

WILLAPA BAY COHO - SUPPORTING DOCUMENTATION OF ABUNDANCE
FORECASTING APPROACH

MEMORANDUM

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FROM: Barbara McClellan

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SUBJECT: 2019 Willapa Bay Pre-Season Forecasts

Willapa Bay Fall Natural Coho: 63,448 ocean recruits (OA3) (60,699 terminal)

The OA3 recruits were calculated using the 2016 brood year spawner escapements expanded by freshwater survival to calculate Willapa Bay smolt outmigrants. That value was then applied to a marine survival rate of 4.60% and corrected for a 4-year average (2015-18) model performance.

The terminal runsize was expanded to ocean-age 3 using a recent 4-year average exploitation rate (2015-18) from the ocean fisheries.

2016 NOR Escapement = 25,290
2017 NOR Escapement = 9,091
2018 NOR Escapement = 11,143 (*preliminary*)
New natural escapement goal of 13,600 as of 2016

Willapa Bay Fall Hatchery Coho: 94,019 ocean recruits (85,801 terminal)

The terminal runsize was calculated using a terminal marine survival rate of 4.60% applied to the 2016 brood year smolts released in the spring of 2018 to create a terminal runsize.

The terminal runsize was expanded to ocean-age 3 using a recent 4-year average exploitation rate (2015-2018) from the ocean fisheries.

2016 HOR Escapement = 21,868
2017 HOR Escapement = 6,459
2018 HOR Escapement = 14,746 (*preliminary*)

Marked Versus Unmarked Terminal Hatchery Forecast			
		% Marked	% Unmarked
2019 Terminal Forecast	85,801	95.28%	4.72%
Total Adults Forecasted		81,748	4,053

The 4.60% terminal marine survival rate used for both natural and hatchery coho was calculated by averaging the results of a Willapa Bay jack to marine survival regression (5.46%) and Coshow's (Quinault Nation) marine survival estimate of 3.73% ocean age 3. Coshow's estimate was 4.6% Jan Age 3 but this was converted to Ocean Age 3 using the scalar of 1.2317.

Willapa Bay Fall Natural Chinook: 4,309 terminal runsize

Return per spawners applied to 3-6 year olds (brood years 2013-16) adjusted by a 4 year model performance (2015-18).

- 2016 Natural Escapement = 1,887
- 2017 Natural Escapement = 3,078
- 2018 Natural Escapement = 2,638 (preliminary)

Brood Year	3 yo – 2016	4 yo – 2015	5 yo – 2014	6 yo - 2013
2019 Forecast	1,644	1,820	839	6

Willapa Bay Fall Hatchery Chinook: 23,807 terminal runsize

Return per spawners applied to 3-6 year olds (brood years 2013-16) adjusted by brood year performance for Naselle and Willapa rivers. For Nemah River, we used a return per spawner applied to 3-6 year olds (brood years 2013-2016) adjusted for a 3 year model performance (2016-18)

- 2016 Hatchery Escapement = 12,898
- 2017 Hatchery Escapement = 19,700
- 2018 Hatchery Escapement = 18,275 (preliminary)

Brood Year	3 yo – 2016	4 yo – 2015	5 yr – 2014	6 yo - 2013	Total
2019 Forecast	6,109	11,983	5,601	113	23,807
Total Marked Adults Forecasted	5,684	11,168	5,348	108	22,488
% Marked	95.99%	93.20%	95.47%	95.14%	
Total Unmarked Adults Forecasted	245	815	254	6	1,319
% Unmarked	4.01%	6.80%	4.53%	4.86%	

Willapa Bay Fall Chum: 52,205 terminal runsize (51,383 natural and 822 hatchery)

Based on average return per spawner by age multiplied by the brood year escapements (2014-16) then adjusted using a calculated expected return per spawner by year class for 2019 using PDO Index May - Nov.

2016 Escapement = 80,284 natural + 647 hatchery = 80,931

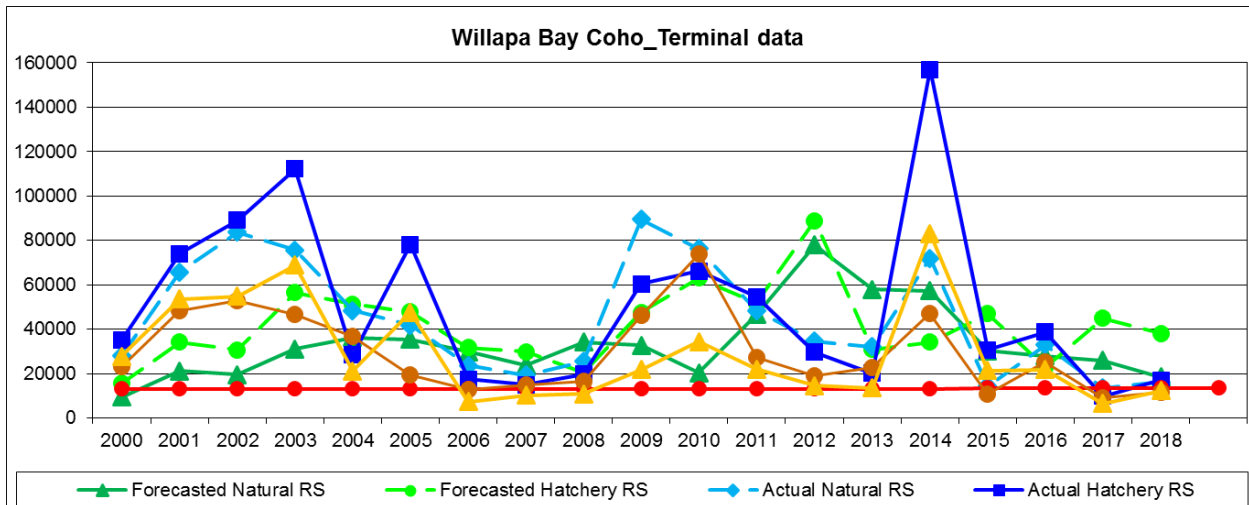
2017 Escapement = 21,749 natural + 237 hatchery = 21,986

2018 Escapement = 40,844 natural + 436 hatchery = 41,280 (preliminary)

Tables and Graphs of Willapa Bay coho data provided in excel spreadsheet 'Coho forecast evaluation'. 2018-19 actual data is preliminary.

Table 1. Willapa Bay Coho: Terminal Runsizes

Terminal Runsizes													
Terminal	Forecasted RS			Actual RS			Actual/Forecasted RS			Nat Goal	Actual Escapement		
	Natural	Hatchery	Total	Natural	Hatchery	Total	Natural	Hatchery	Total		Natural	Hatchery	Total
2000	9,393	15,564	24,957	28,037	34,968	63,005	2.98	2.25	2.52	13,090	23,034	27,865	50,899
2001	21,239	34,146	55,385	65,679	73,902	139,581	3.09	2.16	2.52	13,090	48,414	53,547	101,961
2002	19,477	30,610	50,087	83,598	89,045	172,643	4.29	2.91	3.45	13,090	52,736	54,794	107,530
2003	30,987	56,363	87,350	75,557	112,214	187,771	2.44	1.99	2.15	13,090	46,704	68,762	115,466
2004	36,285	51,297	87,582	48,385	28,354	76,739	1.33	0.55	0.88	13,090	36,674	21,171	57,845
2005	35,508	47,843	83,351	41,754	78,221	119,975	1.18	1.63	1.44	13,090	19,572	47,582	67,154
2006	29,887	31,787	61,674	23,637	17,477	41,114	0.79	0.55	0.67	13,090	12,918	7,437	20,355
2007	23,794	29,783	53,577	19,247	15,008	34,255	0.81	0.50	0.64	13,090	14,766	10,345	25,111
2008	34,187	20,409	54,596	25,592	19,671	45,263	0.75	0.96	0.83	13,090	16,512	10,832	27,344
2009	32,706	47,536	80,242	89,413	60,300	149,713	2.73	1.27	1.87	13,090	46,398	21,759	68,157
2010	20,400	62,979	83,379	76,321	66,176	142,497	3.74	1.05	1.71	13,090	73,985	34,387	108,372
2011	46,593	51,727	98,320	48,355	54,677	103,032	1.04	1.06	1.05	13,090	27,308	22,022	49,330
2012	77,917	88,774	166,691	34,686	29,638	64,324	0.45	0.33	0.39	13,090	18,880	14,609	33,489
2013	57,821	30,977	88,798	32,023	20,096	52,119	0.55	0.65	0.59	13,090	22,834	13,490	36,324
2014	57,252	34,241	91,493	71,939	156,970	228,909	1.26	4.58	2.50	13,090	47,154	83,059	130,213
2015	30,362	47,014	77,375	14,481	30,628	45,109	0.48	0.65	0.58	13,600	10,790	21,297	32,087
2016	27,977	22,893	50,870	32,930	38,799	71,729	1.18	1.69	1.41	13,600	25,290	21,868	47,158
2017	25,998	44,818	70,816	13,605	9,760	23,365	0.52	0.22	0.33	13,600	9,091	6,459	15,550
2018	18,499	38,021	56,520	16,295	16,969	33,264	0.88	0.45	0.59	13,600	11,531	12,253	23,784
2019	60,221	85,801	146,023							13,600			
All yr Avg (2000-18)	33,489	41,410	74,898	44,291	50,151	94,442	1.60	1.34	1.37		29,715	29,134	58,849
3yr Avg (2016-18)	24,158	35,244	59,402	20,944	21,842	42,786	0.86	0.79	0.78		15,304	13,527	28,831
2015-18 Avg (Policy)	25,709	38,187	63,895	19,328	24,039	43,367	0.76	0.75	0.73		14,176	15,469	29,645
5 yr Avg (2014-18)	32,018	37,397	69,415	29,850	50,625	80,475	0.86	1.52	1.08		20,771	28,987	49,758



Graph 1: Willapa Bay Coho: Terminal Runsizes

Table 2: Willapa Bay Coho: Ocean Age 3 Runsizes

Ocean Age 3	Forecasted RS			Actual RS			Actual/Forecasted			Terminal RS used in Planning Model-after FRAM	
	Natural	Hatchery	Total	Natural	Hatchery	Total	Natural	Hatchery	Total	Natural	Hatchery
2001	21,633	36,121	57,754	65,679	73,902	139,581	3.036	2.046	2.417		
2002	21,618	40,370	61,988	83,598	89,045	172,643	3.867	2.206	2.785		
2003	31,832	57,514	89,346	75,557	112,214	187,771	2.374	1.951	2.102		
2004	47,114	46,666	93,780	48,385	28,354	76,739	1.027	0.608	0.818		
2005	35,891	56,427	92,318	41,754	78,221	119,975	1.163	1.386	1.300		
2006	30,342	37,663	68,005	23,637	17,477	41,114	0.779	0.464	0.605		
2007	24,404	37,228	61,632	19,247	15,008	34,255	0.789	0.403	0.556		
2008	35,063	25,511	60,574	25,592	19,671	45,263	0.730	0.771	0.747		
2009	33,544	59,420	92,964	89,413	60,300	149,713	2.666	1.015	1.610		
2010	20,400	78,723	99,123	76,321	66,176	142,497	3.741	0.841	1.438		
2011	47,788	64,658	112,446	48,355	54,677	103,032	1.012	0.846	0.916		
2012	81,325	88,774	170,099	34,686	29,638	64,324	0.427	0.334	0.378		
2013	58,648	44,407	103,055	32,023	20,096	52,119	0.546	0.453	0.506		
2014	58,883	49,087	107,970	71,939	156,970	228,909	1.222	3.198	2.120		
2015	42,884	57,693	100,577	14,481	30,628	45,109	0.338	0.531	0.449	38,505	41,116
2016	39,516	28,093	67,609	32,930	38,799	71,729	0.833	1.381	1.061	37,069	23,810
2017	36,720	54,998	91,718	13,605	9,760	23,365	0.371	0.177	0.255	34,425	46,239
2018	20,870	44,542	65,412	16,295	16,969	33,264	0.781	0.381	0.509	18,994	34,993
2019	62,971	94,019	156,990								
All yr Avg (2000-18)	38,249	50,439	88,687	45,194	50,995	96,189	1.428	1.055	1.143		
3yr Avg (2016-18)	32,369	42,544	74,913	20,944	21,842	42,786	0.662	0.647	0.608	30,163	35,014
2015-18 Avg (Policy)	34,998	46,332	81,329	19,328	24,039	43,367	0.581	0.618	0.568	32,248	36,540
5 yr Avg (2014-18)	39,775	46,883	86,657	29,850	50,625	80,475	0.709	1.134	0.879		