Agenda Item G.1.a
Attachment 3
June 2006

Chinook FRAM
Base Data Development
(Auxiliary Report to FRAM Technical Documentation)

MODEL EVALUATION WORKGROUP[1]
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1. INTRODUCTION

This report describes the data types and process involved in developing the model "base" data inputs for Chinook salmon used in the Fishery Regulation Assessment Model (FRAM). The base data for Chinook FRAM covers the stock abundances and fishery impacts for production from 1974-79 brood years as estimated through coded-wire-tag (CWT) recovery analysis representing FRAM stocks. These base years are used because they covered a period of generally broad CWT tagging of stocks and nearly wide-open fisheries. By having a diverse set of stocks and fisheries covered by CWT analysis, FRAM is able to assess the impacts of likely fishery options proposed in current management forums. Chinook FRAM shares many of the same CWT tag groups that are used in the Chinook model used in fishery management by the Pacific Salmon Commission in accordance with the Pacific Salmon Treaty.

In addition to CWT recovery data representing FRAM stocks, other key data needed for development of the FRAM base period data set includes: 1) stock abundances/recruitment to fisheries and escapements, 2) life history information on maturation, age structure, natural mortality, and growth rates, 3) fishery landings or effort indices, and 4) fishery related mortality factors for fish released or fish encountering the gear.

The base period data is developed into the FRAM base input file through a process of cohort analysis using the CWT groups. Several FRAM stocks were not CWTed during the 1974-79 brood years. For these stocks, CWT groups from out-of-base (OOB) tagging years were used and were simulated back to the base period in a process of calibration. The OOB simulation performed through the calibration process is the most time consuming part of developing the base data input file for Chinook FRAM.

For a detailed discussion of model functions, specifications, and algorithms refer to the report "Fishery Regulation Assessment Model (FRAM) –Technical Documentation for Chinook and Coho" available from Pacific Fishery Management Council (PFMC). A more general discussion of FRAM is contained in a corresponding "Overview" report also available from PFMC.

2. BASE PERIOD MODEL INPUT DATA

Development of the base data is done without regard to fin clip mark status of each FRAM stock group during the base period. This approach is used to ease the computations and is logical since mark status of a stock should not influence the catch during the base period where there were no mark selective fisheries. At the completion of the base data development process, each FRAM stock-age cohort is split in half into "unmarked" and "marked" components to allow for processing of mark-selective fisheries in "forward-projection" runs of FRAM used in preseason fishery modeling (see Section 8 of FRAM Overview).

2.1 CWT Groups

CWT groups were identified representing each of the 33 FRAM stock units (Appendix 4.1). In most cases, CWT groups from hatcheries within a FRAM stock basin were used to represent both hatchery and naturally produced fish. Selected CWT groups were usually from "production" or "indicator" tag groups that were considered similar to the stock ancestry and freshwater and marine life history of the local natural stock. Estimated recoveries (observed expanded by sampling rates) from these tag groups were downloaded in July 2005 from the Regional Mark Information System of the Pacific States Marine Fisheries Commission website. For each of the FRAM stock CWT group aggregates, the "raw" recoveries were run through the program FRAMBUILDER which maps the estimated age-specific CWT recoveries to FRAM fishery and time strata. An example of the output is shown in Appendix 4.2.

2.2 Stock Profiles

Summaries of data and sources used during model base data development were completed for each of the FRAM stocks (Appendix 4.3). Key components used in data development were, of course, CWT groups, abundance information based on terminal area run reconstruction, and length-at-age growth functions used to estimate proportion of the stock-age vulnerable to harvest. Two length-at-age growth functions were developed for each stock; one to be used to estimate proportion vulnerable in mixed maturity fisheries (preterminal) and one for fisheries assumed to be on mature fish only. The length-at-age growth functions were developed from CWT groups for Chinook with similar age of migration as juveniles into salt water (i.e. fingerling vs. yearling) and/or timing as adults into freshwater (spring, summer, summer/fall).

2.3 Base Period Catch and Escapement

Annual catch for each of the FRAM fisheries and escapement for each of the FRAM stocks were compiled (Appendix 4.4). These base period catches and escapements weren't necessarily an average of the same set of recovery years for each fishery or stock, because CWT releases from the stocks never covered all of the brood years considered as base period (1974-79). Therefore, some weighting of fishery catch and stock escapements were made depending on which of the specific brood year CWT release groups were used. For those fisheries that did not occur during the base period or where there was no CWT sampling, stock composition from similar existing fisheries were used as surrogate. .

Base period catch and escapement estimates were key components of the calibration and out-of-base (OOB) CWT recovery simulation process described below. Base period catches were used, in part, to derive an estimate of the proportion of the catch explained by FRAM stocks. This "proportion modeled stocks" was calculated during the model calibration process for the base data and was used as a constant adjustment factor for any out-of- base year model runs including those for preseason modeling. Base period escapement for each stock was used to derive a production expansion factor (PEF) from the base escapement divided by CWT escapement.

2.4 Fishery Induced Mortality Factors

Fishery related mortality factors include hook and release mortality, hook and line drop-off, and net drop-out. Rates associated with these factors are used for the base period data development process and the associated cohort reconstruction. Hook and release mortality rates can vary by region (e.g. ocean vs. Puget Sound), fishery type (commercial troll vs. sport), and gear type (barbed hooks vs. barbless). Hook and release mortality rates assigned are usually based on an ‘average’ value from a variety of separate studies. The PFMC Salmon Technical Team (STT) last reviewed these studies on sport fishery hooking mortality in March 2000 and the Council adopted their recommendation to changed to 14% from 8% in Council managed fisheries. Because of the difficulty in designing experimental tests, few studies address ‘hook and line drop-off’ and ‘net drop-out’ These are mortality types caused by gear contact with fish that are **not** brought to the boat. Drop-off and drop-out mortality may also includes marine mammal predation on gear entangled fish and loss from noncompliance with regulations. In FRAM, drop-off and drop-out rates were based on primarily on agreed values rather than from specific studies. Hook and line drop-off mortality rates are calculated as 5% of landed catch. Net drop-out mortality rates vary between 0-3% of landed catch depending on whether gear is purse seine, gill net or reef net.

3. CALIBRATION

3.1 Overview

The FRAM is one of many salmon fishery simulation models that rely on recoveries of CWTs to estimate stock specific catches, escapements, and exploitation rates. Stock-specific fishery harvests and exploitation rates are predicted using base period CWT recovery data from fishery and escapement sampling. The FRAM base period for Chinook salmon covers CWT recoveries for releases from brood years 1974-79. For stocks without representative CWT release groups during the base period, OOB CWT groups were used and their recoveries were simulated back into the base period in a process of calibration. Calibration involves iterative passes adjusting CWT recoveries for OOB tag groups back to the base period using FRAM derived fishery effort scalars from FRAM “validation” runs (Figure 1). FRAM validation runs are annual model runs which use best post-season estimates of fishery catches and stock abundances. Base period and OOB CWT recoveries by stock, age, and fishery are used to recalculate starting cohort sizes for all stocks during the base period. The final step in the calibration cycle is the development of a completed “base period” input file used by FRAM. This file contains stock abundances, time-age-fishery specific harvest rates, maturation rates, growth rates, and various fishery related parameters such as hooking mortality rates covering the base period considered roughly 1977-1984 fishing years. Calibration is considered “done” usually after at least 3 passes when the difference in cohort sizes, terminal run sizes and fishery harvest rates between passes changes insignificantly. A new calibration of FRAM is warranted when there are changes to the input data and/or model structure. Examples include changes to stocks, fisheries, CWT groups, time structure, and growth, natural, and fishery related handling mortality rates. All of these elements influence the estimates of the cohort sizes calculated during cohort analysis and the corresponding estimates of exploitation rates.

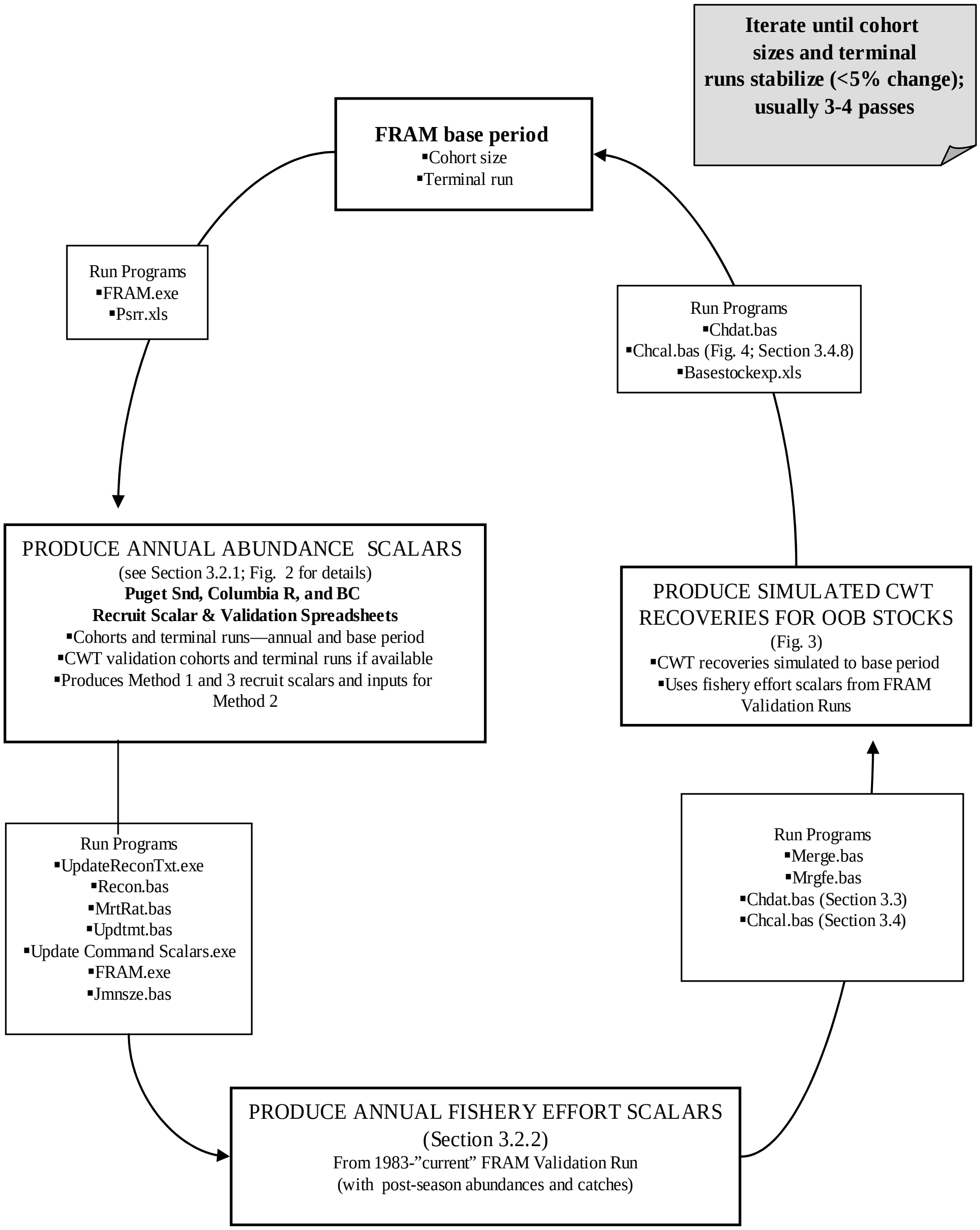
3.2 Calibration Iteration Process and Out-of Base Simulation

For FRAM, the primary purpose of a calibration pass is to create a CWT recovery data set that contains the number of CWT recoveries for stocks that were tagged in the base period with a simulated number of CWT recoveries for those stocks that were not tagged during the base period.

A calibration cycle involves producing annual FRAM "validation" runs for the fishing years that cover the associated brood years of the OOB stock groups. Validation runs are made with FRAM base period input file of stock/age specific cohort sizes, exploitation rates, growth functions, fishery related mortality parameters, etc and best estimates of yearly actual stock abundances and reported fishery catches and/or effort scalars. These validation runs could be considered as annual post season FRAM runs that contain best post-season estimates of annual stock abundance and reported fishery catches or effort by FRAM strata. Validation runs are used to derive fishery effort scalars relative to the FRAM base period for each of the FRAM fisheries. The annual fishery effort scalars are converted to age specific brood year fishery scalars (i.e. 1985 FRAM validation run provides fishery effort scalar for 1983 CWT brood year age-2 recoveries; 1982 CWT brood year age-3 recoveries etc). The brood year specific fishery scalars are applied to the corresponding OOB CWT recoveries in each fishery to yield an estimate of the number of CWTs that would have been recovered for that stock during the base period. The simulated CWT recoveries from the OOB stocks are combined with the base period stock CWT recoveries to create a "All-Stocks" CWT recovery data set. This "All-Stocks" CWT data set is then run through a data-checking program (CHDAT) and then a program (CHCAL) that conducts a cohort analysis for each stock and produces a final "outfile" of cohort sizes, exploitation rates, and other information that is required when running FRAM. (A detailed description of CHDAT and CHCAL presented below describes how the programs work in their two modes; OOB stock and "All-Stocks"). The outfile from the last calibration pass is run through the program SFMCHIN which splits the cohorts in half into marked and unmarked units for each stock. This is the base data file that is used in preseason FRAM runs.

A functional description of the programs and worksheets used during calibration is presented in Appendix 4.5. Stepwise instructions used during the 2005 calibration process are shown in Appendix 4.6.

Figure 1. Chinook FRAM Calibration Overview (Section 3.1)



3.2.1 Annual Abundance Scalar Derivation

Annual abundance scalars are derived from reconstruction of the terminal run size using several methods to account for preterminal fishing impacts. Base period cohort and terminal run sizes from the most recent FRAM base period run are updated in three "validation" run abundance spreadsheets for Puget Sound, Columbia River, and Canadian stocks (Figure 2; Appendix 4.7 for example). Annual abundance scalars used in the FRAM validation runs are generated by comparing annual cohort abundances to the base period cohort abundances calculated in the most recent calibration iteration. Annual pre-fishing cohort abundances for model-run years outside the base period are derived via three methods:

Method 1. Annual Cohort Estimated from CWT Cohort Analysis

From a cohort analysis using on-going CWT tagging studies, an expansion factor was estimated by dividing the CWT terminal run by age by total CWT cohort size. The expansion factor was then multiplied by the terminal run by age of all hatchery and natural production to get total cohort size by age. This method provides the most direct, independent estimate of cohort size since stock specific CWT recoveries are used to expand the terminal run to initial cohort abundance.

Method 2. Annual Cohort Estimated from Change in Preterminal Exploitation Rate

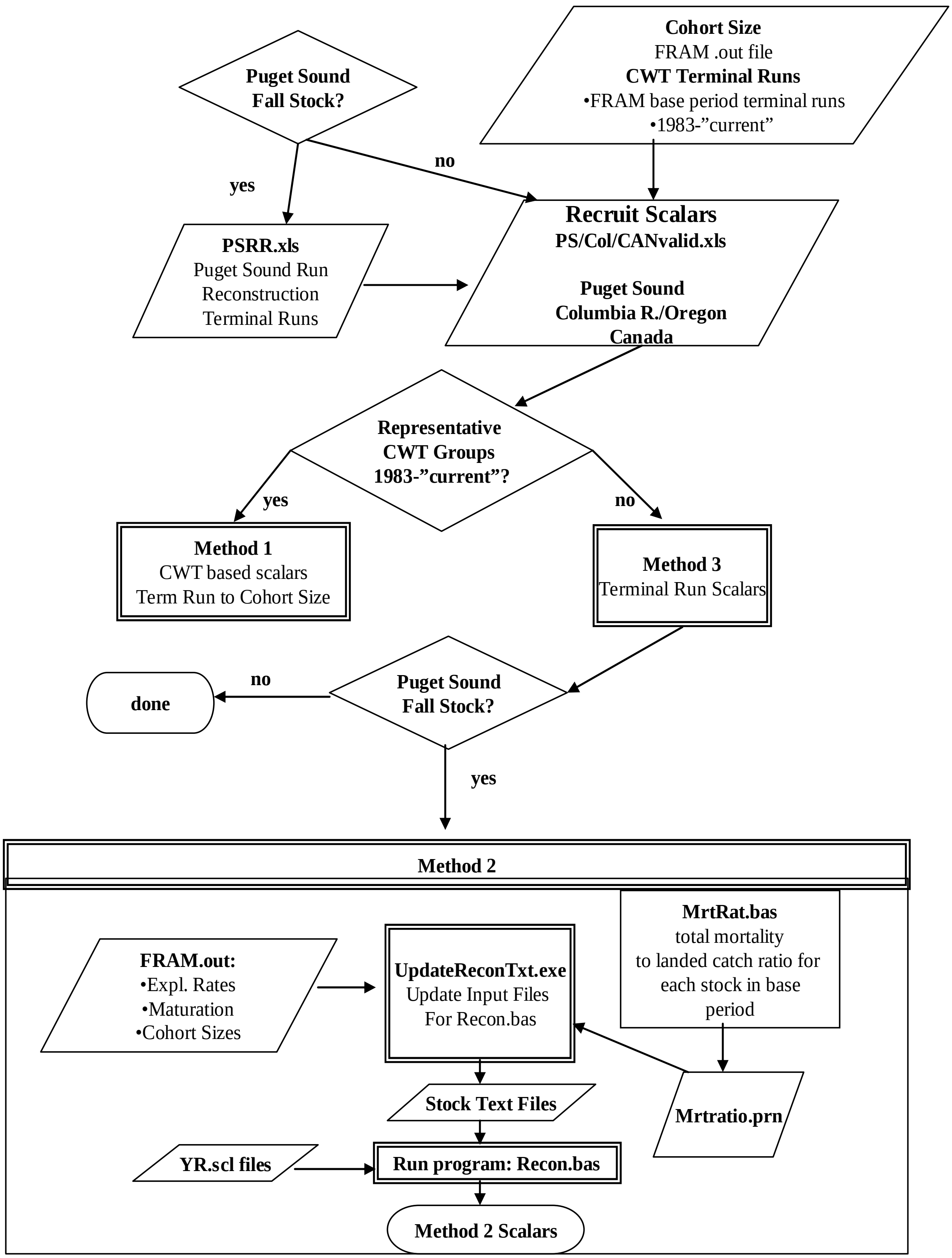
If estimates of changes in the preterminal exploitation rates were available, the cohort was estimated by dividing the terminal run by the survival rate, maturation rate, and escapement rate. This method is similar to Method 1 except that changes in preterminal exploitation rates are estimated from data sources other than CWT recoveries such as fishing effort changes relative to the base period (such as angler-trips or vessel fishing days). For Puget Sound fall chinook stocks, the Quick Basic program RECON was used for this method.

Method 3. Annual Cohort Estimated from Change in Terminal Run

For this method, the annual abundance scalar is simply the ratio of the terminal run in the test year to the terminal run in the base period. This method assumes that preterminal exploitation rates have not changed from the base period of the model and is likely to produce overestimates of abundance, especially in recent years of reduced preterminal fishing.

Method 1 is the preferred method but is not always available for all years and all ages for many stocks. Abundance scalars for Puget Sound stocks were derived from Method 1 or Method 2; Columbia River primarily from Method 1, and Canadian stocks from Method 1 or Method 3.

Figure 2. Chinook FRAM validation annual recruit scalar development



There are several worksheet and file editing programs that are used during this process of updating year specific annual stock abundances and associated maturation rates including:

<u>RECON.bas:</u> Produces Method 2 abundance scalars.
<u>UPDATERECONTXT.vbp:</u> File editing utility for RECON input files.
<u>MRTRAT.bas:</u> Computes ratio of total mortality to landed catch from a FRAM base period model run; output is appended to RECON.bas input file.
<u>UPDATE COMMAND SCALARS.exe:</u> File editing utility that replaces abundance scalars in annual FRAM cmds with new Method 1, 2, or 3 abundance scalars from current calibration iteration.
<u>UPDTMT.bas:</u> File editing utility that replaces base period maturation rates in annual FRAM outfiles for eight Puget Sound fall stocks with year specific maturation rates derived from ongoing CWT programs.
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3.2.2 Fishery Effort Scalar Derivation

After the abundance scalars in the annual validation FRAM cmd files have been updated, then each fishery year is run through FRAM and a file containing FRAM derived fishery effort scalars is produced. The file utility program JMNSZE reformats four successive years of FRAM runs of annual fishery effort scalars into single brood year files of fishery effort scalars for separate ages 2-5.

3.2.3 OOB CWT Expansion

After age specific brood year based fishery effort scalars have been derived, then OOB CWT recoveries for each fishery, age, and time step are expanded by corresponding scalars to yield an estimate of the number of CWTs that would have been recovered during the base period fishery. Two programs, CHDAT and CHCAL, are used to perform these expansions and are described in the next section. Simulated CWT recoveries from each brood year release are combined into a single data set using
MERGE for OOB groups or MRGFE for stocks with both OOB groups and base period CWT groups (as in Fraser Early and Juan de Fuca). A final adjustment to the terminal area CWT recovery data set for some stocks is made by inserting certain adjusted CWT recoveries into another series of worksheets (see Appendix 4.7 for excerpt from PSbasestockexp.xls).

3.3 Primary Calibration Program: CHDAT

CHDAT

The primary purpose of CHDAT is simple error checking of data and reformatting of calibration input data for use by other programs (Figure 3). Error checking includes flagging situations were CWT recoveries exist in fisheries where no legal size population should exist. Other program functions are to ‘impute’ CWT recoveries in fisheries with no sampling during the CWT recovery period. For example,

CHDAT is used for both OOB simulation (Figure 3) and “All-Stocks” base period data development (Figure 4). First, CHDAT is run separately for each OOB stock in FRAM. Each OOB stock requires a separate run through CHDAT to have the data reformatted for use in another program which estimates base cohort information for each OOB stock. The final run of CHDAT uses the input files (".chk", ".cwt") covering all modeled stocks to produce the corresponding input files (".cal", ".edt") for CHCAL.

3.3.1 CHDAT Input file description – ".CHK" file

CHK File Section 1: Input File Names and Global Model Constants

The data in this section of the CHK file, with the exception of line 2 is not modified by CHDAT in any way, but is simply copied to the CAL output file for further processing. Line 2 is replaced with the name of a modified file of CWT recoveries (see below)

TULALIP FALL FING 86 - RETURN TO BASE FILE	Title
TUL8605.CWT	Name of CWT recovery file
Y	Adjust to base period
BROOD864.SCL	File with exploitation rate scale factors – only included if line above = Y
10	Number of stocks in calibration if third line = N, Stock number if third line = Y
73	Number of fisheries in calibration
3	Number of time steps per year
5	Maximum age
4	Maximum age for encounter rate adjustment
.01	Convergence tolerance

CHK File Section 2: Stock Specific Growth Parameters

Von Bertalanffy growth functions are used to describe the growth of an individual fish. For each age, separate growth curves are assumed depending on whether the fish is maturing at that age or remains an 'immature' fish. While CHDAT uses this data to estimate vulnerable population size, the data is not modified in any way but is simply passed on to the CAL file for further processing. There are 14 lines per stock (see below); the total number of lines depends on the total number of stocks being processed.

982.1	LMax, Stock 1; Maturity 0 NSF
2.83	T0,Stock 1; Maturity 0
.029	K, Stock 1; Maturity 0
.11	CV, Stock 1; Maturity 0; Age 2
.12	CV, Stock 1; Maturity 0; Age 3
.09	CV, Stock 1; Maturity 0; Age 4
.09	CV, Stock 1; Maturity 0; Age 5
1085.2	LMax, Stock 1; Maturity 1
1.59	T0, Stock 1; Maturity 1
.03	K, Stock 1; Maturity 1
.11	CV, Stock 1; Maturity 1; Age 2
.11	CV, Stock 1; Maturity 1; Age 3
.11	CV, Stock 1; Maturity 1; Age 4
.11	CV, Stock 1; Maturity 1; Age 5
982.1	LMax, Stock 2; Maturity 0 NNN
	*
	*
.13	CV, Stock n, Maturity 1;Age 5

CHK File Section 3: Terminal Fishery Flags

This section lists, by FRAM time step, fisheries which are deemed ‘terminal’ for the stock or stocks being analyzed. By definition, a fish caught in a terminal fishery is mature. The information in this section is not modified in any way by CHDAT, but is passed through to the CAL file for further processing. The data is used in CHDAT to determine which growth curve (mature or immature) should be associated with a fishery. The number of lines in this section is variable, depending upon the number of fisheries deemed terminal in each time step

3	Step 1; Number of Terminal Fisheries;
28	Columbia River Net
72	Freshwater Sport
73	Freshwater Net
5	Step 2; Number of Terminal Fisheries;
28	Columbia River Net
46	NT Skagit Net
47	T Skagit Net
72	Freshwater Sport
73	Freshwater Net
23	Step 3; Number of Terminal Fisheries
	*
	*
	*

CHK File Section 4: Minimum Size Limits

The section lists, by fishery, minimum size limits in millimeters, one line for each fishery. Size limits are for fork length, and can vary by time step. None of the data in this section is changed, but is simply passed to the CAL file. The data is used in CHDAT along with the growth curve information in Section 2 to estimate the proportions of each age class that are above and below the size limit.

670	670	670	670	Fishery 1 (Alaska Troll)
100	100	100	100	Fishery 2 (Alaska Net)
670	670	670	670	Fishery 3 (Alaska Sport)
100	100	100	100	Fishery 4 (N/C BC Net)
	*			
	*			
	*			
100	100	100	100	Fishery 73 (Freshwater Net)

CHK File Section 5: Natural Mortality Rates

Natural mortality rates by age and time step are listed. The rates are simply the fraction of the starting cohort that dies before fishing begins. The data is not modified in CHDAT but is simply copied to the CAL file for use in other calibration programs.

.2577	Step 1; Age 2
.1878	Step 1; Age 3
.1221	Step 1; Age 4
.0596	Step 1; Age 5
.0816	Step 2; Age 2
.0577	Step 2; Age 3
.0365	Step 2; Age 4
.0174	Step 2; Age 5
.1199	Step 3; Age 2
.0853	Step 3; Age 3
.0543	Step 3; Age 4
.0260	Step 3; Age 5

CHK File Section 6: Shaker Mortality Rates

Shaker mortality rates by fishery are listed, one fishery per line. The information is not used in CHDAT but is simply copied to the CAL file for use in other calibration programs. The rate is simply the fraction of the sub-legal population which dies after encountering the gear as a direct result of the encounter.

.255	Fishery 1 (Alaska Troll TCCHINOOK (97)-1)
.3	Fishery 2 (Alaska Net)
.123	Fishery 3 (Alaska Sport TCCHINOOK (97)-1)
.3	Fishery 4 (N/C BC Net)
	*
	*
	*
.3	Fishery 73 (Freshwater Net)

CHK File Section 7: 'Other' Mortality Rates

Mortality rates by fishery are listed, one fishery per line. The information is not used in CHDAT but is simply copied to the CAL file for use in other calibration programs. The rate is simply the fraction of all encounters, including legal encounters, which die as a result of the encounter. Mortalities due to marine mammal predation are in this category.

.008	Fishery 1 (Alaska Troll TCCHINOOK (97)-1)
.03	Fishery 2 (Alaska Net)
.036	Fishery 3 (Alaska Sport TCCHINOOK (97)-1)
.03	Fishery 4 (N/C BC Net)
	*
	*
	*
.02	Fishery 73 (Freshwater Net WDFW and Tribes)

CHK File Section 8: Encounter Rate Adjustment Factors

FRAM has the capability to adjust estimated total encounter rates to match independent estimates of Chinook encounters in a fishery by using externally computed adjustment factors. The factors are both fishery and time period specific. The adjustment factors are not used in any computations within CHDAT, but are simply written to the CAL file for possible use in other calibration programs.

1.0900	Step 1; Fishery 1 (Alaska Troll)
-1.0000	Step 1; Fishery 2 (Alaska Net)
2.6200	Step 1; Fishery 3 (Alaska Sport)
-1.0000	Step 1; Fishery 4 (N/C BC Net)
	*
	*
	*
-1.0000	Step 3; Fishery 73 (Freshwater Net)

CHK File Section 9: Chinook Non-retention Data

The section contains data, by time step, for Chinook non-retention (CNR) fisheries. The data includes the fishery number of the non-retention fishery, and a flag to indicate the method to use to estimate CNR mortalities. CHDAT uses this information for error checking, but the data are not changed in any way, and are simply written to the CAL file for use in other calibration programs. The number of lines of data depends on the number of CNR fisheries in each time step. In this example, there are no CNR fisheries in any time step.

0	Step 1; Number of CNR fisheries
0	Step 2; Number of CNR fisheries
0	Step 3; Number of CNR fisheries

CHK File Section 10: Base Period Catches

This section contains data on the base period average annual catch in each FRAM fishery. A zero indicates that the base period average catch is not available. Also on each line is a flag signaling various options to adjust the estimated catch by stock to match the total catch in a fishery. Neither the catch information nor the option flag are used in CHDAT; both are simply passed to the CAL file for use in other programs.

283260	2	1-Southeast Alaska Troll
25117	2	2-Southeast Alaska Net
20472	2	3-Southeast Alaska Sport
115266	2	4-N/C BC Net
	*	
	*	
	*	
0	0	73-Freshwater Net

CHK File Section 11: Imputed Recoveries

This section contains data and instructions to CHDAT necessary to 'impute' recoveries from a fishery with CWT sampling (e.g. WCVI troll) to a fishery without CWT sampling (WCVI Sport Imputed Fishery). The procedure is used to 'fill in' missing recovery data in the CWT recovery file. Data in this section is used only by the CHDAT program and is written to a file for use in other programs.

8	Number of fisheries to impute recoveries
1	Impute Group 1
11	WCVI Sport Imputed Fishery
10	WCVI Troll
	*
	*
	*
8	Impute Group 8
70	NT Area 13A Net Imputed Fishery
71	T Area 13A Net

3.3.2 CHDAT Input file description – ".CWT" file

The CWT file has two sections, one listing base period escapements by stock, the second section lists CWT recoveries by stock, age, fishery, and time period. If line 3 of the CHK file = Y, data for only one stock (OOB) is present in the file. If line 3 of the CHK file = N, data for all stocks are present.

CWT File Section 1: Base Period Escapements

Base period escapements for one or more stocks are input in this section. The data here are not used by the CHDAT program, but are simply echoed to the EDT output file.

20224	1 Nooksack/Samish Fall
500	2 NF Nooksack Spr
500	3 SF Nooksack Spr
	*
	*
	*
100	33 White Spring Yearling

CWT File Section 2: CWT Expanded Recoveries

CWT recoveries by stock, age, fishery, and time period are input from the remainder of the CWT file. The general form of the data is shown below. As a rule, CHDAT does not modify this data, but simply echoes it to the EDT file for use by other programs. Two exceptions to this occur, however. First, if a recovery exists where no legal size population is available, that recovery is rejected. Second, if a fishery recovery is to be imputed, one or more lines for the imputed fishery are inserted into the EDT file.

SP	ST	AG	FSH	TP	Catch	Adj Esc		
1	1	2	5	2	8.44		May-June	West Coast Vancouver Island Net
1	1	2	14	2	68.27		May-June	South Georgia St. Sport
1	1	3	4	3	144.75		July-Sept	North/Central British Columbia Net
1	1	3	5	3	47.01		July-Sept	West Coast Vancouver Island Net
					*			
					*			
					*			
1	33	12	74	3	3.21	3.21	Jul-Sep	Escapement

a/ "AG" is index age see Appendix 4.7

3.3.3 CHDAT Program Flow and Calculations

Notation

$AnnSRate_a$	Annual survival rate at age.
a	Age in years (2 to 5) 'Birthday' is assumed to occur on October 1.
$CV_{s,a}$	Coefficient of variation in Length at age (input from section 2 of the CHK file)
t	Time step – there are 3 time steps per 'year' Oct – Apr, May – June, and July – Sept.
s	Stock number. There are currently 33 stocks in the model
f	Fishery number. There are currently 74 fisheries in the model
$CWTCatch_{s,a,f,t}$	Observed CWT recoveries expanded for sampling fraction (input from section 2 of the CHK file.
$CWT_{s,4,f,t}$	Expanded CWT recoveries for age 4
$DFCohort_{s,a}$	Total number of CWT fish alive, before natural mortality.
$DFER_{s,f}$	Fraction of $DFCohort_{s,a}$ caught in a fishery.
K_s	Parameter of the von Bertalanffy growth curve (input from section 2 of the CHK file)
L_{∞_s}	Parameter of the von Bertalanffy growth curve (input from section 2 of the CHK file)
$Mean_{s,a,t}$	Mean fork length.
$SD_{s,a}$	Standard Deviation
T_0	Parameter of the von Bertalanffy growth curve (input from section 2 of the CHK file)
$TotCWTCatch_{s,a}$	Total catch of CWTed fish, expanded for sampling fraction, across all fisheries (terminal and preterminal).

Depending on options chosen or defined by the form of the input files, CHDAT performs the following functions.

1) Pass-through and rearrangement of data.

   Data in the CHK file is rearranged and output to the CAL file. Data in the CWT file is rearranged and if it passes simple error checking outputs to the EDT file.

2) Simple error checking.

Two types of error checking occur. The first checks that a legal (above the size limit) population of a stock/age combination is available to a fishery if CWT recoveries for that stock exist in that fishery. If no legal population is estimated to exist, the recovery data is not written to the EDT file.

The 'legal proportion' is estimated by first computing the stock mean length at age using the input growth data and the von Bertalanffy growth function.

$$Mean_{s,a,t} = L_{\infty_s} * (1 - e^{-k_s(t-t_0)})$$

The Standard Deviation at age of the mean length is computed as:

$$SD_{s,a,t} = Mean_{s,a,t} * CV_a$$

Finally, if the size limit in the fishery is more than three standard deviations above the mean length at age of the stock, the population available to the fishery is assumed to be zero. In this case, an error message is generated and the CWT recovery information is not written to the EDT file for future use.

3) 'Imputing of CWT recoveries in specified fisheries

On occasion, a fishery may not have been sampled for CWT recoveries, while a fishery 'near' it was. In those cases, it can be desirable to use the sampled fishery to represent the stock composition of the unsampled fishery. The imputed recoveries are computed as:

$$CWTCatch_{s,a,f1,t} = \frac{CWTCatch_{s,a,f2,t}}{1000}$$

The imputed catches are written to the EDT file.

4) Setting of Shaker Inclusion Flags (designates stock-fisheries where shaker mortality rates are calculated).
Shaker inclusions flags are set using the following procedure:

   1) Sum CWT recoveries across all fisheries and time steps.

$$TotCWTCatch_{s,a} = \sum_{f,t} CWTCatch_{s,a,f,t}$$

2) Estimate the starting cohort size for the oldest age class.

$$DFCohorts_{s,5} = \frac{TotCWTCatch_{s,5}}{AnnSRate_5}$$

3) Estimate the starting cohort for the younger age classes.

$$DFCohort_{s,a} = \frac{DFCohort_{s,a+1} + TotCWTCatch_{s,a}}{AnnSRate_a}$$

4) Assuming age 4 are fully vulnerable to legal size limits, estimate the age 4 exploitation rate by stock and fishery as:

$$DFER_{s,f,4} = \frac{\sum_t CWT_{s,4,f,t}}{DFCohort_{s,4}}$$

Within a fishery, for the n stocks with non-zero age 4 exploitation rates, the .7*n stocks with the highest age 4 exploitation rates have their Shaker Inclusion flags set to true. The flags are then written to the bottom of the CAL file.

3.3.4 CHDAT Output File Descriptions –". CAL" file

The CAL file is identical to the input CHK file except that the last section (Section 11) of the CHK file, where instructions for imputing recoveries are replaced with Shaker Inclusion flags. There is one line for each stock/fishery combination.

0	Stock 1; Fishery 1;
0	Stock 1; Fishery 2;
0	Stock 1; Fishery 3;
0	Stock 1; Fishery 4;
	*
	*
	*
1	Stock 33; Fishery 73

3.3.5 CHDAT Output File Descriptions –". EDT" file

Like the CWT input file, the EDT file has two sections. The first section contains data on base period escapements, and is identical to the same section in the CWT file. The second section contains the CWT recovery information and is similar, but not identical to, the same section in the CWT file. The differences between the sections are: 1) All escapement recoveries have been moved to the top of the CWT recovery section of the file, 2) Recoveries from stock/age/fishery combinations where no vulnerable (above the size limit) population exists are removed, and 3) Imputed recoveries by stock, age, fishery, and time step are added. The form of the second section of the EDT file is shown below.

SP	STK	AGE	FSH	TIM	RECOVERIES
1	1	2	74	3	71.3
1	1	3	74	1	0.0
1	1	3	74	3	392.2
1	1	4	74	1	0.0
			*		
			*		
			*		
1	33	4	74	3	26.01

3.3.6 CHDAT Output File Description – ".ERR" File

The ERR file lists details of any recoveries rejected because no vulnerable population existed for that stock/fishery/age combination, and flags situations where Chinook non-retention fisheries exist but no legal Chinook catch information is available in the same year. Currently, no procedure exists within FRAM to estimate CNR incidental mortalities without data from a directed fishery in that year.

3.4 Primary Calibration Program: CHCAL

CHCAL

The primary purpose of the CHCAL program is to complete cohort analyses for each stock in the FRAM model and estimate 'base period' exploitation rates by stock, fishery, FRAM time period, and age. Secondary purposes include estimation of the proportion of the catch in each fishery accounted for by stocks in the model, and estimating CWT recoveries that would have occurred for OOB stocks during the model base period using "backward" and "forward" CWT cohort reconstruction simulation. A simple example of backward and forward cohort reconstruction calculations is shown in Appendix 4.8.

CHCAL operates in two different modes depending on whether it is doing an OOB analysis on one stock (Figure 3, described in Sections 3.4.5-3.4.7) or it is completing a final cohort analysis during an "All-Stocks" run (Figure 4, described in Section 3.4.8-3.4.9). The number of input files used and the type of output generated is a function of the run type (OOB or "All-Stocks"), therefore each type of run will be described separately.

Figure 3. Chinook FRAM calibration cycle for OOB stocks

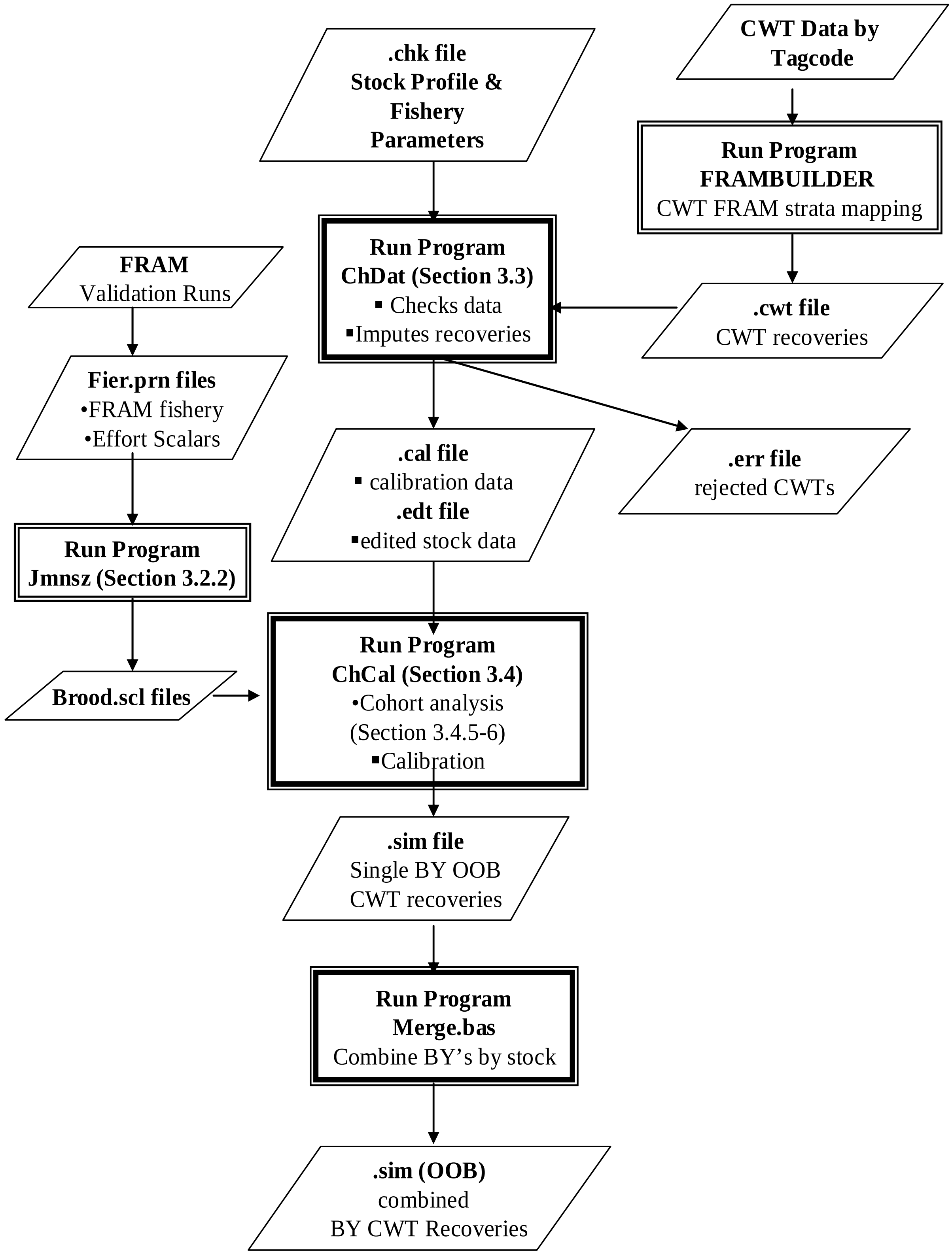
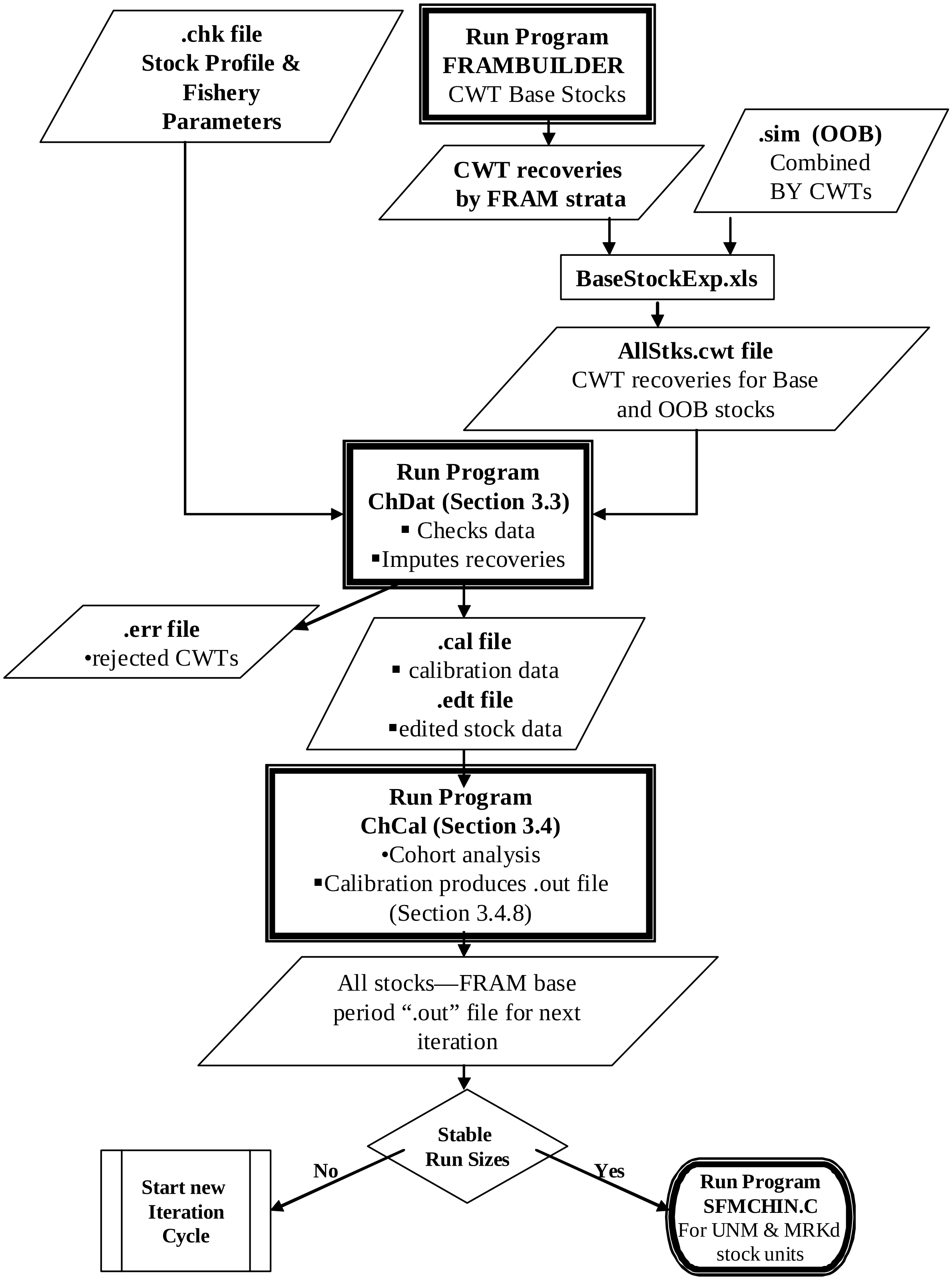


Figure 4. Chinook FRAM calibration for "all-stocks" base data development



3.4.1 CHCAL Input file description – ".CAL" file (from CHDAT)

CAL Section 1: Input File Names and Global Model Constants

The data in this section of the CAL file contains global information such as the names of other input files, the 'type' of run, and a number of constants related to model setup. If the third line = 'Y', the run is an 'OOB' run and the next line must contain the name of an input file containing exploitation rate scale factors. If the third line = 'N', the additional input file is not needed and the line below is omitted.

TULALIP FALL FING 86 - RETURN TO BASE FILE	Title
TUL8605.EDT	Name of CWT recovery file
Y	Adjust to base period
BROOD864.SCL	File with exploitation rate scale factors – only included if line about = Y
10	Number of stocks in calibration if third line = N, Stock number if third line = Y
73	Number of fisheries in calibration
3	Number of time steps per year
5	Maximum age
4	Maximum age for encounter rate adjustment
.01	Convergence tolerance

CAL Section 2: Stock Specific Growth Parameters

Von Bertalanffy growth functions are used to describe the growth of an individual fish. For each age, separate growth curves are assumed depending on whether the fish is maturing at that age or remains an 'immature' fish. There are 14 lines per stock; the total number of lines depends on the total number of stocks being processed.

982.1	LMax, Stock 1; Maturity 0 NSF
2.83	T0,Stock 1; Maturity 0
.029	K, Stock 1; Maturity 0
.11	CV, Stock 1; Maturity 0; Age 2
.12	CV, Stock 1; Maturity 0; Age 3
.09	CV, Stock 1; Maturity 0; Age 4
.09	CV, Stock 1; Maturity 0; Age 5
1085.2	LMax, Stock 1; Maturity 1
1.59	T0, Stock 1; Maturity 1
.03	K, Stock 1; Maturity 1
.11	CV, Stock 1; Maturity 1; Age 2
.11	CV, Stock 1; Maturity 1; Age 3
.11	CV, Stock 1; Maturity 1; Age 4
.11	CV, Stock 1; Maturity 1; Age 5
982.1	LMax, Stock 2; Maturity 0 NNN
	*
	*
	*
.13	CV, Stock n, Maturity 1;Age 5

CAL Section 3: Terminal Fishery Flags

This section lists, by FRAM time step, fisheries which are deemed ‘terminal’ for the stock or stocks being analyzed. By definition, a fish caught in a terminal fishery is mature. The data is used in CHCAL to determine which growth curve (mature or immature) should be associated with a fishery. The number of lines in this section is variable, depending upon the number of fisheries deemed terminal in each time step.

3	Step 1; Number of Terminal Fisheries;
28	Columbia River Net
72	Freshwater Sport
73	Freshwater Net
5	Step 2; Number of Terminal Fisheries;
28	Columbia River Net
46	NT Skagit Net
47	T Skagit Net
72	Freshwater Sport
73	Freshwater Net
23	Step 3; Number of Terminal Fisheries
	*
	*
	*

CAL Section 4: Minimum Size Limits

The section lists, by fishery, minimum size limits in millimeters, one line for each fishery. Size limits are for fork length, and can vary by time step. The data is used in CHCAL along with the growth curve information in Section 2 to estimate the proportions of each age class that are above and below the size limit.

670	670	670	670	Fishery 1 (Alaska Troll)
100	100	100	100	Fishery 2 (Alaska Net)
670	670	670	670	Fishery 3 (Alaska Sport)
100	100	100	100	Fishery 4 (N/C BC Net)
	*			
	*			
	*			
100	100	100	100	Fishery 73 (Freshwater Net)

CAL Section 5: Natural Mortality Rates

Natural mortality rates by age and time step are listed. The rates are simply the fraction of the starting cohort that dies before fishing begins.

.2577	Step 1; Age 2
.1878	Step 1; Age 3
.1221	Step 1; Age 4
.0596	Step 1; Age 5
.0816	Step 2; Age 2
.0577	Step 2; Age 3
.0365	Step 2; Age 4
.0174	Step 2; Age 5
.1199	Step 3; Age 2
.0853	Step 3; Age 3
.0543	Step 3; Age 4
.0260	Step 3; Age 5

CAL Section 6: Shaker Mortality Rates

Shaker mortality rates by fishery are listed, one fishery per line. The rate is simply the fraction of the sublegal population which dies after encountering the gear as a direct result of the encounter.

.255	Fishery 1 (Alaska Troll TCCHINOOK (97)-1)
.3	Fishery 2 (Alaska Net)
.123	Fishery 3 (Alaska Sport TCCHINOOK (97)-1)
.3	Fishery 4 (N/C BC Net)
	*
	*
	*
.3	Fishery 73 (Freshwater Net)

CAL Section 7: 'Other' Mortality Rates

Mortality rates by fishery are listed, one fishery per line. The rate is simply the fraction of the all encounters, including legal encounters, which die as a result of the encounter. Mortalities due to marine mammal predation are in this category.

.008	Fishery 1 (Alaska Troll TCCHINOOK (97)-1)
.03	Fishery 2 (Alaska Net)
.036	Fishery 3 (Alaska Sport TCCHINOOK (97)-1)
.03	Fishery 4 (N/C BC Net)
	*
	*
	*
.02	Fishery 73 (Freshwater Net WDFW and Tribes)

CAL Section 8: Encounter Rate Adjustment Factors

Encounter Rate Adjustment Factors are externally estimated as the ratio of Sublegal Encounters to Legal encounters in a fishery. They are used in the estimation of shaker mortalities. The factors are both fishery and time period specific.

1.0900	Step 1; Fishery 1 (Alaska Troll)
-1.0000	Step 1; Fishery 2 (Alaska Net)
2.6200	Step 1; Fishery 3 (Alaska Sport)
-1.0000	Step 1; Fishery 4 (N/C BC Net)
	*
	*
	*
-1.0000	Step 3; Fishery 73 (Freshwater Net)

CAL Section 9: Chinook Non-retention Data

The section contains data, by time step, on Chinook non-retention (CNR) fisheries. The data includes the fishery number of the non-retention fishery, and a flag to indicate the method to use to estimate CNR mortalities. The number of lines of data depends on the number of CNR fisheries in each time step. In this example, there are no CNR fisheries in any time step.

0	Step 1; Number of CNR fisheries
0	Step 2; Number of CNR fisheries
0	Step 3; Number of CNR fisheries

CAL Section 10: Base Period Catches

This section contains data on the base period annual catch in each FRAM fishery. A zero indicates that the base period average catch is not available. Also on each line is a flag signaling various options to adjust the estimated catch by stock to match the total catch in a fishery.

283260	2	1-Southeast Alaska Troll
25117	2	2-Southeast Alaska Net
20472	2	3-Southeast Alaska Sport
115266	2	4-N/C BC Net
	*	
	*	
	*	
0	0	73-Freshwater Net

CAL Section 11: Shaker Inclusion Flags

There is one line for each stock/fishery combination. A zero means do not include the stock when computing shaker mortalities in that fishery, a one indicates that the stock should be included.

0	Stock 1; Fishery 1;
0	Stock 1; Fishery 2;
0	Stock 1; Fishery 3;
0	Stock 1; Fishery 4;
	*
	*
	*
1	Stock 33; Fishery 73

3.4.2 CHCAL Input file description –". EDT" file (from CHDAT)

EDT Section 1: Base Period Escapements

If the run is an 'OOB' run, this section simply lists the name of the OOB stock being analyzed and a flag indicating that no base period escapement data exists.

Total Base Period Escapement
-1 , Tulalip 86 brd

If the run is not an OOB run, the section contains the average base period escapement for each stock.

20224	1 Nooksack/Samish Fall
500	2 NF Nooksack Spr
500	3 SF Nooksack Spr
10443	4 Skagit Summer Fall Fingerling
	*
	*
	*
100	33 White Spring Yearling

EDT Section 2: CWT recoveries by stock, age, fishery, and time period.

This section of the input file is the same for both types of run. The only difference being that an OOB run contains recovery data from years outside the base period for only one stock, while a non OOB run contains observed or computed data for all stocks during the base period.

SP	STK	AGE	FSH	TIM	RECOVERIES
1	1	2	74	3	71.3
1	1	3	74	1	0.0
1	1	3	74	3	392.2
1	1	4	74	1	0.0
			*		
			*		
			*		
1	33	4	74	3	26.01

3.4.3 CHCAL Input file description –". SCL" file (from FRAM validation runs for OOB)

The SCL file, which is used only for OOB simulation (Figure 3), is produced from the FRAM validation runs using the program JMNSZE (Section 3.2.2). Each SCL file is brood year specific and contains exploitation rate scale factors for each age, fishery and time period. The scale factors represent the ratio of the fishery exploitation rates in the 'current' year to the average fishery exploitation rates during the base period. The data is used when reconstructing base period cohorts and exploitation rates for an OOB stock.

Age 2 (1988) Exploitation Rate Scale Factors	
0.2879	Step 1; Fishery 1 (SEAK Troll)
0.0000	Step 1; Fishery 2 (SEAK Net)
0.6719	Step 1; Fishery 3 (SEAK Sport)
0.0000	Step 1; Fishery 4 (N/C BC Net)
	*
	*
	*

The SCL file also contains size limits for years corresponding to the scale factors. The format of this size limit section of the SCL file is identical to the format of section 4 of the CAL file.

3.4.4 CHCAL Variables and Notation

a	Age in years (2 to 5) 'Birthday' is assumed to occur on October 1.
$AEQ_{s,a,t}$	Adult Equivalence by stock, age, and time step. The probability that a fish will survive to spawn in the absence of future fishing (output to the OUT file).
$BPEscape_{s,a,t}$	Base period CWT recoveries by stock, age, and time step in escapement estimated using forward cohort analysis and exploitation rate scale factors (output to the SIM file for inclusion in the all stocks CHCAL run).
$BPObsCatch_f$	Observed catch by fishery during the base period (input from section 10 of the CAL file).
$BPPTCatch_{s,a,f,t}$	Base period CWT recoveries in preterminal fisheries by stock, age, and time step estimated using forward cohort analysis and exploitation rate scale factors (output to the SIM file for inclusion in the all stocks CHCAL run).
$BPTermCatch_{s,a,f,t}$	Base period CWT recoveries in terminal fisheries by stock, age, and time step estimated using forward cohort analysis and exploitation rate scale factors (output to the SIM file for inclusion= in the all stocks CHCAL run).
$CNRMorts_{s,a,f,t}$	Non-retention mortalities by stock, age, fishery, and time step.
$CV_{s,a}$	Coefficient of variation in length-at-age by stock and age (input from section 2 of the CAL file).
$CWTCatch_{s,a,f,t}$	Observed CWT recoveries by stock, age, fishery, and timestep expanded for sampling fraction (input from section 2 of the CWT file.
$CWTEscape_{s,a,t}$	CWTs by stock, age, and time step recovered in escapement past all fisheries expanded for sampling fraction (input from section 1 of the CWT file).
$DropOff_f$	Dropoff mortality rate by fishery (input from section 7 of the CAL file).
$EncAdj_{f,t}$	Encounter Rate Adjustment factor by fishery and time step (input from section 8 of the CAL file (output to the OUT file).
$ExpRate_{s,a,f,t}$	The fraction of the vulnerable cohort by stock, age, fishery, and time step, after natural mortality, taken as catch in a fishery.

f	Fishery number. There are currently 74 “fisheries” in CHCAL where fishery 74 is the number of CWT recoveries in escapement.
K_s	Stock specific parameter of the von Bertalanffy growth curve (input from section 2 of the CAL file).
L_{∞_s}	Stock specific parameter of the von Bertalanffy growth curve (input from section 2 of the CAL file).
$LandedCatch_{s,a,f,t}$	Estimated total catch of a stock in a fishery by age and time step. Contrast with CWTCatch. CHECK IF THIS SHOULD BE IN HERE OR NOT
$LegalProp_{s,a,f,t}$	Proportion of the cohort (terminal or preterminal) which is above the legal size limit by stock, age, fishery, and time step.
$MatCohort_{s,a,t}$	The ‘mature’ cohort, i.e., the number of fish by stock, age, and time step destined to spawn in the current year in the absence of further fishing.
$MatRate_{s,a,t}$	The fraction of the cohort by stock and age that matures in a given time step.
$Mean_{s,a,t}$	Mean fork length of a fish by stock, age, and time step.
$MinSize_{a,f,t}$	Minimum size limit in a fishery by age, fishery, and timestep. The age subscript is carried but not used in computations (input from section 4 of the CAL file).
$ModelRatio_f$	The proportion of the observed catch in a fishery that can be accounted for by stocks in the model (output to the OUT file as Recovery Adjustment Factor).
PEF_s	Stock specific Production Expansion Factor. The ratio of total stock escapement to the escapement of the CWTed population.
$PTCohort_{s,a,t}$	The preterminal (immature) ocean cohort size by stock, age, and time step.
$PTMorts_{s,a,t}$	Total mortalities of CWTed fish in preterminal fisheries by stock, age, and time step.
s	Stock number. There are currently 33 stocks in the model.
$ScaleFactor_{f,t}$	Fishery and time step specific ratio of fishery exploitation rate during the CWT recovery year to the fishery exploitation rate during the base (input from the SIM file).
$SD_{s,a}$	Standard Deviation by stock and age of the total length distribution of a fish.
$Shakers_{s,a,f,t}$	Total mortalities of sublegal fish by stock, age, fishery, and time step.
$ShakEnc_{s,a,f,t}$	The fraction of the sublegal cohort, after natural mortality, encountered in a fishery by stock, age, fishery, and time step.
$ShakMortRate_f$	Fishery specific shaker mortality rate (input from section 6 of the CAL file).
$SLProp_{s,a,f,t}$	The proportion, by stock and age, of the total sublegal population across all fisheries in a time step which is below the legal size limit in a given fishery and time step.
$SRate_{a,t}$	Compliment of the natural mortality rate by age and time step (natural mortality rates are input from section 5 of the CAL file).
$SubLegProp_{s,a,f,t}$	Proportion of the total cohort size by stock and age (terminal or preterminal) which is below the legal size limit in a given fishery and time step.

t	Time step. There are 3 time steps per 'year' Oct – Apr, May – June, and July – Sept.
$T_{0,s}$	Stock specific parameter of the von Bertalanffy growth curve (input from section 2 of the CAL file).
$TMorts_{s,a,t}$	Total mortalities of CWTed fish in terminal fisheries by stock, age, and time step.
$TotalBPEsc_s$	Adult total escapement by stock during the base period (input from the CWT file).
$TotalCohort_{s,a,t}$	The total cohort available at the start of each time period, before natural mortality by stock, age, and time step.
$TotalSLPop_{f,t}$	The total number of sublegal fish, by time step, across stocks, available to a fishery.

3.4.5 CHCAL "Backward" Cohort Analysis (Age 5 backward thru Age 2) for OOB stocks

CHCAL performs the following calculations during a cohort reconstruction of CWT recoveries for the OOB simulation. The first type of cohort analysis is a reconstruction of the cohort working from the age 5 CWT recoveries back through age 4, then age 3, and ending with age 2. The equations are numbered in this section and the next in order to follow the cohort reconstruction example shown in Appendix 4.8.

1) Read in all data from CHDAT output files

2) Perform a CWT cohort analysis for the OOB brood using the following procedure:

a) Compute the total number of CWT mortalities by age and time step for both terminal and preterminal fisheries.

$$PTMorts_{s,a,t} = \sum_{PTFisheries} CWTCatch_{s,a,f,t} * (1 + DropOff_f) + ShakMorts_{s,a,f,t} + CNRMorts_{s,a,f,t} \quad (1)$$

$$TMorts_{s,a,t} = \sum_{TFisheries} CWTCatch_{s,a,f,t} * (1 + DropOff_f) + Shakers_{s,a,f,t} + CNRMorts_{s,a,f,t} \quad (2)$$

b) Compute the 'terminal' or mature cohort by age and time step.

$$MatCohort_{s,a,t} = TMorts_{s,a,t} + CWTEscape_{s,a,t} \quad (3)$$

In the final time period, the immature cohort for the oldest age and after natural mortality is computed as:

$$PTCohort_{s,a=5,t=3} = MatCohort_{s,a=5,t=3} + PTMorts_{s,a=5,t=3} \quad (4)$$

The cohort size for the younger ages in the final time period is computed as:

$$PTCohort_{,s,a,t=3} = \frac{PTCohort_{s,a+1,t=1}}{SRate_{a+1,t=1}} + MatCohort_{s,a,t} + PTMorts_{s,a,t} \quad (5)$$

The cohort size for all ages in earlier time periods is computed as :

$$PTCohort_{s,a,t} = \frac{PTCohort_{s,a,t+1}}{SRate_{a,t+1}} + MatCohort_{s,a,t} + PTMorts_{s,a,t} \quad (6)$$

Once an initial estimate of preterminal and terminal CWT cohort sizes have been made, incidental (shaker) and CNR mortalities by fishery, age, and time period can be estimated.

For initial iteration, assume the number of encounters is equal to the landed catch.

$$Encounters_{f,t} = \sum_{s}\sum_{a=2}^{5} CWTCatch_{s,a,f,t} * EncAdj_{f,t} \quad (7)$$

Compute the proportions of the cohort at age that are above and below the size limit assuming a normal distribution of fish length at age.

$$Mean_{s,a,t} = L_{\infty_s} * (1 - e^{-k_s(t - t_{0_s})}) \quad (8)$$

$$SD_{s,a,t} = Mean_{s,a,t} * CV_{s,a} \quad (9)$$

$$SubLegProp_{s,a,f,t} = f(Minsize_{a,f,t}, Length_{s,a,t}), Length_{s,a,t} \sim N(Mean_{s,a,t}, SD_{s,a,t}{}^2)$$

$$LegalProp_{s,a,f,t} = 1 - SubLegProp_{s,a,f,t} \quad (10)$$

Compute the total sub-legal population.

$$TotalSLPop_{f,t} = \sum_{s}\sum_{a=2}^{5}(SubLegProp_{s,a,f,t} * Cohort_{s,a,t}) \quad (11)$$

Where:

$Cohort_{s,a,t} = PTCohort_{s,a,t}$ for Preterminal fisheries and

$Cohort_{s,a,t} = MatCohort_{s,a,t}$ for Terminal fisheries.

Compute the proportion of each stock and age that is sublegal.

$$\text{SLProp}_{s,a,f,t} = \frac{\text{SubLegProp}_{s,a,f,t} * Cohort_{s,a,t}}{TotalSLPop_{f,t}} \tag{12}$$

Now compute the number of shaker mortalities as:

$$\text{Shakers}_{\text{s,a,f,t}} = Encounters_{f,t} * \text{SLProp}_{\text{s,a,f,t}} * ShakMortRate_{f} \tag{13}$$

CNR mortalities are not generally estimated in FRAM calibration since CNR fisheries were rare during the base period. Computation details are not included in this description of CHCAL. Now that an initial estimate of shakers is available, cohort sizes are re-estimated based on the new number of total mortalities. This continues iteratively until the change in age 2 cohort size is less than a predefined limit (‘convergence tolerance’, CAL file line 10). Note that at this stage we have available at the start of each time step a preterminal cohort at age and a terminal, or mature cohort at age.

3.4.6 CHCAL “Forward” Cohort Analysis (Age 2 forward thru Age 5) for OOB stocks

Estimation of the recoveries that would have occurred during the base period for the OOB stock requires several steps.

Once cohort sizes are available, maturation rates by age and time step can be computed. The maturation rate for the oldest age in the final time step is assumed to be 1.0

In the last time step, compute a total cohort after fishing mortality.

$$TotalCohort_{s,a,t=3} = MatCohort_{s,a,t=3} + \frac{PTCohort_{s,a+1,t=1}}{SRate_{a+1,t=1}} \tag{14}$$

And the Maturation rate is simply the mature portion of the total cohort after fishing.

$$MatRate_{s,a,t=3} = \frac{MatCohort_{s,a,t=3}}{TotalCohort_{s,a,t=3}}$$

(15)

For earlier time steps, maturation rates are computed in a similar way.

$$TotalCohort_{s,a,t} = MatCohort_{s,a,t} + \frac{PTCohort_{s,a,t+1}}{SRate_{a,t+1}}$$

(16)

$$MatRate_{s,a,t} = \frac{MatCohort_{s,a,t}}{TotalCohort_{s,a,t}}$$

(17)

Compute the exploitation rate on the vulnerable (legal size) cohort estimated from the cohort analysis just performed.

$$ExpRate_{s,a,f,t} = \frac{CWTCatch_{s,a,f,t}}{Cohort_{s,a,t} * SRate_{a,t} * LegProp_{f,a,t}}$$

(18)

Now start the forward analysis to estimate CWT recoveries during the base period, beginning with the youngest age:

1) $PTCohort_{s,a,t} = TotalCohort_{s,a=2,t=1}$

(19)

2) $PTCohort_{s,a,t} = TotalCohort_{s,a,t} * SRate_{a=2,t=1}$

(20)

3) $BPPTCatch_{s,a,f,t} = PTCohort_{s,a,t} * LegProp_{f,a,t} * \frac{ExpRate_{s,a,f,t}}{ScaleFactor_{f,t}}$

(21)

4) $MatCohort_{s,a,f,t} = (PTCohort_{s,a,t} - \sum_{PTF} BPPTCatch_{s,a,f,t}) * MatRate_{s,a,t}$

(22)

5) $BPTermCatch_{s,a,f,t} = MatCohort_{s,a,t} * LegProp_{s,a,f,t} * \frac{ExpRate_{s,a,f,t}}{ScaleFactor_{f,t}}$

(23)

6) $BPEscape_{s,a,t} = MatCohort_{s,a,f,t} - BPTermCatch_{s,a,f,t}$

(24)

Now, recompute the preterminal cohort if time step is less than 3 as:

6) $$TotalCohort_{s,a,t} = \frac{PTCohort_{s,a,t+1} - \sum_{PTF} BPPTCatch_{s,a,f,t}}{1 - MatRate_{s,a,t}}$$ (25)

or if time step =3 as:

$$TotalCohort_{s,a,t} = \frac{PTCohort_{s,a+1,t} - \sum_{PTF} BPPTCatch_{s,a,f,t}}{1 - MatRate_{s,a,t}}$$ (26)

Increment *a* by 1 and return to step 2 above.

3.4.7 CHCAL Outputs – ".SIM" file for OOB Run

Simulated base period recoveries by fishery, age, and time step ($BPPTCatch_{s,a,f,t}$ and $BPTermCatch_{s,a,f,t}$), and escapements by age and time step ($BPEscape_{s,a,t}$) from CHCAL in OOB mode are written to the SIM output file. The SIM files produced from individual brood year runs of CHCAL for a OOB stock are combined using MERGE to produce a single SIM file for each OOB stock.

SP	STK	AGE	FSH	TIM	RECOVERIES
1	1	2	74	3	71.3
1	1	3	74	1	0.0
1	1	3	74	3	392.2
1	1	4	74	1	0.0
			*		
			*		
			*		
1	33	4	74	3	26.01

3.4.8 CHCAL Program Flow and Calculations – All-Stocks Run

After all OOB stocks have been run through CHCAL and their base period CWT recoveries have been estimated, the data is combined with the data for all other stocks and all stocks are run through CHCAL at once. The sequence of computations for an All-Stocks run is as follows.

Estimate base period Production Expansion Factors (PEF) for each stock based on the ratio of the total adult escapement of each stock (from section 1 of the EDT file) to the total adult escapement of the CWTed stock (input from section 2 of the EDT file).

$$PEF_s = \frac{TotalBPEsc_s}{\sum_{a=3,t}^{a=5,t=3} CWTEscape_{s,a,t}}$$

Note that if a 'large' CWT group is used to represent the catch distribution of a 'small' hatchery stock, the expansion factors may be less than 1.0.

Depending on the setting of an input flag, the observed base period CWT recoveries are adjusted so that the sum across stocks of the CWT recoveries in each fishery, expanded by PEF_s, equals the total observed catch in each fishery. The adjustment formula is:

$$LandedCatch_{s,a,f,t} = CWTCatch_{s,a,f,t} * PEF_s * ModelRatio_f$$

Where

$$ModelRatio_f = \frac{BPObsCatch_f}{\sum_{s,a,t} (CWTCatch_{s,a,f,t} * PEF_s)}$$

The adjustment flags are:

"0" – indicates CWT recoveries are not adjusted. In this case,

$$LandedCatch_{s,a,f,t} = CWTCatch_{s,a,f,t} * PEF_s$$

"1" – indicates CWT recoveries are always adjusted to sum to the total catch in the fishery;
"2" – indicates CWT recoveries are adjusted only if the total catch in the fishery is greater than the sum of the CWT recoveries multiplied by the PEFs.

If the CWT recoveries are not adjusted $ModelRatio_f$ is set to 99 as a flag.

At this point, a final observed cath to 'model catch' ratio can be computed for each fishery. This value is, along with a saved to the outfile

$$RecoveryAdjustmentFactor_f = \frac{\sum_{s,a,t} LandedCatch_{s,a,f,t}}{BPObsCatch_f}$$

Now a cohort analysis is performed *for each stock* using the landed catch in each fishery. The cohort analysis procedures are exactly the same as those preformed for an 'OOB' run.

Compute the total number of CWT mortalities by age and time step for both terminal and preterminal fisheries:

$$PTMorts_{s,a,t} = \sum_{PTFisheries} LandedCatch_{s,a,f,t} * (1 + DropOff_f) + ShakMorts_{s,a,f,t} + CNRMorts_{s,a,f,t}$$

$$TMorts_{s,a,t} = \sum_{TFisheries} LandedCatch_{s,a,f,t} * (1 + DropOff_f) + ShakMorts_{s,a,f,t} + CNRMorts_{s,a,f,t}$$

Compute the 'terminal' or mature cohort by age and time step as:

$$MatCohort_{s,a,t} = TMorts_{s,a,t} + Escape_{s,a,t}$$

In the final time period, the immature cohort for the oldest age and after natural mortality is:

$$PTCohort_{s,a=5,t=3} = MatCohort_{s,a=5,t=3} + PTMorts_{s,a=5,t=3}$$

The cohort size for the younger ages in the final time period is computed as:

$$PTCohort_{s,a,t=3} = \frac{PTCohort_{s,a+1,t=1}}{SRate_{a+1,t=1}} + MatCohort_{s,a,t} + PTMorts_{s,a,t}$$

The cohort size for all ages in earlier time periods is computed as:

$$PTCohort_{s,a,t} = \frac{PTCohort_{s,a,t+1}}{SRate_{a,t+1}} + MatCohort_{s,a,t} + PTMorts_{s,a,t}$$

Once an initial estimate of preterminal and terminal cohort sizes for all stocks have been made, incidental (shaker) and CNR mortalities by stock, fishery, age, and time period can be estimated.

For initial iteration, assume the number of encounters of all stocks by fishery and time period is equal to the landed catch. The encounters can be scaled up or down to match available external estimates of encounter rates. The scalars are input in section 8 of the CAL file.

$$Encounters_{f,t} = \sum_{s} \sum_{a=2}^{5} CWTCatch_{s,a,f,t} * EncAdj_{f,t}$$

Compute the proportions of the cohort at age that are above and below the size limit assuming a normal distribution of fish length at age.

$$SubLegProp_{f,a,t} = f(Minsize_{a,f,t}, Length_{a,t}), Length_{a,t} \sim N(Mean_{a,t}, SD_{a,t}^{\;2})$$

$$LegalProp_{f,a,t} = 1 - SubLegProp_{f,a,t}$$

Compute the total sub-legal population as:

$$TotalSLPop_{f,t} = \sum_{s} \sum_{a=2}^{5} SubLegProp_{s,f,a,t} * Cohort_{s,a,t}$$

where

$Cohort_{s,a,t} = PTCohort_{s,a,t}$ for Preterminal fisheries and

$Cohort_{s,a,t} = MatCohort_{s,a,t}$ for Terminal fisheries.

Compute the proportion of each age that is sublegal.

$$SLProp_{s,f,a,t} = \frac{SubLegProp_{s,f,a,t} * Cohort_{s,a,t}}{TotalSlPop_{f,t}}$$

Now compute the number of shaker mortalities as:

$$Shakers_{s,a,f,t} = Encounters_{f,t} * SLProp_{s,f,a,t} * ShakMortRate_{f}$$

CNR mortalities are not generally estimated in FRAM calibration since CNR fisheries were rare during the base period. Computation details are not included in this draft of CHCAL.

Now that an initial estimate of shakers is available, cohort sizes are re-estimated based on the new number of total mortalities. This continues iteratively until the change in age 2 cohort size is less than a predefined limit ('convergence tolerance', CAL file line 10). Note that at this stage we have available at the start of each time step a preterminal cohort at age and a terminal, or mature cohort at age.

Once cohort sizes are available, maturation rates by age and time step can be computed. The maturation rate for the oldest age in the final time step is assumed to be 1.0

In the last time step, compute a total cohort after fishing mortality.

$$TotalCohort_{s,a,t=3} = MatCohort_{s,a,t=3} + \frac{PTCohort_{s,a+1,t=1}}{SRate_{s,a+1,t=1}}$$

And the Maturation rate is simply the mature portion of the total cohort after fishing.

$$MatRate_{s,a,t=3} = \frac{MatCohort_{s,a,t=3}}{TotalCohort_{s,a,t=3}}$$

For earlier time steps, maturation rates are computed in a similar way as:

$$TotalCohort_{s,a,t} = MatCohort_{s,a,t} + \frac{PTCohort_{s,a,t+1}}{SRate_{s,a,t+1}}$$

$$MatRate_{s,a,t} = \frac{MatCohort_{s,a,t}}{TotalCohort_{s,a,t}}$$

Once maturation rates are available, adult equivalence (AEQ) can be computed. AEQ is the probability that a fish of a certain age will survive to spawn, in the absence of future fishing. AEQs are a function of the maturation rate of the stock and therefore are stock specific. AEQ is defined as 1.0 for the oldest age class at the final time step.

$$AEQ_{a=5,t=3} = 1.0$$

In earlier time steps, for all ages, AEQ is computed as

$$AEQ_{a,t} = MatRate_{s,a,t} + ((1 - MatRate_{s,a,t}) * SRate_{a+1,t} * AEQ_{s,a,t+1})$$

Finally, exploitation rates on the vulnerable cohort are computed as:

$$ExpRate_{s,a,f,t} = \frac{LandedCatch_{s,a,f,t}}{TotalCohort_{s,a,t} * SRate_{a,t} * LegalProp_{f,a,t}}$$

And shaker encounter rates are computed as:

$$ShakEnc_{s,a,f,t} = \frac{(Shakers_{s,a,f,t} / ShakMortrate_{f})}{TotalCohort_{s,a,t} * SRate_{a,t} * SLProp_{s,a,f,t}}$$

3.4.9 CHCAL Output— FRAM base period ".out" file from All Stocks Run

CHCAL writes one final output file, which is used as a basic driver file for the FRAM model. The OUT file is described below.

CHCAL OUT File: Section 1

Section 1 contains global values defining the dimensions of the model.

33	Number of Stocks
73	Number of Fisheries
3	Number of Time Steps
5	Maximum Age
4	Maximum Age for Encounter Rate Adjustment

CHCAL OUT File: Section 2

Section 2 contains Adult Equivalencies by stock, age, and time step.

0.95705235	step 4; Stock 1; Age 5
1.00000000	step 3; Stock 1; Age 5
0.97399998	step 2; Stock 1; Age 5
0.95705235	step 1; Stock 1; Age 5
	*
	*
	*
0.27315800	step 1; Stock 33; Age 2

CHCAL OUT File: Section 3

Section 3 contains the growth parameters, by stock.

982.1	Stock 1; LMAX; Maturity 0
2.83	T0
0.029	L
0.11	CV - Age2
0.12	CV - Age3
0.09	CV - Age4
0.09	CV - Age5
1085.2	Stock 1; LMAX; Maturity 1
	*
	*
	*
0.11 ,CV	Age5

CHCAL OUT File: Section 4

Section 4 contains data on the ‘midpoint’, in months from October, of each time step.

1.0	Midpoint month of time step 1
5.5	Midpoint month of time step 2
8.0	Midpoint month of time step 3
1.0	Midpoint month of time step 4

CHCAL OUT File: Section 5

Section 5 contains shaker inclusion flags for each stock/fishery combination in a matrix format. The rows correspond to fisheries, the columns to stocks. This data was input from the CAL file and not modified by CHCAL.

0 1 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 1 1 0 0 1 0
0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0 1 1 1 1 0 1 1 0 1 1 0
0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 1 0 1 1 0 1 1 1 1 0 1 1 0 1 1 0
*
*
*
*
1 0 0 1 0 1 0 0 1 1 1 1 0 0 0 1 1 1 0 0 0 1 0 0 0 0 0 0 0 0 1 0 1

CHCAL OUT File: Section 6

Section 6 contains base period starting cohort sizes (first time period) at age, before natural mortality.

744009	Stock 1; 2
423945	Stock 1; 3
195369	Stock 1; 4
12598	Stock 1; 5
	*
	*
	*
8	Stock 33; 5

CHCAL OUT File: Section 7

Section 7 contains the Recovery Adjustment Factors and the fraction of the observed catch during the base period which can be accounted for by FRAM stocks. This is sometimes called the “proportion modeled stocks”. A ‘99’ in the first column (the recovery adjustment factor)indicates no overall adjustment was made to the CWT recovery data to account for total catches. When adjustments were made, the values in the first and second columns will be the inverse of each other. The left column is for the user’s information and is deleted prior to use of the OUT file in FRAM.

99	.4967	Fishery 1;
99	.2016	Fishery 2;
99	.2709	Fishery 3;
1.636	.6112	Fishery 4;
		*
		*
		*
99		Fishery33;

CHCAL OUT File: Section 8

Section 8 contains 'other' mortality rates by fishery, as input in the CAL file.

.008	Fishery 1 (Alaska Troll TCCHINOOK (97)-1)
.03	Fishery 2 (Alaska Net)
.036	Fishery 3 (Alaska Sport TCCHINOOK (97)-1)
.03	Fishery 4 (N/C BC Net)
	*
	*
	*
.02	Fishery 73 (Freshwater Net WDFW and Tribes)

CHCAL OUT File: Section 9

Section 9 contains natural mortality rates during the first time period.

0.2577	Age 2
0.1878	Age 3
0.1221	Age 4
0.0596	Age 5

CHCAL OUT File: Section 10

Section 10 contains shaker mortality rates by fishery in the first time period.

0.2550	Fishery 1;
0.3000	Fishery 2;
0.1230	Fishery 3;
0.3000	Fishery 4;
	*
	*
	*
0.3000	Fishery 33;

CHCAL OUT File: Section 11

Section 11 contains the encounter rate adjustment factors for ages 2 to 4 in the first time period. A value for each age is written, even though the adjustments are currently not age specific.

1.0000 1.0000 1.0000	Fishery 1;
1.0000 1.0000 1.0000	Fishery 2;
1.0000 1.0000 1.0000	Fishery 3;
1.0000 1.0000 1.0000	Fishery 4;
	*
	*
	*
1.0000 1.0000 1.0000	Fishery 73;

CHCAL OUT File: Section 12

Section 12 contains the terminal fishery flags (0 = preterminal, 1 = terminal) in the first time period.

0	Fishery 1;
0	Fishery 2;
0	Fishery 3;
0	Fishery 4;
	*
	*
	*
1	Fishery 73;

CHCAL OUT File: Section 13

Section 13 contains maturation rates by age for stocks that mature in the first time period.

Stock 49	Age 3	0.0797452400
Stock 50	Age 3	0.0797452400
Stock 49	Age 4	0.5020105200
Stock 50	Age 4	0.5020105200
	*	
	*	
	*	
Stock 52	Age 5	0.9585540900

CHCAL OUT File: Section 14

Section 14 contains exploitation rates and shaker encounter rates by stock, age, and fishery for the first time period.

Stock	Age	Fishery	ER	Shak Enc
1	2	1	0.0000000000	0.0000034900
2	2	1	0.0000000000	0.0000034900
1	3	1	0.0000000000	0.0000034900
2	3	1	0.0000000000	0.0000034900
		*		
		*		
1	3	8	0.0011095100	0.0001878300
		*		
		*		
		*		
66	4	67	0.1635743400	0.0540591100

For the remainder of the OUT file, sections 9 through 14 are repeated for each time period. Time period 4 is included as the last section. It is simply a repeat of the data in time step 1.

4. APPENDIX

4.1 List of CWT groups

TABLE 1. CHINOOK CWT GROUPS USED IN 2005 FRAM CALIBRATION

FRAM	FR Name	RUN NAME	Code	BYR	AGE	DAT1	DAT2	TAGGED	ADS	UNMARKED	FPP	TOTL	Stock	Hatchery
1	NkSM FlFi	FALL CHIN	050324	77	1	780623	780623	96486	1969	101545	80	200000	BIG SOOS CR 09.0072	SKOOKUM CR HATCHERY
1	NkSM FlFi	FALL CHIN	050325	77	1	780620	780620	99240	2025	58266	71.1	159531	BIG SOOS CR 09.0072	SKOOKUM CR HATCHERY
1	NkSM FlFi	FALL CHIN	050726	79	1	800617	800617	59629	1219	2425200	127.4	2486048	SAMISH (FRIDAY CR)	SKOOKUM CR HATCHERY
1	NkSM FlFi	FALL CHIN	050727	79	1	800702	800702	40468	1686	7846	74	50000	SAMISH (FRIDAY CR)	LUMMI SEA PONDS
1	NkSM FlFi	FALL CHIN	632042	79	1	800523	800523	100514	1221	0	96	101735	SAMISH (FRIDAY CR)	SAMISH HATCHERY
1	NkSM FlFi	FALL CHIN	632101	79	1	800523	800523	106037	206	22287	103	128530	SAMISH (FRIDAY CR)	SAMISH HATCHERY
1	NkSM FlFi	FALL CHIN	632102	79	1	800523	800523	103023	1231	9300	93	113554	SAMISH (FRIDAY CR)	SAMISH HATCHERY
2	NF NK Spr	SPRG CHIN	632846	84	1	850531	850531	133418	15653	0	84.6	149071	KENDALL CR 01.0406	KENDALL CR HATCHERY
2	NF NK Spr	SPRG CHIN	633452	84	2	860410	860410	52274	26	48617	6.4	100917	KENDALL CR 01.0406	KENDALL CR HATCHERY
2	NF NK Spr	SPRG CHIN	633453	84	2	860410	860410	52599	26	48293	6.4	100918	KENDALL CR 01.0406	KENDALL CR HATCHERY
2	NF NK Spr	SPRG CHIN	634422	88	2	900402	900402	146729	8212	221851	7.6	376792	KENDALL CR 01.0406	KENDALL CR HATCHERY
4	Skag FlFi	SUMR CHIN	631606	76	1	770603	770603	147153	3928	6040	138	157121	SKAGIT R 03.0176	MARBLEMOUNT HATCHERY
4	Skag FlFi	SUMR CHIN	631624	76	1	7704	7704	5875	0	0	250.6	5875	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631625	76	1	7705	7705	5428	0	0	250.6	5428	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631626	76	1	7705	7705	5438	0	0	250.6	5438	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631627	76	1	770601	770601	5090	0	0	250.6	5090	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631628	76	1	7706	7706	2502	0	0	250.6	2502	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631629	76	1	770420	770617	2126	0	0	250.6	2126	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631630	77	1	7804	7804	2281	0	0	224.6	2281	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631631	77	1	780419	780501	3543	0	0	224.6	3543	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631632	77	1	780402	780402	9584	0	0	224.6	9584	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631633	77	1	7805	7805	10528	0	0	224.6	10528	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631635	77	1	7805	7805	7947	0	0	224.6	7947	SKAGIT R 03.0176	WILDSTOCK
4	Skag FlFi	SUMR CHIN	631636	77	1	7806	7806	2332	0	0	199.8	2332	SKAGIT R 03.0176	WILDSTOCK
5	Skag FlYr	SUMR CHIN	631610	76	2	780502	780502	73428	1575	72063	10	147066	SKAGIT R 03.0176	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	633114	90	2	920416	920416	146265	1687	136571	14	284523	CLARK CR 03.1421	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	634744	87	2	890418	890418	63808	159	0	9.5	63967	SUIATTLE R 03.0710	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	634902	87	2	890418	890418	25725	65	0	9.5	25790	CLARK CR 03.1421	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	635026	87	2	890418	890418	25379	64	0	9.5	25443	CLARK CR 03.1421	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	633314	86	2	880408	880408	80395	405	0		80800	SKAGIT TRIBUTARIES	MARBLEMOUNT HATCHERY
6	Skag SpYr	SPRG CHIN	633323	85	2	870429	870429	47521	191	0		47712	SKAGIT TRIBUTARIES	MARBLEMOUNT HATCHERY
8	Snoh FlYr	SUMR CHIN	631701	76	2	780326	780326	98972	1507	802521	8	903000	SNOHOMISH R 07.0012	WALLACE R HATCHERY
9	Stil FlFi	SUMR CHIN	211826	89	1	900516	900516	44964	1873	0	86.1	46837	STILLAGUAMISH R -NF	STILLAGUAMISH HATCH
9	Stil FlFi	CHINOOK	212026	90	1	910517	910520	63019	5862	219	68.9	69100	STILLAGUAMISH R -NF	STILLAGUAMISH HATCH
9	Stil FlFi	SUMR CHIN	212221	86	1	870414	870414	23904	996	0	90.2	24900	STILLAGUAMISH R	STILLAGUAMISH HATCH
9	Stil FlFi	SUMR CHIN	212555	87	1	880518	880518	127910	9333	7923	90.2	145166	STILLAGUAMISH R	STILLAGUAMISH HATCH
9	Stil FlFi	SUMR CHIN	213147	88	1	890517	890517	36599	4524	0	80	41123	STILLAGUAMISH R -NF	STILLAGUAMISH HATCH
10	Tula FlFi	FALL CHIN	212204	86	1	870519	870519	191825	14660	851175	89.1	1057660	SNOHOMISH R 07.0012	TULALIP SALMON HATCH
10	Tula FlFi	FALL CHIN	212544	87	1	880509	880509	188110	14377	1222513	90.2	1425000	GREEN R +TULALIP BAY	TULALIP SALMON HATCH
10	Tula FlFi	FALL CHIN	213141	88	1	890519	890519	181873	22479	420648	84.9	625000	MAY CR + WALLACE CR	TULALIP SALMON HATCH
11	MiPS Fl Fi	FALL CHIN	631814	78	1	790531	790531	61307	370	1061514	102	1123191	SKAGIT + SKYKOMISH	VOIGHTS CR HATCHERY
11	MiPS Fl Fi	FALL CHIN	631842	78	1	790531	790531	7752	408	134270	102	142430	SKAGIT + SKYKOMISH	VOIGHTS CR HATCHERY
11	MiPS Fl Fi	FALL CHIN	631935	78	1	790517	790517	99372	1207	173396	99	273975	BIG SOOS CR 09.0072	SOOS CREEK HATCHERY
11	MiPS Fl Fi	FALL CHIN	631936	78	1	790517	790517	100664	404	177958	112	279026	BIG SOOS CR 09.0072	SOOS CREEK HATCHERY
11	MiPS Fl Fi	FALL CHIN	631940	78	1	790523	790525	150554	2554	2558955	146.2	2712063	GREEN R + ISSAQUAH	ISSAQUAH HATCHERY
11	MiPS Fl Fi	FALL CHIN	631943	79	1	800509	800509	120515	3497	2691961	125	2815973	ISSAQUAH CR 08.0178	ISSAQUAH HATCHERY
11	MiPS Fl Fi	FALL CHIN	631944	79	1	800502	800502	119913	482	2737105	106	2857500	BIG SOOS CR 09.0072	SOOS CREEK HATCHERY
11	MiPS Fl Fi	FALL CHIN	631945	78	1	790517	790531	185133	1750	4203607	100	4390490	BIG SOOS CR 09.0072	SOOS CREEK HATCHERY
11	MiPS Fl Fi	FALL CHIN	632020	79	1	800523	800523	64238	304	1176650	139	1241192	VOIGHT CR 10.0414	VOIGHTS CR HATCHERY
12	UW-A FlFi	FALL CHIN	111601	77	1	780508	780508	26188	2357	169	31	28714	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY

12	UW-A FlFi	FALL CHIN	111602	77	1	780508	780508	26331	266	13	36	26610	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111603	78	1	790518	790518	24639	1107	0	47	25746	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111604	78	1	790518	790518	23653	858	0	44	24511	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111605	78	1	790518	790518	27165	358	8	50	27531	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111606	78	1	790518	790518	23078	689	0	56	23767	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111618	78	1	790518	790518	53537	1093	0	52	54630	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111624	78	1	790529	790529	3637	15	0	54	3652	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111627	79	1	800528	800528	18488	2077	0	19	20565	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111628	79	1	800519	800519	20573	887	184	37	21644	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111629	79	1	800522	800522	20008	855	0	37	20863	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111630	79	1	800519	800519	20435	697	0	38	21132	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111631	79	1	800528	800528	20196	560	0	19	20756	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
12	UW-A FlFi	FALL CHIN	111632	79	1	800519	800519	21822	220	0	52	22042	PORTAGE BAY STOCK UW	PORTAGE BAY HATCHERY
13	SPSo FlFi	FALL CHIN	050722	79	1	800515	800515	33494	5635	776681	116	815810	BIG SOOS CR 09.0072	KALAMA CR HATCHERY
13	SPSo FlFi	FALL CHIN	631903	79	1	800429	800516	14834	456	334052	83	349342	PUYALLUP + DESCHUTES	GARRISON HATCHERY
13	SPSo FlFi	FALL CHIN	631907	78	1	790523	790523	28188	0	571678	116	599866	DESCHUTES R X MINTER	MINTER HATCHERY
13	SPSo FlFi	FALL CHIN	632063	79	1	800630	800630	34619	69	623527	60	658215	BIG SOOS CR 09.0072	COULTER CR HATCHERY
13	SPSo FlFi	FALL CHIN	632103	79	1	800531	800531	12843	0	6424157	120	6437000	UNDETERMINED MIXED	CAPITOL LAKE REARING
13	SPSo FlFi	FALL CHIN	632104	79	1	800601	800601	72032	361	1612822	116.4	1685215	S PUGET SOUND STOCKS	MINTER HATCHERY
14	SpSo FlYr	FALL CHIN	631853	78	2	800216	800216	3665	37	70316	5.7	74018	MINTER CR 15.0048	FOX ISLAND HATCHERY
14	SpSo FlYr	FALL CHIN	631905	78	2	800228	800228	20400	0	308350	8	328750	BIG SOOS CR 09.0072	SOOS CREEK HATCHERY
14	SpSo FlYr	FALL CHIN	632004	78	2	800131	800312	48196	231	961504	9.8	1009931	HOOD CANAL + GREEN R	CAPITOL LAKE REARING
14	SpSo FlYr	FALL CHIN	632015	79	2	810306	810306	16080	278	294406	8	310764	S PUGET SOUND STOCKS	CAPITOL LAKE REARING
14	SpSo FlYr	FALL CHIN	632019	79	2	810306	810306	30929	703	801336	8	832968	S PUGET SOUND STOCKS	CAPITOL LAKE REARING
14	SpSo FlYr	FALL CHIN	632023	78	2	800310	800310	13495	0	28385	6.2	41880	BIG SOOS CR 09.0072	ALLISON SPRINGS HAT.
14	SpSo FlYr	FALL CHIN	632027	79	2	800919	810214	10243	163	189887	5.4	200293	VOIGHT CR 10.0414	GARRISON HATCHERY
14	SpSo FlYr	FALL CHIN	632055	79	2	810301	810301	9696	59	191526	7	201281	DESCHUTES R 13.0028	COULTER CR HATCHERY
14	SpSo FlYr	FALL CHIN	632056	79	2	810301	810301	8681	21	164635	7	173337	DESCHUTES R X MINTER	COULTER CR HATCHERY
11	SpSo FlYr	FALL CHIN	632128	79	2	810204	810204	10433	31	218532	9	228996	BIG SOOS CR 09.0072	CRISP CR HATCHERY
14	SpSo FlYr	FALL CHIN	632220	79	2	810303	810531	4659	14	0	4.5	4673	DESCHUTES R 13.0028	HUPP SPRINGS REARING
14	SpSo FlYr	FALL CHIN	632221	79	2	810217	810217	3060	0	59815	8.2	62875	BIG SOOS CR 09.0072	ALLISON SPRINGS HAT.
14	SpSo FlYr	FALL CHIN	632228	79	2	810217	810217	10169	51	0	8.2	10220	BIG SOOS CR 09.0072	ALLISON SPRINGS HAT.
15	Whte SprF	SPRG CHIN	211659	91	1	920527	920530	38231	1305	0	89.1	39536	WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212209	91	1	920528	920604	221091	9835	6432	100.1	237358	WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212245	91	1	920527	920530	141164	4817	29	89.1	146010	WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212246	91	1	920527	920527	138995	11759	134918	77.9	285672	WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212321	92	1	930610	930610	167830	4127	45850			WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212322	92	1	930610	930610	214640	34362				WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212462	93	1	940601	940421	218349	20888	3643	120.9		WHITE R 10.0031	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212503	93	1	940512	940523	159348	3144	2978			WHITE R 10.0032	WHITE RIVER HATCHERY
15	Whte SprF	SPRG CHIN	212463	93	1	940321	940325	75866	10248	28785			WHITE R 10.0033	WHITE RIVER HATCHERY
16	HdCl FlFi	FALL CHIN	631752	78	1	790530	790530	37439	360	147624	120	185423	GEORGE ADAMS (PURDY)	GEORGE ADAMS HATCHRY
16	HdCl FlFi	FALL CHIN	631915	78	1	790518	790518	34300	487	752200	100	786987	FINCH CR 16.0222	HOODSPORT HATCHERY
16	HdCl FlFi	FALL CHIN	632041	79	1	800430	800430	73387	1193	1512620	150	1587200	S PUGET SOUND STOCKS	GEORGE ADAMS HATCHRY
16	HdCl FlFi	FALL CHIN	632109	79	1	800425	800425	48954	847	669899	150	719700	FINCH CR 16.0222	HOODSPORT HATCHERY
17	HdCl FlYr	FALL CHIN	631637	78	2	800223	800223	6792	60	137207	12	144059	FINCH CR 16.0222	HOODSPORT HATCHERY
17	HdCl FlYr	FALL CHIN	631840	78	2	800311	800311	1098	6	19065	15	20169	FINCH CR 16.0222	MCKERNAN HATCHERY
17	HdCl FlYr	FALL CHIN	631852	78	2	800311	800311	15935	77	276688	15	292700	FINCH CR 16.0222	MCKERNAN HATCHERY
17	HdCl FlYr	FALL CHIN	632057	79	2	810206	810207	6245	25	130828	11	137098	FINCH CR 16.0222	HOODSPORT HATCHERY
18	SJDF FlFi	FALL CHIN	631919	78	2	790815	800428	42386	780	815057	14.7	858223	ELWHA R 18.0272	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	632107	79	2	800815	810404	39629	170	762425	11	802224	ELWHA R 18.0272	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633038	83	1	840615	840615	25316	2026	801553		802224	ELWHA R 18.0273	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633039	83	1	840615	840615	24964	230	611062		802224	ELWHA R 18.0274	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633419	84	1	850621	850621	26510	227	602571		802224	ELWHA R 18.0275	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633420	84	1	850621	850621	26317	173	645988		802224	ELWHA R 18.0276	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633543	85	1	860610	860610	25992	172	640840		802224	ELWHA R 18.0277	ELWHA HATCHERY
18	SJDF FlFi	FALL CHIN	633544	85	1	860610	860610	26097	68	475337		802224	ELWHA R 18.0278	ELWHA HATCHERY
19	Oreg Tule	FALL CHIN	071842	78	1	790501	790529	287916	68	475338			TANNER CR	BONNEVILLE HATCHERY
19	Oreg Tule	FALL CHIN	072157	79	1	800520	800528	121071	4433	4947400			TANNER CR	BONNEVILLE HATCHERY
19	Oreg Tule	FALL CHIN	072163	79	1		800529	51851	901	1170077			TANNER CR	OXBOW
20	Wash Tule	FALL CHIN	631802	77	1	780619	780619	146001	7523	503262	133	656786	COWLITZ R 26.0002	COWLITZ SALMON HATCH

20	Wash Tule	FALL CHIN	631942	78	1	790627	791016	143568	2326	4157781	54.5	4303675	COWLITZ R	26.0002	COWLITZ SALMON HATCH
20	Wash Tule	FALL CHIN	632154	79	1	800603	800711	244267	9915	5671774	128.4	5925956	COWLITZ R	26.0002	COWLITZ SALMON HATCH
21	Low CR Wi	FALL CHIN	631611	77	1	780714	780714	48567	293	0	140	48860	LEWIS R	27.0168	LEWIS RIVER HATCHERY
21	Low CR Wi	FALL CHIN	631618	77	1	7805	7806	19806	439	0	199.8	20245	LEWIS R	27.0168	WILDSTOCK
21	Low CR Wi	FALL CHIN	631619	77	1	780613	780706	15887	407	0	150.2	16294	LEWIS R	27.0168	WILDSTOCK
21	Low CR Wi	FALL CHIN	631813	78	1	790713	790713	60912	368	0	141	61280	LEWIS R	27.0168	LEWIS RIVER HATCHERY
21	Low CR Wi	FALL CHIN	631858	78	1	7906	7906	26242	0	0	199.8	26242	LEWIS R	27.0168	WILDSTOCK
21	Low CR Wi	FALL CHIN	631859	78	1	790605	790605	23402	165	0	199.8	23567	GRAYS R	25.0093	WILDSTOCK
21	Low CR Wi	FALL CHIN	631902	78	1	7906	7906	21187	0	0	199.8	21187	LEWIS R	27.0168	WILDSTOCK
21	Low CR Wi	FALL CHIN	631920	78	1	790905	790905	51660	420	0	28	52080	LEWIS R	27.0168	SPEELYAI HATCHERY
21	Low CR Wi	FALL CHIN	632002	78	1	7907	7907	18238	55	0	199.8	18293	LEWIS R	27.0168	WILDSTOCK
22	BPH Tule	FALL CHIN	050433	78	1	790518	790518	140948	12590	3569570	52	3723108	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050434	78	1	790420	790420	95581	11035	0	86.9	106616	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050444	78	1	790420	790420	135537	19362	4357431	77.9	4512330	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050446	78	1	790320	790321	245981	13219	9860784	125	1E+07	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050639	79	1	800310	800310	130208	4863	7205064	122.9	7340135	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050640	79	1	800408	800421	77720	2735	3833522	82.9	3913977	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050641	79	1	800509	800509	61771	1325	3127581	51	3190677	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	050642	79	1	800807	800807	23563	456	1088462	19	1112481	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	054101	76	1	770418	770418	87707	0	1376816	77.1	1464523	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	054201	76	1	770418	770418	91438	0	1343481	81.6	1434919	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	054401	76	1	770408	770408	96767	0	0	85.9	96767	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	054501	76	1	770408	770408	95813	0	941640	79.9	1037453	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	054601	76	1	770524	770524	141161	0	3915686	42	4056847	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	055501	77	1	780512	780512	144278	11362	2983318	61	3138958	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	055601	77	1	780321	780321	149725	7549	9785283	103.8	9942557	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	055701	77	1	780518	780518	155177	5296	3758701	55.9	3919174	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	056001	77	1	780418	780418	98122	3643	0	64	101765	SPRING CR	29.0159	SPRING CR NFH
22	BPH Tule	FALL CHIN	056201	77	1	780418	780418	92314	7593	2031781	67.9	2131688	SPRING CR	29.0159	SPRING CR NFH
23	Upp CR Su	SUMR CHIN	631607	76	1	770528	770528	149308	2582	117582	32	269472	WELLS DAM	(47)	WELLS DAM SP CHANNEL
23	Upp CR Su	SUMR CHIN	631642	76	1	770614	770614	145946	6082	102628	160	254656	WELLS DAM	(47)	WELLS DAM SP CHANNEL
23	Upp CR Su	SUMR CHIN	631762	77	1	780613	780613	153604	1787	187921	43	343312	WELLS DAM	(47)	WELLS DAM SP CHANNEL
24	Upp CR Br	FALL CHIN	130713	75	1	760617	760617	102710	0	794778	46	897488	PRIEST RAPIDS	(36)	RINGOLD SPRINGS HATC
24	Upp CR Br	FALL CHIN	131101	75	1	760701	760701	132004	0	759480	95	891484	PRIEST RAPIDS	(36)	PRIEST RAPIDS HATCH.
24	Upp CR Br	FALL CHIN	131202	75	1	760701	760701	152412	0	296839	37	449251	PRIEST RAPIDS	(36)	PRIEST RAPIDS HATCH.
24	Upp CR Br	FALL CHIN	631662	76	1	770627	770627	147338	3287	611808	96	762433	PRIEST RAPIDS	(36)	PRIEST RAPIDS HATCH.
24	Upp CR Br	FALL CHIN	631741	77	1	780627	780627	152532	1308	385483	90	539323	PRIEST RAPIDS	(36)	PRIEST RAPIDS HATCH.
24	Upp CR Br	FALL CHIN	631745	77	1	780623	780623	146296	4836	346274	35	497406	PRIEST RAPIDS	(36)	RINGOLD SPRINGS HATC
25	Cowl Spr	SPRG CHIN	631817	77	2	790423	790423	24079	243	45667	5.3	69989	COWLITZ R	26.0002	COWLITZ SALMON HATCH
25	Cowl Spr	SPRG CHIN	631818	77	2	790423	790423	24341	246	40804	6.8	65391	COWLITZ R	26.0002	COWLITZ SALMON HATCH
26	Will Spr	SPRG CHIN	071737	77	1		781107	22989	1390	303489		327868	WILLAMETTE R		DEXTER PONDS
26	Will Spr	SPRG CHIN	071738	77	1	781106	781108	23974	1051	132996		158021	WILLAMETTE R		WILLAMETTE HATCHERY
26	Will Spr	SPRG CHIN	071741	77	2	790319	790320	30927	1023	397745		429695	WILLAMETTE R		DEXTER PONDS
26	Will Spr	SPRG CHIN	071742	77	2	790319	790320	29463	1920	229835		261218	WILLAMETTE R		DEXTER PONDS
26	Will Spr	SPRG CHIN	071925	78	1	791105	791108	14919	790	262923		278632	WILLAMETTE R		WILLAMETTE HATCHERY
26	Will Spr	SPRG CHIN	072042	78	2		800310	30726	1016	594105		625847	WILLAMETTE R		WILLAMETTE HATCHERY
26	Will Spr	SPRG CHIN	072047	78	1		791105	31309	574	0		31883	WILLAMETTE R		WILLAMETTE HATCHERY
26	Will Spr	SPRG CHIN	072049	78	1		791109	31558	2106	306		33970	MCKENZIE R		MCKENZIE
26	Will Spr	SPRG CHIN	072050	78	2		800315	34897	1959	71304		108160	MCKENZIE R		MCKENZIE
26	Will Spr	SPRG CHIN	091621	76	2	780309	780310	25007	5097	1752		31856	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091622	76	2	780309	780310	29533	2217	382		32132	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091623	76	2	780309	780310	26912	3506	1169		31587	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091624	76	2	780309	780310	24609	6066	754		31429	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091625	76	2	780309	780310	13412	1233	578		15223	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091626	76	2	780309	780310	14917	1355	452		16724	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091627	76	1	771107	771108	28734	4928	800		34462	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091628	76	1	771107	771108	27558	2694	672		30924	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091629	76	1	771107	771108	28703	2370	745		31818	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091630	76	1	771107	771108	25946	4253	158		30357	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091631	76	1	771107	771108	29047	2976	155		32178	S SANTIAM R		SOUTH SANTIAM HATCH
26	Will Spr	SPRG CHIN	091701	76	2	780313	780315	49142	1273	509		50924	N SANTIAM R		MARION FORKS

26	Will Spr	SPRG CHIN	091703	76	2	780313	780315	50076	770	514		51360	N SANTIAM R	MARION FORKS
27	Snake Fl	FALL CHIN	633226	84	1	850606	850606	78417	236	101400	67	180053	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633227	84	1	850606	850606	78064	235	100900	67	179199	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633228	84	1	850606	850606	78504	236	101400	67	180140	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633633	85	1	860613	860613	49112	366	0	46	49478	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633638	85	1	860610	860610	49325	468	0	58	49793	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633639	85	1	860610	860610	49325	468	0	58	49793	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633640	85	1	860610	860610	49325	468	0	58	49793	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633641	85	1	860610	860610	49325	468	0	58	49793	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	633642	85	1	860610	860610	49325	468	0	58	49793	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	634259	86	1	870601	870601	126076	2836	0	48	128912	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
27	Snake Fl	FALL CHIN	634261	86	1	870601	870601	125570	2824	0	48	128394	SNAKE R-LOWR 33.0002	LYONS FERRY HATCHERY
28	Ore No Fl	FALL CHIN	071643	77	1		781025	19800	4877	0		24677	SALMON R	SALMON RIVER
28	Ore No Fl	FALL CHIN	071644	77	1		780814	23974	921	0		24895	SALMON R	SALMON RIVER
28	Ore No Fl	FALL CHIN	071849	78	1		791026	20102	1058	5290		26450	SALMON R	SALMON RIVER
28	Ore No Fl	FALL CHIN	071850	78	1		790815	21558	1303	3430		26291	SALMON R	SALMON RIVER
28	Ore No Fl	FALL CHIN	091637	76	1		771005	21820	980	0		22800	SALMON R	SALMON RIVER
28	Ore No Fl	FALL CHIN	091638	76	1		770823	26281	446	652		27379	SALMON R	SALMON RIVER
29	WCVI Totl	FALL CHIN	020408	75	1	760604	760607	50731	1354	435060		487145	S-ROBERTSON CR/STAMP	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	020409	75	1	760611	760615	47724	2102	413159		462985	S-ROBERTSON CR/STAMP	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	020606	74	1		750611	46194	695	956988		1003877	S-STAMP RIVER	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	020906	74	1		750611	27383	673	425710		453766	S-STAMP RIVER	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	021630	76	1	770526	770610	64550	2385	3121137		3188072	S-ROBERTSON CR/STAMP	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	021631	76	1	770608	770617	69203	933	372351		442487	S-ROBERTSON CR/STAMP	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	022217	77	1	780529	780630	70816	4257	4103278		4178351	S-ROBERTSON CREEK	H-ROBERTSON CREEK
29	WCVI Totl	FALL CHIN	022218	77	1	780603	780617	66725	5400	3481062		3553187	S-ROBERTSON CREEK	H-ROBERTSON CREEK
30	Frasr Lt	FALL CHIN	022658	83	1	840531	840601	26088	475	323310		349873	S-HARRISON RIVER	H-CHILLIWACK RIVER
30	Frasr Lt	FALL CHIN	022659	83	1	840531	840601	24015	415	297349		321779	S-HARRISON RIVER	H-CHILLIWACK RIVER
30	Frasr Lt	FALL CHIN	022660	83	1	840531	840601	26829	219	329214		356262	S-HARRISON RIVER	H-CHILLIWACK RIVER
30	Frasr Lt	FALL CHIN	023414	84	1	850616	850617	14266	1069	148713		164048	S-CHILLIWACK R	H-CHILLIWACK R
30	Frasr Lt	FALL CHIN	023415	84	1	850606	850607	14892	228	147001		162121	S-CHILLIWACK R	H-CHILLIWACK R
30	Frasr Lt	FALL CHIN	023416	84	1	850616	850617	14100	1069	146982		162151	S-CHILLIWACK R	H-CHILLIWACK R
30	Frasr Lt	FALL CHIN	023417	84	1	850616	850617	14233	1069	148368		163670	S-CHILLIWACK R	H-CHILLIWACK R
30	Frasr Lt	FALL CHIN	023418	84	1	850606	850607	15100	228	149055		164383	S-CHILLIWACK R	H-CHILLIWACK R
30	Frasr Lt	FALL CHIN	023419	84	1	850606	850607	14883	227	146912		162022	S-CHILLIWACK R	H-CHILLIWACK R
31	Frasr Erly	SUMR CHIN	021601	79	1	800604	800609	45440	1200	0		46640	S-SHUSWAP R LOWER	
31	Frasr Erly	SUMR CHIN	021602	78	1	790705	790716	45932	2316	0		48248	S-CHILKO RIVER	
31	Frasr Erly	SUMR CHIN	021625	78	1	790613	790624	122797	1125	0		123922	S-SHUSWAP R LOWER	
31	Frasr Erly	SUMR CHIN	021638	78	1	790621	790624	18705	118	0		18823	S-SHUSWAP R LOWER	
31	Frasr Erly	SUMR CHIN	021658	78	1	790705	790716	149523	2492	0		152015	S-CHILKO RIVER	
31	Frasr Erly	SUMR CHIN	021755	79	1		800610	12402	283	0		12685	S-SHUSWAP R LOWER	
31	Frasr Erly	SUMR CHIN	024247	86	1	870507	870508	25256	255	153506		179017	S-CLEARWATER R UP/TO	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024248	86	1	870527	870528	24910	470	153540		178920	S-CLEARWATER R UP/TO	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024249	86	1	870623	870624	25507	159	146313		171979	S-CLEARWATER R UP/TO	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024250	86	1	870722	870724	25687	355	147808		173850	S-CLEARWATER R UP/TO	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024316	86	1	870521	870523	51771	347	499882		552000	S-SHUSWAP R LOW	H-SHUSWAP R
31	Frasr Erly	SUMR CHIN	024521	86	1	870502	870503	25292	255	117360		142907	S-CLEARWATER R LW/BC	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024522	86	1	870519	870520	24877	466	114593		139936	S-CLEARWATER R LW/BC	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024523	86	1	870620	870621	26091	0	115935		142026	S-CLEARWATER R LW/BC	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024524	86	1	870721	870722	25302	288	117250		142840	S-CLEARWATER R LW/BC	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024525	86	1	870414	870416	24846	486	96808		122140	S-FINN CREEK	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024526	86	1	870513	870514	25338	122	101470		126930	S-FINN CREEK	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024527	86	1	870421	870424	25558	330	216492		242380	S-FINN CREEK	H-CLEARWATER R UP/TO
31	Frasr Erly	SUMR CHIN	024528	86	1	870415	870421	25942	262	1912		28116	S-DEADMAN R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024529	86	1	870415	870421	26455	267	1949		28671	S-DEADMAN R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024530	86	1	870415	870421	26197	265	1931		28393	S-DEADMAN R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024531	86	1		870402	25988	262	0		26250	S-BONAPARTE R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024532	86	1		870402	26730	270	0		27000	S-BONAPARTE R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024533	86	1		870402	25443	257	0		25700	S-BONAPARTE R	H-SPIUS CR
31	Frasr Erly	SUMR CHIN	024534	86	1		870409	26009	0	271591		297600	S-SHUSWAP R. MIDDLE	H-SHUSWAP R
31	Frasr Erly	SUMR CHIN	024535	86	1	870520	870522	26505	272	286523		313300	S-SHUSWAP R. MIDDLE	H-SHUSWAP R

31	Frasr ErlySUMR CHIN	024536	86	1	870505	870506	25743	164	86017		111924	S-THOMPSON R N		H-CLEARWATER R UP/TO
31	Frasr ErlySUMR CHIN	024537	86	1	870505	870506	25182	253	84142		109577	S-THOMPSON R N		H-CLEARWATER R UP/TO
31	Frasr ErlySUMR CHIN	024538	86	1	870505	870506	25434	0	84985		110419	S-THOMPSON R N		H-CLEARWATER R UP/TO
31	Frasr ErlySUMR CHIN	024562	86	1	870908	870915	30322	618	10684		41624	S-NICOLA R		H-SPIUS CR
31	Frasr ErlySUMR CHIN	024563	86	1	870908	870915	20913	426	7368		28707	S-NICOLA R		H-SPIUS CR
31	Frasr ErlySUMR CHIN	024601	86	1	870908	870915	25400	520	8949		34869	S-NICOLA R		H-SPIUS CR
31	Frasr ErlySUMR CHIN	024607	86	1	870403	870506	50787	513	75220		126520	S-COLDWATER RIVER		H-SPIUS CR
31	Frasr ErlySUMR CHIN	024610	86	1	870427	870429	49392	500	512008		561900	S-SHUSWAP R LOW		H-SHUSWAP R
31	Frasr ErlySUMR CHIN	024705	86	1	870918	870923	25565	1261	8793		35619	S-BONAPARTE R		H-SPIUS CR
31	Frasr ErlySUMR CHIN	024706	86	1	870918	870923	25697	795	8839		35331	S-BONAPARTE R		H-SPIUS CR
31	Frasr ErlySUMR CHIN	021717	84	1	850415	850507	102737	0	62171		164908	S-STUART R		H-FORT ST JAMES
32	Lwr Geo S FALL CHIN	021612	78	1		790604	72216	3205	559143		634564	S-BIG QUALICUM RIVER		H-BIG QUALICUM RIVER
32	Lwr Geo S FALL CHIN	021613	78	1		790604	73545	1654	696416		771615	S-BIG QUALICUM RIVER		H-BIG QUALICUM RIVER
32	Lwr Geo S FALL CHIN	021639	77	1		780604	56225	4213	113236		173674	S-CAPILANO RIVER		H-CAPILANO RIVER
32	Lwr Geo S FALL CHIN	021642	77	1		780620	72735	3205	401869		477809	S-CAPILANO RIVER		H-CAPILANO RIVER
32	Lwr Geo S FALL CHIN	021656	78	1		790604	74952	834	1072125		1147911	S-BIG QUALICUM RIVER		H-BIG QUALICUM RIVER
32	Lwr Geo S FALL CHIN	021726	77	1		780602	77775	1663	1595825		1675263	S-BIG QUALICUM RIVER		H-BIG QUALICUM RIVER
32	Lwr Geo S FALL CHIN	021727	77	1		780602	79317	399	1051346		1131062	S-BIG QUALICUM RIVER		H-BIG QUALICUM RIVER
32	Lwr Geo S FALL CHIN	021728	78	1		790607	82938	559	107266		190763	S-BIG QUALICUM RIVER		H-CAPILANO RIVER
32	Lwr Geo S FALL CHIN	021729	78	1		790511	84394	535	56360		141289	S-CAPILANO RIVER		H-CAPILANO RIVER
32	Lwr Geo S FALL CHIN	021730	78	1		790511	82723	524	55244		138491	S-CAPILANO RIVER		H-CAPILANO RIVER
33	Whte SprY SPRG CHIN	212263	91	2	930412	930412	55203	558		9.06	55761	WHITE R	10.0031	WHITE RIVER HATCHERY
33	Whte SprY SPRG CHIN	212048	92	2	940413	940419	71834	1392		13.09	73226	WHITE R	10.0031	WHITE RIVER HATCHERY
33	Whte SprY SPRG CHIN	212509	93	2	940601	950421	48971	2765	830		52566	WHITE R	10.0031	WHITE RIVER HATCHERY

4.2 Sample FRAMBUILDER output

```
                      ***********************************
                      *    FRAMBUILDER - Coded Wire     *
                      *    Tag Summarization Program    *
                      *     Version 0.2 for Windows     *
                      *                                 *
                      *     Washington Department of    *
                      *         Fish & Wildlife         *
                      *      600 Capitol Way North      *
                      *  Olympia, Washington 98501-1091 *
                      ***********************************

                                 July 22, 2005


Session began at 16:42

 *********************************************************
 * Selected option to summarize CWT recovery data        *
 *********************************************************

 * Summary format: Generate Input for FRAM Chinook Index Model
 * Description name: Hood Canal Fingerling Base05
 * Description code:    16
 * Selected option to apply age-specific PEF's from release database
 * Selected option to split catches between Treaty & Non-Treaty fisheries based on year-specific proportions
 * Selected option to backshift annual age of winter recoveries
 * Selected option to summarize data by calendar month
 * Selected option to delete actual WCVI sport recoveries
 * Selected option to delete actual Alaska sport recoveries
 * Selected option to generate WCVI sport catch from troll catch (recoveries)
 * Selected option to generate Alaska sport catch from troll catch (recoveries)
 * Summary Tables Located in File: C:\Data\05calib\FRAM05test.mdb
   [File Date Unknown or Unavailable]
 * CWT Recovery Table: tblFRAMcwtrecoveries2005
   [File Date Unknown or Unavailable]
 * CWT Release Table: tblFRAMcwtreleases2005
   [File Date Unknown or Unavailable]
 * Recovery Location Code Table: tblRMISlocations2005
   [File Date Unknown or Unavailable]

Translation Tables:
 * Areas Table: AREAS
```

[File Date Unknown or Unavailable]
* Gears Table: GEARS
  [File Date Unknown or Unavailable]
* Fisheries Table: FISHERIES
  [File Date Unknown or Unavailable]
* Link Table: LINKS
  [File Date Unknown or Unavailable]

* The following tags were specified:

Agcy	Tag	By	Race & Species	Stock	Hatchery	Tagged	Shed Tag	Untagged	Release Weight(gm)
COOP	631752	1978	Fall Chin	GEORGE ADAMS (PURDY)	PURDY CR 16.0005	37439	0	147624	4.00
WDFW	631915	1978	Fall Chin	FINCH CR 16.0222	FINCH CR 16.0222	34300	0	752200	5.00
COOP	632041	1979	Fall Chin	S PUGET SOUND STOCKS	PURDY CR 16.0005	73387	0	1512620	3.00
WDFW	632109	1979	Fall Chin	FINCH CR 16.0222	FINCH CR 16.0222	48954	0	669899	3.00

* The following weights by age were specified for each tag:

Tag	Age 2	Age 3	Age 4	Age 5
631752	1.0000	1.0000	1.0000	1.0000
631915	1.0000	1.0000	1.0000	1.0000
632041	3.2879	3.2879	3.2879	3.2879
632109	3.2879	3.2879	3.2879	3.2879

```
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.383000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.399000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.399000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.399000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.383000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.475000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  5 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.447000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  5 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.407000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  4 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 0.740000
WARNING: Invalid catch (recovery estimate):   0.00; tag: 631915; recovery date 19810817; recovery location 5M22203  O3     10;
fishery/gear 10; sample type: 5
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 0.464000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 0.482000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.383000
NOTE:  Deleted Actual WCVI Sport Catch: Age/Index =  6  Area =    6 User =  2 Gear =  95 Time =   3 Catch = 4.500000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    5 User =  2 Gear =  95 Time =   3 Catch = 1.071000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.416000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.355000
NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.355000
```

```
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index = 12 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 0.913000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    5 User =  2 Gear =  95 Time =   3 Catch = 0.574000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    5 User =  2 Gear =  95 Time =   2 Catch = 0.406000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    5 User =  2 Gear =  95 Time =   2 Catch = 0.212000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    5 User =  2 Gear =  95 Time =   2 Catch = 0.439000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.395000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.355000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.426000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  4 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 0.777000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.030000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.030000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.416000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  7 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 0.382000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  7 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 0.382000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.355000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 0.613000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  5 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.493000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  5 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 0.447000
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  7 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 1.696556
 WARNING: Invalid catch (recovery estimate):   0.00; tag: 632041; recovery date 19820821; recovery location 2MS45           000;
fishery/gear 23; sample type: 5
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index = 11 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 1.903694
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 2.278515
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 2.140423
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 1.657102
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 2.656623
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  7 Area =    6 User =  2 Gear =  95 Time =   1 Catch = 1.318448
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 4.619500
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  5 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 1.400645
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index = 12 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 1.472979
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  9 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 2.906504
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 2.656623
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 2.656623
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  8 Area =    6 User =  2 Gear =  95 Time =   2 Catch = 2.130559
 NOTE:  Duplicated WCVI Troll as WCVI Sport: Age/Index =  6 Area =    6 User =  2 Gear =  95 Time =   3 Catch = 2.955822

 Records extracted from database tblFRAMcwtrecoveries2005: 735
 Records used in constructing summary: 732
 Fabricated records used in summary:   49
NOTE: Numeric items on summary line:
 WDFW species code, stock (or summary code), age index,  fishery code, time period, catch/escapement

*CATCH  Hood Canal FIngerling Base05  CHINOOK
1    16   2   5   2      5.54  May-Jun  West Coast Vancouver Island Net
1    16   2  56   2      3.72  May-Jun  Seattle (10) Sport
1    16   3   4   3      2.55  Jul-Sep  North/Central British Columbia Net
1    16   3   6   3      1.90  Jul-Sep  Georgia/Fraser/Johnstone Net
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1	16	3	7	3	33.59	Jul-Sep	Canadian Juan de Fuca Net
1	16	3	15	3	12.45	Jul-Sep	Canadian Juan de Fuca Sport
1	16	3	33	3	2.84	Jul-Sep	Horse Mountain - Orford Reef Sport
1	16	3	40	3	1.18	Jul-Sep	Nooksack-Samish (7B, 7C, 7D) Net [T]
1	16	3	39	3	0.57	Jul-Sep	Nooksack-Samish (7B, 7C, 7D) Net [NT]
1	16	3	42	3	3.29	Jul-Sep	Strait of Juan de Fuca (5 & 6) Sport
1	16	3	45	3	6.05	Jul-Sep	Skagit (8-1) Sport
1	16	3	53	3	24.80	Jul-Sep	Discovery-Admiralty (9) Sport
1	16	3	56	3	22.92	Jul-Sep	Seattle (10) Sport
1	16	3	64	3	9.49	Jul-Sep	Hood Canal (12) Sport
1	16	3	66	3	40.48	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	3	67	3	6.92	Jul-Sep	South Sound (13) Sport
1	16	3	71	3	10.32	Jul-Sep	Carr Inlet (13A) Net [T]
1	16	3	74	3	62.89	Jul-Sep	Escapement
1	16	4	10	1	15.17	Oct-Apr	West Coast Vancouver Island Troll
1	16	4	11	1	1.52	Oct-Apr	West Coast Vancouver Island Sport
1	16	4	13	1	9.22	Oct-Apr	North Georgia St. Sport
1	16	4	14	1	29.93	Oct-Apr	South Georgia St. Sport
1	16	4	15	1	25.44	Oct-Apr	Canadian Juan de Fuca Sport
1	16	4	17	1	11.64	Oct-Apr	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	4	36	1	43.43	Oct-Apr	San Juans (7) Sport
1	16	4	42	1	12.05	Oct-Apr	Strait of Juan de Fuca (5 & 6) Sport
1	16	4	45	1	20.17	Oct-Apr	Skagit (8-1) Sport
1	16	4	47	1	0.21	Oct-Apr	Skagit (8) Net [T]
1	16	4	46	1	1.65	Oct-Apr	Skagit (8) Net [NT]
1	16	4	53	1	42.42	Oct-Apr	Discovery-Admiralty (9) Sport
1	16	4	55	1	42.18	Oct-Apr	Discovery-Admiralty (6B, 9) Net [T]
1	16	4	54	1	2.66	Oct-Apr	Discovery-Admiralty (6B, 9) Net [NT]
1	16	4	56	1	68.04	Oct-Apr	Seattle (10) Sport
1	16	4	57	1	50.71	Oct-Apr	Tacoma (11) Sport
1	16	4	59	1	1.34	Oct-Apr	Central Sound (10, 11) Net [T]
1	16	4	58	1	10.14	Oct-Apr	Central Sound (10, 11) Net [NT]
1	16	4	64	1	120.41	Oct-Apr	Hood Canal (12) Sport
1	16	4	66	1	2.22	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	4	65	1	1.53	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [NT]
1	16	4	67	1	37.60	Oct-Apr	South Sound (13) Sport
1	16	5	5	2	30.37	May-Jun	West Coast Vancouver Island Net
1	16	5	10	2	31.95	May-Jun	West Coast Vancouver Island Troll
1	16	5	11	2	3.19	May-Jun	West Coast Vancouver Island Sport
1	16	5	12	2	15.07	May-Jun	Georgia/Juan de Fuca/Johnstone Troll
1	16	5	15	2	6.00	May-Jun	Canadian Juan de Fuca Sport
1	16	5	17	2	0.51	May-Jun	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	5	16	2	1.96	May-Jun	Cape Flattery-Quillayute (3, 4, 4B) Troll [NT]
1	16	5	22	2	3.08	May-Jun	Grays Harbor Sport
1	16	5	42	2	4.87	May-Jun	Strait of Juan de Fuca (5 & 6) Sport
1	16	5	44	2	4.29	May-Jun	Str. Juan de Fuca (4B, 5, 6, 6C, 6D) Net [T]
1	16	5	45	2	7.95	May-Jun	Skagit (8-1) Sport

1	16	5	53	2	3.04	May-Jun	Discovery-Admiralty (9) Sport
1	16	5	57	2	2.72	May-Jun	Tacoma (11) Sport
1	16	5	64	2	9.99	May-Jun	Hood Canal (12) Sport
1	16	5	67	2	3.34	May-Jun	South Sound (13) Sport
1	16	6	4	3	11.47	Jul-Sep	North/Central British Columbia Net
1	16	6	5	3	8.97	Jul-Sep	West Coast Vancouver Island Net
1	16	6	9	3	15.39	Jul-Sep	North/Central British Columbia Troll
1	16	6	10	3	129.98	Jul-Sep	West Coast Vancouver Island Troll
1	16	6	11	3	13.00	Jul-Sep	West Coast Vancouver Island Sport
1	16	6	14	3	10.54	Jul-Sep	South Georgia St. Sport
1	16	6	17	3	2.48	Jul-Sep	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	6	16	3	11.14	Jul-Sep	Cape Flattery-Quillayute (3, 4, 4B) Troll [NT]
1	16	6	22	3	15.45	Jul-Sep	Grays Harbor Sport
1	16	6	30	3	3.40	Jul-Sep	Orford Reef - Cape Falcon Troll
1	16	6	36	3	13.30	Jul-Sep	San Juans (7) Sport
1	16	6	38	3	6.36	Jul-Sep	San Juans (7, 7A, 6A) Net [T]
1	16	6	37	3	20.84	Jul-Sep	San Juans (7, 7A, 6A) Net [NT]
1	16	6	42	3	27.16	Jul-Sep	Strait of Juan de Fuca (5 & 6) Sport
1	16	6	44	3	21.25	Jul-Sep	Str. Juan de Fuca (4B, 5, 6, 6C, 6D) Net [T]
1	16	6	43	3	6.07	Jul-Sep	Str. Juan de Fuca (4B, 5, 6, 6C, 6D) Net [NT]
1	16	6	53	3	47.64	Jul-Sep	Discovery-Admiralty (9) Sport
1	16	6	64	3	9.23	Jul-Sep	Hood Canal (12) Sport
1	16	6	66	3	148.32	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	6	69	3	7.65	Jul-Sep	South Sound (13, 13B-13K) Net [T]
1	16	6	71	3	3.82	Jul-Sep	Carr Inlet (13A) Net [T]
1	16	6	73	3	73.48	Jul-Sep	Freshwater net
1	16	6	74	3	90.20	Jul-Sep	Escapement
1	16	7	9	1	3.52	Oct-Apr	North/Central British Columbia Troll
1	16	7	10	1	37.79	Oct-Apr	West Coast Vancouver Island Troll
1	16	7	11	1	3.78	Oct-Apr	West Coast Vancouver Island Sport
1	16	7	15	1	11.19	Oct-Apr	Canadian Juan de Fuca Sport
1	16	7	17	1	9.84	Oct-Apr	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	7	36	1	13.21	Oct-Apr	San Juans (7) Sport
1	16	7	42	1	37.36	Oct-Apr	Strait of Juan de Fuca (5 & 6) Sport
1	16	7	53	1	13.04	Oct-Apr	Discovery-Admiralty (9) Sport
1	16	7	57	1	16.47	Oct-Apr	Tacoma (11) Sport
1	16	7	64	1	34.30	Oct-Apr	Hood Canal (12) Sport
1	16	7	66	1	11.72	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	7	65	1	14.95	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [NT]
1	16	7	67	1	16.04	Oct-Apr	South Sound (13) Sport
1	16	7	74	1	43.01	Oct-Apr	Escapement
1	16	8	9	2	16.70	May-Jun	North/Central British Columbia Troll
1	16	8	10	2	191.77	May-Jun	West Coast Vancouver Island Troll
1	16	8	11	2	19.18	May-Jun	West Coast Vancouver Island Sport
1	16	8	17	2	1.39	May-Jun	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	8	16	2	1.88	May-Jun	Cape Flattery-Quillayute (3, 4, 4B) Troll [NT]
1	16	8	18	2	5.00	May-Jun	Cape Flattery-Quillayute (3, 4) Sport

1	16	8	26	2	1.22	May-Jun	Columbia River Mouth Troll [NT]
1	16	8	42	2	25.35	May-Jun	Strait of Juan de Fuca (5 & 6) Sport
1	16	8	53	2	10.88	May-Jun	Discovery-Admiralty (9) Sport
1	16	9	10	3	106.99	Jul-Sep	West Coast Vancouver Island Troll
1	16	9	11	3	10.70	Jul-Sep	West Coast Vancouver Island Sport
1	16	9	15	3	27.20	Jul-Sep	Canadian Juan de Fuca Sport
1	16	9	17	3	3.57	Jul-Sep	Cape Flattery-Quillayute (3, 4, 4B) Troll [T]
1	16	9	16	3	6.85	Jul-Sep	Cape Flattery-Quillayute (3, 4, 4B) Troll [NT]
1	16	9	42	3	3.81	Jul-Sep	Strait of Juan de Fuca (5 & 6) Sport
1	16	9	44	3	67.90	Jul-Sep	Str. Juan de Fuca (4B, 5, 6, 6C, 6D) Net [T]
1	16	9	43	3	17.55	Jul-Sep	Str. Juan de Fuca (4B, 5, 6, 6C, 6D) Net [NT]
1	16	9	50	3	6.16	Jul-Sep	Stilly-Snohomish (8) Net [T]
1	16	9	49	3	1.11	Jul-Sep	Stilly-Snohomish (8) Net [NT]
1	16	9	53	3	17.20	Jul-Sep	Discovery-Admiralty (9) Sport
1	16	9	66	3	153.14	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	9	65	3	5.00	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [NT]
1	16	9	69	3	4.23	Jul-Sep	South Sound (13, 13B-13K) Net [T]
1	16	9	71	3	22.97	Jul-Sep	Carr Inlet (13A) Net [T]
1	16	9	73	3	105.34	Jul-Sep	Freshwater net
1	16	9	74	3	87.42	Jul-Sep	Escapement
1	16	10	66	1	1.19	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	10	65	1	6.05	Oct-Apr	Hood Canal (12, 12B, 12C, 12D) Net [NT]
1	16	10	74	1	83.46	Oct-Apr	Escapement
1	16	11	10	2	19.04	May-Jun	West Coast Vancouver Island Troll
1	16	11	11	2	1.90	May-Jun	West Coast Vancouver Island Sport
1	16	12	10	3	23.86	Jul-Sep	West Coast Vancouver Island Troll
1	16	12	11	3	2.39	Jul-Sep	West Coast Vancouver Island Sport
1	16	12	42	3	7.91	Jul-Sep	Strait of Juan de Fuca (5 & 6) Sport
1	16	12	66	3	6.78	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [T]
1	16	12	65	3	1.39	Jul-Sep	Hood Canal (12, 12B, 12C, 12D) Net [NT]
1	16	12	73	3	60.86	Jul-Sep	Freshwater net
1	16	12	74	3	12.36	Jul-Sep	Escapement

*END Hood Canal FIngerling Base05 CHINOOK

4.3 FRAM Chinook Stock Profiles

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	1. Nooksack/Samish fall fingerling (NkSm F1Fi)
MANAGEMENT UNITS REPRESENTED:	Natural fall chinook production from Nooksack R., Samish R. and Area 7-7A streams. Hatchery production from Nooksack, Samish, and Skookum Creek hatcheries and Lummi Tribe Sea Ponds.
CALIBRATION CWT GROUPS:	050324 Skookum Creek Hatchery (1977 brd) 050325 Skookum Creek Hatchery (1977 brd) 050726 Skookum Creek Hatchery (1979 lid) 050727 Lummi Sea Ponds (1979 brd) 632042 Samish Hatchery (1979 brd) 632101 Samish Hatchery (1979 brd) 632102 Samish Hatchery (1979 brd)
VALIDATION CWT BROODS	1974-75, 1985-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement in Nooksack/Samish/Area 7-7A streams. Freshwater net Marine net in Area 7B,C for Samish and Nooksack, Area 7B,C,D for Lummi
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement in Nooksack/Samish/Area 7-7A streams Freshwater net Marine net in Area 7C for Samish and Nooksack, Area 7C,D for Lummi Base Period Escapement=20224
SCALE DATA ORIGIN:	Nooksack River net Marine Area 7B,C,D net
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW Escapement Records (jacks) WDFW Hatchery Release Reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	3. North Fork Nooksack Native early (NFNK Sprg)
MANAGEMENT UNITS REPRESENTED:	North Fork Nooksack River springs
CALIBRATION CWT GROUPS:	632846 Nooksack Hatchery (1984 brd, NFK, fing.) 633452 Nooksack Hatchery (1984 brd, NFK, year.) 633453 Nooksack Hatchery (1984 brd, NFK, year.) 634422 Nooksack Hatchery (1988 brd, NFK, year.)
VALIDATION CWT GROUPS	Do not use 1991
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=500
SCALE DATA ORIGIN:	1??
SUPPLEMENTAL DATA SOURCES:	Puget Sound Spring Chinook Status Reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	5. South Fork Nooksack early (SFNK Sprg)
MANAGEMENT UNITS REPRESENTED:	South Fork Nooksack River springs
CALIBRATION CWT GROUPS:	632846 Nooksack Hatchery (1984 brd, NFK, fing.) 633452 Nooksack Hatchery (1984 brd, NFK, year.) 633453 Nooksack Hatchery (1984 brd, NFK, year.) 634422 Nooksack Hatchery (1988 brd, NFK, year.)
VALIDATION CWT GROUPS	Do not use 1991
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=500
SCALE DATA ORIGIN:	1??
SUPPLEMENTAL DATA SOURCES:	Puget Sound Spring Chinook Status Reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	7. Skagit summer/fall fingerling (Skag F1Fi)
MANAGEMENT UNITS REPRESENTED:	Wild production from Skagit River including upper Skagit summers, lower Sauk summers, and lower Skagit falls Marblemount (Skagit) Hatchery
CALIBRATION CWT GROUPS:	631606 Skagit Hatchery (1976 brd brd) 631624 Skagit R. (wild, 1976 brd) 631625 Skagit R. (wild, 1976 brd) 631626 Skagit R. (wild, 1976 brd) 631627 Skagit R. (wild, 1976 brd) 631628 Skagit R. (wild, 1976 brd) 631629 Skagit R. (wild, 1976 brd) 631630 Skagit R. (wild, 1977 brd) 631631 Skagit R. (wild, 1977 brd) 631632 Skagit R. (wild, 1977 brd) 631633 Skagit R. (wild, 1977 brd) 631635 Skagit R. (wild, 1977 brd) 631636 Skagit R. (wild, 1977 brd)
VALIDATION CWT GROUPS	1974, 1975, 1978-81
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net Marine Area 8 net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=10443
SCALE DATA ORIGIN:	Freshwater net Marine Area 8 net
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks) WDFW hatchery release reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	9. Skagit summer/fall yearling (Skag FlYr)
MANAGEMENT UNITS REPRESENTED:	Hatchery production from Skagit River Marblemount (Skagit) Hatchery
CALIBRATION CWT GROUPS:	631610 Skagit Hatchery (1976 brd)
VALIDATION CWT GROUPS	None
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from So. PS summer/fall yearling CWT groups)	Mean $FL_{mixmature}$ =802.6*(1-e**(-0.051(t-9.57)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =1460.9*(1-e**(-0.018(t-5.42)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net Marine Area 8 net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=2105
SCALE DATA ORIGIN:	Freshwater net Marine Area 8 net
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records WDFW hatchery release reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	11. Skagit spring yearling (Skag SpYr)
MANAGEMENT UNITS REPRESENTED:	Skagit River wild Marblemount (Skagit) Hatchery Spring
CALIBRATION CWT GROUPS:	633323 Skagit Hatchery (1985 brd) 633314 Skagit Hatchery (1986 brd) 634744 Skagit Hatchery (1987 brd) 634902 Skagit Hatchery (1987 brd) 635026 Skagit Hatchery (1987 brd)
VALIDATION CWT GROUPS	1981-90 brd
Von Bertalanffy Growth Function Mean Fork Length(cm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (From Skagit H CWT group)	Mean $FL_{mixmature}$ =904.0*(1-e**(-0.043(t-9.54)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =938.6*(1-e**(-0.048(t-11.31)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Area 8 net Freshwater net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=1391
SCALE DATA ORIGIN:	???
SUPPLEMENTAL DATA SOURCES:	Puget Sound Spring Chinook Status Reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	13. Snohomish summer/fall fingerling (Snoh FlFi)
MANAGEMENT UNITS REPRESENTED:	Wild production from Snohomish River system Wallace R. Hatchery fingerlings
CALIBRATION CWT GROUPS:	For preterm.: 212221 Stillaguamish H. (1986 brd), 212555 Still. H. (1987 brd) 213147 Still. H. (1988 brd) For terminal H.R.: 212204 Tulalip H (1986 brd) 212544 Tulalip H.(1987 brd) 213141 Tulalip H.(1988 brd)
VALIDATION CWT GROUPS	None
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net Marine Area 8A net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement Freshwater net Base Period Escapement=4814
SCALE DATA ORIGIN:	Marine Area 8A net for fingerling age composition
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks) WDFW hatchery release reports for basin yearling vs fingerling poundage percentage for ETRS breakdown

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	15. Snohomish summer/fall yearling (Snoh FlYr)
MANAGEMENT UNITS REPRESENTED:	Wild summer/fall yearling production from Snohomish Wallace R. Hatchery yearlings
CALIBRATION CWT GROUPS:	631701 Wallace R. (Skykomish) Hatchery Summer chinook (1976 brd)
VALIDATION CWT GROUPS	None
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from So. PS summer/fall yearling CWT groups)	Mean $FL_{mixmature}$ =802.6*(1-e**(-0.051(t-9.57)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =1460.9*(1-e**(-0.051(t-5.42)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net Marine Area 8A net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement Freshwater net Base Period Escapement=3352
SCALE DATA ORIGIN:	Marine Area 8A net for yearling age composition
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks) WDFW hatchery release reports for basin yearling vs fingerling poundage percentage for ETRS breakdown

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	17. Stillaguamish summer/fall fingerling (Stil F1Fi)
MANAGEMENT UNITS REPRESENTED:	Wild and supplementation production in Stillaguamish River
CALIBRATION CWT GROUPS:	212221 Stillaguamish H. (1986 brd) 212555 Stillaguamish H. (1987 brd) 213147 Stillaguamish H. (1988 brd)
VALIDATION CWT GROUPS	1980-83, 1986-91
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement (0) Freshwater net Marine Area 8A
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement (0) Freshwater net Base Period Escapement=831
SCALE DATA ORIGIN:	Marine Area 8A?
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	19. Tulalip summer/fall fingerling (Tula FlFi)
MANAGEMENT UNITS REPRESENTED:	Tulalip Hatchery
CALIBRATION CWT GROUPS:	212204 Tulalip H. (1986 brd) 212544 Tulalip H. (1987 brd) 213141 Tulalip H. (1988 brd)
VALIDATION CWT GROUPS	1986-91
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Marine Area 8D net Marine Area 8A net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement Marine Area 8D net Base Period Escapement=1
SCALE DATA ORIGIN:	Marine Area 8D
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	21. Mid Puget Sound fall fingerling (MiPS FlFi)
MANAGEMENT UNITS REPRESENTED:	Natural production from Lake Washington, Green-Duwamish Rivers, Puyallup River, Misc. Area 10 streams (Seattle area), Misc. Area 10E streams (Port Orchard) Hatchery production from Issaquah, Soos Creek (Green River), Voights Creek (Puyallup), Crisp Creek, Grovers, Icy Creek facilities
CALIBRATION CWT GROUPS:	631814 Voights Creek (1978 brd) 631842 Voights Creek (1978 brd) 631935 Soos Creek (1978 brd) 631936 Soos Creek (1978 brd) 631940 Issaquah (1978 brd) 631945 Soos Creek (1978 brd) 631943 Issaquah (1979 brd) 631944 Soos Creek (1979 brd) 632020 Voights Creek (1979 brd)
VALIDATION CWT GROUPS	1974-75, 1978-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement in Lake Washington, Green-Duwamish River, Puyallup River and Area 10, 10E streams Freshwater net in Green-Duwamish, Puyallup rivers Marine net fisheries for stocks destined for Lake Washington (Area 10, 10B,C,D); Green Duwamish (Area 10, 10A); Puyallup (Area 10, 11, 11A); Misc. Area 10 streams (Area 10); Misc Area 10E streams (Area 10, 10E)
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement in Lake Washington, Green-Duwamish River, Puyallup River and Area 10, 10E streams Freshwater net in Green-Duwamish, Puyallup rivers Marine net fisheries for stocks destined for Lake Washington (Area 10B,C,D); Green Duwamish (Area 10A); Puyallup (Area 11A); Misc Area 10E streams (Area 10E) Base Period Escapement=20018

SCALE DATA ORIGIN:	Net fisheries for Lake Washington (Area 10B,C,D,F); Green-Duwamish (Area 10A and river); Puyallup (Area 11A and river); Misc. 10 streams (Area 10A and Green); Misc. 10E streams (Area 10E)
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	23. UW Accelerated fall fingerling (UWAc F1Fi)
MANAGEMENT UNITS REPRESENTED:	Accelerated fingerling production from University of Washington Hatchery
CALIBRATION CWT GROUPS:	111601-02 UW Portage Bay (1977 brd) 111603-06 UW Portage Bay (1978 brd) 111617-18 UW Portage Bay (1978 brd) 111624 UW Portage Bay (1978) 111627-32 UW Portage Bay (1979)
VALIDATION CWT GROUPS	1980-84
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from UW for mixed maturity; So. PS summer/fall yearling for mature)	Mean $FL_{mixmature}$ =889.6*(1-e**(-0.039(t-1.96)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =1460.9*(1-e**(-0.018(t-5.42)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Hatchery escapement
ACCOUNTED IN. EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=1062
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	University of Washington

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	25. South Puget Sound fall fingerling (SPSo FlFi)
MANAGEMENT UNITS REPRESENTED:	Wild production in deep south Puget sound tributaries including Nisqually and Deschutes Rivers, Minter Creek, and Misc Area 13 streams Hatchery production from Minter Creek, Hupp Springs, Coulter Creek, Kalama Creek, Garrison Springs (Chambers Creek), Fox Island Net Pens, South Sound Net Pens, Allison Springs, McAllister Creek facilities
CALIBRATION CWT GROUPS:	631907 Minter Creek Hatchery (1978) 050722 Kalama Creek Hatchery (1979) 631903 Garrison Springs Hatchery (1979) 632063 Coulter Creek Hatchery (1979) 632103 Deschutes Hatchery (1979) 632104 Minter Creek Hatchery (1979)
VALIDATION CWT GROUPS	1974-75, 1978, 1980-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement in Nisqually, Deschutes rivers, Chambers Creek, and Misc. Area 13, 13A Carr Inlet/Minter Creek, 13B streams Freshwater net Marine net fisheries for stocks destined for Nisqually River (Area 10, 11, 13); Deschutes River (Area 10, 11, 13, 13B); Chambers Creek (Area 10, 11, 13); Misc. Area 13 streams (Area 10, 11, 13); Misc 13A streams (Area 10, 11, 13, 13A); Misc. 13B streams (Area 10, 11, 13, 13B)

ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement in Nisqually, Deschutes rivers, Chambers Creek, and Misc. Area 13, 13A Carr Inlet/Minter Creek, 13B streams Freshwater net Marine net fisheries for stocks destined for Nisqually River (none); Deschutes River (Area 13B); Chambers Creek (none); Misc. Area 13 streams (none); Misc. 13A streams (Area 13A); Misc. 13B streams (Area 13B) Base Period Escapement=10230
SCALE DATA ORIGIN:	Nisqually River net and Marine net fisheries in Area 13/13B and Area 13C-K
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	27. South Puget Sound fall yearling (SPSo FlYr)
MANAGEMENT UNITS REPRESENTED:	Fall yearling portion of hatchery chinook in Mid- and South Puget Sound
CALIBRATION CWT GROUPS:	631853 Fox Island Net Pens (1978) 631905 Green River Hatchery (1978) 632004 Deschutes Hatchery (1978) 632023 Allison Springs Hatchery (1978) 632015 Deschutes Hatchery (1979) 632019 Deschutes Hatchery (1979) 632027 Fox Island Net Pens (1979) 632055-56 Coulter Creek Hatchery (1979) 632128 Crisp Creek Hatchery (1979) 632220 Hupp Springs Sp. Channel (1979) 632221 Allison Springs Hatchery (1979). 632228 Allison Springs Hatchery (1979)
VALIDATION CWT GROUPS	1974-75, 1980-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from So. PS summer/fall yearling CWT groups)	Mean $FL_{mixmature}$ =802.6*(1-e**(-0.051(t-9.57)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =1460.9*(1-e**(-0.018(t-5.42)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Run Reconstruction TR of Mid- and South Puget Sound chinook adjusted to yearlings leaving Marine Area 10 Base Period Escapement=330

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	29. White River spring fingerling (White SpFi
MANAGEMENT UNITS REPRESENTED:	South Puget Sound spring fingerling
CALIBRATION CWT GROUPS:	211659 White River Hatchery (91 brd) 212209 White River Hatchery (91 brd) 212245 White River Hatchery (91 brd) 212246 White River Hatchery (91 brd) 212321 White River Hatchery (92 brd) 212322 White River Hatchery (92 brd) 212462 White River Hatchery (93 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement to White River Hatchery or Buckley Trap Freshwater net Base Period Escapement=100
SCALE DATA ORIGIN:	Age composition from CWT survival rate applied to number released
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks) WDFW hatchery release reports

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	31. Hood Canal fall fingerling (HdCl FlFi)
MANAGEMENT UNITS REPRESENTED:	Wild production from Hood Canal region including Dosewallips, Duckabush, Hamma Hamma, Skokomish, Quilcene rivers and misc Area 12 streams Hatchery production from George Adams, Hood Canal (Hoodsport), Port Gamble Pens,
CALIBRATION CWT GROUPS:	631752 George Adams (1978) 631915 Hood Canal (1978) 632041 George Adams (1979) 632109 Hood Canal (1979)
VALIDATION CWT GROUPS	1974-75, 1980-81, 1985-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net (primarily Skokomish) Marine net fisheries for stocks destined for Dosewallip (Area 12, 12B), Duckabush (Area 12, 12B), Mamma Hamma (Area 12 12B), Skokomish (Area 12, 12B,C,D), South Hood Canal (Area 12, 12B,C), Southeast Hood Canal (Area 12, 12B,C,D), Hoodsport (Area 12, 12B,C,D), Port Gamble (Area 9A,12)
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement Freshwater net (primarily Skokomish) Marine net fisheries for stocks destined for Skokomish (Area 12D), Southeast Hood Canal (Area 12D), Hoodsport (Area 12D), Port Gamble (Area 9A) Base Period Escapement=4078

SCALE DATA ORIGIN:	Net fisheries in Skokomish R. and marine Area 12 B,C,D
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	33. Hood Canal fall yearling (HdCl FlYr)
MANAGEMENT UNITS REPRESENTED:	Fall yearlings from Hood Canal hatcheries
CALIBRATION CWT GROUPS:	631637 Hood Canal Hatchery (1978 brd) 631840 McKernan Hatchery (1978) 631852 McKernan Hatchery (1978) 632057 Hood Canal Hatchery (1979)
VALIDATION CWT GROUPS	1974, 1980-81, 1985-87, 1989-on
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from So. PS summer/fall yearling CWT groups)	Mean $FL_{mixmature}$ =802.6*(1-e**(-0.051(t-9.57)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =1460.9*(1-e**(-0.018(t-5.42)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Yearling portion of the following components determined from CWT rather than scales because of small sample sizes Natural and hatchery escapement 0 Freshwater net (primarily Skokomish) Marine net fisheries for stocks destined for Dosewallip (Area 12, 12B), Duckabush (Area 12, 12B), Hamma Hamma (Area 12 12B), Skokomish (Area 12, 12B,C,D), South Hood Canal (Area 12, 12B,C), Southeast Hood Canal (Area 12, 12B,C,D), Hoodsport (Area 12, 12B,C,D), Port Gamble (Area 9A,12)
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Natural and hatchery escapement Freshwater net (primarily Skokomish) Marine net fisheries for stocks destined for Skokomish (Area 12D), Southeast Hood Canal (Area 12D), Hoodsport (Area 12D), Port Gamble (Area 9A) Base Period Escapement=126
SCALE DATA ORIGIN:	Net fisheries in Skokomish R. and marine Area 12 B,C,D for age composition of yearlings CWTs used to apportion Hood Canal fall chinook into fingerling and yearling type

SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR) WDFW escapement records (jacks)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	35. Juan de Fuca Tribs Fall Fingerling (SJDF FlFi)
MANAGEMENT UNITS REPRESENTED:	Natural production from Hoko, Elwha, Dungeness and minor tributaries Hatchery production from Hoko, Elwha, Dungeness
CALIBRATION CWT GROUPS:	631919 Elwha Spawning Channel (78 brd) 632107 Elwha Spawning Channel (79 brd) 633038,633039 Elwha (83 brd) 633419,633420 Elwha (84 brd) 633543,633544 Elwha (85 brd)
VALIDATION CWT GROUPS	1985-87, 1989 on Hoko
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from generalized PS summer/fall fingerling CWT groups)	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.03 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater Net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=2365
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	Puget Sound Run Reconstruction (RR)

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	37. Oregon Hatchery Tule (OR LRH)
MANAGEMENT UNITS REPRESENTED:	Natural and hatchery fall chinook from Oregon tribs below Bonneville Dam
CALIBRATION CWT GROUPS:	071842 Bonneville Hatchery (78 brd) 072157 Bonneville Hatchery (79 brd) 072163 Oxbow Hatchery (79 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= $L_{max}*(1-e**(-k(t-t_0))$ where t= (Age-1)*12 + midpt. of time step (from OR and Spring Crk Tule CWT groups)	Mean $FL_{mixmature}$ =970.8*(1-e**(-0.038(t-2.60)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =912.8*(1-e**(-0.064(t-3.97)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=42000
SCALE DATA ORIGIN:	Columbia River Net, Sport, Escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	39. Washington Hatchery Tule (WA LRH)
MANAGEMENT UNITS REPRESENTED:	Natural and hatchery fall chinook from Washington tribs below Bonneville Dam
CALIBRATION CWT GROUPS:	631802 Cowlitz Salmon Hatchery (77 brd) 631942 Cowlitz Salmon Hatchery (78 brd) 632154 Cowlitz Salmon Hatchery (79 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from Cowlitz H CWT groups)	Mean $FL_{mixmature}$ =1182.9*(1-e**(-0.024(t-3.41)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1122.5*(1-e**(-0.020(t+5.80)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=33400
SCALE DATA ORIGIN:	Columbia River Net, Sport, Escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	41. Lower Columbia River Wild (Low CR wild)
MANAGEMENT UNITS REPRESENTED:	Natural "bright" fall chinook from Lewis River and small components in other Lower Columbia tribs (Cowlitz, Sandy)
CALIBRATION CWT GROUPS:	631611 Lewis River Hatchery (77 brd) 631618 Lewis River Wild (77 brd) 631619 Lewis River Wild (77 brd) 631813 Lewis River Hatchery (78 brd) 631858 Lewis River Wild (78 brd) 631859 Lewis River Wild (78 brd) 631902 Lewis River Wild (78 brd) 631920 Speelyai Hatchery (78 brd) 632002 Lewis River Wild (78 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= $L_{max}*(1-e**(-k(t-t_0))$ where t= (Age-1)*12 + midpt. of time step (from No. Lewis R wild fingerling CWT groups)	Mean $FL_{mixmature}$ =3412.3*(1-e**(-0.006(t-1.57)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1294.1*(1-e**(-0.013(t+10.29)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=14192
SCALE DATA ORIGIN:	Columbia River Net, Sport, Escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	43. Bonneville Pool Hatchery (BPH Tule)
MANAGEMENT UNITS REPRESENTED:	Tule type hatchery fall chinook from Spring Creek NFH and some past Klickitat Hatchery, White Salmon Rearing Pond and Little White Salmon NFH. Minor tule type natural production in Bonneville Pool tributataries (Wind, White Salmon, Klickitat R)
CALIBRATION CWT GROUPS:	050433 Spring Creek (78 brd) 050434 Spring Creek (78 brd) 050444 Spring Creek (78 brd) 050446 Spring Creek (78 brd) 050639 Spring Creek (79 brd) 050640 Spring Creek (79 brd) 050641 Spring Creek (79 brd) 050642 Spring Creek (79 brd) 054101 Spring Creek (76 brd) 054201 Spring Creek (76 brd) 054401 Spring Creek (76 brd) 054501 Spring Creek (76 brd) 054601 Spring Creek (76 brd) 055501 Spring Creek (77 brd) 055601 Spring Creek (77 brd) 055701 Spring Creek (77 brd) 056001 Spring Creek (77 brd) 056201 Spring Creek (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from OR and Spring Crk tule CWT groups	Mean $FL_{mixmature}$ =970.8*(1-e**(-0.038(t-2.60)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =912.9*(1-e**(-0.064(t-3.97)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=40367
SCALE DATA ORIGIN:	Columbia River Net, Sport, Escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	45. Columbia Upriver Summer (Upp CR Su)
MANAGEMENT UNITS REPRESENTED:	Natural summer chinook from mainstem and tributaries upstream of Priest Rapids Dam. Hatchery summer chinook from Wells Dam Hatchery, Rocky Reach Hatchery, and Eastbank Hatchery, Methow Hatchery, and Similkameen Rearing Pond supplementation facilities.
CALIBRATION CWT GROUPS:	631607 Wells Dam Sp Channel (76 brd) 631642 Wells Dam Sp Channel (76 brd) 631762 Wells Dam Sp Channel (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step (from No. Lewis R wild fingerling CWT groups)	Mean $FL_{mixmature}$ =3412.3*(1-e**(-0.006(t-1.57)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1294.1*(1-e**(-0.013(t+10.29)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=22205
SCALE DATA ORIGIN:	No data
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	47. Columbia Upriver Bright (Col R Brt)
MANAGEMENT UNITS REPRESENTED:	Natural fall chinook from Deschutes River, brights in Klickitat, White Salmon, and Wind rivers and Columbia main stem and tributaries upstream of McNary Dam, excluding Snake River. Hatchery bright fall chinook at Priest Rapids Hatchery (URB), Mid-Columbia Brights (MCB) at Ringold Rearing Pond, Irrigon Hatchery, Umatilla Hatchery and Bonneville Pool brights (BUB) at Bonneville Hatchery, Klickitat Hatchery, and Little White Salmon NFH.
CALIBRATION CWT GROUPS:	130713 Ringold Rearing Pond (75 brd) 131101 Priest Rapids (75 brd) 131202 Priest Rapids (75 brd) 631662 Priest Rapids (76 brd) 631741 Priest Rapids (77 brd) 631745 Ringold Rearing Pond (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1313.5*(1-e**(-0.023(t-3.17)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1069.4*(1-e**(-0.023(t+4.86)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=51025
SCALE DATA ORIGIN:	Columbia net, sport and escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	49. Washington lower river spring (WaLR Sprg)
MANAGEMENT UNITS REPRESENTED:	Natural spring chinook from Cowlitz, Kalama, and Lewis rivers. Hatchery spring chinook at Cowlitz, Kalama Falls, Lower Kalama, Lewis River, and Speelyai hatcheries.
CALIBRATION CWT GROUPS:	631817 Cowlitz (77 brd) 631818 Cowlitz (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =994.6*(1-e**(-0.046(t-11.36)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =922.0*(1-e**(-0.069(t-16.52)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=23720
SCALE DATA ORIGIN:	Columbia net, sport and escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	51. Willamette River spring (Will Sprg)
MANAGEMENT UNITS REPRESENTED:	Natural spring chinook from Willamette and Sandy rivers. Hatchery spring chinook at Marion Forks, Mckenzie, Willamette/Dexter Pond, S. Santiam, and Clackamas H.
CALIBRATION CWT GROUPS:	071737 Dexter Pond (77 brd) 071738 Willamette (77 brd) 071741 Dexter Pond (77 brd) 071742 Dexter Pond (77 brd) 071925 Willamette (78 brd) 072042 Willamette (78 brd) 072047 Willamette (78 brd) 072049 McKenzie (78 brd) 072050 McKenzie (78 brd) 091621 So. Santiam (76 brd) 091622 So. Santiam (76 brd) 091623 So. Santiam (76 brd) 091624 So. Santiam (76 brd) 091625 So. Santiam (76 brd) 091626 So. Santiam (76 brd) 091627 So. Santiam (76 brd) 091628 So. Santiam (76 brd) 091629 So. Santiam (76 brd) 091630 So. Santiam (76 brd) 091631 So. Santiam (76 brd) 091701 Marion Forks (76 brd) 091703 Marion Forks (76 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =994.6*(1-e**(-0.046(t-11.36)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =922.0*(1-e**(-0.069(t-16.52)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=37928
SCALE DATA ORIGIN:	Columbia net, sport and escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	53. Snake River fall chinook (SnakeR Fl)
MANAGEMENT UNITS REPRESENTED:	Natural fall chinook from Snake River and tributaries. Hatchery fall chinook at Lyons Ferry and Nez Perce Tribal hatcheries.
CALIBRATION CWT GROUPS:	633226 Lyons Ferry (84 brd) 633227 Lyons Ferry (84 brd) 633228 Lyons Ferry (84 brd) 633633 Lyons Ferry (85 brd) 633634 Lyons Ferry (85 brd) 633635 Lyons Ferry (85 brd) 633636 Lyons Ferry (85 brd) 633637 Lyons Ferry (85 brd) 633638 Lyons Ferry (85 brd) 633639 Lyons Ferry (85 brd) 633640 Lyons Ferry (85 brd) 633641 Lyons Ferry (85 brd) 633642 Lyons Ferry (85 brd) 634259 Lyons Ferry (86 brd) 634261 Lyons Ferry (86 brd) 634262 Lyons Ferry (86 brd) 634401 Lyons Ferry (86 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1313.5*(1-e**(-0.023(t-3.17)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1069.4*(1-e**(-0.023(t+4.86)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Columbia River Net Columbia River and tributary sport
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=1000
SCALE DATA ORIGIN:	Columbia net, sport and escapement
SUPPLEMENTAL DATA SOURCES:	Columbia River Fish Runs and Fisheries Status Report

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	55. Oregon north migrating fall (Ore No Fl)
MANAGEMENT UNITS REPRESENTED:	Natural fall chinook from Oregon north coastal tributaries. Hatchery fall chinook at Salmon River Hatchery.
CALIBRATION CWT GROUPS:	071643 Salmon River (77 brd) 071644 Salmon River (77 brd) 071849 Salmon River (78 brd) 071850 Salmon River (78 brd) 091637 Salmon River (76 brd) 091638 Salmon River (76 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1313.5*(1-e**(-0.023(t-3.17)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1069.4*(1-e**(-0.023(t+4.86)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=41074
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	57. West coast Vancouver Island (WCVI Totl)
MANAGEMENT UNITS REPRESENTED:	Natural chinook from west coast Vancouver Island. Hatchery chinook at Robertson Creek Hatchery.
CALIBRATION CWT GROUPS:	020408 Robertson Creek (75 brd) 020409 Robertson Creek (75 brd) 020606 Robertson Creek (74 brd) 020906 Robertson Creek (74 brd) 021630 Robertson Creek (76 brd) 021631 Robertson Creek (76 brd) 022217 Robertson Creek (77 brd) 022218 Robertson Creek (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1313.5*(1-e**(-0.023(t-3.17)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1069.4*(1-e**(-0.023(t+4.86)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Fraser River net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=123406
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	59. Fraser Late (Fraser Lt)
MANAGEMENT UNITS REPRESENTED:	Natural and hatchery fall chinook from lower Fraser River
CALIBRATION CWT GROUPS:	022658 Chilliwack (83 brd) 022659 Chilliwack (83 brd) 022660 Chilliwack (83 brd) 023414 Chilliwack (84 brd) 023415 Chilliwack (84 brd) 023416 Chilliwack (84 brd) 023417 Chilliwack (84 brd) 023418 Chilliwack (84 brd) 023419 Chilliwack (84 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =982.1*(1-e**(-0.029(t-2.83)) where Age 2 CV = 0.11 Age 3 CV = 0.12 Age 4 CV = 0.09 Age 5 CV = 0.09 Mean FL_{mature} =1085.2*(1-e**(-0.030(t-1.59)) where Age 2 CV = 0.11 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Fraser River net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=120000
SCALE DATA ORIGIN:	??
Supplemental Data Sources:	

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	61. Fraser Early (Fraser Er)
MANAGEMENT UNITS REPRESENTED:	Natural and hatchery fall chinook from upper Fraser River
CALIBRATION CWT GROUPS:	021601 Shuswap Wild (79 brd) 021602 Chilko Wild (78 brd) 021625 Shuswap Wild (78 brd) 021638 Shuswap Wild (78 brd) 021658 chilko Wild (78 brd) 021755 Shuswap Wild (79 brd) 024247 Clearwater (86 brd) 024248 Clearwater (86 brd) 024249 Clearwater (86 brd) 024250 Clearwater (86 brd) 024316 Shuswap (86 brd) 024521 Clearwater (86 brd) 024522 Clearwater (86 brd) 024523 Clearwater (86 brd) 024524 Clearwater (86 brd) 024525 Clearwater (86 brd) 024526 Clearwater (86 brd) 024527 Clearwater (86 brd) 024528 Spius (86 brd) 024529 Spius (86 brd) 024530 Spius (86 brd) 024531 Spius (86 brd) 024532 Spius (86 brd) 024533 Spius (86 brd) 024534 Shuswap (86 brd) 024535 Shuswap (86 brd) 024536 Clearwater (86 brd) 024537 Clearwater (86 brd) 024538 Clearwater (86 brd) 024562 Spius (86 brd) 024563 Spius (86 brd) 024601 Spius (86 brd) 024607 Spius (86 brd) 024510 Shuswap (86 brd) 024705 Spius (86 brd) 024706 Spius (86 brd) 021717 Fort St James (86 brd)
VALIDATION CWT GROUPS	

Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1080.3*(1-e**(-0.032(t-3.00)) where Age 2 CV = 0.16 Age 3 CV = 0.08 Age 4 CV = 0.13 Age 5 CV = 0.16 Mean FL_{mature} =1080.3*(1-e**(-0.032(t-3.00)) where Age 2 CV = 0.16 Age 3 CV = 0.08 Age 4 CV = 0.13 Age 5 CV = 0.16
ACCOUNTED IN TERMINAL RUN	Natural and hatchery escapement Fraser River net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=43631
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	63. Lower Georgia Strait fall (Lwr Geo St)
MANAGEMENT UNITS REPRESENTED:	Natural and hatchery fall chinook from Georgia Strait tributaries
CALIBRATION CWT GROUPS:	021612 Big Qualicum (78 brd) 021613 Big Qualicum (78 brd) 021639 Capilano (77 brd) 021642 Capilano (77 brd) 021656 Big Qualicum (78 brd) 021726 Big Qualicum (77 brd) 021727 Big Qualicum (77 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =1445.7*(1-e**(-0.020(t-1.25)) where Age 2 CV = 0.21 Age 3 CV = 0.10 Age 4 CV = 0.08 Age 5 CV = 0.04 Mean FL_{mature} =1445.7*(1-e**(-0.020(t-1.25)) where Age 2 CV = 0.21 Age 3 CV = 0.10 Age 4 CV = 0.08 Age 5 CV = 0.04
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement Freshwater net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=16947
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	

FRAM UNMARKED STOCK NUMBER/NAME/ABBREVIATION:	65. White River spring yearling (White SpYr)
MANAGEMENT UNITS REPRESENTED:	South Puget Sound spring yearling
CALIBRATION CWT GROUPS:	212263 White River Hatchery (91 brd) 212048 White River Hatchery (92 brd) 212509 White River Hatchery (93 brd)
VALIDATION CWT GROUPS	
Von Bertalanffy Growth Function Mean Fork Length(mm)= L_{max}*(1-e**(-k(t-t_0)) where t= (Age-1)*12 + midpt. of time step	Mean $FL_{mixmature}$ =904.0*(1-e**(-0.043(t-9.54)) where Age 2 CV = 0.17 Age 3 CV = 0.14 Age 4 CV = 0.10 Age 5 CV = 0.10 Mean FL_{mature} =938.6*(1-e**(-0.048(t-11.31)) where Age 2 CV = 0.048 Age 3 CV = 0.11 Age 4 CV = 0.11 Age 5 CV = 0.11
ACCOUNTED IN TERMINAL RUN (TR) (or Terminal Area Abundance (TAA) in Puget Sound):	Natural and hatchery escapement to White River Hatchery or Buckley Trap Freshwater net
ACCOUNTED IN EXTREME TERMINAL RUN SIZE (ETRS):	Same as TR Base Period Escapement=100
SCALE DATA ORIGIN:	??
SUPPLEMENTAL DATA SOURCES:	

4.4 Fishery and Stock List

FRAM Fsh Num	Chinook FRAM Fishery Name	Base Catch
1	SEAK Troll	283,260
2	SEAK Net	25,117
3	SEAK Sport	20,472
4	N/C BC Net	115,266
5	WCVI Net	57,783
6	GS Net	88,793
7	Canada JDF Net	25,432
8	Outside BC Sport	15,448
9	N/C BC Troll	321,046
10	WCVI Troll	467,376
11	WCVI Sport	0
12	GS Troll	214,175
13	No GS Sport	104,633
14	So GS Sport	125,934
15	BC JDF Sport	52,729
16	NT Area 3:4:4B Troll	41,789
17	T Area 3:4:4B Troll	20,454
18	NT Area 3:4 Sport	3,954
19	N Wash. Coastal Net	423
20	NT Area 2 Troll	59,869
21	T Area 2 Troll	713
22	NT Area 2 Sport	55,902
23	NT G. Harbor Net	2,387
24	T G. Harbor Net	699
25	Willapa Bay Net	13,836
26	Area 1 Troll	20,435
27	Area 1 Sport	30,099
28	Columbia River Net	67,919
29	Buoy 10 Sport	0
30	Central OR Troll	109,061
31	Central OR Sport	8,796
32	KMZ Troll	261,101
33	KMZ Sport	22,158
34	S. Calif. Troll	424,672
35	S. Calif.Sport	89,045
36	NT Area 7 Sport	13,423

37	NT Area 6A:7:7A Net	34,303
38	T Area 6A:7:7A Net	12,190
39	NT Area 7B-7D Net	25,449
40	T Area 7B-7D Net	39,075
41	T JDF Troll	600
42	NT Area 5-6 Sport	54,503
43	NT JDF Net	5,152
44	T JDF Net	14,807
45	NT Area 8 1-2 Sport	11,161
46	NT Skagit Net	1,455
47	T Skagit Net	1,711
48	NT Area 8D Sport	1
49	NT St/Snohomish Net	1,402
50	T St/Snohomish Net	16,423
51	NT Tulalip Bay Net	1
52	T Tulalip Bay Net	483
53	NT Area 9 Sport	29,586
54	NT Area 6B:9 Net	1,648
55	T Area 6B:9 Net	533
56	NT Area 10 Sport	21,309
57	NT Area 11 Sport	28,258
58	NT Area 10:11 Net	6,151
59	T Area 10:11 Net	4,955
60	NT Area 10A Sport	1
61	T Area 10A Net	5,880
62	NT Area 10E Net	1
63	T Area 10E Net	399
64	NT Area 12 Sport	7,550
65	NT Hood Canal Net	1,228
66	T Hood Canal Net	4,859
67	NT Area 13 Sport	22,997
68	NT SPS Net	1
69	T SPS Net	4,650
70	NT Area 13A Net	1
71	T Area 13A Net	5,084
72	Freshwater Sport	NA
73	Freshwater Net	NA

Model Stock	Model Years	Escapement Timing	Data Source Escapement Magnitude	Base Esc
Nk/Sam Fall Fingerling	77,79	July - Sept	PS Run Reconstruction	20,224
NF Nooksack Spring	OOB 84,88 NF	July - Sept	OOB	500
SF Nooksack Spring	OOB 84,88 NF	July - Sept	OOB	500
Skag Su/Fall Fing	76,77	July - Sept	PS Run Reconstruction	10,443
Skag Su/Fall Year	76	July - Sept	PS Run Reconstruction	2,105
Skagit Spring Year	OOB 85-87,90	May-June, July - Sept	OOB	1,391
Snoh Fall Fing	OOB 86-88	July - Sept	OOB	4,814
Snoh Fall Year	76	July - Sept	not adjusted	3,352
Stil Fall Fing	OOB 86-90	July - Sept	OOB	831
Tulalip Fall Fing	OOB 86-88	July - Sept	OOB	1
Mid PS Fall Fing	78,79	July - Sept	PS Run Reconstruction	20,018
UW Accelerated	77-79	July - Sept	PS Run Reconstruction	1,062
SPS Fall Fing	78,79	July - Sept	PS Run Reconstruction	10,230
SPS Fall Year	78,79	July - Sept	not adjusted	330
White R. Spring Fing	OOB 91-93	July - Sept	ACOE Buckly Trap	100
HC Fall Fing	78,79	July - Sept	PS Run Reconstruction	4,078
HC Fall Year	78,79	July - Sept	PS Run Reconstruction	126
JDF Tribs. Fall Fing	78,79,OOB 83-85	July - Sept	PS Run Reconstruction	2,365
OR Hatchery Tule	78,79	July - Sept	CR Run Reconstruction	42,000
WA Hatchery Tule	77,79	July - Sept	CR Run Reconstruction	33,400
Lower Col R Wild	77,78	July - Sept	CR Run Reconstruction	14,192
Bonneville Pool Hatchery	76-79	July - Sept	CR Run Reconstruction	40,365
Col R. Upriver Summer	76,77	May - June (53%), July - Sept (47%)	PSC Chinook Model	22,205
Col R. Upriver Bright	75-77	July - Sept	CR Run Reconstruction	51,025
Cowlitz Spring	77	Oct - April	CR Run Reconstruction	23,720
Willamette Spring	76-78	Oct - April	CR Run Reconstruction	37,928
Snake River Fall	OOB 84-86	July - Sept	OOB	1,000
OR North Fall	76-78	July - Sept	PSC Chinook Model	41,074
WCVI Total	74-77	July - Sept	PSC Chinook Model	123,406
Fraser Late	OOB 83,84	July - Sept	OOB	120,000
Fraser Early	78,79,OOB 84,86	July - Sept	PSC Chinook Model	43,631
Lower Georgia Strait	77,78	July - Sept	PSC Chinook Model	16,947
White R. Spring Year	OOB 91-93	July - Sept	ACOE Buckly Trap	100

4.5 Functional Description of Calibration Programs and Worksheets

FRAM.exe: Run as base period or as annual 83-03 "validation" runs. Validation runs are made with FRAM base period input file of stock/age specific cohort sizes, exploitation rates, growth functions, fishery related mortality parameters, etc and best estimates of yearly actual stock abundances and reported fishery catches and/or effort scalars.

PSRR.xls: Produces base period terminal run sizes for insertion into Puget Sound stock validation abundance spreadsheets.

Validation Abundance Spreadsheet (Puget Sound, Columbia River, British Columbia): Contains annual terminal run size accounting for various post-season run reconstruction accounting systems, and from these produces age-stock-year specific abundance scalars used in Method 1-3 FRAM starting cohort abundance scalar derivation .

UPDATERECONTXT.exe: Updates input stock text files used by RECON.bas for Method 2 abundance scalar derivation.

RECON.bas: Obtains Method 2 estimates of recruit scale factors for Puget Sound summer/fall stocks by adjusting terminal run based abundance scalars by year-timestep-fishery specific independent effort scalars. These effort scalars are usually derived from comparing within year vessel days, angler-trips, or deliveries to the same measured during the 1979-82 base period.

UPDTMT.bas: Replaces base period maturation rates in the FRAM base period data file ("outfile') with year-specific maturation rates calculated from year-specific CWT groups for eight Puget Sound fall stocks to create annual outfiles.

MRTRAT.bas: Calculates ratio of total mortality to landed catch for Puget Sound summer/fall Chinook. These data are pasted into the RECON text input file and are used in accounting for preterminal fishing impacts in order to derive prefishing age-stock specific abundances.

UPDATE COMMAND SCALARS.exe: Creates new FRAM validation command files with new yearly stock and age specific abundance scalars relative to the base period cohorts.

JMNSZE.bas: Reformats four successive years of FRAM model estimates of annual fishery effort scalars into single brood year files of fishery effort scalars for separate ages 2-5. These brood year specific scale factor files are key part of the process that simulates out-of-base period CWT recoveries back to the base period.

CHDAT.bas: Error checks data and reformats calibration input data for use by other programs.

CHCAL.bas: Has two primary functions: 1) Estimates base period CWT recoveries for out-of-base stocks and brood years; 2) Produces FRAM base period data file containing base period cohort abundances, exploitation rates by stock-age-time, maturation rates, adult equivalency factors, and other model parameters such as natural mortality rates, fishery related mortality rates, etc.

MERGE.bas: Combines OOB CWT recovery simulations for several single brood year tag groups for a stock into single base period CWT recovery list.

MRGFE.bas: Special case for Fraser Early stocks of Merge.bas, which combines OOB simulation CWT groups with base period CWT groups.

BASESTOCKEXP.xls: CWT recovery adjustment spreadsheet for base period terminal net fisheries and escapements.

SFMCHIN.c: converts the final FRAM base period data file ("outfile") produced during calibration to an outfile containing equal numbers of marked and unmarked units of each FRAM stock which sum to the original total.

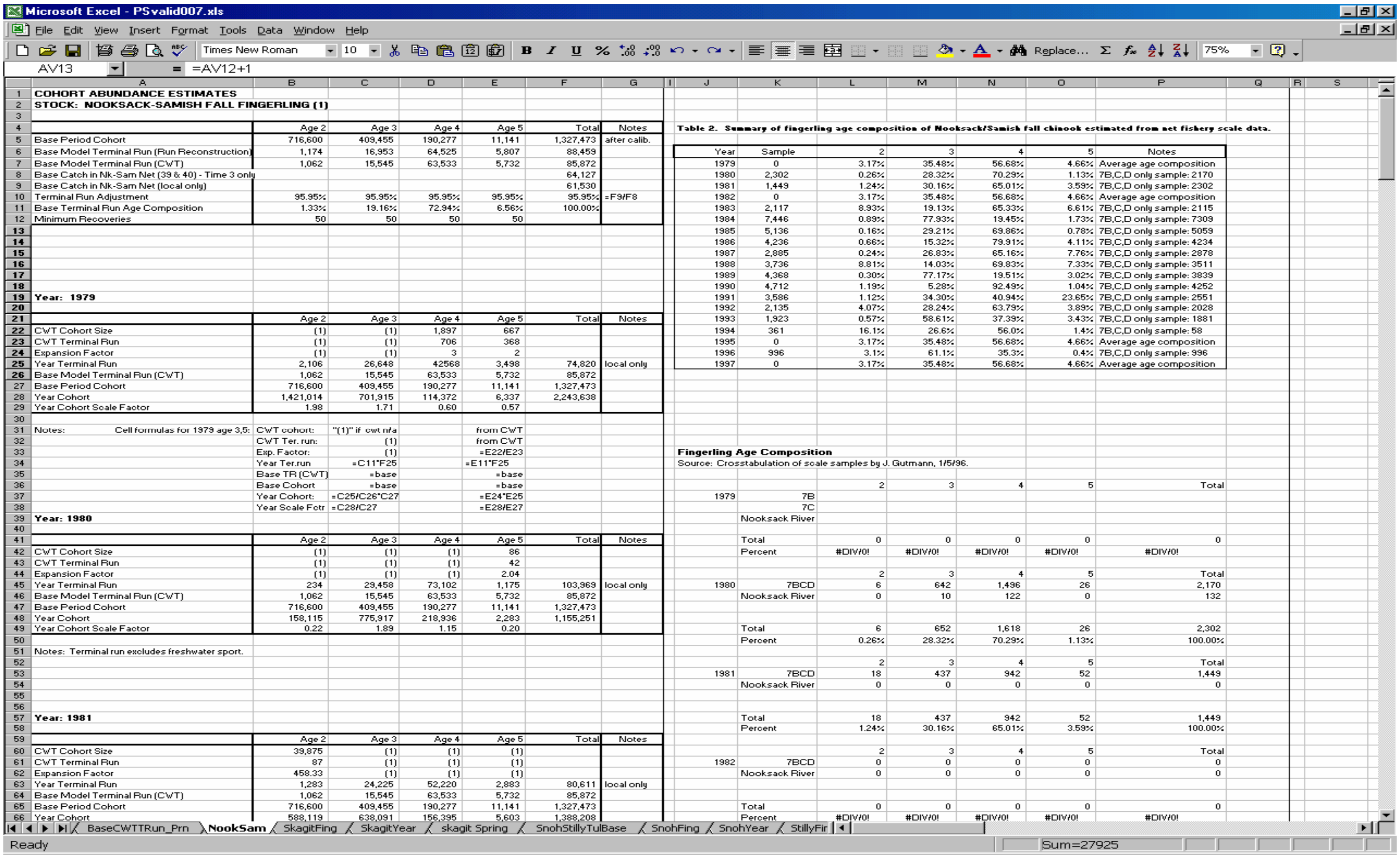
4.6 Stepwise Calibration Instruction

1. Identify CWT groups to represent stocks.
2. Retrieve CWT recoveries from coast wide data source PSMFC.
3. Compile or map the stock and brood year specific CWT recoveries to FRAM fisheries and time periods by age using program FRAMBUILDER.
4. If undergoing major model structure changes to fisheries, stocks, time periods:
   - Update base period landings and escapements.
   - Update terminal run fisheries and escapements with CWT and run reconstruction data in the terminal run spreadsheets for base period stock adjustments.
   - Update validation command files (xxxx.cmd) if warranted.
5. Decide where to "start" the calibration. Generally, where you begin calibration depends on the nature of the changes. Major overalls which involve modifications of base period stock, fisheries, structures, or parameters probably will require building of new base period outfile (stkxxxx .out) and base period command file (base.cmd). Minor changes such as updates to OOB stock(s) are best started with a simulation back to the base period for the updated stock(s). Theoretically, the iterative nature of the calibration minimizes the affect of picking a starting point.
6. Start a new calibration (or pass) using the final input files, validation spreadsheets, stock adjustment spreadsheets, and base and validation .out files and .cmds from the previous calibration (or pass).
7. Run base .cmd and .out in FRAM.
8. Estimate Recruit Scale Factors for validation years using terminal run size and escapement data from this run (Figure 3).
9. Create New Validation and .cmd and .out Files.
10. Run FRAM with new validation command and outfiles to obtain fishery scale factors by fishery year.
11. Estimate Exploitation Rate Scale Factors.
12. Simulate OOB Stocks.
13. Incorporate the new adjusted CWT recoveries from the simulations into the All-Stocks cwt file.

14. Create new .out file. Complete the calibration pass by running Chdat and Chcal on the All-Stocks CWT file to create a new .out file.
15. Run base.cmd and new .out file and begin the next cycle.

4.7 Sample Calibration Inputs, Outputs and worksheets

Puget Sound recruit scalar and validation spreadsheet: Psvalidxx#.xls



COHORT ABUNDANCE ESTIMATES
STOCK: NOOKSACK-SAMISH FALL FINGERLING (1)

	Age 2	Age 3	Age 4	Age 5	Total	Notes
Base Period Cohort	716,600	409,455	190,277	11,141	1,327,473	after calib.
Base Model Terminal Run (Run Reconstruction)	1,174	16,953	64,525	5,807	88,459	
Base Model Terminal Run (CWT)	1,062	15,545	63,533	5,732	85,872	
Base Catch in Nk-Sam Net (39 & 40) - Time 3 only					64,127	
Base Catch in Nk-Sam Net (local only)					61,530	
Terminal Run Adjustment	95.95%	95.95%	95.95%	95.95%	95.95%	=F9/F8
Base Terminal Run Age Composition	1.33%	19.16%	72.94%	6.56%	100.00%	
Minimum Recoveries	50	50	50	50		

Year: 1979

	Age 2	Age 3	Age 4	Age 5	Total	Notes
CWT Cohort Size	(1)	(1)	1,897	667		
CWT Terminal Run	(1)	(1)	706	368		
Expansion Factor	(1)	(1)	3	2		
Year Terminal Run	2,106	26,648	42568	3,498	74,820	local only
Base Model Terminal Run (CWT)	1,062	15,545	63,533	5,732	85,872	
Base Period Cohort	716,600	409,455	190,277	11,141	1,327,473	
Year Cohort	1,421,014	701,915	114,372	6,337	2,243,638	
Year Cohort Scale Factor	1.98	1.71	0.60	0.57		

Notes: Cell formulas for 1979 age 3,5:	CWT cohort:	"(1)" if cwt n/a		from CWT
	CWT Ter. run:	(1)		from CWT
	Exp. Factor:	(1)		=E22/E23
	Year Ter.run	=C11*F25		=E11*F25
	Base TR (CWT)	=base		=base
	Base Cohort	=base		=base
	Year Cohort:	=C25/C26*C27		=E24*E25
	Year Scale Fctr	=C28/C27		=E28/E27

Year: 1980

	Age 2	Age 3	Age 4	Age 5	Total	Notes
CWT Cohort Size	(1)	(1)	(1)	86		
CWT Terminal Run	(1)	(1)	(1)	42		
Expansion Factor	(1)	(1)	(1)	2.04		
Year Terminal Run	234	29,458	73,102	1,175	103,969	local only
Base Model Terminal Run (CWT)	1,062	15,545	63,533	5,732	85,872	
Base Period Cohort	716,600	409,455	190,277	11,141	1,327,473	
Year Cohort	158,115	775,917	218,936	2,283	1,155,251	
Year Cohort Scale Factor	0.22	1.89	1.15	0.20		

Notes: Terminal run excludes freshwater sport.

Year: 1981

	Age 2	Age 3	Age 4	Age 5	Total	Notes
CWT Cohort Size	39,875	(1)	(1)	(1)		
CWT Terminal Run	87	(1)	(1)	(1)		
Expansion Factor	458.33	(1)	(1)	(1)		
Year Terminal Run	1,283	24,225	52,220	2,883	80,611	local only
Base Model Terminal Run (CWT)	1,062	15,545	63,533	5,732	85,872	
Base Period Cohort	716,600	409,455	190,277	11,141	1,327,473	
Year Cohort	588,119	638,091	156,395	5,603	1,388,208	

Table 2. Summary of fingerling age composition of Nooksack/Samish fall chinook estimated from net fishery scale data.

Year	Sample	2	3	4	5	Notes
1979	0	3.17%	35.48%	56.68%	4.66%	Average age composition
1980	2,302	0.26%	28.32%	70.29%	1.13%	7B,C,D only sample: 2170
1981	1,449	1.24%	30.16%	65.01%	3.59%	7B,C,D only sample: 2302
1982	0	3.17%	35.48%	56.68%	4.66%	Average age composition
1983	2,117	8.93%	19.13%	65.33%	6.61%	7B,C,D only sample: 2115
1984	7,446	0.89%	77.93%	19.45%	1.73%	7B,C,D only sample: 7309
1985	5,136	0.16%	29.21%	69.86%	0.78%	7B,C,D only sample: 5059
1986	4,236	0.66%	15.32%	79.91%	4.11%	7B,C,D only sample: 4234
1987	2,885	0.24%	26.83%	65.16%	7.76%	7B,C,D only sample: 2878
1988	3,736	8.81%	14.03%	69.83%	7.33%	7B,C,D only sample: 3511
1989	4,368	0.30%	77.17%	19.51%	3.02%	7B,C,D only sample: 3839
1990	4,712	1.19%	5.28%	92.49%	1.04%	7B,C,D only sample: 4252
1991	3,586	1.12%	34.30%	40.94%	23.65%	7B,C,D only sample: 2551
1992	2,135	4.07%	28.24%	63.79%	3.89%	7B,C,D only sample: 2028
1993	1,923	0.57%	58.61%	37.39%	3.43%	7B,C,D only sample: 1881
1994	361	16.1%	26.6%	56.0%	1.4%	7B,C,D only sample: 58
1995	0	3.17%	35.48%	56.68%	4.66%	Average age composition
1996	996	3.1%	61.1%	35.3%	0.4%	7B,C,D only sample: 996
1997	0	3.17%	35.48%	56.68%	4.66%	Average age composition

Fingerling Age Composition
Source: Crosstabulation of scale samples by J. Gutmann, 1/5/96.

		2	3	4	5	Total
1979	7B					
	7C					
	Nooksack River					
	Total	0	0	0	0	0
	Percent	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
		2	3	4	5	Total
1980	7BCD	6	642	1,496	26	2,170
	Nooksack River	0	10	122	0	132
	Total	6	652	1,618	26	2,302
	Percent	0.26%	28.32%	70.29%	1.13%	100.00%
		2	3	4	5	Total
1981	7BCD	18	437	942	52	1,449
	Nooksack River	0	0	0	0	0
	Total	18	437	942	52	1,449
	Percent	1.24%	30.16%	65.01%	3.59%	100.00%
		2	3	4	5	Total
1982	7BCD	0	0	0	0	0
	Nooksack River	0	0	0	0	0
	Total	0	0	0	0	0
	Percent	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Base period freshwater catch and escapement adjustment spreadsheet: PSBaseSoockExpxx#.xls

Microsoft Excel - PSBaseStockexp024.xls

Computations for Nooksack Fall Fingerling

CWT File: Stk023.cwt 12/02/2004 13:48

Step 1. Compute weigthed base period escapement and freshwater catch.

Sources: (1) WDFW Run Reconstruction (7/27/95), Area 7/7A Independents and Nooksack-Samish Basin;
(2) J. Gutmann program Chin.BAS.

Year	Percent	Escapement	Percent	FW Catch
1980	10%	14,066	36%	1,791
1981	40%	13,886	14%	3,077
1982	10%	20,921	36%	3,955
1983	40%	27,926	14%	4,639
Weighted Average		20,224		3,143

Step 2. Compute catch of nonlocal stocks in Time Step 3.

Stock	Escapement Total	Escapement CWT	Exp. Factor	CWT Net (7B-D net) NonTreaty	CWT Net (7B-D net) Treaty	Exp. CWT Net NonTreaty	Exp. CWT Net Treaty	Exp. CWT Net Total	Stock Label
1	20,224	2,040	9.91			0.0	0.0	0.0	Nooksack/Samish Fall
2	500	12,514	0.04	8.2	403.5	0.3	16.1	16.5	No. Nooksack Native
3	500	1,570	0.32	16.42	66.85	5.2	21.3	26.5	So. Nooksack Native
4	10,443	756	13.81	6.6	13.3	90.7	183.5	274.2	Skagit Summer Fall Fingerling
5	2,105	2,187	0.96	16.5	33.5	15.9	32.2	48.1	Skagit Summer Fall Yearling
6	1,391	1,182	1.18	5.0	7.8	5.8	9.1	15.0	Skagit Spring Yearling
7	4,814	1,554	3.10	0.0	0.0	0.0	0.0	0.0	Snohomish Summer Fall Fingerling
8	3,352	2,791	1.20	33.6	68.0	40.4	81.7	122.1	Snohomish Fall Yearling
9	831	1,554	0.53	0.0	0.0	0.0	0.0	0.0	Stillaguamish Summer Fall Fingerling
10	1	1,135	0.00	4.3	6.7	0.0	0.0	0.0	Tulalip Fall Fingerling
11	20,018	1,290	15.52	2.2	4.5	34.4	69.5	104.0	Mid-Sound Fall Fingerling
12	1,062	2,082	0.51	4.0	6.6	2.1	3.3	5.4	UW Accelerated
13	10,230	225	45.45	0.0	0.0	0.0	0.0	0.0	South Sound Fall Fingerling
14	330	112	2.95	0.0	0.0	0.0	0.0	0.0	South Sound Fall Yearling
15	100	1,596	0.06	0.0	0.0	0.0	0.0	0.0	White (Minter) Spring Fingerling
16	4,078	433	9.42	0.6	1.2	5.5	11.0	16.5	Hood Canal Fall Fingerling
17	126	147	0.86	0.0	0.0	0.0	0.0	0.0	Hood Canal Fall Yearling
18	2,365	384	6.15	0.0	0.0	0.0	0.0	0.0	JDF Tributaries Fall
19	42,000	494	84.97	0.0	0.0	0.0	0.0	0.0	Oregon Hatchery Tule
20	33,400	428	78.00	0.0	0.0	0.0	0.0	0.0	Washington Hatchery Tule
21	14,192	1,158	12.26	0.0	0.0	0.0	0.0	0.0	Lower River Wild
22	40,365	4,900	8.24	4.7	9.5	38.7	78.5	117.2	Bonneville Pool Hatchery
23	22,205	216	102.92	0.0	0.0	0.0	0.0	0.0	Upriver Summer
24	51,025	9,438	5.41	1.2	2.5	6.6	13.4	20.0	Upriver Bright
25	23,720	1,746	13.58	0.0	0.0	0.0	0.0	0.0	Cowlitz Spring
26	37,928	9,475	4.00	0.0	0.0	0.0	0.0	0.0	Willamette Spring
27	1,000	2,114	0.47	0.0	0.0	0.0	0.0	0.0	Snake River Fall
28	41,074	2,825	14.54	0.0	0.0	0.0	0.0	0.0	Oregon Fall North Migrating
29	123,406	14,238	8.67	2.9	5.9	25.5	51.6	77.1	WCVI Total
30	120,000	1,471	81.57	5.9	9.3	484.6	757.8	1242.4	Fraser Late
31	43,631	8,359	5.22	4.5	7.1	23.6	37.0	60.7	Fraser Early
32	16,947	1,127	15.03	6.6	13.4	99.7	201.6	301.3	Lower Georgia Strait
				0	0				
Total						879.0	1567.8	2446.8	

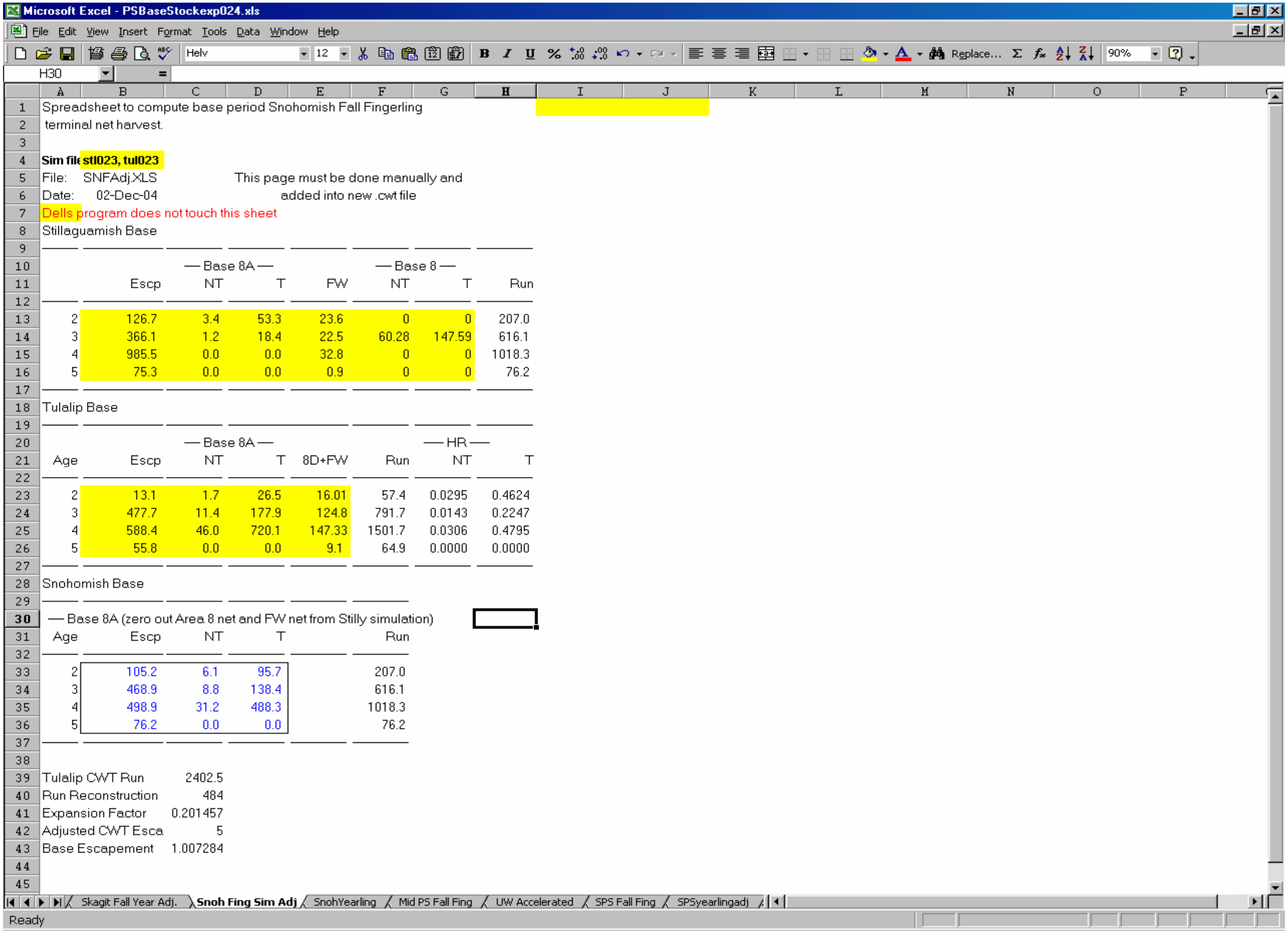
Step 3. Compute target catch/escapement ratio.

Base Period Marine Catch	64,524	(Source: J. Gutmann program Chin.BAS)
Base Period Freshwater Catch	3,143	
Total	67,667	

BaseEsc | NKFallFing | Skagit Fall Fing | Skagit Fall Year | Skagit Fall Year Adj. | Snoh Fing Sim Adj | SnohYearling | Mid PS Fal

Ready

Base period freshwater catch and escapement adjustment spreadsheet: PSBaseStockExp.xls


Microsoft Excel - PSBaseStockexp024.xls

Spreadsheet to compute base period Snohomish Fall Fingerling terminal net harvest.

Sim file stl023, tul023

File: SNFAdj.XLS

Date: 02-Dec-04

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Dells program does not touch this sheet

Stillaguamish Base

		Base 8A			Base 8		
	Escp	NT	T	FW	NT	T	Run
2	126.7	3.4	53.3	23.6	0	0	207.0
3	366.1	1.2	18.4	22.5	60.28	147.59	616.1
4	985.5	0.0	0.0	32.8	0	0	1018.3
5	75.3	0.0	0.0	0.9	0	0	76.2

Tulalip Base

		Base 8A				HR	
Age	Escp	NT	T	8D+FW	Run	NT	T
2	13.1	1.7	26.5	16.01	57.4	0.0295	0.4624
3	477.7	11.4	177.9	124.8	791.7	0.0143	0.2247
4	588.4	46.0	720.1	147.33	1501.7	0.0306	0.4795
5	55.8	0.0	0.0	9.1	64.9	0.0000	0.0000

Snohomish Base

— Base 8A (zero out Area 8 net and FW net from Stilly simulation)

Age	Escp	NT	T		Run
2	105.2	6.1	95.7		207.0
3	468.9	8.8	138.4		616.1
4	498.9	31.2	488.3		1018.3
5	76.2	0.0	0.0		76.2

Tulalip CWT Run	2402.5
Run Reconstruction	484
Expansion Factor	0.201457
Adjusted CWT Esca	5
Base Escapement	1.007284

Skagit Fall Year Adj. | Snoh Fing Sim Adj | SnohYearling | Mid PS Fall Fing | UW Accelerated | SPS Fall Fing | SPSyearlingadj

Ready

Puget Sound Run Reconstruction spreadsheet: PSRR.xls

Microsoft Excel - psrr024.xls

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Y34 =

	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1						**Escapement**							
2						**Calibration: STK024.OUT**							/1
3						**12/02/2004 13:57**							
4													
5						----------------------------------	------	-------	--------	--------	------------		
6	---------	------------------		All Stk	Local fing	Stock	2	3	4	5	Total		
7	--------------------			Time 3	Time 3	----------------------------------	------	-------	--------	--------	------------		
8	4	Total		Total	Total	Nooksack/Samish Fall	738	4,060	15,908	256	20,962		
9	---------	------------------				Skagit Fall Fingerling	1,024	2,146	7,893	404	11,467		
10	24	2116		25247	24148	Skagit Fall Yearling	394	249	1,446	411	2,500		
11	23	3238		38886	37252	Snohomish Fall Fingerling	485	2,162	2,300	352	5,299		
12	5	48		1131	671	Snohomish Fall Yearling	1,428	111	2,383	858	4,780		
13	1	45		1660	41	Stillaguamish Fall Fingerling	74	213	574	44	905		
14	0	36		1311		Tulalip Fall Fingerling	0	0	0	0	0		
15	0	635		15263		Mid Sound Fall Fingerling	490	4,048	14,133	1,838	20,509		
16	0	0		1		UW Accelerated	455	861	194	6	1,516		
17	1	22		480		South Sound Fall Fingerling	130	274	8,604	1,352	10,360		
18	0	229		5654		South Sound Fall Yearling	59	80	196	54	389		
19	0	175		4714		Hood Canal Fall Fingerling	810	1,717	2,202	159	4,888		
20	0	0		0		Hood Canal Fall Yearling	38	11	98	17	164		
21	308	1021		5391		JDF Fall Fingerling	0	29	1,533	804	2,366		
22	0	0		1		----------------------------------	------	-------	--------	--------	------------		
23	0	54		400									
24	7	36		929		**Calibration: STK024.OUT**							
25	28	139		3671									
26	0	0		0		Model Stock	2	3	4	5	Total		
27	0	520		4064									
28	0	0		0		Nooksack/Samish Fall Fingerling							
29	7	410		4153		Marine Net Catch, All Stocks, T3	419	12,373	46,081	5,260	**64,133**		
30	0	9404		34206		Marine Net Catch, Local Stocks, T3					**61,400**		
31	---------	------------------				Freshwater Catch, All Time	16	641	2,435	277	3,369		
32						Escapement	738	4,060	15,908	256	20,962		
33						**RR Terminal Run**	**1,173**	**17,074**	**64,424**	**5,793**	88,464		
34													
35						Skagit Fall							
36	---------	------------------				Fingerling Freshwater Catch	0	569	3,958	1,357			
37	--------------------					Fingerling Escapement	1,024	2,146	7,893	404			
38	4	Total				Fingerling Freshwater Run	1,024	2,715	11,851	1,761			
39	---------	------------------											
40	24	2088		24148		Yearling Freshwater Catch	0	22	0	330			
41	23	3193		37252		Yearling Escapement	394	249	1,446	411			
42	0	0		195		Yearling Freshwater Run	394	271	1,446	741			
43	0	0		667									
44	0	2		68		Marine Catch, All Stocks, T2+3	30	599	2,046	82	**2,757**		
45	0	19		577		Marine Net Catch, Skagit Fing, T2+3					**712**		
46	0	0		0		Marine Catch, RR Fingerling	22	545	1,824	58	2,448		
47	0	0		0		Marine Catch, RR Yearling	8	54	222	24	309		
48	0	0		132									
49	0	0		101		**RR Fingerling Terminal Run**	**1,046**	**3,260**	**13,675**	**1,819**			
50	0	0		0		**RR Yearling Terminal Run**	**402**	**325**	**1,668**	**765**			
51	0	0		10									
52	0	0		0		Snohomish/Stillaguamish Fall							

psrr / EscPRN / CatchPRN

Ready

4.8 Example of CHCAL Cohort Analysis Process (Section 3.4 Equations 1-26)

"Backward" Cohort Analysis (Cohort Reconstruction) Using Section 3.4 Equations 1-13

The next section is a numeric example of a simple cohort analysis using the above equations. Some simplifying assumptions are made.

1) The example is for one stock, and one brood.
2) The example consists of four fisheries, two ocean troll fisheries, one ocean sport fishery, and one freshwater net fishery.
3) Size limits differ between the fisheries. However, size at age (i.e. proportion vulnerable) is assumed, not computed.
4) There is a single, annual timestep.
5) The maximum age is five.
6) 'Dropoff' mortality is assumed to be zero.
7) No CNR fisheries or periods

The starting data set, in practice taken directly from the RMIS CWT database is:

	Expanded Recoveries of BY 1995 CWTs				
	Ocean (Immature)			Inside (Mature)	
	Fishery 1	Fishery 2	Fishery 3	Fishery 4	Escapement
Age 5	0.00	4.84	10.00	25.00	8.00
Age 4	8.00	16.50	30.00	25.00	75.00
Age 3	10.00	9.60	40.00	75.00	106.67
Age 2	0.00	10.00	0.00	0.00	10.00

Assumed or input parameter values are:

	Annual Survival Rates	Proportion Vulnerable				Incidental Mortality Rates	
		Fish 1	Fish 2	Fish 3	Fish 4		
Age 5	0.9	99%	99%	99%	99%	Fishery 1	.25
Age 4	0.8	85%	85%	90%	99%	Fishery 2	.25
Age 3	0.7	70%	70%	80%	95%	Fishery 3	.15
Age 2	0.6	40%	40%	70%	95%	Fishery 4	.40

Encounter Rate Adjustment Factors	
Fishery 1	.382
Fishery 2	.382
Fishery 3	.179
Fishery 4	.035

Some of the simplifying assumptions require slightly different subscripting than is used in CHCAL, and some equations used in CHCAL are not needed. For that reason, new equations will be presented for this example. Notation is straightforward and will not be described. All new, simplified equations and numeric examples are enclosed in boxes.

Step 1) Sum up all age 5 mortalities and escapements, then divide by the age 5 survival rate to estimate an age 5 cohort after natural mortality. Corresponds roughly to equations 1, 2, and 4. (At this stage, Shaker mortalities are zero.)

$$Age5Cohort = \sum Age5OceanCatch + \sum Age5TermCatch + Age5Escapement$$
$$Age5Cohort = 14.84 + 25 + 8$$
$$Age5Cohort = 47.84$$

Step 2) The age 4 starting cohort, after natural mortality, consists of the age 4 fish caught in the ocean, the mature run, and those that remained in the ocean to become the age 5 cohort. Corresponds to equations 5 and 6. Age 3 and age 2 cohorts are computed the same way:

$$Age4Cohort = \frac{Age5Cohort}{.9} + \sum Age4OceanCatch + \sum Age4TermCatch + Age4Escapement$$
$$Age4Cohort = \frac{47.84}{.9} + 54.5 + 25 + 75$$
$$Age4Cohort = 207.66$$

$$Age3Cohort = \frac{Age4Cohort}{.8} + \sum Age3OceanCatch + \sum Age3TermCatch + Age3Escapement$$
$$Age3Cohort = \frac{207.66}{.8} + 59.60 + 75 + 106.67$$
$$Age3Cohort = 500.85$$

$$Age2Cohort = \frac{Age3Cohort}{.7} + \sum Age2OceanCatch + \sum Age2OceanCatch + Age2Escapement$$
$$Age2Cohort = 715.5 + 10 + 10$$
$$Age2Cohort = 735.5$$

Once an initial estimate of cohort sizes is available, an initial estimate of Shaker (bycatch) mortality can be made. Required information includes the number of sublegal encounters by fishery, the proportion of sublegals by age and fishery, and the incidental mortality rate.

Step 1) Compute sublegal encounters by fishery – recall that the Encounter Rate Adjustment Factor is the ratio of sublegal to legal encounters in a fishery. Analogous to Equation 7.

$$Fishery1SLEncounters = Fishery1Catch * Fishery1EncAdjustFactor$$
$$Fishery1SLEncounters = 18 * .382$$
$$Fishery1SLEncounters = 6.88$$

$$Fishery2SLEncounters = Fishery2Catch * Fishery2EncAdjustFactor$$
$$Fishery2SLEncounters = 40.94 * .382$$
$$Fishery2SLEncounters = 15.64$$

Similarly,
$$Fishery3SLEncounters = 14.32$$
$$Fishery4SLEncounters = 4.38$$

Step 2) Within each fishery, compute the sublegal cohorts by age (analogous to Equations 11 and 12):

$$Fishery1Age2SubLegPOP = Age2Cohort * (1 - Fishery1Age2PropVulnerable)$$
$$Fishery1Age2SubLegPOP = 735.5 * (1 - .40)$$
$$Fishery1Age2SubLegPOP = 441.3$$
*
*
*
$$Fishery3Age5SubLegPOP = .48$$

For Fishery4, the Cohort size equals the Terminal Run:
$$Fishery4Age2SubLegPOP = (\sum Fishery4Age2Catch + Age2Escape) * (1 - Fishery4Age2PropVulnerable)$$
$$Fishery4Age2subLegPOP = 10 * .05$$
$$Fishery4Age2SubLegPOP = .5$$
*
*
*
$$Fishery4Age5SubLegPOP = .3$$

This generates a set of sublegal population sizes by fishery and age as show below. Bold numbers correspond to the calculations shown above.

	Sub Legal Populations			
	Fishery 1	Fishery 2	Fishery 3	Fishery 4
Age 5	0.5	0.5	**0.48**	**0.3**
Age 4	31.1	31.1	20.8	1.0
Age 3	150.3	150.3	100.2	9.1
Age 2	**441.3**	441.3	220.6	**0.5**
Total	623.2	623.2	342.1	10.9

Now the Sublegal proportion by age within a fishery can be easily computed:

Sub Legal Proportions	Fishery 1	Fishery 2	Fishery 3	Fishery 4
Age 5	0.1%	0.1%	0.1%	3.0%
Age 4	5.0%	5.0%	6.1%	9.2%
Age 3	24.1%	24.1%	29.3%	83.2%
Age 2	70.8%	70.8%	64.5%	4.6%
Total	100.0%	100.0%	100.0%	100.0%

Now Shaker mortalities can be computed by fishery and age (Equation 13):

$$Fishery1Age2Shakers = Fishery1SLEncounters * Fishery1Age2SubLegProportion * Fishery1IMRate$$
$$Fishery1Age2Shakers = 6.88 * .708 * .25$$
$$Fishery1Age2Shakers = 1.22$$
$$Fishery1Age3Shakers = Fishery1SLEncounters * Fishery1Age3SubLegProportion * Fishery1IMRate$$
$$Fishery1Age3Shakers = 6.88 * .241 * .25$$
$$Fishery1Age3Shakers = .41$$
$$*$$
$$*$$
$$*$$
$$Fishery4Age5Shakers = Fishery4SLEncounters * Fishery4Age5SubLegProportion * Fishery4IMRate$$
$$Fishery4Age5Shakers = 4.38 * .03 * .40$$
$$Fishery4Age5Shakers = .05$$

This generates a first estimate of shaker mortalities by fishery and age as shown below. Bold numbers correspond to the example.

Shaker Mortalities	Fishery 1	Fishery 2	Fishery 3	Fishery 4
Age 5	0.00	0.00	0.00	**0.05**
Age 4	0.09	0.20	0.13	0.16
Age 3	**0.41**	0.94	0.63	1.45
Age 2	**1.22**	0.25	1.38	0.08

Finally, the estimated shaker mortalities are added back into the starting data set of observed recoveries, to generate a new recovery data set that includes shaker mortalities. The new recovery data set is:

	Expanded Recoveries of BY 1995 CWTs +Shakers				
	Ocean (Immature)			Inside (Mature)	
	Fishery 1	Fishery 2	Fishery 3	Fishery 4	Escapement
Age 5	0.00	4.84	10.00	25.05	8.00
Age 4	8.09	16.70	30.13	25.16	75.00
Age 3	10.41	10.54	40.63	76.45	106.67
Age 2	1.22	10.25	1.38	0.08	10.00

Now a backward cohort analysis and shaker mortality estimation is done again with the new recovery data set. This process is repeated until the age 2 cohort size stabilizes (usually three or four iterations).
For this example, the cohort sizes stabilized after 4 iterations. The cohort sizes (after natural mortality) at each iteration were:

	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5
Age 5	47.8	47.9	47.9	47.9	47.9
Age 4	207.7	208.3	208.6	208.3	208.3
Age 3	500.8	505.1	505.4	505.3	505.3
Age 2	735.5	747.0	746.7	747.7	747.7

The complete cohort reconstruction looks like this:

		Fishery 1		Fishery 2		Fishery 3		Term	Fishery 4		
	Cohort	Catch	IM	Catch	IM	Catch	IM	Run	Catch	IM	Escape
Age 5	47.9	0.0	0.0	4.8	0.0	10.0	0.0	33.1	25.0	0.1	8.0
Age 4	208.3	8.0	0.1	16.5	0.2	30.0	0.1	100.2	25.0	0.2	75.0
Age 3	505.3	10.0	0.5	9.6	1.0	40.0	0.6	183.1	75.0	1.5	106.7
Age 2	747.7	0.0	1.3	10.0	3.1	0.0	1.4	10.1	0.0	0.1	10.0

Example of "Forward" Cohort Analysis (Forward Reconstruction) for OOB Return to Base Simulation Using Section 3.4 Equations 14-26.

The objective of a return to base, or OOB analysis, is to estimate the CWTs that would have been recovered from a 'current year' brood had that brood been fished on under base period conditions.
Statistics required for an OOB analysis and forward cohort analysis are

1) the maturation rate at age,
2) the exploitation rate by fishery and age on the *vulnerable* cohort of the 'current year' brood,
3) the proportion vulnerable, by age and fishery, during the base period. This may differ from the 'current year' due to size limit changes, and
4) the ratio of the exploitation rate by each fishery in the current year to the exploitation rate of the same fishery during the base period. This scalar is derived independently of the calibration process. Ideally, it would be estimated for each fishery using a number of CWT stocks, similar to the stock in question, which were tagged both in the 'current year' and during the base period. Ideally, the scalar should be estimated using vulnerable cohorts, not total cohorts.

Starting data sets:

Maturation rates are easily computed from the data in the final backwards cohort analysis (analogous to equations 15 and 17:

$$Age2MatRate = \frac{Age2TerminalRun}{Age2Cohort - \sum Age2OceanMortalities}$$

$$Age2MatRate = \frac{10.1}{747.7 - 15.8}$$

$$Age2MatRate = .0138$$

Similarly,

$$Age3MatRate = .413$$

$$Age4MatRate = .653$$

$$Age5MatRate \equiv 1.000$$

The exploitation rates on the 'current year' vulnerable cohort are simply (analogous to Equation 18):

$$Fishery1Age2ER = \frac{Fishery1Age2Recoveries}{Age2Cohort * (Fishery1Age2PropVulnerable)}$$

$$Fishery1Age2ER = \frac{0}{747.7 * .4}$$

$$Fishery1Age2ER = 0.00$$

$$Fishery1Age3ER = \frac{Fishery1Age3\mathrm{Re}\,\mathrm{cov}\,eries}{Age3Cohort * (Fishery1Age3\,\mathrm{Pr}\,opVu\ln erable)}$$

$$Fishery1Age3ER = \frac{10.0}{505.3 * .7}$$

$$Fishery1Age3ER = .0283$$

*

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*

$$Fishery4Age5ER = \frac{Fishery4Age5Recoveries}{Age5TerminalRun * (Fishery4Age5PropVulnerable)}$$

$$Fishery4Age5ER = \frac{25}{33.1 * .99}$$

$$Fishery4Age5ER = .763$$

Computing the vulnerable cohort exploitation rate for all fisheries and ages yields (values computed in the example are bolded):

Exploitation Rates by age and Fishery ('current year' Vulnerable Cohort)				
	Fishery 1	Fishery 2	Fishery 3	Fishery 4
Age 5	0.0000	0.1020	0.2109	**0.7640**
Age 4	0.0452	0.0932	0.1600	0.2521
Age 3	**0.0283**	0.0271	0.0990	0.4311
Age 2	**0.0000**	0.0334	0.0000	0.0000

In this example, the size limit in fishery 3 was less during the base that in the current year, and the size limits in fishery 2 and fishery 3 were the same:

Base Proportion Vulnerable				
	Fishery 1	Fishery 2	Fishery 3	Fishery 4
Age 5	99%	99%	99%	99%
Age 4	85%	99%	99%	99%
Age 3	70%	90%	90%	95%
Age 2	40%	85%	85%	95%

In this example, the two troll fisheries are a little smaller than they were during the base period, the ocean sport fishery is much bigger, and the freshwater net fishery has not changed. The exploitation rate scalars are:

	ER Scalar
Fishery 1	0.80
Fishery 2	0.85
Fishery 3	4.00
Fishery 4	1.00

A forward cohort analysis simply starts with the age 2 cohort, and moves it forward through time, with natural mortality and fishing processes occurring instantaneously. Again, the objective is to estimate recoveries by age and fishery during the base period. Starting with the age2 cohort from the current year (analogous to equations 19-26):

$$Fish1Age2BP\,Rec = 747.7 * .99 * \frac{0}{.4}$$
$$Fish1Age2BP\,Rec = 0$$
$$Fish2Age2BP\,Rec = Age2Cohort * Fish2Age2\,PropVuln * \frac{Fish2Age2ExpRate}{Fish2ERScalar}$$
$$Fish2Age2BP\,Rec = 747.7 * .85 * \frac{.0334}{.85}$$
$$Fish2Age2BP\,Rec = 25.0$$
$$Fish3Age2BP\,Rec = Age2Cohort * Fish3Age2\,PropVuln * \frac{Fish3Age2ExpRate}{Fish3ERScalar}$$
$$Fish3Age2BP\,Rec = 747.7 * .85 * \frac{0}{4.0}$$
$$Fish3Age2BP\,Rec = 0$$
$$Age2TerminalRun = (Age2Cohort - \sum OceanFisheryAge2Catches) * Age2MatRate$$
$$Age2TerminalRun = (747.7 - (0 + 25 + 0)) * .014$$
$$Age2TerminalRun = 10.0$$
$$Fish4Age2BP\,Rec = Age2TerminalRun * Fish4Age2\,PropVuln * \frac{Fish4Age2ExpRate}{Fish4ERScalar}$$
$$Fish4Age2BP\,Rec = 10.0 * .95 * \frac{0}{1.0}$$
$$Fish4Age2BP\,Rec = 0$$

$$Age3Cohort = RemainingAge2Cohort * Age3NatMortality$$
$$Age3Cohort = (Age2Cohort - \sum OceanFisheryAge2Catches - Age2TerminalRun) * Age3NatMortality$$
$$Age3Cohort = (747.7 - 25.0 - 10.0) * .7$$
$$Age3Cohort = 498.9$$

$$Fish1Age3BP\,Rec = Age3Cohort * Fish1Age3\,PropVuln * \frac{Fish1Age3ExpRate}{Fish1ERScalar}$$
$$Fish1Age3BP\,Rec = 498.9 * .7 * \frac{.0283}{.8}$$
$$Fish1Age3BP\,Rec = 12.35$$

*

*

*

After the above calculations are complete, the result is a reconstructed cohort using a forward analysis as shown below. Derivation of the bold numbers is shown above. Some slight rounding may be present as the table below was computed directly in a spreadsheet.

	Cohort after NM	Fish1	Fish 2	Fish 3	Cohort After Fishing	Terminal Run	Fish 4	Escape	Remaining Ocean Cohort
Age 2	747.7	**0.0**	**25.0**	**0.0**	**722.7**	**10.0**	**0.0**	**10.0**	**712.8**
Age 3	**499.0**	**12.34**	14.3	11.1	461.2	190.4	78.0	112.4	270.8
Age 4	216.6	10.4	23.5	8.6	174.1	113.7	28.4	85.3	85.3
Age 5	76.8	0.0	9.1	4.0	63.7	63.7	48.1	15.5	_-

The data derived from the examples show above, and written to the SIM file are shown in the table below, and are taken directly from data in the forward cohort analysis table in the previous section. Note that this data is directly comparable, and in exactly the same form, as the data set of expanded CWT recoveries used to begin the backward cohort analysis.

	Recoveries of Base Period CWTs from OOB analysis				
	Ocean (Immature)			Inside (Mature)	
	Fishery 1	Fishery 2	Fishery 3	Fishery 4	Escapement
Age 5	0.00	9.1	4.0	48.10	15.5
Age 4	10.4	23.5	8.6	28.40	85.3
Age 3	12.34	14.3	11.1	78.00	112.4
Age 2	0.00	25.0	0.00	0.00	10.00

4.9 Calibration Program "pseudo" code

Chinook FRAM Calibration Programs

ChDat.Bas

This program checks data from the stock spreadsheets and merges it with CWT data from the tag code summary program to create input files for the calibration program.

Input Files are:

- File from stock spreadsheet (for each stock) with stock-specific parameters and target encounter rate (for each fishery). [Stk???.chk]
- File with summarized CWT recoveries (by stock, age, fishery, time step) [Stk???.Cwt]
- File with FRAM fishery effort scalars (by fishery, time step) [Brood??.Scl]

Output Files are:

- Merged Calibration [Stk???.Cal]
- Error Checking [Stk???.Err]

Program Flow

- ReadControl – Reads Chk-File Variables
  - File names, array sizes, and convergence tolerance
- Init – Initialize Arrays
- ReadParam – Reads remainder of Chk-File
  - Growth (L, T0, K, CV), Terminal Flags (TermFlag), Minimum Legal Size (MinSize), Natural Mortality (NatMort), Release Mortality Rate (MortRate), Dropoff Rate (DropOff), Encounter Rate Adjustment Factor (EncRateAdj), Non-Retention (CNR), Total Landed Catch (TrueCatch), Fishery Catch Impute Flags (ImputeFlag)
- ReadRecov – Read CWT-File Variables
  - Base Period Escapement (ObsEscpmnt)
  - Expanded CWT Recovery (Catch) and Modified Escapement (Escape)
- Impute – Copy CWT Recoveries from selected fishery to new fishery
- CheckLegal – Check if Legal Sized Population exists for each CWT Recovery
  - CompLegProp - Compute Legal Sized Proportion (LegalProp)
    - Mean = L * (1-10**(-K * (T-T0)))
    - SD = CV * Mean
    - LegalProp = 1 – NormalDistr(MinSize, Mean, SD)
- CheckCNR – Check if Fishery has Landed Catch for CNR Estimation
  - ShakDistr – Compute Stock Concentration and set Shaker Inclusion Flag
  - Sum CWT Recoveries by Stock, Fishery (StkFishCatch)
  - Compute Concentration (Conc = StkFishCatch / TrueCatch)
  - Set Inclusion Flags (StkCheck) for Upper 70% of "Conc" Fisheries

ChCal.Bas

This program estimates the base period CWT recoveries for each out-of-base (OOB) stock by brood year.

Input Files are:
- Calibration Data from ChkDat.Bas program (Stk???.Cal)
- Edited CWT Recovery File (Stk???.Edt)
- Brood Year FRAM Fishery Scalars (Brood??.Scl)

Output File is:
- Simulation with OOB Stocks included (Stk???.Sim)

Program Flow

ReadControl – Reads Cal-File Variables
- File names, array sizes, and convergence tolerance

Init – Initialize Arrays

ReadParam – Reads remainder of Cal-File
- Growth (L, T0, K, CV), Terminal Flags (TermFlag), Minimum Legal Size (MinSize), Natural Mortality (NatMort), Release Mortality Rate (ShakMortRate), Drop-off Rate (OtherMort), Encounter Rate Adjustment Factor (EncRateAdj), Non-Retention (CNRInput), Total Landed Catch (TrueCatch), Stock Shaker Inclusion Flags (StkCheck)

ReadCatch – Reads Escapement and Edited, Expanded CWT Recoveries
- Base Period Escapement (ObsEscpmnt)
- CWT Recoveries (Escape and StkMortRec.Catch)

CompExpFact - Computes the expansion factor for CWT recoveries by dividing the total (tagged + untagged) observed escapement by the CWT escapement and the total expanded catch in each fishery.
- CWTEscpmnt = Sum of "Escape" by Stock
- ExpFact =ObsEscpmnt / CWTEscpmnt

AddCatch – Add Expanded Catch in all Fisheries and compute the proportion of the catch comprised of each stock.
- Total Catch = ExpFact * Catch (by Stock)
- StockCatchProp = Annual Stock Catch / Total Catch

AdjCatch – Adjust CWT Recoveries for each flagged Fishery to equal Observed Catch (flags are user defined)
- Recovery Adjustment Factor = TrueCatch / AnnualCatch

AddCatch – Recalculate Expanded Catch and Stock Proportions

CompCohort - Reconstruct cohort from CWT recoveries and estimated shaker and CNR mortality. Cohort reconstruction proceeds backwards in time beginning with the oldest age class and last time step.
- Total Escapement = Escapement * ExpFact
- Total Mortality = (Catch + CNR + Shaker) * ExpFact
- Cohort = Total Escapement + Total Mortality
- Cohort in Time Step –1 = Cohort / (1 – NatMort)

Loop Until Age 2 Cohort for all Stocks Stabilizes (< 1% change/loop)
CompIncMort – Compute Incidental Mortality with new Cohort Sizes
CompShakers – Compute Shaker Mortalities in each fishery based upon the ratio of the sublegal population to the legal population. A stock is included within the population for the fishery if its catch comprises more than the value of the parameter StkInclCrit. Encounter rates are adjusted to match those specified in the .Cal file by means of the EncRateAdj array.

Total Encounters (Total Time Step Catch * Target Encounter Rate)
Loop for each Stock
Loop for each Age
Compute Sub-Legal Proportion (SubLegalProp, LegalProp)
Compute Sub-Legal Population (Cohort * SubLegalProp)
Compute Sub-Legal Proportions by Age
Loop for each Age
Shakers = TotalEnc * PropSubPop * ShakMortRate * StockCatch Prop
CompCNR – Compute Non-Retention Mortality using one of two methods
Method 1- Ratio of CNR Days to normal regulation days to get total
Uses normal Fishery stock composition for Non-Retention
Method 2 – External estimates of legal and sub-legal encounters
Loop for each Stock
Loop for each Age
LegProp = ExpFact * StkMortRec.Catch / TotalCatch
Legal-CNR = LegProp * LegalEnc * ShakMortRate
SubLegal-CNR = SubLegProp * SubEnc * ShakMortRate
CohortCheck – Check Age-2 Cohort Size change with Convergence Tolerance
Forward - Adjust recoveries to a different base period using OOB calibration year fishery effort scalars to adjust the base period exploitation rates.
- Compute Exploitation Rates in Recovery Years
Loop for each Time Step
Loop for each Stock
Loop for each Fishery
Loop for each Age
Compute Legal Sized Proportion (LegalProp)
ExRate = ExpFact * Catch / (Cohort * LegalProp)
- Compute Maturation Rates in Recovery Years
Loop for each Time Step
Loop for each Stock
Loop for each Fishery
Loop for each Age

MatRate = TermCohort / [(TermCohort + Cohort) / (1 – NatMort)]

- Read Fishery Effort Scalars from Brood??.Scl File

Initial Cohort = Time 1, Age 2 Cohort / (1 – NatMort)

Loop for each Stock

Check ExRate < 1 else set to .9

Check if new Fisheries have Base Period CWT Recoveries

Loop for each Age

Loop for each Time Step

Loop for each Preterminal Fishery

Compute Legal Sized Proportion (LegalProp)

CompCatch = ExplAdjFact * (ExRate / ExplScale) * Cohort * LegalProp

MixedCatch = Sum of CompCatch

Cohort = Cohort – MixedCatch

MatCohort = Cohort * MatRate

Loop for each Terminal Fishery

Compute Legal Sized Proportion (LegalProp)

CompCatch = ExplAdjFact * (ExRate / ExplScale) * Cohort * LegalProp

MatCatch = Sum of CompCatch

CompEscape = MatCohort – MatCatch

Cohort = Cohort * (1 – MatRate)

Print Output to Stk???.Sim File

- CompEscape (by Stock, Age, Time Step)
- CompCatch (by Stock, Age, Time Step)

SaveDat – Creates FRAM .Out File for validation

ReCalculate Maturation Rates with new Cohort Sizes

Calculate Adult Equivalent (AEQ) Rates with new Maturation Rates

Loop for each Stock

Loop for each Age descending order

Loop for each Time Step descending order

MaxAge AEQ = 1

AEQ = {MatRate + [(1 – MatRate) * (1 – NatMort)]} * (AEQ+1 Time Step)

Print AEQ, Growth, Shaker Inclusion Flags, Initial Cohort Sizes, Model Stock Proportions, Dropoff Rates, Natural Mortality Rates, Shaker Mortality Rates, Encounter Rate Adjustment Factors, Terminal Fishery Flags, Maturation Rates, Exploitation Rates, Shaker Encounter Rates

Merge.Bas

This program merges several non-base period datasets and re-splits the Treaty/Non-Treaty fisheries using preset proportions.

Input File are:

File containing names of ???.sim files to use in merge calculations. [????.cmd]
Simulation files listed in command file above.

Output file is:

Merged simulation file [????.Sim]

Program Flow

Read Command File to get Simulation File names.
Read CWT Recovery Simulation Files

- Species, Stock, Age, Fishery, Time Step, Catch
- Sum Catch for each year

Calculate weighting factors (proportion by year or external if flagged)
Sum weighted catches across years
Split Treaty/Non-Treaty fisheries using PropTreaty array

Treaty Catch Proportion Array

Fishery	Oct-Apr	May-Jun	Jul-Sep
Area 3/4 Troll	1	.19	.22
Area 2 Troll	0	.01	.02
GH Net	0	0	.06
SJ Net	.17	1	.27
NKSM Net	.38	1	.61
JDF Net	.96	1	.71
Area 8 Net	.06	1	.71
Area 8A Net	.81	1	.94
Area 8D Net	1	1	.99
6B/9 Net	.17	1	.54
10-11 Net	.27	1	.6
10A Net	1	1	1
10E Net	1	1	1
HC Net	.53	1	.98
13B Net	1	1	1
13A Net	1	1	1

MrtRatio.Bas

This program calculates the ratio of total mortality to landed catch from the Chinook FRAM base period file.

Input Files are:

Chinook FRAM base period command file [????.CMD]
Chinook FRAM base period calibration file [????.OUT]
Binary save file of Mortality [????MRT]
Binary save file of Cohort Sizes [????COH]

Output File is:

File containing ratios [MrtRatio.Prn]

Program Flow

Read Stock and Fishery names from command file
Read Terminal Fishery Flags from calibration file
Read Landed Catch and Total Mortality from 'MRT' file
Calculate Ratio (Total Mortality / Landed Catch)
If Landed Catch = 0 but Total Mortality <> 0

- Get Cohort Size from 'COH' file
- Ratio = Total Mortality / Cohort Size

Recon.Bas

ReadStk – Read Data from stock text files created by UpDtTxt.Bas

- Base Period Terminal Run (BaseTermRun by age)
- Terminal Run Scalars for OOB years (Scale)
- TermRun = BaseTermRun * Scale (for each year by age)
- Base Period Variables [Cohort Size (Cohort), Maturation Rate (MatRate), Growth (L, T0, K, CV), Terminal Flags (TermFlag), Exploitation Rates (BaseU)]
- Average Ratio of Total Mortality to Landed Catch (MrtRatio)

Loop for each OOB Year

ReadInp – Read Data from stock/year specific SCL file

- Natural Morality Rate (NatMort)
- Minimum Legal Size (MinSize)
- Fishery Scale Factors (UScale)

Loop for each Age

Compute Mature Run (CompMatRun)

- o Compute Legal Sized Proportion (CompLegProp=LegalProp)
- o Compute Terminal Exploitation Rate
    - ▪ U = BaseU * LegalProp
    - ▪ TermU = U * UScale * MrtRatio
- o MatRun = TermRun / (1 – TermU)

Loop for each Time Step

Compute Preterminal Mortality

- ▪ Cohort = Cohort from Time Step +1
- ▪ Cohort = MatRun / MatRate (Terminal Time Step)

Loop for each Preterminal Fishery

- • Compute Legal Sized Proportion (LegalProp)
- • U = BaseU * LegalProp
- • PretermU = U * UScale * MrtRatio

Cohort = Cohort / (1 – PretermU)

Save Results (SaveRes)

- o Print Terminal Run, Cohort Size, Expansion Factor, Recruit Scaler
- o Expansion Factor = Initial Cohort / TermRun
- o Recruit Scaler = Initial Cohort / ModelCohort

[Simulation for Predicted Catch]

Loop for each Age

Loop for each Time Step

- o Cohort = Cohort * (1 – NatMort)

Loop for each Preterminal Fishery

- ▪ Compute Legal Sized Proportion (LegalProp)
- ▪ Catch = UScale * BaseU * LegalProp * Cohort
- ▪ Total = Catch * MrtRatio

- o Cohort = Cohort – TotalMort

Loop for each Terminal Fishery

- ▪ MatRun = Cohort * MatRate

- Compute Legal Sized Proportion (LegalProp)
- Catch = UScale * BaseU * LegalProp * Cohort
- Total = Catch * MrtRatio

End

SfmFram.C

This program splits the stocks into marked and unmarked components for use with mark selective fishery calculations. This process involves splitting the original cohort size for each stock into two equal components and duplicating the variables used for maturation, growth, exploitation, and shakers. Unmarked stock components are always odd numbered and marked components even numbered in the base period and command files.

Input File are:

Base Period File from Calibration Process. [????.out]

Output file is:

New Base Period File with Marked and UnMarked components for each original stock [????.out]

Program Flow

Read Calibration Base Period File.

For Each Line Determine if Marked/UnMarked Split is needed.

If Yes, Write the required two sections for each component.