p. 17).

Of particular note, as mentioned above, were the *Agaideka*, or salmon-eaters. Walker (1977, as cited in Scholz, 1985) reported that "[t]he Shoshone-Bannock, as well as their neighbors the Northern Paiute in southwestern Idaho, regularly took salmon below Shoshone Falls." Craig and Hacker (1940, as cited in Scholz et al, 1985) quote Washington Irving as stating "[t]he early traders report that Indians at Salmon Falls on the Snake River took several thousand salmon in one afternoon by means of spears."

Suckley and Cooper (1860, as cited in Scholz et al., 1985) reported:

> *"In some of the branches of the Columbia salmon penetrate to the Rocky Mountains, but they cannot ascend the Snake above Rock Creek between Fort Boise and Fort Hall, where the great Shoshone Falls stops them. Fort Boise is a great fishing ground for the Bannocks and other bands of the Shoshone or Snake Tribe. We found them taking vast numbers at the end of August 1849."*

In his 1843 journals, explorer John C. Fremont describes the following scene at what is today Shoshone Falls:

> *"Our encampment was about one mile below the Fishing falls…and the great fisheries from which the inhabitants of this barren region almost entirely derive a subsistence commence at this place… The Indians made us comprehend, that when the salmon came up the river in the spring, they are so abundant that they merely throw in their spears at random, certain of bringing out fish…they are still a joyous talkative race, who grow fat and become poor with the salmon, which at least never fail them—the dried being used in the absence of the fresh."*

Although anadromous fish were, and continue to be, important to the Shoshone-Bannock Tribes, this does not diminish the importance of resident fisheries. In May of 1833, while camped near Pohogoy, Captain Bonneville wrote,

> *"found small hordes of Shoshonies lingering upon the minor streams, and living upon trout and other fish, which they catch in great numbers at this season in fish traps."* (Albers, et al., 1998).

Resident fisheries were, and continue to be, an important and reliable source of protein for the Shoshone-Bannock Tribes. Some resident fish harvested and utilized by the Tribes were documented by Liljeblad and Steward included: catfish, sucker, minnows, trout, cray fish, whitefish, and redside shiners. These species of fish were taken on an opportunistic basis when need arose.

Although a vast amount of information exists on the subsistence use of fisheries by the Shoshone-Bannock Tribes, examination of Julian H. Steward's *Basin-Plateau Aboriginal Sociopolitical Groups* and selected excerpts of Sven Liljeblad's Shoshone and Bannock ethnographic and linguistic field notes identify that a total of 17 fish taxa were of traditional and subsistence importance. There were also 6 distinct bands named applied to groups who made major subsistence upon fisheries. These included the *Bia'agaideka, Soho'agaideka'* (Cottonwood Salmon Eaters), *Baingwideka* (Fish Eaters), *Go'a Agaideka* (Little Salmon Eaters or Pile Up Salmon Eaters), *Agaideka'* (Salmon Eaters), and *Daaza'agaideka'a* (Summer Salmon Eaters).

Suppressed Fish Consumption

Suppression for this exercise is defined as the reduction in historic Native American fish consumption caused by non-Indian settlement of Native American lands with consequent environmental and social changes that reduced availability and access to fisheries resources. The Tribes recognized long ago that fish consumption was suppressed due to a number of factors including: physical habitat modification, chemical contamination, habitat fragmentation and loss, passage barriers, stream temperature increase, channelization, and dewatering. Suppression also exists for the Tribes in the form of reduced access to fisheries, acts and/or threats of physical violence against Tribal members (e.g. harassment and/or incarceration by State Law Enforcement Officers), and fish species composition changes. But the most compelling evidence of suppression can be found by comparing fish consumption rates identified in this heritage report with current FCRs in the recently completed Shoshone-Bannock Tribes' Fish Consumptions Study.

As a result of depleted fisheries, regulatory agencies have listed all Columbia River anadromous species of salmonids and bull trout as either threatened or endangered under the Endangered Species Act. Sockeye numbers in the Sawtooth Valley, the only remaining accessible habitat, were reduced to single digits, forcing the Tribes to petition the National Marine Fisheries Service for the listing of Snake River Sockeye Salmon. This eliminated the Tribes' opportunity to harvest and consume the endangered sockeye salmon. Snake River Chinook salmon and steelhead were not far behind and were listed as threatened. Native resident salmonid species such as the Yellowstone and Fine Spotted Cutthroat remain unlisted, but there are very few stronghold populations remaining.

The most significant examples of pollution come from the Pocatello Region where beneficial uses are not being attained in numerous water bodies and ground water is contaminated with ethylene dibromide, a carcinogenic insecticide used to control nematodes impacting potato crops. The Fort Hall Reservation receives waters from the Blackfoot, Snake, and Portneuf rivers which border and enter the Reservation. All of these rivers are listed on the Clean Water Act's 303(d) list for water quality limited stream segments. The Portneuf River begins on the reservation, flows off through ceded lands, and is received back onto the reservation just before it enters the American Falls Reservoir at the Fort Hall Bottoms. At this point, the Portneuf River receives special attention from the Idaho Department of Health and Welfare in the form of Human Health Advisories suggesting that people limit their consumption of fish because of mercury contamination. Signage along the river reminds our membership that this river and its fish are contaminated; it is no longer a perception, it is a fact. The Portneuf at the Fort Hall Bottoms is also the site where avian botulism occurs during the right conditions. In the hot months of July and August, perfect conditions for bacteria growth can exist when flows in the Portneuf are reduced, ambient air temperatures are high, and American Falls Reservoir Pool is reduced to around 25%. Although it does not occur every year, these conditions seem to line up at least once every ten years; the last event killed approximately 20,000 waterfowl and shorebirds.

Shoshone-Bannock Efforts to Improve Fisheries Resources

The Shoshone-Bannock Tribes have been working for many years to improve and return anadromous fish runs to areas where they have been found traditionally, and to protect, restore, and enhance fish-related resources in accordance with the Tribes' unique interests and vested rights in such resources. Currently, many tribal members are concerned that the water and fish are contaminated and not safe for consumption or for cultural/ceremonial use(s). The Tribes' primary objective for the fish consumption survey is to develop water quality standards that are protective of human health and all cultural, ceremonial, physical and biological uses of water. This survey contributes to documenting the Tribes' inherent spiritual, mental, and physical connection with the natural gifts provided by the Creator, often referred to as natural resources in Western Societies.

To ensure the Tribes' aspirations would be met by future management, the Fort Hall Business Council, governing body of the Shoshone-Bannock Tribes, has established the following **policy statement for Management of the Snake River Basin Resources** to provide guidance when determining goals and objectives:

> *The Shoshone-Bannock Tribes (Tribes) will pursue, promote, and where necessary, initiate efforts to restore the Snake River systems and affected unoccupied lands to a natural condition. This includes the restoration of component resources to conditions*

which most closely represents the ecological features associated with a natural riverine ecosystem. In addition, the Tribes will work to ensure the protection, preservation, and where appropriate-the enhancement of Rights reserved by the Tribes under the Fort Bridger Treaty of 1868 (Treaty) and any inherent aboriginal rights.

The Tribes aspire to enhance fisheries by improving habitat conditions and by supplementing depressed populations of anadromous and resident salmonid species. Their commitment to enhance fisheries has been an ongoing effort since the early 1980's with millions of dollars being spent on enhancement projects in the upper Snake and Salmon rivers. The Tribes have partnered with Bonneville Power Administration (BPA) to assist with implementation of the Northwest Power and Conservation Council's Fish and Wildlife Mitigation Program for the Federal Columbia River Power System (FCRPS) and "Reasonable and Prudent Alternatives" derived from the FCRPS Biological opinion.

In 2008, the Tribes and BPA signed an agreement—"Fish Accord"—which committed BPA to provide $61 million over ten years (2008 – 2018) to the Tribes for the implementation of fish and wildlife enhancement projects. The Tribes are proposing to construct and operate a hatchery program for Salmon River Chinook Salmon and Yellowstone Cutthroat Trout in the upper Snake River. Populations of Chinook and Steelhead are depressed in the Yankee Fork of the Salmon River and Panther Creek due to physical alterations and contamination linked to historic mining processes. These hatchery supplementation goals for Chinook salmon will provide for Tribal Member harvest and species conservation on these two culturally significant tributaries of the Salmon River heavily impacted by legacy mining.

The Shoshone-Bannock Tribes were the first to petition the National Marine Fisheries Service to list Snake River sockeye salmon as endangered (the NMFS listed the species in November 1991 under the Endangered Species Act). Since then, the Tribes have actively worked to increase the Snake River sockeye salmon population, with the end goal of delisting the species and providing for tribal harvest opportunities.

On November 7, 2008, the Shoshone-Bannock Tribes signed a Fish Accord with the federal action agencies—the U.S. Army Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration. The Tribes agreed to an adaptive management strategy for the Federal Columbia River Power System (FCRPS) and improved survival of migrating and returning anadromous fish; and, the action agencies committed to fund the Tribes for assisting to implement the integrated Biological Opinion and the Northwest Power and Conservation Council's Fish and Wildlife Mitigation Program.

This Accord committed the action agencies to provide $61 million in funding over a 10-year period. Under it, the Shoshone-Bannock Tribes will continue to implement ongoing and new projects to benefit Snake River Sockeye, spring/summer Chinook, and Steelhead in the Salmon River basin (Mountain Snake Province); and, native salmonids and wildlife in the Mid and Upper Snake River Provinces. The Tribes will implement habitat restoration and production projects that will benefit native wildlife and fish and contribute to the recovery of Endangered Species Act-listed and non-listed species. Of primary concern is the loss of marine derived nutrients; pollution and depletion caused by numerous sources including the hydroelectric facilities, agriculture and the legacy of mining.

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We are grateful to all of those mentioned above, and to others who helped carry this project to its completion. An important addition to any acknowledgment such as this is the authors' affirmation that any errors of fact, method, numeric values or interpretation in this report belong only to the authors and not to any of the people, organizations or sources that were consulted or cited.

Volume I:
Heritage Fish Consumption Rates of the Shoshone-Bannock Tribes

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LIST OF ABBREVIATIONS AND ACRONYMS

BOR	Bureau of Reclamation
EPA	U.S. Environmental Protection Agency
FCR	Fish Consumption Rate
IDFG	Idaho Department of Fish and Game

LIST OF UNITS

%	percent
cal/d	calories per day
g/d	grams per day
kCal	kilocalories
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 Shoshone-Bannock Tribes. Heritage FCRs are those fish consumption rates in practice prior to disruption of tribal culture and fisheries resources by non-tribal use of and settlement on tribal lands. 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 Shoshone-Bannock Tribes' 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.

It is crucial that quantitative characterization of Shoshone-Bannock FCRs, either current or heritage FCRs, be understood in conjunction with other aspects of the Tribes (e.g. the current status of the Shoshone-Bannock Tribes, the history of the Shoshone-Bannock Tribes, the role of fish and fishing in the lives of Tribal members, suppression of fisheries and fish consumption due to the impacts of non-tribal use of and settlement on Native American lands, treaties between the U.S. government and Shoshone-Bannock Tribes, the manner in which treaty language relates to tribal hunting and fishing rights, and the activities of the Tribe in relation to their fisheries). In addition to some of the background material presented here, a foreword to Volumes I-III, authored by the Shoshone-Bannock Tribes, is essential reading.

The heritage report in Volume I discuss the purpose and objectives of characterizing heritage fish consumption rates for the Shoshone-Bannock Tribes, relevant background material (in particular the suppression of current fish consumption relative to historic FCRs and the causes of suppression), approaches used to develop heritage FCRs, a discussion of the factors considered in deriving heritage FCRs, a summary of the literature discussing heritage FCRs, a presentation of heritage FCRs including a discussion of uncertainty in these FCRs, and, finally, a table summarizing heritage FCRs. Additional relevant and important material is provided in two forewords relevant to the entire report. The first forward, mentioned previously, is authored by the Shoshone-Bannock Tribes and EPA. The second, authored solely by the Shoshone-Bannock Tribes, provides the Tribes' perspective.

1.1 Purpose and Objectives

Tribal Governments in the State of Idaho worked closely with the U.S. Environmental Protection Agency (EPA) Region 10 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 the ambient water quality criteria review process of the Idaho Department of Environmental Quality (ID DEQ)—a process that impacts tribal rights and interests. A Tribal heritage rate study was conducted as part of this effort. This study compiled and evaluated available data to determine heritage FCRs for the Shoshone-Bannock Tribes. 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 both on and off the Reservation.

Since a substantial portion of their diet is derived from aquatic sources, water and aquatic resources are of great importance to their subsistence lifestyle; and these resources hold significant cultural and spiritual value for the Shoshone-Bannock Tribes. As part of the survey effort, discussions with the Tribes highlighted the issue of suppression and its causes. The Tribes recognized long ago that fish consumption is suppressed due to a number of factors including: decreased fish populations due to physical habitat modification and adverse effects of chemical contamination, habitat fragmentation and loss, passage barriers, stream temperature increases, channelization and dewatering of streams for irrigation, limitations on Tribal access to fisheries resources due to privatization of public lands, exposure to contaminants in fish, limitations on access imposed by the State, fish species composition changes, and changes in fish harvesting by Tribal members associated with adaptation to economic and cultural shifts.

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 Tribes.

The Shoshone-Bannock Tribes' primary objective for the fish consumption survey is to develop water quality standards that are protective of all cultural, ceremonial, physical and biological uses of water.

The Tribes have been working for many years to improve and return anadromous fish runs to the areas where they were traditionally found and to protect, restore, and enhance fish-related resources in accordance with the Tribes' unique interests and vested rights in such resources. Currently, many tribal members are concerned that the water and fish are contaminated and not safe for consumption or for cultural/ceremonial use(s). Their overarching goal is to bring back ecosystem function and provide clean water resources to sustain not only human populations, but the health and welfare of forms of life in which we all depend. This survey contributes to documenting the Tribes inherent spiritual, mental, and physical connection with the natural gifts provided by the Creator, often referred to as natural resources in Western Societies.

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 Shoshone-Bannock Tribes. 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 Tribes.

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

2.0 BACKGROUND (Authored by the Shoshone-Bannock Tribes)

The Shoshone-Bannock Tribes have relied extensively on fish resources and fishing activities from time immemorial. A summary of fish harvest and the extensive use of fisheries resources, a brief discussion of fish consumption prior to settlement of Native American lands by non-Indians, and the causes of decline in fish availability over time, is provided for context. In order to gain a complete understanding of these issues, it is necessary to read the foreword to Volumes I-III of this report, authored by the Shoshone-Bannock Tribes. This foreword provides a rich understanding of the Tribal perspective on these issues. Importantly, the foreword also delineates subsistence fish and game harvest rights guaranteed to the Shoshone Tribes by treaty with the U.S. Government.

2.1 Summary of Historical Fish Harvest and Consumption

The Shoshone and Bannock people's homelands are vast and far-ranging and encompass what are now known as the states of Idaho, Oregon, Nevada, California, Utah, Wyoming, Montana and beyond. Rivers that the Shoshone and Bannock people used included the Snake, Missouri, and Colorado rivers, all of which provided past and current subsistence needs. These natural resources provided food, medicine, shelter, clothing and other uses and purposes, intrinsic to traditional practices (BOR, 2012).

Anadromous fish provided the Shoshone-Bannock peoples with abundant and predictable supplies of food. For those who lived along the waterways of the Salmon River and its tributaries, or along the Snake below Shoshone Falls, anadromous fish were the primary aquatic food resource. On the Snake River, Shoshone Falls was the absolute limit of salmon migration. Some anadromous species also entered the tributaries of the Snake, such as Rock and Salmon Falls creeks. Shoshone and Bannock people who did not continually live along salmon bearing streams relied upon anadromous fish and traveled annually to locations where fish could be taken (Albers, et al., 1998). Not only were the salmon and steelhead utilized for subsistence, but the Pacific lamprey was an important subsistence species of the Tribes.

Like anadromous fish, resident fisheries were and continue to be an important and reliable source of fish protein for the Shoshone-Bannock Tribes. Some resident fish harvested and utilized by the Tribes were documented by Liljeblad (1957) and Steward (1938) included: catfish, sucker, minnows, trout, cray fish, whitefish, and redside shiners. These species of fish were taken on an opportunistic basis when need arose.

Today, descendants of the Tribes include Shoshone and Bannock speaking peoples whose traditional territorial ranges encompass the Idaho-Utah boarder region, interior Oregon, Nevada, Wyoming, and Montana. Also incorporated into the reservation were bands from the Lemhi, Boise Valley, Bruneau, Weiser, and McCall areas (Albers, et al., 1998). Tribal members continue to exercise off reservation Treaty rights, and return to aboriginal homelands to practice their unique culture and traditions.

2.2 Summary of Causes of Decline in Fish Populations

Salmon once spawned in tributaries of the Snake River throughout Idaho. In the early 1900's, the construction of dams blocked salmon from several tributaries. Many of those dams were constructed without fish ladders or were too high to allow for fish passage. Swan Falls Dam on the mainstem Snake River near Marsing, Idaho, and dams in the Owyhee, Boise, Payette, Grand Ronde, Salmon and Clearwater rivers stopped anadromous species in the early 20th century. The Hells Canyon Dam complex in the middle Snake was completed in 1967, blocking all salmon and steelhead runs above the dams. Fall chinook that spawn in the main stem Snake River are now confined to the stretch below the complex (Idaho Rivers, 2013).

The Upper Snake River subbasin is located in eastern Idaho and extends about 400 river miles from Idaho Falls to Shoshone Falls. Major tributaries include Blackfoot River, Portneuf River, Raft River, Goose Creek, and Big Cottonwood Creek (Colter, et al., 2002). The single most influential limiting factor to native fish populations within the Upper Snake River subbasin is loss and degradation of habitat due to riparian and stream channel disturbance, channel dewatering for irrigation withdrawals, and environmental pollution. The development and operation of hydroelectric dams on the Columbia River and its tributaries has contributed to the decline of fish and wildlife populations throughout the Basin.

Habitat limitations related to agriculture and grazing include unscreened irrigation delivery systems, sedimentation, upland and in-stream habitat disturbances, loss and degradation of functional riparian areas and wetlands, elevated summer temperatures, increased developments in agriculture areas resulting in habitat fragmentation, reduced stream bank vegetation and stability. In years of low snowpack, flows in water bodies and reservoir storage can be drafted to fulfill irrigation water rights impacting the quality and quantity of water (Colter, et al., 2002). Today, climate change is also expected to further reduce and degrade habitat for native fish through alterations of hydrologic regimes and increasing water temperatures (Gillis, et al. 2011).

One of the largest phosphate ore reserves in the United States is located in the Blackfoot and Salt River drainages of southeastern Idaho. Environmental problems associated with phosphate mining were first documented in the 1990’s, and an investigation of potential effects of selenium generated from phosphate mines on the fish and wildlife in the upper Blackfoot River drainage is ongoing (IDFG, 2007). These river systems support populations of trout which have been identified to have selenium contamination and threat to the populations within these drainages (USFWS, 2006). Bioaccumulation of selenium in aquatic systems has been well documented (Presser, et al. 1994; Bowie et al. 1996; Dobbs, et al., 1996; Maier, et al., 1998; Garcia-Hernandez, et al., 2000; and Hamilton, 2002) and bioconcentration factors of 100-10,000 are possible in aquatic food organisms consumed by fish (Lemly, 1999).

The distribution and abundance of Yellowstone cutthroat trout have declined in the Snake River Plain of Idaho through habitat degradation, genetic introgression, and exploitation (Thurow, et al., 1988 and May, 1996, as cited in Colter, et al., 2002). Habitat degradation has included negative impacts from grazing (riparian loss, siltation, and widening and deepening of stream channels) and habitat fragmentation from impoundments and diversions. Many remaining populations exist as localized remnants of original sub-populations with little or no connectivity. Genetic introgression with non-native cutthroat and other trout is one of the greatest threats to remaining pure populations of Yellowstone cutthroat trout (Colter, et al., 2002). Potential threats to Yellowstone cutthroat trout in Idaho have been identified by Thurow, et al. (1988) and Gresswell (1995), as cited in IDFG (2007). Threats include genetic introgression with rainbow trout, impoundments, water diversion, road culverts, improper livestock grazing, mineral extraction, angling, and competition with non-native species. Whirling disease has been identified as a more recent potential threat (IDFG, 2007).

Riparian areas on the Fort Hall Indian Reservation have been negatively affected by lateral scouring and downcutting of stream banks caused by years of unrestricted grazing and rapid flooding and drafting of American Falls Reservoir. Negative impacts from lateral scouring and downcutting include siltation of spawning gravels, loss of cover and pool depth, increasing width to depth ratios of stream channels, and resulting increases in water temperature (Colter, et al., 2002). Impairment to water quality that results from lateral scouring and downcutting of stream banks due to livestock grazing and other agricultural uses is also not limited to the Reservation, but these impacts occur throughout the state of Idaho.

Non-point source pollution and water diversions are the predominant influences on surface water quality in the Upper Snake River subbasin (ID DEQ 2011). Pollutants of greatest concern that have been associated with stream habitat degradation include nutrients, sediment, bacteria, organic waste, and elevated water temperature. Irrigation drainage, aquaculture effluent, municipal effluent, hydrologic modification, and dams affect water quality in the middle reach of the Snake River. Segments of the river were listed as water quality limited in 1990 because nuisance weed growth had exceeded water quality criteria and standards established for protection of cold water biota and salmonid spawning (Colter, et al., 2002). The Tribes believe that environmental, economic, and social factors have all impacted subsistence resource use.

Idaho's 2012 Integrated Report to the EPA presents information about the status of Idaho's water categorized using assessment units. The leading causes of impairment in streams and rivers are temperature, sedimentation/siltation, E. coli, and cause unknown (ID DEQ 2014: 44). According to the report, of the 95,119 total stream / river miles statewide, 36% or 34,396 miles did not support the beneficial uses identified for that stream; and 34% or 32,034 miles were not assessed. The report also summarized the status of Idaho's lakes and reservoirs: based on 469,045 total acres statewide, 56% or 261,709 acres do not support beneficial uses; and 38% or 179,653 acres have not been assessed (ID DEQ 2014). In total, then, 70% of Idaho's stream / river miles and 94% of Idaho's lakes and reservoirs do not meet their designated beneficial uses or it is simply not known.

The Pocatello Region is reported to have the most miles of stream in the State that are not fully supporting designated beneficial uses (595 miles or 66%) with the Idaho Falls Region coming in second at 506 miles or 36%. The Fort Hall Reservation is within the Pocatello Region and the Idaho Falls Region, with its close proximity to the Reservation, provides significant opportunity for Tribal members to exercise reserved Treaty rights. The Fort Hall Reservation is surrounded by 303(d) listed streams. The Blackfoot, Snake, and Portneuf rivers are all on the list of water quality limited stream segments with the Portneuf receiving additional special recognition for the human health advisories for fish consumption related to mercury contamination.

There is a limited area of the state—central Idaho's wilderness—where water bodies meet designated beneficial uses. ID DEQ believes waters within designated wilderness and inventoried roadless areas meet the natural conditions provision by virtue of the fact that little to no significant human management has taken place to cause changes in water quality or affect beneficial uses (ID DEQ 2014:31).

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 Shoshone-Bannock Tribes 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][9]) 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

[9] 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.

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.

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,[10] 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[11] (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

[10] 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.
[11] Calculation: 2000 cal/d * 0.5 * 1 lb/1000 cal = 1 lb/d

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).

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 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., 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 Shoshone-Bannock Tribes Heritage Rates

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

- Hewes, 1973
- Walker, 1985
- Schalk, 1986
- Walker, 1993

3.4.1 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 50 lb/yr (or 62 g/d) for the Shoshone-Bannock Tribes (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.

3.4.2 Walker, 1985

In 1985, Deward Walker conducted ethnographic research that included information about the Shoshone-Bannock Tribes; 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 and resident) FCR of 800 lb/yr (or 995 g/d) for the Shoshone-Bannock Tribes (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.

3.4.3 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 179 lb/yr (or 222 g/d) for the Shoshone-Bannock Tribes (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."

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 35% (0.35) for the Shoshone-Bannock Tribes. Schalk also applied a waste loss factor of 80% (0.80), citing Hunn (1981), therefore, including inedible fish parts in the fish consumption estimate.

3.4.4 Walker, 1993

In 1993, Deward Walker reviewed data from the Northwest Planning Council (Schalk, 1986), which accounted for migration and waste loss factors, to report a per capita average catch of 635 pounds for Plateau-wide Tribes. Walker estimated that this same value of 635 lb/yr (or 790 g/d) was appropriately representative of the Shoshone-Bannock Tribes fish harvest.

Walker conducted a study to reconstruct Lemhi Shoshone-Bannock fishing activities, including evaluating fishing technologies, locations, and harvest, to estimate total fish catches via “a more empirical, comparative, historical, and comprehensive methodology than has been used in previous studies” (Walker, 1993). Walker determined that the value estimated by Schalk (1986) of 179 lb/yr for the Shoshone-Bannock was an underestimate and he proposed a Plateau-wide average of 635 lb/yr as more appropriate estimate for the Shoshone-Bannock (and likely even higher for the Lemhi). This value represents fish caught and, therefore, may include fish used for purposes other than ingestion; the distinction is not made in the publication.

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 Shoshone-Bannock Tribes, 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 (e.g., 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[12]), 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) (Table 1).

4.2.2 Shoshone-Bannock Tribes Heritage Rates

Hewes (1973) continued his earlier dissertation research from 1947 and published his estimates for various Tribes based upon 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 of 50 lb/yr (or 62 g/d) for the Shoshone-Bannock Tribes. Schalk (1986) applied migration and waste loss factors to Hewes' estimate, yielding a rate of 179 lb/yr (or 222 g/d). Walker (1993) determined that Schalk underestimated the total catch and proposed 635 lb/yr as a more appropriate estimate for the Shoshone-Bannock (and likely even higher for the Lemhi). It is unclear if this value represents fish used for purposes other than ingestion.

In 1985, Walker expanded upon his previous work from 1967 and calculated Tribe-specific per capita total FCRs for individual tribes, including 800 lb/yr (or 995 g/d) for the Shoshone-Bannock Tribes. 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).

[12] 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).

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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 ethnographic 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	Migra-tory Caloric Loss Factor [1]	Accounts 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 Shoshone-Bannock 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	Migra-tory Caloric Loss Factor [1]	Accounts for inedible portion [2]
Hewes 1973	Caloric Analysis/Ethnographic Observation	Salmon	62	Methodology not presented	Unknown (U)	Unknown (U)	Unknown (U)
Walker 1985	Unpublished, cited by Scholz, et al. 1985.	Salmon and Resident	995	Methodology not presented	Unknown (U)	Unknown (U)	Unknown (U)
Schalk 1986	Reanalysis of Hewes 1947 and 1973	Salmon	222	222 g/day = 62 g/day from Hewes 1973 ÷ 0.35 caloric loss factor ÷ 0.8 waste loss factor	Unknown (U)	Yes (+)	Yes (+)
Walker 1993	Review of Schalk 1986 for the Northwest Planning Council	Salmon	790	Reviewed work of Schalk 1986, determining this work was applicable to the Shoshone-Bannock Tribe	Unknown (U)	Yes (+)	Yes (+)

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

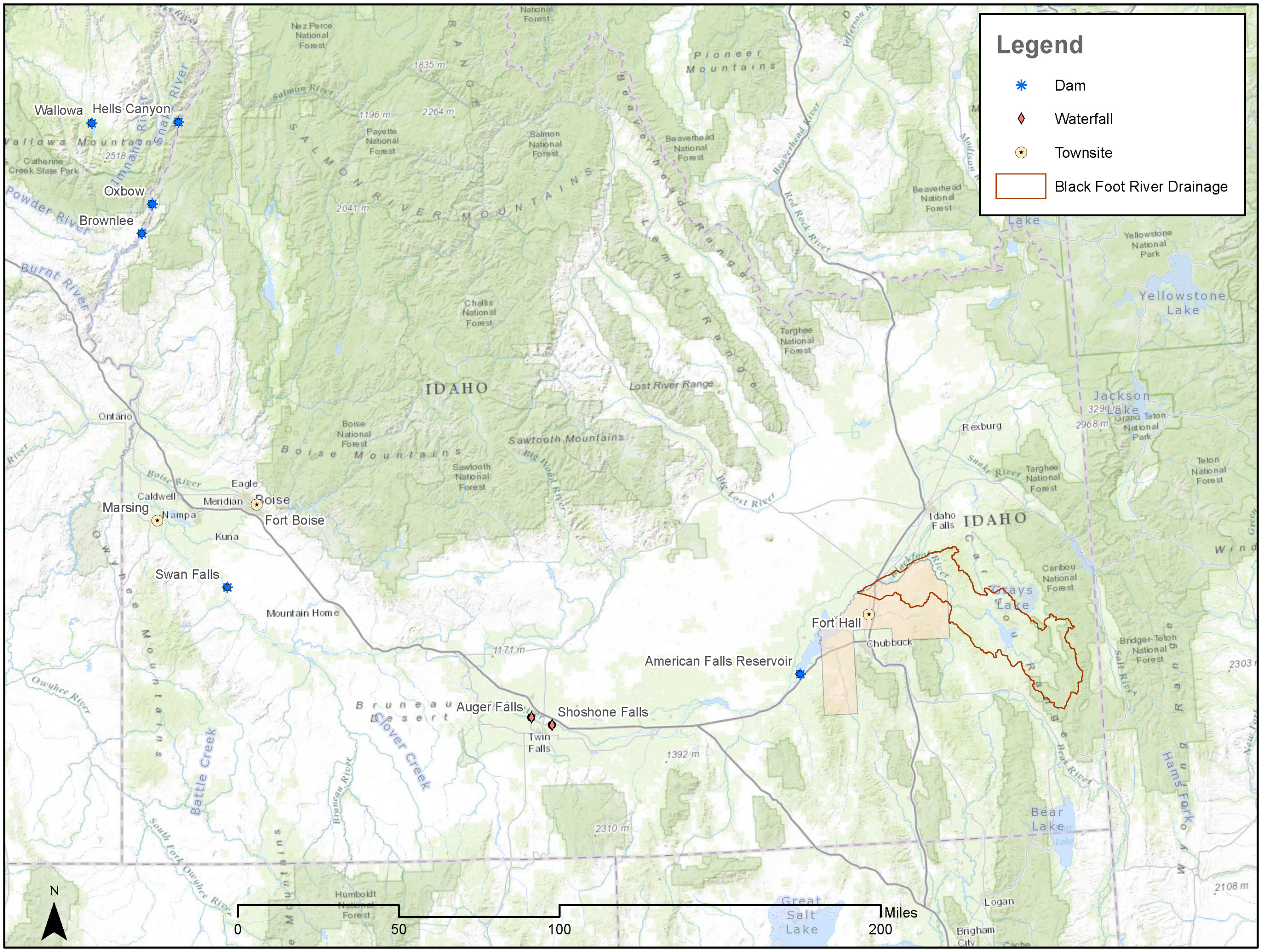
Fraser River Location	**Total Calories[1] (kCal)**	**Total Weight[1] (grams)**	**Caloric Density (calories/ gram)**
At River Mouth	5,173	2,585	2.00
At Spawning Grounds	2,248	2,363	0.95
After Spawning and Death	1,334	1,917	0.70
Percent Loss at Spawning Grounds	**57%**	**9%**	**52%**
Percent Loss After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

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1.0 Preface to Volume II

This report of fish consumption rates (FCRs), which includes both finfish and shellfish, among the Shoshone-Bannock Tribes is a step toward quantitatively documenting the role of fish in the life of the Tribes. The FCRs from this survey can be used by the Tribes, 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. A foreword to Volumes I-III authored by EPA and the Shoshone-Bannock Tribes provides much more comprehensive material on development of this report and the context for use of the information included within the report.

While the main results of this report are numeric, the numbers are only a companion to the Shoshone-Bannock culture, heritage and vision for their future. It is essential that quantitative aspects of the report be understood through who the Shoshone-Bannock Tribes were and who they are today (e.g. the current status and history of the Shoshone-Bannock Tribes, the role of fish in the lives of their members, suppression of fisheries and fish consumption due to the impacts of settlement on Native American lands, treaties between the U.S. government and Shoshone Bannock Tribes, how treaty language relates to tribal hunting and fishing rights, and the activities of the Tribe in relation to their fisheries). The foreword to Volumes I-III authored by the Shoshone Bannock Tribes discusses these points.

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
NEJAC	National Environmental Justice Advisory Council
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 Shoshone-Bannock Tribes (SBT). 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 Shoshone-Bannock Tribes. The second method uses responses to questions asked on two independent 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 survey is to quantitatively describe current fish consumption and related activities of the Shoshone-Bannock Tribes. The FCRs from this survey can be used by the Tribes, 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 the 24-hour recall) that supplied useable data for this report occurred on May 20, 2014. The last in-person interview occurred on April 26, 2015. Telephone interviews continued through May 3, 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 five tribes in Idaho, the Environmental Protection Agency, the Upper Snake River Tribes Foundation (USRTF), the Columbia River Inter-Tribal Fish Commission (CRITFC), 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 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, Fort Hall and Blackfoot, which are 12 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, additional 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 represented Native American fish consumers specific to Idaho. A stratified random sample was drawn from tribal enrollment files, where strata were defined by age, residence on- or off-reservation and presence on the tribal fishers list. Within each stratum, members were drawn randomly. A tribal fishers population for this study (referred to as the "fishers list" in this report) was taken from a list of tribal members who have attended Tribal Fish and Wildlife Department informational meetings to learn about fish run status and/or regulation changes and have submitted their contact information for any future informational outreach opportunities provided by the Fish and Wildlife Department. The individuals on the fishers list may or may not directly engage in fishing activities. The fishers constituted a separate, non-overlapping stratum[1]. All fishers in this stratum were included in the sample. FCRs are reported for the fishers as a distinct population.

Tribal interviewers were employed and trained by an EPA sub-contractor in charge of fieldwork to administer the questionnaire. Tribal interviewers (rather than non-tribal interviewers) were selected, because both tribal representatives and EPA contractors thought that tribal member respondents would be more likely to accept an interview from and convey more accurate information to 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 survey and, also, to provide income for tribal members. 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 sampled members (sometimes the most difficult step) and gaining their cooperation for an interview. Tribal interviewers were also used in other Pacific Northwest fish consumption surveys of Native Americans (CRITFC, 1994, Toy et al, 1996, Suquamish Tribe, 2000). 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 Tribes. Incentives included a $40 payment for completing the first interview. 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.

[1] See Section 5.5 for details on strata and sampling.

Respondents to the survey answered questions about species consumed (frequency and quantity) covering consumption over the past year, as well as questions about fish consumption "yesterday" (the 24-hour recall). The questions from the 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 three 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 timing of the first and second interviews 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), a common format 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 Tribes. 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 Tribes. 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 (species Group 1) and 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 Tribes.

This survey project includes an analysis of heritage rates—the FCRs of the Tribes that were in place prior to modern environmental and social interference with their fishing practices. The current consumption rates presented here, together with the heritage rates (see Volume I), provide a range of potential future 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 661 adult tribal members (age 18 or older) was drawn from tribal enrollment files and the tribal fishers list. Over the course of the interview period, 257 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. These 257 members constituted 7.9% of the adult population size of 3,242. The response rate for the survey is 42%. Thirty-one of the respondents were non-consumers and, using appropriate survey weighting, this count leads to an estimate of 20% non-consumers among adult members of the Shoshone-Bannock Tribes. The FCRs for the Tribes are summarized briefly in Tables S1 and S2. Additional FCRs are provided in the body of this report.

The Tribes' estimated current total fish and shellfish consumption rates are high relative to the U.S. general population (Table S3). SBT fishers and non-fishers have similar mean rates by the FFQ method (Table S2), and the higher percentiles do not show a consistently larger magnitude of consumption between fishers and non-fishers. In contrast, fishers had higher FFQ rates of consumption of Group 2 species than non-fishers, though the pattern reversed at the 95th percentile. For both Group 1 (all species combined) and Group 2 species, fishers have higher rates (mean and percentiles, Table S2) than non-fishers by the NCI method. The consumption rates are skewed toward high consumption rates for each of the populations and the species groups presented in Tables S1 and S2; the 95th percentile is several-fold larger than the median, typically an indication of skewness toward large values. The mean and percentiles of consumption by the NCI method are smaller than those by the FFQ method. For example, among the consumption estimates for Group 1 species, the mean consumption rate from the NCI method is 78% lower than the mean rate from the FFQ method. The NCI method 95th percentile is 77% lower than the corresponding FFQ value. For Group 2 species, the mean and 95th percentile of consumption rates calculated by the NCI method are 83% and 81% lower than the corresponding FFQ rates, respectively.

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 40% as large as the mean frequency from the FFQ data. The corresponding value for Group 2 species was 27%. The Group 1 and Group 2 mean portion sizes from the 24-hour data were 72% and 92% as large as the mean portion size from the FFQ data, respectively. The relative difference in frequencies and portion sizes between 24-hour data and FFQ data was larger for the high consumers. Among the 10% of consumers with the highest FFQ consumption rates (all species combined) the 24-hour mean frequency for Group 1 and Group 2 was 18% and 14% of the FFQ mean frequency, respectively. Again, for these high consumers, the 24-hour mean portion size for Group 1 and Group 2 species was 28% and 6% of the FFQ mean portion size, respectively. These high-consumer portion-size comparison percentages, while lower than the percentages for all of the respondents combined, are quite uncertain; there were only a very small number of respondents in this high-consumer group with the hits (24-hour periods with fish consumption) needed to calculate a portion size.

Table S1. Shoshone-Bannock Tribes. 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	226	158.5	74.6	392.5	603.4
Group 1 - NCI Method	226	34.9	14.9	94.5	140.9
Group 2 - FFQ	225	110.7	48.5	265.6	427.1
Group 2 - NCI Method	225	18.6	6.5	48.9	80.0

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

Table S2. Shoshone-Bannock Tribes. Mean, median and selected percentiles of FFQ 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	Fisher - FFQ	134	160.9	117.7	351.1	459.1
Group 1	Fisher - NCI Method	134	42.4	20.0	114.3	163.6
Group 1	Non-fisher - FFQ	92	158.2	69.7	405.4	604.4
Group 1	Non-fisher - NCI Method	92	33.9	14.4	91.8	138.3
Group 2	Fisher - FFQ	134	125.3	73.9	297.1	370.8
Group 2	Fisher - NCI Method	134	23.3	10.2	61.5	92.6
Group 2	Non-fisher - FFQ	91	108.9	43.4	261.2	441.4
Group 2	Non-fisher - NCI Method	91	17.8	6.3	46.6	76.8

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

Table S3. Shoshone-Bannock Tribes. Total FCRs (g/day, raw weight, edible portion, all species combined) of adults in Pacific Northwest Tribes (with consumption rates available) and the US general population. Consumers only.

Population	No. of Consumers	Mean	Percentiles	
			50%	95%
Shoshone-Bannock Tribes - FFQ	**226**	**158.5**	**74.6**	**603.4**
Shoshone-Bannock Tribes – NCI Method	**226**	**34.9**	**14.9**	**140.9**
Nez Perce Tribe - FFQ	**451**	**123.4**	**70.5**	**437.4**
Nez Perce Tribe – NCI Method	**451**	**75.0**	**49.5**	**232.1**
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
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 (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 Shoshone-Bannock and Nez Perce 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 FFQ FCRs presented here, and those of the Nez Perce Tribe presented in a companion report, are higher than those observed in other Pacific Northwest tribal fish consumption surveys, except for the surveys of the Suquamish Tribe. The Shoshone-Bannock Tribes' FFQ mean consumption rate is from 89% to 150% larger and the 95th percentile of consumption from 125% to 311% larger than those of the other tribes in Table S3, except the Suquamish Tribe and Nez Perce Tribe. The Shoshone-Bannock Tribes' FFQ FCRs are also many-fold higher than FCRs for the U.S. general population. The SBT's NCI-method summary rates are substantially lower than their FFQ rates, as noted in other comparisons of population rates in this Executive Summary and in the main body of the report.

The SBT's NCI rates are generally greater than EPA rates[2] used for national recommended ambient water quality criteria. The mean, median, and 95th percentile SBT-NCI rates are 47% greater, 15% lower, and 107% greater than corresponding national EPA rates (see Table 28).

[2] The EPA rates noted here were derived by Westat using the "EPA method", which is an adaptation of the NCI-method. In the context of this survey the EPA and NCI methods can be considered to be in the same methodologic family and the rates from the two methods can validly be compared. (See U.S. EPA, 2014, for the EPA method).

Likely reasons for the NCI-based consumption rates (which are probably more accurate than the FFQ rates) being lower among the Shoshone-Bannock than among the Nez Perce are that the Shoshone-Bannock Tribes have less access to the more abundant fisheries than the Nez Perce Tribe; beyond the dams that limit anadromous fish access to the Nez Perce fisheries, additional dams further limit access of anadromous fish to Shoshone-Bannock fisheries. As a possible indication of (but not proof of) additional environmental damage to the Shoshone-Bannock fisheries—damage that may reduce fish consumption—there are five Superfund sites within the group of ZIP codes used to define the survey sample area for selecting adult members of the Shoshone-Bannock Tribes. There are no Superfund sites in the corresponding area for the Nez Perce Tribe.[3] However, this rationale does not explain why some summary FFQ rates for the Shoshone Bannock Tribes exceed those of the Nez Perce Tribe.

Sections 6.11 and 7.3 deal with differences in rates derived from the FFQ method vs. rates derived from the NCI method; that presentation and discussion will be helpful in understanding why a comparison of rates between populations may be quite different according to which methodology's rates are used for the comparison.

The estimated mean consumption rate differed (and with statistical significance) between the FFQ-based rates and the rates based on the 24-hour recalls, with the 24-hour mean rates being lower. The survey-weighted 24-hour mean consumption rates of Group 1 and Group 2 species were 27% and 23% as large as the means from the FFQ method. 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[4] FCRs, 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[5] 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 to the actual distribution of fish consumption. 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

[3] Email (with maps showing Superfund sites) from James Lopez-Baird (EPA) to Lon Kissinger (EPA), 9/25/15.
[4] 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.
[5] The NCI method assumes a certain family of shapes derived from the normal distribution by a Box-Cox power transformation.

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 95^{th} 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 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[6] 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 42%. 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 consumption rate, on the average, than those included. That is an unknown at this time, and the response rate of 42%, 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 Tribes, achieving the ideal response rate posed a challenge that was not easily overcome. The Tribes are 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.

[6] 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.

This study could not have been designed or completed without the full collaboration of tribal officials. In order to meet interview quotas, the Tribes 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 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 Shoshone-Bannock Tribes have FFQ FCRs that are among the highest in the Pacific Northwest. (See Table S3.) The Tribes' 95th percentile rates from the NCI method are also two-fold higher than the rates for the U.S. general population. Shoshone Bannock Tribe FCRs (FCR) 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, 78% and 83% lower than means obtained via the FFQ approach.

4.0 Introduction

4.1 A Brief Description of the Shoshone-Bannock Tribes

The Shoshone-Bannock Tribes of today are a self-governing, Federally Recognized Tribe with reserved off-Reservation Treaty rights secured by the Fort Bridger Treaty of July 3, 1868. The Fort Hall Reservation, permanent homeland of the Tribes, is located in Southeastern Idaho near the city of Pocatello. The Snake and Blackfoot rivers provide western and northern reservation boundaries and the Portneuf River begins and ends on the reservation. Additional material about the Tribes is contained in Volume I of this report (Heritage Rates) and in the Shoshone-Bannock Tribes' foreword to this volume of the report.

4.2 Populations

The tribal populations described quantitatively in this report are the Shoshone-Bannock Tribes as a whole and the population of fishers within the Tribe. Identification of tribal members was obtained from confidential tribal enrollment records in close consultation with tribal officials.

The fisher population for this study was taken from a list of tribal members who have attended Tribal Fish and Wildlife Department informational meetings to learn about fish run status and regulation changes and who have submitted their contact information for any future informational outreach opportunities provided by the Tribal Fish and Wildlife Department. The individuals on the fishers list may or may not directly engage in fishing activities, and, similarly, some of those not on the fishers list may, in fact, be fishers. Thus, the fishers list is not a comprehensive representation of all "fishers" of the Tribes, but rather a "fisher indicator" (i.e., a subset) of the actual fisher population plus some fraction of persons who do not fish. 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, but 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. 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 correctly labeled and placed in the correct fisher/non-fisher category.

4.3 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[7] 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.[8] 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

[7] See Section 4.2 for a definition of "fisher" as used in this document.

[8] 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.

accepted FFQ method was run in parallel with the newer NCI method, since the FFQ method can 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[9] 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

[9] 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.

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. 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.

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[10]. 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. 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.

[10] 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.

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[11]. 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 two tribal members whom they encountered as falling in this category.

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

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 four interviewers from the Shoshone-Bannock Tribes.)

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.

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 Tribes. 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. Shoshone-Bannock Tribes. Fort Hall Reservation and surrounding eligible ZIP codes for inclusion in the Shoshone-Bannock Tribes fish consumption survey.

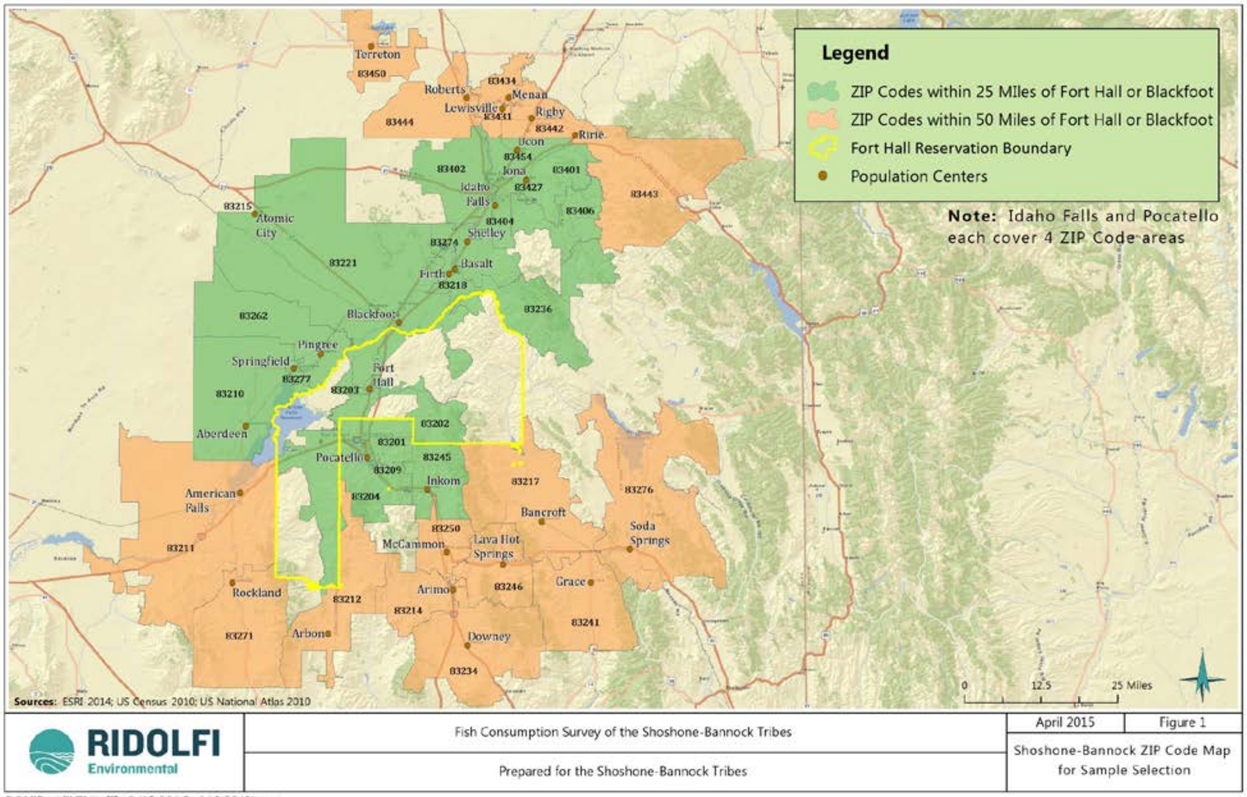

Table 1. Shoshone-Bannock Tribes. ZIP codes included for sampling members of the Shoshone-Bannock Tribes.

ZIP Code	Population Center
83201	Pocatello
83202	Pocatello
83203	Fort Hall
83204	Pocatello
83209	Pocatello
83210	Aberdeen
83211	American Falls
83212	Arbon
83214	Arimo
83215	Atomic City
83217	Bancroft
83218	Basalt

ZIP Code	Population Center
83221	Blackfoot
83234	Downey
83236	Firth
83241	Grace
83245	Inkom
83246	Lava Hot Springs
83250	McCammon
83262	Pingree
83271	Rockland
83274	Shelley
83276	Soda Springs
83277	Springfield

ZIP Code	Population Center
83401	Idaho Falls
83402	Idaho Falls
83404	Idaho Falls
83406	Idaho Falls
83427	Iona
83431	Lewisville
83434	Menan
83442	Rigby
83443	Ririe
83444	Roberts
83450	Terreton
83454	Ucon

5.5 Stratification and Drawing the Sample

The survey statistical team obtained a copy of the tribal enrollment list in Excel format (listing tribal members ages 18 and over) as well as a mailing list for the fishers list. These files were processed for sampling (e.g., limiting the file to residents of specified ZIP codes), a stratified random sample of study participants was drawn, and spreadsheets containing participant information were prepared for the interviewers.

The information in the tribal enrollment files included a list of tribal members and, for each, his or her ZIP code, age, and designation as a person on the fishers list. The ZIP code was used to determine eligibility for the study (see Section 5.4). Whenever available, the ZIP code of the physical (residence) address was used to determine eligibility for the study. In a few cases where this information was unavailable, however, the mailing address's ZIP code was used instead.

All tribal members in the file supplied by the enrollment office were 18 years of age or older and thus were eligible for selection into the sample on the basis of age. A total of 3,242 members qualified by their ZIP codes (55 of these by mailing address, as their physical addresses were not available). Each of these 3,242 members was assigned a unique PMRID (Pacific Market Research Identification Number).

Five age groups were established (18–29, 30–39, 40–49, 50–59 and 60+), after which the number of tribal members was cross-tabulated by age group and by residence (either on- or off-reservation). Gender was considered as an additional potential stratification variable, but was not included due to concerns this would lead to very small sample sizes for some strata. The number of participants who would be sampled in each combination of age group and on/off-reservation status (potential strata) were then calculated. As all of the five potential off-reservation strata were small, all were combined into one stratum ("off-reservation"). The on-reservation members were divided into five strata according to age group, yielding a total of six strata for the sample selection. The fishers became a separate stratum later in the process, described below.

Stratified random sampling was performed. The proportion of random samples from each stratum was chosen to be the same proportion as in the eligible population. The total number of tribal members in the initial primary sample was 400. This number was chosen to yield, with an anticipated high probability, at least 325 sampled members who were *not* on the fishers list (assuming 300 eligible members on that list in the entire eligible population of 3,242 tribal members). All fishers not already selected into the sample were subsequently added into the sample, increasing the sample size.

The primary sample was randomly divided into four waves (one per three-month calendar period), and each wave was further divided among four interviewers according to the sampled members' ZIP codes. As more than three-quarters of the members were from the Fort Hall ZIP code (83203), the sample for this ZIP code was randomly divided among three interviewers. The remaining sample (outside of the Fort Hall ZIP code) was assigned to the fourth interviewer. The sample for the fourth interviewer was smaller in count, but required more substantial travel to reach the participants in these more diverse ZIP codes. Subsequently, interviewers were permitted to transfer potential respondents among themselves. 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").

In addition to the random sampling within the six strata described above, all tribal members on the fishers list were selected and merged with the initial primary sample to form the final sample. Members who were on the fishers list and already in the initial primary sample were identified and were only included once in the sample. Any member on the fishers list was recorded as being in the fishers stratum, regardless of the original strata to which the member belonged. Thus, all strata were mutually exclusive. The fishers eligible to be included in the fisher sample stratum were identified by a knowledgeable member of the Shoshone-Bannock Tribes staff, relying on the available list of fishers and the staff member's knowledge of the Tribes. (See the "Populations" section of this document for a description of the fishers list used by the staff member.)

All data with personally identifiable information (PII) were protected by password and transferred to a tribal staff member authorized to receive PII. The Mountain-Whisper-Light retained a file with some of the data items that did not include PII.

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 Sweat Lodges, Sun Dances and funerals.

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 Tribes, 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 Tribes (including accepting a home interview) than from someone outside the Tribes. 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 Tribes 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 20, 2014 and the last in-person interview included in this report was completed on April 26, 2015. Telephone interviews continued through May 3, 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 (87% of the 1,769 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

$$Rate\_Events = EFREQ \times \%EVENTS \times SIZE\_Events, \text{(3)}$$

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:

$$Rate\_Total = Rate\_Nonevents + Rate\_Events. \text{(4)}$$

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 fish groupings for which FCRs are reported (Table 2) were approved by the Shoshone-Bannock Tribes. To inform this 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 Shoshone-Bannock Tribes 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 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 used for Washington’s proposed AWQC (Washington Department of

Ecology, 2015). For informational purposes, the Shoshone-Bannock Tribes wished to report on total fish consumption (Group 1).

The species included in the species groups (1-7) 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. Across all the respondents, 15% reported consuming freshwater clams or mussels and 35% reported consuming marine clams and mussels (7% reported consuming both). Of note, Groups 1 and 2 contain all shellfish species, so this distinction between freshwater and marine does not affect those groups.

Table 2. Shoshone-Bannock Tribes. 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. The species included in Group 2 in this report were guided in part by the habitat proportions listed by 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 age, whether respondent was a documented fisher (see definition of the fishers list in Section 4.2), and whether the respondent lived on- or off-reservation. The questionnaire was used to define groups based on 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 Note on Design

No design changes were instituted in the survey. The same methodology was followed throughout. The identification of fishers by using the fishers list maintained by the tribes (see Section 4.2) was carried out very near the beginning of interviewing. The fishers were established as a distinct stratum (with 100% of fishers included in the sample) virtually at the start of the fieldwork. Note that though fishers are over-represented in the sample (by design), they are not over-represented in the calculated consumption rates (means, percentiles, etc.), due to the use of appropriate statistical weighting when consumption rates (and other statistics) are calculated.

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 March 31 to May 19, 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, 77 respondents were identified for possible contact for a reinterview, of which 44 (57%) had at least one contact attempt. (There was no requirement to contact or attempt to contact all respondents on the list.) Thirty reinterviewers were completed. Of the 14 reinterviews attempted but not completed, one respondent refused to participate, 5 did not have a valid phone number recorded, 6 had a single attempt before the reinterview quota was reached and 2 had 2 attempts before the reinterview quota was reached. When the reinterview quota for each group was reached, no further contact attempts were needed.

5.16 Reviews and Approvals

The survey team developed a Survey Design Report in 2014 during extensive discussions and collaboration with the Shoshone-Bannock Tribes and the EPA that outlined the approach and procedures for implementing the fish consumption survey. The Coeur d'Alene, Kootenai and Nez Perce 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. Subsequently, Quorum Review IRB (the official IRB on record) 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. The design team felt that it was important to include an IRB with Native American associations in order to fully assess any issues the research might pose for unique Native American cultures. Finally, the EPA HSRRO reviewed the design protocol and supporting documentation, including the IRB letters, and approved the survey design. Ultimately, the Shoshone-Bannock Tribes gave final approval for the survey to proceed.

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 Tribes and Other Organizations

A design report containing planned procedures was prepared for review by the Tribes, 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 Tribes 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 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 (83203, Other ZIP codes), fisher indicator (on vs. not on the fisher list), and an indicator of off-reservation vs. on-reservation residence.

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, gender, fisher indicator, and off-reservation indicator, the age group–fisher interaction and the age group–gender interaction.

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. 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 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.

[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.

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

[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.

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 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.

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

(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 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).

[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.

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.

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.

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

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

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

[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 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 10th 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 Home vs. Non-Home Interview on FFQ Rates

An assessment was conducted to determine whether interviews conducted at a respondent's home differed in fish consumption from interviews not conducted at home.

The impact of the home interview 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 (home vs. not home) and the estimation of the difference of the means. The latter was estimated from linear regression (with the same respondent statistical weighting as in the calculation of means and percentiles). Linear regression was also utilized in the adjusted analysis and included respondent characteristics in addition to the tested design variable. The characteristics included ZIP code (83203 vs. others), age category (<30, 30–39, 40–49, 50–59 and 60+), gender, on- vs. off-reservation, fisher or fishing activity (questions 35 and 36 of the questionnaire) 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 characteristics and not to the tested design variable. The results of this analysis are presented in Section 6.7, "Effect of Home vs. Non-Home Interview 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

[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.

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 Tribes. The Tribes 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 Tribes, there were 12 household clusters that comprised 25 members of the 226 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 12 clusters, 11 had a pair of respondents and one had three respondents.

If, very conservatively, only one respondent per cluster had been included in the analysis, the effective sample would have been reduced by 13, to a net of 213 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 3.0% 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 2.5^{th} and the 97.5^{th} 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 7.8 species on the average and 18% of respondents had at least one missing component among any species reported. In total, there were 1,769 species-specific consumption responses (across all combinations of species and respondents), of which 3.7% had a missing component. The rate of missingness was relatively low at the species level, 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 (Tables C1 and C2).

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.

One additional scenario—where some values were missing—occurred when the respondent was asked specifically about consumption at special events, which uses a different formula than the main portion of the FFQ (see Section 5.10). Specifically, two respondents provided an otherwise complete response for salmon and steelhead consumption at special events but did not provide the percentage of events where these species were consumed. One respondent reported attending three events per year (a low frequency of event attendance) and one reported attending one event per week (a high frequency of event attendance). Similar to the above methodology, the missing percentages were imputed using the mean value from other respondents without missing values. For the respondent with a relatively low attendance frequency, the mean percentage (79.7%) was calculated from respondents who consumed salmon or steelhead at special events and went to six or fewer per year. For the respondent with a relatively higher attendance rate, the mean percentage (50.2%) was calculated from respondents who went to three events per month or more.

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 C3-C8 shows that the final mean and percentiles of consumption rates were similar under a range of possible imputed values, demonstrating that missingness and imputation had a relatively small impact on the final results.

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 (1058–1068 g/day) than the other respondents. The weight and gender of each respondent and the details of each species consumed were further examined and the consumption rates were all determined to be plausible. Accordingly, the respondents were retained in the analysis without modification of any data.

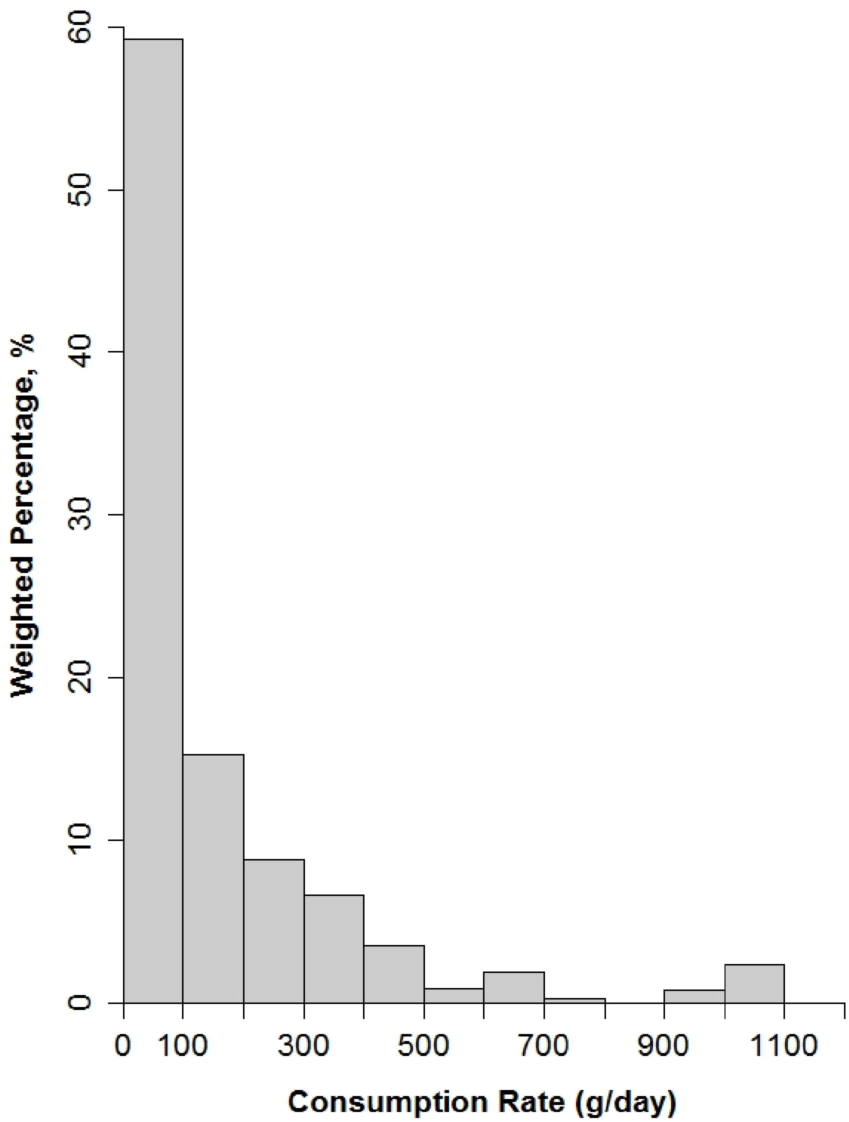

Figure 2. Shoshone-Bannock Tribes. Histogram of Group 1 (all fish) FCRs (g/day, raw weight, edible portion).

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 41.9%. Of the 661 members of the Shoshone-Bannock Tribes originally sampled, during the contact attempts by interviewers 47 were found to be ineligible (e.g., lived out of area[20], were employed as Tribal interviewers involved in the survey, or were deceased, institutionalized or impaired such that they could not be interviewed). Of these, two were classified as impaired. For the purpose of overall response rate calculations, the remaining 614 members, after excluding the 47 ineligible members, were used as the denominator for the response rate (RR1 standard, see AAPOR, 2011).

Of these 614 members, 269 members responded to the screening interview questions used to distinguish between consumers (n=238) and non-consumers (n=31). Of the 238 consumers, 226 completed the first interview and had a calculable FFQ consumption rate. The total number of responders with a complete and usable interview was 257, including the 226 consumers with an FFQ rate plus the 31 non-consumers. The overall RR1 response rate was thus 257 of 614 (41.9%) (Table 3). The number of responders corresponds to 7.9% of the original population size of 3242. 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 226 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. Shoshone-Bannock Tribes. Survey response rate.

	No. or %
Responders*	257
Total sample size**	614
Response rate (RR1)	41.9%

*Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
**Excludes 47 tribal members found to be ineligible during contact attempts.

[20] After the extensive data analysis for this report was completed, one respondent included in the analyses was found to live outside of the survey area at the time of the interview, though still within 70 miles of the Tribal centers (survey ID: KDNZY). According to the interviewer, this respondent moved outside of the area recent to the date of interview and lived in the survey area during most of the prior year (period covered by the FFQ). The data for this respondent were retained in the analyses, which were not re-run. The impact of this one respondent's data on the analyses is considered to be extremely small or negligible.

6.2 Factors Affecting Response Rates

This section uses a more conservative definition of response to the survey that may lead to an underestimation of the true response rate—ineligible members are *not* excluded from the denominator. 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 an underestimate of those response rates[21]. That underestimation is unlikely to have much impact on the difference in response rates between sample or population subgroups.

Response rates did vary by demographic factors. Tables 4 and 5 summarize the details. Males had a response rate of 39%, the same as the female response rate. Those on the fishers list ("documented fishers") had a substantially higher response rate than non-fishers: 46% versus 33%. Those who lived on the reservation had a higher response rate than those living off-reservation (40% versus 33%).

Age also played a strong role in the response rates. Among non-fishers on the reservation, the lowest response rate was among those age 18–29 (27%) vs. those of older ages (response rates ranging from 33% up to 39%). Unweighted demographics of the tribal population, sampled members, and consumers who responded are summarized in Appendix D, Table D1.

Table 4. Shoshone-Bannock Tribes. Response rates by sampling strata. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded** No.	Responded** % of Sample	Responded** % of Pop.
All	3242	661	257	38.9%	7.9%
Sampling Strata* **					
Live off reservation (any age)	448	56	18	32.1%	4.0%
Age 18-29 (on reservation)	809	93	25	26.9%	3.1%
Age 30-39 (on reservation)	535	67	26	38.8%	4.9%
Age 40-49 (on reservation)	420	55	21	38.2%	5.0%
Age 50-59 (on reservation)	361	49	16	32.7%	4.4%
Age 60 or older (on reservation)	370	42	14	33.3%	3.8%
Documented fisher (any age)	299	299	137	45.8%	45.8%

*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;
***Sampling strata are mutually exclusive; all documented fishers are counted in the designated fisher stratum, regardless of age or whether they live on or off the reservation.

[21] The rate of ineligibility in the entire sample is likely to be between 8% and 18%, based on 47 known ineligibles among those contacted within a sample size of 614, from which 257 became respondents. Calculations: 47/614 = 8%, 47/257 = 18%

Table 5. Shoshone-Bannock Tribes. Response rates by demographic factors. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded** No.	% of Sample	% of Pop.
All	3242	661	257	38.9%	7.9%
Gender					
Male	1566	410	159	38.8%	10.2%
Female	1676	251	98	39.0%	5.8%
Documented Fisher* **					
Yes	299	299	137	45.8%	45.8%
No	2943	362	120	33.1%	4.1%
Zip Code					
Fort Hall – 83203	2723	589	233	39.6%	8.6%
Other	519	72	24	33.3%	4.6%
Live on Reservation					
Yes	2786	597	236	39.5%	8.5%
No	456	64	21	32.8%	4.6%

*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 4.2 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 infrequent among the Shoshone-Bannock Tribes, as shown in Table 6. An estimated 20% of tribal members are non-consumers. The single most common reason for non-consumption reported was not liking fish. The percentage of fish consumers is high (80%), yet among the fish-consuming tribal members, most days of the week do not involve fish consumption (Table 6). The vast majority (90%) of consumers eat fish once per week or less often, while about 8% eat fish 1-2 times per week. 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 238 consumers who responded, 226 completed the first interview which collected detailed consumption information. These 226 respondents 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. Shoshone-Bannock Tribes. Rate of fish consumption based on 269 responders to the screening questionnaire. Estimates are weighted.

		Unweighted %	No.	Weighted %
Consumer*	Yes	88.5%	238	79.8%
	No	11.5%	31	20.2%
If consumer, how many days per week**	≤ 1	90.3%	177	90.1%
	1-2	7.6%	15	7.9%
	2-3	2.0%	4	2.0%
	3-4	0.0%	0	0.0%
	4-5	0.0%	0	0.0%
	5-6	0.0%	0	0.0%
	6-7	0.0%	0	0.0%
If non-consumer, why?***	Contamination	7.1%	2	7.7%
(multiple reasons allowed)	Availability	7.1%	2	3.5%
	Access	0.0%	0	0.0%
	Do not like fish	75.0%	21	75.7%
	Too busy to catch or prepare	10.7%	3	10.4%
	Do not know how to prepare	10.7%	3	10.8%
	Cannot afford fish	3.6%	1	3.5%
	Allergies or health concerns	3.6%	1	3.9%
	Vegetarian or vegan	0.0%	0	0.0%
	Religious customs	0.0%	0	0.0%

*Consumer status was determined from the screening interview. Only respondents who sufficiently completed the interview to determine consumer status were considered responders;
**196 consumers responded to this question;
***28 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, the majority of the respondents live in households with three or more persons, 11% of the population are fishers, over 90% of the population has finished high school or obtained a GED, and 27% of the members have attended some college. The household income is also diverse but with 42% 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, 85% were male while 40% of non-fishers were male. Nearly half of fishers (47%) were between 40 and 59 years old.

Of the female consumers, 83% reported giving birth. Of these women, 56% reported breast-feeding or providing breast milk to their babies. Of those women who have finished breast-feeding their youngest child, the median age at which they stopped was 6 months (range: 1 to 24 months). Table D2 in Appendix D summarizes the same demographic variables as Table 7, but without statistical weighting.

Table 7. Shoshone-Bannock Tribes. Demographic characteristics of consumers. Estimates are weighted.

		% or Mean ± SD	No. who Responded
Gender*	Male	45.5%	226
	Female	54.5%	
Age*	18-29 years	27.7%	226
	30-39 years	21.2%	
	40-49 years	16.8%	
	50-59 years	16.4%	
	60 years or older	17.9%	
Weight, kgs		92.9 ± 23.3	219
Weight, kgs (males only)		101.9 ± 23.1	140
Weight, kgs (females only)		85.1 ± 20.5	79
No. in household	1	11.4%	226
	2	19.3%	
	3-4	38.4%	
	5 or more	31.0%	
Documented fisher*	Yes	11.2%	226
	No	88.8%	
Live on reservation*	Yes	87.3%	226
	No	12.7%	
Highest education	Elementary school	1.6%	223
	Middle school	6.7%	
	High School / GED	64.7%	
	Associates degree	16.3%	
	Bachelor's degree	7.1%	
	Master's degree	3.6%	
	Doctorate	0.1%	
Annual household income	≤ $15K	26.6%	144
	$15K – $25K	18.7%	
	$25K – $35K	8.4%	
	$35K – $45K	14.5%	
	$45K – $55K	9.0%	
	$55K – $65K	11.4%	
	>$65K	11.3%	

*From the Tribal enrollment file or the Fishers List; other demographics were determined from the questionnaire. Refer to Section 4.2 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

Table 8 shows the FFQ consumption rate distributions for the Shoshone-Bannock Tribes, which include special event consumption. The Group 1 (all fish) consumption rates are high, and skewed toward large values due to a number of consumers with high consumption rates, as indicated by the comparison of the mean (158.5 grams per day) and median (74.6 grams per day). Specifically, the mean is more than twice the median, and the 90th and 95th percentiles are five- to eight-fold larger than the median. The standard deviation of 215.5 also indicates a large skewness toward high-fish-consuming members of the population. The maximum consumption rate is 1068.2 g/day.

Group 2 fish consumption follows a similar pattern of consumption rates, with a mean of 110.7 grams per day, a median of 48.5 grams per day and a very large standard deviation of 163.5 grams per day, plus 90th and 95th percentiles of consumption that are substantially larger than the mean or the median. The maximum consumption rate is 1029.2 g/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. The choice of the "point estimate," for example, of 603.4 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.

The consumption rates are presented in a graphic format in Figures 2 and 3. The skewness toward high consumption rates is apparent from the plots where the accumulation of population members (percentages on the vertical axis) tapers off at a shallow angle toward the right as the consumption rate increases. There is a distinct subpopulation of tribal members with very high consumption rates.

Groups 3 through 7 are mutually exclusive and completely subdivide Group 1. The most consumed group is Group 6 (marine finfish and shellfish), with 222 consumers and a mean consumption rate of 98.8 grams per day, followed by Groups 3 (salmon and steelhead) and 4 (resident trout), with 215 and 130 consumers, respectively, and mean rates of 47.6 grams per day and 22.1 grams per day. There were 97 consumers of Group 5 (other freshwater finfish and shellfish), with a mean rate of 11.2 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 1.8 grams per day.

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

Species	No. of Consumers	Mean	SD	Min	Percentiles 50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	***99%	Max
Group 1 (all finfish and shellfish)	226	158.5	215.5	0.8	74.6	86.2	106.5	120.3	157.1	212	233.6	310.3	392.5	603.4	1058.5	1068.2
(95% CI)		(118.3-201.2)			(52.0-107.8)	(64.3-119.5)	(74.8-155.8)	(90.7-187.4)	(108.4-232.8)	(128.4-278.3)	(162.7-317.6)	(228.5-444.0)	(279.3-575.7)	(380.4-923.9)	(609.6-1059.4)	
Group 2 (near coastal/estuarine/freshwater/anadromous finfish and shellfish)	225	110.7	163.5	0.1	48.5	57.9	70.9	82.9	103.1	140.2	164.1	211.1	265.6	427.1	792.6	1029.2
(95% CI)		(82.6-144.0)			(32.8-71.3)	(39.3-83.1)	(49.8-102.6)	(62.1-135.6)	(73.4-158.4)	(85.8-179.2)	(123.0-222.4)	(156.6-279.0)	(189.9-396.0)	(256.1-745.8)	(479.6-813.9)	
Group 3 (salmon and steelhead)	215	47.6	78.4	0.3	15.4	18.2	21.8	26.9	34.1	56.3	72	95.6	142.3	233.1	329.6	825.2
(95% CI)		(34.7-65.5)			(9.4-21.8)	(11.6-26.0)	(16.5-34.1)	(19.2-51.8)	(23.4-70.6)	(28.9-83.6)	(41.8-106.2)	(67.8-164.3)	(84.8-237.0)	(133.9-322.8)	(241.3-338.2)	
Group 4 (resident trout)	130	22.1	53.3	0.1	4.6	7.4	7.9	14.9	14.9	15.5	29.8	33.5	56	68.3	**340.6	374.7
(95% CI)		(12.6-41.0)			(2.3-9.0)	(2.6-14.9)	(3.7-15.2)	(5.6-16.3)	(7.5-29.8)	(8.6-38.0)	(14.9-53.6)	(15.5-60.8)	(29.8-68.7)	(51.8-333.8)	(83.9-351.7)	
Group 5 (other freshwater finfish and shellfish)	97	11.2	17.4	0.02	3.6	4.9	5.9	7	7.6	9.8	16.9	22.5	33.7	43.5	**72.9	76.1
(95% CI)		(6.1-15.3)			(1.9-6.4)	(2.5-7.2)	(2.9-7.7)	(3.2-13.5)	(4.7-16.1)	(5.8-20.5)	(6.9-28.4)	(7.7-35.7)	(14.3-57.8)	***(20.5-70.7)	(34.9-75.0)	
Group 6 (marine finfish and shellfish)	222	98.8	175.1	0.1	37.3	45.6	54.5	68.4	79.5	94.7	119.2	156	221.5	402.6	975.8	1019.5
(95% CI)		(65.5-136.1)			(25.5-54.1)	(30.7-66.5)	(40.7-77.5)	(45.7-85.4)	(56.7-107.5)	(69.2-146.2)	(80.3-189.0)	(101.0-265.9)	(146.2-376.7)	(203.1-719.3)	(406.6-999.0)	
Group 7*** (unspecified finfish and shellfish)	2	1.8	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-

*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 and other specified percentiles 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.

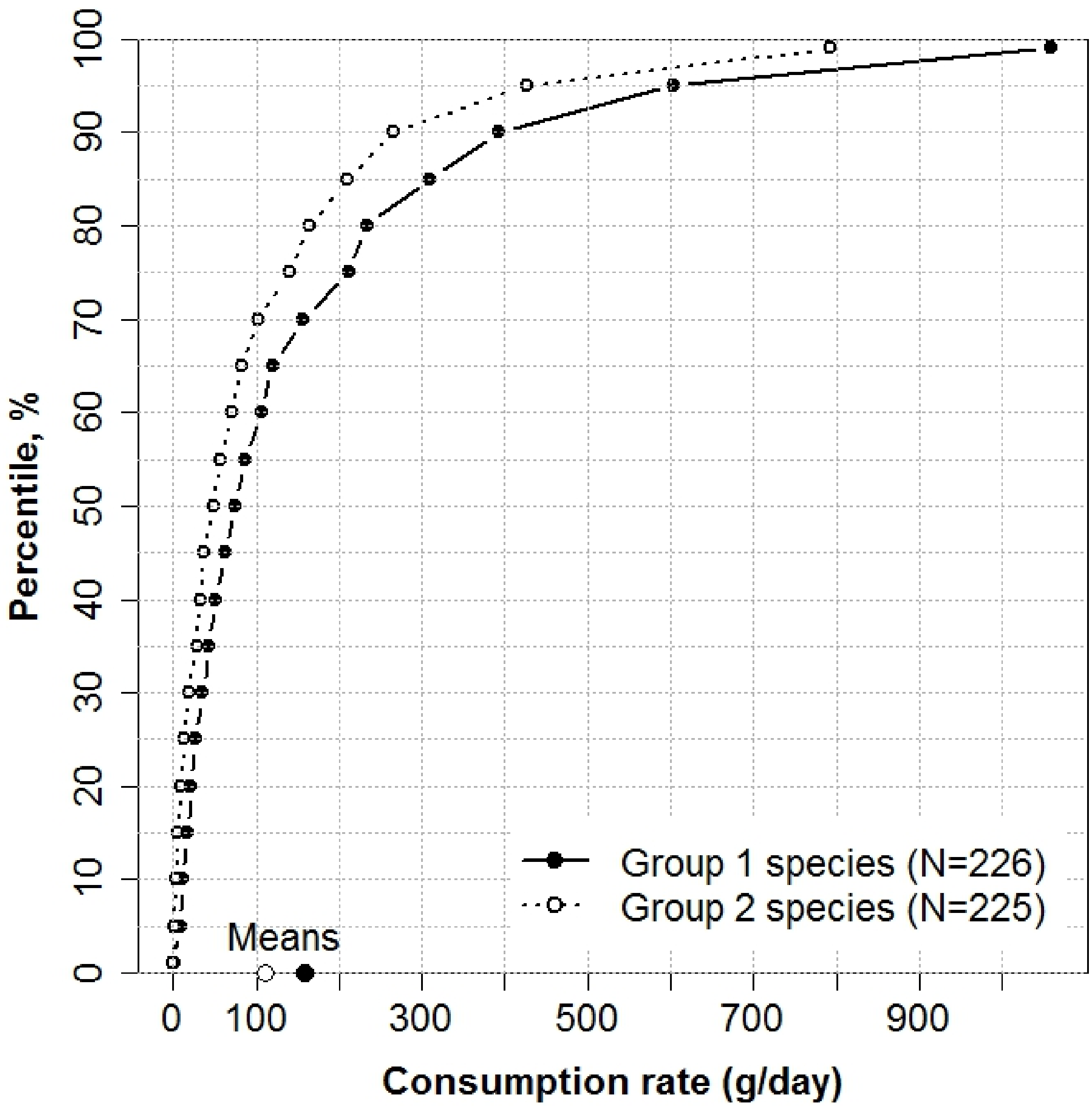

Figure 3. Shoshone-Bannock Tribes. Estimated cumulative distribution of FFQ FCRs (g/day, raw weight, edible portion).

Group 1 includes all species. Group 2 includes near coastal, estuarine, freshwater, and anadromous species. The percentiles are spaced every 5% from the 5th percentile to the 95th percentile along the vertical axis. 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

FFQ consumption rates for Group 1 (all fish) in different demographic groups are reported in Table 9. See Table D3 in Appendix D for an expanded set of consumption rate percentiles in addition to the 50th, 90th, and 95th percentiles. Males had a mean consumption rate that was 39% higher than the mean rate for females: 187.3 g/day vs. 134.4 g/day, respectively. There is no consistent pattern of consumption rates in relation to age across the mean, median, and other percentiles. Being on the fishers list did not have a consistent relationship to consumption rates, with a similar mean between fishers and non-fishers, but a substantially different median (117.7 g/day for fishers and 69.7 g/day for non-fishers) and differences in the opposite direction in several higher percentiles. The highest percentiles are rather unstable due to the relatively small sample size for estimation at these high percentiles. As noted in Section 4.2 (Populations), some active fishers who were not on the fishers list may have been incorrectly classified as non-fishers. Thus, it is likely 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 73% of those on the fishers list did report fishing during the preceding 12 months. In the same group, 34% 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, 49% reported fishing during the last year but only 18% reported fishing at least once per month, on the average. Thus, those on the fishers list include a 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 three-quarters of the respondents who fish more frequently, defined as those fishing once per month or more, on the average. (These calculations are based on 134 respondents on the fishers list and 92 respondents not on the fishers list, limited to those completing questions #35 and #36 of the questionnaire.)

Only a small fraction of the respondents lived off-reservation (210 on vs. 16 off). The evidence in the table suggests that those who live on the reservation have a higher consumption rate than those who live off-reservation.

Examination of the mean and median consumption rates by household size suggests that those who live alone and those in very large households (five or more) have a lower consumption rate than those with 2–4 household members.

Consumption rates appeared to be higher for those with high school/GED or less education compared to associates degree or higher (mean: 174.6 vs. 124.6 g/day). The pattern was similar for the median and upper percentiles.

Household income also seemed to play a role in relationship to consumption rates, with the lowest consumption rates occurring in the lowest income category (at or less than $15,000 per year) for the mean and median and all higher percentiles.

Table 9: Shoshone-Bannock Tribes. 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	143	187.3	245.5	74.9	452.2	806.0
Female	83	134.4	184.5	65.8	313.6	467.7
Age**						
18-29 years	36	181.9	266.6	61.0	456.1	***653.4
30-39 years	39	197.1	272.4	81.8	498.5	***873.9
40-49 years	51	113.5	122.9	69.6	237.1	287.9
50-59 years	48	157.2	169.1	119.7	298.5	606.2
60 years or older	52	119.6	142.1	74.2	412.5	452.1
Documented Fisher**						
Yes	134	160.9	169.8	117.7	351.1	459.1
No	92	158.2	221.4	69.7	405.4	604.4
Live on reservation						
Yes	210	163.1	223.4	74.7	384.4	620.7
No	16	126.7	151.5	57.3	***389.6	***426.5
Number who live in household						
1	29	120.0	152.0	41.2	335.5	***429
2	54	197.4	239.6	105.4	465.7	659.3
3-4	87	182.2	235.4	94.0	435.6	605.4
5 or more	56	119.1	187.4	52.1	308.0	317.2
Highest education						
High school / GED or less	153	174.6	237.1	77.2	453.3	647.9
Associates degree or higher	70	124.6	148.7	56.5	306.3	330.4
Annual household income						
≤ $15K	31	134.0	145.6	76.6	302.3	***422.5
$15K – $45K	62	153.6	234.2	66.4	424.6	584.4
>$45K	51	173.4	159.3	118.3	333.0	495.2

*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 Home vs. Non-Home Interviews on FFQ Rates

The estimated mean and medians of fish consumption according to a home vs. non-home interview location are shown in Table 10. The corresponding differences in means are shown in Table 11. The mean consumption for respondents interviewed at home was 0.5 grams/day higher compared to respondents interviewed elsewhere. This difference was still small and in the opposite direction (5.6 grams/day lower for home interviews) once respondent characteristics were adjusted for. Neither the unadjusted nor the adjusted difference was statistically significant (p = 0.9-1.0). As the differences are small and not statistically significant, we did not adjust for this effect in presenting survey consumption rates. This effect 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. Shoshone-Bannock Tribes. Mean and median of Group 1 (all fish) FFQ FCRs (g/day, raw weight, edible portion) by interview location. Weighted results.

Group	No.	Mean	Median
Non-home interview	133	158.3	75.4
Home interview	104	158.7	74.1

Table 11. Shoshone-Bannock Tribes. Unadjusted and adjusted differences in mean Group 1 (all fish) FFQ FCRs (g/day, raw weight, edible portion) by home interview (yes/no). Linear regression. Weighted results.

	Unadjusted			Adjusted For Respondent Characteristics*		
Difference	***Est.***	***SE***	***p***	***Est.***	***SE***	***p***
Home interview	0.5	43.5	1.0	-5.6	49.9	0.9

*Adjusted for ZIP code (83203 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 weight (as a continuous predictor)

6.8 Consumption Rates from the NCI Method

The 24-hour recall data consisted of 429 interviews from 226 respondents. Of the 429 interviews, 31.9% were conducted on the weekend (Friday, Saturday or Sunday). A total of 203 respondents had two interviews, for which the average interval between the interviews was 17 days (median: 9 days). The intervals were 21 days or less in 86% of those with both interviews, between 21 and 90 days in 11%, and between 90 and 180 days in the remaining 3.0%. Of the 203 respondents with two interviews, 8 had two days with Group 1 positive fish consumption and 47 had one day with Group 1 positive fish consumption. The remaining 23 respondents had one interview. Of these 23, 1 respondent had Group 1 positive fish consumption.

There were 225 Group 2 consumers, with a total of 427 interviews among which 32.1% were conducted on the weekend. Among the respondents in this group, 202 had two interviews. Of the 202 respondents, 3 had two days with Group 2 positive fish consumption and 28 had one day with Group 2 positive fish consumption. The remaining 23 respondents had one interviews. None of these 23 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 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 14 for

[22] The NCI method as implemented in SAS software provides integer percentiles of usual consumption rates up to the 99th percentile. Only values up to the 95th percentile are presented here, due to the expected large uncertainty in the 99th percentiles.

species Group 2 consumption. Table 13 shows the 95% confidence intervals for the species Group 1 statistics among all SBT respondents and among SBT respondents on the fishers list. The bootstrap distributions that were used to derive these distributions are shown in Appendix Figure E20 (all respondents) and Figure E21 (fishers 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 SBT respondents were 34.9 (95% CI 20.6-66.2) g/day and 18.6 g/day, respectively. The 95th percentile of the distribution of fish consumption in groups 1 and 2 among all SBT respondents were 140.9 (95% CI 82.0-312.9) g/day and 80.0 g/day, respectively

Fishers consumed more Group 1 fish than non-fishers (mean 42.4 g/day vs. 33.9 g/day) and men consumed more than women (mean 38.1 g/day vs. 32.2 g/day). The means in the two ZIP code groups (83202 and “Other” ZIPs) were 29.9 and 59.2 g/day, respectively. The means ranged from 24.3 to 51.7 g/day across the five age groups, with the 18–29 age group consuming the least and the 40–49 age group consuming the most. Similar trends were observed for Group 2 species with the exception of gender, where women consumed slightly more than men on average.

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

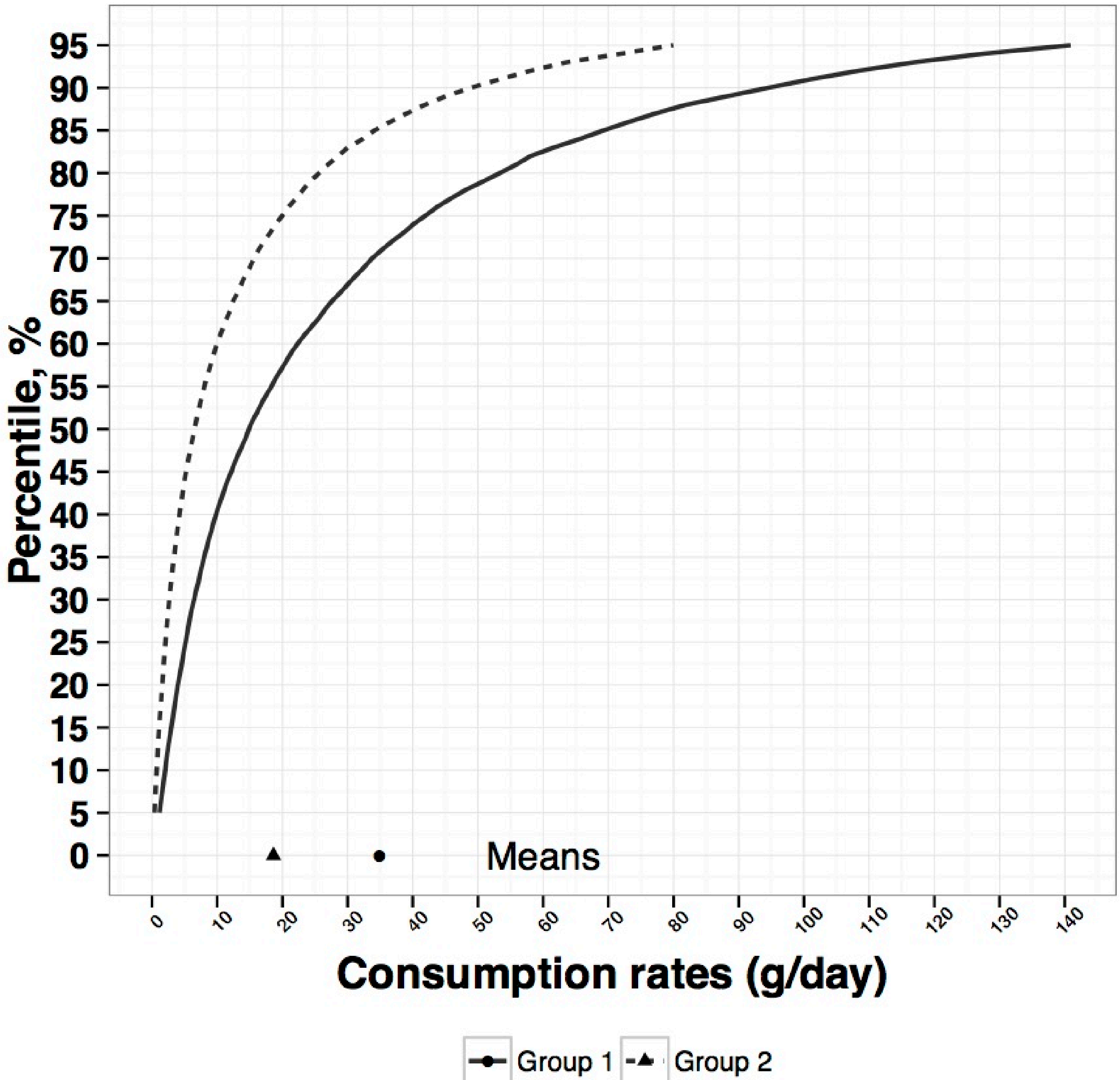

Figure 4. Shoshone-Bannock Tribes. Distribution of the usual fish consumption (g/day, raw weight, edible portion) based on the 24-hour recalls. Estimated by the NCI method.

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

Table 12. Shoshone-Bannock Tribes. 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	**226**	**34.9**	**14.9**	**18.3**	**22.3**	**27.6**	**33.7**	**41.9**	**53.4**	**69.2**	**94.5**	**140.9**
Documented fisher												
Fisher	134	42.4	20.0	24.4	29.7	35.9	43.6	53.6	67.0	84.6	114.3	163.6
Non-fisher	92	33.9	14.4	17.6	21.5	26.6	32.7	40.4	51.6	67.1	91.8	138.3
Gender												
Men	143	38.1	15.7	20.0	25.4	30.8	37.5	46.7	58.3	76.5	103.8	158.3
Women	83	32.2	14.4	17.3	20.6	25.2	31.1	38.3	48.6	62.3	85.6	126.8
ZIP Code												
83203	207	29.9	12.7	15.4	19.0	23.1	28.3	35.3	44.0	57.4	79.2	121.1
SB Other	19	59.2	33.4	40.0	47.8	56.6	67.7	79.5	96.9	118.7	151.0	209.7
Age												
18-29	36	24.3	7.6	9.1	10.9	13.6	17.6	23.8	31.3	42.5	62.9	110.2
30-39	39	44.6	25.6	30.2	35.2	40.7	48.9	57.9	70.9	88.2	113.4	159.0
40-49	51	51.7	23.2	28.2	34.5	42.5	53.7	67.1	85.6	108.6	147.4	202.5
50-59	48	31.8	14.0	17.3	20.7	25.5	32.2	40.6	52.1	65.6	88.9	125.8
60+	52	26.8	14.6	17.0	20.6	24.7	29.7	34.4	42.1	51.9	67.8	90.7

Table 13. Shoshone-Bannock Tribes. 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												
	226	34.9	14.9	18.3	22.3	27.6	33.7	41.9	53.4	69.2	94.5	140.9
(95% CI)		(20.6-66.2)	(3.4-28.9)	(4.7-33.4)	(6.9-39.8)	(9.3-48.8)	(13.1-62.0)	(18.0-80.2)	(25.4-105.8)	(35.6-140.2)	(52.6-199.8)	(82.0-312.9)
Fisher												
	134	42.4	20	24.4	29.7	35.9	43.6	53.6	67	84.6	114.3	163.6
(95% CI)		(23.7-84.6)	(7.3-39.1)	(9.3-46.9)	(12.2-55.8)	(15.7-68.3)	(20.5-81.8)	(27.1-104.5)	(34.7-132.4)	(43.4-174.5)	(56.6-238.3)	(83.6-376.2)

Table 14. Shoshone-Bannock Tribes. 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	**225**	**18.6**	**6.5**	**8.0**	**10.0**	**12.5**	**15.6**	**20.0**	**25.6**	**34.1**	**48.9**	**80.0**
Documented fisher												
Fisher	134	23.3	10.2	12.5	15.4	18.8	22.8	28.0	35.3	45.5	61.5	92.6
Non-fisher	91	17.8	6.3	7.7	9.6	12.1	15.0	19.0	24.5	32.8	46.6	76.8
Gender												
Men	143	18.0	5.5	6.9	8.9	11.2	14.2	18.7	24.7	33.9	49.6	79.4
Women	82	19.5	6.9	8.4	10.4	13.1	16.2	20.2	25.6	34.1	48.2	84.3
ZIP Code												
83203	206	15.8	5.6	6.9	8.4	10.4	12.8	16.3	20.8	28.0	39.7	67.2
SB Other	19	34.1	14.3	19.2	23.9	28.4	34.5	42.1	53.7	67.4	90.2	130.7
Age												
18-29	36	1.3	0.4	0.5	0.6	0.8	1.0	1.3	1.7	2.2	3.1	5.4
30-39	39	36.5	19.8	23.0	27.4	33.1	38.9	46.7	56.8	70.7	93.0	136.3
40-49	51	50.9	19.8	25.9	33.9	42.7	53.6	65.4	81.0	102.8	140.9	203.0
50-59	48	12.6	2.6	3.8	5.9	8.5	11.8	15.7	21.1	27.0	37.5	55.2
60+	51	13.1	7.5	8.8	10.3	12.4	14.5	17.0	20.2	24.7	31.9	45.1

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

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

consumption day and the probability of consumption on a randomly chosen day are higher in the second interview than in the first interview.

E8). The corresponding 95th 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 3/7ths 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 22% of the corresponding mean estimated from the FFQ while the 95th percentile estimated from the NCI method was 23% of the FFQ estimate. The NCI-estimated Group 2 mean and the 95th percentile were 17% and 19% of the FFQ values, respectively. The naïve means were lower in the 24-hour data for all species groups, as shown by the ratios in Table 15. Most of the species had ratios (the 24-hour value divided by the corresponding FFQ value) between 0.02 and 0.33[25]. These results show 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.
[25] The naïve 24-hour mean of the Group 7 species consumption rate was zero, but this value was based on only two consumers of this species group (determined as consumers from their FFQ responses). These two consumers happened not to have consumed these species on their 24-hour recall days, resulting in a naïve mean of zero g/day.

Table 15. Shoshone-Bannock Tribes. Estimated means and 95th percentiles of consumption (g/day, raw weight, edible portion) by species group and estimation method.

		Mean								**95th percentile**		
		24h					**FFQ**	**Ratio**		**24h**	**FFQ**	**Ratio**
Species group	**No. of Consumers**	***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	226	43.3	34.9	56	48	8	158.5	0.27	0.22	140.9	603.4	0.23
Group 2: Near Coastal/Estuarine/Freshwater/Anadromous Finfish and Shellfish	225	25.9	18.6	31	28	3	110.7	0.23	0.17	80.0	427.1	0.19
Group 3: All Salmon and Steelhead	215	9.1		14	12	2	47.6	0.19			233.1	
Group 4: Resident Trout	130	4.4		3	3	0	22.1	0.20			68.3	
Group 5: Other Freshwater Finfish and Shellfish	97	0.2		2	2	0	11.2	0.02			43.5	
Group 6: Marine Finfish and Shellfish	222	32.8		40	35	5	98.8	0.33			402.6	
Group 7: Unspecified Finfish and Shellfish Species	2	0.0		0	0	0	1.8	0.00			2.8	

#>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[26]) 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.[27] The deciles were numbered in an

[26] 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.
[27] 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

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 differences in Group 1 means were mostly moderate in the third to eighth deciles, with the 24-hour recall means typically being 60–70% of the corresponding FFQ means. However, this ratio was 27% and 3% in the first and second deciles, respectively, and 33% and 5% in the 9th and the 10th deciles, respectively, though most deciles had very few "hits" in the 24-hour data. 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 158.5 g/day and the corresponding Group 2 mean of 109.7 g/day, both from Table 17, the Group 2 species contribute 69% of the total amount consumed of Group 1 species (all species combined). The analogous percentage based on the 24-hour recall means was 59%, calculated as 100% x 25.7 g/day (Group 2 mean) / 43.3 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 66% (based on the FFQ) or 10% (based on the 24-hour recall) of the consumption of all species in the 10th decile group. 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.

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).

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. Of the species group with at least 10 respondents with hits on the 24-hour recall, the 24-hour/FFQ ratio of means ranged from 0.19 (Group 3) to 0.33 (Group 6). 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 lower than the FFQ mean in both cases.

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.[28] (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

[28] 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.

day. That assumption appears to be approximately correct. Among the 64 days with fish consumption reported on the 24-hour recall interviews (counting all respondents and all of their 24-hour recall days), only six days (9.4%) showed two or more species consumed on the same day. 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 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 9.4% 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.[29] 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.

[29] 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.

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.) 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 15.6 (mean portion size), the lower consumption rate from the 24-hour recall data relative to the FFQ data came from both lower estimated frequency of consumption in the 24-hour data and lower estimated portion size, though more so from relatively lower frequency estimates. The 24-hour estimated mean frequency (all deciles combined, Group 1 species) was 40% of the FFQ value while the 24-hour mean portion size was 72% of the FFQ value. The mean frequency of Group 2 species was 27% of the FFQ value, though the corresponding 24-hour mean portion size was 92% of the FFQ value. These patterns of lower 24-hour estimates relative to FFQ estimates are most prominent in the highest deciles. 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 (6%) 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. Shoshone-Bannock Tribes. 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	226	23	22	23	22	23	23	22	22	23	23
Respondents with >0 consumption on the 24h recall	56	3	2	4	5	6	9	5	8	8	6
Group 2											
Respondents with >0 consumption on the FFQ	225	23	21	23	22	23	23	22	22	23	23
Respondents with >0 consumption on the 24h recall	31	0	1	2	3	4	6	3	5	5	2
Group 3											
Respondents with >0 consumption on the FFQ	215	20	19	22	21	23	23	20	21	23	23
Respondents with >0 consumption on the 24h recall	14	0	1	1	1	1	3	1	3	3	0
Group 4											
Respondents with >0 consumption on the FFQ	130	5	9	11	15	16	10	16	15	15	18
Respondents with >0 consumption on the 24h recall	3	0	0	0	0	0	0	0	2	0	1
Group 5											
Respondents with >0 consumption on the FFQ	97	2	6	8	7	9	10	13	11	16	15
Respondents with >0 consumption on the 24h recall	2	0	0	0	1	0	1	0	0	0	0
Group 6											
Respondents with >0 consumption on the FFQ	222	21	22	22	22	23	22	22	22	23	23
Respondents with >0 consumption on the 24h recall	40	3	1	3	3	5	6	4	4	6	5
Group 7											
Respondents with >0 consumption on the FFQ	2	0	0	0	0	0	0	0	1	1	0
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. Shoshone-Bannock Tribes. Weighted mean consumption (g/day) from the 24-hour recall and FFQ interviews for each species group, overall and by decile. 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	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean consumption, g/day	158.5	9.2	22.7	36.3	56.0	81.1	114.0	154.6	202.2	280.4	662.7
24h mean consumption, g/day	43.3	2.4	0.7	27.7	25.0	49.7	73.5	105.4	118.6	91.5	31.8
24h/FFQ consumption	0.27	0.27	0.03	0.77	0.45	0.61	0.64	0.68	0.59	0.33	0.05
Group 2											
FFQ mean consumption, g/day	109.7	5.3	12.4	25.0	38.9	54.1	75.4	108.2	129.5	224.5	435.6
24h mean consumption, g/day	25.7	0.0	0.5	19.1	5.2	24.7	34.5	92.2	112.8	60.2	3.3
24h/FFQ consumption	0.23	0.00	0.04	0.76	0.13	0.46	0.46	0.85	0.87	0.27	0.01
Group 3: 24h/FFQ consumption	0.19	0.00	0.10	2.18	0.05	0.58	0.19	0.10	0.65	0.15	0.00
Group 4: 24h/FFQ consumption	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.14	0.00	0.05
Group 5: 24h/FFQ consumption	0.02	0.00	0.00	0.00	0.67	0.00	0.19	0.00	0.00	0.00	0.00
Group 6: 24h/FFQ consumption	0.33	0.45	0.01	0.37	0.65	0.83	0.99	1.01	0.09	0.56	0.06
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. Shoshone-Bannock Tribes. 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	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean frequency, %	34%	5%	10%	16%	19%	33%	33%	44%	45%	70%	81%
24h mean frequency, %	14%	4%	1%	10%	8%	23%	24%	15%	33%	25%	15%
24h/FFQ frequency	0.40	0.80	0.06	0.63	0.39	0.69	0.72	0.35	0.74	0.35	0.18
Group 2											
FFQ mean frequency, %	24%	2%	4%	9%	10%	21%	22%	26%	27%	50%	72%
24h mean frequency, %	6%	0%	0%	4%	1%	11%	8%	8%	30%	11%	10%
24h/FFQ frequency	0.27	0.00	0.06	0.49	0.10	0.52	0.36	0.31	1.12	0.22	0.14
Group 3: 24h/FFQ frequency	0.28	0.00	0.17	1.17	0.09	0.66	0.21	0.09	1.10	0.31	0.00
Group 4: 24h/FFQ frequency	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.14	0.00	0.29
Group 5: 24h/FFQ frequency	0.03	0.00	0.00	0.00	2.43	0.00	0.20	0.00	0.00	0.00	0.00
Group 6: 24h/FFQ frequency	0.48	1.18	0.05	0.57	0.47	1.00	1.23	0.50	0.19	0.56	0.17
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. Shoshone-Bannock Tribes. 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 calculated from 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	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean portion size, grams	386	199	326	283	368	327	484	406	513	425	681
24h mean portion size, grams	279	47	107	281	304	226	168	698	331	326	193
24h/FFQ portion size	0.72	0.24	0.33	1.00	0.83	0.69	0.35	1.72	0.64	0.77	0.28
Group 2											
FFQ mean portion size, grams	394	215	336	287	504	325	369	495	512	464	564
24h mean portion size, grams	364	-	189	423	323	225	442	1149	361	429	33
24h/FFQ portion size	0.92	-	0.56	1.47	0.64	0.69	1.20	2.32	0.71	0.92	0.06
Group 3: 24h/FFQ portion size	0.73	-	0.56	1.69	0.44	0.79	0.77	1.07	0.57	0.51	-
Group 4: 24h/FFQ portion size	1.05	-	-	-	-	-	-	-	1.05	-	0.21
Group 5: 24h/FFQ portion size	0.57	-	-	-	0.21	-	0.76	-	-	-	-
Group 6: 24h/FFQ portion size	0.73	0.26	0.13	0.52	0.92	0.67	0.30	1.64	0.48	0.96	0.33
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).

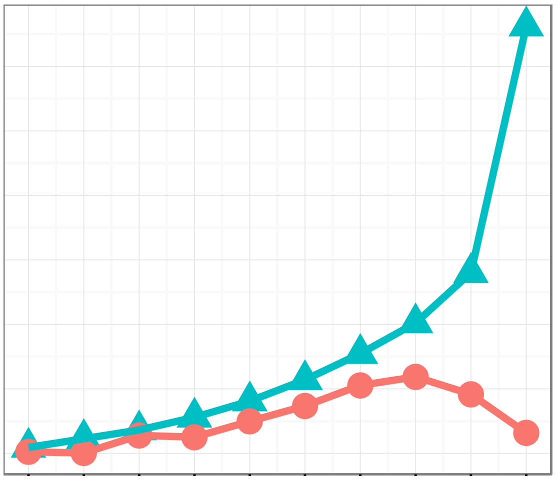

Figure 5. Shoshone-Bannock Tribes. Weighted Group 1 means (g/day) of the 24-hour recall and of the FFQ consumption rates by Group 1 FFQ deciles.

The numerical values for the means are tabulated in Appendix Table F1.

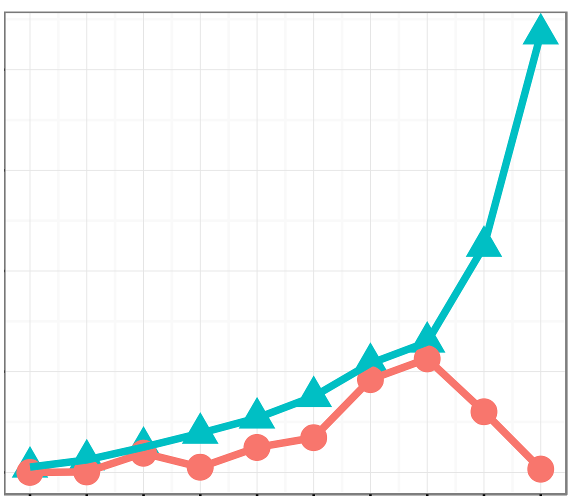

Figure 6. Shoshone-Bannock Tribes. Weighted Group 2 means (g/day) of the 24-hour recall and of the FFQ consumption rates by Group 1 FFQ deciles.

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 13.5 ± 19.4 events per year (median: 6.5). Their consumption at special events was, on average, 8.7 ± 11.1% of their total consumption (median: 4.0%). 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 60% of salmon/steelhead consumers eating from this species group at an average of 8.8 events per year.

Table 20. Shoshone-Bannock Tribes. 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.

	Species or Species Group			
	Salmon and/or Steelhead	**Resident Trout**	**Sturgeon**	**Suckers and/or Whitefish**
No. of consumers (based on the FFQ)	215	130	4	10
% who consume from the species or species group at special events	59.6%	15.2%	0.0%	0.0%
Events per year where species or species group is consumed*	8.8 ± 20.1	5.1 ± 7.3	-	-

*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.

Table 21. Shoshone-Bannock Tribes. Percent of the time other fish parts were consumed for selected species and species groups. Consumers only*. Estimates are weighted.

	Species or Species Group			
Item	**Salmon and Steelhead**	**Resident Trout**	**Sturgeon**	**Suckers and Whitefish**
Skin	33.3 ± 41.9% (184)	44.7 ± 44.5% (105)	0.0 ± 0.0% (1)	0.0 ± 0.0% (1)
Eggs	0.7 ± 5.7% (178)	0.2 ± 4.4% (97)	0.0 ± 0.0% (2)	33.9 ± 49.9% (3)
Head, bone and/or organs	3.6 ± 16.6% (178)	2.6 ± 12.4% (97)	0.0 ± 0.0% (2)	52.6 ± 38.6% (3)

Values are mean ± SD (no.); (sample size). Those who 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.

Table 22 shows the percentage of the time different preparation methods were used. Baked or broiled was a common preparation for salmon/steelhead (mean: 59.9% of the time) and resident trout (mean: 40.9% of the time). Dried or in soups were uncommon (mean <3% for salmon/steelhead, resident trout and sturgeon and 24.4% for suckers and whitefish, which had four consumers).

Table 22. Shoshone-Bannock Tribes. 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/or Steelhead (N=214)	Resident Trout (N=129)	Sturgeon (N=3)	Suckers and/or Whitefish (N=4)
Baked or broiled	59.9 ± 36.7%	40.9 ± 41.8%	7.0 ± 29.5%	24.4 ± 45.3%
Smoked	14.1 ± 24.4%	3.4 ± 15.7%	0.0 ± 0.0%	0.0 ± 0.0%
Dried	2.4 ± 11.5%	2.4 ± 14.1%	0.0 ± 0.0%	0.0 ± 0.0%
In a soup	0.5 ± 3.0%	0.0 ± 0.0%	0.0 ± 0.0%	24.4 ± 45.3%
Other**	23.1 ± 33.0%	53.3 ± 42.3%	93.0 ± 29.5%	51.2 ± 52.7%

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;
**Fried was the most common "Other" preparation method for salmon and steelhead and resident trout; sturgeon were also grilled and fried and suckers and whitefish were boiled, grilled and fried.

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 78.0% and 87.2% of the time on average, respectively.

Table 23. Shoshone-Bannock Tribes. 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=213)	Resident Trout (N=128)	Sturgeon (N=3)	Suckers and/or Whitefish (N=4)
Bought from a store (grocery or market)	10.5 ± 23.3%	1.2 ± 8.6%	0.0 ± 0.0%	0.0 ± 0.0%
From a restaurant	5.3 ± 13.5%	0.4 ± 4.1%	0.0 ± 0.0%	24.4 ± 45.3%
Caught by you or someone else (in Idaho waters)	78.0 ± 33.8%	87.2 ± 31.1%	0.0 ± 0.0%	50.0 ± 52.7%
Caught by you or someone else (outside of Idaho)	6.2 ± 21.4%	11.3 ± 30.1%	100.0 ± 0.0%	25.6 ± 46.0%
Other	0.0 ± 0.8%	0.0 ± 0.0%	0.0 ± 0.0%	0.0 ± 0.0%

Values are mean ± SD;
Notes: 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 53% of consumers took part in fishing activities over the past year. Figure 7 shows the mean number of times respondents went fishing each month. July had the highest fishing frequency, followed by August and then June. January and December had the lowest fishing frequencies. Table 24 summarizes overall fishing frequency and respondents' access to fishing gear and boats.

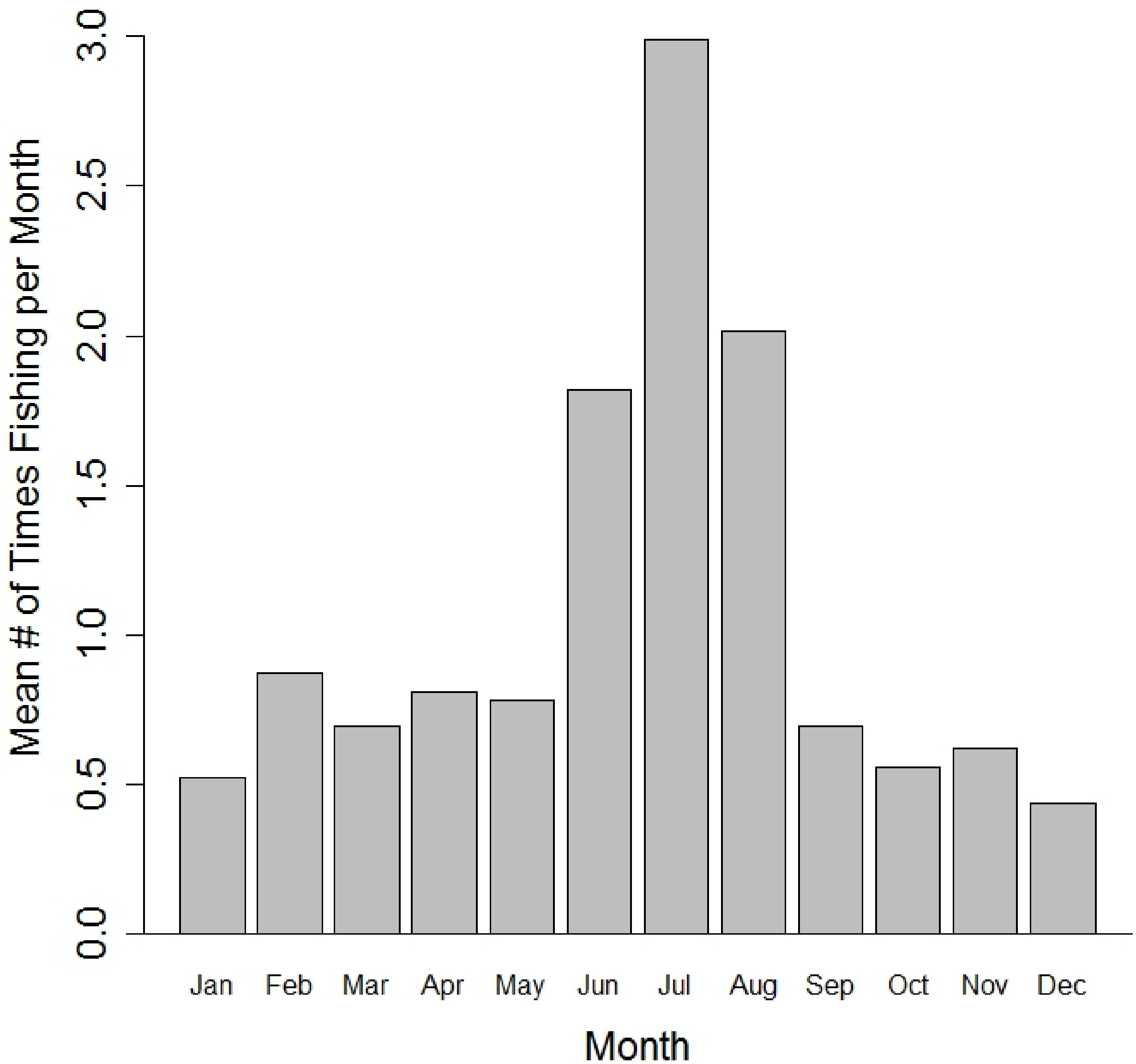

Figure 7. Shoshone-Bannock Tribes. Mean number of times respondents went fishing each month of the 143 who reported fishing at least once.

Table 24. Shoshone-Bannock Tribes. Fishing activities during the preceding year as reported by the 143 respondents who reported fishing at least once. Estimates are weighted.

Variable		% or Mean ± SD	No. who Responded
Number of times went fishing		12.8 ± 15.6	143
Percent of fish harvested which were--	Kept	73.9 ± 26.1%	141
	Given to others	26.1 ± 26.1%	
	Sold	0.0 ± 0.0%	
Own or have access to fishing gear	Yes	95.0%	143
	No	5.0%	
Own or have access to a boat	Yes	25.1%	143
	No	74.9%	

6.15 Changes in Consumption and Reasons

Table 25 summarizes reported changes in consumption and access to fish and fishing. The vast majority of consumers believe that fish were either very important (90%) or somewhat important (6%) in the Tribes' heritage and culture in the past. The total percentage of consumers who believe that fish are either very or somewhat important to the Tribes' heritage and culture in the present was similar at 97%, while the percent who believe fish are very important in the present is 77%.

More than half (53%) of the consumers have experienced a change in fish consumption over time, and among those who have experienced the change, 50% experienced increased consumption and 47% experienced a decrease. A large proportion of the consumers (44%) have experienced a change in fishing access, and, among those experiencing a change, less access to fishing (68%) far outweighed more access (20%). Similarly, 51% of consumers reported a change in fishing frequency, of which 14% reported an increase and 84% reported a decrease. Nearly all consumers want to increase consumption (47%) or maintain current levels of consumption of fish (52%).

Table 25. Shoshone-Bannock Tribes. 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 Tribes' heritage and culture, in the past	Very important	90.2%	220
	Somewhat important	6.4%	
	Not important	3.4%	
Importance of fish in Tribes' heritage and culture, in the present	Very important	77.4%	221
	Somewhat important	20.1%	
	Not important	2.5%	
Change in fish consumption over time	Yes	52.9%	226
	No	47.1%	
If so, how has consumption changed	Increased	49.5%	104
	Decreased	47.0%	
	Other	3.5%	
Change in access to fish and fishing over time	Yes	44.5%	216
	No	55.5%	
If so, how has access changed	More access	19.7%	114
	Less access	67.8%	
What i	Other change	12.5%	
Change in frequency of fishing	Yes	50.5%	219
	No	49.5%	
If so, how has fishing frequency changed	Increased	14.3%	115
	Decreased	83.6%	
	Other	2.1%	
Desired fish consumption in the future compared to now	Increase amount	47.4%	225
	Maintain amount	51.6%	
	Decrease amount	1.0%	

6.16 Reinterviews

Thirty reinterviews were conducted between March 31 and May 19, 2015. The time between the first interview and the reinterview ranged from 28 to 77 days (median 54 days). There were 16 male respondents and 14 female respondents. Of the 30 respondents, 25 (83%) reported consuming Chinook during the reinterview. Of the 5 who did not report consuming Chinook during the reinterview, three did report consuming Chinook on the first interview (10, 12 and 84 days per year). Of the 25 who reported consuming Chinook on the reinterview, 24 also reported Chinook on the first interview and one reported consuming pink salmon but no other salmon species. As the respondents were not always sure of the specific salmon species they consumed, this instance of pink salmon reported on the first interview was assumed to be Chinook salmon for the purposes of comparing consumption frequencies between first and reinterviews.

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 15.5 ± 18.0 and 19.7 ± 24.2 portions/year, respectively, with an average difference of 4.1 ± 28.8 portions/year. The correlation in the number of portions per day between the first interview and reinterview was r = 0.24 (Spearman's correlation coefficient).

Respondents were asked in both interviews whether their overall fish consumption had changed. Of the 30, 17 (57%) gave the same response on both. Eight others reported a change in consumption (1 increased and 7 decreased) on the first interview but no change on the reinterview. Five reported a change in consumption on the reinterview (3 increased and 2 decreased) but not on the first interview. Of the 4 who reported a change in consumption on both interviews, 3 (75%) agreed on the direction of the change. The number living the in household of the respondents was reported to be 3.6 ± 1.6 on the first interview and 3.8 ± 1.4 on the second (Spearman's r = 0.87).

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. Shoshone-Bannock Tribes. Summary of FFQ interview and reinterview responses. All rows are based on all 30 respondents who completed both interviews. Summaries are unweighted.

	Interview	
Questionnaire Item	**FFQ Interview**	**Reinterview**
Consumed Chinook salmon	93.3%	83.3%
Frequency of Chinook consumption*, portions/year	15.5 ± 18.0	19.7 ± 24.2
Overall fish consumption has changed over time	40.0%	30.0%
Overall fish consumption increased	6.7%	16.7%
Overall fish consumption decreased	33.3%	13.3%
Number living in respondent's household	3.6 ± 1.4	3.8 ± 1.6

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

6.17 Reliability and Cooperation of Respondents—Interviewer's Assessment

Of the 226 completed first interviews, the duration ranged from 15 minutes to 145 minutes (mean ± SD: 65 ± 17 minutes). Forty-five percent were conducted at the respondent's home and 82% 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. Only 4 respondents (2%) were thought by the interviewers to have questionable reliability or unreliable in their answers. Thus overall the interviewers appeared to trust the information they were obtaining.

Table 27. Shoshone-Bannock Tribes. Descriptive summary of interviewers' ratings of respondents' cooperation and reliability during the first interview. Summaries are unweighted.

Variable		%	No.
Respondent's cooperation	Very good	86.7%	196
	Good	11.1%	25
	Fair	2.2%	5
	Poor	0.0%	0
Respondent's reliability	Highly reliable	84.1%	190
	Generally reliable	14.2%	32
	Questionable	1.3%	3
	Unreliable	0.4%	1

7.0 Discussion

7.1 Overview

This fish consumption survey provides unique information about fish consumption and fish harvesting by Tribes 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 Shoshone-Bannock Tribes, based on a modest (42%) response rate to the survey—and one that has likely been addressed by use of appropriate survey

[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.

weighting techniques—has a substantial FCR, with quite high consumption rates for a notable fraction of the population, whether the FFQ or NCI method rates are considered. For example, based on the calculated fish consumption rates (Tables 8 and 12, all species), one-quarter of the Shoshone-Bannock adults consume at least 42 g/day (NCI method) or 212 g/day, if the FFQ data are used.

The Shoshone-Bannock Tribes have reported changes in FCRs and fishing in this survey. Among the interviewed tribal members who reported a change in their access to fishing over time, many more members reporting a decrease in access to fishing (68%) than an increase (20%). It is of interest that more fish are available (compared to the 1990s, see above) and yet the respondents report less access to fishing. Possible explanations include less access to harvesting sites due to increased private ownership of adjacent lands, increased competition at harvesting sites from non-Indians and, among the increased fish stock, a substantial population of fish originating from hatcheries and returning to that origin rather than to a wider distribution of harvesting sites.

The Tribal members and staff and Shoshone-Bannock Tribal leadership (Fort Hall Business Council) contributed very significantly to the execution of this survey. Through advertising, offering of incentives[32] (entirely at the Tribes' own expense) and other forms of communication, the Shoshone-Bannock Tribes supported the survey. Thus, in addition to the quantitative findings in this report, the role of the Tribes and their 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 Tribes are a separate and distinct nation, and collaboration with this unique nation is something that involves mutual learning, for both the contractor's staff and the Tribes.

Non-consumers of fish constitute a moderately low percentage of the population as estimated from the survey. The estimated fish non-consumption rate in the tribal population is 20%. This percentage is based on respondents who adequately completed questions 3 through 6 on the screening interviewer (Appendix A, Section 1.0). The subsequent analysis of the percentage of non-consumers used appropriate statistical survey weights for each of the 31 non-consuming respondents and 238 consuming respondents.

7.2 Comparison of FFQ Rates to NCI-Method Rates

The estimated mean consumption rate differed (and with statistical significance) 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 used for this comparison: the "naïve" mean is calculated as the survey-weighted mean of the observations. The naïve 24-hour mean consumption rates of Group 1 and Group 2 species were 27% and 23% as large as the means from the FFQ method ($p < 0.01$ for both comparisons, based on bootstrap CIs for the differences between the FFQ and naïve 24-recall means). 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, 22% and 23% 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

[32] The Shoshone Bannock Tribes offered $40 incentives for completing the survey.

percentile estimates were, respectively, 17% and 19% 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 are closer to the actual FCRs, because the challenge to a respondent's memory is less than that involved in collecting the type of data used by the NCI method. The 24-hour recall data used by the NCI method is 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]. However, the relative accuracy of FFQ and NCI approaches could be affected by the FFQ format and by the dietary items for which a survey was being done.

The NCI method, however, has strong assumptions about the shape of the distribution[34] 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 portions 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 values 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 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 ones known that have collected data using comprehensive FFQ and the NCI 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" 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

[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.
[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.

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 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 218 Shoshone-Bannock respondents' BMI distribution (excluding those with missing height or weight) was 13% normal weight, 22% overweight and 65% obese. 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 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.

[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).

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 was 40% as large as the mean frequency from the FFQ data. The 24-hour recall mean portion size was 72% as large as the FFQ mean portion size. For Group 2 species, the mean frequency of consumption from the 24-hour recall was only 27% of that from the FFQ, though the mean portion size from the 24-hour recall was 92% 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 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

[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.
[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.

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 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 Shoshone-Bannock rates for species Group 1 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. 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 Shoshone-Bannock Tribes have a high rate of fish consumption. Their mean total fish consumption rate for adults is 34.9 g/day and the 95th percentile of consumption is 140.9 g/day—estimates based on the survey data as analyzed by the NCI method. Compared to the NCI method rates for the U.S., the Shoshone-Bannock NCI-method mean, median and 95th percentile rates are 45% larger, 15% smaller and 106% larger, respectively. The FFQ method mean, median and 90th and 95th percentiles of consumption for the Shoshone-Bannock Tribes are high and larger than the corresponding FFQ rates for some other Pacific Northwest tribes, including the four pooled CRITFC survey tribes (the CRITFC survey did not including the SBT). In comparison to tribes with access to Puget Sound fisheries resources, the Shoshone-Bannock 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 tribe with documented fish consumption rates available is the Nez Perce Tribe, who participated in the current survey using the same methodology and survey management as the Shoshone-Bannock Tribes. The Shoshone-Bannock rates are higher than but comparable to the Nez Perce rates (SBT mean, 158.5 g/day, NPT mean, 123.4 g/day; SBT 95th percentile, 603.4 g/day, NPT 95th percentile, 437.0 g/day). Among the rates computed by the NCI method, the Shoshone-Bannock rates are lower than those of the Nez Perce Tribe: the mean, median and 95th percentile rates are 53%, 70% and 39% lower than the corresponding Nez Perce rates, respectively. The notes under Table 28 provide references for rates of these populations.

A contributing factor to the high FFQ FCRs of the Shoshone-Bannock Tribes 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. The 2013–2014 counts of adult Chinook salmon at Lower Granite Dam, for example, are several-fold larger than those during 1991–1992[39]. However, there is no fish consumption rate for the SBT from the 1990s against which to compare their current "high FCRs."

Differences in survey methodology in assessing total fish consumption may also contribute to the higher FFQ FCRs for the SBT's current survey relative to the CRITFC study. (The Shoshone-Bannock Tribes were not among the tribes participating in the CRITFC survey.) While the CRITIC 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

[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, and 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".)

total fish consumption (from all sources, not only from 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 the current SBT survey enumerated 45 species and gave respondents an opportunity to consider each species individually, potentially increasing their recall of consumption.

Likely reasons for the difference in NCI method rates between the Shoshone-Bannock and Nez Perce Tribes include the limited access of the SBT to fisheries and the additional barriers (dams) that affect survival of anadromous fish or prevent their passage to spawning grounds during migration to SBT fisheries, which are generally farther upriver. The Shoshone-Bannock fishing areas may also have greater environmental damage and pollution than elsewhere. As a possible indication of (but not proof of) greater environmental damage to the Shoshone-Bannock fisheries—damage that may reduce fish consumption—there are five Superfund sites within the group of ZIP codes used to define the survey sample area for selecting adult members of the Shoshone-Bannock Tribes.[40] 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).

The NCI method's distribution of usual consumption for the Shoshone-Bannock Tribes is skewed more toward high values than that of the Nez Perce Tribe. That is, considering the median fish consumption rate as a normative value, the SBT 95th percentile is 9.4 times larger than the median, while the corresponding NPT ratio is 4.7 (calculated from Table 28). The same pattern of greater skewness (SBT distribution compared to the NPT distribution) holds true for the FFQ rates, where the SBT 95th percentile of fish consumption is 8.1 times larger than the median, while the same ratio for the NPT is 6.2.

The differences between the FFQ-method rates and those computed by the NCI method are discussed in Section 7.2.

[40] Email (with maps showing Superfund sites) from James Lopez-Baird (EPA) to Lon Kissinger (EPA), 9/25/15.

Table 28. Shoshone-Bannock Tribes. 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*	Mean	Percentiles 50%	90%	95%
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
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
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[41]	*16,363	23.8	17.6	52.8	68.1

*Adults ≥ 21 years old; includes both consumers and non-consumers. Data for populations outside of Idaho from 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 Shoshone-Bannock and Nez Perce 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).

7.4 Strengths and Limitations

Strengths and limitations of the survey are noted below.

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

[41] 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.

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.[42] 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.

Tribal contributions. The Tribes 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 Tribes, 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

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

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 suing 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.

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.

<u>Detailed inventory of species</u>. 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.

<u>Interviews spanned one year</u>. 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 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,[43] 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 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 0.9% 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

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

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.

Response rates. The response rate for the survey was lower than expected at 42%. 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, living on vs. off the reservation, 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 Shoshone-Bannock Tribes are a high fish-consuming population. Their mean total fish consumption rate for adults is 34.9 g/day and the 95th percentile of consumption is 140.9 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, 158.5 g/day, 95th percentile, 603.2 g/day. The Shoshone-Bannock Tribes' FFQ fish consumption 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 Shoshone-Bannock mean FFQ consumption rate of 158.5 g/day can be compared to and is higher than 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 Shoshone-Bannock mean FFQ rate of 158.5 g/day is lower than the FFQ rate for the Suquamish Tribe, 213.9 g/day. The Shoshone-Bannock NCI method rates can be compared to and are lower than those of the Nez Perce Tribe, the second tribal population included in the current consumption survey. The NCI method mean rates for the SBT and NPT are 34.9 g/day and 75.0 g/day, respectively. The SBT and NPT 95th percentile rates are 140.9 g/day and 232.1 g/day, respectively.

There has been a substantial change in access to fish and fishing according to tribal respondents, and the largest change is a decrease in access to fishing for many more of the tribal members than those reporting increased access (Table 25).

Consumption rates were also high when restricted to Group 2 species (near coastal, estuarine, freshwater, and anadromous finfish and shellfish) with a mean of 18.6 g/day and 95th percentile of 80.0 g/day by the NCI method. The mean Group 2 consumption rate based on the FFQ was 110.7 g/day and the 95th percentile was 427.1 g/day.

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 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 higher response rates and the need for significant advance time and preparation prior to field work.

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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).

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.

LIST OF TABLES

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 <u>fish advisories</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

B. "Do you not eat fish because of <u>pollution</u>?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

C. "Do you not eat fish because of <u>other environmental concerns</u> (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 <u>not enough fish available</u> to catch?"

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

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

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Access to Fishing:

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

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

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

______ Yes ______ Answered unaided
______ No ______ Answered by prompt

Other Reasons:

H. "Do you not eat fish because you <u>do not like fish</u> 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 (of call & questions)	
Attempt	**Date**	**Day**	**Time**	***Circle***	**Caller Name**	**Caller ID**	**Codes**	**Notes**
10				AM PM				
11				AM PM				
12				AM PM				
13				AM PM				
14				AM PM				
15				AM PM				

Reported eating fish yesterday *(circle)*: YES / NO / No Answer

Reported eating fish during past week *(circle)*: YES / NO / No Answer / Not Applicable

Reported eating fish during past month *(circle)*: YES / NO / No Answer / Not Applicable

Reported eating fish during past year *(circle)*: YES / NO / No Answer / Not Applicable

Number of days ate fish *(enter number, circle unit)*: __________ in past Week / Month / Year

Number of days generally eat fish *(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.)

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 ☐ 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

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 ☐ 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

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.

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)
All resident trout / species not identified			Day Wk. Mo. Yr.		Wk. Mo.		Day Wk. Mo. Yr.		Wk. Mo.
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.

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)
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									
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 ☐ 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
2		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

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 ☐ 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 ☐ 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-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.

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 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).

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. 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. 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.

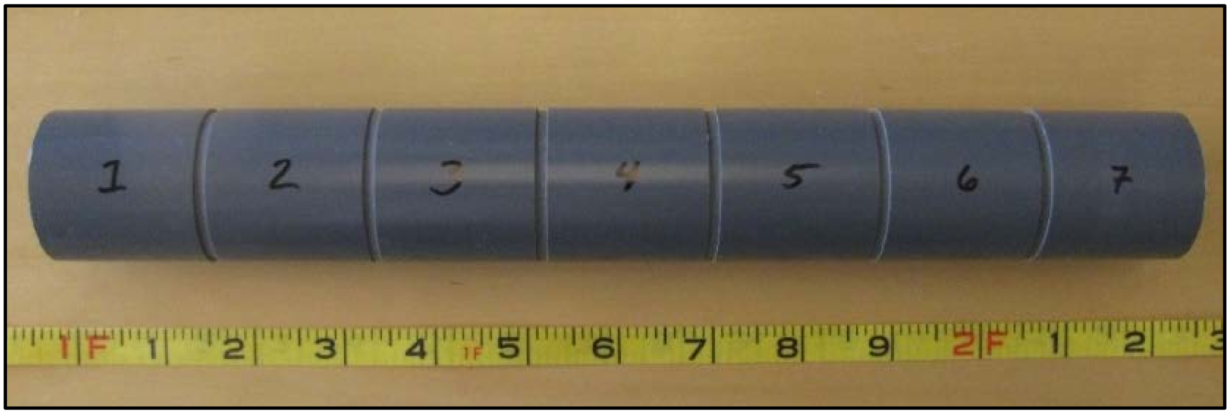
3. Lamprey (PVC Pipe) Display

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

[3] Values shown in ounces and grams reflect the direct mass conversions from cooked to uncooked weights (according to the equation in Attachment 1).

(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. 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. 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. 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. 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.

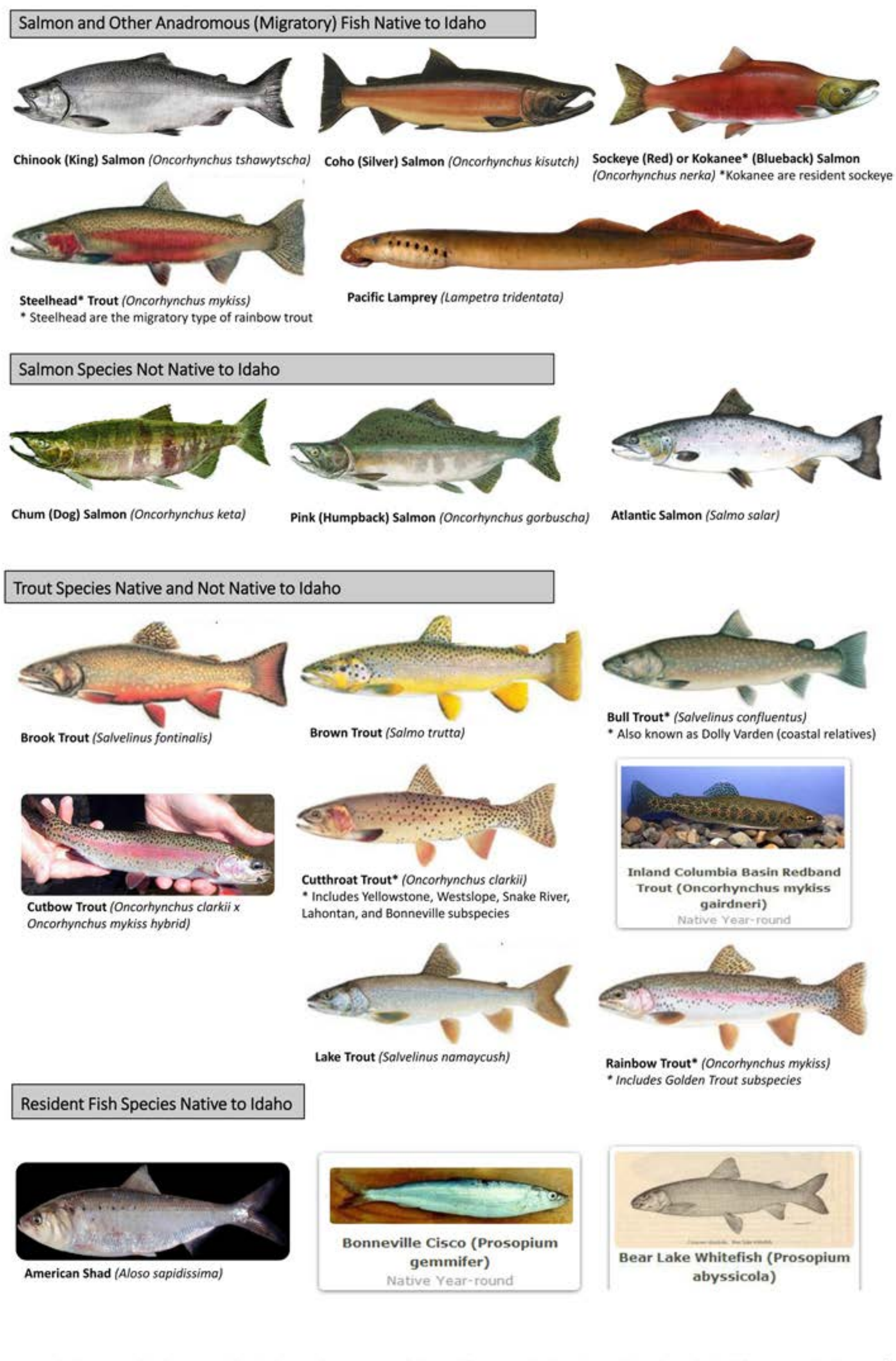


Figure B9. Species Identification Photographs (continued, page 2 of 4)

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.

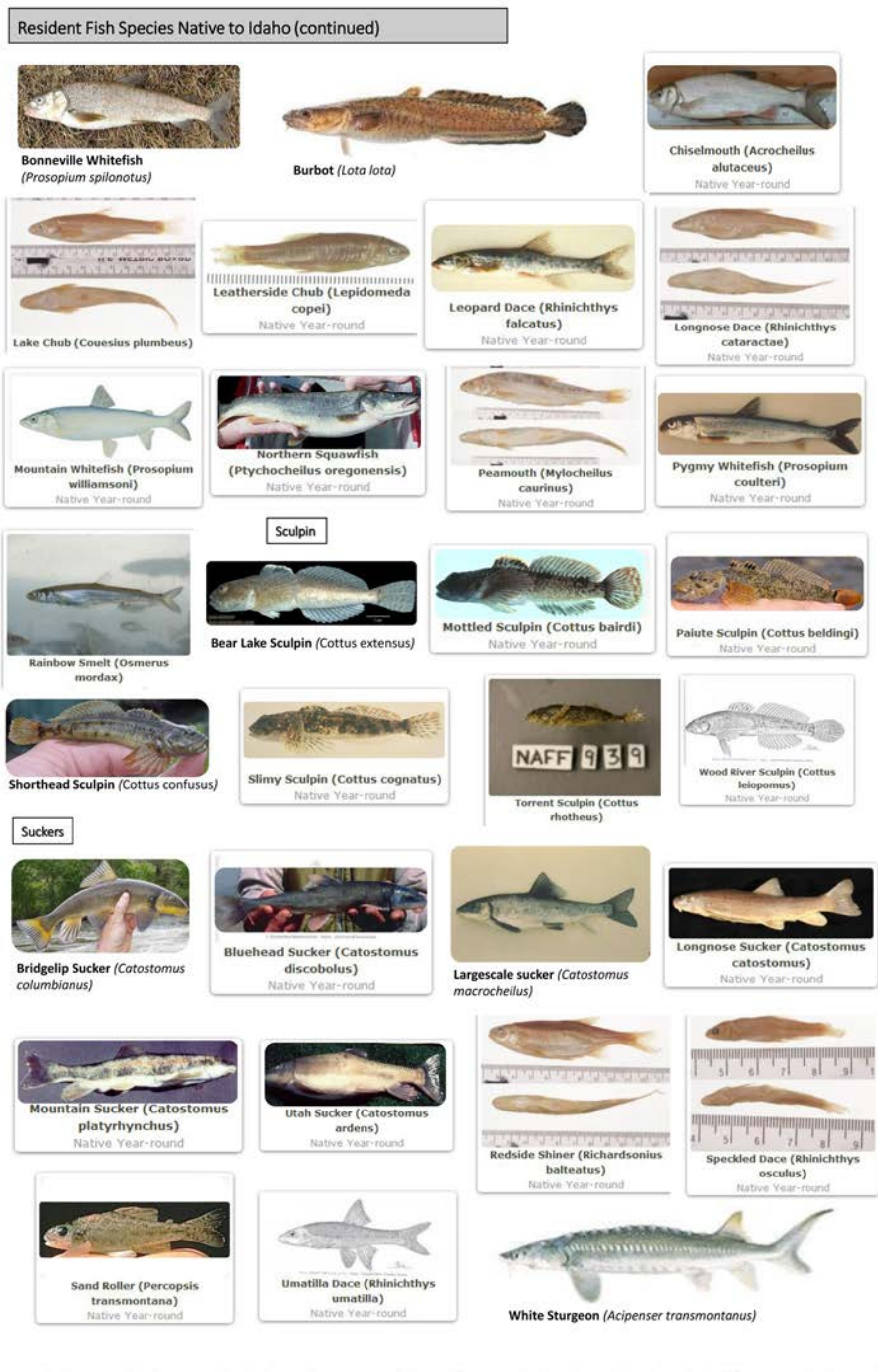


Figure B9. Species Identification Photographs (continued, page 3 of 4)

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.

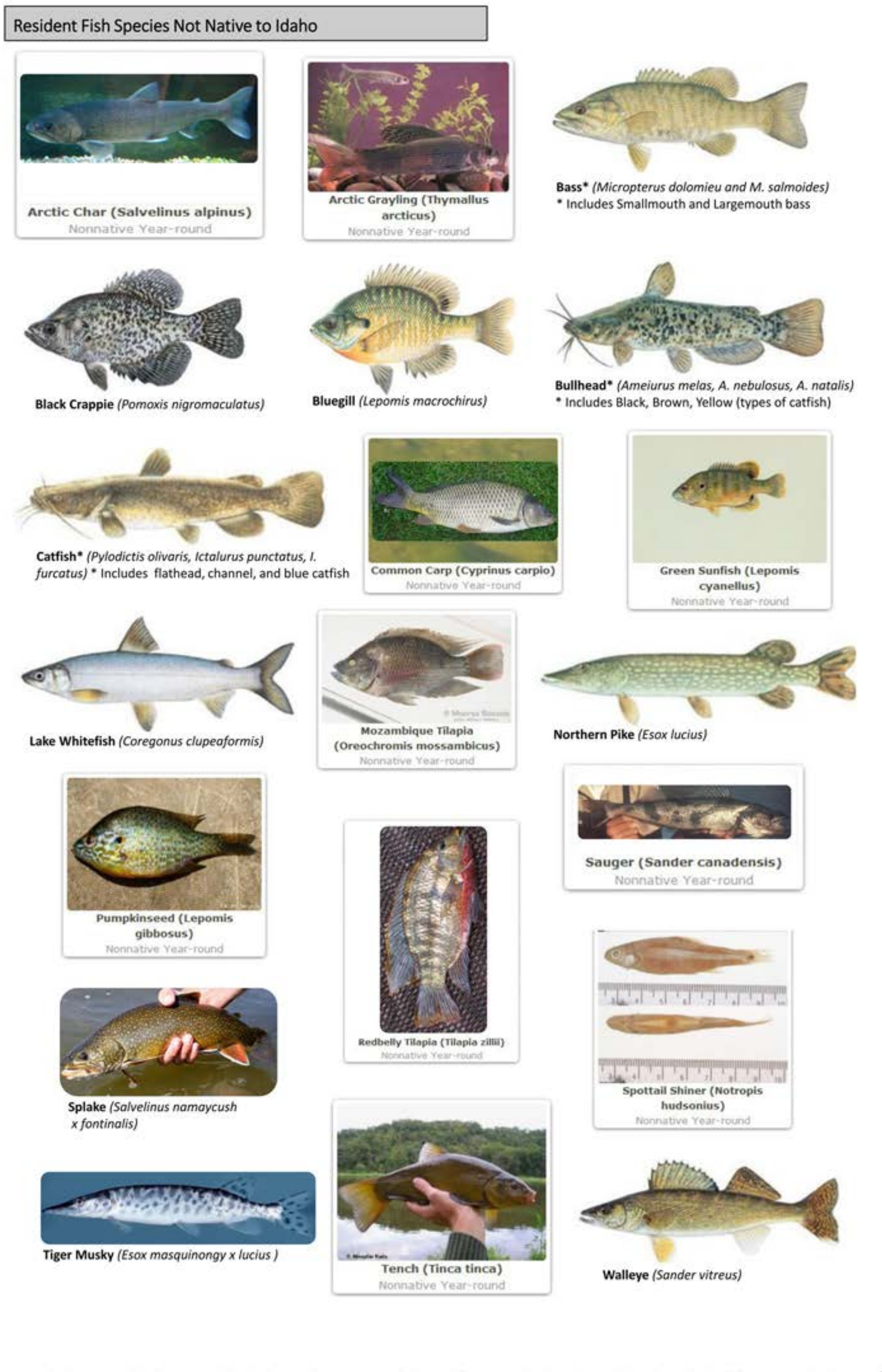
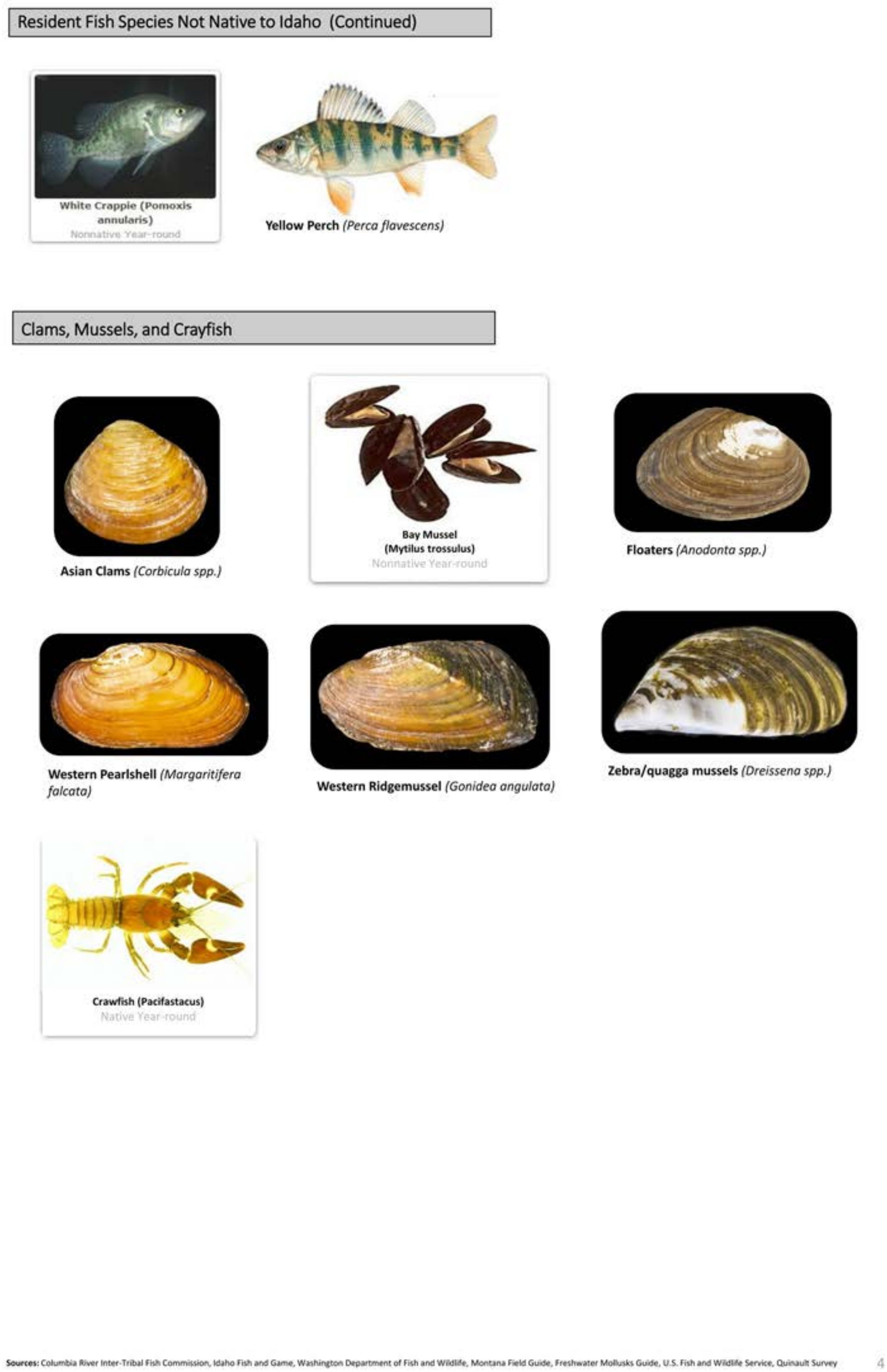


Figure B9. Species Identification Photographs (continued, page 4 of 4)

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.



9. 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. 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.

	Portion-to-Mass (grams)*	
Jerky Model	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. 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. 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. 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. 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. Exceptions to the Portion-to-Mass Conversion Procedure

Three records that did not follow the expected protocol were manually modified to perform the mass conversion. In two cases, the two respondents reported consuming sardines but described their portion sizes using the “number of organisms” field, which is typically reserved for shellfish. In the remaining record, one respondent reported consuming 5 fish sticks using the “number of organisms” field.

For the two sardine cases, the interviewer recorded sardines as the shellfish model, so these responses were interpreted as the number of individual sardines. Through consultation with Ridolfi staff, it was determined that a 5-oz. can would contain 4 sardines on average, so the portion sizes were manually converted into standard can units. Specifically, “4 sardines” was converted to 1 standard 5-oz. can and “6 sardines” was converted to 1.5 standard 5-oz. cans. The portion-to-mass conversion procedure was then performed according to the standard can rules.

For the remaining response describing fish sticks, a conversion factor of 0.30 oz. per stick was chosen through consultation with Ridolfi staff and nutritional information from a common fish stick producer.[4]

[4] http://www.cnputah.org/resources/linked/Gortons_fish_product_information.pdf.

Appendix C—
Additional Detail on Imputations

Appendix C—Additional Detail on Imputations

1. 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 (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 (for imputing portion frequency or size) and Table C2 (for imputing higher period percentage). In general, the choice of groupings was restrictive and based on consultation with Ridolfi. When 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. Shoshone-Bannock Tribes. Species groupings using to impute missing portion frequency or size for uncommon species (less than 5 non-missing responses).

Species in CAPI	Missing Field	No. Imputed	Group used For Imputation
Marine clams or mussels	Size	2	Freshwater and marine clams or mussels
Whitefish	Size	1	Whitefish; there was only a single non-missing response available (lower period consumption) but a suitable group could not be chosen.

Table C2. Shoshone-Bannock Tribes. Species groupings using to impute higher period percentage for uncommon species (less than 5 non-missing responses).

Species in CAPI	No.Imputed	Group used For Imputation
Other salmon	3	Other salmon*, Kokanee, Sockeye, which are less commonly consumed salmon species
Brown trout	1	Other trout*, bull, brook, lake, and brown trout, which are less commonly consumed trout species
Crayfish, freshwater clams or mussels, marine clams or mussels, crab, shrimp	8	All freshwater or marine shellfish species
Bass, catfish, tilapia, whitefish	4	All freshwater finfish species except salmon, steelhead or resident trout
Cod, halibut, tuna	7	All marine finfish species

*Other salmon and other trout are species categories in CAPI that allowed for a specific salmon or trout species not listed to be written in, for example, pink or Atlantic salmon.

2. 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 for Groups 1-6 are shown in Tables C3-C8, respectively. For Groups 1, 5 and 6, differences between 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) were less than 5% except median rate from Group 5 (difference: 8.3%). For Groups 2-4, the differences between approaches was most often less than 10% and otherwise less than 20% except for the median rate from Group 4 (difference: 21.7%). The mean approach is likely to be much more accurate than twice the mean, which is quite an extreme approach, and the differences seen across these extreme scenarios is smaller than the ranges contained within the 95% CIs. For example, the upper bound of the 95% CI of the Group 4 median rate is 96% higher than the point estimate, compared with the 22% higher estimate based on the twice the mean approach. Most differences across imputation approaches were much smaller than this. These results show that imputation of missing values had a relatively small impact on the final consumption rates presented in this report.

Table C3. Shoshone-Bannock Tribes. 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	226	226	226
Mean	155.0	158.5	160.3
50th percentile	74.6	74.6	74.7
90th percentile	392.1	392.5	400.4
95th percentile	603.4	603.4	603.4
Max	1068.2	1068.2	1068.2

*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 C4. Shoshone-Bannock Tribes. 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	225	225	225
Mean	107.5	110.7	112.6
50th percentile	42.2	48.5	49.9
90th percentile	265.6	265.6	310.4
95th percentile	427.1	427.1	427.8
Max	1029.2	1029.2	1029.2

*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 C5. Shoshone-Bannock Tribes. 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	215	215	215
Mean	46.3	47.6	48.7
50th percentile	15.4	15.4	16.7
90th percentile	142.3	142.3	157.7
95th percentile	233.1	233.1	233.1
Max	825.2	825.2	825.2

*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. Shoshone-Bannock Tribes. 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	130	130	130
Mean	19.1	22.1	23.0
50th percentile	3.6	4.6	4.6
90th percentile	56.0	56.0	59.7
95th percentile	68.3	68.3	79.3
Max	374.7	374.7	374.7

*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. Shoshone-Bannock Tribes. 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	97	97	97
Mean	11.1	11.2	11.3
50th percentile	3.6	3.6	3.9
90th percentile	33.7	33.7	33.7
95th percentile	43.5	43.5	43.5
Max	76.1	76.1	76.1

*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 C8. Shoshone-Bannock Tribes. 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	222	222	222
Mean	98.1	98.8	99.2
50th percentile	35.5	37.3	37.3
90th percentile	218.9	221.5	222.2
95th percentile	402.6	402.6	402.6
Max	1019.5	1019.5	1019.5

*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.

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. Some of these differences are by design (e.g., oversampling of fishers). 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. Shoshone-Bannock Tribes. Demographics of the population, selected sample and FFQ consumers with known consumption rates. Estimates are unweighted.

		Population (N=3242)		Sample (N=661)		FFQ Consumer* (N=226)	
Variable		**%**	**No.**	**%**	**No.**	**%**	**No.**
Gender	Male	48.3%	1566	62.0%	410	63.3%	143
	Female	51.7%	1676	38.0%	251	36.7%	83
Age	18-29 years	30.7%	996	24.5%	162	15.9%	36
	30-39 years	20.8%	673	17.9%	118	17.3%	39
	40-49 years	17.9%	581	20.7%	137	22.6%	51
	50-59 years	14.9%	483	18.6%	123	21.2%	48
	60 years or older	15.7%	509	18.3%	121	23.0%	52
Documented fisher	Yes	9.2%	299	45.2%	299	59.3%	134
	No	90.8%	2943	54.8%	362	40.7%	92
Zip code	83203	84.0%	2723	89.1%	589	91.6%	207
	Other	16.0%	519	10.9%	72	8.4%	19
Live on reservation	Yes	85.9%	2786	90.3%	597	92.9%	210
	No	14.1%	456	9.7%	64	7.1%	16

*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. Shoshone-Bannock Tribes. Demographics of the FFQ consumers with known consumption rates. Estimates are unweighted.

		% or Mean ± SD	No. who Responded
Gender*	Male	63.3%	226
	Female	36.7%	
Age*	18-29 years	15.9%	226
	30-39 years	17.3%	
	40-49 years	22.6%	
	50-59 years	21.2%	
	60 years or older	23.0%	
Weight, kgs		95.3 ± 24.6	219
Weight, kgs (males only)		101.0 ± 24.7	140
Weight, kgs (females only)		85.1 ± 21.1	79
No. in household	1	12.8%	226
	2	23.9%	
	3-4	38.5%	
	5 or more	24.8%	
Documented fisher*	Yes	59.3%	226
	No	40.7%	
Live on reservation*	Yes	92.9%	226
	No	7.1%	
Highest education	Elementary school	0.9%	223
	Middle school	5.4%	
	High School / GED	62.3%	
	Associates degree	20.6%	
	Bachelor's degree	8.1%	
	Master's degree	2.2%	
	Doctorate	0.4%	
Annual household income	≤ $15K	21.5%	144
	$15K – $25K	16.7%	
	$25K – $35K	9.7%	
	$35K – $45K	16.7%	
	$45K – $55K	13.2%	
	$55K – $65K	9.7%	
	>$65K	12.5%	

*From the enrollment list or fishers; 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. Shoshone-Bannock Tribes. 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.

	No. of			**Percentiles**									
Group	**Consumers***	**Mean**	**SD**	**50%**	**55%**	**60%**	**65%**	**70%**	**75%**	**80%**	**85%**	**90%**	**95%**
Gender**													
Male	143	187.3	245.5	74.9	136.2	155.1	174.0	199.8	231.7	313.2	335.9	452.2	806.0
Female	83	134.4	184.5	65.8	82.9	90.7	102.2	110.6	122.9	231.6	248.0	313.6	467.7
Age**													
18-29 years	36	181.9	266.6	61.0	65.2	73.2	83.8	200.1	236.4	292.6	364.2	456.1	***653.4
30-39 years	39	197.1	272.4	81.8	93.4	107.1	126.2	171.4	209.1	308.8	326.9	498.5	***873.9
40-49 years	51	113.5	122.9	69.6	97.2	106.5	112.5	151.8	165.3	177.4	229.9	237.1	287.9
50-59 years	48	157.2	169.1	119.7	128.3	154.5	163.9	230.5	232.8	233.7	283.4	298.5	606.2
60 years or older	52	119.6	142.1	74.2	74.9	88.0	91.4	108.4	136.3	136.4	183.9	412.5	452.1
Documented Fisher**													
Yes	134	160.9	169.8	117.7	130.8	147.1	168.8	185.8	198.1	228.5	285.2	351.1	459.1
No	92	158.2	221.4	69.7	76.0	93.7	116.3	146.0	204.4	233.7	311.2	405.4	604.4
Live on reservation													
Yes	210	163.1	223.4	74.7	90.7	107.8	128.0	157.1	229.9	235.5	309.4	384.4	620.7
No	16	126.7	151.5	57.3	69.9	80.2	94.2	134.5	157.6	169.8	231.1	***389.6	***426.5
Number who live in household													
1	29	120.0	152.0	41.2	45.7	49.2	151.0	155.0	172.4	176.0	236.1	335.5	***429
2	54	197.4	239.6	105.4	118.5	143.1	230.6	232.4	233.5	263.4	412.1	465.7	659.3
3-4	87	182.2	235.4	94.0	108.8	120.0	135.2	161.7	229.2	282.6	339.8	435.6	605.4
5 or more	56	119.1	187.4	52.1	62.6	64.3	69.8	82.9	110.4	187.8	235.0	308.0	317.2
Highest education													
High school / GED or less	153	174.6	237.1	77.2	91.7	116.3	134.9	160.1	230.4	281.5	337.5	453.3	647.9
Associates degree or higher	70	124.6	148.7	56.5	69.4	91.7	109.2	134.0	188.2	230.5	257.0	306.3	330.4
Annual household income													
≤ $15K	31	134.0	145.6	76.6	91.1	113.1	161.1	171.9	209.2	239.6	273.2	302.3	***422.5
$15K – $45K	62	153.6	234.2	66.4	74.8	76.9	90.2	105.8	116.9	129.1	348.8	424.6	584.4
>$45K	51	173.4	159.3	118.3	143.6	155.8	205.0	226.8	233.0	307.1	317.2	333.0	495.2

*Consumers with unknown or missing subgroup status were excluded for the analysis of that subgroup;
**From the enrollment list or fishers 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. Shoshone-Bannock Tribes. 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	K16UN, KJPSC
2	K9XL2, K9Y80
3	KM0H7, KM1J5
4	KAP9F, KAPCS
5	K00WJ, K019Q
6	KLJD3, KLLH1
7	K75MG, K7734
8	KLJ8O, KLJEL
9	K5KG5, K5NCE
10	KB048, KDLO6
11	K2PM8, K2Q1X
12	K2XPP, KI8JA, KI8OC

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. Shoshone-Bannock Tribes. 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	226	34.9	1.2	2.0	3.0	4.0	5.2	6.5	8.0	9.9	12.2	14.9	18.3	22.3	27.6	33.7	41.9	53.4	69.2	94.5	140.9
Documented fisher																					
Fisher	134	42.4	1.7	2.9	4.2	5.5	7.0	8.8	11.1	13.6	16.6	20.0	24.4	29.7	35.9	43.6	53.6	67.0	84.6	114.3	163.6
Non-fisher	92	33.9	1.1	1.9	2.8	3.8	5.0	6.2	7.7	9.4	11.6	14.4	17.6	21.5	26.6	32.7	40.4	51.6	67.1	91.8	138.3
Gender																					
Men	143	38.1	0.9	1.7	2.5	3.5	4.7	6.0	7.6	9.8	12.5	15.7	20.0	25.4	30.8	37.5	46.7	58.3	76.5	103.8	158.3
Women	83	32.2	1.4	2.3	3.3	4.4	5.5	6.8	8.2	9.9	11.9	14.4	17.3	20.6	25.2	31.1	38.3	48.6	62.3	85.6	126.8
ZIP Code																					
83203	207	29.9	1.1	1.9	2.7	3.6	4.7	5.7	7.1	8.5	10.3	12.7	15.4	19.0	23.1	28.3	35.3	44.0	57.4	79.2	121.1
SB Other	19	59.2	2.0	3.8	5.9	8.8	11.5	14.5	18.2	23.2	29.5	33.4	40.0	47.8	56.6	67.7	79.5	96.9	118.7	151.0	209.7
Age																					
18-29	36	24.3	0.8	1.2	1.8	2.3	3.0	3.7	4.6	5.4	6.4	7.6	9.1	10.9	13.6	17.6	23.8	31.3	42.5	62.9	110.2
30-39	39	44.6	2.7	4.1	5.7	7.7	9.6	12.1	15.2	18.1	21.3	25.6	30.2	35.2	40.7	48.9	57.9	70.9	88.2	113.4	159.0
40-49	51	51.7	2.2	3.6	5.0	6.6	8.3	10.3	12.7	15.5	18.5	23.2	28.2	34.5	42.5	53.7	67.1	85.6	108.6	147.4	202.5
50-59	48	31.8	0.9	1.3	2.0	2.8	3.8	5.1	6.7	8.9	10.9	14.0	17.3	20.7	25.5	32.2	40.6	52.1	65.6	88.9	125.8
60+	52	26.8	1.5	2.5	3.4	4.6	5.7	7.1	8.5	10.5	12.5	14.6	17.0	20.6	24.7	29.7	34.4	42.1	51.9	67.8	90.7

Table E2. Shoshone-Bannock Tribes. 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	225	18.6	0.4	0.7	1.1	1.6	2.1	2.6	3.4	4.2	5.2	6.5	8.0	10.0	12.5	15.6	20.0	25.6	34.1	48.9	80.0
Documented fisher																					
Fisher	134	23.3	0.3	0.8	1.4	2.2	3.1	4.1	5.4	6.7	8.3	10.2	12.5	15.4	18.8	22.8	28.0	35.3	45.5	61.5	92.6
Non-fisher	91	17.8	0.4	0.7	1.1	1.5	2.0	2.6	3.3	4.1	5.1	6.3	7.7	9.6	12.1	15.0	19.0	24.5	32.8	46.6	76.8
Gender																					
Men	143	18.0	0.3	0.5	0.8	1.2	1.6	2.1	2.7	3.4	4.4	5.5	6.9	8.9	11.2	14.2	18.7	24.7	33.9	49.6	79.4
Women	82	19.5	0.5	0.8	1.3	1.7	2.3	2.9	3.7	4.5	5.6	6.9	8.4	10.4	13.1	16.2	20.2	25.6	34.1	48.2	84.3
ZIP Code																					
83203	206	15.8	0.3	0.7	1.0	1.4	1.9	2.4	3.0	3.7	4.6	5.6	6.9	8.4	10.4	12.8	16.3	20.8	28.0	39.7	67.2
SB Other	19	34.1	0.6	1.2	1.8	2.8	3.8	4.9	6.8	9.2	11.4	14.3	19.2	23.9	28.4	34.5	42.1	53.7	67.4	90.2	130.7
Age																					
18-29	36	1.3	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.8	1.0	1.3	1.7	2.2	3.1	5.4
30-39	39	36.5	0.6	1.5	3.1	5.5	7.6	9.8	12.1	14.4	16.9	19.8	23.0	27.4	33.1	38.9	46.7	56.8	70.7	93.0	136.3
40-49	51	50.9	1.4	2.4	3.4	4.4	5.6	7.2	9.2	12.2	15.5	19.8	25.9	33.9	42.7	53.6	65.4	81.0	102.8	140.9	203.0
50-59	48	12.6	0.1	0.2	0.4	0.5	0.6	0.8	1.0	1.4	1.9	2.6	3.8	5.9	8.5	11.8	15.7	21.1	27.0	37.5	55.2
60+	51	13.1	0.2	1.0	1.6	2.3	2.8	3.5	4.4	5.3	6.4	7.5	8.8	10.3	12.4	14.5	17.0	20.2	24.7	31.9	45.1

Table E3. Shoshone-Bannock Tribes. 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											
	226	34.9	1.2	2.0	3.0	4.0	5.2	6.5	8.0	9.9	12.2
(95% CI)		(20.6-66.2)	(0.0-3.4)	(0.0-5.0)	(0.1-6.7)	(0.2-8.8)	(0.4-11.1)	(0.8-14.0)	(1.2-16.5)	(1.7-19.9)	(2.4-24.0)
Fisher											
	134	42.4	1.7	2.9	4.2	5.5	7	8.8	11.1	13.6	16.6
(95% CI)		(23.7-84.6)	(0.0-6.1)	(0.2-8.4)	(0.4-10.9)	(0.8-14.0)	(1.2-17.2)	(2.0-20.8)	(3.0-25.0)	(4.1-28.9)	(5.5-33.7)

--continued

	Percentiles 50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Overall										
	14.9	18.3	22.3	27.6	33.7	41.9	53.4	69.2	94.5	140.9
(95% CI)	(3.4-28.9)	(4.7-33.4)	(6.9-39.8)	(9.3-48.8)	(13.1-62.0)	(18.0-80.2)	(25.4-105.8)	(35.6-140.2)	(52.6-199.8)	(82.0-312.9)
Fisher										
	20	24.4	29.7	35.9	43.6	53.6	67	84.6	114.3	163.6
(95% CI)	(7.3-39.1)	(9.3-46.9)	(12.2-55.8)	(15.7-68.3)	(20.5-81.8)	(27.1-104.5)	(34.7-132.4)	(43.4-174.5)	(56.6-238.3)	(83.6-376.2)

1. 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[5]). 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[6]. 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

[5] The decile cut points were defined separately within each tribe.

[6] 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 10th 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 50th, 90th and 95th 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 8th decile. While the decrease from the 8th decile to the 9th decile was relative moderate, the decrease from the 8th decile to the 10th decile was pronounced. We therefore introduced an indicator for the 10th SBT decile (but not for the 9th 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 3rd root and $\log_{10}$ FFQ models. Visually, the untransformed FFQ model tends to overestimate the intake for the bottom two FFQ deciles and the 10th 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 3rd 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 3rd root of FFQ as our primary choice because the 3rd 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 3rd 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 3rd root of FFQ. The results of this sensitivity analysis are presented in this appendix.

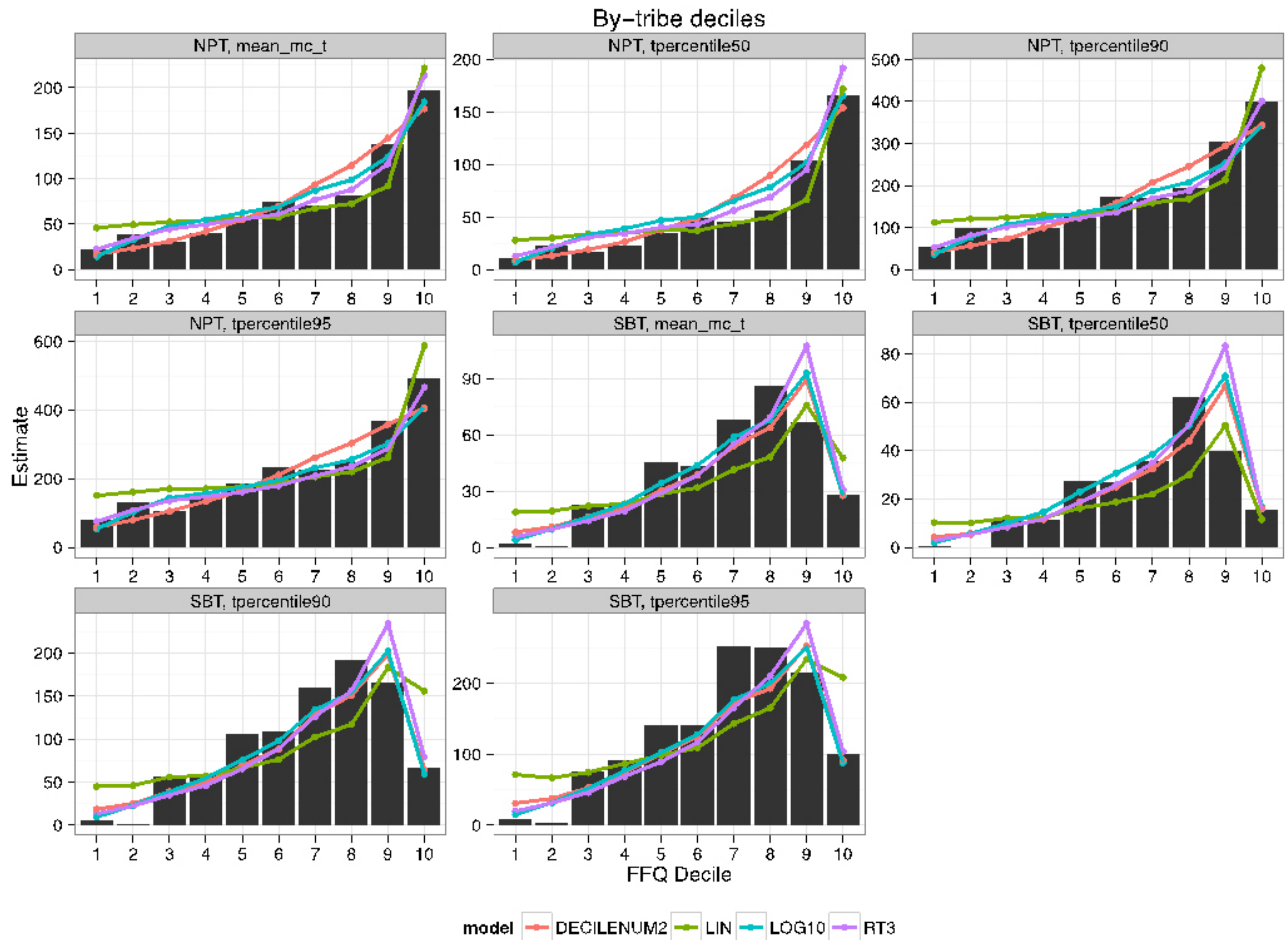


Figure E1. Comparison of *four forms of FFQ adjustment* (colored lines) to the categorical decile FFQ adjustment (black bars). Model for *Group 1 species*. DECILENUM2 = the numerical decile of FFQ (coded as 1-10), LIN = the original (untransformed) FFQ, LOG10 = the $\log_{10}$ FFQ, RT3 = the 3rd root 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**
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= 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.

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)

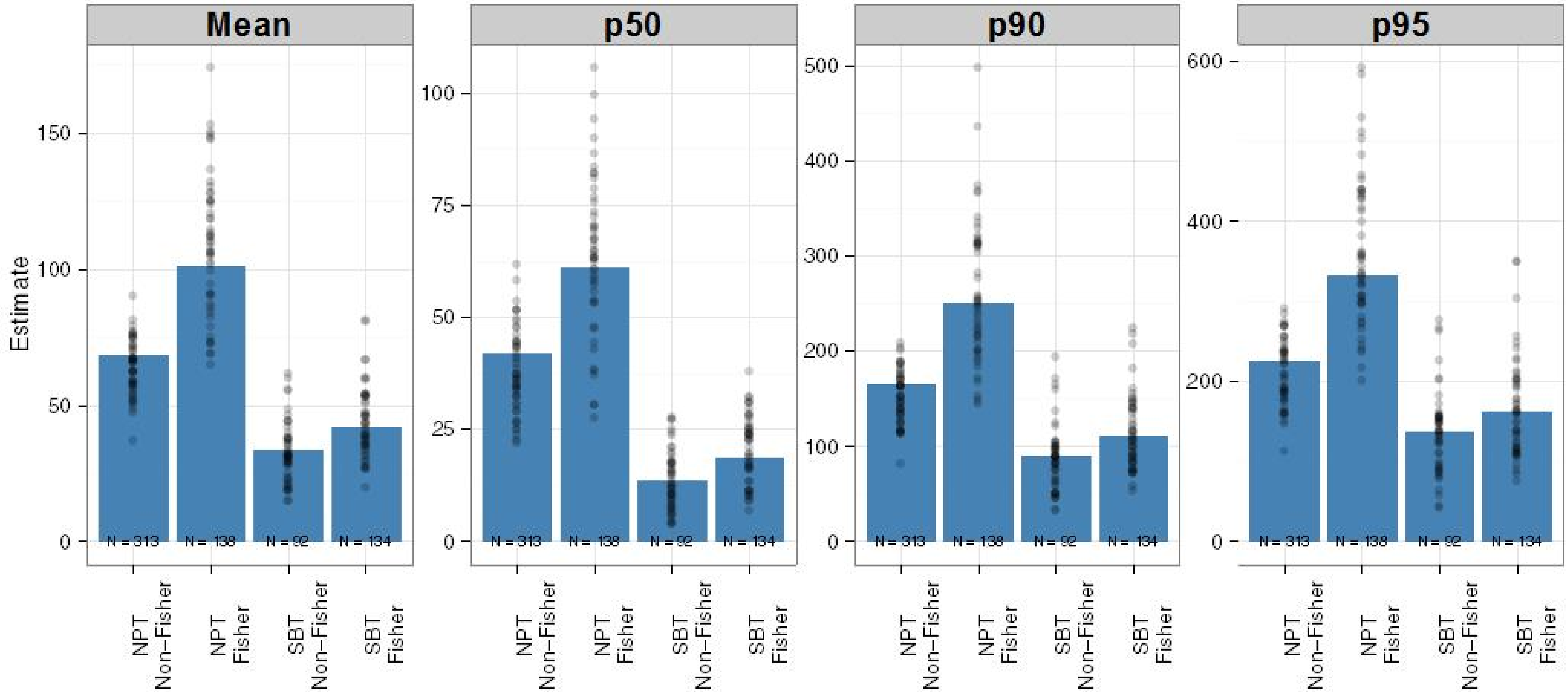


Figure E2. NCI-estimated mean and the 50th, 90th and 95th percentiles by *the presence on the fishers list* and tribe. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

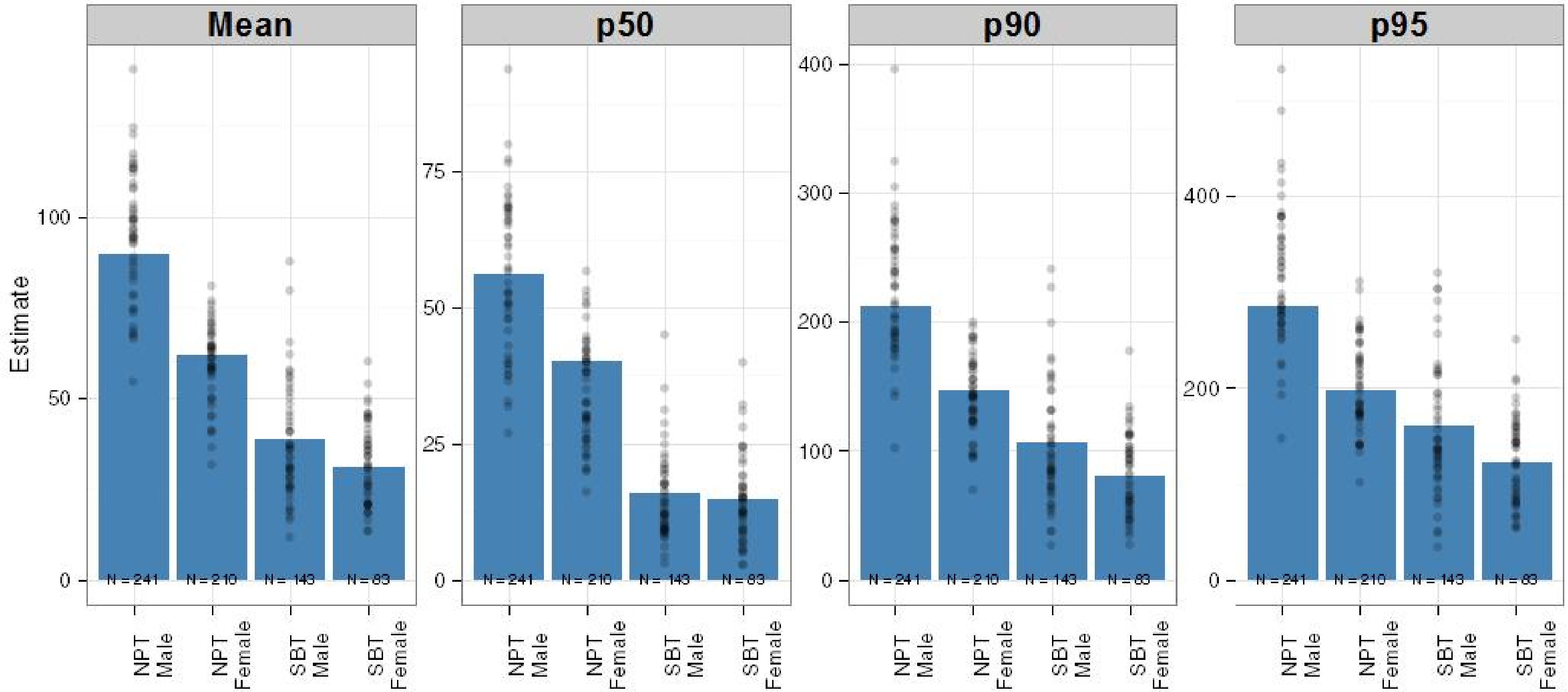


Figure E3. NCI-estimated mean and the 50th, 90th and 95th percentiles by *gender* and tribe. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

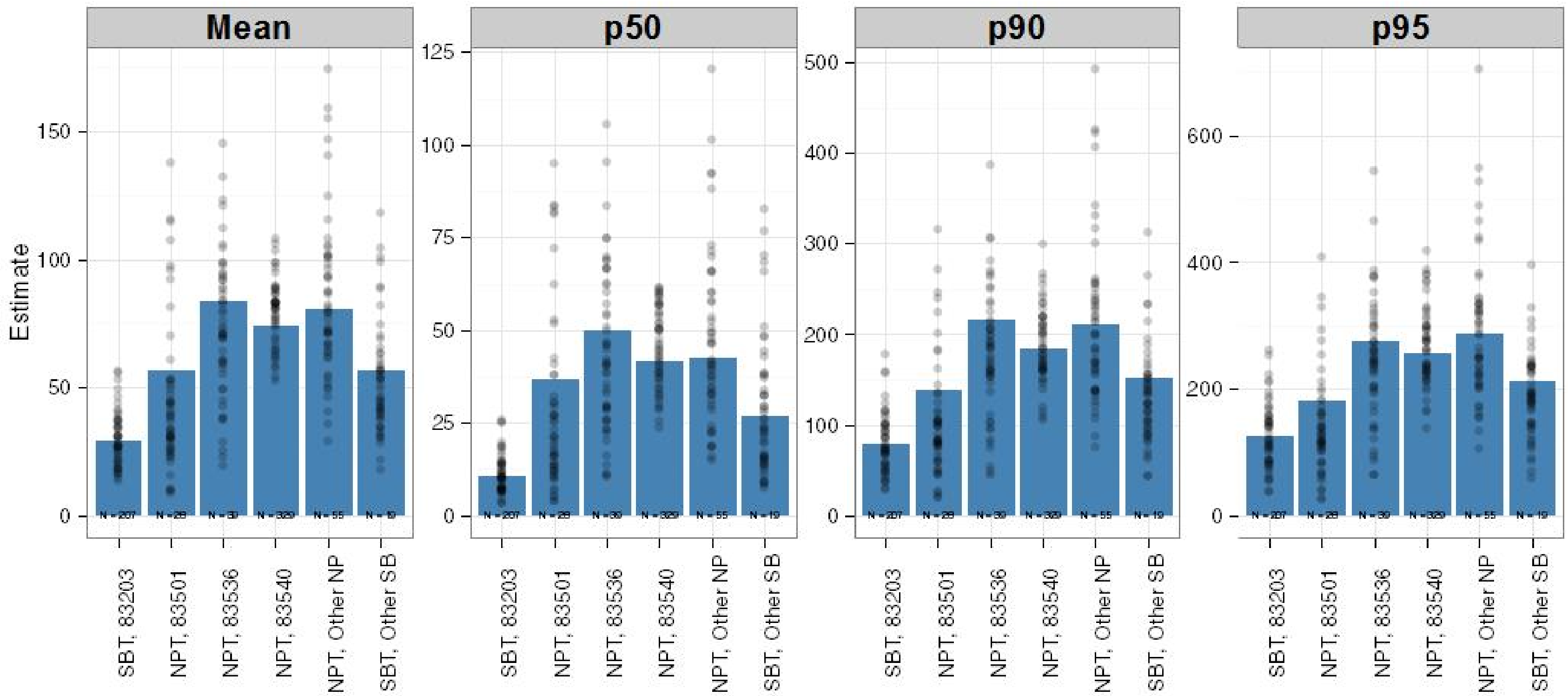


Figure E4. NCI-estimated mean and the 50th, 90th and 95th percentiles by *ZIP code*. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

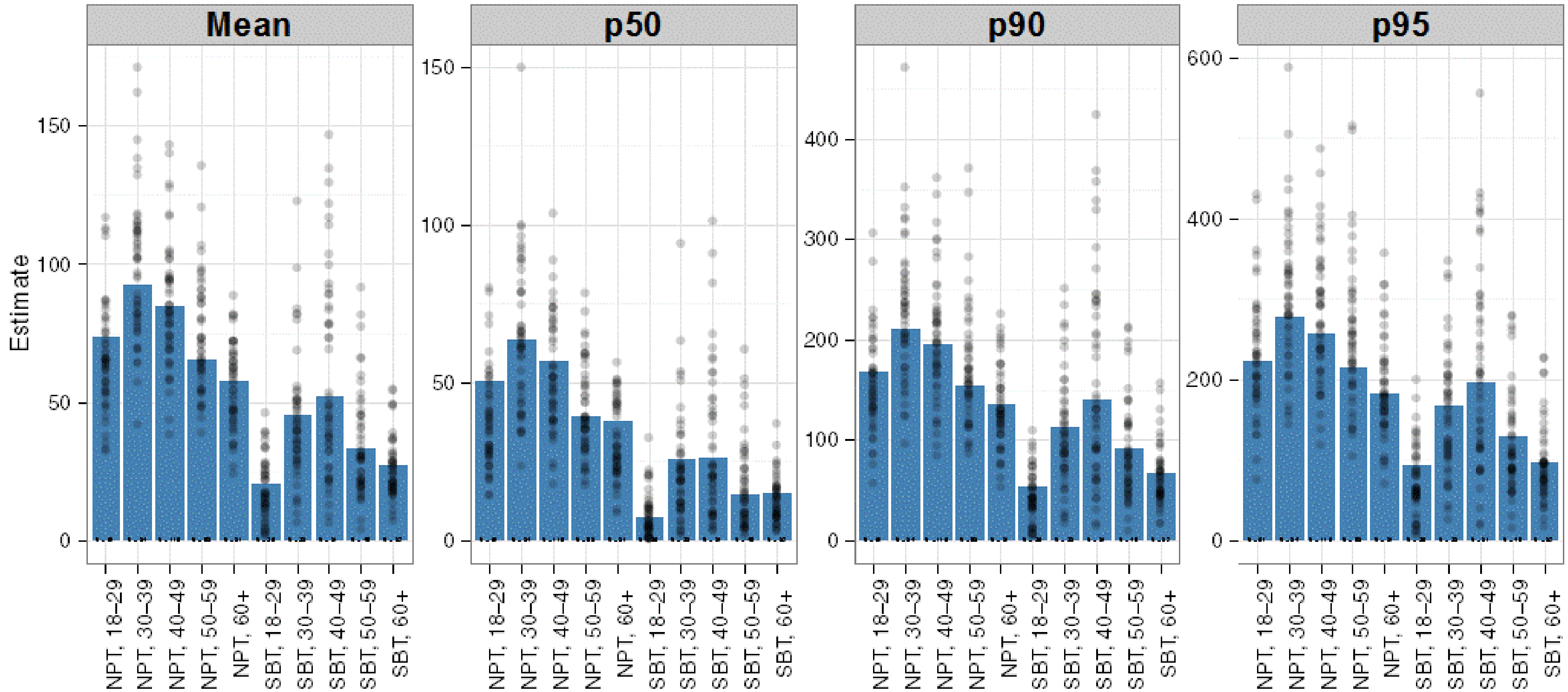


Figure E5. NCI-estimated mean and the 50th, 90th and 95th percentiles by *age* and tribe. Model for *Group 1 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Dots are estimates from 50 bootstrap runs and give some idea of uncertainty around the estimates. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

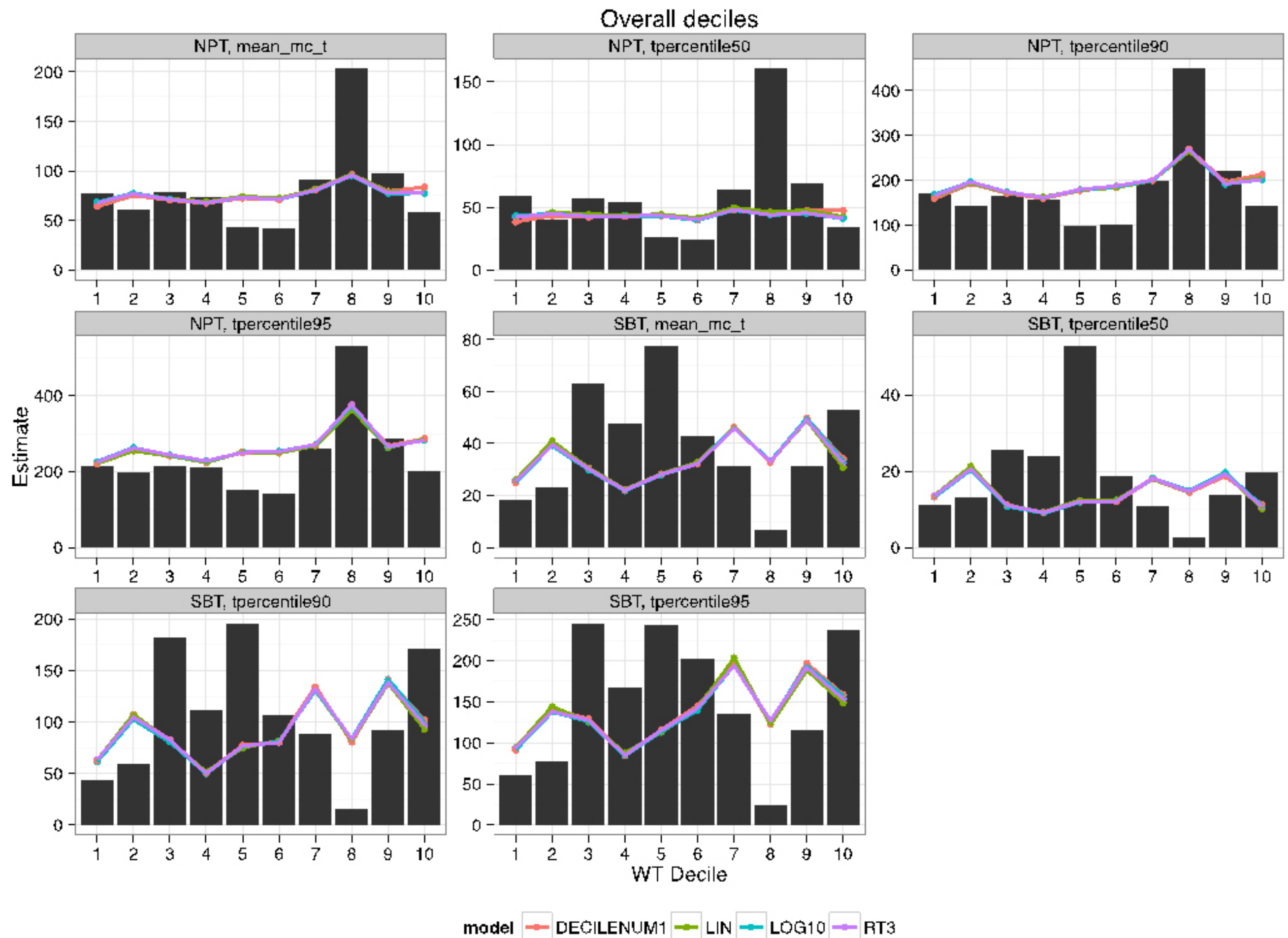


Figure E6. Comparison of *four forms of respondent weight adjustment* (color lines) to the categorical decile respondent weight adjustment (black bars). Model for *Group 1 species*. DECILENUM2 = the numerical decile of respondent weight (coded as 1-10), LIN = the original (untransformed) respondent weight, LOG10 = the $\log_{10}$ respondent weight, RT3 = the 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 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.

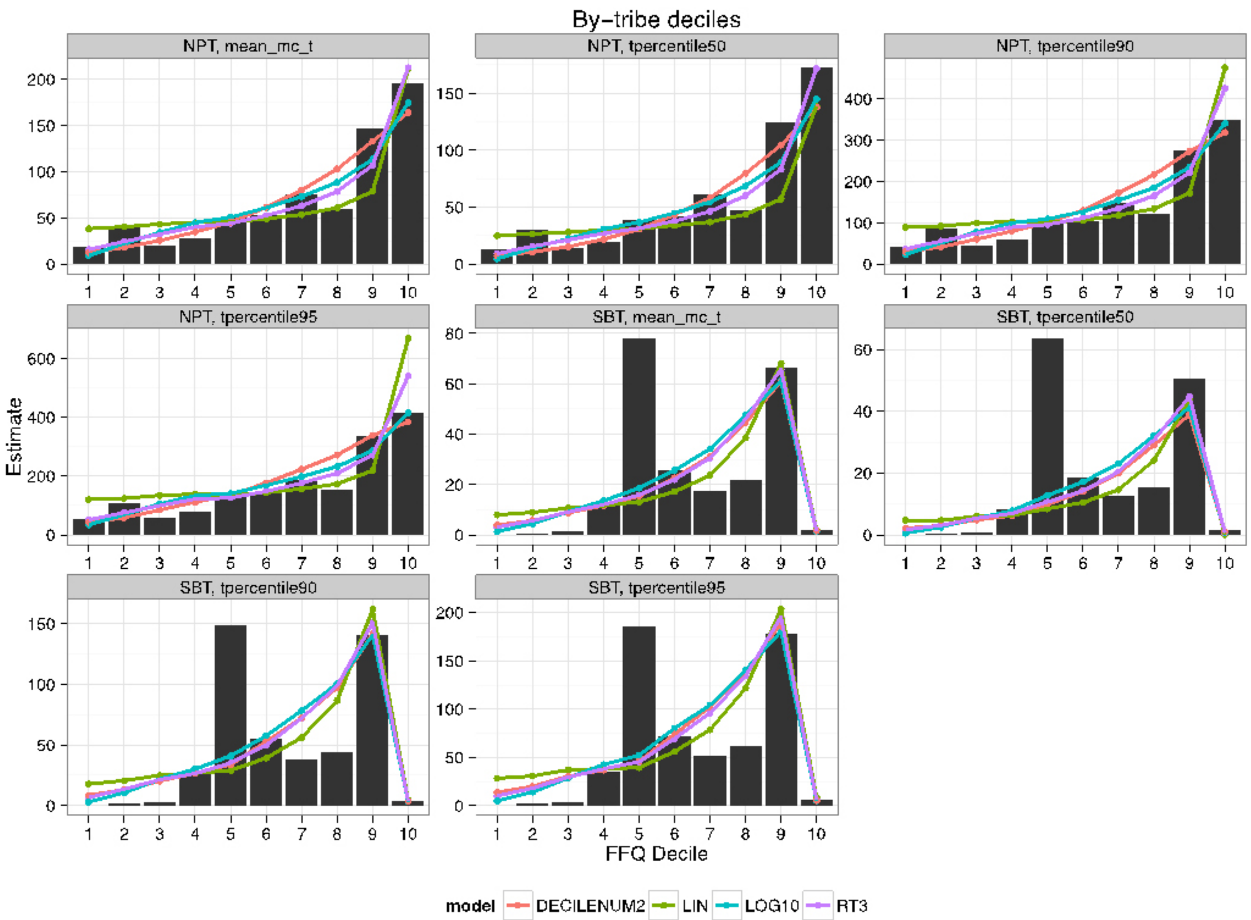


Figure E7. Comparison of *<u>four forms of FFQ adjustment</u>* (colored lines) to the categorical decile FFQ adjustment (black bars). Model for *<u>Group 2 species</u>*. DECILENUM2 = the numerical decile of FFQ (coded as 1-10), LIN = linear—the original (untransformed) FFQ, LOG10 = the $\log_{10}$ FFQ, RT3 = the 3rd root FFQ. All models included an addition adjustment for the 10th decile in 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).

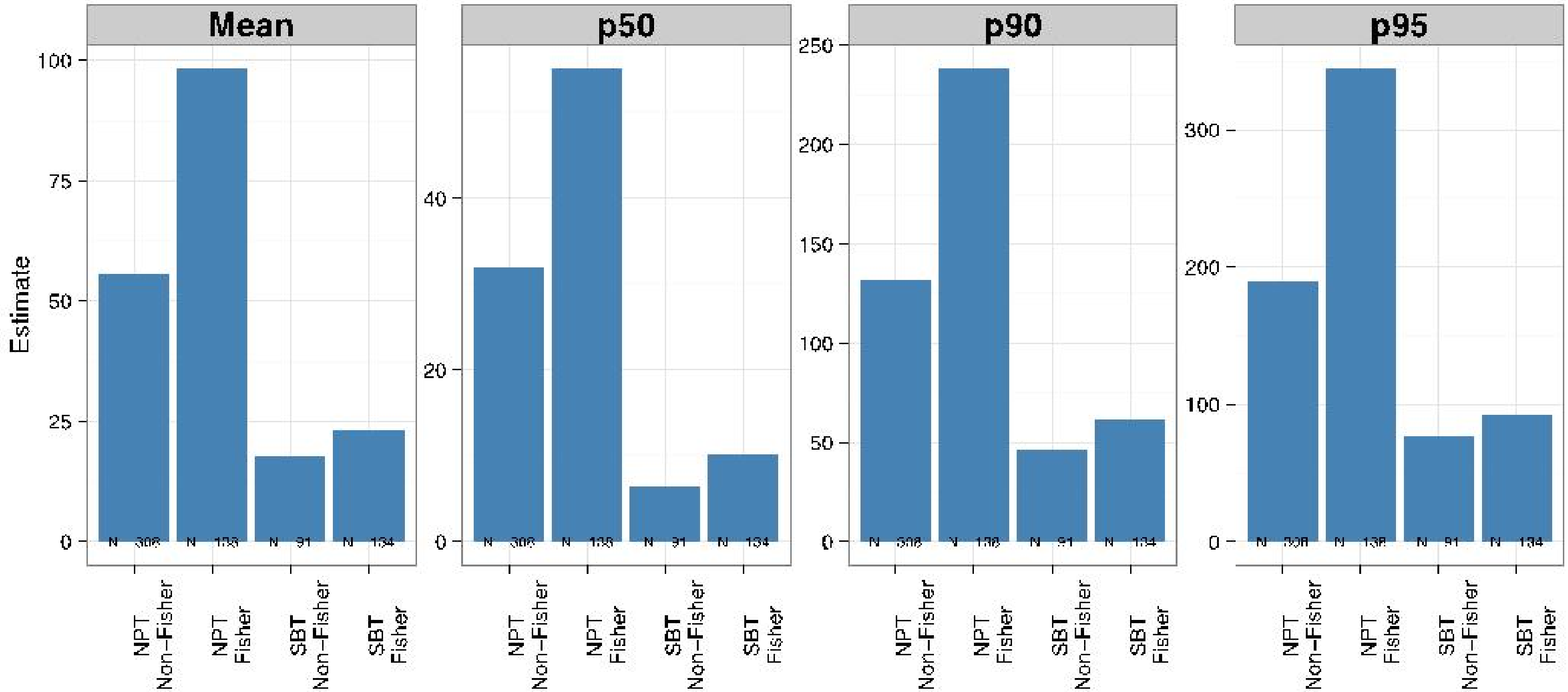


Figure E8. NCI-estimated mean and the 50th, 90th and 95th percentiles by *__the presence on the fishers list__* and tribe. Model for *__Group 2 species__*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for the SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

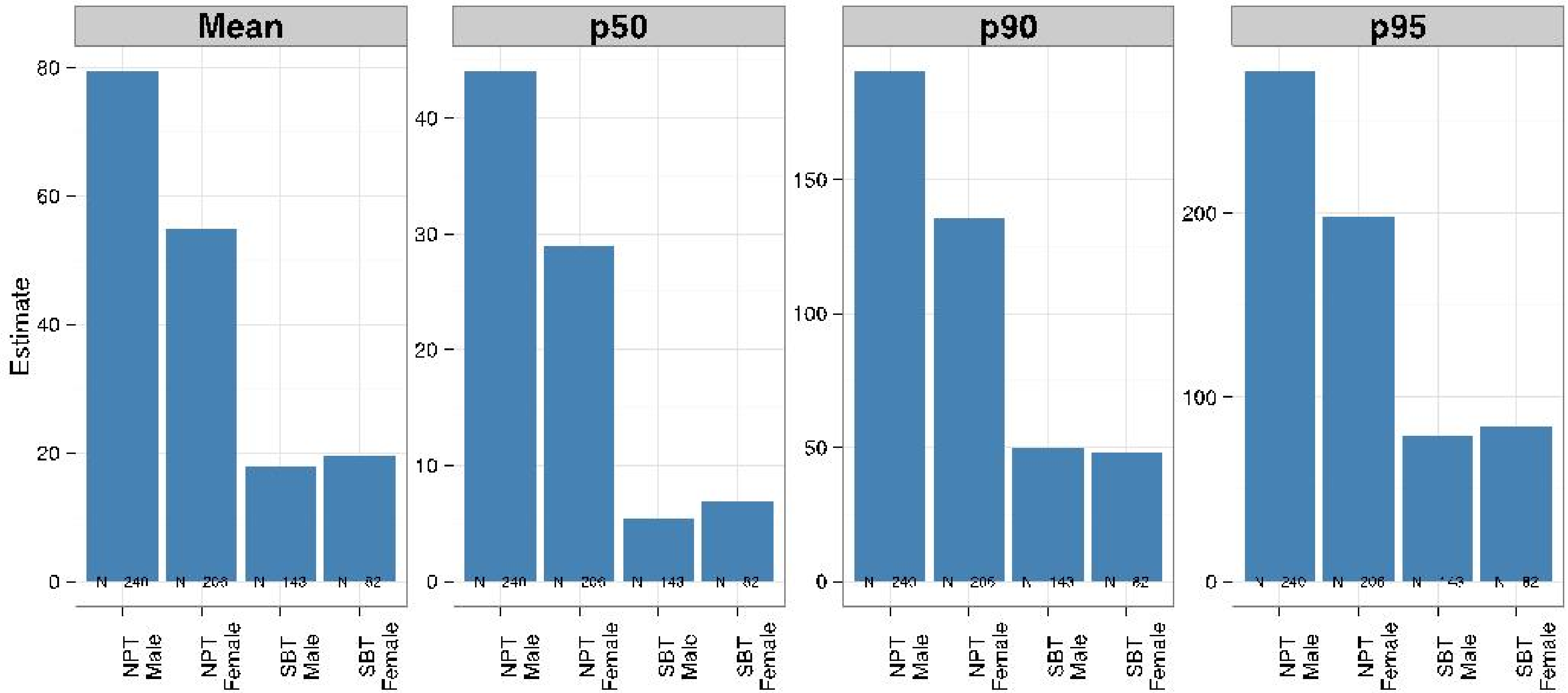


Figure E9. NCI-estimated mean and the 50th, 90th and 95th percentiles by *gender* and tribe. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

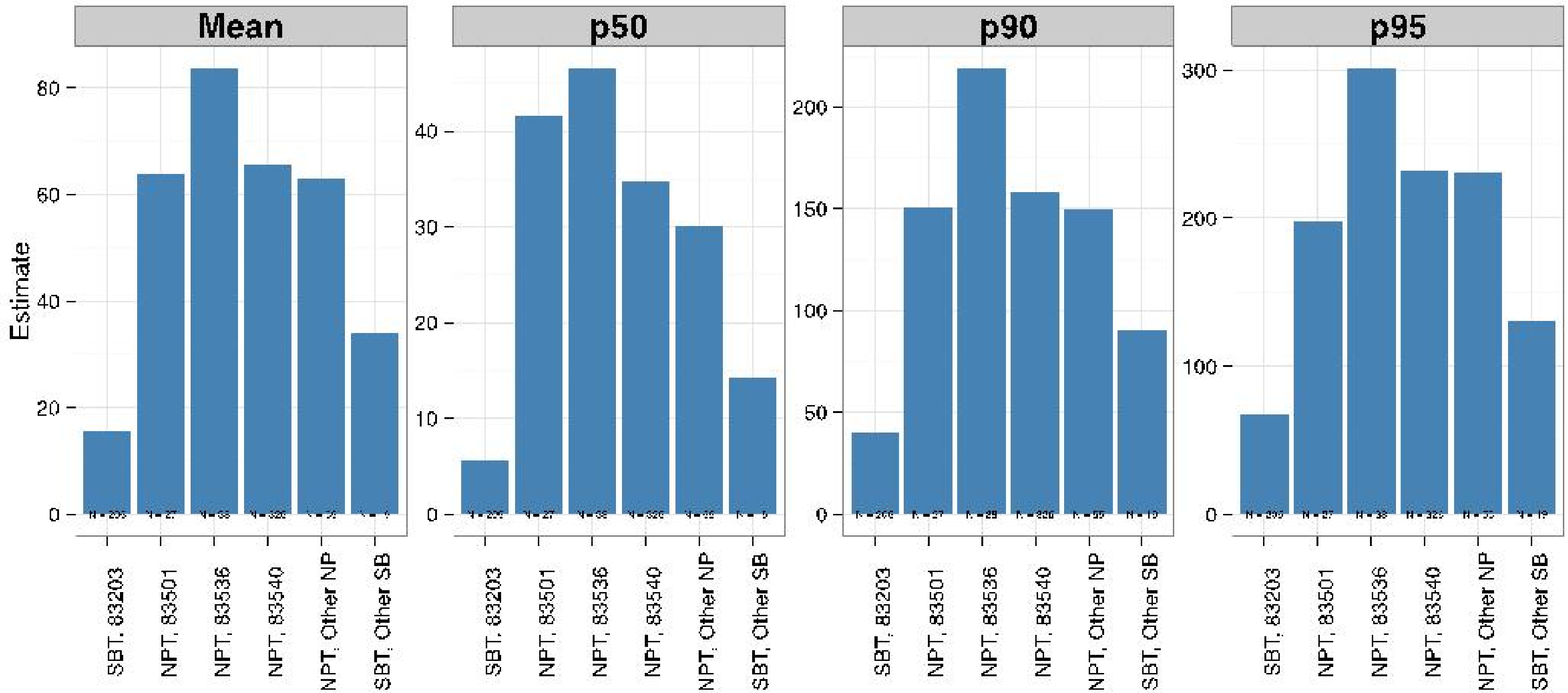


Figure E10. NCI-estimated mean and the 50th, 90th and 95th percentiles by *ZIP code*. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for the SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

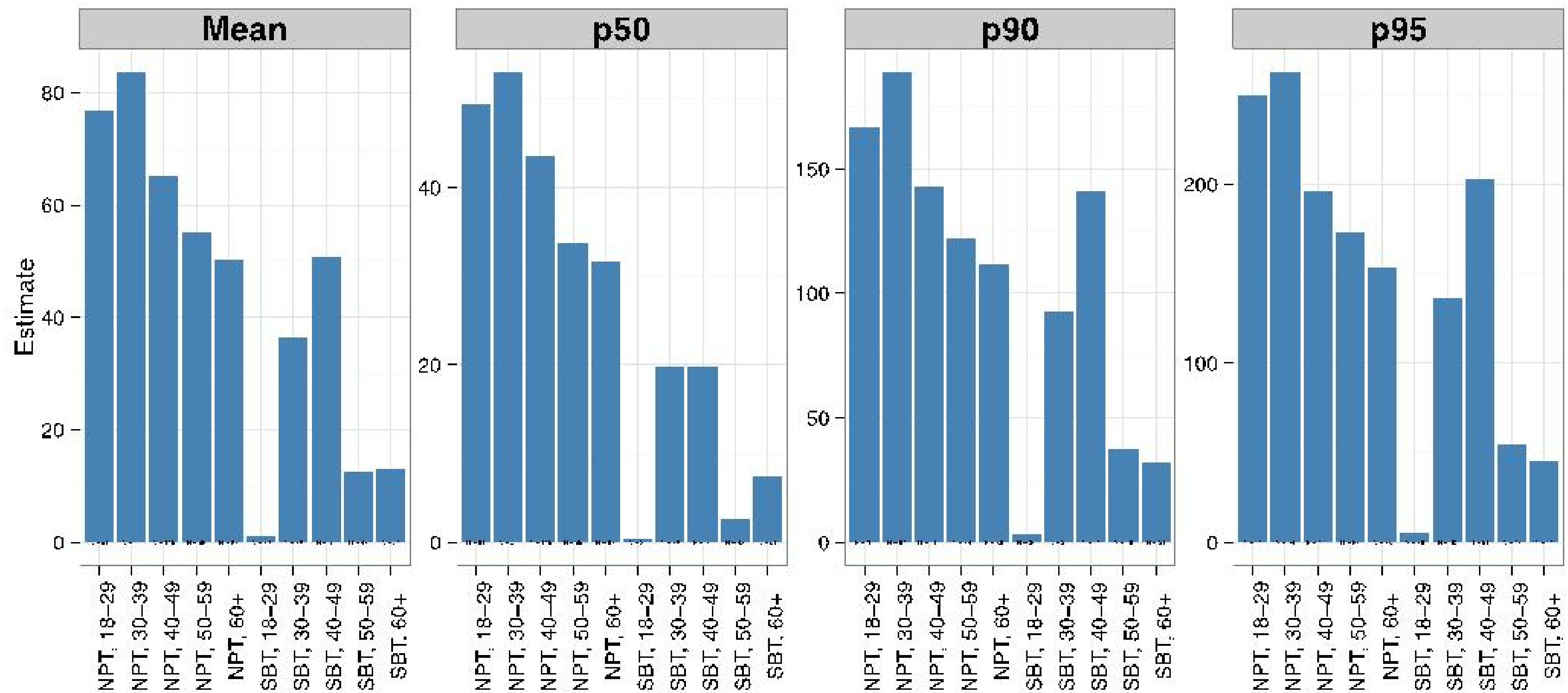


Figure E11. NCI-estimated mean and the 50th, 90th and 95th percentiles by *age* and tribe. Model for *Group 2 species*. Other covariates include the 3rd root of FFQ, its interaction with tribe and the indicator for SBT decile 10. Estimates are NCI estimates of daily consumption in g/day (raw weight, edible portion).

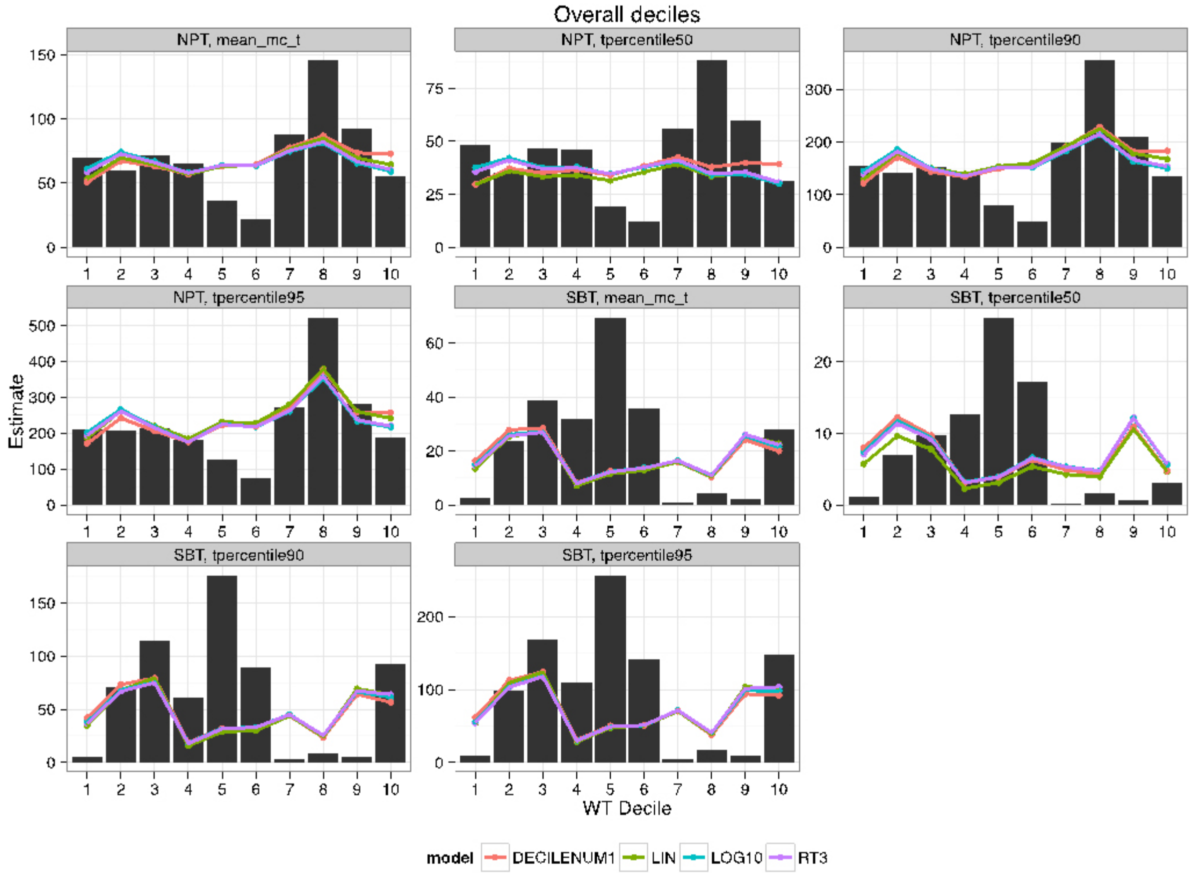


Figure E12. Comparison of *__four forms of respondent body weight adjustment__* (colored lines) to the categorical decile of respondent weight adjustment (black bars). Model for *__Group 2 species__*. DECILENUM2 = the numerical decile of respondent weight (coded as 1-10), LIN = the original (untransformed) 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

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.

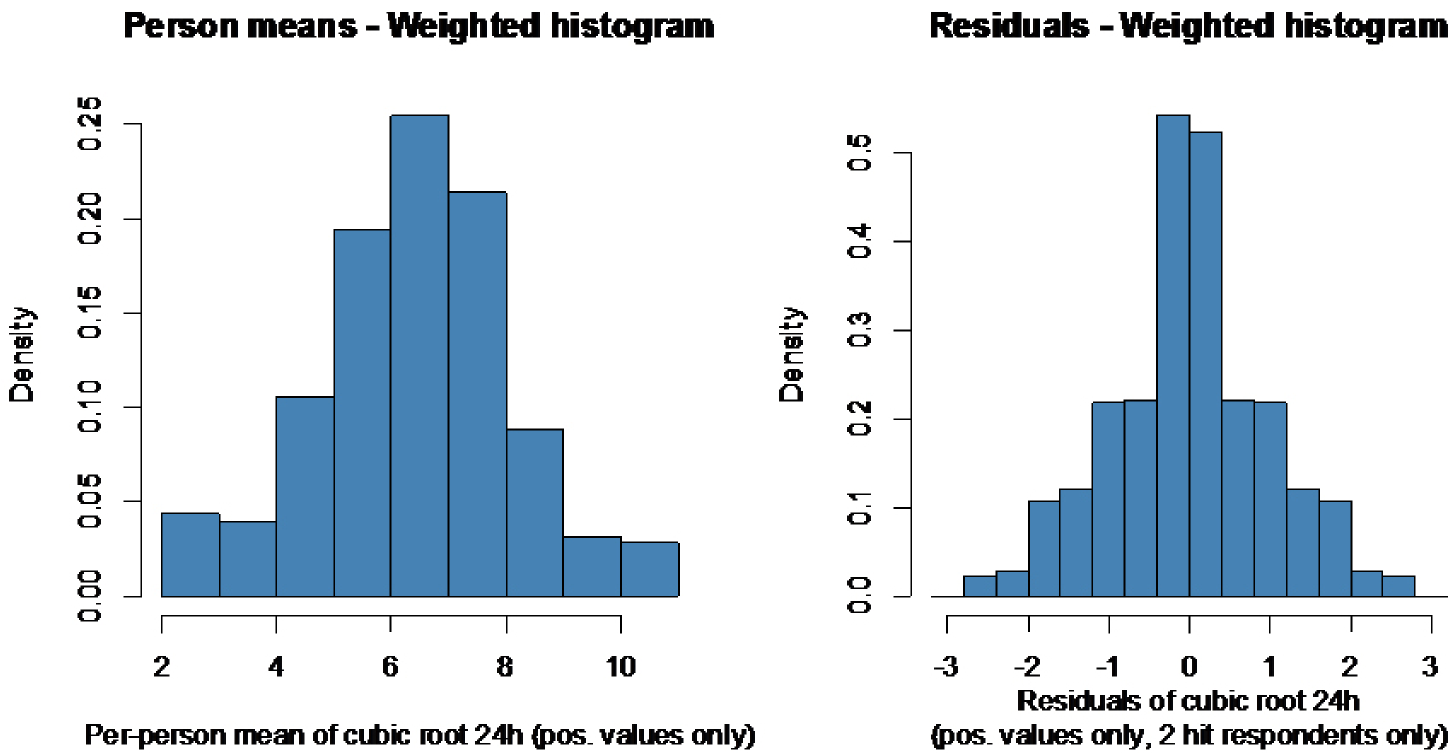


Figure E13. The (survey-weighted) distribution of the person-means and within-person residuals of the third root of the positive Group 1 consumption amounts. Both tribes combined. The units of the original values were g/day (raw weight, edible portion).

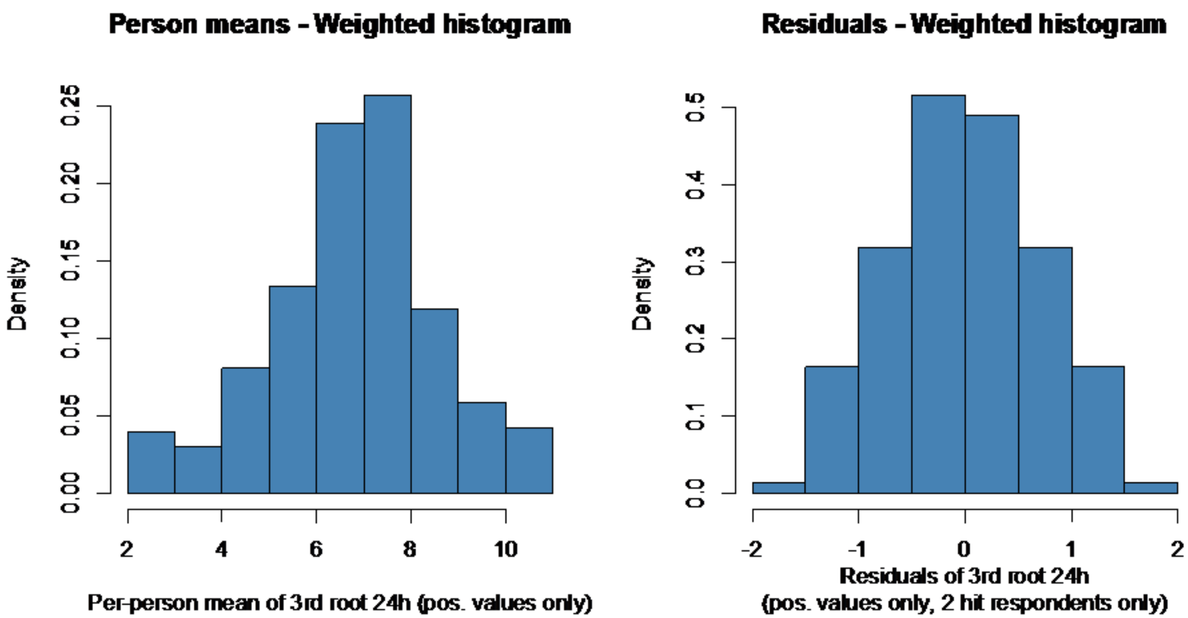


Figure E14. The (survey-weighted) distribution of the person-means and within-person residuals of the third root of the positive Group 2 consumption amounts. Both tribes combined. The units of the original values were g/day (raw weight, edible portion).

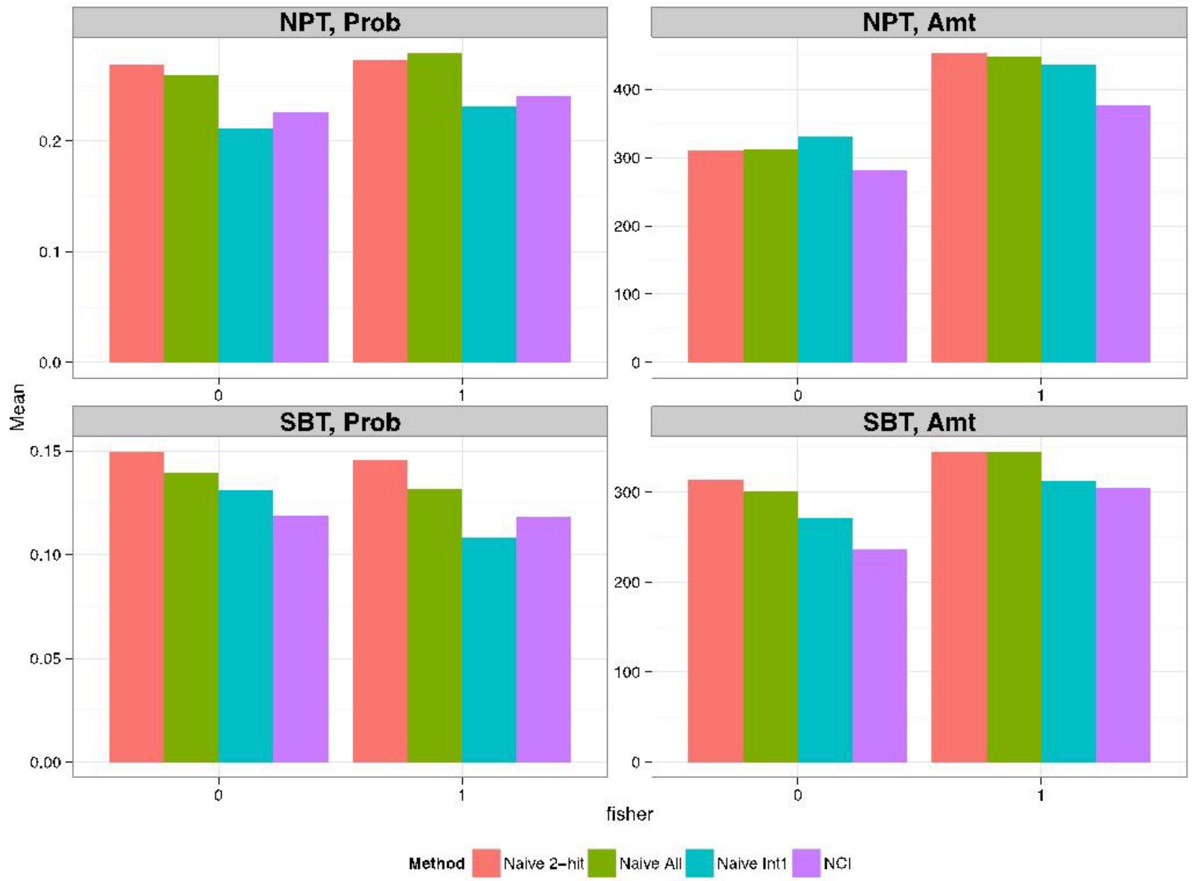


Figure E15. Quality checking of NCI model for *__Group 1 species__*. Consumption probability and mean amount on consumption days by *__the respondent's presence on the fishers list__*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). 0 = not on the fishers 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.

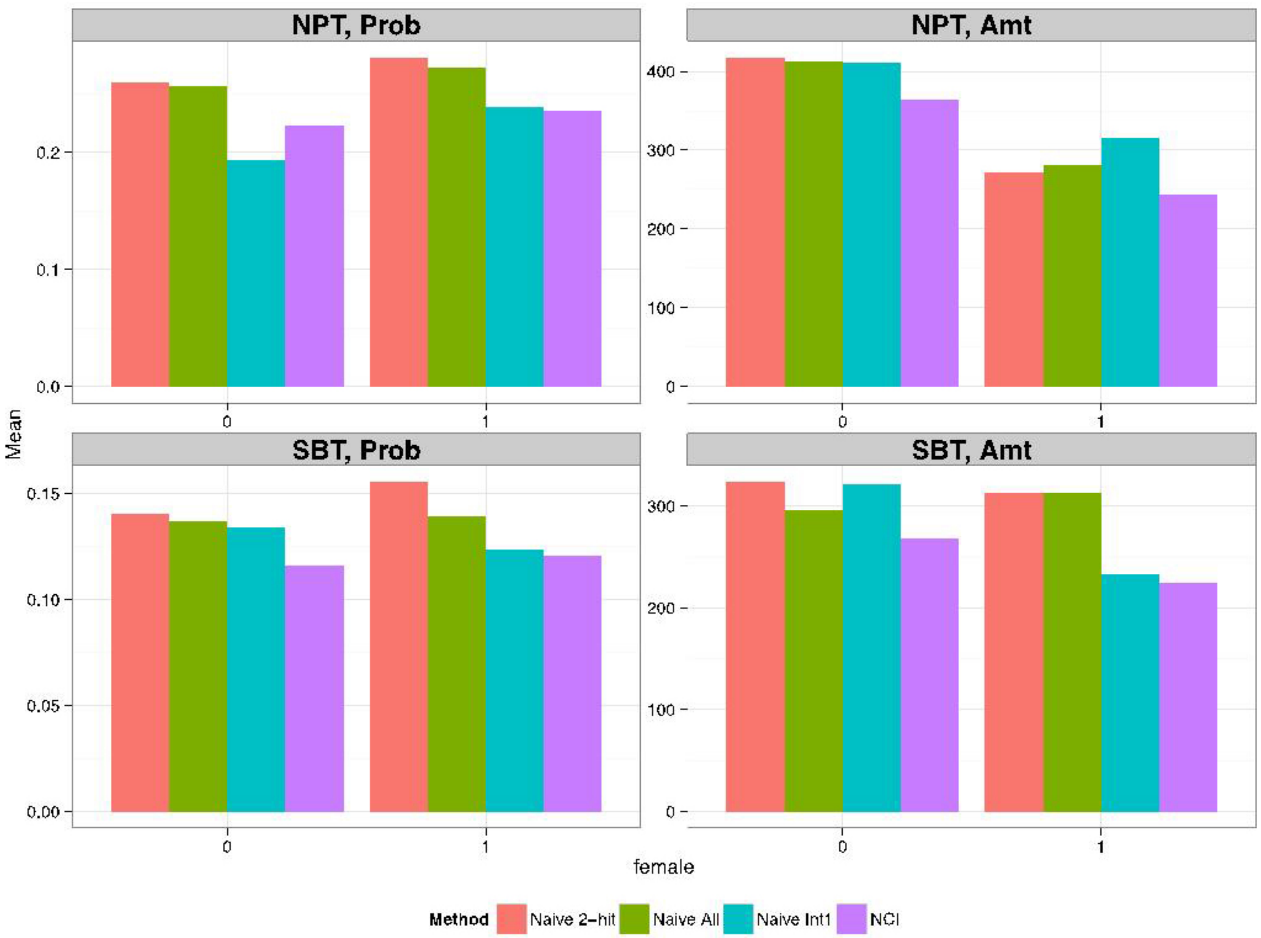


Figure E16. Quality checking of NCI model for *__Group 1 species__*. Consumption probability and mean amount on consumption days by *__the respondent's gender__*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). 0 = men. 1= women. The y-axis shows either the 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.

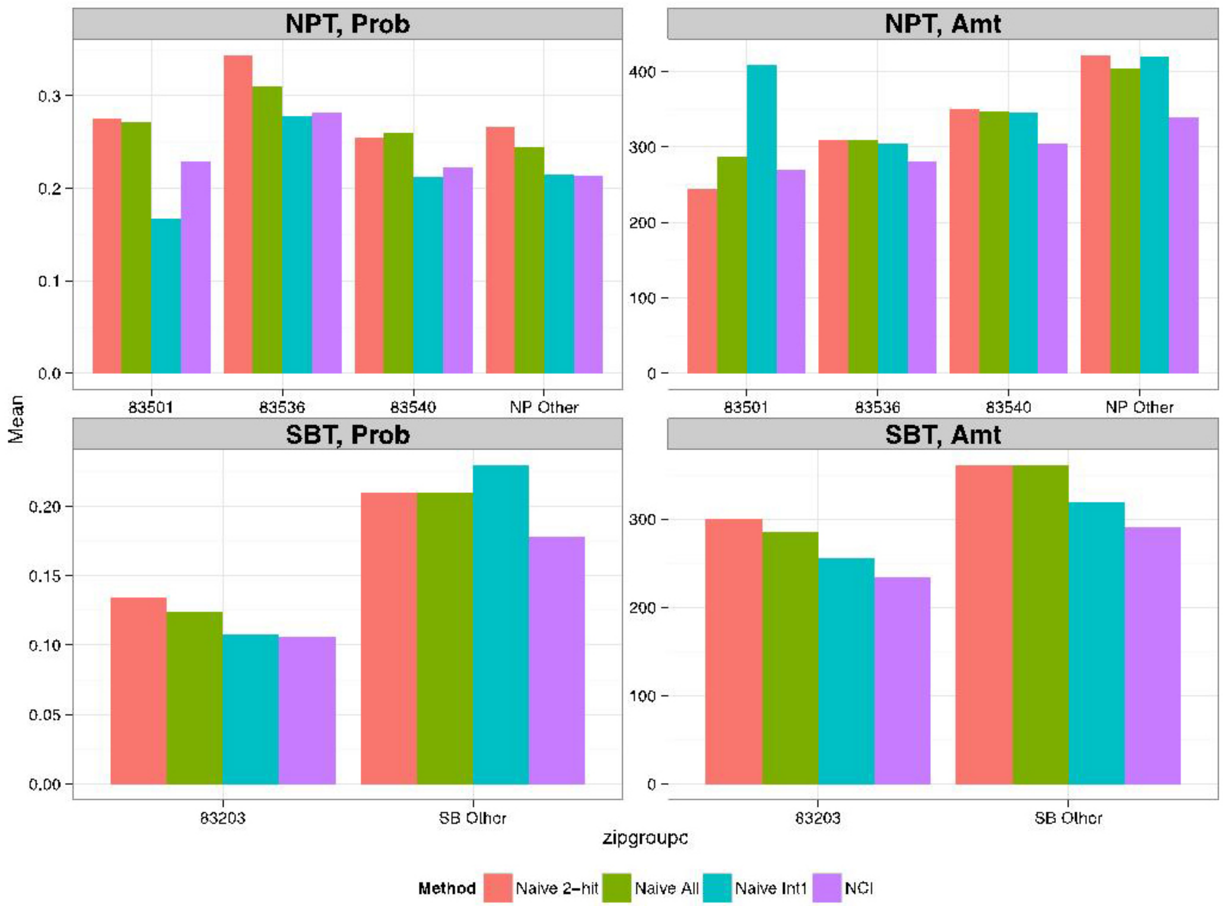


Figure E17. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's ZIP code*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the consumption probability (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.

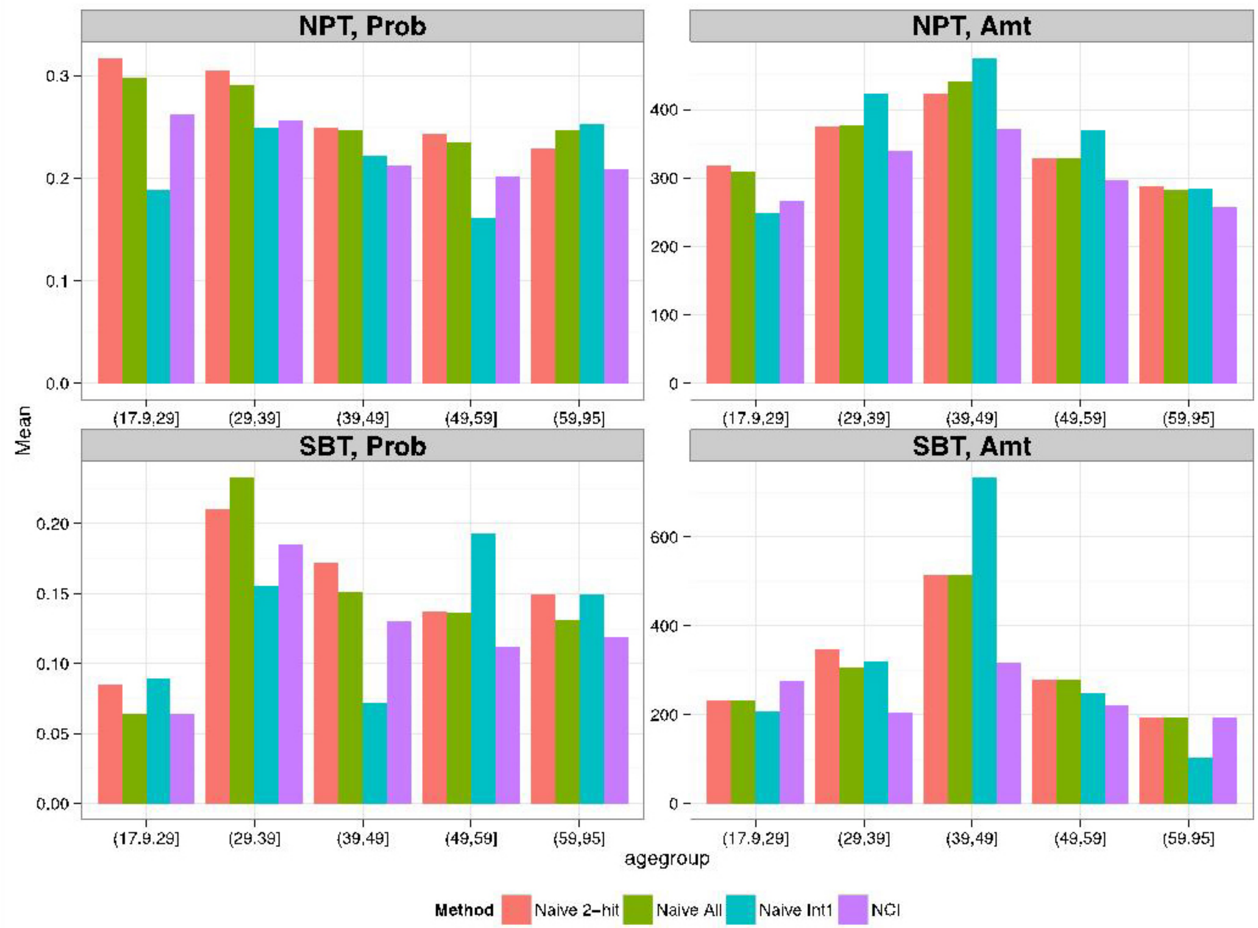


Figure E18. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's age*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the consumption probability (between 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.

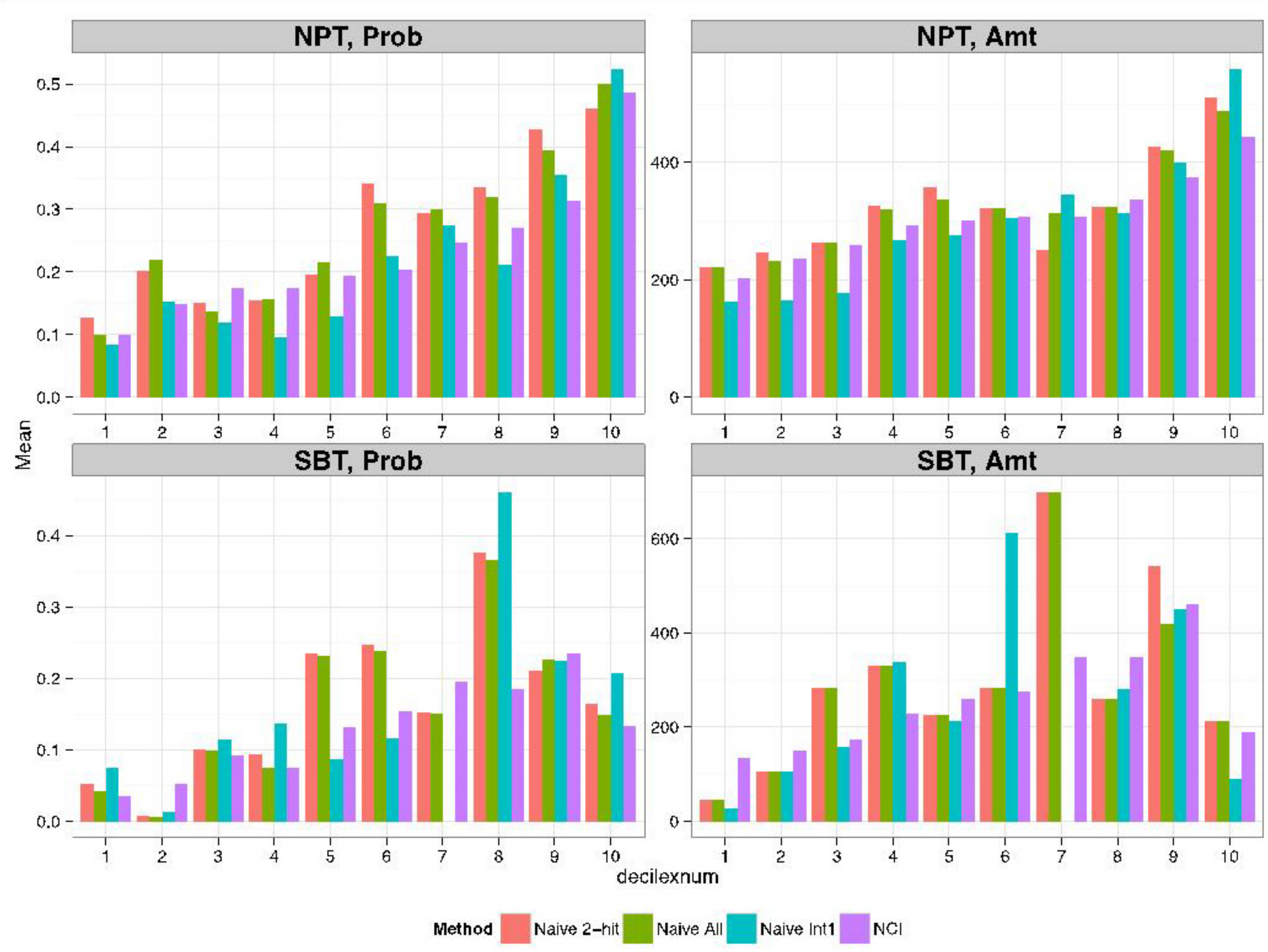


Figure E19. Quality checking of NCI model for *Group 1 species*. Consumption probability and mean amount on consumption days by *the respondent's decile of group 1 FFQ consumption*. Prob = Probability, Amt = positive consumption amount (in g/day, raw weight, edible portion). The y-axis shows either the 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. 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.

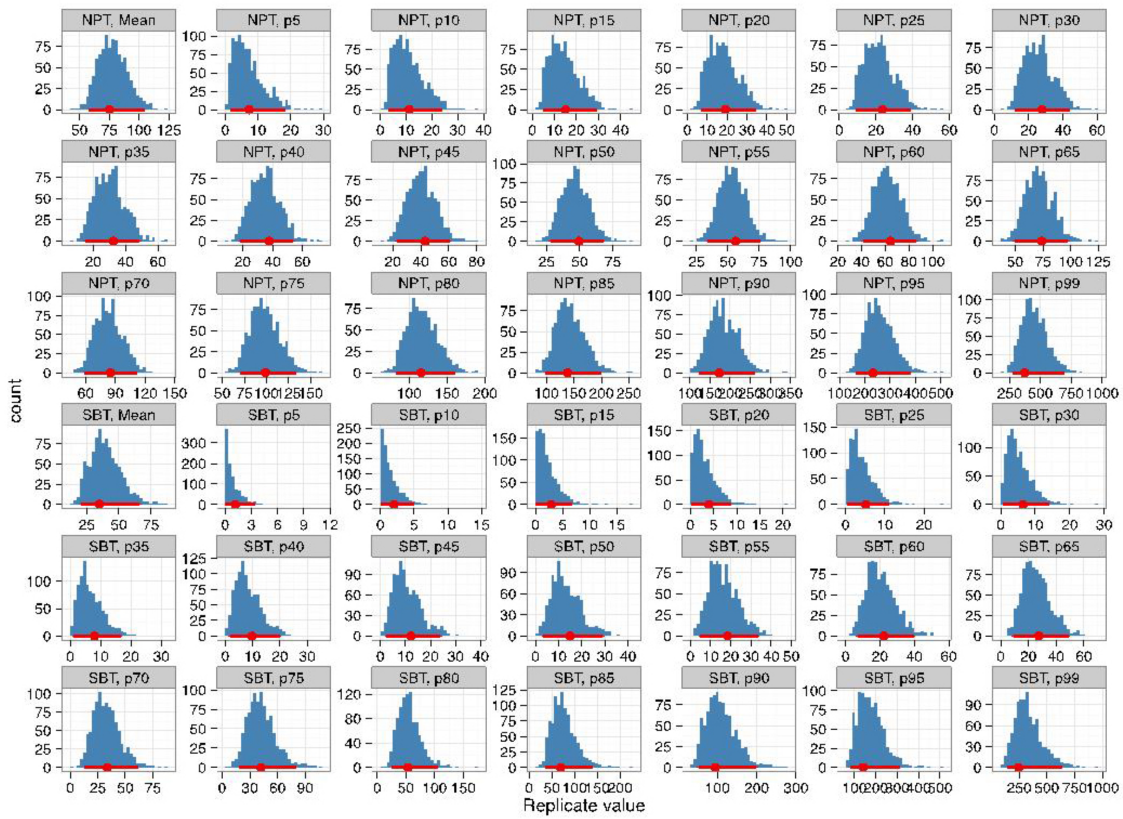


Figure E20. *Bootstrap distribution* of the NCI method estimated means and selected percentiles for all NPT and SBT respondents. N=978 bootstraps (22 of the 1000 bootstraps did not converge). *Group 1 consumption* (in g/day, raw weight, edible portion). Red dot shows the point estimate and the red bar around it shows the 95% confidence interval.

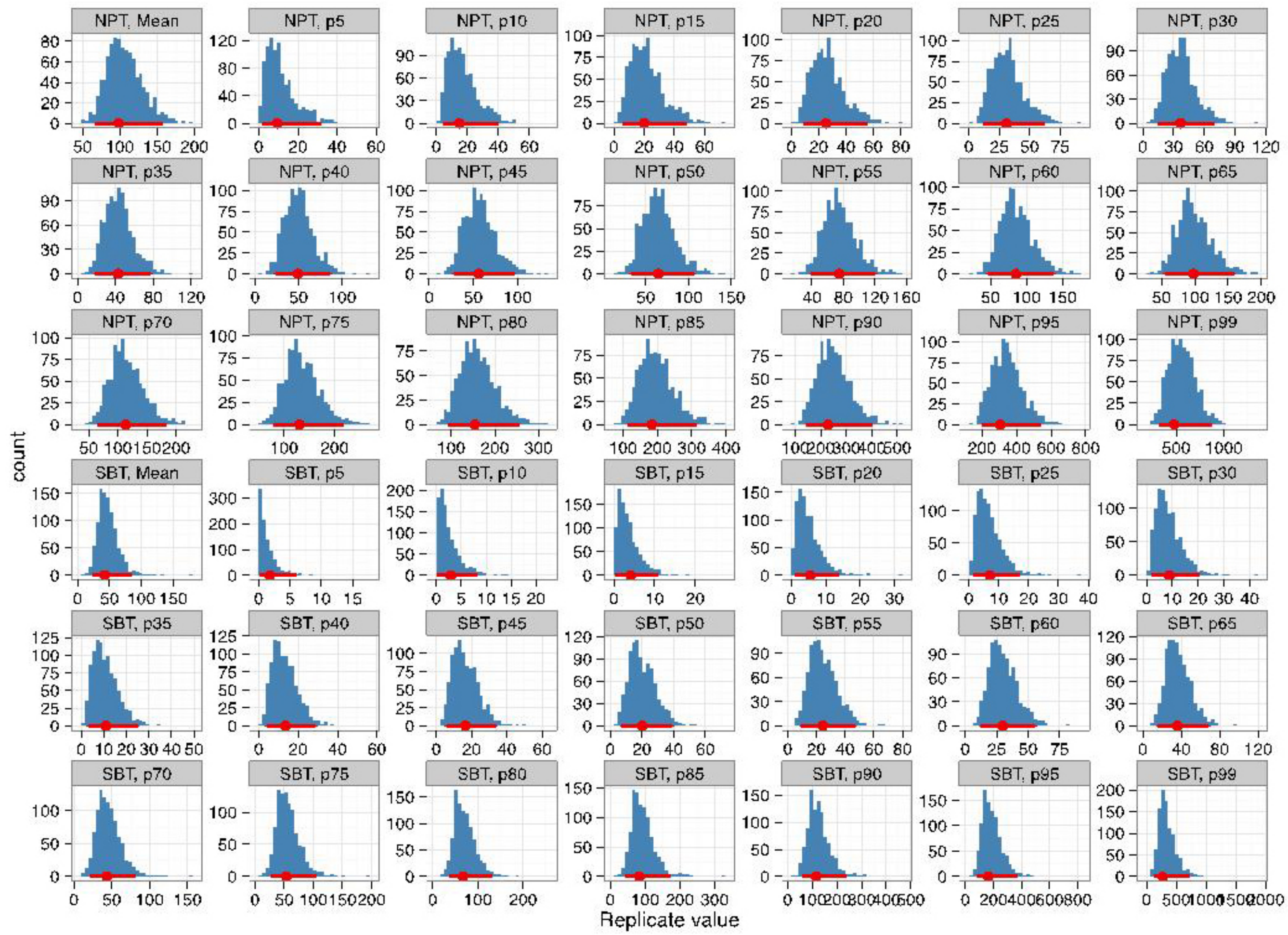


Figure E21. _Bootstrap distribution_ of the NCI method estimated means and selected percentiles for NPT and SBT respondents on the fishers list. N=978 bootstraps (22 of the 1000 bootstraps did not converge). _Group 1 consumption_ (in g/day, raw weight, edible portion). Red dot shows the point estimate and the red bar around it shows the 95% confidence interval.

4. 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 3rd root of FFQ. Group 1 consumption.

				(A) Final model		(B) Log10 FFQ model		% 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	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 Mean	(A) Final model 95th Percentile	(B) Log10 FFQ model Mean	(B) Log10 FFQ model 95th Percentile	% difference (B-A)/A *100% Mean	% difference (B-A)/A *100% 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.

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	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.

				(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	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 Mean	(A) Final model 95th Percentile	(B) Simpler model Mean	(B) Simpler model 95th Percentile	% difference (B-A)/A *100% Mean	% difference (B-A)/A *100% 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. NCI Method—Covariate Selection: Assessment of Seasonality

Figure E22 shows the survey-weighted mean[7] 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.

[7] 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).

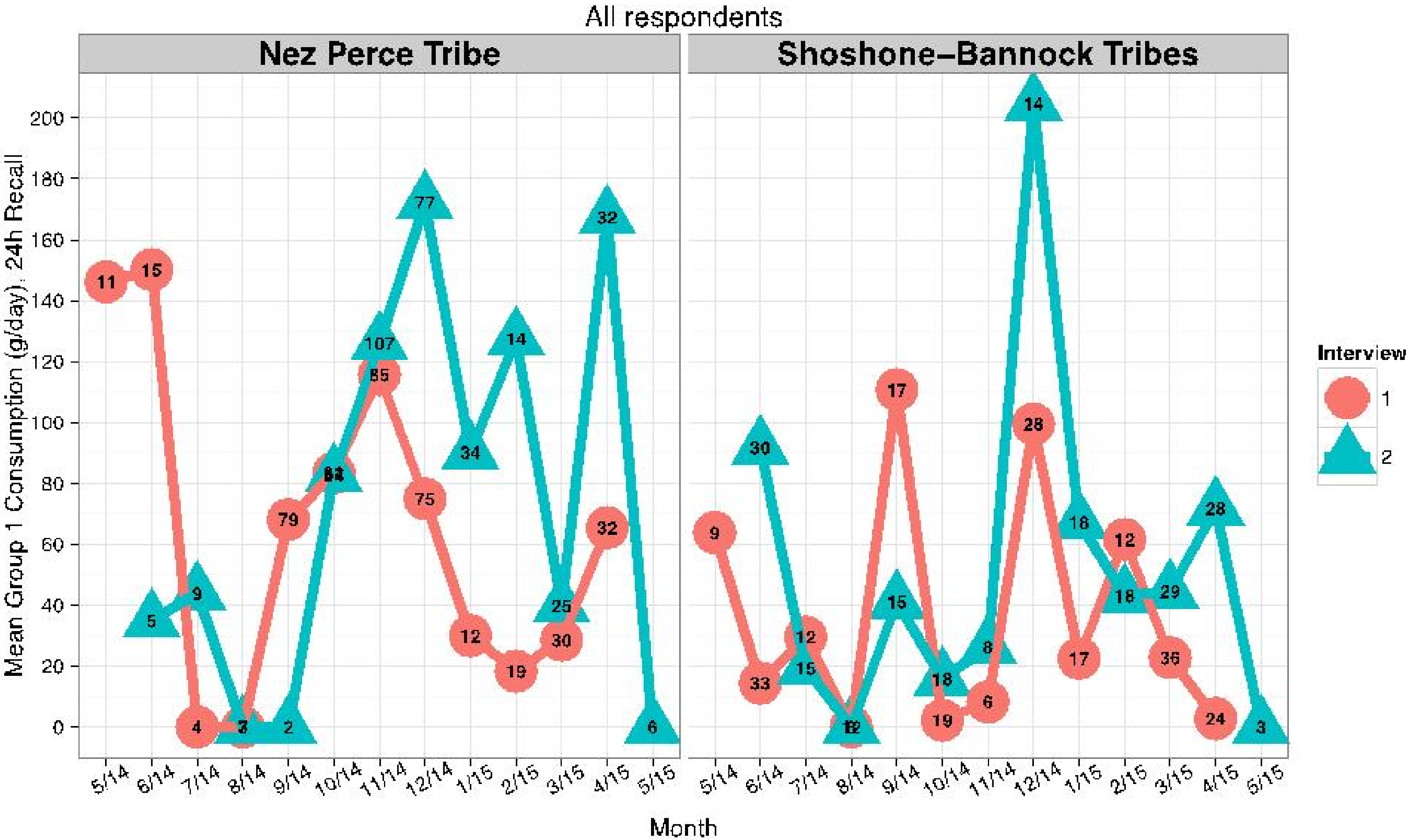


Figure E22. ***Seasonality for Group 1 species consumption on the 24-hour recall.*** **Mean 24-hour recall for species Group 1 consumption (g/day, raw weight, edible portion) by tribe, month and interview number (1st or 2nd 24-hour recall interview). Numbers within each month's dot are the sample size. One very large data point for a single NPT second interview during May (5/14) was excluded from this seasonal analysis**

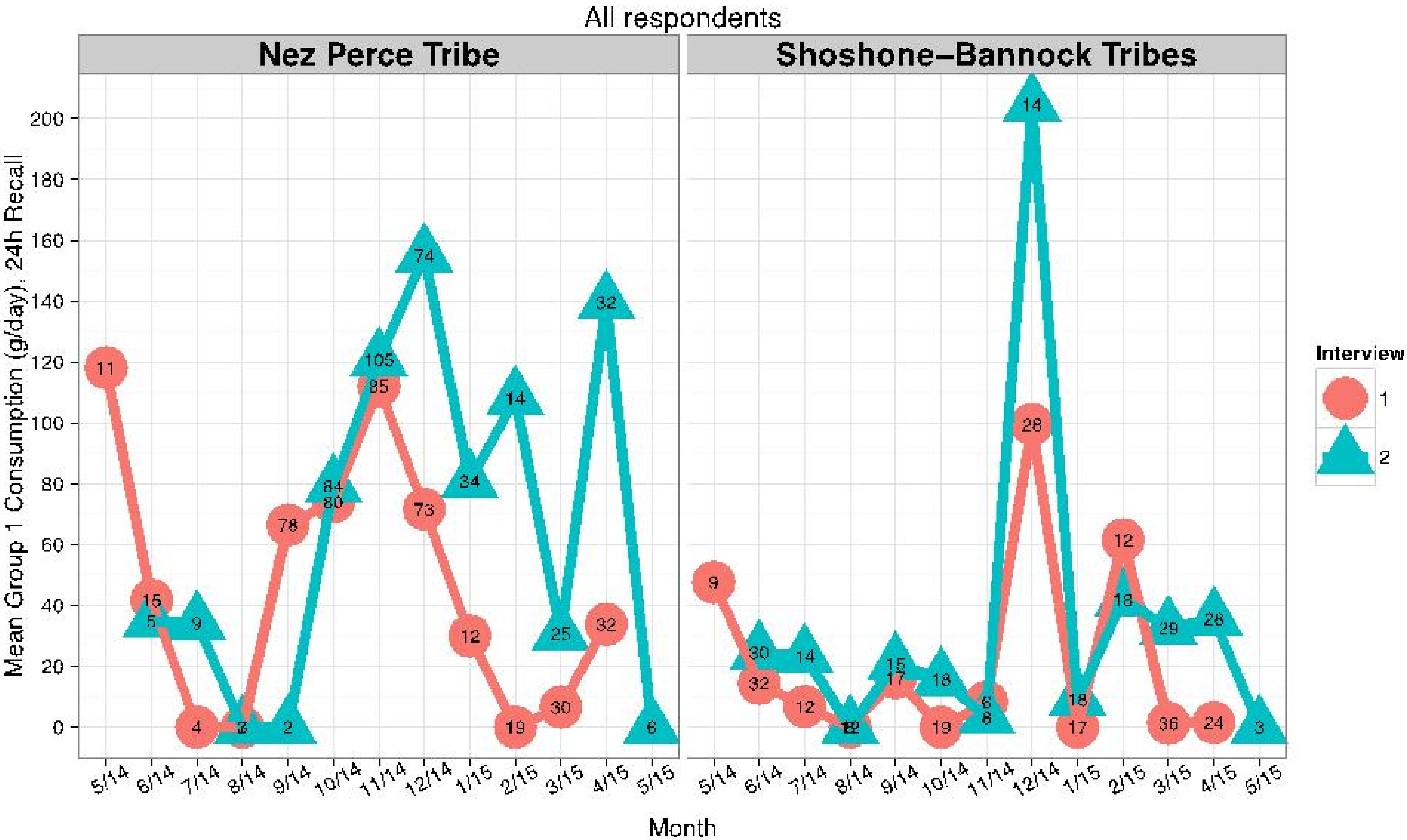


Figure E23. ***Seasonality for Group 2 species consumption on the 24-hour recall.*** **Mean 24-hour recall for species Group 2 consumption (g/day, raw weight, edible portion) by tribe, month and interview number. Numbers within each month's dot are the sample size. One outlier data point for a single NPT second interview during May (5/14) was excluded.**

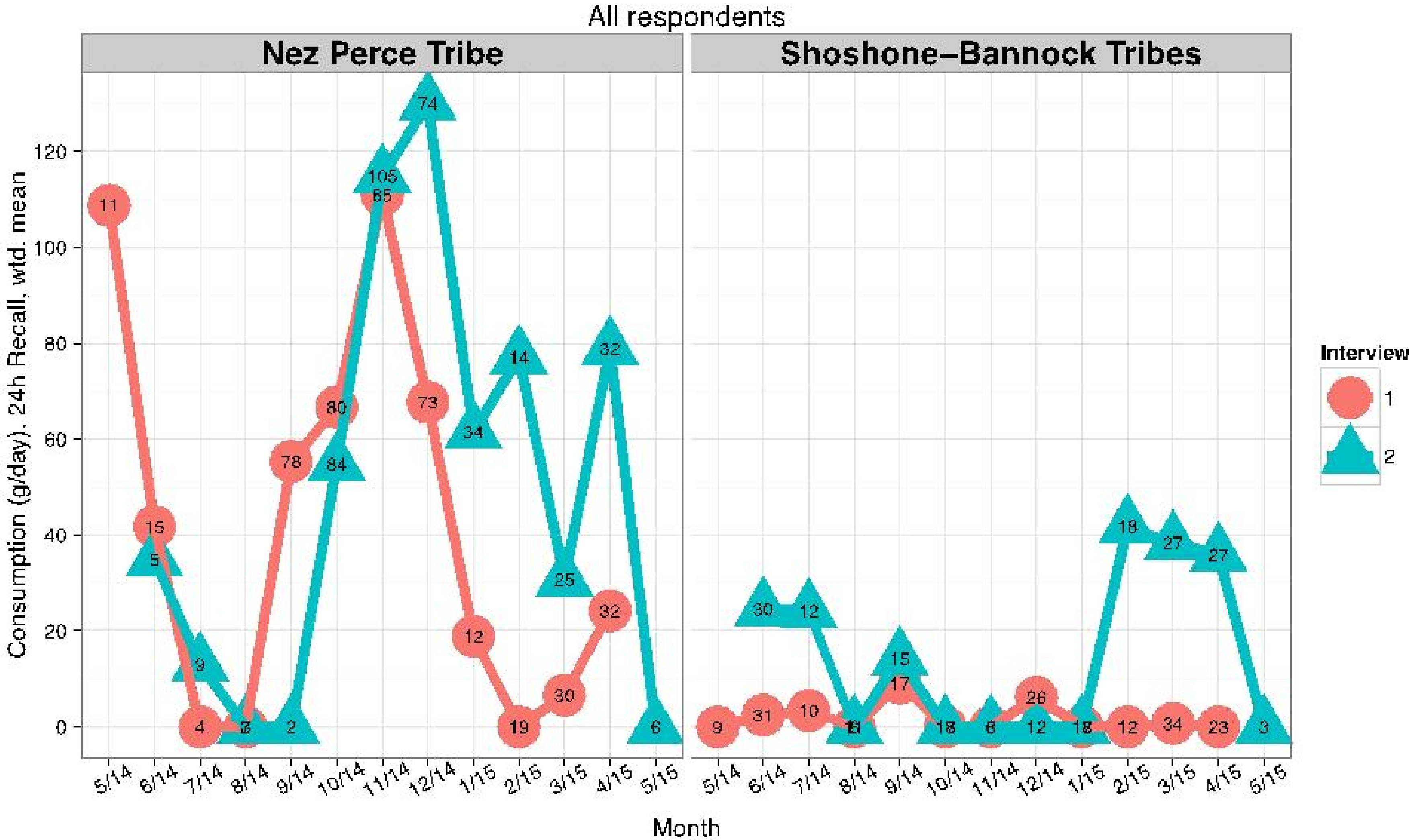


Figure E24. ***Seasonality for salmon and steelhead consumption on the 24-hour recall.*** **Mean 24-hour recall consumption rate (g/day, raw weight, edible portion) for all salmon and steelhead species (combined) by tribe, interview month and interview number (1st and 2nd interview). Numbers within each month's dot are the sample size. One outlier data point for a single NPT second interview during May (5/14) was excluded.**

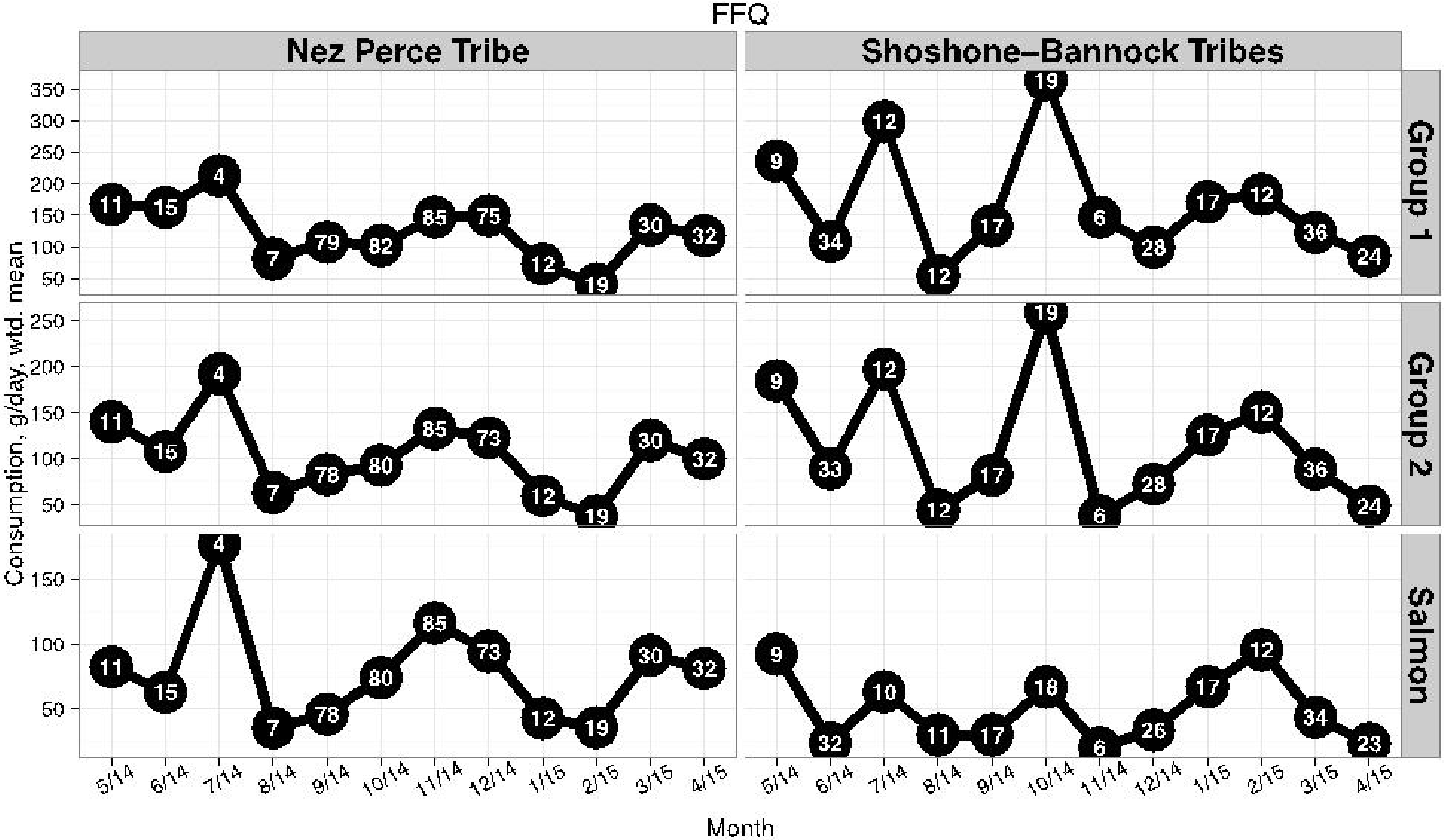


Figure E25. ***Seasonality for Group 1 species, Group 2 species and salmon+steelhead consumption on the FFQ.*** **Mean Group 1 FFQ consumption rate (g/day, raw weight, edible portion) by tribe, species group and interview month. Numbers within each month's dot are the sample size. Salmon: all salmon and steelhead species combined.**

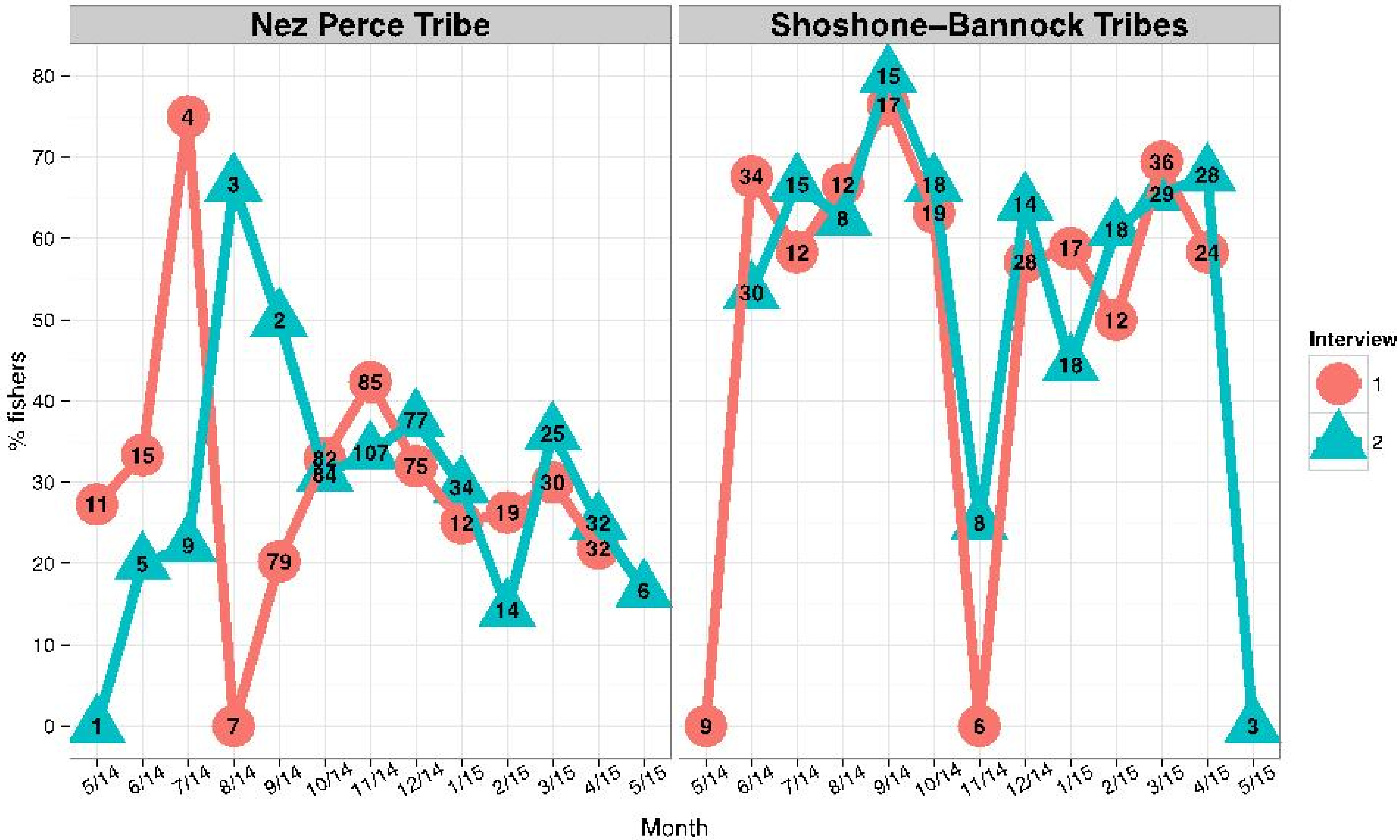


Figure E26. ***Seasonality in the % fisher respondents.*** **Percentages of fishers among respondents by tribe, interview month and interview number (1st and 2nd interviews). Numbers within each month's dot are the sample size.**

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. Shoshone-Bannock Tribes. 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	0.84-16.26	23	344	3	9.2	2.4	-6.7	0.27
2	17.06-27.78	22	285	2	22.7	0.7	-22.1	0.03
3	28.49-43.03	23	237	4	36.3	27.7	-8.5	0.77
4	44.12-68.55	22	295	5	56.0	25.0	-31.0	0.45
5	69.57-95.91	23	265	6	81.1	49.7	-31.4	0.61
6	99.61-129.71	23	196	9	114.0	73.5	-40.5	0.64
7	132.66-177.17	22	152	5	154.6	105.4	-49.2	0.68
8	179.94-230.09	22	84	8	202.2	118.6	-83.6	0.59
9	232.79-342.88	23	312	8	280.4	91.5	-188.9	0.33
10	358.22-1068	23	272	6	662.7	31.8	-630.9	0.05
All		226	2442	56	158.5	43.3	-115.2	0.27

Table F2. Shoshone-Bannock Tribes. 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	0.06-12.24	23	344	0	5.3	0.0	-5.3	0.00
2	0.00-23.80	22	285	1	12.4	0.5	-11.9	0.04
3	0.66-41.47	23	237	2	25	19.1	-6.0	0.76
4	8.39-65.24	22	295	3	38.9	5.2	-33.7	0.13
5	11.95-86.10	23	265	4	54.1	24.7	-29.3	0.46
6	1.22-120.68	23	196	6	75.4	34.5	-40.9	0.46
7	54.10-158.24	22	152	3	108.2	92.2	-16.0	0.85
8	22.98-223.00	22	84	5	129.5	112.8	-16.6	0.87
9	132.86-329.21	23	312	5	224.5	60.2	-164.3	0.27
10	84.70-1029	23	272	2	435.6	3.3	-432.3	0.01
All		226	2442	31	109.7	25.7	-84.0	0.23

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. Shoshone-Bannock Tribes. 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	226	56	158.5	43.3	-115.2	0.27
Group 2	226	31	109.7	25.7	-84.0	0.23
Non-Group 2	226	31	48.8	17.6	-31.2	0.36
Group 3	226	14	44.3	8.4	-35.9	0.19
Group 4	226	3	11.7	2.3	-9.4	0.20
Group 6	226	40	97.7	32.4	-65.3	0.33

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. Shoshone-Bannock Tribes. 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	23	6	662.7	31.8	-630.9	0.05
Group 2	23	2	435.6	3.3	-432.3	0.01
Non-Group 2	23	5	227.1	28.5	-198.6	0.13
Group 3	23	0	136.9	0.0	-136.9	0.00
Group 4	23	1	49.6	2.5	-47.1	0.05
Group 6	23	5	467.3	29.3	-438.0	0.06

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. Shoshone-Bannock Tribes. 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	23	8	280.4	91.5	-188.9	0.33
Group 2	23	5	224.5	60.2	-164.3	0.27
Non-Group 2	23	4	55.9	31.3	-24.6	0.56
Group 3	23	3	112.7	16.5	-96.2	0.15
Group 4	23	0	15.5	0.0	-15.5	0.00
Group 6	23	6	133.6	75.0	-58.6	0.56

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. Shoshone-Bannock Tribes. 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	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean consumption,	158.5	9.2	22.7	36.3	56.0	81.1	114.0	154.6	202.2	280.4	662.7
24h mean consumption,	43.3	2.4	0.7	27.7	25.0	49.7	73.5	105.4	118.6	91.5	31.8
24h/FFQ mean	0.27	0.27	0.03	0.77	0.45	0.61	0.64	0.68	0.59	0.33	0.05
Group 2											
FFQ mean consumption,	109.7	5.3	12.4	25.0	38.9	54.1	75.4	108.2	129.5	224.5	435.6
24h mean consumption,	25.7	0.0	0.5	19.1	5.2	24.7	34.5	92.2	112.8	60.2	3.3
24h/FFQ mean	0.23	0.00	0.04	0.76	0.13	0.46	0.46	0.85	0.87	0.27	0.01
Group 3											
FFQ mean consumption,	44.3	3.2	4.8	8.6	17.2	29.5	36.0	31.7	76.8	112.7	136.9
24h mean consumption,	8.4	0.0	0.5	18.7	0.8	17.1	6.9	3.3	50.3	16.5	0.0
24h/FFQ mean	0.19	0.00	0.10	2.18	0.05	0.58	0.19	0.10	0.65	0.15	0.00
Group 4											
FFQ mean consumption,	11.7	0.4	2.3	1.8	1.6	8.7	8.6	15.2	27.8	15.5	49.6
24h mean consumption,	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.5	0.0	2.5
24h/FFQ mean	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.14	0.00	0.05
Group 5											
FFQ mean consumption,	4.7	0.1	0.1	1.6	0.5	3.7	2.9	6.3	1.9	18.5	8.9
24h mean consumption,	0.1	0.0	0.0	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.0
24h/FFQ mean	0.02	0.00	0.00	0.00	0.67	0.00	0.19	0.00	0.00	0.00	0.00
Group 6											
FFQ mean consumption,	97.7	5.5	15.4	24.3	36.6	39.3	66.6	101.4	95.7	133.6	467.3
24h mean consumption,	32.4	2.4	0.2	9.1	23.9	32.6	66.0	102.1	8.9	75.0	29.3
24h/FFQ mean	0.33	0.45	0.01	0.37	0.65	0.83	0.99	1.01	0.09	0.56	0.06
Group 7											
FFQ mean consumption,	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
24h mean consumption,	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	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. Shoshone-Bannock Tribes. 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	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean frequency, %	34%	5%	10%	16%	19%	33%	33%	44%	45%	70%	81%
24h mean frequency, %	14%	4%	1%	10%	8%	23%	24%	15%	33%	25%	15%
24h/FFQ mean frequency	0.40	0.80	0.06	0.63	0.39	0.69	0.72	0.35	0.74	0.35	0.18
Group 2											
FFQ mean frequency, %	24%	2%	4%	9%	10%	21%	22%	26%	27%	50%	72%
24h mean frequency, %	6%	0%	0%	4%	1%	11%	8%	8%	30%	11%	10%
24h/FFQ mean frequency	0.27	0.00	0.06	0.49	0.10	0.52	0.36	0.31	1.12	0.22	0.14
Group 3											
FFQ mean frequency, %	10%	1%	1%	4%	4%	10%	9%	7%	13%	22%	29%
24h mean frequency, %	3%	0%	0%	4%	0%	7%	2%	1%	15%	7%	0%
24h/FFQ mean frequency	0.28	0.00	0.17	1.17	0.09	0.66	0.21	0.09	1.10	0.31	0.00
Group 4											
FFQ mean frequency, %	4%	0%	1%	1%	1%	4%	3%	5%	6%	4%	15%
24h mean frequency, %	1%	0%	0%	0%	0%	0%	0%	0%	14%	0%	4%
24h/FFQ mean frequency	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.14	0.00	0.29
Group 5											
FFQ mean frequency, %	2%	0%	0%	1%	0%	3%	2%	3%	1%	5%	8%
24h mean frequency, %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24h/FFQ mean frequency	0.03	0.00	0.00	0.00	2.43	0.00	0.20	0.00	0.00	0.00	0.00
Group 6											
FFQ mean frequency, %	22%	4%	7%	10%	15%	16%	18%	29%	24%	38%	63%
24h mean frequency, %	10%	4%	0%	6%	7%	16%	22%	15%	4%	21%	11%
24h/FFQ mean frequency	0.48	1.18	0.05	0.57	0.47	1.00	1.23	0.50	0.19	0.56	0.17
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 10th decile features the biggest differences. This difference is found for all species group. The difference for species Group 2 (mean portion 564 for FFQ vs. 33 grams for 24-hour recall) is particularly striking.

Table F8. Shoshone-Bannock Tribes. 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 respondent	226	23	22	23	22	23	23	22	22	23	23
Group 1											
FFQ mean portion size, grams	386	199	326	283	368	327	484	406	513	425	681
24h mean portion size, grams	279	47	107	281	304	226	168	698	331	326	193
24h/FFQ mean portion size	0.72	0.24	0.33	1.00	0.83	0.69	0.35	1.72	0.64	0.77	0.28
Group 2											
FFQ mean portion size, grams	394	215	336	287	504	325	369	495	512	464	564
24h mean portion size, grams	364	NA	189	423	323	225	442	1149	361	429	33
24h/FFQ mean portion size	0.92	-	0.56	1.47	0.64	0.69	1.20	2.32	0.71	0.92	0.06
Group 3											
FFQ mean portion size, grams	409	338	335	270	536	323	391	512	589	453	487
24h mean portion size, grams	299	NA	189	458	236	256	299	548	338	232	NA
24h/FFQ mean portion size	0.73	-	0.56	1.69	0.44	0.79	0.77	1.07	0.57	0.51	-
Group 4											
FFQ mean portion size, grams	232	144	194	156	220	164	269	307	416	287	270
24h mean portion size, grams	244	NA	NA	NA	NA	NA	NA	NA	436	NA	57
24h/FFQ mean portion size	1.05	-	-	-	-	-	-	-	1.05	-	0.21
Group 5											
FFQ mean portion size, grams	199	101	146	185	550	140	150	212	158	259	138
24h mean portion size, grams	113	NA	NA	NA	113	NA	113	NA	NA	NA	NA
24h/FFQ mean portion size	0.57	-	-	-	0.21	-	0.76	-	-	-	-
Group 6											
FFQ mean portion size, grams	388	179	360	301	344	312	513	430	411	368	763
24h mean portion size, grams	282	47	47	155	316	210	155	704	198	354	249
24h/FFQ mean portion size	0.73	0.26	0.13	0.52	0.92	0.67	0.30	1.64	0.48	0.96	0.33
Group 7											
FFQ mean portion size, grams	213	NA	NA	NA	NA	NA	NA	NA	94	302	NA
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.

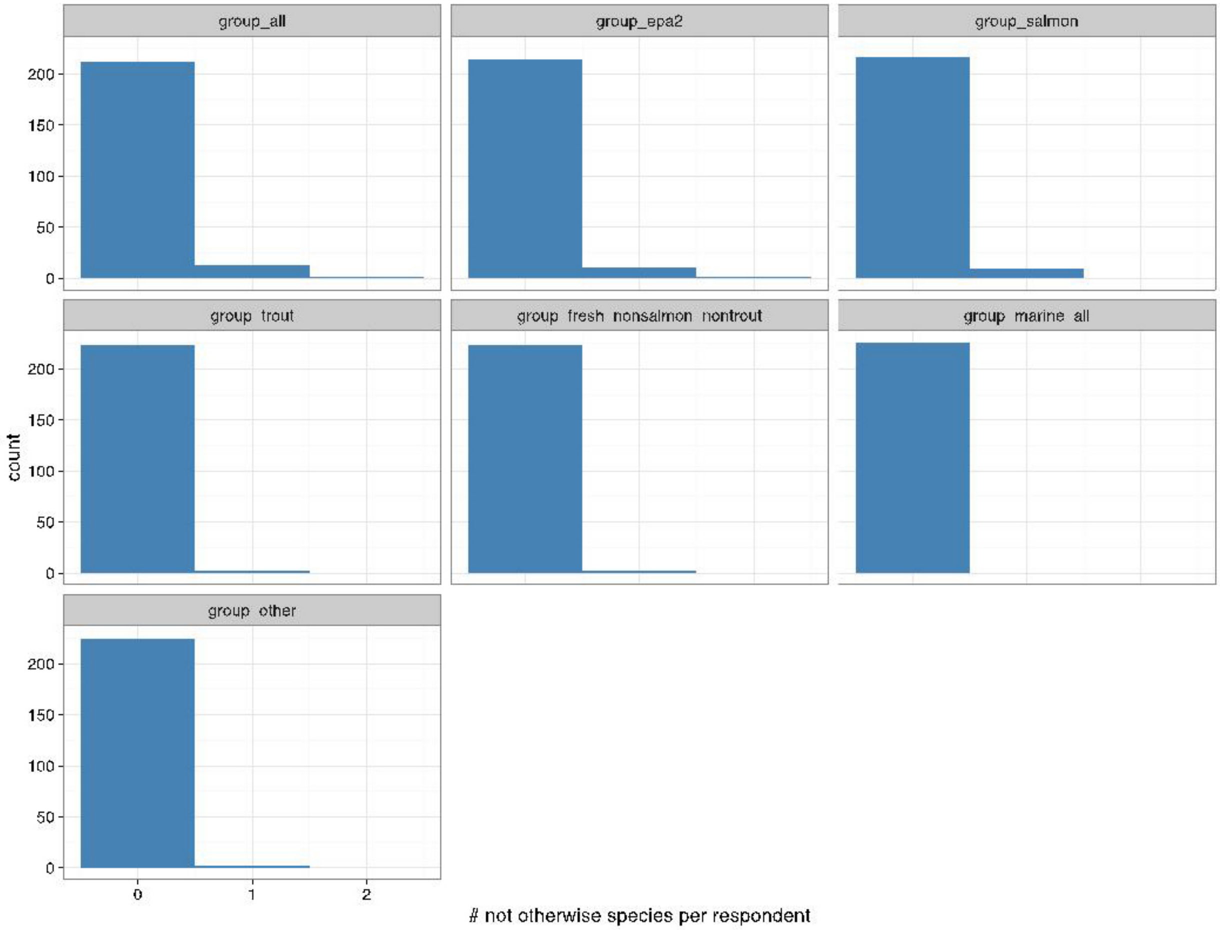


Figure F1. Shoshone-Bannock Tribes. Distribution of the # "not otherwise specified" species (NOS) on the FFQ per respondent.

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 F9. Shoshone-Bannock Tribes. Number and % respondents with any "not otherwise specified" species (NOS) on the FFQ. Overall and by species group.

Species Group	N	%
Group 1	14	6%
Group 2	12	5%
Group 3	9	4%
Group 4	2	1%
Group 5	2	1%
Group 6	0	0%
Group 7	2	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. Shoshone-Bannock Tribes. 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	106.3	**38.0**	-68.5	144.5
Group 2	84.3	**40.2**	-55.6	135.9
Group 3	44.5	**24.3**	-44.8	93.4
Group 4	16.7	**-13.6**	-88.2	60.9
Group 5	3.2	**-3.2**	-19.5	13.1
Group 6	-	**-**	-	-
Group 7	0.0	**2.0**	1.8	2.1

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).

Figure F2 describes the distribution of the number of species with missing data on FFQ for different species groups.

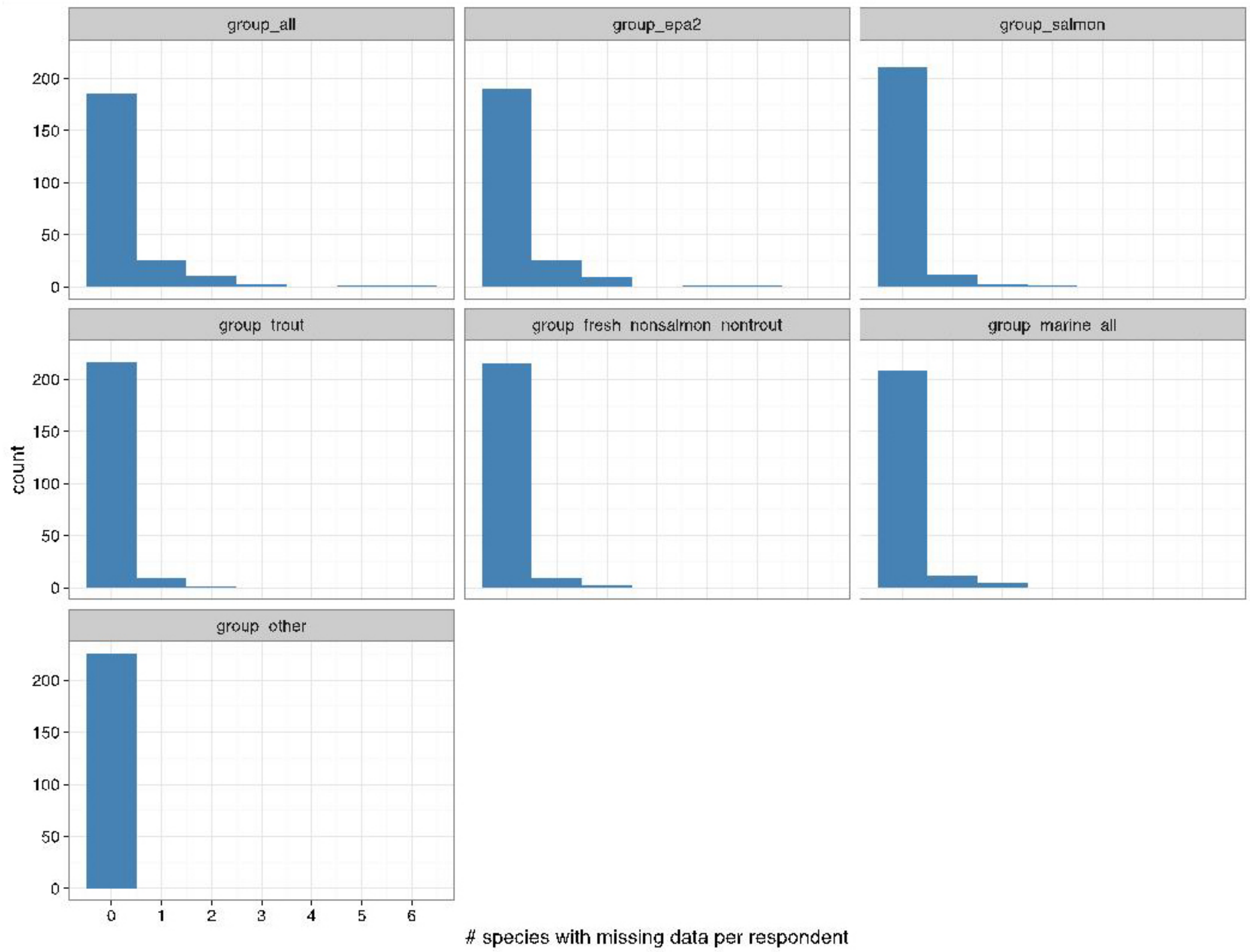


Figure F2. Shoshone-Bannock Tribes. Histogram of the number of species with missing data on the FFQ per respondent.

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. Shoshone-Bannock Tribes. 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	112.0	**-10.9**	-48.3	26.4
Group 2	86.1	**2.1**	-36.0	40.3
Group 3	46.0	**-6.0**	-44.9	32.8
Group 4	14.0	**53.3**	24.4	82.2
Group 5	3.2	**-1.3**	-7.0	4.4
Group 6	48.1	**-47.1**	-105.1	10.9
Group 7	-	**-**	-	-

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 Shoshone-Bannock Tribes was based on ZIP code boundaries for ZIP codes in and around the Shoshone-Bannock 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 Fort Hall and Blackfoot 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 GIS 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 Fort Hall or Blackfoot) 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 distance 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 Fort Hall and to Blackfoot, according to ZIP code, are provided in Table G1.

Figure G1. Fort Hall Reservation and surrounding eligible ZIP codes for inclusion in the Shoshone-Bannock Tribes fish consumption survey.

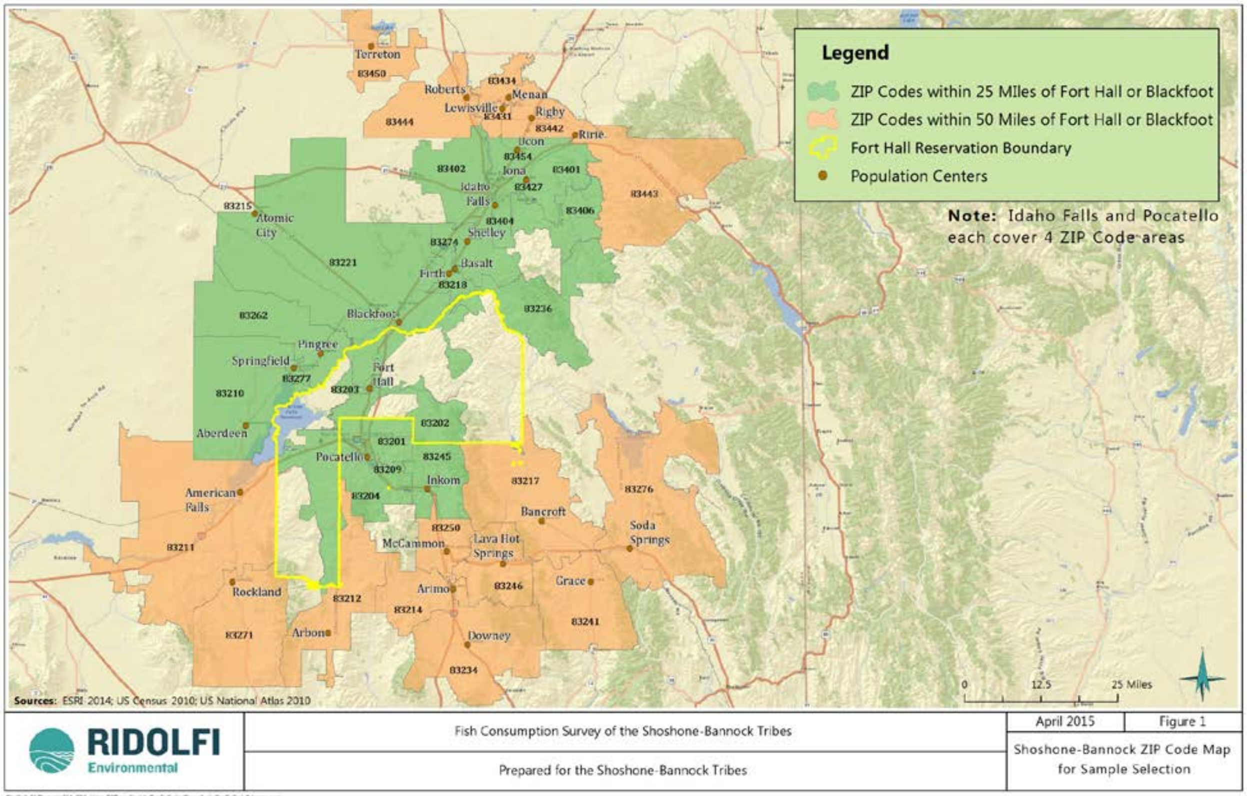


Table G1. Fort Hall Reservation ZIP codes, corresponding population centers, and distances to sampling hubs for the Shoshone-Bannock Tribes survey.

ZIP Code	Population Center	Distance to Fort Hall (Miles)	Distance to Blackfoot (Miles)	Buffer Distance	Closest Sampling Hub
83201	Pocatello	11.2	22.6	25	Fort Hall
83202	Pocatello	11.2	22.6	25	Fort Hall
83203	Fort Hall	0.0	11.9	25	Fort Hall
83204	Pocatello	11.2	22.6	25	Fort Hall
83209	Pocatello	11.2	22.6	25	Fort Hall
83210	Aberdeen	21.1	30.2	25	Fort Hall
83211	American Falls	27.1	38.0	50	Fort Hall
83212	Arbon	40.4	52.0	50	Fort Hall
83214	Arimo	35.4	44.4	50	Fort Hall
83215	Atomic City	34.1	29.4	50	Blackfoot
83217	Bancroft	35.5	39.9	50	Fort Hall
83218	Basalt	24.0	12.5	25	Blackfoot
83221	Blackfoot	11.9	0.0	25	Blackfoot

ZIP Code	Population Center	Distance to Fort Hall (Miles)	Distance to Blackfoot (Miles)	Buffer Distance	Closest Sampling Hub
83234	Downey	44.7	53.8	50	Fort Hall
83236	Firth	22.8	11.4	25	Blackfoot
83241	Grace	47.9	52.6	50	Fort Hall
83245	Inkom	18.9	27.6	25	Fort Hall
83246	Lava Hot Springs	35.9	42.9	50	Fort Hall
83250	McCammon	29.4	38.2	50	Fort Hall
83262	Pingree	9.8	13.8	25	Fort Hall
83271	Rockland	38.7	50.4	50	Fort Hall
83274	Shelley	28.9	17.3	25	Blackfoot
83276	Soda Springs	49.9	52.7	50	Fort Hall
83277	Springfield	12.8	18.7	25	Fort Hall
83401	Idaho Falls	36.3	24.7	25	Blackfoot
83402	Idaho Falls	36.3	24.7	25	Blackfoot
83404	Idaho Falls	36.3	24.7	25	Blackfoot
83406	Idaho Falls	36.3	24.7	25	Blackfoot
83427	Iona	42.6	31.1	50	Blackfoot
83431	Lewisville	50.6	38.7	50	Blackfoot
83434	Menan	52.6	40.7	50	Blackfoot
83442	Rigby	51.4	39.7	50	Blackfoot
83443	Ririe	53.3	41.9	50	Blackfoot
83444	Roberts	50.0	38.2	50	Blackfoot
83450	Terreton	55.8	45.2	50	Blackfoot
83454	Ucon	45.8	34.0	50	Blackfoot