

**2019 PRESEASON FORECAST PACKET
FOR HOOD CANAL
SALMON RUNS'**

PRESEASON FORECAST PACKET PREPARED BY:

SKOKOMISH TRIBE

SALMON FORECASTS AGREED TO BY:

LOWERELWHA TRIBE

PNPTC (FOR JAMESTOWN & PORT GAMBLE)

SKOKOMISH TRIBE

WDFW

DRAFT 14FEB19

SUMMARY OF 2019 HOOD CANAL FORECASTS and Forecasting Methods

Species (Ref.#)	Origin	Type	Number	Mass Marked	Number Type	Model Designation
Chinook (A-1)	Mixed	Secondary	4,421		TRS	Natural
	Hatchery	Primary	62,755		TRS	Hatchery
Summer Chum (A-2)	Natural (supplemented)	Secondary	10,315		Total Recruits	
Coho (A-3)¹	Natural	Primary	53,519		Total DA2 ¹ Recruits	Natural
	Natural	Secondary	1,784		Total DA2 ¹ Recruits	Hatchery
	Hatchery	Secondary	115,372	110,990	Total DA2 ¹ Recruits	Hatchery
Fall Chum (A-4)	Natural		169,233		WA Run	Natural
	Hatchery		349,412			Hatchery
Pink (A-5)	Natural		66,475		WA Run	Natural
	Hatchery		4,200			Hatchery

¹ See overleaf for Coho FRAM model inputs (DA2 = December Age 2; OA3 = Ocean Age 3).

NOTES: Summer Chum salmon, although classified as “secondary”, are under rehabilitation.
Forecasts for individual Hood Canal Management Units (MU) are:

Mainstem Hood Canal MU	6,529
SE Hood Canal MU	1,979
Quilcene MU	1,807

Natural Chinook salmon, although classified as “secondary”, are under rehabilitation.
Forecasts for individual Hood Canal Management Units (MU) are:

Mid Hood Canal MU	286
Skokomish MU	
(Natural)	3,836
(Hatchery)	33,844
Hoodsport MU	28,911
Miscell.	299

Coho FRAM Model Inputs:

Stock Name	DA2	nuFRAM Stock	nuFRAM OA3 = DA2/1.333	Marked nuFRAM	Marked %
Port Gamble Net Pens	18,377	ptgamh	13,783	13,769	99.90%
Port Gamble Bay Natural	718	ptgamw	539		
Area 12/12B Natural	18,479	ar12bw	13,860		
Quilcene Bay Net Pens	0	qlcnbh	0	0	1.00%
Quilcene Hatchery	69,649	qlcenh	52,237	52,049	99.64%
Area 12A Natural	1,066	ar12aw	800		
Hoodspport Hatchery	n/a	hoodsh	0		
Area 12C/12D Natural	20,353	ar12dw	15,265		
George Adams Hatchery	27,347	gadamh	20,510	17,425	84.96%
Skokomish River Natural	14,686	skokr	11,015		

A. Pre-season Forecasting Methods

A-1. Summer/Fall Chinook Salmon

The 2019 forecasted terminal run size of summer-run Hood Canal Chinook salmon is the product of brood 2014 fingerling lbs released from WDFW facilities in 2016, multiplied by the average of post-season estimated terminal area return rates (total terminal run / hatchery fingerling lbs released 3 yrs previous) for the last five return years (2014-2018), (Table A-1-a). The data series used this year was intended to estimate a terminal return to net fisheries, freshwater sport and escapements. It does not include other run components or contributions. The historical data series was recently reconciled from the 2010 through 2018 return years (2018 remains preliminary), to include this information for 2019 forecasting purposes (Tables A-1-a and A-1-b). The resulting terminal area run forecast is 67,176 Chinook salmon. The forecast was apportioned to 62,755 chinook expected to return to hatcheries and 4,421 fish expected to return to natural spawning areas (Table A-1-d), based on the Hood Canal terminal runs' relative contribution of the individual Hood Canal management units in the most recent brood cycle, comprised of the 2014-2018 return years (Table A-1-c). These estimates will be used as inputs to generate ocean recruit forecasts during pre-season simulation modeling.

**Table A-1-a. Hood Canal Summer/Fall Chinook Releases
at WDFW Hatcheries and Run Sizes.**

Return Year (RY)	0+ Lbs. Released in RY-3	Return/Lb	Terminal Run
1984	39,232	0.42295	16,593
1985	40,098	0.50574	20,279
1986	55,499	0.39329	21,827
1987	50,811	0.51412	26,123
1988	55,967	0.50753	28,405
1989	65,510	0.38222	25,039
1990	54,674	0.23280	12,728
1991	100,366	0.18881	18,950
1992	101,102	0.02929	2,961
1993	89,517	0.05293	4,738
1994	78,335	0.04785	3,748
1995	82,895	0.11068	9,175
1996	73,472	0.11065	8,130
1997	32,571	0.23963	7,805
1998	58,652	0.27658	16,222
1999	89,149	0.33894	30,216
2000	87,306	0.23917	20,881
2001	101,591	0.29913	30,389
2002	89,837	0.38332	34,436
2003	106,363	0.36476	38,797
2004	95,282	0.38720	36,893
2005	92,989	0.63831	59,356
2006	76,769	0.61204	46,986
2007	89,952	0.43716	39,323
2008	95,368	0.42885	40,899
2009	88,634	0.49692	44,044
2010	90,491	0.48344	43,747
2011	89,269	0.78651	70,211
2012	89,877	1.08488	97,506
2013	90,075	0.85407	76,930
2014	86,661	0.31241	27,074
2015	89,017	0.40406	35,968
2016	85,353	0.77516	66,162
2017	86,209	1.21818	105,018
2018*	96,926	0.75549	73,227
Average 2014-2018		0.69306	
2019 Forecast			67,176

(*) 2018 return data are preliminary and subject to revision, following reconciliation of records.

Table A-1-b. Hood Canal Summer/Fall Chinook Terminal Runs

Year	12A	12/12B	12C	12D	Skokomish	G.A. Hatchery	Hoodspout Hatchery	Total
1984	0	758	0	440	5,302	5,537	4,183	16,220
1985	0	1,908	0	1,040	8,297	5,739	3,044	20,028
1986	0	21	0	169	8,690	10,628	2,221	21,729
1987	0	112	0	64	8,064	12,743	4,311	25,294
1988	0	150	0	79	7,078	13,086	6,888	27,281
1989	0	129	0	158	6,133	13,023	5,175	24,618
1990	0	47	0	49	2,484	8,454	1,577	12,611
1991	0	88	0	73	5,461	9,746	3,514	18,882
1992	0	96	0	20	1,373	490	965	2,944
1993	29	143	0	46	1,385	883	2,242	4,728
1994	4	384	1	30	809	609	1,889	3,726
1995	7	103	2	491	1,398	5,196	1,978	9,175
1996	8	24	1	1	995	3,100	4,001	8,130
1997	27	6	15	7	452	1,887	5,411	7,805
1998	0	288	0	177	1,187	5,630	8,940	16,222
1999	0	876	86	249	2,123	10,332	16,550	30,216
2000	0	439	262	194	1,203	5,238	13,545	20,881
2001	0	326	605	204	3,247	14,965	11,042	30,389
2002	0	95	38	114	2,273	14,439	17,477	34,436
2003	0	194	93	107	1,928	17,175	19,300	38,797
2004	0	129	1,094	95	3,677	18,824	13,074	36,893
2005	0	45	623	109	3,579	28,226	26,774	59,356
2006	0	30	292	34	2,537	25,930	18,163	46,986
2007	0	73	40	22	959	29,664	8,565	39,323
2008	0	275	10	26	2,416	29,172	9,000	40,899
2009	0	130	20	31	2,199	27,271	14,393	44,044
2010	0	84	32	15	2,800	30,191	10,625	43,747
2011	0	290	21	4	2,377	46,320	21,199	70,211
2012	0	431	21	32	3,193	55,161	38,667	97,506
2013	3	674	49	96	2,805	39,358	33,945	76,930
2014	0	141	1	63	1,564	13,912	11,392	27,074
2015	0	259	221	29	1,014	17,384	17,061	35,968
2016	0	292	98	84	2,100	34,538	29,052	66,162
2017	0	375	100	86	12,334	53,772	38,350	105,018
2018*	0	63	536	78	3,692	35,723	33,135	73,227

*Note: Values for years prior to 1998 DO NOT include freshwater recreational catch and the 2018 run reconstruction is preliminary and subject to revision.

Table A-1-c. Proportional Distribution of Hood Canal Summer/Fall Chinook Returns

Year	12A	12B	12C	12D	Skokomish	G.Adams	Hoodspport
2014	0.00000	0.00522	0.00004	0.00234	0.05777	0.51385	0.42077
2015	0.00000	0.00720	0.00614	0.00080	0.02819	0.48333	0.47435
2016	0.00000	0.00441	0.00148	0.00127	0.03173	0.52202	0.43910
2017	0.00000	0.00357	0.00095	0.00082	0.11745	0.51203	0.36518
2018	0.00000	0.00086	0.00732	0.00107	0.05042	0.48784	0.45250
2014-18 Mean	0.00000	0.00425	0.00319	0.00126	0.05711	0.50381	0.43038

Table A-1-d. Apportionment of the Hood Canal Summer/Fall Chinook Forecast

Hood Canal Production Unit	Terminal Run Forecast	Proportion
12A	0.00	0.00000
12B	286	0.00425
12C	214	0.00319
12D	85	0.00126
Skokomish	3,836	0.05711
Natural Subtotal	4,421	0.06581
George Adams	33,844	0.50381
Hoodspport	28,911	0.43038
Hatchery Subtotal	62,755	0.93419
Total	67,176	1.0

Note: The forecasted proportions are derived from the 2014-2018 mean distribution.

A-2. Summer Chum Salmon

A-2.1 Natural Summer Chum Runs

The 2019 pre-season forecast of the Hood Canal summer chum salmon returns using Ocean Environmental Variables (PDO, NPGO, ONI, & MEI) for the Mainstem Hood Canal, Quilcene/Dabob, and Southeast Hood Canal Management Units (Mus) are shown in Table A-2-a. Please note that this methodology is currently accepted by the co-managers for use during the 2019 forecasting purposes.

The 2019 forecasted returns are 6,529 summer chum to the Mainstem Hood Canal MU, 1,807 summer chum to the Quilcene/Dabob Bays MU, and 1,979 summer chum to the SE Hood Canal MU. The total forecasted return is 10,315 summer chum to Hood Canal in 2019 (Table A-2-a).

The Summer Chum Salmon Conservation Initiative (SCSCI) defines interim Critical and Recovery abundance thresholds for each MU. The interim abundance thresholds are 1,260 (Critical) and 4,570 (Recovery) for the Quilcene/Dabob MU, 2,980 (Critical) and 15,740 (Recovery) for the Mainstem Hood Canal MU, and 340 (Critical) and 550 (Recovery) for the SE Hood Canal MU.

The 2019 forecasted returns of summer chum exceed the interim Critical threshold for each Hood Canal Management Unit and exceed the interim Recovery threshold for the Quilcene/Dabob MU and SE Hood Canal MU.

Table A-2-a. Hood Canal Summer Chum Salmon Natural and Supplementation Origin Recruits.

Year	Mainstem Hood Canal	Quilcene / Dabob	SE Hood Canal
2019 Forecast	6,529	1,807	1,979
2019 Total Hood Canal Forecast			10,315

The Co-managers have agreed to monitor the incidental harvest of summer chum in all scheduled fisheries and to monitor the in-season abundance of summer chum in the Quilcene / Dabob Bays MU. As in 2010 - 2018, the Co-managers agree that no gillnet fisheries will occur in 2019 until spawner escapement exceeds 1,500 summer chum in the Big and Little Quilcene rivers.

The Co-managers will conduct annual post-season abundance assessments comparing the forecasts to actual returns for each MU. All of the above actions are consistent with the requirements and provisions of the SCSCI.

A-3. Coho Salmon

A-3.1 Coho Salmon Natural Runs

The forecasted recruitment of 2019 Hood Canal natural coho salmon runs was based on a linear regression model that related the return of tagged natural jack coho at Big Beef Creek (BBC) to Hood Canal December Age 2 (DA2) recruits in the subsequent run year. This model used recruit data from brood years 1983-1998 and 2002-2014 (Table A-3-a). Recruit data from brood years 1999-2001 were excluded because of their unusually high recruit per tagged jack ratio, which is not expected to occur this year. The final form of the regression is shown below:

$$\text{Hood Canal Recruitment} = 41686.130 + (314.746 * (\text{BBC Tagged Jacks}))$$

Relevant statistics of the model used to derive the 2019 forecast are shown below.

Using Brood Years 1983-1998, 2002-2014		Scaled by Jackknife MPE -26.0
Multiple R	0.67615	NA
R ²	0.45718	NA
Adj. R ²	0.43708	NA
Std Error of Estimate	41261.37	NA
N	29	NA
Intercept	41686.130	NA
Slope	314.746	NA
2018 Jacks	105	NA
2019 Forecast	74,734	55,303

For 2019 as was done in 2016/17/18, the co-managers have agreed to apply a bias correction to the current accepted methodology described above) for forecasting natural coho in Hood Canal. The co-managers felt that this was a conservative approach in order to address concerns of possible poor ocean survival, accounting for and encompasses the same range of error in the regression parameters that would adjust for the known tendency of the BBC jack model to overestimate the recruitment of Hood Canal natural DA2's.

This bias correction factor was calculated by applying the Mean Percent Error (MPE) to the 2019 primary DA2 forecast, as calculated through the Jackknife analysis. The percent error in the MPE, in this case, is an indication of the overestimation of the regression. The subsequent application of the MPE value -26.0 reduces the forecast on the primary DA2 from 74,734 to 55,303. The forecasted recruits were subsequently apportioned to primary and secondary units on the basis of the distribution of their parent brood escapement.

The total adjusted forecast of 55,303 natural DA2 recruits was thus apportioned into 53,519 primary and 1,784 from secondary units, on the basis of their parent brood spawner distribution (Table A-3-b).

Table A-3-a. 2019 Hood Canal Natural Coho Forecast Data

Brood Year	Big Beef Creek Total Smolts	Big Beef Total Natural Jacks	Big Beef Tagged Natural Jacks	Hood Canal Total Dec Age-2 Recruits
1975	35,025			
1976	17,619		36	
1977	45,634		452	
1978	20,715		265	
1979	41,054		398	
1980	25,225			
1981	25,333		210	
1982	36,636		554	
1983	26,062	427	346	211,127
1984	23,994	445	350	232,860
1985	11,510	201	121	40,236
1986	26,534	314	208	117,460
1987	17,594	336	234	118,316
1988	<i>19,739</i>	173	122	<i>81,147</i>
1989	<i>23,646</i>	167	144	<i>66,306</i>
1990	<i>18,677</i>	273	202	<i>67,729</i>
1991	<i>13,071</i>	206	149	<i>140,612</i>
1992	<i>18,431</i>	188	157	<i>95,144</i>
1993	<i>16,574</i>	224	185	<i>73,734</i>
1994	<i>25,820</i>	410	298	<i>149,823</i>
1995	<i>40,828</i>	610	510	<i>180,517</i>
1996	<i>22,222</i>	60	45	<i>23,437</i>
1997	<i>20,967</i>	96	85	<i>55,909</i>
1998	<i>47,088</i>	189	179	<i>165,500</i>
1999	<i>21,803</i>	120	111	<i>107,024</i>
2000	<i>24,352</i>	80	70	<i>268,753</i>
2001	<i>36,060</i>	339	254	<i>298,347</i>
2002	25,060	294	235	76,798
2003	32,949	61	33	57,206
2004	38,579	161	86	111,437
2005	29,911	47	39	39,674
2006	27,416	111	95	96,089
2007	45,399	32	26	18,994
2008	24,396	197	177	102,243
2009	51,932	212	178	154,318
2010	18,732	90	70	53,757
2011	24,028	124	84	82,550
2012	56,389	172	127	56,214
2013	8,115	91	69	45,971
2014	23,912	511	408	57,673
2015	23,912	218	171	
2016	21,916	131	105	

*Data italicized denotes methodology currently under review and agreed to for forecasting purposes only.

Table A-3-b. Apportionment of the 2019 Hood Canal Natural Coho Forecast

Area	Escapement Capacity	Escapement BY 2016	Management Unit Type	Proportion of Brood Escapement	December Age-2 Recruits	Scaled by Jack-knife MPE -26.0
12 / 12B	28.88%	6,587	Primary	33.41%	24,972	18,479
12C / 12D	31.66%	7,255	Primary	36.80%	27,505	20,353
Skokomish	29.01%	5,235	Primary	26.56%	19,847	14,686
9A	1.25%	256	Secondary	1.30%	971	718
12A	9.20%	380	Secondary	1.93%	1,441	1,066
Primary Subtotal	89.55%	19,078		96.77%	72,323	53,519
Secondary Subtotal	10.45%	636		3.23%	2,411	1,784
Grand Total	100.00%	19,713		100.00%	74,734	55,303

**Table A-3-c. Escapement of Coho Salmon to
Primary Natural Spawning Areas of Hood Canal**

Year	North (12-12B)	South (12C-12D)	Skokomish	Total
1986	17,865	19,679	3,432	40,976
1987	7,286	8,026	3,510	18,822
1988	4,523	4,983	1,948	11,454
1989	6,488	7,148	934	14,570
1990	2,518	2,774	1,281	6,573
1991	5,118	5,638	1,541	12,297
1992	8,026	8,842	2,179	19,047
1993	9,800	10,795	1,327	21,922
1994	20,847	22,965	12,128	55,940
1995	16,340	18,000	5,560	39,900
1996	18,428	20,300	4,008	42,736
1997	37,016	40,777	17,568	95,361
1998	40,323	44,420	14,957	99,700
1999	6,854	7,550	1,847	16,251
2000	8,724	9,610	8,288	26,622
2001	35,134	38,703	20,601	94,438
2002	26,170	28,829	13,647	68,646
2003	60,546	66,697	44,757	172,000
2004	39,439	43,445	62,995	145,879
2005	14,854	16,363	6,286	37,503
2006	5,554	6,118	1,597	13,269
2007	19,017	20,949	6,381	46,347
2008	5,082	5,598	836	11,516
2009	12,330	13,583	1,048	26,961
2010	1,906	2,099	192	4,197
2011	9,106	10,030	5,252	24,388
2012	22,400	24,673	4,709	51,782
2013	6,779	7,467	1,798	16,044
2014	8,319	9,163	4,647	22,129
2015	12,252	13,495	590	26,337
2016	6,587	7,255	5,235	19,078
2017	10,353	11,404	763	22,520

A-3.2 Coho Salmon Hatchery Runs

The 2019 forecast utilized survival rates for two complete brood cycles, or six brood years (Table A-3-d). Historic marine survival rates were estimated from CWT-based cohort reconstruction of December Age-2 recruits, as were those of natural coho. Because there are several enhancement facilities in Hood Canal, and tag data were not available for all facilities for all years, marine survival rates were estimated from reconstructed cohorts, using the assumption that untagged releases contributed to preterminal fisheries in a way that maintained the same ratio to tagged releases, as estimated by RRTERM to have entered the Hood Canal terminal area (Table A-3-d).

The 2019 forecast of 115,372 hatchery reared December Age-2 coho recruits (Table A-3-d) was predicted from the brood year 2016 smolt releases multiplied by the average estimated marine survival rate for smolts from the six most recent available brood years for all facilities (Table A-3-d). In 2017 (BY2015) and 2018 (BY2016) coho pre-smolts destined for the Quilcene Bay Net Pens did not take place due to harmful algal blooms and net pen damage, these fish were held and reared at QNFH. Also, in the winter of 2012-2013 a storm damaged the Quilcene Bay Net Pens, as a result BY12 fish destined for the net pens were held and released on station at the Quilcene National Fish Hatchery.

Table A-3-d. Hood Canal Hatchery and Net Pen Smolt to Dec-2 Recruit Survival

Brood Year	George Adams Hatchery			Port Gamble Net Pens			Quilcene NFH			Quilcene Bay Net Pens		
	Smolts	Recruits	R/Sm	Smolts	Recruits	R/Sm	Smolts	Recruits	R/Sm	Smolts	Recruits	R/Sm
1979	1,406,424			682,900			502,189					
1980	322,580			454,000			498,166					
1981	351,474			400,000			352,298					
1982	364,000			394,000			271,035					
1983	310,100	106,593	0.34374	586,400	89,105	0.15195	223,128					
1984	312,800	52,163	0.16676	394,400	73,890	0.18735	542,480			247,221	40,095	0.16218
1985	355,400	20,960	0.05898	351,900	9,450	0.02685	617,231			85,575	4,363	0.05098
1986	337,700	32,908	0.09745	429,141	29,183	0.06800	574,171	<i>98,188</i>	<i>0.17101</i>	193,522	16,075	0.08307
1987	298,000	28,068	0.09419	407,600	157,116	0.38547	753,390	75,121	0.09971	146,000	30,269	0.20732
1988	310,700	14,698	0.04731	383,629	74,033	0.19298	491,303	64,066	0.13040	311,327	21,484	0.06901
1989	300,300	7,106	0.02366	298,944	53,439	0.17876	352,556	9,874	0.02801	266,193	7,834	0.02943
1990	307,300	7,894	0.02569	403,600	32,220	0.07983	501,254	27,662	0.05519	353,263	18,203	0.05153
1991	304,197	20,054	0.06592	383,419	63,120	0.16462	397,701	49,061	0.12336	337,800	24,903	0.07372
1992	301,019	15,688	0.05212	361,553	13,281	0.03673	400,700	34,709	0.08662	287,187	8,379	0.02918
1993	303,054	31,320	0.10335	414,844	4,672	0.01126	425,334	29,577	0.06954	216,737	1,864	0.00860
1994	396,084	17,542	0.04429	378,686	8,741	0.02308	625,700	40,118	0.06412	0		
1995	434,140	6,963	0.01604	342,828	8,450	0.02465	425,971	17,650	0.04143	220,000	5,756	0.02616
1996	527,317	11,878	0.02253	441,656	17,564	0.03977	452,203	9,322	0.02061	225,269	3,421	0.01234
1997	534,554	22,621	0.04232	420,482	3,830	0.00911	437,222	22,091	0.05053	189,951	10,872	0.05724
1998	502,266	38,971	0.07759	391,765	7,196	0.01837	368,399	23,966	0.06505	208,000	9,780	0.04702
1999	493,992	46,008	0.09314	432,847	4,931	0.01139	428,995	33,187	0.07736	0		
2000	587,937	36,351	0.06183	432,161	6,521	0.01509	411,674	27,053	0.06571	210,627	12,982	0.06164
2001	336,886	44,572	0.13231	409,221	4,803	0.01174	388,212	42,242	0.10881	90,000	2,272	0.02524
2002	501,031	55,380	0.11053	423,746	16,270	0.03840	404,582	51,373	0.12698	200,835	15,035	0.07486
2003	309,179	28,359	0.09172	437,306	14,502	0.03316	361,891	25,250	0.06977	179,711	8,165	0.04543
2004	290,570	20,739	<i>0.09056</i>	540,000	13,871	<i>0.02569</i>	488,080	41,686	<i>0.08541</i>	215,731	2,817	<i>0.01306</i>
2005	245,608	26,842	<i>0.10929</i>	247,500	5,081	<i>0.02053</i>	273,099	23,247	<i>0.08512</i>	124,813	8,331	<i>0.06675</i>
2006	294,151	31,150	0.10590	415,000	16,421	0.03957	358,131	57,903	0.16168	193,808	4,945	0.02551
2007	296,474	23,275	0.07851	412,208	4,929	0.01196	357,967	32,815	0.09167	162,381	3,384	0.02084
2008	292,529	27,729	0.09479	423,584	23,035	0.05438	441,117	68,719	0.15578	200,499	3,586	0.01789
2009	306,329	29,754	0.09713	223,210	28,708	0.12861	345,604	68,639	0.19861	179,587	6,025	0.03355
2010	239,228	43,553	0.182056	397,581	15,470	0.03891	393,654	38,934	0.09890	204,578	3,204	0.01566
2011	289,734	15,845	0.05469	397,442	5,667	0.01426	426,115	10,279	0.02412	199,195	2,012	0.01010
2012	301,569	14,428	0.04784	414,013	1,505	0.00364	627,039	20,395	0.03253	0		
2013	314,174	21,011	0.06688	394,424	30,074	0.07625	441,446	75,822	0.17176	199,552	27	0.00014
2014	318,458	22,784	<i>0.07154</i>	383,040	10,000	<i>0.02611</i>	443,838	43,935	<i>0.09899</i>	196,706	2,022	<i>0.01028</i>
2015	298,219			322,219			623,342			0		
2016	315,454			383,148			668,729			0		
Average (2009-14)			0.08669				0.04796				0.10415	0.01395
2019 Forecast:		27,347		18,377			69,649			0		

Note: Values in italics indicate values agreed to for pre-season forecasting only. Values in boldface were excluded from the analysis

A-4. Fall Chum Salmon

The 2019 forecast of the Hood Canal fall chum salmon run was estimated separately for natural production units, off-station augmented production in natural rearing areas, and individual hatchery production units. The following descriptions of methods and source data are intended to provide documentation of the methods and approaches used.

A-4.1.1 Natural Run Forecasts (Tribal)

The 2019 return of Hood Canal natural fall-timed chum salmon of each returning age group (3, 4, and 5 year olds) was forecast using the available mean return-per-spawner-at-age rates for the brood years 2005-12. The mean recruit-per-spawner return rates were 1.42659, 1.71856, and .80715, for 3, 4, and 5 year-olds respectively (Table A-4-a). These adjusted rates of return were multiplied with the 2016, 2015, and 2014 brood escapements (59,905, 63,236, and 49,675; respectively) to estimate the total 2019 forecast of 234,230 Hood Canal natural fall chum returning to Puget Sound, before the addition of anticipated returns from in-stream supplementation projects. The Hood Canal natural run forecast was further apportioned to individual production units (Tables A-4-d and A-4-e), on the basis of relative proportion attributable to each production unit's spawners (brood year escapements), for each returning age group.

The grand total return of 234,423 to each natural production unit was estimated by adding the estimated 193 return from in-stream enhancement and supplementation efforts. The forecast of this latter component is described under "Hatchery runs" (Section A-4.2).

A-4.1.2 Natural Run Forecasts (WDFW)

Natural fall chum forecasts were calculated using the Puget Sound-wide recruit/spawner (R/S) method, with the regional (Hood Canal) forecast, and terminal forecasts within Hood Canal, allocated according to parent escapement and terminal forecasts allocated by escapement goal.

The WDFW natural fall chum salmon forecast was estimated for Puget Sound using the recruit/spawner method. Escapement of parent broods of 2014, 2015, and 2016 and age composition were used to estimate 2019 returns of Age 3, Age 4, and Age 5 natural fall chum. The 2019 forecast of natural fall chum to Puget Sound is 46,111 Age 3, 467,516 Age 4, and 137,068 Age 5 fish for a total run size of 650,695 natural fall chum (Table A-4b).

The apportionment of 650,695 Puget Sound natural fall chum to Hood Canal was determined by applying the Hood Canal parent escapement proportion to each age class. The Hood Canal forecast by age is 32,129 Age 3, 61,786 Age 4, and 9,934 Age 5 fish for a total Hood Canal forecast of 103,850 natural fall chum (Table A-4c).

The Hood Canal natural run forecast was further apportioned to individual production units (Tables A-4-d and A-4-e), on the basis of relative proportion attributable to each production unit's spawners (brood year escapements), for each returning age group. The forecasted return of each age group to Puget Sound was apportioned to Hood Canal using the proportions of the parent escapement of each brood (Table A-4-f).

A-4.1.3 Joint 2019 Hood Canal Natural Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 169,233 natural fall chum, the average of the Tribal and WDFW results. The total forecast was then apportioned to individual production units on the basis of the age specific brood escapement distribution (Table A-4-g).

Table A-4-a. Hood Canal Natural Fall Chum Returns-at-Age per Spawner

Brood Year	Brood Escape	3's	4's	5's	Total
1968	47,802	0.58849	1.63839	0.09531	2.32219
1969	30,070	0.55346	1.14771	0.09264	1.79381
1970	41,698	0.55975	1.58101	0.01314	2.15390
1971	41,139	0.58683	0.41252	0.33535	1.33470
1972	41,602	0.26600	1.27781	0.00000	1.54381
1973	27,870	1.77432	2.60438	0.07441	4.45311
1974	52,224	0.81057	4.42759	0.07083	5.30899
1975	16,266	7.39080	0.05030	0.00000	7.44110
1976	48,078	0.53107	0.20951	0.03284	0.77342
1977	26,074	2.63782	2.75187	0.13638	5.52607
1978	79,156	0.00000	0.60521	0.05628	0.66149
1979	14,323	1.90574	2.12510	0.00000	4.03084
1980	21,672	0.51985	2.14281	0.23020	2.89286
1981	14,311	3.49591	12.57517	0.62961	16.70069
1982	12,134	2.88354	7.08386	0.94399	10.91139
1983	7,121	9.05912	24.36310	1.13297	34.55519
1984	22,751	1.29322	5.88289	0.37653	7.55264
1985	50,910	0.47585	2.67119	0.33941	3.48645
1986	29,549	0.00000	3.15515	0.44356	3.59871
1987	24,481	0.00000	3.54568	1.04655	4.59223
1988	30,704	1.51411	8.58958	1.42974	11.53343
1989	24,873	0.11184	6.46342	5.71902	12.29428
1990	20,811	1.48264	8.26697	0.69326	10.44287
1991	44,745	0.59753	1.58643	0.12973	2.31369
1992	96,382	2.21238	4.21549	0.20013	6.62800
1993	67,770	1.07479	1.38931	0.10130	2.56540
1994	151,821	0.30984	0.88726	0.03062	1.22772
1995	119,344	0.58343	0.40133	0.01270	0.99746
1996	251,803	0.01977	0.20395	0.00000	0.22372
1997	53,492	0.52960	2.05414	0.40225	2.98599
1998	101,631	1.54720	2.17750	0.01927	3.74398
1999	33,924	2.88881	8.36176	1.46228	12.71284
2000	37,131	2.95919	12.40288	0.25103	15.61310
2001	103,713	1.92253	0.71772	0.08583	2.72608
2002	173,037	0.36398	1.62283	0.09993	2.08674
2003	148,512	0.21273	1.32788	0.21269	1.75329
2004	168,126	0.15014	0.91883	0.05347	1.12244
2005	47,598	1.76695	1.02192	0.00000	2.78887
2006	97,104	0.17061	0.44776	0.05885	0.67722
2007	78,218	0.70884	2.44524	0.67400	3.82808
2008	38,512	0.00000	1.52348	0.25191	1.77540
2009	13,961	6.79236	19.92271	2.19560	28.91066
2010	17,223	0.00000	12.36997	2.96419	15.33417
2011	48,446	0.40060	3.12638	0.24802	3.77501
2012	38,102	1.57339	1.76076	0.06403	3.39818
2013	61,190	1.77464	2.83265		
2014	49,675	0.99576			
2015	63,236				
2016	59,905				
Mean: Brood Years 1968-12 (exclusive of outliers, in bold)					
All Odd Years	48,399	1.73570	2.35185	0.68322	4.96447
All Even Years	69,145	0.86465	2.79069	0.36433	4.24042
Years 2005-12*	47,395	1.42659	1.71856	0.80715	1.99088
		3's	4's	5's	
2019 Tribal Forecast*		85,460	108,675	40,095	234,230

Table A-4-b. 2019 WDFW Puget Sound Natural Fall Chum Salmon Forecast

Parent Brood	Age	Parent Escapement	Mean R/S ¹	Adjusted R/S	Estimated R/S (all ages)	Mean Age Composition ¹	Natural Forecast
2014	5	375,874	2.38	2.38	894,732	0.0520000	46,111
2015	4	269,777	3.00	3.00	808,468	0.5780000	467,516
2016	3	295,579	2.38	2.38	703,597	0.1950000	137,068
						Total	650,695

Note: Uses odd or even brood year average, depending on brood year

Table A-4-c. 2019 WDFW Hood Canal Natural Fall Chum Salmon Forecasts

	Puget Sound Forecast	HC Parent Escapement Proportion	HC Forecast by Age
Age 3 (2016 Brood) Forecast	137,068	0.2344030	32,129
Age 4 (2015 Brood) Forecast	467,516	0.1321584	61,786
Age 5 (2014 Brood) Forecast	46,111	0.2154457	9,934
Total WDFW Forecast	650,695		103,850

Table A-4-d. 2019 Hood Canal Natural Fall Chum Salmon Parent Brood Escapement Distribution

Area	2014	2015	2016
9A	0.00%	0.00%	0.00%
12	2.48%	3.87%	4.84%
12A	8.31%	4.41%	2.94%
12B	38.40%	28.57%	37.43%
12C	20.29%	21.49%	27.01%
82G	23.23%	24.95%	15.59%
12D	7.29%	16.71%	12.18%

Table A-4-e. Apportionment of the 2019 Tribal Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	4,136	4,210	995	9,341
12A	2,516	4,789	3,331	10,636
12B	31,991	31,049	15,396	78,436
12C	23,084	23,359	8,136	54,579
82G	13,320	27,109	9,313	49,743
12D	10,412	18,160	2,924	31,496
Total	85,460	108,675	40,095	234,230

Table A-4-f. Apportionment of the 2019 WDFW Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	1,555	2,393	246	4,195
12A	946	2,723	825	4,494
12B	12,027	17,653	3,815	33,495
12C	8,678	13,280	2,016	23,975
82G	5,008	15,413	2,306	22,728
12D	3,915	10,325	724	14,964
Total	32,129	61,786	9,934	103,850

Table A-4-g. Apportionment of the 2019 Joint Hood Canal Natural Fall Chum Salmon Forecast

Area	Tribal Forecast	WDFW Forecast	Joint Forecast
9A	0	0	0
12	9,341	4,195	6,768
12A	10,636	4,494	7,565
12B	78,436	33,495	55,965
12C	54,579	23,975	39,277
82G (Skokomish)	49,743	22,728	36,235
12D	31,496	14,964	23,230
12D Off-Station	193		193
Total	234,423	103,850	169,233

A-4.2 Hatchery Runs (Tribal)

The 2019 hatchery-origin returns of fall-timed chum salmon were generally forecasted using average returns-at-age-per-pound of fingerlings released, to Puget Sound net fisheries and escapements, using historical run sizes from the fall chum database, historical releases from each facility, and applying them to releases from brood years 2014, 2015, and 2016. In estimating the returns, the following information was used for each facility. The problems with recent years’ terminal area run reconstruction, may have introduced significant positive bias to the estimates of Skokomish River hatchery runs, introducing a negative bias to Hoodsport hatchery runs. Off-station production, resulting from instream augmentation programs was estimated separately and was then added to the forecasted return to natural spawning areas.

The effects of changes to the Hood Canal hatchery chum programs will continue to be seen in 2019, including Area 9A Little Boston Hatchery production increases coupled with the return of Area 12A production unit to natural production, since the last release from the Quilcene National Fish Hatchery occurred with the 2002 brood.

A-4.2.1 Forecasts of Instream Augmentation (Tribal)

Egg box and fry-augmented runs to streams of areas 12, 12B, 12C, 12D, 82G: The Tribal forecast applied one half of the mean return rates of age 3, age 4, and age 5 fish per pound planted at Hoodsport Hatchery (2005-2012 broods) (Tables A-4-h and A-4-i). The resulting forecast for 2019 is 193 fish. This forecast was apportioned to each area, according to the volume released from each brood year and the resulting estimates were added to the corresponding natural run components.

Table A-4-h. Tribal Hood Canal Fall Chum 2019, Off-Station Lbs. Planted

Area	BY 2016	BY 2015	BY 2014
	Lbs	Lbs	Lbs
9A	0.0	0.0	0.0
12	34.1	31.0	16.5
12B	0.0		
12A	0.0		
12C	0.0		
Skokomish	0.0	0.9	0.9
12D	97.2	117.7	113.3
Total	131	134	131

Table A-4-i. Apportionment of the 2019 Tribal Hood Canal Fall Chum Off-Station Forecast

Area	3's	4's	5's	Total
9A	0.00	0.00	0.00	0
12	13.00	28.00	1.00	42
12B	0.00	0.00	0.00	0
12A	0.00	0.00	0.00	0
12C	0.00	0.00	0.00	0
82G	0.00	1.00	0.07	1
12D	36.00	106.00	9.00	150
Total	49	134	10	193

A-4.2.2 Fall Chum Hatchery On-Station Forecasts (Tribal)

Hoodsport Hatchery: Mean return rate of age 3, 4, and 5 fish per pound planted at Finch Creek (2005-2012 broods) (Table A-4-j). The resulting forecast for 2019 is 60,049. Run reconstruction problems have biased this run low.

George Adams/McKernan Hatcheries: Mean return rate of age 3, age 4, and age 5 fish per pound released (2005-2012 broods) (Table A-4-k). The resulting forecast for 2019 is 308,805.

Little Boston Hatchery: Mean return rate of age 3, age 4 and age 5 fish per pound planted at Hoodsport Hatchery (2005-2012 broods) (Table A-4-j). The resulting forecast for 2019 is based on the fingerling releases of 2,895 lbs (BY16), 2,944 lbs. (BY15), and 3,069 lbs. (BY2014), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of 7,902 (Table A-4-n).

Enetai Hatchery: Mean return rates of age 3, age 4 and age 5 fish per pound planted (2005-2012 broods). (Table A-4-l). The resulting forecast for 2019 is based on the fingerling releases of 6,805 lbs (BY16), 7,611 lbs. (BY15), and 9,705 lbs. (BY2014), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of 36,789.

The Tribal forecasts of hatchery returns are summarized in Table A-4-n and indicate a total forecast of on-station hatchery-origin fall chum of 413,545.

A-4.2.3 Fall Chum Hatchery Forecasts (WDFW)

The 2019 return of hatchery-origin fall chum was forecast by multiplying pounds released from each facility by long-term even/odd brood year specific average return rates for that facility. For example, 3-year-old returns were forecast by multiplying pounds released of 2016 brood year chum by the long-term, even-year brood Age 3 return rate for that hatchery. The age 4 and 5 returns were forecast by the same method. For off-station releases (volunteer/cooperative projects), return rates were based on rates for a corresponding hatchery, which in some instances were reduced by a factor of 4 to compensate for smaller size at release and whether the fry were fed prior to release. A summary of the WDFW forecasts by age is shown for Hood Canal hatcheries in Table A – 4 – m. The WDFW Hood Canal hatchery fall chum forecast is 263,753 on-station and 21,526 off-station for total forecast of 285,279 returns in 2019.

A-4.2.4 Joint 2019 Hood Canal Hatchery Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 349,412 hatchery fall chum, the average of the Tribal and WDFW forecasting methods' results, apportioned to individual hatchery facilities (Table A-4-o).

**Table A-4-j. Fall Chum Returns-per-Pound,
by Age at Return from Hoodspout Hatchery Releases**

Brood Year	Release Lbs.	3's	4's	5's	Total
1965	888	0.80208	2.35750	0.01558	3.17516
1966	1,771	0.92010	2.66721	0.02299	3.61030
1967	2,301	0.93776	1.15006	0.11132	2.19914
1968	4,373	0.54928	1.56195	0.19686	2.30809
1969	2,424	0.59879	2.69040	0.26275	3.55194
1970	3,036	1.45276	4.96486	0.00000	6.41762
1971	3,794	1.45488	1.48756	0.02969	2.97213
1972	4,126	0.55870	7.49948	0.82970	8.88788
1973	9,202	0.70599	3.60727	0.16357	4.47683
1974	27,368	0.89570	5.68814	0.03343	6.61727
1975	22,776	2.54895	2.78624	0.05244	5.38763
1976	24,490	0.76752	1.80998	0.04155	2.61905
1977	21,883	3.98451	2.02120	0.02757	6.03328
1978	33,256	1.00278	2.34466	0.24428	3.59172
1979	24,238	2.98678	2.89652	0.21504	6.09834
1980	44,336	0.48636	2.23768	0.04039	2.76443
1981	23,589	3.18480	4.51989	0.36118	8.06587
1982	32,058	1.69592	4.43338	0.15862	6.28792
1983	34,748	1.23151	4.91046	0.44689	6.58886
1984	60,763	1.76204	2.85909	0.09411	4.71524

Continued ...

**Table A-4-j (cont'd). Fall Chum Returns-per-Pound,
by Age at Return from Hoodspout Hatchery Releases**

1985	39,279	2.92389	5.00571	0.20595	8.13555
1986	33,036	0.53259	2.21872	0.20579	2.95710
1987	40,323	0.42814	3.70929	0.14736	4.28479
1988	36,877	3.13411	7.17034	0.29712	10.60157
1989	35,149	0.71847	1.79583	0.50845	3.02275
1990	38,422	4.27142	7.01940	0.37401	11.66483
1991	39,379	3.01183	1.98098	0.07460	5.06741
1992	33,678	2.33155	3.93700	0.12497	6.39352
1993	33,920	1.77835	4.03487	0.17676	5.98998
1994	37,075	0.73558	1.96470	0.03943	2.73971
1995	37,583	1.29662	0.93342	0.01997	2.25001
1996	25,374	0.35104	1.66305	0.05572	2.06981
1997	30,276	0.34889	2.52394	0.09089	2.96372
1998	37,534	2.62754	3.21934	0.03818	5.88506
1999	33,196	3.81337	2.85193	0.30443	6.96973
2000	34,067	0.18327	1.12001	0.06995	1.37323
2001	35,033	1.16696	0.88571	0.04609	2.09876
2002	35,574	0.48600	0.98579	0.00808	1.47987
2003	33,231	0.83763	0.63987	0.04794	1.52544
2004	31,410	0.33036	0.56328	0.01959	0.91323
2005	29,031	0.77693	1.52074	0.16253	2.46020
2006	29,958	0.08529	1.31603	0.02103	1.42236
2007	25,523	1.40372	2.16346	0.21276	3.77993
2008	28,653	0.02999	0.29356	0.01520	0.33875
2009	30,092	1.30740	1.65037	0.21783	3.17560
2010	27,262	0.15984	3.06169	0.35500	3.57653
2011	30,171	0.63369	1.12614	0.16702	1.92684
2012	31,246	1.54739	3.21615	0.07462	4.83815
2013	30,347	2.02338	2.90302		
2014	29,497				
2015	21,140				
2016	23,707				
All Odd Years	25,751	1.63621	2.48610	0.16953	4.25833
All Even Years	28,806	1.12071	3.07565	0.11004	4.33638
All Years	27,278	1.38372	2.77485	0.14042	4.29736
All Years 65-73	3,546	0.88670	3.10959	0.10035	4.17768
All Years 74-12	32,868	1.48202	2.69432	0.14863	4.32498
All Years 05-12*	28,992	0.74303	1.79352	0.15325	2.68980
2019 Tribal Forecast*		17,615	37,914	4,520	60,049

**Table A-4-k. Fall Chum Returns-per-Pound, by Age at Return
from George Adams/McKernan Hatchery Releases**

Brood Year	Release Lbs.	3's	4's	5's	Total
1978	18,717	0.11901	0.85327	0.15188	1.12416
1979	40,273	0.36752	0.61002	0.06715	1.04469
1980	24,418	0.30902	2.10810	0.05751	2.47463
1981	12,028	3.24075	4.43634	0.36758	8.04467
1982	26,780	1.03328	3.20556	0.20036	4.43920
1983	25,917	1.25574	8.01500	0.44456	9.71530
1984	28,601	1.49188	1.18815	0.05936	2.73939
1985	24,500	0.78202	1.85405	0.20669	2.84276
1986	36,329	0.12036	1.56008	0.24038	1.92082
1987	30,566	0.10195	1.44458	0.20499	1.75152
1988	31,083	1.45527	4.69637	0.54805	6.69969
1989	32,315	0.52929	2.25103	0.20309	2.98341
1990	17,032	0.47710	5.81499	0.43246	6.72455
1991	30,024	1.45064	1.33176	0.05341	2.83581
1992	25,235	1.59492	2.86789	0.09179	4.55460
1993	27,016	1.21873	2.78823	0.32053	4.32749
1994	27,723	0.54142	3.79484	0.03621	4.37247
1995	22,624	3.11094	1.06483	0.00880	4.18457
1996	23,138	0.27842	0.47256	0.11599	0.86697
1997	27,884	0.06412	5.23332	0.21356	5.51100
1998	33,440	5.59772	3.99864	0.27753	9.87389
1999	27,365	4.78742	22.40721	2.17993	29.37456
2000	8,486	4.76506	15.87349	0.72806	21.36661
2001	31,946	3.95554	2.51829	0.00000	6.47383
2002	30,996	1.44617	4.05078	0.09009	5.58704
2003	32,631	5.01811	6.81432	0.32729	12.15972
2004	23,127	5.35825	3.32306	0.06471	8.74602
2005	22,768	5.35290	12.04153	0.75741	18.15184
2006	24,833	0.95216	3.67314	0.08015	4.70544
2007	21,035	5.61999	14.76001	0.80514	21.18514
2008	22,371	0.86000	2.69175	0.09309	3.64483
2009	22,482	13.30859	35.85918	0.97884	50.14661
2010	22,855	10.16291	9.15311	1.05806	20.37408
2011	33,674	1.20429	4.53218	0.17217	5.908632
2012	24,781	9.77925	9.03033	0.20408	19.01365
2013	25,878	6.04876	14.53482		
2014	29,061				
2015	27,066				
2016	34,410				
Average Return Brood Years (1978-12) excluding outliers in bold.					
Odd Years	27,263	2.59463	3.29953	0.43007	6.13823
Even Years	25,671	2.12819	3.67545	0.22363	4.56491
All Years	26,446	2.36141	3.51255	0.28415	5.85919
Years 05-12*	24,350	3.96143	5.81610	0.51861	8.10269
2019 Tribal Forecast*		136,312	157,421	15,071	308,805

Table A-4-l. Fall Chum Returns-per-Pound, by Age at Return for Enetai Hatchery Releases

Brood Year	Release Lbs.	3's	4's	5's	Total
1976	3,696	0.181550	0.752140	0.000000	0.933690
1977	5,785	1.531980	3.311160		
1978	6,514	1.402970		0.011720	
1979	2,666		0.622230	0.092130	
1980	3,053	0.433280	1.818250	0.102490	2.354020
1981	4,985	2.122020	2.898710	0.101030	5.121760
1982	6,130	2.231980	2.839080	0.057190	5.128250
1983	2,727	3.662950	4.003460	0.123990	7.790400
1984	5,855	2.347900	1.469020	0.027380	3.844300
1985	5,485	2.226960	2.491880	0.031790	4.750630
1986	5,495	1.130610	1.073040	0.096000	2.299650
1987	4,455	1.078890	1.442170		
1988	4,493	1.463080		0.087040	
1989	4,191		1.679620	0.065310	
1990	3,294	3.146150	6.089970		
1991	2,936	6.393020		0.068150	
1992	2,095		3.076920	0.104680	
1993	4,297	1.779560	2.412670	0.084060	4.276290
1994	6,809	1.376180	3.039700	0.002960	4.418840
1995	3,456	4.326990	0.346790	0.006210	4.679990
1996	2,302	0.418830	0.658930	0.070130	1.147890
1997	4,068	0.208130	1.792540	0.130660	2.131330
1998	3,270	1.823320	3.930450		5.753770
1999	1,542	3.211440		0.364810	3.576250
2000	195		1.779610	1.696900	3.476510
2001	4,326	4.123380	2.116840	0.191630	6.431850
2002	7,081	1.580060	6.809960	0.056110	8.446130
2003	3,264	3.103570	2.258850	0.416000	5.778420
2004	6,613	5.501100	1.074940	0.073000	6.649040
2005	6,603	2.701510	3.153352	0.018529	5.873391
2006	6,895	0.389653	0.416988	0.029314	0.835955
2007	6,469	0.887544	3.412616	0.059682	4.359842
2008	3,951	0.051157	0.703563	0.109023	0.863743
2009	4,700	7.540882	5.648894	0.393020	13.582796
2010	5,531	2.194773	5.510529	0.402003	8.107310
2011	6,301	0.507391	1.398907	0.000000	1.906300
2012	9,637	2.959998	1.699276	0.020792	4.680070
2013	7,976	1.798581			
2014	9,705				
2015	7,611				
2016	6,805				
Average (Brood Years 1976-12).					
Odd Years	4,692	2.77675	2.54373	0.13419	5.40456
Even Years	5,210	1.68427	2.51426	0.17331	3.92925
All Years	4,958	2.23051	2.44706	0.15434	4.61421
Years 05-12*	6,261	2.15411	2.74302	0.12905	5.02617
2019 Tribal Forecast*		14,658	20,878	1,252	36,789

Note: Because of incomplete reconstruction, and lack of rack sampling, return rates after 2005 were not available

Table A-4-m. Summary of 2019 WDFW Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	2,778	1,428	280	4,486
Hoodsport Hatchery	27,083	60,892	3,938	91,913
G. Adams / McKernan Hatchery	48,078	79,109	5,940	133,127
Enetai Hatchery	11,978	20,395	1,854	34,227
12D Streams - Augmentation	6,232	14,440	854	21,526
Total	96,149	176,264	12,866	285,279

Table A-4-n. Summary of 2019 Tribal Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	2,151	5,280	470	7,902
Hoodsport Hatchery	17,615	37,914	4,520	60,049
G. Adams / McKernan Hatchery	136,312	157,421	15,071	308,805
Enetai Hatchery	14,658	20,878	1,252	36,789
Total	170,736	221,494	21,315	413,545

Table A-4-o. Apportionment of the 2019 Joint Hood Canal Hatchery Fall Chum Salmon Forecasts

Facility	Tribal Forecast	WDFW Forecast	Joint Forecast
Little Boston Hatchery	7,902	4,486	6,194
Hoodsport Hatchery	60,049	91,913	75,981
G. Adams / McKernan Hatchery	308,805	133,127	220,966
Enetai Hatchery	36,789	34,227	35,508
12D Streams - Augmentation		21,526	
Total	413,545	285,279	349,412

A-5. Pink Salmon.

A-5.1 Pink Salmon Natural Runs

Tribal Forecast:

The 2019 return of naturally reared Hood Canal pink salmon was forecast as recruitment to all fisheries (Canadian and domestic) and escapement, using the product of the 2017 brood year estimated escapement (27,174) (Table A-5-a) multiplied by the long-term recruit per spawner average estimated "Cycle 3" return rate of (3.73) for a forecast of 101,600 natural pink salmon total recruits (Table A-5-b).

Table A-5-a. Pink Salmon Natural Run Reconstruction for Hood Canal

Return Year (RY)	Brood Year (BY)	Hood Canal Parent (BY) Natural Escapement	Hood Canal Natural 4B Run (RY)	Hood Canal Total Natural Recruits (RY) (4B+CDN)	Hoodsport Hatchery Recruits (RY)	Hood Canal Total Recruits (RY)
1961	1959	30,600	37,863	44,388	3,560	47,948
1963	1961	36,900	629,272	901,536	11,893	913,429
1965	1963	503,200	167,326	217,872	586	218,458
1967	1965	160,500	294,136	465,405	3,869	469,274
1969	1967	269,400	42,957	58,604	3,146	61,750
1971	1969	42,100	106,788	138,686	3,188	141,874
1973	1971	104,100	48,991	70,592	2,291	72,883
1975	1973	47,100	13,194	18,402	3,457	21,859
1977	1975	12,600	45,643	79,795	10,530	90,325
1979	1977	44,300	42,243	74,371	8,710	83,081
1981	1979	37,300	7,652	12,013	3,044	15,057
1983	1981	6,550	25,803	29,222	626	29,848
1985	1983	25,200	66,602	91,738	2,196	93,934
1987	1985	64,100	68,988	77,341	11,117	88,458
1989	1987	62,200	87,472	114,943	4,047	118,990
1991	1989	60,970	131,677	166,259	4,683	170,942
1993	1991	118,450	37,225	38,695	12,599	51,294
1995	1993	35,647	32,280	36,148	29,373	65,521
1997	1995	31,306	9,202	9,477	23,969	33,446
1999	1997	8,363	12,673	12,673	7,635	20,308
2001	1999	12,667	98,962	99,061	71,539	170,600
2003	2001	98,338	38,242	38,242	25,217	63,459
2005	2003	37,531	17,585	17,603	14,107	31,710
2007	2005	17,481	29,505	29,564	4,406	33,970
2009	2007	29,001	11,501	11,501	22,455	33,956
2011	2009	11,093	15,256	15,256	17,791	33,047
2013	2011	15,122	202,798	203,204	4,903	208,107
2015	2013	195,601	589,896	591,671	5,948	597,619
2017	2015	595,679	28,304	28,561	2,543	31,104

Table A-5-b. Hood Canal Natural Pink Salmon Returns per Spawner

Cycle 1 BY	Cycle 1 R/S	Cycle 2 BY	Cycle 2 R/S	Cycle 3 BY	Cycle 3 R/S
1959	1.455	1961	24.498	1963	0.433
1965	2.909	1967	0.218	1969	3.302
1971	0.679	1973	0.396	1975	6.384
1977	1.690	1979	0.324	1981	4.531
1983	3.670	1985	1.212	1987	1.851
1989	2.735	1991	0.327	1993	1.023
1995	0.303	1997	1.527	1999	7.823
2001	0.389	2003	0.470	2005	1.695
2007	0.397	2009	0.639	2011	3.131
2013	1.763	2015	0.835	2017	3.910
2019					
Average:	1.599		0.661		3.739
Std. Dev.	1.192		0.449		2.236
2019 Tribal Forecast					101,600
2019 WDFW Forecast					31,350
2019 Joint Forecast					66,475

WDFW Forecast:

The WDFW using SaSI stock escapement values provided a separate 4B run forecast of 31,350 recruits which was then broken down to the respective watersheds by their 2017 escapement proportions, multiplied by a Cycle 3 return rate of 3.921 recruits per spawner. The difference in State and Tribal forecasts arises from the treatment of various outliers in the Cycle 3 datasets.

Joint 2017 Hood Canal Natural Pink Salmon Forecast:

Given the difference between methodology, the agreed to forecast for 2019 is 66,475 natural pink salmon recruits, the mean of the Tribal and WDFW forecasts.

A-5.2 Pink Salmon Hatchery Runs.

Tribal Forecast:

The 2019 return of hatchery reared Hood Canal pink salmon was forecast as recruitment to all fisheries and escapement, using the product of the 2017 brood year fingerling pounds released from the Hoodspout Hatchery (1,684), multiplied by the long term average recruits per pound rate estimated for the Hoodspout Hatchery (2.5983). The resulting recruit forecast is 4,376 pink salmon recruits (Table A-5-c).

WDFW Forecast:

For hatchery returns, the WDFW provided a separate forecast of 4,025 hatchery recruits using the same SaSI stock escapement values, multiplied by a Cycle 3 average return rate, to the years 2009-2017. The difference in State and Tribal forecasts is based on the different averaging methods.

Joint 2019 Hood Canal Hatchery Pink Salmon Forecast:

For 2019, given the relatively small difference between methodology the agreed to forecast is 4,200 hatchery pink salmon recruits, the mean of the Tribal and WDFW forecasts (Table A-5-c).

Table A-5-c. Hoodspout Hatchery Pink Salmon Return Rates.

Brood Year	Lbs. Released	Total Recruits	Recruits/Lb
1959	2,515	3,560	1.4155
1961	492	11,893	24.1728
1963	1,209	586	0.4847
1965	1,283	3,869	3.0156
1967	1,416	3,146	2.2218
1969	2,399	3,188	1.3289
1971	3,071	2,291	0.7460
1973	2,104	3,457	1.6431
1975	3,477	10,530	3.0285
1977	3,496	8,710	2.4914
1979	2,253	3,044	1.3511
1981	1,748	626	0.3581
1983	655	2,196	3.3527
1985	2,152	11,117	5.1659
1987	5,625	4,047	0.7195
1989	1,913	4,683	2.4480
1991	4,453	12,599	2.8293
1993	6,532	29,373	4.4968
1995	7,623	23,969	3.1443
1997	7,851	7,635	0.9725
1999	3,117	71,539	22.9512
2001	3,244	25,217	7.7734
2003	3,563	14,107	3.9593
2005	1,670	4,406	2.6383
2007	1,267	22,455	17.7230
2009	1,600	17,791	11.1194
2011	1,584	4,903	3.0953
2013	1,372	5,948	4.3353
2015	1,309	2,543	1.9427
2017	1,684		
BY 1959-15 Average			2.5983
TRIBAL 2019 Forecast		4,376	
WDFW 2019 Forecast		4,025	
2019 Joint Forecast			4,200

Note: Values in boldface were excluded from both forecast methods.