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## CHAPTER III

# COHO SALMON ASSESSMENTS

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

The majority of coho harvested in the 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 should more accurately forecast 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 Coho 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 2005 abundance forecasts with recent year SRS abundance projections, both preseason and postseason, 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 fewer 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 1996-2005 **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 <sup>a/</sup>	Preseason/Postseason
<b>Oregon Production Index Area Hatchery Total</b>	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	634.6	0.98
	2005	389.9	-	-
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	389.0	0.81
	2005	284.6	-	-
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	203.0	1.35
	2005	78.0	-	-
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	21.7	0.77
	2005	11.5	-	-
Oregon and California 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	29.9	0.64
	2005	15.8	-	-

TABLE III-1. Preliminary 1996-2005 **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 <sup>a/</sup>	Preseason/Postseason
<b>Oregon Coastal Natural</b>	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	197.0	0.77
	2005	152.0	-	-
<b>Salmon Trout Enhancement Program</b>	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	1.0	3.10
	2005	1.0	-	-

a/ Postseason estimates are based on preliminary data, and not all stocks have been updated with final estimates.

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 2004 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 2005 abundance prediction, the data base includes 1970-2004 recruits, excluding 1983 when *El Niño* impacted adult returns. It also includes 1969-2003 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:

$$\begin{aligned} a &= -115.205571 \\ b &= 19.399947 \\ c &= 17.071270 \\ d &= 31.518657 \\ \text{adjusted } r^2 &= 0.96 \end{aligned}$$

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 2004 preseason abundance prediction of 623,900 OPIH coho was 97% of the preliminary postseason estimate of 643,600 coho.

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

### **2005 Stock Status**

Using the appropriate values from Appendix B, Table B-2, the OPIH abundance prediction for 2005 is 389,900 coho, 63% of the 2004 prediction and 61% of the preliminary 2004 postseason estimate. The decrease in predicted OPIH coho from 2004 to 2005 is primarily due to lower hatchery jack returns in 2004 relative to 2003.

### **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 did 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.

Since 2003, 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:

$$\begin{aligned} a &= 4.721254 \\ b &= 0.008261 \\ c &= -0.367755 \\ \text{adjusted } r^2 &= 0.35 \end{aligned}$$

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 2004 abundance was estimated to be 21,800.

### **Predictor Performance**

Recent-year OCN stock preseason SRS abundance predictions are compared to postseason estimates in Table III-1. The OCN predictor has under estimated abundance since 2000. The 2004 preseason abundance prediction of 150,900 OCN coho was 77% of the preliminary postseason estimate of 197,000 coho.

### **2005 Stock Status**

The 2005 preseason prediction for OCN (river and lake systems combined) is 152,000 coho, 101% of the 2004 preseason prediction and 77% of the 2004 postseason estimate (Table III-1). The 2005 preseason SRS prediction for OCNR and OCNL components are 133,100 and 18,900 coho, respectively.

### **Private Hatchery Coho**

There have been no Oregon coastal PRIH coho smolt releases since 1990. Thus, there is no PRIH recruitment in 2005.

## **Salmon Trout Enhancement Hatchery Coho Smolt Program**

### **Predictor Description**

From 1988 to 2004, 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 2005 prediction used the observed 2001 brood smolt to adult survival rate applied to the 2002 brood smolt production.

### **Predictor Performance**

Recent-year STEP preseason abundance predictions are compared to postseason estimates in Table III-1. The 2004 preliminary postseason estimate of 1,000 coho was 32% of the preseason abundance prediction.

### **2005 Stock Status**

The 2005 preseason STEP index abundance prediction is 1,000 coho (Table III-1). The 2005 prediction is below the 2004 preseason prediction of 3,100 coho, but equal to the 2004 preliminary postseason return estimate.

### **Oregon Production Index Area Summary of 2005 Stock Status**

The 2005 combined OPI area stock abundance is predicted to be 542,900 coho, which is 79% of the 2004 preseason prediction of 777,900 coho and 65% of the 2004 preliminary postseason estimate of 841,600 coho. The 2005 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 2004 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 substantially 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.<sup>a/</sup> (Page 1 of 1)

Year or Average	Oregon and California Coastal Returns								Ocean Exploitation Rate Based on OPI Abundance <sup>d/</sup>	OCN Exploitation Rate Based on Postseason FRAM <sup>e/</sup>
	Ocean Fisheries <sup>b/</sup>		Hatcheries and			Columbia River Returns	Abundance	Abundance		
	Troll	Sport	Freshwater Harvest <sup>c/</sup>	OCN Spawners	Private Hatcheries					
1970-1975	1,629.6	558.4	45.8	55.2	-	460.4	2,749.3	0.80	-	
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	24.4	47.4	-	273.6	389.7	0.12	0.09	
2000	25.9	74.2	38.5	66.8	-	549.6	756.0	0.13	0.07	
2001	38.0	216.8	86.5	167.7	-	1,108.1	1,617.0	0.16	0.07	
2002	15.0	118.8	59.5	253.5	-	511.6	958.3	0.14	0.12	
2003	28.8	253.0	50.7	222.4	-	683.7	1,265.8	0.22	0.14	
2004 <sup>f/</sup>	26.2	159.3	42.1	168.7	-	446.0	841.6	0.22	0.15	

a/ The OPI area includes ocean and inside harvest impacts and escapement to streams and lakes south of Leadbetter Pt., Washington.  
 b/ Includes estimated nonretention mortality: troll fishery--hook-and-release mortality for 1982-2004 and drop-off mortality for all years; sport fishery--hook-and-release mortality for 1994-2004 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, 2003, and 2004 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 <sup>a/</sup>		
	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	34.7	0.53	6.9	11.2	0.62	10.2	16.1	0.63	50.3	117.2	0.43
2003	21.2	25.2	0.84	10.4	8.1	1.28	19.6	11.2	1.75	52.3	NA	NA
2004	17.7	20.9 <sup>b/</sup>	0.85	6.6	3.4 <sup>b/</sup>	1.94	14.7	11.3 <sup>b/</sup>	1.30	101.1	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	0.41	18.1	80.6	0.22	40.6	104.6	0.39
2002	79.9	61.0 <sup>a/</sup>	1.31	14.5	30.4 <sup>a/</sup>	0.48	25.6	85.4 <sup>a/</sup>	0.30
2003	97.9	87.8 <sup>a/</sup>	1.12	27.7	49.8 <sup>a/</sup>	0.56	25.8	196.5 <sup>a/</sup>	0.13
2004	130.9	NA	NA	26.6	NA	NA	79.7	NA	NA

a/ Preliminary.

## **2005 Stock Status**

### **Washington Coastal Coho**

#### **Willapa Bay**

This is the fifth year hatchery and wild coho forecasts were estimated independently. The 2005 Willapa Bay hatchery coho abundance forecast is 56,400 ocean recruits, a 2% increase from the 2004 preseason forecast of 55,000. The hatchery forecast is based on 2004 smolt releases multiplied by the 1998-2004 average terminal return per release, expanded for the 1999-2002 average ocean exploitation rate for Forks Creek Hatchery releases. The natural coho forecast is 35,900 ocean recruits, based on the 1998-2004 average terminal run size of natural fish expanded for the 1999-2002 average ocean exploitation rate for unmarked Forks Creek Hatchery releases.

#### **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 2005 is 91,100 ocean recruits. The forecast for hatchery stock ocean abundance is 54,400 adults.

The natural coho forecast was generated by multiplying the 2002 escapement by the average terminal return per spawner for brood years with comparable escapement levels (1970, 1971, 1974, 1984, 1988, 1991, 1996, and 2001) and then expanding to ocean abundance using the 1996-1999 brood year average preterminal fishery exploitation rate for Bingham Creek wild CWT releases. The hatchery forecast is based on 2004 releases multiplied by the 1997-2003 average return per release, expanded to ocean abundance using the 1996-1999 brood year average preterminal exploitation rate for hatchery CWT releases.

#### **Quinault River**

The 2005 forecast for Quinault natural coho is 44,900 ocean recruits, an 11% decrease from the 2004 projected level of 50,500. This estimate represents the 2002 brood year escapement (12,213) multiplied by the 1996-2000 brood year average ocean recruits per spawner (3.67).

The Quinault hatchery coho forecast is 33,600 ocean recruits, an increase of 84% compared to the 2004 forecast level of 18,200. The forecast is derived from the mean 1996-2000 brood year observed marine survival rates (0.051) and 2002 brood year smolt release (657,000). Approximately 528,300 (80%) of the release was marked with an adipose fin clip.

#### **Queets River**

The 2005 Queets natural coho forecast is 17,100 ocean recruits, a decrease of 8% compared to the 2004 forecast level of 18,500. This forecast represents the estimated smolt production (443,600) multiplied by the survival predicted by a General Additive Model that incorporates environmental influences on adult survival.

The 2005 forecast for supplemental production is 2,400 ocean recruits, a decrease of 4% from the 2004 forecast level of 2,500. The abundance forecast is based on smolt releases (181,800) multiplied by the 1996-2000 brood year average recruits/release (0.013). Approximately 24% of supplemental releases are adipose fin clipped.

The 2005 Queets hatchery (Salmon River) coho forecast is 17,400 ocean recruits, an increase of 2% compared to the 2004 forecast level of 17,100. This forecast is based on the smolt release of 760,500 multiplied by the 1996-2000 brood year average observed marine survival rate (0.023). Approximately 10% of the fish released from the Salmon River facility were marked with an adipose fin clip.

### **Hoh River**

The Hoh River natural coho forecast is 7,600 ocean recruits, a decrease of 6% compared to the 2004 forecast of 8,100. 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 190,300 smolts. The total smolt production is then multiplied by 0.04, based on a sea surface temperature to marine survival model.

No hatchery production is projected for the Hoh system for 2005.

### **Quillayute River**

The Quillayute River summer natural and hatchery coho forecasts for 2005 are 800 and 6,100 ocean recruits, respectively. The natural component run size is based on estimated smolt production (18,100) and a projected ocean survival rate of 0.045 based on Bingham Creek jack return data and a sea surface temperature to marine survival model. The hatchery component run forecast is based on a forecast marine survival rate of 0.35 and a release size of 174,300 smolts. The 2005 forecast abundance of natural summer coho is 26% lower than the 2004 forecast, while the hatchery forecast is unchanged from the 2004 forecast level.

The Quillayute River fall natural and hatchery coho forecasts are 18,600 and 22,100 ocean recruits, respectively. The 2005 forecast abundances of natural and hatchery components of Quillayute fall coho are 12% below and 6% above their respective 2004 forecast levels. The forecast for the natural component is based on the estimated smolt production (412,300), multiplied by the projected ocean survival rate of 0.045 derived from Bingham Creek jack return data and a 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 (1.407) represents the ratio between the 2004 estimated smolt production for the Clearwater and the 1987, 1988, and 1990 average. Smolt production for fall and summer components combined was allocated according to brood year spawning escapements to yield smolt estimates of 412,300 and 18,100 for fall and summer stocks, respectively. The hatchery production forecasts are based on average ocean recruits per release (0.035) multiplied by the number of smolts released.

### **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 2005 forecast of natural coho production for these independent streams is 8,500 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 0.04. The marine survival projection was derived from jack-to-adult return information collected at the WDFW Bingham Creek research station.

The hatchery forecast of 5,600 is based on average brood year 1988-2000 marine survivals (0.0244 to December age-2) from the Makah National Fish Hatchery, multiplied by the 2002 brood year release (231,500) from the Makah National Fish Hatchery. Approximately 78% of the 2002 brood year release was marked with an adipose fin clip.

### **Puget Sound**

The 2005 total hatchery and natural coho ocean recruit forecast for the Puget Sound region is 1,009,060; 10% below the year 2004 forecast. The hatchery coho forecast of 463,929 is 8% below the 2004 forecast, and the natural coho forecast of 545,131 is 13% below the 2004 forecast.

Puget Sound hatchery forecasts for 2005 were generally the product of 2002 brood year smolt releases from each facility and a predicted marine survival rate for each facility, typically based on recent year average survival rates derived from CWT recovery information and/or run reconstructions. Forecasts for natural Puget Sound coho stocks 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, recruits/smolt or adult models, or other information.

### **Strait of Juan de Fuca**

The 2005 forecasts for Strait of Juan de Fuca natural and hatchery coho ocean recruits are 20,700 and 26,500, respectively. The natural coho forecast was derived by multiplying the estimated 2002 brood natural smolt production for the region by a predicted marine survival rate of 9.0%. The hatchery forecasts are based on applying hatchery-specific recruitment rate predictions (3.1% for Dungeness, 1.4% for Elwha) to the 2002 BY smolt releases for each hatchery. The recruitment rate predictions are based on recent year averages of cohort reconstruction-based recruits/smolt for the aggregate natural stock, and each hatchery production unit.

### **Nooksack-Samish**

The 2005 forecasts for Nooksack-Samish natural and hatchery coho ocean recruits are 22,697 and 24,540, respectively. The natural coho 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 7.0%. The natural coho marine survival rate prediction is based on the average Baker River (Skagit basin) indicator stock CWT based recruits/smolt rate. The hatchery forecasts are based on the 1999-2000 BY average recruits/smolt rate for Kendall Cr. Hatchery (3.9%), applied to the 2002 BY smolt releases.

### **Skagit**

The 2005 forecasts for Skagit River natural and hatchery coho ocean recruits are 61,881 and 9,119 (8,249 from in-river hatchery production, 870 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 7.0%. The natural coho marine survival rate is based on the average even brood year (1988-2002) Baker River indicator stock CWT based recruits/smolt rate. The even year average was 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 1988-2000 BY even year average marine survival rate for Cascade Hatchery (2.9%) applied to the 2002 BY smolt releases.

### **Stillaguamish**

The 2005 forecast for Stillaguamish River natural coho ocean recruits is 56,700, and 200 from a small tribal hatchery enhancement program. 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 and S. F. Skykomish River natural coho recruits/smolt rate rates. The hatchery forecast is based on the 1998-2000 BY average Wallace River Hatchery CWT based recruits/smolt rate (8.0%).

### **Snohomish**

The 2005 forecast for Snohomish River natural coho ocean recruits is 241,600. The Snohomish regional hatchery coho forecast is 59,100; 12,360 for the Wallace River Hatchery facility, 40,350 for the Tulalip Bay facility, 4,000 for the Possession Baithouse Net Pen located on southeast Whidbey Island, and 2,400 for the Skykomish River CoOp program. 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 and South Fork Skykomish River natural coho recruits/smolt rate rates. The forecast for the hatchery releases in this region is based on the 1998-2000 BY average Wallace River Hatchery CWT based recruits/smolt rate (8.0%).

### **South Sound**

The 2005 forecasts for South Sound region natural and hatchery coho ocean recruits are 45,703 and 222,207, respectively. The natural coho 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 3.0% - 5.0% in the deep South Sound region. The natural coho marine survival rate predictions are based upon review of the Big Beef Creek and Deschutes River indicator stocks, and review of hatchery and natural fish survival rate and/or adult run size information, which shows a consistent gradient of declining marine survival rates for coho originating from the southern vs. central Puget Sound regions. The hatchery coho forecasts are based on the 1998-2000 BY average CWT based recruits/smolt rate for each facility (1.8%-7.6%), applied to the 2002 BY smolt releases. Recent year survival rates have been highest for central Puget Sound hatchery facilities, and lower in southern Puget Sound.

### **Hood Canal**

The 2005 forecasts for Hood Canal region natural and hatchery coho ocean recruits are 98,400 and 60,600, respectively. The natural coho forecast is based on an average of two different regressions of Big Beef Creek jacks versus Hood Canal December age-2 natural coho run sizes. The hatchery coho forecasts are based on the 1998-2000 BY average cohort reconstruction-based recruits/smolt rates for each facility (0.9%-5.6%), applied to the 2002 BY smolt releases.

## **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 pre-season abundance forecasts. Agencies have released coho mass marked with adipose clips from the 2002 brood, making these fish available to 2005 fisheries (Table III-6).

## **EVALUATION OF 2004 REGULATIONS ON 2005 STOCK ABUNDANCE**

Escapements and fishery impacts were estimated using coho FRAM. Abundance forecasts for 2005 were updated for Washington and Oregon stocks, but forecasts for Canadian stocks are unchanged from those employed for 2004 planning. Updated forecasts for Canadian stocks are expected to become available in March 2005. To provide information on the effect of changes in abundance forecasts, the final 2004 pre-season regulatory package for ocean and inside fisheries was applied to 2005 projections of abundance.

## **Oregon Production Index Area**

Ocean fisheries were modeled with 2004 Council regulations and 2004 expectations for non-Council area fisheries. Under this scenario, expected exploitation rates are 21.9% on OCN coho and 10.1% on Rogue/Klamath hatchery coho. Expected spawner escapement is 119,800 for OCN coho (Tables III-7 and III-8).

Based on parent escapement levels and observed OPI smolt-to-jack survival for 2002 brood OPI smolts, the total allowable OCN coho exploitation rate for 2005 fisheries is no greater than 20% under Amendment 13 and no greater than 15% under the matrix developed by the OCN work group. (Table III-9; 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 2005 fisheries is 15% under the Oregon State management plan.

Predicted ocean escapements into the Columbia River in 2005 under this exercise show that under 2004 ocean regulations, marked Columbia River late coho would not meet inside harvest or 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 2005 preseason abundance forecasts and 2004 preseason projections for fishing patterns, are presented in Table III-7. More detailed fishery management goals for Council area coho stocks are listed in Appendix A, Table A-1.

Under 2004 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 U.S. stocks. Skagit and OCN appear to be the most limiting U.S. natural coho stocks. The exploitation rate by U.S. fisheries south of the Canadian border on Interior Fraser coho is projected to be 12%, exceeding the anticipated 10% allowable exploitation rate under the 2002 PST Coho Agreement.

Inside fisheries are anticipated to have greater impacts on Puget Sound and Interior Fraser River coho than 2004 because of the availability of pink salmon. Additionally, coho bycatch during Puget Sound fisheries directed at chum salmon will also be a consideration for preseason planning.

TABLE III-5. **Mass marking** of 2002 brood **coho** available to 2005 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	
<b><u>PUGET SOUND STOCKS:</u></b>			
Nooksack-Samish and 7/7A Independent	17,000	89,459	80.8%
Skagit	61,811	9,120	11.0%
Stillaguamish	56,700	200	0.0%
Snohomish	241,600	59,100	8.6%
South Puget Sound Normal	45,703	212,691	63.9%
South Puget Sound Delayed	0	9,516	99.6%
Hood Canal	99,620	59,302	30.4%
Strait of Juan de Fuca and Area 9	22,697	24,540	36.7%
Puget Sound Total	545,131	463,928	35.7%
<b><u>WASHINGTON COASTAL STOCKS:</u></b>			
North Coast Independent Tributaries	8,480	5,648	78.0%
Quillayute Summer	816	6,100	88.2%
Quillayute Fall	18,555	22,132	47.9%
Hoh	7,611	0	0.0%
Queets	17,123	19,781	15.7%
Quinault	44,912	33,560	34.4%
Grays Harbor	91,062	54,354	35.6%
Willapa Bay	35,891	56,427	58.2%
Washington Coastal Total	224,450	198,002	39.8%
<b><u>COLUMBIA RIVER STOCKS:</u></b>			
Columbia River Early		284,600	72.0%
Columbia River Late	-	78,000	84.0%
Columbia River Total	-	362,600	74.6%
OREGON COASTAL	28,300	152,000	9.0%
<b><u>SOUTHERN BRITISH COLUMBIA STOCKS:<sup>a/</sup></u></b>			
Georgia Strait Mainland	129,295	17,538	5.6%
Georgia Strait Vancouver Island	194,247	12,763	3.3%
Johnstone Strait	90,685	28,172	6.6%
Southwest Vancouver Island	34,011	40,008	30.3%
Northwest Vancouver Island	40,867	12,518	3.3%
Lower Fraser River	5,601	73,362	69.7%
Interior Fraser River	34,360	1,708	0.2%
Southern British Columbia Total	529,066	186,069	38.0%

a/ For this assessment, the percent mass marked was assumed to be the same as in 2004.

TABLE III-6. Projected **coho mark rates** for 2005 fisheries under base period fishing patterns (% marked). (Page 1 of 1)

Area	Fishery	June	July	August	Sept
<u>Canada</u>					
Johnstone Strait	Recreational	-	10%	10%	-
West Coast Vancouver Island	Recreational	32%	22%	20%	15%
North Georgia Strait	Recreational	18%	18%	18%	15%
South Georgia Strait	Recreational	22%	21%	15%	14%
Juan de Fuca Strait	Recreational	29%	27%	30%	31%
Johnstone Strait	Troll	28%	17%	11%	14%
NW Vancouver Island	Troll	25%	22%	25%	25%
SW Vancouver Island	Troll	33%	32%	34%	35%
Georgia Strait	Troll	29%	29%	30%	22%
<u>Puget Sound</u>					
Strait of Juan de Fuca (Area 5)	Recreational	36%	33%	34%	33%
Strait of Juan de Fuca (Area 6)	Recreational	34%	31%	35%	31%
Strait of Juan de Fuca (Area 7)	Recreational	27%	33%	33%	25%
North Puget Sound (Areas 6 & 7A)	Net	-	23%	25%	32%
<u>Council Area</u>					
Neah Bay (Area 4/4B)	Recreational	39%	36%	39%	41%
LaPush (Area 3)	Recreational	41%	38%	47%	26%
Westport (Area 2)	Recreational	51%	50%	54%	57%
Columbia River (Area 1)	Recreational	70%	66%	65%	69%
Tillamook	Recreational	58%	53%	49%	39%
Newport	Recreational	54%	53%	48%	37%
Coos Bay	Recreational	47%	47%	37%	22%
Brookings	Recreational	45%	34%	31%	15%
Neah Bay (Area 4/4B)	Troll	28%	39%	36%	43%
LaPush (Area 3)	Troll	37%	43%	42%	39%
Westport (Area 2)	Troll	34%	43%	52%	43%
Columbia River (Area 1)	Troll	50%	53%	57%	62%
Tillamook	Troll	52%	50%	53%	49%
Newport	Troll	51%	52%	48%	48%
Coos Bay	Troll	46%	46%	38%	31%
Brookings	Troll	38%	40%	42%	29%
<u>Columbia River</u>					
Buoy 10	Recreational	-	-	-	67%

TABLE III-7. Estimated **ocean escapements** for critical natural and Columbia River hatchery **coho** stocks (thousands of fish) based on preliminary 2005 preseason abundance forecasts and 2004 Council regulations.<sup>a/</sup> (Page 1 of 1)

Stock	Ocean Escapement Estimates Under 2004 Regulations <sup>b/</sup>		2005 Spawning Escapement Goal <sup>c/</sup>
	2005 Preseason Abundance	2004 Preseason Abundance	
<u>Natural Coho Stocks</u>			
Skagit	46.9	130.9	30.0 <sup>d/</sup>
Stillaguamish	39.0	26.6	17.0 <sup>d/</sup>
Snohomish	164.8	134.0	70.0 <sup>d/</sup>
Hood Canal	77.2	79.7	21.5 <sup>d/</sup>
Strait of Juan de Fuca	17.9	31.8	12.8 <sup>d/</sup>
Quillayute Fall	14.3	17.7	6.3 - 15.8
Hoh	5.6	6.6	2.0 - 5.0
Queets <sup>e/</sup>	12.3	14.7	5.8 - 14.5
Grays Harbor	74.4	101.1	35.4
OCN	119.8 (21.9%)	129.5 (14.7%)	Exploitation Rate ≤15.0%
R/K	NA (10.1%)	NA (8.6%)	Exploitation Rate ≤13.0%
<u>Hatchery Coho Stocks</u>			
Columbia Early	70.0	157.0	18.6
Columbia Late	4.3	84.1	11.9

a/ Quota levels include harvest and hooking mortality estimates used in planning the Council's 2004 ocean fisheries and a coho catch for the Canadian troll fishery off the West Coast of Vancouver Island (WCVI).

b/ 2004 preseason regulations include the following coho quota fisheries: Treaty Indian troll - 75,000 non-selective; non-Indian troll - 67,500 selective; recreational north of Cape Falcon - 202,500 selective; recreational Cape Falcon to Humbug Mt. - 75,000 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/ Annual management goals will be determined by the state and tribal comanagers during the preseason planning process. These goals will be expressed in terms of total mortality exploitation rate constraints.

e/ Ocean escapement of 12,260 wild does not include 915 supplemental.

TABLE III-8. Comparison of Oregon coastal natural (OCN) and Rogue/Klamath (RK) coho harvest mortality and exploitation rates by fishery under Council-adopted 2004 regulations and preliminary 2005 preseason abundance estimates. (Page 1 of 1)

Fishery	Harvest Mortality and Exploitation Rate			
	OCN		RK	
	Number	Percentage	Number	Percentage
SOUTHEAST ALASKA	0	0.0%	0	0.0%
BRITISH COLUMBIA	391	0.3%	8	0.1%
PUGET SOUND/STRAITS	148	0.1%	0	0.0%
NORTH OF CAPE FALCON				
Recreational	6,200	4.0%	11	0.1%
Treaty Indian Troll	1,707	1.1%	0	0.0%
Non-Indian Troll	3,650	2.4%	4	0.0%
SOUTH OF CAPE FALCON				
<b>Recreational:</b>				
Cape Falcon to Humbug Mt.	9,607	6.3%	59	0.6%
Humbug Mt. to Horse Mt. (KMZ)	2,835	1.8%	542	4.5%
Fort Bragg	1,040	0.7%	192	1.6%
South of Pt. Arena	899	0.6%	119	1.0%
<b>Troll:</b>				
Cape Falcon to Humbug Mt.	2,417	1.6%	26	0.3%
Humbug Mt. to Horse Mt. (KMZ)	158	0.1%	31	0.2%
Fort Bragg	753	0.5%	109	0.9%
South of Pt. Arena	1,026	0.7%	83	0.7%
BUOY 10	1,262	0.8%	0	0.0%
ESTUARY/FRESHWATER	1,435	0.9%	23	0.2%
<b>TOTAL</b>	<b>33,528</b>	<b>21.9%</b>	<b>1,207</b>	<b>10.1%</b>

TABLE III-9. 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.<sup>a/</sup> (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 <sup>b/</sup>		
	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	50,200	102,700	101,000	7,800	0.11%	Med	High	≤20%	Low	High	≤15%
2006	2003	56,800	65,600	96,200	6,800	-	-	Low	-	-	Low	-
2007	2004	59,700	36,900	93,200	24,500	-	-	Med	-	-	Med	-

a/ 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.

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

