2010 PRESEASON FORECAST PACKET
FOR HOOD CANAL
SALMON RUNS'

Joint Report

Prepared by:
Skokomish Tribe
Washington Department of Fish and Wildlife

Agreed to by:
Lower Elwha Tribe
Point No Point Treaty Council
(for the Port Gamble and Jamestown S'Klallam Tribes)

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SUMMARY OF 2010 HOOD CANAL FORECASTS
and Forecasting Methods

Species (Ref.#)	Origin	Type	Number	Mass Marked	Number Type	Model Designation
Chinook (A-1)	Mixed	Secondary	2,414		TRS	Natural
	Hatchery	Primary	42,627		TRS	Hatchery
Summer Chum (A-2)	Natural (supplemented)	Secondary	5,998		Total Recruits	
Coho (A-3)[1]	Natural	Primary	44,257		Total DA2[1] Recruits	Natural
	Natural	Secondary	474		Total DA2[1] Recruits	Hatchery
	Hatchery	Secondary	67,759	60,782	Total DA2[1] Recruits	Hatchery
Fall Chum (A-4)	Natural		181,000		WA Run	
	Hatchery		296,409			

[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	4,005
SE Hood Canal MU	651
Quilcene MU	1,343

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

Mid Hood Canal MU	136
Skokomish MU (Nat.)	2,160
(Hat.)	29,793
Hoodsport MU	12,834
Miscell.	118

Fall Chum forecasts are preliminary and will be updated in July 2010.

Coho FRAM Model Inputs:

Stock Name	DA2	nuFRAM Stock	nuFRAM Age 3	Marked nuFRAM	Marked %
Port Gamble Net Pens	5,048	ptgamh	4,664	4,664	100.00%
Port Gamble Bay Natural	244	ptgamw	226		
Area 12/12B Natural	18,160	ar12bw	16,780		
Quilcene Bay Net Pens	7,221	qlcnbh	6,672	6,638	99.48%
Quilcene Hatchery	29,287	qlcenh	27,061	24,404	90.18%
Area 12A Natural	229	ar12aw	212		
Hoodsport Hatchery	n/a	hoodsh	0		
Area 12C/12D Natural	20,004	ar12dw	18,484		
George Adams Hatchery	26,203	gadamh	24,212	20,456	84.49%
Skokomish River Natural	6,093	skokrw	5,630		

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	0.29912	30,388
2002	89,837	0.37659	33,832
2003	106,363	0.39140	41,630
2004	95,282	0.39327	37,472
2005	92,989	0.50734	47,177
2006	76,769	0.61204	46,986
2007	89,952	0.43716	39,323
2008	95,368	0.42953	40,963
2009*	88,634	0.51223	45,401
2010	90,491		
2011	89,269		
2012	89,877		
Average 2006-2009		0.49774	
2010 Forecast			45,041

(*) : 2009 return data are preliminary and subject to revision, following reconciliation of records.

The 2010 forecasted terminal run size of summer-run Hood Canal chinook salmon is the product of brood 2006 fingerling lbs released from WDFW facilities in 2007, 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 four return years (2006-2009), (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 2006 through 2009 return years, to include this information for 2010 forecasting purposes (Tables A-1-a and A-1-b). The resulting terminal area run forecast is 45,041 chinook salmon. The forecast was apportioned to 42,614 chinook expected to return to hatcheries and 2,446 fish expected to return to natural spawning areas, 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 2006-2009 return years (Table A-1-d). 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	203	3,247	14,965	11,042	30,388
2002	0	95	38	114	2,312	13,801	17,472	33,832
2003	0	194	93	106	2,059	18,346	20,832	41,630
2004	0	129	1,091	95	3,706	18,973	13,478	37,472
2005	0	45	619	108	3,044	24,009	19,352	47,177
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	2,568	29,094	8,990	40,963
2009*	0	130	20	31	2,304	28,574	14,342	45,401

Note: Values for years prior to 1998 DO NOT include freshwater recreational catch
Note: The 2006-2009 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
2006	0.00000	0.00064	0.00621	0.00072	0.05399	0.55187	0.38656
2007	0.00000	0.00186	0.00102	0.00056	0.02439	0.75437	0.21781
2008	0.00000	0.00671	0.00024	0.00063	0.06269	0.71025	0.21947
2009	0.00000	0.00286	0.00044	0.00068	0.05075	0.62937	0.31590
'06 - 2009 Mean	0.00000	0.00302	0.00198	0.00065	0.04796	0.66146	0.28493

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

Hood Canal Production Unit	Terminal Run Forecast	Proportion
12B	136	0.00302
12C	89	0.00198
12D	29	0.00065
Skokomish	2,160	0.04796
Natural Subtotal	2,414	0.05360
George Adams	29,793	0.66146
Hoodsport	12,834	0.28493
Hatchery Subtotal	42,627	0.94640
Total	45,041	1.00000

Note: The forecasted proportions are derived from the 2006-2009 mean distribution.

A-2. Summer Chum Salmon

A-2.1 Natural Runs

The 2010 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, and SE Hood Canal Management Units (MUs). Also factored into the 2010 forecast were (1) the performance of recent summer chum forecasts when compared to actual returns and (2) the potential impact of high flows during brood years expected to contribute to returns in 2010 (i.e., BY 2007 as age 3 and BY 2006 as age 4).

Abundance for each MU was forecast as the mean of the 2007 through 2009 returns and the mean was then adjusted by the ratio of actual abundance to forecast abundance during 2009. The actual to forecast ratios were 0.578, 0.334, and 0.461 for the Mainstem, Quilcene/Dabob, and SE Hood Canal MUs, respectively.

There were extremely high flows (due to rain on snow events) during the summer chum egg incubation period in fall/winter 2007 that likely had detrimental impacts on natural summer chum spawners in Hood Canal streams. The impacts were likely the highest in the SE Hood Canal MU streams (Union and Tahuya rivers). In addition, the numbers of BY 2007 summer chum fry released from the Tahuya River supplementation program were substantially reduced as a result of egg and fry mortality due to damage to the water intake structure at the remote hatchery facility during the floods. Consequently, fewer than normal numbers of age 3 natural and/or supplementation-origin recruits are expected in 2010 and the 2010 forecast for the SE Hood Canal MU was reduced by an additional 25%.

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 2010. 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 2010.

For the Mainstem Hood Canal MU, the returns of summer chum were forecast based on total (NORs + SORs) returns. For the Quilcene / Dabob MU, the returns of summer chum were forecast based NORs. The return to the SE Hood Canal MU was forecast as the mean of the NORs to Union River from 2007 through 2009 plus the mean of the total (NORs + SORs) recruits to Tahuya River from 2008 through 2009.

Estimates of the number of natural-origin recruits and supplementation-origin recruits returning to each MU each year from 2000 through 2009 and forecasts for 2010 are shown in Table A-2-a. The 2010 forecasted returns are 4,005 summer chum to the Mainstem Hood Canal MU, 1,343 summer chum to the Quilcene / Dabob Bays MU, and 651 summer chum to the SE Hood Canal MU. The total forecasted return is 5,998 summer chum to Hood Canal in 2010 (Table A-2-a).

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
2000	2,035		6,704		757	0
2001	2,696	1,552	3,632	3,964	1,517	0
2002	2,832	3,388	4,330	1,720	890	0
2003	8,748	2,394	10,850	2,013	**7,974**	**4,045**
2004	**20,905**	**4,984**	**59,333**	**3,833**	3,611	2,386
2005	4,767	2,360	6,231	792	709	1,293
2006	8,928	2,497	13,093	1,198	1,747	1,883
2007	5,964		3,887	75	2,070	768
2008	9,857		5,701	0	1,174	798
2009	4,971		2,490	0	623	387
Mean 2007-09	6,931		4,026		1,882	
2010 Forecast a/b/	4,005		1,343		651	
2010 Total Hood Canal Forecast					5,998	

a/ 2007-09 mean adjusted by ratio of actual abundance to forecast abundance during 2009; see text.
b/ SE Hood Canal forecast adjusted by an additional 25% to account for detrimental impact of high flows during fall/winter 2007 on natural spawners and supplementation releases: see text.

The Summer Chum Salmon Conservation Initiative (SCSCI) defines Critical and Recovery abundance thresholds for each MU. The abundance thresholds are 1,260 (Critical) and 4,570 (Recovery) for the Quilcene/Dabob MU, 2,980 (Critical) and 15,560 (Recovery) for the Mainstem Hood Canal MU, and 340 (Critical) and 550 (Recovery) for the SE Hood Canal MU.

The 2010 forecasted abundance for the returns of summer chum,, a estimate of 4,005 recruits for the Mainstem Hood Canal MU, provide 1,343 recruits for the Quilcene/Dabob MUand a estimate of 651 recruits for the SE Hood Canal MU. The 2010 forecasted abundance for the returns of summer chum exceed the Critical threshold for each Management Unit and exceeds the Recovery threshold for the SE Hood Canal MU.

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. The Co-Managers will conduct annual post-season abundance assessments comparing the forecasts to actual returns for each MU, as required by the SCSCI.

A-3. Coho Salmon

A-3.1 Natural Runs

The forecasted recruitment of 2010 Hood Canal natural runs was based on a linear regression model that related the return of tagged 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 2002-2005 (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:

$$Hood\ Canal\ Recruitment = 35393.657 + (359.130 * (BBC\ Tagged\ Jacks))$$

Relevant statistics of the model used to derive the 2010 forecast are shown below.

Using Brood Years 1983-1998 , 2002-2005	
Multiple R	0.75968
R^2	0.57711
Adj. R^2	0.55224
Std Error of Estimate	36987.5796
N	20
Intercept	35393.657
Slope	359.130
2009 Jacks (X)	26
2010 Forecast (Y)	44,731

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 natural DA2 recruits was thus apportioned into 44,257 from primary and 474 from secondary units, on the basis of their parent brood spawner distribution (Table A-3-b).

Table A-3-a. 2010 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	25,720	427	346	211,127
1984	24,479	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	*19,565*	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	*47,089*	189	179	*165,500*
1999	*21,803*	120	111	*107,024*
2000	*24,352*	80	70	*269,219*
2001	*36,060*	339	254	*299,727*
2002	28,827	294	235	*77,628*
2003	31,771	61	33	*57,642*
2004	36,163	161	86	*111,959*
2005	28,416	47	39	*31,098*
2006	26,097	111	95	
2007	43,266	32	26	

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

Table A-3-b. Apportionment of the 2010 Hood Canal Natural Coho Forecast

Area	Escapement Capacity	Escapement BY 2007	Management Unit Type	Proportion of Brood Escapement	December Age-2 Recruits
12 / 12B	28.88%	19,017	Primary	40.60%	18,160
12C / 12D	31.66%	20,949	Primary	44.72%	20,004
Skokomish	29.01%	6,381	Primary	13.62%	6,093
9A	1.25%	256	Secondary	0.55%	244
12A	9.20%	240	Secondary	0.51%	229
Primary Subtotal	89.55%	46,347		98.94%	44,257
Secondary Subtotal	10.45%	496		1.06%	474
Grand Total	100.00%	46,843		100.00%	44,731

**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	5,285	5,822	408	11,515

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	*2,815*	*0.01305*
2005	245,608	*28,337*	*0.11537*	247,500	*5,105*	*0.02063*	273,099	*23,679*	*0.08670*	124,813	*7,205*	*0.05773*
2006	294,151			415,000			358,131			193,808		
2007	296,198			247,500			357,967			164,725		
Average (1997-05)		0.08846			0.02040			0.08181			0.04384	
2010 Forecast:	26,203			5,048			29,287			7,221		

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

For 2010, given the lower than average marine survival experienced by BY 2002 and BY 2003 natural and, in the case of BY 2003, hatchery smolts, we have decided to use a longer term mean of the estimated survival rates for each hatchery facility. The 2010 forecast utilized survival rates the latest available three brood cycles, or 9 broods (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 2010 forecast of 67,759 hatchery reared December Age-2 coho recruits (Table A-3-d) was predicted from the brood year 2007 smolt releases multiplied by the average estimated marine survival rate for each facility's smolts from the nine latest available brood years. (Table A-3-d).

A-4. Fall Chum Salmon

The 2010 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 2010 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 1.25732, 2.72237, and 0.31945, for 3, 4, and 5 year-olds respectively (Table A-4-a). However, coupled with a very high return rate of 4 year olds in 2004 and the recent reconciliation of catch data, even these average return rates were considered to be unrealistically high, and given the high levels of parent brood escapement and the lower than expected returns of 2008, all rates were adjusted to 50% of the estimated mean . These adjusted rates of return were multiplied with the 2007, 2006, and 2005 brood escapements (78,218, 97,104, and 47,598; respectively) to estimate the total 2010 forecast of 188,951 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 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.

The Puget Sound forecast was initially estimated using parent brood escapements, long-term odd/even-year specific average R/S values, and long-term odd/even-year specific mean proportions returning at age for 3, 4, and 5-year old returns. For example, the three-year old forecast was derived by multiplying the 2007 natural escapement by the mean even-year brood R/S value to get a total return of 2007 brood offspring. That number was then multiplied by the mean proportion of the return at age 3 for even-year broods, yielding the 2010 age 3 return forecast. This was repeated for the 4 and 5-year old components, and all three were summed to obtain a total Puget Sound forecast.

The Puget Sound natural fall chum parent escapements were large in 2006, there were potential detrimental impacts due to floods in 2006 and 2007, and fall chum survival rates have been relatively low recently. Without some adjustment to the traditional R/S method, the 2010 forecasts would likely be over-estimates. To address this, we (1) applied no R/S rate adjustments for age 5 as 2008 run reconstruction showed the 3-year old return at approximately the long-term average R/S return rate for age 3, (2) applied the average R/S rate for parental escapement >500K (n=6) for age 4 returns, and (3) applied 50% of the long-term R/S average for age 3 to account for the effects of floods in 2007. This keeps the prediction inside the bounds of the existing data and compensates for the uncertainty resulting from record escapements and apparent decreases in survival. This method forecast returns of 1,320,359 natural fall chum to Puget Sound (Table A-4-b).

The forecast for Hood Canal is 173,050 natural fall chum salmon (Table A-4-c). 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 2007 Hood Canal Natural Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 181,001 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 Escapement	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	0.98188		
2005	47,598	1.76695			
2006	97,104				
2007	78,218				
2008	38,425				
Mean: Brood Years 1968-03 (exclusive of outliers, in bold)					
All Odd Years	48,738	1.58383	2.35067	0.36436	5.15930
All Even Years	74,459	0.94799	3.05276	0.27704	4.95661
All Years	61,912	1.25732	2.72237	0.31945	4.40709
		3's	4's	5's	
2010 Tribal Forecast (@0.5)		49,172	132,176	7,603	188,951

Table A-4-b. 2010 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
2005	5	287,596	3.08	3.08	885,867	0.0680000	60,596
2006	4	806,999	2.51	1.58	1,275,059	0.7730000	985,582
2007	3	482,700	3.08	1.54	743,418	0.3690000	274,181
						Total	1,320,359

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

Table A-4-c. 2010 WDFW Hood Canal Natural Fall Chum Salmon Forecasts

	Puget Sound Forecast	HC Parent Escapement Proportion	HC Forecast by Age
Age 3 (2007 Brood) Forecast	274,181	0.1620428	44,429
Age 4 (2006 Brood) Forecast	985,582	0.1203269	118,592
Age 5 (2005 Brood) Forecast	60,596	0.1655030	10,029
Total WDFW Forecast	1,320,359		173,050

Table A-4-d. 2010 Hood Canal Natural Fall Chum Salmon Parent Brood Escapement Distribution

Area	2005	2006	2007
9A	0.00%	0.00%	0.00%
12	1.88%	2.45%	2.39%
12A	8.59%	3.53%	1.09%
12B	22.75%	37.03%	43.40%
12C	23.70%	30.25%	19.15%
82G	18.40%	12.34%	9.82%
12D	24.68%	14.39%	24.15%

Table A-4-e. Apportionment of the 2010 Tribal Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	924	3,244	182	4,349
12A	4,222	4,665	83	8,970
12B	11,187	48,945	3,299	63,432
12C	11,656	39,982	1,456	53,094
82G	9,050	16,314	747	26,110
12D	12,133	19,027	1,836	32,996
Total	49,172	132,176	7,603	188,951

Table A-4-f. Apportionment of the 2010 WDFW Hood Canal Natural Fall Chum Salmon Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	1,062	2,910	188	4,160
12A	483	4,185	861	5,529
12B	19,280	43,915	2,282	65,477
12C	8,510	35,873	2,377	46,760
82G	4,364	14,637	1,846	20,847
12D	10,730	17,071	2,475	30,276
Total	44,429	118,591	10,029	173,049

Table A-4-g. Apportionment of the 2010 Joint Hood Canal Natural Fall Chum Salmon Forecast

Area	Tribal Forecast	WDFW Forecast	Joint Forecast
9A	0	0	0
12	4,349	4,160	4,255
12A	8,970	5,529	7,249
12B	63,432	65,477	64,454
12C	53,094	46,760	49,927
82G (Skokomish)	26,110	20,847	23,479
12D	32,996	30,276	31,636
Total	188,951	173,049	181,000

A-4.2 Hatchery Runs (Tribal)

The 2010 hatchery-origin returns (including in-stream augmentation) 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 2005, 2006, and 2007. 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. These problems should be corrected in the near future. 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 2010, 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 (1965-1971 broods) (Tables A-4-h and A-4-i). The resulting forecast for 2010 is 83 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 2010, Off-Station Lbs. Planted

Area	BY 2007		BY 2006		BY 2005	
	Lbs	%	Lbs	%	Lbs	%
9A	0	0.0%	0	0.0%	0	0.0%
12	0	0.0%	0	0.0%	0	0.0%
12B	0	0.0%	0	0.0%	1	100.0%
12A	0	0.0%	0	0.0%	0	0.0%
12C	0	0.0%	0	0.0%	0	0.0%
Skokomish	0	0.0%	0	0.0%	0	0.0%
12D	148	100.0%	10	100.0%	0	0.0%
Total	148	100.0%	10	100.0%	1	100.0%

Table A-4-i. Apportionment of the 2010 Tribal Hood Canal Fall Chum Off-Station Forecast

Area	3's	4's	5's	Total
9A	0	0	0	0
12	0	0	0	0
12B	0	0	0	0
12A	0	0	0	0
12C	0	0	0	0
82G	0	0	0	0
12D	71	12	0	83
Total	71	12	0	83

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 (1972-2001 broods) (Table A-4-j). The resulting forecast for 2010 is 141,331. Run reconstruction problems may have biased this run low.

George Adams/McKernan Hatcheries: Mean return rate of age 3, age 4, and age 5 fish per pound released (1978-2001 broods), excluding BY 1999 (ages 4 and 5) and BY 2000 (age 4) (Table A-4-k). The resulting forecast for 2010 is 120,068. All available years were used in order to attempt to counteract a probable high bias, caused by run reconstruction and age at return data problems.

Little Boston Hatchery: Mean return rate of age 3, age 4 and age 5 fish per pound planted at Hoodsport Hatchery (1965-1971 broods) (Table A-4-j). The resulting forecast for 2010 is based on the fingerling releases of 1,018 lbs (BY 2007), 847 lbs (BY 2006), and 809 lbs (BY 2005), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of 3,093 (Table A-4-n).

Enetai Hatchery: Mean return rates of age 3, age 4 and age 5 fish per pound planted (1976-2003 broods). (Table A-4-l). The resulting forecast for 2010 is based on the fingerling releases of 6,469 lbs. (BY 2007), 6,895 (BY 2006), and 6,603 lbs (BY 2005), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of . In this instance, all available brood data were used, for the same reasons as those for George Adams / McKernan.

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 297,066.

A-4.2.3 Hatchery Forecasts (WDFW)

The 2010 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 2007 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 WDFW Hood Canal hatchery fall chum forecast is 295,553 on-station and 199 off-station for a total forecast of 295,752.

A-4.2.4 Joint 2010 Hood Canal Hatchery Fall Chum Salmon Forecast

For preliminary preseason planning, we agreed to use a forecast of 296,409 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

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		
2005	29,031				
2006	29,958				
2007	25,523				
All Odd Years	25,353	1.73801	2.63943	0.16542	4.54287
All Even Years	28,980	1.25373	3.29640	0.11364	4.89391
All Years	27,124	1.49587	2.96792	0.14089	4.71389
All Years 65-71	2,655	0.95938	2.41136	0.09131	3.46205
All Years 72-03	32,245	1.64965	3.16481	0.15209	4.98772
All Years 96-03	33,036	1.22684	1.73620	0.08266	3.04570
2010 Tribal Forecast	42,104	94,811	4,415	141,331

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		
2005	22,768				
2006	24,833				
2007	21,035				
Average Return Brood Years (1978-04) excluding outliers in bold.					
Odd Years	27,259	1.99098	3.19681	0.20147	5.15623
Even Years	25,329	1.48196	2.91802	0.19180	4.28145
All Years	26,294	1.86928	3.05184	0.21789	5.38475
2010 Tribal Forecast	39,320	75,786	4,961	120,068	

Note: Because of incomplete reconstruction, 2004-2006 return rates were not available

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	1.07494	6.43736
2004	6,613	5.50110	1.07494		
2005	6,603	2.70151			
2006	6,895				
2007	6,469				
Average (Brood Years 1976-07). Outliers (in bold) excluded.					
Odd Years	4,203	2.80542	2.11474	0.19456	5.02176
Even Years	4,612	1.77208	2.64708	0.19272	3.78031
All Years	4,408	2.28875	2.39156	0.19364	4.36836
2010 Tribal Forecast		14,806	16,490	1,279	32,574

Note: Because of incomplete reconstruction, and lack of rack sampling, return rates after 2004 were not available

Table A-4-m. Summary of 2010 WDFW Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	965	2,595	85	3,645
Hoodsport Hatchery	47,657	100,119	5,239	153,015
G. Adams / McKernan Hatchery	46,930	67,973	4,586	119,489
Enetai Hatchery	0	18,528	876	19,404
12D Streams - Augmentation	192	7	0	199
Total	95,744	189,222	10,786	295,752

Table A-4-n. Summary of 2010 Tribal Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	977	2,042	74	3,093
Hoodsport Hatchery	42,104	94,811	4,415	141,331
G. Adams / McKernan Hatchery	39,320	75,786	4,961	120,068
Enetai Hatchery	14,806	16,490	1,279	32,574
Total	97,207	189,130	10,729	297,066

Table A-4-o. Apportionment of the 2010 Joint Hood Canal Hatchery Fall Chum Salmon Forecasts

Facility	Tribal Forecast	WDFW Forecast	Joint Forecast
Little Boston Hatchery	3,093	3,645	3,369
Hoodsport Hatchery	141,331	153,015	147,173
G. Adams / McKernan Hatchery	120,068	119,489	119,778
Enetai Hatchery	32,574	19,404	25,989
12D Streams - Augmentation		199	
Total	297,066	295,752	296,409