Incorporating dynamic fleet structure in stock assessment models: Accounting for a rapidly developing pot fishery for Alaska sablefish (*Anoplopoma fimbria*)

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Western Groundfish Conference

Acknowledgements

- Cunningham Lab
- North Pacific Groundfish and Halibut Observers
- University of Alaska - College of Fisheries and Ocean Sciences
- Sablefish harvesters and stakeholders
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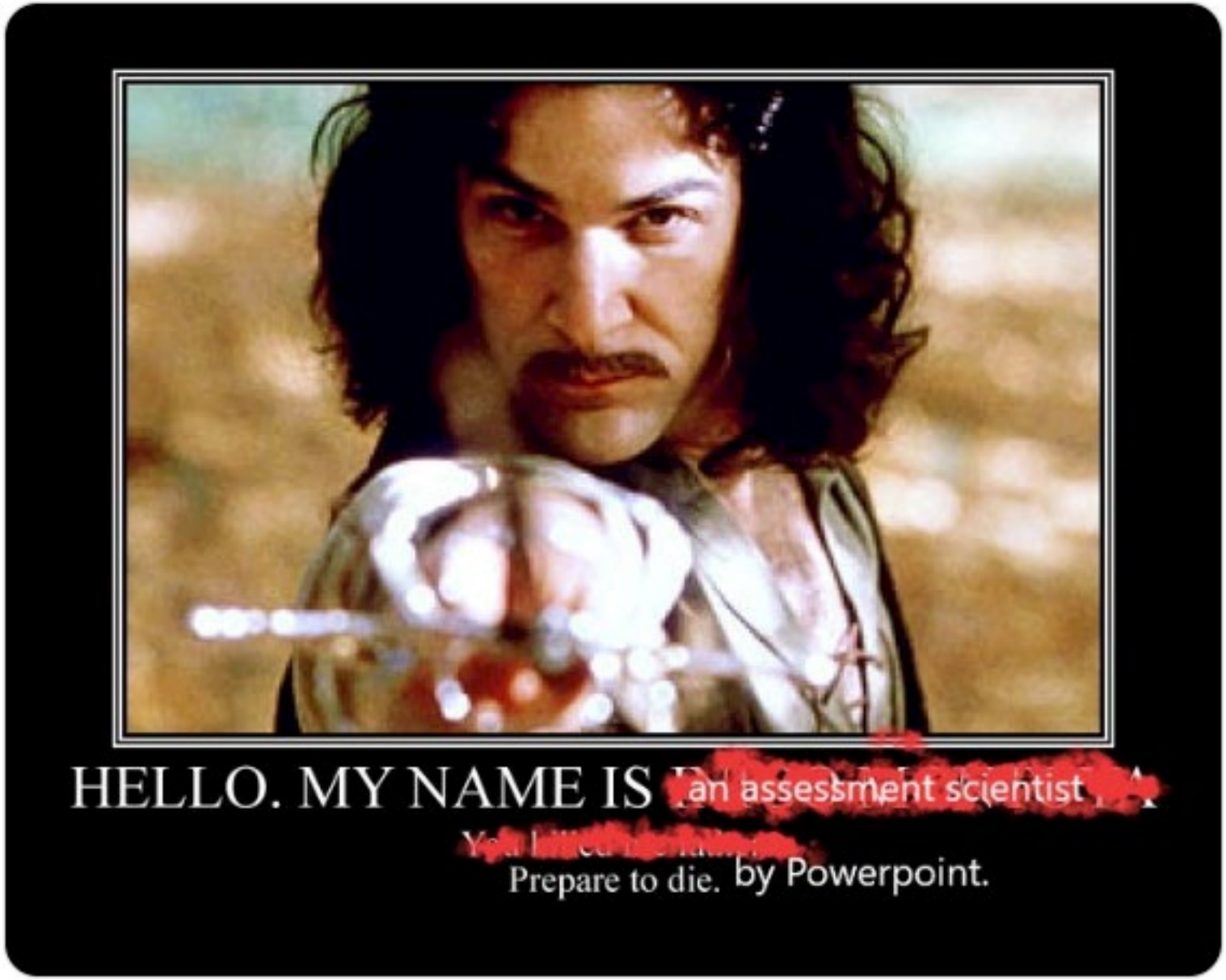

HELLO. MY NAME IS
an assessment scientist
Prepare to die.
by Powerpoint.

What is stock assessment?

Births

Natural Mortality

Growth

Fishery Processes

- ***Fleet Structure***
- ***Selectivity***

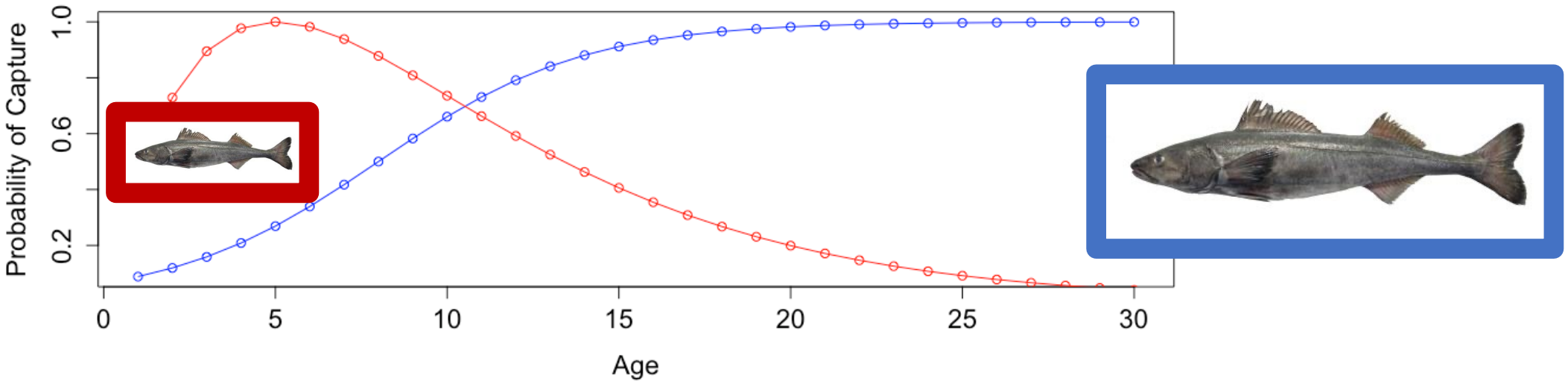
Selectivity and Fleet structure

Fleet Structure

- Groups of vessels that share similar characteristics:
  - Similar gear types
- Fleets have own selectivity pattern

Selectivity

- Probability of capturing an individual given length or age
- Combination of:
  - Gear selectivity
  - Availability



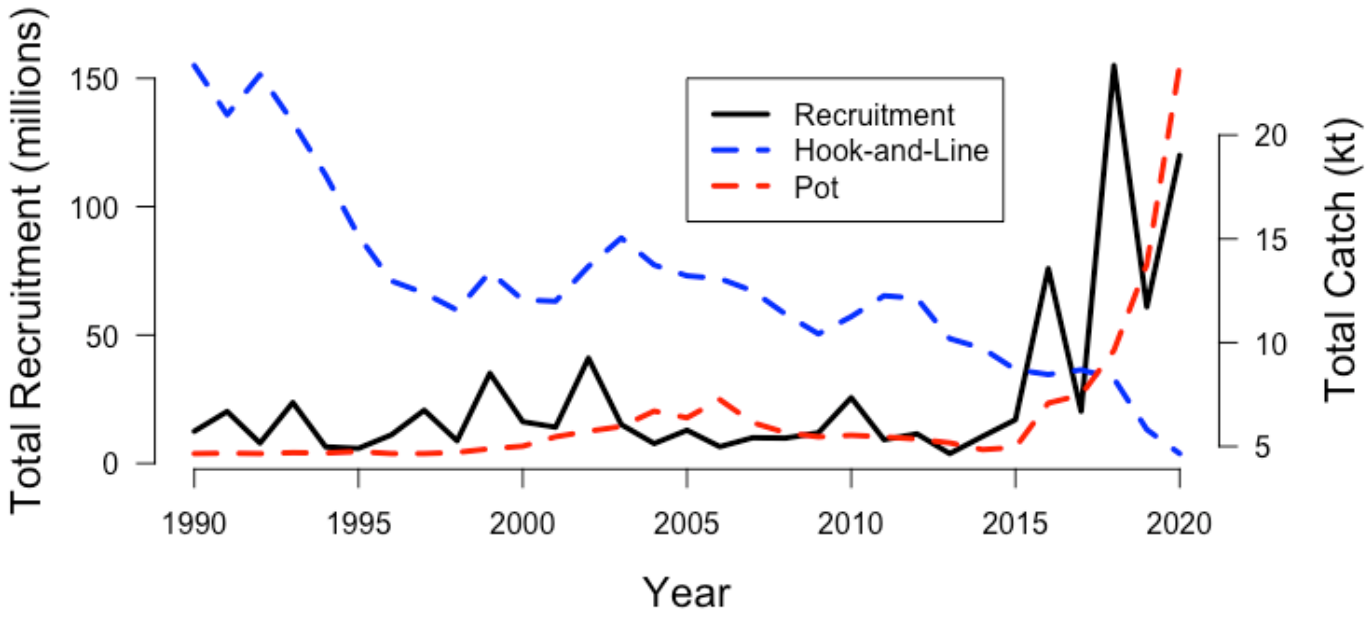
Why care about fleet structure and selectivity?

- Misrepresentation of fishery processes can severely bias management reference points
  - e.g., treating these processes as static
- Most fishery processes change over time!

Case-study Example

- Alaska Sablefish (*Anoplopoma fimbria*)

The Saga's New Haul: Black Cod? | Deadliest Catch



December 10, 2019

Hot for pots: Alaska longliners advocate for new gear

by Jessica Hathaway in Alaska, News

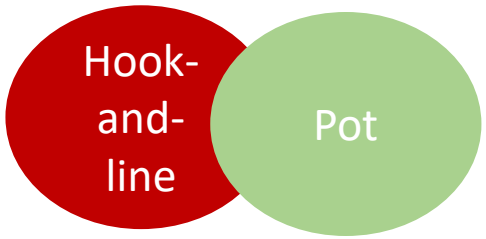
How do we deal with this?

Current Approach

(Combined)

1) Treat data from hook-and-line and pot gear as one fleet

- Selectivity varies (time-block) to account for pot regulatory shift

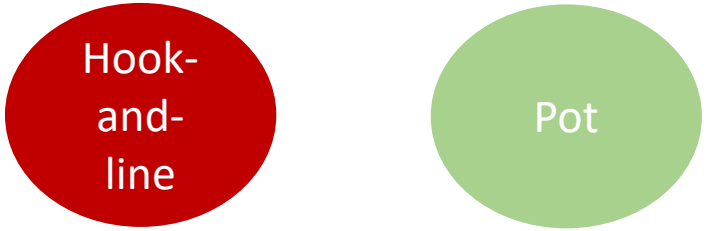


Potential Approach

(Disaggregated)

2) Treat data from hook-and-line and pot gear as two fleets

- Each fleet has its own selectivity



*Unclear if current approach is adequate

Objectives

Compare model variants and investigate implications of:

1) addition of a new pot fishery fleet

2) assumed fleet selectivity (i.e., logistic or dome-shaped)

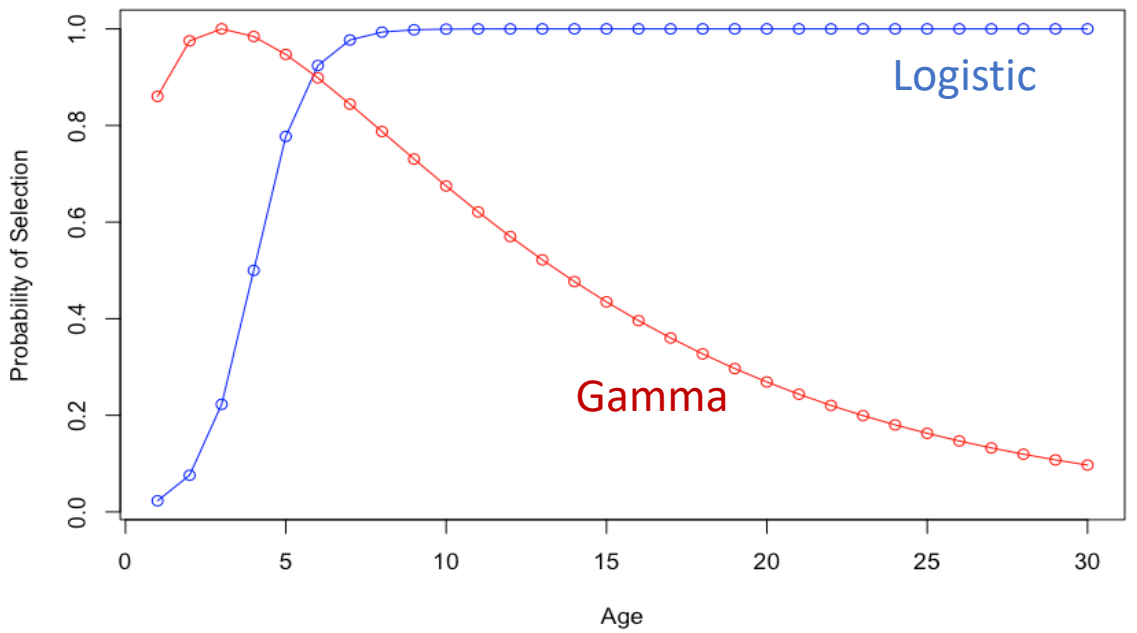
Study Design

- Sex-and age-structured assessment model

- Evaluate models based on:

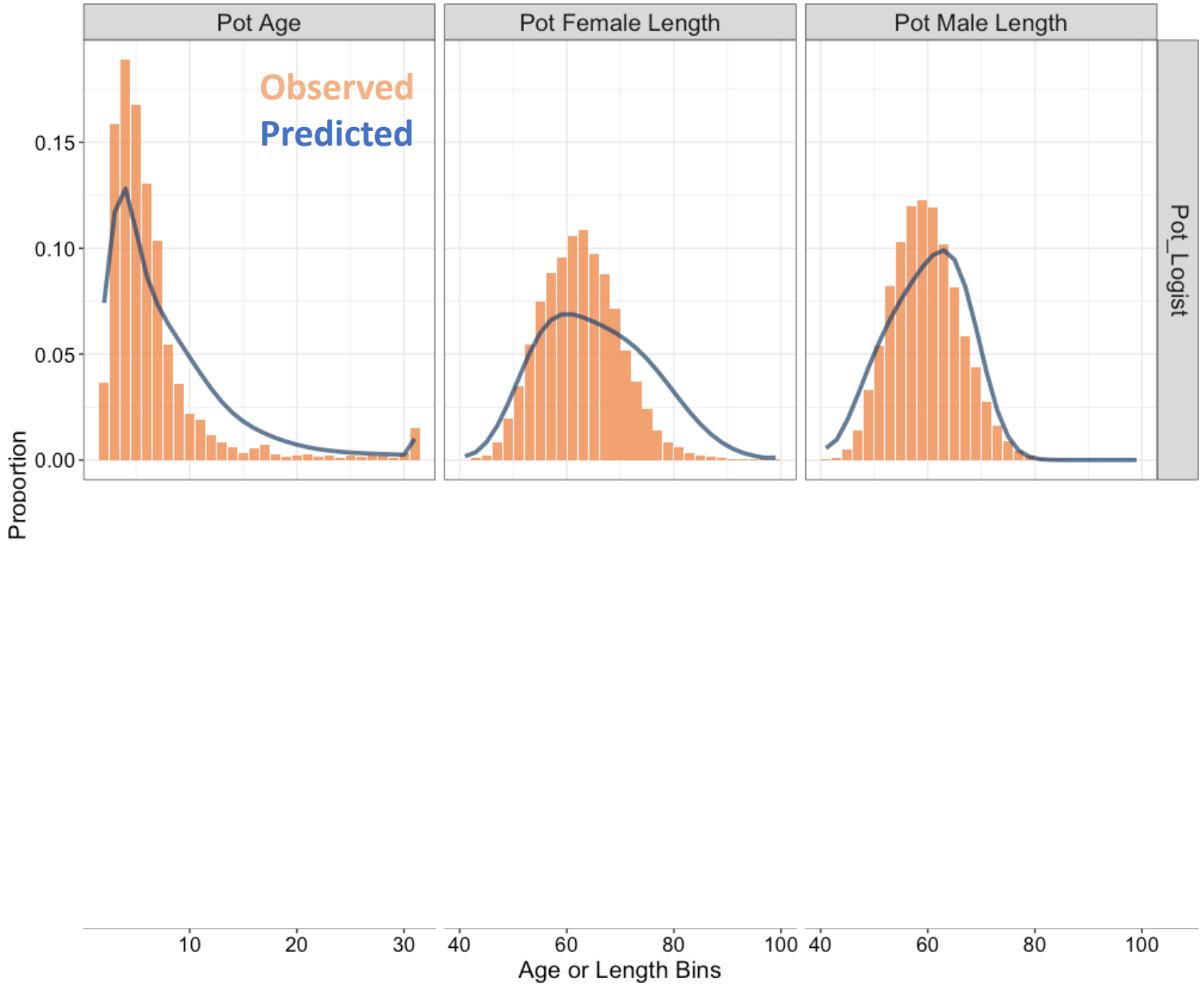
1) Model fit
2) Key management quantities
3) Expert judgement

Model Name	Fleet Structure	Selectivity	Time-variation in selectivity
Comb_Logist (Status-quo)	Combined	Logistic	Time-block
Pot_Logist	Disaggregated	Logistic	None
Pot_Gamma	Disaggregated	Gamma	None



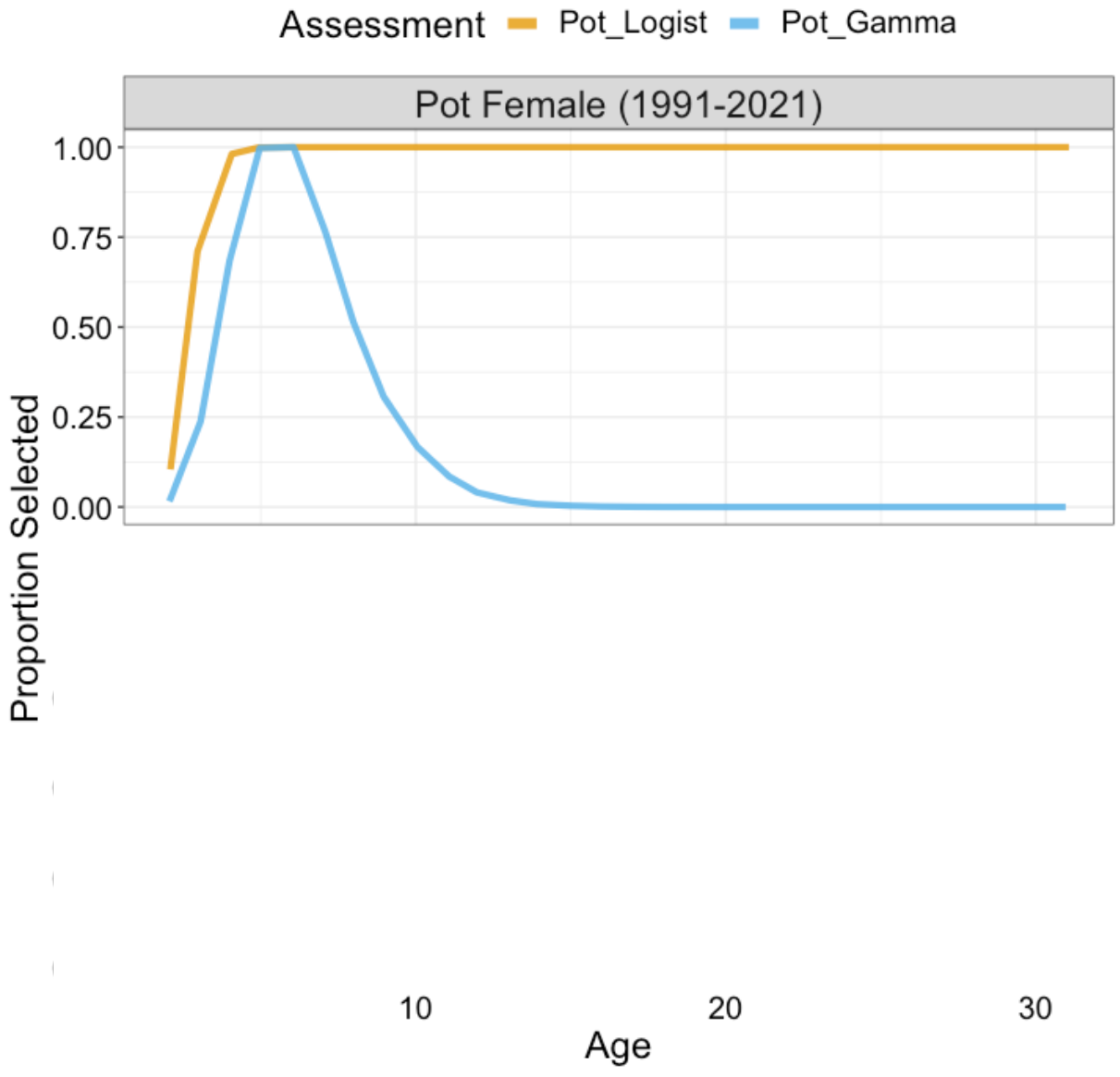
Model Fits to Compositions

Logistic selectivity doesn't fit data well



Gamma selectivity fits better!

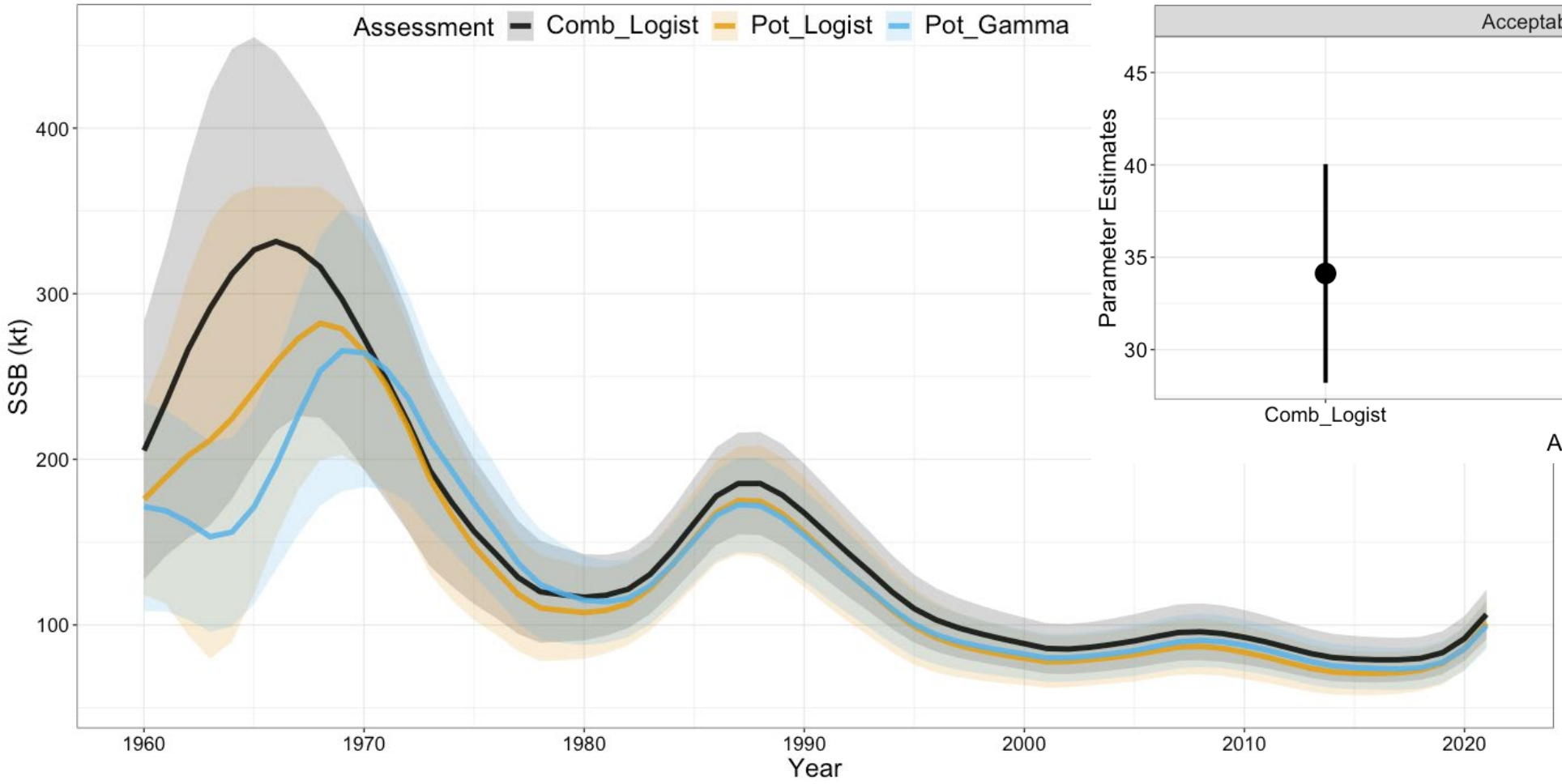
Estimated pot selectivities

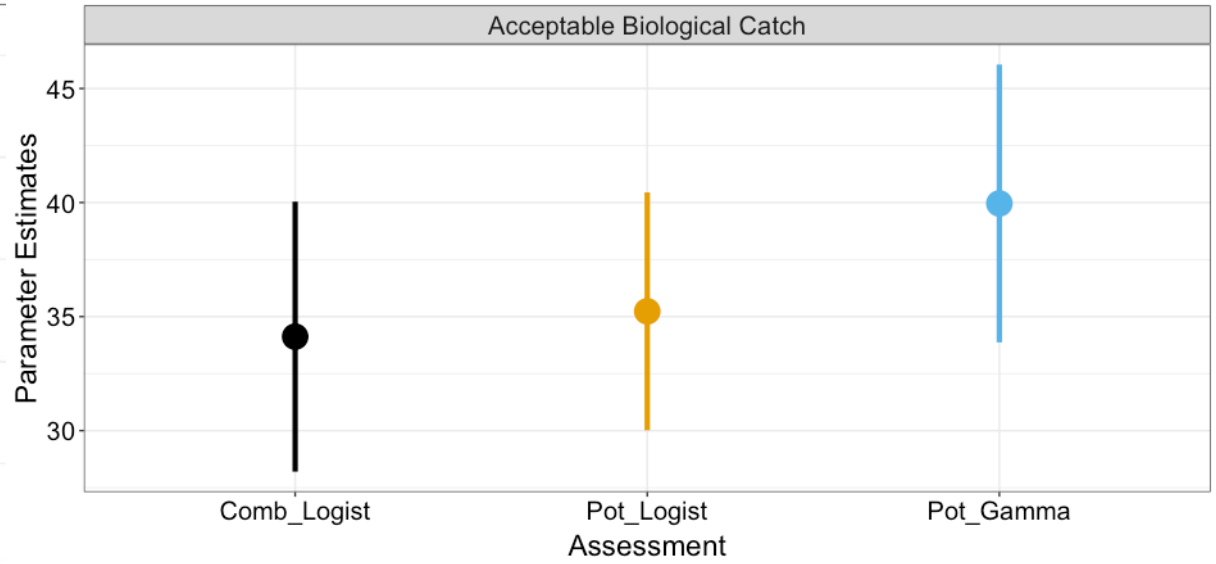


Strong dome-shape estimated for gamma selectivity!

Suspect…

Estimates of key management quantities





But different ABCs?!

Similar Spawning Stock Biomass (SSB) estimates across models

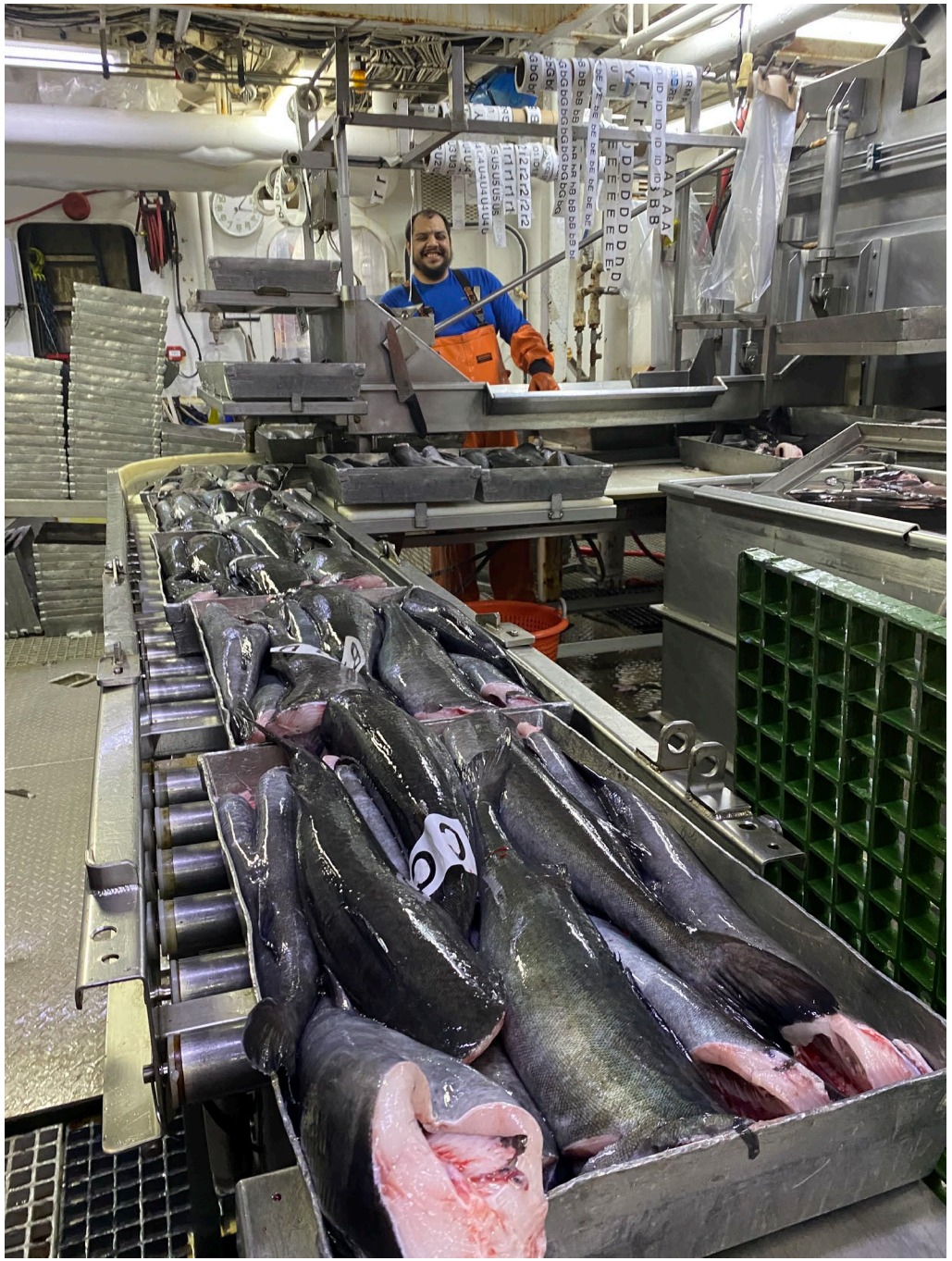
Strong domed selectivity is *suspect*

4 reasons why:

1) Incentive to avoid small fish
2) Limited time-series for pot fishery
3) Experiments suggest contact selectivity is similar
4) High recruitment events coincide with pot gear shift in 2017

Bottom Line

- **Is the time-block an adequate approach?**
- Treatment of fleet structure had minimal impacts on estimates
- Assumed selectivity had substantial impacts on harvest levels
- Knowledge of fishery is integral!
- Precaution needed following gear changes



Future work

- **Ongoing:** Simulations exploring best practices for the treatment of fleet structure and selectivity

- Explore alternative selectivity parameterizations as pot time-series increases

Questions?

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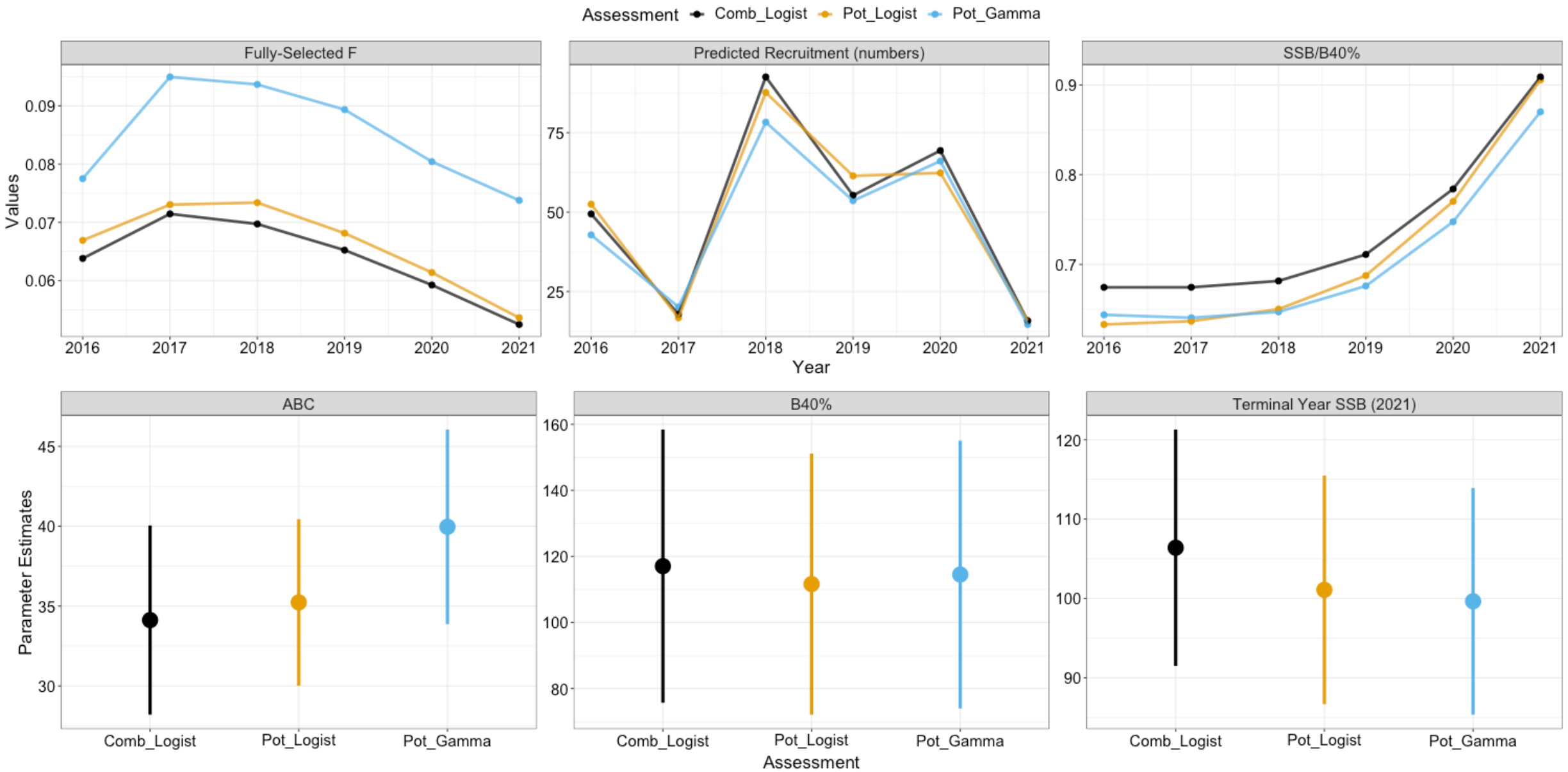
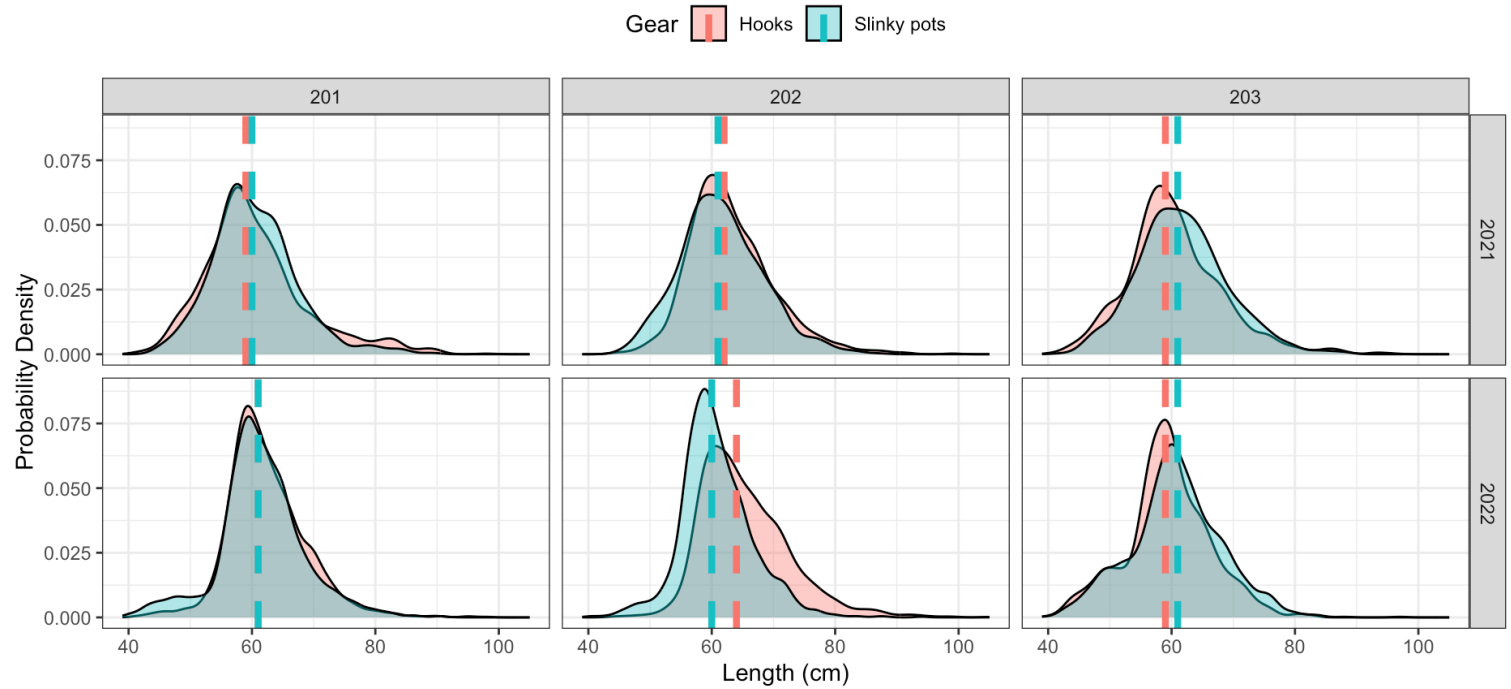
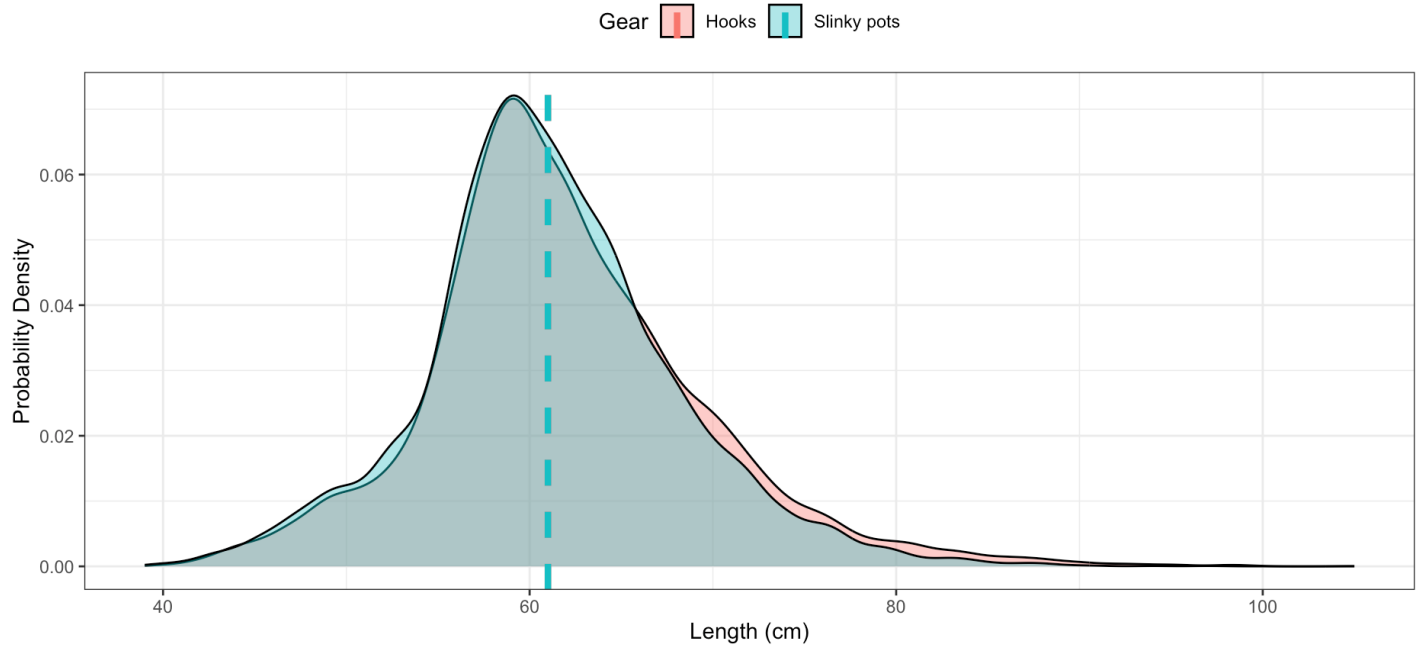
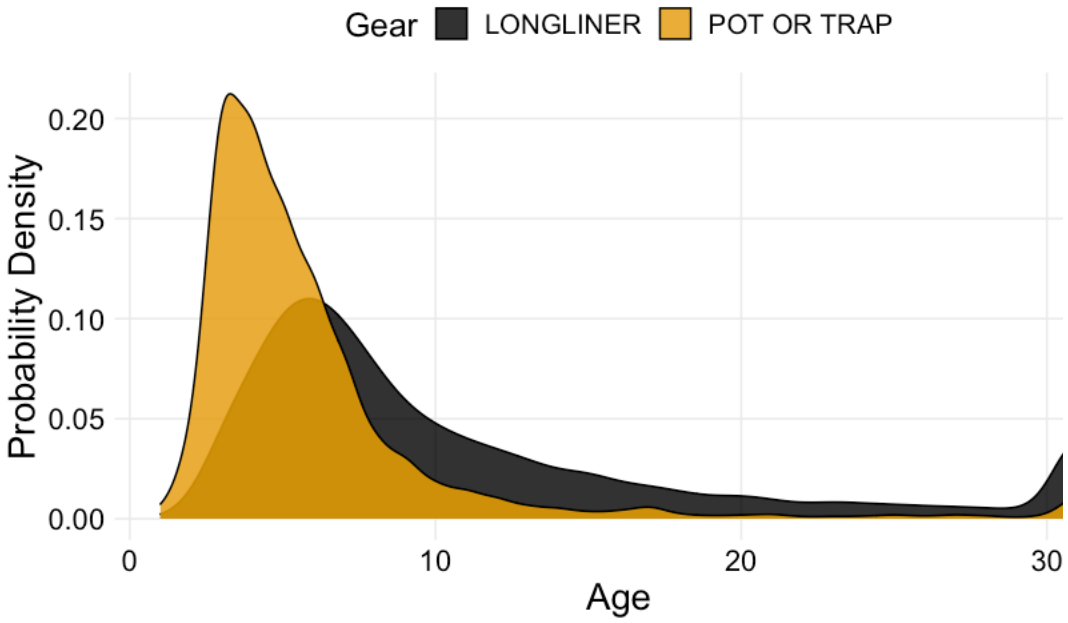
Extra Slides

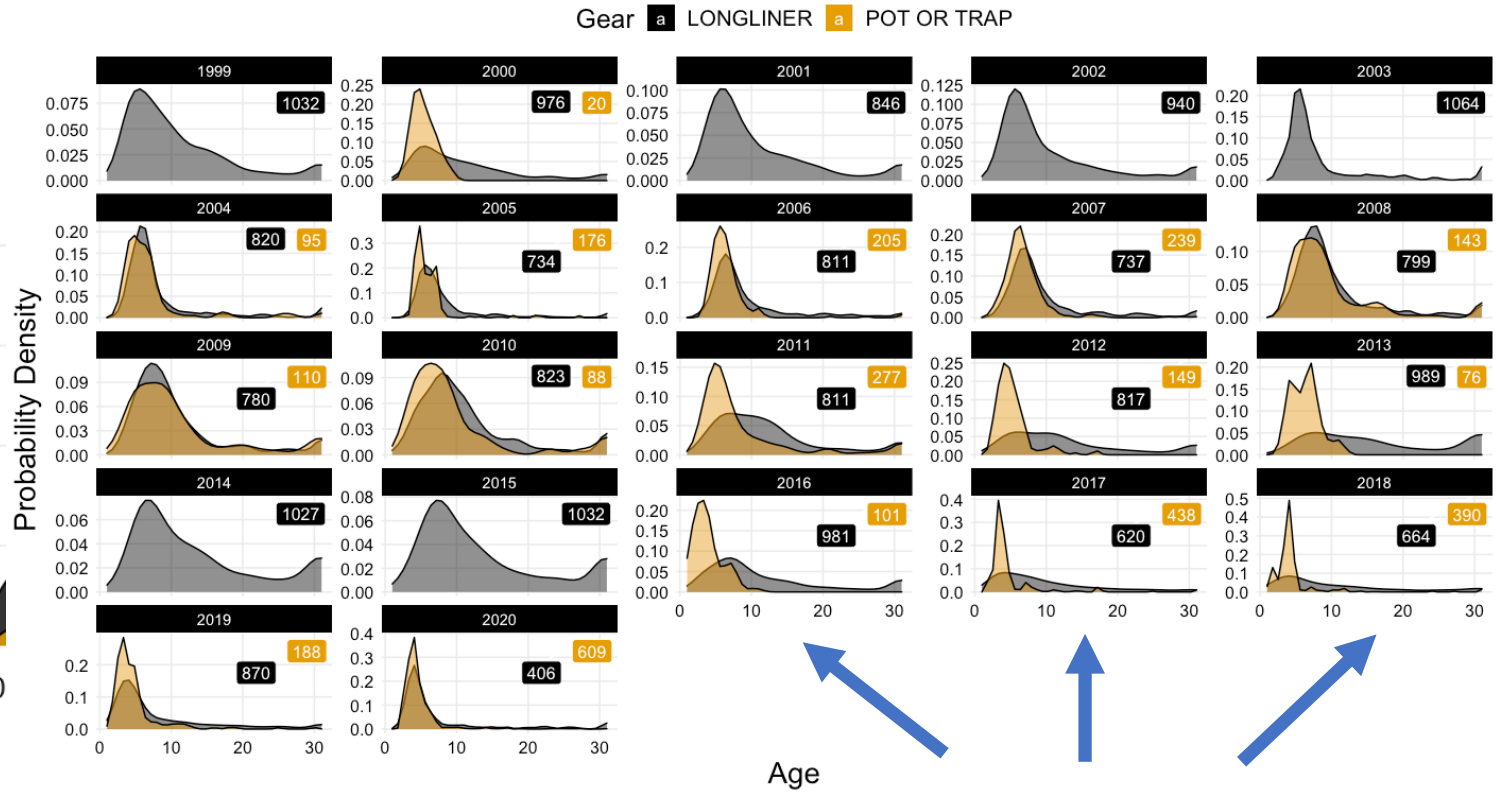

Assessment
Comb_Logist
Pot_Logist
Pot_Gamma
Fully-Selected F
Predicted Recruitment (numbers)
SSB/B40%
Values
Year
ABC
B40%
Terminal Year SSB (2021)
Parameter Estimates
Assessment


Gear
Hooks
Slinky pots
201
202
203
2021
2022
Probability Density
0.075
0.050
0.025
0.000
40
60
80
100
Length (cm)


Gear
Hooks
Slinky pots
Probability Density
0.06
0.04
0.02
0.00
40
60
80
100
Length (cm)

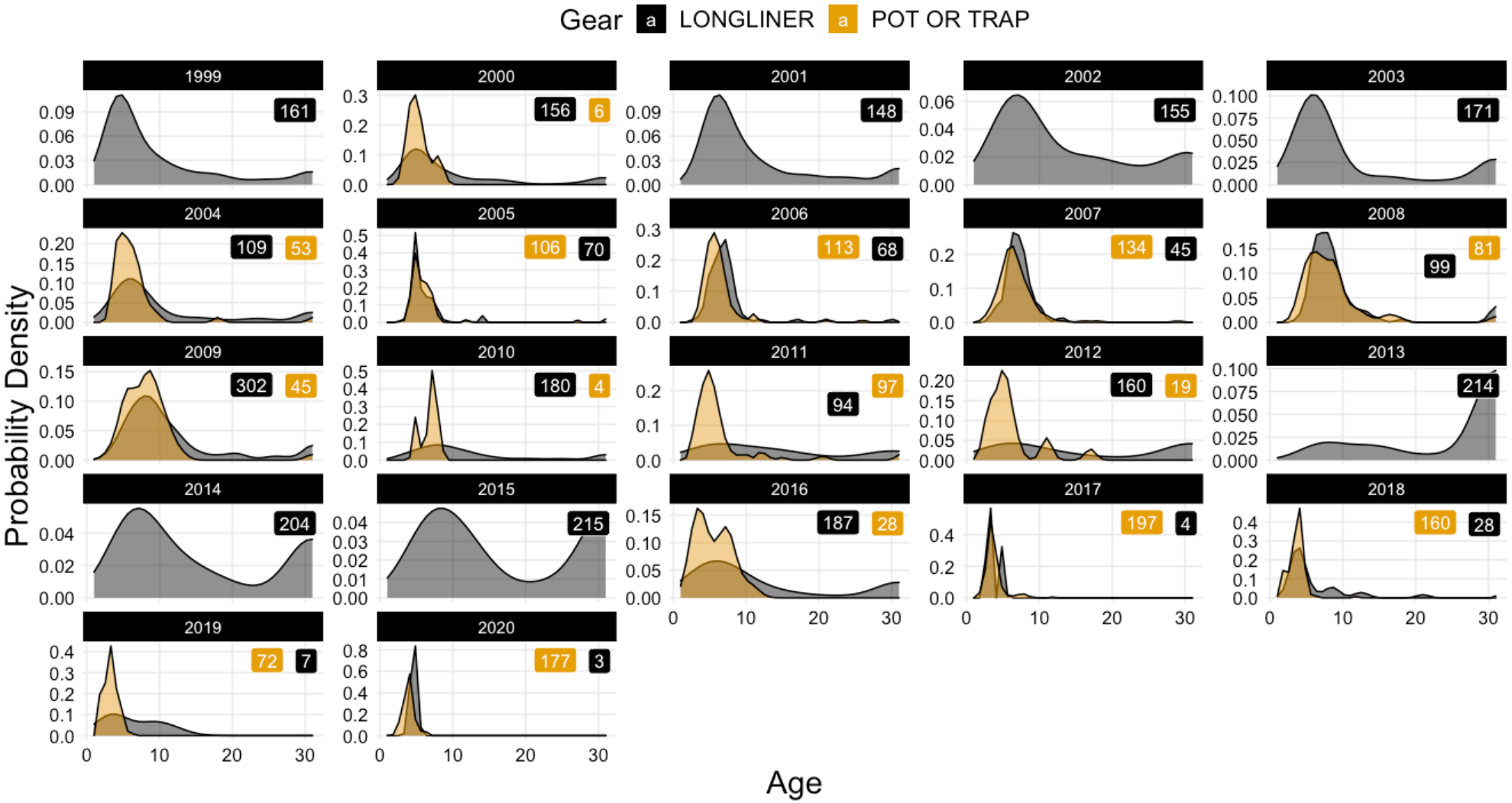
Age Comps



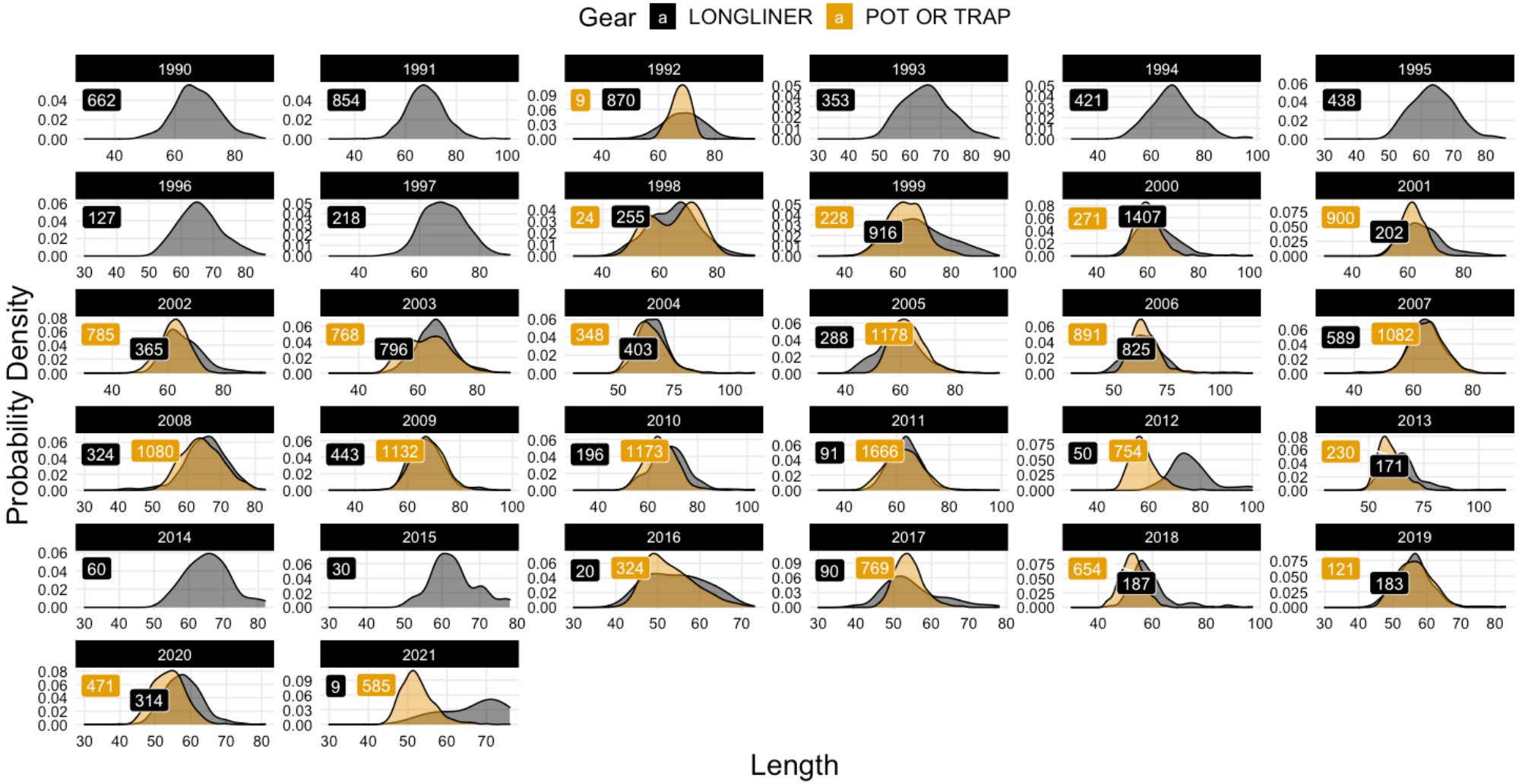


Caveat: High recruitment events are likely masking pot contact selectivity effects on age distributions

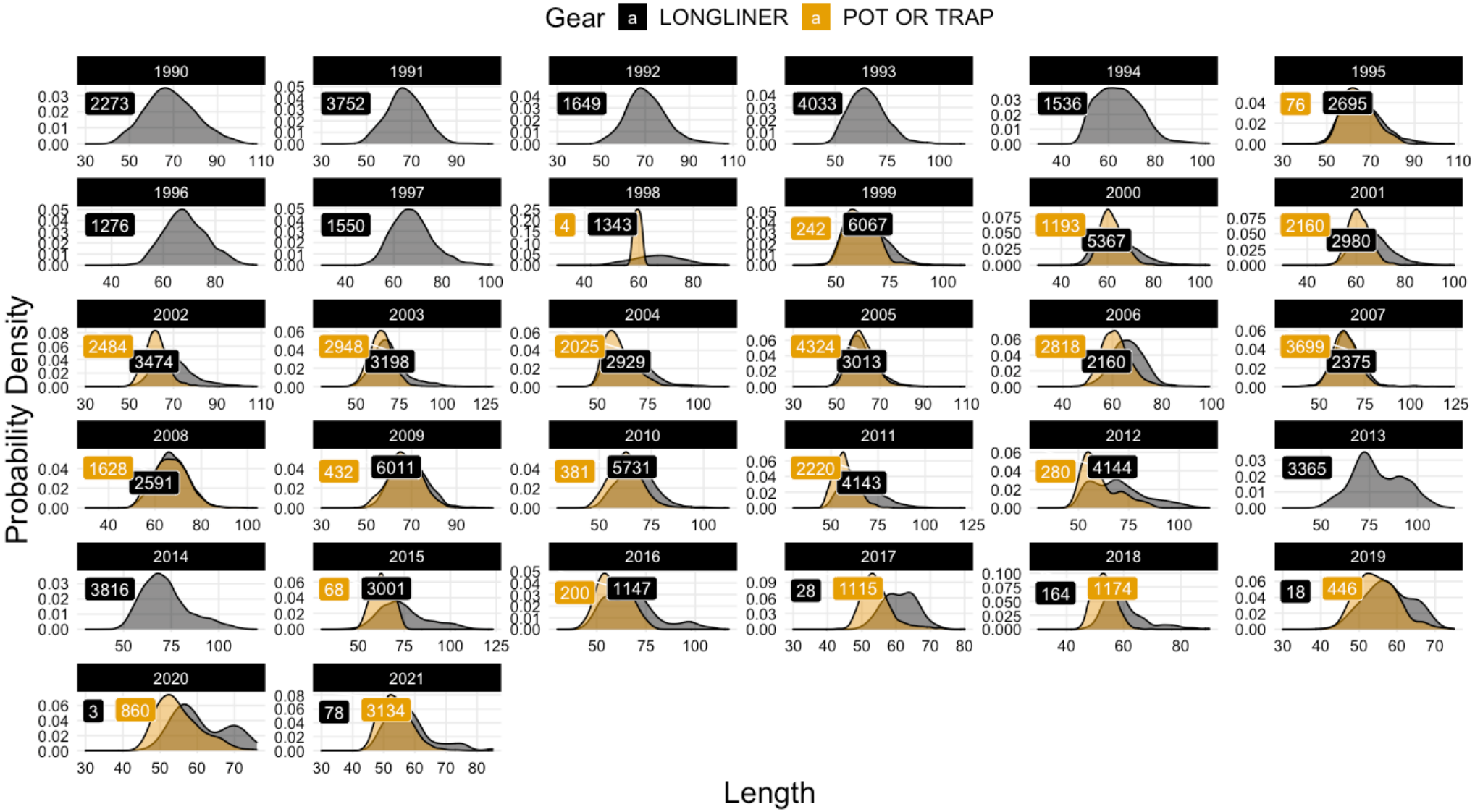
Sample sizes + age distributions from Aleutian Islands



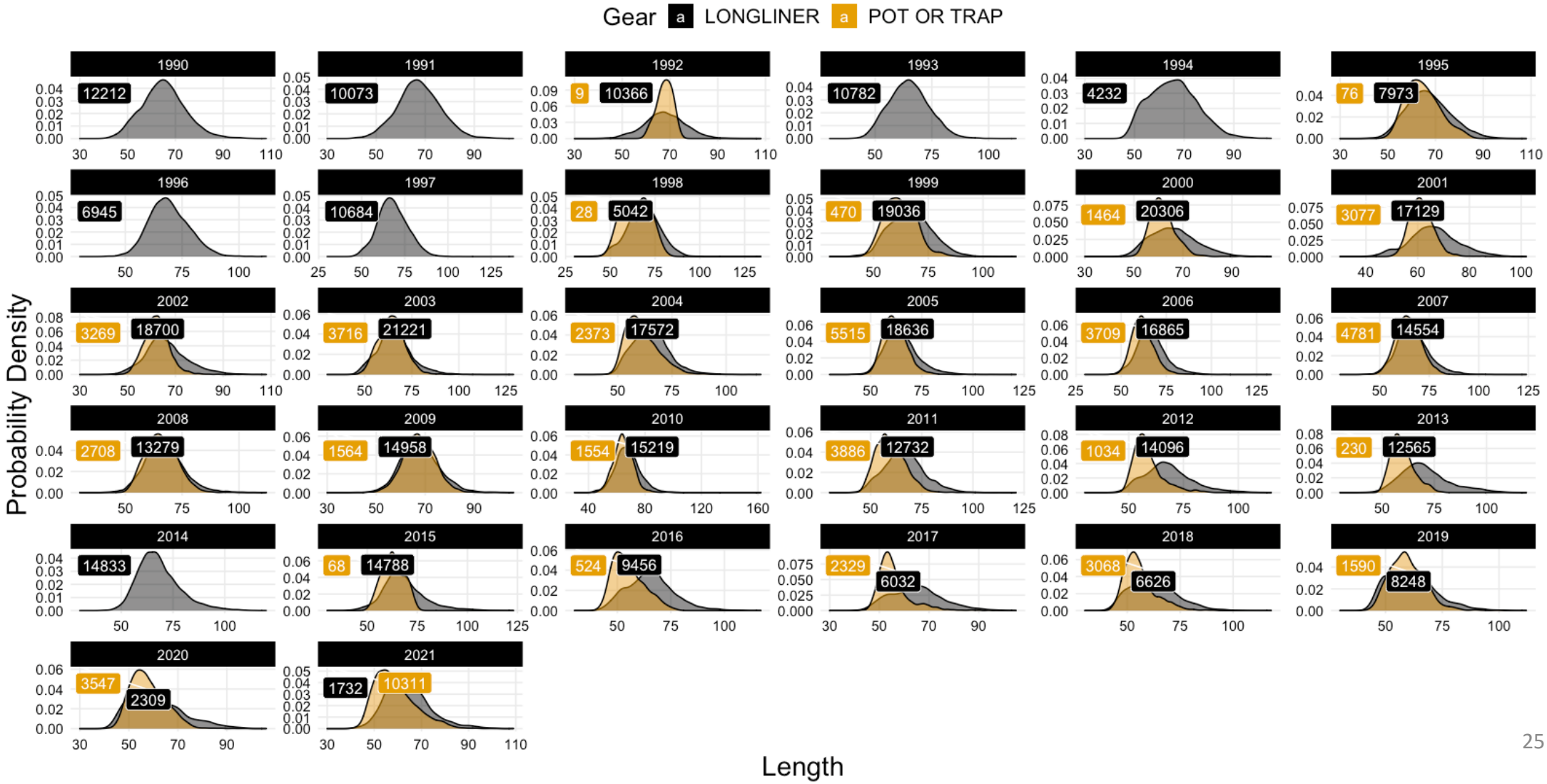
Length distribution in BS



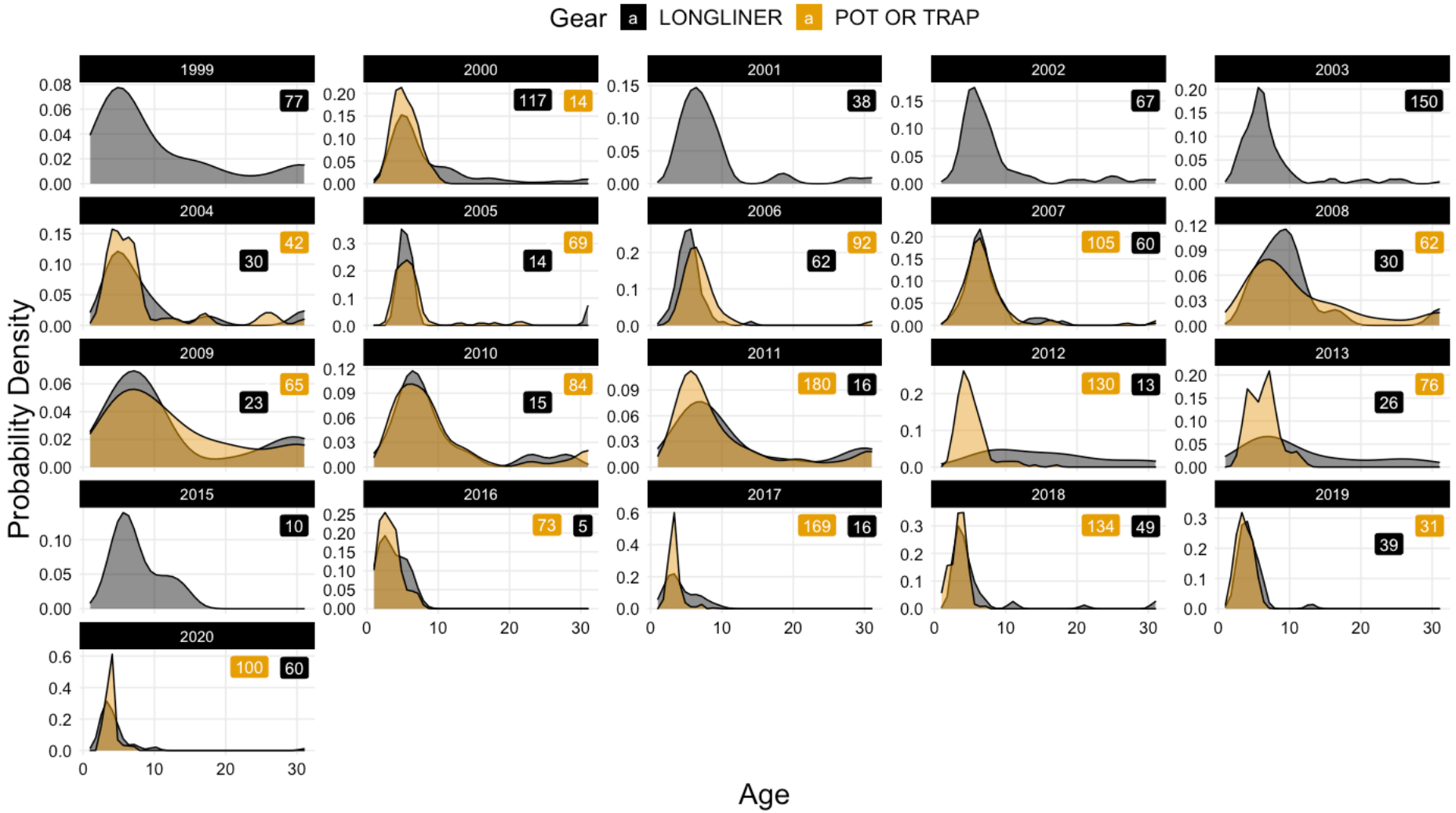
Length distribution in AI



Length distributions



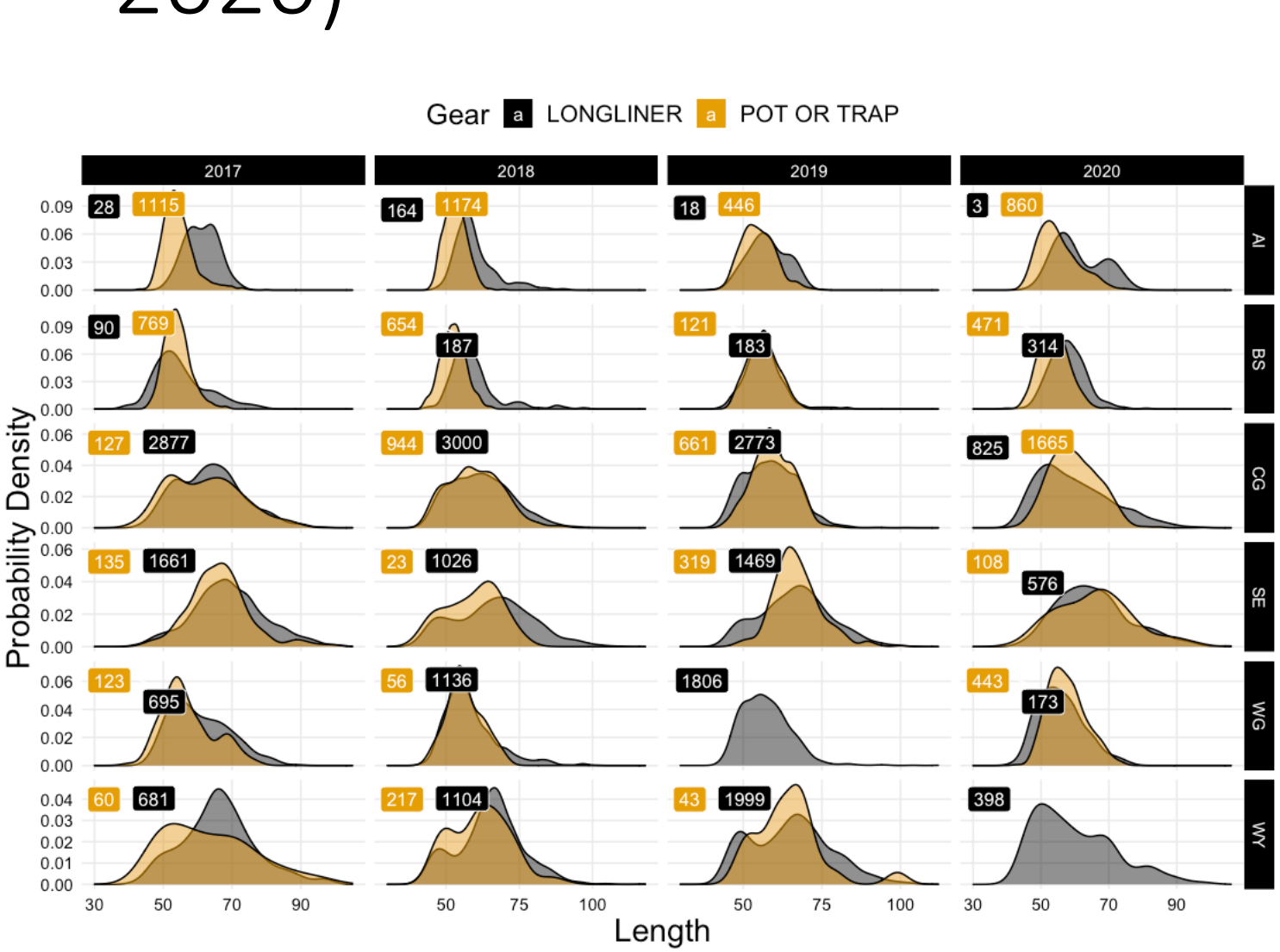
Sample sizes + age distributions from Bering Sea

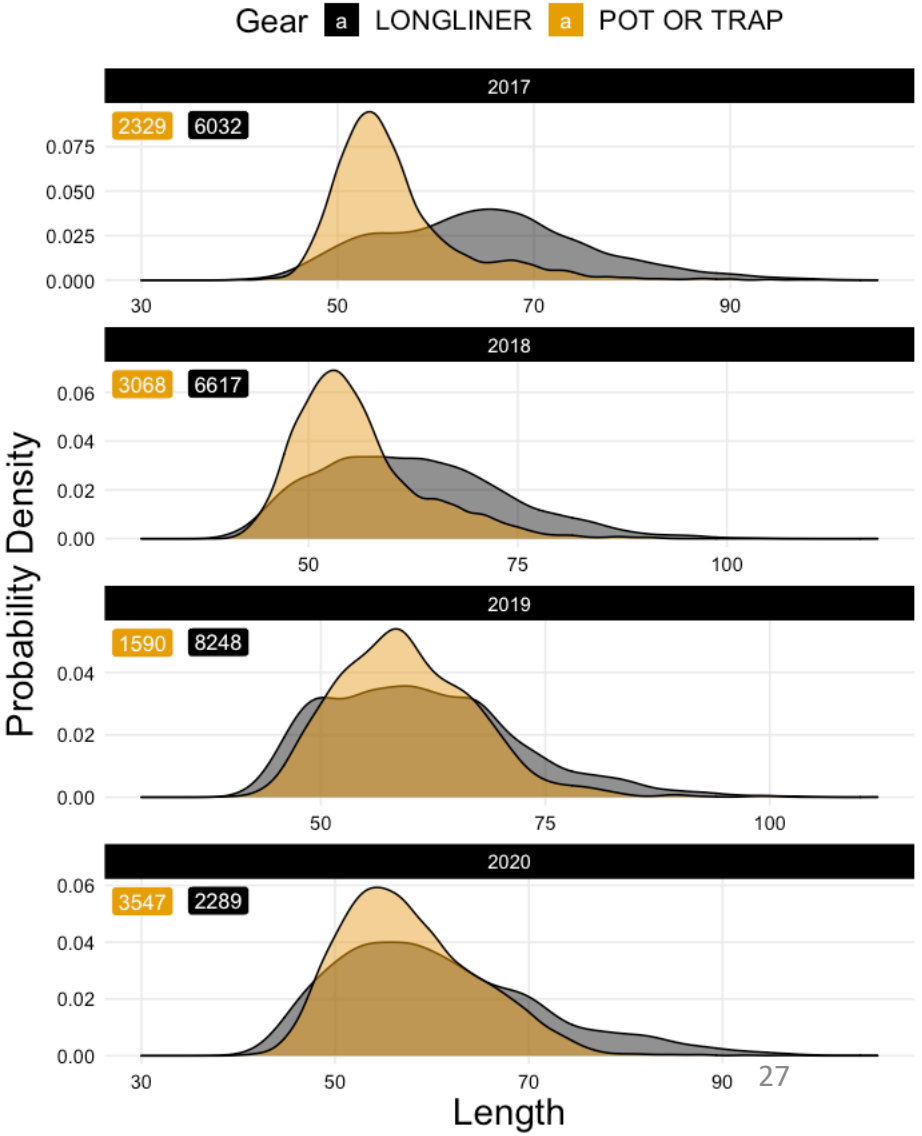


Caveat 2: High recruitment events tend to occur in BSAI region, which may impact the availability aspect of selectivity

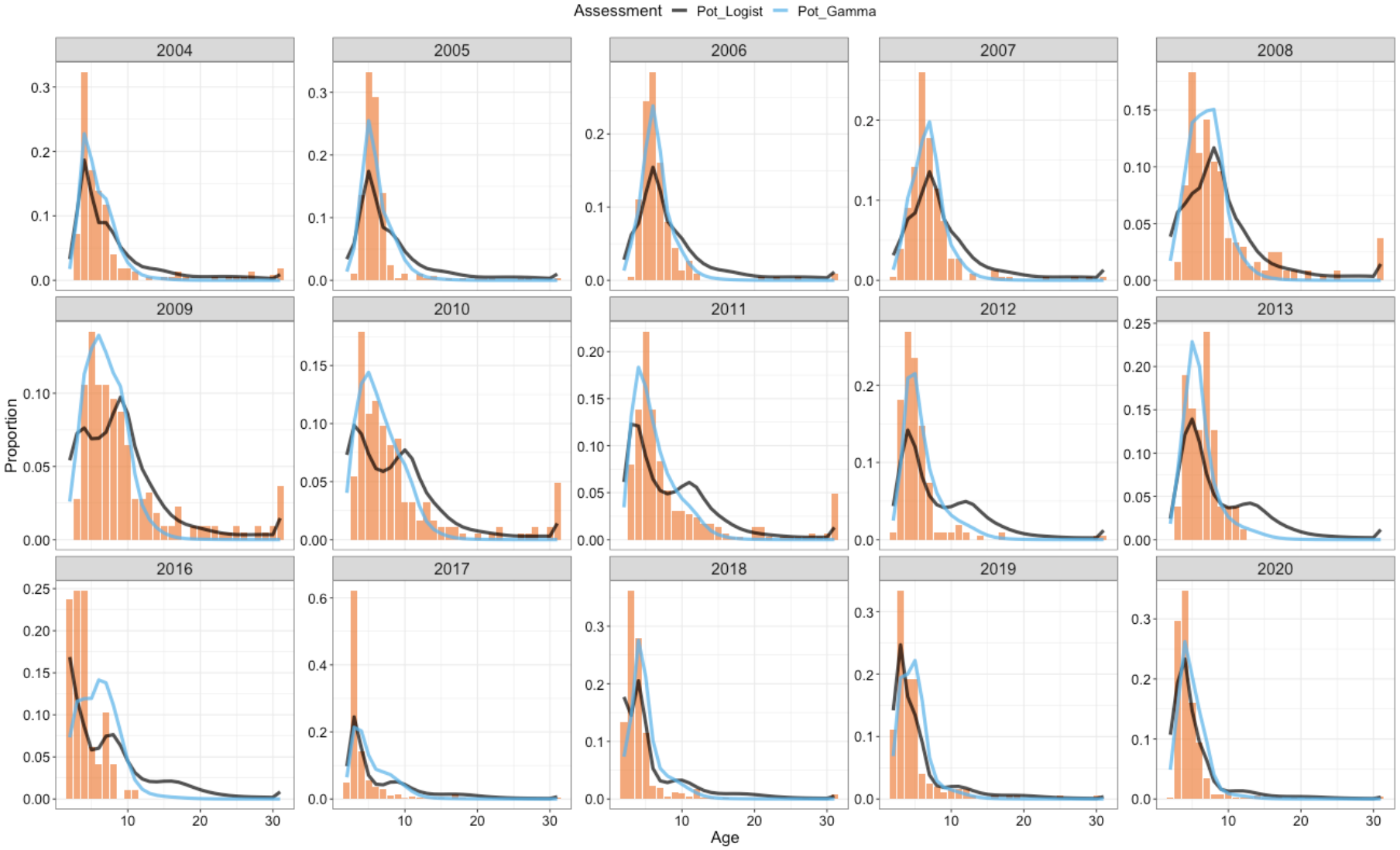
Caveat 3: Sparse samples from BSAI pot fishery. Also, samples are only from a limited spatial distribution and a small subset of vessels

Length distribution in recent years (2017 – 2020)

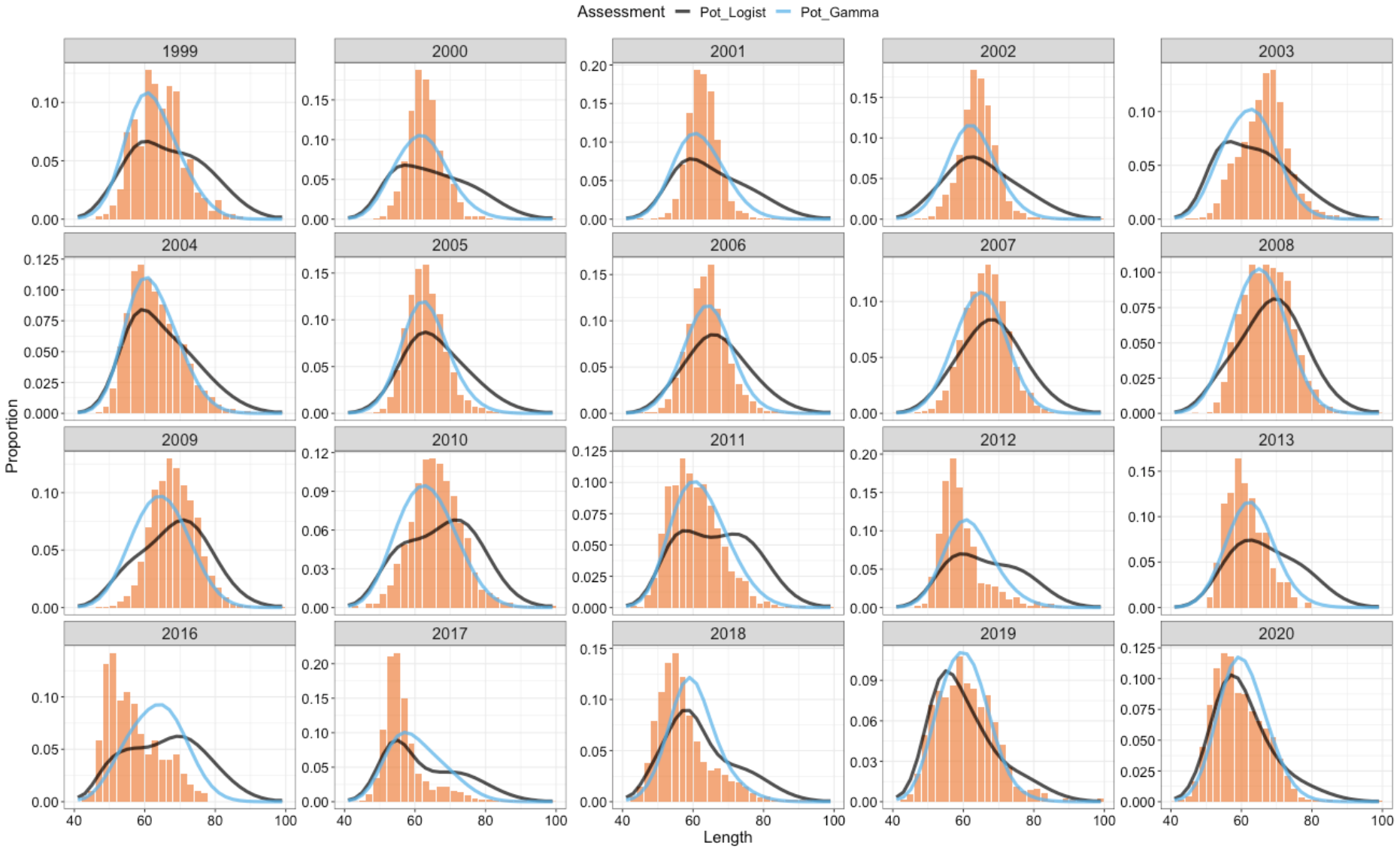




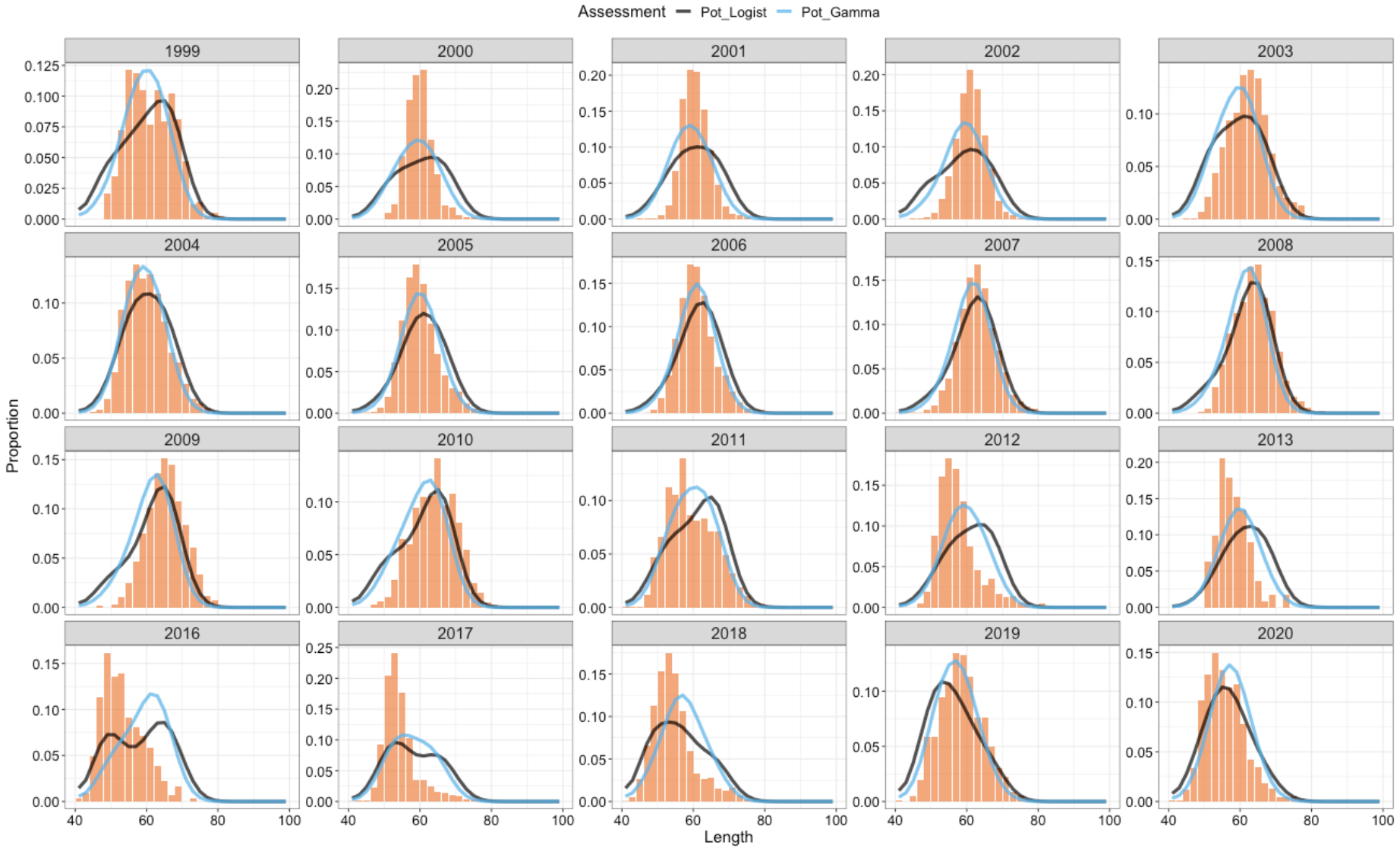
Fits to Age Comps (Pot)



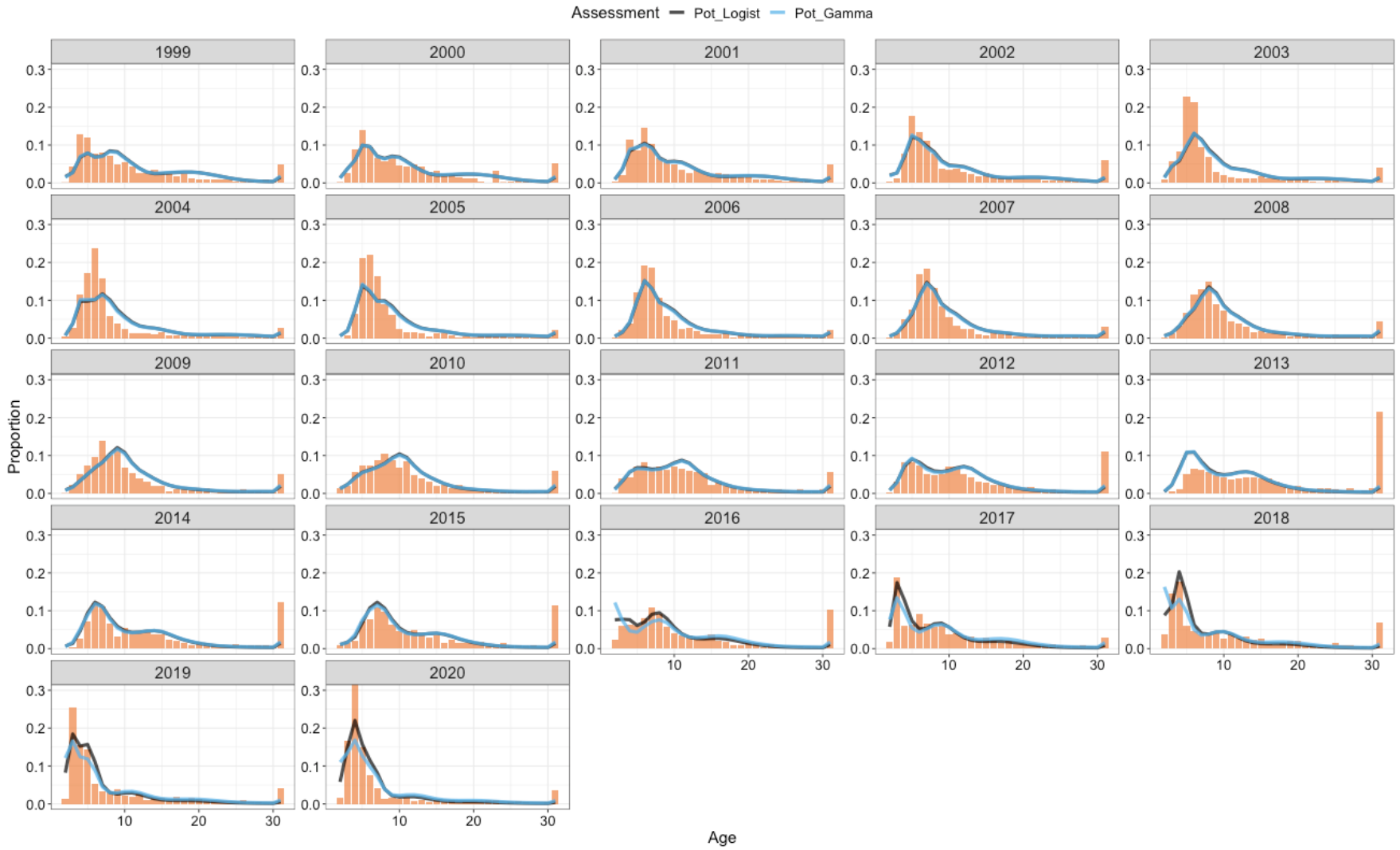
Fits to Length Comps (Females; Pot)



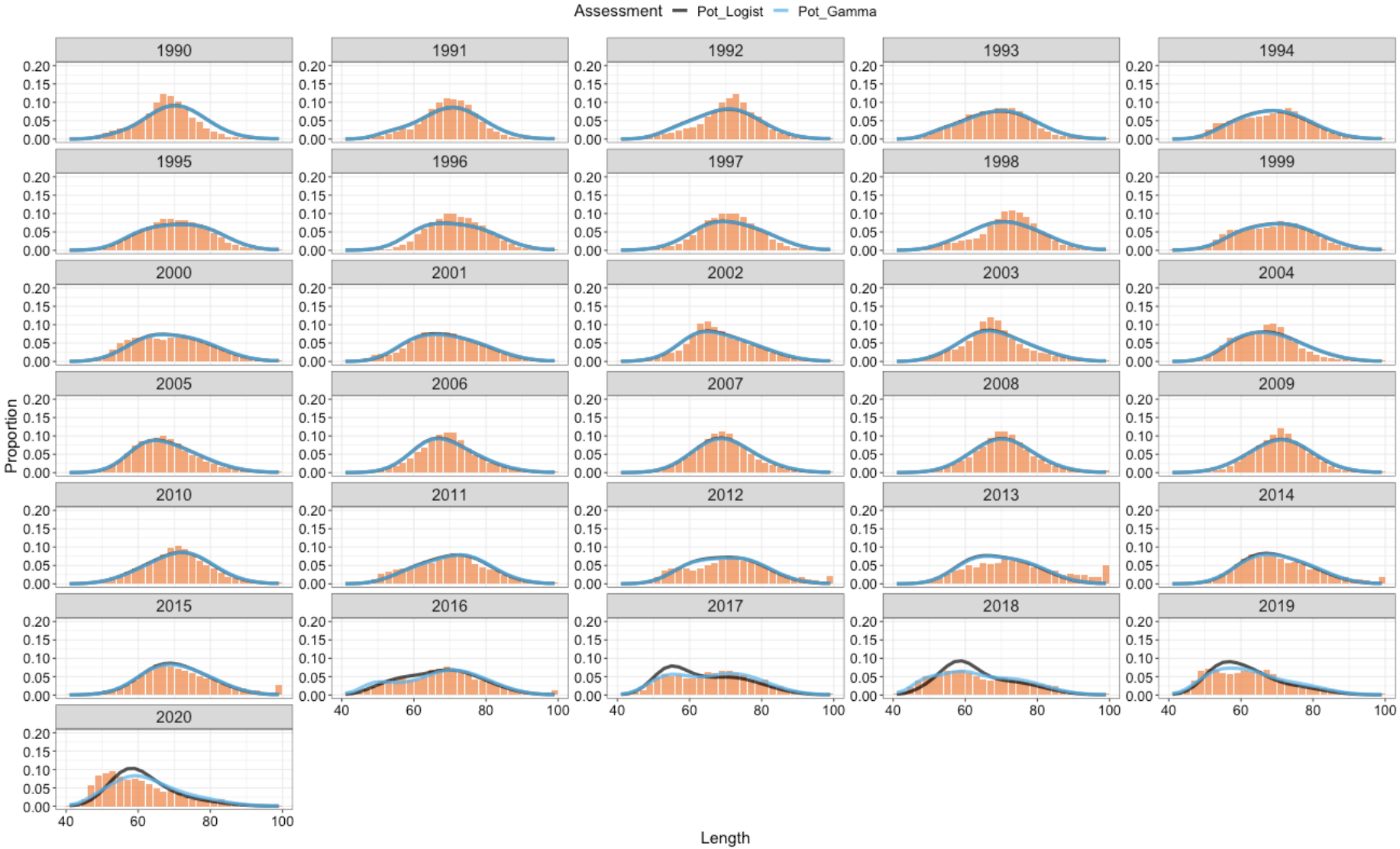
Fits to Length Comps (Males; Pot)



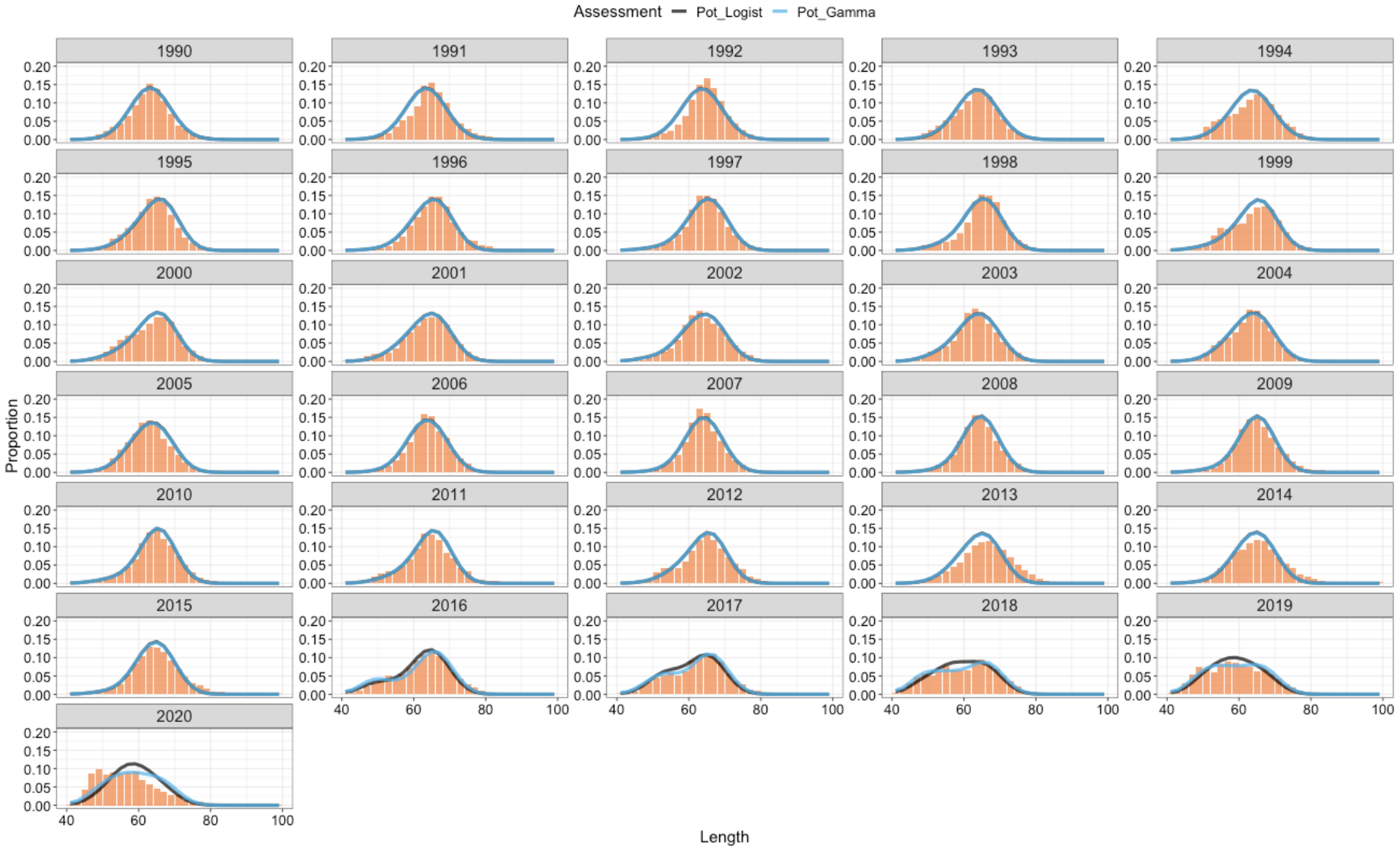
Fits to Age Comps (HAL)

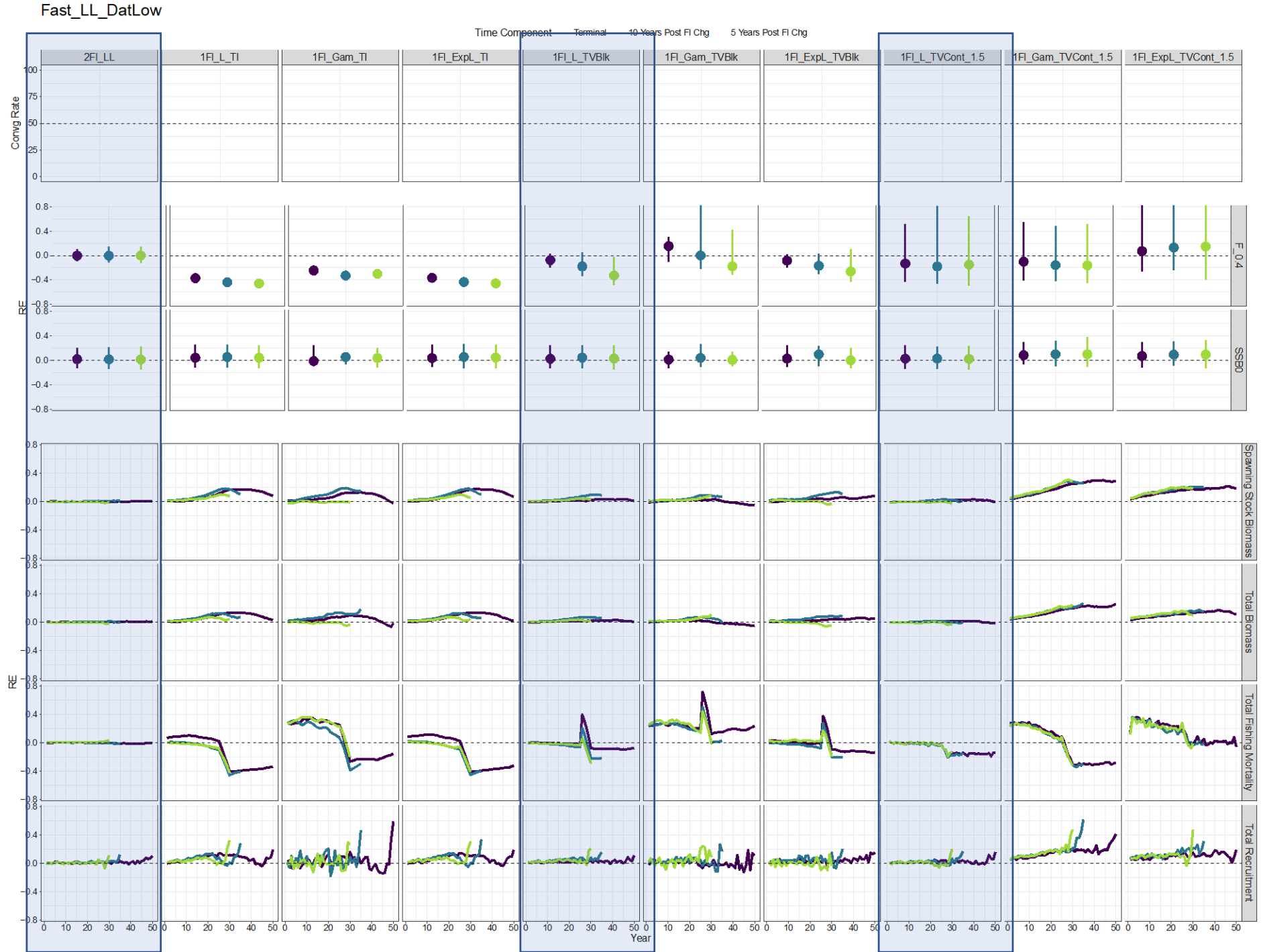


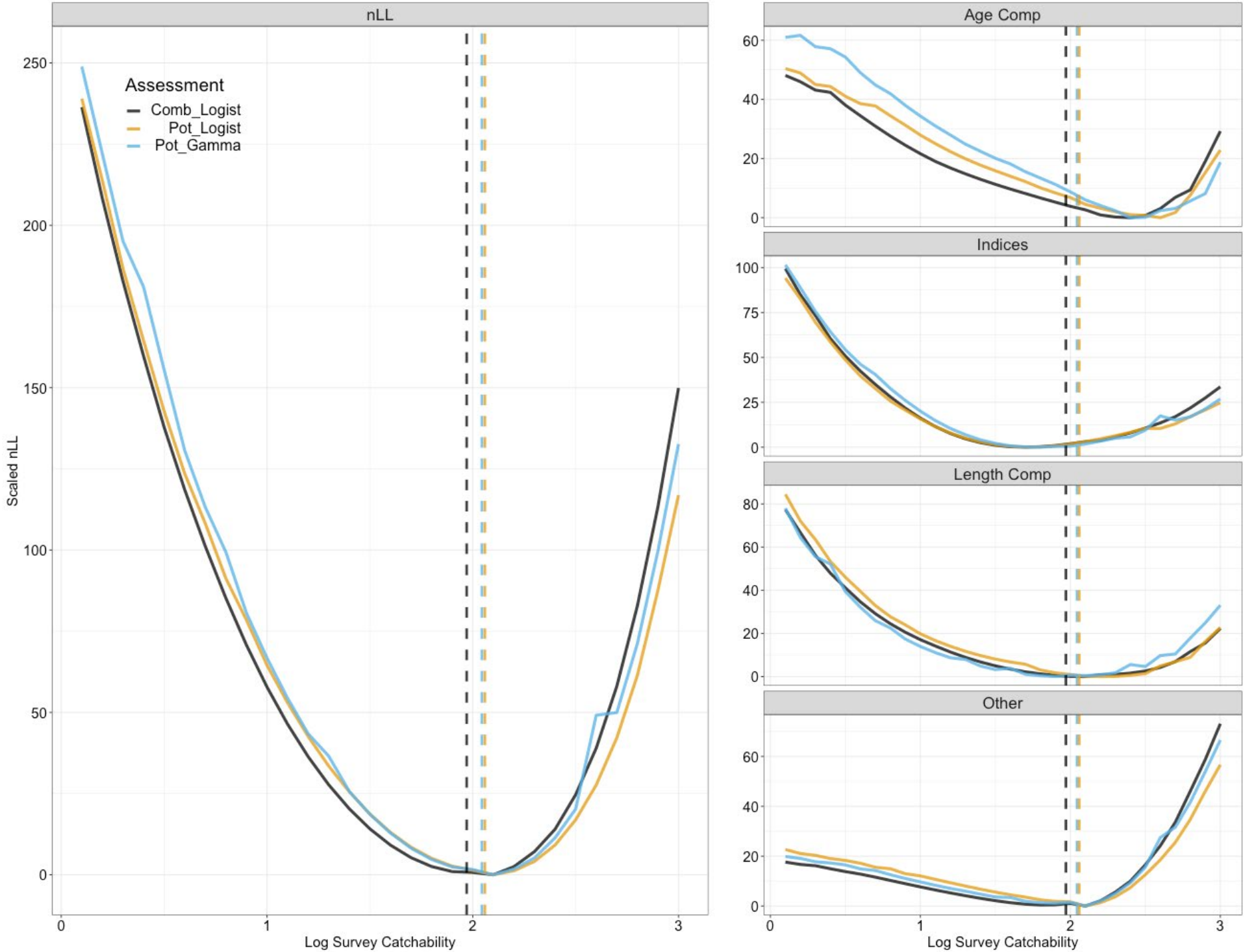
Fits to Length Comps (Females; HAL)

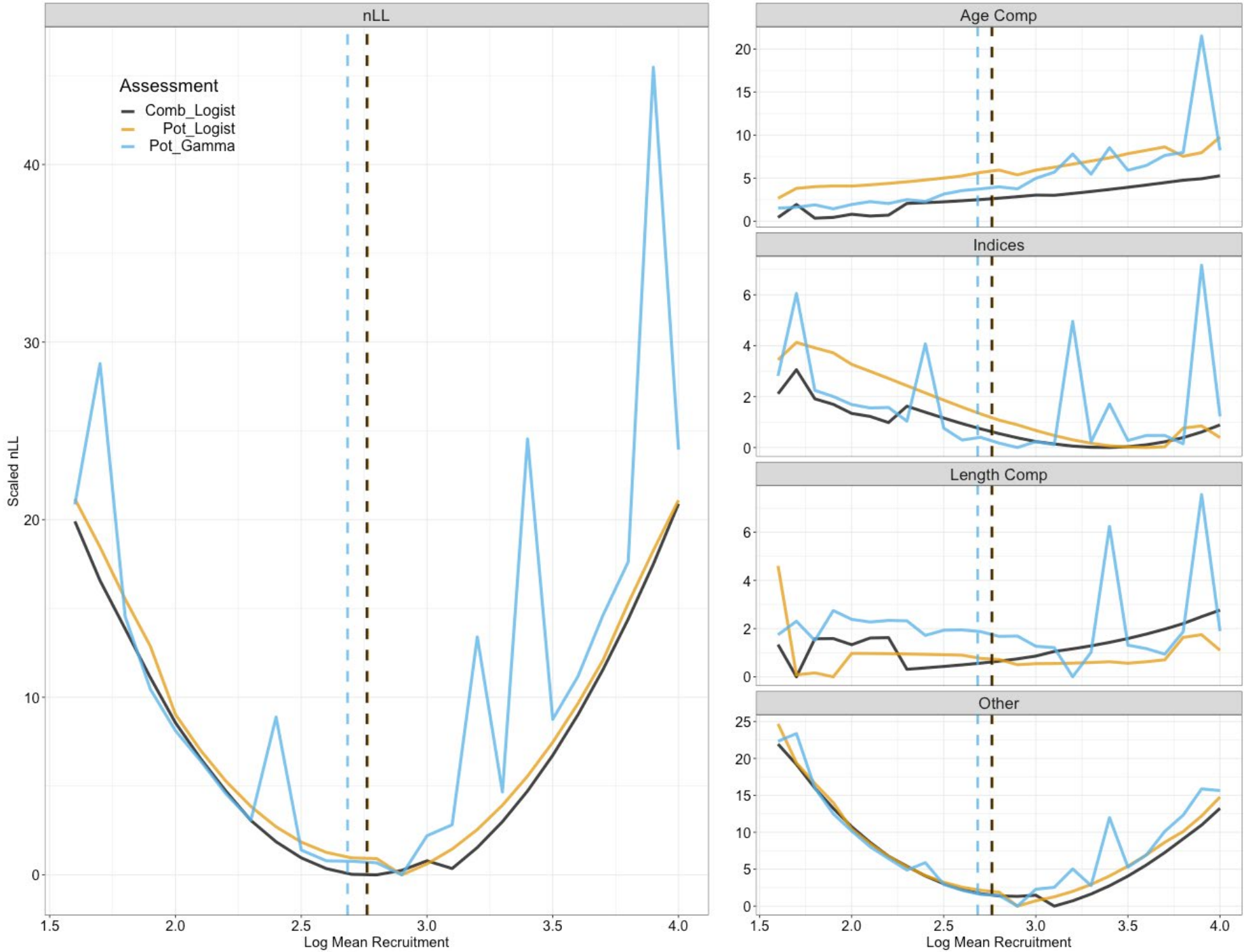


Fits to Length Comps (Males; HAL)




Fast_LL_DatLow
Time Component
Terminal
10 Years Post FI Chg
5 Years Post FI Chg
2FI_LL
1FI_L_TI
1FI_Gam_TI
1FI_ExpL_TI
1FI_L_TVBlk
1FI_Gam_TVBlk
1FI_ExpL_TVBlk
1FI_L_TVCont_1.5
1FI_Gam_TVCont_1.5
1FI_ExpL_TVCont_1.5
Convg Rate
RE
F_0.4
SSB0
Spawning Stock Biomass
Total Biomass
Total Fishing Mortality
Total Recruitment
Year


nLL
Assessment
Comb_Logist
Pot_Logist
Pot_Gamma
Scaled nLL
Log Survey Catchability
Age Comp
Indices
Length Comp
Other
Log Survey Catchability


nLL
Assessment
Comb_Logist
Pot_Logist
Pot_Gamma
Scaled nLL
Log Mean Recruitment
Age Comp
Indices
Length Comp
Other
Log Mean Recruitment