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# BSAI Alaska Plaice Transition to Stock Synthesis

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# Outline

- Transition to Stock Synthesis (SS3)
- Updating new base model

# Old Model

- **Model:** Sex specific, age and length population dynamics model coded in ADMB



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# Old Model

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- **Data:** catch, Biomass Index from survey, age composition data from the fishery and survey and length composition data from the fishery and survey.





# Old Model

- **Model:** Sex specific, age and length population dynamics model coded in ADMB
- **Data:** catch, Biomass Index from survey, age composition data from the fishery and survey and length composition data from the fishery and survey.
- **Sex specific:** length-at-age, weight-at-length, weight-at-age, age-length transition matrix (ALK) and selectivity.



# Old Model

- **Estimated Externally:** length-at-age (2016), weight-at-age (2016), weight-at-length (2016), ALK (<2003), age-at-maturity (2014).



# Old Model

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- **Fixed Parameters:** survey catchability, natural mortality



# Old Model

- **Estimated Externally:** length-at-age (2016), weight-at-age (2016), weight-at-length (2016), ALK (<2003), age-at-maturity (2014).
- **Fixed Parameters:** survey catchability, natural mortality.
- **Estimated Parameters:** Mean recruitment, recruitment deviations, annual fishing mortality, Age-based selectivity (fishery and survey).



# Old Model

- **Estimated Externally:** length-at-age (2016), weight-at-age (2016), weight-at-length (2016), ALK (<2003), age-at-maturity (2014).
- **Fixed Parameters:** SURVEY catchability, natural mortality
- **Estimated Parameters:** Age-based selectivity (fishery and survey),  $R_0$ , recruitment deviations, annual fishing mortality.
- Population age range 3-25, length range 10cm – 60cm



# Why Transition to SS3?

- Estimate more parameters internally
- More flexible
- Better external resources
- Better documented



# Transitioning to SS3

- Base-1
- Base-2
- Base-3
- Base-4



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# Base-1

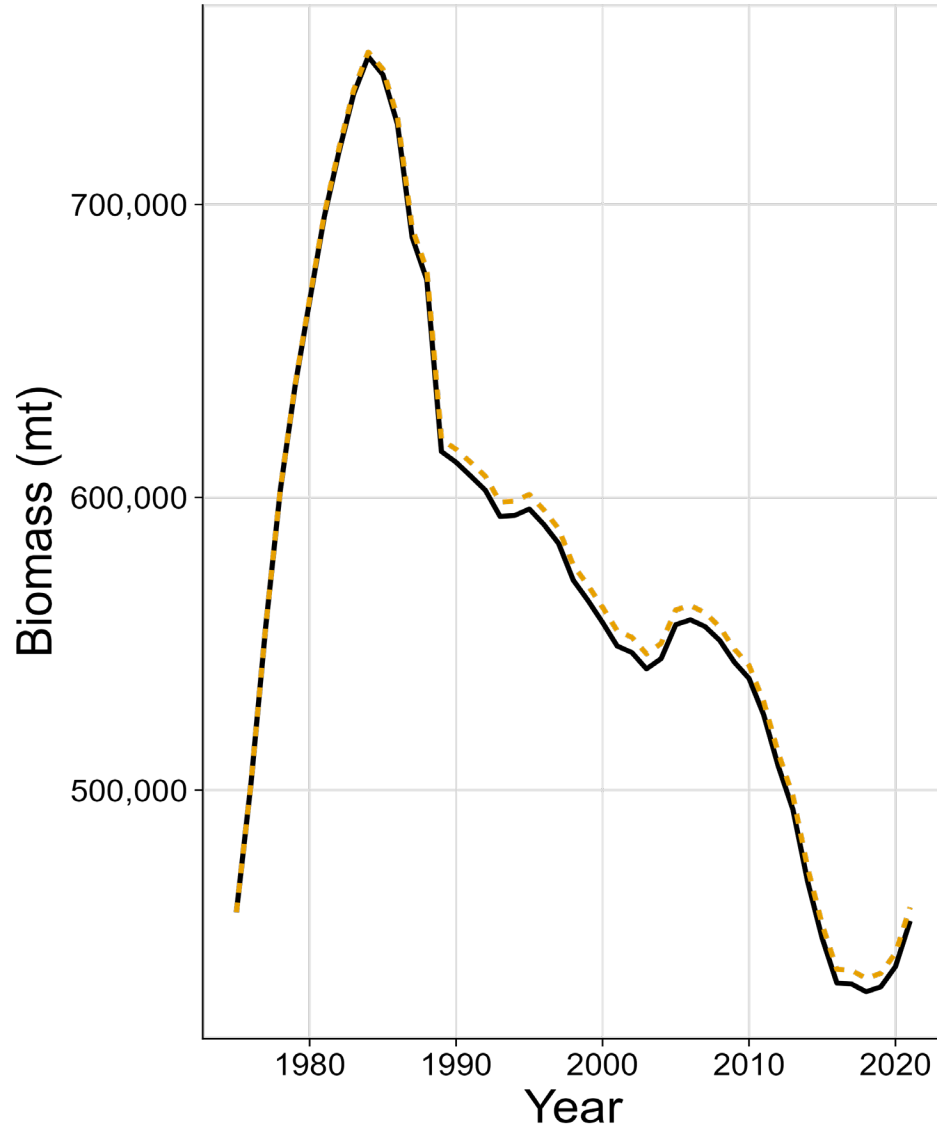
- Deterministic Model
- All parameters fixed except annual fishing mortality and selectivity



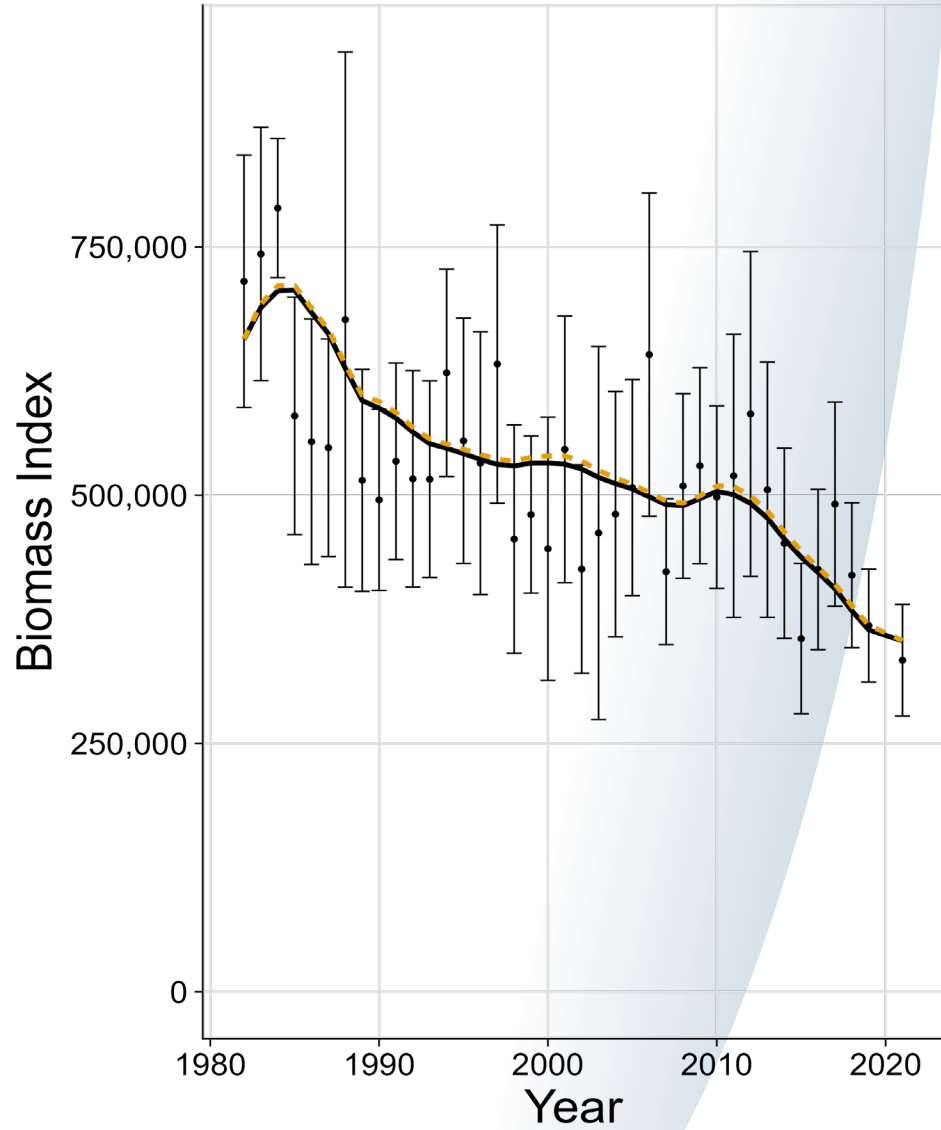


# Base-1

## Total Biomass, age 3 up



## Biomass Index



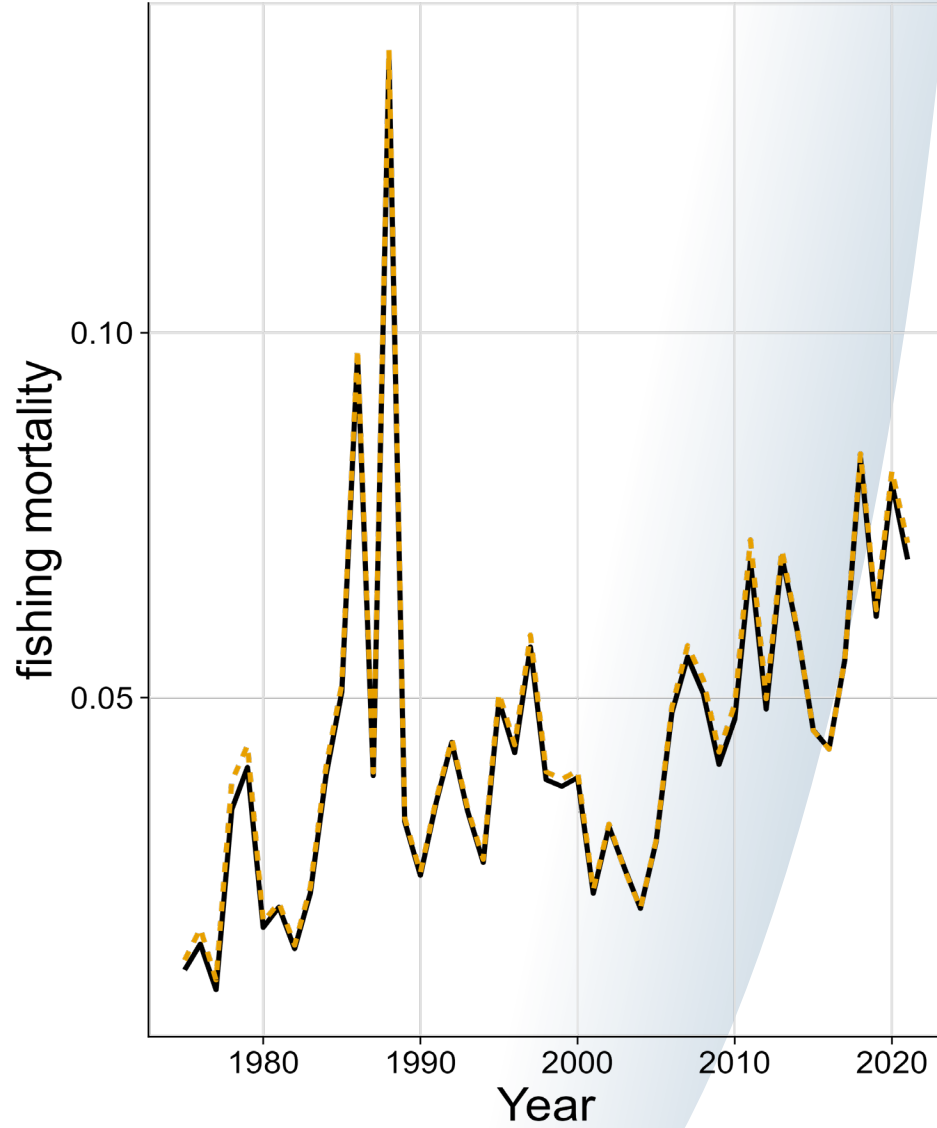
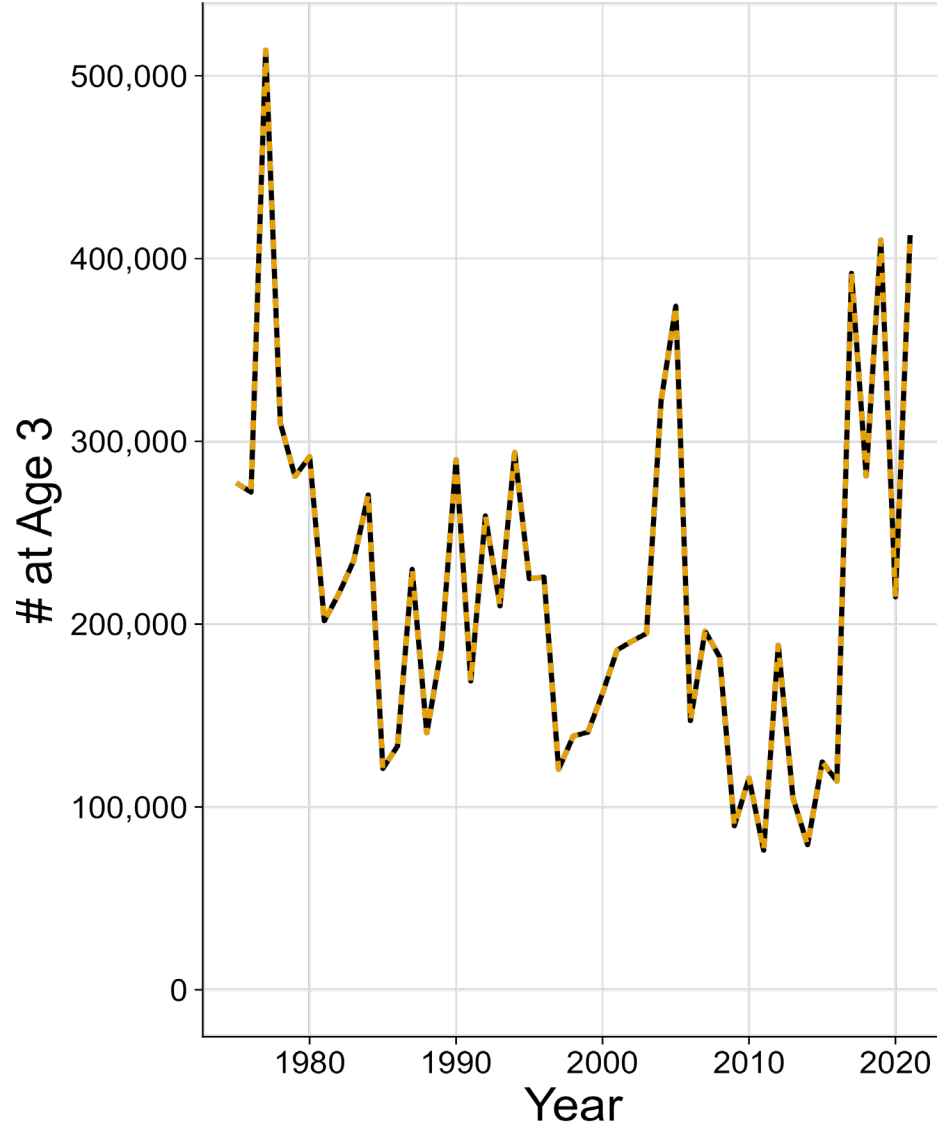
Model - Old - - Base-1



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# Base-1 Fishing mortality

## Age 3



Model - Old - - Base-1

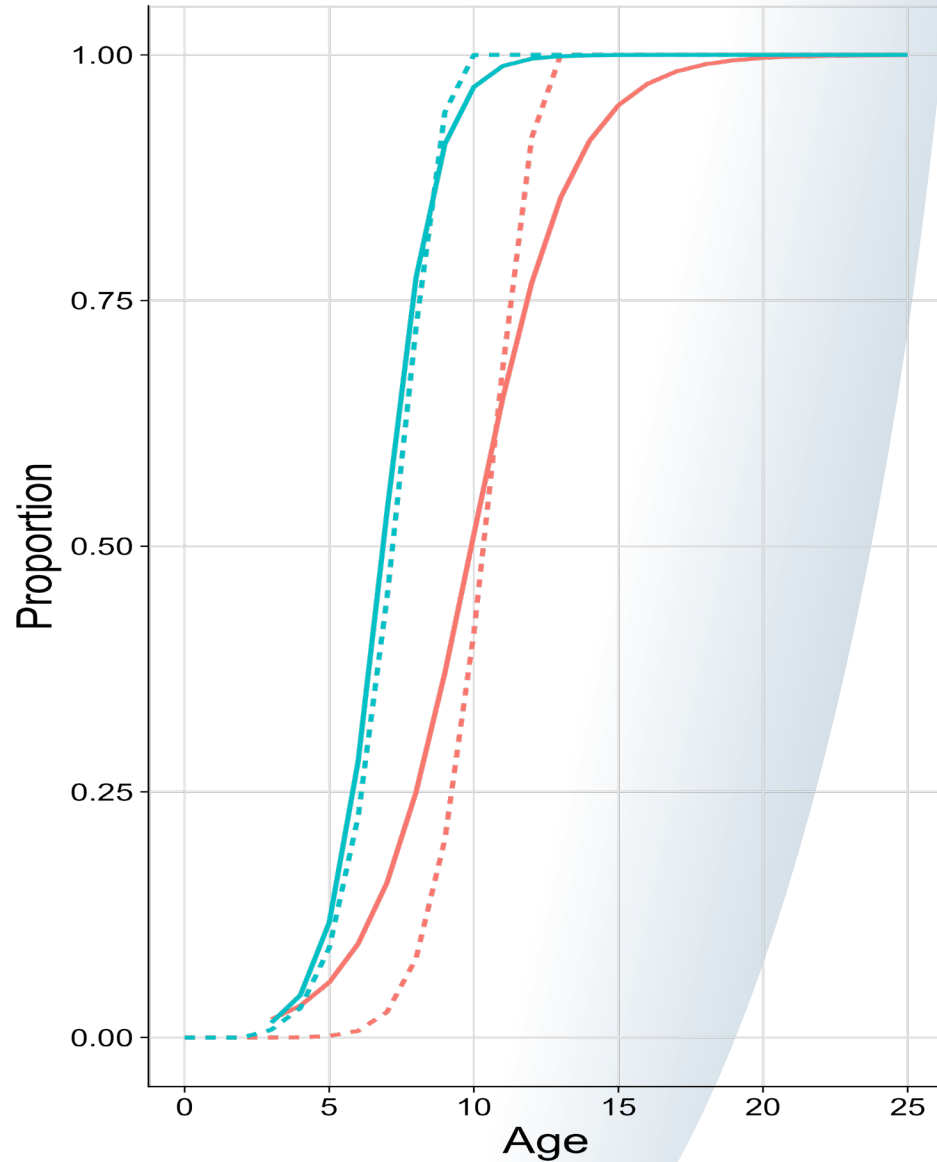
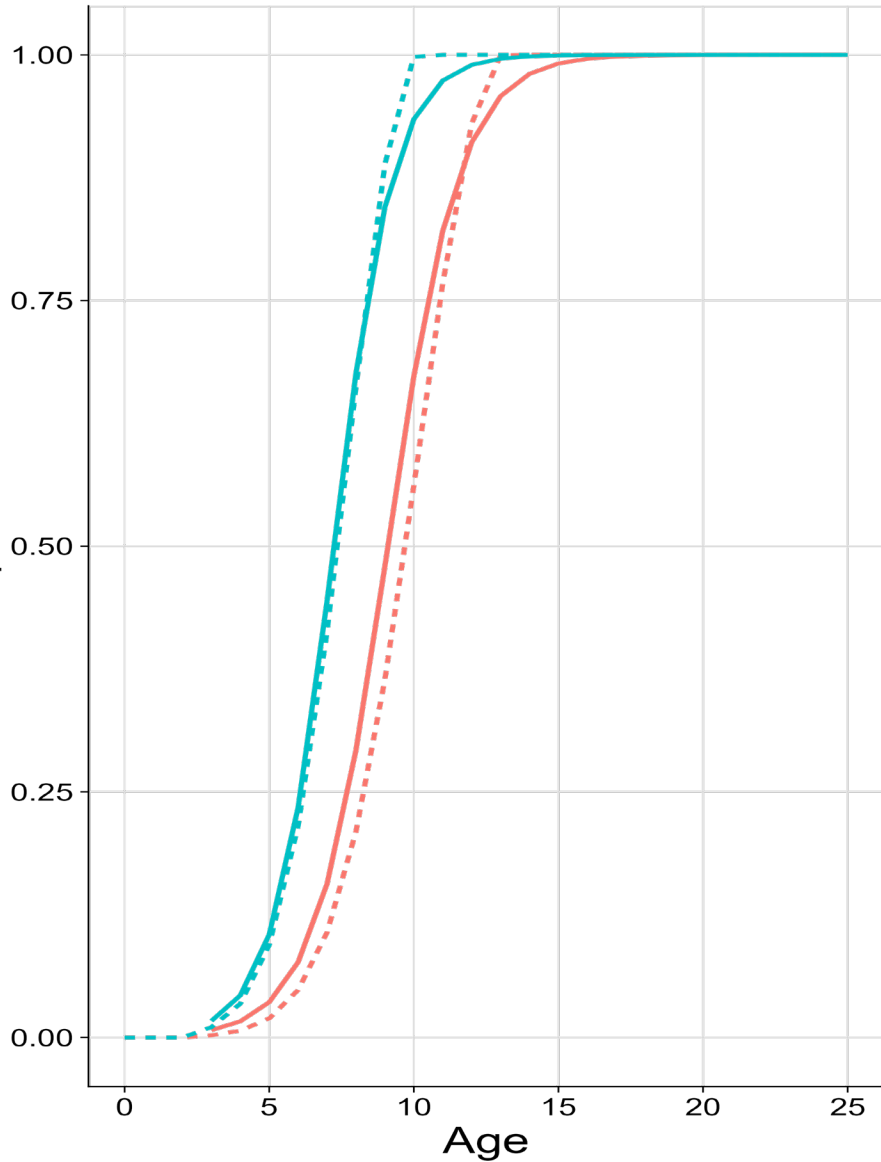


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# Base-1

## Female Selectivity-at-Age

## Male Selectivity-at-Age



Model — Old -- Base-1 fleet — Fishery — Survey



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# Growth in Old Model

Length-at-age

2016

Length-at-age \* Weight-at-length = Weight-at-age

ALK

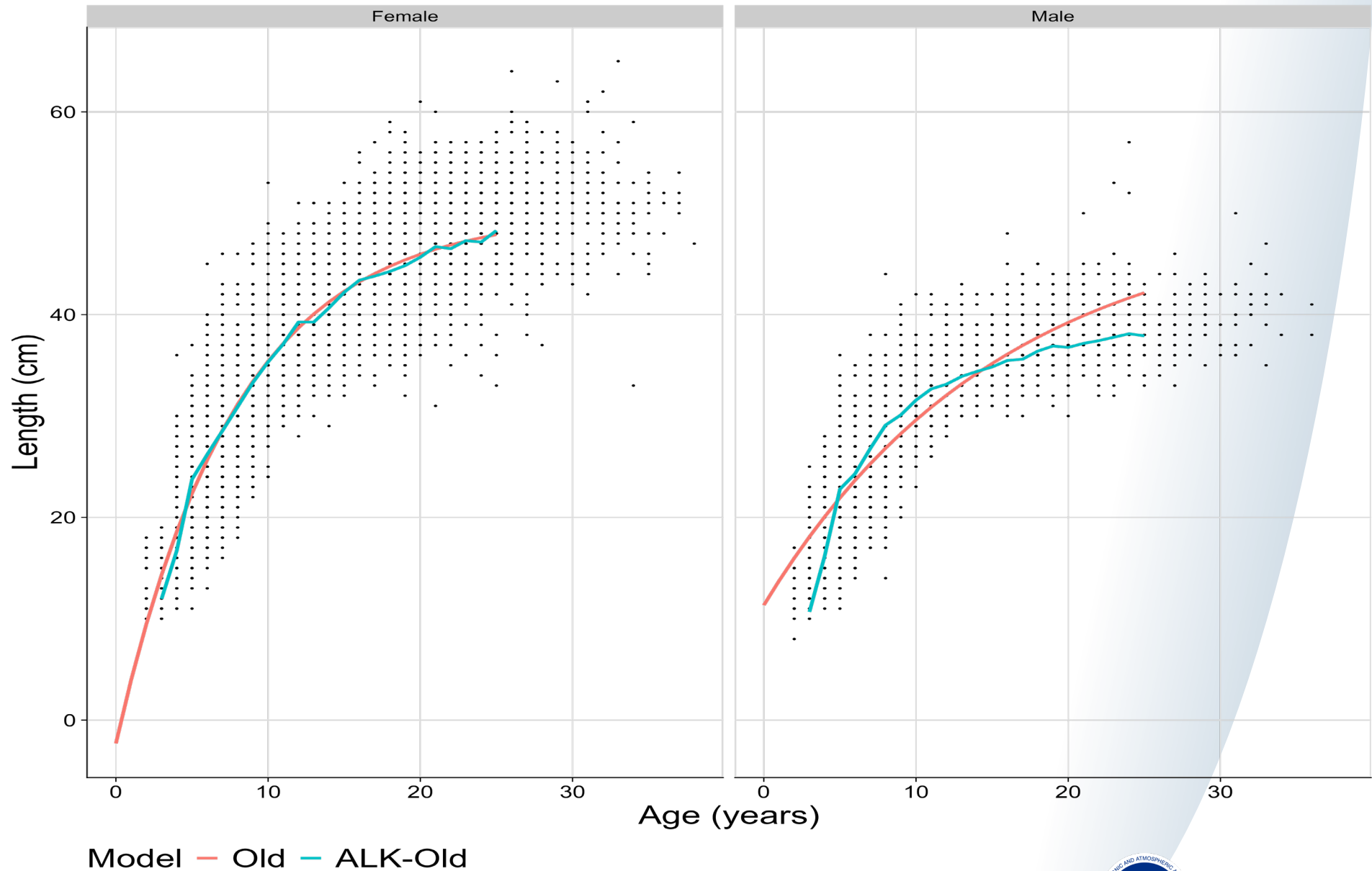
<2003

Length-composition

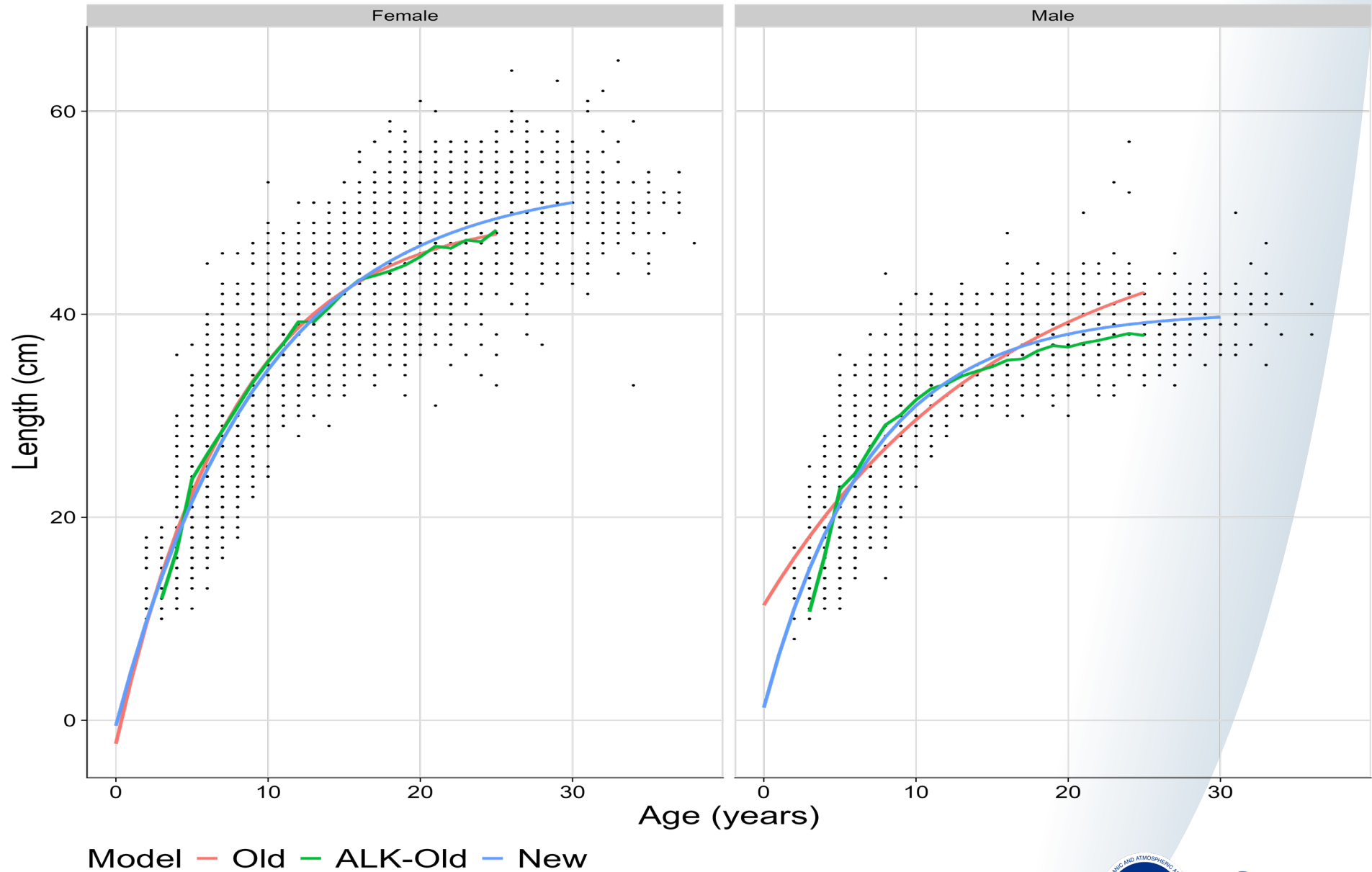


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# Base-1



# Base-1



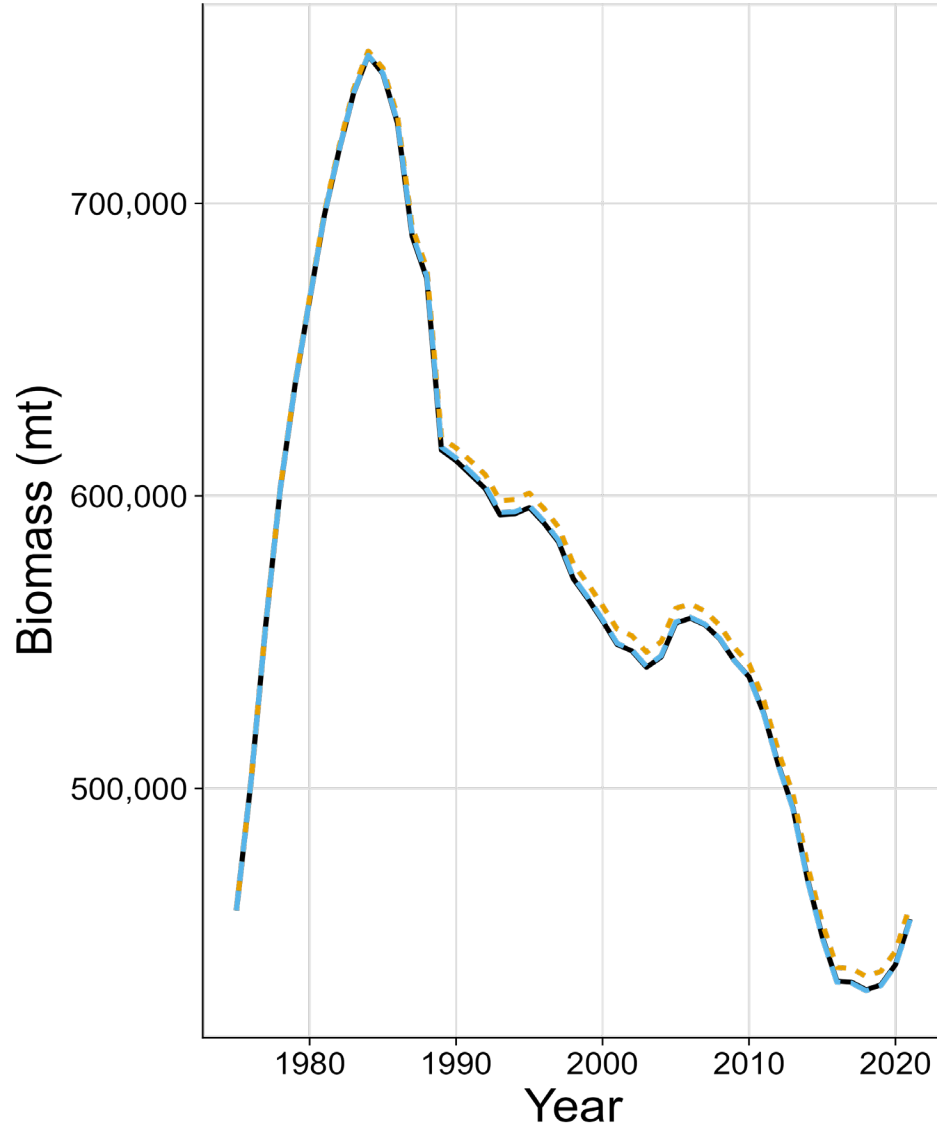
# Base-2

- Updated version of Base-1 with new growth curve
- All parameters fixed except annual fishing mortality and selectivity

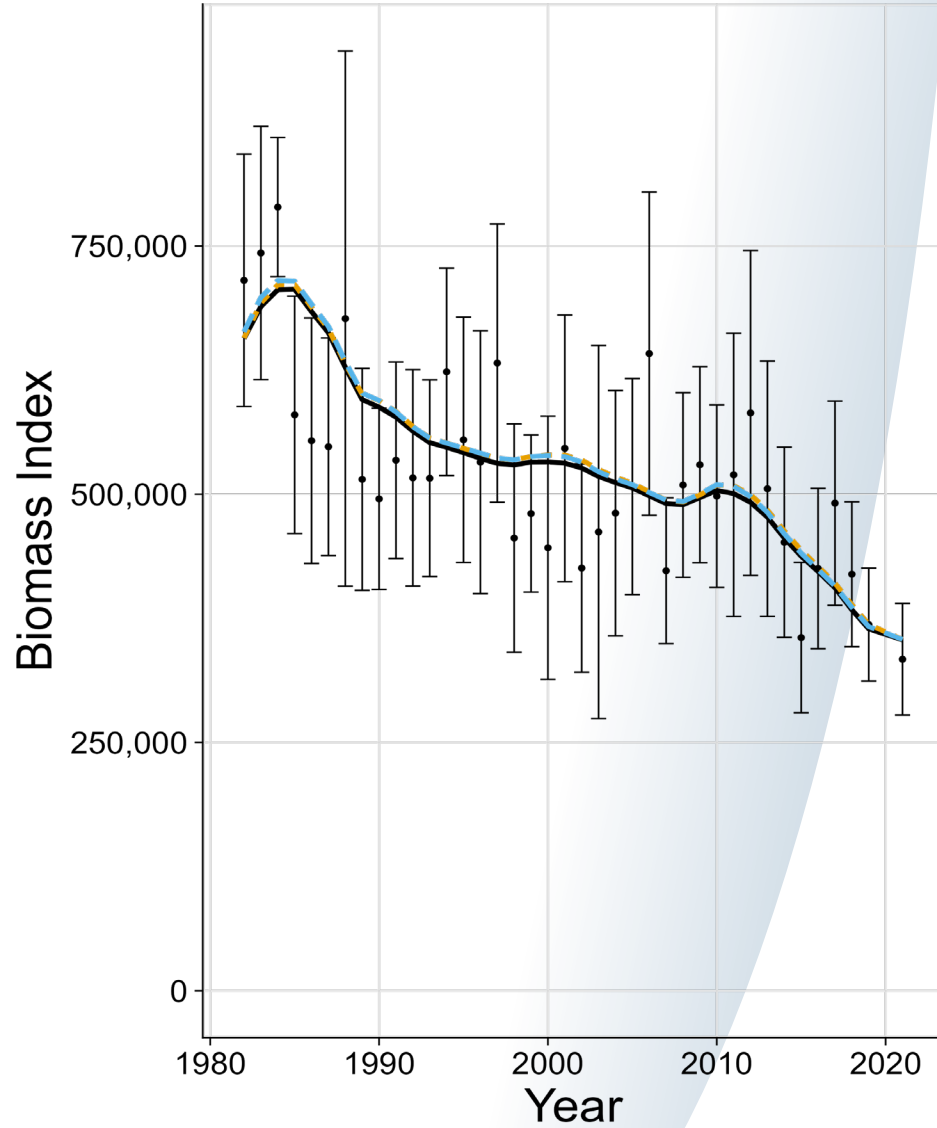


# Base-2

## Total Biomass, age 3 up



## Biomass Index



Model – Old – Base-1 – Base-2

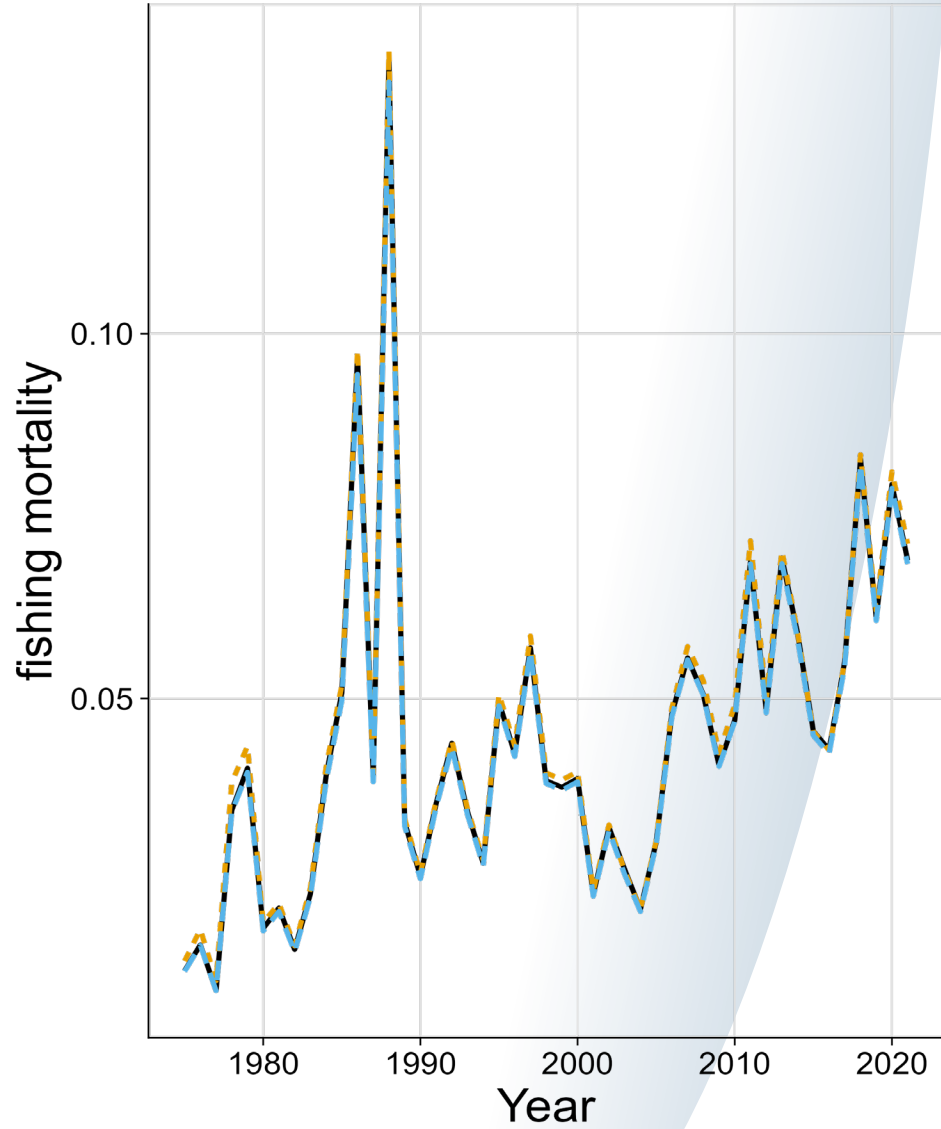
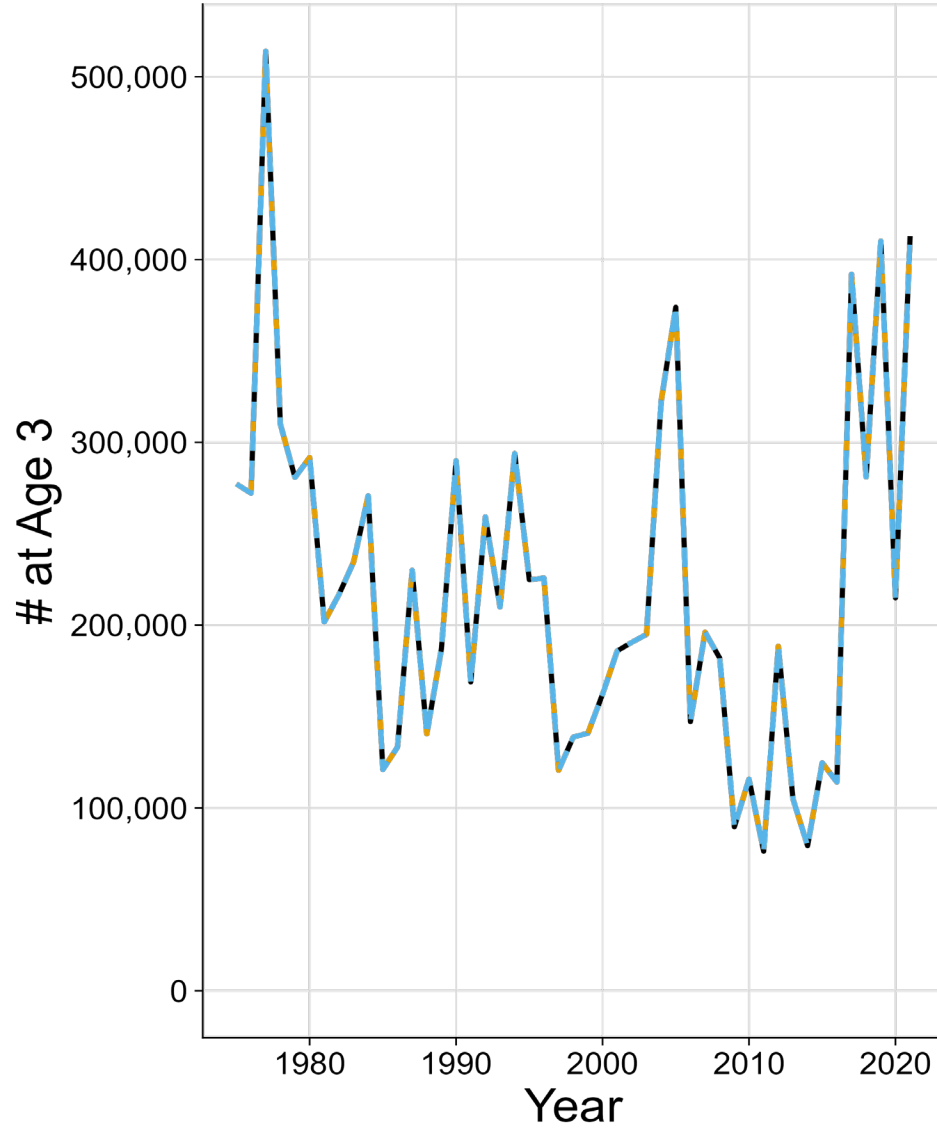




# Base-2

## Fishing mortality

### Age 3



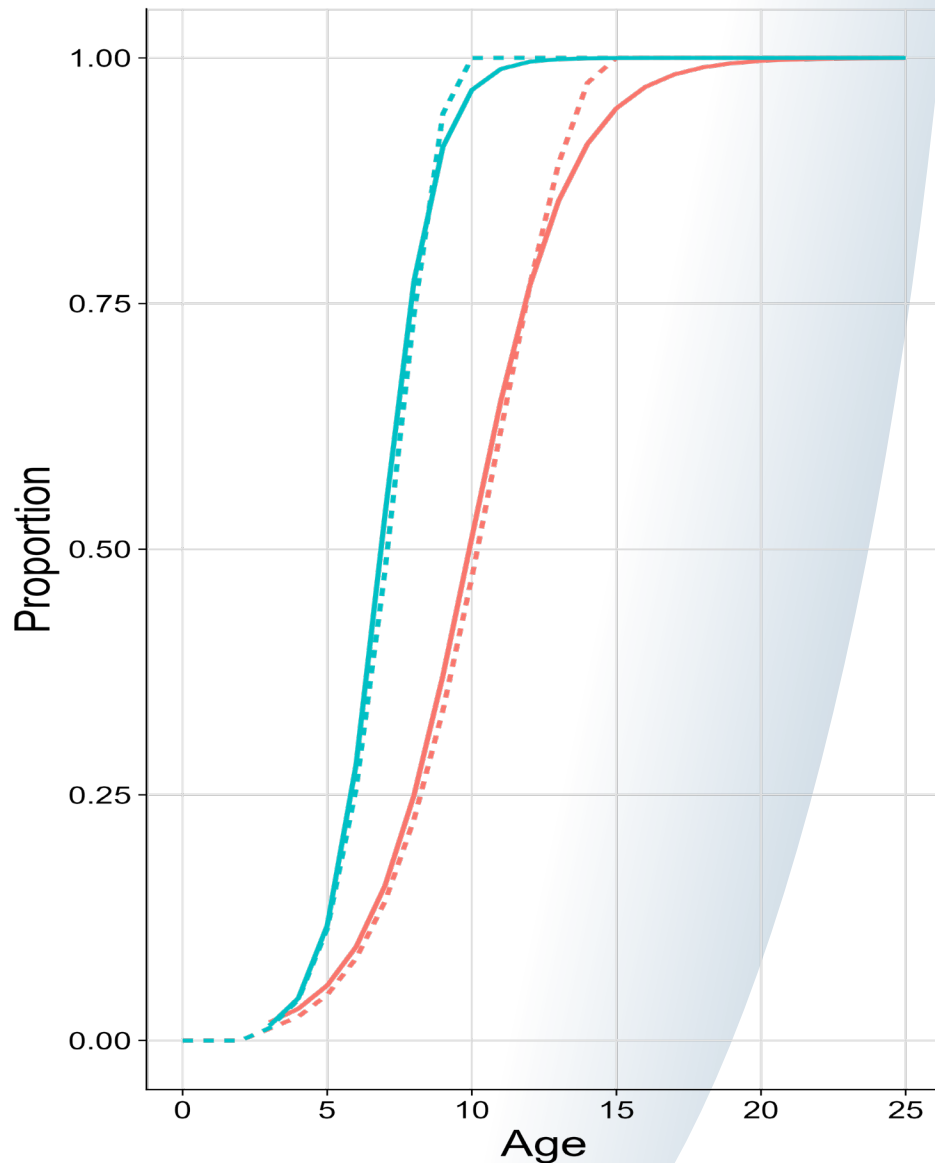
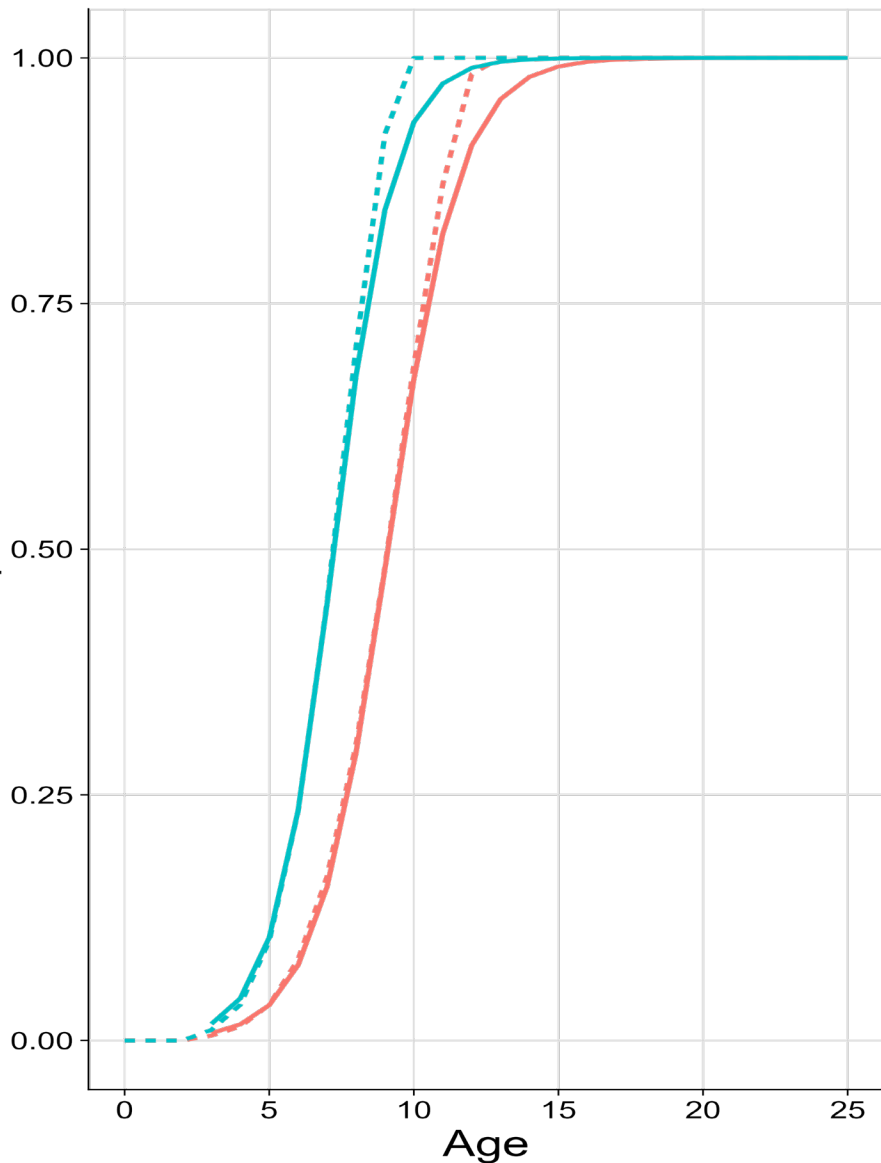
Model - Old - - Base-1 - - Base-2



# Base-2

## Female Selectivity-at-Age

## Male Selectivity-at-Age



Model — Old -- Base-2 fleet — Fishery — Survey



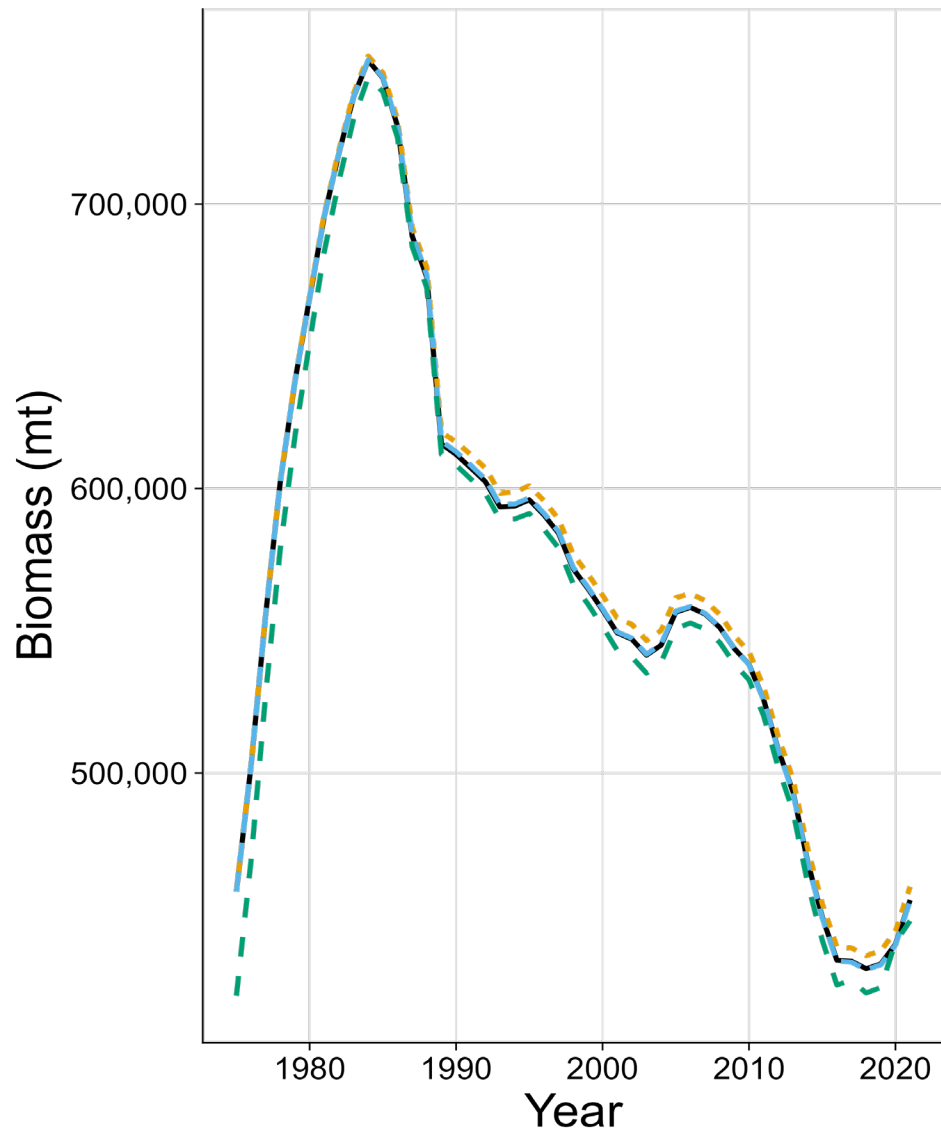
# Base-3

- Updated version of Base-2
- Estimate mean recruitment, recruitment deviations, annual fishing mortality and selectivity
- Use new growth curve

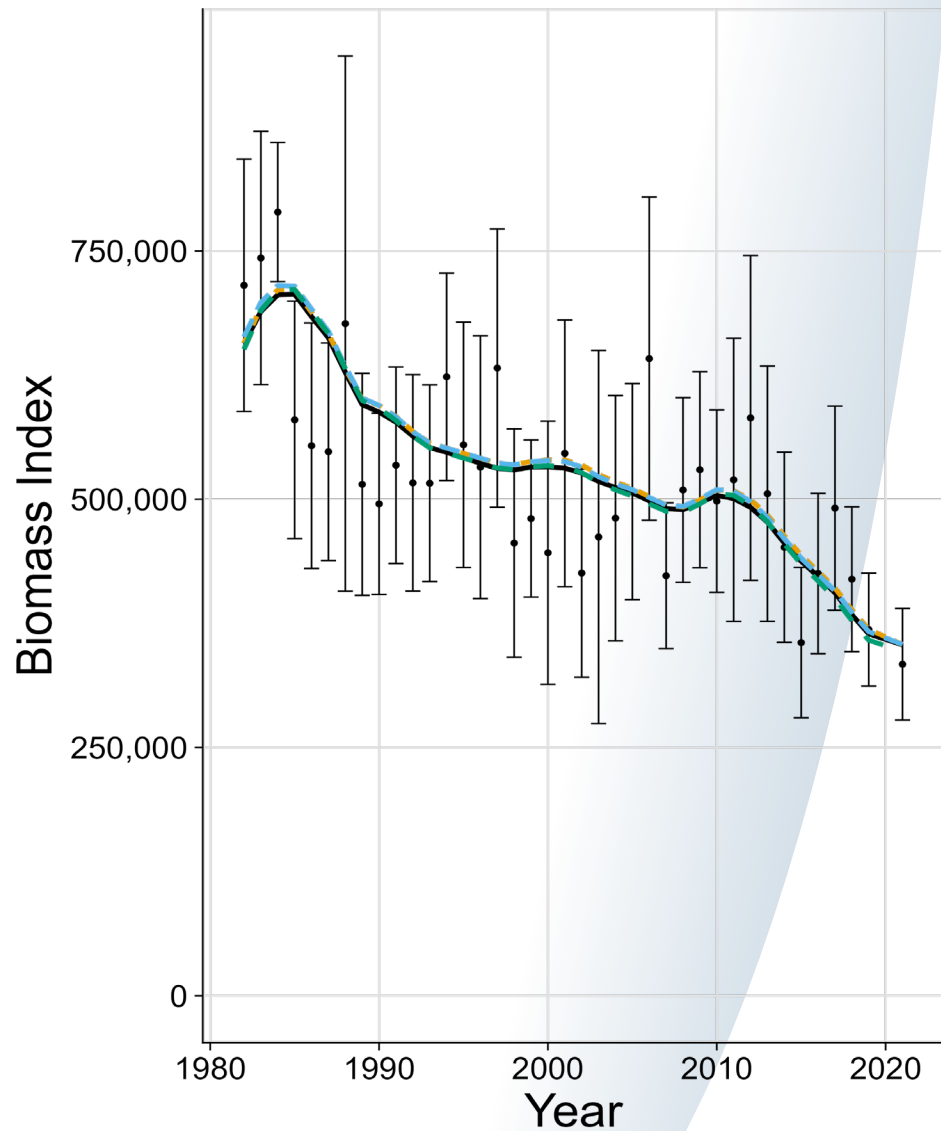


# Base-3

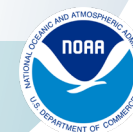
## Total Biomass, age 3 up



## Biomass Index



Model - Old - - Base-1 - - Base-2 - - Base-3

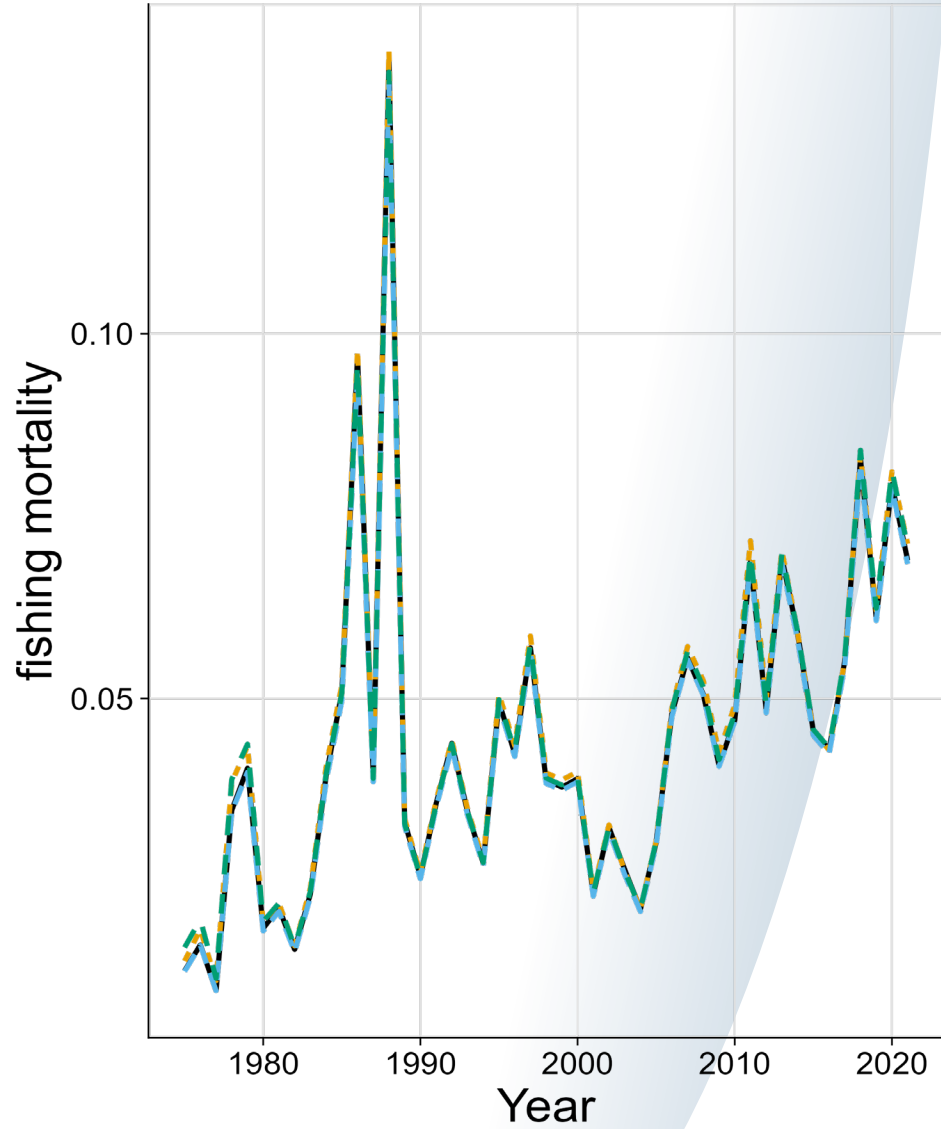
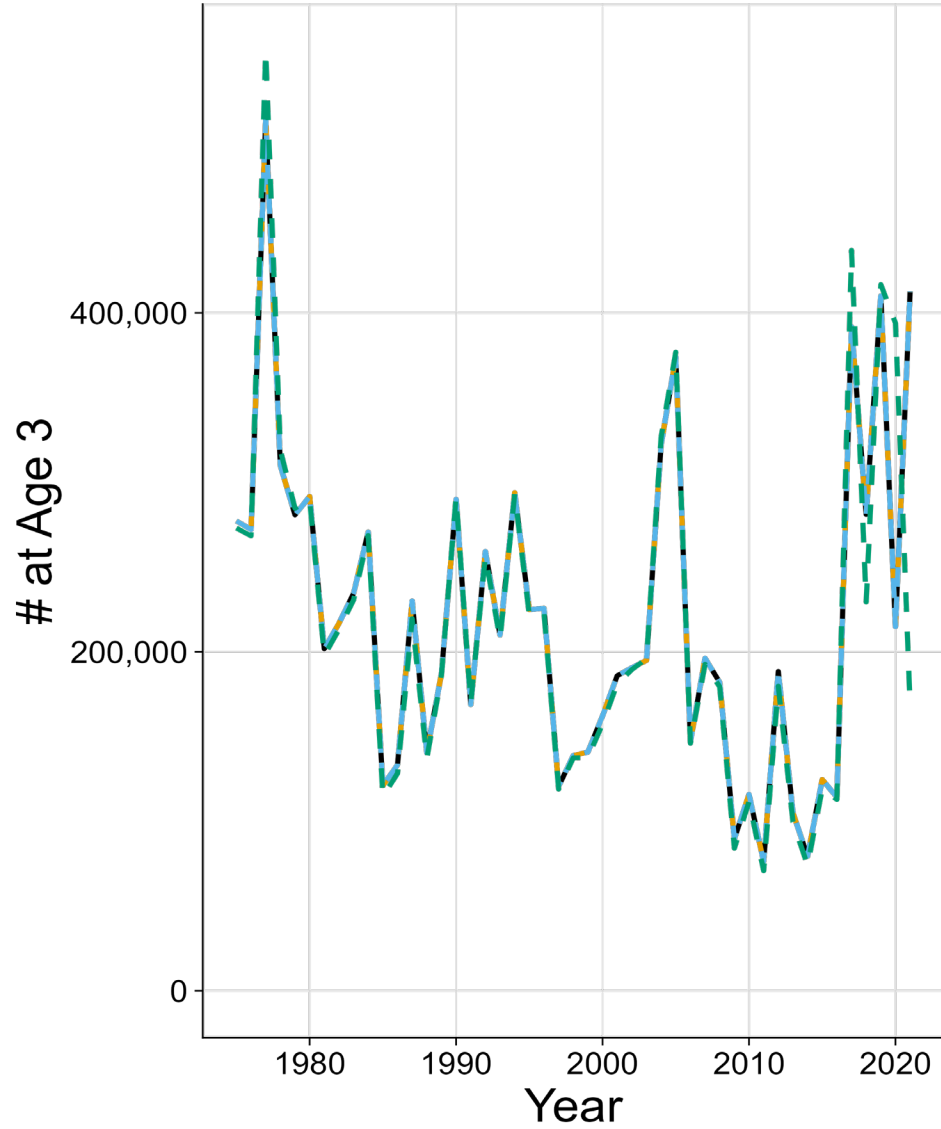


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# Base-3

## Age 3

## Fishing mortality



Model - Old    Base-1    Base-2    Base-3



# Likelihood Components

	Base-1	Base-2	Base-3
Total	1623.974	992.067	982.7518
Survey	-58.9898	-59.209	-58.8731
Length-comp	1007.89	383.985	373.708
Age-comp	656.727	648.944	644.961
Recruitment	18.347	18.347	22.9559



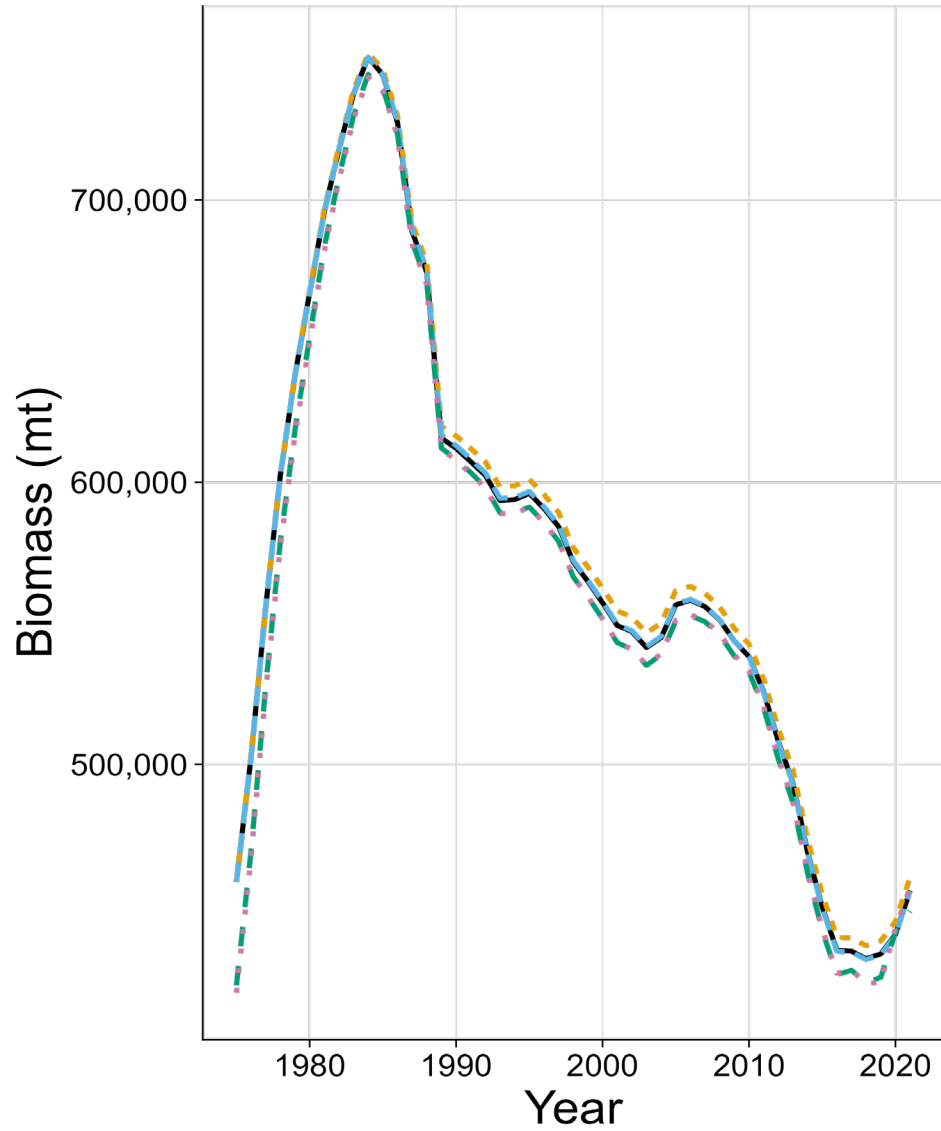
# Base-4

- Updated version of Base-3
- Estimate mean recruitment, recruitment deviations, annual fishing mortality and selectivity, **growth**

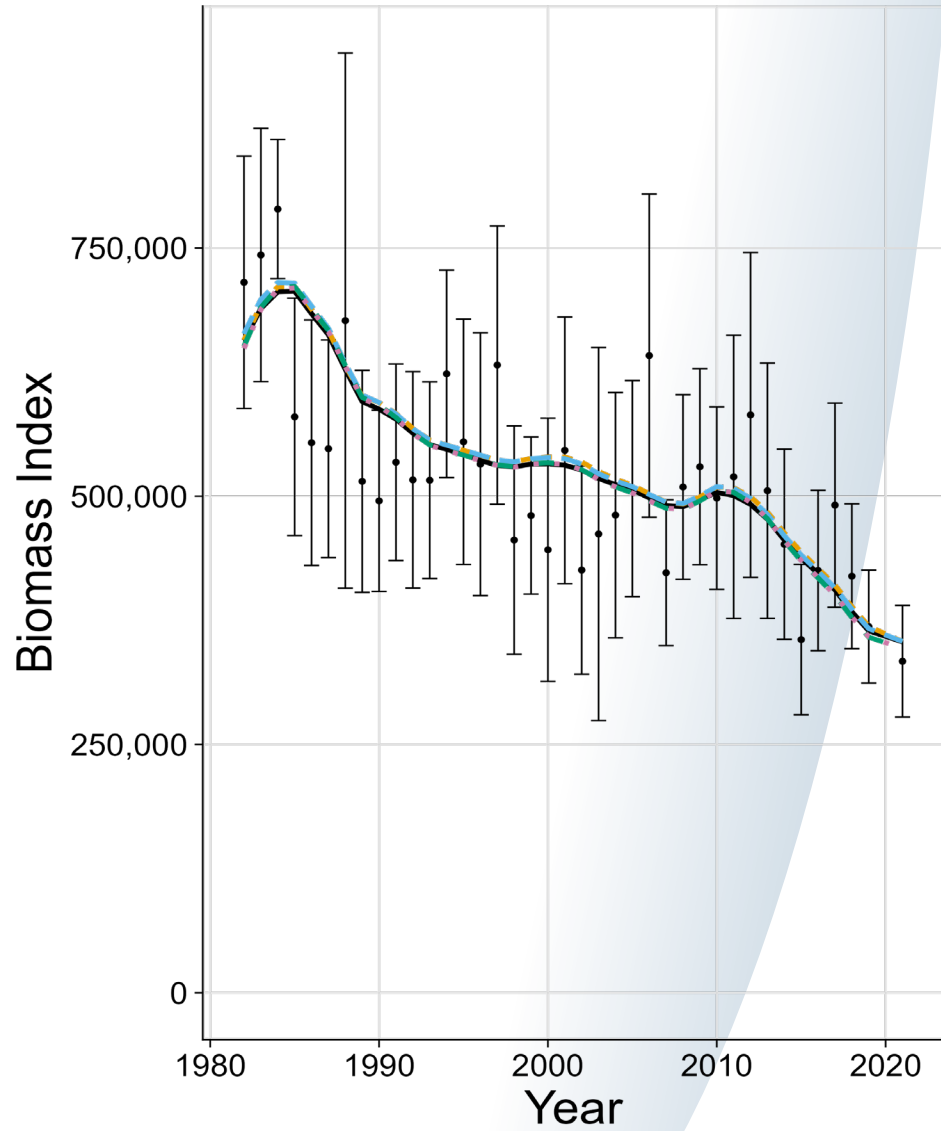


# Base-4

## Total Biomass, age 3 up



## Biomass Index



Model – Old    - - - Base-1    — Base-2    - - - Base-3    ··· Base-4

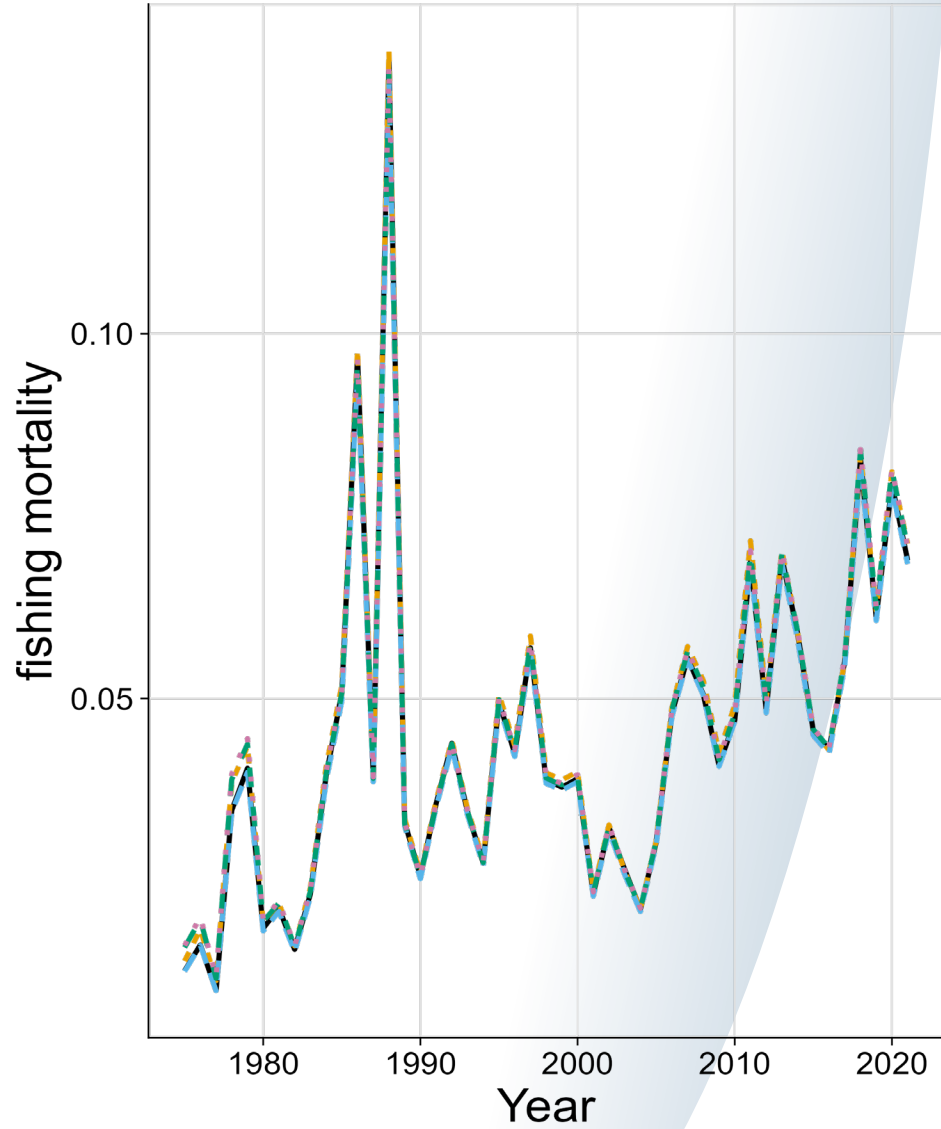
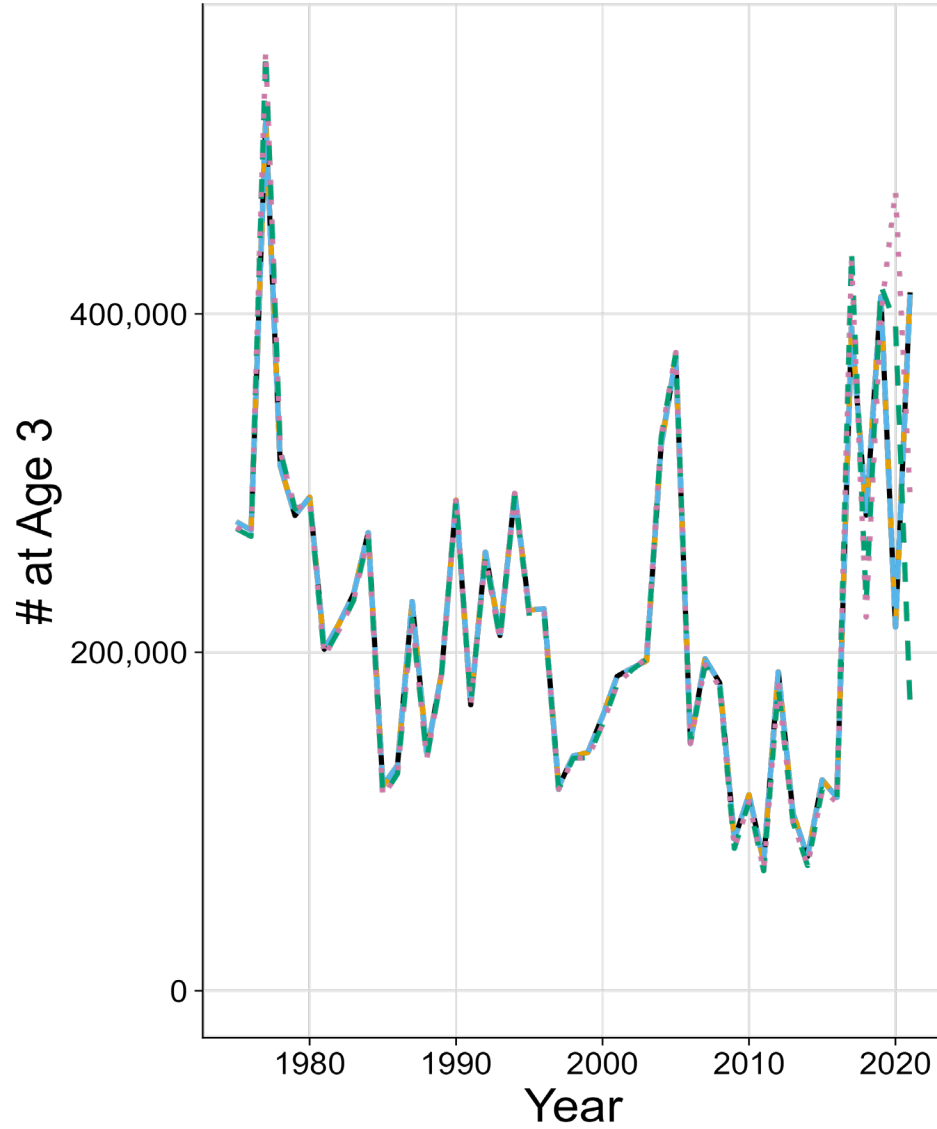




# Base-4

## Age 3

## Fishing mortality

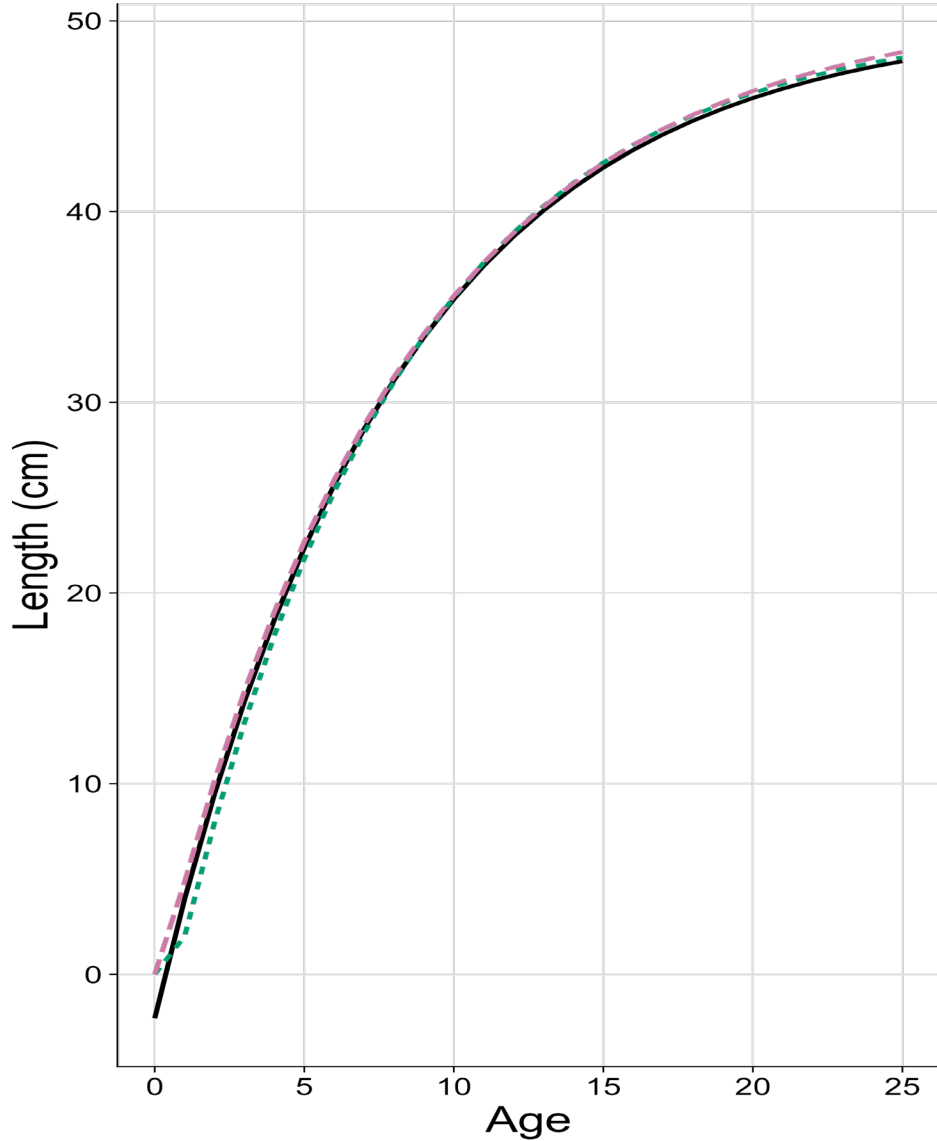


Model – Old – Base-1 – Base-2 – Base-3 – Base-4

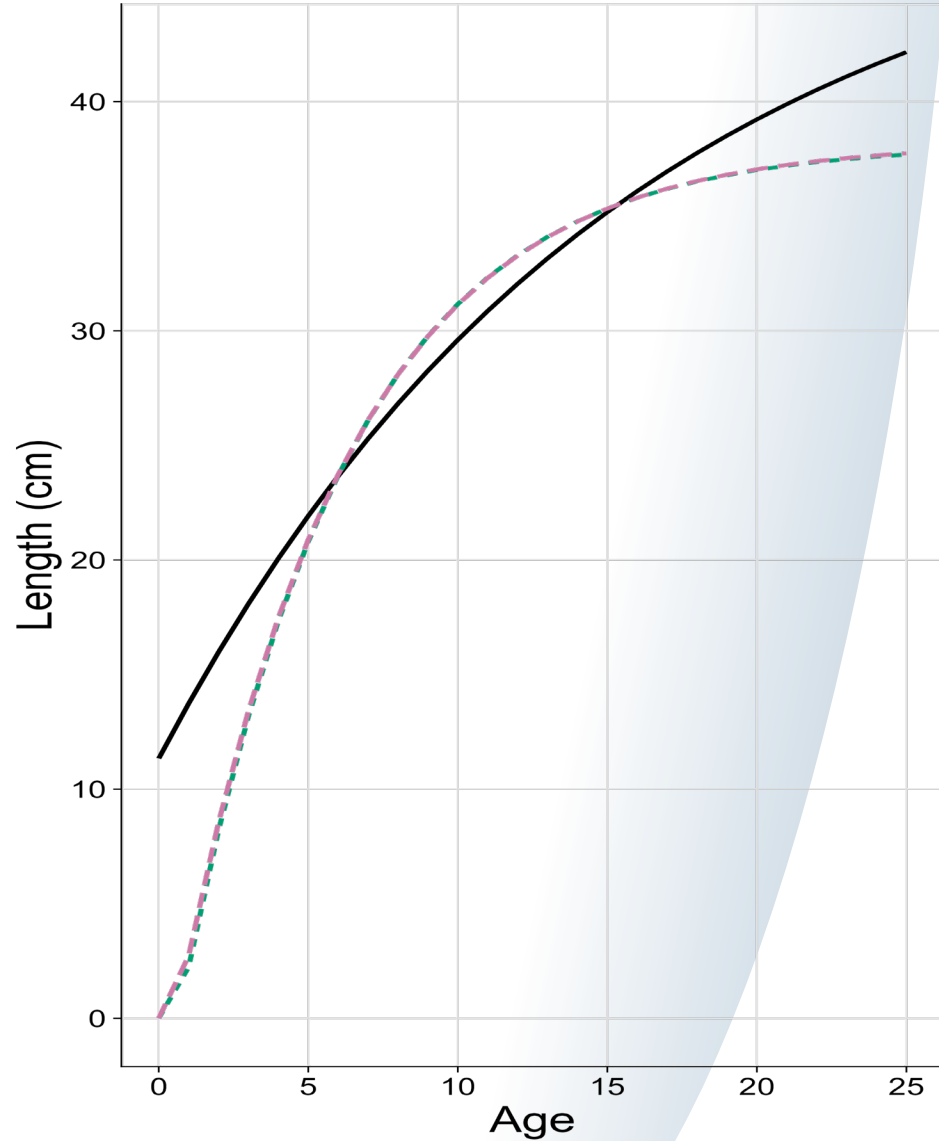


# Base-4

## Female Length-at-Age



## Male Length-at-Age



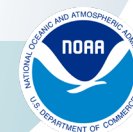
Model - Old -- Base-3 - Base-4



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# Likelihood Components

	Base-1	Base-2	Base-3	Base-4
Total	1623.974	992.067	982.7518	985.547
Survey	-58.9898	-59.209	-58.8731	-58.9021
Length-comp	1007.89	383.985	373.708	374.879
Age-comp	656.727	648.944	644.961	645.987
Recruitment	18.347	18.347	22.9559	23.5831



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# Update/Candidate Models

- Base-4
- Model 24.0
- Model 24.1



# Model 24.0

- Updated survey age-composition input sample size
- General bootstrap framework in “surveyISS” Rpackage (Williams and Hulson 2024)

\* Williams B, Hulson P (2024). *surveyISS: Survey composition input sample size*. R package version 1.0.0, <https://benwilliams-noaa.github.io/surveyISS/>, <https://github.com/BenWilliams-NOAA/surveyISS/>.



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# Model 24.0

- Updated survey age-composition input sample size
- Update survey length-composition input sample size
  - Number of hauls



# Model 24.0

- Updated survey age-composition input sample size
- Update survey length-composition input sample size
- Add age-1 and age-2 to age-composition data



# Model 24.0

- Updated survey age-composition input sample size
- Update survey length-composition input sample size
- Add age-1 and age-2 to age-composition data
- Estimate all growth parameter except CV





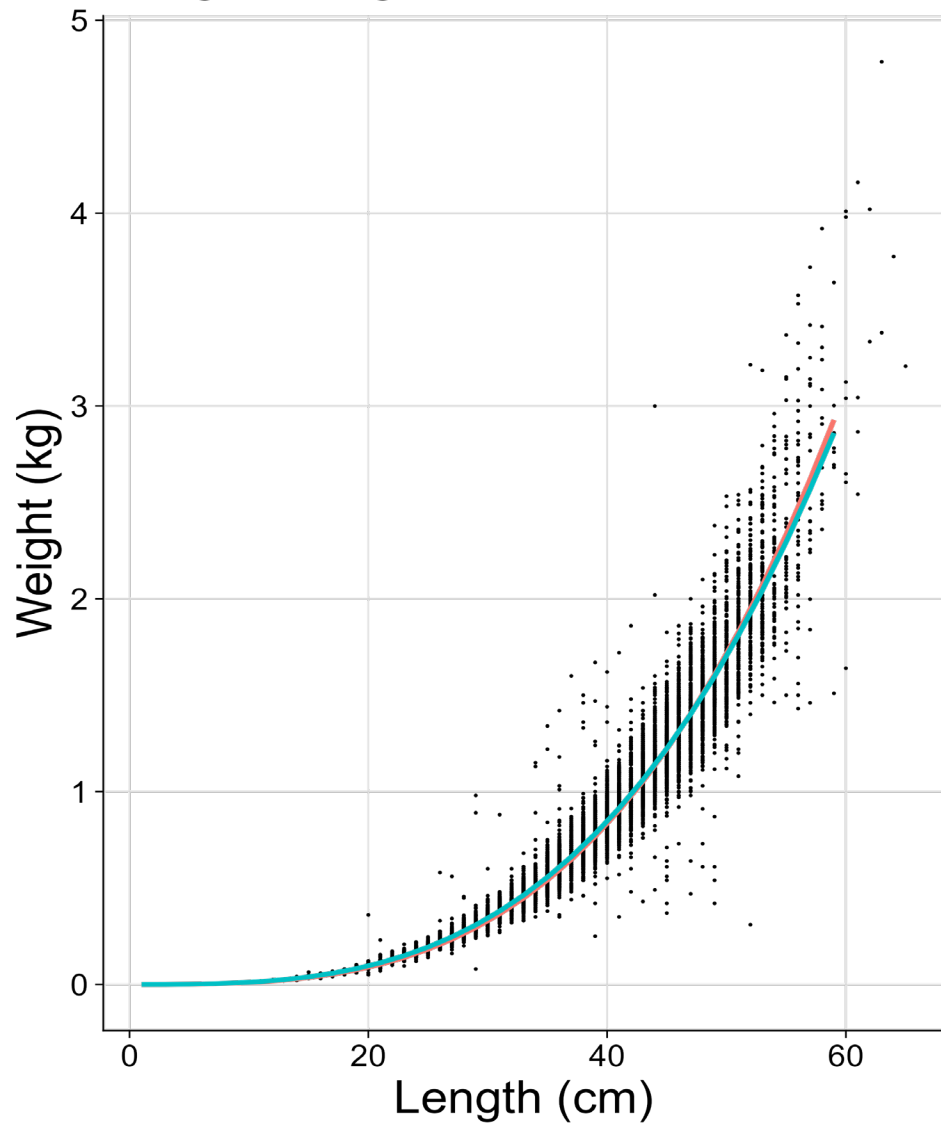
# Model 24.0

- Updated survey age-composition input sample size
- Update survey length-composition input sample size
- Add age-1 and age-2 to age-composition data
- Estimate all growth parameter except CV
- Update length-weight relationship parameters

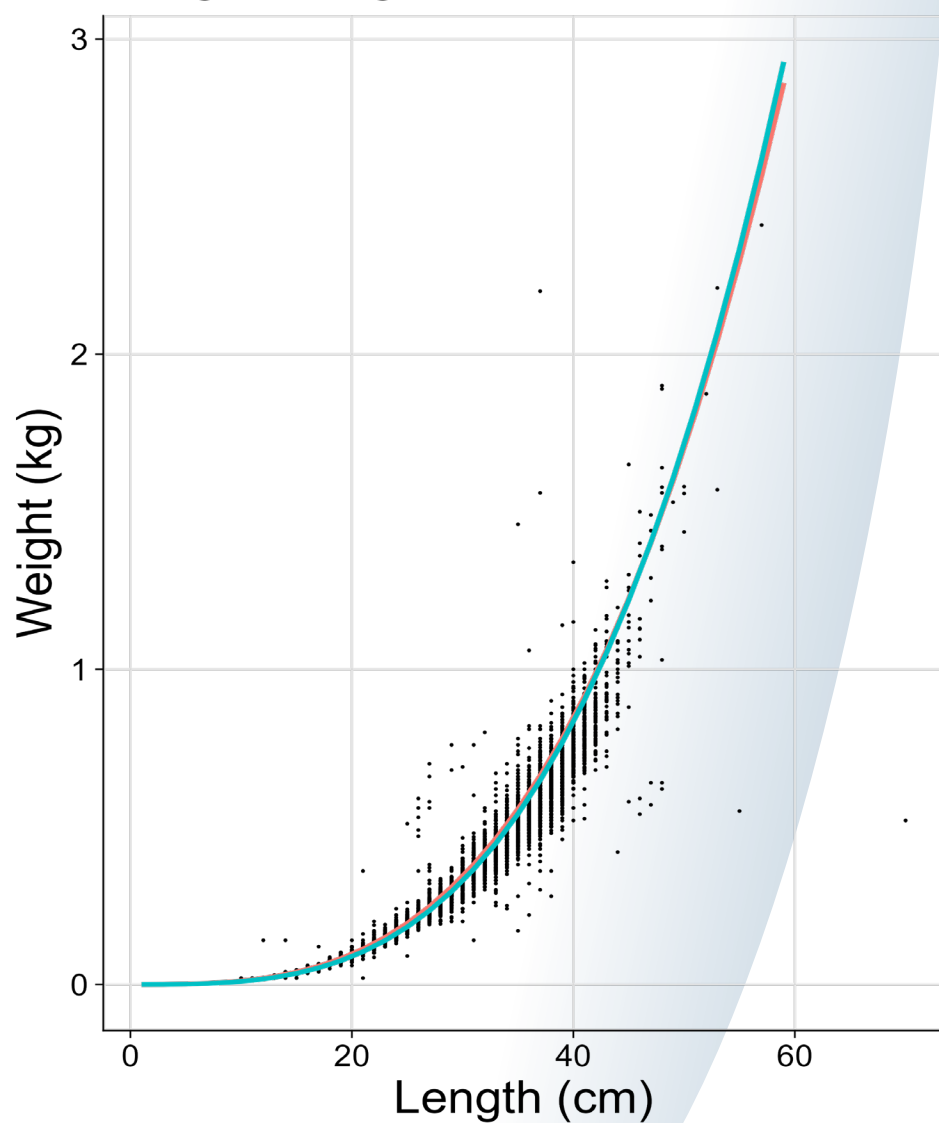


# Model 24.0

## Length-Weight Female



## Length-Weight Male



model — Base-4 — Model 24.0



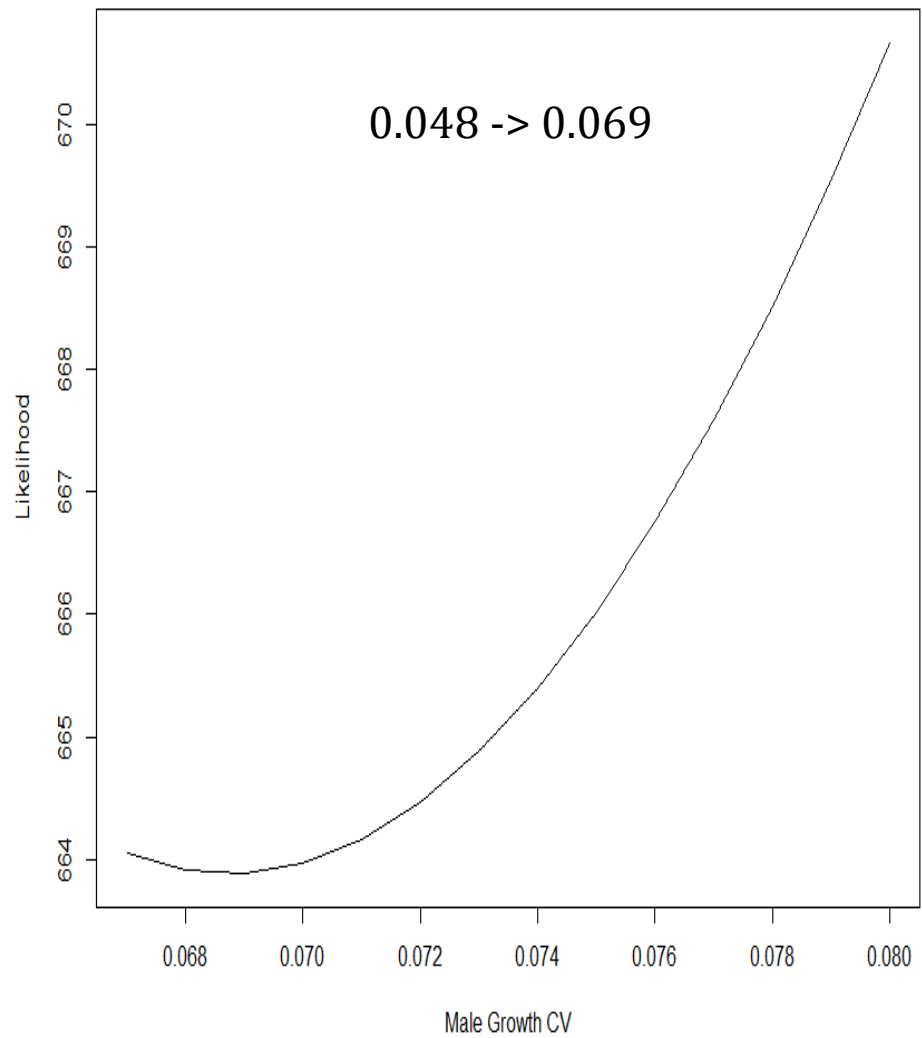
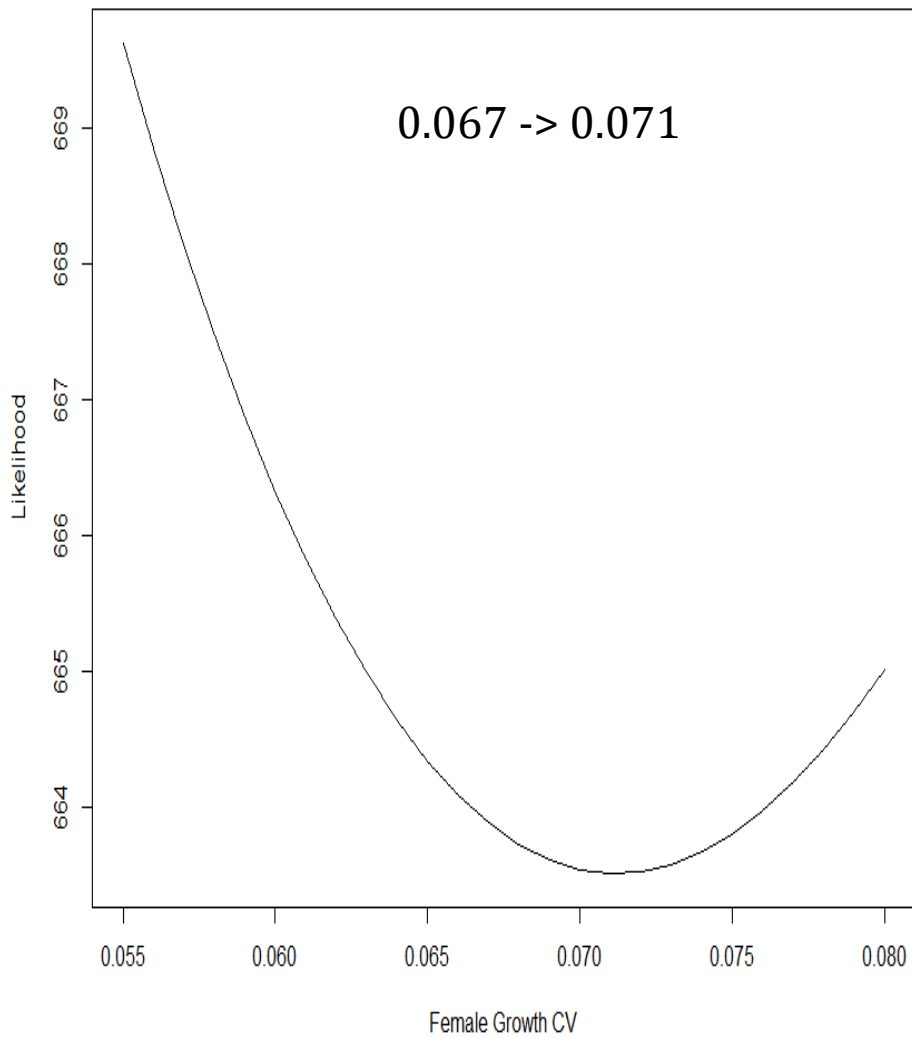
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# Model 24.0

- Updated survey age-composition input sample size
- Update survey length-composition input sample size
- Add age-1 and age-2 to age-composition data
- Estimate all growth parameter except CV
- Update length-weight relationship parameters
- Update old age growth CVs



# Model 24.0

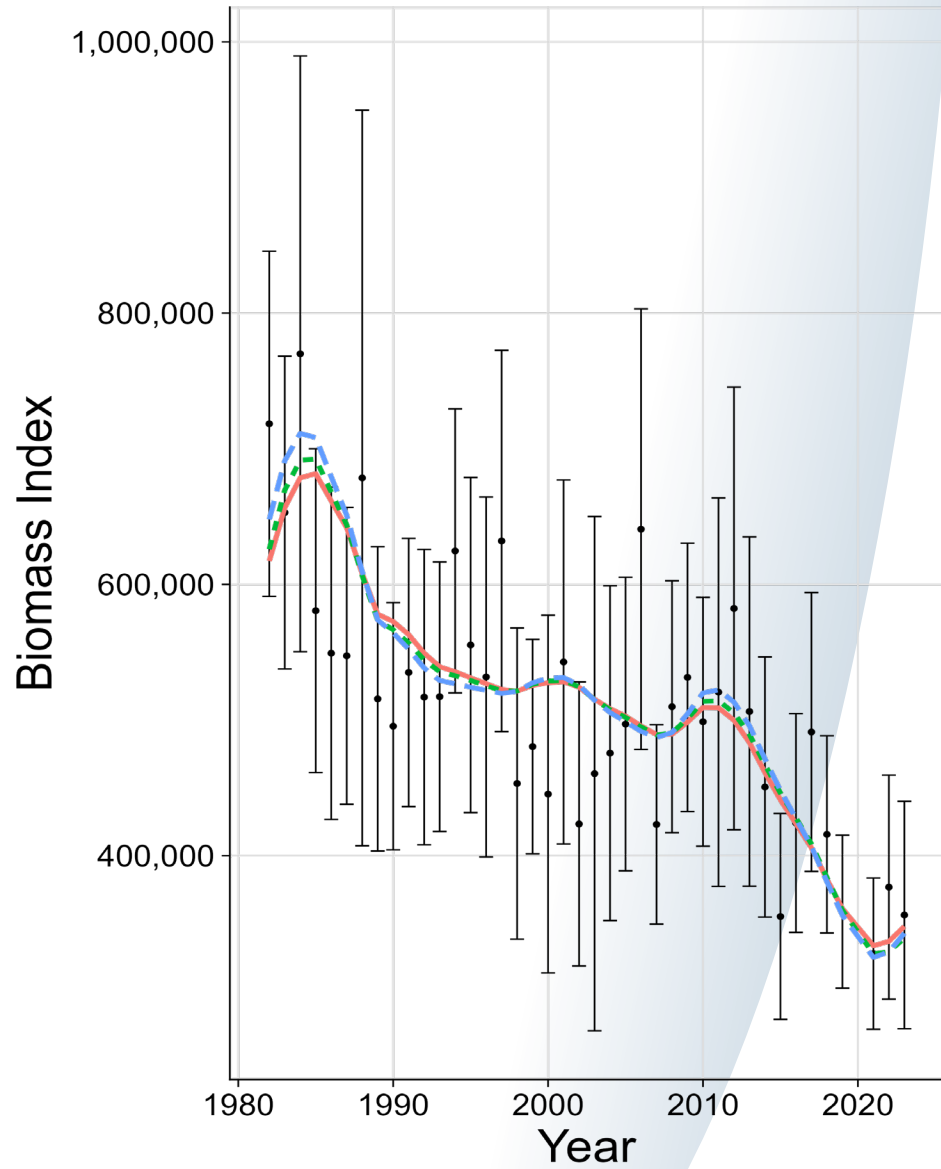
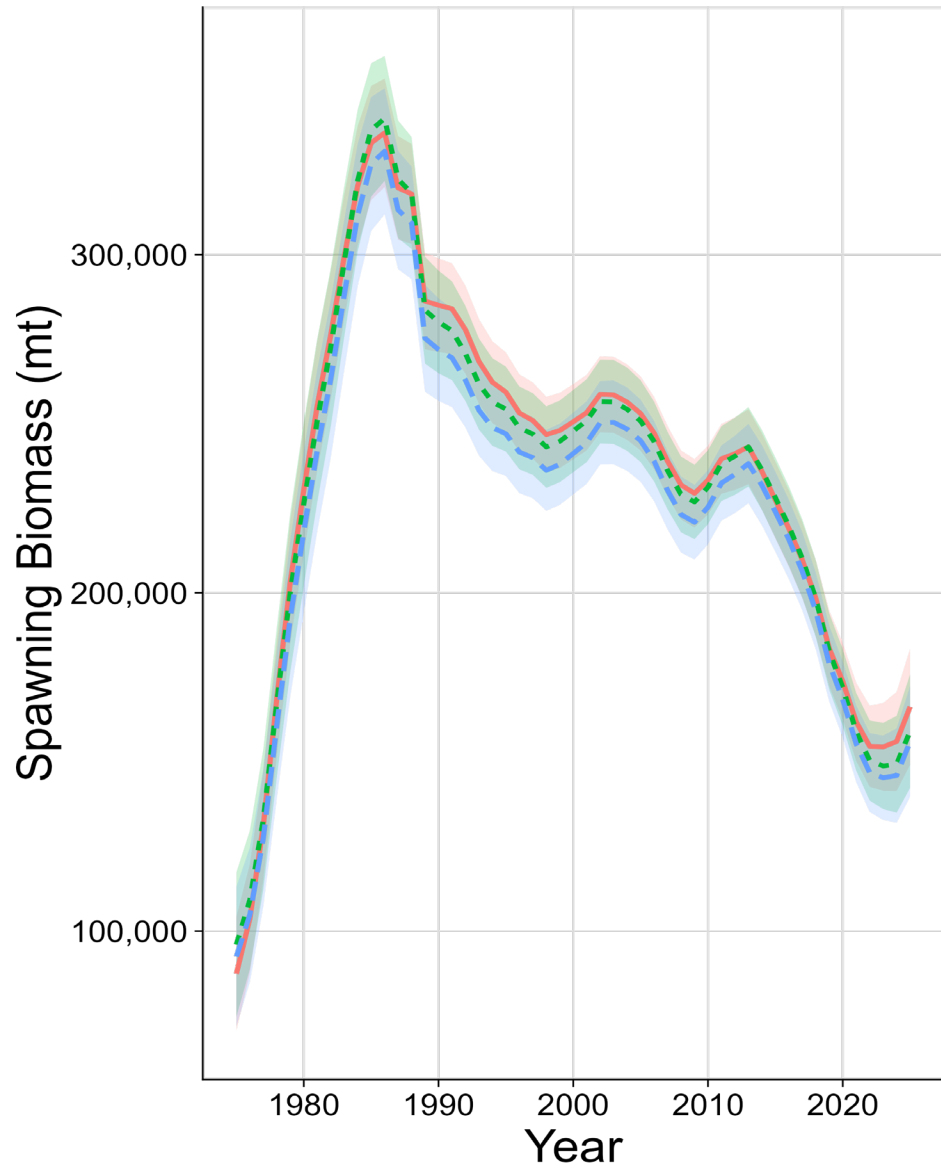


# Model 24.1

- Same as Model 24.0 except weight-at-age is not a manual input



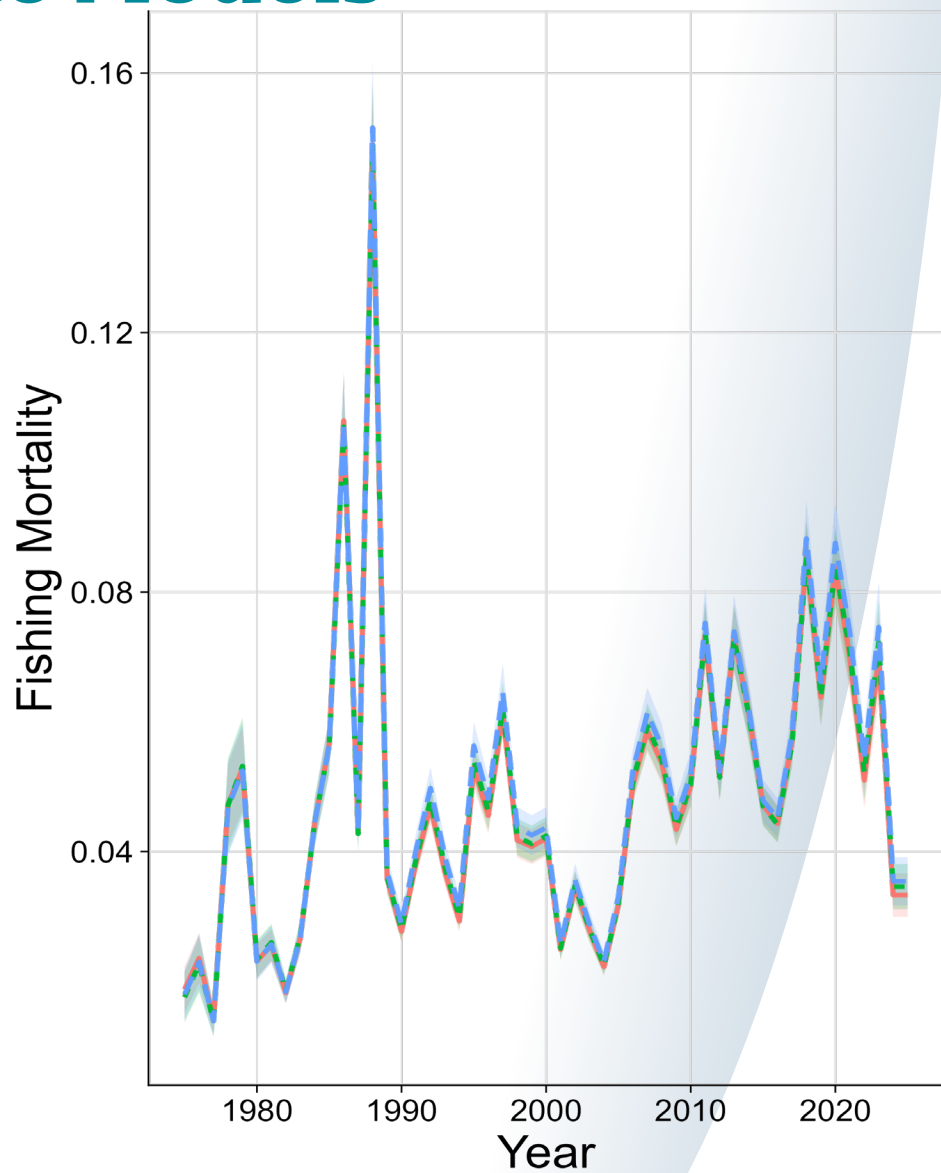
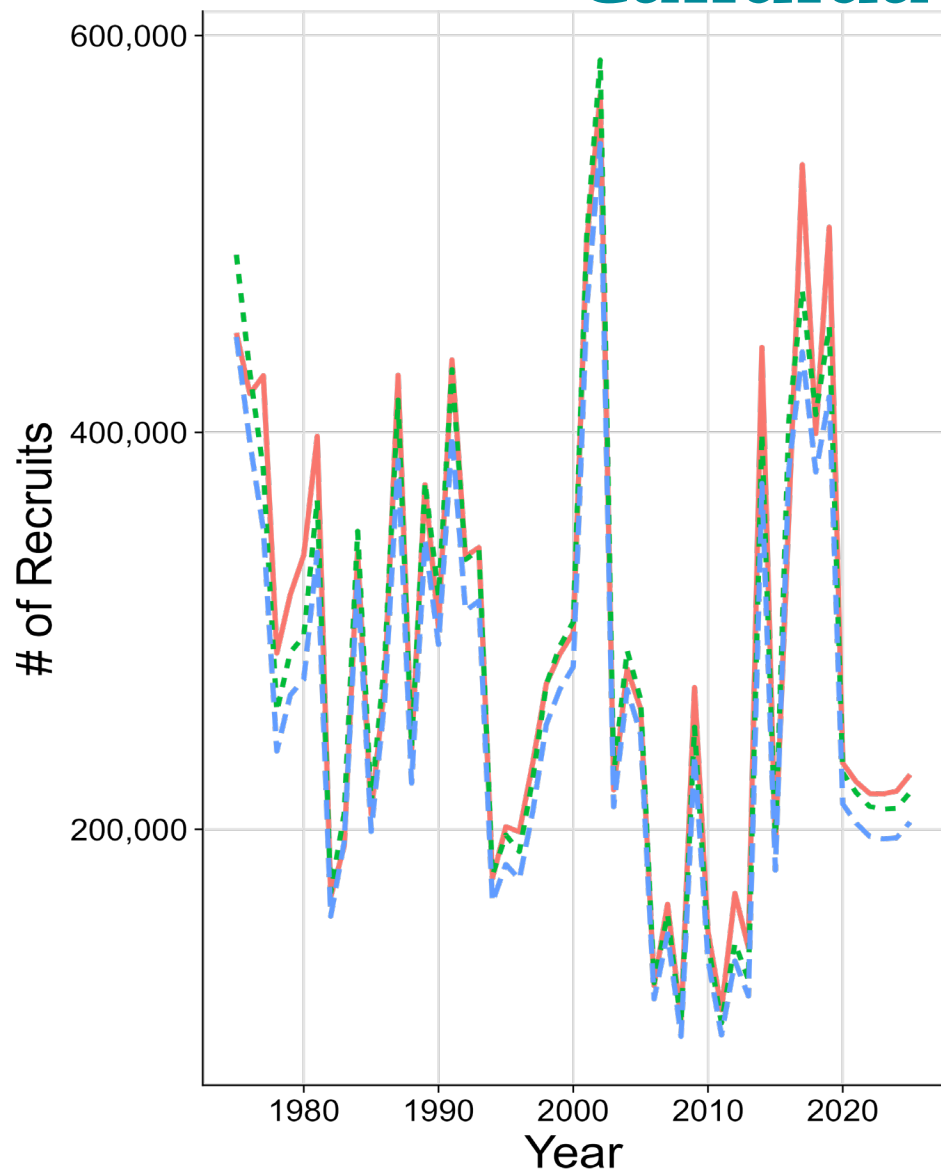
# Candidate Models



Model — Base-4 — Model 24.0 — Model 24.1



# Candidate Models

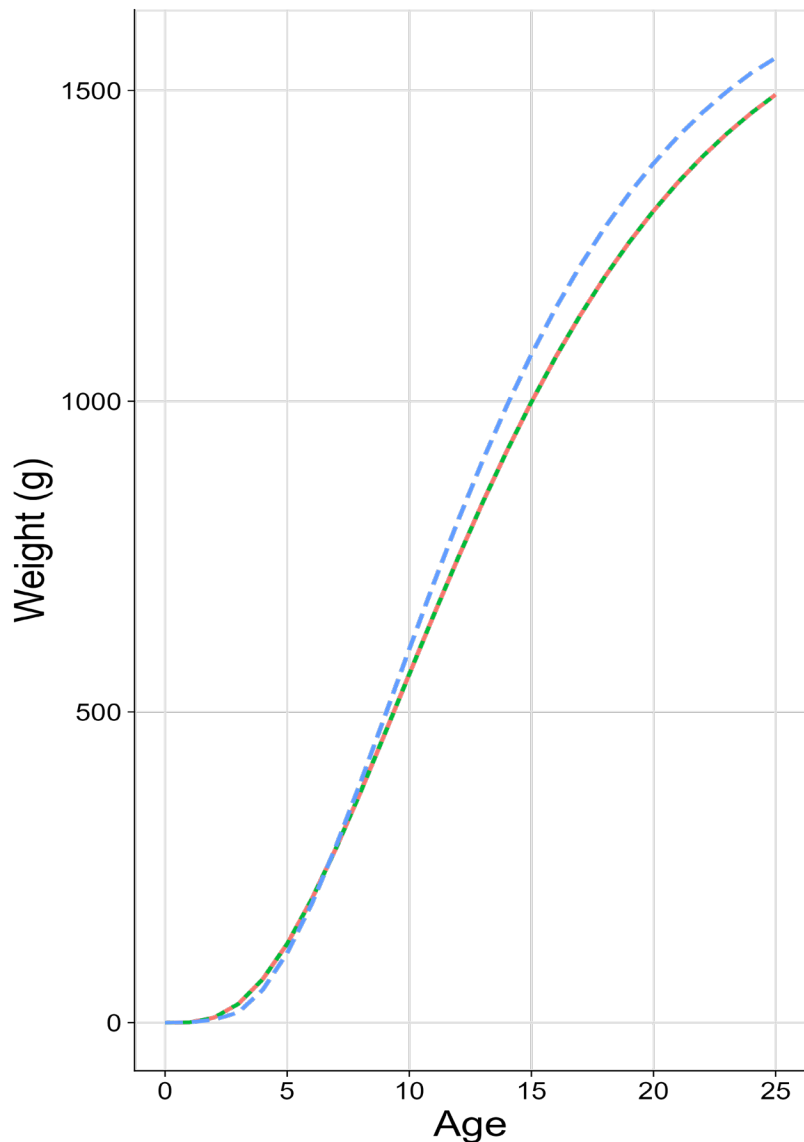


Model — Base-4 — Model 24.0 — Model 24.1

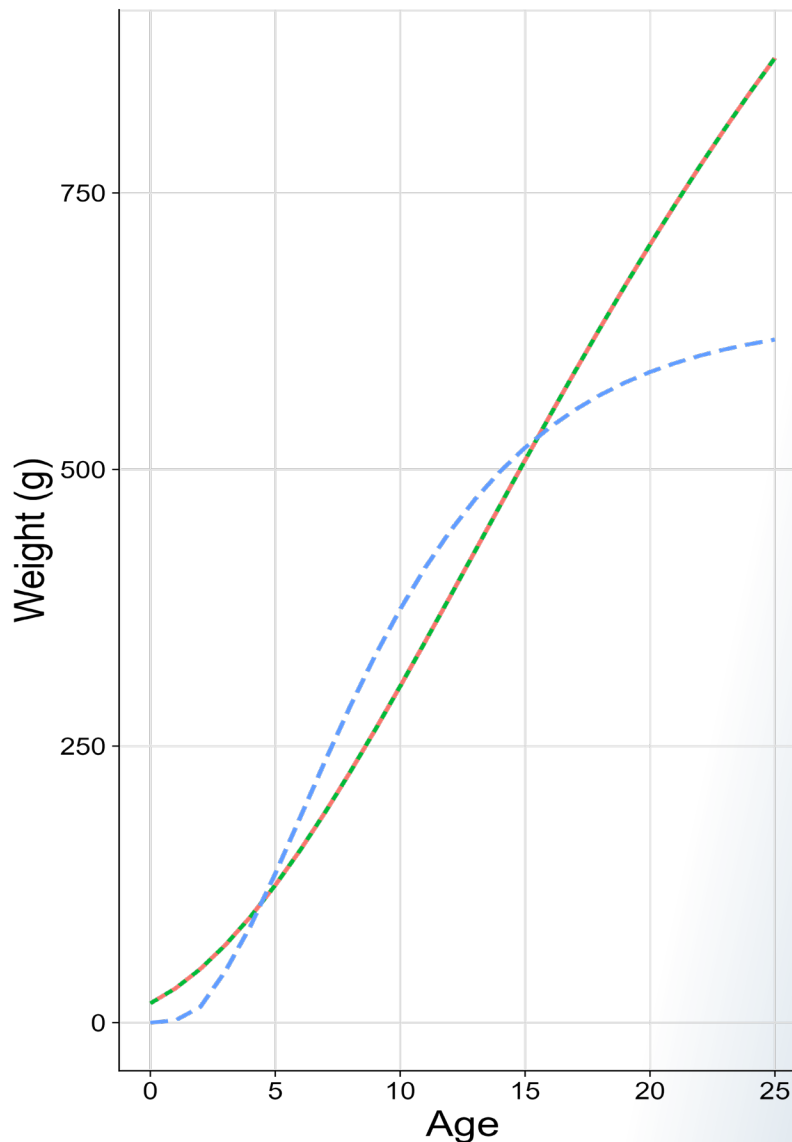


# Candidate Models

## Female Weight-at-Age



## Male Weight-at-Age



Model — Base-4 — Model 24.0 — Model 24.1



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# Likelihood Components

	Base-4	Model 24.0	Model 24.1
Total	1010.07	670.014	673.004
Survey	-66.6602	-66.4449	-65.701
Length-comp	417.408	379.449	380.43
Age-comp	633.643	335.088	335.743
Recruitment	25.6784	21.9209	22.5315



# Conclusion

## Transition to SS3

- Base-4 Model that estimates growth

## Updates for 2024

- 3 options (Base-4, Model 24.0, Model 24.1)
  - Recommendation: Model 24.1

