Yale Reservoir Kokanee (*Oncorhynchus nerka*) Escapement Report

2019

North Fork Lewis River Hydroelectric Project
Yale FERC No. 2071

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1.0   INTRODUCTION

Since 1979, PacifiCorp biologists, along with various state and federal agencies, have conducted annual surveys to estimate spawning escapement of kokanee in Cougar Creek, a tributary to Yale Reservoir. This report presents results of kokanee spawner surveys conducted on Cougar Creek and the Constructed Channel within the Swift Bypass Reach in 2019. Surveys are performed per Article 402(b) of the Yale and Swift Federal Energy Regulatory Commission (FERC) operating licenses and Article 402(c) of the Merwin FERC operating license.

2.0   STUDY AREA

Surveys for kokanee spawners were performed on Cougar Creek and the Constructed Channel in 2019. Cougar Creek is a third order stream and tributary to Yale Reservoir in Southwest Washington. Cougar Creek originates from an underground lava tube and flows for approximately 1,700 meters before entering Yale Reservoir.

The Constructed Channel flows from a valve off of the Swift Power Canal for approximately 200 meters before entering the Lewis River channel within the Swift Bypass Reach. The valve that controls flow into the Constructed Channel is set to a level to contribute a constant flow of 14 cubic feet per second (cfs) (*Figure 1*).

Figure 1. Survey area map.

3.0   METHODS

To enumerate kokanee spawners, two biologists, one on each side of the stream, walk together from the stream mouth upstream to its anadromous fish barrier. Each biologist counts spawning and holding kokanee on his/her side of the stream, including side-channels. This process is repeated on three to four occasions over the course of the kokanee spawn time-frame, mid-September through early-November, to estimate the numbers of live kokanee and estimate the peak timing of the spawning run. The highest count during the survey period is considered the peak, and is preceded and followed by surveys with a lower kokanee count.

4.0   RESULTS

Cougar Creek
Peak kokanee escapement estimates decreased for the second year in a row from 2017 (7,429) and 2018 (6,118) to 2019 (3,703). The 2019 spawning estimate of 3,703 fish (*Figure 2*) is the second lowest count on record (1978-2019) and follows a trend of low population estimates since 2016.

As in previous years, Cougar Creek was surveyed on foot with two surveyors. Kokanee were enumerated from the stream mouth upstream to its origin, a distance of approximately 1,700 meters. For survey purposes, the accessible anadromous fish habitat in Cougar Creek is broken into five survey reaches. There are a series of three major log jams in Reach 2 and 3 of Cougar Creek. In 2019, the upper extent of kokanee spawning was observed to be just below the first log jam in Reach 2 which is the first of three major log jams encountered.

Cougar Creek was surveyed for kokanee three times in 2019 (*Table 1*). Survey conditions during the sampling time period (Sep – Nov) were ideal and water clarity very good throughout the survey season.

4.1   Distribution and Timing

The peak kokanee count was recorded on October 16, 2019 (*Table 1*). This peak timing of kokanee abundance in 2019, though late on the timing spectrum, is within historical timeframes on record (1978-2019). Most kokanee were observed in Reach 2, which is consistent with prior years. This largest concentration of kokanee occurs just below the first log jam encountered on their travel upstream.

Table 1. Distribution and peak counts of kokanee in Cougar Creek in 2019
* Estimate uses a 2.3 multiplier of the peak count (Graves unpublished data, 1982)

Reach	Survey Date		
	10/08	10/16	11/05
1	360	430	110
2	300	1,180	760
3	0	0	0
4	0	0	0
5	0	0	0
Spawning Estimate	**1,518**	**3,703**	**2,001**

4.2   Escapement

The kokanee spawning escapement in 2019 is estimated at 3,703 fish (*Figure 2*).   This is the second lowest spawner count on record, and a decrease from the peak observed in 2018 (6,118). Kokanee escapement into Cougar Creek has been less than the historical running average of 71,519 since 2003. This year's estimate is also well below the ten-year average of 22,426 fish (*Table 3*).
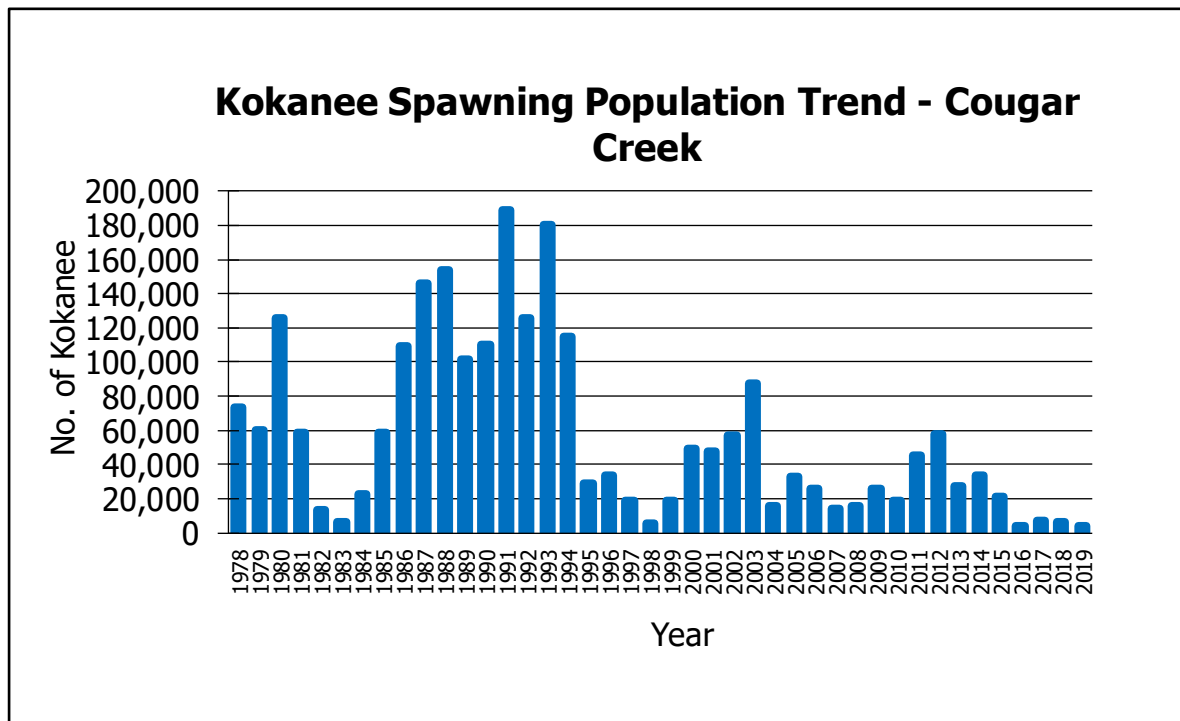

Figure 2. Kokanee spawning estimates for Cougar Creek, 1978-2019

4.3   Length Distribution

Due to low escapement numbers, kokanee carcasses were difficult to find in 2019, therefore lengths were only measured from 12 male and 20 female kokanee (*Figure 3*). Lengths came from both Cougar Creek and Constructed Channel kokanee. Lengths of kokanee in both reaches were similar to each other in 2019, and due to the low numbers of recovered carcasses, were pooled. The average lengths of male and female kokanee in 2019 were 337 and 315 millimeters, respectively.

Combined mean fork length of all kokanee observed in 2019 (323 millimeters) was slightly larger than what was observed during 2018 (318 millimeters). Historically, mean fork length follows a density dependent inverse relationship with estimated escapement. In years, when escapement is lower than average, kokanee length tends to be above average, and vice versa.
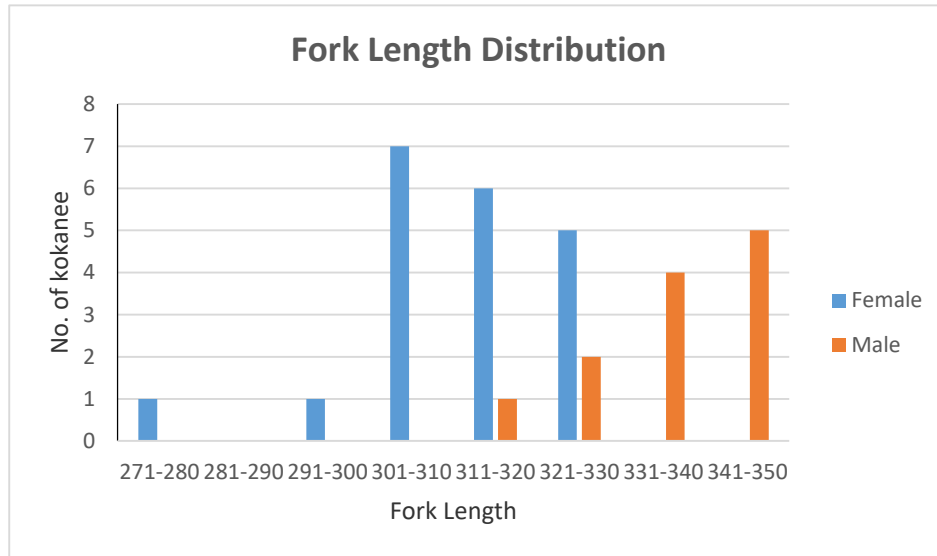

Figure 3. Length frequency histogram of male (n=12) and female (n=20) kokanee lengths (FL) sampled in Cougar Creek and the Constructed Channel, Washington – 2019

The average length of this year's female kokanee (315 mm) was approximate to the average female length observed in 2018 (316 mm). The average female fork length in 2019 is greater than the historical running average of 288 millimeters (1978-2019).

With the regression line established in *Figure 4*, the average fork length size for females in 2019 is over-estimated from the equation by 1.3 percent. The fitted line suggests that given the spawning population estimate the female average length should be 311 millimeters, instead of the observed average of 315 millimeters, an overestimate of 4 millimeters. This observed difference in estimation of 1.3 percent is neglible and may indicate that during the reservoir life-cycle of this brood year that productivity was ideal for proper fish growth and development for this brood escapement estimation.

The size at spawning estimate may be a good indication of reservoir production in terms of food availability and fish growth. When kokanee are smaller than anticipated (based on size at spawning and spawning escapement) it may be an indication that reservoir productivity was limited at some point during their residency in Yale Reservoir.
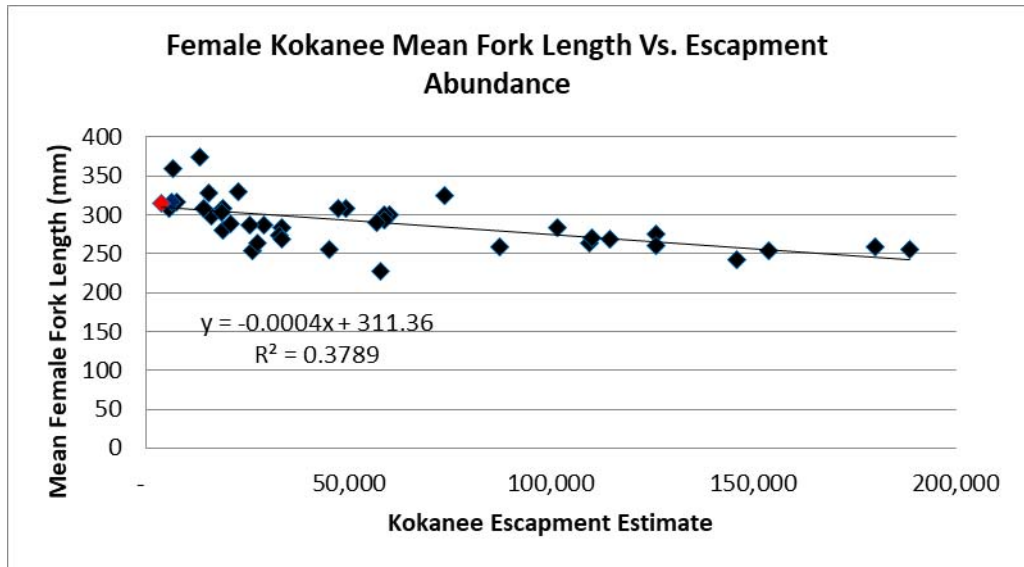

Figure 4. Relationship between mean kokanee fork length (female) and spawning escapement in Cougar Creek (1978-2019). Red dot represents 2019, black dots are all other years on record.

4.4   Constructed Channel

One Constructed Channel kokanee spawner survey was completed on October 21, 2019 from its confluence with the Swift Bypass Reach upstream to its anadromous fish barrier, a distance of approximately 200 meters. A peak count of 1,250 kokanee spawners was recorded, this compares to a peak count of 1,380 kokanee spawners recorded in 2018 (*Table 2*).

The escapement estimate in 2019 (2,875) is very similar to what was estimated in 2018 (3,174) (*Table 2*). It is important to note that the flows within the Constructed Channel come straight off the Swift Power Canal via a mechanically controlled stem valve that is set to release a constant 14 cfs. Habitat improvements to the Constructed Channel were completed by PacifiCorp in 2010, and the constant flow rate of 14 cfs has been in effect since that time.

Table 2. Historical Constructed Channel peak counts and estimated spawning escapement.

Constructed Channel		
Year	Peak Count	Estimated Spawning Escapement
2010	410	943
2011	500	1,150
2012	3,400	7,820
2013	450	1,035
2014	450	1,035
2016	890	2,047
2017	1,190	2,553
2018	1,380	3,174
2019	1,250	2,875

Table 3. Summary of data collected from Cougar Creek kokanee surveys from 1978 to 2019.

Spawn Year	Peak Count	Date	Estimated Escapement*	Moving Average	Number of Females**	Mean Length (mm) Females	Mean Fecundity+	Total Eggs	Egg-to-Adult % Survival^
1978	32,064		73,747	35,930	36,874	325	582	21,468,547	
1979	26,136		60,113	66,930	30,056	300	515	15,485,658	
1980	54,782		125,999	86,620	62,999	275	448	28,237,546	
1981	25,614		58,912	79,693	29,456	300	515	15,176,372	0.27
1982	5,750		13,225	66,399	6,613	375	716	4,736,005	0.09
1983	2,875		6,613	56,435	3,306	359	673	2,226,230	0.02
1984	9,915		22,805	51,630	11,402	329	593	6,760,850	0.15
1985	25,623	9/25/1985	58,933	52,543	29,466	294	499	14,707,884	1.24
1986	47,680	10/10/1986	109,664	58,890	54,832	264	419	22,960,352	4.93
1987	63,406	9/30/1987	145,834	67,584	72,917	242	360	26,234,042	2.16
1988	66,865	10/3/1988	153,790	75,421	76,895	254	392	30,138,128	1.05
1989	44,199	10/11/1989	101,658	77,608	50,829	284	472	24,008,499	0.44
1990	47,859	10/9/1990	110,076	80,105	55,038	270	435	23,931,558	0.42
1991	81,993	10/7/1991	188,584	87,854	94,292	256	397	37,462,192	0.63
1992	54,801	10/2/1992	126,042	90,400	63,021	260	408	25,713,890	0.52
1993	78,260	10/6/1993	179,998	95,999	89,999	259	405	36,480,195	0.75
1994	49,830	9/21/1994	114,609	97,094	57,305	269	432	24,763,567	0.31
1995	12,590	10/12/1995	28,957	93,309	14,479	287	480	6,955,182	0.11
1996	14,508	10/9/1996	33,368	90,154	16,684	284	472	7,880,615	0.09
1997	8,169	10/23/1997	18,789	86,586	9,394	308	537	5,041,572	0.08
1998	2,435	10/6/1998	5,601	82,729	2,800	308	537	1,502,782	0.08
1999	8,260	10/22/1999	18,998	79,832	9,499	281	464	4,410,386	0.24
2000	21,495	10/13/2000	49,439	78,511	24,719	308	537	13,265,833	0.98
2001	20,611	9/24/2001	47,405	77,215	23,703	309	539	12,783,787	3.15
2002	24,750	10/17/2002	56,925	76,403	28,463	290	488	13,901,654	1.29
2003	38,004	10/9/2003	87,409	76,827	43,705	258	403	17,598,094	0.66
2004	6,964	10/8/2004	16,017	74,574	8,009	299	513	4,104,728	0.13
2005	14,226	10/7/2005	32,720	73,080	16,360	273	443	7,245,145	0.24
2006	11,383	10/23/2006	26,181	71,462	13,090	254	392	5,130,671	0.15
2007	6,175	10/17/2007	14,203	69,554	7,101	308	537	3,810,957	0.35
2008	6,780	10/3/2008	15,594	67,813	7,797	328	590	4,602,257	0.22
2009	11,075	9/29/2009	25,473	66,490	12,736	286	478	6,084,107	0.50
2010	8,030	10/4/2010	18,469	65,035	9,235	303	523	4,832,044	0.48
2011	19,610	10/11/2011	45,103	64,449	22,552	254.9	394	8,893,229	0.98
2012	25,150	10/8/2012	57,845	64,260	28,923	227	320	9,243,053	0.95
2013	11,910	10/14/2013	27,393	63,236	13,697	264	419	5,735,272	0.57
2014	14,620	10/3/2014	33,626	62,435	16,813	269	432	7,265,570	0.38
2015	9,105	10/29/2015	20,942	61,008	10,471	289	486	5,086,062	0.23
2016	1,580	10/24/2016	3,634	59,864	1,817	315	555	1,009,198	0.06
2017	3,230	10/17/2017	7,429	58,553	3,715	316	558	2,073,062	0.10
2018	2,660	10/25/2018	6,118	57,274	3,059	316	558	1,707,228	0.12
2019	1,610	10/16/2019	3,703	55,999	1,852	315	555	1,028,360	0.37
MEAN	**24,347**		**55,999**	**71,519**	**27,999**	**290**	**488**	**13,804,823**	

***Peak Count x 2.3 (Graves unpublished data, 1983)**
****Assuming a 1:1 ratio**

+ From the model: Fecundity = -288.78 + 2.68 x Length of Females (Graves unpublished data, 1983)
^ Estimated Escapement of Adults (3 year-olds) / estimated number of eggs