FRAM Harvest Allocation Algorithm

[Summary of email from J. Norris to T. Frever; with comments by J. Scott.]

Geographic Area Concepts. There is one PreTerminal area that we can think of as the open ocean. Then there are six terminal areas:

Nooksack/Sammish
Skagit
Stilly/Sno
Hood Canal
South Sound
Straits

There is one intermediate area called 6B9 that includes the south eastern part of the Straits and Admiralty Inlet. Fish returning to the Stilly/Sno, Hood Canal, and South Sound terminal areas pass through area 6B9 first. The South Sound terminal area has two sub-areas: Areas 10 and 11. Between the terminal areas and the spawning grounds are freshwater fishing areas.

Management Objectives. The first allocation objective is to equalize the catch of all South Sound stocks between Treaty and Non-Treaty fisheries OVER ALL TIMESTEPS AND REGIONS. The second allocation objective is to equalize the catch of all Nooksack/Sammish stocks OVER ALL TIMESTEPS AND REGIONS. Note that the allocation objectives aren't limited to the last several timesteps. In addition there are escapement goal objectives for the South Sound and Nooksack/Sammish stocks.

Computation Steps.

Step 1. The model is run once to completion using given input data. This determines how many fish from each stock were killed in the ocean, in each terminal region, and in the intermediate 6B9 region (i.e., legal catches, shakers, CNRs by timestep, fishery, and stock). It also determines the remaining fish for escapement.

Step 2 (called Step 3 on Tue, but occurs as Step 2 in the code). For the Sound Sound and Nooksack/Sammish stocks, compute the total preterm catches in Non-Treaty fisheries (33 of them) and Treaty fisheries (6 of them). The catches in the 6B9 area also are totalled.

Step 3. The goal here is to figure out how many fish from each terminal stock group are about to enter their corresponding terminal area at the start of the 8th time step, after which terminal area fishing will occur. For the Nooksack/Sammish stock, this is fairly easy. The terminal run size is the sum of the terminal catches in the Nooksack/Sammish region plus the escapement into the terminal region minus the freshwater catch. (I'm not sure why the freshwater catch is subtracted ... seems like it should be added.) Note that

there may have been some terminal area catches of Nooksack/Sammish stocks that stray into other terminal regions, but these are not counted.

Comment. As you noted, catches of the Nooksack/Samish stock are not counted outside of the Nooksack/Samish terminal area. Conversely catches of nonlocal stocks (e.g., Skagit) in the Nooksack/Samish terminal area are counted. This may seem odd, but the model was constructed in this way to provide a bridge between a CWT based model (FRAM) and run reconstruction based inseason and postseason management. In Puget Sound, for allocation purposes, all net catches within a terminal area are counted as originating from that area. For predicting escapement, all mortalities count regardless of the region of capture.

Comment. A similar problem exists with freshwater sport (not freshwater net, as you may have implied above). The run reconstruction previously did not include any sport fisheries, so to put HR's in the same terms, we had to subtract out the freshwater sport catch. Many of these oddities will no longer be a concern when we have finished the new CWT based cohort reconstructions.

The South Sound stocks are more complicated because the South Sound catches in 6B9 must be apportioned to the 3 regions it supplies. These South Sound catches are allocated in proportion to the terminal catches in those three regions. For example, if terminal areas 3, 4, and 5 caught 10, 70, and 20 South Sound fish, respectively, only 70% of the South Sound fish caught in 6B9 would be included in the South Sound terminal run computation.

Comment. Here we have a problem with the CWT data used in FRAM. Catches and sampling were minimal during the base period, so the CWT data give an odd result. As a fix, we used the run reconstruction assumptions for the catch in this fishery.

Step 4. The total available quota for each terminal area is the terminal run size computed in step 3 minus the escapement goal (different from the escapement computed during step 1).

Step 5. The total available harvest of the South Sound stocks is result from Step 4 plus the preterminal catches computed in Step 2.

Step 6. The Non-Treaty and Treaty fisheries will share of the step 5 result 50:50.

Step 7. The total Non-Treaty available terminal harvest over timesteps 8-12 will be the 50:50 share from Step 6 minus the Non-Treaty preterm harvest computed in Step 2. The total Non-Treaty terminal harvest is then allocated to each month using fractions passed in as input data (obtained from the external TAMM model). Similar for the Treaty terminal harvest.

Step 8. The catches by area and timestep computed in step 7 are compared to the original catches determined in Step 1. A ratio scalar is computed for each area and timestep (= step 7 result divided by step 1 result). If any one of the ratios is not close enough to 1.0, then another TAMM iteration is required.

Step 9. The scalars computed in step 8 are global variables used to rescale all the effort levels for the terminal fisheries. This occurs in a routine called TAMMInit. At this point, the CompCatch and CompEscapement subroutines from the main engine are run for timestep 8 to 12. TAMMInit is called at the start of each timestep to adjust the efforts.