

Consumption Patterns of
**Anglers Who Frequently Fish
Lake Roosevelt**

September 1997



Office of Environmental Health Assessments

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Abstract

A fish consumption survey was conducted at Lake Roosevelt during 1994 and 1995 to determine the consumption patterns of anglers who repeatedly fish the lake. These data were gathered in an effort to determine fish consumption patterns for the population of concern, those who consume the greatest amount of fish, in order to assess the public health impacts associated with ingestion of chemically contaminated fish. Inherently all other populations consuming fish less frequently (or in lesser quantity) will also be protected. Surveyed individuals were primarily older adult Caucasian males that are part of two adult households in which both individuals consume fish. Results indicate that surveyed anglers consume an average of 42 meals per year, with greater than 90% consuming 103.2 meals (2 meals/week) or less per year. These individuals consume fish as fillets, prefer to pan fry fish, and prefer rainbow trout and walleye above kokanee and bass, with no sturgeon, sucker, or whitefish caught and consumed.

Introduction

Elevated concentrations of pesticides, polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), mercury, and other chemicals have been measured in sport fish species collected from various waters in Washington State (Davis and Serdar, 1996; Serdar et al., 1991; U.S.G.S., 1996; Golding, 1996; P.S.W.Q.A., 1995). Consumption of chemically contaminated fish is a significant route of human exposure to environmental pollutants (Rifkin and Lakind, 1991; U.S.E.P.A., 1994).

Chemical contaminants have been measured in fish from Franklin D. Roosevelt Lake (Lake Roosevelt), located in the northeast corner of Washington State. Formed in 1941 by the completion of Grand Coulee Dam on the Columbia River, Lake Roosevelt extends 151 miles to within 15 miles of the United States/Canadian border (Figure 1). Lake Roosevelt, which is visited by over one million people annually, is part of the Coulee Dam National Recreation Area and is bordered by both the Colville Indian and Spokane Indian Reservations.

The Cominco (Ltd.) lead-zinc smelter located ten miles north of the United States/Canadian boundary in Trail, B.C. and the Celgar pulp mill located 30 miles north of the border in Castlegar, B.c. have until recently discharged untreated effluent into the Columbia River (Cominco, 1997; Celgar, 1995). These discharges have resulted in the chemical contamination of Lake Roosevelt water, sediment, and fish. Historical studies of contamination in the lake identified elevated concentrations of lead, zinc, cadmium, copper, and mercury in fish tissue (Beckman et al., 1985; Johnson et al., 1988). More recent studies identified high concentrations of PCDDs and PCDFs in fish tissue (B.C. Ministry of Environment, 1990; Johnson et al., 1991). These results raised concerns about the potential human health impacts of toxic chemical contamination in Lake Roosevelt fish. Industrial upgrades by Cominco and Celgar since 1990 have resulted in substantial reductions in the amount and toxicity of effluents discharged to the Columbia River (Cominco, 1997; Celgar, 1995). Monitoring studies were recently completed in order to characterize current fish tissue contaminant levels (Munn et al., 1995; Serdar et al., 1994). To assess the potential human health impacts posed by these newly reported fish tissue contaminant concentrations, Lake Roosevelt angler fish consumption data are needed.

In August 1994, an angler fish consumption survey was initiated at Lake Roosevelt of those individuals that repeatedly fish the lake with the presumption that individuals who repeatedly fish the lake, catch and consume the greatest amount of fish. The primary survey objective was to obtain catch and consumption data from individuals who repeatedly fish the lake; not to determine species-specific fish consumption levels in terms of grams of fish per day for the entire population. Secondary objectives included the collection of data on fish parts consumed, fish cooking methods and angler demographics.

Methods

Collection of fish consumption data from Lake Roosevelt anglers was conducted by the Spokane Tribe of Indians in concert with on-going creel data collection for the Lake Roosevelt Monitoring Program. Lake Roosevelt was divided into three sections: upper, middle and lower, with one creel clerk assigned to each section (Figure 1). Morning and afternoon survey locations were randomly selected from a total of 48 possible locations (Underwood et al., 1996a and b). The systematic sampling scheme included surveying anglers upon return from their fishing trip during shoreside interviews, primarily at National Park Service boat launch facilities. Due to length-biased sampling, anglers who frequent the lake most had the greatest likelihood of being surveyed. Fish consumption data were collected on a survey form that was separate from the creel survey. Creel data were initially collected, which included trip length information, fish species, length and weight (Underwood et al., 1996a and b). Due to logistical limitations, creel clerks were instructed to collect fish consumption data from only one member of a fishing party, unless time allowed and members could be spatially separated to minimize question response bias. The consumption survey (see Appendix) was brief so as not to overly burden anglers in light of the combined fish consumption and creel data collection efforts. Sex, age, and race information provided on the consumption survey reflected surveyor judgment and were not the result of explicit questioning.

The survey period was from August through November of 1994, and from May through September of 1995. Survey months were selected based on high angler catch and pressure data for frequently caught Lake Roosevelt fish species (Griffith and Scholz, 1991; Thatcher et al., 1993; Thatcher et al., 1994). Surveys collected in 1994 were limited to the middle and lower section of Lake Roosevelt whereas surveys collected in 1995 included all three sections of Lake Roosevelt (Figure 1). Surveys were conducted by creel clerks familiar with field survey data collection methods, but were instructed specifically on this survey prior to study initiation. A pilot survey was conducted to aid in questionnaire design.

The 1995 survey instrument was identical to the 1994 survey with slight modifications made after initial data review and after inclusion of recommendations from review staff and creel clerks (see Appendix). For example, a question regarding the number of fish fillets typically consumed per meal was changed so as to obtain amount per meal information on a per-species basis. Additional questions on angling frequency were included in the second survey, while the overall length of the survey remained constant.

A total of 448 surveys were collected (231 in 1994, 217 in 1995). Anglers who did not consume Lake Roosevelt fish (10 in 1994, 4 in 1995), along with anglers who were previously surveyed (19 in 1994, 38 in 1995), were excluded during data analysis. This resulted in 377 surveys for use in assessing fish consumption of the target population.

Results

The anglers surveyed consisted primarily of individuals who repeatedly fish from Lake Roosevelt. The majority of surveys were conducted in September and October 1994 (42%), and in May and June 1995 (30%). Anglers were surveyed at fourteen locations on Lake Roosevelt. The highest percentage of surveys were conducted at Keller Ferry Marina (24%), followed by Spring Canyon (14%), Kettle Falls Marina (12%), and Seven Bays (12%) (Figure 1).

Surveyed anglers were primarily members of two adult households (84%). Of all households, 29% had children under eighteen years of age. In 96% of two adult households, both adults consumed Lake Roosevelt caught fish. Sixty percent of anglers interviewed were considered by the interviewer to be over fifty years of age. Most anglers were male (90%) and Caucasian (97%). Only 2.4% of respondents were identified as Native American. Due to the chosen locations for surveying anglers, it is possible that Native Americans fishing the lake were not surveyed since survey locations were primarily off tribal lands. However, only a limited portion of the Spokane Tribe of Indians and the Colville Indian Nation use the lake as a fisheries resource (K. Underwood, personal communication; B. Aripa, personal communication).

Yearly meal frequencies for the four species were derived for each angler (n=348). Responses were provided on a per week or per month basis. Meals per week values were multiplied by 4.3 to produce meals per month values. To obtain yearly meal frequencies, each angler's fish consumption frequency by species (meals/month) was multiplied by the number of months each species was consumed. The number of meals consumed per year for each of the four species was then totaled for all anglers. Average yearly meal frequency rates for kokanee, rainbow trout, walleye, and bass by consumers of the specific fish type were 22 (± 18), 18 (± 19), 19 (± 16), and 20 (± 14), respectively (Table 1). Distribution data indicate that for the individual species, approximately 90% of all individuals consume 39 or less meals per year (Table 1). However, this is not to imply that fish species were consumed uniformly throughout the year (e.g., kokanee, rainbow trout, walleye and bass were consumed six to nine months per year by 43%, 25%, 32% and 52% of the respondents, respectively; and ten to twelve months per year by 13%, 21%, 24% and 12% of respondents, respectively).

Of respondents indicating type of species they catch and consume, 86% caught and consumed rainbow trout, followed by walleye (66%), kokanee (40%), and bass (28%) (Table 1). Sturgeon, sucker, and whitefish were not caught and consumed by these anglers.

The total number of fish meals consumed over the course of the year for each angler was also determined. To calculate these values, each respondent's fish consumption frequency (meals/month) by species (n=348) was multiplied by the number of months each species was consumed. The number of meals consumed per year for each species was then summed for each angler. Yearly angler meal frequencies were then summed (Table 2). Anglers consumed an average of 42 (± 48) meals per year. The data indicate that greater than 90% of respondents consume 103.2 meals (2 meals/week) or less per year, and that nearly 75% of respondents consume 48 or less meals per year.

Fillets were the primary portion consumed, as indicated by 84% of respondents (n=377). Thirty percent of respondents consumed whole-gutted fish. Few anglers consumed fish skin, eggs, or fish head, while no anglers indicated eating fish bones or guts. Respondents (n=377) also indicated that the primary cooking methods were pan-frying (77%), smoking (41%), and baking (39%). Few anglers prepared fish by broiling, roasting, barbecuing or steaming; and no anglers consumed fish in soup or raw.

The surveys conducted in 1994 queried anglers on general fish meal size by asking for the number of fillets consumed during a meal. Anglers (n=176) consumed an average of 1.7 (± 0.6) fillets per meal with greater than 95% of respondents consuming one or two fillets per meal (Table 3). In 1995, fish meal consumption was queried on a per-species basis, by asking for the number of fish (by species) typically consumed during a meal. Anglers consumed an average of 1.5 (± 0.5), 1.1 (± 0.5), 1.3 (± 0.6) and 1.5 (± 0.5) fish per meal of kokanee (n=48), rainbow trout (n=124), walleye (n=108), and bass (n=21), respectively (Table 3). These data indicate that one or less rainbow trout was eaten by approximately 80% of respondents, and one or less walleye was consumed by 70% of respondents. Approximately half the respondents who consume kokanee and bass consumed one fish during a meal while the remaining half consumed two fish.

Anglers surveyed in 1994 were asked, "How often do you eat fish from Lake Roosevelt?" This open-ended question, which preceded the specific fish consumption characterization questions (data presented in Tables 1-2), was used to acquire general consumption pattern information. Responses were provided on a per week or per month basis. Meals per week values were multiplied by 4.3 to produce meals per month values. Surveyed anglers consumed an average of 4.1 (± 4.0) meals per month (Table 4). Greater than 80% of anglers consume approximately four or less fish meals per month and greater than 90% of anglers consume nine or less meals per month.

In 1995, anglers were asked about their Lake Roosevelt fishing frequency and angling duration. The mean fishing duration of surveyed anglers (n=157) was 14.0 (± 9.3) years with greater than 60% of anglers fishing Lake Roosevelt for ten or more years. The average fishing frequency was 2.1 (± 3.1) trips per month with 40% of respondents fishing from Lake Roosevelt less than once per month, and 86% fishing three or fewer times per month.

Discussion

This study was initiated to characterize the fish consumption patterns of anglers who repeatedly catch fish from Lake Roosevelt in an effort to determine fish consumption patterns for those who consume the greatest amount of fish. These data will aid in protecting these anglers from the possible human health impacts associated with consuming chemically contaminated fish species. By protecting this angler population, all other individuals consuming these fish less frequently (or in lesser quantity) will also be protected. Results from this work provide: (1) demographic information; (2) consumption information on a per species basis (Table 1); and (3) consumption information on a yearly basis (Table 2) for the angling population that repeatedly fish Lake Roosevelt.

In 1994, surveyed anglers were asked, "How often do you eat fish from Lake Roosevelt?" (Table 4). Initially, this question was included as a method by which to gain insight into general fish consumption patterns. Time intervals were not placed on this open-ended question to allow for easy reply. The limitation of this question was that answers most likely represented consumption patterns indicative of the time period when the survey was administered. Since these data could only be used if one assumed these rates were consistent over time, the question was not asked in 1995.

If the assumption was made that fish meal frequencies expressed in this general open-ended question (Table 4) prevailed throughout the year, then several comparisons could be made between the results of this question and the results from the detailed per-species questions, which yielded total number of fish meals consumed by respondents over the course of the year (Table 2). Results from the open-ended general question would suggest that: (1) anglers consume an average of 49 fish meals per year; (2) approximately 90% of surveyed anglers consume 108 or less fish meals per year; and (3) 80% of anglers consume 60 meals or less per year. Similarly, results from the detailed per-species questions indicate that: (1) anglers consume an average of 42 meals per year; (2) approximately 90% of anglers consume 103.2 meals per year or less; and (3) nearly three of four anglers consume 48 or less meals per year. Although a more accurate depiction of fish consumption patterns was obtained from the detailed per-species questions (Tables 1 and 2), the general open-ended question provided comparable data and could be used independently if resources were unavailable to acquire species specific data.

In an effort to gain insight into amount consumed per meal, the 1994 surveys contained a general query about the number fillets consumed per meal. A similar question was asked in the 1995 surveys, although the query asked about consumption on a per species basis and on the number of fish, not fillets, consumed per meal. Data (Table 3) indicate that angler responses were similar regardless of how the question was posed. That is, greater than 95% of the individuals in 1994, and 80% to 100% of the individuals in 1995, depending on fish species, responded to the questions with the value of one or two.

This indicates that the questions were not adequate for determining fish meal size, and that accuracy in response will only be enhanced through the use of standardized fish/fillet models. Models have been used successfully in fish consumption studies (C.R.I.T.F.C., 1994; Toy et

al., 1996). The results of this work indicate that models are requisite for properly determining fish meal size.

Conducting surveys of this type in the future should, if possible, be independent of other data collection efforts. By combining this consumption survey with the creel data collection effort, immediate access to anglers was obtained. However, in so doing, the survey instrument may have become too lengthy. Surveyors noted that some anglers were anxious to depart the public boat launch facilities at the completion of their fishing trip, and thus may have provided responses in haste so as to expedite the interview process.

The data presented here allow for the determination of specific exposure patterns for this population and can, along with fish contaminant levels and toxicity data on the chemical contaminants, aid in safeguarding this angler population from the possible human health impacts associated with consuming contaminated fish. By protecting individuals who repeatedly catch and consume fish from Lake Roosevelt, all other individuals consuming fish less frequently (or in lesser quantity) from this area are also protected.

Table 1. Fish meals consumed per year on a per-species basis for individuals consuming that particular fish type.

Meals/Year	Kokanee (n=140)	Rainbow Trout (n=299)	Walleye (n=231)	Bass (n=99)
>0 – 6	27 (19%)	109 (36%)	57 (25%)	18 (18%)
8 – 14	31 (22 %)	63 (21 %)	52 (23%)	22 (22%)
15 - 20	23 (16%)	28 (9%)	33 (14%)	22 (22%)
22 - 28	22 (16%)	46 (15%)	44 (19%)	16 (16%)
30 - 39	20 (14%)	28 (9%)	26 (11 %)	13 (13%)
42 - 52	14 (10%)	19 (6%)	15 (6%)	7 (7%)
>52	3 (2%)	6 (2%)	4 (2%)	1 (1%)
mean ±s.d.	22± 18	18± 19	19± 16	20± 14

Table 2. The total number of fish meals consumed by anglers over the course of the year.

Consumption Frequency (meals/year)	≤12	>12-24	>24-48	>48-103.2*	>103.2	mean ± s.d.
Respondents (n=348)	121 (35%)	65 (19%)	67 (19%)	68 (20%)	27 (8%)	42.2± 47.7

*Reflects two fish meals per week based on 4.3 weeks per month.

Table 3. Fillets consumed per meal (1994 data) and fish consumed per meal on a per-species basis (1995 data).

Fillet or Fish Meal
≤0.5
1
2
>2
mean ± s.d.

1994 Data
General
n=176
0
59
110
7
1.7± 0.6

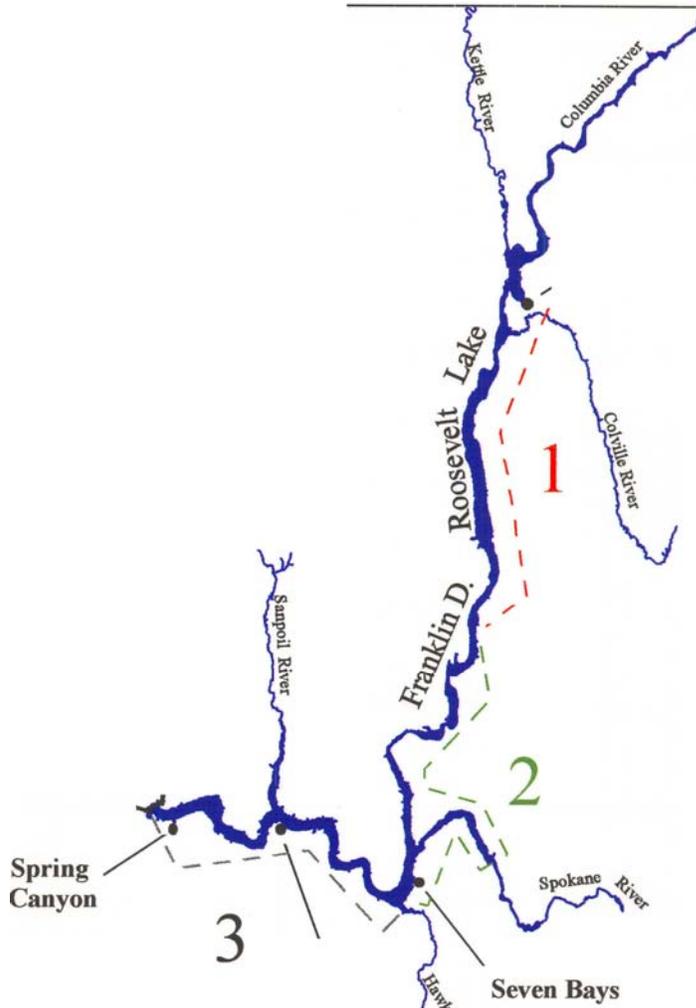
1995		Data	
Kokanee n=48	Rainbow Trout n=124	Walleye n= 108	Bass n=21
1	26	2	0
21	72	74	10
26	26	28	11
0	0	4	0
1.5± 0.5	1.1±0.5	1.3±0.6	1.5± 0.5

Table 4. Consumption frequencies as provided by respondents surveyed in 1994 on a per month basis in response to the question "How often do you eat fish from Lake Roosevelt?"

Consumption Frequency (meals/month)	0.08	1	2	3	4 or 4.3*	5	8.6*	>8.6	mean ± s.d.
Respondents (n=193)	1 (0.5%)	25 (13%)	60 (31 %)	26 (14%)	48 (25%)	2 (1%)	21 (11%)	10 (5%)	4.1 ± 4.0

*Reflects one or two fish meals per week based on 4.3 weeks per month.

Figure 1.
 Canada
 United States



Fish Consumption Survey Locations

\ /
 / Kettle Falls

1 - Upper lake 2 - Mid lake 3 - Lower lake

Grand Coulee Dam

**Keller
 Ferry**

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Appendix

1994 and 1995 Fish Consumption Survey Forms.

FISH CONSUMPTION SURVEY
1995 Survey Form

Surveyor: _____	Party #: _____	Location: _____	Survey Date: ____/____/____
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The following questions concern your consumption of fish caught in Lake Roosevelt. Information given in this survey will be used to assess fish consumption rates of Lake Roosevelt recreational fishermen.

1. Have you or a member of your family taken this fish consumption survey this year? YES NO

(If YES, go to Question #11)

2. How many people are in your household? (____) Adults (____) Children (*less than 18 years of age*)

3. How many people in your household eat fish? (____) Adults (____) Children (*less than 18 years of age*)

4. Is this the first time you've ever gone fishing on Lake Roosevelt? YES NO *(If YES, go to Question #11)*

5. How often do you fish on Lake Roosevelt? (Enter number of fishing TRIPS and \surd appropriate box)

_____ Trips	<input type="checkbox"/> week,	<input type="checkbox"/> month,	<input type="checkbox"/> year
-------------	--------------------------------	---------------------------------	-------------------------------

6. How many years have you fished on Lake Roosevelt? (____) Years (0, 1, 2, 3, etc.)

7. Do you eat fish from Lake Roosevelt? YES NO *(If NO, go to Question #11)*

8. The following questions concern your catch and consumption of fish specifically from **Lake Roosevelt** over the past year.

WHAT TYPE OF LAKE ROOSEVELT FISH DO YOU CATCH TO CONSUME? (Circle all that apply)	HOW OFTEN DO YOU EAT THESE LAKE ROOSEVELT CAUGHT FISH? (# of fish meals per week <u>OR</u> month)	# MONTHS PER YEAR FISH ARE EATEN? (1/4, 1/2, 3/4, 1, 2, 3)	HOW MANY FISH DO YOU TYPICALLY CONSUME PER MEAL? (1/4, 1/2, 3/4, 1, 2, 3)
a. Kokanee (silvers)	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		
b. Rainbow T.	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		
c. Walleye	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		
d. Bass	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		
e. Whitefish	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		
f. Other _____	_____ Meals per <input type="checkbox"/> week OR <input type="checkbox"/> month		

9. What parts of these fish do you eat? (Circle all that apply)

Whole Fillets Only Skin Head Eggs Bones
(Gutted) Internal Organs
(Skin removed)

10. How do you usually prepare fish from Lake Roosevelt? (Circle all that apply)

Smoked Pan Fried Broiled Baked Roasted (open fire)
In soup or stew Raw Barbecue Other _____
(specify)

11. Interviewee Information-
65+

Sex: M F

Age: <18

18-34

35-49

50-64

Race:

Native American

African-American

Hispanic

Caucasian

Asia

Zip Code: _____

Filename: Anglers_Who_Frequently_Fish_Lake_Roosevelt-09-
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