NOAA FISHERIES
Southeast Fisheries Science Center

A novel multispecies framework for setting ecological reference points for Atlantic menhaden management

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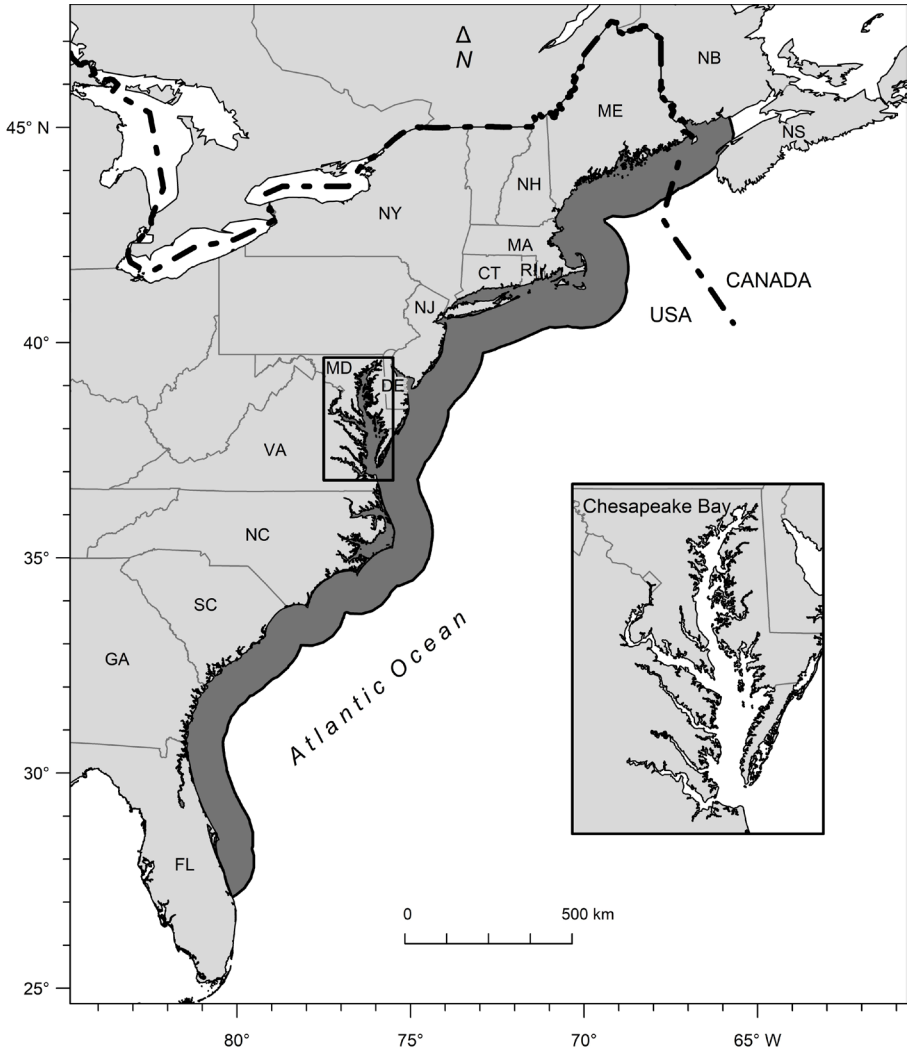
Outline

- Atlantic menhaden (*Brevoortia tyrannus*)
- Competing interests
- Stock assessment and management
- Lessons learned

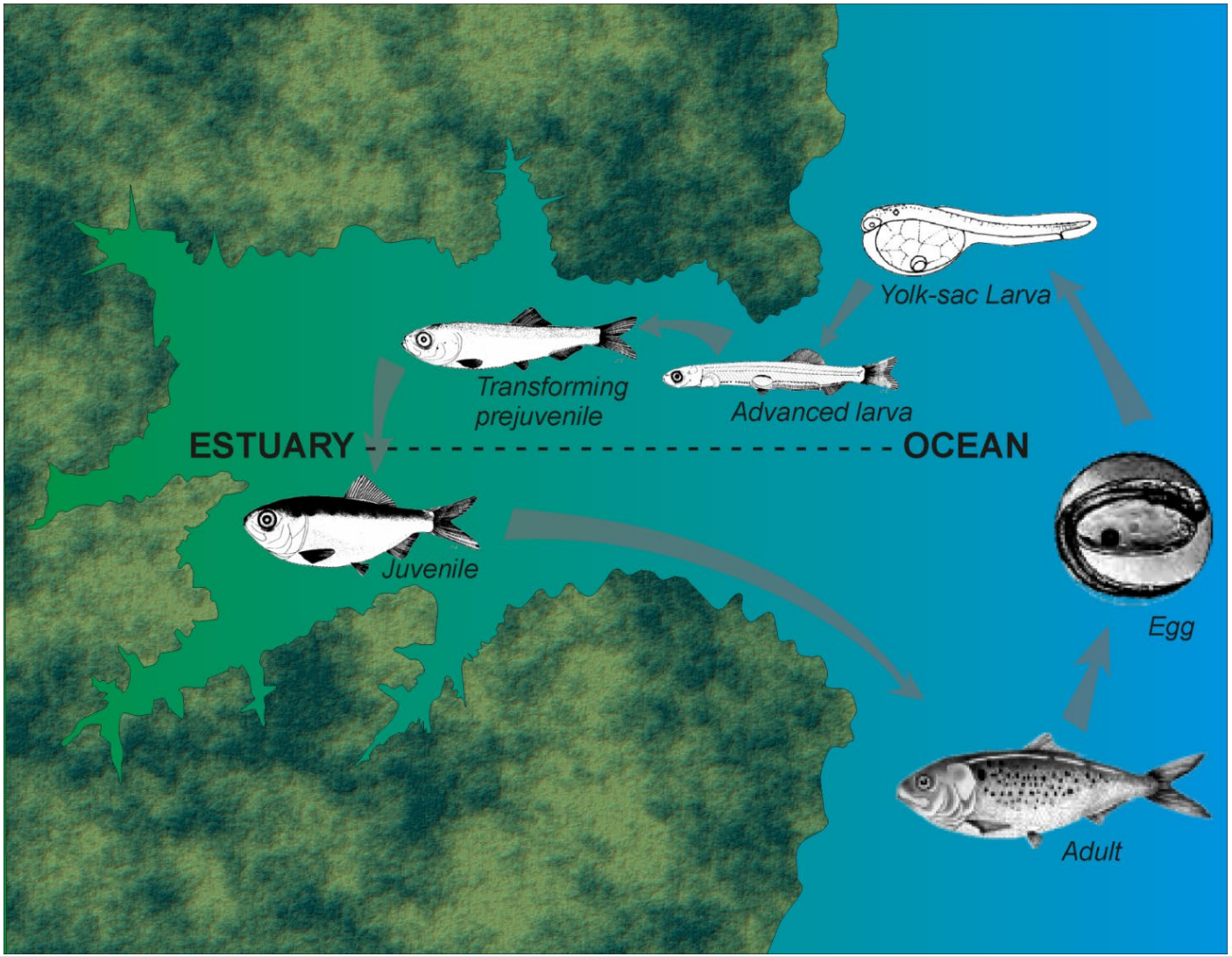
Atlantic menhaden (*Brevoortia tyrannus*)

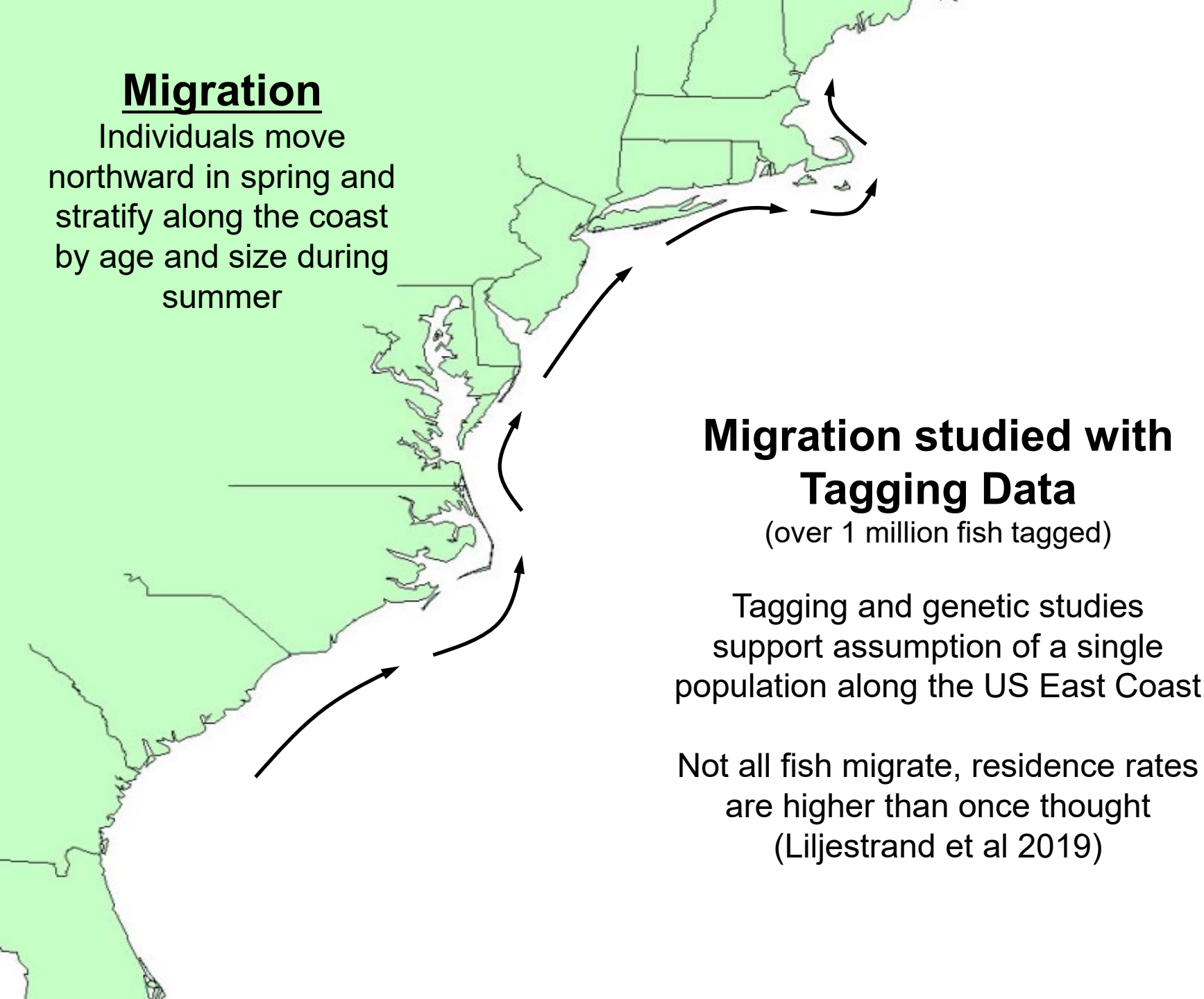
Life history

- Pelagic, forage fish
- Dense near surface schools
- East coast of the United States and Canada
  - Center - Chesapeake Bay



Atlantic menhaden life cycle





Migration

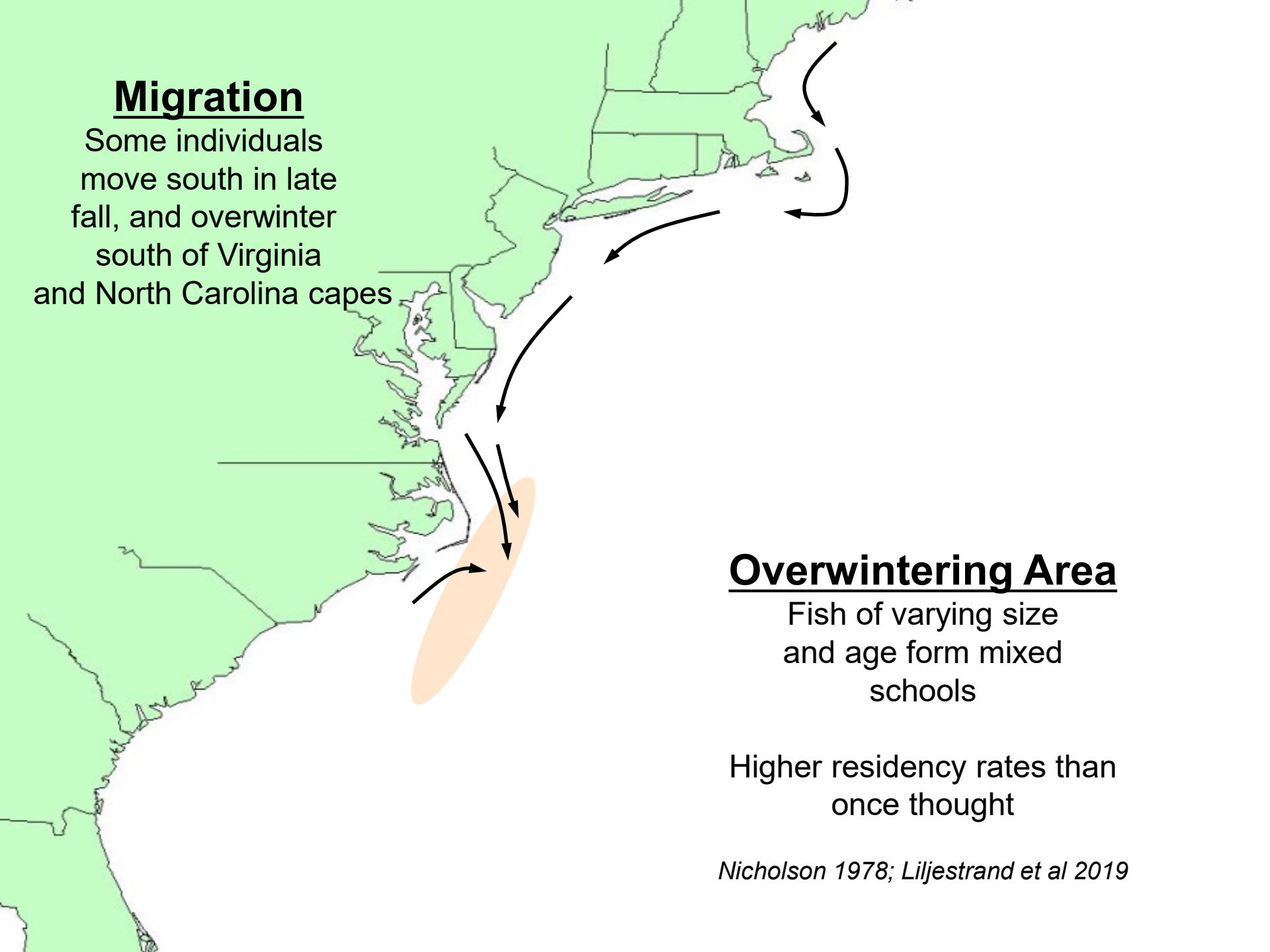
Individuals move northward in spring and stratify along the coast by age and size during summer

Migration studied with Tagging Data

(over 1 million fish tagged)

Tagging and genetic studies support assumption of a single population along the US East Coast

Not all fish migrate, residence rates are higher than once thought (Liljestrand et al 2019)



Migration

Some individuals move south in late fall, and overwinter south of Virginia and North Carolina capes

Overwintering Area

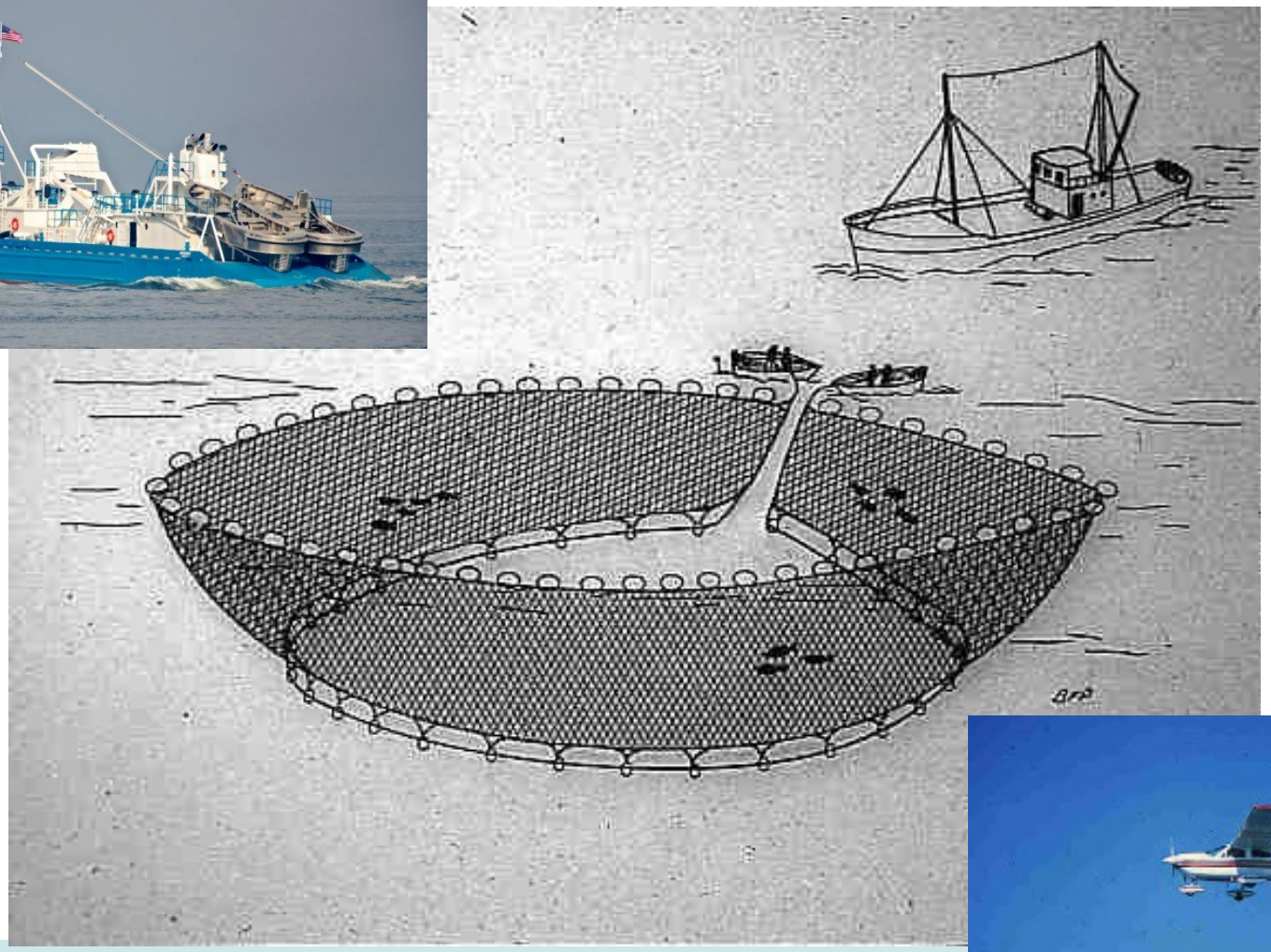
Fish of varying size and age form mixed schools

Higher residency rates than once thought

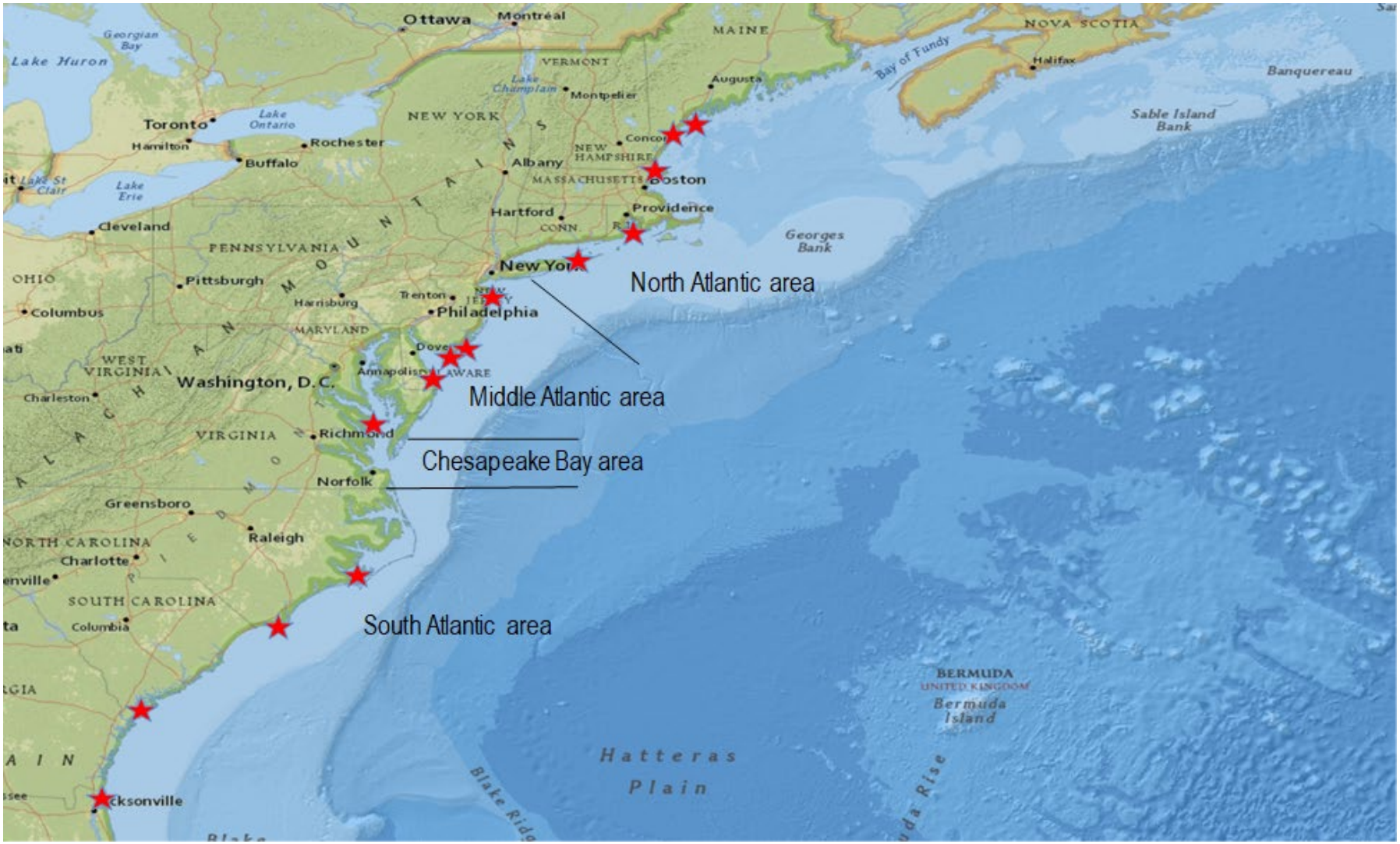
Nicholson 1978; Liljestrand et al 2019

Competing interests

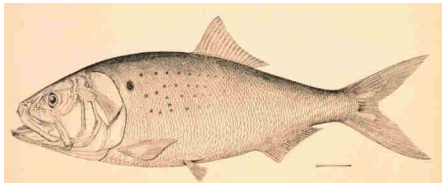
Reduction fishery



Reduction fishery



Processed Products



Fish factory

Cookers
Presses
Dryers
Centrifuges

Fish meal

Poultry feed
Swine feed
Pet feeds
Aquaculture feed

Fish oil

Feed ingredient

Edible oils
(omega-3's)

Aquaculture feed

Fish solubles

Feed additive

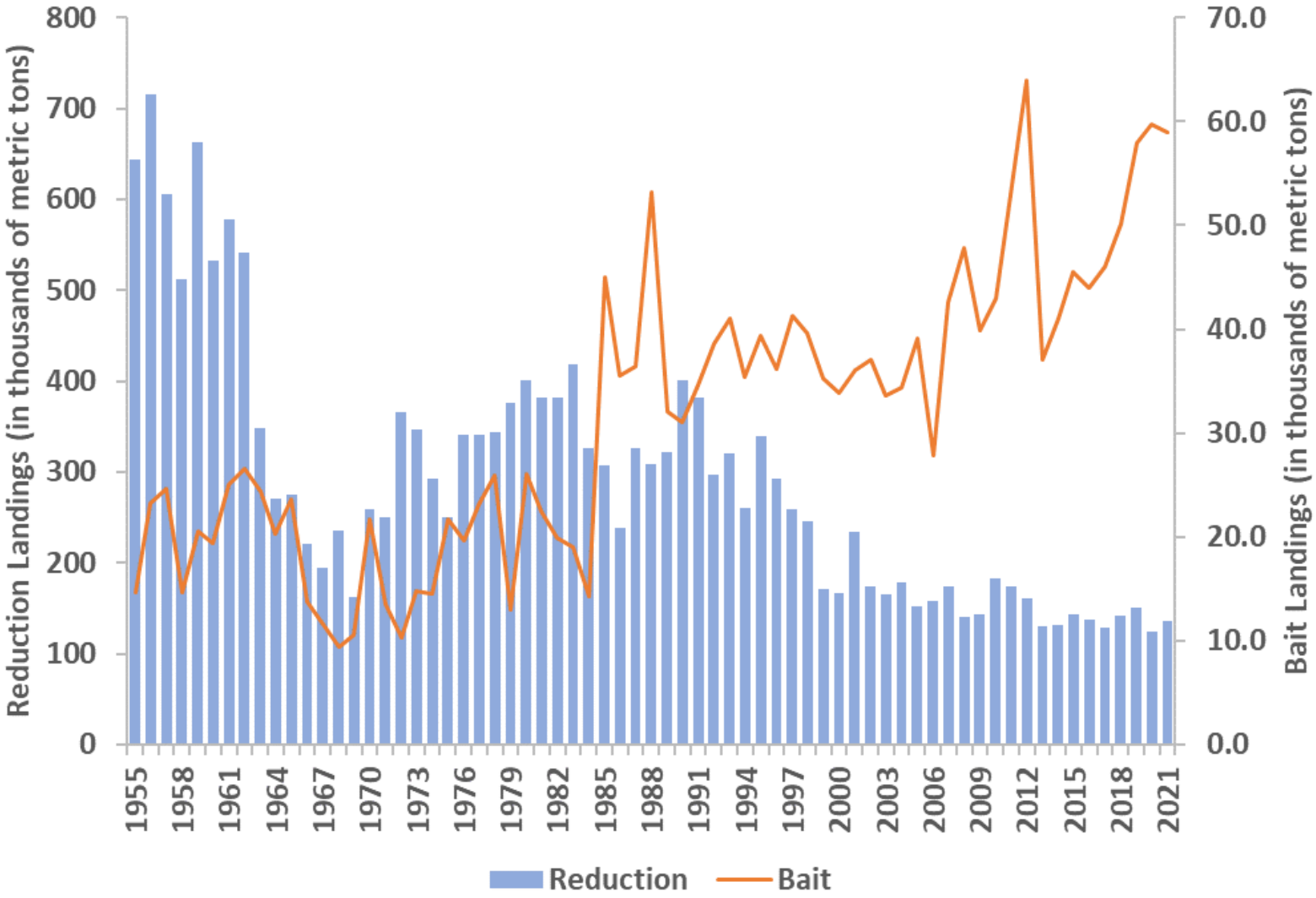
Enriched meal

Bait fishery

- Used for bait for lobsters, crabs, and other finfish species
  - Increasing importance given reduction in Atlantic herring
- Bait important for states even when allocation seems smaller
  - ME, RI, NY, NJ, MD, VA, PRFC, NC

State	Allocation (%)
ME	0.52%
NH	0.50%
MA	1.27%
RI	0.52%
CT	0.52%
NY	0.69%
NJ	10.87%
PA	0.50%
DE	0.51%
MD	1.89%
PRFC	1.07%
VA	78.66%
NC	0.96%
SC	0.50%
GA	0.50%
FL	0.52%
TOTAL	100.00%

Reduction and bait landings



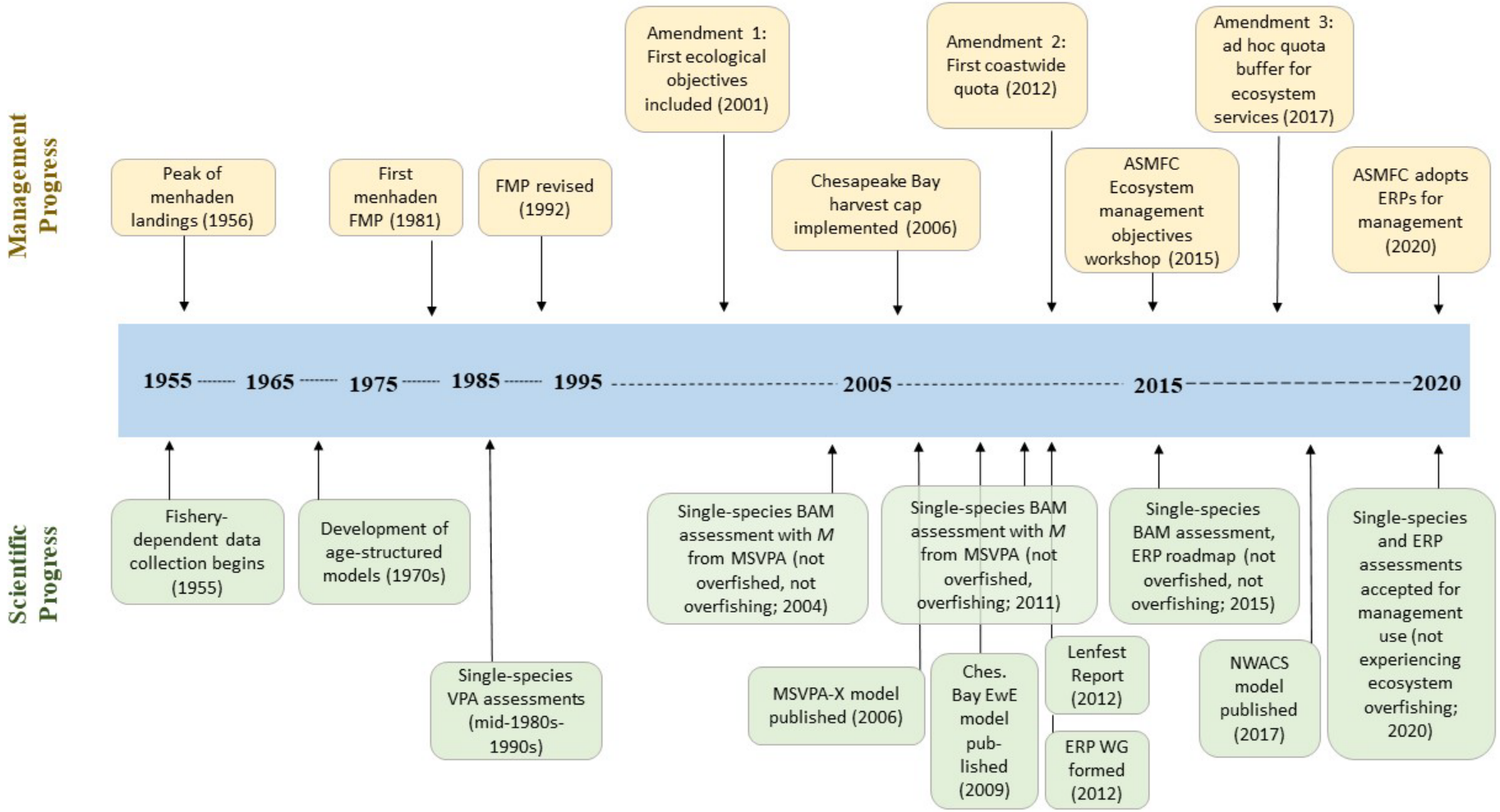
Forage fish species

- Stakeholders/NGOs are concerned about enough prey for predatory species
  - **Striped bass**, bluefish, weakfish, spiny dogfish
    - Fishing of predators
  - Marine mammals and birds
    - Ecotourism
- Diet data can be a limiting factor
- Interests in species change over time

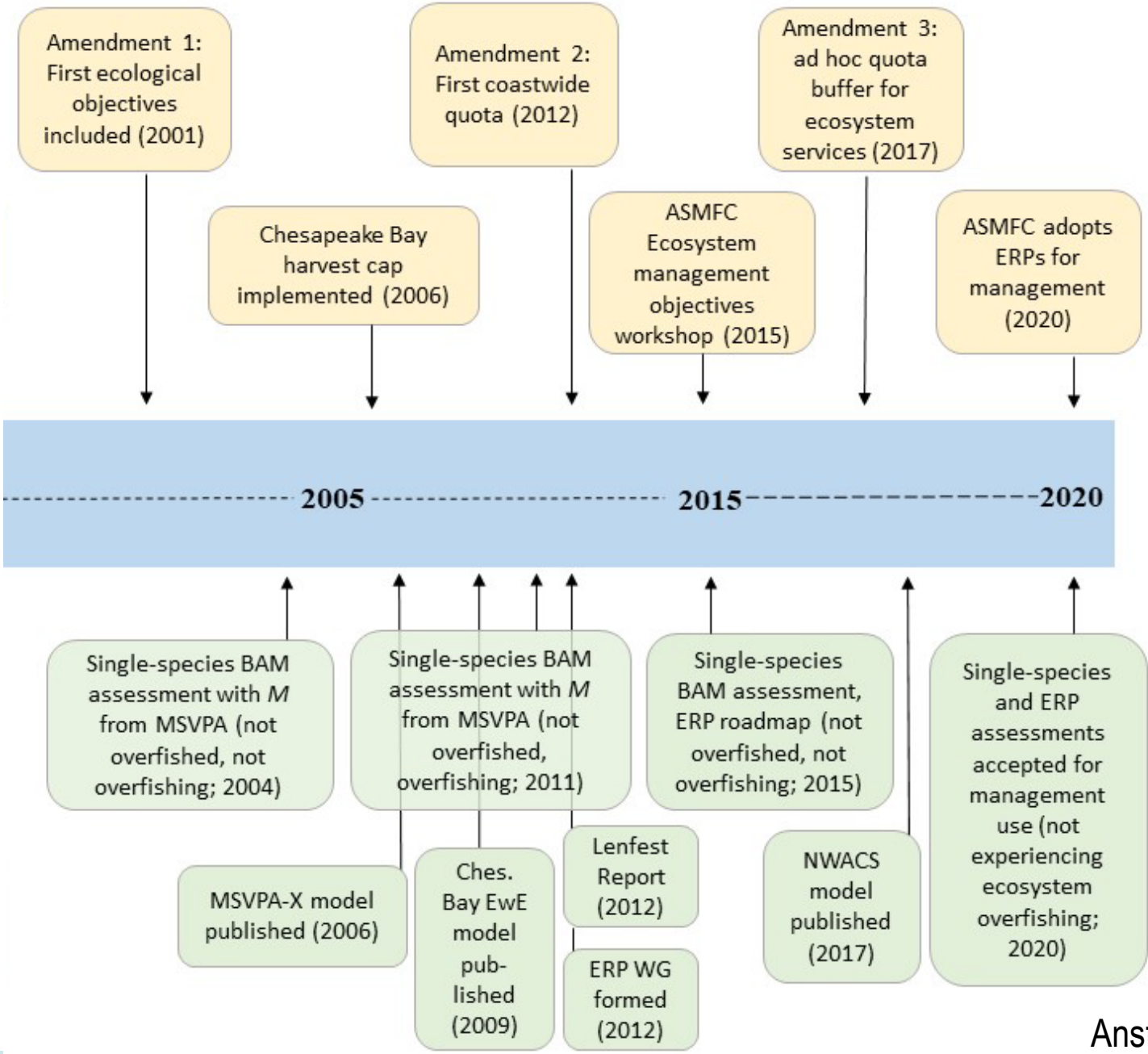
Stock assessment and management

Goals and objectives

- Managed by Atlantic Menhaden Management Board
  - Atlantic States Marine Fisheries Commission
  - 3 members from each Atlantic coast state + PRFC + USFWS + NMFS
- Not clearly defined - “More fish in the water”



Anstead et al 2021

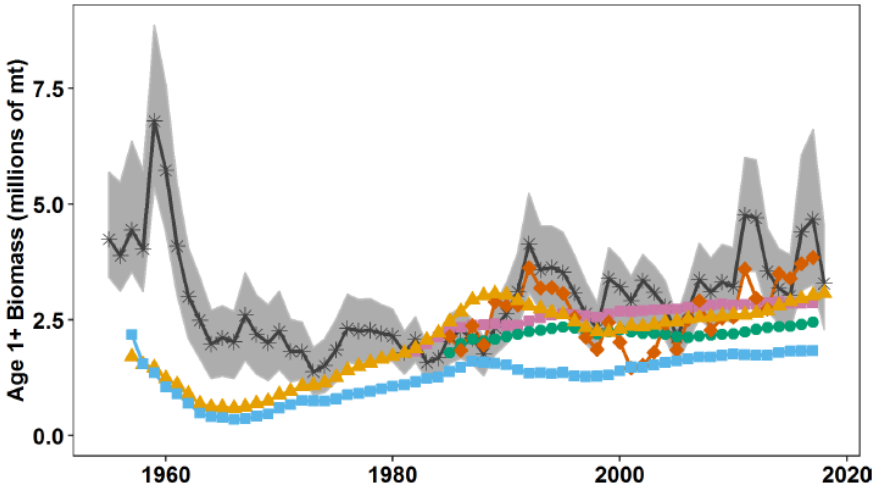


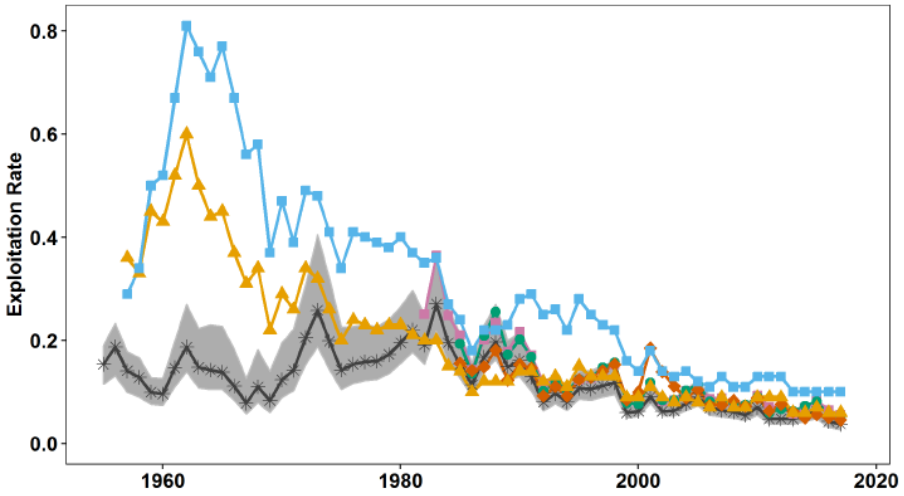
Anstead et al 2021

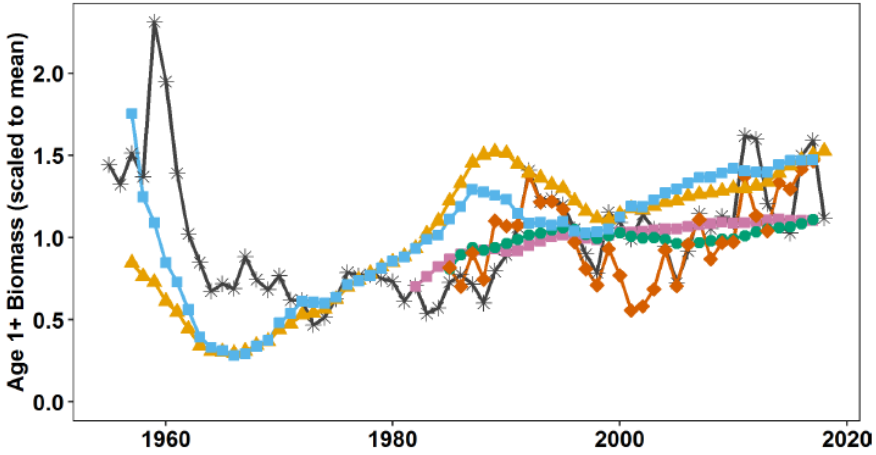
2020 Stock assessment

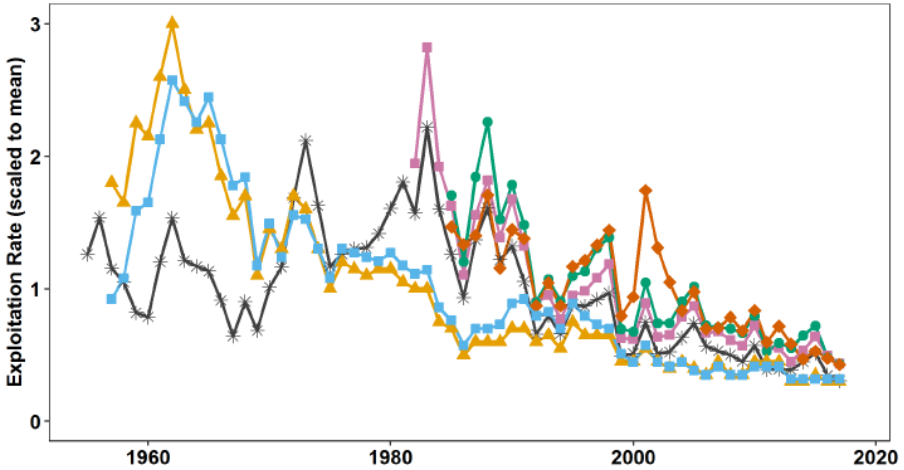
- Worked to prepare data and configure single species stock assessment and additional assessments to consider ERPs during 2018-19
  - 2 surplus production models
  - 1 multispecies statistical catch-at-age model
  - 2 Ecopath with Ecosim [EwE] models
- How to combine for management advice?

Comparison among models





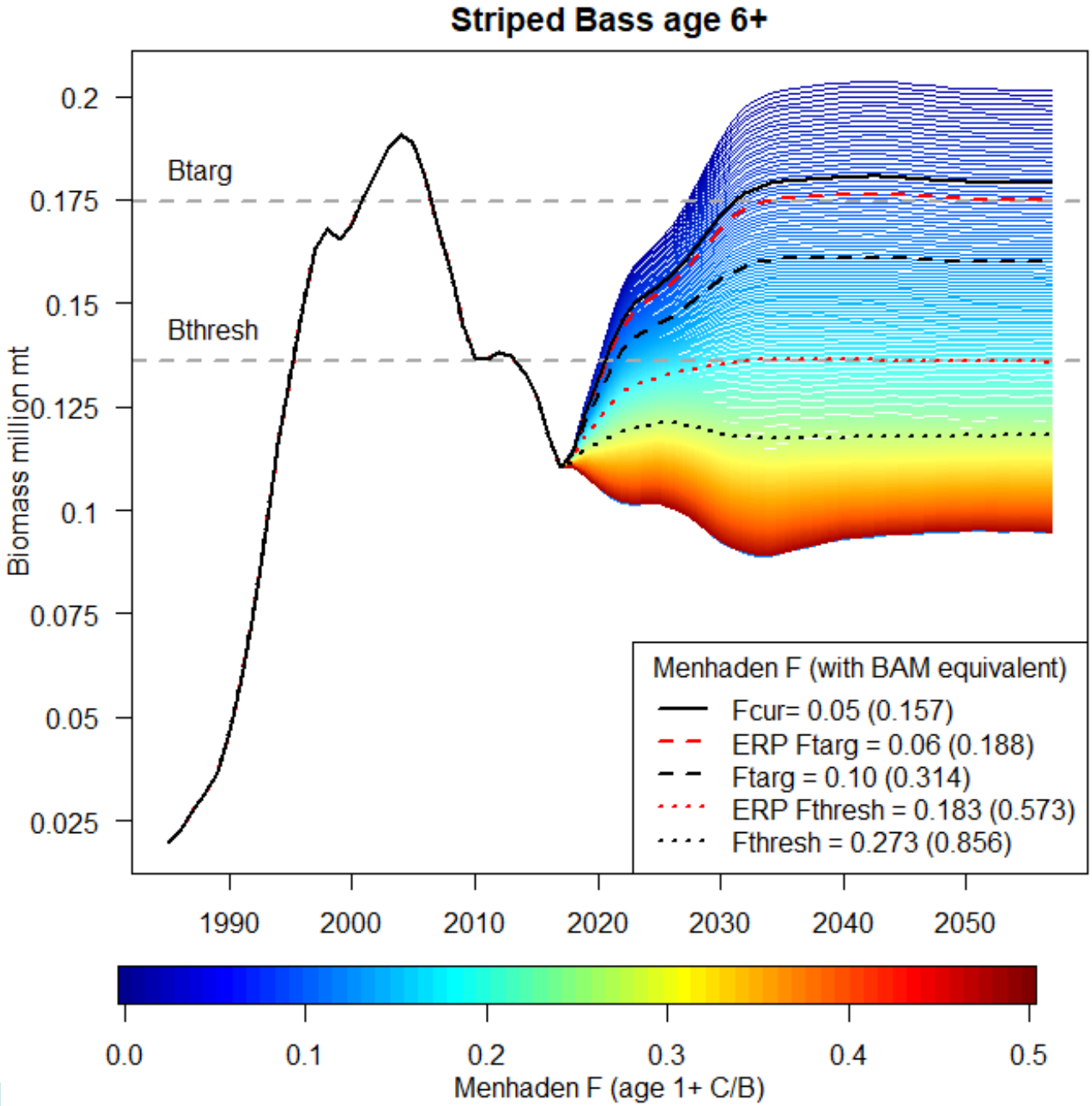


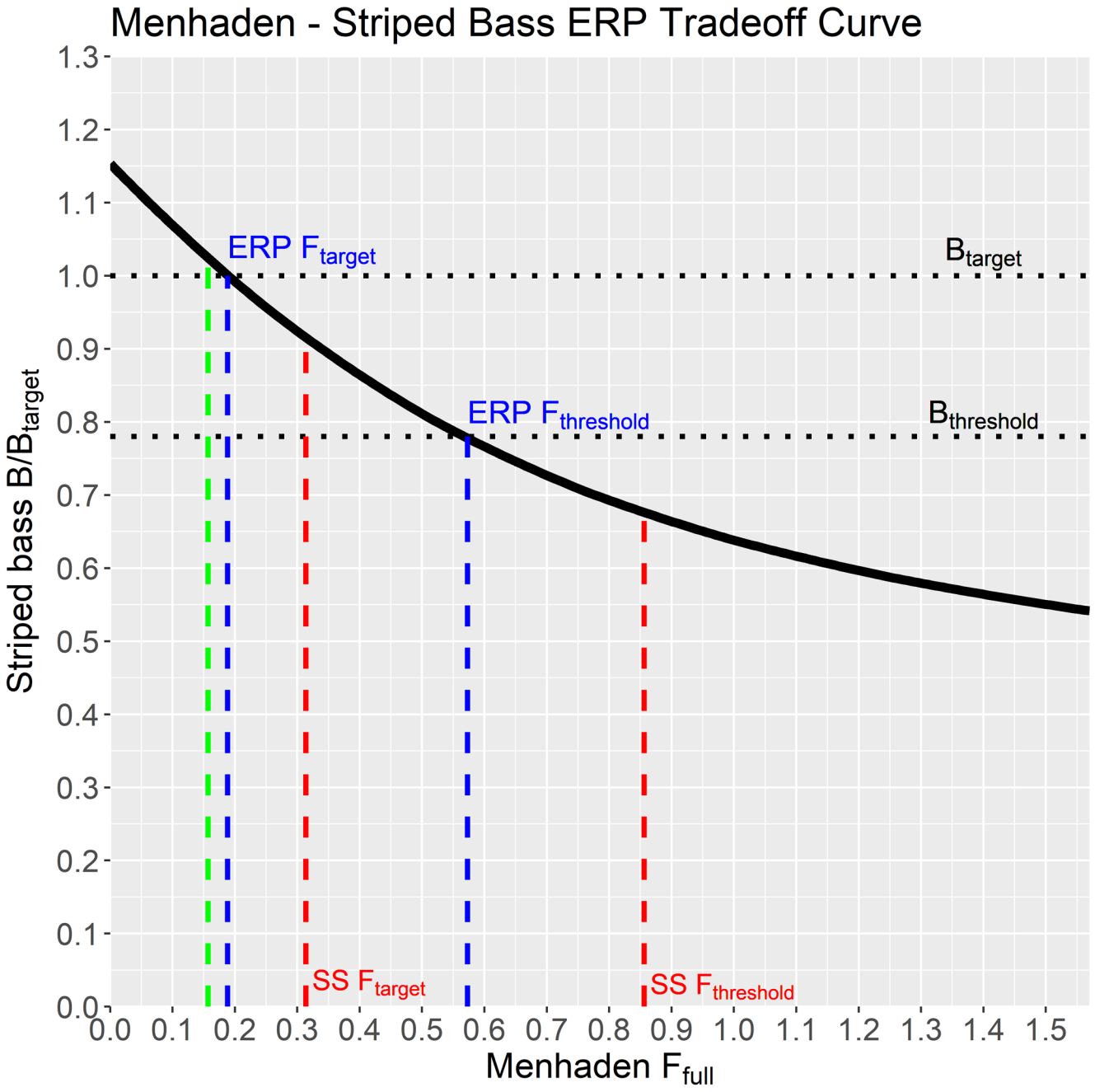


BAM NWACS-MICE SPM S-H
NWACS-Full VADER SPM TVr

Stock assessment

- Models were fairly congruent given differing assumptions and data inputs
- Recommendation was to use single species model in conjunction with MICE EwE
  - Provides information on other species of interest
  - Not overly complicated with fewer data inputs than the full EwE
  - Addresses goals and objectives as outlined
- Striped bass was most sensitive predator species


Striped Bass age 6+
Biomass million mt
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
Btarg
Bthresh
1990
2000
2010
2020
2030
2040
2050
Menhaden F (with BAM equivalent)
Fcur= 0.05 (0.157)
ERP Ftarg = 0.06 (0.188)
Ftarg = 0.10 (0.314)
ERP Fthresh = 0.183 (0.573)
Fthresh = 0.273 (0.856)
0.0
0.1
0.2
0.3
0.4
0.5
Menhaden F (age 1+ C/B)


Menhaden - Striped Bass ERP Tradeoff Curve
Striped bass B/B$_{target}$
Menhaden F$_{full}$
ERP F$_{target}$
B$_{target}$
ERP F$_{threshold}$
B$_{threshold}$
SS F$_{target}$
SS F$_{threshold}$
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5

Management Board

- Assessment and multispecies modeling framework was presented to Atlantic Menhaden Management Board and accepted for use in management
  - Set a coastwide TAC using ERPs

- Assessment was updated this year
  - New TACs based on the ERPs will be set this month

Lessons learned

Lessons learned

- Single species assessments key for ecosystem models
- Maintain strong working relationship with managers
- Provide a tool to evaluate stakeholder tradeoffs
- Data are lacking in some areas
- Time of staff and scientists; External funding is key
- Uncertainties surrounding outcomes
- But, ecological considerations can be incorporated into quantitative management!

Acknowledgements

- Atlantic States Marine Fisheries Commission
  - Staff –Max Appelman and Sarah Murray
  - AM SAS – Joey Ballenger, Ray Mroch, Alexei Sharov*, Micah Dean*, Rob Latour, Jeff Brust, Chris Swanson
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Questions?