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Chief Joseph Kokanee Enhancement Project
Project No. 199501100
2007 Annual Report

Prepared for
Bonneville Power Administration
Portland Oregon

CHIEF JOSEPH

KOKANEE ENHANCEMENT

PROJECT

2007 ANNUAL REPORT
(Non-Technical)

CONFEDERATED TRIBES
OF THE COLVILLE INDIAN RESERVATION

BPA Project No. 9501100
Report prepared for
Carlos Mathews

Project Funded By

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Introduction

This annual report is submitted as partial substantiation of work accomplished for 2007.

The Chief Joseph Kokanee Enhancement Project was first initiated into the Northwest Power Planning and Conservations Council in 1995. Its purpose is to evaluate the status, enhance and protect natural origin kokanee in streams tributary to Lake Roosevelt and Lake Rufus Woods as well as entrainment through Grand Coulee Dam From 1996 to 2005 the project monitored and tested entrainment and deterrent technologies while also monitoring escapement, collecting tissue samples for genetics research and habitat enhancement. Entrainment was determined to be substantial and deterrent technologies (strobe lights) did not function as expected so the project was ultimately discontinued. In 2006, the project shifted directions towards habitat enhancement, genetics research, monitoring and evaluating kokanee populations in tributary streams and initiating supplementation efforts in the San Poil River to increase natural production.

In 2003, a genetic study was conducted to determine the stock origin of kokanee found in Lake Roosevelt. Genetic evaluation of the natural production stocks indicated a mixed population consisting mostly of San Poil River with some evidence of Upper Columbia River stocks including Norns Creek and Hill Creek Hatchery (Loxterman and Young 2003). The Nespelem River (Lake Rufus Woods) and San Poil River (Lake Roosevelt) had a similar relationship that possibly pre-dates the construction of Grand Coulee Dam or was a result of entrainment below the dam (Loxterman and Young 2003). There is a perception by lake managers that native origin kokanee are driven by immigration from Canada. Immigration via the Kettle River is also an unknown and there are no current plans to assess it. Further genetics analysis evaluating data gaps in the 2006 report are underway and will provide further information to the origin of native stocks. This report will be finished in late 2009.

In 2005, two enhancement projects were conducted to improve fish passage by the Chief Joseph Kokanee Enhancement Project. Thirty Mile Creek culvert was an old existing arch culvert that was replaced with a bottomless arch culvert with new approaches and road alignment. This improvement increased access to available habitat above the culvert. The second project that was undertaken was the Bridge Creek habitat improvement project. The project involved re-channeling, placement of large woody debris (LWD), construction of relief channels and restored direct access to the San Poil River. The project is expected to improve spawning and rearing habitat for kokanee and rainbow trout which has shown an increase in two years from 13 and 16 rainbow trout captured in 2004 and 2005 respectively to 137 in 2007 (Colville Tribe unpublished data). Kokanee utilization has not been determined because very few escape into the San Poil River.

The status of natural origin kokanee in Lake Roosevelt and Lake Rufus Woods is decreasing. Populations that once numbered in the hundreds in the San Poil and Nespelem River now average 2 and ~30 individuals per year respectively (Colville Tribe unpublished data). Predation and entrainment are two factors that limit kokanee success

(Baldwin 1999; LeCaire 1998). Fish managers have attempted to solve both factors using increased harvest regulations for predation and deterrent technologies for entrainment (failed). Entrainment is difficult to manage due to the operational plans developed for the Columbia River. Predation control measures have only just begun and therefore limited information is available to assess their impacts on salmonids. Habitat, a third factor that could potentially impact kokanee success, is of good quality; however temperatures do climb at or above optimal levels for kokanee from mid to late summer in some tributaries and the reservoir is above optimal temperatures down to 33 meters from July to September (Colville unpublished data; Baldwin 1998). The zone between the reservoir and tributary may cause a thermal barrier to migrating kokanee because inlet tributary streams that are within optimal temperature units enter at or above the 33 meter zone in the reservoir. This could potentially increase shoreline spawning in deep waters along the reservoir. Shoreline spawning has not been observed in FDR or Rufus Woods.

The San Poil River was noted for its large runs of steelhead trout and Chinook salmon during the pre-dam era. After the construction of Grand Coulee Dam in 1939, kokanee were observed in the San Poil in small numbers. These were thought to be a remnant population from the Arrow Lakes in British Columbia which supported a natural reproductive stock of sockeye before the dam. However stocking records from Ferry County indicate that several thousand kokanee were planted in lakes and tributaries to the San Poil River from 1915 to 1918 that were reared at the Republic Fish Hatchery (Darwin 1917; 1920 and 1921; Dibble and Kinney 1923). These were believed to be Whatcom stock located near the west coast in Washington (Al Scholz personal communication). No records have been found from 1932 to present. From 1995 to 2000 individual kokanee returning to the San Poil ranged from 54 to 100 individuals per year. From 2001 to present only a couple individuals per year returned indicating that the population was not successfully reproducing.

In 2005, the Lake Roosevelt hatchery program had surplus Meadow Creek fingerling kokanee and needed a place to release them. Due to the severity of the current population, the availability of an in basin stock and the fact that the project wanted to enhance the kokanee in the San Poil, managers decided to release approximately 67,520 in 2005 and another 65,455 in 2006 to try to re-establish a new population. Expected returns are anticipated in 2008 and 2009.

The Lake Roosevelt hatchery kokanee program has been unsuccessful in producing fry kokanee that return as adults since the program began in the 1990's. In order to improve hatchery returns, the program decided to release kokanee fry higher in the system in order to provide separation from predators and entrainment at Grand Coulee Dam. An in basin stock (Meadow Creek) was the primary stock chosen for release because studies had shown that they return at higher rates than that of Lake Whatcom stock (McLellan 2003). By utilizing tributaries higher in the system and a stock adapted to the basin, managers hope to improve the success of the hatchery program.

Big Sheep Creek was selected as one of the release sites and has been monitored by this project since 1995. The creek has supported a small run of kokanee since the1980's

when the U.S.Fish and Wildlife Service stocked it (taken from LeCaire 1998). Additionally, hatchability tests indicated that sockeye and kokanee eggs hatched with 92 and 77% success respectively (Fulton and Laird, no date) indicating that if kokanee returned and spawned, natural production could be successful. Over a three year period starting in 2004, approximately 1.3 million kokanee fry (differently marked) were stocked in the Big Sheep Creek. In 2007, no kokanee returned to the creek. Monitoring will continue through 2009.

Description of Study Area

The Chief Joseph Kokanee Enhancement project area incorporates both Lake Rufus Woods and Lake Roosevelt (Figure 1. Map of Lake Roosevelt.). The Colville Indian Reservation and "north half Colville Reservation" border the entire north shore of both systems. The major contributors to these fisheries are walleye (*Sander vitreum*), rainbow trout (*Oncorhynchus mykiss*), kokanee (*Oncorhynchus nerka*), smallmouth bass (*Micropterus dolomieui*), lake whitefish (*Coregonus clupeaformis*), and burbot (*Lota lota*). Mountain whitefish (*Coregonus williamsoni*) support mid-winter tributary fisheries.

Lake Rufus Woods is the impoundment created upon the completion of Chief Joseph Dam in 1956. It extends upstream a distance of approximately 82 km to below Grand Coulee Dam at river mile 596.6. The Nespelem River is the only major tributary to the system and a waterfall 1.5 miles from the confluence with Lake Rufus Wood blocks adfluvial salmonid migrations.

Lake Roosevelt is the impoundment located behind Grand Coulee Dam and is the largest reservoir in Washington extending 243 km. Flood control operations at Grand Coulee Dam reduce water elevation up to 24 m during the months between January and June to create room for the spring freshet. The current management plan have recently called for a three-meter reduction in water level to facilitate anadromous fish migrations downstream in late summer coupled with another foot to foot and half for the Columbia River Water Management Program. However, the plan still provides water elevations at 1280 or above during the kokanee spawning migration.

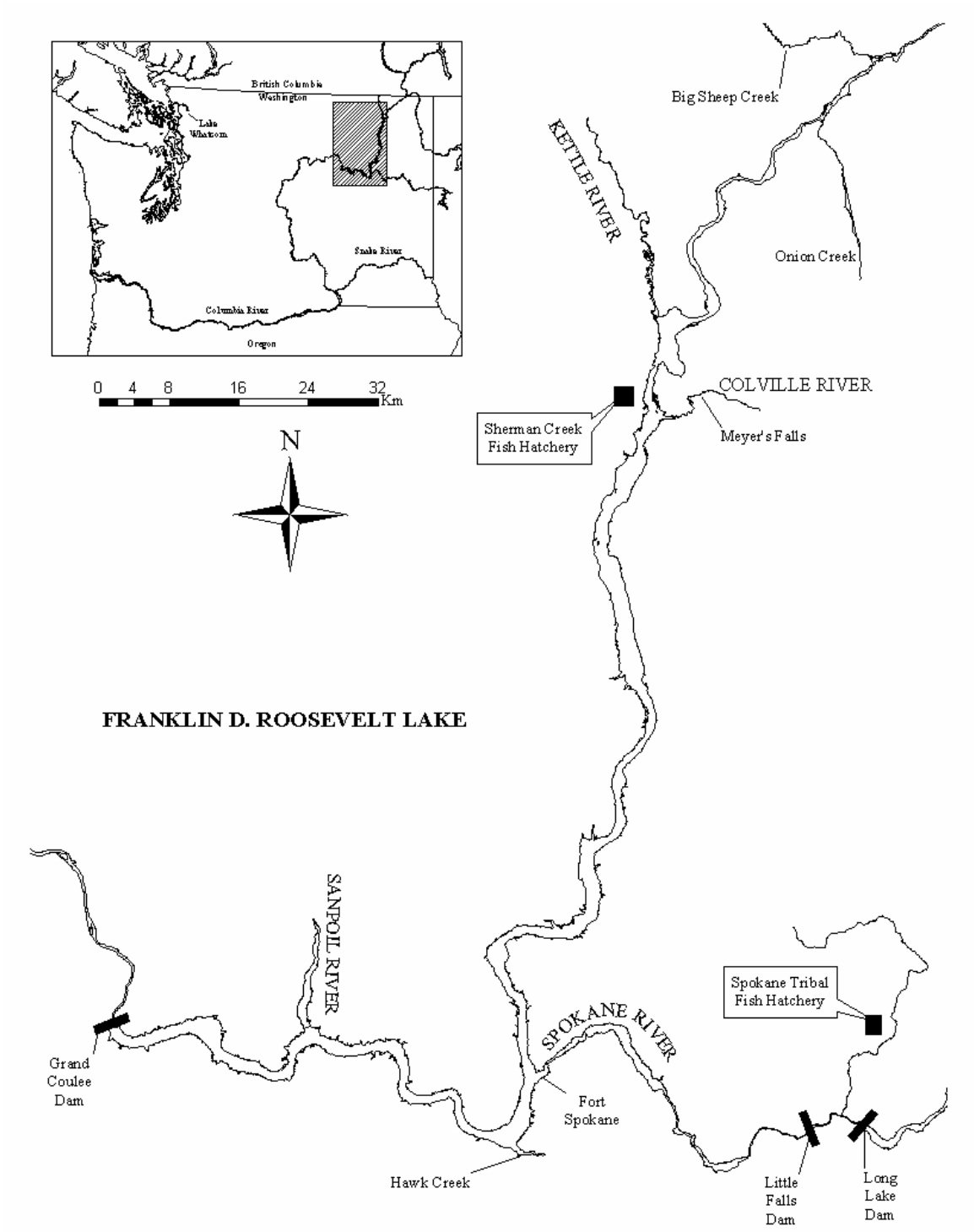

Figure 1. Map of Lake Roosevelt.

Project Goals

In an effort to effectively manage and evaluate natural origin and hatchery supplementation kokanee populations in Lake Rufus Woods and Lake Roosevelt, specific objectives included:

1. Continued monitoring and assessment of adult kokanee spawner escapement in Nespelem River, San Poil River and Big Sheep Creek.
2. Monitor and evaluate juvenile outmigration in the San Poil River.
3. Assess the specific origin of kokanee stocks comprised of tributary spawning populations and the “free ranging” kokanee populations in Lake Roosevelt and Rufus Woods Reservoir and the upper Columbia River in B.C. using micro satellite DNA.
4. Improve habitat in tributary streams and rivers.
5. Determine the feasibility of fish passage at Barnaby Cr.

Methods and Results by Work Element

Work Element A: Produce Environmental Compliance Documentation

Work Element Title: Collection Permit
Deliverable: Federal, State and other necessary permits

A section 10 permit was applied for and obtained from the U.S. Fish and Wildlife Service 8/25/05 for Big Sheep Creek. The permit was granted until 2009. Surveys conducted on the San Poil and Nespelem Rivers did not require federal or state permits because they fell within reservation boundaries. A reservation HPA permit was granted.

Work Element B: Install Fish Monitoring Equipment

Work Element Title: Spawning Escapement Enumeration Weirs
Deliverable: Functional and daily-maintained traps.

Enumeration data was collected on the San Poil River and Big Sheep Creek using a picket style weir. The weir traps were installed and in operation between 25 July 2007 and 1 August 2007. The traps were monitored through 1 November 2007. The traps included a large holding box (1 m x 1m x 2.7 m long); two side panels were placed into the down stream end of the holding box in the form of a V that helped channel fish into the trap. Additional panels (baffles) were placed inside the box to help prevent escapement and to slow water velocity to prevent mortality caused by exhaustion. Tripods were placed diagonally downstream from the live box. The tripods were approximately 1.5 m long with the back post made adjustable to add a degree of slope to the panels. The tripods were then attached to the live box and to each tripod using wire. Each tripod had two cross bar with a series of holes (22) drilled in them for the 1.5 m aluminum tubing. Once the tripods were in place the aluminum tubing was placed through the crossbars so that all the holes were filled making a complete barrier across the tributary.

The traps were checked almost every day between 1 August and 8 November. The WDFW, Colville Tribe and Eastern Washington University employees shared in the daily maintenance of the Big Sheep Creek trap while the Colville Tribe employees also maintained the San Poil River. Each day the trap was checked, debris was cleaned off the trap and the appropriate data (species, length, weight, sex, origin (wild or hatchery) marks, and release location) from each fish was taken. Temperatures were collected using an Onset thermograph.

Work Element C: Collect/Generate/Validate Field and Lab Data

Work Element Title: Kokanee Spawning Ground and Adult Trapping Survey
Deliverable: Collection of kokanee tissues for genetic analysis by WDFW. Enumeration data collected and presented in this report.

San Poil Rotary Screw Trap

A rotary screw trap was monitored from April 3, 2007 to June 7, 2007. The trap was typically run for 4 nights and 4 days per week. Efficiency testing could not be accomplished due to the limited number of fish captured at any one time. Protocols identified a minimum of 30 fish during a 24 hour period before efficiency testing could be conducted. Discharge increased from March to April and decreased from April to June (Figure 2). The highest mean monthly discharge was 237 cfs in April. Discharge did not affect operation but did create debris that jammed the trap one time (April 10).

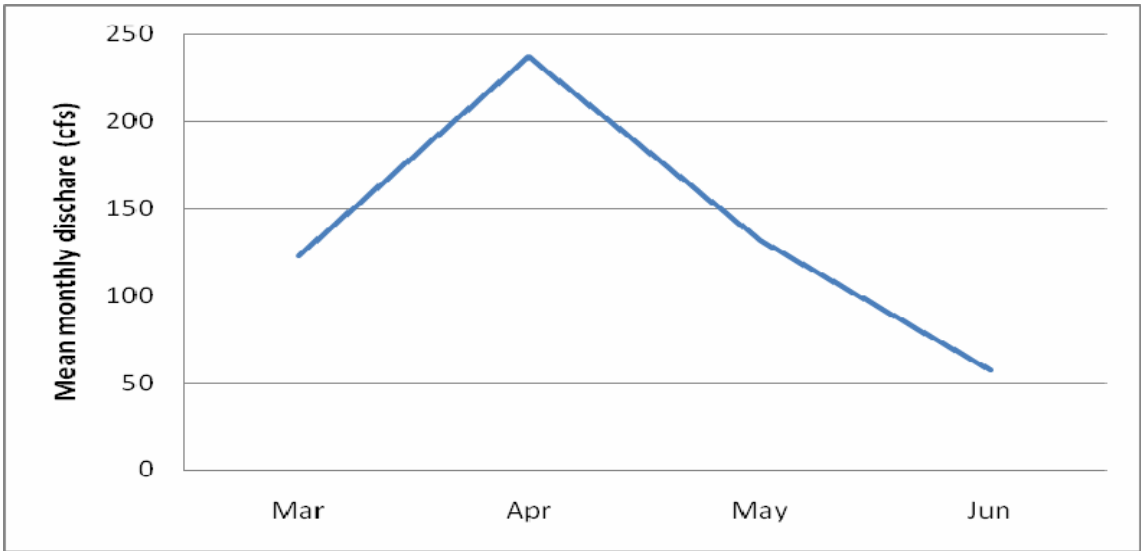

Figure 2. Mean monthly discharge from the USGS West Fork San Poil site during the sampling period.

A total of 57 rainbow trout and 2 kokanee were captured in the trap. Rainbow trout ranged in lengths from 50mm to 202mm (up to 2 distinct age classes; no scales were taken) and were all wild. Of the two kokanee captured one was 35 mm in length while the second was not measured by technicians but was identified as a sacfry (egg sac still attached). Other species captured include speckled dace, longnose dace, tench and sculpins (Table 1).

Foot Surveys

Foot surveys were not completed on Big Sheep Cr and the San Poil River due to the limited number of kokanee in the traps. These surveys were meant to determine potential spawning grounds if enough fish returned from initial supplementations. No traps were installed on the Nespelem River due to high water temperatures and a history of mortalities that occur just below the weir site. Foot surveys were conducted instead and occurred every Friday during the spawning season. A total of 6 trips were made that identified 13 kokanee. The majority of kokanee seen were oriented under a barrier

waterfall so it was hard to determine how many individuals or pairs occurred due to plunge bubbles. Estimated number shown above doesn't represent the total number of kokanee utilizing the Nespelem because the plunge pool is so deep and visibility is near zero. Only one kokanee was observed below the plunge pool.

One thermograph was placed in the Nespelem River. Temperatures were above optimal temperatures for kokanee from August 3rd to September 7th and fell within optimal temperatures thereafter (Figure 3).

Table 1. List of species captured including total number, mean length (mm), range (mm) and origin.

Species	N	Mean Length (TL mm)	Range (mm)	Origin
Kokanee	2	35	35	w
Rainbow trout	57	112	50-202	w
Speckled dace	2	115	115	w
Longnose dace	2	103	96-110	w
Tench	2	97	76-118	w
Sculpin	1	115	115	w

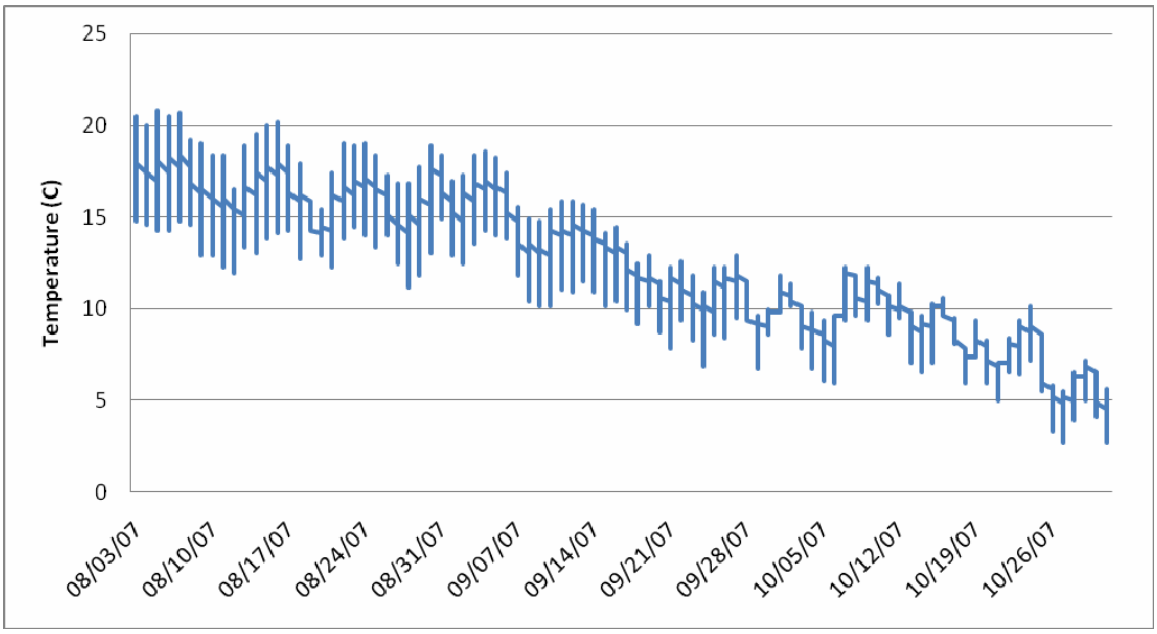

Figure 3. Nespelem River daily temperatures in degrees C during kokanee spawning migration.

Genetic Tissue Sampling

Genetic tissue samples were collected throughout 2007 from all areas of Lake Roosevelt and Upper Columbia River in British Columbia. Additional samples (350) were collected at 7 tributary streams to the Arrow Lakes. A total of 443 samples were stored in 100% ethanol and delivered to WDFW Genetics Laboratory where they are currently being analyzed. The project will collect one more year of data before the final results and report are complete in 2009.

Big Sheep Creek

In fall of 2007, the returns of the initial supplementation effort were due to return. The trap was installed on July 24th and monitored to November 1, 2007 . Four eastern brook trout and one kokanee were captured during the sampling period. The kokanee was 354 mm in total length and weighed 482 g.

Water quality in Big Sheep Creek has typically been within optimal levels for kokanee in the past. However in the 2007, water temperatures migrated into regions that tend to be unsuitable for kokanee (Table 2). From August 2, 2007 to August 22, 2007 temperatures were at or above the optimal levels for kokanee. However the times in which these temperatures occurred probably had little effect on the kokanee migration in Big Sheep Cr. because typically migrations occur in late August into September as temperatures begin to cool. However, reservoir temperature may have been above optimal ranges up to late September but were not reported by this project. All other water quality parameters were within the optimal ranges for kokanee.

Table 2. Water quality data from Big Sheep Creek including discharge, velocity, temperature, D.O. and Dissolved Gas (Collected by the Spokane Tribe of Indians).

Date	Discharge (cfs)	Mean Velocity (ft/s)	Mean Temperature (C)	Mean Dissolved Oxygen (mg/l)	Mean Dissolved Gas (%)
8/2/2007	36.9	1.4	18.4	9.3	105.1
8/7/2007	29.5	1.4	18.4	9.4	104.6
8/15/2007	35.2	1.4	16.0	9.7	103.3
8/22/2007	31.3	1.4	15.0	10.0	103.8
8/28/2007	25.1	1.1	14.1	10.3	104.2
9/6/2007	20.2	1.1	15.9	9.8	103.9
9/12/2007	19.3	1.1	14.5	10.6	105.0
9/18/2007	19.4	1.0	11.6	11.2	104.0
9/27/2007	21.2	1.0	9.8	11.5	103.0
10/1/2007	27.0	1.1	10.2	11.7	103.8
10/12/2007	24.8	1.0	8.2	11.7	100.8
10/24/2007	24.1	1.1	7.0	12.1	101.5
10/29/2007	23.8	1.1	4.4	12.6	100.0
11/8/2007	20.2	1.0	6.2	12.2	102.1
8/2/2007	36.9	1.4	18.4	9.3	105.1

San Poil River

The San Poil River was monitored from July 30th to November 6, 2007. A total of 36 fish were captured consisting of 20 kokanee and 14 rainbow trout (Table 3). Kokanee ranged in size from 270 mm to 410 mm. Eighteen kokanee were of hatchery origin and two were wild while rainbow trout were all wild. The hatchery kokanee (jacks) were presumably from the 2005 supplementation effort that planted ~67,520 fingerlings. We expect that the bulk of these plants will return in 2008. No foot or aerial surveys were conducted due to the limited number of kokanee that returned to the river.

Temperatures were above optimal levels for kokanee from July 30, 2007 to September 8 2007 and fell within optimal temperatures thereafter (Figure 4).

Table 3. List of species captured including total number, mean length (mm), range (mm) and origin.

Species	N	Mean total length (mm)	Range (mm)	Number of hatchery/wild
Kokanee	20	319	270-410	18 H; 2W
Rainbow trout	14	390	235-520	14W
Mountain whitefish	1	294	294	W
Smallmouth bass	1	170	170	

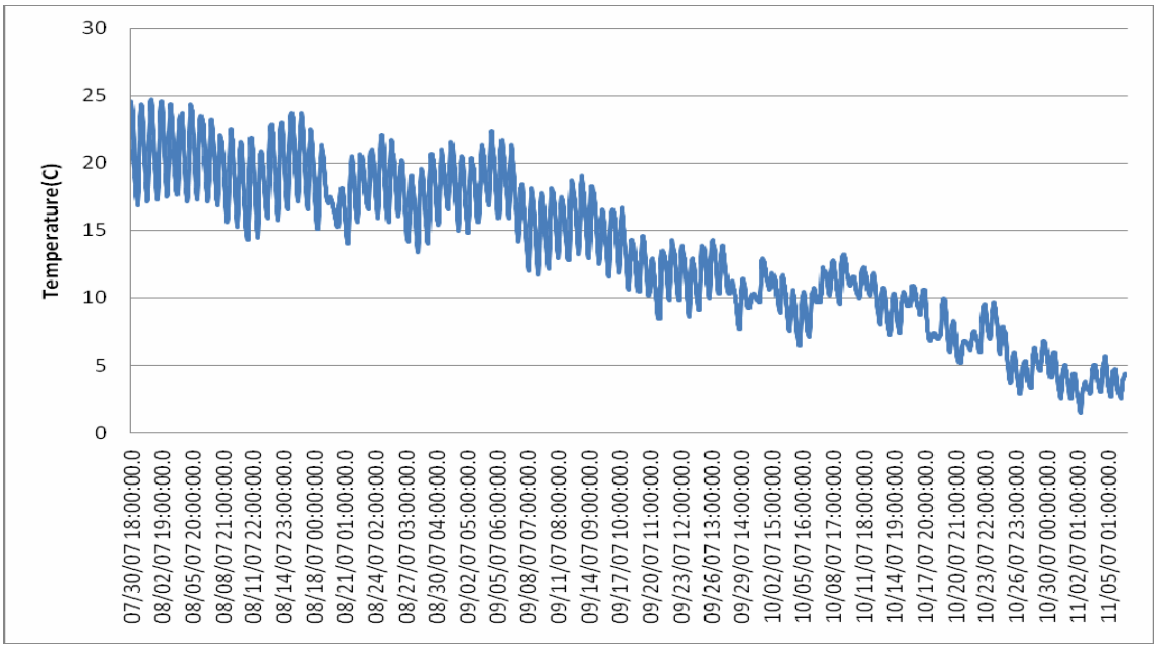

Figure 4. Graph depicting temperature over time at the San Poil River weir site.

Work Element D: Analyze/Interpret Data

Work Element Title: Genetic Evaluation of kokanee salmon in the blocked area.
Deliverable: Analysis of tissue samples and full scale report completed by late 2009.

Information regarding kokanee genetics was inserted in the previous section as part of the collection effort. A final report will be complete in late 2009.

Work Element E: Regional Coordination

Work Element Title: Coordination with other BPA projects and hatcheries.
Deliverable: Coordination

The Chief Joseph Kokanee Enhancement Project assisted and coordinated with other Lake Roosevelt management personnel at quarterly meetings. Additional coordination also included ISRP review of the kokanee program on Lake Roosevelt and BPA COTR and Environmental Compliance personnel visits. The project also purchased acoustic telemetry equipment in order to monitor tagged kokanee within areas of interest to the project that were not being covered under the original plan. These receivers were deployed on the San Poil Arm and information exchanged with EWU (project lead).

Work Element F: Outreach and Education

Work Element Title: Local and regional information exchange.
Deliverable: Information exchange.

Information exchange was provided at the Lake Roosevelt Forum, local clubs and at fish and wildlife meetings.

Work Element G: Manage and Administer Project

Work Element Title: Project Administration
Deliverable: Submit draft funding package

This work element involved the management and administration of the Chief Joseph Kokanee Enhancement Project with guidelines established by the Colville Confederated Tribes and BPA. The project managed and administered personnel, purchasing requirements for project implementation and operations, developed sub contracts for the Barnaby Cr feasibility study and processed BPA requirements and requests. For the deliverable the project developed a SOW and budget that was submitted for FY08 approval.

Work Element H: Produce Plan
Work Element Title: Fish Passage
Deliverable: Feasibility report

During the FY07-09 funding cycle request, the project proposed investigating the feasibility of providing passage at the Barnaby Creek culvert which is perched some 40+ feet above the lake surface impeding fish passage. The project contracted with LGL Limted to assess the feasibility of providing access over a range of lake elevations. Their tasks included:

1. Site Assessment
2. Regulatory Assessment
3. Biological and Physical Assessments
4. Concept Development and Refinement
5. Reporting
6. Project Management

The report concluded that it would appear feasible to construct a fishway and fish passage facility at Barnaby Creek using one of two alternatives presented. They also recommended carrying both alternatives (vertical slot fish ladder and natural fishway channel) to the feasibility level to determine more realistic construction and final engineering costs. The full report is posted on the PISCES account.

Discussions with the lead engineer, who developed the draft designs and cost estimates for the feasibility, indicated that a third alternative may in fact be more feasible. He concluded that there seemed to be enough fill material to the south of the culvert to create a natural fishway. An additional feasibility study would need to be conducted that would ultimately decrease initial costs. From our perspective, this approach is logical and cost effective compared to the other alternatives. Funds to conduct the additional study will be part of the Columbia River Management Agreement between the state and tribe.

Work Element I: Produce PISCES Status Report

Work Element Title: Period Status Report for BPA
Deliverable: Quarterly updates submitted through PISCES

Quarterly status reports were completed using PISCES and were typically delivered on time. A few of the work elements were not completed fully due to unforeseen circumstances and those are identified in the report under each work element heading.

Work Element J: Produce Annual Progress Report

Work Element Title: Submit Progress Report
Deliverable: Annual report submitted to COTR

Annual report was approved by COTR to be complete the following year (2009). Reports will now be submitted the following year to allow for analysis and time to write the report.

Work Element K: Increase Instream Habitat Complexity

Work Element Title: Nespelem Instream Habitat Restoration
Deliverable: Restore habitat (NRCS cost share)

This work element and the ones preceding it were part of a cost share project with Natural Resources Conservation Services (NRCS) on the Nespelem River (Norm McClures property). The project is intended to decrease sedimentation downstream where kokanee salmon spawn. Increased sediment is currently a limiting factor for kokanee production in the Nespelem River.

Instream habitat work included excavating and installing a series of rock step and k-log structures to improve water flow and to decrease incising. A series of pools were created with the rock step structures as a result of a drop in elevation (Figure 5). Log structures were placed at the head of the site to prevent bank erosion (Figure 6). All structures were placed according to specifications outlined in drawings.

Work Element L: Install Fence

Work Element Title: Nespelem River Fencing
Deliverable: Install exclusion fencing (NRCS cost share)

The landowner installed one 850' fence to restrict cattle from a pond, one approx 2300' fence to enhance and manage a riparian pasture, and one 2600' fence to exclude livestock from riparian areas adjacent to a stream and restoration work (Figure 7).

Work Element M: Plant Vegetation

Work Element Title: Nespelem River Tree/Shrub Establishment
Deliverable: Grass and tree shrub establishment (NRCS cost share)

Riparian forest plantings of trees and shrubs were complete this spring (2008) as specified by NRCS drawings. A 12 'wide and 200 plus foot long erosion control blanket on each side of the stream gradient structure was installed to increase bank stability (Figure 5).

Figure 5. Photo depicting rock alignment and creation of pools. Erosion control blanket lines the bank.

Figure 6. Photo at the head of the structure where k-log structures were placed into the bank to channel flow and limit bank erosion.

Figure 7. Photo illustrating a section of fencing installed near stream to prevent cattle grazing.

Discussion

The fall of 2007 was the first year mature kokanee were to return to Big Sheep Creek. Data indicated that the initial 2004 plants were unsuccessful. Factors that possibly contributed to this include predation, entrainment, disease, and straying. However no clear factor has been identified. Observations by the Washington Department of Fish and Wildlife personnel in 2007 indicated that schools of kokanee (red) were seen below the Little Dalles area approximately 5 miles south of Big Sheep Creek in back eddies along the shore of FDR. It's unknown whether these kokanee were associated with Big Sheep Cr. or Onion Cr but hatchery straying has occurred in the San Poil River and Barnaby Creek and other areas along FDR in the past. Returns are expected through 2009 from releases in 2005 (released below the falls) and 2006 (released above the falls) and will be monitored.

The return of kokanee to the San Poil River has been less than desirable the last ten years. Natural production kokanee populations are below the threshold for sustaining a population. As a result, this project is completing a conceptual plan for artificial production in the San Poil River. The plan will address all step 1 elements which will determine the feasibility of supplementation. The plans approximate completion date is December 2008.

A pilot release was conducted in October 2005 and 2006 that included 67,520 and 65,455 fingerling kokanee (Meadow Cr. stock). A screw trap was placed approximately 5 miles below the confluence of West Fork San Poil and San Poil River in late March 2007 to determine when these kokanee out migrated. Only two kokanee were captured that were both less than 32mm indicating that some natural production had occurred and the fingerling releases must have migrated immediately upon release or the months preceding trap placement.

The fall of 2007 was the first year early maturing age-2 kokanee would have returned to the San Poil River. A total of 18 were captured. Estimated return of age 2 kokanee based on total number released (67,520) was approximately .03%. We had 0% return at age 1. Fall of 2008 will determine the adult survival to age 3. Age 2 kokanee from the 2006 plant will also be verified during the upcoming season. No age 1 kokanee were observed from the 2006 plant either.

Critical information gaps exist on the impacts of predators on salmonids in the San Poil River. Baldwin et al. found that up to 73% of all hatchery released salmonids were consumed by walleye and northern pikeminnow in Lake Roosevelt (Baldwin et al. 1999). Observations by tribal biologist indicate a high proportion of walleye and smallmouth bass staging in critical migration routes of salmonids in the San Poil River mainly at the junction between the free flowing section and the lacustrine section. Large proportions of juvenile rainbow trout have been monitored out migrating towards this reach and have been visually seen along the banks. Information such as seasonal habitat utilization, specific interaction points between predators and salmonids, and seasonal diet preferences of predators would be important in determining future release strategies and

management of predators.

Natural origin kokanee (no adipose clip) contribute to the fishery in Lake Roosevelt in fairly large numbers compared to hatchery origin kokanee. However their origin is unknown. Two possibilities exist: 1) Immigration from Upper Columbia Basin stocks in Canada, and 2) Deep shoreline spawning. Current genetic analysis is determining the contribution of Upper Columbia River kokanee to the natural origin kokanee in Lake Roosevelt. Deep water shoreline spawning has never been documented in Lake Roosevelt but has been well documented in other lakes (Hassemer and Riemen 1981; Modde et al. 1997; Morris and Caverty 2004; Gipson and Hubert 1993; Wilson and Andrusak 2003). Kokanee have been found to be successful shoreline spawners in lakes with minimal elevation changes. Better survival of kokanee at shallow depths results in higher mortality in shallow shoreline spawning locations exposed to water fluctuations (Modde et al. 1997). However, incubation success at groundwater upwellings has had increased success compared to tributary spawning kokanee (Garrett et al. 1998). Higher incubation temperatures (increased temperature units) increase development and therefore increases hatch timing. An increase in hatch timing could potentially benefit fry during critical drawdown periods by allowing eggs to hatch earlier before drawdown begins. At the fry stage, kokanee have adapted swim characteristics allowing them to swim to deep waters during water elevation changes. In Great Central Lake, Vancouver, sockeye fry at swim up move directly to deeper water (Barraclough and Robinson 1972). However it may be deep shoreline spawning is a potential source of the kokanee fishery in Lake Roosevelt and needs to be examined in greater detail.

The Chief Joseph Kokanee Enhancement Project continues its efforts to enhance wild kokanee production. Future objectives for the project that investigate origin, population status, habitat and other biotic factors affecting natural origin kokanee will include the following:

1. Continued escapement monitoring in San Poil and Nespelem Rivers and Big Sheep and Barnaby Cr.
2. Continue the Councils three step process for artificial production in San Poil River.
    a. Conduct studies recommended in master plan.
3. Genetic determination of wild origin kokanee in FDR (2009).
4. Completion of fish passage at Barnaby Creek.
    a. Determine feasibility of artificial supplementation and spawning channels.
5. Determine level of shoreline spawning in the San Poil arm of FDR.
    a. Continue this effort into the reservoir.
6. Determine spawning locations in San Poil River using radio telemetry.
7. Determine interactions between walleye and kokanee or rainbow trout through acoustic telemetry.
8. Determine diet of walleye and bass and other piscivores in the San Poil arm and relate that to the telemetry study.
9. Develop a priority list of habitat restoration projects to increase quality and quantity of habitat and then move on each action.

10. Assess entrainment at Chief Joseph Dam.
11. Determine juvenile kokanee production and survival in San Poil River, Nespelem River, Big Sheep Cr. and Barnaby Cr.
12. Assist EWU with acoustic telemetry work on wild adult kokanee in Lake Roosevelt and continue work into Rufus Woods.

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Appendix A

Summary of fish collected on San Poil River 2007.

Date	WDFD #	CCT #	Species	TL(mm)	Wt (g)	H/W	Sex	Hd #	Notes
07/27/07			RBT	250		W			
08/02/07			RBT	350	547	W			24 @ 3:32pm
08/09/07			RBT	290	301	W			16 @ 9:10AM
08/10/07			RBT	490	1115	W			17 @ 9:00AM
08/11/07			RBT	510	369	W			14 @ 9:30AM
08/11/07		RB 1	RBT	520		W			
08/13/07			RBT	376	580	W			17 @ 11:00am
08/14/07			RBT	443	863	W			22 @ 3:40pm
08/15/07			RBT	485	1029	W			16 @ 9:00am
08/16/07			NF						17 @ 9:22am
08/17/07			NF						17 @10:12am
08/20/07			NF						15 @ 8:10am
08/21/07		SP001	KOK	293	286	H			14 @ 8:20am
08/22/07			NF						15 @ 8:35am
08/23/07		SP002	KOK	339	452	H			15 @ 8:15am
08/23/07		SP003	KOK	310	420	H			15 @ 8:15am
08/23/07		SP004	KOK	<310	<420	H			15 @ 8:15am
08/24/07		SP 1	KOK	275	208	W	F	AD	16 @ 8:54AM
08/24/07		RB2	RBT	310	279	W			15 @ 10:21am
08/27/07		SP005	KOK	340	503	H			14 @ 8:20am
08/27/07		SP006	KOK	350	497	H			14 @ 8:20am
08/27/07		SP007	KOK	302	331	H			14 @ 8:20am
08/27/07		RB001	RBT	442		W			14 @ 8:20am
08/27/07		RB002	RBT	325	430	W			14 @ 8:20am
08/28/07			NF						13 @ 9:00am
08/29/07			NF						
08/31/07		RB 3	RBT	430	1007	W	F		17 @ 9:45AM
08/31/07		SP 2	KOK	319	429	H	F		
08/31/07		SP 3	KOK	270	297	H	M		
08/31/07		SP 4	KOK	285	302	H	M		
08/31/07		SP 5	KOK	305	351	H	F		
09/04/07		SP008	KOK	293	291	H	F		16 @ 9:00am
09/05/07			NF						15 @ 8:10am
09/06/07			NF						15 @ 8:05am
09/07/07			NF						18 @ 8:30AM
09/10/07			NF						12 @ 8:45am
09/11/07			NF						12 @ 8:40am
09/12/07			NF						12 @ 9:30AM
09/13/07			NF						12 @ 8:10am
09/14/07		SP009	KOK	291	175	W	M		12 @ 9:30am
09/20/07			KOK	340	425	H	M		9 @ 9:30AM
09/20/07			NF						10 @ 11:25am

09/21/07			NF						8 @ 9:00AM
09/24/07			KOK	320	405	H	M		12 @ 12:30PM
09/25/07			KOK	325	440	H	M		8 @ 8:15AM
09/26/07			NF						8 @ 8:20AM
09/27/07			KOK	362	506	H	M		9 @ 10:O1AM
09/28/07			NF						10 @ 10:00am
10/02/07			SMB	170					11 @ 10:00AM
10/03/07			RBT	235		W			10 @ 10:20AM
10/04/07			NF						7 @ 9:55AM
10/05/07			NF						6 @ 8:30AM
10/08/07			NF						10 @ 10:20AM
10/09/07			KOK	410	758	H	M		10 @ 10:30AM
10/10/07			NF						10 @ 10:30AM
10/11/07			MWF	294					10 @ 11:09AM
10/12/07			KOK	325	420	H	F		10 @ 10:10AM
10/15/07			NF						8 @ 11:45am
10/16/07			NF						9 @ 10:00am
10/17/07			NF						9 @ 11:00am
10/19/07			NF						8 @ 12:05am
10/22/07			NF						6 @ 9:50am
10/23/07			NF						5.5 @ 8:51am
10/24/07			NF						6 @ 9:45am
10/25/07			NF						5 @ 9:35am
10/26/07			NF						3 @ 9:15am
10/30/07			NF						4 @10:42 am
10/31/07			NF						3 @ 10:30 am
11/01/07			NF						2 @ 9:10am
11/02/07			NF						1 @ 9:45am
11/05/07			NF						4 @ 3:20am
11/06/07			NF						2 @ 8:30am

Appendix B

Summary of fish collected at Big Sheep Cr.

Date	Temp (C)	Species	TL (mm)	Wt (g)	Sex	Maturity	Fin Clips	Release	Comments
8/1/07		EBT	270	250				Y	
8/1/07	17.5	EBT	270	216				Y	
8/2/07	20	EBT	273	246				Y	
8/2/07		EBT	270					Y	
10/14/07		KOK	354	482	M	M	W	Y	DOW 10/15/07

Appendix C

Summary of fish collected at San Poil River screw trap 2007.

Screwtrap Data 2007							
ID	Date	Time	Species	TL(mm)	Origin (H/W)	Fin Clips	Notes
1	4/6	am	cot	115	w	0	
2	5/4	11:00am	kok	35	w	0	sample # 1A
3	4/24	10:00am	lnd	110	w	0	LND = longnose dace
4	5/15	11:00am	lnd	96			
5	4/6	am	rbt	50	w	0	
6	4/6	am	rbt	95	w	0	
7	4/6	am	rbt	75	w	0	
8	4/10	10am	rbt	146	w	0	
9	4/10	10am	rbt	185	w	0	log in cone/not rotating
10	4/10	10am	rbt	170	w	0	
11	4/10	10am	rbt	85	w	0	
12	4/10	10am	rbt	88	w	0	
13	4/11	9:30am	rbt	129	w	0	
14	4/11	9:30am	rbt	160	w	0	
15	4/11	9:30am	rbt	134	w	0	
16	4/11	9:30am	rbt	133	w	0	
17	4/11	9:30am	rbt	85	w	0	
18	4/17	10:15am	rbt	92	w	0	
19	4/18	9:00am	rbt	142	w	0	
20	4/18	9:00am	rbt	94	w	0	
21	4/18	9:00am	rbt	202	w	0	
22	4/19	10:00am	rbt	80	w	0	
23	4/19	10:00am	rbt	75	w	0	
24	4/24	10:00am	rbt	104	w	0	
25	4/24	10:00am	rbt	90	w	0	
26	4/24	10:00am	rbt	89	w	0	
27	4/24	10:00am	rbt	87	w	0	
28	4/25	11:00am	rbt	135	w	0	
29	4/25	11:00am	rbt	85	w	0	
30	4/25	11:00am	rbt	80	w	0	
31	4/26	11:00am	rbt	63	w	0	
32	4/26	11:00am	rbt	104	w	0	

Screwtrap Data 2007							
ID	Date	Time	Species	TL(mm)	Origin (H/W)	Fin Clips	Notes
33	5/2	11:00am	rbt	155	w	0	
34	5/2	11:00am	rbt	109	w	0	
35	5/2	11:00am	rbt	162	w	0	
36	5/2	11:00am	rbt	154	w	0	
37	5/3	11:00am	rbt	105	w	0	
38	5/4	11:00am	rbt	75	w	0	
39	5/8	10:30am	rbt	75	w	0	
40	5/8	10:30am	rbt	82	w	0	
41	5/9	10:30am	rbt	93	w	0	
42	5/9	10:30am	rbt	87	w	0	
43	5/9	10:30am	rbt	92	w	0	
44	5/9	10:30am	rbt	116	w	0	
45	5/10	10:30am	rbt	154	w	0	
46	5/10	10:30am	rbt	68	w	0	
47	5/10	10:30am	rbt	77	w	0	
48	5/10	10:30am	rbt	83	w	0	
49	5/15	11:00am	rbt	136	w	0	
50	5/15	11:00am	rbt	78	w	0	
51	5/16	7:00am	rbt	95	w	0	
52	5/16	7:00am	rbt	197	w	0	
53	5/17	11:00am	rbt	89	w	0	
54	5/24	11:30am	rbt	98	w	0	
55	5/30	11:00am	rbt	158	w	0	
56	6/6	2:00pm	rbt	142	w	0	
57	6/6	2:00pm	rbt	118	w	0	
58	6/6	2:00pm	rbt	122	w	0	
59	6/6	2:00pm	rbt	128	w	0	
60	6/7	11:30am	rbt	130	w	0	
61	6/7	11:30am	rbt	124	w	0	
62	4/11	9:30am	spd	115	w	0	
63	4/11	9:30am	spd	115	w	0	
64	5/17	11:00am	tench	76		0	
65	5/9	10:30am	tench	118		0	