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EXECUTIVE SUMMARY

In 2008, the Kalispel Natural Resource Department (KNRD) continued to implement its habitat enhancement projects for bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Baseline fish population and habitat assessments were conducted in Upper West Branch Priest River. Additional fish and habitat data were collected for the Granite Creek Watershed Assessment, a cooperative project between KNRD and the U.S. Forest Service Panhandle National Forest (FS) . The watershed assessment, funded primarily by the Salmon Recovery Funding Board of the State of Washington, will be completed in 2009.

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INTRODUCTION

Fire history, past timber harvest activities, and dams have influenced the landscape in the Pend Oreille Subbasin. The subbasin was first logged in the late 1890s and much of the old-growth timber was removed. Railroads and log flumes were used on the mainstem Priest River and several of its tributaries to transport logs. Log flumes were common, simplified the instream habitat, and decreased the recruitment source of large woody debris. In more recent years, road construction and maintenance, timber harvest, and cattle grazing have degraded stream habitat conditions. Numerous forest fires occurred between 1910 and 1929 and impacted many watersheds.

The fish assemblage existing today in the Lower Pend Oreille subbasins is dramatically different from pre-dam development. Due to the construction of Grand Coulee Dam, anadromous fish have been extirpated and over 1,140 linear miles of spawning and rearing habitat in the Upper Columbia River System were eliminated (Scholz et al. 1985). The five dams on the lower Pend Oreille River are also believed to be a significant reason for the decline of native salmonid populations. These dams include Waneta (Canada), Seven Mile (Canada), Boundary (U.S.), Box Canyon (U.S.), and Albeni Falls (U.S.). None of these dams were built with fish passage facilities. Outlet dam (U.S.) on the lower end of Priest Lake further fragmented the connectivity of native salmonid populations.

In an attempt to partially mitigate for the resident and anadromous fish losses caused by hydropower development and operation, the Northwest Power Planning Council (Council) called for recommendations to develop a program that would provide measures to protect, mitigate and enhance fish and wildlife affected by the construction and operation of hydroelectric facilities located on the Columbia River and its tributaries. The Kalispel Tribe (Tribe), in conjunction with the Upper Columbia United Tribes (UCUT) Fisheries Center, undertook a three-year assessment of the fishery opportunities in the Pend Oreille River (Ashe et al. 1991) to provide the Council with recommendations. Assessment findings indicated that trout species were rare in the reservoir and compose less than 1% of the total abundance. Brown trout (*Salmo trutta*), an introduced species, were the most abundant trout species. Factors limiting trout production in the reservoir were identified as warm water temperatures, lack of habitat diversity and food availability. Trout were more abundant in the tributaries to the reservoir, which mostly supported brook trout (*Salvelinus fontinalis*) and brown trout; however, westslope cutthroat (*Oncorhynchus clarki lewisi*), rainbow (*O. mykiss*), and bull trout (*S. confluentus*) were also captured.

The recommendations from Ashe et al. (1991) were adopted and incorporated into the 1994 resident fish and wildlife section of the Council's Program and was further revised in the Council's 1995 Program. These recommendations called for:

- 1) Restoring tributary populations of native cutthroat and bull trout, and
- 2) Enhancing the largemouth bass population to provide a quality sport and subsistence fishery in the reservoir.

These goals may appear to conflict, but there is a dramatic difference in habitat between the tributaries and Box Canyon Reservoir. The Box Canyon reach of the Pend Oreille River was formed in 1955 by the construction of Box Canyon Dam. The dam changed the riverine habitat in this reach to habitat typical of a broad, shallow reservoir. The resulting high summer water temperatures continue to exceed Washington Department of Ecology and Kalispel Tribe

temperature criterion on a regular basis. This change in habitat made favorable conditions for warmwater species. Ashe et al. (1991) and Bennett and Liter (1991) concluded that yellow perch is the most abundant species in Box Canyon Reservoir. The other species in descending order based on relative abundance are pumpkinseed, tench, and largemouth bass. Trout species are rare and of the trout species present, brown trout are the most abundant. Tributary trapping data suggests that brown trout is the only trout species in Box Canyon Reservoir having an adfluvial population (Lockwood et al. 2001). Temperature conditions limit the distribution of native trout in the reservoir. Bull trout have optimal rearing temperatures of 7-8⁰C (Goetz, 1989) and temperatures exceeding 15⁰C are thought to limit distribution (Fraley and Shepard, 1989, Goetz, 1991, Pratt, 1985). In Box Canyon reservoir, bull trout are limited to microhabitats in cold water springs, or metalimnion areas. A culvert located on the southern bank, 1.6 km downstream of Albeni Falls Dam is one of these cool water refuges. In 2004, 9 bull trout were captured and tagged in or near this culvert (Geist et al., 2004). Bull trout require spawning areas with clean gravel and temperatures ranging from 5-9⁰C; these conditions do not exist in the reservoir. Conversely, largemouth bass have optimum temperatures of 13-26⁰C and will select habitats in the littoral zone where temperatures exceed the optimum for bull trout. Thus, habitat overlap between native trout and largemouth bass is unlikely and interaction very unlikely (NEPA Doc, 1996).

Cutthroat and bull trout populations residing in the tributaries need to be protected since these appear to be the remaining populations in the Pend Oreille Subbasin. The greatest impacts to these populations include: 1) habitat degradation from past land use activities; 2) habitat fragmentation and loss of connectivity due to man-made structures; and 3) hybridization and competition from introduced species. Isolation due to the fragmentation of native populations is likely to increase the risk of extinction through both environmental stochasticity and lack of genetic variation (Rieman and McIntyre 1993; Lacy 1987). Degraded habitat resulting in poor complexity further increases the risk of extinction for small, isolated populations because refugia from extreme environmental events are lacking (Pearsons et al. 1992, Saunders et al. 1990; Sedell et al. 1990). Hilderbrand and Kershner (2000) estimated that 8 km of stream length are required to sustain an isolated population of cutthroat trout with high abundance (0.3/m).

Interactions with non-native species have also had an impact on resident populations of westslope cutthroat and bull trout. Brook trout X bull trout hybridization appears to be the most prevalent problem in isolated populations (Markle 1992). Competitive interactions with introduced species (mainly brook trout) have likely contributed to depressed cutthroat trout populations in the Pend Oreille Subbasin. Of the streams surveyed by the KNRD in the Lower Pend Oreille Subbasin, the highest cutthroat trout densities have been observed in streams and headwater reaches where brook trout were absent.

The habitat restoration portion of this project primarily addresses factors that limit native tributary populations. Our in-channel restoration increases habitat complexity, which provides refugia during extreme environmental events and, therefore, lowers the extinction risk for the targeted populations. The Tribe recognizes that instream habitat restoration is a temporary solution to habitat degradation and that recovery will only occur when future human impacts are minimized and watershed processes are restored. The Tribe has and will pursue opportunities for watershed restoration projects. However, watershed restoration will not yield significant improvements for years or decades. The Tribe also recognizes that some of the native fish populations in the Lower Pend Oreille subbasin will not persist for years or decades. In some watersheds, individual native fish sightings are rare or populations are isolated in small tributaries. Restoration implemented by the project increases the habitat attributes that are

limiting native salmonids while non-native fish removal will eliminate the threats associated with competition and hybridization with the native populations.

In summary, KNRD's plan for recovering native salmonid populations is:

1. Perform baseline stream habitat and fish population assessments to determine current distribution and abundance and identify core watersheds where recovery efforts will be focused.
2. Work to protect existing native populations and good habitat through participation in regional policy setting groups and consultation with area land, fish, and wildlife management agencies.
3. Pursue funding from various sources and participate jointly with other agencies in watershed restoration projects.
4. Implement instream and riparian restoration in identified recovery areas.
5. In recovery areas with non-native populations: 1) capture and relocate native fish, 2) treat streams to remove non-native species, and 3) translocate genetically identical or similar native fish from sister watersheds.
6. Monitor restoration and adapt management plans if needed.

2008 TRIBUTARY HABITAT AND FISH POPULATION ASSESSMENTS

DESCRIPTION OF STUDY AREA

Habitat and fish surveys were conducted in the Upper West Branch Priest River (UWB) in Idaho and Washington (Figure 1). UWB flows in a southeasterly direction and enters Priest River approximately 10 Km downstream of Priest Lake. Total drainage area in the UWB watershed is 184 Km². In 2008, surveys were completed in the upper portion of UWB and its tributaries; drainage area of the surveyed reaches was 104 Km². Surveys were completed in 30.7 Km of stream channel.

Except for two small private inholdings, the watershed where surveys were completed is public land administered by the FS. Historically, resource management activities in lower UWB were cattle grazing, timber harvest, and road construction; these activities have impacted the lower watershed. However, in the upper watershed timber harvest and associated road building have been relatively light. Although a road exists up to a trailhead, the upper watershed has never been harvested upstream of Sockwa Creek. This headwater area has been designated by Congress as a roadless area and current use is primarily recreational.

The fire history in UWB is extensive. The first fire on record was in 1890. Parts of the upper watershed also burned in large fires that occurred in 1926 and 1939. It appears that each fire burned less than 50% of upper watershed. However, because of the fires, there are just a few stands of old growth and mature timber existing in the project area (M. Fairchild, pers. comm.).

Figure 1. Location of UWB and tributaries where fish and habitat surveys were completed in 2008.

Geology in the upper watershed (from Klahowya Creek upstream) consists of monzogranite. The Solo and Galena watersheds are composed of grandiorite. The valley bottom in UWB from Colza Creek downstream is comprised of glacial and alluvial deposits.

METHODS

Habitat data was collected using the R1/R4 Fish and Fish Habitat Standard Inventory Procedures (Overton et al. 1997). Large woody debris (LWD) was collected using the procedure described in Davis et al. (2001). This method measures the quantity of pieces and debris dams, but also evaluates the function of the wood in influencing stream morphology, hydrology, and organic material retention. Reaches were defined by lengths of stream channel with common confinement, gradient, and substrate (Rosgen, 1994). Breaks between two homogeneous areas defined a new reach. Reach break locations were recorded using a hand-held GPS unit. Spawning habitat was evaluated using the methods described in the Clearwater Stream Methodology (Espinosa 1988). The proper gravel size for resident fish ranges from 0.6 – 6.4 cm; optimum size ranges from 1.3 – 3.8 cm (Espinosa 1988). All potential spawning habitat is estimated using a minimum gravel size patch of 0.5 square meters and summed into number of square meters by quality rating of good, fair, and poor (Table 1). Spawning habitat is characterized by three basic components:

1. Clean spawning size gravels, free of excessive sand and fine sediments.
2. Located within close proximity to cover and resting pools.
3. Current velocities of 0.2 - 0.6 m (0.5 - 2.0 ft) per second are considered optimum and desirable for spawning activity and incubation requirements.

Table 1. Spawning Gravel Condition Rating.

Spawning Gravel Condition	Rating
All three components of spawning habitat exist in optimum conditions	Good
Two components of spawning habitat exist or conditions for any of the three components are not optimum.	Fair
Two components of spawning habitat exist and conditions are impaired.	Poor

Habitat variables were selected for analysis based on habitat requirements of native salmonids as well as consideration for the limitations with precision/accuracy noted by Roper et al. others (2002). For quantitative evaluation, we compared values of the habitat variables to values collected in reference reaches. Comparable reference streams were selected from the relatively undisturbed Upper Priest River watershed that flows into Upper Priest Lake. This watershed continues to support adfluvial runs of westslope cutthroat trout and bull trout. R1/R4 habitat surveys were completed in stream reaches from this watershed to develop the reference range of conditions. The method of selecting reaches and developing the benchmark values are described in the Granite Creek Watershed Assessment (in preparation).

The interquartile range, the range between the 25th and 75th percentile, was used to describe the distribution of data for reference conditions. The descriptive rating, from 1 to 4, is based on the interquartile range, with a rating of 1 -2 indicating habitat quality values outside of the interquartile range of the reference stream, and 3 – 4 indicating habitat values similar to reference conditions. The benchmark values are listed in Table 2.

Fish populations were sampled with a backpack eletrofishing unit. Each sampling station was 100 m in length and effort (time) was recorded for each station. Captured fish were identified to species (salmonids) or family (cottids), counted, and measured for total length. Total densities of each salmonid species and cottids were reported as the number of fish per 100 m². Fish sampling stations were sited where prior sampling by the FS has occurred so that trends in density and distribution could be examined.

Table 2. Benchmark habitat values derived from reference reaches surveyed in the Upper Priest River watershed.

Habitat Variable	Benchmark Value			
	1 (Poor)	2 (Fair)	3 (Good)	4 (Good)
Percent Bank Stability (%)	< 50	50 - 84	85 - 95	> 95
Percent Bank Undercut (%)	0 – 1.5	1.6 - 2.2	2.3 - 4.2	> 4.2
Riffle Pool/Ratio	0.1 - 0.39	0.4 - 0.79	0.8 - 1.0	
Pools per Km	< 13	13 - 25	26 - 39	> 39
Average Residual Pool Depth (m)	< 0.3	0.3 - 0.45	0.46 - 0.54	> .54
LWD Piece plus Debris Dam (Count per 100 m)	< 8	8 - 9	10 - 15	> 15
Percent Surface Fines in Riffles (%)	> 35	25 - 35	< 25

Figure 2. Unstable banks in the lower reaches of UWB.

Figure 3. Fine sediment deposition in the lower reaches of UWB.

RESULTS

Upper West Branch Priest River

Six reaches totaling 17.8 Km (3.7 miles) were surveyed in UWB. The survey began at the confluence with Solo Creek and was terminated in the headwaters. Beaver activity was evident in all of the reaches surveyed. Many of the pools in reach 2 were formed from recent beaver activity or were the result of old beaver dams that were deteriorating and creating plunge pools below. Reaches 1 and 2 were located in an old cattle allotment; these were also the reaches with the highest bank instability (1.1% and 2.4%, respectively; Table 3). Although bank stability was high, relatively long spans of unstable bank were actively eroding (Figure 2) and appeared to be contributing significant volumes of sediment to the stream annually (Figure 3). Historic logging occurred in reaches 3 and 4; many large, old stumps and logs with cut ends were observed. No

Figure 4. Large burned snags in reach 6 of UWB.

fish passage barriers were present until reach 4; upstream of that point many barriers were noted throughout the rest of the survey. Evidence of historic fires was more frequent in the upper watershed (Figure 4). Beaver dams/ponds were common in reach 6.

Relatively high fine sediment levels were measured throughout the stream. High levels of sediment are expected in the lower gradient, depositional type reaches (e.g. Rosgen C channels). However, fine sediment was also high in the steeper channels, reaches 4, 5, and 6, despite being located in a relatively unmanaged, pristine area. Therefore, background levels of fine sediment due to the predominance of granitics in the watershed are likely high.

Fines and residual pool depth (Table 4) were rated as poor or fair relative to reference values (Table 5). Fine sediment may be filling pools and resulting in poor residual pool depths. The LWD frequency was poor in reach 6, potentially due to a lack of recruitable wood as a result of past fires. Spawning habitat was relatively low through most of UWB (range of 0.3 – 0.5 m²/100 m, Figure 6). However, the highest density of spawning habitat in all of the 2008 surveys occurred in UWB reach 6 at 9.7 m²/100 m.

Table 3. Habitat attributes of reaches surveyed in the UWB watershed.

Stream	Reach	Rosgen	Mean					
			Length (Km)	Width (m)	Fines (%)	LWD (No./100m)	Unstable Bank (%)	Undercut Bank (%)
Upper West Branch Priest River	1	C4	5.3	5.3	52	14.6	1.1	11.2
	2	C4	4.0	4.4	44	14.3	2.4	10.6
	3	C4	4.3	4.4	44	17.9	0.2	15.4
	4	A	2.1	4.7	49	14.6	0.1	13.1
	5	A	1.2	3.2	41	17.6	0.0	10.7
	6	B	0.9	2.2	74	4.3	0.1	14.2
Colza Creek	1	Aa+4	1.5	2.7	54	6.6	0.1	19.0
	2	Aa+	1.1	2.4	53	4.9	0.1	19.3
Galena Creek	1	Aa+	0.9	2.9	35	9.9	0.0	16.8
	2	B	1.7	2.4	93	8.9	0.1	23.0
	3	Aa+	1.0	2.0	81	10.2	0.0	16.5
Klahowya Creek	1	A	1.3	1.8	83	15.5	0.1	26.9
	2	A	0.5	2.3	62	17.9	0.0	7.1
Paqua Creek	1	A4	0.5	2.4	47	6.5	0.0	11.9
	2	A4	0.4	2.5	47	12.3	0.0	14.6
	3	A4	0.3	1.3	24		0.0	7.9
Sockwa Creek	1	Aa+	0.4	1.2	72	8.2	0.0	33.3
	2	Aa+	0.5	1.1	97	8.2	0.0	18.5
Solo Creek	1	C5	0.8	3.3	99	6.8	0.1	37.0
	2	B	1.0	4.7	66	10.4	0.0	10.6
	3	A	0.6	3.5	39	8.1	0.0	8.1
	4	A	0.4	1.9	57	10.1	0.3	10.5

Table 4. Summarized pool attributes for reaches surveyed in UWB.

Stream	Reach	Pool:Riffle	Pool Frequency (No./Km)	Mean Residual Pool Depth (m)	Mean Pool Volume (m³)
Upper West Branch Priest River	1	1.68	35.7	0.66	38.9
	2	1.87	43.5	0.95	26.2
	3	1.15	32.4	0.40	23.9
	4	1.18	34.4	0.38	15.7
	5	1.03	32.5	0.43	17.1
	6	1.30	28.8	0.38	4.7
Colza Creek	1	0.76	30.0	0.32	6.1
	2	0.76	31.3	0.27	5.2
Galena Creek	1	0.57	14.0	0.25	1.6
	2	1.09	22.0	0.30	3.7
	3	0.71	10.2	0.26	2.6
Klahowya Creek	1	1.27	72.3	0.32	2.1
	2	0.82	39.8	0.24	2.5
Paqua Creek	1	0.82	55.2	0.28	2.0
	2	1.11	72.3	0.28	3.0
	3	0.77	34.5	0.22	1.2
Sockwa Creek	1	0.87	34.3	0.24	0.8
	2	0.50	11.8	0.24	0.8
Solo Creek	1	0.73	13.8	0.46	16.4
	2	1.03	31.0	0.35	9.9
	3	1.00	27.4	0.30	6.7
	4	0.64	21.2	0.26	1.6

Table 5. Rankings of habitat attributes relative to reference values.

Stream	Reach	Pool:Riffle	Mean Residual					
			Pool Frequency (No./Km)	Pool Depth (m)	Fines (%)	LWD (No./100m)	Unstable Bank (%)	Undercut Bank (%)
Upper West Branch Priest River	1	3	3	4	1	3	4	4
	2	3	4	4	1	3	4	4
	3	3	3	2	1	4	4	4
	4	3	3	2	1	3	4	4
	5	3	3	2	1	4	4	4
	6	3	3	2	1	1	4	4
Colza Creek	1	2	3	2	1	1	4	4
	2	2	3	1	1	1	4	4
Galena Creek	1	2	2	1	2	2	4	4
	2	3	2	2	1	2	4	4
	3	2	1	1	1	3	4	4
Klahowya Creek	1	3	4	2	1	4	4	4
	2	3	4	1	1	4	4	4
Paqua Creek	1	3	4	1	1	1	4	4
	2	3	4	1	1	3	4	4
	3	2	3	1	3		4	4
Sockwa Creek	1	3	3	1	1	2	4	4
	2	2	1	1	1	2	4	4
Solo Creek	1	2	2	3	1	1	4	4
	2	3	3	2	1	3	4	4
	3	3	3	2	1	2	4	4
	4	2	2	1	1	3	4	4

1 = Poor, 2 = Fair, 3 and 4 = Good, shaded values indicate poor and fair ratings.

Table 6. Amount and frequency of spawning habitat in reaches of UWB.

Stream	Reach	Spawning Gravel (m²)	Spawning Gravel Frequency (m²/100m)
Upper West Branch Priest River	1	13.5	0.3
	2	16.3	0.4
	3	11.0	0.3
	4	8.5	0.4
	5	6.0	0.5
	6	64.5	9.7
Colza Creek	1	21.5	1.5
	2	8.5	0.8
Galena Creek	1	0.5	0.1
	2	16.5	1.3
	3	0.0	0.0
Klahowya Creek	1	2.0	0.2
Paqua Creek	1	0.5	0.1
	2	4.5	1.1
Sockwa Creek	1	1.5	0.4
	2	0.0	0.0
Solo Creek	1	0.5	0.1
	2	54.5	5.3
	3	48.5	7.8
	4	27.5	6.5

Figure 5. Culvert located between reaches 2 and 3 of Solo Creek.

Solo Creek

Four reaches totaling 2.8 Km (1.7 miles) were surveyed from the mouth of Solo Creek upstream to a point where fish were no longer present. Much of reach 1 was comprised of beaver ponds. A culvert was present at reach break 2/3 and appeared to be undersized (Figure 5). Due to the vertical drop, the culvert may be a passage barrier to juvenile salmonids and cottids. Providing passage at this culvert would allow fish upstream access for approximately 650 m, where a natural barrier limits further upstream passage. A series of waterfall and cascade barriers near the downstream end of reach 4 appeared to limit upstream distribution of fish; no fish were observed by the surveyors beyond this point.

Mean residual pool depth in reach 1 of Solo Creek was one of only three reaches surveyed in the upper UWB watershed with a good rating. However, pool and LWD frequencies were fair and poor, respectively, in that reach. The LWD density in reach 3 was rated as fair but pool frequency was good. Although little spawning habitat was observed in reach 1 (0.5 m^2 total), the rest of the Solo Creek reaches had relatively high frequencies of spawning habitat ($5.3 - 7.8 \text{ m}^2/100\text{m}$).

Figure 6. Bedrock falls at the start of reach 2 in Klahowya Creek. Falls limit upstream fish distribution.

Galena Creek

Three reaches were surveyed in Galena Creek totaling 3.6 Km (2.2 miles). The survey started where Galena Creek flows into Solo Creek and terminated in the headwaters where several steep cascades and waterfalls were observed. Overall, the channel was relatively steep; two of the three reaches were Rosgen Aa+ channels (>10% gradient). Recent beaver activity was observed in reach 1; however, no dams were present. An old clearcut was present near the end of the survey in reach 3.

Pool frequency in all reaches surveyed in Galena Creek was rated as fair or poor. The LWD density in reaches 1 and 2 were rated as fair. LWD density in reach 3 had a good rating; however, pool frequency and residual depth were both rated poor. Little to no spawning habitat was observed in reaches 1 and 3; reach 2 had a moderate frequency of spawning habitat (1.3 m²/100 m).

Klahowya Creek

Two reaches totaling 1.8 Km (1.1 miles) were surveyed in Klahowya Creek. The survey started at the confluence with UWB. Some older evidence of beaver activity was observed at the start of the survey; however, no recent activity was noted throughout the rest of the survey. A series of bedrock falls were present at the start of reach 2 (Figure 6). These falls limit the upstream distribution of fish in Klahowya Creek – no fish were captured by electrofishing upstream of the falls.

Figure 7. Passage barrier in Paqua Creek located 230 m upstream from the mouth. This barrier limited upstream distribution of fish.

Although fines and residual pool depth had low ratings, Klahowya Creek had the best habitat attribute ratings of all the surveyed streams overall. LWD and pool frequency ratings in both reaches were good. Only 2.0 m² of spawning habitat was observed in the surveyed reach.

Paqua Creek

Three reaches totaling 1.2 Km (0.7 miles) were surveyed in Paqua Creek. The survey started where Paqua Creek enters UWB and terminated in the headwaters. The first significant passage barrier was located in reach 1 less than 100 m upstream from the mouth. The barrier was a 1.5 m high bedrock falls with no pool at the base. Another waterfall, approximately 5.5 m high, was located 150 m upstream of the first barrier (Figure 7). All of the reaches were dominated by bedrock substrate. No fish were present upstream of these falls. A culvert was located at the break between reaches 1 and 2. The culvert (1.5 m diameter) appeared to be appropriately sized to pass flow.

Figure 8. Corduroy road in reach 1 of Paqua Creek.

Remnants of historic logging were observed throughout all reaches surveyed. In reach 1, portions of the channel were covered with old corduroy road for up to 15 m in length (Figure 8). Other evidence included cut-end logs in the stream channel and old stumps along the banks.

LWD density in reach 1 was rated as poor. Historic logging likely left little timber in the riparian area; therefore, potential long-term recruitment of LWD is low. Pool frequency was good in all three reaches. Reach 3 of Paqua Creek had the best rating for fines of all the stream reaches surveyed in the upper UWB watershed. Spawning habitat was sparse in reach 1 ($0.1 \text{ m}^2/100 \text{ m}$) and moderate in reach 2 ($1.1 \text{ m}^2/100 \text{ m}$).

Figure 9. Fish passage barrier in reach 1 of Sockwa Creek. The barrier limited upstream fish distribution.

Sockwa Creek

Two reaches totaling 0.9 Km (0.6 miles) were surveyed in Sockwa Creek. The survey started at the mouth where a perched culvert limits upstream movement of fish. The first natural barrier was observed 202 m upstream from the mouth (Figure 9.). The creek had sub-surface flows at three different locations in the survey area. However, lengths of channel with subsurface flow were relatively short – 7 to 15 m. Remnants of historic logging practices were observed throughout the survey. Four old road crossings made of logs were observed.

Habitat in Sockwa Creek was marginal due to the small size and low flows. Reaches in Sockwa Creek had the lowest mean widths than any other surveyed reach. It has been reported that cutthroat trout reside in Sockwa Creek and that the culvert at the mouth prevents passage thereby causing isolation of the population (M. Fairchild, pers. comm.). However, if fish are present, they are limited to the lowest 200 m of the stream channel. Electrofishing surveys found no fish in two stations sampled above the barrier at 202 m.

Figure 10. Fish passage barrier in reach 1 of Colza Creek. This barrier limits upstream distribution of fish.

Colza Creek

Two reaches in Colza Creek were surveyed measuring 2.6 Km (1.6 miles) in length. Both surveyed reaches were steep with channel gradients greater than 10%. A culvert was located 87 m upstream of the mouth; it appeared to adequately pass all flows. The culvert was 1.8 m wide, 1.2 m high, and had a drop from the culvert lip to water's surface of 0.2 m. A potential fish passage barrier was observed approximately 380 m from the mouth; the barrier was a small bedrock falls measuring 1.3 m in height. However, fish were observed above this barrier. A significant barrier was observed 965 m upstream from the mouth (Figure 10); this barrier limits upstream distribution of fish.

Despite the high gradient, fines in reaches 1 and 2 were relatively high and ranked poor. LWD frequency was also poor for both reaches; however, pool frequency was rated as good. Most of the pools were bedrock or boulder formed. Spawning habitat was moderately frequent in both the reaches surveyed; frequencies in reaches 1 and 2 were 1.5 and 0.8 m²/100 m, respectively.

Figure 11. Fish species and barrier distribution in UWB.

Table 7. Fish densities in reaches of the UWB watershed.

Stream	Reach	BKT Density*	WCT Density*
Colza Creek	1	0.0	5.2
	2	0.0	0.0
	3	0.0	0.0
Galena Creek	1	1.4	6.2
	1	2.3	2.3
	2	0.0	16.0
	3	0.0	15.0
Klahowya	1	0.1	0.0
Lunar Creek	1	0.0	23.3
Paqua Creek	1	15.9	2.9
	2	0.0	0.0
Sockwa Creek	1	0.0	0.0
	2	0.0	0.0
Solo Creek	1	2.3	0.0
	2	0.8	0.0
	2	1.2	0.0
	3	4.4	0.0
	3	3.5	0.3
Tola Creek	1	99.0	0.0
	1	48.0	0.0
	1	45.0	0.0
	2	8.5	0.0
UNT 1 of UWB		40.0	0.0
UNT 2 of UWB		0.0	0.0
UNT 3a of UWB		0.0	13.6
UNT 3b of UWB		0.0	13.6
UWB Priest River	1	2.5	0.0
	1	2.2	0.0
	2	4.3	1.0
	3	5.0	1.2

*Number of fish per 100m²

Fisheries Assessment

Brook trout appear to be suppressing native WCT populations in the UWB watershed. Generally, only non-native brook trout (BKT) were found in the lower reaches and westslope cutthroat trout (WCT) were collected in upper reaches of UWB (Figure 11.). Barriers appeared to limit the upstream invasion of BKT in Colza Creek, Galena Creek, and in the upper reaches of UWB. Densities in these isolated, allopatric WCT populations ($\bar{x}$ = 14.5 fish/100 m²) were significantly higher ($P < 0.001$) than WCT densities sympatric with BKT ($\bar{x}$ = 2.3 fish/100 m². Table 7).

Table 8. BKT and WCT densities from sites sampled by the FS from 1995 to 2006. These sites were re-sampled by KNRD in 2008.

Stream	BKT Density No./100m ²		WCT Density No./100m ²		WCT : BKT Ratio		FS Year
	KNRD	FS	KNRD	FS	KNRD	FS	
Colza Creek	0.0	1.0	5.2	0.3	A	0.30	1996
Galena Creek	1.4	5.7	6.2	0.0	4.43	B	2003
Galena Creek	2.3	15.8	2.3	1.5	1.00	0.09	2006
Klahowya Creek	5.5	3.9	0.0	0.0	B	B	1996
Lunar Creek	0.0	0.0	23.3	15.6	A	A	2006
Solo Creek	4.4	0.3	0.0	0.0	B	B	1995
Solo Creek	3.5	0.9	0.3	0.0	0.09	B	1999
Solo Creek	0.8	9.1	0.0	0.0	B	B	2006
Solo Creek	1.2	0.1	0.0	0.0	B	B	1999
Solo Creek	2.3	1.6	0.0	0.0	B	B	2000
UNT 1 of UWB	40.0	34.0	0.0	0.0	B	B	2000
UWB Priest River	2.5	0.2	0.0	0.0	B	B	2000
UWB Priest River	2.2	5.5	0.0	0.0	B	B	2000
UWB Priest River	4.3	5.8	1.0	0.0	0.23	B	2006
UWB Priest River	5.0	8.7	1.2	0.0	0.24	B	2000

A – BKT absent

B – WCT absent

Where present, WCT populations in the UWB watershed appear to be stable. In 2008, we found WCT present in four stations where previous FS surveys had found none (Table 8). WCT were present in two of the four stations in UWB; earlier FS surveys found no WCT in UWB. In Galena Creek, densities of WCT in 2008 at the two sites sampled increased markedly from earlier samples. In one site, we found a WCT to BKT ratio of over 4:1 whereas in 2003 the FS sampled no WCT. At the other Galena Creek site, we found an equal ratio of WCT and BKT while in 2006 the FS found BKT outnumbered WCT 10 to 1. However, these two sites were located just downstream from a barrier that isolates WCT above; increased WCT numbers may be a result of downstream migration of fish from the allopatric population residing above the barrier. In Colza Creek, BKT were absent from our 2008 sample while in 1996 the FS found BKT comprised 23% of the fish community. Since GPS use was relatively limited in 1996 it's likely that the site on Colza Creek that the FS sampled was hand-drawn on a map and coordinates were derived from that hand-drawn point (resulting in a high amount of error). The lower end of Colza Creek had numerous small barriers that could potentially block fish passage. Considering the frequency of small barriers and the potential mapping errors, the possibility exists that the site we sampled in 2008 was upstream of the 1996 FS site and that a barrier was present between the two sites – thus explaining the lack of BKT in our sample.

CEE CEE AH CREEK 2008 BANK RESTORATION

Figure 12. Lower end of restoration in Site 1. Rootwads were inserted into the stream bank and upper banks were planted with native riparian shrub cuttings.

Site 1

Site 1 was 76 ft. in length with a mean bank height of 5.4 ft. Most of the bank was slumping and actively eroding. Ten rootwads were buried into the toe of the bank to provide structure and stability (Figure 12). The upper banks were excavated to a 2:1 slope and planted with native shrub cuttings to prevent further slumping.

Figure 13. Streambank reconstruction at Site 2.

Site 2

Site 2 was a 100 ft long section of actively eroding bank; mean bank height was 2.6 ft. The streambank was composed of fine material and vegetation was limited to grasses and knapweed. Six rootwads with 5 ft. stumps were anchored into the bank (Figure 13). In between the rootwads, interlocking log structures were placed. These log structures were comprised of four logs that were interlocked with spars leaving a void in the center of the structure. The center of the log structure was filled with 6 – 12 inch riprap. An excavated rock toe was constructed; 6 – 12 inch riprap was placed down to an elevation of 1.5 feet below the streambed elevation. Ten inch lifts were constructed using coir fabric and topsoil. The newly created bank was then planted with cuttings and transplanted native shrubs.

Figure 14. Large wood jam constructed at Site 3.

Site 3

Site 3 was a relatively short (16 ft.) span of unstable bank. Mean bank height at this site was 3.7 ft. At base flow, the channel adjacent to Site 3 is dewatered because a small log jam just upstream of the site diverts all of the flow down the low flow channel. The streambank at Site 3 was stabilized using a small engineered log jam (Figure 14). Eighteen 8 inch diameter logs ranging from 2.5 to 7.5 ft. in length were used. 3 stakes, 5.5 ft. in length, were driven into the channel bottom to secure the structure.

Figure 15. Location of streambank restoration project on Cee Cee Ah Creek.

CEE CEE AH CREEK 2009 BANK RESTORATION DESIGN

INTRODUCTION

Cee Cee Ah Creek is a 2nd order tributary that drains directly into the Pend Oreille River approximately 5 miles north of the town of Usk, Washington. The site of the bank restoration project is just upstream of the LeClerc Road on Kalispel Tribe owned land. Previous to 1999, the LeClerc Road crossing was a double culvert that created a velocity barrier for native fish

migrating upstream at spring high flows. The culvert also created a channel constriction resulting in a backwater effect at high flows. Excess deposition of bedload due to the backwater caused channel migration upstream of the culvert, resulting in unstable banks. In 1999, a SRFB funded project removed the culverts and replaced them with a 24 ft. span, 32 ft. wide, 6 ft. high concrete modular arch. The project was a joint effort between the Pend Oreille County Public Works and Kalispel Tribe. Despite removal of the site-based cause for bank erosion (channel constriction at the culverts), the banks continued to erode because little deep rooted vegetation remained in the riparian area upstream of the LeClerc Road crossing.

METHODS

In 2007, data were collected in Cee Cee Ah Creek (Figure 15) using the PACFISH/INFISH Biological Opinion (PIBO) sampling protocol for stream channel attributes. Data from the PIBO survey were used in the plan and design of streambank restoration to be implemented in three sections of actively failing streambank. Specific bank treatments were designed using the Integrated Streambank Protection Guidelines (ISPG, 2002). PIBO data will also be used to monitor the effectiveness of the restoration practices. This restoration project is cost-shared by a Bureau of Indian Affairs (BIA) grant obtained by the Tribe.

In 2008, three sections of streambank were restored in a 1000 ft. reach of lower Cee Cee Ah Creek. In 2009, four additional sites will be restored just upstream of the 2008 sites. Treatment techniques were determined using three screening matrices described in the ISPG. Treatments for each section were limited to biotechnical techniques. Extensive riparian planting using native shrubs and conifers will be completed along the entire restoration reach.

RESULTS

Pool frequency in the treatment area was 33 pools per mile and the mean pool residual depth was 1.5 feet. Mean surface fines (<4 mm) in the pool tailouts was 14%. Mean bankfull width to depth ratio of four riffles was 17.6. Large woody debris (LWD) frequency for the restoration reach was 178 pieces per mile. LWD mean length and diameter were 13.3 ft. and 0.9 ft., respectively. Mean annual maximum instantaneous flow for Cee Cee Ah Creek from 2007 was 44.1 cfs (range 27.1 to 59.0 cfs). Continuous discharge was measured in Cee Cee Ah Creek from 2004 to 2006; discharge ranged from 27.8 cfs in 2005 to 98.0 cfs in 2006. Relatively significant flows were measured in 2006. Priest River has the nearest USGS gauge that continuously monitors discharge. In 2006, the annual peak discharge exceedence probability was 11% at the Priest River gauge. Therefore, we used the 98.0 cfs measured in Cee Cee Ah in 2006 and assumed that discharge was approximately a 10-year flood event.

We used WinXSPRO (Version 3.0) to calculate bed shear in four riffle cross sections at 98 cfs. Mean bed shear was 0.65 pounds per square foot (psf) and ranged from 0.47 to 0.76 psf. Bend shear was estimated using a calculation developed by the US Department of Transportation. Bend shear ranged from 0.96 psf to 1.63 psf at four riffle cross sections. Therefore, we used the maximum value of 1.63 psf to evaluate the types of materials and size of riprap to be used for streambank restoration.

The U.S. Bureau of Reclamation (BOR) check method (ISPG, 2002) was used to estimate scour depth at bends. The BOR method uses three equations to calculate depth of scour adjusted

Figure 16. Unstable bank at Site 1. Two rootwads will be inserted into the bank for stabilization.

to different channel conditions; the three estimates are then averaged to determine scour depth. Using the three equations and adjusting for a straight reach, mean depth of scour in the treatment area was 0.52 ft. However, since two of the values (0.66 and 0.70 ft.) were three times greater than the third value (0.21 ft.), we chose to use the highest value in designing the bank restoration treatments.

Site 1

Site 1 is 10 ft. in length with a mean bank height of 2.0 ft. Most of the bank is slumping and actively eroding (Figures 16). Two rootwads will be buried into the toe of the bank to provide structure and stability (Figures 17, 18). The upper banks will be excavated to a 2:1 slope to prevent further slumping (Figure 19). The exposed banks will be planted with native shrub cuttings.

Figure 17. Elevation view of restoration design for Site 1.

Figure 18. Plan view of restoration design for Site 1.

Figure 19. Profile view of restoration design for Site 1.

Figure 20. Unstable, eroding bank at Site 2.

Site 2

Site 2 is a 23 ft. long unstable bank with a mean bank height of 2.9 ft. (Figure 20). Most of the bank is slumping and actively eroding. Four rootwads will be buried into the toe of the bank to provide structure and stability (Figures 21, 22). The upper banks will be excavated to a 2:1 slope to prevent further slumping (Figure 23). The exposed banks will be planted with native shrub cuttings.

Figure 21. Elevation view of restoration design for Site 2.

Figure 22. Plan view of bank restoration for Site 2.

Figure 23. Profile view of bank restoration design at Site 2.

Figure 24. Old culvert buried in the stream channel at Site 3.

Figure 25. Old culvert in the stream channel creating a debris dam.

Site 3

An old, buried culvert will be removed in site 3 (Figure 24). The culvert is likely refuse that was either dumped at the site or transported by high flows. At its current site, the culvert has no apparent function (i.e. no diversion or old road crossing is apparent). Over time the culvert has trapped debris, eventually causing the channel to cut off a meander (Figure 25). The old meander is now a side channel with little flow during the summer and fall. In 2009, we will remove the old culvert and a debris jam from the channel. Once these are removed, we anticipate the main flow will naturally be recaptured in the old meander.

Figure 26. A section of eroding bank at Site 4.

Site 4

Site 4 is a 43 ft. actively eroding streambank section with relatively high (7.4 ft. average) banks (Figure 26). The streambank will be reconstructed at this site. The toe of the bank will be reinforced with riprap (6-12 inch) down to 2 ft. below the streambed elevation (Figures 27, 28). Four rootwads with 5 ft. stumps will be placed in trenches and anchored with 12 inch riprap (Figure 29). In between the rootwads, interlocking log structures will be placed. These log structures are comprised of four logs that are interlocked with spars leaving a void in the center of the structure. The center of the log will be filled with 6 – 12 inch riprap. A small (4 ft.) floodplain will be excavated and the streambank will be constructed using four 15 inch soil lifts (Figure 30). The floodplain and soil lifts will be covered with coir fabric. The floodplain and lower bank will be planted with native shrubs using cuttings and by transplanting nearby shrubs. The upper banks will be revegetated with small conifer species supplied by a nursery.

Figure 27. Elevation view of design for bank restoration at Site 4.

Figure 28. Plan view of bank restoration design for Site 4.

Figure 29. Section view of streambank restoration design where root wads will be trenched.

Figure 30. Section view of streambank resoration at Site 4.

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