SEDAR 92 Atlantic Blueline Tilefish: South of Cape Hatteras, Age-aggregated Production Model (AAPM)

NOAA FISHERIES

Southeast Fisheries Science Center

April 15, 2025

Table of contents

Methods

Model description

- Models run with ASPIC Suite Version 7
- Age-aggregated annual biomass, no age-structure
- Assumes recruitment + growth - nat. mortality = 'surplus' production
- Graham-Schaefer logistic formulation (continuous time): $\frac{d\mathrm{B}_t}{dt} = r\mathrm{B}_t - \frac{r}{K}\mathrm{B}_t^2 - F_t\mathrm{B}_t$
- Assumes surplus production symmetric about $B_{\mathrm{MSY}} = 0.5K$ (shape parameter=0.5)
- Conditioned on yield (removals)
- Fit to indices of abundance (ASPIC, Prager 1994)
- Model estimates B_1/K, F_{MSY}, MSY, and q_i parameters

Methods

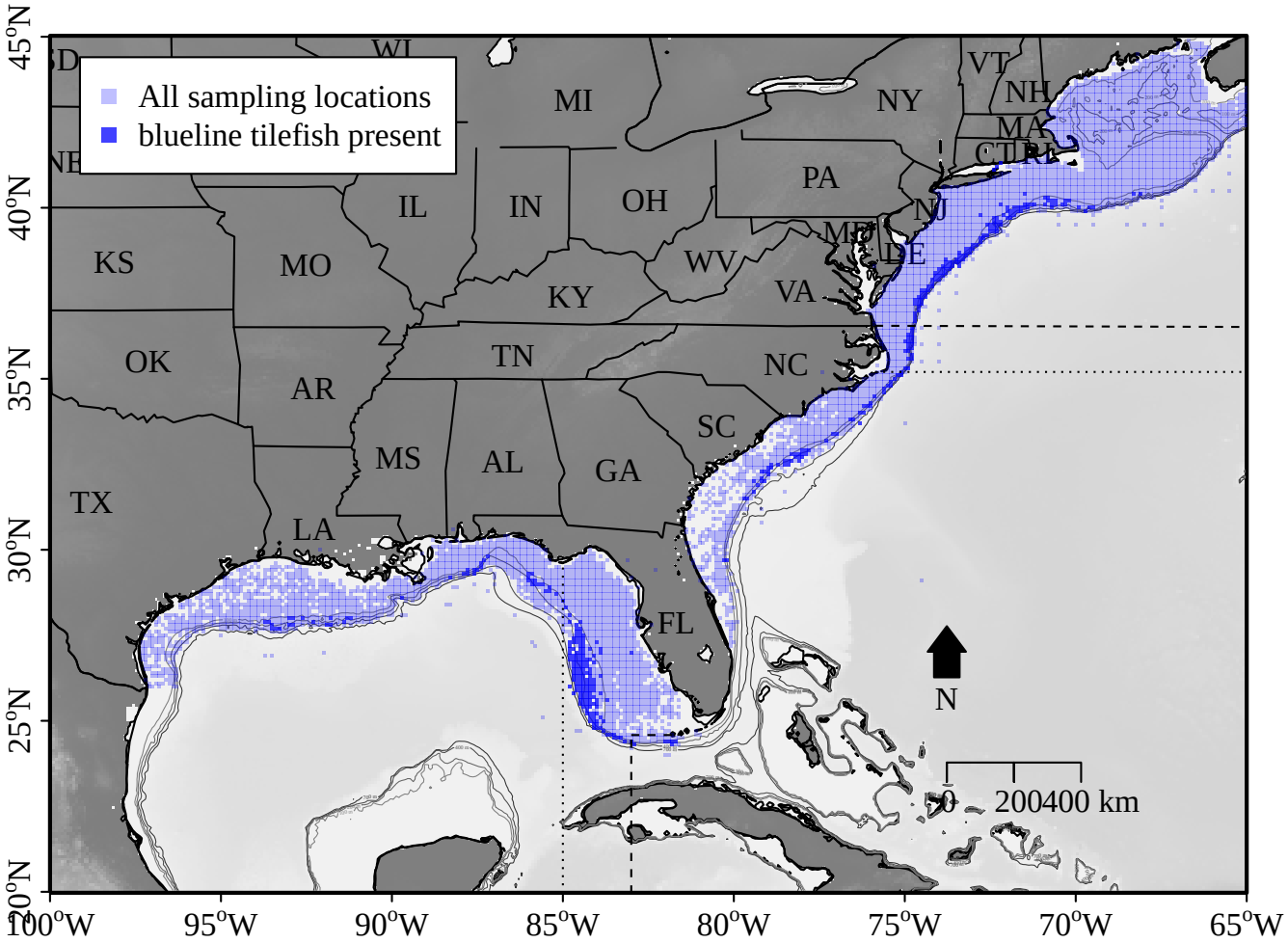
Model description

- Inputs
  - Single series of removals
  - Abundance indices and annual CVs
  - Initial values of B_1/K, F_{MSY}, MSY, and q_i parameters
  - Range limits or prior distributions on parameters
  - Settings (e.g. fitting method, rules, tolerance)
- Outputs
  - Single estimated biomass series
  - Estimates of B_1/K, F_{MSY}, MSY, and q_i parameters
  - Estimated CPUE series (scaling B by q_i)
  - Status series (F/F_{MSY}, B/B_{MSY})

Methods

Data

Data series restricted to area between GMFMC/SAFMC boundary at Key West north in the Atlantic to Cape Hatteras

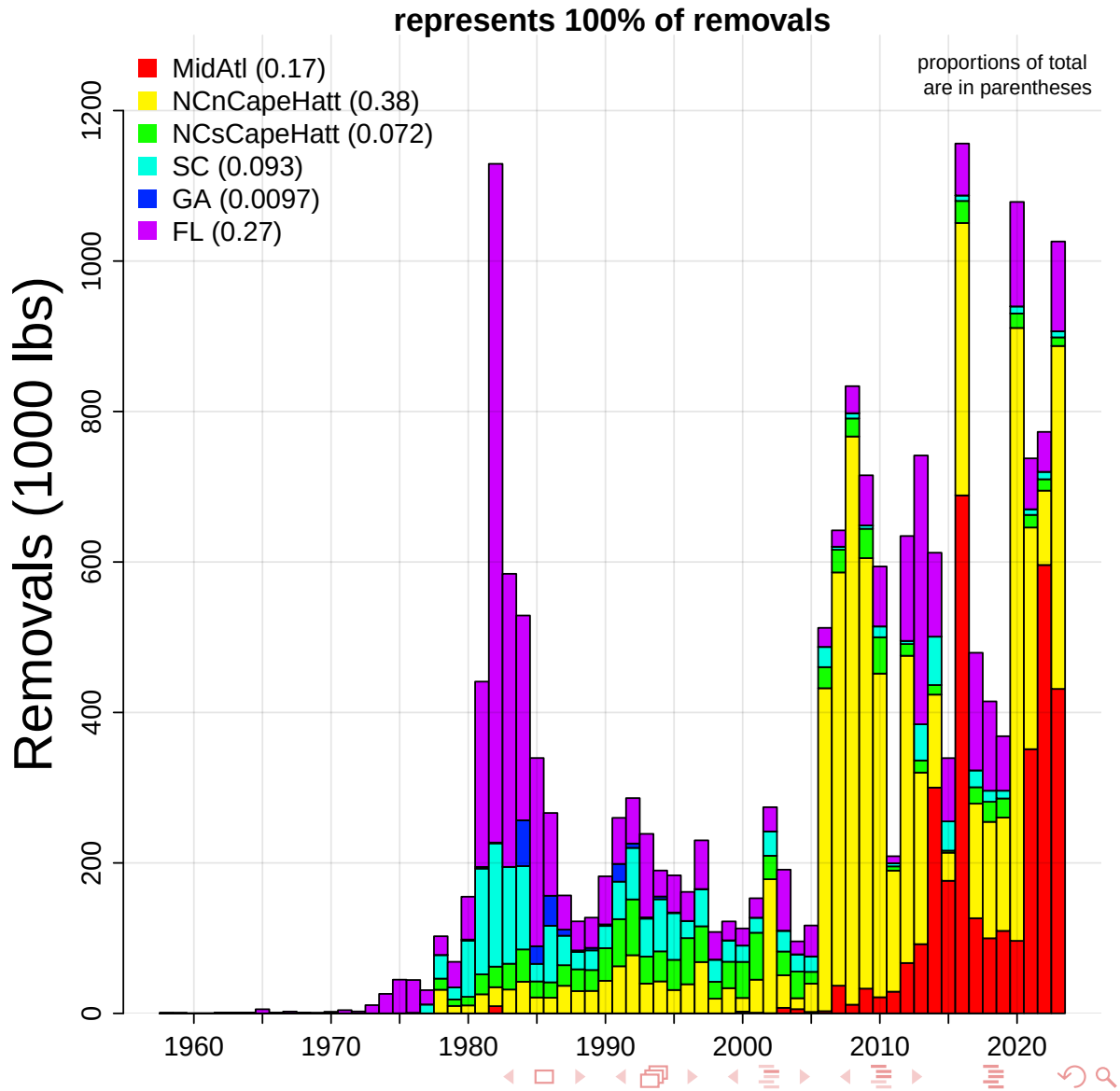


Methods

Data

All Atlantic removals by aggregated area

- Landings included in models south of Cape Hatteras included:
  - NCsCapeHatt
  - SC
  - GA
  - FL (east)

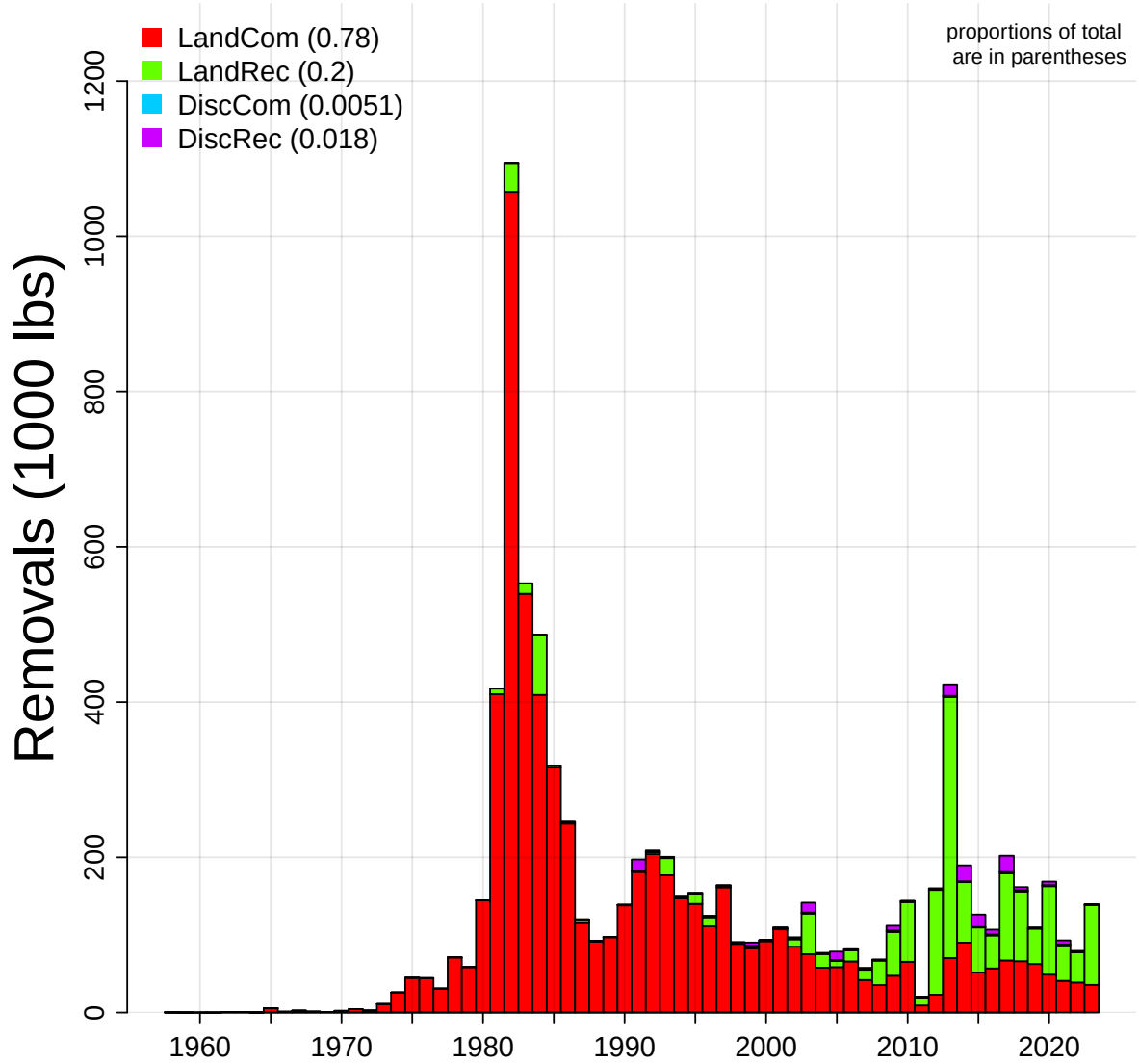


Methods

Data

Removals south of Cape Hatteras, by fleet

- Commercial landings
- Recreational landings
- Commercial dead discards
- Recreational dead discards

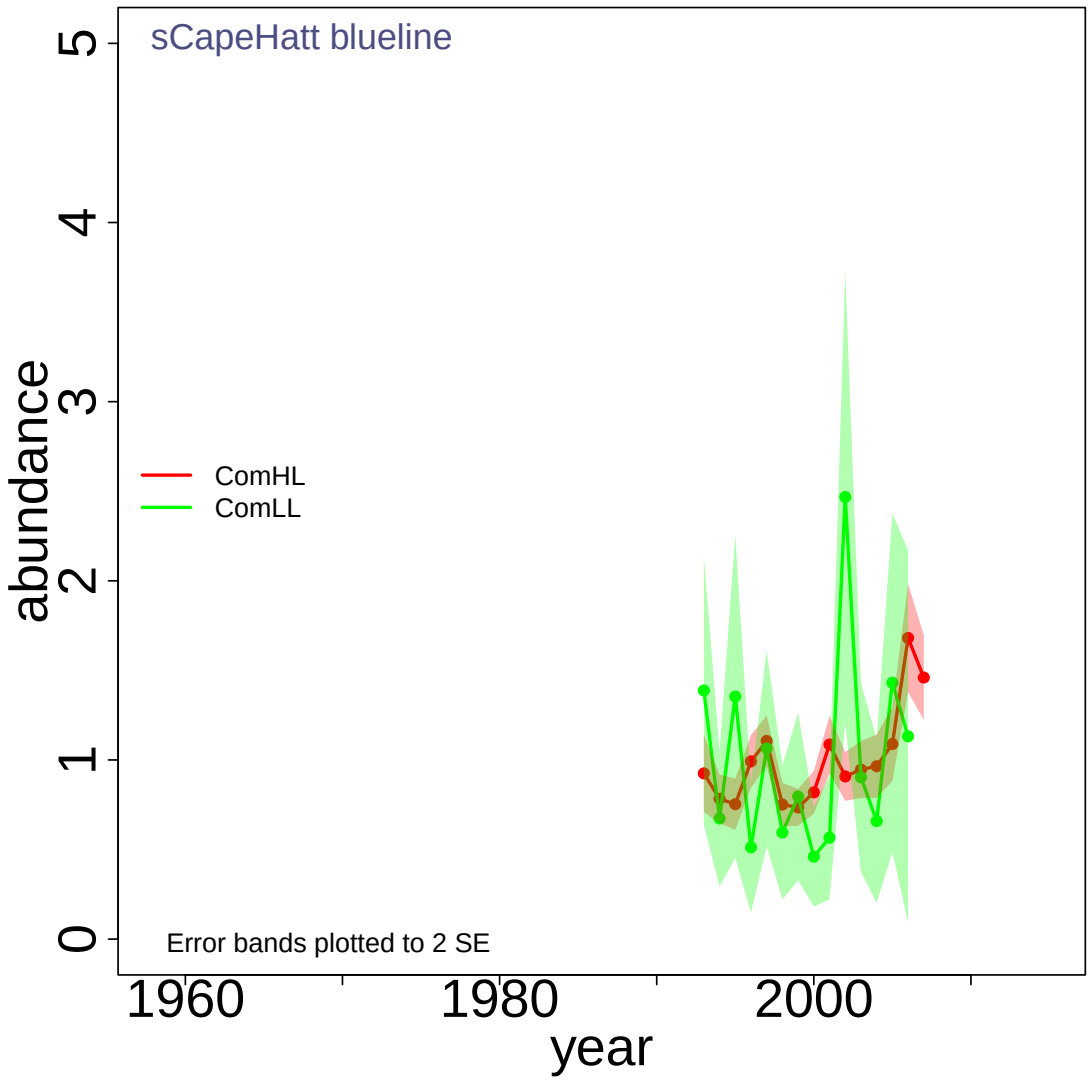


Methods

Data

Indices of abundance

- Commercial handline (ComHL)
- Commercial longline (ComLL)



Methods

Base Model Specifications

- Model started when removals were minimal (1958) so initial population was considered unexploited (B_1/K was fixed at 1)
- Model estimated F_{MSY}, MSY, and q_i parameters without priors
- Handline and longline indices considered equal quality
- Current base model (ensemble) averages the results of two separate ASPIC runs using either index
- Combining indices or running both in one model weights indices based on CVs, placing undue weight on the handline index

Methods

Base Model Specifications

- Models run from 1958-2023
- Removals 1958-2023
- Indices of abundance
  - Commercial handline (1993-2007)
  - Commercial longline (1993-2006)
- Status determination
  - F status: $F_{\text{current}}/F_{\text{MSY}}$
    - $F_{\text{current}} = \text{geomean}(F_{2021-2023})$
  - Overfishing if $F_{\text{current}}/F_{\text{MSY}} > 1$
  - Minimum Stock Size Threshold $= \text{MSST} = 0.75B_{\text{MSY}}$
  - B status: B_{2023}/MSST
  - Overfished if $B_{2023}/\text{MSST} < 1$

Methods

Sensitivity

1. Run including both handline and longline index

Methods

Uncertainty

- ASPIC bootstrap procedure run to estimate uncertainty
  1. ASPIC fits to observed data and saves predicted population data and residuals
  2. Normalized inflated residuals are randomly drawn with replacement and incorporated into predicted values to generate a trial resampled dataset
  3. Resampled data are fit, results saved, and the next trial begins
- Results of bootstrapping were combined (i.e. merged) to characterize the uncertainty in the average of the handline and longline models

Methods

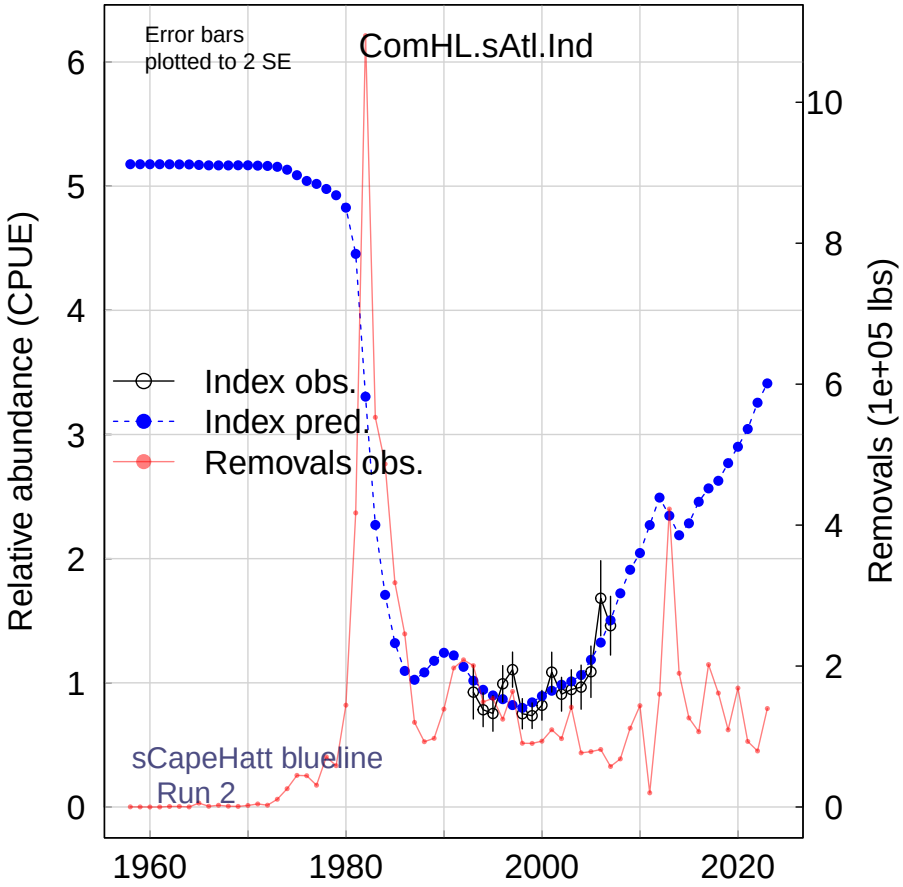
Projections

- Five year projections (2024-2028), setting F:
  - $F_{2024-2025} = F_{\text{current}}$
  - $F_{2026-2028} = F_{\text{P}^*_{30\%}}$
- Projections were made from the combined bootstrap results from the handline and longline models
- Uncertainty in projections based on bootstrap runs

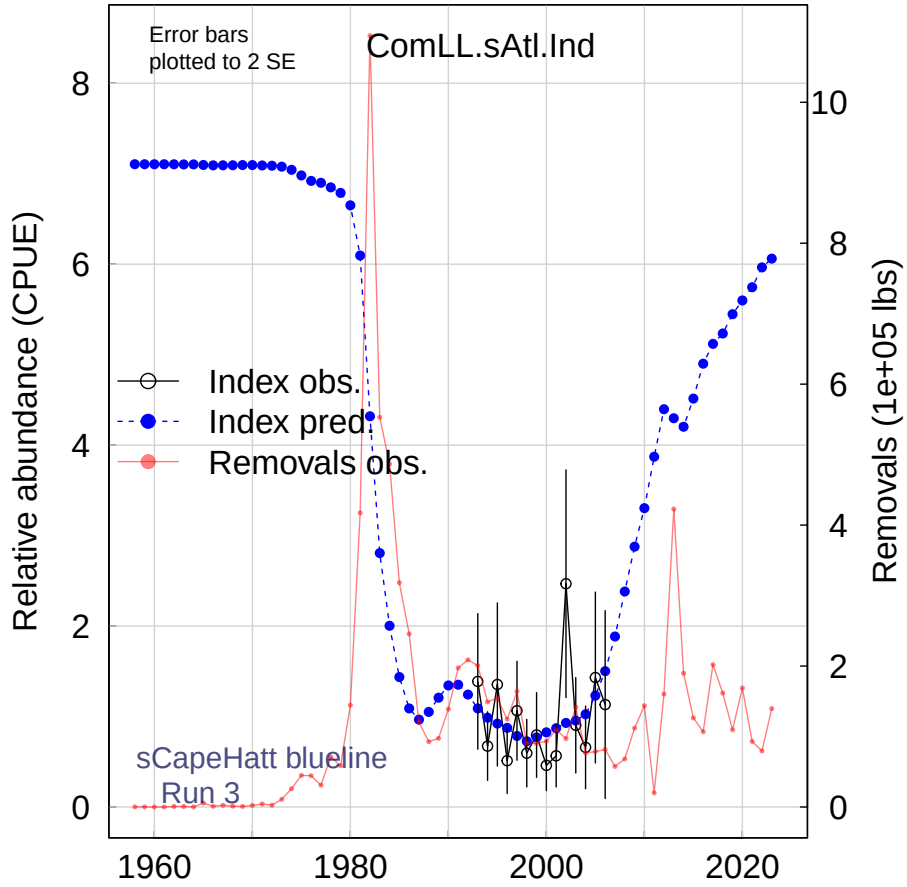
Results

Base Model Results and Uncertainty

Fit to handline model (Run 02)



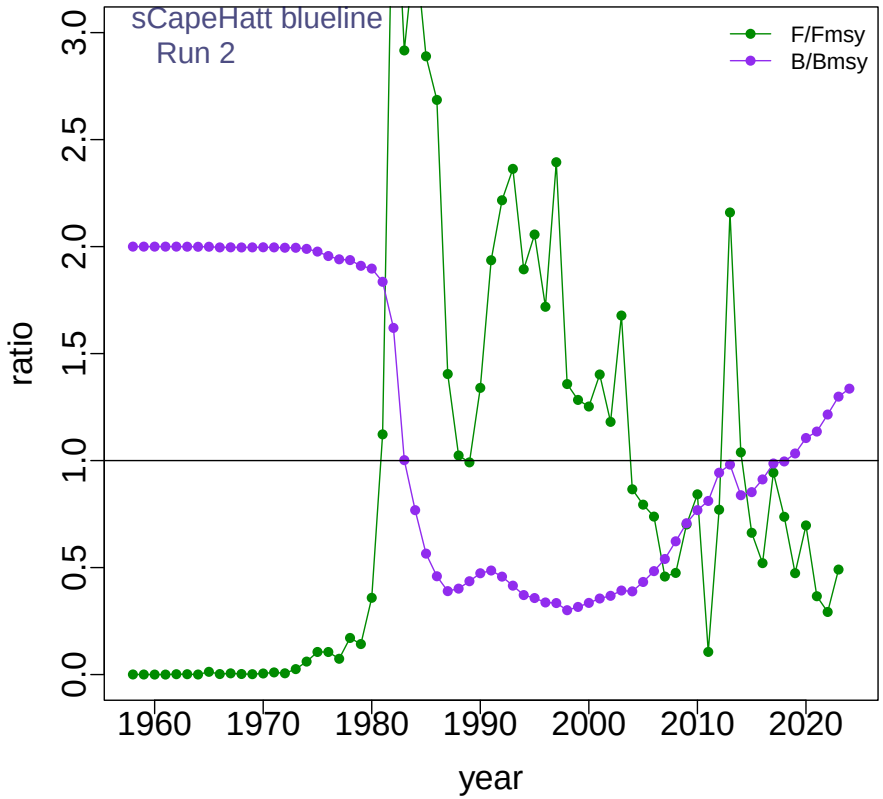
Fit to longline model (Run 03)



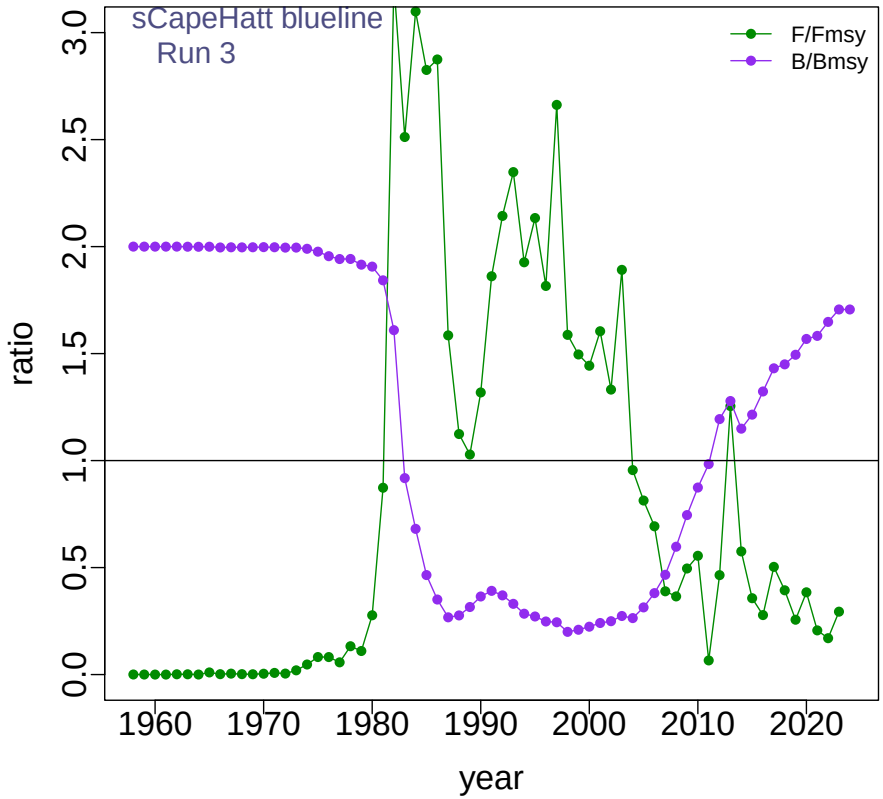
Results

Base Model Results and Uncertainty

Status trends for handline model (Run 02)



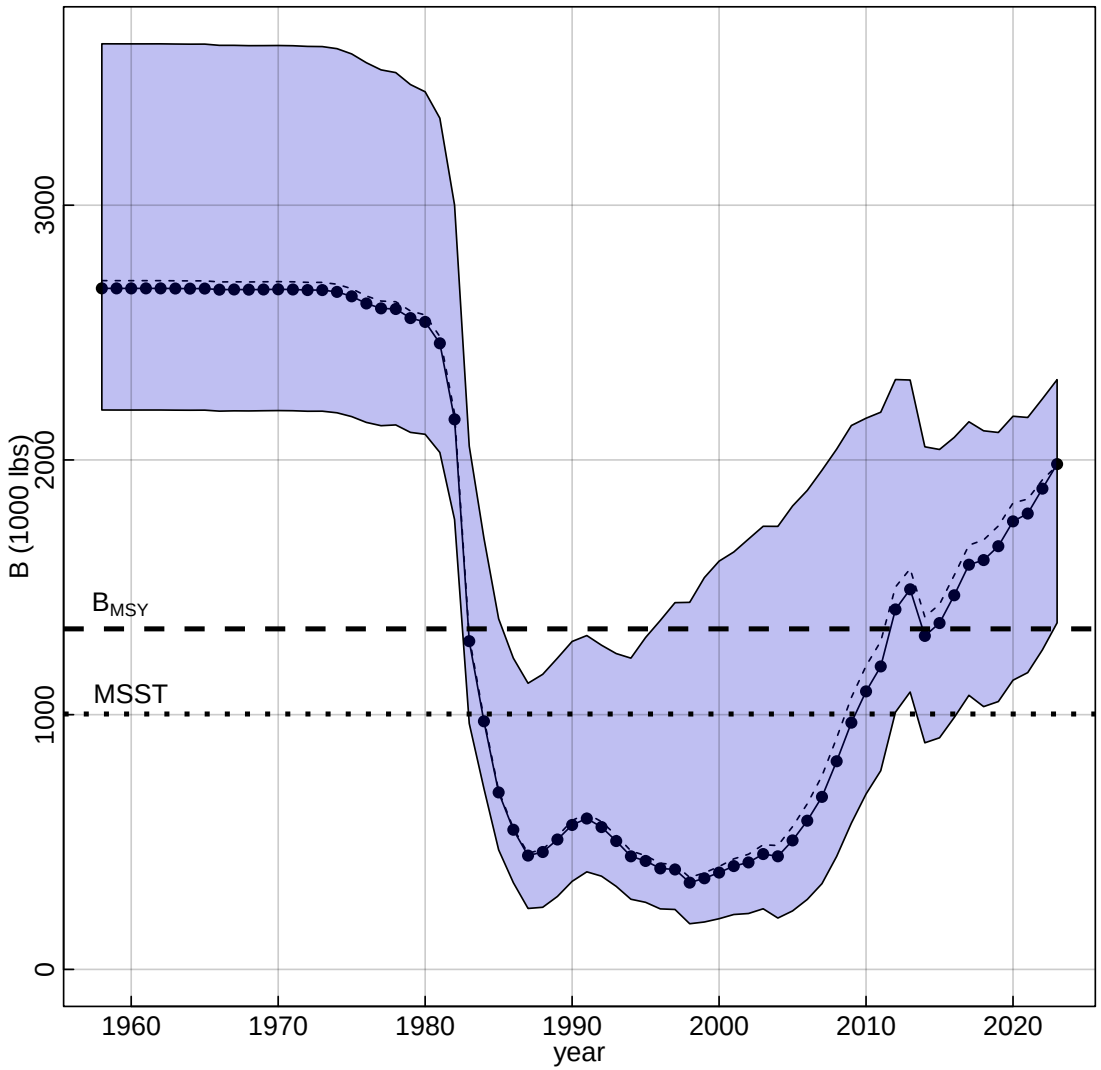
Status trends for longline model (Run 03)



Results

Base Model Results and Uncertainty

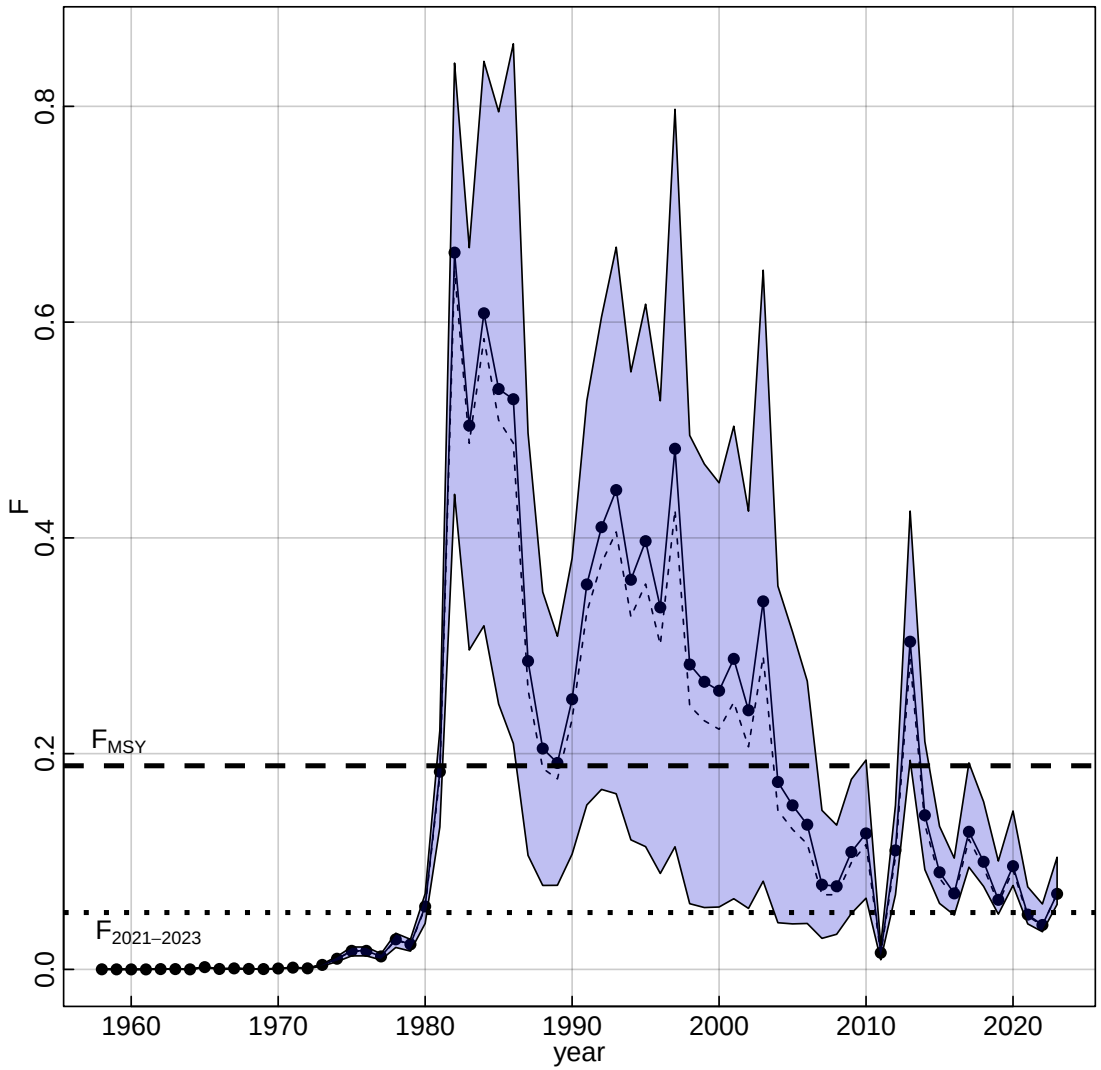
Estimated biomass series (B) combining Runs 02 and 03 from ASPIC



Results

Base Model Results and Uncertainty

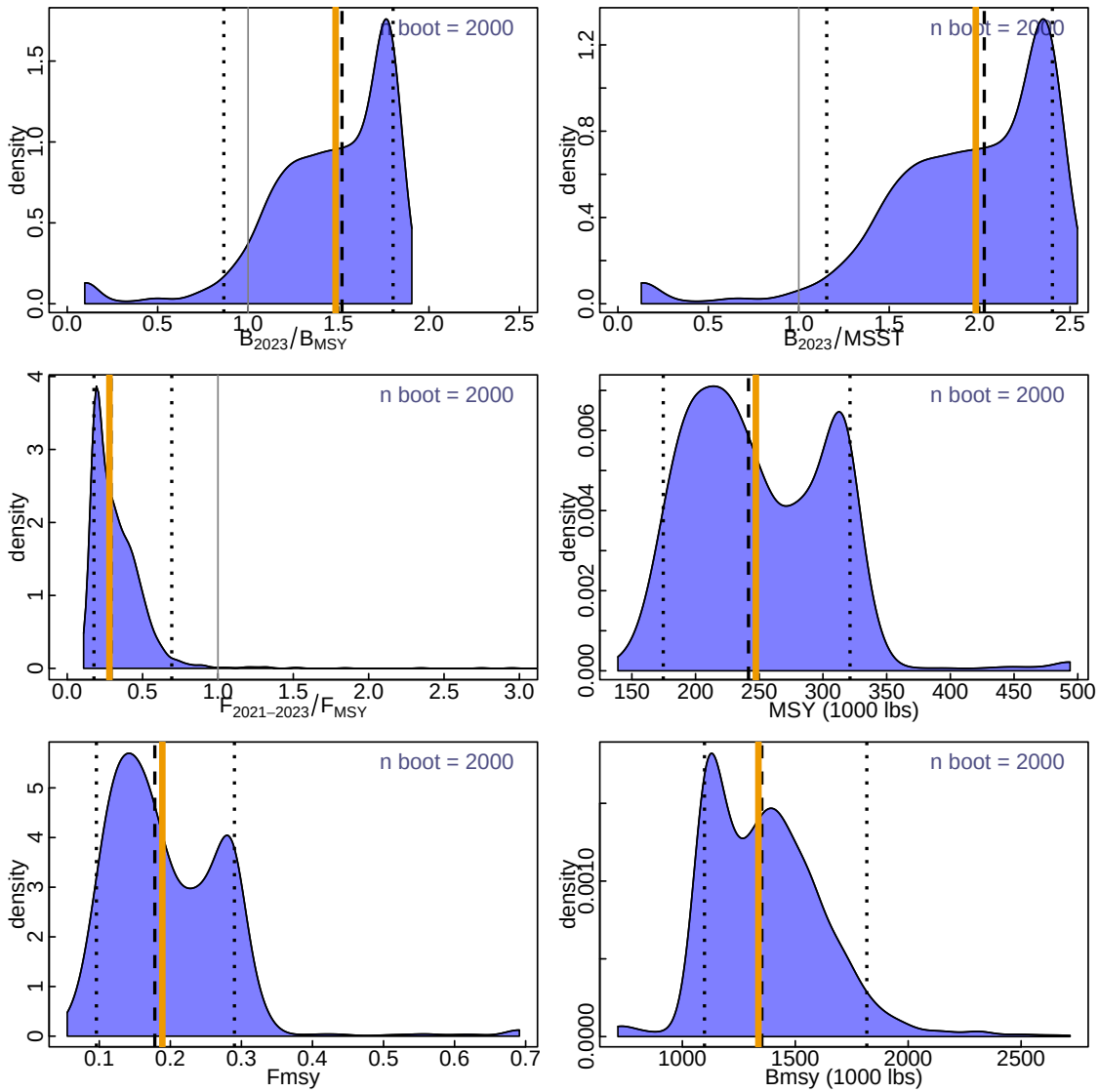
Estimated fishing mortality series (F) combining Runs 02 and 03 from ASPIC



Results

Base Model Results and Uncertainty

ASPIC bootstrap parameter distributions combining Runs 02 and 03

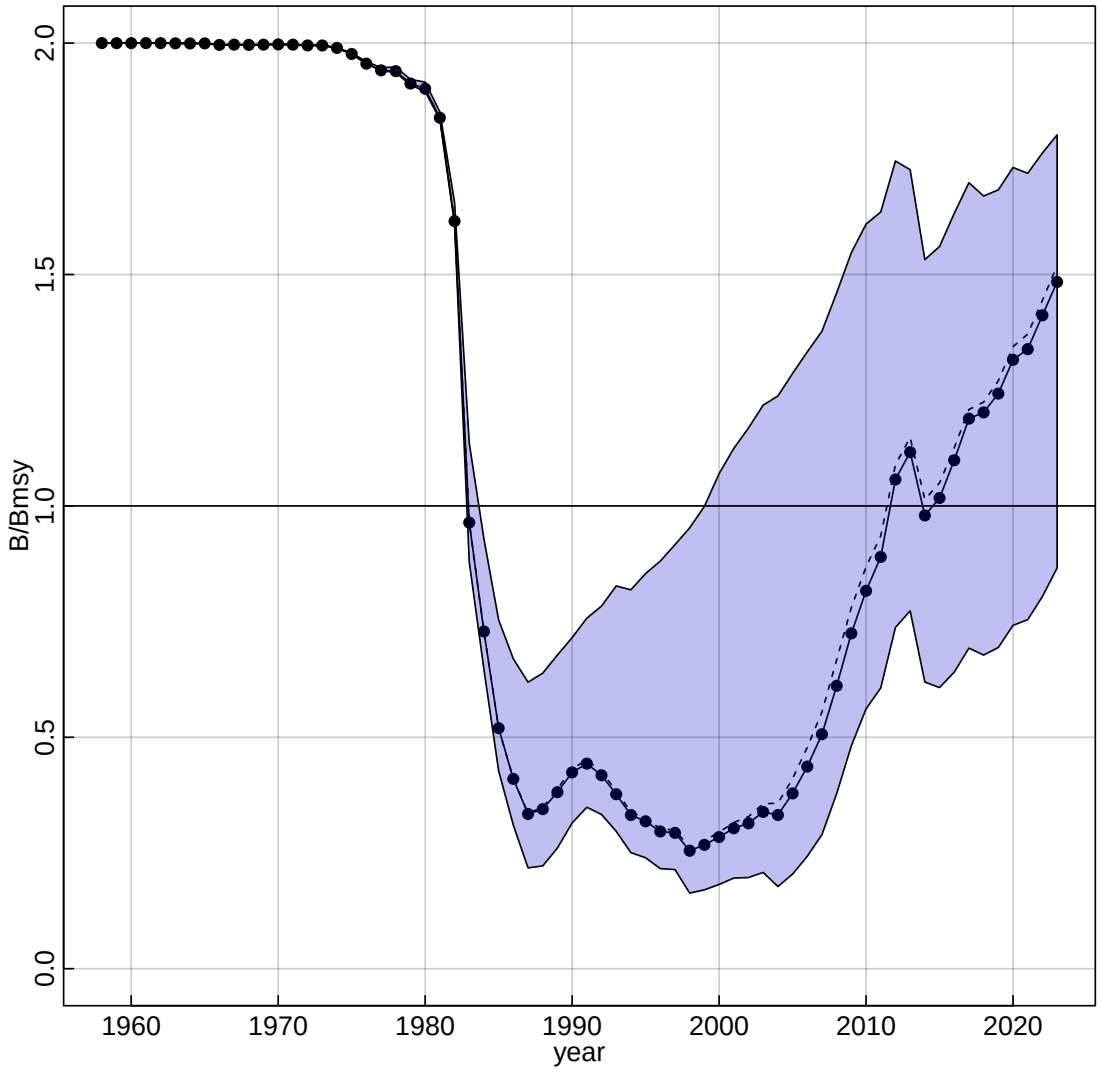


Results

Base Model Results and Uncertainty

Estimated biomass series (B) relative to B_{MSY} combining Runs 02 and 03 from ASPIC

- Solid line indicates average B series relative to average B_{MSY}.
- Dashed line represents the median B/B_{MSY}
- Blue error bands indicate 5^{th} and 95^{th} percentiles of the combined bootstrap trials

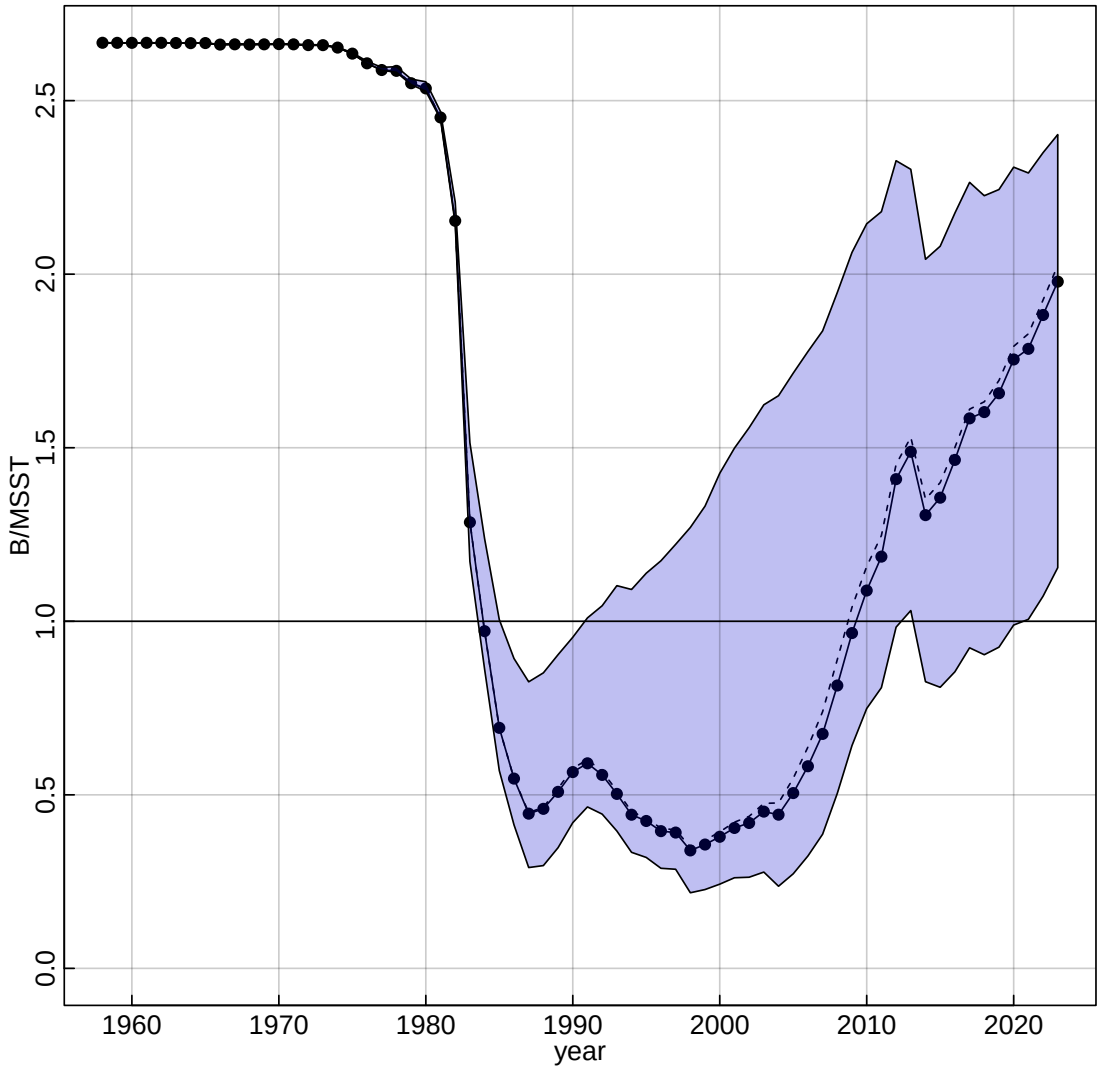


Results

Base Model Results and Uncertainty

Estimated biomass series (B) relative to MSST combining Runs 02 and 03 from ASPIC

- Solid line indicates average B series relative to average MSST.
- Dashed line represents the median B/MSST
- Blue error bands indicate 5^{th} and 95^{th} percentiles of the combined bootstrap trials

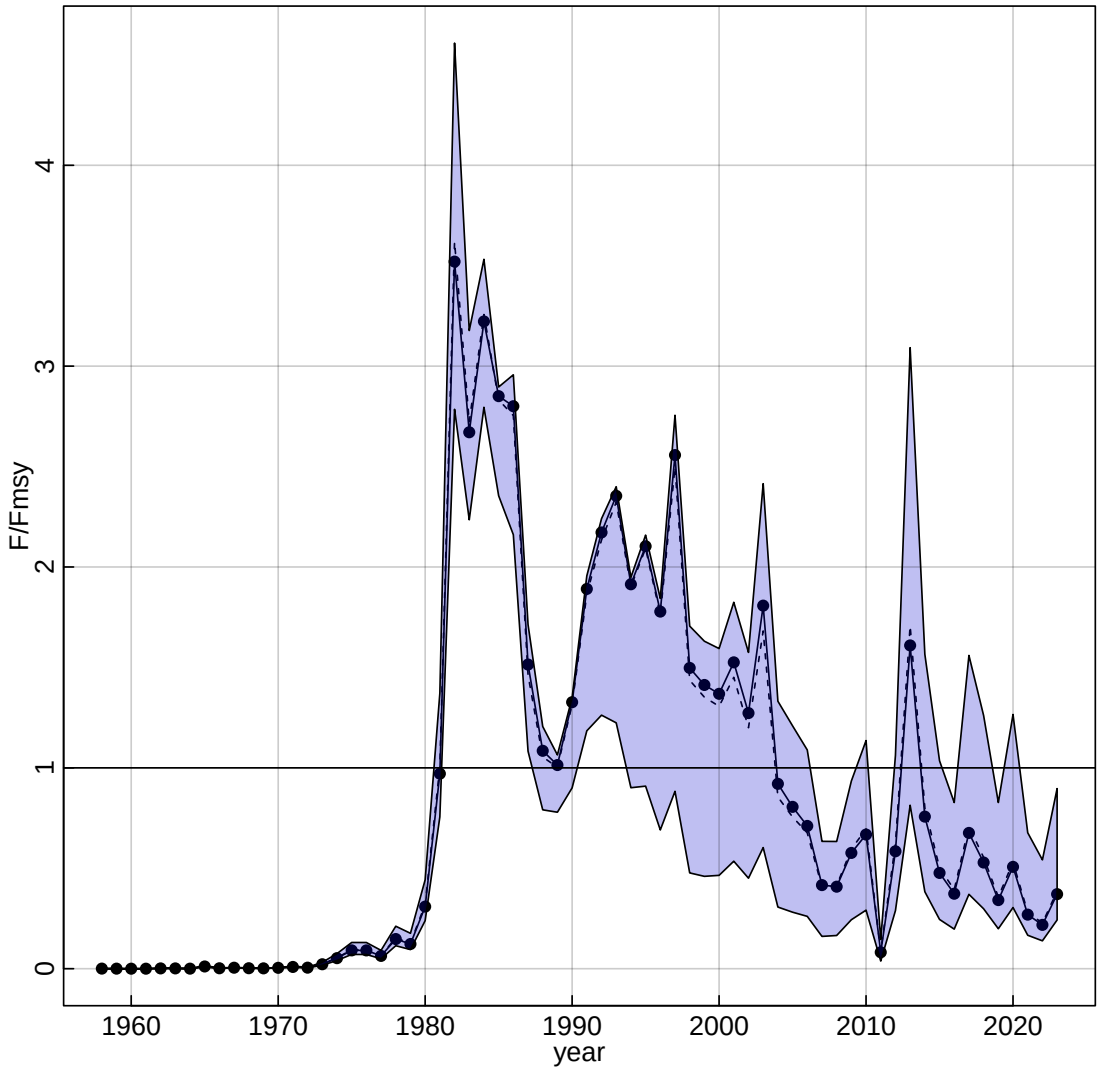


Results

Base Model Results and Uncertainty

Estimated F series relative to F_{MSY} combining Runs 02 and 03 from ASPIC

- Solid line indicates average F series relative to average F_{MSY}.
- Dashed line represents the median F/F_{MSY}
- Blue error bands indicate 5^{th} and 95^{th} percentiles of the combined bootstrap trials

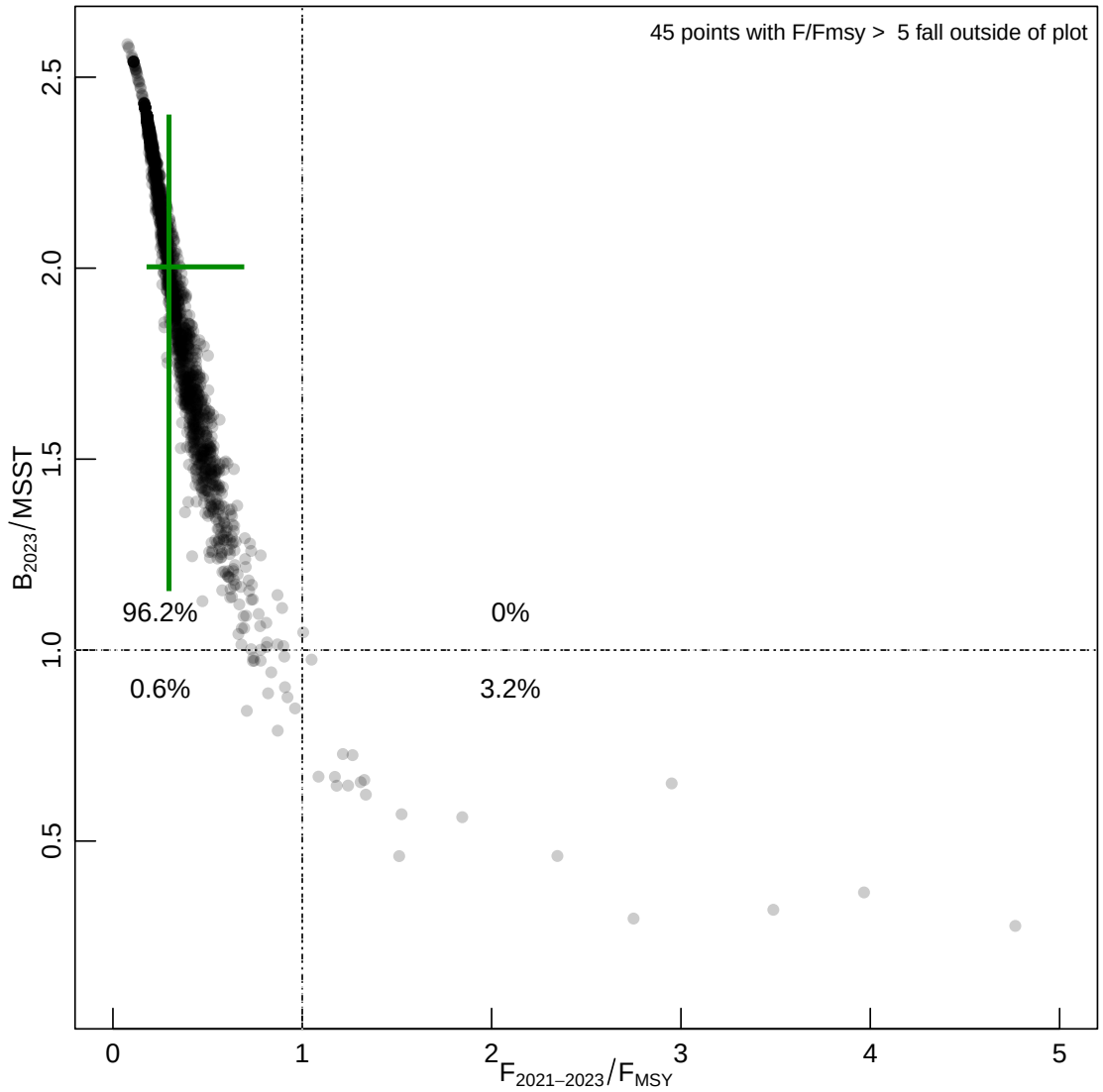


Results

Base Model Results and Uncertainty

Bootstrap status phase plots combining Runs 02 and 03 from ASPIC

- Bootstrapping was conducted for each model separately, results were combined
- The intersection of crosshairs indicates average estimate from the base runs
- Lengths of crosshairs defined by 5^{th} and 95^{th} percentiles
- Percent of runs falling into each quadrant indicated



Results

Base Model Results and Uncertainty

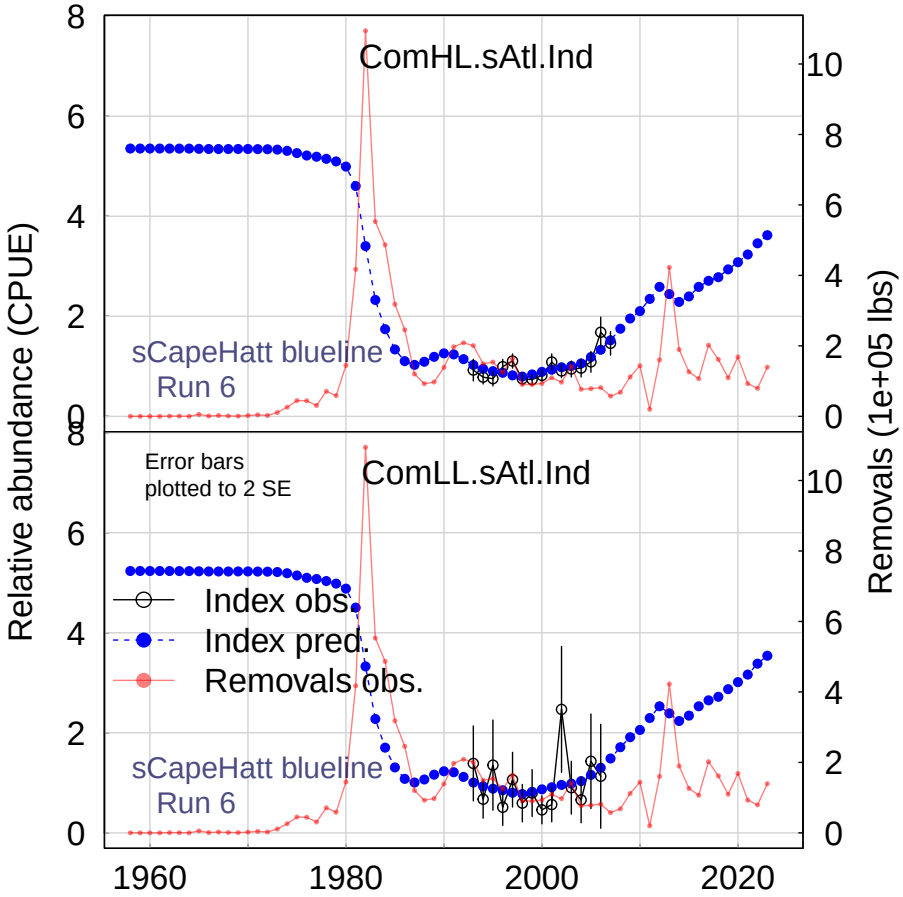
Table: Estimated status indicators, benchmarks, and related quantities from ASPIC, averaged between the handline and longline models for the Atlantic south of Cape Hatteras. Also presented are median values and measures of precision (standard errors, SE) from the bootstrap analysis. Rate estimates (F) are in units of y^{-1}; status indicators are dimensionless; and biomass estimates are in units of 1000 pounds, as indicated.

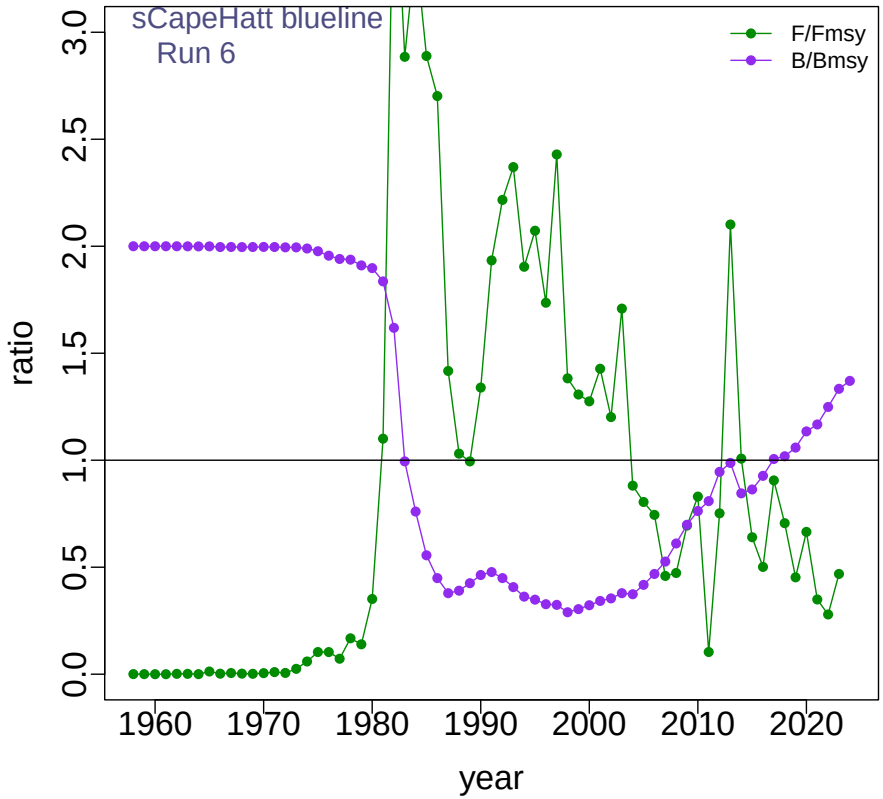
Quantity	Units	Estimate	Median	SE
F_{MSY}	y^{-1}	0.189	0.178	0.099
$85\%F_{\text{MSY}}$	y^{-1}	0.160	0.151	0.084
$75\%F_{\text{MSY}}$	y^{-1}	0.142	0.134	0.074
$65\%F_{\text{MSY}}$	y^{-1}	0.123	0.116	0.064
B_{MSY}	1000 lb	1337	1352	307
MSST	1000 lb	1003	1014	230
MSY	1000 lb	247	242	60
$L_{85\%\text{MSY}}$	1000 lb	242	236	58
$L_{75\%\text{MSY}}$	1000 lb	232	226	56
$L_{65\%\text{MSY}}$	1000 lb	217	212	52
$F_{2021-2023}/F_{\text{MSY}}$	—	0.28	0.29	1.00
B_{2023}/MSST	—	1.98	2.03	0.48
B_{2023}/B_{MSY}	—	1.48	1.52	0.36

Results

Sensitivity

Include handline and longline indices (Run 06)





Results

Sensitivity

Table: Parameter estimates from selected ASPIC surplus production model runs. B_{MSY}, $MSST$, and MSY are in units of 1000 pounds. Lik_{total} = total likelihood. The numerator in F/F_{MSY} is the geometric mean F from the last three years of the assessment (2021-2023) and the numerator in B/B_{MSY} is biomass in the terminal year of the assessment (2023). HL = handline, LL = longline

Run	RunName	F/F_{MSY}	B/B_{MSY}	$B/MSST$	B_{MSY}	$MSST$	MSY	F_{MSY}	Lik_{total}
2	HL	0.3746	1.299	1.732	1459	1094.0	216.0	0.1480	3.573
3	LL	0.2177	1.706	2.275	1214	910.7	278.6	0.2294	12.140
6	HLLL	0.3574	1.334	1.778	1438	1078.0	220.4	0.1533	16.030

Results

Projections

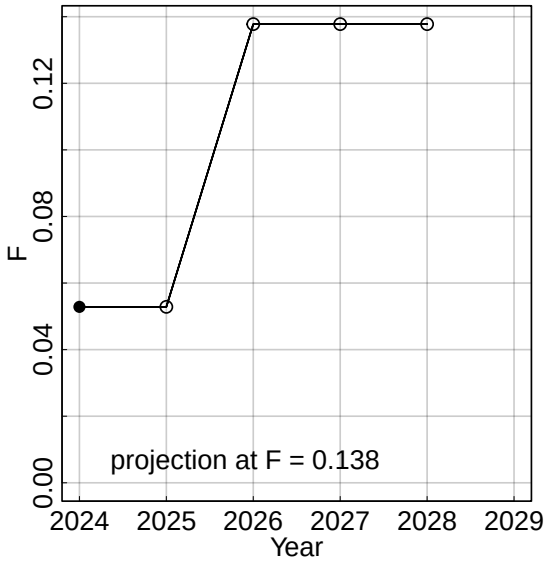
Notes on projection plots:

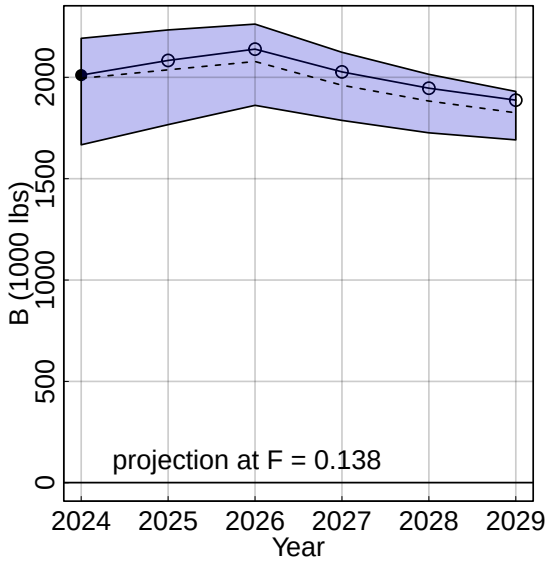
- Solid circles (2023) represent values projected by the assessment model
- Open circles (2024-2029) represent values produced by the projection code
- Solid lines are deterministic estimates
- Dashed lines are medians of the bootstrap projections, respectively
- Blue error bands indicate 10^{th} and 90^{th} percentiles of the combined bootstrap trials

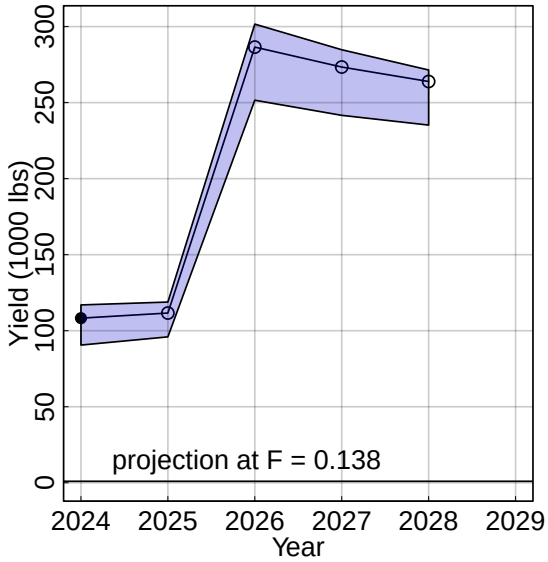
Results

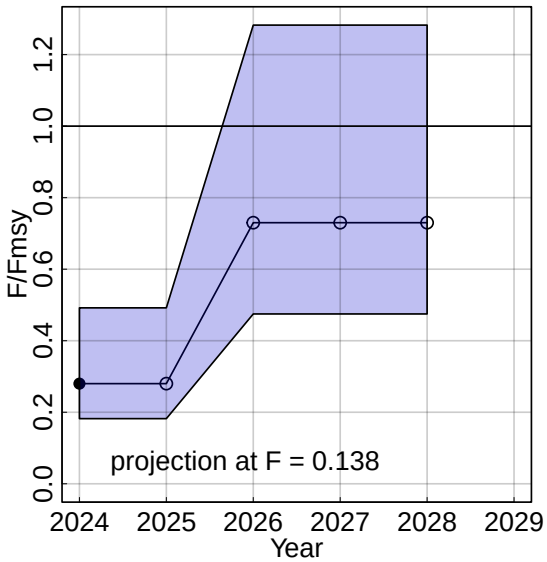
Projections

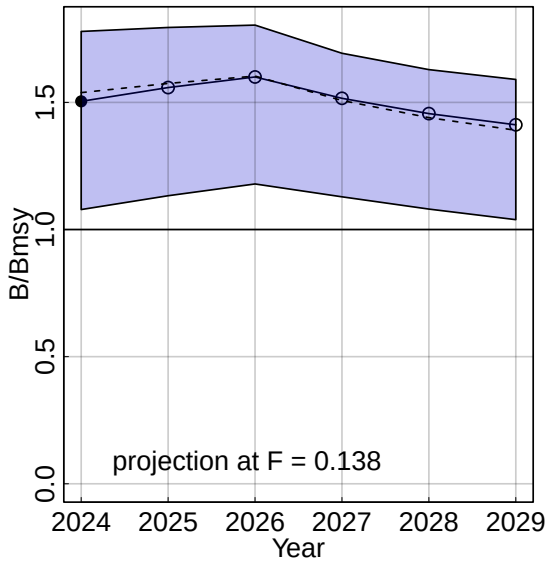
Projections at: $F_{2026-2028} = F_{\mathrm{P}^*_{30\%}}$

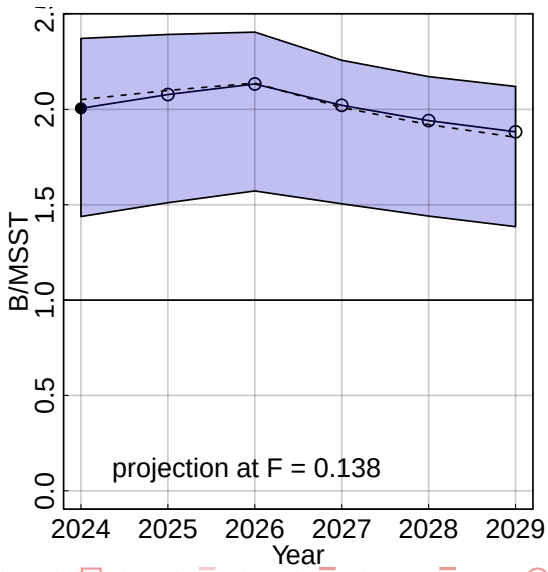












Results

Projections

Projections at: $F_{2026-2028} = F_{\mathrm{P}^*_{30\%}}$

Table: Projection results with fishing mortality fixed at $F = F_{\mathrm{P}^*_{30\%}}$ starting in 2026 . For years prior to 2026 , $F = F_{\text{current}}$. F = fishing mortality rate (per year), $P(B > B_{\text{MSY}})$ = proportion of stochastic projection replicates exceeding B_{MSY}, $P(B > \text{MSST})$ = proportion of stochastic projection replicates exceeding MSST, B_{median} = median biomass (1000 lbs) estimate among projections, B = deterministic biomass (1000 lbs) estimate, Y = deterministic yield (1000 lbs) estimate, Sum Y = cumulative sum of deterministic yield (1000 lbs). Yield includes landings and dead discards. Note that observed dead discards were 7, 3 and 1% of total removals from 2021 to 2023 respectively.

Year	F(per yr)	$P(B > B_{\text{MSY}})$	$P(B > \text{MSST})$	B_{median}	B	Y	Sum Y
2024	0.053	0.92	0.96	1995	2011	108	108
2025	0.053	0.94	0.97	2037	2083	112	220
2026	0.138	0.95	0.97	2078	2139	287	506
2027	0.138	0.95	0.97	1961	2027	273	780
2028	0.138	0.93	0.97	1883	1946	264	1044
2029		0.92	0.96	1825	1887		

Conclusions

- Blueline Tilefish south of Cape Hatteras are not overfished (B_{2023}/MSST=1.98) and overfishing is not occurring ($F_{2021-2023}/F_{\mathrm{MSY}}$=0.28)
- Bootstrap analysis showed little statistical uncertainty in stock status (B) and fishery status (F)
- With no index of abundance for the last 16 years of the model period (2008 to 2023), the model had no information on recent abundance trends and largely depended on historical data to estimate model parameters
- Though parameters differ from SEDAR 50, the SEDAR 92 model is largely a long-term projection with updated removals
- Catch levels have been relatively low and fairly stable since the beginning of the indices (1993)