Northern Boundary and Transboundary Rivers Restoration & Enhancement Fund

BOUNDARY AREA COHO ESCAPEMENT 2018

Final Report

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INTRODUCTION:

The Hugh Smith Lake coho salmon (*Oncorhynchus kisutch*) stock assessment project has been the only long-term, continuously operated wild coho salmon indicator stock project in the Northern Boundary Area. The project has provided annual estimates of catch, escapement, smolt production, marine survival, and age composition dating from 1982 (Figure 1; Shaul et al. 2009, 2011, *in prep*). In addition to the higher resolution stock assessment provided by the Hugh Smith Lake project, standardized helicopter surveys have been used to broaden Northern Boundary coho salmon escapement assessment to 14 additional streams in the Ketchikan area that have been surveyed annually since 1987 (Figure 1).

Combined, these projects form the core stock assessment program used to manage fisheries for coho salmon in the Northern Boundary Area. The Hugh Smith Lake coho salmon population is substantially exploited by mixed stock fisheries in both the U.S. and Canada and is, therefore, a key indicator stock used to monitor total adult abundance and escapements and the pattern and intensity of exploitation by these fisheries on populations in the Northern Boundary Area. It is the only stream in the southern portion of Southeast Alaska where a total count (with back-up mark–recapture estimate) of coho salmon escapement has been routinely collected. Its location, 70 km southeast of Ketchikan, makes it a particularly strategic indicator stock for boundary area fisheries. It has also been one of three key indicator stocks used to measure the exploitation rate by the Alaska commercial troll fishery and to estimate the overall abundance of wild coho salmon available to the fishery. Timely escapement projections are made from both the cumulative weir count and estimation models based on recovery of coded wire tags (Shaul et al. 2009) to provide real-time information for management of fisheries for escapement. Peak helicopter survey counts provide an index with greater coverage that complements higher resolution assessment at Hugh Smith Lake.

This report summarizes data collected during the 2018 coho salmon return year.

OBJECTIVES:

The overall purpose primary purpose of the project was to obtain an accurate and precise estimate of the Hugh Smith Lake coho salmon spawning escapement (including age, sex and size composition) and to sample adults marked in the prior year for coded wire tags (CWTs). CWT sampling results were used to provide a suite of population and fishery estimates. Methods and objectives are also described by Shaul and Crabtree (2017). Specific project objectives were as follows:

1. Determine the total coho salmon escapement to Hugh Smith Lake using a weir count. In the event of a failure to enumerate all fish that pass the weir, obtain a Chapman mark–recapture estimate of the escapement such that the estimated coefficient of variation is 7% or less.
2. Estimate the age and sex compositions of the coho salmon escapement to Hugh Smith Lake from a sample of approximately 600 returning adult spawners distributed throughout the run so that the estimated proportion of each age class is within 5% of the true value with at least 95% probability.
3. Sample as many returning adults as possible at the Hugh Smith Lake weir (up to 100%) for adipose clips and coded-wire tags in order to generate estimates of smolt production, marine survival, and harvest and exploitation rate by area, time and gear type.
4. Obtain peak survey counts of coho salmon spawning escapements that are comparable with prior years from 14 index streams in the Ketchikan area.

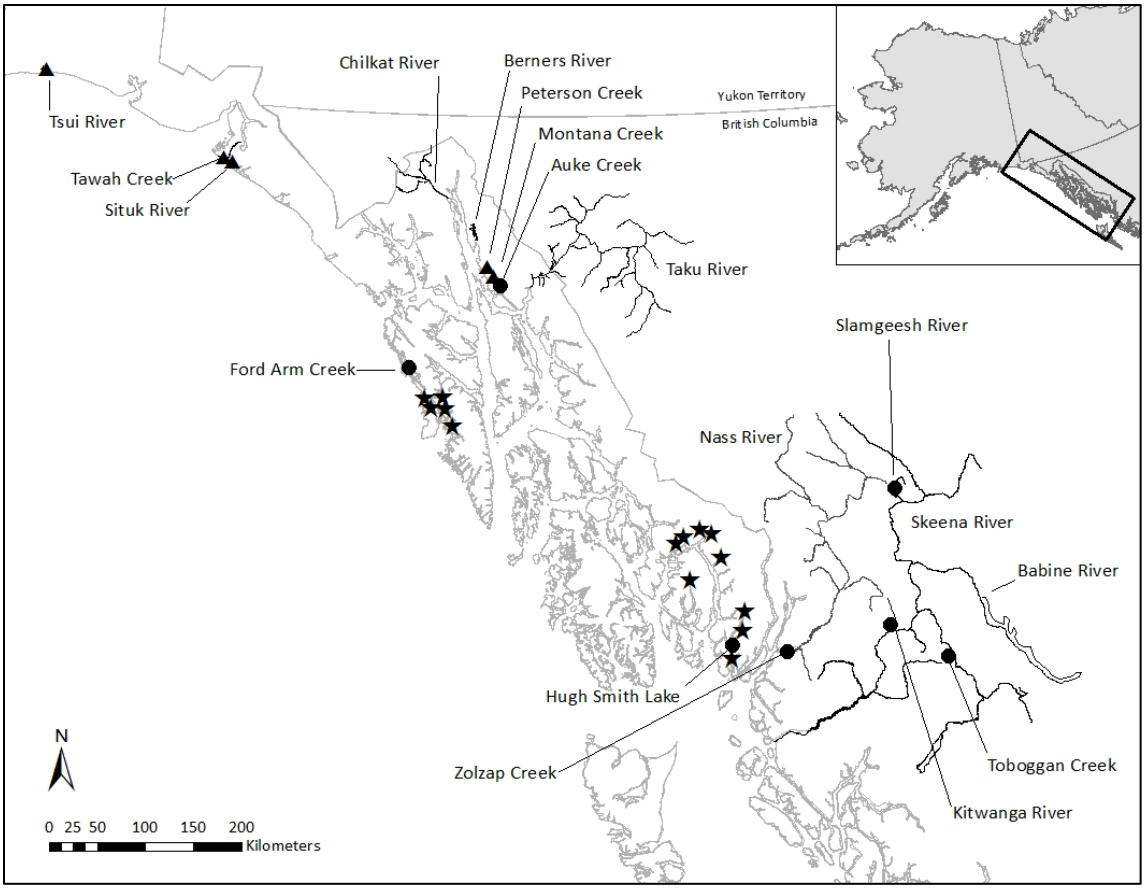

Figure 1.–Map of Southeast Alaska and northern British Columbia, showing the locations of recent coho salmon full indicator stock assessment projects. Stars mark area index streams and triangles mark surveyed streams with independent escapement goals.

METHODS:

Coho salmon production in the Northern Boundary Area is broadly distributed, necessitating an assessment and monitoring approach that combines a small number of "indicator stocks" with broader, lower-resolution coverage based on escapement surveys. The wide distribution of populations across thousands of streams, combined with a high average smolt-to-adult survival rate, favors an indicator stock approach over other assessment methods (including genetic stock identification) for this species.

Returning adult coho salmon were counted and marked at an aluminum bipod weir at the outlet of Hugh Smith Lake and sampled in spawning areas at the head of the lake to validate the weir count with a mark–recapture estimate. Escapement counts were used to determine if the established escapement goal of 500–1,600 spawners was met. The coho salmon return was reconstructed (based on recovery of coded wire tags from smolts marked during spring in 2017), including spawning escapement and catch by area, statistical week, and gear type. Smolt estimates and tag recovery rates in the Southeast Alaska troll fishery were used to generate inseason estimates of marine survival and total adult abundance for fishery management (Shaul et al. 2009). Estimates of brood year smolt production and adult return by age class were used to evaluate and refine the biological escapement goal. The sum of peak counts from two helicopter surveys conducted on each of 14 streams were used to evaluate escapement relative to the biological escapement goal of 4,250–8,500 spawners.

The strategy for helicopter surveys was to initially target two surveys, one for pre-peak timing when most fish are highly visible in holding areas (but may not have reached peak instream abundance), followed by a survey targeted at peak abundance when fish may be more dispersed but before there has been substantial loss to predation and drift-out (Shaul and Crabtree 2017). Surveys were conducted only under good or better visibility and water conditions, while only counts that occurred under acceptable conditions and within a defined time period were included in the index. Statistical interpolations were made for any streams that do not meet those criteria when peak counts are summed for the overall index.

Hugh Smith Lake Escapement (objective 1)

An adult salmon weir was operated at the outlet of Hugh Smith Lake during 15 August–7 November 2018, continuing from an earlier project that operated the weir beginning on 16 June to enumerate the sockeye salmon (*O. nerka*) run. The weir and its trap were constructed of vertical pickets of ¾" EMT conduit supported in three 8' sections of aluminum channel drilled to accommodate 43 evenly spaced pickets per section, with a larger hole on each end for nominal 1" black iron or aluminum pipe. To provide extra height during periods of high water, the weir was extended from the top of the pickets to the catwalk handrail with 2"×2" 12-gauge galvanized hardware cloth.

Almost all healthy adult coho salmon that passed through the weir were captured in the trap, sampled for coded wire tags, and marked with a fin clip. Three fin marks are used for periods that corresponded to historical average thirds of the run: a partial dorsal fin clip 1 July–15 September, a left ventral fin clip 16 September–6 October, and a right ventral fin clip 7 October–November.

Mark–recovery sampling was conducted from late October and mid-November. Fish were captured with a beach seine and dip nets from the earlier-spawning Cobb Creek escapement and with spinning gear (spoons and spinners) off the mouths of both Buschmann and Cobb creeks. All sampled fish were marked with a single left opercular punch (to prevent resampling) and released. All marks (adipose clip, left or right ventral clip, dorsal clip, opercular punch) were recorded and the fish classified as adults (age .1) or jacks (age .0).

Age, Sex, and Length Composition (objective 2)

The age-sex-length composition of the escapement was estimated from a target sample of 630 fish apportioned to weekly targets based on average run timing. Males less than 400 mm mid eye to fork length were classified as jacks while larger fish were classified as adults. Samples were randomly collected from both adults and jacks. Fish sampled for age-sex-length were removed from the weir trap, anesthetized in a clove oil solution (Woolsey et al. 2004), placed in a padded measuring trough, and measured to the nearest millimeter (mid eye to fork length). Four scales were taken from the left side of the fish approximately two rows above the lateral line along a diagonal downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). Scales were mounted on gum cards and impressions later made in cellulose acetate (Clutter and Whitesel 1956).

Coded-wire Tag Sampling (objective 3)

All fish counted past the weir were captured in the trap and examined for the presence of an adipose fin. When an adipose clip was encountered, a coded wire tag detecting wand was passed over the snout to determine the presence of a tag. Fish that produced a strong signal were recorded as having a tag, while those that did not produce a signal were released and recorded as having no tag.

An individual record was made for each fish, including whether it was an adult (age .1) or jack (age .0), whether or not it had an adipose clip, and, if clipped, whether or not it registered a positive signal on the detector. Age-sex-length samples were recorded on the same form.

Helicopter Survey Index Counts (objective 4)

Helicopter surveys were conducted on 14 index streams in the Boundary Area of District 1, near Ketchikan, that have been surveyed annually since 1987 (Shaul and Tydinco 2006). The annual escapement survey index was the sum of peak counts for all 14 streams, including interpolated values for missing counts.

Surveys were timed so that the maximum (peak) number of fish were available for counting. This usually occurs after most fish have entered the stream from saltwater but before most have begun spawning. Most fall coho salmon stocks migrate into freshwater beginning in late August through mid- to late October, with peak entry in late September through the first week of October. In most short, coastal streams, spawning begins in early October, peaks in late October, and continues through mid-November. Initial surveys were conducted at the end of September, when the majority of the run has entered the stream but before a substantial number are lost after spawning. A second survey was conducted in mid-October to account for later migrants and variations in run timing.

The index streams were divided into three groups of four to six streams based on geographical proximity and the timing of coho salmon migration and spawning. The streams in each group were surveyed on the same day. Pre-peak surveys for the three groups were scheduled for 28 September–1 October, and the peak surveys were scheduled for 15–20 October. If weather and water conditions were unfavorable, the surveys were to be conducted as soon after these dates as possible.

Surveys were conducted from a Bell 206 B Jet Ranger or Hughes 500 helicopter at altitudes of 6–50 m unless obstructions required flying higher. Airspeed varied from approximately 5 km to 50 km per hour depending on terrain, visibility, and the presence or absence of fish. The helicopter was maneuvered so the stream could be continuously viewed from the observer's side. The observer wore polarized glasses to reduce reflective glare. Surveys were conducted by observers experienced on each system area (ADF&G management biologists Justin Breese and Bo Meredith; both have conducted coho salmon helicopter surveys on these index streams for 10 or more years). Survey data, including the number of fish counted and survey conditions (water level and visibility), were recorded and entered into the Southeast Alaska Integrated Fisheries Database.

Only peak survey counts that met standards for timing, survey conditions, and completeness were included in the annual index. Missing counts were interpolated in order to maintain a comparable aggregate escapement index. Interpolations were made for missing counts under the assumption that the expected value is determined for a given stream and year in a multiplicative way (i.e., counts across streams for a given year are multiples of counts for other years, and counts across years for a stream are multiples of counts for other streams). The estimated expected count for a given stream in a given year is then equal to the sum of all counts for the year times the sum of all counts for the stream divided by the sum of counts over all streams and years. If there was more than one missing value, an iterative procedure, as described by Brown (1974), was used since the sums change as missing counts are filled in at each step.

RESULTS AND DISCUSSION:

In 2018, 619 wild adult coho salmon were enumerated at the Hugh Smith Lake weir, which fell within the biological escapement goal range of 500–1,600 spawners (Figure 2). A total of 616 was examined for adipose clips. Of the examined fish, 293 had adipose clips. Of the adipose clipped fish, all were examined for tags, of which 287 elicited a signal indicating the presence of a tag. Heads were collected from all 6 clipped adults that did not elicit a signal and sent to the MTA Lab, which determined that none contained tags. The mark–recapture recovery sample of 66 adults from the upper lake all had marks, indicating that no adults likely escaped past the weir undetected. The proportion of the wild adult return marked with valid coded-wire tags was estimated at 0.4659.

After adding 32 0-ocean jacks sampled in 2017 in the recovery sample, the total sea-ward migration

in 2017 was estimated at 51,887 smolts (95% Confidence Interval 46,652–58,446 smolts; Table 1 and Figure 3). Marine survival of those smolts to adulthood in 2018 was estimated at 2.7%, a record low that was far below the average of 12.5% for the previous 35 years (Table 1 and Figure 4). The adult return, including catch and escapement, was estimated at 1,384 fish, of which 765 fish were caught and 619 spawners escaped into the system. Based on 98 coded-wire tag recoveries from fisheries, Alaska drift gillnet fisheries (288 fish) accounted for the largest harvest, followed by the Alaska troll fishery (230 fish), northern British Columbia fisheries (132 fish), Alaska purse seine fisheries (98 fish), and Alaska marine sport fisheries (17 fish) (Table 2; Figure 5).

The all-fishery exploitation rate on the Hugh Smith Lake stock was estimated at 55.3%, of which the Alaska troll and drift gillnet fisheries accounted for 16.6% and 20.8%, respectively. In addition, 8.3% were harvested in purse seine, and sport fisheries in Alaska and 9.6% were harvested by fisheries in northern British Columbia (Table 3). The total exploitation rate estimate was below the long-term (36-year) average of 61.5%.

A total of 411 age-length-sex samples were collected from the spawning escapement, of which 327 fish had ageable scales. Of those, all were age 1-ocean adults (270 age 1.1 and 57 age 2.1). Of the adults, 57.7% were males and 42.3% were females. Adult males averaged 611 mm in mid eye to fork length and females averaged 636 mm (Figure 6).

Helicopter surveys met criteria for timing and conditions on 12 of 14 streams in the Ketchikan survey index. A count was interpolated for two single streams (Grant and Humpback creeks) for which survey criteria were not met (Table 4) using the method presented by Brown (1974). Water levels were very low in survey streams. The surveys were conducted under excellent conditions on 2 October for the west Behm Canal circuit and on 4 October for the Boca de Quadra and Portland Canal circuit. The sum of peak counts for the 14 streams (including the statistical interpolation for Grant Creek) totaled 14,060 spawners, well above the biological escapement goal range of 4,250–8,000 spawners (Figure 2).

CONCLUSION:

In the spring of 2018, the Northern Fund was used to successfully obtain a count and back-up mark–recapture estimate of the adult coho salmon escapement entering Hugh Smith Lake and a comparable peak index count of coho salmon spawners in streams in the Ketchikan area.

Table 1.–Annual Hugh Smith Lake coho salmon smolt weir counts and total population estimates in 1982–2018, and estimated survival to adulthood the following year. The 2018 smolt population estimate is preliminary, based on a recovery sample from 2018 age-.0 jacks.

Smolt Year	Smolt Weir Count	Number Marked (M)	Returns Sampled (C)	Adjusted Ad Clips (R)	Smolt Estimate (N)	95% C.I. Lower Bound	95% C.I. Upper Bound	Total Adult Return	Marine Survival (%)
1982	5,925	5,573	1,160	221	29,117	25,738	33,519	3,875	13.3
1983	27,552	9,647	1,242	224	53,227	47,087	61,209	4,024	7.6
1984	22,803	16,928	806	422	32,283	29,474	35,683	2,440	7.6
1985	11,111	9,833	692	288	23,572	21,136	26,643	4,365	18.5
1986	6,819	5,716	508	132	21,878	18,705	26,349	2,244	10.3
1987	4,965	4,819	262	34	36,218	27,276	53,883	1,473	4.1
1988	5,319	5,292	341	64	27,904	22,463	36,824	2,404	8.6
1989	7,187	7,187	736	198	26,620	23,376	30,910	4,794	18.0
1990	11,106	11,106	1,582	530	33,101	30,507	36,177	5,767	17.4
1991	13,371	13,269	1,059	601	23,373	21,643	25,402	4,895	20.9
1992	5,519	5,514	835	140	32,657	28,042	39,092	4,242	13.0
1993	19,422	19,401	1,719	688	48,434	45,069	52,341	9,464	19.5
1994	15,993	15,941	1,919	617	49,516	45,898	53,752	6,708	13.5
1995	12,586	12,585	1,034	584	22,267	20,597	24,230	3,948	17.7
1996	24,243	24,220	699	524	32,294	29,748	35,316	2,696	8.3
1997	26,791	26,367	1,061	747	37,436	34,932	40,327	4,371	11.7
1998	20,522	20,213	1,370	927	29,875	28,068	31,930	4,221	14.1
1999	12,001	11,999	616	371	19,902	18,066	22,154	1,346	6.8
2000	19,668	19,663	1,443	1,216	23,327	22,086	24,716	3,119	13.4
2001	30,335	29,388	3,282	2,643	36,487	35,147	37,933	5,406	14.8
2002	19,326	18,935	1,497	1,056	26,841	25,315	28,564	3,676	13.7
2003	16,317	15,572	929	629	22,997	21,331	24,946	2,492	10.8
2004	24,379	23,517	1,807	1,064	39,924	37,662	42,476	3,652	9.1
2005	17,799	17,795	935	590	28,184	26,080	30,656	1,926	6.8
2006	26,128	25,375	1,339	911	37,267	34,996	39,854	3,309	8.9
2007	19,602	19,306	1,732	1,161	28,793	27,228	30,550	3,776	13.1
2008	10,131	10,046	2,277	952	24,006	22,573	25,633	4,383	18.3
2009	18,988	18,722	2,876	2,086	25,813	24,751	26,970	5,417	21.0
2010	25,727	25,437	2,131	1,436	37,742	35,886	39,800	3,937	10.4
2011	21,359	21,359	1,851	1,217	32,482	30,755	34,415	4,163	12.8
2012	21,638	21,456	3,069	1,602	41,093	39,175	43,208	6,906	16.8
2013	24,398	24,113	4,075	2,079	47,247	45,300	49,368	7,707	16.3
2014	18,908	18,675	988	544	33,860	31,238	36,962	1,954	5.8
2015	9,860	9,787	1,058	266	38,808	34,656	44,090	2,466	6.4
2016	11,468	11,432	1,496	486	35,143	32,277	38,568	2,425	6.9
2017	24,862	24,384	648	304	51,887	46,652	58,446	1,384	2.7
2018	17,195	16,127	55	36	27,621	19,947	38,247		
1982–2017 Avg. Average	17,059	16,127	1,419	765	33,099	30,304	36,747	3,927	12.2

Table 2.–Estimated fishery sample size (expanded CWT recoveries), harvest by gear type, escapement, and total run of coho salmon returning to Hugh Smith Lake, 1982–2018.

	Fishery	Number of Fish										
Year	Sample Size	Alaska Troll	Alaska Seine	Alaska Gillnet	Alaska Trap	Alaska Sport	B.C. Troll	B.C. Net	B.C. Sport	Total Catch	Escapement	Total Return
1982	91	2,758	628	203	0	0	316	84	0	3,988	2,144	6,132
1983	185	1,374	424	277	49	0	214	50	0	2,388	1,487	3,875
1984	151	1,266	504	471	18	0	331	27	0	2,617	1,407	4,024
1985	213	868	287	137	5	0	201	39	0	1,537	903	2,440
1986	256	1,598	493	213	0	16	236	28	0	2,583	1,782	4,365
1987	99	657	82	148	4	28	155	53	0	1,127	1,117	2,244
1988	41	406	207	78	0	0	242	27	0	960	513	1,473
1989	91	1,217	320	247	0	62	106	20	0	1,971	433	2,404
1990	263	1,803	566	637	23	0	840	54	0	3,924	870	4,794
1991	399	2,103	190	941	0	38	614	44	0	3,931	1,836	5,767
1992	497	1,854	676	600	0	40	289	10	0	3,469	1,426	4,895
1993	155	2,227	269	666	0	0	207	41	0	3,410	832	4,242
1994	838	4,333	1,123	1,450	0	45	694	53	13	7,711	1,753	9,464
1995	432	2,018	947	1,588	0	98	236	28	11	4,927	1,781	6,708
1996	502	1,585	623	487	0	125	125	38	14	2,998	950	3,948
1997	480	1,321	108	397	0	45	91	0	0	1,964	732	2,696
1998	668	1,771	471	980	0	150	0	0	15	3,388	983	4,371
1999	623	1,757	283	726	0	180	0	0	30	2,975	1,246	4,221
2000	161	489	45	116	0	97	0	0	0	746	600	1,346
2001	314	696	454	324	0	58	7	0	0	1,539	1,580	3,119
2002	434	892	451	555	0	91	65	0	61	2,115	3,291	5,406
2003	335	894	354	690	0	106	91	31	0	2,166	1,510	3,676
2004	244	1,017	196	243	0	60	48	20	69	1,652	840	2,492
2005	256	1,163	122	532	0	59	36	8	0	1,920	1,732	3,652
2006	169	703	64	170	0	7	34	0	58	1,035	891	1,926
2007	294	1,262	175	300	0	74	57	11	186	2,065	1,244	3,309
2008	302	716	244	779	0	33	59	12	192	2,035	1,741	3,776
2009	253	1,049	268	483	0	18	265	0	19	2,102	2,281	4,383
2010	632	1,205	287	692	0	36	218	0	101	2,539	2,878	5,417
2011	376	778	148	417	0	25	189	4	239	1,800	2,137	3,937
2012	542	821	348	703	0	41	169	0	173	2,255	1,908	4,163
2013	552	1,754	767	793	0	108	283	32	121	3,858	3,048	6,906
2014	566	1,873	399	798	0	121	218	0	188	3,597	4,110	7,707
2015	203	470	112	272	0	24	102	6	12	998	956	1,954
2016	123	767	150	429	0	90	39	0	43	1,518	948	2,466
2017	93	674	50	273	0	56	106	0	0	1,159	1,266	2,425
2018	98	230	98	288	0	17	26	0	106	765	619	1,384
Average		1,307	350	516	3	53	187	20	45	2,479	1,507	3,987

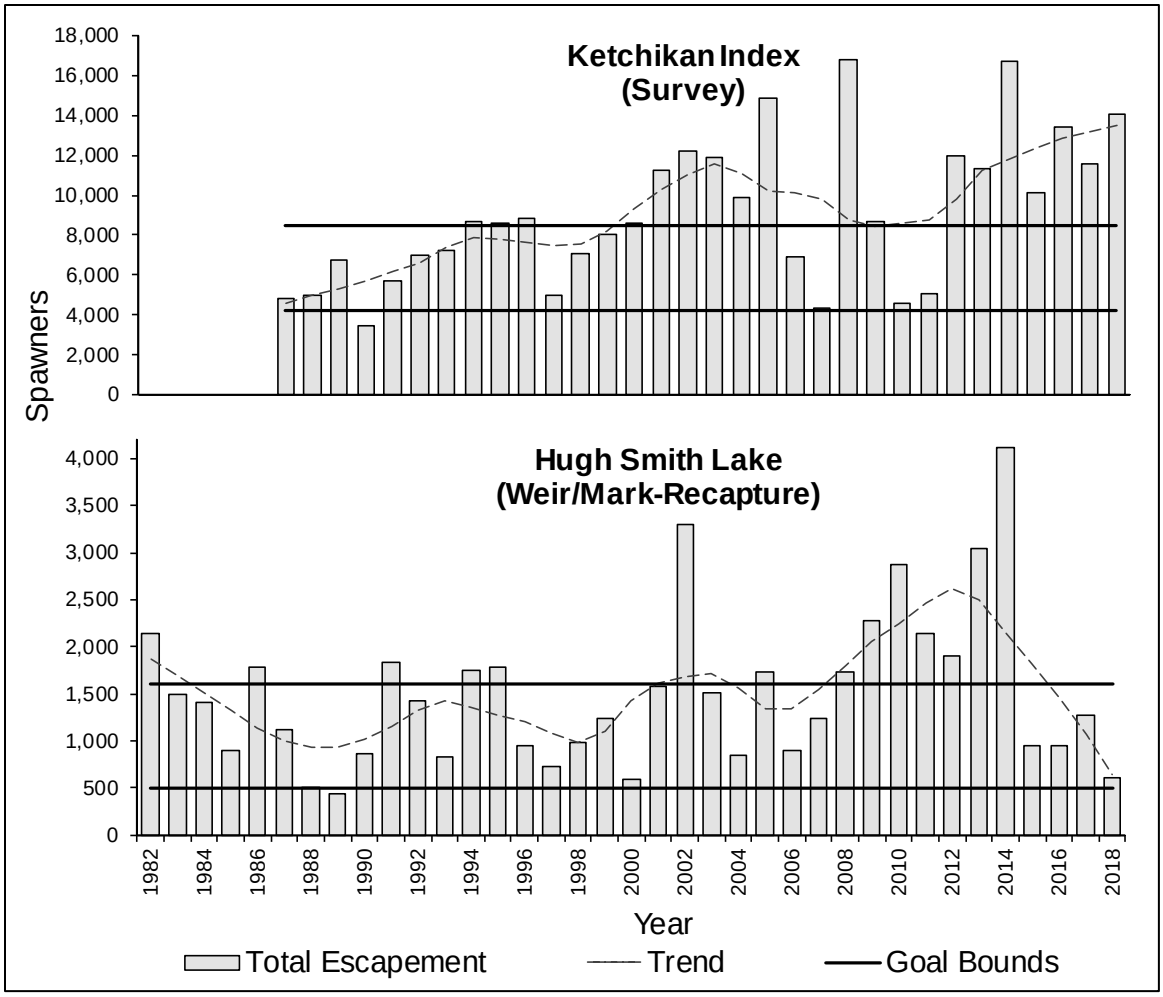

Figure 2.–Sum of peak coho salmon escapement survey counts for 14 streams in the Ketchikan area (top graph) and coho salmon escapement counts and estimates for Hugh Smith Lake (bottom graph), with biological escapement goal ranges (solid lines) and 7-point LOESS trends (dashed lines), 1982–2018.

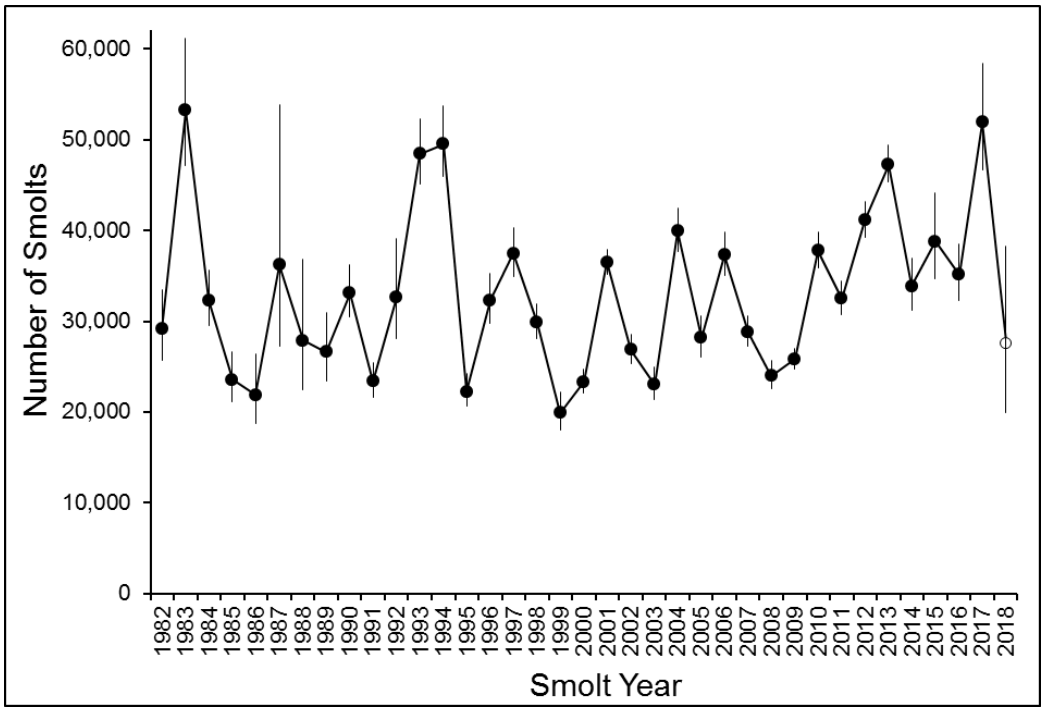

Figure 3.–Estimated number of coho salmon smolts migrating from Hugh Smith Lake with 95% confidence intervals by smolt year, 1982–2018.

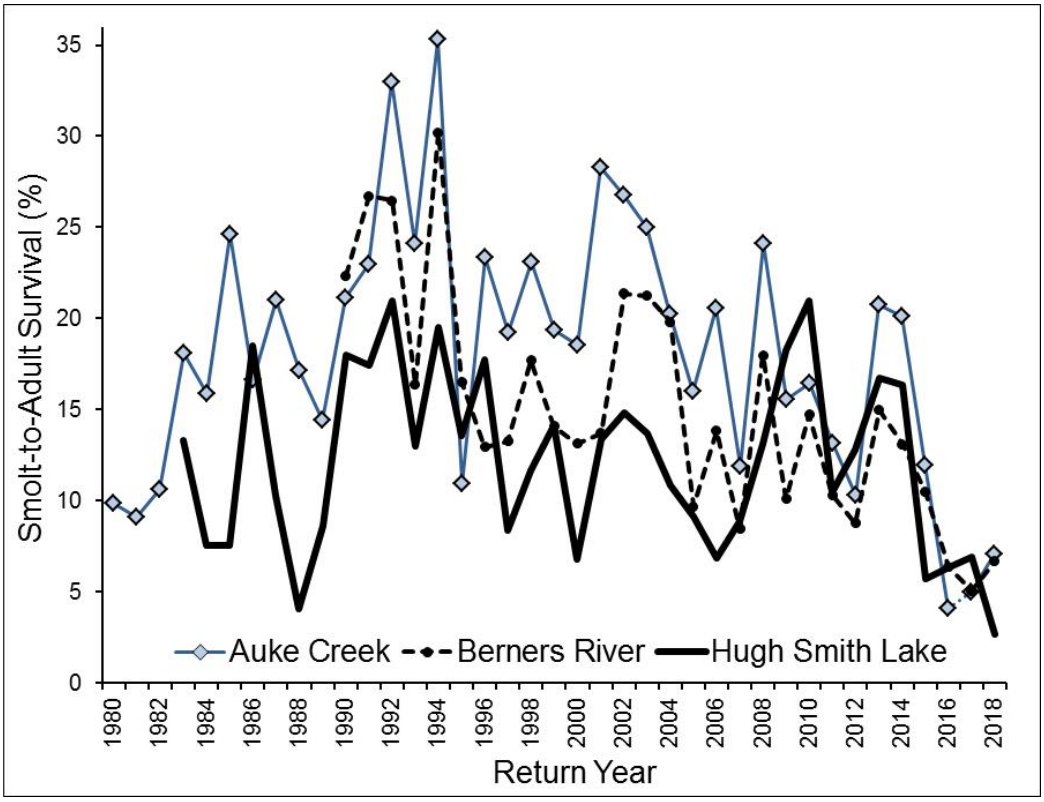

Figure 4.–Estimated smolt-to-adult survival rate for coho salmon returns to Hugh Smith Lake compared with two coded wire tagged indicator systems in northern Southeast Alaska, Auke Creek and Berners River, 1980–2018.

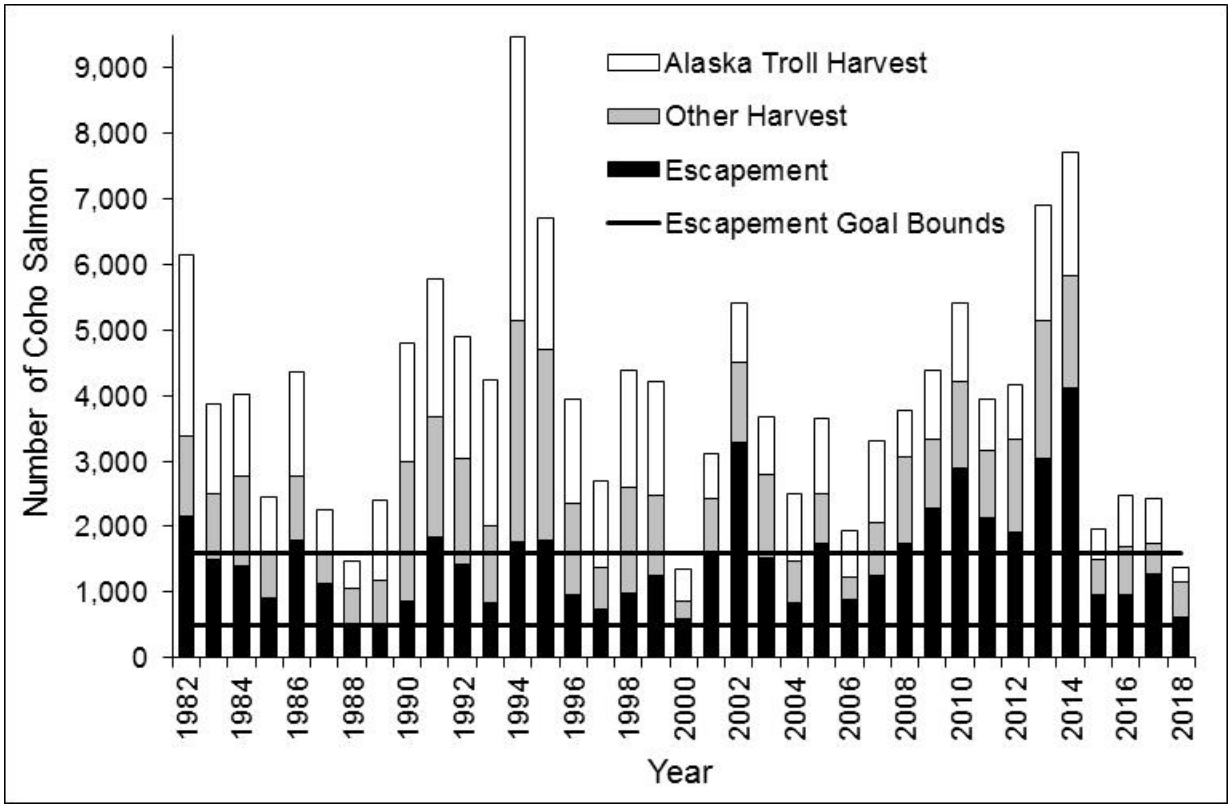

Figure 5.–Estimated escapement and harvest of Hugh Smith Lake coho salmon by the Alaska troll fishery and other fisheries combined, 1982–2018. The biological escapement goal range is 500–1,600 spawners.

Table 3.–Estimated harvest (by gear type) and escapement as a percent of the total Hugh Smith Lake coho salmon run, 1982–2018.

	Fishery	Percent of Run										
Year	Sample Size	Alaska Troll	Alaska Seine	Alaska Gillnet	Alaska Trap	Alaska Sport	B.C. Troll	B.C. Net	B.C. Sport	Total Catch	Escapement	Total Return
1982	91	45.0	10.2	3.3	0.0	0.0	5.2	1.4	0.0	65.0	35.0	100.0
1983	185	35.5	10.9	7.1	1.3	0.0	5.5	1.3	0.0	61.6	38.4	100.0
1984	151	31.5	12.5	11.7	0.5	0.0	8.2	0.7	0.0	65.0	35.0	100.0
1985	213	35.6	11.8	5.6	0.2	0.0	8.2	1.6	0.0	63.0	37.0	100.0
1986	256	36.6	11.3	4.9	0.0	0.4	5.4	0.7	0.0	59.2	40.8	100.0
1987	99	29.3	3.6	6.6	0.2	1.3	6.9	2.4	0.0	50.2	49.8	100.0
1988	41	27.6	14.0	5.3	0.0	0.0	16.4	1.8	0.0	65.2	34.8	100.0
1989	91	50.6	13.3	10.3	0.0	2.6	4.4	0.8	0.0	82.0	18.0	100.0
1990	263	37.6	11.8	13.3	0.5	0.0	17.5	1.1	0.0	81.9	18.1	100.0
1991	399	36.5	3.3	16.3	0.0	0.7	10.6	0.8	0.0	68.2	31.8	100.0
1992	497	37.9	13.8	12.3	0.0	0.8	5.9	0.2	0.0	70.9	29.1	100.0
1993	155	52.5	6.3	15.7	0.0	0.0	4.9	1.0	0.0	80.4	19.6	100.0
1994	838	45.8	11.9	15.3	0.0	0.5	7.3	0.6	0.1	81.5	18.5	100.0
1995	432	30.1	14.1	23.7	0.0	1.5	3.5	0.4	0.2	73.5	26.5	100.0
1996	502	40.2	15.8	12.3	0.0	3.2	3.2	1.0	0.4	75.9	24.1	100.0
1997	480	49.0	4.0	14.7	0.0	1.7	3.4	0.0	0.0	72.8	27.2	100.0
1998	668	40.5	10.8	22.4	0.0	3.4	0.0	0.0	0.3	77.5	22.5	100.0
1999	623	41.6	6.7	17.2	0.0	4.3	0.0	0.0	0.7	70.5	29.5	100.0
2000	161	36.3	3.4	8.6	0.0	7.2	0.0	0.0	0.0	55.4	44.6	100.0
2001	314	22.3	14.6	10.4	0.0	1.9	0.2	0.0	0.0	49.3	50.7	100.0
2002	434	16.5	8.3	10.3	0.0	1.7	1.2	0.0	1.1	39.1	60.9	100.0
2003	335	24.3	9.6	18.8	0.0	2.9	2.5	0.8	0.0	58.9	41.1	100.0
2004	244	40.8	7.9	9.7	0.0	2.4	1.9	0.8	2.8	66.3	33.7	100.0
2005	256	31.8	3.4	14.6	0.0	1.6	1.0	0.2	0.0	52.6	47.4	100.0
2006	169	36.5	3.3	8.8	0.0	0.4	1.8	0.0	3.0	53.7	46.3	100.0
2007	294	38.1	5.3	9.1	0.0	2.2	1.7	0.3	5.6	62.4	37.6	100.0
2008	302	19.0	6.5	20.6	0.0	0.9	1.6	0.3	5.1	53.9	46.1	100.0
2009	253	23.9	6.1	11.0	0.0	0.4	6.0	0.0	0.4	48.0	52.0	100.0
2010	632	22.2	5.3	12.8	0.0	0.7	4.0	0.0	1.9	46.9	53.1	100.0
2011	376	19.8	3.8	10.6	0.0	0.6	4.8	0.1	6.1	45.7	54.3	100.0
2012	542	19.7	8.4	16.9	0.0	1.0	4.1	0.0	4.2	54.2	45.8	100.0
2013	552	25.4	11.1	11.5	0.0	1.6	4.1	0.5	1.8	55.9	44.1	100.0
2014	566	24.3	5.2	10.4	0.0	1.6	2.8	0.0	2.4	46.7	53.3	100.0
2015	203	24.1	5.7	13.9	0.0	1.2	5.2	0.3	0.6	51.1	48.9	100.0
2016	123	31.1	6.1	17.4	0.0	3.6	1.6	0.0	1.7	61.6	38.4	100.0
2017	93	27.8	2.1	11.3	0.0	2.3	4.4	0.0	0.0	47.8	52.2	100.0
2018	98	16.6	7.1	20.8	0.0	1.2	1.9	0.0	7.7	55.3	44.7	100.0
Average		32.5	8.4	12.6	0.1	1.5	4.5	0.5	1.2	61.3	38.7	100.0

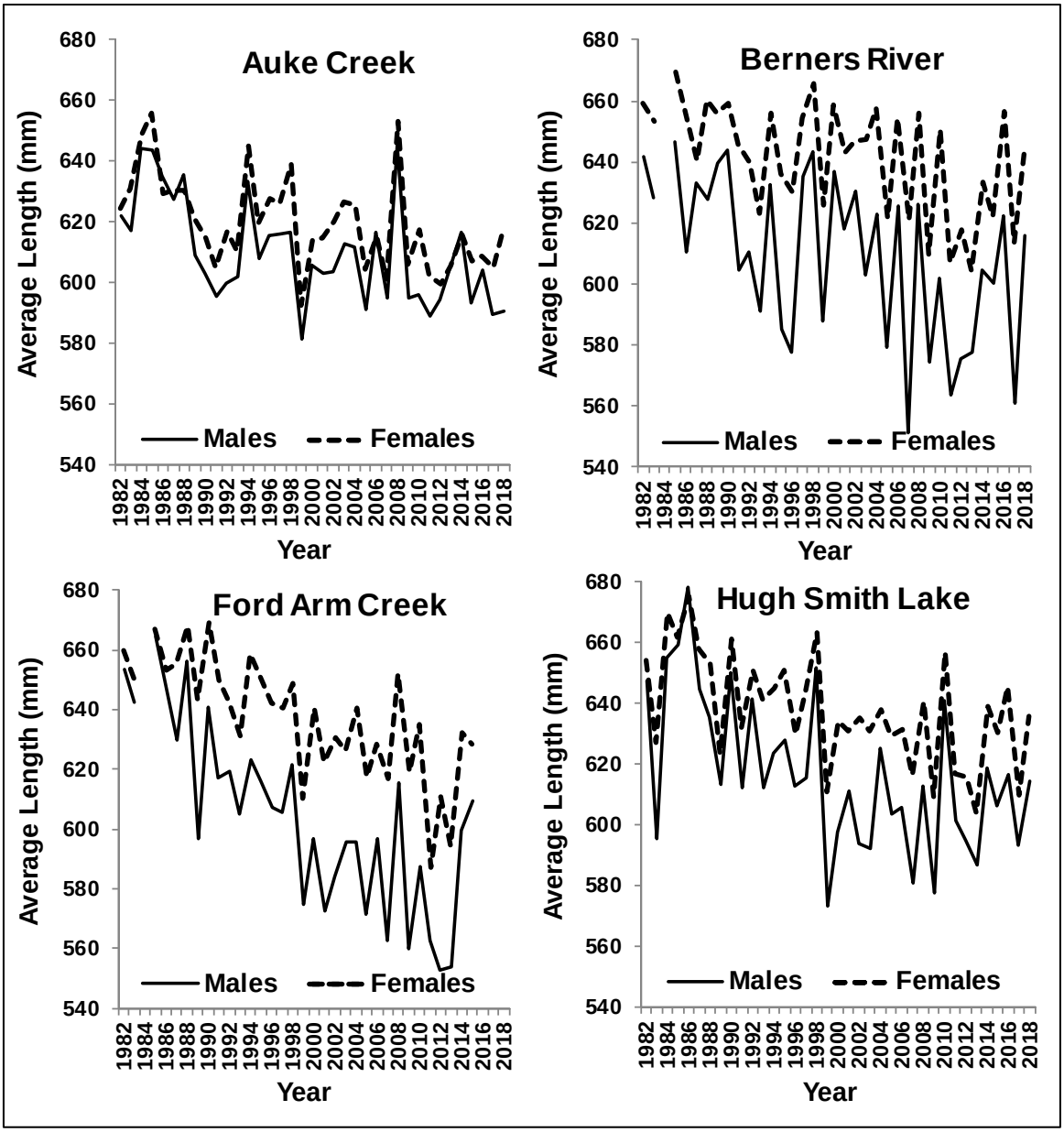

Figure 6.–Annual average mid eye to fork lengths of age-.1 male and female coho salmon sampled in Auke Creek, Berners River, Ford Arm Creek, and Hugh Smith Lake, 1982–2018.

Table 4.–Peak helicopter survey counts of coho salmon spawners in 14 index streams in the Ketchikan area, 1987–2018.

Year	Herman Creek	Grant Creek	Eulachon River	Klahini River	Indian River	Barrier Creek	King Creek	Choca Creek
1987	92	78	154	65	336	70	282	113
1988	72	150	205	20	300	50	175	150
1989	75	101	290	15	925	450	510	200
1990	150	30	235	150	242	50	35	81
1991	245	50	285	50	550	100	300	220
1992	115	270	860	90	675	100	250	150
1993	90	175	460	50	475	325	110	300
1994	265	220	755	200	560	175	325	225
1995	250	94	435	165	600	220	415	180
1996	94	92	383	40	570	230	457	220
1997	75	82	420	60	353	73	295	175
1998	94	130	460	120	304	50	411	190
1999	75	127	657	150	356	25	627	225
2000	135	94	600	110	380	72	620	180
2001	80	110	929	151	1,140	164	891	450
2002	88	138	1,105	20	940	70	700	220
2003	242	194	875	39	690	57	1,140	380
2004	150	230	801	170	935	250	640	180
2005	510	300	1,240	360	890	190	810	270
2006	165	113	190	176	280	30	405	130
2007	134	75	276	35	245	15	290	210
2008	115	55	570	25	1,250	23	420	100
2009	149	330	330	340	750	110	1,050	100
2010	85	102	370	62	880	90	570	190
2011	87	83	350	69	175	74	110	85
2012	25	60	400	162	170	40	703	110
2013	194	184	722	153	792	164	664	266
2014	425	80	660	226	1,500	242	850	400
2015	20	200	550	136	1,200	242	550	200
2016	160	25	810	450	370	90	540	315
2017	40	167	540	280	850	20	100	240
2018	75	55	280	70	610	95	595	110
Average	143	131	537	132	634	124	495	205

Year	Carroll River	Blossum River	Keta River	Marten River	Humpback Creek	Tombstone River	Combined Survey Count	Hugh Smith Lake (Weir)
1987	180	700	800	740	650	532	4,792	1,117
1988	193	790	850	600	52	1,400	5,007	513
1989	70	1,000	650	1,175	350	950	6,761	433
1990	136	800	550	575	135	275	3,444	870
1991	375	725	800	575	671	775	5,721	1,836
1992	360	650	627	1,285	550	1,035	7,017	1,426
1993	310	850	725	1,525	600	1,275	7,270	832
1994	475	775	1,100	2,205	560	850	8,690	1,753
1995	400	800	1,155	1,385	82	2,446	8,627	1,781
1996	240	829	1,506	1,924	440	1,806	8,831	950
1997	140	1,143	571	759	32	847	5,025	732
1998	280	1,004	1,169	1,961	256	666	7,095	983
1999	425	598	1,895	1,518	520	840	8,038	1,246
2000	275	1,354	1,619	1,421	102	1,672	8,634	600
2001	173	1,561	1,714	1,956	506	1,442	11,267	1,580
2002	270	1,359	1,368	2,302	2,004	1,639	12,223	3,291
2003	469	1,940	1,934	1,980	214	1,745	11,899	1,510
2004	455	1,005	1,200	1,835	1,230	823	9,904	840
2005	500	3,680	3,290	1,130	500	1,170	14,840	1,732
2006	272	2,300	645	335	260	1,600	6,901	891
2007	170	990	970	351	3	552	4,316	1,244
2008	660	7,100	2,549	925	2,600	360	16,752	1,741
2009	1,100	1,536	315	1,675	700	225	8,710	2,281
2010	180	350	550	350	200	584	4,563	2,878
2011	201	1,235	776	350	850	652	5,098	2,137
2012	330	2,400	3,300	2,650	360	1,250	11,960	1,908
2013	215	2,140	1,560	2,370	530	1,340	11,295	3,048
2014	220	2,000	1,300	2,661	1,110	5,000	16,675	4,110
2015	450	2,310	1,470	1,555	210	1,035	10,128	956
2016	750	3,070	2,470	2,120	280	1,970	13,420	948
2017	285	3,100	2,450	1,675	830	980	11,557	1,266
2018	160	3,100	3,300	1,750	864	2,700	13,764	619
Average	335	1,662	1,412	1,426	570	1,264	9,069	1,502

[a] Total index is the sum of counts and interpolated values. Interpolated values are shown in shaded bold italic print. italic print.

DETAILED BUDGET SUMMARY:

The budget shows a surplus of $20,255, primarily in Personnel and Contractual services, including helicopter charter. This occurred primarily because of 1) lower than anticipated Personnel cost related to both the lower cost of new employees and the lower than anticipated sampling effort, because the number of spawners passing the weir was low compared with the recent average; and 2) limited favorable stream conditions during the fall allowed only one full helicopter circuit of all surveyed streams within acceptable limits of visibility and timing. In addition, over expenditure of Travel funds occurred because State of Alaska Administrative changes now require travel to and from the field camp on air charters be accounted for in Travel, rather than in Contractual as it has been accounted for in the past. Please note that the grant application approved by the Northern Endowment Fund for this project in 2019 was reduced from $97,865 to $86,335, to better account for reduced personnel and other costs of this project.

Table 5.–Allocated and expended costs for major spending categories in the Northern Fund project Boundary Area Coho Escapement, 2018.

Line Item	Allocations	Expenditures	Balance
Personnel	$47,389	$37,594	$9,795
Travel	$1,500	$4,174	($2,674)
Contractual	$26,000	$16,805	$9,195
Commodities	$12,200	$8,272	$3,928
Equipment	$0	$0	$0
Administrative Overhead	$10,776	$10,776	$0
All Lines	$97,865	$77,610	$20,255

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