Coho FRAM Base Period Development
(Auxiliary Report to FRAM Technical Documentation)

$ DRAFT VERSION $

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ABSTRACT

This report describes the data types and process used in developing the model "base" data inputs for the Coho Fishery Regulation Assessment Model (FRAM). Coho FRAM is the primary tool used to evaluate performance of fisheries regimes adopted by the Pacific Fishery Management Council (PFMC) and the parties to the Pacific Salmon Treaty (PST). The dual role of this model necessitates the complete documentation of the data and algorithms used to create the base period input variables. Documentation is also essential in reaching agreement among all of the parties that use the FRAM.

The base period data is developed into a FRAM base input file through a process of cohort analysis using coded-wire-tag (CWT) groups. In 2001, the base period data development process was successfully completed for the 1986-1991 catch years and the Coho FRAM has been used for all PFMC and PST evaluations since 2002. Previous versions of the Coho FRAM were used for PFMC activities since 1992.

Due to recent changes in stock distribution, tagging programs, and fishing patterns, there is a need to improve the current FRAM 1986-1991 base period file for assessing fishery exploitation and stock distribution profiles. Substantial effort in the past few years has resulted in the development of an integrated system of PC programs that can quickly generate annual estimates of exploitation rates for Coho salmon from production regions coastwide. This system (MSM-VB) provides the means to accelerate postseason evaluation of each catch year as the data become available. Using the MSM-VB system, current research investigations include evaluation of catch years 1992-1997 and an updated cohort analysis of the 1986-1991 time period. These investigations are subject to review by the PFMC Scientific and Statistical Committee (SSC) and the Pacific Salmon Commission bilateral Coho Technical Committee (CoTC). An updated current base period and the potential to include additional catch years in FRAM improves the information base available for assessing fishery exploitation.

Successful implementation of the PSC Southern Coho Management Plan (JTC 2002) depends on the development of updated planning tools for evaluating fishery regulations. The current research described below represents a large portion of the essential tasks that have been defined by the CoTC and PSC Southern Panel, which oversees all fishery management issues on the southern U.S./Canada border.

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1. INTRODUCTION

The Coho Fishery Regulation Assessment Model (FRAM) is a forward projecting evaluation tool that uses current year estimates of stock abundances and fishery regulations scaled to a base period average. This model is the primary tool used to evaluate performance of fisheries regimes adopted by the Pacific Fishery Management Council (PFMC) and the parties to the Pacific Salmon Treaty (PST). The adoption of Coho FRAM for both fishery management processes has greatly simplified the exchange of information between all parties charged with managing salmon populations and the user groups affected by the adopted regulations.

The algorithms, input variables, and processing procedures for FRAM are described in the PFMC Model Evaluation Workgroup (MEW) document titled "Fishery Regulation Assessment Model – An Overview for Chinook and Coho" (PFMC 2006). The model uses two input files. The first is a command file that contains all the current year variables that are accessible to the user. The second is a base period file that contains all the static information that has been averaged over the range of catch years analyzed. This information includes initial cohort sizes for each stock; exploitation rates by stock, fishery, and time-period; landed catch by fishery and time-period; and gear-related incidental mortality rates by fishery. There is a need to improve the current FRAM base period file for assessing fishery exploitation and stock distribution profiles. The purpose of this document is to describe the new tools available to develop this base-period file and the current research underway to update and expand the range of catch years available for use in the FRAM.

Current research goals include the development of an expanded historical database for all the catch years with adequate CWT recovery information. The priority of analysis is 1992-1997, followed by 1979-1985, 1998-2005, and reanalysis of 1986-1991. The periods 1992-1997 and reanalysis of 1986-1991 are given the highest priority because of interest in exploring different stock distribution patterns (inside Georgia Strait vs. outside) and changes in fisheries that have occurred during these years. The period 1979-1985 is given the next highest priority because fishery harvest rates were relatively high, yielding more coded-wire-tag (CWT) recoveries for parameter estimation. The period 1998-2005 is assigned the lowest priority because the emergence of non-retention and mark-selective fisheries are problematic for the algorithms employed to estimate Production Expansion Factors (PEFs).

2. COHO FRAM BASE PERIOD DEVELOPMENT PROCESS

The Coho FRAM base period development process requires a complete cohort analysis of all stocks and fisheries within the study area. This is accomplished in two distinct and separate steps (Figure 1). First, the newly developed Mixed Stock Model (MSM-VB) program is used to estimate stock composition in the pre-terminal mixed stock fisheries using CWT recovery data expanded by PEFs that represent all production from a particular geographic region. Need to elaborate. To complete the cohort analysis, this pre-terminal information is then combined with terminal run and escapement data from the terminal area run reconstruction program (RRTERM), plus estimates of incidental fishery mortalities and natural mortality rates. The cohort analysis results in estimates of exploitation rates by stock, fishery, and time period, and total runsize.

Generally, the process of creating a new FRAM base period consists of the following steps (Figure 2):

For Each Catch Year-

1. User Specification of Fishery and Stocks (MSM-VB system)-
   The User identifies: (a) The production regions and CWT codes selected to characterize fishery composition profiles for selected production regions; and (b) The fishery strata to be used for estimation. All Coho salmon stocks coastwide are represented by regional CWT groups.

2. CWT and Catch Matrices by Stock and Fishery (MSM-VB system)-
   The MSM-VB System then extracts relevant CWT release and recovery information and maps recoveries and total catch into appropriate fishery strata (annual time strata), creating CWT and catch by stock and fishery matrices.

3. Production Expansion Factor (PEF) Estimation (MSM-VB system)-
   The above files are then used as input to the MSM-VB to generate estimates of PEFs for each MSM stock. The PEF estimates are calculated on an annual basis. MSM-VB is an analytical tool that estimates PEFs from the stock CWT distribution profiles and reported catches. Two MSM algorithms have been incorporated into the system. One, is a simple unconstrained linear least squares model (ULS) that minimizes the difference in total expanded catch to total observed catch in mixed stock fisheries from California to Alaska. The second is a Bayesian estimation method developed under a separate project funded by the Southern Boundary Restoration and Enhancement Fund (Gazey 2005). PEFs are assumed to be constant across all fisheries for individual production regions.

4. Catch Adjustment (MSM-VB system)-
   Once the PEFs are estimated, a Catch Adjustment Program (CAP) is used to adjust CWT recoveries so that the estimated and reported catches are equivalent. The CWT recovery data are summarized using the fishery-time strata defined for

the Coho FRAM so that averages of exploitation rates and cohort sizes by MU can be calculated over a range of years.

5. Terminal Run Estimates (RRTERM and MSMSplit programs)-

   The PEFs estimated by MSM-VB are employed for pre-terminal fisheries. Because of the complexity of interactions between fisheries and individual stocks represented by regional production units, separate programs (RRTERM and MSMSplit) are employed for reconstructing the terminal area fisheries. RRTERM uses terminal runsize, harvest, and escapement data, plus user-specified fishery sequences (gauntlet) to generate estimates of escapement and terminal run sizes of individual Coho populations (Management Units, or MUs) within a production region. MSMSplit generates estimates of catches by pre-terminal fisheries for each MU among the fishery-time strata desired for analysis and modeling.

6. Cohort Analysis-

   Cohort analysis is then performed for individual MUs using estimates of terminal catch and escapement from RRTERM and Pre-Terminal catches from MSMSplit. Results of Cohort Analysis are then placed in a MS Access Database. Finally, MSM-VB includes a program to extract estimates for years specified by the user and to average these estimates to generate stock distribution profile input files for FRAM.

3. MIXED STOCK MODEL (MSM-VB) PROJECT OVERVIEW

3.1 MSM-VB Project Objectives

The main objectives for the development of the MSM-VB program were to create an efficient, documented, and easy-to-use program that could be used to analyze catch years as the data becomes available. Problems experienced during the development of the original 1986-1991 stock distribution input file currently used for Coho FRAM and the length of time (nearly 10 years) it took to analyze the data served as the impetus for the development of the new MSM-VB program. A new system was needed to replace a set of computer programs developed for the UNIX operating system. The original programs were written in the "C" programming language and the "PERL" scripting language. The "C" and "PERL" program code was fragmented into many separate programs and needed substantial user involvement to create and edit the input files needed for each program. The file editing process was prone to transcription errors and the formats of the various input files were undocumented and typically contained several disjointed sections where parameter values had to be entered. In many cases the output from one program was used to create the input file for the next program in the estimation process. Any data or selection changes usually resulted in re-running of all components of the system. This typically required 2-3 days of intense work for two people. In addition, some of the original code for the "C" programs was undocumented and key files needed for program compilation were missing.

Many of the fragmented programs were written in response to analytical problems that arose in the development process. This fragmentation is understandable because the focus of the original work was development of a new technique for analyzing CWT recovery information.

Project objectives have been met as the MSM-VB program now combines seven previously separate programs into one and greatly simplifies the analytical process needed for cohort analysis. This program now provides a means to accelerate postseason evaluation of each catch year as the data become available. Figure 2 illustrates the relationships among the various integrated programs and the input data sources needed to create the base period. The User interacts with this system through input files that specify the data to be used and the analysis options to be employed.

The MSM-VB program is an integrated system of PC programs that can, when used in conjunction with RRTERM, quickly generate annual estimates of exploitation rates for Coho salmon from production regions coastwide. This new program will allow for the most recent catch year data available to be routinely incorporated into an historical database, yielding a convenient source of information to support many types of analyses and facilitate tailoring of base period files. The MSM-VB program has been used to analyze the 1992-1997 catch years and to reanalyze the 1986-1991 catch years. This report documents the algorithms and program processes used in these analyses.

3.2 MSM-VB Project Component Overview

The MS Visual Basic (VB) language was chosen to create an integrated analysis system because it is widely used in salmon management. The MSM-VB program, like the terminal run reconstruction program (RRTERM) and the FRAM base period construction program, is written

in MS Visual Basic and uses MS Access database files for data storage and retrieval. With all of the programs used for Coho cohort analysis now in the same programming language, data can be easily and efficiently exchanged between processes using PC database files. VB is able to use the Access database files without having the user install the Access program and can use the "Active-X Data Object" (ADO) methodology to perform input and output functions for each of the various tables contained in the database file. The ADO method uses the "Standard Query Language" (SQL) for its core functions. This combination of language and database programs forms a seamless development environment that greatly simplifies the cohort analysis process and is easy to modify when necessary. In addition, the basic data needed was retrieved from the PSMFC RMIS (Pacific Salmon Marine Fishery Council – Regional Mark Information System) internet site using a standard retrieval format so that in the future, the most up-to-date data can be downloaded and the Access database easily updated. The previous MSM estimation programs used truncated files of the same information obtained from various sources.

The general design of the MSM-VB program is illustrated in the flowcharts depicted in Figures 2-11. The MSM-VB program is organized into six main sections (Figures 3-4). The first section deals with selection of the database file and the recordset within the database file for the catch year being analyzed. The second section involves the CWT release data and association to stock groups. The third section deals with the MSM-VB analysis and contains many functions. Stocks and mixed-stock fisheries can be selected, combined, or deleted. Terminal fisheries can also be defined and estimated CWT recoveries entered. Summaries of total catch by time period and numbers of CWT recoveries by stock and fisheries can be displayed. The matrices of CWT recoveries and catches are used in the MSM-VB algorithms to estimate the PEF values. The matrices are recalculated each time any changes are made in stock, fishery, or CWT associations. The PEF estimates can be calculated using either the ULS or Bayesian methods. A more detailed list of these functions is shown in Figure 4. The final 3 sections calculate the fishery catch adjustment factors by time period, the split of MSM-VB catches into management unit specific catches, and the cohort analysis which add incidental and natural mortality estimates. These final three sections are typically done in sequential order after the final PEF values for the current run have been estimated.

The sequence of analytical steps for PEF estimation, catch adjustment, MU splits, and cohort analysis must be done in the sequential order to insure data integrity for each recordset. Typically when changes are made to any data source all of the analytical steps must be re-executed. The only exception is for the MU split and cohort analysis steps that use RRTERM information. These steps can be re-run separately when the RRTERM data change.

The MS Access database constructed to be used by the MSM-VB program holds multiple recordsets representing catch years analyzed. The database can include multiple recordsets for each catch year. This was accomplished by having a unique identification number (RunID) for each recordset in the database. Each variable table in the database file contains records that are linked by the RunID value. Tables were created for the stock, fishery, CWT associations, terminal runs, and rejected CWT recoveries that were linked by the RunID values. Other tables in the database are static and are not linked by the RunID variable. These tables include the "Catch Area" and the "Management Unit" tables used in RRTERM and FRAM, and the CWT release, recovery, and catch-sample data from RMIS. The CWT recovery and catch-sample

tables are arranged into separate tables by catch year to reduce size and to allow for quick updating. The RunID information is stored in a separate table and each record is linked to the individual catch year recovery and catch-sample information using the "year" variable in each table. The separation of the data into year-specific tables allows for multiple database files that do not need to retain all the data for all years. The large numbers of recovery records for each catch year required this table design structure. It also lets the user easily export analyses for an individual year or range of years into a single database. This database structure also aids in the sharing of the data and analyses with multiple users of the program.

Flowcharts depicting the general associations between major processes and data structures handled by the most important subroutines within the MSM-VB program are shown in Figures 5-11. The subroutine that creates a temporary table of the selected fisheries combined with the input values for the terminal fisheries is shown in Figure 5. The creation of the temporary stock table is illustrated in Figure 6. The temporary table of CWT recovery information uses the results from the stock and fishery initialization subroutines (Figure 7). The matrix used for the PEF estimation routines is compressed from the original data using the fishery and stock combinations selected by the user (Figure 8). The calculation of sweep vector values is shown in Figure 9. The ULS method for PEF calculation is shown in Figure 10 and the general process for the Bayesian analysis is described in Figure 11. Table 1 is a list of the tables contained in the MS-Access datafile that are used by the MSM-VB program. Table 2 lists the variables in each of these tables.

3.3 MSM-VB Project Validation

System validation of the MSM-VB was completed to insure accuracy and compatibility with the previous version of the MSM process. This evaluation was difficult because the old MSM programs could not be recompiled to yield values at intermediate steps of the calculation process. The calculation of PEF values involves association of CWT releases by stock, summarization of CWT recoveries by variable fishery definitions, user-defined PEF values, year-specific combinations of stocks and fisheries, and the addition of terminal run estimates. When errors occurred in the MSM-VB development process, it was difficult to compare input values because of the size and sorting of the data input matrices. The most difficult process to test was summarization of the CWT recovery data. Some of the recovery and catch data in the Regional Mark Information System databases had been updated since the original catch years were analyzed and PSC recovery location codes used to summarize the data varied among catch years.

Two basic tests were performed to evaluate the MSM-VB program algorithms. First, the original input data for the 1986-1991 catch years were modified to be read by the program and the PEFs were estimated. This yielded results that were exactly the same as the original estimates. Second, the MSM-VB program was used to summarize the latest available CWT data for the 1986-1991 period and estimate the PEFs. The PEF results were slightly different due to changes in CWT recovery and fishery catch information, primarily from Southeast Alaska net and Canadian Strait of Juan de Fuca troll and sport fisheries.

4. MIXED STOCK MODEL (MSM-VB) USER SPECIFICATIONS

In order to estimate stock composition in the pre-terminal mixed stock fisheries using the MSM-VB estimation process, the User must identify: (1) The production regions (PR) or management units (MU) and associated CWT codes selected to characterize fishery composition profiles for each modeled stock; and (2) The fishery strata to be used for estimation. All Coho salmon stocks coastwide should be represented by regional CWT groups.

4.1 Stock Selection Process

The selection of stocks for the MSM-VB PEF estimation process closely follows the stock designation used in the Coho FRAM model, but has some variation within each catch year analyzed. The list of FRAM stocks from each production region is listed in Table 3. The stocks used in the MSM-VB process are usually aggregated at the production region level but can be specified for any of the FRAM management units listed in Table 3. The variations are the result of differences in the quality and availability of CWT recovery data for each of the stock groupings. The designation and description of production regions and the individual management units or stocks within the regions is the same for all the major processes used to analyze Coho CWT data. These processes include the terminal run reconstruction program RRTERM, the MSM-VB and associated cohort analysis programs described in this report, the FRAM base period calculation program, and the FRAM program.

In the original 1986-1991 MSM analyses, some management units were estimated separately because of high quality CWT recovery data for that stock. Typically CWT data for the Puget Sound and Columbia River stocks allowed for management unit use in some cases. In cases where the distribution data is well known and adequate numbers of CWT recoveries were available, the PEF values were fixed or "user-defined" for those stocks. In this original 1986-1991 analysis many of the management unit stocks were given these "user-defined" PEF values because of high CWT tagging rates. It was thought that explicitly defining these stocks would reduce the overall catch for the PEF estimation process because the "user-defined" stocks and associated catches are subtracted from the observed landed catch numbers. This method did not work as well as expected because the total number of CWT recoveries remaining was greatly reduced which increased the variance estimates of the other PEF values.

4.1.1 Stocks modeled at the Management Unit (MU) Scale

The stocks used in the current MSM-VB PEF analysis for the 1986-1997 catch years were all at the production region level of aggregation except for Columbia River and Oregon Coastal regions. The production region aggregation was chosen so that less PEF parameters would need to be estimated, more CWT recoveries could be summed for each stock, and less data would be removed from the PEF estimation algorithm. The Columbia River late hatchery and Young's Bay net pen stocks were estimated separately as management units because of different ocean distribution patterns and in-river contribution rates from the primary Columbia River early hatchery and wild stocks in the region. All of these hatchery stocks have large numbers of releases, CWT recoveries, and accurate escapement estimates for all of the catch years, which greatly facilitated separating the management units from the regional aggregation. The "ocean ranching" management units for the Oregon Coast production region were also estimated

separately from the production region estimate. The two major production facilities (Anadromous-oranad, Aqua Foods-oraqua) had good CWT representation and significantly different ocean distribution patterns from the other coastal management units which necessitated the separation as individual units. The smolts released from these facilities had accelerated growth and returned primarily as two-year-old adults. Defining the stock at the MU level allowed us the ability to assign "user-defined" PEF values for these MU's using production data supplied by the Oregon Production Index Technical Team (OPITT).

4.1.2 Combining Production Regions

One of the more difficult problems to deal with when designating stocks is the low CWT tagging rate in many years for some stocks, including those from Southeast Alaska, North and Central British Columbia (BC) coast, and California. Most of these areas have low hatchery production and are so remote that it is logistically impractical to tag significant numbers of smolts. In addition, stock distributions for the Alaskan and Northern BC stocks are fairly similar and the PEF estimates are easily confounded in the linear modeling process, resulting in both high positive and high negative estimated PEF values for the confounded stocks. This was also often the case for Puget Sound stocks with good CWT recovery data, but similar catch distribution patterns. The fixed PEF method could be used with the Puget Sound stocks because better information was available for escapement and total terminal run estimates. In contrast, escapement and terminal run estimates are typically not available for the stocks from remote areas and fixed PEF values could not be estimated and used. In the MSM-VB process, stocks with poor CWT data were usually combined with other production regions. The data availability was fairly similar for most years and the combinations of stocks were also similar between the catch years analyzed. This results in the same PEF value for each of the components of a combined stock grouping. This technique greatly helps in the estimation of total catch in the major marine mixed stock fisheries, but probably gives a somewhat biased view of the relative contribution rates within the combined stock groupings. This outcome is unavoidable given the poor quality and low tagging rates for these areas. This is an acceptable outcome because it reflects the low priority for assessment of these stocks.

4.2 CWT Selection Process

The selection of stocks and fisheries for the first step in cohort reconstruction requires the user to make year-specific decisions based on the availability and quality of CWT data. The selection of CWT data to represent each stock is one of the most important steps that must be taken in the analytical procedure. The MSM-VB program was created to aid with the selection of stocks, fisheries, and CWT groups and to apply the MSM algorithms to those selections.

The CWT release, recovery, and catch-sample data were downloaded from the PSMFC RMIS site using the PSC standard retrieval format protocol and placed in the MS-Access datafile for record retrieval and manipulation by the program. The decision to use this data source and format was made because the data are readily available and the data file formats are standardized, allowing for quick update of the data on a catch year basis for any data that change and when new catch years become available. All Coho release and recovery data available from RMIS was downloaded for all years in an attempt to avoid missing any data. Earlier versions of the MSM program used CWT release selection criteria for region-of-origin and a small range of

brood years, but several problems were encountered and CWTs were missed. The program now provides all possible Coho CWT releases to the program user during the CWT selection process.

The majority of Coho salmon harvested in marine fisheries are 3 year-old fish, so the CWT groups considered for inclusion in the model are from the brood year 3 years previous to the catch year being analyzed. Exceptions were made for Alaskan and northern Canadian stocks that have significant fishery contributions and escapements of 4 year-old fish and from Oregon coastal ocean ranching facilities with primarily 2 year-old returns. The northern stocks have fish that reside in freshwater for two years, resulting in four year-old returns, while the Oregon ocean ranching facilities used accelerated rearing practices that reduced ocean residency time.

Selection of CWT groups associated with each production region has been completed for Alaska, Canada, Washington, Oregon, and California. Tag group selection was accomplished using 4 steps: 1) Compilation of all Coho CWT release information; 2) Compilation of all CWT recovery data; 3) Assessment of tag recovery rates, tag recovery distributions, and other criteria; and 4) Review of draft CWT lists by state, tribal, and federal fisheries managers.

To assess a CWT group for inclusion in the model, estimated tag recoveries were summed over all fisheries for each tag group by catch year and the tag recovery rate (estimated tag recoveries in fisheries / total tags released *100) was calculated. Mean tag recovery rates and standard deviations were then calculated for each management unit by age and catch year using all tag codes with at least 1 estimated recovery for that catch year. A CWT group was included in the lists of potential CWTs to use in the MSM-VB process if its tag recovery rate was above the lower confidence limit (alpha = 95%) of the mean. Regional biologists familiar with the stocks then reviewed the draft CWT selections and release data for each area and additional deletions to the list were made. CWT groups were removed from consideration if they were released early due to flooding, released diseased, or the stock was transferred and released outside of the management unit area. The current CWT groups chosen to represent MSM-VB production regions and management units for 1986-1991 catch years are listed in Table 5 and for 1992-1997 catch years in Table 6.

Our current database development process has determined that very little information for these years is available for representing California Coho production. While our intention was to include complete coastwide representation of Coho CWT and production data, this discovery is not considered a serious shortcoming to the project's purpose. In addition, there were only 11 MSM stocks of the 372 total stocks (31 stocks times 12 years) that were not represented by CWT release and recovery data. Surrogate CWT recoveries were created for the missing stocks using the "Backwards FRAM" program described in Section 13.

4.3 Fisheries Selection Process

The selection of fisheries for the MSM-VB PEF estimation process is similar to the stock selection in that the description of fisheries follows the standardized lists used in the other Coho CWT programs. The list of available fisheries is shown in Table 4 and is the same as that used for the Coho FRAM program. One important difference for the MSM-VB process is the exclusion of many terminal area fisheries. One of the basic assumptions of the ULS estimation technique is that the grouping of CWT recoveries is uniform among all the tag codes used for

each stock. This assumption is not satisfied for many terminal areas where the fish from individual tag codes have different terminal migration routes. For example, the Puget Sound South Sound production region stretches from the Seattle area to Olympia and includes many management units. The fish originating from the northern portion of the production region would not be expected to contribute to terminal fisheries in the southern portion. Terminal area fisheries are generally included in the PEF process if they have considerable non-local origin fish contributing to the catch. Estimates of non-local contribution are calculated for those fisheries and are used in the RRTERM program.

Some fisheries are combined for PEF estimation because of low CWT recovery rates or poor sampling rates. These fisheries are typically combined for the PEF estimation but resulting estimates are broken back out in the catch adjustment program and cohort analysis, which use a standardized set of fisheries for the FRAM base period (Table 4).

5. MSM-VB PEF ANALYSES

The MSM-VB system allows the user to estimate PEF values using two different methodologies. The standard method for previous Coho cohort analyses used the ULS method described by Scott et al. (1995) for the PSC Coho Technical Committee. The committee accepted this algorithm after investigating several calculation techniques including constrained least squares and non-linear approaches. The second method of PEF estimation in the MSM-VB program was developed for this project using a Bayesian estimation technique (Gazey 2005). This method uses a Bayesian approach where weighting factors can be applied to the CWT recoveries by fishery. The estimated PEF values using this technique when all fisheries are weighted equally are identical to those produced by the ULS algorithm. The Bayesian approach using variable fishery weighting factors will be used in future work to allow the fisheries with the most recoveries to have the greatest effect on the PEF estimation process. The production regions from the Columbia River, Puget Sound, and the Strait of Georgia have the highest production of hatchery fish and the highest CWT release and recovery rates. Using the Bayesian method with a fishery-weighting scheme proportional to CWT recovery rates will improve the PEF estimation for these production regions.

A bootstrap method is used to calculate the PEF variances estimated using the ULS algorithm. This method is very time-consuming have not been used for any of the analyses. The Bayesian method also includes a variance calculation as described in Gazey (2005). These variance estimates are displayed by the MSM-VB program and will be used in future projects that have been funded by the PSC Southern Restoration and Enhancement process to investigate parameter sensitivity for the cohort analysis process.

The next step done by the MSM-VB program is to calculate the catch adjustment factors by fishery and time step. These factors are the ratio between the total estimated catch and the observed total catch. The estimated catch is calculated by multiplying the PEF values times the CWT recoveries for each stock. The catch and CWT recovery data for this procedure are summarized by the standard definitions for fisheries and time steps used in the RRTERM and FRAM programs. The catch and CWT recovery data are summarized on an annual basis for estimation of the PEF values using a set of user-specified fisheries so they cannot be used in this step of the cohort analysis.

The MSM-stock results from the CAP procedure are split into MU-specific estimates in the next step using MU-proportions estimated by the RRTERM program. The MSM-Split procedure and algorithms are shown in Section 10.

The final step in the MSM-VB program is the cohort analysis that calculates cohort sizes and exploitation rates by fishery and time-period. This procedure is done using estimates of non-retention, natural mortality, and stock-specific terminal area impacts from RRTERM. This procedure and algorithms are shown in Section 12.

5.1 Unconstrained Least-Squares Model (Mixed Stock Model)

Once the User identifies the production regions and CWT codes selected to characterize fishery composition profiles for selected production regions; and the fishery strata to be used for

estimation, the Mixed Stock Model is employed to estimate Production Expansion Factors (PEF). The minimal information required to estimate the PEFs and subsequent stock composition are the catch by fishery, the sampling rate in each fishery, and the observed recovery of CWT's by stock and fishery. There must be more fisheries than stocks for estimates to be calculated. The multiple linear regression model, MSM, is an ULS model developed with the assumption that the variance of the estimated catch does not vary with the size of the catch and only the PEF values are estimated. The ULS estimates can be found analytically and there are no constraints on the solution space. The model can be written as:

$$\min \sum_{f} (RC_f - TotalCatch_f)^2 \quad (4.1)$$

Where: RC = reported catch in fishery f and

$$TotalCatch_f = \sum_{s} (PEF_s \times CWTRec_{s,f}) + e_f \quad (4.2)$$

Where:

$TotalCatch_f$	Total Landed Catch for year in fishery ***f***
PEF_s	Production Expansion Factor for stock ***s***
$CWTRec_{s,f}$	Coded Wire Tag Recoveries, expanded by sample rate, for stock ***s*** in fishery ***f***
e_f	Error in estimate of catch in fishery ***f***

Assumptions of the ULS model include:

1) CWT recoveries are obtained from a random sample.
2) All stocks caught in modeled fisheries are represented by a CWT group.
3) CWT groups are representative of all untagged production within their release or production region (i.e. ocean distributions of tagged groups and untagged wild stocks are similar).
4) Harvest rates are the same for tagged and untagged stock components in all fisheries.
5) The PEFs are essentially constant across modeled fisheries for each stock.
6) The CWT recovery profile for each stock or production region is distinct from the CWT recovery profile of other groups.

5.2 Challenges in Estimating PEFs

Development of the historical database for catch years 1992-1997 is now complete and required the selection of CWT groups for each production region and year, gathering RRTERM data for each region and catch year, and MSM-VB analysis of PEF values for each catch year. Contacts were made with the management agencies responsible for each region and the majority of necessary data was collected. Some important CWT-based estimates for the RRTERM fisheries using localized PEF values were not readily available and alternate estimates using landed catch and escapement numbers were derived from various agency publications. The CWT associations by stock and catch year have been made and have been reviewed by most of the affected agencies.

The preliminary PEF estimation process for the 1992-1997 catch years yielded some poor results that were very similar to those encountered in the 1986-1991 analyses. The initial calculations, without user-defined PEFs and terminal run data, resulted in many large positive and negative PEF values for some production regions due to poor CWT representation for some stocks and similar recovery distribution patterns among the stocks. Stocks with low numbers of CWT recoveries can be more easily expanded by the MSM algorithms to estimate observed catch. Stocks with similar distribution patterns can cancel each other out in the ULS estimation process with large positive and negative MSM estimated PEF values. The pattern of nonsensical initial PEF estimates for stocks during the 1992-1997 catch years was very similar to that observed of the 1986-1991 catch years.

Results from the MSM-VB program show that the PEF values estimated by the ULS model are very unstable and small changes in one stock can result in major changes in many other stocks. For the 1992-1997 catch years, model constraints, such as the use of user-defined PEFs and terminal run information, were investigated as potential methods to force the MSM-VB analysis to produce more plausible results. Production regions with poor initial PEF estimates were from the Puget Sound, Washington coast, and Canadian regions. The Puget Sound regions, including the Stillaguamish, Hood Canal, Strait of Juan de Fuca, and Makah production regions, were usually assigned user-defined PEFs. The Washington coastal regions were combined for PEF estimation and usually included the Hoh, Quillayute, and Queets production regions. The Canadian regions from the Georgia Strait and Vancouver Island areas were always combined for PEF estimation and user-defined PEF values were used for some Canadian stocks based on expected run sizes. In addition to the use of user-defined PEFs, terminal run data was added for some stocks to help constrain the PEF estimation process to produce more plausible results. Typically this data was either hatchery rack or wild smolt outmigration estimates of tagged to untagged ratios applied to terminal returns. Externally estimated PEF values were used when either the data was considered to be “good” or when the use of terminal area data in the mixed-stock-model continued to produce nonsensical PEF estimates. The MSM analyses also included a Bayesian approach for fishery-weighting schemes based on the proportion of CWT recoveries to total catch. These results are described in Section 14 below.

The designation of stocks for the MSM-VB analysis generally follows a set of guidelines for regional groupings of production regions. The production regions defined in MSM-VB are the same as those used in the terminal run reconstruction. The production regions are collections of stock management units. The management units are typically the smallest groupings of Coho stocks that enter into the negotiations for fishery regulation impacts and form the consistent link between MSM-VB estimation, terminal run reconstruction, cohort analysis, and development of fishery regulation models. Management unit groupings are used as MSM-VB stocks when PEF estimation problems occur for production regions or when good quality data is available for a particular management unit. The majority of the management units are designated as hatchery or natural production, rather than a combination of the two types of production.

The MSM-VB fishery groupings combine similar gear and adjacent areas, CWT recovery data, and generally follow the scheme used to estimate the sampling expansion factors for those fisheries. Fisheries are grouped when poor CWT sampling occurs and these fisheries are thought to have similar CWT recovery patterns. The fishery groupings used for PEF estimation are

generally larger than the groupings used for cohort analysis and FRAM. For example, smaller fisheries with inconsistent sampling and recovery data are often grouped for PEF estimation, while they are broken out for cohort analysis and for use in FRAM.

6. RRTERM PROGRAM

The RRTERM program was designed to calculate and store estimates of terminal runsize, terminal harvest, and escapement for all Coho salmon populations defined in the MSM-VB/FRAM management system. It was created to accomplish two major objectives:

1) To serve as a repository for terminal area and escapement information.
2) Replace run reconstruction algorithms that had been used for terminal area runsize estimation for Puget Sound Coho populations for the 1967 to 1996 catch years. Those algorithms had several flaws and did not make use of CWT recovery information.

There are currently 34 production regions (PRs) on the Pacific Coast for which terminal runsize estimates are derived for the Coho cohort reconstruction process. Terminal run reconstruction estimates are required for each of these PRs to estimate the abundance of the portion of the cohort not accounted for by the MSM-VB PEF analysis of stock composition in mixed stock fisheries. In addition, the MSMSplit program uses the relative abundance of the terminal runsize estimates to calculate management unit proportions within each production region.

The production regions were identified on the criteria of being geographically distinct freshwater/estuarine location nodes from which significant natural and or hatchery-origin salmon production originates. There are usually multiple individual Management Units (MUs) within each PR, each representing distinct major freshwater natural spawning streams, hatcheries, or net pens.

A terminal reconstruction consists of the sum of:

1) Spawning escapement(s) for each of the stock(s) being reconstructed, for year x.
2) Portion of the terminal marine and freshwater fishery catch(es) assigned to each of the stock(s) being reconstructed for year x , time period i , and optionally.
3) Estimates of mortality from non-landed fishery losses, marine mammal predation, or other sources.

The RRTERM terminal runsize estimation program uses the following inputs to derive the terminal runsize estimates for each MU in each PR:

1) Adult (age 3 and/or 4) escapement values for each MU.
2) Adult landed catch values for each sport and commercial fishery described in the RRTERM model (values typically constrained to Sept. 1-Dec. 31 in the estuarine fisheries, because landing prior to this time period often have significant numbers of non-local origin Coho present, and the MSM-VB model itself allocates these catches to locations of origin).
3) PEFs (juvenile-release or adult-recovery based).
4) CWT recovery values from each sampled fishery (constrained to the same time period of the fishery catch inputs).
5) The non-local catch estimate for each MSM-VB fishery flagged for terminal area calculation (this estimate is not available until the initial MSM-VB run, which typically is done after the preliminary terminal runsize estimates are completed).

Escapement data used in this process were collected from the Washington Department of Fish and Wildlife (WDFW) annual post season hatchery escapement reports, summaries provided by Oregon Department of Fish and Wildlife (ODFW) biologists, natural escapement estimates directly provided by regional state and tribal biologists, the PFMC 2004 Review of Ocean Salmon Fisheries report (PFMC 2005), and other sources. Catch data were retrieved from the WDFW commercial fishticket database, WDFW annual post-season sport catch reports, summaries provided by ODFW biologists, PFMC 2004 Review of Ocean Salmon Fisheries report, and other sources.

Fishery catch allocation to the MUs of origin is conducted in the RRTERM model by a combination of CWT recovery expansions and proportional escapement-based catch allocation. The CWT recoveries are used to estimate the portion of the catch belonging to each MU for which tag recovery data is provided by multiplication of the MU-of-origin-specific CWT recoveries for each fishery by the MU-of-origin-specific PEF value provided for each MU. The order of precedence for the allocation of catch in each fishery is to first allocate catch to MUs for which CWT recovery values were entered, then, the remainder of the catch is distributed among the MUs for which CWT data were not provided (or not used due to problems with the CWT recovery data and/or PEF) by the ratio of the MU escapement values. The raw CWT recovery data were extracted from the PSMFC RMIS database and imported into Microsoft Access for summarization and analysis. To expand the CWT recoveries for terminal fisheries, PEF values for the CWT grouping were calculated.

There are two types of terminal area PEFs:

1) Release PEF = Total number of smolts produced from MU / Number of tagged smolts released from MU.
2) Recovery PEF = Total adults recovered in hatchery rack or extreme terminal fishery / Number of tagged adults recovered in hatchery rack or extreme terminal fishery.

Release PEFs were used almost exclusively for the CWT recovery expansions in this process due to the consistent availability of information to derive these values. The historical hatchery release data for Washington was downloaded from the RMIS database to derive the values. The use of recovery PEFs was briefly examined, but the difficulty of finding "clean" fisheries that would allow calculation of an accurate terminal adult PEF was problematic, and apparent year-to-year inconsistencies in sampling/tag expansion accuracy at many hatchery rack locations made use of hatchery-rack derived PEFs difficult also.

Proportional-abundance based estimation of management unit catches is the default method used in the RRTERM program. This method assumes that a gauntlet of terminal fisheries can be defined for the management unit(s) in question based on knowledge of the migration paths of the units. Then, as Starr and Hilborn (1988) describe, the terminal return is reconstructed working backwards from the escapement and last terminal (or extreme terminal) fishery. It is assumed that the management units present in each fishery are known and that the harvest rate in a fishery is equal on all management units present in the fishery. Then, for the last fishery in the gauntlet, the proportion of each management unit exiting the fishery is estimated using escapement estimates.

6.1
$$\hat{\pi}_{jkl} = \frac{\hat{E}_j}{\sum_{j \in l} \hat{E}_j}$$

and its variance,

6.2
$$V(\hat{\pi}_{jkl}) = \hat{\pi}^2_{jkl} \left[\frac{V(\hat{E}_j)}{\hat{E}^2_j} + \frac{\sum_{j \in l} V(\hat{E}_j)}{(\sum_{j \in l} \hat{E}_j)^2} \right]$$

Where:

$\hat{\pi}_{jkl}$	MU proportion of escapement for stock ***j*** in production region ***k*** for fishery ***l***
E_j	Escapement for stock ***j***
V	Variance of parameter
C_{jkl}	Catch of stock ***j*** in production region ***k*** for fishery ***l***
N_{jl}	Cohort Size (Abundance) for stock ***j*** for fishery ***l***

Under the assumption of equal harvest rates on all management units present in the fishery, then this proportion can be used to apportion the terminal catch in the last fishery to each management unit by,

6.3
$$\hat{C}_{jkl} = C_l \ \hat{\pi}_{jkl}$$

with a variance of,

6.4
$$V(\hat{C}_{jkl}) = V(\hat{C}_l)\hat{\pi}^2_{jkl} + \hat{C}^2_l V(\hat{\pi}_{jkl}) + V(\hat{C}_l)V(\hat{\pi}_{jkl})$$

The terminal area abundance of management unit *j* entering the last fishery will then be,

6.5
$$\hat{N}_{jl} = \hat{E}_j + \hat{C}_{jl}$$

where *l* indicates the last fishery. The variance of the abundance is the sum of the variances of the escapement and the estimated catches.

The combined abundance for all management units entering this last fishery is calculated similarly. The proportion of management unit *j* exiting the next to last fishery is,

6.6
$$\hat{\pi}_{jk(l1)} = \frac{\hat{E}_j + \hat{C}_{jkl}}{\sum_{j \in l} \hat{E}_j + \sum_{j \in l} \hat{C}_{jkl}}$$

and the variance is estimated as in equation above for the last fishery. This proportion is then used to apportion catches in the next to last fishery. In this manner the abundances of management units entering each fishery can be estimated and the proportion used to allocate the catch to each unit. The equation for estimation of this proportion for fisheries prior to the last fishery is,

6.7

$$\hat{\pi}_{jk(lx)} = \frac{\hat{E}_j + \sum_{\eta}^{x} \hat{C}_{jk(l\eta+1)}}{\sum_{j \in l} \hat{E}_j + \sum_{j \in l} \sum_{\eta}^{x} \hat{C}_{jk(l\eta+1)}}$$

where x indicates the location of the fishery away from the last fishery (e.g. x=1) for the second to last fishery. The variance of this ratio is estimated as described above.

As the process moves forward in the fishery gauntlet the number of management units assumed to be present in the terminal fishery might increase or decrease. The total terminal runsize of a management unit is then estimated by summing all the escapement and catch estimates for that unit and the variance estimated by summing their variances.

6.1 Overview of 1992-97 Terminal Runsize Estimation Process

It was our intent to prepare the terminal runsize estimates for the 1992-97 time period in a cooperative process with state and tribal biologists. An RRTERM/MSM overview meeting was held in July 2004 at the Northwest Indian Fisheries Commission (NWIFC) office in Olympia, Washington. Attendees included technical representatives from WDFW, NWIFC, Bold Case area tribes, and CDFO. Presentations were conducted showing the basic theory and design of the MSM and RRTERM process and software tools that had been developed. A follow-up meeting to discuss coastal Washington terminal runsize estimation issues was held in December 2004 at the NWIFC office in Forks, Washington.

Over the course of winter-summer of 2005 a series of individual meetings were held between WDFW and technical representatives of the Nooksack, Swinomish, Upper Skagit, Tulalip, Quileute, and Quinault Tribes to discuss the terminal runsize estimation process for the Nooksack-Samish, Skagit, Stillaguamish-Snohomish, Quillayute, Queets, Quinault, and Grays Harbor production regions. Preliminary estimates of terminal runsize with co-manager technical agreement have been completed for the Skagit, Stillaguamish-Snohomish, Quillayute, and Queets productions regions. The remainder of the current production regions estimates presented in this report for Washington and Oregon are preliminary estimates to facilitate the MSM-VB model run process, and have not yet been subject to formal review or agreement by the co-managers in each production region. Estimates of “non-local” catch from the MSM-VB analyses have been incorporated into the RRTERM runs.

Appendix C contains summary tables of the terminal runsize estimates for each production region for the 1992-1997 time period, and relevant background information specific to each terminal estimate.

7. USER-DEFINED PEF VALUES FOR MSM-VB ANALYSIS

Estimates of user-defined PEF values for Coho stocks originating in Washington State and Canada were made to facilitate the different analyses done for the MSM-VB process. These estimates were used to evaluate which analysis gave the most plausible results for the other stocks used in each analysis. The evaluations simply focused on insuring that the estimated PEF values for the other stocks were positive values and not too large.

The MSM-VB user-defined PEF values for Coho stocks originating in Washington State are listed in Table 7 for 1986-1991 and Table 8 for 1992-1997. These values were calculated from hatchery release numbers of tagged and untagged fish and the estimated numbers of wild-origin smolts. The hatchery release information was obtained from the PSMFC RMIS database. The estimated wild smolt numbers were obtained from the WDFW preseason forecast report. Actual estimated numbers were used from river systems that have wild smolt enumeration projects. The numbers for other areas were derived by formulas relating size of the watershed to expected production potential. These estimates are potentially biased by the wild smolt estimates but are reasonable for the expected rate of CWT returns for each of the stocks.

The other production region where user-defined PEF values were always used in these analyses was the Upper Fraser / Thompson River stock (FRSUPP). The management of this stock has been important for Canada for several years because of low returns. It is usually the focus of bi-lateral fishery management issues, given constraints on allowable exploitation rates. Extensive analyses have been done on escapements and exploitation for recovery planning purposes. The user-defined PEF values were calculated using the CWT recovery data for the tag codes associated with this production region so that the MSM-VB analysis would exactly match the data used in the recovery planning process. This was accomplished by dividing the total marine landed catch by the number tags from the MSM-VB summary. The values used in the current base period are shown in Table 9 and the revised estimates for 1986-1991 in Table 10 and for 1992-1997 in Table 11. The total marine landed catch was calculated by multiplying the escapement number times the ratio of total marine exploitation rate over the escapement rate. The escapement and exploitation rate numbers were obtained from the Canadian recovery planning documents.

The final PEF analysis described below in Section 14 used user-defined PEF values for the Canadian stocks. This was done to split the PEF estimated run sizes for combined production region estimates. The Canadian production regions were combined because the relatively low numbers of CWT recoveries for closely related regions did not yield plausible results. The combined regions for each of the runs included northwest and southwest Vancouver Island (NWVNCI and SWVNCI), Strait of Georgia and Johnston Strait (GSMNLD, GSVNCI, FRSLOW, and JNHSTN), and North and Central Coast (BCNCST and BCCNTL). The MSM-VB program yielded plausible PEF values when these regions were combined but the resulting run sizes were a function of the number of CWT recoveries originating from each region.

The PEF values used in the current MSM/FRAM base period analysis are listed in Table 12. The user-defined PEF values are shown in bold type. These PEF values were calculated by various

regional biologists and had very little documentation. Many of these user-defined estimates were for individual management units that were not used in the new MSM-VB analysis.

The PEF values estimated using the MSM-VB system are listed in Table 13 for 1986-1991 and in Table 14 for 1992-1997. The majority of the user-defined values for these analyses were for surrogate CWT recoveries generated by the "Backwards FRAM" program (Section 13) or for stocks with very few CWT recoveries.

8. REVISED CANADIAN CWT RECOVERIES AND CATCH DATA

The expansion of CWT recoveries for the Canadian fisheries in the Johnstone Strait and lower Fraser River areas were aggregated into large geographic areas for most of the catch years to be analyzed in this project. These fisheries are now managed at a finer scale than these larger aggregated areas and it was necessary to identify and expand the CWT recoveries by the new fisheries designations, and apportion the catch by the new fisheries. This work was done by the CDFO Southern Boundary Restoration and Enhancement Fund project (Tompkins 2005) and the updated information is stored in separate tables for record keeping in the MSM-Access datafile.

9. CATCH ADJUSTMENT PROCEDURE

The Catch Adjustment Procedure (CAP) is used to modify the summed estimated catch by stock to equal the observed total catch by fishery and time period. The same CWT release and recovery information used in the MSM-VB analysis to estimate PEFs are used in CAP, except that the catch and recovery data are summed using the standard FRAM definitions for fisheries and time periods. A catch adjustment factor is calculated for each fishery/time-period stratum and applied to the estimated catches by stock. This can be viewed as applying the stock composition estimated by CWT recoveries to total landed catch. The adjustment procedure insures that all catch is assigned to the contributing stocks in each stratum in the forwarding projecting FRAM program.

An exception to the adjustment procedure is made for stocks with "good" user-defined PEF values. The catch for these stocks is deleted from the total and estimated catches before the catch adjustment factor is calculated. The user-defined PEFs flagged as "poor" are included in the calculation.

CAP also generates estimates of "non-local" catch in terminal fisheries. Non-local refers to Coho salmon originating from production regions outside of where the terminal fishery occurs. The non-local estimates are used by RRTERM to calculate stock composition in terminal fisheries with substantial non-local contribution. These terminal fisheries generally had more than 5% non-local contribution for more than half of the years analyzed. The CAP adjustment factor was not applied to the non-local estimates when the adjustment factor value was greater than one. This was done so that the non-local impacts in these terminal fisheries would reflect the actual CWT recoveries observed and would not include the added adjustment due to sampling variance.

Equations 9.1- 9.5 —

$$CAPCatch_{f,t} = TotCatch_{f,t} - \sum_{s=s1}^{s2}\sum_{a}(PEF_{s,a} \times CWTRec_{s,a,f,t})$$

$$EstPEFCatch_{f,t} = \sum_{s=s3}^{s4}\sum_{a}(PEF_{s,a} \times CWTRec_{s,a,f,t})$$

$$CatAdjFact_{f,t} = CAPCatch_{f,t} / EstPEFCatch_{f,t}$$

$$MSMCatch_{s,a,f,t} = MSMCatch_{s,a,f,t} \times CatAdjFact_{f,t}$$

$$NonLocal_{f,t} = \sum_{s=s5}^{s6}\sum_{a} MSMCatch_{s,a,f,t}$$

Where:

$CAPCatch_{f,t}$	Catch after deleting for MSM stocks with "good" PEF values
$TotCatch_{f,t}$	Total Catch for fishery ***f,*** at time step ***t***
$PEF_{s,a}$	Production Expansion Factor for stock ***s,*** age ***a***
$CWTRec_{s,a,f,t}$	Coded Wire Tag Recovery for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***

$EstPEFCatch_{f,t}$	Estimated Catch of remaining stocks for fishery ***f*** at time step ***t***
$CatAdjFact_{f,t}$	Catch Adjustment Factor for fishery ***f*** at time step ***t***
$MSMCatch_{s,a,f,t}$	Catch for MSM stock ***s,*** age ***a***, in fishery ***f*** at time step ***t***
$NonLocal_{f,t}$	Catch of NonLocal stocks in terminal fishery ***f*** at time step ***t***
Stocks s_1,s_2	List of stocks with "good" or user-defined PEF estimates
Stocks s_3,s_4	List of stocks with estimated PEF estimates (from MSM)
Stocks s_5,s_6	List of stocks from other regions in terminal fishery ***f*** at time step ***t***

10. MSMSPLIT PROGRAM ALGORITHMS

The MSMSplit program divides the stock aggregations used for the MSM-VB process into the management unit components defined in the terminal run reconstruction program RRTERM. The MSM-VB stocks are generally defined as either production regions or management units. The production regions are groupings of MUs that are used for management purposes. The exceptions for MSM-VB stocks are aggregations of production regions for northern British Columbia in years without CWT representation and Columbia River late runs.

The program determines which MUs are included in each MSM-VB stock definition and uses the terminal run proportions from RRTERM to allocate the MSM catch estimates. The MSM-VB stock names must match either the PR or MU names from RRTERM. The terminal run proportions from RRTERM are recalculated when MSM-VB stock corresponds to a MU name because that stock is longer included in the production region PEF estimate. A file containing catch estimates by MU is created for use in the cohort analysis program.

The MSM-VB stocks that are aggregations of production regions are allocated with user-defined proportions contained in the MSM-VB input file. These estimates are usually averages of recent years.

The Columbia River late run stock group is treated essentially like a separate production region for MSM-VB estimation. The MU components are lower river hatchery and Clackamas River wild. They are split using the RRTERM proportions separately from the early-timed MUs.

Equations 10.1- 10.4 —

$$MSMProp_{s,a} = RRPct_{s,a} \Big/ \sum_{s=s1}^{s2} \sum_{a} RRPct_{s,a}$$

$$Catch_{s,a,f,t} = MSMCatch_{k,a,f,t} \times MSMProp_{s,a} \quad \textbf{where stock } \boldsymbol{s} \textbf{ is subset of MSM stock } \boldsymbol{k}$$

Columbia River Late Hatchery

$$Catch_{h,a,f,t} = ColLHW_{f,t} \times (RRPct_{h,a,s,a} \big/ (RRPct_{h,a,s,a} + RRPct_{w,a,s,a}))$$

Columbia River (Clackamas) Late Wild

$$Catch_{h,a,f,t} = ColLHW_{f,t} \times (RRPct_{w,a,s,a} \big/ (RRPct_{h,a,s,a} + RRPct_{w,a,s,a}))$$

Where:

$MSMProp_{s,a}$	MU proportion of MSM stock
$RRPct_{s,a}$	MU proportion of Terminal Run for stock ***s,*** age ***a*** from RRTERM
$Catch_{s,a,f,t}$	Landed Catch by MU for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***
$MSMCatch_{k,a,f,t}$	Catch for MSM stock ***k,*** age ***a***, in fishery ***f*** at time step ***t***
$ColLHW_{f,t}$	Catch for MSM stock Columbia River Late Hatchery/Wild
Stocks s_1,s_2	List of MU stocks contained in MSM grouping
Stock k	MSM stock grouping of MUs
Stocks h,w	Columbia River Late Hatchery and Clackamas River Late Wild

11. MSM COHORT ANALYSIS PROGRAM ALGORITHMS

The MSM Cohort Analysis Program calculates abundances by MU and time-step using catch data from the MSMSplit program, terminal catch and escapement data from RRTERM, and estimates of incidental fishing mortality and natural mortality. The cohort abundances are then used to calculate exploitation rates that can be used for fishery modeling purposes.

The cohort reconstruction starts with escapement and works backwards through time adding fishery impacts and natural mortality. Landed catch data comes directly from MSMSplit and RRTERM. Incidental fishery impacts include dropoff and non-retention. Dropoff is calculated as add-on mortality to landed catch. Non-retention estimates are input as numbers of dead fish and must be associated with the stock composition of another fishery. The associated fishery is generally the same gear/area fishery in another time-step or an adjacent area fishery in the same time-step. A small group of fisheries with either no sampling or no CWT recoveries were handled in the same way as the non-retention estimates. These fisheries were typically in terminal areas with relatively small catches.

The exploitation rate calculations were done using either the initial cohort sizes or with the time-step cohort sizes. The non-retention mortalities were treated like landed catch for these computations. Exploitation rates using the initial abundances can be summed across time-steps but are not particularly useful for modeling of regulation impacts. The time-step exploitation rates are used to create the base period information for FRAM. They are calculated after natural mortality has been subtracted from the time-step cohort size to match the sequence of computations used in FRAM.

Equations 11.1- 11.6 —

$$Cohort_{s,a,t} = Cohort_{s,a,t+1} + \left(\sum_{f}(Catch_{s,a,f,t} + IncMort_{s,a,f,t}) + Escape_{s,a,t}\right) \Big/ (1 - NatMort_{t})$$

$$IncMort_{s,a,f,t} = Dropoff_{s,a,f,t} + CNR_{s,a,f,t}$$

$$Dropoff_{s,a,f,t} = Catch_{s,a,f,t} \times DropoffRate_{f,t}$$

$$CNR_{s,a,f,t} = CNRMort_{f,t} \times (Catch_{s,a,f',t} \Big/ TotCatch_{f',t})$$

$$Catch_{s,a,f,t} = NOSMort_{f,t} \times (Catch_{s,a,f',t} \Big/ TotCatch_{f',t})$$

$$ExplRate_{s,a,f,t} = Catch_{s,a,f,t} \Big/ (Cohort_{s,a,t} \times (1 - Natmort_{t}))$$

Where:

$Cohort_{s,a,t}$	MU Population Size for stock ***s,*** age ***a***, at time step ***t***
$Escape_{s,a,t}$	Escapement for stock ***s,*** age ***a***, at time step ***t***
$Catch_{s,a,f,t}$	Landed Catch by MU for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***
$IncMort_{s,a,f,t}$	Incidental Fishery Mortality for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***

$Dropoff_{s,a,f,,t}$	Dropoff Mortality for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***
$DropoffRate_{f,t}$	Dropoff Mortality Rate for fishery ***f,*** at time step ***t***
$CNRMort_{f,,t}$	Total Non-Retention Mortality for fishery ***f,*** at time step ***t***
$CNR_{s,a,f,,t}$	Non-Retention Mortality for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***
$NOSMort_{f,,t}$	Total Catch for fishery ***f,*** at time step ***t*** with No Sample or No CWT Recovery
Fishery *f*'	Associated Fishery for stock composition of CNR and NOS mortalities
$ExplRate_{s,a,f,,t}$	Exploitation Rate for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***

12. COHO FRAM BASE PERIOD ALGORITHMS

The Coho FRAM Base Period file is generated by averaging cohort sizes and exploitation rates over a range of selected years. The base period file contains the initial cohort sizes by stock and age, plus the average exploitation rate by stock, age, fishery, and time-step.

The base period cohort size is an average of initial cohorts from all the years selected divided equally into marked and un-marked components. The two components are necessary for evaluating mark-selective fisheries. There were no mass-marked Coho during the base period years. Each component uses the same, original MSM exploitation rate because the cohort split was weighted equally.

Four methods were evaluated for averaging exploitation rates: 1) Average over all years selected; 2) Average over years with a fishery occurring; 3) Average over all years selected weighted by cohort size; and 4) Average over years with fishery occurring weighted by cohort size. The second method was chosen by the PFMC SSC because it averaged actual rates without missing values. The only exception was for Thompson River Coho, were the 1986 data was excluded because of poor escapement data.

The exploitation rates for troll and net fisheries in Washington State were split into Treaty Tribal and Non-Treaty fisheries so that sharing allocation summaries could be calculated. The MSM-VB fisheries for Washington State were combined Treaty and Non-Treaty to increase the number of CWT recoveries and decrease the variance of the exploitation rates. The exploitation rate split was made using the average Treaty proportion for the years selected. If either component was missing for all years it was arbitrarily set to 0.01 and no average was allowed to be lower than that value.

Equations 12.1- 12.6 —

$$BPCohort_{s,a,t} = \left(\sum_{y=y1}^{y2} Cohort_{s,a,t,y} \Big/ NumYears\right) \times 0.5$$

Method 1- Average Exploitation Rate Over All Years Selected

$$BPER_{s,a,f,t} = \sum_{y=y1}^{y2} ExplRate_{s,a,f,t,y} \Big/ NumYears$$

Method 2- Average Exploitation Rate Over Years with Fishery Occurring

$$BPER_{s,a,f,t} = \sum_{y=y3}^{y4} ExplRate_{s,a,f,t,y} \Big/ NumYears \qquad \text{(except Thompson)}$$

Method 3- Average Exploitation Rate Over All Years Selected Weighted by Cohort size

$$BPER_{s,a,f,t} = \left(\sum_{y=y1}^{y2} (ExplRate_{s,a,f,t,y} \times Cohort_{s,a,f,t,y}) \Big/ NumYears\right) \Big/ \left(\sum_{y=y1}^{y2} Cohort_{s,a,f,t,y} \Big/ NumYears\right)$$

Method 4- Average Exploitation Rate Over Years with Fishery Occurring Weighted by Cohort size

$$BPER_{s,a,f,t} = \frac{\left(\sum_{y=y3}^{y4}(ExplRate_{s,a,f,t,y} \times Cohort_{s,a,f,t,y})\right) / NumYears}{\left(\sum_{y=y3}^{y4} Cohort_{s,a,f,t,y}\right) / NumYears}$$

$$AvgTreatyPct_{f,t} = \sum_{y=y1}^{y2} TreatyPct_{f,t,y} / NumYears$$

Where:

$BPCohort_{s,a,t}$	FRAM Base Period Cohort Size for stock ***s,*** age ***a***, at time step ***1***
$Cohort_{s,a,t1,y}$	MSM Cohort for stock ***s,*** age ***a***, at time step ***1***, year ***y***
$BPER_{s,a,f,t}$	FRAM Base Period Expl. Rate for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***
$ExplRate_{s,a,f,t,y}$	MSM Exploitation Rate for stock ***s,*** age ***a***, in fishery ***f,*** at time step ***t***, year ***y***
$AvgTreatyPct_{f,t}$	Average Treaty Percent for fishery ***f,*** at time step ***t***
$TreatyPct_{f,t,y}$	Treaty Percent for fishery ***f,*** at time step ***t***, year ***y***
NumYears	Number of Years in List Selected
Years *y1, y2*	List of Years Selected
Years *y3, y4*	List of Years Selected where fisheries occurred

13. BACKWARDS FRAM FOR MISSING CWT DATA

An estimation procedure using the existing Coho FRAM was developed to create "surrogate" CWT recoveries for MSM stocks that did not have CWT releases during the 1986-1997 catch years. Problems can arise in MSM estimation procedures if CWTs for some production regions are not represented by CWT releases or if recovery patterns of release groups are similar. When production regions do not have CWT releases for a particular analysis, it is necessary to find a way to generate "surrogate" estimates of time-fishery exploitation rates.

For example, the Willapa Bay production region is an important stock on the Washington coast with both hatchery and wild components. The lack of CWT releases for the 1987-1989 brood years was a significant problem that required generating CWT recovery estimates for those broods (1990-1992 catch years). The problem was further complicated by the lack of CWT sampling in the large fall gillnet fisheries in Willapa Bay because no local CWT contributions were expected.

For the current 1986-1991 base period used for FRAM, the PSC CoTC created the original missing Willapa Bay estimates of fishery-time exploitation rates by scaling the recoveries from 1989 by the proportion of observed total landed catch from the estimated year to the comparable catch in 1989. This method was satisfactory for the original MSM analysis and FRAM base period. However, this type of procedure does not provide a mechanism to adjust for the effect of different stock compositions resulting from the variable run sizes of individual stocks contributing to each of the fisheries.

The CoTC has employed a procedure that used FRAM to produce post-season estimates of exploitation rates of individual management units for comparison with obligations set forth in the 2002 PSC Southern Coho Agreement. Basically, the procedure involved estimation of a the set of stock abundance scalars that best explains observed escapements and reported catches through an iterative process involving modification of stock abundance scalars specified in a FRAM command file.

This manual procedure has been automated by creating a special version of backwards FRAM (BFRAM). The starting command file is generated by the MSM program and uses the catch/sample data from the PSMFC RMIS system to get landed catch for the mixed stock marine fisheries and the RRTERM program for terminal fishery landed catch and stock specific escapements. Observed catches by fishery and time period are treated as quotas and initial stock scalar values of 2.0 for all the unmarked model stock components. (None of the stocks were mass-marked during the 1986-1997 study period so all of the marked stock components were set to zero.) The values of observed escapements are extracted from the RRTERM tables and are appended to the BFRAM command file.

A series of algorithms were employed to estimate stock scalars using an iterative mathematical approach. This approach was taken because the large number of stocks made a direct computational solution impractical and post-season application of this process allows for user selection of a subset of stocks. The algorithms for each iteration approximate the difference in starting cohort size necessary to explain the difference between target (or observed) escapement

and model-estimated escapement. The starting cohort size is calculated by multiplying the stock scalar times the base period cohort size for each stock (Equation 14.1). The escapement difference is calculated by subtracting the model escapement from the target escapement (Equation 14.2). An approximation of the exploitation rate total is computed by dividing the model escapement by the starting cohort size and then multiplying times the natural mortality expansion value of 1.33571 (Equation 14.3). The natural mortality expansion value is the product of the survival rate (1- natural mortality rate) inverse summed across all model time steps. The difference in starting cohort size that would translate into the difference in target and model escapement is calculated by multiplying the escapement difference times the exploitation rate total times the natural mortality rate expansion (Equation 14.4). The stock scalar for the next iteration is calculated by dividing the sum of the starting cohort and escapement-difference cohort by the base period cohort size (Equation 14.5). If the escapement-difference cohort is larger than the starting cohort an average of the stock scalars from the previous iterations is used (Equation 14.5) to avoid negative escapements.

Equations 14.1- 14.5 —

(14.1) $StartCohort_s = StockScalar_{s,1,I} \times InitCohort_s$

(14.2) $EscDiff_s = TargetEsc_s - ModelEsc_s$

(14.3) $ERTotal_s = ModelEsc_s / StartCohort_s \times 1.33571$

(14.4) $CohortDiff_s = EscDiff_s \times (ERTotal_s \times 1.33571)$

(14.5)
$$IF\,(CohortDiff_s > StartCohort_s)\,THEN$$
$$\_\_\_\; StockScalar_{s,1,I+1} = (StockScalar_{s,1,I-1} + StockScalar_{s,1,I}) / 2$$
$$ELSE$$
$$\_\_\_\; StockScalar_{s,1,I} = (StartCohort_s + CohortDiff_s) / InitCohort_s$$

Where:

$InitCohort_s$	Base Period Cohort Size of FRAM stock ***s***
$StkScalar_{s,1,I}$	Stock Abundance Scalar for stock ***s,*** time step 1, iteration ***I***
$StartCohort_s$	Starting Cohort Size for stock ***s***
$TargetEsc_s$	Observed Escapement for stock ***s***
$ModelEsc_s$	FRAM Escapement for stock ***s***
$EscDiff_s$	Difference between Observed and FRAM Escapement for stock ***s***
$ERTotal_s$	Total Mortality Exploitation Rate expanded by Natural Mortality Rate
$CohortDiff_s$	Starting Cohort Size Difference expected to result in $EscDiff_s$

The flowchart for this process is shown in Figure 12.

After the iterative procedure has been run for a selected catch year, the user can select which stocks will have the "surrogate" CWT recoveries generated. The output from this step is produced in the same format as the records that are retrieved from the RMIS system.

The BFRAM procedure was used for 11 of the total 372 production regions (31 MSM stocks times 12 years = 372) in this study. These production regions were Makah (MAKAHC) for the

1986, 1987, 1988, and 1990 catch years; Transboundary (TRANAC) for 1986 and 1987; Willapa (WILLAP) for 1990, 1991, and 1992; Northwest Vancouver Island (NWVNCI) for 1994; and Southeast Alaska Outside (SOASKA) for 1995. These estimates are stored separately in the MSM database so that they can be easily added to the primary CWT recovery tables when updates are made from the RMIS system.

14. ANALYSIS OF MSM-VB PEF ESTIMATES

Several new techniques were analyzed for the 1986-1997 catch years so that a consistent set of PEF estimates and resulting cohort analyses could be used to make a new Coho FRAM base period. Each analysis used the same set of techniques for all stocks for all years. The analyses were done in a consecutive order to evaluate each technique. Each technique was used to improve the PEF estimates from the previous analysis. The techniques evaluated include user-defined PEF's for Washington State stocks, terminal run estimates of CWT recoveries for Washington State stocks, combining Canadian production regions for PEF estimates, and splitting combined Canadian PEF estimates based on expected total run sizes. The evaluation of each analysis was somewhat subjective because there is no reliable, independent data source to compare results. The primary consideration was that the PEF values were plausible and consistent by stock across all 12 years.

To insure consistency for all the analyses, stocks and fisheries were defined the same for all of the catch years. This is substantially different from the current coho base period where many individual management units were estimated separately and many fisheries were combined. When the original analysis was done it was theorized that using estimates for individual management units with large numbers of CWT recoveries would reduce the PEF estimation problem for the remaining stocks. This created two problems. First, the production regions with the separate management units PEF estimates had less CWT recoveries resulting PEF estimates with higher variances. Second, the separate management unit did not have the range of CWT recoveries by fishery and time period as the larger, aggregated production region estimate. All stocks were aggregated at the production region level for all analyses except for the Columbia River and the Oregon Coast. The Columbia River estimates were split into early, late, and Young's Bay components because of the significant differences in timing, distribution, and the availability of CWT recoveries for all the years. The ocean-ranching management units were estimated separately for the Oregon Coast region.

The Bayesian estimation technique developed for the MSM-VB PEF program (Gazey 2005) was used for all the analyses. The PEF estimates were exactly the same as the original MSM-VB algorithm when all the weighting factors were set to a value of one. The Baysesian approach was used so that a fishery-weighting scheme could used to address the problem of low CWT recovery levels in fisheries with large catches. The fishery-weighting value used was the number of CWT recoveries used in the analysis divided by the total landed catch and then multiplied times 100. This weighting scheme mostly affected the troll fisheries in southeast Alaska and northern Canada where most of the contributing stocks had low CWT tagging rates. The PEF estimates for other stocks were greatly influenced by these fisheries because they are much larger than any other fisheries in the analysis. The Canadian stocks were most affected by the use of the fishery-weighting scheme and resulted in less negative values being estimated.

The first analysis estimated all PEF values for all stocks in all years without any used-defined PEF values, terminal run estimates, or stock combinations. Each year in this analysis had significant problems with very large positive and negative PEF values. This result was most likely due to the difference in the level of CWT recoveries for each MSM stock. Most of the Canadian stocks had relatively low CWT tagging levels compared to Puget Sound and Columbia

River stocks. The Canadian stocks are generally from much larger geographical regions and have significantly larger numbers of fish. It was common in most years that the smaller stocks were given large PEF estimates and the remaining stocks had a wide range of positive and negative PEF estimates.

The second analysis used the user-defined PEF values for stocks originating in Washington State. The initial runs attempted to use only the PEF values for stocks with obvious estimation problems such as negative values. This technique did not work very well because fixing one stock typically caused problems with the other remaining stocks. All user-defined PEF values for all years were used for this analysis to evaluate this technique. This resulted in estimation problems for remaining stocks from Alaska, Canada, and Oregon.

The third analysis used terminal run estimates of CWT returns for the Washington State stocks. The terminal run estimates used for this analysis are listed in Tables 18-21. The terminal runsizes from RRTERM for each production region for each year were divided by the user-defined PEF values to estimate the expected number of CWT returns.

Equation 14.1 --

$$EstCWTRec_f = TermRun_s / UserPEF_s$$

Where:

$EstCWTRec_f$	Estimated CWT Returns for Total Terminal Run (MSM Terminal Fishery)
$TermRun_s$	Total Terminal Run for stock ***s*** (from RRTERM)
$UserPEF_s$	User Defined PEF value for stock ***s*** (release PEF)

The advantage of using the terminal run estimate compared to the user-defined value for these stocks is the terminal run estimate is not static. Allowing for some flexibility in the PEF estimates for the Washington State stocks reduced the estimation problems for the other stocks. There were still problems for the Canadian stocks however. These problems were addressed by combining the regions with the greatest similarity. These combinations include northwest and southwest Vancouver Island (NWVNCI, SWVNCI), Strait of Georgia and Johnstone Strait (GSMNLD, GSVNCI, FRSLOW, JHNSTN), and north and central coast (BCNCST, BCCNTRL).

The final analysis split the combined PEF estimates for the Canadian stocks into individual production region components. This step was necessary because the resulting runsizes from the previous analysis yielded unlikely values. Stock runsizes are estimated by multiplying the PEF estimates times the number of CWT recoveries for each stock. When a combined PEF estimate is used the runsize value is a function of the CWT releases for that brood year in each region. The Canadian production regions have relatively low levels of CWT tagging and were highly variable between the years analyzed. No regional estimates of escapement or terminal runsize were available for any of the years. This problem was addressed by estimating a relative run strength between the combined regions to split the combined PEF values and was applied across all years. The relative run strength values were provided by Canadian DFO biologists. The split

user-defined PEF values were calculated by dividing the proportion of the combined runsize attributed to a stock by the total number of CWT recoveries for the stock.

Equations 14.2 and 14.3 --

$$MSMRunSize_s = \sum (EstCmbPEF_s * CWTRec_s)$$

$$UserPEF_s = (MSMRunSize_s * RelRunStrength_s) / CWTRec_s$$

Where:

$MSMRunSize_s$	Mixed Stock Runsize for stock ***s*** (does not include terminal or escapement)
$UserPEF_s$	Estimated User PEF value for stock ***s***
$EstCmbPEF_s$	Estimated PEF for Combined stock ***s*** (MSM Estimate)
$RelRunStrength_s$	Relative Run Strength for Combined stock ***s*** (DFO Estimate)
$CWTRec_s$	Total CWT Recoveries for stock ***s*** (for CWT releases used in MSM)

Tables 13 and 14 show the combined and recalculated PEF values for the Canadian production regions. The effect of these changes for the Coho FRAM base period exploitation rates are minor because the escapement numbers for these production regions are derived from the index exploitation rates provided by DFO staff. The index values are shown in Table 18. The Coho FRAM base period exploitation rates are an average of the rates from each used in the base period selected and will not change. The final step in the MSM analysis is the computation of cohort sizes by time step and the exploitation rates by stock and fishery. A comparison of cohort sizes by stock and year between the old methodology for the current Coho FRAM base period and the new MSM program is shown in Figures 13-43. Each figure is for an individual production region across all the years analyzed. Estimates for the old methodology are only available for the 1986-1991 catch years. The differences between the old and new estimates for most stocks were relatively small except for some of the Canadian stocks and some years for other stocks. The Washington State stocks with the greatest differences were Stillaguamish/Snohomish, Strait of Juan de Fuca, and Queets. These stocks are smaller in total numbers than nearby stocks and typically had "user-defined" PEF values for many of the years in the old methodology. The Canadian stocks were expected to be substantially different because of the technique used to split the combined PEF estimates.

The results of these analyses show that the estimation algorithm has problems with closely stock groups that have similar CWT recovery distributions and not being able to be constrained to positive values only. The large differences in CWT tagging rates between production regions have a direct influence the PEF estimation problems. The use of terminal run estimates and "user-defined" PEF values are a convenient method of using CWT recovery information with other known information about each stock. The comparison of the old and new cohort sizes resulting from the PEF estimation procedures show that different approaches yield very similar results. This suggests that the general technique of estimating PEF values using CWT distribution data is valid. The final step of calculating a Coho FRAM base period by averaging the results over many years should result in a better predictive tool for fishery regulation analysis.

15. LITERATURE CITED

Gazey, B. 2005. Development and Documentation of Coho Mixed Stock Model Component. Southern Boundary Restoration & Enhancement Fund 2004/2005 Project #A-022.

JTC (Joint Canada-US Coho Technical Committee). 2002. Joint Canada-U.S. Coho Technical Committee Workplan. Pacific Salmon Commission.

PFMC (Pacific Fishery Management Council). 2006. Fishery Regulation Assessment Model – An overview for Chinook and Coho. Model Evaluation Workgroup, PFMC.

PFMC (Pacific Fishery Management Council). 2005. Review of 2004 ocean salmon fisheries. Pacific Fishery Management Council, Portland, Oregon.

PSC (Pacific Salmon Commission). 1994. Interim estimates of the Coho stock composition for the 1984-1991 southern area fisheries and for the 1987-1991 northern panel area fisheries, TCCOHO(94)-1.

Scott, J.B., R.A. Moore, R.A. Comstock, M. Alexandersdottir, and W. Tweit. 1995. A coded wire tag based methodology for reconstructing Coho salmon (*Oncorhynchus kisutch*) cohorts. Draft Manuscript. Washington Department of Fisheries, Olympia, Washington.

Starr, P.J., and R. Hilborn. 1988. Reconstruction of harvest rates and stock contribution in gauntlet salmon fisheries. Canadian Journal of Fisheries and Aquatic Sciences 45:2216-2229.

Tompkins, A. 2005. Development and documentation of expanded Canadian FRAM base period for Coho. Pacific Biological Station, Canada Department of Fisheries and Oceans. Southern Boundary Restoration & Enhancement Fund 2004/2005 Project #A-050.

16. FIGURES

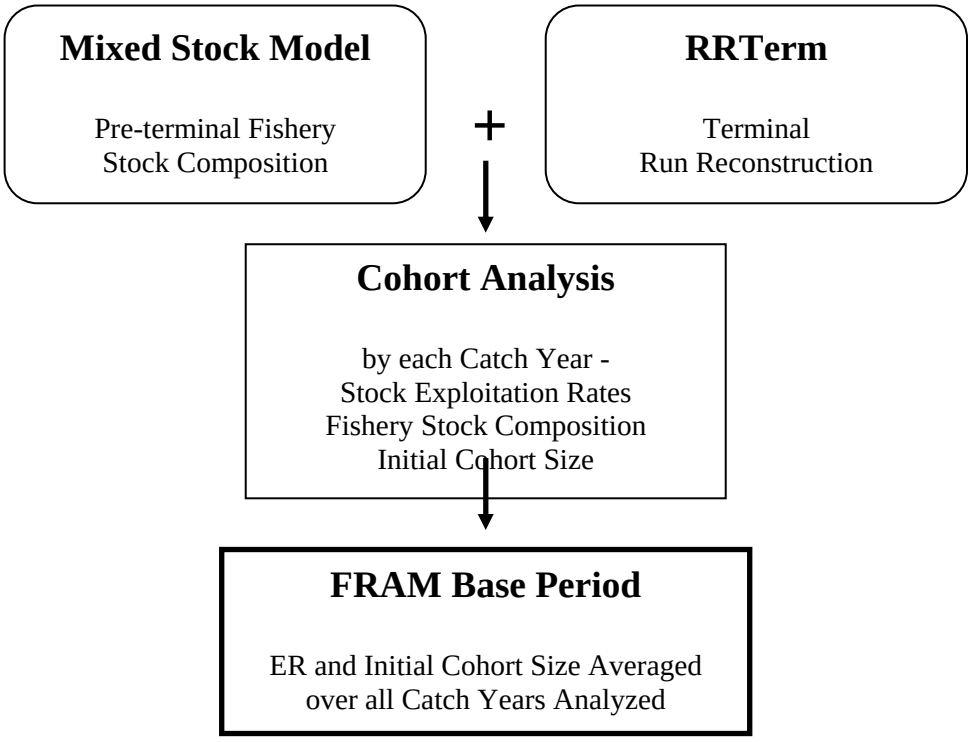

Figure 1. An overview of the process in which cohort analysis is completed and the Coho FRAM base period is developed.

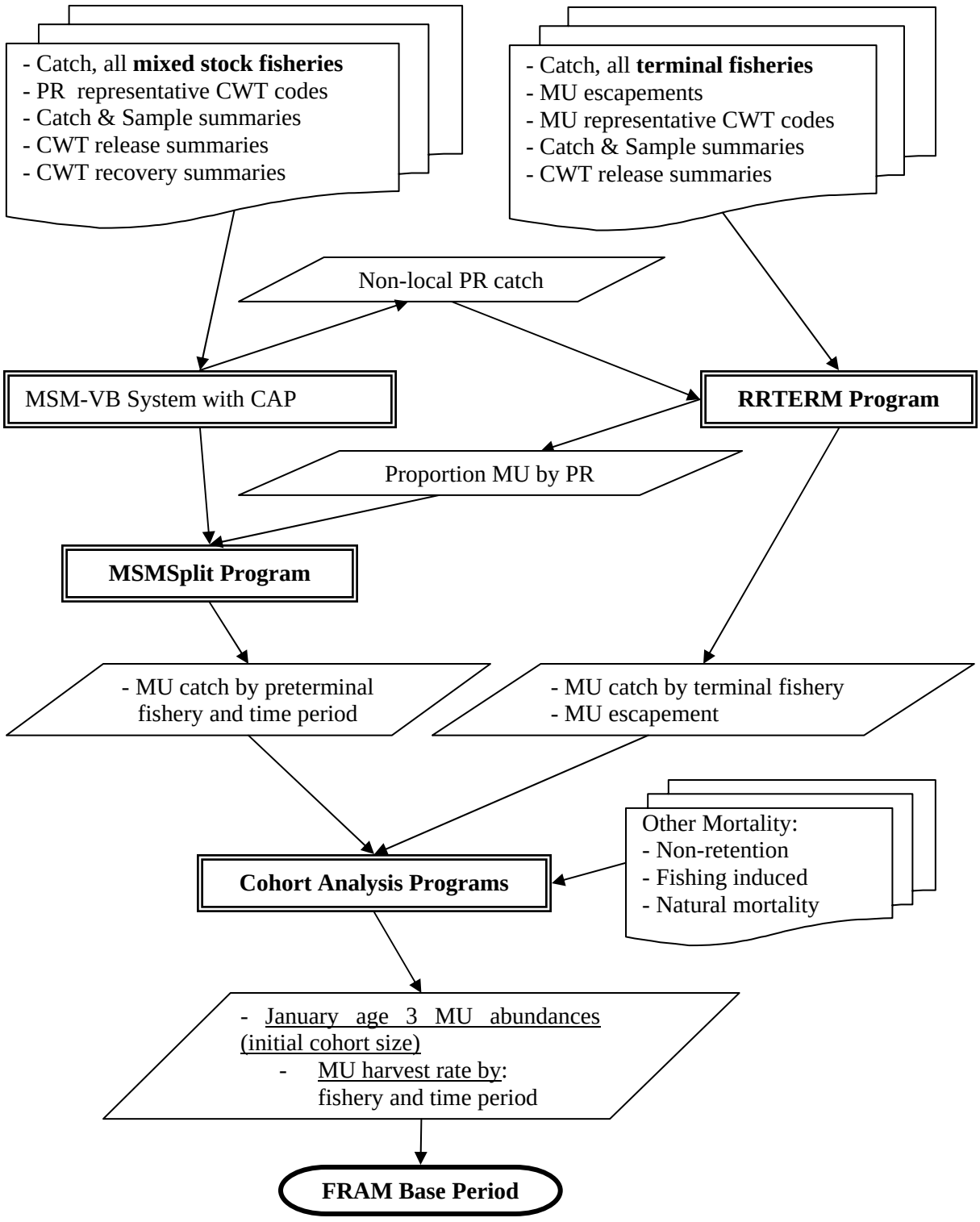

Figure 2. Flowchart of Coho FRAM base period development process and data inputs. MU = Management Unit, PR = Production Region, CAP = Catch Adjustment Program.

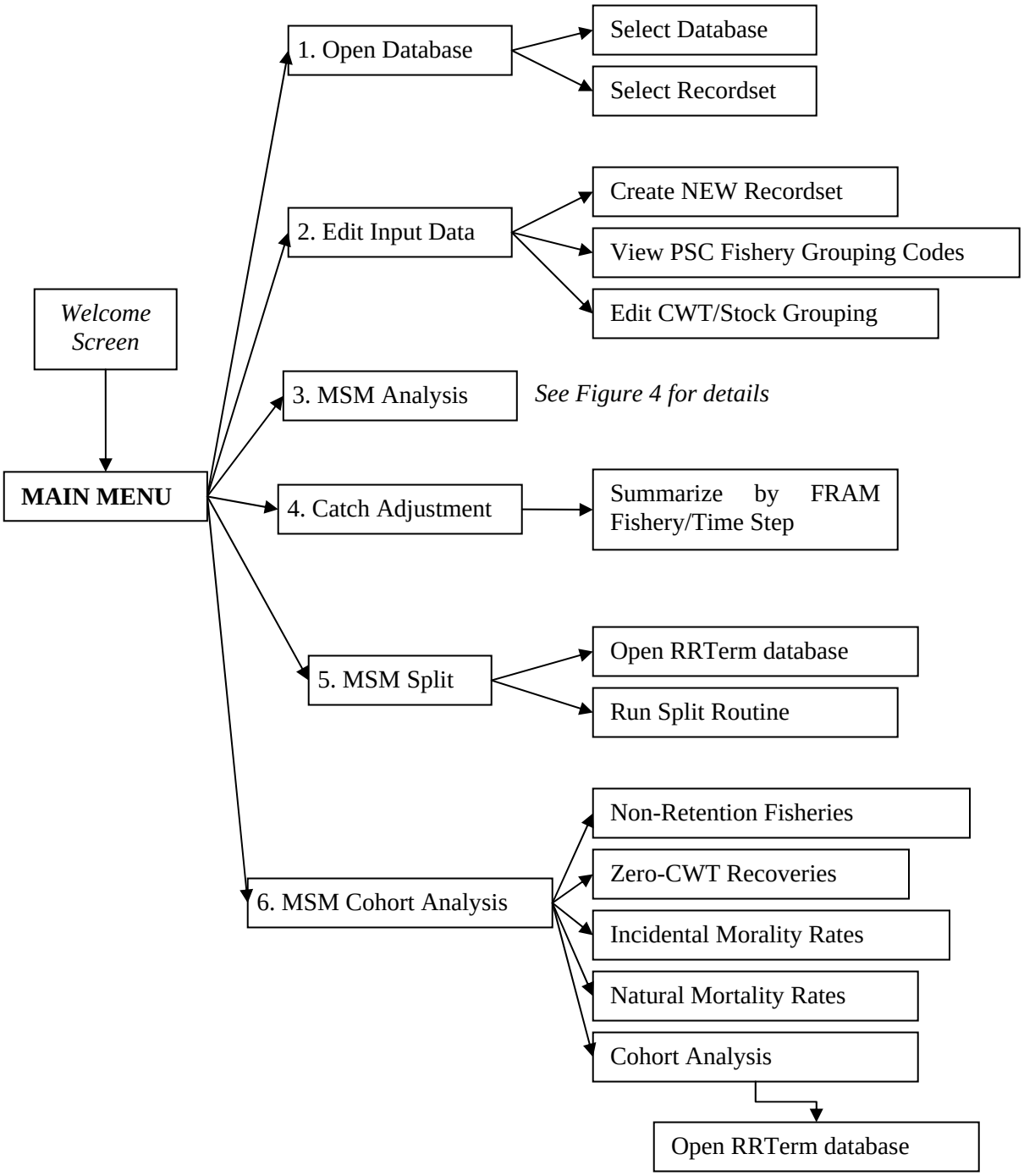

Figure 3. Flowchart of the six MSM-VB System components.
See Figure 4 for MSM Analysis options.

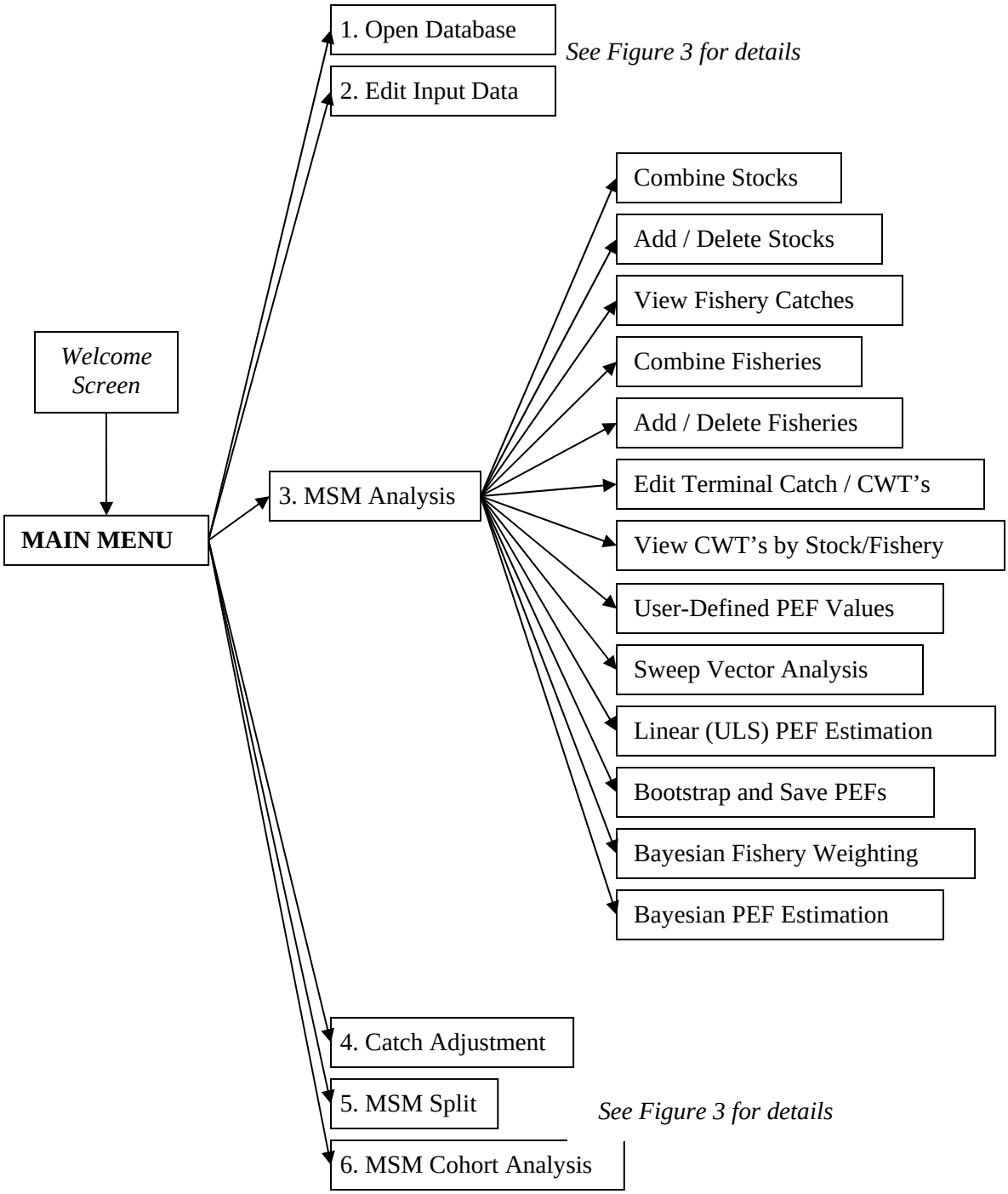

Figure 4. Flowchart of MSM-VB system's MSM Analysis components.
See Figure 3 for options available under all other MSM-VB subprograms.

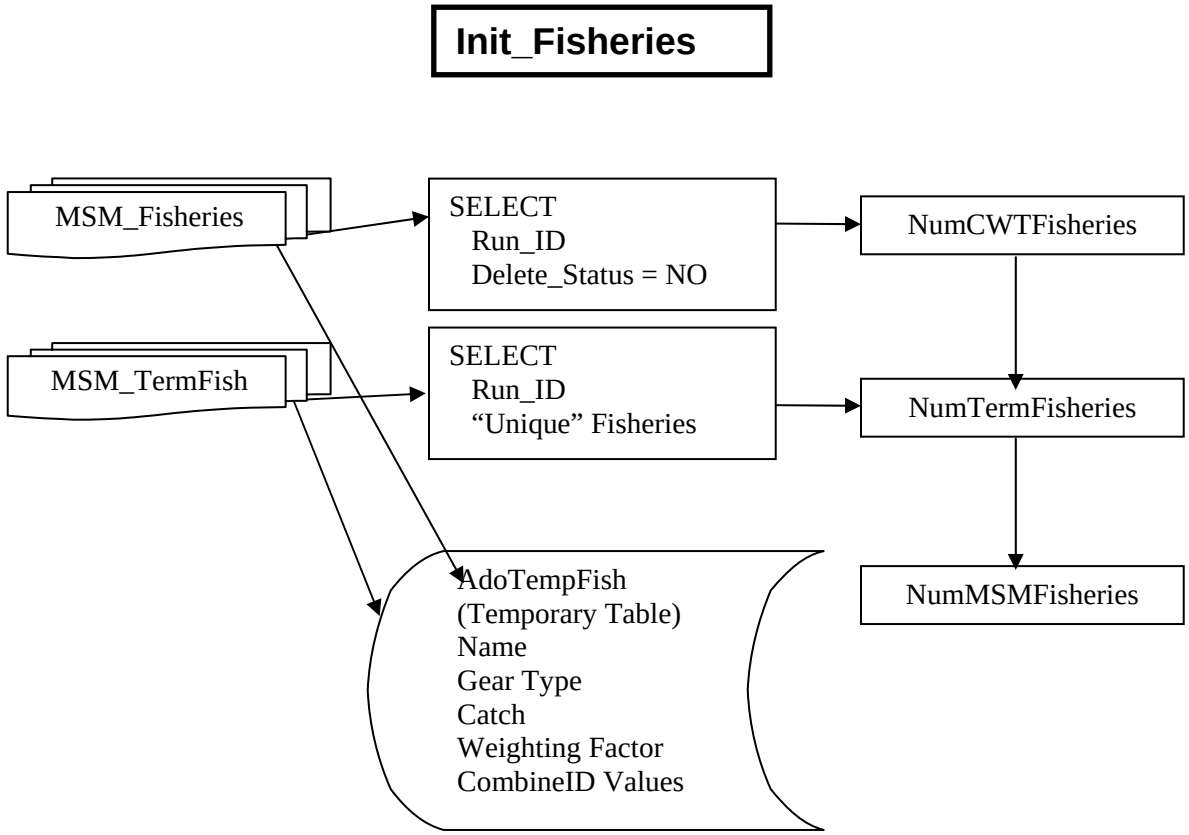

Figure 5. Flowchart of subroutine "Init_Fisheries" in the MSM-VB program.

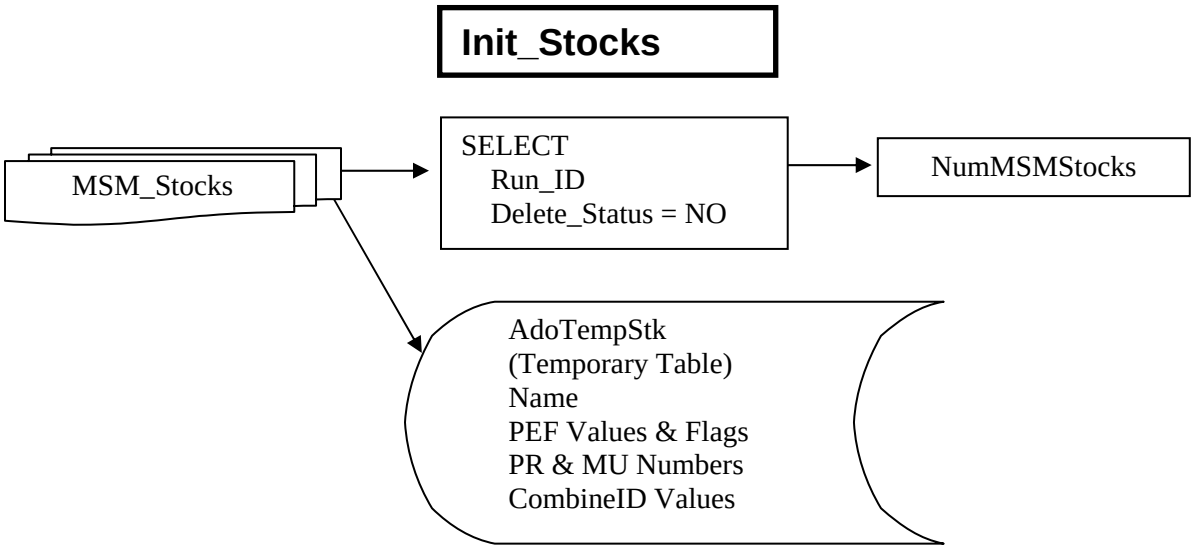

Figure 6. Flowchart of subroutine "Init_Stocks" in the MSM-VB program.

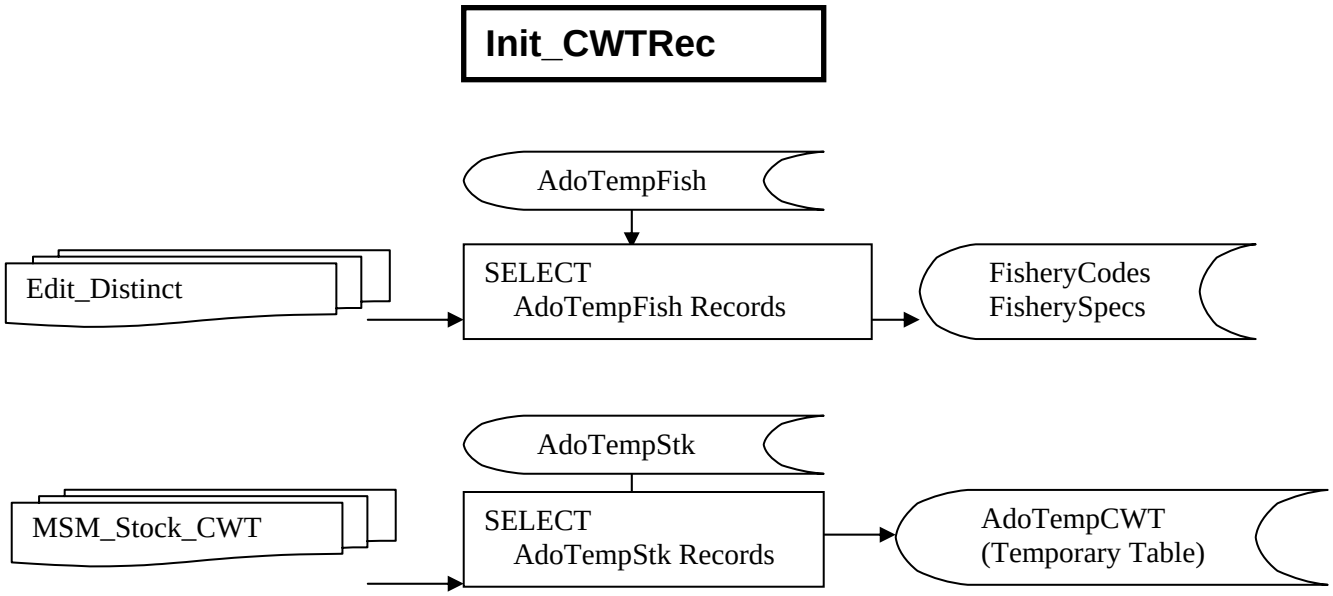

Figure 7. Flowchart of subroutine "Init_CWTRec" in the MSM-VB program.

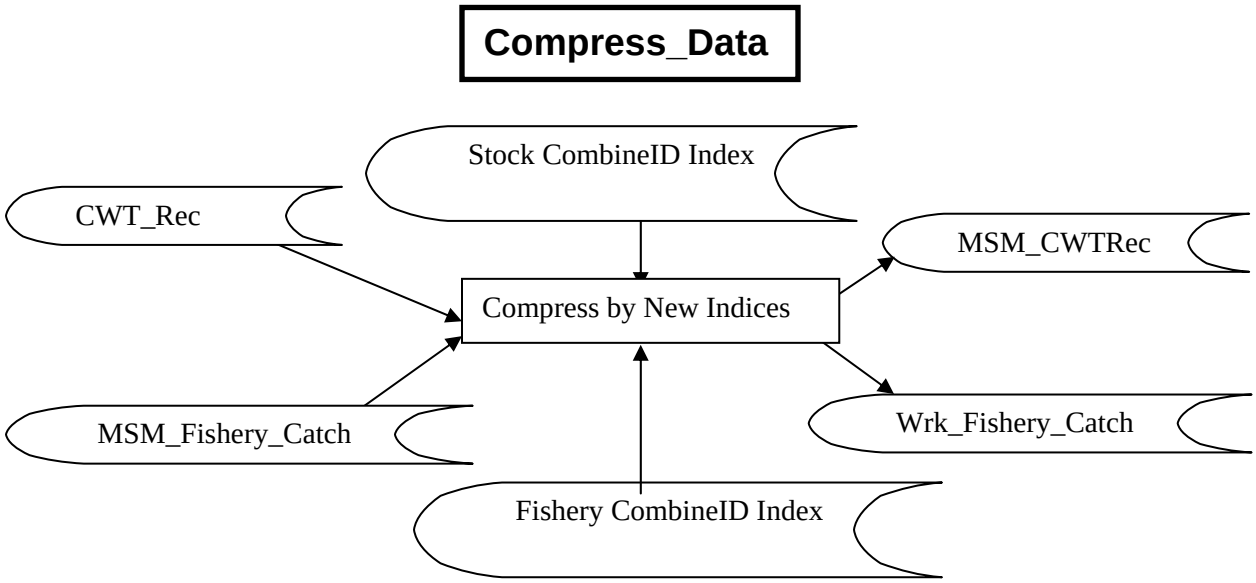

Figure 8. Flowchart of subroutine "Compress_Data" in the MSM-VB program.

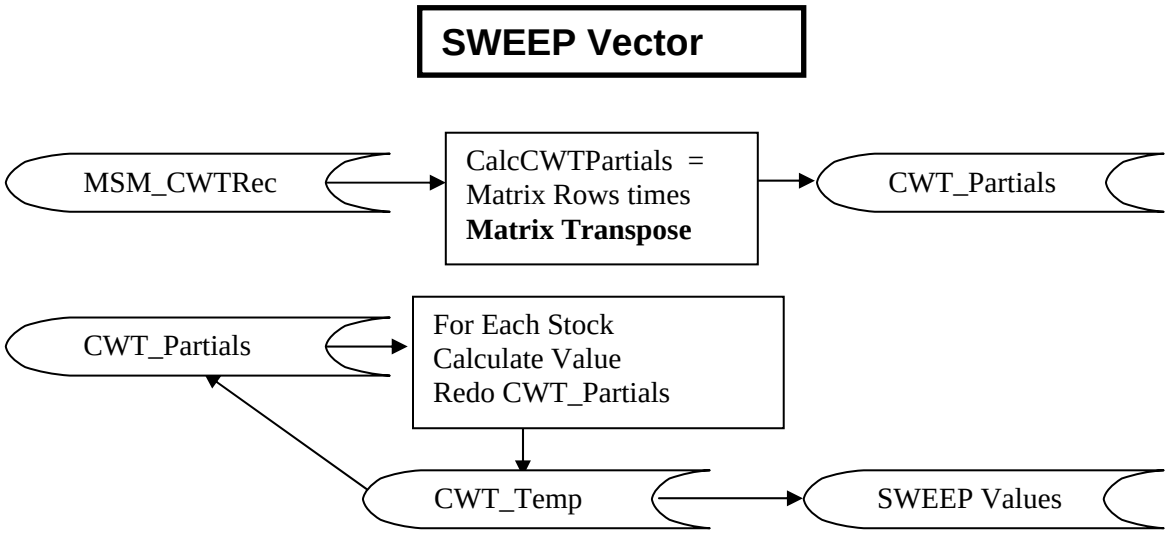

Figure 9. Flowchart of subroutine "SweepVector" in MSM-VB program.

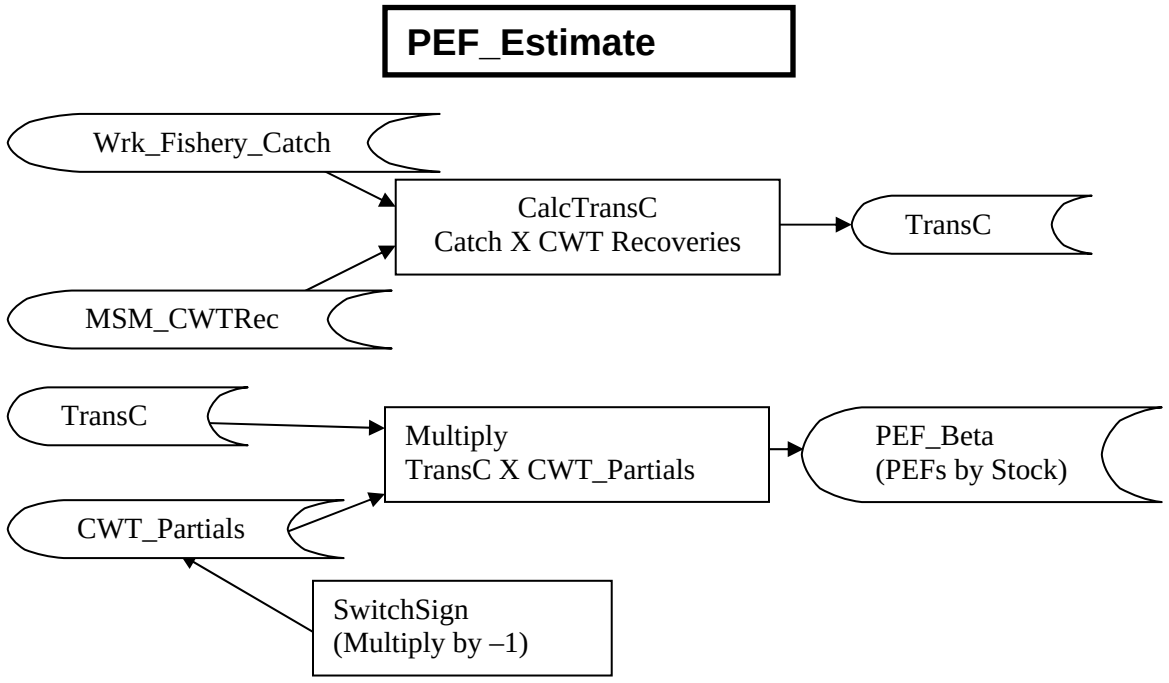

Figure 10. Flowchart of subroutine "PEF_Estimate" in the MSM-VB program.

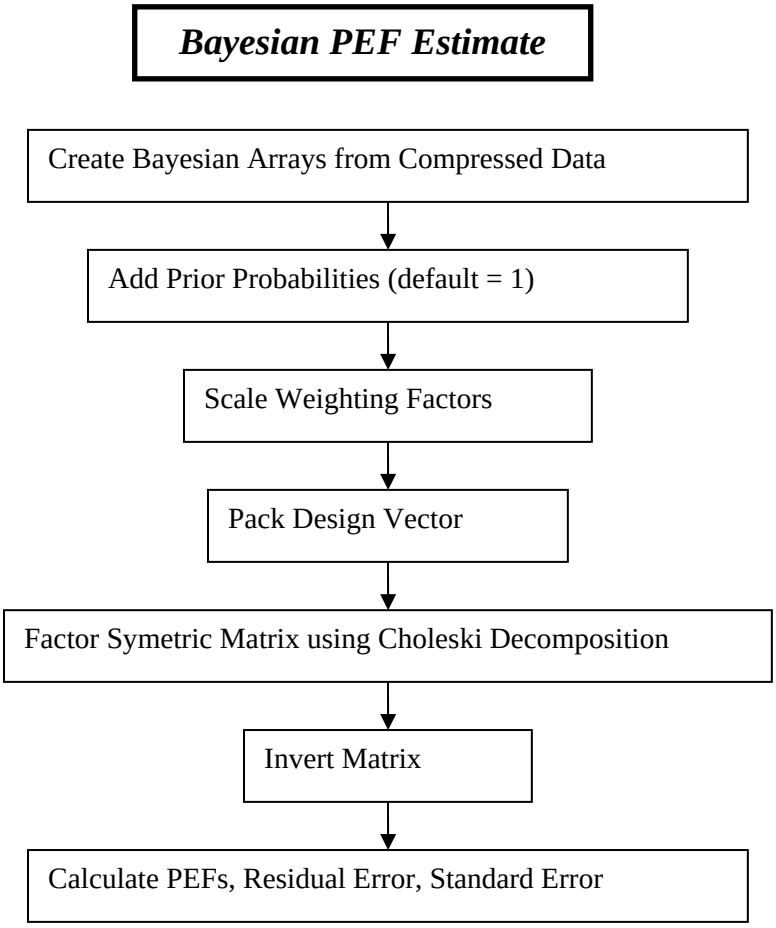

Figure 11. Steps performed by the subroutine "Bayesian_PEF_Estimate" in the MSM-VB program.

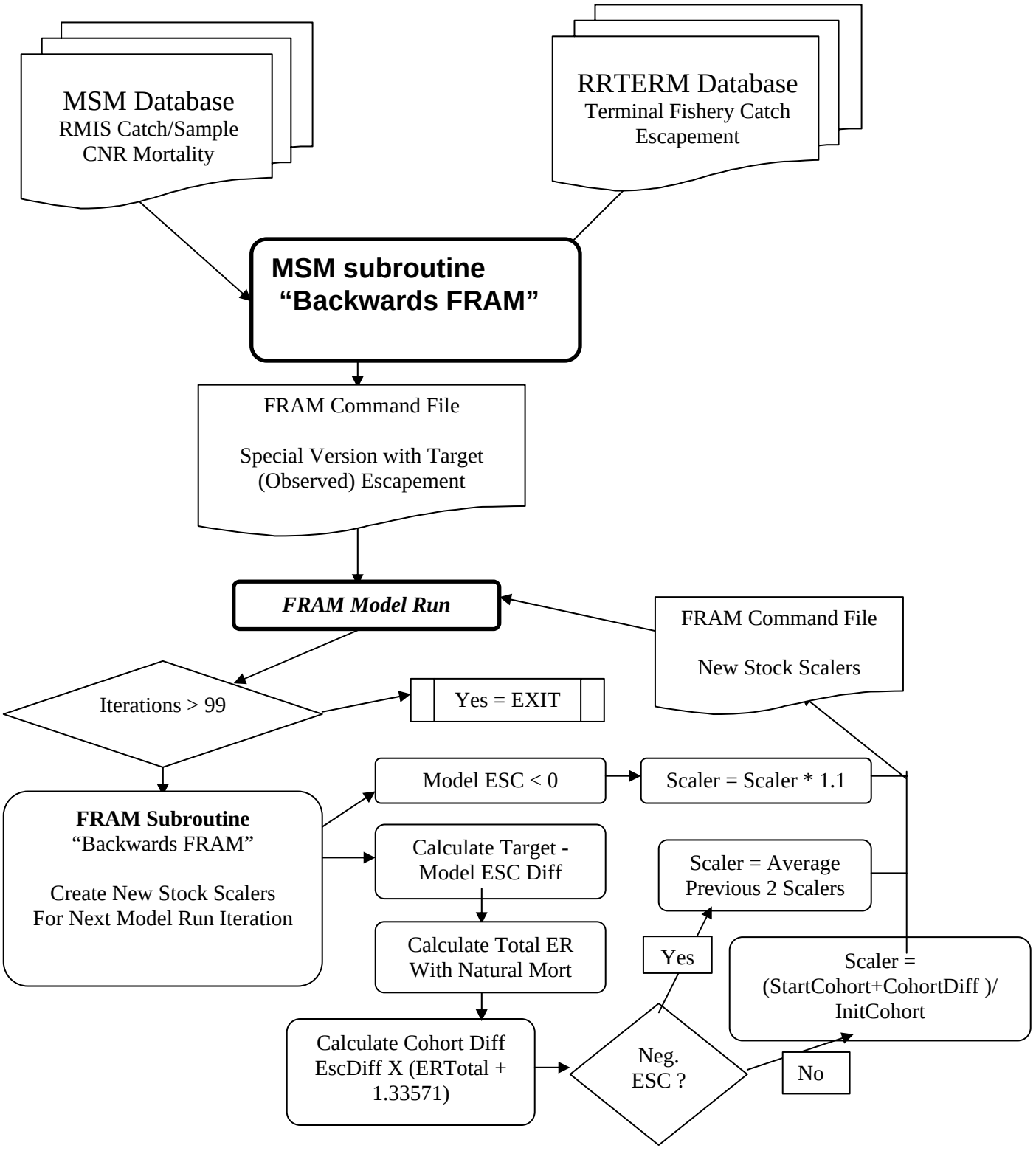

Figure 12. Flowchart depicting the steps in performing "Backwards FRAM".

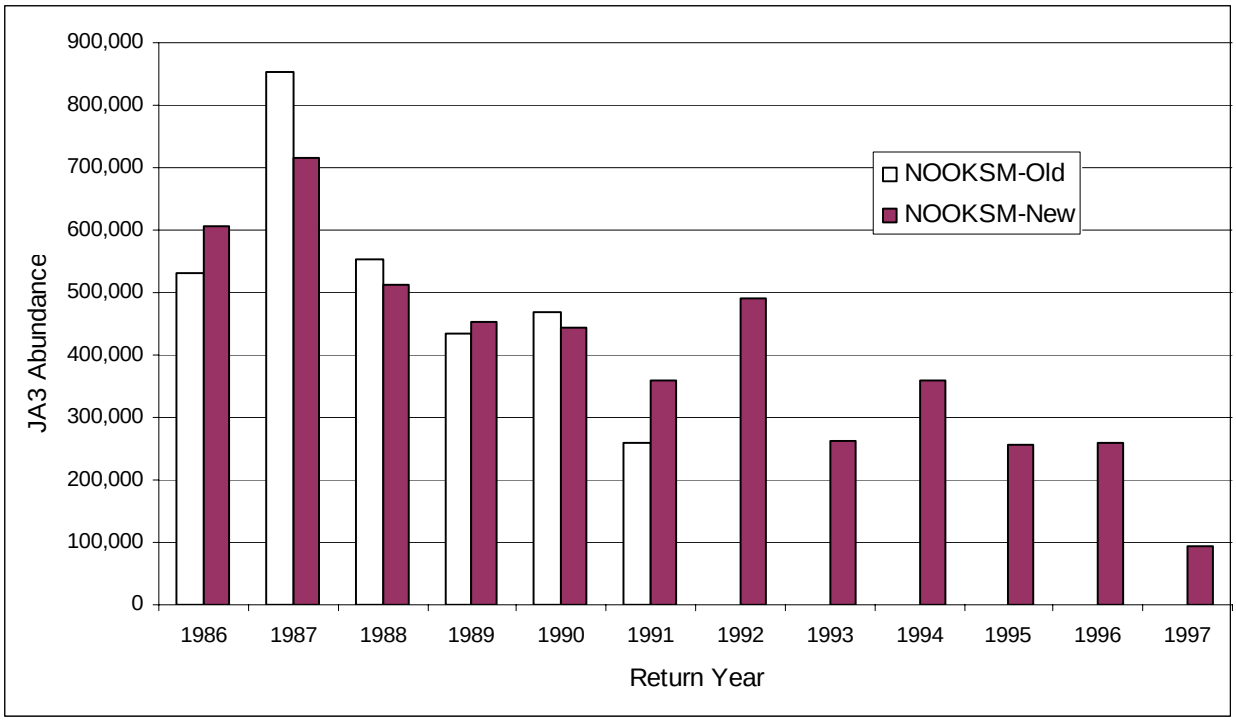

Figure 13. Comparison of old and new MSM Nooksack-Samish cohort sizes.

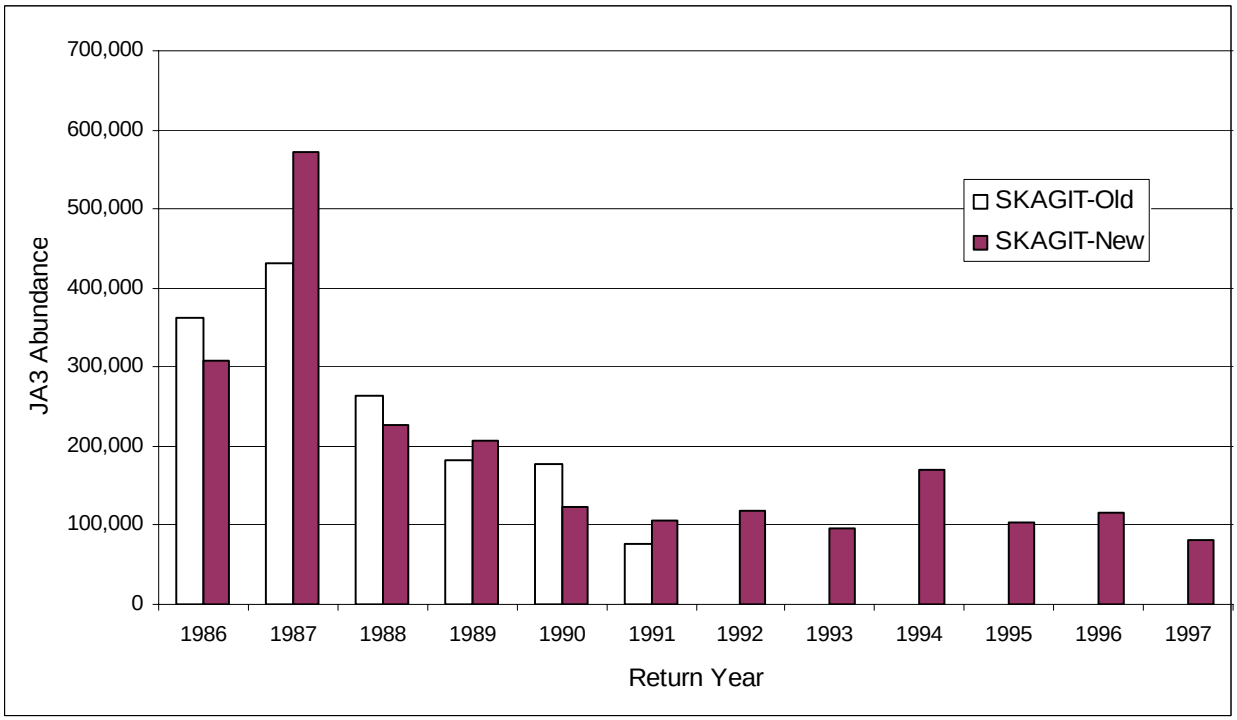

Figure 14. Comparison of old and new MSM Skagit cohort sizes.

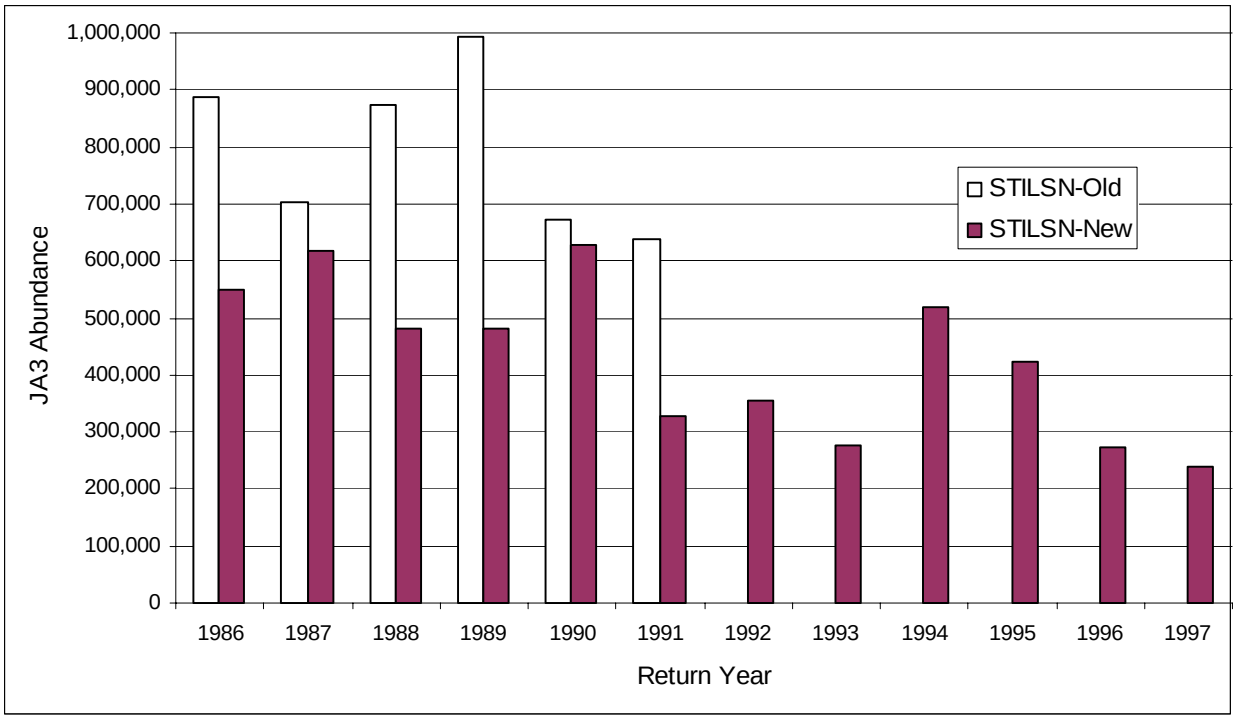

Figure 15. Comparison of old and new MSM Stillaguamish-Snohomish cohort sizes.

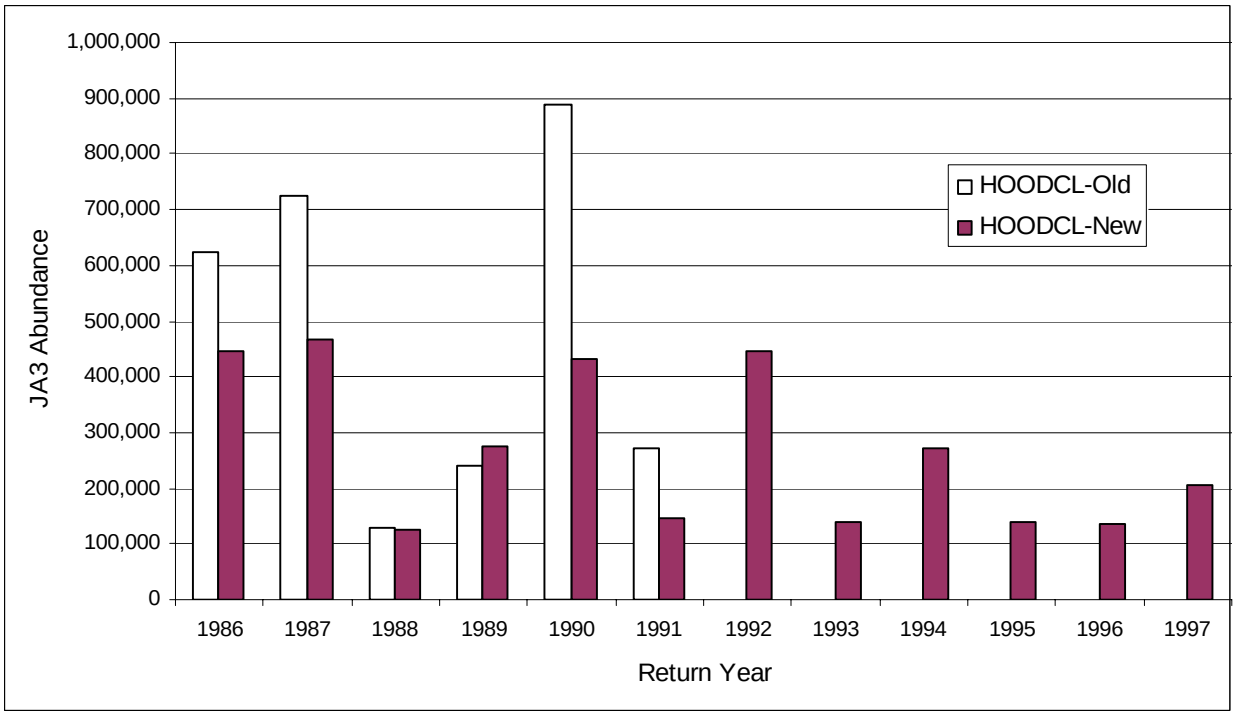

Figure 16. Comparison of old and new MSM Hood Canal cohort sizes.

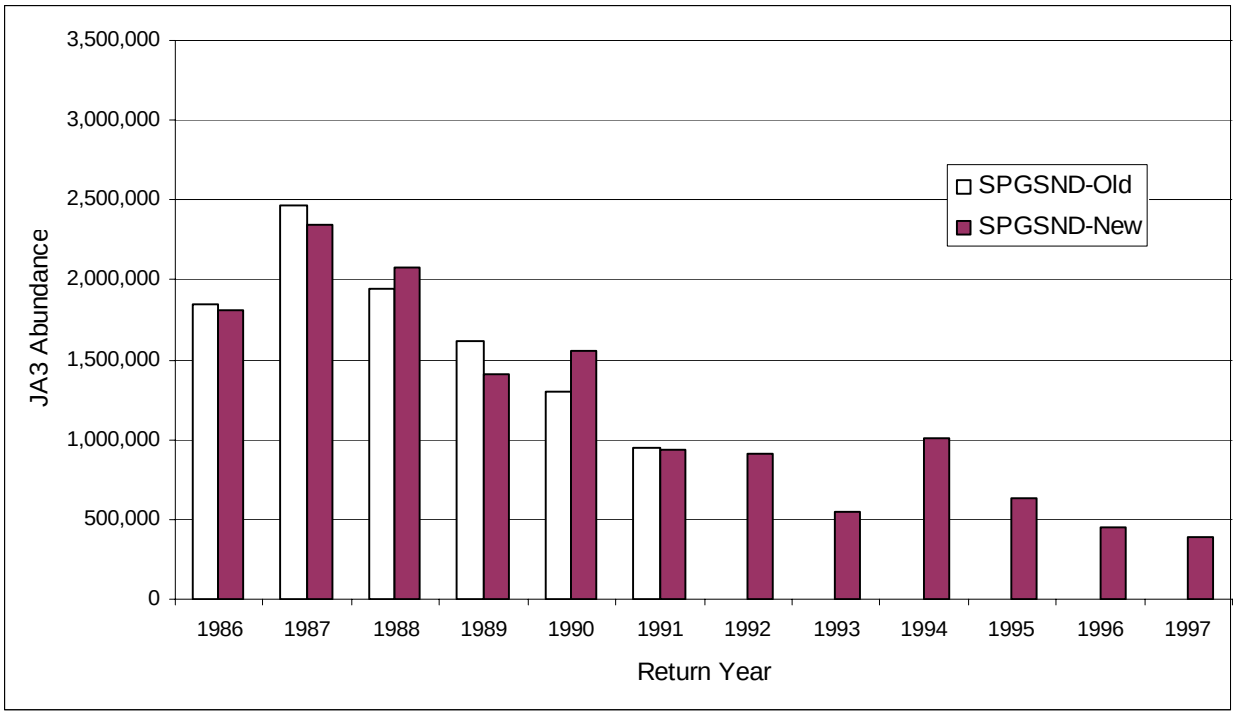

Figure 17. Comparison of old and new MSM South Puget Sound cohort sizes.

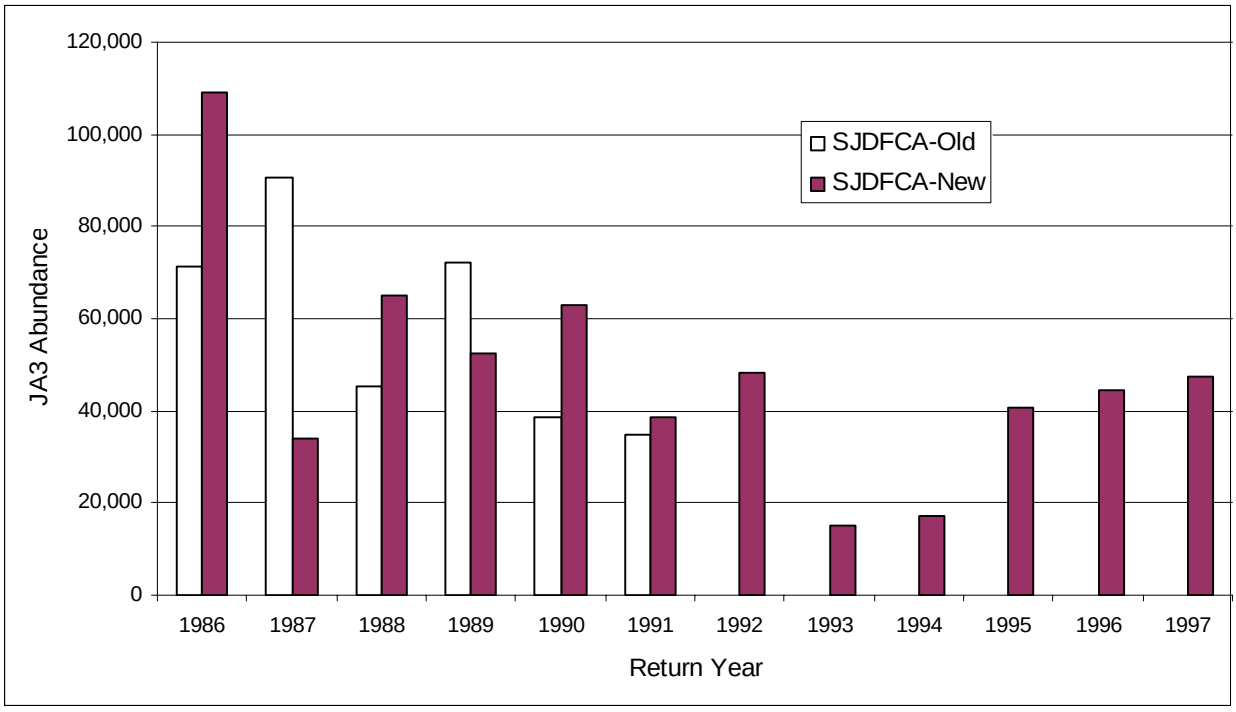

Figure 18. Comparison of old and new MSM Strait of Juan de Fuca cohort sizes.

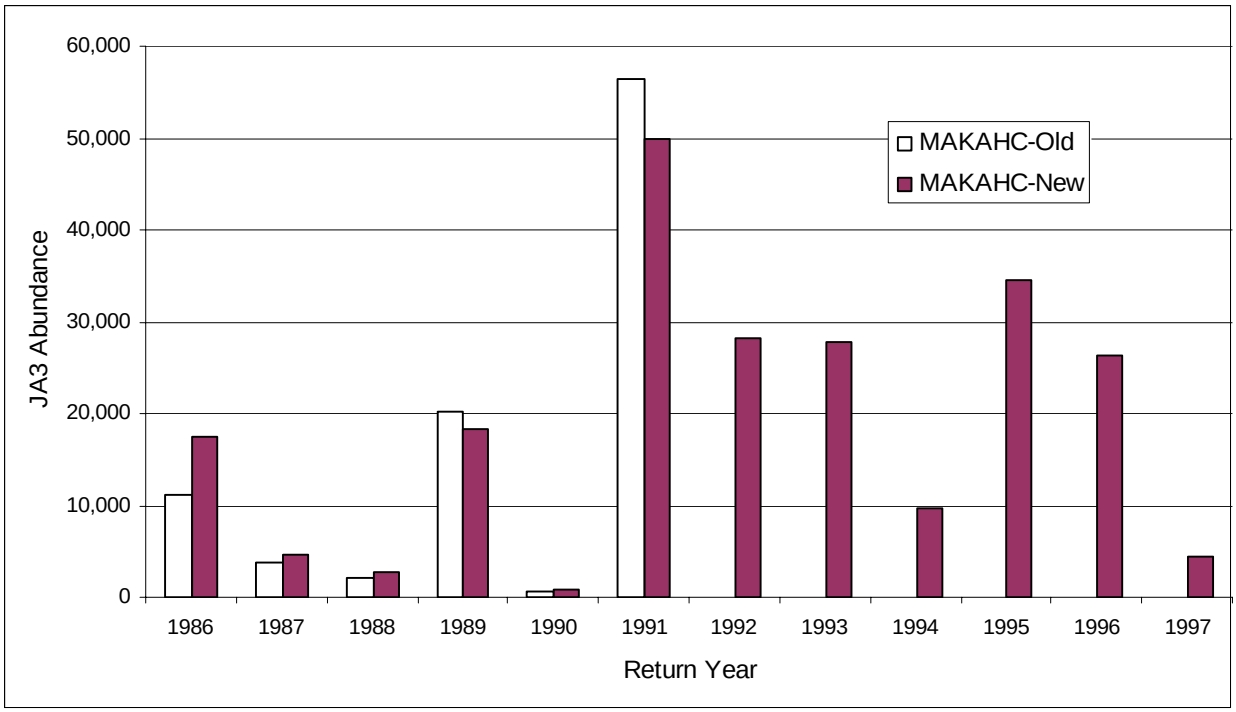

Figure 19. Comparison of old and new MSM Makah cohort sizes.

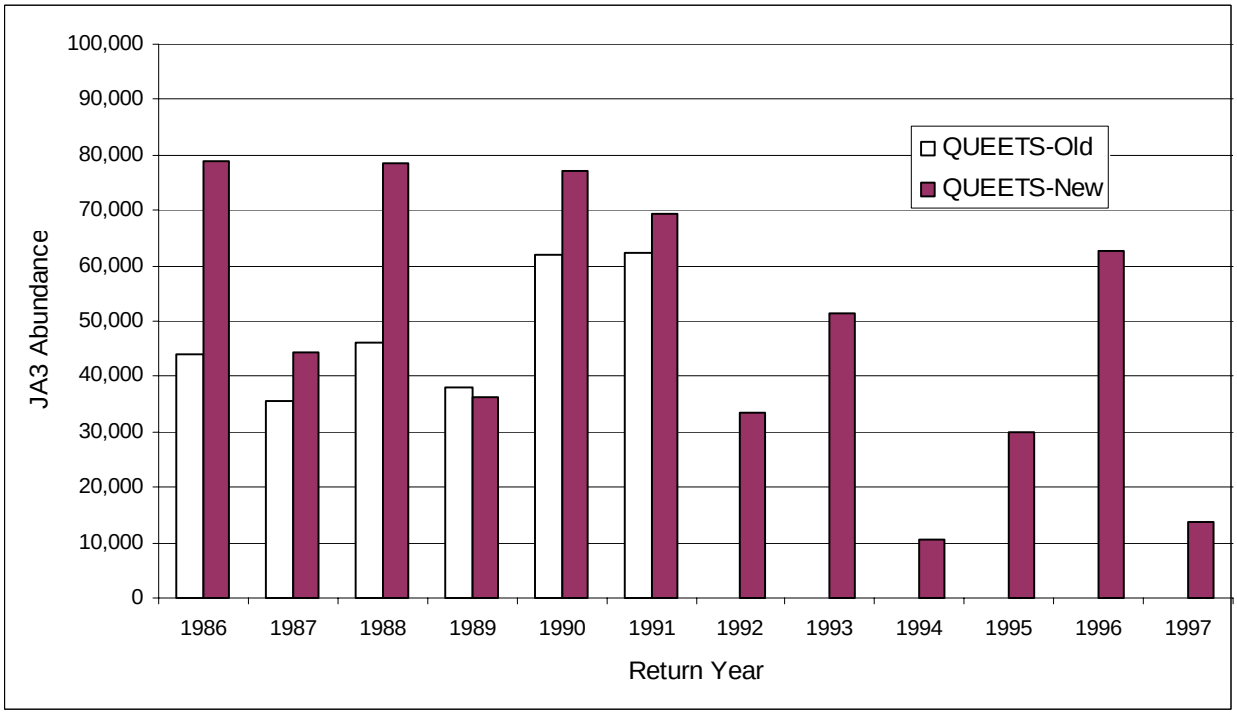

Figure 20. Comparison of old and new MSM Queets cohort sizes.

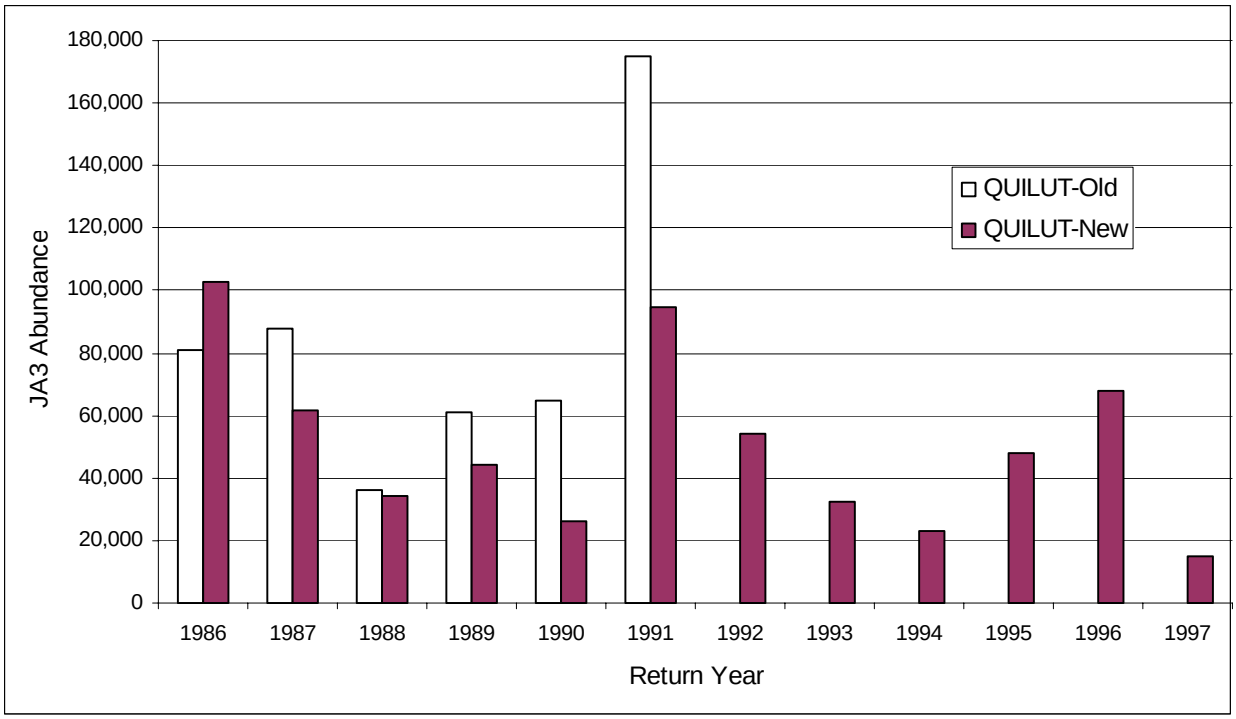

Figure 21. Comparison of old and new MSM Quillayute cohort sizes.

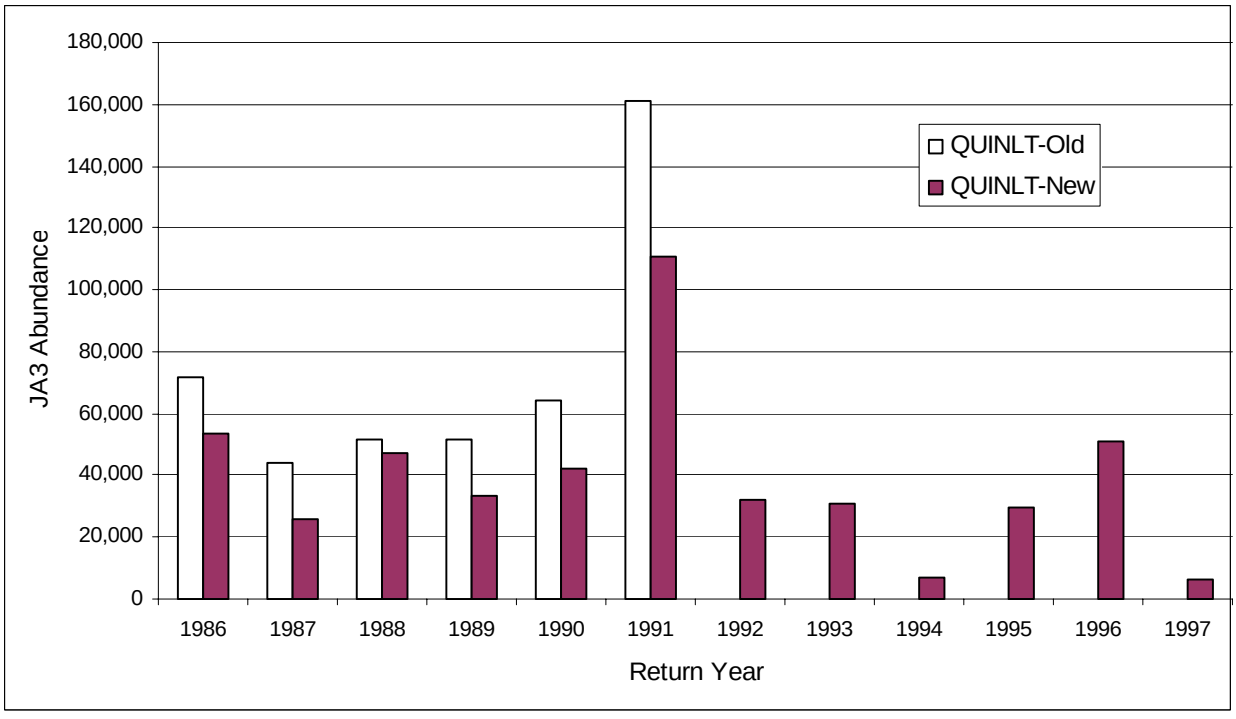

Figure 22. Comparison of old and new MSM Quinault cohort sizes.

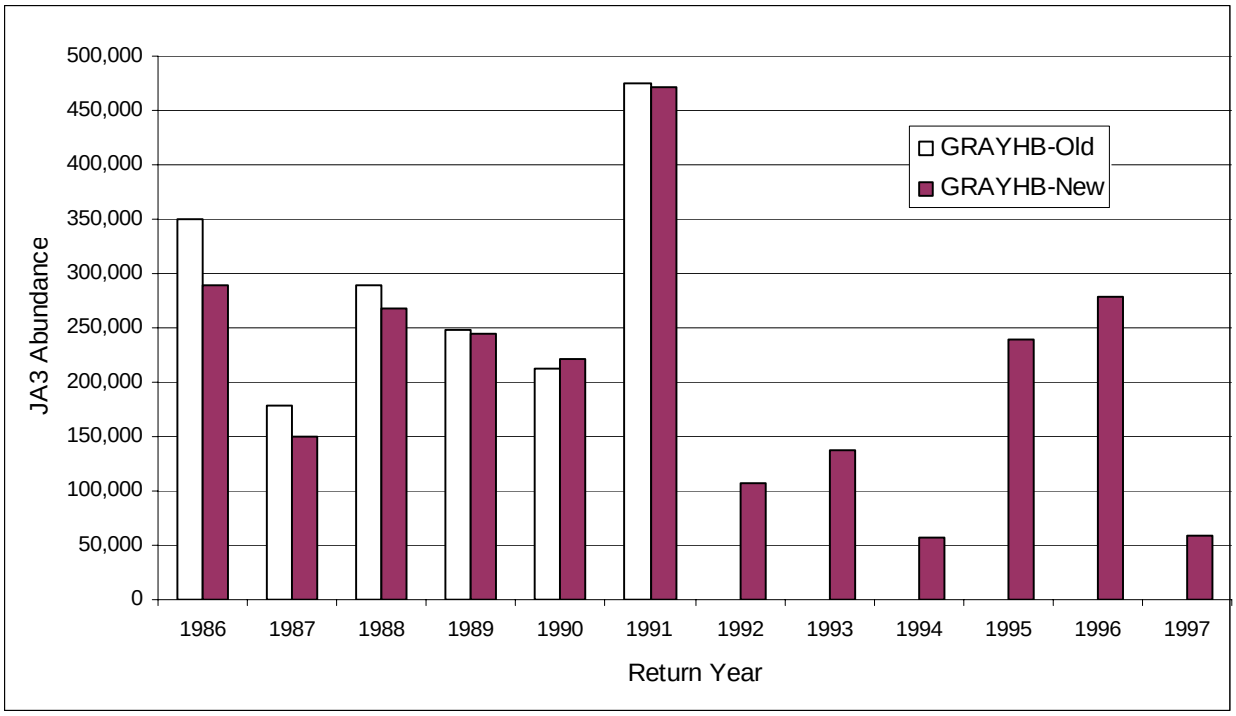

Figure 23. Comparison of old and new MSM Grays Harbor cohort sizes.

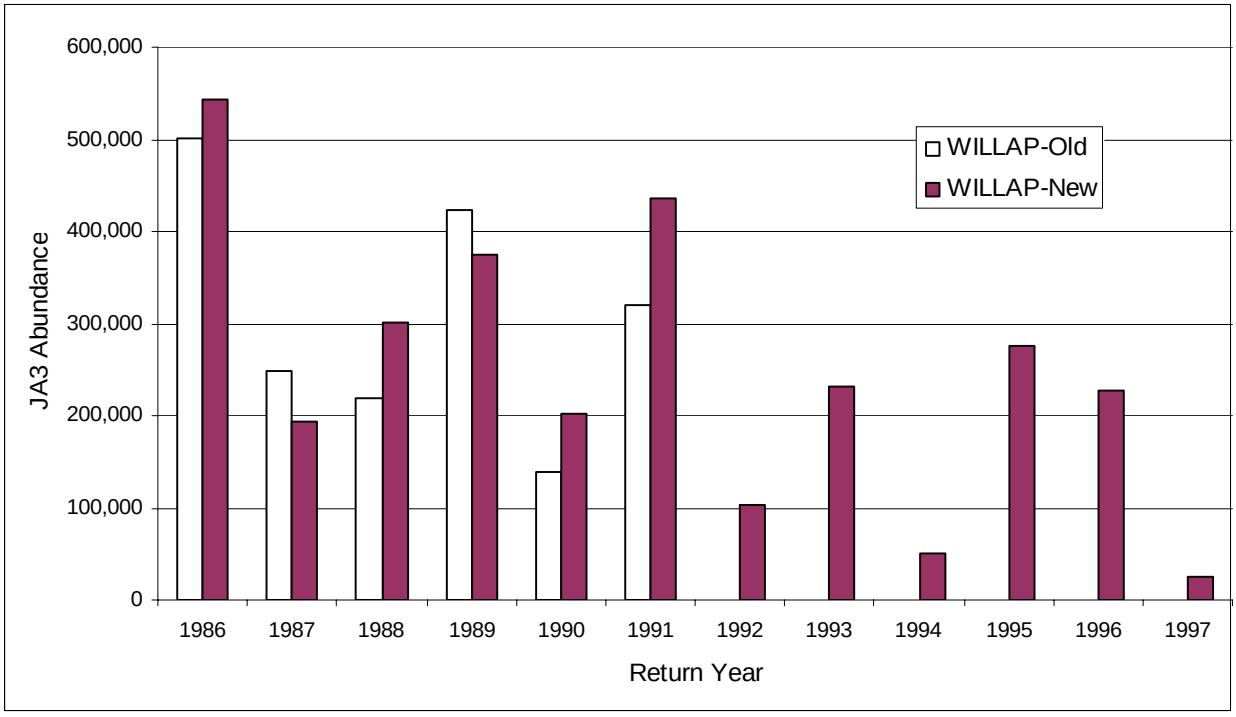

Figure 24. Comparison of old and new MSM Willapa Bay cohort sizes.

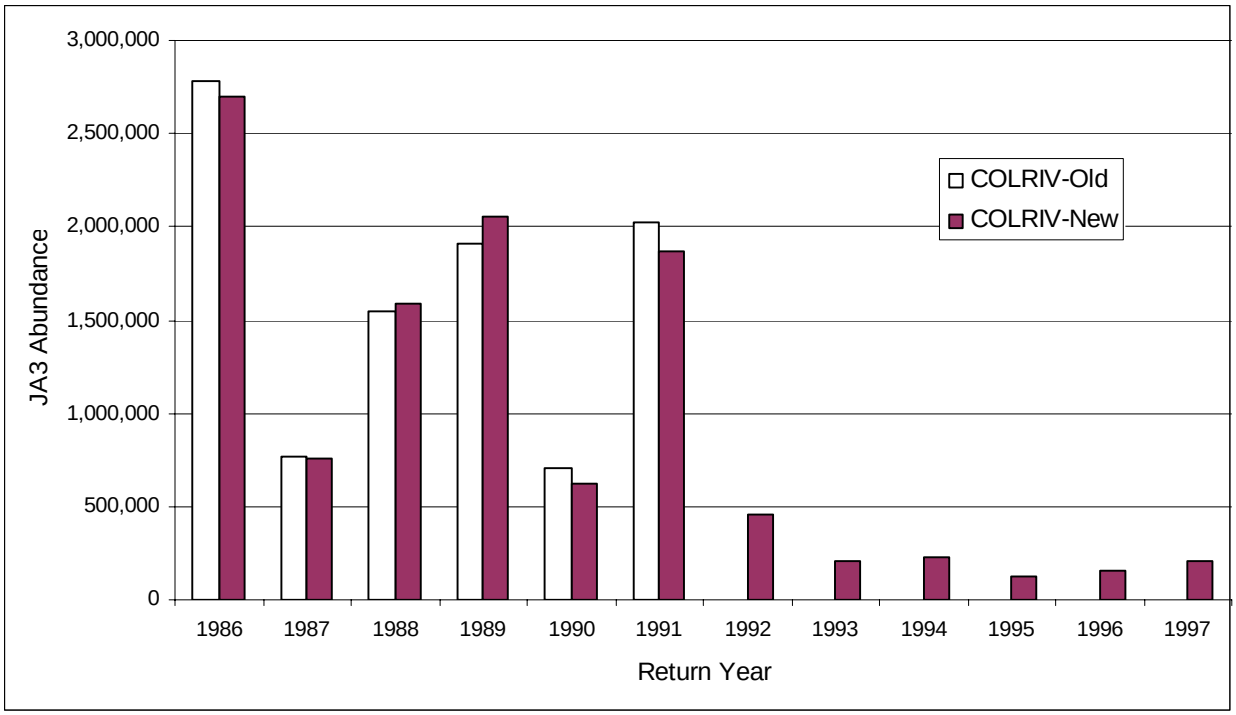

Figure 25. Comparison of old and new MSM Columbia River Early cohort sizes.

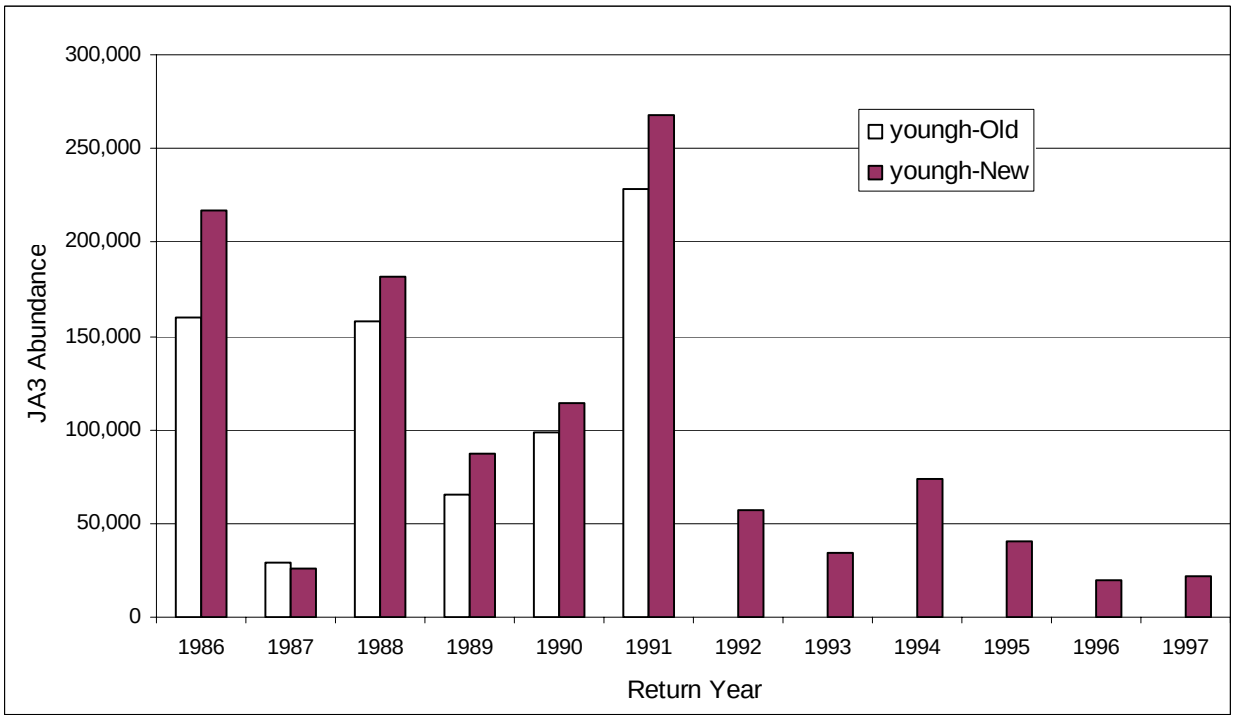

Figure 26. Comparison of old and new MSM Youngs Bay cohort sizes.

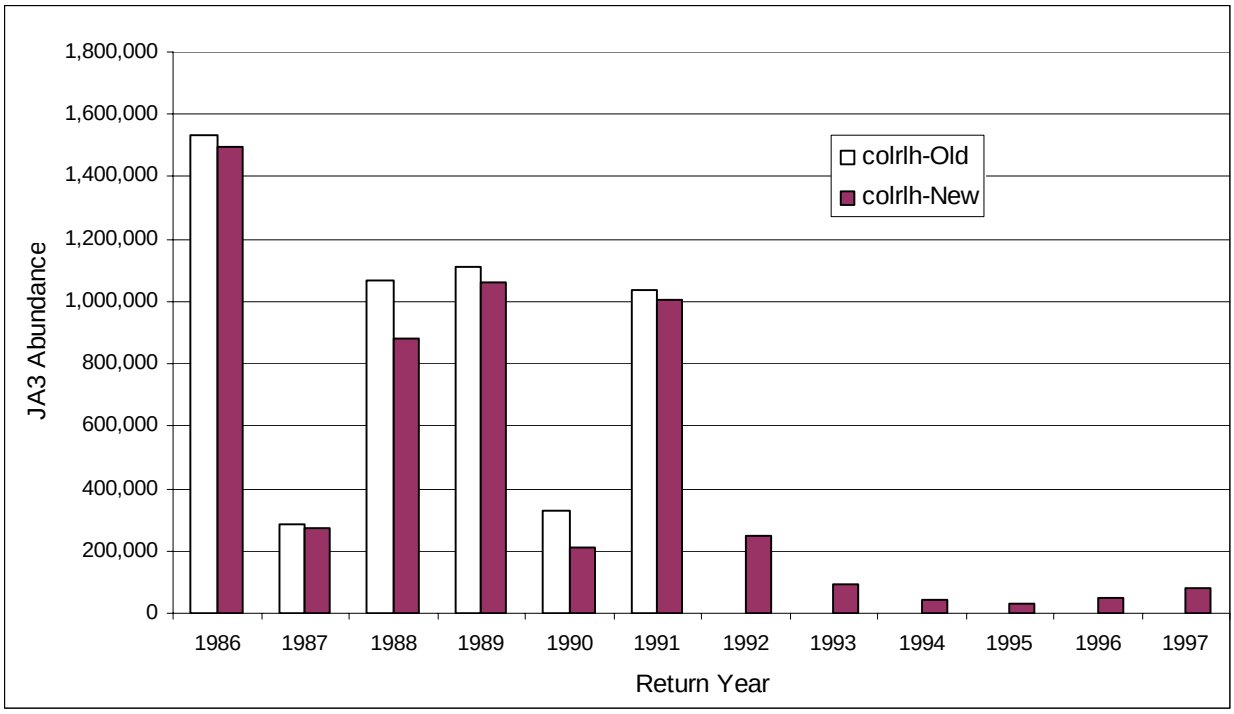

Figure 27. Comparison of old and new MSM Columbia River Late cohort sizes.

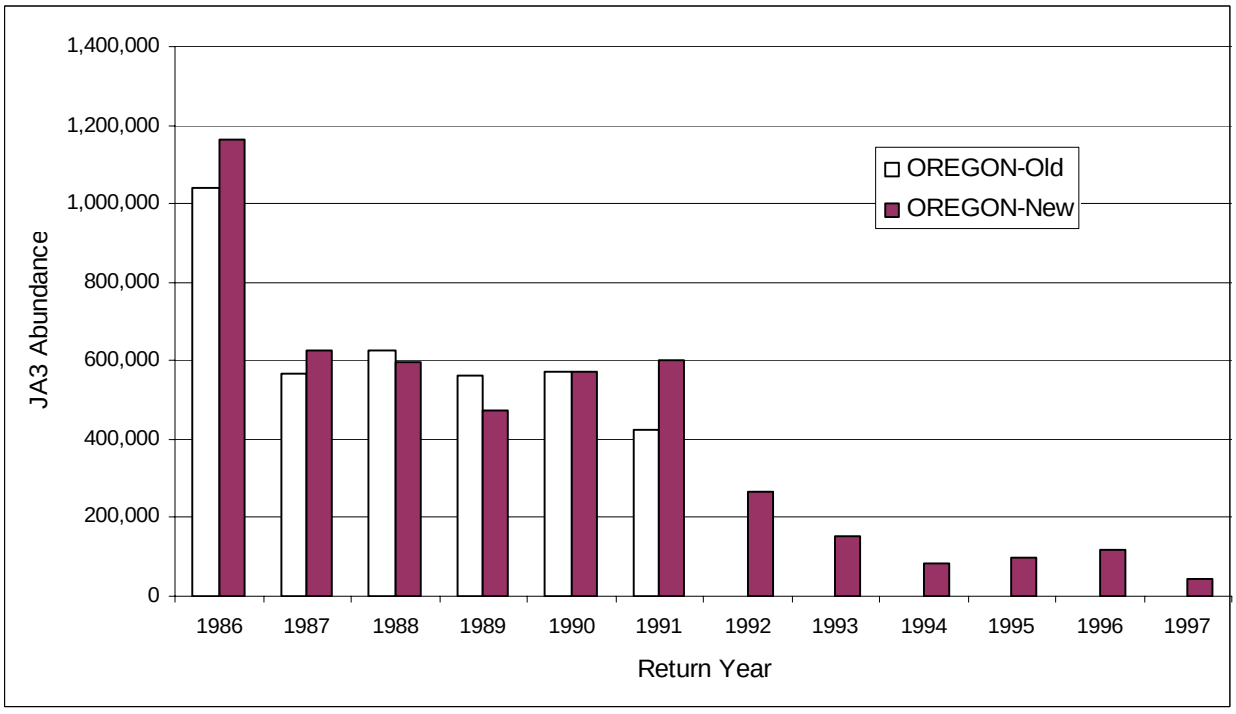

Figure 28. Comparison of old and new MSM Oregon Coast cohort sizes.

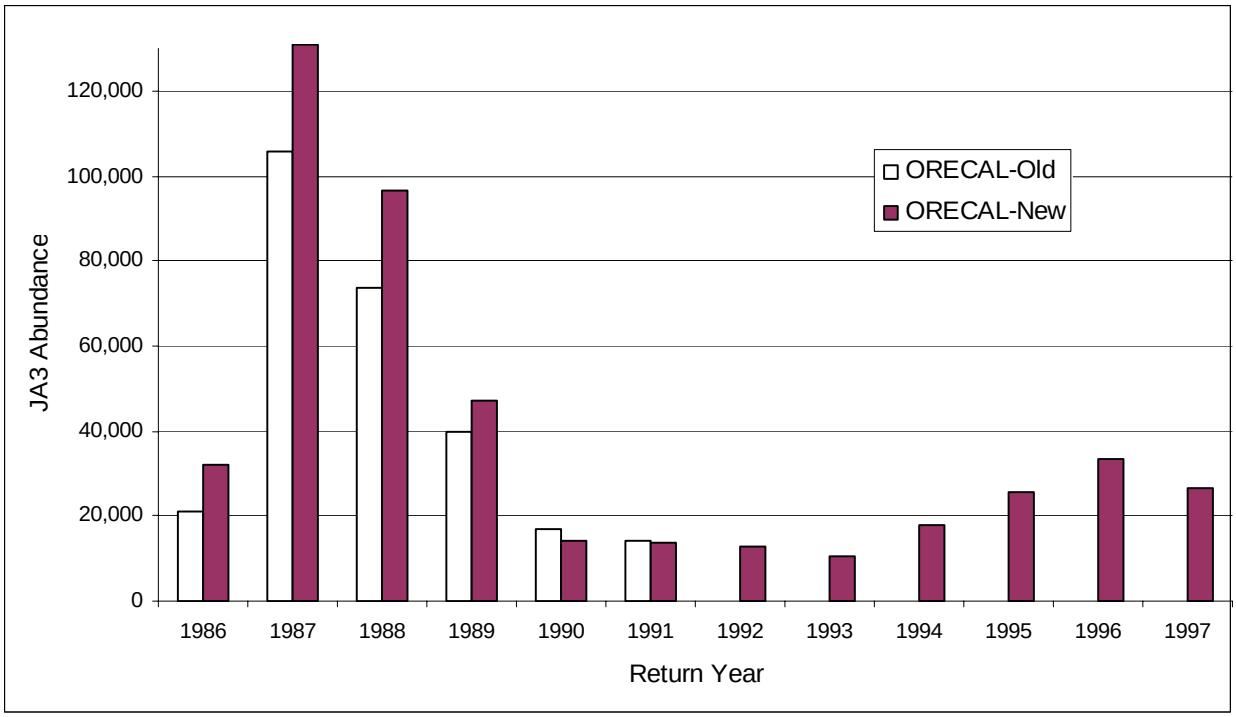

Figure 29. Comparison of old and new MSM South Oregon-California cohort sizes.

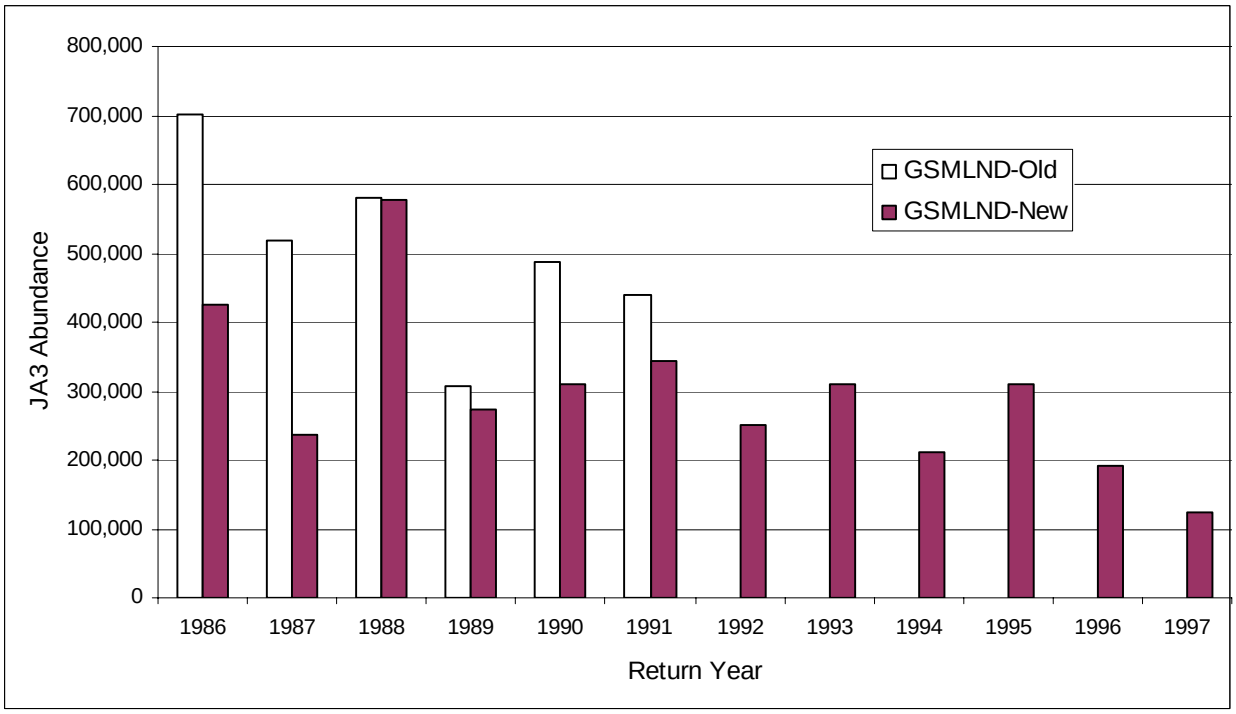

Figure 30. Comparison of old and new MSM Georgia Strait Mainland cohort sizes.

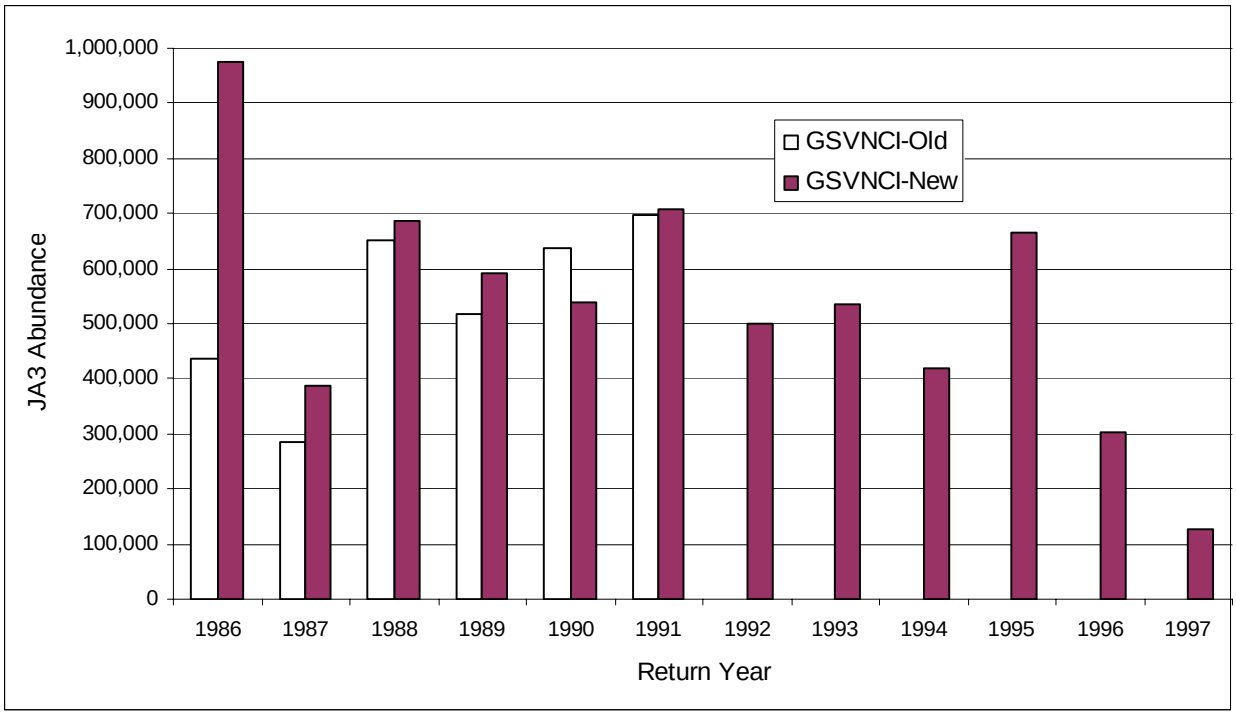

Figure 31. Comparison of old and new MSM Georgia Strait-Vancouver. Island cohort sizes.

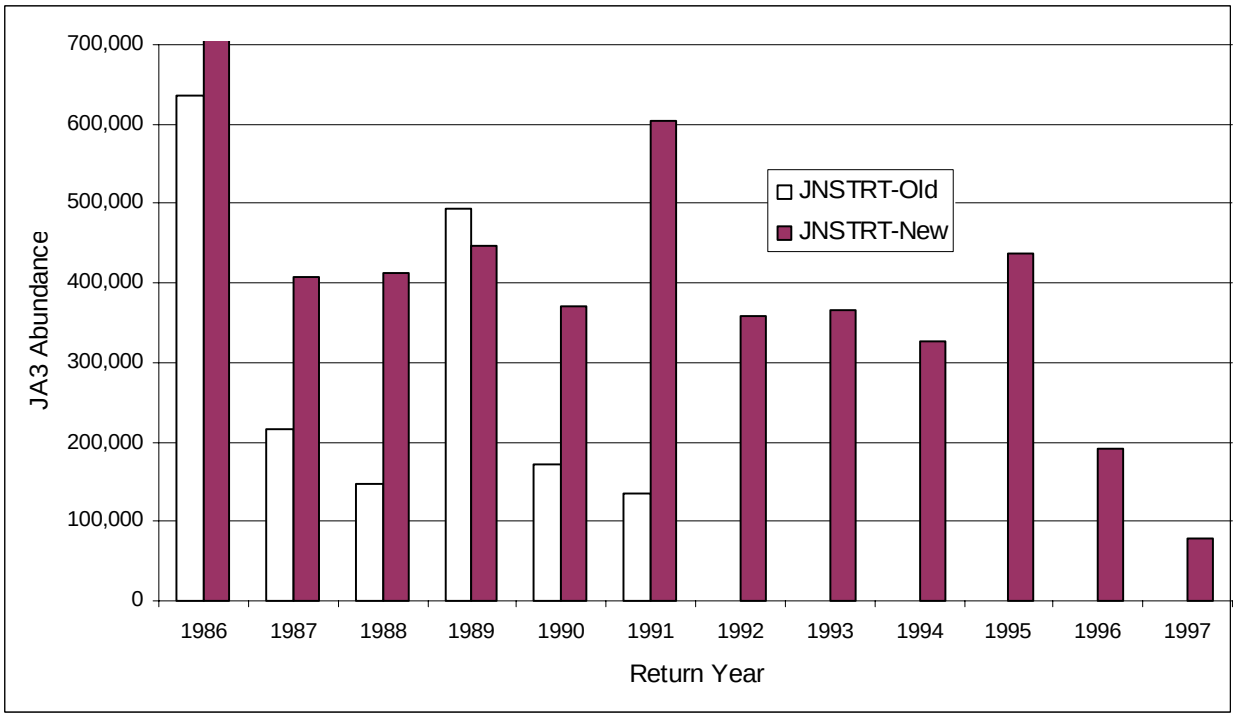

Figure 32. Comparison of old and new MSM Johnstone Strait cohort sizes.

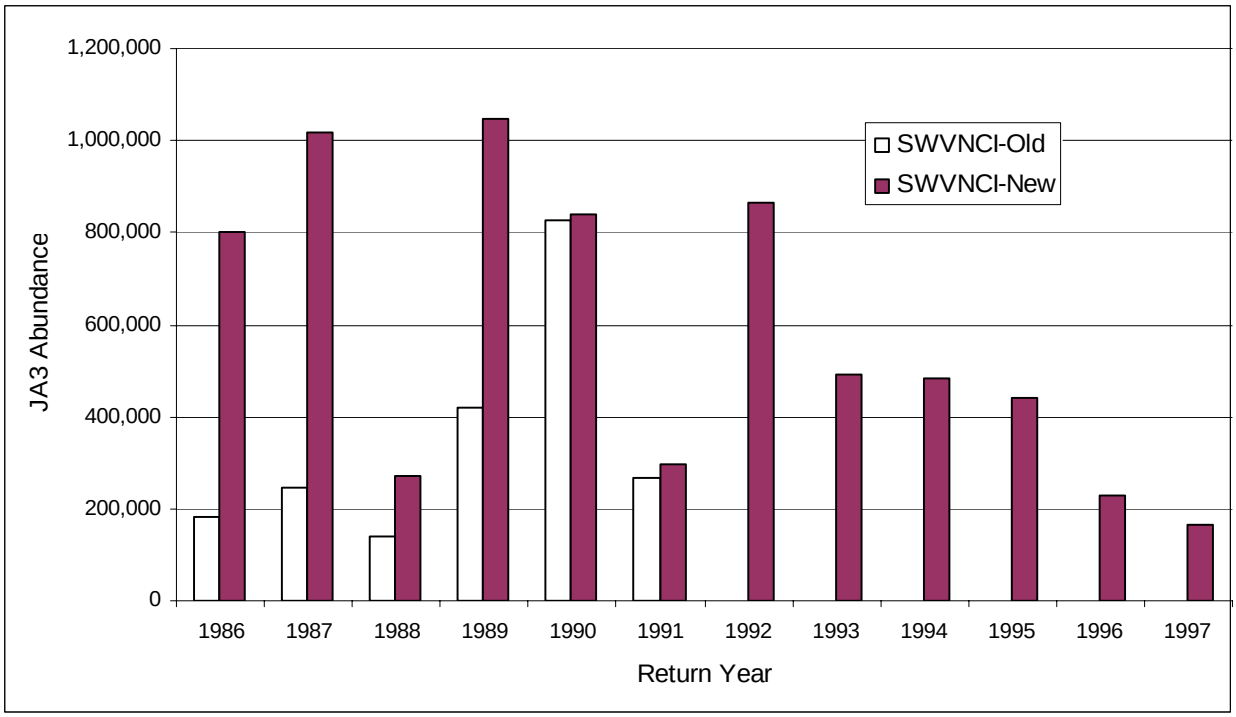

Figure 33. Comparison of old and new MSM Southwest Vancouver Island cohort sizes.

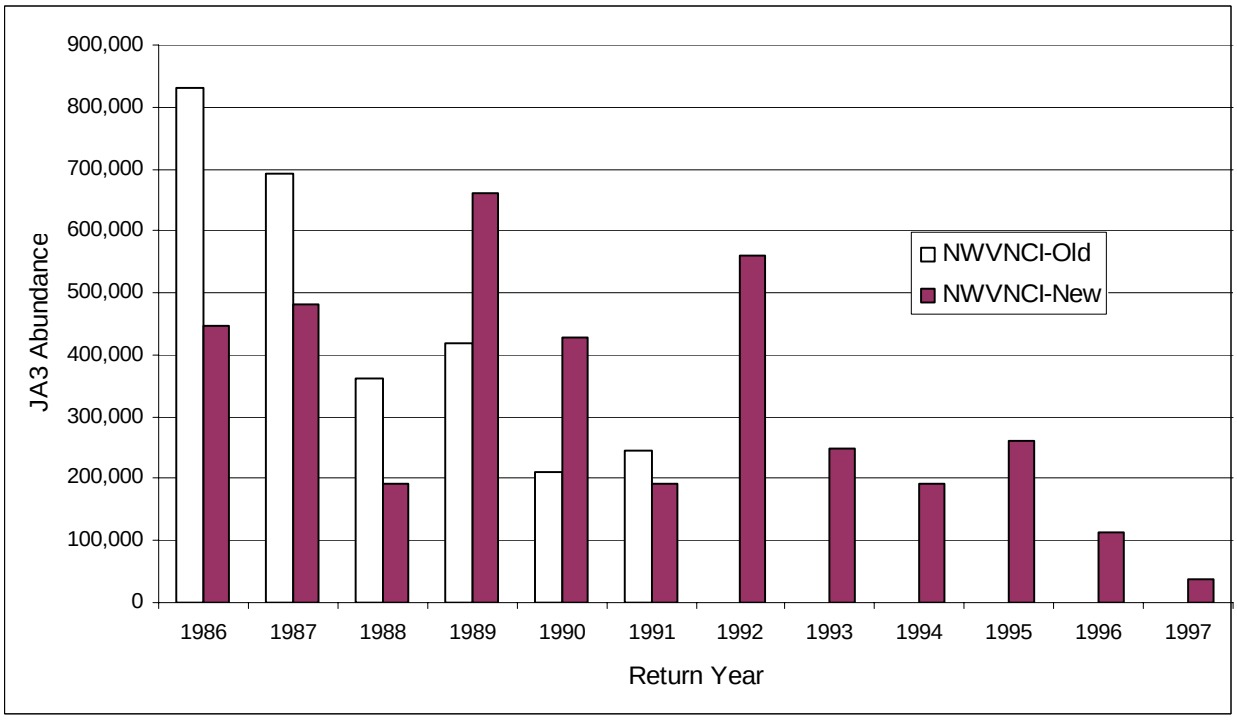

Figure 34. Comparison of old and new MSM Northwest Vancouver Island cohort sizes.

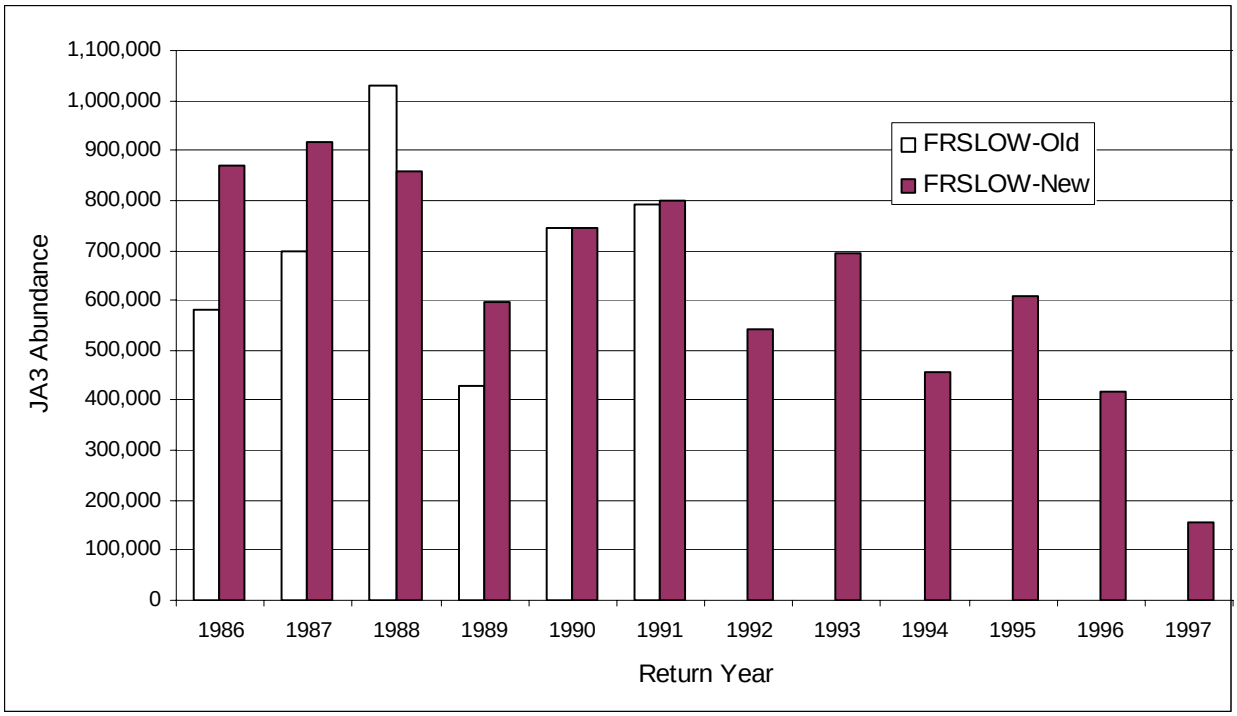

Figure 35. Comparison of old and new MSM Lower Fraser cohort sizes.

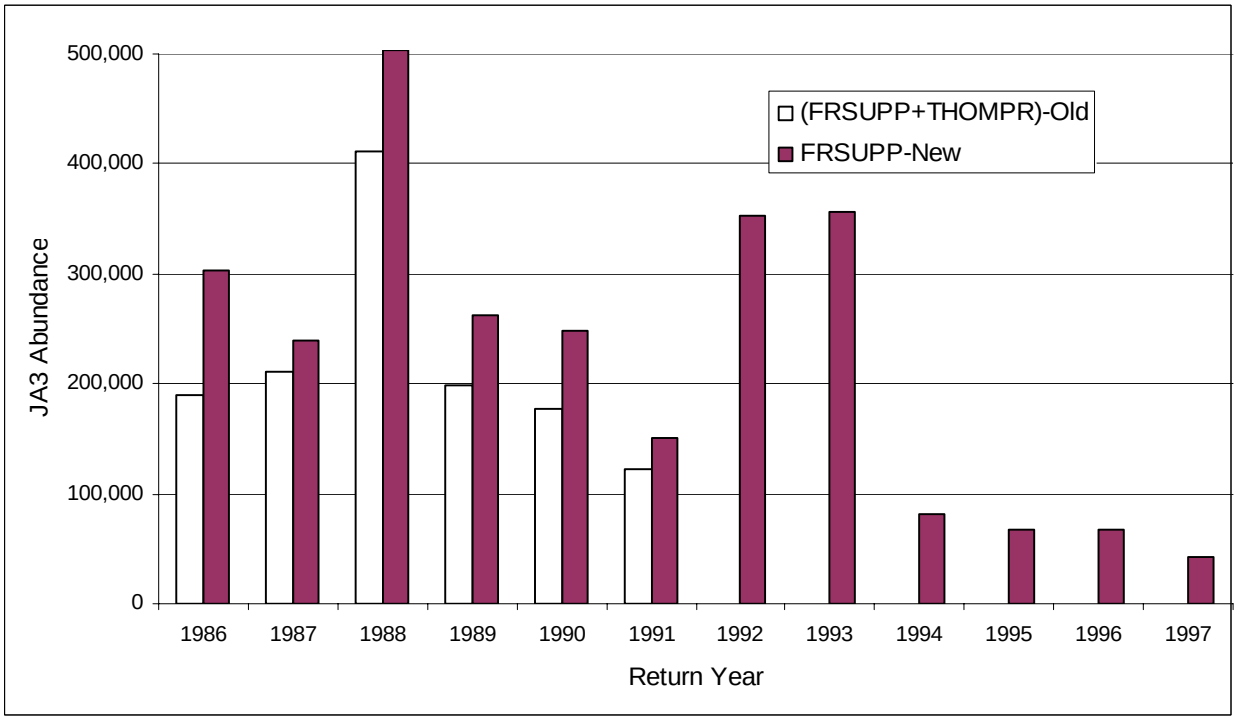

Figure 36. Comparison of old and new MSM Upper Fraser cohort sizes.

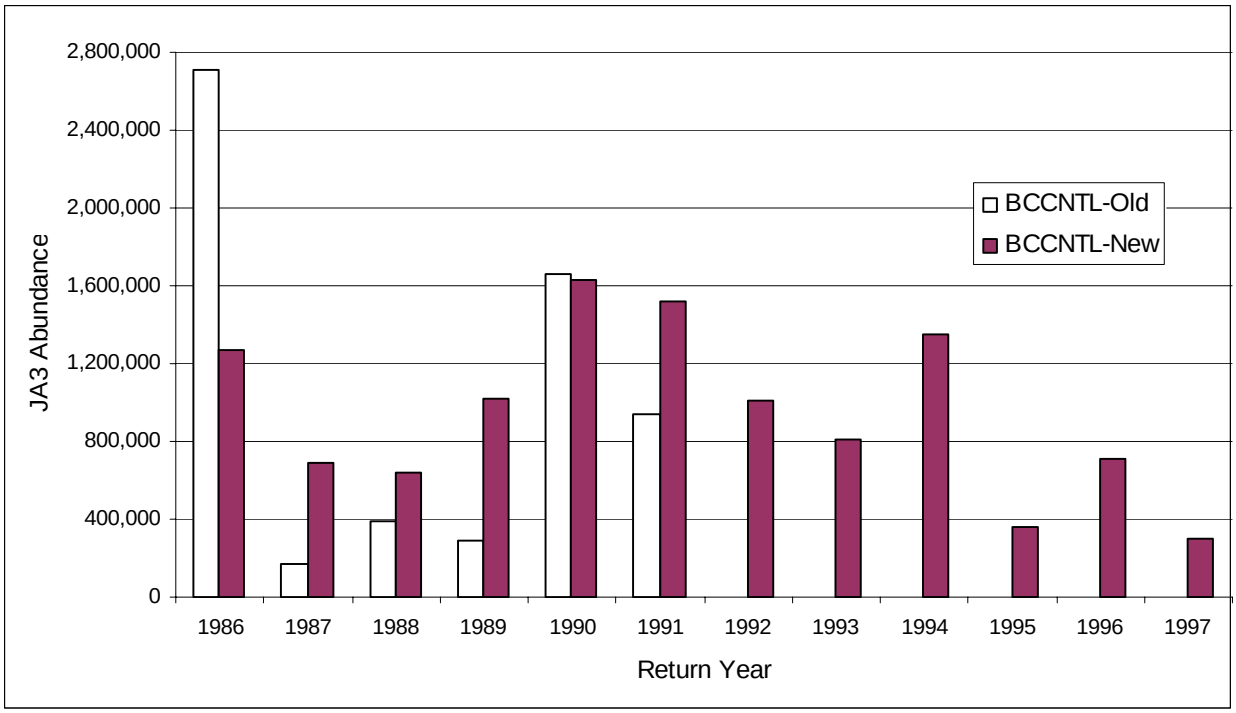

Figure 37. Comparison of old and new MSM BC Central Coast cohort sizes.

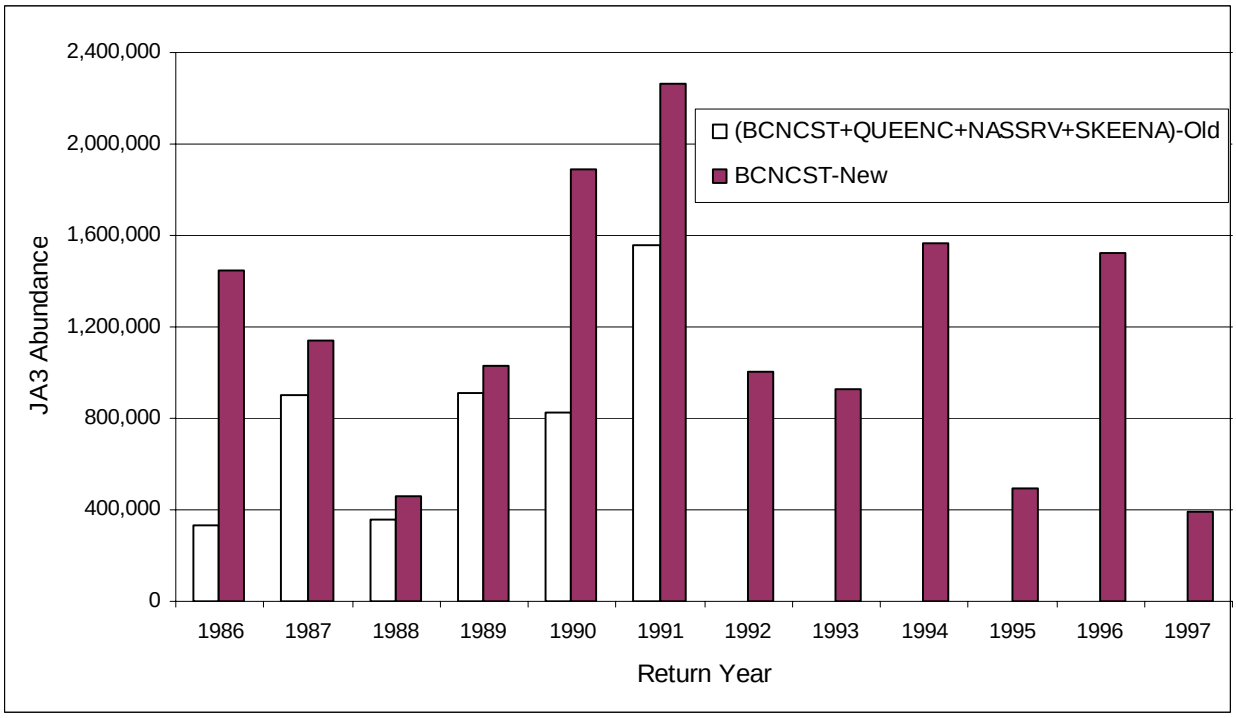

Figure 38. Comparison of old and new MSM BC North Coast cohort sizes.

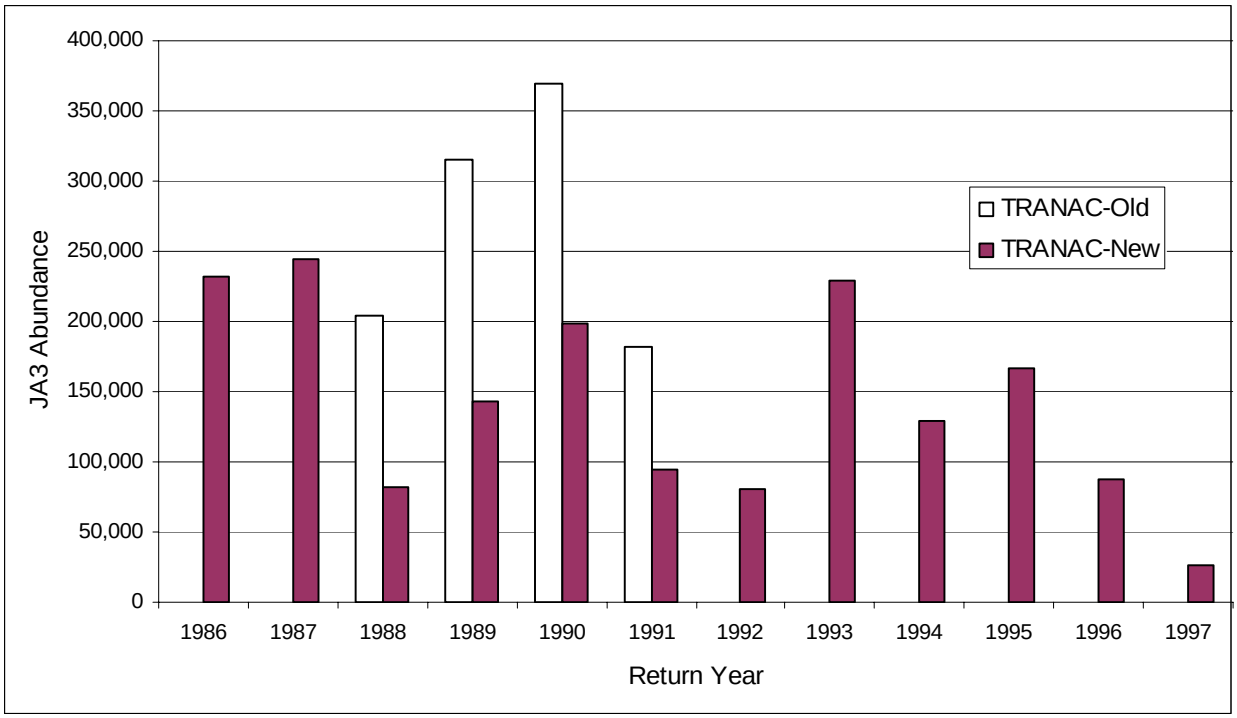

Figure 39. Comparison of old and new MSM BC Transboundary cohort sizes.

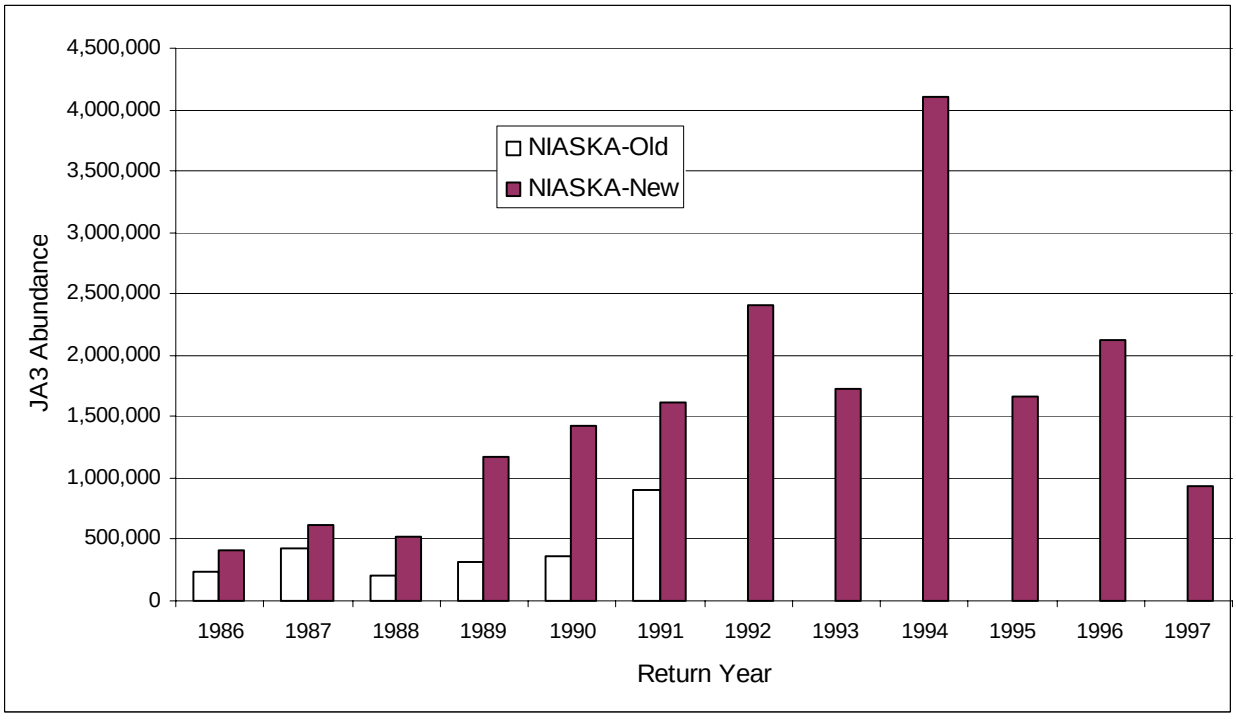

Figure 40. Comparison of old and new MSM Alaska Northern Inside cohort sizes.

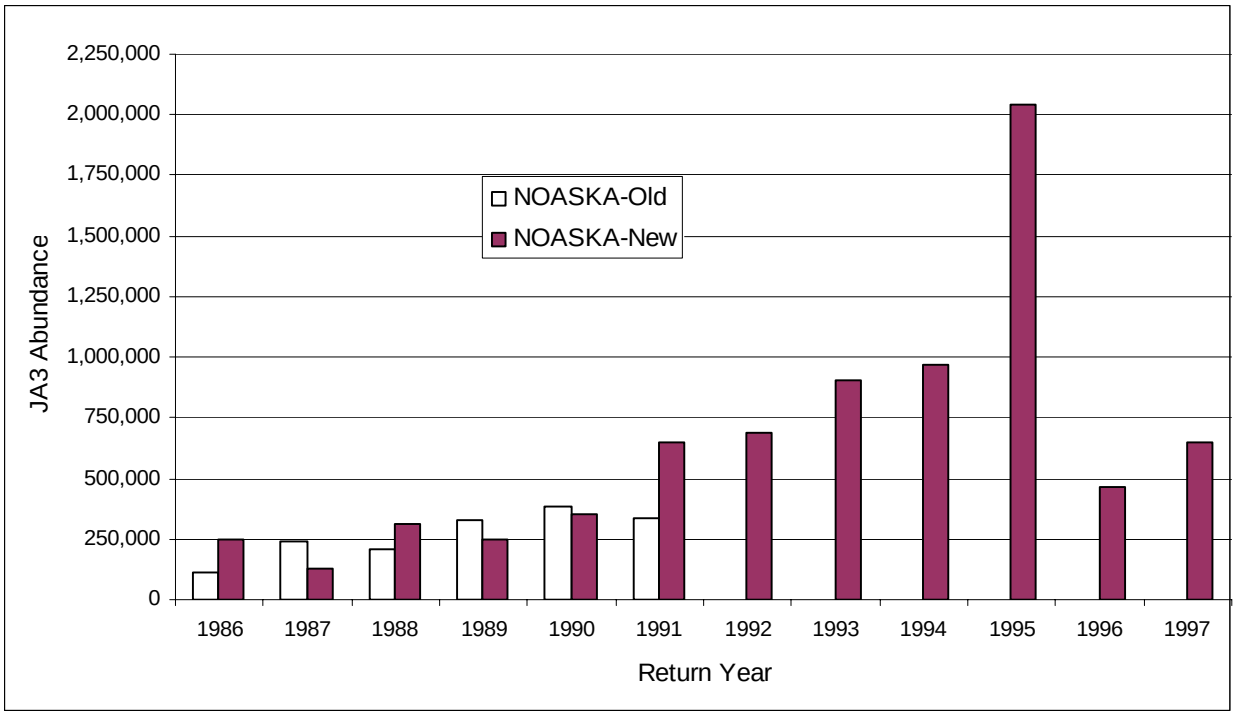

Figure 41. Comparison of old and new MSM Alaska Northern Outside cohort sizes.

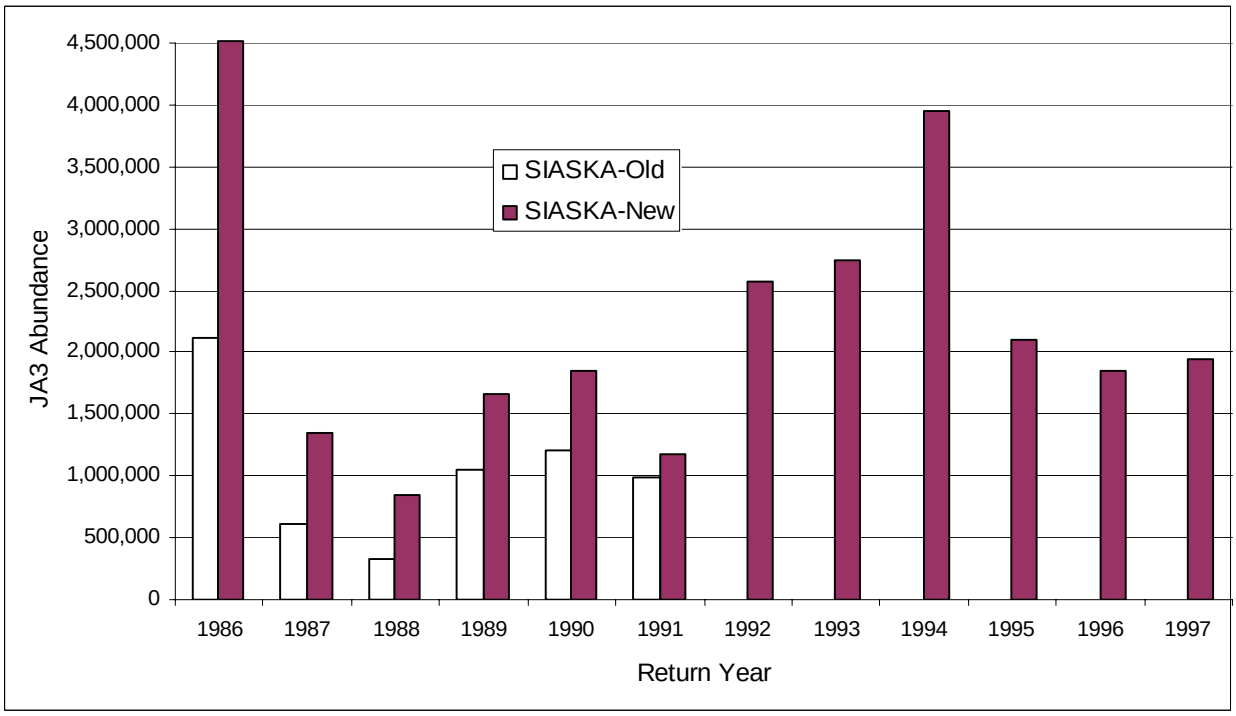

Figure 42. Comparison of old and new MSM Alaska Southern Inside cohort sizes.

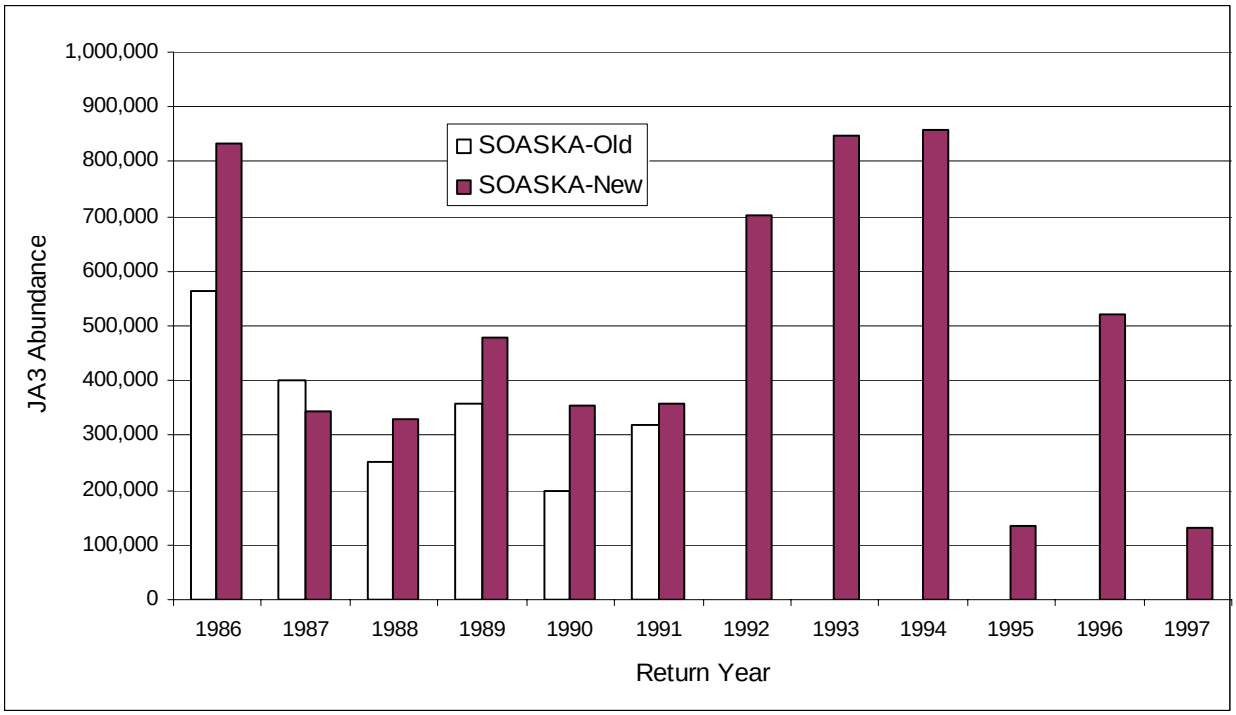

Figure 43. Comparison of old and new MSM Alaska Southern Outside cohort sizes.

17. TABLES

Table 1. Descriptions of the tables included in the MSM-VB MS-Access database file.

Table Name	Description
Run_Data	Recordset attributes; including Recordset index number, catch year, and description
CohoCWTyyyy	CWT recovery data by catch year – yyyy is catch year
CS_yyyy	CWT catch/sample data by catch year – yyyy is catch year
All_Releases	All CWT release data available from RMIS
Edit_Distinct	Specifications of PSC Recovery_Location_Code for each fishery
MSM_Fisheries	Indexed fishery list and fishery status (Flag) by Recordset index Number
MSM_Stock	Indexed stock list and stock status (Flag) by Recordset index Number
MSM_Stock_CWT	CWT release codes associated with MSM_Stocks
MSM_TermRun	Terminal run catch and estimated CWT recoveries
MSM_CWT_Reject	CWT recoveries associated with MSM_Stocks, but are not used (record does meet Recovery_Location_Code specifications in Edit_Distinct table)
CA_Data	Catch Area data used in RRTERM and FRAM
PR_Data	Production Region data used in RRTERM and FRAM
MU_Data	Management Unit data used in RRTERM and FRAM

Table 2. Variables included in MSM-VB MS-Access database tables (table names).

CWT Recovery Tables (CohoCWTyyyy and MSM_CWT_Reject)	**Catch/Sample** Tables (CS_yyyy)
record_code	record_code
format_version	format_version
submission_date	submission_date
reporting_agency	reporting_agency
sampling_agency	sampling_agency
recovery_id	catch_sample_id
species	species
run_year	catch_year
recovery_date	period_type
recovery_date_type	period
period_type	first_period
period	last_period
fishery	fishery
gear	adclip_selective_fishery
adclip_selective_fishery	estimation_level
estimation_level	catch_location_code
recovery_location_code	detection_method
sampling_site	sample_type
recorded_mark	sampled_maturity
sex	sampled_run
weight	sampled_length_range
weight_code	sampled_sex
weight_type	sampled_mark
length	number_caught
length_code	escapement_estimation_method
length_type	number_sampled
detection_method	number_estimated
tag_status	number_recovered_decoded
tag_code	number_recovered_no_cwts
tag_type	number_recovered_lost_cwts
sequential_number	number_recovered_unreadable
sequential_column_number	number_recovered_unresolved
sequential_row_number	number_recovered_not_processed
catch_sample_id	number_recovered_pseudotags
sample_type	mr_1st_partition_size
sampled_maturity	mr_1st_sample_size
sampled_run	mr_1st_sample_known_ad_status
sampled_length_range	mr_1st_sample_obs_adclips
sampled_sex	mr_2nd_partition_size
sampled_mark	mr_2nd_sample_size
estimated_number	mr_2nd_sample_known_ad_status
recovery_location_name	mr_2nd_sample_obs_adclips
record_origin	mark_rate
	awareness_factor
	sport_mark_incidence_sampl_size
	sport_mark_inc_sampl_obs_adclips

Table 2. Variables included in MSM-VB MS-Access database tables (continued).

CWT Release Table (All_Releases)	**PSC Fishery Specification** Table (Edit_Distinct)
record_code	Gear
format_version	Fishery_Short_Name
submission_date	Fishery_Number
reporting_agency	Num_Chars
release_agency	PSC_Code
coordinator	
tag_code_or_release_id	
release_location_state	**MSM_Fisheries** Table
release_location_psc_region	
release_location_psc_basin	Run_ID
release_location_name	CA_Number
tag_type	CA_Short_Name
first_sequential_number	Delete_Status
related_group_type	CombineID
related_group_id	Weight_Factor
species	
run	
brood_year	**MSM_Stock** Table
first_release_date	
last_release_date	Run_ID
release_location_code	PR_Number
hatchery_location_code	PR_MU_Number
stock_location_code	MSM_Short_Name
release_stage	MSM_Long_Name
rearing_type	PSC_State
study_type	Combine_StockID
release_strategy	Delete_Status
avg_weight	MSM_User_PEF
avg_length	MSM_User_PEF_Flag
study_integrity	
cwt_1st_mark	
cwt_1st_mark_count	**MSM_Stock_CWT** Table
cwt_2nd_mark	
cwt_2nd_mark_count	Run_ID
non_cwt_1st_mark	PR_Number
non_cwt_1st_mark_count	PR_MU_Number
non_cwt_2nd_mark	CWT_Code
non_cwt_2nd_mark_count	
counting_method	**CA_Data** Table
tag_loss_rate	
tag_loss_days	PR_Short_Name
tag_loss_sample_size	CA_Number
tag_reused	FRAM_Flag
comments	
hatchery_location_name	
stock_location_name	
record_origin	

Table 2. Variables included in MSM-VB MS-Access database tables (continued).

MSM_TermRun Table	**MU_Data** Table
Run_ID	PR_Short_Name
Terminal_Name	MU_Short_Name
PR_Number	FRAM_MU_Number
PR_MU_Number	PR_Number
MSM_Short_Name	PR_MU_Number
MSM_Long_Name	MU_Long_Name
Terminal_RunSize	IOFlag
Terminal_SampleRate	PSC_State
Terminal_CWT_Recs	Type_Calc
Weight_Factor	State
Terminal_Description	CA_Long_Name
	CWT_Flag
	Cat_Flag
	CA_Short_Name
	FRAM_CA_Number

PR_Data Table
PR_Short_Name
PR_Number
PR_Long_Name
PSC_State

Table 3. Fish stocks included in Coho FRAM. Marked components are the even numbered stocks (not shown).

Production Region	Unmarked Stock #	Coho Stock Name	
		Abbreviated	Long Name
NOOKSM	1	nkskrw	Nooksack River Wild
	3	kendlh	Kendall Creek Hatchery
	5	skokmh	Skookum Creek Hatchery
	7	lumpdh	Lummi Ponds Hatchery
	9	bhambh	Bellingham Bay Net Pens
	11	samshw	Samish River Wild
	13	ar77aw	Area 7/7A Independent Wild
	15	whatch	Whatcom Creek Hatchery
SKAGIT	17	skagtw	Skagit River Wild
	19	skagth	Skagit River Hatchery
	21	skgbkh	Baker (Skagit) Hatchery
	23	skgbkw	Baker (Skagit) Wild
	25	swinch	Swinomish Channel Hatchery
	27	oakhbh	Oak Harbor Net Pens
STILSN	29	stillw	Stillaguamish River Wild
	31	stillh	Stillaguamish River Hatchery
	33	tuliph	Tulalip Hatchery
	35	snohow	Snohomish River Wild
	37	snohoh	Snohomish River Hatchery
	39	ar8anh	Area 8A Net Pens
HOODCL	41	ptgamh	Port Gamble Net Pens
	43	ptgamw	Port Gamble Bay Wild
	45	ar12bw	Area 12/12B Wild
	47	qlcnbh	Quilcene Hatchery
	49	qlcenh	Quilcene Bay Net Pens
	51	ar12aw	Area 12A Wild
	53	hoodsh	Hoodsport Hatchery
	55	ar12dw	Area 12C/12D Wild
	57	gadamh	George Adams Hatchery
	59	skokrw	Skokomish River Wild
SPGSND	61	ar13bw	Area 13B Misc. Wild
	63	deschw	Deschutes R. (WA) Wild
	65	ssdnph	South Puget Sound Net Pens
	67	nisqlh	Nisqually River Hatchery
	69	nisqlw	Nisqually River Wild
	71	foxish	Fox Island Net Pens
	73	mintch	Minter Creek Hatchery
	75	ar13mw	Area 13 Miscellaneous Wild
	77	chambh	Chambers Creek Hatchery
	79	ar13mh	Area 13 Misc. Hatchery
	81	ar13aw	Area 13A Miscellaneous Wild
	83	puyalh	Puyallup River Hatchery
	85	puyalw	Puyallup River Wild

Table 3. Fish stocks included in Coho FRAM (continued). Marked components are the even numbered stocks (not shown).

Production Region	Unmarked Stock #	Coho Stock Name	
		Abbreviated	Long Name
SPGSND (cont.)	87	are11h	Area 11 Hatchery
	89	ar11mw	Area 11 Miscellaneous Wild
	91	ar10eh	Area 10E Hatchery
	93	ar10ew	Area 10E Miscellaneous Wild
	95	greenh	Green River Hatchery
	97	greenw	Green River Wild
	99	lakwah	Lake Washington Hatchery
	101	lakwaw	Lake Washington Wild
	103	are10h	Area 10 H inc. Ebay,SeaAq NP
	105	ar10mw	Area 10 Miscellaneous Wild
SJDFCA	107	dungew	Dungeness River Wild
	109	dungeh	Dungeness Hatchery
	111	elwhaw	Elwha River Wild
	113	elwhah	Elwha Hatchery
	115	ejdfmw	East JDF Miscellaneous Wild
	117	wjdfmw	West JDF Miscellaneous Wild
	119	ptangh	Port Angeles Net Pens
	121	area9w	Area 9 Miscellaneous Wild
MAKAHC	123	makahw	Makah Coastal Wild
	125	makahh	Makah Coastal Hatchery
QUILUT	127	quilsw	Quillayute R Summer Natural
	129	quilsh	Quillayute R Summer Hatchery
	131	quilfw	Quillayute River Fall Natural
	133	quilfh	Quillayute River Fall Hatchery
HOHRIV	135	hohrvw	Hoh River Wild
	137	hohrvh	Hoh River Hatchery
QUEETS	139	quetfw	Queets River Fall Natural
	141	quetfh	Queets River Fall Hatchery
	143	quetph	Queets R Supplemental Hat.
QUINLT	145	quinfw	Quinault River Fall Natural
	147	quinfh	Quinault River Fall Hatchery
GRAYHB	149	chehlw	Chehalis River Wild
	151	chehlh	Chehalis River (Bingham) Hat.
	153	humptw	Humptulips River Wild
	155	humpth	Humptulips River Hatchery
BCCNTL	233	bccnhw	BC Central Coast Hat./Wild
BCNCST	235	bcnchw	BC North Coast Hatchery/Wild
TRANAC	237	tranhw	Trans Boundary Hatchery/Wild
NIASKA	239	niakhw	Alaska No. Inside Hat./Wild
NOASKA	241	noakhw	Alaska No. Outside Hat./Wild
SIASKA	243	siakhw	Alaska So. Inside Hat./Wild
SOASKA	245	soakhw	Alaska So. Outside Hat./Wild

Table 4. Fisheries included in the Coho FRAM.

Fishery			Fishery		
Abbreviation	**Num.**	**Long Name**	**Abbreviation**	**Num.**	**Long Name**
No Cal Trm	1	North California Coast Terminal Catch	Area3TrlNT	38	Area 3 Troll Nontreaty (LaPush)
Cn Cal Trm	2	Central California Coast Term Catch	Area3TrlTR	39	Area 3 Troll Treaty (LaPush)
Ft Brg Spt	3	Fort Bragg Sport	Area 3 Spt	40	Area 3 Sport (LaPush)
Ft Brg Trl	4	Fort Bragg Troll	Area 4 Spt	41	Area 4 Sport (Neah Bay)
Ca KMZ Spt	5	KMZ Sport (Klamath Management Zone)	A4/4BTrlNT	42	Area 4/4B (Neah Bay PFMC Regs) Troll NonT
Ca KMZ Trl	6	KMZ Troll (Klamath Management Zone)	A4/4BTrlTR	43	Area 4/4B (Neah Bay PFMC Regs) Troll Treaty
So Cal Spt	7	Southern California Sport	A 5-6C Trl	44	Area 5, 6, 6C Troll (Strait of Juan de Fuca)
So Cal Trl	8	Southern California Troll	Willpa Spt	45	Willapa Bay (Area 2.1) Sport
So Ore Trm	9	South Oregon Coast Terminal Catch	Wlp Tb Spt	46	Willapa Tributary Sport
Or Prv Trm	10	Oregon Private Hatchery Terminal Catch	WlpaBT Net	47	Willapa Bay & FW Trib Net
SMi Or Trm	11	South-Mid Oregon Coast Terminal Catch	GryHbr Spt	48	Grays Harbor (Area 2.2) Sport
NMi Or Trm	12	North-Mid Oregon Coast Terminal Catch	SGryHb Spt	49	South Grays Harbor Sport (Westport Boat Basin)
No Ore Trm	13	North Oregon Coast Terminal Catch	GryHbr Net	50	Grays Harbor Estuary Net
Or Cst Trm	14	Mid-North Oregon Coast Terminal Catch	Hump R Spt	51	Humptulips River Sport
Brkngs Spt	15	Brookings Sport	LwCheh Net	52	Lower Chehalis River Net
Brkngs Trl	16	Brookings Troll	Hump R C&S	53	Humptulips River Ceremonial & Subsistence
Newprt Spt	17	Newport Sport	Chehal Spt	54	Chehalis River Sport
Newprt Trl	18	Newport Troll	Hump R Net	55	Humptulips River Net
Coos B Spt	19	Coos Bay Sport	UpCheh Net	56	Upper Chehalis River Net
Coos B Trl	20	Coos Bay Troll	Chehal C&S	57	Chehalis River Ceremonial & Subsistence
Tillmk Spt	21	Tillamook Sport	Wynoch Spt	58	Wynochee River Sport
Tillmk Trl	22	Tillamook Troll	Hoquam Spt	59	Hoquiam River Sport
Buoy10 Spt	23	Buoy 10 Sport (Columbia River Estuary)	Wishkh Spt	60	Wishkah River Sport
L ColR Spt	24	Low. Columbia River Mainstem Sport	Satsop Spt	61	Satsop River Sport
L ColR Net	25	Low. Columbia R. Net (Exc. Youngs Bay)	Quin R Spt	62	Quinault River Sport

Table 4. Fisheries included in the Coho FRAM (continued).

Fishery			Fishery		
Abbreviation	**Num.**	**Long Name**	**Abbreviation**	**Num.**	**Long Name**
Yngs B Net	26	Youngs Bay Net	Quin R Net	63	Quinault River Net
LCROrT Spt	27	Below Bonneville Ore. Tributary Sport	Quin R C&S	64	Quinault River Ceremonial & Subsistence
Clackm Spt	28	Clackamas River Sport	Queets Spt	65	Queets River Sport
SandyR Spt	29	Sandy River Sport	Clrwtr Spt	66	Clearwater River Sport
LCRWaT Spt	30	Below Bonneville Washington Trib Sport	Salm R Spt	67	Salmon River (Queets) Sport
UpColR Spt	31	Above Bonneville Sport	Queets Net	68	Queets River Net
UpColR Net	32	Above Bonneville Net	Queets C&S	69	Queets River Ceremonial & Subsistence
A1-Ast Spt	33	Area 1 (Illwaco) & Astoria Sport	Quilly Spt	70	Quillayute River Sport
A1-Ast Trl	34	Area 1 (Illwaco) & Astoria Troll	Quilly Net	71	Quillayute River Net
Area2TrlNT	35	Area 2 Troll Nontreaty (Westport)	Quilly C&S	72	Quillayute River Ceremonial & Subsistence
Area2TrlTR	36	Area 2 Troll Treaty (Westport)	Hoh R Spt	73	Hoh River Sport
Area 2 Spt	37	Area 2 Sport (Westport)	Hoh R Net	74	Hoh River Net
Hoh R C&S	75	Hoh River Ceremonial & Subsistence	Ar8A NetNT	109	Area 8A Stillaguamish/Snohomish Net NonT
Mak FW Spt	76	Makah Tributary Sport	Ar8A NetTR	110	Area 8A Stillaguamish/Snohomish Net Treaty
Mak FW Net	77	Makah Freshwater Net	Ar8D NetNT	111	Area 8D Tulalip Bay Net Nontreaty
Makah C&S	78	Makah Ceremonial & Subsistence	Ar8D NetTR	112	Area 8D Tulalip Bay Net Treaty
A 4-4A Net	79	Area 4, 4A Net (Neah Bay)	Stil R Net	113	Stillaguamish River Net
A4B6CNetNT	80	Area 4B, 5, 6C Net NonT (Strait of JDF)	Snoh R Net	114	Snohomish River Net
A4B6CnetTR	81	Area 4B, 5, 6C Net Treaty (Strait of JDF)	Ar 8-2 Spt	115	Area 8.2 Marine Sport
Ar6D NetNT	82	Area 6D Dungeness Bay/River Net NonT	Stil R Spt	116	Stillaguamish River Sport
Ar6D NetTR	83	Area 6D Dungeness Bay/River Net Treaty	Snoh R Spt	117	Snohomish River Sport
Elwha Net	84	Elwha River Net	Ar 10 Spt	118	Area 10 Marine Sport (Seattle)
WJDF T Net	85	West JDF Straits Tributary Net	Ar10 NetNT	119	Area 10 Net Nontreaty (Seattle)
EJDF T Net	86	East JDF Straits Tributary Net	Ar10 NetTR	120	Area 10 Net Treaty (Seattle)
A6-7AnetNT	87	Area 7, 7A Net NonT (San Juan Islands)	Ar10AnetNT	121	Area 10A Net Nontreaty (Elliott Bay)
A6-7AnetTR	88	Area 7, 7A Net Treaty (San Juan Islands)	Ar10AnetTR	122	Area 10A Net Treaty (Elliott Bay)

Table 4. Fisheries included in the Coho FRAM (continued).

Fishery			Fishery		
Abbreviation	**Num.**	**Long Name**	**Abbreviation**	**Num.**	**Long Name**
EJDF FWSpt	89	East JDF Straits Tributary Sport	Ar10EnetNT	123	Area 10E Net Nontreaty (East Kitsap)
WJDF FWSpt	90	West JDF Straits Tributary Sport	Ar10EnetTR	124	Area 10E Net Treaty (East Kitsap)
Area 5 Spt	91	Area 5 Marine Sport (Sekiu)	10F-G Net	125	Area 10F-G Ship Canal/Lk. WA Net Treaty
Area 6 Spt	92	Area 6 Marine Sport (Port Angeles)	Duwm R Net	126	Green/Duwamish River Net
Area 7 Spt	93	Area 7 Marine Sport (San Juan Islands)	Duwm R Spt	127	Green/Duwamish River Sport
Dung R Spt	94	Dungeness River Sport	L WaSm Spt	128	Lake Washington-Lake Sammamish Trib. Spt.
ElwhaR Spt	95	Elwha River Sport	Ar 11 Spt	129	Area 11 Marine Sport (Tacoma)
A7BCDNetNT	96	Area 7B-7C-7D Net Non-T	Ar11 NetNT	130	Area 11 Net Nontreaty (Tacoma)
A7BCDNetTR	97	Area 7B-7C-7D Net Treaty	Ar11 NetTR	131	Area 11 Net Treaty (Tacoma)
Nook R Net	98	Nooksack River Net	Ar11ANetNT	132	Area 11A Net Nontreaty (Commencement Bay)
Nook R Spt	99	Nooksack River Sport	Ar11AnetTR	133	Area 11A Net Treaty (Commencement Bay)
Samh R Spt	100	Samish River Sport	Puyl R Net	134	Puyallup River Net
Ar 8 NetNT	101	Area 8 Skagit Marine Net Nontreaty	Puyl R Spt	135	Puyallup River Sport
Ar 8 NetTR	102	Area 8 Skagit Marine Net Treaty	Ar 13 Spt	136	Area 13 Marine Sport (South Puget Sound)
Skag R Net	103	Skagit River Net	Ar13 NetNT	137	Area 13 Net Nontreaty (South Puget Sound)
SkgR TsNet	104	Skagit River Test Net	Ar13 NetTR	138	Area 13 Net Treaty (South Puget Sound)
SwinCh Net	105	Swinomish Channel Net	Ar13CnetNT	139	Area 13C Net Nontreaty (Chambers Bay)
Ar 8-1 Spt	106	Area 8.1 Marine Sport	Ar13CnetTR	140	Area 13C Net Treaty (Chambers Bay)
Area 9 Spt	107	Area 9 Marine Sport (Admiralty Inlet)	Ar13AnetNT	141	Area 13A Net Nontreaty (Carr Inlet)
Skag R Spt	108	Skagit River Sport	Ar13AnetTR	142	Area 13A Net Treaty (Carr Inlet)
Ar13DnetNT	143	Area 13D Net Nontreaty (S. P.S.)	No BC Trl	175	Northern British Columbia Troll
Ar13DnetTR	144	Area 13D Net Treaty (S. P.S.)	NoC BC Trl	176	North Central British Columbia Troll
A13FKNetNT	145	Area 13F-13K Net Nontreaty (S. P.S.)	SoC BC Trl	177	South Central British Columbia Troll
A13FKNetTR	146	Area 13F-13K Net Treaty (S. PS Inlets)	NW VI Trl	178	NW Vancouver Island Troll
Nisq R Net	147	Nisqually River Net	SW VI Trl	179	SW Vancouver Island Troll
McAlls Net	148	McAllister Creek Net	GeoStr Trl	180	Georgia Straits Troll

Table 4. Fisheries included in the Coho FRAM (continued).

Fishery			Fishery		
Abbreviation	**Num.**	**Long Name**	**Abbreviation**	**Num.**	**Long Name**
13D-K TSpt	149	13D-13K Tributary Sport (South PS Inlets)	BC JDF Trl	181	British Columbia Juan de Fuca Troll
Nisq R Spt	150	Nisqually River Sport	No BC Net	182	Northern British Columbia Net
Desc R Spt	151	Deschutes River Sport (Olympia)	Cen BC Net	183	Central British Columbia Net
Ar 12 Spt	152	Area 12 Marine Sport (Hood Canal)	NW VI Net	184	NW Vancouver Island Net
1212BNetNT	153	Area 12-12B Net Nontreaty (Upper HC)	SW VI Net	185	SW Vancouver Island Net
1212BnetTR	154	Area 12-12B Net Treaty (Upper HC)	Johnst Net	186	Johnstone Straits Net
Ar9A NetNT	155	Area 9A Net Nontreaty (Port Gamble)	GeoStr Net	187	Georgia Straits Net
Ar9A NetTR	156	Area 9-9A Net Treaty (Port Gamble)	Fraser Net	188	Fraser River Gill Net
Ar12AnetNT	157	12A Net Nontreaty (Quilcene Bay)	BC JDF Net	189	British Columbia Juan de Fuca Net
Ar12AnetTR	158	12A Net Treaty (Quilcene Bay)	No BC Spt	190	Northern British Columbia Sport
A12CDNetNT	159	12C-12D Net Nontreaty (Lower HC)	Cen BC Spt	191	Central British Columbia Sport
A12CDNetTR	160	12C-12D Net Treaty (Lower Hood Canal)	BC JDF Spt	192	British Columbia Juan de Fuca Sport
Skok R Net	161	Skokomish River Net	WC VI Spt	193	West Coast Vancouver Island Sport
Quilcn Net	162	Quilcene River Net	NgaStr Spt	194	North Georgia Straits Sport
1212B TSpt	163	12-12B Tributary FW Sport	SgaStr Spt	195	South Georgia Straits Sport
Quilcn Spt	164	12A Tributary FW Sport (Quilcene River)	Albern Spt	196	Alberni Canal Sport
12C-D TSpt	165	12C-12D Tributary FW Sport	BCCNTL TTR	197	BCCNTL Terminal Run (Catch + Esc.)
Skok R Spt	166	Skokomish River Sport	BCNCST TTR	198	BCNCST Terminal Run (Catch + Esc.)
GSMLND Trm	167	Georgia Strait Mainland Terminal Catch	QUEENC TTR	199	QUEENC Terminal Run (Catch + Esc.)
GSVNCI Trm	168	Georgia Strait Vancouver Island Term Catch	NASSRV TTR	200	NASSRV Terminal Run (Catch + Esc.)
JNSTRT Trm	169	Johnstone Strait Terminal Catch	SKEENA TTR	201	SKEENA Terminal Run (Catch + Esc.)
SWVNCI Trm	170	SW Vancouver Island Terminal Catch	SW AK Trl	202	Southwest Alaska Troll
NWVNCI Trm	171	NW Vancouver Island Terminal Catch	SE AK Trl	203	Southeast Alaska Troll
FRSLOW Trm	172	Lower Fraser River Terminal Catch	NW AK Trl	204	Northwest Alaska Troll
FRSUPP Trm	173	Upper Fraser River Terminal Catch	NE AK Trl	205	Northeast Alaska Troll
THOMPR Trm	174	Thompson River Terminal Catch	Alaska Net	206	Alaska Net (Areas 182:183:185:192)

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991.

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
BRITISH COLUMBIA CENTRAL COAST		022910	023515	023847	023805	023917	020139
		022911	023516	023848	023806	023962	020140
		022952	023517	023849	023807	023963	020141
		022953		024107	023808	024001	020142
		022954		024108	023907	024333	023917
		022955		024109	023962	024432	024333
				024110	023963	024433	025442
				024111	024001	024434	025618
				024112	024432	024435	025619
				024113	024433	024436	026002
				024114	024434	024655	026003
				024115	024435	024811	
					024436	024837	
					024605	024838	
					024651	024839	
					024928	024928	
					024929	025142	
					025018	025143	
					025019	025347	
					025062	025442	
					025063	025563	
					025101	025601	
						025602	
BRITISH COLUMBIA NORTH COAST		022444	022835	023249	023526	023109	020143
		022449	023249	023250	023527	024430	020144
		022508	023250	023501	023528	024431	024857
		022746	023426	023502	023529	024444	025041
			023427	023521	023932	024445	025044
			023428	023526	024332	024446	025045
			023429	023527	024422	024447	025046
			023430	023528	024423	024448	025047
			023431	023529	024424	024449	025119
			023501	023852	024425	024450	025120
			023502	023853	024426	024451	025125
			023521	023854	024427	024857	025313
				023855	024428	025044	025314
				023856	024429	025045	025460
				023857	024430	025046	025540
				023858	024431	025047	025545
				023859	024444	025119	025546
				023901	024445	025120	025548

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
BRITISH COLUMBIA				023902	024446	025121	025551
NORTH COAST				023903	024447	025122	025559
(cont.)				023904	024448	025123	025560
				023905	024449	025124	025561
				023906	024450	025125	025621
				023925	024451	025126	025622
				023926	024901	025456	025711
				023927	024902	025535	025712
				023928	025020	025540	025713
				023929	025021	025543	025714
				023930	025022	025545	025715
				023931	025023	025546	025716
				023932	025024	025548	025717
				023933	025025	025551	025718
				023934	025026	025556	025917
					025027	025557	026104
					025028	025559	026105
					082456	025560	026106
					082457	025561	026107
					082458	025603	026108
						025604	026109
						025605	026110
						025606	026111
						025607	026112
						025608	026113
						025609	026114
						025610	026115
						025611	026116
						082622	026117
						082625	026118
						082626	026119
						082627	026120
						082629	026121
						082647	026122
						082648	026123
						082649	026133
							026134
							026135
							026214
							026215
							026216
							026217

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
BRITISH COLUMBIA NORTH COAST (cont.)							026306 026307 082630 082634 082707 082718 082719
COLUMBIA RIVER		072654 072802 072811 073030 073031 073032 073045 073046 073047 073048 073049 073050 073105 073106 073107 073108 633030 633031 633132 633133 633134 633135 633259 633260 633261 633262 633263 633301	073056 073057 073058 073061 073062 073063 073251 073252 073253 073254 073255 073261 073262 073263 073301 073302 073303 073304 073305 073618 073619 073620 073621 073622 073623 073630 073743 073744 073745 073746 633515 633516 633517 633518 633519	073547 073548 073549 073550 073551 073552 073616 073617 073624 073625 073958 074108 074111 074113 074114 074116 074119 074121 074441 074442 074444 074447 074449 074450 633663 633701 633702 634247 634249 634250 634252	074226 074228 074231 074232 074235 074237 074426 074726 074728 074950 074952 074955 074956 074959 074961 634450 634735	074244 074247 074410 074412 074445 074454 074457 074458 074606 074607 074608 074609 074610 074611 074703 074705 074706 635256 635507	052225 052226 074209 074210 074211 074502 074712 074810 074811 074812 074845 074846 074945 074946 075029 630141 630144 631128 631319 635044 635047

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
COLUMBIA RIVER (cont.)			633520				
			633531				
			633532				
			633533				
			633534				
			633535				
			633536				
	Col Rvr Late Hatchery/Wild	633156	633106	633649	634213	634747	630147
		633157	633142	633650	634214		630238
		633232	633143	633658	634919		630241
		633233	633454	633659	634956		630750
		633249	633455	634138			630762
		633250	633456	634208			631131
		633253	633457	634211			631137
		633254	633513	634216			631161
			633514	634219			631162
			633521	634221			631316
			633522	634222			
			633523				
			633524				
			633525				
			633526				
			633527				
			633528				
	Youngs Bay Hatchery	072801	073306	073444	073532	074156	074219
		073029	073307	073445	073533	074157	074220
		073343	073308	073446	073534	074158	074221
		073344	073309	073614	074551	074463	074307
			073310	073615		074501	074308
			073311			074744	075128
GEORGIA STRAIT MAINLAND		022445	022811	022854	024116	024417	025051
		022617	022844	023115	024117	024418	025052
		022629	022846	023447	024123	024452	025053
		022638	022854	023452	024241	024548	025057
		022640	022931	023455	024242	024713	025918
		022641	022935	023456	024246	025051	025919
		022642	023061	023817	024417	025052	025920
		022649	023062	023818	024418	025053	025921
		022809	023137	023942	024438	025054	026130
		022810	023339	023943	024439	025055	026131
		022811	023340	023957	024548	025056	026140
		022843	023447	023958	024713	025057	026141

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
GEORGIA STRAIT MAINLAND (cont.)		022844	023452	023959	024845	025210	026142
		022845	023453	024116	024846	025211	026143
		022846	023454	024117	024903	025212	026144
		022853	023455	024118	024904	025455	026251
		022862	023456	024122	024905	025553	
		022931	023518	024123	024906	025554	
		022932	023817	024241	024927	025633	
		022933	023818	024242	025115	025634	
		022934	023820	024243	025116	025639	
		022935	023821	024246	025117		
		022936	082249	082408	025118		
		023008	082250	082409			
		023009	082408	420122			
		023056	082409				
		023137	420122				
		082249					
		082250					
GEORGIA STRAIT/ VANCOUVER ISLAND		022645	022904	023655	023916	025133	020840
		022644	022801	023446	023915	024621	020138
		022723	022905	023825	023918	025233	020841
		022763	022906	023829	024628	025234	025136
		022801	023120	023833	024629	025235	025239
		022903	023121	023918	024630	025415	025321
		022906	023124	023919	024631	025501	025322
		022912	023125	023920	024638	025502	025323
		022913	023126	023921	024639	025508	025416
		022914	023127	024058	024719	025719	025729
		022915	023130	024124	025102	025720	025941
		022937	023152	024125	025111	025721	025942
		022938	023153	024126	025112	025722	025943
		022939	023154	024127	025130	025723	025949
		022943	023232	024128	025133	025724	025950
		022944	023233	024129	025134	025916	025951
		022945	023432	024130	082410	080001	025952
		022946	023433	024131	082435	080002	026238
		022957	023434	024144	082436	080003	081607
		022958	023443	024145	082437	080004	081608
		022959	023444	024146	082438	080005	082650
		022960	023445	024149	082439	080006	082651
		023119	023446	024150	082440	080007	082652
		023120	023712	024151	082441	080008	082653
		023121	023815	024440	082442	080009	082654

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
GEORGIA STRAIT/ VANCOUVER ISLAND (cont.)		023122	023823	024441	082443	080010	082655
		023123	023824	024442	082446	081606	082658
		082251	023825	024443	082447	081609	082660
		082252	023826	082406	082448	081610	082661
			023827	082410	082449	081611	082662
			023828	082411	082450	082459	082663
			023829	082417	082451	082463	082703
			023830	082418	082453	082505	082704
			023831	082419	082459	082507	082705
			023832	082421	082460	082511	082706
			023833	082422	082461	082513	082708
			023837	082423	082462	082514	082709
			023841	082424	082501	082516	082711
			023918	082425	082502	082519	082712
			081603*1	082426	082503	082521	082713
			081604*1	082427	082504	082522	082714
			082251	082429	082508	082525	082720
			082406	082431	082516	082526	082721
			082407	082432		082528	082722
				082438		082531	082723
				082501		082532	082724
						082535	082725
						082537	082726
						082538	
						082541	
						082542	
						082544	
						082547	
						082549	
						082550	
						082552	
						082555	
						082556	
						082559	
						082561	
						082562	
						082617	
						082618	
						082620	
						082623	
						082631	
						082638	

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
GEORGIA STRAIT/ VANCOUVER ISLAND (cont.)						082639 082640 082641 082642 082643 082644 082645 082646	
GRAYS HARBOR		632817 632818 632819 632823 632824 632825 632826 632827 632828 632829 632830 632831 633010 633035 633209 633345 633346 633347 633348 633423 633424 633425 633443 633444	633138 633139 633163 633201 633540 633541 633542 634131 634137 634141	633110 633655 633656 633657 633660 633661 633662 634238 634425 634426 634438	634449 634452 634901 635021 635022 635032	630252 630428 634749 635255 635521	630259 630728 630752 630816 630828 630831 630832 630837 631438
	Bingham Hatchery				634449	634749	
	Grays Harbor Net Pens						630437 630721 631335 631337 631338 631341 631342 631344

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
GRAYS HARBOR (cont.)	**Humptulips River Hatchery**		633138 633139 633163 633201				
HOH		211638 211639 211640	211736 211737 211738 632511	211735 211762 211763 211801 211802 211803 211811 211812	211813 211814 211815 211816 211817 212837 633858 633859 633906 634154 634237 634428	213250 213252 634907 634908	213516
HOOD CANAL		632751 632752 632832 632833 633034	211909 633355 633356 633357 633358 633359 633360 633614 633615 633616 634144	212225 633361 633617 633621 634226 634241	212814 635041	052107 052108 052111 630159 634761	630438 633312
	Area 12/12B Wild					211729 630432	
	Area 12A Wild					211729 630432	
	Area 12C/12D Wild					211729 630432	
	George Adams Hatchery				633718 633719 633720		631142 631144
	Hoodsport Hatchery				633718 633719 633720		631138
	Port Gamble Net Pens				634231		213150

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
HOOD CANAL (cont.)	**Quilcene Bay Net Pens**				634231		052253 052254 052255
	Quilcene Hatchery				634231		631141
	Skokomish River Wild					211729 630432	
JOHNSTONE STRAIT		022839 022916 022917 022918 022919 022920 022921 022922 022923 022949 022950 022951 022962 022963 023001 023002 082244 082313 082314	022836 022962 022963 023001 023002 023111 023201 023202 023205 023207 023435 023436 023437 023438 023439 023440 023441 023442 023834 023835 023836 082313	023439 023835 024106 024135 024136 024138 024139 024140 082420	024453 024454 024455 024456 024457 024458 024459 024460 024461 024505 024506 024507 082444 082445	025144 025612 025613 025614 082445	020837 020838 025928 025929 025930 025931 082710
LOWER FRASER RIVER		022832 022907 022908 022909 022924 022925 022926 022927 022928 022929 022930 022942 022947	022851 023035 023139 023140 023141 023216 023448 023449 023450 023451 023457 023458 023459	023138 023840 023938 023939 023940 023941 023944 023945 023946 023947 023948 023949 023950	024632 024851 024852 024853 024854 024855 024938 025033 025034 025035 025036 025037 025038	024640 024649 024650 024820 024832 025137 025138 025139 025140 025141 025725 026322	020834 020835 020836 024649 025236 025237 025238 025725 025932 025933 025934 025935 025936

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
LOWER FRASER RIVER (cont.)		022948	023460	023951	025039		025937
		022956	023461	023952	025113		025938
		022961	023462	023953	025114		025939
		023003	023463	023954			025940
		023004	023506	023955			025945
		023420	023811	023956			025946
			023812	024310			025947
			023813	420121			026322
			023814				
			023816				
			023838				
			023839				
			023840				
			420121				
MAKAH COASTAL					051740		052256
					051741		052257
					051742		052258
					051743		052259
					051949		
NOOKSACK/SAMISH		632753	211721	211944	212501	212528	213155
		632754	211722	211947	212502	212855	213156
			211723	633626	634432	635516	630716
			211724	633627	634708		
			211725	633628			
			211726				
			420116				
			633144				
			633145				
			633146				
			633147				
			633148				
	Bellingham Bay Net Pens				634431	635526	
NORTHERN ALASKA INSIDE		031822	031900	032023	042646	041318	041319
		031823	032020	032024	042656	042833	042661
		031841	032021	032025	042659	042855	042662
		031842	032022	032026	042708	042923	042931
		040317	032023	042305	042727	042926	042953
		041862	032024	042656	042729	042927	043105
		042310	041336	042707	042730	042942	043146
		042311	042135	042709	042740	042947	043216
		042312	042423	042820	042751	042948	043217

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
NORTHERN ALASKA INSIDE (cont.)		042329	042446	B41100	042752	042949	043218
		042351	042455	B41200	042811	042950	043228
		042362			042836	042951	043230
		042416			042855	042953	043234
		042417			042916	043146	043235
		042418			042917	043153	043236
		042419			042942	043154	043237
		042420			042946	043155	043345
		042421			042947	043156	043419
		042433			042948	043231	043420
		042434			042949	043235	043421
		042436			042950	043237	043422
		042446			042951	0401010403	043423
					043014	0401010404	043424
					043015	0401010405	043443
					043153	0401010406	
					043154	B31402	
					043155	B31403	
					B31402	B31501	
					B31403		
NORTHERN ALASKA OUTSIDE		040326	040351	040318	042315	042918	042941
		041324	041324	041339	042555	042922	043227
		041325	041325	042303	042657	043111	043438
		042127	042440	042527	042844	043113	
		042128	042447	042549	042860	043114	
		042308	042617	042623	043005	043116	
		042309	042618	042624	043006	043119	
		042320	042619	042625	043007	043121	
		042328	B40315	042657		043122	
		042332	B40506	042701		043125	
		042333	B40507	042802		043126	
		042427		042803		043128	
		042429		042804		043131	
		042435		042805		043222	
		042438		042806		043224	
		042439		042807			
		042440		042808			
				042809			
				042860			

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
NORTHWEST VANCOUVER ISLAND		022705	022705	024055	024724	025452	025259
		022706	023213				026136
		022840	023214				026334
			023343				
			023344				
OREGON NORTH AND MID COAST		072754	072927	073339	073558	074249	074552
		072755	073043	073340	073559	074350	074808
		072756	073059	073341	074055	074351	074809
		072757	073060	073544	074238	074352	074816
		072758	073101	073545	074241	074353	074817
		072759	073102	073546	074242	074354	074840
		072760	073256	073554	074310	074355	074841
		072958	073257	073610	074311	074435	074842
		073022	073258	073611	074312	074437	074843
		073025	073259	073612	074313	074438	074844
		073026	073260	073647	074314	074660	074848
		073027	073331	073648	074363	074661	074858
		073028	073332	073649	074403	074662	074939
		073033	073333	074414	074405	074663	074940
		073034	073411	074416	074406	074748	074943
		073035	073412	074419	074409	074751	075155
			073413	074421	074428		075156
			073414	074422	074431		075157
			073415		074432		
			073416				
			073417				
			073418				
			073601				
			073602				
			073603				
			073604				
			073605				
			073606				
			073607				
	Oregon Anadromous Hatchery	623047	620518	620634	621633	622135	
		623048	620636	621729	621913	622137	
		623122	620637	621833	621921	622138	
		623123	620640	621838	621925	622141	
		623124	620641	621839	621928	622142	
		623125	621810			622144	

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
OREGON NORTH AND MID COAST (cont.)	**Oregon Anadromous Hatchery (cont.)**	623126 623127 623128 623129	621811 621812 621814 621816				
	Oregon Aqua-Foods Hatchery	603658 603659 603704 603705 603820 603821 603822 603823 603825	603824 603826 603827 603831 603832 603833 603834 603835 603836 603837 603838	603629 603816 603817 603853 603854 603855 603856 603857	603912 603913 603914 603915 603916 603917 603925	603910 603928 603929 603930 603931 603935 603936 603939 603940 603941 603944 603945 603946 603947 603948 603953 604007 604008	603950 603963 604009 604010 604011 604012 604015
OREGON SOUTH/CALIFORNIA COAST		065650 065651 065930	062901 062902 062903 065103 065104 065105 065106 065652 065653 065655 065943 065961	062913 065109 065110 065111 065112 065654 073613 073723 074004 074005	062916 065115 065116 065656	065121 065122 065123 065124 065938	066322
	Oregon South Coast Hatchery	073011	073161		074058 074059	074060 074550	074847
	Oregon South Coast Wild	073011	073161		074058 074059	074060 074550	074847
QUEETS		211642 211643 211648	211719 211743 211744	211955 211956 212104	212252 212255 212514	212562 212601 212602	211655 211848 211849

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
QUEETS (cont.)		211710	211747	212107	212516	212604	211851
		211711	211748	212111	212559	212849	213114
		211713	211749	212113	212561	212850	213508
		211714	211750	212114	212608	212856	213511
		211715	211751	212116	212611	212859	213513
		211718	211752	212119	212613	212861	213531
			211753	212121	212614	212862	213537
			211754	212122	212616	213101	213538
			211755	212125	212619	213102	213542
			211757	212126	212621	213104	213544
			211933	212237	212622	213107	213547
				212250	212625	213108	213549
				632512	212626	213111	213550
				633245	212831	213113	213552
					212832	213116	213555
					634461	213119	213556
					634462	213122	213561
						213125	213562
						213126	213701
						213128	213702
						213131	
						213259	
						213261	
						213507	
						635513	
						635514	
QUILLAYUTE		633255	633052	633549	633861	634762	211844
		633256	633053	633550	633862	635511	630459
		633257	633136	633551	634232		
		633258	633137	633552	634235		
		633417	633441	633553	634444		
		633418	633839	633554	634456		
				633555	634459		
				633556	635025		
				633557			
				633558			
				633559			
				634244			
QUINAULT		211635	211656	211952	212259	212535	213161
		211636					213532
SKAGIT		211703	211731	212132	212659	213162	211838
		211704	211732	212135	212661	213201	211839

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
SKAGIT (cont.)		632755	211758	212137	212662	213202	211840
		632756	420119	212138	212801	213242	211841
		632757	633149	212141	212802	213244	211842
		632758	633150	212142	212804	630149	211843
		633154	633151	212238	212807	630216	211852
		633155	633206	634225	212808	630219	213247
			633207		212811	630221	213249
			633603		212813	630222	213502
			633604		633711		213504
			633605		633712		630747
					633713		631425
							631426
							631428
							631431
	Baker Hatchery			633651	633717	635055	
				633652	633916	635056	
				633653	634711	635522	
				633654	634713	635525	
					634928		
	Oak Harbor Net Pens			633622			
				633623			
	Skagit River Hatchery		420119				
			633149				
			633150				
			633151				
			633206				
			633207				
			633603				
			633604				
			633605				
	Swinomish Channel Hatchery	211705	211702	211804	212508	212521	
SOUTH PUGET SOUND		632454	633208	211949	212262	212522	213522
		632759	633210	211950	212504	212852	213704
		632760	633211	633629	633714	630116	630125
		632761	633362	633630	633715	630119	630126
		632762	633363	633704	633716	630121	630128
		632804	633438	633705	634441	630122	630256
		632805	633439	633706	634719	630150	630441
		632806	633440	633707	634721	630152	630722
		632807	633606	633708	634722	630156	630726

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
SOUTH PUGET SOUND (cont.)		632855	633607	633709	634726	633310	630822
		632856	633608	633710	635001	633311	630825
		633057	633609	633754	635002	633901	630826
		633058	633610	633755	635004	633902	634026
		633059	633611	633756	635007	635528	
		633140	633734	633757	635008		
		633204	633735	633758	635011		
		633205	633736	633851			
		633352	633846	633852			
		633426	633847	633853			
		633427	633848	633854			
			633849	633855			
			633850	633856			
				633857			
				634147			
	Nisqually River Hatchery				212504	212852	213704
	Puyallup River Hatchery			633629	635008		
				633630	635011		
				633704			
				633705			
				633706			
SOUTHERN ALASKA INSIDE		040319	040319	042635	042641	042718	042720
		040320	040323	042636	042663	042720	042919
		042155	040324	042637	042718	042957	043256
		042156	040327	042638	042753	043023	043257
		042324	040328	042639	042842	043024	043258
		042358	040334	042640	042845	043025	043259
		042359	040335	042641	042861	043050	043260
		042432	040337	042642	042862	043051	043261
		042450	040338	042643	042901	043052	043262
		042451	040339	042652	042902	043053	043263
		042452	040340	042736	042903	043054	043301
		042461	040341	042810	042904	043055	043302
		042462	041337	471637	042905	043056	043307
		042504	042134		042906	043057	043325
		042506	042441		042907	043060	043326
		042507	042453		042910	043061	043327
		042508	042561		042911	043062	043328
		042509	471632		042912	043152	043329
		042514	471633		042913	043211	043330

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
		042515	471634		042957	471606	043331
		042516			043010		043332
		042517			043016		043405
		042521			471640		043442
		042522			471641		471612
		471630					
SOUTHERN ALASKA OUTSIDE		042318	041955	042313	042543	0401010407	043203
		042325	042327	042314	042741	0401010408	043205
		042410	042454	042316	042914	042834	043219
		042413	042518	042317	042915	042914	043311
		042414	042519	042518	043019	043017	043312
				042543	043021	043018	043313
				042553		043019	043314
				042554		043021	043315
				042611		043022	043316
				042613			043317
							043318
SOUTHWEST VANCOUVER ISLAND		023007	023504	024142	024560	025336	025731
		023006	023503	024141	024437	024161	025337
			023505	024143	024561	025337	025732
						025418	025737
						025419	025944
						082515	082825
						082558	082826
						082560	082827
						082563	082828
STILLAGUAMISH/ SNOHOMISH		211634	211662	211927	212261	212531	213149
		633051	211663	211930	212631	213208	631147
		633141	211701	211942	212632	213211	
		633203	211922	212144	212635	213213	
		633429	211923	212147	212637	213214	
		633430	211924	212149	212638	213216	
			211925	212150	212641	213219	
			211926	212152	212642	213221	
			211928	212155	212644	213222	
			211929	212156	212647	213225	
			211931	212159	212649	213226	
			633618	212161	212650	213228	
			633619	212162	212652	213231	
			633620	212201	212655	213232	
			634142	212202	212656	213235	

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
STILLAGUAMISH/ SNOHOMISH (cont.)				212241 212242 212244 212247 212249 634228	634701	630155	
	Area 8A Net Pens				633337	635519	
STRAIT OF JUAN DE FUCA		B10408 B10409 B10410 B10411 B10412 B10414 B10415 B10508 B10509 B10510	211913 211914	211941 212222 212226	212256 212821 634728 634731	211728 212532 213237 213238 213514	213159
	Dungeness Hatchery	B10408 B10409 B10410 B10411 B10412 B10414 B10415 B10508 B10509 B10510			634728 634731		
	Elwha Hatchery					212532	213159
	Port Angeles Net Pens						631321
TRANSBOUNDARY ALASKA CANADA		B40909 B40910	B40603 B40604 B40605 B41207	024340 024341 024342 024347 024348	024340 024345 024346 024347 024821 024822 042647 042653	024345 024346 024843 025623 025624 025625 025626 025627 025628 031503 042920 042921	025048 025623 025625 025626 025628 026159 026329 031503 042920

Table 5. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1986-1991 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
UPPER RIVER	**FRASER**	022829	023058	023106	024132	024807	024808
		022850	023104	023227	024133	024808	025242
		023005	023114	023413	024134	025127	025243
			023118	023649	024147	025128	025244
			023163	023650	024148	025129	025245
			023263	023914	024329	025405	025307
			023301	023935	024330	025406	025308
			023309	023936	024508	025412	025309
				023937	024602	025413	025403
				024004	024603	025414	025558
				024005	024604	025506	025726
				024006	024932	025513	025727
				024043	024933		025728
				024044			025730
				024045			025860
				024046			025861
							025862
							025863
							025903
							025905
							025911
							026012
							026013
							026024
							026025
							026026
							026027
							026037
							026038
WILLAPA BAY		632808	633537	633624	634447		
		632809	633538	633625			
		632810	633539	634207			
		632811	633612				
		632812	633613				
		632813					
		632814					
		632815					
		632816					
		633341					
		633342					
		633343					
		633344					

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997.

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
BRITISH COLUMBIA CENTRAL COAST		020161	021127	020922	021254	180147	181119
		020162	021128	020923	021255	180412	181120
		020233	021357	020924	021256	180713	181121
		020746	021358	180141	021258	181242	
		020747	021359	180142	021259	181315	
		021015	021415	180143	021260	181326	
		021016	180125	180533	021340	181550	
		021017	180207	180534	021341	181857	
		026151	180208	180838	021355		
		026152	180240	180919	181221		
		026153	180241	180920			
				181005			
BRITISH COLUMBIA NORTH COAST (BCNCST)		020824	020508	020925	021241	080163	080905
		020825	020545	020926	021242	081613	181116
		020843	020546	020927	021243	082915	181117
		020844	020911	020935	021247	180701	181118
		020845	020912	020936	021248	180702	
		020846	020913	020937	021249	180703	
		025041	020914	021228	021336	180704	
		026028	020915	021229	021337	180705	
		026204	020916	021230	082912	180706	
		026205	021036	021231	082913	180707	
		026206	021037	021232	082916	180708	
		026306	021308	021233	180847	180709	
		080801	021309	021234	180922	180710	
		080805	021416	080125	180933	180711	
		080909	021417	080129		180712	
			025656	080151		180714	
			080126	080152		180715	
			080128	080153		180716	
			080802	080802		181218	
			080803	180145		181250	
			180925	180146		181842	
			180926	180537		181843	
			180927	180801		181856	
			180928	180832		182051	
				180929			
				180930			
COLUMBIA RIVER (COLRIV)		052532	052749	071428	053305	053626	053248
		052533	074045	071516	070256	070137	070925
		074222	074046	071521	070257	070138	070958

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
COLUMBIA RIVER (COLRIV) (cont.)		074517	074047	071522	070337	070356	070959
		074518	074520	071523	070338	070554	071147
		075426	074644	071524	070339	070555	071148
		075427	074645	071530	070340	070556	071149
		075533	075616	071534	070341	071544	075334
		075534	075617	074832	070342	071545	075415
		075535	075620		070362	075262	075901
		075536	075621		075130	075329	635433
		075538	075622		076145	075445	635448
		075549	075624		634805	075446	635450
		075551	075625		634860	635361	635739
		631155	075721		634862	635363	635763
		633722	075748		635063	635444	635917
		633723	634003		635104	635462	635951
		633944	634005		635301		
		635531	634006				
		635631	634248				
		635632	634342				
	Clakamas Early Wild	075552	052620	052745	053260	053624	053827
		075553		052746	053261		
					053262		
					053263		
	Col Rvr Late Hatchery/ Wild	631359	075747	071533	074936	635342	075414
		631462	633963	634440	635101	635356	635730
		633338	634001	634641	635236	635359	635731
		633339	634002	634727	635348	635360	635732
		633922	634007		635349	635463	635740
		633923	634253			635725	635741
		633924	634254			635955	635742
		633945	634343				635802
		635532	634344				635912
		635635					
	Sandy Early W	075542	075720	071531	070239	070551	070837
		075543	075724	071532	074929	070552	070838
		075544		075951	074930		070839
		075545		076016	074933		070840
		075546		076017	074934		071134
		075547		076018	075126		071135
				076019	075127		

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
COLUMBIA RIVER (COLRIV) (cont.)	**Youngs Bay Hatchery**	075554 075555 075558 075559	075455 075712	075952 076014 076015 076111 076128 076129 076130	070124 070135 070136 076142		070961 071222 071223 071242
GEORGIA STRAIT MAINLAND		020617 021018 021027 021028 021111 021116 021117 026162 026207 026208 026228 026229 026230 026233 026360 026361 026362 026363	021046 021124 021125 021126 021219 021224 180101 180102 180103 180104 180109 180110 180111 180112 180237 180238	021046 021311 021351 021353 021354 025213 025214 180128 180129 180130 180131 180604 180739 180740 180741 180742	180757 180758 180759 180760 180944 180945 181601 181602 181603 181604 181605 181606 181607 181608 181609 181610	180720 181107 181108 181638 181743 181744 181745 181806 181958 181959 181960 181961 182101 182102 182103 182104	181134 181302 181303 181806 182101 182102 182103 182104 182107 182108
GEORGIA STRAIT VANCOUVER ISLAND (GSVNC)		020812 021019 021020 021021 021023 021024 021025 021026 021040 021152 026154 026201 026202 026203 080804	021008 021040 021151 021225 021226 021227 080123 080134 080142 081007 081008 081009 081010 081011 081832	020839 080141 080142 080143 080144 080145 080147 080148 080149 080156 080159 081834 081835 081836 180127	080145 080147 080148 080149 080154 080155 080156 080157 080158 080160 080810 080812 180736 180737 180946	080150 080707 080810 080811 080812 080813 181251 181252 181253 181747 182004 182005 182006 182007 182008	080813 080814 181940 181941 181942 181943 182012 182013 182054 182109 182110

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
GEORGIA STRAIT VANCOUVER ISLAND (GSVNC) (cont.)		081001	081833	180559	180947	182009	
		081002	081834	180560	180948	182010	
		081003	081836	180724	181618	182011	
		081004	180114	181003	181620		
		081005	180115	181004	181621		
		081006	180116		181624		
		081007	180117		181625		
		081008	180120		181626		
		081009	180121		181634		
		081010	180122		181746		
		081011	180123		182005		
		082715			182006		
		082717					
		180120					
		180121					
		180122					
		180123					
GRAYS HARBOR (GRAYHB)		633403	634258	634712	634753	635115	635430
		633917	634307	634718	634906	635116	635456
		633918	634308	634733	635060	635403	635746
		633919	634345	634734	635102	635404	635747
		633920	634346	634808	635103	635447	635803
		633921	634347	634809	635212	635503	635804
		633942	634348	634829	635215	635505	635853
		633943	634349	634838	635402	635636	635929
		633946	634350	634839	635411	635726	635933
		633947	634359		635412	635727	635945
		633961	634360			635743	635954
		634009	634453				636010
		634010	634454				
		634033	634532				
		634157					
HOH		213516	212050	212304	212422	635337	635854
		631322	212248	212405			
		631325					
		631416					
HOOD CANAL (HOODCL)		052451	052613	052450	053418	053746	054058
		052452	052614	052910	053419	053747	054059
		052453	052615	052911	053420	053748	054060
		211823	211825	053140	212334	053749	054061
		633934	634018	634445	634963	212458	212460
		633935	634352	634828	635304	635455	634334

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
HOOD CANAL (HOODCL) (cont.)		633936 633937 634310	634415 634439 634650		635658 635660	635744	635653 635818
JOHNSTONE STRAIT		020157 025758 026145 026146 026147	180105 180106 180107 180108 180132 180133 180134 180135 180206 180249	180132 180133 180134 180135 180545	180243 181611 181612 181613 181614 181615	180961 181762 181763	181304 181305 181306 181307 182115 182116 182629 182630 182631 182632 182633 182634 182635 182636
LOWER FRASER RIVER (FRSLOW)		020158 020160 020218 020219 020220 020221 020228 020318 020544 020849 020850 020851	020229 020551 020917 020919 020920 020921 021412 021413 021414 180113 180118 180119	020134 020135 026352 026353 180136 180157 180158 180646 180647 180648 180939 180940 180941 180942 180943	180652 180653 180654 180655 180656 180657 180659 180660 180661 180662 180663 181616 181617 181619 181627 181628 181635 181636 181637	082909 181555 181760 181761 181801 181802 181844 181845 181846 181847 181848 181849 181850 181851 181854 181855 181962 181963 182001 182002 182003	023245 181308 181309 182112 182113 182114 182301 182302 182305 182431 182601 182603
MAKAH COASTAL		052352 052505 052506 052507	052616 052618 052658 052660	052912 052913 052914 053123	053136 053421 053422 053423	053424 053750 053751 053752	054044 054045 054046 054047 054057

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
NOOKSACK/ SAMISH		211859	212021	212227	212230	212456	212623
		211861	212024	212229	212243	212457	212627
		631159	634112	212310	212421	212539	635457
				634448	634754	212627	635648
				634710	634909	635260	635939
					635233	635346	635940
NORTHERN ALASKA INSIDE		042944	040704	040707	040714	040715	040717
		043106	042850	040708	043837	043555	043734
		043110	042851	043554	043841	043842	043735
		043544	043622	043649	043956	043843	043836
		043545	043624	043840	043957	043954	044015
		043550	043649	043909	043958	043960	044448
		043551	043650	043910	043959	044330	044449
		043610	043725	043911	044048	044360	044450
		043611	043730	044023	044122	044361	044515
		043612	043731	044024	044123	044362	044516
		043613	043732	044039	044124	044363	044517
		043614	043808	044040	044125	044403	044518
		043615	043831	044041	044130	044433	044529
		043621	043832	044042	044131	044434	044535
		043623	043833	044043	044132	044435	044660
		043634	043834	044054	044246	044436	044661
		0401011505	043835	0401020503	044247	044443	500406
			043844	0401020901	044248	044447	500407
			043846		044249	044514	500408
			0401011505		044250		500409
			0401011512		044322		500410
			0401020503		044323		044534*1
NORTHERN ALASKA OUTSIDE (NOASKA)		043138	042852	0401010912	0401010912	0401021310	0401030209
		043354	043335	043654	044114	0401021313	0401030514
		043433	043636	043807	044115	044018	044347
		043434	043637	043915	044116	044327	044401
		043538	043638	043916	044117	044328	044402
			043656	043921	044119	044332	044404
			043722	043922	044217	044356	044520
			043723	043924	044306	044357	044612
			043760	044053		044510	
			043761	044055			
NORTHWEST VANCOUVER ISLAND		020227	020908		181208	181417	181515
		020534	020909				
		020535	020910				
		020536	180159				
		020610					

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
OREGON NORTH AND MID COAST	**Oregon North Coast Hatchery**	074819 075424 075425 075556 075557	074932 074935 075731 075750 075751 075752	070316 074920 074923 074924 074927	070316 070317 070853 075137 075138 075139 075251 075252	070853 075251 075252	071137 075339 075410
	Oregon North-Mid Coast Hatchery	074829 074830 074831 074902 074904 074907 074908 074911 074913 074922	074413 074919 074921 074922 074941 074942 075817	071519 071520 075953 076008 076012	070258 070260 070262 070263 070312 070363 076035	075253 075254 075255 075257 075258	071224 075416
	Oregon South-Mid Coast Hatchery	072338 074937 075238 075239 075240 075241 075242 075428 075431 075432 075610 075613 075614	074937 074938 075609 075610 075612 075613 075614	071422 071423 076005 076006 076007	070248 070319 070320 075261	075249 075250 075260 075261 075411 075412	075332 075411 075412 075736 091811 091812
OREGON SOUTH/ CALIFORNIA COAST (ORECAL)	**California North Coast Hatchery**	065660 066320 066323	0601080106 065657 066325	062820	062819 065760		
	Oregon South Coast Hatchery	075531	075615	071526 071527 071528 075950	070642 076354 076355 076356 076357 076358 076359 076360	070641 070642 070643 070645 070646	071116 071221

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
QUEETS	**Queets River Fall Hatchery**	211936 212007	212056 212057	B50814	212415	212543	212935
	Queets River Fall Natural	211943 211945 211946 211948 211951 211953 211954 211957 211958 211960 211963 212001 212002 212003 212004 212005 212030 213541	212031 212032 212105 212109 212110 212112 212118 212123 212124 212127 212129 212130 212133 212134 212136 212139	212336 212338 212341 212342 212343 212345 212347 212348	212346 212352 212353 212354 212356 212357 212358 212360 212361 212362 212363 212430 212431 212434 212435 212436 212440 212442	212433 212438 212443 212445 212446 212447 212448 212848 212851 212853 212854 212857 212863 212902 212903 212905 212913	212846 212901 212904 212906 212908 212909 212912 212915 212916 213005 213006 213007 213008 213009 213010 213011 213012 213014 213015
	Queets River Suppl. Hatchery	633925	634524 634525	633732 634410	212417 212418 212419 212420	212512 212515 212517 212518 212520 212524	212523 212932
QUILLAYUTE		211854 211855	212050 212248 634230	212304 212405 634729	212422 635333	635337	635854
QUINAULT		211857 211863	052659 052661 052714 211939 212058	053128 053129 053130 212307	053137 053138 053139	053615 053616 053617 212545	053857 053858 053859 053860 212937
SKAGIT		212008 212009 212033 212034 212035 212037	212036 212038 212041 212063 212103 212140	212151 212312 212313 212316 212318 212319	212148 634910 635128 635401	635130 635254 635345 635745	635909 635910 635927 635946

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
SKAGIT (cont.)		212039	212143	212320			
		212040	212145	634715			
		631355	634536	634717			
		634011		634820			
				634846			
SOUTH SOUND	**PUGET**	211821	212025	053220	053536	053540	212459
		211822	212233	053221	053537	053541	212630
		631331	213708	053222	053538	053542	212924
		631332	634353	053223	053539	053543	634324
		631356	634354	212223	212331	212424	634325
		631361	634356	212311	212332	212455	634326
		631442	634357	634322	212411	212540	634327
		633948	634358	634451	212427	212557	634328
		633949	634409	634540	634954	634333	635423
		633950	634457	634541	634957	635131	635426
		633952	634458	634801	634960	635258	635427
		633956	634460	634802	635105	635362	635657
		634518		634803	635109	635438	635736
		634519			635129	635439	635810
		634520			635303	635451	635915
						635452	635924
						635454	
SOUTHERN ALASKA INSIDE (SIASKA)		043361	043143	043729	042856	043724	043733
		043448	043145	043754	043743	043728	043809
		043451	043151	043758	043744	044156	044214
		043452	043630	043759	043961	044226	044215
		043453	043631	043850	044009	044256	044321
		043454	043659	043851	044010	044257	044458
		043455	043660	043852	044011	044258	044459
		043456	043661	043853	044014	044307	044460
		043457	043662	043854	044045	044308	044461
		043458	043703	043855	044136	044309	044462
		043459	043709	043856	044138	044310	044463
		043460	043710	043908	044139	044311	044501
		043461	043711	043931	044140	044312	044540
		043520	043712	043932	044141	044313	044541
		043521	043713	043935	044144	044405	044542
		043522	043714	043940	044145	044406	044545
		043523	043715	043941	044146	044408	044546
		043524	043716	043942	044147	044409	044547
		043525	043717	043943	044150	044410	044548

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
		043526	043718	043944	044151	044411	044549
		043527	043719	044012	044152	044412	044550
		043528	043814	044013	044153	044413	044551
		043529	043848	044016	044154	044414	044552
		043552	471650	044022	044155	044415	044553
		043602	471652	471655	044245	044422	044554
		043603	0401011514	471656	044259	044423	044555
		043632	0401011515	471657	471659	044424	044556
		471607		0401011003	471662	044429	044557
		471611			471663	044444	044558
		471649			0401021212	044445	044559
						044446	044560
						471702	044609
						471703	471721
						471704	471722
						471706	471724
						471707	
						471710	
SOUTHERN		043425	043515	043755		044341	044613
ALASKA OUTSIDE		043444	043516	043806		044342	044614
		043503	043517	043860			
		043505	043752	043861			
		043506	043753	043862			
		043508		043901			
		043509					
		043510					
		043511					
		043512					
		043513					
		043514					
SOUTHWEST		020316	020222	021342	180949	181209	181210
VANCOUVER		020317	020514	021343	180950	181210	
ISLAND (SWVNCI)		020529	021030	021344	180951	181803	
		020530	021031	180605	181629	181804	
		020531	021032	180606	181630		
		020537	021360	180607	181631		
		020538	021361		181632		
		020539	021362				
		020540	021554				
		020541					
		020542					

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
SOUTHWEST VANCOUVER ISLAND (cont.)		020816 082815 082821					
STILLAGUAMISH/ SNOHOMISH		211824 631362	212023 634436	212022 212301 634804	212333 634958	212224 212534 212536 635453	212633 212926 212927 212928 212929 635735 635811
STRAIT OF JUAN DE FUCA		211858 633340 634316 634317	212047 634302	212220 634821 634822	212406 212409 212410	212423 212458 212510	212454 212460 212620
TRANSBOUNDARY ALASKA CANADA		042849		043801 043802	044209 044210	044232	044233
UPPER FRASER RIVER (FRSUPP)		020651 020718 020719 020720 020721 020722 020723 020724 020725 020726 020737 025953 025954 025955 026218 026219 026220 026221 026222 026223 026224 026225 026226 026227 026335 026336 026337 026338	020745 020761 020762 020852 020853 020854 020855 020856 020857 020858 020859 020860 021538 021539 180257 180258 180307 180308 180331	020510 020862 020931 020932 020933 020934 021047 180126 180205	020137 021338 021339 021447 025926 180649 180650 180952 180953 181207 181219 181220	021103 025948 181249 181254 181255 181310 181559 181639 181757 181758 181852	181257 181262 181263 181301 181513 182243 182244

Table 6. Coded-wire-tag groups chosen to represent Mixed-Stock-Model (MSM) stocks for catch years 1992-1997 (continued).

MSM Stock		Catch Year					
Production Region	**Mgt Unit**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
WILLAPA BAY		633403	634355	634538	635108	635720	635857
		633961					
		634010					
		634033					

Table 7. Preliminary "User-Defined" PEF values for Washington State Production Regions for 1986-1991 MSM PEF estimation process.
These values were derived using release and smolt trap information, when available.

Brood Year >	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**
Return Year >	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
MSM Production Region						
NOOKSM						
Wild smolts	113,000	113,000	113,000	113,000	113,000	113,000
Hatchery smolt (age 2) Total	3,339,099	3,431,710	2,708,393	4,314,591	4,139,144	4,305,832
Total wild+hatchery smolts	3,452,099	3,544,710	2,821,393	4,427,591	4,252,144	4,418,832
Tagged Hatchery smolts	32,673	170,564	142,790	174,221	169,763	157,663
Tagged wild smolts						
Total tagged smolts	32,673	170,564	142,790	174,221	169,763	157,663
PEF	**105.66**	**20.78**	**19.76**	**25.41**	**25.05**	**28.03**
SKAGIT						
Wild smolts	652,000	1,073,000	652,000	1,073,000	652,000	1,073,000
Hatchery smolt (age 2) Total	575,012	282,000	383,231	518,081	402,652	301,247
Total wild+hatchery smolts	1,227,012	1,355,000	1,035,231	1,591,081	1,054,652	1,374,247
Tagged Hatchery smolts	228,865	147,308	195,331	199,824	203,364	107,227
Tagged wild smolts	13,017	44,133	62,002	57,949	70,308	49,461
Total tagged smolts	241,882	191,441	257,333	257,773	273,672	156,688
PEF	**5.07**	**7.08**	**4.02**	**6.17**	**3.85**	**8.77**
STILSN						
Wild smolts	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000
Hatchery smolt (age 2) Total	791,603	1,017,647	1,108,453	1,120,452	1,008,387	1,659,222
Total wild+hatchery smolts	1,983,603	2,209,647	2,300,453	2,312,452	2,200,387	2,851,222
Tagged Hatchery smolts	91,714	201,818	127,596	93,465	128,433	128,337
Tagged wild smolts	60,441	43,875	56,831	48,601	52,237	
Total tagged smolts	152,155	245,693	184,427	142,066	180,670	128,337
PEF	**13.04**	**8.99**	**12.47**	**16.28**	**12.18**	**22.22**
SPGSND						
Wild smolts (Total)	443,000	443,000	443,000	443,000	443,000	443,000
Hatchery smolt (age 2) Total	9,178,602	9,863,330	10,502,283	10,029,847	10,119,615	10,776,487
Total wild+hatchery smolts	9,621,602	10,306,330	10,945,283	10,472,847	10,562,615	11,219,487
Tagged Hatchery smolts	309,527	255,538	352,475	382,453	348,361	381,785
Tagged wild smolts	18,166	9,777	13,199	7,480	11,565	14,704
Total tagged smolts	327,693	265,315	365,674	389,933	359,926	396,489
PEF	**29.36**	**38.85**	**29.93**	**26.86**	**29.35**	**28.30**
HOODCL						
Wild smolts	550,000	550,000	550,000	550,000	550,000	550,000
Hatchery smolt (age 2) Total	1,299,228	1,855,807	1,458,539	1,803,234	1,941,435	1,559,663
Total wild+hatchery smolts	1,849,228	2,405,807	2,008,539	2,353,234	2,491,435	2,109,663
Tagged Hatchery smolts	92,629	128,218	84,075	91,689	149,724	280,816
Tagged wild smolts	21,309	30,540	16,973	22,698	22,313	17,528
Total tagged smolts	113,938	158,758	101,048	114,387	172,037	298,344
PEF	**16.23**	**15.15**	**19.88**	**20.57**	**14.48**	**7.07**
SJDFCA						
Wild smolts	300,000	300,000	300,000	300,000	300,000	300,000
Hatchery smolt (age 2) Total	989,684	1,340,000	1,711,100	552,915	806,452	1,155,779
Total wild+hatchery smolts	1,289,684	1,640,000	2,011,100	852,915	1,106,452	1,455,779
Tagged Hatchery smolts	196,183		72,340	404,368	60,809	96,654
Tagged wild smolts		7,155	14,328	7,037	30,587	
Total tagged smolts	196,183	7,155	86,668	411,405	91,396	96,654
PEF	**6.57**	**229.21**	**23.20**	**2.07**	**12.11**	**15.06**

Table 7. Preliminary "User-Defined" PEF values for Washington State Production Regions for 1986-1991 MSM PEF estimation process (continued).

Brood Year >	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**
Return Year >	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
MSM Production Region						
MAKAHC						
Wild smolts	n/a	n/a	n/a	n/a	n/a	n/a
Hatchery smolt (age 2) Total	307,091	306,000	286,466	302,664		310,481
Total wild+hatchery smolts	307,091	306,000	286,466	302,664	0	310,481
Tagged Hatchery smolts				99,056		120,567
Tagged wild smolts						
Total tagged smolts	0	0	0	99,056	0	120,567
PEF				**3.06**		**2.58**
QUILUT/HOH						
Wild smolts	618,000	618,000	618,000	618,000	618,000	618,000
Hatchery smolt (age 2) Total	1,022,500	1,158,271	1,252,174	1,098,667	1,023,400	880,300
Total wild+hatchery smolts	1,640,500	1,776,271	1,870,174	1,716,667	1,641,400	1,498,300
Tagged Hatchery smolts	92,022	74,499	442,880	363,187	155,757	90,704
Tagged wild smolts	35,878	30,834	16,721	41,002	9,122	4,712
Total tagged smolts	127,900	105,333	459,601	404,189	164,879	95,416
PEF	**12.83**	**16.86**	**4.07**	**4.25**	**9.96**	**15.70**
QUEETS						
Wild smolts	440,000	440,000	440,000	440,000	440,000	440,000
Hatchery smolt (age 2) Total	792,009	236,845	696,761	780,449	1,084,965	782,032
Total wild+hatchery smolts	1,232,009	676,845	1,136,761	1,220,449	1,524,965	1,222,032
Tagged Hatchery smolts	80,781	48,665	153,851	77,945	176,754	80,699
Tagged wild smolts	16,438	40,860	19,940	125,890	44,623	41,108
Total tagged smolts	97,219	89,525	173,791	203,835	221,377	121,807
PEF	**12.67**	**7.56**	**6.54**	**5.99**	**6.89**	**10.03**
QUINLT						
Wild smolts	217,000	217,000	217,000	217,000	217,000	217,000
Hatchery smolt (age 2) Total	871,434	670,098	737,191	665,880	833,573	739,637
Total wild+hatchery smolts	1,088,434	887,098	954,191	882,880	1,050,573	956,637
Tagged Hatchery smolts	50,236	41,201	77,132	76,413	71,220	111,551
Tagged wild smolts						
Total tagged smolts	50,236	41,201	77,132	76,413	71,220	111,551
PEF	**21.67**	**21.53**	**12.37**	**11.55**	**14.75**	**8.58**
GRAYHB						
Wild smolts	1,702,000	1,702,000	1,702,000	1,702,000	1,702,000	1,702,000
Hatchery smolt (age 2) Total	4,796,790	2,288,814	2,592,604	3,077,665	3,489,584	3,660,908
Total wild+hatchery smolts	6,498,790	3,990,814	4,294,604	4,779,665	5,191,584	5,362,908
Tagged Hatchery smolts	405,110	142,675	152,576	148,181	147,655	501,563
Tagged wild smolts	121,967	82,816	76,810	68,564	60,279	88,529
Total tagged smolts	527,077	225,491	229,386	216,745	207,934	590,092
PEF	**12.33**	**17.70**	**18.72**	**22.05**	**24.97**	**9.09**
WILLAP						
Wild smolts	425,000	425,000	425,000	425,000	425,000	425,000
Hatchery smolt (age 2) Total	4,285,028	4,147,832	4,217,300	3,464,700	3,406,100	3,654,497
Total wild+hatchery smolts	4,710,028	4,572,832	4,642,300	3,889,700	3,831,100	4,079,497
Tagged Hatchery smolts	255,080	109,599	109,178	78,499		
Tagged wild smolts						
Total tagged smolts	255,080	109,599	109,178	78,499	0	0
PEF	**18.46**	**41.72**	**42.52**	**49.55**		

Table 8. Preliminary "User-Defined" PEF values for Washington State Production Regions for 1992-1997 MSM PEF estimation process.

Brood year >	1989	1990	1991	1992	1993	1994
Return year >	1992	1993	1994	1995	1996	1997
MSM Production Region						
NOOKSM						
Wild smolts	113,000	113,000	113,000	113,000	113,000	113,000
H smolts	4,221,656	5,202,979	4,846,242	5,284,854	4,802,550	3,744,483
Total smolts	4,334,656	5,315,979	4,959,242	5,397,854	4,915,550	3,857,483
Tagged H smolts	145,420	149,141	200,645	276,459	193,780	196,531
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	145,420	149,141	200,645	276,459	193,780	196,531
PEF	**29.81**	**35.64**	**24.72**	**19.52**	**25.37**	**19.63**
SKAGIT						
Wild smolts	652,000	1,073,000	623,000	1,129,000	727,000	1,125,000
H smolts	355,616	577,024	500,905	403,366	682,386	363,878
Total smolts	1,007,616	1,650,024	1,123,905	1,532,366	1,409,386	1,488,878
Tagged H smolts	96,451	129,971	125,587	44,613	126,198	347,307
Tagged W smolts	43,550	37,674	39,686	27,261	21,060	19,687
Total tagged smolts	140,001	167,645	165,273	71,874	147,258	366,994
PEF	**7.20**	**9.84**	**6.80**	**21.32**	**9.57**	**4.06**
STILSN						
Wild smolts	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000
H smolts	1,278,447	1,310,771	1,271,672	1,256,500	1,368,012	1,307,813
Total smolts	2,470,447	2,502,771	2,463,672	2,448,500	2,560,012	2,499,813
Tagged H smolts	253,305	94,162	116,283	92,223	109,751	143,080
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	253,305	94,162	116,283	92,223	109,751	143,080
PEF	**9.75**	**26.58**	**21.19**	**26.55**	**23.33**	**17.47**
SPGSND						
Wild smolts w/out Deschutes	443,000	443,000	443,000	443,000	443,000	443,000
Deschutes	14,103	56,170	20,353	7,191	19,130	n/a
H smolts	9,132,989	10,369,813	8,124,913	7,709,098	7,663,714	9,415,423
Total smolts	9,590,092	10,868,983	8,588,266	8,159,289	8,125,844	9,858,423
Tagged H smolts	348,180	377,372	403,062	493,025	531,680	449,813
Tagged W smolts	1,996	7,154	10,908	1,354	3,571	5,817
Total tagged smolts	350,176	384,526	413,970	494,379	535,251	455,630
PEF	**27.39**	**28.27**	**20.75**	**16.50**	**15.18**	**21.64**
HOODCL						
Wild smolts	550,000	550,000	550,000	550,000	550,000	550,000
H smolts	1,587,365	1,704,802	1,543,980	1,509,655	1,516,464	1,298,758
Total smolts	2,137,365	2,254,802	2,093,980	2,059,655	2,066,464	1,848,758
Tagged H smolts	299,773	247,209	130,492	204,682	247,151	141,209
Tagged W smolts	21,149	16,979	10,908	16,274	15,146	21,834
Total tagged smolts	320,922	264,188	141,400	220,956	262,297	163,043
PEF	**6.66**	**8.53**	**14.81**	**9.32**	**7.88**	**11.34**
SJDFCA						
Wild smolts	300,000	300,000	300,000	300,000	300,000	300,000
H smolts	1,017,646	1,219,378	949,400	1,542,131	1,609,700	1,593,821
Total smolts	1,317,646	1,519,378	1,249,400	1,842,131	1,909,700	1,893,821
Tagged H smolts	108,955	97,791	107,025	149,488	145,368	144,895
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	108,955	97,791	107,025	149,488	145,368	144,895
PEF	**12.09**	**15.54**	**11.67**	**12.32**	**13.14**	**13.07**

Table 8. Preliminary "User-Defined" PEF values for Washington State Production Regions for 1992-1997 MSM PEF estimation process (continued).

Brood year >	1989	1990	1991	1992	1993	1994
Return year >	1992	1993	1994	1995	1996	1997
MSM Production Region						
MAKAHC						
Wild smolts	n/a	n/a	n/a	n/a	n/a	n/a
H smolts	366,500	351,028	335,210	359,880	341,489	1,047,163
Total smolts	366,500	351,028	335,210	359,880	341,489	1,047,163
Tagged H smolts	130,022	95,259	108,709	68,054	60,683	127,551
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	130,022	95,259	108,709	68,054	60,683	127,551
PEF	**2.82**	**3.68**	**3.08**	**5.29**	**5.63**	**8.21**
QUILUT/HOH						
Wild smolts	618,000	618,000	618,000	618,000	618,000	618,000
H smolts	1,276,311	855,133	586,376	594,211	822,900	793,400
Total smolts	1,894,311	1,473,133	1,204,376	1,212,211	1,440,900	1,411,400
Tagged H smolts	87,228	69,717	65,163	63,922	73,116	73,302
Tagged W smolts	9,838	9,411	16,611	22,751	0	0
Total tagged smolts	97,066	79,128	81,774	86,673	73,116	73,302
PEF	**19.52**	**18.62**	**14.73**	**13.99**	**19.71**	**19.25**
QUEETS						
Wild smolts	444,000	444,000	444,000	444,000	444,000	444,000
H smolts	628,293	1,009,418	650,108	753,374	1,057,131	999,033
Total smolts	1,072,293	1,453,418	1,094,108	1,197,374	1,501,131	1,443,033
Tagged H smolts	108,518	155,009	106,122	157,126	212,569	135,330
Tagged W smolts	32,163	41,156	20,202	31,319	31,738	23,460
Total tagged smolts	140,681	196,165	126,324	188,445	244,307	158,790
PEF	**7.62**	**7.41**	**8.66**	**6.35**	**6.14**	**9.09**
QUINLT						
Wild smolts	217,000	217,000	217,000	217,000	217,000	217,000
H smolts	592,758	741,785	713,553	659,322	731,806	270,774
Total smolts	809,758	958,785	930,553	876,322	948,806	487,774
Tagged H smolts	78,662	99,812	145,697	68,802	107,068	85,806
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	78,662	99,812	145,697	68,802	107,068	85,806
PEF	**10.29**	**9.61**	**6.39**	**12.74**	**8.86**	**5.68**
GRAYHB						
Wild smolts	1,702,000	1,702,000	1,702,000	1,702,000	1,702,000	1,702,000
H smolts	2,618,250	3,209,508	3,444,173	3,319,376	3,115,790	3,682,514
Total smolts	4,320,250	4,911,508	5,146,173	5,021,376	4,817,790	5,384,514
Tagged H smolts	466,538	495,724	261,238	250,741	285,816	299,169
Tagged W smolts	89,028	42,971	32,027	76,161	57,321	46,942
Total tagged smolts	555,566	538,695	293,265	326,902	343,137	346,111
PEF	**7.78**	**9.12**	**17.55**	**15.36**	**14.04**	**15.56**
WILLAP						
Wild smolts	425,000	425,000	425,000	425,000	425,000	425,000
H smolts	2,939,175	3,905,934	3,470,035	3,421,495	2,117,300	2,543,000
Total smolts	3,364,175	4,330,934	3,895,035	3,846,495	2,542,300	2,968,000
Tagged H smolts	n/a	50,374	26,502	23,781	74,758	76,069
Tagged W smolts	n/a	n/a	n/a	n/a	n/a	n/a
Total tagged smolts	0	50,374	26,502	23,781	74,758	76,069
PEF	**n/a**	**85.98**	**146.97**	**161.75**	**34.01**	**39.02**

Table 9. Original escapement, average marine exploitation rate and total CWT recovery data used to derive total marine catch and "User-Defined" Production Expansion Factors (PEF) for upper Fraser River Coho (FRSUPP) Production Region for catch years 1986-1991.

	Catch Year					
Estimate	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Total Escapement	158,380	103,242	127,542	66,067	49,866	29,022
Average Marine Exploitation Rate	0.65	0.54	0.71	0.65	0.74	0.68
Marine Catch	293,388	121,197	312,259	122,695	141,927	61,672
MSM Tag Recoveries	1,071	4,700	10,931	7,078	7,466	4,597
PEF	273.94	25.79	28.57	17.33	19.01	13.42

Table 10. Revised escapement, average marine exploitation rate and total CWT recovery data used to derive total marine catch and "User-Defined" Production Expansion Factors (PEF) for upper Fraser River Coho (FRSUPP) Production Region for catch years 1986-1991.

	Catch Year					
Estimate	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Total Escapement	68,344	80,559	96,702	69,714	48,485	33,545
Average Marine Exploitation Rate	0.66	0.54	0.71	0.65	0.74	0.68
Marine Catch	132,666	93,514	239,028	126,759	135,552	70,455
MSM Tag Recoveries	1,071	4,544	11,148	7,218	7,086	4,659
PEF	123.88	20.58	21.44	17.56	19.13	15.12

Table 11. Revised escapement, average marine exploitation rate and total CWT recovery data used to derive total marine catch and "User-Defined" Production Expansion Factors (PEF) for upper Fraser River Coho (FRSUPP) Production Region for catch years 1992-1997.

	Catch Year					
Estimate	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Total Escapement	50,528	29,381	35,517	22,996	9,294	18,675
Average Marine Exploitation Rate	0.81	0.88	0.43	0.56	0.83	0.40
Marine Catch	222,077	206,635	27,160	29,458	47,022	12,704
MSM Tag Recoveries	7,870	4,279	2,585	1,248	496	455
PEF	28.22	48.29	10.51	23.60	94.86	27.95

Table 12. Original MSM-estimated PEF values for 1986-1991 catch years.

PRODUCTION REGIONS / Management Units		Catch Year					
Abbrev.	**MSM_Long_Name**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
NOOKSM	NOOKSACK/SAMISH	89.94	28.38	24.82	27.41	28.48	35.47
bhambh	Bellingham Bay Net Pens	--	--	--	**1.01**	**1.3**	**1.18**
SKAGIT	SKAGIT	15.44	8.87	14.57	11.22	12.32	12.97
skagth	Skagit River Hatchery	--	**1.91**	**1.08**	--	--	**2.81**
skgbkh	Baker (Skagit) Hatchery	--	--	--	**1.39**	**1.07**	--
swinch	Swinomish Channel Hatchery	**1.28**	**2**	**2**	**2**	**2.15**	**2.04**
oakhbh	Oak Harbor Net Pens	--	--	**1.02**	--	--	--
STILSN	STILLAGUAMISH/SNOHOMISH	47.49	14.17	51.67	59.73	21.88	67.31
ar8anh	Area 8A Net Pens	--	--	--	**1**	**1**	--
HOODCL	HOOD CANAL	38.69	39.19	**39.2**	**24.38**	52.9	**33.88**
ptgamh	Port Gamble Net Pens	--	--	--	**9.21**	--	**53.5**
ar12bw	Area 12/12B Wild	--	--	--	**--**	**2.06**	--
qlcnbh	Quilcene Hatchery	--	--	--	**4.15**	**--**	**8.25**
qlcenh	Quilcene Bay Net Pens	--	--	--	**12.32**	**--**	**6.38**
ar12aw	Area 12A Wild	--	--	--	**--**	**0.5**	--
hoodsh	Hoodsport Hatchery	--	--	--	**5.96**	--	**0.95**
ar12dw	Area 12C/12D Wild	--	--	--	**--**	**4.13**	--
gadamh	George Adams Hatchery	--	--	--	**7.49**	**--**	**3.9**
skokrw	Skokomish River Wild	--	--	--	--	**10.15**	--
SPGSND	SOUTH PUGET SOUND	44.86	55.26	37.33	37.7	22.27	36
nisqlh	Nisqually River Hatchery	--	--	--	**9.9**	**10.28**	**9.7**
puyalh	Puyallup River Hatchery	--	--	**13.15**	**23.97**	--	--
SJDFCA	STRAIT OF JUAN DE FUCA	**11.62**	**127.9**	**46.42**	**3.71**	**9.65**	**234.92**
dungeh	Dungeness Hatchery	**1.52**	--	--	**3**	**--**	**7.25**
elwhah	Elwha Hatchery	--	--	--	--	**6.8**	--
ptangh	Port Angeles Net Pens	--	--	--	--	**--**	**1**
MAKAHC	MAKAH COASTAL	--	--	--	**5.68**	**--**	**3.61**
QUILUT	QUILLAYUTE	**14.53**	**49.69**	**10.58**	**10.43**	**116.33**	**48.79**
HOHRIV	HOH	**25.77**	**28.05**	**6.79**	**8.92**	**25.45**	**17.95**
QUEETS	QUEETS	**12.29**	9.66	4.68	8.06	6.88	10.59
QUINLT	QUINAULT	42.96	70.95	21.35	37.54	42.47	18.03
GRAYHB	GRAYS HARBOR	27.99	49.99	28.9	18.03	21.85	19.38
chehlh	Chehalis River (Bingham) Hatchery	--	--	--	**20.4**	**19.66**	**9.31**
humpth	Humptulips River Hatchery	--	**17.47**	--	--	--	--
gryhbh	Grays Harbor Net Pens	--	--	--	--	--	**1.3**
WILLAP	WILLAPA BAY	23.21	91.64	42.91	69.51	40.35	40.11
COLRIV	COLUMBIA RIVER	20.46	16.6	5.21	14.16	18.96	29.26
youngh	Youngs Bay Hatchery	**29.97**	**31.15**	**19.31**	**22.1**	**16.1**	**23.99**
collhw	Columbia River Late Hatchery/Wild	62.01	34.65	45.23	61.46	437.32	40.94

Note: **Bold PEF** values indicate User-Defined Values.

Table 12. Original MSM-estimated PEF values for 1986-1991 catch years (continued).

PRODUCTION REGIONS / Management Units		**Catch Year**					
Abbrev.	**MSM_Long_Name**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
OREGON	OREGON NORTH AND MID COAST	23.59	10.21	17.23	34.45	24.25	28.15
oranah	Oregon Anadromous Hatchery	56.22	40.56	12.52	34.25	77.66	31.03
oraqah	Oregon Aqua-Foods Hatchery	35.78	35.84	30.4	29.8	24.56	
ORECAL	OREGON SOUTH/CALIFORNIA CST	**3.83**	19.78	7.46	**18.46**	14.86	25.7
oresoh	Oregon South Coast Hatchery	**6.8**	**10.3**	--	**4.3**	**5.3**	**8.5**
oresow	Oregon South Coast Wild	**1.6**	**2.07**	--	**3.15**	**13.37**	**1.14**
GSMLND	GEORGIA STRAIT MAINLAND	20.25	15.52	25.42	15.85	42.25	34.8
GSVNCI	GEORGIA STRAIT VANC. ISLAND	20.25	15.52	25.42	21.01	42.25	34.8
JNSTRT	JOHNSTONE STRAIT	20.25	15.52	25.42	21.01	42.25	34.8
SWVNCI	SOUTHWEST VANCOUVER ISLAND	71.36	125.11	166.73	112.61	110.33	54.74
NWVNCI	NORTHWEST VANCOUVER ISLAND	71.36	125.11	166.73	112.61	110.33	54.74
FRSLOW	LOWER FRASER RIVER	20.25	15.52	25.42	15.85	42.25	34.8
FRSUPP	UPPER FRASER RIVER	**273.94**	**25.79**	**28.57**	**17.33**	**19.01**	**13.42**
BCCNTL	BRITISH COLUMBIA CENTRAL CST	505.2	198.5	517.4	190.63	303.4	113.96
BCNCST	BRITISH COLUMBIA NORTH COAST	292.37	198.5	79.9	190.63	47.16	113.96
TRANAC	TRANSBOUNDARY AK / CANADA	49.48	--	100.47	78.78	71.12	286.49
NIASKA	NORTHERN ALASKA INSIDE	49.48	173.36	100.47	78.78	71.12	27.16
NOASKA	NORTHERN ALASKA OUTSIDE	49.48	173.36	100.47	78.78	71.12	125.24
SIASKA	SOUTHERN ALASKA INSIDE	109.57	43.87	47.86	102.22	43.09	25.36
SOASKA	SOUTHERN ALASKA OUTSIDE	248.64	326.69	117.47	129.34	32.07	43.08

Note: **Bold PEF** values indicate User-Defined Values.

Table 13. MSM-VB estimated PEF values for 1986-1991 catch years.

PRODUCTION REGIONS / Management Units		**Catch Year**					
Abbrev.	**MSM_Long_Name**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
NOOKSM	NOOKSACK/SAMISH	124.10	21.36	20.61	27.09	25.90	32.87
SKAGIT	SKAGIT	5.19	7.64	4.16	6.42	3.96	9.93
STILSN	STILLAGUAMISH/SNOHOMISH	13.35	9.25	15.33	16.48	14.76	16.58
HOODCL	HOOD CANAL	17.94	16.61	30.23	23.35	15.57	7.48
SPGSND	SOUTH PUGET SOUND	30.44	38.87	30.56	29.40	29.92	29.14
SJDFCA	STRAIT OF JUAN DE FUCA	9.85	6.00	60.28	3.18	19.19	21.18
MAKAHC	MAKAH COASTAL	**10.00**	**10.00**	**10.00**	4.76	**10.00**	2.66
QUILUT	QUILLAYUTE	18.06	15.80	5.54	4.37	10.28	17.40
HOHRIV	HOH	27.81	22.24	16.34	4.63	13.65	19.48
QUEETS	QUEETS	24.50	10.23	9.10	6.62	7.88	11.11
QUINLT	QUINAULT	14.35	10.36	15.75	12.83	17.38	8.76
GRAYHB	GRAYS HARBOR	13.24	18.78	19.45	22.67	25.47	8.88
WILLAP	WILLAPA BAY	20.14	45.08	61.39	58.03	**10.32**	**10.12**
COLRIV	COLUMBIA RIVER	10.84	14.17	11.39	19.14	17.41	15.62
youngh	Youngs Bay Hatchery	39.93	23.46	23.74	34.10	17.81	29.01
collhw	Col Rvr Late Hatchery/Wild	37.37	28.39	29.71	53.22	145.66	32.94
OREGON	OREGON NORTH AND MID COAST	45.37	31.96	14.14	26.16	38.97	59.36
oranah	Oregon Anadromous Hatchery	**35.80**	**36.40**	**25.90**	**22.00**	**17.40**	--
oraqah	Oregon Aqua-Foods Hatchery	**35.80**	**36.40**	**25.90**	**22.00**	**17.40**	**24.10**
ORECAL	OREGON SOUTH/CALIFORNIA COAST	**15.00**	11.90	**15.00**	**15.00**	**15.00**	**15.00**
GSMLND	GEORGIA STRAIT MAINLAND	13.13	8.30	29.35	14.77	28.48	57.13
GSVNCI	GEORGIA STRAIT VANCOUVER ISL.	46.18	33.76	28.42	24.53	42.28	32.58
JNSTRT	JOHNSTONE STRAIT	22.20	31.83	93.08	19.68	99.46	157.69
SWVNCI	SOUTHWEST VANCOUVER ISLAND	259.98	542.49	224.35	152.43	101.70	58.27
NWVNCI	NORTHWEST VANCOUVER ISLAND	30.88	83.82	74.84	422.66	209.40	41.81
FRSLOW	LOWER FRASER RIVER	27.20	18.07	22.96	20.51	43.61	52.95
FRSUPP	UPPER FRASER RIVER	124.34	20.60	21.38	17.46	19.30	15.45
BCCNTL	BRITISH COLUMBIA CENTRAL COAST	139.02	323.91	183.11	323.89	140.70	155.28
BCNCST	BRITISH COLUMBIA NORTH COAST	2398.60	129.41	84.95	117.60	126.38	130.68
TRANAC	TRANSBOUNDARY ALASKA CANADA	**10.00**	**10.00**	**75.00**	**75.00**	**75.00**	**75.00**
NIASKA	NORTHERN ALASKA INSIDE	64.24	157.53	97.84	78.84	64.30	27.31
NOASKA	NORTHERN ALASKA OUTSIDE	64.24	50.51	97.84	78.84	176.88	180.61
SIASKA	SOUTHERN ALASKA INSIDE	139.11	84.27	103.19	102.77	41.17	15.96
SOASKA	SOUTHERN ALASKA OUTSIDE	210.81	208.38	112.89	126.28	57.38	27.76

Note: Bold PEF values indicate User-Defined Values**.** PEF values for other Canadian stocks were derived from combined MSM-VB estimates using Equations 14.2 and 14.3 (also see Table 15).

Table 14. MSM-VB estimated PEF values for 1992-1997 catch years.

PRODUCTION REGIONS / Management Units		**Catch Year**					
Abbrev.	**MSM_Long_Name**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
NOOKSM	NOOKSACK/SAMISH	30.13	36.20	24.57	20.32	19.49	13.36
SKAGIT	SKAGIT	7.37	10.15	7.92	21.00	16.11	5.65
STILSN	STILLAGUAMISH/SNOHOMISH	9.78	26.56	21.57	26.52	24.32	17.51
HOODCL	HOOD CANAL	41.99	8.71	15.63	9.37	10.86	11.34
SPGSND	SOUTH PUGET SOUND	27.53	28.35	21.17	16.48	15.18	21.83
SJDFCA	STRAIT OF JUAN DE FUCA	14.61	16.69	19.19	12.86	13.33	12.80
MAKAHC	MAKAH COASTAL	3.09	3.93	3.86	5.58	5.66	5.99
QUILUT	QUILLAYUTE	15.82	21.87	16.77	14.28	19.40	19.86
HOHRIV	HOH	8.64	32.90	35.50	18.61	1.25	28.73
QUEETS	QUEETS	8.21	7.70	10.76	6.58	6.21	9.11
QUINLT	QUINAULT	11.34	10.01	7.68	13.20	8.91	5.69
GRAYHB	GRAYS HARBOR	6.89	9.21	17.66	14.23	14.15	15.68
WILLAP	WILLAPA BAY	**10.42**	212.40	153.57	207.58	34.28	39.35
COLRIV	COLUMBIA RIVER	15.43	15.54	13.58	13.19	11.23	13.52
youngh	Youngs Bay Hatchery	30.21	18.35	23.63	20.57	15.48	20.44
collhw	Col Rvr Late Hatchery/Wild	34.64	31.56	46.07	36.24	32.01	34.16
OREGON	OREGON NORTH AND MID COAST	44.51	20.77	**33.00**	**33.00**	**33.00**	**33.00**
ORECAL	OREGON SOUTH/CALIFORNIA COAST	**15.00**	**10.00**	**15.00**	**15.00**	**15.00**	**15.00**
GSMLND	GEORGIA STRAIT MAINLAND	16.15	24.54	26.26	35.48	69.17	99.36
GSVNCI	GEORGIA STRAIT VANCOUVER ISL	31.80	37.07	37.07	72.35	78.67	69.61
JNSTRT	JOHNSTONE STRAIT	58.44	96.50	174.95	242.71	138.10	45.86
SWVNCI	SOUTHWEST VANCOUVER ISLAND	114.83	82.91	175.00	87.40	212.85	77.45
NWVNCI	NORTHWEST VANCOUVER ISLAND	100.09	216.93	**10.00**	83.74	51.79	478.11
FRSLOW	LOWER FRASER RIVER	35.99	37.84	31.95	53.05	38.26	23.68
FRSUPP	UPPER FRASER RIVER	**27.84**	**47.87**	**10.44**	**23.40**	**24.59**	**27.98**
BCCNTL	BRITISH COLUMBIA CENTRAL COAST	68.02	94.31	100.74	21.60	106.40	84.19
BCNCST	BRITISH COLUMBIA NORTH COAST	98.14	140.05	100.02	66.12	205.23	158.93
TRANAC	TRANSBOUNDARY ALASKA CANADA	75.00	10.00	75.00	75.00	75.00	75.00
NIASKA	NORTHERN ALASKA INSIDE	50.84	51.71	59.08	46.08	73.13	74.80
NOASKA	NORTHERN ALASKA OUTSIDE	172.32	109.92	43.93	165.82	76.96	240.12
SIASKA	SOUTHERN ALASKA INSIDE	34.17	61.41	86.01	69.03	39.74	40.26
SOASKA	SOUTHERN ALASKA OUTSIDE	34.38	236.96	177.87	**10.00**	289.59	300.00

Note: **Bold PEF values** indicate User-Defined Values. PEF values for other Canadian stocks were derived from combined MSM-VB estimates using Equations 14.2 and 14.3 (also see Table 16).

Table 15. "User-Defined" Production Expansion Factors (PEF) for Canadian Coho Production Regions for catch years 1986-1991. NC = North Coast, CC = Central Coast, GS = Georgia Strait, JS = Johnstone Strait, FR = Fraser River.

	Catch Year					
Production Region	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Combined NC/CC*	475	130	225	148	124	117
BCCNTL	139	324	183	324	141	155
BCNCST	2,399	129	85	118	126	131
Combined NW/SW*	63	207	125	216	138	50
SWVNCI	260	542	224	152	102	58
NWVNCI	31	84	75	423	209	42
Combined GS/JS/FR*	23	17	28	20	44	54
GSMLND	13	8	29	15	28	57
GSVNCI	46	34	29	25	42	33
JNSTRT	22	32	93	20	99	158
FRSLOW	27	18	23	21	44	53

* Indicates MSM-VB estimated PEF values. All other values were derived from combined MSM-VB estimates using Equations 14.2 and 14.3.

Table 16. "User-Defined" Production Expansion Factors (PEF) for Canadian Coho Production Regions for catch years 1992-1997. NC = North Coast, CC = Central Coast, GS = Georgia Strait, JS = Johnstone Strait, FR = Fraser River.

	Catch Year					
Production Region	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Combined NC/CC*	87	117	100	45	175	97
BCCNTL	68	94	101	22	106	84
BCNCST	98	140	100	66	205	159
Combined NW/SW*	114	114	115	85	71	93
SWVNCI	115	83	205	87	213	77
NWVNCI	100	217	21	84	52	478
Combined GS/JS/FR*	30	36	37	42	54	44
GSMLND	16	25	26	35	69	99
GSVNCI	32	36	37	72	79	70
JNSTRT	58	97	175	243	138	46
FRSLOW	36	38	32	53	38	24

* Indicates MSM-VB estimated PEF values. All other values were derived from combined MSM-VB estimates using Equations 14.2 and 14.3.

Table 17. Exploitation rate index values used to estimate Canadian coho total escapement numbers by production region. These values were calculated by DFO staff using CWT index groups with adequate escapement sampling.

Catch	Production Regions								
Year	FRSUPP	GSVNCI	GSMNLD	JNSTRT	FRSLOW	SWVNCI	NWVNCI	BCCNTL	BCNCST
1986	0.66	0.70	0.70	0.72	0.80	0.63	0.63	0.81	0.83
1987	0.54	0.78	0.78	0.82	0.76	0.55	0.55	0.62	0.64
1988	0.71	0.75	0.75	0.78	0.81	0.72	0.72	0.61	0.63
1989	0.65	0.66	0.66	0.69	0.70	0.70	0.70	0.65	0.67
1990	0.74	0.71	0.71	0.83	0.81	0.68	0.68	0.72	0.74
1991	0.68	0.70	0.70	0.67	0.78	0.65	0.65	0.75	0.77
1992	0.81	0.77	0.77	0.79	0.75	0.72	0.72	0.68	0.70
1993	0.88	0.77	0.77	0.76	0.67	0.76	0.76	0.70	0.72
1994	0.43	0.73	0.73	0.74	0.73	0.62	0.62	0.67	0.86
1995	0.56	0.56	0.56	0.62	0.63	0.60	0.60	0.56	0.87
1996	0.83	0.63	0.63	0.41	0.69	0.55	0.55	0.64	0.67
1997	0.40	0.47	0.47	0.35	0.24	0.35	0.35	0.42	0.55

Table 18. Estimated CWT returns for Washington State coho terminal runs for catch years 1986-1988.

Year	Name	MSM_Long_Name	Term. Run	PEF	Est. CWT
1986	NOOKSM	NOOKSACK/SAMISH	207,306	105.66	1,962
	SKAGIT	SKAGIT	160,919	5.14	31,331
	STILSN	STILLAGUAMISH/SNOHOMISH	278,255	13.04	21,344
	HOODCL	HOOD CANAL	162,369	16.23	10,004
	SPGSND	SOUTH PUGET SOUND	749,780	29.35	25,547
	SJDFCA	STRAIT OF JUAN DE FUCA	24,845	6.57	3,779
	MAKAHC	MAKAH COASTAL	8,939		
	QUILUT	QUILLAYUTE	34,551	12.83	2,694
	HOHRIV	HOH	7,503	12.83	585
	QUEETS	QUEETS	16,350	12.71	1,286
	QUINLT	QUINAULT	33,126	12.85	2,577
	GRAYHB	GRAYS HARBOR	129,762	12.33	10,524
	WILLAP	WILLAPA BAY	201,781	18.46	10,928
	COLRIV	COLUMBIA RIVER (Early)	609,494	10.74	56,719
	youngh	Youngs Bay Hatchery	84,336	29.96	2,815
	collhw	Col Rvr Late Hatchery/Wild	818,798	35.78	22,879
1987	NOOKSM	NOOKSACK/SAMISH	269,686	20.78	12,977
	SKAGIT	SKAGIT	161,138	7.27	22,177
	STILSN	STILLAGUAMISH/SNOHOMISH	318,878	9.11	34,997
	HOODCL	HOOD CANAL	162,061	15.15	10,694
	SPGSND	SOUTH PUGET SOUND	1,122,444	38.05	29,500
	SJDFCA	STRAIT OF JUAN DE FUCA	23,799	232.22	102
	MAKAHC	MAKAH COASTAL	2,984		
	QUILUT	QUILLAYUTE	35,827	14.10	2,540
	HOHRIV	HOH	7,934	14.10	563
	QUEETS	QUEETS	15,937	7.95	2,005
	QUINLT	QUINAULT	17,087	9.64	1,773
	GRAYHB	GRAYS HARBOR	91,250	17.70	5,156
	WILLAP	WILLAPA BAY	86,542	37.85	2,287
	COLRIV	COLUMBIA RIVER (Early)	161,360	13.96	11,559
	youngh	Youngs Bay Hatchery	8,483	17.25	492
	collhw	Col Rvr Late Hatchery/Wild	127,277	27.13	4,691
1988	NOOKSM	NOOKSACK/SAMISH	192,389	19.76	9,737
	SKAGIT	SKAGIT	93,454	4.08	22,891
	STILSN	STILLAGUAMISH/SNOHOMISH	223,038	14.79	15,078
	HOODCL	HOOD CANAL	32,264	19.88	1,623
	SPGSND	SOUTH PUGET SOUND	888,159	29.81	29,793
	SJDFCA	STRAIT OF JUAN DE FUCA	12,469	23.20	537
	MAKAHC	MAKAH COASTAL	1,725		
	QUILUT	QUILLAYUTE	16,231	4.90	3,316
	HOHRIV	HOH	3,384	4.90	691
	QUEETS	QUEETS	17,417	6.56	2,653
	QUINLT	QUINAULT	19,355	12.37	1,565
	GRAYHB	GRAYS HARBOR	144,564	18.72	7,722
	WILLAP	WILLAPA BAY	77,250	42.52	1,817
	COLRIV	COLUMBIA RIVER (Early)	142,290	11.19	12,705
	youngh	Youngs Bay Hatchery	67,409	22.75	2,963
	collhw	Col Rvr Late Hatchery/Wild	436,145	29.41	14,826

Table 19. Estimated CWT returns for Washington State Coho terminal runs for catch years 1989-1991.

Year	Name	MSM_Long_Name	Term. Run	PEF	Est. CWT
1989	NOOKSM	NOOKSACK/SAMISH	126,664	25.41	4,984
	SKAGIT	SKAGIT	82,271	6.31	13,034
	STILSN	STILLAGUAMISH/SNOHOMISH	232,804	16.28	14,302
	HOODCL	HOOD CANAL	71,212	20.57	3,462
	SPGSND	SOUTH PUGET SOUND	545,388	28.80	18,935
	SJDFCA	STRAIT OF JUAN DE FUCA	18,845	3.05	6,179
	MAKAHC	MAKAH COASTAL	2,450	3.06	802
	QUILUT	QUILLAYUTE	21,097	4.25	4,967
	HOHRIV	HOH	6,251	4.25	1,472
	QUEETS	QUEETS	12,732	6.01	2,120
	QUINLT	QUINAULT	17,830	11.55	1,543
	GRAYHB	GRAYS HARBOR	105,963	22.05	4,805
	WILLAP	WILLAPA BAY	105,822	49.55	2,136
	COLRIV	COLUMBIA RIVER (Early)	286,030	19.04	15,020
	youngh	Youngs Bay Hatchery	24,424	30.31	806
	collhw	Col Rvr Late Hatchery/Wild	392,231	52.54	7,465
1990	NOOKSM	NOOKSACK/SAMISH	144,949	25.05	5,787
	SKAGIT	SKAGIT	52,095	3.91	13,324
	STILSN	STILLAGUAMISH/SNOHOMISH	257,951	14.51	17,774
	HOODCL	HOOD CANAL	67,155	14.48	4,637
	SPGSND	SOUTH PUGET SOUND	589,643	30.08	19,599
	SJDFCA	STRAIT OF JUAN DE FUCA	12,174	12.11	1,006
	MAKAHC	MAKAH COASTAL	576		
	QUILUT	QUILLAYUTE	17,226	9.96	1,730
	HOHRIV	HOH	5,615	9.96	564
	QUEETS	QUEETS	19,083	6.91	2,763
	QUINLT	QUINAULT	16,908	14.75	1,146
	GRAYHB	GRAYS HARBOR	126,776	24.97	5,078
	WILLAP	WILLAPA BAY	76,605	10.00	7,661
	COLRIV	COLUMBIA RIVER (Early)	71,930	16.35	4,397
	youngh	Youngs Bay Hatchery	34,491	16.08	2,144
	collhw	Col Rvr Late Hatchery/Wild	88,140	119.47	738
1991	NOOKSM	NOOKSACK/SAMISH	79,113	28.03	2,823
	SKAGIT	SKAGIT	31,329	9.00	3,481
	STILSN	STILLAGUAMISH/SNOHOMISH	165,959	16.37	10,139
	HOODCL	HOOD CANAL	44,411	7.07	6,281
	SPGSND	SOUTH PUGET SOUND	335,513	28.35	11,834
	SJDFCA	STRAIT OF JUAN DE FUCA	11,051	15.06	734
	MAKAHC	MAKAH COASTAL	16,896	2.58	6,561
	QUILUT	QUILLAYUTE	33,622	15.70	2,141
	HOHRIV	HOH	5,693	15.70	363
	QUEETS	QUEETS	20,271	10.07	2,014
	QUINLT	QUINAULT	51,962	8.58	6,059
	GRAYHB	GRAYS HARBOR	284,646	9.09	31,320
	WILLAP	WILLAPA BAY	174,006	10.00	17,401
	COLRIV	COLUMBIA RIVER (Early)	342,111	15.55	21,999
	youngh	Youngs Bay Hatchery	114,307	27.62	4,138
	collhw	Col Rvr Late Hatchery/Wild	473,510	32.40	14,614

Table 20. Estimated CWT returns for Washington State Coho terminal runs for catch years 1992-1994.

Year	Name	MSM_Long_Name	Term. Run	PEF	Est. CWT
1992	NOOKSM	NOOKSACK/SAMISH	97,623	29.72	3,285
	SKAGIT	SKAGIT	44,777	7.23	6,195
	STILSN	STILLAGUAMISH/SNOHOMISH	192,492	9.73	19,784
	HOODCL	HOOD CANAL	30,802	6.65	1,129
	SPGSND	SOUTH PUGET SOUND	333,700	27.28	12,233
	SJDFCA	STRAIT OF JUAN DE FUCA	12,909	12.09	1,067
	MAKAHC	MAKAH COASTAL	7,244	2.82	2,570
	QUILUT	QUILLAYUTE	38,130	15.74	2,423
	HOHRIV	HOH	6,199	15.74	394
	QUEETS	QUEETS	10,139	7.62	1,330
	QUINLT	QUINAULT	14,686	10.76	1,365
	GRAYHB	GRAYS HARBOR	49,180	7.76	6,337
	WILLAP	WILLAPA BAY	33,687	10.00	3,369
	COLRIV	COLUMBIA RIVER (Early)	93,631	15.34	6,101
	youngh	Youngs Bay Hatchery	16,157	25.14	642
	collhw	Col Rvr Late Hatchery/Wild	101,416	33.18	3,056
1993	NOOKSM	NOOKSACK/SAMISH	93,869	35.54	2,641
	SKAGIT	SKAGIT	46,249	10.03	4,610
	STILSN	STILLAGUAMISH/SNOHOMISH	112,278	26.34	4,263
	HOODCL	HOOD CANAL	43,070	8.50	5,069
	SPGSND	SOUTH PUGET SOUND	209,366	27.96	7,488
	SJDFCA	STRAIT OF JUAN DE FUCA	8,799	15.54	566
	MAKAHC	MAKAH COASTAL	6,337	3.68	1,720
	QUILUT	QUILLAYUTE	11,769	18.49	636
	HOHRIV	HOH	2,174	18.49	118
	QUEETS	QUEETS	18,010	7.41	2,431
	QUINLT	QUINAULT	13,648	9.61	1,421
	GRAYHB	GRAYS HARBOR	65,430	9.27	7,062
	WILLAP	WILLAPA BAY	38,363	172.91	222
	COLRIV	COLUMBIA RIVER (Early)	57,176	15.58	3,669
	youngh	Youngs Bay Hatchery	15,461	17.83	867
	collhw	Col Rvr Late Hatchery/Wild	41,447	31.18	1,329
1994	NOOKSM	NOOKSACK/SAMISH	91,847	22.27	4,125
	SKAGIT	SKAGIT	79,946	7.66	10,435
	STILSN	STILLAGUAMISH/SNOHOMISH	275,962	21.19	13,025
	HOODCL	HOOD CANAL	112,548	14.79	7,608
	SPGSND	SOUTH PUGET SOUND	446,914	20.87	21,416
	SJDFCA	STRAIT OF JUAN DE FUCA	6,881	11.60	593
	MAKAHC	MAKAH COASTAL	3,977	3.08	1,290
	QUILUT	QUILLAYUTE	13,938	14.36	970
	HOHRIV	HOH	1,448	14.36	101
	QUEETS	QUEETS	5,364	8.66	619
	QUINLT	QUINAULT	3,683	6.39	577
	GRAYHB	GRAYS HARBOR	39,916	17.42	2,292
	WILLAP	WILLAPA BAY	35,954	145.80	247
	COLRIV	COLUMBIA RIVER (Early)	82,649	13.55	6,095
	youngh	Youngs Bay Hatchery	55,433	22.95	2,415
	collhw	Col Rvr Late Hatchery/Wild	30,696	41.44	741

Table 21. Estimated CWT returns for Washington State Coho terminal runs for catch years 1995-1997.

Year	Name	MSM_Long_Name	Term. Run	PEF	Est. CWT
1995	NOOKSM	NOOKSACK/SAMISH	89,688	19.25	4,658
	SKAGIT	SKAGIT	53,378	20.36	2,621
	STILSN	STILLAGUAMISH/SNOHOMISH	221,789	26.33	8,422
	HOODCL	HOOD CANAL	73,157	9.28	7,886
	SPGSND	SOUTH PUGET SOUND	319,317	16.42	19,451
	SJDFCA	STRAIT OF JUAN DE FUCA	19,169	11.99	1,599
	MAKAHC	MAKAH COASTAL	13,469	5.29	2,547
	QUILUT	QUILLAYUTE	28,851	13.84	2,085
	HOHRIV	HOH	5,460	13.84	395
	QUEETS	QUEETS	14,356	6.35	2,259
	QUINLT	QUINAULT	16,340	12.74	1,283
	GRAYHB	GRAYS HARBOR	138,261	14.15	9,771
	WILLAP	WILLAPA BAY	77,897	158.47	492
	COLRIV	COLUMBIA RIVER (Early)	36,398	13.08	2,782
	youngh	Youngs Bay Hatchery	21,291	19.70	1,081
	collhw	Col Rvr Late Hatchery/Wild	16,598	32.49	511
1996	NOOKSM	NOOKSACK/SAMISH	94,361	19.25	4,901
	SKAGIT	SKAGIT	46,610	16.07	2,901
	STILSN	STILLAGUAMISH/SNOHOMISH	127,333	24.33	5,233
	HOODCL	HOOD CANAL	75,126	10.85	6,921
	SPGSND	SOUTH PUGET SOUND	219,344	15.15	14,481
	SJDFCA	STRAIT OF JUAN DE FUCA	18,561	13.16	1,410
	MAKAHC	MAKAH COASTAL	13,964	5.63	2,481
	QUILUT	QUILLAYUTE	38,273	19.86	1,928
	HOHRIV	HOH	5,981	19.86	301
	QUEETS	QUEETS	34,529	6.14	5,620
	QUINLT	QUINAULT	32,935	8.86	3,717
	GRAYHB	GRAYS HARBOR	184,617	14.07	13,122
	WILLAP	WILLAPA BAY	132,691	34.25	3,874
	COLRIV	COLUMBIA RIVER (Early)	68,715	11.69	5,875
	youngh	Youngs Bay Hatchery	14,057	22.45	626
	collhw	Col Rvr Late Hatchery/Wild	28,811	33.97	848
1997	NOOKSM	NOOKSACK/SAMISH	58,607	13.32	4,400
	SKAGIT	SKAGIT	51,314	5.65	9,085
	STILSN	STILLAGUAMISH/SNOHOMISH	139,450	17.48	7,977
	HOODCL	HOOD CANAL	142,022	11.35	12,518
	SPGSND	SOUTH PUGET SOUND	212,957	21.71	9,807
	SJDFCA	STRAIT OF JUAN DE FUCA	23,549	13.20	1,783
	MAKAHC	MAKAH COASTAL	3,086	5.92	522
	QUILUT	QUILLAYUTE	10,190	19.67	518
	HOHRIV	HOH	1,500	19.67	76
	QUEETS	QUEETS	7,273	9.09	800
	QUINLT	QUINAULT	4,569	5.68	804
	GRAYHB	GRAYS HARBOR	41,087	15.65	2,625
	WILLAP	WILLAPA BAY	17,030	39.02	436
	COLRIV	COLUMBIA RIVER (Early)	90,879	13.51	6,725
	youngh	Youngs Bay Hatchery	13,843	20.88	663
	collhw	Col Rvr Late Hatchery/Wild	43,642	33.59	1,299

18. APPENDICES

Appendix A. CWT recoveries by fishery and Production Region are updated frequently, stored in a file titled “86-97 cwt matrices.xls” and can be downloaded at:
http://www.fws.gov/filedownloads/ftp_westwafwo/FRAM

Appendix B. Catches by fishery and year are stored in a file titled “86-97 catch.xls” and can be downloaded at:
http://www.fws.gov/filedownloads/ftp_westwafwo/FRAM

Appendix C. RRTERM summary tables of the terminal runsize estimates are stored in a file titled “MSM_Appendix_C.Zip” and can be downloaded at:
http://www.fws.gov/filedownloads/ftp_westwafwo/FRAM

Appendix D. Catch Adjustment Factor summary tables of the PEF expanded CWT recovery estimates by fishery and time-step are stored in a file titled “MSM_Appendix_D.Zip” and can be downloaded at:
http://www.fws.gov/filedownloads/ftp_westwafwo/FRAM