Eastern Bering Sea walleye pollock stock assessment

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Executive Summary

The work presented below was based on the same data sets used in the 2024 assessment. The first task was to update the model runs to include the 2023 data. The model runs were updated and the results are presented below. The model runs were then used to compare the FT-NIR data with the traditional data sources (BTS and ATS). The results of these comparisons are presented below. The model fits to the data are presented in the tables at the end of the document.

Comparing FT-NIR compositions with traditional microscope age estimations

The fish age and growth lab at the AFSC have endeavored to expand on new technologies (Helser et al. (2019)).

Examining the abundance-at-age (for design-based estimates of the bottom-trawl age compositions) we show that in general, the TMA estimates show a high level of consistency by cohort (Figure 1). For these same data, when applied to the FTNIRs age-estimation method, the consistency was lower (Figure 2).

When preparing the data for the assessment, we plotted out the proportions-at-age for the TMA data and noted the differences in the estimates using the FTNIRs age estimates (Figure 3, Figure 4, and Figure 5). Other preparations involved estimating the age-determination errors for each method following that of Punt et al. (2008). For the FTNIRs data, we optionally estimated separate age-estimation error matrices by gear type. The appearance of the fleet-aggregated and fleet-specific input data files is shown in Figure 6.

For the assessment model, the alternatives are shown based on the coverage of data and availability among types of ageing is shown in Figure 7.

Fit to models

Component	Base	FT-NIR fleets aggregated	FT-NIR fleet-specific
RMSE BTS	0.150	0.152	0.152
RMSE ATS	0.167	0.192	0.184
RMSE AVO	0.216	0.241	0.237

Component	Base	FT-NIR fleets aggregated	FT-NIR fleet-specific
RMSE CPUE	0.097	0.097	0.097
SDNR BTS	0.890	0.900	0.880
SDNR ATS	0.930	1.130	1.070
SDNR AVO	0.950	1.080	1.050
Eff. N Fishery	357.670	335.240	380.560
Eff. N BTS	159.430	147.180	152.120
Eff. N ATS	233.170	214.610	227.210
Catch NLL	2.960	4.250	3.010
BTS NLL	23.910	24.410	23.430
ATS NLL	7.750	11.390	10.080
AVO NLL	8.240	10.530	10.060
Fish Age NLL	416.810	558.820	613.350
BTS Age NLL	286.120	330.370	314.100
ATS Age NLL	42.550	46.970	45.970
NLL selectivity	212.700	209.530	209.850
NLL Priors	20.330	20.650	20.730
Data NLL	807.120	1,007.770	1,042.700
Total NLL	1,110.900	1,305.930	1,339.140

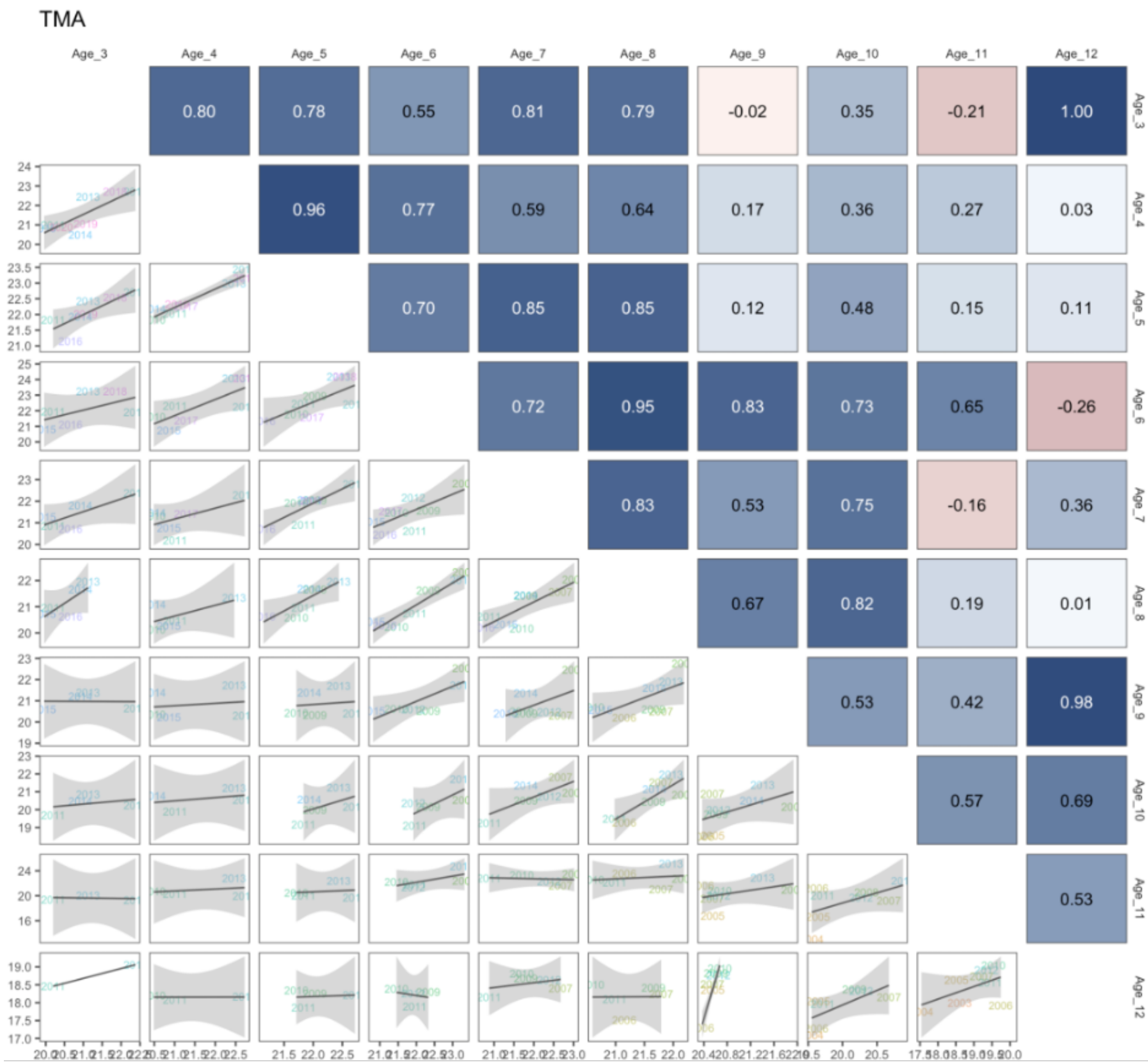

Figure 1: Cohort consistency over different ages based on log-abundance from the bottom-trawl survey data for pollock in recent years for traditional microscope age estimates. The cohorts are shown in the labels.

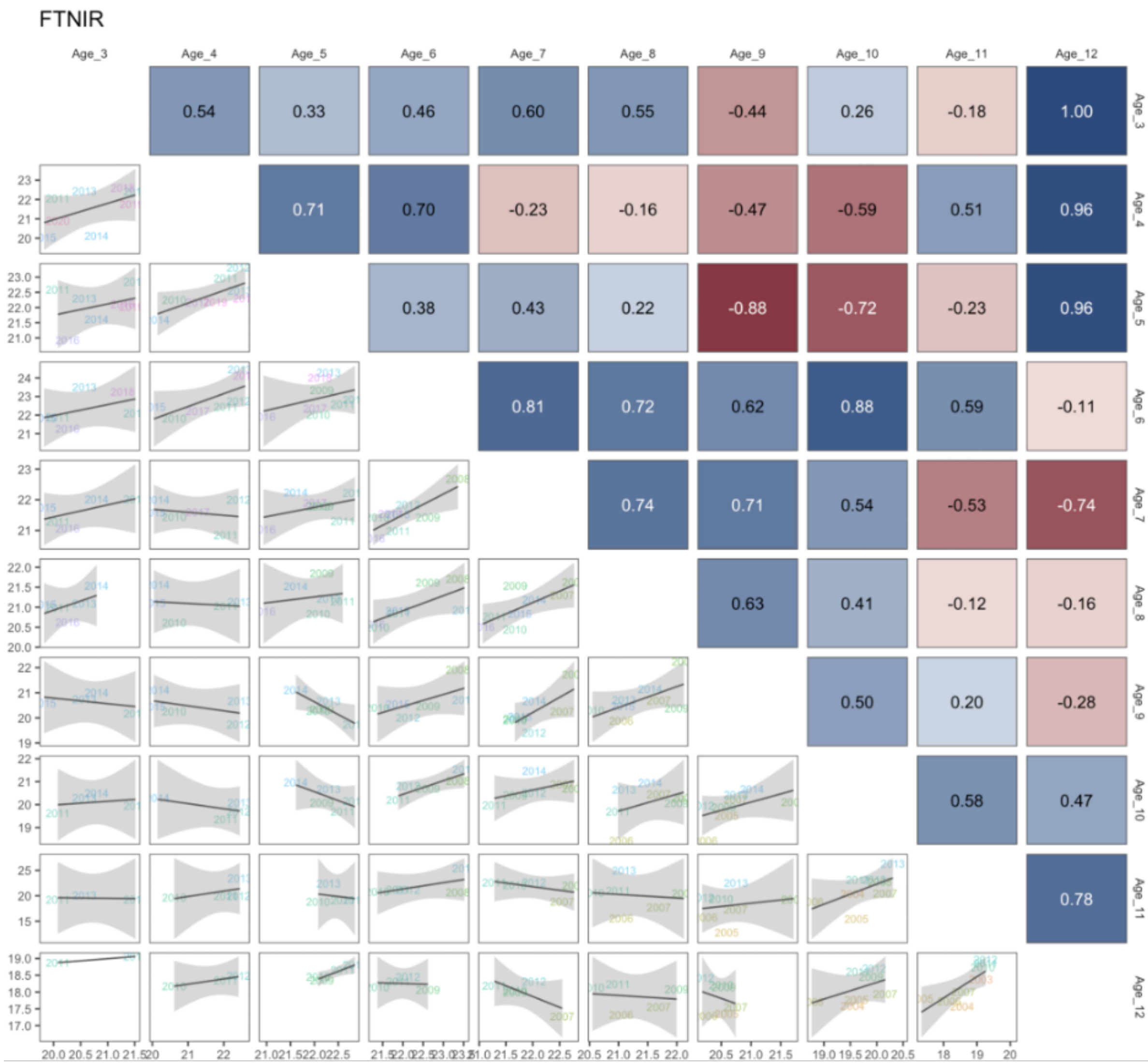

Figure 2: Cohort consistency over different ages based on log-abundance from the bottom-trawl survey data for pollock in recent years for FTNIRs age estimates. The cohorts are shown in the labels.

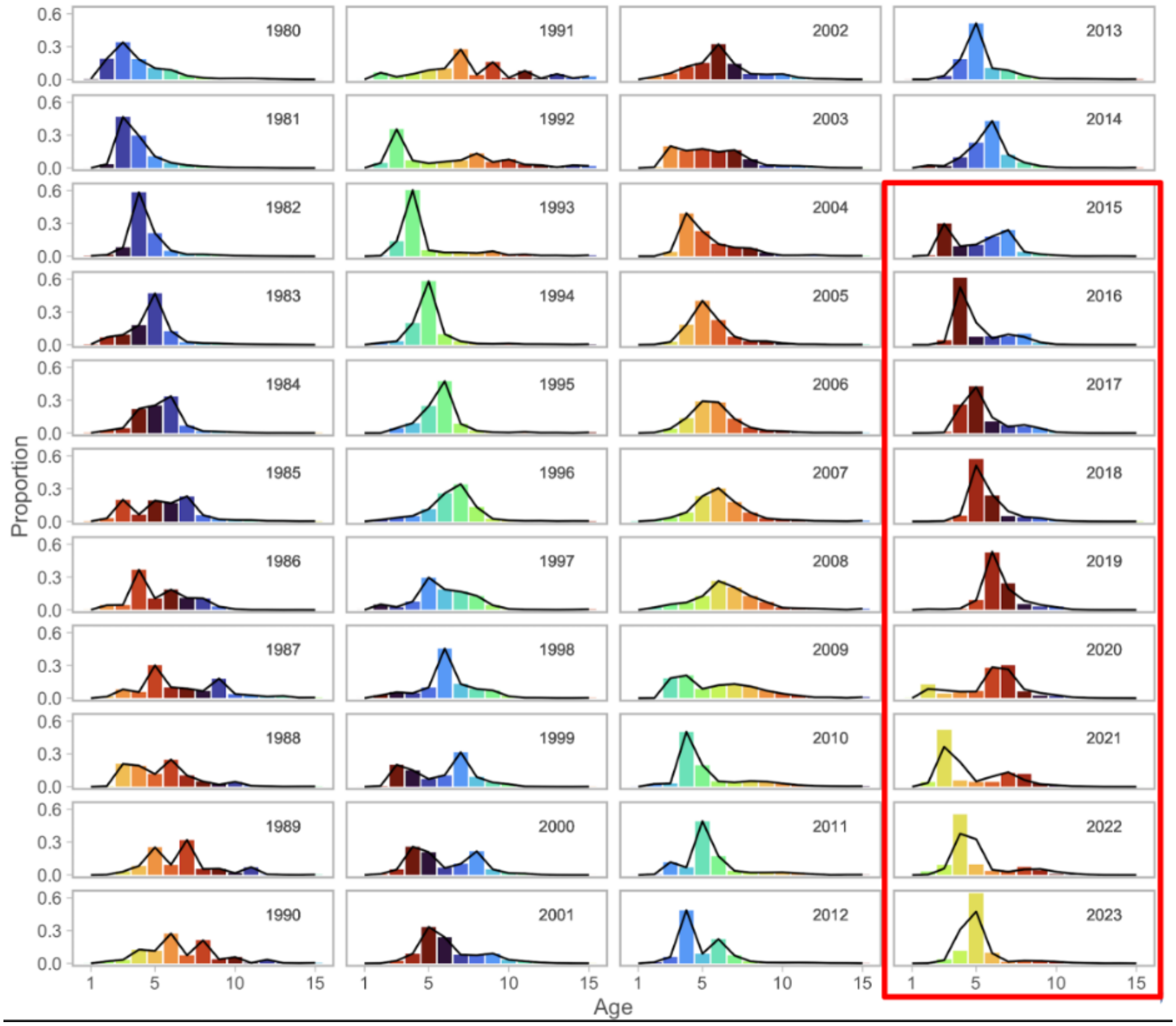

Figure 3: Proportions at age for recent years for the fishery data where the columns represent the traditional microscope age estimates (TMA) compared to the FTNIRs age estimates (lines for the red-outlined panels).

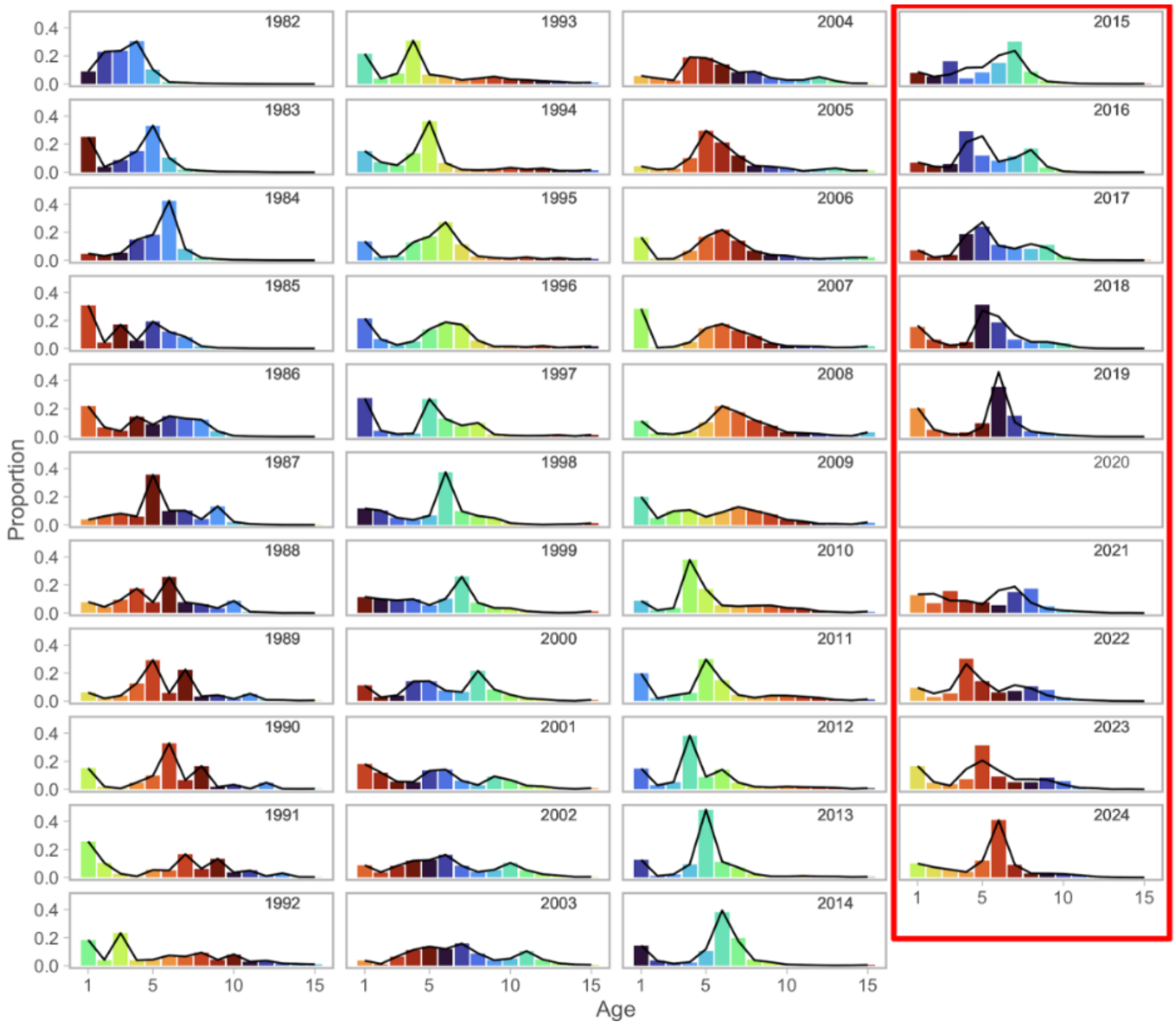

Figure 4: Proportions at age for recent years for the bottom-trawl survey data where the columns represent the traditional microscope age estimates (TMA) compared to the FTNIRs age estimates (lines for the red-outlined panels).

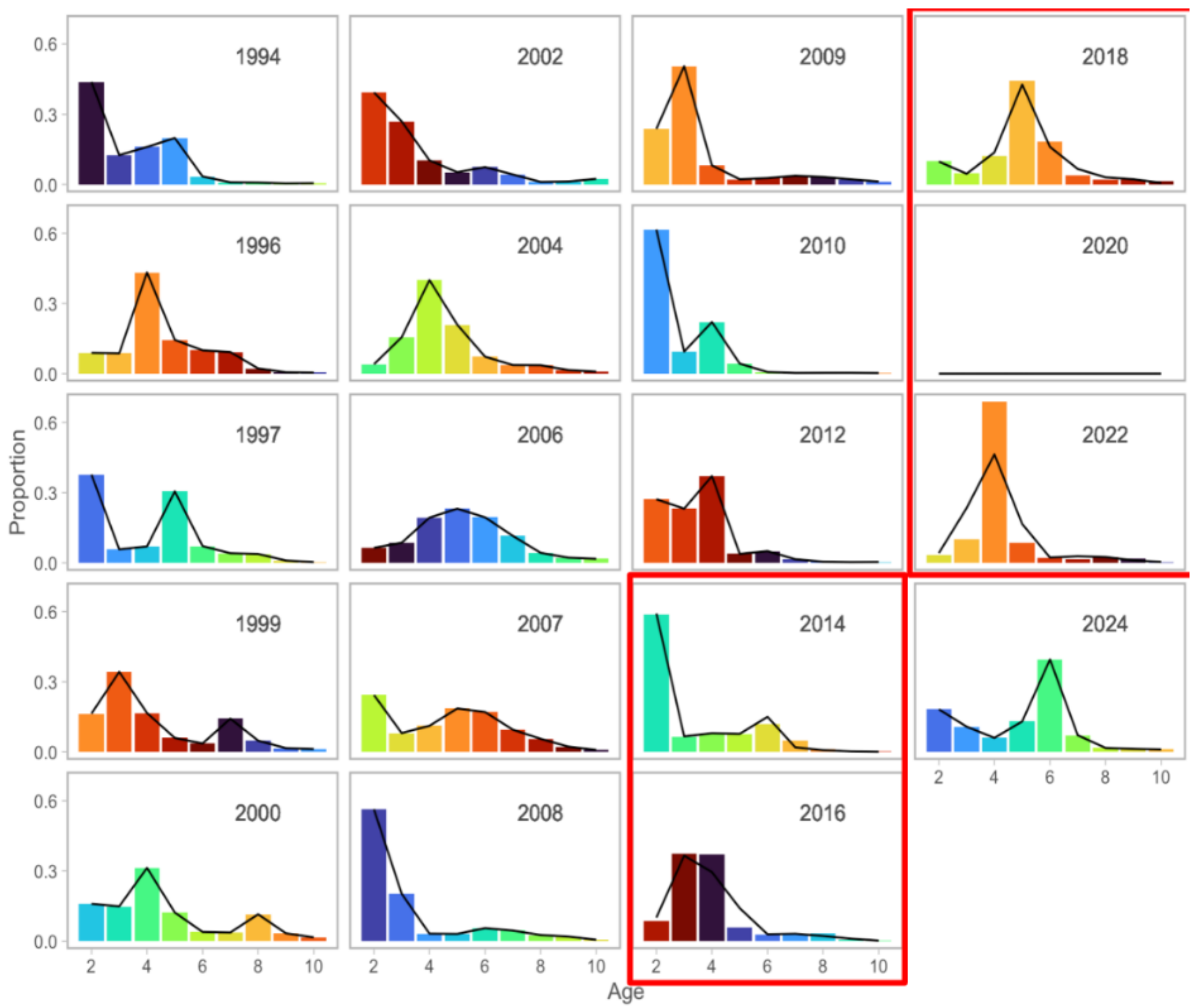

Figure 5: Proportions at age for recent years for the acoustic-trawl survey data where the columns represent the traditional microscope age estimates (TMA) compared to the FTNIRs age estimates (lines for the red-outlined panels).

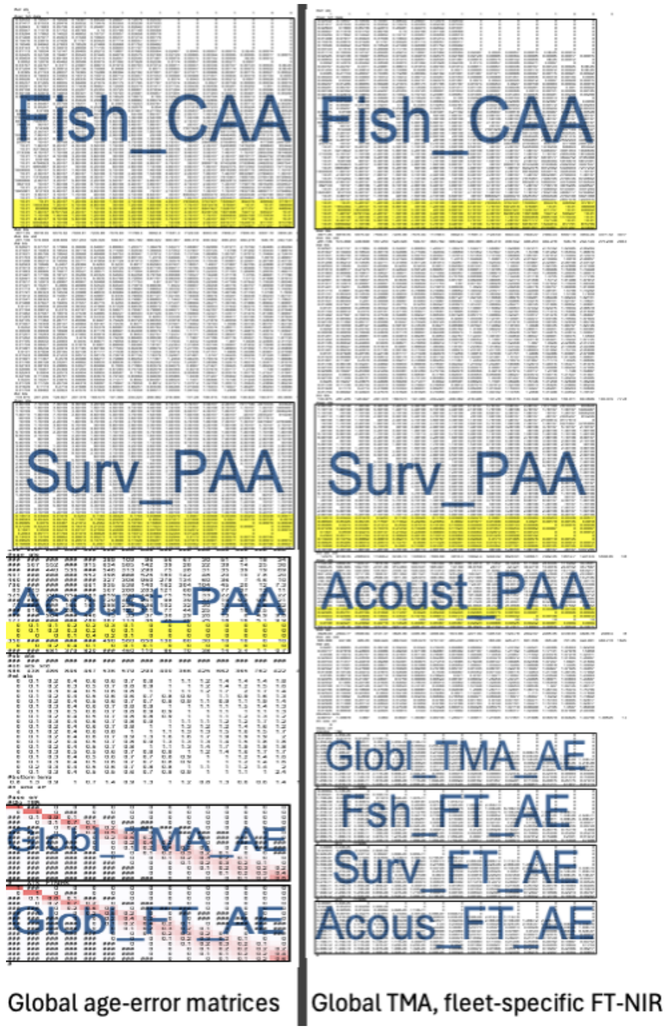

Figure 6: Schematic of input datafile showing the breakout of the fleet-specific FTNIRs age-error matrices (right panel) compared to that where the global FTNIRs age-error matrices are used (left panel).

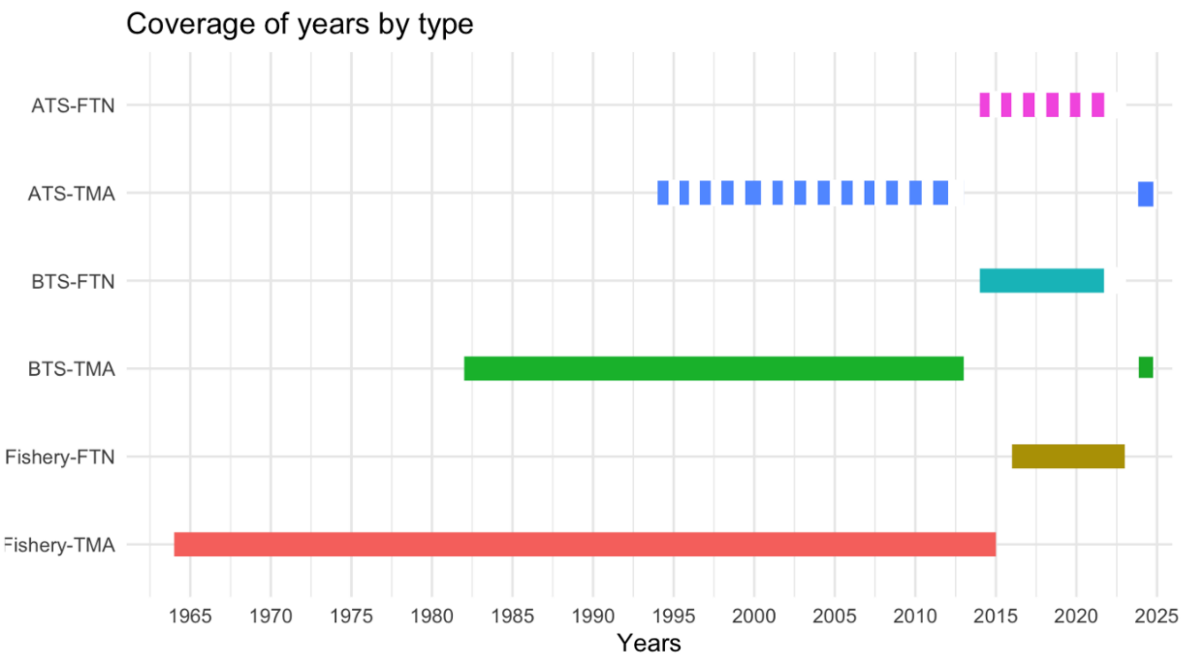

Figure 7: Data extent by age composition for the models with FTNIRs age estimates. The data types are for the Fishery, bottom trawl survey (BTS), and acoustic trawl survey (ATS) and the years of coverage are shown in the x-axis.

Table 1: Goodness-of-fit measures to primary data for different data and age-error applications. RMSE=root-mean square log errors, NLL=negative log-likelihood, SDNR=standard deviation of normalized residuals, Eff. N=effective sample size for composition data). See text for incremental model descriptions.

Component	Base	FT-NIR fleet-specific	FT-NIR fleets aggregated
RMSE BTS	0.15	0.15	0.15
RMSE ATS	0.17	0.18	0.19
RMSE AVO	0.22	0.24	0.24
RMSE CPUE	0.10	0.10	0.10
SDNR BTS	0.89	0.88	0.90
SDNR ATS	0.93	1.07	1.13
SDNR AVO	0.95	1.05	1.08
Eff. N Fishery	357.67	380.56	335.24
Eff. N BTS	159.43	152.12	147.18
Eff. N ATS	233.17	227.21	214.61
Catch NLL	2.96	3.01	4.25
BTS NLL	23.91	23.43	24.41
ATS NLL	7.75	10.08	11.39
AVO NLL	8.24	10.06	10.53
Fish Age NLL	416.81	613.35	558.82
BTS Age NLL	286.12	314.10	330.37
ATS Age NLL	42.55	45.97	46.97
NLL selectivity	212.70	209.85	209.53
NLL Priors	20.33	20.73	20.65
Data NLL	807.12	1042.70	1007.77
Total NLL	1110.90	1339.14	1305.93

Leave-one-out sensitivity analysis

Here we present model runs that downweight one source of age composition data at a time, as well as a run that downweights all survey biomass indices.

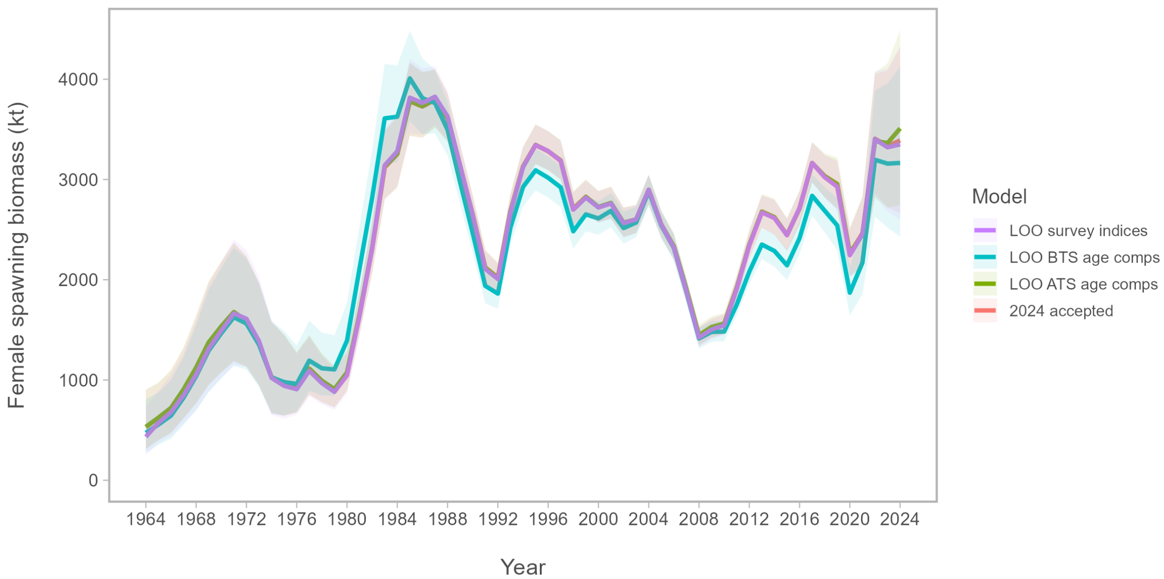

Figure 8: Model results comparing models that downweight one data source at a time

Alternative assessment software

Stock-synthesis 3

Stock synthesis 3 (SS3) is a well establish framework and is common in many diverse settings. (Methot and Wetzel (2013)) For EBS pollock, we extended an initial framework based on the configurations used for Pacific hake (Grandin et al. (2024)) since there are many similarities in the type of data available. Namely, empirical weight-at-age, acoustic survey data, and indices of 1-year olds (ref).

WHAM

The "Woods Hole Assessment model" (WHAM) is written in TMB and is a fully state-space model (Stock and Miller (2021)).

RTMB model

Work at AFSC has developed a general model which has flexibility to specify regions and a variety of options including random effects. While this model is not yet fully developed, we present preliminary results here. The model is written in TMB and is similar to the WHAM model. We pursue this model to explore the potential for a more flexible model that can be used for more explicit considerations of stocks linked to different regions (e.g., the US and Russian portions of the EBS). Also, this model to add sex-specificity and random effects (Cheng et al. (2025)).

CEATTLE model

The CEATTLE model is a new model developed by the AFSC and is written in TMB (Adams et al. (2022)). The model is an extension of the ADMB version used for the three-species multi-species model (Jurado-Molina, Livingston, and Ianelli (2005), Holsman et al. (2024)).

Bottom-trawl survey spatial distribution modeling

Sophia's work here

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