
CHAPTER III

COHO SALMON ASSESSMENTS

COLUMBIA RIVER AND OREGON/CALIFORNIA COASTAL COHO (OREGON PRODUCTION INDEX AREA)

The majority of coho harvested in the Oregon production index (OPI) area originate from stocks produced in rivers located within the OPI area (Leadbetter Point, Washington, to the U.S./Mexico border). These stocks include hatchery and natural production from the Columbia River, Oregon Coast, and northern California.

The Council adopted revised abundance estimation predictors in 1987 for use starting in 1988, which were expected to more accurately predict the abundance of individual stock components originating in the OPI area. These stock components are, (1) public hatchery (OPIH), (2) Oregon coastal natural river (OCNR), (3) Oregon coastal natural lake (OCNL), (4) private hatchery (PRIH), and (5) hatchery smolt production from the Oregon coastal Salmon Trout Enhancement Program (STEP).

A stratified random sampling (SRS) study implemented in 1990 indicated an overestimation of annual OCN spawner escapement, which had previously been based on index surveys. Because OPI area ocean impacts are proportioned to the ocean escapements of various OPI components, a reduction in OCN spawner escapement indicated traditional OCN abundances were overestimated, while traditional abundance estimates for other OPI area stocks were underestimated. Starting in 1992, the Council adopted an abundance adjustment procedure for use in assessing fishery impacts. This procedural change, based on improved estimates of OCN spawner escapements, adjusted traditional index abundances of the other OPI area stocks. To achieve targeted exploitation rates and spawner escapement goals, the various OPI area stock abundance index predictions were scaled in the FRAM to reflect the results of the ongoing OCN spawner study and are referred to as SRS abundances. In 1998, after eight years of SRS abundance estimates, the historic OPI data set was rescaled to reflect the revised OCN abundance estimates.

Beginning in 1999, with the availability of a long-term data set in SRS values, all five OPI area stock abundances were projected in SRS accounting. Direct comparisons of 2003 abundance forecasts with recent year SRS abundance projections, both pre-season and post-season, are reported in Table III-1. All fishery impacts and escapements from the coho FRAM are reported in SRS values.

Public Hatchery Coho

OPI area public hatchery coho smolt production occurs primarily in Columbia River facilities and net pens. Several facilities located in Oregon coastal rivers and in the Klamath River Basin, California, collectively produce lesser amounts of coho. OPI area smolt releases since 1960 are reported by geographic area in Appendix B, Table B-1.

Predictor Description

Since 1988, the OPIH stock predictor was a multiple linear regression with the following variables: Columbia River jacks (Jack CR), Oregon coastal and Klamath River Basin jacks (Jack OC), and a correction term for delayed smolts released from Columbia River hatcheries (Jack CR * [SmD/SmCR]) to predict public hatchery stock abundance.

TABLE III-1. Preliminary 1996-2004 **preseason and postseason coho** stock **Stratified Random Sampling abundance** estimates for Oregon production index area stocks in thousands of fish. (Page 1 of 2)

Stock	Year	Preseason	Postseason	Preseason/Postseason
Oregon Production Index Area Hatchery Total	1996	309.2	182.6	1.69
	1997	376.1	215.3	1.75
	1998	118.4	203.6	0.58
	1999	559.2	319.6	1.75
	2000	671.4	677.1	0.99
	2001	1,707.6	1,395.5	1.22
	2002	361.7	660.1	0.55
	2003	863.1	952.5	0.91
	2004	623.9	-	-
Columbia River Early	1996	142.2	98.0	1.45
	1997	206.9	129.8	1.59
	1998	63.8	126.4	0.50
	1999	325.5	174.9	1.86
	2000	326.3	378.0	0.86
	2001	1,036.5	815.9	1.27
	2002	161.6	324.7	0.50
	2003	440.0	645.7	0.68
	2004	313.6	-	-
Columbia River Late	1996	114.4	30.8	3.71
	1997	86.5	53.7	1.61
	1998	24.9	47.3	0.53
	1999	140.9	120.7	1.17
	2000	278.0	260.1	1.07
	2001	491.8	488.3	1.01
	2002	143.5	271.8	0.53
	2003	377.9	248.0	1.52
	2004	274.7	-	-
Oregon Coastal North of Cape Blanco	1996	38.5	28.0	1.38
	1997	60.4	19.0	3.18
	1998	21.6	19.7	1.10
	1999	59.4	14.4	4.13
	2000	48.5	23.4	2.07
	2001	127.3	46.9	2.71
	2002	36.6	41.6	0.88
	2003	29.3	34.5	0.85
	2004	16.6	-	-
Oregon Coastal South of Cape Blanco	1996	14.2	25.8	0.55
	1997	22.3	12.8	1.74
	1998	8.1	10.2	0.79
	1999	33.4	9.6	3.48
	2000	18.6	15.6	1.19
	2001	52.0	46.0	1.13
	2002	20.0	22.0	0.91
	2003	15.9	24.3	0.65
	2004	19.0	-	-

TABLE III-1. Preliminary 1996-2004 **preseason and postseason coho** stock **Stratified Random Sampling abundance** estimates for Oregon production index area stocks in thousands of fish. (Page 2 of 2)

Stock	Year	Preseason	Postseason	Preseason/Postseason
Oregon Coastal Natural	1996	63.2	86.1	0.73
	1997	86.4	27.8	3.11
	1998	47.2	29.2	1.62
	1999	60.7	51.9	1.17
	2000	55.9	69.0	0.81
	2001	50.1	163.2	0.31
	2002	71.8	304.5	0.24
	2003	117.9	278.8	0.42
	2004	150.9	-	-
Salmon Trout Enhancement Program	1996	0.4	1.2	0.33
	1997	1.3	0.3	4.33
	1998	0.2	0.3	0.67
	1999	0.7	0.4	1.75
	2000	0.6	0.5	1.20
	2001	1.0	1.4	0.71
	2002	0.6	3.0	0.20
	2003	3.6	3.6	1.00
	2004	3.1	-	-

The OPIH stock predictor is partitioned into Columbia River early and late stocks and coastal stocks north and south of Cape Blanco, Oregon based on the proportion of the 2003 jack returns to each area adjusted for stock specific maturation rates. The northern OPIH coastal stock is comprised of hatchery production from the central Oregon Coast. The southern OPIH coastal stock is comprised of hatchery production from the Rogue River basin in southern Oregon and the Klamath and Trinity basins in northern California.

For the 2004 abundance prediction, the data base includes 1970-2003 recruits, excluding 1983 when *El Niño* impacted adult returns. It also includes 1969-2002 jack returns, excluding 1982, also due to *El Niño* influence. The model is:

$$\text{OPIH}(t) = a+b*\text{Jack CR}(t-1)+c*\text{Jack OC}(t-1)+d*(\text{Jack CR}(t-1)*[\text{SmD}(t-1)/\text{SmCR}(t-1)])$$

Where:

$$\begin{aligned} a &= -114.207340 \\ b &= 19.373314 \\ c &= 17.523576 \\ d &= 31.301425 \\ \text{adjusted } r^2 &= 0.96 \end{aligned}$$

The OPIH stock data set and a definition of the above terms are presented in Appendix B, Table B-2.

Predictor Performance

Recent year OPIH stock preseason abundance predictions, partitioned by production area and as a total, are compared with postseason estimates in Table III-1. The 2003 preseason abundance prediction of 863,100 OPIH coho was 91% of the preliminary postseason estimate of 952,500 coho.

Since 1983, the OPIH predictor has often performed poorly, due principally to high interannual variability in the jack to adult ratios.

2004 Stock Status

Using the appropriate values from Appendix B, Table B-2, the OPIH abundance prediction for 2004 is 623,900 coho, 72% of the 2003 prediction and 66% of the preliminary 2003 postseason estimate. The decrease in predicted OPIH coho from 2003 to 2004 is primarily due to lower hatchery jack returns in 2003 relative to 2002.

Oregon Coastal Natural Coho

The OCN stock is composed of natural production north of Cape Blanco, Oregon from OCNR and OCNL systems, which are predicted independently.

Predictor Description

Oregon Coastal Natural Rivers

From 1988-1993 the abundance of OCNR index coho was predicted using a modified Ricker spawner-recruit model. The predictor related OCNR recruits to the parent brood stock size incorporating an adjustment for ocean survival based on OPI hatchery smolt to jack survival the previous year. Due to a tendency to overpredict abundances, the data base in the predictor was shortened from 1970-1991 to 1980-1991 starting with 1992 predictions.

Because of concern that the adopted OCNR model does not adequately incorporate environmental variability, an alternative model was used to predict the 1994 and 1995 index abundances. The model used ocean upwelling, sea surface temperatures, and year to predict OCNR index coho abundance. The year term was included in the model to reflect an observed decline in stock productivity.

For 1996-1998, the environmental based model without the year component was used in predicting OCNR stock abundances. In addition, the predictions were in SRS rather than traditional index accounting. The OCNR environmental variables are annual deviation from the mean April-June Bakun upwelling index at 42° N latitude (UpAnom), and annual deviation from the mean January sea surface temperature at Charleston, Oregon (JanAnom).

For 1999-2002, the environmental based model with the year component included was used to predict OCNR stock abundances.

For 2003 and 2004, the same environmental based model without the year component that was used for 1996-1998 was used in predicting OCNR abundance. The model is:

$$\ln(\text{Recruits}(t)) = a+b*\text{UpAnom}(t-1)+c*\text{JanAnom}(t)$$

Where:

$$\begin{aligned} a &= 4.614428 \\ b &= 0.008259 \\ c &= -0.312692 \\ \text{adjusted } r^2 &= 0.32 \end{aligned}$$

The OCNR stock data set and a definition of the above terms are presented in Appendix B, Table B-4.

Oregon Coastal Natural Lakes

Since 1988, the abundance of OCNL index coho has been predicted using the most recent three-year average adult stock abundance. OCNL coho production occurs from three lake systems (Tenmile, Siltcoos, and Tahkenitch lake systems). Production from these systems has declined substantially from the levels observed during 1950-1973, but has been steadily increasing in recent years. The 2003 abundance of 25,100 was the highest since 1971.

Predictor Performance

Recent-year OCN stock preseason SRS abundance predictions are compared to postseason estimates in Table III-1. The 2003 preseason abundance prediction of 117,900 OCN coho was 42% of the preliminary postseason estimate of 278,800 coho.

2004 Stock Status

The 2004 preseason prediction for OCN (river and lake systems combined) is 150,900 coho, 128% of the 2003 preseason prediction and 54% of the 2003 postseason estimate (Table III-1). The 2004 preseason SRS prediction for OCNR and OCNL components are 125,400 and 25,500 coho, respectively.

Private Hatchery Coho

There have been no Oregon coastal private hatchery (PRIH) coho smolt releases since 1990. Thus, there is no PRIH recruitment in 2004.

Salmon Trout Enhancement Hatchery Coho Smolt Program

Predictor Description

From 1988 to 2003, preseason abundance predictions for Oregon coastal STEP index coho smolt production facilities have been based on the Council-approved procedure. This procedure involved calculating the smolt to adult survival rate for the current return and multiplying it by the ratio of the current OPI jack survival to the previous year's OPI jack survival.

The 2004 prediction used the observed 2000 brood smolt to adult survival rate applied to the 2001 brood smolt production.

Predictor Performance

Recent-year STEP preseason abundance predictions are compared to postseason estimates in Table III-1. The preliminary postseason estimate of 3,600 coho was the same as the preseason abundance prediction.

2004 Stock Status

The 2004 preseason STEP index abundance prediction is 3,100 coho (Table III-1). The 2004 prediction is slightly below the 2003 preseason prediction of 3,600 coho.

Oregon Production Index Area Summary of 2004 Stock Status

The 2004 combined OPI area stock abundance is predicted to be 777,900 coho, which is 79% of the 2003 preseason prediction of 984,600 coho and 61% of the 2003 postseason estimate of 1,265,800 coho. The 2004 OPI area predictions can be compared to historical abundances in Table III-2.

WASHINGTON COASTAL AND PUGET SOUND COHO STOCKS

Predictor Description and Past Performance

A variety of preseason abundance estimators currently are employed for Washington coastal and Puget Sound coho stocks (Table I-2). These estimators are used to forecast preseason abundance of adult ocean recruits.

The performance of preseason abundance forecasts (adult ocean recruits) cannot be evaluated at this time because postseason run reconstructions for U.S. and Canadian coho production units have not been completed. A comparison of expected preseason and postseason ocean escapements for Washington coastal and Puget Sound stocks in recent years is presented in Tables III-3 and III-4. Postseason estimates of 2003 ocean escapements for some of these stocks are not available at this time. The comparison of preseason and postseason estimates of ocean escapement reflects annual errors in abundance estimates, deviations in ocean fisheries from preseason expectations, and variations in ocean distributions of stocks as described in the introduction. Fishery impact levels anticipated preseason may be quite different than those that actually occur.

TABLE III-2. Oregon production index (OPI) area coho harvest impacts, spawning, abundance, and exploitation rate estimates by SRS accounting in thousands of fish.^{a/} (Page 1 of 1)

Year or Average	Oregon and California Coastal Returns								Ocean Exploitation Rate Based on OPI Abundance ^{d/}	OCN Exploitation Rate Based on Postseason FRAM ^{e/}
	Ocean Fisheries ^{b/}		Hatcheries and Freshwater Harvest ^{c/}			Columbia River Returns	Abundance	Private Hatcheries		
	Troll	Sport	Freshwater Harvest ^{c/}	OCN Spawners	Private Hatcheries					
1970-1975	1,629.6	558.4	45.8	55.2	-	460.4	2,749.3	0.8	0.0	
1976	2,936.1	977.7	62.6	40.7	-	337.0	4,354.1	0.90	-	
1977	664.4	412.1	21.4	19.5	4.2	93.8	1,215.4	0.89	-	
1978	1,104.2	524.6	12.6	19.8	12.3	307.5	1,981.0	0.83	-	
1979	1,056.6	334.4	27.4	45.0	49.2	276.5	1,789.1	0.79	-	
1980	506.9	526.4	32.1	30.3	38.7	301.6	1,436.0	0.73	-	
1981	830.9	339.9	34.1	32.6	117.8	170.2	1,525.5	0.81	-	
1982	740.9	300.4	37.1	76.2	184.7	453.1	1,792.4	0.62	-	
1983	429.6	275.0	18.2	22.8	133.9	111.2	990.7	0.79	-	
1984	95.8	174.2	51.2	74.5	115.4	425.9	937.0	0.32	-	
1985	166.4	280.4	45.4	73.9	332.0	367.2	1,265.3	0.43	-	
1986	643.5	320.6	81.8	70.0	453.7	1,549.1	3,118.7	0.34	-	
1987	469.1	296.2	45.3	30.1	119.3	316.6	1,276.6	0.60	-	
1988	844.7	297.2	62.4	56.8	116.1	670.8	2,048.0	0.56	-	
1989	646.9	425.5	62.3	46.4	46.9	712.8	1,940.8	0.55	-	
1990	277.6	357.1	30.6	20.9	35.6	196.7	918.5	0.69	-	
1991	450.6	469.9	84.0	36.4	35.1	954.3	2,030.3	0.45	-	
1992	67.5	256.5	53.8	40.6	-	217.7	636.1	0.51	-	
1993	13.2	140.8	41.5	54.5	-	114.2	364.2	0.42	-	
1994	2.7	3.0	30.8	43.3	-	169.1	248.9	0.02	0.07	
1995	5.4	43.5	40.0	52.5	-	75.2	216.6	0.23	0.12	
1996	7.0	31.8	48.9	73.0	-	104.6	265.3	0.15	0.08	
1997	5.5	22.4	27.9	22.7	-	145.3	223.8	0.13	0.12	
1998	3.5	12.6	30.5	30.9	-	164.5	242.0	0.07	0.08	
1999	3.6	41.8	24.1	47.4	-	273.6	389.7	0.12	0.09	
2000	25.9	74.2	38.1	66.8	-	549.6	756.0	0.13	0.07	
2001	38.0	216.8	85.4	167.7	-	1,108.1	1,617.0	0.16	0.07	
2002	15.0	118.8	57.0	253.5	-	511.6	956.6	0.14	0.12	
2003 ^{f/}	28.8	253.0	48.1	238.0	-	694.8	1,265.8	0.22	0.14	

a/ The OPI area includes ocean and inside harvest impacts and escapement to streams and lakes south of Leadbetter Point, Washington.

b/ Includes estimated nonretention mortality: troll fishery--hook-and-release mortality for 1982-2003 and drop-off mortality for all years; sport fishery--hook and release mortality for 1994-2003 and drop-off mortality for all years.

c/ Includes returns from Salmon-Trout Enhancement Program (STEP) smolt releases.

d/ Ocean fishery impacts on private hatchery stock and returns to private hatcheries are excluded in calculating the OPI area stock aggregate ocean exploitation rate index.

e/ 2001, 2002, and 2003 based on preseason FRAM estimate.

f/ Preliminary.

TABLE III-3. **Preseason and postseason estimates of ocean escapements** for selected **Washington coastal adult natural coho** stocks in thousands of fish. (Page 1 of 1)

Year	Quillayute River Fall			Hoh River			Queets River			Grays Harbor ^{a/}		
	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason
1984	7.0	11.0	0.64	2.7	7.7	0.35	5.2	9.7	0.54	28.7	103.8	0.28
1985	19.2	15.8	1.22	6.6	5.2	1.27	11.3	6.0	1.88	56.4	25.1	3.25
1986	6.1	17.1	0.36	3.9	6.4	0.61	5.2	5.8	0.90	51.6	33.3	1.55
1987	11.7	23.8	0.49	5.5	7.2	0.76	9.0	8.9	1.01	103.3	55.7	1.85
1988	10.4	9.1	1.14	2.0	2.6	0.77	4.7	4.5	1.04	26.4	58.0	0.46
1989	14.5	11.1	1.31	5.7	5.4	1.06	6.2	5.4	1.15	43.0	60.9	0.71
1990	15.2	9.5	1.60	5.1	4.5	1.13	5.9	7.1	0.83	48.3	57.3	0.84
1991	8.8	10.6	0.83	3.4	5.4	0.63	7.9	8.6	0.92	138.0	108.7	1.27
1992	12.5	13.6	0.92	4.9	5.0	0.98	5.6	7.0	0.80	48.4	40.9	1.18
1993	7.6	4.7	1.62	4.8	1.9	2.53	6.5	5.4	1.20	84.7	37.3	2.27
1994	7.0	6.4	1.09	3.0	1.4	2.14	3.6	1.2	3.00	31.3	11.8	2.65
1995	8.5	14.3	0.59	4.4	5.4	0.81	7.2	7.3	0.99	64.4	58.9	1.09
1996	9.2	14.6	0.63	3.0	5.8	0.52	5.4	10.7	0.50	82.7	82.4	1.00
1997	5.1	5.0	1.02	1.6	1.4	1.14	2.4	2.0	1.20	14.8	18.9	0.78
1998	7.4	17.0	0.44	3.2	5.2	0.62	4.5	4.6	0.98	27.1	41.2	0.66
1999	12.8	19.5	0.66	2.8	6.3	0.44	3.7	5.0	0.74	50.3	38.9	1.29
2000	8.2	17.7	0.46	3.3	8.8	0.38	2.5	8.3	0.30	44.2	40.8	1.08
2001	20.6	36.7	0.56	7.6	14.8	0.51	10.6	27.8	0.33	46.6	73.5	0.63
2002	18.5	34.8	0.71	6.9	11.2	0.62	10.2	16.1	0.63	50.3	NA	NA
2003	21.2	22.1 ^{b/}	0.96	10.4	5.4 ^{b/}	1.93	19.6	19.5 ^{b/}	1.01	52.3	NA	NA

a/ The source for postseason return estimates is Washington Department of Fish and Wildlife.

b/ Preliminary.

TABLE III-4. Preseason and postseason estimates of ocean escapements for selected Puget Sound adult natural coho stocks in thousands of fish. (Page 1 of 1)

Year	Skagit River			Stillaguamish River			Hood Canal		
	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason
1984	29.6	37.2	0.80	NA	26.9	NA	NA	57.5	NA
1985	26.1	31.3	0.83	NA	34.4	NA	NA	38.5	NA
1986	43.5	73.4	0.59	37.0	49.9	0.74	NA	82.2	NA
1987	33.0	41.2	0.80	29.7	46.3	0.64	NA	71.7	NA
1988	29.6	29.9	0.99	24.5	35.4	0.69	18.2	15.5	1.17
1989	31.2	27.6	1.13	24.5	13.5	1.81	36.8	25.5	1.44
1990	37.6	25.9	1.45	30.8	34.1	0.90	43.9	14.2	3.09
1991	40.8	11.8	3.46	32.9	11.3	2.91	17.6	15.3	1.15
1992	35.7	9.5	3.76	18.7	18.0	1.04	10.1	19.9	0.51
1993	28.1	14.5	1.94	24.5	10.6	2.31	39.5	16.7	2.37
1994	17.9	30.5	0.59	10.2	30.3	0.34	13.5	57.0	0.24
1995	30.0	16.2	1.85	32.7	20.4	1.60	19.3	41.1	0.47
1996	26.7	8.7	3.07	29.8	12.2	2.44	15.4	37.3	0.41
1997	34.2	40.2	0.85	15.7	13.8	1.14	38.1	99.8	0.38
1998	41.1	85.9	0.48	37.7	30.7	1.23	87.3	122.4	0.71
1999	53.4	37.2	1.44	27.3	7.5	3.64	45.2	18.6	2.43
2000	24.7	71.6	0.35	15.0	32.5	0.46	50.4	40.7	1.24
2001	46.9	115.6 ^{a/}	0.41	18.1	80.6 ^{a/}	0.22	40.6	104.6 ^{a/}	0.39
2002	79.9	61.0 ^{a/}	1.31	14.5	30.4 ^{a/}	0.48	25.6	85.4 ^{a/}	0.30
2003	97.9	NA	NA	27.7	NA	NA	25.8	NA	NA

a/ Preliminary.

2004 Stock Status

Washington Coastal Coho

Willapa Bay

This is the fifth year hatchery and wild coho forecasts were estimated independently. The 2004 Willapa Bay hatchery coho abundance forecast is 55,000 ocean recruits, an 18% increase from the 2003 preseason forecast of 46,700. The hatchery prediction is based on a recent four-year mean return per release without adjustment for jack abundance. The natural coho ocean abundance forecast is 36,700 ocean recruits, which is the average terminal run size estimate from 1998-2002. Terminal forecasts for both hatchery and natural stocks were expanded to ocean abundances using an ocean survival rate derived from Forks Creek Hatchery (Willapa River) CWT recovery data for 1999-2002.

Grays Harbor

Preseason abundance forecasts are made for natural fish throughout the system and for hatchery fish returning to three freshwater rearing complexes and three saltwater net-pen sites. The forecasts include returns expected from numerous volunteer production projects. The abundance forecast for Grays Harbor natural stock coho for 2004 is 118,900 ocean recruits. The forecast for hatchery stock ocean abundance is 71,700 adults.

The natural coho forecast was generated by estimating a terminal run size using a six-year average (1991-1996) return per spawner, which was then expanded to ocean abundance using Bingham Creek wild CWT recovery data. The hatchery forecast was generated by multiplying smolt releases by an average ocean recruit per release survival rate.

Quinault River

The 2004 forecast for Quinault natural coho is 92,800 ocean recruits, a 51% increase from the 2003 projected level of 47,700. This estimate represents the 2001 brood year escapement (21,565) multiplied by the 1993-1999 brood year average ocean recruits per spawner (4.30). There is considerable uncertainty surrounding the projected 2004 abundance for Quinault natural coho. From 1991 through 2000, natural spawning escapements of Quinault coho ranged from a low of 820 fish in 1994 to a high of 12,666 in 1999. The 2001 escapement (21,569) far exceeds the range experienced for previous years. The average ocean escapement per spawner method results in a forecast of 92,800, substantially larger than the run sizes observed since the mid 1990's; this forecast of greatly increased natural production is inconsistent with the natural production forecasts for other Washington coastal coho stocks.

The Quinault hatchery coho forecast is 18,200 ocean recruits, a decrease of 12% compared to the 2003 forecast level of 20,600. The forecast is derived from the mean 1990-1999 brood year observed marine survival rates (0.0296) and 2001 brood year smolt release (631,300). Approximately 474,200 (77%) of the release was marked with an adipose fin clip.

Queets River

The Queets natural coho forecast is 18,500 ocean recruits, a decrease of 23% compared to the 2003 forecast level of 24,000. This forecast represents the estimated tagged smolts (38,153) multiplied by the 1993-2002 average ocean recruits per smolt (0.0424) for Queets tagged coho, plus the estimated untagged smolts (333,922) multiplied by the 1993-2002 average ocean recruits per smolt (0.0505) for Queets untagged coho.

The forecast for supplemental production is 2,500 ocean recruits, based on releases (183,800) multiplied by the 1993-1999 brood year average recruits/release (0.0138). Approximately 26.4% of supplemental releases were adipose fin clipped.

The Queets hatchery (Salmon River) coho forecast is 17,100 ocean recruits, a decrease of 31% compared to the 2003 forecast level of 24,900. This forecast is based on the smolt release of 867,400 multiplied by the 1993-1999 brood year average observed marine survival rate (0.0197). Approximately 16.9% of the fish released from the Salmon River facility were marked with an adipose fin clip and CWTs.

Hoh River

The Hoh River natural coho forecast is 8,100 ocean recruits, a decrease of 35% compared to the 2003 forecast of 12,500. This forecast is based on estimated smolt production per square mile of watershed (based on Clearwater tributary to the Queets) multiplied by the size of the Hoh watershed for a total of 159,000 smolts. The total smolt production is then multiplied by .051, based on a sea surface temperature to marine survival model.

No hatchery production is projected for the Hoh system for 2004.

Quillayute River

The Quillayute River summer natural and hatchery coho forecasts for 2004 are 1,080 and 6,100 ocean recruits, respectively. The natural component run size is based on estimated smolt production (17,400) and a projected ocean survival rate of 0.062 based on Bingham Creek jack return data and a sea surface temperature to marine survival model. The hatchery component run forecast is based on 1980-1993 brood year average ocean recruits per release (0.035) multiplied by the number of smolts released (175,300). The 2004 forecast abundance of natural summer coho is nearly identical to the 2003 forecast while the hatchery forecast is 13% above the 2003 forecast level.

The Quillayute River fall natural and hatchery coho forecasts are 21,200 and 20,900 ocean recruits, respectively. The forecast for the natural component is based on the estimated smolt production (342,100), multiplied by the projected ocean survival rate of 0.062 derived from Bingham Creek jack return data and sea surface temperature to marine survival model. The smolt production estimate was derived by (1) multiplying the 1987, 1988, and 1990 average smolt production for the Quillayute system (306,000) by a scalar derived from smolt estimates for the Clearwater tributary to the Queets and (2) apportioning smolt production to summer and fall stocks based on brood escapements. The scalar value (1.175) represents the ratio between the 2003 estimated smolt production for the Clearwater and the 1987, 1988, and 1990 average. The combined summer and fall coho smolt production was estimated as 359,550 (1.175*306,000). Smolt production for fall and summer components was allocated according to brood year spawning escapements to yield smolt estimates of 342,100 and 17,400 for fall and summer stocks, respectively.

The hatchery production forecast is based on average ocean recruits per release (0.035) multiplied by the number of smolts released (597,700). The 2004 forecast abundances of natural and hatchery components of Quillayute fall coho are 15% below and 38% above their respective 2003 forecast levels.

North Washington Coast Independent Tributaries

Production from several smaller rivers and streams along the north Washington Coast (Waatch River, Sooes River, Ozette River, Goodman Creek, Mosquito Creek, Cedar Creek, Kalaloch Creek, Raft River, Camp Creek, Duck Creek, Moclips River, Joe Creek, Copalis River, Conner Creek), which flow directly into the Pacific Ocean, is forecast as an aggregate. Generally, stock assessment programs on these systems are minimal. The 2004 forecast of natural coho production for these independent streams is 12,700 based on a

prediction of 500 smolts per square mile of watershed drainage (212,000 smolts based on 424 square miles of watershed) and an expectation for marine survival of 0.07. The marine survival projection was derived from jack-adult information collected at the WDFW Bingham Creek research station.

The hatchery forecast of 4,300 is based on average brood year 1988-1999 marine survivals (0.0247 to December age-2) from the Makah National Fish Hatchery, multiplied by the 2001 brood year release (232,900) from the Makah National Fish Hatchery, converted to ocean recruits (by dividing the product by 1.33). Approximately 83% of the 2001 brood year release was marked with an adipose fin clip.

Puget Sound

The 2004 total hatchery and wild coho ocean recruit forecast for the Puget Sound region is 1,116,498, which is 8% above the 2003 forecast. The hatchery forecast of 502,134 is 2% above the 2003 forecast, and the wild forecast of 615,152 is 15% above the 2003 forecast.

Puget Sound hatchery forecasts for 2004 were generally the product of 2001 brood year smolt releases from each facility and predicted marine survival rates for each facility, which were typically based on recent year average survival rates. Forecasts for Puget Sound natural coho were generally derived by measured or predicted smolt production from each major watershed or region, multiplied by stock-specific marine survival rate predictions based on jack return models, average recruits/smolt rates, or other information.

Strait of Juan de Fuca

The 2004 forecasts for Strait of Juan de Fuca natural and hatchery coho ocean recruits are 41,603 and 22,834, respectively. The natural forecast was derived by multiplying the estimated 2001 brood natural smolt production for the region by a predicted marine survival rate of 12.4%. The hatchery forecasts are product of hatchery-specific survival rate predictions (3.0% for Dungeness, 1.1% for Elwha) to the 2001 brood year (BY) smolt releases for each hatchery. The survival rate predictions for both the natural and hatchery forecasts are based on recent year averages of cohort reconstruction-based recruits/smolt values for the aggregate natural stock, and each hatchery production unit. For purposes of implementing the 2002 PSC coho agreement, the status of the Strait of Juan de Fuca management unit is "abundant" with a total fishery exploitation rate limit of 60%.

Nooksack-Samish

The 2004 forecasts for Nooksack-Samish natural and hatchery coho ocean recruits are 27,500 and 76,610, respectively. The natural forecast is the product of projected natural smolt production from each of the stream basins in the region, multiplied by a marine survival rate expectation of 11.3%. The natural coho marine survival rate prediction is based on the average Baker River (Skagit basin) indicator stock CWT recovery smolt rate. The hatchery forecasts are based on the 1997-99 BY average marine survival rate for each facility (1.7%-3.8%), applied to the 2001 BY smolt releases.

Skagit

The 2004 forecasts for Skagit River natural and hatchery coho ocean recruits are 155,814 and 22,788 (20,903 from in-river hatchery production, 1,885 from Oak Harbor Net Pens) respectively. The natural coho forecast is the product of measured smolt production from the Skagit basin, multiplied by a marine survival rate expectation of 11.3%. The natural coho marine survival rate is based on the average odd brood year (1989-97) Baker River (Skagit basin) indicator stock CWT recovery/smolt rate. The odd year average is used due to the observation that both juvenile coho production, and marine survival rates have an odd/even year pattern in this basin. The hatchery forecasts are based on the 1997-99 BY average marine survival rate for Cascade Hatchery (6.4%) applied to the 2001 BY smolt releases. For purposes of implementing the 2002 PSC coho

agreement, the status of the Skagit management unit is “abundant” with a total fishery exploitation rate limit of 60%.

Stillaguamish

The 2003 forecast for Stillaguamish natural coho ocean recruits is 37,800. The Stillaguamish wild coho ocean survival rate (0.09%) was developed from the 1997 and 1998 brood year Wallace River Hatchery coho marine survival rates and applied to estimated smolt production to predict ocean recruits. No hatchery production is anticipated. For purposes of implementing the 2002 PSC coho agreement, the status of the Stillaguamish management unit is “abundant” with a total fishery exploitation rate limit of 50%.

Snohomish

The 2004 forecast for Snohomish River natural coho ocean recruits is 38,000. The Snohomish regional hatchery forecast is 48,300; 11,700 for the Wallace Hatchery facility, 31,300 for the Tulalip Bay facility, 3,280 for the Possession Bait House Net Pen located on southeast Whidbey Island, and 2,050 for the Mukilteo Net Pen. The natural coho forecast is based upon an adult/recruit spawner production model, which contains a recruitment rate adjustment variable based on the deviation pattern in Wallace River hatchery coho recruits/smolt rate. The hatchery forecast for the Wallace, Possession, and Mukilteo programs are based on the 1997-99 BY average Wallace River Hatchery CWT recovery-based recruits/smolt rate (8.2%), and the Tulalip forecast on the 1997-99 BY average Tulalip CWT recovery-based recruits/smolt rate (8.5%). For purposes of implementing the 2002 PSC coho agreement, the status of the Snohomish management unit is “abundant” with a total fishery exploitation rate limit of 60%.

South Sound

The 2004 forecasts for South Sound region natural and hatchery coho ocean recruits are 61,300 and 288,369, respectively. The natural forecast is the product of projected smolt production from each of the stream basins in the region, multiplied by marine survival rate expectations ranging from 12.0% in central Puget Sound, to 5.0% in the deep South Sound region. The natural coho marine survival rate predictions are based upon the Deschutes River indicator stock, and hatchery and wild fish survival rate and/or adult runsize information that shows a consistent gradient of declining marine survival rates for coho originating from the southern vs. central Puget Sound region. The hatchery forecasts are based on the 1997-99 BY average CWT recovery-based recruits/smolt rate for each facility (0.5%-8.1%), applied to the 2001 BY smolt releases.

Hood Canal

The 2004 forecasts for Hood Canal region natural and hatchery coho ocean recruits are 98,152 and 42,733, respectively. The 2004 Hood Canal natural coho forecast is based on an average of two different regressions of Big Beef Creek jacks versus Hood Canal December age-two natural run sizes. The hatchery forecasts are based on the 1997-99 BY average cohort reconstruction-based recruits/smolt rates for each facility (1.0%-5.1%), applied to the 2001 BY smolt releases. For purposes of implementing the 2002 PSC coho agreement, the status of the Hood Canal management is “abundant” with a total fishery exploitation rate limit of 65%.

SELECTIVE FISHERY CONSIDERATIONS

As the region has moved forward with mass marking of hatchery coho salmon stocks, selective fishing options have become an important consideration for fishery managers. Table III-5 summarizes estimates of mass mark rates for coho stocks from Southern British Columbia, Canada to the Oregon coast, based on preseason abundance forecasts. Agencies have released coho mass marked with adipose clips from the 2001 brood, making these fish available to 2004 fisheries.

EVALUATION OF 2003 REGULATIONS ON 2004 STOCK ABUNDANCE

Escapements and fishery impacts were estimated using coho FRAM, with a new 1986-1991 base period modified to include a new September time step. Abundance forecasts for 2004 were updated for Washington and Oregon stocks, but forecasts for Canadian stocks are not yet available.

Oregon Production Index Area

Ocean fisheries were modeled with 2003 Council regulations and 2003 expectations for non-Council area fisheries. Under this scenario, expected exploitation rates are 18.0% on OCN coho and 10.5% on Rogue/Klamath hatchery coho. Expected spawner escapement is 124,600 for OCN coho (Tables III-6 and III-7).

Based on parent escapement levels and observed OPI smolt-to-jack survival for 2001 brood OPI smolts, the total allowable OCN coho exploitation rate for 2004 fisheries is no greater than 15% under Amendment 13 and the matrix developed by the OCN work group. (Table III-8; Appendix A, Tables A-2 and A-3). The total allowable Rogue/Klamath hatchery coho marine exploitation rate is 13% (NMFS ESA consultation standard). An additional consideration is impact to Oregon State-ESA listed lower Columbia natural coho. The total allowable lower Columbia River natural coho marine exploitation rate for 2004 fisheries is 30% under the Oregon State management plan.

Predicted ocean escapements into the Columbia River in 2004 under this exercise show that it would be questionable whether there would be sufficient coho to provide both inside harvest and meet hatchery egg take goals.

North of the Oregon Production Index Area

Ocean escapement expectations in relation to management goals for selected naturally-spawning coho stocks, given 2004 preseason abundance forecasts and 2003 preseason projections for fishing patterns, are presented in Table III-6. More detailed fishery management goals for Council area coho stocks are listed in Appendix A, Table A-1.

Under 2003 regulations, ocean escapements for natural coho stocks north of the OPI index area are expected to be at levels that would permit attainment of FMP escapement goals for all stocks. Impacts of inside fisheries would ultimately determine levels of anticipated spawning escapements.

TABLE III-5. **Mass marking** of 2001 brood **coho** available to 2004 Council fisheries. The mark used is an adipose fin clip. (Page 1 of 1)

Region	Ocean Recruits (thousands of fish)		Percent Mass Marked
	Wild	Hatchery	
PUGET SOUND STOCKS:			
Nooksack-Samish and 7/7A Independent	27.5	75.5	69.5%
Skagit	155.8	22.8	10.5%
Stillaguamish	38.0	0.5	0.0%
Snohomish	192.1	48.3	9.3%
South Puget Sound Normal	61.3	271.3	61.1%
South Puget Sound Delayed	-	17.0	97.3%
Hood Canal	99.1	42.7	24.6%
Strait of Juan de Fuca and Area 9	41.6	22.8	26.2%
Puget Sound Total	615.4	507.3	34.5%
WASHINGTON COASTAL STOCKS:			
North Coast Independent Tributaries	12.7	4.3	21.1%
Quillayute Summer	1.1	6.1	84.0%
Quillayute Fall	21.2	20.9	43.0%
Hoh	8.1	0.0	0.0%
Queets	18.5	19.6	14.2%
Quinault	92.8	18.2	12.7%
Grays Harbor	118.9	71.7	35.6%
Willapa Bay	36.7	55.0	58.3%
Washington Coastal Total	310.0	195.8	33.3%
COLUMBIA RIVER STOCKS:			
Columbia River Early	-	313.6	70.0%
Columbia River Late	-	274.7	68.6%
Columbia River Total	-	588.3	69.3%
OREGON COASTAL	150.9	35.6	19.1%
SOUTHERN BRITISH COLUMBIA STOCKS:^{a/}			
Georgia Strait Mainland	189.3	22.8	6.8%
Georgia Strait Vancouver Island	188.0	73.8	21.1%
Johnstone Strait	39.5	13.3	14.7%
Southwest Vancouver Island	148.1	38.9	29.6%
Northwest Vancouver Island	235.9	4.6	1.9%
Lower Fraser River	37.4	121.0	72.6%
Interior Fraser River	31.1	4.0	2.7%
Southern British Columbia Total	869.3	278.4	20.4%

a/ For this assessment, the same numbers were used as in 2003.

TABLE III-6. Estimated **ocean escapements** for critical natural and Columbia River hatchery **coho** stocks (thousands of fish) based on preliminary 2004 preseason abundance forecasts and 2003 Council regulations.^{a/} (Page 1 of 1)

Ocean Escapement Estimates Under 2003 Regulations ^{b/}			
Stock	2004 Preseason Abundance	2003 Preseason Abundance	2003 Spawning Escapement Goal ^{c/d/}
<u>Natural Coho Stocks</u>			
Skagit	129	98	Exploitation Rate (30.0)
Stillaguamish	28	28	Exploitation Rate (17.0)
Snohomish	139	148	Exploitation Rate (70.0)
Hood Canal	80	26	Exploitation Rate (21.5)
Strait of Juan de Fuca	32	18	Exploitation Rate (12.8)
Quillayute Fall	18	21	6.3 - 15.8
Hoh	7	10	2.0 - 5.0
Queets ^{e/}	14	20	5.8 - 14.5
Grays Harbor	102	52	35.4
OCN	124.6 (18%)	101.5	Exploitation Rate #15%
<u>Hatchery Coho Stocks</u>			
Columbia Early	128	246	18.6
Columbia Late	64	146	11.9

a/ Quota levels include harvest and hooking mortality estimates used in planning the Council's 2003 ocean fisheries and a coho catch for the Canadian troll fishery off the West Coast of Vancouver Island (WCVI).

b/ 2003 regulations include the following coho quota fisheries: Treaty Indian troll - 90,000 non-selective; non-Indian troll - 75,000 selective; recreational north of Cape Falcon - 225,000 selective; recreational Cape Falcon to Humbug Mt. - 88,000 selective. Ocean escapement is generally the estimated number of coho escaping ocean fisheries and entering freshwater. For Puget Sound stocks, ocean escapement is the estimated number of coho entering Area 4B which are available for U.S. net fisheries in Puget Sound and spawning escapement after impacts associated with the Canadian and Puget Sound troll and recreational fisheries have been deducted. For the OCN coho stock, this value represents the estimated spawner escapement in SRS accounting. For Columbia River hatchery stocks, ocean escapement represents the number of coho after the Buoy 10 fishery.

c/ Spawning escapement goals are not directly comparable to ocean escapement, because inside fishery harvest is not considered.

d/ Number in parentheses are presented for convenient reference to numerical escapement goals identified in the Pacific Coast Salmon Plan (Salmon FMP).

e/ Ocean escapement of 14,400 wild does not include 1,373 supplemental.

TABLE III-7. Comparison of Oregon coastal natural (OCN) and Rogue/Klamath (RK) coho harvest mortality and exploitation rates by fishery under Council-adopted 2003 regulations and preliminary 2004 preseason abundance estimates. (Page 1 of 1)

Fishery	Harvest Mortality and Exploitation Rate			
	OCN		RK	
	Number	Percent	Number	Percent
SOUTHEAST ALASKA	0	0.0	0	0.0
BRITISH COLUMBIA	63	0.0	4	0.0
PUGET SOUND/STRAITS	159	0.1	0	0.0
NORTH OF CAPE FALCON				
Recreational	3,412	2.2	6	0.0
Treaty Indian Troll	1,418	0.9	0	0.0
Non-Indian Troll	1,539	1.0	2	0.0
SOUTH OF CAPE FALCON				
Recreational:				
Cape Falcon to Humbug Mt.	9,159	6.1	64	0.5
Humbug Mt. to Horse Mt. (KMZ)	2,586	1.7	586	4.4
Fort Bragg	946	0.6	195	1.5
South of Pt. Arena	847	0.6	126	0.9
Troll:				
Cape Falcon to Humbug Mt.	2,289	1.5	27	0.2
Humbug Mt. to Horse Mt. (KMZ)	125	0.1	30	0.2
Fort Bragg	1,585	1.0	263	2.0
South of Pt. Arena	843	0.6	79	0.6
BUOY 10	971	0.6	0	0.0
ESTUARY/FRESHWATER	1,493	1.0	26	0.2
TOTAL	27,435	18.0	1,408	10.5

TABLE III-8. Maximum **allowable** fishery **impact** rate for **OCN coho** under Amendment 13 matrix (Appendix A, Table A-2) and the OCN work group matrix (Appendix A, Table A-3) based on parent escapement levels by stock component and marine survival category. (Page 1 of 1)

Fishery Year (t)	Estimated OCN Coho Spawners by Stock Component					Hatchery Jack Survival Rate (t-1)	Amendment 13 Matrix			OCN Work Group Matrix ^{a/}		
	Parent Spawner Year (t-3)	Northern	North-Central	South-Central	Southern		Marine Survival Category	Parental Spawner Category	Maximum Allowable Impacts	Marine Survival Category	Parental Spawner Category	Maximum Allowable Impacts
1998	1995	3,800	13,600	35,000	3,800	0.04%	Low	Very Low	#10-13%	Extremely Low	Very Low	#8%
1999	1996	3,300	18,100	51,500	4,600	0.10%	Med	Very Low	#15%	Low	Critical	0-8%
2000	1997	2,100	2,800	17,700	8,300	0.12%	Med	Very Low	#15%	Low	Critical	0-8%
2001	1998	2,600	3,300	25,200	2,300	0.27%	Med	Very Low	#15%	Medium	Critical	0-8%
2002	1999	8,800	11,400	27,100	1,400	0.09%	Med	Low	#15%	Low	Low	#15%
2003	2000	17,900	14,300	34,700	11,000	0.20%	Med	Low	#15%	Med	Low	#15%
2004	2001	33,400	25,200	109,000	12,200	0.15%	Med	Low	#15%	Med	Low	#15%
2005	2002	49,700	102,700	101,000	7,800	-	-	High	-	-	High	-
2006 ^{b/}	2003	56,800	68,800	112,400	2,000	-	-	Low	-	-	Low	-

a/ Developed by the OCN workgroup as a result of the 2000 Review of Amendment 13.

b/ Under the NMFS ESA consultation standards, the southern stock component is managed for a total allowable Marine Exploitation rate of 13%, as represented by Rogue/Klamath hatchery stocks, which is separate from these OCN coho impact rates. The 2006 parental spawner category would be classified as high if the southern stock component were not reflected in these matrices.