APPENDIX 3

FISH CONSUMPTION RATE

CTUIR Fish Consumption Rate = 620 g/d or 500 pounds per year (adult) .

SUMMARY

Although many indigenous peoples living along coasts or major waterways originally had very high fish consumption rates, most are now suppressed due to destruction of fisheries, lost access to aboriginal lands, or awareness of contamination. Therefore, studies that assess the current fish consumption rates are not measuring the true subsistence rate, but a modern suppressed rate. Even so, a subset of tribal members remain heavily fish-dependent, creating a bimodal distribution that is missed in most conventional survey methods.

The Confederated Tribes (Cayuse, Umatilla, Walla Walla) have relied on resident and anadromous fish in the Columbia River and its tributaries for at least 10,000 years. Salmon and the people are inseparable, and people will and must continue to partake in the circle of life with salmon as a partner. We regard current fish numbers as a temporary decline, with continued improvement through concerted efforts in watershed restoration. Therefore, since Hanford cleanup must remain protective for thousands of years, we are using our subsistence consumption rate, not the current average suppressed consumption rate.

The subsistence consumption rate is an average of 620 grams per day for adults. This is known through anthro-historical data, anecdotal information by early observers such as Lewis & Clark, nutritional analysis, and documentation from the era of dam construction (1920-1950), interviews of current subsistence fishers, and literature review. Table 1 shows examples of the range of consumption rates that were reviewed.

Table 1. Summary of selected fish ingestion rates.

Fish Ingestion Rate	***Derivation***
6.5 g/day	Previously used in federal promulgations based on national food consumption surveys of the general non-tribal population; now superceded by 17.5 g/d.
17.5 g/day	EPA's new recommendation for the general non-tribal population and recreational fishers
54 g/d	MTCA and OSWER
63.2 g/day (about 1 pound/week)	CRITFC (1994) average for current tribal fish consumers, excluding subsistence fishers. See commentary below.
142.4 g/day	EPA proposed average rate for tribal subsistence fishers and 99th % of the general non-tribal population
389 g/day	CRITFC 99th percentile of non-subsistence fish consumers plus non-consumers, minus 7 "outliers." The 90th percentile was between 97 and 130 g/day, and the 95th percentile was between 170 and 194 g/day.
454 g/day (1 pound/day)	Anecdotal subsistence estimate, commonly cited during interviews with traditional and subsistence people..
540 g/day	Harris & Harper (1997), based on averages for traditional CTUIR fishing families, and the lower end of the Treaty-based range; approved by BOT for use at Hanford and Columbia River. The authors sought out and interviewed traditional and subsistence fishing members.
620 g/day	Cited in the Boldt decision ("Salmon, however, both fresh and cured, was a staple in the food supply of these Indians. It was annually consumed by these Indians in the neighborhood of 500 pounds per capita.") U.S. District Judge George Boldt, U.S. v. Washington, February 12, 1974, note 151. *Note: Boldt was referring to Columbia mainstem fishers when he wrote this. This does not include resident fish.*
650 g/day	Walker (1999) mid-range of top third of Yakama members using the Columbia River during the 1950s and 1960s (both resident and anadromous fish). This is based on interviews of tribal fishermen, fish market records, nutritional analysis, archaeological and ethnographic evidence, and literature reviews. Walker cites other studies that support this number. Walker estimated that minimal river users ate 80 g/d, and the median river user ate 350 g/d. The BOT endorsed the numbers in this paper.
1000 g/day	Walker (1985) estimate of pre-dam rates for Columbia Plateau Tribes, accounting for calorie loss as fish migrate upriver and other documentation.
To convert from ounces to grams, multiply by 28.35. There are 3.53 ounces in 100 grams. To convert from pound to gram, multiply by 453.6 There are 16 ounces in a pound. 100 grams or 3.5 ounces is about the size of a deck of cards. Meal sizes are generally assumed to be 8 ounce portions for adults	

1.0 Approach and Assumptions

Within the Confederation of Cayuse, Walla Walla and Umatilla Tribes, there are different family natural resource uses according to the specific area that a family is from. Nevertheless, while the Cayuse Tribe emphasized hunting more than fishing and the Walla Walla and Umatilla Tribes emphasized fishing more than hunting, both diets are "subsistence" diets because they provide all the food and medicine that a family needs to survive and thrive. However, in this scenario we are using the term "subsistence fisher" to refer to original consumption rates along the Columbia River and its major tributaries, and which the Treaty of 1855 was intended to protect.

The development of the CTUIR fish consumption rate was based on the following premise:

- Subsistence consumption rates were practiced by many or all members of a Tribe, but today are practiced by a subset of tribal members;

- Within tribes or confederations of tribes there may be distinct patterns of natural resource use that are obscured by statistical cross-sectional surveys. Therefore, cross-sectional fish consumptions surveys in tribal communities may not be able to identify subsistence fishers;

- In order to develop a subsistence consumption rate, subsistence fishers must be specifically identified and interviewed, and existing studies must be reviewed to determine whether they are suitable for developing true subsistence rates, or combined/ suppressed consumption rates.

Our goal was to identify the subsistence consumption rate because that is the rate that the Treaty of 1855 was designed to protect and which is upheld by case law. It also reflects tribal fish restoration goals and healthy lifestyle goals.

As other investigators have done (Walker, in particular), the CTUIR fish consumption rate was developed using multiple lines of evidence: literature review of ethnohistorical evidence, review of cross-sectional fish consumption surveys (a combination of subsistence and non-subsistence fishers), interviews of current subsistence fishers, and caloric and nutritional analysis.

2.0 Current Federal and State Guidance

The EPA Office of Water provides guidance for setting ambient water quality standards for surface water, and includes a consideration of fish consumptions rates. The prior national fish consumption rate for the general population [6.5 gpd] was based on the mean national per capita (both consumer and non-consumers) consumption rate of freshwater and estuarine finfish and shellfish from 3-day diary results that were reported in the 1973-74 National Purchase Diary Survey (Javitz, 1980).

The EPA Office of Water[1] now recommends a default fish intake rate of 17.5 grams/day to adequately protect the general population of fish consumers including sport fishers, and 142.4 grams/day for subsistence fishers. The basis for the fish intake rates is the 1994-96 Continuing Survey of Food Intake by Individuals and 1998 Continuing Survey of Food Intakes by Individuals *(*CSFII) conducted by the U.S. Department of Agriculture.

When Tribes develop ambient water quality standards, EPA[2] recommends using either an upper percentile of a cross-section or an average rate specific for a higher fishing group, according to the policies of the Tribe. EPA says that the two numbers should be compared to ensure that the higher fishing group (if one is present within a general tribal population) is protected. In the case of CTUIR, these two numbers are quite different (see discussion below), so the CTUIR rate is based on the average rate specific to the higher fishing group rather than the average for the whole Tribe.

The U.S. EPA Office of Solid Waste and Emergency Response (OSWER) also considers fish consumption in the Superfund program. OSWER's policy is to assume an ingestion rate of 54g/day for high recreational consumers of locally caught fish [OSWER directive 9285.6-03]. This number is based on recreational, not Native American data. Region 10 of the U.S. EPA recommends the use of results from local or regional seafood intake surveys for use in the regional Superfund program[3]. If Tribal-specific or local information is not available, EPA-OSWER recommends using the U.S. EPA Exposure Factors Handbook, which recommends a mean and 95th percentile for the general U.S. population of 20.1 g/day and 63 g/day, respectively (U.S. EPA, 1997). For Native American subsistence populations the recommended value for mean intake is 70 g/day and the recommended 95th percentile is 170 g/day.

The Washington State Department of Ecology recently recommended a *draft* statewide default of 177g/day to protect all Washington residents including the highest consumers, subsistence fishers. The draft report recommends "final default consumption values of approximately 178 and 175 g/day for marine and freshwater areas, respectively. These values represent approximately the 90th percentile of the fish consumption rate distribution from the Toy et al. study and the 95th percentile from the CRITFC study, respectively[4]. State-wide criteria may use the mid-point between these values, or 177 g/day as a reasonably protective default. Shellfish may be separated out from the marine values. Shellfish estimates are recommended as 68 g/day based on the Toy et al. study."

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[1] Estimated Per Capita Fish Consumption in the United States. (EPA-821-C-02-003) (August 2002). http://www.epa.gov/waterscience/fish/consumption_report.pdf; *and* Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) EPA-822-B-00-004, October 2000. http://www.epa.gov/waterscience/humanhealth/method/chapter4.pdf

[2] www.epa.gov/ost/standards/tribal/tribalfact2004.html or www.epa.gov/ost/standards/tribal/tribalfact2004.pdf.

[3] Currently being revised: http://yosemite.epa.gov/r10/oea.nsf/af6d4571f3e2b1698825650f0071180a/db6a5cf0b287291c88256c55006cd81e?OpenDocument

[4] Washington Department of Ecology, Analysis and selection of fish consumption rates for Washington State risk assessments and risk-based standards, external review draft, March 1999. http://www.ecy.wa.gov/biblio/99200.html

The Washington Department of Ecology's 1997 standards for surface water refer to WAC 173-340-730 (Model Toxics Control Act), which includes a "placeholder" for fish consumption of 54 gpd.

3.0 Fish Consumption Surveys of Current Suppressed Rates

Several studies have evaluated current Tribal fish consumption rates in the Pacific Northwest in order to evaluate current exposures and risks (Table 2). None of them addressed the issue of original fish consumptions rates which are protected by Treaty or by judicial decisions, and none addressed the current tribal conditions which forced many people off the River and away from their hereditary or Usual and Accustomed fishing sites. Additionally, none of them specifically consider the range of lifestyles within tribal communities, but assumed that Tribes are all composed of a homogeneous population even if Tribes with different histories and homelands and even languages were forced onto the same reservation. This results in bimodal or more distributions within many tribes. In the case of the Confederated Umatilla Tribes, there is a subset of tribal members who maintain high fishing rates and consumption rates (see next section). The studies summarized in Section 3 assumed that Tribes were homogeneous in their activities and lifestyles, and therefore took a statistical cross-section approach. In contrast, the studies summarized in Section 4 specifically focused on the subset of tribal members who maintain a true subsistence lifestyle, and on documenting original consumption rates.

Table 2. Major Pacific Northwest cross-sectional studies of current suppressed fish consumption rates.

Survey	Mean (converted to g/person/d)			95th	99th
	finfish	shellfish	combined	Fish + shellfish	
CRITFC	63.2	-	63.2	170-194	389
Suquamish	81.8	132.7	213.9	798	ND
Toy - Tulalip/Squaxin	48.8	22.3	72.9	177	ND
Sechena - Asian / Pac Isl.	-	-	119.3	?	?
CRITFC – outliers were eliminated from the database (implies a presumption of not valid). Suquamish – no labeling of high end consumers as outliers; says they were assumed to be accurate reports. Tulalip – recoded outliers (implies a presumption that these were valid but mistaken)					

3.1 CRITFC (1994)

CRITFC (1994). "A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin." CRITFC Technical Report No. 94-3, Portland, OR.

The CRITFC fish consumption survey was designed in a way that is conventionally used in typical suburban populations. It used statistical rather than ethnographic research methods. Both methods are "scientific" in that they are systematic, repeatable, and verifiable, but they are suitable for different populations and situations. The CRITFC

survey was a random cross-section of tribal members (names were randomly selected from enrollment lists), with ultimate surveys of 126 Warm Springs, 133 Nez Perce, 131 CTUIR, and about 130 Yakama members. The mean age of respondents was 39 years old (less than 10% were elders 60 years old or older). Tribal members were contacted by phone, mail, or in person. They were asked to drive to a central location on a particular day, and answer a lengthy set of questions read from a script (for consistency) by an interviewer. The overall response rate was 69% (31% of selected people either refused, could not be located, or did not participate for unknown reasons). It is likely that traditional members were under-represented due to refusal, lack of a phone, car, or permanent address, or inability to respond for the small amount of payment ($40).

Seven individuals reported that they ate more than 389 g/day, or more than 99% of the amount eaten by fish consumers (4 people ate 486 g/day, and one person each ate 648 g/d, 778 g/d, and 972 g/d). These values were treated as statistical outliers and were eliminated from the database. No follow-up was done to find out whether these higher rates were accurate or not, but we assume that these people are true subsistence fishers. Because these numbers are based on a reported meal frequency and size, we assume that the underlying answers by the interviewees were accurate, because people can provide information about meal frequency more easily than poundage.

During the research for the Harris & Harper paper (1977) traditional members who had been included in the CRITFC survey were asked if they gave accurate information, and several said no. Some traditional fishers said they simply refused to participate, or reported lower consumption rates than reality, due to a fear of law enforcement or fear of being accused of knowingly eating contaminated fish. Other factors are unknown, such as whether traditional members were away from home during a fishing season, or otherwise engaged in activities that prevented them from participating. The personal experiences of the people we are most interested in (elders and subsistence fishing families) make them less likely to answer questions, even when posed by a member of the community. Fishing families often have a family history of having to fish clandestinely and being persecuted by authorities or jailed as a result of fishing in their own rivers to feed their families.

The point of this discussion is that the makeup and history of the community must be understood before conducting a conventional survey. In addition to the above items, we know that elders tend to eat more traditionally (including people who return to traditional ways as they get older). Within the Umatilla and Walla Walla membership there are people who lost access to their hereditary fishing sites, or who have full-time day jobs or other family circumstances that prevent them from designating a family member as a fish provider.

Arithmetic mean = 63.2 grams/day
50^{th} percentile = 42 gpd
90^{th} percentile = 127 gpd (Table 10 says the weighted 90^{th} = 97 – 130 gpd).
95^{th} percentile = 182 (Table 10 says the weighted 95^{th} = 170 – 194 gpd. The 95^{th} % is also cited as 175 from Table 18 for the Portland Harbor)
98^{th} percentile = 317 gpd
99^{th} percentile = 389 gpd
Average serving size = 8.42 oz +/- 0.13 oz.

3.2 TOY et al. (1996).

Toy KA, Polissar NL, Liao S, and Mittelstaedt GD. (1996) "A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region." Tulalip Tribes, Department of the Environment, 7615 Totem Beach Road, Marysville, WA 98721.

This survey was designed to focus on frequency (daily, weekly, monthly, annually) and portion size of fish and shellfish, both fresh and frozen. Commercial fishing and shellfishing is an important source of income for both tribes, but for the Tulalip, "at present, the consumption of shellfish is limited to a personal-use activity." Sample size goals were developed by assuming a homogeneous (not bimodal) population and a certain standard deviation. Random names were generated, and children were evaluated if a parent was included (limited to one child per family). The final sample sizes were 73 Tulalip and 117 Squaxin adults over 18 and 68 children. A scripted questionnaire with food models was used.

52 edible species were divided into anadromous, pelagic, bottom fish, shellfish, and other (canned tuna or trout) categories. Consumption per body weight was recorded (average weight = 81 kg). Participants were paid $25. There was no correlation of consumption with income (i.e., low income did not drive people to eat more fish; high income did not allow more fish as a luxury purchase; or the two factors balanced each other).

"Outliers" were recoded to the 3 SD value. "The distribution of consumption rates was skewed toward large values." At least 25 people (out of 190, or 13% of participants) ate more than the 95th % of total finfish. This suggests that there is an underlying bimodal distribution of higher consumers, rather than being a single homogeneous population.

Weighted results (after the outliers were recoded), both tribes combined are:

- Tulalip median = 0.55 g/kg/d of all fish (53 g/d male and 34 g/d female);
- Squaxin median= 0.52 g/kg/d (66 g/d male and 25 g/d female).

Table 3. Combined Tulalip and Squaxin Island results. Results are given in grams per kg body weight per day and grams per person (assumed to weigh 70 kg) per day.

	Finfish g/kg/d	***Finfish g/70kg/d***	***Shellfish g/kg/d***	***Shellfish g/70kg/d***
50th %	0.317	25.7	0.115	9.32
90th	0.84	68	1.75	142
95th	1.31	106	2.19	177
99th	Not calculated	Not calculated	Not calculated	Not calculated

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3.3 Suquamish (2000).

> **Suquamish Tribe (2000). "Fish Consumption Survey of the Suquamish Indian Tribe of The Port Madison Indian Reservation, Puget Sound Region." Suquamish Tribe, Fisheries Department, PO Box 498, Suquamish, WA.**

This study used a questionnaire with food models, as well as maps, pictures, and interviews. The study used scripted statistical methods for the questionnaire and ethnographic methods for oral history and elders' interviews. There were 3 special interest groups: children under 6, women between 16 and 42, and elders 55 and over.

> "Despite degraded water quality and habitat, tribal members continue to rely on fish and shellfish as a significant part of their diet. All species of seafood are an integral component of the cultural fabric that weaves people, the water, and the land together in an interdependent linkage which was been experienced and passed on for countless generations."

Given a SD of 1.26 (from the span of ingestion rates for the Toy study), and a target precision of +/-20%, the target sample size was *n = 150*, indicating that one-quarter of the adults should be sampled. The final sample size was 92 adults (out of 425 eligible) and 31 children. Participants were paid $25. The participation rate was 65%.

Consumption rates "have very little correlation with body weights among adults," but people did not want to report their weights or be weighed. The average weight (males and females combined) was 79 kg. As with the Tulalip study, some people report eating more for health benefits, but twice as many people ate less now than 20 years ago due to contamination and restricted access.

Outliers were not recoded because high values were believed to reflect actual high consumption. When tested, it was found that recoding outliers had "virtually no effect" on results. The distribution graph again appears bimodal, with a group of people eating 9-10 g/kg/d (750 g/d), but the "best fit" line obscures this. One respondent reported an ingestion of 1 kg/d, which is nutritionally possible, although it may also have reflected a short-term seasonal availability – it is known that people tend to overestimate whatever is seasonally available and underestimate whatever is out of season.

> Adults total average finfish and shellfish = 2.7 g/kg/d.
> Average finfish = 1.03 g/kg/d; shellfish = 1.68 g/kg/d.
> 90th percentile = 2.5 finfish, 4.6 shellfish, 6.2 total (all in g/kg/d) (or 197.5, 363.4, 490.0 in g/70kg/d)
> 95th percentile = 3.4 finfish, 7.75 shellfish, 10.1 total (all in g/kg/d)
> (or 269, 612, 798 in g/70kg/d)
> 99th percentile = not calculated

3.4 Sechena et al. (1999)

R Sechena, C Nakano, S Liao, N Polissar, R Lorenzana, S Truong, and R Fenske (1999) "Asian and Pacific Islander Seafood Consumption Study," (EPA 910/R-99-003). Seattle: EPA Region 10; http://www.epa.gov/r10earth/offices/oea/risk/a&pi.pdf

Sechena R, Liao S, Lorenzana R, Nakano C, Polissar N, and Fenske R. (2003) "Asian American and Pacific Islander seafood consumption -- a community-based study in King County, Washington." J Expo Anal Environ Epidemiol. 13(4):256-66.

This paper describes and quantifies seafood consumption rates and acquisition and preparation habits of 202 first- and second-generation Asian American and Pacific Islanders (AAPI) from 10 ethnic groups (Cambodian, Chinese, Filipino, Hmong, Japanese, Korean, Laotian, Mien, Samoan, and Vietnamese) in King County, Washington in 1997.

A sample size of 200 fish consumers was the target, and 202 people actually participated, with 5-30 interviews per ethnic group. Because it was not possible to pre-identify first and second generation A/PI for random name generation, half the participants were invited to participate from rosters provided by community leaders for random contact, and half were volunteers who had previously been recruited for a Dietary Habits Study. The interviewee pool was adjusted to reflect age and gender of the populations (from census and other information), so the participants had to fit the ethnic, age and gender profiles before inclusion in the study. If groups were still too small, relatives of participants were actively recruited. The sample size of some ethnicities was deliberately larger than others, according to a judgment about how well established that group was in the Seattle area (e.g., they knew where and how to get fish, etc.). The majority of the 202 respondents (89%) were first generation (i.e., born outside the United States). There were slightly more women (53%) than men (47%), and 35% lived under the 1997 Federal Poverty Line. Participants were paid $25 or given a store voucher

In general, the A/PI members consumed seafood at a very high rate. The average overall consumption rate for all seafood combined was 1.891 grams/per kilogram body weight/day (g/kg/day), with a median consumption rate of 1.439 g/kg/day (or a mean of 117.2 and a median of 89 g/70kg/day). Seafood consumption based on gender, age, income, and "fishermen" status did not differ significantly. However, mean consumption rates varied significantly between ethnic groups with Vietnamese (2.63 g/kg/day) and Japanese (2.18 g/kg/day) having the highest average consumption rates, and Mien (0.58 g/kg/day) and Hmong (0.59 g/kg/day) the lowest.

The predominant seafood consumed was shellfish (46% of all seafood). The most frequently consumed finfish and invertebrates were salmon (93% of respondents), tuna (86%), shrimp (98%), crab (96%), and squid (82%). Fish fillets were eaten with the skin 55% of the time, and the head, bones, eggs, and/or other organs were eaten 20% of the time. Crabmeat including the hepatopancreas was consumed 43% of the time.

Outliers (more than 3 SD from the mean) had "large but uncertain" ingestion rates. They were recoded to 3 SD. Again, fish consumption rates were skewed considerably for all fish groups. The skewed distribution indicates that a few respondents had a larger consumption rate than other respondents. Because outliers had already been recoded

within each fish group, these large consumption rates reflected the fact that some API members were, indeed, higher consumers of seafood.

People over 55 ate more fish (131 gpd) than younger people (111 gpd). There was no correlation with income. Volunteer participants ate very slightly more than roster recruits (random contact from lists). Fishermen and non-fishermen did not show any statistical difference, and there was little or no difference between first generation (foreign born) and second generation (bore here).

TABLE 4. Consumption Rates of Asian/Pacific Islanders in King County (From Sechena et al., 1999). [LCI= lower confidence interval; UCI = upper confidence interval]

Category	**N**	**Mean g/kg/d**	**Median g/kg/d**	**Percentage of consumption**	**S.E.**	**95% LCI g/kg/d**	**95%UCl g/kg/d**	**90% g/kg/d**
Anadromous Fish	202	0.093	0.201	10.6%	0.008	0.187	0.216	0.509
Pelagic Fish	202	0.215	0.382	20.2%	0.013	0.357	0.407	0.829
Freshwater Fish	202	0.043	0.110	5.8%	0.005	0.101	0.119	0.271
Bottom Fish	202	0.047	0.125	6.6%	0.006	0.113	0.137	0.272
Shellfish Fish	202	0.498	0.867	45.9%	0.023	0.821	0.913	1.727
Seaweed/ Kelp	202	0.014	0.084	4.4%	0.005	0.075	0.093	0.294
Miscellaneous Seafood	202	0.056	0.121	6.4%	0.004	0.112	0.130	0.296
All Finfish	202	0.515	0.818	43.3%	0.023	0.774	0.863	1.638
All Fish	202	1.363	1.807	95.6%	0.042	1.724	1.889	3.909
All Seafood	202	1.439	1.891	100.0%	0.043	1.805	1.976	3.928
All Seafood, converted to g/person/d (*63.5)		91.4	120.1			114.6	125.5	249.4

4.0 Studies of subsistence fishers and Treaty-based Consumption Rates

In order to document original fish consumption rates, as well as to evaluate the subset of tribal members who maintain a subsistence level of fish consumption, a combination of historical documentation, literature review, and additional ethnographic interviews were used. These three lines of evidence indicate that the range of original rates (also referred to as a Treaty-protected rate) is 540 to 1000 gpd. Interviews confirm that there are quite a few people who consume fish two to three times a day in various forms (whole filet, soup, powdered thickener or flavoring, dried or smoked as snacks). Some of the primary references are summarized below, with citations of other literature included. It should be noted that these rates persist to the present despite the decimation of salmon runs by canneries and dams, and knowledge of contamination.

4.1 Harris and Harper (1997)

Harris, S.G. and Harper, B.L. (1997) "A Native American Exposure Scenario." Risk Analysis, 17(6): 789-795.

Harris interviewed 75 people in order to identify members of the special interest group (the higher fishing group). A subset of 35 traditional fishers, including many elders, were then interviewed in detail using ethnographic methods. The ethnographic interview is actually a process (Schensul et al., 1999a,b; Spradley, 1979; Emerson et al., 1995; Fetterman, 1998; Thornton, 1998; Mihesuah, 1998). It involves establishing community standing and personal credibility, and demonstrating cultural sensitivity and an understanding of what information is proprietary. Without this process, information collected from interviews or questionnaires with Native Americans risks being inaccurate. Interviewees were asked how the accuracy of their responses compared to other studies, including the CRITFC study, and many stated that they do not try to provide accurate information (or actively seek to avoid revealing information) unless they know the person and know how the information could be used or misused. The authors consider this to be an essential part of the bioethics and informed consent safeguards, even if this takes considerably more time than simply asking people to answer questions.

Interviewees reported eating fish daily, with fresh and dried fish in equal weights. This amount reflects one 4-ounce portion of fresh fish and 4 ounces of dried fish, which is equivalent to 12 ounces of wet weight. Since these interviews, more research has been done which indicates that several forms of fish consumption were overlooked, including use as a thickener and flavoring, and the use of whole fish and eggs were probably underestimated. In addition, the CRITFC (1994) results indicates that half of the interviewees ate less than they did twenty years previously.

Anecdotally, people are now eating more fish as the salmon runs are being restored in the Umatilla and Walla Walla Rivers. The Umatilla Tribes have invested a large amount of money, time, and effort to restore these runs, with the goal of regaining subsistence fishing capabilities.

4.2 Walker (1967).

Walker DE (1967. Mutual Cross-Utilization of Economic Resources in the Plateau: from aboriginal Nez Perce Fishing Practices. Washington State University Laboratory of Anthropology, Report of Investigations, No. 21, Pullman WA.

Walker estimated that fish consumption rates before dam construction ranged from 365 to 800 pounds per year.

4.3 Walker (1985)

cited in: **Scholtz A, O'Laughlin K, Geist D, Peone D, Uehara J, Fields L, Kleist T, Zozaya I, Peone T, and Teesatuskie K, (1985), "Compilation of information on salmon and steelhead total run size, catch, and hydropower related losses in the Upper Columbia River Basin, above Grand Coulee Dam." Fisheries Technical Report No. 2., Upper Columbia United Tribes Fisheries Center, Eastern Washington University, Department of Biology, Cheney, WA 99004.**

Walker reviewed the ethno-historical and scientific literature to estimate the pre-dam fish consumption rates of Tribes along the Columbia River. He estimated that total fish consumption (not harvest) was 1000 lbs per capita for lower Columbia Tribes, of which 75% were salmon (Umatilla and Yakama estimates), and the Nez Perce also ate 1000 lbs per capita of which 90% were salmonids (including trout and whitefish). Other estimates (Hewes; Boyd) are very close to this. Hewes, (1947, 1973) originally estimated from 50 to 900 pound per year for Plateau Tribes by estimating a total catch, subtracting an estimate of the amount of salmon that was trade, used as dog food, and other uses, and adding additional 1/3 of the weight of salmon to account for resident fish consumption during the 1/3 of the year that salmon are not running, (but considering the dried, pounded (pemmican or powder) fish are eaten in the winter).

Walker improved on Hewes' estimate by using actual historical observational counts of the Indian catch, rather than a global estimate of a Tribe's entire catch for a season. The median annual per capita consumption of salmonids for the Columbia Plateau Tribes derived by Walker was 585 pounds per capita. "Walker's figures provide a more accurate picture of the catch..." based on direct observation and ethnographic fieldwork."

Other authors were also cited in this reference. "Schalk (1985) pointed out that the early caloric estimates were for salmon flesh in the ocean. Since salmon lose calories as they migrate upstream, tribes living upriver would actually have to take more fish than tribes living downriver to obtain an equivalent amount of calories." He estimated that 1.5 pounds of wet weight are equivalent to 1 pound dried, and that 20% of a whole fish is entrails. Schalk estimated that a family needs 250 to 500 dried fish per family, or 2000 pounds per family.

Walker also cited Swindell (1942), who interviewed 55 family heads from Yakama, Umatilla and Warm Springs (not specifically fishing families) for an average of 322 pounds/yr in 1941 (the time when the canneries were taking a large percentage of the fish, leaving fewer for the Indians). Hewes estimated that Cayuse ate 365 pounds per capita, while Umatilla and Walla Walla ate 500 pounds per capita. Yakama, Klickitat, Wanapum, and Palus were estimated to eat 400 lbs, and Nez Perce were estimated to eat 300 lbs.

Hudson Bay records from 1827, 1829, and 1830 indicated that the company supplemented the regular supplies that were shipped to them by purchasing about 535 lbs of fish per person (about 30 people were housed at the Colville Post), as well as around 100 lbs dried venison (for the 30 men), 1500 pounds of fresh venison, 10 beavers, 275 ducks, 200 geese, 10 cranes, 75 dogs, 50 grouse, and a few swans, beaver tails, and small fish.

4.4 Walker (1992)

Walker, D.E. (1992). Productivity of Tribal Dipnet Fishermen at Celilo Falls: Analysis of the Joe Pinkham Fish Buying Records. Northwest Anthropol. Res. Notes. 26(2):123-135.

Walker review an earlier reference (Anastasio, 1972), who reviewed historical accounts of early explorers, as well as thoroughly reviewing ethnographic and ethnohistoric research. Archaeological research indicates that this region has been the scene of relatively continuous anadromous fishing activity for at least 10,000 years. Walker reviewed fish buying records in 1945, a time when fish runs were declining rapidly, continuing a trend begun with the canneries. Over the years, packing house and cannery records support statements that salmon runs have been 99% decimated.

4.5 Walker (1999)

Walker, D.E. and Pritchard, L.W.(1999). "Estimated Radiation Doses to Yakama Tribal Fishermen: An Application of the Columbia River Dosimetry Model for the Hanford Environmental Dose Reconstruction Project." Boulder, CO: Walker Research Group.

This study relied on the use of officially recorded fishing sites along the Columbia River mainstem, and interviews with the individuals who actually used those sites between 1950 and 1971. Fishermen were grouped as maximum, median, or minimum river users according to how many fishing sites they held. Minimum river users used between 1 and 9 fishing sites, and ate 64 pounds per year (29 kg/yr or 80 gpd). Median river users used between 10 and 19 sites and ate 282 pounds per year (128 kg or 350 gpd). Maximum river users "would be considered subsistence fishermen," and used 20 or more fishing sites. They ate 522 pounds per year (237 kg or 650 gpd). 75% of fish were caught between April 1 through October 31; of this 75%, 90% was anadromous and 10% was resident. Between November 1 and March 31, 25% of the annual catch was caught; of this 75% were resident and 25% anadromous.

4.6 Hunn (1990)

Hunn ES (1990). Nch'i-Wana, The Big River: Mid-Columbians and Their Land. Seattle: University of Washington Press.

Hunn estimated that 30-40% of caloric needs supplied by salmon. Table 13 (Hunn, 1990, page 150) provides estimates of salmon consumption per capita from Hewes (not including resident fish during the winter quarter): Wishram (400 pounds per year), Tenino (500 pounds), Umatilla (500 pounds), and Nez Perce (382 pounds from Hewes estimate and 582 pounds from Walker's estimates), including the adjustment for caloric loss as fish move upstream.

4.7 Ray (1977)

Ray, V.E. (1977). "Ethnic Impact of the Event Incident to Federal Power Development on the Colville and Spokane Indian Reservations." Prepared for the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians, Port Townsend, WA. Available at Eastern Washington State Historical Society, Spokane WA.

Ray provided expert testimony of the amount of fish consumption of the upper Columbia River Tribes during the discussions of the impact of the Grand Coulee Dam. . Ray estimates 1.25 pound per person per day based on 50 years of observation and research, including fish counts, catch rates, early observers. This is also supported by contemporaneous observations at Celilo during the late 1940s.

> "The salmon and other fish taken from the rivers provided around half of the native subsistence, and the lands immediately adjacent to the rivers supplied a significant part of the game which was taken."
>
> "Apart from fish and game, the most important component of the Indian diet was roots."
>
> "Salmon was the staple food for both the Colvilles and the Spokanes. The fish were taken during the long fishing seasons – May to October – but during the same period great quantities were dried to serve and the basic item of subsistence during the winter."

4.8 Boldt (1994) case law

Judge Boldt stated that "Salmon, however, both fresh and cured, was a staple in the food supply of these Indians. It was annually consumed by these Indians in the neighborhood of 500 pounds per capita."[5] Boldt was referring to Columbia mainstem fishers when he wrote this. This does not include resident fish.

4.9 Bimodality in Tribal communities

In the above discussion, we have suggested that the cross-sectional tribal surveys summarized in Section 3 revealed a bimodal distribution, with a cluster of people consuming high amounts of fish. We believe that these are accurate reports from members of a distinct group of subsistence consumers, and that most of this group is missed in cross-sectional surveys because they decline to participate in conventional surveys. However, this raises the question of how a tribal or tribal confederation should be stratified, and whether this reflects simply a high end tail of a normal distribution defined by an arbitrary upper percentile or standard deviation, or whether there is a discernible subset of tribal members with a distinct lifestyle and/or a statistically detectable consumption rate.

- In the Sechena study, respondents were divided into low (<75th percentile) or higher (> 75th percentile) consumers; the basis for this is not given.

[5] U.S. District Judge George Boldt, U.S. v. Washington, February 12, 1974, note 151.

- In the Walker (1999) study, Columbia River mainstem fishers were divided into three groups according to how many fishing sites were used by a fisherman; the basis for this was not given.
- In the three tribal cross-sectional studies, there appear to be clusters of high consumers; since no follow-up was done to investigate the characteristics or accuracy of these individuals, we conclude (as others have concluded) from indirect evidence that these people are members of a subsistence subset that is otherwise obscured by poor study design, and that their reports were indeed accurate.
- In our review of subsistence and cross-sectional studies, we have concluded that a threshold for subsistence consumption rates is roughly 1 pound per day, without regard to the shape of a distribution curve.

The Confederated Umatilla Tribes have distinct subsets of natural resource use according to the original Tribe's homeland; Cayuse emphasized upland hunting more than fishing, while Walla Walla and Umatilla Tribes emphasized fishing more than hunting. During ethnographic interviews, several subsistence consumers confirmed our supposition that traditional subsistence fishers generally decline to participate in surveys by people they don't know, or who give information that they assume is "correct" rather than accurate.

5.0 SUMMARY

We conclude that the subsistence consumption rate for the Confederated Tribes is in the range of 540 to 650 gpd or more (particularly at permanent fishing villages such as Celilo). Within this range, we have concluded that the best estimate is 500 pounds per year (or 620 gpd) as the central tendency of subsistence fish consumption, as well as being recognized in a widely-cited legal decision.

- The CRITFC study (1994) is judged to reflect the median river user (350 gpd from Walker) and minimum river users (80 gpd from Walker). This is comparable to the CRITFC 95th and 99th percentiles (175-182 gpd and 389 gpd) and the CRITFC median (63 gpd), further indicating that the CRITFC study captured data for the minimum and median river users, not the maximum river users.
- The CRITFC "outliers" (reporting a consumption rate of 486-972 gpd) are comparable to Walker's maximum river users (650 gpd), which reflect subsistence use.
- Most per capita estimates of fish consumption rates for subsistence fishers are approximately 500 pounds per year, or 620 gpd as a mean value. These results are based on direct observation of early observers, fish buying records, interview with current members, caloric and nutritional calculations, and ecological and archaeological information.
- Salmon supplied 30% to 40% of the total calories in the river-based subsistence diet. At an average of 175 kcal per 100g of raw fish weight, 620 gpd would provide roughly 1000 kcal daily, which is 40% of a 2500 kcal diet. This conforms with the estimates of Hunn and others that salmon provide 30-40% of the subsistence diet.

- The number of people in the high consumer or maximum river user group diminished as runs were decimated, dams were constructed, and awareness of contamination increased. However, the existence of the subsistent or maximum river user clearly persists to this day, and in fact may be increasing recently as runs are restored and health benefits of eating fish are emphasized.

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