Atlantic Herring

Jonathan J. Deroba
NEFSC
Population Dynamics Branch
ASMFC
August 2, 2022

Background

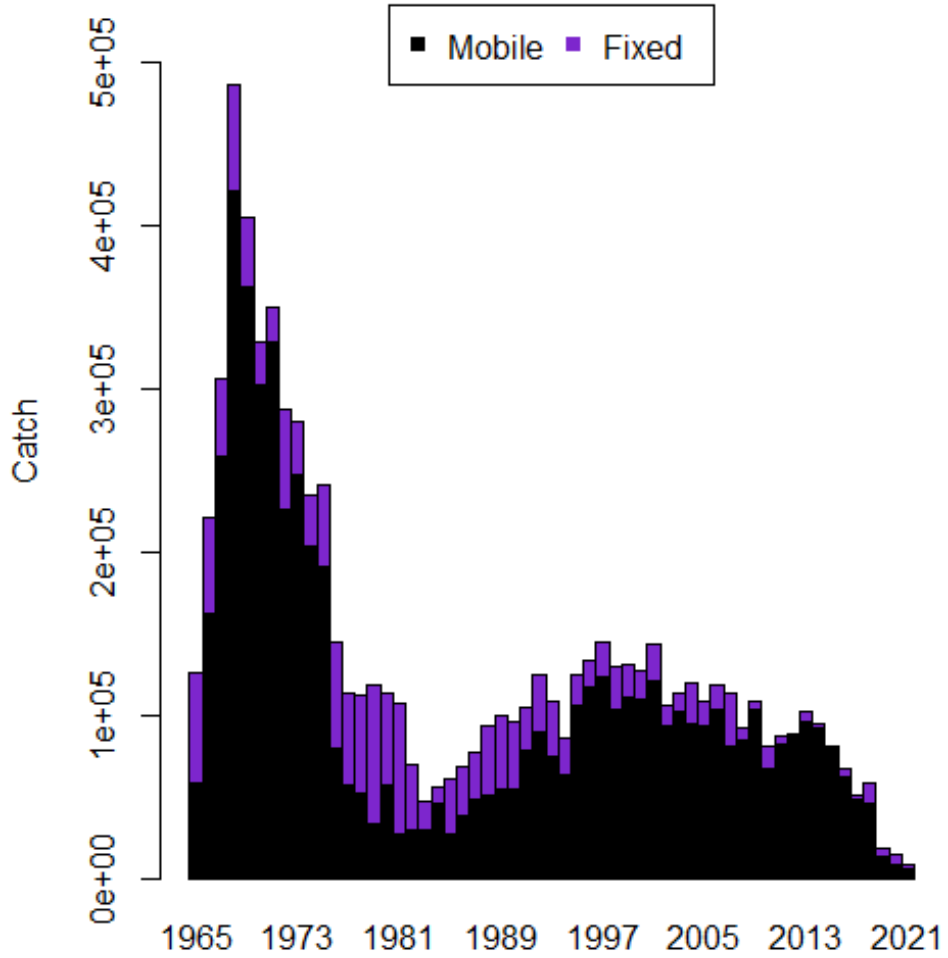
- Last assessed and reviewed June 2020
- Assessed using ASAP
  - Two fleets (fixed and mobile gears); fixed catch >90% Canadian
  - Four surveys: spring BTS, fall BTS, summer/shrimp BTS, acoustic time series collected during fall BTS
  - Constant M=0.35
  - No ability to estimate SR relationship; MSY reference points use F40% as proxy
- 2020 assessment concluded stock overfished but overfishing not occuring

TOR 1: Estimate catch from all sources including landings and discards

- Canada made some changes since last assessment (affects fixed gear catches)
  - Catch weights at age are no longer gear specific, now sampled throughout Bay of Fundy (most samples from seine gear)
  - ALKs, W-L, and quality control now standardized (previously ad hoc)
  - ALKs use 1cm bins by season (Jan-May; June-Aug; Sept-Oct; and Nov-Dec), combined among gears
  - W-L by fleet, year, month
- So Canadian (i.e., fixed gear) catches and CAA slightly different than before
- Negligible effect on the stock assessment

TOR 1: Estimate catch from all sources including landings and discards

- Catch = landings + discards
  - Discards only available since 1996, but generally <1% of landings



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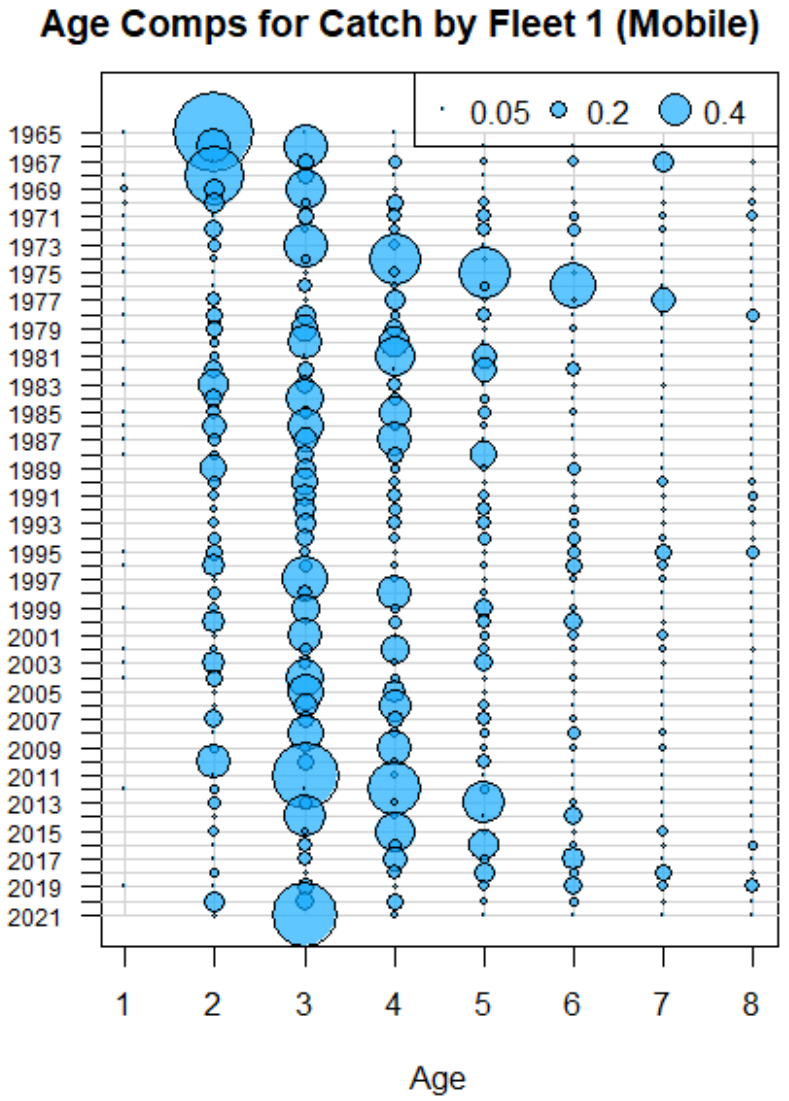

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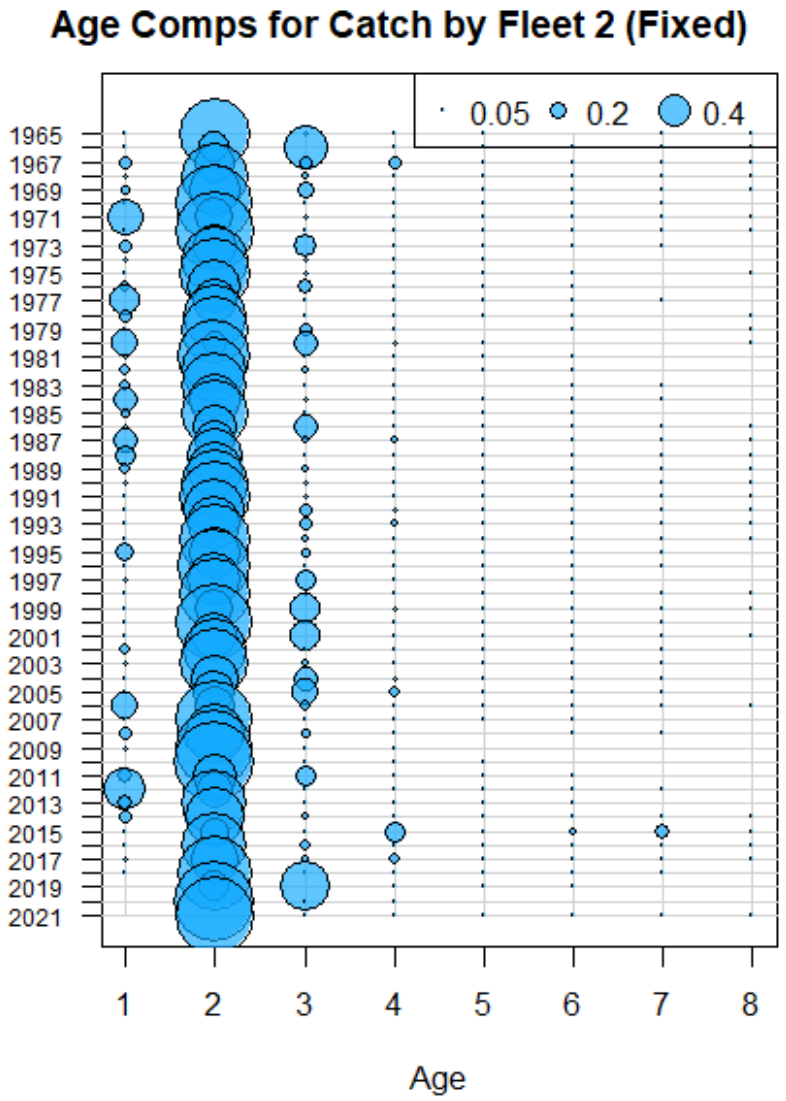

TOR 2: Evaluate indices used in the assessment

- NMFS Spring and Fall bottom trawl surveys switched to using tow-specific, measured-distance, adjusted catches
- Negligible effect on the indices and stock assessment

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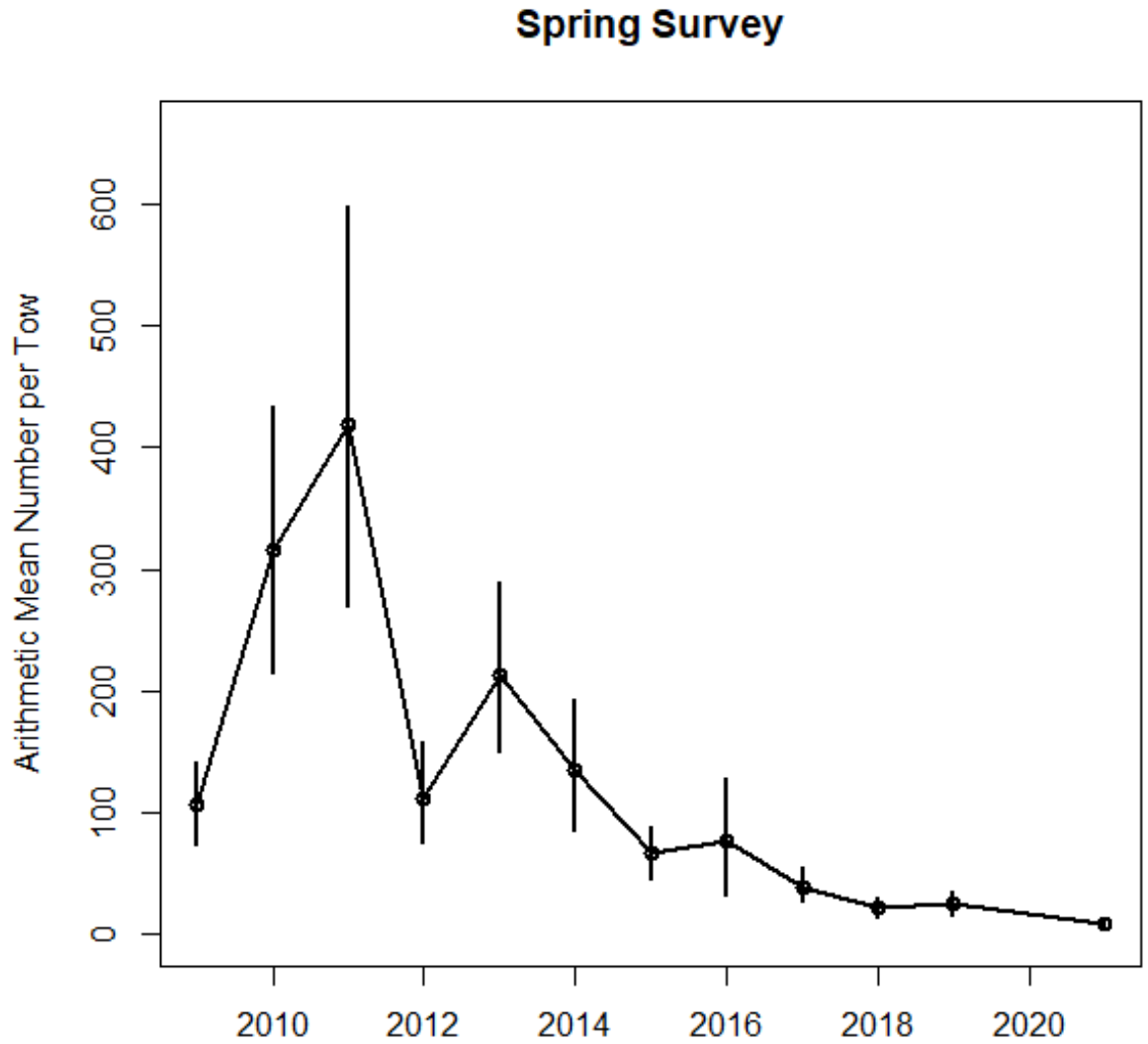

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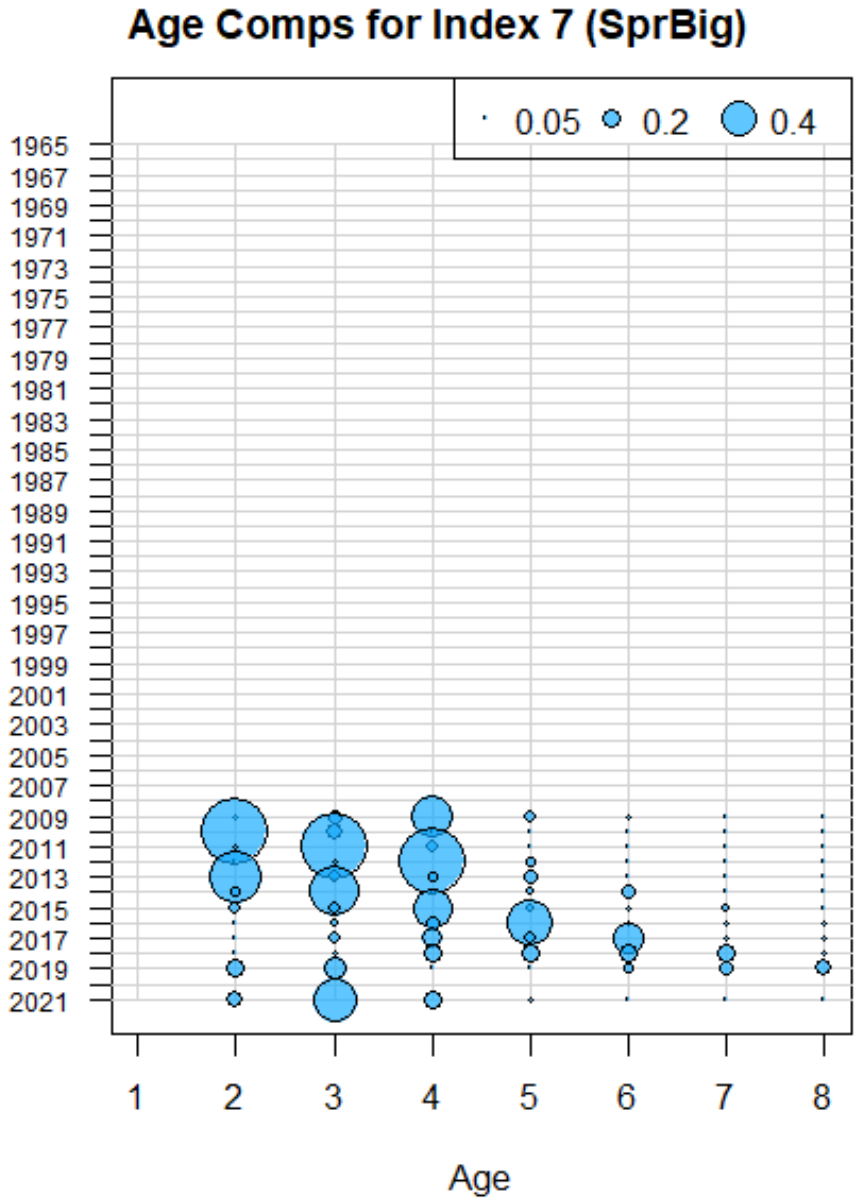

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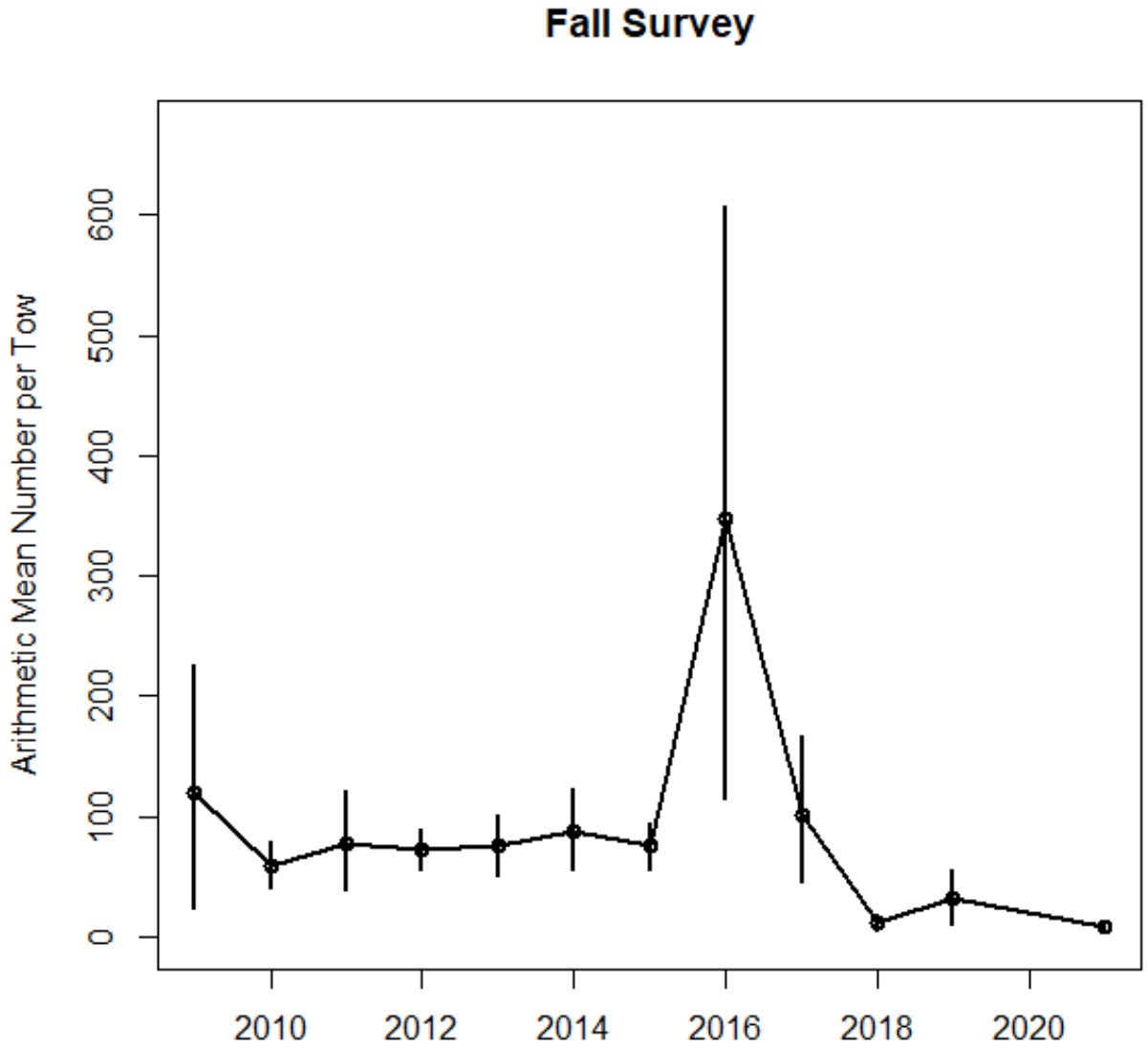

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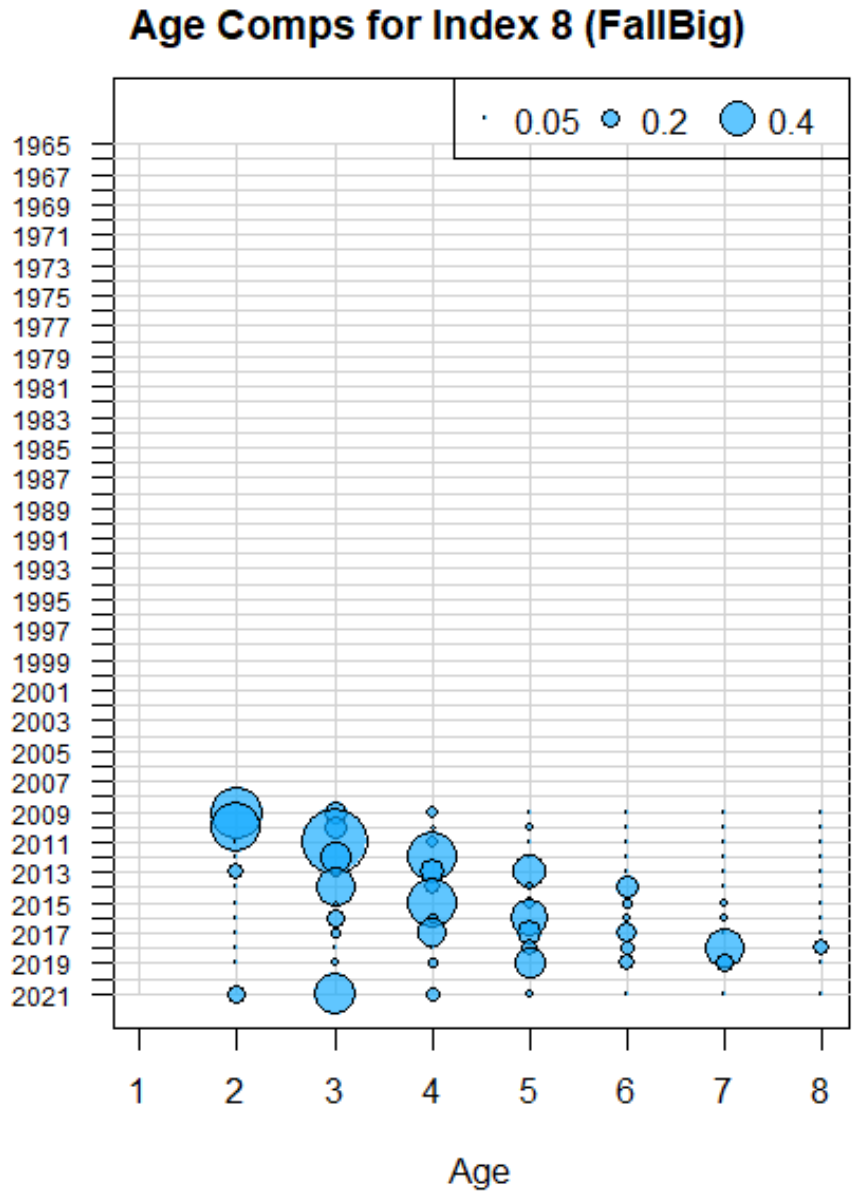

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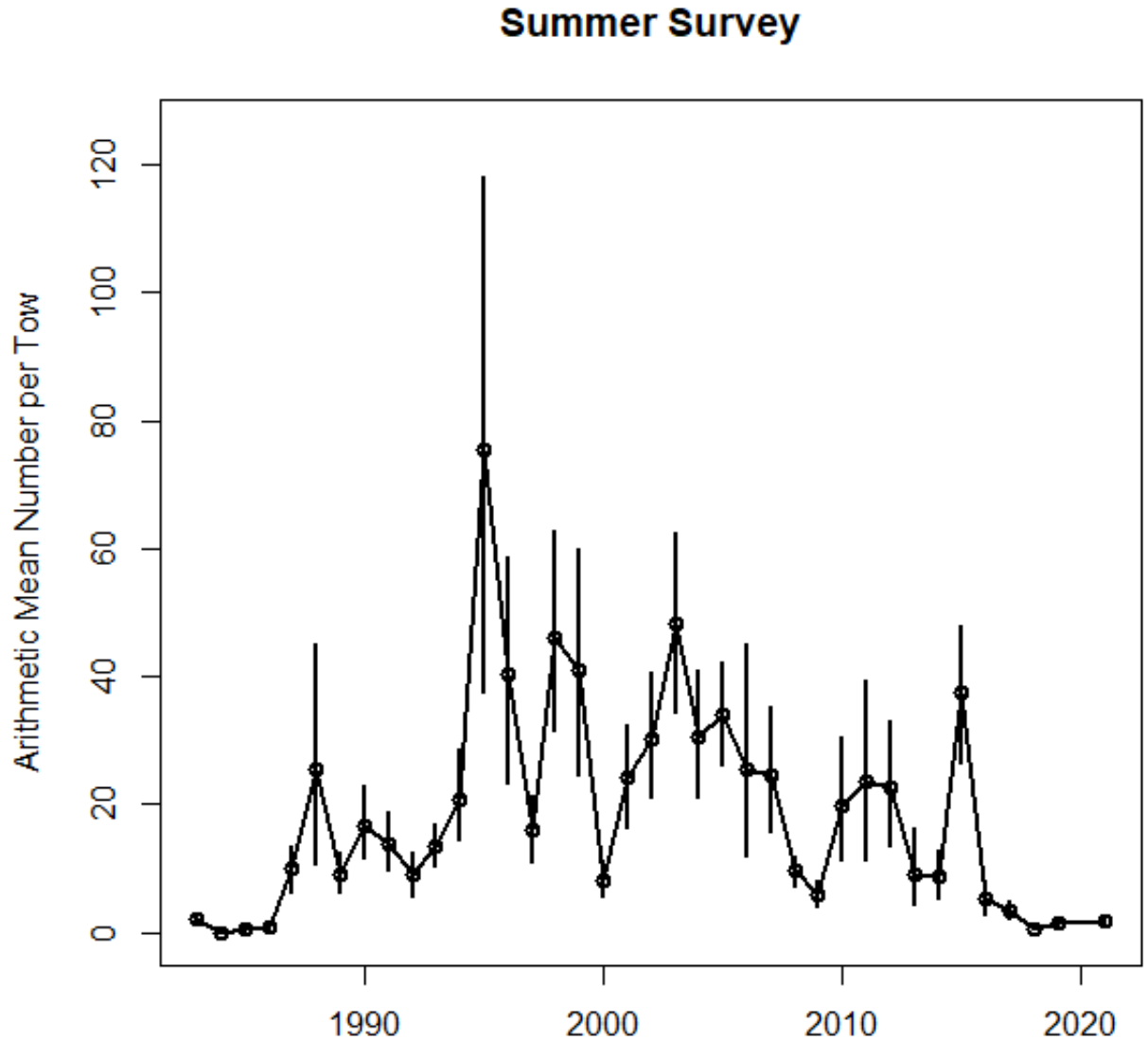

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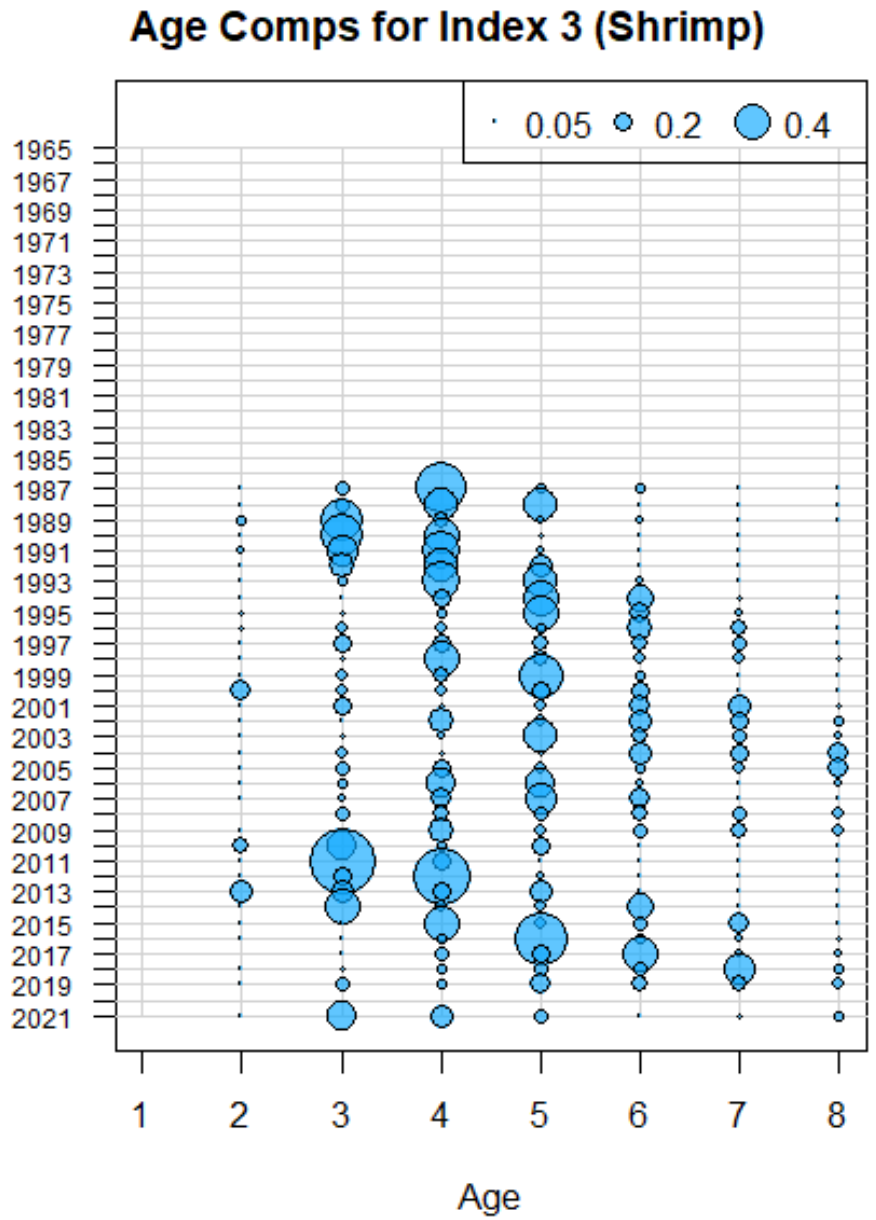

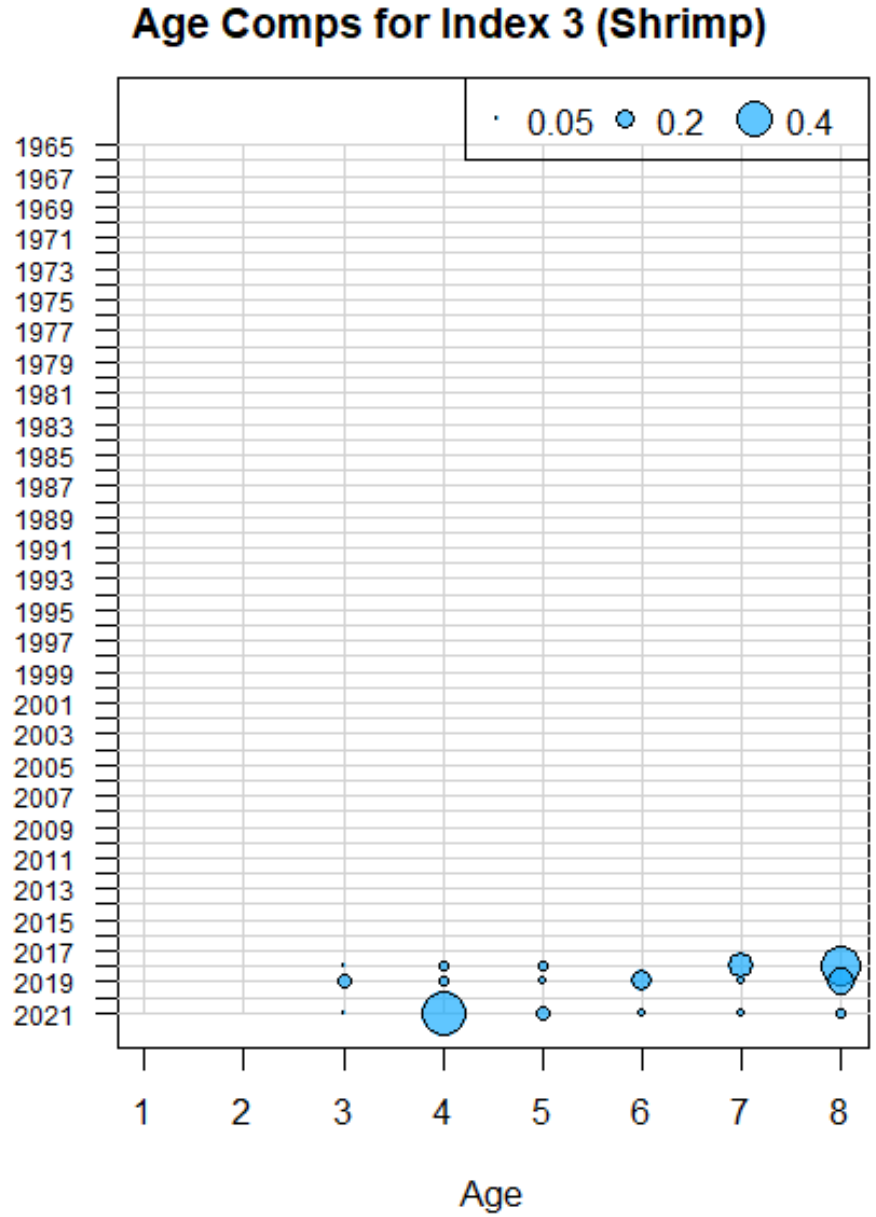

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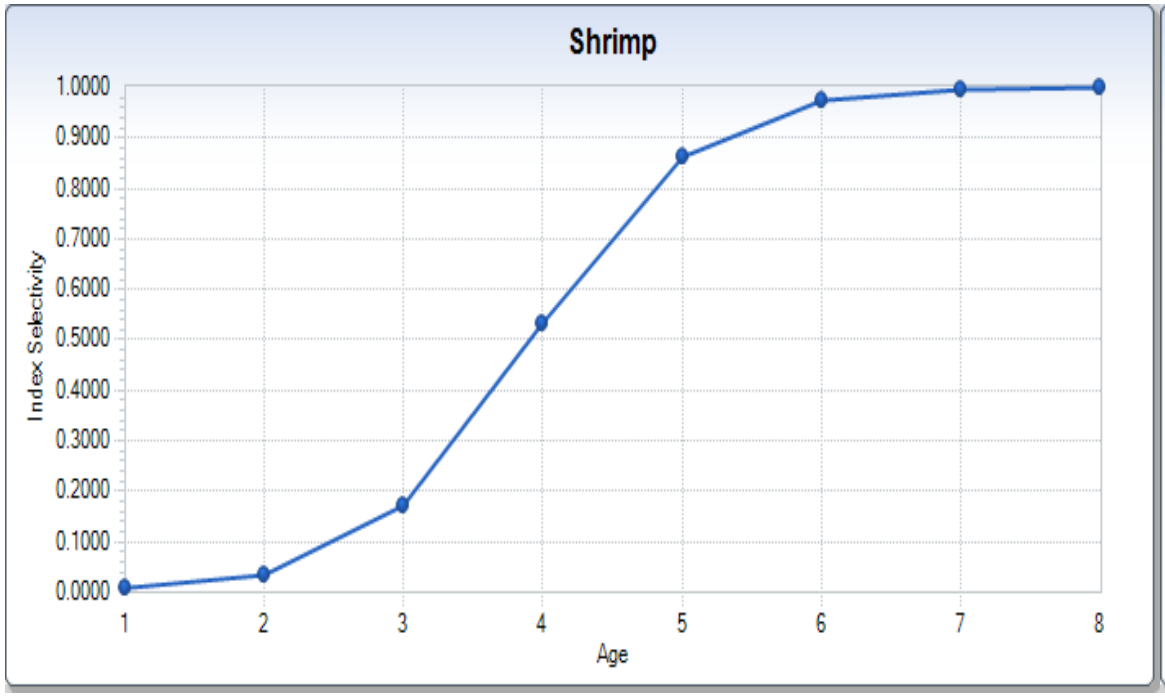
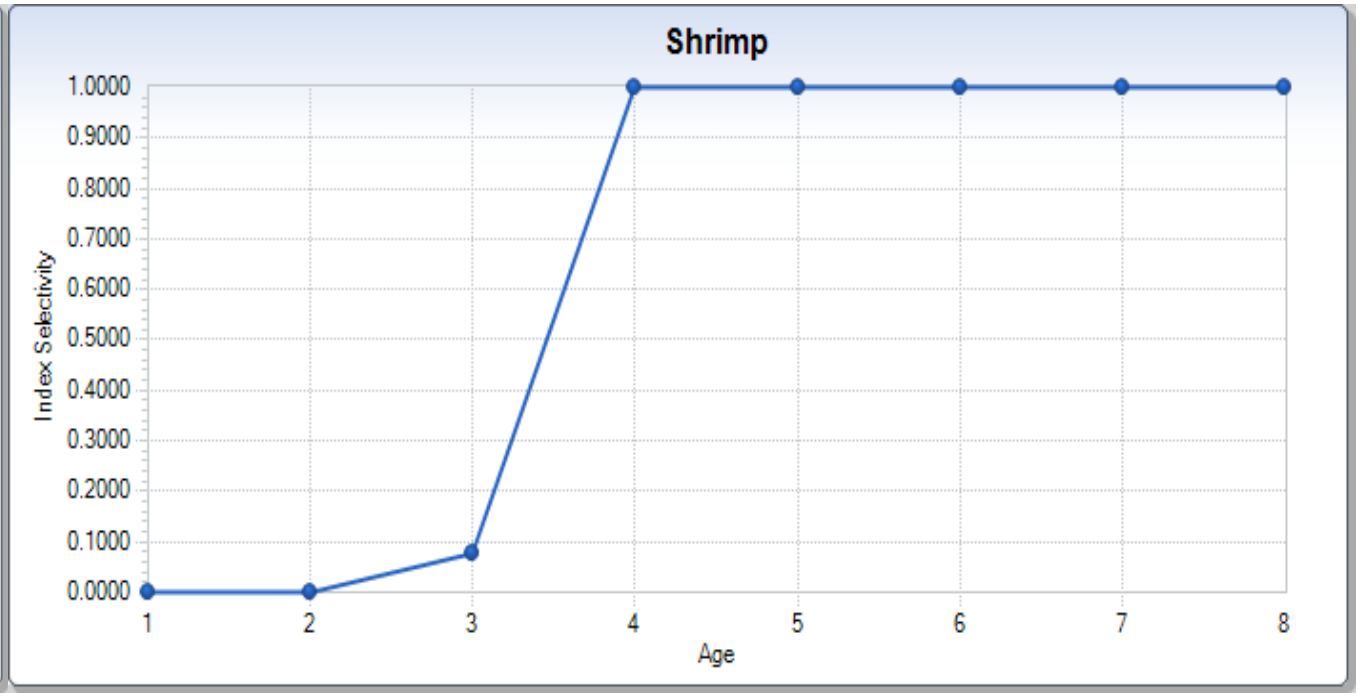
- Negligible effect on index fit and stock assessment





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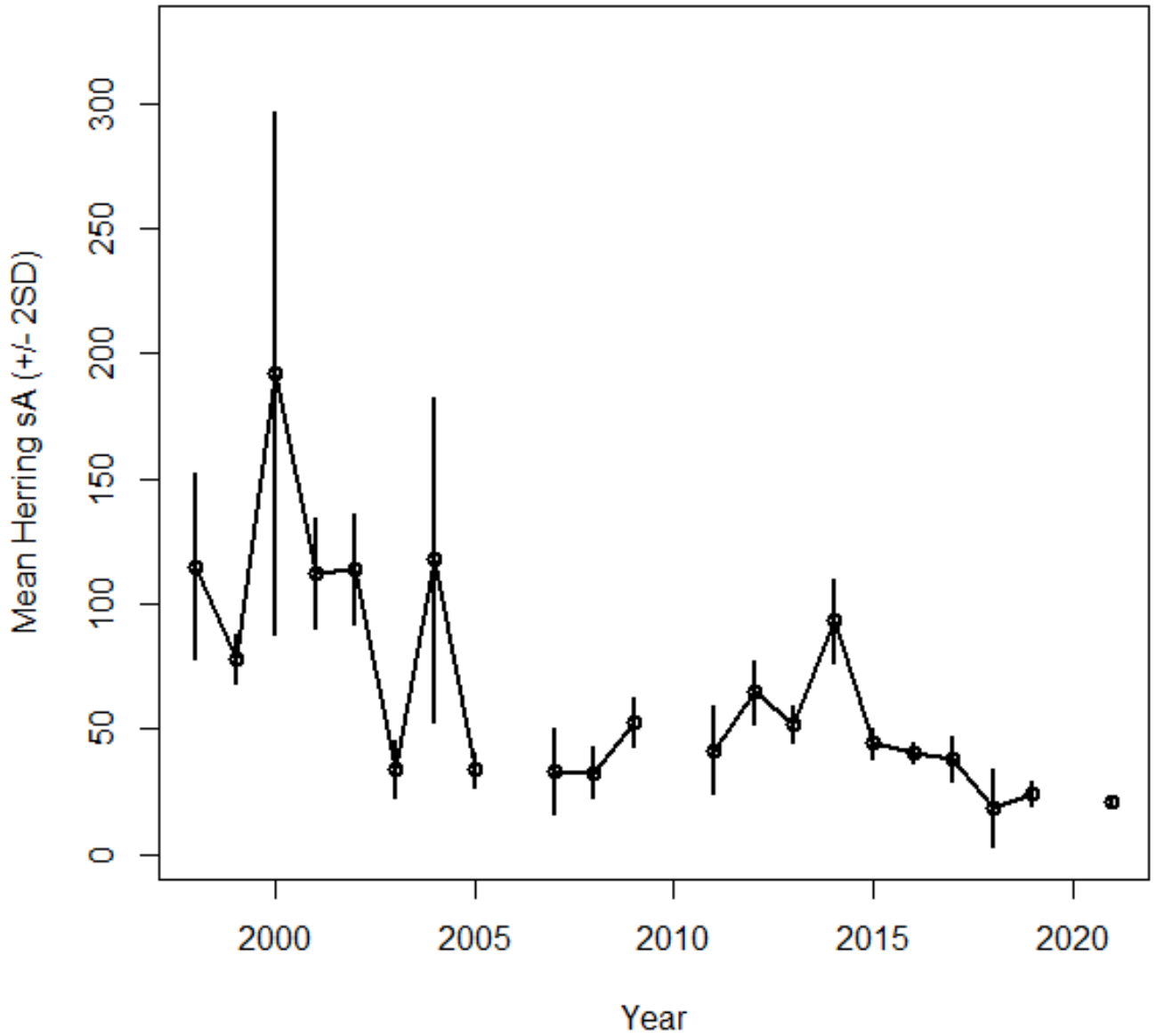
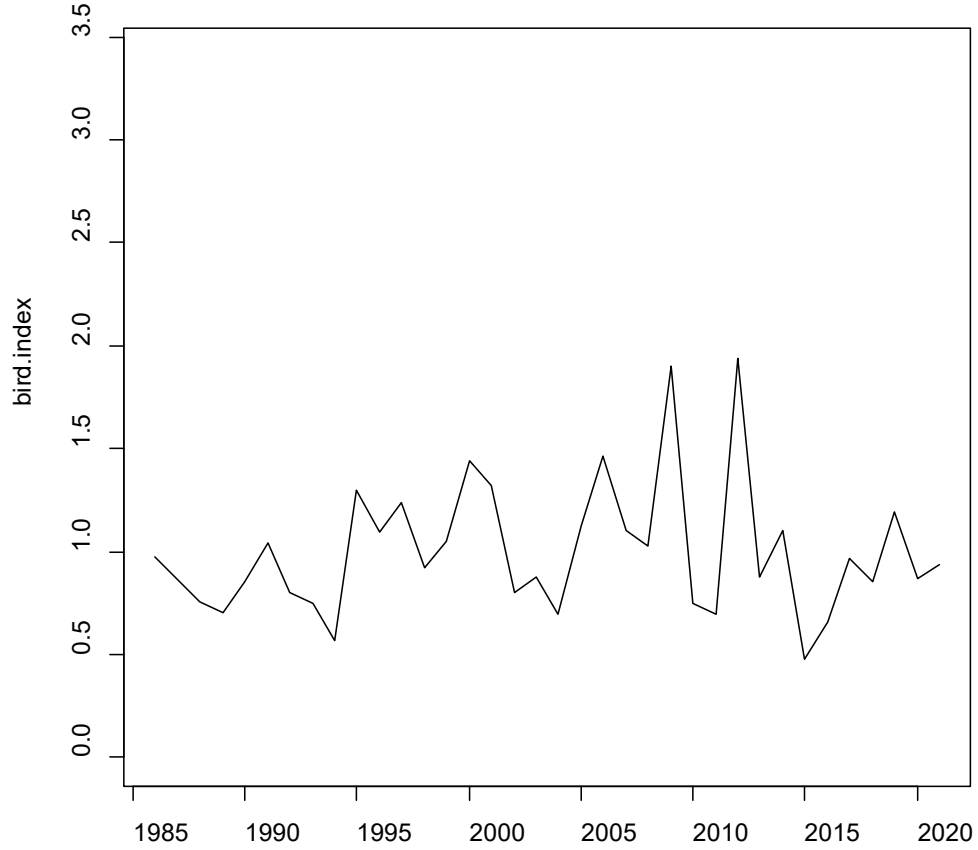


TOR 3: Estimate…

- With just the previously noted data changes, the model blew up!
- 70 parameters with CV > 0.5, median = 27, max = 7.1E+79
- 1,654 parameter pairs with correlation near 1 or -1
- Relatively large gradient (0.006)
- Explored two solutions:
  - Derive a recruitment index from seabird diet data
  - Penalize recruitment deviations for deviating from the median

TOR 3: Estimate…

- Adding the index based on seabird diet data resolved all the high CV, correlations, and gradient issues
- But, the model did not fit the index very well, especially at high and low recruitments



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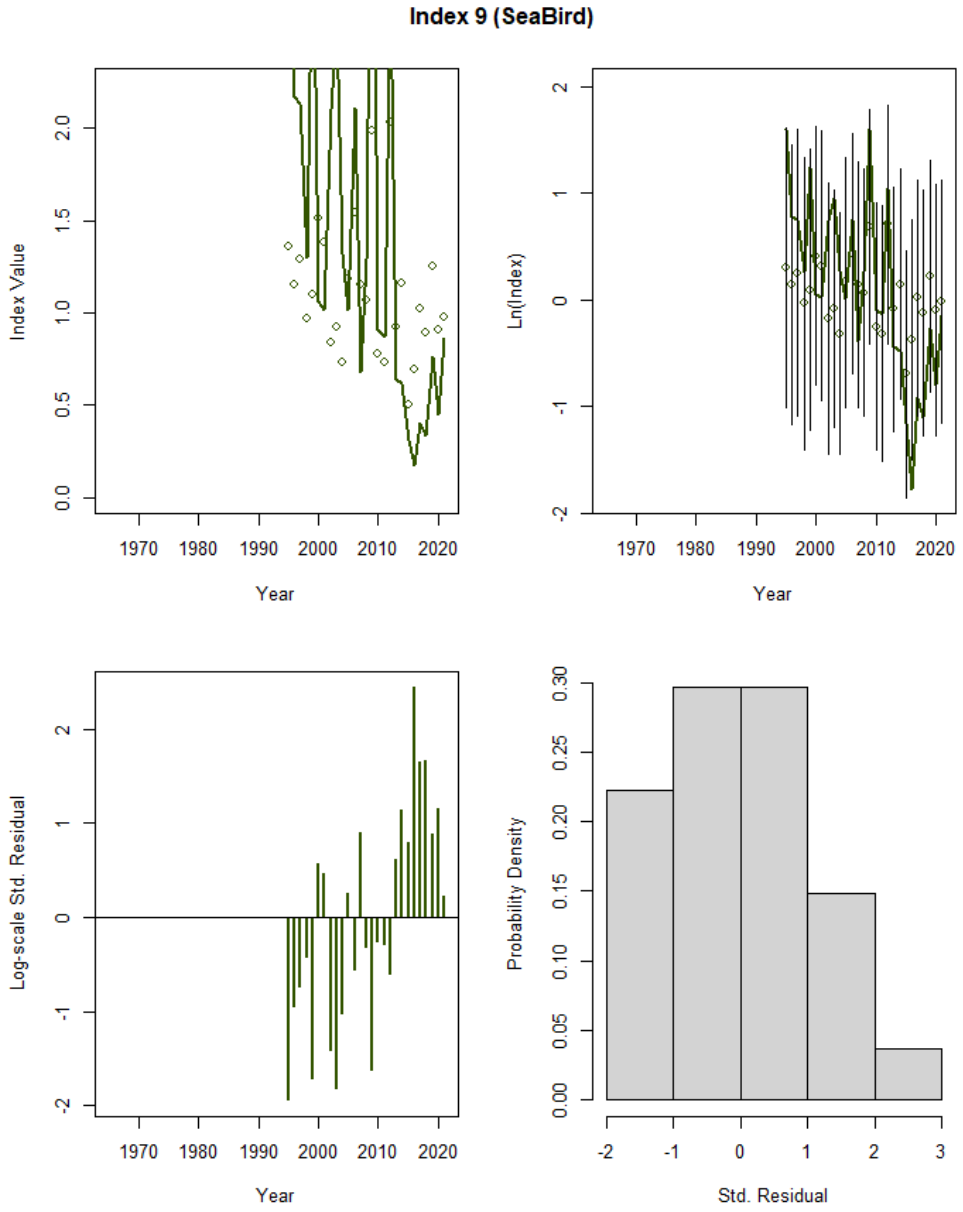


TOR 3: Estimate…

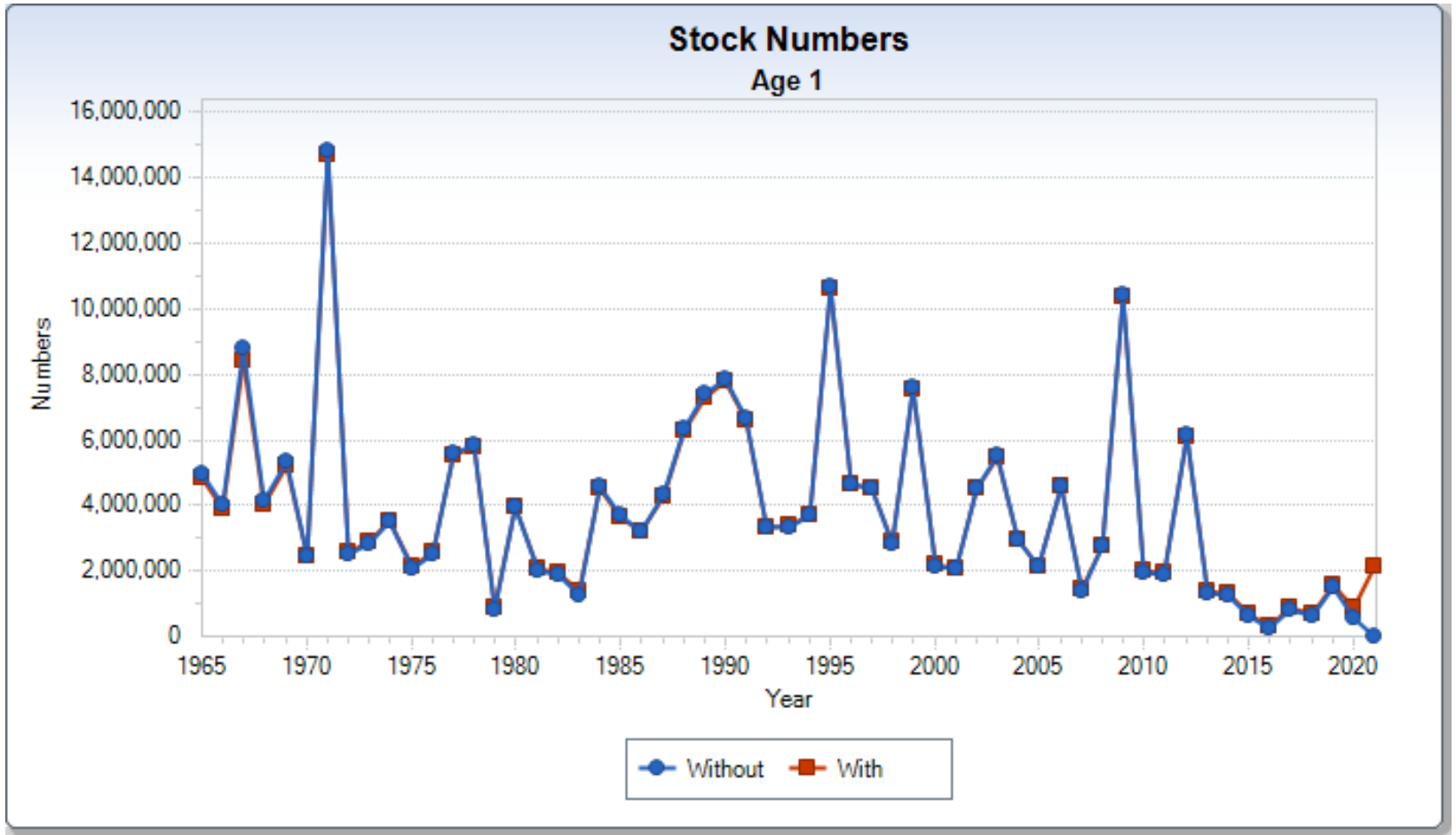
- Adding the index based on seabird diet data resolved all the high CV, correlations, and gradient issues
- But, the model did not fit the index very well, especially at high and low recruitments
- I suspect some non-linearity between index and recruitment, possibly fixable
- Received this data in early May and I do not understand it well
- I do not understand seabird feeding habits well, either
- Would fill a data gap and worth more consideration (2025 RT maybe)
- Thanks to Sean Hardison, Don Lyons, Heather Major, Linda Welch, Lauren Scopel, Paula Shannon, and others
- A formal data sharing agreement would help in the future

TOR 3: Estimate…

- This model formulation represents a completed update, but it blew up!
- 70 parameters with CV > 0.5, median = 27, max = 7.1E+79
- 1,654 parameter pairs with correlation near 1 or -1
- Relatively large gradient (0.006)
- Explored two solutions:
  - Derive a recruitment index from seabird diet data
  - Penalize recruitment deviations for deviating from the median
    - Used a penalty with CV = 1 each year; common in the region
    - Resolved the CV, correlation, and gradient issues

TOR 3: Estimate…

- Compare with and without the likelihood penalty on recruitment
- SSB and F nearly indistinguishable



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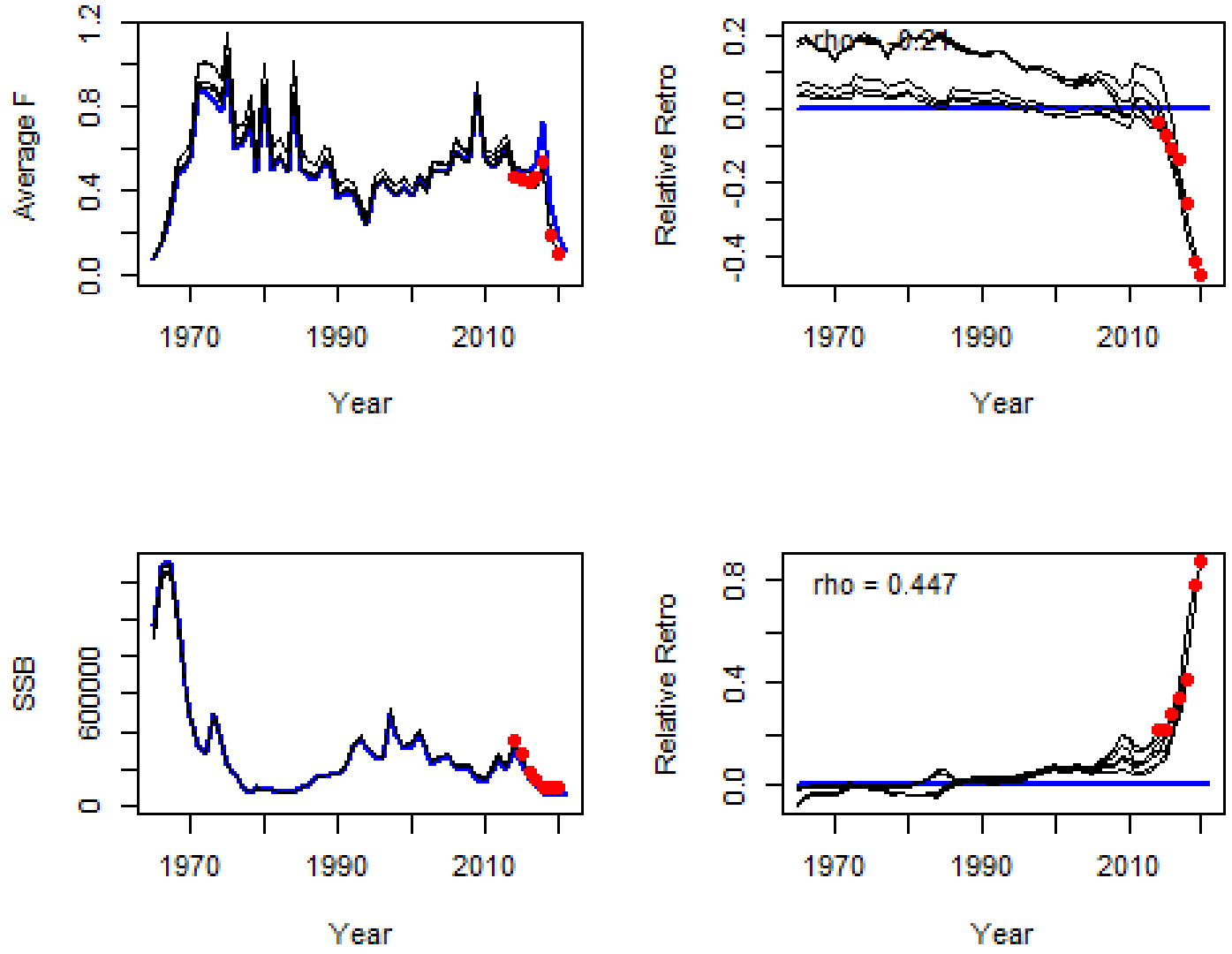

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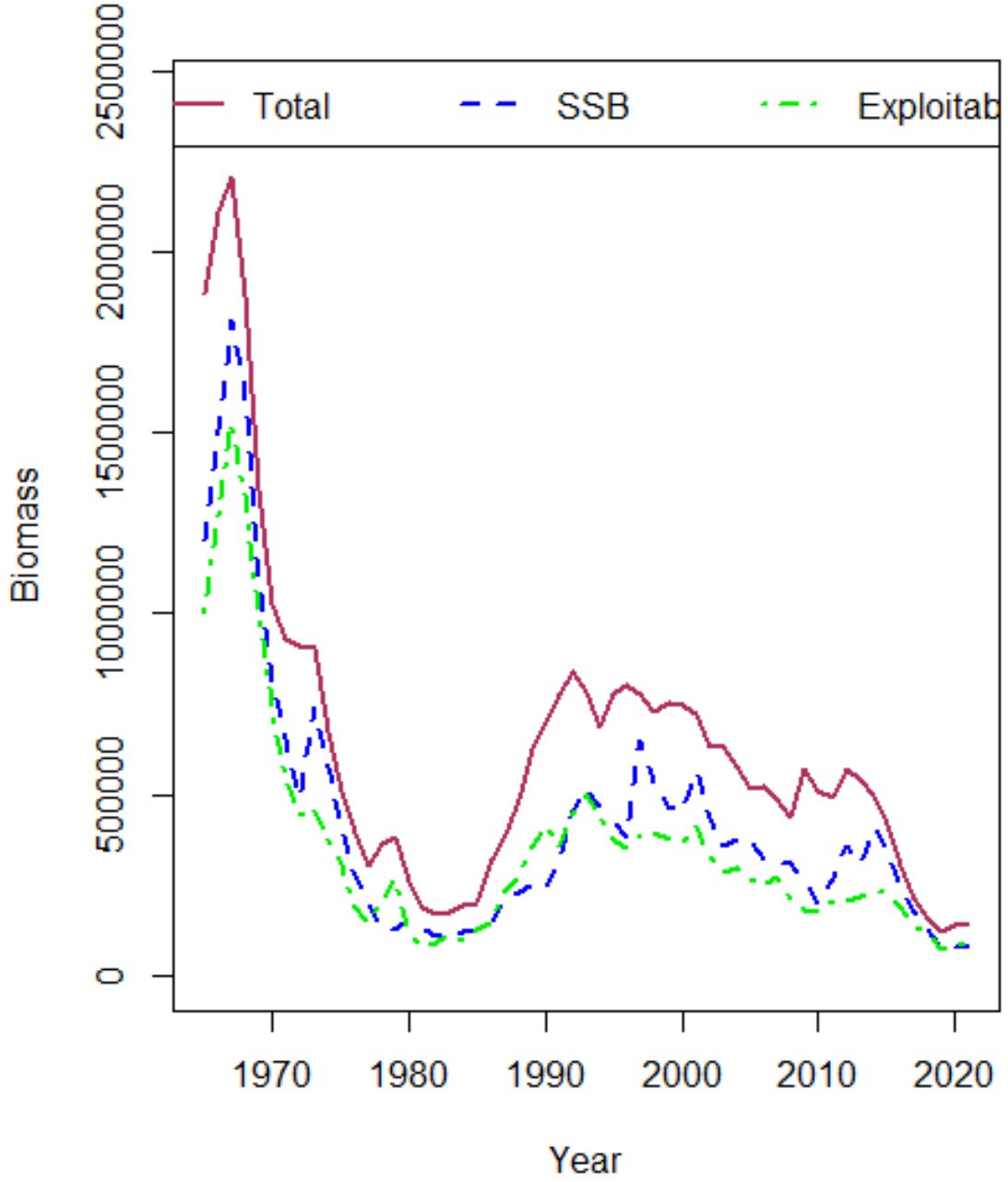

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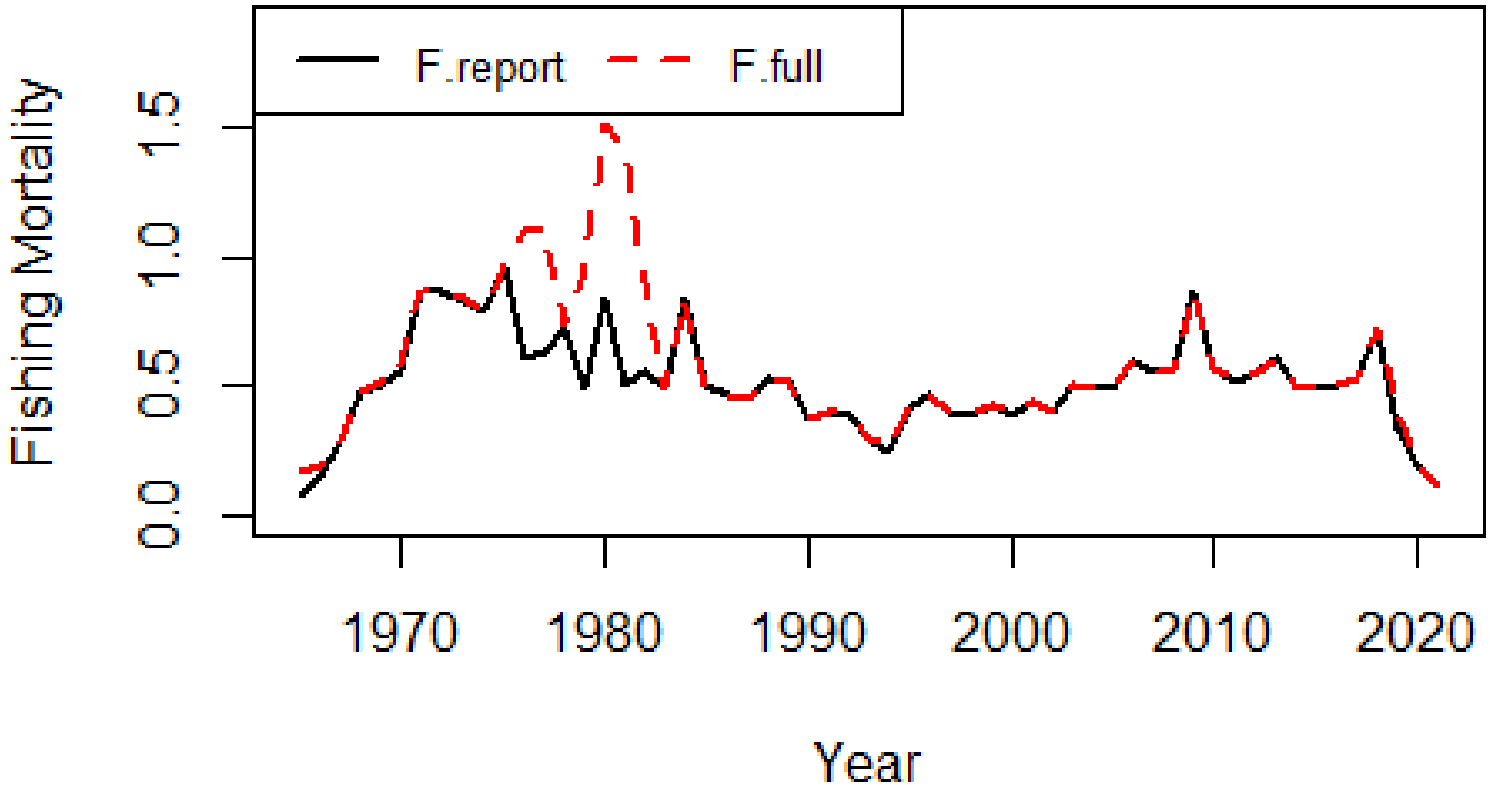

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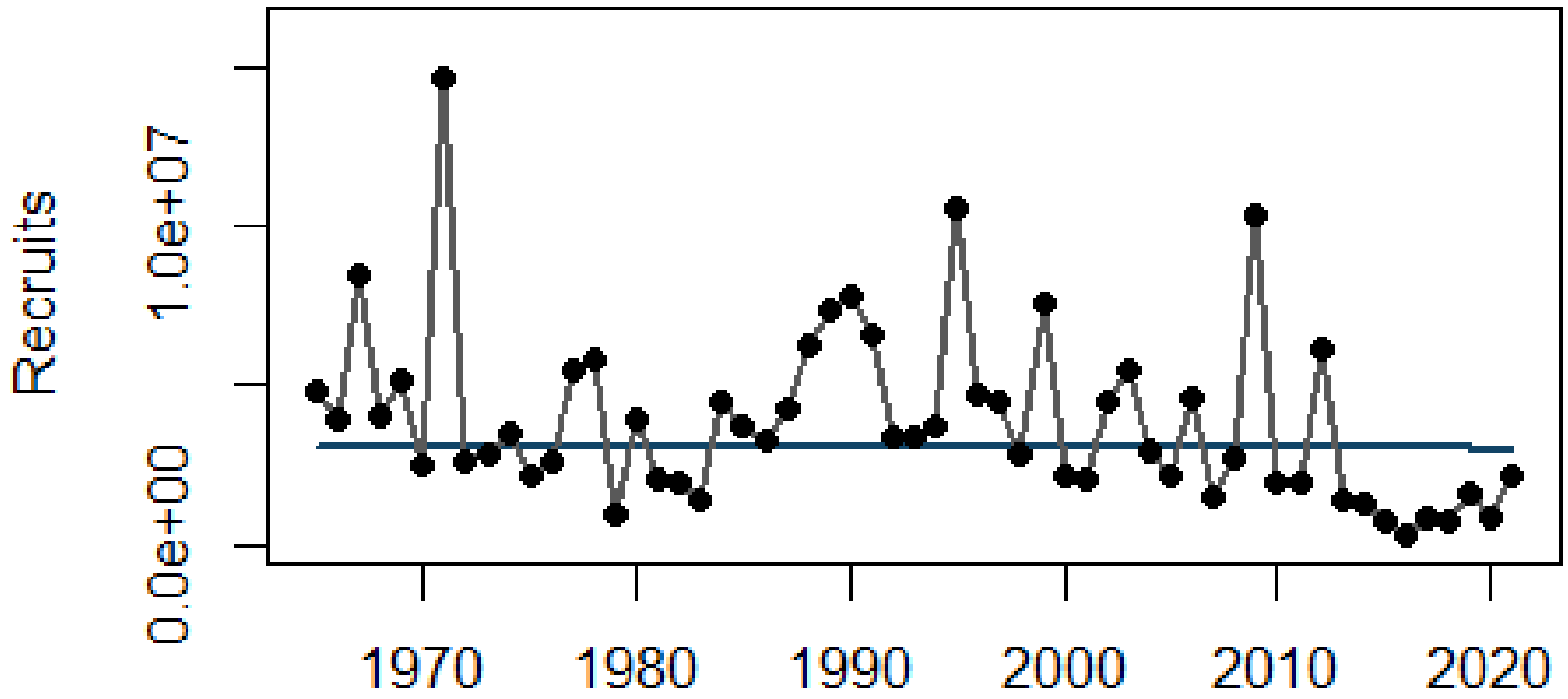

TOR 4: BRPs

- Previous/existing methods summary
  - Life history traits (e.g., weights-at-age) based on 5 year average
  - Selectivity equals that from the mobile fleet (US fleet)
  - F40% as proxy Fmsy and long term projections for SSB proxy
  - Recruitment sampled from empirical CDF using the entire times series except most recent two years due to high imprecision
  - Fixed gear F = 0 when calculating BRPs
- Propose accounting for fixed F in BRPs, as recommended
  - Fully selected fixed gear fleet F = 10 year average (0.13)

TOR 4: BRPs

- 2020 BRPs: F40% = 0.54, SSBproxy = 269,000mt
- Update as in 2020: F40% = 0.5, SSBproxy = 266,140mt
- Add fixed fleet F: F40% = 0.5, SSBproxy = 219,500mt

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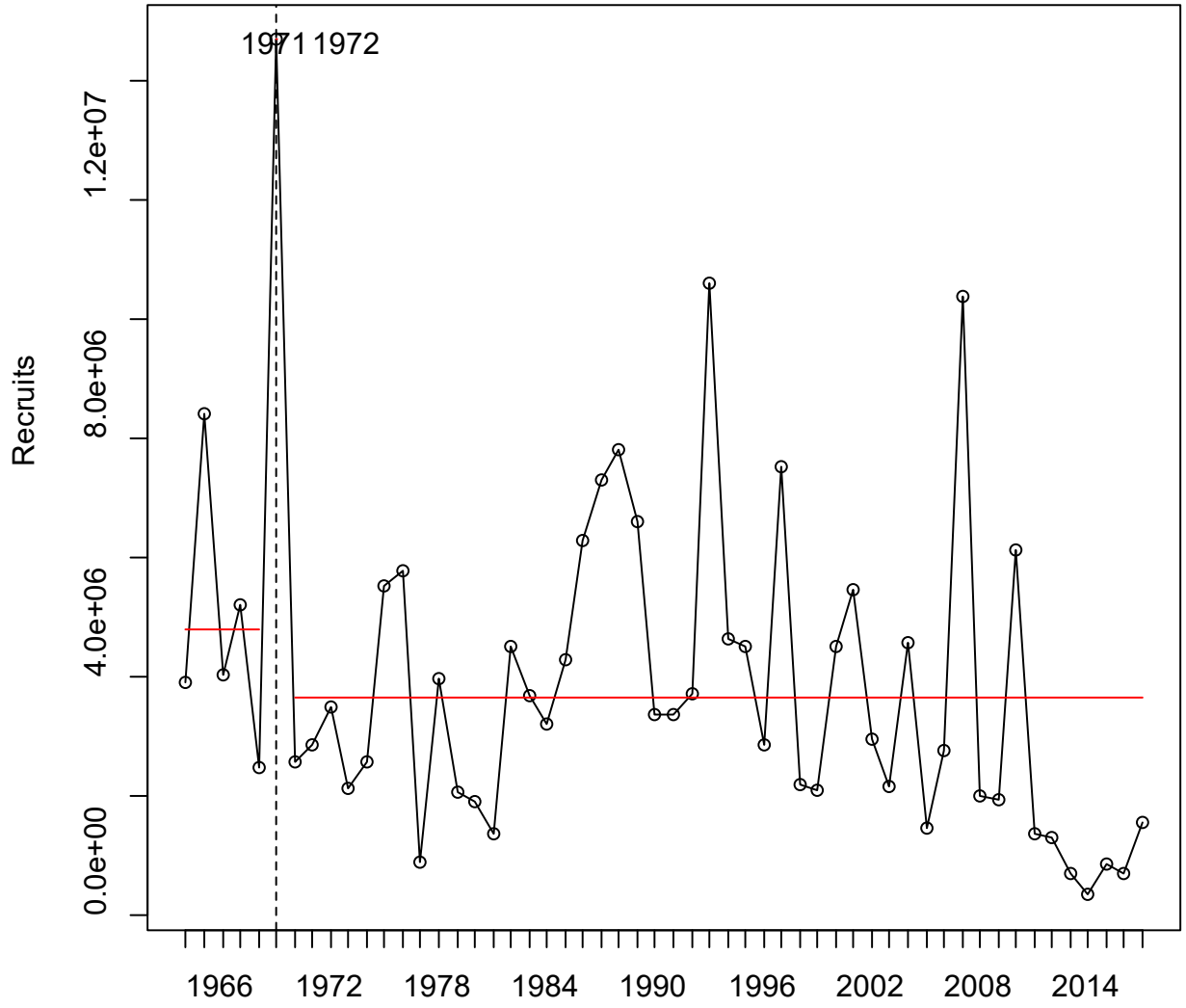
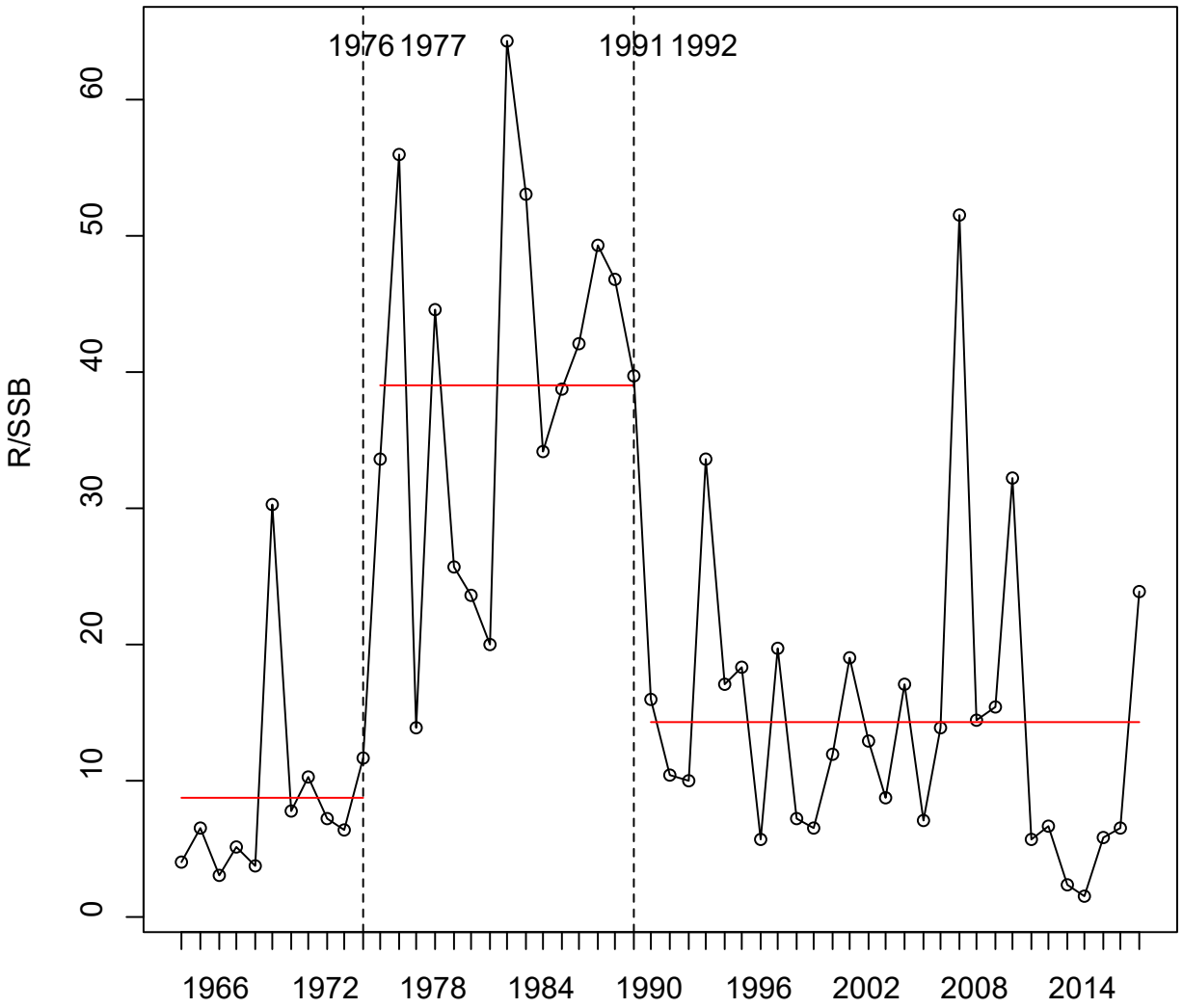
  - Life history traits (e.g., weights-at-age) based on 5 year average
  - Selectivity equals that from the mobile fleet (US fleet)
  - F40% as proxy Fmsy and long term projections for SSB proxy
  - Recruitment sampled from empirical CDF using the entire times series except most recent two years due to high imprecision
  - Fixed gear F = 0 when calculating BRPs
- Propose accounting for fixed F in BRPs, as recommended
  - Fully selected fixed gear fleet F = 10 year average (0.13)
- Reconsider recruitment stanza to use
  - Unprecedented string of poor recruitments makes use of full time series indefensible
  - Possible alternatives
    - Just use all the poor recruitments, 2013-2019
    - Try to disentangle environment and SSB effects to find a middle ground

TOR 4: BRPs

- Conduct a change point analysis (Killick and Eckley 2014) on the recruitment and recruit/spawner time series
- All analyses applied to estimates from 1965-2019 (exclude last two years)
- Number of change points limited to 3 so that each “block” would contain 2-3 generations

TOR 4: BRPs


Recruits
1971 1972
0.0e+00
4.0e+06
8.0e+06
1.2e+07
1966
1972
1978
1984
1990
1996
2002
2008
2014

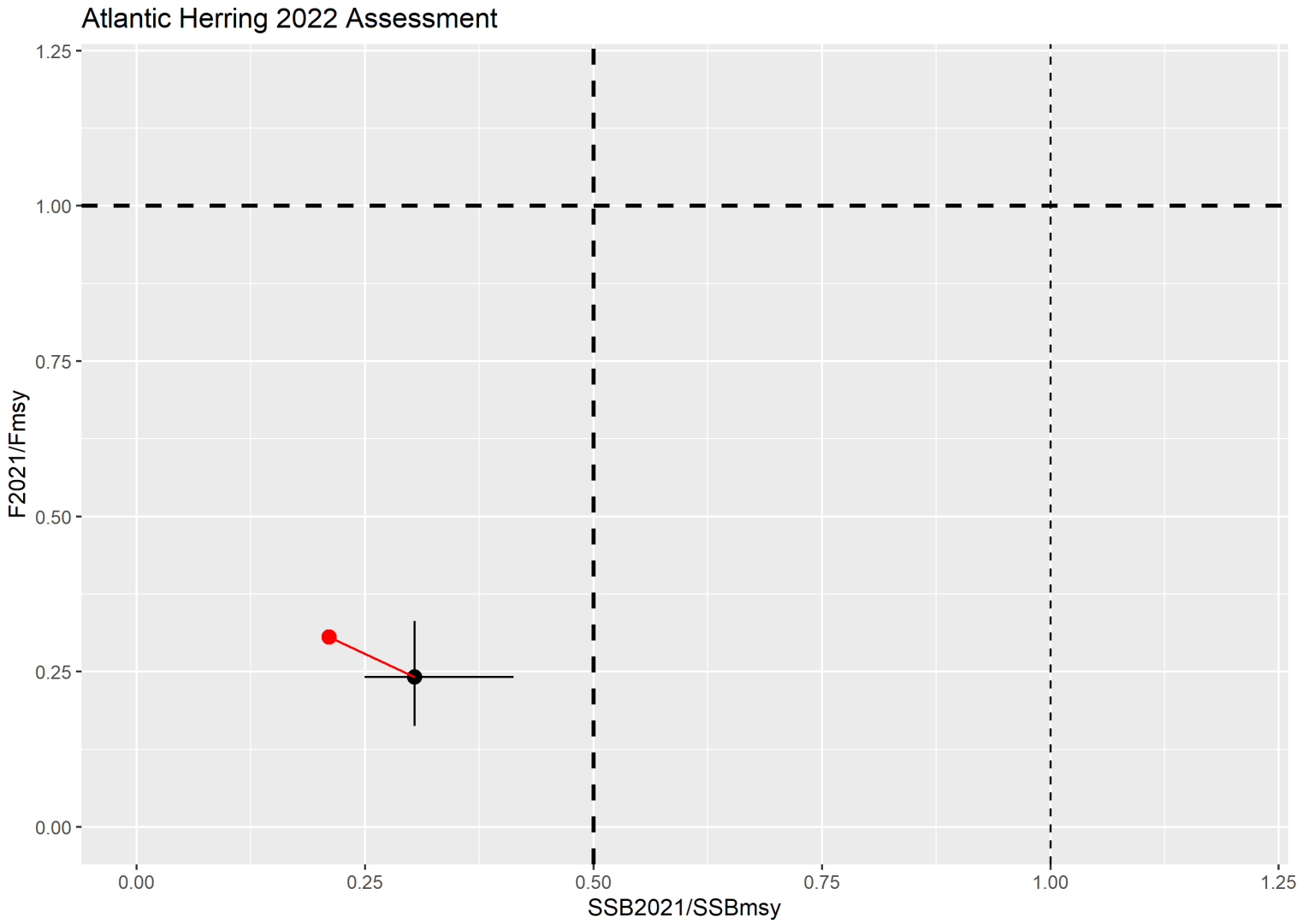

R/SSB
1976 1977
1991 1992
0
10
20
30
40
50
60
1966
1972
1978
1984
1990
1996
2002
2008
2014

TOR 4: BRPs

- 2020 BRPs: F40% = 0.54, SSBproxy = 269,000mt
- Update as in 2020: F40% = 0.5, SSBproxy = 266,140mt
- Add fixed fleet F: F40% = 0.5, SSBproxy = 219,500mt
- Use stanza 1992-2019: F40% = 0.5, SSBproxy = 185,750mt

TOR 4: BRPs

- The stock is overfished; overfishing is not occurring



TOR 5: Short-term projections

- Previous/existing methods summary
  - Fixed gear catches equal in all years and based on 10 year average
  - Mobile fleet F based on NEFMC selected harvest control rule
  - Recruitments drawn from empirical CDF of entire time series
- As with BRPs, random draws from the entire recruitment time series indefensible
  - Solution
    - Estimate an autoregressive model (AR(1))

TOR 5: Short-term projections

- Previous/existing methods summary
  - Fixed gear catches equal in all years and based on 10 year average
  - Mobile fleet F based on NEFMC selected harvest control rule
  - Recruitments drawn from empirical CDF of entire time series
- As with BRPs, random draws from the entire recruitment time series indefensible
  - Solution: Estimate an autoregressive model (AR(1))
  - AR parameters estimated using arima package in R using 1992-2019 estimates
  - Initialized at rho-adjusted 2021 recruitment estimate (1,483,061)

$$R_t = e^{\mu_{\log(\hat{R})}+\epsilon_t}$$

$$\epsilon_t = \rho\epsilon_{t-1} + \omega_t$$

$$\omega_t \sim N(0, \sigma_\omega^2)$$

$$\sigma_\omega^2 = (1-\rho^2)\sigma_{\log(\hat{R})}^2$$

$$\hat{\epsilon}_t = \log(\hat{R}_t) - \mu_{\log(\hat{R})}$$

$\mu_{\log(\hat{R})}$=14.76

$\sigma^2_{\log(\hat{R})}$=0.679

$\rho = 0.484$

$\hat{\epsilon}_{t=2021} = -0.543$

TOR 5: Short-term projections

No changes to methods used for BRPs or short-term projections

Canadian Catch= 4220 US Fixed= 18

	Mobile Fleet F	SSB	P(overfishing)	P(overfished)	OFL	ABC	SSB/SSBmsy	P(rebuild)
2022	0.097	61644	0.000	1.000	–	–	0.232	0.000
2023	0.132	83095	0.000	0.892	29155	11498	0.312	0.005
2024	0.212	85788	0.001	0.854	35216	18389	0.322	0.008
2025	0.222	148607	0.023	0.391	52519	27154	0.558	0.076

BRPs using change point time frame and AR(1) recruitment

Canadian Catch= 4220 US Fixed= 18

	Mobile Fleet F	SSB	P(overfishing)	P(overfished)	OFL	ABC	SSB/SSBmsy	P(rebuild)
2022	0.097	61645	0.000	0.989	–	–	0.332	0.000
2023	0.232	79231	0.000	0.677	29138	16649	0.427	0.025
2024	0.327	76795	0.109	0.683	32233	23409	0.413	0.033
2025	0.313	103645	0.167	0.397	40727	28181	0.558	0.105

TOR 6: Research

Recommended in 2020

- Account for fixed gear mortality when calculating reference points
  - Done

Recommended by SSC members during development of rebuilding plan

- Refine and consider AR models for short-term projections
  - Done

TOR 6: Research

Those listed as "high" priority research areas in 2018

- Further research on the use of acoustic technology for inclusion in stock assessment, including information using industry based platforms
  - No progress
- Evaluate data collected in study fleet program for informing assessment data. Development research ideas that can be addressed within the context of the study fleet
  - Herring depth preference (ongoing)
- Evaluate the ability of state-space models to reliably estimate observation and process error variances under a range of scenarios, as well as their ability to estimate quantities of management interest
  - Several local, national, and international projects

Review Panel Feedback

- Stock assessment was accepted
- Recommended:
  - Some simple data suggestions (e.g., continued otolith collections in summer survey)
  - Explorations as to why missing 2020 survey data was so impactful
  - Exploring mechanistic relationships to explain recruitment and recruit per spawner trends
  - Continued consideration of dynamic reference points
  - Continued work on use of seabird diet data

Questions?

Portside Biological and Bycatch Sampling for Atlantic herring: Past, Present, and Future

Matt Cieri: Maine DMR

History

- ME DMR has been sampling Atlantic herring since the 1960s
  - Back when ME DMR Boothbay facility was a federal lab and sampling was done at canneries!
  - Sampling generally takes place portside
- ACCSP support since 2001
  - Expanded to mackerel and bycatch in 2004
  - Expanded to menhaden in 2010
- Since 2016 cost has been $23k-$26k
- Four main data products

Biological sampling

- Based on VMS Pre-landings
- Range from NJ to Canadian border
- Collect 50-fish samples: generally frozen
- Two samples per gear type, per statistical area, per bi-weekly period: all year
- Approximately one sample per 200 – 350 mt
- Samples brought back to the lab for later analysis
- Data are housed at DMR and used as input to the assessment (more later)

Spawning sampling

- Based on VMS Pre-landings
- Generally Aug to Nov
- Within the State of Maine
  - Sometimes NH and Mass
- 100 adult-sized fish: fresh sample
- Two samples per spawning closure area per week
- Used to close and re-open ASMFC spawning management areas

Bycatch sampling

- Conducted portside
- Based on VMS Pre-landings
- Range from NJ to Canadian border
- Systematic sub-sampling at timed intervals during off-loading: all year
- Determine bycatch composition
- Used for monitoring River herring and haddock bycatch quotas

Other sampling

- Menhaden
  - For use in the assessment
  - Data and scales forwarded to Beaufort
- Mackerel sampling
  - Data and samples forwarded to NMFS Woods Hole
- Herring genetic samples
- Herring otolith samples
- Spiny dogfish sampling
  - Not currently

Lab Analysis

- Funded by a separate grant (IJ)
- Host of biological information
  - Length & weight
  - Sex
  - Age: including calibration with NOAA and DFO
  - Spawning condition
  - Fecundity
- Primary fishery-dependent data used in the assessment
- Data supports Council and ASMFC management

Results

- DMR Herring project with ACCSP funding provided excellent results
- Low-cost method of biological sampling and bycatch sampling
- Portside bycatch sampling compared well with at-sea observer data
- Use of VMS pre-landings ensured unbiased sampling
- Used by a myriad of projects and monitoring programs

Future

- ACCSP funding ends during 2023
  - At maximum term for ACCSP-funded programs
  - Project ends January 1, 2024
  - Maybe some extra funds left over to last a few months longer
- ME DMR will collect herring biological and spawning samples from Maine landings
  - Collect menhaden samples per the FMP
  - Unable to conduct sampling out of state, conduct portside bycatch sampling, or mackerel sampling

Future

- DMR will still process any samples it receives from other states
  - Age, weight, length, etc. and provide those to NOAA for the assessment
  - Funded by another grant
- About 50% of coastwide catch is landed in ME
- **Likely to result in Herring being undersampled which may impact the assessment**
- Particularly in Herring Areas 2 & 3

Thank you

I would be happy to answer any questions

New England Fishery Management Council
Atlantic Herring Update

Dr. Jamie Cournane, Council Staff

Atlantic States Marine Fisheries Commission
Atlantic Herring Management Board
August 2, 2022

New England
Fishery Management Council

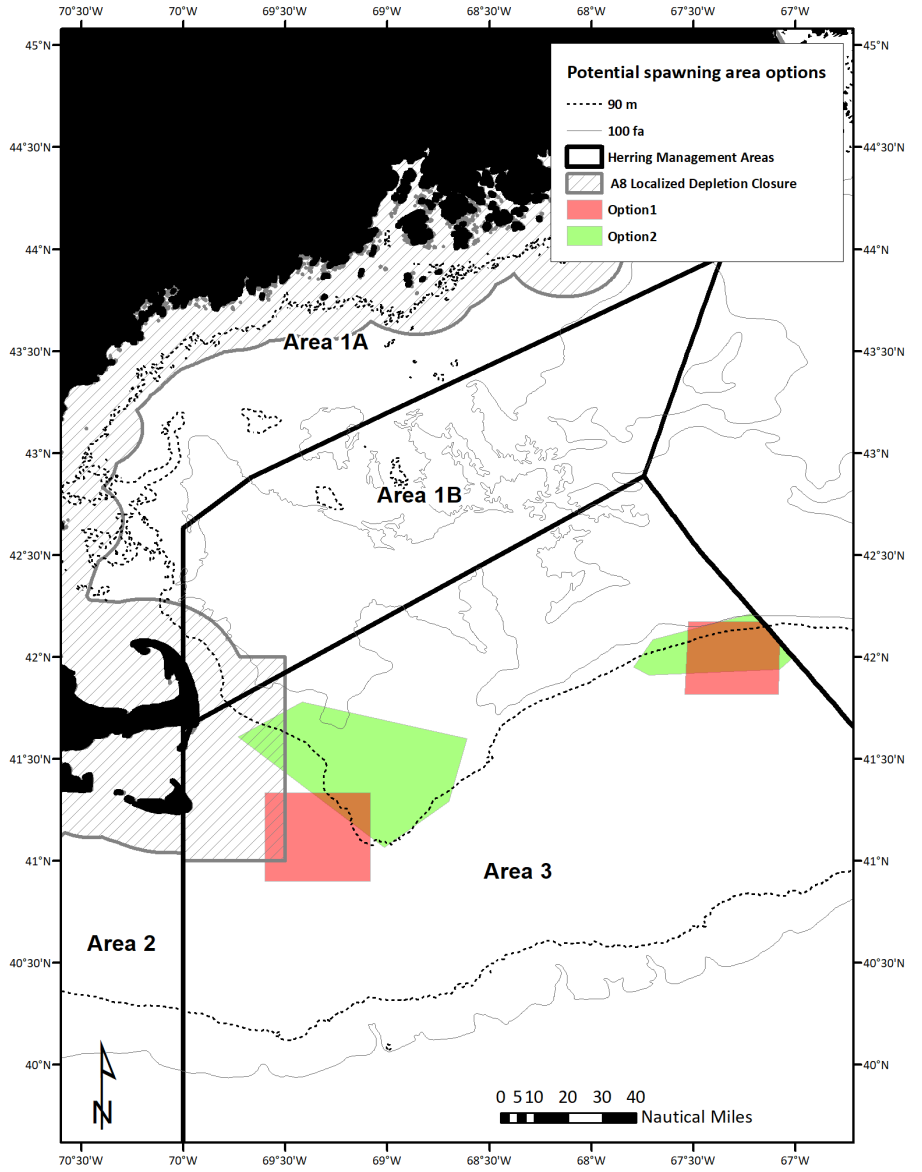
Framework Adjustment 9

Effective date is August 18, 2022

- Establishes a rebuilding plan for Atlantic herring based on the Council's ABC Control Rule.
  - Rebuilding projections indicated herring can rebuild in 5 years (by fishing year 2026) under this rebuilding plan, assuming long-term average recruitment.
  - The Council's herring ABC control rule is biomass-based :
    - When biomass is greater than 0.5 for the ratio of SSB/SSBMSY, the maximum fishing mortality allowed is 80% of FMSY.
    - As biomass declines, fishing mortality declines linearly, and if biomass falls below 0.1 for the ratio of SSB/SSBMSY, then ABC is set to zero, no fishery allocation.
  - The rebuilding plan continues to use the ABC control rule that is currently used to set herring specifications.
- Adjusts accountability measure catch threshold triggers so that an overage of a management area sub-ACL in one fishing year (Year 1) will only be deducted in a subsequent fishing year (Year 3) if the overage exceeds 10 percent of the sub-ACL; and/or if the ACL is also exceeded in the same year.

Framework Adjustment 7

2019	• Contract to review A. herring spawning on Georges Bank. Sept: action initiated to protect spawning herring in Areas 1B, 2, 3. Ideas for alternatives floated, not approved.
2020	• April: set goal and objective – protect spawning adults and egg mats, considering measures like in Area 1A. • June-Dec: develop alternatives (areas, closures, spawning tolerance, program review).
2021	• Feb: develop alternatives (avoidance program). • April: focus action on declared herring vessels and on protecting spawning adults (not egg mats). • June: pause for joint PDT/AP meeting to discuss in-season monitoring of spawning tolerance.
2022	• May: PDT/AP mtg. Many details to develop still. PDT: difficult to monitor and enforce. AP supports incentive to avoid spawning herring. • June: Committee passed no motions. Tabled motion to stop action. Council postponed further work over the summer.



2023-2025 Specifications

Action expected to set:

1. Overfishing limit, acceptable biological catch (ABC) using ABC control and rebuilding plan
2. Management uncertainty, annual catch limit (ACL), management area sub-ACLs, river herring and shad catch caps, and other components

Timeline:

June 27-29	Atlantic herring Management Track assessment peer review	Webinar
July 7 & 15	Plan Development Team develops ABC recommendation	Webinars
Aug 4	Scientific and Statistical Committee recommends OFLs and ABCs	Webinar
September 23	Advisory Panel and Committee review analysis (supplemental information report), recommend preferred alternatives	Webinar
September 27-29	Council final action	In-Person & Webinar Gloucester, MA

Industry Funded Monitoring

- IFM Year 2022 outlook
  - NMFS has funding to administer program, conduct video review.
  - Funding to help offset industry costs expiring September 2022.
  - Observer training ongoing, expect to be ready for trips.
- IFM Year 2023 outlook
  - No funding has been identified to administer program.
  - IFM only operates if federal funds are available to administer.
- In May 2022, AP recommended initiating a framework action to revise the IFM weighting approach for the herring fishery.
- In June 2022, Committee made no motions on IFM. Council took no action.
  - Program will be on hold past April 2023 without federal funds.
  - Required program review in 2023.