

Snorkel and Redd Surveys of
Bull Trout in French Creek
2012



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U.S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
Leavenworth, WA

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On the cover: A resident-sized bull trout in the draft Mid-Columbia Recovery Unit. USFWS photograph by Drew Pearson.

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Abstract- Detailed information on distribution, abundance, habitat conditions, and genetic diversity is needed for all bull trout life history forms in order to aid recovery and ultimately remove them from the threatened species list. In Icicle Creek, a resident population with a small migratory component is present in the upper drainage, but until recently, few surveys for bull trout were conducted. Two sites in French Creek (tributary to Icicle Creek at rkm 35) were established and surveyed in 2005 and 2006 during night snorkels under the Integrated Status and Effectiveness Monitoring Program (ISEMP). These sites were revisited and surveyed by USFWS biologists in 2012. A total of 50 bull trout were observed during night snorkeling at site WC-06 (rkm 6.4) in 2012 and the numbers were similar to the surveys in 2005 (44 bull trout) and 2006 (64 bull trout). In 2012, the WM-232 site at rkm 3.7 was significantly changed since it was mapped in 2006 and is now less complex, with fewer logs in the wetted channel, less off-channel habitat, reduced pool habitat, increased riffle habitat and higher overall water velocities. Only 8 bull trout were counted at this site in 2012, compared to 20 in 2006, and the decrease may be the result of the observed habitat changes. Genetic tissue samples were collected from 50 bull trout in 2012 and will be used to increase the robustness of the recently completed genetic baseline of local populations. Two bull trout redds (1 migratory-sized and 1 resident-sized) were observed during the spawning ground survey conducted on September 26, 2012. French Creek has cold water with complex habitats in a pristine wilderness area and is an ideal stream for bull trout that is critical for the maintenance of bull trout in the watershed. Additional snorkel surveys and mark-recapture studies are needed in French Creek to continue monitoring bull trout and to map the extent of their distribution.

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Introduction

Detailed information on distribution, abundance, habitat conditions, and genetic diversity is needed for all bull trout life history forms in order to aid recovery and ultimately remove them from the threatened species list (USFWS 2008). In Icicle Creek, migrant bull trout are observed in the lower river and resident individuals are present in the upper drainage (Brown 1992; Kelly Ringel 1997), but until recently, few surveys for bull trout were conducted (see Nelson et al. 2009). During 2005, 2006, and 2007 two sites in French Creek were surveyed by U.S. Forest Service biologists under the Integrated Status and Effectiveness Monitoring Program (ISEMP). These snorkel surveys indicated that the observed density of resident bull trout is comparable to other streams with local populations in the Wenatchee River basin (Nelson 2007). Recent radio-telemetry studies in Icicle Creek documented that the French Creek population includes migratory individuals (Nelson et al. 2009), and follow-up redd surveys have observed both migratory-sized and resident-sized redds (Nelson et al. 2009; 2011; 2012). Genetic analysis indicates that the level of genetic diversity of French Creek bull trout is within the range of other populations in the Columbia River Basin (DeHaan and Neibauer 2012). Analyses of additional samples from French Creek and other areas such Jack Creek or Leland Creek are needed to determine if there are finer scales of population structure in the upper Icicle Creek watershed.

In 2012, the two ISEMP sites in French Creek were re-visited by biologists from the USFWS Mid-Columbia River Fishery Resource Office and the Wild Fish Conservancy. The objectives were to re-map the sites, conduct night snorkel surveys to count bull trout and other fish, and to collect genetic tissue samples. During the spawning season, USFWS conducted a survey to enumerate bull trout redds and record the number and location of log complexes in the stream. This report presents the results of the surveys, compares the data to previous years, discusses the results, and makes recommendations for future studies in French Creek.

Study Area

French Creek is located within the Alpine Lake Wilderness of the Okanogan-Wenatchee National Forest in Chelan County, Washington. Originating at Sprite Lake near the crest of the Wenatchee Mountains, this third order stream flows for approximately 15.5 km to its confluence with Icicle Creek at about river kilometer (rkm) 35 (Figure 1). Formed by glacial activity, the French Creek Basin drains 6,440 hectares and includes 22 tributaries and several alpine lakes, the largest of which is Klonaqu Lake. The mean annual discharge is 90 ft³/s and minimum flow is 14 ft³/s (Mullan et al. 1992).

French Creek has an average gradient of 6%, with Rosgen channel type B throughout most of the creek, and waterfalls at rkm 8.8 and rkm 9.3 are considered fish migration barriers (Resource Northwest, Inc. 1996). Cobble and gravel dominate the substrate of the low gradient sections downstream of the barriers to rkm 1.5 while cobble and small boulder along with bedrock are the primary substrate from rkm 1.5 to the mouth. The stream bank is armored with bedrock, and glacial till occurs along the valley floor. The vegetative cover in the riparian zone is primarily coniferous forest, and western red cedar (*Thuja plicata*) is the dominant tree species in the floodplain (Resource Northwest, Inc. 1996).

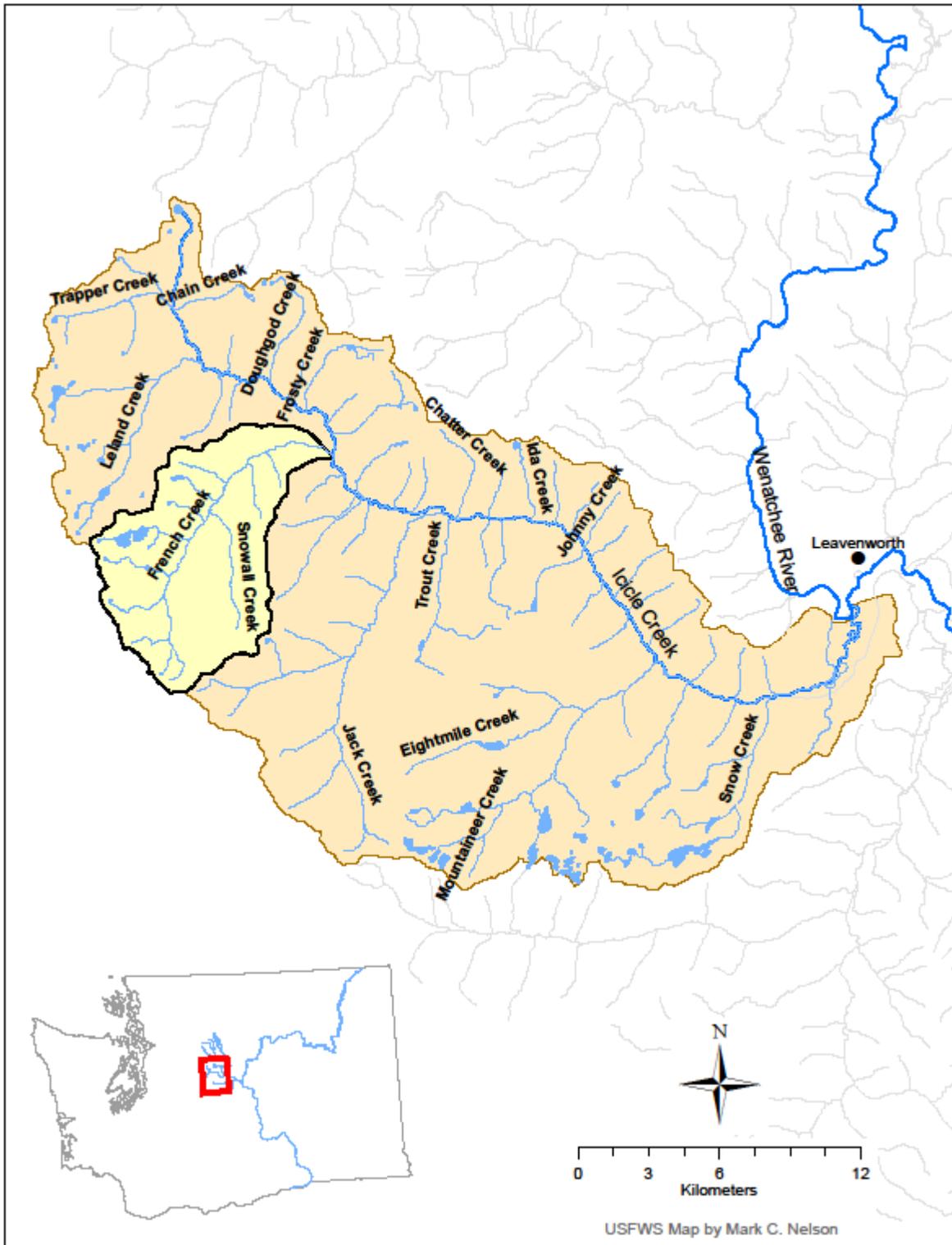


Figure 1. Map of the Icicle Creek watershed showing French Creek in the upper basin.

Methods

Snorkeling efficiencies to detect bull trout are higher at night (mean = 33.2%) than during the day (mean = 12.5%; Thurow et al. 2006). This indicates that snorkel surveys should be conducted at night to provide a better estimate of the abundance of bull trout in a stream reach and that repeat surveys should be conducted within the same period as the original survey. Due to the relative remoteness of French Creek, night snorkels require the packing of gear for both snorkeling and camping. Therefore, the crew was organized into two 2-man teams, and in addition to each man carrying his own personal gear and food, one man packed one set of snorkeling-related gear and the other packed one set of camping gear for each team.

Snorkel survey

Two sites in French Creek previously marked and snorkeled by ISEMP teams were revisited (Figure 2). Site WC-06 is located at rkm 6.4 and site WM-232 at rkm 3.7. Prior to surveys in 2005, both sites were monumented with rebar and geo-referenced with GPS. The habitat units in each site were mapped in 2006 (Appendix Figures A1 and A2).

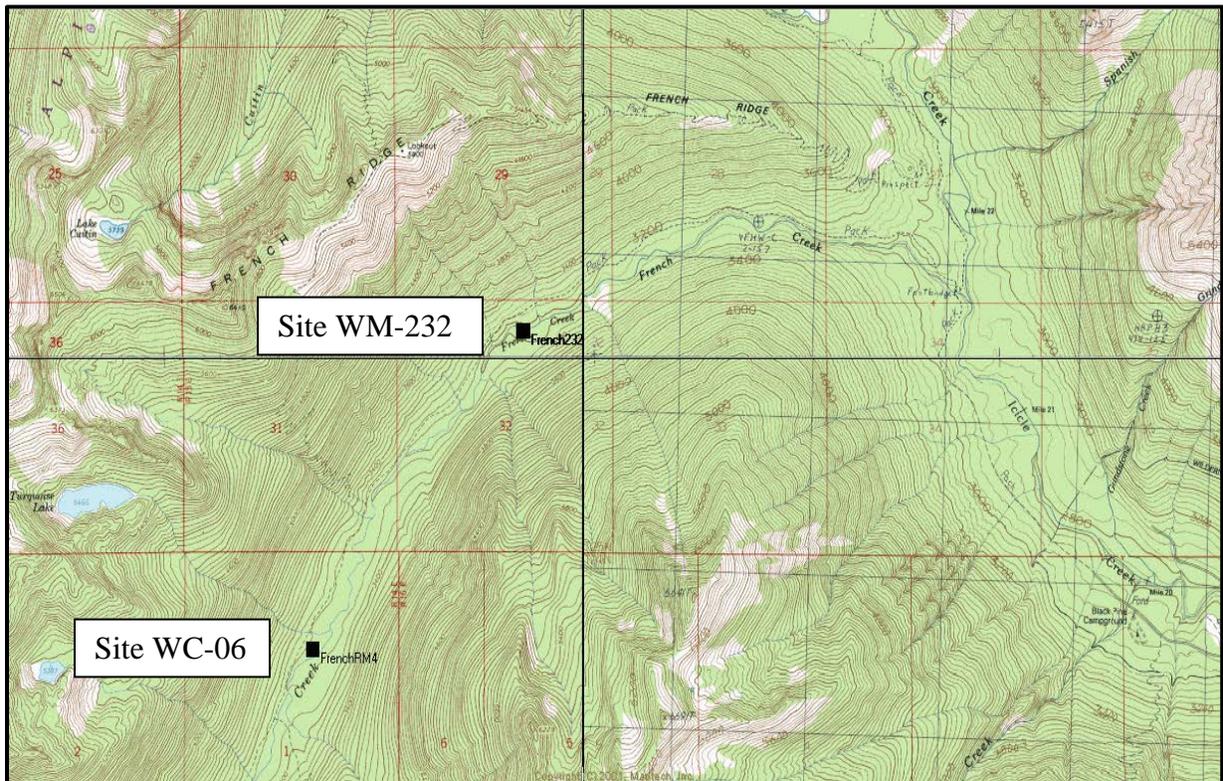


Figure 2. Map of lower French Creek showing locations of snorkel survey sites WC-06 and WM-232.

Snorkel surveys began after the first star was visible in the night sky. Surveys were designed for two snorkelers evenly spaced and moving upstream (however, note that site WC-06 had only one snorkeler- see results). Each snorkeler was equipped with a dive light and counted fish to his left, with the right-side snorkeler responsible for fish to his right as well as those between himself and the left snorkeler. All fish were counted and assigned to a size class of 20 mm intervals, with the

classes designated by the odd integer mid-point of the interval; i.e. size class “30” contains fish that were estimated between 20 and 40 mm in size (Murdoch and Nelle 2008). Data were called out by each snorkeler and recorded in the field book by one of the bank observers. The other observer monitored the habitat map and noted the habitat units as the snorkelers moved upstream.

Genetic collection

During the night snorkel surveys, bull trout were spotlighted and captured by hand with knotless nets. Prior to capture, the snorkeler scanned the habitat unit and noted the location of other bull trout in order to avoid double counting fish. When a bull trout was caught, the net was exchanged for an empty net by the bank observer and the snorkeler continued his count. The netted bull trout was brought to the other bank observer, and with the head of the inverted bull trout submerged underwater, a small amount of tissue was clipped from the ventral lobe of the caudal fin. The sample was placed in a labeled vial of 95% ethyl alcohol and the label number associated with the estimated size of the fish was recorded in the field notebook. The bull trout was then released downstream of the snorkeler in the same habitat unit it was captured in.

Redd survey

Spawning ground surveys to count bull trout redds have been conducted annually in French Creek since 2008. The survey is partitioned into three reaches based on hiking distance and recognizable tributaries as the reach breaks: Reach 1 (rkm 0 – 3.2), Reach 2 (rkm 3.2 – 5.6) and Reach 3 (rkm 5.6 – 7.2). All three reaches were surveyed by experienced observers moving downstream on the same day. Redds were categorized as definite, probable, or possible, with only definite and probable redds included in the final count (Bonar et al. 1997). Redd dimensions were measured with a wading staff graduated in 0.05 m increments. Redd area (m²) was approximated as length multiplied by width. Locations were geo-referenced with GPS units (Rino530HCx®, Garmin Corp.) and waypoints downloaded onto a digital topographic map (MapTech® Terrain Navigator Pro 2010).

Log complex survey

During the redd survey, observers also recorded the number and location of log complexes within the stream. Each complex was geo-referenced with GPS and the size of the complex or the number of large logs was estimated.

Results

Site WC-06

2012 Survey- Site WC-06 at rkm 6.4 was snorkeled on August 28-29, 2012 from 21:25 to 00:50 hrs. Water temperature was 10° C. Only one snorkeler covered the unit, due to the damaged dry suit of the second snorkeler. A total of 50 bull trout and 117 rainbow trout were observed. Tissue samples were collected from 27 of the bull trout (Appendix Table 1). Size classes of bull trout ranged from 30 to 210 mm, with the majority (84%) of bull trout in the 110 to 150 mm classes (Figure 3). Sizes classes of rainbow trout ranged from 30 to 230 mm (Figure 4).

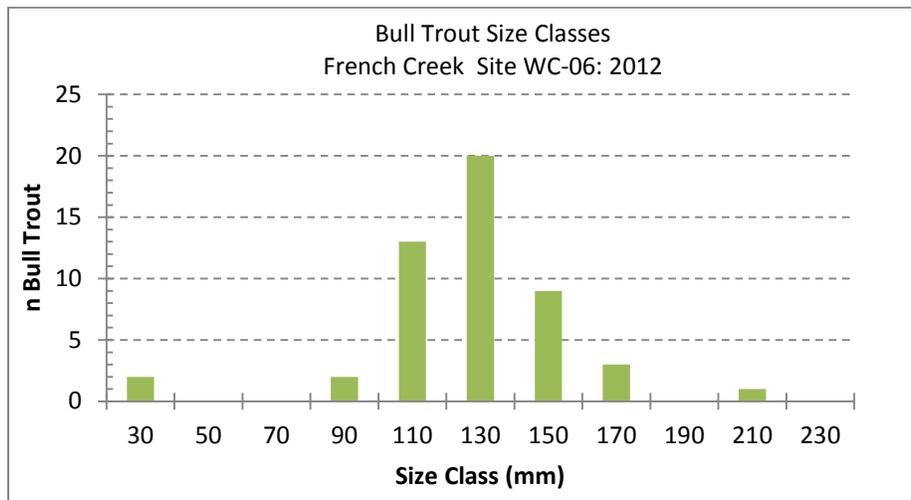


Figure 3. Size classes of bull trout counted at site WC-06 in French Creek during night snorkel conducted on August 28, 2012.

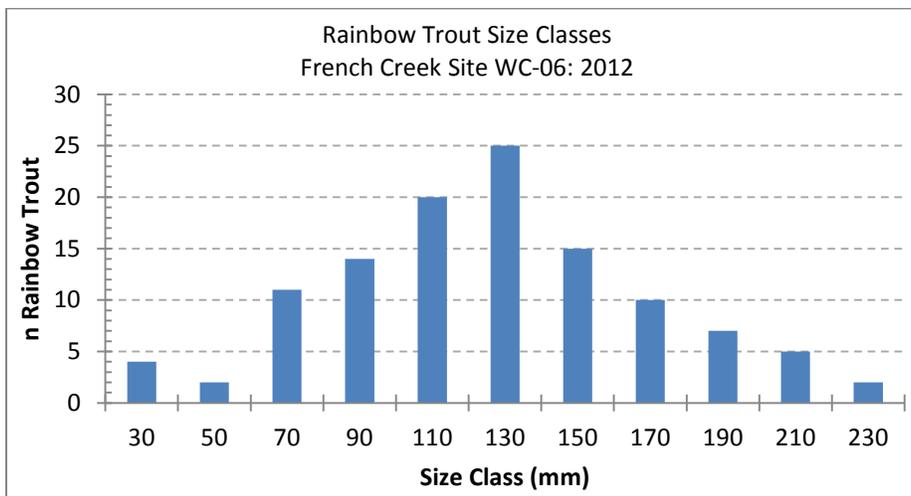


Figure 4. Size classes of rainbow trout counted at site WC-06 in French Creek during night snorkel survey conducted on August 28, 2012.

Comparisons to previous surveys- During night snorkels at site WC-06, 44 bull trout were observed in 2005 and 64 bull trout in 2006, compared to 50 bull trout in 2012. (During a day snorkel in 2007, a total of 40 bull trout were observed.) Because the 2012 count was compiled by only one snorkeler and the earlier counts were compiled by two snorkelers, no direct or statistical comparisons can be made, but in general, the numbers of bull trout at this site have remained stable over time. In 2012, fewer bull trout in the smaller size classes were observed (Figure 5). Overall, the distributions of bull trout in the habitat units were similar each year (Figure 6).

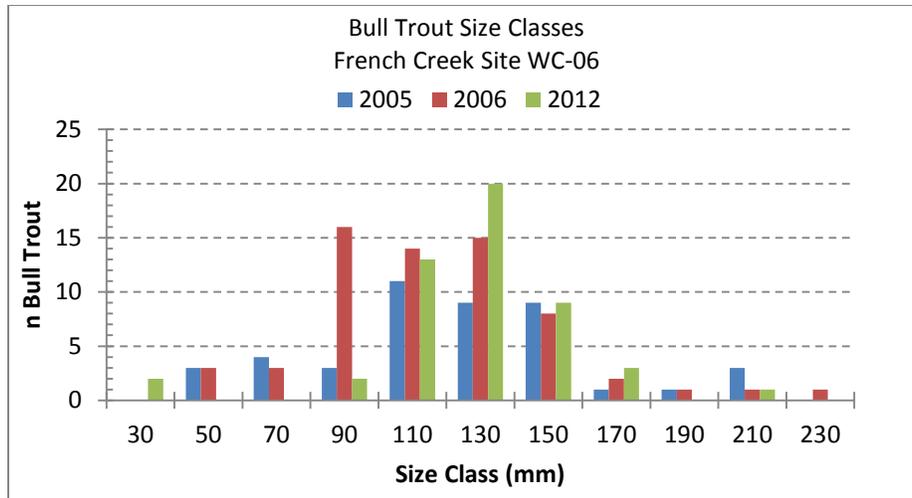


Figure 5. Comparison of size classes of bull trout observed at site WC-06 in French Creek during night snorkel surveys conducted in 2005, 2006, and 2012.

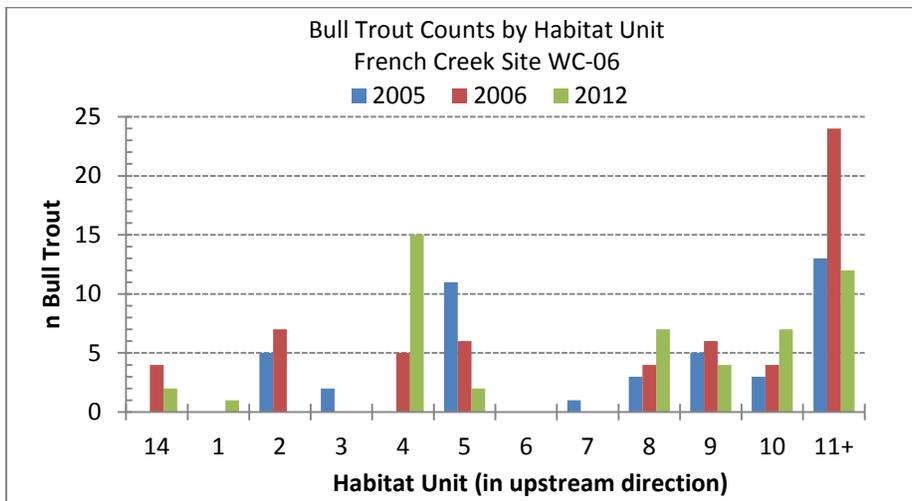


Figure 6. Comparison of counts of bull trout in habitat units at site WC-06 in French Creek during night snorkel surveys conducted in 2005, 2006, and 2012.

In 2012, a total of 117 rainbow trout were counted in site WC-06, compared to 121 counted in 2005 and 202 in 2006. Similar to the bull trout data, more rainbow trout were counted in the smaller size classes in 2006 (Figure 7). The distributions of rainbow trout in the habitat units of site WC-06 were similar in all three years (Figure 8).

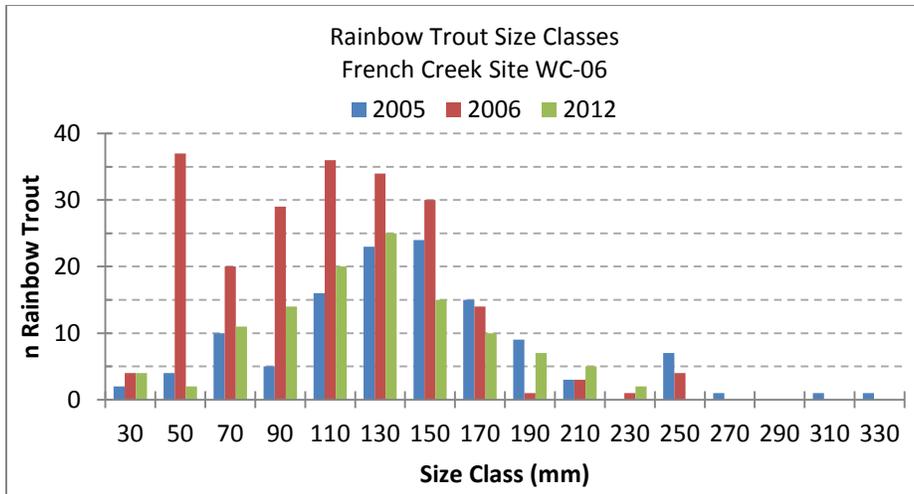


Figure 7. Comparison of size classes of rainbow trout observed at site WC-06 in French Creek during night snorkel surveys conducted in 2005, 2006 and 2012.

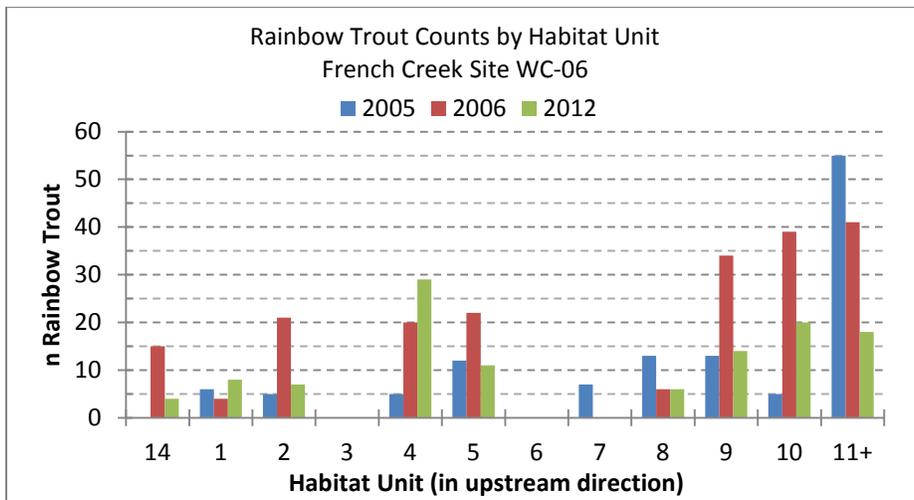


Figure 8. Comparison of counts of rainbow trout in habitat units at site WC-06 in French Creek during night snorkel surveys conducted in 2005, 2006 and 2012.

Site WM-232

In 2012, the WM-232 site at rkm 3.7 was significantly changed since it was mapped in 2006. The site is now less complex, with fewer logs in the wetted channel, less off-channel habitat, shallower and reduced pool habitat, increased riffle habitat and higher overall water velocities (Appendix Figures A2 and A3). A total of 8 bull trout were counted in 2012, compared to 20 in 2006. Sizes of bull trout ranged from 90 to 210 mm in 2012, with more observed in the larger size classes than in 2006 (Figure 9). Tissue samples were collected from 4 bull trout (Appendix Table A1).

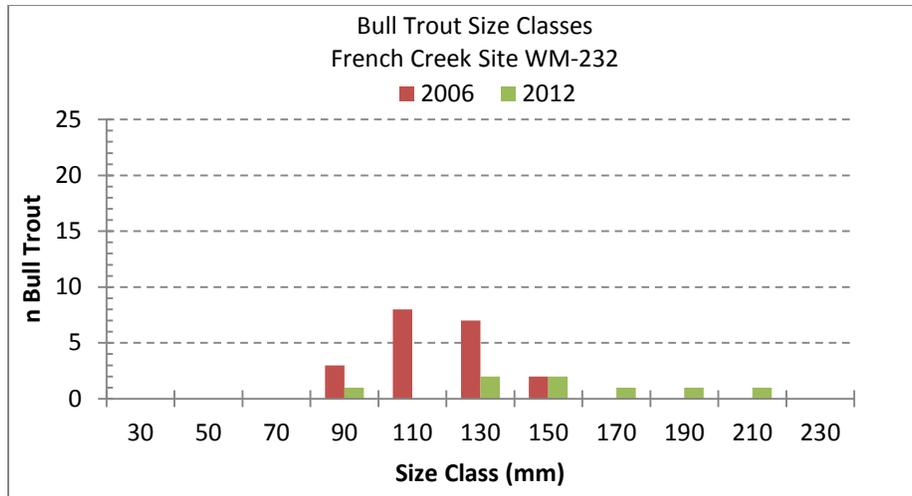


Figure 9. Size classes of bull trout counted at site WM-232 in French Creek during night snorkel surveys conducted in 2006 and 2012.

Seventy-two rainbow trout were counted in 2012 and ranged from 90 to 230 mm (Figure 10). Rainbow trout data from 2006 are unavailable for comparisons.

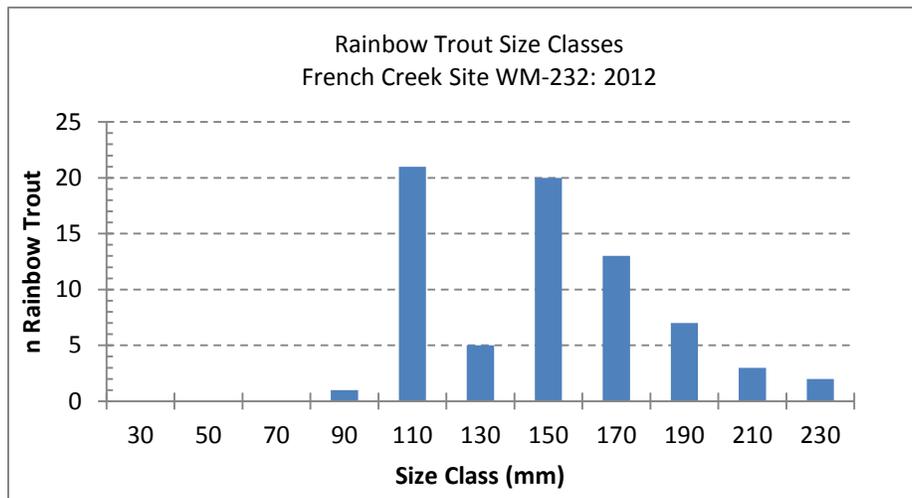


Figure 10. Size classes of rainbow trout counted at site WM-232 in French Creek during night snorkel survey conducted in 2012.

Redd survey

The bull trout redd survey of French Creek was conducted on September 26, 2012. Water temperatures ranged from 5.5 to 7.0 °C and two redds were observed- one redd in Reach 2 and one in Reach 3 (Figure 11). Dimensions of both redds were relatively small with the larger redd within the range of sizes of migratory bull trout redds (Table 1). Only a few bull trout redds have been documented in French Creek during the surveys, which began in 2008 (Figure 12).

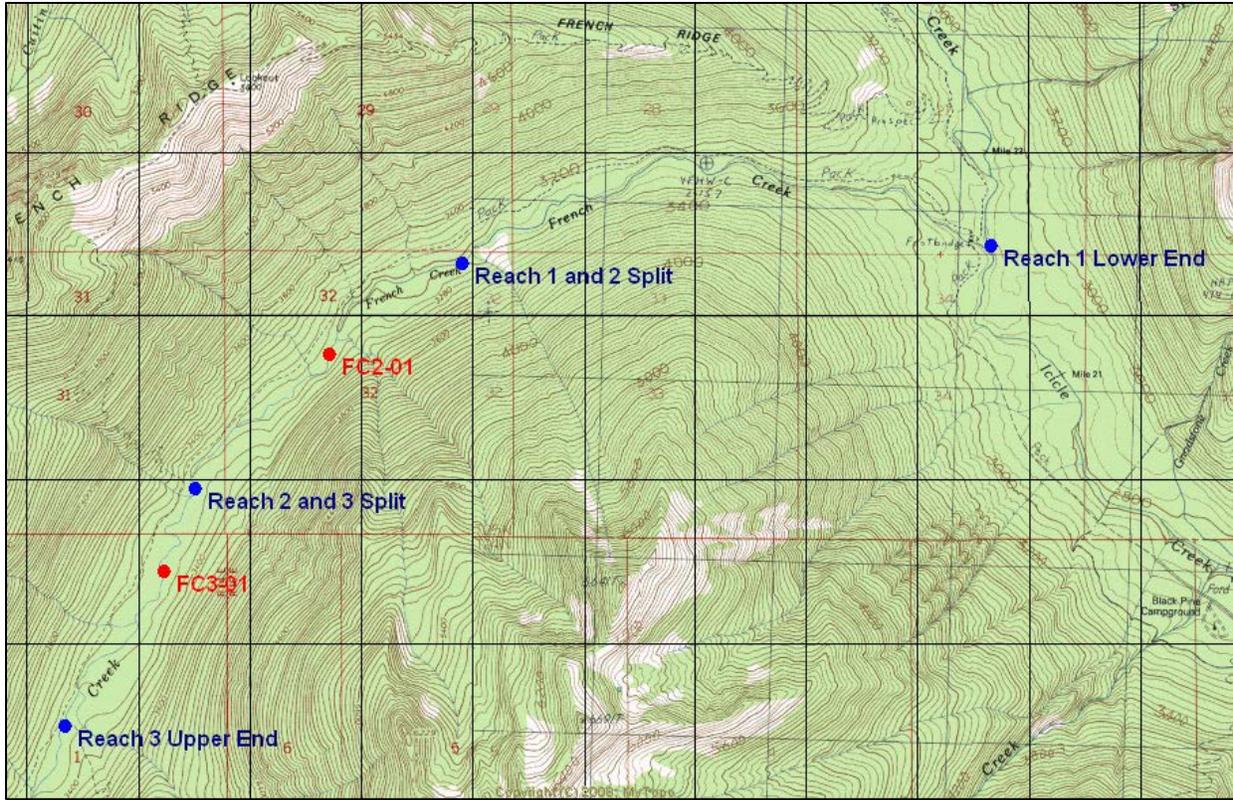


Figure 11. Map of spawning ground survey reaches and locations of redds observed during survey conducted September 26, 2012.

Table 1. Measurements of length, width, pit depth, stream bed depth, and area of bull trout redds observed during spawning ground survey in French Creek on September 26, 2012.

Redd	Length (m)	Width (m)	Depth pit (m)	Depth bed (m)	Area (m ²)	Category
FC2-01	1.0	0.7	0.21	0.2	0.7	Probable
FC3-01	0.9	0.4	0.25	0.2	0.36	Probable

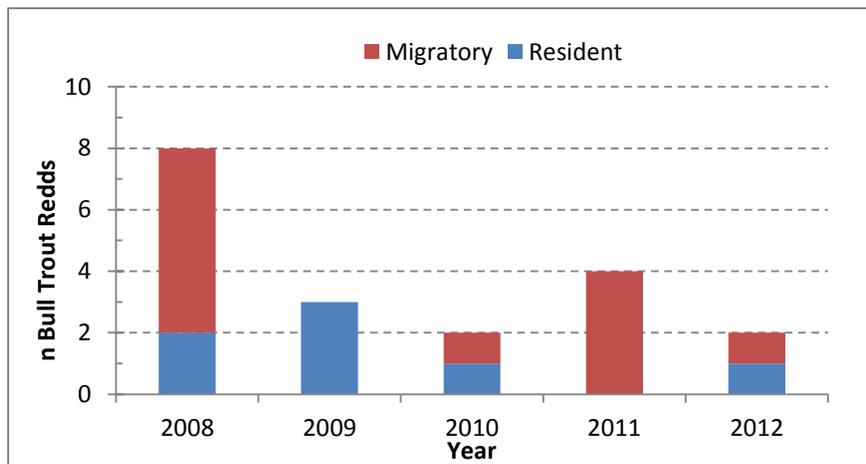


Figure 12. Number of migratory and resident bull trout redds observed during annual spawning ground surveys in French Creek, 2008 - 2012.

Log complex survey

During the redd survey on September 26, surveyors recorded a total of 26 log complexes spanning the channel in the redd survey reaches from rkm 7.2 to the mouth (Figure 13; Appendix Table A2). Seven of the log complexes were in Reach 1, twelve were in Reach 2, and seven were located in Reach 3. Some of the accumulations were small and contained less than 10 logs, but others were very large; for example in Reach 2, one contained over 100 logs and another had over 300 logs of various sizes.

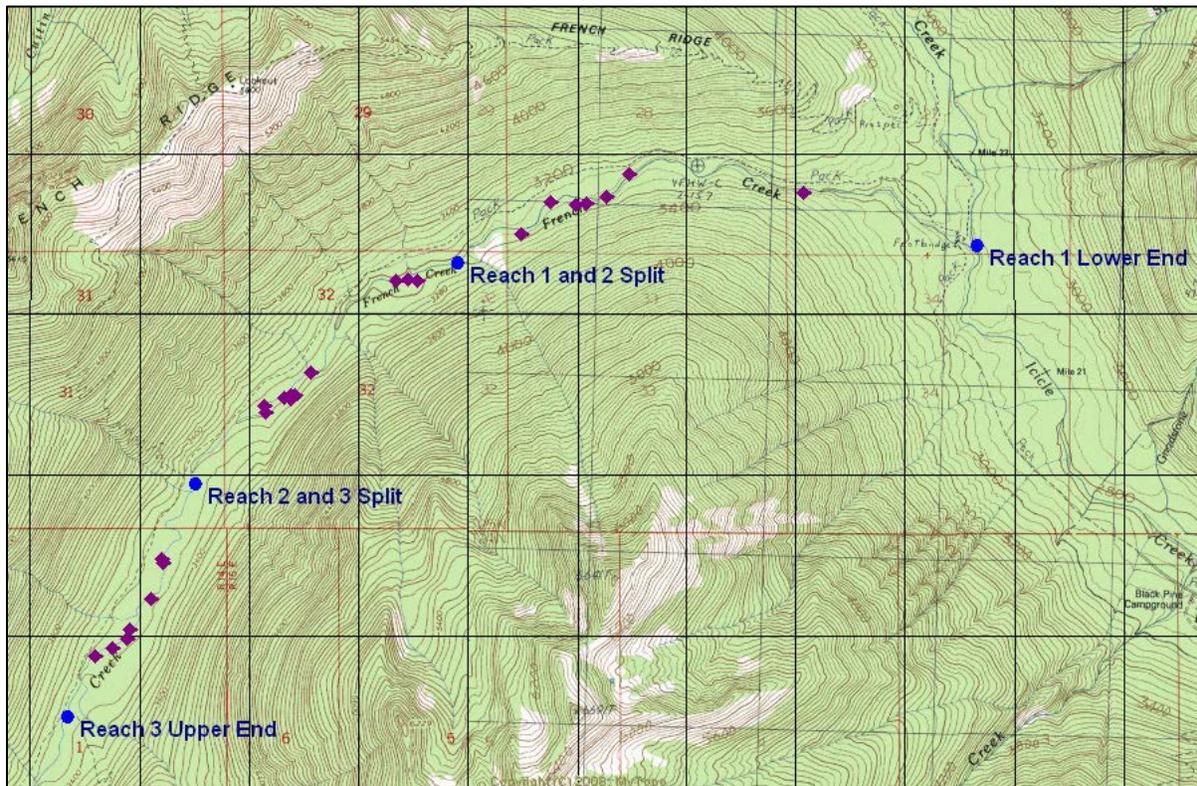


Figure 13. Locations of log complexes (diamond symbols) recorded in French Creek during spawning ground survey on September 26, 2012.

Discussion

French Creek has cold water with complex habitats in a pristine wilderness area and is an ideal stream for bull trout. The nighttime snorkel surveys conducted in 2005, 2006, and 2012 indicate that French Creek is the known stronghold for bull trout in Icicle Creek. Although surveys were conducted only in a limited area and the protocols differed between some years, it appears that the population is stable. Coupled with the known migratory component of the population, French Creek is a critical area for the maintenance of bull trout in the Icicle Creek watershed (Nelson 2007).

Direct comparison of snorkel counts between years is not possible due to differences in survey effort or changes at the sites. For example, at Site WC-06 during the 2012 survey, fewer bull trout were observed (primarily in the smaller size classes), but this could merely be an observer

effect due the overall smaller area covered by the single snorkeler and the resultant limited time spent exploring each habitat unit. In 2006, the 90 mm size class had the highest number of bull trout and could reflect higher recruitment from the previous spawning cohort. Overall, however, the distributions of bull trout in the habitat units were similar each year. At Site WM-232 fewer bull trout were observed in 2012, but because the snorkeling protocol was similar to previous years, the lower number was probably affected by the reduced habitat complexity at the site. These physical changes were caused by natural hydro-geomorphological processes and illustrate the dynamic nature of habitats in a bull trout stream.

Additional snorkel surveys are needed in French Creek to continue monitoring bull trout and to map the extent of their distribution. Snorkel sites should be established and mapped at several of the log complexes that were recorded in 2012 and additional sites should be established at randomly selected locations. Mark and recapture studies using PIT tag techniques should be conducted to estimate the population size and the proportions of resident and migratory life histories expressed by the population. Additional tissue samples should be collected across several sites in French Creek and genotyped to increase the robustness of the genetic baseline for the population (DeHaan and Neibauer 2012). Samples collected from bull trout at other locations in the watershed will be compared to the baseline to determine their population of origin (Nelson and DeHaan 2013).

Funding for surveys of bull trout is projected to be limited into the foreseeable future. In French Creek, spawning ground surveys have successfully documented migratory redds, and since that was the initial goal, it is recommended that those labor intensive surveys be suspended. In addition, resident sized redds are extremely difficult to identify and surveys do not reliably monitor population size or trends. Therefore, we recommend that any available monies should instead be used to conduct snorkel surveys and PIT-tagging studies of bull trout in French Creek.

Acknowledgments

Cal Yonce and Andy Johnsen (USFWS) assisted with the spawning ground surveys. James Fletcher and Aaron Jorgenson (Wild Fish Conservancy) assisted with the snorkel surveys. James White (UCSRB) provided 2005, 2006, and 2007 snorkel summary data from the ISEMP database. Justin Call, Pierre Dawson and Cindy Raekes (USFS) shared snorkel/habitat data and field maps from the 2006 snorkel surveys and Level II stream survey reports.

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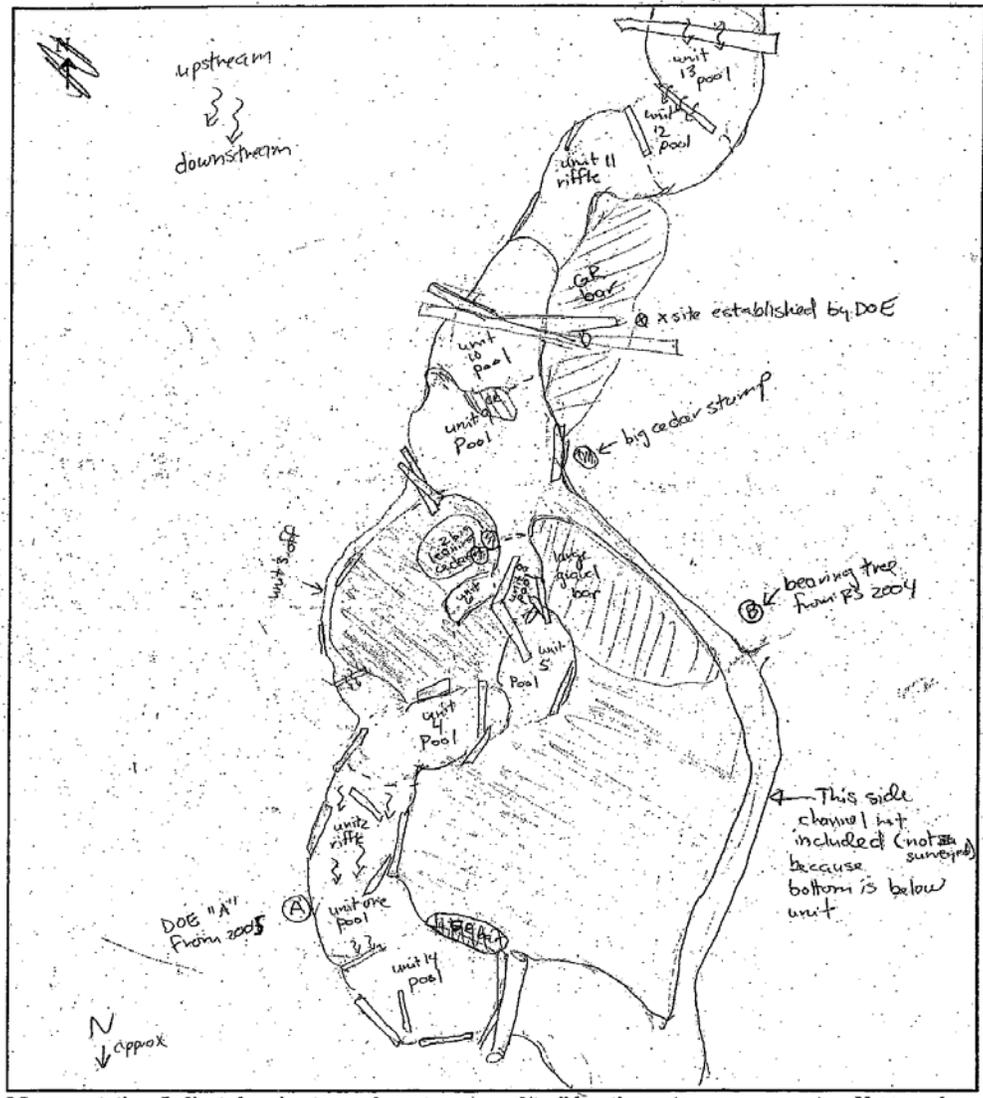
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Appendix

Figures A1 – A3 and Tables A1 – A2

Fish Population Form A: Site Diagram

Stream Name: French ck annual	Site Num: WC-6	Date: 2 Aug 2006
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Monumentation: Indicate bearing tree, rebar, stream, road/trail locations, etc.
Snorkel sketch: Show habitat units, fish locations, other points of interest.

Not to scale

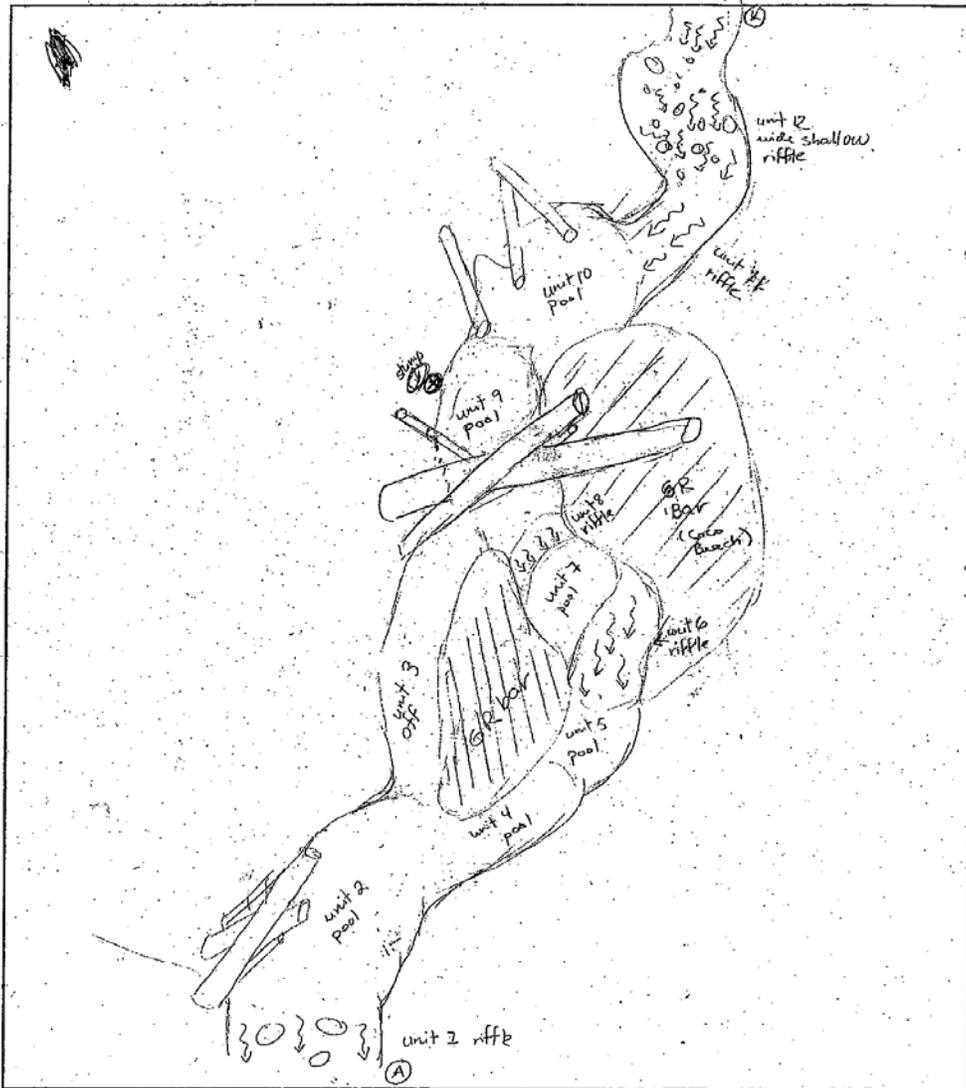
Legend: GR bar = gravel bar.

Figure A1. Field map of habitat units in Site WC-06 of French Creek (rkm 6.4), August 2, 2006.

Fish Population Form A: Site Diagram

Page 1 of 1

Stream Name: French Creek	Site Num: WM 232	Date: 31 Jul 2006
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Monumentation: Indicate bearing tree, rebar, stream, road/trail locations, etc.
 Snorkel sketch: Show habitat units, fish locations, other points of interest.

Not to scale

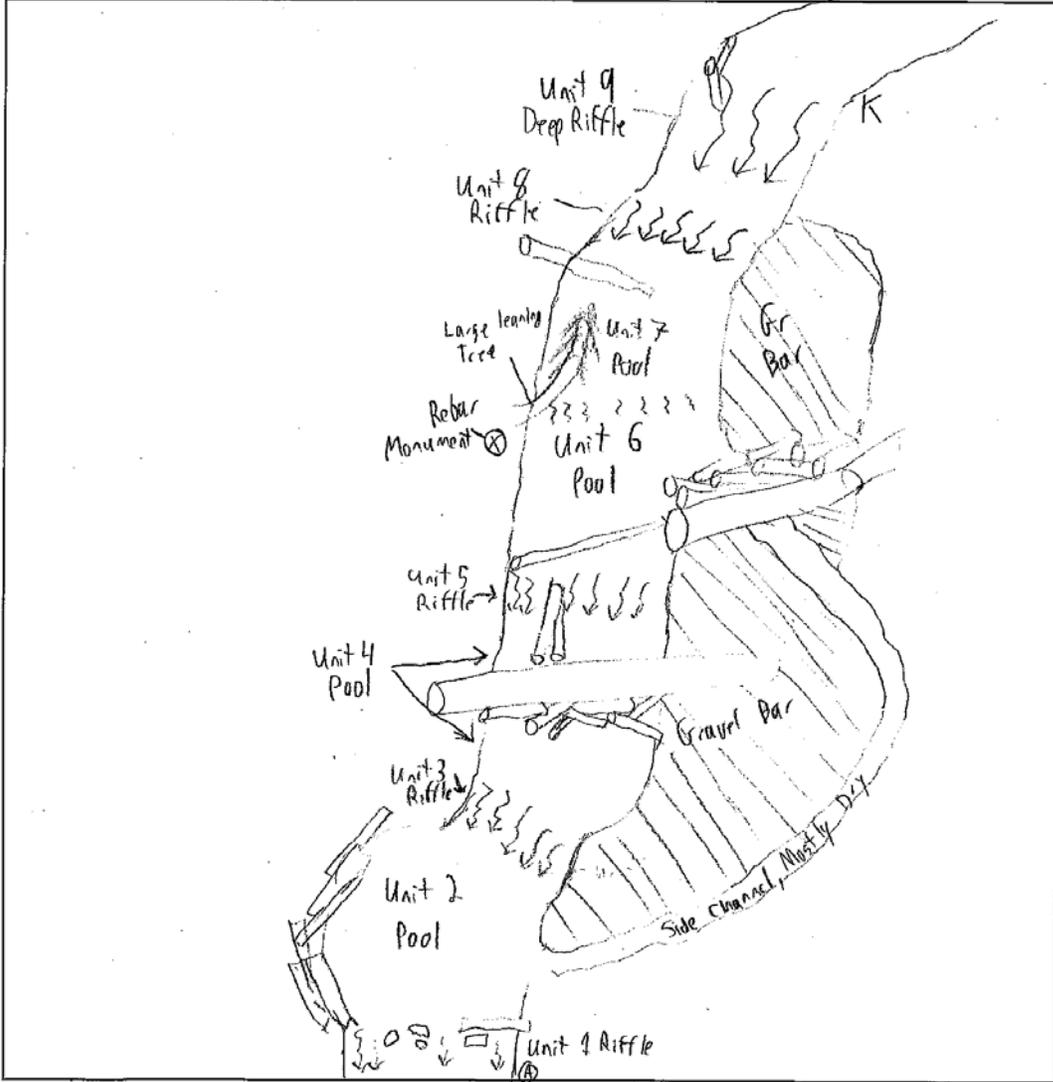
Legend:

Figure A2. Field map of habitat units in Site WM-232 in French Creek (rkm 3.7), July 31, 2006.

Fish Population Form A: Site Diagram

Page ___ of ___

Stream Name: French Creek Site Num: WM 232 Date: 29 August 2012



Monumentation: Indicate bearing tree, rebar, stream, road/trail locations, etc.
 Snorkel sketch: Show habitat units, fish locations, other points of interest

Not to scale

Legend:

Figure A3. Field map of habitat units in Site WM-232 in French Creek (rkm 3.7), August 29, 2012.

Table A1. Information on genetic tissue samples of bull trout collected in habitat units at Sites WC-06 (rkm 6.4) and WM-232 (rkm 3.7) in French Creek during 2012.

Genetic vial	Species	Size (m)	Stream	River km	Habitat unit
878-021	BLT	170	French Creek	6.4	14
878-022	BLT	130	French Creek	6.4	1
878-023	BLT	130	French Creek	6.4	4
878-024	BLT	130	French Creek	6.4	4
878-025	BLT	150	French Creek	6.4	4
878-026	BLT	110	French Creek	6.4	4
878-027	BLT	110	French Creek	6.4	4
878-028	BLT	150	French Creek	6.4	4
878-029	BLT	130	French Creek	6.4	4
878-030	BLT	150	French Creek	6.4	4
878-031	BLT	150	French Creek	6.4	4
878-032	BLT	110	French Creek	6.4	5
878-033	BLT	130	French Creek	6.4	8
878-034	BLT	150	French Creek	6.4	8
878-035	BLT	150	French Creek	6.4	8
878-036	BLT	110	French Creek	6.4	8
878-037	BLT	130	French Creek	6.4	9
878-038	BLT	110	French Creek	6.4	9
878-039	BLT	150	French Creek	6.4	10
878-040	BLT	130	French Creek	6.4	10
878-041	BLT	110	French Creek	6.4	10
878-042	BLT	130	French Creek	6.4	11
878-043	BLT	110	French Creek	6.4	11
878-044	BLT	170	French Creek	6.4	11
878-045	BLT	110	French Creek	6.4	11
878-046	BLT	150	French Creek	6.4	11
878-047	BLT	130	French Creek	6.4	11
878-048	BLT	130	French Creek	3.7	4
878-049	BLT	90	French Creek	3.7	4
878-050	BLT	190	French Creek	3.7	5
878-051	BLT	210	French Creek	3.7	9

Table A2. Coordinates of log complexes and notes recorded during spawning ground surveys in French Creek during 2012.

Log Complex	Notes	Latitude	Longitude
FC3LOG01	--	47.60710	-121.02962
FC3LOG02	--	47.60757	-121.02827
FC3LOG03	Snorkel Site WC-06	47.60800	-121.02714
FC3LOG04	Snorkel Site WC-06	47.60850	-121.02693
FC3LOG05	--	47.61013	-121.02532
FC3LOG06	--	47.61192	-121.02449
FC3LOG07	--	47.61213	-121.02453
FC2 LOG05	50+ logs	47.62042	-121.01471
FC2 LOG04	300+ logs	47.62052	-121.01525
FC2 LOG01	Large log with pool	47.61112	-121.02150
FC2 LOG02	At head of side channel	47.61976	-121.01661
FC2 LOG03	100+ logs	47.62008	-121.01673
FC2 LOG06	20+ logs, deep pool	47.62058	-121.01453
FC2 LOG07	20 logs	47.62065	-121.01444
FC2 LOG08	10 logs and large fallen spanner tree	47.62181	-121.01319
FC2 LOG09	10+ logs, deep pool (Snorkel Site WM-232)	47.62666	-121.00575
FC2 LOG10	< 10 logs (Snorkel Site WM-232)	47.62661	-121.00505
FC2 LWD01	Large submerged log, pool	47.62064	-121.01475
FC2 LWD02	10+ logs, plunge pool	47.62666	-121.00670
FC1 LOG01	Large jam and pool	47.62923	-120.99595
FC1 LOG02	Medium jam w/ spanner logs, good habitat	47.63082	-120.99378
FC1 LOG03	Medium jam with pool	47.63068	-120.99181
FC1 LOG04	Small jam with deep pool	47.63078	-120.99093
FC1 LOG05	Small, mostly on bank, high water habitat?	47.63111	-120.98936
FC1 LOG06	Medium jam, bedrock pool	47.63229	-120.98767
FC1 LOG07	Big jam, bedrock pool	47.63131	-120.97435