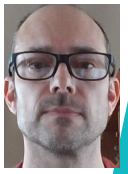
Updating sablefish maturity in Alaskan waters

Ben Williams and Cara Rodgveller



Sablefish maturity

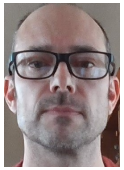
Assessment uses age-converted length-based macroscopic estimates from Sasaki 1985

Histological data available from 2011 & 2015

- noted skip spawning (Rodgveller et al 2016)
- macroscopic ≠ histological (Rodgveller 2018)
- skip spawning found between ages 4-22
    - median 10.5%, min 2%, max 22%

Skip spawning cannot be directly accounted for using GLM (Trippel and Harvey 1991)

More flexible models can account for skip spawning (Head et al. 2020)



Sablefish maturity

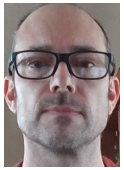
Biological maturity = physiologically capable of spawning
Functional maturity = potential spawner in a given year

Functional maturity $\leq$ Biological maturity

Assessment is concerned with **functional** maturity

Simulation analysis:
Examine misspecified maturity estimation effects on spawning biomass (can lead to bias in BRPs)

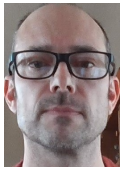
Use results to understand histologically determined maturity samples for sablefish in Alaska waters



Simulation - Design

Design:

- Length, weight, and probability of being mature at age from the 2020 SAFE
- Numbers at age and year, fishery selectivity, M, and F from the 2020 SAFE
- 10,000 Bernoulli random variables generated for each age
  - Maturity status: 1 = mature, 0 = immature
  - Skip spawning: 1 = skip spawn, 0 = maturity status
- Skip spawning at 2, 5, and 10% rates, also increasing rates with age
  - Age groups: young (1-12) , mid(5-22), old (20-50)
- Examine impact to spawning biomass for multiple recruitment types



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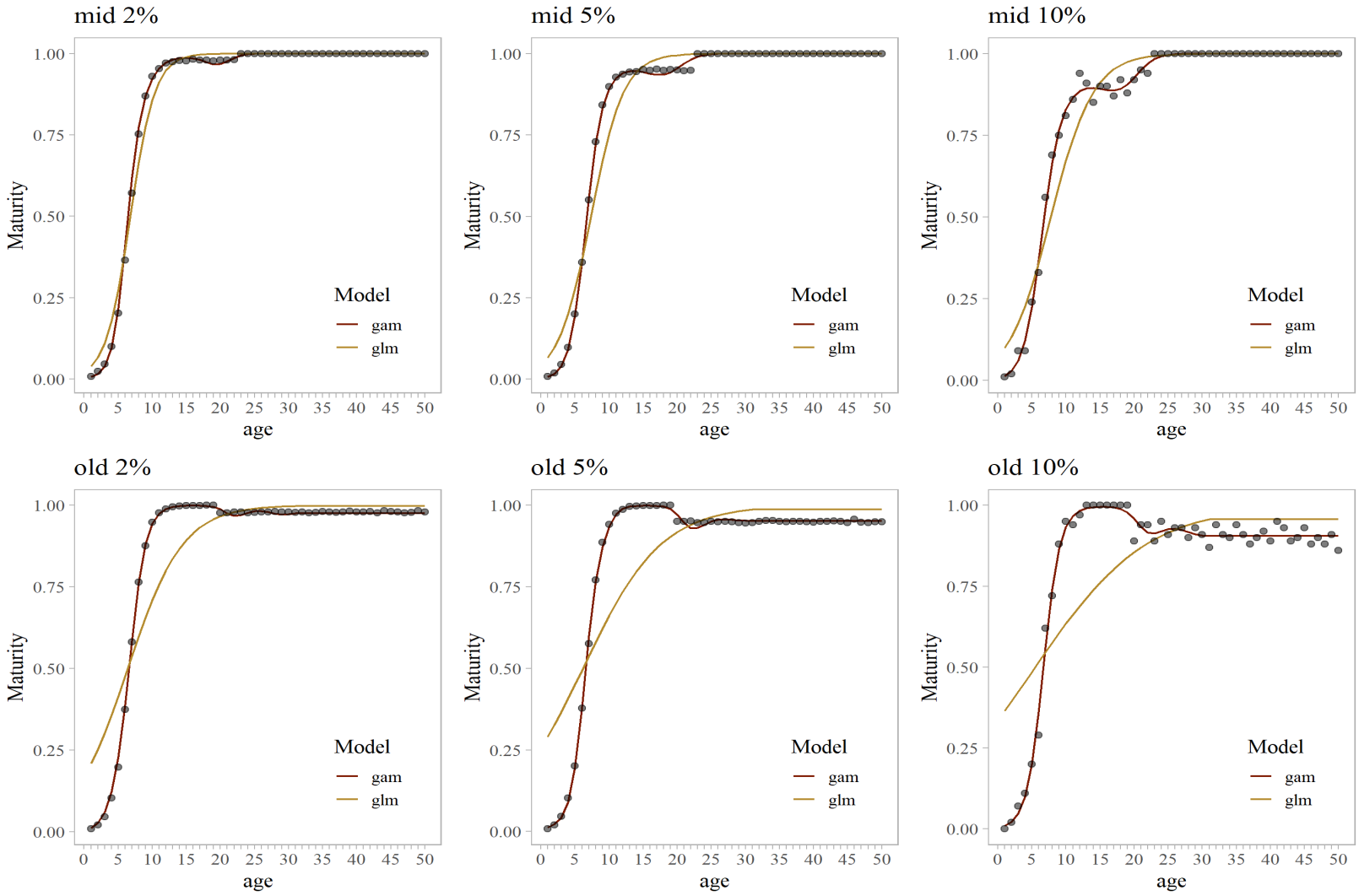
Simulation - Results



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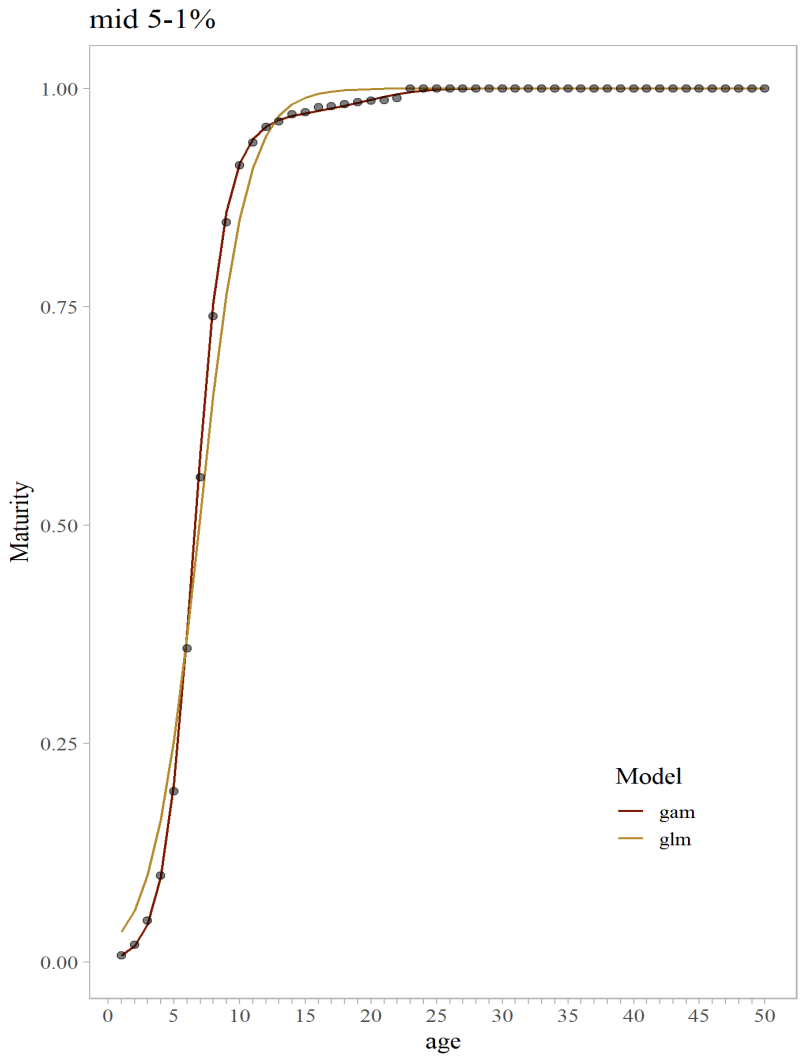
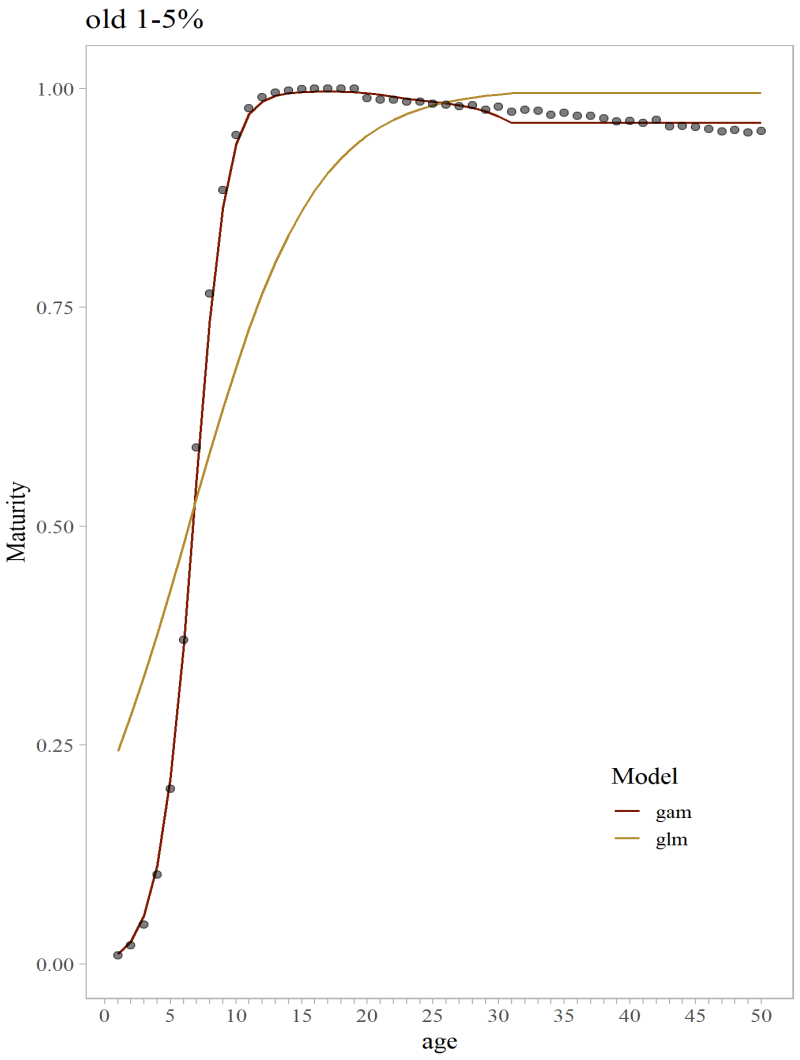
Simulation - Results





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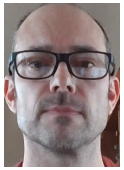
Simulation – Maturity Diagnostics

- Increasing error from GLM with increasing % skip spawning
- If maturity curve is unrealistically high at youngest ages, there is likely unaccounted for skip spawning (or sampling issues)
- GLM performs very poorly if older fish are skip spawning

- GAM can greatly improve the accuracy of the maturity curve



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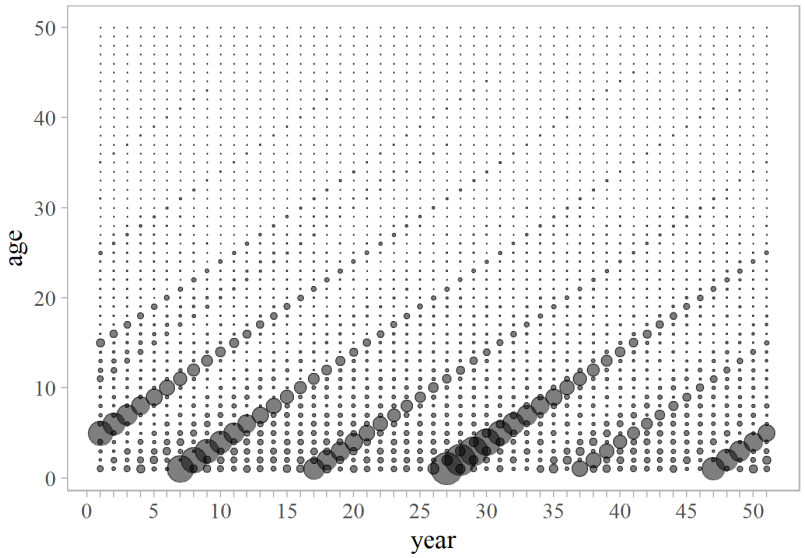
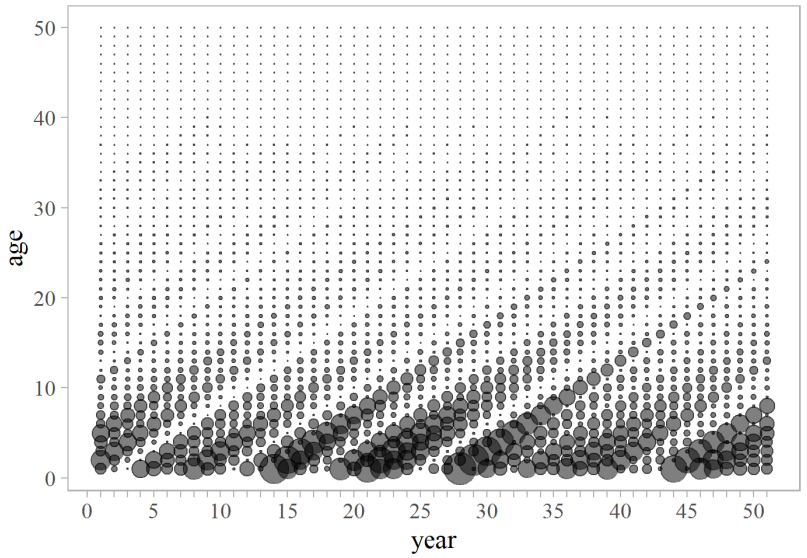
Simulation - Results

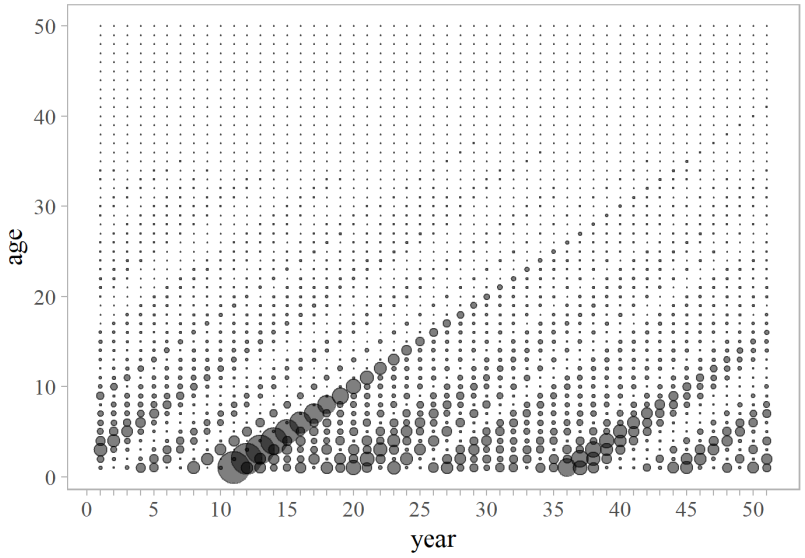
Cyclical



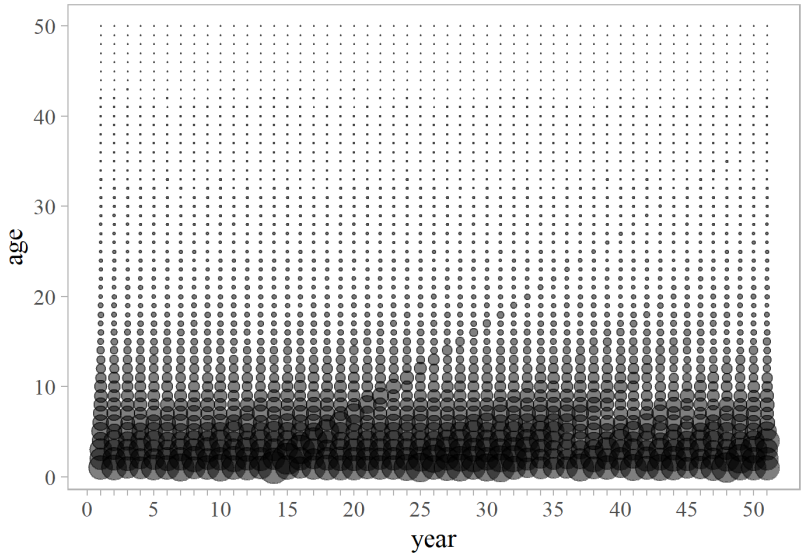
Irregular



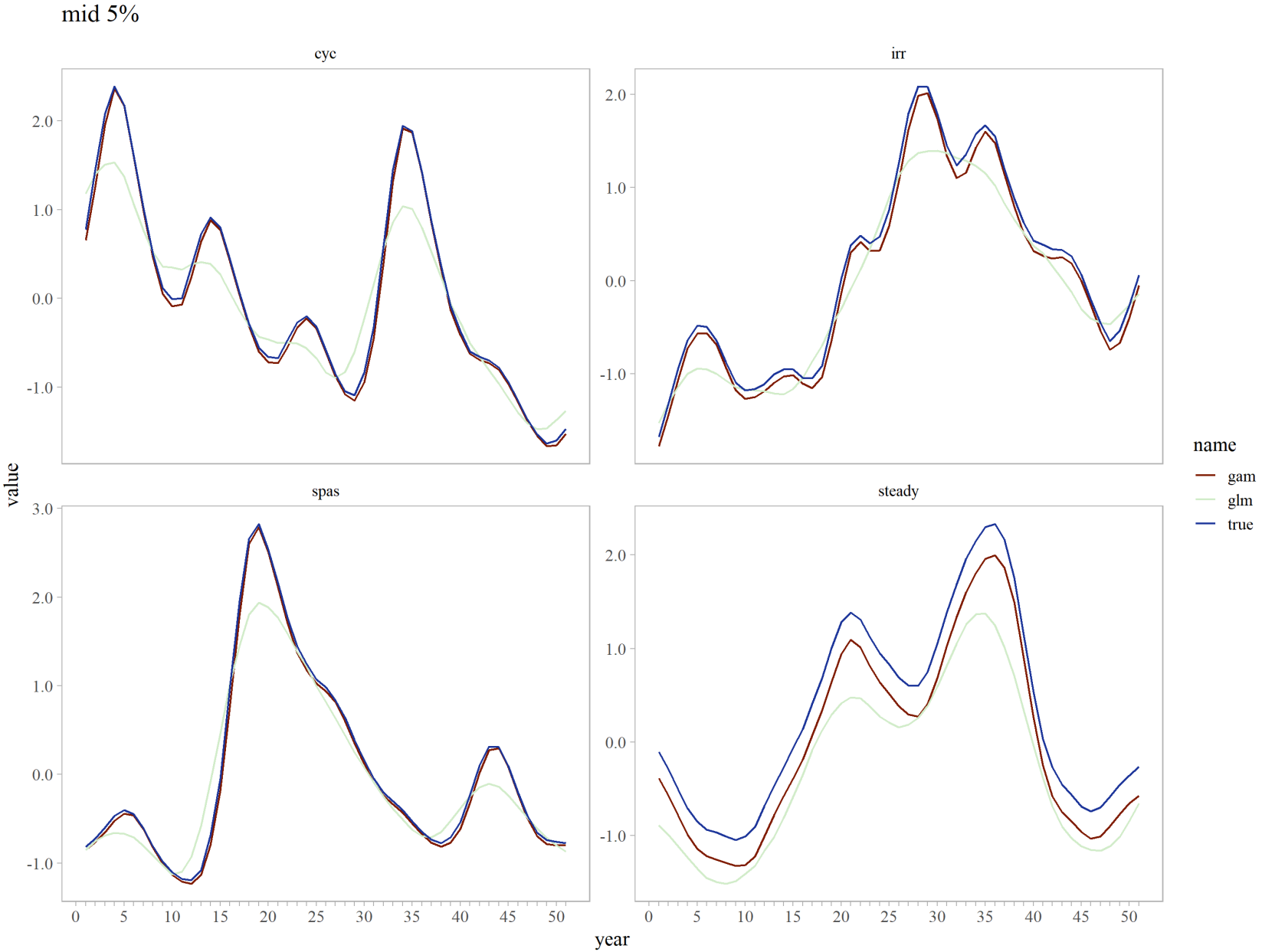
Spasmodic



Steady



Simulation - Results



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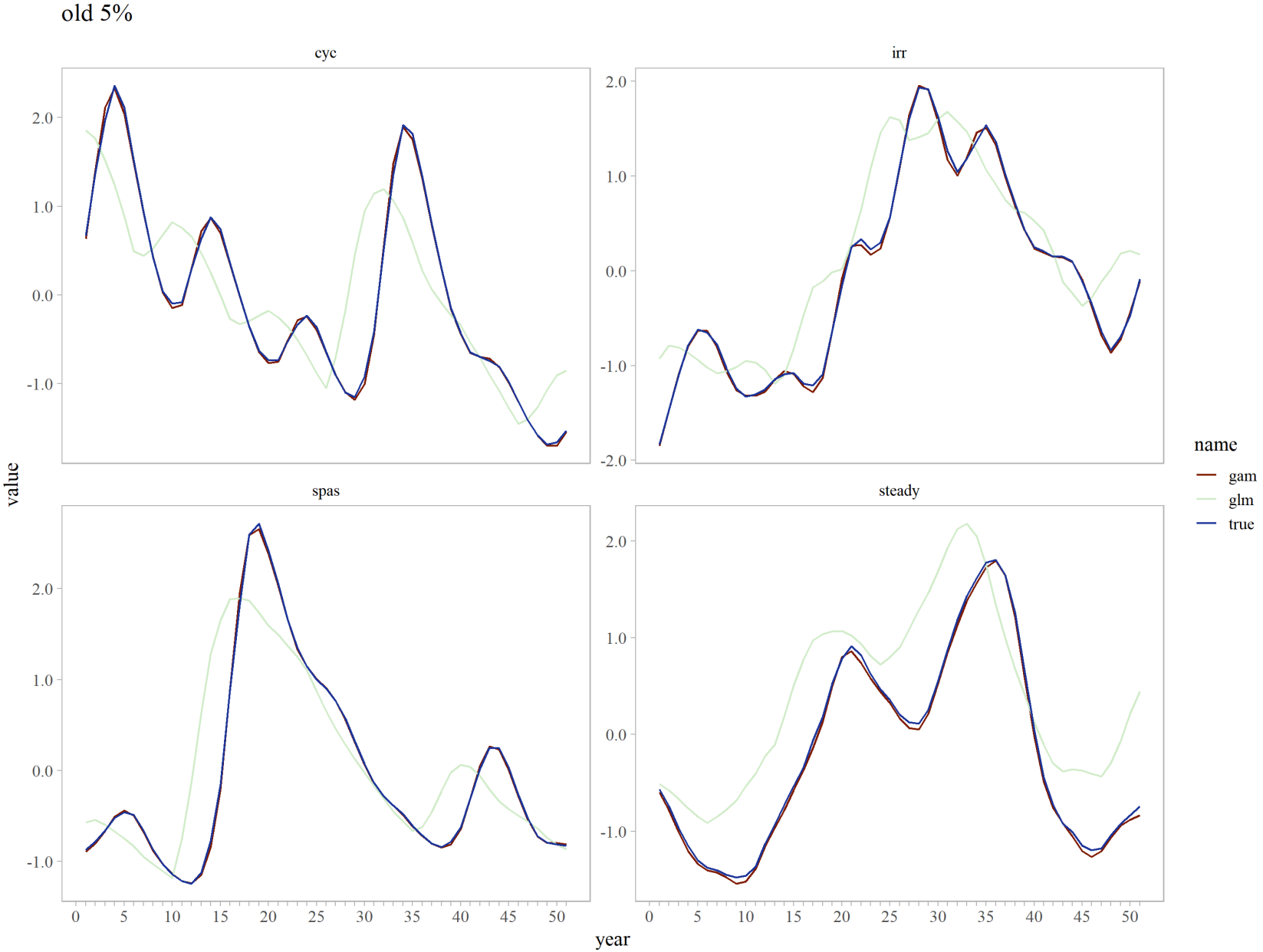

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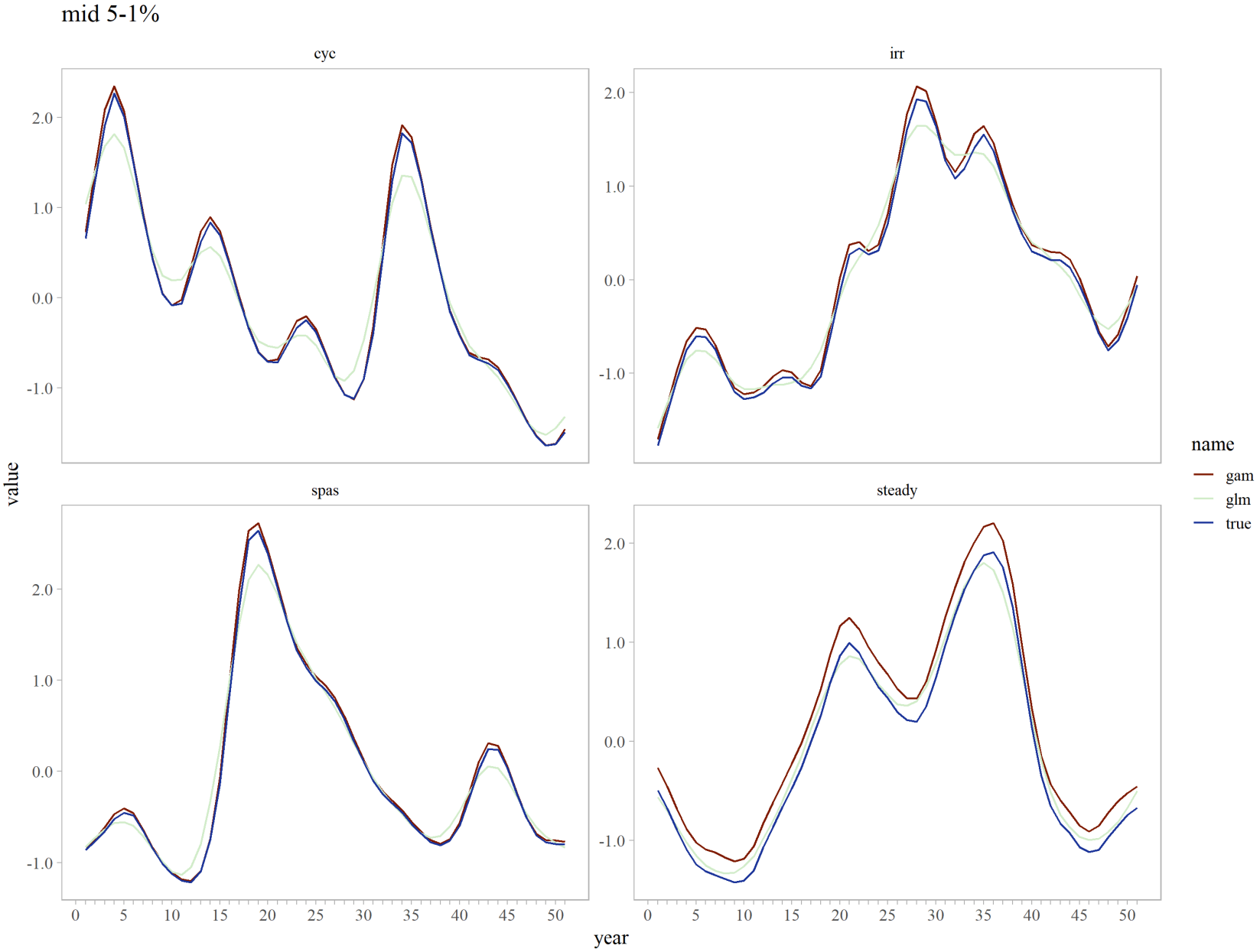

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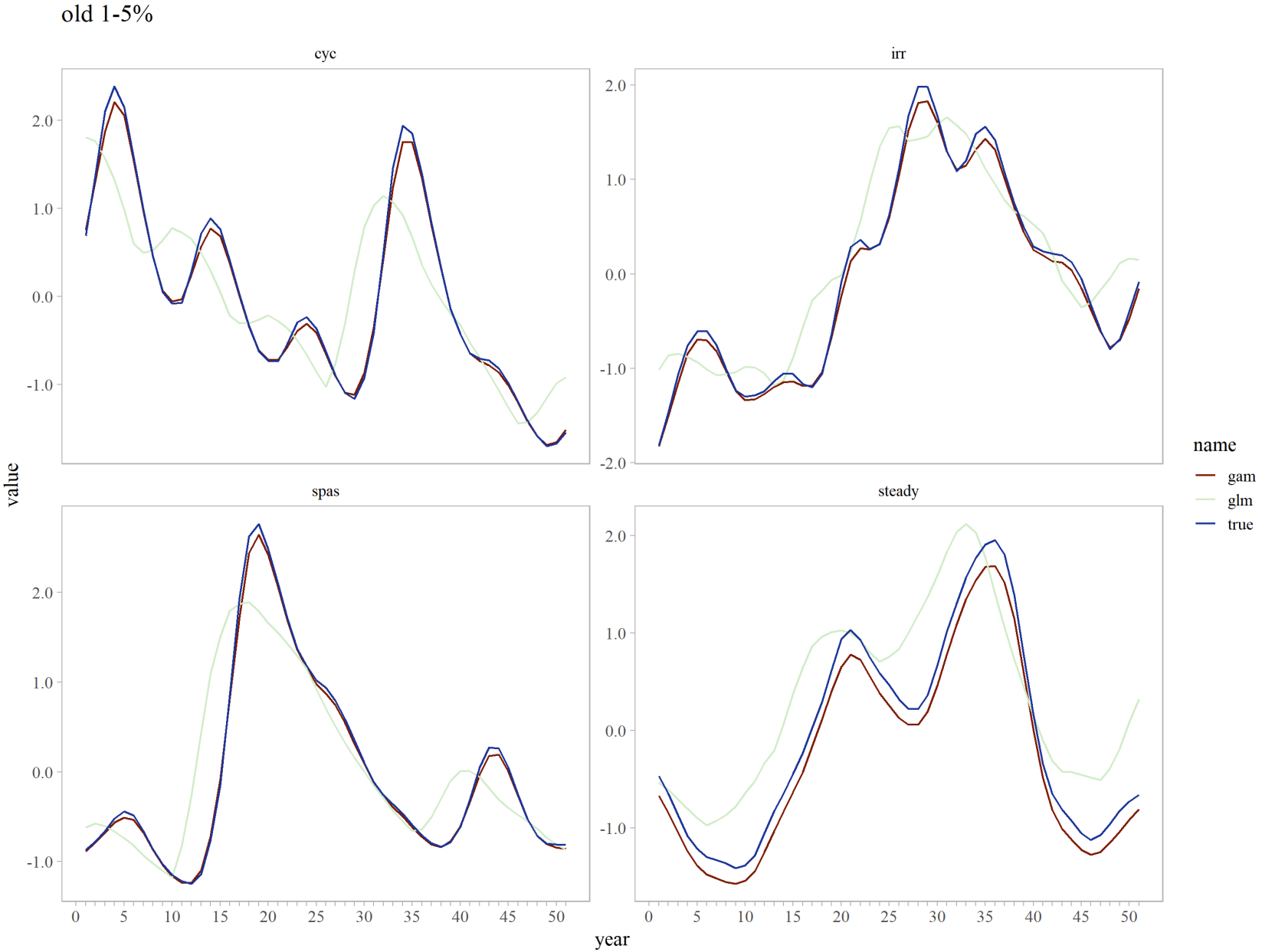
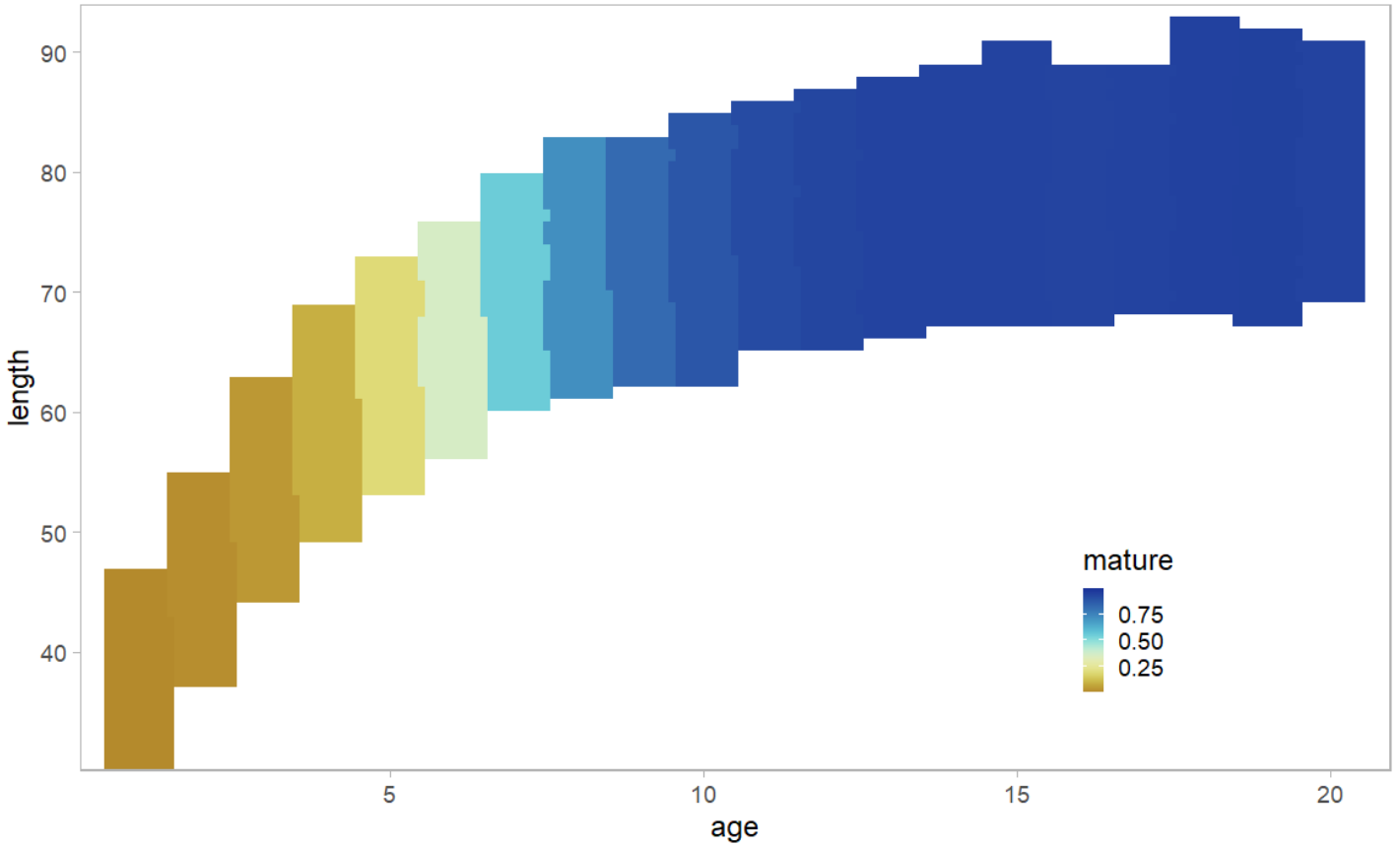


Age-based maturity



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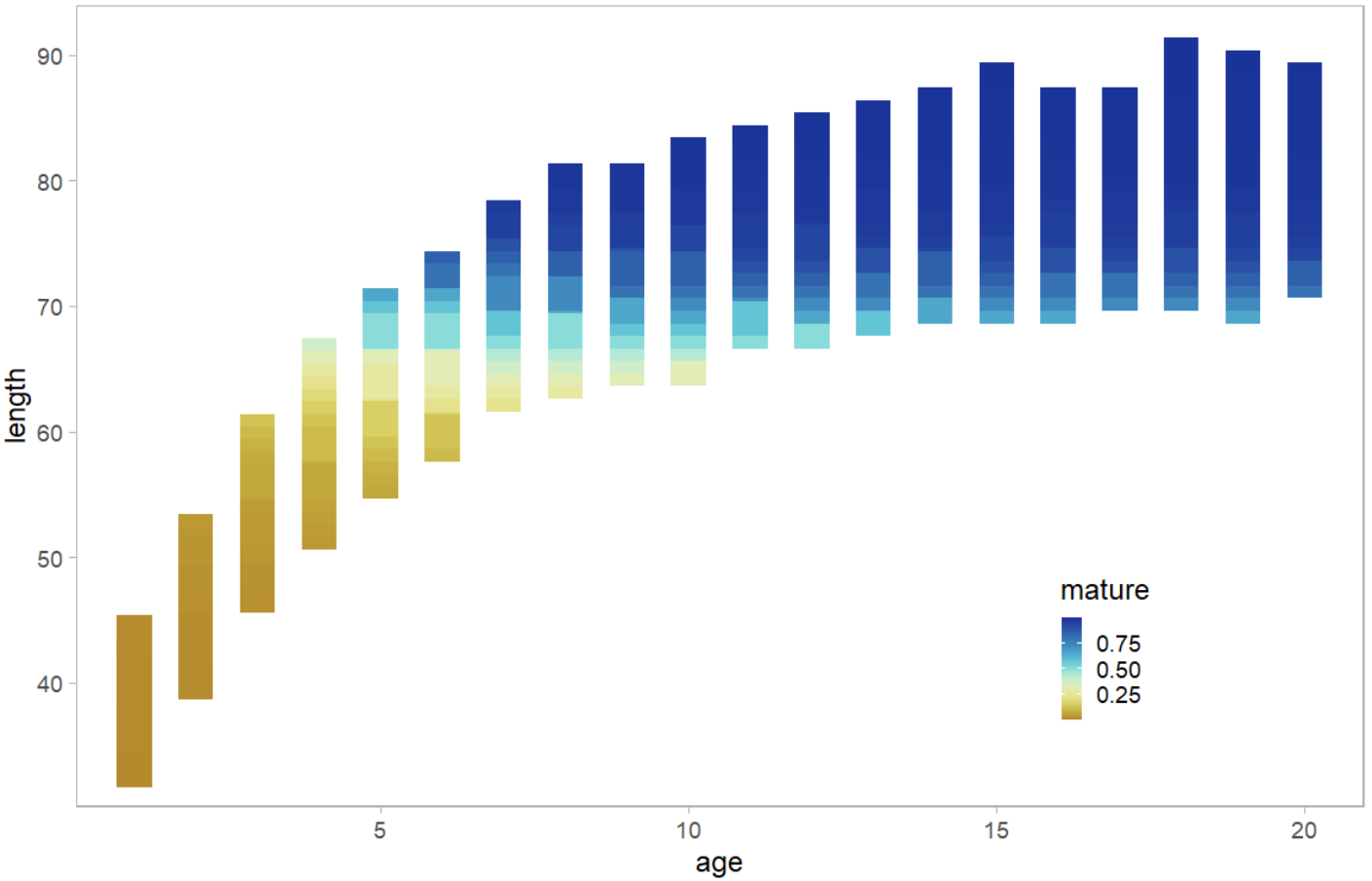
Length-based maturity



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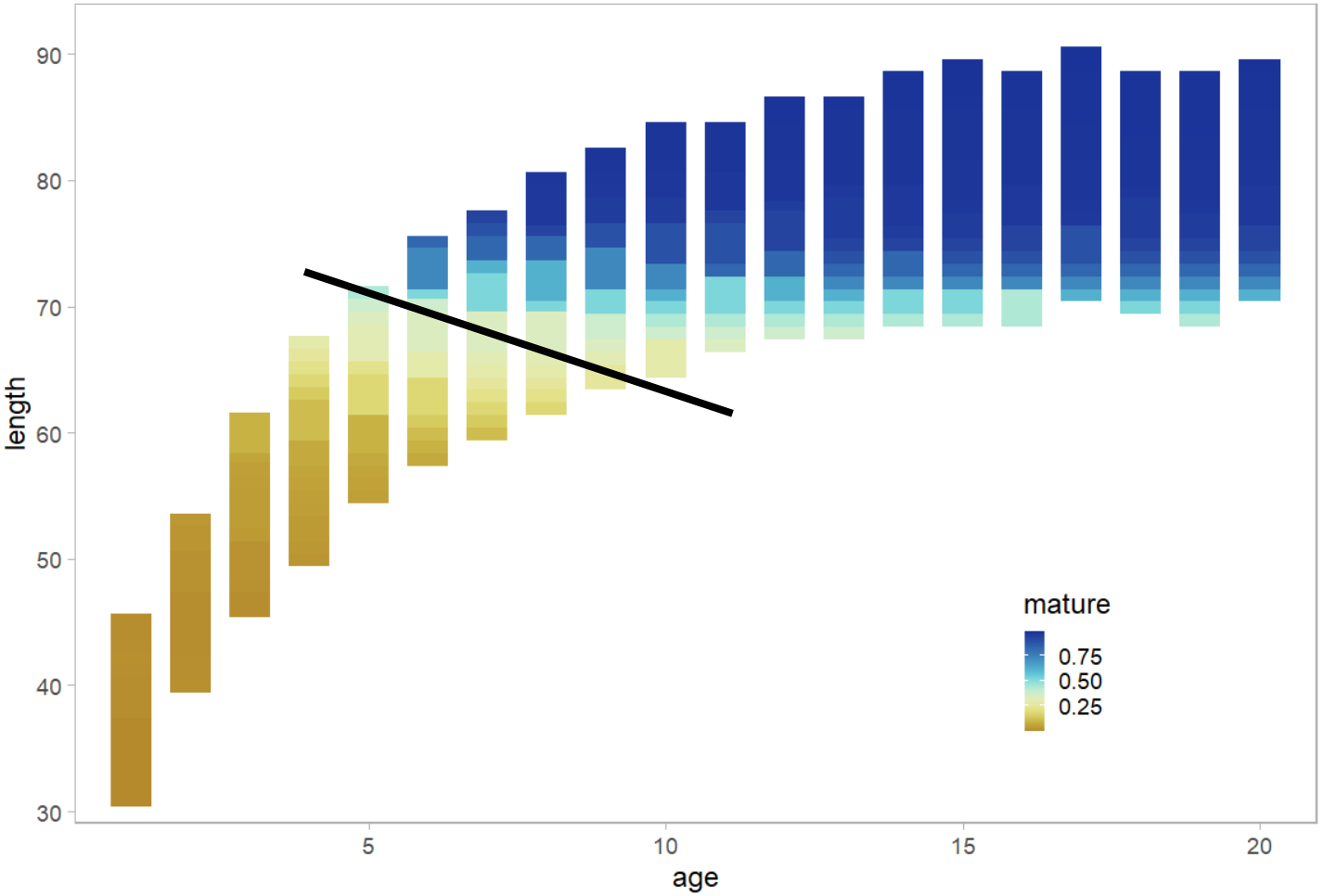
Age/length-based maturity



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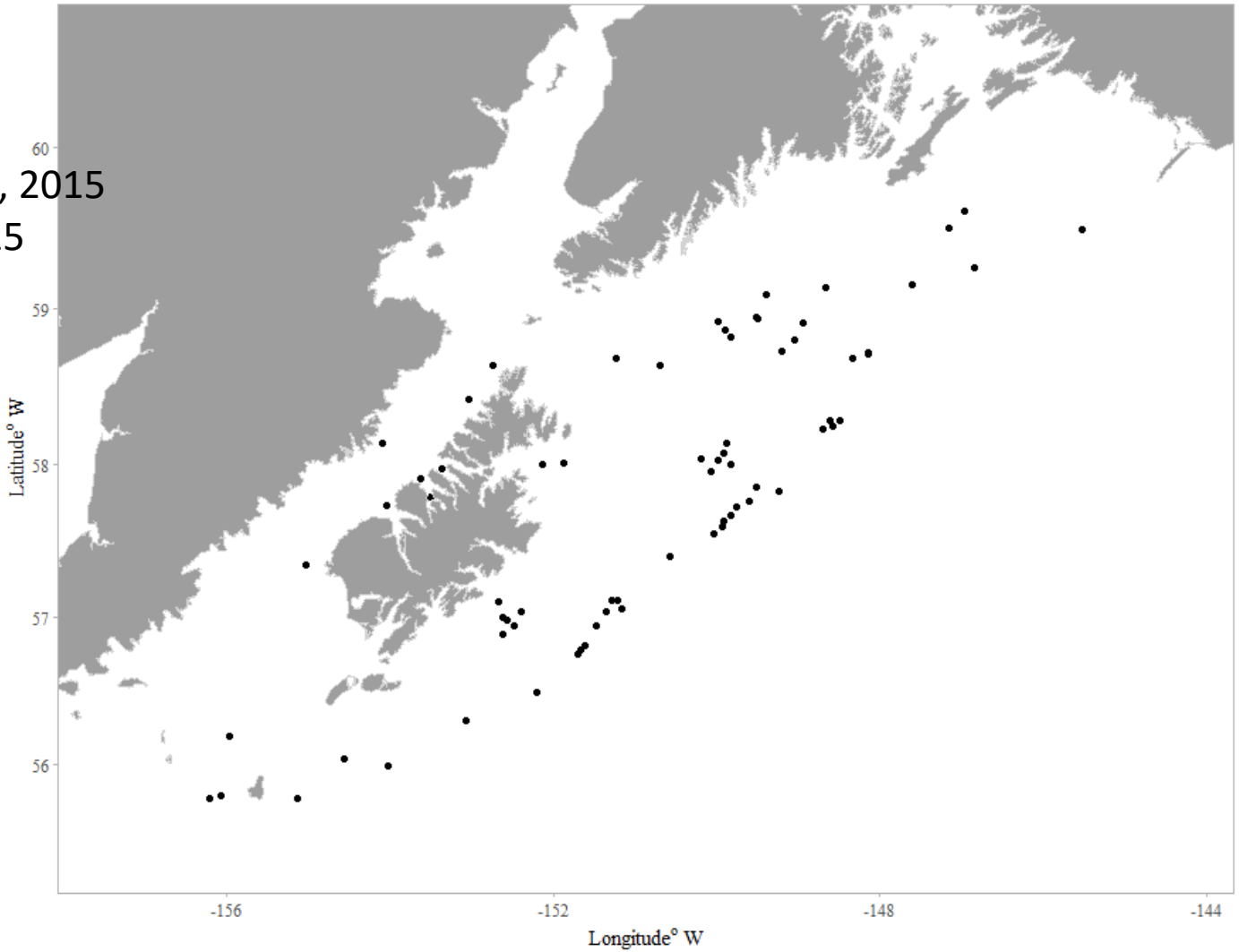
Sablefish - Maturity

Collections:

- Winter 2011, 2015
- Summer 2015



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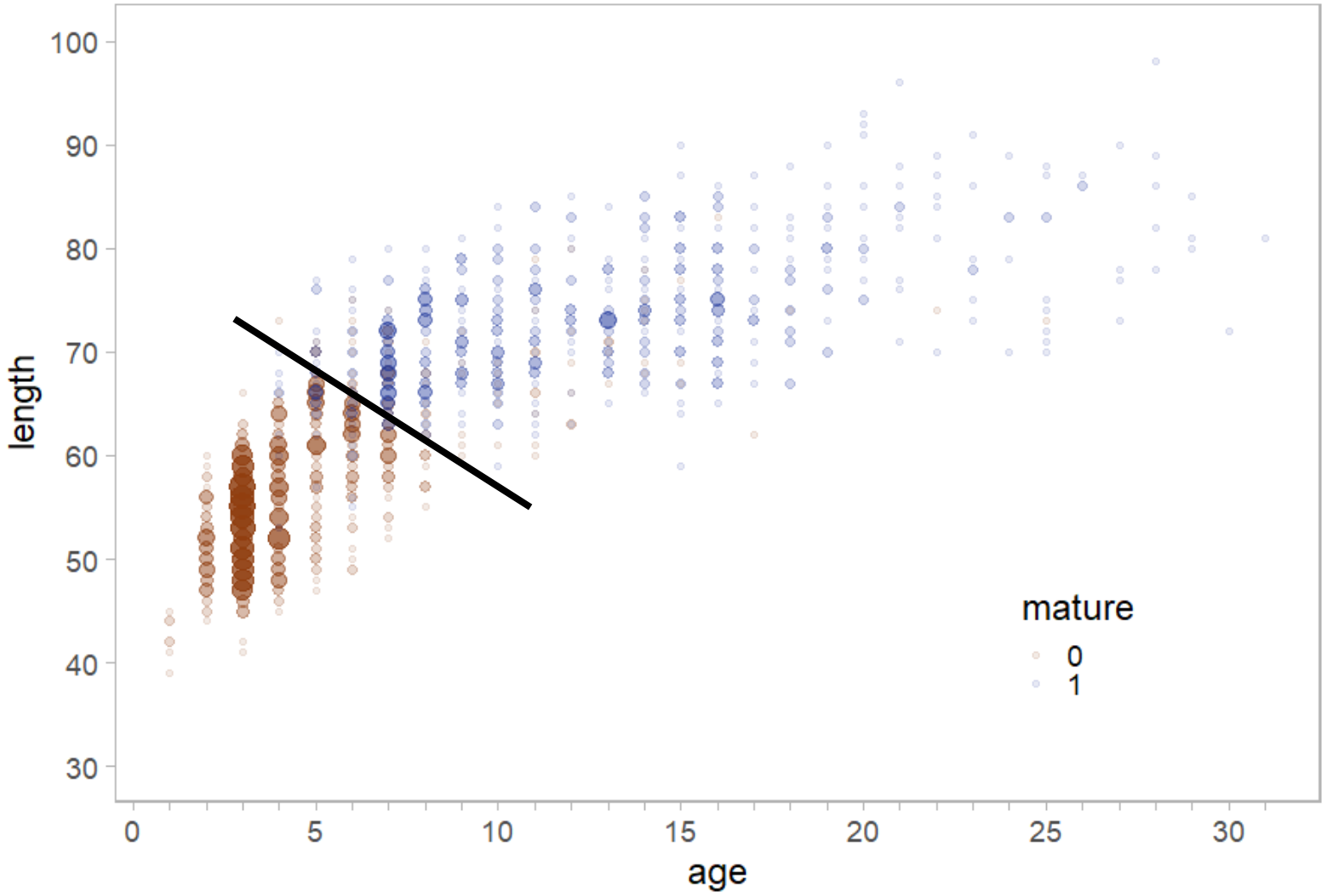
Sablefish - Maturity



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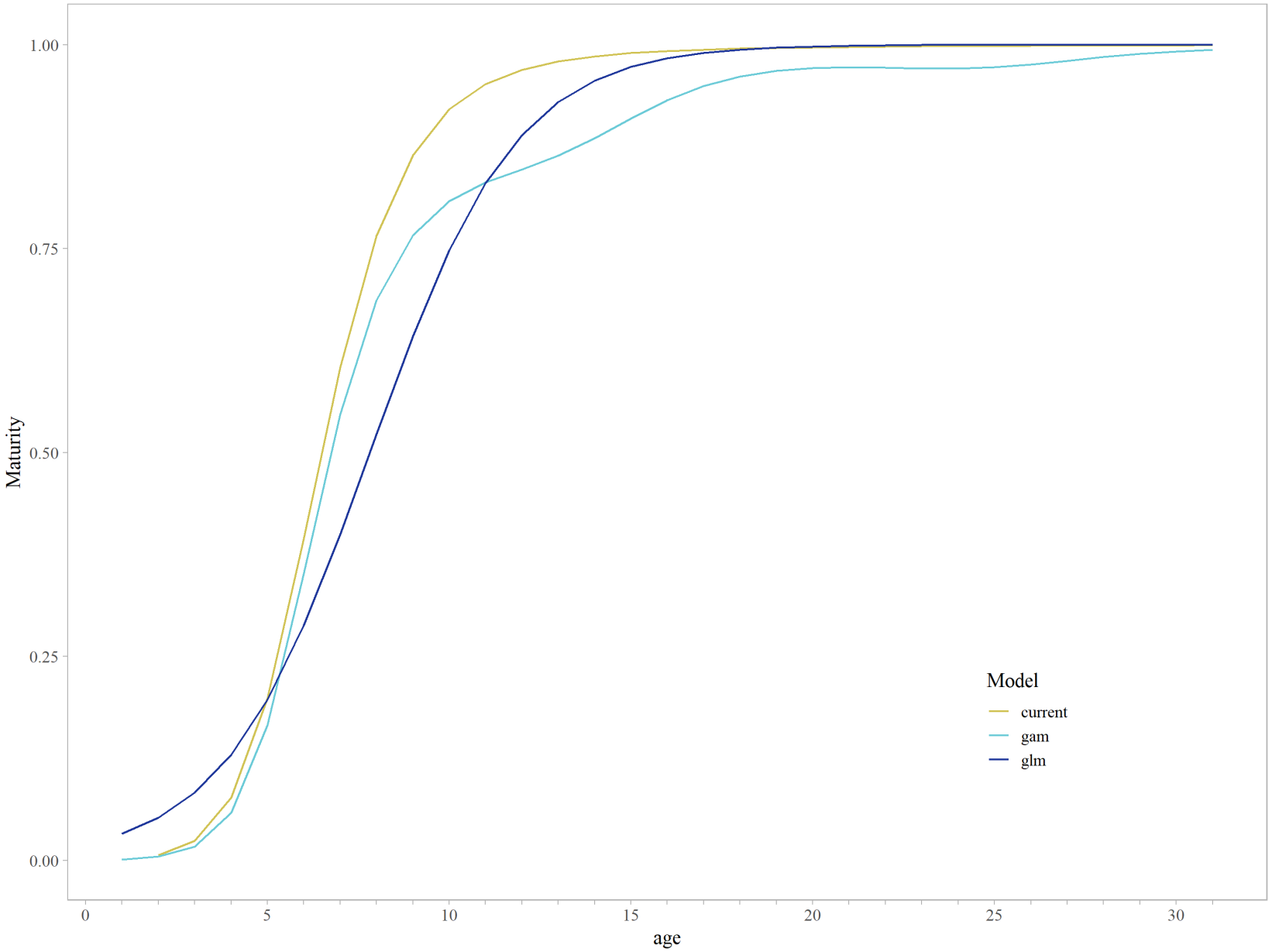
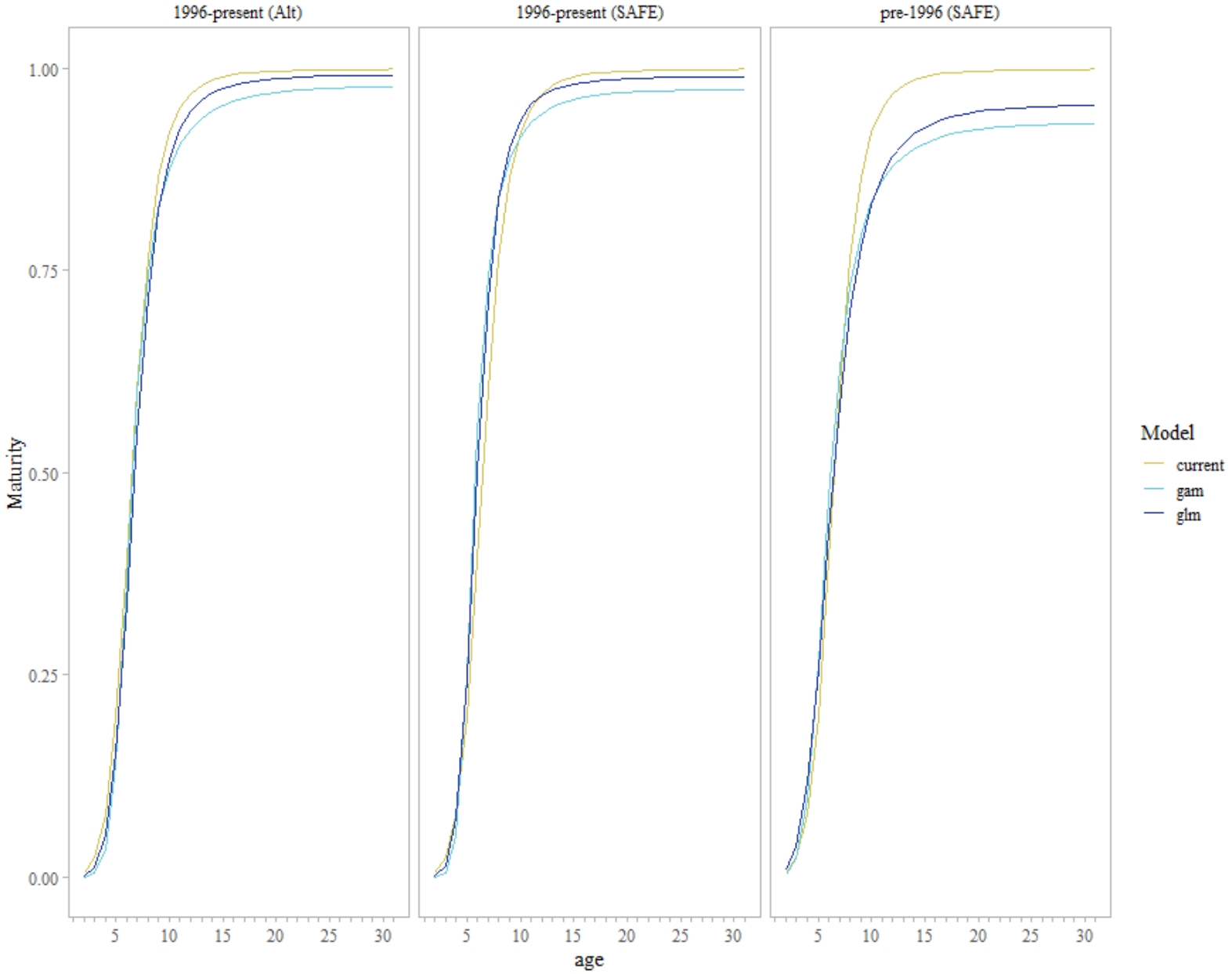
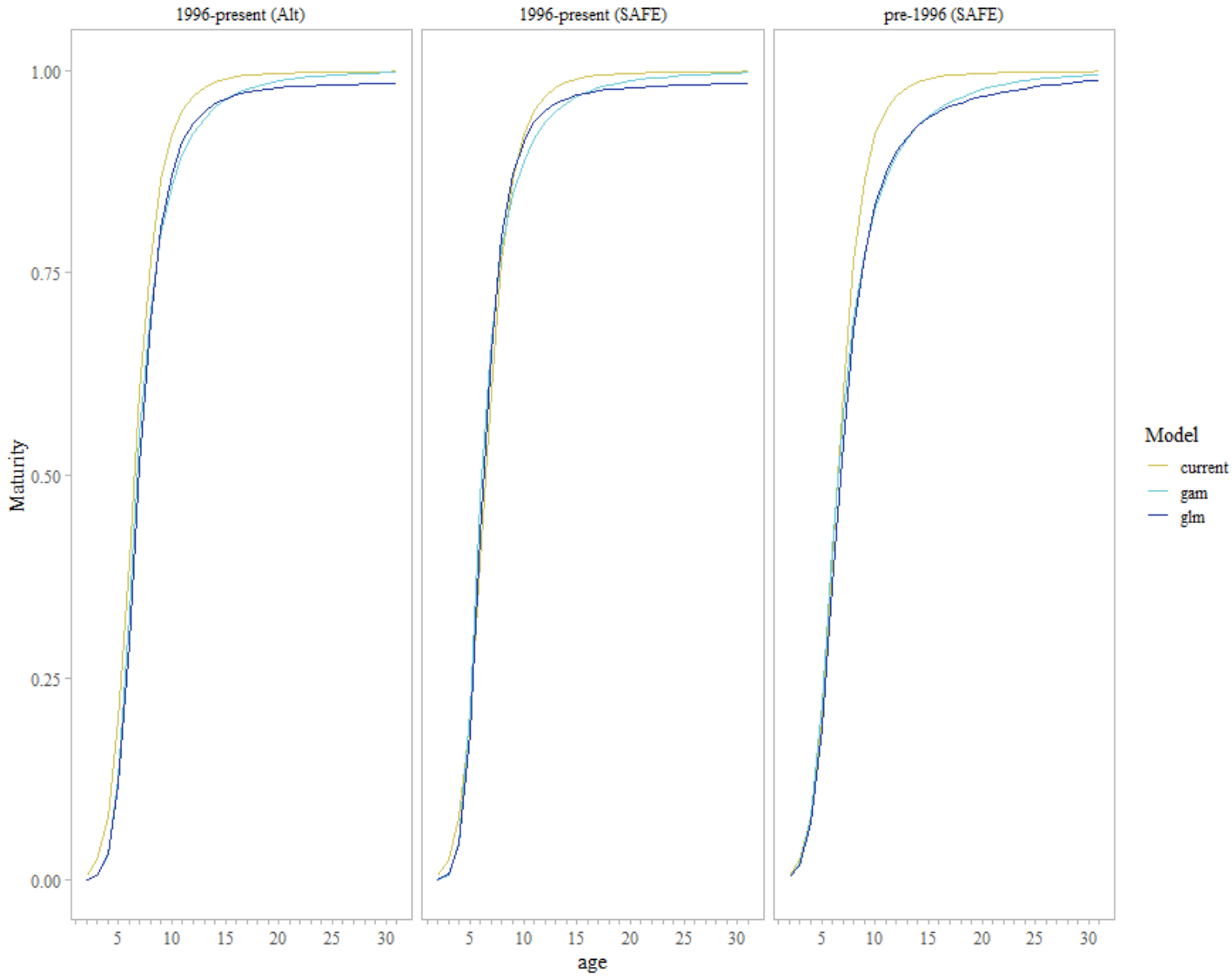
Sablefish: Age-based maturity



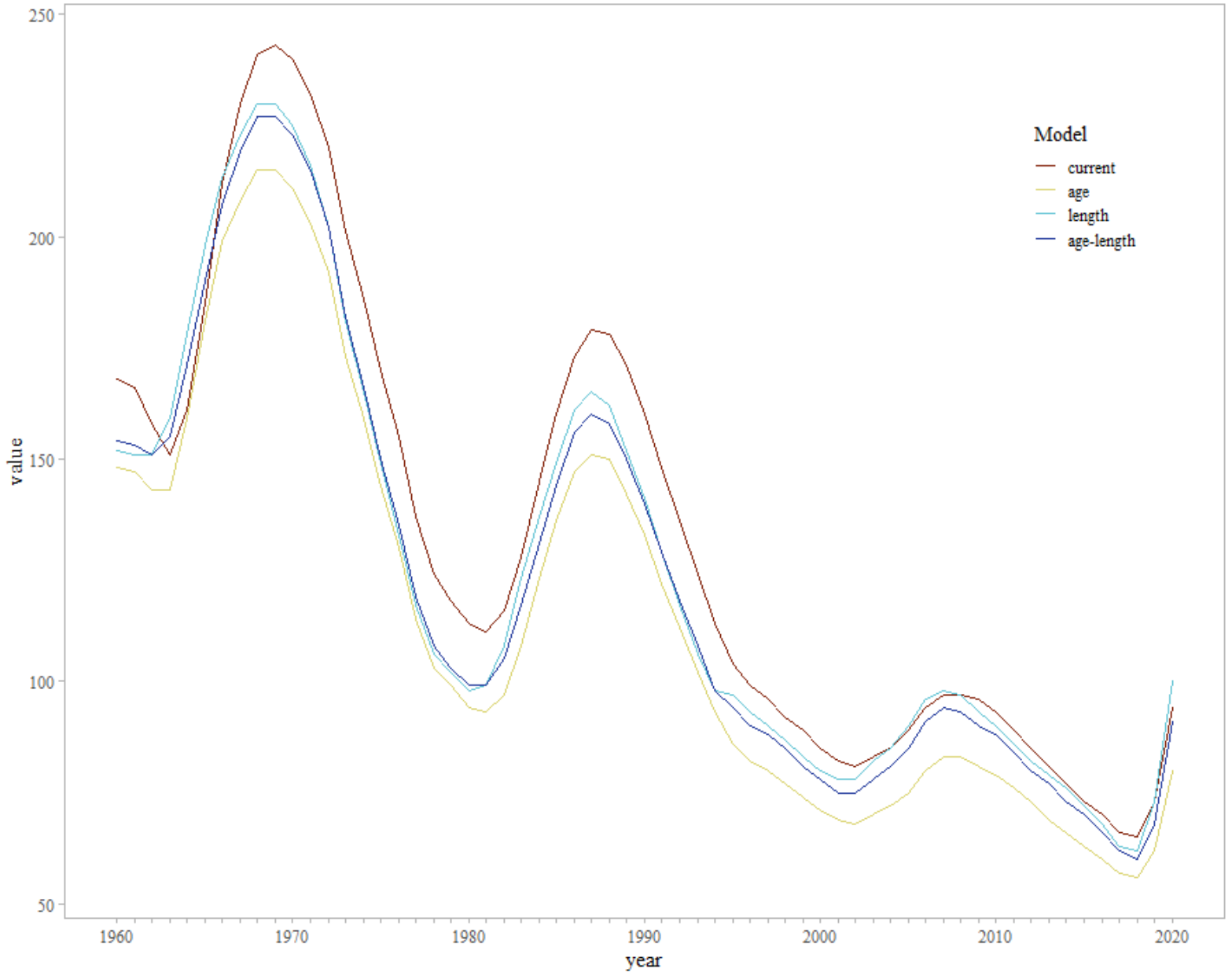
Sablefish: Length-based maturity



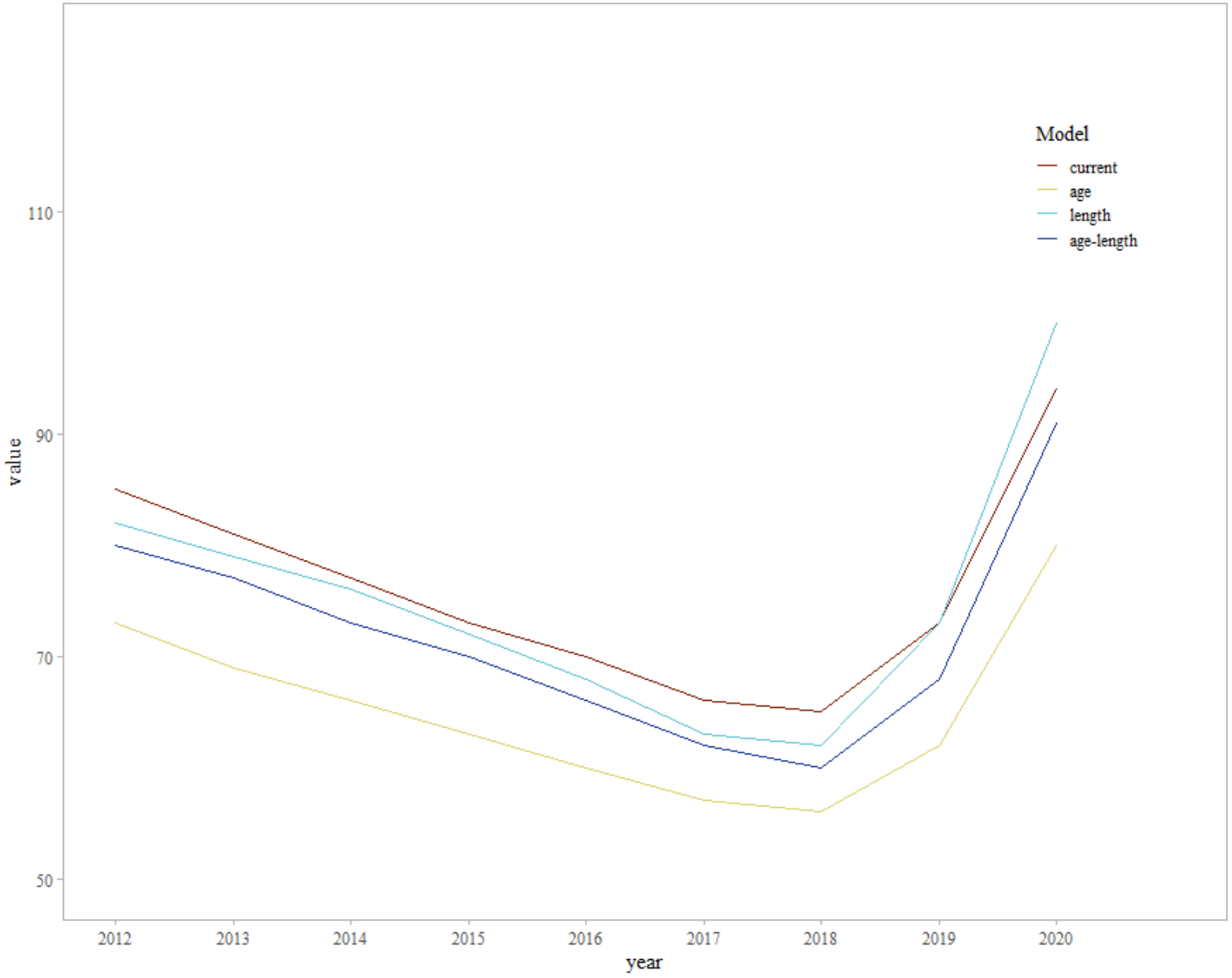
Sablefish: Age/Length-based maturity



Analysis - SSB

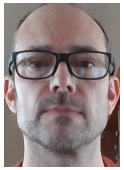


Analysis - SSB



Analysis – SSB Differences

Year	SSB (KT)				% difference		
	Current	Age	Length	Age/ Length	Age	Length	Age/ Length
2016	70	60	68	66	15.4	2.9	5.9
2017	66	57	63	62	14.6	4.7	6.3
2018	65	56	62	60	14.9	4.7	8.0
2019	73	62	73	68	16.3	0.0	7.1
2020	94	80	100	91	16.1	6.2	3.2



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Recommendations

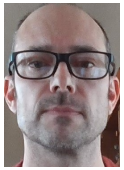
1. Accept **functional** maturity curve
2. More research on spatial & temporal aspects of skip spawning

Pros:

- Contemporary estimates of maturity based upon histology
- Accounts for skip spawning, which GLM cannot do accurately
- Direct age-based estimates, as opposed to length converted to age
- Maturity is an integration of numerous biological processes – not best described by age

Cons

- Changes to assessment?
- Limited data (2 years)
- No accounting for spatial or temporal changes (data-limited)
  - Sasaki 1985 covers a broader spatial area – but location was not part of the maturity analysis



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Questions?

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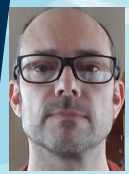

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