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 Environmental Protection Agency'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 2011 abundance forecasts with recent year preseason abundance forecasts and postseason estimates, are reported in Table III-1. All fishery impacts and escapements from 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 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 CWT recoveries 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 run reconstructions 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 2011 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 C, Table C-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 2011 the longer (1970-2010) 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 2010 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 2011 partition was based on the proportion of the smolt releases in 2010.

For the 2011 abundance forecast, the data base includes 1970-2010 recruits and 1969-2009 jack returns (in thousands of fish). The model was:

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

Where:

a = -87.98
b = 19.48
c = 25.69
adjusted r^2 = 0.94

The OPIH stock data set and a definition of the above terms are presented in Appendix C, Table C-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 2010 preseason abundance prediction of 408,000 OPIH coho was 74 percent of the preliminary postseason estimate of 551,300 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.

2011 Stock Status

Using the appropriate values from Appendix C, Table C-2, the OPIH abundance forecast for 2011 is 375,100 coho, 92 percent of the 2010 prediction and 68 percent of the preliminary 2010 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 was 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 could 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 regimes (1990 – 2000) with a 1, and by itself explains over 50 percent of the variability of the time series.

For 2011, generalized additive models (GAMs) were used to relate OCNR recruitment to ocean environment indices. Nine variables were evaluated, ranging from indices of large-scale ocean patterns (e.g., Pacific Decadal Oscillation (PDO)) to local ecosystem variables (e.g., sea surface temperature at Charleston, OR). It was found that high explanatory power and promising forecast skill could be achieved when the mean May-July PDO averaged over the four years prior to the return year was used in combination with two other variables in a GAM. The multi-year average of the PDO, in essence, explains the lower frequency (multi-year) variability in recruitment and can be viewed as a replacement of the Regime Index used previously. A final set of six models using six different environmental indices plus parent spawner abundance was chosen from the possible model combinations. When averaging the predictions from the set of models (the ensemble mean) a higher skill (in terms of variance explained or cross-validation) was achieved than by selecting any single model. Making multiple forecasts from a set of models also provides a range of possible outcomes that reflects, to some degree, the uncertainty in understanding how salmon productivity is driven by ocean conditions.

The GAM with 3 predictor variables can be expressed in the following general form:

$$\hat{Y} = f(X_1) + f(X_2) + f(X_3) + \varepsilon$$

Where $\hat{Y}$ is the prediction, X_1 through X_3 are the predictor variables, and ε is the deviation of $\hat{Y}$ from the observation Y. For the prediction, Y was the log-transformation of annual recruit abundance. The term f represents a smooth function, which in this case is a cubic spline.

GAM Model Predictor used for 2011 forecast was:

Ensemble Mean of six forecasts based on environmental conditions and spawners.

Variables			Prediction	r^2	OCV[a/]
PDO	Spring Transition (Julian date; t-1)	Log Spawners (t-3)	234,400	0.77	0.70
PDO	Multivariate ENSO Index (Oct-Dec; t-1)	Upwelling (July-Sept; t-1)	277,700	0.78	0.69
PDO	Spring Transition (Julian date; t-1)	Multivariate ENSO Index (Oct-Dec; t-1)	240,200	0.76	0.69
PDO	Upwelling (July-Sept; t-1)	Sea Surface Temperature (May-Jul; t-1)	208,400	0.78	0.69
PDO	Sea Surface Height (Apr-June; t-1)	Upwelling (July-Sept; t-1)	181,400	0.77	0.68
PDO	Upwelling (Sept-Nov; t-1)	Sea Surface Temperature (Jan; t)	200,200	0.76	0.67
Ensemble Mean (90% prediction intervals)			221,600 (117,600-418,600)	0.81	0.74

a/ OCV – ordinary cross-validation score

The OCNR stock data set and a definition of the above terms are presented in Appendix C, Table C-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 2011, OPITT chose to use the most recent three-year average adult stock abundance which predicts 27,800 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 2010 preseason abundance prediction of 148,000 OCN coho was 55 percent of the preliminary postseason estimate of 266,800 coho.

2011 Stock Status

The 2011 preseason prediction for OCN (river and lake systems combined) is 249,400 coho, 169 percent of the 2010 preseason prediction and 93 percent of the 2010 postseason estimate (Table III-1). The 2011 preseason prediction for OCNR and OCNL components are 221,600 and 27,800 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.

2011 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 2011 prediction for the Clackamas River is based on the recent 3-year cohort average counts at North Fork dam. The Clackamas forecast for 2011 is 800 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 2011 ocean abundance forecast for all Oregon areas combined is 4,600 coho.

The 2011 prediction for the Washington LCN coho populations are derived by combining estimates of natural smolt production based on watershed area and a predicted 2008 brood year marine survival rate of 3.3 percent. The 2011 adult ocean abundance forecast for Washington LCN coho is 18,100 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 2010 preseason abundance prediction of 15,100 LCN coho was 49 percent of the preliminary postseason estimate of 30,800 coho.

2011 Stock Status

The 2011 prediction for LCN coho is 22,700 coho (Table III-1). This ocean abundance estimate includes both Oregon and Washington LCN components.

Oregon Production Index Area Summary of 2011 Stock Status

The 2011 combined OPI area stock abundance is predicted to be 624,500 coho, which is 112 percent of the 2010 preseason prediction of 556,000 coho and 76 percent of the 2010 preliminary postseason estimate of 818,100 coho. The 2011 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 2010 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 2011 Willapa Bay hatchery coho abundance forecast is 64,658 ocean recruits compared to a 2010 preseason forecast of 78,700. The natural coho forecast is 47,788 ocean recruits, compared to a 2010 preseason forecast of 20,400. 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 1994-2007 brood years

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 fish originating from numerous volunteer production projects. The abundance forecast for Grays Harbor natural stock coho for 2011 is 89,097 ocean age-3 recruits. The forecast for hatchery stock ocean abundance is 43,958 ocean age-3 recruits.

The natural coho forecast consists of an estimate of smolt production in the Humptulips and Chehalis basins multiplied by a PDO based marine survival rate.

The 2011 hatchery coho forecast of 43,958 is an estimate of smolt releases from on- and off-station sites, multiplied by the average return per release for four years (2004-2007 BY) and then expanded to ocean recruit abundance based on CWT recoveries for 2000-2001 return years.

Quinault River

The 2011 forecast for Quinault natural coho is 22,947 ocean recruits, an increase of 37 percent from the 2010 forecast of 16,706. This forecast is based on the mean estimate of recent ocean recruits for 2004 through 2009. All natural coho are unmarked.

The Quinault hatchery coho forecast is 35,545 ocean recruits. This return is from an estimated release of 643,592 smolts, and is based on a recent 5-year average smolt return rate of 5.52 percent for the Quinault National Fish Hatchery. The number of marked coho is estimated at 30,811 and unmarked coho at 4,733.

Queets River

The 2011 Queets natural coho forecast is 13,279 ocean recruits, a decrease of 39 percent compared to the 2010 forecast level of 21,823. This forecast represents the estimated smolt production (238,055) multiplied by an expected survival rate of 5.6 percent. The survival rate estimate is based on a binomial logistic regression model developed by Quinault Fisheries Department. This model consists of a regression of Queets survival rates from return years 1993-2007 as estimated using backward FRAM run reconstructions, and the standardized monthly mean Pacific Decadal Oscillation (PDO) values from January through August for the corresponding years the smolts entered salt water.

The 2011 Queets hatchery (Salmon River) coho forecast is 16,331 ocean recruits, an increase of 27 percent compared to the 2010 forecast of 11,900. This forecast is based on a smolt release of 712,685 multiplied by the recent 10 year average marine survival rate (2.3 percent). Approximately 89 percent of the fish released from the Salmon River facility were marked with an adipose fin clip.

Hoh River

The 2011 Hoh River natural coho forecast is 11,625 ocean recruits, an increase of 53 percent compared to the 2010 forecast of 7,608. This forecast is based on estimated smolt production per square mile of watershed from the Clearwater tributary to the Queets River (648 smolts/square mile), multiplied by the size of the Hoh watershed (299 square miles), for a total of 193,752 smolts. The total natural smolt production estimate was then multiplied by an expected survival rate of 6.0 percent. Because freshwater production is measured directly in the Queets River, marine survival estimates for the Queets are used when forecasting Hoh wild coho marine survival. The Queets PDO model developed by the Quinault Fisheries Department estimates a 5.6 percent marine survival rate for Queets wild coho. This was used as the base rate and then increased according to the pattern of increasing marine survival moving north on the coast. This base rate of 5.6 percent was increased to 6.0 percent for the Hoh River.

No hatchery production is projected for the Hoh system for 2011.

Quillayute River

The 2011 Quillayute River summer natural and hatchery coho forecasts are 2,796 and 5,403 ocean recruits, respectively. The natural component run size is based on the estimated total summer coho smolt production (39,947) and a projected ocean survival rate of 7.0 percent. This is a higher ocean survival rate than the 5.0 percent used in 2010. The Queets PDO model and Elwha jack returns result in a 5.6 percent marine survival estimate.

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. Thus, for the hatchery component, an ocean survival rate of 5.0 percent was selected. The survival rate of 5.0 percent was multiplied by a release of 108,054 smolts. Approximately 99 percent of the fish were marked with an adipose fin clip; an additional 853 unmarked smolts were released. The 2011 forecast abundance of natural summer coho is essentially the same as the 2010 forecast, while the hatchery forecast is 69 percent higher than the 2010 forecast.

The 2011 Quillayute River fall natural and hatchery coho forecasts are 28,191 and 31,042 ocean recruits, respectively. The 2011 forecast abundance of natural Quillayute fall coho is 28 percent higher, and the hatchery forecast is 75 percent higher, than their respective 2010 forecasts. The forecast for the natural component is based on the estimated total fall coho smolt production (402,728) multiplied by an expected marine survival rate of 7.0 percent, which was the same as used for the summer natural returns above. The fall hatchery production forecast was based on the same prediction of marine survival (5.0 percent) used for the summer hatchery coho forecast, multiplied by a release of 620,841 smolts. Approximately 86.9 percent of the hatchery fish were marked with an adipose fin clip.

The basin total coho smolt production estimate (summer and fall stocks) was derived using the estimated coho smolt production in the Clearwater Basin of 90,737, which is 1.43 times its average production during the years a smolt trap was operated on the Bogachiel River (1987, 1988 and 1990) and 1.49 times its average production during the years a trap was operated on the Dickey River (1992-1994). Using 1.43 as a multiplier of the estimated average smolt production of the Quillayute system excluding the Dickey (217,257) yields an estimated production of 311,263 coho smolts. The Dickey production yields an additional 131,410 smolts to the system. The total freshwater production for the basin is estimated to be 442,674 smolts. 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 2011 forecast of natural coho production for these independent streams is 21,590 ocean recruits, based on a prediction of 600 smolts per square mile of watershed drainage, 424 square miles of watershed, and an expected marine survival rate of 8.5 percent. This rate was the average of the jack-based and the PDO models.

The hatchery forecast of 11,815 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 8.98 percent for the brood year 2008 was multiplied by the 2008 brood year smolt release (248,891) from the Makah National Fish Hatchery. For the 2008 brood year release, 83 percent were marked with an adipose fin clip.

Puget Sound

The 2011 total hatchery and natural coho ocean recruit forecast for the Puget Sound region of 981,000 38.5 compared to a 2010 forecast of 613,930. The hatchery coho forecast is 380,900 compared to the 2010 forecast of 316,133, and the natural coho forecast for 2011of 600,100 is much higher than the 2010 forecast of 297,797.

Puget Sound hatchery forecasts for 2011 were generally the product of 2008 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 2011 forecasts for Strait of Juan de Fuca (SJF) natural and hatchery coho ocean recruits are 12,317 and 15,244, respectively. As in past years, this forecast includes both Eastern and Western SJF drainages. The natural coho forecast was derived by multiplying the estimated 2008 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 2008 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/smolts released in each hatchery production unit.

The preliminary preseason forecast of 12,317 age-3 ocean recruits places SJF 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).

Nooksack-Samish

The 2011 forecasts for Nooksack-Samish natural and hatchery coho ocean recruits are 29,507 and 45,745 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 6.0 percent. The hatchery forecasts are based on the 2004-2006 BY average recruits/smolt rate

Skagit

The 2011 forecasts for Skagit River natural and hatchery coho ocean recruits are 138,117 and 16,176 (14,712 from in-river hatchery production, 1,464 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 9.5 percent. The natural coho marine survival rate is based on the average of the 1988-2006 BY (even years only) Skagit natural recruits/smolt rate. The hatchery forecasts are based on an average marine survival rate of the 1988-2006 BY (even years only) Cascade Hatchery CWT-based recruits/smolt rate of 4.9 percent.

The preliminary preseason forecast of 138,117 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 2011 forecast for Stillaguamish River natural coho ocean recruits is 66,600. The natural coho forecast is derived from the estimated smolt production from the basin for brood year 2008, multiplied by a 12.0 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 66,600 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 2011 forecast for Snohomish River natural coho ocean recruits is180,000. The Snohomish regional hatchery coho forecast is 54,978; 8,400for Skykomish River/Wallace River Hatchery facility releases and 46,578 for the Tulalip Bay facility. The natural coho forecast used the estimated smolt production from the basin for brood year 2006, multiplied by a 12.0 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 180,000 age-3 ocean recruits places Snohomish 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).

South Sound

The 2011 forecasts for South Sound region natural and hatchery coho ocean recruits are 98,947 and 173,348 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 6.2 to 16.1 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 2004-2005 BY average CWT-based recruits/smolt rate for each facility, applied to the 2008 BY smolt releases. The expected survival rates range from 0.8 to 6.2 percent

Hood Canal

The 2011 forecasts for Hood Canal region natural and hatchery coho ocean recruits are 74,741 and 74,897 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 1997-2006 BY average cohort reconstruction-based recruits/smolt for each facility, applied to the 2008 BY smolt releases for each facility.

The marine survival rates used for these forecasts were 7.3 percent for George Adams Hatchery, 2.5 percent for Port Gamble Net Pens, 8.2percent for the Quilcene National Fish Hatchery, and 3.2percent for the Quilcene Bay Net Pens.

The preliminary preseason forecast of 74,741 age-3 ocean recruits places Hood Canal natural coho in the normal abundance based status category, which results in an allowable total exploitation rate of no more than 65 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 2008 brood, making these fish available to 2011 fisheries (Table III-6).

TABLE III-1. Preliminary 1996-2011 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	551.3	0.74
	2011	375.1	-	-
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	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	274.3	0.89
	2011	216.0	-	-
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	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	263.6	0.55
	2011	146.5	-	-

TABLE III-1. Preliminary 1996-2011 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	8.6	0.51
	2011	3.6	-	-
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	4.8	2.94
	2011	9.0	-	-
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	30.8	0.49
	2011	22.7	-	-
Oregon Coastal Natural	1996	63.2	86.1	0.73
(Rivers and Lakes)	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	266.8	0.55
	2011	249.4	-	-

TABLE III-1. Preliminary 1996-2011 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	-	-	-
	2011	-	-	-

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.	Ocean Fisheries[b/]		Oregon and California Coastal Returns			Columbia River Returns	Abundance[d/]	Ocean Exploitation Rate Based on OPI Abundance[e/]	OCN Exploitation Rate Based on Postseason FRAM
	Troll	Sport	Hatcheries and Freshwater Harvest[c/]	OCN Spawners	Private Hatcheries				
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	28.2	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	45.8	79.3	-	113.0	297.3	0.14	0.08
1997	5.5	22.4	27.0	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	75.9	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	45.2	235.3	-	677.3	1,183.6	0.23	0.14
2004	26.2	159.3	38.5	197.2	-	442.5	826.8	0.22	0.15
2005	10.5	58.2	42.9	164.6	-	341.0	592.1	0.12	0.11
2006	4.5	47.5	29.6	132.8	-	386.4	557.1	0.09	0.06
2007	26.2	128.5	11.1	71.5	-	331.1	536.5	0.28	0.11
2008	0.6	26.4	15.6	180.1	-	493.8	736.3	0.04	0.02
2009	27.7	201.2	16.2	265.3	-	729.8	1,323.2	0.19	0.07
2010[f/]	5.8	48.8	19.4	256.8	-	441.1	818.1	0.07	0.05

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/ Not equal to the sum of previous columns due to stock and fishery accounting north and south of Leadbetter Point.

e/ 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.

f/ 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 Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason 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	87.9	0.94
1997	5.1	5.0	1.02	1.6	1.4	1.14	2.4	2.0	1.20	14.8	19.3	0.77
1998	7.4	17.0	0.44	3.2	5.2	0.62	4.5	4.6	0.98	27.1	40.4	0.67
1999	12.8	19.5	0.66	2.8	6.3	0.44	3.7	5.1	0.73	50.3	38.0	1.32
2000	8.2	17.7	0.46	3.3	8.8	0.38	2.5	8.7	0.29	44.2	43.4	1.02
2001	20.6	36.7	0.56	7.6	14.8	0.51	10.6	28.4	0.37	46.6	76.4	0.61
2002	18.5	34.7	0.53	6.9	11.2	0.62	10.2	16.1	0.63	50.3	111.0	0.45
2003	21.2	25.2	0.84	10.4	8.1	1.28	19.6	13.2	1.48	52.3	94.8	0.55
2004	17.7	25.1	0.71	6.6	6.3	1.05	14.7	10.0	1.47	101.1	64.4	1.57
2005	16.1	22.1	0.73	6.4	8.2	0.78	14.1	9.7	1.45	78.5	43.7	1.80
2006	13.0	12.2	1.07	5.6	2.3	2.43	7.1	6.4	1.11	60.3	20.4	2.96
2007	10.8	10.9	0.99	5.4	5.1	1.06	13.6	6.1	2.23	59.4	32.5	1.83
2008	10.5	12.9	0.81	4.3	4.3	1.00	10.2	6.2	1.65	42.7	47.1	0.91
2009	19.3	24.5	0.79	9.5	10.7	0.89	31.4	17.4	1.80	59.2	88.4	0.67
2010[b/]	22.0	21.7	1.01	7.6	10.5	0.72	21.8	NA	NA	67.9	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 Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason	Preseason Forecast	Postseason Return	Pre/Postseason
		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	72.7	0.37	10.2	27.4	0.37	36.1	45.7	0.79
2010	60.3	NA	-	16.3	NA	-	19.0	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 2008 brood coho available to 2011 Council fisheries. The mark used is an adipose fin clip.

	Ocean Recruits		
Region	Natural	Hatchery	Percent Mass Marked
PUGET SOUND STOCKS:			
Nooksack-Samish and 7/7A Independent	29,507	45,744	59.3%
Skagit	138,117	16,176	9.0%
Stillaguamish	66,600	600	0.9%
Snohomish	180,000	54,977	19.1%
South Puget Sound Normal	98,947	171,001	61.0%
South Puget Sound Delayed	0	2,308	97.9%
Hood Canal	74,741	74,897	42.3%
Strait of Juan de Fuca and Area 9	12,317	15,243	43.9%
Puget Sound Total	600,229	380,946	35.3%
WASHINGTON COASTAL STOCKS:			
North Coast Independent Tributaries	21,590	11,904	29.5%
Quillayute Summer	2,796	5,403	65.6%
Quillayute Fall	28,191	31,042	45.5%
Hoh	11,625	0	0.0%
Queets	13,279	16,331	49.0%
Quinault	21,723	35,544	53.8%
Grays Harbor	89,097	43,957	25.5%
Willapa Bay	47,788	64,658	54.1%
Washington Coastal Total	236,089	208,839	41.0%
COLUMBIA RIVER STOCKS:			
Columbia River Early	10,946	205,294	70.1% [a/]
Columbia River Late	11,793	134,468	77.9% [a/]
Columbia River Total	22,739	339,762	73.2% [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 2010.

TABLE III-6. Projected coho mark rates for 2011 fisheries under base period fishing patterns (percent marked).

Area	Fishery	June	July	August	Sept
Canada					
Johnstone Strait	Recreational	-	19%	17%	-
West Coast Vancouver Island	Recreational	31%	28%	27%	31%
North Georgia Strait	Recreational	31%	30%	30%	26%
South Georgia Strait	Recreational	32%	33%	24%	27%
Juan de Fuca Strait	Recreational	33%	35%	37%	36%
Johnstone Strait	Troll	40%	29%	22%	28%
NW Vancouver Island	Troll	35%	32%	33%	31%
SW Vancouver Island	Troll	40%	38%	39%	40%
Georgia Strait	Troll	40%	42%	43%	38%
Puget Sound					
Strait of Juan de Fuca (Area 5)	Recreational	42%	39%	38%	38%
Strait of Juan de Fuca (Area 6)	Recreational	40%	36%	37%	34%
San Juan Island (Area 7)	Recreational	30%	34%	35%	28%
North Puget Sound (Areas 6 & 7A)	Net	-	32%	30%	34%
Council Area					
Neah Bay (Area 4/4B)	Recreational	28%	42%	40%	45%
LaPush (Area 3)	Recreational	50%	45%	50%	44%
Westport (Area 2)	Recreational	57%	55%	54%	48%
Columbia River (Area 1)	Recreational	68%	65%	62%	65%
Tillamook	Recreational	56%	51%	44%	28%
Newport	Recreational	51%	45%	41%	26%
Coos Bay	Recreational	38%	34%	23%	12%
Brookings	Recreational	31%	21%	18%	7%
Neah Bay (Area 4/4B)	Troll	42%	41%	41%	41%
LaPush (Area 3)	Troll	45%	48%	43%	44%
Westport (Area 2)	Troll	43%	46%	51%	51%
Columbia River (Area 1)	Troll	57%	56%	54%	59%
Tillamook	Troll	52%	49%	49%	45%
Newport	Troll	49%	46%	42%	39%
Coos Bay	Troll	38%	35%	29%	17%
Brookings	Troll	25%	28%	30%	48%
Columbia River					
Buoy 10	Recreational	-	-	-	68%