Chinook FRAM Base Period Documentation: Surrogate Fisheries

# Background

Coded wire tag (CWT) recoveries in fisheries for the Chinook FRAM base period are a function of landed catches, marked and tagged stock abundances, and sampling rates. Some fisheries in the new base period contain too few tag recoveries to reliably estimate exploitation rates. Additionally, some fisheries and time steps were closed to Chinook retention during base period years, yet encounter rates are needed to model non-retention impacts. For these fisheries (recipient fisheries), a work group evaluated whether other fisheries or time step could stand in as surrogates; i.e. using CWT recoveries from the surrogate fishery/time step to represent the recipient fishery. This was done for all fisheries that were deemed significant enough to allow future FRAM modeling or for backwards compatibility, i.e. to be able to model a previously existing FRAM fishery for historical evaluations.

# Method

1. Compile and Clean-up CWT recovery summary information

In a first step the group summarized raw CWT recoveries from the new calibration by fishery and time step. Some fisheries had a low number of recoveries during closed periods that were likely grouped in the wrong time step. These recoveries were added to the nearest open time step.

Table 1. Original (left) and revised (right) estimates of unexpanded raw CWT recoveries per fishery and time step. Highlights identify recoveries that were corrected.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Initial CWT Recoveries** | | | **Edited CWT Recoveries** | | |
| **Fish #** | **Fish Name** | **Time 1**  **Oct-Apr** | **Time 2**  **May-Jun** | **Time 3**  **Jul-Sep** | **Time 1**  **Oct-Apr** | **Time 2**  **Jul-Sep** | **Time 3**  **Oct-Apr** |
| 3 | SE Alaska Sport | 1 | 215 | 241 |  | 216 | 241 |
| 18 | NT Area 3:4 Sport | 1 | 25 | 234 |  | 25 | 235 |
| 23 | NrT G. Harbor Net | 1 |  | 6 |  |  | 7 |
| 25 | Willapa Bay Net | 5 |  | 470 |  |  | 475 |
| 31 | Central OR Sport | 10 | 34 | 132 |  | 34 | 142 |
| 33 | KMZ Sport | 1 | 233 | 417 |  | 233 | 418 |
| 34 | So Calif. Troll | 39 | 2250 | 3390 |  | 2289 | 3390 |
| 37 | NT Area 6A:7:7A Net | 1 |  | 59 |  |  | 60 |
| 39 | NT Area 7B-7D Net | 3 |  | 744 |  |  | 747 |
| 40 | Tr Area 7B-7D Net | 5 |  | 776 |  |  | 781 |
| 41 | Tr JDF Troll | 100 | 56 | 1 | 100 | 57 |  |
| 42 | NT Area 5 Sport | 13 | 1 | 617 | 13 |  | 618 |

1. Determine Recipient fisheries and surrogates

As a general rule, if a fishery or time step had fewer than 20 recoveries, it was evaluated for suitable surrogates. The group made an exception to this rule for the Grays Harbor net fishery because there were no appropriate surrogates and the stock composition resulting from the 7 recoveries looked plausible.

CWT recoveries from Puget Sound net fisheries, with the exception of Bellingham Bay, are automatically combined by FRAMbuilder, because non-treaty net fisheries are usually too small to provide a significant number of CWT recoveries. Additionally, coding in the Regional Mark Processing System (RMIS) does often not allow a differentiation between treaty and non-treaty tag recoveries. For the purpose of the cohort reconstruction each fishery of a treaty/non-treaty pair is modeled at 50% of the combined catch. CWT recoveries are adjusted to produce the combined catch.

Unlike the previous base period that only allowed for whole sale replacement of one fishery with another fishery, even if some of the time steps had sufficient recoveries, the new calibration programs have been adapted to allow a more flexible approach.

Surrogate fisheries were assigned using the best judgement and expertise of the workgroup. For fisheries with no obvious surrogates, the group compared the stock composition from the tags on hand (if any) with the current base period before making a final determination. Generally, assignments occurred in the following order:

1. Use the same fishery, but a different time step; i. e. Bellingham Bay net time 3 for Bellingham Bay net time 1. Time steps 2 (May-June) or 3 (Jul- Sep) were always used as a surrogate for each other.
2. Use a fishery in the same area and time step; i.e. Area 9 sport for Area 9 net.
3. Combine several fisheries or time steps rather than replacing CWTs from one fishery with CWTs from another fishery; Central Oregon Sport time 1 (9) and 3 (103) were combined for a total of 112 recoveries to represent both time steps.
4. Use base period exploitation rates (BPER) from the current base period to impute CWT recoveries for the new base period; i.e. WCVI net. This fishery had only 3 recoveries in the new base period. WCVI sport was deemed unsuitable as a surrogate, because the net fishery is located much more terminally than the sport fishery. Instead, the current base period stock composition based on 175 recoveries (time 2) was used as a surrogate (see methods under paragraph “Surrogate Methods”).
5. Use out-of-base fishery method (OOBER) to obtain exploitation rates to impute CWT recoveries for the new base period. This method is similar to the method described in bullet “d”, but develops exploitation rates from brood years that are neither part of the current nor the new base period (see Appendix C); i.e. South Puget Sound net (A13A net). There are too few recoveries in the new base period for this fishery. Base period exploitation rates from the current base period produce a Hood Canal fall fingerling impact that has been deemed too high during previous investigations. Instead a suite of recent brood years with adequate sampling was selected to represent exploitation rate patterns for this fishery.

Table 2. Average marked (mrkd) and total catches in the new base period, raw unexpanded CWT recoveries by time step (T), surrogate matrix, and comments. The surrogate matrix lists the number of CWT recoveries by time step for fisheries without a surrogate. For fisheries with surrogates the matrix lists the surrogate fishery number (F), and/or time step number (T), or “BPER” for fisheries where the current base period exploitation rate is used as a surrogate.

Color Index:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | combine tag recoveries | |  | time step surrogate |  |
|  | previous BPER | |  | fishery & time step surrogate | |
|  | fishery surrogate |  |  | eliminate fishery |  |
|  | out-of-base ER (OOBER) |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Raw CWT recoveries** | | | **Surrogate Matrix** | | |  |
| **Fishery** | **Avg Mrkd Catch** | **Avg Total Catch** | **T 1** | **T2** | **T3** | **T 1** | **T2** | **T3** | **Comment** |
| 1. SE Alaska Troll | 16084 | 179018 | 722 | 369 | 2928 | 722 | 369 | 2928 |  |
| 2. SE Alaska Net | 1051 | 15503 |  | 32 | 150 | \*\*\*\* | 32 | 150 |  |
| 3.SE Alaska Sport | 3995 | 43902 | 1 | 215 | 241 | \*\*\*\* | 216 | 241 | no fishery in time 1 |
| 4.BC No/Cent Net | 274 | 6791 |  |  | 13 | \*\*\*\* | BPER | BPER | due to terminal nature of net fisheries sport fisheries were deemed unsuitable surrogates |
| 5.BC WCVI Net | 115 | 6664 |  | 1 | 2 | BPER | BPER | BPER |
| 6.BC Georgia St Net | 76 | 166 |  |  |  | BPER | BPER | BPER |
| 7.BC JDF Net | 107 | 242 |  |  |  | F 15 | \*\*\*\* | F 15 |  |
| 8.BC Outside Sport | 3458 | 45514 | 14 | 322 | 885 | T 2 | 322 | 885 |  |
| 9.BC No/Cent Troll | 7253 | 72332 |  | 708 | 955 | \*\*\*\* | 708 | 955 | catch not provided by time |
| 10.BC WCVI Troll | 30795 | 80758 | 266 | 1428 | 765 | 266 | 1428 | 765 |  |
| 11.BC WCVI Sport | 14411 | 55459 | 36 | 484 | 1506 | 36 | 484 | 1506 |  |
| 12.BC Geo St Troll | 1 | 1 |  |  |  | F 13 | F 13 | F 13 |  |
| 13.BC N Geo St Sport | 2055 | 13705 | 21 | 136 | 263 | 21 | 136 | 263 |  |
| 14.BC S Geo St Sport | 974 | 10527 | 40 | 82 | 43 | 40 | 82 | 43 |  |
| 15.BC JDF Sport | 10725 | 20079 | 115 | 77 | 226 | 115 | 77 | 226 |  |
| 16.NT A 3:4:4B Troll | 3802 | 10840 |  | 576 | 127 | \*\*\*\* | 576 | 127 |  |
| 17.Tr A 3:4:4B Troll | 12354 | 33089 |  | 725 | 645 | F 41 | 725 | 645 | use winter troll (JDF) |
| 18.NT A 3:4 Sport | 2372 | 4548 | 1 | 25 | 234 | \*\*\*\* | 25 | 235 |  |
| 19.N. WA Coast Net | 0 | 0 |  |  |  | \*\*\*\* | \*\*\*\* | \*\*\*\* | eliminate fishery |
| 20.NT A 2 Troll | 9040 | 14508 |  | 685 | 194 | \*\*\*\* | 785 | 194 |  |
| 21.Tr A 2 Troll | 752 | 1193 |  |  |  | \*\*\*\* | F 20 | F 20 |  |
| 22.NT A 2 Sport | 8685 | 15884 |  | 253 | 700 | \*\*\*\* | 253 | 700 |  |
| 23.NT G. Harbor Net | 215 | 1076 | 1 |  | 6 | \*\*\*\* | \*\*\*\* | 7 | stock comp looks plausible |
| 24.T G. Harbor Net | 562 | 2262 |  |  |  | \*\*\*\* | \*\*\*\* | F 23 | NT/T pair |
| 25.Willapa Bay Net | 8012 | 8821 | 5 |  | 470 | \*\*\*\* | \*\*\*\* | 475 |  |
| 26.A 1 Troll | 3206 | 5526 |  | 386 | 82 | \*\*\*\* | 386 | 82 |  |
| 27.A 1 Sport | 3715 | 6430 |  | 90 | 5950 | \*\*\*\* | 90 | 595 |  |
| 28.Columbia R Net | 0 | 0 |  |  |  | \*\*\*\* | \*\*\*\* | \*\*\*\* | modeled in freshwater |
| 29.Buoy 10 Sport | 0 | 0 |  |  |  | \*\*\*\* | \*\*\*\* | \*\*\*\* | modeled in freshwater |
| 30.Central OR Troll | 4923 | 34096 | 329 | 810 | 422 | 329 | 810 | 422 |  |
| 31.Central OR Sport | 468 | 5128 | 10 | 34 | 132 | T 1/3 | 27 | T 1/3 |  |
| 32.KMZ Troll | 1022 | 6553 |  | 64 | 181 | \*\*\*\* | 64 | 181 |  |
| 33.KMZ Sport | 2974 | 18310 | 1 | 233 | 417 | \*\*\*\* | 233 | 418 |  |
| 34.So Calif. Troll | 14090 | 83194 | 39 | 2250 | 3390 | \*\*\*\* | 2289 | 3390 |  |
| 35.So Calif. Sport | 5588 | 25917 | 514 | 723 | 1448 | 514 | 723 | 1448 |  |
| 36.NT A 7 Sport | 3871 | 6854 | 219 |  | 74 | 219 | T 3 | 74 |  |
| 37.NT A6A:7:7A Net | 109 | 1410 | 1 |  | 59 | T 3 | \*\*\*\* | 60 | NT/T pair |
| 38.T A 6A:7:7A Net | 109 | 1410 |  |  |  | F37T3 | \*\*\*\* | F 37 | NT/T pair |
| 39.NT A 7B-7D Net | 5863 | 7328 | 3 |  | 744 | T 3 | \*\*\*\* | 747 |  |
| 40.T A 7B-7D Net | 9283 | 11625 | 5 |  | 776 | T 3 | \*\*\*\* | 781 |  |
| 41.T JDF Troll | 2116 | 4293 | 100 | 56 | 1 | 100 | 57 | F42T3 |  |
| 42.NT A 5 Sport | 5519 | 11196 | 13 | 1 | 617 | F54T1 | T 3 | 618 | A 5/6 formerly a unit |
| 43.NT JDF Net | 0 | 0 | 1 | 2 | 146 | \*\*\*\* | \*\*\*\* | \*\*\*\* | no fishery in time 1 |
| 44.T JDF Net | 600 | 1443 |  |  |  | F43T3 | \*\*\*\* | F43 | NT/T pair |
| 45.NT A 8-1 Sport | 917 | 1243 | 101 |  |  | 101 | T1 | T1 |  |
| 46.NT Skagit Net | 12 | 28 |  | 2 | 6 |  | \*\*\*\* | T 2/3 | Few recoveries, but small catch and plausible pattern |
| 47.T Skagit Net | 12 | 28 |  |  |  | F46T3 | F46T3 | F46 | NT/T pair |
| 48.NT A 8D Sport | 139 | 220 |  | 3 | 9 | \*\*\*\* | BPER | BPER | No suitable surrogate |
| 49.NT St/Sno Net | 47 | 105 |  |  | 8 | \*\*\*\* | \*\*\*\* | 8 | NT/T pair; no suitable surrogate |
| 50.T St/Sno Net | 47 | 105 |  |  |  | \*\*\*\* | \*\*\*\* | F49T3 | NT/T pair; no suitable surrogate |
| 51.NT Tulalip Net | 747 | 1891 |  | 143 | 64 | T 3 | \*\*\*\* | 64+143 | NT/T pair; T2+3 in T3 |
| 52.T Tulalip Net | 747 | 1891 |  |  |  | F51T3 | \*\*\*\* | F 51 | NT/T pair; T2+3 in T3 |
| 53.NT A 9 Sport | 5853 | 8450 | 70 |  | 284 | 70 | T 3 | 284 |  |
| 54.NT A 6 Sport | 3434 | 5161 | 95 |  | 129 | 95 | T 3 | 129 |  |
| 55.T A 6B:9 Net | 85 | 98 | 8 |  |  | F 53 | \*\*\*\* | F 53 |  |
| 56.NT A 10 Sport | 2970 | 4167 | 50 |  | 261 | 50 | T 3 | 261 |  |
| 57.NT A 11 Sport | 5630 | 8416 | 29 | 41 | 206 | 29 | 41 | 206 |  |
| 58.NT A 10:11 Net | 15 | 19 | 7 |  | 4 | F 56 | \*\*\*\*\* | F 56 | NT/T pair |
| 59.T A 10:11 Net | 15 | 19 |  |  |  | F 56 | \*\*\*\* | F 56 | NT/T pair |
| 60.NT A 10A Sport | 603 | 779 |  |  |  | F61T3 | \*\*\*\* | F 61 |  |
| 61.T A 10A Net | 444 | 545 |  |  | 119 | T 3 | \*\*\*\* | 119 |  |
| 62.NT A 10E Sport | 244 | 354 |  |  |  | F63T3 | \*\*\*\* | F 63 |  |
| 63.T A 10E Net | 2549 | 2967 |  |  | 30 | T 3 | \*\*\*\* | 30 |  |
| 64.NT A 12 Sport | 1217 | 2068 | 71 |  | 12 | 71 | T 1 | F65T3 |  |
| 65.NT Hood Cnl Net | 2811 | 3203 | 2 |  | 144 | F 64 | \*\*\*\* | 144 | NT/T pair |
| 66.T Hood Cnl Net | 2811 | 3203 |  |  |  | F 64 | \*\*\*\* | F 65 | NT/T pair |
| 67.NT A 13 Sport | 1406 | 2377 | 4 | 6 | 12 | **F67T3** | **F67T3** | **OOBER** |  |
| 68.NT SPS Net | 2726 | 3143 |  |  | 14 | **BPER** | **\*\*\*\*** | **BPER** |
| 69.Tr SPS Net | 2726 | 3143 |  |  |  | **BPER** | **\*\*\*\*** | **BPER** |
| 70.NT A 13A Net | 1827 | 2144 |  |  | 4 | F70T3 | \*\*\*\* | **OOBER** |
| 71.Tr A 13A Net | 1827 | 2144 | 0 | 0 | 0 | F70T3 | \*\*\*\* | F70T3 |

# Surrogate Methods

For documentation and repeatability purposes all surrogate fisheries are processed in module “ImputeRecov” of the “MainCalibration” program. Instruction for surrogate fisheries are located in table “ImputeRecoveries” of the “CalibrationSupport” database (Appendix A). The “Type” column of the “ImputeRecoveries” table specifies the method, whereas the columns “RecipientFishery” and “RecipientTimeStep” specify the fishery number and time step receiving CWT information from a surrogate fishery (column “SurrogateFishery”) and surrogate time step (column “SurrogateTimeStep”).

Unless otherwise specified CWTs from the recipient fishery and time step are replaced with CWTs from the surrogate fishery and time step and divided by 1000. This results in a recipient fishery with an identical stock composition as the surrogate fishery but only 1/1000 of the CWT catch of the surrogate.

Equation 1:

CWT(Stock, Age, RecipientFishery, RecipientTimeStep) += CWT(Stock, Age, SurrogateFishery, SurrogateTimeStep) / 1000

The original intent of this division was to keep the recipient catch small under the assumption that a lack of sufficient CWT recoveries is due to small catches. This provides a fishery with a stock composition for modeling, while minimally influencing the cohort reconstruction. For out of base runs (OOB) the recipient fishery is not re-adjusted and hence stays at the low value, for the “All Stocks” run CWTs from the recipient fishery are later adjusted so that the CWT catch matches the estimated catch in the fishery. This produces a model stock proportion of 100% for all recipient fisheries. For this calibration, algorithms were further adjusted to allow the incorporation of an external model stock proportion (see paragraph “Surrogate Fisheries and Model Stock Proportion”).

The following surrogate methods are available:

* Type 0: This is currently the only method for out of base stocks. It results in the replacement of the recipient fishery and time step with the surrogate fishery and time step and uses the divide by 1000 equation to scale recoveries (equation 1).
* Type 1: Combines recoveries for a fishery from different time steps and/or fisheries. The surrogate fishery and/or time step is deleted. Recipient CWTs are not divided by 1000. This method is commonly used to edit CWT recoveries in cases where recoveries were reported in the wrong time step. These recoveries are added to the correct time step and zeroed out in the incorrect time step. This method is also used to combine recoveries from multiple fisheries and time step to gain an adequate number of recoveries for analysis; i.e. deep SPS (Area 13+) net and sport.
* Type 2: Same as Type 0. Allows for replacement of a fishery and time step with another time step and/or fishery and uses the divide by 1000 equation to scale recoveries (equation 1). Zeroes out the original fishery/time step. This method is used for most fisheries and conforms to the standard surrogate fishery replacement concept.
* Type 3: This method eliminates a fishery and time step

CWT(Stock, Age, RecipientFishery, RecipientTimeStep) = 0

* Type 9: This method uses base period exploitation rates from the previous calibration or the out-of-base fishery method (Appendix C) to impute CWT recoveries for the recipient fishery. These base period exploitation rates are stored in table “SurrogateFishBPER” of the “CalibrationSupport” database. The “ImputeRecoveries” table designates the surrogate fishery and time step for use of base period exploitation rates. The base period exploitation rates are applied to the legal cohort sizes of the exploited stocks in the fishery.

Equation 2:

CWT (Stock, Age, RecipientFishery, RecipientTimeStep) = Cohort(Stock, Age, TimeStep) \* SurrogateFishery BPER(Stock, Age, SurrogateFishery, SurrogateTimeStep) \* LegalProportion

For a recipient fishery and time step the imputed CWT recoveries are summed over stocks and ages to compute the CWTCatch.

Equation 3:

The surrogate CWT recoveries are then adjusted according to the rules in the “BasePeriodCatch” table (see chapter “Surrogate Fisheries and Model Stock Proportion”). The goal of the adjustment is to match CWT catches to estimates of actual catches or actual catches times model stock proportion.

CWT recoveries, catches, and cohort sizes are iteratively computed until the cohort size stabilizes.

# Surrogate Fisheries and Model Stock Proportions

In the previous base period, CWT recoveries for recipient fisheries were either set to very small values (divide by 1000 in the out of base run) or adjusted to match base period catch (All Stocks run). As long as recipient fisheries were small, this resulted in a small error. Some recipient fisheries are quite large and have significant non-model stock proportions. In the new calibration program, the user has the option of externally assigning non-model stock proportions for these fisheries.

Handling of CWTCatch is specified in table “BasePeriodCatch” of the “CalibrationSupport” database. A flag of 0 specifies no adjustment, a flag of 1 adjusts the CWTCatch to match the estimated catch, a flag of 2 adjusts the CWTCatch to match the estimated catch if the CWTCatch exceeds the estimated catch, and a flag of 3 adjusts the CWTCatch to equal estimated catch times an external model stock proportion. External model stock proportions are specified in column “ModelStockProportion” of the “BasePeriodCatch” table.

Table 3. Model stock proportions for recipient fisheries

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **Surrogate Matrix** | | |  |  |  |  |
| **Fishery** | **Avg Mrkd Catch** | **Avg Total Catch** | **T 1** | **T2** | **T3** | **Model Stock Proportion (MSP) Approach** | **Flag** | **MSP Mrkd Run** | **MSP Total Run** |
| 4.BC No/Cent Net | 274 | 6791 | \*\*\*\* | BPER | BPER | use CTC model STk PPN | 3 | 1 | 86.5% |
| 5.BC WCVI Net | 115 | 6664 | BPER | BPER | BPER | use CTC model STk PPN | 3 | 1 | 98.6% |
| 6.BC Georgia St Net | 76 | 166 | BPER | BPER | BPER | use CTC model STk PPN | 3 | 1 | 92.0% |
| 7.BC JDF Net | 107 | 242 | F 15 | \*\*\*\* | F 15 | Flag 1, small catch | 1 |  |  |
| 8.BC Outside Sport | 3458 | 45514 | T 2 | 322 | 885 | no change; just divide T1 by 1000 | 2 |  |  |
| 12.BC Geo St Troll | 1 | 1 | F 13 | F 13 | F 13 | Flag 1; negligible catch | 1 |  |  |
| 14.BC S Geo St Sport | 974 | 10527 | 40 | 82 | 43 | Flag 1, MSP in old BP was 100% | 1 |  |  |
| 17.Tr A 3:4:4B Troll | 12354 | 33089 | F 41 | 725 | 645 | no change; just divide T1 by 1000 | 2 |  |  |
| 21.Tr A 2 Troll | 752 | 1193 | \*\*\*\* | F 20 | F 20 | GSI for total, set at 100% for mrkd | 3 | 1 | 99% |
| 23.NT G. Harbor Net | 215 | 1076 | \*\*\*\* | \*\*\*\* | 7 | no change | 2 |  |  |
| 24.T G. Harbor Net | 562 | 2262 | \*\*\*\* | \*\*\*\* | F 23 | use MSP from first calibration round; see “Modeling Grays Harbor Net…” | 3 | 35.3% | 11.3% |
| 31.Central OR Sport | 468 | 5128 | T 1/3 | 27 | T 1/3 | no change; just divide T1 by 1000 | 2 | 1 | 53% |
| 36.NT A 7 Sport | 3871 | 6854 | 219 | T 3 | 74 | no change model at 100% MSP | 1 |  |  |
| 37.NT A6A:7:7A Net | 109 | 1410 | T 3 | \*\*\*\* | 60 | no change model at 100% MSP | 1 |  |  |
| 38.T A 6A:7:7A Net | 109 | 1410 | F37T3 | \*\*\*\* | F 37 | no change model at 100% MSP | 1 |  |  |
| 39.NT A 7B-7D Net | 5863 | 7328 | T 3 | \*\*\*\* | 747 | no change model at 100% MSP | 1 |  |  |
| 40.T A 7B-7D Net | 9283 | 11625 | T 3 | \*\*\*\* | 781 | no change model at 100% MSP | 1 |  |  |
| 41.T JDF Troll | 2116 | 4293 | 100 | 57 | F42T3 | no change model at 100% MSP | 1 |  |  |
| 42.NT A 5 Sport | 5519 | 11196 | F54T1 | T 3 | 618 | no change model at 100% MSP | 2 |  |  |
| 44.T JDF Net | 600 | 1443 | F43T3 | \*\*\*\* | F43 | no change model at 100% MSP | 1 |  |  |
| 45.NT A 8-1 Sport | 917 | 1243 | 101 | T1 | T1 | no change model at 100% MSP | 1 |  |  |
| 46.NT Skagit Net | 12 | 28 |  | \*\*\*\* | **8** | no change model at 100% MSP | 1 |  |  |
| 47.T Skagit Net | 12 | 28 | F46T3 | F46T3 | F46T3 | no change model at 100% MSP | 1 |  |  |
| 48.NT A 8D Sport | 139 | 220 | \*\*\*\* | BPER | BPER | no change model at 100% MSP | 1 |  |  |
| 49.NT St/Sno Net | 47 | 105 | BPER F49T3 | \*\*\*\* | BPER F49T3 | no change model at 100% MSP | 1 |  |  |
| 50.T St/Sno Net | 47 | 105 | BPER F49T3 | BPER F49T3 | BPER F49T3 | no change model at 100% MSP | 1 |  |  |
| 51.NT Tulalip Net | 747 | 1891 | T 3 | 143 | 64 | no change model at 100% MSP | 1 |  |  |
| 52.T Tulalip Net | 747 | 1891 | F51T3 | F 51 | F 51 | no change model at 100% MSP | 1 |  |  |
| 53.NT A 9 Sport | 5853 | 8450 | 70 | T 3 | 284 | no change model at 100% MSP | 1 |  |  |
| 54.NT A 6 Sport | 3434 | 5161 | 95 | T 3 | 129 | no change model at 100% MSP | 1 |  |  |
| 55.T A 6B:9 Net | 85 | 98 | F 53 | \*\*\*\* | F 53 | no change model at 100% MSP | 1 |  |  |
| 56.NT A 10 Sport | 2970 | 4167 | 50 | T 3 | 261 | no change model at 100% MSP | 1 |  |  |
| 58.NT A 10:11 Net | 15 | 19 | F 56 | \*\*\*\*\* | F 56 | no change model at 100% MSP | 1 |  |  |
| 59.T A 10:11 Net | 15 | 19 | F 56 | \*\*\*\* | F 56 | no change model at 100% MSP | 1 |  |  |
| 60.NT A 10A Sport | 603 | 779 | F61T3 | \*\*\*\* | F 61 | no change model at 100% MSP | 1 |  |  |
| 61.T A 10A Net | 444 | 545 | T 3 | \*\*\*\* | 119 | no change model at 100% MSP | 1 |  |  |
| 62.NT A 10E Sport | 244 | 354 | F63T3 | \*\*\*\* | F 63 | no change model at 100% MSP | 1 |  |  |
| 63.T A 10E Net | 2549 | 2967 | T 3 | \*\*\*\* | 30 | no change model at 100% MSP | 1 |  |  |
| 64.NT A 12 Sport | 1217 | 2068 | 71 | T 1 | F65T3 | no change model at 100% MSP | 1 |  |  |
| 65.NT Hood Cnl Net | 2811 | 3203 | F 64 | \*\*\*\* | 144 | no change model at 100% MSP | 1 |  |  |
| 66.T Hood Cnl Net | 2811 | 3203 | F 64 | \*\*\*\* | F 65 | no change model at 100% MSP | 1 |  |  |
| 67.NT A 13 Sport | 1406 | 2377 | **F67T3** | **F67T3** | **OOBER** | no change model at 100% MSP | 1 |  |  |
| 68.NT SPS Net | 2726 | 3143 | **BPER** | **\*\*\*\*** | **BPER** | no change model at 100% MSP | 1 |  |  |
| 69.Tr SPS Net | 2726 | 3143 | **BPER** | **\*\*\*\*** | **BPER** | no change model at 100% MSP | 1 |  |  |
| 70.NT A 13A Net | 1827 | 2144 | F70T3 | \*\*\*\* | **OOBER** | no change model at 100% MSP | 1 |  |  |
| 71.Tr A 13A Net | 1827 | 2144 | F70T3 | \*\*\*\* | F70T3 | no change model at 100% MSP | 1 |  |  |

# Appendix A. Surrogate Fishery Assignments

| **ImputeRecoveries** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **ID** | **Type** | **SurrogateFishery** | **SurrogateTimeStep** | **RecipientFishery** | **RecipientTimeStep** |
| 698 | 1 | 3 | 1 | 3 | 2 |
| 699 | 9 | 4 | 2 | 4 | 2 |
| 700 | 9 | 4 | 3 | 4 | 3 |
| 701 | 9 | 5 | 1 | 5 | 1 |
| 702 | 9 | 5 | 2 | 5 | 2 |
| 703 | 9 | 5 | 3 | 5 | 3 |
| 704 | 9 | 6 | 1 | 6 | 1 |
| 705 | 9 | 6 | 2 | 6 | 2 |
| 706 | 9 | 6 | 3 | 6 | 3 |
| 707 | 2 | 15 | 1 | 7 | 1 |
| 708 | 2 | 15 | 3 | 7 | 3 |
| 709 | 2 | 8 | 2 | 8 | 1 |
| 710 | 3 | 9 | 1 | 9 | 1 |
| 711 | 2 | 13 | 1 | 12 | 1 |
| 712 | 2 | 13 | 2 | 12 | 2 |
| 713 | 2 | 13 | 3 | 12 | 3 |
| 716 | 2 | 41 | 1 | 17 | 1 |
| 717 | 1 | 18 | 1 | 18 | 3 |
| 718 | 3 | 19 | 1 | 19 | 1 |
| 719 | 3 | 19 | 2 | 19 | 2 |
| 720 | 3 | 19 | 3 | 19 | 3 |
| 721 | 2 | 20 | 2 | 21 | 2 |
| 722 | 2 | 20 | 3 | 21 | 3 |
| 723 | 1 | 23 | 1 | 23 | 3 |
| 724 | 2 | 23 | 3 | 24 | 3 |
| 725 | 1 | 25 | 1 | 25 | 3 |
| 726 | 2 | 31 | 3 | 31 | 1 |
| 727 | 1 | 31 | 1 | 31 | 3 |
| 728 | 3 | 32 | 1 | 32 | 1 |
| 729 | 1 | 33 | 1 | 33 | 3 |
| 730 | 1 | 34 | 1 | 34 | 2 |
| 731 | 2 | 36 | 3 | 36 | 2 |
| 732 | 1 | 37 | 1 | 37 | 3 |
| 733 | 2 | 37 | 3 | 37 | 1 |
| 734 | 2 | 37 | 3 | 38 | 1 |
| 735 | 2 | 37 | 3 | 38 | 3 |
| 736 | 1 | 39 | 1 | 39 | 3 |
| 737 | 2 | 39 | 3 | 39 | 1 |
| 738 | 1 | 40 | 1 | 40 | 3 |
| 739 | 2 | 40 | 3 | 40 | 1 |
| 740 | 1 | 41 | 3 | 41 | 2 |
| 741 | 2 | 42 | 3 | 41 | 3 |
| 742 | 1 | 42 | 2 | 42 | 3 |
| 743 | 2 | 42 | 3 | 42 | 2 |
| 744 | 2 | 54 | 1 | 42 | 1 |
| 745 | 2 | 43 | 3 | 44 | 3 |
| 746 | 2 | 43 | 3 | 44 | 1 |
| 749 | 2 | 45 | 1 | 45 | 2 |
| 750 | 2 | 45 | 1 | 45 | 3 |
| 751 | 1 | 46 | 2 | 46 | 3 |
| 752 | 2 | 46 | 3 | 47 | 1 |
| 753 | 2 | 46 | 3 | 47 | 2 |
| 754 | 2 | 46 | 3 | 47 | 3 |
| 755 | 9 | 48 | 3 | 48 | 2 |
| 756 | 9 | 48 | 3 | 48 | 3 |
| 757 | 9 | 49 | 3 | 49 | 1 |
| 758 | 9 | 49 | 3 | 49 | 3 |
| 759 | 9 | 49 | 3 | 50 | 1 |
| 760 | 9 | 49 | 3 | 50 | 2 |
| 761 | 9 | 49 | 3 | 50 | 3 |
| 762 | 2 | 51 | 3 | 51 | 1 |
| 763 | 2 | 51 | 3 | 52 | 1 |
| 764 | 2 | 51 | 2 | 52 | 2 |
| 765 | 2 | 51 | 3 | 52 | 3 |
| 766 | 2 | 53 | 3 | 53 | 2 |
| 767 | 2 | 54 | 3 | 54 | 2 |
| 768 | 2 | 53 | 1 | 55 | 1 |
| 769 | 2 | 53 | 3 | 55 | 3 |
| 770 | 2 | 56 | 3 | 56 | 2 |
| 771 | 2 | 56 | 1 | 58 | 1 |
| 772 | 2 | 56 | 3 | 58 | 3 |
| 773 | 2 | 56 | 1 | 59 | 1 |
| 774 | 2 | 56 | 3 | 59 | 3 |
| 775 | 2 | 61 | 3 | 60 | 1 |
| 776 | 2 | 61 | 3 | 60 | 3 |
| 777 | 2 | 61 | 3 | 61 | 1 |
| 778 | 2 | 63 | 3 | 62 | 1 |
| 779 | 2 | 63 | 3 | 62 | 3 |
| 780 | 2 | 63 | 3 | 63 | 1 |
| 781 | 2 | 64 | 1 | 64 | 2 |
| 782 | 2 | 65 | 3 | 64 | 3 |
| 783 | 2 | 64 | 1 | 65 | 1 |
| 784 | 2 | 64 | 1 | 66 | 1 |
| 785 | 2 | 65 | 3 | 66 | 3 |
| 821 | 9 | 67 | 3 | 67 | 1 |
| 822 | 9 | 67 | 3 | 67 | 2 |
| 823 | 9 | 67 | 3 | 67 | 3 |
| 824 | 9 | 68 | 1 | 68 | 1 |
| 825 | 9 | 68 | 3 | 68 | 3 |
| 826 | 9 | 69 | 1 | 69 | 1 |
| 827 | 9 | 69 | 3 | 69 | 3 |
| 828 | 9 | 70 | 3 | 70 | 1 |
| 829 | 9 | 70 | 3 | 70 | 3 |
| 830 | 9 | 70 | 3 | 71 | 1 |
| 831 | 9 | 70 | 3 | 71 | 3 |

# Appendix B. VISUAL BASIC CODE FOR COMPUTING Surrogate Feries

Module ImputeRecov

' Impute recoveries

Sub Impute()

Dim IF As Integer

Dim ITStep As Integer

Dim SF As Integer

Dim STStep As Integer

Dim Imputecatch As String

Dim FTSCatchOrig(NumF, NumSteps) As Double

Dim FTSCatchNew(NumF, NumSteps) As Double

Dim CWTAllOrig(NumStk, MaxAge, NumF, NumSteps) As Double

Dim AdjCheck(NumF, NumSteps) As Boolean

Imputecatch = filepath & "\" & "ImputeCatch.txt"

FileOpen(15, Imputecatch, OpenMode.Output)

Print(15, "Stock, Age, F, TStep, CWT" & vbCrLf)

'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

'AHB 8/21/2015

'

'Type 0 for surrogates needed for OOB stocks

'Type 1 combines recoveries for a Fery from different time steps. This is done before surrogates are processed. Recipient time step is deleted

'Type 11 combines recoveries for a Fery from different time steps. Source time step is included in combo. Feries are rescaled to original size.

'Type 2 flag reassigns or combines CWTs to new time step or Fery based on records in ImputeRecoveries table'Type'= original concept

'Type 3 zero out Fery and time step

'Type 9 applies exploitation rates from old base period (processed in ImputeOldBPERs(), not here)

If OOBStatus = 1 Or Firstpass = True Then

BaseType = 0

Else

BaseType = 1

End If 'during the last base period calibration OOB stocks had different imputed Feries than Allstocks

If BaseType = 0 Then

'this code needs to be reviewed to make sure it works with all the new BaseType options!!!! AHB 8/21/15

Dim newlist As New List(Of CWTData)

Dim newlist2 As New List(Of CWTData)

Dim imputerecoveries As CWTData

For Each ImputeItem In ImputeList

If BaseType = ImputeItem.cBaseType Then

'find all the records that meet criteria set in findRecord

sublist = CWTList.FindAll(AddressOf findRecord)

For Each RecordCWT In sublist

imputerecoveries.cCatch = Math.Round(RecordCWT.cCatch / 1000, 4)

imputerecoveries.cF = ImputeItem.cImputedF

imputerecoveries.cBY = RecordCWT.cBY

imputerecoveries.cStk = RecordCWT.cStk

imputerecoveries.cAge = RecordCWT.cAge

imputerecoveries.cStage = RecordCWT.cStage

imputerecoveries.cTStep = ImputeItem.cImputedTStep

imputerecoveries.cLookUp = RecordCWT.cLookUp

newlist.Add(imputerecoveries)

Next

'newlist.AddRange(sublist) 'add sublist to newlist for each row in ImputeItem

End If

Next

Dim Deletelist As New List(Of CWTData)

For Each ImputeItem In ImputeList

If BaseType = ImputeItem.cBaseType Then

'delete records that are going to be replaced with the source Fery

'Deletelist = CWTList.FindAll(AddressOf FindDelRec)

CWTList.RemoveAll(AddressOf FindDelRec)

End If

Next

CWTList.AddRange(newlist)

End If

'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

'impute for all stocks file using array

'store original Fery catches

For STk = 1 To NumStk

For Age = 2 To MaxAge

For F = 1 To NumF - 1

For TStep = 1 To NumSteps

FTSCatchOrig(F, TStep) += CWTAll(STk, Age, F, TStep)

CWTAllOrig(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep)

Next

Next

Next

Next

'add CWTs from source F/ts to imputed F/ts

'if BaseType = 1, delete source value; if BaseType = 11, divide sum by 1000; if BaseType = 111 add time steps preserve source value

For Each ImputeItem In ImputeList

If ImputeItem.cBaseType = 1 Or ImputeItem.cBaseType = 11 Or ImputeItem.cBaseType = 111 Then

IF = ImputeItem.cImputedF

ITStep = ImputeItem.cImputedTStep

SF = ImputeItem.cSourceF

STStep = ImputeItem.cSourceTStep

For STk = 1 To NumStk

For Age = 2 To MaxAge

If ImputeItem.cBaseType = 1 Then

CWTAll(STk, Age, IF, ITStep) += CWTAllOrig(STk, Age, SF, STStep)

CWTAll(STk, Age, SF, STStep) = 0

End If

If ImputeItem.cBaseType = 11 Then

CWTAll(STk, Age, IF, ITStep) += Math.Round(CWTAllOrig(STk, Age, SF, STStep) / 1000, 4, MidpointRounding.AwayFromZero)

End If

If ImputeItem.cBaseType = 111 Then

CWTAll(STk, Age, IF, ITStep) += CWTAllOrig(STk, Age, SF, STStep)

End If

Next

Next

End If

Next

'zero out CWTs to be replaced then start the surrogate process that also allows for adding Feries and time steps

For Each ImputeItem In ImputeList

If ImputeItem.cBaseType = 2 Or ImputeItem.cBaseType = 3 Then

IF = ImputeItem.cImputedF

ITStep = ImputeItem.cImputedTStep

SF = ImputeItem.cSourceF

STStep = ImputeItem.cSourceTStep

For STk = 1 To NumStk

For Age = 2 To MaxAge

CWTAll(STk, Age, IF, ITStep) = 0

If ImputeItem.cBaseType = 2 Then

CWTAll(STk, Age, IF, ITStep) += Math.Round(CWTAll(STk, Age, SF, STStep) / 1000, 4, MidpointRounding.AwayFromZero)

End If

Next

Next

End If

Next

'For debugging purposes, recompute FTSCatchNew and output CWTAll where > 0

ReDim FTSCatchNew(NumF, NumSteps)

For STk = 1 To NumStk

For Age = 2 To MaxAge

For F = 1 To NumF

For TStep = 1 To NumSteps

If CWTAll(STk, Age, F, TStep) > 0 Then

Print(15, STk & "," & Age & "," & F & "," & TStep & "," & CWTAll(STk, Age, F, TStep) & vbCrLf)

End If

Next

Next

Next

Next STk

FileClose(15)

End Sub

'########## Begin JC Update; 9/25/2015 ##########

'subroutine to compute CWTs for Feries using BPERERs as surrogates after cohort sizes are available or change with each iteration

'!!! method needs to be applied to the entire Fery (all time steps) !!!!

Sub ImputeOldBPERs()

Dim SF As Integer

Dim STStep As Integer

Dim FTSCatchOrig(NumF, NumSteps) As Double

Dim FTSCatchNew(NumF, NumSteps) As Double

ReDim BPERFeries(NumF)

Dim ExpCWTfile As String

ExpCWTfile = filepath & "ExpCWTfile.txt"

FileOpen(3, ExpCWTfile, OpenMode.Output)

'zero out arrays & Estimate CWT catch for Feries using BPERER as surrogate

For Each ImputeItem In ImputeList

If ImputeItem.cBaseType = 9 Then

F = ImputeItem.cImputedF

TStep = ImputeItem.cImputedTStep

SF = ImputeItem.cSourceF

STStep = ImputeItem.cSourceTStep

FYear = 2010

TermStat = TermFlag(FNum, TStep)

TimeCatch(F, TStep) = 0

TotCatch(F, TStep) = 0

AnnualCatch(F) = 0

For STk = MinStk To NumStk

StockCatch(STk, F) = 0

StockCatchProp(STk, F) = 0

For Age = 2 To MaxAge

CWTAll(STk, Age, F, TStep) = 0

TotExpCWTAll(STk, Age, F, TStep) = 0

Next

Next STk

BPERFeries(F) = 1

'Estimate recoveries using BPERERs

For STk = 1 To NumStk

For Age = 2 To MaxAge

CompLegProp()

CWTAll(STk, Age, F, TStep) = CohortAll(STk, Age, TermStat, TStep) \* SurrogateFBP\_ER(STk, Age, SF, STStep) \* LegalProp

'this is equivalent to CWTAll expanded for escapement (PEF)

Next

Next

End If

Next

'ADD CATCH

'COMPUTE TOTAL CATCH IN EACH FERY

For F = 1 To NumF

If BPERFeries(F) = 1 Then

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotCatch(F, TStep) = TotCatch(F, TStep) + CWTAll(STk, Age, F, TStep)

AnnualCatch(F) = AnnualCatch(F) + CWTAll(STk, Age, F, TStep)

StockCatch(STk, F) = StockCatch(STk, F) + CWTAll(STk, Age, F, TStep)

StockCatchProp(STk, F) = StockCatchProp(STk, F) + CWTAll(STk, Age, F, TStep)

TimeCatch(F, TStep) = TimeCatch(F, TStep) + CWTAll(STk, Age, F, TStep)

End If

Next Age

Next STk

Next TStep

End If

Next

'ADJUST CATCH

For F = 1 To NumF

If BPERFeries(F) = 1 Then

Select Case CatchFlag(F) 'located in cal file to the right of base period Fery catches or in BasePeriodCatch table of Calibration Support db

' ADJUST MODEL CATCH TO ESTIMATE CATCH

Case 1

RecAdjFactor(F) = TrueCatch(F) / AnnualCatch(F) 'true catch = base period catch

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotExpCWTAll(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep) \* RecAdjFactor(F)

End If

Next Age

Next STk

Next TStep

' ADJUST MODEL CATCH IF GREATER THAN ESTIMATED CATCH

Case 2

RecAdjFactor(F) = TrueCatch(F) / AnnualCatch(F)

If RecAdjFactor(F) < 1 Then

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotExpCWTAll(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep) \* RecAdjFactor(F)

End If

Next Age

Next STk

Next TStep

Else

RecAdjFactor(F) = 99

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotExpCWTAll(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep)

End If

Next Age

Next STk

Next TStep

End If

' ADJUST MODEL CATCH TO ESTIMATE CATCH

Case 3

RecAdjFactor(F) = TrueCatch(F) \* ExternalModelStockProportion(F) / AnnualCatch(F) 'true catch = base period catch

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotExpCWTAll(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep) \* RecAdjFactor(F)

End If

Next Age

Next STk

Next TStep

'NO ADJUSTMENT

Case Else

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If CWTAll(STk, Age, F, TStep) > 0 Then

TotExpCWTAll(STk, Age, F, TStep) = CWTAll(STk, Age, F, TStep)

End If

Next Age

Next STk

Next TStep

RecAdjFactor(F) = 99

End Select

End If

Next

'ADD CATCH

'COMPUTE TOTAL CATCH IN EACH FERY

For F = 1 To NumF

If BPERFeries(F) = 1 Then

AnnualCatch(F) = 0

For TStep = 1 To NumSteps

TimeCatch(F, TStep) = 0

TotCatch(F, TStep) = 0

Next

For STk = MinStk To NumStk

StockCatch(STk, F) = 0

StockCatchProp(STk, F) = 0

Next STk

For TStep = 1 To NumSteps

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If TotExpCWTAll(STk, Age, F, TStep) > 0 Then

TotCatch(F, TStep) = TotCatch(F, TStep) + TotExpCWTAll(STk, Age, F, TStep)

AnnualCatch(F) = AnnualCatch(F) + TotExpCWTAll(STk, Age, F, TStep)

StockCatch(STk, F) = StockCatch(STk, F) + TotExpCWTAll(STk, Age, F, TStep)

StockCatchProp(STk, F) = StockCatchProp(STk, F) + TotExpCWTAll(STk, Age, F, TStep)

TimeCatch(F, TStep) = TimeCatch(F, TStep) + TotExpCWTAll(STk, Age, F, TStep)

End If

Next Age

Next STk

Next TStep

'COMPUTE PROPORTION OF CATCH COMPRISED OF EACH STOCK

If AnnualCatch(F) > 0 Then

For STk = MinStk To NumStk

StockCatchProp(STk, F) = StockCatch(STk, F) / AnnualCatch(F)

Next STk

End If

End If

Next F

Print(3, "Stock" & "," & "Age" & "," & "F" & "," & "TStep" & "," & "Catch" & vbCrLf)

For TStep = 1 To NumSteps

For F = 1 To NumF - 1

If F = 4 And TStep = 3 Then

TStep = 3

End If

For STk = MinStk To NumStk

For Age = 2 To MaxAge

If TotExpCWTAll(STk, Age, F, TStep) > 0 Then

Print(3, STk & "," & Age & "," & F & "," & TStep & "," & TotExpCWTAll(STk, Age, F, TStep) & vbCrLf)

End If

Next Age

Next STk

Next F

Next TStep

FileClose(3)

End Sub '########## End JC Update; 9/25/2015 ##########

'Function findRecord(ByVal b As CWTData) As Boolean

Function findRecord(ByVal b As CWTData) As Boolean

If (b.cF = ImputeItem.cSourceF And b.cTStep = ImputeItem.cSourceTStep) Then

Return True

Else

Return False

End If

End Function

Function FindDelRec(ByVal d As CWTData) As Boolean 'find records to delete

n = n + 1

If (d.cF = ImputeItem.cImputedF And d.cTStep = ImputeItem.cImputedTStep) Then

Return True

Else

Return False

End If

End Function

End Module

# Appendix C. Out-of-base fishery method

This method was used for fisheries where none of the previously discussed methods were feasible; i.e. no suitable surrogates in the new base period, problematic exploitation rates in the current base period, etc.

South Puget Sound (Area 13) sport and net fisheries have very few CWT recoveries during the new base period years due to sporadic sampling and tagging or a lack of access to landed catches.

This method developed base period exploitation rates from select fisheries from brood years that differ from the new as well as the current base period using the following steps:

1. Select brood years with adequate number of CWT recoveries. See also “SouthSoundSurrogateTagWorkup.xlsx” for more information.
2. Identify FRAM stock aggregates contributing to the recoveries from step 1. Marked recoveries were used for all stocks except White River Yearlings, because this stock was not marked.
3. Select tag groups for brood years and stocks identified
4. Impute missing freshwater sport recoveries
5. Summarizes CWTs by running through FRAMbuilder (manual summary for White Yearlings) and import into main calibration database table “CWTforSPS\_SurrogateMethod”.
6. Run recoveries from main calibration database table “CWTforSPS\_SurrogateMethod”. Select run option for “Cohort Reconstruction w/o Expansions”. This produces a cohort reconstruction without escapement expansions (production expansion factors) , fishery expansions, incidental mortalities (routines not set up for single stock runs), and surrogate fishery methods (not needed for this method).
7. Paste exploitation rates produced during previous step for selected fisheries and time steps into table “SurrogateFishBPER”
8. Set flagging in table “ImputeRecoveries” to initiate “Type 9”method described above.

Area 13 sport and Area 13A net were identified as prime candidates for this method, because there were very few tag recoveries in the new base period (Area 13 sport: 4 tags time 1, 7 tags time 2, 12 tags time 3; Area 13A net: 4 tags time 4). There were no obvious surrogates for these fisheries as none of the deep South Puget Sound fisheries had sufficient tag recoveries. The old base period exploitation rate method was considered, but produced very high Hood Canal fall fingerling impacts (> 50%) for the sport fishery due to different availability of legal sized age-2 Chinook; a consequence of the new growth functions.

During step 1 tag recoveries for fishing year1995 to 2013 were evaluated.

Table 1. Number of tag recoveries by brood year and fishery

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Fishery** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** |
| 13+Net | 24 | 7 | 9 | 9 | 8 | 2 |  | 1 | 1 | 3 | 6 | 13 | 1 |  | 21 | 5 |
| 13ANet |  |  |  | 2 | 4 | 1 | 6 | 13 | 11 | 108 | 268 | 82 | 2 | 3 | 5 |  |
| 13Sport | 46 | 25 | 38 | 51 | 94 | 23 | 12 | 19 | 7 | 21 | 27 | 70 | 10 | 5 | 4 | 7 |

Brood years 2002 to 2004 had sufficient recoveries for Area 13 sport and Area 13A net, but few recoveries for Area 13+ net. These brood years were selected for out-of-base recoveries. 13+ was eliminated from the out-of-base fishery method, because of the low number of CWT recoveries. This fishery will instead be incorporated using the current base period exploitation rate method *(or alternative approach from regional bios).*

Table 2. Number of fingerling (f) and yearling (y) tag recoveries by FRAM stock for brood years 2002 to 2004

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fishery** | **HDF** | **HDY** | **MPS** | **SKS** | **SPS** | **SPY** | **TUL** | **WHITE Y** | **Grand Total** |
| 13+ |  |  | 1 |  | 10 | 8 |  |  | 19 |
| 13A Net | 5 | 1 | 9 |  | 379 | 17 |  |  | 411 |
| 13 Sport | 2 | 3 | 9 | 2 | 38 | 42 | 1 | 3 | 100 |

Based on the stocks encountered in table 2, the following stocks and tag codes were included in the out-of-base fishery analysis:

* Upper South Puget Sound Fall Fingerlings (Stk ID 11)

210479, 210546, 210592, 630992, 631386, 631780, 631784, 632283, 632378, 632385, 632388, 632964, 632967, 632972

* Deep South Puget Sound Fall Fingerlings (Stk ID 13)

210483, 210484, 210506, 210547, 210548, 210559, 210598, 631547, 631558, 631781, 631879, 631880, 632166, 632277, 632282, 632284, 632783, 632786, 632870, 632872, 632873, 632965

* South Puget Sound Fall Yearlings (Stk ID 14)

631864, 631867, 631964, 631965, 631966, 631971, 632464, 632472, 632479, 632582, 632583, 632871, 632877, 632880, 632978, 633089

* Hood Canal Fall Fingerlings (Stk ID 16)

631371, 631777, 632375, 632389, 632897, 632973

* Hood Canal Fall Yearlings (Stk ID17)

631798, 632471, 632879

* Tulalip (Stk ID 10)

210342, 210519, 210570

* White River Spring Yearlings (Stk ID 33)

210512, 210556, 210595

* Skagit Springs (Stk ID 6)

630874, 631414, 632273, 632274, 632888, 632889

2002-2004 brood year recoveries for the stocks listed above were summarized in FRAMbuilder following the procedures documented in XXX. Freshwater sport recoveries were imputed for Lake Sammamish, Green, Puyallup, Nisqually, Chambers, Deschutes, Skokomish, Skykomish, and Skagit River per descriptions in “FWsportCWT\_documentation.docx”.

These pre-summarized tag recoveries were then added to the “CWTforSPS\_SurrogateMethod” table of the Access database “CalibrationSupport.accdb” and run through the “Main Calibration Program” using run option “Cohort Reconstruction w/o expansions”. This results in a cohort reconstruction for each stock selected, but unlike the traditional calibration does not perform tag expansions to match CWT escapement to observed escapement and CWT catch to observed catch. The calibration program returns exploitation rates by stock, age, fishery, and time step. These exploitation rates are processed as previously described under Type 9 using equation 2.

Given that the stock composition in Area 13+ net (13D-K) is derived from the old base period, only minor differences between the base periods are observed.

For Area 13A net, the new stock composition shows a much higher contribution of deep South Puget Sound fall fingerlings mostly at the expense of upper South Puget Sound Chinook. Unlike the old base period there are very few non-local stocks with the exception of Hood Canal Chinook, which contribute at a low level.

Figure 1. Stock composition of Areas 13D-K landed net catches old base period versus new base period

Figure 2. Stock composition of Area 13A landed net catches old base period versus new base period

Figure 3. Stock composition of Area 13 sport landed catches old base period versus new base period

# References

Angelika Hagen-Breaux. 2015. *Modeling Grays Harbor Net Fisheries and Washington North Coast stock bkFRAM Abundance*

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