Developing a Size Structured Assessment for Scallops

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CPT Modelling Workshop Jan 2026

Background

- Outstanding SSC request for SPT to develop model-based stock assessment for weathervane scallops

- Currently assessment is total catch based (~Tier 5), OFL/ABC fixed in FMP (very high compared to ADF&G management – makes snow crab gap seem aggressive)

- Pursued age structured model for a long time – some uncertainty surrounding age validity and error – don't need age cohort resolution anyway…

Background

- Outstanding SSC request for SPT to develop model-based stock assessment for weathervane scallops

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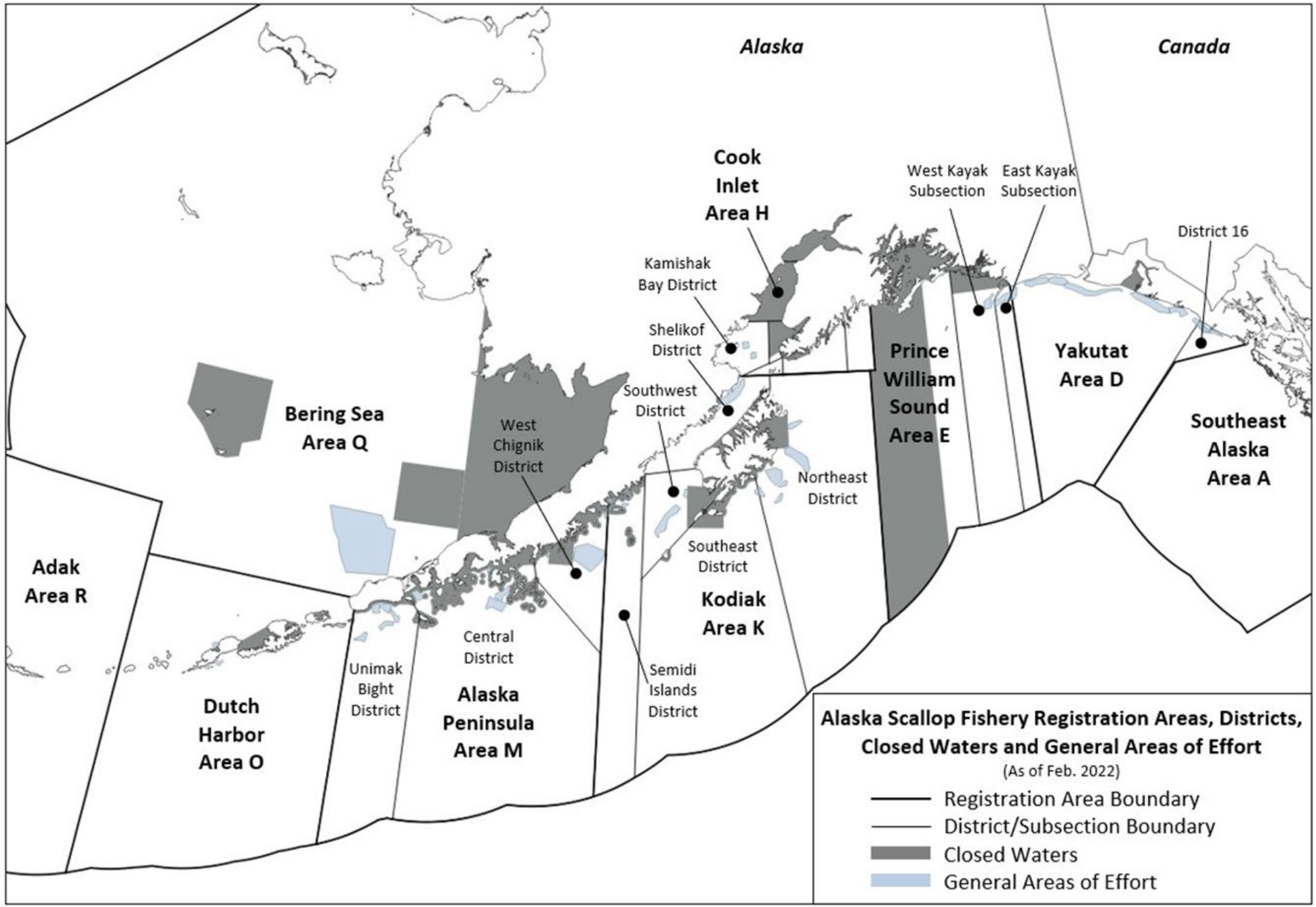
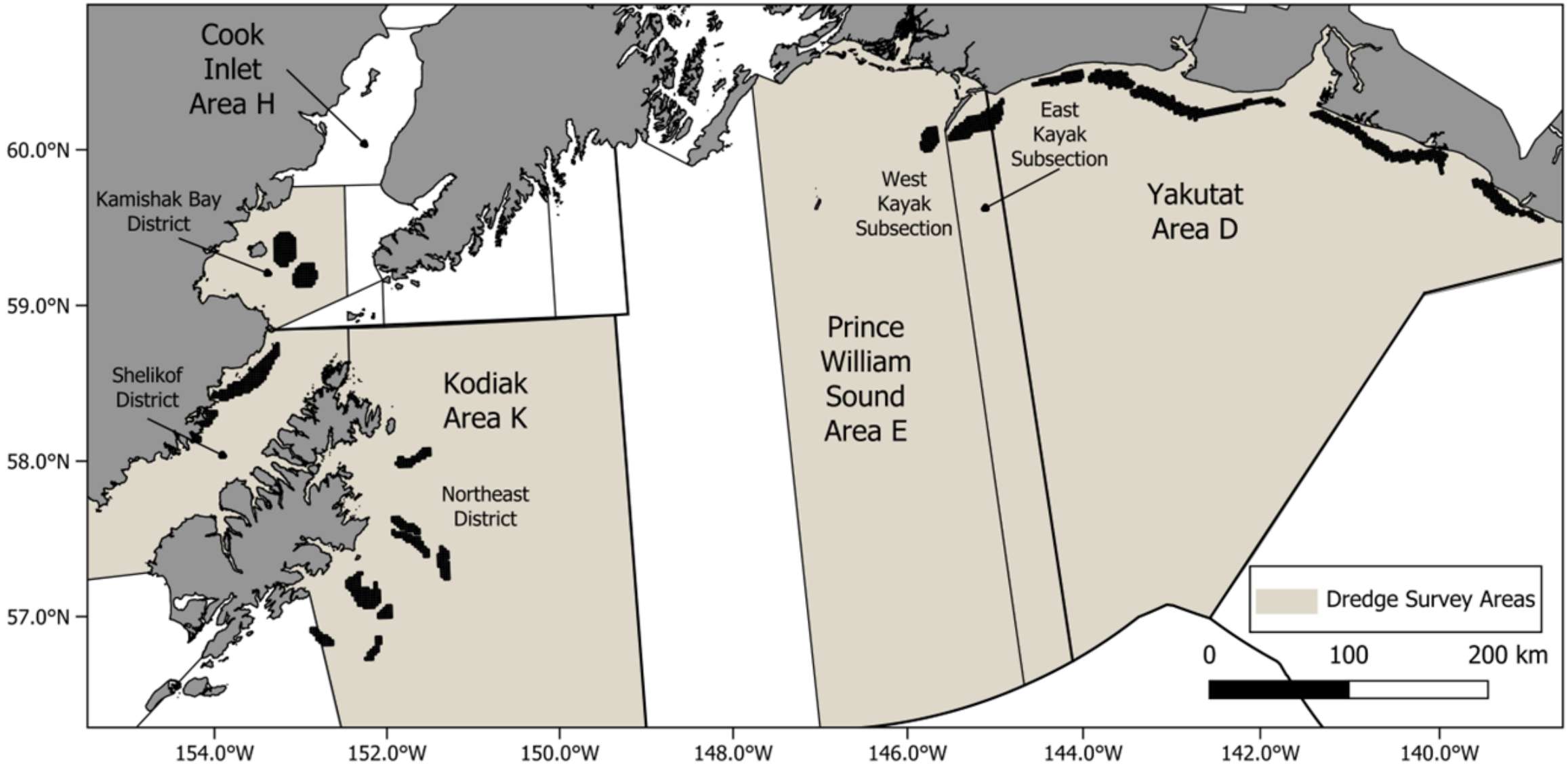
- Produced *rema* RE model – doesn't make use of all the available size data

- Solution – **simple** size structured model

Why bold and underline ‘simple’?

- Scallop fishery is not economically irrelevant, but its small (i.e., avoid over capitalizing assessment author time)
- SPT has always lacked quantitative expertise, very few folks doing AK scallop science otherwise
- Considered 1 stock in FMP, more likely at least 4, managed in 11 areas
- Solution – Core/Non-core approach, population model in “non-data-limited” districts, total catch in others

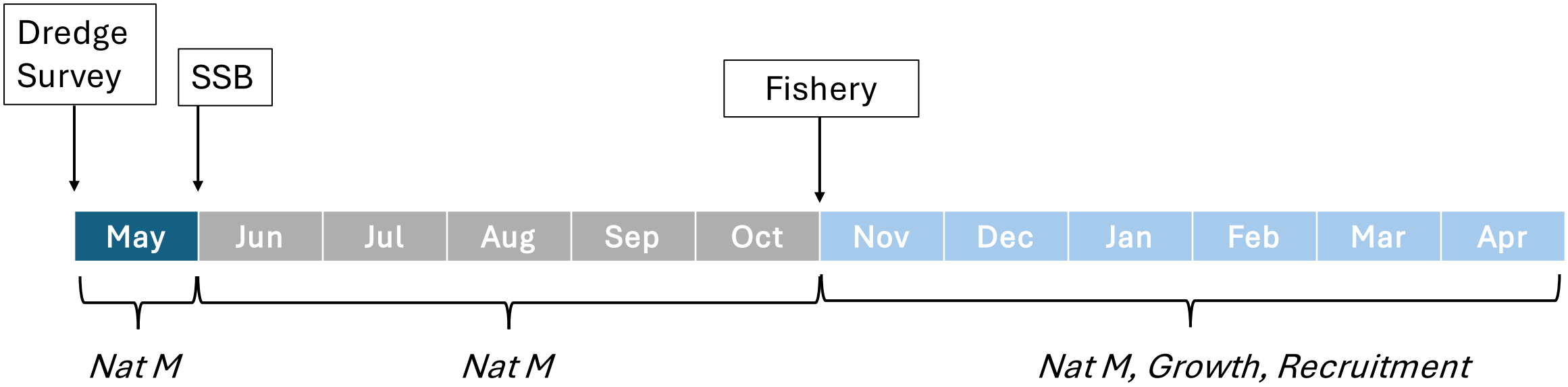

Alaska
Canada
Cook Inlet Area H
West Kayak Subsection
East Kayak Subsection
District 16
Kamishak Bay District
Shelikof District
Southwest District
Prince William Sound Area E
Yakutat Area D
Southeast Alaska Area A
Bering Sea Area Q
West Chignik District
Northeast District
Southeast District
Kodiak Area K
Adak Area R
Central District
Unimak Bight District
Alaska Peninsula Area M
Semidi Islands District
Dutch Harbor Area O
Alaska Scallop Fishery Registration Areas, Districts, Closed Waters and General Areas of Effort
(As of Feb. 2022)
Registration Area Boundary
District/Subsection Boundary
Closed Waters
General Areas of Effort


Cook
Inlet
Area H
Kamishak Bay
District
Shelikof
District
Kodiak
Area K
Northeast
District
Prince
William
Sound
Area E
West
Kayak
Subsection
East
Kayak
Subsection
Yakutat
Area D
Dredge Survey Areas
0
100
200 km
60.0°N
59.0°N
58.0°N
57.0°N
154.0°W
152.0°W
150.0°W
148.0°W
146.0°W
144.0°W
142.0°W
140.0°W

Model Dimensions

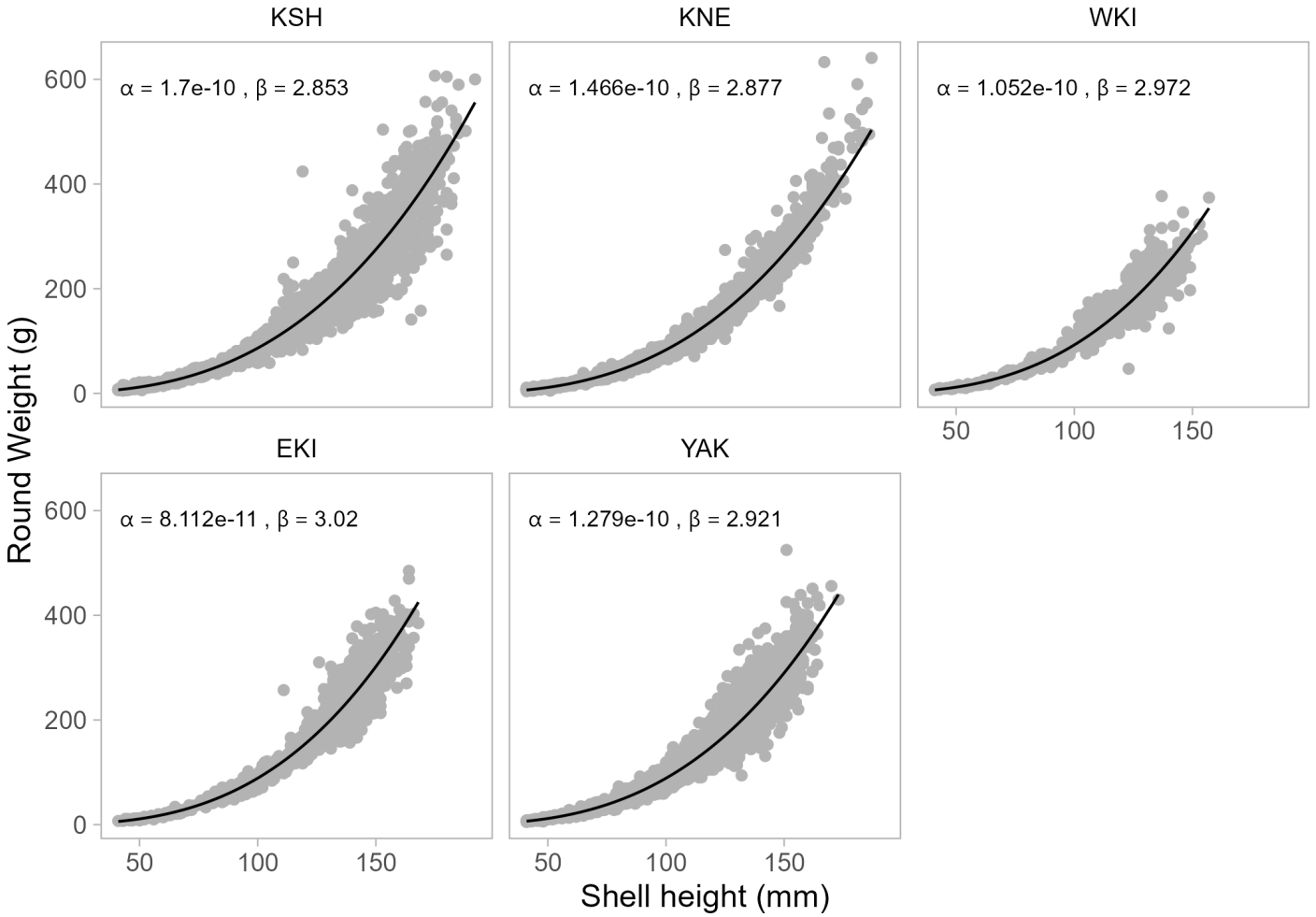
- Model runs from 1990 (1997) – 2025
  - Non-equilibrium initial conditions
- Single sex (i.e., males + females combined)
- No shell condition, no maturity groups
- 10 mm size classes from 31 mm – 160+ mm
- Two fleets: directed fishery, dredge survey

Annual Structure: May 1 – Apr 30

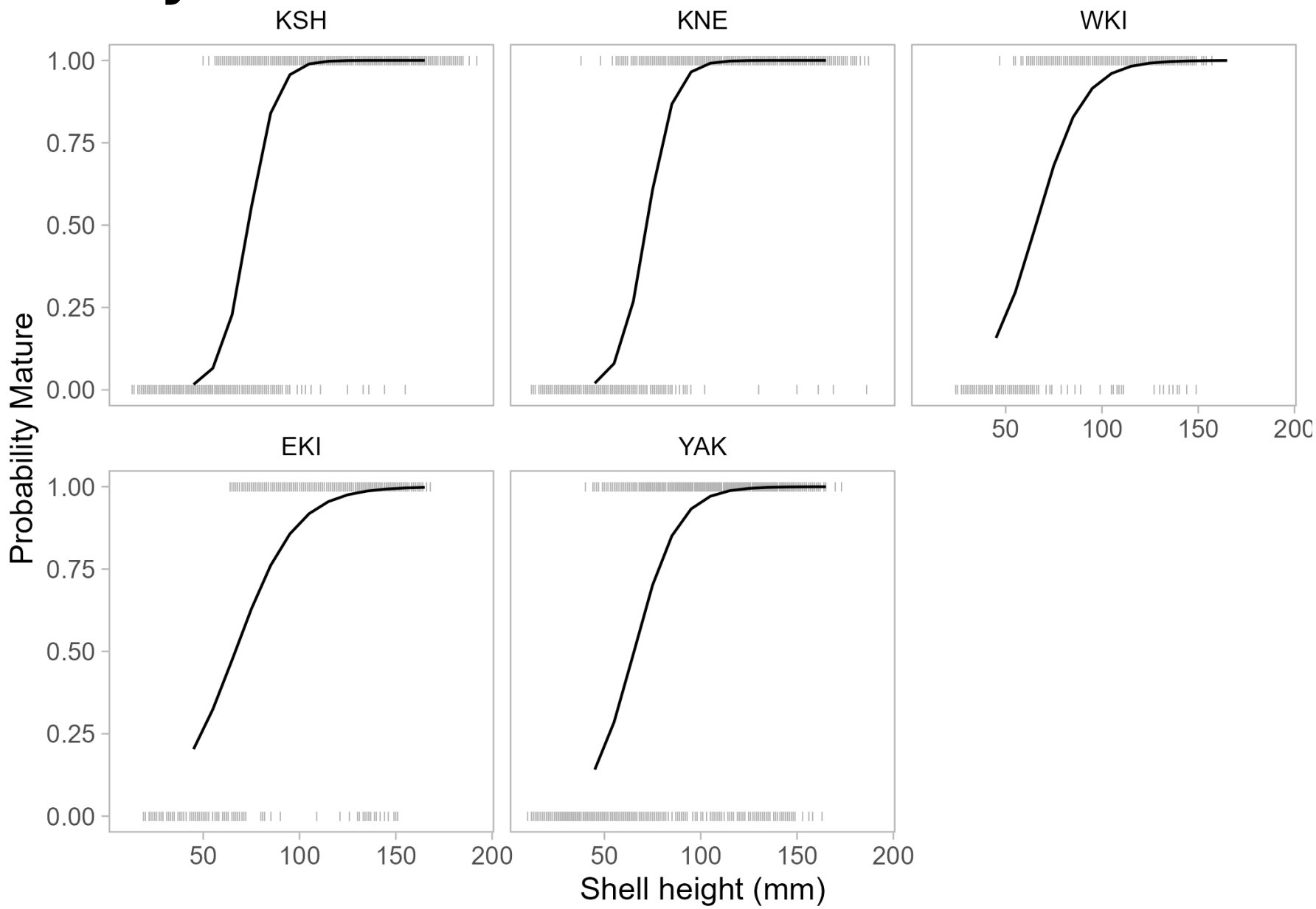


Biological Info and Natural Mortality

- Weight at length is allometric, area specific (from survey data)
- All sizes are legal
- Natural Mortality = 0.13 (FMP)



Maturity

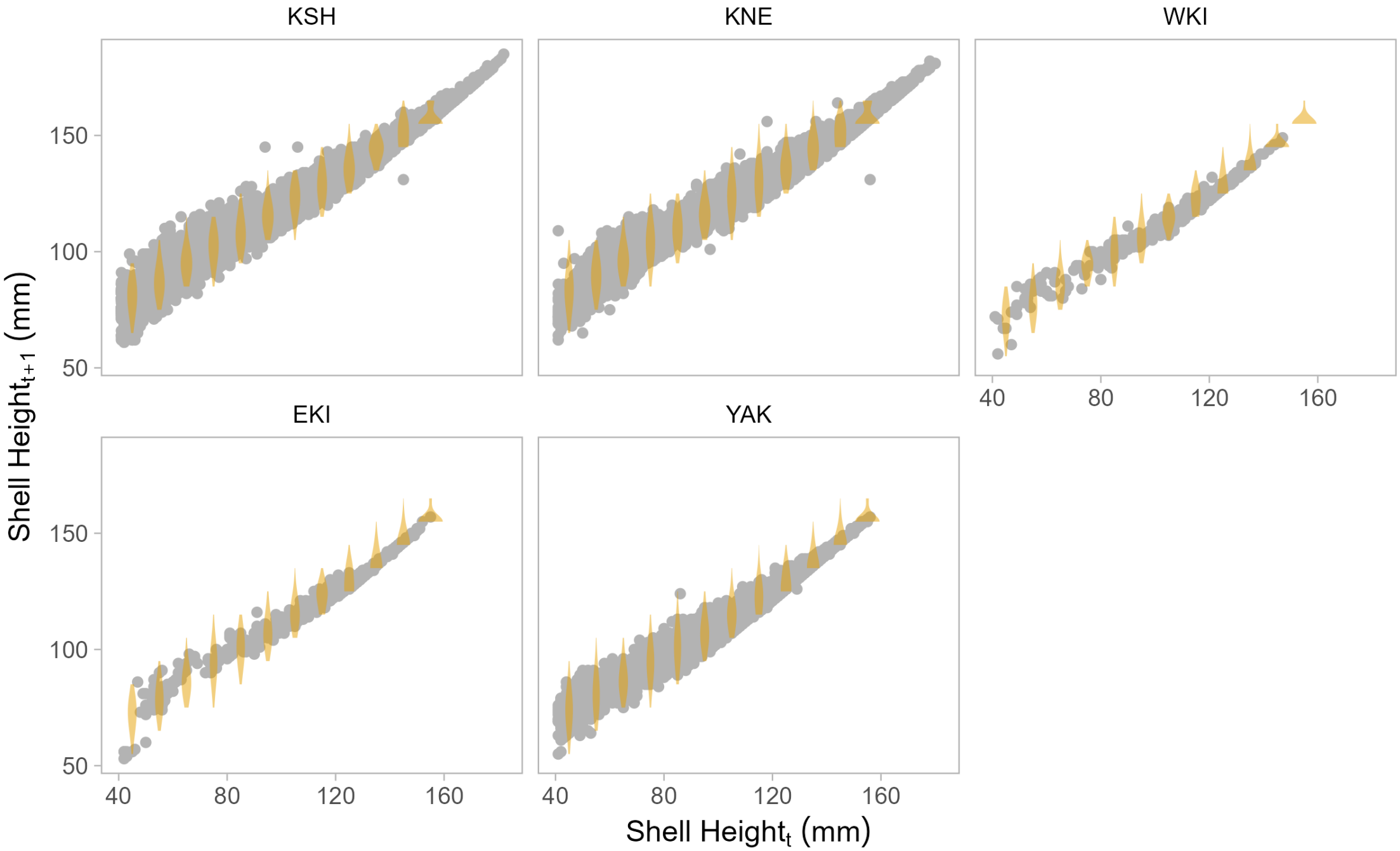

KSH
KNE
WKI
EKI
YAK
Probability Mature
1.00
0.75
0.50
0.25
0.00
50
100
150
200
Shell height (mm)

Growth Transition

- Growth occurs annually for all sizes

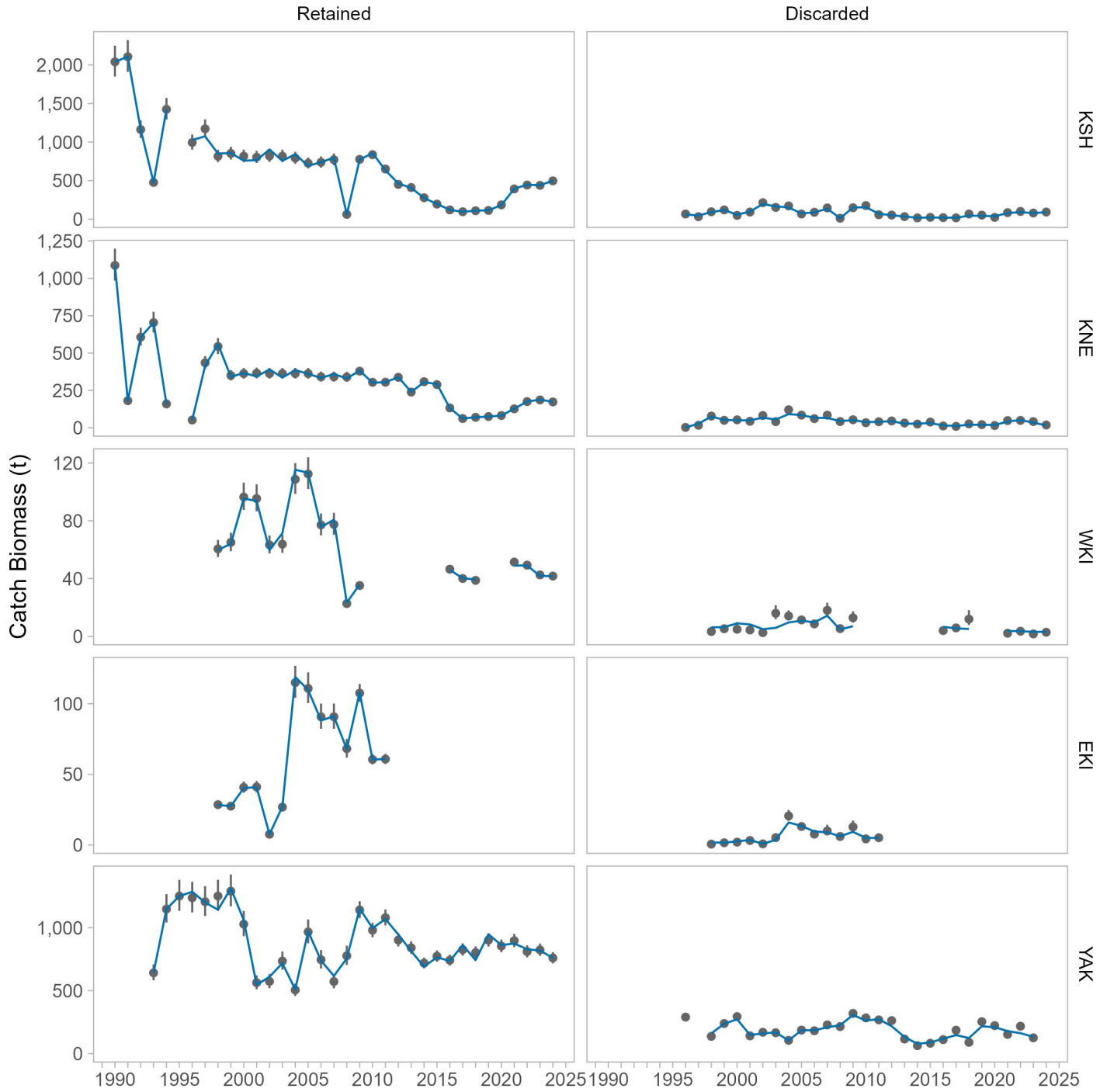
- Assumes LVB growth, w/ σ_{L_∞} (individual variation in L_{inf})(Cronin-Fine and Punt 2020)

- Mean L_{inf} and *K,* and σ_{L_∞} estimated from mixed model on growth increment data (Hart and Chute 2009)


KSH
KNE
WKI
EKI
YAK
Shell Height$_{t+1}$ (mm)
Shell Height$_t$ (mm)
50
100
150
40
80
120
160

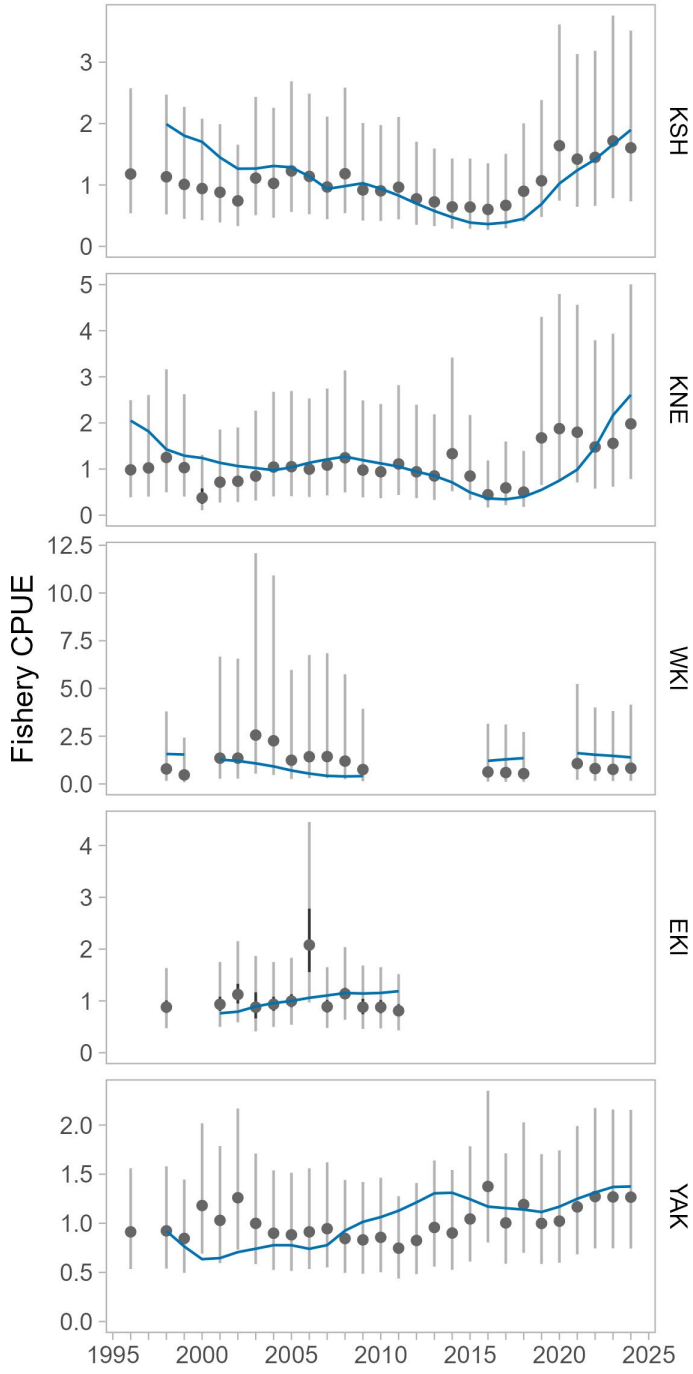
Catch Data

- Round weight, mgmt happens in meat weight
- Round weight less seasonally variable
- Fishery selectivity and retention logistic



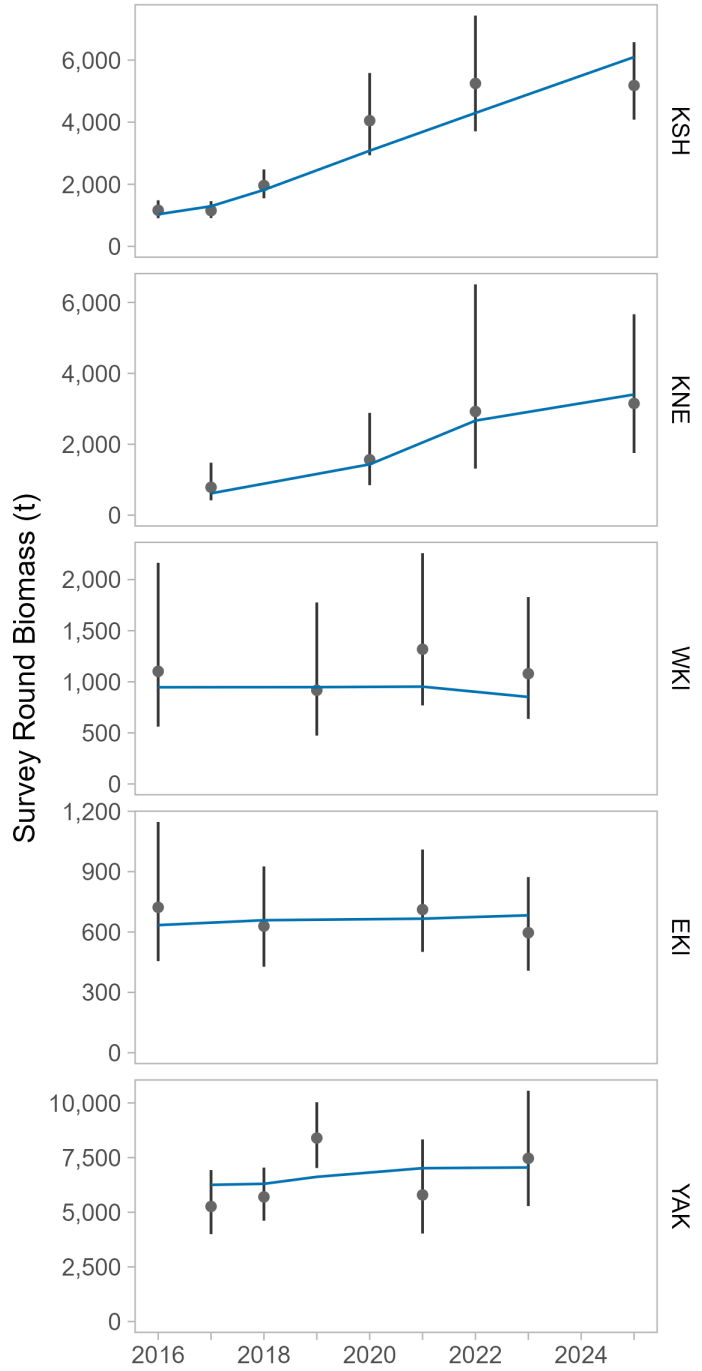
CPUE Data

- GAM CPUE standardization – *for review another day…*
- Catchability estimated, additional CV estimated
- *KNE and YAK contain multiple beds that are fished inconsistently*



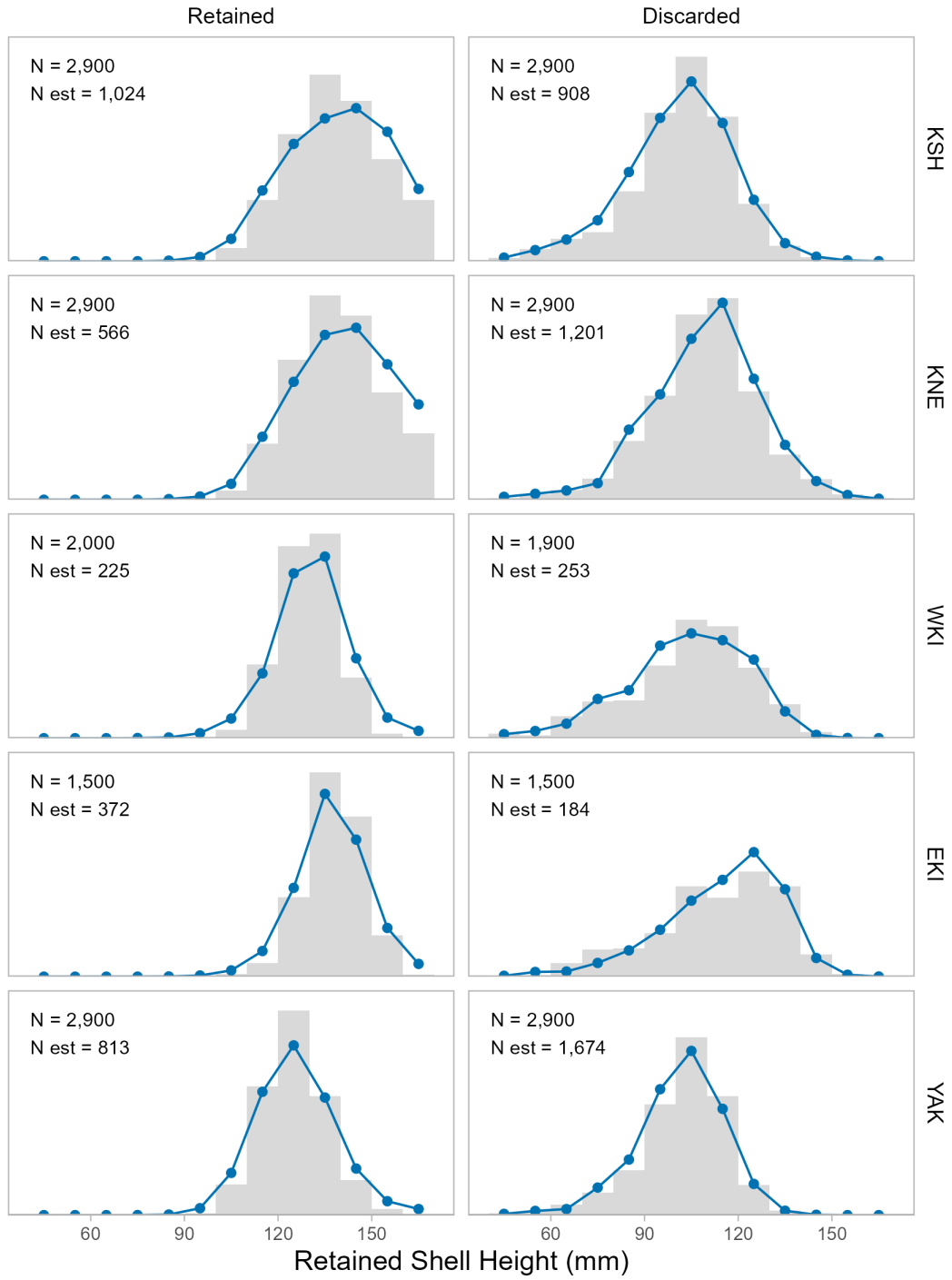
Survey Biomass

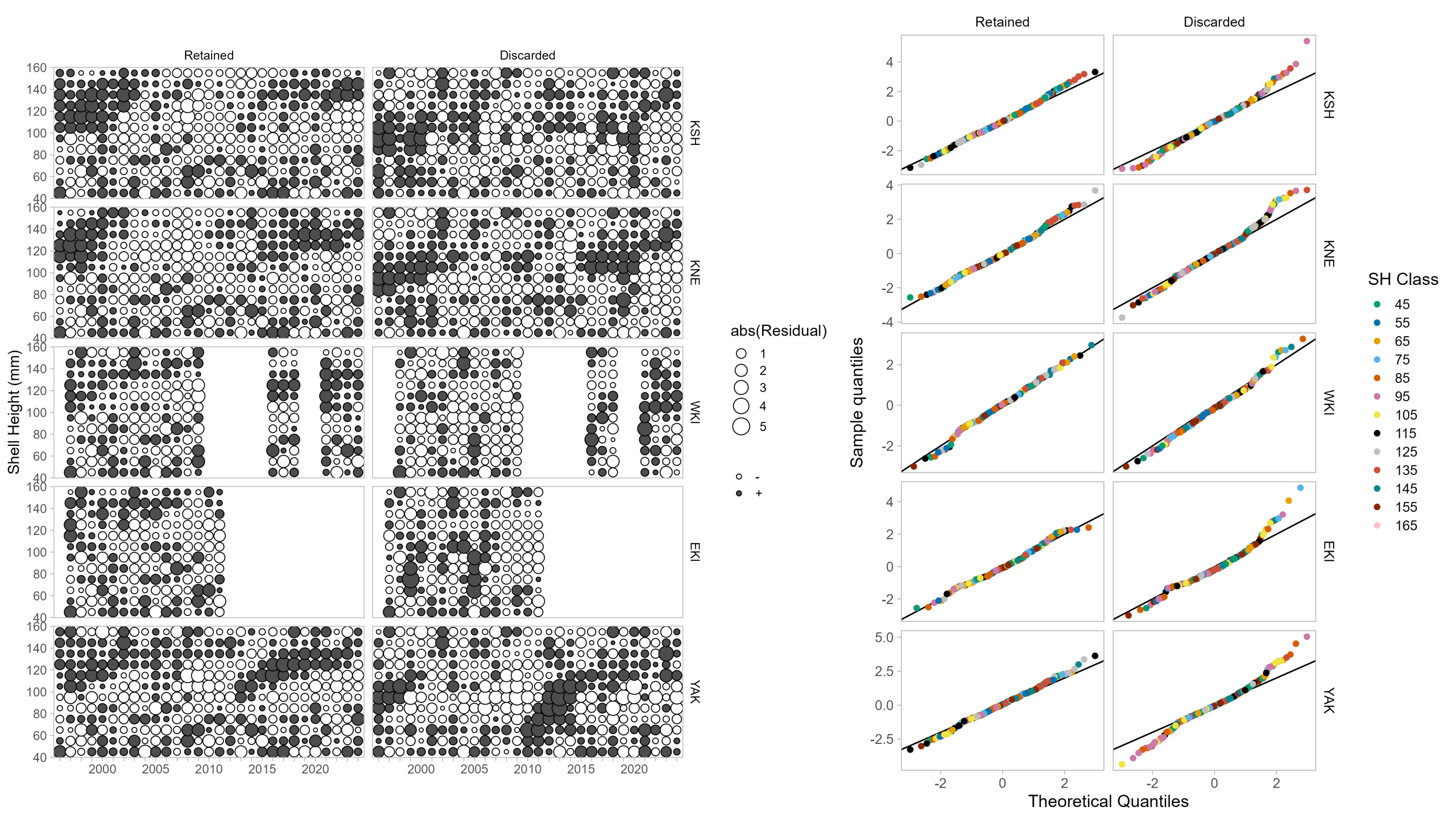
- All scallops > 41 mm SH
- No retention
- Catchability = 1
- Logistic selectivity



Fishery Size

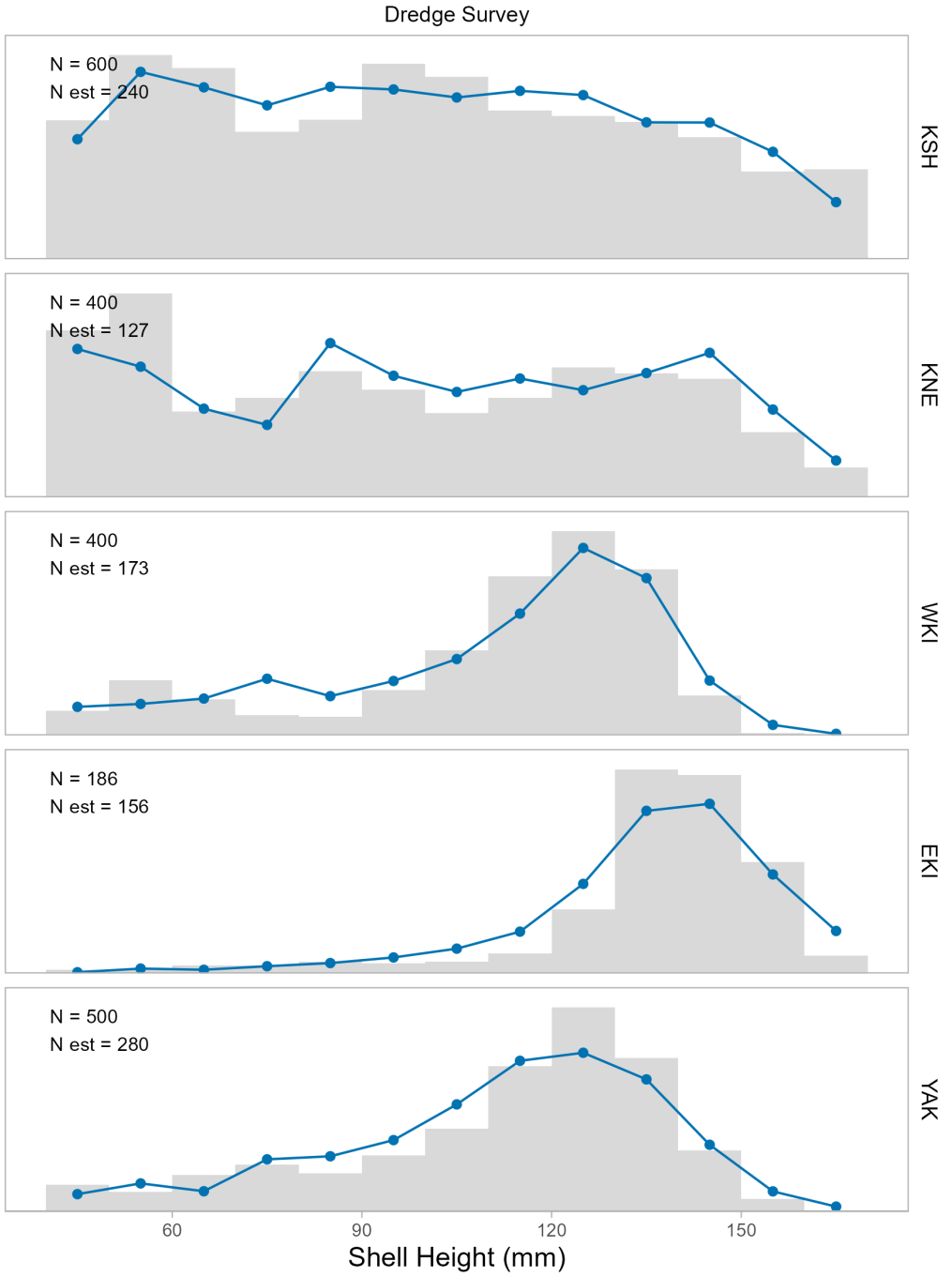
- Dirichlet multinominal
- Input N = 100

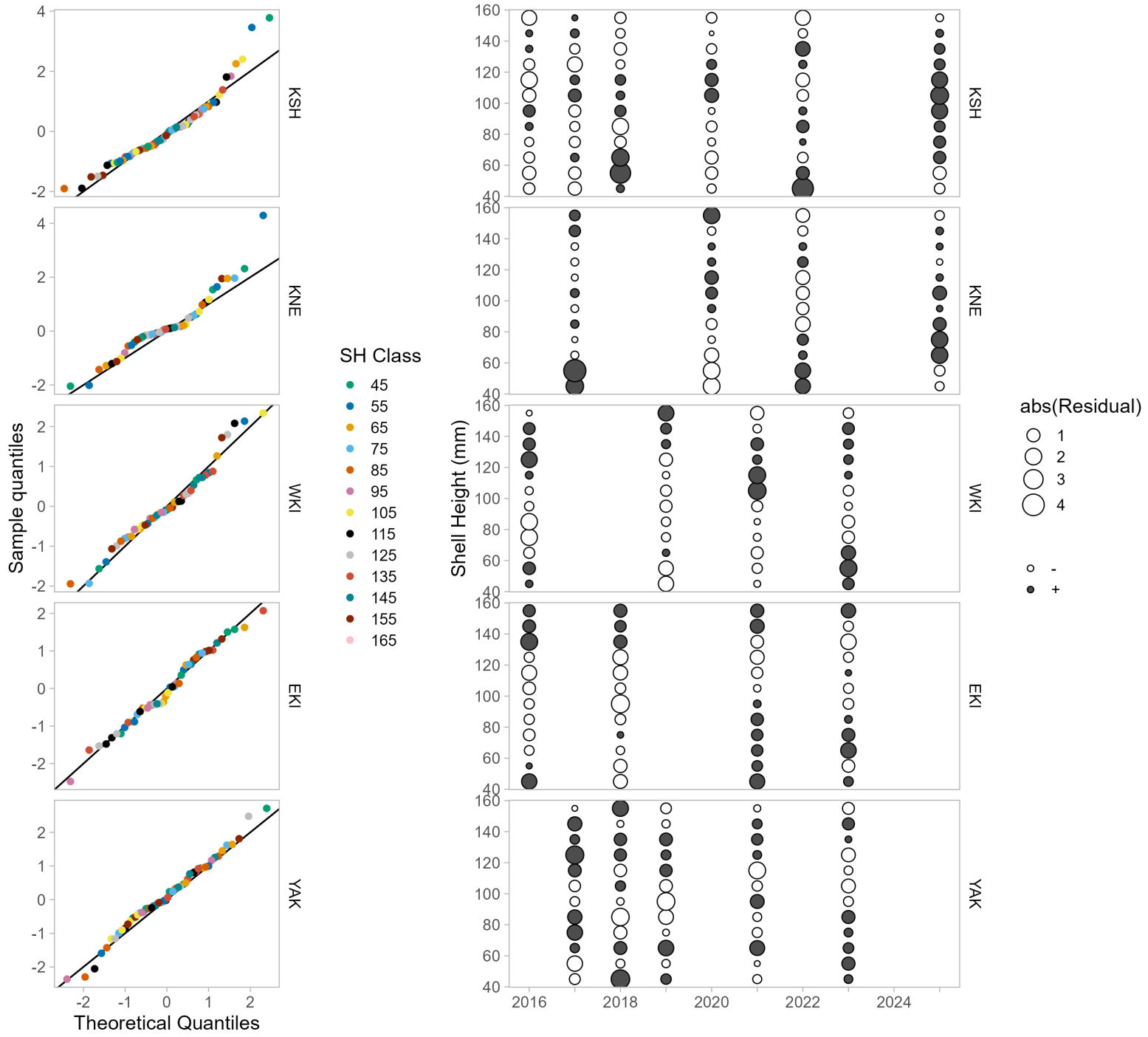



Retained
Discarded
KSH
KNE
WKI
EKI
YAK
Shell Height (mm)
160
140
120
100
80
60
40
2000
2005
2010
2015
2020
abs(Residual)
1
2
3
4
5
-
+
Sample quantiles
Theoretical Quantiles
4
2
0
-2
-4
5.0
2.5
0.0
-2.5
SH Class
45
55
65
75
85
95
105
115
125
135
145
155
165

Survey Size

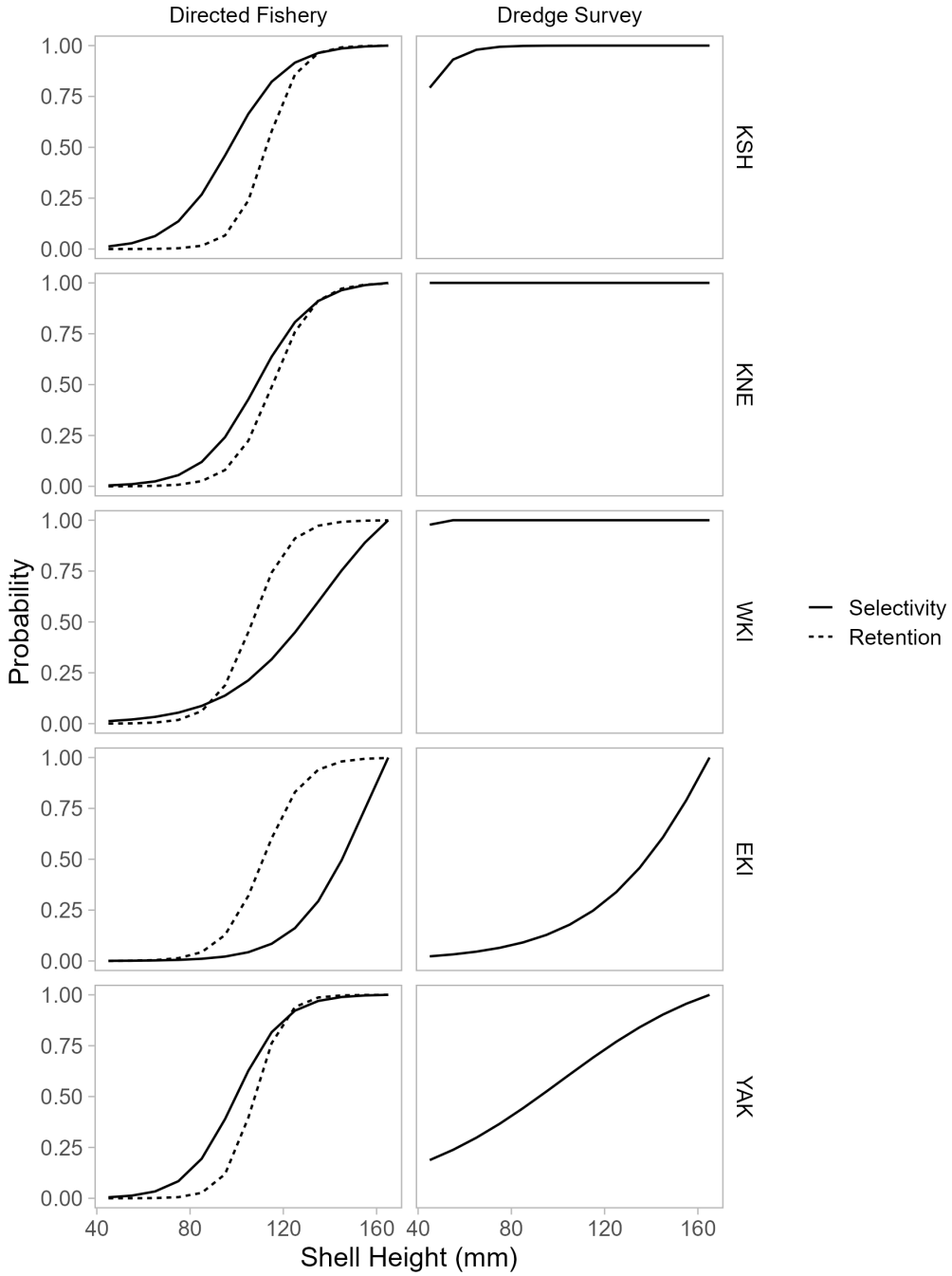
- Dirichlet multinominal
- Input N = 100

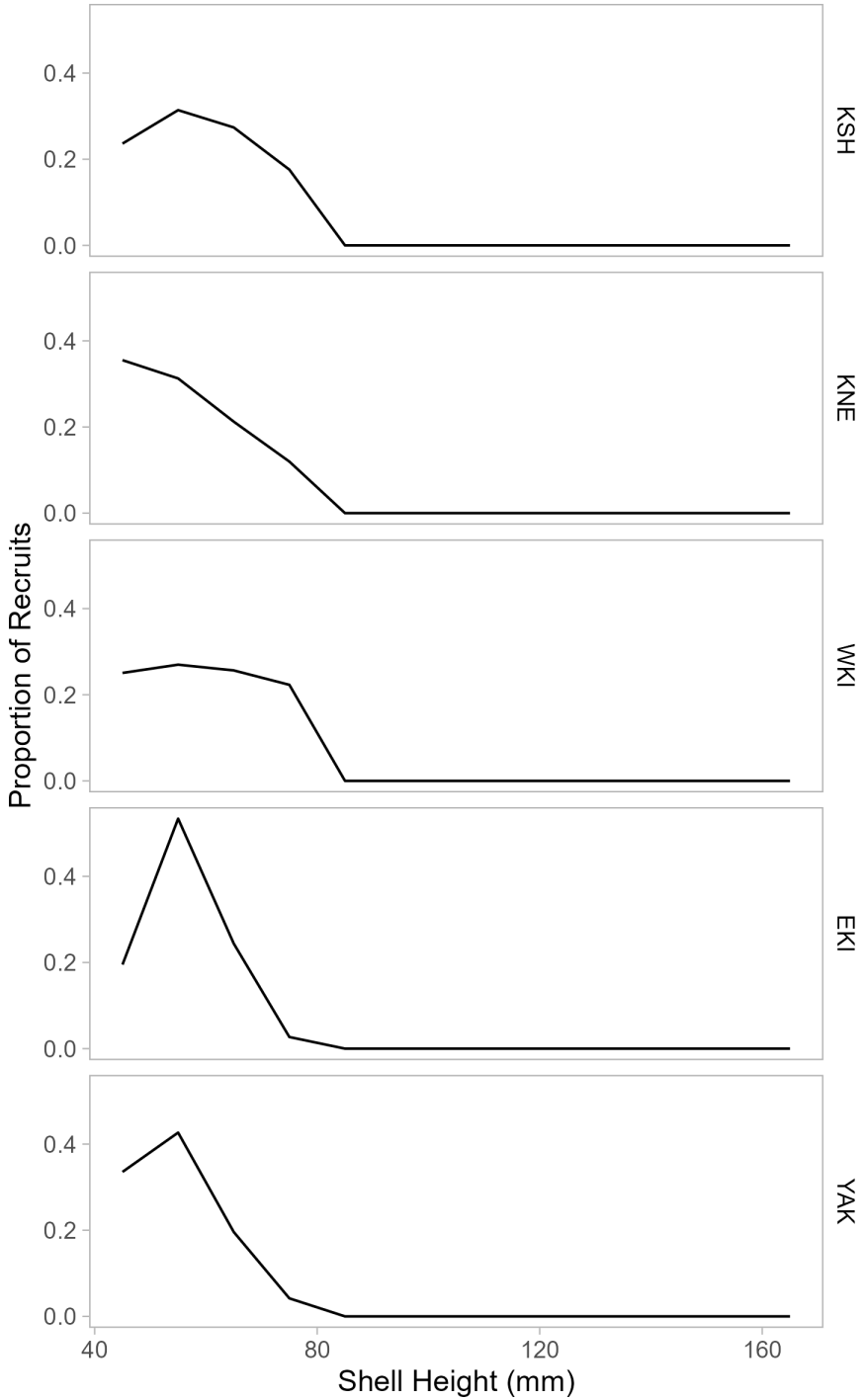


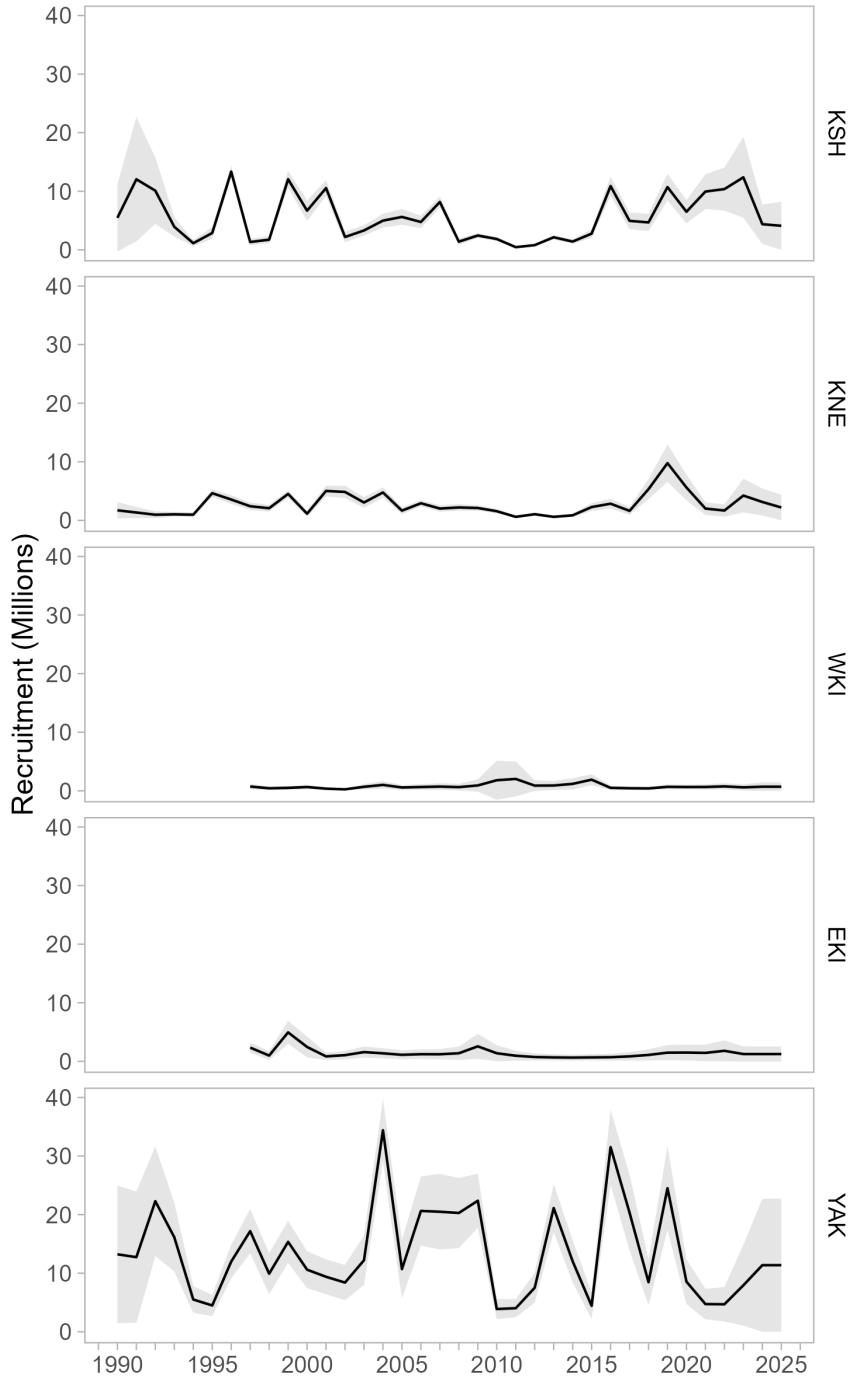

KSH
KNE
WKI
EKI
YAK
Sample quantiles
Theoretical Quantiles
Shell Height (mm)
SH Class
45
55
65
75
85
95
105
115
125
135
145
155
165
abs(Residual)
1
2
3
4
-
+
2016
2018
2020
2022
2024

Selectivity

- Logistic, forced to 1 at 160+
- No retention in survey
- Survey dredge uses 1” mesh liner




Proportion of Recruits
0.0
0.2
0.4
KSH
KNE
WKI
EKI
YAK
40
80
120
160
Shell Height (mm)


Recruitment (Millions)
0
10
20
30
40
KSH
KNE
WKI
EKI
YAK
1990
1995
2000
2005
2010
2015
2020
2025

To – Do list

- Likelihood profiles of scaling parameters
- Refine data weighting
- Refine sigmaR
- HCR, probably borrow from Tier 4, need reference periods

Feedback?

Toss or keep going?

Is CPT willing to provide review in the future? (SPT is lacking quantitative expertise)

Simplicity is key, what level of misspecification is acceptable?