

CHAPTER III - COHO SALMON ASSESMENT

COLUMBIA RIVER AND OREGON/CALIFORNIA COAST 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, and are divided into the following components: (1) public hatchery (OPIH), (2) Oregon coastal natural (OCN), including river and lake components, (3) Lower Columbia natural (LCN), and (4) natural and hatchery stocks south of Cape Blanco, Oregon, which include the Rogue, Klamath, and Northern California coastal stocks.

A stratified random sampling (SRS) study implemented in 1990 indicated an overestimation of annual OCN spawner escapement, which had previously been based on nonrandom standard index surveys. Because the stock composition of the OPI area ocean impacts is based on the proportions of the OPI ocean escapements, a reduction in OCN spawner escapement meant that traditional OCN ocean impacts and abundances were overestimated, while traditional ocean impact and abundance estimates for other OPI area stocks had been 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 1998, a random site selection procedure based on the EPA's Environmental Monitoring and Assessment Program (EMAP) has been used instead of the SRS methodology. The random survey sampling provides abundance estimates consistent with SRS estimates.

Beginning in 1998, with the availability of a long-term data set in SRS values and the random survey sampling values, all OPI area stock abundances were projected using random sampling accounting. Direct comparisons of 2010 abundance forecasts with recent year preseason abundance forecasts and postseason estimates, are reported in Table III-1. All fishery impacts and escapements from the Coho FRAM are reported in random sampling values.

Beginning in 2008, a new method was developed to estimate coho abundances for both the natural and hatchery components of the Columbia River and the Oregon coast. The traditional method of stock abundance estimation used only catch data from Leadbetter Point, Washington, to the U.S./Mexico border. The assumption in the SRS accounting was that OPI stocks that were caught north of the OPI area were balanced by northern stocks that were caught inside the OPI area. This assumption was valid as long as fisheries north and south were balanced. However, in recent years, fisheries to the south have been more restrictive than those to the north, leading to underestimation of harvest of OPI area stocks. In addition, the estimation technique was not consistent with the methods used in the Coho FRAM. The Mixed Stock Model (MSM) used for constructing the FRAM base period data was used to estimate the contribution of various coho stocks, including the OPI area stocks, to ocean fisheries and was based on CWTs and associated tag rates. The MSM includes all fisheries that impact a particular stock and therefore should provide a better overall accounting of total harvest and mortality of both Columbia River and Oregon coast coho stocks. The new run size estimates are based on the 1986-1997 base period and "backwards" FRAM runs for more recent years. The Oregon Production Index Technical Team (OPITT) decided to use the MSM run reconstruction database for future accounting and forecasts. The MSM

estimates were refined for use in 2009, with particular attention to the base period reconstruction for OCN coho. In 2010 the relationship between the SRS and MSM time series was reconsidered. The changes in fishery effort patterns that resulted in biased harvest estimates began in the mid- to late-1990s, so the first few years of the MSM time series should be equivalent to the SRS time series. This was used as justification to use the MSM data set as a continuation of the SRS time series starting in 1986. In 2010 the OPI hatchery and OCN predictors used the longer, merged time series. This results in a higher level of statistical significance for the predictors and lower residuals in most recent years.

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

Prior to 2008, the OPIH stock predictor was a multiple linear regression with the following variables: (1) Columbia River jacks (Jack CR), (2) Oregon coastal and Klamath River Basin jacks (Jack OC), and (3) a correction term for the proportion of delayed smolts released from Columbia River hatcheries (Jack CR * [SmD/SmCR]).

In 2008 the stock predictor was modified slightly from that used in previous years. Because of the shorter data set (1986-2007 vs. 1970-2007) and the near-total phase-out of coastal coho salmon hatcheries, the factor for Oregon and California jacks (Jack OC) was not significant in the regression. A simplified model with all OPI jacks combined into one term (Jack OPI) was used, and all parameters were significant. In 2010 the longer (1970-2009) time series was used with the simplified model.

The OPIH stock predictor is partitioned into Columbia River early and late stocks based on the proportion of the 2009 jack returns of each stock adjusted for stock specific maturation rates. The coastal hatchery stock is partitioned into northern and southern coastal stock components. 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. The 2010 partition was based on the proportion of the smolt releases in 2009.

For the 2010 abundance forecast, the data base includes 1970-2009 recruits and 1969-2008 jack returns (in thousands of fish). The model was:

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

Where:

$$a = -92.45$$

$$b = 19.55$$

$$c = 25.79$$

$$\text{adjusted } r^2 = 0.94$$

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 forecasts, partitioned by production area, stock, and as a total, are compared with postseason estimates in Table III-1. The 2009 preseason abundance prediction of 1,073,100 OPIH coho was 101 percent of the preliminary postseason estimate of 1,066,200 coho.

Since 1983, the OPIH predictor has performed well. The years with the highest variations were due principally to high interannual variability in the jack-to-adult ratios.

2010 Stock Status

Using the appropriate values from Appendix B, Table B-2, the OPIH abundance forecast for 2010 is 408,000 coho, 38 percent of the 2009 prediction and also 38 percent of the preliminary 2009 postseason estimate.

OREGON COASTAL NATURAL COHO

The OCN stock is composed of natural production north of Cape Blanco, Oregon from river (OCNR) and lake (OCNL) systems, which are forecasted independently.

Predictor Description

Oregon Coastal Natural Rivers

From 1988-1993, the abundance of OCNR index coho was forecasted 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 over-predict abundances, the database in the predictor was shortened from 1970-1991 to 1980-1991 in 1992 and 1993.

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 were 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 2003-2007, the same environmental-based model without the year component that was used for 1996-1998 was used in predicting OCNR abundance.

In 2008, OPITT adopted a new abundance time series based on MSM run reconstructions and “backwards” FRAM modeling. This time series starts in 1986, in contrast to the SRS time series, which starts in 1970. There is much less contrast in the environmental variables in the shorter time period than there was in the longer period. In addition, there appears to be a weaker relationship between abundance and the environmental variables in recent years.

For 2008, several models using the MSM time series were considered. These all tended to predict higher abundances than what would reasonably be expected and none were statistically significant. In the absence of a satisfactory model, OPITT examined patterns in ocean conditions and hatchery jack returns and determined that the 2007 postseason abundance estimate of 50,000 coho was the most appropriate forecast for 2008.

In 2009 the MSM base period estimates for OCN coho were revised to resolve some of the issues raised in 2008. As the new estimates were not available until the day before the prediction was due, there was little time to explore predictive relationships. There were indications that the revised data set was better correlated with environmental data, and the new environmental indicators looked promising. For 2009 and 2010, however, a variation on the adopted predictor was chosen. The adopted predictor is based on JanAnom in the return year and UpAnom in the year of ocean entry. In some years, an additional variable, Year, was added to capture a long-term downward trend in the data that was not represented in the environmental time series. With the recent shift in ocean conditions this linear trend was no longer apparent, but the pattern in residual errors of the predictor matched the regime shifts in 1990 and 2000. Until a more objective index of regime changes can be incorporated in the predictor, an index variable called RegInd (Regime Index) was used for the 2009 and 2010 predictor. This variable flags the cold regimes (1986-1989, 2001 - 2009) with a 0 and the warm regime (1990 – 2000) with a 1, and by itself explains over 50 percent of the variability of the time series.

The model used for the 2010 forecast was:

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

Where:

a	=	5.0245
b	=	0.0057
c	=	-0.2343
d	=	-0.9949
adjusted r ²	=	0.71

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, except for 2008, 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). Production from these systems has declined substantially from the levels observed during 1950-1973, but has steadily increased in recent years. Following the same reasoning used for the OCN Rivers predictor in 2008, OPITT chose to use the 2007 postseason abundance estimate of 10,000 coho for the 2008 preseason prediction instead of using the most recent three-year average.

For 2010, OPITT chose to use the most recent three-year average adult stock abundance which predicts 16,600 coho.

Predictor Performance

Recent year OCN preseason abundance predictions are compared to postseason estimates in Table III-1. Since 2000 the OCN predictor has under estimated abundance except for 2005 and 2007. The 2009 preseason abundance prediction of 211,600 OCN coho was 82 percent of the preliminary postseason estimate of 257,000 coho.

2010 Stock Status

The 2010 preseason prediction for OCN (river and lake systems combined) is 148,000 coho, 70 percent of the 2009 preseason prediction and 58 percent of the 2009 postseason estimate (Table III-1). The 2010 preseason prediction for OCNR and OCNL components are 131,400 and 16,600 coho, respectively.

PRIVATE HATCHERY COHO

There have been no Oregon coastal PRIH coho smolt releases since 1990.

SALMON TROUT ENHANCEMENT HATCHERY COHO SMOLT PROGRAM

Predictor Description

From 1988 to 2007, preseason abundance predictions for Oregon coastal STEP index coho smolt production facilities were based on the Council-approved procedure, which involved multiplying the average smolt to adult survival rate by the ratio of the current OPI jack survival to the previous year's OPI jack survival.

Predictor Performance

Recent year STEP preseason abundance predictions are compared to postseason estimates in Table III-1.

2010 Stock Status

Due to changes with the STEP program, releases were discontinued after the 2004 brood and forecasts were discontinued in 2008 (Table III-1).

LOWER COLUMBIA RIVER NATURAL

Predictor Description

The 2010 prediction for the Clackamas River is based on the recent 3-year cohort average counts at North Fork dam. The Clackamas forecast for 2010 is 3,500 wild fish at North Fork dam. The forecast for other Oregon lower Columbia natural (LCN) populations, including the Sandy River, are 3-year averages of recent year abundances based on spawning ground counts. The 2010 forecast for these other Oregon areas combined is 3,500 coho returning to their respective tributaries.

The 2010 prediction for the Washington LCN coho populations are derived by combining estimates of natural smolt production based on watershed area and a predicted 2007 brood year marine survival rate. The 2010 adult ocean abundance forecast for Washington LCN coho is 7,900 coho.

Predictor Performance

The LCN stock predictor methodology was developed in 2007. The preseason abundance compared to the postseason estimate is presented in Table III-1. The 2009 preseason abundance prediction of 32,700 LCN coho was 81 percent of the preliminary postseason estimate of 40,400 coho.

2010 Stock Status

The 2010 prediction for LCN coho is 15,100 coho (Table III-1). This ocean abundance estimate includes both Oregon and Washington LCN components.

OREGON PRODUCTION INDEX AREA SUMMARY OF 2010 STOCK STATUS

The 2010 combined OPI area stock abundance is predicted to be 556,000 coho, which is 43 percent of the 2009 preseason prediction of 1,284,700 coho and 42 percent of the 2009 preliminary postseason estimate of 1,323,200 coho. The 2010 OPI area forecasts are compared to historical abundances in Table III-2.

WASHINGTON COAST 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 (age-3) 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 2009 ocean escapements for some of these stocks were not available. 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.

2010 STOCK STATUS

Washington Coastal Coho

Willapa Bay

The 2010 Willapa Bay hatchery coho abundance forecast is 78,700 ocean recruits compared to a 2009 preseason forecast of 59,420. The natural coho forecast is 20,400 ocean recruits, compared to a 2009 preseason forecast of 33,544. Both the hatchery and natural forecasts are based on a regression of hatchery or natural jacks on terminal adult hatchery or natural returns for the 1994-2006 brood years (1998 excluded as an outlier for the natural forecast).

Grays Harbor

For 2010, Grays Harbor natural and hatchery coho forecasts were not agreed-to by the co-managers at the time of this report. This forecast and a description of the method used will be provided at a later date..

The hatchery coho forecast consists of an estimate of smolt releases from on- and off-station sites, multiplied by the average return per release for return years 1999-2008 then expanded to ocean recruit abundance based on CWT recoveries.

Quinault River

The 2010 forecast for Quinault natural coho is 16,706 ocean recruits, a slight increase from the 2009 forecast of 16,313. This forecast is based on the mean estimate of recent ocean recruits for 2003 through 2008.

The Quinault hatchery coho forecast is 26,575 ocean recruits, virtually the same as the 2009 forecast. This return is from a release of 643,592 smolts compared to a release of 667,406 smolts the previous year,

and is based on a recent 5-year average smolt return rate of 4.13 percent for the Quinault National Fish Hatchery.

Queets River

For 2010, a Queets natural and hatchery coho forecast was not agreed-to by the co-managers at the time of this report. This forecast and a description of the method used will be provided at a later date.

Hoh River

The Hoh River natural coho forecast is 7,608 ocean recruits, a decrease of 19.9 percent compared to the 2009 forecast of 9,496. This forecast is based on estimated smolt production per square mile of watershed from the Clearwater tributary to the Queets River (397 smolts/square mile), multiplied by the size of the Hoh watershed (299 square miles), for a total of 217,373 smolts. The total natural smolt production estimate was then multiplied by an expected survival rate of 3.5 percent. This survival rate is lower than the 8.0 percent used in 2009 because of a sharp downturn in jack returns in 2009 from the record returns of 2008, including hatchery jacks to the Sol Duc Hatchery, wild jack returns to the Bingham trap on the Satsop River, and Columbia River jacks. The Pacific Decadal Oscillation (PDO) was favorable during the spring outmigration period, but conditions turned warmer and less favorable later in the summer, possibly explaining NWFSC's very low trawl catch of juvenile coho off the coasts of Washington and Oregon, and lower than average jack returns to the Coast and Columbia River. A model produced by the Quinault Tribe's Fisheries Department using an annual PDO index derived by taking the mean of the 12 monthly PDO values during calendar year 2009, points to 6.09 percent marine survival to ocean age-3 for Queets wild coho, but when the same survivals are regressed against the NWFSC's September trawl catch of coho, to the marine survival estimate is 2.7 percent. Given the ocean trawl results, and the estimate of natural freshwater production, the 3.5 percent survival rate is a reasonable estimate for the Hoh system natural coho.

No hatchery production is projected for the Hoh system for 2010.

Quillayute River

The Quillayute River summer natural and hatchery coho forecasts for 2010 are 2,801 and 3,198 ocean recruits, respectively. The natural component run size is based on the estimated total summer coho smolt production (56,011) and a projected ocean survival rate of 5.0 percent. This is a lower ocean survival rate than the 8.0 percent used in 2009. The Queets Pacific Decadal Oscillation model and Elwha jack returns result in a 6.0 percent marine survival estimate. The September trawls off the coasts of Washington and Oregon indicate lower coho populations and the Bingham Creek jack model indicates a marine survival estimate of 2.6 percent. The 5.0 percent marine survival estimate for the Quillayute system wild coho represents a reasonable value within the range of estimates available.

For the hatchery component, an ocean survival rate of 3.0 percent was selected. An examination of the return rates of both hatchery releases and natural smolts indicates that hatchery return rates are 1.5 to 2.0 percent below natural returns. The survival rate of 3.0 percent was multiplied by a release of 106,600 smolts. Approximately 99 percent of the fish were marked with an adipose fin clip; an additional 853 unmarked smolts were released. The 2010 forecast abundance of natural summer coho is 25 percent higher than the 2009 forecast, while the hatchery forecast is 75 percent lower than the 2009 forecast level.

The Quillayute River fall natural and hatchery coho forecasts are 22,037 and 17,742 ocean recruits, respectively. The 2010 forecast abundance of natural Quillayute fall coho is 14 percent higher, and the hatchery forecast is 55 percent lower, than their respective 2009 forecast levels. The forecast for the natural component is based on the estimated total fall coho smolt production (440,733) multiplied by an expected marine survival rate of 5.0 percent, which was derived as described for the summer natural

returns above. The fall hatchery production forecast was based on the same prediction of marine survival (3.0 percent) used for the summer hatchery coho forecast, multiplied by a release of 591,426 smolts. Approximately 73.7 percent of the hatchery fish were marked with an adipose fin clip only, 12.7 percent with an adipose fin clip and coded wire tag, and 12.8 percent with coded wire tag only. An additional 0.75 percent or 4,423 smolts were estimated to have been released without a mark or tag.

The basin total coho smolt production estimate (summer and fall stocks) was derived using the estimated coho smolt production in the Clearwater Basin of 101,820, which is 1.6 times its average production during the years a smolt trap was operated on the Bogachiel River (1992-1994) and 1.7 times its average production during the years a trap was operated on the Dickey River (1987, 1988, and 1990). Using 1.61 as a multiplier of the estimated average smolt production of the Quillayute system excluding the Dickey, yields an estimated production of 349,282 coho smolts. The Dickey production yields an additional 147,462 smolts to the system. The total freshwater production for the basin is estimated to be 496,744. Smolt production was apportioned according to brood year natural spawning escapements of summer and fall coho to yield the smolt estimates for each natural population.

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 2010 forecast of natural coho production for these independent streams is 4,200 ocean recruits, based on a prediction of 500 smolts per square mile of watershed drainage, 424 square miles of watershed, and an expected marine survival rate of 2.0 percent. The marine survival projection was derived from jack-to-adult return information collected at the WDFW Bingham Creek research station (2.6 percent) and then reduced for the uncertainty associated with 2009 *El Niño* conditions.

The hatchery forecast of 5,707 ocean recruits is developed from linear regression model estimates of marine survival, predicted by the jack return rate for coho from the Makah National Fish Hatchery. The predicted marine survival of 4.7 percent for the brood year 2007 was multiplied by the 2007 brood year smolt release (162,156) from the Makah National Fish Hatchery. For the 2007 brood year release, 79 percent were marked with an adipose fin clip.

Puget Sound

The 2010 total hatchery and natural coho ocean recruit forecast for the Puget Sound region of 613,930 is 5.4 percent above the 2009 forecast of 582,462. The hatchery coho forecast of 316,133 is 6.7 percent below the 2009 forecast of 338,968, and the natural coho forecast of 297,797 is 22.3 percent above the 2009 forecast of 243,495.

Puget Sound hatchery forecasts for 2010 were generally the product of 2007 brood year (BY) smolt releases from each facility, and a predicted marine survival rate for each program. Marine survival rates were typically based on recent year average survival rates derived from CWT recovery information and/or run reconstructions, and review of relationships between jack returns and adult marine survival rates at selected hatcheries. 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 a jack return model from the WDFW Big Beef Creek Research Station in Hood Canal, adult recruits/smolt data generated from the WDFW Deschutes River Research Station, and a natural coho CWT tagging program at Baker Lake (Skagit River basin), or other information.

Strait of Juan de Fuca

The 2010 forecasts for Strait of Juan de Fuca (SJF) natural and hatchery coho ocean recruits are 8,463 and 7,768, respectively. As in past years, this forecast includes both Eastern and Western Strait of Juan de Fuca drainages. The natural coho forecast was derived by multiplying the estimated 2007 brood natural smolt production for the region by a predicted ocean marine survival rate developed by two different models. One of the predictive models was based on a relationship between an index of the PDO and observed survival rates, and the other a relationship of Elwha Hatchery jack returns to observed survival rates. The forecasted abundances developed by each model were averaged to produce the final forecast. The hatchery forecasts were based on applying hatchery-specific ocean recruitment rate predictions (1.29 percent for Dungeness, 0.29 percent for Elwha) to the 2007 BY smolt releases for each hatchery. The recruitment rate predictions for the hatchery stocks were based on recent 3-year averages of cohort reconstruction-based recruits/smolt released in each hatchery production unit.

The preliminary preseason forecast of 8,463 age-3 ocean recruits places Strait of Juan de Fuca natural coho in the critical abundance based status category, which results in an allowable total exploitation rate of no more than 20 percent under the Council adopted exploitation rate matrix (Appendix A, Table A-4).

Nooksack-Samish

The 2010 forecasts for Nooksack-Samish natural and hatchery coho ocean recruits are 9,600 and 35,999 respectively. The natural coho forecast is the product of projected natural smolt production from each stream basin in the region, multiplied by a marine survival rate expectation of 3.0 percent. The natural coho marine survival rate prediction is based on the Big Beef Creek jack-based marine survival prediction, with a 50 percent discount applied to reflect the significantly lower survival rates observed for extreme northern Puget Sound-origin coho in recent years relative to elsewhere in Puget Sound. The hatchery forecasts are based on the 2003-2005 BY average recruits/smolt rate for Kendall Creek Hatchery (1.0 percent), applied to the 2007 BY smolt releases for each facility in the region.

Skagit

The 2010 forecasts for Skagit River natural and hatchery coho ocean recruits are 95,880 and 9,541 (8,551 from in-river hatchery production, 990 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 9.1 percent. The natural coho marine survival rate is based on the average of the 1990-2009 BY (even years only) Skagit natural recruits/smolt rate. The hatchery forecasts are based on an average marine survival rate of the 2003-2005 BY Cascade Hatchery CWT-based recruits/smolt rate of 3.3 percent.

The preliminary preseason forecast of 95,880 age-3 ocean recruits places Skagit natural coho in the normal abundance based status category, which results in an allowable total exploitation rate of no more than 60 percent under the Council adopted exploitation rate matrix (Appendix A, Table A-4).

Stillaguamish

The 2010 forecast for Stillaguamish River natural coho ocean recruits is 25,900. The natural coho forecast is derived from the estimated smolt production from the basin for brood year 2007, multiplied by a 7.0 percent marine survival rate expectation, which was based on correlations with the PDO, the Vancouver Island boreal copepod anomaly, and September trawl survey coho catch.

The preliminary preseason forecast of 25,900 age-3 ocean recruits places Stillaguamish natural coho in the normal abundance based status category, which results in an allowable total exploitation rate of no more than 50 percent under the Council adopted exploitation rate matrix (Appendix A, Table A-4).

Snohomish

The 2010 forecast for Snohomish River natural coho ocean recruits is 99,400. The Snohomish regional hatchery coho forecast is 24,498; 7,600 for Skykomish River/Wallace River Hatchery facility releases, 14,898 for the Tulalip Bay facility, and 2,000 for the Possession net-pen project. The natural coho forecast used the estimated smolt production from the basin for brood year 2006, multiplied by a 7.0 percent marine survival rate expectation based, which was based on correlations with the PDO, the Vancouver Island boreal copepod anomaly, and September trawl survey coho catch.

The preliminary preseason forecast of 99,400 age-3 ocean recruits places Snohomish natural coho in the low abundance based status category, which results in an allowable total exploitation rate of no more than 40 percent under the Council adopted exploitation rate matrix (Appendix A, Table A-4).

South Sound

The 2010 forecasts for South Sound region natural and hatchery coho ocean recruits are 25,360 and 181,722 respectively. The natural coho forecast is the product of projected smolt production from each of the stream basins in the region multiplied by variable marine survival rate expectations of 2.0 to 5.0 percent for natural coho in the region. The marine survival prediction was first derived for Big Beef Creek coho and then extrapolated to other regions of Puget Sound based on assumed differences in survival among regions. The hatchery coho forecasts are typically based on the 2003-2005 BY average CWT-based recruits/smolt rate for each facility, applied to the 2007 BY smolt releases. The expected survival rates range from 2.4 to 5.9 percent for central Puget Sound hatchery programs north of the Tacoma Narrows and 0.9 to 2.6 percent for the deep South Sound region, consistent with the observed trend of lower observed survival rates for hatchery coho originating from south of the Tacoma Narrows in the past decade. Low (0.6 percent) survival was expected for coho released five months early from the Voight Creek facility due to winter flooding on the Puyallup River. For Lake Washington facilities, the Soos Creek facility's average survival was multiplied by an adjustment factor of 75 percent to account for in-lake juvenile mortality.

Hood Canal

The 2010 forecasts for Hood Canal region natural and hatchery coho ocean recruits are 33,193 and 51,175 respectively. The natural coho forecast is based on a regression of Big Beef Creek jacks on Hood Canal natural coho run sizes. The hatchery coho forecasts are based on the 1997-2005 BY average cohort reconstruction-based recruits/smolt for each facility, applied to the 2007 BY smolt releases for each facility.

The marine survival rates used for these forecasts were 8.8 percent for George Adams Hatchery, 2.0 percent for Port Gamble Net Pens, 8.2 percent for the Quilcene National Fish Hatchery, and 4.4 percent for the Quilcene Bay Net Pens.

The preliminary preseason forecast of 33,193 age-3 ocean recruits places Hood Canal natural coho in the low abundance based status category, which results in an allowable total exploitation rate of no more than 45 percent under the Council adopted exploitation rate matrix (Appendix A, Table A-4).

SELECTIVE FISHERY CONSIDERATIONS FOR COHO

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 fin clips from the 2007 brood, making these fish available to 2010 fisheries (Table III-6).

EVALUATION OF 2009 REGULATIONS ON 2010 STOCK ABUNDANCE

Escapements and fishery impacts were estimated using coho FRAM. Abundance forecasts for 2010 were updated for Washington and Oregon stocks, but forecasts for Canadian stocks are unchanged from those employed for 2009 planning. Updated forecasts for Canadian stocks are expected to become available in March 2010. To provide information on the effect of changes in abundance forecasts, the final 2009 pre-season regulatory package for ocean and inside fisheries was applied to 2010 projections of abundance.

OREGON PRODUCTION INDEX AREA

Ocean fisheries were modeled with 2009 Council regulations and 2009 expectations for non-Council area fisheries. Under this scenario, expected exploitation rates are 30.2 percent on OCN coho and 7.0 percent on Rogue/Klamath hatchery coho. Expected spawner escapement is 104,400 for OCN coho (Tables III-7 and III-8). For Columbia River hatchery coho stocks, the predicted ocean exploitation rate (excluding Buoy 10) is 62.1 percent on the Columbia River early stock and 72.9 percent on the Columbia River late stock. Predicted ocean escapements (after Buoy 10) into the Columbia River in 2010 under this exercise show that under 2009 ocean regulations, Columbia River early coho would not be expected to meet egg take goals and Columbia River late coho would be expected to meet hatchery egg take goals (without further inside fishing).

Based on parent escapement levels and observed OPI smolt-to-jack survival for 2007 brood OPI smolts, the total allowable OCN coho exploitation rate for 2010 fisheries is no greater than 15 percent under FMP Amendment 13 and no greater than 15 percent 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 13.0 percent (NMFS ESA consultation standard).

Lower Columbia River natural (LCN) coho were listed as Endangered under the Oregon state ESA in 1999 and have been managed under a state Recovery Plan harvest rate matrix since 2001. LCN coho were listed as threatened under the Federal ESA in 2005. From 2001 through 2005, Oregon coast hatchery stocks were used as a surrogate in FRAM; beginning in 2006 unmarked Columbia River hatchery stocks were used as a surrogate in FRAM. In 2009, NMFS allowed a 20.0 percent exploitation rate in marine area and mainstem Columbia River fisheries combined. The 20.0 percent exploitation rate was split by managers to allow about one-third for inriver fisheries and two-thirds for all marine fisheries. Under 2009 fishery regulations and 2010 abundance forecasts, the exploitation rate is predicted to be 27.5 percent for marine fisheries (excluding the Buoy 10 fishery) using combined unmarked Columbia River hatchery stocks as the proxy. There has been no guidance from NMFS so far on the allowable exploitation rate on LCN coho in 2010.

NORTH OF THE OREGON PRODUCTION INDEX AREA

Ocean escapement expectations in relation to management goals for selected naturally-spawning coho stocks, given 2010 preseason abundance forecasts and 2009 preseason projections for fishing patterns, are presented in Table III-7. The 2010 forecasts for Canadian coho stocks are not available, but are assumed to be at 2009 levels for this analysis. More detailed fishery management goals for Council area coho stocks are listed in Appendix A, Table A-1.

Under 2009 regulations, 2010 ocean escapements for natural coho stocks north of the OPI index area are expected to be at levels that would permit attainment of the former FMP spawning escapement conservation objectives. In addition, all annual management objectives for stocks subject to the PSC

agreement would be met except for Hood Canal coho. The exploitation rate by U.S. fisheries south of the Canadian border on Interior Fraser coho is projected to be 12.4 percent, which is over the anticipated 10.0 percent allowable exploitation rate under the 2002 PST Coho Agreement. The Council area fisheries portion would be 8.8 percent.

Coho bycatch during Puget Sound fisheries directed at chum and sockeye salmon will also be a consideration for preseason planning.

TABLE III-1. Preliminary 1996-2010 preseason and postseason coho stock abundance estimates for Oregon production index area stocks in thousands of fish. (Page 1 of 2)

Stock	Year	Preseason	Postseason ^{a/}	Preseason/Postseason ^{a/}
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	634.6	0.98
	2005	389.9	443.1	0.88
	2006	398.8	440.6	0.91
	2007	593.6	476.5	1.25
2008	216.1	565.4	0.38	
2009	1,073.1	1,066.2	1.01	
2010	408.0	-	-	
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	282.7	1.01
	2006	245.8	251.4	0.98
	2007	424.9	291.0	1.46
2008	110.3	333.9	0.33	
2009	672.7	681.4	0.99	
2010	245.3	-	-	
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	111.6	0.70
	2006	113.8	156.3	0.73
	2007	139.5	171.0	0.82
2008	86.4	207.6	0.42	
2009	369.7	374.1	0.99	
2010	144.2	-	-	

TABLE III-1. Preliminary 1996-2009 preseason and postseason coho stock abundance estimates for Oregon production index area stocks in thousands of fish. (Page 2 of 3)

Stock	Year	Preseason	Postseason ^{a/}	Preseason/Postseason ^{a/}
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	10.7	1.07
	2006	8.6	7.9	1.09
	2007	7.0	1.3	5.38
	2008	1.7	7.1	0.24
2009	7.3	7.5	0.97	
2010	4.4	-	-	
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	38.1	0.41
	2006	30.6	25.0	1.22
	2007	22.2	13.2	1.68
	2008	17.7	16.8	1.05
2009	23.4	3.1	7.55	
2010	14.1	-	-	
Lower Columbia River Natural	2007	21.5	19.4	1.11
	2008	13.4	27.2	0.49
	2009	32.7	40.4	0.81
	2010	15.1	-	-
Oregon Coastal Natural (Rivers and Lakes)	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	150.1	1.01
	2006	60.8	116.4	0.52
	2007	255.4	60.0	4.26
	2008	60.0	170.9	0.35
2009	211.6	257.0	0.82	
2010	148.0	-	-	

TABLE III-1. Preliminary 1996-2009 preseason and postseason coho stock abundance estimates for Oregon production index area stocks in thousands of fish. (Page 3 of 3)

Stock	Year	Preseason	Postseason ^{a/}	Preseason/Postseason ^{a/}
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	0.4	2.50
	2006	0.6	0.1	6.00
	2007	0.2	0.0	-
	2008	-	-	-
2009	-	-	-	
2010	-	-	-	

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

b/ Program was discontinued in 2005.

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

Year or Avg.	Oregon and California Coastal Returns							Ocean	OCN Exploitation
	Ocean Fisheries ^{b/}		Hatcheries and			Columbia River	Exploitation Rate	Rate Based on	
	Troll	Sport	Freshwater Harvest ^{c/}	OCN Spawners	Private Hatcheries	Returns	Abundance	Postseason	
						Abundance	Based on OPI	FRAM	
1970-1975	1,629.6	558.4	45.8	55.2	-	460.4	2,749.3	0.80	-
1976-1980	1,253.6	555.0	31.2	31.1	26.1	263.3	2,154.2	0.83	-
1981-1985	451.2	274.0	37.2	56.0	176.8	305.3	1,328.6	0.60	-
1986	638.9	320.6	79.3	70.0	453.7	1,549.1	3,026.7	0.34	-
1987	468.2	296.2	45.1	30.1	119.3	316.5	1,377.9	0.60	-
1988	844.7	297.2	61.1	56.8	116.1	670.9	1,989.2	0.57	-
1989	645.1	425.5	61.1	46.4	46.9	709.0	1,871.2	0.57	-
1990	275.9	357.1	28.7	22.5	35.6	196.7	1,128.5	0.69	-
1991	448.4	469.9	77.8	38.1	35.1	955.1	1,823.2	0.45	-
1992	67.4	256.5	51.0	44.2	-	216.1	610.0	0.51	-
1993	13.1	140.8	38.6	55.7	-	114.2	342.1	0.42	-
1994	2.7	3.0	28.1	48.5	-	169.2	250.5	0.02	0.07
1995	5.4	43.5	37.5	57.3	-	74.8	215.9	0.22	0.12
1996	7.0	31.8	45.7	79.3	-	113.0	297.3	0.14	0.08
1997	5.5	22.4	26.9	31.6	-	148.1	204.6	0.12	0.12
1998	3.5	12.8	29.4	34.3	-	168.4	265.2	0.06	0.08
1999	3.6	36.5	22.6	51.2	-	274.1	414.0	0.10	0.08
2000	25.2	74.6	33.3	81.1	-	547.6	901.0	0.13	0.07
2001	38.1	216.8	75.7	185.2	-	1,108.3	1,438.6	0.16	0.07
2002	15.0	118.7	54.0	269.0	-	499.9	990.5	0.14	0.12
2003	28.8	252.4	45.0	235.3	-	677.3	1,183.6	0.23	0.14
2004	26.2	159.3	38.1	199.9	-	442.5	826.8	0.22	0.15
2005	10.5	58.2	42.5	164.1	-	341.0	592.1	0.12	0.11
2006	4.5	47.5	29.3	132.8	-	386.4	557.1	0.09	0.06
2007	26.2	128.5	11.0	71.4	-	331.1	536.5	0.28	0.11
2008 ^{e/}	0.6	26.4	14.8	165.8	-	488.4	736.3	0.04	0.02
2009 ^{e/}	27.7	201.2	15.6	235.5	-	721.6	1,323.2	0.19	0.11

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 1982-2005 and drop-off mortality for all years; sport fishery--hook-and-release mortality for 1994-2005 and drop-off mortality for all years.

c/ Includes returns from Salmon-Trout Enhancement Program (STEP) smolt releases through the 2007 return year, after which the program was terminated.

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/ Preliminary.

TABLE III-3. Preseason forecasts and postseason estimates of ocean escapements for selected Washington coastal adult natural coho stocks in thousands of fish.

Year	Preseason			Postseason			Preseason			Postseason			Preseason			Postseason		
	Forecast	Return	Pre/Postseason	Forecast	Return	Pre/Postseason	Forecast	Return	Pre/Postseason	Forecast	Return	Pre/Postseason	Forecast	Return	Pre/Postseason	Forecast	Return	Pre/Postseason
	Quillayute River Fall			Hoh River			Queets River			Grays Harbor^{a/}								
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	2.25						
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	87.6	0.94						
1997	5.1	5.0	1.02	1.6	1.4	1.14	2.4	2.0	1.20	14.8	19.1	0.77						
1998	7.4	17.0	0.44	3.2	5.2	0.62	4.5	4.6	0.98	27.1	41.0	0.66						
1999	12.8	19.5	0.66	2.8	6.3	0.44	3.7	5.1	0.73	50.3	38.1	1.32						
2000	8.2	17.7	0.46	3.3	8.8	0.38	2.5	8.7	0.29	44.2	41.9	1.05						
2001	20.6	36.7	0.56	7.6	14.8	0.51	10.6	28.4	0.37	46.6	72.6	0.64						
2002	18.5	34.7	0.53	6.9	11.2	0.62	10.2	16.1	0.63	50.3	111.3	0.45						
2003	21.2	25.2	0.84	10.4	8.1	1.28	19.6	13.2	1.48	52.3	95.2	0.55						
2004	17.7	25.1	0.71	6.6	6.3	1.05	14.7	10.0	1.47	101.1	66.1	1.53						
2005	16.1	22.1	0.73	6.4	8.2	0.78	14.1	9.7	1.45	78.5	44.0	1.78						
2006	13.0	12.2	1.07	5.6	2.3	2.43	7.1	6.4	1.11	60.3	20.3	2.97						
2007	10.8	10.9	0.99	5.4	5.1	1.06	13.6	6.1	2.23	59.4	31.9	1.86						
2008	10.0	12.9	0.78	3.9	4.3	0.91	8.9	6.2	1.44	41.5	45.7	0.91						
2009 ^{b/}	17.8	23.3	0.76	7.9	8.2	0.96	25.5	NA	NA	53.8	NA	NA						

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

b/ Postseason returns are preliminary.

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

Year	Preseason	Postseason	Pre/Postseason	Preseason	Postseason	Pre/Postseason	Preseason	Postseason	Pre/Postseason
	Forecast	Return		Forecast	Return		Forecast	Return	
	Skagit River			Stilliguamish River			Hood Canal		
1984	29.6	36.0	0.82	NA	26.9	NA	NA	57.5	NA
1985	26.1	27.4	0.95	NA	34.4	NA	NA	38.5	NA
1986	43.5	69.7	0.62	37.0	49.9	0.74	NA	82.2	NA
1987	33.0	39.4	0.84	29.7	46.3	0.64	NA	71.7	NA
1988	29.6	28.4	1.04	24.5	35.4	0.69	18.2	15.5	1.17
1989	31.2	24.4	1.28	24.5	13.5	1.81	36.8	25.5	1.44
1990	37.6	24.3	1.55	30.8	34.1	0.90	43.9	14.2	3.09
1991	40.8	10.3	3.96	32.9	11.3	2.91	17.6	15.3	1.15
1992	35.7	9.4	3.80	18.7	18.0	1.04	10.1	19.9	0.51
1993	28.1	14.2	1.98	24.5	10.6	2.31	39.5	16.7	2.37
1994	17.9	30.3	0.59	10.2	30.3	0.34	13.5	57.0	0.24
1995	30.0	15.8	1.90	32.7	20.4	1.60	19.3	41.1	0.47
1996	26.7	8.6	3.09	29.8	12.5	2.38	15.4	37.2	0.41
1997	34.2	45.7	0.75	15.7	14.1	1.12	38.1	101.8	0.37
1998	41.1	85.2	0.48	37.7	31.1	1.21	87.3	118.5	0.74
1999	53.4	38.3	1.39	27.3	7.5	3.64	45.2	17.6	2.57
2000	24.7	75.1	0.33	15.0	31.2	0.48	50.4	39.7	1.27
2001	46.9	115.6	0.41	18.1	81.8	0.22	40.5	110.0	0.37
2002	79.9	70.8	1.13	14.5	30.4	0.48	25.6	81.0	0.32
2003	97.4	114.4	0.85	27.7	49.8	0.56	25.7	199.9	0.13
2004	129.4	151.0	0.86	26.6	73.9	0.36	79.8	219.7	0.36
2005	48.6	53.1	0.92	41.9	29.1	1.44	79.8	68.3	1.17
2006	87.8	12.8	6.86	32.7	11.8	2.77	46.4	49.7	0.93
2007 ^{b/}	21.7	71.2	0.30	52.0	45.2	1.15	30.9	78.6	0.39
2008 ^{b/}	51.3	32.1	1.60	25.5	15.3	1.67	21.5	25.8	0.83
2009 ^{b/}	27.2	NA	-	10.2	NA	-	36.1	NA	-

a/ Preseason forecasts are Puget Sound (4B) runsizes which are defined as the spawning escapement plus Puget Sound net fishery catch. Puget Sound runsize does not include Puget Sound troll and recreational catch. Postseason returns are Puget Sound runsizes from 1984-1995 and total terminal runsize thereafter. Total terminal runsize includes spawning and recreational catch within the terminal fisheries.

b/ Preliminary.

TABLE III-5. Mass marked 2007 brood coho available to 2010 Council fisheries. The mark used is an adipose fin clip.

Region	Ocean Recruits		Percent
	Natural	Hatchery	Mass Marked
PUGET SOUND STOCKS:			
Nooksack-Samish and 77A Independent	9,600	35,999	75.9%
Skagit	95,880	9,541	7.9%
Stillaguamish	25,900	0	0.0%
Snohomish	99,400	22,595	14.1%
South Puget Sound Normal	25,360	160,332	76.3%
South Puget Sound Delayed	0	26,075	97.6%
Hood Canal	33,193	51,174	54.0%
Strait of Juan de Fuca and Area 9	8,463	7,768	35.4%
Puget Sound Total	297,796	313,484	45.6%
WASHINGTON COASTAL STOCKS:			
North Coast Independent Tributaries	4,240	7,614	51.0%
Quillayute Summer	2,801	3,198	52.9%
Quillayute Fall	22,037	17,742	38.5%
Hoh	7,608	0	0.0%
Queets	0	0	NA
Quinault	16,706	26,576	53.2%
Grays Harbor	0	0	NA
Willapa Bay	20,400	78,723	75.7%
Washington Coastal Total	73,792	133,853	59.1%
COLUMBIA RIVER STOCKS:			
Columbia River Early	10,002	235,298	70.7% ^{a/}
Columbia River Late	5,147	139,053	80.6% ^{a/}
Columbia River Total	15,149	374,351	74.4% ^{a/}
OREGON COASTAL	148,000	18,499	4.7%
SOUTHERN BRITISH COLUMBIA STOCKS^{b/}:			
Georgia Strait Mainland	10,674	13,914	23.2%
Georgia Strait Vancouver Island	25,602	7,014	14.4%
Johnstone Strait	13,624	7,138	24.8%
Southwest Vancouver Island	3,242	40,907	31.5%
Northwest Vancouver Island	2,066	3,494	0.0%
Lower Fraser River	1,162	35,513	81.4%
Interior Fraser River	15,625	324	0.5%
Southern British Columbia Total	71,995	108,304	29.5%

a/ Columbia River estimate of percent mass marked includes natural production.

b/ For this assessment, the percent mass marked was assumed to be the same as in 2009.

TABLE III-6. Projected coho mark rates for 2010 fisheries under base period fishing patterns (percent marked).

Area	Fishery	June	July	August	Sept
Canada					
Johnstone Strait	Recreational	-	29%	27%	-
West Coast Vancouver Island	Recreational	43%	37%	35%	39%
North Georgia Strait	Recreational	39%	39%	39%	36%
South Georgia Strait	Recreational	38%	40%	31%	34%
Juan de Fuca Strait	Recreational	44%	45%	49%	44%
Johnstone Strait	Troll	49%	39%	30%	37%
NW Vancouver Island	Troll	45%	42%	42%	40%
SW Vancouver Island	Troll	51%	48%	49%	48%
Georgia Strait	Troll	48%	49%	52%	46%
Puget Sound					
Strait of Juan de Fuca (Area 5)	Recreational	54%	51%	49%	49%
Strait of Juan de Fuca (Area 6)	Recreational	53%	47%	48%	45%
San Juan Island (Area 7)	Recreational	32%	41%	43%	35%
North Puget Sound (Areas 6 & 7A)	Net	-	45%	38%	44%
Council Area					
Neah Bay (Area 4/4B)	Recreational	37%	53%	51%	56%
LaPush (Area 3)	Recreational	53%	55%	57%	47%
Westport (Area 2)	Recreational	63%	63%	61%	55%
Columbia River (Area 1)	Recreational	72%	70%	68%	69%
Tillamook	Recreational	64%	60%	54%	39%
Newport	Recreational	60%	56%	53%	38%
Coos Bay	Recreational	49%	46%	34%	20%
Brookings	Recreational	42%	30%	26%	11%
Neah Bay (Area 4/4B)	Troll	52%	50%	52%	51%
LaPush (Area 3)	Troll	55%	57%	52%	51%
Westport (Area 2)	Troll	50%	54%	59%	58%
Columbia River (Area 1)	Troll	65%	64%	63%	64%
Tillamook	Troll	62%	59%	58%	55%
Newport	Troll	58%	57%	53%	50%
Coos Bay	Troll	49%	46%	40%	27%
Brookings	Troll	36%	37%	40%	54%
Columbia River					
Buoy 10	Recreational	-	-	-	71%

TABLE III-7. Estimated ocean escapements for critical natural and Columbia River hatchery coho stocks (thousands of fish) based on preliminary 2010 preseason abundance forecasts and 2009 Council regulations.^{a/}

Stock	Ocean Escapement Estimates Under 2009 Regulations ^{b/}		2010 FMP Conservation Objective ^{c/}
	2010 Preseason Abundance	2009 Preseason Abundance	
Natural Coho Stocks			
Skagit	76.9	27.5	Exploitation Rate ≤60.0% ^{d/}
Stillaguamish	19.2	10.5	Exploitation Rate ≤50.0% ^{d/}
Snohomish	73.6	53.7	Exploitation Rate ≤40.0% ^{d/}
Hood Canal	23.4	39.1	Exploitation Rate ≤45.0% ^{d/}
Strait of Juan de Fuca	7.4	19.1	Exploitation Rate ≤20.0% ^{d/}
Quillayute Fall	19.7	18.5	6.3 - 15.8 Spawners
Hoh	5.7	8.8	2.0 - 5.0 Spawners
Queets	e/	31.4	5.8 - 14.5 Spawners
Grays Harbor	e/	56.8	35.4 Spawners
LCN	11.1 (27.5%)	31.7 (2.3%)	Exploitation Rate TBD
OCN	204.4 (30.2%)	206.9 (2.3%)	Exploitation Rate ≤15.0%
R/K	NA (7.0%)	NA (0.5%)	Exploitation Rate ≤13.0%
Hatchery Coho Stocks			
Columbia Early	96.7	636.6	18.6 Hatchery Escapement
Columbia Late	40.6	342.1	11.9 Hatchery Escapement

a/ Quota levels include harvest and hooking mortality estimates used in planning the Council's 2009 ocean fisheries and a coho catch for the Canadian troll fishery off the West Coast of Vancouver Island (WCVI).

b/ 2009 preseason regulations include the following coho quota fisheries: U.S. Canada Border to Cape Falcon: Treaty Indian troll - 60,000 non-selective; non-Indian troll - 33,600 selective; recreational - 176,400 selective; Cape Falcon to OR/CA border: recreational - 117,000 selective; troll - 11,000 nonselective. 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 Puget Sound (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 and LCN stocks, ocean escapement represents the number of coho before the Buoy 10 fishery; the LCN exploitation rate shown is the Council fisheries exploitation rate, which had an ER forecast of 12.5% and an ESA limit of 20% including mainstem Columbia River fisheries.

c/ Goals represent Salmon FMP conservation objectives, ESA consultation standards, or hatchery escapement needs. Spawning escapement goals are not directly comparable to ocean escapement because the latter occur before inside fisheries.

d/ Assumed exploitation rate based on preliminary abundance forecasts.

e/ No runsize forecast was available; for modeling purposes, abundance was set at base period levels (Queets: 20.1; Grays Harbor: 105.2).

TABLE III-8. Comparison of Lower Columbia natural (LCN), Oregon coastal natural (OCN), and Rogue/Klamath (RK) coho projected harvest mortality and exploitation rates by fishery under Council-adopted 2009 regulations and preliminary 2010 preseason abundance estimates.

Fishery	Projected Harvest Mortality and Exploitation Rate					
	LCN		OCN		RK	
	Number	Percent	Number	Percent	Number	Percent
SOUTHEAST ALASKA	0	0.0%	0	0.0%	0	0.0%
BRITISH COLUMBIA	13	0.1%	387	0.3%	14	0.1%
PUGET SOUND/STRAITS	19	0.1%	120	0.1%	0	0.0%
NORTH OF CAPE FALCON						
Recreational	1,756	11.5%	3,420	2.3%	14	0.1%
Treaty Indian Troll	509	3.3%	1,377	0.9%	0	0.0%
Non-Indian Troll	477	3.1%	1,406	0.9%	1	0.0%
SOUTH OF CAPE FALCON						
Recreational:	1,211	7.9%				
Cape Falcon to Humbug Mt.			21,477	14.3%	170	1.5%
Humbug Mt. to Horse Mt. (KMZ)			2,433	1.6%	408	3.8%
Fort Bragg			0	0.0%	0	0.0%
South of Pt. Arena			0	0.0%	0	0.0%
Troll:	227	1.5%				
Cape Falcon to Humbug Mt.			5,906	4.0%	122	1.1%
Humbug Mt. to Horse Mt. (KMZ)			2	0.0%	0	0.0%
Fort Bragg			0	0.0%	0	0.0%
South of Pt. Arena			0	0.0%	0	0.0%
BUOY 10	3,371	22.0%	2,051	1.4%	0	0.0%
ESTUARY/FRESHWATER	NA	NA	6,502	4.3%	26	0.2%
TOTAL	7,583	49.5%	45,081	30.1%	755	6.8%

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.^{a/}

Fishery Year (t)	Estimated OCN Coho Spawners by Stock Component					Hatchery Jack Survival Rate (t-1)	Amendment 13 Matrix			OCN Work Group Matrix ^{b/}		
	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	3,900	13,600	36,500	3,400	0.04%	Low	Very Low	≤10-13%	Extremely Low	Very Low	≤8%
1999	1996	3,300	18,100	52,600	5,200	0.10%	Med	Very Low	≤15%	Low	Critical	0-8%
2000	1997	2,100	2,800	18,400	8,200	0.12%	Med	Very Low	≤15%	Low	Critical	0-8%
2001	1998	2,600	3,300	25,900	2,300	0.27%	Med	Very Low	≤15%	Medium	Critical	0-8%
2002	1999	8,900	11,800	29,100	1,400	0.09%	Med	Low	≤15%	Low	Low	≤15%
2003	2000	17,900	14,300	36,500	11,000	0.20%	Med	Low	≤15%	Med	Low	≤15%
2004	2001	33,500	25,200	112,000	12,600	0.14%	Med	Low	≤15%	Med	Low	≤15%
2005	2002	52,500	104,000	104,100	8,400	0.11%	Med	High	≤20%	Low	High	≤15%
2006	2003	59,600	68,900	99,800	6,800	0.12%	Med	High	≤20%	Low	High	≤15%
2007	2004	33,100	40,400	96,400	24,500	0.17%	Med	Med	≤20%	Med	Med	≤20%
2008	2005	16,500	51,400	86,300	10,000	0.07%	Low	High	≤15%	Extremely Low	High	≤8%
2009	2006	24,100	21,200	82,400	3,900	0.27%	Med	Low	≤15%	Med	Low	≤15%
2010	2007	17,500	12,300	36,000	5,200	0.12%	Low	Low	≤15%	Low	Low	≤15%
2011	2008	27,700	57,900	79,100	400	-	-	High	-	-	High	-
2012	2009	39,600	74,600	116,300	2,600	-	-	High	-	-	High	-

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 work group as a result of the 2000 Review of Amendment 13.