

97-e04

DEPARTMENT OF ECOLOGY

July 8, 1997

TO: Carl Nuechterlein and David T Knight, ERO

FROM: Art Johnson, EILS

SUBJECT: 1996 RESULTS ON PCBs IN UPPER SPOKANE RIVER FISH
(Waterbody Numbers WA-54-1010, WA-54-1020, WA-57-1010)

Summary

Rainbow trout, mountain whitefish, and largescale suckers from the upper Spokane River were collected for PCB analysis in August 1996 to determine if concentrations had decreased from the levels seen in 1993-94. Samples were collected above Upriver Dam, above Monroe Street Dam, above Nine-Mile Dam, and in the Little Spokane River. In eight of the ten sample sets evaluated, mean PCB concentrations showed a consistent decrease from when first analyzed in 1993 or 1994. The decline in PCB concentrations was statistically significant in the four instances where there were sufficient data for testing.

Mean PCB concentrations in rainbow trout above Upriver Dam and in whitefish above Nine-Mile Dam were higher in 1996 than in 1994. The 1996 results for Upriver trout were strongly influenced by one outlier sample very high in PCBs. The increased concentrations found in Nine-Mile whitefish may be related to much larger individuals being analyzed than in past years. Both species from these two sites had lower mean concentrations compared to initial results from 1993.

Factors that may have broadly influenced the findings for 1996 include the unusually high river flows that preceded sample collection and the existence of continuing sources of PCBs. Source sampling conducted by EILS in November-December 1995 detected PCBs in effluents from the Kaiser Trentwood aluminum mill and wastewater from the Spokane Industrial Park, which goes to the City of Spokane treatment plant above Nine-Mile Dam. The final phases of cleanup at these facilities are to occur during the next permit cycle.

Although the 1996 results suggest PCB levels have decreased in both the upper Spokane and Little Spokane River, more than two to three years of data are needed before strong conclusions can be made. Fish from these areas continue to have elevated concentrations compared to other parts of the state. PCB concentrations still exceed levels considered

protective of wildlife and human health, the existence of significant human health concerns depending on the amount of fish in the diet

Recommendation

- Re-sample Spokane River fish for PCBs after cleanups are completed.

Background

The Department of Ecology collected data on PCBs in Spokane River fish during 1993 and 1994 (Toxic Investigations Section, 1995). Based on these results, it was recommended that fish in the upper Spokane River be re-sampled in 1996 to determine if the level of contamination had decreased. This recommendation stemmed from an expectation that the apparent decline in PCB levels from 1993 to 1994 would continue due to corrective actions taken or planned by several industries. It also recognized that the concentrations found in 1994 remained sufficiently high to be a concern for wildlife and, potentially, human health. Additional sampling was also recommended for the Little Spokane River where PCB-1260 was the predominant mixture identified, compared to PCB-1254 in the main stem.

Results from the 1996 fish collection are reported here and compared to data from 1993-94. To the extent possible, sampling methods, sample size, and analytical methods for 1996 were identical to those of 1994. The sample size for 1994, and thus 1996, was selected to meet requirements of the Washington State Department of Health for purposes of assessing implications to human health. The 1993 survey was a screening study, where fewer numbers of samples were analyzed; methods were otherwise equivalent to 1994. All samples were collected by electroshocking during the first two weeks of August.

Figure 1 shows the locations that were sampled in 1993-94. In 1996, fish were collected from three sites on the main stem, above Upriver Dam, above the Monroe Street Dam, and above Nine-Mile Dam. Fish were also collected in the Little Spokane River, which was previously sampled in 1994 only. The species analyzed each year were rainbow trout, mountain whitefish, and largescale suckers. Each sample was a composite of five or more individuals. Skin-on filets were analyzed for trout and whitefish; suckers were analyzed whole.

The reach from Monroe Dam to Upriver Dam is stocked yearly with rainbow trout. Fifty percent of the trout analyzed in the 1996 composite samples were marked fish. In 1994, the first time PCBs were analyzed in this reach, no marked fish were observed among the individuals analyzed (Dale Davis, personal communication).

The samples were analyzed by Bob Rieck of the EPA Manchester Laboratory using EPA Method 8080. Bob also analyzed the 1993-94 samples using the same method. Details of sample preparation and analytical methods can be found in the above cited report. Appendix A contains a case narrative on the 1996 data, evaluating adherence to sample holding times and results on procedural blanks, surrogate spikes, and matrix spikes. No significant problems were encountered with the analysis.

The data contained in this report have been given to Glen Patrick of the Washington State Department of Health (Johnson, 1997)

Results

Trends in the Data

The 1996 results for total PCBs in upper Spokane River fish are summarized as mean values in Table 1, along with comparable data from 1993-94. The distribution of the individual data points is plotted in Figure 2. Overall, 51 composite fish tissue samples have now been analyzed from this area: 21 rainbow trout, 18 mountain whitefish, and 12 largescale suckers. The complete Spokane River fish tissue data for 1993-96 are in Appendix B and C.

The evidence for a downward trend in PCB concentrations was evaluated by: 1) looking for a consistent decrease from year to year; and 2) testing for a statistically significant difference among or between years.

As shown in Table 1, the mean PCB concentrations in eight of the ten sample sets analyzed showed a consistent decline from when first analyzed in 1993 or 1994. The decreases observed were generally substantial, by a factor of two or more.

The two instances where mean PCB concentration did not decline were for rainbow trout above Upriver Dam and mountain whitefish above Nine-Mile Dam. As can be seen in Figure 2, the Upriver trout results for 1996 were strongly affected by a single outlier. This sample had 1,840 ug/Kg total PCBs vs. 215 and 313 ug/Kg in the other composites. A duplicate analysis of the high sample gave essentially the same results (Table 2, sample number 428096). The concentrations measured in Nine-Mile whitefish collected in 1996 were all consistently higher than in 1994. However, both species from these two sites had lower mean concentrations than when first analyzed in 1993.

Because multiple composites have been analyzed for trout and whitefish, the differences between years can be tested statistically. Two nonparametric tests were used; Mann-Whitney for two samples (years) and its extension for multiple samples, Kruskal-Wallis. Both tests are based on the rankings of total PCB concentrations in individual composite samples. These tests are more conservative (i.e., less likely to show a significant difference) than the parametric alternative, analysis of variance.

Results confirm that each of the downward trends that could be tested was statistically significant (Table 1). Because PCBs are lipid soluble, concentration differences between samples could be due to simple differences in lipid content. However, normalizing the PCB concentrations to the amount of lipid in these samples (Appendix B) did not alter the outcome.

Concentrations could also vary from year to year due to differences in the size classes (age) analyzed. Significant differences ($\geq 90\%$ probability, tested as above) in the size of fish used in the composite samples were limited to rainbow trout and whitefish from above Nine-Mile Dam. On average, larger rainbow trout were analyzed in 1994 and larger whitefish were analyzed in 1996 than in other years (Appendix B). The substantial changes observed for these species at this site between 1994 and 1996 (PCBs decreased in trout but increased in whitefish) may bear some relation to the size of the fish analyzed.

With limited numbers of samples being analyzed from each site, and only two or three years of data, it is not possible to make strong conclusions about trends. Two additional factors that are likely to have broadly influenced the 1996 results are: 1) the unusually high river flow during February (to 35,500 cfs) and April-May (to 26,200 cfs); and 2) the existence of continuing sources of PCBs to the river.

Monitoring data collected by EILS during November-December 1995 suggest PCBs are still being released to the Spokane River (Golding, 1996). PCB-1248 was detected in the 001 discharge from Kaiser Trentwood aluminum mill above Upriver Dam and in wastewater from the Spokane Industrial Park, which goes to the City of Spokane treatment plant above Nine-Mile Dam. PCB-1248 was also detected in sludge from the Liberty Lake WWTP upstream of Kaiser, but concentrations were much lower than in 1994 (220-300 ug/Kg vs 4,400 ug/Kg).

With each year of data collected the effects of random events such as extreme flows are diminished. However, additional fish sampling for purposes of determining trends in PCB contamination may be of limited value until the cleanups scheduled for the next permit cycle are completed.

Little Spokane River

When fish were first sampled from the Little Spokane River in 1994 it was noted that PCB-1260 accounted for 59-74% of the total PCB concentrations. This finding, coupled with the elevated levels of 145-440 ug/Kg total PCBs, suggested the presence of a source of -1260 in the watershed. The re-sampling done in 1996 shows approximately the same relative percentage of PCB-1260 in Little Spokane fish (Figure 3). Although concentrations are somewhat lower, 135-366 ug/Kg, they indicate a source may still exist.

Implications for Wildlife and Human Health

Table 3 summarizes environmental criteria and guidelines pertinent to the issue of PCB contamination in fish. The Great Lakes criteria of 50 and 220 ug/Kg, shown near the bottom of the table, were used by the Washington State Department of Health to assess human health implications of PCBs in lower Columbia River fish (Laflamme, 1996).

When the values in Table 3 are compared to the results obtained for the Spokane River in 1996, the following can be concluded:

- Upper Spokane River and Little Spokane River fish continue to have higher concentrations of total PCBs than typically encountered in other parts of the state, and in most cases exceed the state 85th percentile. Concentrations are also elevated on a nation-wide perspective.
- PCB concentrations still exceed levels considered protective of fish-eating wildlife.
- The EPA human health criterion under which the Spokane and Little Spokane are listed as water quality limited (303(d)) for PCBs, continues to be exceeded by two orders of magnitude.
- If individuals regularly consume fish from the Spokane River, the PCB concentrations could be a human health concern, depending on the amount eaten.

Acknowledgments

Fish samples for this study were collected with the assistance of Dave Serdar and John Summers. The work of Bob Rieck and other Manchester Laboratory staff in analyzing the Spokane River fish tissue samples is very much appreciated.

References

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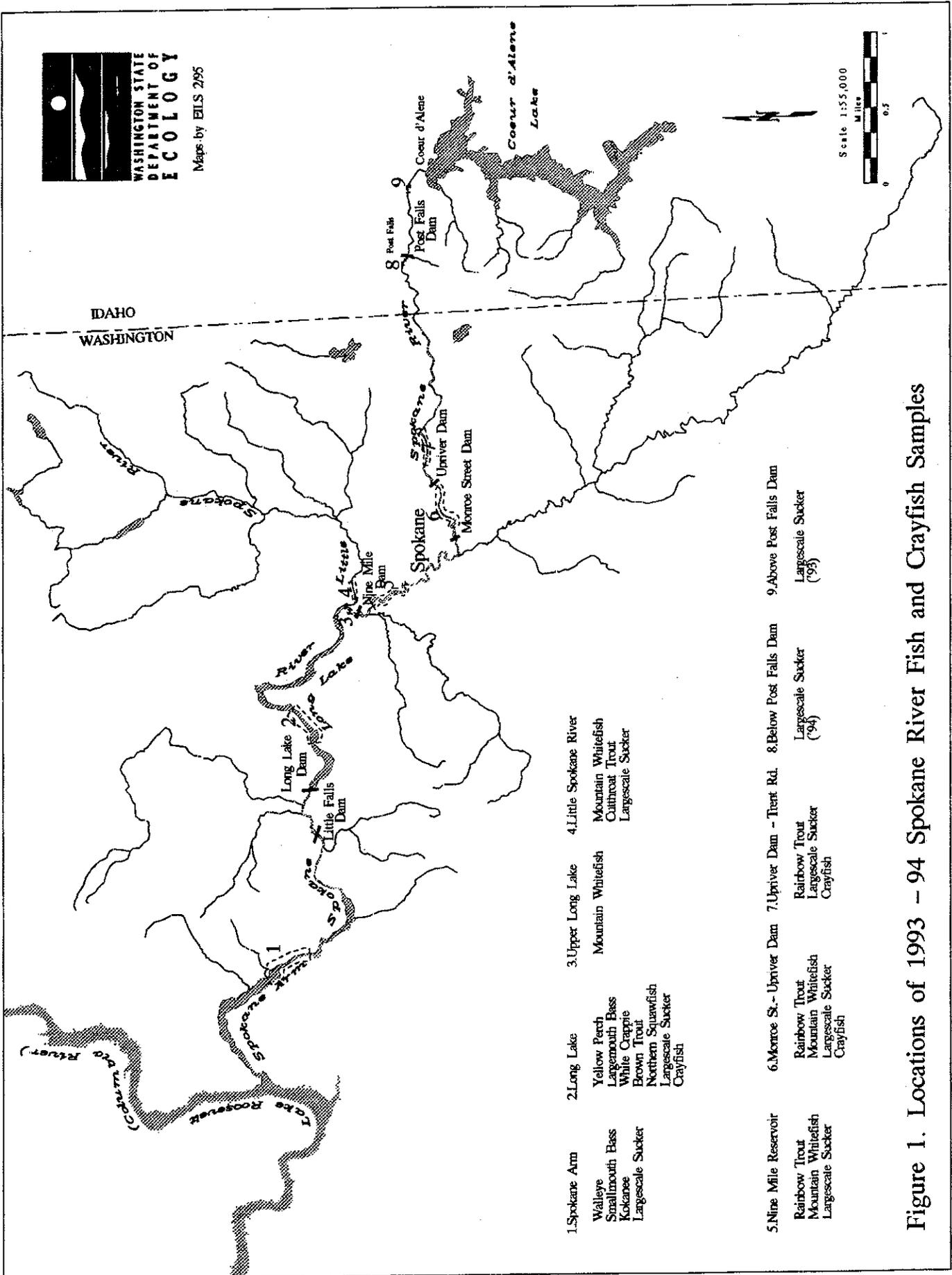
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Toxics Investigations Section 1995 Department of Ecology 1993-94 Investigation of PCBs in the Spokane River Pub No. 95-310. Washington State Dept of Ecology, Olympia, WA



- | | | | | | | | | |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| <p>1. Spokane Arm
Walleye
Smallmouth Bass
Kokanee
Largescale Sucker</p> | <p>2. Long Lake
Yellow Perch
Largemouth Bass
White Crappie
Brown Trout
Northern Squawfish
Largescale Sucker
Crayfish</p> | <p>3. Upper Long Lake
Mountain Whitefish</p> | <p>4. Little Spokane River
Mountain Whitefish
Cutthroat Trout
Largescale Sucker</p> | <p>5. Nine Mile Reservoir
Rainbow Trout
Mountain Whitefish
Largescale Sucker</p> | <p>6. Monroe St. - Upriver Dam
Rainbow Trout
Mountain Whitefish
Largescale Sucker
Crayfish</p> | <p>7. Upriver Dam - Trent Rd.
Rainbow Trout
Largescale Sucker
Crayfish</p> | <p>8. Below Post Falls Dam
Largescale Sucker
(1994)</p> | <p>9. Above Post Falls Dam
Largescale Sucker
(1995)</p> |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|

Figure 1. Locations of 1993 - 94 Spokane River Fish and Crayfish Samples

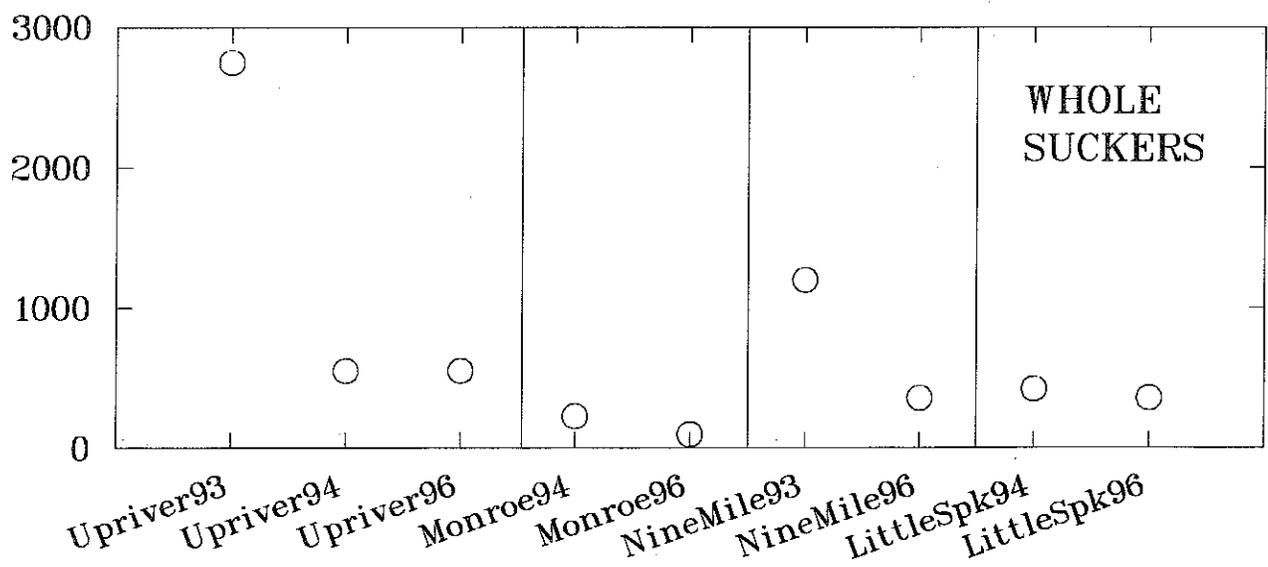
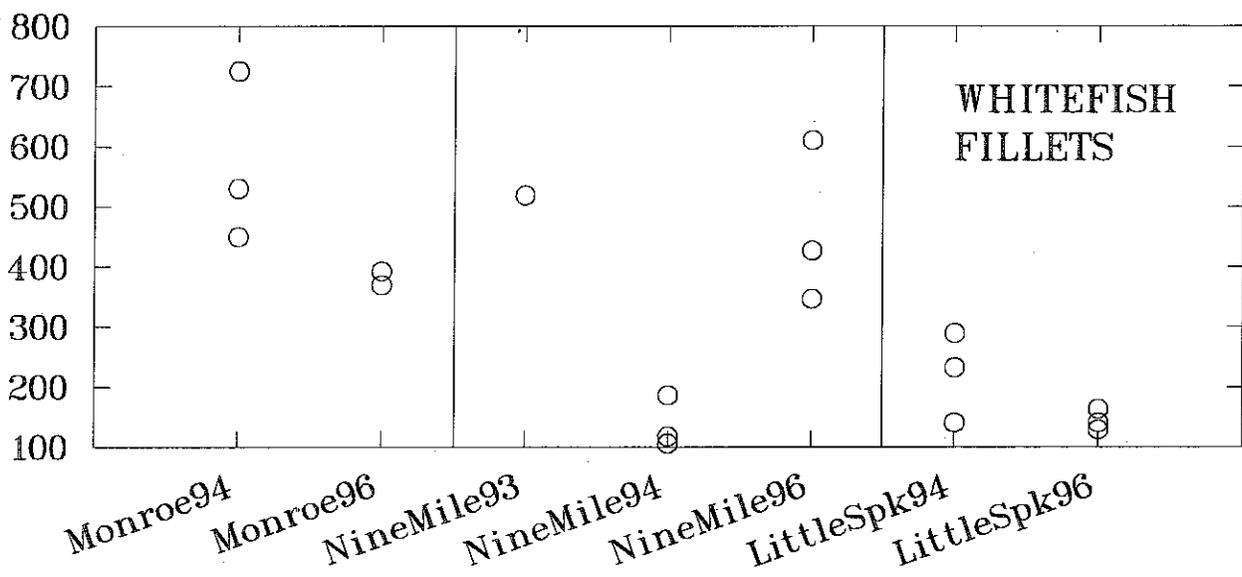
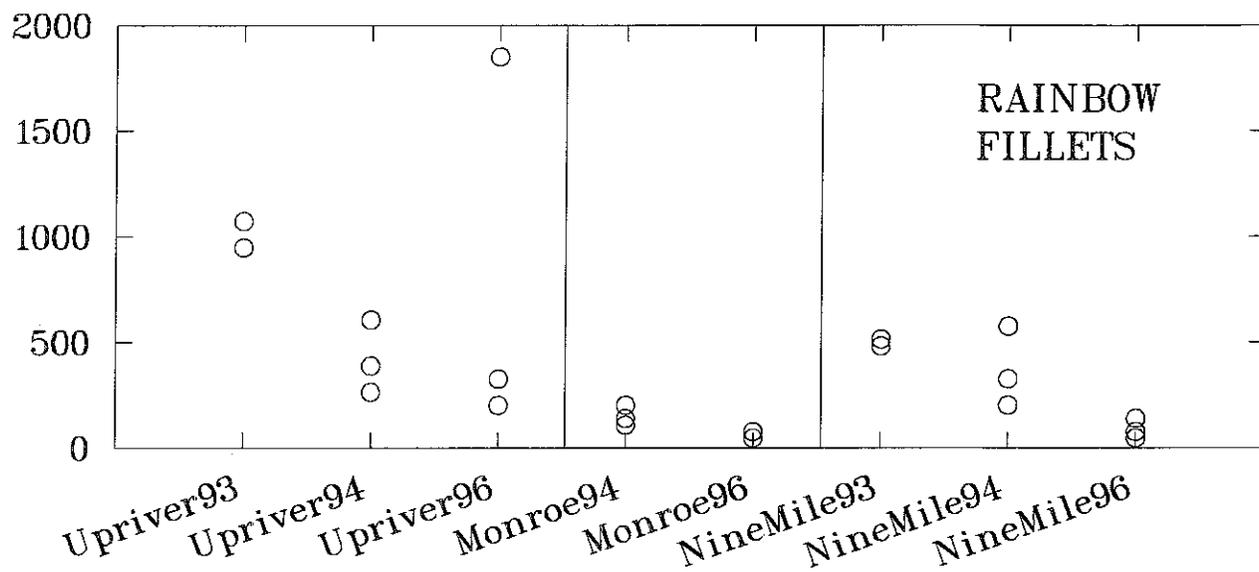


Figure 2. Total PCBs in Upper Spokane Fish, 1993–96 (ug/Kg)

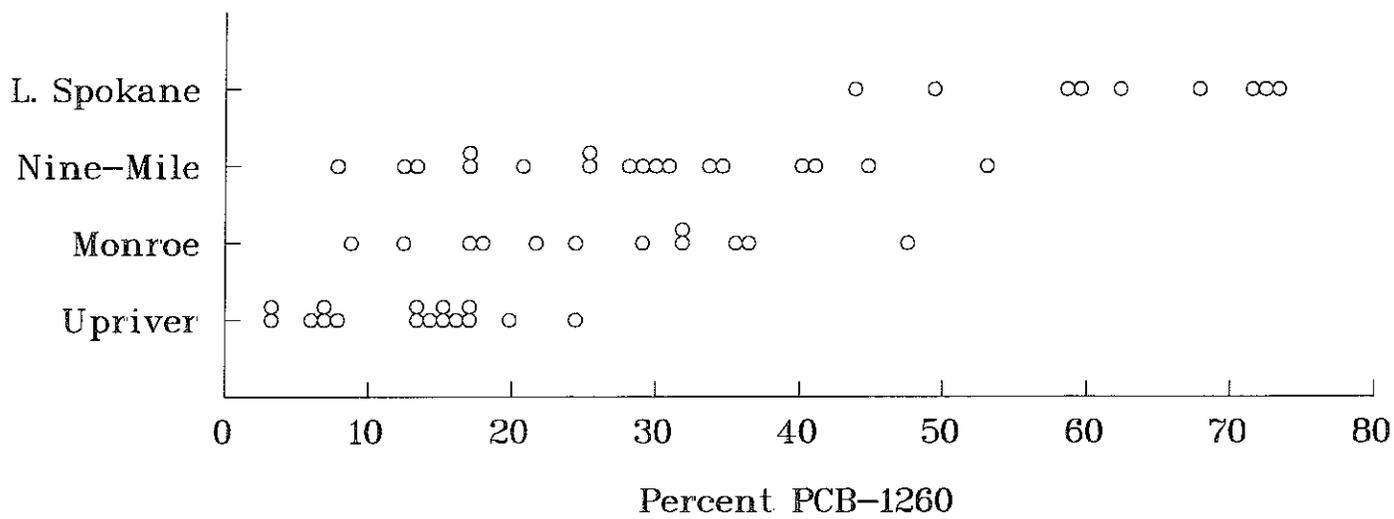


Figure 3. Relative Amount of PCB-1260 in 1993-96 Fish Samples

Table 1. Trend Indications for Total PCBs in Upper Spokane River Fish (ug/Kg, wet weight)

Location	Species	1993 mean	1994 mean	1996 mean	N =	Apparent Downward Trend?	Statistically Significant?*
Ab Upriver Dam	Largescale Sucker	2780	531	520	3	yes	insuff data
	Rainbow Trout	1020	424	790	8	no	--
Ab Monroe Dam	Largescale Sucker	201	ns	116	3	yes	insuff data
	Rainbow Trout	ns	152	76	5	yes	yes
	Mountain Whitefish	ns	568	381	5	yes	yes
Ab Nine-Mile Dam	Largescale Sucker	1210	ns	345	3	yes	insuff data
	Rainbow Trout	490	371	76	8	yes	yes
	Mountain Whitefish	522	139	463	7	no	--
Little Spokane River	Largescale Sucker	ns	440	366	3	yes	insuff data
	Mountain Whitefish	ns	222	145	6	yes	yes

* $\geq 90\%$ probability, Mann-Whitney/Kruskal-Wallis test
 ns = no samples

Table 2. Precision of PCB Data on Spokane River Fish

Species	Year	Sample Number	Total PCBs (ug/Kg)		Relative Percent Difference*
			Analysis #1	Analysis #2	
Rainbow Trout	1994	318260	393	377	4.1%
" "	1994	318261/328437	740	471	44%
" "	1996	428096	1870	1812	3.2%
Mountain Whitefish	1996	428087	673	560	18%
Largescale Sucker	1993	318243	2780	2770	0.4%
" "	1994	428099	530	510	3.8%
Yellow Perch	1993	318251	9.6	9.2	4.3%

*range of duplicates as percent of mean

Table 3. Environmental Criteria and Guidelines for PCBs in Fish (ug/Kg)

Total PCBs	Criteria/Guideline	Source	Reference
<u>STATE AND NATIONAL DATA</u>			
67	Wash. state mean - fillets	Dept. of Ecology,	Davis & Serdar (1996)
103	Wash. state mean - whole fish	Washington State	
120	Wash. state 85 th percentile - fillets	Pesticide Monitoring	
225	Wash. state 85 th percentile - whole fish	Program	
47	U.S. background, fillets & whole fish	EPA National Study	EPA (1992)
209	U.S. median, fillets & whole fish		
<u>WILDLIFE</u>			
100	Protect fish-eating birds & mammals	IJC Great Lakes Goal	IJC (1975)
110	Protect fish-eating wildlife	Niagara River Fish Flesh Criteria	Newell et al (1987)
500	Protect aquatic life	Nation Acad. Sciences Recommendation	NAS (1973)
<u>HUMAN HEALTH</u>			
1.4*	To determine need for more intensive monitoring	EPA Screening Level	EPA (1995)
1.4*	Criterion for listing as water-quality limited (303(d))	EPA National Toxics Rule	40 CFR Part 131
50	Health protective value (@140g/day)	Great Lakes Sport Fish Advisory Task Force	GLSFATF (1993)
220	Health protective value (@ 32g/day)		
2,000	Legal limit for removing fish from market place	FDA Tolerance Level	FDA (1984)

*for a 10⁻⁶ increased life-time cancer risk

Appendix A

MANCHESTER ENVIRONMENTAL LABORATORY

7411 Beach Drive E , Port Orchard Washington 98366

CASE NARRATIVE

February 7, 1997

Subject: Spokane PCBs
Samples: 96 -428080 to -428099
Case No. 1697-96
Officer: Art Johnson
By: Dickey D. Huntamer *DDH*
Organics Analysis Unit

POLYCHLORINATED BIPHENYLS

ANALYTICAL METHODS:

The tissue samples were extracted using acetone as the solvent followed by Florisil column cleanup. Analysis was done by EPA Method 8080 using dual column capillary GC analysis with Electron Capture Detectors (ECD).

HOLDING TIMES:

The samples were stored frozen until extracted. After extraction analysis was completed within forty days. All extraction and analysis holding times were met.

BLANKS:

No target compounds were detected in the laboratory blanks.

SURROGATES:

All surrogates recoveries were within the acceptable limits of 50 to 150%.

MATRIX SPIKE AND MATRIX SPIKE :

Matrix spike recoveries ranged from 79% to 91% and were within acceptable limits. The Relative Percent Differences (RPD) ranged from 2.5% to 5.6%.

ANALYTICAL COMMENTS:

The samples were initially extracted and analyzed in November 1996 however a problem was discovered with the Florisil cleanup. This resulted in incorrect partitioning of the Florisil fractions and low recoveries for the surrogate compounds. Since frozen sample was still available for reanalysis the samples were re-extracted and analyzed in January.

There were no significant problems with the second PCB analysis and the data is acceptable as qualified.

DATA QUALIFIER CODES:

- U - The analyte was not detected at or above the reported value.
- J - The analyte was positively identified. The associated numerical value is an estimate.
- UJ - The analyte was not detected at or above the reported estimated result.
- REJ - The data are unusable for all purposes.
- EXP - The result is equal to the number before EXP times 10 to the power of the number after EXP. As an example 3EXP6 equals 3×10^6 .
- NAF - Not analyzed for.
- N - For organic analytes there is evidence the analyte is present in this sample.
- NJ - There is evidence that the analyte is present. The associated numerical result is an estimate.
- E - This qualifier is used when the concentration of the associated value exceeds the known calibration range.
- bold** - The analyte was present in the sample. (Visual Aid to locate detected compound on report sheet.)

Appendix B. Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

Location	Date	Species	Sample Type	Sample Number	PCB Concentrations			Percent Lipid	Number of Fish in Composite	Mean	
					-1248	-1254	-1260			Total Length (mm)	Weight (grams)
Above Idaho Border	8/9/93	LSS	WF	318244	<28	55	41	7.2	1	411	802
"	8/10/94	LSS	WF	328435	<39	81	71	5.5	5	495	1343
Above Upriver Dam	7/27/93	LSS	WF	318243	800	1800	180	4.3	5	434	837
"	7/27/93	LSS	WF	318243D	800	1800	170	na	(duplicate analysis of 318243)		
"	8/6/94	LSS	WF	318263	230	230	71	3.6	5	417	745
"	8/14/96	LSS	WF	428099	140	260	130	3.7	5	430	764
"	8/14/96	LSS	WF	428099D	150	260	100	3.5	(duplicate analysis of 428099)		
"	7/27/93	RBT	F	318255	400	610	74	1.9	5	363	481
"	7/27/93	RBT	F	318256	400	550	<78	1.7	5	288	267
"	8/6/94	RBT	F	318260	133	197	63	2.9	8	354	444
"	8/6/94	RBT	F	318260D	127	193	57	na	(duplicate analysis of 318260)		
"	8/6/94	RBT	F	318261	240	390	110	2.5	8	319	358
"	8/6/94	RBT	F	328437	172	218	81	2.8	(duplicate analysis of 318261)		
"	8/6/94	RBT	F	318262	130	110	40	3.7	8	305	320
"	8/14/96	RBT	F	428096	1020	790	60	2.2	8	303	354
"	8/14/96	RBT	F	428096D	980	770	62	2.1	(duplicate analysis of 428096)		
"	8/14/96	RBT	F	428097	130	140	43	2.4	8	290	319
"	8/14/96	RBT	F	428098	94	85	36	2.2	8	317	359
"	8/6/94	CRF	M	318264	<8	<8	<8	0.1	8	--	67
"	8/6/94	CRF	M	318265	<7	<7	<7	0.2	8	--	65
"	8/6/94	CRF	M	318266	<6	<6	7	0.1	8	--	55
Above Monore St. Dam	8/8/94	LSS	WF	328431	34	96	71	1.2	5	416	667
"	8/14/96	LSS	WF	428095	34	45	37	0.8	5	395	607
"	8/8/94	RBT	F	328425	29	67	88	1.2	8	293	270
"	8/8/94	RBT	F	328426	27	44	40	1.1	7	263	196
"	8/8/94	RBT	F	328427	39	71	51	1.2	7	242	153
"	8/14/96	RBT	F	428093	26	26	21	1.5	7	262	185
"	8/14/96	RBT	F	428094	28	33	17	1.1	7	251	163

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

Location	Date	Species	Sample Type	Sample Number	PCB Concentrations			Percent Lipid	Number of Fish in Composite	Mean Total Length (mm)	Mean Weight (grams)
					-1248	-1254	-1260				
Above Monore St. Dam	8/8/94	MWF	F	328428	139	261	130	5.6	7	287	237
"	8/8/94	MWF	F	328429	99	311	39	5.5	8	300	257
"	8/8/94	MWF	F	328430	174	462	89	4.6	8	288	232
"	8/14/96	MWF	F	428091	110	220	68	4.2	5	289	210
"	8/14/96	MWF	F	428092	77	220	67	3.9	5	299	216
"	8/8/94	CRF	M	328432	<7	<7	<7	0.2	8	--	60
"	8/8/94	CRF	M	328433	<7	<7	<7	0.3	8	--	56
"	8/8/94	CRF	M	328434	<7	<7	<7	0.2	8	--	60
Above Nine-Mile Dam	8/10/93	LSS	WF	318242	400	600	210	5.6	5	517	1460
"	8/13/96	LSS	WF	428090	75	170	100	2.1	5	449	1029
"	8/10/93	RBT	F	318252	200	210	64	2.7	4	342	410
"	8/10/93	RBT	F	318253	200	240	65	2.9	4	262	164
"	8/5/94	RBT	F	318254	52	98	170	5.4	6	407	788
"	8/5/94	RBT	F	318255	44	76	85	3.0	6	396	709
"	8/5/94	RBT	F	318256	59	410	120	5.2	6	421	881
"	8/13/96	RBT	F	428084	19	28	16	1.5	5	272	252
"	8/13/96	RBT	F	428085	28	60	40	1.7	6	289	302
"	8/13/96	RBT	F	428086	15	17	6.4	1.5	5	267	231
"	8/10/93	MWF	F	318254	200	280	42	2.7	5	242	122
"	8/5/94	MWF	F	318257	56	30	34	6.9	8	234	117
"	8/5/94	MWF	F	318258	43	35	33	8.4	8	243	142
"	8/5/94	MFW	F	318259	91	20	74	6.6	8	259	182
"	8/13/96	MWF	F	428087	100	270	190	4.5	8	327	317
"	8/13/96	MWF	F	428087D	93	280	300	4.4	(duplicate analysis of 428087)		
"	8/13/96	MWF	F	428088	110	210	110	5.5	8	307	277
"	8/13/96	MWF	F	428089	83	140	120	5.1	8	305	270
Little Spokane River	8/3/94	LSS	WF	318236	40	140	260	4.3	5	453	935
"	8/13/96	LSS	WF	428083	46	160	160	1.3	5	453	968
"	8/3/94	MWF	F	318237	20	35	90	2.5	8	318	289

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

Location	Date	Species	Sample Type	Sample Number	PCB Concentrations			Percent Lipid	Number of Fish in Composite	Mean	
					-1248	-1254	-1260			Total Length (mm)	Weight (grams)
Little Spokane River	8/3/94	MWF	F	318238	20	45	170	2.2	8	271	183
"	8/3/94	MWF	F	318239	25	50	210	3.2	8	279	207
"	8/13/96	MWF	F	428080	23	60	81	4.2	8	290	239
"	8/13/96	MWF	F	428081	9.1	30	97	3.0	8	263	173
"	8/13/96	MWF	F	428082	15	29	91	2.0	8	269	173
"	8/3/94	CTT	F	318242	23	55	110	3.5	1	345	420
Long Lake	7/27/93	LSS	WF	318241	100	180	130	2.3	5	469	967
"	8/2/94	LSS	WF	318248	140	410	270	3.4	8	468	1005
"	7/27/93	MWF	F	318250	200	410	170	3.5	5	309	242
"	8/2/94	MWF	F	318249	38	62	60	3.6	8	252	152
"	8/2/94	MWF	F	318250	23	38	57	3.4	7	247	138
"	8/2/94	MWF	F	318251	18	19	34	1.9	7	231	101
"	7/27/93	LMB	F	318249	<45	74	23	0.6	5	394	1093
"	8/2/94	LMB	F	318240	20	38	36	1	5	361	841
"	8/2/94	LMB	F	318247	27	53	24	1.1	5	372	906
"	7/7/93	YLP	F	318251	<10	9.2	<7	0.2	5	181	162
"	7/7/93	YLP	F	318251D	<10	9.6	<7	na	(duplicate analysis of 318251)		
"	8/2/94	YLP	F	318244	<6	9	<6	0.2	8	237	190
"	8/2/94	YLP	F	318245	<6	10	6	0.2	8	245	218
"	8/2/94	YLP	F	318246	<6	6	<6	0.2	8	223	167
"	8/2/94	BRT	F	318241	40	90	63	4	3	309	327
"	8/2/94	WCP	F	318243	22	46	29	2.5	7	237	282
"	8/2/94	WCP	F	328436	24	42	32	2.5	(duplicate analysis of 318243)		
"	8/2/94	NSQ	F	318233	40	150	110	1.5	8	382	505
"	8/2/94	NSQ	F	318234	30	100	76	1.6	8	384	475
"	8/2/94	NSQ	F	318235	30	100	70	1.2	8	388	484
"	8/2/94	CRF	M	318253	<9	<9	<9	na	3	--	63
"	7/7/93	CRF	M	318248	<17	<17	<17	0.4	5	--	56

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

Location	Date	Species	Sample Type	Sample Number	PCB Concentrations			Percent Lipid	Number of Fish in Composite	Mean	
					-1248	-1254	-1260			Total Length (mm)	Weight (grams)
Spokane Arm.	7/26/93	LSS	WF	318240	200	250	190	5.1	5	434	1272
"	7/26/93	WAL	F	318245	<9	15	<9	0.4	5	318	255
"	7/26/93	SMB	F	318247	<20	28	<7	1.2	5	230	211
"	7/26/93	KOK	F	318246	<50	70	22	4.4	2	240	172
"	8/2/94	WAL	F	318230	<7	20	11	0.9	8	263	165
"	8/2/94	WAL	F	318231	15	30	13	0.8	8	257	148
"	8/2/94	WAL	F	318232	14	25	11	0.9	8	299	197

D = duplicate analysis

- LSS = largescale sucker
- RBT = rainbow trout
- CRF = crayfish
- MWF = mountain whitefish
- CIT = cutthroat trout
- LMB = largemouth bass
- YLP = yellow perch
- BRT = brown trout
- WCP = white crappie
- NSQ = northern squawfish
- WAL = walleye
- SMB = smallmouth bass
- KOK = kokanee
- WF = whole fish
- F = fillet (skin on)
- M = muscle
- na = not analyzed

Appendix C. Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)	Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)
Above Upriver Dam					Above Upriver Dam				
7/27/93	LSS	318243	505	1367	8/6/94	RBI	318262	285	284
			406	637				350	444
			427	721				300	296
			410	739				341	453
			420	723				276	195
8/6/94	LSS	318263	377	525				350	449
			399	653				319	325
			410	680				218	118
			485	1188	8/14/96	RBT	428096	414	875
			415	680				254	158
8/14/96	LSS	428099	445	933				260	189
			391	573				276	258
			424	786				238	143
			421	713				374	598
			467	813				330	391
7/27/93	RBI	318255	373	498				275	219
			360	528	8/14/96	RBI	428097	243	168
			333	374				225	115
			386	541				239	159
			365	464				240	156
7/27/93	RBI	318256	280	241				262	205
			285	255				413	770
			240	161				339	471
			331	393				362	505
			305	286	8/14/96	RBT	428098	321	359
8/6/94	RBI	318260	454	915				370	578
			319	358				348	469
			331	395				366	430
			275	197				277	241
			428	701				347	469
			389	262				265	163
			284	279				239	162
			353	445					
8/6/94	RBI	318261	310	317					
			325	411					
			225	130					
			313	308					
			323	329					
			335	388					
			318	298					
			400	679					

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)	Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)
Above Monroe St. Dam					Above Monroe St. Dam				
8/8/94	LSS	328431	386	516	8/14/96	RBT	428094	263	158
			453	793				300	269
			406	677				267	174
			430	744	8/8/94	MWF	328428	326	340
			403	603				305	259
8/14/96	LSS	428095	406	624				218	105
			453	801				295	222
			399	674				319	323
			380	540				302	263
			335	395				242	144
8/8/94	RBT	328425	280	207	8/8/94	MWF	328429	322	293
			309	293				311	275
			224	120				230	125
			352	419				285	206
			296	262				307	269
			321	322				318	246
			195	67				307	324
			370	472				319	316
8/8/94	RBT	328426	197	79	8/8/94	MWF	328430	317	278
			300	265				298	270
			339	355				335	312
			192	62				340	334
			296	287				235	126
			247	160				307	287
			268	163				230	115
8/8/94	RBT	328427	220	109				246	136
			280	233	8/14/96	MWF	428091	282	217
			286	263				311	232
			217	104				280	191
			240	131				269	168
			229	136				305	240
			221	94	8/14/96	MWF	428092	312	254
8/14/96	RBT	428093	196	80				285	219
			205	101				304	231
			280	227				287	162
			264	151				305	214
			270	176					
			318	303					
			298	259					
8/14/96	RBT	428094	194	72					
			202	93					
			253	140					
			281	236					

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)	Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)
Above Nine-Mile Dam					Above Nine-Mile Dam				
8/10/93	LSS	318242	553	1834	8/13/96	RBT	428085	251	160
			539	1691				264	235
			542	1530				285	284
			504	1354				257	183
			447	889				415	729
8/13/96	LSS	428090	426	966	8/13/96	RBT	428086	259	220
			455	1087				260	201
			418	937				306	337
			474	1094				260	224
			473	1061				248	187
8/10/93	RBT	318252	384	608	8/10/93	MWF	318254	260	208
			295	237				249	131
			334	364				249	144
			356	432				245	122
8/10/93	RBI	318253	284	221	8/5/94	MWF	318257	235	104
			293	171				232	111
			232	135				245	149
			238	129				238	124
8/5/94	RBI	318254	370	608				235	118
			390	657				236	119
			420	852				235	118
			397	740				238	120
			393	639				220	95
			470	1230				225	96
8/5/94	RBI	318255	355	580	8/5/94	MWF	318258	234	117
			425	877				224	102
			380	661				230	110
			400	625				255	164
			376	563				232	109
			440	947				298	274
8/5/94	RBI	318256	395	613				235	121
			351	468				237	142
			435	1007	8/5/94	MFV	318259	348	416
			442	1129				235	128
			427	770				236	124
			474	1301				305	300
8/13/96	RBI	428084	281	278				228	105
			240	166				246	148
			271	273				236	116
			242	152				236	118
			328	390					

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)	Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)
Above Nine-Mile Dam					Little Spokane River				
8/13/96	MWF	428087	298	240	8/3/94	LSS	318236	430	825
			336	348				450	855
			386	460				485	1145
			371	461				460	1070
			306	247				438	780
			280	200	8/13/96	LSS	428083	461	972
			343	316				446	948
			299	261				426	805
8/13/96	MWF	428088	350	361				451	1016
			310	320				480	1098
			304	268	8/3/94	MWF	318237	324	280
			229	123				310	270
			315	269				326	300
			321	308				305	280
			313	314				290	205
			312	256				342	345
8/13/96	MWF	428089	349	346				313	285
			321	294				334	350
			325	305	8/3/94	MWF	318238	283	220
			282	211				277	215
			289	262				294	215
			286	253				230	93
			293	251				327	292
			297	241				280	200
								241	112
								239	116
					8/3/94	MWF	318239	325	295
								277	208
								217	90
								224	98
								287	215
								294	231
								305	264
								305	256

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

Date	Species	Sample Number	Mean Total Length (mm)	Mean Weight (grams)
Little Spokane River				
8/13/96	MWF	428080	374	499
			275	169
			304	250
			270	193
			267	165
			305	304
			265	176
			256	157
8/13/96	MWF	428081	222	102
			299	267
			255	142
			275	167
			285	231
			222	101
			262	165
			281	204
8/13/96	MWF	428082	266	179
			227	103
			254	131
			312	240
			248	129
			329	284
			252	148
			267	167

LSS = largescale sucker
RBT = rainbow trout
MWF = mountain whitefish