NOAA FISHERIES

SEDAR 89

South Atlantic Golden Tilefish

October 22nd 2024

Outline

- Background
- Data
- Assessment Model
- Assessment Results
- Uncertainty
- Projections

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Terms of Reference

1. Submit all data used in the SEDAR 66 South Atlantic Tilefish SEDAR process. Add all new and recent available data sufficient for use in the stock assessment through 2023. Data providers may decide to include additional preliminary or partial data that could be used in the stock assessment models or projection analyses (check with analysts if unsure about what could or could not be used).
2. Update the approved SEDAR 66 Atlantic Tilefish models with all provided and relevant data. Incorporate the latest and most appropriate BAM model methodologies, including relevant advances in fisheries science, biology, population dynamics, and stock assessment science.
3. Apply appropriate model diagnostics and make expert determinations for data and model changes as necessary to improve the accuracy and precision of population estimates.
4. Detail all the input data and model changes made between the SEDAR 66 South Atlantic Tilefish Operational assessment model and the proposed SEDAR 89 Operational assessment model. Write a final report describing all necessary details of the stock assessment model, data, and important issues. Include required management reference points and other important population dynamic information relevant for managers. Include a list of unresolved issues and research recommendations for future consideration.

Terms of Reference continued

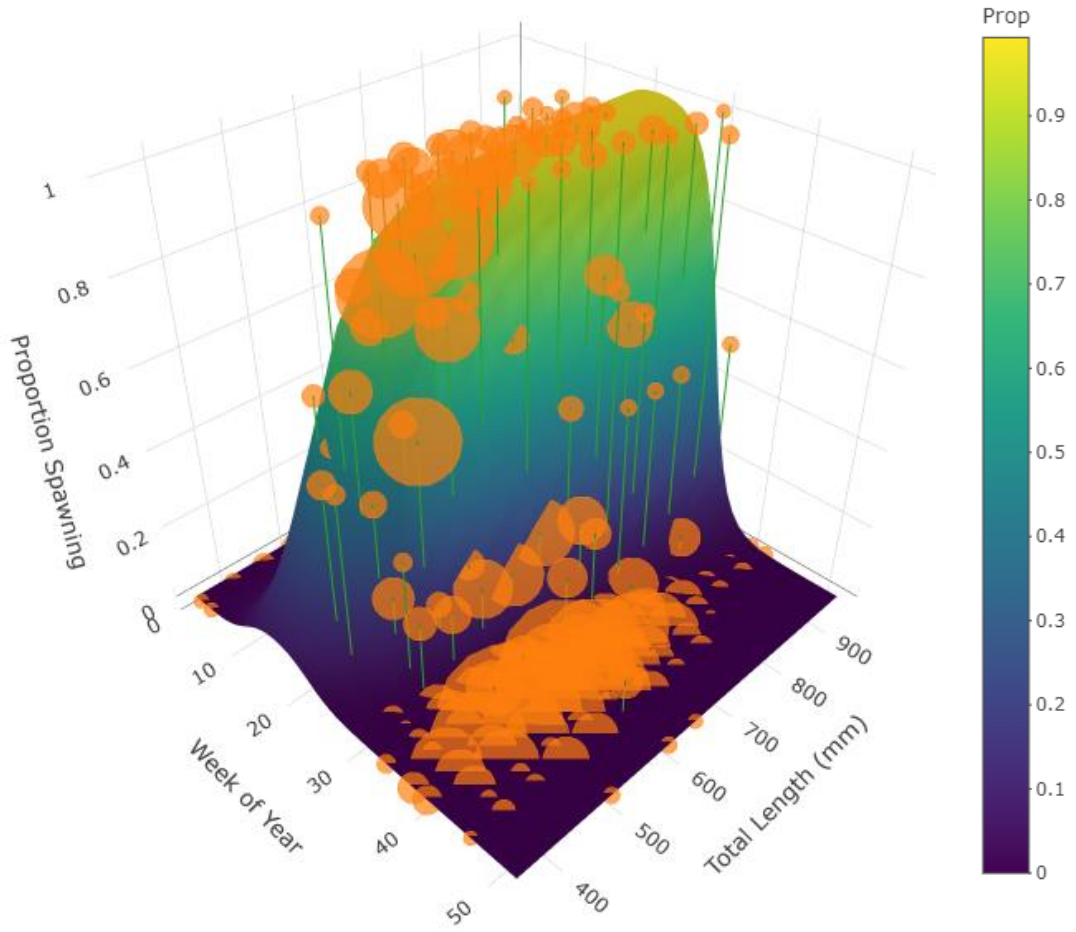
5. Convene a topical working group including SSC representatives, industry representatives, and outside experts to meet via webinar or in-person. This group of specialists will evaluate the following subjects and document specific changes in input data or deviations from the SEDAR 66 South Atlantic Tilefish.
   a) Review and explore the potential utility and incorporation of new life history information, including:
      i. Data collected from expanded SCDNR SBLL survey, new cooperative SADLS survey, and SCDNR CRP pilot study (abundance, life history, etc). Examine spatial differences.
      ii. Evidence for hermaphroditism in the South Atlantic (specifically the interpretation and applicability of analyses conducted in Gulf of Mexico by Lombardi-Carlson (2012)).
      iii. Evidence for age or size dependence of spawning frequency and spawning season duration.
      iv. Genetic evidence of connectivity between northern and southern stocks (McDowell, VIMS).
      v. Evidence for potential northward range shift.
6. Develop a stock assessment report to address these TORs and fully document the input data, methods, and results.

Updated conversion factors

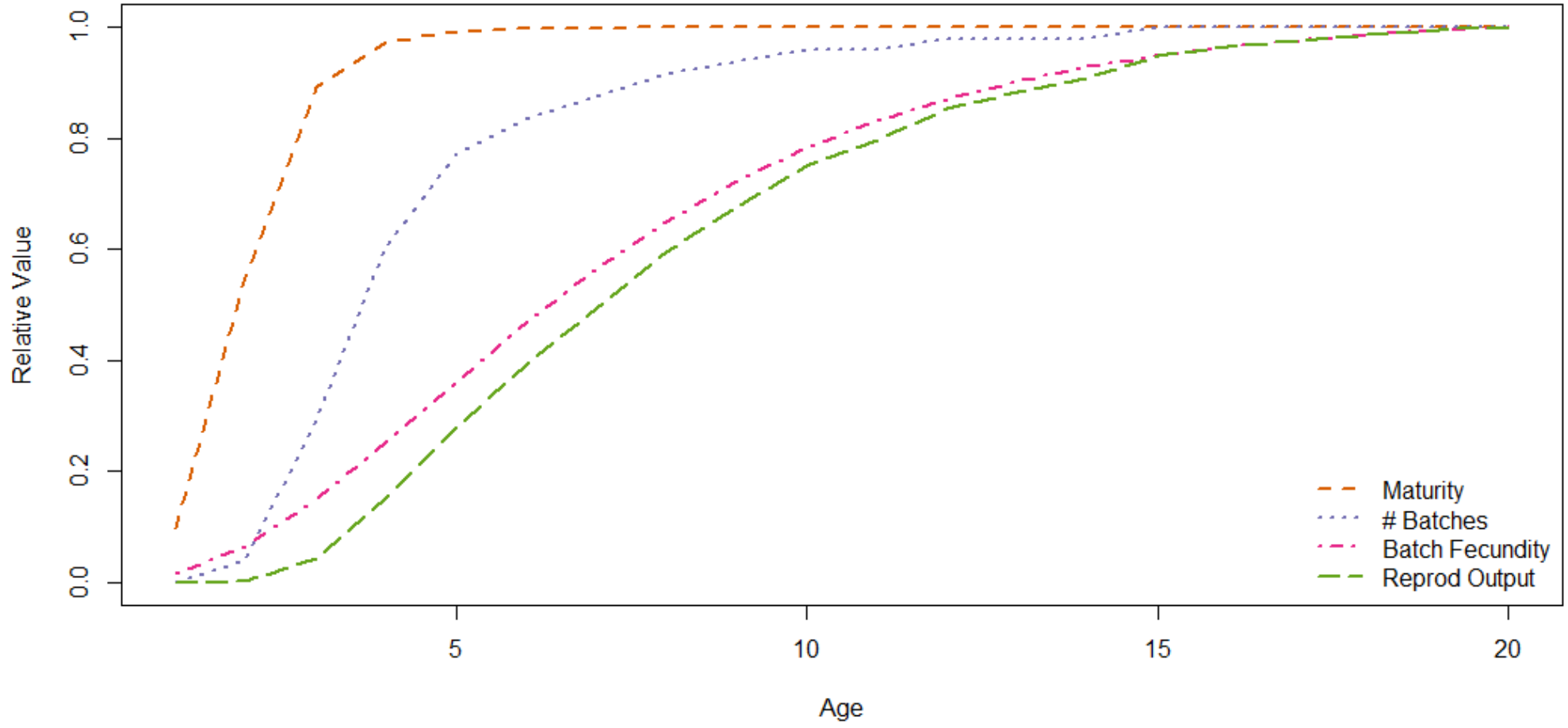
- Logical error in order of conversions corrected
- Updated life history conversions
  - Age – Max Total Length
  - Max Total Length – Whole Weight
  - Max Total Length – Gutted Weight
  - Standard Length – Max Total Length
  - Fork Length – Max Total Length

Reproductive Output at age

- Fit maturity at length logit model
- Fit log(batch fecundity) at log(length) model
- Fit plateau model to spawning indicators by length and day
  - Provides spawning frequency at length and peak spawning date



Reproductive output at age



No evidence of Hermaphroditism

- No disparity in age frequency of sexes
- No ovarian lumen in 4,372 male histological samples
- No testicular remnants in 2,697 female histological samples
- 1% of males had previtellogenic oocytes
  - No evidence of functionality
  - Weakest indication of hermaphroditism
  - Common causes that may produce this
- Lack of transitional individuals from both sexes in all months of year
- Do not meet any of 4 criteria to be classified as hermaphroditic

No data on connectivity and range shift

- Tagging study suggests limited movement of adults
  - Within 2 km after up to 1.6 years at large
- Stock structure analysis had limited samples for South Atlantic with conflicting evidence between meristics and electrophoresis gels
- Would need a historical base line of stock composition and current
- South Atlantic waters are within middle of range of tilefish
  - Nova Scotia to Surinam
- Commercial fishermen suggest no change in extent of population

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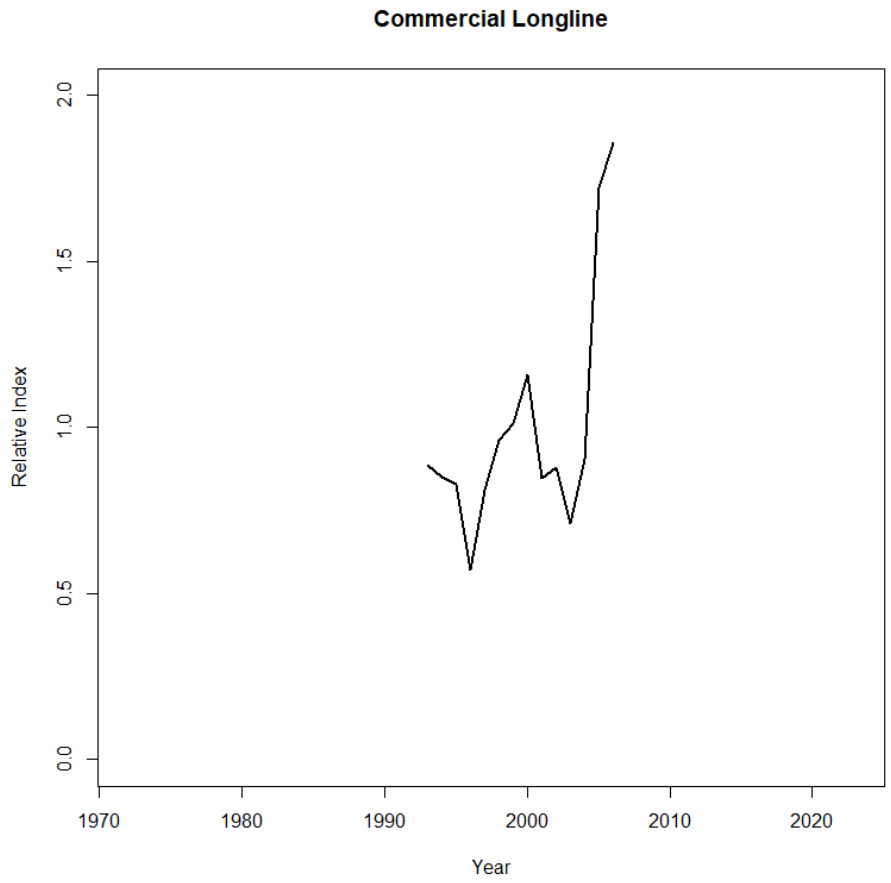
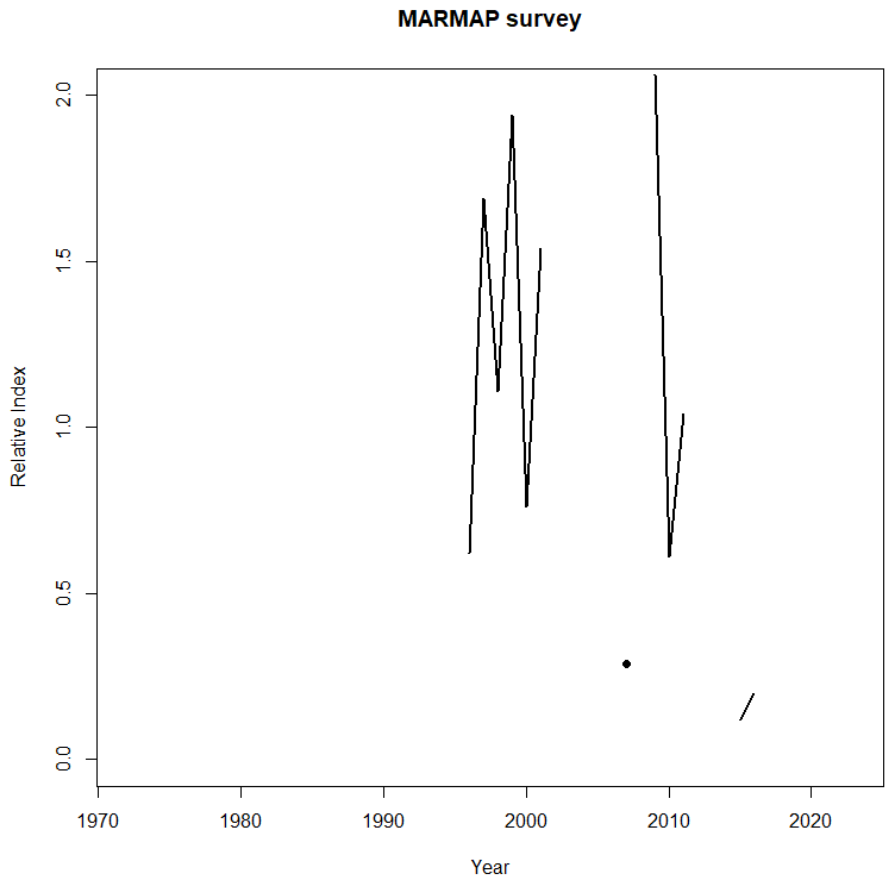
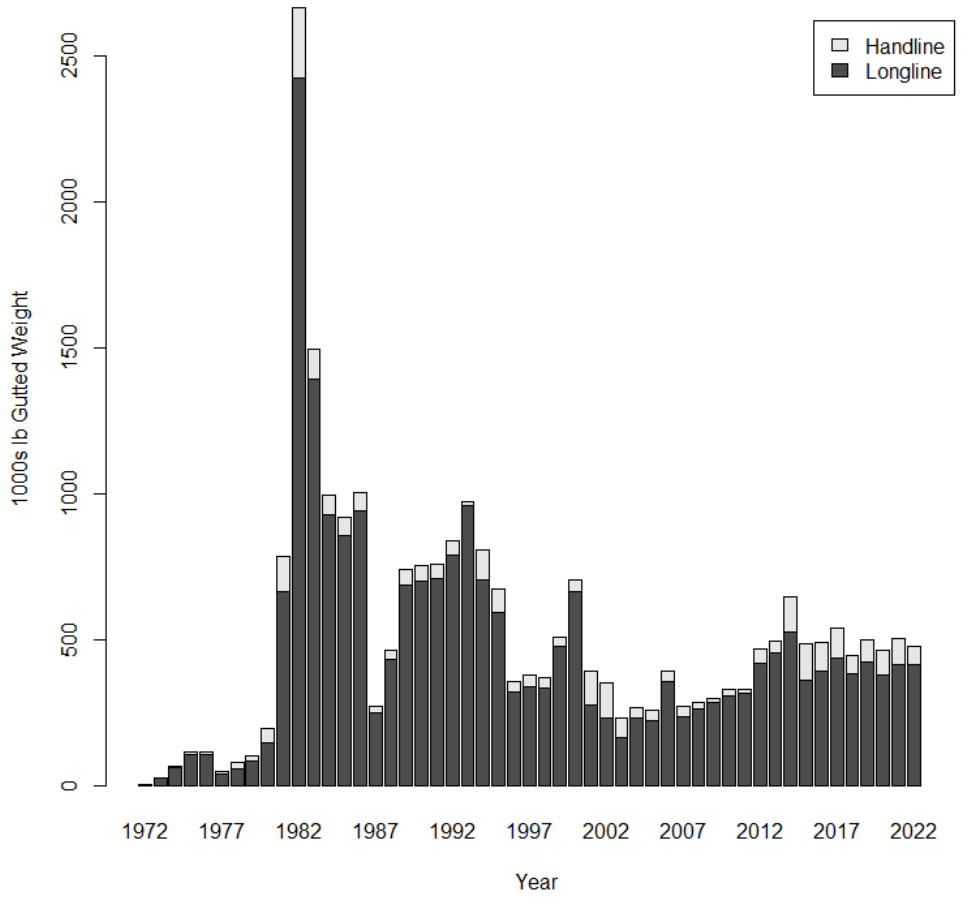
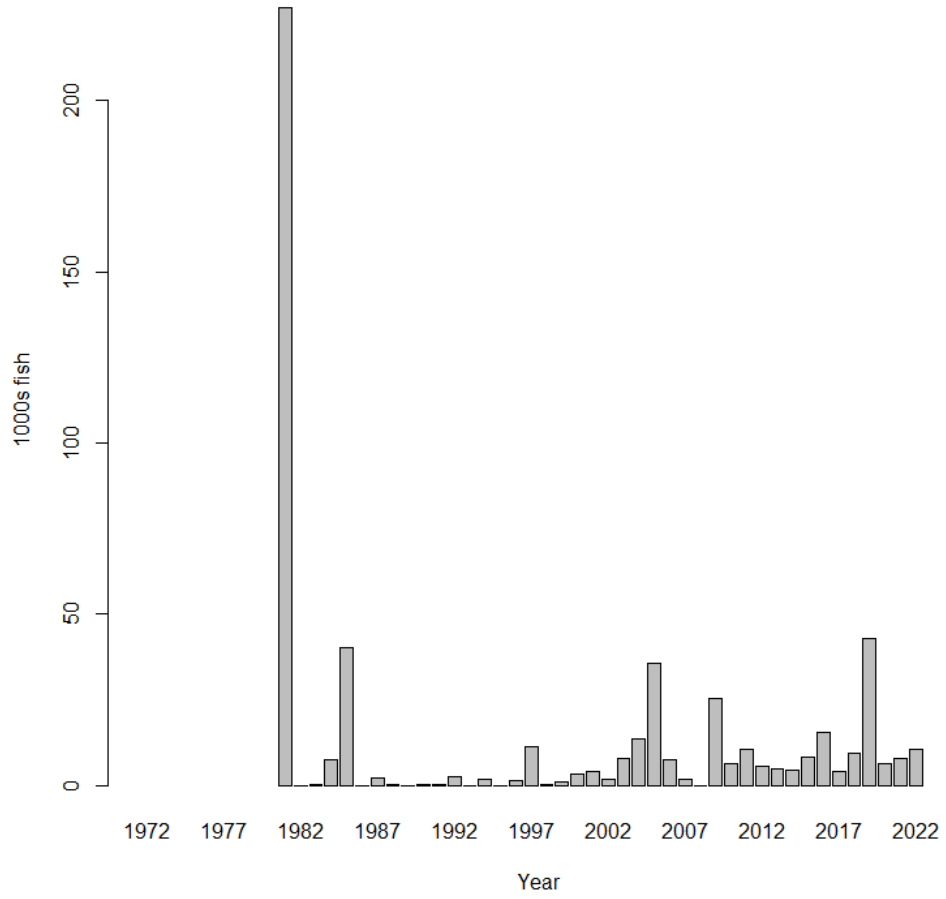
Indices of Abundance





Landings

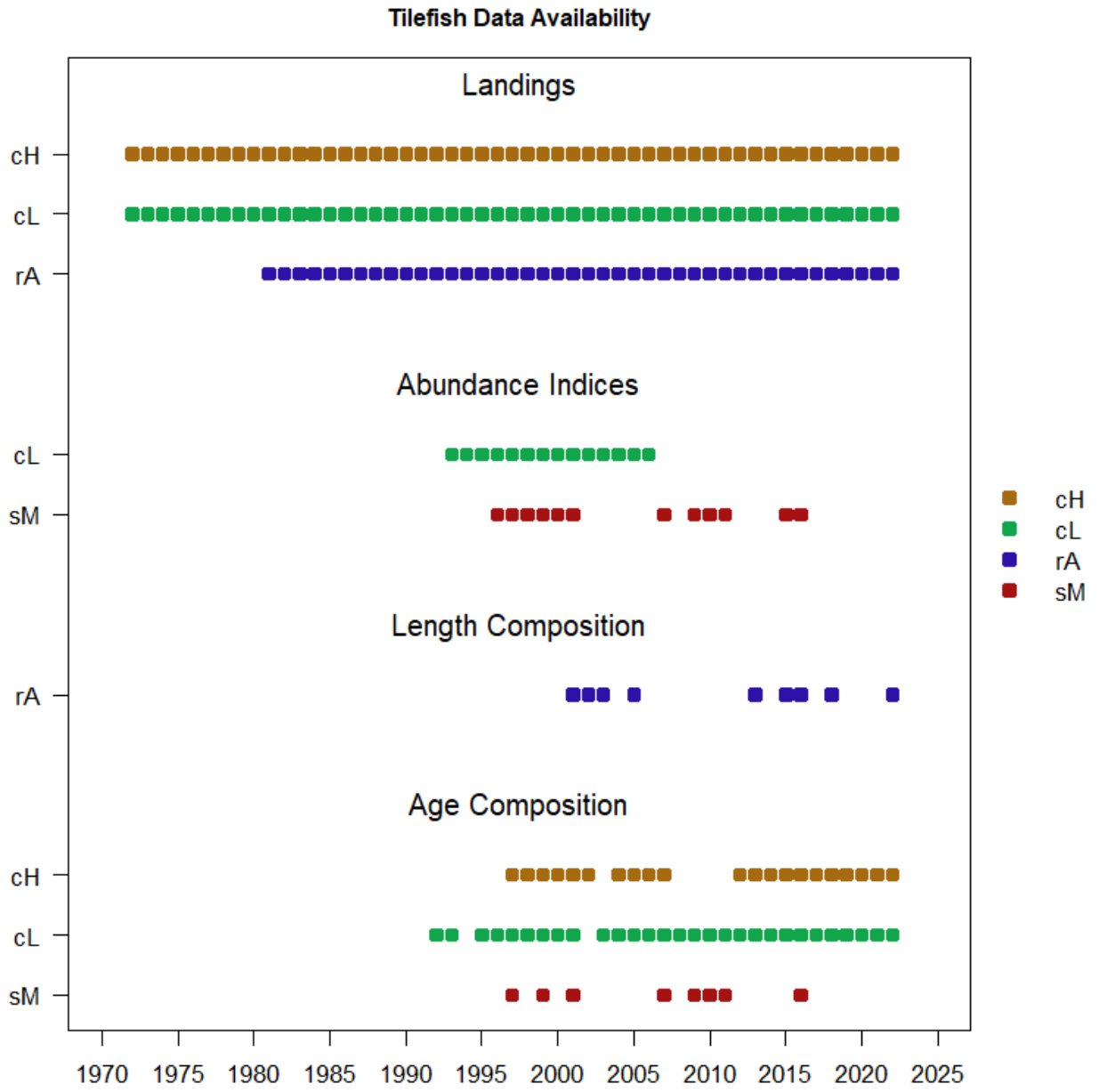

Handline
Longline
1000s lb Gutted Weight
0
500
1000
1500
2000
2500
1972
1977
1982
1987
1992
1997
2002
2007
2012
2017
2022
Year


1000s fish
0
50
100
150
200
1972
1977
1982
1987
1992
1997
2002
2007
2012
2017
2022
Year

Changes to Landings Streams

- Recreational landings modeled in number of fish
- Recreational landings include MRIP and SRHS landings
- Longline landings includes estimate of discards

Data Availability



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Modifications to BAM

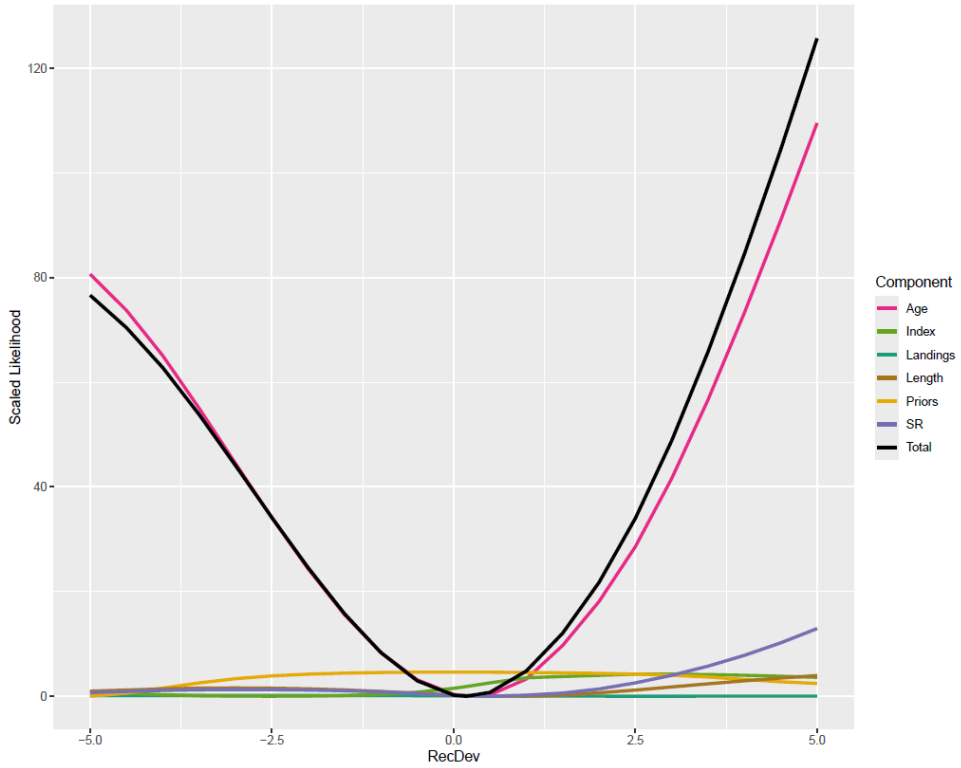
- Model recreational landings in 1000s of fish
- Model commercial landings in gutted weight with length-weight
- Natural mortality modeled by Lorenzen 2022 inverse length with maximum and minimum age inputs
- Time block selectivity starting in 2020 with domed function
  - Removed time block selectivity in 2009
- Biomass calculated in 1000 lbs; SSB in trillions of eggs
- Beverton-Holt steepness estimated within the model
- Terminal recruitment deviate set to 2019

Changes to input values

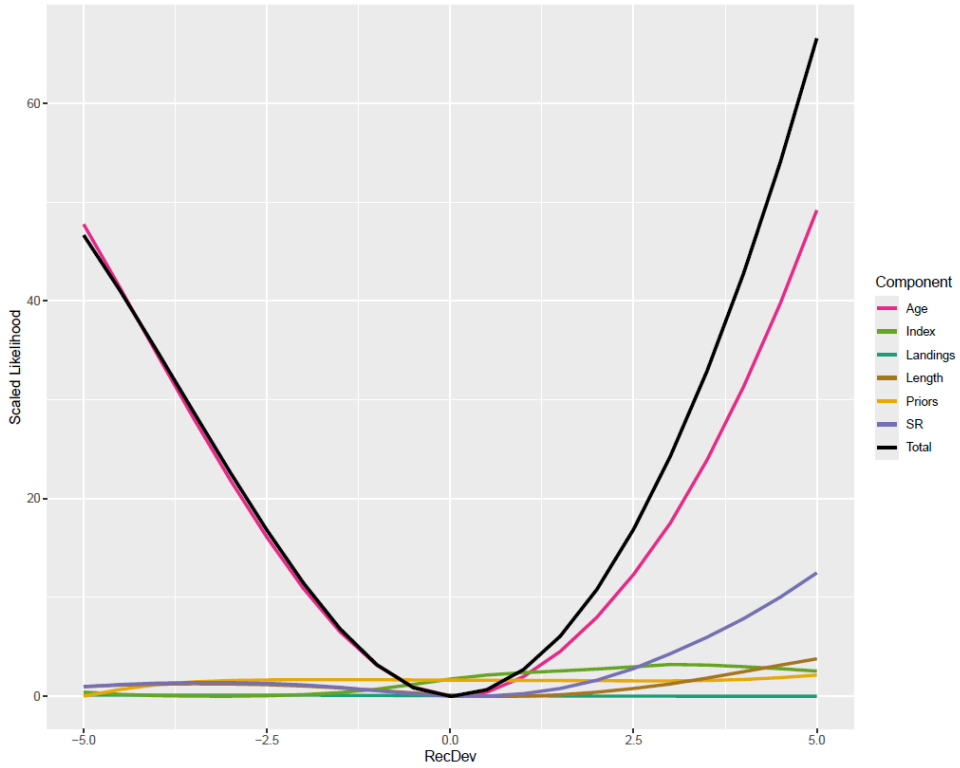
- Constant Natural mortality determined by Hamel and Cope 2022
- Length- weight relationships updated (Gutted and whole)
- Growth curves updated (Population and female)
- Maturity at age fit using logistic model to length
- Reproductive output calculate as eggs produced at age
- Peak spawning time derived from model fecundity
- Ageing error matrix incorporated based on reference set ageing

Recruitment Likelihood Profiles

2017

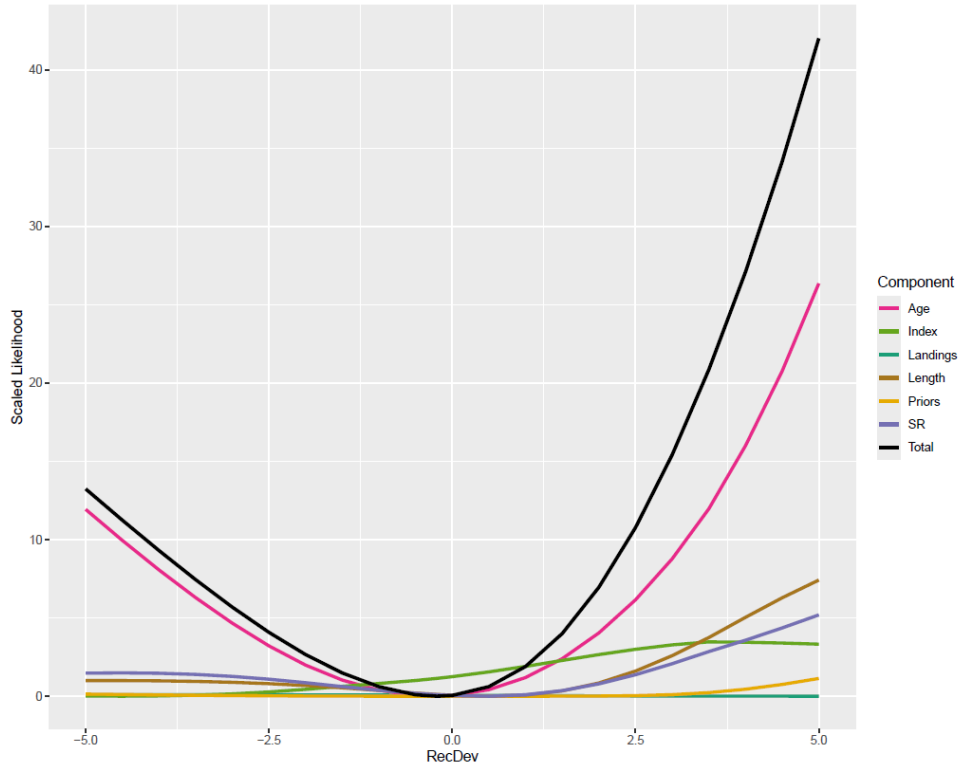


2018

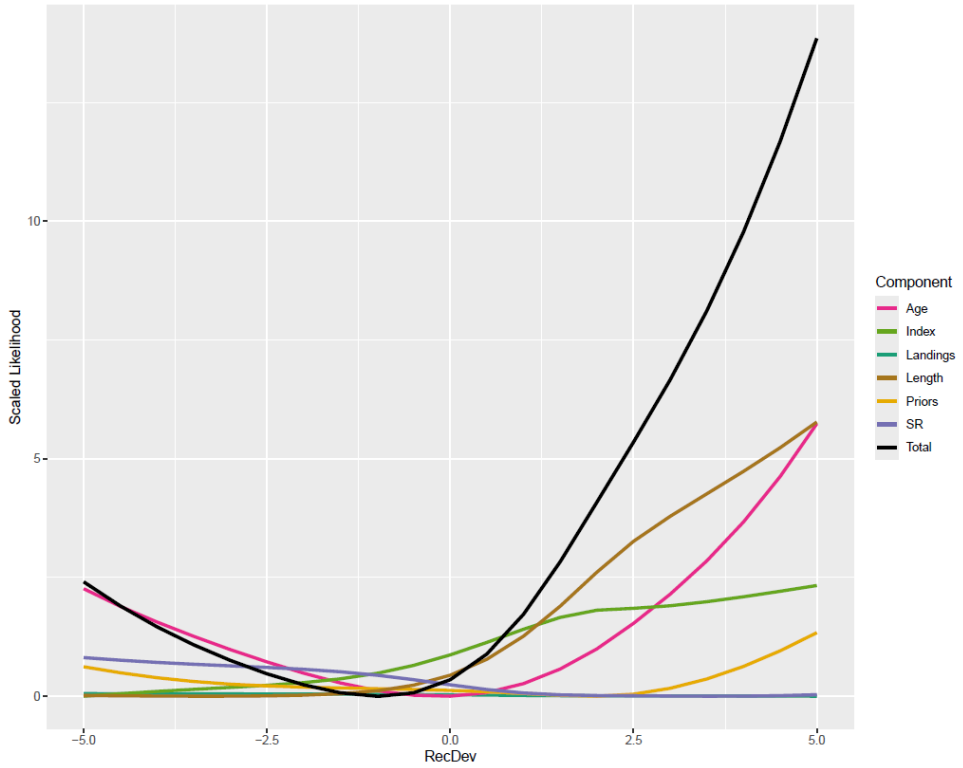


Recruitment Likelihood Profiles

2019



2020



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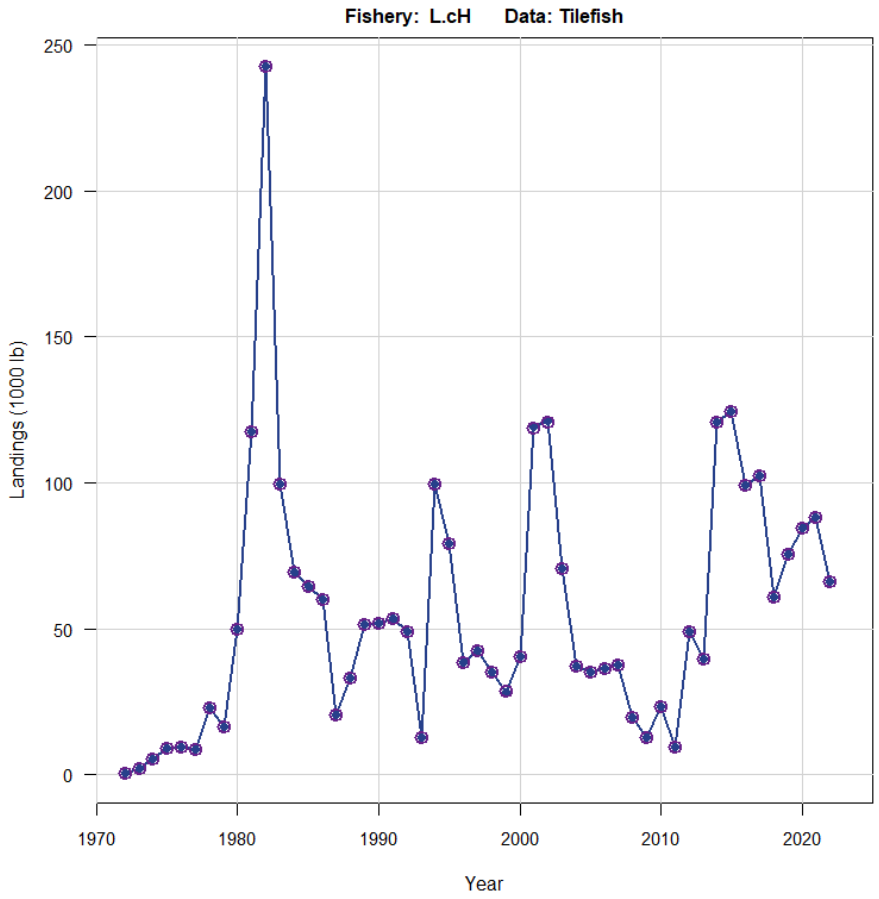
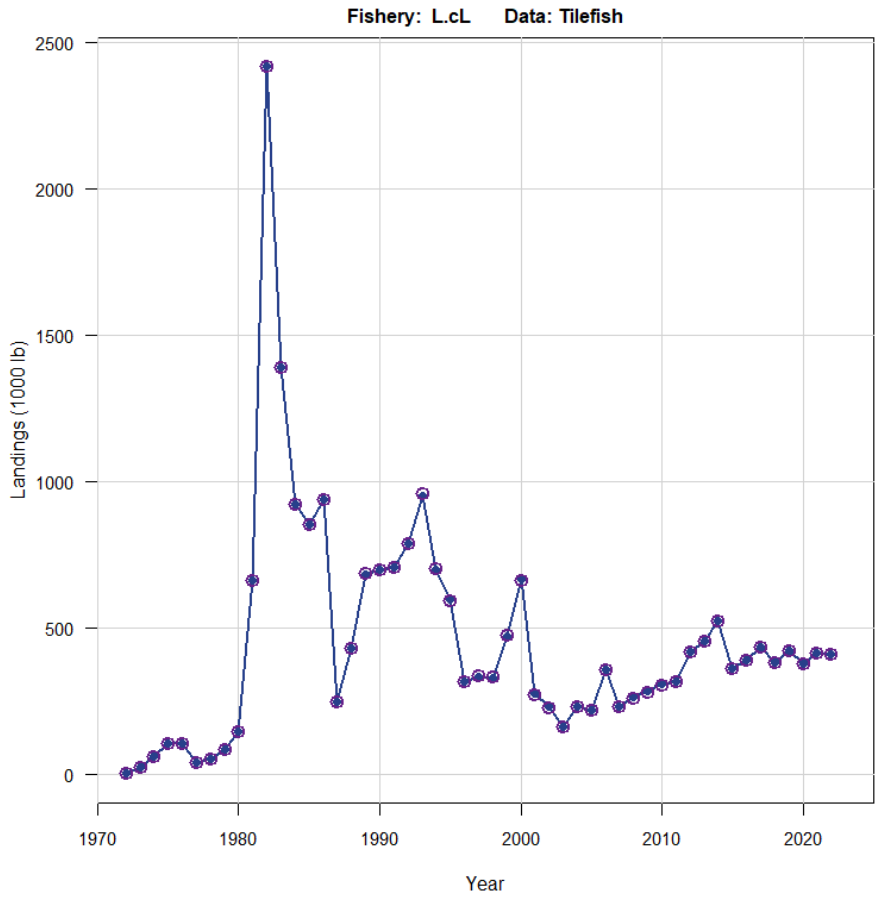
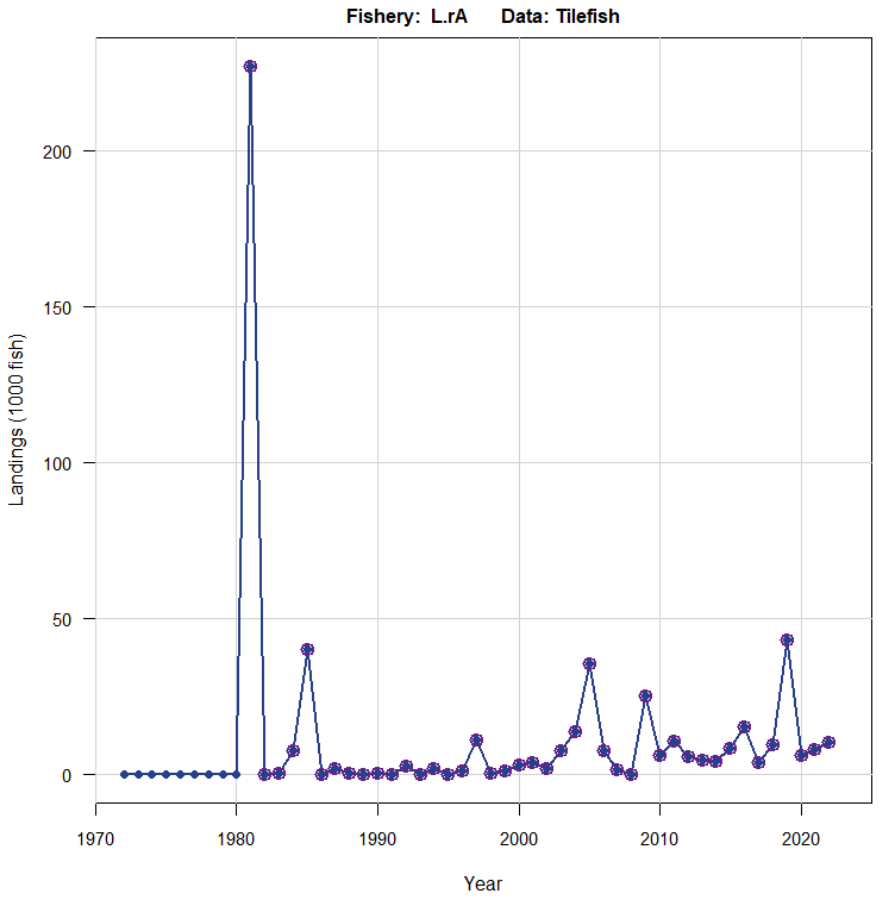
BAM base model – fit to comm landings

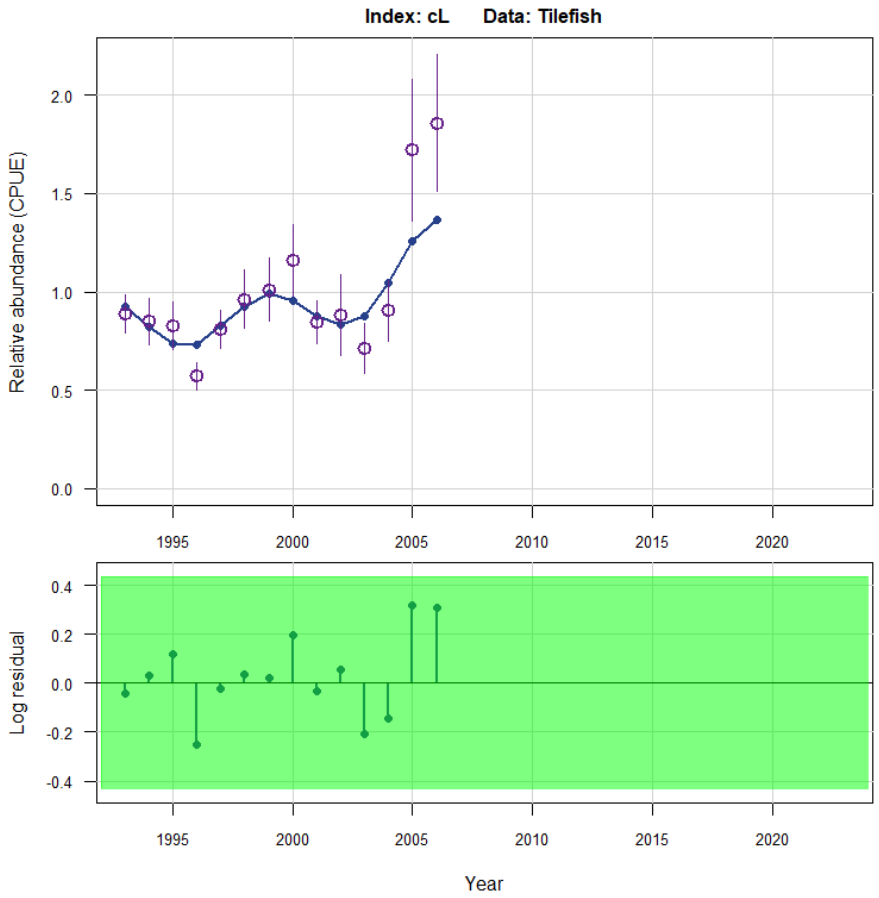


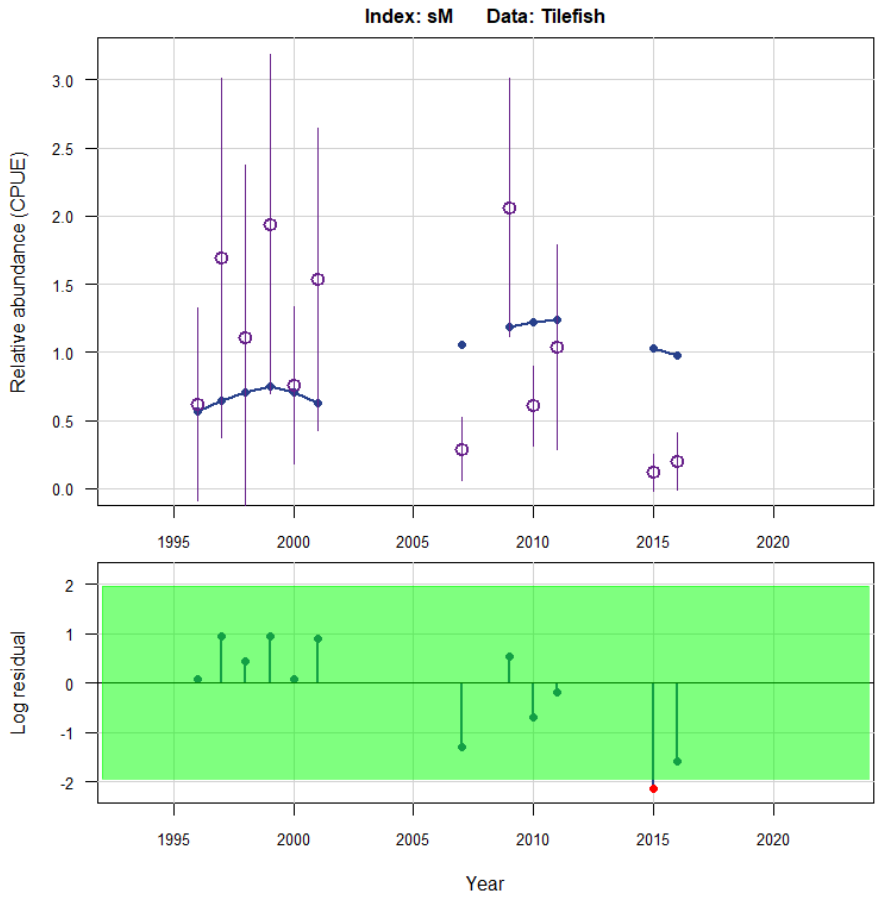


BAM base model – fit to rec landings

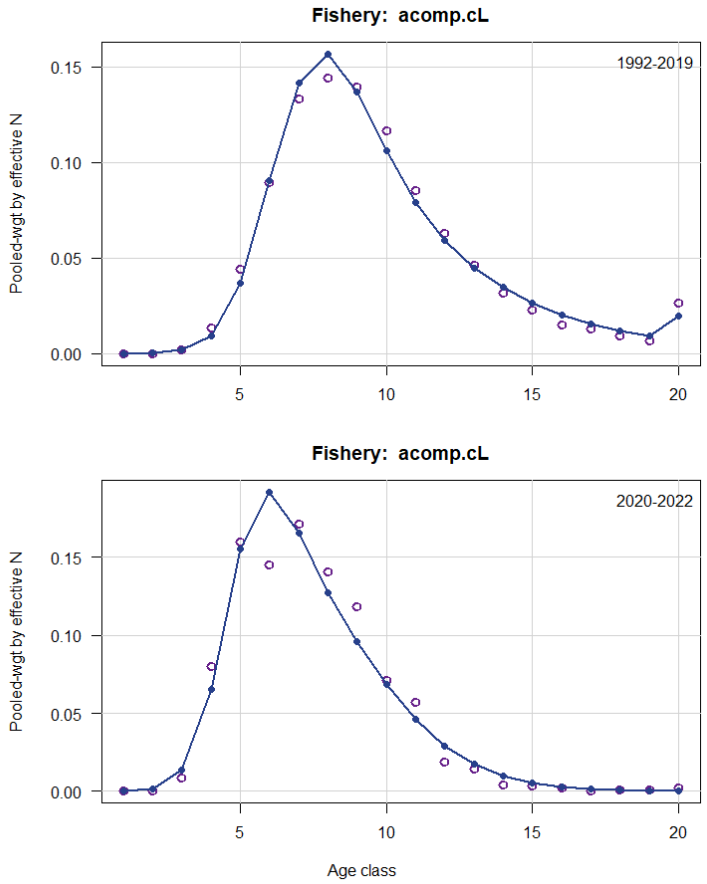


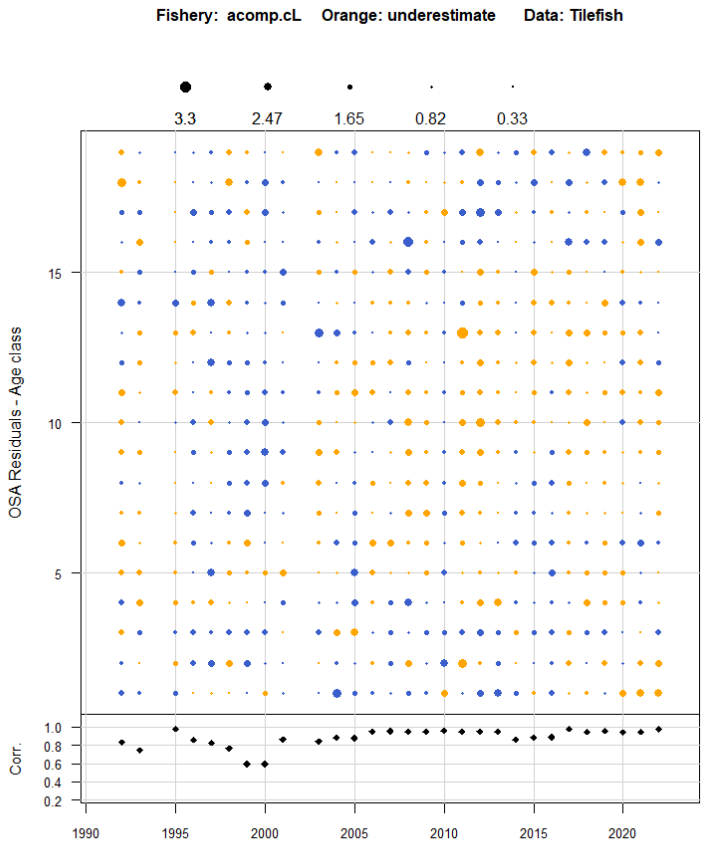
BAM base model – fit to fishery index



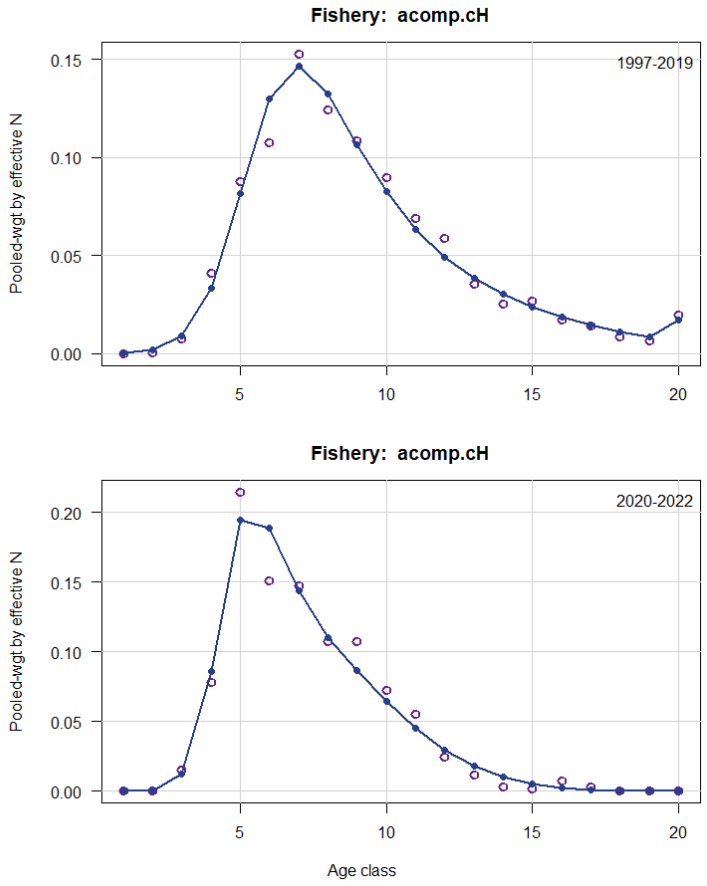


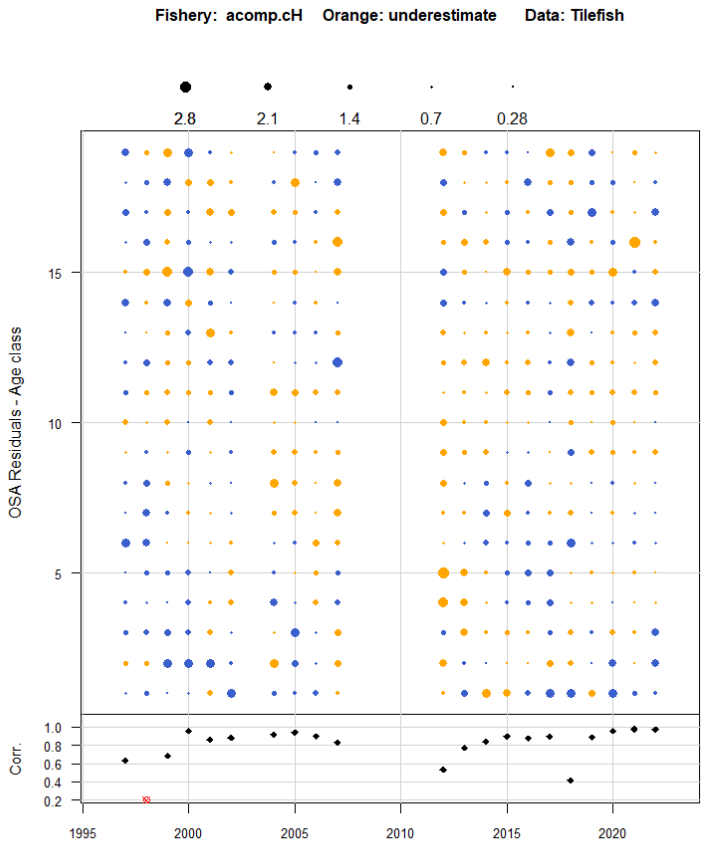
BAM base model – fit to age comp comm LL



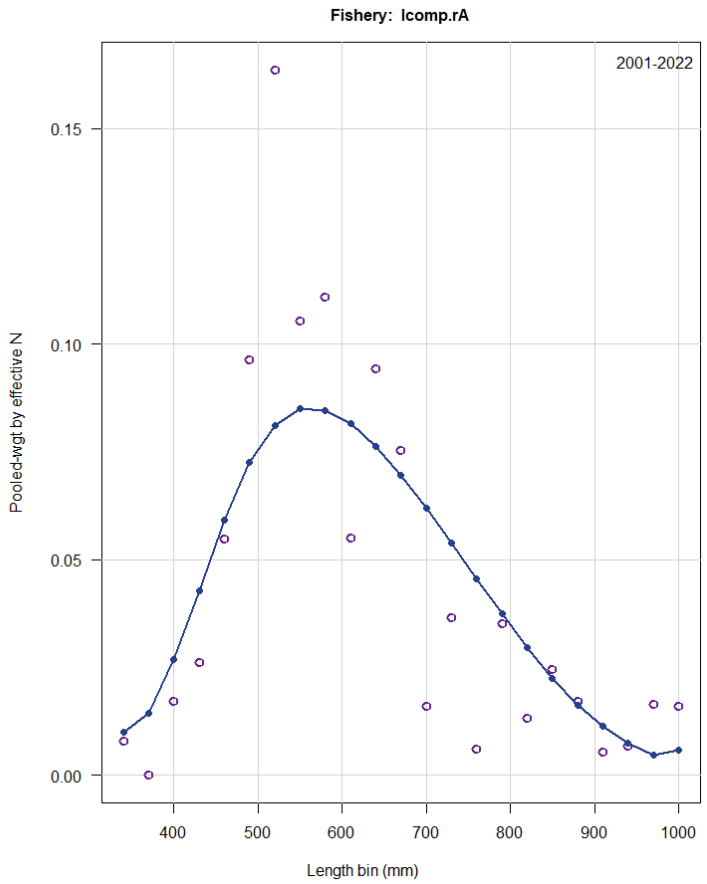


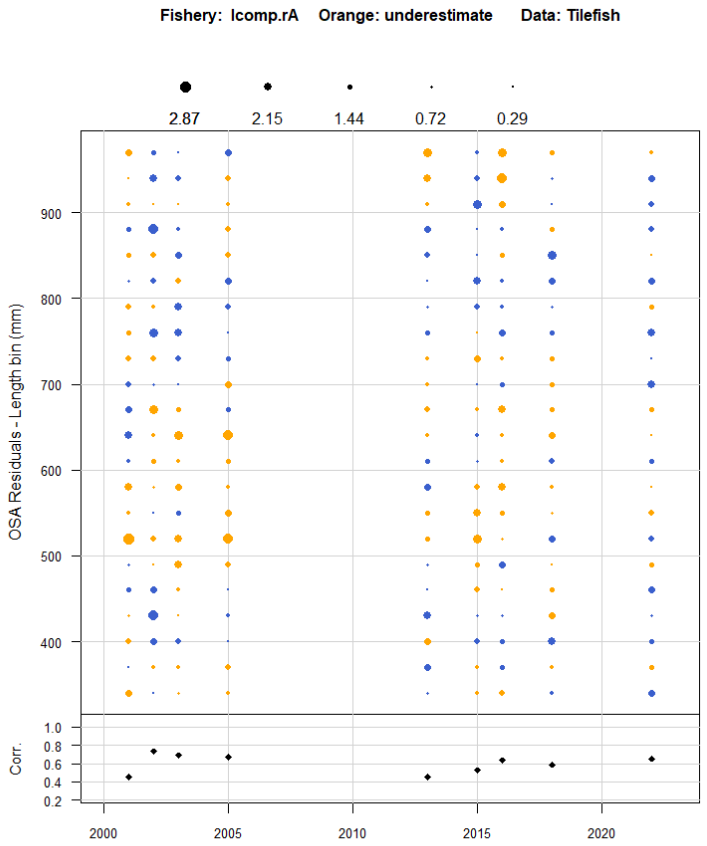
BAM base model – fit to age comp comm HL



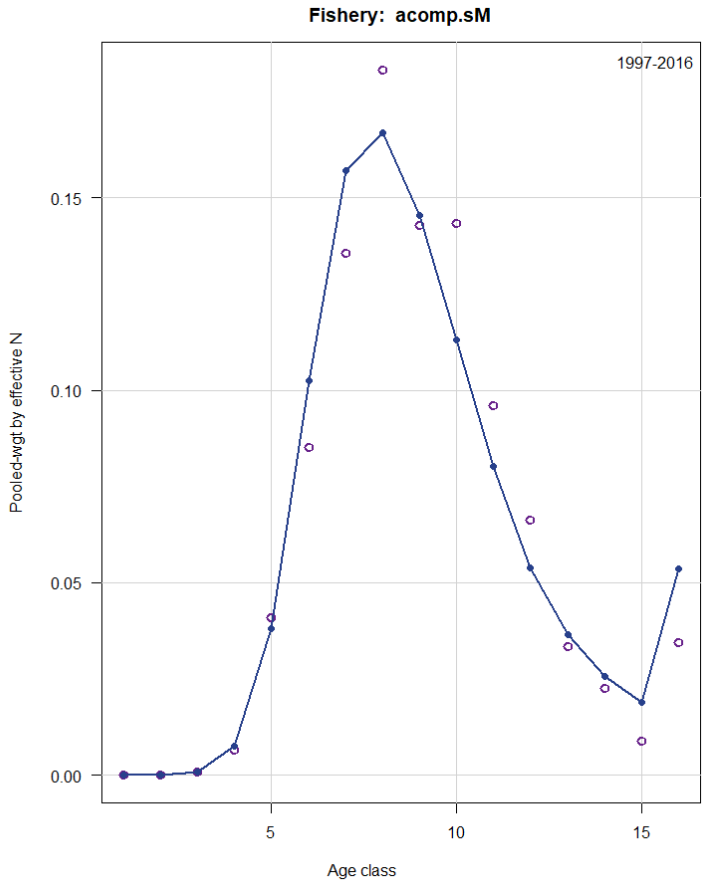


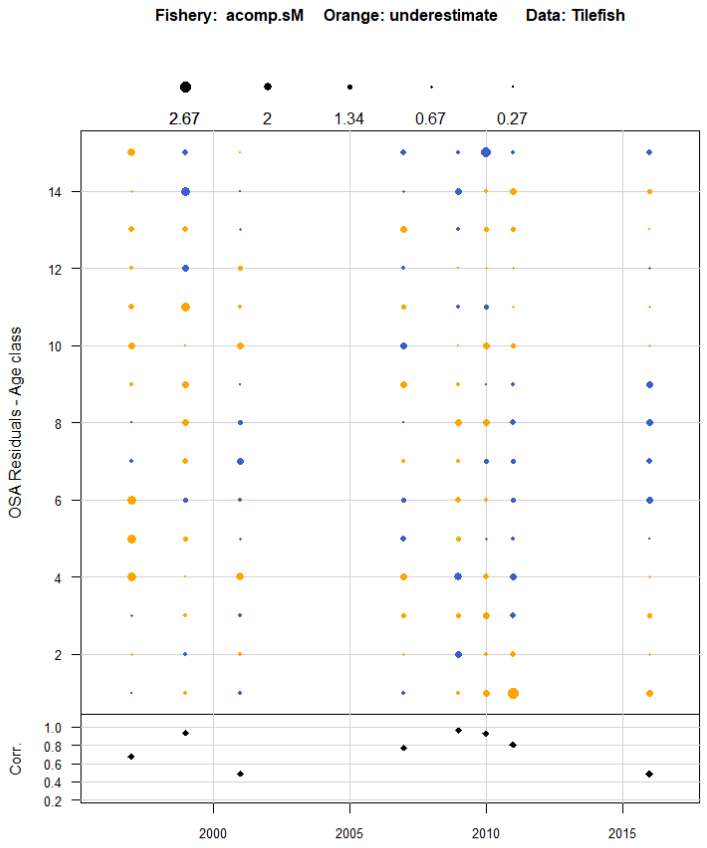
BAM base model – fit to length comp Gen Rec



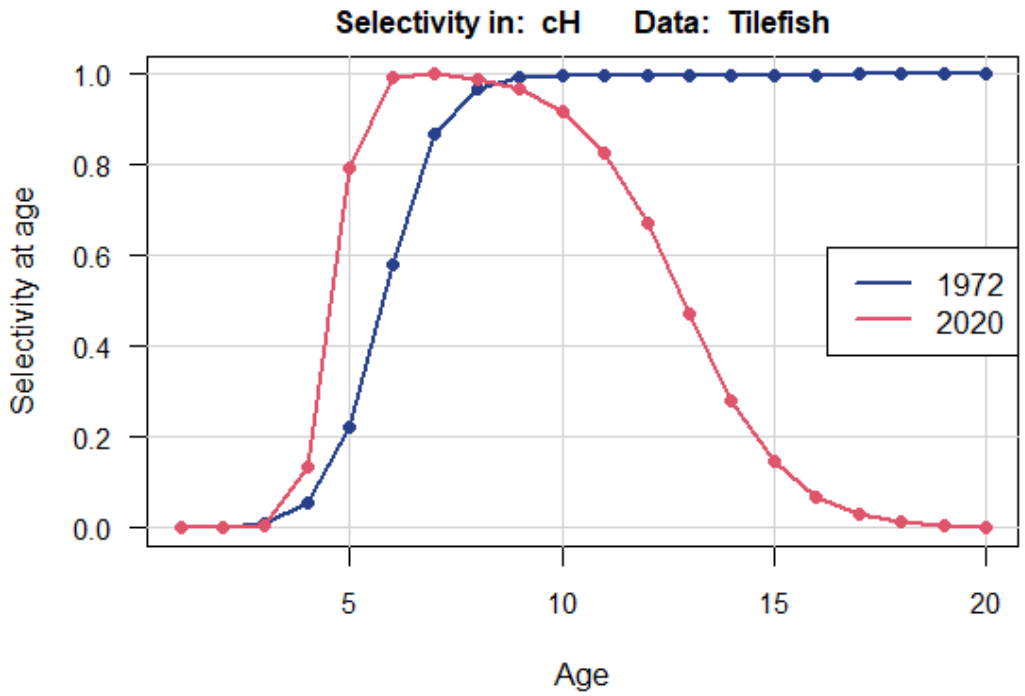


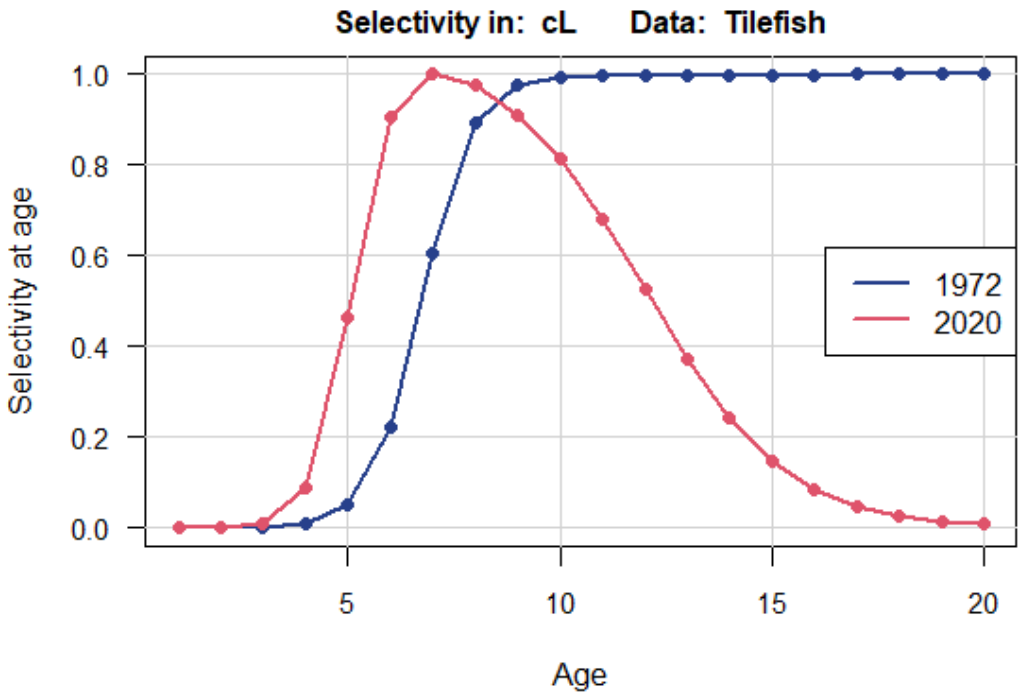
BAM base model – fit to age comp survey



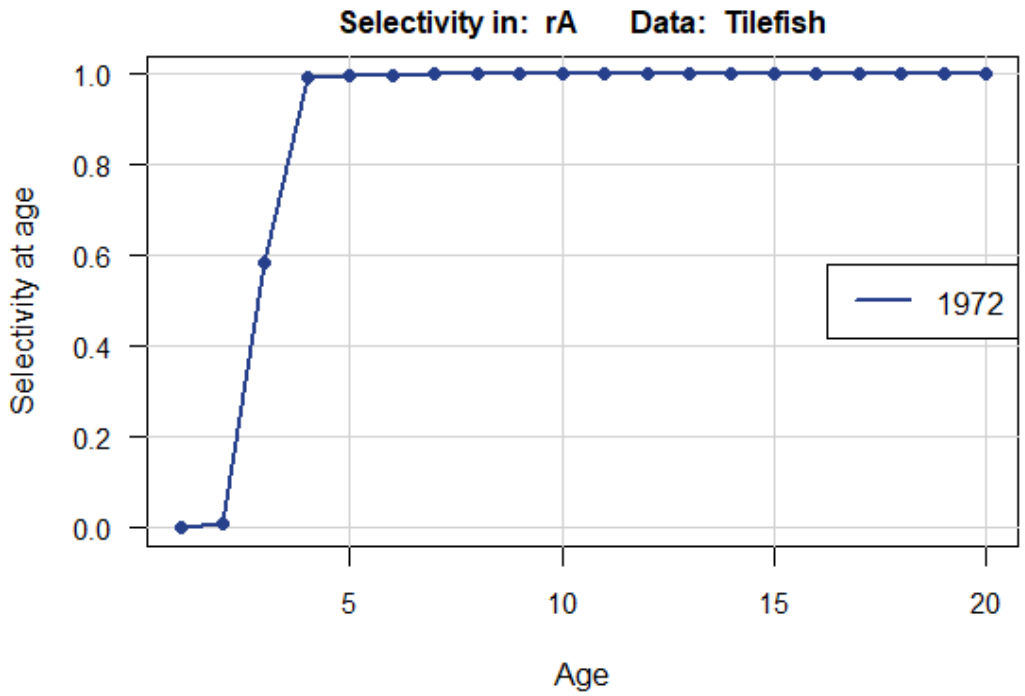


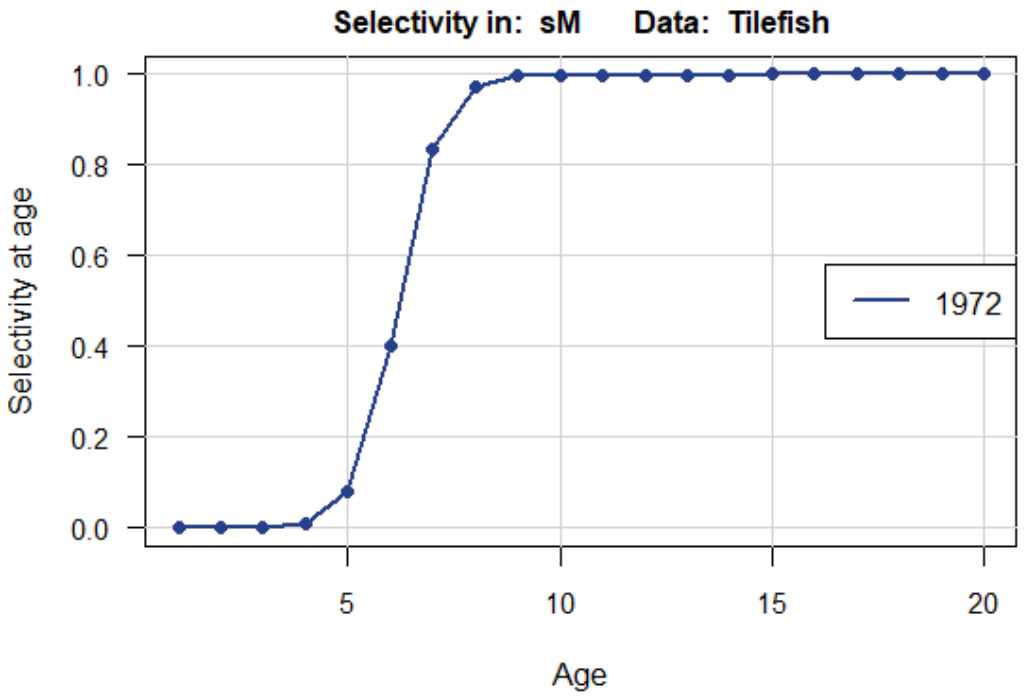
BAM base model – Commercial Selectivity



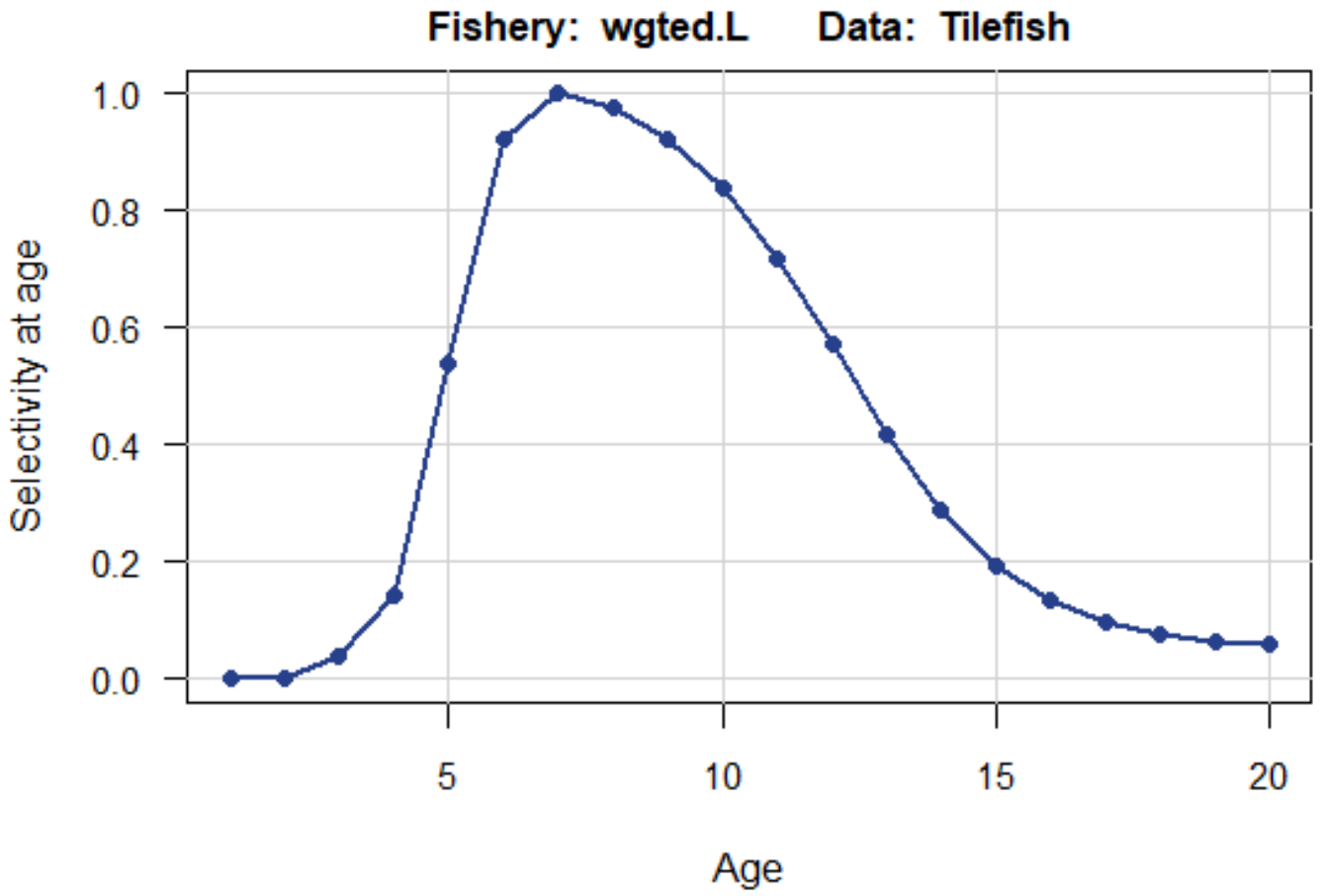


BAM base model – Recreational and Survey Selectivity



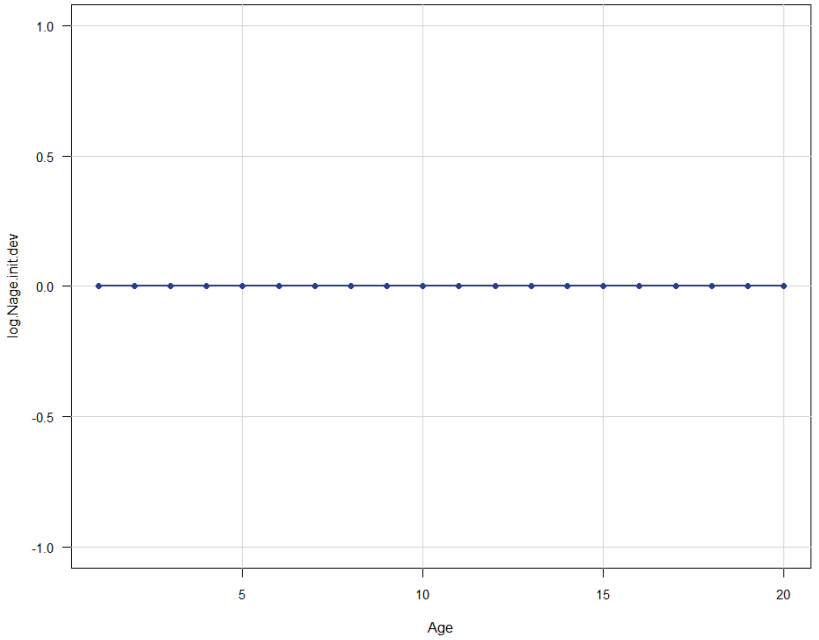


BAM base model – Weighted Selectivity

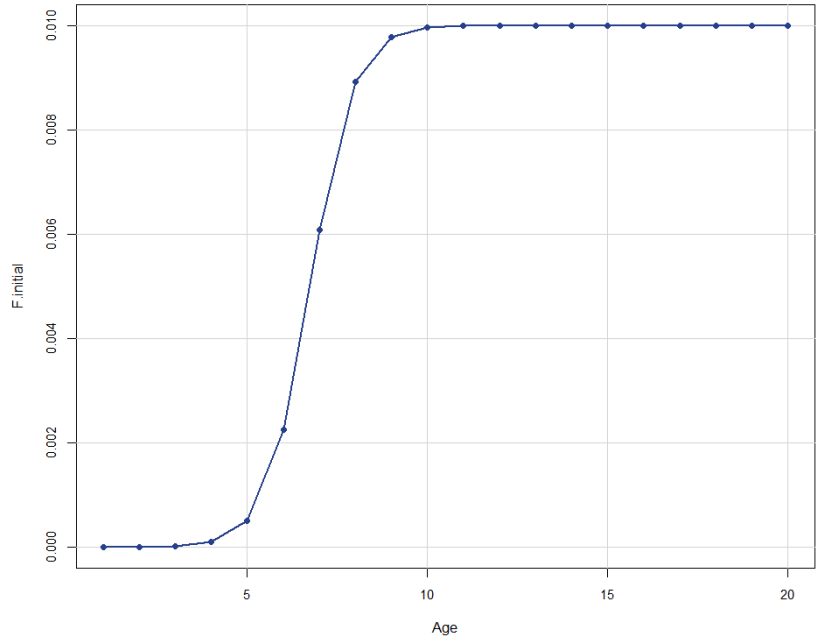


BAM base model – Initial conditions

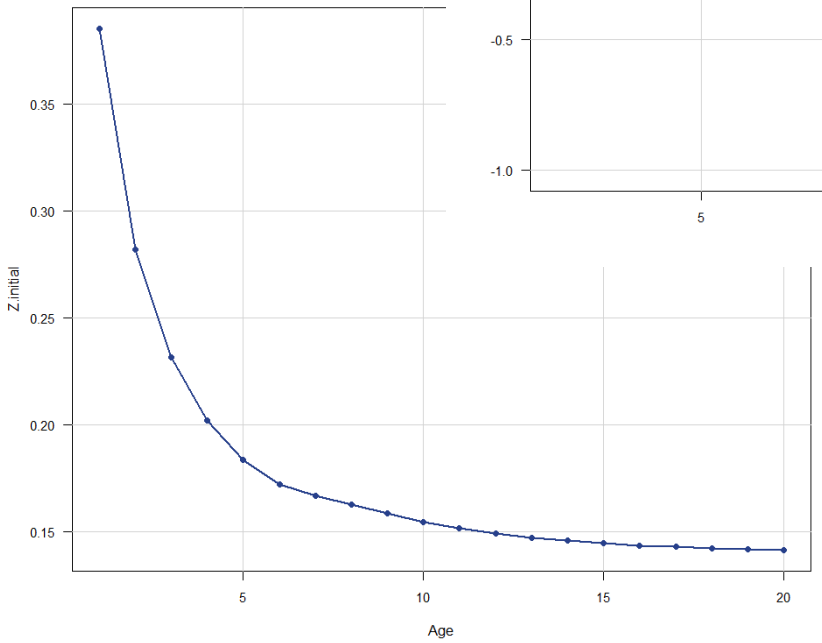
Initial N deviates



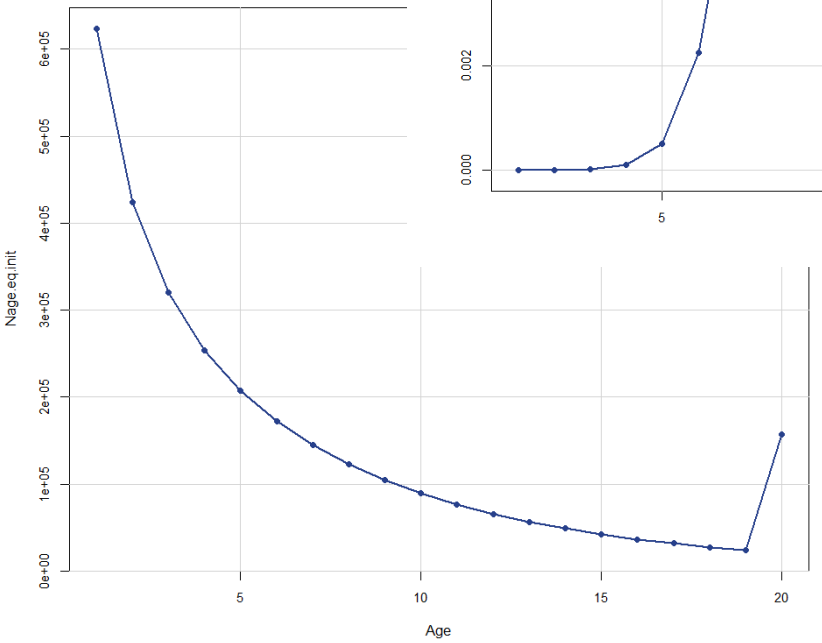
Initial F at age



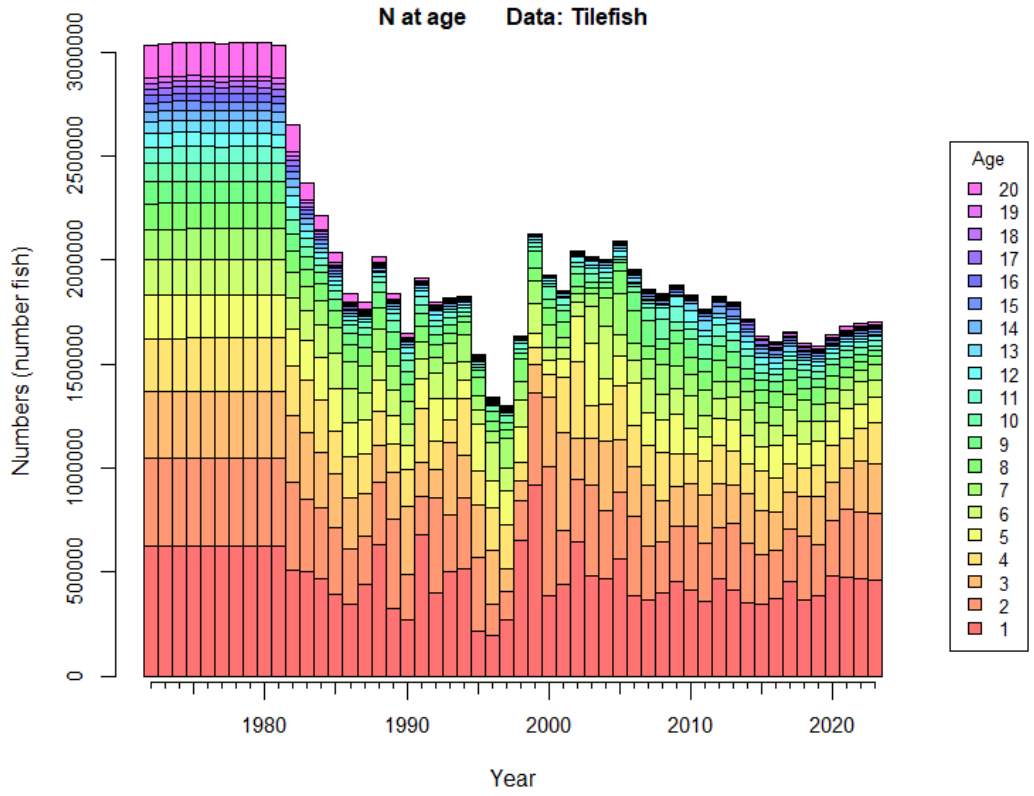
Initial Z at age

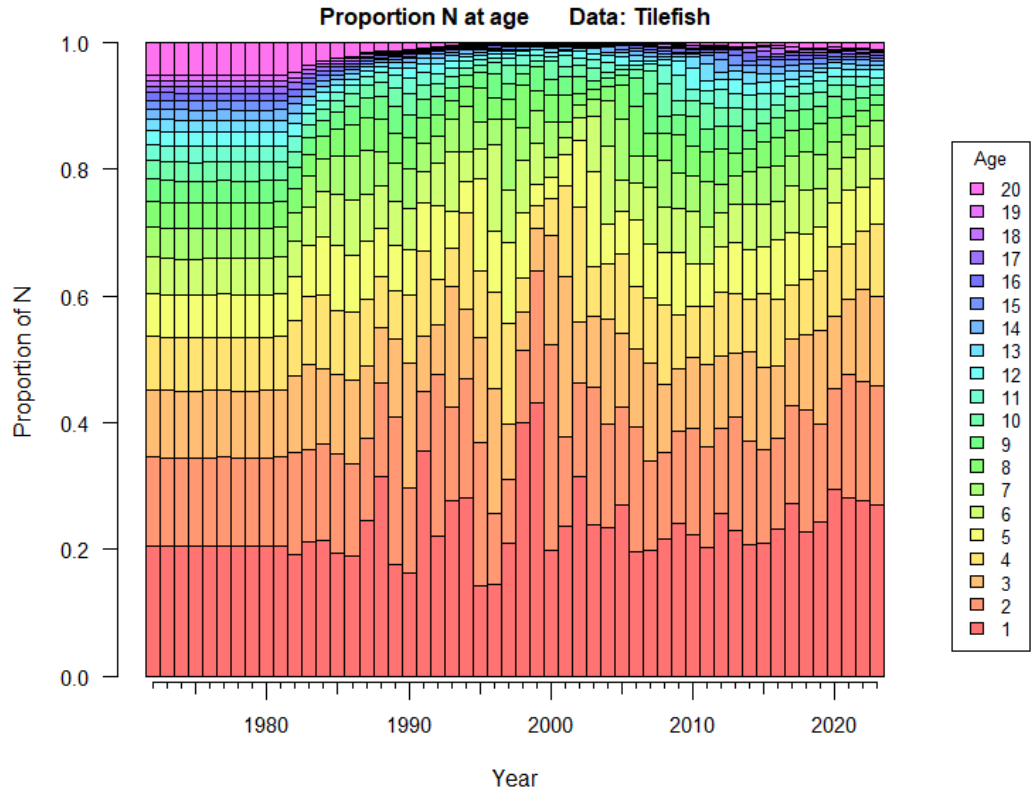


Initial N at age

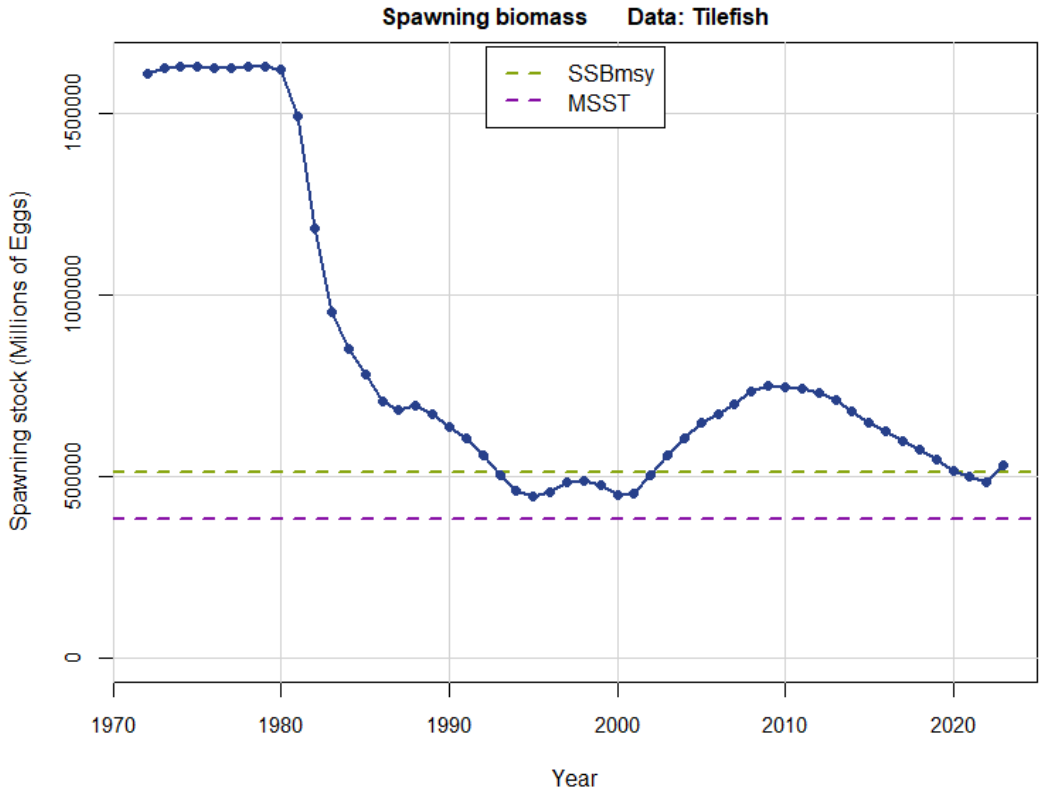


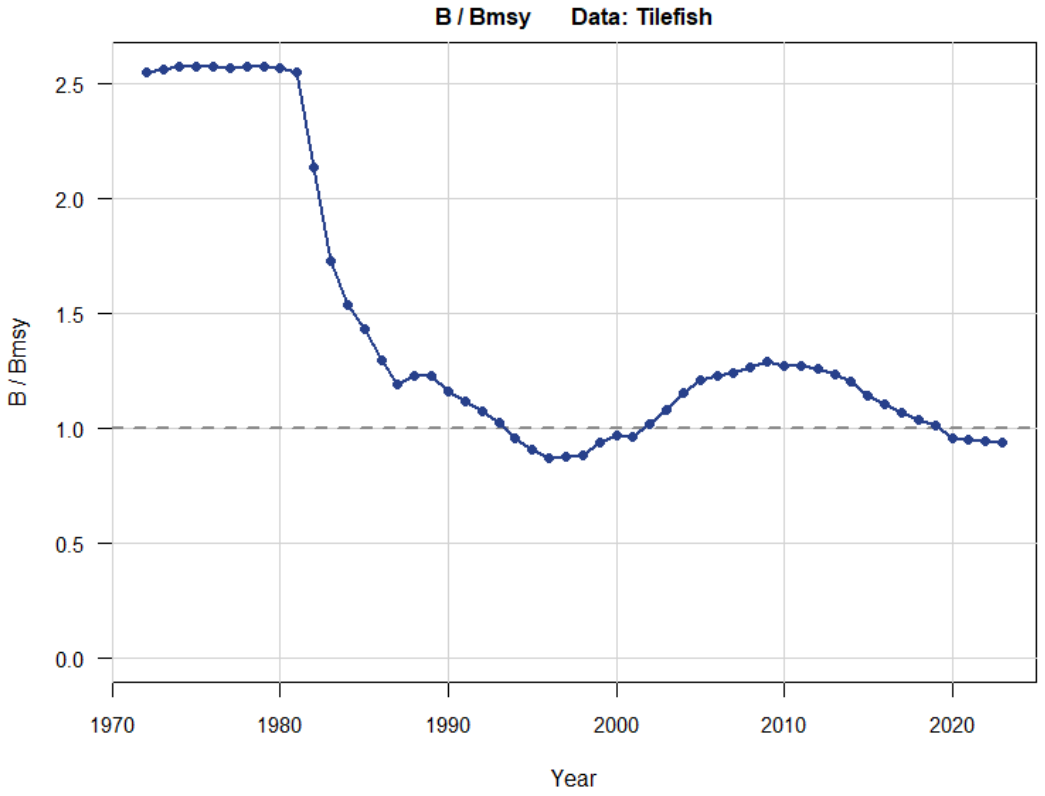
BAM base model – Abundance at age



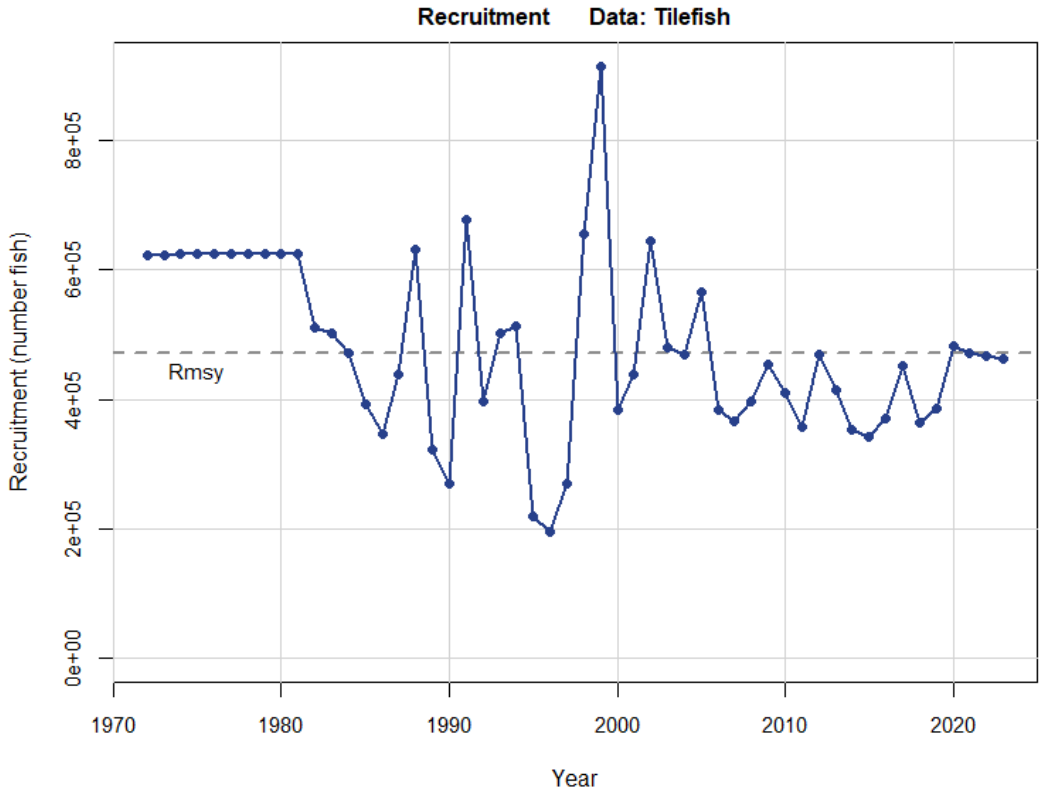


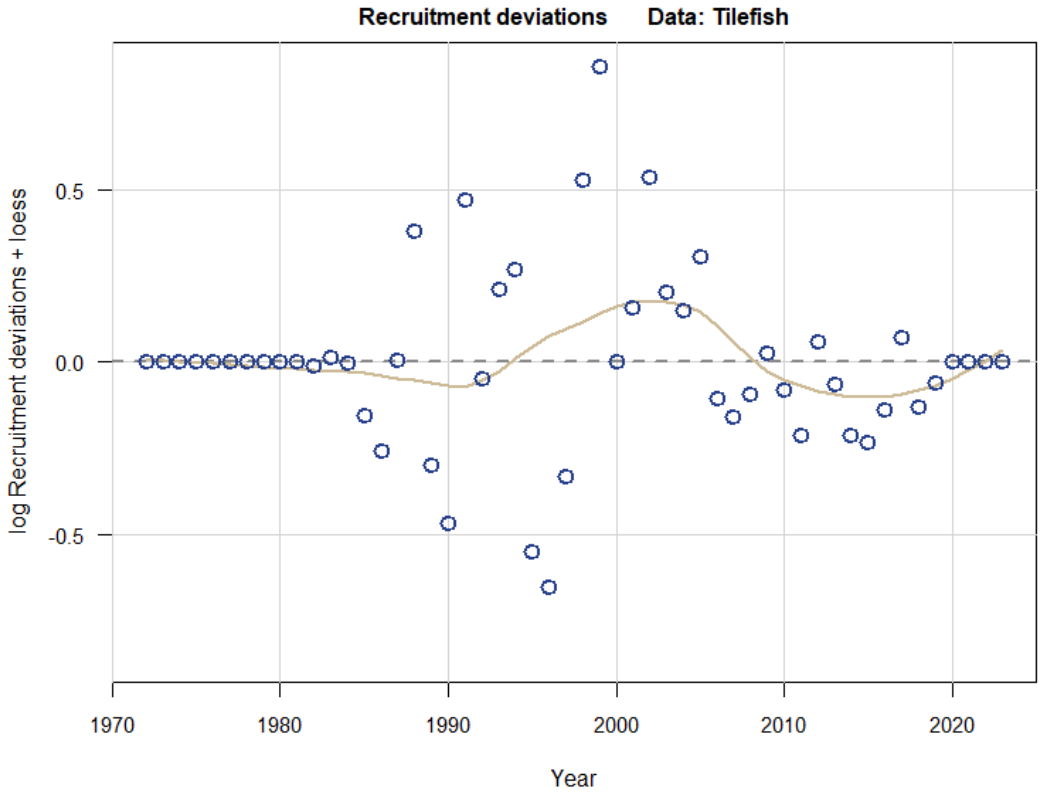
BAM base model – Spawning stock biomass



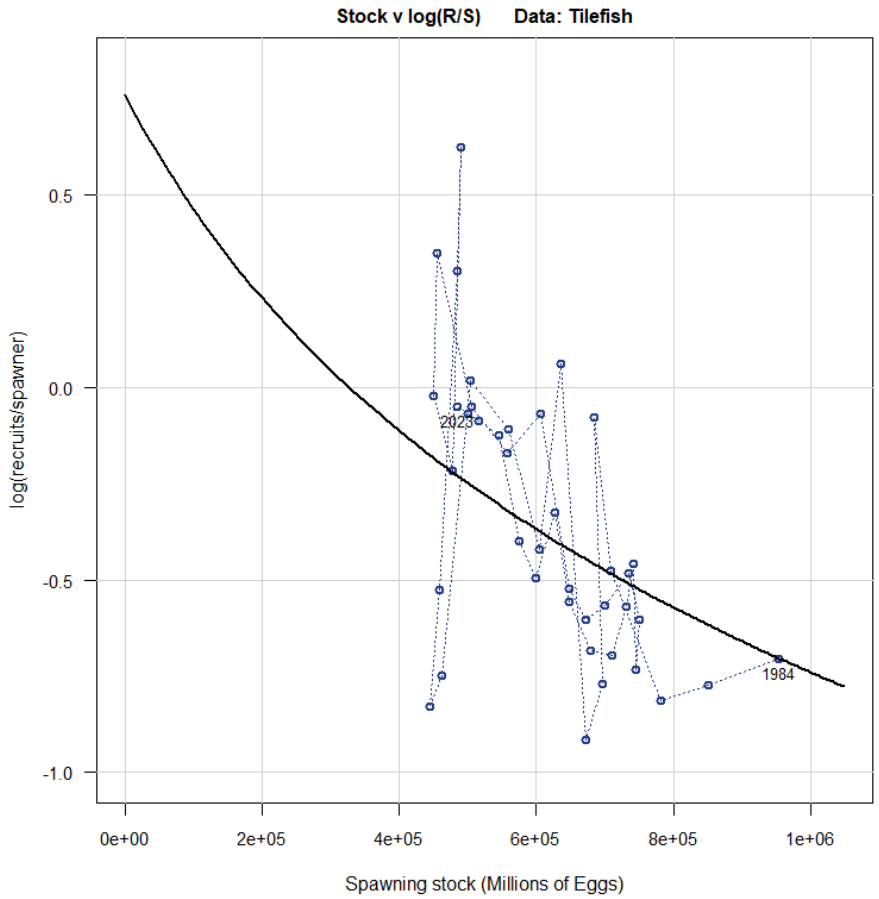


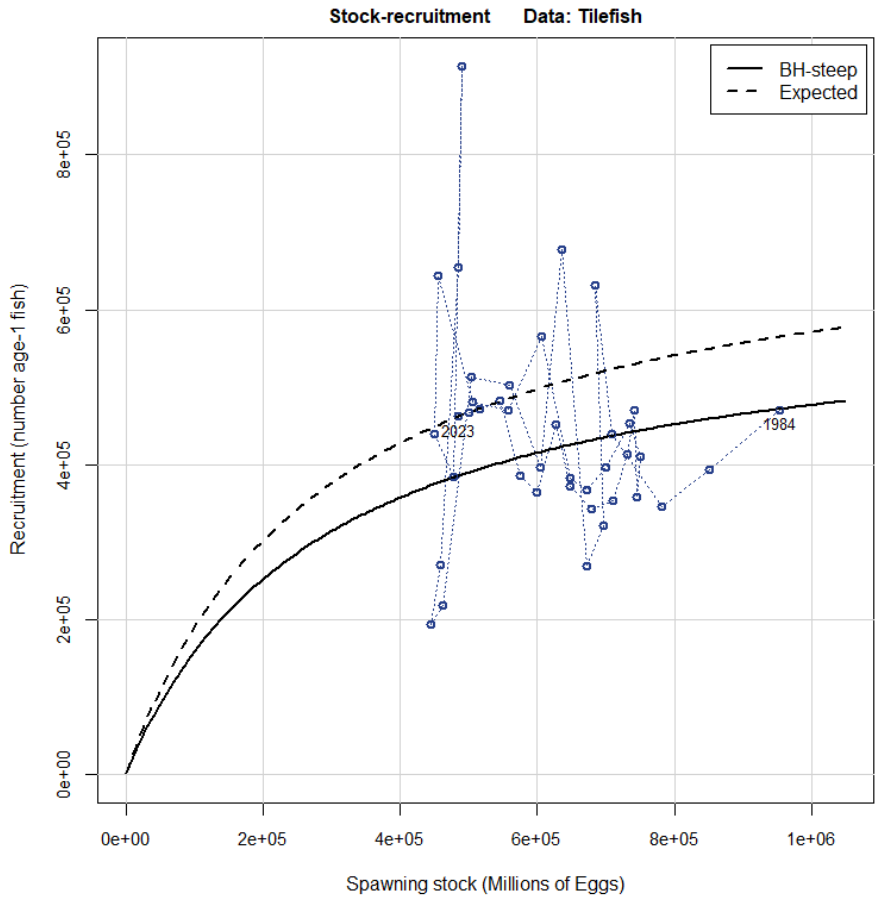
BAM base model – Recruitment



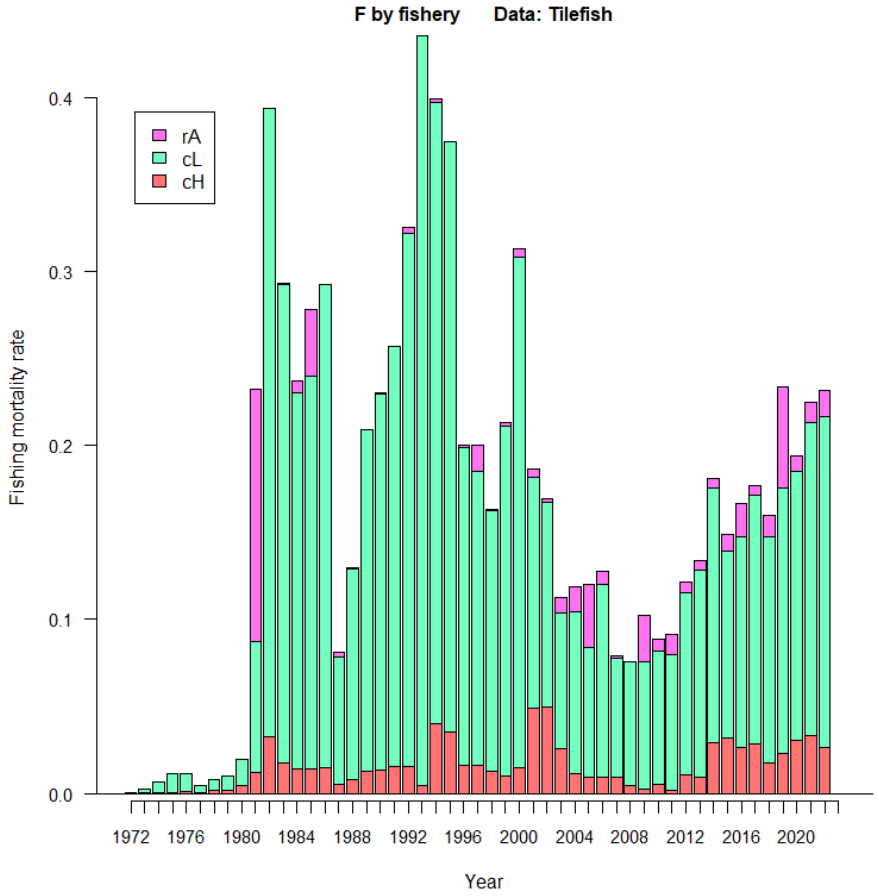


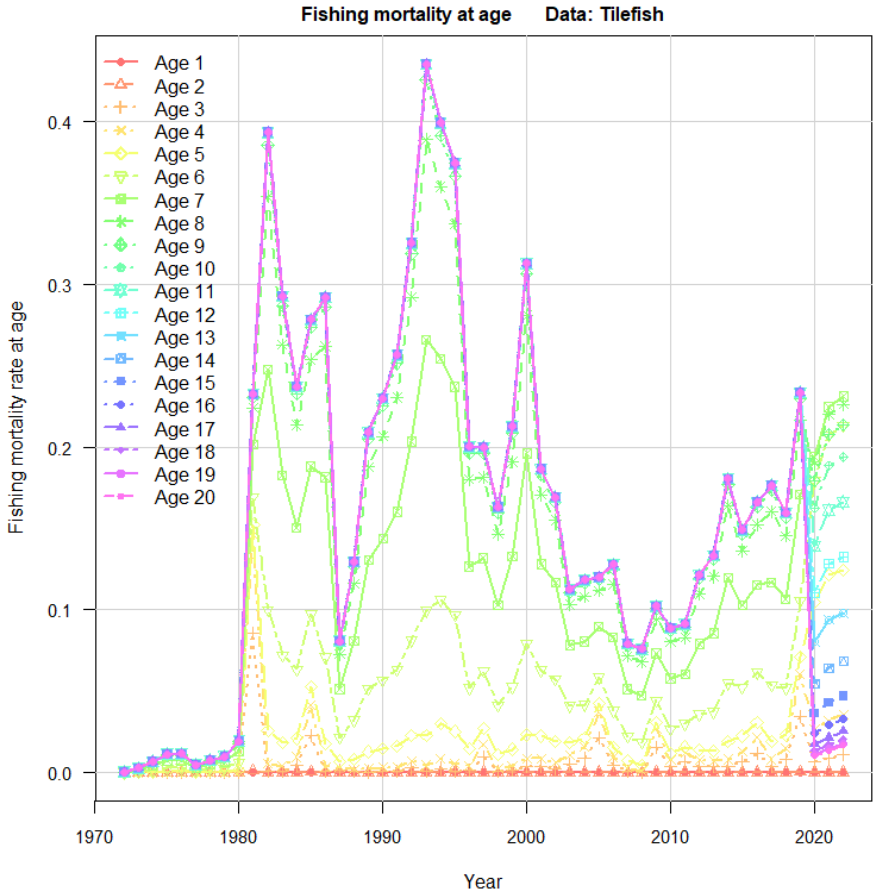
BAM base model – Spawners-recruits



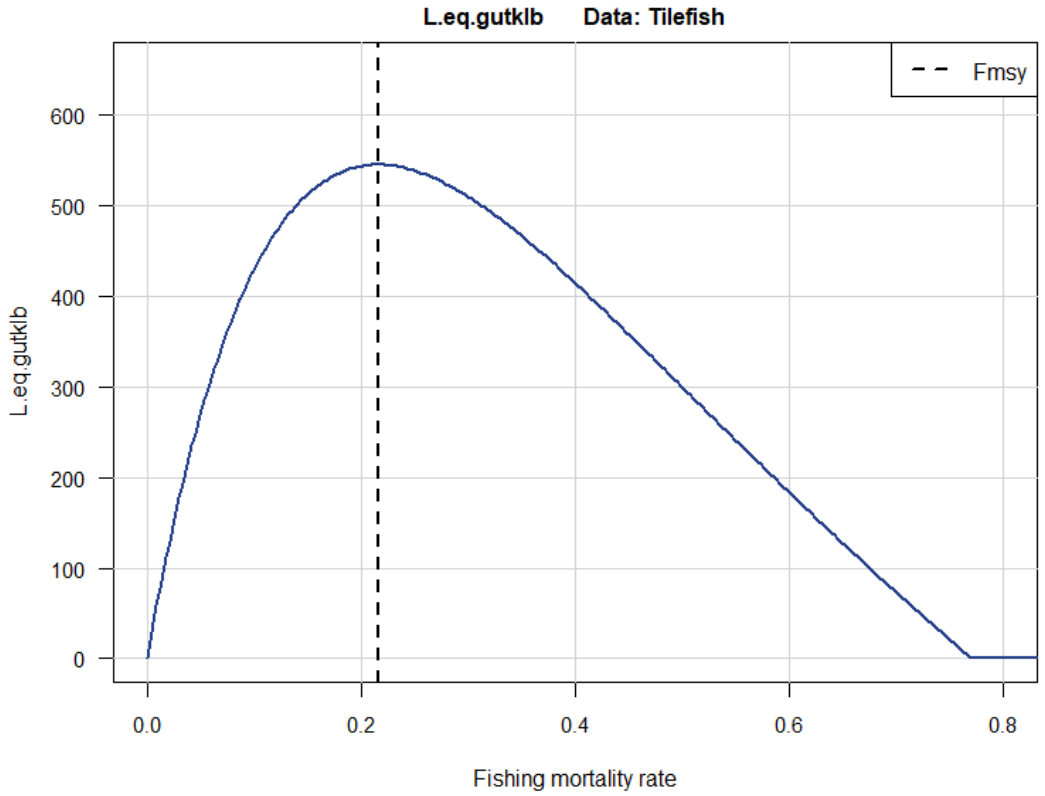


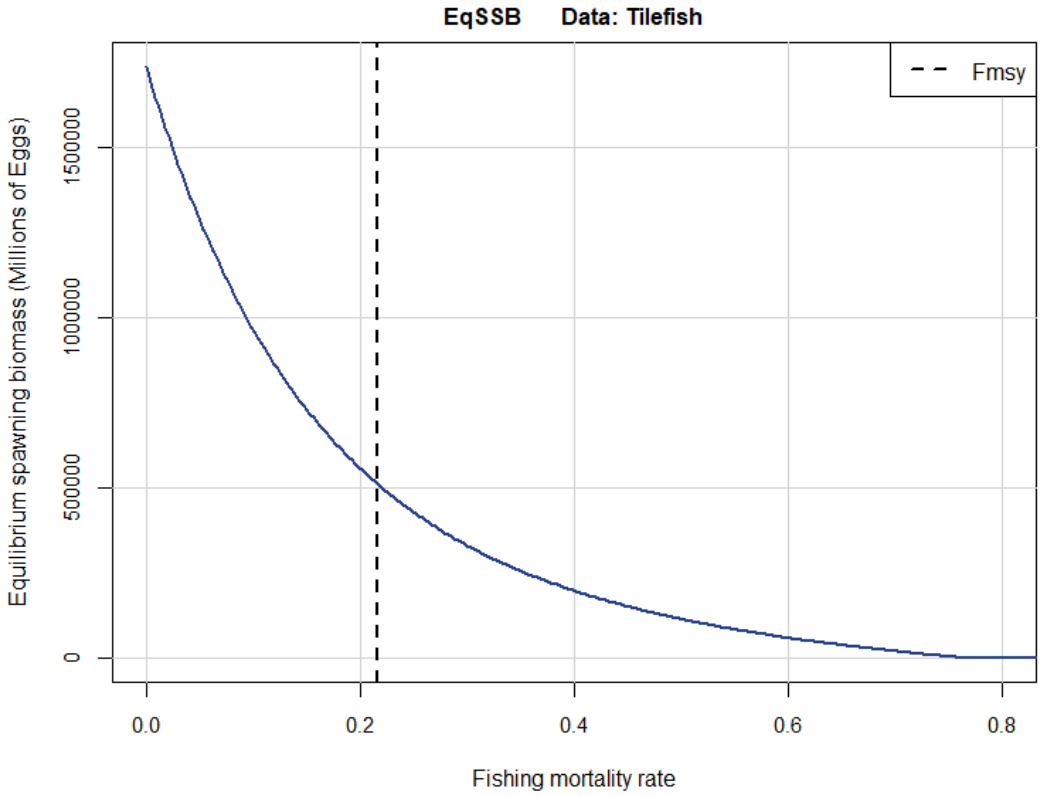
BAM base model – Fishing mortality



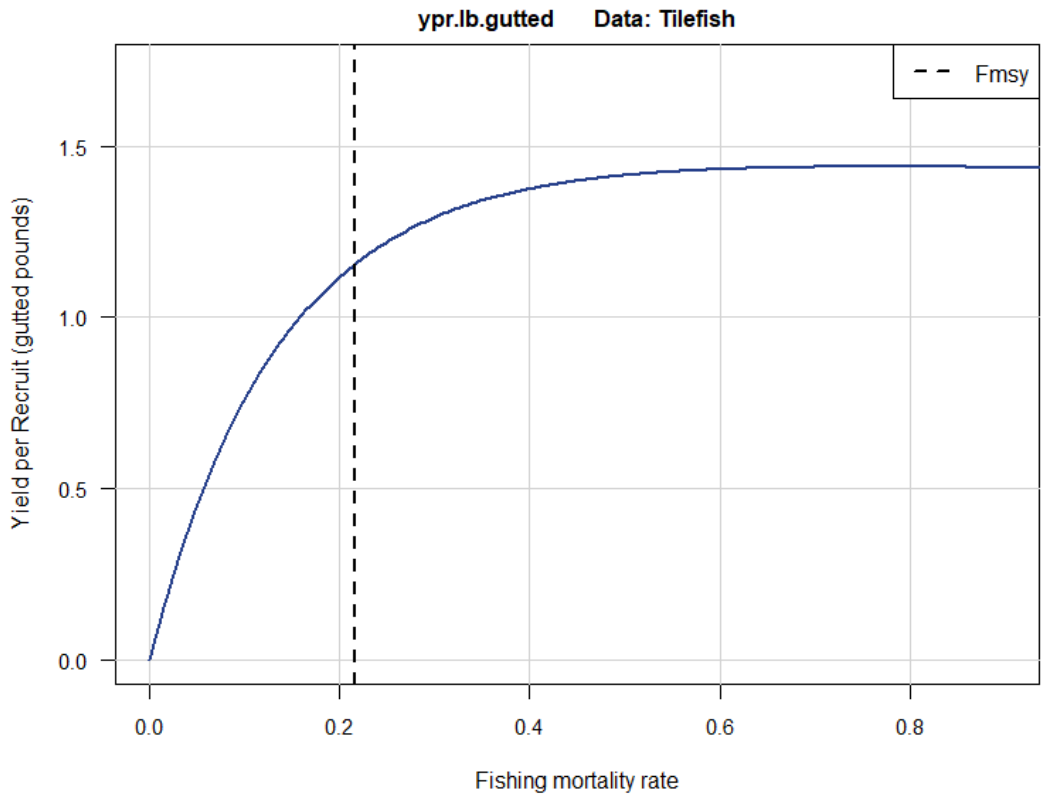


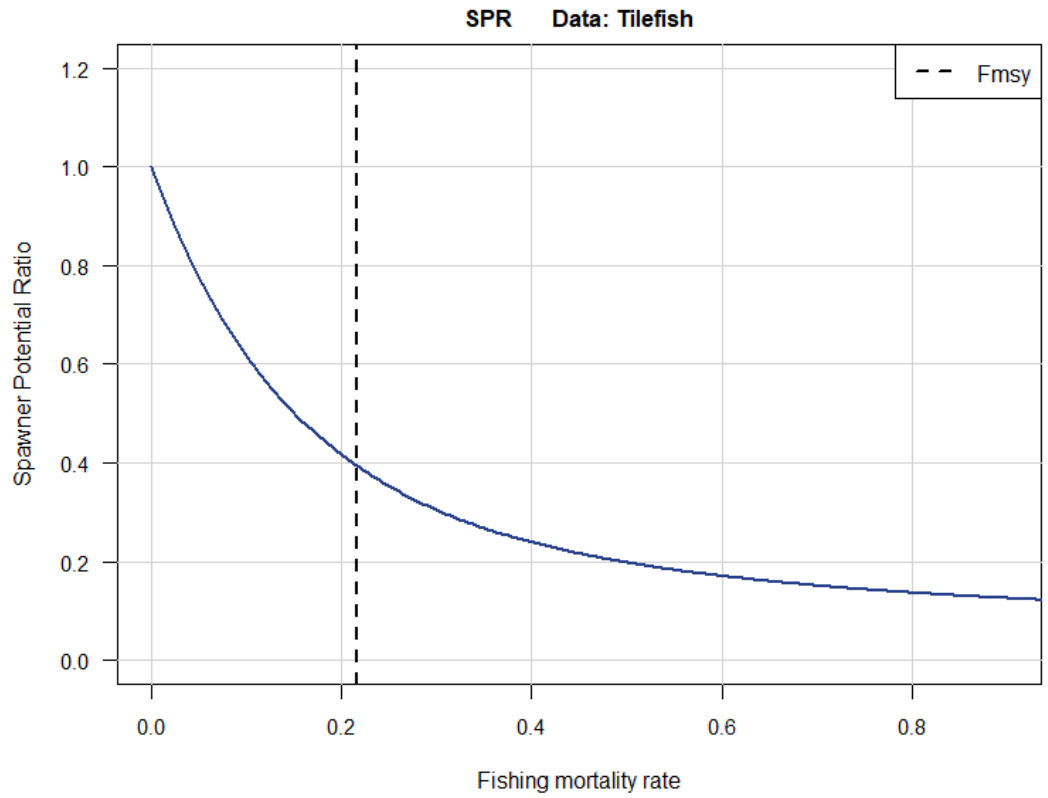
BAM base model – Equilibrium Landings



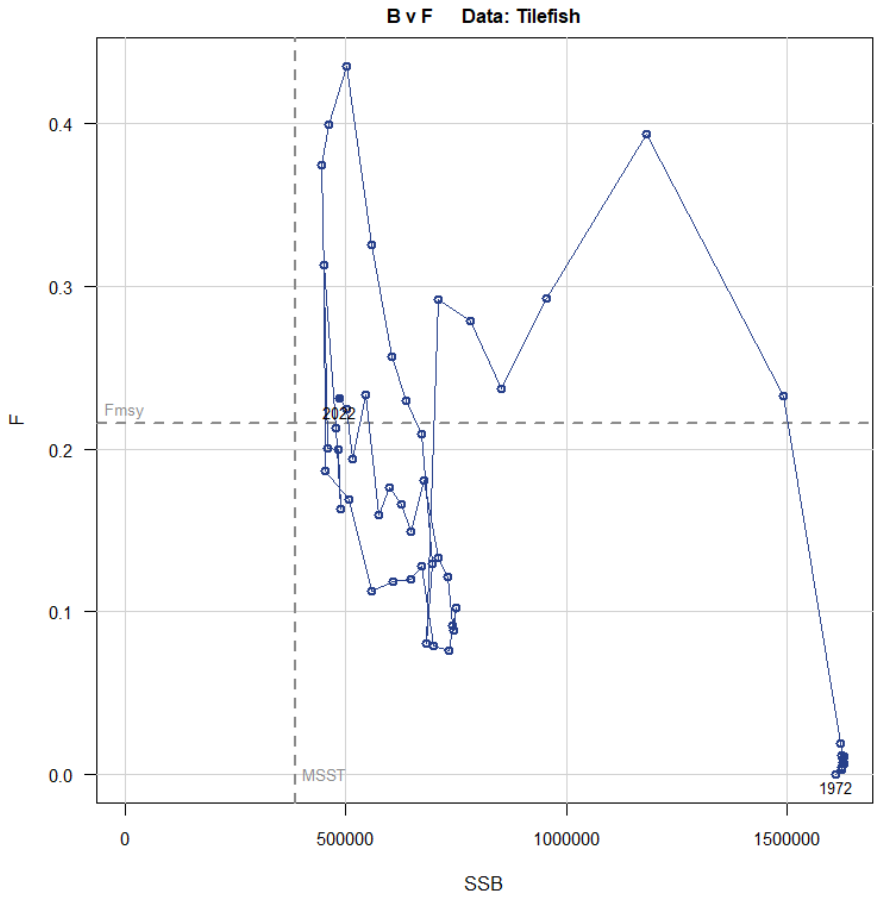


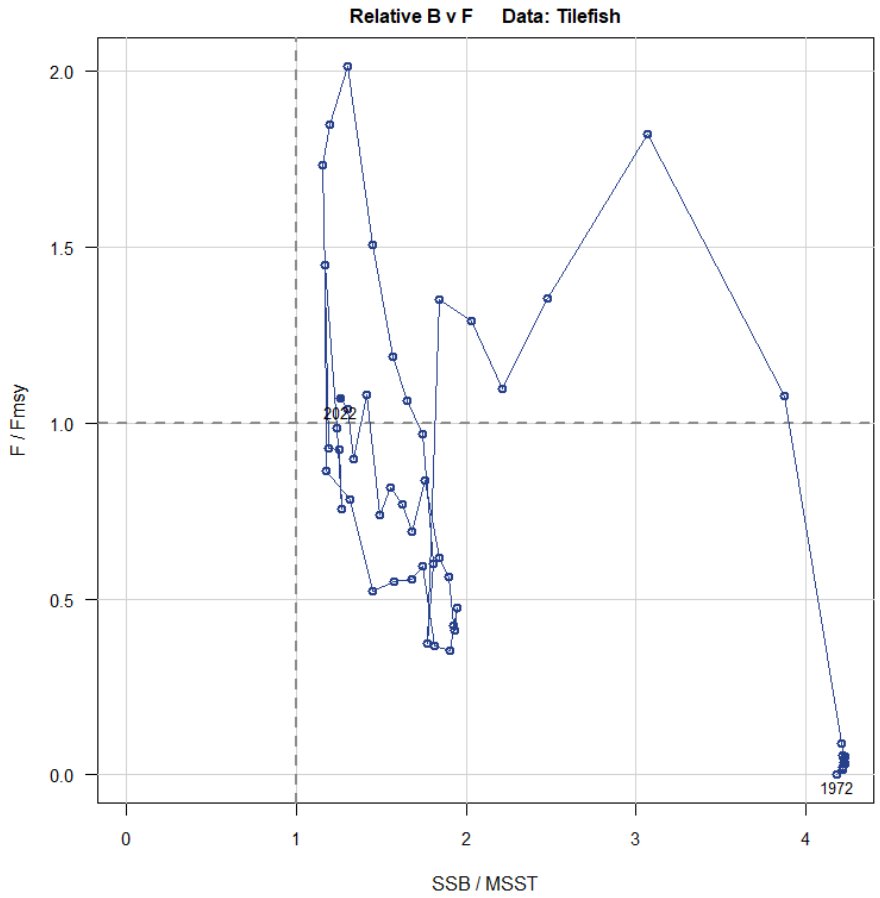
BAM base model – Per recruit



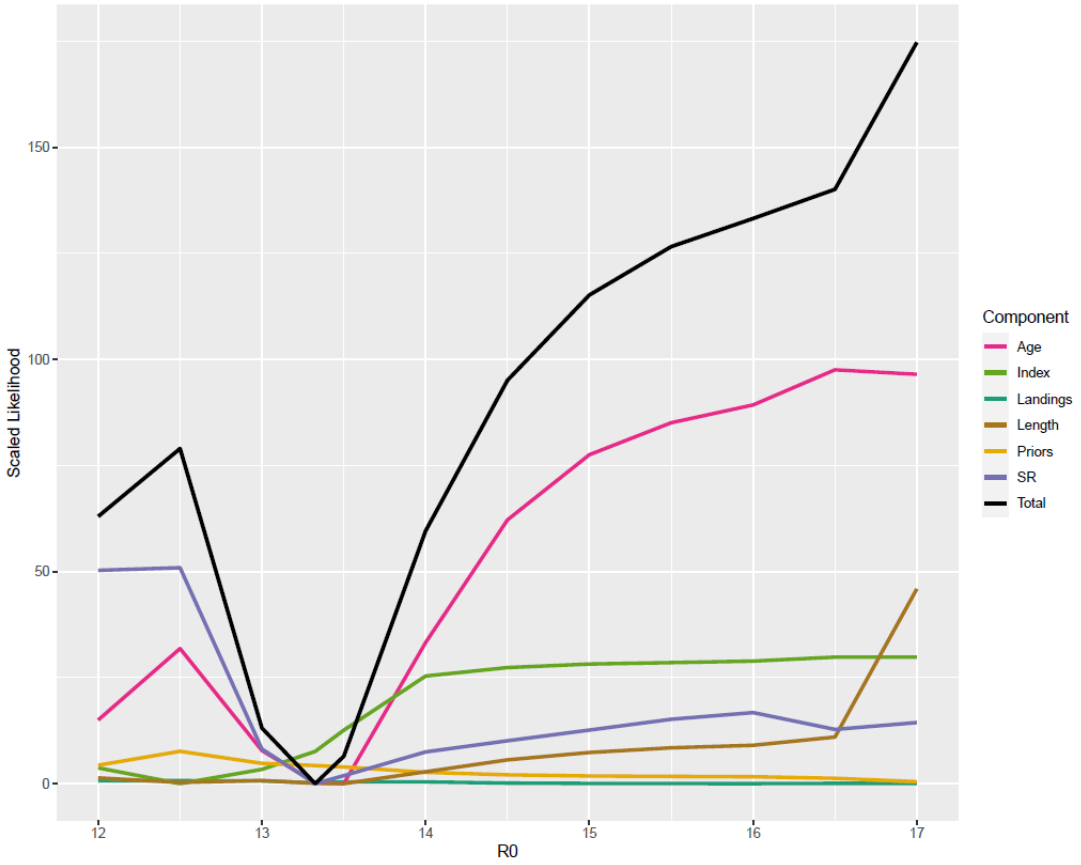


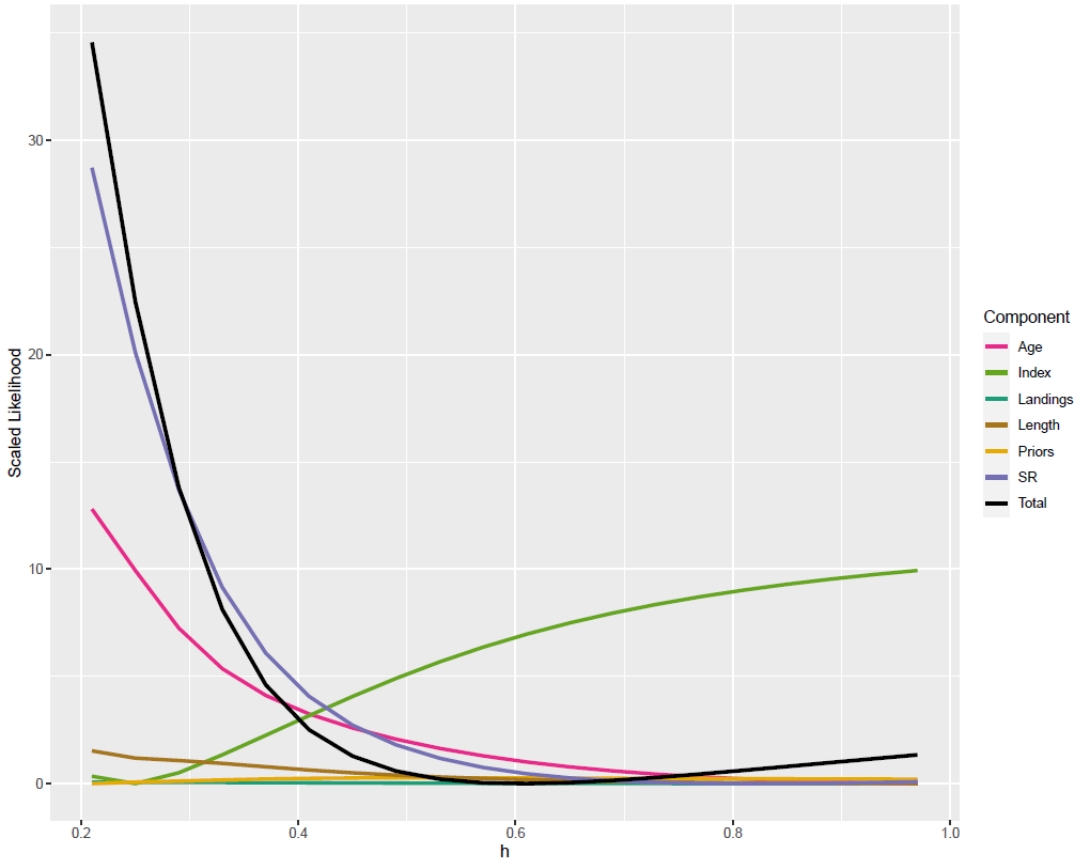
BAM base model – Phase Plot



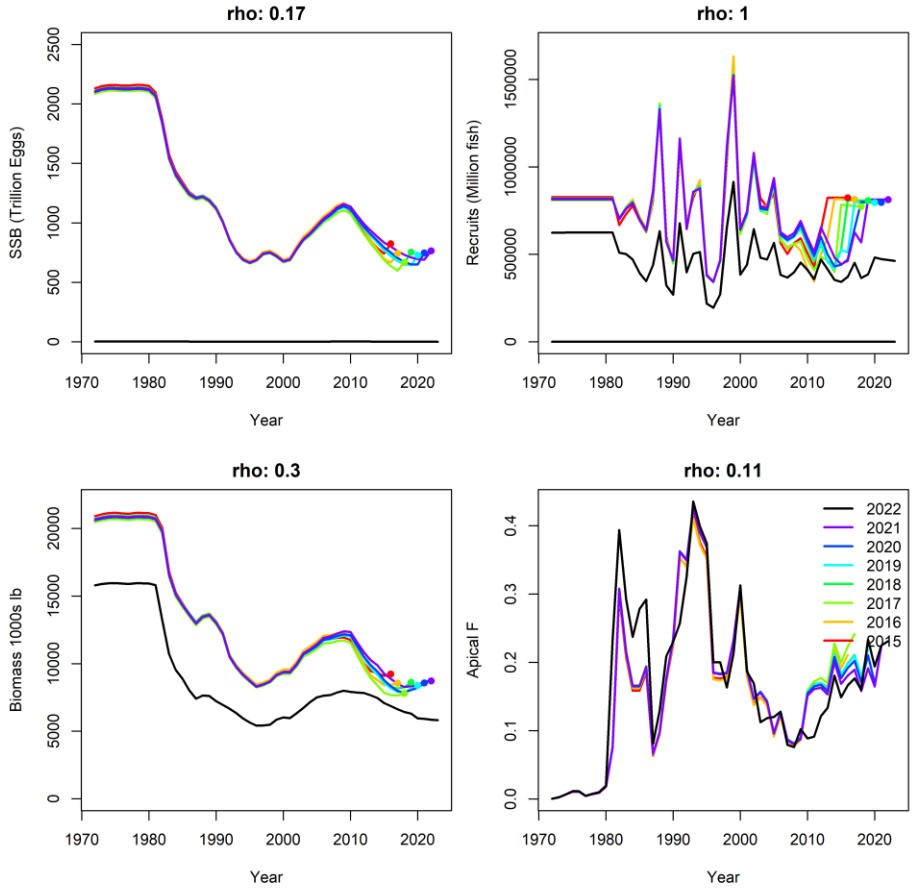


BAM base model – LogR0 & steepness profile

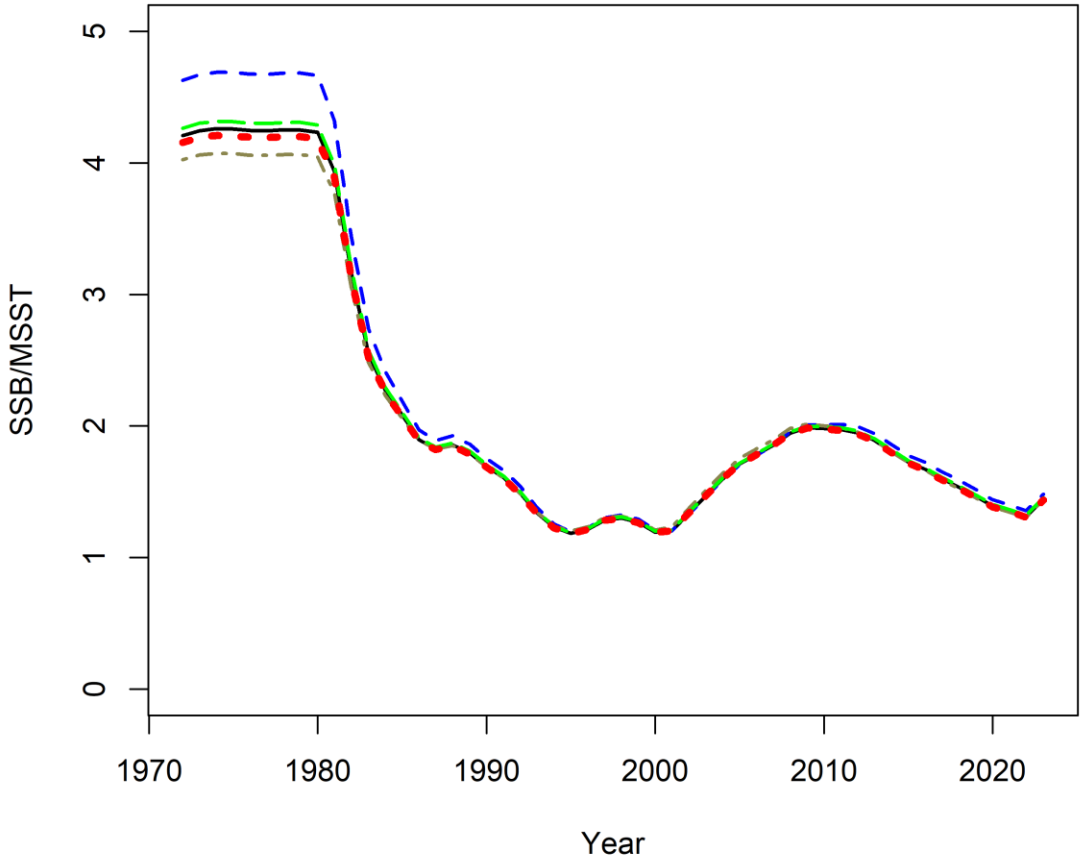


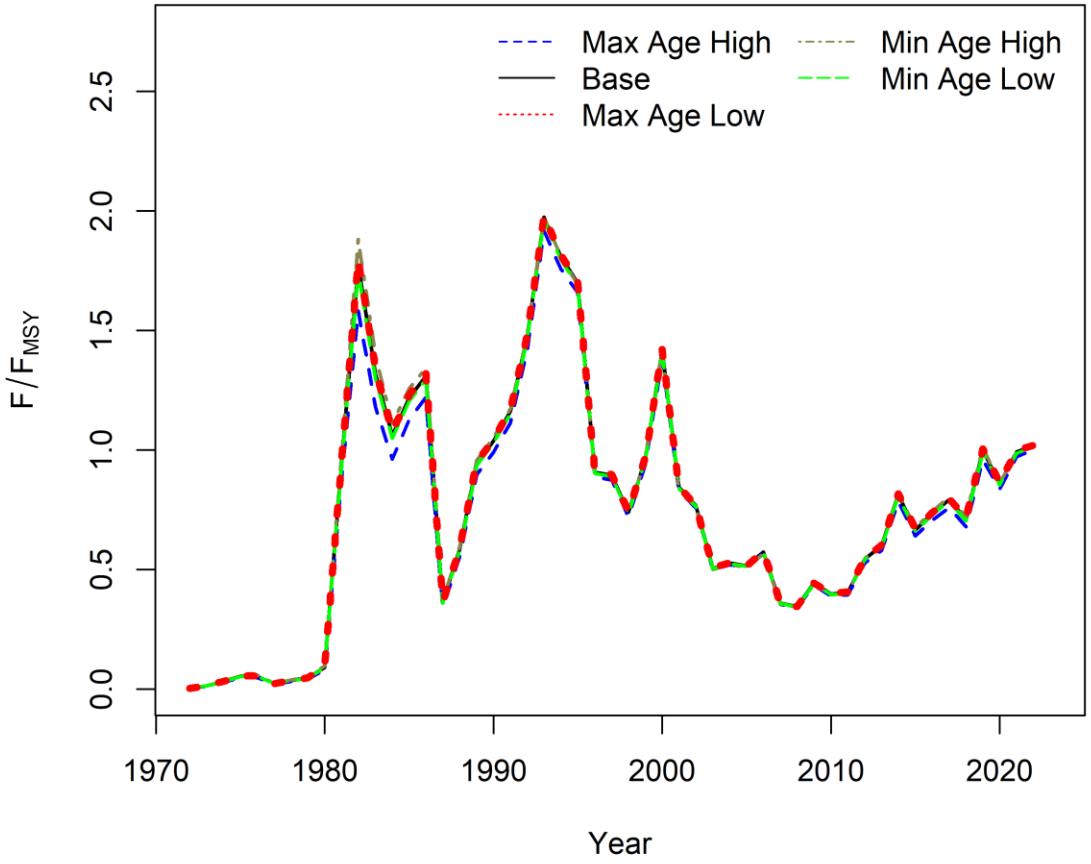


BAM base model – Retrospective analysis

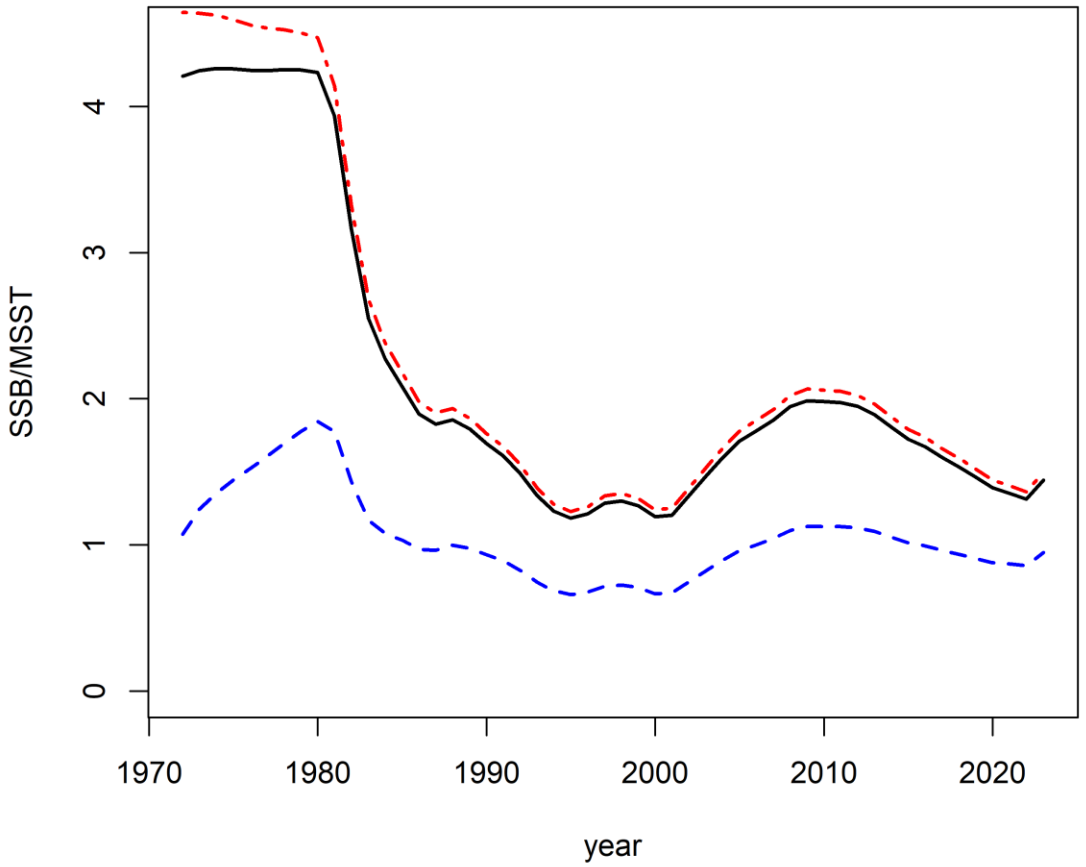


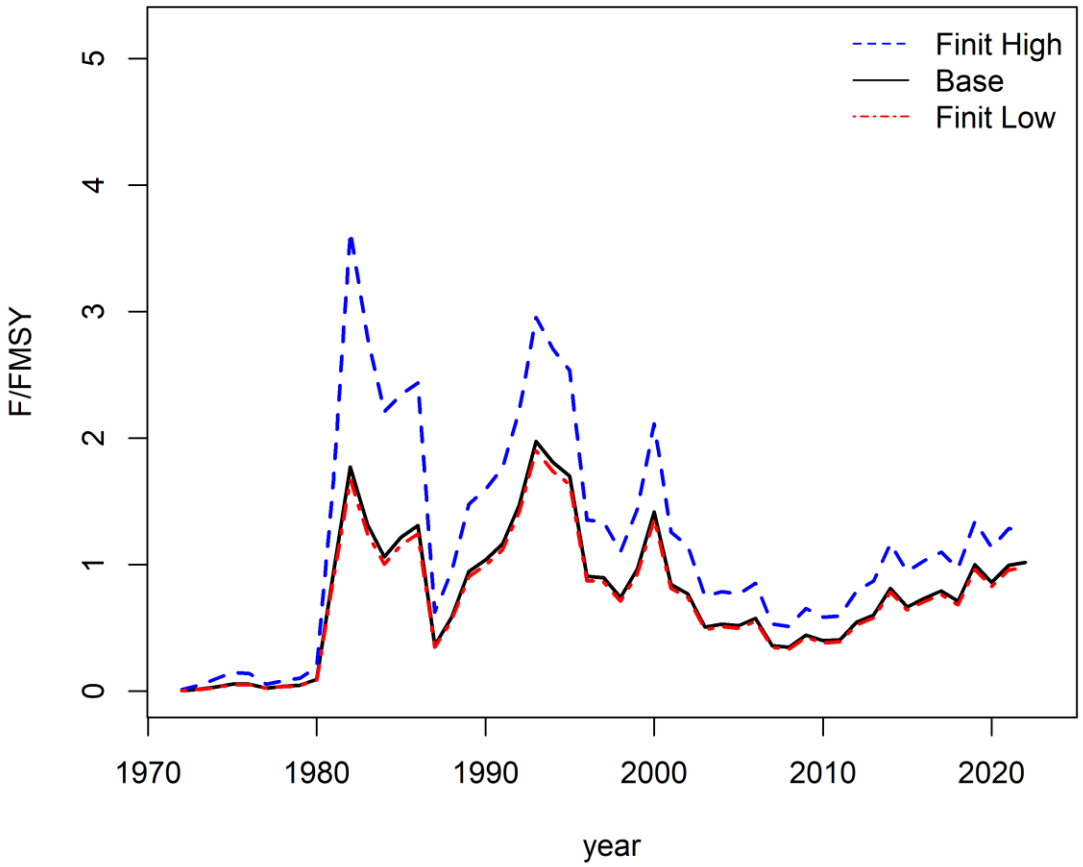
BAM base model sensitivity – Natural Mortality



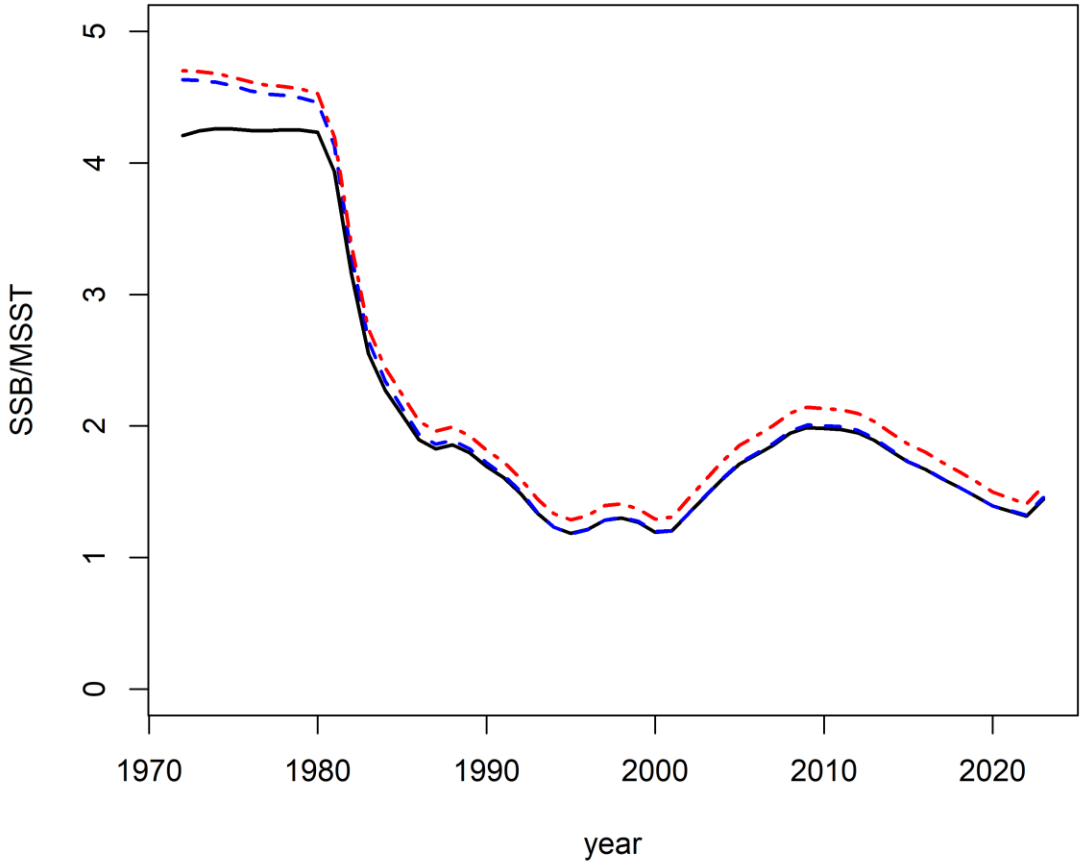


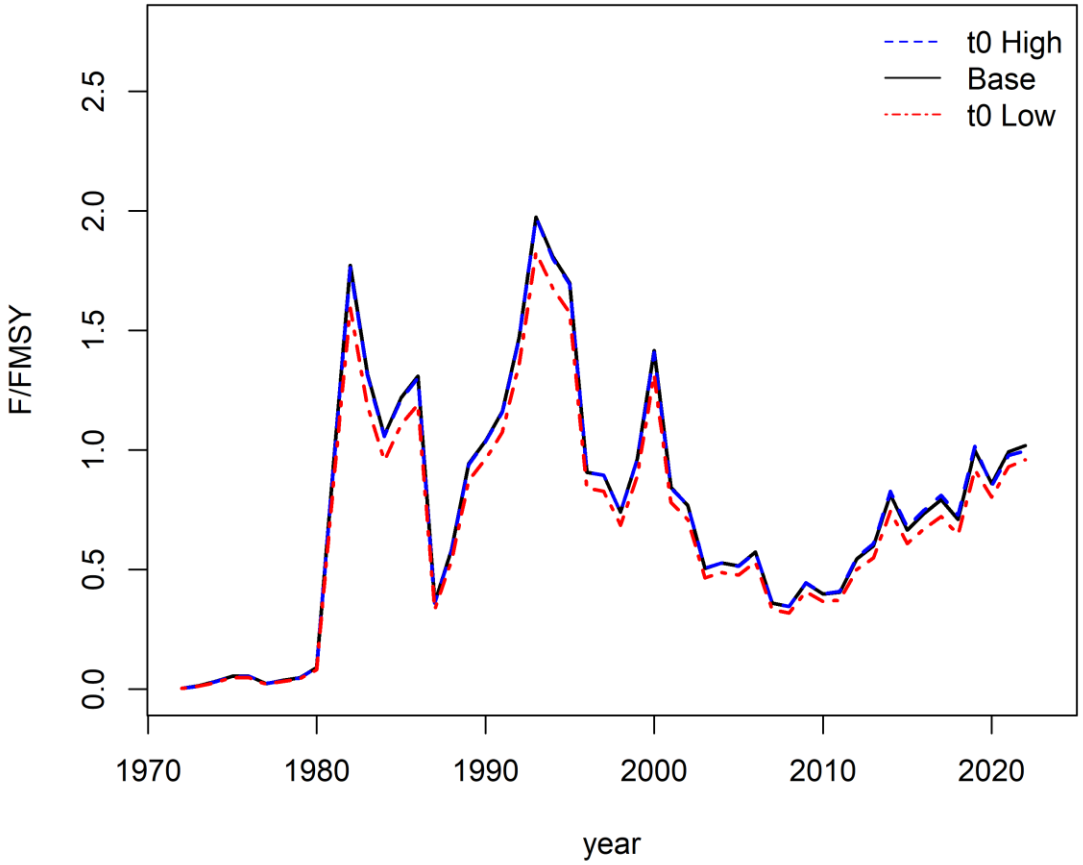
BAM base model sensitivity – F_{init}



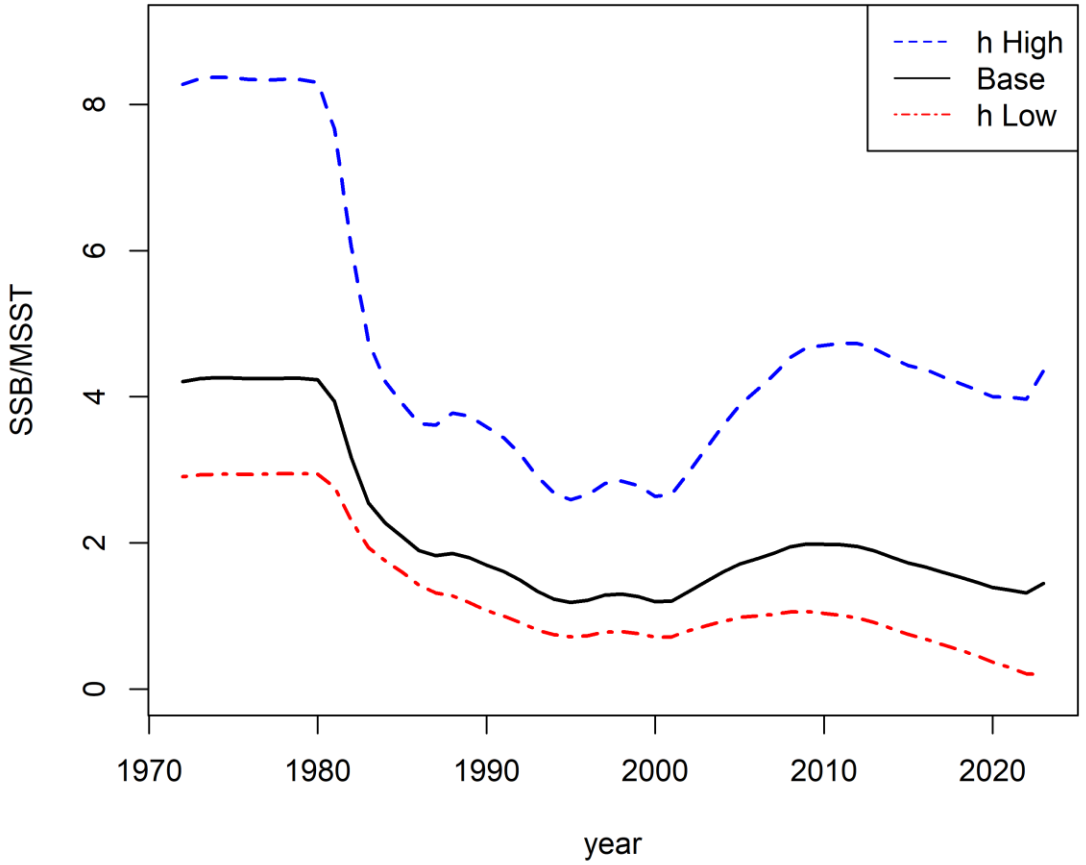


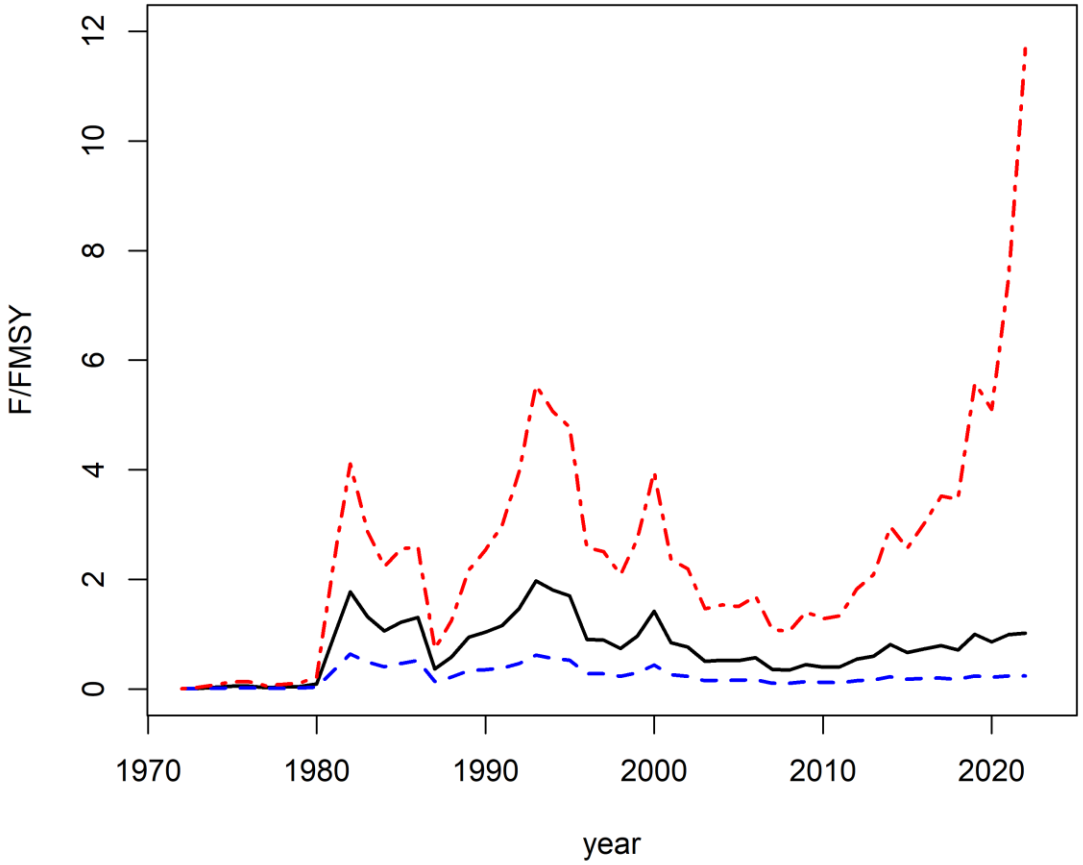
BAM base model sensitivity – Growth t_0





BAM base model sensitivity – Steepness





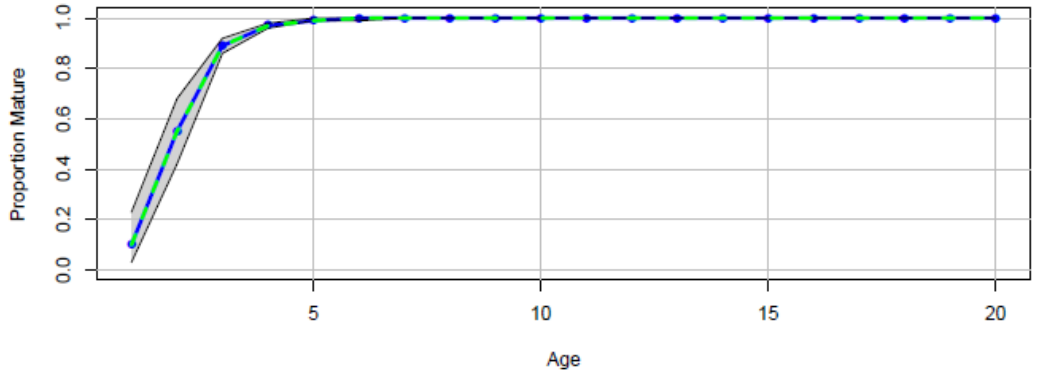
Outline

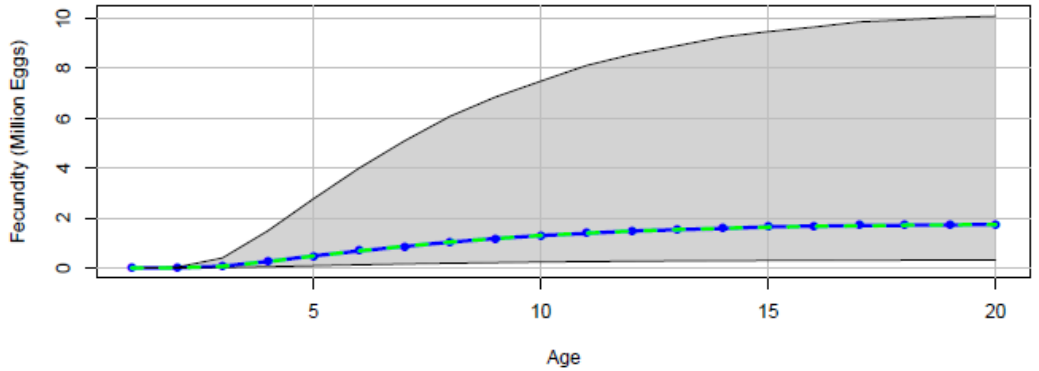
- Background
- Data
- Assessment Model
- Assessment Results
- **Uncertainty**
- **Projections**

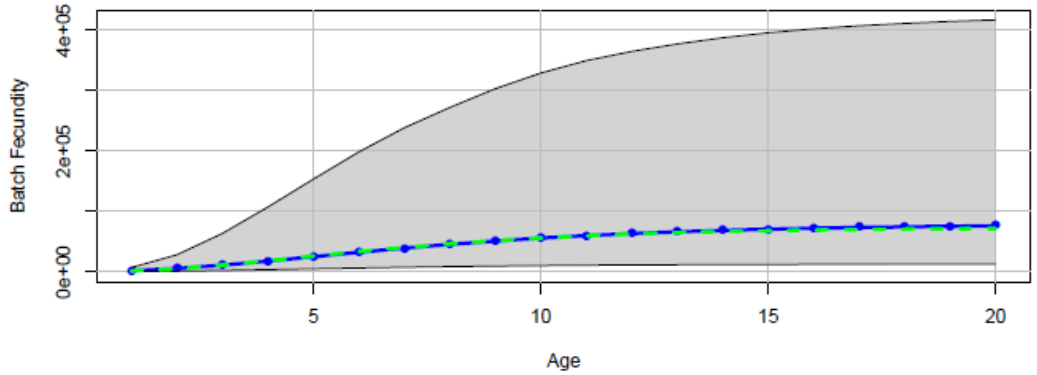
Characterizing uncertainty: Monte Carlo/Bootstrap Ensemble (MCBE)

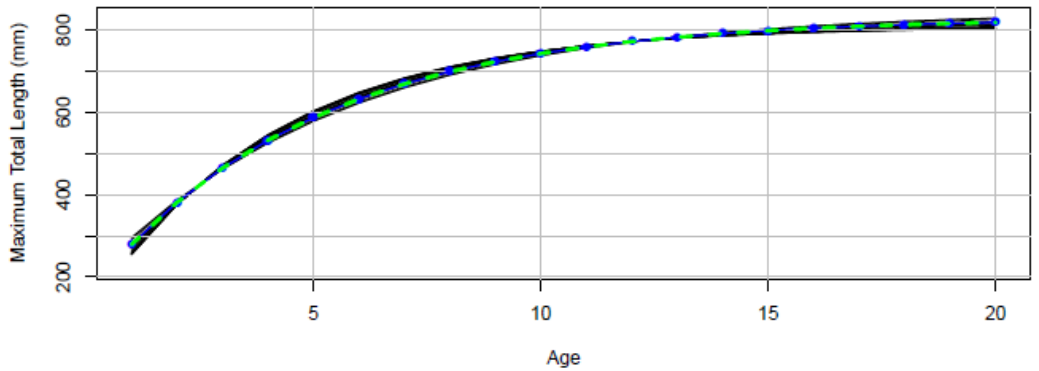
- Bootstrap the data
  - Multinomial resampling of age and length compositions
  - Multiplicative lognormal error on indices and removes
  - Natural mortality database for Hamel and Cope (2022) regression
- Monte Carlo draws
  - Natural mortality max age: Drawn from U()
  - Natural mortality min age: Drawn from U()
  - F_{init}: Drawn from U(0,0.2)
  - Growth model: refit to data with t_0 drawn from U(-1,0)
  - Batch Fecundity
  - Number of batches
  - Peak spawning time
  - Rec Sigma
  - Maturity at age
  - Length-Weight relationships – Whole weight and gutted weight
- 4000 model fits
  - Retained 3018

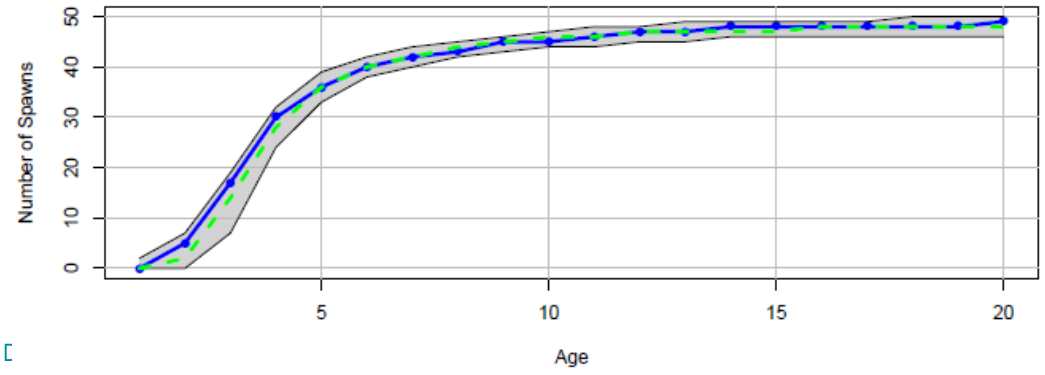
Input Uncertainty

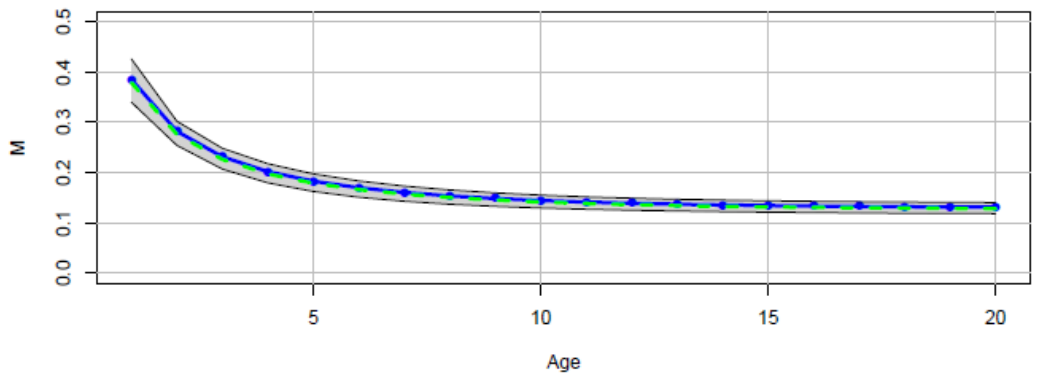




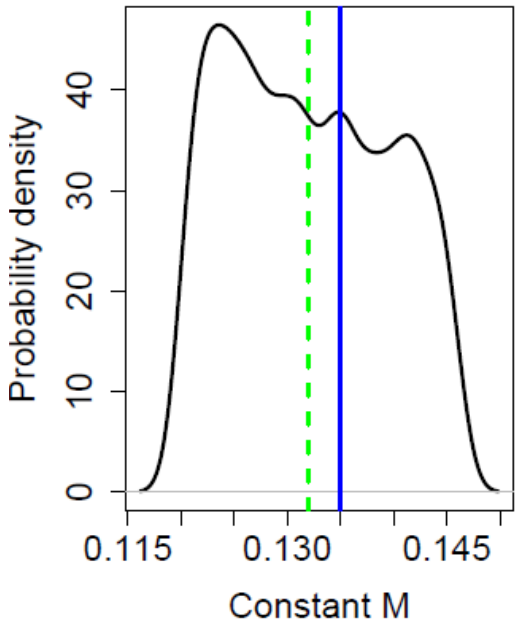


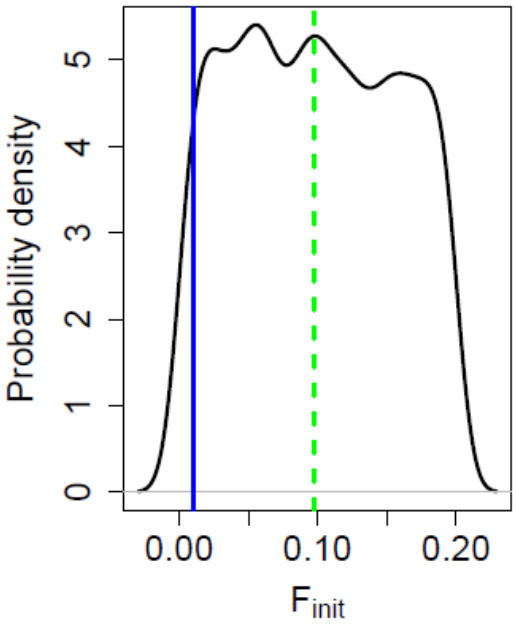


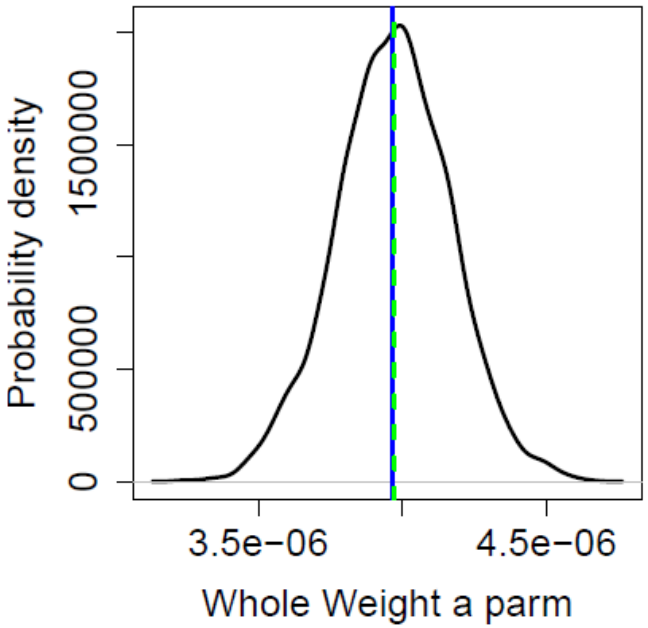


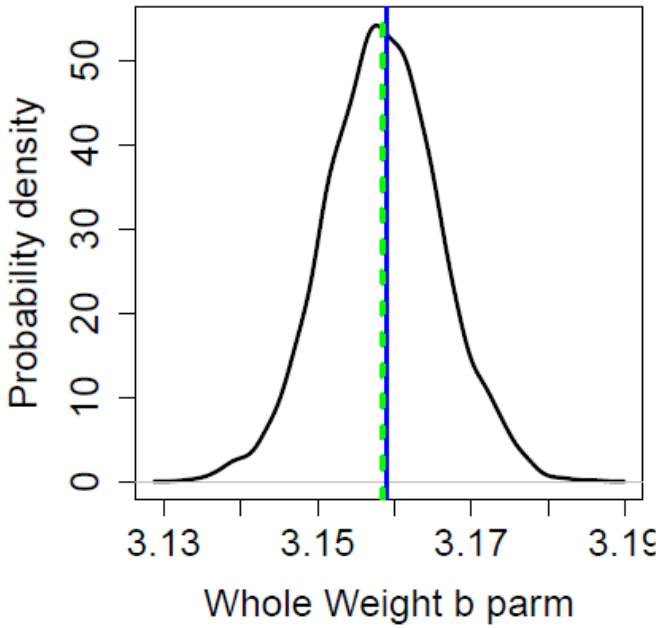


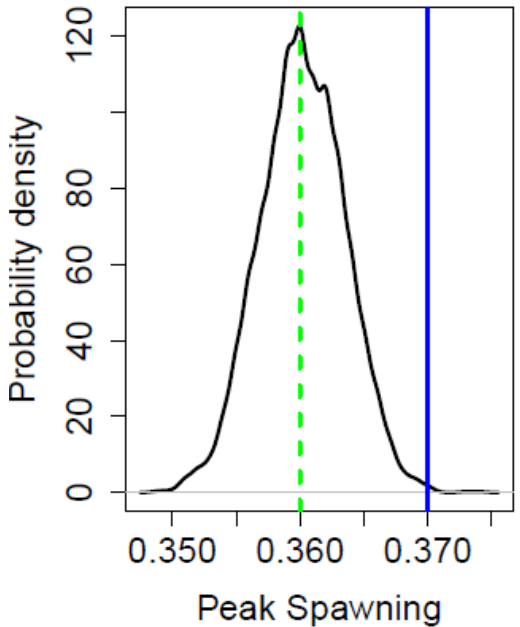
Input Uncertainty

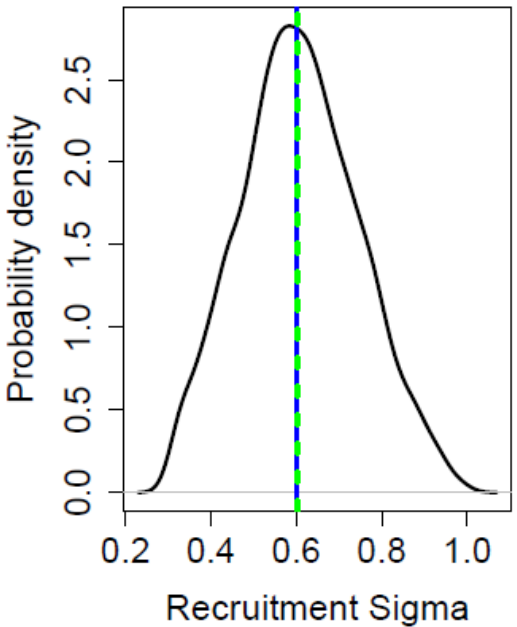


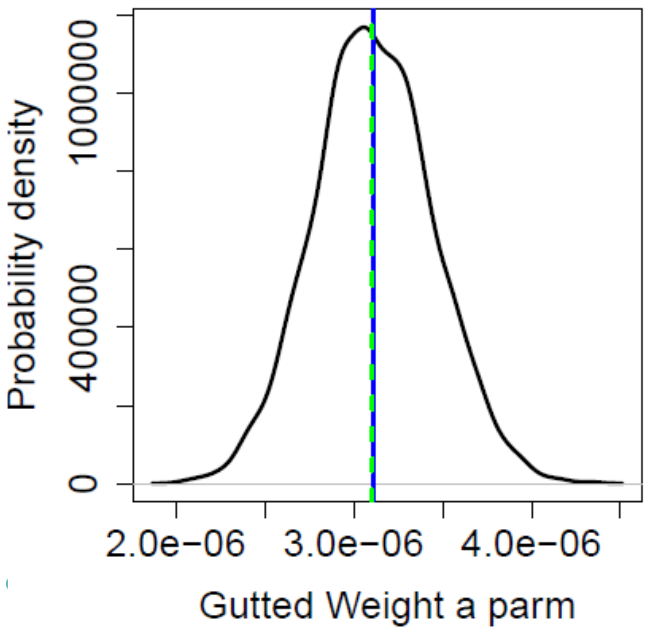


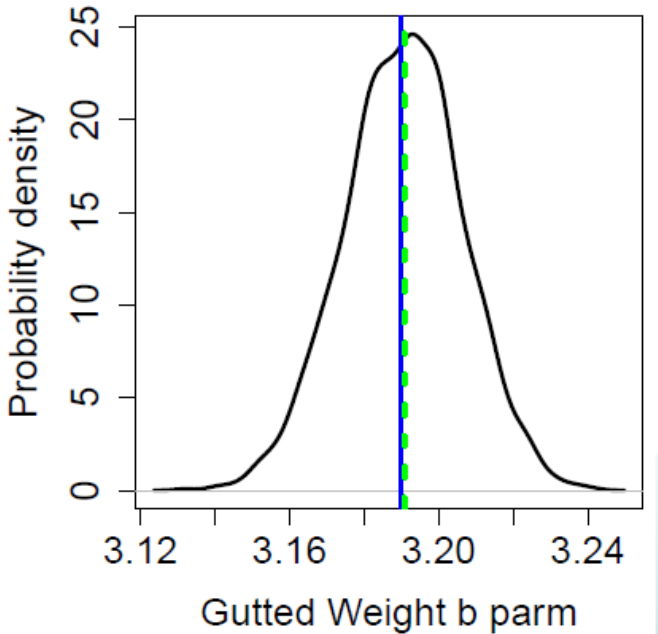




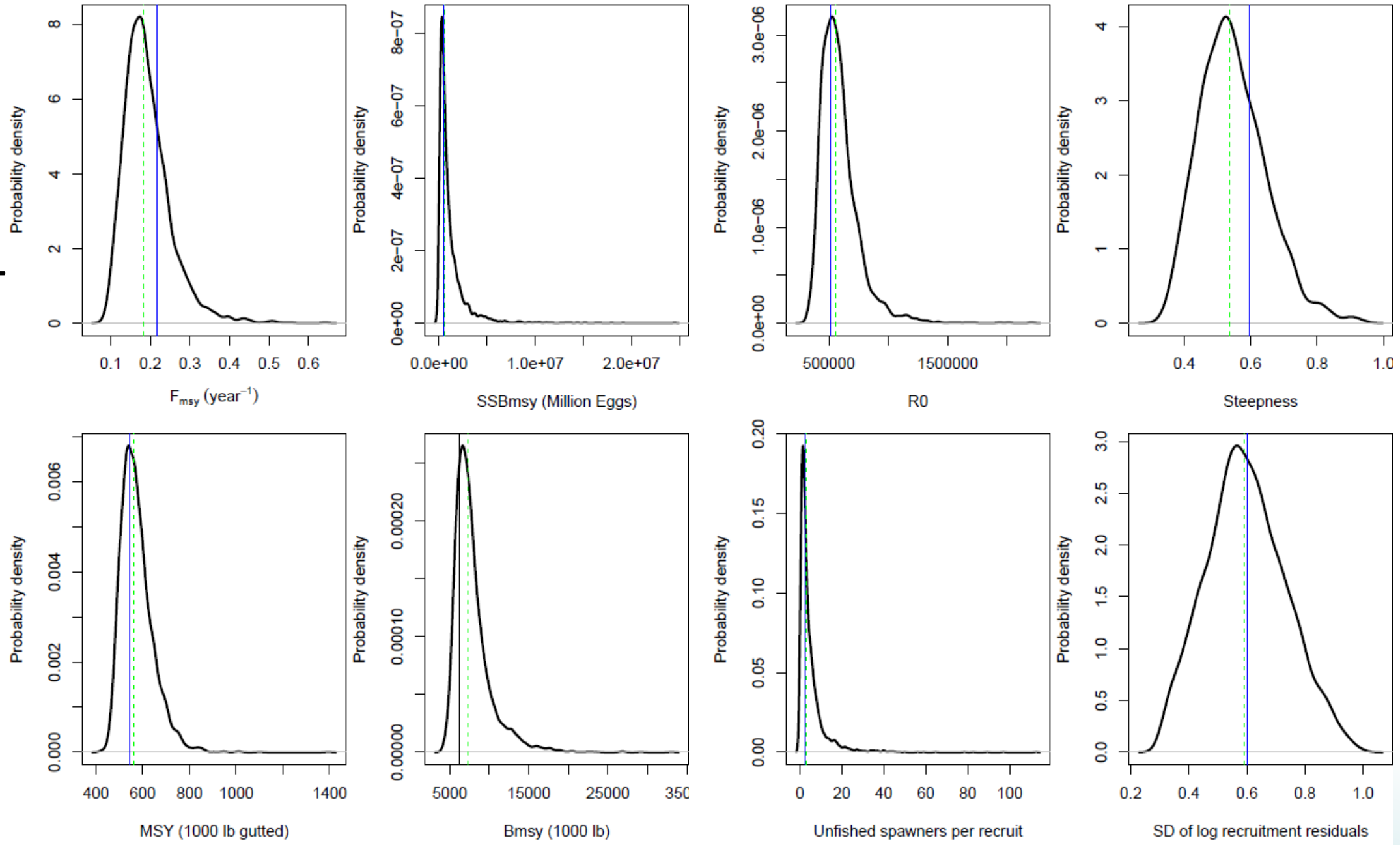




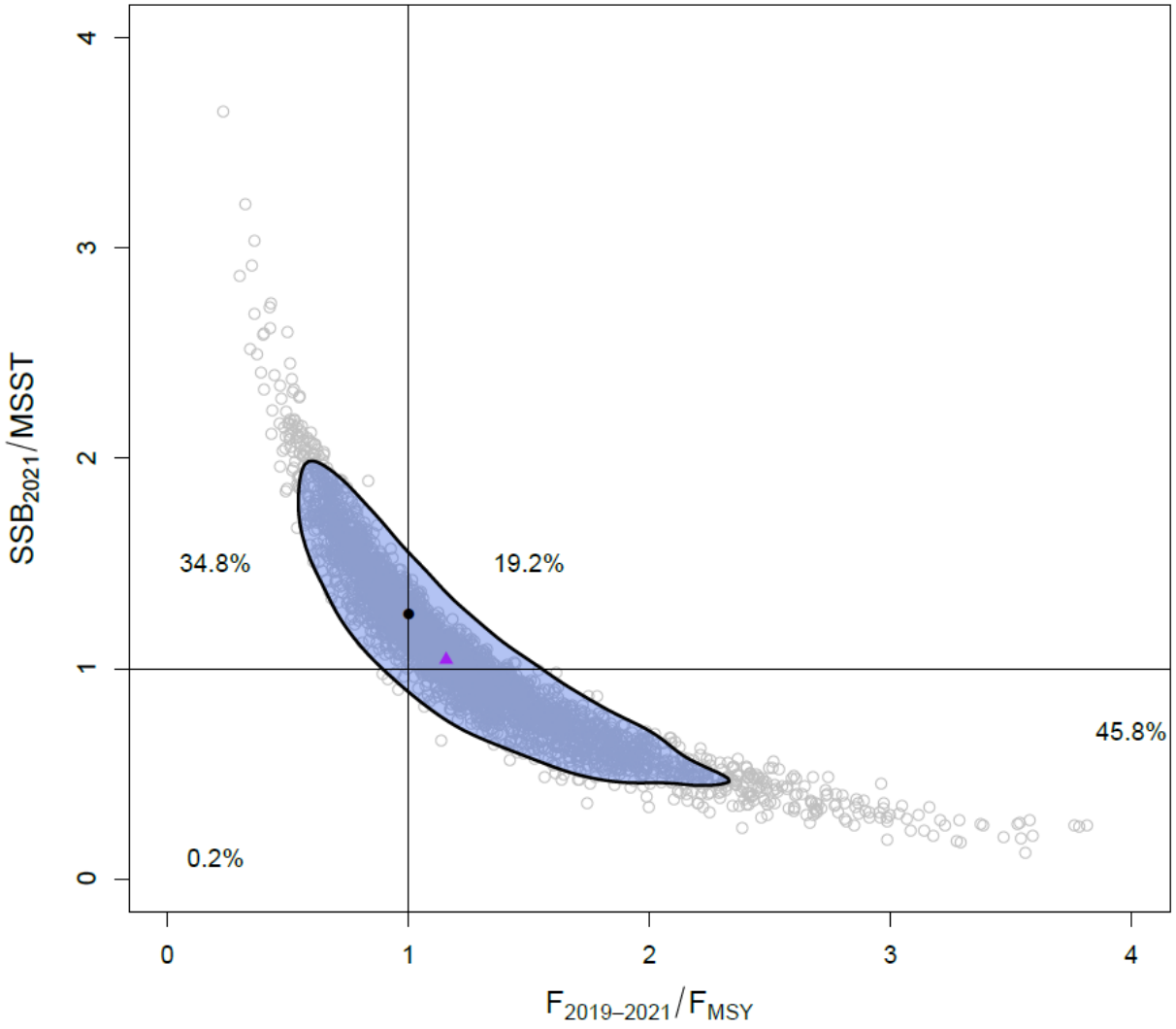


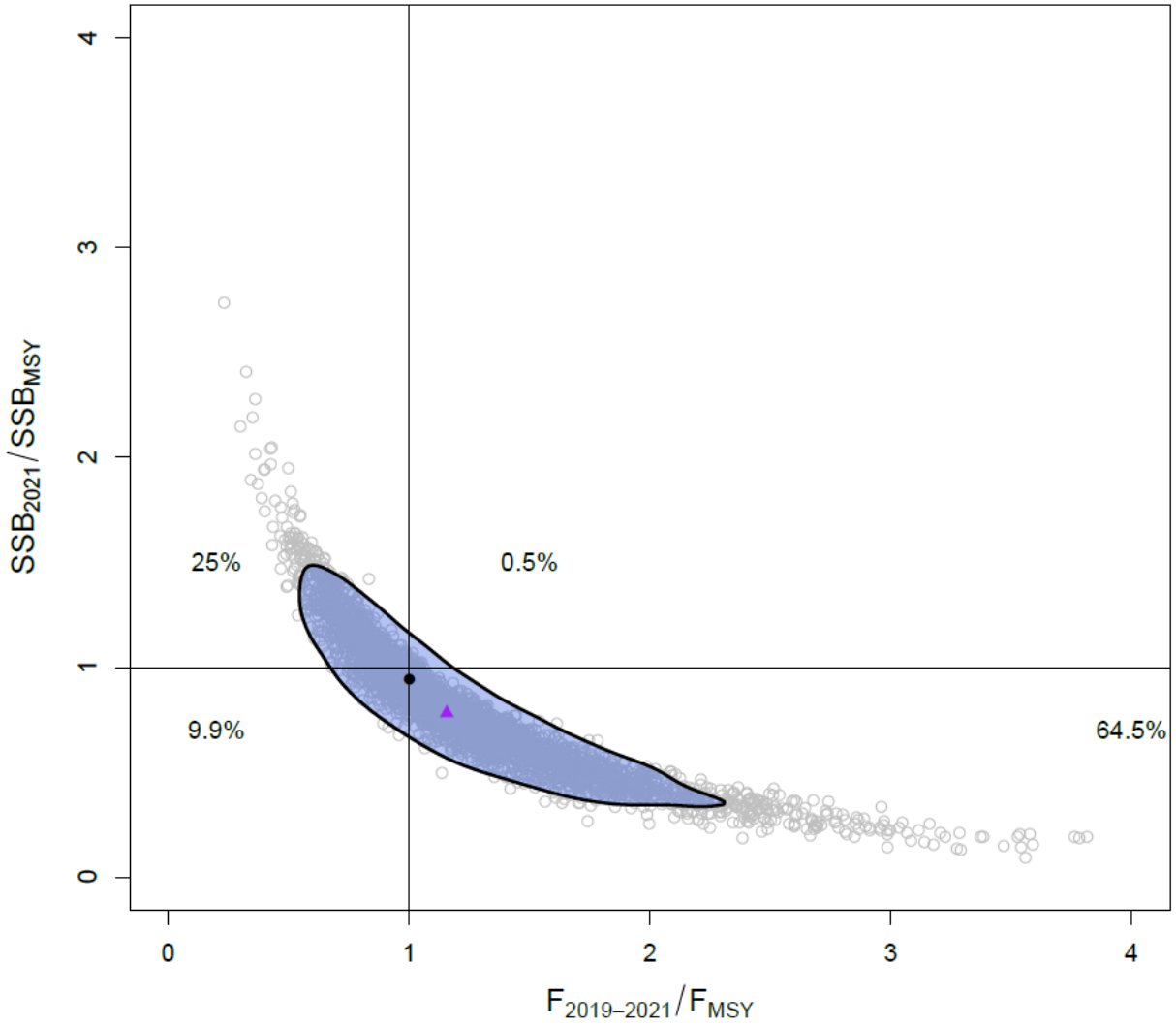


MCBE – Bench marks

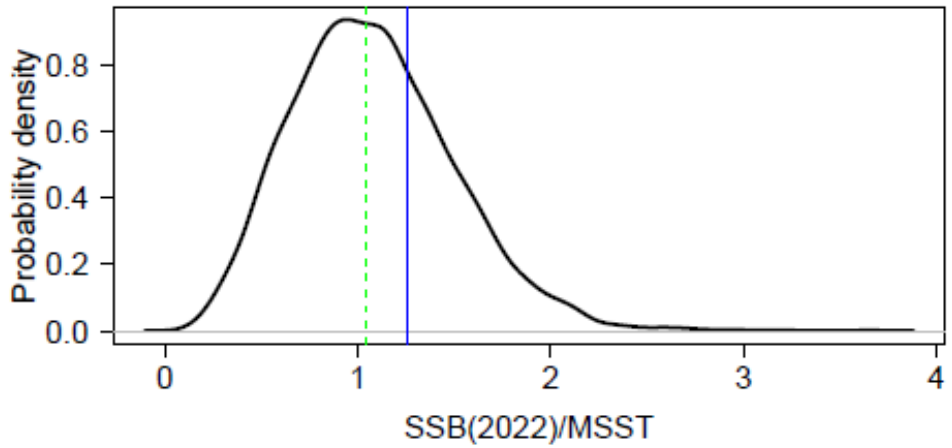


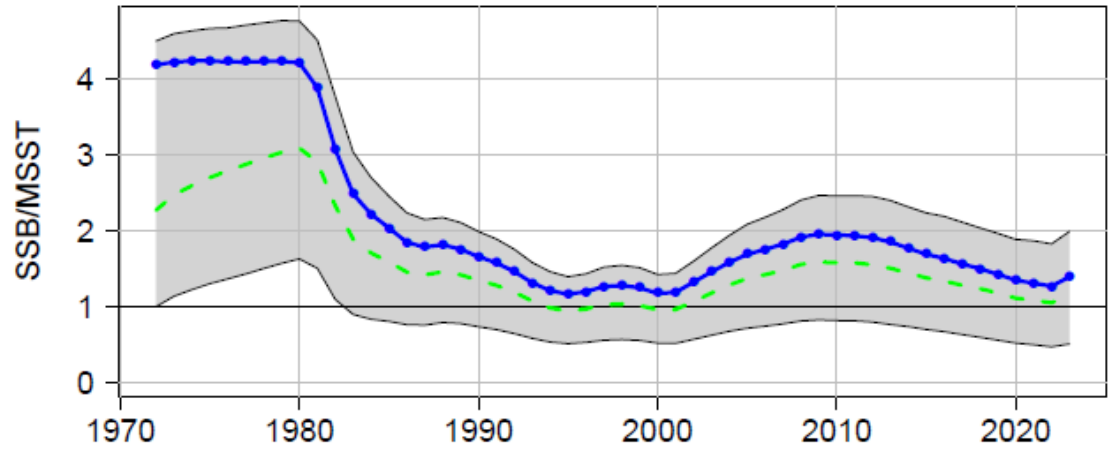
MCBE – Phase Plots

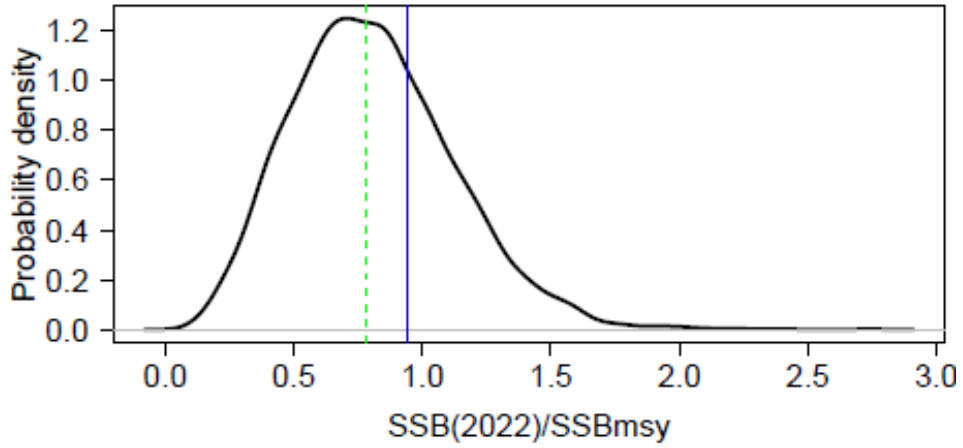


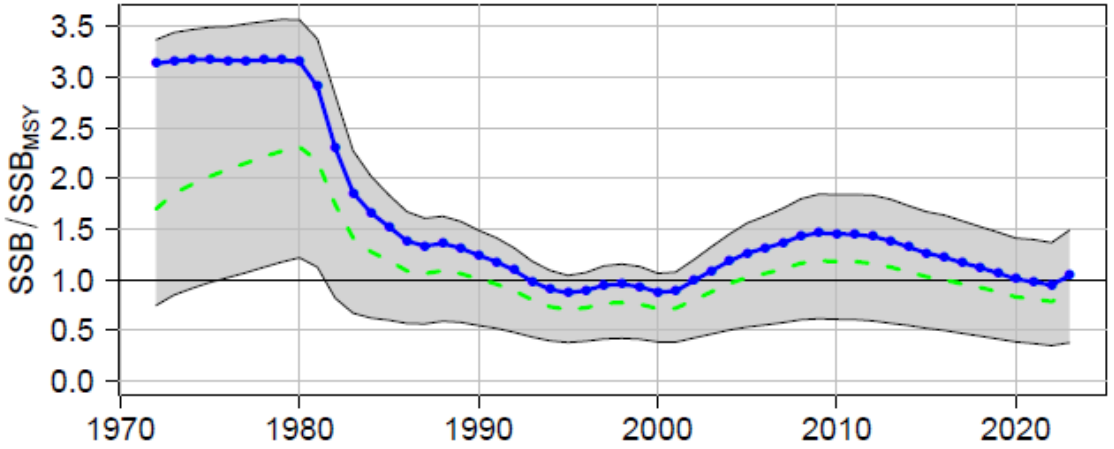


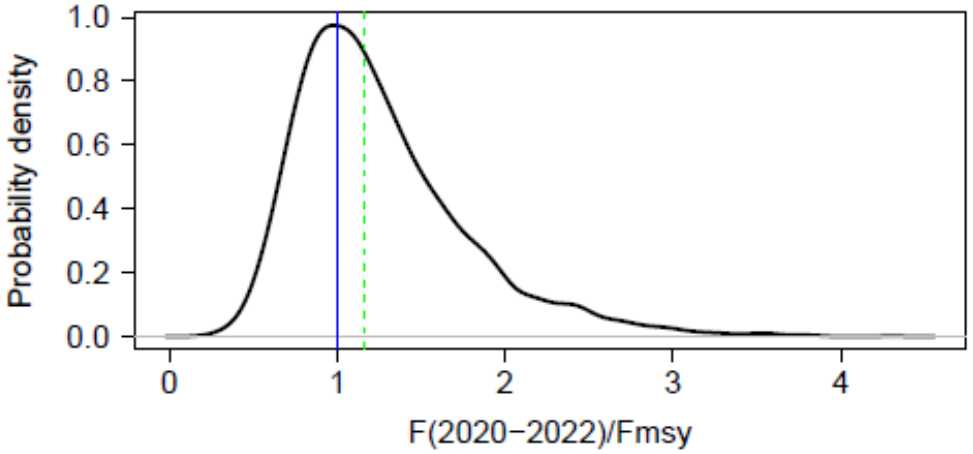
MCBE – Status

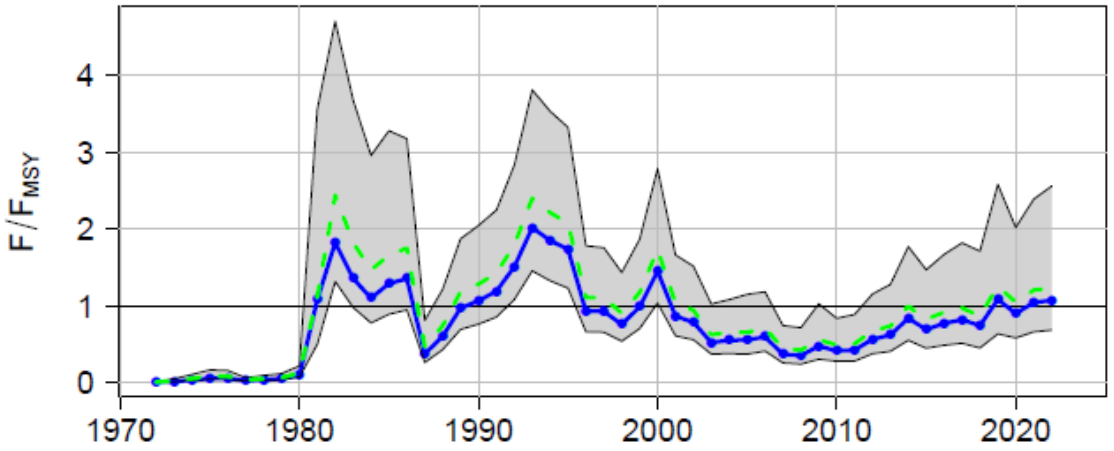

Probability density
0.0
0.2
0.4
0.6
0.8
0
1
2
3
4
SSB(2022)/MSST


SSB/MSST
0
1
2
3
4
1970
1980
1990
2000
2010
2020


Probability density
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0.0
0.5
1.0
1.5
2.0
2.5
3.0
SSB(2022)/SSBmsy


SSB / SSBMSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1970
1980
1990
2000
2010
2020


Probability density
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
F(2020−2022)/Fmsy


F / FMSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020

MCBE – Status Indicator Values

Quantity	Units	Estimate	Median	SE
F_{MSY}	y^{-1}	0.22	0.18	0.06
$75\%F_{\text{MSY}}$	y^{-1}	0.16	0.14	0.04
B_{MSY}	1000 lb whole	6191.07	7263.71	2446.69
SSB_{MSY}	Trillions of Eggs	0.514	0.651	1.738
MSST	Trillions of Eggs	0.385	0.488	1.304
MSY	1000 lb gutted	545.08	564.30	70.90
$L_{75\%\text{MSY}}$	1000 lb gutted	524.22	540.50	68.97
L_{current}	1000 lb gutted	531.56	530.24	19.54
R_{MSY}	millions fish	0.05	0.05	0.01
$F_{2020-2022}/F_{\text{MSY}}$	—	1.00	1.16	0.52
$\text{SSB}_{2022}/\text{MSST}$	—	1.26	1.04	0.42
$\text{SSB}_{2022}/\text{SSB}_{\text{MSY}}$	—	0.95	0.78	0.32

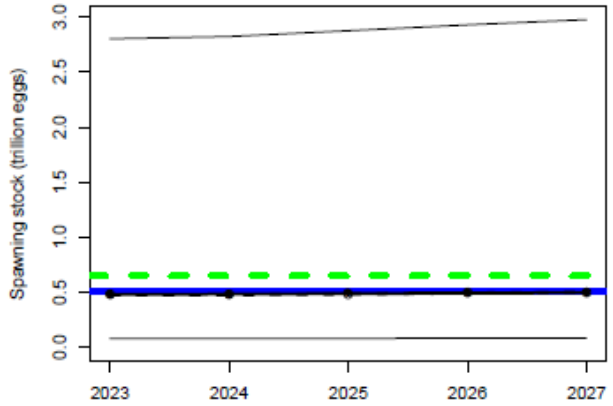
Summary of assessment results

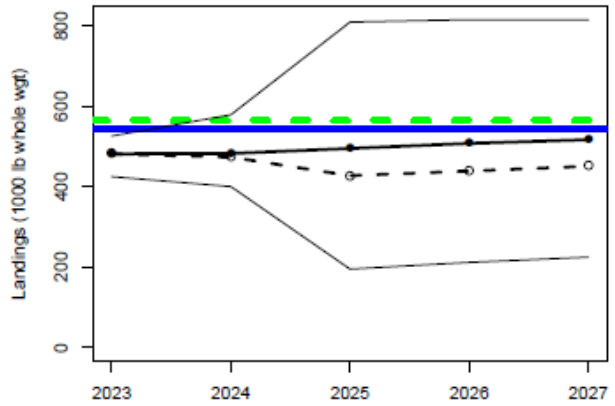
- 74.4% of MCBE and base model say biomass is below the target reference point
- 46% of MCBE suggest biomass is below MSST
- Slight majority of MCBE suggest stock is not overfished
- Base model suggests fully exploited ($F/F_{MSY} = 1$)
- Median and 65% of MCBE suggests overfishing

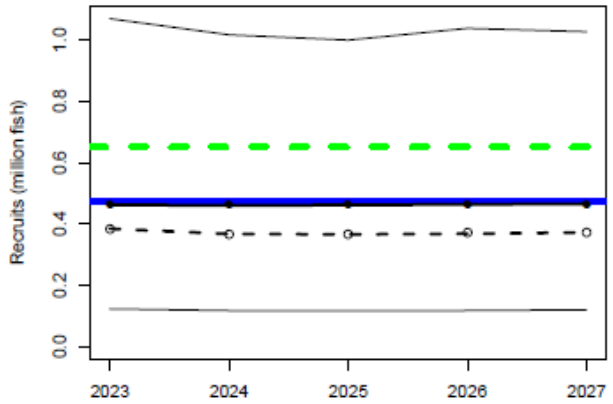
Outline

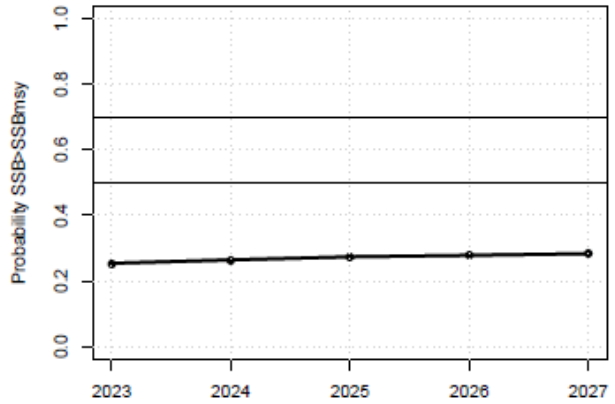
- Background
- Data
- Assessment Model
- Assessment Results
- **Projections**

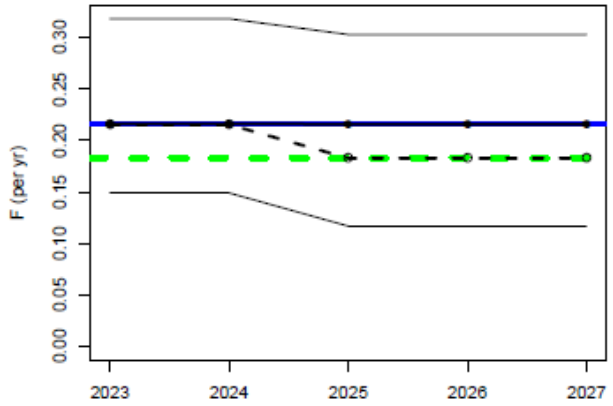
$F = P^*_{50\%}$

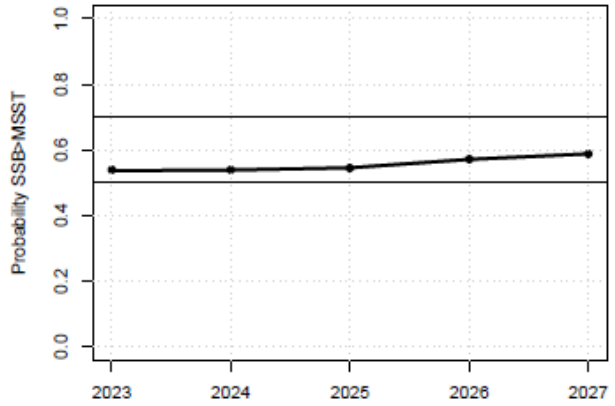

Spawning stock (trillion eggs)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2023
2024
2025
2026
2027


Landings (1000 lb whole wgt)
0
200
400
600
800
2023
2024
2025
2026
2027

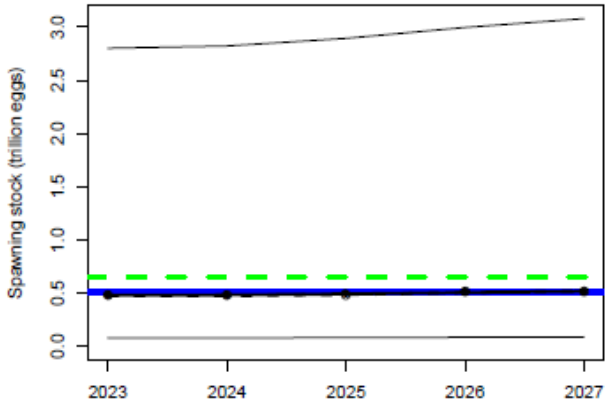

Recruits (million fish)
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027

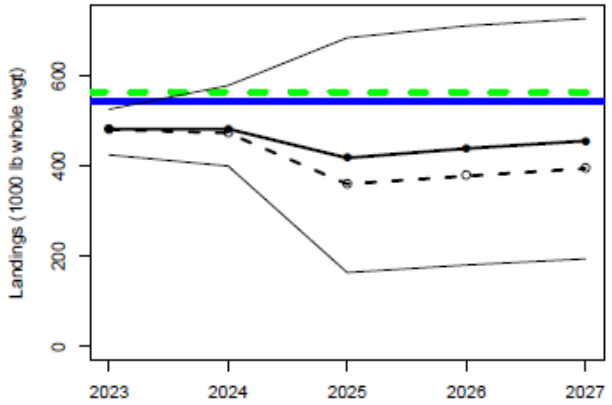

Probability SSB>SSBmsy
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027

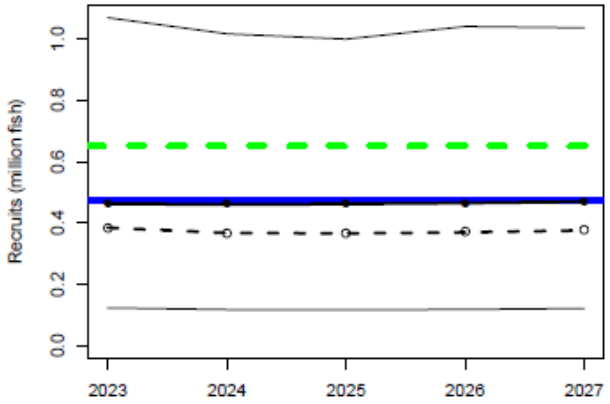

F (per yr)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
2023
2024
2025
2026
2027

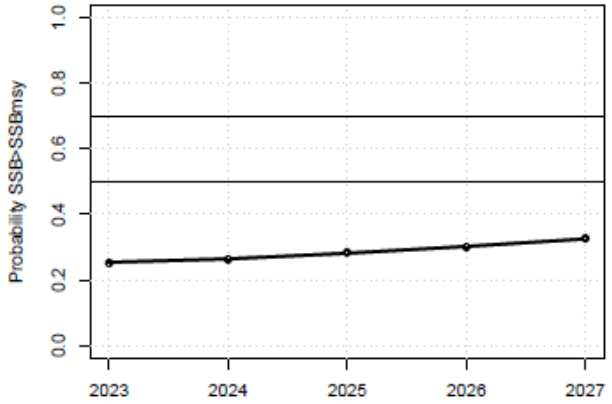

Probability SSB>MSST
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027

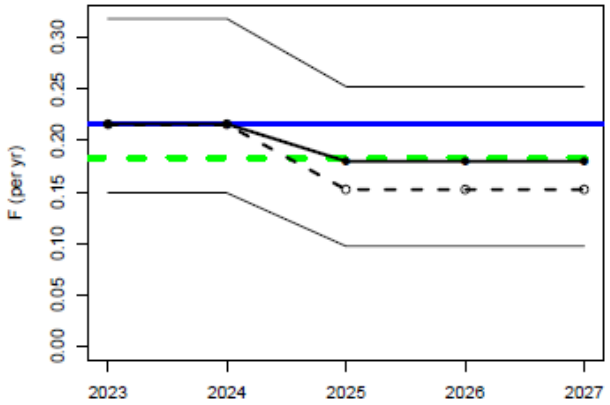
$F = P^*_{32.5\%}$

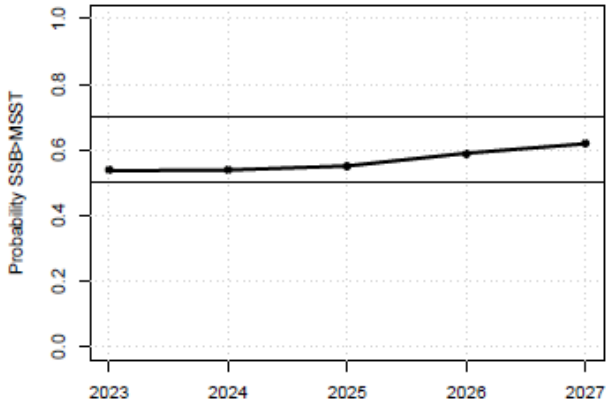

Spawning stock (trillion eggs)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2023
2024
2025
2026
2027


Landings (1000 lb whole wgt)
0
200
400
600
2023
2024
2025
2026
2027


Recruits (million fish)
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027


Probability SSB>SSBmsy
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027


F (per yr)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
2023
2024
2025
2026
2027


Probability SSB>MSST
0.0
0.2
0.4
0.6
0.8
1.0
2023
2024
2025
2026
2027

Questions

NOAA FISHERIES