2014 PRESEASON FORECAST PACKET FOR HOOD CANAL SALMON RUNS'

PRESEASON FORECAST PACKET PREPARED BY:

SKOKOMISH TRIBE

SALMON FORECASTS AGREED TO BY:

LOWER ELWHA TRIBE

PNPTC (FOR JAMESTOWN & PORT GAMBLE)

SKOKOMISH TRIBE

WDFW

FINAL 06FEB14

SUMMARY OF 2014 HOOD CANAL FORECASTS
and Forecasting Methods

Species (Ref.#)	Origin	Type	Number	Mass Marked	Number Type	Model Designation
Chinook (A-1)	Mixed	Secondary	2,971		TRS	Natural
	Hatchery	Primary	80,636		TRS	Hatchery
Summer Chum (A-2)	Natural (supplemented)	Secondary	31,400		Total Recruits	
Coho (A-3)[1]	Natural	Primary	63,473		Total DA2[1] Recruits	Natural
	Natural	Secondary	3,907		Total DA2[1] Recruits	Hatchery
	Hatchery	Secondary	106,427	98,877	Total DA2[1] Recruits	Hatchery
Fall Chum (A-4)	Natural		93,721		WA Run	Natural
	Hatchery		348,587			Hatchery

[1] See overleaf for Coho FRAM model inputs.

NOTES: Summer Chum salmon, although secondary, are under rehabilitation.
Forecasts for individual Hood Canal Management Units are:

Mainstem Hood Canal MU	14,171
SE Hood Canal MU	4,131
Quilcene MU	13,098

Natural Chinook salmon, although classified as "secondary", are under rehabilitation.
Forecasts for individual Hood Canal Management Units are:

Mid Hood Canal MU	473
Skokomish MU (Nat.)	2,971
(Hat.)	49,441
Hoodsport MU	31,195
Miscell.	76

Coho FRAM Model Inputs:

Stock Name	DA2	nuFRAM Stock	nuFRAM Age 3	Marked nuFRAM	Marked %
Port Gamble Net Pens	18,331	ptgamh	16,938	16,931	100%
Port Gamble Bay Natural	666	ptgamw	616		
Area 12/12B Natural	23,700	ar12bw	21,898		
Quilcene Bay Net Pens	5,927	qlcnbh	5,477	5,468	100%
Quilcene Hatchery	55,272	qlcenh	51,072	47,854	93.70%
Area 12A Natural	3,240	ar12aw	2,994		
Hoodsport Hatchery	n/a	hoodsh	0		
Area 12C/12D Natural	26,104	ar12dw	24,120		
George Adams Hatchery	26,896	gadamh	24,852	21,110	84.94%
Skokomish River Natural	13,669	skokrw	12,630		

A. Pre-season Forecasting Methods

A-1. Summer/Fall Chinook Salmon

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	1.13439	101,956
2013*	90,075	0.88195	79,442
Average 2011-2013		0.93429	
2014 Forecast			84,156

(*) 2013 return data are preliminary and subject to revision, following reconciliation of records.

The 2014 forecasted terminal run size of summer-run Hood Canal Chinook salmon is the product of brood 2010 fingerling lbs released from WDFW facilities in 2011, 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 three return years (2011-2013), (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 2013 return years, to include this information for 2014 forecasting purposes (Tables A-1-a and A-1-b). The resulting terminal area run forecast is 84,156 Chinook salmon. The forecast was apportioned to 80,636 chinook expected to return to hatcheries and 3,519 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 2011-2013 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-b. Hood Canal Summer/Fall Chinook Terminal Runs

Year	12A	12/12B	12C	12D	Skokomish	G.A. Hatchery	Hoodsport 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*	*430*	*22*	*33*	*3,428*	*58,782*	*39,261*	*101,956*
2013	*3*	*674*	*49*	*95*	*3,054*	*41,802*	*33,766*	*79,442*

Note: Values for years prior to 1998 DO NOT include freshwater recreational catch
Note: The 2011-2013 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	Hoodsport
2011	0.00000	0.00413	0.00030	0.00006	0.03386	0.65973	0.30193
2012	0.00000	0.00422	0.00022	0.00032	0.03362	0.57654	0.38508
2013	0.00004	0.00848	0.00062	0.00120	0.03844	0.52620	0.42504
2011-13 Mean	0.00001	0.00561	0.00038	0.00053	0.03531	0.58749	0.37068

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

Hood Canal Production Unit	Terminal Run Forecast	Proportion
12A	1	0.00001
12B	472	0.00561
12C	32	0.00038
12D	44	0.00053
Skokomish	2,971	0.03531
Natural Subtotal	3,519	0.04182
George Adams	49,441	0.58749
Hoodsport	31,195	0.37068
Hatchery Subtotal	80,636	0.95817
Total	84,156	1.0

Note: The forecasted proportions are derived from the 2011-2013 mean distribution.

A-2. Summer Chum Salmon

A-2.1 Natural Runs

The 2014 pre-season forecast of the Hood Canal summer chum salmon returns was forecast as total recruitment to all fisheries and escapements for the Mainstem Hood Canal, Quilcene/Dabob, and SE Hood Canal Management Units (MUs).

Abundance for each MU was forecast as the mean of the 2010 through 2013 returns and the mean was then adjusted by the ratio of actual abundance to forecast abundance during 2010-2013. The actual to forecast ratios were 1.493 for the Mainstem Hood Canal MU, 2.009 for the Quilcene/Dabob MU, and 1.750 for the SE Hood Canal MU.

For the Mainstem Hood Canal MU, forecasted returns of summer chum were based on total (NORs + SORs) returns. For the Quilcene/Dabob MU, the returns of summer chum were forecast based on NORs. The return to the SE Hood Canal MU was forecast as the mean of the NORs to Union River plus the mean of the total (NORs + SORs) recruits to Tahuya River.

Estimates of the number of natural-origin recruits and supplementation-origin recruits returning to each MU each year from 2007 through 2013 and associated forecasts for 2014 are shown in Table A-2-a.

The 2014 forecasted returns are 14,171 summer chum to the Mainstem Hood Canal MU; 13,098 summer chum to the Quilcene/Dabob Bays MU; and 4,131 summer chum to the SE Hood Canal MU. The total forecasted return is 31,400 summer chum to Hood Canal in 2014 (Table A-2-a).

Summer chum returns declined in 2009 through 2011 compared to 2008 and then increased during 2012 and 2013. The 2014 forecast method takes this into account and is a better measure of the 2014 anticipated return than just the mean of the 2010 through 2013 returns.

Supplementation and reintroduction projects were implemented in the Big Quilcene River from 1992 through 2003 (Quilcene/Dabob MU); in the Union River from 2000 through 2003 and in the Tahuya River from 2003 through the present (SE Hood Canal MU). In the Mainstem Hood Canal MU, supplementation and reintroduction projects were implemented in Lilliwaup Creek from 1992 through the present, in Big Beef Creek from 1996 through 2004 and in the Hamma Hamma River from 1997 through 2008. Summer chum fry from each project were marked and natural-origin recruits (NORs) can be distinguished from supplementation-origin recruits (SORs) upon return as adults. Fry released from each project have contributed substantially to the summer chum adult recruitment and escapements.

The supplementation projects in Lilliwaup Creek, the Hamma Hamma River, and the Tahuya River are each expected to contribute supplementation-origin recruits (SORs) during 2014. The projects in the Quilcene River, Big Beef Creek, and the Union River were terminated and no SORs are expected to return from those projects in 2014.

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 2014 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	
	NOR	SOR	NOR	SOR	NOR	SOR
2007	5,939		3,887	75	2,070	768
2008	9,835		5,866	0	1,174	798
2009	4,953		2,498	0	615	383
2010	8,625		2,110		1,170	979
2011	3,700		2,741		627	
2012	14,315		12,500		3,762	
2013	11,336		8,723		2,906	
2014 Forecast a/	**14,171**		**13,098**		**4,131**	
2014 Total Hood Canal Forecast					**31,400**	

a/ 2010-13 mean return adjusted by ratio of actual abundance to forecast abundance during 2010 through 2013; see text.

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 - 2013, the Co-managers agree that no gillnet fisheries will occur in 2014 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 Natural Runs

The forecasted recruitment of 2014 Hood Canal natural runs was based on a linear regression model that related the return of tagged natural jack coho at BBC to Hood Canal December Age 2 recruits in the subsequent run year. This model used recruit data from brood years 1983-1998 and 2002-2009 (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:

$$\textit{Hood Canal Recruitment} = 34486.625 + (391.580 * (\textit{BBC Tagged Jacks}))$$

Relevant statistics of the model used to derive the 2014 forecast are shown below.

Using Brood Years 1983-1998, 2002-2009	
Multiple R	0.78385
R^2	0.61442
Adj. R^2	0.59690
Std Error of Estimate	36471.202
N	24
Intercept	34486.625
Slope	391.580
2013 Jacks (X)	84
2014 Forecast (Y)	67,379

The forecasted recruits were subsequently apportioned to primary and secondary units on the basis of the distribution of their parent brood escapement. The total forecast of 67,379 natural DA2 recruits was thus apportioned into 63,473 from primary and 3,907 from secondary units, on the basis of their parent brood spawner distribution (Table A-3-b).

Table A-3-a. 2014 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	*19,739*	173	122	*81,147*
1989	*23,646*	167	144	*66,306*
1990	*18,677*	273	202	*67,729*
1991	*13,071*	206	149	*140,612*
1992	*18,431*	188	157	*95,144*
1993	*16,574*	224	185	*73,734*
1994	*25,820*	410	298	*149,823*
1995	*40,828*	610	510	*180,517*
1996	*22,222*	60	45	*23,437*
1997	*20,967*	96	85	*55,909*
1998	*47,088*	189	179	*165,500*
1999	*21,803*	120	111	*107,024*
2000	*24,352*	80	70	*268,753*
2001	*36,060*	339	254	*298,347*
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	57,271	212	178	153,700
2010	21,243	90	70	
2011	27,246	124	84	

*Data Italicized Denotes Methodology Currently Under Review and agreed to for forecasting purposes only

Table A-3-b. Apportionment of the 2014 Hood Canal Natural Coho Forecast

Area	Escapement Capacity	Escapement BY 2011	Management Unit Type	Proportion of Brood Escapement	December Age-2 Recruits
12 / 12B	28.88%	9,106	Primary	35.17%	23,700
12C / 12D	31.66%	10,030	Primary	38.74%	26,104
Skokomish	29.01%	5,252	Primary	20.29%	13,669
9A	1.25%	256	Secondary	0.99%	666
12A	9.20%	1,245	Secondary	4.81%	3,240
Primary Subtotal	89.55%	24,388		94.20%	63,473
Secondary Subtotal	10.45%	1,501		5.80%	3,907
Grand Total	100.00%	25,889		100.00%	67,379

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	19,611	21,601	4,709	45,921

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**
1976	30,171						397,562					
1977	1,816,704						490,611					
1978	1,042,520						377,098					
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	*98,188*	*0.17101*	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*	*0.07137*	540,000	*13,871*	*0.02569*	488,080	*41,686*	*0.08541*	215,731	*2,817*	*0.01306*
2005	245,608	*26,842*	*0.10929*	247,500	*5,081*	*0.02053*	273,099	*23,247*	*0.08512*	124,813	*8,331*	*0.06675*
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	28,443	0.12743	345,604	68,639	0.19861	179,587	*6,025*	*0.03355*
2010	239,228			397,581			393,654			204,578		
2011	289,734			393,442			426,115			200,249		
Average (2004-09)			0.09283			0.04659			0.12971			0.02960
2014 Forecast:		26,896			18,331			55,272			5,927	

Note: DEC Age-2 Recruits have been recalculated for BY95 - BY2001 and are therefore NOT comparable to those from earlier years. Earlier broods are in the process of being recalculated as well. Note: Values in italics indicate values agreed to for preseason forecasting only. Values in boldface were excluded from the analysis

A-3.2 Hatchery Runs

The 2014 forecast utilized survival rates the two 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 2014 forecast of 106,426 hatchery reared December Age-2 coho recruits (Table A-3-d) was predicted from the brood year 2011 smolt releases multiplied by the average estimated marine survival rate for each facility's smolts from the six latest available brood years. (Table A-3-d).

A-4. Fall Chum Salmon

The 2014 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 2014 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 all available broods, from 1968 to the present, excluding estimates from the 1983 brood (ages 3 and 4) and the 1989 brood (age 5) return. The mean recruit-per-spawner return rates were 1.18500, 2.57726, and 0.30685, for 3, 4, and 5 year-olds respectively (Table A-4-a). These adjusted rates of return were multiplied with the 2011, 2010, and 2009 brood escapements (48,103, 17,221, and 13,961; respectively) to estimate the total 2014 forecast of 105,670 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 107,408 to each natural production unit was estimated by adding the estimated 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 2009, 2010, and 2011 and age composition were used to estimate 2014 returns of Age 3, Age 4, and Age 5 natural fall chum. The 2014 forecast of natural fall chum to Puget Sound is 46,157 Age 3; 364,619 Age 4; and 385,454 Age 5 fish for a total run size of 796,230 (Table A-4b).

The apportionment of 796,230 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 52,480 Age 3, 22,948 Age 4, and 2,866 Age 5 fish for a total Hood Canal forecast of 78,295 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 2014 Hood Canal Natural Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 93,721 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	1.52373		
2009	13,961				
2010	17,221				
2011	48,103				
Mean: Brood Years 1968-11 (exclusive of outliers, in bold)					
All Odd Years	47,128	1.53778	2.28211	0.36148	4.96447
All Even Years	71,861	0.86583	2.84291	0.25495	4.55093
All Years *	59,495	1.18500	2.57726	0.30685	4.75240
		3's	**4's**	**5's**	
2014 Tribal Forecast*		57,003	44,383	4,284	105,670

Table A-4-b. 2014 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
2009	5	224,841	2.99	2.99	671,807	0.0690000	46,158
2010	4	273,621	2.34	1.75	479,744	0.7600000	364,619
2011	3	353,305	2.99	2.99	1,055,648	0.3650000	385,454
						Total	796,230

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

Table A-4-c. 2014 WDFW Hood Canal Natural Fall Chum Salmon Forecasts

	Puget Sound Forecast	HC Parent Escapement Proportion	HC Forecast by Age
Age 3 (2011 Brood) Forecast	385,454	0.1360000	52,480
Age 4 (2010 Brood) Forecast	364,619	0.0630000	22,948
Age 5 (2009 Brood) Forecast	46,158	0.0620000	2,866
Total WDFW Forecast	796,231		78,295

Table A-4-d. 2014 Hood Canal Natural Fall Chum Salmon Parent Brood Escapement Distribution

Area	2009	2010	2011
9A	0.00%	0.00%	0.00%
12	7.49%	4.84%	4.70%
12A	0.19%	0.79%	4.37%
12B	22.03%	29.30%	47.09%
12C	11.33%	36.19%	15.46%
82G	21.63%	12.22%	23.29%
12D	37.33%	16.66%	5.09%

Table A-4-e. Apportionment of the 2014 Tribal Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	2,679	2,148	321	5,148
12A	2,491	351	8	2,850
12B	26,843	13,004	944	40,791
12C	8,813	16,062	485	25,360
82G	13,276	5,424	927	19,626
12D	2,901	7,394	1,599	11,895
Total	57,003	44,383	4,284	105,670

Table A-4-f. Apportionment of the 2014 WDFW Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	2,467	1,111	215	3,793
12A	2,293	182	5	2,480
12B	24,713	6,724	631	32,068
12C	8,115	8,305	325	16,745
82G	12,221	2,804	620	15,645
12D	2,672	3,822	1,070	7,564
Total	52,481	22,948	2,866	78,295

Table A-4-g. Apportionment of the 2014 Joint Hood Canal Natural Fall Chum Salmon Forecast

Area	Tribal Forecast	WDFW Forecast	Joint Forecast
9A	0	0	0
12	5,148	3,793	4,471
12A	2,850	2,480	2,665
12B	40,791	32,068	36,429
12C	25,360	16,745	21,053
82G (Skokomish)	19,626	15,645	17,636
12D	11,895	7,564	9,729
12D Off-Station	1,739		1,739
Total	107,408	78,295	93,721

A-4.2 Hatchery Runs (Tribal)

The 2014 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 2009, 2010, and 2011. 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 2014, including 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. Also, the 2004 brood was the first year of reduced production at the Hoodsport and George Adams / McKernan facilities, which first affected age-5 returns in 2009 and subsequent years.

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 (1998-2007 broods) (Tables A-4-h and A-4-i). The resulting forecast for 2014 is 1,739 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 2014, Off-Station Lbs. Planted

Area	BY 2011	BY 2010	BY 2009
	Lbs	Lbs	Lbs
9A	0	0	10
12	13	26	10
12B	0	0	0
12A	0	0	0
12C	0	0	0
Skokomish	145	158	155
12D	30	87	0
Total	188	271	175

Table A-4-i. Apportionment of the 2014 Tribal Hood Canal Fall Chum Off-Station Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	8	20	0	28
12B	0	0	0	0
12A	0	0	0	0
12C	0	0	0	0
82G	85	121	7	213
12D	18	1,480	0	1,498
Total	110	1,620	8	1,739

A-4.2.2 Hatchery On-Station Forecasts (Tribal)

Hoodsport Hatchery: Mean return rate of age 3, 4, and 5 fish per pound planted at Finch Creek (1998-2007 broods) (Table A-4-j). The resulting forecast for 2014 is 79,752. 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 (1998-2007 broods), excluding BY 1999 (ages 4 and 5) and BY 2000 (age 4) and includes a release of 4,119 pounds from Rick's Pond. The resulting forecast for 2014 is 244,986 (Table A-4-k).

Little Boston Hatchery: Mean return rate of age 3, age 4 and age 5 fish per pound planted at Hoodsport Hatchery (1998-2007 broods) (Table A-4-j). The resulting forecast for 2014 is based on the fingerling releases of 866 lbs. (BY2011), 1,324 lbs (BY 2010), and 1,087 lbs (BY 2009), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of 3,137 (Table A-4-n).

Enetai Hatchery: Mean return rates of age 3, age 4 and age 5 fish per pound planted (1998-2007 broods). (Table A-4-l). The resulting forecast for 2014 is based on the fingerling releases of 6,301 lbs. (BY2011), 5,531 lbs. (BY 2010), 4,700 lbs (BY2009), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of 33,180.

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 361,055.

A-4.2.3 Hatchery Forecasts (WDFW)

The 2014 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 2011 brood year chum by the long-term, even-year brood age 3 return rate for that hatchery. Age 4 and age 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, reduced by a factor of 2 or 4 to compensate for smaller size at release. A summary of the WDFW forecasts by age are shown for Hood Canal hatcheries in Table A-4-m. The 2014

WDFW Hood Canal hatchery fall chum forecast is 334,884 on-station and 1,235 off-station for a total forecast of 336,119.

A-4.2.4 Joint 2014 Hood Canal Hatchery Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 348,587 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 Hoodsport 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 Hoodsport 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		
2009	30,092	1.30740			
2010	27,262				
2011	30,171				
All Odd Years	25,751	1.66297	2.56695	0.16744	4.41352
All Even Years	28,891	1.14500	3.06989	0.10430	4.53904
All Years	27,288	1.40974	2.81842	0.13738	4.47482
All Years 65-73	3,546	0.88670	3.10959	0.10035	4.17768
All Years 74-07	33,366	1.58325	2.76582	0.14428	4.55348
All Years 98-07*	32,456	1.17111	1.52662	0.09306	2.79078
2014 Tribal Forecast*		35,333	41,619	2,800	79,752

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		
2009	22,482	**13.30859**			
2010	22,855				
2011	33,674				
Average Return Brood Years (1978-07) excluding outliers in bold.					
Odd Years	27,356	3.13527	3.19681	0.28430	6.15589
Even Years	25,010	1.65000	2.95328	0.17475	4.63063
All Years	26,183	2.07986	3.06152	0.24671	5.93650
Years 98-07*	25,663	4.28533	4.06304	0.34782	10.88305
2014 Tribal Forecast*		144,304	92,861	7,820	244,985

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	0.18155	0.75214	0.00000	0.93369
1977	5,785	1.53198	3.31116		
1978	6,514	1.40297		0.01172	
1979	2,666		0.62223	0.09213	
1980	3,053	0.43328	1.81825	0.10249	2.35402
1981	4,985	2.12202	2.89871	0.10103	5.12176
1982	6,130	2.23198	2.83908	0.05719	5.12825
1983	2,727	3.66295	4.00346	0.12399	7.79040
1984	5,855	2.34790	1.46902	0.02738	3.84430
1985	5,485	2.22696	2.49188	0.03179	4.75063
1986	5,495	1.13061	1.07304	0.09600	2.29965
1987	4,455	1.07889	1.44217		
1988	4,493	1.46308		0.08704	
1989	4,191		1.67962	0.06531	
1990	3,294	3.14615	6.08997		
1991	2,936	6.39302		0.06815	
1992	2,095		3.07692	0.10468	
1993	4,297	1.77956	2.41267	0.08406	4.27629
1994	6,809	1.37618	3.03970	0.00296	4.41884
1995	3,456	4.32699	0.34679	0.00621	4.67999
1996	2,302	0.41883	0.65893	0.07013	1.14789
1997	4,068	0.20813	1.79254	0.13066	2.13133
1998	3,270	1.82332	3.93045		5.75377
1999	1,542	3.21144		0.36481	3.57625
2000	195		1.77961	1.69690	3.47651
2001	4,326	4.12338	2.11684	0.19163	6.43185
2002	7,081	1.58006	6.80996	0.05611	8.44613
2003	3,264	3.10357	2.25885	0.41600	5.77842
2004	6,613	5.50110	1.07494	0.07300	6.64904
2005	6,603	2.70151	3.15335	0.01853	5.87339
2006	6,895	0.38965	0.41699	0.02931	0.83596
2007	6,469	0.88754	3.41262	0.05968	4.35984
2008	3,951	0.05116	0.70356		
2009	4,700	7.54088			
2010	5,531				
2011	6,301				
Average (Brood Years 1976-07).					
Odd Years	4,348	2.99326	2.28163	0.12528	4.97910
Even Years	4,626	1.56519	2.36884	0.17249	3.77400
All Years	4,487	2.27922	2.32674	0.14889	4.35036
Years 98-07*	4,626	2.59129	2.77262	0.32289	5.11812
2014 Tribal Forecast*		16,328	15,335	1,518	33,181

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

Table A-4-m. Summary of 2014 WDFW Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	821	4,093	115	5,029
Hoodsport Hatchery	54,711	83,829	5,455	143,995
G. Adams / McKernan Hatchery	72,650	63,569	7,441	143,660
Enetai Hatchery	18,144	13,292	643	32,079
12D Streams - Augmentation	10,141	1,215	0	11,356
Total	156,467	165,998	13,654	336,119

Table A-4-n. Summary of 2014 Tribal Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	1,014	2,021	101	3,137
Hoodsport Hatchery	35,333	41,619	2,800	79,752
G. Adams / McKernan Hatchery	144,304	92,861	7,820	244,985
Enetai Hatchery	16,328	15,335	1,518	33,181
Total	196,980	151,836	12,239	361,054

Table A-4-o. Apportionment of the 2014 Joint Hood Canal Hatchery Fall Chum Salmon Forecasts

Facility	Tribal Forecast	WDFW Forecast	Joint Forecast
Little Boston Hatchery	3,137	5,029	4,083
Hoodsport Hatchery	79,752	143,995	111,874
G. Adams / McKernan Hatchery	244,985	143,660	194,322
Enetai Hatchery	33,181	32,079	32,630
12D Streams - Augmentation		11,356	
Total	361,054	336,119	348,587