SEDAR 92 Atlantic Blueline Tilefish: South of Cape Hatteras Data Limited Methods (DLM)

Nikolai Klibansky

National Oceanic and Atmospheric Administration

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Introduction

- Age aggregated surplus production model (AAPM) currently used to provide management advice for blueline tilefish south of Cape Hatteras from the SEDAR 50 benchmark stock assessment
- AAPM was updated for the current SEDAR 92 operational stock assessment and presented to the South Atlantic SSC on April 15, 2025
- An April 22, 2025 memo sent to the SEFSC, by the SAFMC on behalf of the South Atlantic SSC, requested that a "DLM model similar to approach applied for area north of Cape Hatteras" be completed
- The DLM analysis was completed by the SEFSC following the approach applied to the area north of Cape Hatteras and was documented as an addendum to the SEDAR 92 Report, submitted to SAFMC staff on May 23, 2025

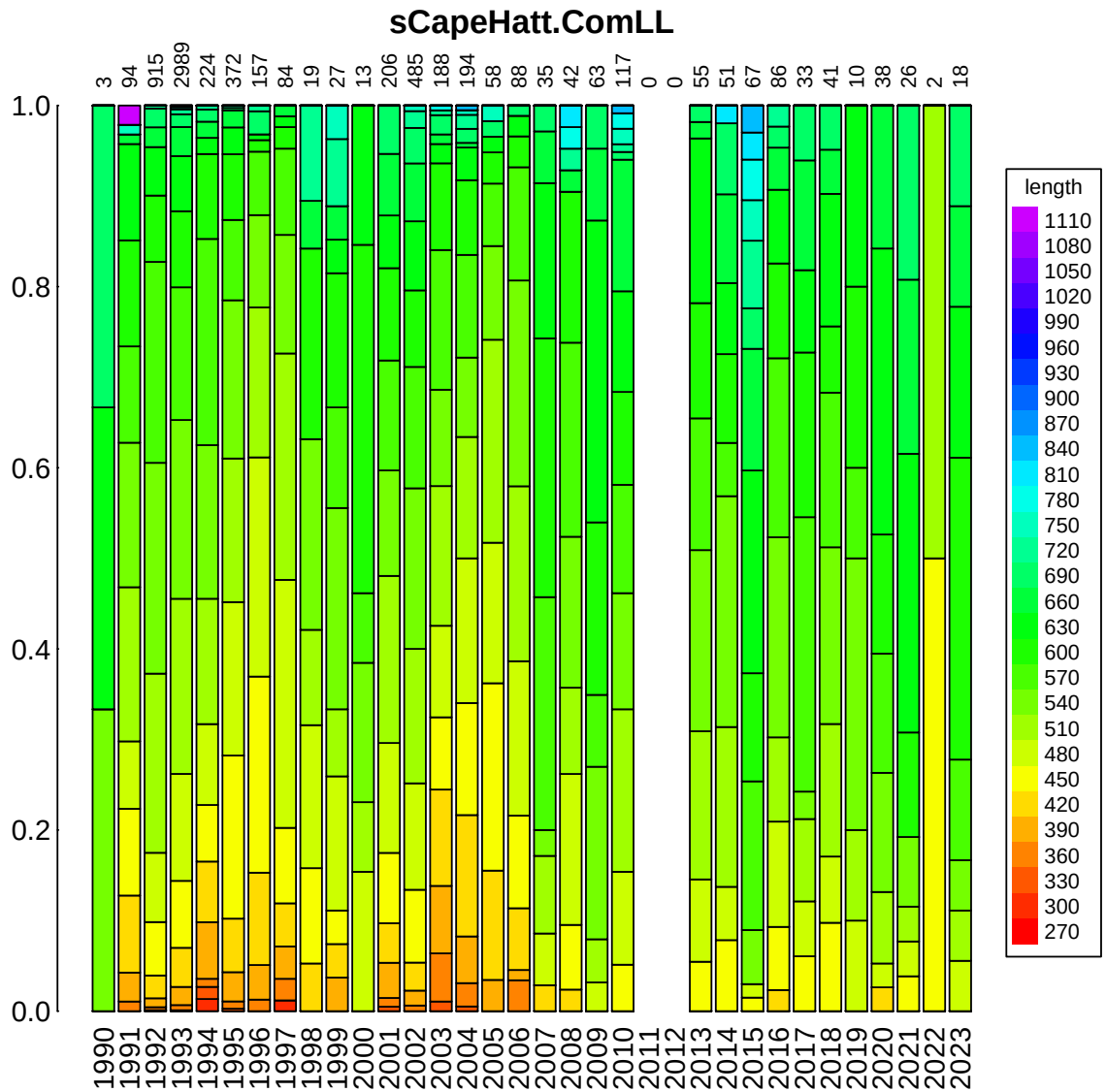
Methods

- Input data for DLMtool functions are listed below and plotted thereafter where appropriate
- Data supplied to DLMtool are presented here by type:
  - Matrices
  - Vectors
  - Points

Methods

Matrices

- Catch-at-length (`CAL`): a single matrix of numbers-at-length by year
- Data used for `CAL` were longline length compositions (1990-2023) south of Cape Hatteras
- No length data 1987-1989
- Not specifically provided for use in the assessment but available in existing data sets

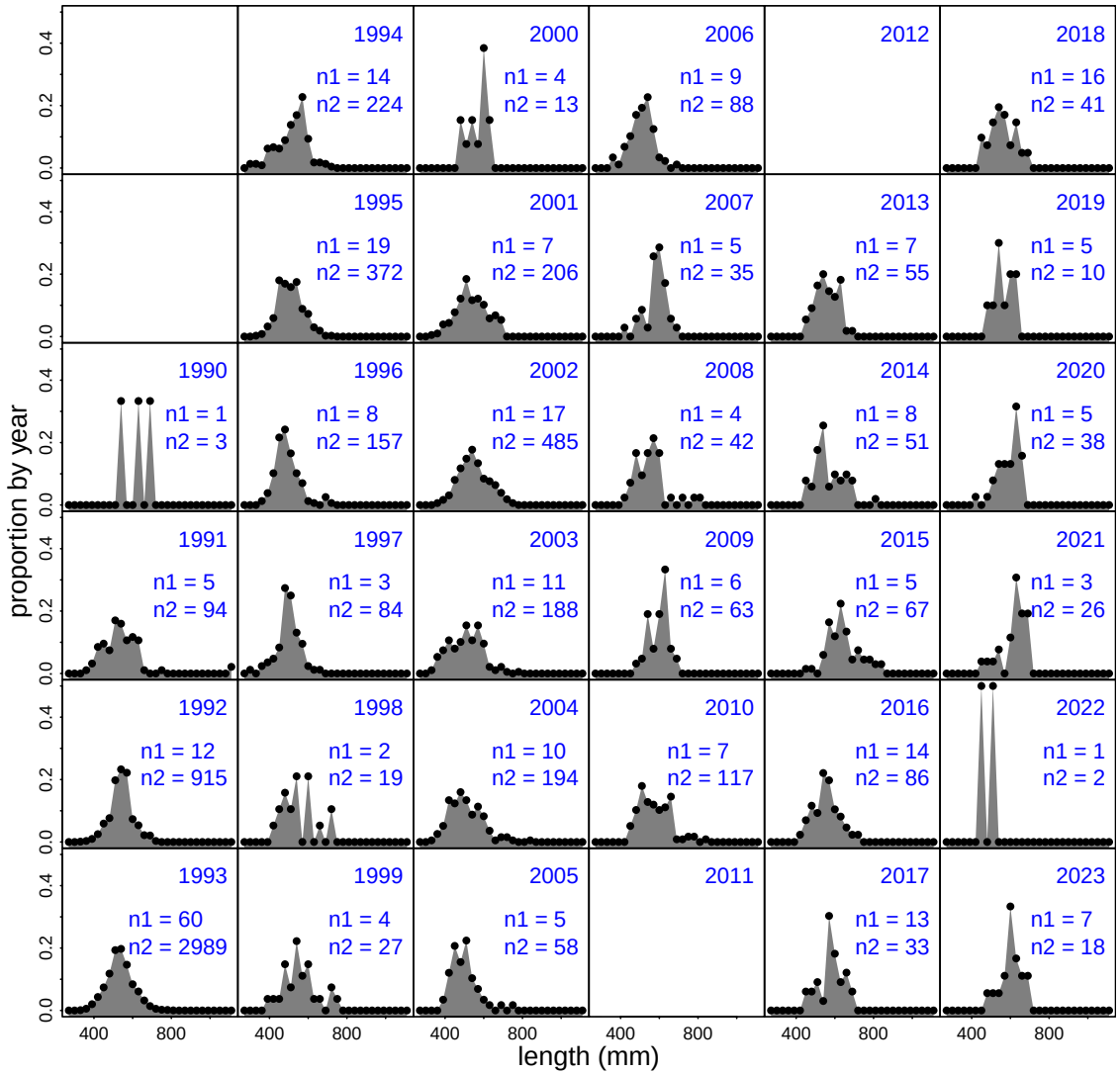


Methods

Data

Matrices

- Catch-at-length (`CAL`): a single matrix of numbers-at-length by year
- Data used for `CAL` were longline length compositions (1990-2023) south of Cape Hatteras
- No length data 1987-1989
- n1 = number of trips, n2 = number of fish



Methods

Data

Vectors

1. catch (`Cat`): time series of removals in pounds. Also used to calculate a CV of catches (`CV_Cat` = 0.5)
2. years (`Year`): years associated with catch data 1987 to 2023

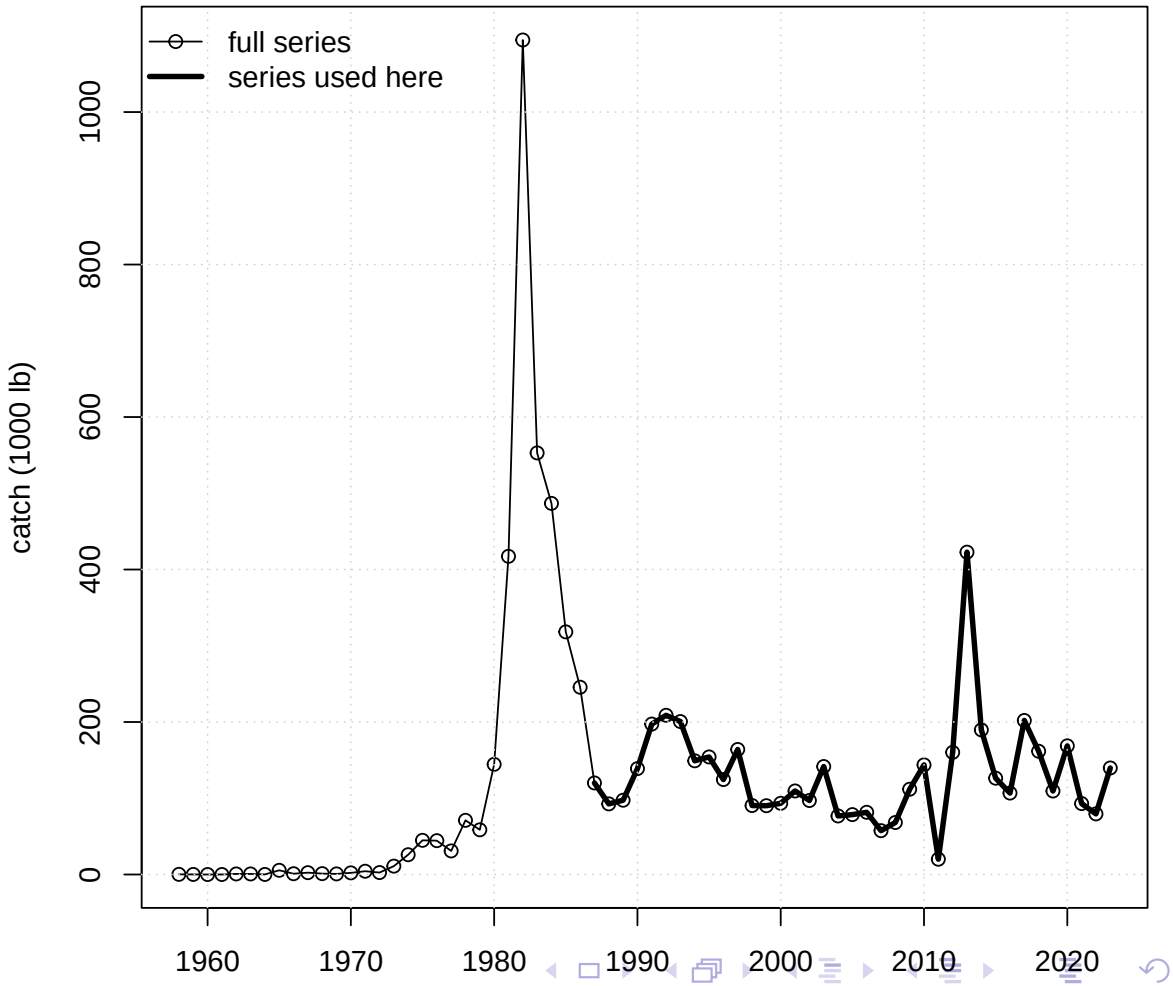
Methods

Data

Vectors

Catch data used in north of Cape Hatteras DLM analysis

- Full series (thin solid line) includes all removals for all years available
- A truncated series of years (thick solid line) representing a long period of recent, fairly stable removals (1987-2023) was used for `Cat`



Methods

Data

Points

1. natural mortality (M; `Mort`)
   - Estimate of M based on $t_{\max} = 40$ and the Then et al (2014) equation:
     $\texttt{Mort} = 4.899 * 40^{-0.916} = 0.17$
   - An upper estimate of $M = 0.25$ was computed from a minimum $t_{\max} = 26$ using the Then et al (2014) equation. A normal distribution was assumed around M, for which 0.25 represented the 97.5th percentile. The CV of this distribution was then determined (`CV_Mort` $= 0.24$)

Methods

Data

Points

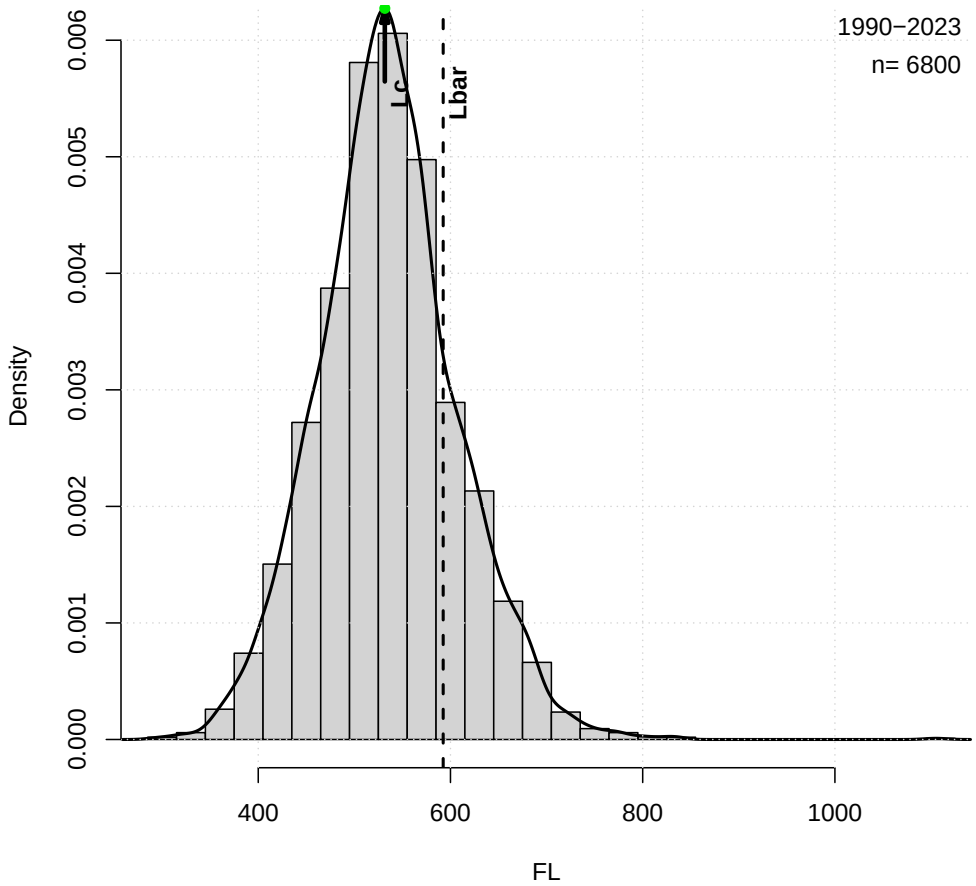
2. L_{50} (`L50`): length at 50% maturity = 305 mm. Very few immature fish observed in data. (`CV_L50` = 0.45)

Methods

Data

Points

3. Modal length of catches: Size of fish in first length mode in catch length composition (`Lc` = 532 mm.).
4. Length at full selection (`LFS`): Set equal to `Lc`. The CV was also calculated directly from the first size mode in the catch length composition (`CV_LFS` = 0.13)
5. Mean length of catch larger than `Lc` (`Lbar` = 592 mm.).



Methods

Data

Points

Growth parameters from growth model fit to SCDNR blueline tilefish age data recommended by SEDAR 92 Life History Topical Working Group (LH TWG)

6. von Bertalanffy K:
   `vbK` $= 0.16$
   `CV_vbK` $= 0.141$
7. von Bertalanffy L_∞:
   `vbLinf` $= 679.01$
   `CV_vbLinf` $= 0.014$
8. von Bertalanffy t_0:
   `vbt0` $= -6.16$
   `CV_vbt0` $= -0.19$

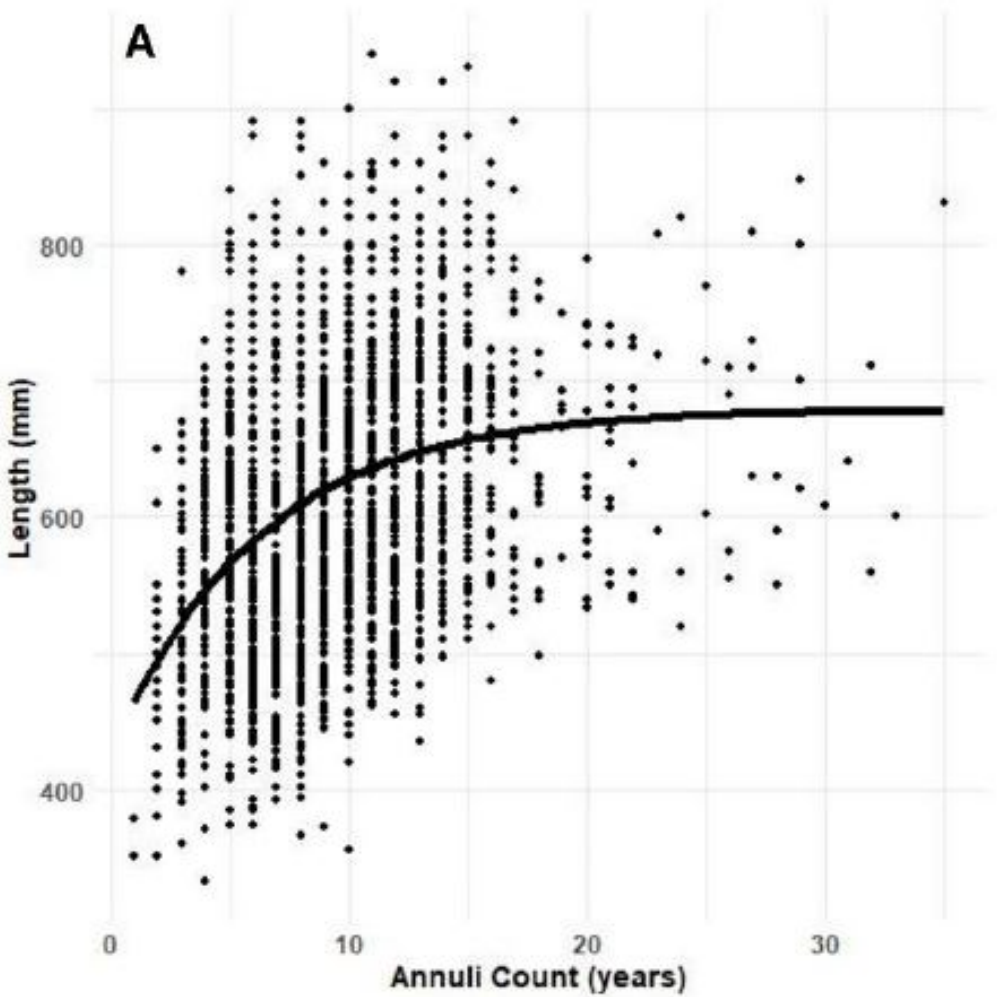


Figure 1 from Bubley (2024) SEDAR92-WP-06

Methods

Data

Points

10. weight length equation parameter a: SEDAR 50 blueline tilefish $W = aL^b$ fit (`wla` = 0.0000178, `CV_wla` = 0.08; units: mm and g)
11. weight length equation parameter b: SEDAR 50 blueline tilefish $W = aL^b$ fit (`wlb` = 2.94, `CV_wlb` = 0.004; units: mm and g)

Methods

Data

Points

12. Beverton-Holt steepness parameter: Based on a meta-analysis of marine demersal teleost fishes by Shertzer and Conn (2012)
    `steep` = 0.836
    `CV_steep` = 0.24
13. maximum age: Estimate from SEDAR 50 (SEDAR 92 LH TWG did not recommend a change)
    `MaxAge` = 40 years.

Methods

Analysis

1. `AvC`: Average catch over entire `Cat` time series (1987 – 2023)
2. `CC1`: Average catch over most recent 5 years of `Cat` time series
3. `CC4`: 70% of average catch over most recent 5 years of `Cat` time series

Methods

Analysis

4. `Fdem_ML`: Demographic F_{MSY} method that uses mean length data to estimate recent Z.
   - Uses Beverton-Holt equilibrium mean length method to estimate recent $Z = K(L_\infty - Lbar)/(Lbar - Lc)$
   - $Z - M = F_{\text{recent}}$
   - Calculates B_{current} as the most recent year of catch divided by $1 - \exp(-F_{\text{recent}})$
   - Using life history data, solves the Euler-Lotka equation for r
   - Calculates $r/2 = F_{\text{MSY}}$
   - $F_{\text{MSY}} B_{\text{current}} = \text{TAC}$

Methods

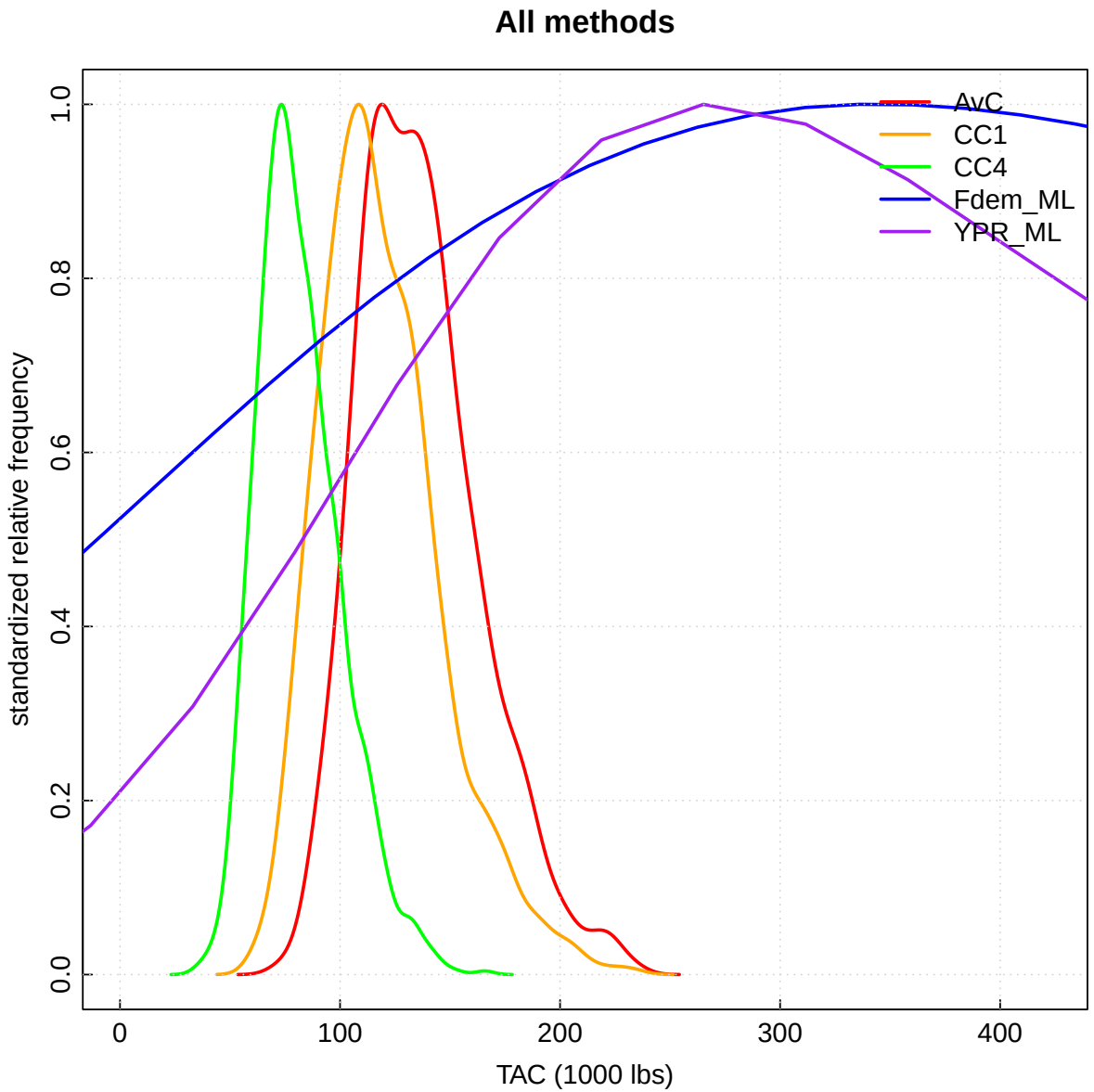
Analysis

5. `YPR_ML`: Yield Per Recruit analysis to get F_{MSY} proxy ($F_{0.1}$) paired with a mean-length estimate of current stock size
   - Uses Beverton-Holt equilibrium mean length method to estimate recent $Z = K(L_\infty - Lbar)/(Lbar - Lc)$
   - $Z - M = F_{\text{recent}}$
   - Calculates B_{current} as the most recent year of catch divided by $1 - \exp(-F_{\text{recent}})$
   - Conducts a yield-per-recruit analysis to determine the value of F at which the slope of the $YPR = f(F)$ curve is 10% of the slope of this curve at the origin (i.e. $F_{0.1}$)
   - $F_{0.1}$ serves as a proxy for F_{MSY}
   - $F_{\text{MSY}} B_{\text{current}} = \text{TAC}$

Results

Distributions of TACs from south of Cape Hatteras DLM analysis

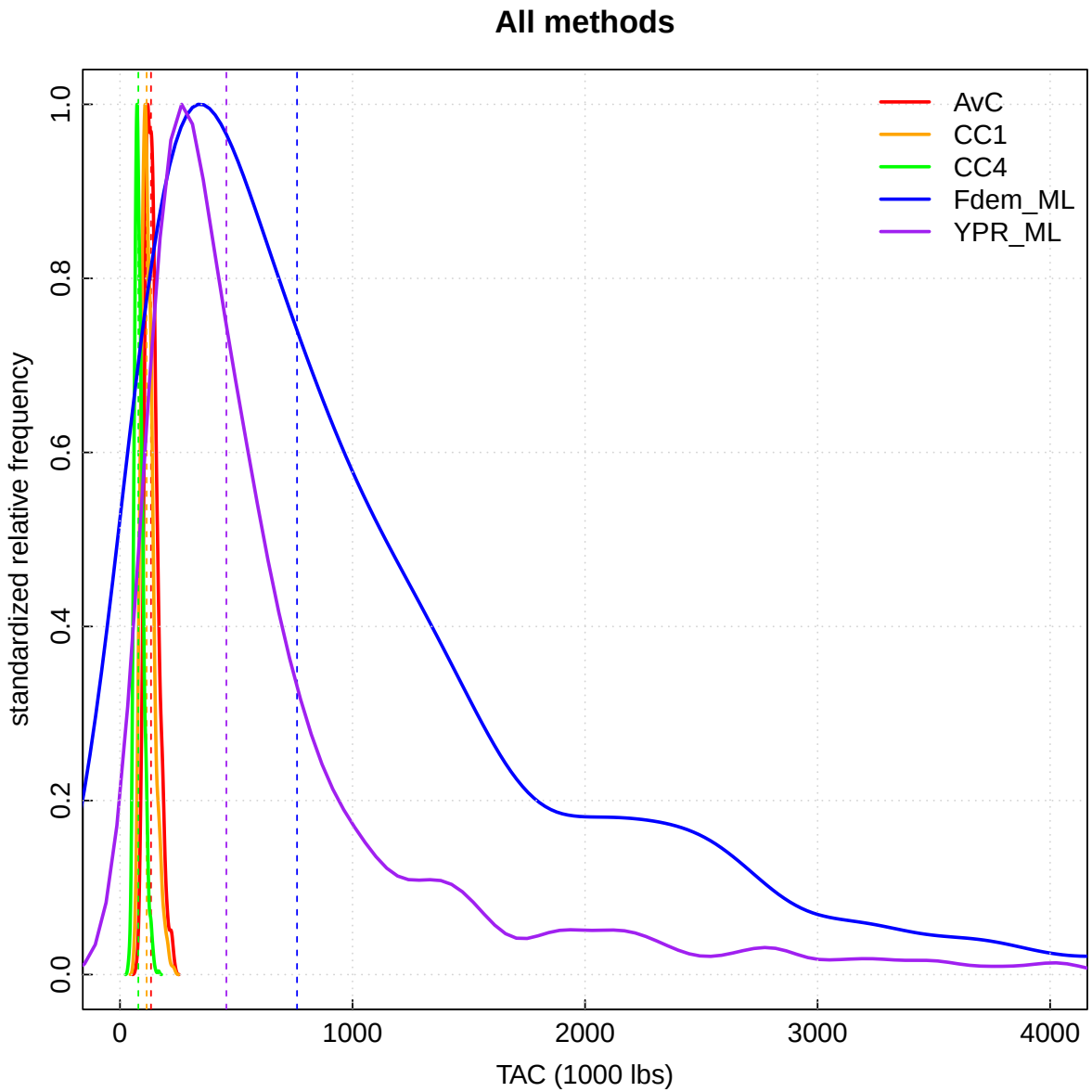
- Catch based methods produce TACs in a similar range
- mean length (ML) methods produce very high and uncertain TACs



Results

Distributions of TACs from south of Cape Hatteras DLM analysis

- TAC distributions replotted with wider range of x-axis to show distribution of ML methods
- Dashed vertical lines show median TACs



Results

Table: Quantiles (%) and standard error (SE) of TAC (total allowable catch) distributions from all `DLMtool` management procedures applied south of Cape Hatteras. Column names AvC, CC1, CC4, Fdem_ML, and YPR_ML are abbreviations for management procedures defined in the main text. Quantity indicates either a percentile or the TAC distribution or its standard error.

Quantity	AvC	CC1	CC4	Fdem_ML	YPR_ML
2.5%	92	76	53	46	105
5%	97	80	55	85	134
10%	105	87	60	152	161
25%	116	99	68	350	260
50%	133	115	79	761	457
75%	152	134	93	1485	858
90%	174	155	108	2666	2024
95%	187	172	117	4084	3238
97.5%	200	185	125	5500	4878
SE	28	28	19	1472	1836

Discussion

ML methods internal F estimates

- Internal estimates of $F_{current}$ using the Beverton-Holt equilibrium mean length equation were generally plausible for DLMtool analysis south of Cape Hatteras, unlike analysis north of cape Hatteras

$$Z = K(L_\infty - Lbar)/(Lbar - Lc)$$
$$Z = 0.16(679.01 - 592)/(592 - 532) = 0.23$$

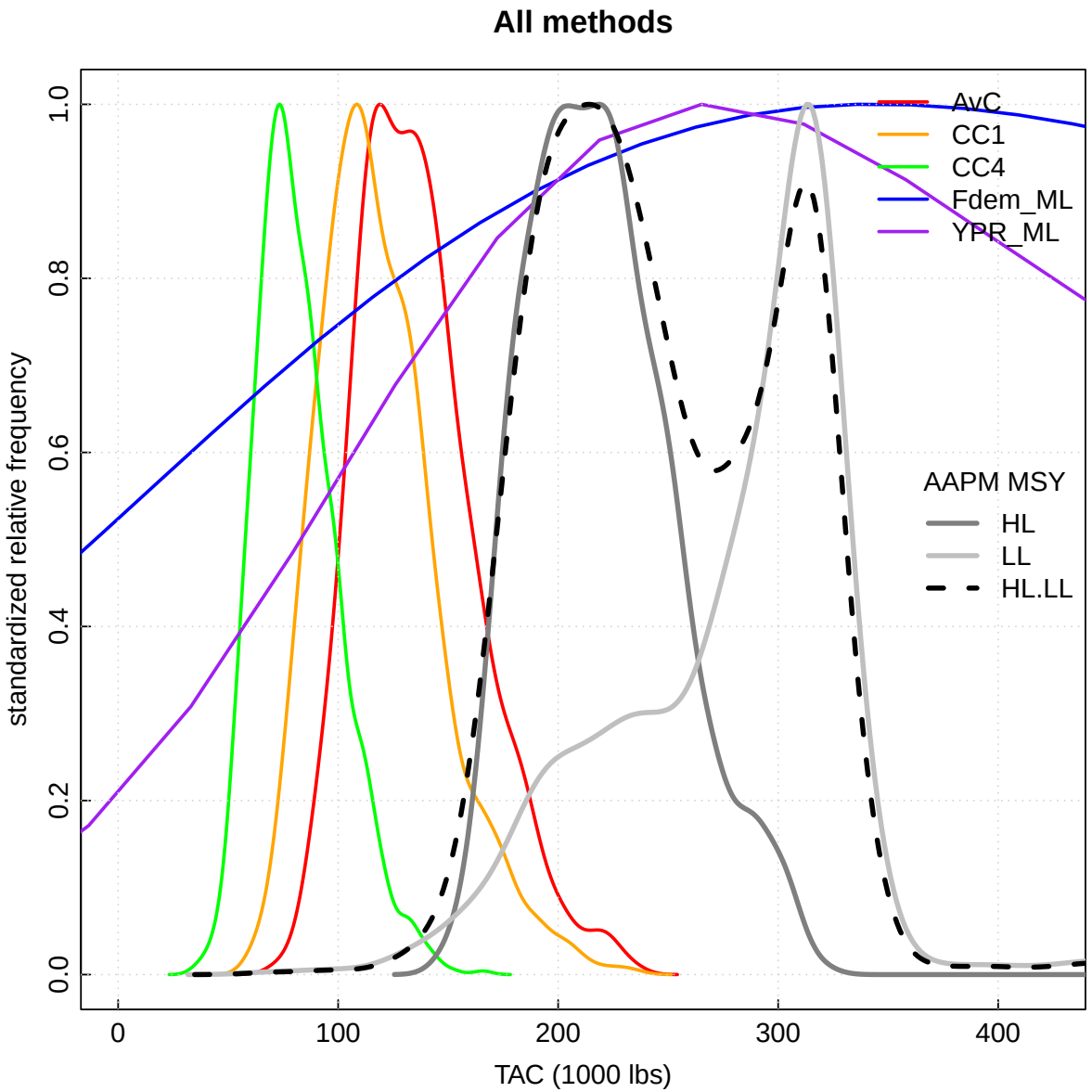
$$Z - M = F_{current}$$
$$0.23 - 0.17 = 0.06$$

- Median TACs from these MPs were fairly high but within the range of observed catches (removals)
- TAC distributions from ML methods were very uncertain
- ML methods are very sensitive to $Lbar$ value

Discussion

Distributions of TACs from south of Cape Hatteras DLM analysis compared with MSY distributions from Age Aggregated Production Models (AAPM)

- MSY estimates from AAPM models fall between median TACs of DLM catch-based methods and ML methods
- For individual AAPM model runs, uncertainty of MSY is similar to TACs of catch-based DLM methods and much lower than ML methods



Conclusions

- Simple catch-based MPs produced TACs in the range of recent catches, as expected, and are lower than MSY estimates from any AAPM runs
- Median TACs from `ML` methods were within the range of historical removals, but were higher than any MSY from AAPM, and were extremely uncertain
- The data-limited methods applied here are less sophisticated than the AAPM and generally produce more uncertain catch advice
- In contrast to the AAPM, the data limited methods did not incorporate time series trends, fit any data sets, produce user-accessible parameter estimates aside from TACs, or any estimates of population trends or status

Questions

Sara P. Duke Gardens, Durham, NC