APPENDIX C

Technical Methods - Derivation of Chinook Management Objectives and Fishery Impact Modeling Methods

Appendix C1.

Basis for Puget Sound chinook salmon escapement goals used in determining the harvestable abundance for Alternative 2. Several of these goals were also used as standards to evaluate the predicted effects of the alternatives when they represented the best information available about the habitat capacity and productivity of the watershed in which the chinook salmon population spawns.

Nooksack early

The management unit escapement goal of 4,000 early chinook salmon implies a goal of 2,000 natural-origin early chinook salmon spawners in each of the South Fork and North Fork Nooksack Rivers. The goal is not based on current habitat capacity, or the current productivity of either population. This interim goal was established in the 2001 Harvest Management Plan (WWIT and WDFW 2001).

Skagit Summer-fall and spring – Escapement goals are defined as the level, within the framework of the Puget Sound Chinook Harvest Management Plan, most likely to maximize long-term harvest. Escapement goals were derived analytically, based on recent productivity parameters derived by the Ecosystem Diagnosis and Treatment (EDT) method (Mobrand Biometrics 1999), assuming current habitat conditions. The population simulation model and methodological assumptions are described in detail in Appendix A to the HMP, Skagit River Management Unit Profile. (Note: The HMP is Appendix A to the DEIS.) The summer-fall chinook salmon escapement goal is 14,500; i.e. 8,434 for the upper Skagit summer population, 1,926 for the lower Sauk summer population, and 4,140 for the lower Skagit fall population. The spring chinook salmon escapement goal is 2,000, comprised of 986 for the upper Sauk, 440 for the Cascade, and 574 for the Suiattle populations. These goals are considerably higher than the MSY escapement levels calculated from spawner recruit parameters, without consideration of management error or environmental variation.

Stillaguamish – The escapement goal for the North Fork Stillaguamish (600) is an estimate of optimum (Maximum Sustained Yield) escapement, derived from fitting a Ricker recruitment function to recent spawner – recruit data. Cohort reconstruction of brood-year recruitment was calculated from coded-wire tag recoveries. The goal for the South Fork Stillaguamish (300) resulted from habitat-based analysis (EDT method – Mobrand Biometrics 1999; and Mobrand 2000) of the performance of various life history trajectories in the watershed given current habitat conditions. The output represents the average performance of the population under the given conditions, and there is no adjustment for random fluctuations or for improvements or degradation of habitat conditions. Additionally, average

marine survival conditions for 1989–1995 were assumed in this analysis (personal communication with Kit Rawson, Tulalip Department of Natural Resources, Senior Fishery Management Biologist, December 6, 2002). A Beverton-Holt recruitment function was fit to habitat-based productivity estimates, allowing a determination of escapement at Maximum Sustained Yield.

Snohomish – The Snohomish system escapement goal of 4,600 is a composite of population goals for the Skykomish (3,600) and Snoqualmie (1,000) systems. These goals were derived by the Ecosystem Diagnosis and Treatment method, described above for the Stillaguamish analysis. The Skykomish goal was verified using coded-wire-tag (CWT)-based cohort reconstruction, and spawner-recruit analysis. See the Puget Sound Chinook Harvest Management Plan, Appendix A, Snohomish River Management Unit Profile, for a detailed description of the derivation of these goals.

Lake Washington

The Lake Washington management unit escapement goal of 1,550 comprises goals for the Cedar River and Bear Creek of 1,200 and 350, respectively. The Cedar River escapement goal should be considered a conservative estimate. The goal is based on historical escapement estimates where an attempt is made to survey the entire known spawning area. However, in some years, chinook salmon adults spawn in tributaries to the Cedar River that are not usually part of the major spawning area. In addition, some fish are missed by the surveyors as they raft the river (personal communication with Steve Foley, Washington Department of Fish and Wildlife, Fisheries Biologist, February 18, 2004). The Bear Creek escapement goal is based on spawner counts in index reaches that have not been expanded to include chinook spawners in other known spawning areas of the river. They are based on historical counts in these areas, specifically the 1965–1969 average for the Cedar River, and the 1983–1992 average for Bear Creek. These interim goals were stated in a technical memorandum to WDFW and tribal managers (P. Hage, R. Hatch, and C. Smith. March 28, 1994. *Interim escapement goals for Lake Washington chinook salmon*). This goal was used to assess predicted impacts to escapement among the alternatives.

Green-Duwamish

The escapement goal of 5,800 for the Green – Duwamish River is based on survey of the index reach from RM 29.6 to 47.6 (17.4 stream miles). Accurate escapement estimates from this reach were expanded to the total system according to the distribution of total escapement determined from tagging

studies. Corrected total escapements for the 12-year period from 1965 to 1976 averaged 5,740, so the system escapement goal was set at 5,800 (Washington Department of Fisheries Technical Report 29).

White

The interim escapement goal for the White River is for 1,000 adult chinook salmon to be captured at the Buckley Trap and transported above Mud Mountain Dam. These fish then migrate to natural spawning areas in the upper watershed. This goal was established by the inter-agency White River Recovery Team (WDFW et al. 1996. *Recovery Plan for White River Spring chinook salmon*). It is based on an analysis of habitat capacity (Warren 1994) in three tributaries to the upper mainstem, in which the majority of natural spawning now occurs. This goal was used to assess predicted impacts to escapement among the alternatives.

Puyallup

The current intent of fisheries management, for Puyallup fall chinook salmon, is to achieve escapement of at least 500 into the South Prairie/Wilkeson Creek tributary system. While the relationship between escapement to South Prairie and the entire Puyallup River system is not yet exactly quantified, the best available information suggests this level of escapement to South Prairie Creek represents an index of adequate seeding of the entire system. Uncertainty persists regarding system capacity due to the difficulty in enumerating adult chinook salmon in the mainstem, and the unknown potential of recently re-colonized habitat upstream of Electron Dam. For the purposes of catch modeling done for NEPA review, a system escapement goal was established at 1,200. This estimate is based on analysis of productivity under current habitat constraints, using the EDT method, which indicated that Maximum Sustained Yield (MSY) escapement is approximately 600, assuming a 50 percent hatchery contribution to natural spawning yields the escapement goal for the system.

Nisqually

Based on EDT habitat analysis, fitting a Beverton-Holt function to existing data on current habitat potential, Maximum Sustained Yield escapement, under current conditions, was estimated to be 1,100 (NCRT 2001, Chapter 5, p. 46, and Appendix 4 Section 3.2).

Skokomish and Mid- Hood Canal

Current natural escapement goals for the Skokomish River, and the three Mid-Canal rivers (Dosewallips, Duckabush, and Hamma Hamma) are 1,650 and 750, respectively. These goals are based

on the historical average escapement from 1965–1976 (WDFW 1977 Technical Report 29). The current capacity of habitat in these systems has not been quantified. Spawning habitat in the South Fork Skokomish is severely degraded and subject to annual flood or high flow. Hydroelectric facility operations constrain spawning success in the North Fork Skokomish.

Dungeness

The Dungeness River escapement goal of 925 is based on accessible spawning habitat (i.e., 17.7 miles in the mainstem, 8.0 miles in the Gray Wolf River), historical redd density (12 redds per mile), and spawner distribution (three adults per redd) (C. Smith and B. Sele. July 12, 1994. M*emorandum: Dungeness River escapement goal*). This goal was used to assess predicted impacts to escapement among the alternatives.

Elwha

The escapement goal for the Elwha River (2,900) is a composite of 2,400 adults required for broodstock by the hatchery programs, and 500 natural spawners. The natural component is based on the capacity of habitat that currently exists in the 4.9 river miles below Elwha Dam.

Hoko

The Hoko River escapement goal of 1,050 comprises the broodstock requirement for the Hoko Hatchery supplementation program of 200 (100 pairs), and 850 natural spawners to adequately seed natural spawning habitat in the mainstem and tributaries (Washington Department of Fisheries Technical Report 29).

Appendix C2.

Basis for National Marine Fisheries Service Critical and Viable Escapement Thresholds, and Rebuilding Exploitation Rates used to assess the effects on abundance and recovery of Puget Sound chinook salmon populations.

The method used to determine critical and viable escapement thresholds and Rebuilding Exploitation Rates was developed with three objectives in mind[1]. This method is described in more detail by NMFS in a document titled Viable Risk Assessment Procedure (McElhaney et al. 1999). First, NMFS sought to evaluate the proposed fisheries using biologically-based measures of the total exploitation rate that occurred across the full range of the species. Second, NMFS sought to use an approach that was consistent with the concepts developed by NMFS' Northwest Fisheries Science Center for the purpose of defining the conservation status of populations and ESUs; i.e.,Viable Salmonid Populations (McElhaney et al. 1999). Finally, NMFS sought to develop an approach for defining target exploitation rates that could be related directly to the regulatory definition of jeopardy. The product of this approach is a set of Rebuilding Exploitation Rates for representative stocks within each Evolutionarily Significant Unit. Rebuilding Exploitation Rates were developed for a limited set of Puget Sound chinook salmon populations. The proposed fisheries were then evaluated, in part, by comparing the Rebuilding Exploitation Rates to exploitation rates anticipated as a result of the proposed fishery regime, recognizing that the jeopardy determination must be made with respect to the overall ESU. More qualitative considerations were used to extrapolate where necessary from the available Rebuilding Exploitation Rate analyses.

There are four steps involved with determining population-specific Rebuilding Exploitation Rates: 1) identify populations, 2) set critical and viable threshold abundance levels, 3) estimate population productivity as indicated by a spawner-recruit relationship, and 4) identify an appropriate Rebuilding Exploitation Rate through simulation.

As described in Subsection 3.3, Fish – Affected Environment, the population structure used for the Puget Sound chinook salmon Evoluntionarily Significant Unit is that defined by the Puget Sound and Olympic Peninsula Technical Recovery Team (Puget Sound Technical Recovery Team 2003).

[1] This method was first used to assess the impacts from implementation of the Pacific Salmon Treaty (NMFS 1999) and has been used by NMFS to evaluate harvest actions impacting the Puget Sound chinook salmon ESU since that time (NMFS 2000 [PFMC BO], NMFS 2001 [4(d) Rule]).

The Viable Salmonid Populations document (McElhaney et al. 1999) develops the idea of threshold abundance levels as one of several indicators of population status (others being productivity, spatial structure, and diversity). The thresholds described include a critical threshold and a viable population abundance level. The critical threshold generally represents a boundary below which uncertainties about population dynamics increase and therefore extinction risk increases substantially. The viable population threshold is a higher abundance level that would generally indicate recovery or a point beyond which ESA-type protections are no longer required, with the caveat that abundance is not the only relevant or necessary indicator of recovery.

The Viable Salmonid Populations document provides several rules of thumb that are intended to serve as guidelines for setting population-specific thresholds (McElhaney et al. 1999). Unfortunately, these guidelines continue to evolve as part of the ongoing development process. Population-specific targets will be identified in the final recovery plan for the Puget Sound chinook salmon ESU. However, because the thresholds were needed to set the Rebuilding Exploitation Rates, NMFS considered the existing rules of thumb, and other relevant guidance, to make preliminary threshold determinations for Puget Sound chinook salmon populations.

The critical threshold was developed from a consideration of genetic, demographic, and spatial risk factors for each population. Genetic risks to small populations include the loss of genetic variation, inbreeding depression, and the accumulation of deleterious mutations. The risk posed to a population by genetic factors is often expressed relative to the effective population size, or the size of an idealized population that would produce the same level of inbreeding or genetic drift that is seen in an observed population. Guidance from the existing Viable Salmonid Populations document suggests that effective population sizes of less than 500 to 5,000 per generation are at increased risk. The population size range per generation was converted to an annual spawner abundance range of 125 to 1,250 by dividing by four, which is the approximate generation length. An escapement level of 200 fish was selected from this range to represent a critical threshold for genetic risk factors (Method 1), since most of the populations that were subject to the Rebuilding Exploitation Rate analysis were relatively small. For example, the interim escapement objectives for the Nooksack River stocks are 2,000 fish each. Critical escapement threshold values much larger than 200 would be out of context for the populations of concern.

The Biological Requirements Work Group (BRWG 1994) took genetic considerations and other factors into account in their effort to provide guidance with respect to a lower population threshold for Snake

River spring/summer chinook salmon. They recommended annual escapements of 150 and 300, for small and large populations, which represented levels below which survival becomes increasingly uncertain due to various risk factors and a lack of information regarding population responses at low spawning levels. This provides independent support for the use of 200 (which is within the range of 150 to 300) as a critical threshold.

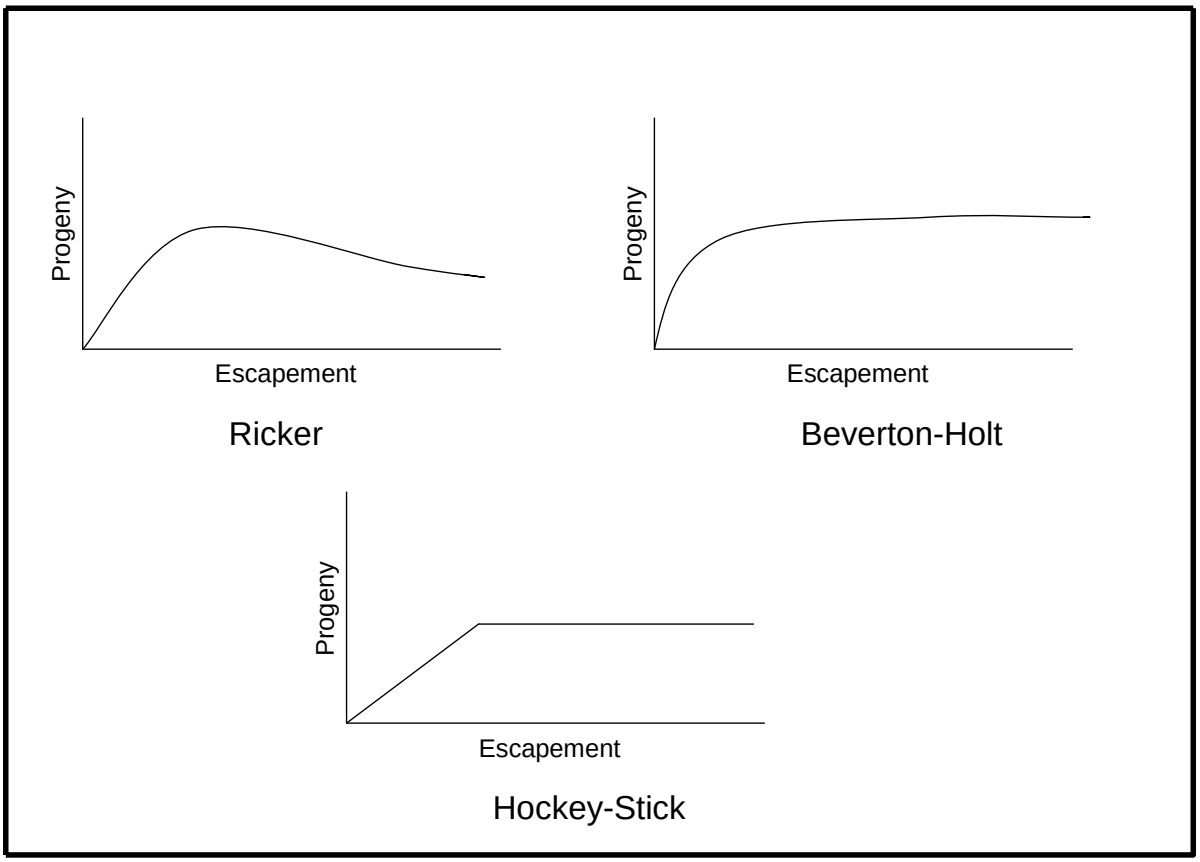
Factors associated with demographic risks include environmental variability and depensation. Depensation – a decline in the productivity of a population (e.g., smolts per spawner) as the abundance declines – can result from the uncertainty of finding a mate in a sparse population and/or increased predation rates at low abundance. Demographic risks were assessed using a Ricker stock-recruit model (Method 2). Peterman (1977 and 1987) provided a rationale for depensation and suggested relating the escapement level at which depensation occurs to the size of the population in the absence of fishing (equilibrium escapement level). NMFS set this measure of the critical threshold equal to 5 percent of the equilibrium escapement level. In cases where there were no data in the lower range of escapements, a third method (Method 3) was used. In these cases, the lowest escapement with a positive adult return was used.

Each of the measures of the preliminary critical threshold was considered in the context of the types and quality of data available, the characteristics of the watershed, and the biology of the population (Table C2-1). For "large populations," NMFS typically selected a critical threshold based on Method 2 to assure a sufficient density of spawners, or Method 3 where there were no escapements in the lower range to define the lower limb of the stock-recruit relationship. Method 1 was used for small populations or populations for which NMFS was unable to estimate the equilibrium population size or analysis is not complete at this time.

Similar methods were used to establish the viable population threshold. In this case, the criteria were 1,250 spawners (genetics, derived from the Viable Salmonid Population guideline range of 5,000 to 16,700 divided by the average generation length of approximately 4 years) (Method 1); the level of escapement required to achieve the maximum sustainable yield (demographics) under current environmental conditions (Method 2); or other information related to the productivity and capacity of the watershed (Method 3). Again, the decision concerning which method to use was based on a consideration of the context of the types and quality of data available, the characteristics of the watershed, and the biology of the population (Table C2-1).

The third step in the process of identifying population-specific Rebuilding Exploitation Rates is to estimate the stock-recruit parameters. Estimates of the stock-recruit parameters for each population were required for both establishing the escapement threshold levels (Method 2), and for the simulations of population dynamics. Several different stock-recruit relationships were examined: Ricker, Beverton-Holt and the Hockey Stick. The three functions differ primarily in the response of population abundance at higher escapement levels. The Ricker function assumes that at some level of spawners, productivity begins to decline as escapement increases; i.e., at higher escapement levels, competition for natural resources (such as spawning or rearing space and food) results in fewer progeny produced for each additional spawner. The Beverton-Holt function assumes that at some level of escapement, productivity continues to increase with increasing escapement, but only gradually. The Hockey-Stick function assumes that at some level of escapement, productivity levels off, neither increasing nor decreasing. Below this level of escapement, the relationship is density-independent; i.e., the number of progeny produced is independent of the number of spawners. Where data were sufficient to conduct spawner-recruit analyses, hatchery-origin spawners were included in the estimate of parent escapement since they contributed to the progeny produced, but were removed from the escapement of adults produced from that brood year in order to assess the natural productivity of the parental spawners.

Figure C2-1. Spawner-recruit response for each spawner-recruit function evaluated in development of escapement thresholds and Rebuilding Exploitation Rates.



The final step in determining Rebuilding Exploitation Rates is to use a simulation model to iteratively solve for an exploitation rate that meets specific criteria related to both survival and recovery given the specified thresholds and estimated spawner/recruit parameters. The consultation regulations define "jeopardize the continued existence" to mean:

> "... to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing appreciably the reproduction, numbers, or distribution of the species" (50 CFR section 402.2).

The simulation then uses a quantified level of risk associated with this definition - "... reduce appreciably the likelihood of survival and recovery ..." and the population specific threshold levels to identify an exploitation rate that meets the following criteria:

1) Did the percentage of escapements less than the critical threshold value increase by less than 5 percentage points relative to the baseline?

   and, either

2a) Does the escapement at the end of the 25-year simulation exceed the viable threshold at least 80 percent of the time?

   or

2b) Does the percentage of escapements less than the viable level at the end of the 25-year simulation differ from the baseline by less than 10 percentage points?

For comparison purposes, these simulations were measures against simulations that assumed these species were not harvested anywhere as the baseline (a zero exploitation rate). In addition, the simulation model uses available information on management error, and errors in measurement of the stock-recruit parameters used in the model to account for uncertainty in management precision and parameter estimation.

The Rebuilding Exploitation Rate is then the level of exploitation rate that results in a low probability that the proposed harvest action will endanger the survival of the population, and a relatively high probability that the proposed harvest action will not impede recovery as defined in this context. Recovery in this context means achieving the viable abundance threshold for a population, assuming current habitat conditions. That is why they are called Rebuilding and not Recovery Exploitation Rates. Recovery will require improvements in all primary sources of salmon mortality. A separate recovery planning process is currently underway that will ultimately define recovery in terms of necessary improvements in all four Hs (harvest, hatchery, habitat and hydropower), and in the context of the ESU as a whole.

The Rebuilding Exploitation Rate is the highest exploitation rate that can meet Criterion 1 and Criterion 2a or 2b. Once identified, proposed fisheries can be evaluated by considering the likelihood that they will meet the Rebuilding Exploitation Rates. It is important to emphasize that the Rebuilding Exploitation Rate analysis is made with respect to populations, while ESA determinations must be made with respect to the anticipated impacts to the ESU. For example, failure to meet the Rebuilding

Exploitation Rate standards for one population in a large ESU such as the Puget Sound chinook salmon ESU does not necessarily indicate jeopardy to the ESU as a whole.

A final step was to convert the Rebuilding Exploitation Rates based on coded-wire tags (CWT) into values that could be easily compared with output from the model used to assess the alternatives in this Environmental Impact Statement: the Fishery Regulation Assessment Model (FRAM). This step was necessary to compare the exploitation rates resulting from the fishery strategies under each alternative to the Rebuilding Exploitation Rates used to assess progress toward recovery. This was done by regressing validated FRAM exploitation rates from past years against the brood year CWT-based exploitation rates from which the Rebuilding Exploitation Rates were derived. The regression relationship was then applied to the Rebuilding Exploitation Rate CWT-based value, resulting in a Rebuilding Exploitation Rate measured in FRAM terms.

The following tables summarize the data and methods used to determine the critical and viable thresholds and Rebuilding Exploitation Rates used in the evaluation of effects to Puget Sound chinook salmon.

Table C2-1. Methods used to derive critical and viable thresholds for Puget Sound chinook salmon populations.

Population	Critical Threshold	Method	Viable Threshold	Method
Strait of Juan de Fuca				
Dungeness Spring	200	1	925	3
Elwha	200	1	2,900	3
North Puget Sound				
Nooksack Spring			500	2
North Fork Nooksack	200	1		
South Fork Nooksack	200	1		
Skagit Spring				
Upper Cascade	170	3	NA	
Upper Sauk	130	3	330	2
Suiattle	170	3	400	2
Skagit Summer/Fall				
Lower Sauk	200	1	681	2
Upper Skagit	967	2	7,454	2
Lower Skagit	251	2	2,182	2
Stillaguamish Summer/Fall				
North Fork Stillaguamish	300	2	552	2
South Fork Stillaguamish	200	1	300	2
Snohomish Summer/Fall				
Skykomish	1,650	3	3,500	2
Snoqualmie	400	3	NA	
South Puget Sound				
Lake Washington-Cedar R.	200	1	1,200	3
Green-Duwamish	835	2	5,523	2
Puyallup	200	1	1,200	3
Nisqually	200	1	1,100	3
White Spring	200	1	1,000	3
Hood Canal				
Mid-Canal Summer/Fall	200	1	1,250	1
Skokomish	200	1	1,250	1

Source: S. Bishop, National Marine Fisheries Service, data analysis conducted in 1999–2003.

1 = Generic guidelines from Viable Salmonid Population document (McElhaney et al. 2000).
2 = Spawner-recruit analysis.
3 = Critical: lowest escapement with a positive adult return.
4 = Viable: other sources of information related to population productivity/capacity (see Appendix C1).

Table C2-2. Data used to derive critical and viable escapement thresholds and Rebuilding Exploitation Rates.

	Escapement	Age	Environmental Variables	
			Freshwater	Marine
Nooksack Spring	1984–2001	1992,93,95,99,2001	1984–1997	1984–1997 BY
Skagit Spring				
Upper Cascade	1980–2001			
Upper Sauk	1980–2001	1986,92-95,1997–2001	1981-1997	1981–97 BY
Suiattle	1980–2001	1986–90,1992–2001	1986-1997	none
				(Skagit spring yearling indicator stock)
Skagit Summer/Fall				
Lower Sauk	1974–1997	Area 8/Skagit River	1970–1996	1979, 1981–1992 BY
Upper Skagit	1974–1997	1965–72,74–77,80–89, 1992–1993	1970–1996	1979, 1981–1992 BY
Lower Skagit	1974–1997		1970–1996	1979, 1981–1992 BY
				(Stillaguamish and Samish indicator stocks)
Stillaguamish Summer/Fall				
North Fork Stillaguamish	1974–1997	none	No relationship	1983–1992 BY
South Fork Stillaguamish	1985–1997	none	No relationship	1983–1992 BY
				(Stillaguamish and Samish used for marine survival pre-1986)
Snohomish Summer/Fall				
Skykomish	1979–2000	1989,1997–1999 (1979–1988, 1990–1996 simulated)	1979–1996	1979–1994 BY
				(Stillaguamish, Samish, Quinsam, CHI indicator stocks)
Green-Duwamish	1971–1996	none	No relationship	1983–1992 BY

Source: Susan Bishop, Puget Sound/Washington Coastal Harvest Management Leader, Sustainable Fisheries Division, National Marine Fisheries Service, data analysis conducted 1999-2003.

Table C2-3. Data used to derive critical and viable escapement thresholds and Rebuilding Exploitation Rates.

	Fishery Mortality	Management Error	Spawner-Recruit Function	Indicator Stock
Nooksack Spring	1984–1997 BY	1988–1993	Ricker, Bev-H, Hockey Stick	1984–1987 South Fork Nooksack fingerling 1989–1997 North Fork Nooksack yearling
Skagit Spring				
Upper Sauk	1981–1997 BY	1988–1993	Ricker	1981–1997 BY
Suiattle	1981–1997 BY	1988–1993	Ricker, Bev-H, Hockey Stick	(Skagit spring yearling indicator stocks)
Skagit Summer/Fall				
Lower Sauk	1971–1992 BY	1988–1993	Ricker	Stillaguamish and Samish
Upper Skagit	1971–1992 BY	1988–1993	Ricker	
Lower Skagit	1971–1992 BY	1988–1993	Ricker	
Stillaguamish Summer/Fall				
North Fork Stillaguamish	1974–1993 BY	1988–1993	Ricker	Stillaguamish
South Fork Stillaguamish	1974–1993 BY	1988–1993	Ricker	
Snohomish Summer/Fall				
Skykomish	1979–1996 BY	1988–1993	Beverton-Holt	PS aggregate for preterminal fishing rates; terminal run reconstruction for terminal fishing rates
Green-Duwamish	1973–1975, 1978–1981, 1985–1993	1988–1993	Ricker	Soos Creek (Nisqually and Grovers also used for marine survival in 1984–1985)

Source: Susan Bishop, Puget Sound/Washington Coastal Harvest Management Leader, Sustainable Fisheries Division, National Marine Fisheries Service, data analysis conducted 1999-2003.
Age Data: Based on scales sampled from spawning grounds. If insufficient samples were available, age data was simulated.
Management Error: Uses management error from several Puget Sound chinook salmon indicator stocks (J. Gutmann, 1998).
BY = Brood year or the year in which the parents spawned.

Appendix C3. Modeling Assumptions and Inputs for EIS Alternatives and Scenarios

The effects on listed and unlisted salmon and socio-economic impacts evaluated in the Environmental Impact Statement were determined by the distribution and magnitude of catch, fishing opportunity (sport angler trips) and escapement. The Fisheries Regulation Assessment Model (FRAM) and other sources of data were used to predict catch, exploitation rates, angler trips and escapement. Results were reported for five regional fisheries consistent with the available FRAM model output:

Regional Fishery	Washington Catch Areas
Strait of Juan de Fuca	4B (except May-September when area is under the jurisdiction of the Pacific Fisheries Management Council), 5, 6, 6A, 6C Dungeness Bay (6D) All freshwater rivers flowing into the Strait of Juan de Fuca.
North Puget Sound	7, 7A Bellingham Bay (7B, 7C, 7D) All freshwater rivers flowing into these marine areas.
Central Puget Sound	8, , 8A, 9 Skagit Bay (8) Tulalip Bay (8D) All freshwater rivers flowing into these marine areas.
South Puget Sound	Marine areas 10,11,13, 13A-13K Eliott Bay (10A) Sinclair Inlet (10E) Commencement Bay (11A) Lake Washington and a freshwater rivers flowing into South Puget Sound marine areas.
Hood Canal	Marine areas 12, 12B, 12C Port Gamble Bay (9A) Quilcene/Dabob Bays (12A) All freshwater rivers flowing into these marine areas.

The following sections describes the assumptions made regarding the abundance of contributing salmon stocks and the structure of fisheries, in order to predict the catch and escapement of the five species of salmon associated with each alternative. As described below (C4), the FRAM allows a very detailed assessment of commercial and recreational harvest of chinook and coho salmon in Puget Sound, based on equally detailed input of expected stock abundance and the expected fishery regime, and predicts natural and hatchery escapement for management units or, with subsequent analysis, individual populations. Chinook catch and escapement were analyzed in greater detail (four scenarios), to consider the effects of variable northern (Canadian/Alaskan) intercepting fisheries and of variable abundance.

Fisheries for other species (i.e., pink, sockeye, coho, and chum salmon) are managed to achieve escapement goals established for management units. Their harvest distribution is analyzed in less detail because the structure of fisheries, which are primarily commercial, is much less complex. For species other than chinook salmon the effects of variable abundance were not modeled or described.

Catch and escapement for each species of salmon was reported for each Puget Sound management unit, with catch in regional fisheries detailed where applicable. Total exploitation rates were estimated for each management unit. Estimates of total mortality and escapement were also reported for hatchery and naturally-spawning components where applicable. Exploitation rates were assumed to be the same for hatchery- and naturally-spawning components since the information is not available to distinguish between the two components.

With the forecast abundance of hatchery production and natural components, and the expected catch in all fisheries as input, the FRAM estimates catch by fishery and escapement for individual management units of chinook and coho salmon. Catch was reported either as catch of all populations within a region, or catch of a mangement unit across all regional fisheries.

For management units with multiple populations, the exploitation rate for each population was assumed to be the same as that of the management unit because the available model does not distinguish among populations. At this time, one coded-wire tag indicator stock is used to represent the exploitation rate on all populations within a management unit. A more detailed description of the FRAM is provided below in C4.

Chinook Salmon

Alternative 1

To simplify the analysis, and yet give a current perspective on the outcome of fisheries, modeling chinook salmon catch and escapement for the four alternative fishing regimes was based on the forecasts of abundance developed for pre-season planning in 2003. Modeling of Alternative 1 was based on the 2003 pre-season FRAM run, with some adjustments in the harvest objectives (e.g, Exploitation Rate [ER] ceilings) for some management units to reflect the proposed 2004–2009 Puget Sound Chinook Harvest Management Plan (HMP), and consequent shaping of fisheries to achieve all those objectives. The pre-season (prior to implementation of the fisheries) expectations in 2003 were used to assess Alternative 1 because: 1) 2003 is generally representative of status quo conditions – management objectives were identical to the proposed Puget Sound chinook harvest plan; 2) it includes

impacts to chinook that occur in pink fisheries that do not occur in even-numbered years, and; 3) pre-season expectations better reflect the intended implementation of the HMP.

The pre-season 2003 fishing regime provides a valid general example of management intent under the HMP. Because chinook salmon from critical and non-critical units commingle in many marine areas, meeting the objectives for the weak stocks implies that otherwise-surplus chinook from strong units will not be harvested. In principle, this surplus could be harvested selectively in freshwater areas. However, the HMP states that stronger stocks will only be harvested 'down' to their escapement goals, or 'up' to their ER ceilings, if they meet stringent criteria defining harvestable surplus. It was assumed that these conditions would not be met during the term of the proposed HMP, so for many units (e.g., Skagit spring, Stillaguamish, Snohomish), the surplus was accrued to escapement. For other units (e.g., Green, Nisqually, Puyallup), harvestable surplus was forecasted, so the pre-season FRAM was configured to harvest that surplus, 'up' to the Recovery Exploitation Rate (RER), or 'down' to the stated escapement goal.

Chinook salmon escapement estimates for each Puget Sound management unit were taken from FRAM runs that simulated each scenario under Alterative 1. The FRAM subtracts fishery-related mortality that occurs through the month of September from the initial (i.e., unfished) abundance of each unit, then discounts the contribution of surviving 2-, 3-, and 4-year-old fish, according to their maturation rates.

<u>Alternatives 2 and 3</u>

Due to the implications of escapement goal management, Alternatives 2 and 3 involved similar, very sweeping changes in the distribution of fisheries, relative to Alternative 1. Under Alternative 3, terminal-area fisheries were defined as those harvesting only local-origin chinook. For example, the terminal area for the Skagit River would be defined where only Skagit-origin chinook would be caught. However, it was determined at the outset that virtually all marine area fisheries in Puget Sound encounter a mixture of Puget Sound chinook stocks. Since the abundance of one or more of these commingled stocks was below their escapement goals, marine area fishing was precluded under both Alternative 2 and 3. It was assumed that freshwater fishing areas harvested only the local management unit, and, in the case of the Skagit River where spring and summer/fall chinook units are present, they could be selectively harvested in management periods. In actuality, straying probably occurs naturally in all systems, so that even freshwater fisheries may encounter small numbers of non-local chinook. The fisheries regime developed to model Alternatives 2 and 3 allowed freshwater chinook fisheries to occur where abundance exceeded the escapement goals. Where chinook abundance was less than the

escapement goals, chinook fisheries, and fisheries directed at other salmon species that incur incidental chinook mortality, were precluded.

With commercial and recreational fishing limited to freshwater areas, the technical workgroup assessed the extent to which harvestable surplus could be caught. It was assumed that treaty commercial and recreational fisheries would operate at their current scale of effort (i.e., fleet sizes, recreational trips), use existing gear types and season structure, and occur only in rivers where such commercial or recreational fishing has occurred in recent years. For example, if a large harvestable surplus was forecast to occur for a given stock, a priori judgment determined whether the local tribal commercial fleet effort (operating within their defined 'usual and accustomed area') and recent freshwater recreational angling effort could reasonably catch the harvestable surplus. Based on past harvest rates and harvest rates in areas of similar fleet size and fishery structure, the workgroup concluded that the Green River fishery was capable of harvesting the full amount of chinook (11,500) above the escapement goal. In contrast, it was determined that the current fleet size and fishery structure in the Nooksack-Samish area would not be capable of harvesting the total surplus of fall chinook (41,900) above its hatchery escapement goal.

If the lack of harvestable surplus chinook precluded freshwater fisheries that would directly or incidentally harvest chinook, late-season chum and steelhead fisheries (i.e., those occurring from December through March) were assumed free of incidental impacts to listed chinook, and thus included in Alternative 2 and 3. The co-managers' fish ticket database provided support for this assumption.

No new fisheries were envisioned for Alternative 2 or 3. For example, non-tribal commercial fisheries have not occurred in the Strait of Juan de Fuca (Marine Catch Areas 4B, 5, and 6C), deep South Puget Sound (Marine Catch Areas 13 through 13I), or freshwater areas for at least two decades, based on agreements with the tribes and to meet allocation objectives among non-tribal commercial and recreational users. It was assumed that the size of treaty gillnet fishing fleets that have operated recently in these freshwater areas would not expand. Fishing was not expanded to any freshwater areas that have not been recently opened to commercial or freshwater salmon harvest, even though, with the closure of marine areas, substantial harvestable surplus was projected to occur in some such areas. Similarly, it was assumed that recreational effort or regulatory bag limits would not increase, and the current scale of mark selective fisheries would not expand. These somewhat qualitative assessments of the harvest capability of existing commercial and recreational fisheries were made by a small group of WDFW and tribal fisheries management biologists.

With forecasts of which stocks would return with harvestable abundance, and having determined the potential for current fishing effort to harvest that surplus, harvest scalars or catch levels were input accordingly to the FRAM. The primary distinction between the structure of fisheries in Alternatives 2 and 3 was due to different escapement goals. When more than one population returns to a given river, for some management units Alternative 3 would set a more constraining escapement goal for the management units appropriate to its weakest population.

The principle difference between the chinook salmon harvest allowed under Alternatives 2 and 3, and consequently the difference in allowable harvest of other species, was due to the harvestable surplus of listed chinook in the Snohomish and Stillaguamish units associated with Alternative 2. The chinook surplus also enabled harvest of pink, coho, and chum salmon in the Stillaguamish River and in Tulalip Harbor (Area 8D). Area 8D is an isolated marine area, adjacent to the hatchery facilities of the Tulalip Tribes; harvest in that area is believed not to harvest non-local chinook.

Chinook escapement was estimated as the catch subtracted from the predicted abundance, i.e., those fish that escaped the fishery to spawn. It should be noted that the escapement does not increase by the same amount as the difference in catch between Alternatives 2 or 3 and Alternative 1. This is because escapement is comprised of those fish that escape fisheries to spawn. In the absence of fisheries, not all fish would escape. Some would die of natural causes, and some fish would remain in marine waters to mature and return to spawn in future years.

Alternative 4

Alternative 4 involves the closure of all fisheries that would harvest any listed Puget Sound chinook salmon, regardless of their forecast abundance status, precluding all marine area fisheries, and all freshwater fisheries except those late-season chum and steelhead fisheries (operating from December through March) that would have no incidental impact to chinook.

Abundance and Northern (Canadian/Alaskan) Fishery Scenarios

NMFS decided early in the DEIS analysis to examine the contingent effects of variable abundance, and increasing northern (Canadian/Alaskan) fishery interceptions, on harvest and escapement of Puget Sound chinook. As explained in DEIS Section 2, Alternatives Including the Proposed Action, the two abundance conditions modeled for Puget Sound chinook were the 2003 forecast level, and 30 percent reduced abundance (Table C3-1). The need to examine the effects of variable abundance was driven, in part, by the widely accepted view that marine survival has varied in a cyclic manner (Mantua et al. 1997), and evidence that freshwater survival has also varied widely under the primary influence of

incubation period flows (Seiler et al. 2002). The reduced abundance condition was based on observations of the period 1990 through 1999, for which average, aggregate abundance of all Puget Sound salmon stocks, natural and hatchery production combined, was approximately 30 percent lower than forecast for 2003. Individual natural and hatchery stocks varied independently to a greater or lesser extent

Table C3-1. Annual abundance of Puget Sound chinook salmon management units under 2003 forecasted and 30 percent reduced conditions, expressed as AEQ catch and escapement from the FRAM.

	2003	-30%
Nooksack	1849	1294
Skagit S/F	23287	16301
Skagit Spr	1475	1032
Stillaguamish	2849	1994
Snohomish	6356	4449
L. Washngton	8809	6166
Green	31128	21789
White	1858	1301
Puyallup	11548	8084
Nisqually	27040	18928
Hood Can	47542	33279
JDF	4234	2964

Chinook salmon abundance during the term of the proposed HMP cannot be forecasted exactly, and may in fact increase from the 2003 level. However, the average of the previous decade provides a reasonable view of the potential for abundance to decline.

It was necessary to examine the effects of higher northern (Canadian/Alaskan) fishery interceptions because the stated intent of the Canada Department of Fisheries and Oceans, and recent-year catch estimates support this likelihood. The modeled high northern fishery condition comprised different assumptions for the various areas. The west coast Vancouver Island troll fishery, and troll fisheries in Southeast Alaska were modeled at the maximum levels allowed by the current Chinook Annex to the Pacific Salmon Treaty (PST). Canadian fisheries in the Strait of Georgia and the Strait of Juan de Fuca were modeled as the observed catch in 1996 and 2002, respectively. Other northern fisheries were modeled at the level forecast for 2003.

Recreational Effort

To assess economic consequences, it was necessary to estimate recreational fishing effort for each alternative. To estimate the number of recreational trips corresponding to modeled harvest, catches of all salmon, whether caught in marine areas or freshwater, and including chinook and coho from FRAM runs, were multiplied by 4. This generic estimate of salmon 'angler success' (i.e., 0.25 fish per trip) was derived from the WDFW Catch Record Card Analysis used to estimate recreational catch and effort on an annual basis.

Other Salmon Species

Modeled catch only differed among alternatives, and was not specified differently for the abundance / northern (Canadian/Alaskan) fishery scenarios, which were intended to assess only the effect of variable chinook abundance and northern fisheries on chinook catch. The high and 2003 northern fishery conditions included in the scenarios may imply a different level of coho catch in Canada, and therefore affect coho catch in Puget Sound, but these indirect effects could not be reliably predicted.

Coho

Commercial and recreational coho salmon harvest was extracted directly from the final 2003 pre-season coho FRAM model for Alternative 1. For Alternatives 2 and 3, marine area fisheries were closed, and only those freshwater fisheries left open where harvestable chinook abundance also enabled coho harvest. These open fisheries corresponded to those in the chinook models created to simulate Alternatives 2 and 3. No coho fishing was allowed under Alternative 4.

Coho escapement estimates for each Puget Sound management unit extracted from FRAM 0319 (April 2003) for Alternative 1, and modified as necessary to simulate the freshwater fisheries associated with Alternatives 2, 3, and 4.

Sockeye

Sockeye salmon are primarily caught by commercial fisheries in marine fishing areas, in particular those fisheries directed at Fraser River (British Columbia) stocks that occur in the Strait of Juan de Fuca (SJDF) and San Juan Islands (SJI). However, in years when the Lake Washington sockeye run exceeds its escapement goal (325,000), commercial and recreational fisheries occur in the Lake Washington Ship Canal and Lake Washington, respectively. Relatively small tribal commercial fisheries, intended to harvest Lake Washington sockeye salmon, also occur in Central Puget Sound under this circumstance. The Baker River (Skagit system) sockeye salmon stock has occasionally

returned at levels slightly above the escapement goal, but the small surplus has been harvested in the river by tribes for ceremonial and subsistence purposes. This Baker River fishery was not included in any alternative model.

For Alternative 1, Fraser sockeye catch in the SJDF and SJI areas was modeled as the average of actual catch in 1998–2002. Lake Washington sockeye catch in marine and freshwater areas was modeled as the average of three recent years in which these fisheries occurred – 1996, 2000, and 2002. For Alternatives 2, 3 and 4, no sockeye catch was modeled, because the marine areas were closed due to commingled weak chinook stocks, and the terminal (freshwater) areas were closed because the forecast abundance of Lake Washington (Cedar River) chinook was below the escapement goal.

Pink

Pink salmon harvest occurs primarily in odd-numbered years in Puget Sound, due to the predominance of odd-year returning stocks in Puget Sound and southern British Columbia. The majority of pink salmon harvest occurs in treaty and non-Indian commercial fisheries directed at Fraser River stocks that occur in the SJDF and SJI in August and September. For Alternative 1, pink harvest in these marine areas was modeled as the average of the last three fisheries (i.e., 1997, 1999, and 2001).

A subset of pink salmon stocks in Puget Sound systems has consistently reached harvestable abundance, so models of Alternatives 1, 2, and 3 included terminal-area marine and/or freshwater, commercial and recreational fisheries to harvest that surplus. These abundant stocks include those in the Skagit, Stillaguamish, Snohomish, and Puyallup Rivers. These fisheries were modeled for Alternative 1 as they were projected during 2001 pre-season planning from forecast abundance.

Pink salmon stocks in Puget Sound are managed to achieve escapement goals. Harvestable surplus is projected to occur, during pre-season planning, based on the surplus in excess of escapement goals, allocated to treaty and non-Indian fisheries.

Chum

Commercial fisheries directed at fall chum salmon occur throughout Puget Sound in marine and freshwater areas. Harvestable surplus was modeled for Alternative 1 according to 2001 forecast abundance in excess of escapement goals. Fall chum fisheries generally extend from the last week of October through mid-December in freshwater areas, so harvest in December comprises a small proportion of the total harvestable abundance. Recreational chum salmon catch in marine and freshwater areas was modeled as the 1997–1999 average, from Catch Record Card estimates. For

Alternatives 2 and 3, chum salmon harvest was precluded in some rivers due to the lack of surplus chinook that would be caught incidentally, except in the late season (December) when chinook are absent. The late chum stock that returns to the Nisqually River supports commercial and recreational fisheries that extend from December through January, so it is the only salmon population that would be harvested as usual under Alternative 4.

For Alternatives 2 and 3, chum salmon fisheries in freshwater were modeled to harvest surplus chum, subject to the availability of surplus chinook that would be caught incidentally.

Steelhead

Small-scale commercial fisheries for winter steelhead are promulgated by the tribes in many freshwater areas, and usually extend from December through April. Recreational steelhead fisheries are not included in the Proposed Action. Commercial steelhead catch was modeled according to pre-season forecasts (Status Reports) in some areas, and from recent-year average catch in other areas. Summer steelhead fisheries, defined for the purpose of this modeling exercise as those occurring from June through November, were included in the model for Alternative 1, but not in models for Alternatives 2, 3, or 4.

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-1. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario A

Alternative 1--Proposed Action

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									135	80	67	70	743	797
Dungeness Spring	10% SUS ER		0.22	--	100	--	352	0.05	14	8	7	7	79	85
Western Strait-Hoko	10% SUS ER		0.23	--	230	--	785	0.05	33	20	16	17	181	194
Elwha	10% SUS ER		0.22	--	615	--	2,125	0.05	88	52	43	46	483	518
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.20	--	96	--	388	0.07	5	4	30	33	60	51
Nooksack/Samish summer-fall			0.84	54,124	--	10,044	--	0.84	6,049	5,868	40,602	40,675	7,473	9,079
Central Sound (Area 8, 9)														
Skagit														
Spring	38% Total ER		0.23	341	577	1,136	1,921	0.14	336	348	233	222	349	408
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	50% Total ER		0.48	108	10,662	118	11,633	0.18	1,443	1,310	2,516	2,584	6,811	9,704
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.17	--	471	--	2,322	0.11	153	142	166	171	152	212
Snohomish	21% Total ER		0.19	2,117	1,218	4,564	5,073	0.14	1,435	1,377	914	948	986	1,238
Tulalip Tribal Hatchery			0.99	9,175	--	98	--	0.99	1,795	2,100	6,969	6,918	411	462
South Sound (Area 10,11,13)														
Lake Washington (w Cedar River index)	15% pre-terminal SUS ER		0.31	3,118	272	4,937	305	0.20	835	738	1,267	1,300	1,289	1,709
Green-Duwamish	15% pre-terminal SUS ER	5800	0.62	10,415	9,397	5,016	5,819	0.51	4,042	3,776	11,897	12,125	3,873	5,134
Puyallup	50% Total ER		0.49	4,284	2,338	2,338	2,392	0.39	1,825	1,718	3,278	3,308	1,518	2,013
Nisqually		1100	0.76	16,467	3,487	4,911	1,106	0.68	6,421	5,774	11,542	11,651	1,991	2,639
White Spring	20% Total ER		0.20	--	366	--	1,468	0.19	105	103	250	253	11	14
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.54	35,136		29,528	--	0.44	11,573	10,406	17,106	15,382	6,458	8,562
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER		0.26	--	188	--	531	0.13	56	50	39	45	95	127
Skokomish	15% pre-terminal SUS ER	1200 nat.	0.63	9,792	2,020	6,104	1,211	0.50	4,116	3,952	5,198	5,420	2,497	3,361
Hoodsport H, Dewato, Union, Tahuya tribs.			0.76	19,272	225	5,594	591	0.63	2,286	2,030	13,909	14,202	3,301	4,443

LA WA components:									
all natural (cedar plus N trib)	**0.31**	**0**	**272**	**0**	**610**		**49**	**131**	**92**
cedar only natural	**0.31**	**0**	**136**	**0**	**305**		**25**	**65**	**46**
all hatchery	**0.40**	**3,118**	**0**	**4,632**	**0**		**785**	**1,136**	**1,197**
Combined	**0.39**	**3,118**	**272**	**4,632**	**610**		**835**	**1,267**	**1,289**

Table C3-2. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario A

Alternative 1--Proposed Action

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	10,840	6,465	268,418	21,030	2,580	2,363	0
North Sound (Area 7)	9,740	7,999	41,857	55,261	47,180	22,648	23,853
Central Sound (Area 8, 9)	21,552	8,608	170,440	351,773	9,514	9,165	250
South Sound (Area 10,11,13)	41,060	27,393	188,834	277,041	37,063	35,026	1,939
Hood Canal (Area 12)	4,509	3,696	54,014	13,946	9,371	16,962	140
TOTAL	87,700	54,160	723,563	719,051	105,707	86,163	26,182

Angler trips during "base" Sport Catch Area	**Marine**	**Freshwater**
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	188,282
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Angler-trips this run	
Juan de Fuca (Area 5, 6)	289,448
North Sound (Area 7)	97,119
Central Sound (Area 8, 9)	522,213
South Sound (Area 10,11,13)	465,874
Hood Canal (Area 12)	67,960
	1,442,614

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-3. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario A

Alternative 2-Escapement Goal Management at the Management Unit Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	746	801
Dungeness Spring		**925**	0.19	--	82	--	360	0.01	0	0	3	3	79	85
Western Strait-Hoko		**850**	0.19	--	184	--	807	0.01	0	0	6	6	178	192
Elwha		**2,900**	0.19	--	504	--	2,172	0.01	0	0	16	16	488	524
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.14	--	70	--	422	0.01	0	0	6	8	64	54
Nooksack/Samish summer-fall		**8,900**	0.44	26,496	--	33,887	--	0.44	16,384	16,388	2,601	2,858	7,511	9,123
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.12	162	273	1,229	2,073	0.02	0	0	69	73	365	420
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall		**14,500**	0.32	69	6,879	147	14,656	0.01	41	55	74	92	6,833	9,719
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish		**900**	0.66	--	1,768	--	903	0.60	782	782	829	832	157	219
Snohomish		**4,600**	0.22	2,306	1,313	4,024	4,634	0.16	1,104	1,105	1,491	1,501	1,025	1,286
Tulalip Tribal Hatchery		--	0.98	8,676	--	195	--	0.98	20	17	8,235	8,139	421	474
South Sound (Area 10,11,13)														
Lake Washington (w Cedar River index)		**1,200**	0.18	1,589	133	5,755	307	0.05	14	18	398	473	1,309	1,736
Green-Duwamish		**5,800**	0.55	7,937	7,036	5,948	5,800	0.42	4,532	4,543	6,510	6,769	3,931	5,213
Puyallup		**1,200**	0.70	4,916	2,795	1,100	1,200	0.57	963	968	5,206	5,303	1,541	2,044
Nisqually		**1,100**	0.72	13,197	2,885	4,913	1,100	0.63	1,822	1,847	12,205	12,528	2,054	2,724
White Spring		**1,000**	0.46	--	860	--	1,000	0.46	416	0	432	434	13	15
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.30	16,604		38,545	--	0.18	2,805	2,843	7,193	7,291	6,606	8,762
Hood Canal (Area 12)														
Mid-Canal		**750**	0.19	--	127	--	552	0.05	6	7	27	32	96	129
Skokomish		**1200**	0.60	8,850	1,816	6,174	1,218	0.46	3,197	3,242	4,939	5,092	2,530	3,403
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.90	21,315	144	1,851	625	0.76	202	261	17,912	18,115	3,345	4,498

LA WA components:									
all natural (cedar plus N trib)	**0.18**	**0**	**133**	**0**	**614**		**1**	**38**	**93**
cedar only natural	**0.18**	**0**	**66**	**0**	**307**		**0**	**19**	**47**
all hatchery	**0.23**	**1,589**	**0**	**5,448**	**0**		**13**	**360**	**1,215**
Combined	**0.22**	**1,589**	**133**	**5,448**	**614**		**14**	**398**	**1,309**

Table C3-4. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario A

Alternative 2-Escapement Goal Management at the Management Unit Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	16,147	16,147	0	69,659	0	0	0
Central Sound (Area 8, 9)	1,100	1,100	0	55,875	9,730	8,531	2
South Sound (Area 10,11,13	9,800	9,800	0	85,277	23,734	24,150	0
Hood Canal (Area 12)	3,044	3,044	0	21,130	9,371	21,213	0
TOTAL	30,091	30,091	0	231,940	42,835	53,893	2

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-5. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario B

Alternative 3--Escapement Goal Management at the Population Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	746	801
Dungeness Spring		**925**	0.19	--	82	--	360	0.01	0	0	3	3	79	85
Western Strait-Hoko		**850**	0.19	--	184	--	807	0.01	0	0	6	6	178	192
Elwha		**2,900**	0.19	--	504	--	2,172	0.01	0	0	16	16	488	524
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.14	--	70	--	422	0.01	0	0	6	8	64	54
Nooksack/Samish summer-fall		**8,900**	0.44	26,496	--	33,887	--	0.44	16,384	16,388	2,601	2,858	7,511	9,123
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.12	161	272	1,230	2,074	0.02	0	0	67	71	366	420
Upper Sauk		**986**												
Suiattle		**574**												
Upper Cascade		**440**												
Summer/Fall		**14,500**	0.32	69	6,879	147	14,656	0.01	41	55	74	92	6,833	9,719
Lower Sauk		**1,926**												
Upper Skagit		**8,434**												
Lower Skagit		**4,140**												
NF Stillaguamish		**600**	0.08	--	201	--	2,468	0.02	0	0	44	47	157	219
SF Stillaguamish		**300**												
Skykomish		**3,600**	0.10	1,253	617	4,933	5,475	0.04	531	532	314	325	1,025	1,286
Snoqualmie		**1,000**												
Tulalip Tribal Hatchery		--	0.10	842	--	7,906	--	0.10	20	17	401	459	421	474
South Sound (Area 10,11,13)														
Lake Washington (w Cedar River index)		**1,200**	0.18	1,588	132	5,756	307	0.05	14	18	397	473	1,309	1,736
Green-Duwamish		**5,800**	0.55	7,937	7,036	5,948	5,800	0.42	4,532	4,544	6,510	6,768	3,931	5,213
Puyallup		**1,200**	0.70	4,916	2,795	1,100	1,200	0.57	963	968	5,206	5,303	1,541	2,044
Nisqually		**1,100**	0.72	13,197	2,885	4,913	1,100	0.63	1,822	1,847	12,205	12,528	2,054	2,724
White Spring		**1,000**	0.46	--	860	--	1,000	0.46	416	0	432	434	13	15
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.30	16,602		38,547	--	0.18	2,805	2,843	7,191	7,289	6,606	8,762
Hood Canal (Area 12)														
Mid-Canal		**750**	0.19	--	127	--	552	0.05	6	7	27	32	96	129
Skokomish		**1200**	0.60	8,849	1,816	6,175	1,218	0.46	3,197	3,242	4,938	5,091	2,530	3,403
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.90	21,315	144	1,851	625	0.76	202	261	17,912	18,114	3,345	4,498

LA WA components:									
all natural (cedar plus N trib)	**0.18**	**0**	**132**	**0**	**614**		**1**	**38**	**93**
cedar only natural	**0.18**	**0**	**66**	**0**	**307**		**0**	**19**	**47**
all hatchery	**0.23**	**1,588**	**0**	**5,449**	**0**		**13**	**359**	**1,215**
Combined	**0.22**	**1,588**	**132**	**5,449**	**614**		**14**	**397**	**1,309**

Table C3-6. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario B

Alternative 3--Escapement Goal Management at the Population Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	16,147	16,147	0	69,659	0	0	0
Central Sound (Area 8, 9)	29	29	0	1,461	0	0	0
South Sound (Area 10,11,13)	9,801	9,801	0	85,279	23,737	24,153	0
Hood Canal (Area 12)	3,044	3,044	0	21,130	9,371	21,215	0
TOTAL	29,021	29,021	0	177,529	33,108	45,368	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-7. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario A

Alternative 4--No Action/No Authorized Take

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	746	801
Dungeness Spring	10% SUS ER		0.19	--	82	--	360	0.01	0	0	3	3	79	85
Western Strait-Hoko	10% SUS ER		0.19	--	184	--	807	0.01	0	0	6	6	178	192
Elwha	10% SUS ER		0.19	--	504	--	2,172	0.01	0	0	16	16	488	524
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.14	--	70	--	422	0.01	0	0	6	8	64	54
Nooksack/Samish summer-fall			0.51	10,349	--	10,083	--	0.51	237	241	2,601	2,858	7,511	9,123
Central Sound (Area 8, 9)														
Skagit														
Spring	42% Total ER		0.12	161	272	1,230	2,074	0.02	0	0	67	71	366	420
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	52% Total ER		0.32	69	6,879	147	14,656	0.01	41	55	74	92	6,833	9,719
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.08	--	201	--	2,468	0.02	0	0	44	47	157	219
Snohomish	24% Total ER		0.09	778	564	5,432	5,504	0.03	3	4	314	325	1,025	1,286
Tulalip Tribal Hatchery			0.10	842	--	7,906	--	0.10	20	17	401	459	421	474
South Sound (Area 10,11,13)														
Lake Washington (w Cedar River index)	15% pre-terminal SUS ER	1200	0.18	1,588	132	5,756	307	0.05	14	18	397	473	1,309	1,736
Green-Duwamish	15% pre-terminal SUS ER	5800 spawners?	0.18	3,058	2,278	10,827	10,558	0.05	41	53	1,363	1,622	3,931	5,213
Puyallup	50% Total ER		0.18	1,359	709	4,656	3,286	0.05	16	21	511	608	1,541	2,044
Nisqually		1100 spawners?	0.16	3,201	647	14,908	3,338	0.07	89	114	1,705	2,028	2,054	2,724
White Spring	20% Total ER		0.02	--	29	--	1,831	0.01	0	0	16	18	13	15
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.20	10,577		41,786	--	0.08	175	224	3,796	4,861	6,606	8,762
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER	750 spawners??	0.19	--	127	--	552	0.05	6	7	27	32	96	129
Skokomish	15% pre-terminal SUS ER	**1200**	0.19	2,811	577	12,214	2,482	0.05	153	197	704	857	2,530	3,403
Hoodsport H, Dewato, Union, Tahuya tribs.			0.19	4,334	144	18,833	625	0.05	202	261	930	1,133	3,345	4,498

LA WA components:										
all natural (cedar plus N trib)			**0.18**	**0**	**132**	**0**	**614**		**1**	**38**	**93**
cedar only natural			**0.18**	**0**	**66**	**0**	**307**		**0**	**19**	**47**
all hatchery			**0.23**	**1,588**	**0**	**5,449**	**0**		**13**	**359**	**1,215**
Combined			**0.22**	**1,588**	**132**	**5,449**	**614**		**14**	**397**	**1,309**

Table C3-8. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario A

Alternative 4--No Action/No Authorized Take

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	0	0	0	840	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	0	0	0	2,092	0	0	0
Hood Canal (Area 12)	0	0	0	32	9,371	0	0
TOTAL	0	0	0	4,308	9,371	0	0

Sport Catch Area	Salmon Angler Trips Marine	Freshwater
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	8,682
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-9. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario B

Alternative 1--Proposed Action

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									134	79	67	70	998	1,085
Dungeness Spring	10% SUS ER		0.27	--	127	--	336	0.05	14	8	7	7	106	115
Western Strait-Hoko	10% SUS ER		0.28	--	293	--	750	0.05	33	19	16	17	243	265
Elwha	10% SUS ER		0.28	--	780	--	2,031	0.05	87	51	43	46	649	705
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.25	--	121	--	365	0.07	5	4	31	34	85	50
Nooksack/Samish summer-fall			0.85	56,201	--	9,855	--	0.85	5,969	5,802	36,076	36,211	14,156	17,025
Central Sound (Area 8, 9)														
Skagit														
Spring	38% Total ER		0.27	397	672	1,088	1,845	0.14	334	345	234	222	501	574
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	50% Total ER		0.55	132	13,219	110	11,029	0.16	1,411	1,279	2,396	2,458	9,544	13,999
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.19	--	532	--	2,281	0.11	152	142	168	172	212	291
Snohomish	21% Total ER		0.22	2,417	1,377	4,342	4,901	0.13	1,399	1,341	909	945	1,487	1,826
Tulalip Tribal Hatchery			0.99	9,179	--	96	--	0.99	1,794	2,101	6,781	6,738	604	684
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)	15% pre-terminal SUS ER		0.35	3,759	320	4,743	294	0.20	826	731	1,267	1,300	1,986	2,635
Green-Duwamish	15% pre-terminal SUS ER	5800	0.63	11,267	9,805	5,019	5,816	0.47	3,628	3,367	11,507	11,736	5,937	7,877
Puyallup	50% Total ER		0.50	4,592	2,437	2,424	2,419	0.35	1,724	1,618	2,975	3,005	2,332	3,094
Nisqually		1100	0.76	16,975	3,590	5,007	1,126	0.65	6,373	5,731	11,087	11,198	3,105	4,119
White Spring	20% Total ER		0.20	--	356	--	1,459	0.18	105	103	217	220	34	40
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.57	37,998		28,954	--	0.42	10,661	9,587	17,356	17,530	9,982	13,245
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER		0.32	--	238	--	504	0.13	55	49	38	45	147	204
Skokomish	15% pre-terminal SUS ER	1200 nat.	0.63	10,228	2,109	6,213	1,237	0.44	3,699	3,531	4,758	4,978	3,880	5,390
Hoodsport H, Dewato, Union, Tahuya tribs.			0.78	20,326	282	5,372	562	0.58	2,252	1,991	13,228	13,518	5,129	7,125

LA WA components:										
all natural (cedar plus N trib)	**0.35**	**0**	**320**	**0**	**588**		**49**	**131**	**140**
cedar only natural	**0.35**	**0**	**160**	**0**	**294**		**24**	**65**	**70**
all hatchery	**0.46**	**3,759**	**0**	**4,449**	**0**		**778**	**1,136**	**1,846**
Combined	**0.45**	**3,759**	**320**	**4,449**	**588**		**826**	**1,267**	**1,986**

Table C3-10. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario B

Alternative 1--Proposed Action

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	10,850	6,430	268,288	21,020	2,584	2,363	0
North Sound (Area 7)	9,605	7,874	41,642	54,977	42,289	20,381	21,301
Central Sound (Area 8, 9)	21,449	8,551	170,366	351,620	9,200	8,857	247
South Sound (Area 10,11,13)	39,570	25,912	186,432	273,517	36,137	34,070	1,939
Hood Canal (Area 12)	4,077	3,267	52,650	13,594	9,371	15,848	140
TOTAL	85,550	52,033	719,378	714,728	99,581	81,520	23,627

Angler trips during "base" Sport Catch Area	Marine	Freshwater
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	188,282
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Angler-trips this run	
Juan de Fuca (Area 5, 6)	289,308
North Sound (Area 7)	96,619
Central Sound (Area 8, 9)	521,985
South Sound (Area 10,11,13)	459,949
Hood Canal (Area 12)	66,244
	1,434,105

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-11. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario B

Alternative 2-Escapement Goal Management at the Management Unit Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	1,000	1,086
Dungeness Spring		**925**	0.24	--	108	--	344	0.01	0	0	3	3	106	115
Western Strait-Hoko		**850**	0.24	--	246	--	772	0.01	0	0	6	6	241	261
Elwha		**2,900**	0.24	--	669	--	2,079	0.01	0	0	16	16	654	710
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.19	--	99	--	412	0.01	0	0	6	9	93	55
Nooksack/Samish summer-fall		**8,900**	0.76	31,437	--	9,906	--	0.76	14,683	14,689	2,559	2,811	14,195	17,070
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.16	223	378	1,188	2,009	0.02	0	0	71	74	530	592
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall		**14,500**	0.41	96	9,584	139	13,935	0.00	39	53	75	94	9,567	14,013
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish		**900**	0.67	--	1,807	--	904	0.59	770	770	819	821	219	301
Snohomish		**4,600**	0.23	2,485	1,404	3,947	4,603	0.15	1,082	1,083	1,254	1,264	1,553	1,905
Tulalip Tribal Hatchery		--	0.98	8,712	--	192	--	0.98	20	17	8,073	7,978	619	699
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)		**1,200**	0.23	2,249	181	5,568	295	0.05	15	18	401	477	2,015	2,673
Green-Duwamish		**5,800**	0.56	8,804	7,469	5,982	5,800	0.38	4,372	4,384	5,880	6,142	6,022	7,987
Puyallup		**1,200**	0.71	5,322	2,929	1,109	1,200	0.53	965	970	4,922	5,020	2,365	3,137
Nisqually		**1,100**	0.73	13,835	3,017	4,920	1,100	0.60	1,784	1,808	11,869	12,202	3,199	4,242
White Spring		**1,000**	0.46	--	844	--	1,000	0.44	396	0	412	414	36	41
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.35	20,095		37,477	--	0.17	2,748	2,786	7,147	7,347	10,201	13,530
Hood Canal (Area 12)														
Mid-Canal		**750**	0.25	--	179	--	527	0.05	6	7	27	32	149	206
Skokomish		**1200**	0.61	9,412	1,931	6,220	1,231	0.40	3,038	3,081	4,379	4,531	3,926	5,454
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.90	22,254	203	1,850	597	0.69	202	259	17,065	17,267	5,190	7,209

LA WA components:										
all natural (cedar plus N trib)		**0.23**	**0**	**181**	**0**	**590**		**1**	**38**	**142**
cedar only natural		**0.23**	**0**	**91**	**0**	**295**		**0**	**19**	**71**
all hatchery		**0.30**	**2,249**	**0**	**5,273**	**0**		**14**	**363**	**1,873**
Combined		**0.29**	**2,249**	**181**	**5,273**	**590**		**15**	**401**	**2,015**

Table C3-12. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario B

Alternative 2-Escapement Goal Management at the Management Unit Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	14,454	14,454	0	62,889	0	0	0
Central Sound (Area 8, 9)	1,090	1,090	0	55,833	9,330	8,349	2
South Sound (Area 10,11,13)	9,547	9,547	0	84,265	22,342	22,738	0
Hood Canal (Area 12)	2,885	2,885	0	20,495	9,371	19,802	0
TOTAL	27,976	27,976	0	223,482	41,043	50,888	2

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-13. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario B

Alternative 3--Escapement Goal Management at the Population Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
			AEQ Mortality			Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	1,000	1,086
Dungeness Spring		**925**	0.24	--	108	--	344	0.01	0	0	3	3	106	115
Western Strait-Hoko		**850**	0.24	--	246	--	772	0.01	0	0	6	6	241	261
Elwha		**2,900**	0.24	--	669	--	2,079	0.01	0	0	16	16	654	710
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.19	--	99	--	412	0.01	0	0	6	9	93	55
Nooksack/Samish summer-fall		**8,900**	0.76	31,438	--	9,906	--	0.76	14,684	14,690	2,559	2,811	14,195	17,070
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.16	223	377	1,189	2,010	0.02	0	0	69	72	530	592
Upper Sauk		**986**												
Suiattle		**574**												
Upper Cascade		**440**												
Summer/Fall		**14,500**	0.41	96	9,584	139	13,935	0.00	39	53	75	94	9,567	14,013
Lower Sauk		**1,926**												
Upper Skagit		**8,434**												
Lower Skagit		**4,140**												
NF Stillaguamish		**600**	0.10	--	265	--	2,446	0.02	0	0	46	48	219	301
SF Stillaguamish		**300**												
Skykomish		**3,600**	0.12	1,130	739	5,203	5,368	0.03	3	4	313	324	1,553	1,905
Snoqualmie		**1,000**												
Tulalip Tribal Hatchery		**--**	0.12	1,050	--	7,730	--	0.12	20	17	411	466	619	699
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)		**1,200**	0.23	2,249	181	5,569	295	0.05	15	18	400	477	2,015	2,673
Green-Duwamish		**5,800**	0.56	8,804	7,469	5,981	5,800	0.38	4,372	4,384	5,879	6,142	6,022	7,987
Puyallup		**1,200**	0.71	5,322	2,929	1,109	1,200	0.53	965	970	4,922	5,020	2,365	3,137
Nisqually		**1,100**	0.73	13,835	3,017	4,920	1,100	0.60	1,784	1,808	11,869	12,202	3,199	4,242
White Spring		**1,000**	0.46	--	844	--	1,000	0.44	396	0	412	414	36	41
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.35	20,093		37,479	--	0.17	2,748	2,786	7,145	7,345	10,201	13,530
Hood Canal (Area 12)														
Mid-Canal		**750**	0.25	--	179	--	527	0.05	6	7	27	32	149	206
Skokomish		**1200**	0.61	9,411	1,931	6,221	1,231	0.40	3,038	3,081	4,378	4,530	3,926	5,454
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.90	22,254	203	1,850	597	0.69	202	259	17,066	17,267	5,190	7,209

LA WA components:									
all natural (cedar plus N trib)	**0.23**	**0**	**181**	**0**	**590**		**1**	**38**	**142**
cedar only natural	**0.23**	**0**	**91**	**0**	**295**		**0**	**19**	**71**
all hatchery	**0.30**	**2,249**	**0**	**5,274**	**0**		**14**	**362**	**1,873**
Combined	**0.29**	**2,249**	**181**	**5,274**	**590**		**15**	**400**	**2,015**

Table C3-14. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario B

Alternative 3--Escapement Goal Management at the Population Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality	Salmon Angler Trips			Mortality	anded Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	14,455	14,455	0	62,891	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	9,548	9,548	0	84,266	22,344	22,740	0
Hood Canal (Area 12)	2,885	2,885	0	20,495	9,371	19,805	0
TOTAL	26,887	26,887	0	168,996	31,715	42,545	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-15. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario B

Alternative 4--No Action/No Authorized Take

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	24	24	1,000	1,086
Dungeness Spring	10% SUS ER		0.24	--	108	--	344	0.01	0	0	3	3	106	115
Western Strait-Hoko	10% SUS ER		0.24	--	246	--	772	0.01	0	0	6	6	241	261
Elwha	10% SUS ER		0.24	--	669	--	2,079	0.01	0	0	16	16	654	710
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.19	--	99	--	412	0.01	0	0	6	9	93	55
Nooksack/Samish summer-fall			0.63	16,983	--	9,906	--	0.63	229	235	2,559	2,811	14,195	17,070
Central Sound (Area 8, 9)														
Skagit														
Spring	42% Total ER		0.16	223	377	1,189	2,010	0.02	0	0	69	72	530	592
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	52% Total ER		0.41	96	9,584	139	13,935	0.00	39	53	75	94	9,567	14,013
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.10	--	265	--	2,446	0.02	0	0	46	48	219	301
Snohomish	24% Total ER		0.12	1,130	739	5,203	5,368	0.03	3	4	313	324	1,553	1,905
Tulalip Tribal Hatchery			0.12	1,050	--	7,730	--	0.12	20	17	411	466	619	699
South Sound (Area 10,11,13)														
	15% pre-terminal SUS ER	1,200	0.23	2,249	181	5,569	295	0.05	15	18	400	477	2,015	2,673
Green-Duwamish	15% pre-terminal SUS ER	5800	0.23	4,316	3,117	10,470	10,153	0.05	42	53	1,369	1,631	6,022	7,987
Puyallup	50% Total ER		0.23	1,925	970	4,506	3,160	0.05	17	21	513	612	2,365	3,137
Nisqually		1100	0.21	4,168	856	14,587	3,261	0.07	88	113	1,737	2,070	3,199	4,242
White Spring	20% Total ER		0.03	--	52	--	1,792	0.01	0	0	16	18	36	41
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.26	14,227		40,641	--	0.07	175	223	3,851	4,589	10,201	13,530
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER	750 spawners???	0.25	--	179	--	527	0.05	6	7	27	32	149	206
Skokomish	15% pre-terminal SUS ER	1200	0.25	3,970	815	11,662	2,370	0.05	153	196	706	858	3,926	5,454
Hoodsport H, Dewato, Union, Tahuya tribs.			0.25	6,122	203	17,983	597	0.05	202	259	933	1,134	5,190	7,209
LA WA components:														
all natural (cedar plus N trib)			**0.23**	**0**	**181**	**0**	**590**		**1**		**38**		**142**	
cedar only natural			**0.23**	**0**	**91**	**0**	**295**		**0**		**19**		**71**	
all hatchery			**0.30**	**2,249**	**0**	**5,274**	**0**		**14**		**362**		**1,873**	
Combined			**0.29**	**2,249**	**181**	**5,274**	**590**		**15**		**400**		**2,015**	

Table C3-16. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario B

Alternative 4--No Action/No Authorized Take

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	0	0	0	840	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	0	0	0	2,092	0	0	0
Hood Canal (Area 12)	0	0	0	32	0	0	0
TOTAL	0	0	0	4,308	0	0	0

Sport Catch Area	Salmon Angler Trips Marine	Freshwater
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	8,682
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-17. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario C

Alternative 1--Proposed Action

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									89	52	51	55	530	568
Dungeness Spring	10% SUS ER		0.22	--	71	--	245	0.05	9	6	5	6	56	60
Western Strait-Hoko	10% SUS ER		0.23	--	165	--	545	0.05	22	13	12	14	131	140
Elwha	10% SUS ER		0.23	--	434	--	1,480	0.05	58	34	33	36	343	368
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.20	--	69	--	278	0.07	3	3	22	23	44	52
Nooksack/Samish summer-fall			0.80	37,544	--	9,528	--	0.80	5,378	5,271	26,731	26,887	5,435	6,616
Central Sound (Area 8, 9)														
Skagit														
Spring	38% Total ER		0.23	238	402	788	1,331	0.14	207	219	187	174	245	288
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	50% Total ER		0.49	77	7,717	80	8,033	0.18	949	871	1,850	1,907	4,995	7,159
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.17	--	342	--	1,620	0.12	93	85	137	140	112	157
Snohomish	21% Total ER		0.20	1,497	868	3,185	3,543	0.14	918	878	730	755	716	899
Tulalip Tribal Hatchery			0.99	6,538	--	58	--	0.99	1,681	2,008	4,561	4,531	296	335
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)	15% pre-terminal SUS ER		0.33	2,370	219	3,305	223	0.23	522	462	1,108	1,128	960	1,274
Green-Duwamish	15% pre-terminal SUS ER	5800	0.49	6,396	5,684	4,558	5,801	0.39	1,427	1,265	7,774	7,920	2,880	3,823
Puyallup	50% Total ER		0.50	3,177	1,772	1,478	1,798	0.39	1,401	1,336	2,418	2,436	1,129	1,499
Nisqually		1100	0.64	9,342	1,978	4,972	1,119	0.56	3,776	3,406	6,070	6,138	1,474	1,957
White Spring	20% Total ER		0.20	--	254	--	1,011	0.19	58	54	188	189	8	9
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.58	25,723		18,808	--	0.47	6,249	5,637	14,682	13,244	4,792	6,362
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER		0.26	--	132	--	367	0.12	32	29	30	36	71	96
Skokomish	15% pre-terminal SUS ER	1200 nat.	0.45	4,930	1,017	6,147	1,239	0.31	1,656	1,566	2,420	2,600	1,871	2,539
Hoodsport H, Dewato, Union, Tahuya tribs.			0.74	13,074	158	4,209	410	0.60	1,338	1,199	9,421	9,659	2,474	3,356

LA WA components:										
all natural (cedar plus N trib)	**0.33**	**0**	**219**	**0**	**446**		**31**	**120**	**68**
cedar only natural	**0.33**	**0**	**110**	**0**	**223**		**15**	**60**	**34**
all hatchery	**0.43**	**2,370**	**0**	**3,082**	**0**		**491**	**987**	**891**
Combined	**0.42**	**2,370**	**219**	**3,082**	**446**		**522**	**1,108**	**960**

Table C3-18. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario C

Alternative 1--Proposed Action

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	9,881	5,417	257,620	20,184	2,577	2,363	0
North Sound (Area 7)	8,232	6,922	39,590	52,268	33,639	16,259	16,901
Central Sound (Area 8, 9)	12,892	5,336	161,151	332,601	6,455	6,175	228
South Sound (Area 10,11,13)	26,750	17,738	172,509	253,091	27,187	25,099	1,939
Hood Canal (Area 12)	1,863	1,391	46,677	12,052	9,371	10,166	140
TOTAL	59,619	36,805	677,547	670,196	79,228	60,062	19,208

Angler trips during "base" Sport Catch Area	**Marine**	**Freshwater**
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	188,282
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Angler-trips this run	
Juan de Fuca (Area 5, 6)	277,804
North Sound (Area 7)	91,859
Central Sound (Area 8, 9)	493,752
South Sound (Area 10,11,13)	425,600
Hood Canal (Area 12)	58,729
	1,347,743

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-19. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario C

Alternative 2-Escapement Goal Management at the Management Unit Level

Chinook (by MU/Pop)	Regional Stocks Only														
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC		
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality		
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed	
Juan de Fuca (Area 5, 6)									0	0	17	17	535	573	
Dungeness Spring		**925**	0.19	--	58	--	251	0.01	0	0	2	2	57	61	
Western Strait-Hoko		**850**	0.19	--	133	--	564	0.01	0	0	4	4	129	138	
Elwha		**2,900**	0.19	--	360	--	1,516	0.01	0	0	11	11	349	374	
North Sound (Area 7)															
Nooksack Spring	7% SUS ER	**4,000**	0.14	--	51	--	304	0.01	0	0	5	6	46	55	
Nooksack/Samish summer-fall		**8,900**	0.66	18,809	--	9,571	--	0.66	11,428	11,432	1,907	2,095	5,474	6,659	
Central Sound (Area 8, 9)															
Skagit															
Spring		**2,000**	0.12	114	192	865	1,460	0.02	0	0	49	53	257	298	
Upper Sauk															
Suiattle															
Upper Cascade															
Summer/Fall		**14,500**	0.33	50	5,047	102	10,215	0.01	29	38	54	67	5,014	7,180	
Lower Sauk															
Upper Skagit															
Lower Skagit															
Stillaguamish		**900**	0.52	--	979	--	909	0.46	414	414	448	450	117	161	
Snohomish		**4,600**	0.10	569	414	3,812	3,875	0.03	3	3	232	241	748	939	
Tulalip Tribal Hatchery		--	0.10	612	--	5,531	--	0.10	14	12	294	334	304	344	
South Sound (Area 10,11,13)															
Lake Washington (Cedar River portion)		**1,200**	0.19	1,180	98	4,018	214	0.05	10	13	291	346	977	1,295	
Green-Duwamish		**5,800**	0.36	3,879	3,255	5,950	5,800	0.23	1,597	1,606	2,607	2,797	2,930	3,886	
Puyallup		**1,200**	0.57	3,160	1,618	1,100	1,200	0.44	959	962	2,670	2,741	1,149	1,524	
Nisqually		**1,100**	0.61	7,873	1,712	4,914	1,100	0.51	1,274	1,294	6,788	7,030	1,522	2,019	
White Spring		**1,000**	0.23	--	304	--	1,000	0.23	142	0	154	156	9	10	
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.30	11,654		27,007	--	0.17	1,963	1,993	4,781	4,856	4,912	6,515	
Hood Canal (Area 12)															
Mid-Canal		**750**	0.20	--	95	--	385	0.05	4	5	19	24	72	98	
Skokomish		**1200**	0.43	4,528	929	6,080	1,221	0.29	1,566	1,597	1,990	2,104	1,901	2,576	
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.86	14,501	107	1,857	436	0.72	146	187	11,950	12,100	2,512	3,406	

LA WA components:									
all natural (cedar plus N trib)	**0.19**	**0**	**98**	**0**	**428**		**1**	**28**	**70**
cedar only natural	**0.19**	**0**	**49**	**0**	**214**		**0**	**14**	**35**
all hatchery	**0.24**	**1,180**	**0**	**3,804**	**0**		**10**	**263**	**907**
Combined	**0.23**	**1,180**	**98**	**3,804**	**428**		**10**	**291**	**977**

Table C3-20. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario C

Alternative 2-Escapement Goal Management at the Management Unit Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	11,255	11,255	0	50,093	0	0	0
Central Sound (Area 8, 9)	414	414	0	30,389	415	415	0
South Sound (Area 10,11,13)	5,560	5,560	0	68,316	11,381	11,523	0
Hood Canal (Area 12)	1,456	1,456	0	14,777	9,371	12,745	0
TOTAL	18,685	18,685	0	163,575	21,167	24,683	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-21. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario C

Alternative 3--Escapement Goal Management at the Population Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	17	17	535	573
Dungeness Spring		**925**	0.19	--	58	--	251	0.01	0	0	2	2	57	61
Western Strait-Hoko		**850**	0.19	--	133	--	564	0.01	0	0	4	4	129	138
Elwha		**2,900**	0.19	--	360	--	1,516	0.01	0	0	11	11	349	374
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.144	--	51	--	304	0.01	0	0	5	6	46	55
Nooksack/Samish summer-fall		**8,900**	0.66	18,809	--	9,571	--	0.66	11,428	11,432	1,907	2,095	5,474	6,659
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.12	114	192	865	1,460	0.02	0	0	49	53	257	298
Upper Sauk		**986**												
Suiattle		**574**												
Upper Cascade		**440**												
Summer/Fall		**14,500**	0.33	50	5,047	102	10,215	0.01	29	38	54	67	5,014	7,180
Lower Sauk		**1,926**												
Upper Skagit		**8,434**												
Lower Skagit		**4,140**												
NF Stillaguamish		**600**	0.08	--	150	--	1,738	0.02	0	0	33	35	117	161
SF Stillaguamish		**300**												
Skykomish		**3,600**	0.10	569	414	3,812	3,875	0.03	3	3	232	241	748	939
Snoqualmie		**1,000**												
Tulalip Tribal Hatchery		**--**	0.10	612	--	5,531	--	0.10	14	12	294	334	304	344
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)		**1,200**	0.19	1,180	98	4,018	214	0.05	10	13	291	346	977	1,295
Green-Duwamish		**5,800**	0.36	3,879	3,255	5,950	5,800	0.23	1,597	1,606	2,607	2,797	2,930	3,886
Puyallup		**1,200**	0.57	3,160	1,618	1,100	1,200	0.44	959	962	2,670	2,741	1,149	1,524
Nisqually		**1,100**	0.61	7,873	1,712	4,914	1,100	0.51	1,274	1,294	6,788	7,030	1,522	2,019
White Spring		**1,000**	0.23	--	304	--	1,000	0.23	142	0	154	156	9	10
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.30	11,654		27,007	--	0.17	1,963	1,993	4,781	4,856	4,912	6,515
Hood Canal (Area 12)														
Mid-Canal		**750**	0.20	--	95	--	385	0.05	4	5	19	24	72	98
Skokomish		**1200**	0.43	4,528	929	6,080	1,221	0.29	1,566	1,597	1,990	2,104	1,901	2,576
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.86	14,501	107	1,857	436	0.72	146	187	11,950	12,100	2,512	3,406

LA WA components:									
all natural (cedar plus N trib)	**0.19**	**0**	**98**	**0**	**428**		**1**	**28**	**70**
cedar only natural	**0.19**	**0**	**49**	**0**	**214**		**0**	**14**	**35**
all hatchery	**0.24**	**1,180**	**0**	**3,804**	**0**		**10**	**263**	**907**
Combined	**0.23**	**1,180**	**98**	**3,804**	**428**		**10**	**291**	**977**

Table C3-22. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario C

Alternative 3--Escapement Goal Management at the Population Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	11,255	11,255	0	50,093	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	5,560	5,560	0	68,316	11,381	11,523	0
Hood Canal (Area 12)	1,456	1,456	0	14,777	9,371	12,745	0
TOTAL	18,271	18,271	0	134,530	20,752	24,267	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-23. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario C

Alternative 4--No Action/No Authorized Take

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	17	17	535	573
Dungeness Spring	10% SUS ER		0.19	--	58	--	251	0.01	0	0	2	2	57	61
Western Strait-Hoko	10% SUS ER		0.19	--	133	--	564	0.01	0	0	4	4	129	138
Elwha	10% SUS ER		0.19	--	360	--	1,516	0.01	0	0	11	11	349	374
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.14	--	51	--	304	0.01	0	0	5	6	46	55
Nooksack/Samish summer-fall			0.44	7,554	--	9,571	--	0.44	173	177	1,907	2,095	5,474	6,659
Central Sound (Area 8, 9)														
Skagit														
Spring	42% Total ER		0.12	114	192	865	1,460	0.02	0	0	49	53	257	298
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	52% Total ER		0.33	50	5,047	102	10,215	0.01	29	38	54	67	5,014	7,180
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.08	--	150	--	1,738	0.02	0	0	33	35	117	161
Snohomish	24% Total ER		0.10	569	414	3,812	3,875	0.03	3	3	232	241	748	939
Tulalip Tribal Hatchery			0.10	612	--	5,531	--	0.10	14	12	294	334	304	344
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)	15% pre-terminal SUS ER	1,200	0.19	1,180	98	4,018	214	0.05	10	13	291	346	977	1,295
Green-Duwamish	15% pre-terminal SUS ER	5800	0.19	2,271	1,687	7,558	7,367	0.05	30	39	999	1,189	2,930	3,886
Puyallup	50% Total ER		0.19	1,010	525	3,250	2,293	0.05	12	16	374	445	1,149	1,524
Nisqually		1100	0.17	2,378	482	10,408	2,330	0.08	64	84	1,274	1,516	1,522	2,019
White Spring	20% Total ER		0.02	--	21	--	1,283	0.01	0	0	12	14	9	10
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.21	7,855		29,169	--	0.08	127	166	2,818	3,696	4,912	6,515
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER	750 spawners???	0.20	--	95	--	385	0.05	4	5	19	24	72	98
Skokomish	15% pre-terminal SUS ER	1200	0.20	2,096	430	8,513	1,730	0.05	110	141	515	628	1,901	2,576
Hoodsport H, Dewato, Union, Tahuya tribs.			0.20	3,231	107	13,126	436	0.05	146	187	681	830	2,512	3,406
LA WA components:														
all natural (cedar plus N trib)			**0.19**	**0**	**98**	**0**	**428**		**1**		**28**		**70**	
cedar only natural			**0.19**	**0**	**49**	**0**	**214**		**0**		**14**		**35**	
all hatchery			**0.24**	**1,180**	**0**	**3,804**	**0**		**10**		**263**		**907**	
Combined			**0.23**	**1,180**	**98**	**3,804**	**428**		**10**		**291**		**977**	

Table C3-24. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario C

Alternative 4--No Action/No Authorized Take

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	0	0	0	840	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	0	0	0	2,092	0	0	0
Hood Canal (Area 12)	0	0	0	32	0	0	0
TOTAL	0	0	0	4,308	0	0	0

Sport Catch Area	Salmon Angler Trips	
	Marine	Freshwater
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	8,682
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-25. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario D

Alternative 1--Proposed Action

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									95	56	51	54	762	827
Dungeness Spring	10% SUS ER		0.29	--	96	--	231	0.05	10	6	5	6	81	88
Western Strait-Hoko	10% SUS ER		0.30	--	223	--	514	0.05	23	14	12	13	187	203
Elwha	10% SUS ER		0.30	--	589	--	1,395	0.05	62	36	33	35	494	537
North Sound (Area 7)														
Nooksack Spring	?		0.26	--	87	--	252	0.07	3	3	22	24	62	50
Nooksack/Samish summer-fall			0.81	39,341	--	9,370	--	0.81	5,403	5,305	23,057	23,264	10,881	13,079
Central Sound (Area 8, 9)														
Skagit														
Spring	38% Total ER		0.28	294	498	749	1,270	0.15	232	241	189	174	371	420
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	50% Total ER		0.56	97	9,749	75	7,551	0.16	970	891	1,751	1,807	7,125	10,500
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.20	--	407	--	1,584	0.12	105	96	141	143	161	221
Snohomish	21% Total ER		0.23	1,782	1,020	3,007	3,399	0.14	956	927	730	758	1,116	1,370
Tulalip Tribal Hatchery			0.99	6,562	--	56	--	0.99	1,698	2,025	4,395	4,371	469	530
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)	15% pre-terminal SUS ER		0.38	2,958	262	3,147	214	0.22	580	524	1,107	1,128	1,534	2,034
Green-Duwamish	15% pre-terminal SUS ER	5800	0.51	7,263	6,090	4,512	5,802	0.36	1,583	1,430	7,191	7,338	4,579	6,074
Puyallup	50% Total ER		0.50	3,445	1,862	1,588	1,834	0.35	1,332	1,270	2,176	2,194	1,799	2,386
Nisqually		1100	0.66	10,280	2,163	4,935	1,109	0.53	4,133	3,779	5,865	5,935	2,445	3,243
White Spring	20% Total ER		0.20	--	250	--	1,011	0.17	70	67	151	152	30	33
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.62	29,428		17,893	--	0.46	7,045	6,442	14,608	13,358	7,776	10,315
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER		0.34	--	179	--	344	0.12	35	32	30	35	114	158
Skokomish	15% pre-terminal SUS ER	1200 nat.	0.48	5,531	1,139	6,069	1,225	0.26	1,430	1,337	2,196	2,375	3,044	4,223
Hoodsport H, Dewato, Union, Tahuya tribs.			0.76	14,062	211	4,010	384	0.55	1,443	1,302	8,806	9,043	4,024	5,583

LA WA components:										
all natural (cedar plus N trib)	**0.38**	**0**	**262**	**0**	**428**		**34**	**120**	**108**
cedar only natural	**0.38**	**0**	**131**	**0**	**214**		**17**	**60**	**54**
all hatchery	**0.50**	**2,958**	**0**	**2,933**	**0**		**546**	**986**	**1,426**
Combined	**0.49**	**2,958**	**262**	**2,933**	**428**		**580**	**1,107**	**1,534**

Table C3-26. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario D

Alternative 1--Proposed Action

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	10,269	5,710	266,077	20,847	2,579	2,363	0
North Sound (Area 7)	8,366	6,975	40,095	52,935	29,564	14,368	14,777
Central Sound (Area 8, 9)	14,353	6,252	162,367	335,111	6,188	5,913	226
South Sound (Area 10,11,13)	29,864	19,333	175,635	257,678	26,087	23,961	1,939
Hood Canal (Area 12)	1,421	1,001	45,438	11,732	9,371	9,340	140
TOTAL	64,273	39,271	689,612	678,303	73,788	55,944	17,082

Angler trips during "base" Sport Catch Area	**Marine**	**Freshwater**
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	188,282
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Angler-trips this run	
Juan de Fuca (Area 5, 6)	286,924
North Sound (Area 7)	93,031
Central Sound (Area 8, 9)	497,477
South Sound (Area 10,11,13)	433,313
Hood Canal (Area 12)	57,170
	1,367,915

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-27. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario D

Alternative 2--Escapement Goal Management at the Management Unit Level

Chinook (by MU/Pop)	Regional Stocks Only														
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC		
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality		
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed	
Juan de Fuca (Area 5, 6)									0	0	17	17	763	830	
Dungeness Spring		**925**	0.26	--	83	--	237	0.01	0	0	2	2	81	88	
Western Strait-Hoko		**850**	0.26	--	188	--	532	0.01	0	0	4	4	184	201	
Elwha		**2,900**	0.26	--	509	--	1,431	0.01	0	0	11	11	498	542	
North Sound (Area 7)															
Nooksack Spring	7% SUS ER	**4,000**	0.20	--	73	--	285	0.01	0	0	5	6	68	55	
Nooksack/Samish summer-fall		**8,900**	0.52	22,812	--	20,673	--	0.52	10,016	10,022	1,868	2,051	10,928	13,132	
Central Sound (Area 8, 9)															
Skagit															
Spring		**2,000**	0.17	163	277	825	1,395	0.02	0	0	49	54	390	436	
Upper Sauk															
Suiattle															
Upper Cascade															
Summer/Fall		**14,500**	0.43	71	7,157	96	9,625	0.00	28	37	54	68	7,146	10,524	
Lower Sauk															
Upper Skagit															
Lower Skagit															
Stillaguamish		**900**	0.52	--	984	--	919	0.43	391	391	425	426	167	227	
Snohomish		**4,600**	0.13	847	557	3,596	3,720	0.03	7	7	231	241	1,166	1,430	
Tulalip Tribal Hatchery		--	0.13	795	--	5,351	--	0.13	14	12	300	340	481	545	
South Sound (Area 10,11,13)															
Lake Washington (Cedar River portion)		**1,200**	0.25	1,723	138	3,852	204	0.05	11	14	293	349	1,558	2,066	
Green-Duwamish		**5,800**	0.38	4,553	3,583	5,995	5,800	0.18	1,171	1,179	2,314	2,506	4,651	6,167	
Puyallup		**1,200**	0.59	3,481	1,720	1,113	1,200	0.39	961	965	2,412	2,484	1,828	2,423	
Nisqually		**1,100**	0.62	8,425	1,827	4,920	1,100	0.47	1,240	1,259	6,490	6,739	2,521	3,343	
White Spring		**1,000**	0.22	--	289	--	1,000	0.20	123	0	135	137	31	34	
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.36	14,603		26,063	--	0.16	1,913	1,941	4,734	4,805	7,957	10,551	
Hood Canal (Area 12)															
Mid-Canal		**750**	0.28	--	139	--	361	0.05	4	5	19	24	117	162	
Skokomish		**1200**	0.46	5,024	1,031	6,038	1,215	0.23	1,300	1,331	1,669	1,782	3,085	4,278	
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.87	15,202	158	1,854	408	0.64	144	184	11,138	11,286	4,078	5,656	

LA WA components:									
all natural (cedar plus N trib)	**0.25**	**0**	**138**	**0**	**408**		**1**	**28**	**110**
cedar only natural	**0.25**	**0**	**69**	**0**	**204**		**0**	**14**	**55**
all hatchery	**0.32**	**1,723**	**0**	**3,648**	**0**		**10**	**265**	**1,448**
Combined	**0.31**	**1,723**	**138**	**3,648**	**408**		**11**	**293**	**1,558**

Table C3-28. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario I

Alternative 2--Escapement Goal Management at the Management Unit Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	9,851	9,851	0	44,474	0	0	0
Central Sound (Area 8, 9)	392	392	0	30,301	391	391	0
South Sound (Area 10,11,13)	5,052	5,052	0	66,282	10,414	10,537	0
Hood Canal (Area 12)	1,191	1,191	0	13,719	9,371	11,608	0
TOTAL	16,485	16,485	0	154,776	20,176	22,537	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-29. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario D

Alternative 3--Escapement Goal Management at the Population Level

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	17	17	763	830
Dungeness Spring		**925**	0.26	--	83	--	237	0.01	0	0	2	2	81	88
Western Strait-Hoko		**850**	0.26	--	188	--	532	0.01	0	0	4	4	184	201
Elwha		**2,900**	0.26	--	509	--	1,431	0.01	0	0	11	11	498	542
North Sound (Area 7)														
Nooksack Spring	7% SUS ER	**4,000**	0.203	--	73	--	285	0.01	0	0	5	6	68	55
Nooksack/Samish summer-fall		**8,900**	0.52	22,812	--	20,673	--	0.52	10,016	10,022	1,868	2,051	10,928	13,132
Central Sound (Area 8, 9)														
Skagit														
Spring		**2,000**	0.17	163	277	825	1,395	0.02	0	0	49	54	390	436
Upper Sauk		**986**												
Suiattle		**574**												
Upper Cascade		**440**												
Summer/Fall		**14,500**	0.43	71	7,157	96	9,625	0.00	28	37	54	68	7,146	10,524
Lower Sauk		**1,926**												
Upper Skagit		**8,434**												
Lower Skagit		**4,140**												
NF Stillaguamish		**600**	0.11	--	201	--	1,702	0.02	0	0	34	35	167	227
SF Stillaguamish		**300**												
Skykomish		**3,600**	0.13	847	557	3,596	3,720	0.03	7	7	231	241	1,166	1,430
Snoqualmie		**1,000**												
Tulalip Tribal Hatchery		**--**	0.13	795	--	5,351	--	0.13	14	12	300	340	481	545
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)		**1,200**	0.25	1,723	138	3,852	204	0.05	11	14	293	349	1,558	2,066
Green-Duwamish		**5,800**	0.38	4,553	3,583	5,995	5,800	0.18	1,171	1,179	2,314	2,506	4,651	6,167
Puyallup		**1,200**	0.59	3,481	1,720	1,113	1,200	0.39	961	965	2,412	2,484	1,828	2,423
Nisqually		**1,100**	0.62	8,425	1,827	4,920	1,100	0.47	1,240	1,259	6,490	6,739	2,521	3,343
White Spring		**1,000**	0.22	--	289	--	1,000	0.20	123	0	135	137	31	34
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes		**9,600**	0.36	14,603		26,063	--	0.16	1,913	1,941	4,734	4,805	7,957	10,551
Hood Canal (Area 12)														
Mid-Canal		**750**	0.28	--	139	--	361	0.05	4	5	19	24	117	162
Skokomish		**1200**	0.46	5,024	1,031	6,038	1,215	0.23	1,300	1,331	1,669	1,782	3,085	4,278
Hoodsport H, Dewato, Union, Tahuya tribs.		**1,850**	0.87	15,202	158	1,854	408	0.64	144	184	11,138	11,286	4,078	5,656

LA WA components:									
all natural (cedar plus N trib)	**0.25**	**0**	**138**	**0**	**408**		**1**	**28**	**110**
cedar only natural	**0.25**	**0**	**69**	**0**	**204**		**0**	**14**	**55**
all hatchery	**0.32**	**1,723**	**0**	**3,648**	**0**		**10**	**265**	**1,448**
Combined	**0.31**	**1,723**	**138**	**3,648**	**408**		**11**	**293**	**1,558**

Table C3-30. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario

Alternative 3--Escapement Goal Management at the Population Level

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	9,851	9,851	0	44,474	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,345	0	0	0
South Sound (Area 10,11,13)	5,052	5,052	0	66,282	10,414	10,537	0
Hood Canal (Area 12)	1,191	1,191	0	13,719	9,371	11,608	0
TOTAL	16,093	16,093	0	125,820	19,784	22,145	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-31. Total fishing related mortality of Puget Sound hatchery and natural chinook stocks: Scenario D

Alternative 4--No Action/No Authorized Take

Chinook (by MU/Pop)	Regional Stocks Only													
	Objective		All Fisheries						SUS Sport		SUS Net &Troll		AK and BC	
				AEQ Mortality		Escapement			Mortality		Mortality		Mortality	
	Exp. Rate	Escapement	Exp.Rate	Hatchery	Natural	Hatchery	Natural	SUS ER	Total AEQ	Landed	Total AEQ	Landed	Total AEQ	Landed
Juan de Fuca (Area 5, 6)									0	0	17	17	763	830
Dungeness Spring	10% SUS ER		0.26	--	83	--	237	0.01	0	0	2	2	81	88
Western Strait-Hoko	10% SUS ER		0.26	--	188	--	532	0.01	0	0	4	4	184	201
Elwha	10% SUS ER		0.26	--	509	--	1,431	0.01	0	0	11	11	498	542
North Sound (Area 7)														
Nooksack Spring	7% SUS ER		0.20	--	73	--	285	0.01	0	0	5	6	68	55
Nooksack/Samish summer-fall			0.58	12,961	--	9,424	--	0.58	165	171	1,868	2,051	10,928	13,132
Central Sound (Area 8, 9)														
Skagit														
Spring	42% Total ER		0.17	163	277	825	1,395	0.02	0	0	49	54	390	436
Upper Sauk														
Suiattle														
Upper Cascade														
Summer/Fall	52% Total ER		0.43	71	7,157	96	9,625	0.00	28	37	54	68	7,146	10,524
Lower Sauk														
Upper Skagit														
Lower Skagit														
Stillaguamish	25% Total ER		0.11	--	201	--	1,702	0.02	0	0	34	35	167	227
Snohomish	24% Total ER		0.13	844	556	3,600	3,720	0.03	3	3	231	241	1,166	1,430
Tulalip Tribal Hatchery			0.13	795	--	5,351	--	0.13	14	12	300	340	481	545
South Sound (Area 10,11,13)														
Lake Washington (Cedar River portion)	15% pre-terminal SUS ER	1,200	0.25	1,723	138	3,852	204	0.05	11	14	293	349	1,558	2,066
Green-Duwamish	15% pre-terminal SUS ER	5800	0.25	3,306	2,376	7,242	7,006	0.05	31	40	1,001	1,192	4,651	6,167
Puyallup	50% Total ER		0.25	1,476	739	3,118	2,180	0.05	12	16	375	447	1,828	2,423
Nisqually		1100	0.23	3,221	663	10,124	2,264	0.08	64	82	1,299	1,548	2,521	3,343
White Spring	20% Total ER		0.03	--	43	--	1,246	0.01	0	0	12	14	31	34
Gorst, Grovers, Minter, Chambers & McAllister, Deschutes			0.28	10,944		28,157	--	0.08	127	164	2,860	3,693	7,957	10,551
Hood Canal (Area 12)														
Mid-Canal	15% pre-terminal SUS ER	750 spawners???	0.28	--	139	--	361	0.05	4	5	19	24	117	162
Skokomish	15% pre-terminal SUS ER	1200	0.28	3,079	632	7,983	1,622	0.05	109	139	516	628	3,085	4,278
Hoodsport H, Dewato, Union, Tahuya tribs.			0.28	4,747	158	12,309	408	0.05	144	184	682	831	4,078	5,656
LA WA components:														
all natural (cedar plus N trib)			**0.25**	**0**	**138**	**0**	**408**		**1**		**28**		**110**	
cedar only natural			**0.25**	**0**	**69**	**0**	**204**		**0**		**14**		**55**	
all hatchery			**0.32**	**1,723**	**0**	**3,648**	**0**		**10**		**265**		**1,448**	
Combined			**0.31**	**1,723**	**138**	**3,648**	**408**		**11**		**293**		**1,558**	

Table C3-32. Total fishing-related mortality of all chinook (U.S. and Canadian) by Puget Sound regional fishery: Scenario D

Alternative 4--No Action/No Authorized Take

Region	All Stocks in Regional Fisheries						
	Sport				Net and Troll		
	Mortality		Salmon Angler Trips		Mortality	Landed Catch	
	Total AEQ	Landed	Marine	Freshwater	AEQ	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0	0	0
North Sound (Area 7)	0	0	0	840	0	0	0
Central Sound (Area 8, 9)	0	0	0	1,344	0	0	0
South Sound (Area 10,11,13)	0	0	0	2,092	0	0	0
Hood Canal (Area 12)	0	0	0	32	0	0	0
TOTAL	0	0	0	4,308	0	0	0

Sport Catch Area	Salmon Angler Trips Marine	Freshwater
Area 5	42,841	89
Area 6	19,275	4,777
Area 7	33,132	43,741
Area 8	51,743	218,796
Area 9	54,268	0
Area 10	40,291	8,682
Area 11	75,935	21,832
Area 12	19,588	5,057
Area 13	34,875	11,569

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-33. Total fishing related mortality of Puget Sound hatchery and natural coho stocks: All Scenarios

Alternative 1--Proposed Action

Coho (by MU)	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.14	14,570	2,739	9,516	17,323	6,659	5,319	10,432	9,686	218	185
North Sound (Area 7)											
Nooksack/Samish	0.50	39,524	8,291	27,518	8,184	10,450	9,454	32,791	31,761	4,574	4,240
Central Sound (Area 8, 9)											
Skagit	0.37	4,559	43,233	5,872	74,038	11,842	9,596	35,079	32,897	871	550
Stillaguamish	0.37	65	13,988	1,174	24,096	4,678	3,620	9,216	8,449	159	89
Snohomish	0.33	22,473	67,223	13,541	137,327	32,426	25,767	55,926	50,953	1,344	920
So. Sound (Area 10,11,13)											
South Sound	0.55	206,910	57,064	120,196	47,446	85,517	79,452	173,914	166,931	4,543	4,173
Hood Canal (Area 12)											
Hood Canal	0.41	37,333	13,512	11,457	19,091	21,126	18,803	28,855	24,106	864	726

Table C3-34. Total fishing-related mortality of all coho (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

All Stocks in Regional Fisheries					
Region	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	63,798	46,029	26,304	23,865	1,886
North Sound (Area 7)	7,549	7,104	52,633	37,374	14,234
Central Sound (Area 8, 9)	43,693	42,080	67,399	64,453	1,625
So. Sound (Area 10,11,13)	41,595	39,903	146,277	141,144	2,269
Hood Canal (Area 12)	9,161	8,746	21,692	17,051	4,379

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-35. Total fishing related mortality of Puget Sound hatchery and natural sockeye stocks: All Scenarios

Alternative 1--Proposed Action

Sockeye	Regional Stocks Only										
	All Fisheries					SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	--	--	--	--	--	--	--	--	--	--	--
North Sound (Area 7)											
Nooksack/Samish	--	--	--	--	--	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.00	250	--	--	11,823	--	--	--	250	--	--
Stillaguamish	--	--	--	--	--	--	--	--	--	--	--
Snohomish	--	--	--	--	--	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.19	22,224	70,376	92,184	291,916	--	44,900	--	47,700	--	--
Hood Canal (Area 12)											
Hood Canal	--	--	--	--	--	--	--	--	--	--	--

Table C3-36. Total fishing-related mortality of all sockeye (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	15			26,419	0
North Sound (Area 7)	94			255,609	246,594
Central Sound (Area 8, 9)	0			250	0
So. Sound (Area 10,11,13)	44,900			47,700	0
Hood Canal (Area 12)	0			0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-37. Total fishing related mortality of Puget Sound hatchery and natural pink stocks: All Scenarios

Alternative 1--Proposed Action

Pink	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.35	--	2,574	--	4,848	116		1,374		1,084	
North Sound (Area 7)											
Nooksack/Samish	0.07	--	7,184	--	91,988	734		6,450		--	
Central Sound (Area 8, 9)											
Skagit	0.30	--	184,614	--	430,792	49,312		135,302		--	
Stillaguamish	0.36	--	90,690	--	164,000	9,690		81,000		--	
Snohomish	0.37	--	101,193	--	173,000	14,193		87,000		--	
So. Sound (Area 10,11,13)											
South Sound	0.09	6	1,313	66	13,283	1,003		316		--	
Hood Canal (Area 12)											
Hood Canal	0.39	27,056	12,870	4,513	20,065	424		33,043		6,459	

Table C3-38. Total fishing-related mortality of all pink (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	19,963			1,374	0
North Sound (Area 7)	6,357			529,707	609,422
Central Sound (Area 8, 9)	73,661			201,880	101,422
So. Sound (Area 10,11,13)	1,003			316	0
Hood Canal (Area 12)	424			28,602	4,441

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-39. Total fishing related mortality of Puget Sound hatchery and natural chum stocks: All Scenarios

Alternative 1--Proposed Action

Chum	Regional Stocks Only										
		All Fisheries				SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.07	--	196	--	2,585		0		137		59
North Sound (Area 7)											
Nooksack/Samish	0.56	9,976	44,763	7,936	35,610		2,686		52,052		--
Central Sound (Area 8, 9)											
Skagit	0.09	177	4,076	1,834	42,237		1,166		3,087		--
Stillaguamish	0.59	970	20,608	700	14,400		1,077		20,500		--
Snohomish	0.51	36,193	18,091	7,200	17,600		1,084		53,200		--
So. Sound (Area 10,11,13)											
South Sound	0.68	37,613	323,645	17,540	150,923		3,189		358,069		--
Hood Canal (Area 12)											
Hood Canal	0.49	169,630	49,357	37,637	50,382		4,121		214,866		--

Table C3-40. Total fishing-related mortality of all chum (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

All Stocks in Regional Fisheries					
Region	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)		13		10,450	0
North Sound (Area 7)		2,727		103,933	88,120
Central Sound (Area 8, 9)		2,377		48,257	28,530
So. Sound (Area 10,11,13)		3,189		196,350	161,719
Hood Canal (Area 12)		4,121		107,433	107,433

Table C3-41. Total fishing related mortality of Puget Sound hatchery and natural steelhead stocks: All Scenarios

Alternative 1--Proposed Action

Steelhead	Regional Stocks Only				
	All Fisheries			Tribal Net Mortality	
	Wild Exp. Rate	Escapement Hat.	Escapement Nat.	Total	Landed
Juan de Fuca (Area 5, 6) Juan de Fuca	na	na	na		739
North Sound (Area 7) Nooksack/Samish	na	na	na		20
Central Sound (Area 8, 9) Skagit Stillaguamish Snohomish	na	na	na		512
So. Sound (Area 10,11,13) South Sound	na	na	na		663
Hood Canal (Area 12) Hood Canal	na	na	na		0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-42. Total fishing related mortality of Puget Sound hatchery and natural coho stocks: All Scenarios

Alternative 2--Escapement Goal Management at the Management Unit Level

Coho (by MU)	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.06	6,345	1,212	17,622	18,819	591	413	6,747	6,079	219	186
North Sound (Area 7)											
Nooksack/Samish	0.13	10,674	2,142	56,057	14,272	3,758	3,405	4,449	3,981	4,609	4,272
Central Sound (Area 8, 9)											
Skagit	0.06	1,208	7,102	9,241	109,887	1,327	415	6,105	4,604	878	554
Stillaguamish	0.17	2,840	6,532	1,296	31,413	1,491	1,031	7,721	6,993	160	91
Snohomish	0.08	1,909	16,706	30,927	187,066	3,614	6,775	13,645	40,819	1,361	929
So. Sound (Area 10,11,13)											
South Sound	0.33	92,656	33,957	233,962	69,945	22,184	20,084	99,739	95,161	4,690	4,321
Hood Canal (Area 12)											
Hood Canal	0.12	11,327	3,937	37,046	28,533	4,031	3,265	10,314	4,666	919	777

Table C3-43. Total fishing-related mortality of all coho (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	4,109	1,725	2,304
North Sound (Area 7)	1,034	1,034	0	0	0
Central Sound (Area 8, 9)	1,062	1,062	2,542	2,492	0
So. Sound (Area 10,11,13)	8,897	8,897	74,347	72,889	0
Hood Canal (Area 12)	1,395	1,395	4,583	4,493	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-44. Total fishing related mortality of Puget Sound hatchery and natural sockeye stocks: All Scenarios

Alternative 2--Escapement Goal Management at the Management Unit Level

Sockeye	Regional Stocks Only										
	All Fisheries					SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild	Total Mortality		Escapement							
	Exp. Rat	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	--	--	--	--	--	--	--	--	--	--	--
North Sound (Area 7)											
Nooksack/Samish	--	--	--	--	--	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.0	--	--	--	12073	--	--	--	--	--	--
Stillaguamish	--	--	--	--	--	--	--	--	--	--	--
Snohomish	--	--	--	--	--	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.0	--	--	114,408	362,292	--	--	--	--	--	--
Hood Canal (Area 12)											
Hood Canal	--	--	--	--	--	--	--	--	--	--	--

Table C3-45. Total fishing-related mortality of all sockeye (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)		0		0	0
North Sound (Area 7)		0		0	0
Central Sound (Area 8, 9)		0		0	0
So. Sound (Area 10,11,13)		0		0	0
Hood Canal (Area 12)		0		0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-46. Total fishing related mortality of Puget Sound hatchery and natural pink stocks: All Scenarios

Alternative 2--Escapement Goal Management at the Management Unit Level

Pink	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.15	--	1084	--	6338	--	--	--	--	--	1084
North Sound (Area 7)											
Nooksack/Samish	0.00	--	--	--	99172	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.00	--	--	--	615406	--	--	--	--	--	--
Stillaguamish	0.21	--	54331	--	200360	0	5731	0	48600	--	--
Snohomish	0.00	--	--	--	274193	--	--	--	34800	--	--
So. Sound (Area 10,11,13)											
South Sound	0.04	3	597	69	13999	0	284	0	316	--	--
Hood Canal (Area 12)											
Hood Canal	0.16	27080	5379	4488	27556	0	209	0	25792	--	6459

Table C3-47. Total fishing-related mortality of all pink (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries			
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0			0	0
North Sound (Area 7)	0			0	0
Central Sound (Area 8, 9)	5,731			83,400	0
So. Sound (Area 10,11,13)	284			316	0
Hood Canal (Area 12)	209			25,792	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-48. Total fishing related mortality of Puget Sound hatchery and natural chum stocks: All Scenarios

Alternative 2--Escapement Goal Management at the Management Unit Level

Chum	Regional Stocks Only									
		All Fisheries				SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.02	--	59	--	2722		0		2		59
North Sound (Area 7)											
Nooksack/Samish	0.01	199	891	17713	79482		234		856		--
Central Sound (Area 8, 9)											
Skagit	0.01	10	242	2000	46071		193		59		--
Stillaguamish	0.02	39	813	1631	34194		56		796		--
Snohomish	0.00	131	108	43262	35583		142		97		--
So. Sound (Area 10,11,13)											
South Sound	0.16	8,694	74,807	46459	399761		2338		81163		--
Hood Canal (Area 12)											
Hood Canal	0.04	62182	4266	145084	95473		635		65813		--

Table C3-49. Total fishing-related mortality of all chum (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries			
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)		0		2	0
North Sound (Area 7)		234		856	0
Central Sound (Area 8, 9)		391		952	0
So. Sound (Area 10,11,13)		2,338		81,163	0
Hood Canal (Area 12)		635		65,813	0

Table C3-50. Total fishing related mortality of Puget Sound hatchery and natural steelhead stocks: All Scenarios

Alternative 2--Escapement Goal Management

Steelhead	Regional Stocks Only				
	All Fisheries			Tribal Net Mortality	
	Wild Exp. Rate	Escapement Hat.	Escapement Nat.	Total	Landed
Juan de Fuca (Area 5, 6) Juan de Fuca	na	na	na		610
North Sound (Area 7) Nooksack/Samish	na	na	na		14
Central Sound (Area 8, 9) Skagit Stillaguamish Snohomish	na	na	na		213
So. Sound (Area 10,11,13) South Sound	na	na	na		653
Hood Canal (Area 12) Hood Canal	na	na	na		0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-51. Total fishing related mortality of Puget Sound hatchery and natural coho stocks: All Scenarios

Alternative 3--Escapement Goal Management at the Population Level

Coho (by MU)	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.06	6,345	1,212	17,622	18,819	591	413	6,747	6,079	219	186
North Sound (Area 7)											
Nooksack/Samish	0.13	10,674	2,142	56,057	14,272	3,758	3,405	4,449	3,981	4,609	4,272
Central Sound (Area 8, 9)											
Skagit	0.06	1,208	7,102	9,241	109,887	1,327	415	6,105	4,604	878	554
Stillaguamish	0.08	19	3,105	1,317	34,840	429	42	2,535	1,866	160	91
Snohomish	0.08	4,699	16,706	30,938	187,066	3,614	1,338	16,435	12,434	1,361	931
So. Sound (Area 10,11,13)											
South Sound	0.33	92,656	33,957	233,962	69,945	22,184	20,084	99,739	95,161	4,690	4,321
Hood Canal (Area 12)											
Hood Canal	0.12	11,327	3,937	37,046	28,533	4,031	3,265	10,314	4,666	919	777

Table C3-52. Total fishing-related mortality of all coho (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	4,109	1,725	2,304
North Sound (Area 7)	1,034	1,034	0	0	0
Central Sound (Area 8, 9)	0	0	146	143	0
So. Sound (Area 10,11,13)	8,897	8,897	74,347	72,889	0
Hood Canal (Area 12)	1,395	1,395	4,583	4,493	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-53. Total fishing related mortality of Puget Sound hatchery and natural sockeye stocks: All Scenarios

Alternative 3--Escapement Goal Management at the Population Level

Sockeye	Regional Stocks Only										
	All Fisheries					SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	--	--	--	--	--	--	--	--	--	--	--
North Sound (Area 7)											
Nooksack/Samish	--	--	--	--	--	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.0	--	--	--	12073	--	--	--	--	--	--
Stillaguamish	--	--	--	--	--	--	--	--	--	--	--
Snohomish	--	--	--	--	--	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.0	--	--	114,408	362,292	--	--	--	--	--	--
Hood Canal (Area 12)											
Hood Canal	--	--	--	--	--	--	--	--	--	--	--

Table C3-54. Total fishing-related mortality of all sockeye (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)		0		0	0
North Sound (Area 7)		0		0	0
Central Sound (Area 8, 9)		0		0	0
So. Sound (Area 10,11,13)		0		0	0
Hood Canal (Area 12)		0		0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-55. Total fishing related mortality of Puget Sound hatchery and natural pink stocks: All Scenarios

Alternative 3--Escapement Goal Management at the Population Level

Pink	Regional Stocks Only										
		All Fisheries				SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.15	--	1084	--	6338	--	--	--	--	--	1084
North Sound (Area 7)											
Nooksack/Samish	0.00	--	--	--	99172	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.00	--	--	--	615406	--	--	--	--	--	--
Stillaguamish	0.00	--	--	--	254690	--	--	--	--	--	--
Snohomish	0.00	--	--	--	274193	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.04	3	597	69	13999	0	284	0	316	--	--
Hood Canal (Area 12)											
Hood Canal	0.16	27080	5379	4488	27556	0	209	0	25792	--	6459

Table C3-56. Total fishing-related mortality of all pink (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
	Total	Landed	Total Mortality	Landed Catch Treaty	Landed Catch NonTreaty
Juan de Fuca (Area 5, 6)	0			0	0
North Sound (Area 7)	0			0	0
Central Sound (Area 8, 9)	--			--	0
So. Sound (Area 10,11,13)	284			316	0
Hood Canal (Area 12)	209			25,792	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-57. Total fishing related mortality of Puget Sound hatchery and natural chum stocks: All Scenarios

Alternative 3--Escapement Goal Management at the Population Level

Chum	Regional Stocks Only										
		All Fisheries				SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.02	--	59	--	2722		0		2		59
North Sound (Area 7)											
Nooksack/Samish	0.01	199	891	17713	79482		234		856		--
Central Sound (Area 8, 9)											
Skagit	0.01	10	242	2000	46071		193		59		--
Stillaguamish	0.00	2	44	1668	34964		1		45		--
Snohomish	0.00	131	108	43262	35583		142		97		--
So. Sound (Area 10,11,13)											
South Sound	0.16	8,694	74,807	46459	399761		2338		81163		--
Hood Canal (Area 12)											
Hood Canal	0.04	62182	4266	145084	95473		635		65813		--

Table C3-58. Total fishing-related mortality of all chum (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
			Total Mortality	Landed Catch	
	Total	Landed		Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0			2	0
North Sound (Area 7)	234			856	0
Central Sound (Area 8, 9)	336			201	0
So. Sound (Area 10,11,13)	2,338			81,163	0
Hood Canal (Area 12)	635			65,813	0

Table C3-59. Total fishing related mortality of Puget Sound hatchery and natural steelhead stocks: All Scenarios

Alternative 3--Escapement Goal Management at the Population Level

Steelhead	Regional Stocks Only				
	All Fisheries			Tribal Net Mortality	
	Wild Exp. Rate	Escapement Hat.	Escapement Nat.	Total	Landed
Juan de Fuca (Area 5, 6) Juan de Fuca	na	na	na		610
North Sound (Area 7) Nooksack/Samish	na	na	na		14
Central Sound (Area 8, 9) Skagit Stillaguamish Snohomish	na	na	na		213
So. Sound (Area 10,11,13) South Sound	na	na	na		653
Hood Canal (Area 12) Hood Canal	na	na	na		0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-60. Total fishing related mortality of Puget Sound hatchery and natural coho stocks: All Scenarios

Alternative 4--No Action/No Authorized Take

Coho (by MU)	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.06	2,236	1,212	21,732	18,819	591	413	2,638	2,050	219	186
North Sound (Area 7)											
Nooksack/Samish	0.07	10,674	1,108	56,057	15,305	2,724	2,420	4,449	3,989	4,609	4,272
Central Sound (Area 8, 9)											
Skagit	0.06	1,197	6,967	9,253	110,022	1,327	415	5,959	4,790	878	554
Stillaguamish	0.08	21	3,105	1,317	34,840	429	42	2,537	1,868	160	91
Snohomish	0.08	4,697	16,706	30,938	187,066	3,614	1,338	16,433	12,446	1,361	931
So. Sound (Area 10,11,13)											
South Sound	0.06	37,270	6,099	293,781	97,804	13,287	11,610	25,392	22,276	4,690	4,321
Hood Canal (Area 12)											
Hood Canal	0.07	7,160	2,126	41,214	30,345	2,636	1,936	5,731	4,667	919	777

Table C3-61. Total fishing-related mortality of all coho (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0	0	0	0	0
North Sound (Area 7)	0	0	0	0	0
Central Sound (Area 8, 9)	0	0	0	0	0
So. Sound (Area 10,11,13)	0	0	0	0	0
Hood Canal (Area 12)	0	0	0	0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-62. Total fishing related mortality of Puget Sound hatchery and natural sockeye stocks: All Scenarios

Alternative 4--No Action/No Authorized Take

Sockeye	Regional Stocks Only										
	All Fisheries					SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Wild Exp. Rate	Total Mortality Hat.	Total Mortality Nat.	Escapement Hat.	Escapement Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	--	--	--	--	--	--	--	--	--	--	--
North Sound (Area 7)											
Nooksack/Samish	--	--	--	--	--	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.00	--	--	--	12,073	--	--	--	--	--	--
Stillaguamish	--	--	--	--	--	--	--	--	--	--	--
Snohomish	--	--	--	--	--	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.00	--	--	114,408	362,292	--	--	--	--	--	--
Hood Canal (Area 12)											
Hood Canal	--	--	--	--	--	--	--	--	--	--	--

Table C3-63. Total fishing-related mortality of all sockeye (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport Mortality		Net and Troll		
			Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0			0	0
North Sound (Area 7)	0			0	0
Central Sound (Area 8, 9)	0			0	0
So. Sound (Area 10,11,13)	0			0	0
Hood Canal (Area 12)	0			0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-64. Total fishing related mortality of Puget Sound hatchery and natural pink stocks: All Scenarios

Alternative 4--No Action/No Authorized Take

Pink	Regional Stocks Only										
		All Fisheries				SUS Sport		SUS Net & Troll		AK and BC	
	Wild	Total Mortality		Escapement		Mortality		Mortality		Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.15	--	1,084	--	6,338	--	--	--	--	--	1,084
North Sound (Area 7)											
Nooksack/Samish	0.00	--	--	--	99,172	--	--	--	--	--	--
Central Sound (Area 8, 9)											
Skagit	0.00	--	--	--	615,406	--	--	--	--	--	--
Stillaguamish	0.00	--	--	--	254,690	--	--	--	--	--	--
Snohomish	0.00	--	--	--	274,193	--	--	--	--	--	--
So. Sound (Area 10,11,13)											
South Sound	0.00	--	--	72	14,596	--	--	--	--	--	--
Hood Canal (Area 12)											
Hood Canal	0.10	1,186	5,273	10,658	47,387	--	--	--	--	--	6,459

Table C3-65. Total fishing-related mortality of all pink (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

Region	All Stocks in Regional Fisheries				
	Sport		Net and Troll		
	Mortality		Total	Landed Catch	
	Total	Landed	Mortality	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)	0			0	0
North Sound (Area 7)	0			0	0
Central Sound (Area 8, 9)	0			0	0
So. Sound (Area 10,11,13)	0			0	0
Hood Canal (Area 12)	0			0	0

Note: It is suggested that these tables be printed on larger paper to improve readability.

Table C3-66. Total fishing related mortality of Puget Sound hatchery and natural chum stocks: All Scenarios

Alternative 4--No Action/No Authorized Take

Chum	Regional Stocks Only										
	Wild	All Fisheries Total Mortality		Escapement		SUS Sport Mortality		SUS Net & Troll Mortality		AK and BC Mortality	
	Exp. Rate	Hat.	Nat.	Hat.	Nat.	Total	Landed	Total	Landed	Total	Landed
Juan de Fuca (Area 5, 6)											
Juan de Fuca	0.02	--	59	--	2,722		0		2		59
North Sound (Area 7)											
Nooksack/Samish	0.01	194	872	17,717	79,501		210		856		--
Central Sound (Area 8, 9)											
Skagit	0.01	10	242	2,000	46,071		193		59		--
Stillaguamish	0.00	2	44	1,668	34,964		1		45		--
Snohomish	0.00	131	108	43,262	35,583		142		97		--
So. Sound (Area 10,11,13)											
South Sound	0.07	3,843	33,069	51,310	441,499		523		36,389		--
Hood Canal (Area 12)											
Hood Canal	0.00	243	117	207,023	99,621		8		352		--

Table C3-67. Total fishing-related mortality of all chum (U.S. and Canadian) by Puget Sound regional fishery: All Scenarios

All Stocks in Regional Fisheries					
Region	Sport Mortality		Net and Troll		
			Mortality	Landed Catch	
	Total	Landed	Total	Treaty	NonTreaty
Juan de Fuca (Area 5, 6)		0		2	0
North Sound (Area 7)		210		856	0
Central Sound (Area 8, 9)		336		201	0
So. Sound (Area 10,11,13)		523		36,389	0
Hood Canal (Area 12)		8		352	0

Table C3-68. Total fishing related mortality of Puget Sound hatchery and natural steelhead stocks: All Scenarios

Alternative 4--No Action/No Authorized Take

Steelhead	Regional Stocks Only				
	All Fisheries			Tribal Net Mortality	
	Wild Exp. Rate	Escapement Hat.	Escapement Nat.	Total	Landed
Juan de Fuca (Area 5, 6) Juan de Fuca	na	na	na		609
North Sound (Area 7) Nooksack/Samish	na	na	na		14
Central Sound (Area 8, 9) Skagit Stillaguamish Snohomish	na	na	na		213
So. Sound (Area 10,11,13) South Sound	na	na	na		512
Hood Canal (Area 12) Hood Canal	na	na	na		0

Appendix C4. Structure and Function of the FRAM

The Fishery Regulation Assessment Model (FRAM) is currently used by the Pacific Fishery Management Council (PFMC) to annually estimate impacts of proposed ocean and terminal fisheries on chinook and coho salmon stocks. The DEIS incorporates by reference a document entitled "FRAM – An overview for chinook and coho", written by the Model Evaluation Workgroup for the Salmon Technical Team of the PFMC[1]. The following was excerpted from that report.

FRAM is a single season modeling tool with separate processing code for chinook and coho salmon. The chinook version evaluates impacts on most stock groups originating from the south central Oregon coast, Columbia River, Puget Sound, and Southern British Columbia. The coho version evaluates impacts on a comprehensive set of stocks originating from Central California to Southeast Alaska and represents total West Coast production. The FRAM produces a variety of output reports that are used to examine fishery impacts for compliance with management objectives, allocation arrangements, ESA compliance, and domestic and international legal obligations. Until recently FRAM was not used for assessing compliance with chinook or coho agreements in international fisheries management forums. However, the U.S. and Canada have agreed to develop a bilateral regional coho planning tool. FRAM will be used for the development of the first version of this regional model. The intent is to have a single common tool that can support both domestic and international fishery planning processes using a common set of data and assumptions.

BACKGROUND

The need for salmon fishery assessment tools at the stock-specific level became apparent beginning in the mid-1970s with treaty fishery rights litigation and the associated legal obligation for the states of Washington and Oregon to provide treaty tribes with the opportunity to harvest specific shares of individual runs. Other legal issues such as the Magnuson Fishery Conservation Management Act and the Law of the Seas convention contributed to the need for developing better assessment tools. These legal issues in conjunction with the information available from the coast wide coded wire tag (CWT) program provided the impetus for developing the early salmon fishery assessment models.

In the late 1970s, the Washington Department of Fisheries (WDF) and U.S. National Bureau of Standards (NBS) developed a model for evaluating alternative fishery regulatory packages. The WDF/NBS Model could be configured for either chinook or coho by using different input data files. This model was coded in FORTRAN and ran on a mainframe computer at the University of Washington. Model runs were usually processed over night and results were painstakingly extracted from large volumes of printed output reports. The WDF/NBS model was not extensively used by the PFMC because it proved costly to operate and its results were difficult to obtain in a timely manner. Morishima and Henry (2000) provide a more in-depth history of Pacific Northwest salmon management and fishery modeling.

In the early 1980s, the development of personal computers permitted the WDF/NBS model to be converted into simple spreadsheet models. This transformation improved accessibility to the

[1] Yuen, H., A.Rankis,, L.LaVoy, J.Packer, C.Melcher, R. Conrad , C. D. Simmons, R. Sharma, and A.Grover. 2004 In prep. FRAM: an overview of chinook and coho. Report of the Model Evaluation Workgroup to the STT.

model during the PFMC preseason planning processes. The first spreadsheet model for chinook used by the PFMC was developed in the mid 1980s to model Columbia River "tule" fall chinook. The Coho Assessment Model (CAM) was the corresponding spreadsheet model for coho and covered stocks from the Columbia River, Puget Sound, and Washington and Oregon coastal areas. The Coho Assessment Model was revised over time, principally to improve report generation capabilities and provide more detailed information on management of terminal area fisheries through the use of Terminal Area Management Modules (TAMMs). The CAM was used as the primary model for evaluating coho impacts for PFMC fisheries until the mid 1990s.

Increasing demands for information soon outstripped the capacity of these spreadsheet models to evaluate the fishery regimes under consideration by the PFMC. In the mid 1990s, CAM was programmed in QUICK BASIC and was renamed FRAM. The recognition that common algorithms underlie both the coho and chinook spreadsheet models led to the effort to develop the QUICK BASIC version of FRAM for both species. The FRAM code could be used to evaluate fishery regimes for either chinook or coho by using different input file configurations. In 1998, FRAM was converted to VISUAL BASIC to take advantage of improved user interfaces available through the MS WINDOWS operating system. A multi-agency Model Evaluation Subgroup periodically reviewed model performance and parameter estimation methods and coordinated revisions to model capabilities during this period (1998-2000).

MODEL OVERVIEW

The FRAM is a discrete, time-oriented, age-structured, deterministic computer model intended to predict the impacts from a variety of proposed fishery regulation mechanisms for a single management year. It produces point estimates of fishery impacts by stock for specific time periods and age classes. The FRAM performs bookkeeping functions to track the progress of individual stock groups as the fisheries in each time step exploit them. Individual stock age groups are exploited as a single pool, that is, in each time step all pre-terminal fisheries operate on the entire cohort and all terminal fisheries operate on the mature run.

Currently, 33 stock groups are represented in Chinook FRAM and 128 stock groups are represented in Coho FRAM (see Appendices 1 and 2 for lists of the stocks). Each of these groups have both marked and unmarked components to permit assessment of mark-selective fishery regulations. For most wild stocks and hatchery stocks without marking or tagging programs, the cohort size of the marked component is zero and therefore the current version of FRAM has a virtual total of 66 stock groups for chinook and 256 for coho. Stocks or stock-aggregates represented in the FRAM were chosen based on the level of management interest, their contribution rate to PFMC fisheries, and the availability of representative CWT recoveries in the fisheries.

The FRAM includes pre-terminal and terminal fisheries in southeast Alaska, Canada, Puget Sound, and off the coasts of Washington, Oregon, and California. There are 73 fisheries in Chinook FRAM and 206 fisheries in Coho FRAM. The intent is to encompass all fishery impacts to modeled chinook and coho stocks in order to account for all fishing-related impacts and thereby improve model accuracy. Terminal fisheries in Chinook FRAM are aggregations of gears and management areas. Terminal fisheries in Coho FRAM are modeled with finer resolution, most notably by including individual freshwater fisheries. Fishery number and fishery name for each of the FRAM fisheries are listed in Appendix 3 for chinook and Appendix 4 for coho.

The time step structure used in FRAM represents a compromise level of resolution that corresponds to management planning fishery seasons and species-specific migration and maturation schedules.

The FRAM consists of four time periods for chinook and five periods for coho (Table 2-1). At each time step a cohort is subjected to natural mortality, pre-terminal fisheries, and also potentially to maturation (chinook only), and terminal fisheries.

Table 2-1. FRAM time steps for coho and chinook.

Coho		Chinook	
Period	Months	Period	Months
Time 1	January-June	Time 1	Preceding October-
Time 2	July	Time 2	May-June
Time 3	August	Time 3	July-September
Time 4	September	Time 4	October-April
Time 5	October -		

The recovery data available in the CWT database limit the time-step resolution of the model. Increasing the time-step resolution of the model usually decreases the number of CWT recoveries for a stock within a time period. Since estimation of fishery impacts, like exploitation rates, is dependent on CWT recovery information, decreasing the number of CWT recoveries in time/area strata increases the variance of the estimated exploitation rates in those strata. In recognition of these data limitations, efforts were made to restrict the level of time-step resolution to that necessary for fishery management purposes.

Major assumptions and limitations of the model are described briefly below.

1. CWT fish accurately represent the modeled stock. Many "model" stocks are aggregates of stocks that are represented by CWTs from only one component. For example, in many cases wild stocks are aggregated with hatchery stocks and both are represented by the hatchery stock's CWT data. Therefore, for each modeled stock aggregate, it is assumed that the CWT data accurately depict the exploitation and distribution of the untagged fish in the modeled stock.

2. Length at age of chinook is stock specific and is constant from year to year. Growth functions are used for chinook in determining the proportion of the age class that is legal size in size-limit fisheries. Parameters for the growth curves were estimated from data collected over a number of years. It is assumed that growth in the year to be modeled is similar to that in the years used to estimate the parameters.

3. Stock distribution and migration is constant from year to year and estimated as the average distribution in the base period data. We currently lack data on the annual variability in distribution and migration patterns of chinook and coho salmon stocks. In the absence of such estimates, fishery-specific exploitation rates are computed relative to the entire cohort. Changes in the distribution and migration of stocks from the base period will result in poor estimates of stock composition and stock-specific exploitation rates.

4. There are not multiple encounters with the gear by the fish in a specific time-area fishery stratum. Within each time-area fishery stratum, fish are assumed to be vulnerable to the gear only once. The catch equations used in the model are discrete and not instantaneous. Potential bias in the estimates may increase with large selective fisheries or longer time intervals, both of which increase the likelihood that fish will encounter the gear more than once.

While it is difficult to directly test the validity of these assumptions, results of validation exercises could provide one assessment of how well these assumptions are met and the sensitivity of the model to the assumptions. Currently, there is little effort directed at model validation.

BASE PERIOD DATA

The Chinook FRAM is calibrated using escapement, catch, and CWT recovery data from 1974-1979 brood year CWT releases. During the late 1970s and early 1980s, fisheries were being conducted across an extensive geographic area and over an extended period of time, thus giving the best available representation of CWT stock distribution. Not all stocks represented in the Chinook FRAM have CWT recovery data available from the 1974-1979 brood year base period (e.g., Snake River fall chinook). These stocks are categorized as "Out-of-Base" stocks. Available CWT data for these stocks are translated to equivalent base period recovery and escapement data using known fishing effort and harvest relationships between recovery years.

Model base period data for the Coho FRAM is derived from fishery and escapement recoveries of CWTs and terminal area run size estimates for the return years 1986-1991.

Chinook and coho base period data are used to estimate base period stock abundances and age-specific time-area fishery exploitation rates and maturation rates for modeled stocks. These estimates are derived through species-specific cohort analysis procedures. Cohort analysis is a series of steps and processes that uses CWT recoveries and base period catch and escapement data to "back-calculate" or reconstruct a pre-fishing cohort size for each stock and age group using assumed natural mortality and incidental mortality rates.

GENERAL INPUT TYPES

The five general types of input values used by FRAM are:

1. Cohort Abundance: For each stock or stock aggregate, an annual estimate of abundance is obtained from a source that is independent of the model. For preseason simulation modeling, these forecasts of stock abundance are used to estimate initial cohort size. For chinook, initial stock abundance estimates are segregated by age class, from age-2 to age-5 year old fish. For coho, only one age class (age 3) is assumed vulnerable to fisheries. Coho abundances are input to the model as January age-3 abundance. Chinook and coho abundance estimates are further segregated by mark status ("marked" or "unmarked").

2. Size Limits: For chinook, minimum size limits are specified by fishery where appropriate. For coho, age-3 fish are assumed fully vulnerable and age-2 fish are assumed fully invulnerable to modeled fisheries.

3. Fishery Catch Mortality: The model provides five options for estimating mortality in a fishery: a quota, an exploitation rate scalar, a ceiling, "selective", and harvest rate (for Puget Sound terminal fisheries only).
   a) Quota. Catch in the fishery is set equal to a value input by the user.
   b) Exploitation rate scalar. The exploitation rate in the fishery is scaled, relative to the base period, using a scalar input by the user.
   c) Ceiling. Catch is first calculated based on an exploitation rate scalar and then compared to a ceiling; if the estimated catch exceeds the ceiling, then the catch is truncated at the ceiling value.
   d) Selective. Identified as either a quota or exploitation rate scalar controlled fishery with additional calculations to cover catches and encounters for marked and unmarked groups.

e) Harvest rate. A terminal area harvest rate is applied to either all fish present in the terminal area or to the number of local-origin stock only.

4. Release Mortality: This is the mortality associated with the release of landed fish from hook-and-line and other gears. Release mortality rates assumed for coho are shown in Table 3-1a and for chinook in Table 3-1b. Hook-and-release mortality is assessed when coho or chinook are not allowed to be retained (so-called "chinook/coho non-retention", or CNR fisheries), when size limits apply, or in mark-selective fisheries. Release mortality has been estimated in a number of studies of hook-and-line fisheries, and release mortality rates for troll and recreational fisheries in the ocean have been formally adopted by the PFMC. Release mortality in net fisheries for chinook or coho non-retention is estimated external to FRAM and input into the model as either "landed catch" or as CNR mortality.

   Mark-selective fisheries have two additional variations of "release" mortality that are described as either the inappropriate retention of an unmarked fish or the release of a marked fish which consequently endures some release mortality. The failure to release an unmarked fish is a user input to the model called "Unmarked Recognition Error" (or Retention Error Rate) and is the proportion of the unmarked fish encountered that are retained. The release of marked fish that subsequently die due to release is a user input to the model called "Marked Recognition Error" and is the proportion of the marked fish encountered that are released. These rates are identified in Table 3-2.

5. Other Non-landed Mortality: This category includes fishing-induced mortality not associated with direct handling (or landing) of the fish (see Table 3-1a for coho and Table 3-1b for chinook). Application is for sport and troll hook-and-line "drop-off" (fish that drop off from the hook before they are brought to vessel but die from hook injuries), and net gear "drop-out" (fish which are not brought on board but die from injury as a result of being netted). In general, a 5% mortality rate is applied to the landed catch to account for "other non-landed mortality" in hook-and-line fisheries. Net drop-out mortality rates vary depending on species, net type, or terminal versus pre-terminal nature of the fishery.

Table 3-1a. FRAM/TAMM fishery-related mortality rates for coho salmon used for Southern U.S. fisheries in 2003.

Fishery: designated by area, user group, and/or gear type	Fishery Type	Comments	Release Mortality	"Other" Mortality[a]
PFMC Ocean Recreational	MSF	barbless	14.0%	5.0%
	Non-Retention	N. Pt. Arena	14.0%[b]	5.0%[b]
	Non-Retention	S. Pt. Arena	23.0%[b]	5.0%[b]
PFMC Ocean T-Troll	Retention		n.a.[c]	5.0%
PFMC Ocean NT-Troll	MSF	barbless	26.0%	5.0%
Area 5, 6C Troll	Retention		n.a.	5.0%
Puget Sound Recreational	Retention		n.a.	5.0%
	MSF	barbless	7.0%	5.0%
WA Coastal Recreational	Retention		n.a.	5.0%
Buoy 10 Recreational	MSF	barbed	16.0%	5.0%
Gillnet and Setnet			n.a.	2.0%
PS Purse Seine			26.0%[b]	0.0%
PS Reef Net, Beach Seine, Round Haul			n.a.	n.a.
Freshwater Net			n.a.	2.0%
Freshwater Recreational	Retention		n.a.	5.0%
	Non-Retention		10.0%[b]	5.0%

[a] The "other" mortality rates (which include drop-out and drop-off) are applied to landed fish (retention fisheries), thus FRAM does not assess "drop-off" in non-retention fisheries. Drop-off (and release mortality) associated with CNR fisheries are estimated outside the model and used as inputs to the model. For mark-selective fisheries (MSF), "other" mortality rates are applied to encounters of marked and unmarked fish.

[b] Rate assessed external to FRAM.

[c] None assessed.

Table 3-1b. FRAM/TAMM fishery-related mortality rates for chinook salmon used for Southern U.S. fisheries in 2003.

Fishery: designated by area, user group, and/or gear type	Fishery Type	Comments	"Shaker" Release Mortality	"Adult" Release Mortality	"Other" Mortality[a]
PFMC Ocean Recreational	Retention	N Point Arena	14.0%	n.a.[c]	5.0%
	Retention	S Point Arena	23.0%	n.a.	5.0%
PFMC Ocean Troll	Retention	barbless	25.5%	n.a.	5.0%
Area 5,6,7 T-Troll	Retention	barbed	30.0%	n.a.	5.0%
Puget Sound (PS) Recreational	Retention	barbless	20.0%	n.a.	5.0%
	MSF	barbless	20.0%	10.0%	5.0%
	Non-Retention	barbless	20.0%	10.0%	n.a.
Buoy 10 Recreational	not modeled within FRAM		n.a.	n.a.	n.a.
<u>Commercial Net</u>					
PS Areas 4B,5,6,6C	PT[d] GN, SN		n.a.	n.a.	3.0%
WA Coastal & Col R. Net	PT[d] GN, SN		n.a.	n.a.	3.0%
PS Areas 6A,7,7A	PT[d] GN, SN, Purse S		n.a.	n.a.	1.0%
NT PS Areas: 6B,9,12,12B,12C	PT[d] GN, SN, Purse S		n.a.	n.a.	1.0%
T PS Areas:7B,7C,7D	PT[d] GN, SN, Purse S		n.a.	n.a.	1.0%
All other PS marine net	Terminal GN, SN		n.a.	n.a.	2.0%
PS Purse Seine		immature	n.a.	45.0%[b]	0.0%
		mature	n.a.	33.0%[b]	0.0%
PS Reef Net, Beach Seine, Round Haul			n.a.	n.a.	n.a.
Freshwater Net			n.a.	n.a.	n.a.
Freshwater Recreational	Retention		n.a.	n.a.	n.a.
	MSF	TAMM	n.a.	10.0%[b]	n.a.
	Non-Retention	TAMM	n.a.	10.0%[b]	n.a.

[a] The "other" mortality rates (which include drop-out and drop-off) are applied to landed fish (retention fisheries), thus FRAM does not assess "drop-off" in non-retention fisheries. Drop-off (and release mortality) associated with CNR fisheries are estimated outside the model and used as inputs to the model. For mark-selective fisheries (MSF), "other" mortality rates are applied to encounters of marked and unmarked fish.

[b] Rate assessed external to FRAM.

[c] None assessed.

[d] PT = Pre-terminal.

Table 3-2. Mark-selective fishery input values for Southern U.S. fisheries.

Fishery	Unmarked Retention Rate (% of unmarked fish retained)	Mark Release Rate (% of marked fish released)
NOF troll, sport	2%	6%
SOF sport	2%	6%
Area 5,6 sport—2001 coho		
Area 5,6 sport—2002 coho	2%	34%
Area 5,6 sport—2003 coho	2%	38%
Area 5,6 sport—2003 chinook	2%	38%
	8%	6%
Area 7 sport—2001 coho	5%	6%
Area 7 sport—2002 coho	8%	9%
Area 7 sport—2003 coho	8%	9%
Area 13 sport—2002 coho	27%	18%
Area 13 sport—2003 coho	27%	18%
Other PS marine sport	8%	9%

OUTPUT REPORTS AND MODEL USE

Model results are available as either standard FRAM printed output reports or in Excel spreadsheets that are linked to FRAM results/reports. The TAMM spreadsheets provide comprehensive summaries of fishery mortality, exploitation rate, run size, and escapement for key stocks in the PFMC and North of Falcon annual salmon season setting processes. Early versions of these spreadsheets focused on finer resolution of stocks and fisheries for Puget Sound terminal areas. The TAMM spreadsheets have now broadened in scope and contain information for both pre-terminal and terminal fisheries as well as FRAM fishery inputs for terminal fisheries in coastal Washington (coho) and in Puget Sound (both species). Other model results not shown in the spreadsheets can be generated directly from FRAM. These reports include summaries of catch by fishery, catch by stock, catch by age, and escapement/run size reports. A new report has been created for FRAM to provide more detailed information relative to mark-selective fisheries for chinook and coho. For a full scope of FRAM report generating functions, refer to "Users Manual for the Fishery Regulation Assessment Models (FRAM) for Chinook and Coho" (MEW *in prep*.).

COMPUTATIONAL STRUCTURE

For each time step and fishery, FRAM simulates fishery regulations following the sequence of computations depicted for coho (Figure 1) and chinook (Figure 2). The first step for both coho and chinook is to scale the predicted cohort size for the current year to the base period: this is done by stock for the January age-3 cohort for coho and for the age-2 through age-5 cohorts for chinook. Each stock's cohort is then processed through a time step loop defined for the species (five time steps for coho and four for chinook). Within the time step loop: (1) natural mortality is applied to the beginning cohort size; (2) the procedures to calculate projected catches for the all fisheries in the time step are executed; and (3) all fishery mortalities for the cohort (stock) are totaled and the remaining abundance of the stock is calculated.

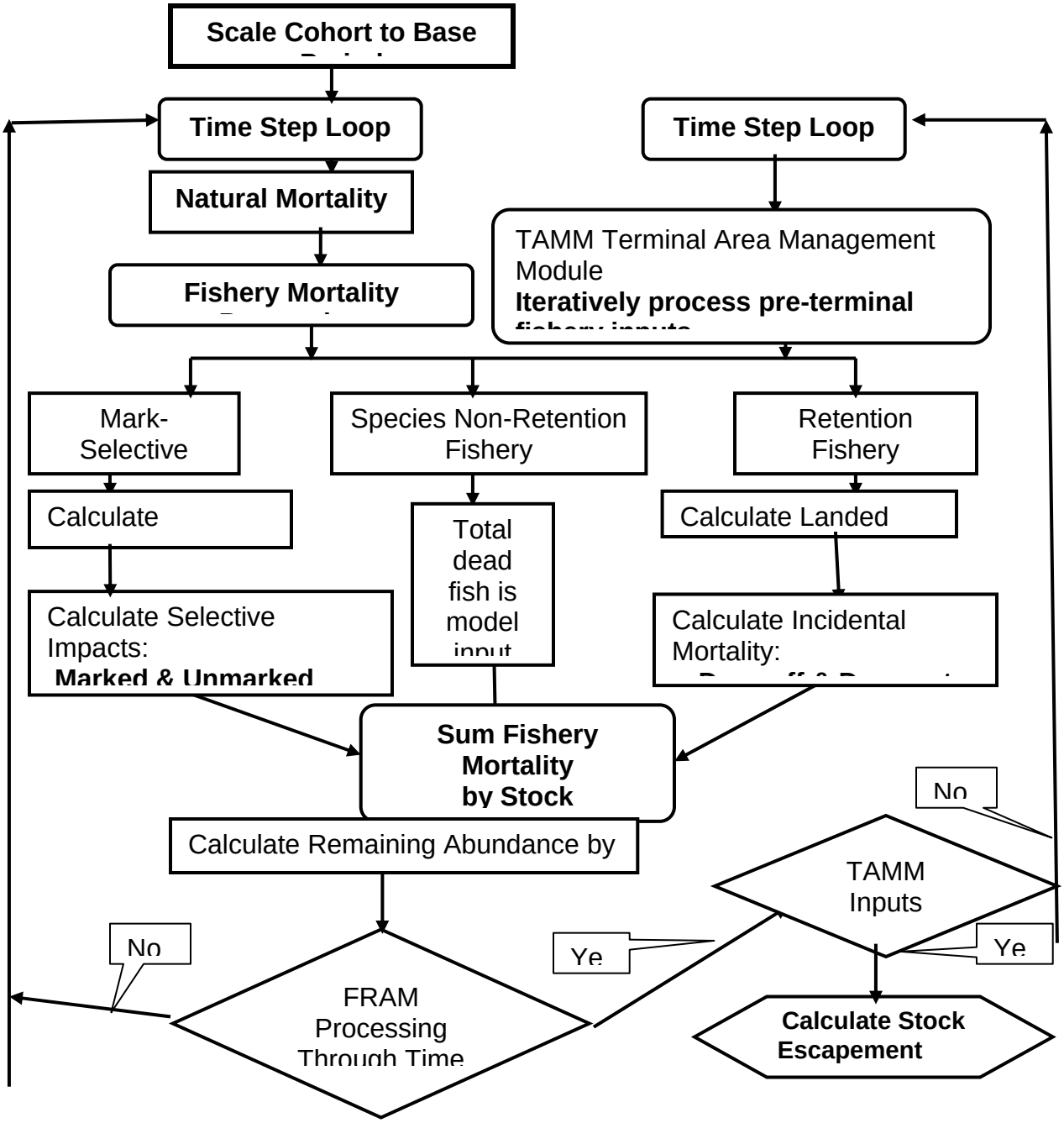


Figure 1. Flow chart for FRAM coho model.

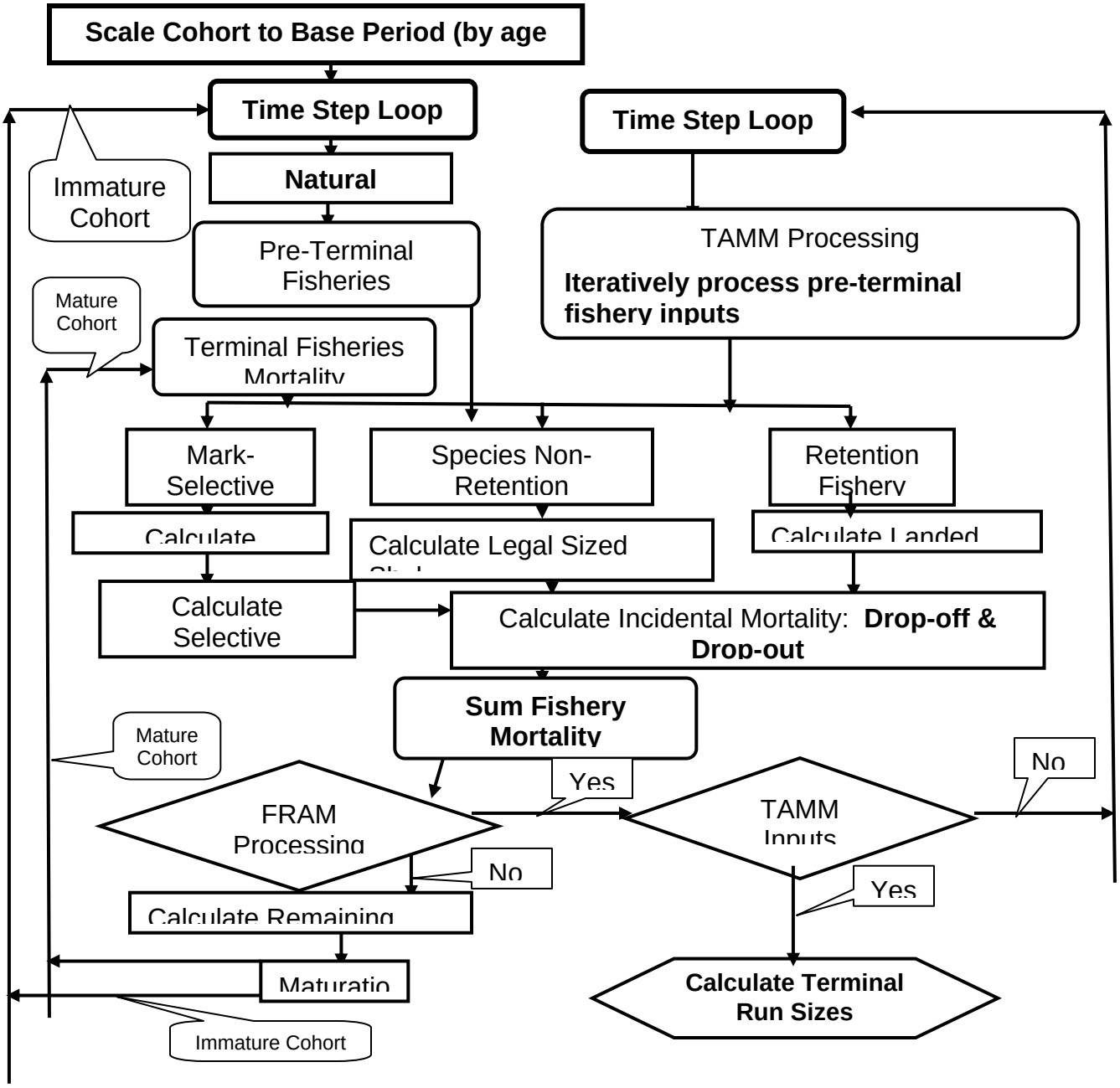


Figure 2. Flow chart for FRAM chinook model.

After FRAM has processed all steps in the time step loop, the program checks for the presence of an optional Terminal Area Management Module (TAMM). If the model user has not specified a TAMM input file for additional modeling, FRAM processing is complete and final terminal run sizes (chinook) or escapements (coho) are calculated. If a TAMM has been specified, then FRAM will repeat processing through the specified fisheries and time step loops. Although TAMMs are focused upon terminal area fisheries, some of these fisheries are in mixed-stock areas and may also impact both mature and immature chinook. Thus there exists an iterative FRAM/TAMM process to obtain the final tabulations of fishery mortalities and stock escapements (see Section 7 for further TAMM explanation).

Scale Cohort to Base Period

The equation below establishes the starting cohort size for all stocks as a product of two parameters: the average cohort size for stock *s* at age *a* ($BPCohort_{s,a}$) during the base period and a stock and age specific scalar ($StockScalar_{s,a}$). $StockScalar_{s,a}$ is estimated externally to the model and is an annual input to the model.

$$Cohort_{s,a,1} = BPCohort_{s,a} \ x \ StockScalar_{s,a}$$

Natural Mortality

At the beginning of each time step, each cohort is decreased to account for projected natural mortality using the following equation:

$$Cohort_{s,a,t} = Cohort_{s,a,t} \ x \ \left(1 - M_{a,t}\right)$$

where $M_{a,t}$ is the natural mortality rate for age *a* fish during time step *t* (see Appendix Table 5 for specific rates used for coho and chinook).

Catch

The FRAM simulates fisheries through the use of linear equations. Different types of computations are used depending upon whether or not a fishery operates under mark-retention restrictions. If all fish can be retained regardless of mark status, the following general formula is used (mark-selective fisheries are described in Section 6.5):

$$Catch_{s,a,f,t} = BPER_{s,a,f,t} \ x \ Cohort_{s,a,t} \ x \ PV_{s,a,t} \ x \ FishScalar_{f,t} \ x \ SHRS_{s,f,t}$$

where:

$Catch_{s,a,f,t}$	=	Catch of stock *s*, age *a*, in fishery *f*, at time step *t;*
$BPER_{s,a,f,t}$	=	Base Period Exploitation Rate (harvest rate for terminal fisheries) for stock *s*, age *a*, in fishery *f*, at time step *t* (*BPER* is derived from cohort analysis using CWT release and recovery data);
$Cohort_{s,a,t}$	=	Number of fish in cohort (chinook are expressed as both immature and mature cohorts) for stock *s* at age *a* in time step *t*;
$PV_{s,a,t}$	=	Proportion of cohort for stock *s*, age *a*, vulnerable to the gear at time step *t* (for chinook *PV* is a function of a Von Bertalanffy growth curve; for coho *PV* is always = 1.0);
$FishScalar_{f,t}$	=	Impact scalar for fishery *f* at time step *t* relative to the base period; and
$SHRS_{s,f,t}$	=	Stock-specific exploitation rate scalar for stock *s*, in fishery *f*, at time step *t* (the default value of 1.0 is rarely changed).

The parameter $FishScalar_{f,t}$ is the foundation for the model's fishery simulation algorithms. FRAM can evaluate two general types of fisheries: (1) effort-based or (2) catch-based. For effort-based fisheries, the parameter $FishScalar_{f,t}$ is specified by the modeler to reflect expected effort relative to the average effort observed during the model's base period. For catch-based fisheries, $FishScalar_{f,t}$ is computed automatically so as to attain a specified catch level. If the catch level is to be modeled as a quota, then $FishScalar_{f,t}$ is computed as:

$$FishScalar_{f,t} = \frac{QuotaLevel_{f,t}}{\sum_{s}\sum_{a} Catch_{s,a,f,t} \;\; x \;\; (1/PropModelStock_{f})}$$

where $\sum_{s}\sum_{a} Catch_{s,a,f,t}$ is computed with $FishScalar_{f,t}$ = 1.0 and $PropModelStock_f$ is the proportion of model stocks in the catch to the total catch in fishery *f* for the base period ($PropModelStock_f$ is used for chinook only, it is always set to 1.0 for coho).

If the catch level is to be modeled as a ceiling, both an effort scalar and quota are specified. A catch estimate is made during a first iteration of FRAM using the effort scalar. If the effort scalar computes a catch level that is less than the catch ceiling, then the final catch estimate is this effort-based catch. If the initial effort scalar computes to a catch level that exceeds the ceiling, then the final catch estimate is the quota. In the case of a ceiling-type fishery, the final $FishScalar_{f,t}$ will be calculated based on the lower of the two types of catch estimates (effort scalar or quota).

Incidental Mortality

Several types of incidental mortality can be accounted for in FRAM either through external calculations of mortality or internal FRAM processing. Incidental mortality associated with hook-and-line drop-off and net drop-out is expressed as a fraction of retained catch or as a fraction of encounters in the case of mark-selective fisheries. Incidental mortality in mark-selective fisheries is discussed in the next section.

Mortalities in species non-retention fisheries (CNR) are derived using four different methods for chinook and one for coho. Chinook non-retention mortalities are model estimates from inputs of: the level of open versus non-retention effort within each time step (Methods 1 and 2), legal and sub-legal encounters (Method 3), or from total encounters (Method 4). The method for coho is simply an external-to-the-model estimate of coho mortalities in a fishery based on historical observations. The methods were developed to fit the observations from various fisheries. Method 1 was developed for Canadian and Alaskan fisheries that had both open and non-retention regulation periods and had changes in the gear or fishing patterns to avoid chinook encounters.

METHOD 1 – Computed Mortalities

$$CNRLegal_{s,a,f,t} = Catch_{s,a,f,t} \ x \ \frac{1 - FishScaler_{f,t}}{FishScaler_{f,t}} \ x \ RelRate_{f,t} \ x \ LegalSelRate_{f,t}$$

$$TotalLegPop_{f,t} = \sum_s \sum_a (Cohort_{s,a,t} \ x \ PV_{s,a,t})$$ for stocks with catch in fishery *f*

$$TotalSubLegPop_{f,t} = \sum_s \sum_a (Cohort_{s,a,t} \ x \ (1 - PV_{s,a,t}))$$ for stocks with catch in fishery *f*

$$EncRate_{f,t} = TotalSubLegPop_{f,t} / TotalLegPop_{f,t}$$

$$TotCatch_{f,t} = \sum_s \sum_a Catch_{s,a,f,t} \ x \ (1 / PropModelStock_f)$$

$$CNRSub_{s,a,f,t} = TotCatch_{f,t} \ x \ EncRate_{f,t} \ x \ \frac{1 - FishScaler_{f,t}}{FishScaler_{f,t}} \ x \ RelRate_{f,t} \ x \ SubSelRate_{f,t} \ x \ PropSubPop_{s,a,f,t}$$

METHOD 2 – Ratio of Non-Retention to Retention Days

$$CNRLegal_{s,a,f,t} = Catch_{s,a,f,t} \ x \ (CNRDays_{f,t} / RetentDays_{f,t}) \ x \ RelRate_{f,t} \ x \ LegalSelRate_{f,t}$$

$$CNRSub_{s,a,f,t} = Shakers_{s,a,f,t} \ x \ (CNRDays_{f,t} / RetentDays_{f,t}) \ x \ SubSelRate_{f,t}$$

METHOD 3 – External Estimates of Legal and Sub-Legal Sized Encounters

$$LegalPropCatch_{s,a,f,t} = Catch_{s,a,f,t} / TotCatch_{f,t}$$

$$SubLegPop_{s,a,t} = Cohort_{s,a,t} \ x \ (1 - PV_{s,a,t})$$

$$SubLegNR_{s,a,f,t} = SubLegPop_{s,a,t} \ x \ SubER_{s,a,f,t} \ x \ RelRate_{f,t}$$

$$SubLegPropEnc_{s,a,f,t} = SubLegNR_{s,a,f,t} \Big/ \sum_s \sum_a SubLegNR_{s,a,f,t}$$

$$CNRLegal_{s,a,f,t} = LegalPropCatch_{s,a,f,t} \ x \ LegalEnc_{f,t} \ x \ RelRate_{f,t} \ x \ PropModelStock_f$$

$$CNRSub_{s,a,f,t} = SubLegPropEnc_{s,a,f,t} \ x \ SubLegEnc_{f,t} \ x \ RelRate_{f,t} \ x \ PropModelStock_f$$

METHOD 4 – External Estimate of Total Encounters

$$LegalPropCatch_{s,a,f,t} = Catch_{s,a,f,t} / TotCatch_{f,t}$$

$$LegalEnc_{s,a,f,t} = BPER_{s,a,f,t} \ x \ Cohort_{s,a,t} \ x \ PV_{s,a,t} \ x \ SHRS_{s,f,t} \ x \ LegalPropCatch_{s,a,f,t}$$

$$SubLegEnc_{s,a,f,t} = SubER_{s,a,f,t} \ x \ SubLegPop_{s,a,t}$$

$$CNRScaler_{f,t} = \frac{TotalEstCNR_{f,t}}{\sum_s \sum_a LegalEnc_{s,a,f,t} + \sum_s \sum_a SubLegEnc_{s,a,f,t}}$$

$$CNRLegal_{s,a,f,t} = LegalEnc_{s,a,f,t} \ x \ CNRScaler_{f,t} \ x \ RelRate_{f,t}$$

$$CNRSub_{s,a,f,t} = SubLegEnc_{s,a,f,t} \ x \ CNRScaler_{f,t} \ x \ RelRate_{f,t}$$

METHOD 5 – Coho Non-Retention Mortalities from External Estimates

$$PropCatch_{s,f,t} = \frac{BPER_{s,f,t} \ x \ Cohort_{s,t} \ x \ SHRS_{s,f,t}}{\sum_s BPER_{s,f,t} \ x \ Cohort_{s,t} \ x \ SHRS_{s,f,t}}$$

$$CNR_{s,f,t} = EstCNRMorts_{f,t} \ x \ PropCatch_{s,f,t}$$

where $Cohort_{s,a,t}$, $Catch_{s,a,f,t}$, $FishScaler_{f,t}$, $PV_{s,a,t}$, $PropModelStock_f$, $BPER_{s,a,f,t}$, and $SHRS_{s,f,t}$, are previously defined and:

$CNRLegal_{s,a,f,t}$	=	Legal-sized adult non-retention mortality for stock *s*, age *a*, in fishery *f*, at time step *t*;
$RelRate_{f,t}$	=	Release mortality rate for fish in fishery *f* at time step *t*;
$LegalSelRate_{f,t}$	=	Legal-sized adult selectivity rate for fishery *f* in time step *t*, in response to changes in gear or fishing pattern (model input for Methods 1 and 2);
$TotalLegPop_{f,t}$	=	Total number of legal-sized fish from modeled stocks available to fishery *f* at time step *t*;
$TotalSubLegPop_{f,t}$	=	Total number of sub-legal sized fish from modeled stocks available to fishery *f* at time step *t*;
$EncRate_{f,t}$	=	For modeled stocks, the ratio of sub-legal sized chinook encountered for every legal-sized chinook in fishery *f* at time step *t*;
$TotCatch_{f,t}$	=	Total landed catch in fishery *f* at time step *t*;
$CNRSub_{s,a,f,t}$	=	Sub-legal sized non-retention mortality for stock *s*, age *a*, in fishery *f*, at time step *t*;
$SubSelRate_{f,t}$	=	Sub-legal sized selectivity rate for fishery *f* in time step *t*, in response to changes in gear or fishing pattern (model input for Methods 1 and 2);
$PropSubPop_{s,a,f,t}$	=	Proportion of sub-legal sized population for stock *s*, age *a*, in fishery *f*, at time step *t*;
$CNRDays_{f,t}$	=	Number of non-retention days in fishery *f*, at time step *t* (model input for Method 2);
$RetentDays_{f,t}$	=	Number of retention days in fishery *f* at time step *t* (model input for Method 2);

$Shakers_{s,a,f,t}$	=	Sub-legal shaker mortality for stock *s*, age *a*, in fishery *f*, at time step *t* (see following sub-section for method of calculation);
$LegalPropCatch_{s,a,f,t}$	=	Proportion of legal-sized catch for stock *s*, age *a*, in fishery *f*, at time step *t*;
$SubLegPop_{s,a,t}$	=	Sub-legal sized population for stock *s*, age *a*, at time step *t*;
$SubLegNR_{s,a,f,t}$	=	Sub-legal sized non-retention mortalities for stock *s*, age *a*, in fishery *f*, at time step *t*;
$SubER_{s,a,f,t}$	=	Sub-legal sized encounter rate for stock *s*, age *a*, in fishery *f*, at time step *t* calculated from base period data;
$SubLegPropEnc_{s,a,f,t}$	=	Sub-legal sized proportion of encounters for stock *s*, age *a*, in fishery *f*, at time step *t*;
$LegalEnc_{f,t}$	=	Total number of legal-sized encounters in fishery *f* at time step *t* (model input for Method 3);
$SubLegEnc_{f,t}$	=	Total number of sub-legal sized encounters in fishery *f* at time step *t* (model input for Method 3);
$LegalEnc_{s,a,f,t}$	=	Legal-sized encounters for stock *s*, age *a*, in fishery *f*, at time step *t*;
$SubLegEnc_{s,a,f,t}$	=	Sub-legal sized encounters for stock *s*, age *a*, in fishery *f*, at time step *t*;
$CNRScalar_{f,t}$	=	Non-retention scalar in fishery *f* at time step *t*;
$TotalEstCNR_{f,t}$	=	Total estimated non-retention (legal and sub-legal) in fishery *f* at time step *t* (model input for Method 4);
$PropCatch_{s,f,t}$	=	Proportion of coho catch for stock *s* in fishery *f* at time step *t*;
$EstCNRMorts_{f,t}$	=	Estimated coho non-retention mortalities in fishery *f* at time step *t* (model input for Method 5); and
$CNR_{s,f,t}$	=	Coho non-retention mortality for stock *s* in fishery *f*, at time step *t*.

<u>Sub-legal shaker mortality</u> is not estimated for coho since most minimum size limits - if they exist - apply to age 2 fish that are not represented in the model. The sub-legal and legal size encounters are stock and age specific and are calculated using Von Bertalanffy growth curves generated from CWT data. The calculations for sub-legal sized chinook (shakers) are shown below:

$$SubLegProp_{s,a,t} = 1 - PV_{s,a,t}$$

$$SubLegPop_{s,a,t} = Cohort_{s,a,t} \ x \ SubLegProp_{s,a,t}$$

$$Shakers_{s,a,f,t} = SubER_{s,a,f,t} \ x \ SubLegPop_{s,a,t} \ x \ FishScalar_{f,t} \ x \ RelRate_{f,t}$$

where all components are defined previously and (1-$PV_{s,a,t}$) is the proportion of the cohort for stock *s*, age *a*, vulnerable to the gear at time step *t* (for chinook *PV* is function of Von Bertalanffy growth curve; for coho *PV* is always = 1).

Mark-Selective Fisheries

The implementation of mark-selective fishery regulations requires the use of more complex computations. Different equations are employed for marked and unmarked fish. The time-period specific forms of the equations utilized in Coho FRAM under non-selective and mark-selective fisheries are depicted in the following table. Computations for chinook mark-selective fisheries must account for sub-legal mortality, which does not differ between marked and unmarked components. The counterpart equations for chinook would contain the elements associated with sub-legal mortality, but due to the increased complexity this introduces the analogous equations for chinook are not presented here.

	Non-Selective Fisheries	Mark-Selective Fisheries	
	Discrete Equations	Marked Fish	Unmarked Fish
Landed mortalities	$C_{s,f} = ER_{s,f} \ x \ N_{s,t}$	$C_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ (1 - mre_f)$	$C_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ ure_f$
Release mortalities		$R_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ mre_f \ x \ rm_f$	$R_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ (1 - ure_f) \ x \ rm_f$
Drop-off mortalities	$D_{s,f} = C_{s,f} \ x \ dmr_f$	$D_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ dmr_f$	$D_{s,f} = ER_{s,f} \ x \ N_{s,t} \ x \ dmr_f$

where:

- $C_{s,f}$ = number of landed mortalities of stock *s* in fishery *f*;
- $D_{s,f}$ = drop-off mortalities for stock *s* in fishery *f*;
- dmr_f = drop-off mortality rate in fishery *f*;
- $ER_{s,f}$ = exploitation rate for stock *s* in fishery *f* (this parameter is equivalent to *BPER* x *PV* x *SHRS* in the previously described formulation);
- mre_f = marked-retention error (releasing marked fish in a selective fishery) in fishery *f*;
- $N_{s,t}$ = cohort size for stock *s* at the beginning of time period *t*;
- $R_{s,f}$ = number of release mortalities for stock *s* in fishery *f*;
- rm_f = release mortality rate in fishery *f*; and
- ure_f = unmarked recognition error (retaining and landing unmarked fish in a selective fishery) in fishery *f*.

Maturation (chinook only)

For chinook, the maturation process occurs after the pre-terminal catch has been calculated and results in a mature cohort for each stock, age, and time step. The number of fish from the age *a* cohort for stock *s* that matures at time step *t* ($TermCohort_{s,a,t}$) is calculated by:

$$TermCohort_{s,a,t} = Cohort_{s,a,t} \ x \ MatRate_{s,a,t}$$

where $MatRate_{s,a,t}$ is a stock, age, and time step specific maturation rate that is calculated from base period data. The mature portion of the cohort is available to those fisheries, during the same time period, that have been designated as harvesting only mature fish while the immature portion of the cohort ($Cohort_{s,at,}$ - $TermCohort_{s,a,t}$) is then used to initiate the next time step.

Escapement

All chinook fisheries in FRAM are designated as pre-terminal or terminal in the base period data. The terminal fisheries only harvest fish from the mature cohort thus simulating a migration pattern from the pre-terminal mixed stock areas. Escapement is defined as any fish from the mature cohort that does not die from fishery-related mortality. For coho, fisheries during time steps 1 through 4 are on immature fish and by default all coho fisheries in time step five are on mature fish. In the current versions of the chinook and coho base periods, all maturation and escapement of a stock occurs within a single time step. The only exceptions are Skagit stocks of spring and summer/fall chinook and Columbia River summer chinook. The equations for chinook and coho are given below:

chinook:

$$TotTermMort_{s,a,t} \sum_{f-term} (Catch_{s,a,f,t} + Shakers_{s,a,f,t} + Dropoff_{s,a,f,t} + LegalShakers_{s,a,f,t} + CNR_{s,a,f,t})$$

$$Escape_{s,a,t} = TermCohort_{s,a,t} - TotTermMort_{s,a,t}$$

coho:

$$Escape_{s,a} = Cohort_{s,a,5} - (\sum_{f}(Catch_{s,f,5} + LegalShakers_{s,f,5} + Dropoff_{s,f,5} + CNR_{s,f,5}))$$

where (age = 3 and time step = 5 for coho):

$TotTermMort_{s,a,t}$	=	Total terminal fishery mortality for stock *s*, age *a*, at time step *t*;
$Escape_{s,a,t}$	=	Escapement for stock *s*, age *a*, at time step *t*;
$Catch_{s,a,f,t}$	=	Catch for stock *s*, age *a*, in terminal fishery *f*, at time step *t*;
$Shakers_{s,a,f,t}$	=	Sub-legal mortality for stock *s*, age *a*, in terminal fishery *f*, at time step *t*;
$Dropoff_{s,a,f,t}$	=	Non-landed mortality for stock *s*, age *a*, in terminal fishery *f*, at time step *t*;
$LegalShakers_{s,a,f,t}$	=	Legal-sized mortality of fish released during mark-selective fisheries for stock *s*, age *a*, in terminal fishery *f*, at time step *t*; and
$CNR_{s,a,f,t}$	=	Non-retention mortality (legal and sub-legal sized) for stock *s*, age *a*, in terminal fishery *f*, at time step *t*.

Other Algorithms and Equations Used in the Model

<u>Adult Equivalency</u> (chinook only). Fishery-related mortality for chinook is expressed as a nominal value or adjusted for "Adult Equivalents" (AEQ) to account for the multiple ages that the fish mature and are vulnerable to fisheries. Fishery-related mortalities are expressed as adult equivalent mortalities so that all fishery mortalities can be expressed in a common unit of measure, which is the number of fish that would have matured (escaped to spawn) in the absence of fishing. The AEQ factors adjust for the natural mortality that would have occurred between the time/age the fish were caught and the time/age that they would have matured or escaped to spawn. The factors used in FRAM are calculated in the CWT base period calibration process and take into account fixed age-specific natural mortality rates and age and stock specific maturation rates which are calculated from CWT recoveries. Stock and age specific AEQ values are

expressed in terms of the expected contribution to the age-5, time step 3 fish, which is the oldest age-class at the final time step for mature fish. The AEQ value at the maximum age and final time-step is 1.0 and all other age/time-step values are a proportion of this value. Note that all age classes have an AEQ value of 1.0 in designated "terminal fisheries" (exploitation rates for chinook are usually expressed in terms of adult equivalent mortality). The AEQ factor is calculated as:

$$AEQ_{s,a,t} = MatRate_{s,a,t} + [(1 - MatRate_{s,a,t}) \quad x \quad (1 - M_{a,t+1}) \quad x \quad AEQ_{s,a,t+1}]$$

where $AEQ_{s,a,t}$ =1 for a = 5 and t = 3 (maximum age and final time step for most chinook stocks).

Proportion Modeled Stocks (for chinook only and calculated using base period data). The "model stock proportion" is a value unique to chinook and is the proportion of the total catch in a fishery that is accounted for by the modeled stocks. These proportion modeled stocks values are calculated during the chinook FRAM calibration process. They are fishery specific and remain constant through all time periods. The coho cohort analysis used to create the model base period exploitation rates include estimates for all stock production regions, thus the proportion modeled stock is assumed to always be 1.0.

$$PropModelStock_f = \frac{\sum_s \sum_a \sum_t Catch_{s,a,f,t}}{TotalCatch_f}$$

where $TotalCatch_f$ = the average total Base Period catch in fishery f.

Total Mortality. Total mortality is used to calculate simple exploitation rates by stock, age (chinook), fishery, and time period. The equations used for chinook and coho, respectively, are:

chinook:

$$TotMort_{s,a,t} = \sum_f (Catch_{s,a,f,t} + Shakers_{s,a,f,t} + Dropoff_{s,a,f,t} + LegalShakers_{s,a,f,t} + CNR_{s,a,f,t})$$

coho:

$$TotMort_{s,t} = \sum_f (Catch_{s,f,t} + Dropoff_{s,f,t} + LegalShakers_{s,f,t} + CNR_{s,f,t})$$

and Total Exploitation Rate is then estimated as:

$$ER_s = \frac{\sum_a \sum_t TotMort_{s,a,t}}{\sum_a \sum_t TotMort_{s,a,t} + \sum_a \sum_t Escape_{s,a,t}}$$

where all components are defined previously.

TERMINAL AREA MANAGEMENT MODULE (TAMM)

The FRAM program interacts with two species-specific (chinook and coho) spreadsheet programs that allow users to specify terminal fishery impacts on a finer level of resolution. The spreadsheet program, TAMM, began with separate sections for each of the six Puget Sound terminal areas (Table 7-1) that are defined in the Puget Sound Salmon Management Plan (1985) for the State of Washington and the Treaty Tribes of Puget Sound. This structure has supported development of unique regional management goals and allows managers the flexibility to analyze and report FRAM model output according to their needs. The chinook TAMM contains the original Puget Sound sections, while the coho TAMM has been expanded to allow report generation for many non-Puget Sound stock groups.

Table 7-1. Puget Sound terminal management regions.

Nooksack-Samish	Skagit
Stillaguamish-Snohomish	South Sound
Hood Canal	Strait of Juan de Fuca

Historically, managers used TAMMs to analyze fishery impacts on individual population components of the larger FRAM stock groupings. The relatively new 1986-1991 coho base period now includes individual Puget Sound populations (61 stocks) at the management level of resolution. Similarly, the expanded Puget Sound coho fisheries are comprehensive; thus coho TAMM now serves more as a recipient of FRAM output for customized report generation. In contrast, chinook TAMM remains a critical element of pre-season Puget Sound modeling, as many populations of management focus need to be “extracted” from the aggregated FRAM stock groupings. Abundance levels of every Puget Sound chinook hatchery and natural population are entered into the TAMM, as are harvest impacts from all Puget Sound fisheries, to allow fishery-specific impact analyses on all the populations of interest.

The current chinook base period data (as in the older versions of the coho base period) aggregates terminal area fisheries for FRAM modeling at a higher level than used for management. Typically chinook FRAM has no individual area freshwater terminal sport fisheries or freshwater net fisheries. The chinook TAMM provides the ability to model the individual Puget Sound marine and freshwater net fisheries by smaller date increments associated with fisheries directed at chinook, pink, coho, chum, or steelhead. In addition, test fisheries and fisheries in sub-areas can be specified. Similarly, the ability to model individual Puget Sound freshwater sport fisheries is also provided. The appropriate chinook TAMM fishery impacts are summed into the terminal fishery definitions used by FRAM to calculate the FRAM fishery scalar inputs.

The TAMM fishery inputs, in addition to a fixed catch, allow for two fishery control mechanisms that are not used by FRAM. The control mechanisms (harvest rates) are percent of terminal area abundance (TAA) and percent of extreme terminal run size (ETRS). Each terminal area has specific rules for calculation of the TAA and ETRS values. Basically, the TAA rules include the escapement of all local area stocks and the terminal catch of all stocks. The ETRS rules include escapement and only the terminal catch of the local area stocks, but for a mixed-stock area an associated non-local stock catch is also calculated by FRAM as a base period proportion of total fishery catch. The derivation of these rules comes from the definitions used in the annual terminal run reconstruction for each of the species. Run reconstruction estimates are used in the calculation of modeling inputs for terminal area fishery impacts under the TAA and ETRS methods. The same run reconstructions may be used to develop in-season run size update models.

The TAA and ETRS methods create a problem for estimating the FRAM fishery scalars because the run size in each terminal region is dependent on the impacts from all the other regions. For example, a decrease in Skagit terminal fisheries results in higher escapement for Nooksack and higher TAA and ETRS values. The fishery impacts in Nooksack terminal fisheries would then be calculated higher which lowers the original Skagit TAA and ETRS values.

An iterative process was developed to solve the problem of simultaneous equations between the terminal areas. The FRAM program reruns the terminal fishery time steps until the difference between the TAMM specified expected fishery impacts and FRAM estimates (calculated from base period exploitation rates) are within ±0.1% of the expected value or the difference is less than one fish. On each iteration the FRAM fishery scalars are adjusted by a proportion that is calculated as the expected value divided by the FRAM estimate for each terminal fishery.

As already discussed, the current FRAM coho base period data has much finer resolution of the terminal area fisheries than does the chinook base period. This is a result of the coho run reconstruction program RRTERM fishery definitions that were used to develop this coho base period data. The coho TAMM fishery definitions are the same as the FRAM terminal fisheries and thus allow direct input for effort base fishery scalars and quota values. An iterative process is still needed for the TAA and ETRS abundance based methods.

The TAMM spreadsheets are used to create most of the output reports needed by fishery managers during the pre-season fishery negotiation processes. This functionality was preserved in the current TAMM spreadsheets to ensure continuity and familiarity with the older versions of the program and to divide the duties and responsibilities for input and error checking during the intense management sessions.

Appendix 1. Chinook FRAM Stocks.

Unmarked Stock #	Stock Name	Abbreviated Name	CWT Broods Included*
1	Nooksack-Samish summer/fall	NkSm FlFi	77,79
3	North Fork Nooksack early (spring)	NFNK Sprg	OOB - 84,88 (N. Fk.)
5	South Fork Nooksack early (spring)	SFNK Sprg	OOB - 84,88 (N. Fk.)
7	Skagit summer/fall fingerling	Skag FlFi	76,77
9	Skagit summer/fall yearling	Skag FlYr	76
11	Skagit spring yearling	Skag SpYr	OOB - 85, 86, 87,90
13	Snohomish summer/fall fingerling	Snoh FlFi	OOB - 86, 87, 88
15	Snohomish summer/fall yearling	Snoh FlYr	76
17	Stillaguamish summer/fall fingerling	Stil FlFi	OOB - 86, 87, 88,89,90
19	Tulalip summer/fall fingerling	Tula FlFi	OOB - 86, 87, 88
21	Mid S. Puget Sound fall fingerling	USPS FlFi	78,79
23	UW Accelerated fall fingerling	UW-A FlFi	77-79
25	Deep S. Puget Sound fall fingerling	DSPS FlFi	78,79
27	South Puget Sound fall yearling	SPSo FlYr	78,79
29	White River spring fingerling	Whte SpFi	OOB – 91-93
31	Hood Canal fall fingerling	HdCl FlFi	78,79
33	Hood Canal fall yearling	HdCl FlYr	78,79
35	Juan de Fuca Tribs. fall fingerling	SJDF FlFi	78,79
37	Oregon Lower Columbia River Hatchery	Oregn LRH	78,79
39	Wash. Lower Columbia River Hatchery	Washn LRH	77,79
41	Lower Columbia River Wild	Low CR Wi	77-78
43	Bonneville Pool Hatchery tule	BP H Tule	76-79
45	Columbia Upriver summer	Upp CR Su	76,77
47	Columbia Upriver bright	Col R Brt	75-77
49	Washington Lower River spring	WaLR Sprg	77
51	Willamette spring	Will Sprg	76-78
53	Snake River fall	SnakeR Fl	OOB - 84, 85, 86
55	Oregon North Migrating fall	Ore No Fl	76-78
57	West Coast Vancouver Island Total	WCVI Totl	74-77
59	Fraser Late	Fraser Lt	OOB - 81,82,83
61	Fraser Early	Fraser Er	78,79; OOB -, 86
63	Lower Georgia Strait fall	Lwr Geo St	77,78
65	White River spring yearling	Whte SpYr	OOB – 91-93

*OOB = Out-of-base stock.

Appendix 2. Coho FRAM Stocks.

Production Region	Unmarked Stock #	Abbreviated Name	Coho Stock Name
NOOKSM	1	nkskrw	Nooksack River Wild
NOOKSM	3	kendlh	Kendall Creek Hatchery
NOOKSM	5	skokmh	Skookum Creek Hatchery
NOOKSM	7	lumpdh	Lummi Ponds Hatchery
NOOKSM	9	bhambh	Bellingham Bay Net Pens
NOOKSM	11	samshw	Samish River Wild
NOOKSM	13	ar77aw	Area 7/7A Independent Wild
NOOKSM	15	whatch	Whatcom Creek Hatchery
SKAGIT	17	skagtw	Skagit River Wild
SKAGIT	19	skagth	Skagit River Hatchery
SKAGIT	21	skgbkh	Baker (Skagit) Hatchery
SKAGIT	23	skgbkw	Baker (Skagit) Wild
SKAGIT	25	swinch	Swinomish Channel Hatchery
SKAGIT	27	oakhbh	Oak Harbor Net Pens
STILSN	29	stillw	Stillaguamish River Wild
STILSN	31	stillh	Stillaguamish River Hatchery
STILSN	33	tuliph	Tulalip Hatchery
STILSN	35	snohow	Snohomish River Wild
STILSN	37	snohoh	Snohomish River Hatchery
STILSN	39	ar8anh	Area 8A Net Pens
HOODCL	41	ptgamh	Port Gamble Net Pens
HOODCL	43	ptgamw	Port Gamble Bay Wild
HOODCL	45	ar12bw	Area 12/12B Wild
HOODCL	47	qlcnbh	Quilcene Hatchery
HOODCL	49	qlcenh	Quilcene Bay Net Pens
HOODCL	51	ar12aw	Area 12A Wild
HOODCL	53	hoodsh	Hoodsport Hatchery
HOODCL	55	ar12dw	Area 12C/12D Wild
HOODCL	57	gadamh	George Adams Hatchery
HOODCL	59	skokrw	Skokomish River Wild
SPGSND	61	ar13bw	Area 13B Misc. Wild
SPGSND	63	deschw	Deschutes R. (WA) Wild
SPGSND	65	ssdnph	South Puget Sound Net Pens
SPGSND	67	nisqlh	Nisqually River Hatchery
SPGSND	69	nisqlw	Nisqually River Wild
SPGSND	71	foxish	Fox Island Net Pens
SPGSND	73	mintch	Minter Creek Hatchery
SPGSND	75	ar13mw	Area 13 Miscellaneous Wild
SPGSND	77	chambh	Chambers Creek Hatchery

Appendix 2. Coho FRAM Stocks (continued).

Production Region	Unmarked Stock #	Abbreviated Name	Coho Stock Name
SPGSND	79	ar13mh	Area 13 Misc. Hatchery
SPGSND	81	ar13aw	Area 13A Miscellaneous Wild
SPGSND	83	puyalh	Puyallup River Hatchery
SPGSND	85	puyalw	Puyallup River Wild
SPGSND	87	are11h	Area 11 Hatchery
SPGSND	89	ar11mw	Area 11 Miscellaneous Wild
SPGSND	91	ar10eh	Area 10E Hatchery
SPGSND	93	ar10ew	Area 10E Miscellaneous Wild
SPGSND	95	greenh	Green River Hatchery
SPGSND	97	greenw	Green River Wild
SPGSND	99	lakwah	Lake Washington Hatchery
SPGSND	101	lakwaw	Lake Washington Wild
SPGSND	103	are10h	Area 10 H inc. Ebay,SeaAq NP
SPGSND	105	ar10mw	Area 10 Miscellaneous Wild
SJDFCA	107	dungew	Dungeness River Wild
SJDFCA	109	dungeh	Dungeness Hatchery
SJDFCA	111	elwhaw	Elwha River Wild
SJDFCA	113	elwhah	Elwha Hatchery
SJDFCA	115	ejdfmw	East JDF Miscellaneous Wild
SJDFCA	117	wjdfmw	West JDF Miscellaneous Wild
SJDFCA	119	ptangh	Port Angeles Net Pens
SJDFCA	121	area9w	Area 9 Miscellaneous Wild
MAKAHC	123	makahw	Makah Coastal Wild
MAKAHC	125	makahh	Makah Coastal Hatchery
QUILUT	127	quilsw	Quillayute R Summer Natural
QUILUT	129	quilsh	Quillayute R Summer Hatchery
QUILUT	131	quilfw	Quillayute River Fall Natural
QUILUT	133	quilfh	Quillayute River Fall Hatchery
HOHRIV	135	hohrvw	Hoh River Wild
HOHRIV	137	hohrvh	Hoh River Hatchery
QUEETS	139	quetfw	Queets River Fall Natural
QUEETS	141	quetfh	Queets River Fall Hatchery
QUEETS	143	quetph	Queets R Supplemental Hat.
QUINLT	145	quinfw	Quinault River Fall Natural
QUINLT	147	quinfh	Quinault River Fall Hatchery
GRAYHB	149	chehlw	Chehalis River Wild
GRAYHB	151	chehlh	Chehalis River (Bingham) Hat.
GRAYHB	153	humptw	Humptulips River Wild
GRAYHB	155	humpth	Humptulips River Hatchery

Appendix 2. Coho FRAM Stocks (continued).

Production Region	Unmarked Stock #	Abbreviated Name	Coho Stock Name
GRAYHB	157	gryhmw	Grays Harbor Misc. Wild
GRAYHB	159	gryhbh	Grays Harbor Net Pens
WILLAPA	161	willaw	Willapa Bay Natural
WILLAPA	163	willah	Willapa Bay Hatchery
COLRIV	165	colreh	Columbia River Early Hatchery
COLRIV	167	youngh	Youngs Bay Hatchery
COLRIV	169	sandew	Sandy Early Wild
COLRIV	171	clakew	Clakamas Early Wild
COLRIV	173	claklw	Clakamas Late Wild
COLRIV	175	colrlh	Columbia River Late Hatchery
OREGON	177	orenoh	Oregon North Coastal Hat.
OREGON	179	orenow	Oregon North Coastal Wild
OREGON	181	orenmh	Oregon No. Mid Coastal Hat.
OREGON	183	orenmw	Oregon No. Mid Coastal Wild
OREGON	185	oresmh	Oregon So. Mid Coastal Hat.
OREGON	187	oresmw	Oregon So. Mid Coastal Wild
OREGON	189	oranah	Oregon Anadromous Hatchery
OREGON	191	oraqah	Oregon Aqua-Foods Hatchery
ORECAL	193	oresoh	Oregon South Coastal Hat.
ORECAL	195	oresow	Oregon South Coastal Wild
ORECAL	197	calnoh	California North Coastal Hat.
ORECAL	199	calnow	California North Coastal Wild
ORECAL	201	calcnh	California Central Coastal Hat.
ORECAL	203	calcnw	California Central Coastal Wild
GSMLND	205	gsmndh	Georgia Strait Mainland Hat.
GSMLND	207	gsmndw	Georgia Strait Mainland Wild
GSVNCI	209	gsvcih	Georgia Strait Vanc. Is. Hat.
GSVNCI	211	gsvciw	Georgia Strait Vanc. Is. Wild
JNSTRT	213	jnstrh	Johnstone Strait Hatchery
JNSTRT	215	jnstrw	Johnstone Strait Wild
SWVNCI	217	swvcih	SW Vancouver Island Hat.
SWVNCI	219	swvciw	SW Vancouver Island Wild
NWVNCI	221	nwvcih	NW Vancouver Island Hatchery
NWVNCI	223	nwvciw	NW Vancouver Island Wild
FRSLOW	225	frslwh	Lower Fraser River Hatchery
FRSLOW	227	frslww	Lower Fraser River Wild
FRSUPP	229	frsuph	Upper Fraser River Hatchery
FRSUPP	231	frsupw	Upper Fraser River Wild

Appendix 2. Coho FRAM Stocks (continued).

Production Region	Unmarked Stock #	Abbreviated Name	Coho Stock Name
THOMPR	233	thomph	Thompson River Hatchery
THOMPR	235	thompw	Thompson River Wild
BCCNTL	237	bccnhw	BC Central Coast Hat./Wild
BCNCST	239	bcnchw	BC North Coast Hatchery/Wild
QUEENC	241	quenhw	Queen Charlotte Is. Hat/Wild
NASSRV	243	nasshw	Nass River Hatchery/Wild
SKEENA	245	skeehw	Skeena River Hatchery/Wild
TRANAC	247	tranhw	Trans Boundary Hatchery/Wild
NIASKA	249	niakhw	Alaska No. Inside Hat./Wild
NOASKA	251	noakhw	Alaska No. Outside Hat./Wild
SIASKA	253	siakhw	Alaska So. Inside Hat./Wild
SOASKA	255	soakhw	Alaska So. Outside Hat./Wild

Appendix 3. Chinook FRAM Fisheries.

#	Fishery Name	#	Fishery Name
1	Southeast Alaska Troll	38	T San Juan Net (Area 6A,7,7A)
2	Southeast Alaska Net	39	NT Nooksack-Samish Net
3	Southeast Alaska Sport	40	T Nooksack-Samish Net
4	North/Central British Columbia Net	41	T Juan de Fuca Troll (Area 5,6,7)
5	West Coast Vancouver Island Net	42	Area 5/6 Sport
6	Strait of Georgia Net	43	NT Juan de Fuca Net (Area 4B,5,6,6C)
7	Canada Juan de Fuca Net (Area 20)	44	T Juan de Fuca Net (Area 4B,5,6,6C)
8	North/Central British Columbia Sport	45	Area 8 Sport [a]
9	North/Central British Columbia Troll	46	NT Skagit Net (Area 8)
10	West Coast Vancouver Island Troll	47	T Skagit Net (Area 8)
11	West Coast Vancouver Island Sport	48	Area 8D Sport
12	Strait of Georgia Troll	49	NT Stilly-Snohomish Net (Area 8A)
13	North Strait of Georgia Sport	50	T Stilly-Snohomish Net (Area 8A)
14	South Strait of Georgia Sport	51	NT Tulalip Bay Net (Area 8D)
15	BC Juan de Fuca Sport	52	T Tulalip Bay Net (Area 8D)
16	NT Cape Flattery-Quillayute Troll (Area 3-4)	53	Area 9 Sport
17	T Cape Flattery-Quillayute Troll (Area 3-4)	54	NT Area 6B/9 Net
18	Cape Flattery-Quillayute Sport (Area 3-4)	55	T Area 6B/9 Net
19	Cape Flattery-Quillayute Net (Area 3-4)	56	Area 10 Sport
20	NT Grays Harbor Troll (Area 2)	57	Area 11 Sport
21	T Grays Harbor Troll (Area 2)	58	NT Area 10/11 Net
22	Grays Harbor Sport (Area 2)	59	T Area 10/11 Net
23	NT Grays Harbor Net	60	NT Area 10A Net
24	T Grays Harbor Net	61	T Area 10A Net
25	Willapa Net	62	NT Area 10E Net
26	NT Columbia River Troll (Area 1)	63	T Area 10E Net
27	Columbia River Sport (Area 1)	64	Area 12 Sport
28	Columbia River Net	65	NT Hood Canal Net (Area 12,12B,12C)
29	Buoy 10 Sport	66	T Hood Canal Net (Area 12,12B,12C)
30	Orford Reef-Cape Falcon Troll (Central OR)	67	Area 13 Sport
31	Orford Reef-Cape Falcon Sport (Central OR)	68	NT Deep S. Puget Sound Net (13,13D-K)
32	Horse Mountain-Orford Reef Troll (KMZ)	69	T Deep S. Puget Sound Net (13,13D-K)
33	Horse Mountain-Orford Reef Sport (KMZ)	70	NT Area 13A Net
34	Southern California Troll	71	T Area 13A Net
35	Southern California Sport	72	Freshwater Sport
36	Area 7 Sport	73	Freshwater Net [b]
37	NT San Juan Net (Area 6A,7,7A)		

Notes: * (T = Treaty; NT = Non-treaty)

[a] Sport areas 8-1 and 8-2 were combined and input into Fishery 45.

[b] In Puget Sound, fishery 73 combines Area 11A with Puyallup River; Areas 9A, 12A, 12D with Hood Canal; Area 13C with Chambers Creek.

Appendix 4. Coho FRAM Fisheries.

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
No Cal Trm	1	North California Coast Terminal Catch
Cn Cal Trm	2	Central California Coast Terminal Catch
Ft Brg Spt	3	Fort Bragg Sport
Ft Brg Trl	4	Fort Bragg Troll
Ca KMZ Spt	5	KMZ Sport (Klamath Management Zone)
Ca KMZ Trl	6	KMZ Troll (Klamath Management Zone)
So Cal Spt	7	Southern California Sport
So Cal Trl	8	Southern California Troll
So Ore Trm	9	South Oregon Coast Terminal Catch
Or Prv Trm	10	Oregon Private Hatchery Terminal Catch
SMi Or Trm	11	South-Mid Oregon Coast Terminal Catch
NMi Or Trm	12	North-Mid Oregon Coast Terminal Catch
No Ore Trm	13	North Oregon Coast Terminal Catch
Or Cst Trm	14	Mid-North Oregon Coast Terminal Catch
Brkngs Spt	15	Brookings Sport
Brkngs Trl	16	Brookings Troll
Newprt Spt	17	Newport Sport
Newprt Trl	18	Newport Troll
Coos B Spt	19	Coos Bay Sport
Coos B Trl	20	Coos Bay Troll
Tillmk Spt	21	Tillamook Sport
Tillmk Trl	22	Tillamook Troll
Buoy10 Spt	23	Buoy 10 Sport (Columbia River Estuary)
L ColR Spt	24	Lower Columbia River Mainstem Sport
L ColR Net	25	Lower Columbia River Net (Excl Youngs Bay)
Yngs B Net	26	Youngs Bay Net
LCROrT Spt	27	Below Bonneville Oregon Tributary Sport
Clackm Spt	28	Clackamas River Sport
SandyR Spt	29	Sandy River Sport
LCRWaT Spt	30	Below Bonneville Washington Tributary Sport
UpColR Spt	31	Above Bonneville Sport
UpColR Net	32	Above Bonneville Net
A1-Ast Spt	33	Area 1 (Illwaco) & Astoria Sport
A1-Ast Trl	34	Area 1 (Illwaco) & Astoria Troll
Area2TrlNT	35	Area 2 Troll Non-treaty (Westport)
Area2TrlTR	36	Area 2 Troll Treaty (Westport)
Area 2 Spt	37	Area 2 Sport (Westport)
Area3TrlNT	38	Area 3 Troll Non-treaty (LaPush)
Area3TrlTR	39	Area 3 Troll Treaty (LaPush)

Appendix 4. Coho FRAM Fisheries (continued).

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
Area 3 Spt	40	Area 3 Sport (LaPush)
Area 4 Spt	41	Area 4 Sport (Neah Bay)
A4/4BTrlNT	42	Area 4/4B (Neah Bay PFMC Regs) Troll Non-treaty
A4/4BTrlTR	43	Area 4/4B (Neah Bay PFMC Regs) Troll Treaty
A 5-6C Trl	44	Area 5, 6, 6C Troll (Strait of Juan de Fuca)
Willpa Spt	45	Willapa Bay (Area 2.1) Sport
Wlp Tb Spt	46	Willapa Tributary Sport
WlpaBT Net	47	Willapa Bay & FW Trib Net
GryHbr Spt	48	Grays Harbor (Area 2.2) Sport
SGryHb Spt	49	South Grays Harbor Sport (Westport Boat Basin)
GryHbr Net	50	Grays Harbor Estuary Net
Hump R Spt	51	Humptulips River Sport
LwCheh Net	52	Lower Chehalis River Net
Hump R C&S	53	Humptulips River Ceremonial & Subsistence
Chehal Spt	54	Chehalis River Sport
Hump R Net	55	Humptulips River Net
UpCheh Net	56	Upper Chehalis River Net
Chehal C&S	57	Chehalis River Ceremonial & Subsistence
Wynoch Spt	58	Wynochee River Sport
Hoquam Spt	59	Hoquiam River Sport
Wishkh Spt	60	Wishkah River Sport
Satsop Spt	61	Satsop River Sport
Quin R Spt	62	Quinault River Sport
Quin R Net	63	Quinault River Net
Quin R C&S	64	Quinault River Ceremonial & Subsistence
Queets Spt	65	Queets River Sport
Clrwtr Spt	66	Clearwater River Sport
Salm R Spt	67	Salmon River (Queets) Sport
Queets Net	68	Queets River Net
Queets C&S	69	Queets River Ceremonial & Subsistence
Quilly Spt	70	Quillayute River Sport
Quilly Net	71	Quillayute River Net
Quilly C&S	72	Quillayute River Ceremonial & Subsistence
Hoh R Spt	73	Hoh River Sport
Hoh R Net	74	Hoh River Net
Hoh R C&S	75	Hoh River Ceremonial & Subsistence
Mak FW Spt	76	Makah Tributary Sport
Mak FW Net	77	Makah Freshwater Net
Makah C&S	78	Makah Ceremonial & Subsistence

Appendix 4. Coho FRAM Fisheries (continued).

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
A 4-4A Net	79	Area 4, 4A Net (Neah Bay)
A4B6CNetNT	80	Area 4B, 5, 6C Net Nontreaty (Strait of Juan de Fuca)
A4B6CNetTR	81	Area 4B, 5, 6C Net Treaty (Strait of Juan de Fuca)
Ar6D NetNT	82	Area 6D Dungeness Bay/River Net Nontreaty
Ar6D NetTR	83	Area 6D Dungeness Bay/River Net Treaty
Elwha Net	84	Elwha River Net
WJDF T Net	85	West Juan de Fuca Straits Tributary Net
EJDF T Net	86	East Juan de Fuca Straits Tributary Net
A6-7ANetNT	87	Area 7, 7A Net Nontreaty (San Juan Islands)
A6-7ANetTR	88	Area 7, 7A Net Treaty (San Juan Islands)
EJDF FWSpt	89	East Juan de Fuca Straits Tributary Sport
WJDF FWSpt	90	West Juan de Fuca Straits Tributary Sport
Area 5 Spt	91	Area 5 Marine Sport (Sekiu)
Area 6 Spt	92	Area 6 Marine Sport (Port Angeles)
Area 7 Spt	93	Area 7 Marine Sport (San Juan Islands)
Dung R Spt	94	Dungeness River Sport
ElwhaR Spt	95	Elwha River Sport
A7BCDNetNT	96	Area 7B-7C-7D Net Nontreaty (Bellingham Bay)
A7BCDNetTR	97	Area 7B-7C-7D Net Treaty (Bellingham Bay)
Nook R Net	98	Nooksack River Net
Nook R Spt	99	Nooksack River Sport
Samh R Spt	100	Samish River Sport
Ar 8 NetNT	101	Area 8 Skagit Marine Net Nontreaty
Ar 8 NetTR	102	Area 8 Skagit Marine Net Treaty
Skag R Net	103	Skagit River Net
SkgR TsNet	104	Skagit River Test Net
SwinCh Net	105	Swinomish Channel Net
Ar 8-1 Spt	106	Area 8.1 Marine Sport
Area 9 Spt	107	Area 9 Marine Sport (Admiralty Inlet)
Skag R Spt	108	Skagit River Sport
Ar8A NetNT	109	Area 8A Stillaguamish/Snohomish Net Nontreaty
Ar8A NetTR	110	Area 8A Stillaguamish/Snohomish Net Treaty
Ar8D NetNT	111	Area 8D Tulalip Bay Net Nontreaty
Ar8D NetTR	112	Area 8D Tulalip Bay Net Treaty
Stil R Net	113	Stillaguamish River Net
Snoh R Net	114	Snohomish River Net
Ar 8-2 Spt	115	Area 8.2 Marine Sport
Stil R Spt	116	Stillaguamish River Sport
Snoh R Spt	117	Snohomish River Sport

Appendix 4. Coho FRAM Fisheries (continued).

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
Ar 10 Spt	118	Area 10 Marine Sport (Seattle)
Ar10 NetNT	119	Area 10 Net Nontreaty (Seattle)
Ar10 NetTR	120	Area 10 Net Treaty (Seattle)
Ar10ANetNT	121	Area 10A Net Nontreaty (Elliott Bay)
Ar10ANetTR	122	Area 10A Net Treaty (Elliott Bay)
Ar10ENetNT	123	Area 10E Net Nontreaty (East Kitsap)
Ar10EnetTR	124	Area 10E Net Treaty (East Kitsap)
10F-G Net	125	Area 10F-G Ship Canal/Lake Washington Net Treaty
Duwm R Net	126	Green/Duwamish River Net
Duwm R Spt	127	Green/Duwamish River Sport
L WaSm Spt	128	Lake Washington-Lake Sammamish Tributary Sport
Ar 11 Spt	129	Area 11 Marine Sport (Tacoma)
Ar11 NetNT	130	Area 11 Net Nontreaty (Tacoma)
Ar11 NetTR	131	Area 11 Net Treaty (Tacoma)
Ar11ANetNT	132	Area 11A Net Nontreaty (Commencement Bay)
Ar11ANetTR	133	Area 11A Net Treaty (Commencement Bay)
Puyl R Net	134	Puyallup River Net
Puyl R Spt	135	Puyallup River Sport
Ar 13 Spt	136	Area 13 Marine Sport (South Puget Sound)
Ar13 NetNT	137	Area 13 Net Nontreaty (South Puget Sound)
Ar13 NetTR	138	Area 13 Net Treaty (South Puget Sound)
Ar13CNetNT	139	Area 13C Net Nontreaty (Chambers Bay)
Ar13CNetTR	140	Area 13C Net Treaty (Chambers Bay)
Ar13ANetNT	141	Area 13A Net Nontreaty (Carr Inlet)
Ar13ANetTR	142	Area 13A Net Treaty (Carr Inlet)
Ar13DNetNT	143	Area 13D Net Nontreaty (South Puget Sound)
Ar13DNetTR	144	Area 13D Net Treaty (South Puget Sound)
A13FKNetNT	145	Area 13F-13K Net Nontreaty (South PS Inlets)
A13FKNetTR	146	Area 13F-13K Net Treaty (South PS Inlets)
Nisq R Net	147	Nisqually River Net
McAlls Net	148	McAllister Creek Net
13D-K TSpt	149	13D-13K Tributary Sport (South PS Inlets)
Nisq R Spt	150	Nisqually River Sport
Desc R Spt	151	Deschutes River Sport (Olympia)
Ar 12 Spt	152	Area 12 Marine Sport (Hood Canal)
1212BNetNT	153	Area 12-12B Net Nontreaty (Upper Hood Canal)
1212BNetTR	154	Area 12-12B Net Treaty (Upper Hood Canal)
Ar9A NetNT	155	Area 9A Net Nontreaty (Port Gamble)
Ar9A NetTR	156	Area 9-9A Net Treaty (Port Gamble/On Reservation)

Appendix 4. Coho FRAM Fisheries (continued).

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
Ar12ANetNT	157	12A Net Nontreaty (Quilcene Bay)
Ar12ANetTR	158	12A Net Treaty (Quilcene Bay)
A12CDNetNT	159	12C-12D Net Nontreaty (Lower Hood Canal)
A12CDNetTR	160	12C-12D Net Treaty (Lower Hood Canal)
Skok R Net	161	Skokomish River Net
Quilcn Net	162	Quilcene River Net
1212B TSpt	163	12-12B Tributary FW Sport
Quilcn Spt	164	12A Tributary FW Sport (Quilcene River)
12C-D TSpt	165	12C-12D Tributary FW Sport
Skok R Spt	166	Skokomish River Sport
GSMLND Trm	167	Georgia Strait Mainland Terminal Catch
GSVNCI Trm	168	Georgia Strait Vancouver Island Terminal Catch
JNSTRT Trm	169	Johnstone Strait Terminal Catch
SWVNCI Trm	170	SW Vancouver Island Terminal Catch
NWVNCI Trm	171	NW Vancouver Island Terminal Catch
FRSLOW Trm	172	Lower Fraser River Terminal Catch
FRSUPP Trm	173	Upper Fraser River Terminal Catch
THOMPR Trm	174	Thompson River Terminal Catch
No BC Trl	175	Northern British Columbia Troll
NoC BC Trl	176	North Central British Columbia Troll
SoC BC Trl	177	South Central British Columbia Troll
NW VI Trl	178	NW Vancouver Island Troll
SW VI Trl	179	SW Vancouver Island Troll
GeoStr Trl	180	Georgia Straits Troll
BC JDF Trl	181	British Columbia Juan de Fuca Troll
No BC Net	182	Northern British Columbia Net
Cen BC Net	183	Central British Columbia Net
NW VI Net	184	NW Vancouver Island Net
SW VI Net	185	SW Vancouver Island Net
Johnst Net	186	Johnstone Straits Net
GeoStr Net	187	Georgia Straits Net
Fraser Net	188	Fraser River Gill Net
BC JDF Net	189	British Columbia Juan de Fuca Net
No BC Spt	190	Northern British Columbia Sport
Cen BC Spt	191	Central British Columbia Sport
BC JDF Spt	192	British Columbia Juan de Fuca Sport
WC VI Spt	193	West Coast Vancouver Island Sport
NGaStr Spt	194	North Georgia Straits Sport
SGaStr Spt	195	South Georgia Straits Sport

Appendix 4. Coho FRAM Fisheries (continued).

Fishery Abbreviation	Fishery Number	Coho FRAM Fishery Long Name
Albern Spt	196	Alberni Canal Sport
BCCNTL TTR	197	BCCNTL Terminal Run (Catch + Escapement)
BCNCST TTR	198	BCNCST Terminal Run (Catch + Escapement)
QUEENC TTR	199	QUEENC Terminal Run (Catch + Escapement)
NASSRV TTR	200	NASSRV Terminal Run (Catch + Escapement)
SKEENA TTR	201	SKEENA Terminal Run (Catch + Escapement)
SW AK Trl	202	Southwest Alaska Troll
SE AK Trl	203	Southeast Alaska Troll
NW AK Trl	204	Northwest Alaska Troll
NE AK Trl	205	Northeast Alaska Troll
Alaska Net	206	Alaska Net (Areas 182:183:185:192)

GLOSSARY

Adult Equivalent (AEQ) - The potential contribution of fish of a given age to the spawning escapement, in the absence of fishing. Because of natural mortality and unaccounted losses, not all unharvested fish contribute to spawning escapement. For example, a two-year-old chinook has a lower probability of surviving to spawn, in the absence of fishing, than does a five-year-old, and these two age classes have different "adult equivalents".

Base Period - A set of years used to estimate exploitation rates, maturation rates, and stock abundances from CWT data. The years used for the base period differ by species and stock, but range from 1974-1979. Brood years are chosen based on consistent coded-wire tagging, and consistent sampling and fisheries in return years. Some stocks in the model were not tagged during the 1974-1979 period; recoveries of these stocks (called "out-of-base" stocks) are adjusted to account for changes in exploitation rates relative to the base period.

Catch Ceiling - A fishery catch limitation expressed in numbers of fish. A ceiling fishery is managed so as not to exceed the ceiling; actual catch is expected to fall somewhere below the ceiling.

Catch Quota - A fishery catch allocation expressed in numbers of fish. A quota fishery is managed to catch the quota; actual catch is expected to be slightly above or below the quota.

Chinook/Coho Nonretention (CNR) - Time periods when salmon fishing is allowed, but the retention of chinook (or coho) salmon is prohibited.

Cohort Analysis - A sequential population analysis technique that is used during model calibration to reconstruct the exploited life history of coded-wire tag groups.

Cohort Size (initial) - The total number of fish of a given age and stock at the beginning of the fishing season.

Coded-Wire Tag (CWT) - Coded microtags that are implanted in juvenile salmon prior to release. A tagged fish usually has its adipose fin removed to signal tag presence. Fisheries and escapements are sampled for tagged fish. When recovered, the binary code on the tag provides specific information about the individual's tag group (e.g., location and timing of release, special hatchery treatments).

Dropoff Mortality - Mortality of salmon that "drop-off" sport or troll fishing gear before they are landed, and die from their injuries prior to harvest or spawning.

Dropout Mortality - Mortality of salmon that die in a fishing net and "drop-out" prior to harvest or salmon that disentangle from a net while it is in the water and die from their injuries prior to harvest or spawning.

Exploitation Rate (ER) - Catch or total fishing mortality in a fishery expressed as a proportion of the total cohort size in all areas (i.e., the total number of fish in the stock of interest at the beginning of the fishing year).

Exploitation Rate Scalar - A multiplier used to estimate fishery impacts by adjusting the base periods exploitation rates. Exploitation rate scalars can be either stock and fishery specific, or they can be applied to all stocks in a fishery.

FRAM - The Fishery Regulation Assessment Model is a simulation model developed for use in estimating the impacts of Pacific Coast fisheries on chinook and coho stocks of interest to fishery managers.

Harvest Rate (HR) - Catch or total fishing mortality in a fishery expressed as a proportion of the total fish abundance available in a given fishing area at the start of a time period.

Hooking Mortality - Mortality of salmon that are caught and released by sport or troll gear, and die from their injuries prior to harvest or spawning.

Management System Evaluation - An evaluation of how well the model predicts variables of interest (e.g., terminal runs, catch by stock, and stock composition) when pre-season estimates of abundance and fishery catches are used as input data. In other words, given that the model performs adequately, does our preseason decision making process, based on preseason predictions, result in the anticipated outcome?

Marked Recognition Error - the probability that a marked fish will be inadvertently released.

Model Calibration - Model process involving base period data which (1) scales the coded-wire tag recoveries to represent a stock, (2) allocates nonlanded catch mortality to stocks, and (3) reconstruct the cohort in order to compute exploitation rates, maturation rates, and stock abundance.

Model Simulation - Use of the model to vary the calibrated fish population abundance and fishing rates to portray the effects, on the stocks and fisheries, of different sets of regulations.

Nonlanded Catch - This category of fishery-related mortality includes hook-and-line drop-off, net gear drop-out, hooking mortality, and other sources of nonlanded mortality such as unreported or illegal catch.

Nontreaty Fisheries - Fisheries conducted by fishers who are not members of the twenty-four Belloni or Boldt Case Area Tribes.

Preterminal - In FRAM, a “preterminal” fishery is one that operates on both mature and immature fish.

Shaker Mortality - "Shakers": This term represents fish that are released from recreational and troll hook and line fisheries, either because they are outside of the regulatory size limits, because the species is not allowed to be kept, or because the individual fisher chooses, for personal or economic reasons, to release the fish.

Terminal - In FRAM, a "terminal" fishery is one that operates only on mature fish. These fisheries tend to be adjacent to a stock's stream of origin and harvest returning adult fish.

Terminal Area Management Modules (TAMM) - Spreadsheets external to but integrated with FRAM that are used to: (1) provide input for FRAM simulations regarding projected Puget Sound terminal area catches or stock-specific impacts; (2) compute escapements for Puget Sound stock aggregates; and (3) create output reports that summarize simulated regulations, stock exploitation rates, allocation accounting, and escapement estimates.

Treaty Fisheries - Fisheries conducted by fishers who are members of the twenty-four Belloni or Boldt Case Area Tribes.

Unmarked Recognition Error (or Retention Error Rate) **-** the probability that an unmarked fish will be retained inappropriately in a selective fishery (e.g. naturally-occurring marks, fisher fails to identify mark, fisher fails to comply with release requirement).

Validation - An evaluation of how well the model predicts variables of interest (e.g., terminal runs, catch by stock, and stock composition) when post-season estimates of stock abundance and fishery catches are used as input data. Validation is intended to evaluate performance of the model. In other words, does the model yield correct stock-specific impacts using, as inputs, actual stock size and fishery catch information.

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