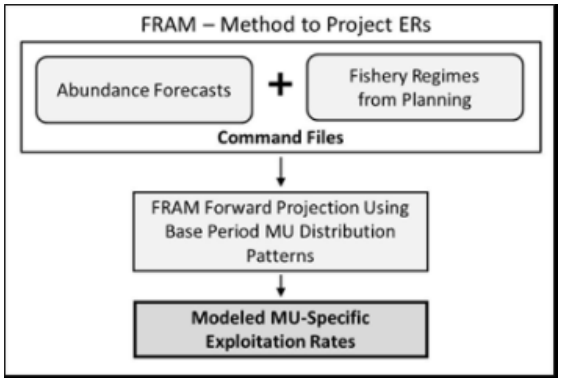
Fishery Regulation and Assessment Model (FRAM) use in preseason and postseason

The FRAM:

Coho fisheries are evaluated with the Coho Fishery Regulation Assessment Model (Coho FRAM), a bilaterally (U.S. and Canada) developed tool that is employed for both pre-season fishery planning and post-season estimation of escapements and exploitation rates. In simplest terms the Coho FRAM is an accounting model that evaluates X stocks in Y fisheries over Z time periods. It can be used to estimate catch and escapement based on forecast abundance and planned fisheries (forward FRAM) or it can be used to reconstruct ocean abundance from observed escapements and catches (backward FRAM). The model is founded on a Base Period (currently 1986 to 1992) and scales it according to current stock abundances and fisheries impacts. The user manual for the Coho FRAM model can be found at here: *(insert once we receive the link)*

Preseason use:

FRAM is used to project the ocean exploitation rate for unmarked Rogue/Klamath coho, the proxy for the SONCC coho. The ocean exploitation rate for Rogue/Klamath coho is overwhelmingly due to catch and release mortalities, since there is no direct harvest of any coho in California ocean fisheries, and little harvest of unmarked Rogue/Klamath coho in Oregon ocean fisheries. The general procedure used to project expected exploitation rates using FRAM is:



The base period is a key component of FRAM modeling. The FRAM base period dataset (a summary of catch years 1986–1992) consists of estimates of average stock abundances and exploitation rates by time, area, and gear. The base period year range was chosen because coho coded-wire tagging levels coastwide were good and there were widespread coho fisheries occurring in those years which allowed for inference about the spatial and temporal distribution of coho harvest (or encounters) in the ocean.

For preseason fishery planning, coho non-retention inputs for fisheries south of Humbug Mountain are derived using a two-step process. The first step is to estimate the number of encounters in fisheries that will be designated as non-retention for coho. For this step, FRAM is used to project total coho catch that would occur in these fisheries given base period data and current year projections of coho abundance and fishing effort. Since we would not expect stock abundances and fishing effort to be

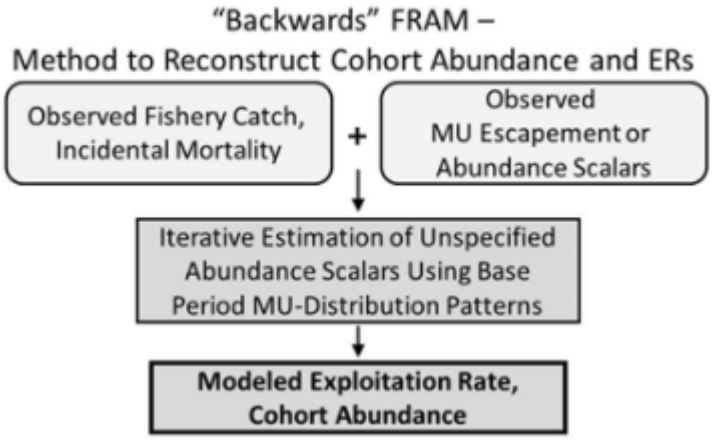
identical to the base period values each year, this scaling adjusts the base period exploitation rates up or down given what we know about stock abundances and fishing effort for the coming fishing season. The resulting projected catch serves as the estimated number of encounters and subsequent releases that would occur in the non-retention fisheries.

The second step is to convert the resulting estimates of total encounters into "dead fish" (all stocks) by applying release mortality rates, dropoff mortality rates, and gear adjustments (e.g., the 4 spread discount in Oregon). The projection of "dead fish" is then used as an input for a second FRAM run which is used to determine the stock-specific fishing mortality. At this stage, FRAM projects stock-specific mortalities that, when summed, add up to the projected number of dead coho. Given stock-specific mortalities, and the forecasted abundance, the stock-specific exploitation rates can be projected for the upcoming season.

Post-season use:

The Coho FRAM can also be used to reconstruct stock abundances from known catch and escapement. In Backwards Coho FRAM, base period stock-fishery-period exploitation rates are used to estimate annual cohort abundances for post-season evaluation of stocks and fisheries. The Backwards Coho FRAM provides two estimates of cohort abundance, termed "Ocean age-3" and "January age-3". Ocean age-3 abundance includes escapement and fishery impacts. January age-3 includes escapement, fishery impacts, and natural mortality.

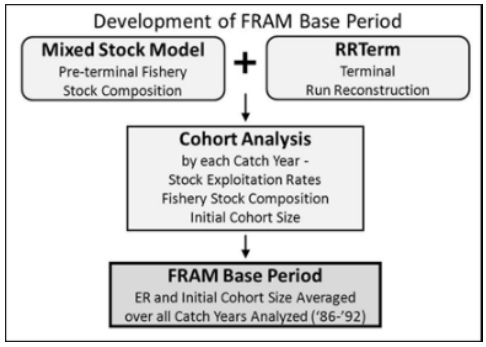
The Backwards Coho FRAM derives total cohort abundance through an iterative process of estimating the set of stock abundance scalars that best explain observed escapements and reported catches. In most cases, total cohort abundance for each MU is derived by summing pre-terminal catch, terminal catch, and escapement for all stocks. Total fishery-related impacts are derived from total catch in each mixed-stock fishery, a stock abundance scalar for a given fishing year relative to the base period, and ocean distributions of each stock during the base period. This depicts how Backwards Coho FRAM generates estimates of post-season exploitation rates:



The Backwards Coho FRAM has been used for post-season reconstruction two years following the catch year for years 1998 to present for most stocks.

FRAM Base Period and CWTs used to represent SONCC:

The current base period is constructed from stock-specific ocean distributions by fishery and time period CWT recoveries in coast wide fisheries between 1986 and 1992. The procedure used to generate base period data is depicted here:



For each base period year, post-season reconstruction of cohort abundances for each Coho MU is based on two different models: the Mixed-Stock Model (MSM) that estimates the Production Expansion Factors for each Production Region and RRTERM program that estimates stock-specific impacts for terminal marine and freshwater fisheries. The MSM uses CWT recoveries for each model stock expanded by the Production Expansion Factors to best describe the total catch in each marine mixed-stock fishery.

The CWTs used to represent Southern Oregon and Northern California Coho stocks within the base period included the following hatchery tagging programs:

Hatchery Program[1]	total # Released during the base period	% of releases caught as 3-yr old in fisheries	% of total tags used to represent the stock in the base period
COLE RIVERS HATCHERY (OR)	254,442	1.0%	24.8%
TRINITY R HATCHERY (CA)	445,137	0.6%	25.2%
IRON GATE HATCHERY (CA)	181,984	0.9%	17.0%
BUTTE FALLS HATCHERY (OR)	35,070	2.5%	8.8%
SAWMILL PONDS (CA)	51,721	1.9%	9.5%
MAD RIVER HATCHERY (CA)	88,640	1.0%	8.7%
WARM SPRINGS HATCHERY (CA)	263,218	0.2%	6.0%

[1] Programs highlighted in yellow are outside of the current SONCC geographic area.

The base period annual total exploitation rates by fishery and management unit are provided here:

	Northern CA Hatchery		Northern CA Wild		Southern OR Hatchery		Southern OR Wild	
Fishery	**Marked**	**Unmarked**	**Marked**	**Unmarked**	**Marked**	**Unmarked**	**Marked**	**Unmarked**
BC WC VI Spt	0.000641	0.000641	0.000641	0.000641	0.000639	0.000639	0.000639	0.000639
BC SW VI Net	0.000029	0.000029	0.000029	0.000029	0.000029	0.000029	0.000029	0.000029
BC SW VI Trl	0.001866	0.001866	0.001867	0.001867	0.001864	0.001864	0.001865	0.001865
WA Area 5 Spt	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093	0.000093
WA Area 4 Spt	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018	0.000018
WA Area 2 Spt	0.001275	0.001275	0.001275	0.001275	0.001273	0.001273	0.001273	0.001273
Astoria Spt	0.001107	0.001107	0.000174	0.000174	0.001104	0.001104	0.001104	0.001104
Astoria Trl	0.000170	0.000170	0.000170	0.000170	0.000170	0.000170	0.000170	0.000170
OR Tillmk Spt	0.000903	0.000903	0.000369	0.000369	0.000902	0.000902	0.000902	0.000902
OR Tillmk Trl	0.000504	0.000504	0.000504	0.000504	0.000505	0.000505	0.000505	0.000505
OR Newprt Spt	0.002353	0.002353	0.002350	0.002350	0.002350	0.002350	0.002351	0.002351
OR Newprt Trl	0.006185	0.006185	0.004656	0.004656	0.006182	0.006182	0.006183	0.006183
OR Coos B Spt	0.022594	0.022594	0.011873	0.011873	0.022547	0.022547	0.022551	0.022551
OR Coos B Trl	0.039523	0.039523	0.037808	0.037808	0.039494	0.039494	0.039501	0.039501
OR Brkngs Spt	0.083703	0.083703	0.072001	0.072001	0.083512	0.083512	0.083526	0.083526
OR Brkngs Trl	0.014131	0.014131	0.014131	0.014131	0.014119	0.014119	0.014120	0.014120
Ca KMZ Spt	0.196835	0.196835	0.170533	0.170533	0.196547	0.196547	0.196571	0.196571
Ca KMZ Trl	0.069275	0.069275	0.069260	0.069260	0.069197	0.069197	0.069210	0.069210
No Cal Trm	0.043015	0.043015	0.057087	0.057087				
CA Ft Brg Spt	0.031379	0.031379	0.019209	0.019209	0.031314	0.031314	0.031318	0.031318
CA Ft Brg Trl	0.115717	0.115717	0.115712	0.115712	0.115582	0.115582	0.115590	0.115590
So Cal Spt	0.014605	0.014605	0.012284	0.012284	0.014577	0.014577	0.014582	0.014582
So Cal Trl	0.032133	0.032133	0.027833	0.027833	0.032078	0.032078	0.032085	0.032085
So Ore Trm					0.089552	0.089552	0.081914	0.081914
Grand Total	**0.67805**	**0.67805**	**0.61988**	**0.61988**	**0.72365**	**0.72365**	**0.71610**	**0.71610**