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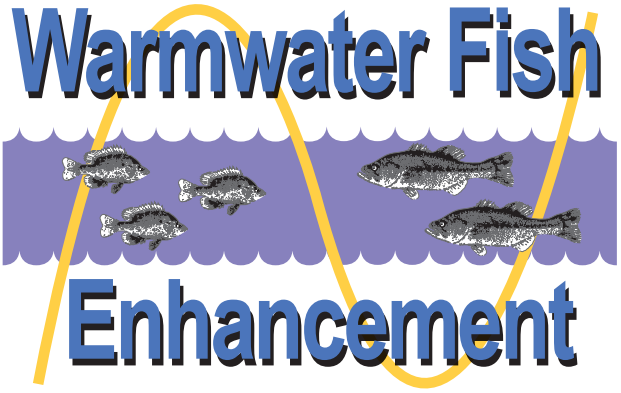
The Presence of Salish Sucker and the Native Fish Fauna at Naval Radio Station Jim Creek, Washington

Warmwater Fish Enhancement



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Washington Department of Fish and Wildlife
Fish Program
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Introduction

Naval Radio Station (NRS) Transmitting (T) Jim Creek is home to one of few known populations of Salish Sucker in Washington (Wydosky and Whitney 2003). They were documented in the Cub Creek system of the Jim Creek watershed about 20 years ago; however, the native fish fauna have never been scientifically evaluated (Linda Wagoner, pers. comm., 2015). The reported presence of the Salish Sucker (*Catostomus sp.*) is of particular significance given its decline in the western U. S. and British Columbia (McPhail and Taylor 1999). Although the Salish Sucker has not been taxonomically separated from the Longnose Sucker (*Catostomus catostomus*), the Salish Sucker diverged from the Longnose Sucker in western Washington and western British Columbia during the last four major glaciations of the Pleistocene Period and became reproductively isolated (Wydosky and Whitney 2003). Populations of *Catostomus catostomus* east and west of the Cascade Mountains are referred to as Longnose Sucker and Salish Sucker, respectively, and they differ morphologically, i.e., snout size and lateral line scale counts.

Though reproductively isolated from their parent species, the Salish Sucker in western Washington is thought to contribute significantly to the ecological or genetic diversity of the species (McPhail and Taylor 1999). The Salish Sucker is listed as an endangered fish species in Canada (Campbell 2001), but has no federal listing status in the U.S. (Pearson and Healey 2003). At the state level, the Washington Department of Fish and Wildlife (WDFW) list the Salish Sucker as a "monitored species," a designation for species that are not considered endangered, threatened or sensitive. These listings may reflect the fact that Salish Sucker populations are more stable in Washington and declining rapidly in British Columbia (McPhail 1987, Pearson 1998).

Information collected from these surveys will place NRS (T) Jim Creek in a strong position to ensure compliance with natural resource laws, such as the Endangered Species Act (16 USC 1531 et seq), Fish and Wildlife Conservation Act (16 USC 2901 et seq), Fish and Wildlife Coordination Act (16 USC 661 et seq), and SAIA (Section 2905 (c)). Additionally, surveys of the lakes will inform natural resources management at NRS (T) Jim Creek in the future, providing a better understanding of the native fish fauna inhabiting the lake system. The objectives of this study were to (1) evaluate the presence of Salish Sucker within lake habitats and beaver pond complexes between Upper Twin Lake and Cub Creek Reservoir; and (2) describe the native fish fauna inhabiting Upper Twin Lake.

Materials and Methods

Study Area

Naval Radio Station (T) Jim Creek is located in the foothills of the Cascade Mountains in Snohomish County, Washington, approximately 60 miles northeast of Seattle, and 12 miles east of the city of Arlington. The installation covers about 4800 acres across a largely forested area, sharing common boundaries with the Mount Baker-Snoqualmie National Forest, state-owned forested lands, and private land. Approximately one quarter of the installation is a highly modified antenna field area, located within the valley formed by Jim Creek. About 3900 acres of the 4800-acre installation are undeveloped forested lands. There are five lakes on the property. Three lakes (Upper Twin, Lower Twin and Cub Creek Reservoir) are connected by waterways to form a lake system (Figure 1). Upper Twin Lake is accessible by vehicle using a graveled, native surface road which leads to one access point with a boat ramp. Access to Lower Twin Lake and Cub Creek Reservoir is limited to hiking trails. At approximately 35 acres (14 hectares), Upper Twin is the largest lake in the system, followed by Lower Twin (29 acres; 12 hectares) and Cub Creek Reservoir (3 acres; 1 hectare).

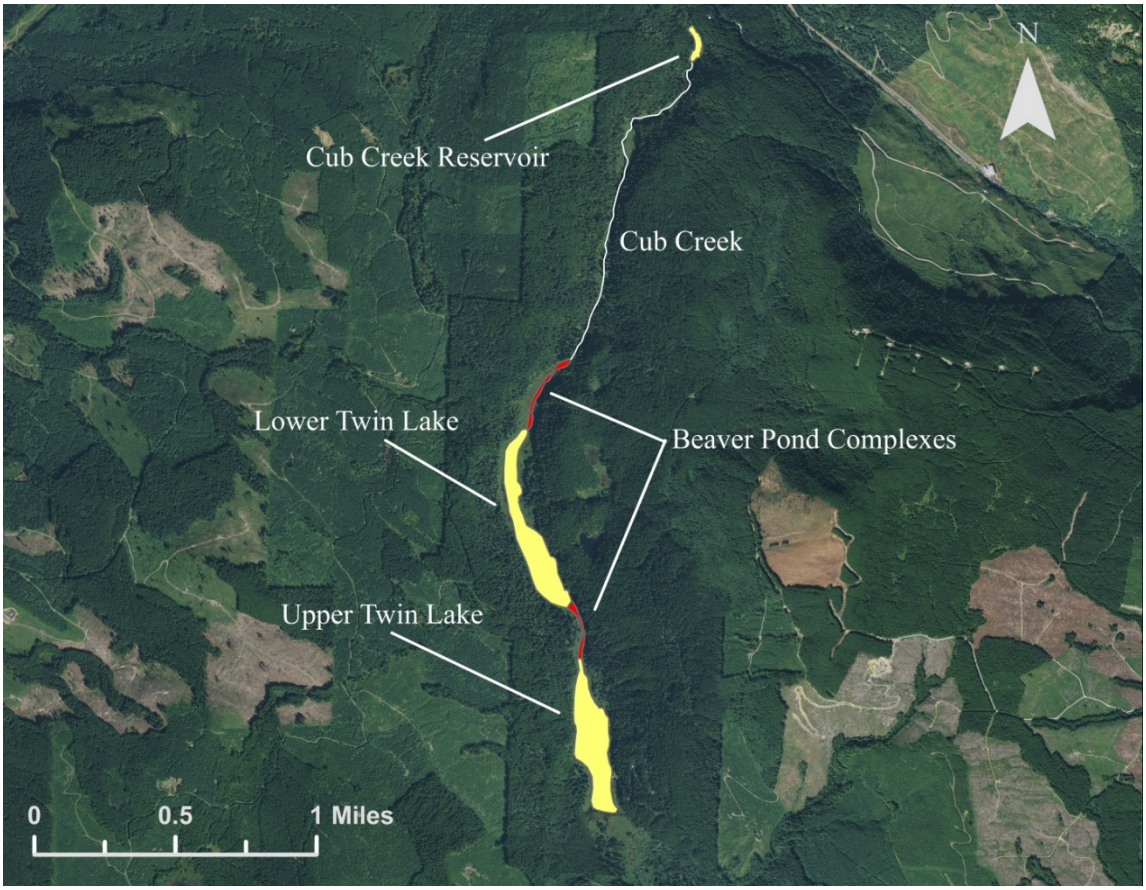

Figure 1. Map of the study area at the Naval Radio Station (T) Jim Creek, Washington. Yellow, red, and white denote lake/reservoir, beaver pond complex, and stream habitat, respectively. Cub Creek was not included within the scope of this project.

At the downstream end of Cub Creek Reservoir there is a concrete dam initially constructed in the 1940s. At one time water impounded behind the dam supplied drinking water to the installation. The dam is about 25 feet wide and is located at an elevation of about 690 feet. It has a concrete pool & weir fish ladder alongside the spillway for upstream fish passage; however a steep stream gradient and series of cascades immediately below the dam prevent upstream fish passage.

Two of the three lakes within the lake system, i.e., Upper and Lower Twin, receive recreational fishing and boating use throughout the summer. Catchable size Rainbow Trout (*Oncorhynchus mykiss*) are stocked annually to provide a recreational fishery. Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) are also known to occur naturally in the lake system, based on anecdotal angler reports. The Salish Sucker was found in the Jim Creek lake system about 20 years ago; however, the native fish fauna have never been scientifically evaluated (Linda Wagoner, pers. comm., 2015).

Data Collection

Salish Sucker Presence Study

Two WDFW biologists sampled for juvenile and adult Salish Sucker throughout the lake/reservoir and beaver pond complex habitats depicted in Figure 1. Upper and Lower Twin Lake and associated beaver pond complexes were sampled between August 1st–18th, 2016, and Cub Creek Reservoir was sampled between September 12th–13th, 2016. Cub Creek was not included within the scope of this project (Figure 1). Two sizes of cylindrical, live traps were used: Gee traps (44 X 23 cm) and Feddes traps (81 cm X 40 cm). Feddes traps were constructed following guidelines by Pearson (2009).

Sampling locations were selected from a map by dividing all available lake/reservoir shoreline into 200 m sections, and beaver pond complex habitat into 100 m sections. Each sampling location was sampled systematically to cover the entire study area, with the exception of Cub Creek.

At each sampling location, GPS coordinates were recorded before setting Feddes and Gee traps overnight for 20-24 hours. Following guidelines by Pearson (2009), Gee traps were set close to shore in water no deeper than 50 cm. Feddes traps were set offshore of the Gee traps in water deeper than 70 cm. All traps were baited with dry cat food.

All fish captured were identified to species and measured to the nearest millimeter total length (mm TL) and weighed to the nearest gram (g). Salish suckers were sexed using the anal fin, which is dimorphic (male large and fan-shaped; female rectilinear with thickened leading ray).

Upper Twin Lake Fish Survey

Upper Twin Lake was surveyed from August 29th–31st, 2016 by two WDFW biologists using four gear types: gillnetting, fyke netting, gee traps and feddes traps. Experimental gill nets (45.6 m long x 2.4 m deep) were constructed of four sinking panels (two each at 7.6 m and 15.2 m long) of variable-size (1.3, 1.9, 2.5, and 5.1 cm) stretch monofilament mesh. Fyke nets (modified hoop) were constructed of five 1.2 m diameter hoops with two funnels, and a 2.4 m

cod end (6 mm nylon delta mesh). Attached to the mouth of the net were two 7.6 m wings, and a 30.5 m lead. Feddes and Gee traps had the same dimensions as described in the previous section.

Sampling locations were selected from a map by dividing all available shoreline into 200 m sections, numbering them consecutively and randomly selecting sites without replication. Four random sites were selected for each gear type.

Gill nets were fished perpendicular to the shoreline with the small-mesh end on shore and the large-mesh end anchored off shore. Fyke nets were fished perpendicular to the shoreline with the lead anchored to the shore and the cod end anchored off shore. The wings were anchored at approximately a 45° angle from the net lead. Gee traps and feddes traps were set in the same manner as described in previous section. All gear types were deployed mid-day and left overnight, with a set time of 20-24 hours.

All fish captured were identified to the species level measured to the nearest millimeter total length (mm TL) and weighed to the nearest gram (g).

Analysis

Salish Sucker Presence Study

Species composition by weight (kg) and number were calculated as proportions of total catch. For Salish Sucker, catch-per-unit-effort (CPUE) was calculated for each gear type as the mean number of individuals captured in a trap night (20-24 hours). Standard deviation was calculated for each mean. For all other species, CPUE was calculated for each gear type and sampling location (Appendix I). The total lengths of all Salish Sucker captured were described statistically using median, interquartile range, and minimum/maximum for both sexes and gear types. Capture locations for all Salish Sucker were mapped using ArcGIS.

Upper Twin Lake Fish Survey

Species composition by weight (kg) and number were calculated as proportions of total catch. Catch-per-unit-effort (CPUE), by gear type, was determined for each fish species collected, i.e., mean number of fish/gill net-night, and number of fish/fyke net-night (20-24 hours). Standard deviation was calculated for each mean. The total length of all species captured was described statistically using median, interquartile range, and minimum/maximum for both gear types. The total length of all Salish Sucker captured was described statistically using median, interquartile range, and minimum/maximum for both sexes and gear types. To analyze size structure of populations, length frequency histograms were calculated for each gear type as percent frequency of each 10-mm size class of fish sampled.

Results

Salish Sucker Presence

Species Composition

A total of 3,994 fish representing four fish species were captured from the study area (Figure 1). Redside shiner *Richardsonius balteatus* comprised the greatest proportion of biomass (78%), followed by Salish Sucker (12.4%), Longnose Dace *Rhinichthys cataractae* (8.8%), and Coastal Cutthroat Trout (0.8%). Salish Sucker (N=105) comprised 2.6% of the total number of fish sampled (Table 1).

Table 1. Composition of fish by weight and number captured from the study area (Figure 1) from August to September, 2016.

Species	Number	% by Number	Weight (kg)	% by Weight
Salish Sucker	105	2.6	1.7	12.4
Redside Shiner	3,400	85.1	10.9	78.0
Longnose Dace	487	12.2	1.2	8.8
Coastal Cutthroat Trout	2	0.1	0.1	0.8

Catch per unit effort

Mean CPUE was greater for Feddes traps than Gee traps (Table 2). Both means had a high standard deviation associated with them, demonstrating the high variability in catch rates across all sampling sections (Appendix I). Feddes were set in deeper water than Gee traps, which negates any statistical comparison between these two gear types.

Table 2. Catch rates (CPUE) of Salish Sucker captured in 42 trap-nights using Feddes and Gee traps in the Cub Creek system from August to September 2016.

Trap Type	Mean CPUE (n per trap-night)	Standard Deviation
Feddes	2.0	3.7
Gee	0.5	0.8
Combined	2.5	3.9

Total Lengths of Salish Sucker.—Descriptive statistics of total length data for all Salish Sucker captured are reported for both sexes and gear types (Table 3).

Table 3. Total length (mm) statistics for Salish Sucker captured using Feddes and Gee traps in the study area (Figure 1) from August to September 2016. Values were rounded to the nearest whole number; nine Salish Sucker that were not sexed are omitted.

			Total Length (mm)		
Sex	Trap Type	n	Median	IQ Range	Minimum – Maximum
Female (26%)	Feddes	21	100	85 – 115	80 – 161
	Gee	4	114	111 – 118	107 – 118
Male (74%)	Feddes	54	106	70 – 142	75 – 163
	Gee	17	124	76 – 172	75 – 212

Presence/Absence of Salish Sucker

Salish Sucker were captured throughout the entire study area; including Upper and Lower Twin Lakes, connecting beaver pond complexes, and Cub Creek Reservoir (Figure 2). The majority of individuals were sampled in three areas: (1) beaver pond complexes downstream of Lower Twin Lake; (2) beaver pond complexes between Upper and Lower Twin Lake; and (3) Cub Creek Reservoir.

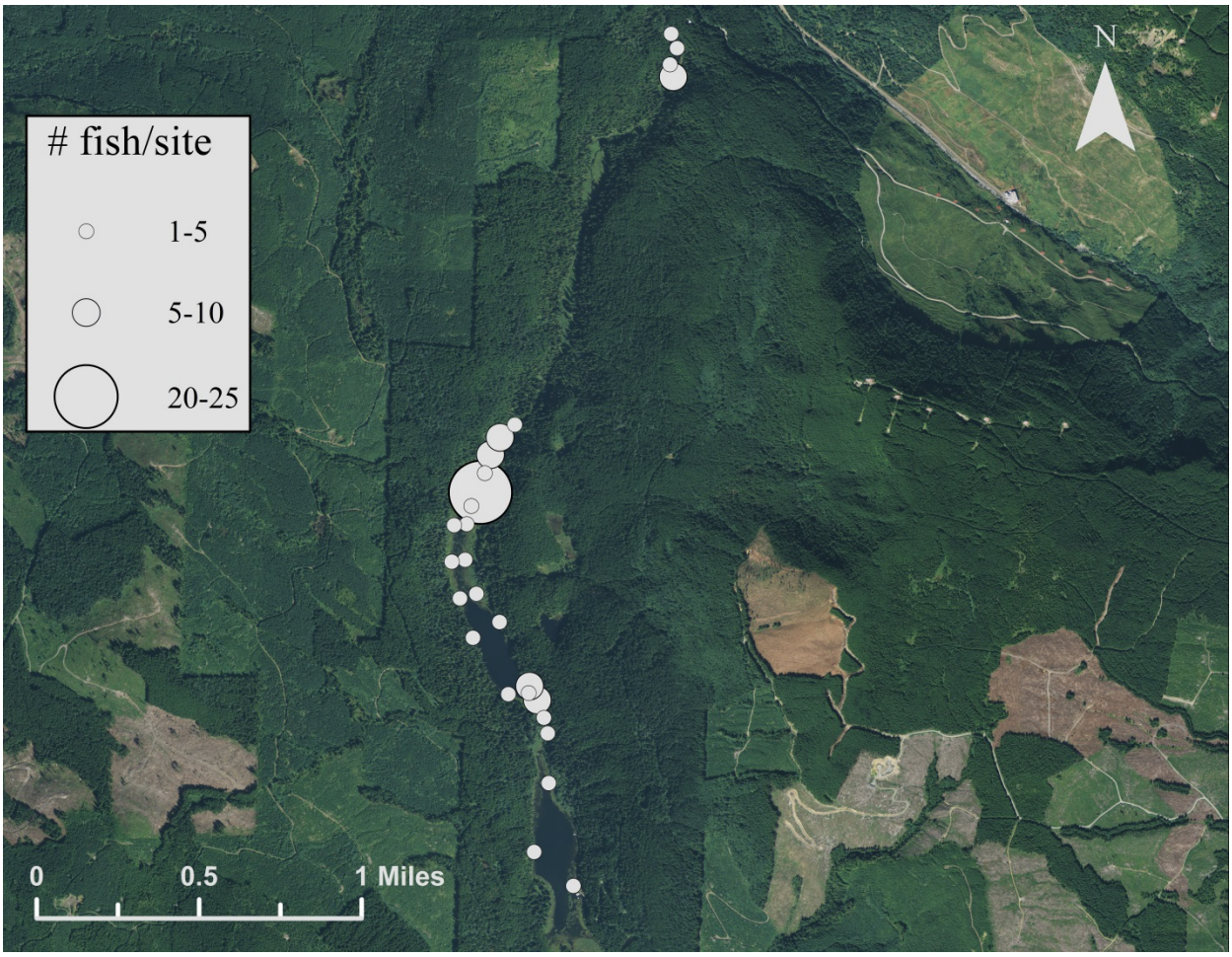

Figure 2. Graduated circle classes showing numbers of Salish Sucker sampled throughout the study area between August–September, 2016.

Upper Twin Fish Survey

Species Composition

A total of 1,475 fish representing five fish species were captured from Upper Twin Lake (Figure 1). Salish Sucker comprised the greatest proportion of biomass (74.7%), followed by Coastal Cutthroat Trout (17.1%), Redside Shiner (4.2%), Rainbow Trout (2.4%), and Longnose Dace (1.6%). In terms of relative abundance, Salish Sucker (N=675) comprised 45.8% of the total number of fish sampled, followed by Redside Shiner (34.5%) and Longnose Dace (14.6%; Table 4).

Table 4. Composition of fish by weight and number captured in Upper Twin Lake in August, 2016.

Species	Number	% by Number	Weight (kg)	% by Weight
Coastal Cutthroat Trout	66	4.5	8.2	17.1
Rainbow Trout	9	0.6	1.2	2.4
Redside Shiner	509	34.5	2.0	4.2
Longnose Dace	216	14.6	0.8	1.6
Salish Sucker	675	45.8	36.1	74.7

Catch per unit effort

Fyke netting appeared to be the most effective gear type overall, accounting for the highest catch rates of Salish Sucker, Redside Shiner, and Longnose Dace (Table 5). Gill nets were also highly effective (74.8 fish/net-night) for capturing Salish Suckers. Gill netting and fyke netting combined accounted for all catches of Coastal Cutthroat Trout and stocked Rainbow Trout. Feddes and Gee traps predominantly sampled Redside Shiners, although Longnose Dace and Salish Sucker were encountered at a low rate.

Table 5. Mean catch rates (CPUE) and standard deviations (SD) of fishes captured in Upper Twin Lake in August, 2016.

	Mean CPUE (n/net-night; SD)			
Species	GN (4 net-nights)	FN (4 net-nights)	FT (4 net-nights)	GT (4 net-nights)
Coastal Cutthroat Trout	9.2 (5.0)	7.2 (6.9)	0 (—)	0 (—)
Rainbow Trout	1.0 (1.2)	1.2 (1.5)	0 (—)	0 (—)
Redside Shiner	2.2 (1.7)	87.5 (59.3)	29.0 (38.4)	8.5 (11.4)
Longnose Dace	0.2 (0.5)	51.0 (46.1)	0.5 (1.0)	2.2 (4.5)
Salish Sucker	74.8 (55.4)	93.8 (52.6)	0.2 (0.5)	0 (—)

Total Length Statistics

Descriptive statistics of total length data for all fish captured in Upper Twin Lake are reported for all gear types (Table 6).

Table 6. Fish total length (mm) statistics of fishes captured in Upper Twin Lake in August, 2016. Values were rounded to the nearest whole number for gill nets (GN), fyke nets (FN), Feddes traps (FT), and Gee traps (GT).

			Total Length (mm)		
Species	Gear Type	n	Median	IQ Range	Minimum – Maximum
Coastal Cutthroat Trout	GN	37	255	200 – 310	150 – 330
	FN	29	235	181 – 289	77 – 296
	FT	0	—	—	—
	GT	0	—	—	—
Rainbow Trout	GN	4	240	186 – 293	217 – 320
	FN	5	213	185 – 241	194 – 249
	FT	0	—	—	—
	GT	0	—	—	—
Redside Shiner	GN	9	107	105 – 109	103 – 110
	FN	350	74	61 – 87	47 – 128
	FT	116	71	56 – 86	48 – 127
	GT	34	76	58 – 94	48 – 140
Longnose Dace	GN	1	100	—	—
	FN	204	68	57 – 79	57 – 106
	FT	2	59	—	55 – 63
	GT	9	70	54 – 86	64 – 90
Salish Sucker	GN	299	187	141 – 233	108 – 286
	FN	375	127	75 – 179	52 – 262
	FT	1	55	—	—
	GT	0	—	—	—

Total Lengths of Salish Sucker.—Descriptive statistics of total length data for all Salish Sucker captured in Upper Twin Lake are reported for both sexes and all gear types (Table 7).

Table 7. Fish total length (mm) statistics of Salish Sucker captured in Upper Twin Lake in August, 2016. Values were rounded to the nearest whole number for gill nets (GN), fyke nets (FN), Feddes traps (FT), and Gee traps (GT).

			Total Length (mm)		
Sex	Gear Type	n	Median	IQ Range	Minimum – Maximum
Female (62%)	GN	185	191	152 – 230	109 – 286
	FN	226	131	60 – 202	52 – 262
	FT	1	55	—	—
	GT	0	—	—	—
Male (38%)	GN	114	179	122 – 236	108 – 267
	FN	140	121	80 – 162	81 – 220
	FT	0	—	—	—
	GT	0	—	—	—

Size Structure of Salish Sucker

A total of 675 Salish Sucker were sampled from Upper Twin Lake. Total lengths ranged from 52 to 286 mm (Table 6; Figure 3).

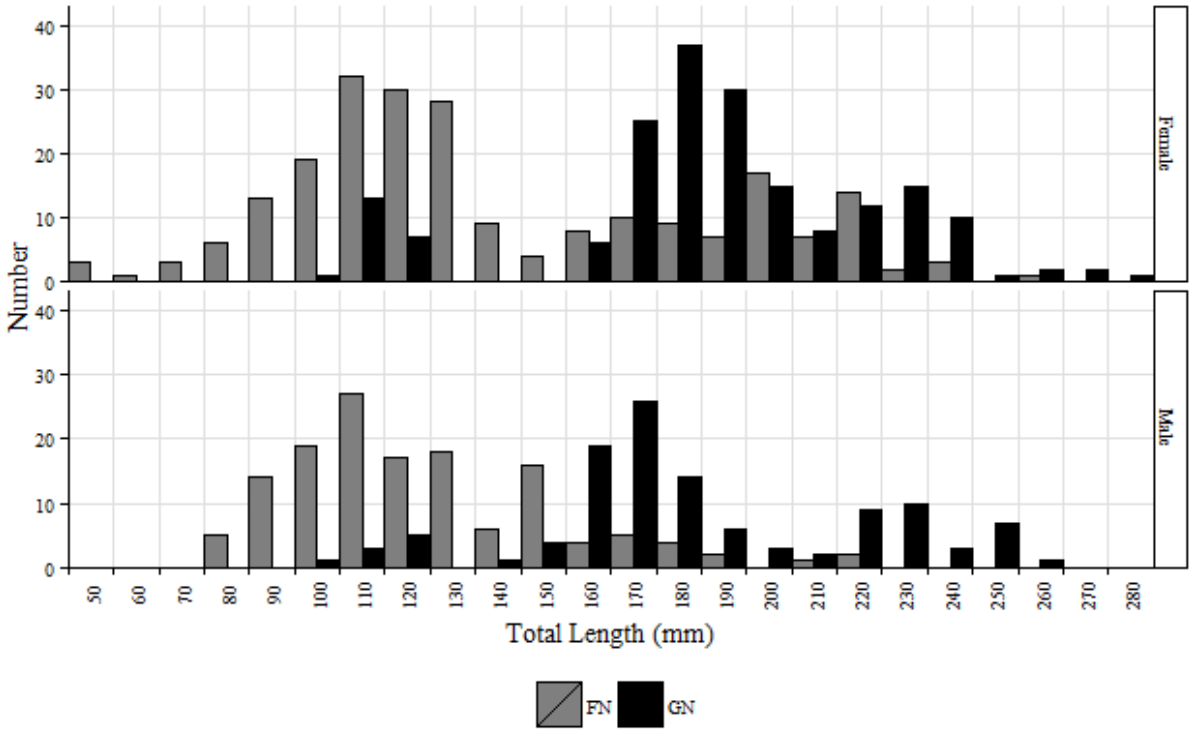

Figure 3. Length frequency distribution of male and female Salish Sucker sampled from Upper Twin Lake with fyke nets (FN) and gill nets (GN).

Size Structure of Coastal Cutthroat Trout

A total of 66 Coastal Cutthroat Trout were sampled from Upper Twin Lake. Total lengths ranged from 77 to 330 mm (Table 6; Figure 4).

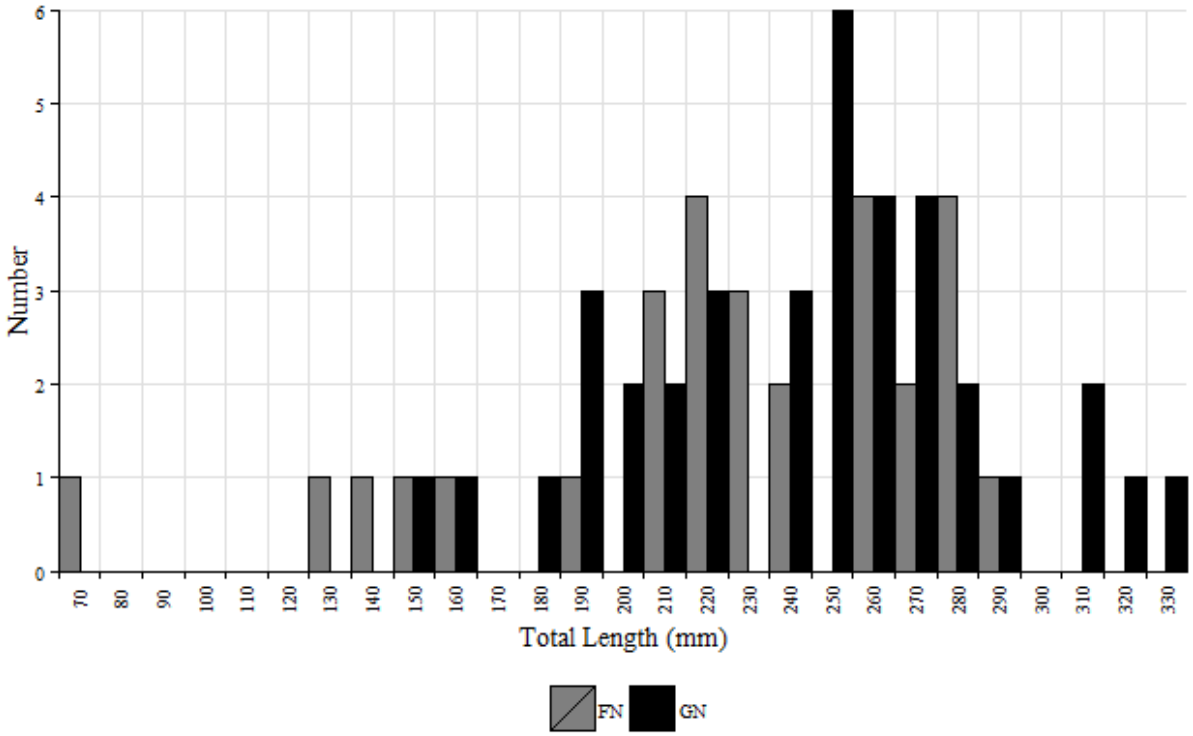

Figure 4. Length distribution of Coastal Cutthroat Trout sampled from Upper Twin Lake with fyke nets (FN) and gill nets (GN).

Size Structure of Redside Shiner

A total of 509 Redside Shiner were sampled from Upper Twin Lake. Total lengths ranged from 47 to 140 mm (Table 6; Figure 5).

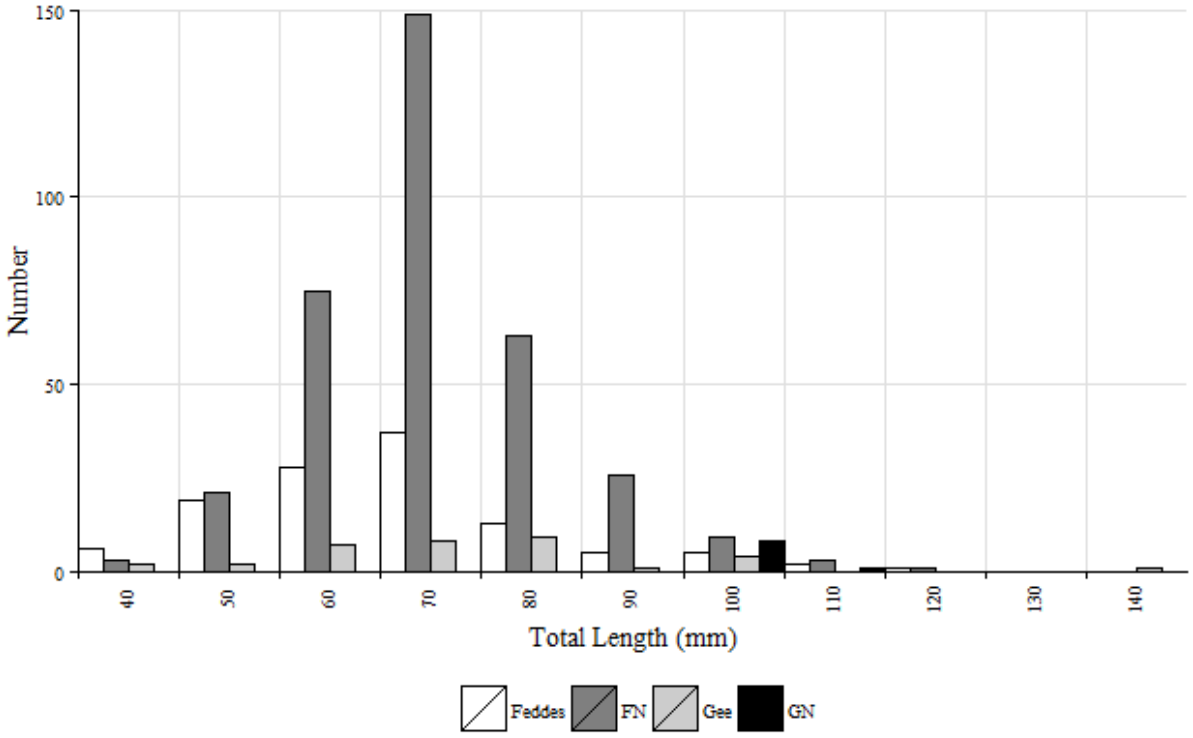

Figure 5. Length frequency distribution of Redside Shiner sampled from Upper Twin Lake with Feddes traps (FT), fyke nets (FN), Gee traps (GT), and gill nets (GN).

Size Structure of Longnose Dace

A total of 216 Longnose Dace were sampled from Upper Twin Lake. Total lengths ranged from 55 to 106 mm (Table 6; Figure 6).

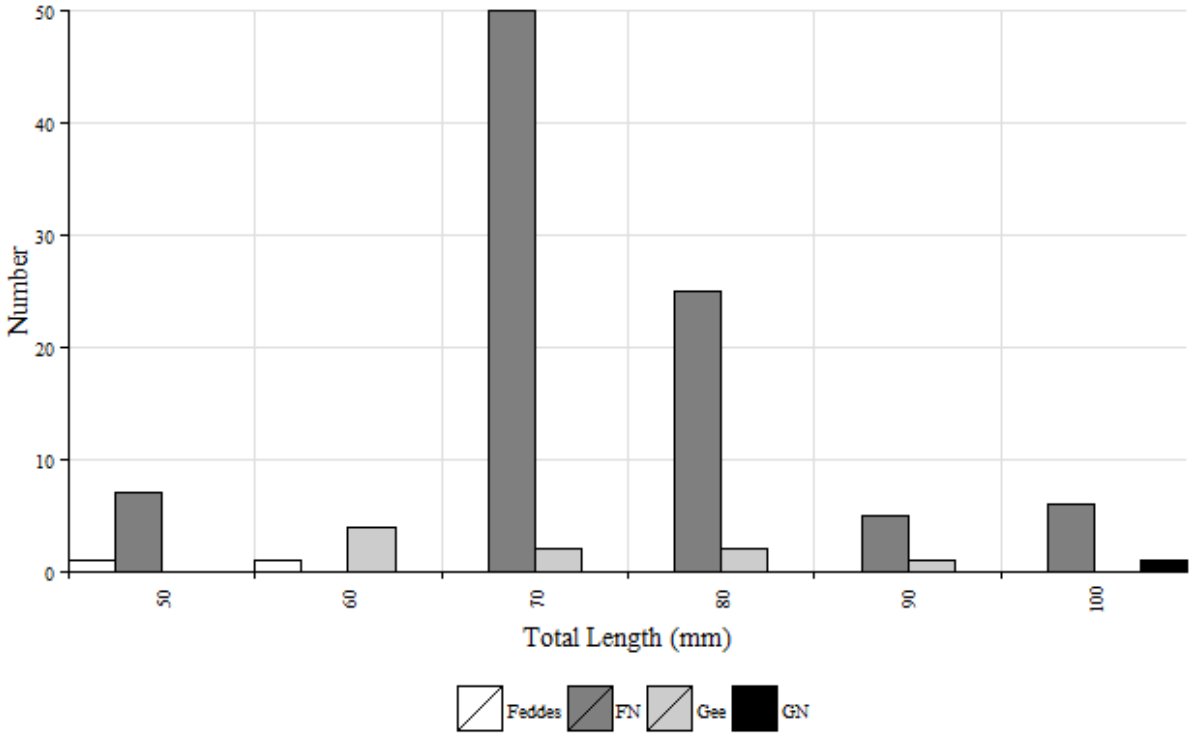

Figure 6. Length frequency distribution of Longnose Dace sampled from Upper Twin Lake with Feddes traps (FT), fyke nets (FN), Gee traps (GT), and gill nets (GN).

Discussion

This study provides substantial evidence that the lake and beaver pond habitats within the Cub Creek system at NRS (T) Jim Creek support a robust population of Salish Sucker. Live trapping results demonstrated that adult Salish Sucker are found throughout the study area, although more Salish Sucker were sampled in beaver pond complexes connecting Upper Twin Lake, Lower Twin Lake, and Cub Creek. Larger adults (212-286 mm TL) were caught in fyke nets and gill nets in Upper Twin Lake.

Although we did not quantitatively assess habitat use and availability, the macroscale habitat features where Salish Sucker were found are important to maintaining these populations. The Cub Creek system can be classified as a headwater stream, with an abundance of beaver pond habitat upstream of Cub Creek Reservoir. Beavers maintain multiple dams in this reach, creating a series of deep pools (depth >70 cm) with in-stream vegetation and reduced flow, conditions that have been linked to Salish Sucker abundance in British Columbia (Pearson and Healey 2003; Cooke et al. 2003). These habitat features are indicative of a natural landscape that has not been impacted by agricultural and urban development, with associated habitat loss and degradation, including loss of connectivity between habitats and degraded water quality. Moreover, this reach is bordered by the Walter R. Briggs Old Growth Forest Area, a 3-mile long band of relict Douglas-fir, Sitka spruce, western red cedar and western hemlock that was designated for protection in the early 1990's. Consequently, the riparian buffer along this entire reach is not degraded by land use practices. Given the abundance of Salish Sucker and the quality of habitat, NRS (T) Jim Creek represents a unique "hotspot" for Salish Sucker in western Washington. Riparian buffers, water quality and beaver pond habitats that support the life history requirements of Salish Sucker are valuable to conserving this population over time. Managers at NRS (T) Jim Creek should continue to protect and monitor the health of Salish Sucker in the system. Future surveys that include spatial and temporal habitat selection and spawn timing would all help to build the knowledge of Salish Sucker in the Pacific Northwest.

The native fish community in Upper Twin Lake is comprised of four native species including Coastal Cutthroat Trout, Redside Shiner, Longnose Dace, and Salish Sucker. Based on the size range and number sampled, all four species appear to be thriving in Upper Twin Lake. Stocked Rainbow Trout appeared less abundant than naturally-occurring Coastal Cutthroat Trout, suggesting that a portion of the recreational fishery may be comprised of naturally-occurring fish. Future evaluations may include a creel survey to determine the relative contribution of stocked Rainbow Trout and native Coastal Cutthroat Trout to the fishery. A creel survey would also help to estimate fishing mortality and the risk of angler harvest on native Coastal Cutthroat Trout.

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Appendix I

Sampling locations and catches of fish in Upper Twin Lake (UT), Lower Twin Lake (LT), Cub Creek Reservoir (CCR), and the beaver complexes downstream of Upper Twin (UBC) and Lower Twin (LBC) using Feddes (FT) and Gee (GT) traps from August to September 2016. Species abbreviations are Salish Sucker (SSK), Redside Shiner (RS), Longnose Dace (SD), and Coastal Cutthroat Trout (CCT).

				CPUE (n per trap-night; FT / GT)											
Location	Date	Latitude	Longitude	SSK			RS			SD			CCT		
UT	8/1 – 8/2	48.17259	121.94525	5	/	0	58	/	33	0	/	0	0	/	0
UT	8/1 – 8/2	48.17443	121.94513	0	/	0	13	/	26	0	/	0	0	/	0
UT	8/1 – 8/2	48.17601	121.94624	0	/	0	76	/	2	0	/	0	0	/	0
UT	8/1 – 8/2	48.17714	121.94702	0	/	2	50	/	24	0	/	0	0	/	0
UT	8/1 – 8/2	48.17824	121.94765	0	/	0	0	/	33	0	/	0	0	/	0
UT	8/1 – 8/2	48.17776	121.94747	0	/	0	77	/	15	0	/	0	0	/	0
UT	8/2 – 8/3	48.17572	121.94775	0	/	0	34	/	18	0	/	0	0	/	0
UT	8/2 – 8/3	48.17407	121.94791	0	/	1	81	/	4	1	/	0	0	/	0
UT	8/2 – 8/3	48.17263	121.94666	0	/	0	15	/	5	0	/	0	0	/	0
UT	8/2 – 8/3	48.17113	121.94649	0	/	0	7	/	13	0	/	0	0	/	0
UT	8/2 – 8/3	48.17038	121.94578	0	/	0	0	/	1	0	/	0	0	/	0
UT	8/2 – 8/3	48.17111	121.94495	0	/	0	0	/	34	0	/	0	0	/	0
UT	8/3 – 8/4	48.17854	121.94760	0	/	0	95	/	67	0	/	0	0	/	0
UT	8/3 – 8/4	48.17635	121.94765	0	/	0	107	/	24	0	/	0	0	/	0
UBC	8/3 – 8/4	48.17936	121.94715	3	/	0	137	/	10	0	/	0	0	/	0
UBC	8/3 – 8/4	48.18005	121.94742	0	/	1	68	/	19	0	/	0	0	/	0
UBC	8/3 – 8/4	48.18083	121.94788	3	/	1	210	/	30	1	/	0	0	/	0
LT	8/3 – 8/4	48.18114	121.94847	3	/	0	132	/	29	10	/	0	0	/	0
LT	8/15 – 8/16	48.18943	121.95252	0	/	2	49	/	12	7	/	1	0	/	0
LBC	8/15 – 8/16	48.19005	121.95192	22	/	1	169	/	24	33	/	8	0	/	0
LBC	8/15 – 8/16	48.19090	121.95166	2	/	0	41	/	19	29	/	7	1	/	0
LBC	8/15 – 8/16	48.19173	121.95130	8	/	0	155	/	45	10	/	11	0	/	0
LBC	8/15 – 8/16	48.19251	121.95069	4	/	3	52	/	32	1	/	4	0	/	0
LBC	8/15 – 8/16	48.19309	121.94972	1	/	0	66	/	0	0	/	0	1	/	0
LT	8/16 – 8/17	48.18856	121.95364	3	/	0	36	/	21	7	/	1	0	/	0
LT	8/16 – 8/17	48.18552	121.95207	0	/	1	15	/	4	2	/	2	0	/	0
LT	8/16 – 8/17	48.18703	121.95286	2	/	0	59	/	5	6	/	0	0	/	0
LT	8/16 – 8/17	48.18862	121.95280	4	/	1	2	/	37	4	/	0	0	/	0
LT	8/16 – 8/17	48.18693	121.95375	1	/	0	15	/	20	0	/	0	0	/	0
LT	8/16 – 8/17	48.18530	121.95316	2	/	1	18	/	0	4	/	0	0	/	0
LT	8/17 – 8/18	48.18145	121.94841	4	/	1	20	/	0	18	/	0	0	/	0
LT	8/17 – 8/18	48.18281	121.94962	0	/	0	41	/	11	78	/	7	0	/	0
LT	8/17 – 8/18	48.18428	121.95049	5	/	0	88	/	2	74	/	1	0	/	0
LT	8/17 – 8/18	48.18356	121.95225	1	/	2	26	/	33	31	/	12	0	/	0
LT	8/17 – 8/18	48.18229	121.95136	0	/	0	72	/	1	43	/	17	0	/	0
LT	8/17 – 8/18	48.18107	121.94982	1	/	1	3	/	0	17	/	2	0	/	0
CCR	9/12 – 9/13	48.20847	121.94015	0	/	0	77	/	0	22	/	0	0	/	0
CCR	9/12 – 9/13	48.20855	121.93994	0	/	0	58	/	44	8	/	0	0	/	0
CCR	9/12 – 9/13	48.20872	121.93958	4	/	2	179	/	56	8	/	0	0	/	0
CCR	9/12 – 9/13	48.21064	121.93977	0	/	2	27	/	3	0	/	0	0	/	0
CCR	9/12 – 9/13	48.21000	121.93937	0	/	1	82	/	44	0	/	0	0	/	0

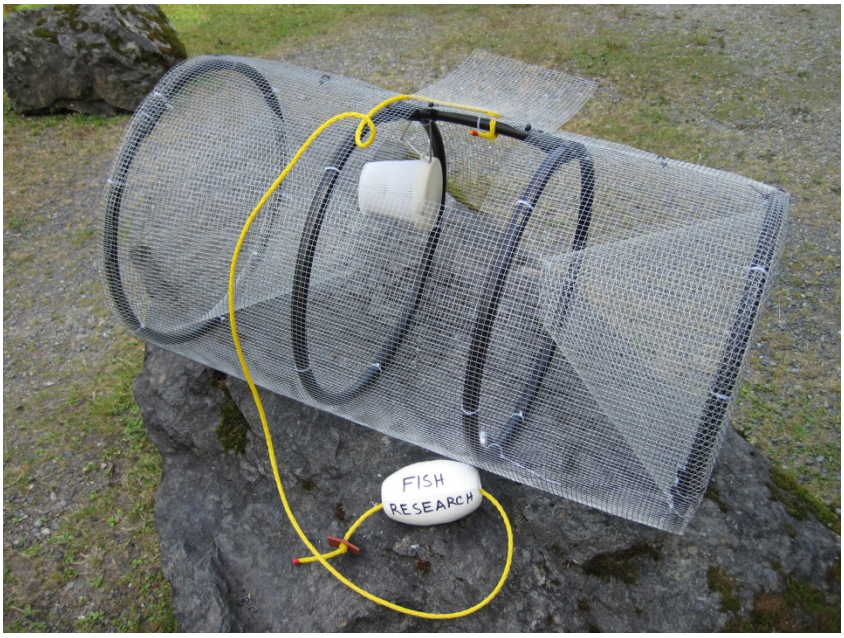
CCR	9/12 – 9/13	48.20927	121.93982	4	/ 0	80	/ 10	0	/ 0	0	/ 0
n				82	/ 23	2,590	/ 810	414	/ 73	2	/ 0
mean CPUE				2.0	/ 0.5	61.7	/ 19.3	9.8	/ 1.7	0.04	/ 0
standard deviation CPUE				3.7	/ 0.8	52.2	/ 16.9	18.4	/ 3.9	0.2	/ 0

Appendix II: Sampling Photographs

Redside Shiner

Longnose Dace

Sampling beaver pond habitat with Gee Trap



Baited Gee Trap constructed by Justin Spinelli

Redside Shiners in Gee Trap

Sampling Lower Twin Lake

Gee trap site location, shoreline habitat

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