Analysis of California Current groundfish size using a state-space size-at age model

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3 Marine Scotland

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ICES/PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (WGGRAFY)

Former Co-chairs

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John Morrongiello (Australia, Guest)

Paul Spencer (USA, PICES)

Shin-ichi Ito (Japan, PICES)

Research Goals

1. **Assess the capacity of statistical models** to incorporate temperature-dependency of growth, and compare their predictions of growth variation across specific warming scenarios and locations.
2. Analyze long-term growth patterns across ecosystems
3. Assess the impacts of warming on past yield
4. Global length-at-age database

Assess the capacity of **statistical models..**

NRC Research Press

2139

ARTICLE

Temporal and environmental variation in growth and maturity and effects on management reference points of Georges Bank Atlantic cod

Timothy J. Miller, Loretta O'Brien, and Paula S. Fratantoni

Warming temperatures and smaller body sizes: synchronous changes in growth of North Sea fishes

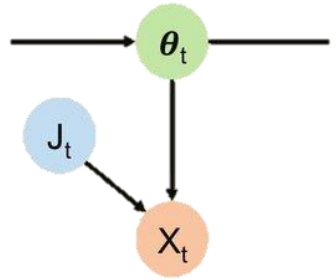
Alan R. Baudron, Coby L. Needle, Adriaan D. Rijnsdorp, C. Tara Marshall

A state-space approach for detecting growth variation and application to North Pacific groundfish

Christine C. Stawitz, Timothy E. Essington, Trevor A. Branch, Melissa A. Haltuch, Anne B. Hollowed, and Paul D. Spencer

Three methods; two kinds of variation

State-space



Three methods; two kinds of variation

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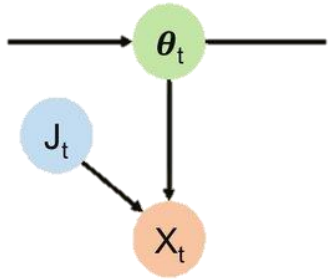
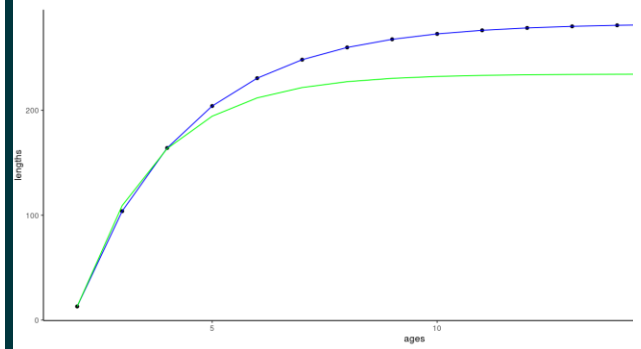


Mechanism



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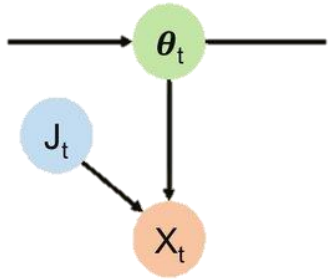
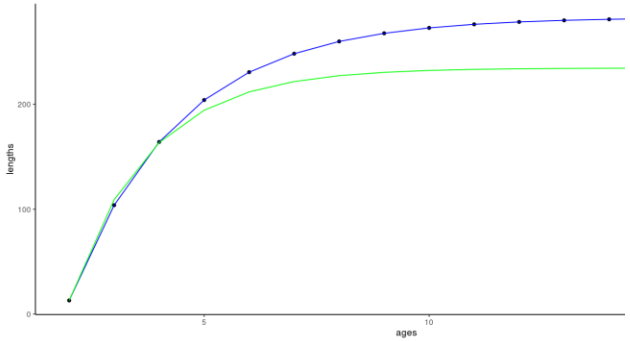
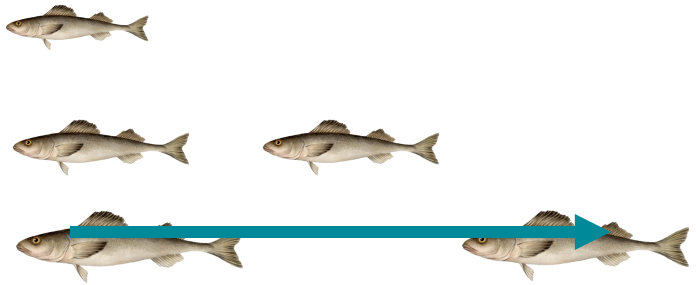


Mechanism



Annual variation



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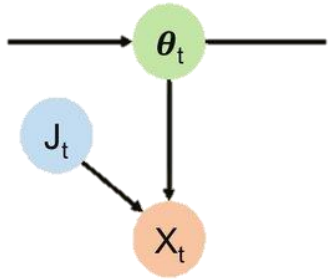
Three methods; two kinds of variation

State-space



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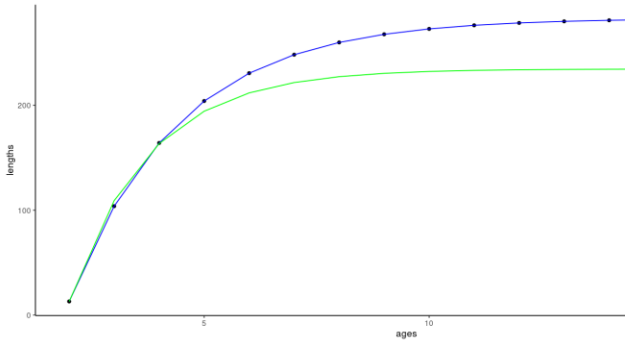
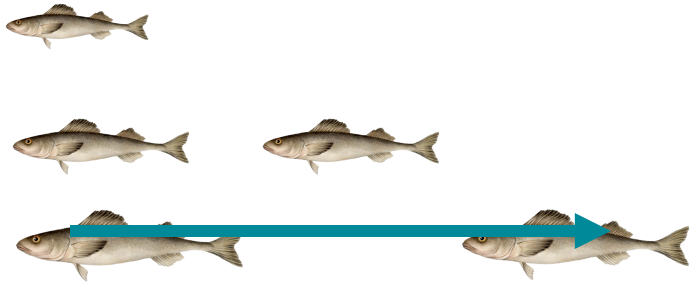
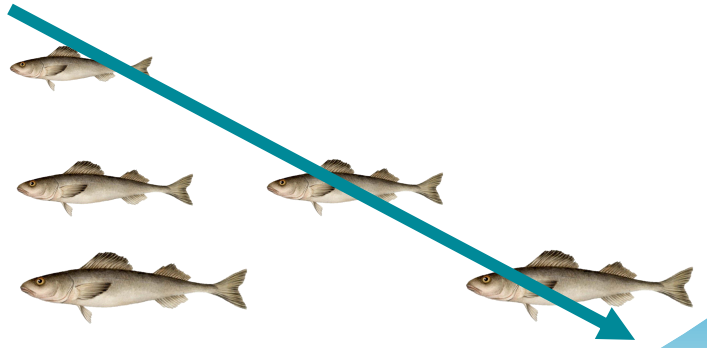


Annual variation

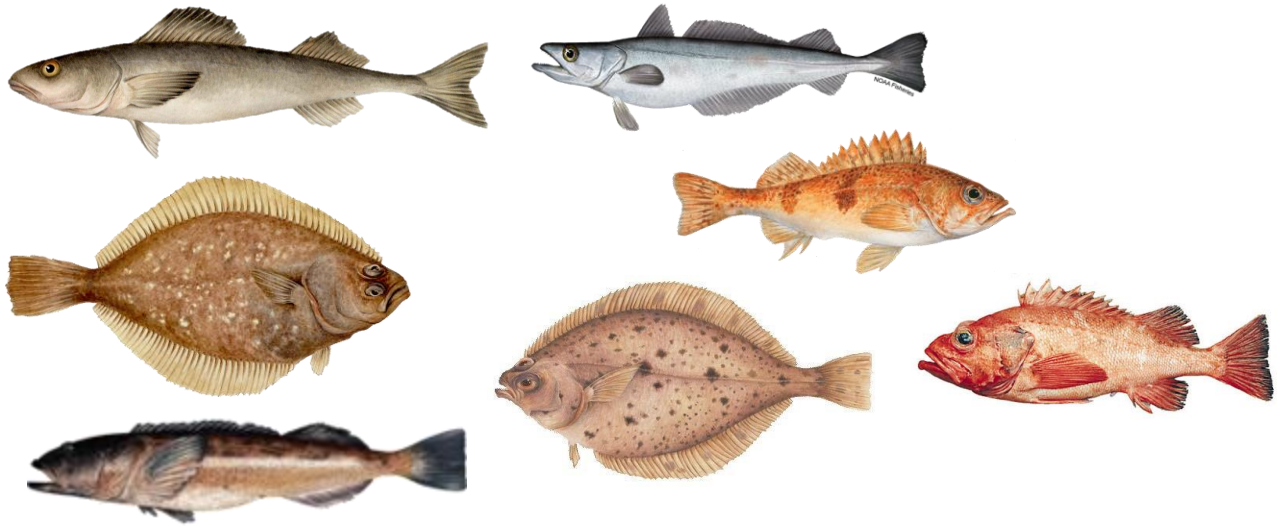


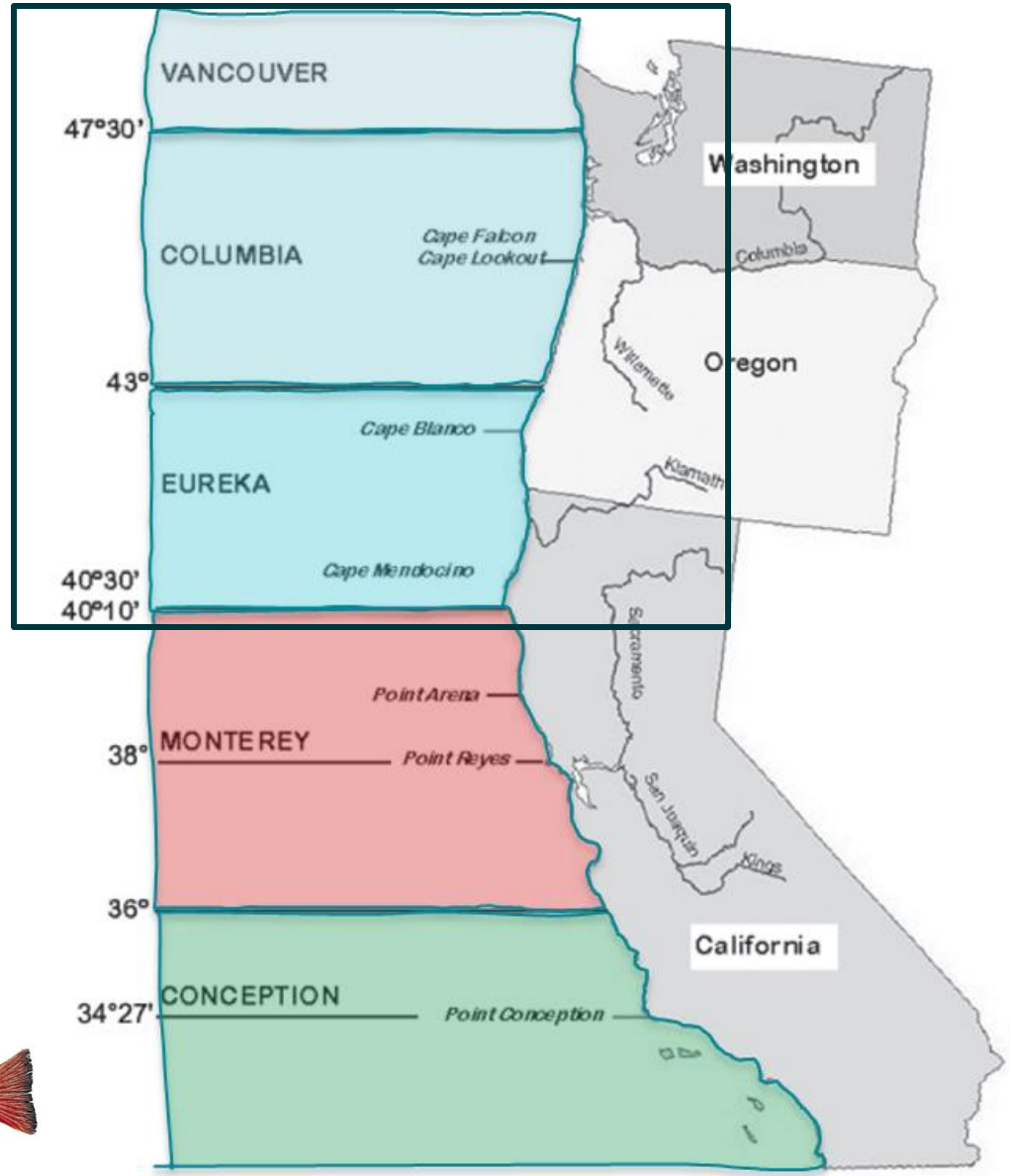
Cohort variation



Data

- Survey length and age samples
- Temperature measurements from expected habitats





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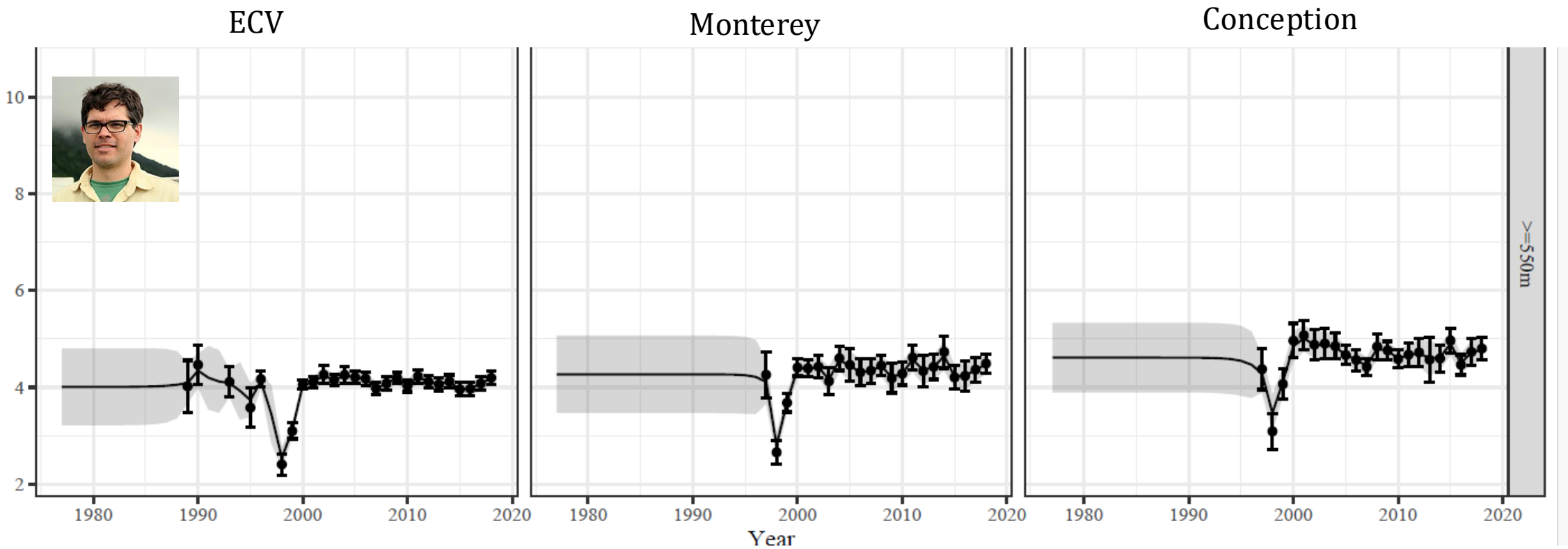
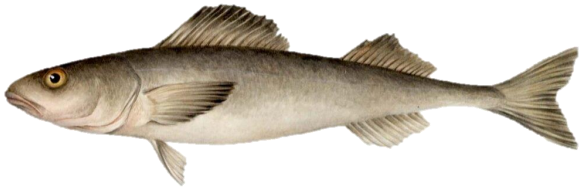
Modeled bottom temperature

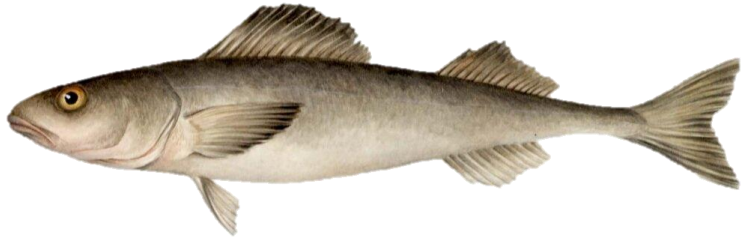


Model structure

year

age





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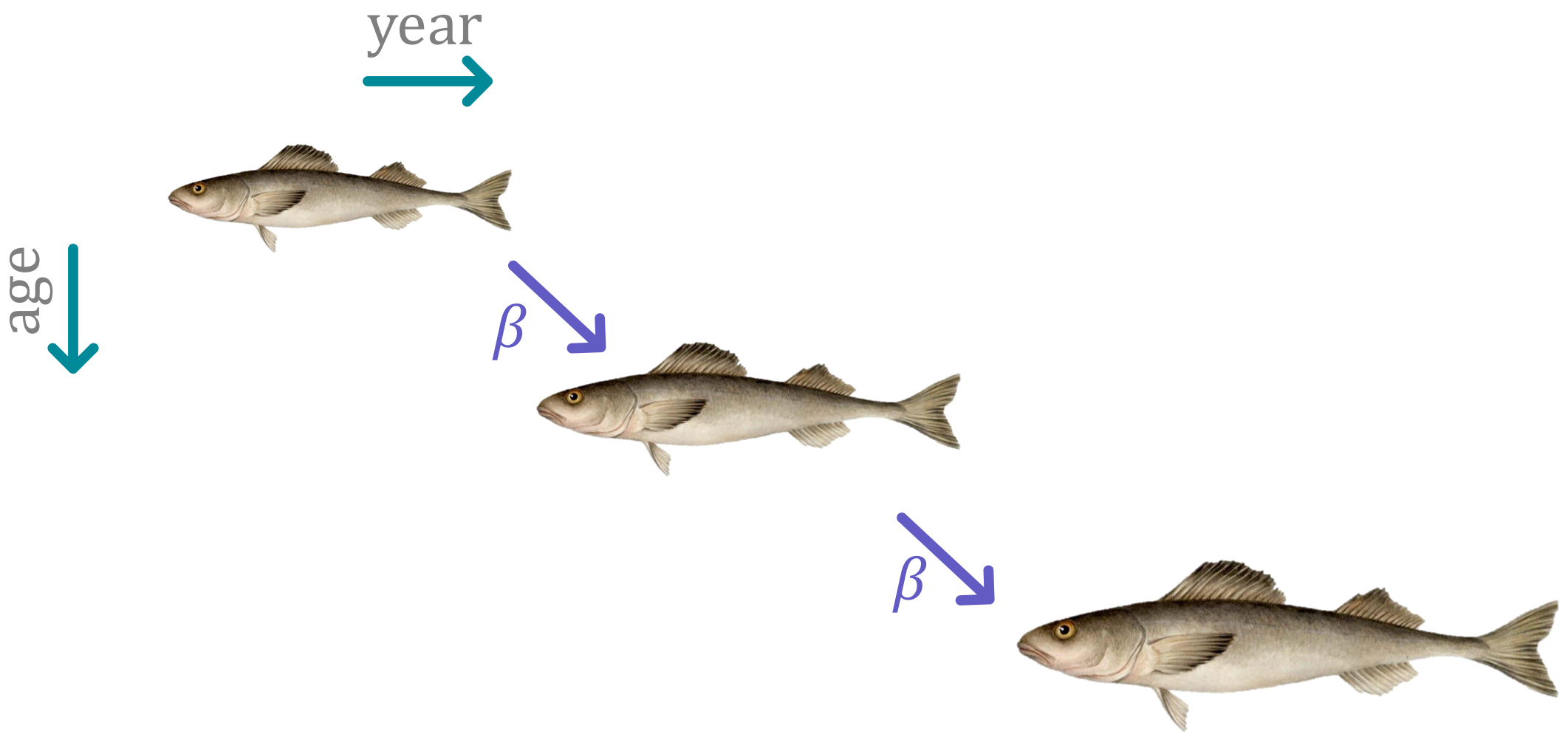
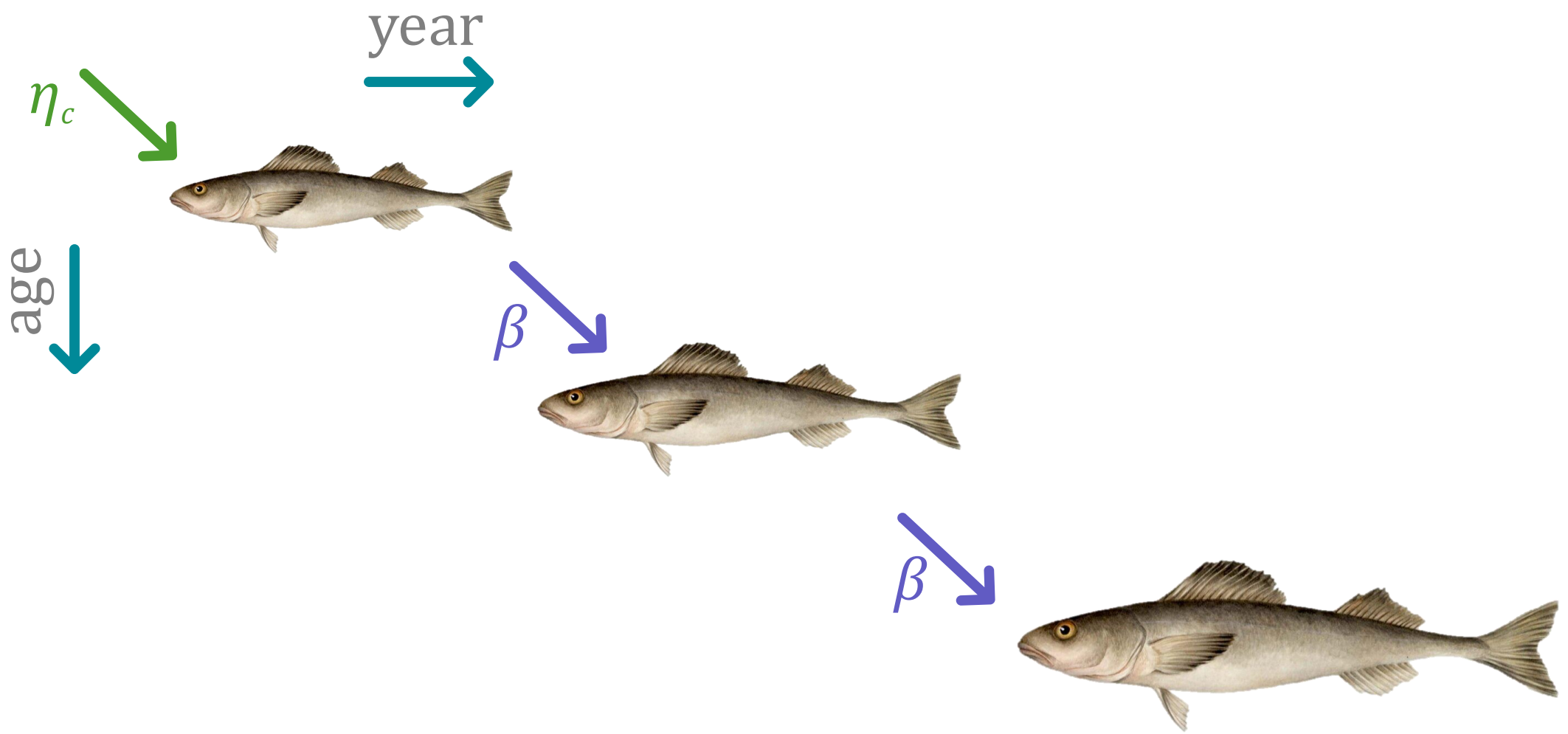
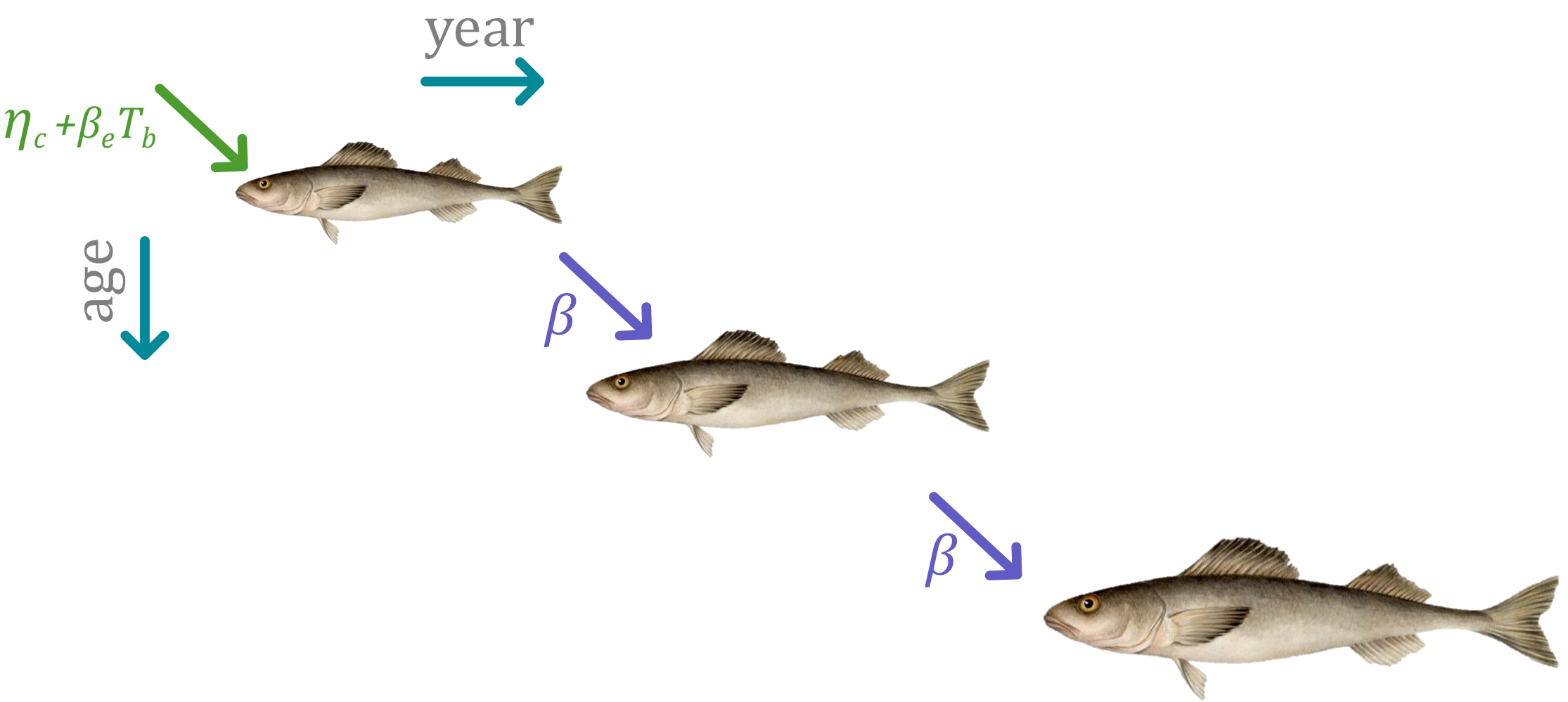
null model: AR1



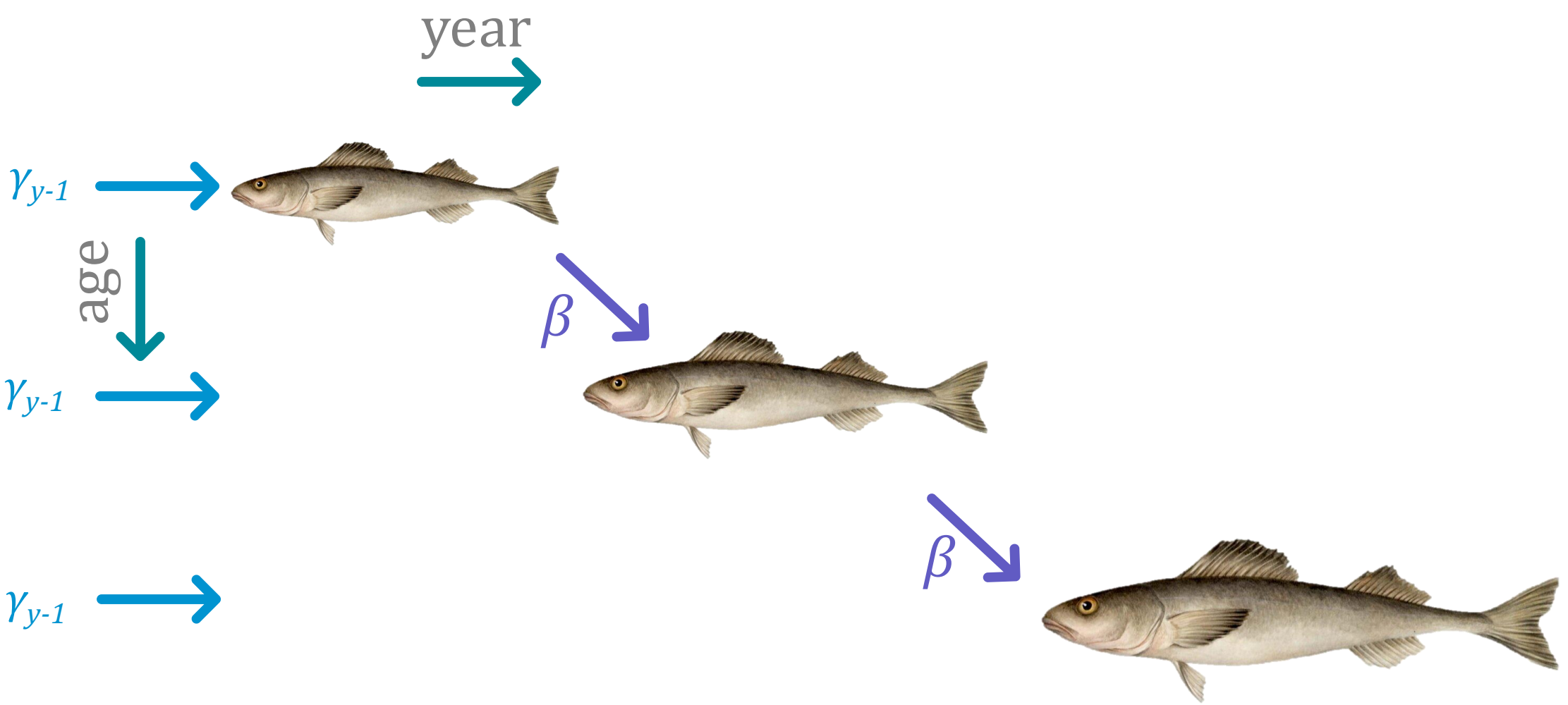
AR1 & initial size ~ cohort



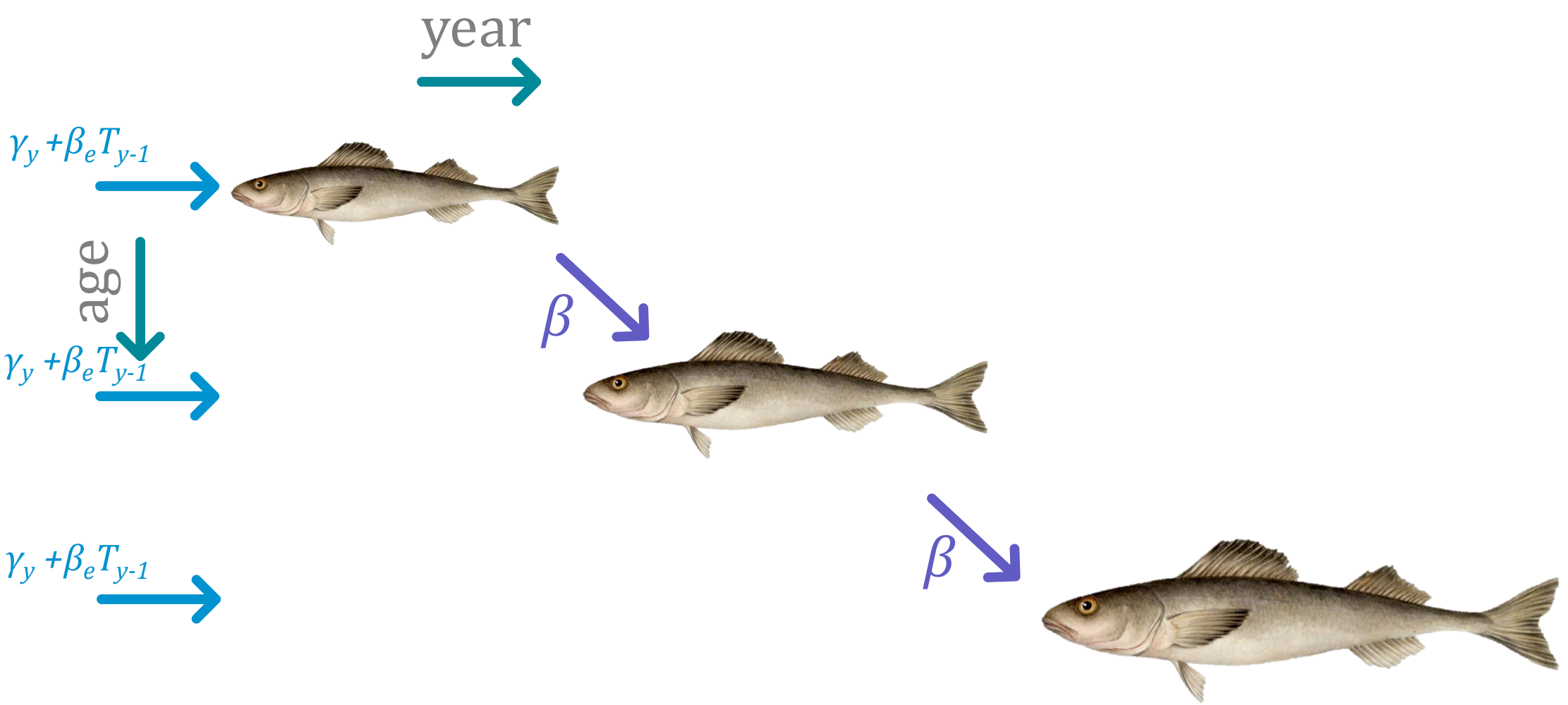
AR1 & initial size ~ cohort + temperature



AR1 + annual variation

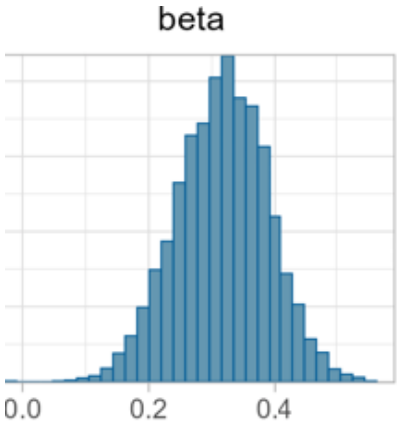


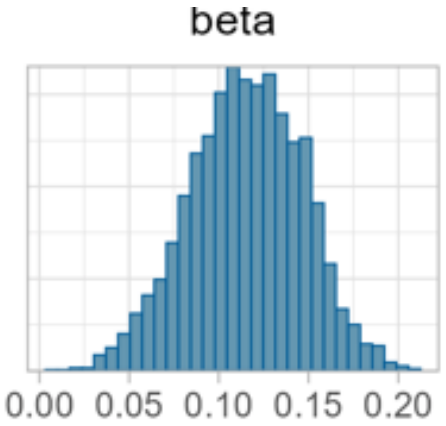
AR1 + annual variation + temperature



Results

Strength of autocorrelation β





- Positive autocorrelation for most species
  - Significant for shortbelly rockfish and sablefish
  - Negative (not significant) for Pacific hake

Initial size effects strong, but no temp effect

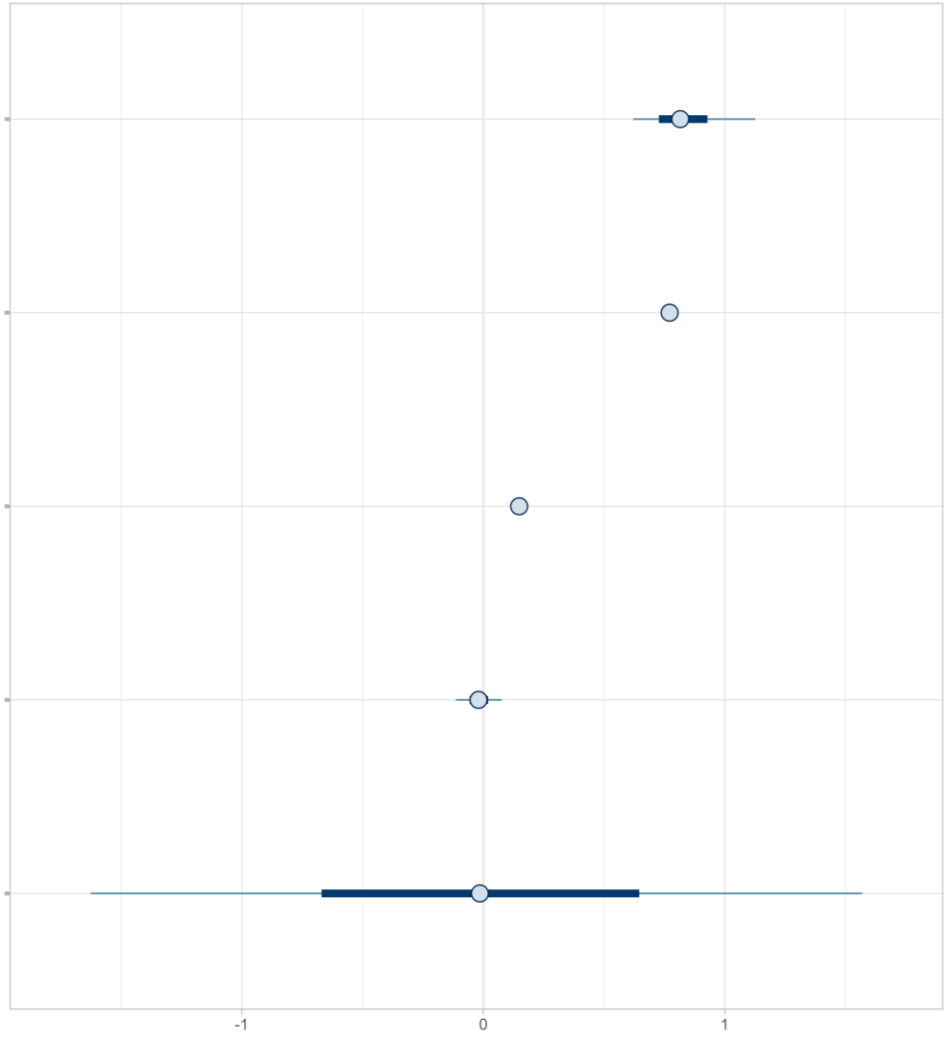
Initial size variation η_c

Process error σ_p

Observation error σ_p

Autocorrelation β

Temperature effect β_e



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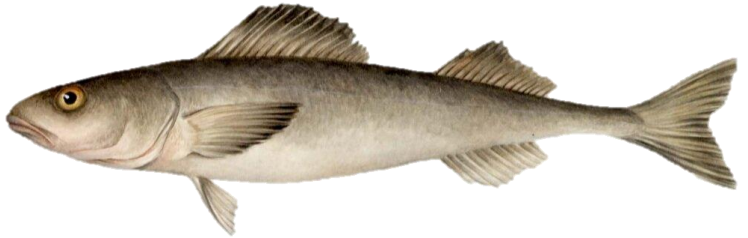
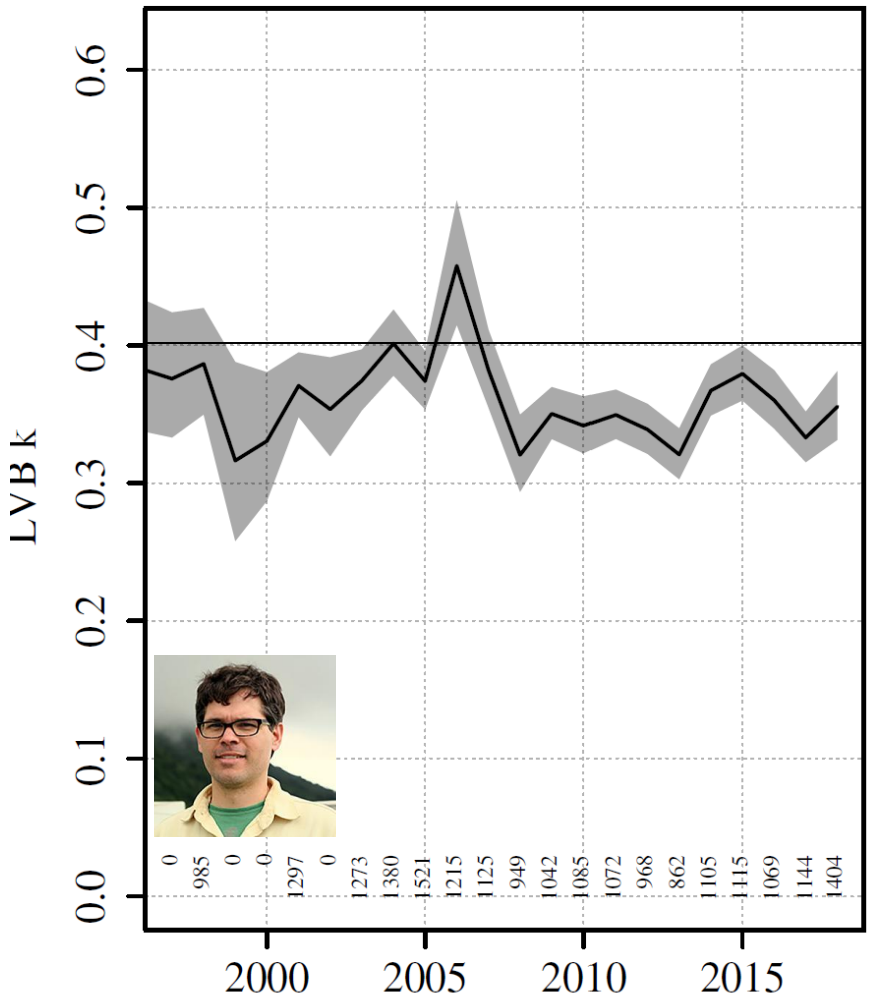
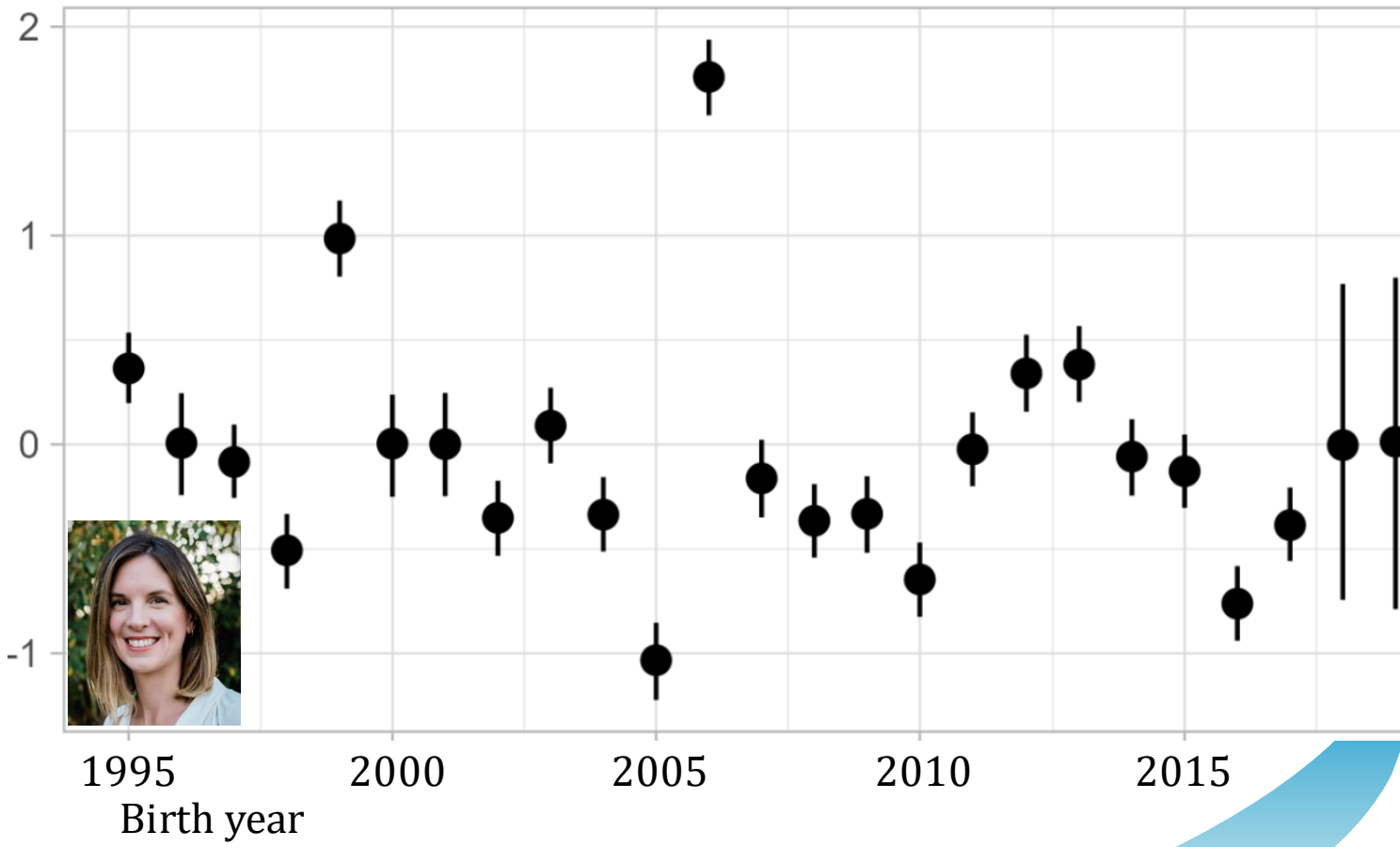
Initial size effects - sablefish







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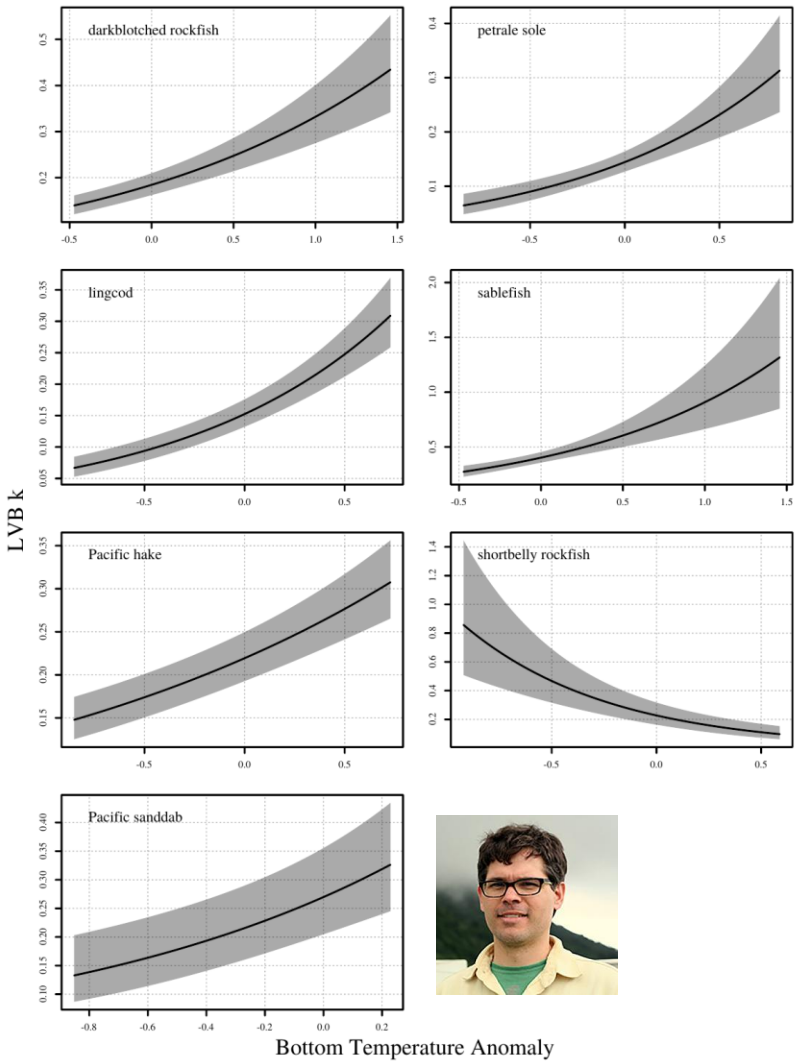
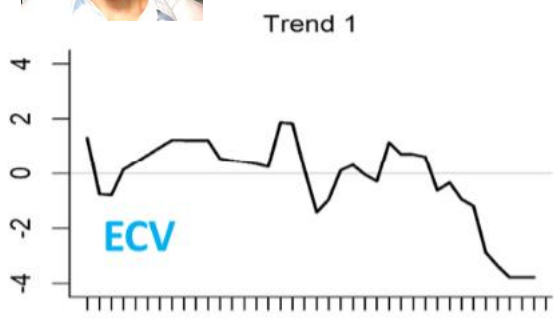
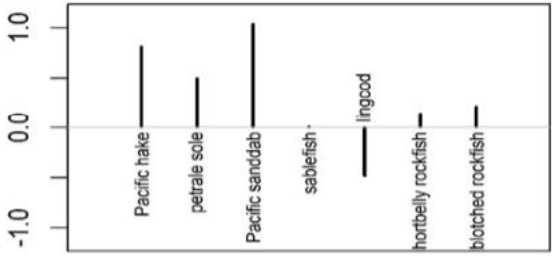
Assess the capacity of **statistical models..**



- AR1 and initial size variation most important (me)
- Temperature has a fairly large (0.4-0.95) effect on early life growth for all species (Miller)
- Common decline in max L, not related to F or temperature (Baudron)





How you model matters

- **Next steps:** simulation
- Use an **ensemble**
- We need reproducible, consistent processes for:
  - Data **extraction and scale**
  - Convergence **diagnostics**
  - **Weighting**

Thank You!

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