Overview of Striped Bass Stock Assessment

Stock Assessment Modeling

1) Estimate age-specific abundances, and fishing mortality rates
2) Derive spawning stock biomass and F reference points from resulting estimates
3) Determine stock status
   - Is the spawning stock biomass overfished?
   - Is overfishing occurring (F too high)?

~~4) Make projections of future spawning stock biomass for possible changes in status~~

Current Assessment Model

- Forward projecting statistical catch-at-age model
- Single stock, model ages 1-15+ over time, 1982-present

Abundance Indices

1. *Single Age*

MD YOY, VA YOY, NJ YOY, NYYOY (age-1)

MD Age 1, NY Age 1 (age-2)

2. *Age-specific (Index, Age Composition)*

ChesMMAP (ages 1-15+)

MD Gillnet (ages 2-15+)

DE 30ft Trawl (ages 1-15+)

DE Electrofishing (ages 1- 15+)

NJ Trawl (ages 2-15+)

NY Ocean Haul (ages 2-13+,ended 2006)

CT Trawl (ages 1-13+)

MRIP CPUE (ages 1-15+)

Total Removals (Split Bay and Ocean)

1. MRIP Recreational Harvest and Dead Releases (ME-NC)
2. Commercial Harvest and Dead Discards (MA, RI, NY, DE, VA, Potomac River, MD, NC)
3. Age Compositions

Other

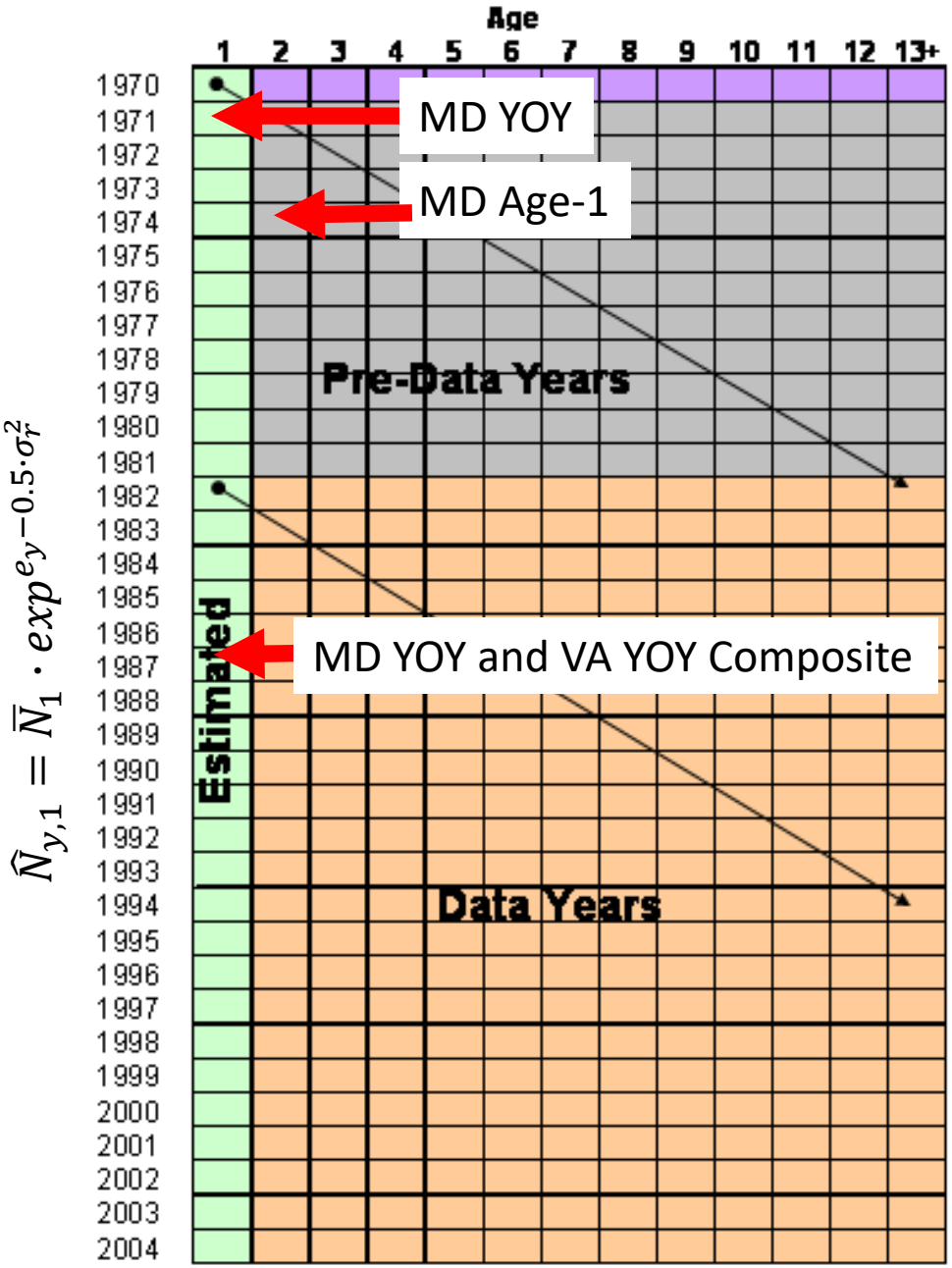
1. Age-specific natural mortality rates
2. Age-specific sex proportions
3. Age-specific ssb weights
4. Age-specific maturity proportions

Female SSB

Indices Workshop

- ASMFC held a workshop in 2007 to critically assess survey indices used in the assessment
- Developed criteria that would indicate a survey was a valid relative measure of abundance and age structure (if applicable)
- Technical committee members were asked to analyze their survey to determine if criteria were met
- Some survey indices were eliminated
- Any new applicant has to provide analyses that show criteria are met before the ASMFC Technical Committee will accept the survey (a one or two proposed surveys indices have been rejected since the workshop)

Abundance Estimates



$$\hat{N}_{y,a} = \hat{N}_{y,a-1} \exp^{-\hat{F}_{1982,a-1} - M_{1982,a-1}}$$

$$\hat{N}_{y,a} = \hat{N}_{y-1,a-1} \exp^{-\hat{F}_{y-1,a-1} - M_{y-1,a-1}}$$

$$\hat{N}_{y,A} = \hat{N}_{y-1,A-1} \exp^{-\hat{F}_{y-1,A-1} - M_{y-1,A-1}} + \hat{N}_{y-1,A} \exp^{-\hat{F}_{y-1,A} - M_{y-1,A}}$$

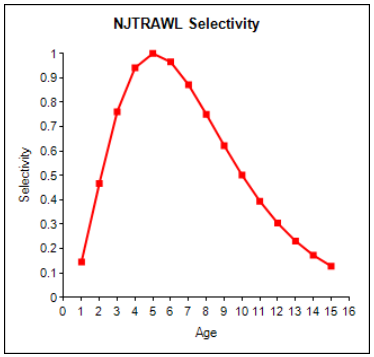
$$\hat{N}_{y,1} = \bar{N}_1 \cdot exp^{e_y - 0.5 \cdot \sigma_r^2}$$

Model Fitting

Predicted Indices

YOY/Age-1: $\hat{I}_{y,a} = \hat{q} \cdot \hat{N}_{y,a} \cdot exp^{-p \cdot \hat{Z}_{y,a}}$

Age Comps: $\hat{I}_{y,a} = \hat{q} \cdot \hat{s}_a \cdot \hat{N}_{y,a} \cdot exp^{-p \cdot \hat{Z}_{y,a}}$



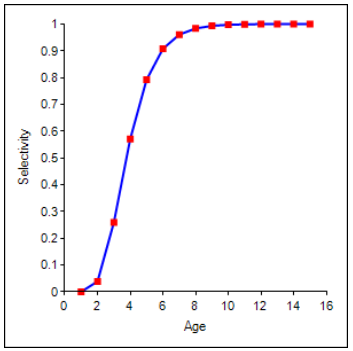
Predicted Total: $\hat{I}_y = \sum_a \hat{I}_{y,a}$

Predicted Age Props: $\hat{U}_{y,a} = \hat{I}_{y,a} \Big/ \sum_a \hat{I}_{y,a}$

Removals

$$\hat{C}_{y,a} = \frac{\hat{F}_{y,a}}{\hat{F}_{y,a} + M_{y,a}} \cdot (1 - \exp^{-\hat{F}_{y,a} - M_{y,a}}) \cdot \hat{N}_{y,a}$$

$\hat{F}_{y,a} = \hat{F}_y \cdot \hat{s}_a$



Predicted Total: $\hat{C}_y = \sum_a \hat{C}_{y,a}$

Predicted Age Props: $\hat{P}_{y,a} = \frac{\hat{C}_{y,a}}{\sum_a \hat{C}_{y,a}}$

Current Assessment Model

Parameter Estimates (n=198)

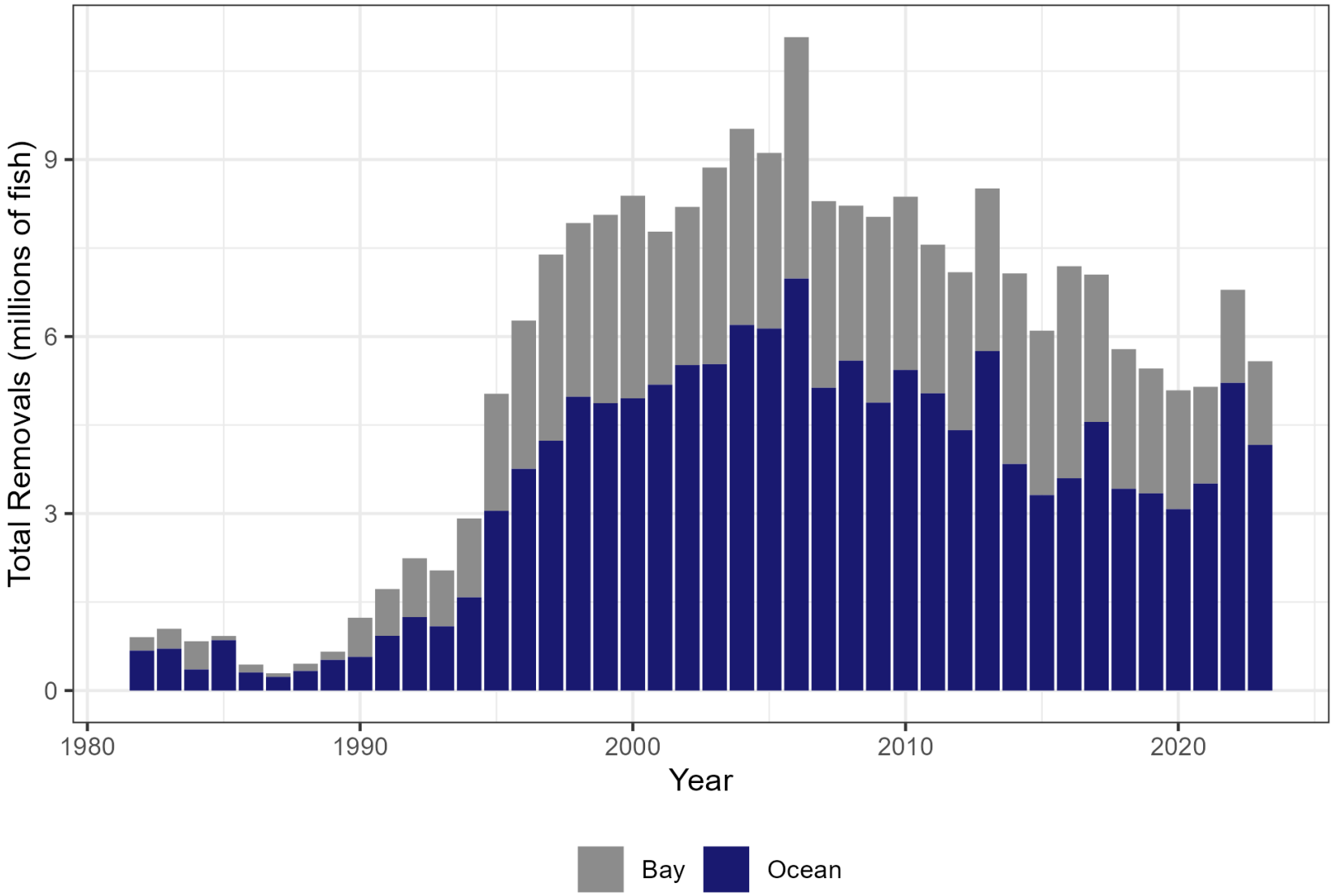
- Age-1 abundance (recruitment) in each year
- Fully-recruited F in each year
- Catch selectivity in 4 regulatory periods
- Catchability coefficients for all indices (14)
- Selectivity for each survey (8) with age composition data

- Data are split into two "Fleets" – Ocean and Bay regions
  - Improved selectivity fits
  - Provided partial F for each fleet

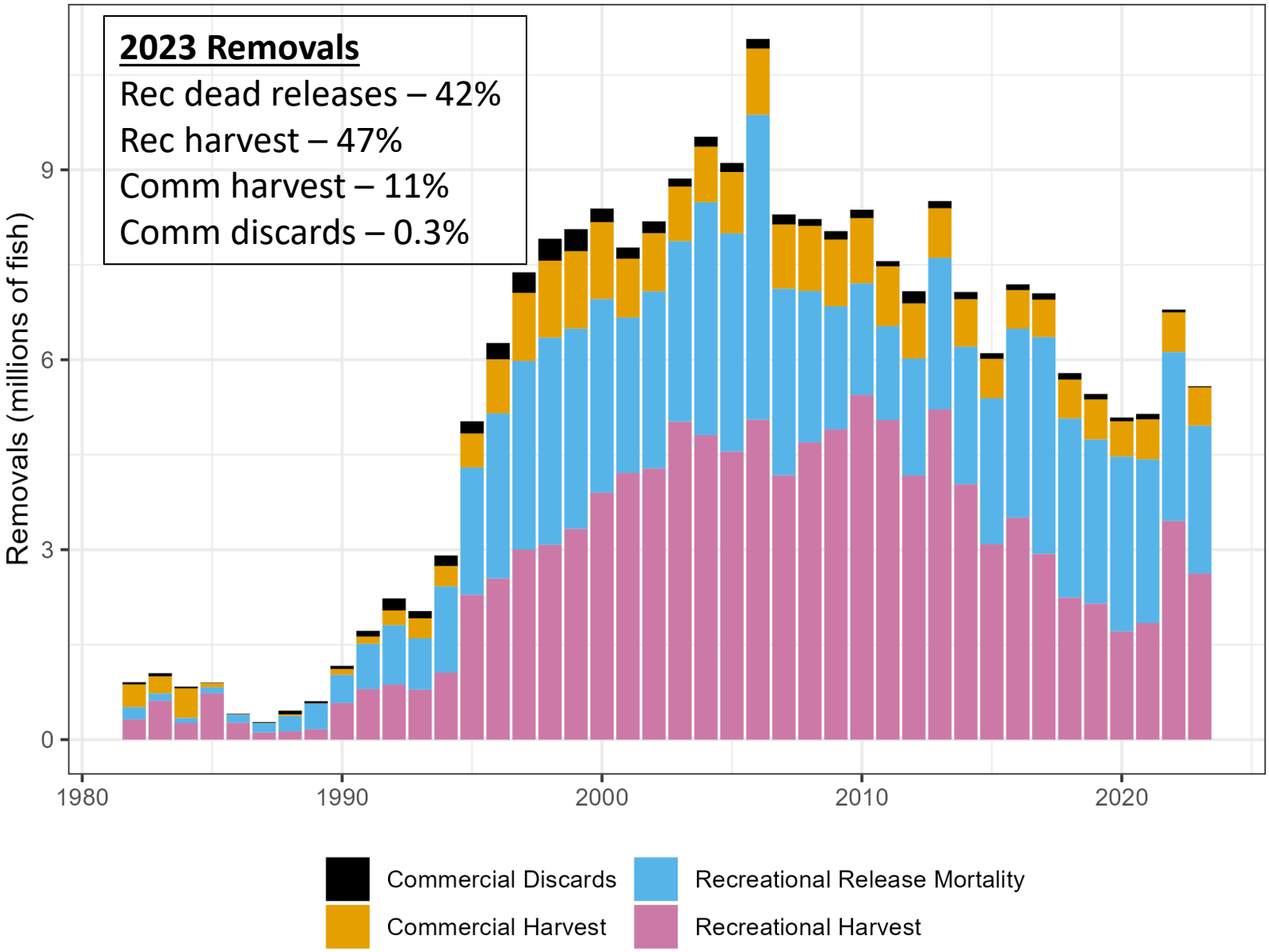
- Age-specific M were used (1.13: age 1 to 0.15: age 7+)
- Weighting of indices and age composition (effective samples size) accomplished using Francis (2011)

Data

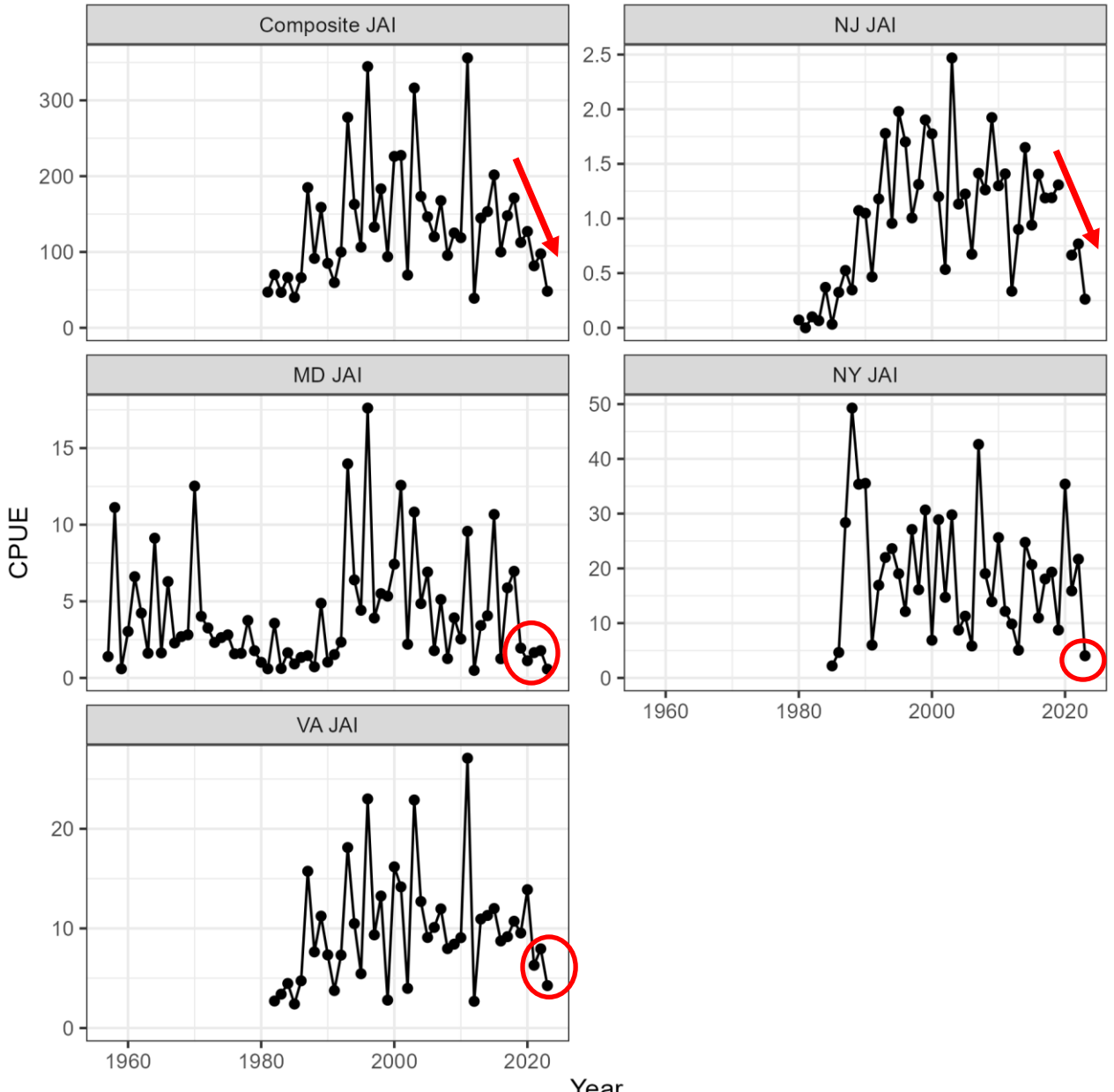
Total Removals By “Fleet”



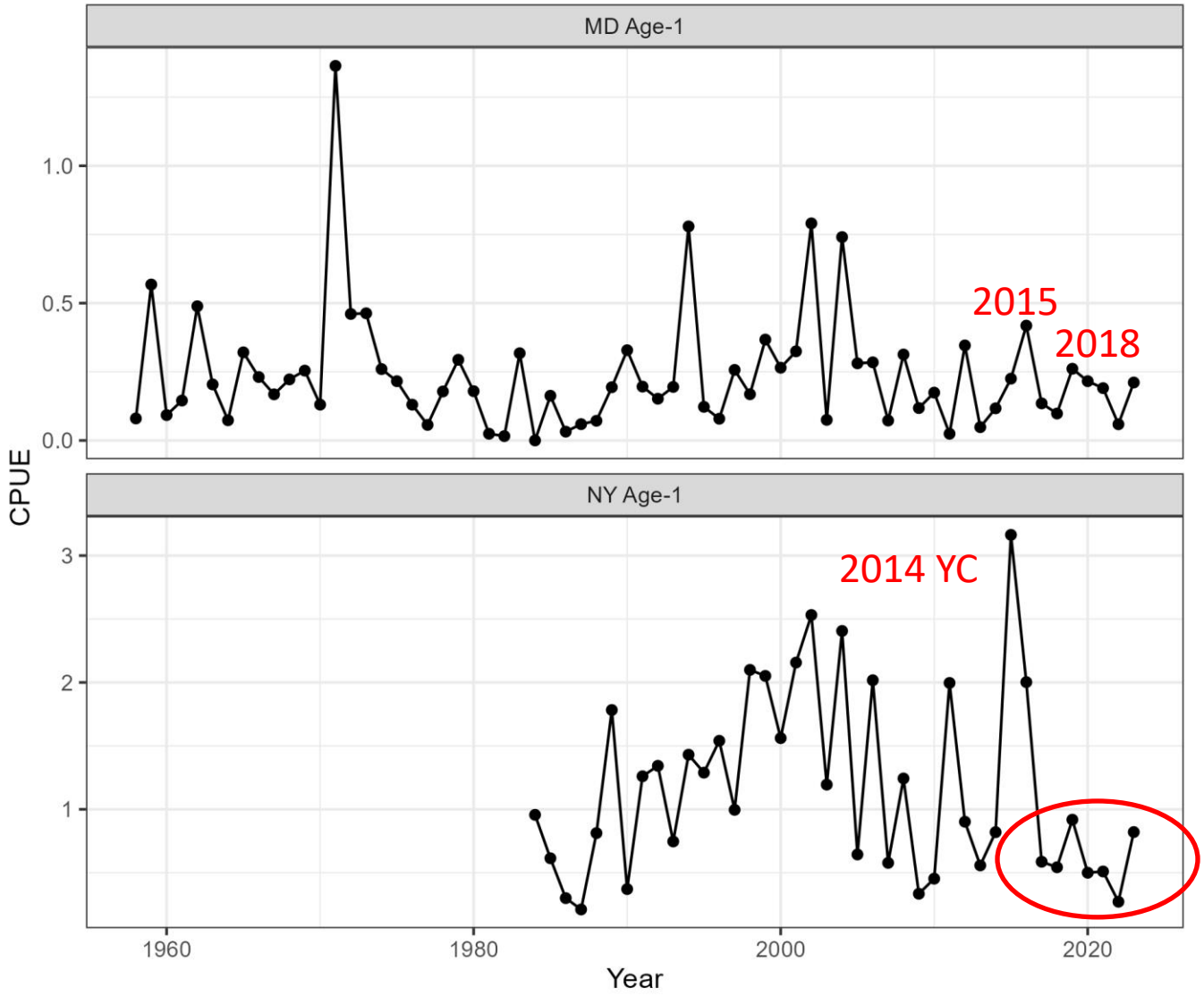
Total Removals By Disposition

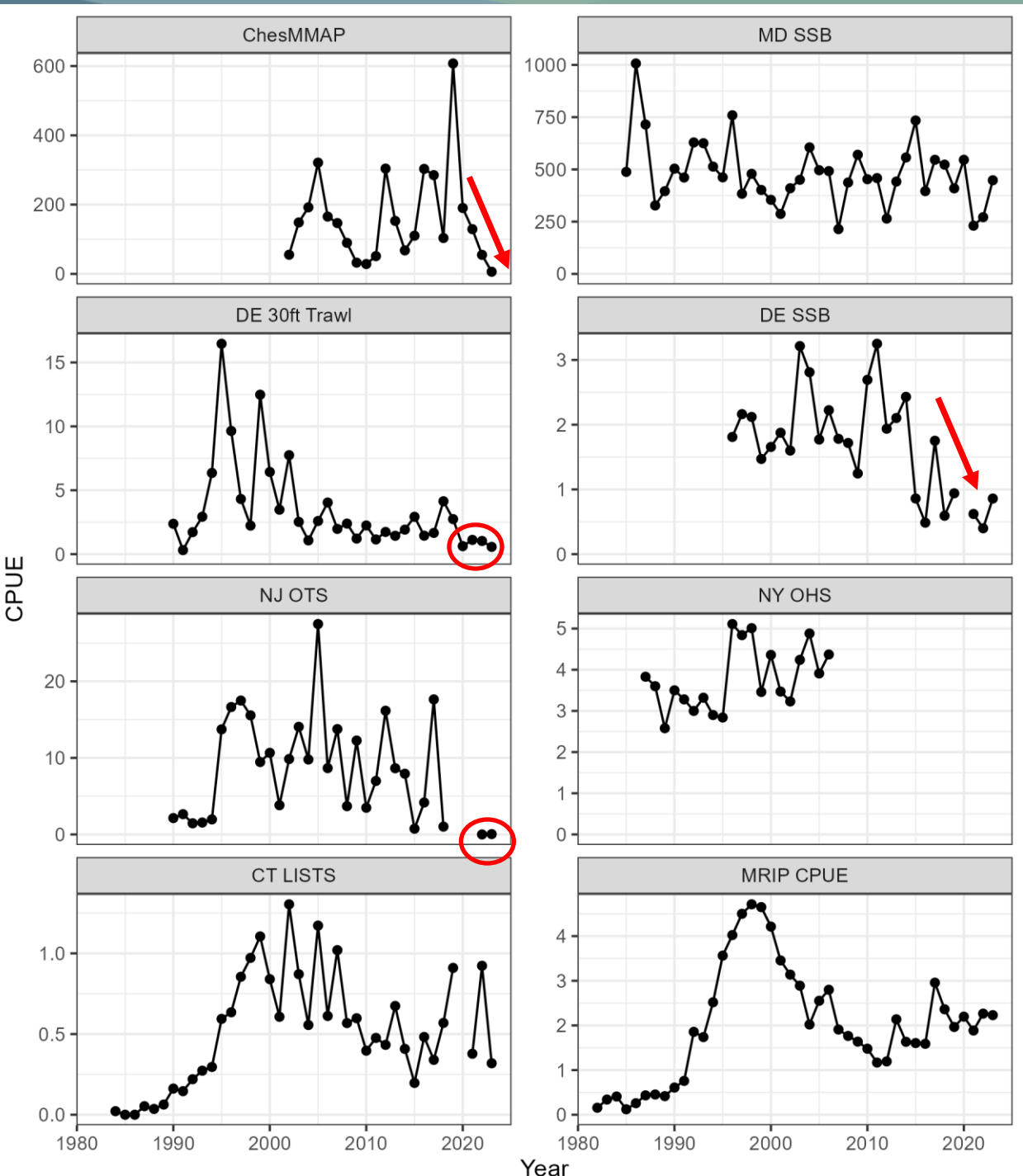


YOY Indices


Composite JAI
NJ JAI
MD JAI
NY JAI
VA JAI
CPUE
Year
0
100
200
300
0.0
0.5
1.0
1.5
2.0
2.5
5
10
15
20
30
40
50
1960
1980
2000
2020

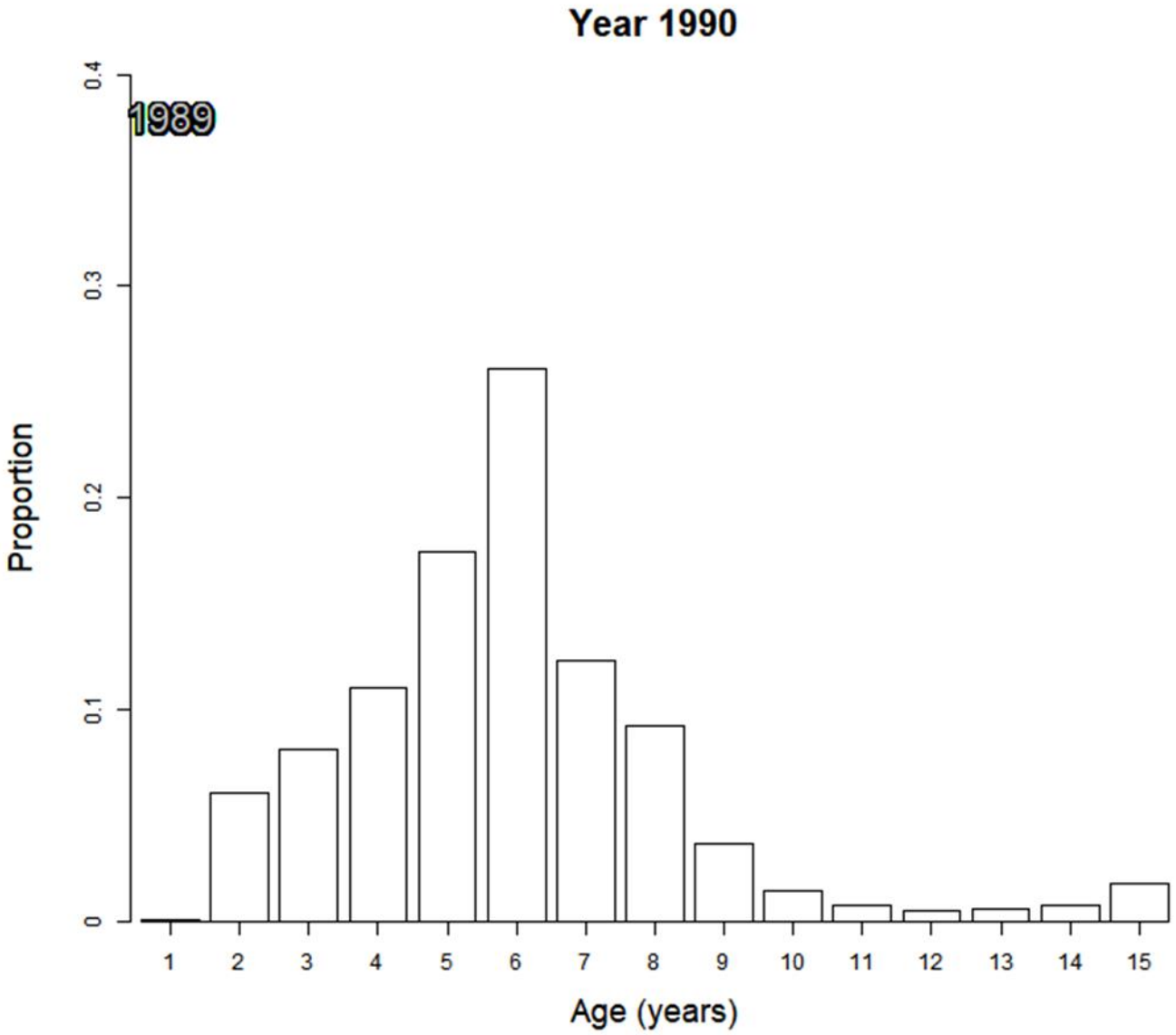
Age-1 Indices





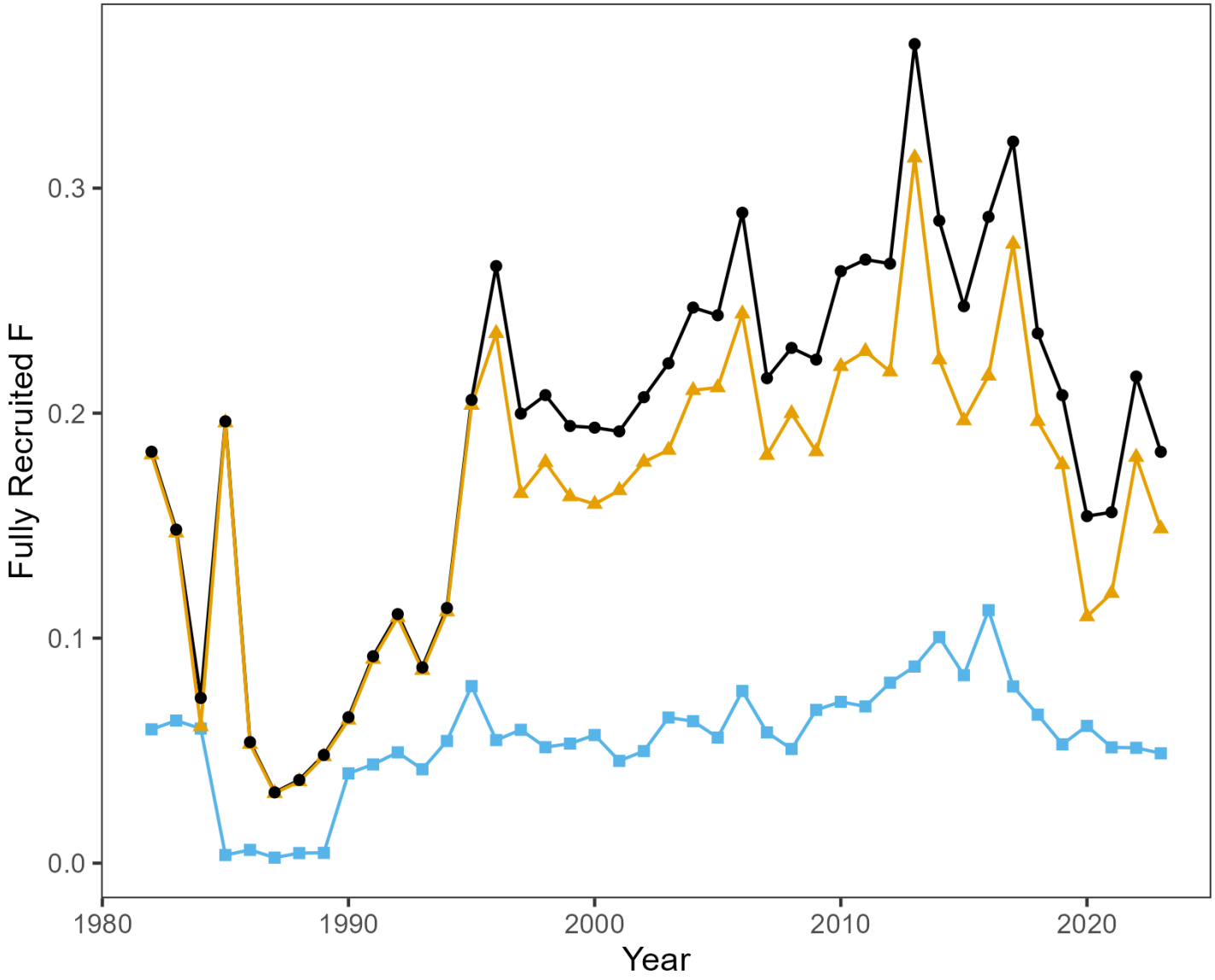
Age Composition Total Indices

MD/VA YOY large year-classes observed in coastwide total catch (harvest + dead releases)



Results

Fully-Recruited F By "Fleet"



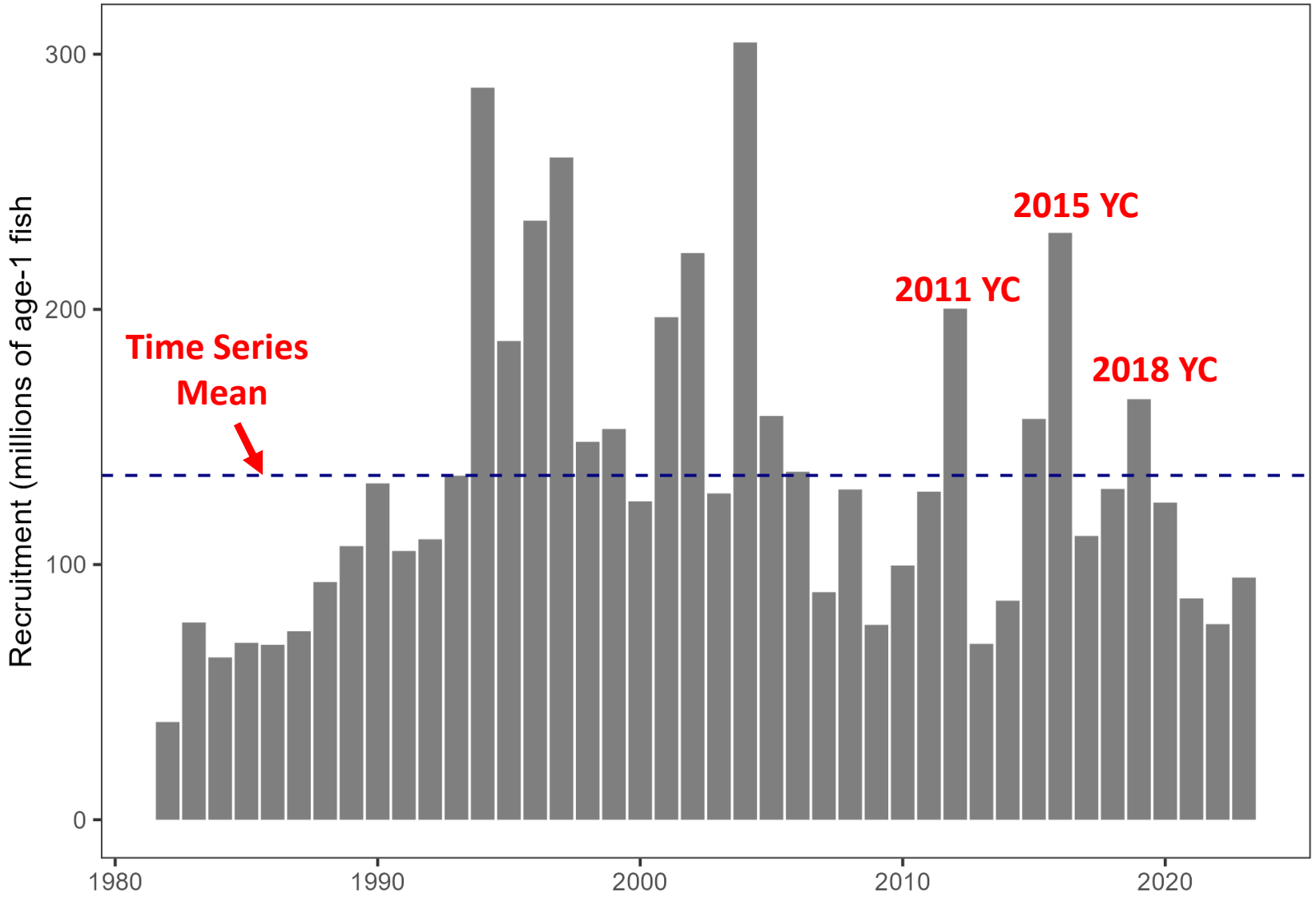
2023

Bay: 0.05

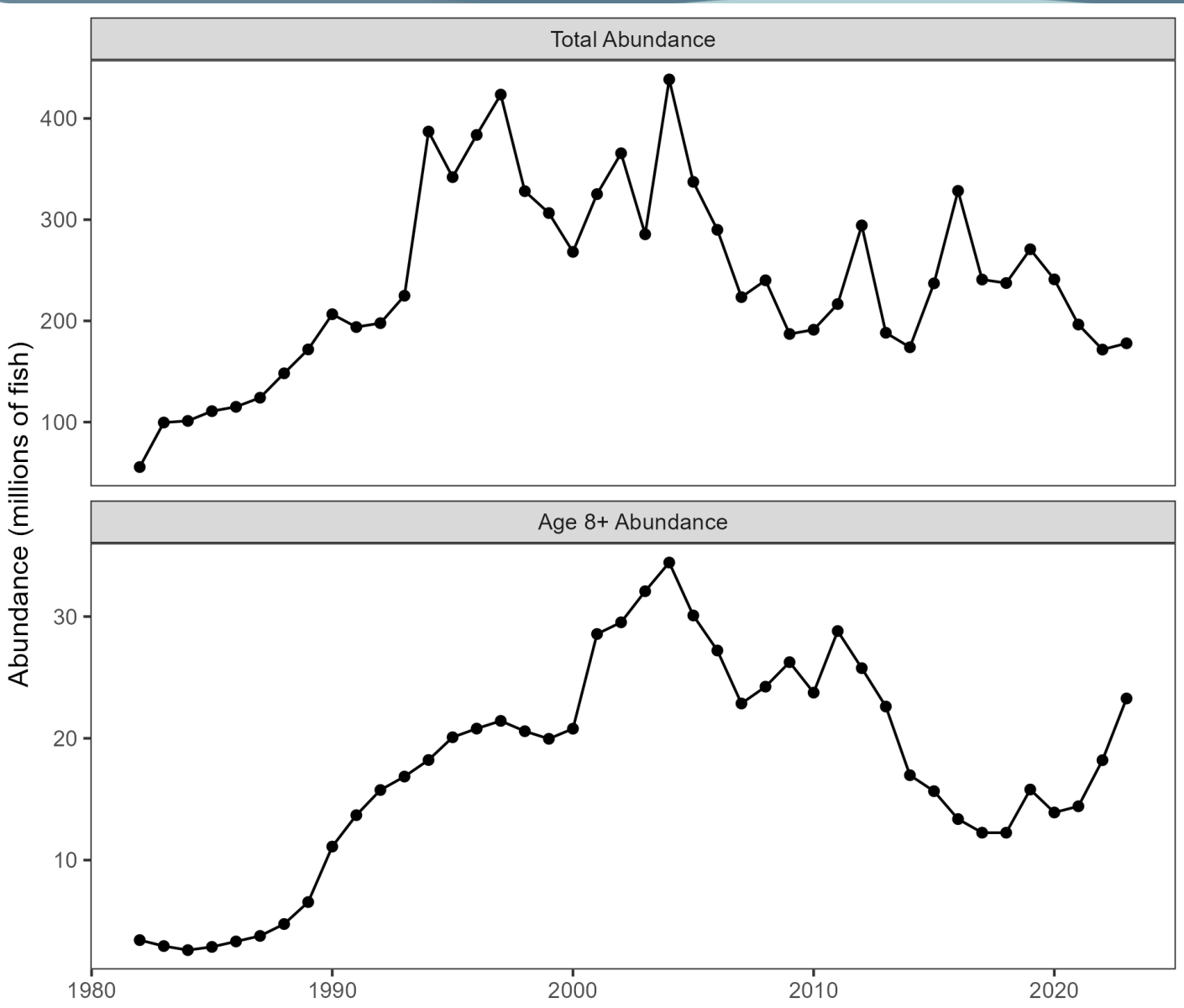
Ocean: 0.15

Total: 0.18

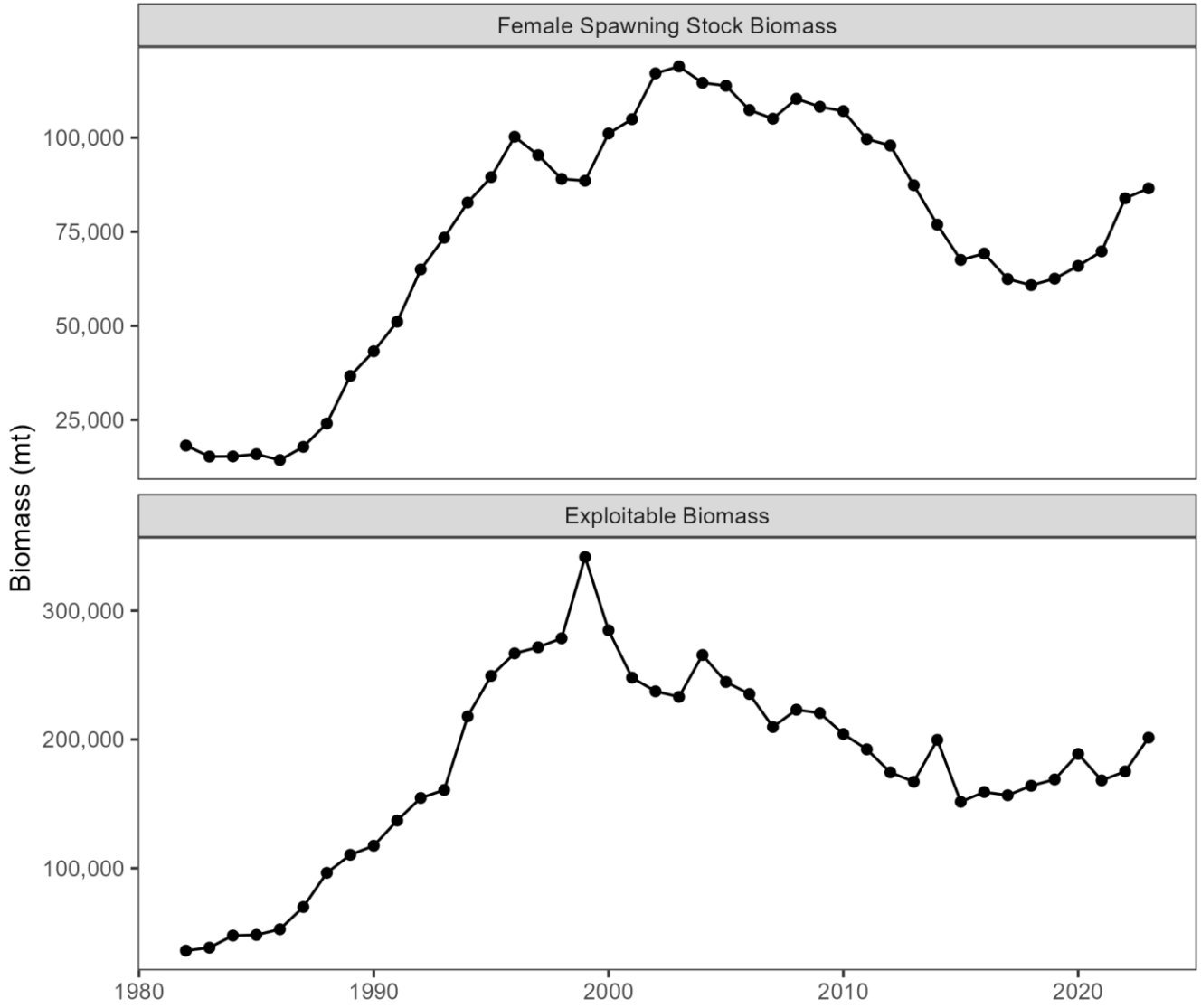
Recruits (Age-1)

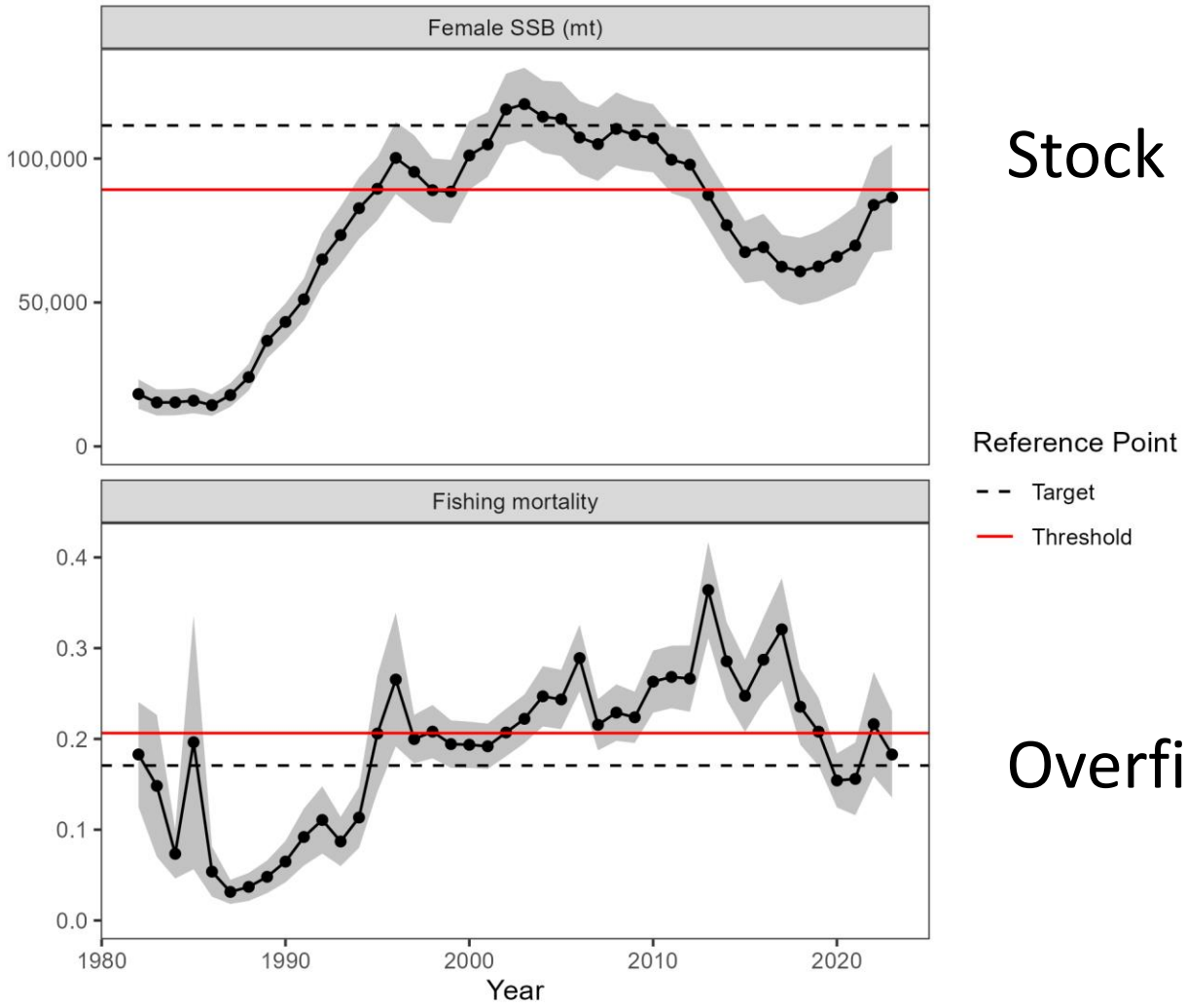


Abundance


Total Abundance
Age 8+ Abundance
Abundance (millions of fish)
400
300
200
100
30
20
10
1980
1990
2000
2010
2020

Female Spawning Stock Biomass





Stock is overfished

Overfishing is <u>not</u> occurring

Additional Evidence MD and VA Indices Reflect Trends in YOY Abundance

Goodyear (1985)

- Showed trends in reported Maryland landings could be predicted from the MD YOY Index

TABLE 1.—*Harvest data, juvenile (young-of-the-year) abundance indices, and fitted regression statistics for striped bass in Maryland waters of Chesapeake Bay. Values for ages 2, . . . , 5 are juvenile indices 2, . . . , 5 years before the calendar year of the landings. Asterisks denote significance at* $P < 0.05$* *or* $P < 0.01$**.

Year or statistic	Reported commercial landings[a] (tonnes)	Juvenile index[a] (mean fish/beach-seine haul)				Estimated landings (tonnes)	
		Age 2	Age 3	Age 4	Age 5	Regression 1[b] 1959–1983	Regression 2[c] 1963–1983
1959	1,973	3.2	15.2	5.5	5.2	1,351	
1960	2,000	19.2	3.2	15.2	5.5	1,362	
1961	2,453	1.6	19.2	3.2	15.2	1,581	
1962	1,805	7.1	1.6	19.2	3.2	1,036	
1963	1,700	16.9	7.1	1.6	19.2	1,312	1,289
1964	1,497	12.2	16.9	7.1	1.6	1,683	1,478
1965	1,338	4.0	12.2	16.9	7.1	1,526	1,311
1966	1,518	23.5	4.0	12.2	16.9	1,566	1,569
1967	1,882	7.4	23.5	4.0	12.2	1,959	1,816
1968	2,056	22.1	7.4	23.5	4.0	1,873	1,756
1969	2,308	7.8	22.1	7.4	23.5	2,106	2,064
1970	1,804	7.2	7.8	22.1	7.4	1,505	1,314
1971	1,244	10.2	7.2	7.8	22.1	1,337	1,294
1972	1,465	30.4	10.2	7.2	7.8	1,859	1,832
1973	2,257	11.8	30.4	10.2	7.2	2,565	2,412
1974	1,589	8.5	11.8	30.4	10.2	2,010	1,856
1975	1,436	9.0	8.5	11.8	30.4	1,575	1,597
1976	1,003	10.1	9.0	8.5	11.8	1,339	1,206
1977	1,021	6.7	10.1	9.0	8.5	1,288	1,102
1978	670	4.9	6.7	10.1	9.0	1,086	891
1979	496	4.9	4.9	6.7	10.1	909	723
1980	1,104	8.4	4.9	4.9	6.7	916	724
1981	940	4.2	8.4	4.9	4.9	981	745
1982	277	1.9	4.2	8.4	4.9	779	526
1983	237	1.2	1.9	4.2	8.4	562	333
				Regression statistics			
Regression 1[b]							
t		2.1*	4.4**	2.0*	0.8		
R^2						0.57	
F						6.55**	
Regression 2[c]							
t		3.9**	6.5**	3.0**	2.3*		
R^2							0.83
F							18.89**

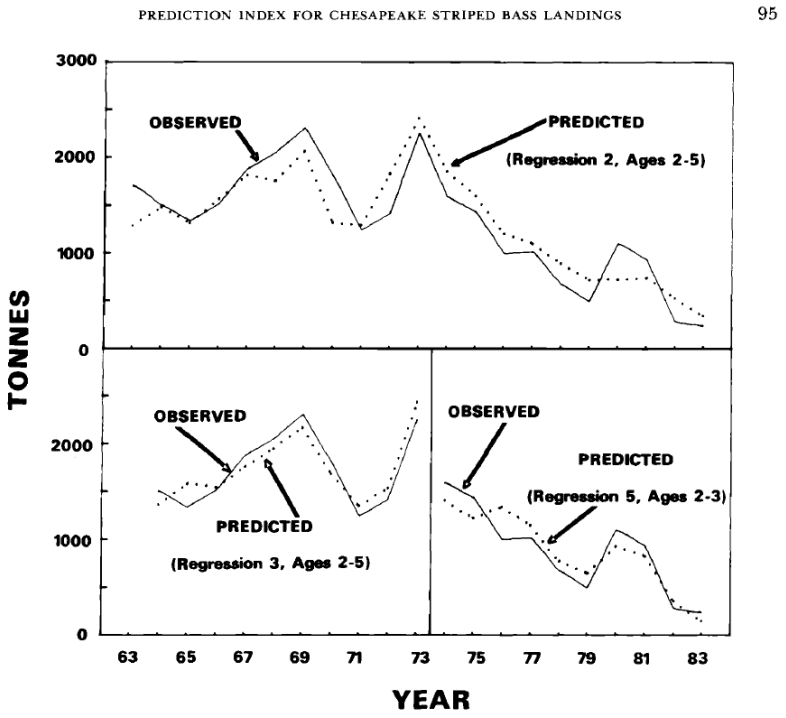
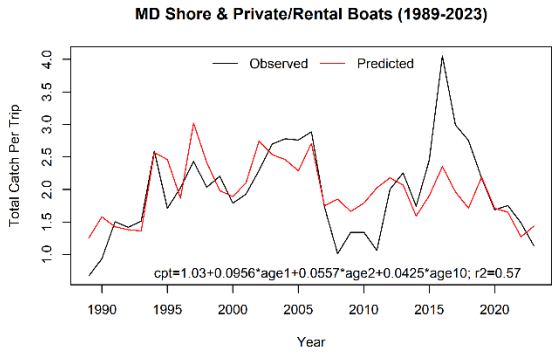


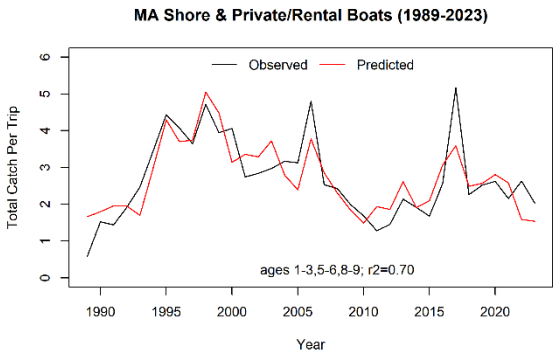
FIGURE 2.—*Comparison of observed landings with those predicted from regressions 2, 3, and 5 (Tables 1 and 3).*

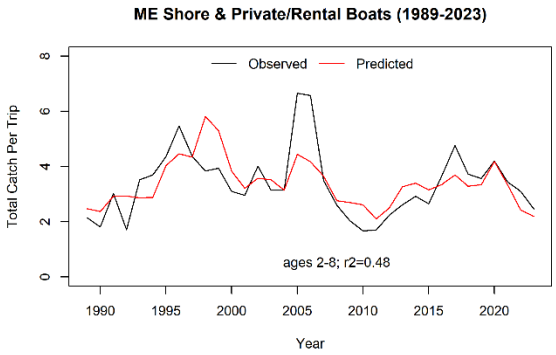
MDYOY Predicts Trends in MRIP Total Catch Rates

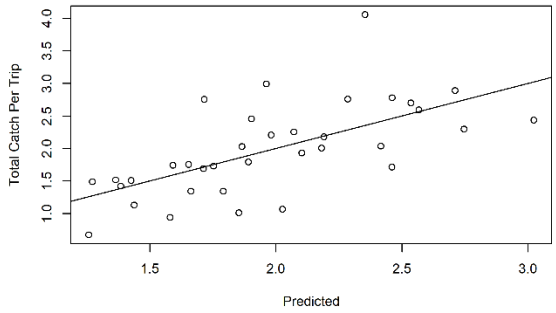
1) Fit Delta-Gamma model to state intercepts to get standardized C/T
- PRIM1 and PRIM2 = Striped Bass
- Covariates = year, mode, area, wave, county, hours fished, avidity

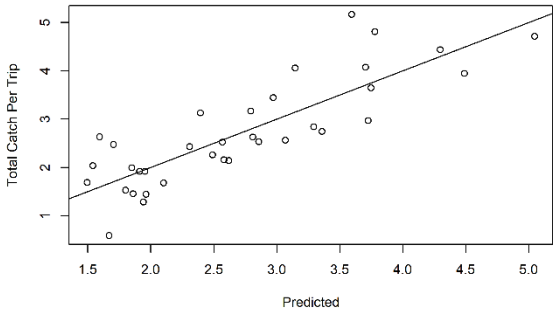
2) Used stepAIC with linear model to predict the C/T from MD YOY index lagged to different ages (ages 0-10)

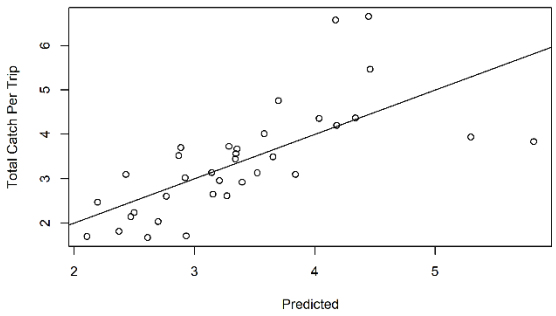




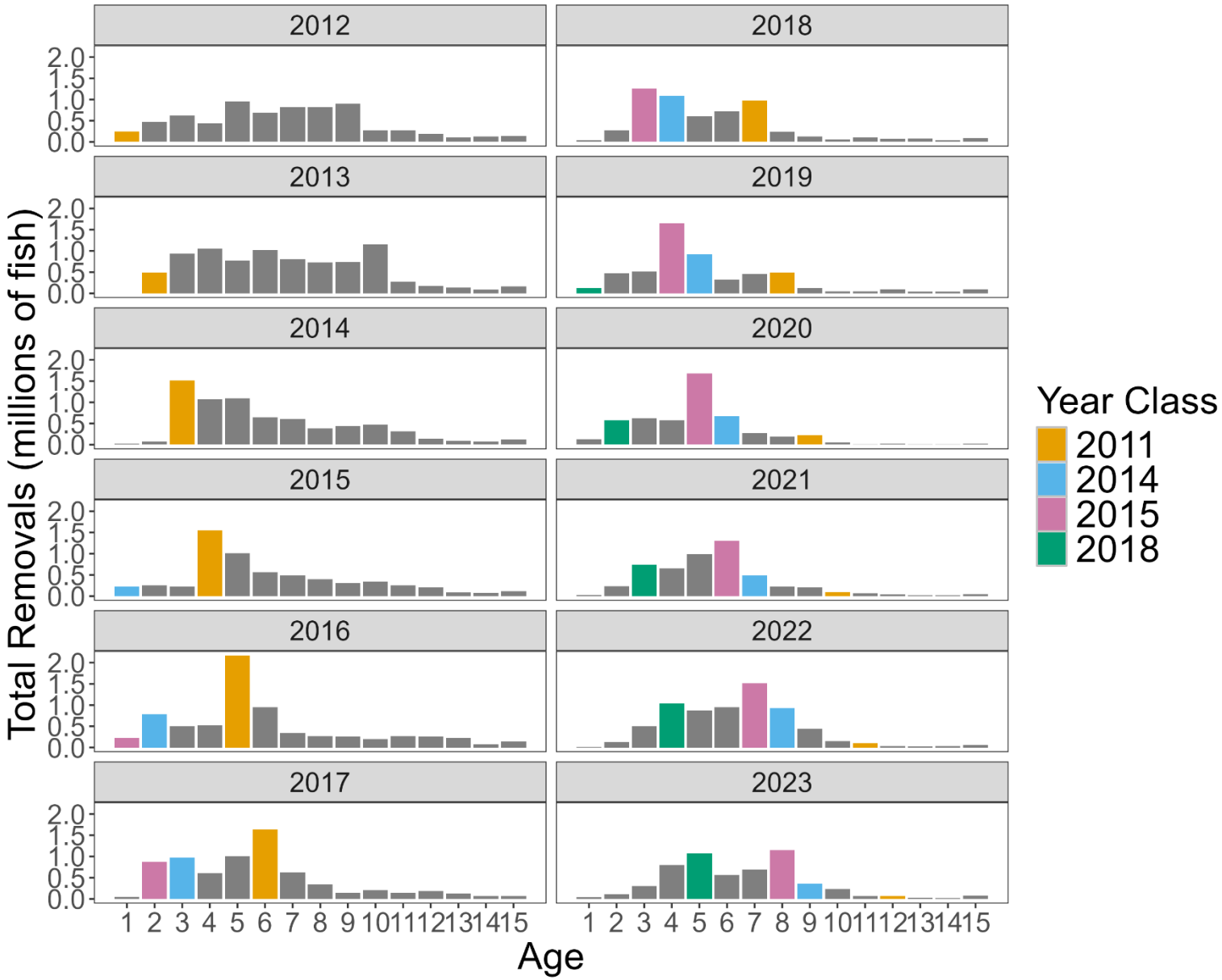




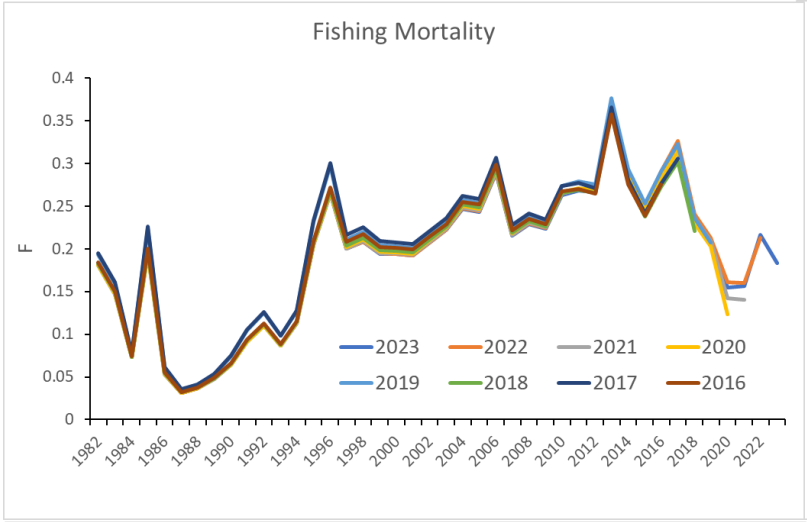


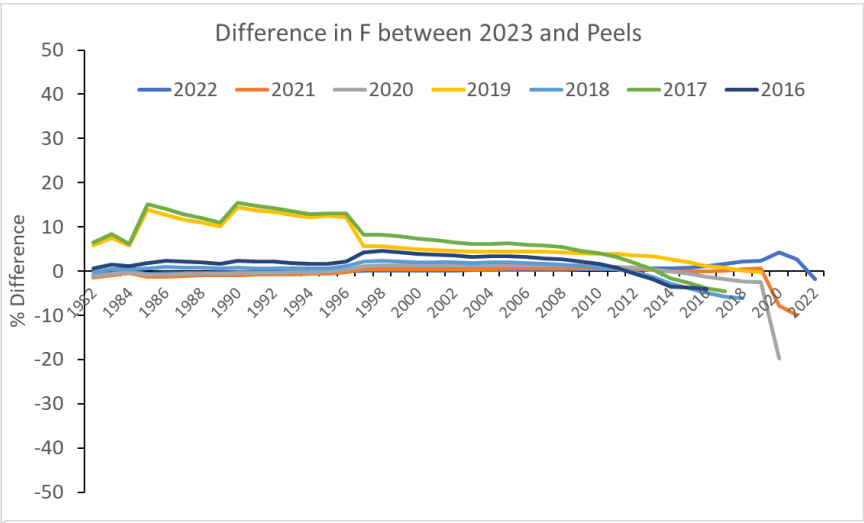


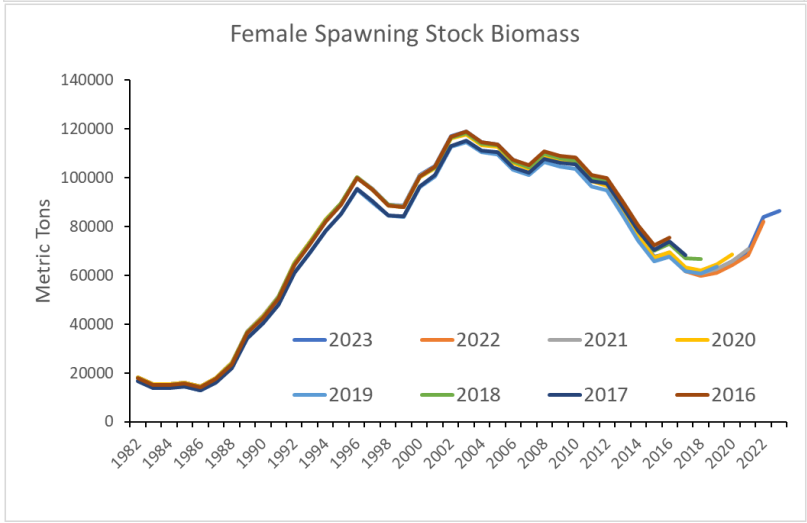
Total Catch Composition

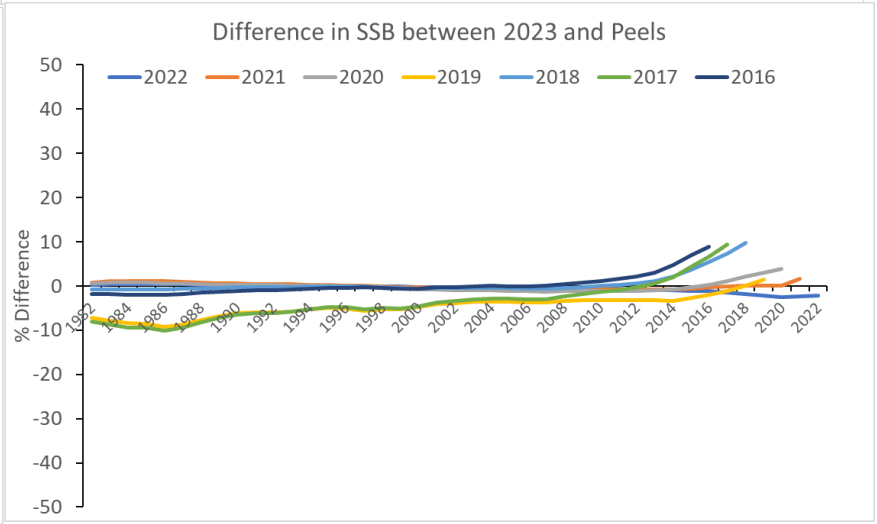


Retrospective Analysis









ASMFC Striped Bass Management Changes Since 2019

	Implementation	Recreational Changes	Commercial Changes
Addendum VI	April 2020	Ocean 1 fish at 28” to <35”* Ches Bay 1 fish at 18” minimum* Circle hooks required when fishing with bait (except for artificial lures)	18% quota reduction*
Amendment 7	January 2023 gear restrictions	Gaffing prohibited. Striped bass caught on any unapproved method of take must be returned to the water immediately without unnecessary injury.	NA
Addendum I	May 2023	NA	Quota transfers allowed under certain conditions
Emergency Action	No later than July 1, 2023	31” maximum size limit	NA
Addendum II	May 2024	Ocean 1 fish at 28” to 31” Ches Bay 1 fish at 19” to 24”	7% quota reduction

*For Addendum VI, some states implemented alternative measures through conservation equivalency.

Update

Selectivity Time Blocks

- Base Run: Single time block (2020-2023) for both regions (used for determining status)
- Alternate Run: Two time blocks (2020-2022, 2023)
- TC was uncomfortable with only a single year of data used for the estimation. Also, the estimated Ocean curve showed a descending limb that was steeper than would be expected by a change from max. 35” to 31” and the curve shifted to older ages.