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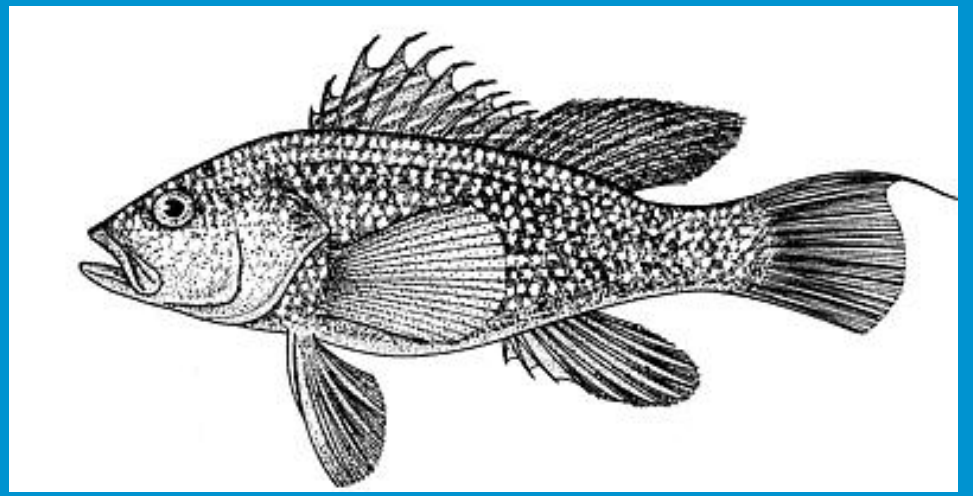
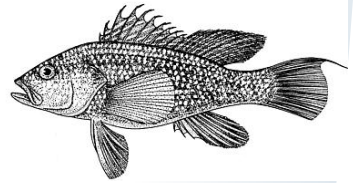
Northeast Fisheries Science Center

Black Sea Bass

Research Track Stock Assessment



Objective and Terms of Reference



Objective: Develop the assessment and projection methodology that will be used in subsequent management track assessments

Terms of Reference (TORs):

1. Identify relevant ecosystem and climate influences on the stock….
2. Estimate catch from all sources including landing and discards…
3. Present the survey data used in the assessment…
4. Estimate annual fishing mortality, recruitment and stock biomass…
5. Define status determination criteria…
6. Develop appropriate methods for producing projection…
7. Report on the status of research recommendations…
8. Develop a backup assessment approach…

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Black Sea Bass RT Stock Assessment Working Group

Working Group Members:

- Kiersten Curti (NEFSC) - assessment lead
- Anna Mercer (NEFSC) - chair
- Julia Beaty (MAFMC)
- Gavin Fay (UMassD - SMAST)
- Marissa McMahan (Manomet)
- Jason McNamee (RIDEM)
- Tim Miller (NEFSC)
- Sam Truesdell (MADMF/NEFSC)
- Ricky Tabendera (NEFSC/HCRI)

Working Group Meetings: 42

Other Contributors: 31 total

- Alex Hansell (NEFSC)
- Andy Jones (NEFSC)
- Jeff Brust (NJDEP)
- Lisa Chong (MSU)
- Scott Large (NEFSC
- Abby Tyrell (NEFSC)
- Andie Painten (UMassD - SMAST)
- Maria Cristina Perez (UMassD - SMAST)
- Hannah Verkamp (CFRF)
- John Wiedenmann (Rutgers)
- Paula Fratantoni (NEFSC)
- Gary Shephard (NEFSC - retired)

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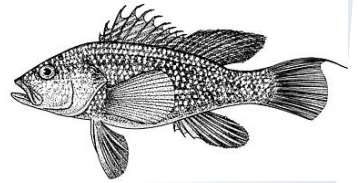
General Working Group Approach



- 42 working group meetings from August 2021 through Dec 2023
- Numerous additional meetings for sub-teams focusing on individual topics, including ecosystem influences, discard mortality, natural mortality, assessment modeling
- 18 individual working papers generated
- Input and contributions from non-Working Group members was encouraged
- All work was reviewed for discussions and consensus decisions
- Rapporteurs documented decisions and rationale
- Working group chair and assessment lead produced a draft report, which was then reviewed by all working group members

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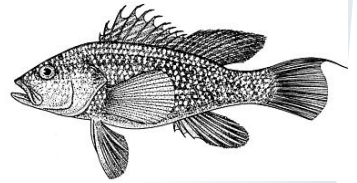
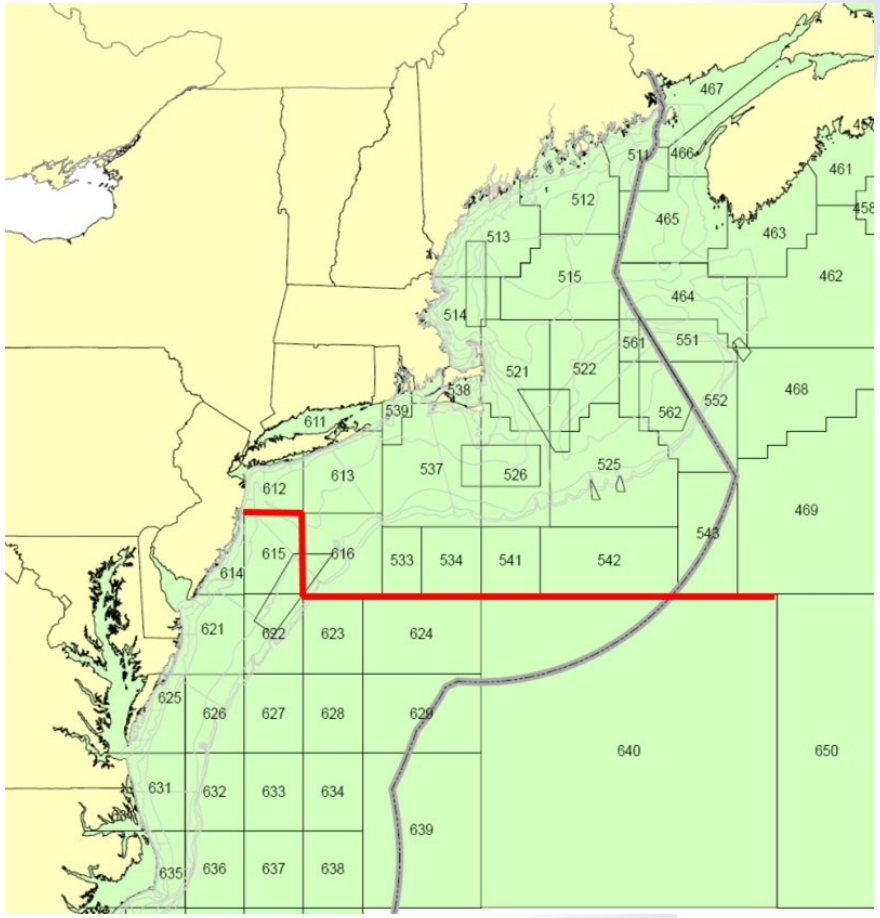
Pre-Research Track Assessment



2021 Management Track

- **Age-structured models for each region** (ASAP)
- **Terminal year**: 2019
- **Reference points (combined regions)**
  - $F_{MSY\ PROXY} = F_{40\%} = 0.46$
  - $SSB_{MSY\ PROXY} = 14{,}441$ mt
  - $MSY_{PROXY} = 5{,}334$ mt
- **Stock status (combined regions)**
  - Not overfished
    $SSB_{2019} = 29{,}538$ mt ~ 205% of $SSB_{MSY\ PROXY}$ (retro adjusted)
  - Overfishing not occurring
    $F_{2019} = 0.41$ ~ 89% of $F_{40\%}$ (retro adjusted)



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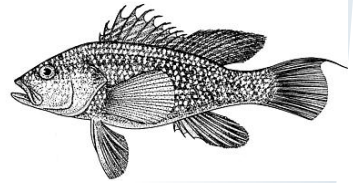
2023 Research Track Advances



- Multi-region state-space modeling framework that accounts for spatial dynamics, differences in productivity and movement between regions
- Ecosystem impacts (bottom temperature) on productivity
- Range expansion and varying catchability impacts on indices of abundance (VAST modeling)
- Reevaluation of discard mortality and natural mortality
- Enhanced reproducibility of data inputs and time series development to account for spatial structure

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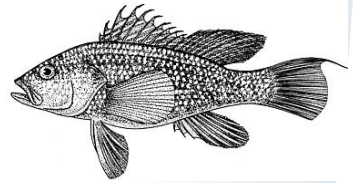
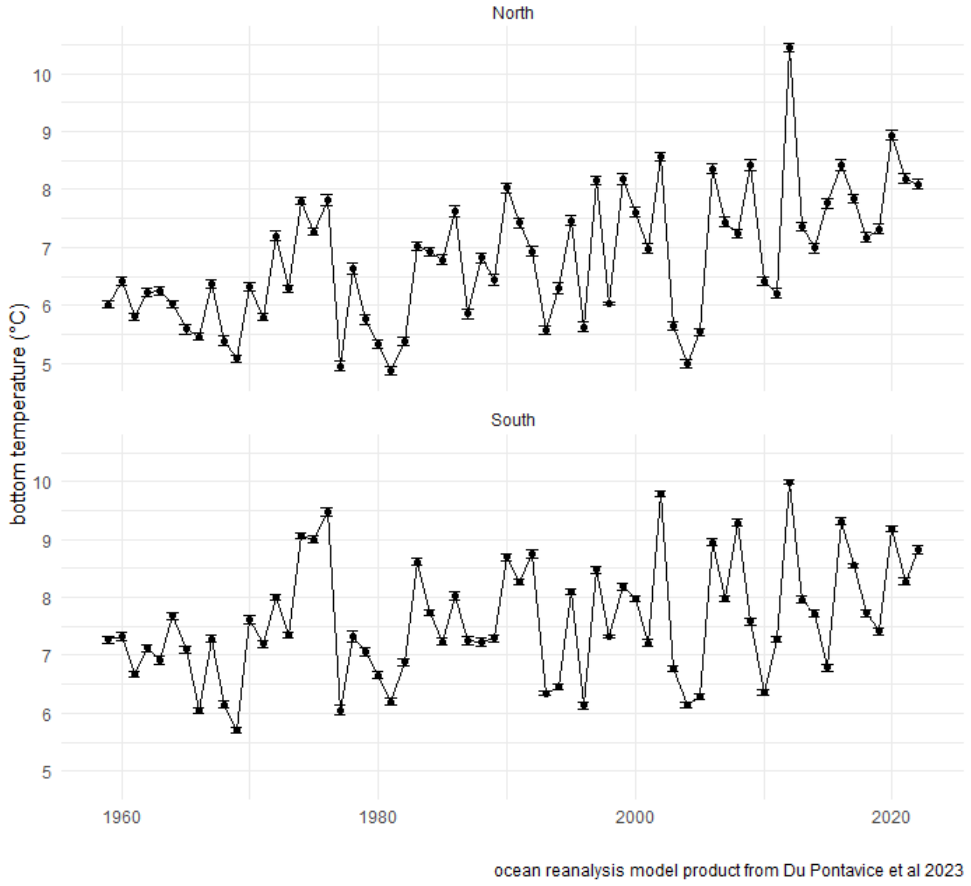
TOR 1: Ecosystem Considerations



Accomplishments

- Temporal and spatial patterns in biology
- Spatiotemporal modeling of abundance indices
- Food habits
- Reevaluation of natural mortality
- Ecosystem drivers (building off Miller et al. 2016, Moser and Shepherd 2009)
  - Higher winter bottom water temperature across shelf → higher overwinter survival → higher recruitment
    - *Bottom temp used a covariate on recruitment in recommended model*
  - Higher shelf water volume (lower temp/salinity) → less offshore winter thermal habitat → more movement of BSB from northern region to southern region (possible misattribution of catch)



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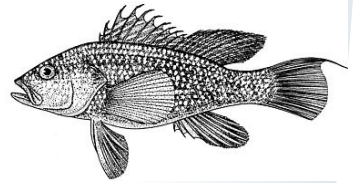
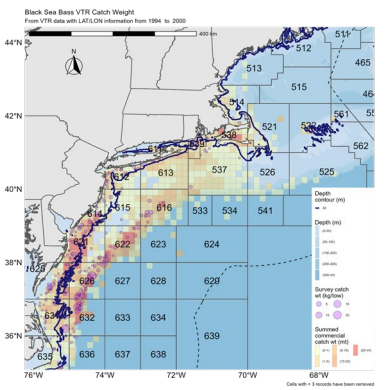
Stakeholder knowledge



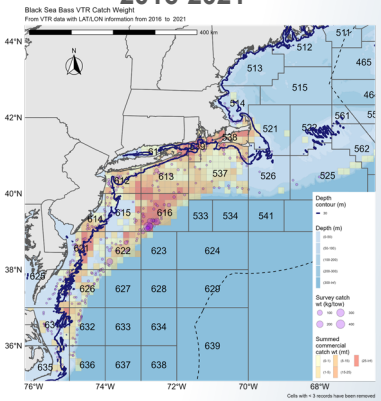
- Worked with industry groups to develop list of black sea bass stakeholders and contact information
- Developed a list of topics to cover with each stakeholder
- 16 conversations (most BSB fishing for over 20 years)
  - 10 commercial / 6 recreational
  - 7 Mid-Atlantic, 9 New England (VA to MA)
  - 4 gear types (trawl, pot gillnet, hook and line)
- Topics discussed included: fishing operations, fishery selectivity, biogeography (distribution, abundance), migration, habitat associations, environmental drivers, behavior, trophic ecology, and CPUE drivers
- Direct applications to the stock assessment
  - Sense check fishery data & discard mortality estimates
  - Inform commercial CPUE index development
  - Interpret trends in fishery data and survey indices
  - Interpret model outputs and results

Commercial

1994-2000

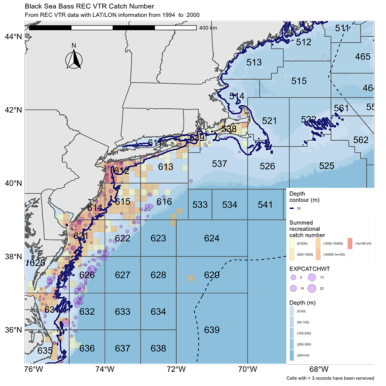


2016-2021

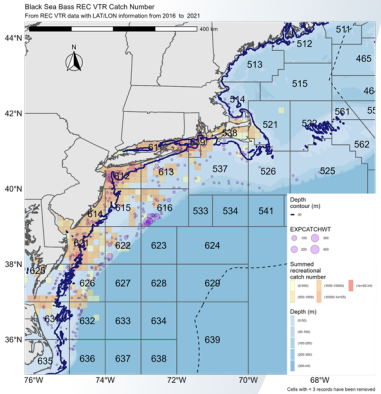


Recreational

1994-2000



2016-2021



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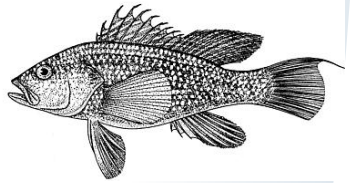
TOR 2: Fishery Data



Accomplishments

- Reevaluation of discard mortality
- Spatiotemporal fishery characterization and catch expansions
- Semi-automation of catch estimation with repeatable rules for borrowing
- Addition of scallop fleet to discard estimation
- New data stream (CFRF Black Sea Bass Research Fleet) for discards at length

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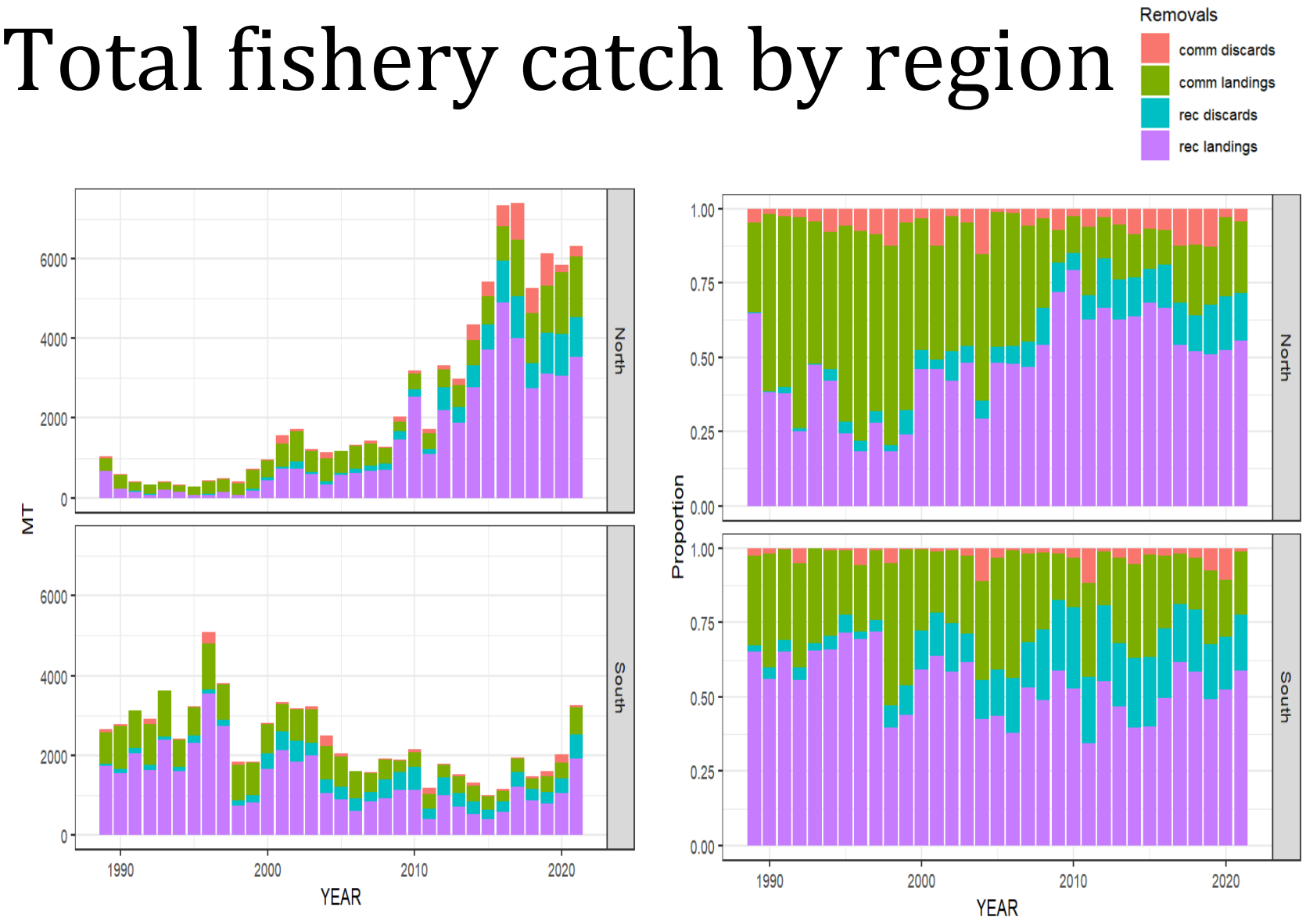
Total fishery catch by region

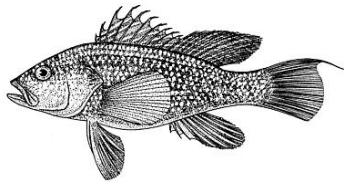


TOTAL CATCH

- NORTH - Averaged ~870mt through 2009, generally increased from 2010-2015 and has averaged 6,390 mt since 2016
- SOUTH - Averaged ~3,050mt through 2003, declined slightly during the mid-2000's and has averaged 1,700mt since 3006

RECREATIONAL PROPORTION

- NORTH- Generally increased ver the time series, representing ~38% of the total catch through 2000 and 75% since 2009
- SOUTH - Catches averaged ~69% of the total fishery and did not exhibit a trend over the time series



Majority of the Commercial discards were from the bottom trawl fleet

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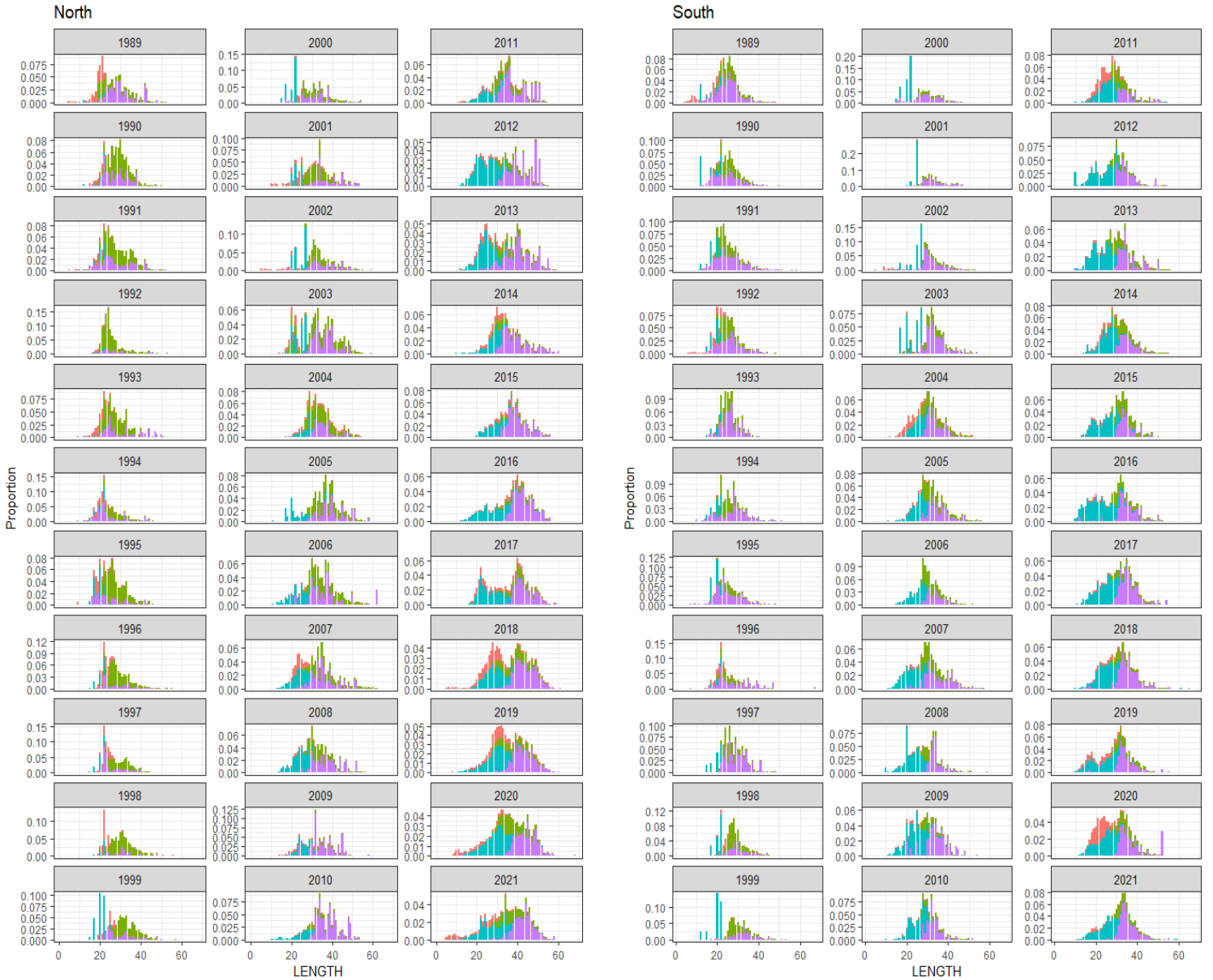
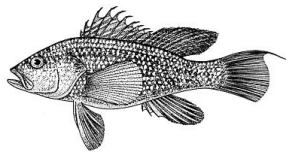
Total fishery catch-at-length

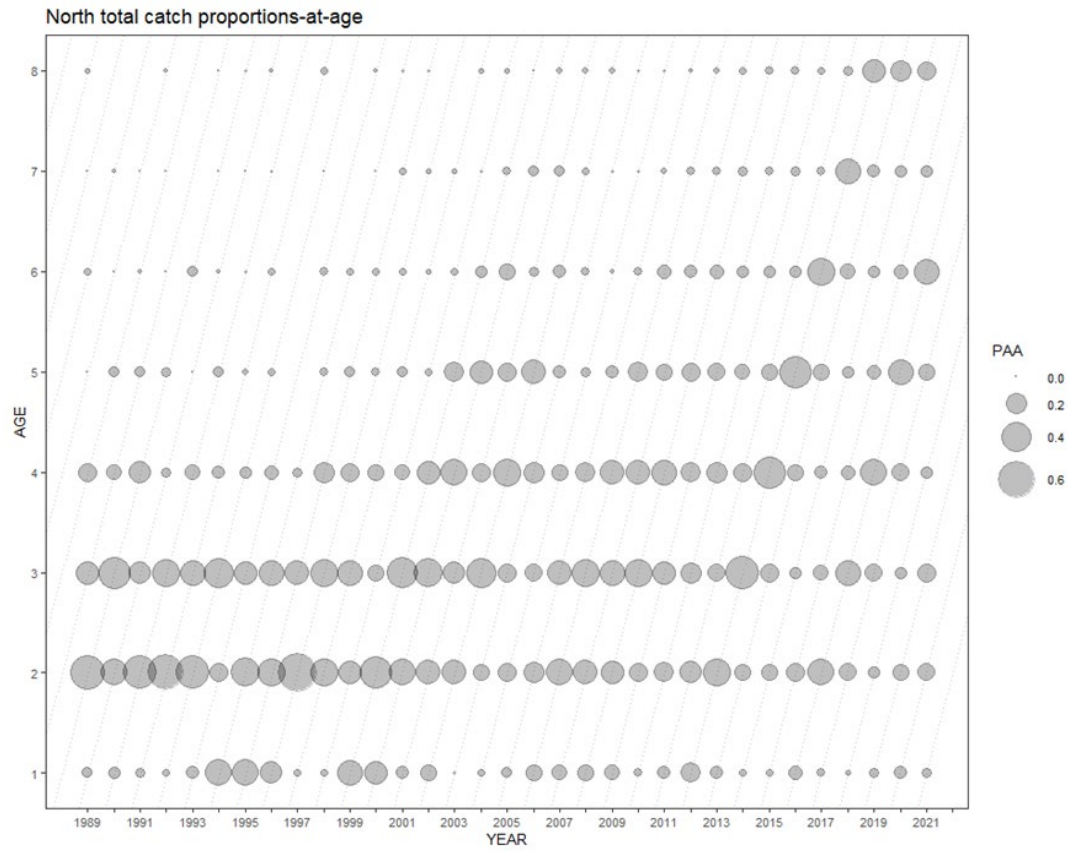
- Expansion in length structure; most pronounced in north
- Discards comprised smaller lengths than landings

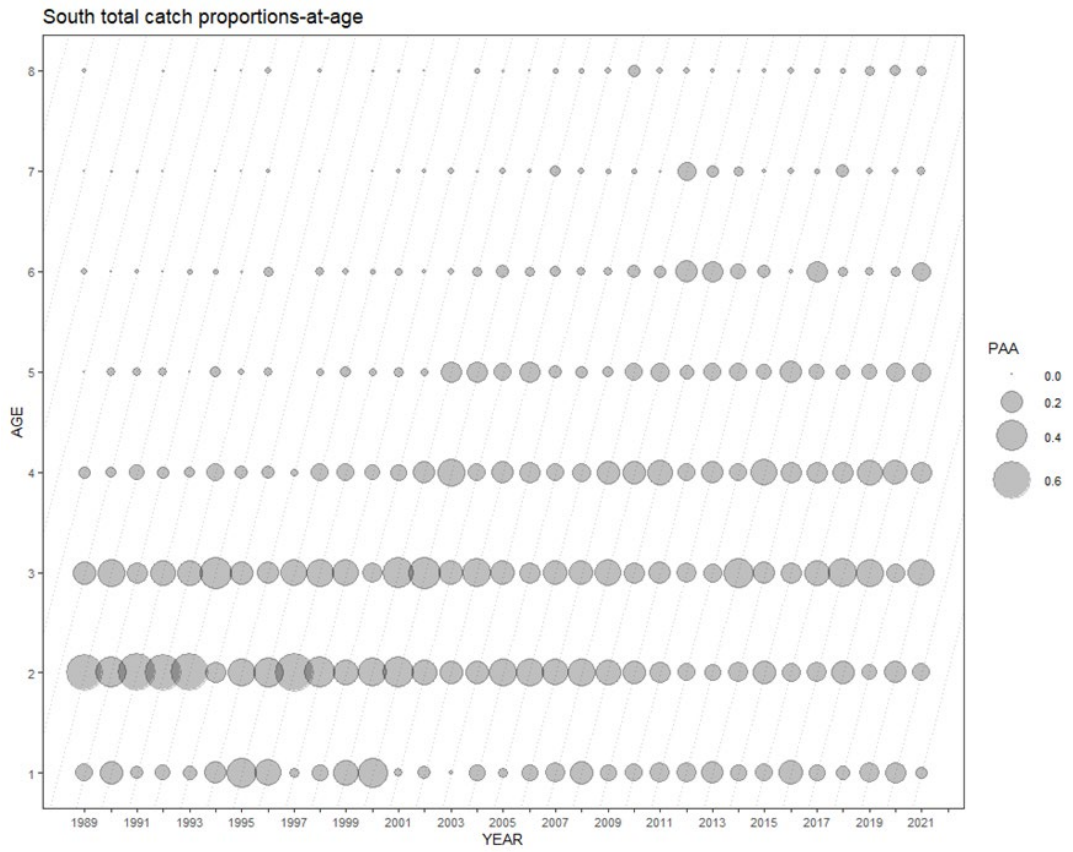


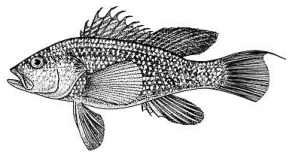


Total fishery catch-at-age

- Expansion in age structure in both regions
- Cohort tracking apparent in northern region (2011 and 2015 year classes) but not as clear in southern region



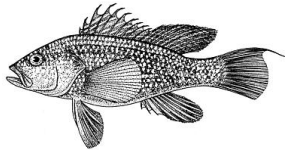


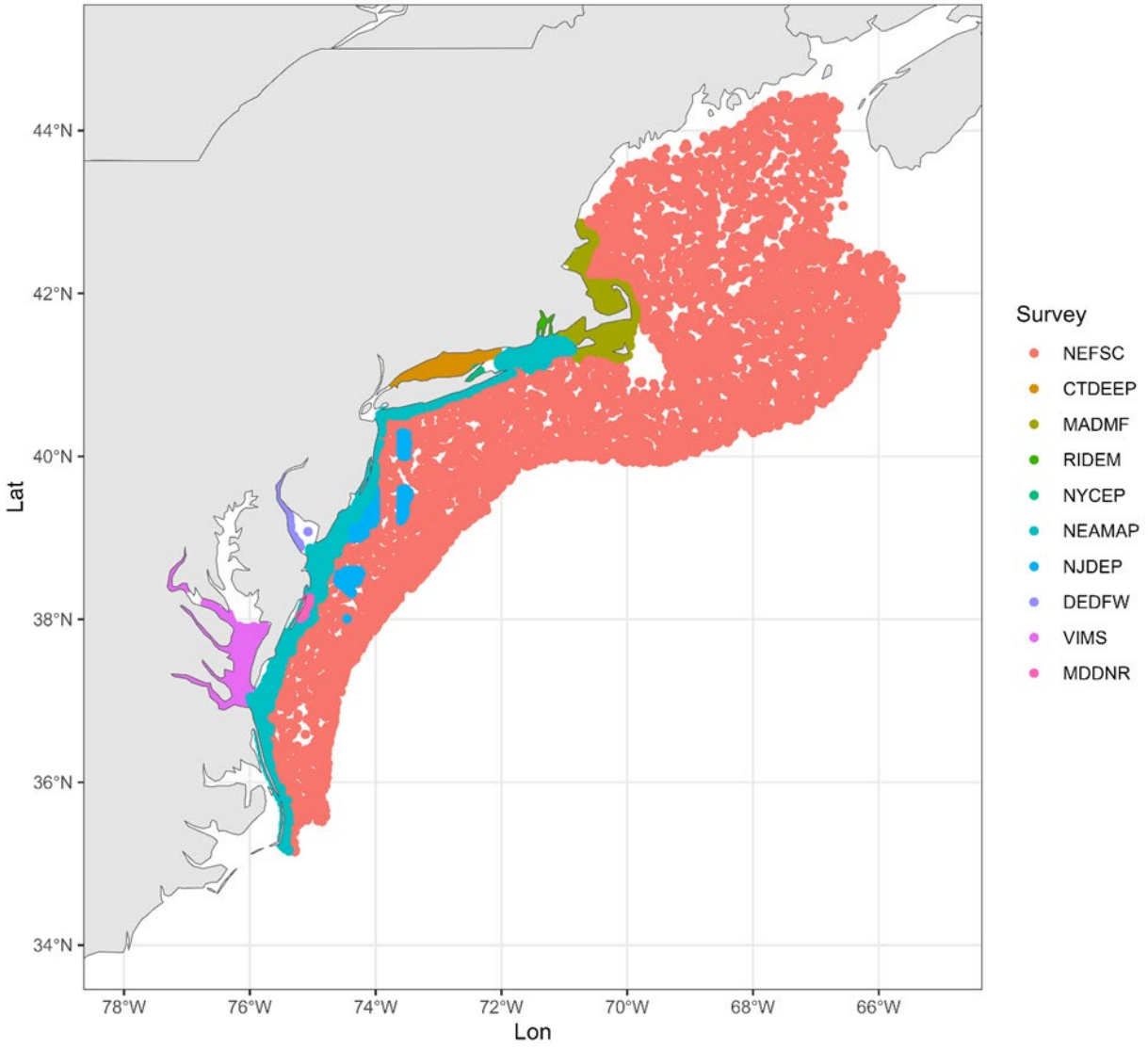


TOR 3: Survey data

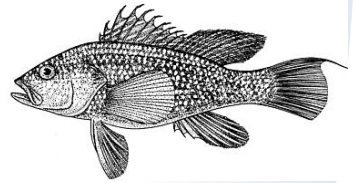
Accomplishments

- 26 indices of abundance considered
  - New indices of abundance explored (ventless trap survey, fall trawl surveys, commercial CPUE)
- Included Gulf of Maine strata in NEFSC trawl survey indices
- Standardization of individual surveys
- Spatio-temporal (VAST) modeling to produce aggregate indices of abundance
- Fishery dependent indices of abundance (Recreational CPA and Commercial CPUE)

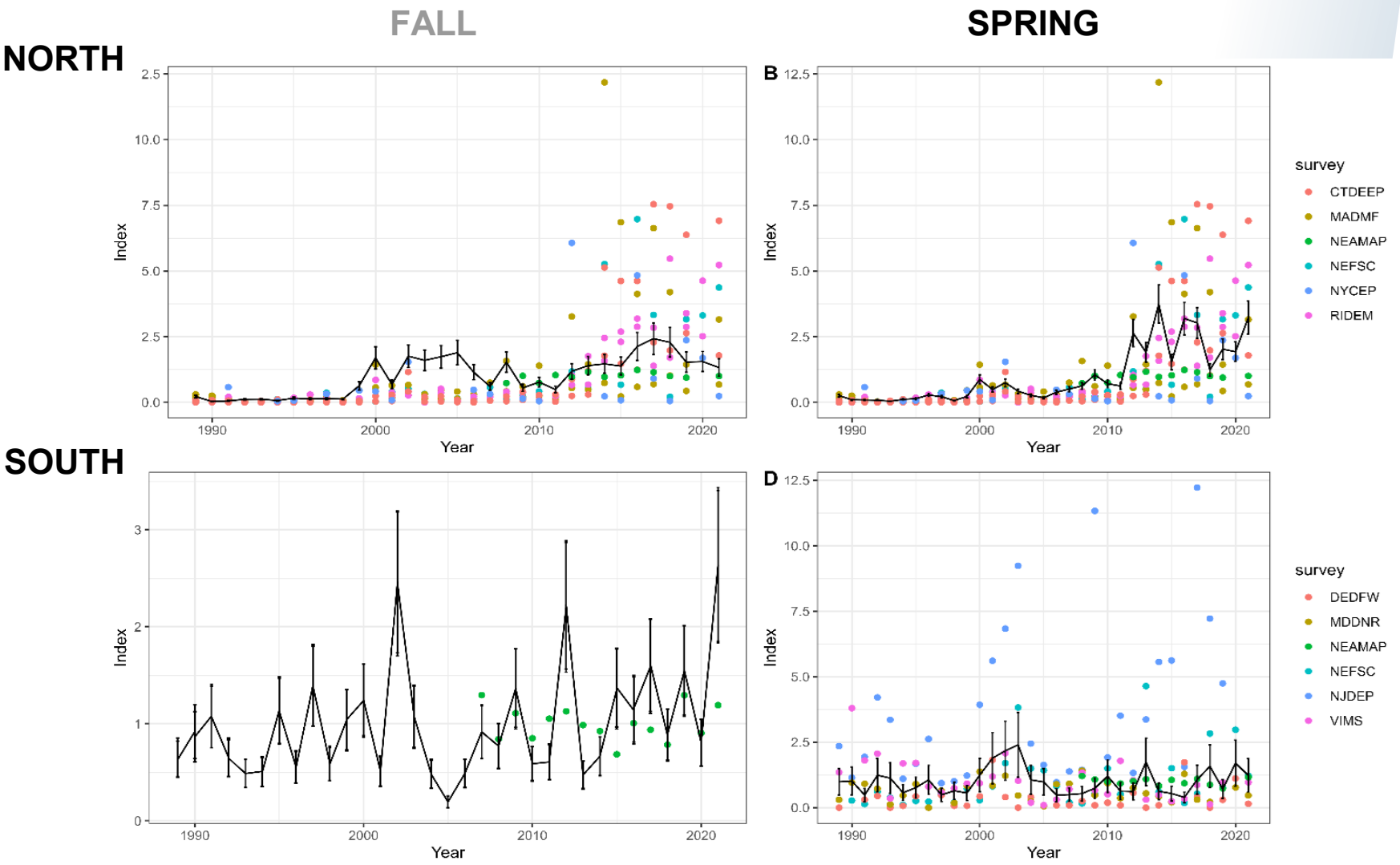




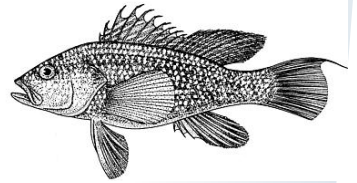
Spatio-temporal modeling



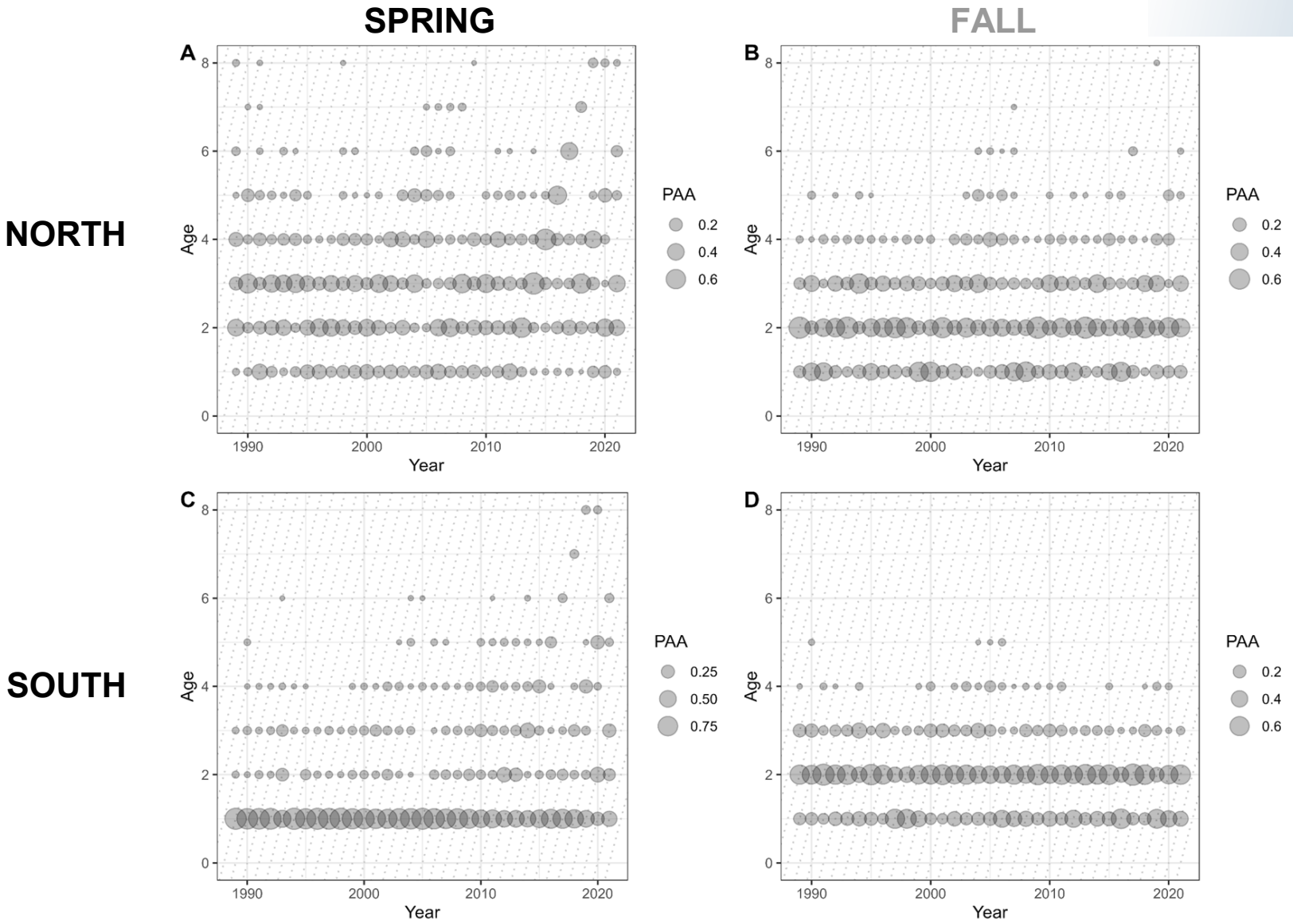
Individual state and federal trawl survey data were combined into aggregate time series using VAST models that incorporated environmental covariates to account for time-varying catchability among surveys and spatial changes between survey footprints



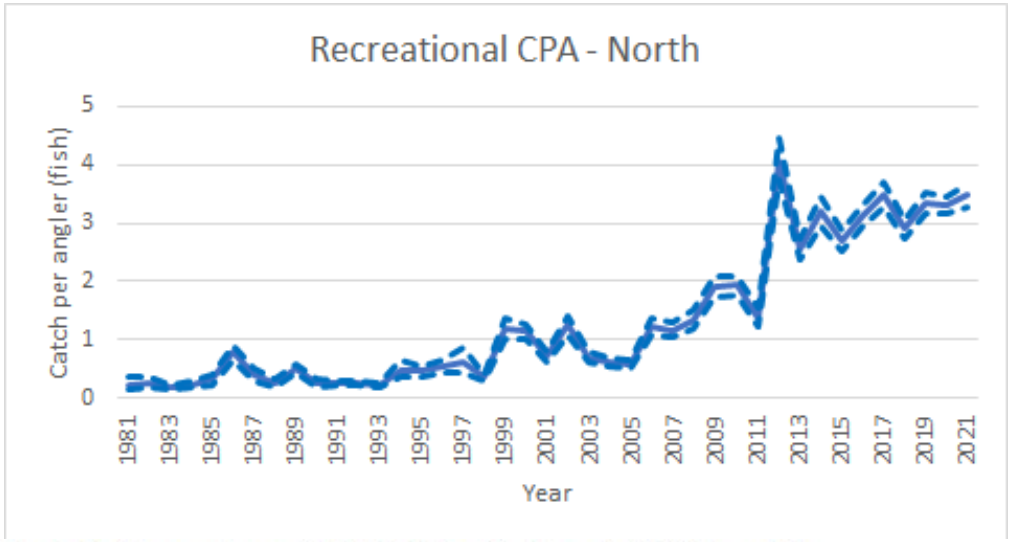
Spatio-temporal modeling

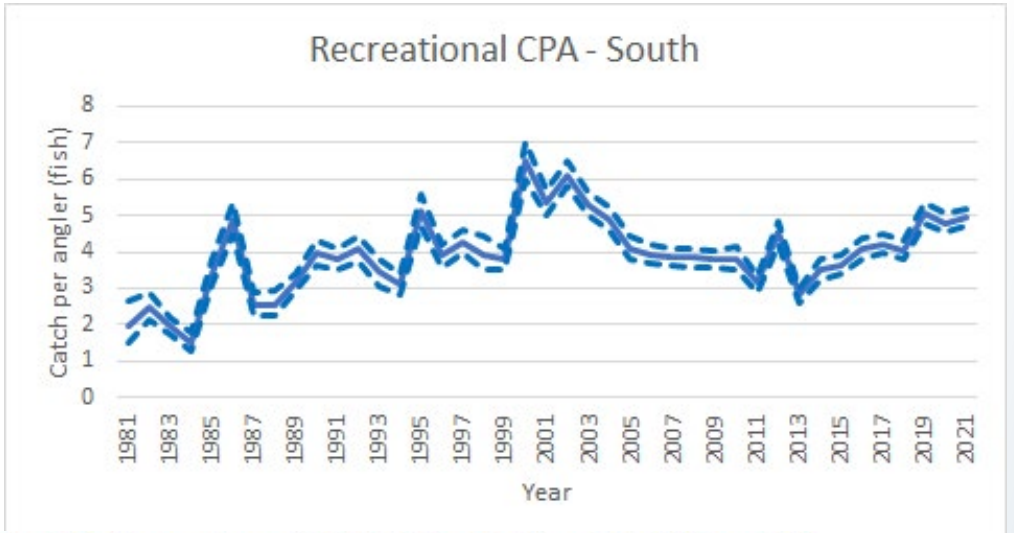


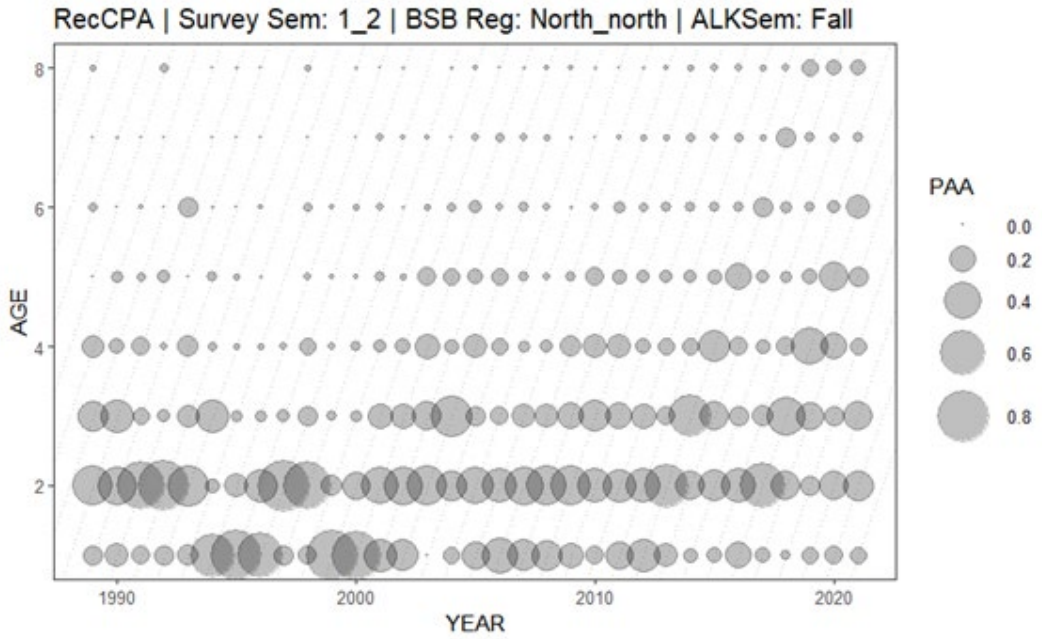
VAST age compositions

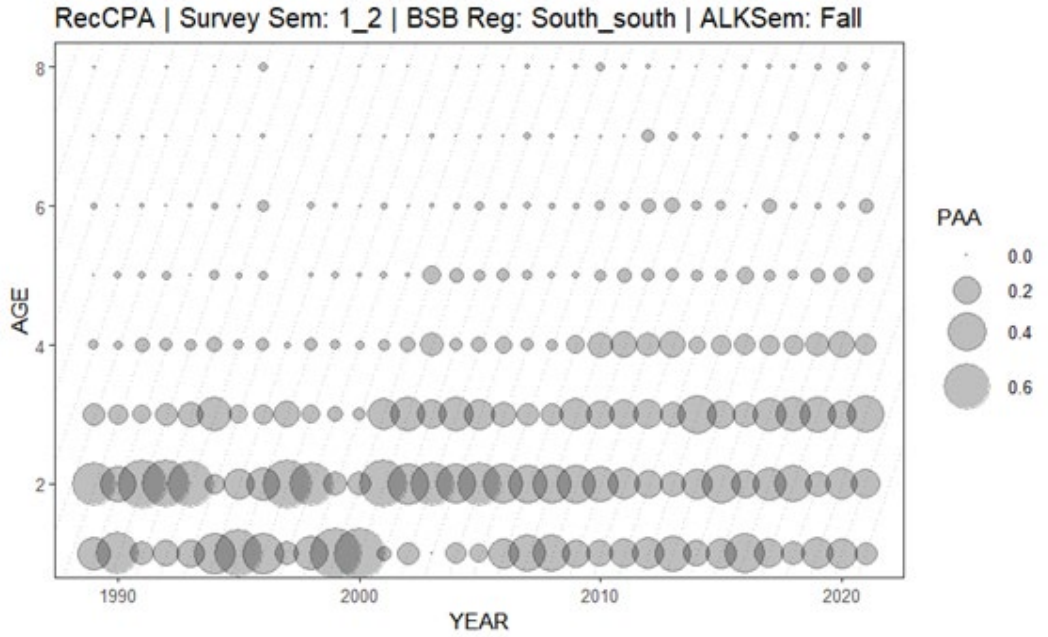


Recreational catch-per-angler





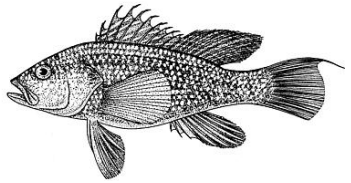




TORs 4-6: Model, reference points and projections

Accomplishments

- Research track so focus is on methodology
- Multi-region state-space model (multi-WHAM)
  - Accounts for spatial dynamics and differences in productivity
  - Mixing between regions
  - Bottom temp covariate on recruitment
  - Projections consider recent recruitment dynamics
- Supporting stock synthesis model
  - Sense checked WHAM outputs
  - Provided movement estimates



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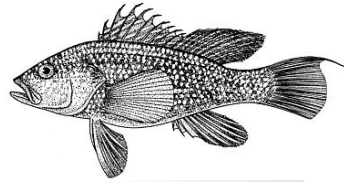
BSB Multi-WHAM formulation



- Two regions (Boundary approximates location of Hudson Canyon)
- Time series: 1989 - 2021; Ages 1-8+
- Fishery catch
  - Commercial and recreational fleets in each region
  - Fleet Selectivity: Time and age varying processes in the north only
- Indices
  - Recreational CPA and Spring VAST
  - Selectivity: Age and/or year varying processes in the north only
- Environmental processes: bottom temperature covariate on recruitment in both regions
- Maturity: Age and time-varying
- Movement rates (priors from Stock Synthesis)
- Natural mortality = 0.4 (constant across ages, years, regions)

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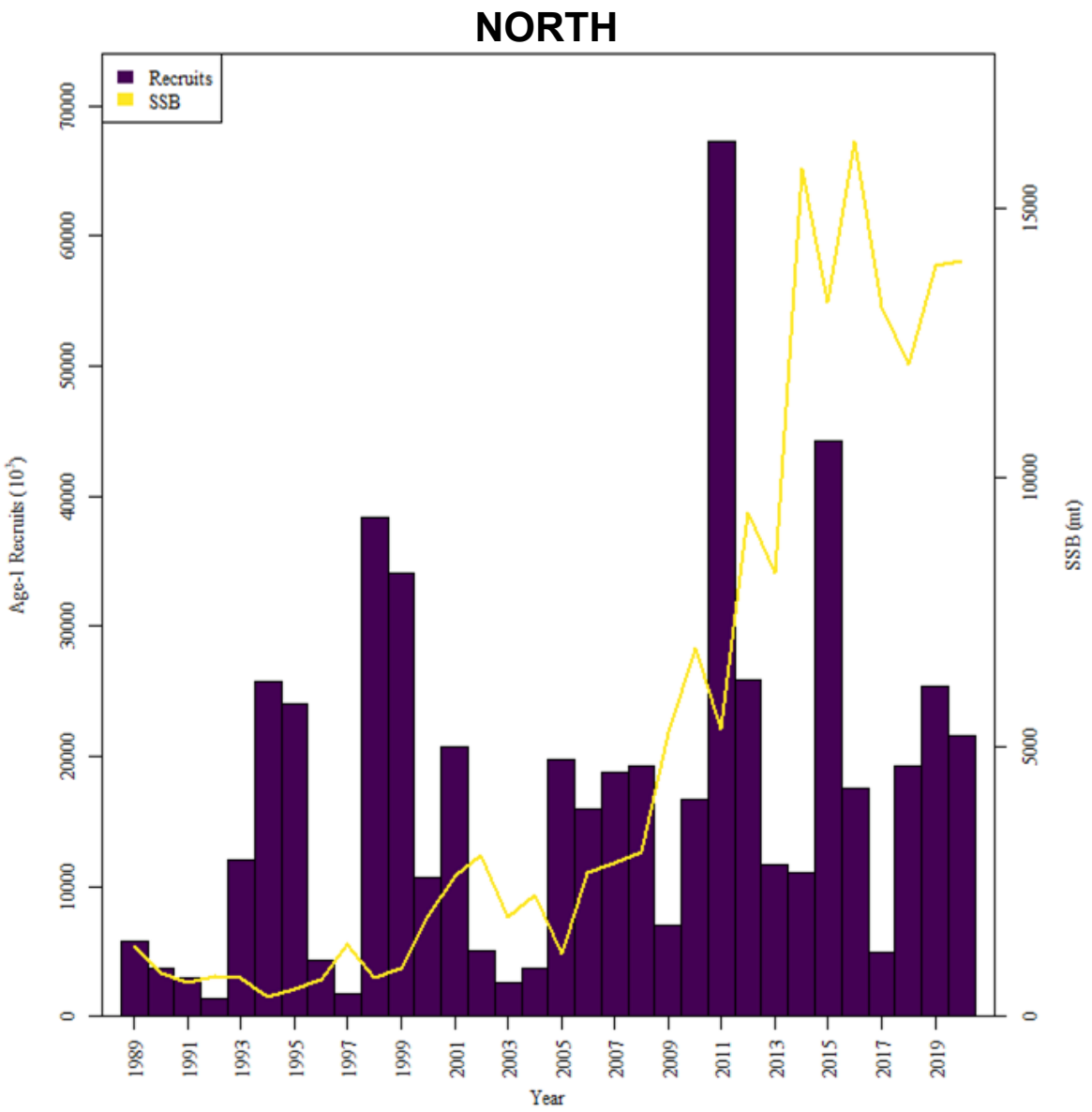
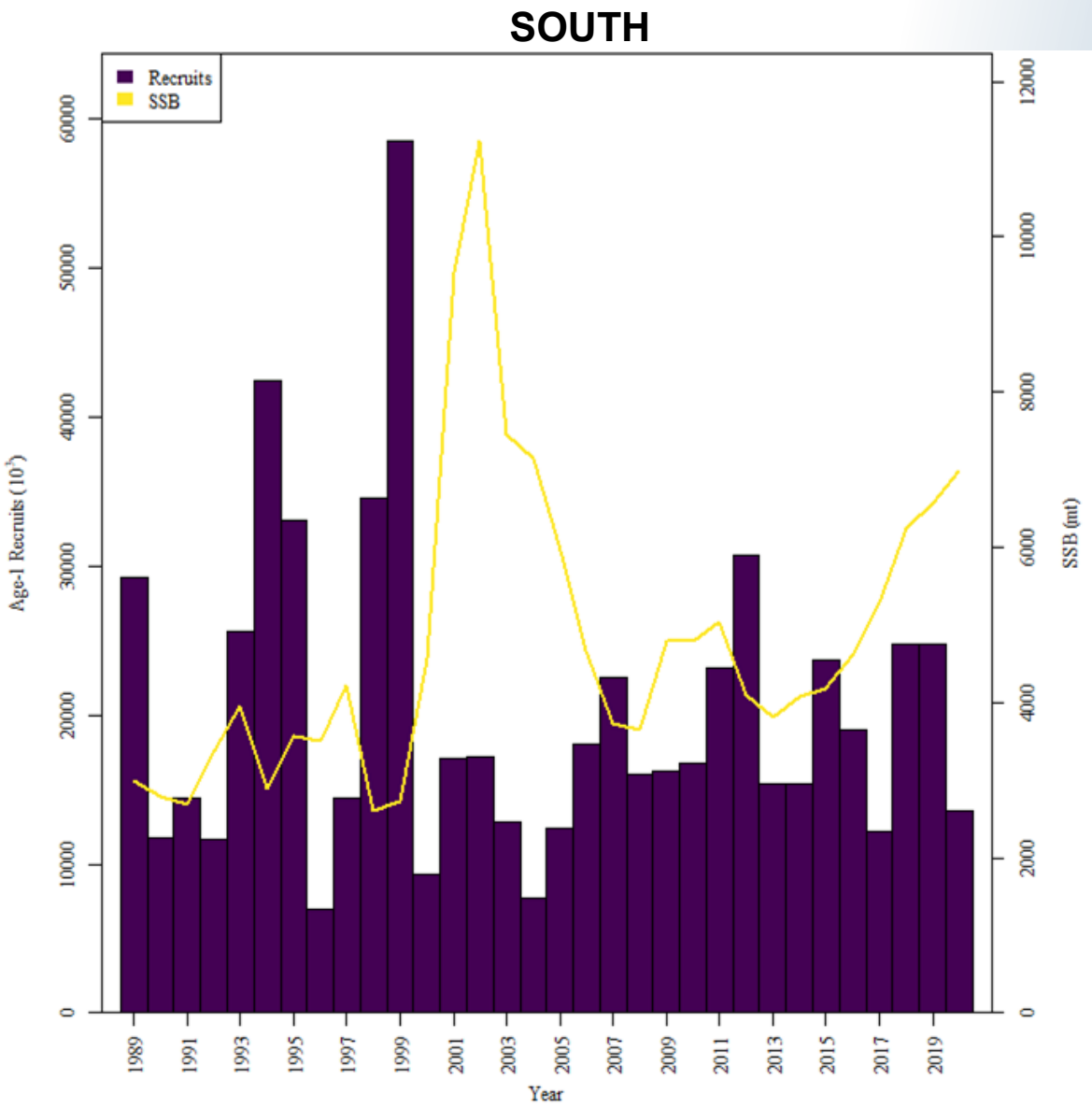
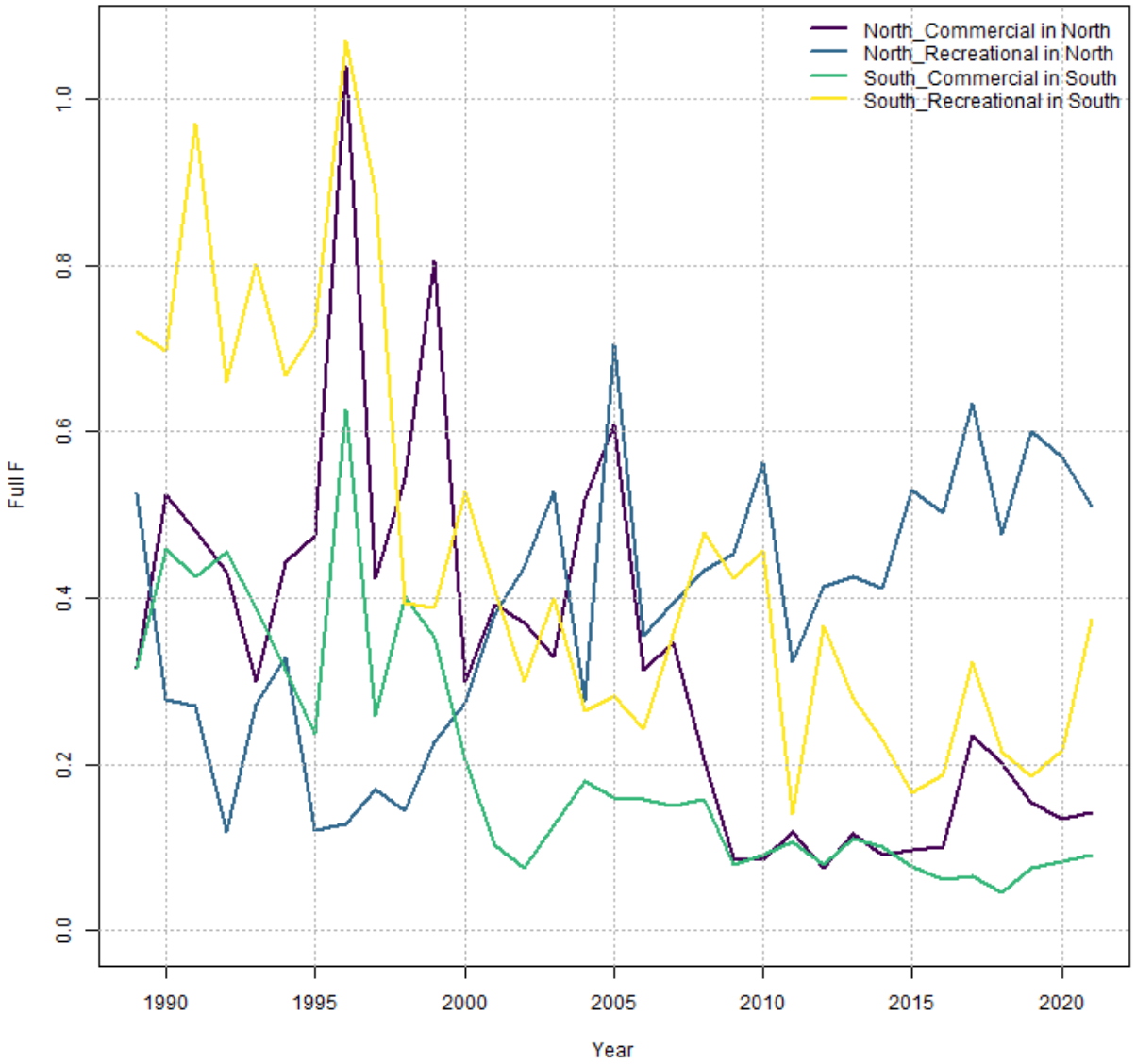
Estimated SSB and recruitment





Estimated SSB and fishing mortality

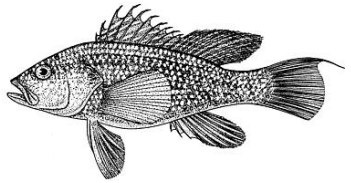


TORs 4-6: Model, reference points and projections

Reference points and projections…

- Stock status recommendations are not part of the RT TORs and the results from this RT will not be used directly in management.
- This RT will inform a MT scheduled for June 2024 that will provide updated estimates of stock status using data through 2023 and will be used to inform management measures for 2025-2026.

- Reference points were based on recent 5-year averages of selectivity, maturity and weight-at-age and incorporated recruitment estimates from 2000 onward
- Short-term projections include forecasted bottom temperature covariate for recruitment



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TORs 4-6: Model, reference points and projections

Reference points

$F_{MSY\ PROXY} = F_{40\%} = 1.03$ (cannot be compared to previous ASAP values)

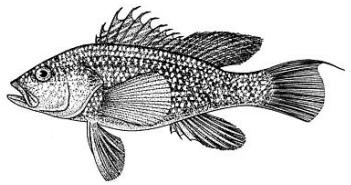
$SSB_{MSY\ PROXY} = 12{,}491$ mt (14,441 mt in 2021 MT)

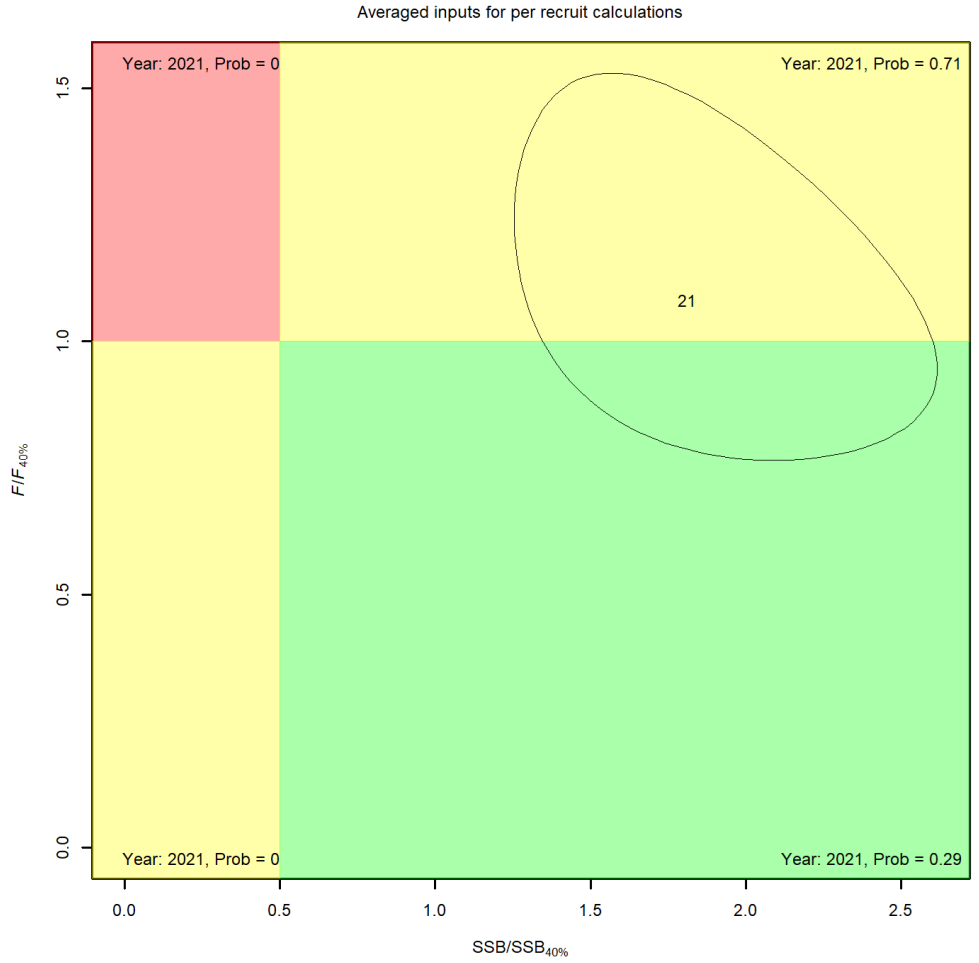
$MSY_{PROXY} = 3{,}975$ mt (5,334 mt in 2021 MT)

Terminal year (2021) estimates

$F_{2021} = 1.12 = 108\%$ of $F_{40\%}$

$SSB_{2021} = 22{,}630$ mt $= 181\%$ of $SSB_{MSY\ PROXY}$

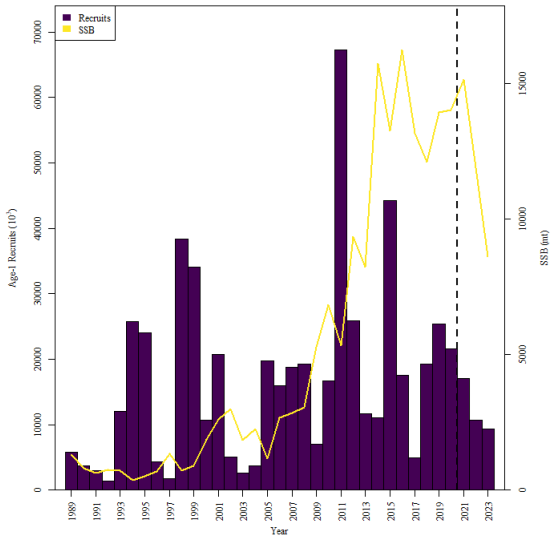




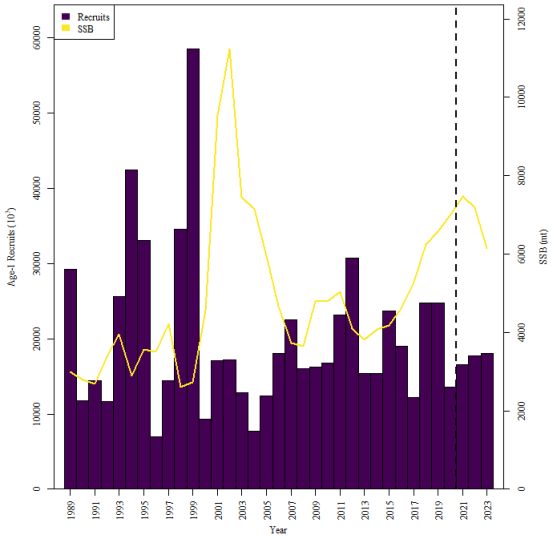
TORs 4-6: Model, reference points and projections

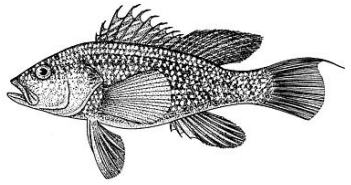
Short-term projections at $F_{40\%}$

North

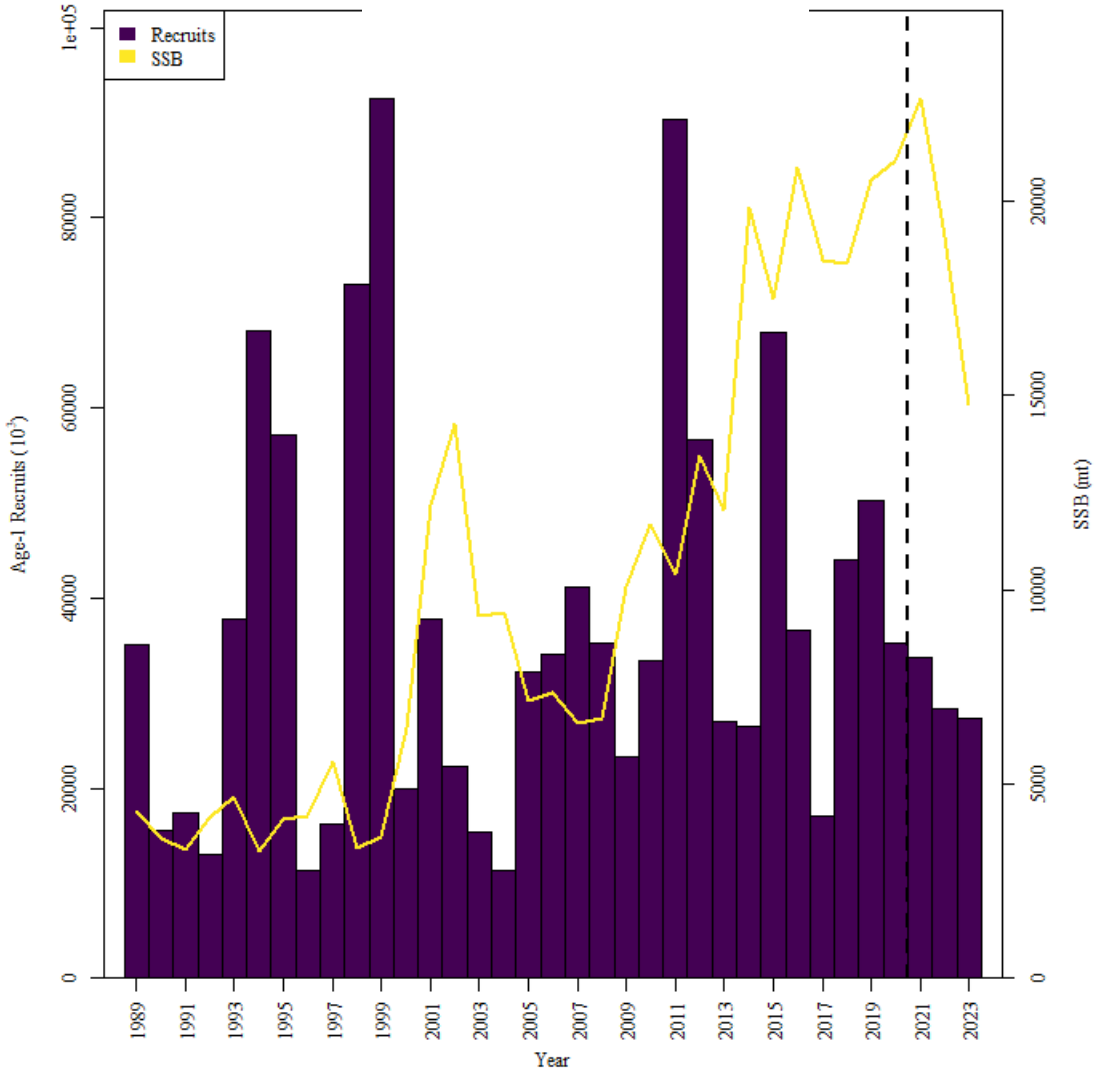


South





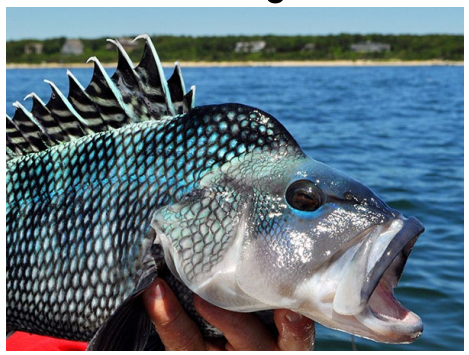
Combined regions



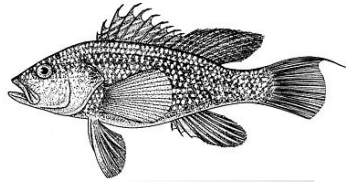
TOR 7: Research Recommendations

Accomplishments

- Most research recommendations from previous assessment addressed by the working group
- New research recommendations prioritized by high, medium, low
  - High priority research recommendations reflect remaining uncertainties and needs
    - Movement rates and drivers
    - Role and drivers of varying recruitment in stock dynamics
    - Reliable indices of abundance beyond existing surveys
    - Enhanced sampling to support estimation of fishery length and age compositions
    - Metrics for measuring recruitment as a response variable to environmental indicators



TOR 8: Backup Assessment Approach

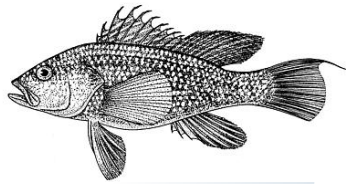


Backup plan

- Effort to stay in WHAM framework to provide flexibility moving forward
- ASAP-like WHAM (fixed effects SCAA model) with retrospective adjustment if needed
  - Following results of Index-Based Research Track Stock Assessment

NOAA FISHERIES

Peer Review Panel Recommendations



Peer review panel accepted the BSB Research Track Assessment

Required for 2024 Management Track

- Exploration of alternative parameterizations for natural mortality (e.g. different age-independent constant values, or age-dependent M)
- Profiles of the initial fishing mortality (i.e. initial depletion)
- An evaluation of which individual surveys should be included in the VAST index by comparing WHAM estimates (e.g., biomass time series) from the proposed run with individual fishery independent surveys. Surveys that do not appear to accurately reflect changes in stock size through this analysis should not be included in the VAST index.

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Questions?

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