



**NOAA
FISHERIES**

**Southeast
Fisheries
Science Center**

Gulf Menhaden Assessment Update

October 5, 2021
Dr. Amy M. Schueller

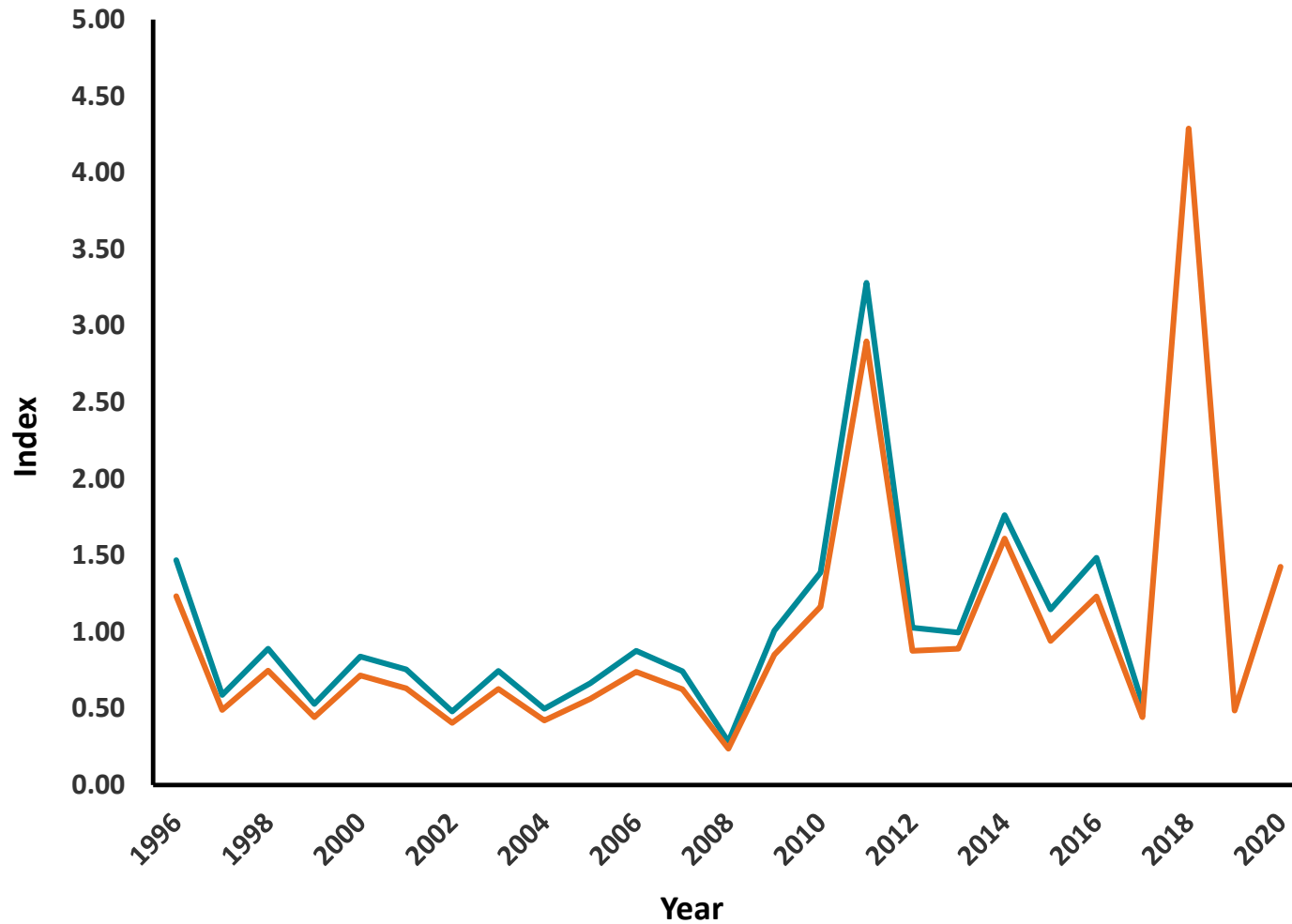
Outline

- Data included in current model
- Model structure
- Results
- Sensitivity analyses and retrospective
- Monte Carlo bootstrap
- Stock status determination
- Research recommendations

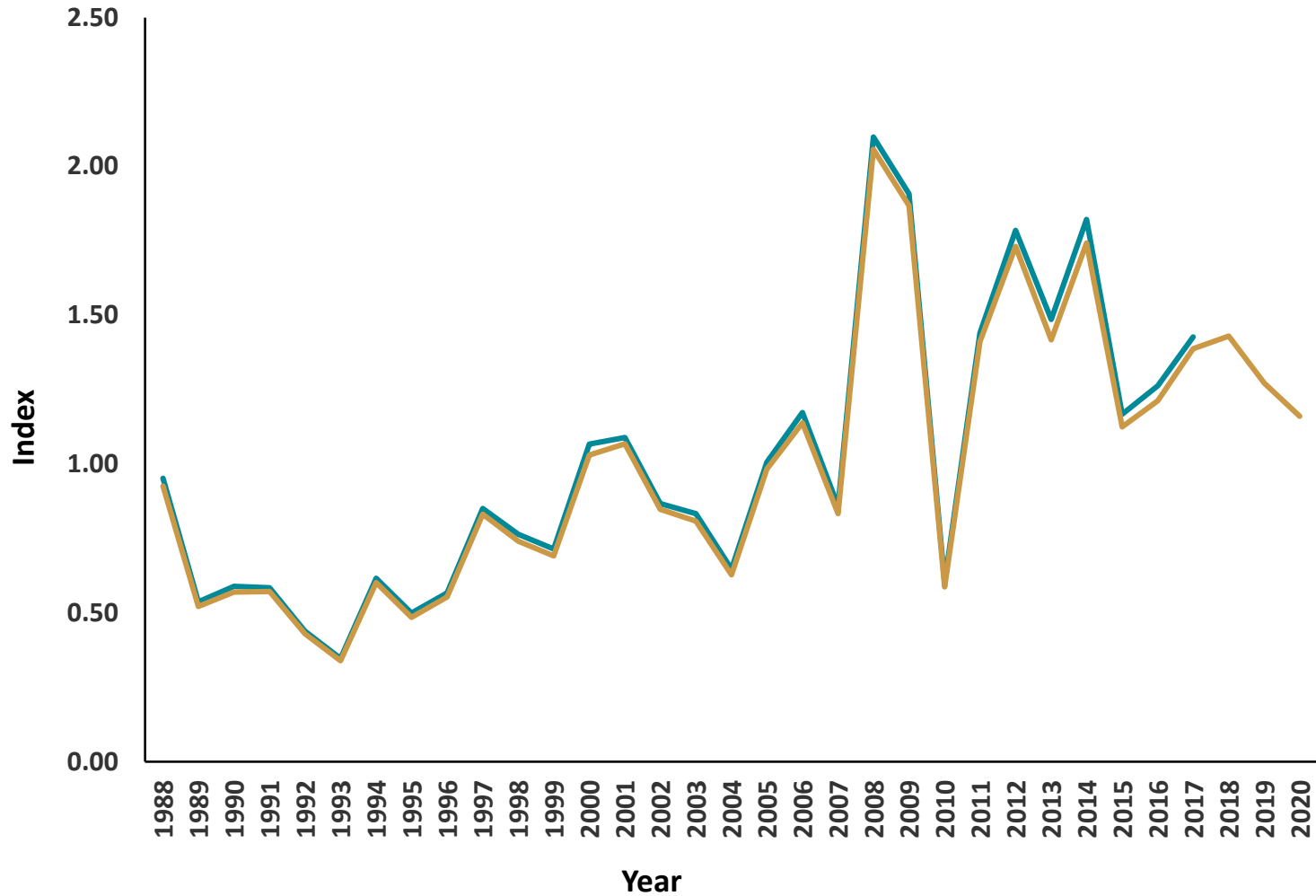
Data included in current model

- Commercial reduction landings [bait and MRIP]
- Commercial reduction age compositions
- 2 indices – LA gill net and seine
- LA gill net length compositions
- Life history information
 - Lorenzen M scaled to tagging data
 - Weights at age for population and fishery
 - Fecundity, maturity, sex ratio

Updated seine index

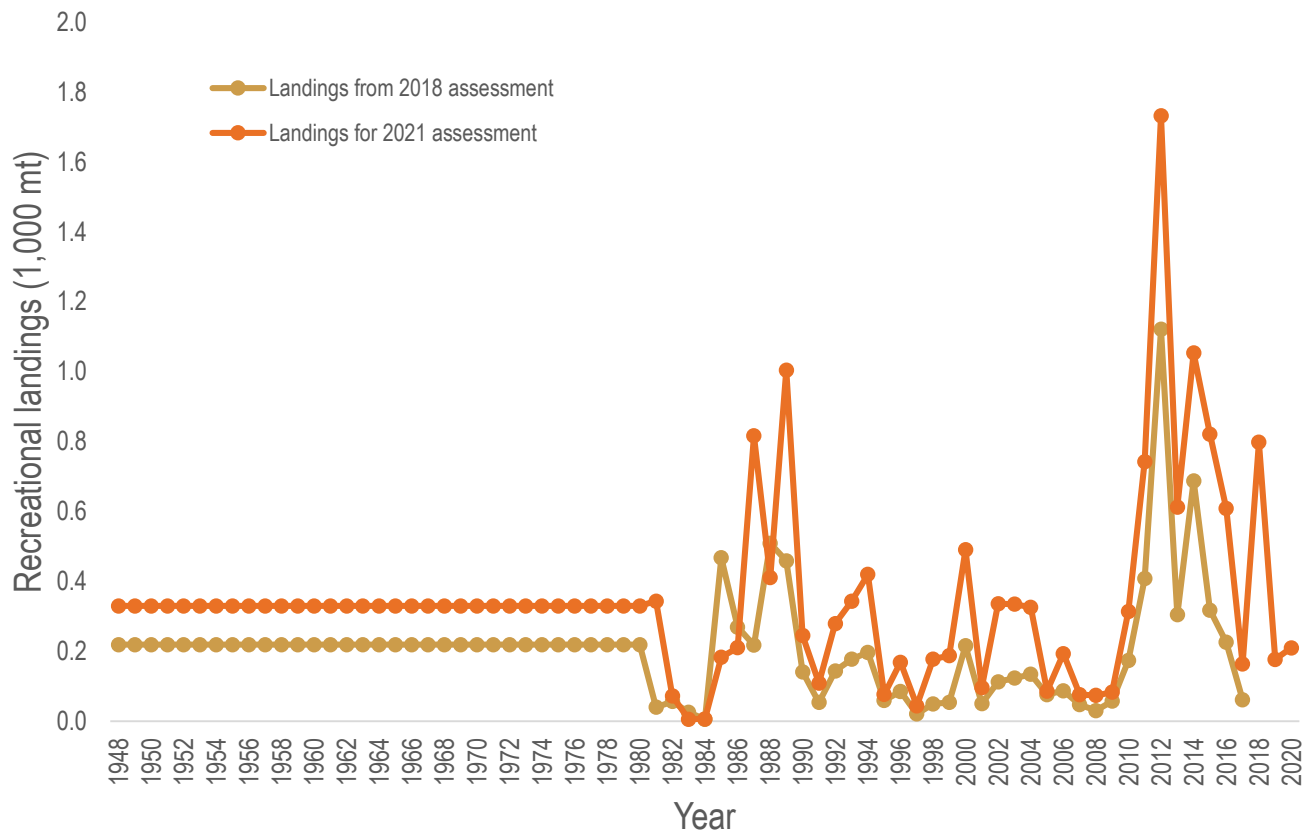


Updated gill net index



Changes to data inputs

- MRIP landings – 2014 to 2018 LA



Model structure

- 1977-2020 (Jan 1 to Dec 31; annual time step)
- Ages 0 to 4+
- Landings data from 1977-2020
 - Age composition data 1977-2020
- LA gill net index 1988-2020 – July 1
 - Length composition data 1996-2020
- Seine (recruitment) index 1996-2020 – April 1

Model structure

- Fixed parameters
 - L_{inf} , K , t_0 – uses 2018 benchmark values
 - Steepness – fixed at 0.99
 - SD of Recruitment in log space (0.6)
 - Some age based selectivity parameters

Model structure

- Estimated parameters
 - CV of length at age
 - Log R_0 (R_0)
 - Dirichlet multinomial likelihood parameters
 - Double logistic fishery selectivity or age based selectivity parameters
 - Logistic LA gill net selectivity
 - Catchability for each index
 - Average F

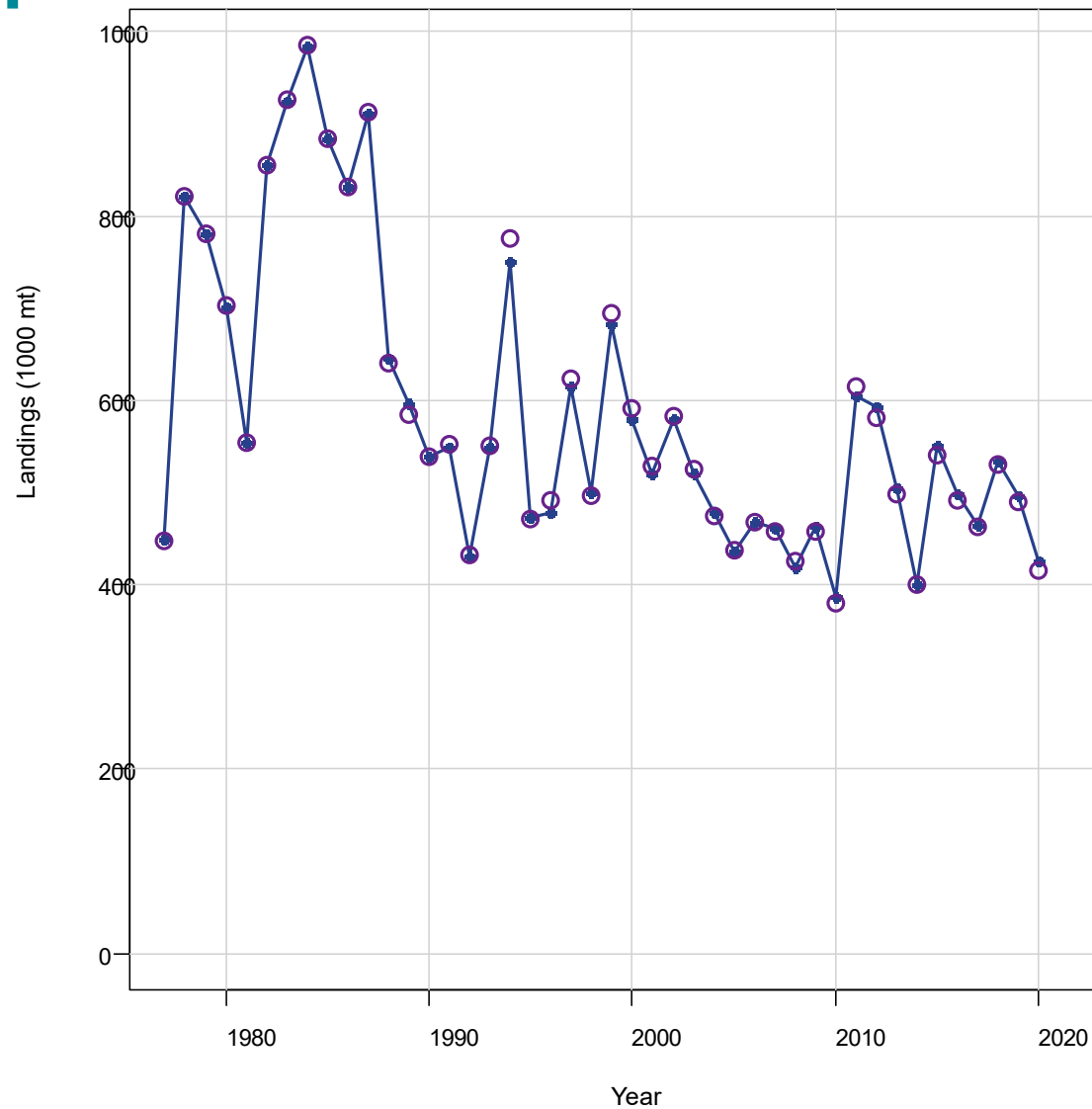
Model structure

- Estimated parameters
 - Annual deviations in F
 - Annual deviations in recruitment
 - Deviations in initial age structure

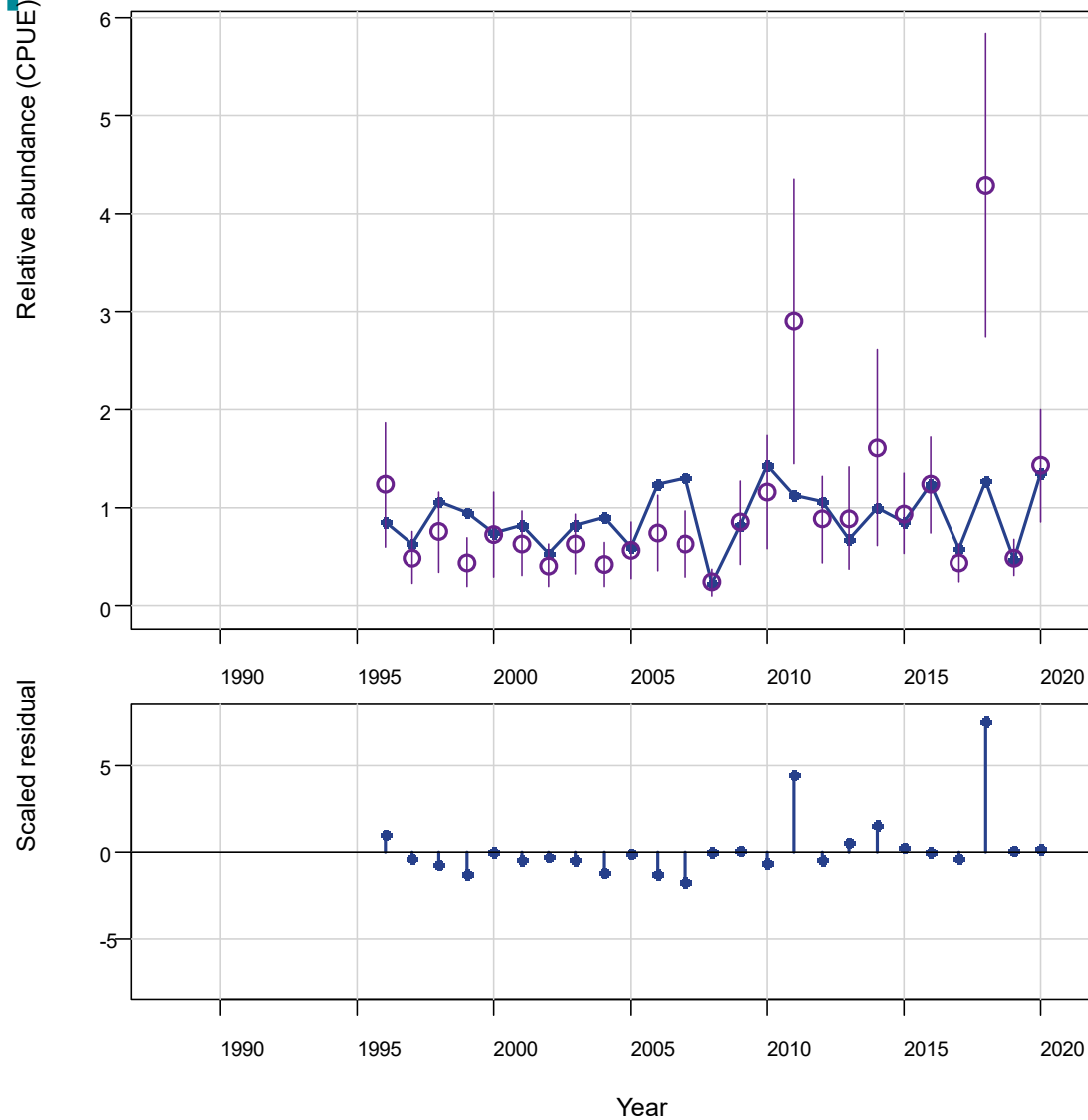
Model structure

- Benchmarks
 - $F=M$; $F=0.75M$
 - Geo mean of ages-0, -1 and -2
 - $F = 1.32$ (threshold/limit) and $F = 0.75*1.32 = 0.99$ (target)
- SSB based metrics (threshold and target)
 - 25% and 50% of the equilibrium value of SSB when $F=0$

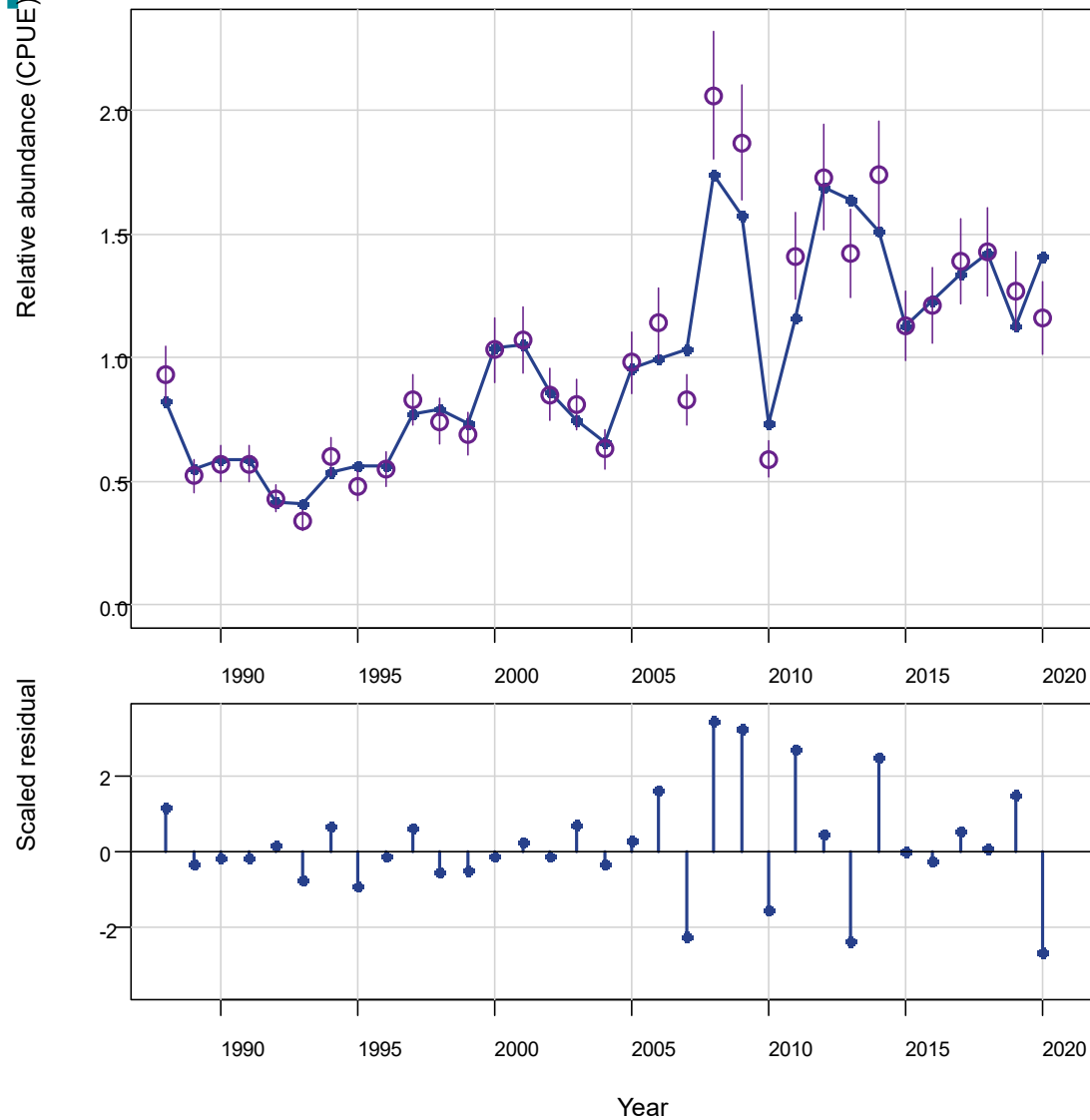
2021 Update assessment



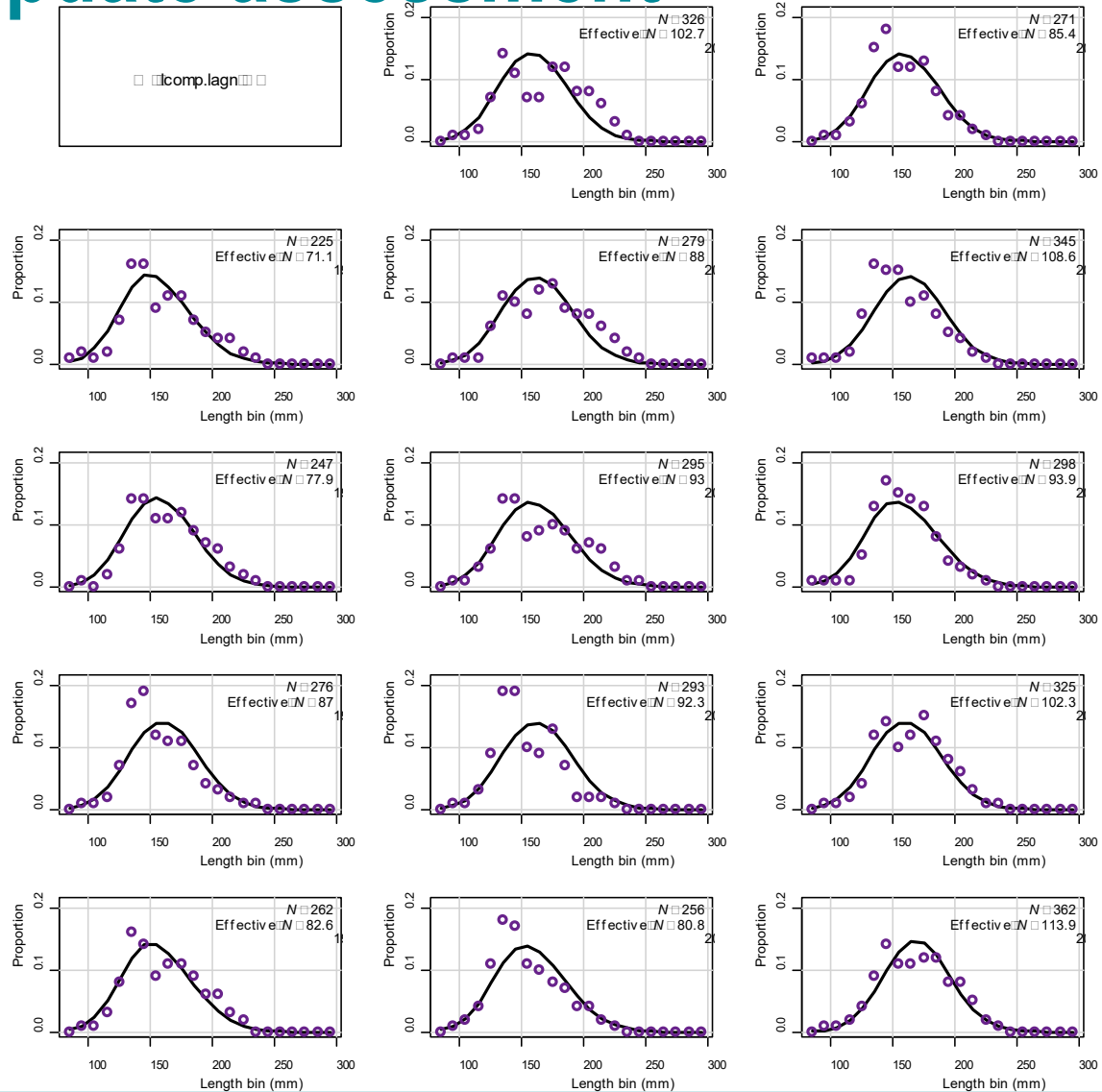
2021 Update assessment



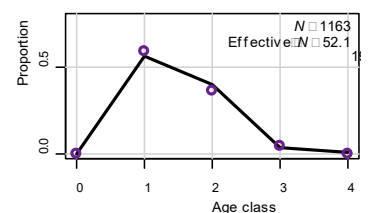
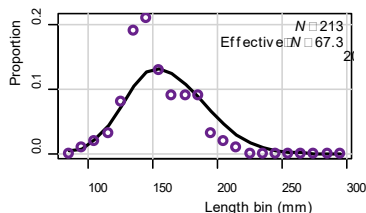
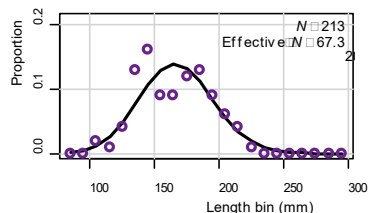
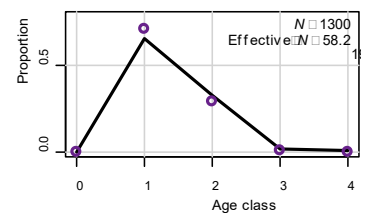
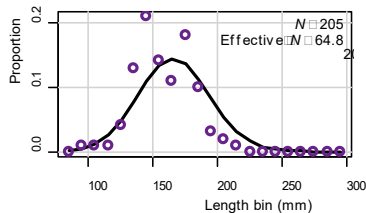
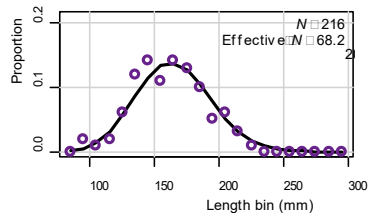
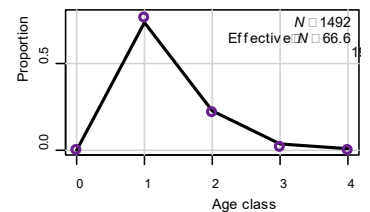
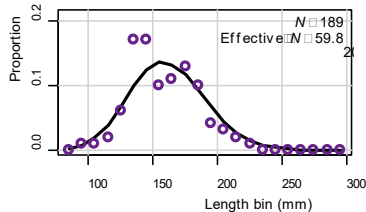
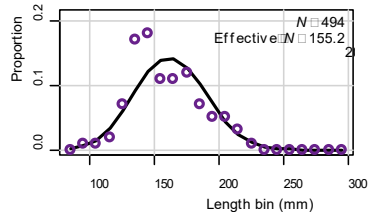
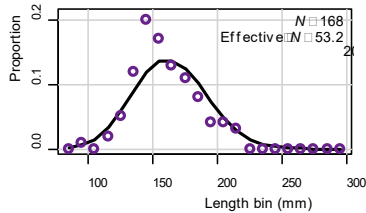
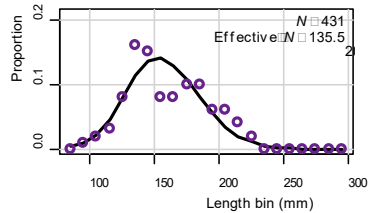
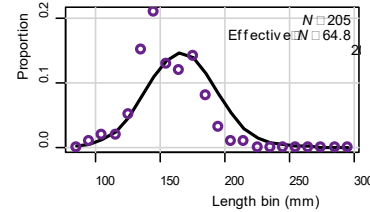
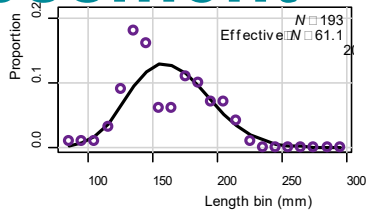
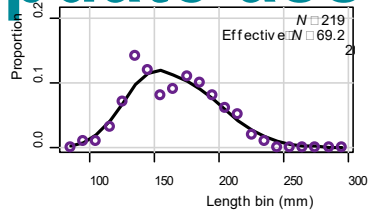
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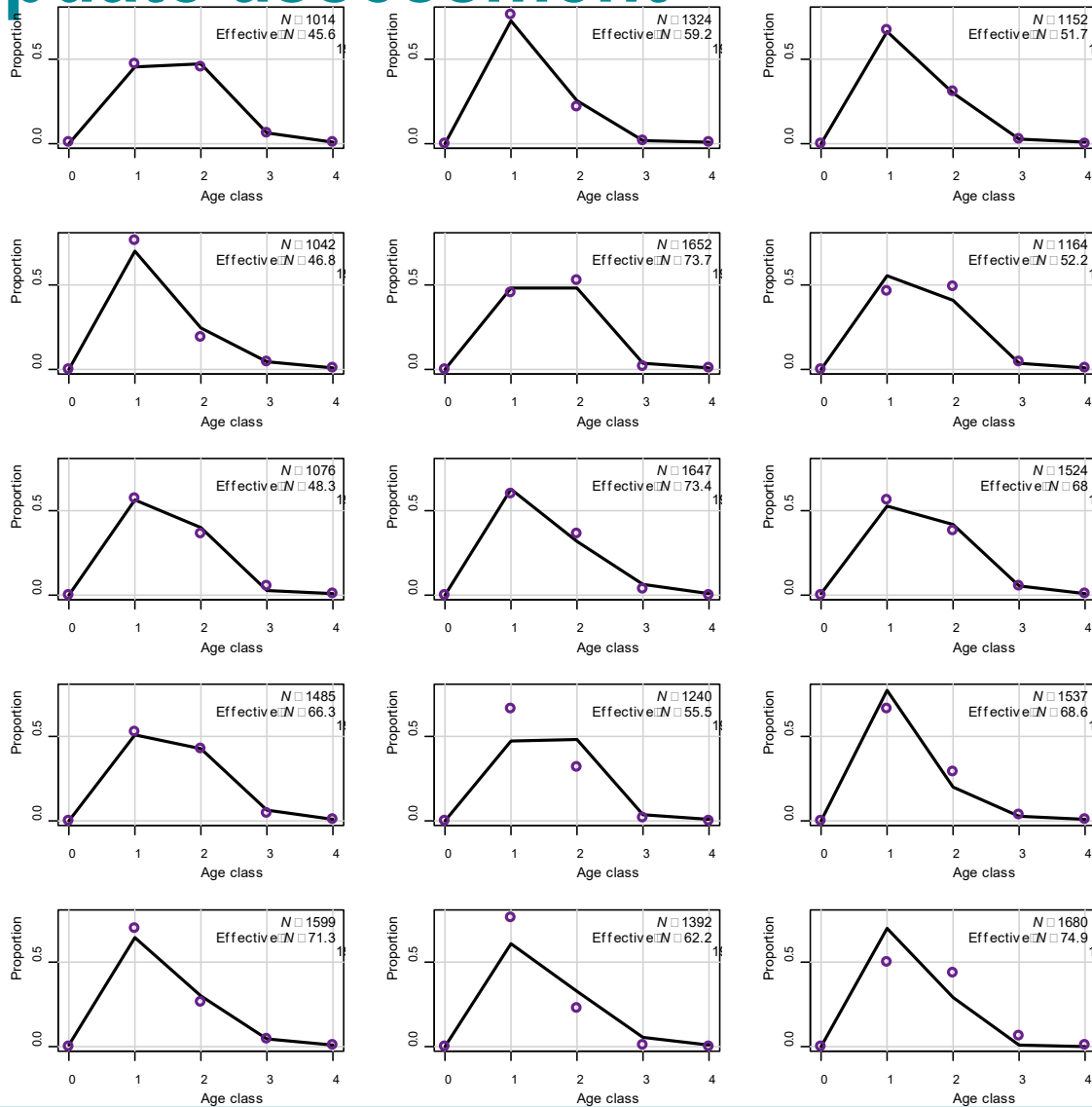
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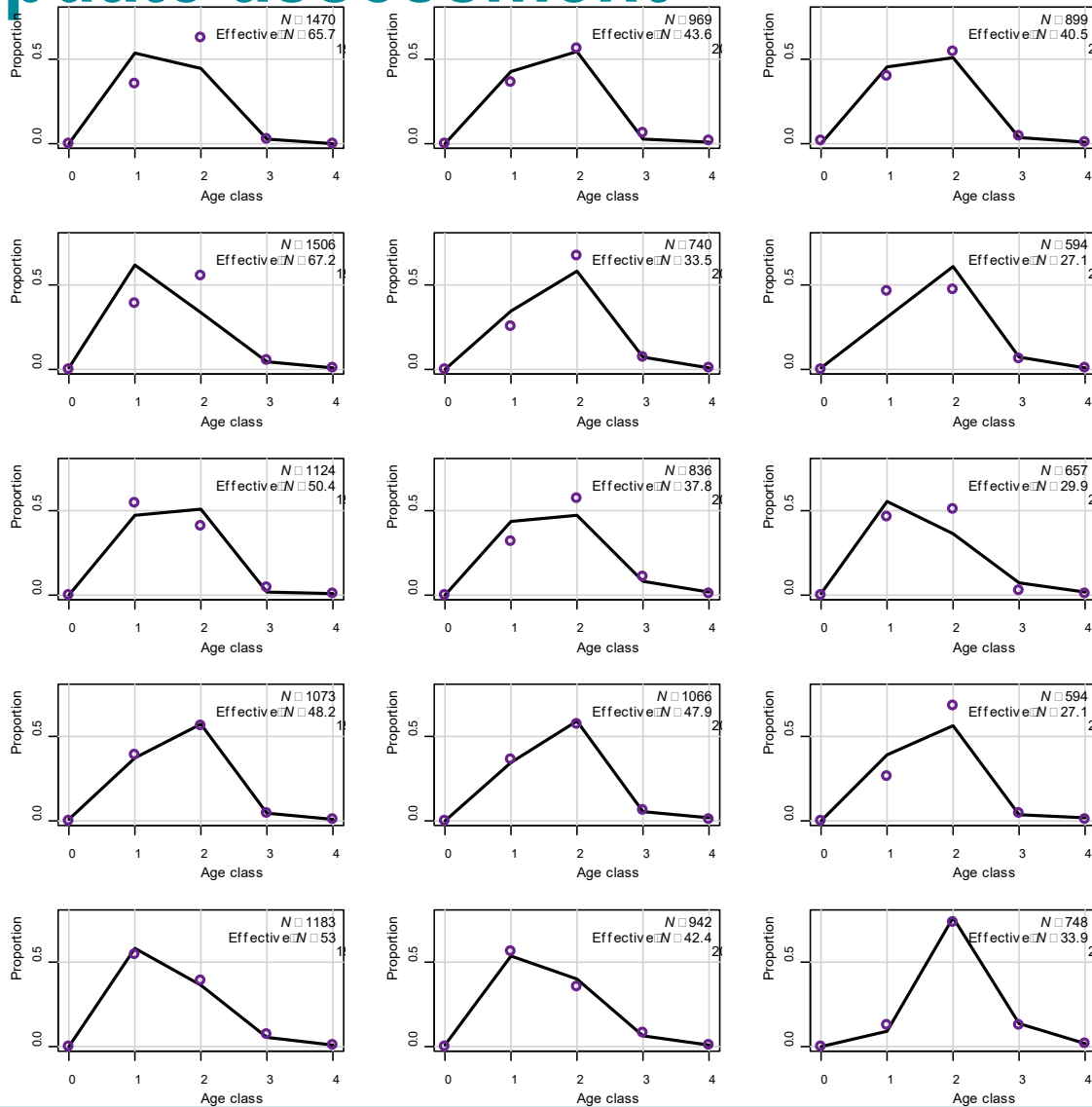
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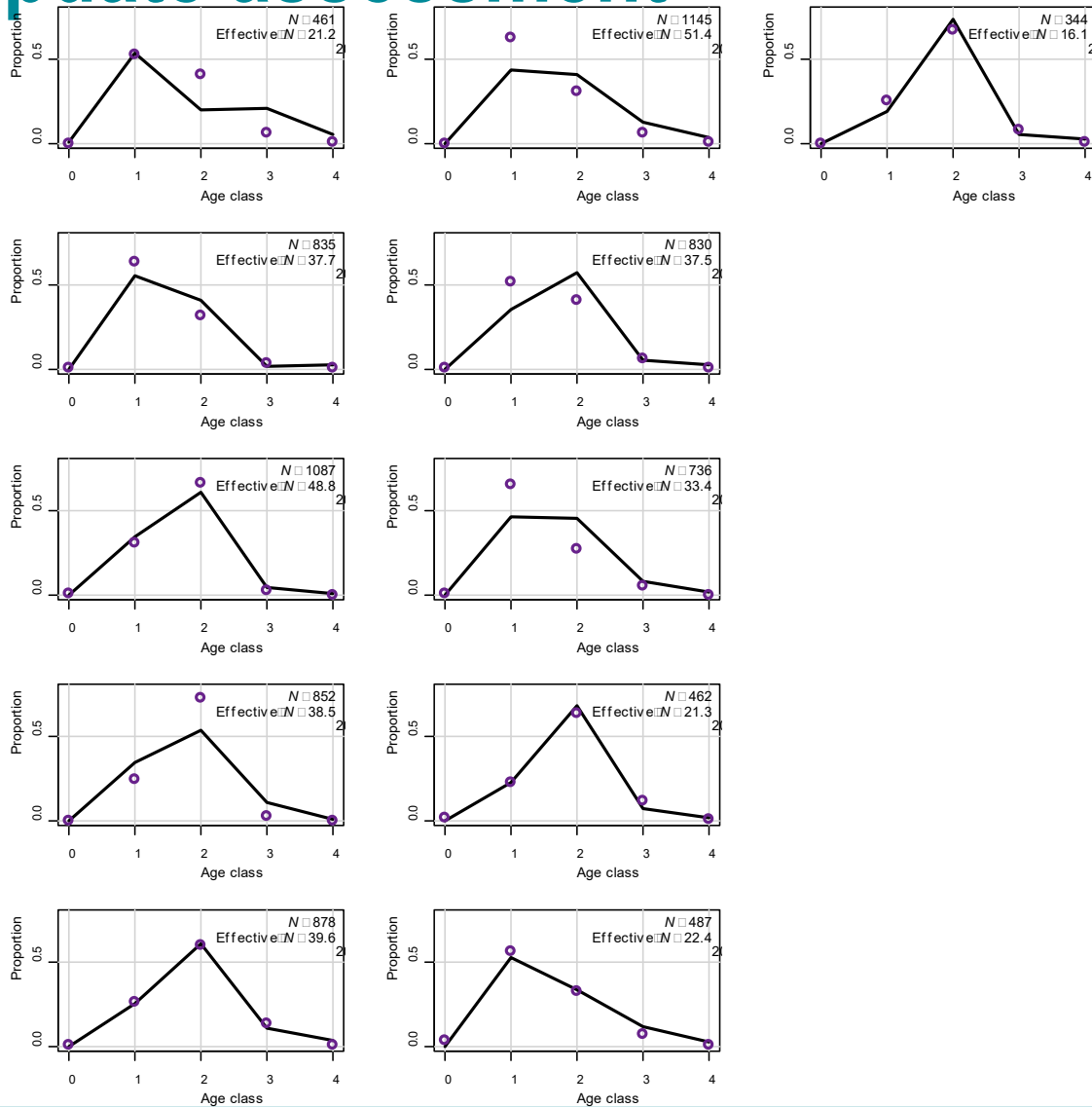
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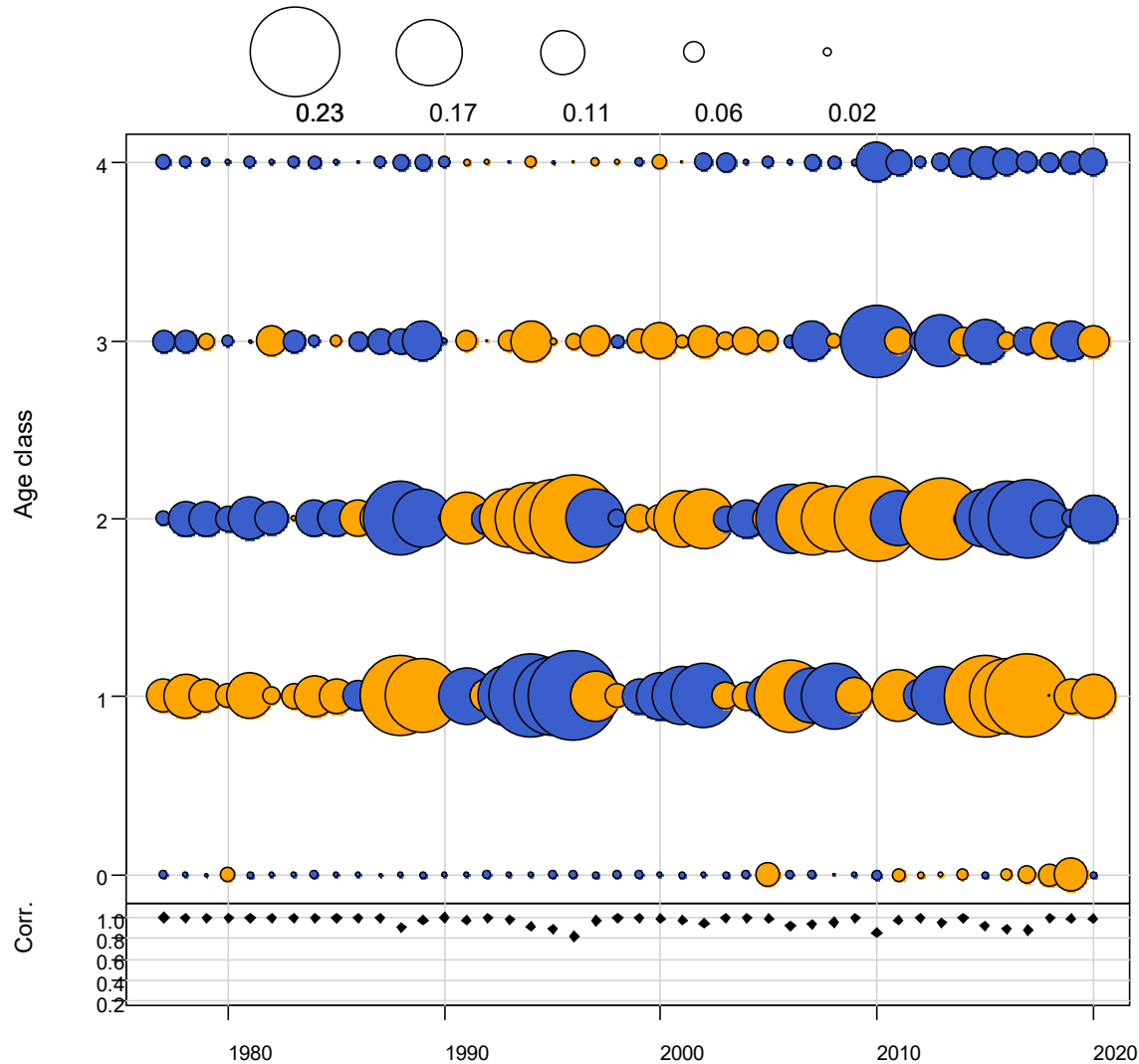
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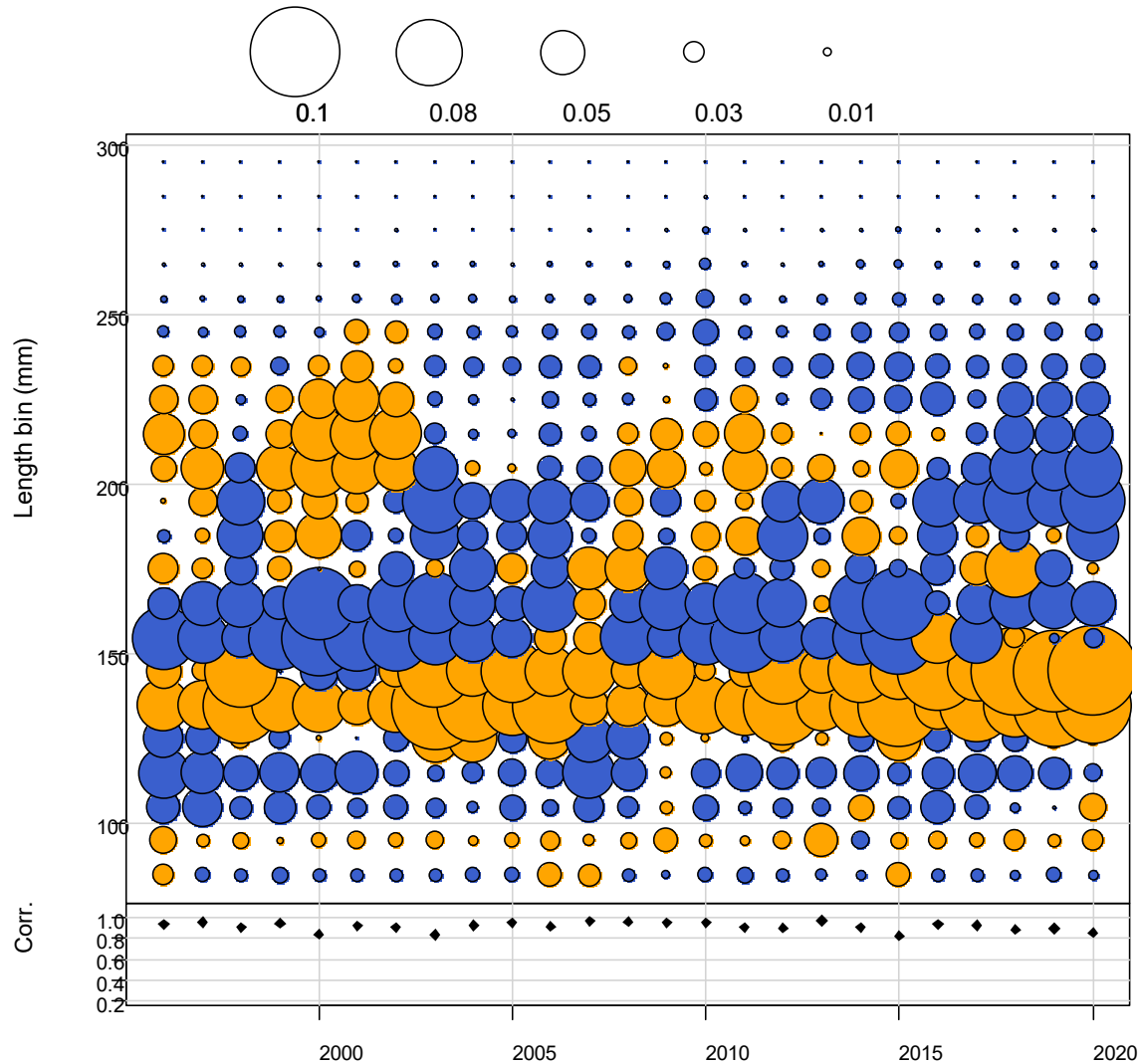
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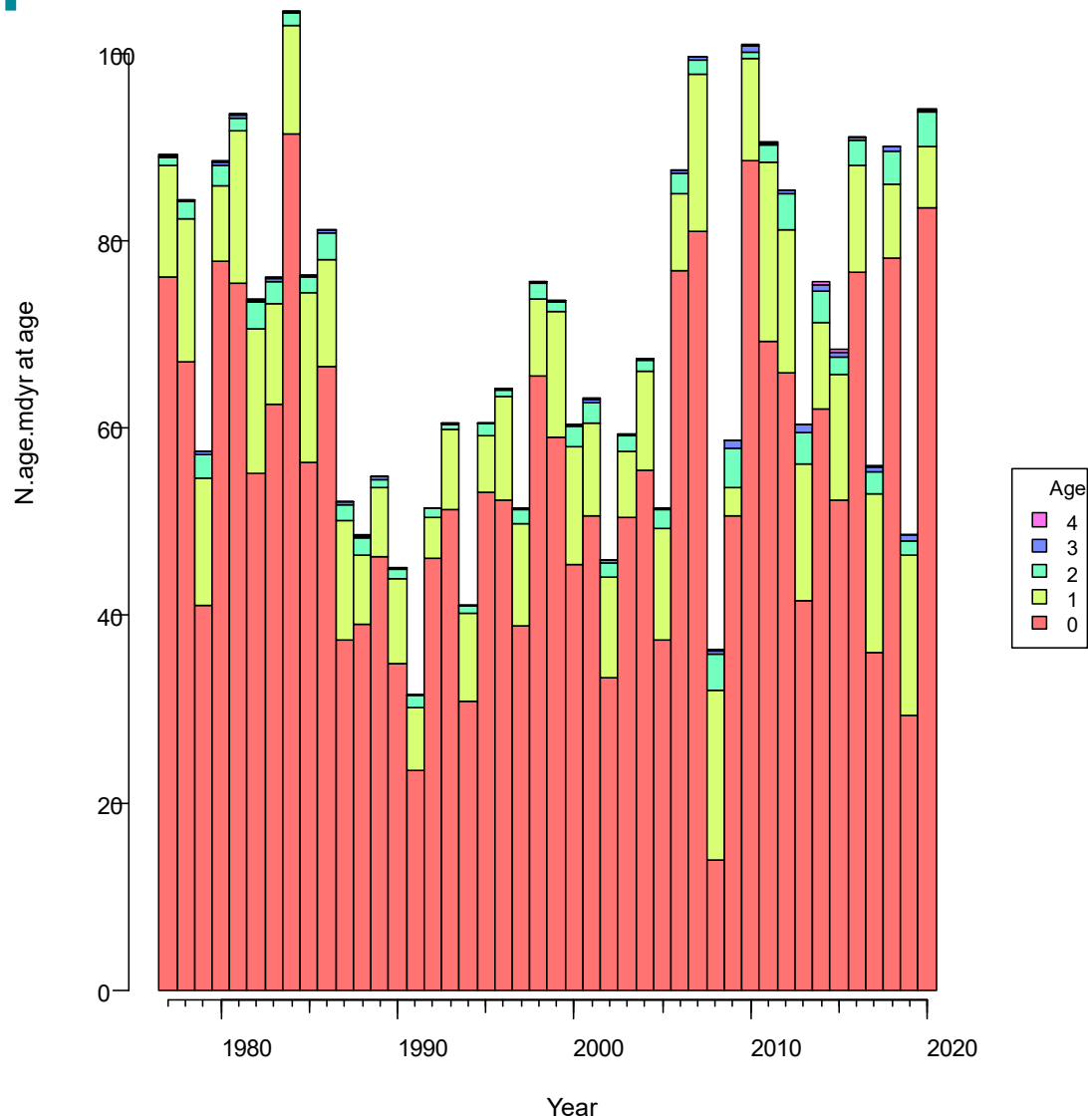
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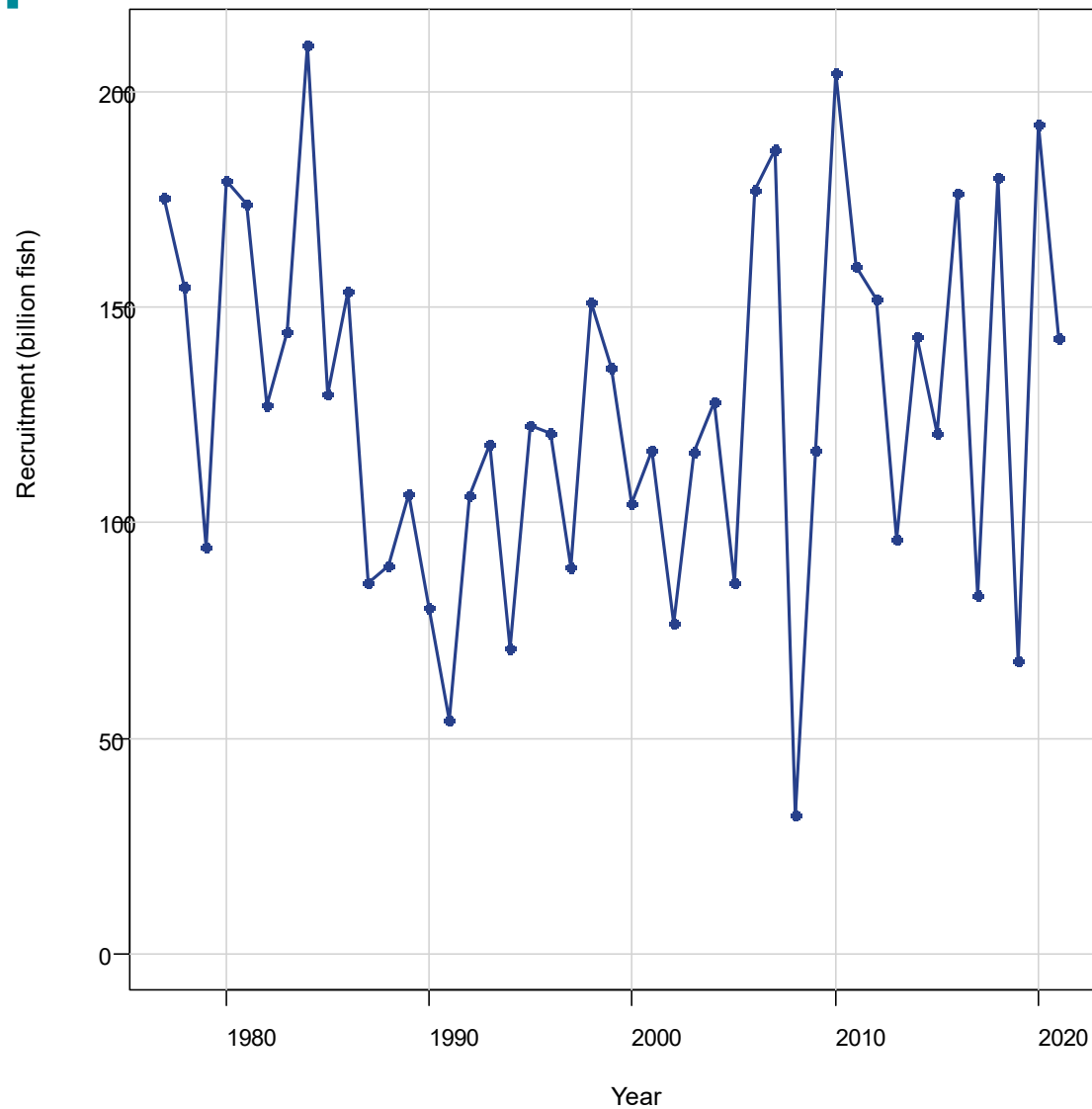
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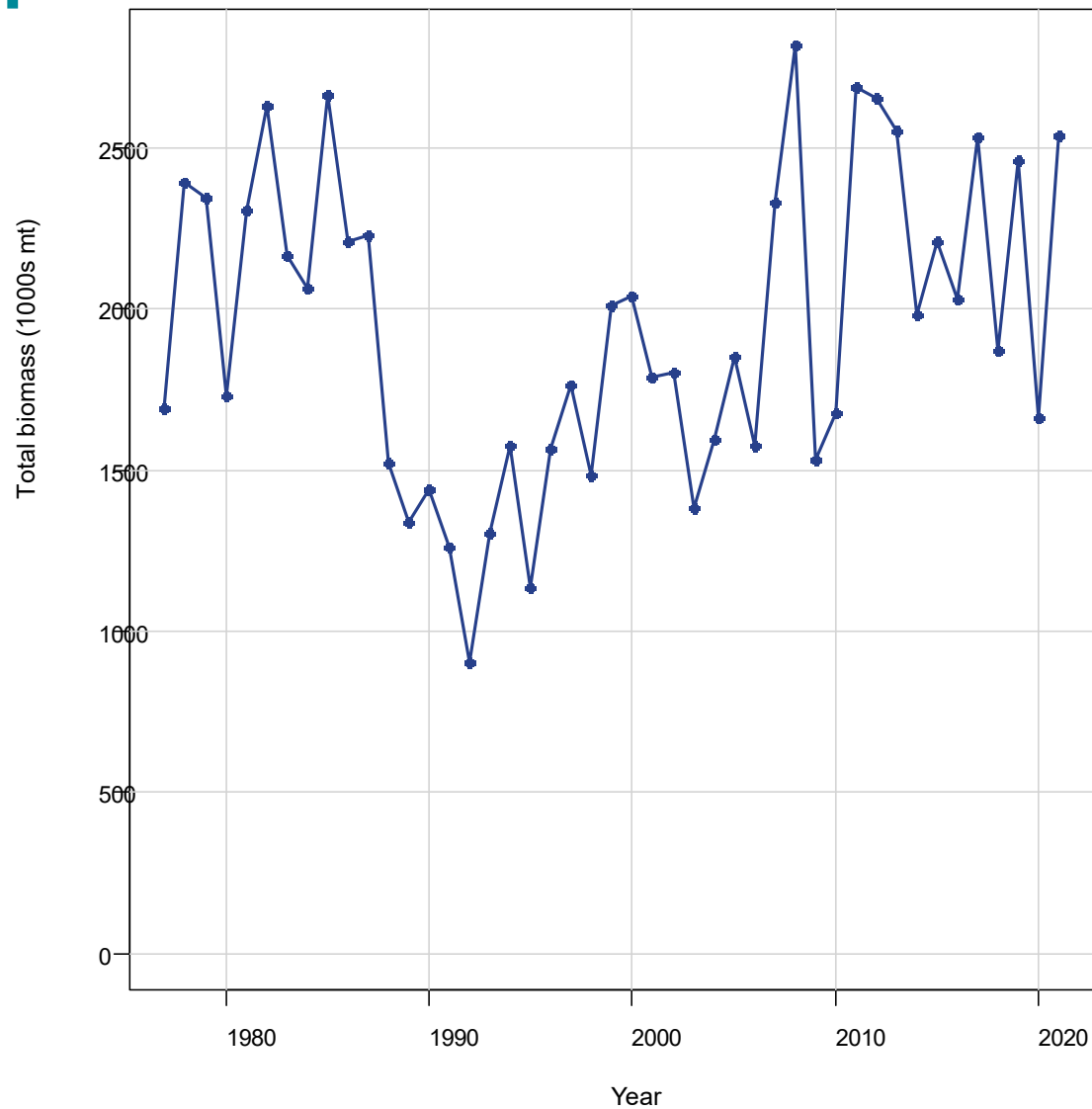
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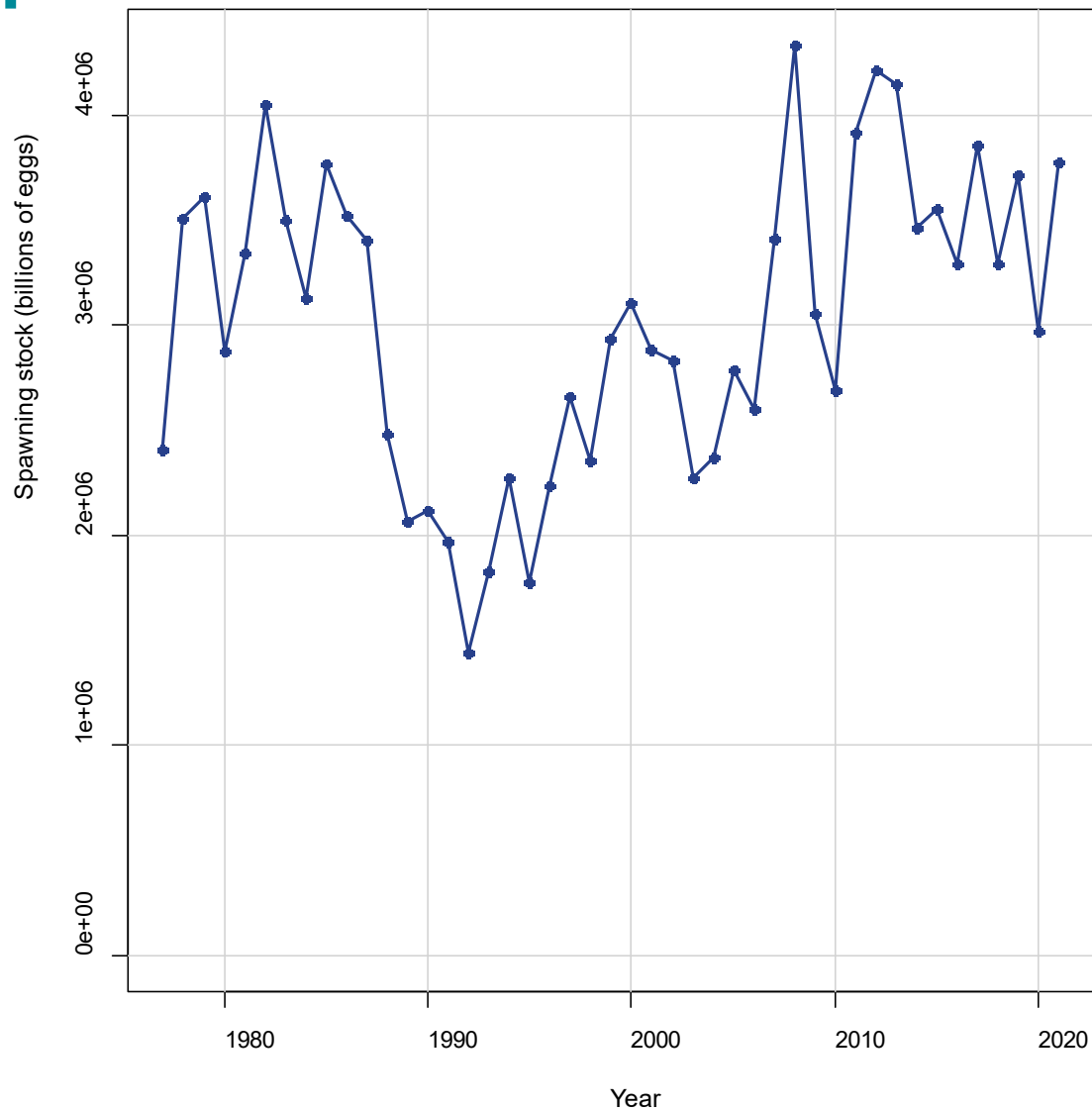
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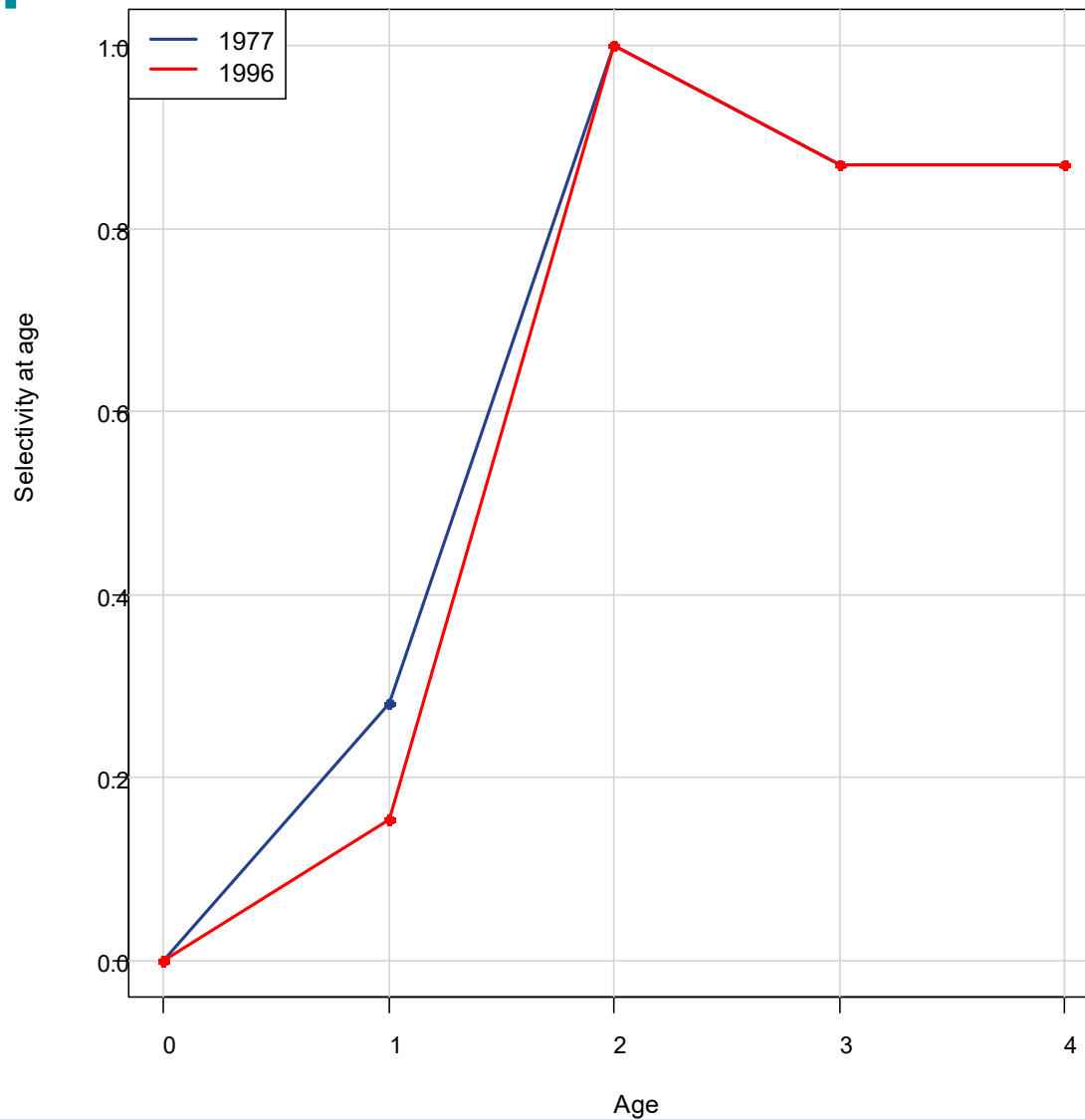
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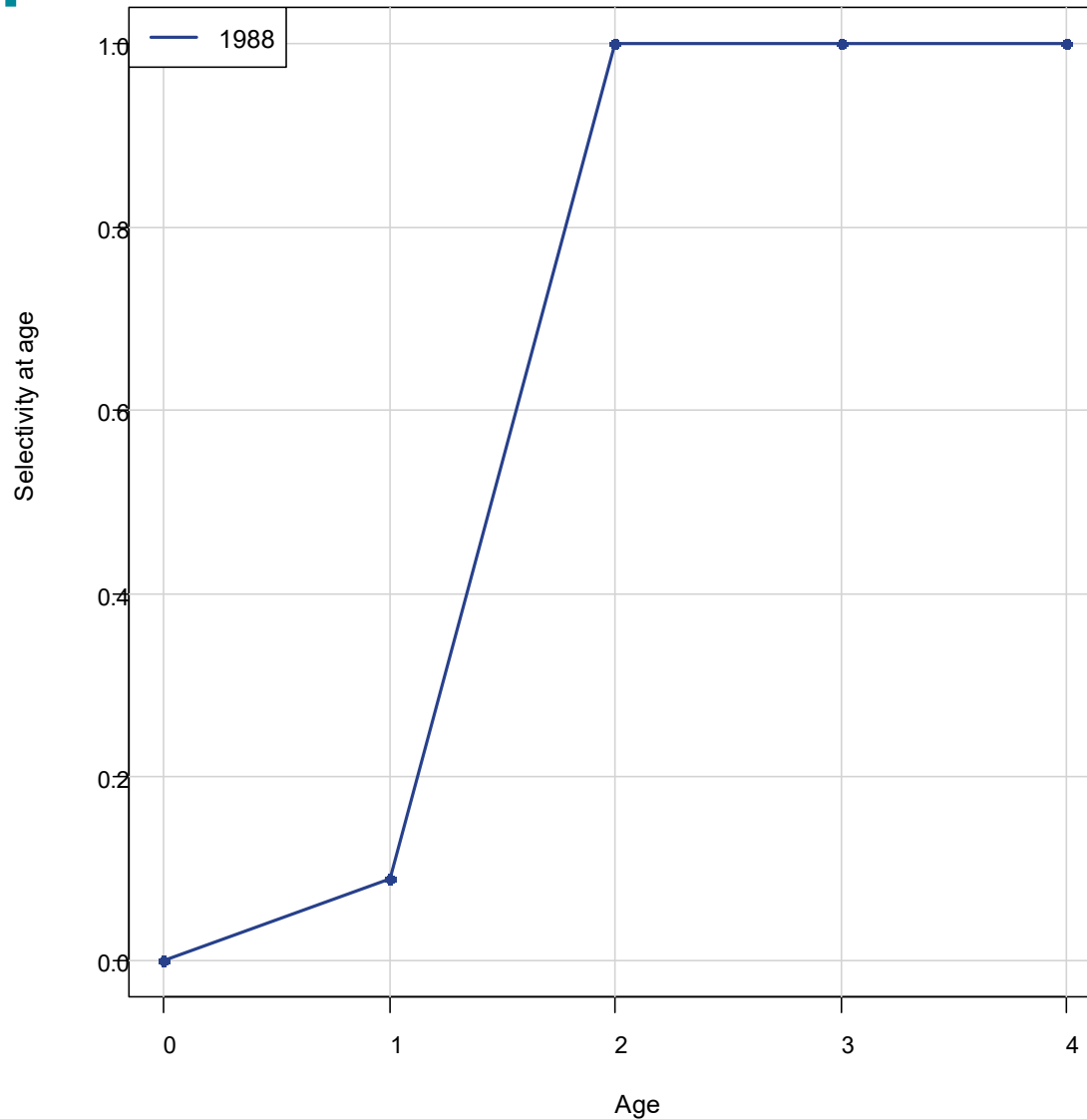
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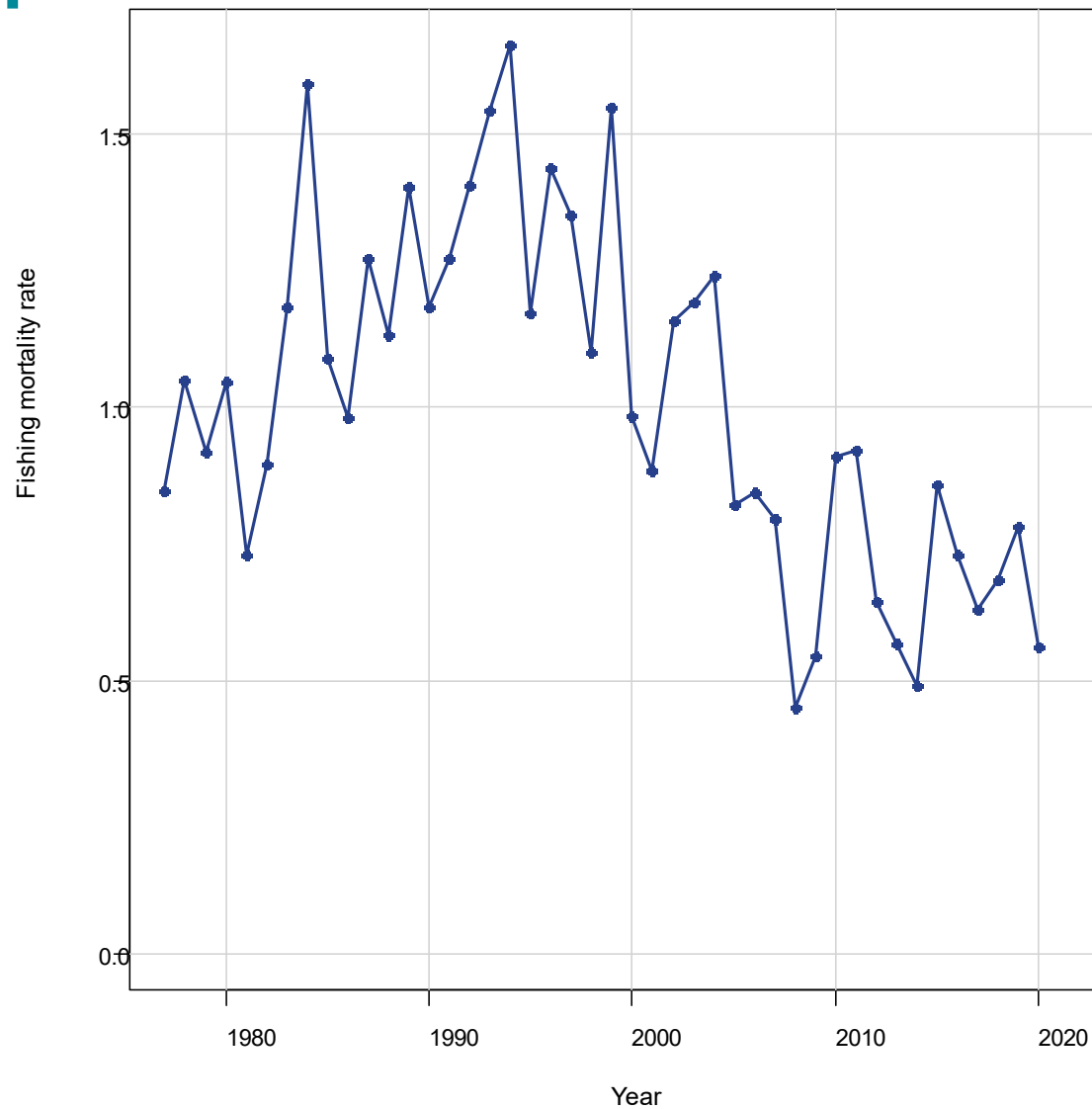
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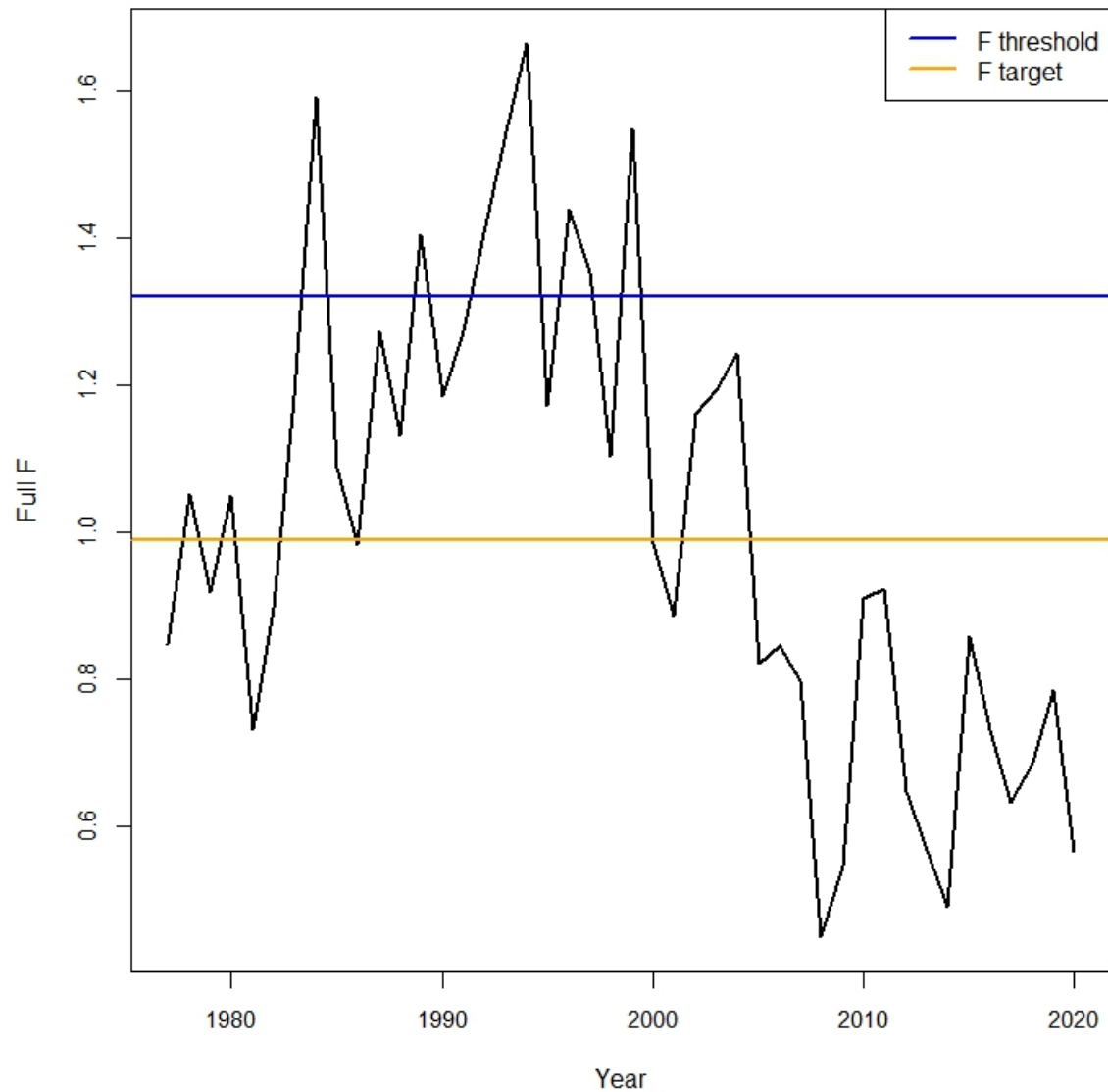
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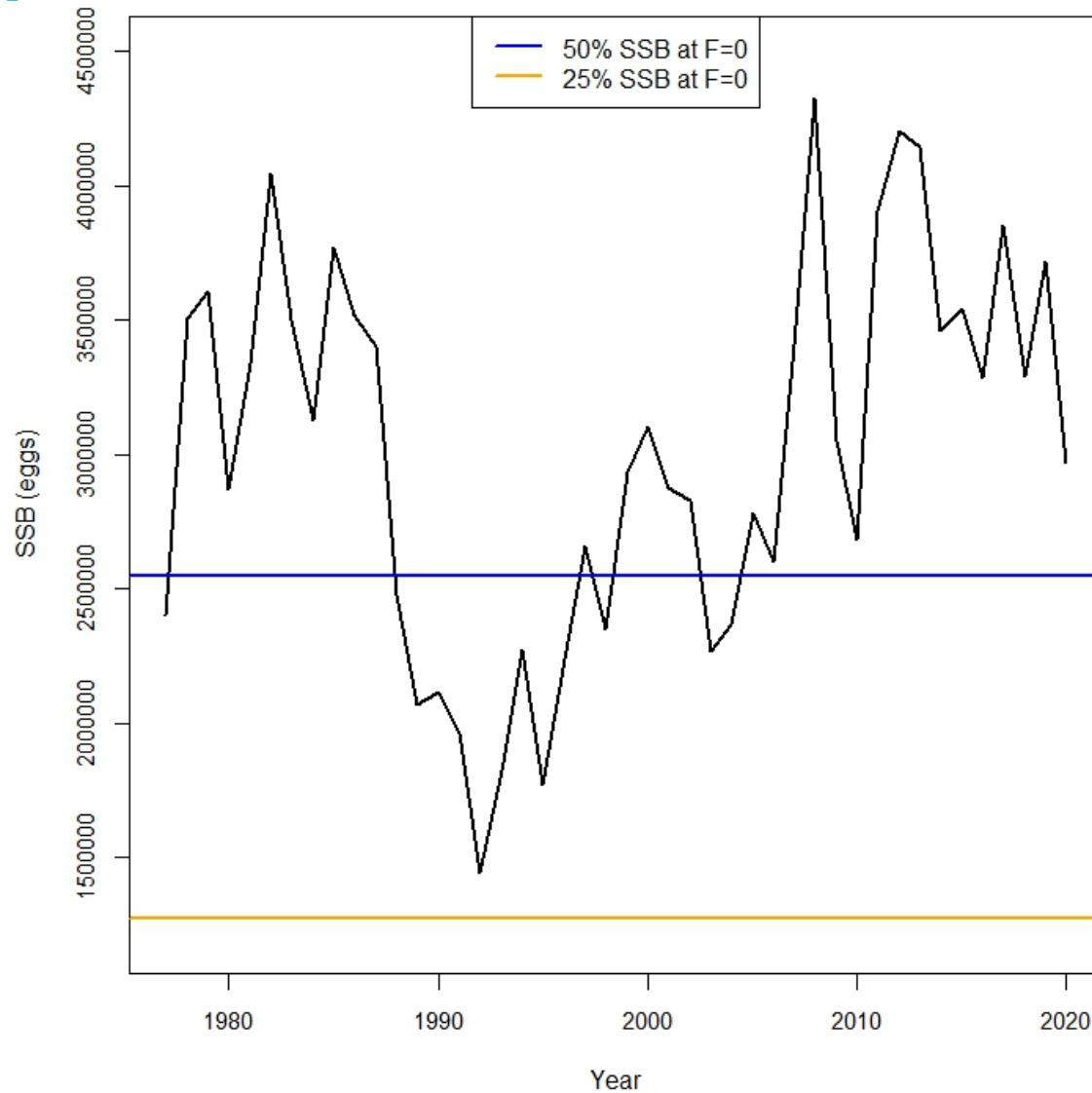
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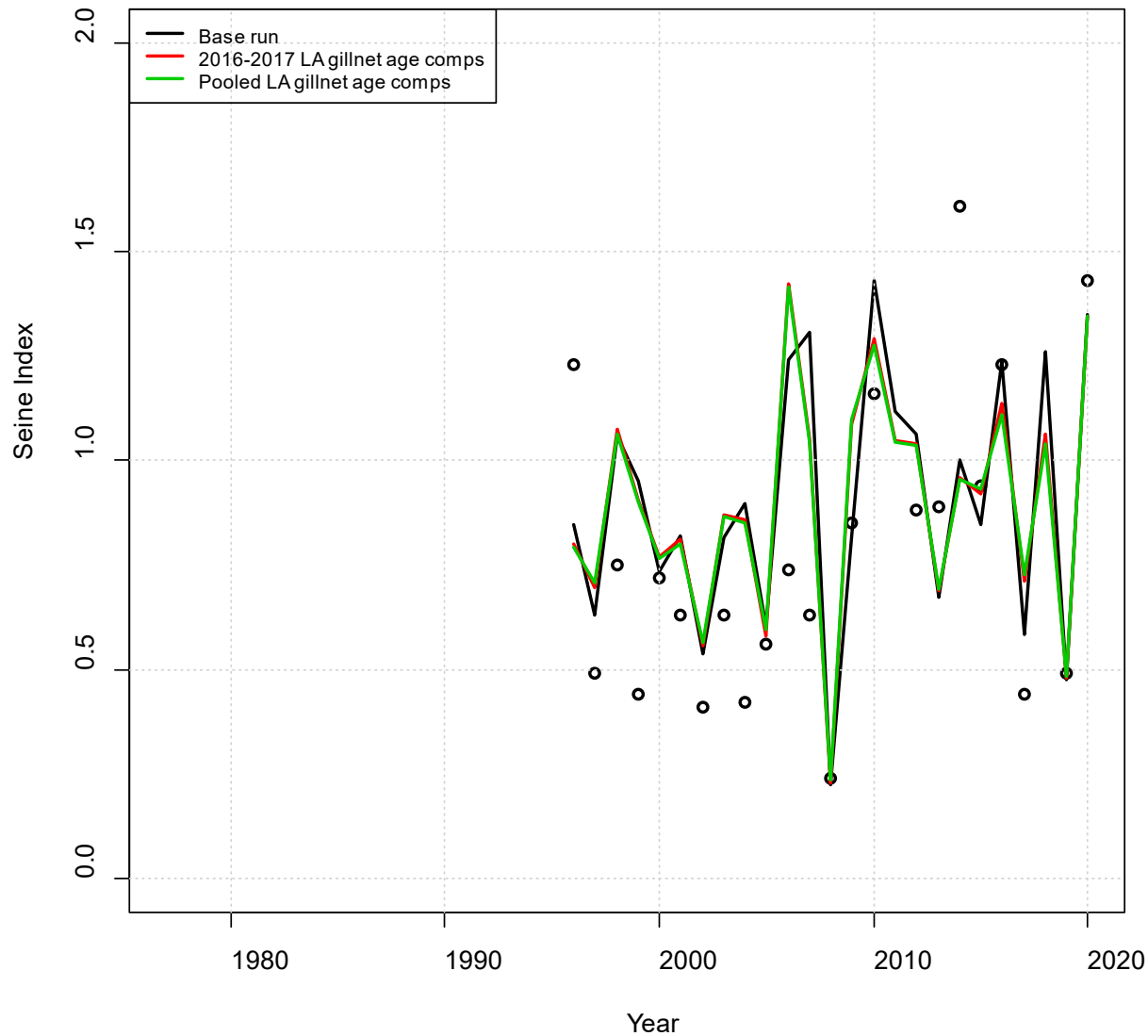
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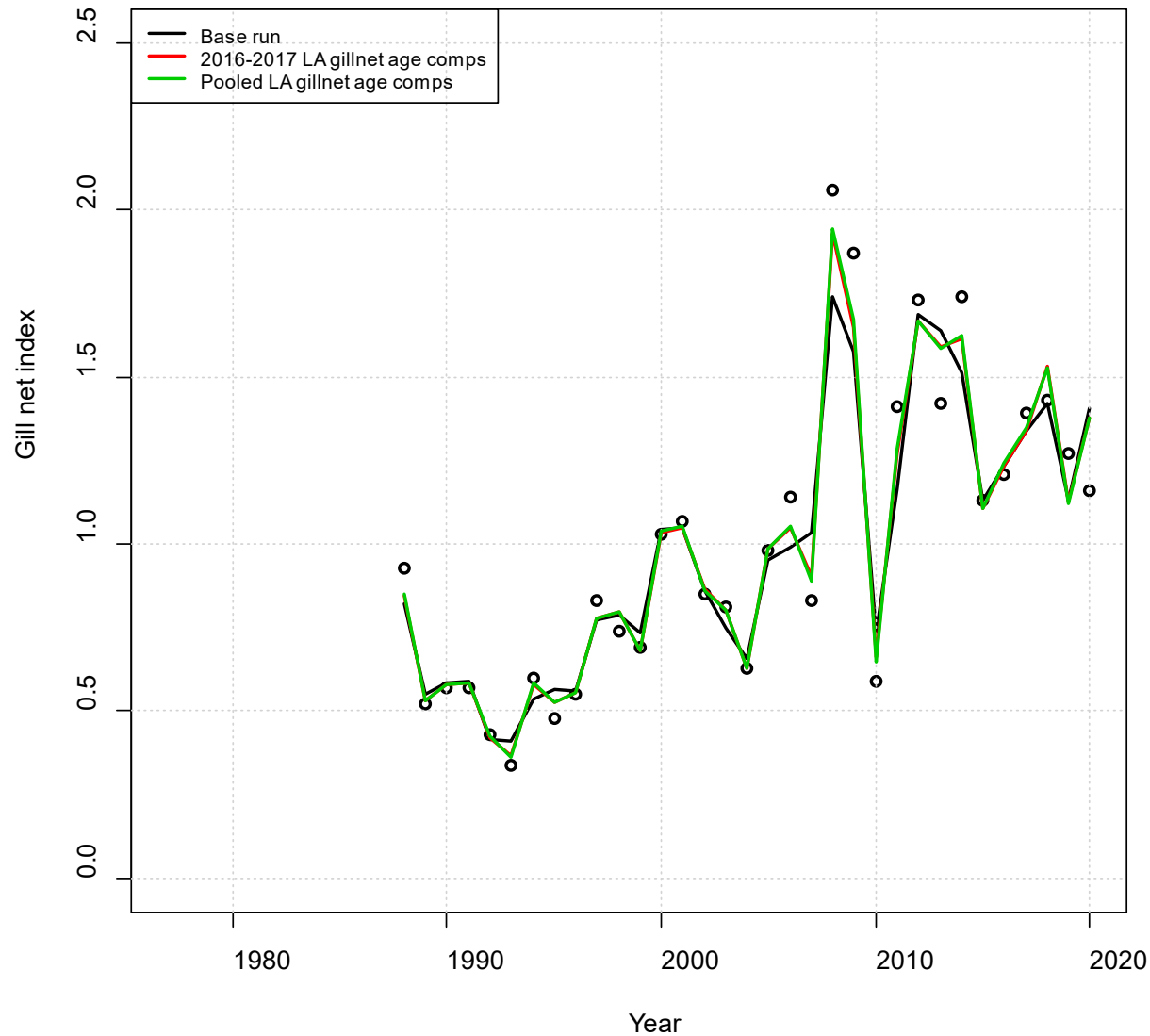
Sensitivity analyses

- Age data from FI indices – LA gill net index
 - Annual age comps for 2016 and 2017
 - Pooled age comps

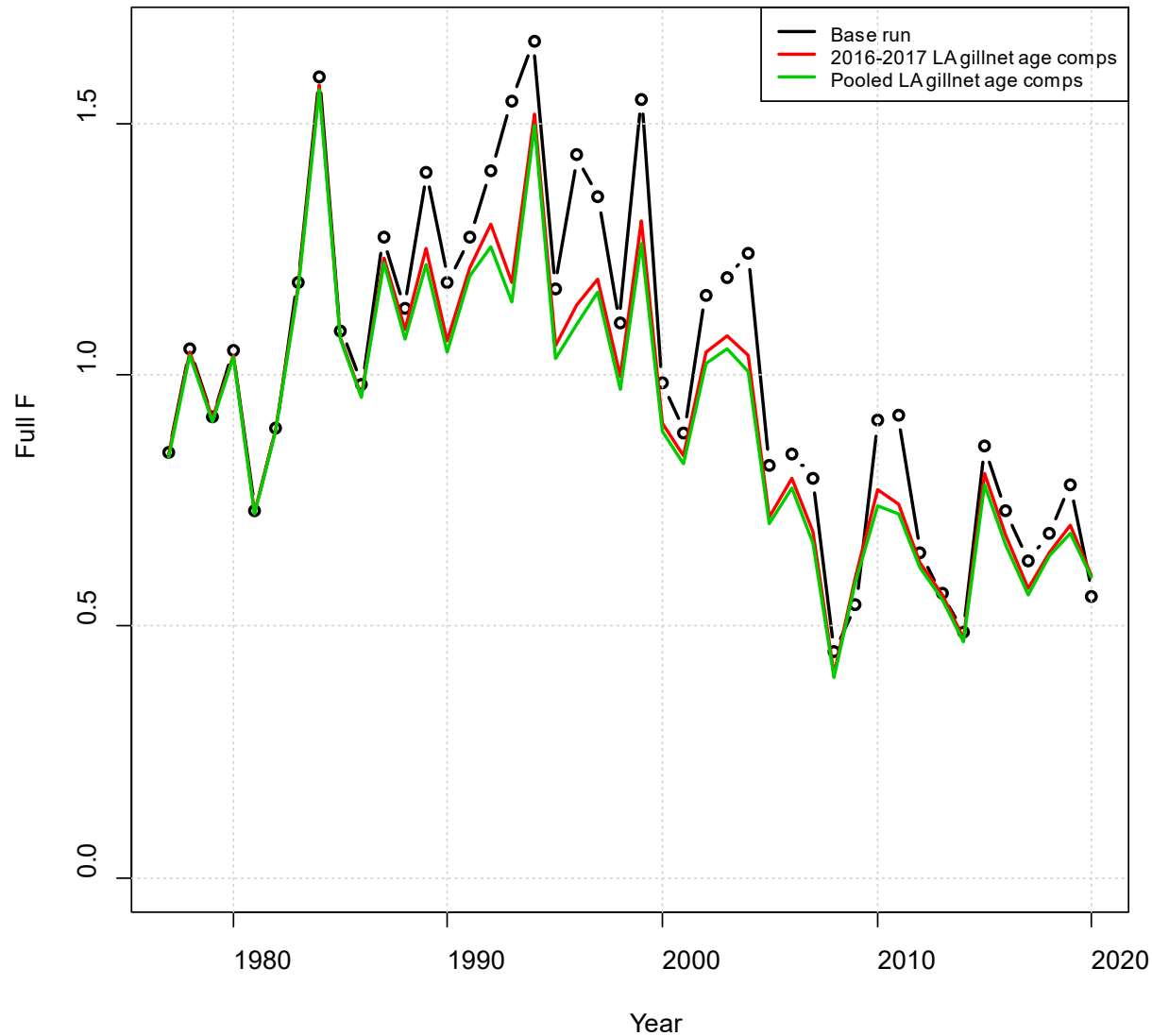
Sensitivity analyses



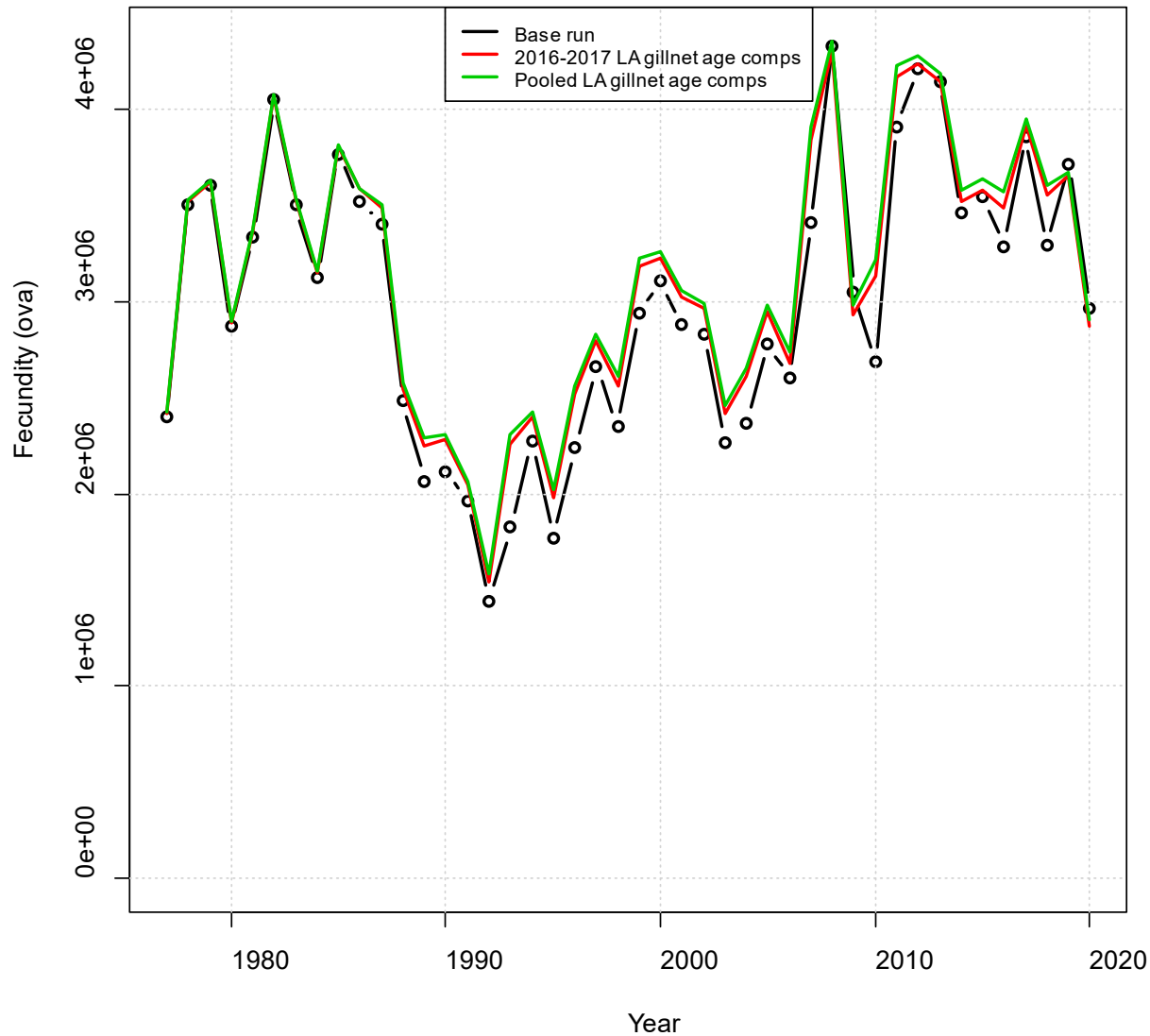
Sensitivity analyses



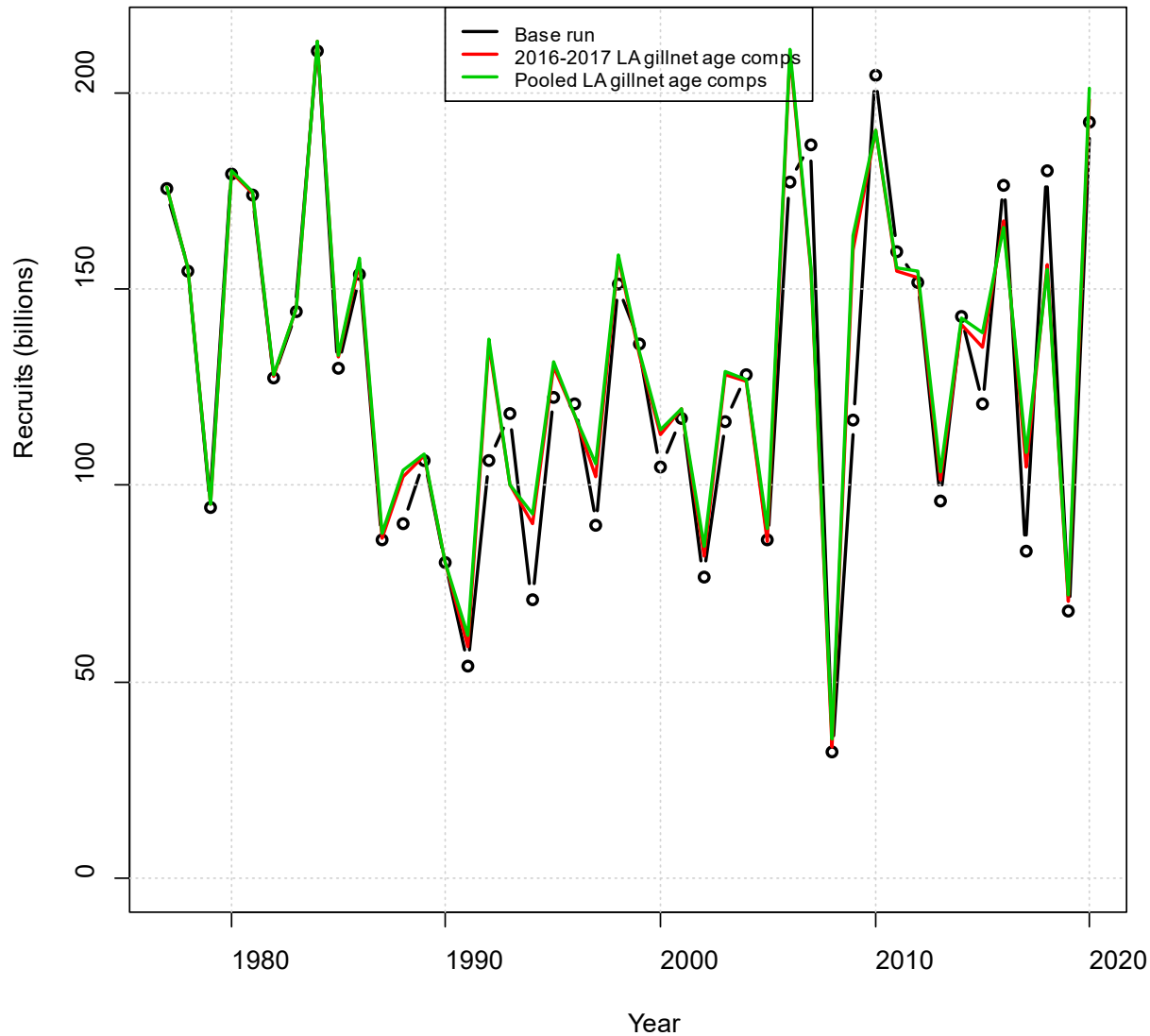
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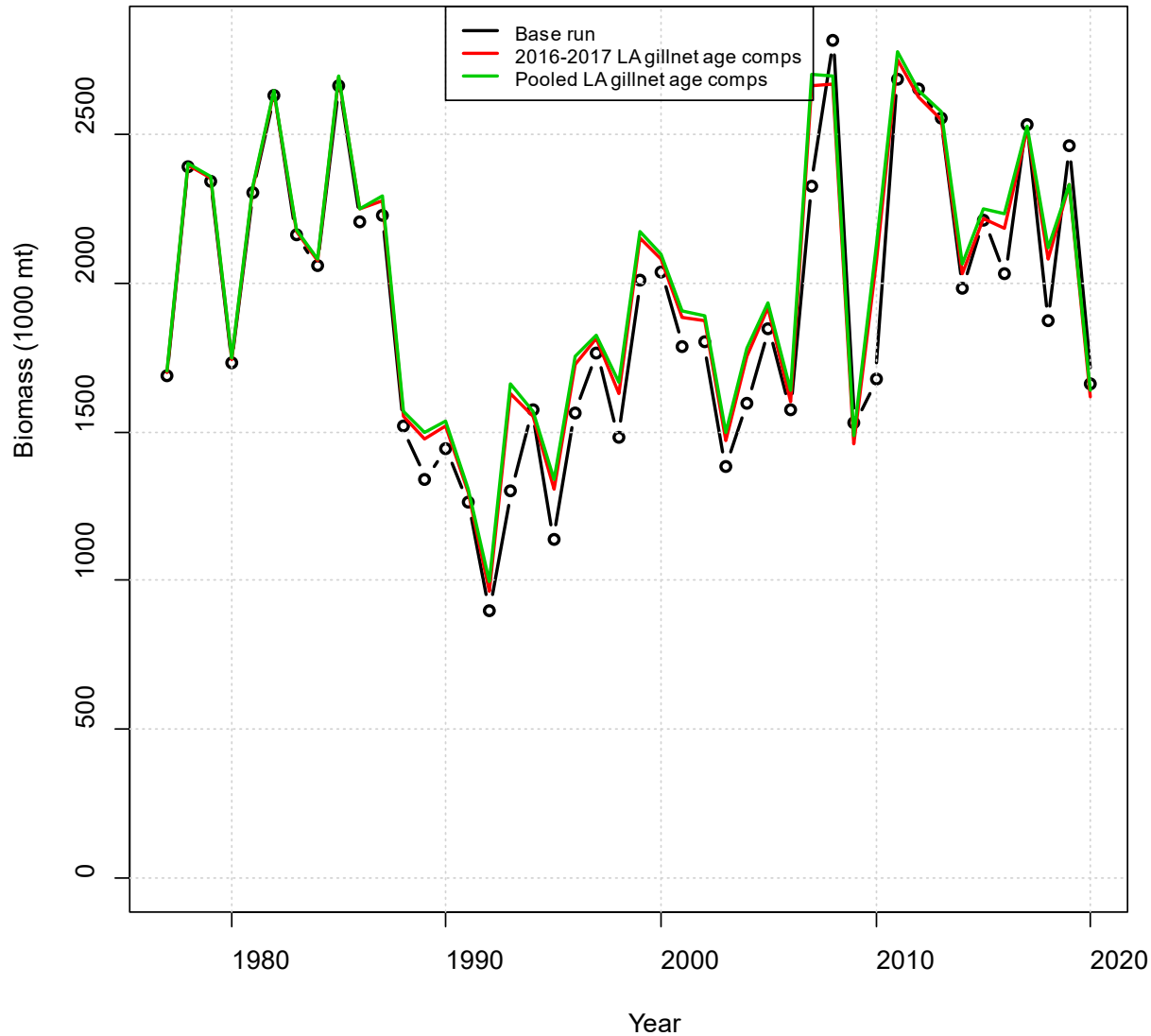
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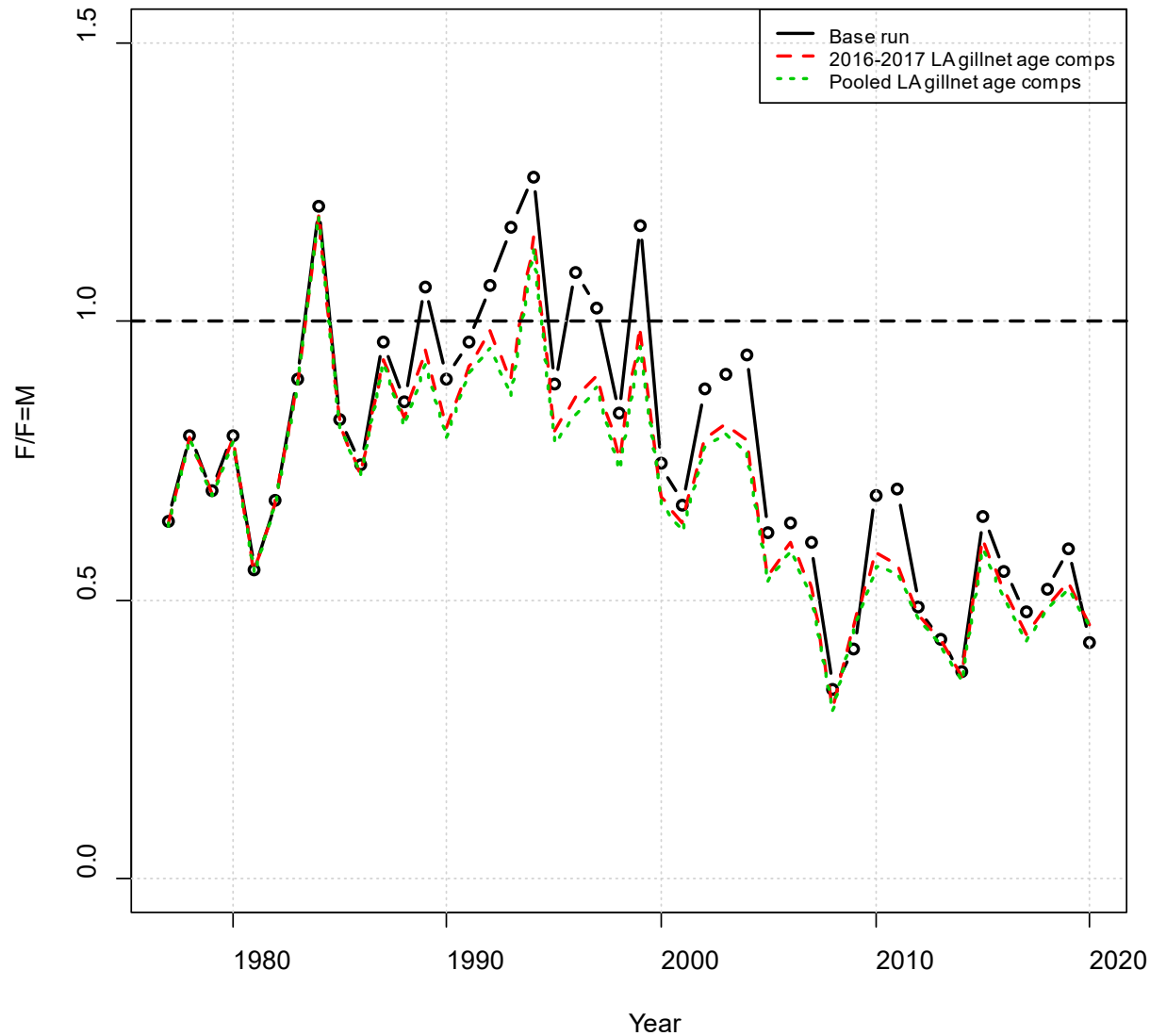
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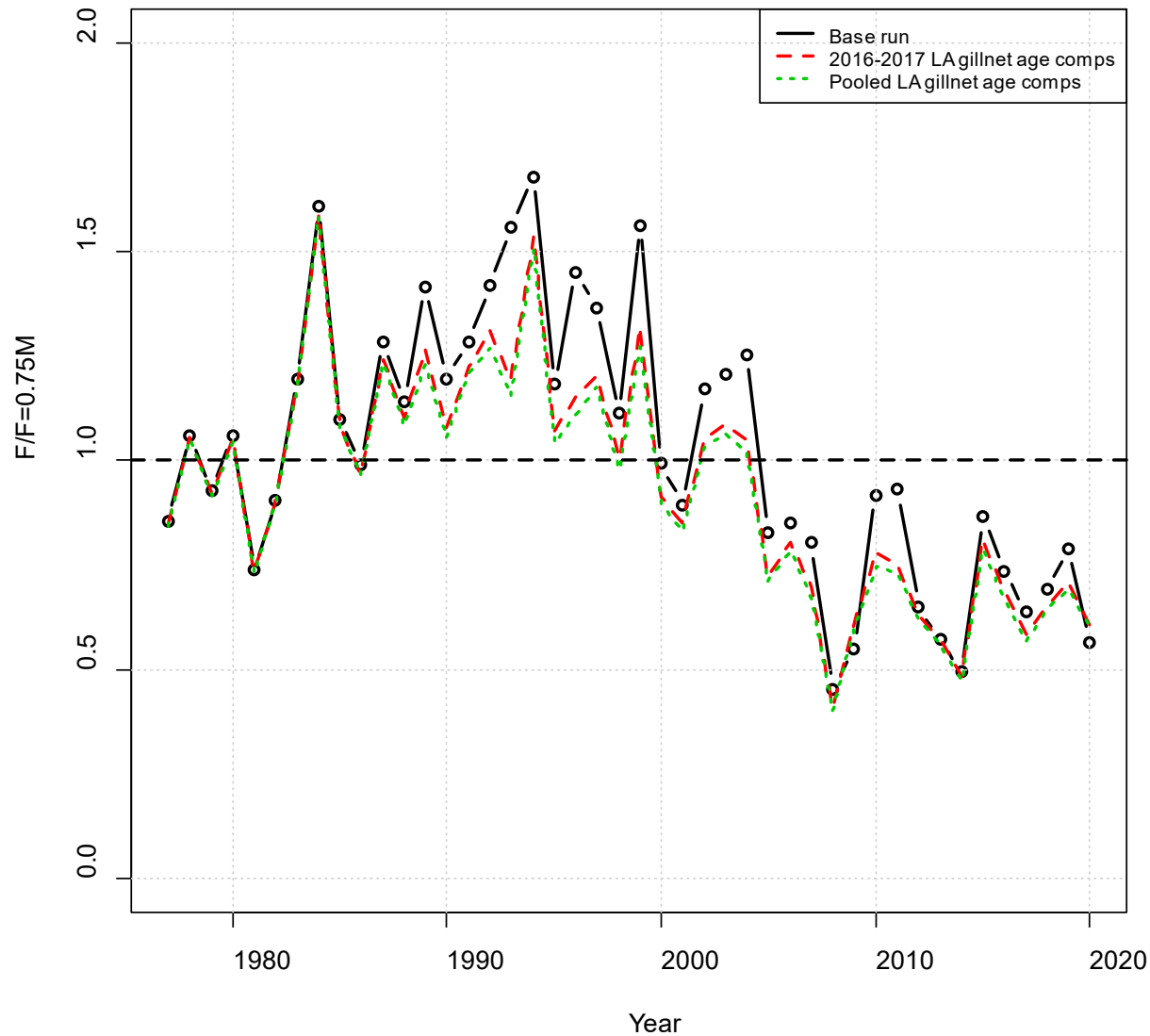
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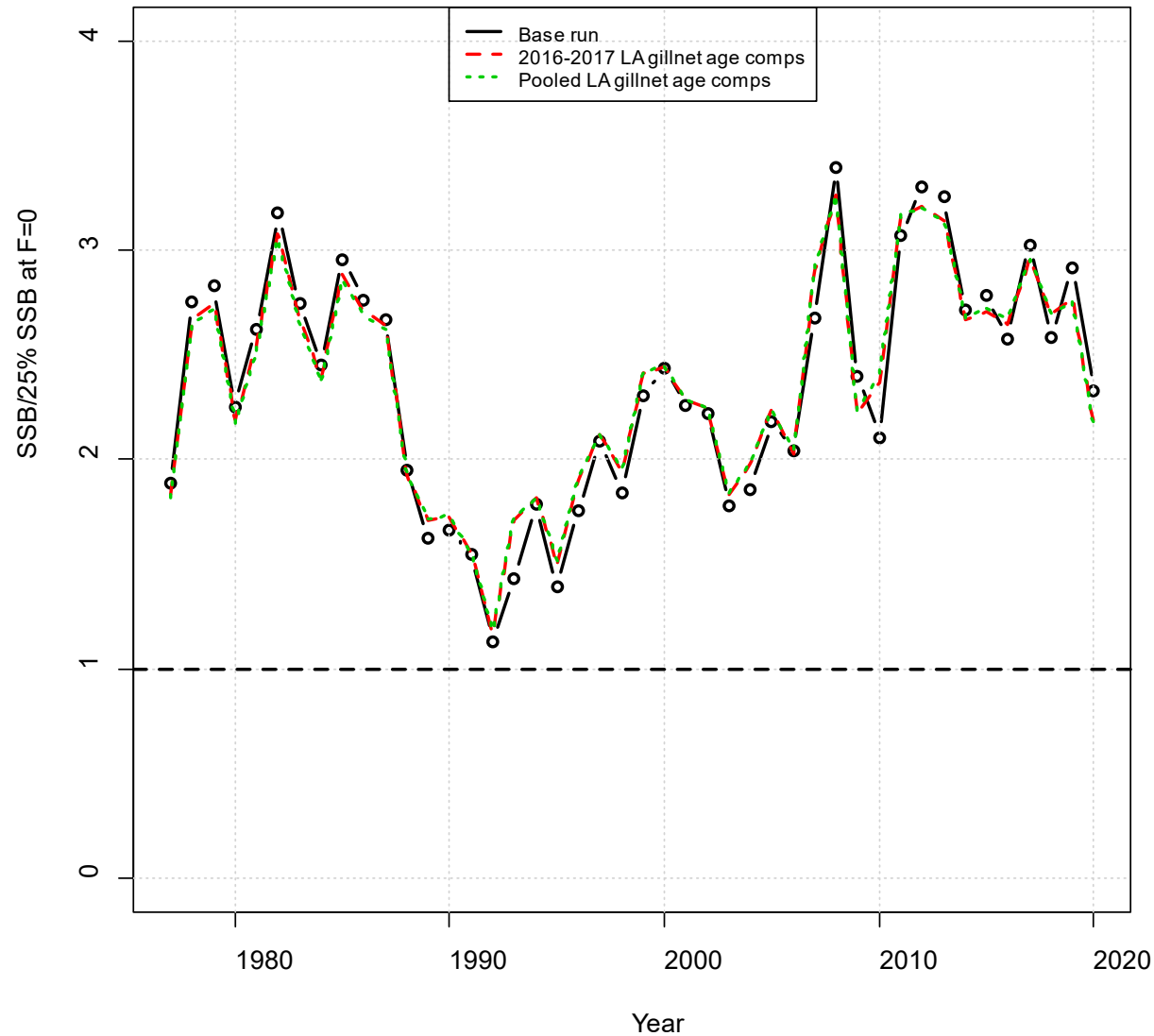
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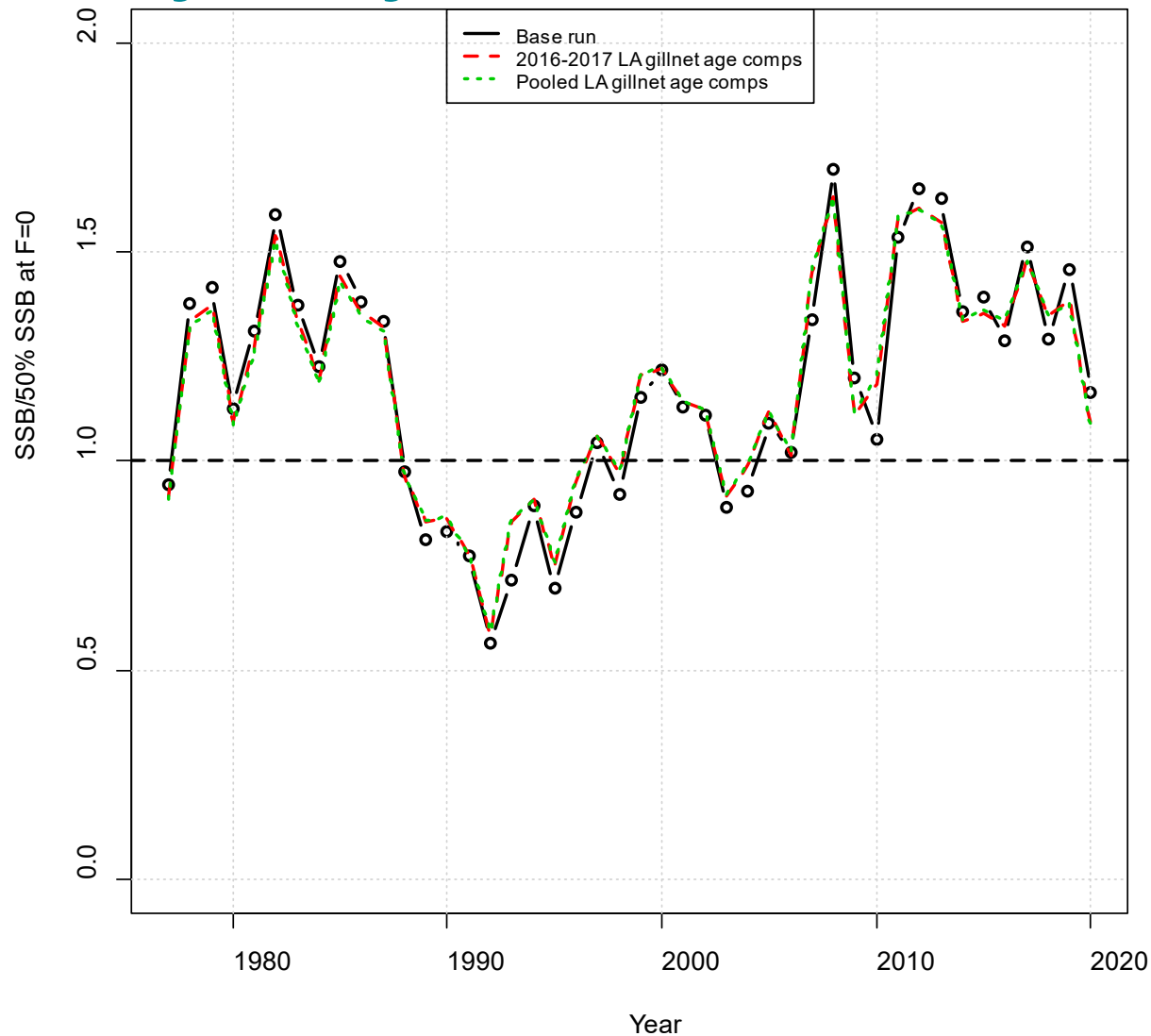
Sensitivity analyses



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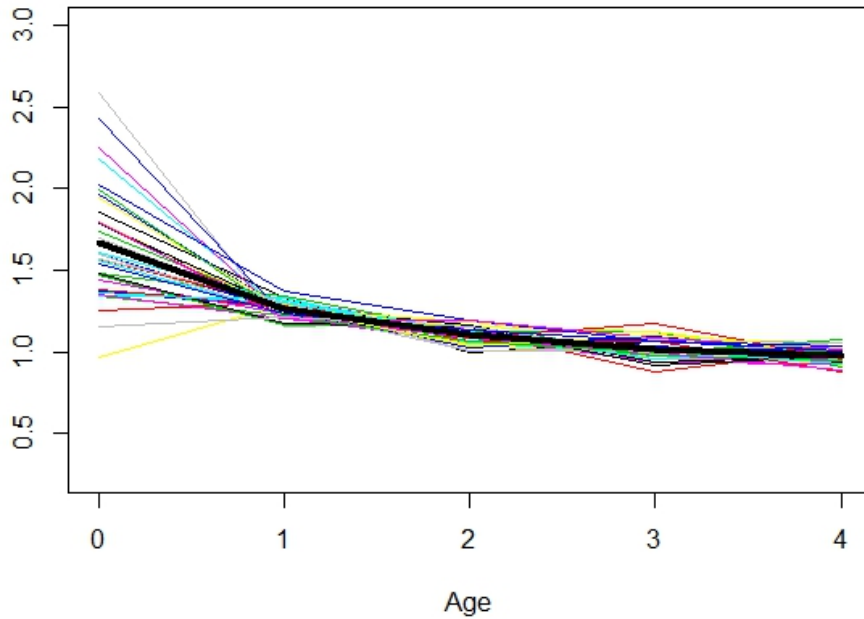


Sensitivity analyses

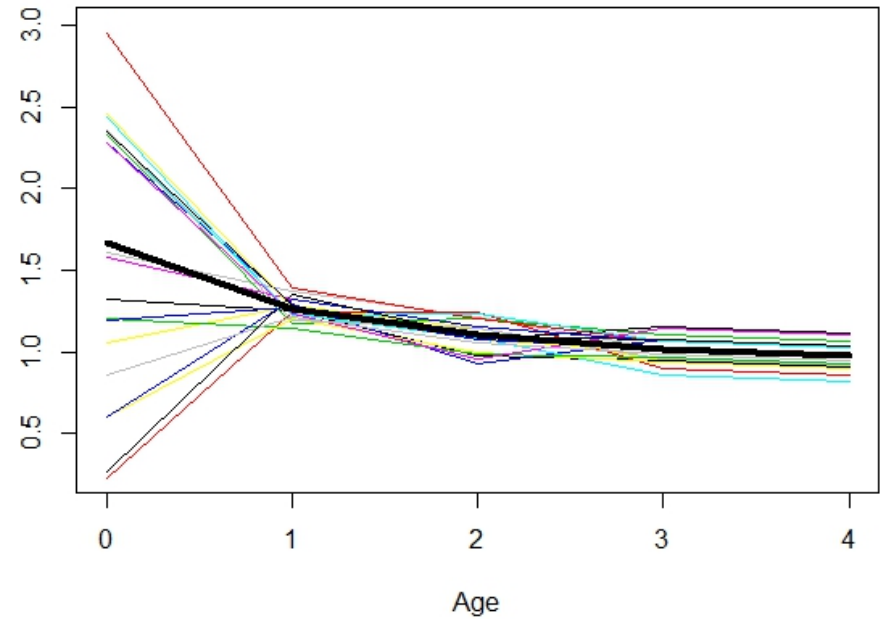
- M matrix from each EwE model
 - Gulf-wide: age (0-4) and year (1980-2016)
 - 1977-1979 = 1980 – 1982 average
 - 2017-2020 = 2014 – 2016 average
 - Scaled to M vector from base [used deviations]
 - NGOMEX: age (0-3) and year (2000-2017)
 - 1977-1999 = 2000 – 2002 average
 - 2018-2020 = 2015 – 2017 average
 - Age-4 = age-3
 - Scaled to M vector from base [used deviations]

Sensitivity analyses – M comparison figures

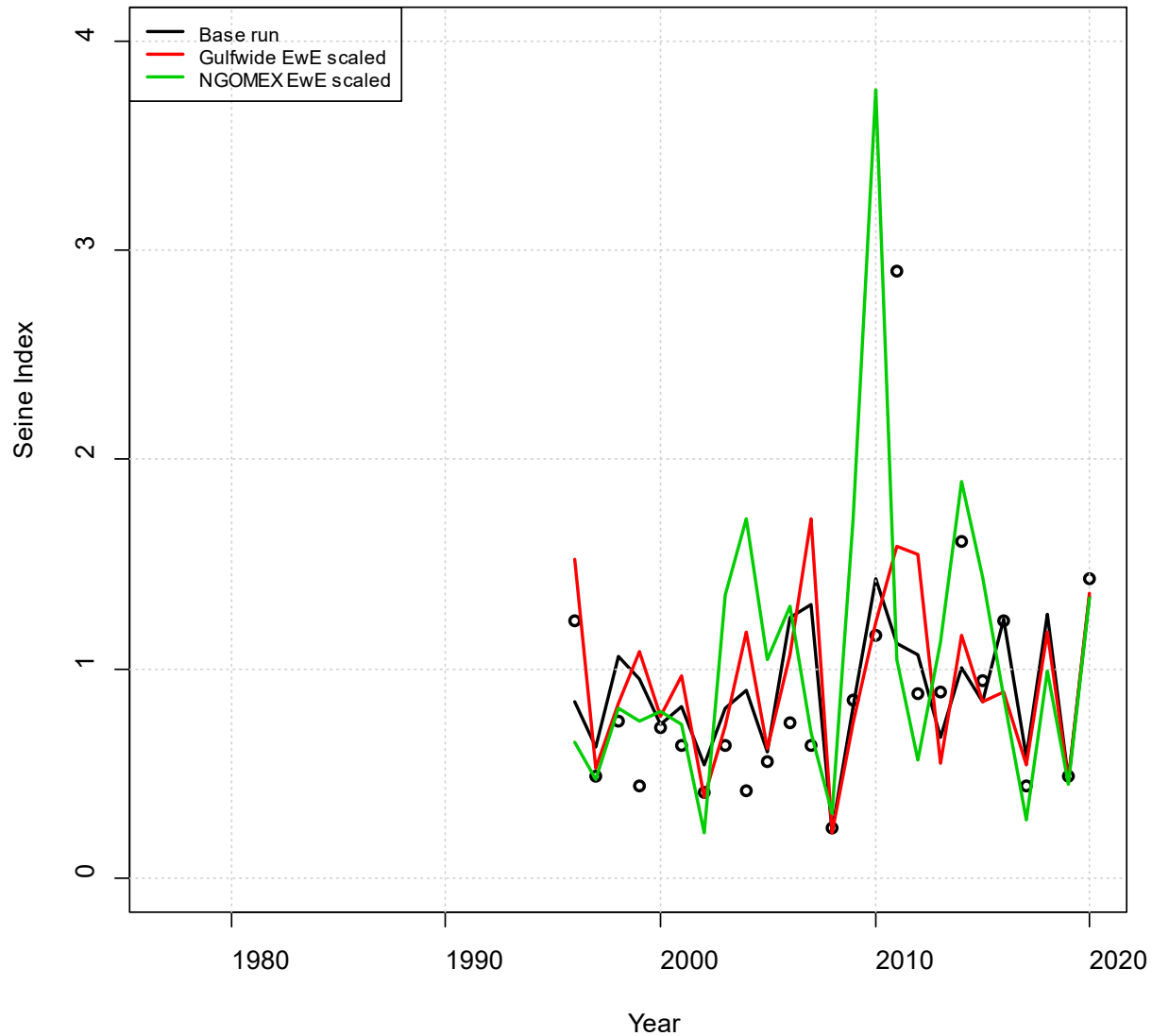
Gulfwide



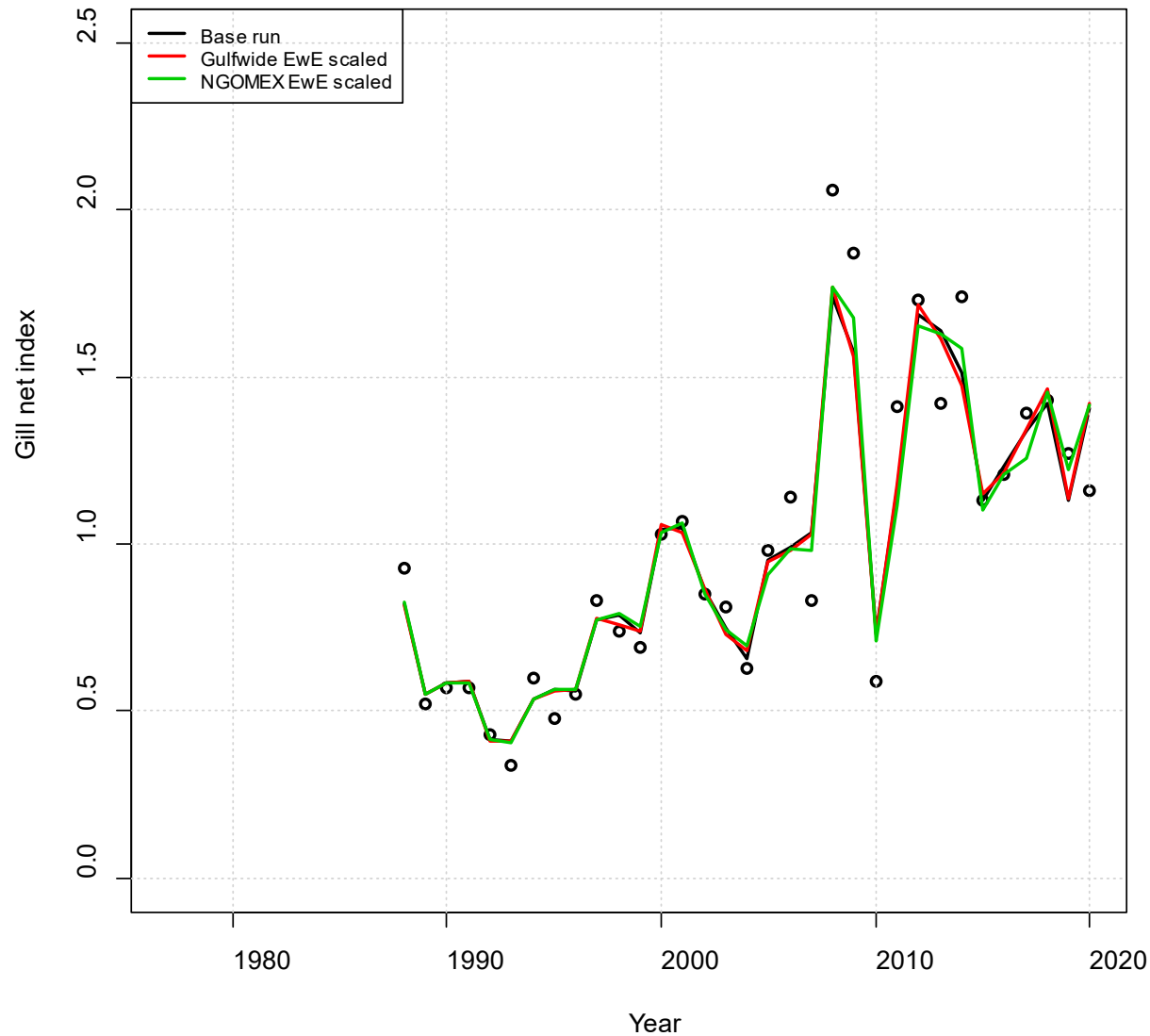
NGOMEX



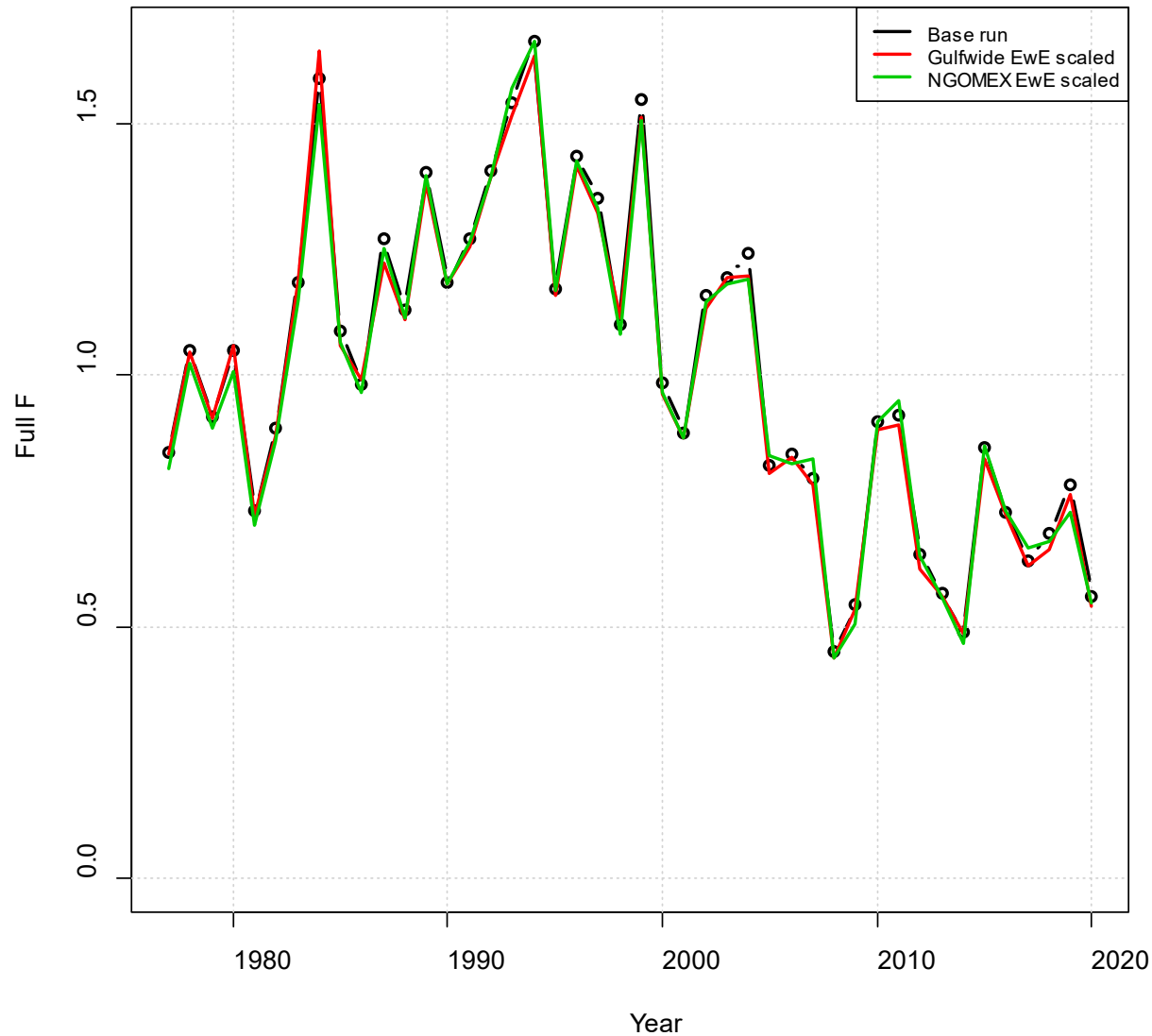
Sensitivity analyses



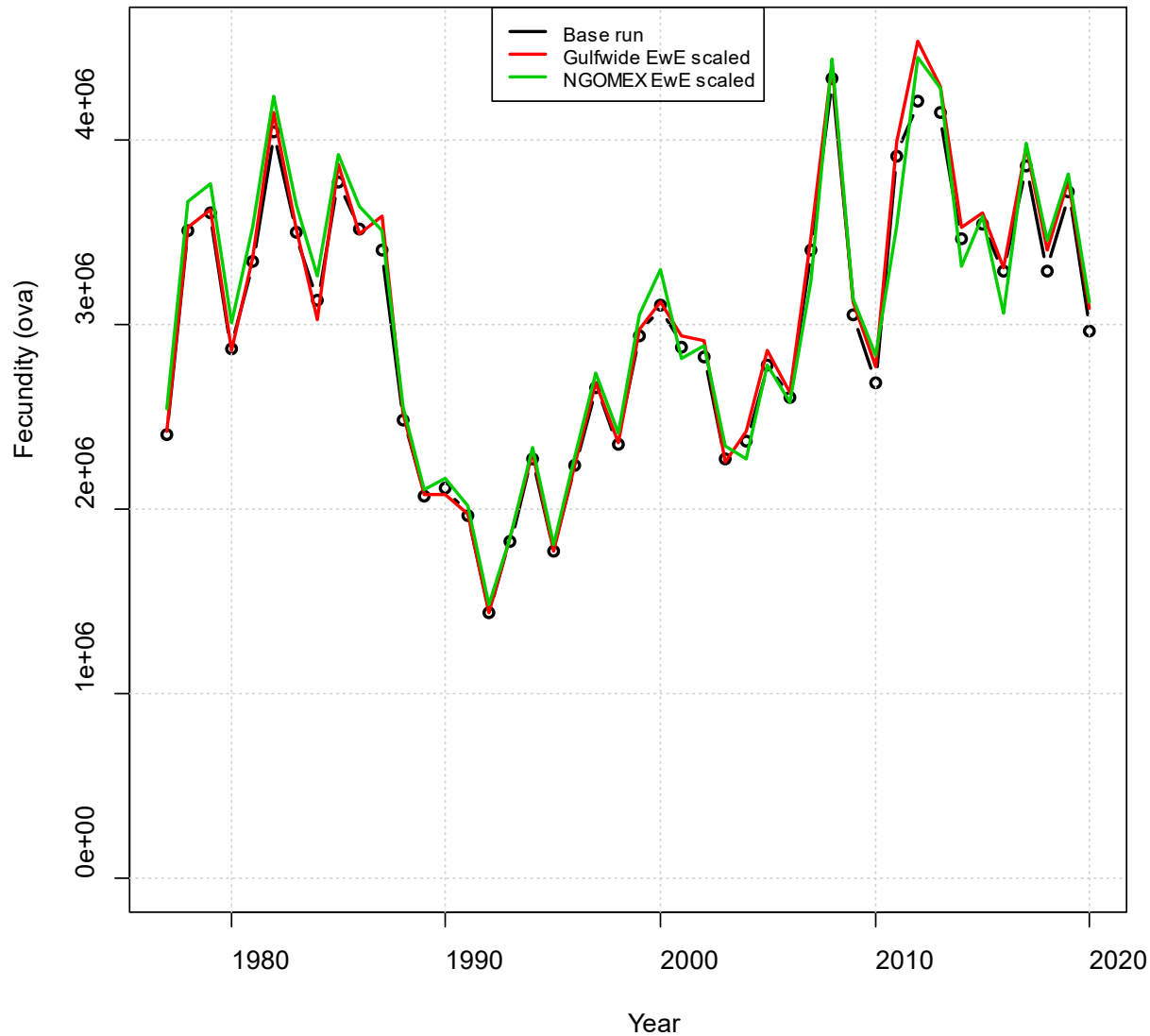
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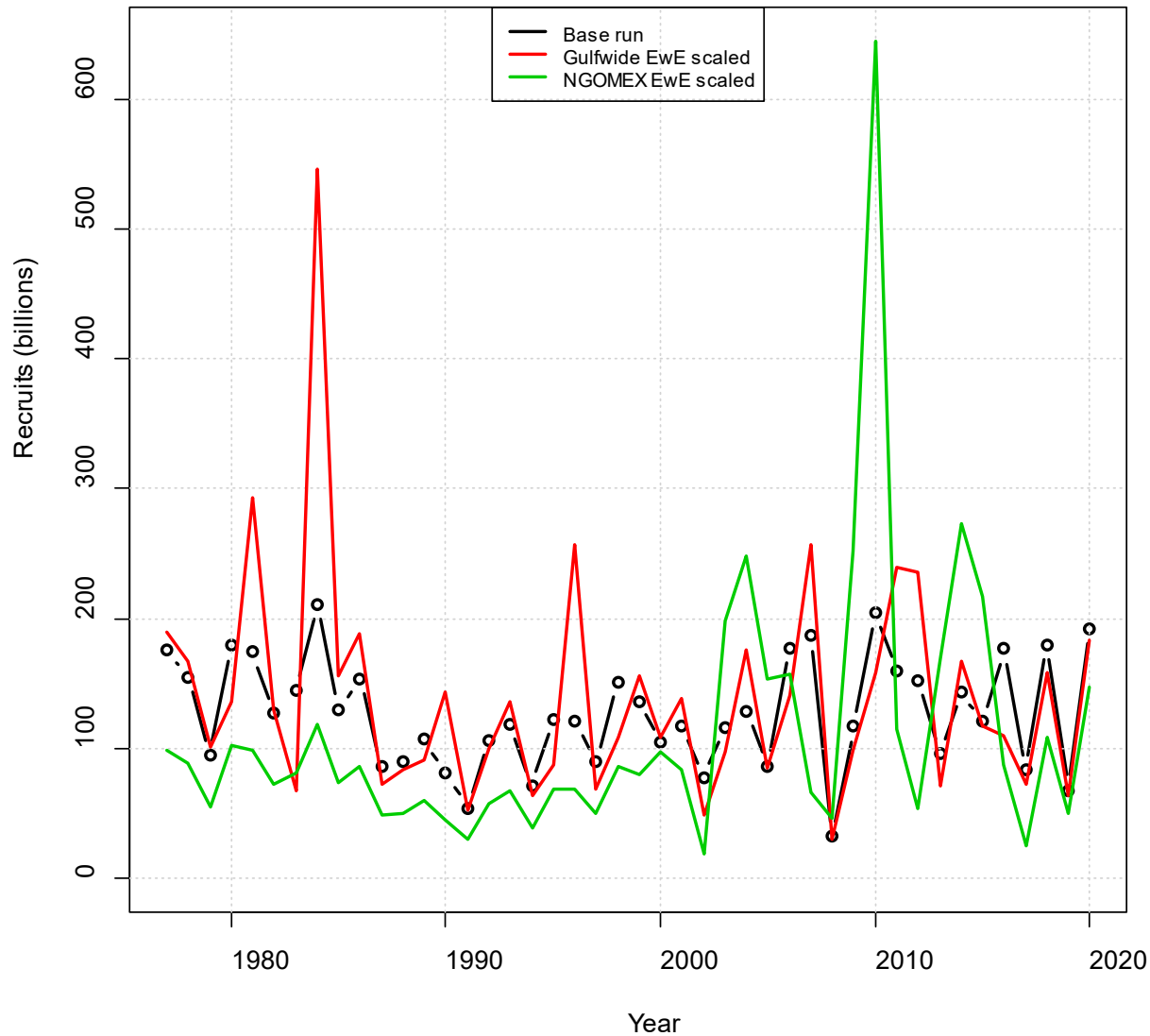
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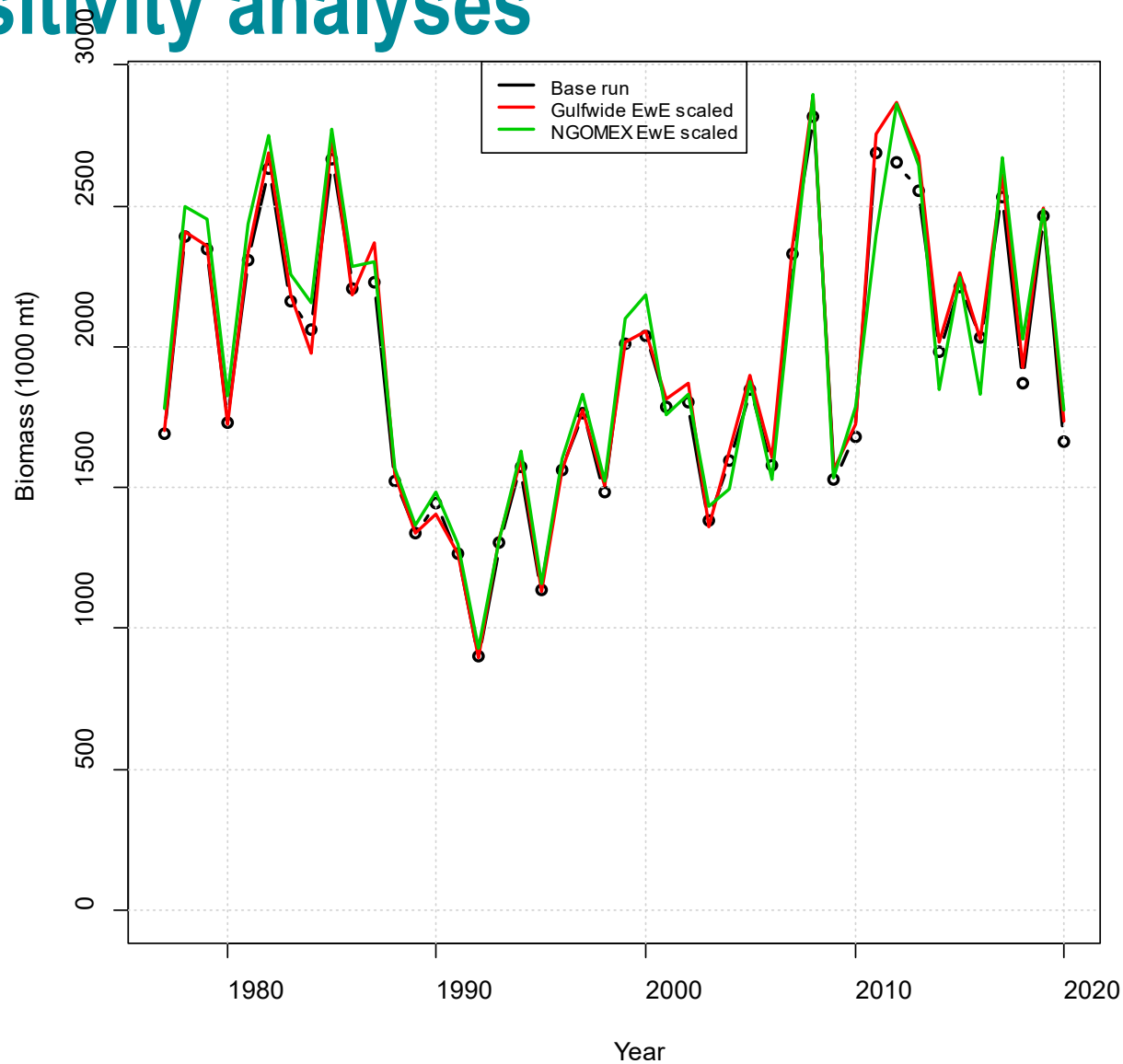
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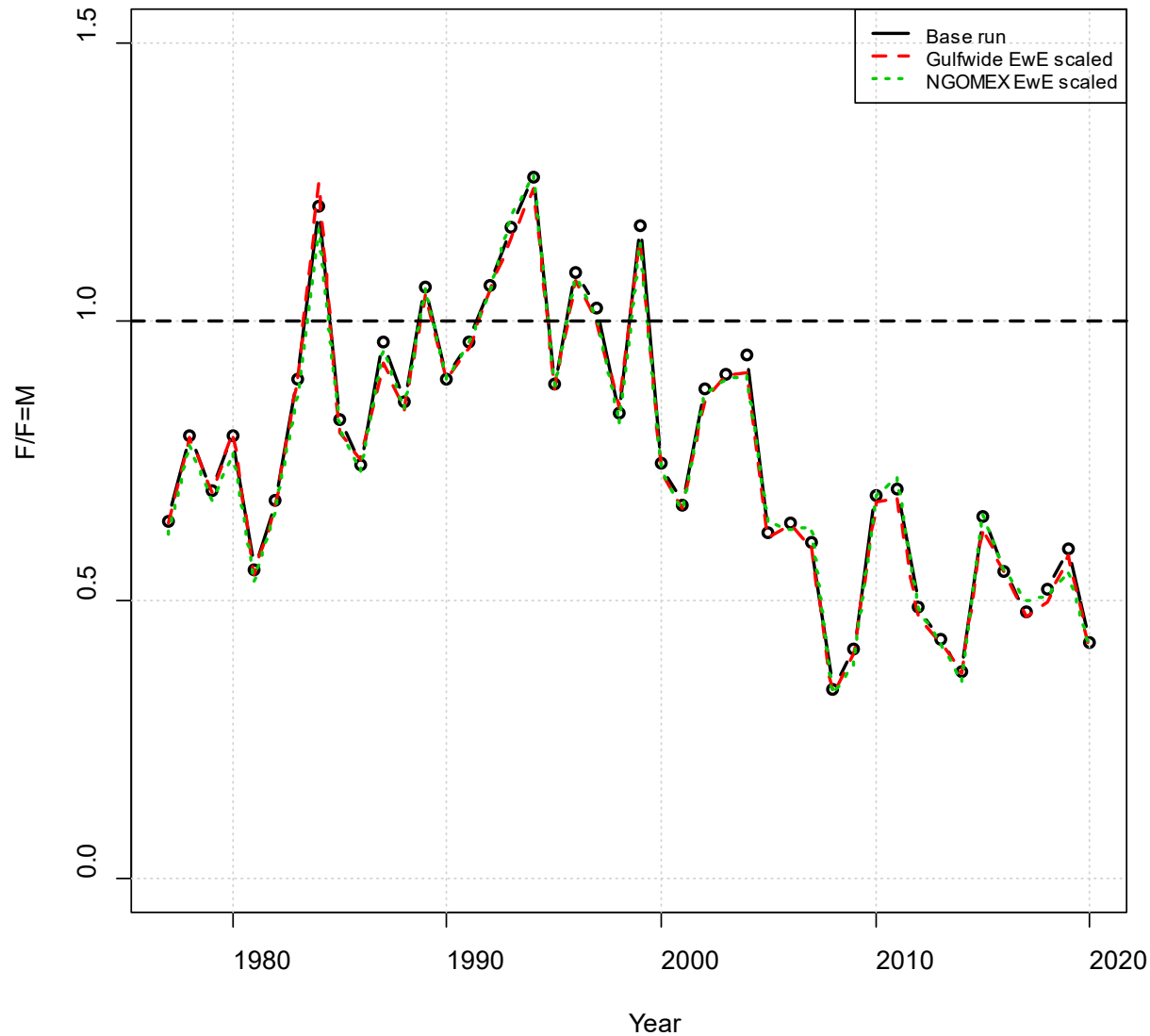
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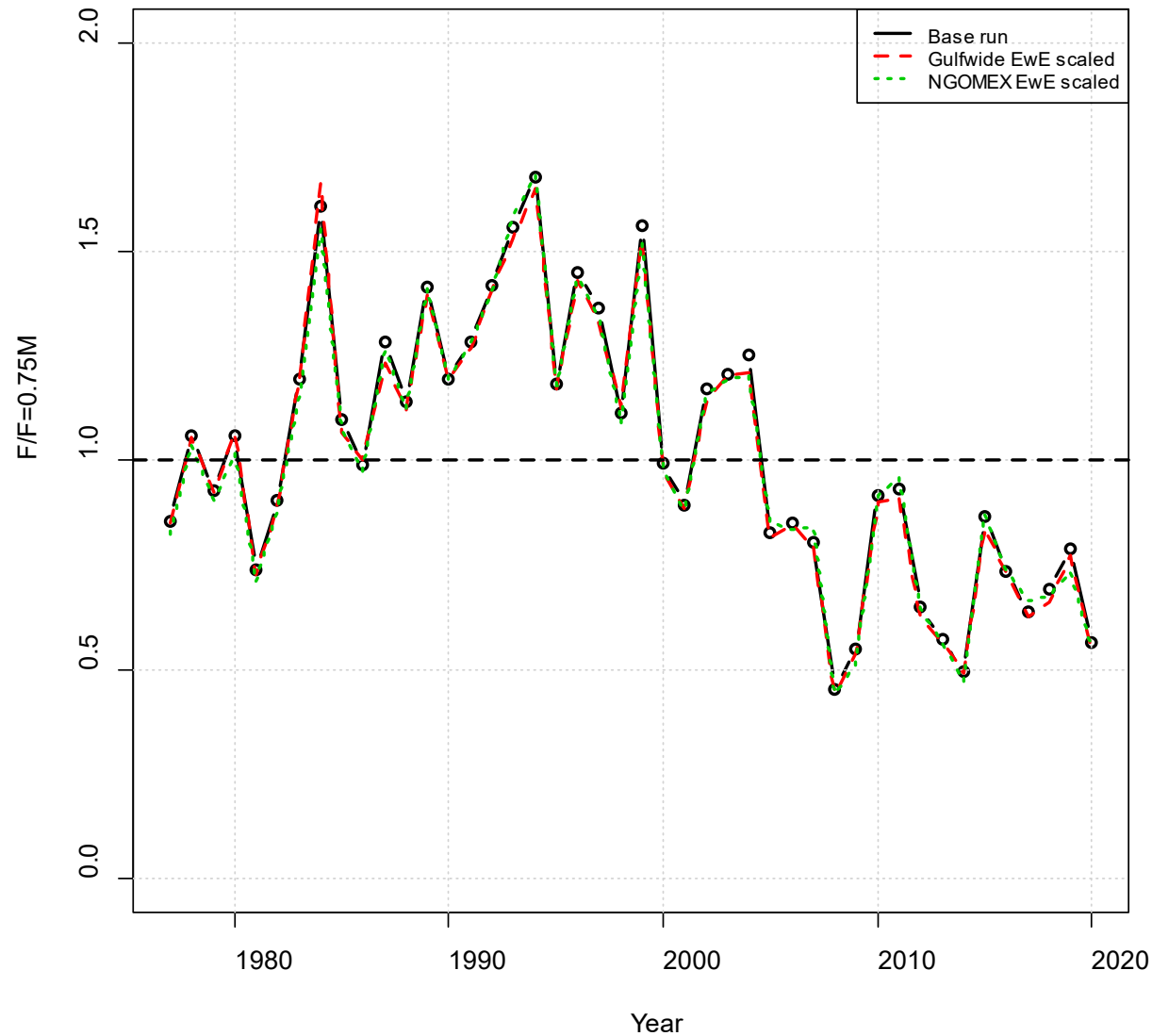
Sensitivity analyses



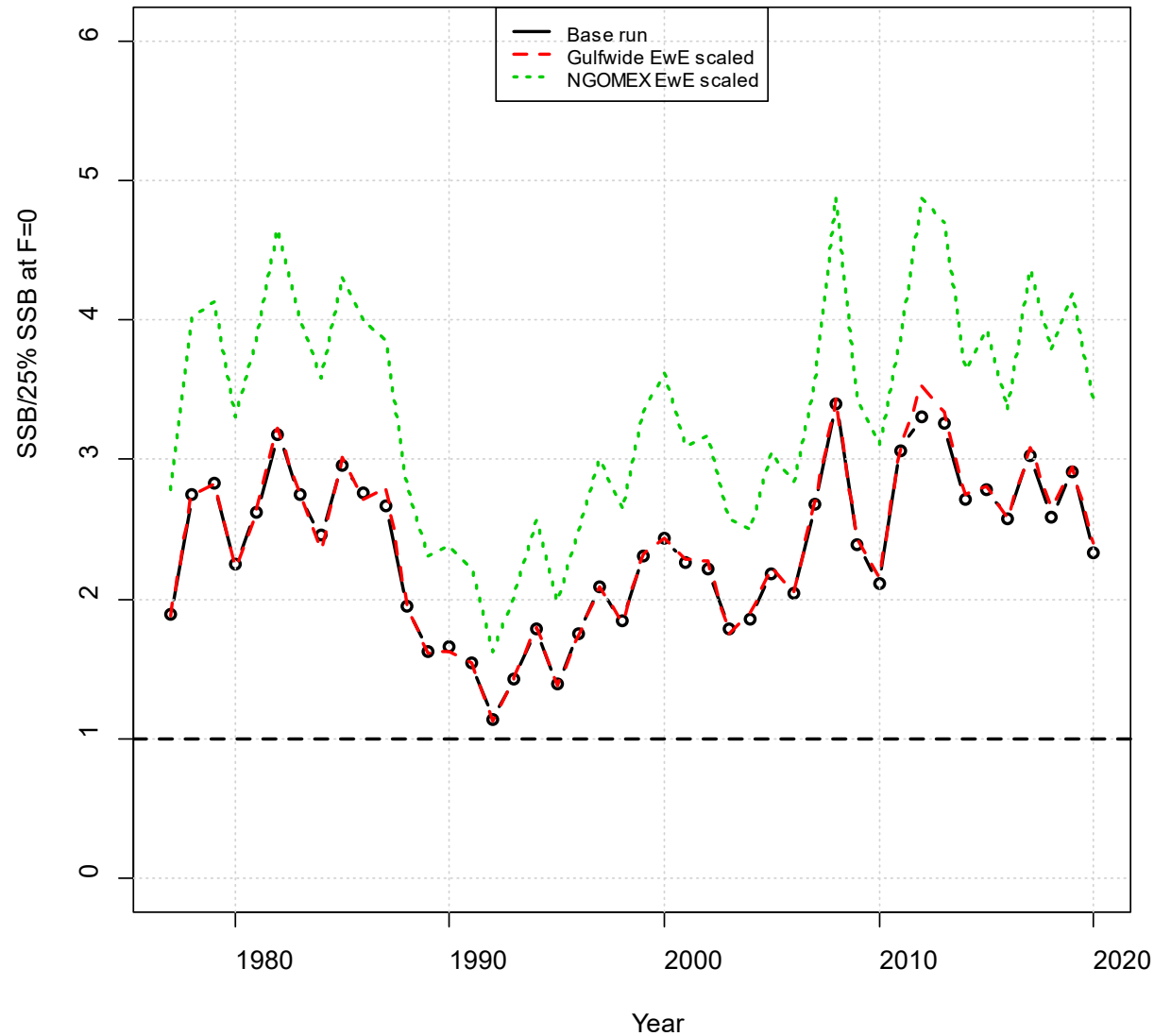
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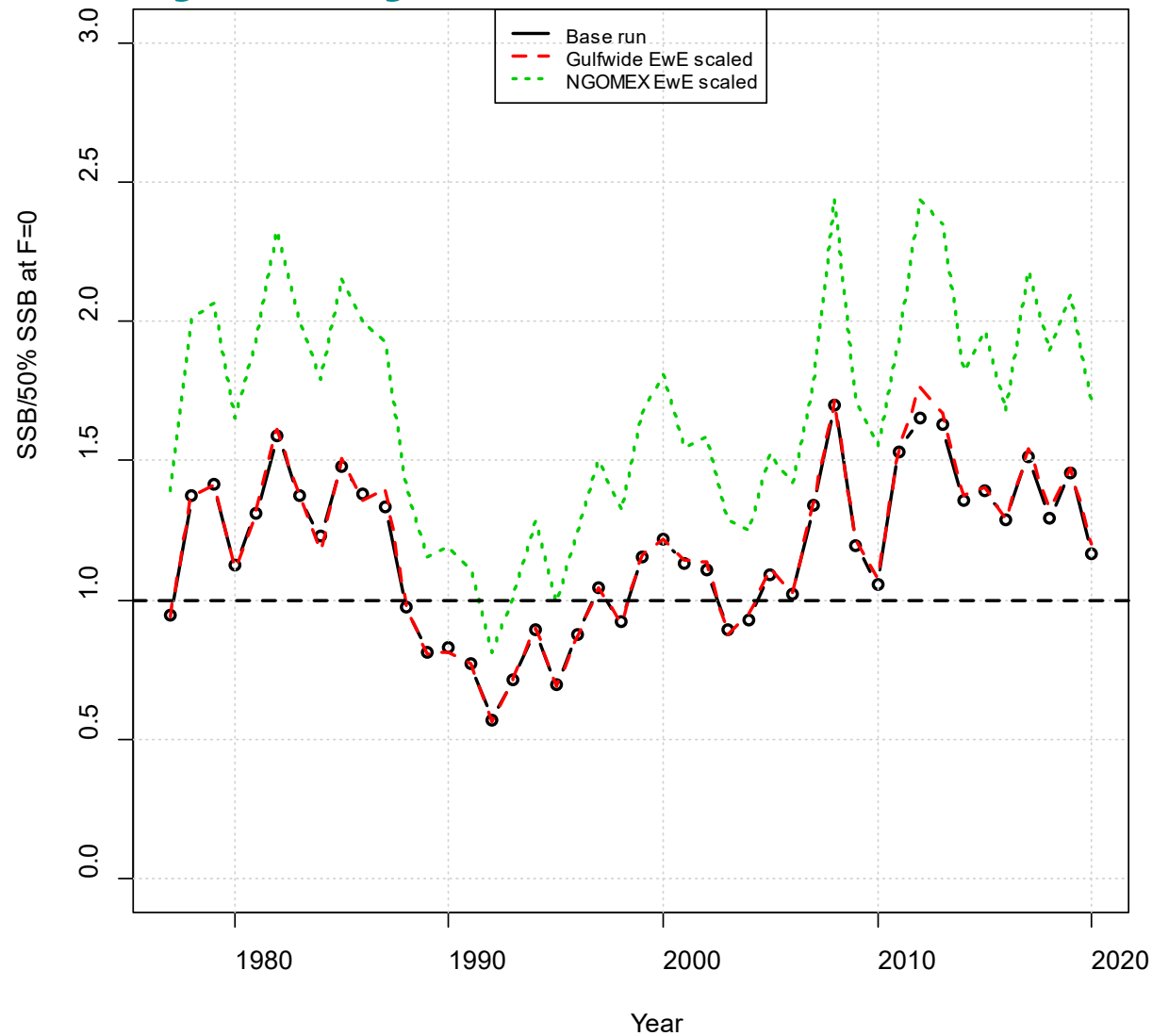
Sensitivity analyses



Sensitivity analyses



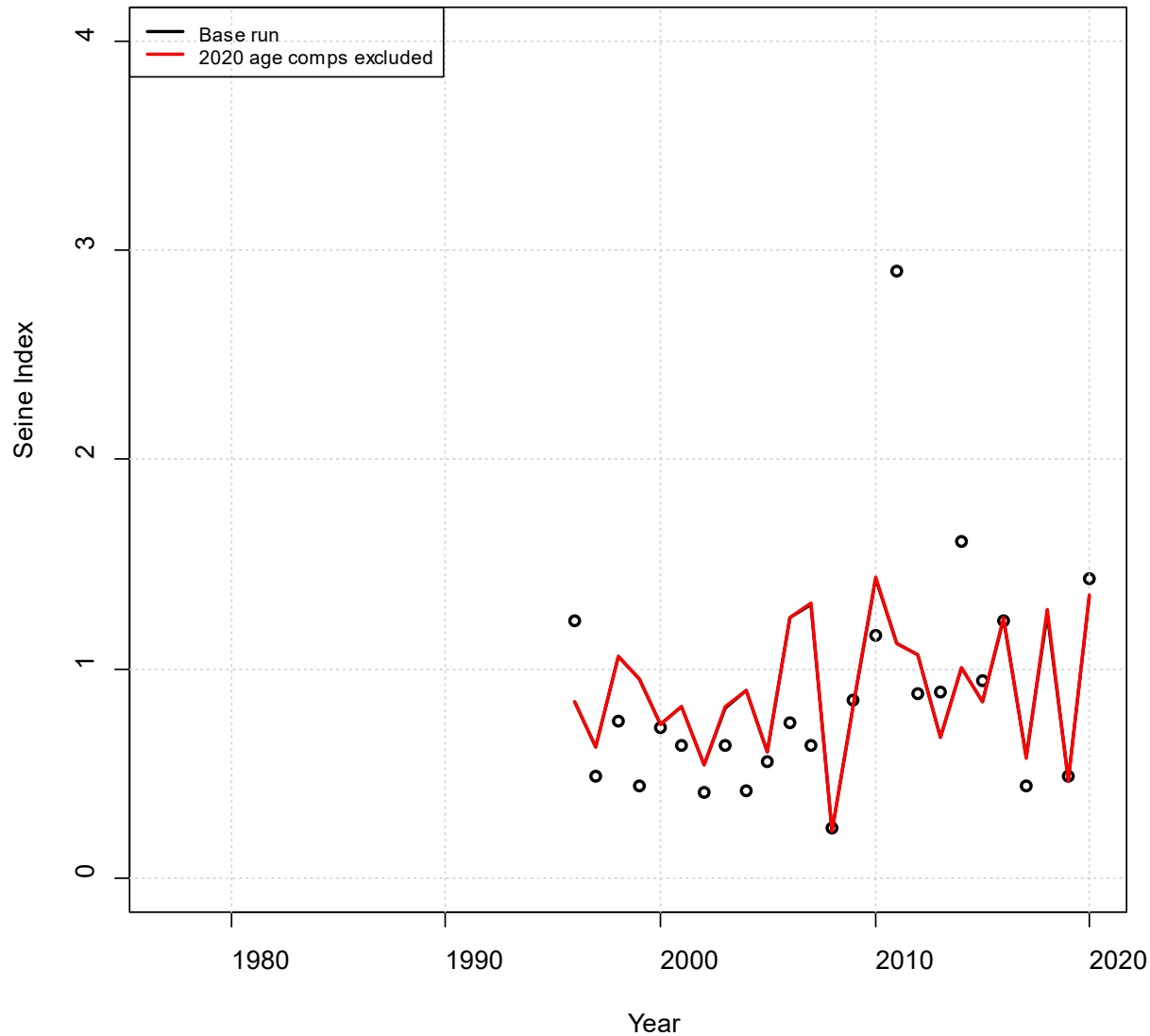
Sensitivity analyses



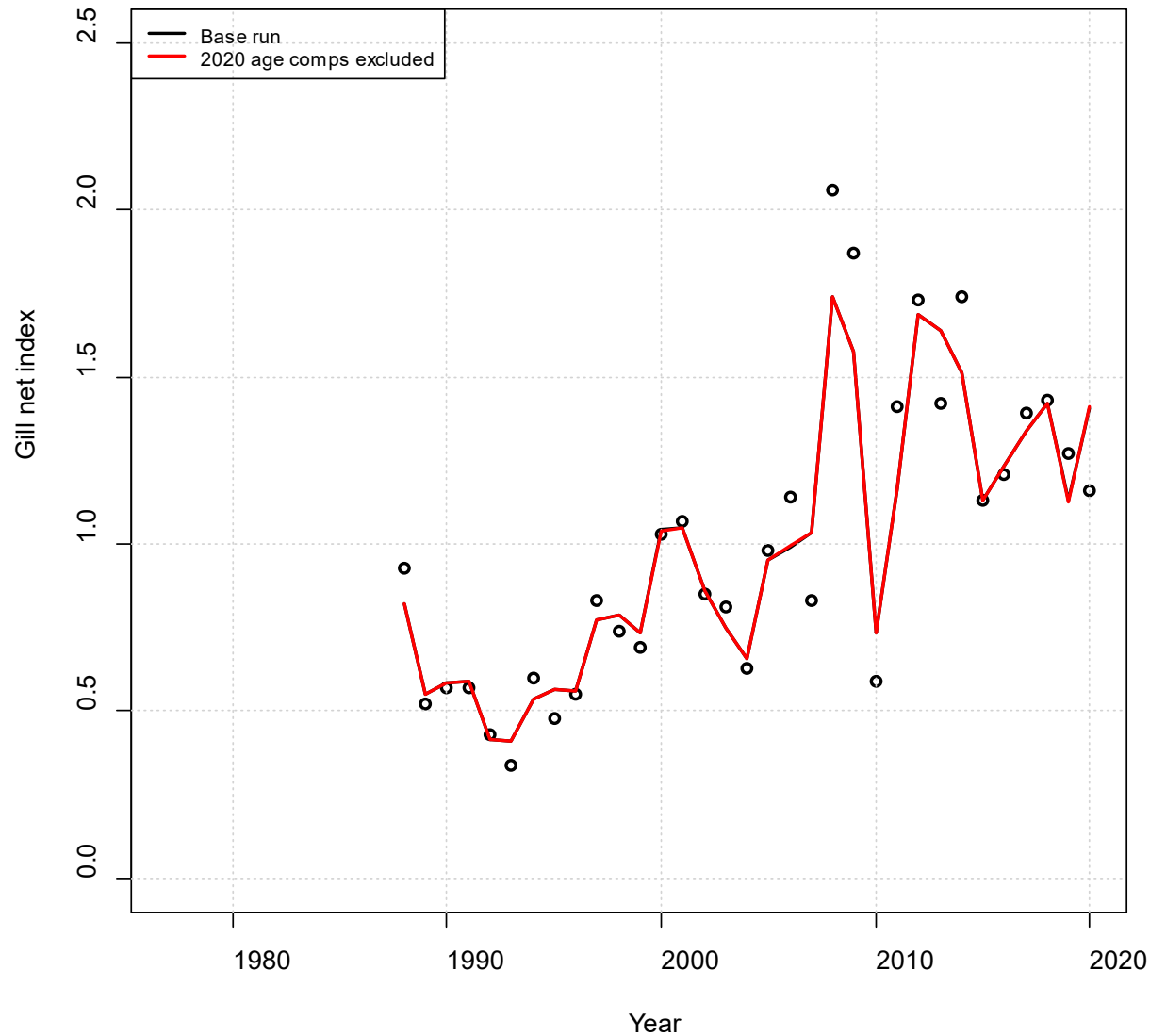
Sensitivity analyses

- Age data for 2020 for the commercial reduction fishery
 - How does the 2020 sampling compare to other years?
- Ran without the 2020 age data

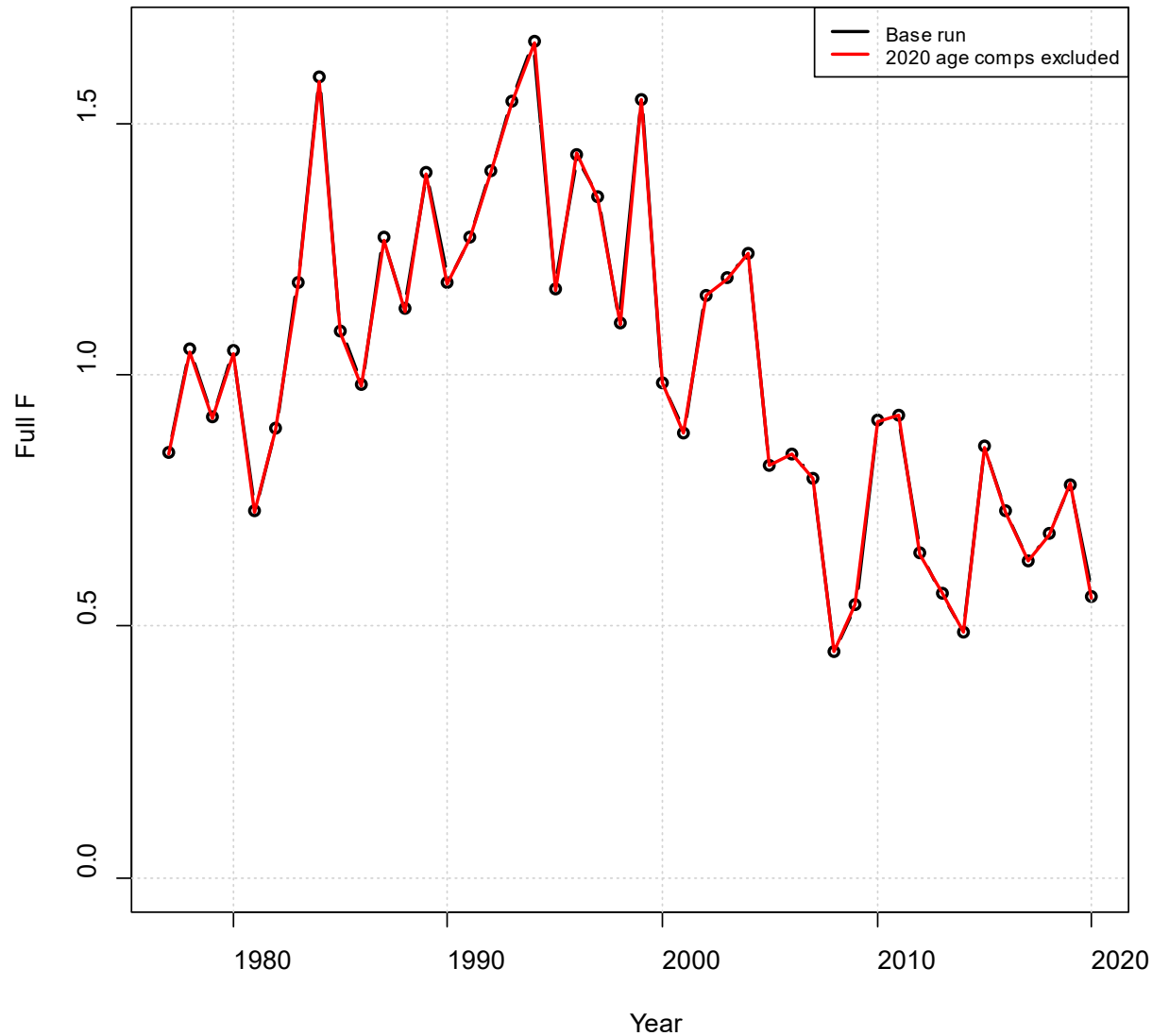
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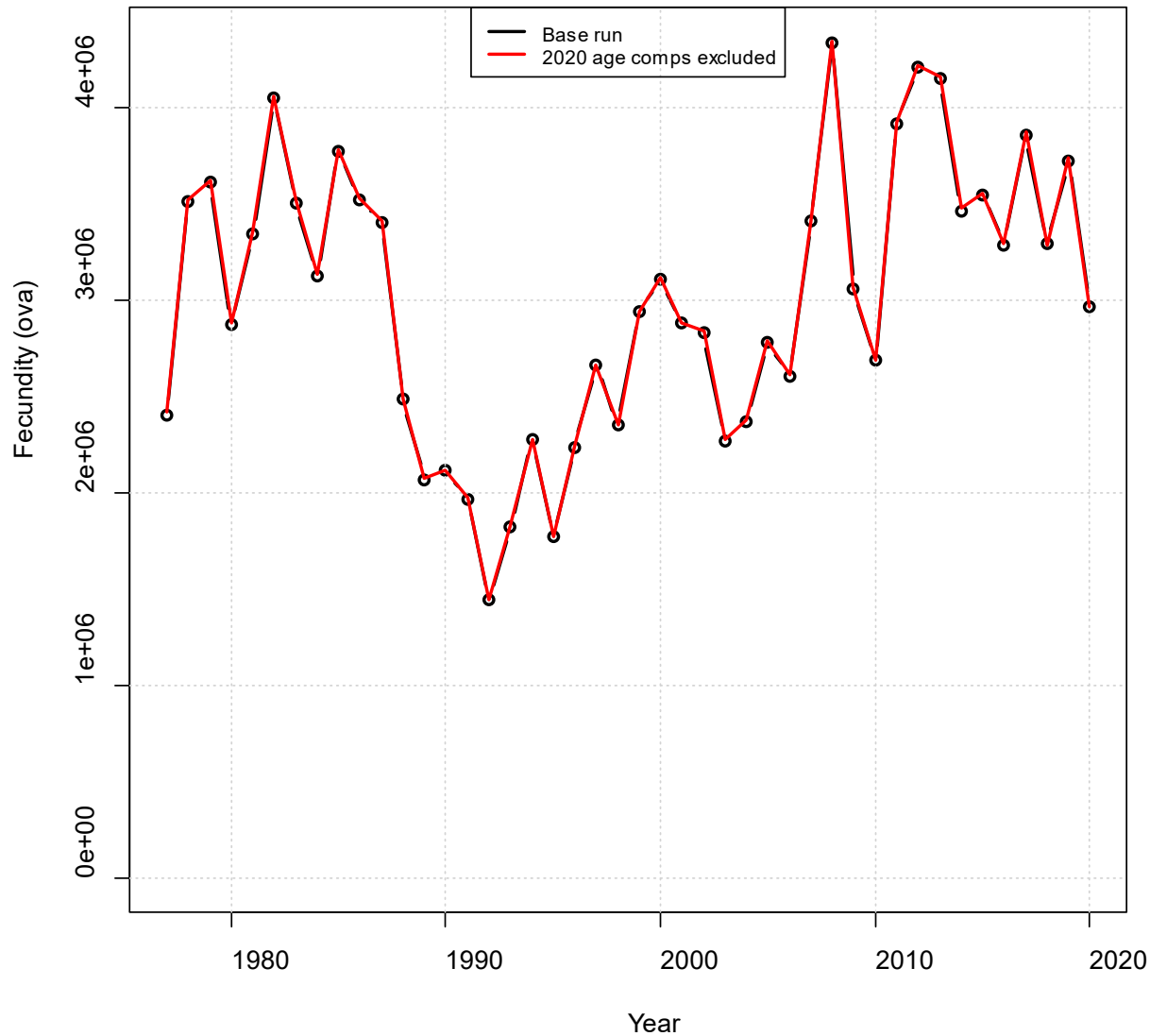
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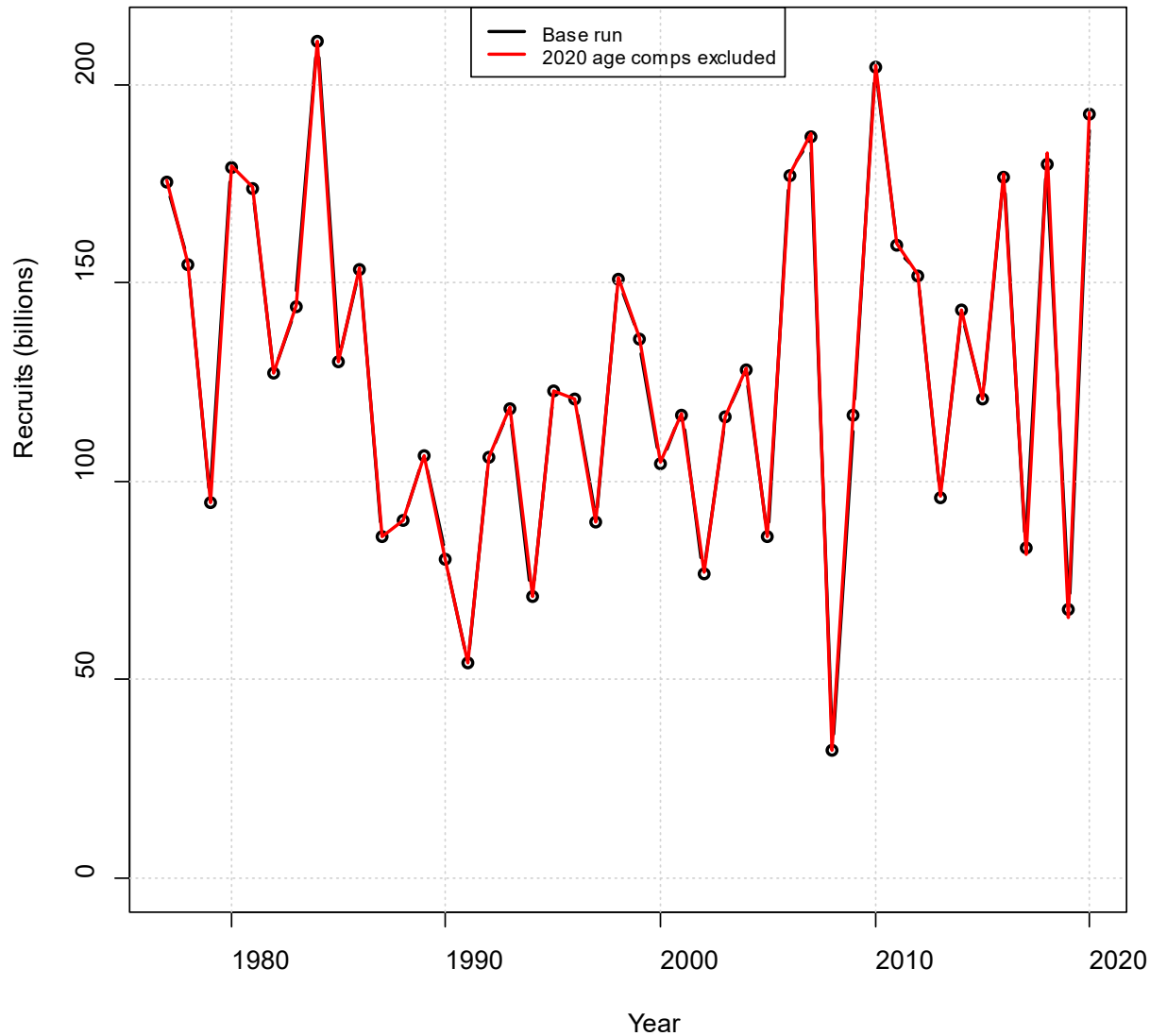
Sensitivity analyses



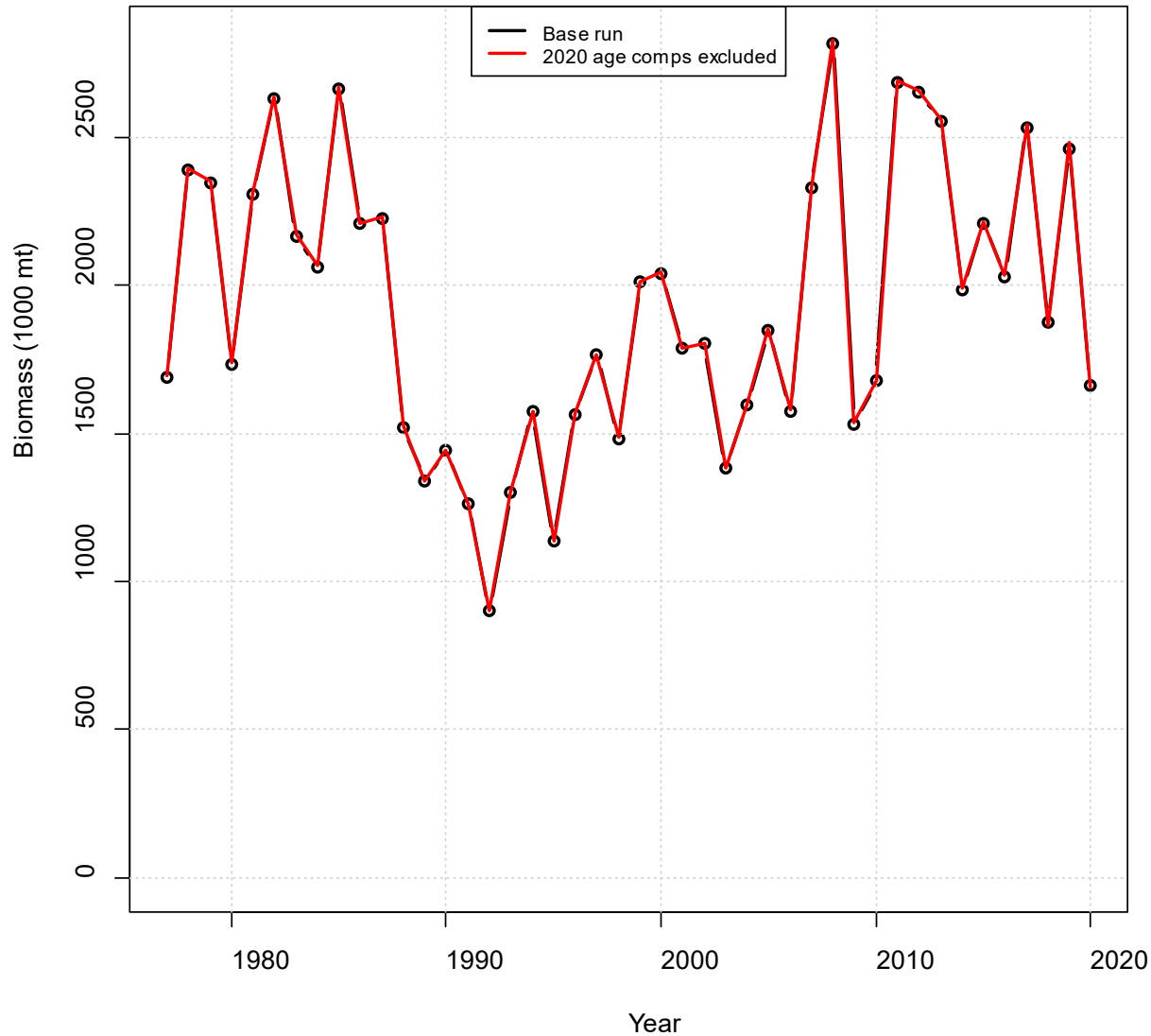
Sensitivity analyses



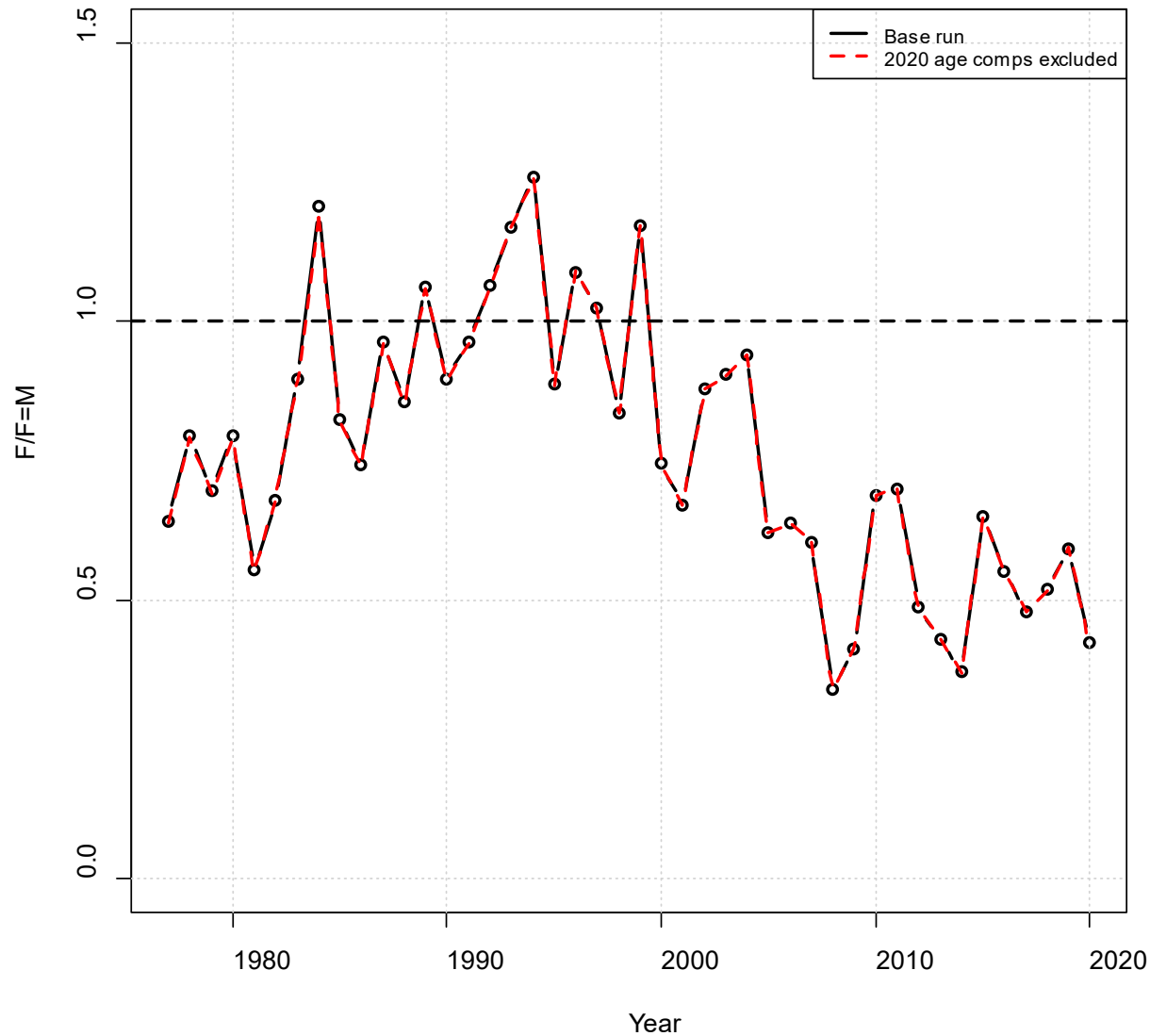
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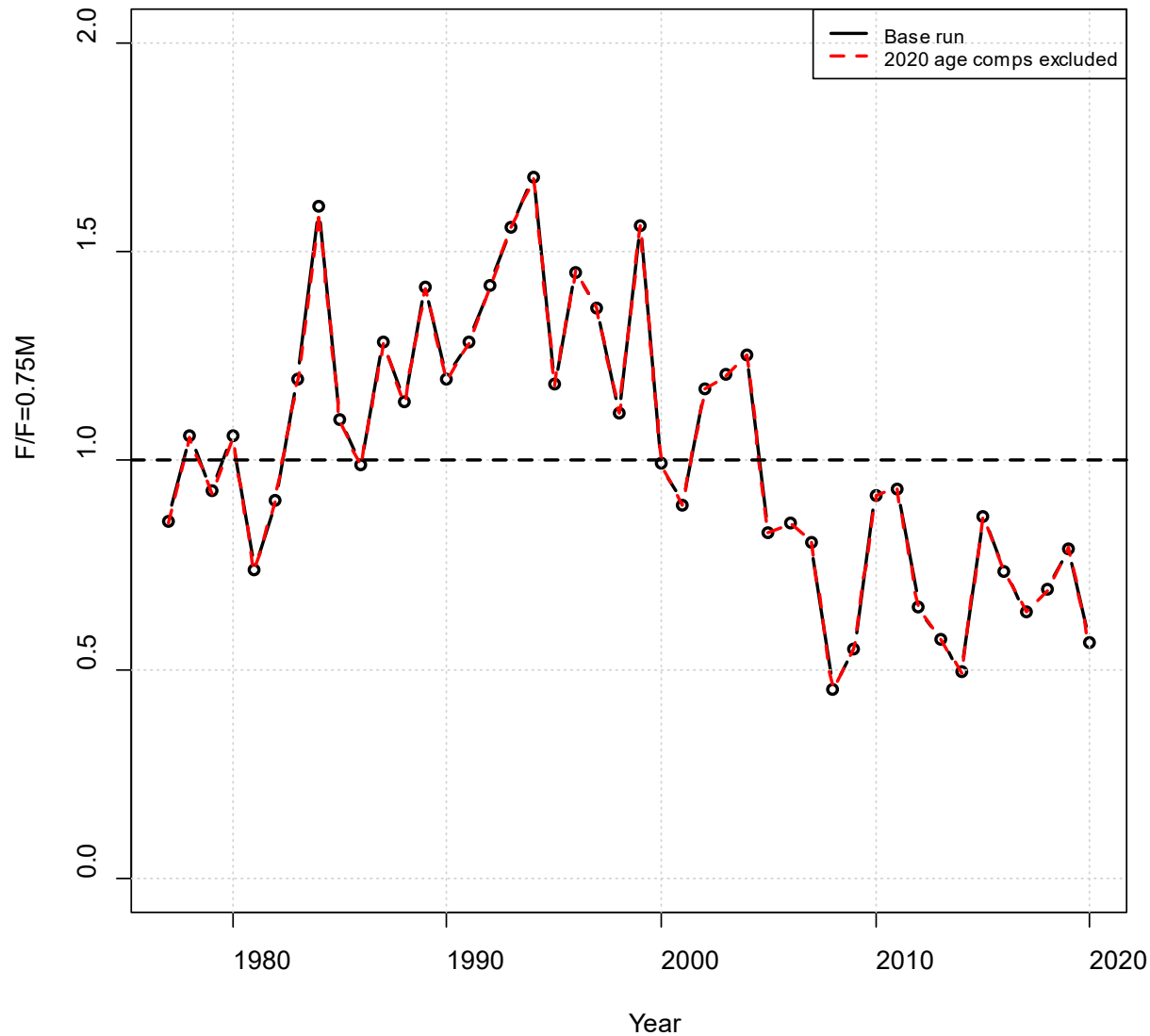
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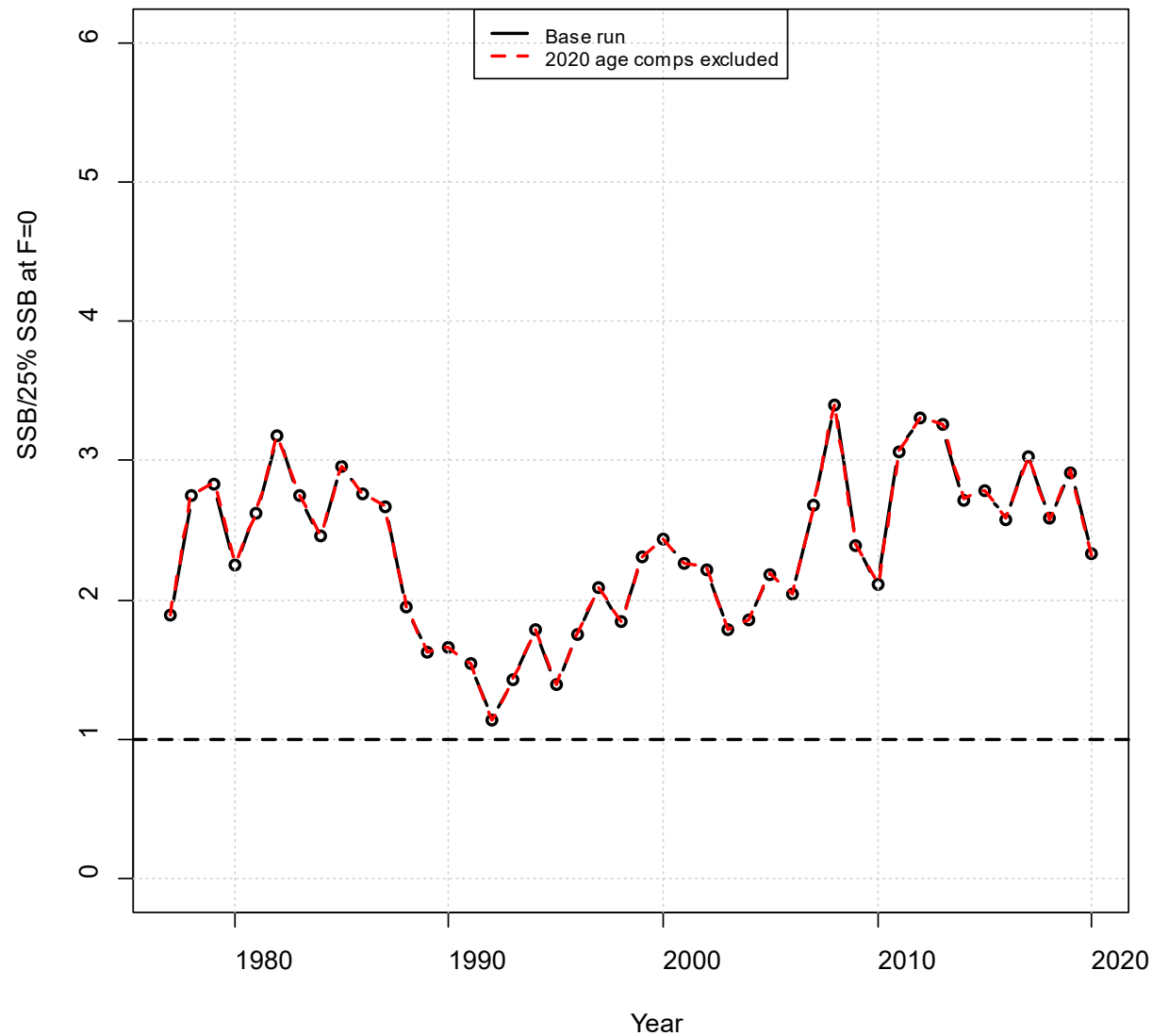
Sensitivity analyses



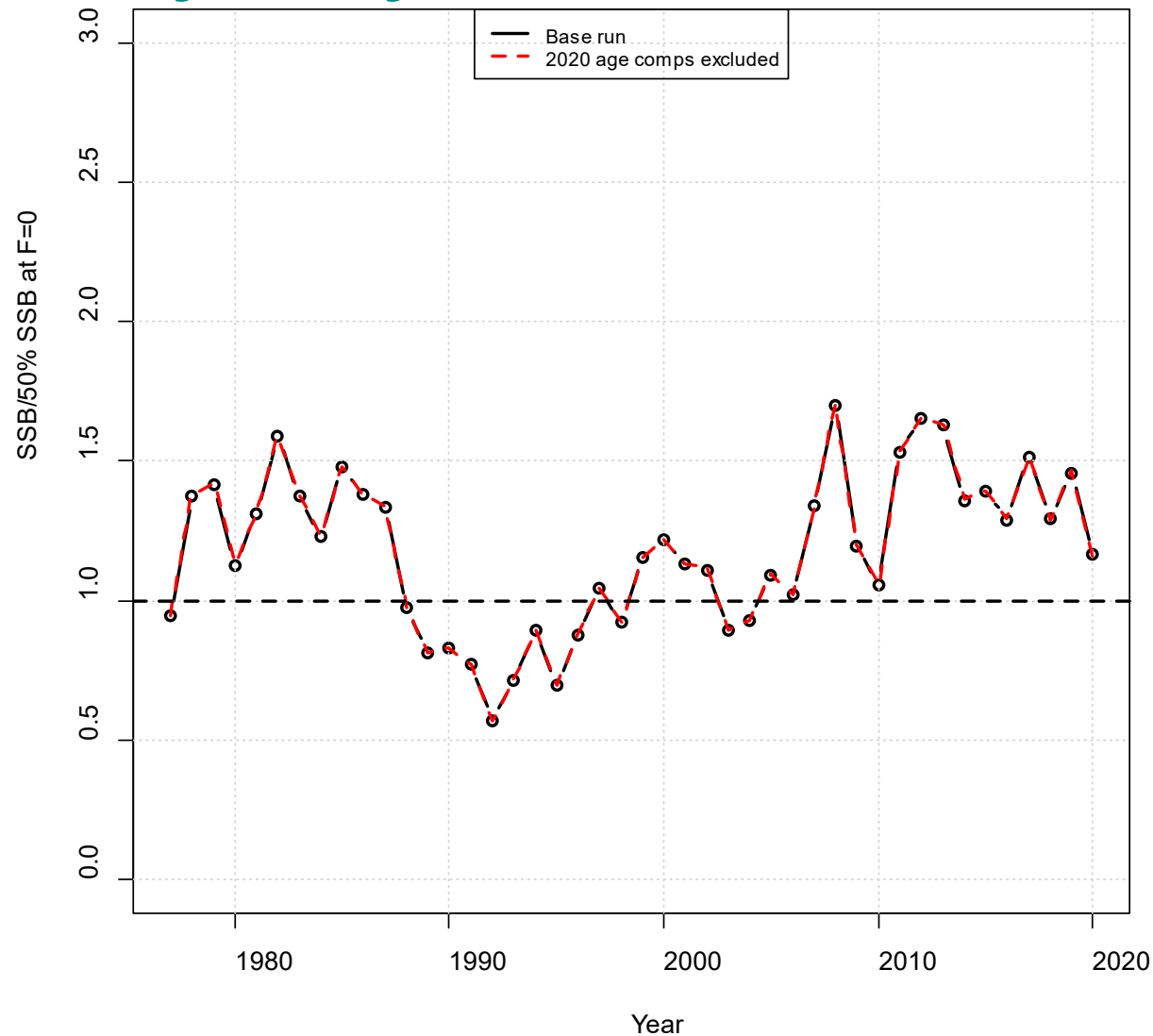
Sensitivity analyses



Sensitivity analyses



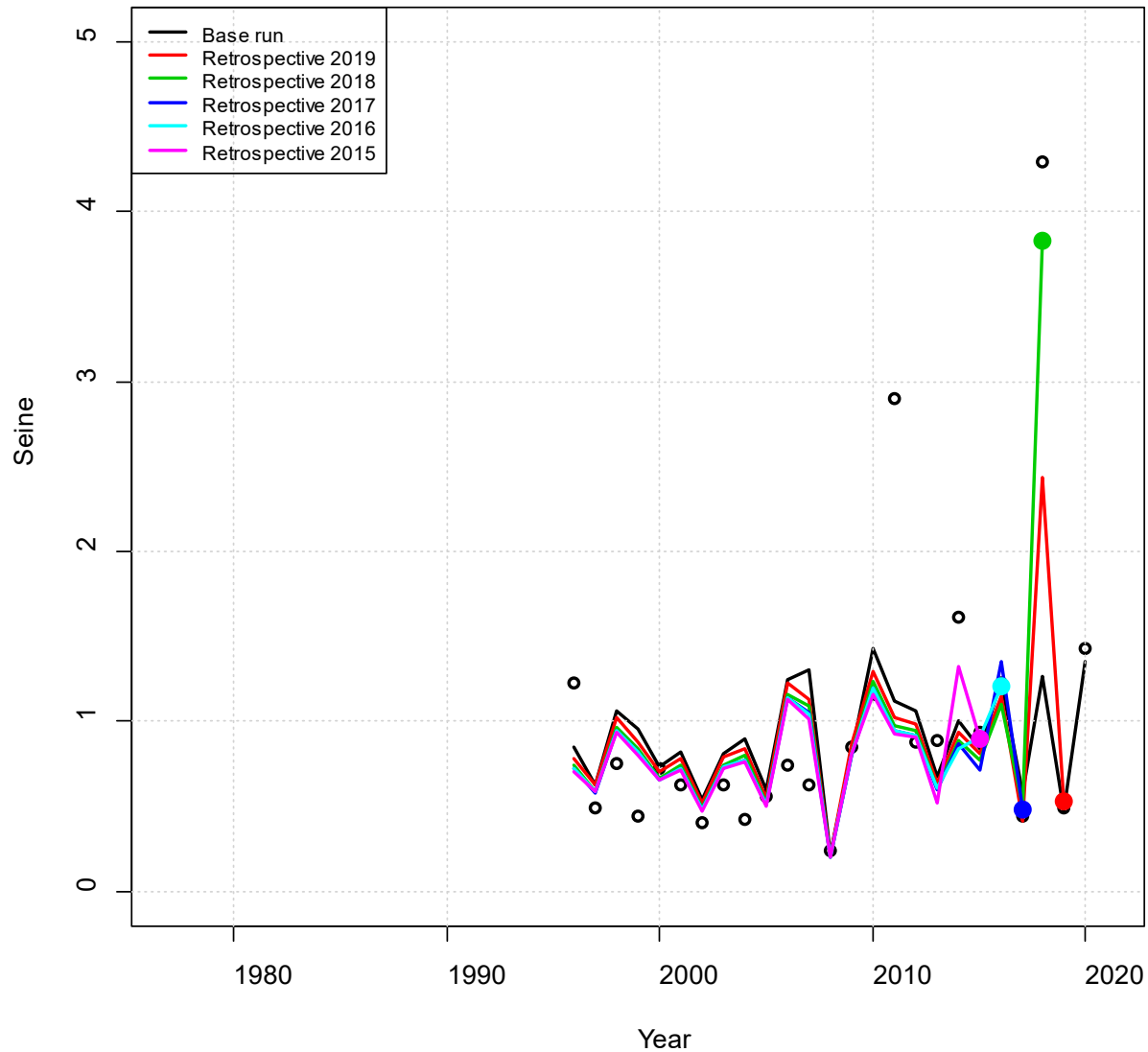
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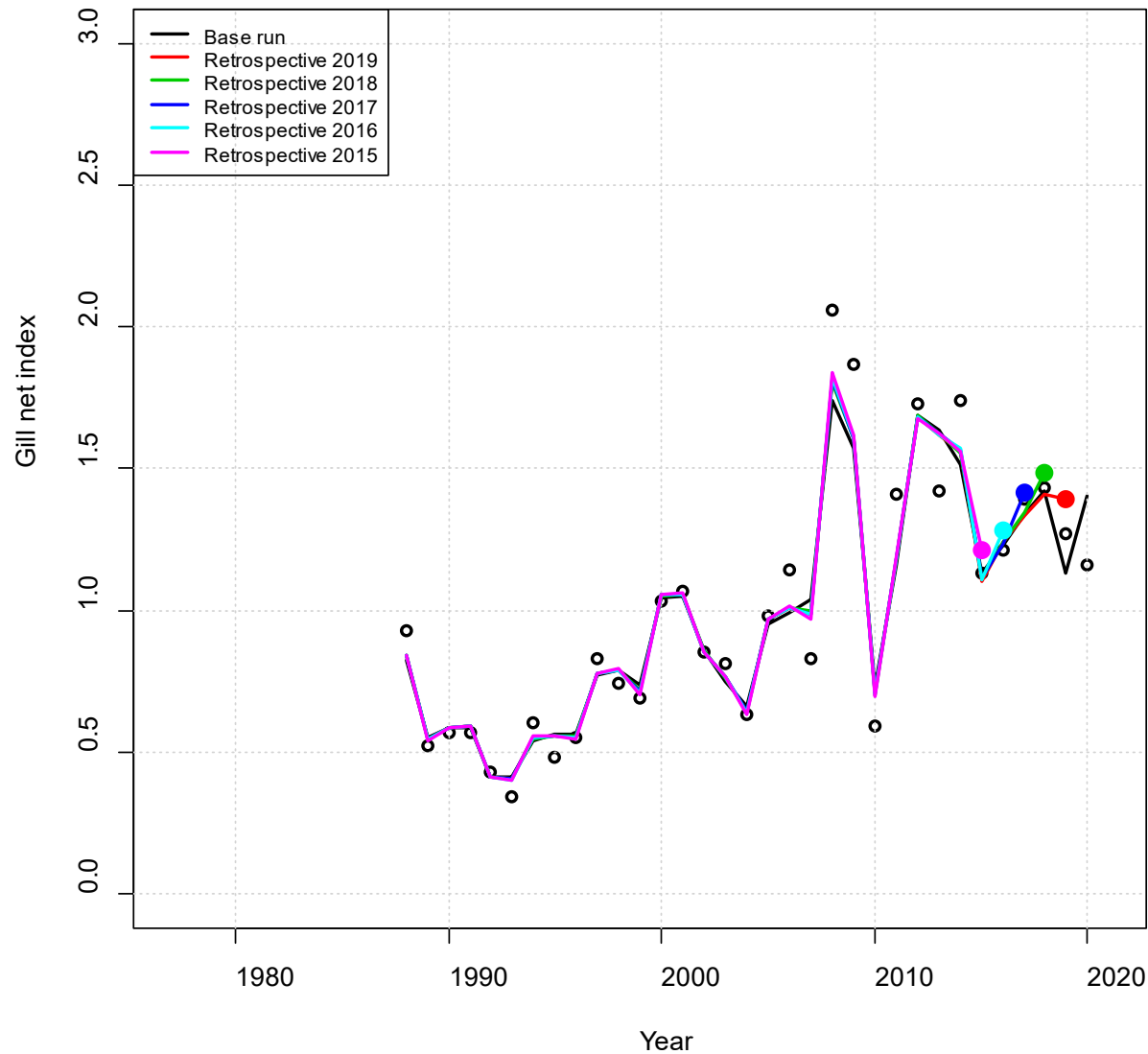
Sensitivity analyses

- Retrospective

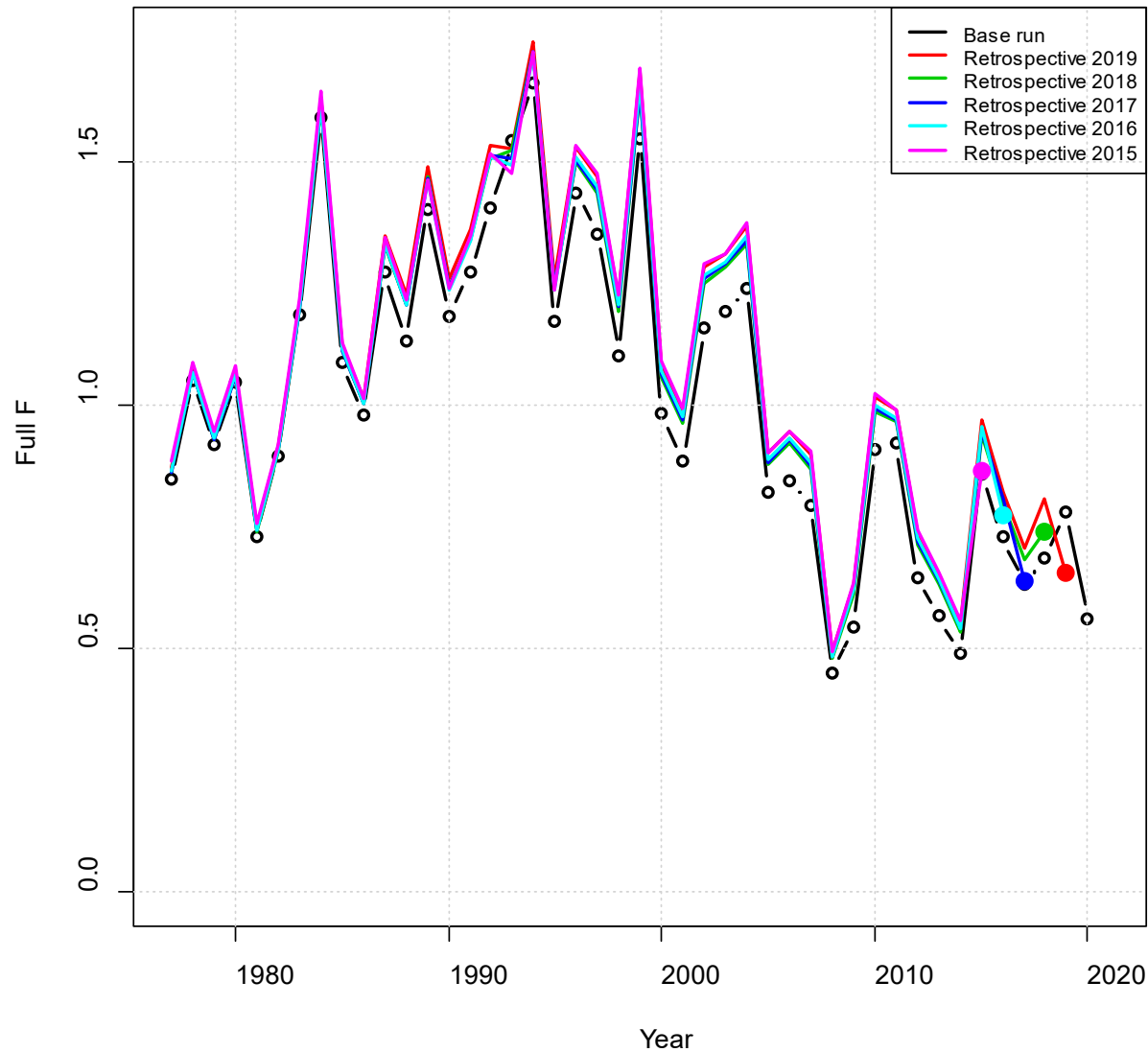
Sensitivity analyses - Retrospective



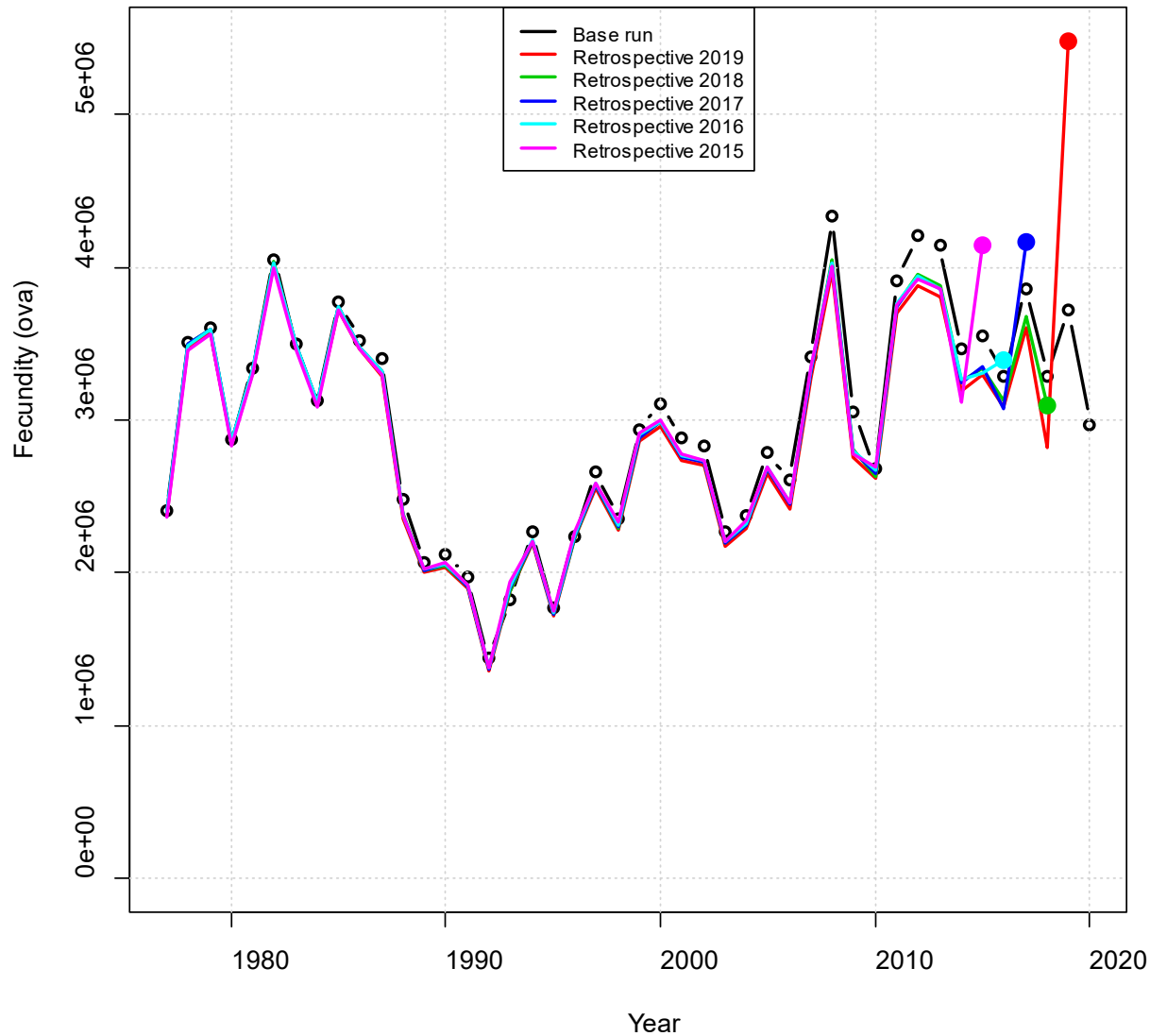
Sensitivity analyses - Retrospective



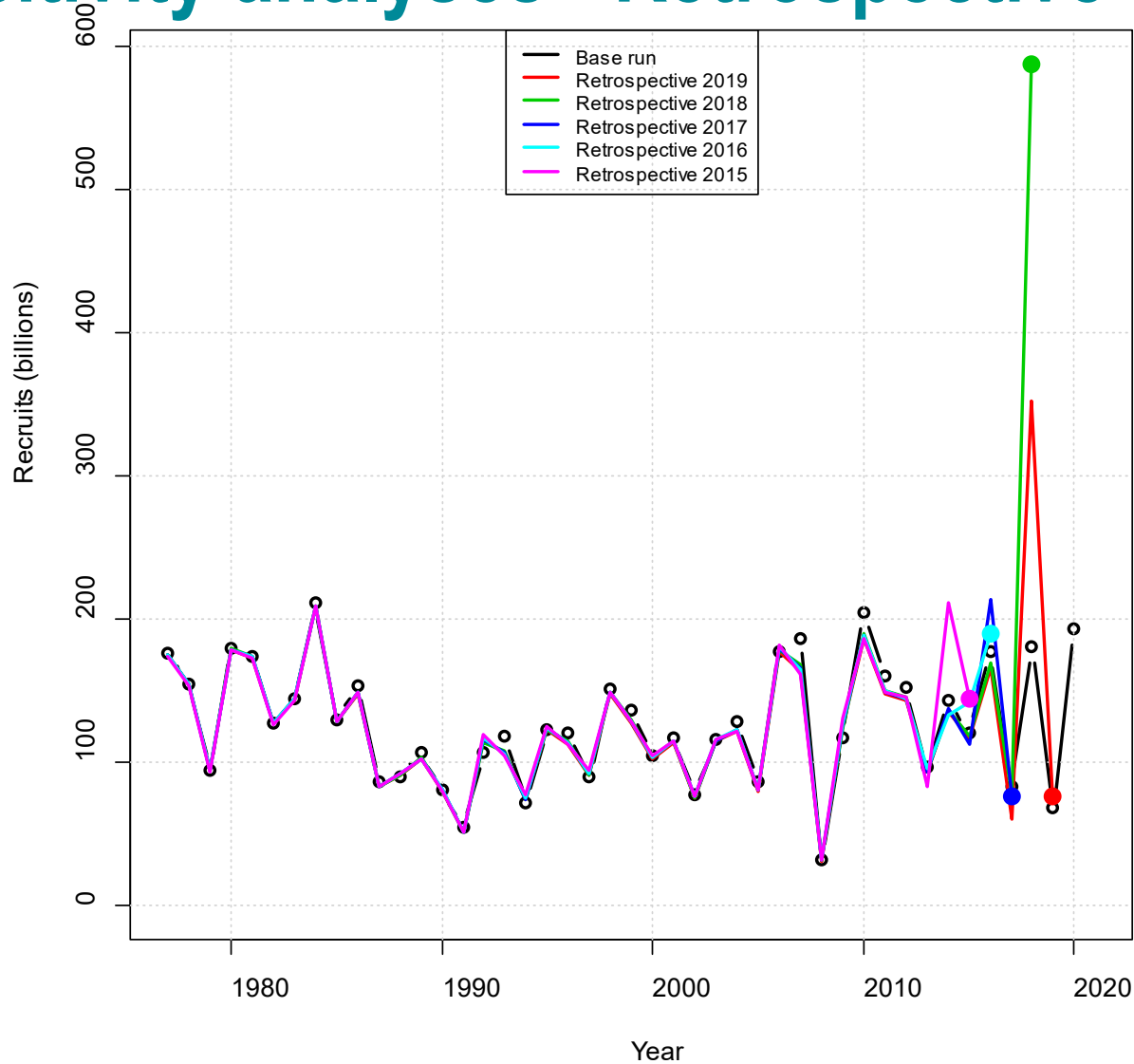
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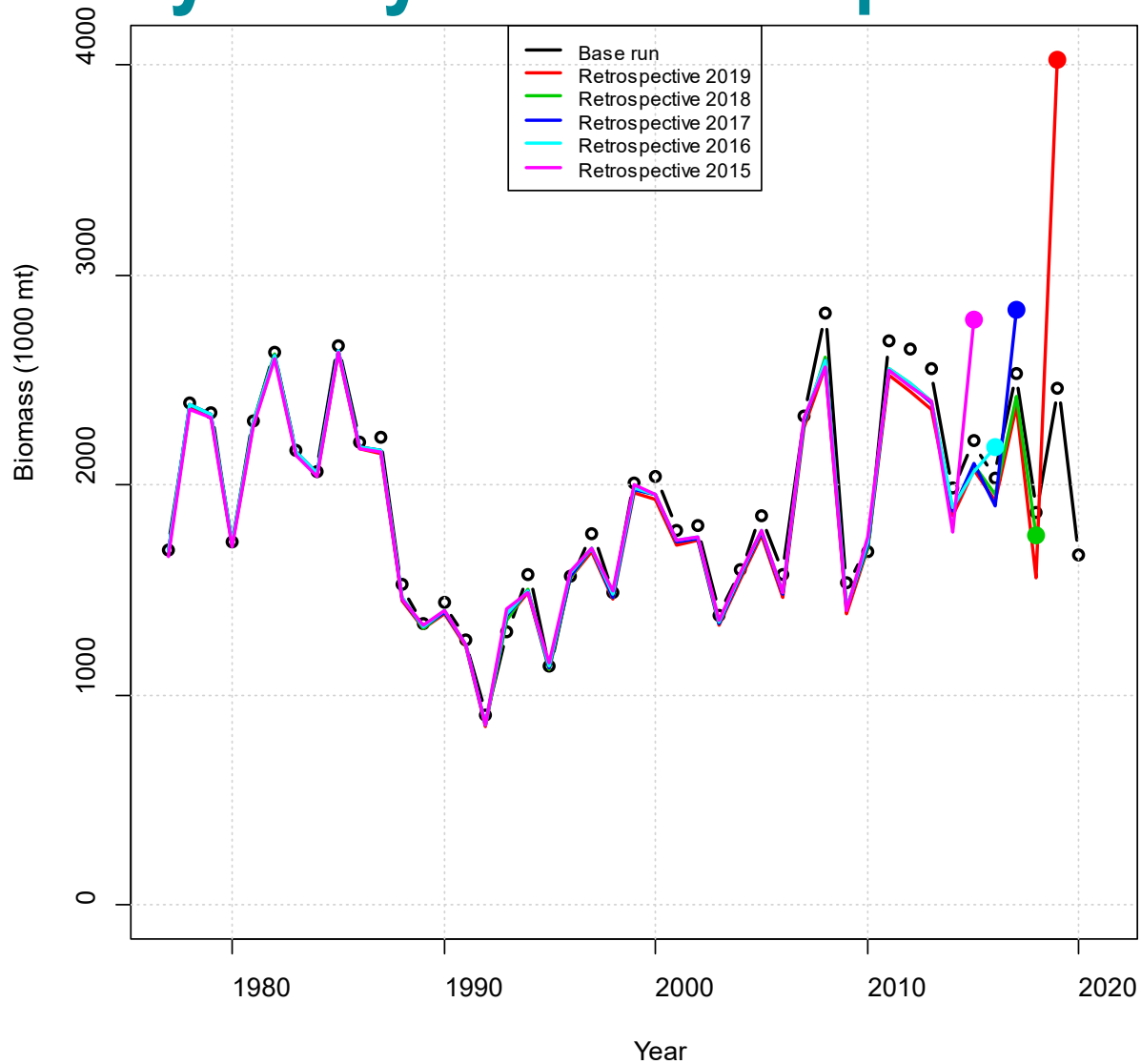
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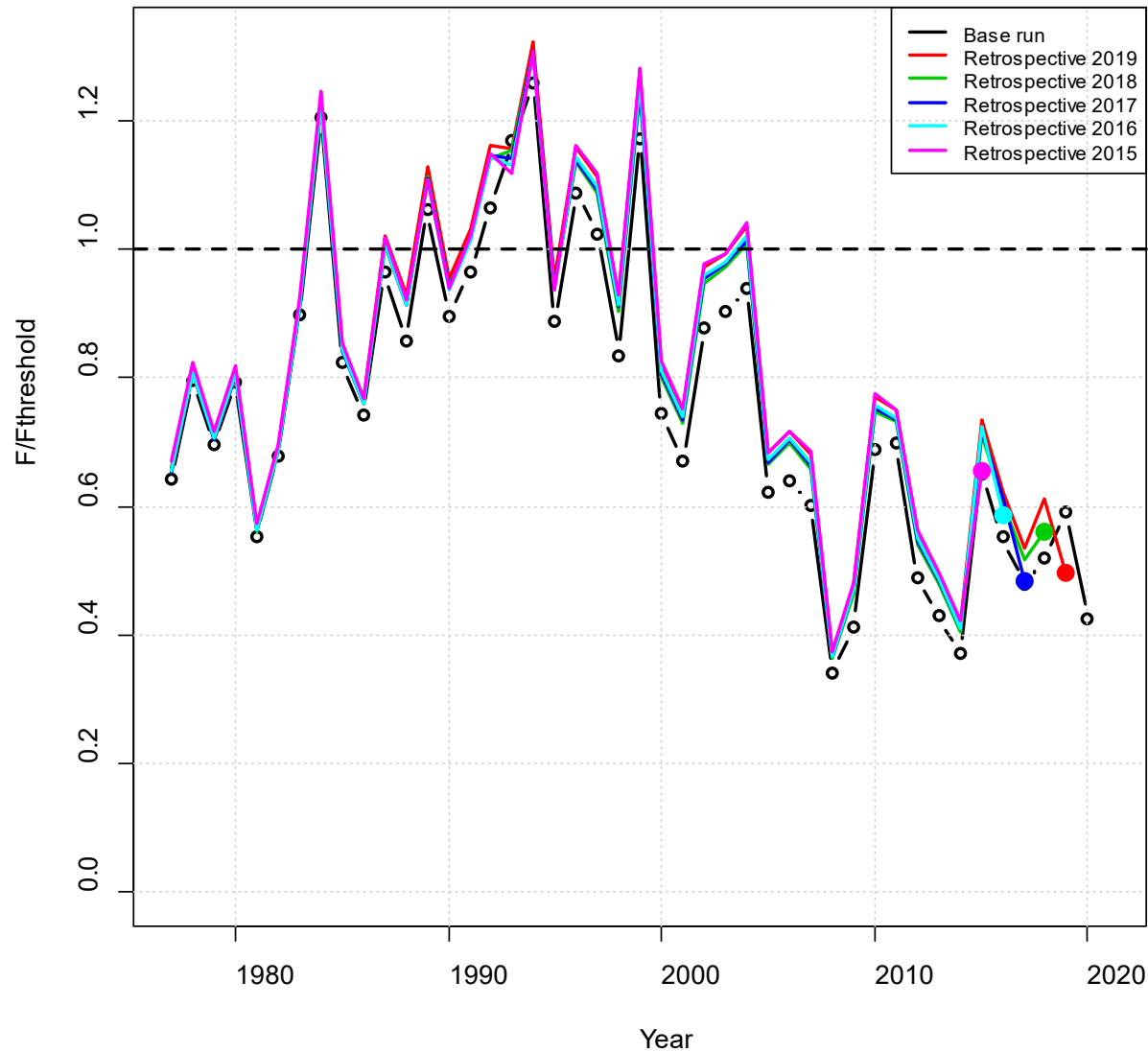
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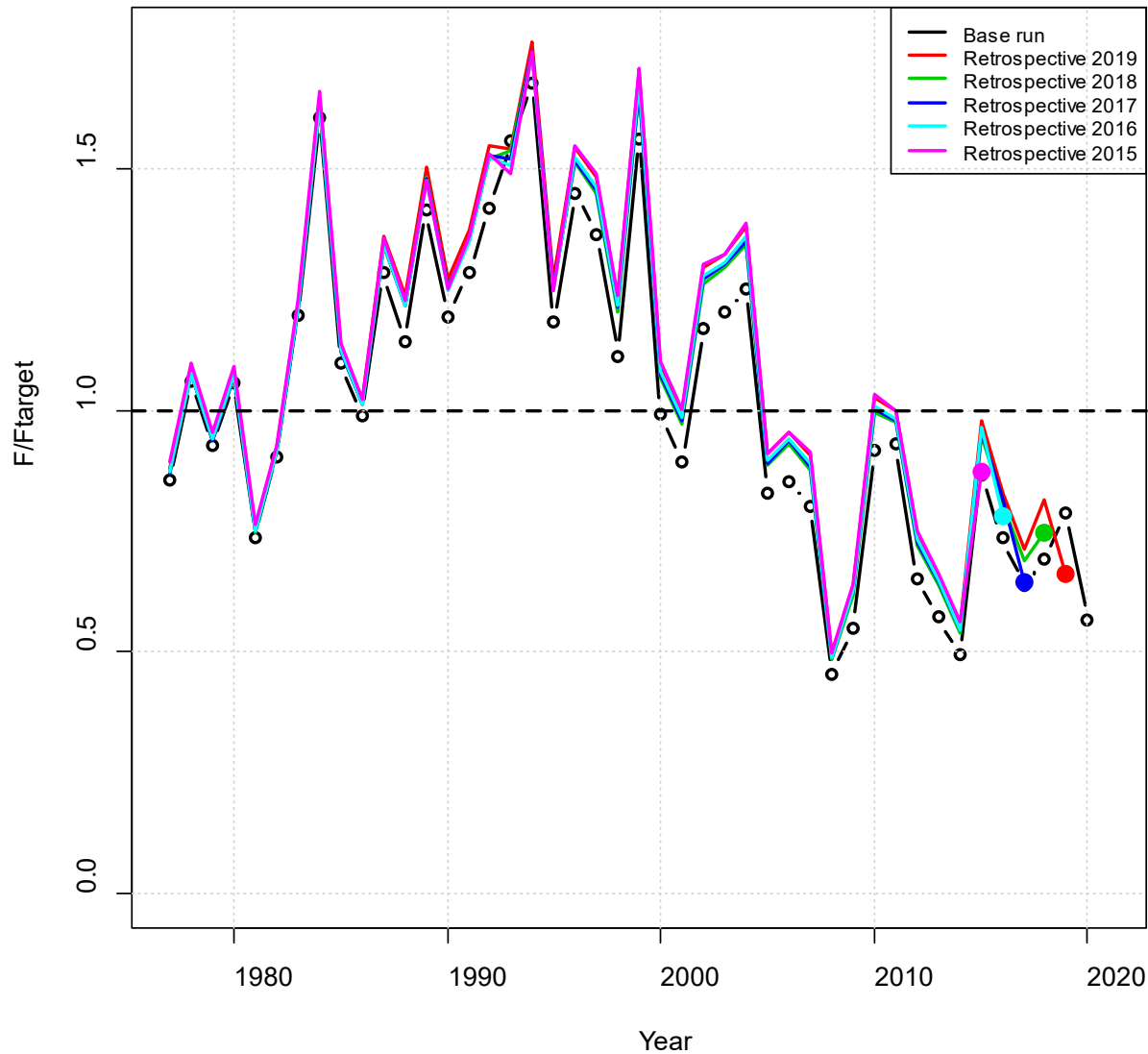
Sensitivity analyses - Retrospective



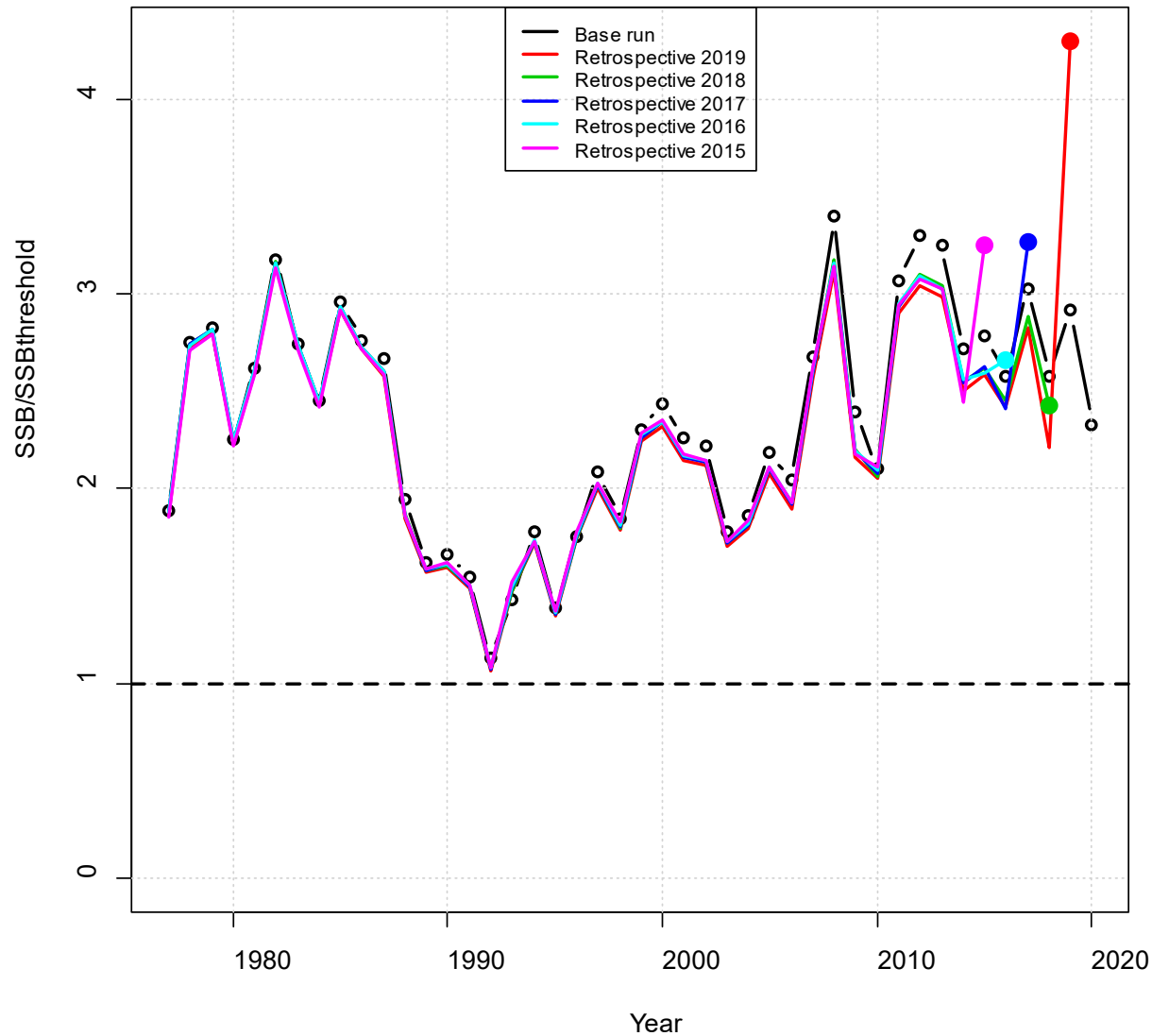
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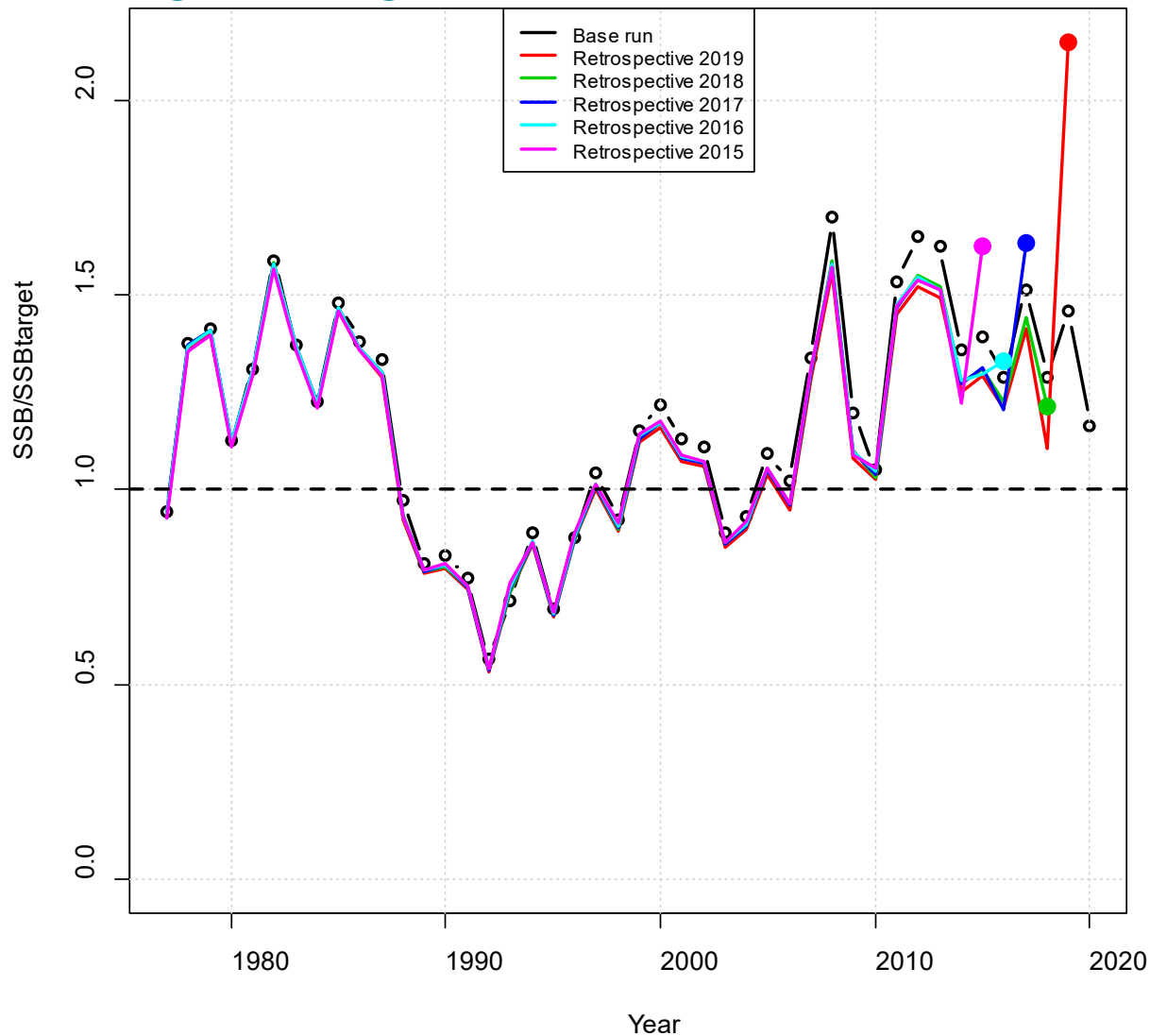
Sensitivity analyses - Retrospective



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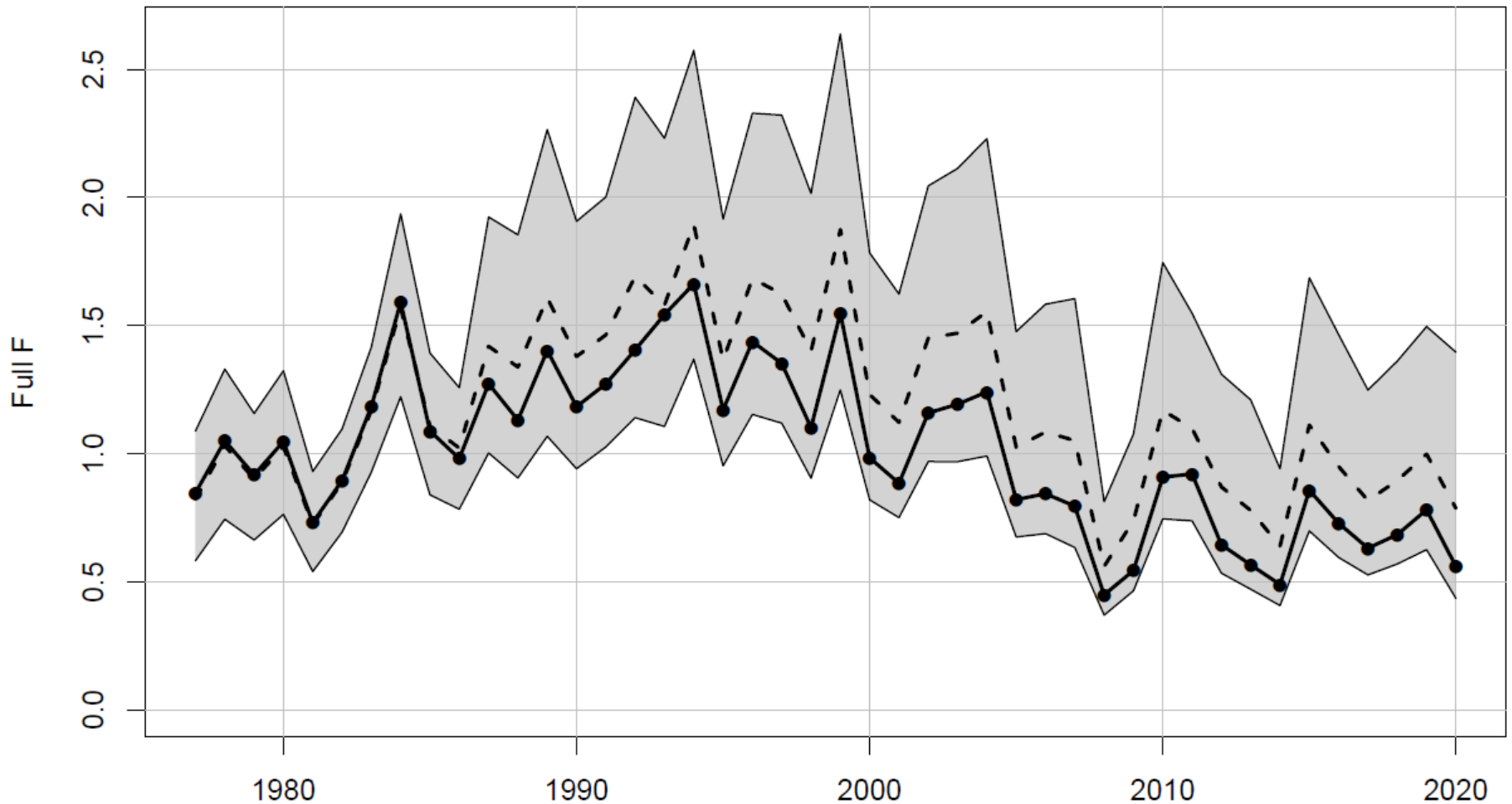
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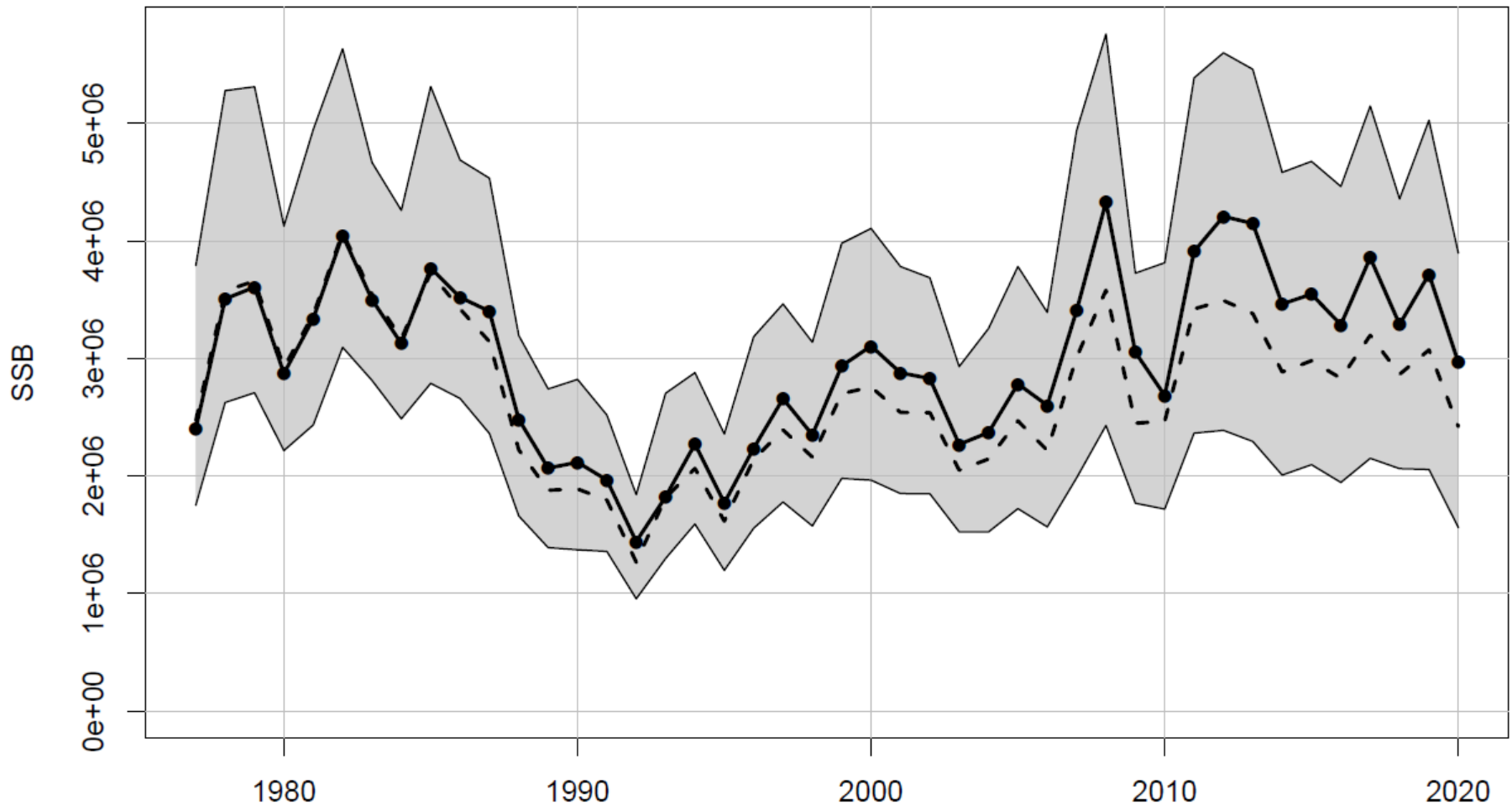
Monte Carlo bootstrap configuration

- Include uncertainty in (same as benchmark):
 - Landings
 - Indices
 - Composition data
 - Age-3 and 4 cR sel – uniform [0.68, 0.95]
 - M – scale based on est from paper
- Trimmed runs – total of 2,482 runs

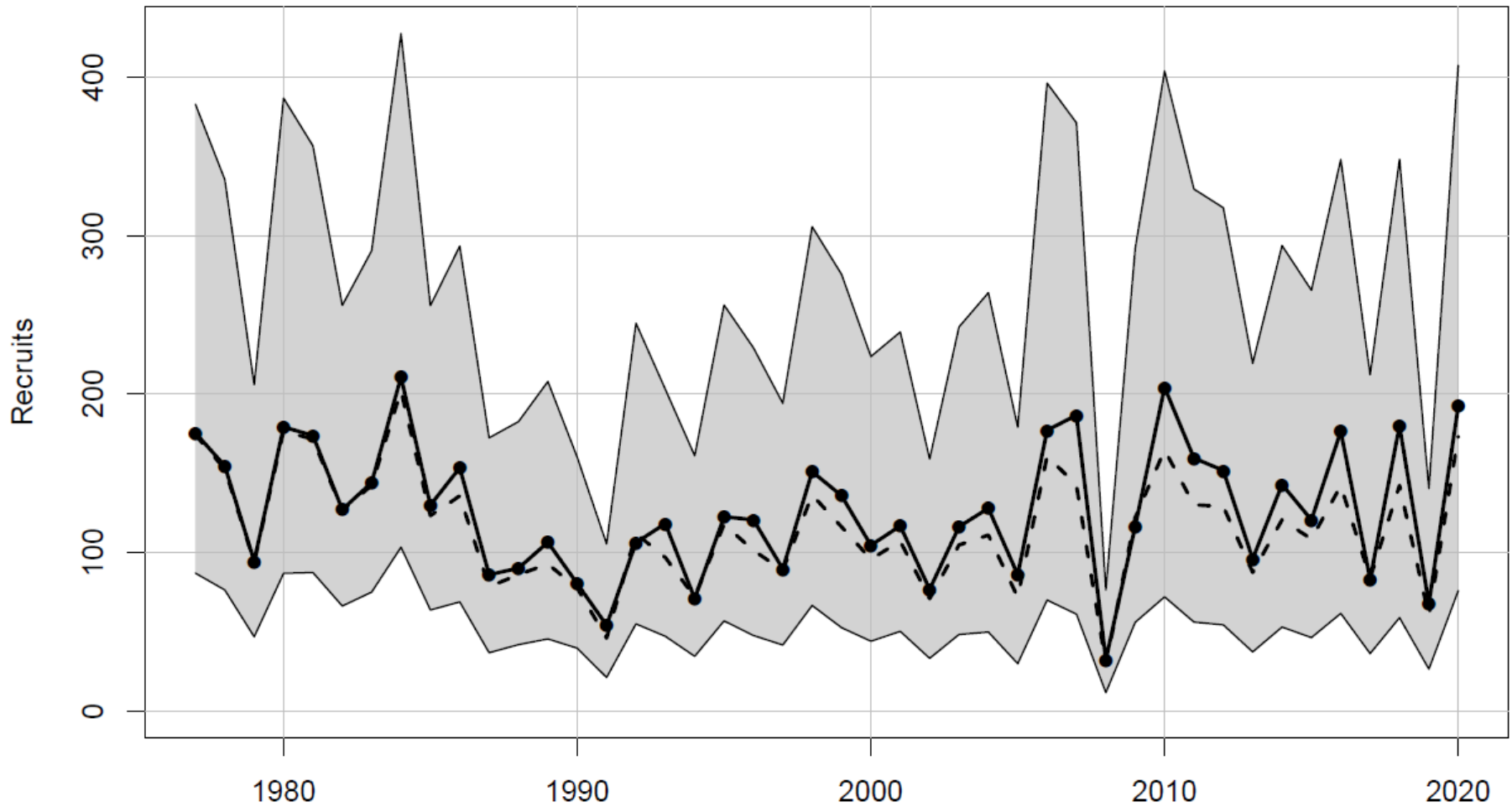
Monte Carlo Bootstrap Ensemble



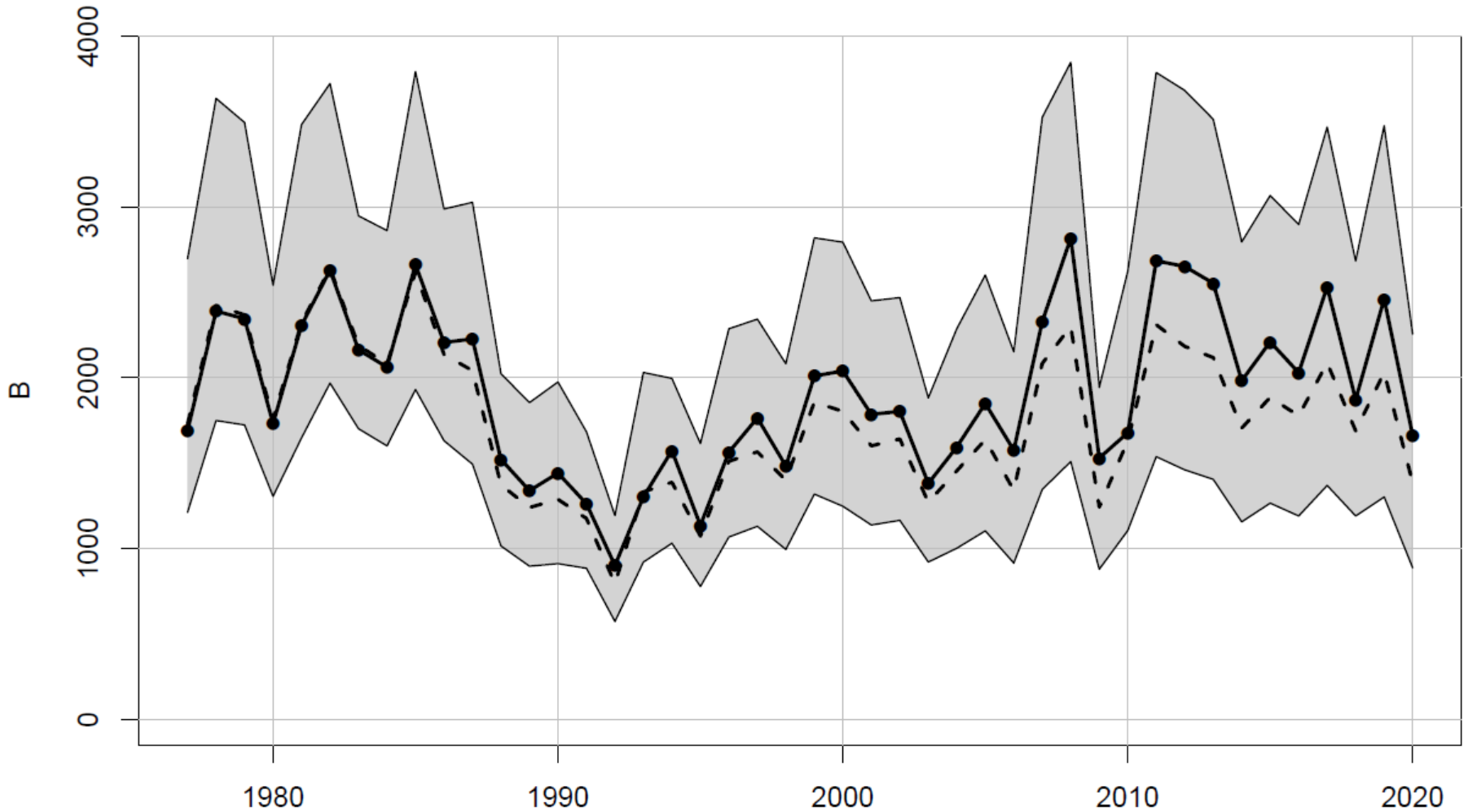
Monte Carlo Bootstrap Ensemble



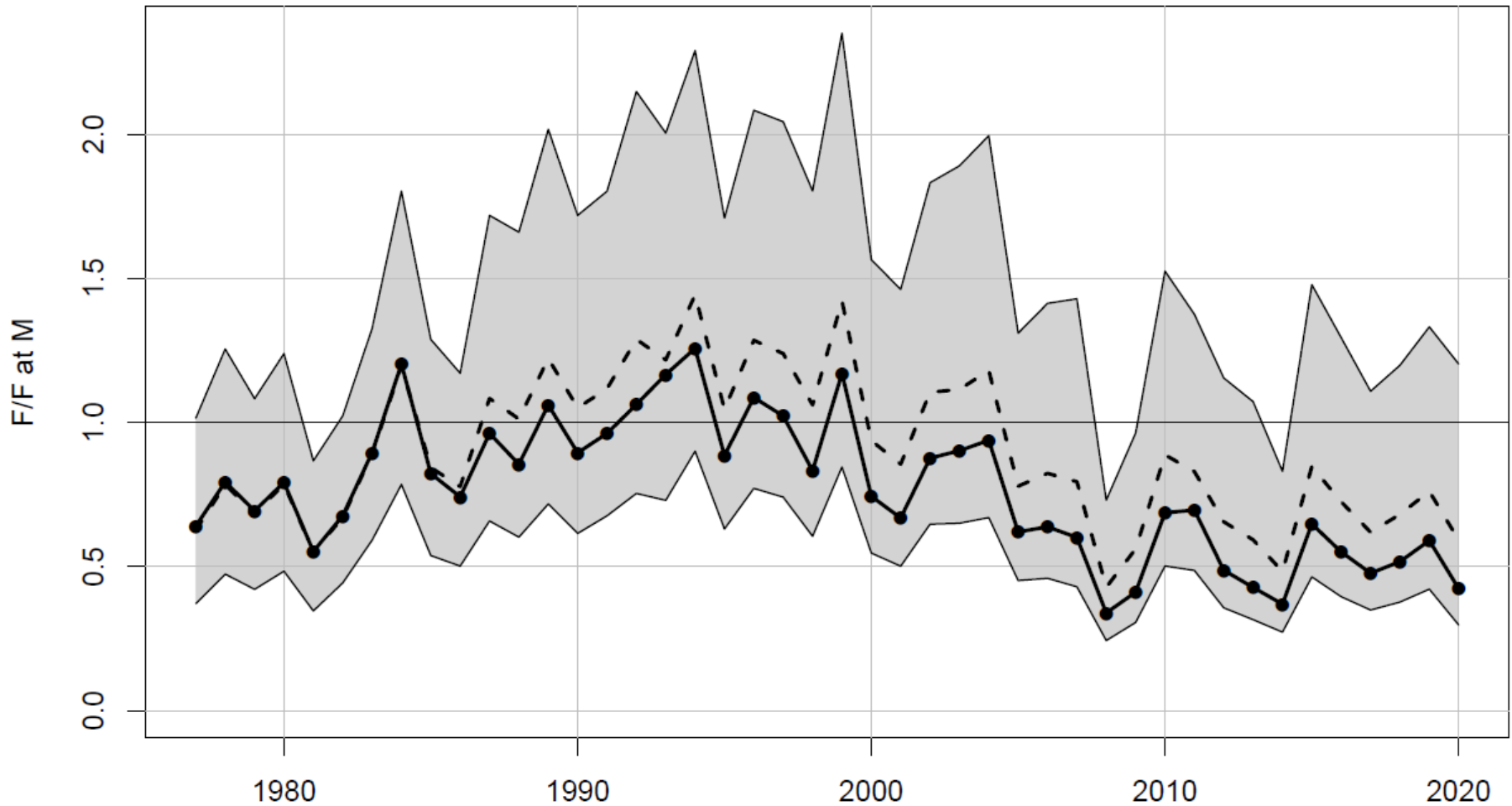
Monte Carlo Bootstrap Ensemble



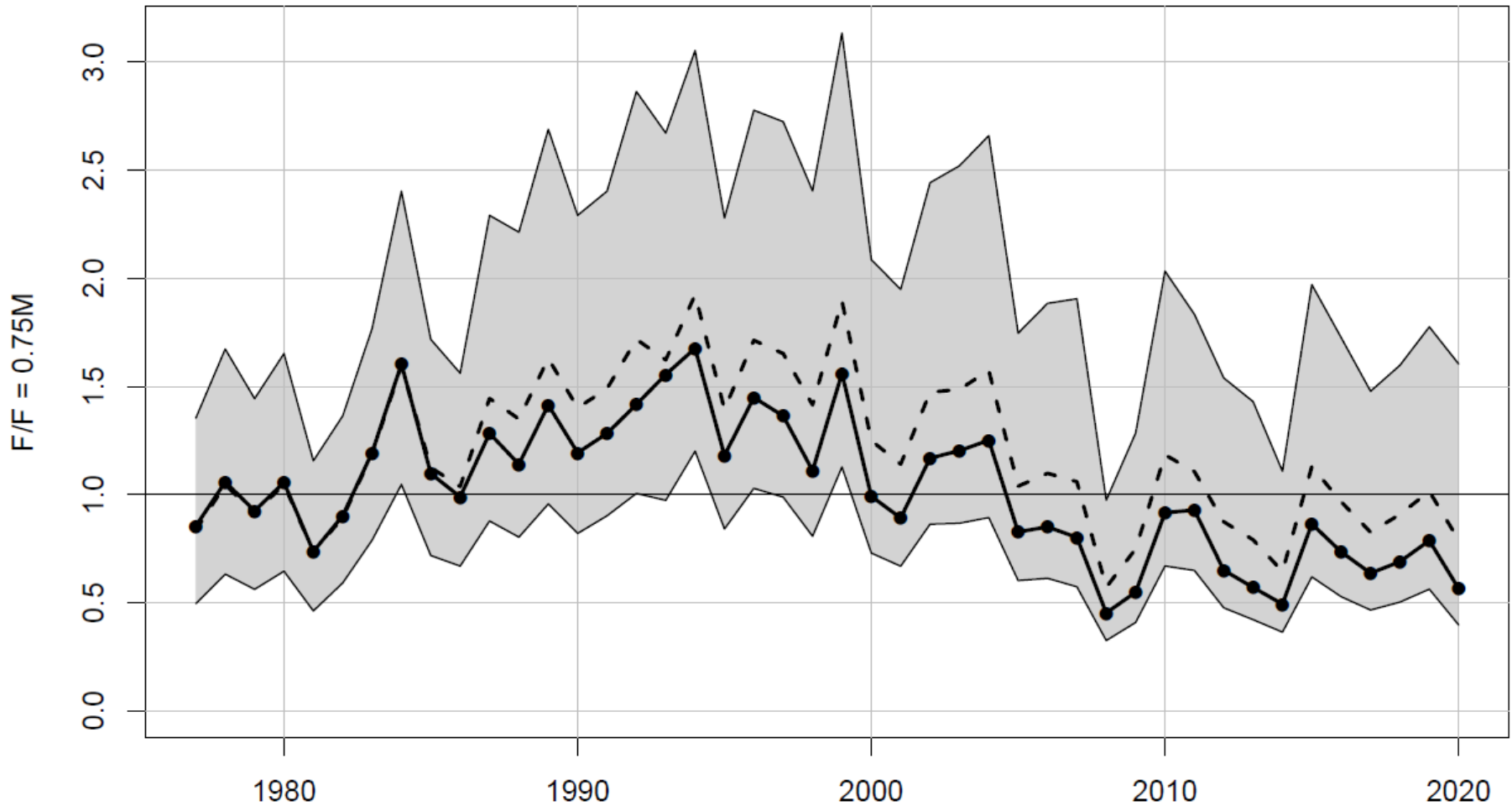
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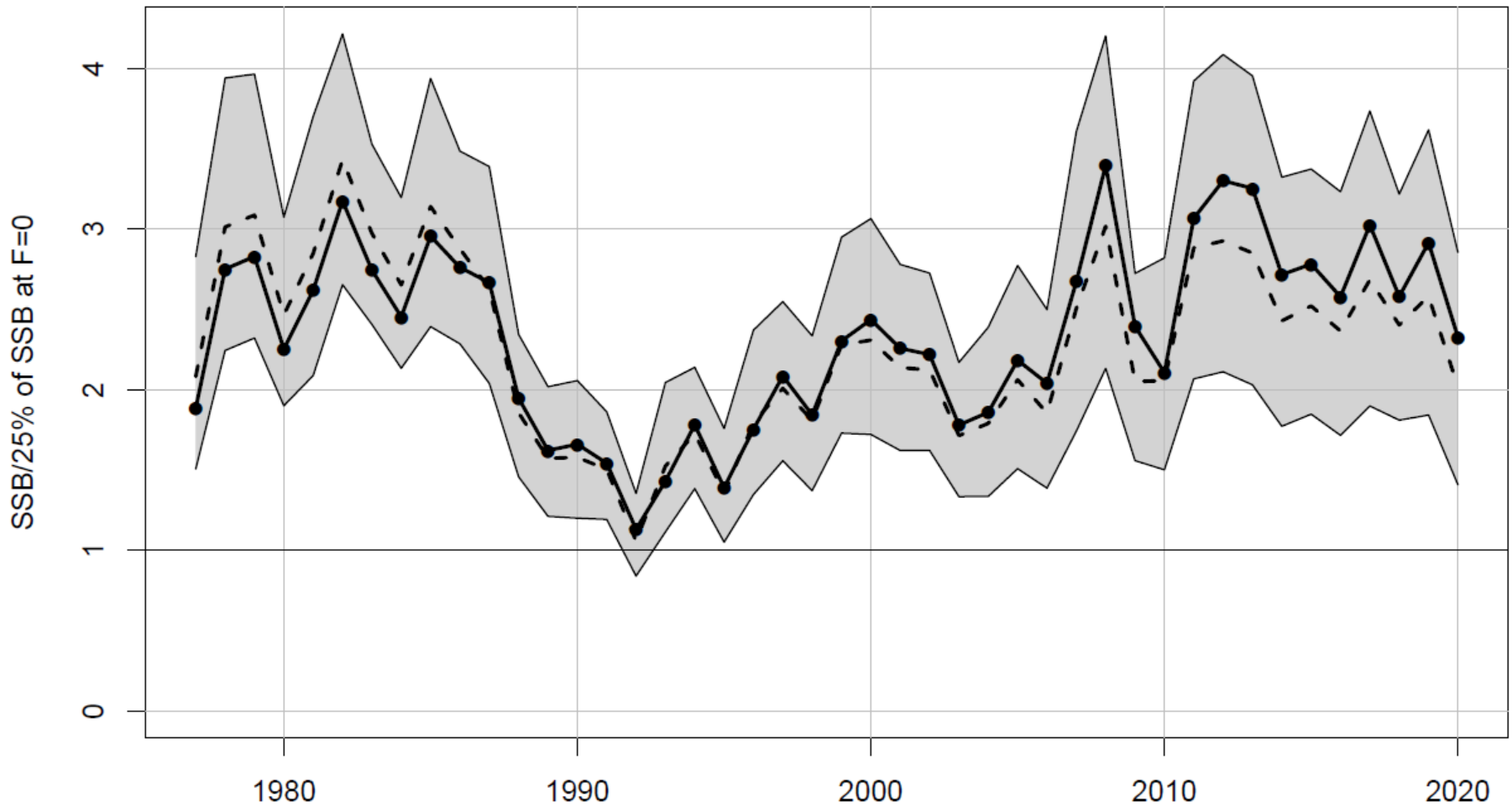
Monte Carlo Bootstrap Ensemble



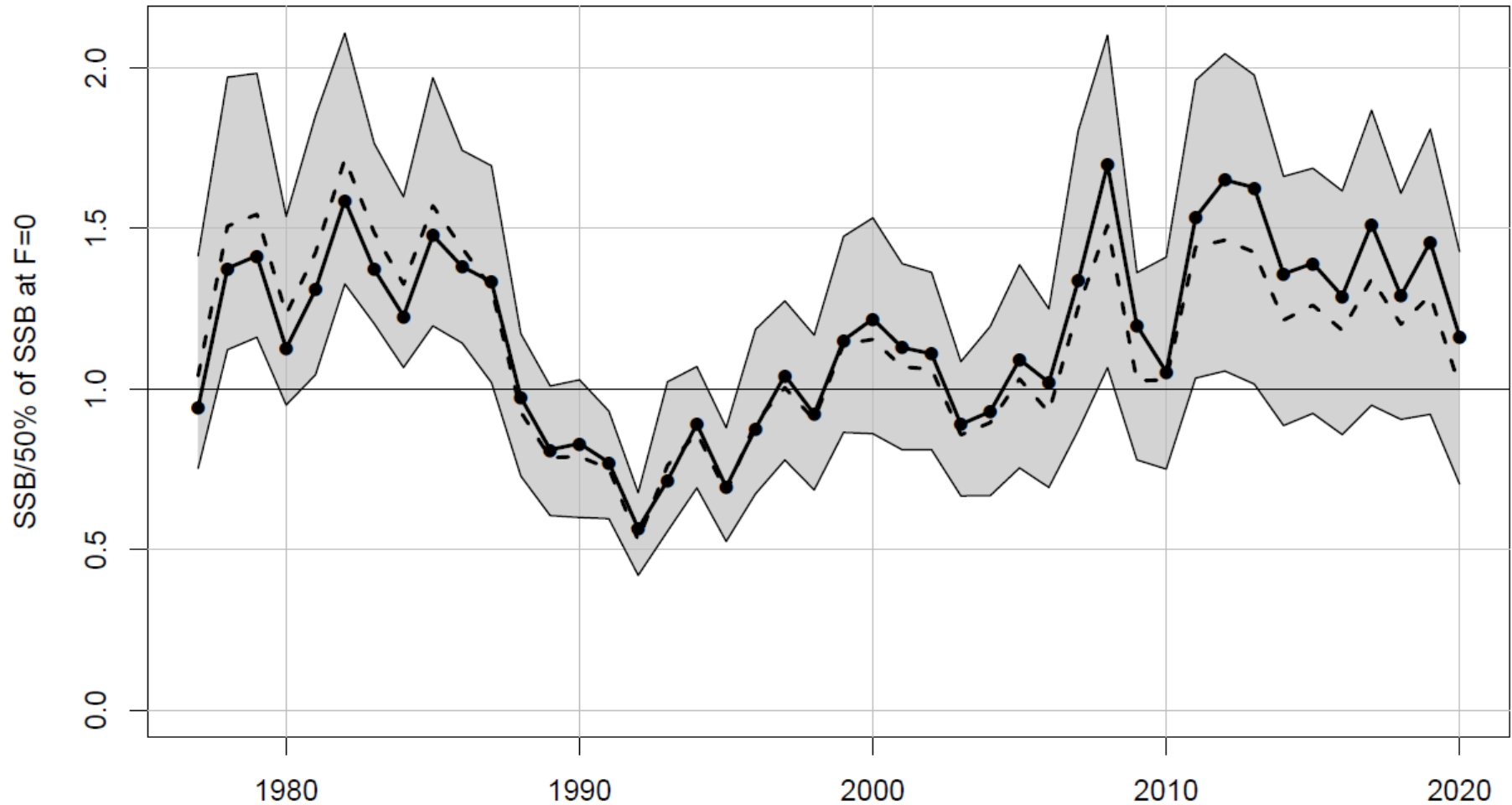
Monte Carlo Bootstrap Ensemble



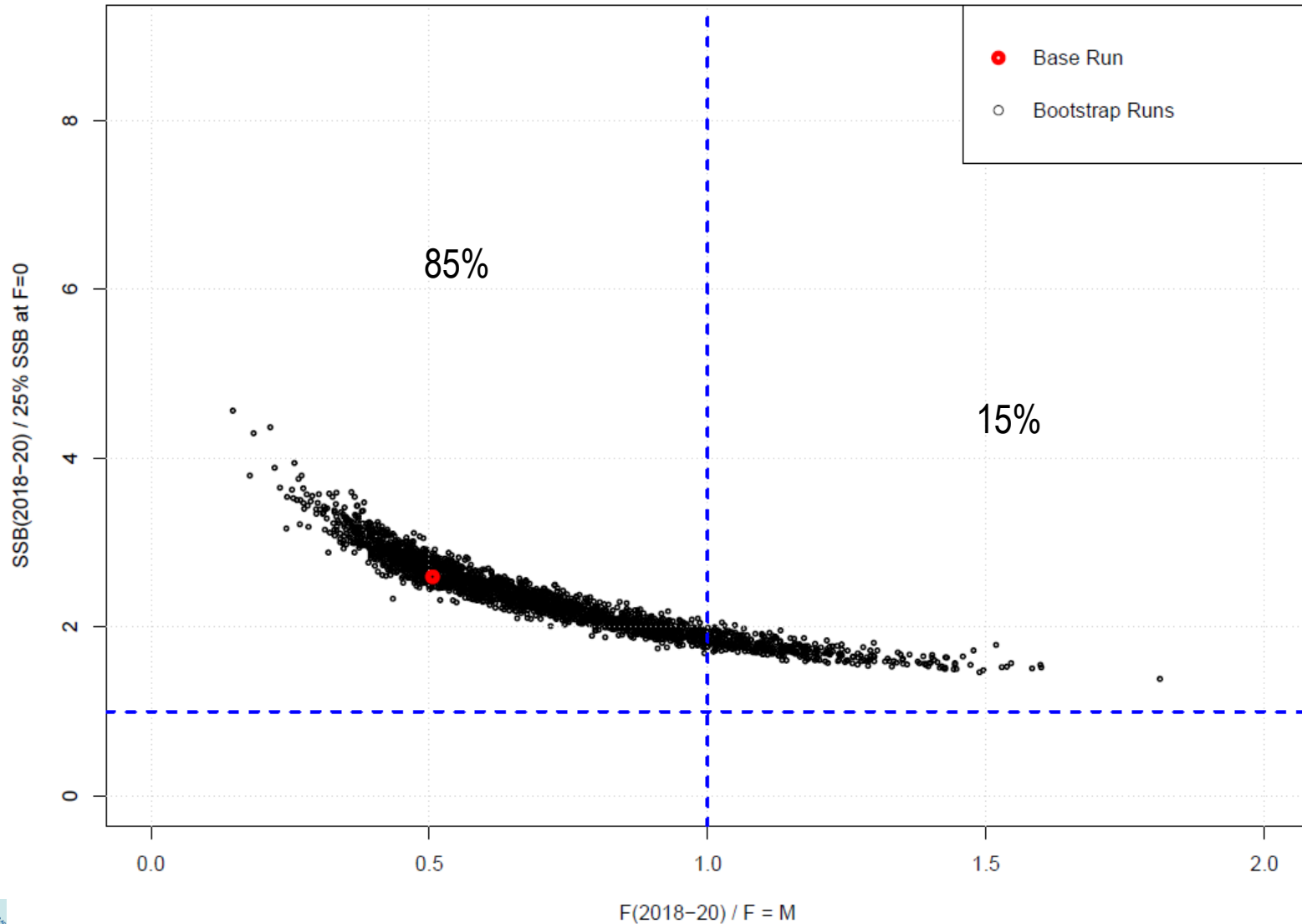
Monte Carlo Bootstrap Ensemble



Monte Carlo Bootstrap Ensemble



Monte Carlo Bootstrap Ensemble



Stock status determination

- Benchmarks
 - $F = 1.32$ (threshold); $F = 0.75 * 1.32 = 0.99$ (target)
 - SSB(FEC) based metrics – Threshold = 1,274,663 and Target = 2,549,325
- Stock status determination
 - G. mean (2018-20) of F – 0.67 – **not overfishing**
 - G. mean (2018-20) of SSB – 3310900 – **not overfished**
 - Sensitivity analyses agree with determination
 - MCBE runs generally agree, but some uncertainty in F Threshold

Research recommendations

| DATA ELEMENT | DATA ELEMENT | RECOMMENDATION | Priority |
|-----------------------------------|---------------------------------|--|----------|
| Single Species Assessment | | | |
| Stock Status Benchmarks | Single Species Benchmarks | Research effort should be focused on determining appropriate reference points for the stock to ensure long term sustainability while balancing the desires of stakeholders to effectively exploit the stock (Short Term Objective). | High |
| Genetics and Stock Structure | Stock Structure | Use traditional (mark and recapture) and state of the art methods (otolith shape, natural occurring exogenous markers, and potential genetic markers) to determine estimates of natural mortality, migration, and growth. | High |
| Genetics and Stock Structure | Stock Structure | Evaluate the genetic markers for confirming the meristic identifications of species. We are particularly interested in the periphery of the Gulf menhaden's range in Texas and Alabama/Florida waters for juveniles and adults. | Med/High |
| Modeling | Bootstrap considerations | Evaluate the relationships between the various life history and productivity input parameters, which could be impacting bootstrap results due to unrealistic combinations of parameters drawn from the specified distributions. | Med/High |
| Fishery-Independent Adult Index | Fishery-Independent Adult Index | Collect and age Gulf menhaden from fishery-independent gears (e.g., gillnets) to determine selectivity and possibly track cohorts within the stock assessment. This could be useful when and if large variations in length-at-age are present. | Med |
| Legacy Data (FD Surveys) | Legacy Data (FD Surveys) | Process and analyze samples that address the homogeneity of the catch in the hold of the reduction fishery vessels. | Med |
| Mortality Study | FI Adult Survey | Examine the feasibility of an acoustic survey for menhaden populations during winter months to determine spatial distribution and abundance (singles species) to get at something like an area swept biomass. | Med/Low |
| Ecosystem Based Assessment | | | |
| Predator/Prey | Predator/Prey | Expand understanding of diets of potential Gulf menhaden predators using a variety of tools including traditional stomach analysis, DNA barcoding, and fatty acid profiles Gulf wide - ecosystem critical. (long term objective) | Med/High |
| Stock Status Benchmarks | Ecosystem Benchmarks | Benchmarks – Develop procedures to establish assessment benchmarks (e.g., F or proxies) that account for the multiple priorities of ecosystem management that could include predation mortality and ecological yield separate from other forms of natural mortality (Long Term Objective). | High/Med |
| Environmental Indices | Environmental Indices | Develop a habitat index to examine the potential shift in the Gulf Menhaden population to more inshore waters as marsh converts to open water from coastal land loss. | Med/Low |
| Recruitment Evaluation | Recruitment Evaluation | Understand the recruitment drivers for Gulf menhaden from the estuary to the spawning grounds. (mechanistic understanding of larval migration and movement from offshore to inshore - cues and behavior and general oceanographic events - important for ecological reference points) (Long Term Objective). | Low |