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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 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 2002 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 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 ( $\text{Jack CR} * [\text{SmD}/\text{SmCR}]$ ) to predict public hatchery stock abundance.

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 2002 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 2003 abundance prediction, the data base includes 1970-2002 recruits, excluding 1983 when *El Niño* impacted adult returns. It also includes 1969-2001 jack returns, excluding 1982, also due to *El Niño* influence.

TABLE III-1. Preliminary 1996-2003 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
<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	-	-
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	-	-
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	-	-
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	-	-
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	-	-

TABLE III-1. Preliminary 1996-2003 **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
<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	-	-
<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	-	-

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:

$$\begin{aligned} a &= -118.268383 \\ b &= 19.416675 \\ c &= 16.916639 \\ d &= 31.850566 \\ \text{adjusted } r^2 &= 0.96 \end{aligned}$$

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 2002 preseason abundance prediction of 361,700 OPIH coho was 55% of the preliminary postseason estimate of 660,100 coho.

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

### **2003 Stock Status**

Using the appropriate values from Appendix B, Table B-2, the OPIH abundance prediction for 2003 is 863,100 coho, 239% of the 2002 prediction and 131% of the preliminary 2002 postseason estimate. The increase in predicted OPIH coho from 2002 to 2003 is primarily due to higher hatchery jack returns in 2002 relative to 2001.

## **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, 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:

a	=	4.603930
b	=	0.006892
c	=	-0.355493
adjusted r <sup>2</sup>	=	0.32

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 2002 abundance of 22,100 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 2002 preseason abundance prediction of 71,800 OCN coho was 24% of the preliminary postseason estimate of 304,500 coho.

### **2003 Stock Status**

The 2003 preseason prediction for OCN (river and lake systems combined) is 117,900 coho, 164% of the 2002 preseason prediction and 39% of the 2002 postseason estimate (Table III-1). The 2003 preseason SRS prediction for OCNR and OCNL components are 97,800 and 20,100 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 2003.

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

#### **Predictor Description**

From 1988 to 2002, 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 2003 prediction used the observed 1999 brood smolt to adult survival rate applied to the 2000 brood smolt production.

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

Year	Oregon and California Coastal Returns									
	Ocean Fisheries <sup>b/</sup>					Hatcheries and Freshwater Harvest <sup>c/</sup>				
	Troll	Sport	OCN Spawners	Private Hatcheries	Columbia River Returns	Abundance	Ocean Exploitation Rate Based on OPI Abundance	OCN Exploitation Rate Based on Postseason FRAM <sup>e/</sup>		
1970	1,463.7	499.0	80.3	71.7	895.3	3,010.0	0.65	-		
1971	2,543.5	715.8	53.8	94.8	544.5	3,952.4	0.83	-		
1972	1,275.6	560.3	29.9	34.1	277.8	2,177.7	0.84	-		
1973	1,320.3	443.2	42.2	55.4	291.3	2,152.4	0.82	-		
1974	2,095.1	668.6	49.5	34.5	460.8	3,308.5	0.84	-		
1975	1,079.2	463.7	19.2	40.4	292.5	1,895.0	0.81	-		
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	93.8	1,215.4	0.89	-		
1978	1,104.2	524.6	12.6	19.8	307.5	1,981.0	0.83	-		
1979	1,056.6	334.4	27.4	45.0	276.5	1,789.1	0.79	-		
1980	506.9	526.4	32.1	30.3	301.6	1,436.0	0.73	-		
1981	830.9	339.9	34.1	32.6	170.2	1,525.5	0.81	-		
1982	740.9	300.4	37.1	76.2	453.1	1,792.4	0.62	-		
1983	429.6	275.0	18.2	22.8	111.2	990.7	0.79	-		
1984	95.8	174.2	51.2	74.5	425.9	937.0	0.32	-		
1985	166.4	280.4	45.4	73.9	332.0	1,265.3	0.43	-		
1986	643.5	320.6	81.8	70.0	453.7	3,118.7	0.34	-		
1987	469.1	296.2	45.3	30.1	119.3	1,276.6	0.60	-		
1988	844.7	297.2	62.4	56.8	116.1	2,048.0	0.56	-		
1989	646.9	425.5	62.3	46.4	46.9	1,940.8	0.55	-		
1990	277.6	357.1	30.6	20.9	35.6	918.5	0.69	-		
1991	450.6	469.9	84.0	36.4	35.1	2,030.3	0.45	-		
1992	67.5	256.5	53.8	40.6	-	636.1	0.51	-		
1993	13.2	140.8	41.5	54.5	-	364.2	0.42	-		
1994	2.7	3.0	30.8	43.3	-	248.9	0.02	0.07		
1995	5.4	43.5	40.0	52.5	-	216.6	0.23	0.12		
1996	7.0	31.8	48.9	73.0	-	265.3	0.15	0.08		
1997	5.5	22.4	27.9	22.7	-	223.8	0.13	0.12		
1998	3.5	12.6	30.5	30.9	-	242.0	0.07	0.08		
1999	3.6	41.8	24.1	47.3	-	389.7	0.12	0.09		
2000	25.9	74.2	38.1	75.8	-	765.0	0.13	0.07		
2001 <sup>f/</sup>	38.0	216.8	85.4	169.5	-	1,618.9	0.16	0.07		
2002 <sup>f/</sup>	14.9	118.0	57.0	264.3	-	967.6	0.14	0.12		

a/ The OPI 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 1982-2002 and drop-off mortality for all years; sport fishery--hook and release mortality for 1994-2002 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 and 2002 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		Postseason		Preseason		Postseason		Preseason		Postseason		Preseason		Postseason		Preseason		Postseason		Preseason		Postseason	
	Forecast	Return	Pre/Postseason	Return	Forecast	Return	Pre/Postseason	Return	Forecast	Return	Pre/Postseason	Return	Forecast	Return	Pre/Postseason	Return	Forecast	Return	Pre/Postseason	Return	Forecast	Return	Pre/Postseason	Return
1984	7.0	11.0	0.64	7.7	2.7	0.35	7.7	5.2	9.7	0.54	9.7	5.2	28.7	103.8	0.28	28.7	103.8	0.28	28.7	103.8	0.28	28.7	103.8	0.28
1985	19.2	15.8	1.22	5.2	6.6	1.27	5.2	11.3	6.0	1.88	6.0	11.3	56.4	25.1	3.25	56.4	25.1	3.25	56.4	25.1	3.25	56.4	25.1	3.25
1986	6.1	17.1	0.36	6.4	3.9	0.61	6.4	5.2	5.8	0.90	5.8	5.2	51.6	33.3	1.55	51.6	33.3	1.55	51.6	33.3	1.55	51.6	33.3	1.55
1987	11.7	23.8	0.49	7.2	5.5	0.76	7.2	9.0	8.9	1.01	8.9	9.0	103.3	55.7	1.85	103.3	55.7	1.85	103.3	55.7	1.85	103.3	55.7	1.85
1988	10.4	9.1	1.14	2.6	2.0	0.77	2.6	4.7	4.5	1.04	4.5	4.7	26.4	58.0	0.46	26.4	58.0	0.46	26.4	58.0	0.46	26.4	58.0	0.46
1989	14.5	11.1	1.31	5.4	5.7	1.06	5.4	6.2	5.4	1.15	5.4	6.2	43.0	60.9	0.71	43.0	60.9	0.71	43.0	60.9	0.71	43.0	60.9	0.71
1990	15.2	9.5	1.60	4.5	5.1	1.13	4.5	5.9	7.1	0.83	7.1	5.9	48.3	57.3	0.84	48.3	57.3	0.84	48.3	57.3	0.84	48.3	57.3	0.84
1991	8.8	10.6	0.83	5.4	3.4	0.63	5.4	7.9	8.6	0.92	8.6	7.9	138.0	108.7	1.27	138.0	108.7	1.27	138.0	108.7	1.27	138.0	108.7	1.27
1992	12.5	13.6	0.92	5.0	4.9	0.98	5.0	5.6	7.0	0.80	7.0	5.6	48.4	40.9	1.18	48.4	40.9	1.18	48.4	40.9	1.18	48.4	40.9	1.18
1993	7.6	4.7	1.62	1.9	4.8	2.53	1.9	6.5	5.4	1.20	5.4	6.5	84.7	37.3	2.27	84.7	37.3	2.27	84.7	37.3	2.27	84.7	37.3	2.27
1994	7.0	6.4	1.09	1.4	3.0	2.14	1.4	3.6	1.2	3.00	1.2	3.6	31.3	11.8	2.65	31.3	11.8	2.65	31.3	11.8	2.65	31.3	11.8	2.65
1995	8.5	14.3	0.59	5.4	4.4	0.81	5.4	7.2	7.3	0.99	7.3	7.2	64.4	58.9	1.09	64.4	58.9	1.09	64.4	58.9	1.09	64.4	58.9	1.09
1996	9.2	14.6	0.63	5.8	3.0	0.52	5.8	5.4	10.7	0.50	10.7	5.4	82.7	82.4	1.00	82.7	82.4	1.00	82.7	82.4	1.00	82.7	82.4	1.00
1997	5.1	5.0	1.02	1.4	1.6	1.14	1.4	2.4	2.0	1.20	2.0	2.4	14.8	18.9	0.78	14.8	18.9	0.78	14.8	18.9	0.78	14.8	18.9	0.78
1998	7.4	17.0	0.44	5.2	3.2	0.62	5.2	4.5	4.6	0.98	4.6	4.5	27.1	41.2	0.66	27.1	41.2	0.66	27.1	41.2	0.66	27.1	41.2	0.66
1999	12.8	19.5	0.66	6.3	2.8	0.44	6.3	3.7	5.0	0.74	5.0	3.7	50.3	38.9	1.29	50.3	38.9	1.29	50.3	38.9	1.29	50.3	38.9	1.29
2000	8.2	17.7	0.46	8.8	3.3	0.38	8.8	2.5	8.3	0.30	8.3	2.5	44.2	40.8	1.08	44.2	40.8	1.08	44.2	40.8	1.08	44.2	40.8	1.08
2001	20.6	36.7 <sup>b/</sup>	0.56	14.8 <sup>b/</sup>	7.6	0.51	14.8 <sup>b/</sup>	10.6	32.6 <sup>b/</sup>	0.33	32.6 <sup>b/</sup>	10.6	46.6	71.3	0.65	46.6	71.3	0.65	46.6	71.3	0.65	46.6	71.3	0.65
2002	18.5	26.2 <sup>b/</sup>	0.71	10.2 <sup>b/</sup>	6.9	0.68	10.2 <sup>b/</sup>	10.2	NA	NA	NA	10.2	50.3	NA	NA	50.3	NA	NA	50.3	NA	NA	50.3	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 <sup>a/</sup>	0.35	15.0	32.5 <sup>a/</sup>	0.46	50.4	40.7 <sup>a/</sup>	1.24
2001	46.9	99.2 <sup>a/</sup>	0.47	18.1	78.6 <sup>a/</sup>	0.23	40.6	102.1 <sup>a/</sup>	0.40
2002	79.9	NA	NA	14.5	NA	NA	25.6	NA	NA

a/ Preliminary.



## **Predictor Performance**

Recent-year STEP preseason abundance predictions are compared to postseason estimates in Table III-1. The 2002 preseason abundance prediction of 600 coho was 20% of the preliminary postseason estimate of 3,000 coho.

## **2003 Stock Status**

The 2003 preseason STEP index abundance prediction is 3,600 coho (Table I-2). The 2003 prediction is above the 2002 preseason prediction of 600 coho due to improved smolt to adult survival rates.

### **Oregon Production Index Area Summary of 2003 Stock Status**

The 2003 combined OPI area stock abundance is predicted to be 984,600 coho, which is 227% of the 2002 preseason prediction of 434,100 coho and 102% of the 2002 postseason estimate of 967,600 coho. The 2003 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 2002 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.

#### **2003 Stock Status**

##### **Washington Coastal Coho**

###### **Willapa Bay**

This is the fourth year hatchery and wild coho forecasts were estimated independently. The 2003 Willapa Bay hatchery coho abundance forecast is 46,700 ocean recruits, a 16% increase from the 2002 preseason forecast of 40,400. The prediction is based on a recent four year mean return per release without adjustment for jack abundance. The natural coho ocean abundance forecast is 31,800 ocean recruits. This prediction is the average terminal run size estimate from 1998-2001. Terminal forecasts for both hatchery and natural stocks were expanded to ocean abundances using an ocean survival rate derived from Bingham Creek wild coded-wire tag recovery data.

###### **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 2003 is 58,018 ocean recruits. The forecast for hatchery stock ocean abundance is 64,000 adults.

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

### **Quinault River**

The 2003 forecast for Quinault natural coho is 47,700 ocean recruits, a 62% increase from the 2002 projected level of 29,400. This estimate represents the 2000 brood year escapement (11,474) multiplied by the 1993-1997 brood year average ocean recruits per spawner (4.16).

The Quinault hatchery coho forecast is 20,600 ocean recruits, an increase of 75% compared to the 2002 forecast level of 11,750. The forecast is derived from the mean 1994-1998 brood year observed marine survival rates (0.0326) and 2000 brood year smolt release (631,300). Approximately 486,800 (77%) of the fish released were marked with an adipose fin clip.

### **Queets River**

The Queets natural coho forecast is 24,000 ocean recruits, an increase of 92% compared to the 2002 forecast level of 12,500. This forecast represents the estimated smolt production multiplied by a projected survival of 6.03%, based on Bingham Creek jack returns and the 1997-2001 average ocean recruits/smolt.

The forecast for supplemental production is 1,300 ocean recruits, based on releases (111,380) multiplied by the 1995-1997 brood year average recruits/release (0.0121). Approximately 50% of supplemental releases were adipose fin clipped.

The Queets hatchery (Salmon River) coho forecast is 24,900 ocean recruits, an increase of 78% compared to the 2002 forecast level of 14,000. This forecast is based on the smolt release of 875,300 multiplied by the 1996-1999 brood year average observed marine survival rate (0.0284). Approximately 8.6% of the fish released from the Salmon River facility were marked with an adipose fin clip. CWTs were inserted into 16.4% of the fish released.

### **Hoh River**

The Hoh River natural coho forecast is 12,500 ocean recruits, an increase of 47% compared to the 2002 forecast of 8,500. 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 178,000 smolts. The total smolt production is then multiplied by 7%, the average of two point estimates of marine survival based on the Bingham Creek jack return model.

No hatchery production is projected for the Hoh system for 2003.

### **Quillayute River**

The Quillayute River summer natural and hatchery coho forecasts for 2003 are 1,800 and 5,400 ocean recruits, respectively. The natural component run size is based on estimated smolt production (26,200) and a projected ocean survival rate of 0.07 based on Bingham Creek jack return data. The hatchery component run forecast is based on 1980-1993 brood year average ocean recruits per release (0.0253) multiplied by the number of smolts released (215,300). The 2003 forecast abundance of natural summer coho is 50% above the 2002 forecast while the hatchery forecast is 10% above the 2002 forecast level.

The Quillayute River fall natural and hatchery coho forecasts are 24,900 and 15,200 ocean recruits, respectively. The forecast of the natural component run size is based on the estimated smolt production (348,900), multiplied by the projected ocean survival rate of 0.07 derived from Bingham Creek jack return data. The smolt production estimate was derived from the smolt production estimate from the Clearwater River tributary of the Queets. During 1987, 1988, and 1990, smolt production in the Clearwater was 1.32

times the average production of the Bogachiel and Dickey. Using 1.32 as a scalar for higher gradient tributaries of the Quillayute system (Bogachiel, Calawah, and SolDuc), yields an estimated 286,800 smolts ( $1.32 \times 217,257$ ). Because the Dickey is a lower gradient system, smolt production was estimated at its average production of 88,300. Total smolt production of summer and fall coho was estimated as 375,100 ( $1.32 \times 217,257 + 88,344$ ); smolt production for fall and summer components was proportioned according to brood year spawning escapements (348,900 fall and 26,200 summer). The hatchery production forecast is based on average ocean recruits per release (0.0247) multiplied by the number of smolts released (616,800). The 2003 forecast abundances of natural and hatchery components of Quillayute fall coho are 12% and 1% above their respective 2002 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 2003 forecast of natural coho production for these independent streams is 14,900 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 Cr. research station.

The hatchery forecast of 10,700 is based on average brood year 1988-1997 marine survivals (0.047 to December Age 2) from the Makah National Fish Hatchery, multiplied by the 2000 brood year release (304,300) from the Makah National Fish Hatchery, converted to ocean recruits (by dividing the product by 1.33). Approximately 87% of the 2000 brood year release was ad-clipped.

### **Puget Sound**

The 2003 total hatchery and wild coho ocean recruit forecast for Puget Sound is 1,029,600, 27% above the year 2002 forecast. The hatchery forecast of 493,200 is 10% over the 2002 forecast. The wild forecast of 536,400 is 49% above the 2002 forecast.

Puget Sound hatchery forecasts are generally the product of 2000 brood year smolt releases from each facility and the predicted marine survival rate. Natural forecasts for Puget Sound coho were generally derived by measured or estimated smolt production from each major watershed or region within Puget Sound, multiplied by a marine survival rate prediction.

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

The 2003 forecasts for Strait of Juan de Fuca natural and hatchery coho ocean recruits are 25,563 and 18,609, respectively. The estimate is derived by multiplying the estimated natural smolt production by the predicted marine survival rate (0.076%).

### **Nooksack-Samish**

The 2003 forecasts for Nooksack-Samish natural and hatchery coho ocean recruits are 16,360 and 66,174, respectively. The forecast is the product of projected smolt production from these basins and a predicted marine survival rate.

### **Skagit**

The 2003 forecasts for Skagit natural and hatchery coho ocean recruits are 116,626 and 10,385, respectively. The estimate is derived by multiplying the estimated natural smolt production by the predicted marine survival rate.

### **Stillaguamish**

The 2003 forecast for Stillaguamish natural coho ocean recruits is 37,800. No hatchery production is anticipated. 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.

### **Snohomish**

The 2003 forecasts for Snohomish natural and hatchery coho ocean recruits are 203,00 and 35,400, respectively. The Snohomish wild coho prediction was developed from a recruit per spawner times the Wallace River Hatchery coho marine survival rate. The Snohomish Hatchery coho prediction was based on the Wallace River Hatchery coho marine survival rate.

### **South Sound**

The 2003 forecasts for South Puget Sound natural and hatchery coho ocean recruits are 103,600 and 315,648, respectively. The estimate is derived by multiplying the estimated natural smolt production based on watershed area by the predicted marine survival rate.

### **Hood Canal**

The 2003 forecasts for Hood Canal natural and hatchery coho ocean recruits are 33,437 and 46,963, respectively. The 2002 Hood Canal natural coho forecast is based on an average of four different regressions of Big Beef Creek jacks versus Hood Canal December age-two run sizes.

## **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 2000 brood, making these fish available to 2003 fisheries.

## **EVALUATION OF 2002 REGULATIONS ON 2003 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 2003 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 2002 Council regulations and 2002 expectations for non-Council area fisheries. Under this scenario, expected exploitation rates are 7.2% on OCN coho and 5.4% on Rogue/Klamath hatchery coho. Expected spawner escapement is 109,700 for OCN coho (Tables III-6 and III-7).

Based on parent escapement levels and observed OPI smolt-to-jack survival for 2000 brood OPI smolts, the total allowable OCN coho exploitation rate for 2003 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%. 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 2003 fisheries is 20% under the Oregon State management plan.

Ocean escapements into the Columbia River in 2003 would be sufficient to provide inside harvest and meet hatchery egg take goals.

TABLE III-5. **Mass marking** of 2000 brood **coho** available to 2003 Council fisheries. All stocks were marked with an adipose fin clip. (Page 1 of 1)

Region	Ocean Recruits (thousands of fish)		Percent Mass Marked
	Wild	Hatchery	
<b>PUGET SOUND STOCKS:</b>			
Nooksack-Samish and 7/7A Independent	16.4	66.2	77.1%
Skagit	116.6	10.4	6.9%
Stillaguamish	37.8	1.3	0.6%
Snohomish	203.0	35.4	9.4%
South Puget Sound Normal	103.6	297.0	71.0%
South Puget Sound Delayed	-	18.7	100.0%
Hood Canal	33.4	47.0	46.0%
Strait of Juan de Fuca and Area 9	25.6	18.6	33.9%
Puget Sound Total	536.4	494.6	43.7%
<b>WASHINGTON COASTAL STOCKS:</b>			
North Coast Independent Tributaries	14.8	10.7	36.4%
Quillayute Summer	1.8	5.4	74.8%
Quillayute Fall	24.9	15.2	33.3%
Hoh	12.5	0.0	0.0%
Queets	24.0	26.2	6.9%
Quinault	47.7	20.6	23.2%
Grays Harbor	58.0	64.0	51.0%
Willapa Bay	31.8	57.5	62.3%
Washington Coastal Total	215.5	199.6	39.8%
<b>COLUMBIA RIVER STOCKS:</b>			
Columbia River Early	-	440.0	79.6%
Columbia River Late	-	377.9	76.9%
Columbia River Total	-	817.9	86.7%
OREGON COASTAL	117.9	45.2	78.4%
<b>SOUTHERN BRITISH COLUMBIA STOCKS:<sup>a/</sup></b>			
Georgia Strait Mainland	60.4	22.8	17.3%
Georgia Strait Vancouver Island	75.6	74.2	37.2%
Johnstone Strait	32.3	13.2	16.8%
Southwest Vancouver Island	66.3	39.0	34.1%
Northwest Vancouver Island	105.6	4.6	4.2%
Lower Fraser River	45.3	121.4	69.2%
Upper Fraser River	2.9	0.0	0.1%
Thompson River	104.0	0.7	0.2%
Southern British Columbia Total	492.4	275.9	30.4%

a/ For this assessment, the same numbers were used as in 2002.

TABLE III-6. Estimated **ocean escapements** for critical natural and Columbia River hatchery **coho** stocks based on preliminary 2003 preseason abundance forecasts and 2002 Council regulations. <sup>a/</sup> (Page 1 of 1)

Stock	Ocean Escapement Estimates Under 2002 Regulations <sup>b/</sup>		2002 Spawning Escapement Goal <sup>c/d/</sup>
	2003 Preseason Abundance	2002 Preseason Abundance	
<b>COHO (thousands)</b>			
<u>Natural Coho Stocks</u>			
Skagit	99.5	88.4	Exploitation Rate (30.0)
Stillaguamish	30.0	15.7	Exploitation Rate (17.0)
Snohomish	157.4	98.0	Exploitation Rate (70.0)
Hood Canal	26.3	29.5	Exploitation Rate (21.5)
Strait of Juan de Fuca	18.4	19.7	Exploitation Rate (12.8)
Quillayute Fall	22.2	20.8	6.3 - 15.8
Hoh	11.0	7.5	2.0 - 5.0
Queets <sup>e/</sup>	20.9	12.4	5.8 - 14.5
Grays Harbor	54.7	51.5	35.4
OCN	109.7 (7.2%) <sup>f/</sup>	63.8 (10.8%) <sup>f/</sup>	Exploitation Rate ≤ 15% <sup>g/</sup>
<u>Hatchery Stocks</u>			
Columbia Early	355.5	78.4	18.6
Columbia Late	258.9	49.6	11.9

a/ Quota levels include harvest and hooking mortality estimates used in planning the Council's 2002 ocean fisheries and a coho catch for the Canadian troll fishery off the West Coast of Vancouver Island (WCVI).

b/ 2002 regulations include the following coho quota fisheries: Treaty Indian troll - 60,000 non-selective; non-Indian troll - 5,000 selective; recreational north of Cape Falcon - 109,700 selective; recreational Cape Falcon to Humbug Mt. - 22,500 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 Amendment 14 of the Salmon Framework Management Plan.

e/ Ocean escapement of 12,400 is 10,800 wild and 1,600 supplemental.

f/ Numbers in parentheses represent estimated total exploitation rates.

g/ The OCN coho maximum allowable exploitation rate (marine and freshwater combined) of 15% under Amendment 13. For 2002, the Council elected to constrain fisheries so that the OCN exploitation rate would not exceed 12.5% per ODFW's recommendation to provide additional protection for lower Columbia River natural coho, which are listed as endangered under the Oregon State-ESA.

TABLE III-7. Comparison of Oregon coastal natural (OCN) and Rogue/Klamath (RK) coho harvest mortality and exploitation rates by fishery under Council-adopted 2002 regulations and preliminary 2003 pre-season 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	57	0.0	0	0.0
PUGET SOUND/STRAITS	152	0.1	0	0.0
NORTH OF CAPE FALCON				
Treaty Indian Troll	429	0.4	0	0.0
Recreational	606	0.5	2	0.0
Non-Indian Troll	389	0.3	0	0.0
SOUTH OF CAPE FALCON				
<b>Recreational:</b>				
Cape Falcon to Humbug Mt.	1,065	0.9	4	0.0
Humbug Mt. to Horse Mt. (KMZ)	903	0.8	152	1.3
Fort Bragg	601	0.5	106	1.0
South of Pt. Arena	670	0.6	108	1.0
<b>Troll:</b>				
Cape Falcon to Humbug Mt.	803	0.7	8	0.1
Humbug Mt. to Horse Mt. (KMZ)	184	0.2	59	0.5
Fort Bragg	328	0.3	50	0.4
South of Pt. Arena	784	0.7	79	0.7
BUOY 10	169	0.1	0	0.0
ESTUARY/FRESHWATER	1,312	1.1	28	0.3
<b>TOTAL</b>	<b>8,452</b>	<b>7.2</b>	<b>596</b>	<b>5.4</b>

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 <sup>a/</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	18,600	15,800	38,000	11,000	0.20%	Med	Low	≤15%	Med	Low	≤15%
2004	2001	33,700	25,500	109,000	12,200	-	-	Low	-	-	Low	-
2005	2002	52,200	104,100	108,000	7,800	-	-	High	-	-	High	-

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



### **North of the Oregon Production Index Area**

Ocean escapement expectations in relation to management goals for selected naturally-spawning coho stocks, given 2003 preseason abundance forecasts and 2002 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 2002 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.