Dana Davolt

A FISH CONSUMPTION SURVEY OF THE TULALIP AND SQUAXIN ISLAND TRIBES OF THE PUGET SOUND REGION

By
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SQUAXIN ISLAND TRIBE

"People of the Water"

THE TULALIP TRIBES

" A Fishing people"

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In Memory of Skip Houseknecht

This report is dedicated to the memory of Clyde (Skip) Houseknecht, Ph.D., M.P.H. Skip, as Head of EPA's Fish Contamination Section, was instrumental in garnering financial and technical support for the project. This is just one of many demonstrations of his dedication to human health and Native American issues. He will be fondly remembered by those of us who worked with him on this project.

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Throughout the project, Jim Albrecht acted as our Squaxin Island coordinator, providing valuable assistance in organization and execution of the survey. Developing the survey, we relied upon input from tribal members at both Tulalip and Squaxin Island. Charlene Post of Squaxin Island and Daryl Williams at Tulalip were helpful in this regard. We were also fortunate to have ongoing financial, technical and administrative support from the U.S. Environmental Protection Agency (EPA). AT EPA Region X, Marcia Lagerloef served as Project Officer and her contributions were invaluable to the success of this project.

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PREFACE

This project was funded by the U.S. Environmental Protection Agency, contract # X000833-01-1. All views are those of the authors and do not necessarily reflect the views of funding or affiliated agencies. The data from this survey are not necessarily representative of all Puget Sound tribes.

The Coordinator for the project was Gillian Mittelstaedt. Kelly Toy served as Project Manager for the Tulalip Tribes, while Jim Albrecht acted as the liaison for the Squaxin Island tribe. The EPA Project Officer for the study was Marcia Lagerloef. Nayak Polissar, Ph.D. and Shiquan Liao, Ph.D. were the statistical consultants.

Proper citation for this report is:

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Abstract

A survey was conducted to determine fish and shellfish consumption rates of the Tulalip and Squaxin Island tribes of Puget Sound. Interviews took place between February 25 and May 15, 1994 at central locations on the Tulalip and Squaxin Island reservations. A total of 190 tribal members, age eighteen and older, were surveyed on consumption of 52 species. Data were collected for sixty-nine children between the ages of birth and five years. Information was obtained for species consumed, fish parts consumed, preparation methods, sources of fish, and children's consumption rates. Weight-adjusted consumption rates were calculated by tribe, age, gender, income, and species groups. Species groups (anadromous, bottom, pelagic, and shellfish) were defined by life history and distribution in the water column. Both median and mean fish consumption rates for adults and children within each tribe were calculated in terms of grams per kilogram body weight per day (g/kg/day). Anadromous fish and shellfish were the groups of fish most frequently consumed. Consumption per body weight varied by gender (males consumed more) and age (35-64 years consumed more than those younger and older), and there was no consistent pattern of consumption by income. The consumption rates for groups of fish differed between the tribes. The distribution of consumption rates was skewed toward large values. In the Tulalip Tribes, the estimated median consumption rate for all forms of fish combined was 0.55 g/kg/day, and in the Squaxin Island tribe, the estimated median rate was 0.52 g/kg/day. The median rates for the Tulalip Tribes (unadjusted for weight) were 53 g/day for males, 34 g/day for females, and for the Squaxin Island tribe the rates were 66 g/day for males and 25 g/day for females. The median consumption rate for children age birth to five years was 0.17 g/kg/day. The median consumption rate for the Tulalip children was 0.08 g/kg/day and 0.51 for the Squaxin Island children. For the majority of consumption, fish were prepared and eaten in a manner that tends to reduce intake of contaminants. Most anadromous fish and shellfish were obtained by harvesting in the Puget Sound area (rather than by purchasing), though sources of the harvest varied between tribes.

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Introduction

Ingestion of fish and shellfish represents a significant pathway of human exposure to persistent and bioaccumulative chemicals in aquatic environments (EPA 1989; Rifkin and LaKind 1991). For regulatory purposes, the risk assessor must include a careful evaluation of affected populations and select a fish consumption rate that is relevant and applicable to the exposed population (CHEMRISK 1994; Keenan et al. 1994). Fish consumption rates are likely to vary between the general population and subpopulations (EPA 1991) because existing fish consumption surveys of the general population (Javitz 1980; Rupp et al. 1980; Pao et al. 1982) do not consider regional and cultural factors, which can significantly affect rates (EPA 1989; CHEMRISK 1994; Ebert et al. 1993). Furthermore, existing studies are limited to characterizing consumption rates of fish from specific water bodies or by specific populations such as recreational anglers. For example, Landolt et al. (1985), Puffer et al. (1981), and Pierce et al. (1981) confined their studies to estimating consumption rates of sport-caught marine fish by anglers. Other studies (Rupp et al. 1980; Ebert et al. 1993; West et al. 1989) were limited exclusively to consumption of freshwater fish.

This fish consumption study was initiated due to lack of information specific to Puget Sound tribes. It was intended to provide tribes, and state and federal agencies with scientifically defensible data for use in developing water quality standards, sediment quality criteria, and risk assessments. While data from these tribes may be representative of consumption rates of other tribes, it should be understood that fish consumption rates, habits, and patterns can vary among tribes and other subpopulations.

Goals and Objectives

The goal of this study was to collect representative data on fish consumption habits, rates, and patterns of participating Puget Sound Indian tribes. A Steering Committee, established at the outset of this project, was tasked with the responsibility of translating this goal into concrete objectives. They accomplished this, in part, by assisting in the

formation of a Technical Advisory Panel (TAP). The TAP helped design the survey to ensure that three specific data objectives would be satisfied:

- The first objective was to describe fish consumption for Puget Sound tribal members over the age of eighteen, and their dependent(s) ages five and under, living on or within a fifty-mile radius of the reservation, in terms of their consumption rate of anadromous, pelagic, bottom fish, and shellfish in grams per kilogram of body weight, per day.
- The second objective was to describe methods of preparation for anadromous, pelagic, bottom fish, and shellfish.
- The third objective was to describe patterns of acquisition for all fish and shellfish consumption (with sources of acquisition described as harvested from accustomed fishing areas or purchased from grocery stores or restaurants).

Survey Methodology

Sample Selection. The survey included two of the fourteen Puget Sound tribes: the Tulalip Tribes (a conglomeration of tribes treated as a single unit in this study) and the Squaxin Island tribe. These two tribes were selected nonrandomly to represent the expected range of fishing and fish consumption activities of tribes in the region. The Tulalip Indian reservation in Marysville, Washington, is situated on Tulalip Bay on the northeast side of Puget Sound. The reservation is adjacent to a predominantly urban area. Tulalip has 1,398 enrolled tribal members with an estimated 1,000 living in the Puget Sound area on or within a fifty-mile radius of the reservation. Commercial fishing is an important source of income for many Tulalip tribal members, at present, the consumption of shellfish is limited to a subsistence activity.

The Squaxin Island tribe is located at the southern end of Puget Sound situated in a more rural setting. Squaxin Island has over 500 enrolled tribal members, with an estimated 295 living in the Puget Sound area within a fifty-mile radius of the reservation. Commercial fishing and shellfishing provide a primary source of income for many

*Enrollment numbers represent tribal members age 18 years and older.

Squaxin Island tribal members. In addition, subsistence fishing and shellfishing is an important part of their economy and diet.

Sample Size. Sample size was calculated separately for each tribe in order to estimate the consumption rates for individual tribes. A sample size was selected that would provide reasonable precision of estimates of mean consumption for each tribe. Precision can be expressed as the width of confidence intervals for means. Upper and lower bounds of confidence intervals lying within 20% of an estimated mean were considered to represent good precision. This precision depends on distribution of consumption rates. Previous surveys have shown that consumption rates are approximately lognormally distributed. For a lognormal distribution of consumption rates, the normally approximated 95% confidence interval is given by

$$\exp(\bar{x} \pm 1.96 \frac{s}{\sqrt{n}} \sqrt{1 - \frac{n}{N}}).$$

On a logarithmic scale, $\bar{x}$ is the mean, s is the sample standard deviation, n is the sample size and N is the size of the population sampled. The 20% precision criterion translates into the requirement that

$$\exp(1.96 \frac{s}{\sqrt{n}} \sqrt{1 - \frac{n}{N}}) = 1.2 .$$

(The ".2" of 1.2 incorporates the 20% criterion.) Once s is specified, the sample size, n, can be calculated. Using data from other studies, we estimated a standard deviation, s, (on a logarithmic scale) of 1.15.

The standard deviation value of 1.15 was the mean of standard deviations implied by the 5th to 95th percentile values from the following five studies: Landolt et al. (1985), McCallum (1985), Pierce et al. (1981), Landolt et al. (1987). All of these studies had similar standard deviations implied by their data, based on the 5th and 95th percentiles. The standard deviations on a logarithmic scale ranged from 1.02-1.22 for the five studies.

The intended sample size was increased, prior to sample selection, to allow for an anticipated refusal rate of 20%. An additional 5% was added in anticipation of unusable or missing data. Based on the calculated sample size, we expected to contact 200 adult members of the Tulalip Tribes. From this sample, we expected to interview 160 tribal members, and of those interviews, 150 were expected to be completely usable. For the Squaxin Island tribe, we expected to contact 160 tribal members, expected to interview 125, and of those interviews, 120 were expected to be completely usable.

Target Population. The target population included enrolled tribal members age eighteen and older and children age five and under who lived in the enrolled member's household. Participants had to live on or within a fifty-mile radius of the reservation.

Sampling Procedures. Each enrolled tribal member, age eighteen and older, was assigned a sequential number on a list provided by the tribes. Computer-generated random numbers were then used to select survey participants from this list.

It was impossible to construct a list of every child under the age of five due to budget constraints and lack of information on tribal children. Rather than sampling children separately, we sampled them with adult tribal members. At the time of interview, adult participants were asked about the number of children age five or under living in their household. If a survey participant had more than one child in this age category, then only one child was randomly selected for inclusion. Due to non-uniform tribal enrollment practices for children, tribal membership was not a criterion for their inclusion. Because children in this age group are not capable of answering detailed questions about their fish consumption habits, information was obtained from a parent or guardian.

Participation in this study was based on the following specific criteria:

a) Adults had to be enrolled tribal members.

b) Adults had to be eighteen years or older and children five years or younger. Children in the household of a selected adult did not need to be enrolled tribal members.

c) Respondents had to reside on the reservation or within a fifty-mile radius of the external boundaries of the reservation.

d) Adults responding for a child had to reside in the same household as the child.

Design of Survey Questionnaire. Draft survey questionnaires were circulated to all Technical Advisory Panel members for review. Revisions were made before approval of the final version. The survey questionnaire was designed to focus on frequency (number of fish meals eaten per day, per week, per month or per year over a one-year period) and portion size of each meal. Respondents were asked to consider seasonal variations in fish consumption: fresh and readily available (in season) and/or frozen and stored (out of season). Consumption questions were asked for fifty-two individual fish and shellfish species known to be consumed by Native Americans.

Because the length of the survey was a major concern, the fifty-two species were divided into six groups: A) anadromous, B) pelagic, C) bottom, D) shellfish, E) canned tuna, and F) miscellaneous (see Table 1). Grouping of fish species was based on life history and distribution within the water column. Questions concerning fish parts consumed, methods of preparation, and location of the fish were asked collectively for each fish group. Questions for group E (canned tuna) and for the nineteen species in group F addressed consumption rates only (as measured in ounces by the respondent). In the computation of consumption rates, fish in groups E and F were classified and added into groups A-D based on actual fish type. In this report, consumption rates were presented by anadromous, pelagic, bottom fish, shellfish, "other fish" (only canned tuna and trout

occurred for "other" in the sample), total finfish (anadromous, pelagic and bottom fish combined), and total fish (the sum of finfish, shellfish and "other" fish).

Table 1. Species Grouping Used in Interviewing

Group A (Anadromous)	Group B (Pelagic)	Group C (Bottom)	Group D (Shellfish)	Group E	Group F (Other)
Salmon: Chinook Pink Sockeye Coho Chum unidentified Steelhead Smelt	Cod Pollock Sablefish Rockfish Greenling Herring Spiny Dogfish Perch	Halibut Sole/Flounder Sturgeon	Clams (Manila/Littleneck) Horse Clam Butter Clam Cockles Mussels Oysters Shrimp Dungeness Crab Red Rock Crab Moon Snail Scallops Squid Sea Urchin Sea Cucumber Sea Urchin	Canned Tuna*	Trout* Geoduck** Limpets** Lobster** Bullhead** Manta Ray** Razor Clam** Chitons** Octopus** Abalone** Chitons** Barnacles** Crayfish** Mackeral*** Shark*** Skate**** Eel**** Grunters****

*Consumption rate was added to the "other" group for reporting (see text).
**Consumption rate was added to the shellfish group for reporting.
***Consumption rate was added to the pelagic group for reporting.
****Consumption rate was added to the bottom group for reporting.

Additional information was obtained concerning methods of preparation, fish parts consumed, sources of fish and shellfish, and harvesting areas. Ten methods of preparation were identified and divided into two groups. The first group included methods that leached out toxins (baked, boiled, broiled, roasted, or poached). The second group included methods that sealed in toxins (canned, fried, raw, smoked, or dried). Respondents were instructed to identify the percentage of time they ate fish prepared using the two groups of preparation methods. Percentages for both groups were to total 100%.

The fish parts consumed were divided into three categories: (A) fillet with skin, (B) fillet without skin, and (C) bones, organs, eggs, and skin. Categories "A" and "B" were to total 100%. Respondents had the option of answering from 0 to 100% for Category "C". A separate category, D, was created for shellfish parts consumed, which varied according to the different shellfish types.

Questions concerning the source of fish were divided into five categories: a) caught in Puget Sound, b) caught outside Puget Sound, c) restaurants, d) grocery stores, and e) other. Percentages for these categories were to total 100%. If a respondent was familiar with specific harvest locations, interviewers inquired about these sites and referred to a detailed map of fishing areas to record the exact location.

Models. Physical display models (Appendix G) were designed for the following fish: salmon, herring, shrimp, mussels, oysters, scallops, and cockles, as well as horse, butter, manila, and native littleneck clams. (Methods used to construct the models are described below). Surrogate models were used for geoduck, lobster, and razor clams. The horse clam model, which resembles a young geoduck, was used as the geoduck model. The prawn model was used as a lobster model because prawns have the same texture as lobster. There was no physical model for the razor clam, as it was out of season when the models were under development. Instead, respondents were instructed to estimate portion size for a four-inch razor clam whose length was drawn beneath the geoduck model. Models were not used for sea urchins (eggs), sea cucumber, or octopus; consumption of these species was given in total ounces.

Both raw and cooked fish were used to build fish models. Raw fish were used for finfish, horse clam, shrimp, squid, and scallops. Cooked fish were used for malina/littleneck clam, butter clam, mussels, and cockles.

Fish Models. A one-pound raw salmon fish fillet was weighed and measured using a Braun food scale and calipers. It was wrapped in cellophane and a cameo plaster wrap

was applied to create a mold. When the mold hardened, the fish was removed, and the mold was filled with plaster. After drying, the mold was painted to resemble a salmon fillet (Appendix G). This mold was then used to create the remaining fish models, except herring. With the exception of the salmon fillet, all models were weighed in grams with a Ohaus Triple Beam Balance.

Shellfish Models. The mussels, scallops, oysters, squid, and crab from which models were made were purchased at a grocery store; specific location of harvest is unknown. Cockles, manila, littleneck, butter, and horse clams were harvested from Point No Point beach in Hansville, Washington. Meat was removed and shells were glued together and mounted on foam core board. A single estimate of meat weight for each species was determined by weighing the most common parts eaten. Average meat weight for mussels, manila, and littleneck clams was determined by measuring the average length of all species collected and comparing it with the meat weight of species of that size. Each interviewer showed twenty-four clams and eighteen mussels when conducting the interview. Fresh crab and squid were kept frozen until needed by the interviewer.

There were slight variations in length and weight for cockles, butter clams, horse clams, crab, and squid. These species were weighed and measured individually and were assigned to an interviewer (Appendix F). The visual difference between display models was negligible (Appendix G).

Maps. Interviewers were supplied with a map of the entire Puget Sound area and one showing the usual and accustomed fishing areas for both tribes (Appendix C). Respondents indicated where they harvested fish and shellfish, though they were not limited to designated fishing areas (Appendix D). Maps were created on a GIS system.

The Gladys Block Food Frequency Questionnaire. The Gladys Block Food Frequency Questionnaire ([redacted]) consisted of questions concerning the

respondent's total diet. A small section addressed fish and shellfish consumption. The food frequency form was mailed to the respondent's home prior to the interview, with instructions to complete the form and bring it to their scheduled appointment.

Answers from the interview and from the food frequency form were analyzed and compared. The results produced separate annual consumption rates for finfish and shellfish. Tallies from the two separate sources were expected to be somewhat congruent, acting as a validity check. Calculation of total daily calories from the food frequency questionnaire was used to ascertain if an individual over- or underreported their food consumption.

Quality Assurance and Quality Control. The following quality control procedures were established to maintain a high standard of accuracy for this study:

a) A pilot survey was conducted prior to implementation of the final survey, and its purpose was to test the design and clarity of the questionnaire. Ten respondents were selected from the tribal membership roster—six from the Tulalip Tribes and four from the Squaxin Island tribe. The respondents were selected to represent at least one each of the following:

- One family with no children under their care
- One family with at least one child
- One family with exactly one child age five or under
- One family with two or more children age five or under
- At least two male respondents and at least two female respondents
- At least one younger respondent (less than age 65) and at least one older respondent (age 65 or over)
- At least one respondent living on the reservation and at least one respondent living off the reservation

b) Repeat interviews were conducted by phone. Ten percent of survey respondents were reinterviewed by selecting every tenth person who had

completed an interview (Appendix H). Five key questions from the survey were selected. Because the repeated interviews were conducted without the benefit of portion size models, the questions addressed the frequency of consumption of king salmon, cod, halibut, clams, and for children, salmon. Data from the first interview were then compared with data from the second. The total mean frequency was calculated for a) first and second interview responses, and b) difference between responses (Appendix A).

c) Survey information was keyed and verified (double-entry) to minimize data entry errors. Data entry was conducted at the Tulalip Department of Environment.

d) Exploratory data analyses (histograms, crosstabulations, etc.) were carried out prior to the final statistical analyses. The exploratory data analyses aided in identification of outliers and other problems.

Data Collection. Two tribal members from each tribe were hired to conduct interviews. Interviewers attended a two-day training session that included general interviewing techniques, practice interviews, explanation of survey format, and proper use of the models. The general interviewing techniques were obtained from experienced personnel at the Fred Hutchinson Cancer Research Center in Seattle. Interviewers were instructed on the purpose and relevance of each survey question. Meetings or phone conversations were held daily with the interviewers.

Respondents were interviewed over an eight-week period. The Tulalip Tribes conducted interviews from March 3 though May 15, 1994, at the Tulalip Department of Environment. The Squaxin Island tribe conducted interviews from February 25 through April 4, 1994, at the Squaxin Island Fisheries Department.

Introductory letters were sent out to randomly selected respondents requesting their participation and explaining the general purpose of the survey (Appendix H). In the letter, respondents were informed that they would be paid a $25 participation fee. The letters

were followed by phone calls during which interview appointments were made and questions were answered. The food frequency form was also mailed to each respondent.

Follow-up Procedures for Nonrespondents. When a person was not interested in participating during the initial telephone contact, the interviewer inquired as to the reason, and if it was due to nonconsumption of fish, then demographic information was obtained for this person. Selected participants were dropped from the sampling list if they could not be reached by the eighth phone call, or if they did not appear for their third scheduled appointment. Interviewers documented their attempts in the interviewer's activity log located on the first page of each questionnaire.

Statistical Methods

Hypothesis Testing. Analyses of consumption rates (grams of fish/kg of body weight/day, or g/kg/day) are presented in terms of medians (the 50th percentile) and other percentiles, means, and 95% confidence intervals for the mean. The statistical significance of differences in consumption rates and practices by tribe, gender, age, and income was also calculated. In this report, $p < 0.05$ is considered statistically significant. Since there are many hypothesis tests and associated p-values, some results may be significant by chance alone. This is known as the "multiple testing problem". Any interpretation of statistical significance should take into account the number of statistical tests (p-values) performed in the area of interest to the reader. Consistency or plausibility of significant results is an important consideration. No formal methods to adjust for multiple testing were used in this report.

Weighting. When results are presented for the two tribes combined, each tribe is weighted equally, without respect to the size of tribal population. Weighting is also used to adjust for the varying probability that a child in a household is selected into the sample. This probability depends on the number of adult tribal members living in the household and the number of children age five and under in the household. Children in households with two or more tribal members are more likely to be selected than children

in households with only one tribal member, because there are more "pathways" in the sampling procedure that lead to selection of the child. In addition, if there is only one child age five or under in the household, then that child is certain to be selected if one of the adult tribal members in the household is selected. A child under age five in a household with two or more children in the same age group is less likely to be selected because only one child in the household is randomly selected. In summary, weighting either gives equal emphasis to each tribe or corrects for the varying probability of a child being sampled. Specific weighting schemes are presented in appropriate methodological sections below.

Treatment of Outliers. A number of outliers representing unusually large consumption rates were recorded in this study. For example, the largest reported consumption rate for anadromous fish was approximately 9.5 g/kg/day (see Table E1). Values such as these represent large but uncertain consumption rates. These outliers were handled by recoding them to the largest reported consumption rate within three standard deviations of the arithmetic mean. This recoding was done separately by tribe and separately within each fish group subtotal: anadromous, pelagic, bottom, shellfish, and other fish. These corrections were applied separately for adults and for children. Appendix E lists specific values that were recoded. These values, along with the means and standard errors reported in the tables, are sufficient statistics for recalculation should the reader wish to recalculate means, standard errors, and confidence intervals, with outlier values as originally reported. Results (including graphs) presented in this report are based on values after the substitutions for these outliers. The aggregate categories, total finfish and total fish, are the sum of subcategories after substitutions for outliers in the subcategories. To maintain consistency between subcategory and aggregate category means, no adjustment of any values for aggregated categories was carried out. Aggregate category values beyond three standard deviations from the respective mean are noted in Table E2. No values exceed four standard deviations.

Calculation of Means, Standard Errors, and Confidence Intervals for Adult Consumption Rates. The arithmetic mean consumption rate (g/kg/day) was calculated for adults within each tribe. Adults who consumed no fish at all were completely excluded from the survey (i.e.,, all adults included in the survey consumed at least one type of fish). However, if a respondent did not consume a specific fish group (e.g., anadromous), a consumption rate of zero was assigned for the fish group, and this value of zero was used in the calculation of means, median, etc. Standard errors were calculated using the finite population correction, as is standard when sampling from a limited population (Cochran 1977). The standard error, *SE*, of the mean $\bar{x}$ for adult data from a tribe was calculated as

$$SE = \frac{s}{\sqrt{n}}\sqrt{1 - \frac{n}{N}},$$

where *s* is the sample standard deviation, *n* is the sample size, *N* is the size of the eligible population, *n/N* is the sampling fraction. In this report, we use subscript *i* to denote the two tribes (*i* = 1 for Tulalip and *i* = 2 for Squaxin Island). From the tribal rosters, the adult eligible population was estimated to be 1,055 for the Tulalip Tribes (N_1 = 1,055) and 295 for the Squaxin Island tribe (N_2 = 295). Survey results are based on 73 completed interviews with eligible adults from the Tulalip Tribes (n_1 = 73) and 117 for the Squaxin Island tribe (n_2 = 117), resulting in sampling percentages of 6.9% and 39.7%, respectively. A 95% confidence interval for the population mean was calculated as $\bar{x} \pm 1.96SE$.

Calculation of adult means for combined tribal populations involved equal weighting of tribal results, as noted above. In combining adult tribal results, equal weights of p = 0.5 and (1-p) = 0.5 were used for the Tulalip and Squaxin Island means, respectively. The weighted mean and standard error of the weighted mean for the combined tribes were calculated as

$$\bar{x}_{combined} = p\bar{x}_1 + (1-p)\bar{x}_2,$$

$$SE_{combined} = \sqrt{p^2 s_1^2 \frac{1}{n_1}(1-\frac{n_1}{N_1}) + (1-p)^2 s_2^2 \frac{1}{n_2}(1-\frac{n_2}{N_2})},$$

where $\bar{x}_1$ and $\bar{x}_2$ are the means for the Tulalip and Squaxin Island tribes, respectively; n_1 is sample size from the Tulalip Tribes; n_2 is sample size from the Squaxin Island tribe; N_1 and N_2 are the size of eligible population of the Tulalip Tribes and Squaxin Island tribe, respectively; p=0.5 to give equal weight to each tribe; s_1 is the sample standard deviation for the Tulalip Tribes, and s_2 is the standard deviation for the Squaxin Island tribe. 95% confidence intervals for the two tribes combined were calculated as $\bar{x}_{combined} \pm 1.96 SE_{combined}$.

Calculation of Means, Standard Errors, and Confidence Intervals for Consumption Rates of Children. Calculation of means and standard errors of the mean for children in each tribe and for combined tribes also involved weighting. Within each tribe, there is a different probability of selecting children in different households, depending on the number of eligible adult members of the household and the number of children age five years and under living in the household. The weighting schemes, presented in this section, require knowledge of the total number of children age five and under living in households of eligible adult members of the tribe These data are unavailable in their entirety from tribal records. Thus, we estimated the total number of eligible children in each tribe based on the sample using the equation

$$T_i = \frac{N_i}{n_i} \sum_j \frac{k_{ij}}{m_{ij}}$$

where i = 1 for the Tulalip Tribes, i = 2 for the Squaxin Island tribe, n_i and N_i are sample and eligible adult population totals, respectively; k_{ij} = number of children under the age of five years in the household of the j^{th} sampled adult respondent of tribe i; and m_{ij} = the number of adult tribal members in the household of the j^{th} adult respondent. (Note that k_{ij} counts eligible children reported by adult respondents whether or not the children were selected into the sample). The quantity m_{ij} is a count of the number of pathways in the household that would have led to inclusion of children ages birth to five years in the survey (typically, m_{ij} = 1 or 2). The summation is taken over the sampled adults.

There were twenty-one children from the Tulalip Tribes (t_1 = 21) and forty-eight from the Squaxin Island tribe (t_2 = 48) in the sample. The estimated total number of children ages birth to five years in households of eligible adults in the Tulalip Tribes was 252 (T_1 = 252). The estimated total number of children ages birth to five years in the Squaxin Island tribe was 147 (T_2 = 147). Thus, the sampling fraction for children was 21/252 = 8.3% for the Tulalip Tribes and 48/147 = 32.7% for the Squaxin Island tribe.

In calculating the mean consumption rate for children in a tribe, we have weighted each child's consumption rate by the factor w_{ij}.

$$w_{ij} = g_i \frac{k_{ij}}{m_{ij}},$$

where the scale factor $g_i = 1/[\Sigma_j(k_{ij} / m_{ij})]$ forces the weights to add to unity ($\sum_i g_i = 1$), and k_{ij} and m_{ij} are as defined previously.

If x_{ij} is the consumption rate for the child selected in the process of interviewing the j^{th} adult in tribe i, then the mean for children in tribe i (i = 1,2) was calculated as

$$\bar{x}_i = \sum_j x_{ij} w_{ij}.$$

The standard error of the mean for children in tribe i was calculated as

$$SE_i = \sqrt{(1 - \frac{t_i}{T_i}) \sum_j w_{ij}^2 (x_{ij} - \bar{x}_i)^2},$$

where t_i = number of sampled children age birth to five years, and T_i = estimated total number of children age birth to five in eligible households.

In order to combine estimates of children's means to yield a mean for combined tribes, the mean for each tribe was given equal weight. The mean and standard error for children in combined tribes were calculated as

$$\bar{x}_{combined,children} = p\bar{x}_1 + (1-p)\bar{x}_2,$$

$$SE_{combined,children} = \sqrt{p^2 SE_1^2 + (1-p)^2 SE_2^2},$$

where $\bar{x}_1$ and $\bar{x}_2$, SE_1^2 and SE_2^2 refer to the Tulalip and Squaxin Island children, respectively, and p=0.5, the same value as used for adults.

A 95% confidence interval for the children's mean consumption rate (either within-tribe or the two tribes combined) was calculated by the standard formula,

$$mean \pm 1.96SE,$$

where *mean* denotes either within-tribe mean or combined-tribes mean, and *SE* is within-tribe standard error or combined-tribes standard error.

Calculation of Percentiles for Adults and Children. Within-tribe percentiles were calculated for adults in a standard fashion from the cumulative distribution of consumption rates for each tribe. We used the 5th, 50th, 90th, and 95th percentiles for adults. Percentiles for adults in the combined tribes were calculated by creating a weighted, mixed distribution. The weight for each adult tribal member was $0.5/N_i$ for tribe i = 1,2, with notation as before. This procedure gives each tribe equal statistical weight. Percentiles were calculated by a) ordering consumption rates from smallest to largest, b) cumulating weights, and c) reading off consumption rates corresponding to the 5th, 50th, 90th and the 95th percentile of cumulative weights, using interpolation if necessary.

A similar procedure was used to derive the 10th, 25th, 50th, 75th, and 90th. percentiles for children. Each child was assigned a weight w_{ij} that was defined earlier for use in calculating the mean for a tribe. In order to calculate percentiles within a tribe, children's consumption rates were ordered from smallest to largest, and the consumption rates corresponding to the 10th, 25th, 50th, 75th and 90th percentile of the cumulative weights (w_{ij}) were used. To derive children's percentiles in combined tribes, the same process

used for adults was carried out with cumulative distribution of children's weights v_{ij}, defined by

$$v_{ij} = 0.5 w_{ij},$$

where w_{ij} was defined earlier.

Statistical Significance. Various statistical tests were used to determine significance of differences between tribes, and between gender groups, age groups, and income groups within each tribe. Due to the occurrence of right-skewed distributions (often due to fairly large values), nonparametric tests were used, which are more robust against skewness than parametric tests. When comparing groups on categorical or dichotomous variables (e.g., comparing gender between tribes), the Chi-squared test was used. When comparing consumption rates and other continuous measures between two groups, the Wilcoxon-Mann-Whitney test was used. When comparing consumption and other continuous measures across three or more groups, the Kruskal-Wallis test (Fisher and Van Belle 1993) was used. The Spearman Correlation Coefficient was used to describe association between two variables. Values of $p < 0.05$ were considered statistically significant in this report.

Results

In the following sections, sample populations and their consumption rates and patterns are described. All estimates are based on an unbiased sampling procedure and can therefore be considered as unbiased estimates of the corresponding population values had 100% of the tribal populations been interviewed.

After interviewing was completed, it was discovered that one of the four interviewers did not consistently follow specified survey procedures. It was impossible to determine which of the interviewers' surveys were affected, so all surveys conducted by this interviewer were dropped from the study (n=73 adult Tulalip tribal members). The results presented in this report are thus based on the remaining 73 adult Tulalip respondents and 117 adult Squaxin Island respondents.

Summary tables are presented in the text and more detailed tables are available in Appendix A. Because consumption rate distributions are right-skewed, the findings are described in terms of the median (50th percentile). If a distribution is right-skewed, the median is smaller than the mean. We have also included means and 95% confidence intervals for the mean in Appendix A. Due to the skewness of fish consumption distributions, mean consumption rate and median consumption rate presented in this report differ substantially for some categories.

Descriptive Characteristics. As shown in Table 2, the two tribes are similar in having slightly more males (56-58%) than females, a large percentage of young people (at least 37% under age thirty-five), and a small percentage of elderly (8-9% are age sixty-five or over). About half of the members in both tribes live in households with combined incomes of $15,000 or less per year.

A substantial percentage of respondents live on a reservation (74% for the Tulalip and 56% for the Squaxin Island tribe, see Appendix A). These percentages are probably higher than those for all tribal members as a whole due to the requirement that tribal members, in order to be eligible for the survey, had to live within fifty miles of the reservation.

Mean body weights differed between the tribes. Males in the Squaxin Island tribe were, on the average, heavier than the Tulalip's (mean of 93 vs. 86kg). On the contrast, the females in Tulalip Tribes were heavier than the Squaxin's (76 vs. 68 kg).

The observed gender composition among children differed substantially between the two tribes: 57% of the Tulalip children were boys vs. 40% among the Squaxin Island children. The mean age of sampled children (approximately 30 months) was similar between the two tribes. The mother was the usual source of information regarding the child's fish consumption, providing information on approximately half of the children; the father provided information for about one-third of the children, and other household members

provided information for about one-fifth of the children. Breastfeeding practices differed substantially between the tribes with 43% of the Tulalip and 75% of the Squaxin Island children under age five having been breastfed (Appendix A). The mean duration of breastfeeding (8-9 months) was similar in the two tribes.

Table 2. Descriptive Characteristics

Adults		
	Tulalip Tribes (n=73)	**Squaxin Island Tribe (n=117)**
Gender (%)		
Male	58	56
Female	42	44
Age (%)		
18-34	37	46
35-64	55	44
65+	8	9
Household Income (%)		
<15,000	46	49
≥15,000	54	51
Weight (kg) mean ±s.d.		
Male *	86±19	93±17
Female	76±16	68±14
Children		
	Tulalip Tribes (n=21)	**Squaxin Island Tribe (n=48)**
Gender (%)		
Boys	57	40
Girls	43	60
Age (mo.) mean ± s.d.	33±17	32±18
Source of information on child (%)		
Mother	43	46
Father	38	33
Other	19	21

n varies slightly due to missing values. Percentages might not add to 100 due to rounding.
* $p<0.05$ comparing two tribes (Wilcoxon-Mann-Whitney test).

Adult Consumption Rates. Adults of both tribes consume fish at a very high rate (Table 3). Finfish are consumed the most—primarily anadromous fish—followed by shellfish. Bottom fish and pelagic fish are consumed at a lower rate. The median consumption rate for all forms of fish combined was 0.55 g/kg/day for the Tulalip Tribes and 0.52 g/kg/day for the Squaxin Island tribe. These rates are much larger than the rate implied by the typical value of daily consumption often used: 6.5 g/day (SRI International, 1980). Even using an average body weight as low as 70 kg, the daily rate of 6.5 g/day implies a weight-adjusted rate of 6.5/70 = 0.093 g/kg/day. The value of 0.093g/kg/day can be rejected as the mean for either tribe ($p<0.001$, Wilcoxon Signed Rank Test).

Table 3. Consumption Rates (g/kg/day) for Adult Tribal Members: 5th, 50th, 95th Percentiles and Mean

	5%	50% (median)	95%	95% Mean
Tulalip Tribes (n = 73)				
Anadromous fish	.006	.190	2.114	147.98 .426
Pelagic fish	.000	.004	.234	16.38 .036
Bottom fish**	.000	.008	.186	13.02 .033
Shellfish**	.000	.153	1.826	127.82 .362
Total finfish	.010	.284	2.149	150.43 .495
Other fish*	.000	.000	.264	.031
Total fish	.046	.552	2.876	201.32 .889
Squaxin Island Tribe (n =117)				
Anadromous fish	.016	.308	2.182	152.74 .590
Pelagic fish	.000	.003	.248	17.36 .043
Bottom fish**	.000	.026	.345	24.15 .063
Shellfish **	.000	.065	.849	59.43 .181
Total finfish	.027	.383	2.538	177.66 .697
Other fish*	.000	.000	.123	.014
Total fish	.045	.524	3.016	211.12 .891
Both Tribes Combined (weighted)				
Anadromous fish	.010	.239	2.085	145.95 .508
Pelagic fish	.000	.004	.226	15.82 .040
Bottom fish	.000	.015	.118	8.26 .048
Shellfish	.000	.115	1.308	91.56 .272
Total finfish	.017	.317	2.188	153.16 .596
Other fish	.000	.000	.145	10.16 .023
Total fish	.047	.531	2.936	205.52 .890

*p<0.05, **p<0.01 comparing two tribes (Wilcoxon-Mann-Whitney test).

The median (or mean) total consumption of all forms of fish differs between tribes by less than 10%, a difference that is not statistically significant. However, adult consumption rates differ substantially between tribes for subgroups of fish (see Table 3). Squaxin Island tribal members eat more finfish than members from the Tulalip Tribes (median of 0.38 vs. 0.28 g/kg/day). Conversely, Tulalip tribal members eat substantially more shellfish than the Squaxin Island members (median of 0.15 vs. 0.07 g/kg/day). These differences in consumption rates of bottom fish and shellfish between the two tribes are statistically significant. Differences between tribes for all other categories of fish—separately or aggregated into finfish and total fish—are not statistically significant. Consumption of the residual "other" category of fish (tuna and trout) is very low in both tribes (median less than 0.001 g/kg/day).

Fish consumption rates are skewed considerably for all fish groups (see Figure 1a-b). For each group, outliers representing high consumption rates are indicated by circles and asterisks (one symbol per respondent). The plots in the body of the report have been truncated on top to avoid visually compressing the data due to outliers. (The full plots, without truncation, are included in the appendix.) The upper quartile (indicated by the top of the box) lies farther from the median (the center line of the box) than the lower quartile (the bottom of the box). In a symmetric, nonskewed distribution, the upper and lower quartiles lie at the same distance from the median.

The 95th percentiles of fish consumption (2.9-3.0 g/kg/day for total fish consumption) are at least five times as large as the median consumption. At the other end of the spectrum, a percentage of tribal members are nonconsumers of some fish groups or consume very little. These low consumption rates are indicated by 5th percentile values of 0.05g/kg/day or less for all individual or combined consumption categories.

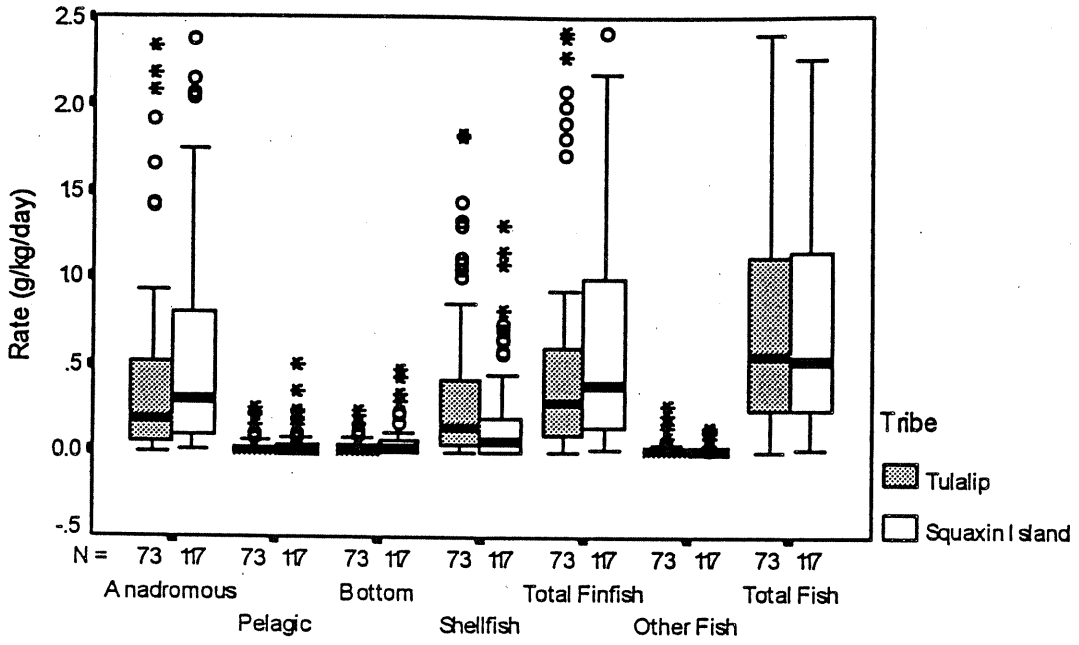

Figure 1-a. Consumption Rates (g/kg/day) by Type of Fish and Tribe

(Circles and asterisks represent outliers and extreme values, respectively, in all figures)

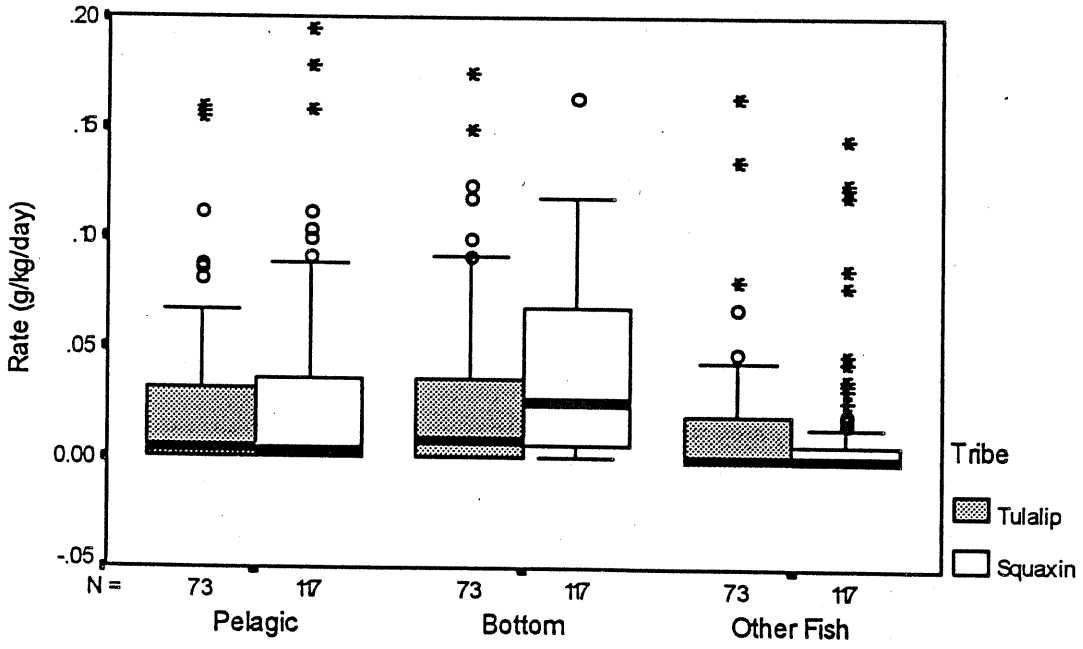

Figure 1-b. Consumption Rates (g/kg/day) for Pelagic, Bottom, and Other Fish by Tribe

Adult Consumption Rate by Gender within Each Tribe. Men consume more per body weight than women for all forms of fish combined (and for all subgroups of fish, as indicated by median consumption in Table 4, Figure 2, and Appendices A and B). In the Tulalip Tribes, the median total consumption rate is 0.62g/kg/day for men and 0.47 for women. In the Squaxin Island tribe, the median total fish consumption rate for men is 0.78 g/kg/day, and for women, 0.35 g/kg/day. Note that the gender differential is greater in the Squaxin Island tribe than in the Tulalip Tribes.

Table 4. Median Consumption Rates by Gender (g/kg/day) within Each Tribe

	Tulalip Tribes	Squaxin Island Tribe
Shellfish		
Male	.158	.100
Female	.153	.038
Total finfish		
Male	.414	.500
Female	.236	.272
Total fish		
Male	.623	.775*
Female	.472	.353

*p<.05 for difference in consumption rate by gender within a tribe (Wilcoxon-Mann-Whitney test).

The adult daily median consumption rate (g/day) of total fish by gender and tribe (gross consumption of fish with no adjustment for body weight) is shown in Table 5. For women in the Tulalip Tribes, the median total fish consumption rate (g/day) was 63% of the men's consumption rate. For women in the Squaxin Island tribe, the median total fish consumption rate (g/day) was 38% of the men's.

Table 5. Median Consumption Rate for Total Fish by Gender and Tribe (g/day)

Weight? Difference? Table 3

	Tulalip Tribes	Squaxin Island Tribe
Male	53	66
Female	34	25

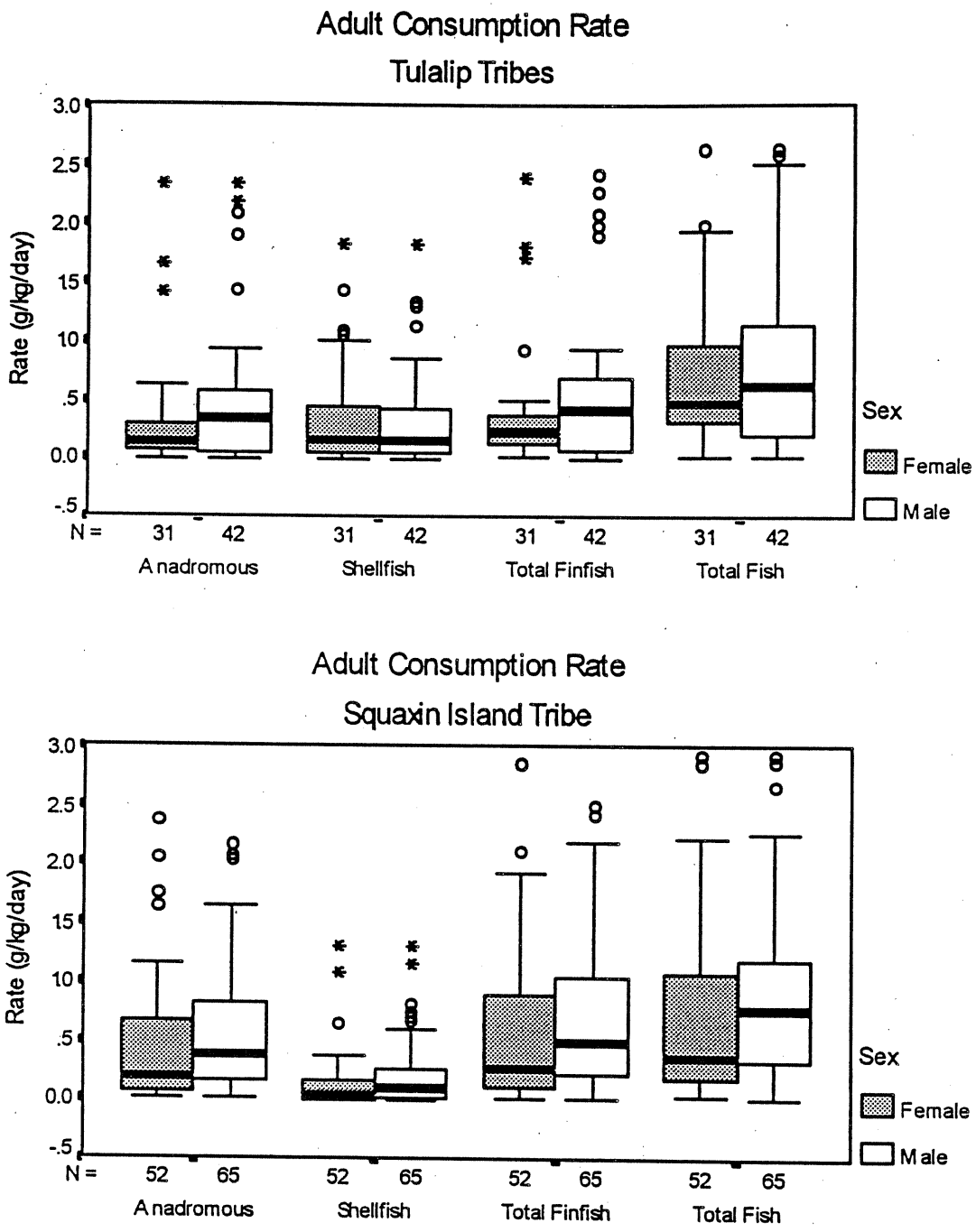

Figure 2. Consumption Rates by Gender and Type of Fish

Note: pelagic, bottom, and "other" fish are excluded from these plots due to low consumption rates.

Adult Consumption Rate by Age within Each Tribe. Among adults, consumption generally follows a curvilinear pattern with greater median consumption in the age range of 35-64 and lower consumption in the age range of 18-34 and 65 and over (Table 6, Figure 3, and Appendix A). In both tribes, there is almost a two-fold variation in median total fish consumption rates across the age groups. In the Tulalip Tribes, the range of median for four age groups was 0.5-1.0 g/kg/day, and among the Squaxin Island tribe, the range was 0.5-1.1 g/kg/day. The variation in consumption rates by age was statistically significant only for pelagic fish in the Squaxin Island tribe (p=.03, see Appendix Tables A5-A6).

Table 6. Median Consumption Rates by Age Group (g/kg/day)

Age	Tulalip Tribes Median Rate	Squaxin Island Tribe Median Rate
Shellfish		
18-34	.181	.073
35-49	.161	.073
50-64	.173	.000
65+	.034	.035
Total finfish		
18-34	.156	.289
35-49	.533	.383
50-64	.301	.909
65+	.176	.601
Total fish		
18-34	.571	.500
35-49	.968	.483
50-64	.476	1.106
65+	.195	.775

Consumption patterns among age groups within each tribe for anadromous, shellfish, total finfish, and total fish are shown in Figure 3 and Appendix B.

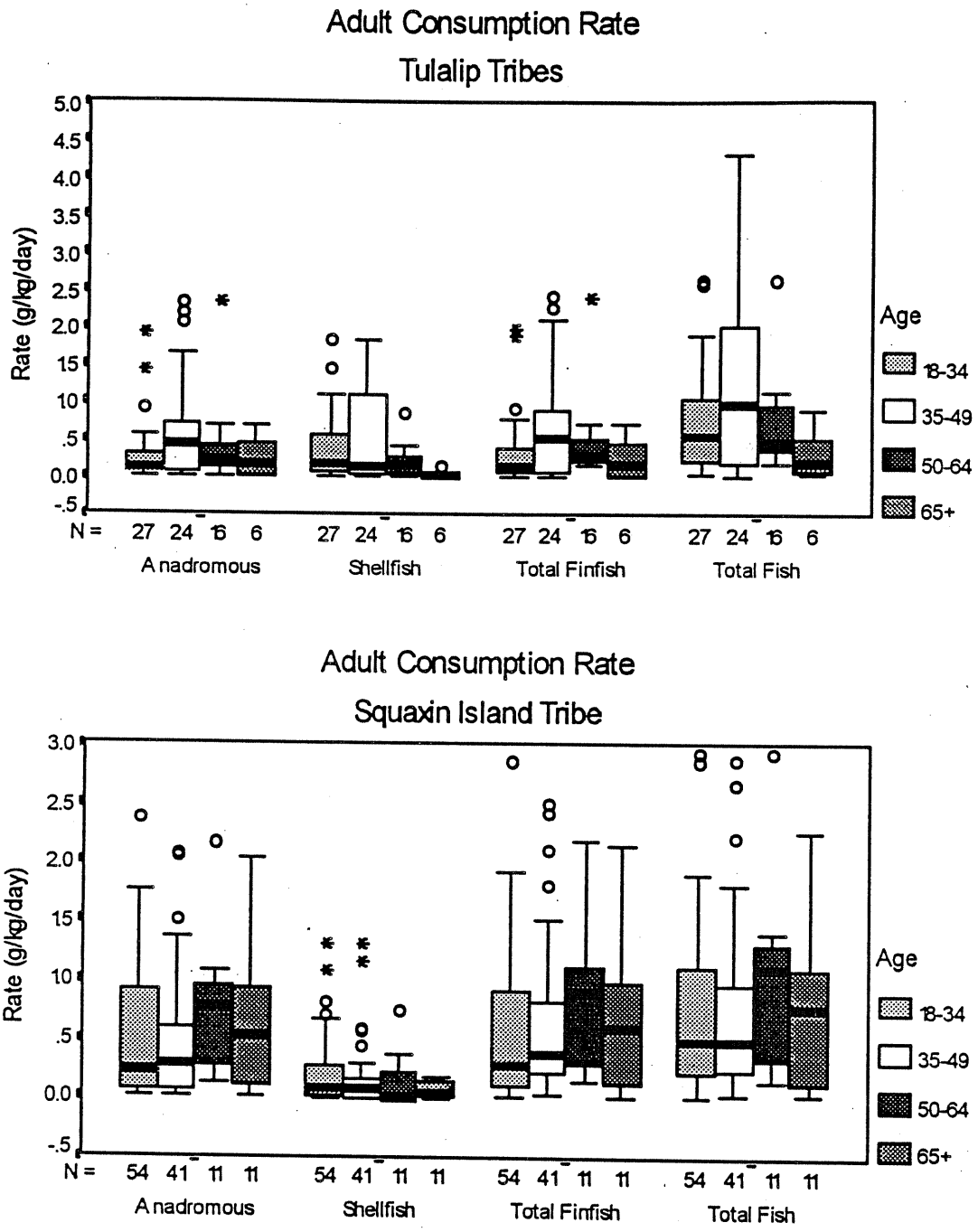

Figure 3. Consumption Rates by Age Group and Type of Fish

Note: pelagic, bottom, and "other" fish are excluded from these plots due to low consumption rates.

Adult Consumption Rate by Income within Each Tribe. There is no clear pattern of consumption rates across income levels for either tribe. For the major fish groups presented in Table 7, consumption rates vary at least two fold across income categories, but the variation is not statistically significant for any fish consumption category (or for other categories presented in the appendix). As shown in Appendix Table A8, consumption rates vary considerably within each income group.

Table 7. Median Consumption Rates by Income (g/kg/day) within Each Tribe

	Tulalip Tribes	Squaxin Island Tribe
Income	Median Rate	Median Rate
Shellfish		
<= $10000	.143	.078
$10001-$15000	.071	.121
$15001-20000	.144	.072
$20001-25000	.202	.000
$25001-35000	.416	.030
$35001+	.175	.090
Total finfish		
<= $10000	.235	.272
$10001-$15000	.095	.254
$15001-20000	.490	.915
$20001-25000	.421	.196
$25001-35000	.236	.387
$35001+	.286	.785
Total fish		
<= $10000	.521	.473
$10001-$15000	.266	.432
$15001-20000	.640	.961
$20001-25000	.921	.233
$25001-35000	.930	.426
$35001+	.607	1.085

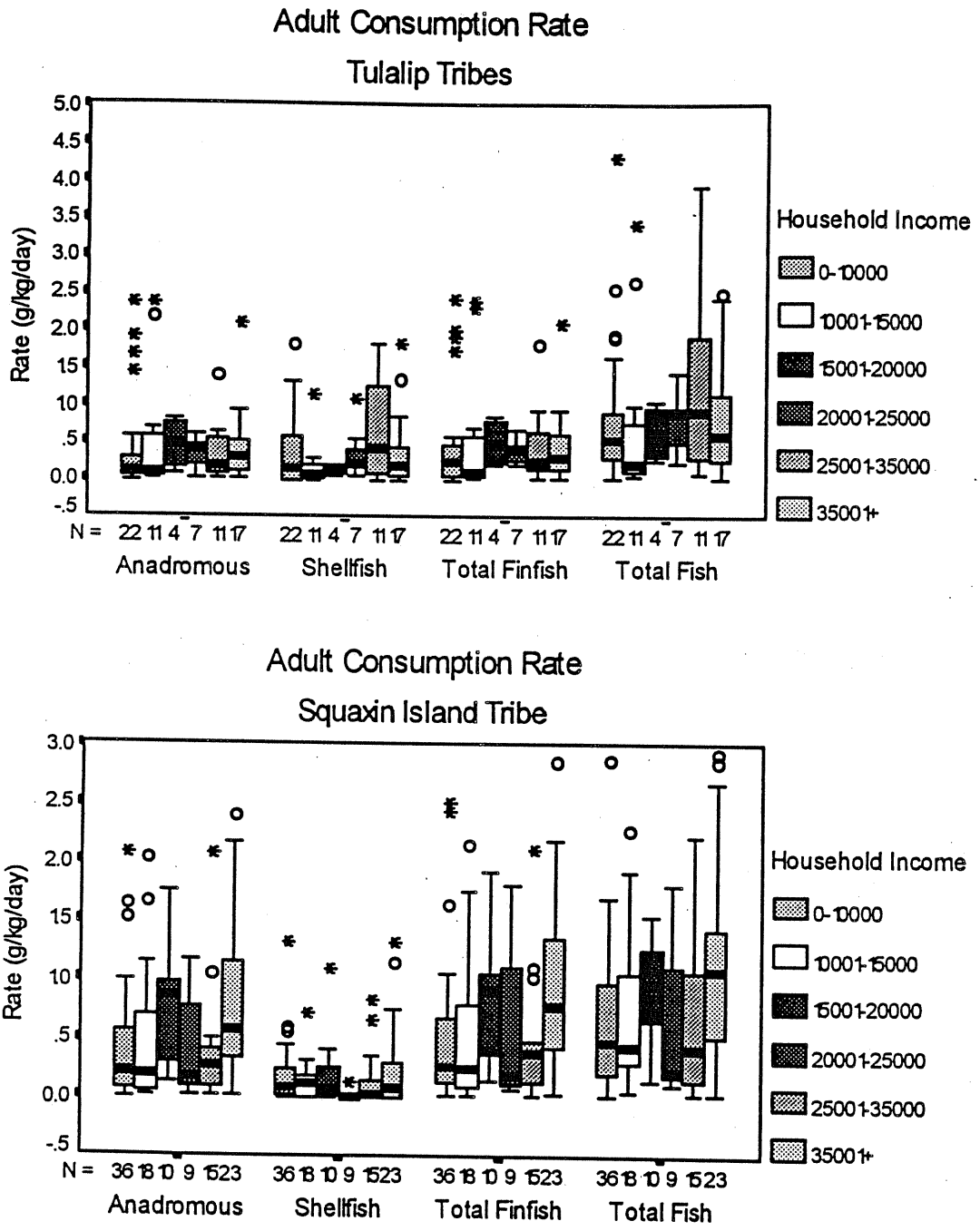

Figure 4. Consumption Rates by Income and Type of Fish

Note: pelagic, bottom, and "other" fish are excluded from these plots due to low consumption rates.

Children's Consumption Rates. This study showed that children's consumption of all forms of fish is lower than that of adults, even when the consumption rate is adjusted for body weight (Table 8). Squaxin Island children tend to consume more fish (total) than the Tulalip children (median 0.51 vs. 0.08 g/kg/day, p=0.06). They also consume more shellfish (0.05 vs. 0.00 g/kg/day) and more "other" fish (0.1 vs. 0.0 g/kg/day). The reader should bear in mind that 1) a number of the sampled children are nonconsumers of fish: 29% of Tulalip children and 25% of Squaxin Island children consumed no fish at all and these children have a consumption rate of zero in our computation for children; and 2) some of the percentiles in this and the corresponding appendix table are based on very few numbers of children, e.g., usually two children are beyond the 90th percentile in the Tulalip Tribes and four or five children are beyond the 90th percentile in the Squaxin Island tribe. The medians are also not additive (as are means), so that subcategory median may appear inconsistent with medians for combined categories.

Table 8. Median and 90th Percentile of Consumption Rates for Children Age Birth to Five Years (g/kg/day)

	Median	90%tile
Tulalip Tribes (n=21)		
Shellfish	.000	.597
Total finfish	.060	.290
Total, all fish	.078	.738
Squaxin Island Tribe (n =48)		
Shellfish	.045	.574
Total finfish	.061	.826
Total, all fish	.508	2.056
Both Tribes Combined (weighted)		
Shellfish	.012	.574
Total finfish	.064	.315
Total, all fish	.173	1.357

Change in Consumption Over Time. A substantial number of adults (age thirty and over) reported changes in their fish consumption patterns over the last twenty years (64% of Tulalip and 70% of Squaxin Island tribal members, Appendix Tables A10 and A11). Among those adults who had changed their consumption habits, a greater number

reported eating less fish now than they had in the past (58% Tulalip and 74% Squaxin Island). Individual reasons for eating less fish indicated unavailability (fish were less plentiful or more difficult to catch). Among the forty-four respondents who reported eating less, 68% noted unavailability as the cause. Among the twenty-one respondents who gave a reason for eating more fish, 33% noted greater availability as the cause. Thus, impressions on availability indicate decreasing resources overall, but these impressions are not uniform.

Consumption of Specified Fish Parts. A minority of consumers eat fish parts that are considered to have a higher concentration of toxins: skin, head, bones, eggs, and organs (Table 9). Eating fish skin is significantly more prevalent in the Tulalip Tribes than in the Squaxin Island tribe for all three fish groups. Among the Tulalip, 41% of the respondents consume anadromous fish skin, 21% consume pelagic fish skin, and 16% consume bottom fish skin. Among the Squaxin Island Tribe, 26% of the respondents consume anadromous fish skin, and 3% consume pelagic and bottom fish skin. Only a small percentage of members (0-11% in each tribe for any fish group) eat head, bones, eggs, organs, and skin.

Table 9. Mean Percent Consumption of Specified Fish Parts

	Tulalip Tribes	Squaxin Island Tribe
Anadromous fish	(n=72)	(n=117)
Eat fillet with skin (%) *	41	26
Eat head, bones, eggs, organs, skin (%)	8	11
Pelagic fish	(n=38)	(n=62)
Eat fillet with skin (%) **	21	3
Eat head, bones, eggs, organs, skin (%)	3	0
Bottom fish	(n=44)	(n=93)
Eat fillet with skin (%) **	16	3
Eat head, bones, eggs, organs, skin (%)	0	0

Limited to those consuming specified fish group. The percent is the mean stated percent of the time that consumers reported eating the specified part, including only those who consume the specified parts.
*p<0.05 and **p<0.01 comparing tribes (Wilcoxon-Mann-Whitney test).

Methods of Fish Preparation. The survey covered two categories of preparation methods. Both tribes prepare fish by the first category (baking, boiling, broiling, roasting, or poaching) more often than by the second (canning, frying, eating raw, smoking, or drying by—methods that tend to seal in toxins). However, a substantial percentage of fish is prepared using methods in the second category, varying from a low of 31% for shellfish in the Squaxin Island tribe to a high of 50% for bottom fish in the Tulalip Tribes. The two tribes do not differ significantly in their percent use of the two categories of preparation methods.

Table 10. Mean Percent Specified Preparation Methods: Mean (%) ± S.D.

	Tulalip Tribes	Squaxin Island Tribe
Anadromous fish	(n=72)	(n=117)
Bake, boil, broil, roast, or poach	64±4	56±3
Canned, fried, raw, smoked, or dried	36±4	44±3
Pelagic fish	(n=38)	(n=62)
Bake, boil, broil, roast, or poach	50±8	54±6
Canned, fried, raw, smoked, or dried	50±8	46±6
Bottom fish	(n=44)	(n=94)
Bake, boil, broil, roast, or poach	55±6	62±4
Canned, fried, raw, smoked, or dried	45±6	37±4
Shellfish	(n=61)	(n=80)
Bake, boil, broil, roast, or poach	66±4	69±3
Canned, fried, raw, smoked, or dried	34±4	31±3
Utilization of boiled water of shellfish+	(n=61)	(n=86)
Throw out	59%	59%
Use in cooking **	3%	21%
Drink	41%	41%

Limited to those consuming specified fish group. Percent is the mean among consumers of stated percent of time they use the specified preparation method.
+Percentages do not add to 100 because respondents may have multiple answers.
*p<0.05 and **p<0.01 comparing tribes (Wilcoxon-Mann-Whitney or Chi-squared test).

Both tribes throw out or drink the boiled water used to prepare shellfish at about the same rate. The Squaxin Island members use the boiled water significantly more often in cooking than Tulalip members (21% vs. 3%, p=0.002). Both tribes dispose of the water about 60% of the time. The percentages for use of boiled water do not add up to 100%,

because tribal members may employ multiple uses, for example, drinking some and using the rest in cooking.

Sources of Consumed Fish. The source of fish consumed (caught, purchased at grocery stores or restaurants) varies widely by type of fish and differs between the two tribes. Respondents were asked to give a percentage for each source, with percentages adding to 100%. For the few sources where percentages did not total 100, the percentage for each source was rescaled to yield a total of 100%. Table 11 reports the mean of each respondent's distribution. The "other" category is not presented in this table because it accounted for 3% or less of the fish sources. A complete table appears in Appendix A (Table A14).

The main source for the most heavily consumed fish group, anadromous fish, was Puget Sound, which supplied a mean of 72-80% consumed by each tribe. For pelagic fish, the pattern was more diverse. Among the Tulalip Tribes, a mean of approximately two-thirds of the pelagic fish were bought in grocery stores or restaurants, with approximately one-third caught in Puget Sound. Among the Squaxin Island tribe, about half of the pelagic fish were caught and half were purchased in grocery stores or restaurants, while the harvesting sites were evenly distributed inside and outside of Puget Sound (23% vs. 25%).

For bottom fish, both tribes caught about half of their fish, but locations of the catch differed. The Tulalip Tribes caught bottom fish much more frequently within Puget Sound than the Squaxin Island tribe, which caught bottom fish more frequently outside Puget Sound. (This result is surprising since the Squaxin Island tribe lives farther from the mouth of Puget Sound than the Tulalip Tribes, requiring more travel time to fish outside Puget Sound.) Among shellfish consumers in both tribes, the source for more than half of their shellfish consumption was from inside the Puget Sound, and they purchased less than one-third of their shellfish at grocery stores or restaurants. For pelagic fish, bottom fish, and shellfish, the source of the harvest (percentage caught outside Puget Sound),

differs significantly between the tribes. Generally, the Tulalip use Puget Sound more frequently than the Squaxin Island, and the Squaxin Island use sources outside Puget Sound more frequently than the Tulalip.

Table 11. Mean Percent of Sources of Fish Consumed: Mean (%) ± S.D.

	Tulalip Tribes	Squaxin Island Tribe
Anadromous fish	(n=72)	(n=117)
Grocery stores	4±2	6±1
Restaurants	7±2	3±1
Caught in Puget Sound **	72±3	80±3
Caught outside Puget Sound *	17±2	11±2
Pelagic fish	(n=38)	(n=62)
Grocery stores	28±7	30±5
Restaurants	41±8	21±5
Caught in Puget Sound	28±7	23±5
Caught outside Puget Sound ***	4±3	25±5
Bottom fish	(n=44)	(n=94)
Grocery stores	23±6	26±4
Restaurants	29±6	17±4
Caught in Puget Sound ***	39±7	13±33
Caught outside Puget Sound ***	6±3	41±5
Shellfish	(n=61)	(n=79)
Grocery stores *	9±3	13±3
Restaurants	14±3	16±3
Caught in Puget Sound **	73±5	62±4
Caught outside Puget Sound ***	4±2	7±2

Limited to those consuming specified fish group. Percent is the mean among consumers of stated percent of time they use the specified preparation method.
Percentages may not add to 100 due to rounding.
"Other" fish was omitted from this table.
*p<0.05, **P<0.01 and *** p<0.001 between the tribes (Wilcoxon-Mann-Whitney test).

Fish Harvest Locations. Locations for fish harvests were quite diverse. One hundred and one (101) locations were used at least once. For the Tulalip Tribes, the most frequently noted sites of fish harvesting in Puget Sound were Tulalip Bay (reported as a source for at least one fish group by 64% of respondents), Baby Island (48%), Port Susan (41%), and Spee Bi Dah (37%). The main source for the Tulalip Tribes outside Puget Sound was Salmon Banks (41%).

For the Squaxin Island tribe, the main harvesting sources inside Puget Sound were Peale Passage (67%), Peckering Passage (56%), Squaxin Island (56%), and Budd Inlet (50%). The main Squaxin Island source outside Puget Sound was Alaska (26%).

The most frequently used fishing areas, both inside and outside Puget Sound, varied substantially for each tribe by fish group. Detailed tables on percentage use of fishing areas by fish group and tribe are included in Appendix A (Tables A17-A24).

Comparison of the Gladys Block Food Frequency Questionnaire with Interview-Based Dietary Recall. A comparison of the two methods of assessing fish consumption shows that the median interview-based consumption rate was higher than the self-administered consumption rate (Table 12 and Appendix Table A25). In six comparisons (three fish categories for each tribe), the interview yielded a higher median consumption rate than the self-administered survey for every comparison (Appendix Table A25). We also noted that caloric intake was low in the self-administered survey (1619 calories/day for Tulalip and 1688/day for Squaxin Island tribe), which suggests underreporting of consumption in the self-administrated Gladys Block Food Frequency Questionnaire. In contrast to the interview, the self-administered procedure did not include any probing or monitoring or any portion size models. In addition, the questions in the self-report are very limited and are not directed to a full list of fish species eaten by these tribes. For example, in the self-administered survey, the category "shellfish" is the sum of the two categories 1)"oysters," and 2) "shrimp, crab, lobster, etc." This is a far more limited list than that presented in Table 1 and used in the interview survey. The consumption rates from the two surveys were significantly correlated but the magnitude of the correlations was small (rho=0.3-0.4 for total fish consumption, see Table 12 and Appendix A).

Reinterviews. The resemblance between the in-person interview and the telephone reinterview varies across respondents, across fish species, and between the two tribes (Appendix Tables A26 and A27). Differences may be due to the context of data collection in each case. The in-person format was a comprehensive approach with an

interviewer using models and monitoring the flow of information. The telephone reinterview was a brief look at consumption out of context.

Table 12. Median Consumption Rates (g/kg/day, all fish groups combined) Derived from Self-Administered Dietary Recall Survey and from In-Person Interview

Tribe	Median		Spearman Correlation
	Self-Administered	Interview	
Tulalip Tribes (n = 68)	.24	.55	.38**
Squaxin Island Tribe (n = 108)	.26	.52	.41***

**p<0.01, ***p<0.001
Note: Spearman correlation is calculated between individual consumption rates from the two sources.

The results suggest that individual recall may vary across repetitions. However, the aggregate measures, such as mean, median, and percentiles, are based on a number of individuals and are more reliable than individual observations.

Confidence Intervals for Percentiles. Confidence intervals for the mean presented in Appendix A take appropriate account of variability—both within and between individuals. Approximate 95% confidence bounds for percentiles can be obtained by dividing or multiplying the observed percentile by a "multiplier" to yield the lower or upper confidence limit, respectively. The "multiplier" is based on a lognormal model. The approximation is good to the extent that the actual distribution approximates the lognormal distribution. The value of C in the multiplier equation is 1.25 for the median, 1.71 for the 10th or 90th percentile and 2.12 for the 5th or 95th percentile.

$$Multiplier = \exp\{1.96 \times C/\sqrt{n} \times \sqrt{\log_e(SE^2 \times n/\bar{x}^2 + 1)}\}$$

The quantity $\bar{x}$ and SE are the observed mean, standard error, and sample size, respectively. For example, an approximate 95% confidence interval for the 95th percentile of total fish consumption for the Tulalip Tribes is calculated based on the

observed 95th percentile = 2.876g/kg/day, n = 73, $\bar{x}$ = 0.889 , SE = 0.111 and C = 2.12. The multiplier is 1.53 and the approximate 95% confidence interval is 1.88 to 4.39 g/kg/day. Again, these intervals should be taken as "rough" (or approximate).

The multiplier equation is based on the variance of quantiles (Kendall, M.G., Stuart, A. 1963) and an expression for the standard deviation of the normal distribution in terms of the mean and standard deviation of a specified lognormal distribution.

Response Rate. Response rate for the Squaxin Island tribe was 77% (117 completed interviews out of 151 attempted). Approximately 6% of those contacted refused the interview. Explanations for refusals included lack of time, transportation, and child care. The balance of those not interviewed (16%) were either repeated "no shows" for interviews or could not be contacted. The response rate for the Tulalip Tribes was 76% (73 complete interviews out of 96 attempts). Refusals were 8% for the Tulalip Tribes and the non-contact or "no show" rate was 15%. Less than 1% of those contacted in the combined tribes were excluded due to non-consumption of fish.

Discussion

Summary. Median consumption rates for Tulalip and Squaxin Island tribal members for all forms of fish combined are 0.55 and 0.52/g/kg/day, respectively. This survey of 190 members of the Tulalip and Squaxin Island tribes has shown considerably higher consumption rates for both adults and children than the 0.09 g/kg/day (i.e., 6.5 g/day for a 70-kilogram person) reported for the general population (SRI International, 1980). The consumption pattern varies between tribes by age, gender, and across the different groups of fish. In both tribes, finfish are consumed at a higher rate than shellfish. Consumption of the categories "other" fish (trout and tuna) is almost negligible. The median total fish consumption rate (g/day) for women of both tribes was four to five times higher than the rate of 6.5 g/day as recommended as a national default value used by the EPA. For males of both tribes, the median consumption rate was eight to ten times higher than 6.5 g/day.

A broad range of consumption rates exists within each tribe. The distribution is skewed toward high rates, a feature that should be considered when these data are used for risk analysis. For example, it may be more appropriate to use 90th or 95th percentiles for some regulatory purposes rather than means or medians.

In general, men consume more fish than women. Consumption by age follows a curvilinear pattern with greater consumption in the age range of 35-64 than in ages on either side of this range. There was no consistent pattern of adult consumption rates by income group. Children consume less per body weight than adults. Squaxin Island children consume more fish (total) than Tulalip children (six fold, based on medians). As noted earlier in the report, a substantial fraction of children do not consume any fish at all. The non-consumers are younger (mean age = 12.5 months) than consumers (mean age = 39.0 months). The inclusion of the non-consumer group of children (with zero consumption rate) in the calculation reduces the overall consumption rate for children. If the non-consumers were removed, the consumption rates for children would be higher than the rates reported in this study.

Members of both tribes tend to eat fish in a manner that would decrease but not eliminate intake of contaminants: nonconsumption of head, bones, skin, organs, and eggs, and preparation of the fish by baking, boiling, broiling, roasting, or poaching. The source of fish consumed varies depending on fish group and tribe. For the two major fish groups, anadromous and shellfish, at least half are caught as opposed to purchased in grocery stores or restaurants. For pelagic and bottom fish, 32-54% are caught. Geographic source of the catch (inside versus outside Puget Sound and specific locations in Puget Sound) also depends on the fish group and tribe.

Extrapolation to Other Tribes. Results presented here are a snapshot of consumption practices in two specific tribes, as viewed during 1994. While results are based on a sample, they represent all eligible members of these tribes. Extrapolation to other tribes around Puget Sound or in other areas involves some degree of speculation. As noted

earlier, the two tribes were not selected randomly from among the fourteen tribes that regularly consume fish from Puget Sound. Even though the Tulalip and Squaxin Island tribes have similar total fish consumption rates, results show that the two differ in consumption pattern by fish group and other factors. A number of differences are statistically significant (e.g., consumption by fish groups, parts of fish consumed, source of fish), suggesting that extrapolation should be based on specified assumptions. Consumption rates and patterns of other tribes may differ from those in this study.

Importance of Potential Changes in Consumption. Many tribal members noted that they consume less fish now than they did in earlier years because it is less abundant. The reported consumption rates in this report may underestimate future consumption if fish runs and fish populations increase. If growth in tribal or other populations places pressure on fish resources, or if fish populations decline, consumption rates could fall and figures from this study would be overestimates. Relative scarcity or abundance of fish could also cause a shift in consumption habits of specified fish parts. Finally, a shift toward purchase of fish in stores or restaurants could also shift consumption rates for fish harvested in Puget Sound.

Comparison to Other Studies. Fish consumption rates are likely to be different between the general population and subpopulations (Table 13). EPA (1989) and Rupp (et al. 1980) have acknowledged substantial regional and site-specific variations in consumption rates. Rates of consumption from specific types of water bodies differ substantially depending upon regional considerations, ethnic or cultural backgrounds, fishing regulations, accessibility to fisheries, availability of target species, and climate.

Consumption rates found in this survey are similar to rates from other surveys conducted on Native American populations. The mean daily intake of fish and shellfish of Alaska Natives (53% Eskimo, 34% Indians, 13% Aleuts) was 109 g/day. Columbia River tribes of Washington and Oregon reported a consumption rate of 59 g/day for anadromous and resident fish (CRITFC 1994). The daily consumption rate for the Tlingit tribe of Angoon,

Alaska was 46 g/day for bottom fish and 9 g/day for filter-feeding invertebrates, for a total of 55 g/day.

Table 13. Estimates of Average Fish Consumption Rates Per Sources of Consumed Fish (g/d)

Source and Water Body Type	Range of Average Rates	Reference
General Population Surveys		
Marine, freshwater, and estuarine	12.7 to 54	Javitz et al., 1980 Rupp et al., 1980 USDA, 1980 Pao et al., 1982
Marine only	8.8	Rupp et al., 1980
Freshwater only	1.2	Rupp et al., 1980
Angler Surveys		
Marine, freshwater, and estuarine	18.3 to 28	West et al., 1989 Fiore et al., 1989 NYSDEC, 1990
Marine only	15 to 37	Pierce et al., 1981 Puffer et al., 1981 Landolt et al., 1985
Freshwater-multiple water bodies	6.4 to 21.8	Cox et al., 1990 Fiore et al., 1989 West et al., 1989 Connelly et al., 1992 Ebert et al., 1994
Freshwater-single water body	1.8 to 7.7	Soldat, 1970 Honstaedt et al., 1971 Turcotte, 1983 CHEMRISK, 1991a
Native American Surveys		
Marine and estuarine	Male: 53-66; Female 25-34 109 55	Median rate, current study, 1996 Alaska Natives (Nobmann et al, 1992) Angoon (George et al, 1988)
Freshwater	58.7	Columbia River Basin (CRITFC, 1994)

Quality of Data. Long-term recall studies have potential for recall bias resulting from over- or underestimation due to difficulty recalling detail over a long period of time. However, for foods that are eaten habitually, recall is more accurate than for foods consumed less often or without a pattern (Krall 1988). Because fish and shellfish are an integral part of Native American diet and culture, long-term recall bias may have been minimized. Individual consumption data are likely to be quite variable or uncertain, but aggregate measures (mean, median, percentiles) will be more accurate. Standard errors, confidence intervals for means, and guidelines for confidence intervals of percentiles indicate the precision of estimates.

Gladys Block Food Frequency Questionnaire and Reinterviews. Several factors affect fish consumption rates derived from the Gladys Block Food Frequency Questionnaire. First, the questionnaire was self-administered and therefore did not have an interviewer probing for information. Secondly, the questionnaire did not include the same number or type of fish or shellfish species as the in-person interview. Third, the questionnaire lacked the aid of fish models. The reinterviews, conducted by telephone, were considered less accurate than in-person interviews. Factors affecting these reinterviews include distractions in the home environment, lack of prescheduled time, timing of the reinterview, and questions out of context. In the future, more accurate and complete information can be derived from in-person reinterviews.

Timing of Survey. There may be a possible bias due to the timing of the survey. Many species in this survey are seasonal. For example, all species of salmon are present in Puget Sound at different times of the year. Most shellfish harvests take place during spring and summer when low tides occur during daylight hours. The survey was conducted during a low season for anadromous (salmon) fish but prior to and during the shellfish (clam) season. Respondents may tend to weight their responses on frequency and quantity of consumption toward the interview period, and not annualize the response, even though the goal of the study is an annualized rate. Because of the timing of the study, some individuals may have underestimated annual salmon consumption and

overestimated annual consumption of shellfish. If the survey were conducted throughout the year, this bias would have been minimized.

Data Uses. Anecdotal evidence suggests that certain subgroups of the population, such as sport fisherman, urban anglers, low-income families, Asians, and Native Americans, may bear a disproportionate health risk due to their patterns and rates of fish consumption. EPA (1989) has acknowledged substantial regional and site-specific variations in consumption rates and, as a result, has recommended that site- or region-specific consumption estimates be used whenever possible. Currently, EPA relies on data from a National Purchase Diary (NPD) Survey conducted in 1973 and 1974 to estimate human exposure through fish ingestion. The NPD survey estimated that the mean fish consumption rate for both consumers and nonconsumers was 6.5 grams per person per day (g/day). EPA uses this value in the calculation of human health criteria. Our study shows that tribal members have a higher consumption rate than 6.5g/day.

The data from this study provide valuable information for risk assessments, such as information on exposure distributions and risk factors through the fish ingestion pathway. Data can be used to improve exposure assessment methods for high consumer populations and to identify cultural characteristics that may place tribal members at disproportionate risk to chemical contamination. However, if the fish consumption rates in this report are to be used to represent fish consumption in other tribal populations, information should be collected about their species consumption, preparation methods and other relevant factors. This will place the consumption rates from this report in context.

The data also address Washington State Department of Health's goal to "protect and preserve the health of individual citizens and local communities, protecting the public from exposure to toxic substances which may lead to adverse health impacts or pose unacceptable health risks." Moreover, these data address two key recommendations made by a national EPA work group on Environmental Equity. The first states that EPA

should, "establish and maintain information which provides an objective basis for assessment of risks by income and race, commencing with developing a research and data collection plan." The second states that EPA should "incorporate considerations of environmental equity into the risk assessment process. It (EPA) should revise its risk assessment procedures to ensure, where practical and relevant, better characterization of risk across populations, communities or geographic areas" (EPA Equity Report, 1991).

The data will also assist the federal government in exercising its fiduciary and treaty responsibilities to protect the natural resources and well-being of Native Americans. The study can be used as a model for future exposure and risk analysis research of other sensitive populations. Finally, data can be used by other tribes should they elect to develop their own water quality standards.

Conclusions. The following conclusion can be drawn based on the results in this report for Tulalip Tribes and Squaxin Island tribe:

- These two tribes consumed fish at a significantly higher rate than the general population. Tulalip adult tribal members consumed a median of 0.55g/kg/day and Squaxin Island tribal members consumed 0.52g/kg/day.
- In both tribes, males consumed fish at a higher rate than females.
- There was a slightly higher consumption rate in the age group of 35-64 than in other age groups. There was no consistent consumption pattern by income group.
- Children age 0-5 years consumed a median rate of 0.078g/kg/day for Tulalip Tribes and 0.51g/kg/day for Squaxin Island tribe.
- 72% - 80% of anadromous fish and 62% - 72% of shellfish were caught in Puget Sound. Sources of fish varied by species group and tribe. Fish were harvested from a wide range of locations in Puget Sound.

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Appendices

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Appendix A

Detailed Tables

Table A1. Descriptive Characteristics

Adults				
	Tulalip Tribes (n=73)		Squaxin Island Tribe (n=117)	
	n	%	n	%
Gender				
Male	42	57.5	65	55.6
Female	31	42.5	52	44.4
Age				
18-34	27	37.0	54	46.2
35-49	24	32.9	41	35.0
50-64	16	21.9	11	9.4
65+	6	8.2	11	9.4
Household Income				
≤ $10,000	22	30.1	36	30.8
$10,001 - $15,000	11	15.1	18	15.4
$15,001 - $20,000	4	5.5	10	8.5
$20,001 - $25,000	7	9.6	9	7.7
$25,001 - $35,000	11	15.1	15	12.8
$35,001+	17	23.3	23	19.7
Unknown	1	1.4	6	5.1
Residence				
On Reservation	54	74.0	65	55.6
Off Reservation	18	24.7	52	44.4
Unknown	1	1.4	0	0
Quality of Respondent's Answer				
High Quality	5	6.8	70	59.8
Generally reliable	67	91.8	43	36.8
Questionable	1	1.4	4	3.4
Weight (kg): mean ± s.d.				
Male	86 ± 19		93 ± 17	
Female	76 ± 16		68 ± 14	
Age: mean ± s.d.				
Male	40 ± 15		40 ± 17	
Female	43 ± 19		37 ± 16	
Interview Time (minutes): mean ± s.d.	30.5 ± 10.7		35.7 ± 13.8	

Table A1. Descriptive Characteristics

Children				
	Tulalip Tribes (n=21)		Squaxin Island Tribe (n=48)	
	n	%	n	%
Gender				
Boys	12	57.1	19	39.6
Girls	9	42.9	29	60.4
Respondent's relationship to child				
Mother	9	42.9	22	45.8
Father	8	38.1	16	33.3
Step-parent	0	0	3	6.3
Grandparent	1	4.8	1	2.1
Guardian	0	0	1	2.1
Other	3	14.3	5	10.4
Child breastfed?				
Yes	9	42.9	36	75.0
No	12	57.1	9	18.8
Unknown	0	0	3	6.2
Weight (kg): mean ± s.d.	15.2 ± 5.1		15.5 ± 5.2	
Age (mo.): mean ± s.d.	33.3 ± 17.2		31.5 ± 18.3	
Duration of breastfeeding (month)*: mean ± s.d.	8.6 ± 12.4 (n=18)		7.8 ± 6.8 (n=33)	

*Among those who were breastfed, unknown excluded.

Table A2. Consumption Rates (g/kg/day) for Adult Tribal Members: Percentiles, Means, and 95% Confidence Intervals

	5%	50%	90%	95%	Mean	S.E.	95% C.I.
Tulalip Tribes (n = 73)							
Anadromous fish	0.006	0.190	1.429	2.114	0.426	0.068	(0.297, 0.555)
Pelagic fish	0.000	0.004	0.156	0.234	0.036	0.008	(0.021, 0.051)
Bottom fish	0.000	0.008	0.111	0.186	0.033	0.007	(0.020, 0.046)
Shellfish	0.000	0.153	1.241	1.826	0.362	0.059	(0.250, 0.474)
Total finfish	0.010	0.284	1.779	2.149	0.495	0.072	(0.359, 0.631)
Other fish	0.000	0.000	0.113	0.264	0.031	0.008	(0.016, 0.046)
Total fish	0.046	0.552	2.466	2.876	0.889	0.111	(0.679, 1.099)
Squaxin Island Tribe (n = 117)							
Anadromous fish	0.016	0.308	1.639	2.182	0.590	0.069	(0.485, 0.695)
Pelagic fish	0.000	0.003	0.106	0.248	0.043	0.009	(0.029, 0.057)
Bottom fish	0.000	0.026	0.176	0.345	0.063	0.010	(0.048, 0.078)
Shellfish	0.000	0.065	0.579	0.849	0.181	0.027	(0.140, 0.222)
Total finfish	0.027	0.383	1.828	2.538	0.697	0.075	(0.583, 0.811)
Other fish	0000	0.000	0.037	0.123	0.014	0.003	(0.009, 0.019)
Total fish	0.045	0.524	2.348	3.016	0.891	0.088	(0.757, 1.025)
Both Tribes Combined (weighted)							
Anadromous (p=0.07)	0.010	0.239	1.433	2.085	0.508	0.042	(0.425, 0.591)
Pelagic (p=0.9)	0.000	0.004	0.112	0.226	0.040	0.005	(0.029, 0.050)
Bottom (p=0.004)	0.000	0.015	0.118	0.228	0.048	0.005	(0.038, 0.058)
Shellfish (p=0.004)	0.000	0.115	0.840	1.308	0.272	0.030	(0.212, 0.331)
Total finfish (p=0.06)	0.017	0.317	1.751	2.188	0.596	0.045	(0.507, 0.685)
Other fish (p=0.017)	0.000	0.000	0.049	0.145	0.023	0.004	(0.015, 0.030)
Total fish (p=0.9)	0.047	0.531	2.312	2.936	0.890	0.064	(0.765, 1.015)

P-values are for differences between tribes (Wilcoxon-Mann-Whitney test).

Table A3. Mean Adult Consumption Rate (g/kg/day) by Gender

	Tulalip Tribes				Squaxin Island Tribe				Both Tribes Combined (weighted)			
	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.
Anadromous fish			**p=0.2**				**p=0.09**				**p=0.029**	
Male	42	.498	.095	(.318, .678)	65	.596	.078	(.477, .715)	107	.547	.055	(.439, .655)
Female	31	.327	.095	(.147, .507)	52	.582	.121	(.398, .766)	83	.455	.066	(.326, .583)
Pelagic fish			**p=0.4**				**p=0.1**				**p=0.1**	
Male	42	.033	.009	(.016, .050)	65	.046	.012	(.028, .064)	107	.040	.006	(.027, .052)
Female	31	.041	.014	(.015, .067)	52	.040	.014	(.019, .061)	83	.041	.009	(.024, .057)
Bottom fish			**p=0.4**				**p=0.3**				**p=0.8**	
Male	42	.028	.008	(.013, .043)	65	.065	.013	(.045, .085)	107	.047	.006	(.034, .059)
Female	31	.041	.012	(.018, .064)	52	.061	.015	(.038, .084)	83	.051	.008	(.035, .067)
Shellfish			**p=0.9**				**p=0.08**				**p=0.2**	
Male	42	.370	.082	(.215, .525)	65	.202	.035	(.149, .255)	107	.286	.042	(.204, .368)
Female	31	.353	.085	(.192, .514)	52	.155	.041	(.093, .217)	83	.254	.044	(.168, .340)
Total finfish			**p=0.2**				**p=0.1**				**p=0.06**	
Male	42	.559	.100	(.370, .748)	65	.707	.086	(.576, .838)	107	.633	.059	(.518, .748)
Female	31	.409	.101	(.218, .600)	52	.684	.130	(.486, .882)	83	.547	.070	(.409, .684)
Other fish			**p=0.3**				**p=0.037**				**p=0.017**	
Male	42	.030	.010	(.011, .049)	65	.017	.005	(.009, .025)	107	.024	.005	(.013, .034)
Female	31	.032	.013	(.007, .057)	52	.009	.004	(.003, .015)	83	.021	.006	(.008, .033)
Total fish			**p=0.6**				**p=0.028**				**p=0.045**	
Male	42	.959	.155	(.666, 1.252)	65	.926	.102	(.771, 1.081)	107	.943	.085	(.777, 1.108)
Female	31	.794	.156	(.499, 1.089)	52	.847	.153	(.614, 1.080)	83	.821	.096	(.633, 1.008)

P-values are for differences by gender (Wilcoxon-Mann-Whitney test). Unweighted consumption rates are used for both tribes combined.

Table A5. Mean Adult Consumption Rate (g/kg/day) by Age

	Tulalip Tribes				Squaxin Island Tribe				Both Tribes Combined (weighted)			
	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.
Anadromous fish			**p=.3**				**p=.2**					**p=.3**
18-34	27	.298	.088	(.132, .464)	54	.547	.101	(.393, .701)	81	.423	.058	(.309, .536)
35-49	24	.634	.151	(.348, .920)	41	.534	.108	(.370, .698)	65	.584	.084	(.419, .749)
50-64	16	.393	.137	(.134, .652)	11	.938	.290	(.496, 1.380)	27	.666	.131	(.410, .921)
65+	6	.251	.116	(.032, .470)	11	.662	.205	(.350, .974)	17	.457	.097	(.266, .647)
Pelagic fish			**p=.7**				**p=.03**					**p=.043**
18-34	27	.038	.014	(.012, .064)	54	.027	.009	(.013, .041)	81	.033	.008	(.018, .047)
35-49	24	.040	.014	(.014, .066)	41	.067	.019	(.038, .096)	65	.054	.010	(.034, .073)
50-64	16	.039	.018	(.005, .073)	11	.056	.046	(0, .126)	27	.048	.020	(.009, .086)
65+	6	.004	.003	(0, .010)	11	.020	.007	(.009, .031)	17	.012	.003	(.006, .018)
Bottom fish			**p=.4**				**p=.2**					**p=.074**
18-34	27	.029	.011	(.008, .050)	54	.045	.011	(.028, .062)	81	.037	.007	(.024, .050)
35-49	24	.044	.013	(.019, .069)	41	.089	.020	(.059, .119)	65	.067	.010	(.047, .086)
50-64	16	.035	.013	(.010, .060)	11	.091	.048	(.018, .164)	27	.063	.020	(.024, .102)
65+	6	.007	.004	(0, .015)	11	.029	.009	(.015, .045)	17	.018	.004	(.010, .026)
Shellfish			**p=.2**				**p=.4**				**p=.2**	
18-34	27	.374	.091	(.202, .546)	54	.217	.044	(.150, .284)	81	.296	.047	(.203, .388)
35-49	24	.525	.135	(.270, .780)	41	.174	.045	(.105, .243)	65	.350	.067	(.217, .482)
50-64	16	.215	.054	(.113, .317)	11	.146	.073	(.035, .257)	27	.181	.039	(.105, .256)
65+	6	.052	.026	(.003, .101)	11	.069	.024	(.032, .106)	17	.061	.016	(.030, .091)
Total finfish			**p=.1**				**p=.2**				**p=.1**	
18-34	27	.365	.099	(.178, .552)	54	.620	.108	(.456, .784)	81	.493	.064	(.368, .617)
35-49	24	.719	.157	(.422, 1.016)	41	.690	.121	(.506, .874)	65	.705	.089	(.530, .879)
50-64	16	.467	.134	(.214, .720)	11	1.084	.321	(.595, 1.573)	27	.776	.140	(.500, 1.051)
65+	6	.263	.120	(.036, .490)	11	.711	.211	(.390, 1.032)	17	.487	.100	(.290, .684)
Other fish			**p=.5**				**p=.072**				**p=.2**	
18-34	27	.041	.015	(.013, .069)	54	.025	.006	(.016, .034)	81	.033	.008	(.018, .048)
35-49	24	.031	.014	(.005, .057)	41	.003	.001	(.001, .005)	65	.017	.007	(.004, .030)
50-64	16	.022	.016	(0, .052)	11	.001	.001	(0, .003)	27	.012	.008	(0, .027)
65+	6	.008	.006	(0, .019)	11	.006	.002	(.003, .009)	17	.007	.003	(.001, .013)
Total fish			**p=.2**				**p=.6**				**p=.4**	
18-34	27	.780	.140	(.515, 1.045)	54	.862	.127	(.669, 1.055)	81	.821	.084	(.657, .985)
35-49	24	1.275	.263	(.778, 1.772)	41	.867	.154	(.633, 1.101)	65	1.071	.140	(.796, 1.346)
50-64	16	.704	.148	(.424, .984)	11	1.232	.345	(.707, 1.757)	27	.968	.152	(.670, 1.266)
65+	6	.322	.140	(.057, .587)	11	.786	.219	(.453, 1.119)	17	.554	.109	(.341, .767)

P-values are for differences among age groups (Kruskal-Wallis test). Unweighted consumption rates are used for comparison.

Table A4. Percentiles of Adult Consumption Rate (g/kg/day) by Gender

	Tulalip Tribes				Squaxin Island Tribe			
	5%	50%	90%	95%	5%	50%	90%	95%
Anadromous fish								
Male	.006	.341	1.769	2.166	.019	.388	1.416	2.058
Female	.007	.134	1.263	1.935	.013	.184	1.967	3.276
Pelagic fish								
Male	.000	.014	.087	.223	.000	.011	.123	.224
Female	.000	.000	.159	.256	.000	.000	.110	.347
Bottom fish								
Male	.000	.006	.092	.142	.000	.030	.159	.404
Female	.000	.012	.165	.224	.000	.020	.206	.361
Shellfish								
Male	.000	.158	1.332	1.829	.000	.100	.626	.800
Female	.000	.153	1.085	1.599	.000	.038	.355	1.163
Total finfish								
Male	.007	.414	1.966	2.258	.034	.500	1.564	2.352
Female	.017	.236	1.561	2.046	.022	.272	2.055	3.299
Other fish								
Male	.000	.004	.071	.256	.000	.000	.082	.124
Female	.000	.000	.158	.264	.000	.000	.028	.081
Total fish								
Male	.042	.623	2.553	3.304	.064	.775	1.920	2.917
Female	.038	.472	1.982	3.149	.038	.353	2.913	3.628

Table A6. Percentiles of Adult Consumption Rate (g/kg/day) by Age

	Tulalip Tribes				Squaxin Island Tribe			
	5%	50%	90%	95%	5%	50%	90%	95%
Anadromous fish								
18-34	.007	.120	1.028	1.721	.016	.233	1.450	2.605
35-49	.001	.430	2.133	2.299	.017	.292	1.482	2.067
50-64	.025	.228	1.181	1.181	.135	.771	3.053	3.053
65+	.006	.164	.522	.522	.009	.522	1.957	1.957
Pelagic fish								
18-34	.000	.000	.172	.243	.000	.000	.090	.204
35-49	.000	.014	.184	.245	.000	.016	.225	.495
50-64	.000	.010	.187	.187	.000	.000	.419	.419
65+	.000	.001	.008	.008	.000	.010	.065	.065
Bottom fish								
18-34	.000	.006	.129	.204	.000	.016	.111	.222
35-49	.000	.021	.152	.234	.000	.046	.286	.472
50-64	.000	.011	.136	.136	.000	.027	.449	.449
65+	.000	.004	.017	.017	.000	.022	.094	.094
Shellfish								
18-34	.000	.181	1.163	1.676	.000	.073	.690	1.141
35-49	.000	.161	1.827	1.830	.000	.073	.547	1.094
50-64	.000	.173	.549	.549	.000	.000	.671	.671
65+	.000	.034	.088	.088	.000	.035	.188	.188
Total finfish								
18-34	.013	.156	1.129	1.956	.023	.289	1.618	2.963
35-49	.002	.533	2.188	2.388	.043	.383	2.052	2.495
50-64	.156	.301	1.211	1.211	.141	.909	3.439	3.439
65+	.006	.176	.531	.531	.015	.601	2.049	2.049
Other fish								
18-34	.000	.006	.184	.264	.000	.000	.124	.145
35-49	.000	.004	.147	.251	.000	.000	.018	.021
50-64	.000	.000	.110	.110	.000	.000	.009	.009
65+	.000	.000	.019	.019	.000	.005	.019	.019
Total fish								
18-34	.044	.571	2.034	2.615	.043	.500	2.385	3.147
35-49	.006	.968	3.666	4.204	.043	.483	2.577	3.053
50-64	.190	.476	1.586	1.586	.141	1.106	3.589	3.589
65+	.050	.195	.623	.623	.036	.775	2.153	2.153

Table A7. Mean Adult Consumption Rate (g/kg/day) by Income (in dollars)

	Tulalip Tribes				Squaxin Island Tribe				Both Tribes Combined (weighted)			
	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.
Anadromous fish			p=.6				p=.071				p=.041	
<=$10000	22	.447	.149	(.165, .729)	36	.612	.157	(.373, .851)	58	.530	.094	(.345, .714)
$10001- $15000	11	.577	.260	(.085, 1.069)	18	.487	.141	(.272, .702)	29	.532	.137	(.264, .800)
$15001- $20000	4	.456	.176	(.123, .789)	10	.748	.155	(.512, .984)	14	.602	.104	(.398, .806)
$20001- $25000	7	.328	.073	(.190, .466)	9	.407	.154	(.173, .641)	16	.368	.069	(.231, .504)
$25001- $35000	11	.341	.128	(.099, .583)	15	.408	.136	(.201, .615)	26	.375	.081	(.215, .534)
$35001+	17	.412	.120	(.185, .639)	23	.746	.130	(.548, .944)	40	.579	.077	(.428, .730)
unknown	1	.011	--	--	6	.636	.530	(0, 1.443)	7	.324	--	--
Pelagic fish			p=.5				p=.4				p=.2	
<=$10000	22	.052	.019	(.016, .088)	36	.036	.016	(.012, .060)	58	.044	.011	(.022, .066)
$10001- $15000	11	.005	.003	(0, .011)	18	.019	.007	(.008, .030)	29	.012	.003	(.006, .018)
$15001- $20000	4	.020	.009	(.003, .037)	10	.038	.012	(.020, .056)	14	.029	.006	(.017, .041)
$20001- $25000	7	.025	.016	(0, .055)	9	.046	.038	(0, .104)	16	.036	.017	(.003, .068)
$25001- $35000	11	.047	.019	(.011, .083)	15	.050	.033	(0, .100)	26	.049	.016	(.018, .079)
$35001+	17	.040	.017	(.008, .072)	23	.070	.026	(.030, .110)	40	.055	.013	(.030, .080)
unknown	1	.000	--	--	6	.048	.033	(0, .098)	7	.024	--	--
Bottom fish			p=.2				p=.9				p=.8	
<=$10000	22	.028	.012	(.005, .051)	36	.065	.019	(.036, .094)	58	.047	.009	(.028, .065)
$10001- $15000	11	.012	.008	(0, .027)	18	.042	.010	(.027, .057)	29	.027	.005	(.016, .038)
$15001- $20000	4	.035	.020	(0, .073)	10	.054	.023	(.019, .089)	14	.045	.013	(.019, .070)
$20001- $25000	7	.035	.017	(.003, .067)	9	.090	.044	(.023, .157)	16	.063	.019	(.025, .100
$25001- $35000	11	.085	.028	(.032, .138)	15	.030	.008	(.018, .042)	26	.058	.014	(.030, .085)
$35001+	17	.022	.007	(.009, .035)	23	.096	.032	(.047, .145)	40	.059	.013	(.034, .047)
unknown	1	.006	--	--	6	.048	.026	(.008, .088)	7	.027	--	--
Shellfish			p=.5				p=.1				p=.9	
<=$10000	22	.319	.100	(.130, .508)	36	.203	.052	(.124, .282)	58	.261	.052	(.158, .364)
$10001- $15000	11	.196	.098	(.011, .381)	18	.147	.041	(.085, .209)	29	.172	.065	(.074, .269)
$15001- $20000	4	.129	.030	(.072, .186)	10	.223	.105	(.063, .383)	14	.176	.043	(.091, .261)
$20001- $25000	7	.357	.136	(.100, .614)	9	.020	.014	(0, .041)	16	.189	.066	(.059, .318)
$25001- $35000	11	.738	.218	(.326, 1.150)	15	.156	.067	(.054, .258)	26	.447	.108	(.235, .659)
$35001+	17	.356	.126	(.118, .594)	23	.244	.077	(.127, .361)	40	.300	.068	(.167, .433)
unknown	1	.108	--	--	6	.148	.107	(0, .311)	7	.128	--	--
Total finfish			p=.6				p=.057				p=045	
<=$10000	22	.528	.158	(.229, .827)	36	.713	.171	(.453, .973)	58	.621	.101	(.422, .819)
$10001- $15000	11	.594	.269	(.085, 1.103)	18	.548	.147	(.324, .772)	29	.571	.142	(.293, .849)
$15001- $20000	4	.510	.165	(.198, .822	10	.840	.162	(.593, 1.087)	14	.675	.101	(.476, .874)
$20001- $25000	7	.387	.065	(.264, .510)	9	.543	.212	(.220, .866)	16	.465	.088	(.292, .638)
$25001- $35000	11	.473	.160	(.170, .776)	15	.487	.144	(.268, .706)	26	.480	.095	(.293, .667)
$35001+	17	.473	.120	(.246, .700)	23	.912	.144	(.693, 1.131)	40	.693	.080	(.535, .850)
unknown	1	.017	--	--	6	.731	.557	(0, 1.579)	7	.374	--	--

Table A7. Mean Adult Consumption Rate (g/kg/day) by Income (in dollars)

	Tulalip Tribes				Squaxin Island Tribe				Both Tribes Combined (weighted)			
	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.	n	Mean	S.E.	95% C.I.
Other fish			p=.7				p=.2				p=.7	
<=$10000	22	.036	.014	(.010, .062)	36	.017	.007	(.006, .028)	58	.027	.007	(.012, .041)
$10001- $15000	11	.006	.003	(0, .012)	18	.009	.003	(.004, .014)	29	.008	.002	(.004, .011)
$15001- $20000	4	.005	.003	(0, .011)	10	.022	.014	(.001, .043)	14	.014	.006	(.002, .025)
$20001- $25000	7	.041	.037	(0, .111)	9	.016	.014	(0, .037)	16	.029	.019	(0, .065)
$25001- $35000	11	.033	.023	(0, .076)	15	.006	.003	(.001, .011)	26	.020	.011	(0, .041)
$35001+	17	.042	.019	(.006, .078)	23	.013	.008	(.001, .025)	40	.028	.010	(.009, .046)
unknown	1	.000	--	--	6	.007	.007	(0, .018)	7	.004	--	--
Total fish			p=.6				p=.1				p=.2	
<=$10000	22	.883	.219	(.469, 1.297)	36	.933	.195	(.636, 1.230)	58	.908	.130	(.653, 1.163)
$10001- $15000	11	.796	.348	(.138, 1.454)	18	.704	.150	(.476, .932)	29	.750	.178	(.402, 1.098)
$15001- $20000	4	.644	.194	(.277, 1.078)	10	1.084	.250	(.703, 1.465)	14	.864	.135	(.600, 1.128)
$20001- $25000	7	.785	.155	(.492, 1.078)	9	.579	.204	(.269, .889)	16	.682	.109	(.468, .896)
$25001- $35000	11	1.244	.372	(.541, 1.947)	15	.649	.166	(.396, .902)	26	.947	.191	(.573, 1.320)
$35001+	17	.871	.190	(.512, 1.230)	23	1.169	.188	(.883, 1.455)	40	1.020	.117	(.790, 1.250)
unknown	1	.125	--	--	6	.887	.667	(0, 1.902)	7	.506	--	--

P-values are for differences among income groups (Kruskal-Wallis test). Unweighted consumption rates are used for analysis of both tribes combined.

Table A8. Percentiles of Adult Consumption Rate (g/kg/day) by Income

	Tulalip Tribes				Squaxin Island Tribe			
	5%	50%	90%	95%	5%	50%	90%	95%
Anadromous fish								
<=$10000	.001	.129	1.838	2.275	.008	.211	2.430	3.276
$10001 - $15000	.006	.095	2.308	2.308	.015	.204	1.688	1.688
$15001 - $20000	.066	.472	.781	.781	.135	.855	1.678	1.678
$20001 - $25000	.031	.421	.431	.431	.016	.172	.925	.925
$25001 - $35000	.006	.176	1.263	1.263	.026	.268	1.451	1.451
$35001+	.008	.284	1.159	1.159	.027	.575	1.838	1.838
Pelagic fish								
<=$10000	.000	.006	.247	.265	.000	.000	.139	.278
$10001 - $15000	.000	.000	.021	.021	.000	.001	.072	.072
$15001 - $20000	.000	.017	.039	.039	.000	.030	.091	.091
$20001 - $25000	.000	.000	.035	.035	.000	.000	.031	.031
$25001 - $35000	.000	.015	.158	.158	.000	.018	.234	.234
$35001+	.000	.013	.177	.177	.000	.012	.281	.479
Bottom fish								
<=$10000	.000	.003	.104	.222	.000	.023	.227	.477
$10001 - $15000	.000	.000	.079	.079	.000	.029	.106	.106
$15001 - $20000	.000	.024	.076	.076	.000	.022	.221	.221
$20001 - $25000	.000	.024	.051	.051	.000	.026	.196	.196
$25001 - $35000	.000	.026	.235	.235	.000	.023	.093	.093
$35001+	.000	.009	.076	.076	.000	.036	.459	.477
Shellfish								
<=$10000	.000	.143	1.147	1.753	.000	.078	.579	1.308
$10001 - $15000	.000	.071	.962	.962	.000	.121	.364	.364
$15001 - $20000	.049	.144	.177	.177	.000	.072	1.108	1.108
$20001 - $25000	.049	.202	.557	.557	.000	.000	.025	.025
$25001 - $35000	.000	.416	1.830	1.830	.000	.030	.718	.718
$35001+	.000	.175	1.436	1.436	.000	.090	.989	1.276
Total finfish								
<=$10000	.003	.235	1.966	2.358	.020	.272	2.735	3.404
$10001 - $15000	.006	.095	2.368	2.368	.015	.254	1.792	1.792
$15001 - $20000	.203	.490	.824	.824	.141	.915	1.838	1.838
$20001 - $25000	.180	.421	.455	.455	.077	.196	1.119	1.119
$25001 - $35000	.017	.236	1.639	1.639	.026	.387	1.516	1.516
$35001+	.008	.284	1.167	1.167	.055	.785	1.919	2.724
Other fish								
<=$10000	.000	.003	.155	.249	.000	.000	.098	.145
$10001 - $15000	.000	.000	.030	.030	.000	.005	.036	.036
$15001 - $20000	.000	.004	.011	.011	.000	.005	.133	.133
$20001 - $25000	.000	.000	.025	.025	.000	.000	.010	.010
$25001 - $35000	.000	.014	.218	.218	.000	.000	.026	.026
$35001+	.000	.005	.224	.224	.000	.000	.084	.140
Total fish								
<=$10000	.014	.521	2.383	4.042	.033	.473	3.220	3.889
$10001 - $15000	.041	.206	3.265	3.265	.058	.432	1.947	1.947
$15001 - $20000	.255	.640	1.008	1.008	.141	.961	2.863	2.863
$20001 - $25000	.238	.921	1.012	1.012	.117	.233	1.119	1.119
$25001 - $35000	.057	.930	3.658	3.658	.034	.426	1.734	1.734
$35001+	.008	.607	2.427	2.427	.058	1.085	2.905	2.936

Table A9. Consumption Rate (g/kg/day) for Children (age 0-5): Percentiles, Means, and 95% Confidence Intervals

	10%	25%	50%	75%	90%	Mean	S.E.	95% C.I.
Tulalip Tribes (n=21)								
Anadromous fish	0	0	0	.075	.183	.068	.023	(.023, .114)
Pelagic fish	0	0	0	.022	.165	.043	.017	(.009, .077)
Bottom fish (p=.026)	0	0	0	0	0	.003	.002	(0, .007)
Shellfish	0	0	0	.035	.597	.125	.056	(.014, .236)
Total finfish	0	0	.060	.199	.290	.114	.030	(.056, .173)
Other fish (p<.001)	0	0	0	0	0	.000 +	.000 +	(0, 0) +
Total fish (p=.06)	0	0	.078	.297	.738	.239	.077	(.088, .390)
Squaxin Island Tribe (n=48)								
Anadromous fish	0	0	.030	.077	.449	.174	.051	(.075, .273)
Pelagic fish	0	0	0	.022	.165	.049	.014	(.021, .077)
Bottom fish (p=.026)	0	0	0	.020	.052	.027	.009	(.010, .044)
Shellfish	0	0	.045	.340	.574	.229	.053	(.126, .374)
Total finfish	0	0	.061	.138	.826	.250	.063	(.126, .374)
Other fish (p<.001)	0	0	.097	.462	1.386	.346	.078	(.192, .500)
Total fish (p=.06)	0	.007	.508	1.200	2.056	.825	.143	(.546, 1.105)
Both Tribes Combined (weighted)								
Anadromous fish	0	0	.028	.075	.321	.121	.028	(.067, .176)
Pelagic fish	0	0	0	.043	.138	.046	.011	(.024, .068)
Bottom fish	0	0	0	0	.031	.015	.004	(.006, .024)
Shellfish	0	0	.012	.204	.574	.177	.039	(.101, .253)
Total finfish	0	0	.064	.180	.315	.182	.035	(.104, .251)
Other fish	0	0	0	.096	.493	.173	.039	(.096, .250)
Total fish	0	0	.173	.660	1.357	.532	.081	(.373, .691)

P-values are for difference between tribes (Wilcoxon-Mann-Whitney test). Unweighted consumption rates are used.

+ Note: Only one child consumed "other fish" in the Tulalip tribes (case #556, 0.1148g/kg/day). The consumption rate for "other fish" with this child in (no substitution) was: mean=0.0055, S.E.=0.0055, 95% C.I. = (0.000, 0.0016). With this child's rate for "other fish", p<0.001 (Wilcoxon-Mann-Whitney for Tulalip Tribes vs. Squaxin Island tribe).

Table A10. Change over Time in Consumption among Adults

	Tulalip Tribes		Squaxin Island Tribe	
	n	%	n	%
Has your fish consumption changed in the last 20 years?				
Yes	26	35.6	40	34.2
No	22	30.1	42	35.9
Don't know	25	34.2	35	29.9
If "yes", then . . .	(n=26)		(n=39)+	
Eat more now	11	42.3	10	25.6
Eat less now	15	57.7	29	74.4

+ One respondent did not give what change was.

Table A 11. Reasons for Change in Fish Consumption Patterns for Tulalip and Squaxin Island Tribes over the Past 20 Years

Reasons for Eating Less Fish (n=44)	Percentage	Reasons for Eating More Fish (n=21)	Percentage
Less available/accessible	68.2	More available/accessible	33.3
Family reduction/influence	13.6	Moved to area	23.8
Personal reasons	9.1	Health reasons	19.0
Health reasons	4.5	Like seafood more	19.0
Other	4.5	Became a fisherman	4.8

Table A 12. Percent Consumption of Specified Fish Parts: Mean ± Standard Error

Adults		
Fish Parts Consumed	**Tulalip Tribes**	**Squaxin Island Tribe**
Anadromous fish	n=72	n=117
Fillet with skin (p=0.037)	40.8 ± 5.3	26.3 ± 3.6
Fillet without skin (p=0.037)	59.2 ± 5.3	73.7 ± 3.6
Head, bones, eggs, organs, skin (p=0.9)	7.7 ± 2.3	10.6 ± 2.5
Pelagic fish	n=38	n=62
Fillet with skin (p=0.004)	21.1 ± 6.4	2.6 ± 1.8
Fillet without skin (p=0.004)	78.9 ± 6.4	97.4 ± 1.8
Head, bones, eggs, organs, skin (p=0.6)	2.6 ± 2.6	0.4 ± 0.3
Bottom fish	n=44	n=93
Fillet with skin (p=0.001)	15.9 ± 5.1	2.7 ± 1.6
Fillet without skin (p=0.001)	84.1 ± 5.1	97.3 ± 1.6
Head, bones, eggs, organs, skin (p=0.5)	0 ± 0	0.1 ± 0.1

Limited to those consuming the specified fish group. P-values are for differences between tribes (Wilcoxon-Mann-Whitney test).
The first two categories (Fillet with Skin and Fillet without Skin) add to 100%.

Table A 13. Percent Using Specified Preparation Methods: Mean ± Standard Error

Adults		
Preparation Method	**Tulalip Tribes**	**Squaxin Island Tribe**
Anadromous fish (p=0.059)	n=72	n=117
Baked, boiled, broiled, roasted, or poached	63.5 ± 3.8	56.0 ± 2.7
Canned, fried, raw, smoked, or dried	36.5 ± 3.8	44.0 ± 2.7
Pelagic fish (p=0.7)	n=38	n=62
Baked, boiled, broiled, roasted, or poached	49.9 ± 7.7	53.5 ± 5.7
Canned, fried, raw, smoked, or dried	50.1 ± 7.7	46.5 ± 5.7
Bottom fish (p=0.3)	n=44	n=94
Baked, boiled, broiled, roasted, or poached	54.8 ± 6.4	61.7 ± 4.2
Canned, fried, raw, smoked, or dried	45.2 ± 6.4	37.3 ± 4.2
Shellfish (p=0.6)	n=61	n=79
Baked, boiled, broiled, roasted, or poached	65.8 ± 3.6	69.0 ± 2.8
Canned, fried, raw, smoked, or dried	34.2 ± 3.6	31.0 ± 2.8
For shellfish, use of water (%) +	n=61	n=86
Throw out (p=1.0, chi-squared test)	59%	59%
Use in cooking (p=0.002, chi-squared test)	3%	21%
Drink (p=1.0, chi-squared test)	41%	41%
No answer	2%	11%

+Percentages do not add to 100 because respondents may have multiple answers.
Limited to those consuming the specified fish group. P-values are for differences between tribes (Wilcoxon-Mann-Whitney test, except where stated otherwise).

Table A 14. Percent Distribution Across Sources of Fish: Mean ± Standard Error

Adults		
Source of Fish Consumed	**Tulalip Tribes**	**Squaxin Island Tribe**
Anadromous fish	n=72	n=117
Grocery stores (p = 0.3)	4.4 ± 1.9	5.9 ± 1.4
Restaurants (p = 0.088)	6.7± 2.0	2.9 ± 0.7
Fish caught in Puget Sound (p = 0.009)	72.2 ± 3.2	79.5 ± 2.8
Fish caught outside Puget Sound (p = 0.012)	16.7 ± 2.4	10.9 ± 2.2
Other (p = 0.4)	0 ± 0	0.9 ± 0.9
Pelagic fish	n=38	n=62
Grocery stores (p = 0.6)	27.5 ± 6.7	30.3 ± 5.4
Restaurants (p = 0.053)	40.8 ± 7.6	20.9 ± 4.7
Fish caught in Puget Sound (p = 0.9)	27.6 ± 7.0	22.7 ± 4.6
Fish caught outside Puget Sound (p < 0.001)	4.1 ± 2.8	24.5 ± 5.0
Other (p = 0.4)	0 ± 0	1.6 ± 1.6
Bottom fish	n=44	n=94
Grocery stores (p = 0.8)	23.1 ± 5.7	25.5 ± 4.1
Restaurants (p = 0.072)	29.3 ± 6.1	16.9 ± 3.5
Fish caught in Puget Sound (p < 0.001)	38.9 ± 6.5	12.9 ± 3.3
Fish caught outside Puget Sound (p < 0.001)	6.4 ± 2.8	41.0 ± 4.9
Other (p = 0.8)	2.3 ± 2.3	2.8 ± 1.6
Shellfish	n=61	n=79
Grocery stores (p = 0.016)	8.9 ± 2.8	13.1 ± 2.6
Restaurants (p = 0.4)	14.0 ± 3.2	16.2 ± 3.0
Fish caught in Puget Sound (p = 0.004)	72.9 ± 4.5	62.3 ± 3.5
Fish caught outside Puget Sound (p < 0.001)	4.2 ± 2.2	7.5 ± 1.7
Other (p = 0.1)	0 ± 0	0.7 ± 0.5

Limited to those consuming the specified fish group. P-values are for differences between tribes (Wilcoxon-Mann-Whitney test, except where stated otherwise).

Table A 15. Percent of Tulalip Tribal Members Utilizing Specified Fishing Areas for All Species of Fish and Shellfish (n = 73)

In Puget Sound		Outside Puget Sound	
Fishing Area	Tribal Members Using Area (%)	Fishing Area	Tribal Members Using Area (%)
Tulalip Bay	64	Salmon Banks	41
Baby Island	48	Point Roberts	19
Port Susan	41	Bellingham/Lummi	7
Spee Bi Dah	37	Rosario Strait	7
Mission Point	32	Alaska	7
Mukilteo	30		
Camano	30		
Hermosa Point	30		
Straits of Juan de Fuca	27		
Shipwreck	15		
Coupeville	12		
Sneatlum	11		
Sandy Point/Langley	11		
Apple Cove Point	11		
Everett	11		

Table A 16. Percent of Squaxin Island Members Utilizing Specified Fishing Areas for All Species of Fish and Shellfish (n = 117)

In Puget Sound		Outside Puget Sound	
Fishing Area	Tribal Members Using Area (%)	Fishing Area	Tribal Members Using Area (%)
Peale Passage	67	Alaska	26
Pickering Passage	56	West Port/Grays Harbor	15
Squaxin Island	56	Neah Bay	13
Budd Inlet	50	Quinalt	11
Totten Inlet	32	La Push/Quiliet/Pacific	8
281030	27		
Hood Canal	25		
281050	25		
281090	24		
281060	22		
281020	20		
Eld Inlet	20		
281040	15		
Dana Passage	14		
Hammersly Inlet	14		

Table A17. Percent of Tulalip Tribal Members (n = 72)[+] Who Report Consuming Anadromous Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Tulalip Tribal Members (%)	Fishing Area	Tulalip Tribal Members (%)
Port Susan	33	Salmon Banks	40
Tulalip Bay	31	Point Roberts	19
Spee Bi Dah	28	Rosario Strait	6
Straits of Juan de Fuca	25	Haro Strait	3
Mukilteo	18		
Shipwreck	15		
Mission Point	13		
Apple Cove Point	11		
Langley	10		
Edmonds	10		
Hermosa Point	10		
Everett	7		
Pocession Point	6		
Priest Point	3		
Hat Island	3		
Saratoga	3		
Camano Head	3		

[+] Number of respondents who consume this species group.

Table A18. Percent of Tulalip Tribal Members (n = 38)[+] Who Report Consuming Bottom Fish Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Tulalip Tribal Members (%)	Fishing Area	Tulalip Tribal Members (%)
Tulalip Bay	8	Salmon Banks	3
Hermosa Point	8	Alaska	3
Port Susan	5	Swinomish/Skagit	3
Mission Point	5		
Everett	3		
Hat Island	3		
Useless Bay	3		
Spee Di Bah	3		

[+] Number of respondents who consume this species group.

Table A19. Percent of Tulalip Tribal Members (n = 44)[+] Who Report Consuming Pelagic Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Tulalip Tribal Members (%)	Fishing Area	Tulalip Tribal Members (%)
Port Susan	18	Alaska	11
Spee Bi Dah	16	Salmon Banks	2
Mission Point	16		
Tulalip Bay	11		
Hermosa Point	7		
Everett	5		
Priest Point	5		
Point No Point	2		
Outer Hood Canal	2		

[+] Number of respondents who consume this species group.

Table A20. Percent of Tulalip Tribal Members (n = 61)[+] Who Report Consuming Shellfish Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Tulalip Tribal Members (%)	Fishing Area	Tulalip Tribal Members (%)
Tulalip Bay	62	Bellingham/ Lummi	8
Baby Island	57	Rosario	3
Camano	44		
Mission Point	26		
Hermosa Point	23		
Mukilteo	15		
Coupeville	15		
Port Susan	13		
Sneatlum Point	13		
Sandy Point/Langly	13		
Priest Point	5		
Spee Bi Dah	5		
Saratoga	3		
Suquamish/Kingston	3		
Hat Island	3		

[+] Number of respondents who consume this species group.

Table A21. Percent of Squaxin Island Members (n = 117)[+] Who Report Consuming Anadromous Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Squaxin Island Tribal Members (%)	Fishing Area	Squaxin Island Tribal Members (%)
Peale Passage	65	Quinalt	9
Pickering Passage	56	Alaska	9
Budd Inlet	50	West Port/Grays Harbor	4
Totten Inlet	32	Neah Bay	3
Eld Inlet	19	Columbia River	3
Skookum Inlet	15	La Push/Quiliet/Pacific	3
Carr Inlet	15	Cowlitz River	3
Dana Passage	14	Pt. Roberts	3
Hammersly Inlet	12	Salmon Banks	3
Henderson Inlet	5	Hood Canal	2
Commencement Bay	3	Port Angeles	1
Squaxin Island	3	Pillar Point	1
Southern Case Inlet	3	Port Townsend	1
East/West Passage	3	Lewis River	1
Northern Case Inlet	2	Humptulips	1
Nisqually Reach	2	Haro Strait	1
Straits of Juan de Fuca	2	Rosario Strait	1
Lower Case Inlet	2	Chehalis	1
Fox Island	2		
Suquamish/Kingston	1		

[+] Number of respondents who consume this species group.

Table A22. Percent of Squaxin Island Members (n = 62)[+] Who Report Consuming Bottom Fish Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Squaxin Island Tribal Members (%)	Fishing Area	Squaxin Island Tribal Members (%)
Peale Passage	23	Alaska	8
Pickering Passage	10	Neah Bay	8
Eld Inlet	8	West Port/Grays Harbor	8
Carr Inlet	6	La Push/Quiliet/Pacific	5
Dana Passage	5	Quinalt	3
Straits of Juan de Fuca	5	Haro Strait	2
Budd Inlet	5	Port Townsend	2
Hammersly Inlet	3	Hood Canal	2
Totten Inlet	3	Kennedy Creek	2
Non-specified area	3	Lake Isabella	2
Lower Carr Inlet	2	Cowlitz River	2
Henderson Inlet	2	Point Roberts	2
Oyster Co./ Harstene Island	2		
Nisqually Reach	2		
Elliot Bay	2		
Commencement Bay	2		
Skookum Inlet	2		

[+] Number of respondents who consume this species group.

Table A23. Percent of Squaxin Island Members (n = 94)[+] Who Report Consuming Pelagic Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Squaxin Island Tribal Members (%)	Fishing Area	Squaxin Island Tribal Members (%)
Straits of Juan de Fuca	5	Alaska	28
Peale Passage	5	Neah Bay	10
Pickering Passage	2	Quinalt	4
Eld Inlet	2	Columbia River	3
Lower Carr Inlet	1	La Push/Quiliet/Pacific	2
Carr Inlet	1	West Port /Grays Harbor	2
East / West Passage	1	Chelalis	2
Hammersly Inlet	1	Hood Canal	1
South Case Inles	1	Point Roberts	1
Dana Passage	1		
Nisqually Reach	1		
Totten Inlet	1		
Nonspecified area	1		

[+] Number of respondents who consume this species group.

Table A24. Percent of Squaxin Island Members (n = 86)[+] Who Report Consuming Shellfish Species Caught from Locations Listed

In Puget Sound		Outside Puget Sound	
Fishing Area	Squaxin Island Tribal Members (%)	Fishing Area	Squaxin Island Tribal Members (%)
Squaxin Island	73	Hood Canal	31
281030	36	West Port/Grays Harbor	12
281050	33	Neah Bay	5
281090	31	La Push/Quiliet/Pacific	2
281060	28	Alaska	2
281020	26	Bellingham/Lummi	1
281040	16	Cowlitz River	1
Oyster/Harstene Island	9	Salmon Banks	1
Eld Inlet	8	Oregon	1
Skookum Inlet	3		
Totten Inlet	3		
Budd Inlet	2		
Carr Inlet	2		
Peale Passage	2		
Straits of Juan de Fuca	1		
Pickering Passage	1		
Nonspecified area	1		

[+] Number of respondents who consume this species group.

Table A25. Comparison of Short-Form Self-Administered Dietary Recall with Interviewer-based Detailed Dietary Recall of Fish Consumption (g/kg/day) Medians and Spearman Correlation Coefficients (rho)

Category	Tulalip Tribes (n = 67)			Squaxin Island Tribe (n = 108)		
	Self-administ-ered, median	Interviewer, median	rho	Self-administ-ered, median	Interviewer, median	rho
"Total finfish"	0.18	0.28	.27*	0.16	0.38	.44***
"Shellfish"	0.00	0.15	.16**	0.05	0.07	-.01
"Total fish"	0.24	0.55	.38**	0.26	0.52	.41***
Daily caloric intake (calories/day)	1619	--	--	1688	--	--
Daily consumption per calorie (g/cal/day)						
"Total finfish"	0.009	--	--	0.009	--	--
"Shellfish"	0.002	--	--	0.005	--	--
"Total fish"	0.012	--	--	0.014	--	--

*p <.05, **p <.01, ***p<.001
Note: Quotation marks indicate that the categories are not equivalent between the two sources.

Table A 26. Tulalip Tribes Reinterview

Comparison Between In-Person Interview (1st) and Telephone Reinterview (2nd) on Consumption of Fish and Shellfish (Values shown are calculated frequency of consumption per year)															
Quest.	King Salmon			Cod			Halibut			Clams			Children's consumption of salmon		
	Responses			Responses			Responses			Responses			Responses		
No.	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2
561	16	22	-6	52	26	26				12	24	-12	16	16	0
571	4	8	-4	2	52	-50	4	5	-1	16	12	4			
581	2	3	-1							3	4	-1	2	2	0
591	14	17	-3				2	0	2	6	0	6			
605	6	16	-10	8	8	0	4	0	4	12	10	2			
618	6	12	-6	6	12	-6	8	0	8						
626	24	12	12				12	0	12	18	13	5			
651	30	4	26	1	0	1	2	3	-1	16	20	-4			
660	5	16	-11	5	0	5	1	0	1	20	18	2			
701	3	10	-7				1	1	0	8	2	6			
Mean	11.0	12.0	-1.0	12.3	16.3	-4.0	4.3	1.1	3.2	12.3	11.4	0.9	9.0	9.0	0.0

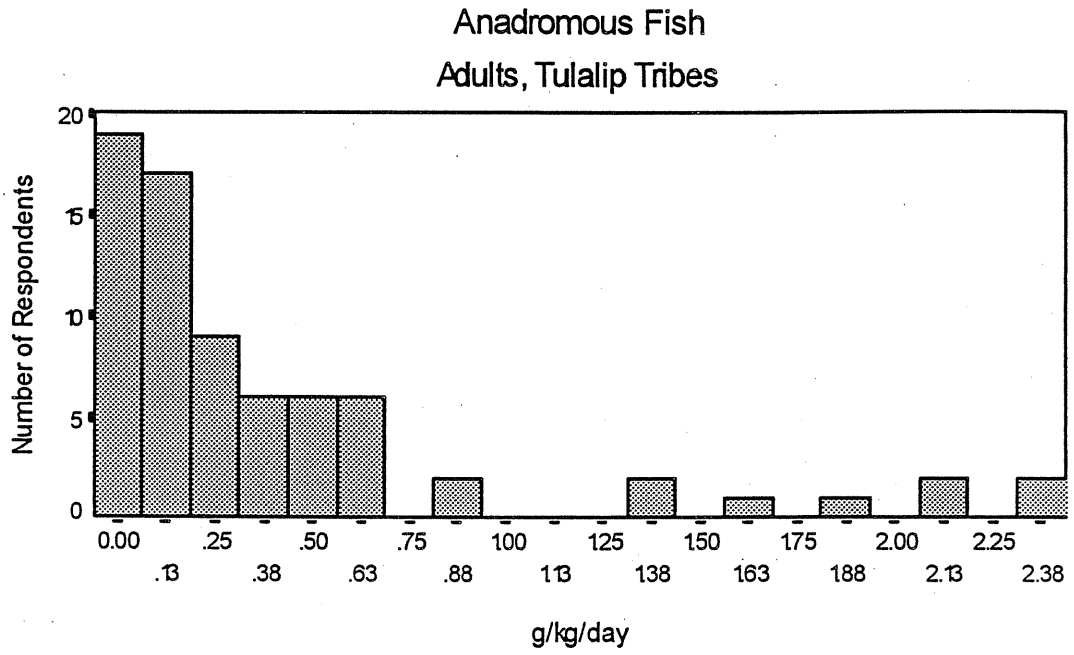
Table A 27. Squaxin Island Reinterview

Comparison Between In-Person Interview (1st) and Telephone Reinterview (2nd) on Consumption of Fish and Shellfish(Values shown are calculated frequency of consumption per year)															
Quest. No.	King Salmon			Cod			Halibut			Clams			Children's consumption of salmon		
	Responses			Responses			Responses			Responses			Responses		
	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2	1st	2nd	1-2
116	21	8	13				2	1	1	72	24	48			
120	15	12	3	1	0	1	1	0	1	48	12	36			
129							6	2	4	6	12	-6			
136	6	4	2	12	7	5	2	1	1	24	24	0	6	24	-18
138	12	6	6				6	0	6	24	36	-12			
151	12	4	8	12	24	-12	4	8	-4	96	36	60			
155				12	4	8	12	4	8	24	12	12			
160	14	6	8				6	24	-18						
161	12	1	13	24	3	21	1	3	-2	6	3	3			
198	1	8	-7	24	12	12	1	1	0	24	12	12	1	1	0
220	90	12	78	5	6	-1	2	24	-22	8	12	-4	30	6	24
225				2	1	1				3	3	0			
Mean	20.3	6.6	*13.8	11.5	7.1	4.25	3.9	6.2	-2.3	30.5	18.7	13.5	10.2	10.3	2.0

*Mean = 5.8 without outlier (Questionnaire #220)

Appendix B

Additional Plots



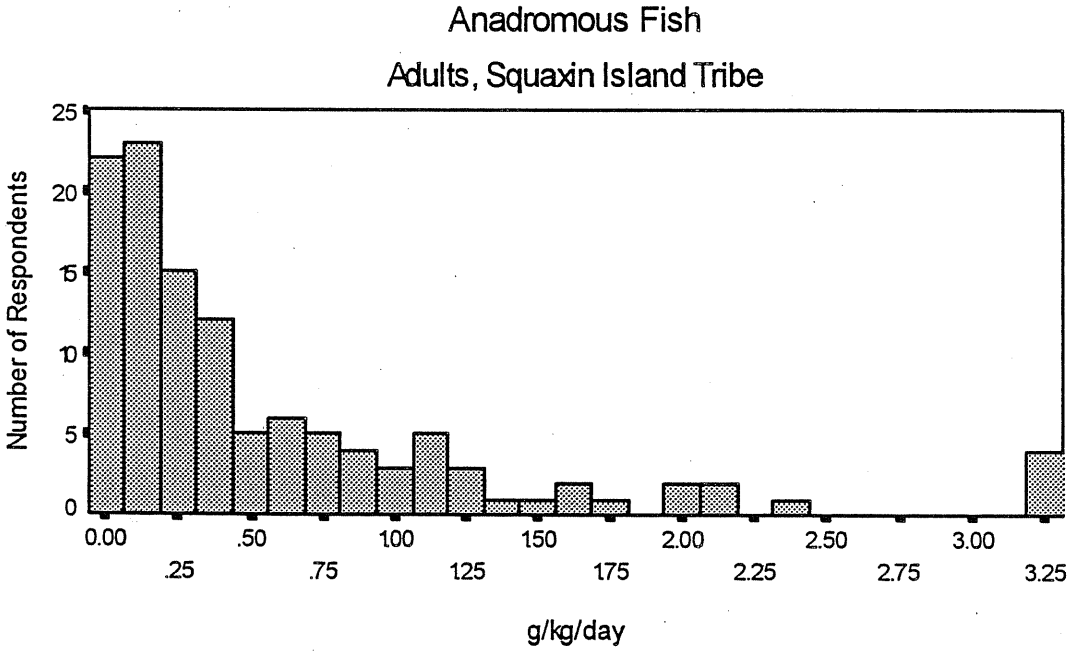
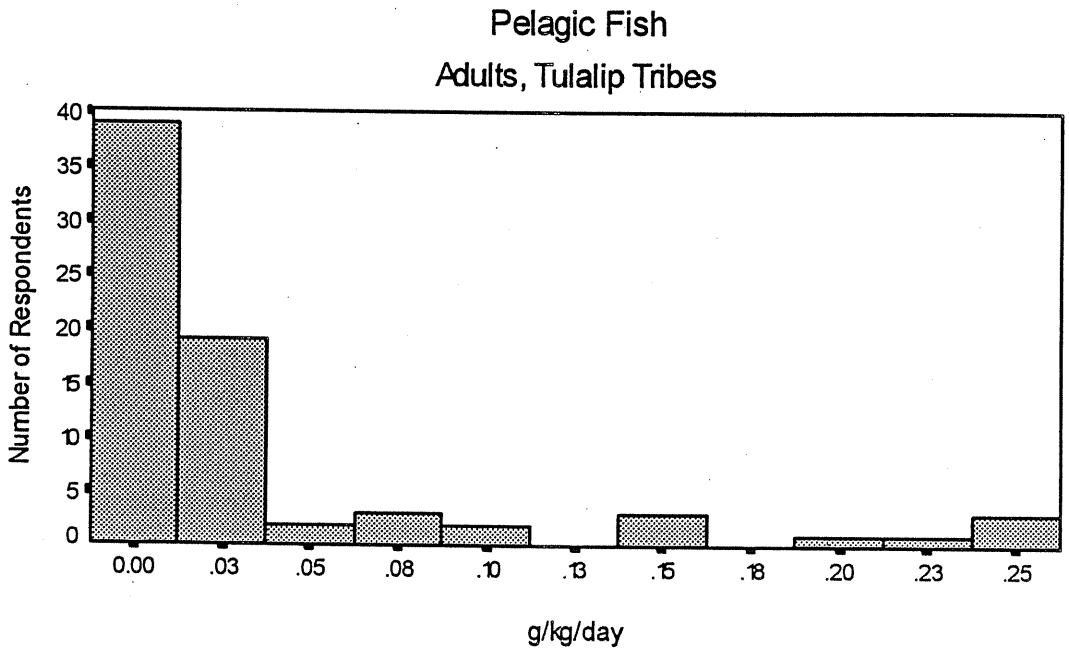


Figure B1. Distribution of Consumption Rates of Anadromous Fish by Tribe



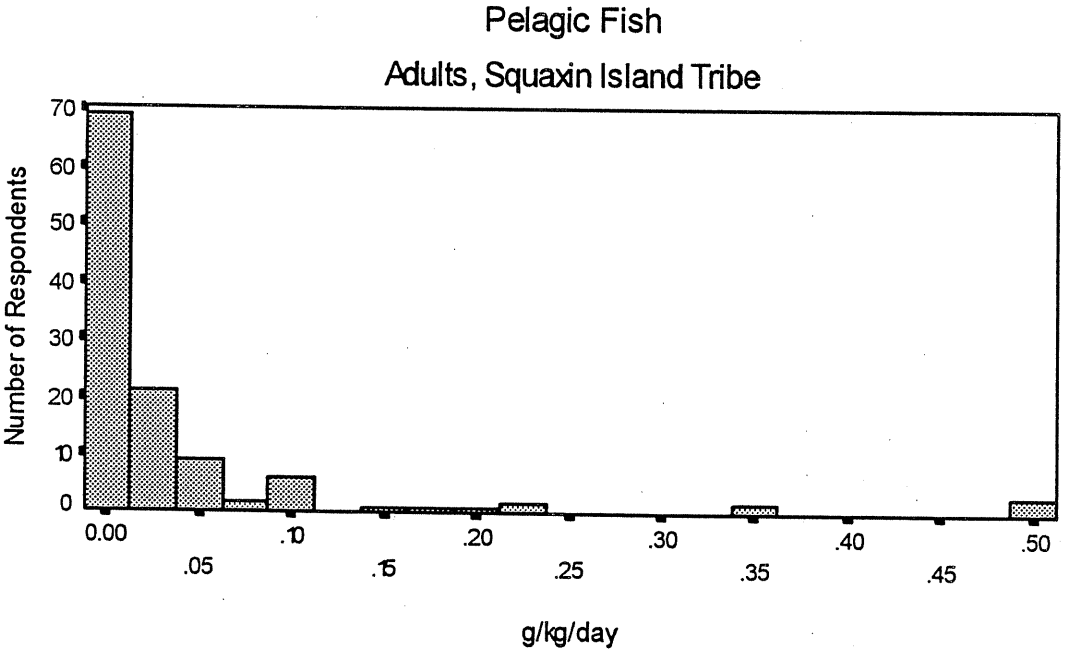
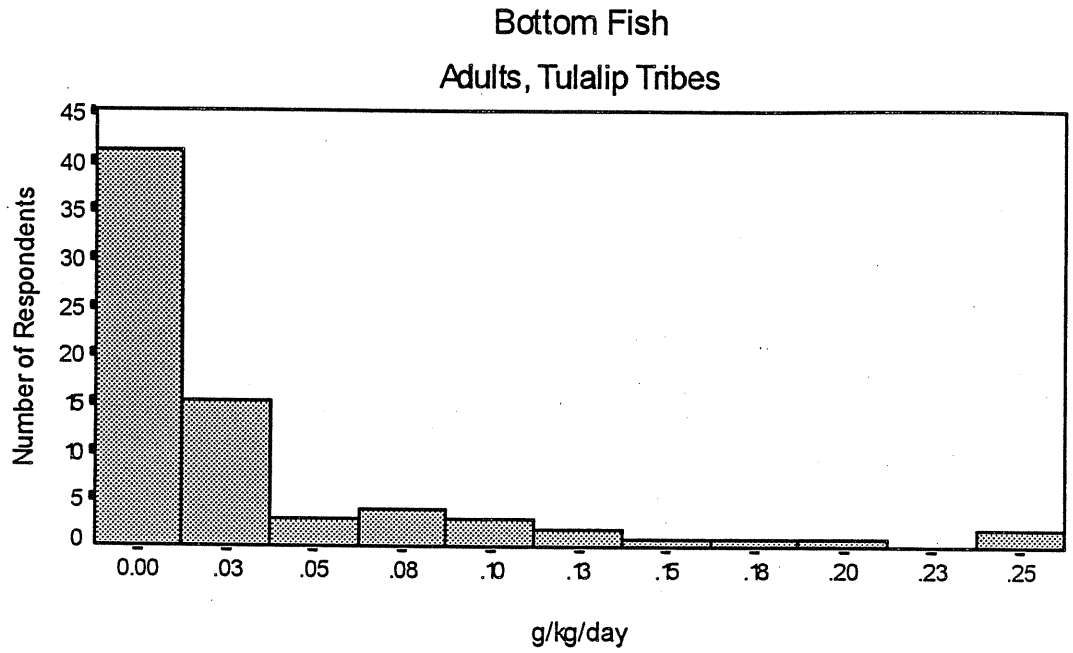


Figure B2. Distribution of Consumption Rates of Pelagic Fish by Tribe



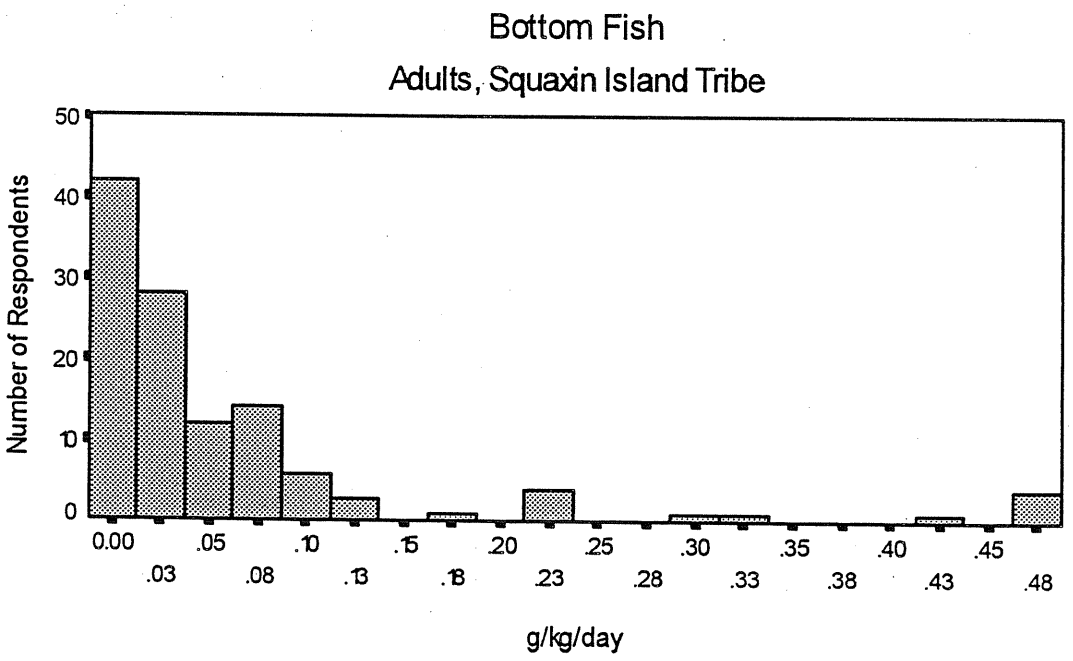


Figure B3. Distribution of Consumption Rates of Bottom Fish by Tribe

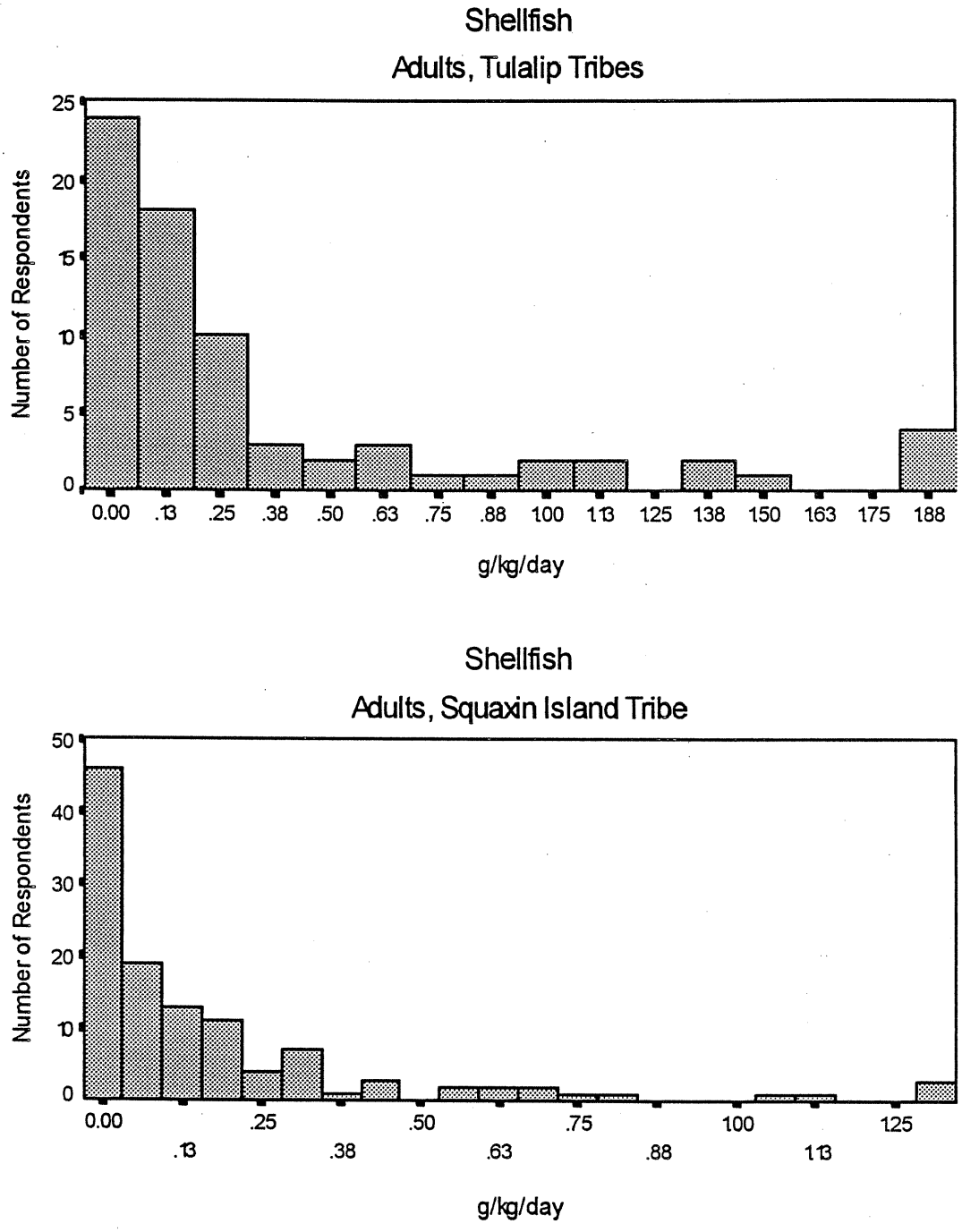


Figure B4. Distribution of Consumption Rates of Shellfish by Tribe

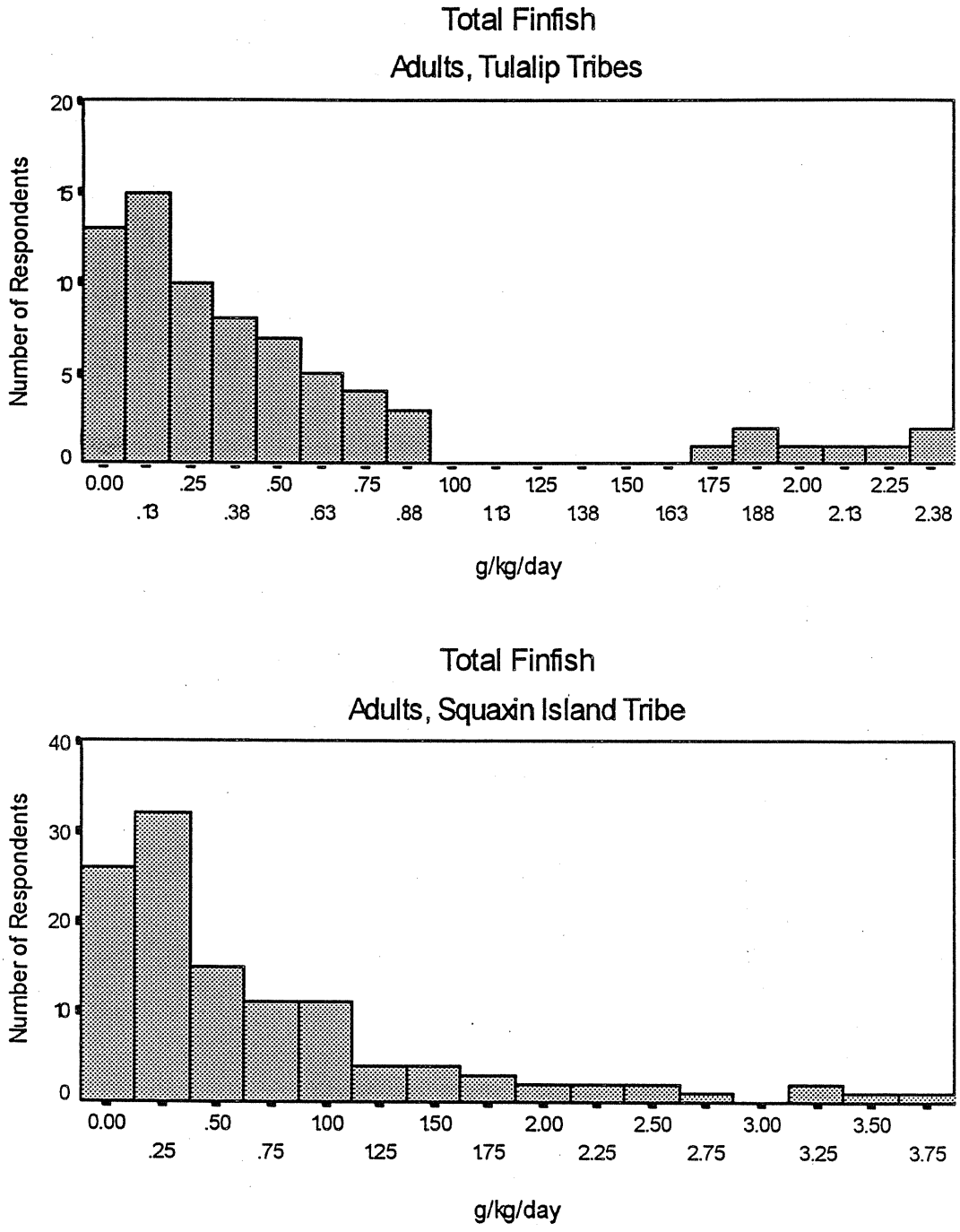
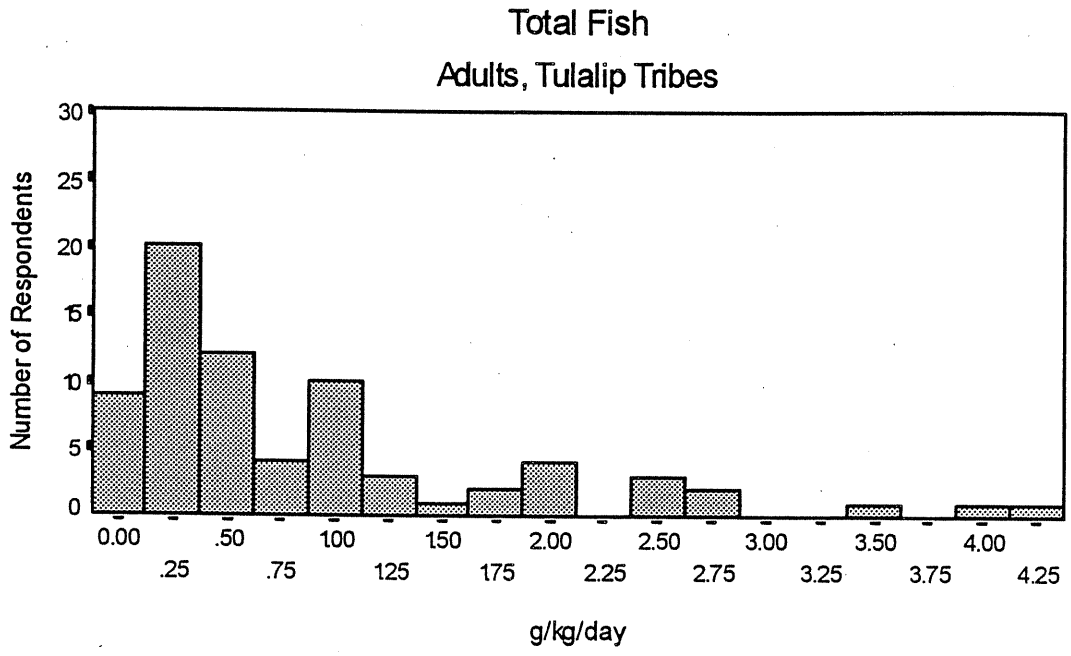


Figure B5. Distribution of Consumption Rates of Total Finfish by Tribe



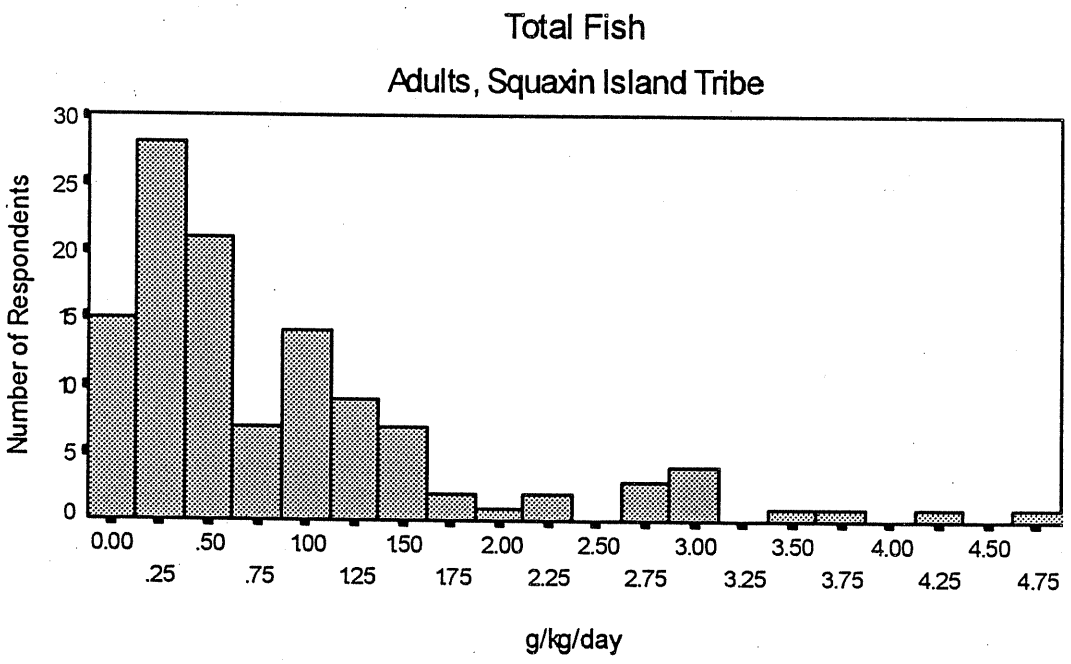
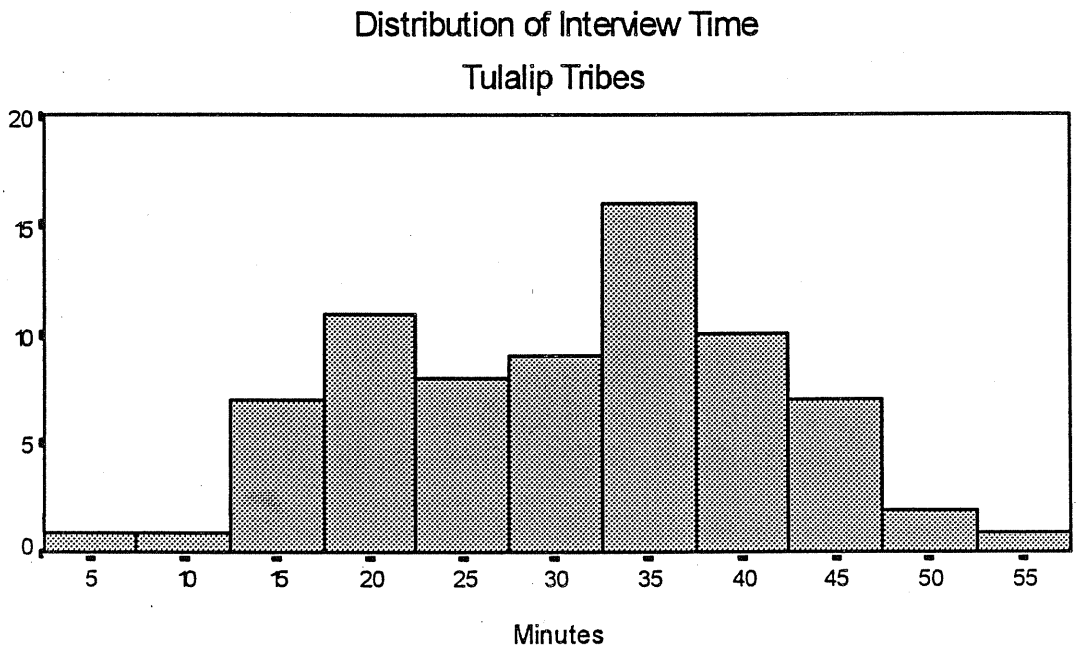


Figure B6. Distribution of Consumption Rates of Total Fish by Tribe



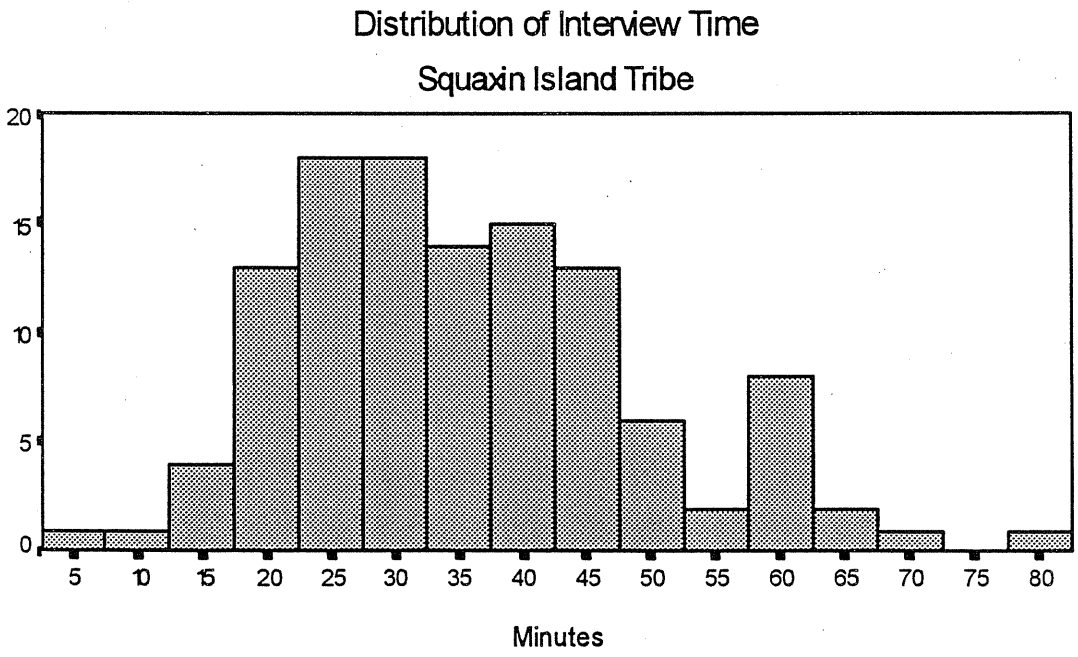


Figure B7. Distribution of Length of Interview Time by Tribe

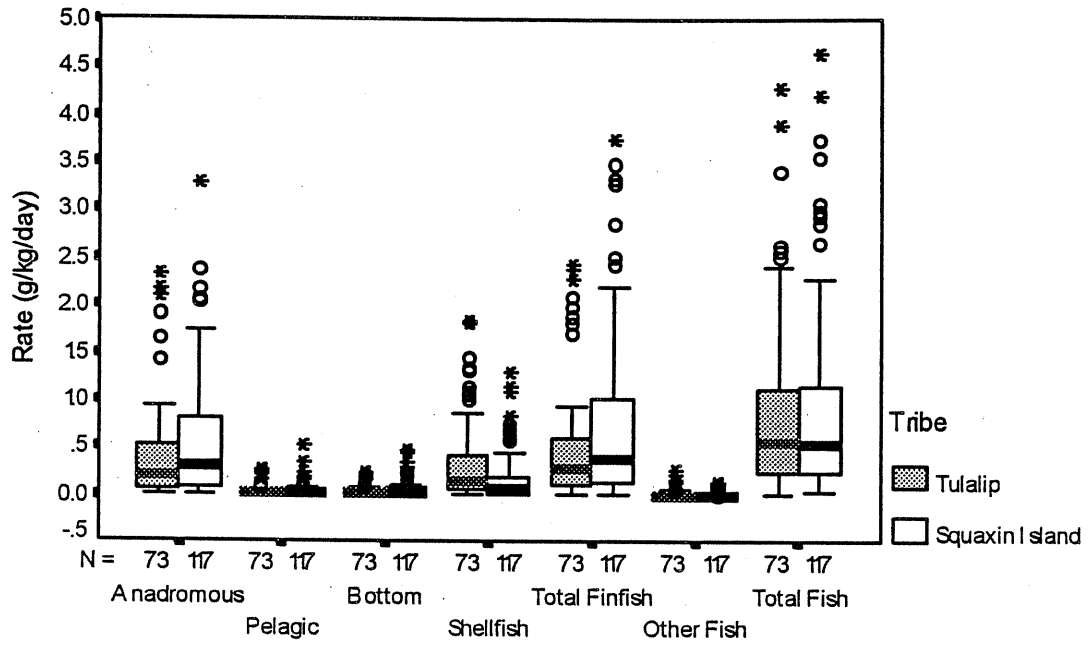


Figure B8-1. Consumption Rates by Type of Fish and Tribe

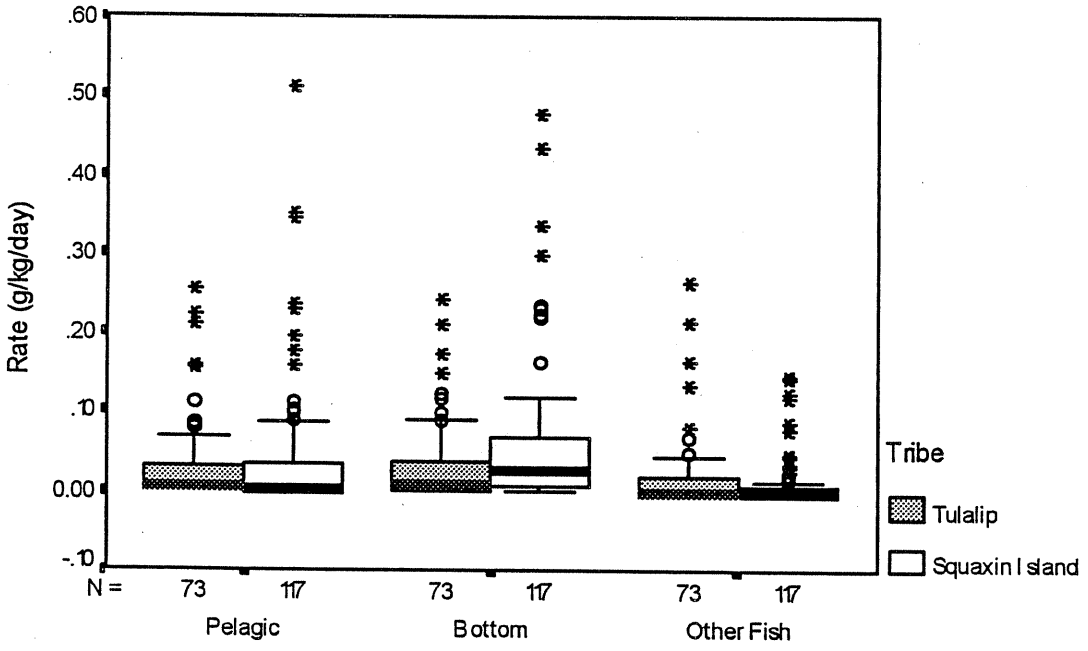
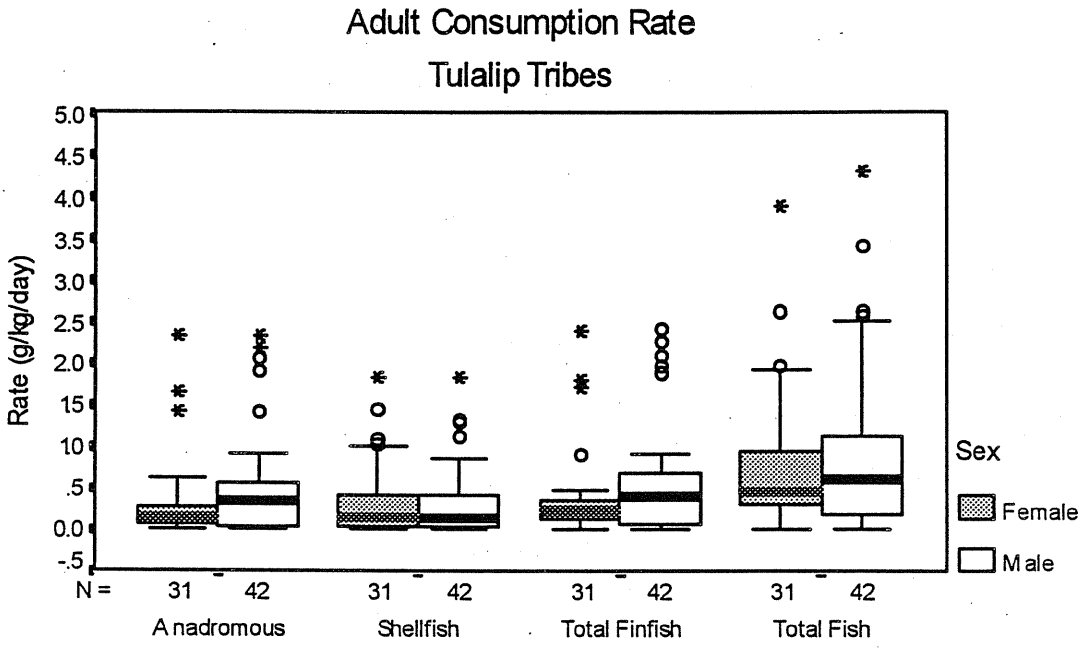


Figure B8-2. Consumption Rates of Pelagic, Bottom and Other Fish by Tribe



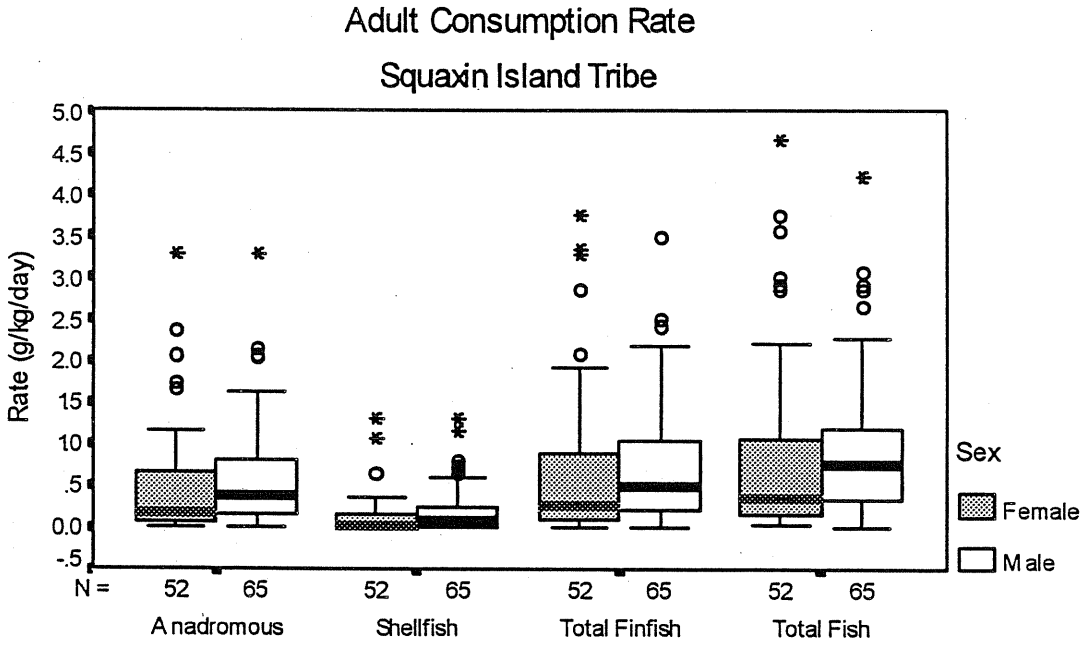
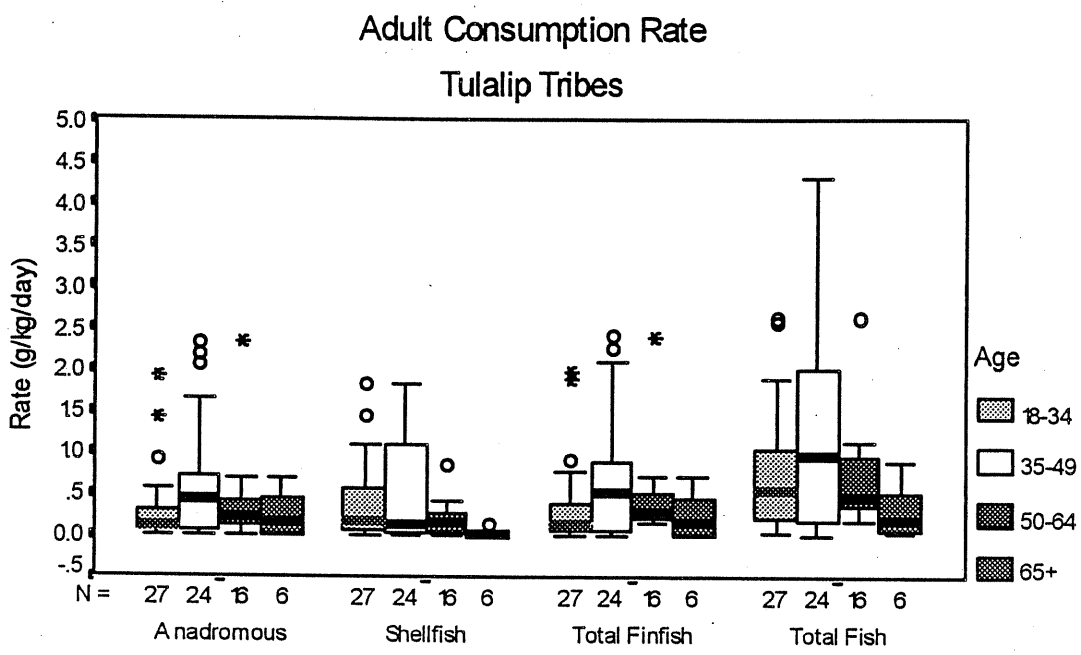


Figure B9. Consumption Rates by Type of Fish, Gender and Tribe

Note: Pelagic, bottom and "other" fish are excluded from this graph due to low consumption rates.



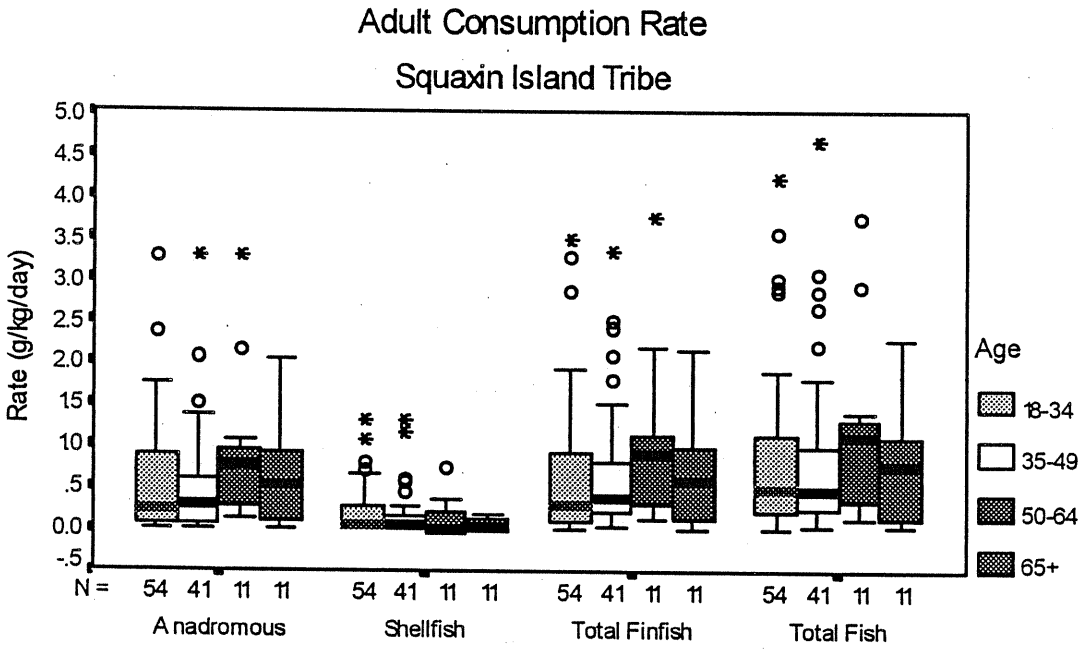
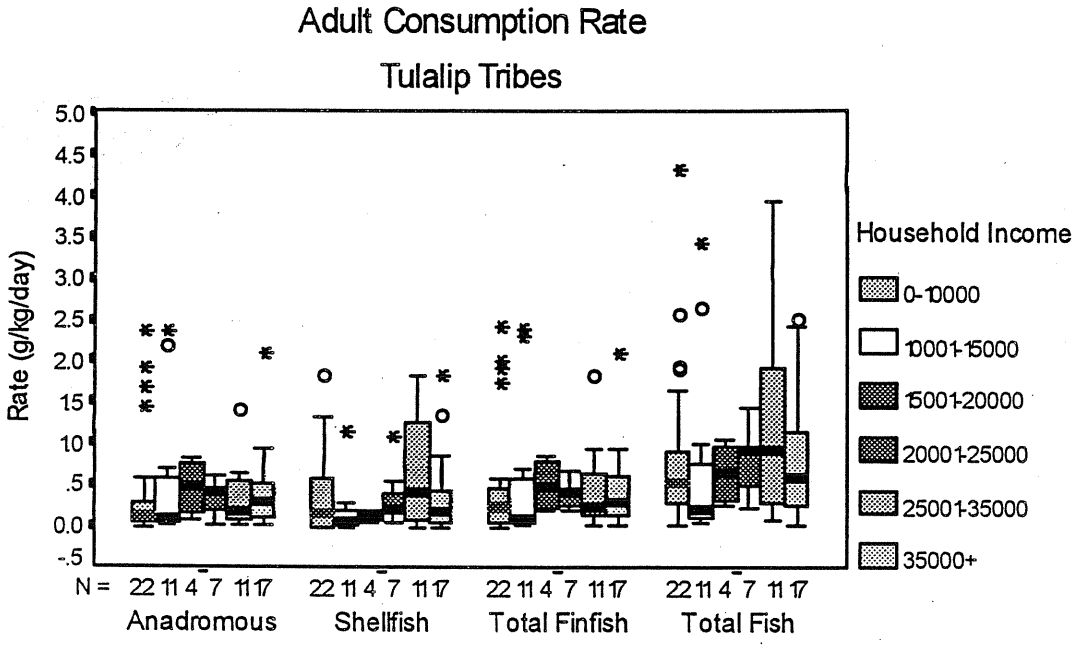


Figure B10. Consumption Rates by Type of Fish, Age Group and Tribe

Note: Pelagic, bottom and "other" fish are excluded from this graph due to low consumption rates.



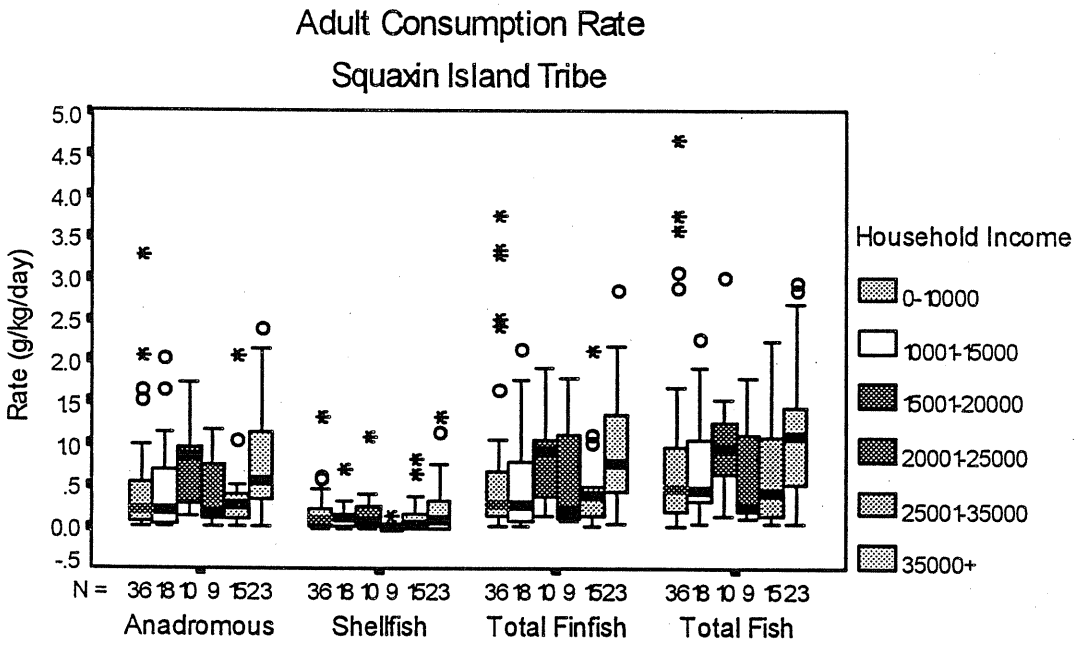
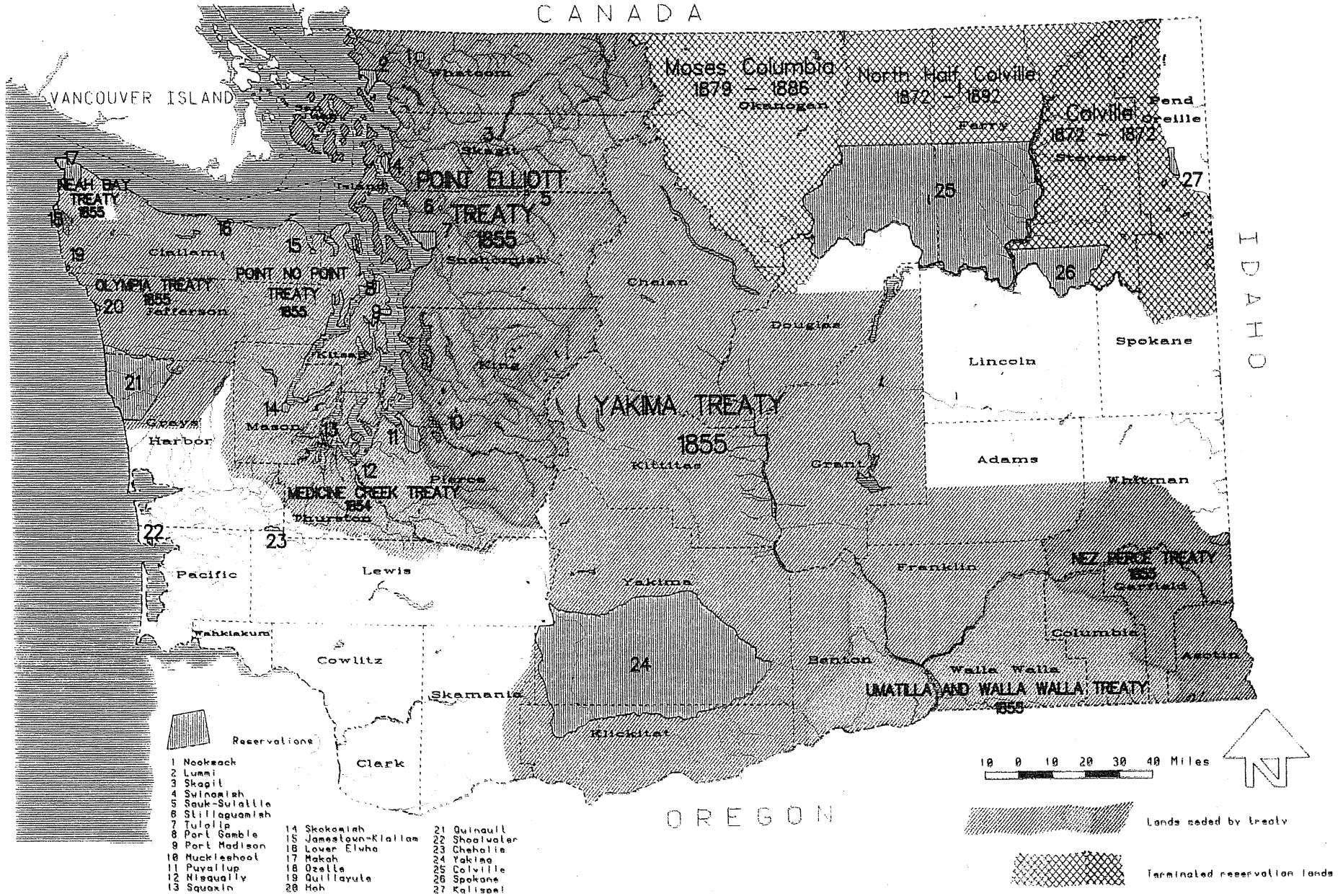


Figure B11. Consumption Rates by Type of Fish, Income and Tribe

Note: Pelagic, bottom and "other" fish are excluded from this graph due to low consumption rates.

Appendix C

Map of Puget Sound Region



Northwest Indian Fisheries Commission

STATE OF WASHINGTON

Ceded Tribal Lands and Reservations

Appendix D

Fishing Location Codes

Location Codes
Inside Puget Sound

Code #	Location Site
5	Point No Point
6	Possession Point
7	Useless Bay
8	Picnic Point
9	Outer Hood Canal
10	Apple Cove Point
11	Edmonds
12	Shipwreck
13	Mukilteo
14	Everett
15	Priest Point
16	Hat Island
17	Camano Head
18	Port Susan
19	Spee Bi Dah
20	Saratoga
21	Langley
22	Tulalip Bay
23	Hermosa Point
24	Mission Point
25	Carr Inlet
26	Inner Chambers Bay
27	Peale Passage
28	Pickering Passage
29	Dana Passage
30	Southern Case Inlet
31	Henderson Inlet
32	Budd Inlet
33	Eld Inlet
34	Totten Inlet
35	Skookum Inlet
36	Hammersly Inlet
37	Northern Case Inlet
38	Nisqually Reach
39	Marine Pass
40	Lower Carr Inlet

Location Codes
Inside Puget Sound

Code #	Location Site
41	Fox Island
42	Sequalitchew
43	East/West Passage
44	Commencement Bay
45	Seattle
46	Elliot Bay
47	Camano
48	Sneatlum Point
49	Mukilteo
50	Baby Island
51	Coupeville
52	Sandy Point/Langley
53	Coronet Bay
54	Suquamish/Kingston
55	All Squaxin U and A #s 60 - 73
56	Carr Inlet
60	281040
61	281030
62	281090
63	281050
64	281020
65	281060
66	280710
67	280700
68	280730
69	280740
70	280760
71	280790
72	Squaxin Island
73	Oyster Co./ Harstene Island
88	Straits of Juan de Fuca
89	Little Boston

Location Codes
Outside Puget Sound

Code #	Location Site
1	Point Roberts
2	Salmon Banks
3	Rosario Strait
4	Haro Strait
57	Columbia River
58	Port Angeles
59	Chehalis River
74	Cowlitz River
75	Lewis River
76	Humptulips River
77	Lake Isabella
78	Kennedy Creek
86	Oregon
87	Bellingham/Lummi/Sammish Bay
90	Blaine
91	Quinalt
92	Alaska
93	Westport/Grays Harbor
94	La Push/Quiliet/Pacific Ocean
95	Neah Bay
96	Hood Canal
97	Port Townsend
98	Pillar Point
99	Unspecified area in Puget Sound
100	Muckleshoot
101	Swinomish/Skagit River
102	Canada

Appendix E

Outliers List

Table E1. Consumption Rates (g/kg/day) Substituted for Outliers (see text)

Respondent I.D.	Reported Rate	Substituted Rate	Age	Gender	Income
Adults - Tulalip Tribes					
Anadromous fish					
583	3.7791	2.3398	37	M	1
Pelagic fish					
656	0.3265	0.2558	19	F	1
561	0.4448	0.2558	37	M	6
Bottom fish					
584	0.5267	0.2408	22	M	1
Shellfish					
575	4.0282	1.8301	36	F	5
583	7.2591	1.8301	37	M	1
Other fish					
553	0.4504	0.2636	25	M	4
594	0.3559	0.2636	50	M	1
705	0.4223	0.2636	27	F	6
Adults - Squaxin Island Tribe					
Anadromous fish					
159	4.4680	3.2756	42	F	1
168	5.3447	3.2756	55	F	1
181	9.5668	3.2756	29	F	1
Pelagic fish					
117	0.8554	0.5113	39	M	6
226	1.2560	0.5113	48	M	1
Bottom fish					
166	0.6128	0.4768	25	F	6
168	0.9144	0.4768	55	F	1
226	1.2405	0.4768	48	M	1
Shellfish					
128	1.5898	1.3075	29	F	6
176	4.0472	1.3075	18	M	1
Other fish					
128	0.1549	0.1447	29	F	6
179	0.2139	0.1447	18	F	1
230	0.2947	0.1447	19	M	1

Table E1. Consumption Rates (g/kg/day) Substituted for Outliers (see text)

Respondent I.D.	Reported Rate	Substituted Rate	Age (months)	Gender	Income
Children - Tulalip Tribes					
Anadromous fish					
586	0.7975	0.3826	48	F	5
Pelagic fish					
563	0.5127	0.2296	44	F	6
Bottom fish					
586	0.0459	0.0383	48	F	5
Shellfish					
586	1.0574	0.7415	29	F	6
Other fish					
556	0.1148	0.0000	24	F	1
Children - Squaxin Island Tribe					
Anadromous fish					
164	8.0111	2.3155	30	F	2
Pelagic fish					
135	0.7871	0.4132	54	M	4
166	0.6646	0.4132	26	F	6
Bottom fish					
135	1.3292	0.2755	54	M	4
166	0.9445	0.2755	26	F	6
Shellfish					
135	37.6642	1.7071	54	M	4
Other fish					
166	1.9939	1.6314	26	F	6

Table E2. Consumption Rates (g/kg/day) Nonsubstituted Outliers (see text)

Respondent I.D.	Reported Rate	Substituted Rate	Age	Gender	Income
Adults - Tulalip Tribes					
Total finfish (mean=0.495,S.D.=0.615)					
583	2.4220	None	37	M	1
702	2.3877	None	60	F	2
Total fish (mean=0.889,S.D.=0.946)					
575	3.9118	None	26	F	5
583	2.4220	None	37	M	1
Adults - Squaxin Island Tribe					
Total finfish (mean=0.697,S.D.=0.808)					
159	3.3420	None	42	F	1
168	3.7524	None	55	F	1
181	3.2756	None	29	F	1
228	3.4956	None	31	2	Missing
Total fish (mean=0.891,S.D.=0.951)					
159	4.6619	None	42	F	1
168	3.7524	None	55	F	1
228	4.2083	None	31	M	Missing
Children - Squaxin Island Tribe					
Total finfish (mean=0.285,S.D.=0.548)					
164	2.3339	None	30 mo	F	2
169	2.3155	None	24 mo	M	1

Note: Substitution of outliers was carried out for anadromous, pelagic, bottom fish, shellfish, and "other fish" only. The total finfish and total fish are aggregated consumption rates. No substitution for outliers was used for the aggregated consumption rates (total finfish and total fish).

Appendix F

Weights (grams) of Fish Models Assigned to Interviewers

Interviewers:	Code	Model
1. Carl	111	D
3. Christine	333	B
4. Walter	444	A

Horse Clams:

Model	Length (mm)	Whole Weight (g) Shell and Meat	Meat Weight (g)	Meat w/o Belly	Meat w/o Belly and Siphon Skin
A	115.3	306.8.	120.2	89.9	73.6
B	119.5	336.2	124.0	87.5	70.8
D	109.5	259.4	92.2	70.3	61.5

Cockles:

Model	Length (mm)	Whole Weight (g) (Shell and Meat)	Meat Weight (g) (Cooked Meat)	Meat w/o Belly (g)
A	88.6	244.6	56.9	41.5
B	86.6	217.2	56.7	40.3
D	87.6	230.0	56.8	41.5

Oysters:

Model	Length (mm)	Depth (mm)	Whole Weight (g) (Shell and Meat)	Shell Weight (g)	Meat Weight (g)
A	100.6	34.9	86.2	59.5	26.7
B	96.8	35.4	85.6	61.3	24.3
D	114.9	28.8	89.7	63.9	25.8

Model Weights Assigned to Interviewer A,B, and D

Crabs:

Model	Carapace Length (inches)	Whole Weight (g)	Crab Butter	Meat Only
A	7 1/4	750		
B	7 1/4	735		
D	7 1/2	820		
Example	7 1/2	840	73.0	* 280.6

* Stomach meat weight = 130.5 g, Leg meat weight = 150.1

Squid:

Model	Whole Weight	Meat Weight (body & tentacles)
A	52.9	37.1
B	55.9	39.6
D	63.6	40.5

Scallops:

Model	Whole Weight (g)	Adductor Muscle (g)	Shell Weight (g)	Gonads and Other Parts (g)
A, B, D	35.9	6.1	14.4	15.4

* Top view 26 mm X 22.3 mm Side measurements: 15.7 mm & 13.0 mm

Shrimp:

Model	Length (mm)	Weight (body) g
A, B, D	108	26.6

Model Weights Assigned to Interviewer A,B, and D

Butter clams:

Models	Length	Whole Weight (g)	Meat Weight (g)
A	64.0	61.0	24.2
B	66.5	62.6	24.8
D	64.6	61.5	23.9

Clams (Manila and Littleneck)

Model X Length = 40 mm	Whole Weight (g)	Meat Weight (g)
A, B, D	23.3	5.4

Mussels:

Model X Length = 50 mm	Whole Weight (g)	Meat Weight (g)
A, B, D	7.7	3.1

Razor Clams:

Model length = 4 in. Weight: 65 g

Lobster model (shrimp model used):

Shrimp weight (26.6g) x number (respondent's answer)

Moon Snails:

Weight = 50 g

Herring:

Model	Length (mm)	Weight (g)
A, B, D	135	15.5

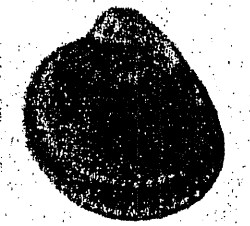
Site codes for Squaxin Island usual and accustomed shellfish areas:

Beach #	Code	Beach #	Code
281040	60	281030	61
281090	62	281050	63
281020	64	281060	65
281710	66	281700	67
281730	68	281740	69
281760	70	281790	71
Squaxin Island	72		

Appendix G

Fish Model Displays

Horse Clam
(Geoduck)

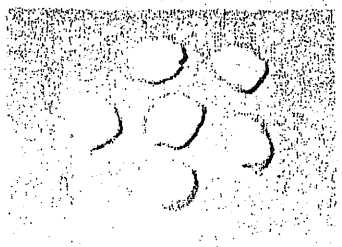


Cockle

Oyster

Butter Clam

Shrimp
(Lobster)



Scallops