Lake Roosevelt Fisheries Evaluation Program

Meadow Creek vs. Lake Whatcom Stock Kokanee Salmon Investigations in Lake Roosevelt

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Lake Roosevelt Fisheries Evaluation Program

Meadow Creek vs. Lake Whatcom Stock Kokanee Salmon Investigations in Lake Roosevelt

Annual Report 2001-2002

Contributions to Fisheries Management in Eastern Washington State Number 5

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Abstract

Lake Roosevelt has been stocked with Lake Whatcom stock kokanee since 1989 with the primary objective of creating a self-sustaining recreational fishery. Due to low return numbers, it was hypothesized a stock of kokanee, native to the upper Columbia River, might perform better than the coastal Lake Whatcom strain. Kokanee from Meadow Creek, a tributary of Kootenay Lake, British Columbia were selected as an alternative stock. Matched pair releases of Lake Whatcom and Meadow Creek kokanee were made from Sherman Creek Hatchery in late June 2000 and repeated in 2001. Stock performance between Lake Whatcom and Meadow Creek kokanee was evaluated using three performance measures; 1) the number of returns to Sherman Creek, the primary egg collection facility, 2) the number of returns to other tributaries and 3) the number of returns to the creel.

Kokanee were collected during five passes through the reservoir via electrofishing, which included 87 tributary mouths during the fall of 2000 and 2001. Chi-square analysis indicated age two Meadow Creek kokanee returned to Sherman Creek in significantly higher numbers when compared to the Whatcom stock in 2000 ($\chi^2 = 736.6$; d.f. = 1; $P < 0.01$) and 2001 ($\chi^2 = 156.2$; d.f. = 1; $P < 0.01$). Reservoir wide recoveries of age two kokanee had similar results in 2000 ($\chi^2 = 735.3$; d.f. = 1; $P < 0.01$) and 2001 ($\chi^2 = 150.1$; d.f. = 1; $P < 0.01$). Six Lake Whatcom and seven Meadow Creek three year olds were collected in 2001. The sample size of three year olds was too small for statistical analysis. No kokanee were collected during creel surveys in 2000, and two (age three kokanee) were collected in 2001. Neither of the hatchery kokanee collected were coded wire tagged, therefore stock could not be distinguished.

After two years of monitoring, neither Meadow Creek or Lake Whatcom kokanee appear to be capable of providing a run of three-year-old spawners to sustain stocking efforts. The small number of hatchery three-year-olds collected indicated that the current stocking methods will continue to produce a limited jacking run largely composed of precocious males and a small number of three-year-olds. However, supplemental creel data indicated anglers harvested two-year-old hatchery kokanee 30-45 days after release. Supplemental creel data should continue to be collected to accurately evaluate hatchery contributions to the creel.

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Introduction

The construction of Grand Coulee Dam prevented anadromous salmon and steelhead from returning to their natal streams. To partially mitigate for the loss of anadromous fish, Lake Whatcom kokanee salmon (*Oncorhynchus nerka kennerlyi*) have been stocked in Lake Roosevelt since 1987. The primary purpose of the stocking was to develop a self-sustaining sport fishery and restore a migratory salmonid species to the Lake Roosevelt ecosystem. In 1990, kokanee were coded wire tagged to evaluate planting strategies (Thatcher et al. 1993, Tilson et al. 1994, 1995, 1996, 1997, Tilson and Scholz 1998, McLellan et al. 2001).

Since 1996, residualized smolts were planted instead of fry because they returned to egg collection facilities in larger numbers (Tilson and Scholz 1998). In 1998 and 1999, a variety of matched pair releases were conducted in an attempt to improve returns. Each year a “jack” run composed primarily of precocious males, approximately 0.2-0.5% of the total fish stocked, returned in the fall. However, few three-year-old male and female spawners returned the following year (McLellan et al. 2001).

Hatchery kokanee contributions to the fishery have been difficult to assess. Kokanee harvest in Lake Roosevelt increased from approximately 100-300 per year from 1980-1982 (Beckman, personal communication) to 1,265-32,353 per year after hatchery stocking began in 1987 (Cichosz et al. 1998). Only a portion of the hatchery fish in the Spokane Tribe (STI) creel were marked during the first ten years of stocking, therefore it was not possible to determine if unmarked fish were of hatchery origin. Beginning in 1997, all hatchery kokanee stocked in Lake Roosevelt were adipose fin clipped. In 1998, 36 kokanee were observed in the creel of which 12 were of hatchery origin (Cichosz et al. 1998). Hatchery kokanee appeared to be contributing at least 33% of the kokanee fishery in Lake Roosevelt (McLellan et al. 2001). In 1999 two kokanee, 1 wild and 1 hatchery were observed in the creel (STI unpublished data). Small sample sizes of kokanee observed in the creel has restricted our ability to determine the hatchery contribution to the fishery, as well as evaluate stock performance.

Evidence from the Lake Roosevelt Monitoring Program (LRMP) test fishery suggested the creel surveys underestimated the kokanee harvest. Employees from the STI, Colville Confederated Tribe (CCT), Department of Fish and Wildlife (WDFW), and Eastern Washington University (EWU) conducted 3-4 days of angling in the Spring Canyon/Swawilla Basin area in the middle of January 1999 and 2000 (STI unpublished data). In 1999, 61 kokanee were

collected of which 3 were of hatchery origin. In 2000, 46 kokanee were harvested of which 1 was of hatchery origin (STI unpublished data). These results only have partial value because fish were collected during a short period of time in a small section of the reservoir.

Rock Island Dam and Rocky Reach Dam operate fish passage facilities that count a percentage ($\approx 5\%$) of the fish that pass through the dams from April 1 to August 31st. During this time they have collected Lake Roosevelt hatchery kokanee that were moving downstream. The data they collected supported the idea that hatchery kokanee entrain over Grand Coulee Dam. In 1998 the fish passage facilities returned 238 kokanee to EWU in which the majority (87%) had just been released that spring (McLellan et. al 2001). In 1999, the fish passage centers only collected kokanee over 170 mm, which limited the number of hatchery smolts they returned ($n = 10$).

It was concluded that Whatcom stock kokanee responded poorly to conditions in Lake Roosevelt and fisheries managers should obtain a stock of kokanee native to the upper Columbia River system. It was hypothesized that a locally adapted kokanee might perform better in Lake Roosevelt.

Kokanee stocks native to the upper Columbia River basin that were considered as possible egg sources for supplementing Lake Roosevelt included; 1) Arrow Lakes, upper Columbia River, British Columbia, 2) Meadow Creek, a tributary to Kootenay Lake, British Columbia and 3) Chain Lakes, Little Spokane River drainage. The kokanee population in the Arrow Lakes system was decreasing and eggs were not available. The spawning population in the Chain Lakes was small, approximately 50 spawning pairs, therefore it was not considered. Consequently, Meadow Creek was chosen because the eggs were abundant and available.

The objective of the study was to test stock performance using three criteria. A significant difference in at least two of the three categories, with one stock consistently out performing the other, would indicate greater performance. The criteria were to determine if there was a significant difference between stocks that: (1) returned to Sherman Creek Hatchery (2) returned to other tributaries throughout the reservoir and (3) recruited to the creel. A secondary objective was to determine if there was a significant difference in the number of kokanee from each stock recovered below Grand Coulee Dam at Rock Island Dam's fish passage centers.

Methods

Description of the Study Area

Lake Roosevelt was formed when Grand Coulee Dam impounded the waters of the Columbia River in 1939 (Figure 1). At full pool the reservoir is 243 kilometers long, inundates 334.9 square kilometers, and has a maximum depth of 122 meters (Stober et al. 1981). At full pool, the lake's surface elevation is 430 m (1,290 ft) above mean sea level (MSL) and minimum operating pool is 403 m (1,208 ft.) above MSL. Grand Coulee Dam was constructed primarily for hydropower, flood control, and irrigation with secondary operations for recreation, fish and wildlife.

Rearing, Marking, Release, and Long Term Tag Retention

Lake Whatcom stock kokanee (LKW) eyed eggs from the 1999 and 2000 brood stocks were obtained from the Lake Whatcom Hatchery (WDFW) in Bellingham, WA. Kokanee were collected from Meadow Creek, a tributary of Kootenay Lake, British Columbia by WDFW and British Columbia personnel. The fertilized eggs were held at the Clearwater Hatchery in British Columbia until they were eyed, and then transported to the Spokane Tribal Hatchery for incubation and rearing (Combs 2001).

All fish were reared at the Spokane Tribal Hatchery in Wellpinit, WA. Fish were supplied with a combination of spring and well water ranging from 8-11°C. Fish were feed trained on Biodiet[®] feed from Bioproducts, Inc. Once the fish were approximately 100 mm, they were 100% adipose fin clipped and a portion coded wire tagged (CWT). Unique tag numbers were given to each lot of fish based on their stock origin (Meadow Creek or Lake Whatcom) and release location. Coded wire tags were injected into the rostrum using a model MK4 CWT machine (Northwest Marine Technology, Inc.). After marking, fish were returned to the hatchery raceways via a quality control device, which ensured 100% of the fish were marked.

Kokanee were transferred from the Spokane Tribal Hatchery to Sherman Creek Hatchery in March 2000 and again in 2001. Meadow Creek and Lake Whatcom CWT kokanee were released from the Sherman Creek Hatchery on June 28th, 2000 and June 25th, 2001 (Table 1; Combs 2001). Additional kokanee were released from the Sherman Creek Hatchery (Lake Whatcom-left pectoral clipped), Kettle Falls net pens (Meadow Creek-adipose fin clipped), Colville River (Meadow Creek- right pectoral clipped), below Little Falls Dam (Meadow Creek-62-03-67), at Two Rivers Casino (Lake Whatcom-62-03-65), and from Seven Bays net pens

(Meadow Creek-adipose fin clipped) that were not a part of this study, but collected during sampling (Appendix A).

In previous Lake Roosevelt studies, tag retention could be determined from returning fish because all hatchery kokanee were coded wire tagged. Not all hatchery kokanee were CWT in 1999 and 2000, so tag retention could not be calculated for those years. Tag retention of returning age two smolts was estimated at 74% in 1996, 90% in 1997, and 73% in 1998 (Tilson et al. 1997, 1998). Therefore, the average long term CWT retention was estimated to be 79% for returning age two smolts (Table 1). The number of CWT kokanee stocked was adjusted for long-term tag retention by multiplying the total number stocked by 79%. Long-term tag retention was never established for age three fish because of low numbers of returns.

Figure 1. Map of Lake Roosevelt, Spokane Tribal Hatchery and Sherman Creek hatchery.

Table 1. Meadow Creek and Lake Whatcom stock coded wire tagged (CWT) kokanee released from Sherman Creek, Lake Roosevelt, during 2000 and 2001.

Date Released	Stock	CWT Code	Brood Year	No. Kokanee Released	Adjusted Long Term Retention ¹	Stocking size (mm)
<i>2000 Releases</i>						
06/28/2000	Meadow Ck	62-03-35	1998	105,432	83,291	168
06/28/2000	Lake Whatcom	62-23-34	1998	94,518	74,669	168
<i>2001 Releases</i>						
05/25/2001	Meadow Ck	62-02-98	1999	62,928	49,713	184
05/25/2001	Meadow Ck	62-02-99	1999	39,065	30,861	167
05/25/2001	Lake Whatcom	62-03-64	1999	61,288	48,418	176
05/25/2001	Lake Whatcom	62-03-62	1999	52,062	41,129	167

¹The number of kokanee released was multiplied by 0.79 to adjust for long-term tag retention.

Experimental Design for Coded Wire Tag Release Groups

The null hypothesis was tested using chi-square tests for independence (Minitab[®]; $\alpha = 0.05$) to determine if one group returned in significantly larger numbers compared to the other. The hypotheses tested were:

Hypothesis 1 - Returns to Sherman Creek

1-H₀: There was no significant difference in the number of Meadow Creek stock kokanee and Lake Whatcom stock kokanee that returned to Sherman Creek.

Hypothesis 2 - Returns to Tributaries throughout Lake Roosevelt

2-H₀: There was no significant difference in the number kokanee collected throughout the reservoir of each stock released from Sherman Creek.

Hypothesis 3 - Returns to the creel

3-H₀: There was no significant difference between the numbers of Meadow Creek stock kokanee and Lake Whatcom stock kokanee that recruited to the creel.

Recoveries below Grand Coulee Dam

A secondary objective was to determine if there was a significant difference between the numbers of Meadow Creek and Lake Whatcom stock kokanee collected below Grand Coulee Dam.

Sampling Procedures

Kokanee recovery was conducted from August 17th to November 7th, 2000 and August 15th to November 20th, 2001. Kokanee collection in Lake Roosevelt was two tiered: (1) Weekly electrofishing surveys at Sherman Creek to collect kokanee returning to the primary egg collection location. Backpack electrofishing in Sherman Creek was utilized when kokanee moved into the creek. (2) Five passes through the reservoir in both 2000 and 2001. A pass consisted of electrofishing for 10 minute transects at the primary embayments to Lake Roosevelt on five different occasions (embayments = 87). These included areas of the Sanpoil River, Hawk Creek, Spokane River, Kettle River, and main stem Columbia River, and were found to be the most productive during past studies. Sites were sampled approximately every two weeks (Figure 2).

All kokanee collected were checked with a coded wire tag detector, measured to the nearest mm (total length), and a sub-sample weighed (grams). Heads were removed from kokanee with CWT and placed in individually numbered bags for lab analysis.

Lake Roosevelt creel surveys were a cooperative effort between the STI, the CCT, and the WDFW. For specific methods refer to Cichosz et al. (1998). Creel clerks took heads of hatchery kokanee captured by anglers. Heads were sent to EWU for analysis. No heads were collected in 2000 (McLellan and Scholz 2001), which suggested the kokanee harvest was below the threshold of the design of creel (K. Underwood, STI personal communication). Therefore, kokanee data were collected during the Two Rivers Casino Trout Derby held in August 2001, at Two Rivers Resort. Data were also collected through angler diaries sent out by WDFW to fishing guides who primarily fished in the southern part of the reservoir. Supplemental creel data was also collected during the test fisheries conducted during the beginning of January 2001 and 2002, also held in the lower reservoir.

Rock Island Dam and Rocky Reach Dam monitored downstream fish passages between April 1st and August 31st, 2000 and 2001. Coded wire tagging studies were conducted on the Lake Wenatchee sockeye, therefore only CWT kokanee/sockeye greater than 150 mm in 2000 and greater than 200 mm in 2001 were sacrificed and returned to EWU as Lake Roosevelt kokanee (L. Praye, WDFW personal communication). All CWT were extracted from the kokanee heads at the EWU Fisheries Research Center and examined with a dissecting

microscope to determine the binary code or numerical code. For quality control, 50% of the tags were re-read.

Lake Roosevelt

Figure 2. Map of Lake Roosevelt and 89 locations sampled for kokanee during 2000.

Results

During the fall 2000 sampling, 2,762 hatchery kokanee were collected (1,692 AD+ [adipose fin clipped with CWT]; and 1,070 AD- [adipose fin clipped only]). The majority of the fish were collected at Sherman Creek (96%; $n = 2,657$), with 1,539 CWT kokanee from the experiment. An additional 31 wild kokanee were collected at sites throughout the reservoir (NO- = no adipose clip; [wild]; Table 2).

During the fall 2001 sampling, 2,094 hatchery kokanee were collected (AD+ = 886, AD- = 863, AD left pectoral = 314, and AD right pectoral = 31). The majority of kokanee were collected at Sherman Creek (68%; $n = 1,374$), with 720 coded wire tagged kokanee from the experiment. An additional 32 wild kokanee were also collected in the reservoir (Table 3). During sampling, all fish species were collected to standardize catch data with previous surveys. Total number, catch-per-unit-effort (CPUE) and relative abundance of all fish species captured was summarized (Appendix B). Number of kokanee per sample site was summarized (Appendix C).

The mean total length ($\pm$ standard deviation) of age two Lake Whatcom kokanee in 2000 was 279 mm (± 24) and 298 mm (± 36) in 2001. Meadow Creek stock averaged 271 mm (± 23) in 2000 and 279 mm (± 25) in 2001. Age three Meadow Creek kokanee averaged 440 mm (± 57) and Lake Whatcom averaged 438 mm (± 28 ; Table 4). An age-length distribution of all the fish collected at Sherman Creek indicated the majority of fish were two year olds ($n=2,043$; Figure 3).

In 2000, the female to male ratio of age two kokanee to Sherman Creek was higher for Meadow Creek kokanee (1:9) compared to Lake Whatcom kokanee (1:62). However, in 2001 the female to male ratio decreased for Meadow Creek kokanee (1:12) and increased for Lake Whatcom kokanee (1:7). More age three females returned from the Meadow Creek stock (5:3) compared to Lake Whatcom kokanee (1:5; Table 5).

The peak of the Meadow Creek spawning run occurred during mid-September in 2000 (598 fish/hr) and 2001 (1,588 fish/hr; Table 6; Figure 4). Lake Whatcom kokanee experienced variable peaking times, but primarily during October in 2000 (109 fish/hr) and 2001 (218 fish/hr; Figure 5).

Table 2. Number of coded wire tagged (AD+), adipose clipped only (AD-), and wild kokanee (NO-) collected in Lake Roosevelt, fall 2000.

Location	# of sites per section	Effort (min)	AD+	AD-	NO-	Total
Grand Coulee	8	337	0	0	0	0
Keller Ferry	8	205	0	0	0	0
Sanpoil	4	138	1	0	5	6
Hawk Creek/Seven Bays	11	618	12	7	13	32
Fort Spokane	9	328	0	0	0	0
Hunters	7	318	2	5	2	9
Gifford	4	212	1	2	2	5
Bradbury Beach	7	271	1	0	1	2
Kettle Falls	8	550	7	4	0	11
<i>Sherman Creek Cove¹</i>	1	338	1,624	1,033	1	2,658
Evans/China Bend	4	160	0	2	6	8
Porcupine Bay	11	490	18	8	1	27
Little Falls	5	351	26	9	0	35
Grand Total	87	4,316	1,692	1,070	31	2,793

¹ Primary egg collection site.

Table 3. Number of coded wire tagged (AD+), adipose clipped (AD-), left pectoral clipped (ADLP-), right pectoral clipped (ADRP-) and wild kokanee (NO-) collected in Lake Roosevelt, fall 2001.

Location	# of sites per section	Effort (min)	AD+	AD-	ADLP-	ADRP-	NO-	Total
Grand Coulee	8	313		4				4
Keller Ferry	8	320		5				5
Sanpoil	4	149	1	1			2	4
Hawk Creek/Seven Bays	11	472	101	361	2		8	472
Fort Spokane	9	317	1	2				3
Hunters	7	281	11	21			1	33
Gifford	4	152		8				8
Bradbury Beach	7	249	4	10	3	1	2	20
Kettle Falls	8	476	16	45	2	15	6	84
<i>Sherman Creek Cove¹</i>	1	275	711	338	306	15	4	1,374
Evans/China Bend	4	155	1	2	1		3	7
Porcupine Bay	11	390	38	63			6	107
Little Falls	5	268	2	3				5
Grand Total	87	3,817	886	863	314	31	32	2,126

¹ Primary egg collection site.

Table 4. Mean total length (TL; mm) and standard deviation (S.D.) of kokanee from Lake Whatcom and Meadow Creek kokanee collected during 2000 and 2001.

Tag Number	n	Mean TL ($\pm$ S.D.)	Range	n	Mean TL (mm)	Range
<i>Experiment 1</i>			<i>Age 2 (2000)</i>	<i>Age 3 (2001)</i>		
Lake Whatcom						
62-03-34	201	281 (24)	217-350	6	438 (28)	410-490
62-03-36	27	265 (19)	229-300	0	0	0
Mean	228	279 (24)	217-350	6	438 (28)	410-490
Meadow Creek						
62-03-35	1,342	271 (23)	125-376	8	440 (57)	345-498
62-03-37	33	263 (22)	211-320	1	505 (0)	505
Mean	1,375	271 (23)	125-376	9	447(58)	345-505
Grand Mean	1,603	272 (23)	125-376	15	443(47)	345-505
<i>Experiment 2</i>			<i>Age 2 (2001)</i>	<i>Age 3(2002)¹</i>		
Lake Whatcom						
62-03-62&64	209	298 (36)	178-435			
62-03-65	147	306 (32)	162-392			
Meadow Creek						
62-02-98&99	497	279 (25)	215-350			
62-02-67	5	283 (54)	222-356			
Grand Mean	858	289 (31)	162-435			

¹ Data to be collected fall 2002

Figure 3. Age Length Distribution of hatchery kokanee collected in Lake Roosevelt, 2001 (Age 2 = 2,043; Age 3 = 50)

Table 5. Female to male ratio (F:M) of Meadow Creek and Lake Whatcom kokanee that returned to Sherman Creek Hatchery.

Stock (Age)	Tag Number	Females	Males	F:M
<i>Experiment 1 (2000-01)</i>				
Meadow Creek (2)	62-03-35	130	1,151	1:9
Meadow Creek (3)		5	3	5:3
Lake Whatcom (2)	62-03-34	3	185	1:62
Lake Whatcom (3)		1	5	1:5
<i>Experiment 2 (2001-02)</i>				
Meadow Creek (2)	62-02-98&99	37	450	1:12
Meadow Creek (3)		--	--	--
Lake Whatcom (2)	62-03-62&64	25	172	1:7
Lake Whatcom (3)		--	--	--

Table 6. Number (n) and catch-per-unit-effort (CPUE) of Meadow Creek and Lake Whatcom kokanee collected at Sherman Creek per date sampled, 2000 and 2001.

Date	Effort (hours)	Meadow Creek (n)	CPUE (fish/hr)	Lake Whatcom (n)	CPUE (fish/hr)
<i>Experiment 1 (2000-01)</i>					
08/23/00	0.25	16	64	0	0
09/05/00	0.5	258	516	6	12
09/06/00	0.62	196	316	7	11
09/12/00	0.87	287	330	40	46
09/19/00	0.5	299	598	45	90
09/27/00	0.72	239	332	42	58
10/11/00	0.33	5	15	36	109
10/18/00	0.33	1	3	6	18
10/25/00	0.42	0	0	2	5
11/01/00	0.42	0	0	12	29
Total	4.96	1,337	270	197	40
<i>Experiment 2 (2001-02)</i>					
08/21/01	0.33	94	285	13	39
08/28/01	0.67	17	25	1	1
09/07/01	0.33	270	1,588	38	224
09/14/01	0.17	58	341	16	94
09/19/01	0.17	44	133	3	9
09/28/01	0.33	4	12	1	3
10/05/00	0.33	0	0	0	0
10/10/01	0.17	0	0	1	6
10/24/01	0.33	0	0	72	218
10/31/01	0.42	0	0	1	2
11/08/01	0.17	0	0	37	218
11/14/01	0.33	0	0	14	42
11/20/01	0.2	0	0	1	5
Total	3.95	488	124	198	50

* October 4th, 2001 backpack electrofishing was not included in CPUE summary.

Figure 4. Meadow Creek stock and Whatcom stock kokanee collected per date at Sherman Creek, 2000. (Graph excludes 10/4/2000 backpack shocking day).

Figure 5. Meadow Creek stock and Whatcom stock kokanee collected per date at Sherman Creek, 2001.

Hypotheses Results

Hypothesis 1- Sherman Creek Returns

Chi-square analysis indicated that the age two Meadow Creek kokanee returned to Sherman Creek in significantly higher numbers when compared to the Lake Whatcom stock in 2000 (χ^2 , d.f. = 1; $P < 0.01$) and 2001 (χ^2 , d.f. = 1; $P < 0.01$; Table 7). Six age three Lake Whatcom and seven age three Meadow Creek coded wire tagged kokanee returned to Sherman Creek. The number of three year olds recovered was too small to perform statistical analysis.

Table 7. Returns to Sherman Creek of coded wire tagged age 2 Whatcom stock (62-03-34) vs. Meadow Creek stock (62-03-35) released from the Sherman Creek Hatchery.

Stock (age)	CWT #	Fish Stocked	Fish Recovered	Recovery %	χ^2	P-value
<i>Experiment 1</i>						
Lake Whatcom (2)	62-03-34	74,669	197	0.26		
Meadow Creek (2)	62-03-35	83,291	1,337	1.61	736.6	< 0.01
Lake Whatcom (3)	62-03-34		6			
Meadow Creek (3)	62-03-35		7		NA	NA
<i>Experiment 2</i>						
Lake Whatcom (2)	62-02-62&64	89,547	198	0.22		
Meadow Creek (2)	62-02-98&99	80,574	488	0.61	156.2	< 0.01
Lake Whatcom (3) ¹	62-02-62&64					
Meadow Creek (3) ¹	62-02-98&99					

¹ Data to be collected fall 2002

Hypothesis 2- Reservoir Wide Recoveries

Four additional kokanee were collected in the reservoir during 2000; two Meadow Creek and two Lake Whatcom stock. Twenty-one additional kokanee were collected in the reservoir during 2001; ten Meadow Creek and eleven Lake Whatcom. For reservoir wide recoveries, including those at Sherman Creek, there were significantly more Meadow Creek kokanee recovered when compared to the Lake Whatcom stock in 2000 (χ^2 , d.f. = 1; $P < 0.01$;) and 2001(χ^2 , d.f. = 1; $P < 0.01$; Table 8). Only two 3-year-old fish were recovered at sites other than Sherman Creek. The number of three year olds recovered was too small to perform statistical analysis.

Table 8. Reservoir wide recoveries for coded wire tagged age 2 Whatcom (62-03-34) vs. Meadow Creek stock (62-03-35) released from the Sherman Creek Hatchery.

Stock (Age)	CWT #	Fish Stocked	Fish Recovered	% Recovery	χ^2	P- value
<i>Experiment 1(2000-01)</i>						
Lake Whatcom (2)	62-03-34	74,669	199	0.27	735.3	< 0.01
Meadow Creek (2)	62-03-35	83,291	1,340	1.61		
Lake Whatcom (3)	62-03-34		6		NA	NA
Meadow Creek (3)	62-03-35		9			
<i>Experiment 2 (2001-02)</i>						
Lake Whatcom (2)	62-02-62&64	89,547	209	0.18	150.1	< 0.01
Meadow Creek (2)	62-02-98&99	80,574	496	0.49		
Lake Whatcom (3) ¹	62-02-62&64					
Meadow Creek (3) ¹	62-02-98&99					

¹Data to be collected fall 2002

Hypothesis 3- Recoveries from the Creel

No hatchery kokanee were collected in the STI creel during 2000 and two hatchery kokanee in 2001 (STI unpublished data). Neither of the hatchery kokanee had coded wire tags, so stock could not be distinguished. On June 27th, 2001 EWU performed a supplementary creel at Spring Canyon from 2:00-6:00 p.m. Five wild and one hatchery (17%) kokanee was collected (no coded wire tag).

During the 2000 Two Rivers Casino Trout Derby, 20 kokanee were captured, (0.7 kokanee/boat) however, origin (hatchery or wild) was not distinguished (STI unpublished data). During the 2001 derby, anglers captured 193 kokanee (2.4 kokanee/boat), of which 88 (46%) were hatchery fish. Coded wire tags were detected in 47 of those fish. All coded wire tagged kokanee were two-year-old Lake Whatcom fish (62-03-65), stocked at Two Rivers Casino, which were not a part of the experiment (Table 9).

Anglers recorded data in their diaries from June 15th – November 27th, 2001. Anglers recorded 204 total kokanee of which 37 (18%) were of hatchery origin (C. Baldwin, WDFW personal communication). Hatchery kokanee captured by anglers were not regularly checked for CWTs, however, three CWTs were collected and all were three-year-old Meadow Creek kokanee (16-17 inches TL; 62-03-35). During the annual kokanee test fishery in January 2000, 52 wild, 1 hatchery (2%), and 2 unknown kokanee were captured (STI unpublished data).

During the 2002 test fishery 67 kokanee were captured of which 9 (13%) were of hatchery origin.

Table 9. Number of coded wire tagged (AD+), adipose clipped (AD-), and wild (NO-) kokanee collected through the Spokane Tribe creel surveys, Lake Roosevelt Test Fishery, Rainbow and Kokanee Derby, angler diaries, and EWU supplemental creel, 2000 and 2001.

	AD+	AD-	NO-	Unknown	Total
2000					
Spokane Tribe Creel ¹	0	0	0	0	0
Test Fishery ¹	0	1	58	0	59
Trout Derby ¹	NA	NA	NA	20	20
2001					
Spokane Tribe Creel ¹	0	2	UN	0	UN
Test Fishery ¹	0	9	58	0	67
Trout Derby ¹	54	34	99	6	193
Kokanee Angler Diaries ²	2	37	167	0	204
EWU supplemental creel	0	1	5	0	6

¹Spokane Tribe (K. Underwood, unpublished data)- UN: data unavailable

²WDFW (C. Baldwin, unpublished data)

Recoveries below Grand Coulee Dam

There were no Meadow Creek or Lake Whatcom stock age two fish collected at the fish passage center in 2000. Two kokanee were collected at the Rock Island Dam fish passage center during 2001. Both kokanee were Lake Whatcom stock (62-03-64), with one captured in May and one in June.

Discussion

The goal of testing new stocks of fish was to increase return rates of age three fish to Sherman Creek and increase the harvest of hatchery fish by anglers. Two-year-old kokanee (jacks) only have three months to recruit to the creel before they mature. Additionally, the returning jacks were primarily males, which was not conducive for establishing a self-sustaining fishery. During the first two year of the experiment, two-year-old Meadow Creek kokanee returned in significantly higher numbers when compared to Lake Whatcom kokanee. However,

similar numbers of three-year-old kokanee returned to Sherman Creek in 2001 (Lake Whatcom = 6; Meadow Creek = 7).

The Spokane Tribe of Indians is responsible for coordinating the creel surveys at Lake Roosevelt and analyzing the data. The latest harvest data available indicated that hatchery kokanee contributed 33% of the kokanee harvested (3,323 hatchery kokanee; Cichosz et al. 1998). Age three kokanee were expected to recruit to the creel in 2001. However, only two hatchery kokanee were observed in the creel, and stock could not be distinguished. The lack of kokanee observed in the creel during 2000 prompted fisheries managers to look elsewhere for creel information. The 2001 Two Rivers Casino Trout Derby held in August revealed that age two kokanee did recruit to the creel. During two days of fishing, 88 hatchery kokanee were caught and 47 had coded wire tags. All coded wire tagged kokanee were Lake Whatcom fish that were stocked at Two Rivers Casino in June 2001. Meadow Creek kokanee were not stocked with the Lake Whatcom kokanee, therefore stock performance could not be evaluated. However, the results indicate two year old kokanee can recruit to the creel.

Various anglers and agencies collected supplementary creel information during 2001. Angler diaries sent out by WDFW indicated the majority of fish captured were of wild origin with 18% being hatchery kokanee (C. Baldwin, WDFW unpublished data). Three coded wire tags were collected in which all were three year old Meadow Creek kokanee. During one six hour period, EWU biologist observed six kokanee at the Keller boat launch in which one was of hatchery origin. The test fishery, angler diaries, EWU survey, and other creel information collectively indicate that the current creel survey methods do not accurately portray the kokanee fishery in Lake Roosevelt.

Despite the new information on hatchery kokanee harvest, the planting of alternative stocks has not increased the number of three-year-old returns to Sherman Creek Hatchery. The large number of “jack” returns also occurred with the new stock of kokanee. Why three-year-olds do not return is still a pending question. Maturity of fish has been related to productivity in lakes, the faster they grew the sooner they matured (Lewis 1970). Lake Roosevelt kokanee were not limited in food (Underwood et al. 1996) and grew to larger sizes when compared to other areas (Table 10). Kokanee in Dworshak Reservoir were of similar sizes at maturity and also mature at age two.

Table 10. Comparison of spawning kokanee total lengths (mm) at age two and age three for selected lakes and reservoirs.

Location	Year	Age 2	Age 3	Citation
Lake Roosevelt, WA	2001	289	443	current study
Lake Roosevelt, WA	2000	272	322	McLellan et al. 2001
Dworshak Reservoir, ID	1999	219-336	--	Maiolie et al. 2001
Dworshak Reservoir, ID	1988	261	310	Rieman and Myers 1992
Flathead Lake, MT	1996	269-405	--	Hansen et al. 1996
Redfish Lake, ID	1990	150	190	Rieman and Myers 1992
Coeur d' Alene Lake, ID	1985	192	225	Rieman and Myers 1992
Coeur d' Alene Lake, ID	1983	182	220	Rieman and Myers 1992
Spirit Lake, ID	1988	240	270	Rieman and Myers 1992
Pend Oreille Lake, ID	1988	205	242	Rieman and Myers 1992
Priest Lake, ID	1985	245	290	Rieman and Myers 1992

Parameters such as entrainment, precocity, and predation have potentially contributed to the low numbers of kokanee returns in the past. Previous entrainment studies conducted by the Colville Tribe have demonstrated that the majority of entrainment occurred around the third powerhouse (Biosonics, Inc. 2000). Batelle Northwest is currently studying the dynamic flows around the third powerhouse of Grand Coulee Dam in an attempt to use strobe lights to reduce entrainment. Precocity of kokanee reared in the hatchery is being evaluated by the STI (K. Underwood, STI, personal communication).

Extensive predation by lake trout (*Salvelinus namaycush*) has hindered recovery efforts of kokanee in Flathead Lake, Montana (Fredenberg et al. 1999). Predation by walleye (*Stizostedion vitreum*) on hatchery kokanee in Lake Roosevelt is being evaluated by the WDFW (C. Baldwin, WDFW personal communication). Preliminary results from the 1999 predation study conducted between Daisy and Snag Cove during June and July indicated 55,694 (39,681-79,228; 95% CI) kokanee were consumed within 41 days of the release (C. Baldwin, WDFW, personal communication). That represented 15.1 % (10.8-21.5 %) of the Sherman Creek raceway releases. Additionally, lake wide modeling indicated that predation on kokanee was as high at 43% (21%-64%; 95% confidence interval; C. Baldwin, WDFW personal communication). In 2000 the number of kokanee lost dropped to 22,883 (16,919-31,278 CI), or 6.3% (4.7-8.6%) of Sherman Creek raceway and net pen releases (C. Baldwin, WDFW, personal communication).

The current method of raising and stocking kokanee into Lake Roosevelt produces a small jacking run in the fall comprised primarily of precocious males. Kokanee stocked from the Sherman Creek Hatchery experience the best returns compared to other areas tested. However, walleye predation on the kokanee stocked appears to substantially reduce the size of the population.

Wild kokanee grow to very large sizes in Lake Roosevelt, up to 533 mm in length and 1,589 grams in weight (STI, unpublished data). Two-year-old hatchery kokanee average 289 mm after only three months in the reservoir. Very little is known about the wild fish, such as when and where they migrate into Lake Roosevelt or if, when, or where they go to spawn. Mimicking the wild kokanee population may provide the best opportunity to improve the current hatchery kokanee program.

Recommendations

Stocking Strategies for 2002

1. Experiment with stocking kokanee at the Two Rivers Casino area again to determine if they recruit to the Fishing Derby in 2002.
2. Explore stocking fry and/or post smolts in the area Northport area or below Keenlyside Dam tailrace to mimic wild kokanee migrations into Lake Roosevelt.

Future Research

1. Determine the life history of the wild kokanee in Lake Roosevelt including: origin (natural reproduction in Lake Roosevelt, or entrainment), size, time, and where they entrain.
2. Radio track wild kokanee in an attempt to locate spawning areas, which would be sources of wild production.
3. Experiment with rearing practices, such as temperature, food or densities to reduce growth of hatchery fish to reduce the “jacking rate”.
4. Improve the creel survey to include kokanee harvest.

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Appendix A- Kokanee Stocking Records, 2000-2001

Table 11. Summary of Lake Whatcom (WHAL) and Meadow Creek (MEAD) kokanee stocked into Lake Roosevelt from Sherman Creek Hatchery, Kettle Falls net pens, Spokane River (Little Falls Dam), Spokane River (Two Rivers), Seven Bays net pens, and the Colville River, 2000 and 2001.

CWT Code	Brood Year	Date	Release Location	Stock	Run Time	Kokanee Released	Release fish/lb.	Total Length (mm)
62-23-34	1998	06/28/2000	Sherman Creek	WHAL	early	94,518	9.6	168
62-03-35	1998	06/28/2000	Sherman Creek	MEAD	X	105,432	9.6	168
62-55-29	1998	07/25/2000	Sherman Creek	WHAL*	middle	5,829	8.9	173
62-51-44	1998	07/25/2000	Sherman Creek	WHAL*	middle	3,557	8.9	173
AD ONLY	1998	07/25/2000	Sherman Creek	WHAL	middle	72,602	8.9	173
AD ONLY	1998	06/14/2000	Kettle Falls NP	WHAL	middle	197,975	19.6	133
AD ONLY	1998	06/28/2000	Sherman Creek	WHAL	middle	95,680	9.6	168
62-03-36	1998	6/20-29/00	Spokane River	WHAL	early	51,075	10.0	167
62-03-37	1998	6/20-29/00	Spokane River	MEAD	X	55,675	10.0	167
AD ONLY	1998	06/12/2000	Spokane River	WHAL	middle	15,770	14.0	150
AD ONLY	1998	05/19/2000	Spokane River	WHAL	middle	41,600	18.0	137
AD ONLY	1998	05/30/2000	Spokane River	WHAL	middle	21,600	3.5	237
AD ONLY	1998	06/12/2000	Spokane River	WHAL	middle	30,000	15.0	146
Total						791,313		
AD ONLY	1999	4/25/2001	Spokane River	WHAL	middle	46,560	16.0	143
AD Right Pec	1999	5/14/2001	Colville River	MEAD	X	21,648	7.0	188
62-03-67	1999	6/1/01	Spokane River	MEAD	X	24,533	7.0	188
62-03-67	1999	6/6/01	Spokane River	MEAD	X	27,875	7.0	188
62-03-65	1999	6/11&12/2001	Two Rivers	WHAL	middle	57,477	8.0	180
AD ONLY	1999	5/4/2001	Seven Bays NP	MEAD	X	98,217	11.5	159
AD ONLY	1999	5/8/2001	Kettle Falls NP	MEAD	X	49,699	18.0	137
62-02-98	1999	5/25/2001	Sherman Creek	MEAD	X	62,928	7.6	184
62-02-99	1999	5/25/2001	Sherman Creek	MEAD	X	39,065	10.0	167
62-03-64	1999	5/25/2001	Sherman Creek	WHAL	X	35,251	7.6	184
62-03-64	1999	5/25/2001	Sherman Creek	WHAL	X	26,037	10.0	167
62-03-62	1999	5/25/2001	Sherman Creek	WHAL	X	52,062	10.0	167
AD Left Pectoral	1999	5/25/2001	Sherman Creek	WHAL	X	92,558	7.0	188
Total						633,910		

WHAL = Whatcom stock

MEAD = Meadow Creek stock

WHAL* = Whatcom kokanee that returned to Sherman Creek in 1998 and were spawned.

Appendix B- Summary of all fish species collected in Lake Roosevelt, 2000-01.

Table 12. Summary of the total number of fish collected (n), relative abundance (R.A.), catch-per-unit-effort (CPUE), and size range (mm) of the fish collected by EWU via boat electrofishing at Lake Roosevelt between August 17th – November 17th, 2000 (effort = 71.2 hours).

Family	Species	n	R.A. %	CPUE (fish/hr)	Size range
Cyprinidae	Chiselmouth	1	0.02	0.01	113
	Carp	35	0.68	0.49	42-747
	Peamouth	5	0.1	0.07	60-138
	Northern pikeminnow	61	1.18	0.86	33-599
	Longnose dace	1	0.02	0.01	35
	Speckled dace	1	0.02	0.01	
	Redside shiner	29	0.56	0.41	41-79
	Tench	7	0.14	0.1	148-470
Catostomidae	Longnose sucker	8	0.15	0.11	80-437
	Bridgelip sucker	7	0.14	0.1	191-360
	Largescale sucker	397	7.69	5.58	43-682
Ictaluridae	Yellow bullhead	1	0.02	0.01	180
Salmonidae	Cutthroat	1	0.02	0.01	411
	Lake Whitefish	4	0.08	0.06	493-523
	Rainbow trout	502	9.72	7.05	30-588
	Kokanee	2807	54.35	39.42	167-562
	Chinook	6	0.12	0.08	425-752
	Mountain whitefish	27	0.52	0.38	109-418
	Brown trout	31	0.6	0.44	113-567
	Bull trout	2	0.04	0.03	417-800
	Bull trout/E. brook hybrid	1	0.02	0.01	383
	Eastern brook trout	47	0.91	0.66	73-409
Gadidae	Burbot	37	0.72	0.52	95-601
Cottidae	Cottidae	107	2.07	1.5	18-143
Centrarchidae	Pumpkinseed	3	0.06	0.04	93-103
	Smallmouth bass	187	3.62	2.63	24-297
	Largemouth bass	26	0.5	0.37	33-380
	Black crappie	41	0.79	0.58	36-206
Percidae	Yellow perch	478	9.25	6.71	49-210
	Walleye	178	3.45	2.5	66-536
Grand Total		5,165	100	72.54	

Table 13. Summary of the total number of fish collected (n), relative abundance (R.A.), catch-per-unit-effort (CPUE), and size range (mm) of the fish collected by EWU via boat electrofishing at Lake Roosevelt between August 15th – November 20th, 2001 (effort = 64.35 hours).

Family	Species	n	RA %	CPUE (fish/hr)	Size range
Cyprinidae	Carp	80	1.6	1.24	32-815
	Peamouth	2	0.04	0.03	130-284
	Northern pikeminnow	63	1.26	0.98	38-600
	Speckled dace	1	0.02	0.02	50
	Redside shiner	2	0.04	0.03	104-109
Catostomidae	Longnose sucker	4	0.08	0.06	161-431
	Bridgelip sucker	4	0.08	0.06	75-512
	Largescale sucker	483	9.65	7.51	29-635
Ictaluridae	Yellow bullhead	1	0.02	0.02	123
Salmonidae	Cutthroat (Westslope)	1	0.02	0.02	232
	Lake Whitefish	5	0.1	0.08	172-585
	Rainbow trout	326	6.51	5.07	47-547
	Kokanee	2126	42.47	33.04	89-600
	Chinook	1	0.02	0.02	645
	Mountain whitefish	17	0.34	0.26	99-349
	Brown trout	18	0.36	0.28	95-676
	Bull trout	1	0.02	0.02	512
	Eastern brook trout	59	1.18	0.92	73-430
Gadidae	Burbot	13	0.26	0.2	96-602
Cottidae	Cottidae	112	2.24	1.74	30-138
Centrarchidae	Smallmouth bass	527	10.53	8.19	38-365
	Largemouth bass	17	0.34	0.26	57-422
	Black crappie	242	4.83	3.76	37-251
Percidae	Yellow perch	789	15.76	12.26	39-197
	Walleye	112	2.24	1.74	70-485
Grand Total		5,006	100	77.79	

Appendix C – Number of kokanee collected per site, 2000-01.

Table 14. Kokanee collected per site sampled during 2000. AD- = fin clipped only, AD+ = fin clipped and coded wire tag, NO- = no clips or coded wire tag (wild fish).

Location	Site Number	Days Fished	Effort (min)	AD-	AD+	NO-	Total
Grand Coulee							
Crescent Bay	E1	5	46				0
Eden Harbor	E2	5	40				0
Spring Canyon	E3	5	56				0
Qui Qui Creek	E4	5	39				0
Swawilla Basin	E5	5	41				0
Cayuse Bay	E6	5	50				0
Wynhoff Cove	E7	5	30				0
Coffman Canyon	E8	5	35				0
Keller Ferry							
Bay at RM 14 (Flats)	E11	1	10				0
Keller Boat Launch							
Bay	55	1	8				0
Covington Cove	E13	1	10				0
Hellgate Canyon	70	2	15				0
Penix Canyon	E14	5	43				0
Spiegel Canyon	E15	5	38				0
Whitestone Creek	E16	5	38				0
Burbot Creek	E17	5	43				0
Sanpoil							
Manila Creek	SP14	3	25				0
John Tom Creek	SPE3	3	23				0
Silver Creek	SPE4	1	10				0
Sanpoil River Mouth	SPE5	4	80		1	5	6
Hawk Creek/Seven Bays							
Lundstrom Bay	E18	4	30				0
Moonshine Bay	E19	4	33				0
Halverson Canyon	E20	4	33				0
Sterling Point Creek A	E21	4	28				0
Sterling Point Creek B	E22	4	33				0
Lincoln Creek Cove	E23	5	53		1		1
Hawk Creek	HE2	6	290	7	11	13	31
Sunday Bay	E24	5	43				0
George Creek	E25	5	45				0
Friday Bay	E26	4	30				0
Fort Spokane							
Spokane River	S2/S4	4	29				0
Columbia River	137	4	28				0

Louie Creek	E28	4	30				0
Table 14 Continued							
Location	Site Number	Days Fished	Effort (min)	AD-	AD+	NO-	Total
Abraham Creek	E29	4	31				0
Denison Canyon	E31	4	31				0
Three mile Creek	E30	4	48				0
Castle Rock Creek	E33	4	41				0
Six Mile Creek	E34	4	50				0
Nine Mile Creek	E35	4	40				0
Hunters							
Wilmont Cove	E36	4	60	1	1		2
Gerome Bay	E37	4	40		1	1	2
Alder Creek	E39	4	50	1			1
Managhan Creek	E40	4	22				0
Hunters Creek	E41	4	50	3		1	4
Falls Creek	E42	4	38				0
Nez Perce Creek	E43	4	58				0
Gifford							
Cloverleaf	E46	5	45				0
East Strange Creek	E47	5	50		1	1	2
West Stranger Creek	E44/E45	5	55				0
Hall Creek	E48	5	62	2		1	3
Bradbury Beach							
Cheweka Creek	281	5	32				0
Barnaby Creek	282	5	43				0
Quilisacut Creek	289	5	30				0
La Fleur Creek	294	5	26			1	1
Martin Creek	302	5	23				0
Roper Creek	E49	5	74		1		1
Rickey Creek	E50	5	43				0
Kettle Falls							
Colville River	E51	9	190	1	2		3
Sherman Creek Cove	E52	10	297	996	1,568	1	2,565
Sherman Creek (BP)	Creek	4	41	37	56		93
Kettle Marina	E53	5	45	1			1
Across Kettle Marina	E54	5	45				0
Fenders Creek	E55	5	50	2	3		5
Nancy Creek	E56	5	48		2		2
Napoleon Bridge	K16	5	65				0
Deadman Creek	K8	5	52				0
Kettle Bridge	K1/K3	5	55				0
Evans/China Bend							
15-mile Creek	E60	5	30			1	1
Flat Creek	E61	5	45				0
Crow Creek	406	5	45	2		5	7

Table 14 Continued							
Location	Site Number	Days Fished	Effort (min)	AD-	AD+	NO-	Total
Rattlesnake Creek	408	5	40				0
Porcupine Bay							
McCoy Springs	SE2	5	38.3	5	10		15
Orazada Creek	SE3	4	38.3	1	3	1	5
Hollies Creeks	SE4	5	43				0
Sand Creek	SE5	5	40				0
Porcupine Creek	S37	5	32				0
Blue Creek	SE7	5	60	2	4		6
Pitney Creek	SE8	5	35				0
Springs	S57	5	46.7		1		1
Cayuse Cove	SE10	5	55				0
Harker Canyon	SE11	5	56.7				0
Mill Canyon	SE12	5	45				0
Little Falls							
Pumphouse	S80	5	45				0
Boat Launch	S82	5	50.5		1		1
Above Spring Creek	S93	1	20				0
Spring Creek	SE13	5	70				0
Powerhouse	S94	5	65	3	19		22
Spillway	SE14	5	100	6	6		12
Grand Total			4,316	1,066	1,692	31	2,789

BP = backpack shocked in Sherman Creek.

Numbers represent all fish collected by EWU.

Table 15. Kokanee collected per site sampled during 2001. AD- = fin clipped only, AD+ = fin clipped and coded wire tag, ADLP- = adipose and left pectoral fin clip, ADRP- = adipose and right pectoral fin clip, and NO- = no clips (wild fish).

Location	Site Number	Days Fished	Effort (min)	AD-	AD+	ADLP-	ADRP-	NO-	Total
Grand Coulee									
Crescent Bay	E1	4	35						0
Eden Harbor	E2	4	40	3					3
Spring Canyon	E3	4	45	1					1
Qui Qui Creek	E4	4	40						0
Swawilla Basin	E5	4	33						0
Cayuse Bay	E6	4	46						0
Wynhoff Cove	E7	4	40						0
Coffman Canyon	E8	4	33						0
Keller Ferry									
Bay at RM 14 (Flats)	E11	3	24						0
Keller Boat Launch Bay	55	5	34						0
Covington Cove	E13	5	45						0
Hellgate Canyon	70	4	41						0
Penix Canyon	E14	4	45						0
Spiegel Canyon	E15	4	39						0
Whitestone Creek	E16	4	45	2					2
Burbot Creek	E17	4	46	3					3
Sanpoil									
Manila Creek	SP14	4	40						0
John Tom Creek	SPE3	4	28						0
Silver Creek	SPE4	4	38						0
Sanpoil River Mouth	SPE5	4	43	1	1			2	4
Hawk Creek/Seven Bays									
Lundstrom Bay	E18	4	43						0
Moonshine Bay	E19	4	42						0
Halverson Canyon	E20	4	36	3					3
Sterling Point Creek A	E21	4	35						0
Sterling Point Creek B	E22	4	40	1					1
Lincoln Creek Cove	E23	4	49	20	1				21
Hawk Creek	HE2	6	75	118	97	2		8	223
Hawk Creek (backpack)	HE2	2	32	219	5				224
Sunday Bay	E24	4	40						0
George Creek	E25	4	40						0
Friday Bay	E26	4	40						0

Table 15 Continued

Location	Site Number	Days Fished	Effort (min)	AD-	AD+	ADLP-	ADRP-	NO-	Total
Fort Spokane									
Spokane River	S2/S4	3	28						0
Columbia River	137	4	32						0
Louie Creek	E28	4	33						0
Abraham Creek	E29	4	37						0
Denison Canyon	E31	4	28						0
Three mile Creek	E30	4	40						0
Castle Rock Creek	E33	4	40						0
Six Mile Creek	E34	4	38						0
Nine Mile Creek	E35	4	40	2	1				3
Hunters									
Wilmont Cove	E36	4	60	1					1
Gerome Bay	E37	4	41	16	2			1	19
Alder Creek	E39	4	40		1				1
Managhan Creek	E40	4	28						0
Hunters Creek	E41	4	40	2	8				10
Falls Creek	E42	4	40						0
Nez Perce Creek	E43	3	32	2					2
Gifford									
Cloverleaf	E46	4	27						0
East Strange Creek	E47	4	35						0
West Stranger Creek	E44/E45	4	40	2					2
Hall Creek	E48	4	50	6					6
Bradbury Beach									
Cheweka Creek	281	4	32	2				1	3
Barnaby Creek	282	4	35			1			1
Quilisacut Creek	289	4	33						0
La Fleur Creek	294	4	33				1		1
Martin Creek	302	4	35						0
Roper Creek	E49	4	44	8	4	2		1	15
Rickey Creek	E50	4	37						0
Kettle Falls									
Colville River	E51	10	154	26	3	1	13	2	45
Sherman Creek Cove	E52	20	237	314	711	236	15	4	1,280
Sherman Creek (BP)	Creek	4	38	24		70			94
Kettle Marina	E53	5	75	8	4	1	1	2	16
Across Kettle Marina	E54	4	40	1					1
Fenders Creek	E55	4	39	7	6			2	15

Table 15 Continued									
Location	Site Number	Days Fished	Effort (min)	AD-	AD+	ADLP-	ADRP-	NO-	Total
Nancy Creek	E56	4	38	1	2		1		4
Napoleon Bridge	K16	4	50						0
Deadman Creek	K8	4	40	2	1				3
Kettle Bridge	K1/K3	4	40						0
Evans/China Bend									
15-mile Creek	E60	4	35						0
Flat Creek	E61	4	40	1				2	3
Crow Creek	406	4	43		1	1		1	3
Rattlesnake Creek	408	4	37	1					1
Porcupine Bay									
McCoy Springs	SE2	6	50	9	2			2	13
Orazada Creek	SE3	3	30	53	36			4	93
Hollies Creeks	SE4	5	40						0
Sand Creek	SE5	4	30						0
Porcupine Creek	S37	4	30						0
Blue Creek	SE7	4	40						0
Pitney Creek	SE8	4	25	1					1
Springs	S57	4	40						0
Cayuse Cove	SE10	4	35						0
Harker Canyon	SE11	4	40						0
Mill Canyon	SE12	4	30						0
Little Falls									
Pumphouse	S80	3	30						0
Boat Launch	S82	5	48	1					1
Spring Creek	SE13	4	65						0
Powerhouse	S94	3	45	1	1				2
Spillway	SE14	3	80	1	1				2
Grand Total			3,816	863	886	314	31	32	2,126

Appendix D – Summary of kokanee collected by other agencies, 2000-01.

Table 16. Summary of kokanee collected by the Spokane Tribe, Colville Tribe, and Washington Department of Fish and Wildlife (WDFW) during 2000 and 2001.

	AD+	AD-	ADRP-	NO-	Unknown	Total
2000						
Spokane Tribe (EF and GN)	13	12	--	31	0	56
Spokane Tribe Creel	0	0	--	0	0	0
Colville Tribe (EF)	2	0	--	2	0	4
WDFW (GN)	21	30 ¹	--	45	1	97
Rainbow and Kokanee Derby	NA	NA	NA	NA	20	20
2001						
Spokane Tribe (EF and GN)	?	?	?	?	?	?
Spokane Tribe Creel	0	2	0	?	0	?
Colville Tribe (EF)	6	86 ²	0	18	0	107
WDFW (GN)	8	25	2	18	2	55
Rainbow and Kokanee Derby	54	34	--	99	6	193
Kokanee Angler Diaries						

¹22 hatchery kokanee were not checked for coded wire tags

²18 hatchery kokanee were not checked for coded wire tags