

SUMMARY OF 2006 HOOD CANAL FORECASTS and Forecasting Methods

Species (Ref.#)	Origin	Type	Number	Mass Marked	Number Type	Model Designation
Chinook (A-1)	Mixed	Secondary	2,523		TRS	Natural
	Hatchery	Primary	27,658		TRS	Hatchery
Summer Chum (A-2)	Natural	Secondary	11,365		Total Recruits	
	Quilcene (Mixed)	Secondary	8,415		Total Recruits	
Coho (A-3)¹	Natural	Primary	79,262		Total DA2 ¹ Recruits	Natural
	Natural	Secondary	406		Total DA2 ¹ Recruits	Hatchery
	Hatchery	Secondary	76,819	67,906	Total DA2 ¹ Recruits	Hatchery
Fall Chum (A-4)	Natural	Secondary	347,295		WA Run	
	Hatchery	Primary	321,054		WA Run	

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	7,208
SE Hood Canal MU	4,157
Quilcene MU	8,415

Chinook salmon, although classified as “secondary”, are under rehabilitation.

Forecasts for individual Hood Canal Management Units are:

Mid Hood Canal MU	102
Skokomish MU (Nat.)	1,930
(Hat.)	11,657
Hoodsport MU	16,001
Miscell.	491

Fall Chum forecasts are preliminary. They will be updated in July 2006, when 2005 return data become available, and the 2000 - 2004 return year data have been reconciled and corrected.

Coho FRAM Model Inputs:

Stock Name	DA2	nuFRAM Stock	nuFRAM Age 3	Marked	Marked %
Port Gamble Net Pens	4,477	ptgamh	4,137	3,707	89.60%
Port Gamble Bay Natural	180	ptgamw	166		
Area 12/12B Natural	27,901	ar12bw	25,781		
Quilcene Bay Net Pens	8,848	qlcnbh	8,176	8,176	100.00%
Quilcene Hatchery	33,626	qlcenh	31,071	27,570	88.73%
Area 12A Natural	226	ar12aw	209		
Hoodspport Hatchery	n/a	hoodsh	0		
Area 12C/12D Natural	30,736	ar12dw	28,400		
George Adams Hatchery	29,867	gadamh	27,597	23,293	84.40%
Skokomish River Natural	20,625	skokrw	19,058		

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	0.27682	16,236
1999	89,149	0.32795	29,236
2000	87,306	0.27240	23,782
2001	101,591	0.25803	26,214
2002	89,837	0.41251	37,059
2003*	106,363	0.30057	31,970
2004*	95,282	0.34299	32,681
2005*	92,989	0.51650	48,029
2006	76,768		
2007	89,952		
2008	95,366		
Average 2002-2005		0.39315	
2006 Forecast			30,181

(*) : 2003-05 return data are preliminary and subject to revision, following reconciliation of records.

The 2006 forecasted terminal run size of summer-run Hood Canal chinook salmon is the product of brood 2002 fingerling lbs released from WDFW facilities in 2003, 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 (2002-2005), which are believed to represent current survival rates (Table A-1-a). The resulting terminal area run forecast is 30,181 chinook salmon. The Hood Canal forecast was apportioned to 27,658 hatchery fish (42.1% George Adams and 57.9% Hoodsport Hatchery) and 2,523 (8.4% of the total) natural fish based on the Hood Canal terminal run reconstruction-based relative contribution of the individual Hood Canal management units in the 2002-2005 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	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	44	287	148	187	1,263	5,949	8,358	16,236
1999	0	900	112	376	2,512	11,939	13,397	29,236
2000	0	438	256	189	1,240	5,403	16,256	23,782
2001*	0	326	636	214	2,616	12,273	10,149	26,214
2002*	0	95	39	114	1,880	11,219	23,712	37,059
2003*	0	194	92	105	1,296	11,555	18,728	31,970
2004*	0	129	1,190	103	3,677	15,375	12,207	32,681
2005*	0	45	620	109	2,500	19,705	25,050	48,029

Note: The 2001-2005 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
2002	0.00000	0.00256	0.00105	0.00308	0.05073	0.30273	0.63984
2003	0.00000	0.00607	0.00288	0.00328	0.04054	0.36143	0.58580
2004	0.00000	0.00395	0.03641	0.00315	0.11251	0.47046	0.37352
2005	0.00000	0.00094	0.01291	0.00227	0.05205	0.41027	0.52156
'02 - 2005 Mean	0.00000	0.00338	0.01331	0.00295	0.06396	0.38622	0.53018

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

Hood Canal Production Unit	Terminal Run Forecast	Proportion
12B	102	0.00338
12C	402	0.01331
12D	89	0.00295
Skokomish	1,930	0.06396
Natural Subtotal	2,523	0.08360
George Adams	11,657	0.38622
Hoodsport	16,001	0.53018
Hatchery Subtotal	27,658	0.91640
Total	30,181	1.00000

Note: The forecasted proportions are derived from the 2002-2005 mean return.

A-2. Summer Chum Salmon

A-2.1 Natural Runs

The 2006 forecast of the Hood Canal natural summer-timed chum salmon returns was forecast as total recruitment to all fisheries and escapements returning to the Mainstem Hood Canal, and SE Hood Canal management units.

Because of the exceptionally high return in 2004, all Hood Canal units were forecast as the mean of the 2001 - 03 and 2005 (four years) recruitment, as estimated by the current run reconstruction (Table A-3-a). Insufficient age-specific information is currently available for summer chum salmon, to attempt forecasts that are based on age specific, or cohort returns.. The forecasted recruitment, to all fisheries (domestic and Canadian) and escapement, for summer chum, is 7,208 for the Mainstem and 4,157 for the SE Hood Canal units, for a total of 11,365. The forecasts include summer chum salmon which are expected to return to a number of streams from supplementation and reintroduction projects. However, those numbers are not separately quantifiable at present.

A-2.2 Aggregate Runs - Quilcene/Dabob.

The run of fish returning to Quilcene/Dabob is an aggregate run which includes both naturally reared and supplementation fish, reared in previous years (incomplete broods), at the Quilcene National Fish Hatchery. The forecasted recruitment, to all fisheries and escapement, is 8,415. Methods used to estimate the forecast are identical to those used for other Hood Canal units.

Table A-2-a. Hood Canal Summer Chum Salmon Recruits.

Year	Mainstem Hood Canal	Quilcene / Dabob	SE Hood Canal	Hood Canal Total
1974	11,810	944	1,067	13,821
1975	19,370	3,235	3,757	26,362
1976	35,613	11,206	21,869	68,688
1977	11,159	1,918	2,587	15,664
1978	18,791	5,555	716	25,062
1979	7,844	734	817	9,395
1980	8,867	1,932	2,133	12,932
1981	4,331	761	477	5,569
1982	5,522	1,494	956	7,972
1983	543	2,351	597	3,491
1984	1,279	1,486	502	3,267
1985	1,765	1,025	1,417	4,207
1986	1,284	1,483	5,001	7,768
1987	150	2,722	1,030	3,902
1988	2,191	2,540	915	5,646
1989	614	1,599	2,184	4,397
1990	259	623	577	1,459
1991	700	1,174	321	2,195
1992	1,953	1,237	183	3,373
1993	402	183	283	868
1994	1,170	896	891	2,957
1995	4,394	4,830	760	9,984
1996	10,734	9,801	511	21,046
1997	681	8,199	493	9,373
1998	758	3,201	255	4,214
1999	778	3,554	174	4,506
2000	2,035	6,704	757	9,496
2001	4,248	7,595	1,516	13,359
2002	6,220	6,050	890	13,160
2003	11,140	13,073	12,017	36,230
2004	25,898	56,722	5,999	88,619
2005*	7,224	6,943	2,203	16,370
2006 Forecast **	7,208	8,415	4,157	19,780

* 2005 Data is preliminary and subject to revision. ** 2004 data were not used

A-3. Coho Salmon

A-3.1 Natural Runs

The forecasted recruitment of 2006 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 1983-2001 (Table A-3-a). The final form of the regression is shown below:

$$\text{Hood Canal Recruitment} = 66983.908 + (294.964 * (\text{BBC Tagged Jacks}))$$

Relevant statistics of the model used to derive the 2005 forecast are shown below.

Using Brood Years 1983-2001	
Multiple R	0.48176
R ²	0.23209
Adj. R ²	0.18619
Std Error of Estimate	63841.68
N	19
Intercept	66,983.908
Slope	294.964
2005 Jacks (X)	43
2006 Forecast (Y)	79,667

It should be noted that, for 2006, the pre-season forecast model used DA2 estimates (dependent variable) which were calculated by an earlier method, for brood years 1983-97, and a current method for all subsequent years (Table A-3-a). This discrepancy was unavoidable, because of time limitations and will be corrected during 2006.

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 79,667 natural DA2 recruits was thus apportioned into 79,262 from primary and 406 from secondary units, on the basis of parent brood spawner distribution (Table A-3-b).

Table A-3-a. 2006 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	70,422
1989	23,646	167	144	61,949
1990	18,677	273	202	64,929
1991	13,071	206	149	138,845
1992	18,431	188	157	94,029
1993	16,574	224	185	71,422
1994	25,820	410	298	145,541
1995	40,828	610	510	176,029
1996	22,222	60	45	23,436
1997	20,967	96	85	54,905
1998	47,089	189	179	164,989
1999	21,855	114	90	112,737
2000	24,352	80	70	277,605
2001	36,060	350	257	202,564
2002	25,062	318	262	
2003	32,222	72	43	

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.

Table A-3-b. Apportionment of the 2006 Hood Canal Natural Coho Forecast

Area	Escapement Capacity	Escapement BY 2003	Management Unit Type	Proportion of Brood Escapement	December Age-2 Recruits
12 / 12B	28.88%	60,546	Primary	35.02%	27,901
12C / 12D	31.66%	66,697	Primary	38.58%	30,736
Skokomish	29.01%	44,757	Primary	25.89%	20,625
9A	1.25%	390	Secondary	0.23%	180
12A	9.20%	490	Secondary	0.28%	226
Primary Subtotal	89.55%	172,000		99.49%	79,262
Secondary Subtotal	10.45%	880		0.51%	406
Grand Total	100.00%	172,880		100.00%	79,667

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	17,485	18,943	3,432	39,860
1987	6,922	7,498	3,510	17,930
1988	4,623	5,009	1,948	11,580
1989	6,924	7,502	934	15,360
1990	2,664	2,885	1,281	6,830
1991	5,433	5,886	1,541	12,860
1992	8,199	8,882	2,179	19,260
1993	10,052	10,890	1,327	22,269
1994	21,289	23,063	12,128	56,480
1995	17,049	18,470	5,560	41,079
1996	16,254	17,609	4,008	37,871
1997	37,338	40,450	17,568	95,356
1998	40,323	44,420	14,957	99,700
1999	6,854	7,550	1,847	16,251
2000	8,687	9,569	8,288	26,544
2001	35,134	38,703	20,601	94,438
2002	26,172	28,831	13,647	68,650
2003	60,546	66,697	44,757	172,000
2004	39,439	43,445	62,995	145,879

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	<i>0.05098</i>
1986	337,700	32,908	0.09745	429,141	29,183	0.06800	574,171	98,188	<i>0.17101</i>	193,522	16,075	<i>0.08307</i>
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	<i>0.07372</i>
1992	301,019	15,688	0.05212	361,553	13,281	0.03673	400,700	34,709	0.08662	287,187	8,379	<i>0.02918</i>
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	40,014	0.08100	432,847	2,141	0.00495	428,995	33,289	0.07760	0		
2000	587,937	41,467	0.07053	432,161	6,059	0.01402	411,674	33,141	0.08050	210,627	15,195	0.07214
2001	336,886	46,582	0.13827	409,221	4,808	0.01175	388,212	46,839	0.12065	90,000	2,569	0.02854
2002	501,031			423,746			404,582			200,835		
2003	309,179			437,316			361,891			179,711		
Average (1999-01)			0.09660	0.01024			0.09292			0.04924		
2006 Forecast:		29,867		4,477			33,626			8,848		

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 untagged production units. Values in boldface were excluded from the analysis.

A-3.2 Hatchery Runs

The 2006 forecast utilized survival rates from the 1999 through 2001 period of broods (Table A-3-d). Historical 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). A program error was identified in the RRTERM model, causing a misallocation of the Quilcene area stocks. The error has been corrected in late 2004, and the RRTERM model was run for years from 1998 on, using an updated version of RRTERM. It will be re-run for all years, later in this year.

The 2006 forecast of 76,819 hatchery reared December Age-2 coho recruits (Table A-3-d) was predicted from the brood year 2003 smolt releases multiplied by the average estimated marine survival rate for each facility's smolts from the three latest available brood years. In all cases, except for Quilcene Bay Pens, this meant brood years 1999-2001 (Table A-3-d).

A-4. Fall Chum Salmon

The 2006 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. Because of delays in catch reconciliation records from 2002, 2003 and 2004 fisheries, combined with the lack of age specific data from 2004, the forecasts are extremely preliminary and possibly biased.

A-4.1 Natural Runs

A-4.1.1 Natural Run Forecasts (PNPTC)

The 2006 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 broods 1996-2000. The mean recruit-per-spawner return rates were 2.15983, 2.98708, and 0.09810, for 3, 4, and 5 year-olds respectively (Table A-4-a). These age specific rates were used because they may better reflect the recent trends of survival. However, given the problems identified above, including the lack of age information from 2004, average return rates were considered to be unrealistically high, and given the high levels of parent brood escapement and the less than expected returns of 2005, all rates were adjusted to 50% of the estimated mean. These adjusted rates of return were multiplied with the 2003, 2002, and 2001 brood escapements (150,252, 173,036, and 101,902; respectively) to estimate the total 2006 forecast of **425,693** Hood Canal natural fall chum returning to Puget Sound, before the addition of anticipated returns from instream 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 escapement), 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)

The 2006 return of natural fall-timed chum salmon to Hood Canal was preliminarily forecast as a portion of the total return of all Puget Sound natural fall-timed chum. The Puget Sound return was initially forecast 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 2003 natural escapement by the mean odd-year brood R/S value to get a total return of 2003 brood offspring. That number was then multiplied by the mean return at age 3 for even-year broods, yielding the 2006 age 3 return forecast. This was repeated for 4 and 5-year old components, and all three were summed to obtain a total Puget Sound forecast of 3,065,669 (Table A-4-b). However, given the lower than expected returns in 2005 and the lack of age information from 2004 and 2005, this estimated was reduced by 50%, to 1,532,834

The estimated return of each age group to Puget Sound was further apportioned to individual regions (including Hood Canal) and regional production units, using proportions of the parent escapement of each brood into each production unit. The resulting forecast for Hood Canal natural fall chum salmon is **268,304** (Table A-4-c). The forecasts for individual production units are shown in Table A-4-f.

While the resulting estimates prepared by PNPTC and WDFW are significantly different, it should be noted that the difference is mainly due to the forecast of 3 year olds, whose estimate is heavily influenced by the choice of odd-even vs. average survival estimation. For preliminary preseason planning, we agreed to use an average of the two results. 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	1.48266	8.26712	0.69327	10.44305
1991	44,745	0.59754	1.58645	0.12973	2.31372
1992	96,381	2.21239	4.21551	0.20013	6.62803
1993	67,771	1.07477	1.38928	0.10130	2.56535
1994	151,821	0.30984	0.88726	0.03062	1.22772
1995	119,344	0.58343	0.37619	0.01541	0.97503
1996	251,803	0.01674	0.18578	0.00000	0.20252
1997	53,493	0.62363	2.02701	0.17179	2.82243
1998	101,632	1.52336	1.69466	0.02440	3.24242
1999*	33,923	4.75467	8.04086		
2000*	37,131	3.88075			
2001*	101,902				
2002*	173,036				
2003*	150,252				
2004*	169,991				
Mean: Brood Years 1968-00 (exclusive of outliers, in bold)					
All Odd Years	37,295	1.77111	3.18448	0.30040	5.02356
All Even Years	63,938	1.08190	3.24026	0.29005	4.43729
All Years	51,020	1.40497	3.21327	0.29488	4.71088
Mean: Brood Years 1996-00					
All Years	99,554	2.15983	2.98708	0.09810	1.81060
2006 Forecast (@ 0.5)		162,259	258,436	4,998	425,693

Table A-4-b. 2006 Puget Sound Natural Fall Chum R/S Based WDFW Forecast

Parent Brood	Age	Parent Escapement	Mean R/S¹	Estimated R/S (all ages)	Mean Age Composition¹	Natural Forecast
2001	5	572,576	3.11245	1,782,114	0.07026	125,211
2002	4	1,082,187	2.58517	2,797,637	0.76724	2,146,459
2003	3	698,551	3.11245	2,174,205	0.36519	793,998
					Total	3,065,669
Adjusted to 50% Prior to Use						1,532,834

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

Table A-4-c. 2006 WDFW Hood Canal Natural Chum R/S Forecasts

	R/S	HC Parent Escapement Proportion	HC Forecast by Age
Age 3 (2003 Brood) Forecast	396,999	0.21509	85,391
Age 4 (2002 Brood) Forecast	1,073,230	0.15990	171,609
Age 5 (2001 Brood) Forecast	62,606	0.18056	11,304
Total Forecast	1,532,834		268,304

Table A-4-d. 2006 Hood Canal Natural Fall Chum Parent Brood Escapement Distribution

Area	2003	2002	2001
9A	0.00%	0.00%	0.00%
12	3.88%	2.33%	1.33%
12A	3.79%	6.59%	5.32%
12B	41.97%	49.58%	26.32%
12C	24.33%	17.06%	20.37%
82G	6.56%	7.90%	13.81%
12D	19.47%	16.55%	32.85%

Table A-4-e. Apportionment of the PNPTC 2006 Hood Canal Natural Fall Chum Run

Area	3's	4's	5's	Total
9A	0	0	0	0
12	6,293	6,014	66	12,374
12A	6,151	17,026	266	23,444
12B	68,097	128,122	1,315	197,534
12C	39,481	44,092	1,018	84,591
82G	10,649	20,414	690	31,753
12D	31,589	42,767	1,642	75,998
Total	162,259	258,436	4,998	425,693

Table A-4-f. Apportionment of the WDFW 2006 Hood Canal Natural Fall Chum Run

Area	3's	4's	5's	Total
9A	0	0	0	0
12	3,312	3,994	150	7,455
12A	3,237	11,306	602	15,145
12B	35,837	85,077	2,975	123,888
12C	20,777	29,279	2,303	52,358
82G	5,604	13,555	1,562	20,721
12D	16,624	28,399	3,713	48,736
Total	85,391	171,609	11,304	268,304

Table A-4-g. Apportionment of the Joint 2005 Hood Canal Natural Fall Chum Salmon Forecasts

Area	PNPTC Forecast	WDFW Forecast	Joint Forecast
9A	0	0	0
12	12,374	7,455	9,914
12A	23,444	15,145	19,294
12B	197,534	123,888	160,711
12C	84,591	52,358	68,475
82G (Skokomish)	31,753	20,721	26,237
12D	75,998	48,736	62,367
Total	425,693	268,304	346,999

A-4.2 Hatchery Runs.

The 2006 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 2001, 2002, and 2003. In estimating the returns, the following information was used for each facility. Off-station production, resulting from instream augmentation programs was estimated separately and was then added to the forecasted return to natural spawning areas.

A-4.2.1 Forecasts of Instream Augmentation

Egg box and fry-augmented runs to streams of areas 12, 12B, 12C, 12D, 82G: PNPTC applied one half of the mean return rates of age 3, age 4, and age 5 fish per pound planted at Hoodspout Hatchery (1965-1971 broods). (Tables A-4-h and A-4-i). The resulting forecast for 2006 is 369 fish. WDFW applied return rates that were based on rates for corresponding hatcheries, reduced by a factor of 2 to 4, to compensate for the smaller size at release, resulting in a forecast of 223 fish (Table A-4-n). 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. Hood Canal Fall Chum, Off-Station Lbs. Planted

Area	BY 2003		BY 2002		BY 2001	
	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	0.5%
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	191	100.0%	222	100.0%	205	99.5%
Total	191	100.0%	222	100.0%	206	100.0%

Table A-4-i. Apportionment of the 2006 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	92	268	9	369
Total	92	268	9	369

A-4.2.2 Hatchery On-Station Forecasts (PNPTC)

Hoodsport Hatchery: Mean return rate of age 3, 4, and 5 fish per pound planted at Finch Creek (1995-2000 broods) (Table A-4-j). The resulting forecast for 2006 is **130,289**. 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 (1978-2000 broods) (Table A-4-k). The resulting forecast for 2006 is **144,579**. 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.

Quilcene Hatchery: Mean return rate of age 3, age 4 and age 5 fish per pound planted at Walcott Slough (1965-1974 and 1979-1984 broods). The age specific return rates for age 3 and age 5 (brood 1968) were

determined to be outliers and were excluded from the estimation of the age specific mean return rates (Table A-4-l). The resulting forecast for 2006 is based on the fingerling releases of 2,740 lbs. and (BY 2002), 3,557 lbs. (BY 2001), which were used to estimate the return of 4, and 5-year olds respectively (the QNFH ceased production of fall chum, following the BY 2002 release), for a total return of **7,949**.

Little Boston Hatchery and Port Gamble Pens: Mean return rate of age 3, age 4 and age 5 fish per pound planted at Hoodspout Hatchery (1965-1971 broods) (Table A-4-j). The resulting forecast for 2006 is based on the fingerling releases of 1,699 lbs (BY 2003), 1,890 lbs (BY 2002), and 1,444 lbs (BY 2001), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of **6,319**.

Enetai Hatchery: Mean return rates of age 3, age 4 and age 5 fish per pound planted (1976-1999 broods). (Table A-4-m). The resulting forecast for 2006 is based on the fingerling releases of 3,264 BY 2003), 7,081 lbs (BY 2002), and 5,321 lbs. (BY 2001), which were used to estimate the return of 3, 4, and 5-year olds respectively, for a total return of **22,440**. In this instance, all available brood data were used, for the same reasons as those for George Adams / McKernan.

The PNPTC hatchery forecasts are summarized in Table A-4-o and indicate a total forecast of on-station hatchery-origin fall chum, for 2006, of **311,577**.

A-4.2.3 Hatchery Forecasts (WDFW)

The 2006 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 2003 brood year chum by the long-term, odd-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 corresponding hatchery, reduced by a factor of 2 or 4 to compensate for smaller size at release. Individual station forecasts are shown in the tables below. A summary of the WDFW forecasts by age are shown for Hood Canal hatcheries in Table A-4-n. The WDFW total Hood Canal hatchery on-station forecast is **330,530**.

**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	0.35824	1.78350	0.05543	2.19717
1997	30,276	0.24440	2.52591	0.08956	2.85987
1998*	37,534	2.61358	3.17189	0.04088	5.82635
1999*	33,196	3.75717	3.05376		
2000*	34,067	0.19623			
2001*	35,033				
2002*	35,574				
2003*	33,231				
All Odd Years	24,164	1.81083	2.85927	0.17110	4.71527
All Even Years	28,424	1.34803	3.72541	0.12312	5.30587
All Years	26,294	1.57943	3.27997	0.14783	5.01057
All Years 65-71	2,655	0.95938	2.41136	0.09131	3.46205
All Years 72-00	32,000	1.72909	3.49712	0.16305	5.41203
All Years 95-00	33,005	1.41104	2.29370	0.05146	3.28335
2006 PNPTC Forecast		46,890	81,596	1,803	130,289
2006 WDFW Forecast		68,365	92,222	6,708	167,295

Note: Because of incomplete reconstruction, 2003 and 2004 return rates were not available.

**Table A-4-k. Fall Chum Returns-per-Pound, by Age at Return
from G.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	0.26978	0.51881	0.11447	0.90306
1997	27,884	0.07039	5.16473	0.21978	5.45490
1998	33,440	5.52435	4.11516	0.30166	9.94117
1999	27,365	4.92693	24.35584		
2000	8,486	5.17945			
2001	31,946				
2002	30,996				
2003	32,631				
Average Return Brood Years (1978-00) excluding outliers in bold.					
Odd Years	27,319	1.55045	2.89606	0.20966	4.31851
Even Years	25,082	1.50965	2.79302	0.20310	4.17216
All Years	26,152	1.52916	2.84209	0.20622	4.24185
All Years 95-00	23,823	3.18031	2.71588	0.16118	5.12093
2006 PNPTC Forecast		49,898	88,093	6,588	144,579
2006 WDFW Forecast		45,076	80,353	6,698	132,127

Note: Because of incomplete reconstruction, 2003 & 2003 return rates were not available

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

Brood Year	Release Lbs.	3's	4's	5's	Total
1965	2,971	0.50151	1.05452	0.00849	1.56452
1966	2,903	0.84004	2.96892	0.02785	3.83681
1967	3,059	1.28706	1.71775	0.12019	3.12500
1968	1,615	2.95329	6.07059	0.82275	9.84663
1969	3,185	0.65411	3.16035	0.21257	4.02703
1970	7,612	0.89432	2.10500	0.02127	3.02059
1971	6,198	0.94671	1.07801	0.02229	2.04701
1972	5,998	0.65865	3.40362	0.04857	4.11084
1973	15,437	0.90626	1.41069	0.00213	2.31908
1974	10,192	1.41133	2.31994	0.04420	3.77547
1975	21,245	0.42200	0.34770	0.00374	0.77344
1976	32,295	0.04795	0.04098	0.00089	0.08982
1977	21,573	0.27020	0.25917	0.02519	0.55456
1978	13,970	0.01073	0.14823	0.01255	0.17151
1979	7,552	0.89457	1.59961	0.08287	2.57705
1980	2,844	1.85564	2.69076	0.03265	4.57905
1981	4,658	1.27643	1.71673	0.15167	3.14483
1982	1,804	1.94934	5.91494	0.33628	8.20056
1983	1,994	1.67552	5.31753	0.24362	7.23667
1984	1,301	1.52052	1.92800	0.06040	3.50892
Average Brood Years (1965-84; w/o 1975-78) excluding outliers in bold.					
Odd Years	5,632	1.01777	2.13190	0.10548	3.25515
Even Years	4,284	1.30426	3.42522	0.08160	4.43318
All Years	4,958	1.15147	2.77856	0.09434	3.80490

QNFH	Lbs Release	2006 Forecast
BY 2001	3,557	336
BY 2002	2,740	7,613

Table A-4-m. 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	0.00283	4.41871
1995	3,456	4.32699	0.34679	0.00000	4.67378
1996	2,302	0.40142	0.65064	0.11105	1.16311
1997	4,068	0.20989	1.78593	0.13968	2.13550
1998	3,270	1.81444	3.78351		5.59795
1999	1,542	3.49463			
2000	194				
2001	5,321				
2002	7,081				
2003	3,264				
Average (Brood Years 1976-00). Outliers (in bold) excluded.					
Odd Years	3,883	2.68269	2.09946	0.07846	4.79139
Even Years	4,417	1.44814	2.45923	0.06004	3.21746
All Years	4,150	1.81817	2.27934	0.06876	3.89200
All Years 95-00	2,928	2.04947	1.64172	0.08358	3.39259
2006 PNPTC Forecast		5,935	16,140	366	22,440
2006 WDFW Forecast		7,411	15,713	471	23,595

Note: Because of incomplete reconstruction, and lack of rack sampling, return rates after 2002 were not available

Table A-4-n. Summary of WDFW 2006 Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	1,429	5,786	151	7,366
Quilcene National Hatchery	0	0	147	147
Hoodsport Hatchery	68,365	92,222	6,708	167,295
G. Adams / McKernan Hatchery	45,076	80,353	6,698	132,127
Enetai Hatchery	7,411	15,713	471	23,595
12D Streams - Augmentation	66	145	12	223
Total	122,347	194,219	14,187	330,753

Table A-4-o. Summary of PNPTC 2006 Hood Canal Hatchery Fall Chum Forecasts

Facility	Age 3	Age 4	Age 5	Total
Little Boston Hatchery	1,630	4,557	132	6,319
Quilcene National Hatchery	0	7,613	336	7,949
Hoodsport Hatchery	46,890	81,596	1,803	130,289
G. Adams / McKernan Hatchery	49,898	88,093	6,588	144,579
Enetai Hatchery	5,935	16,140	366	22,440
Total	104,353	198,000	9,224	311,577

Table A-4-p. Apportionment of the 2006 Joint Hood Canal Hatchery Fall Chum Salmon Forecasts

Facility	PNPTC Forecast	WDFW Forecast	Joint Forecast
Little Boston Hatchery	6,319	7,366	6,843
Quilcene National Hatchery	7,949	147	4,048
Hoodsport Hatchery	130,289	167,295	148,792
G. Adams / McKernan Hatchery	144,579	132,127	138,353
Enetai Hatchery	22,440	23,595	23,018
Total	311,577	330,530	321,054