Assessment of BSAI Kamchatka flounder

Meaghan D. Bryan, Thomas K. Wilderbuer,
James Ianelli,
Daniel G. Nichol and Robert Lauth

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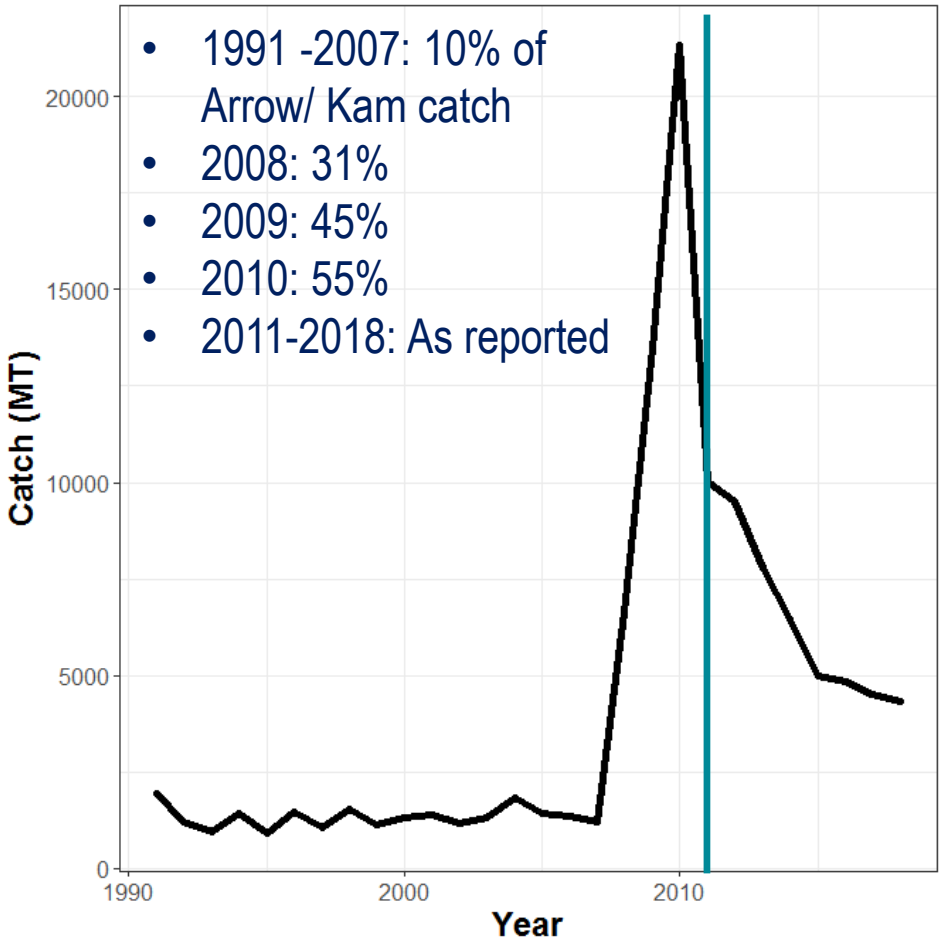
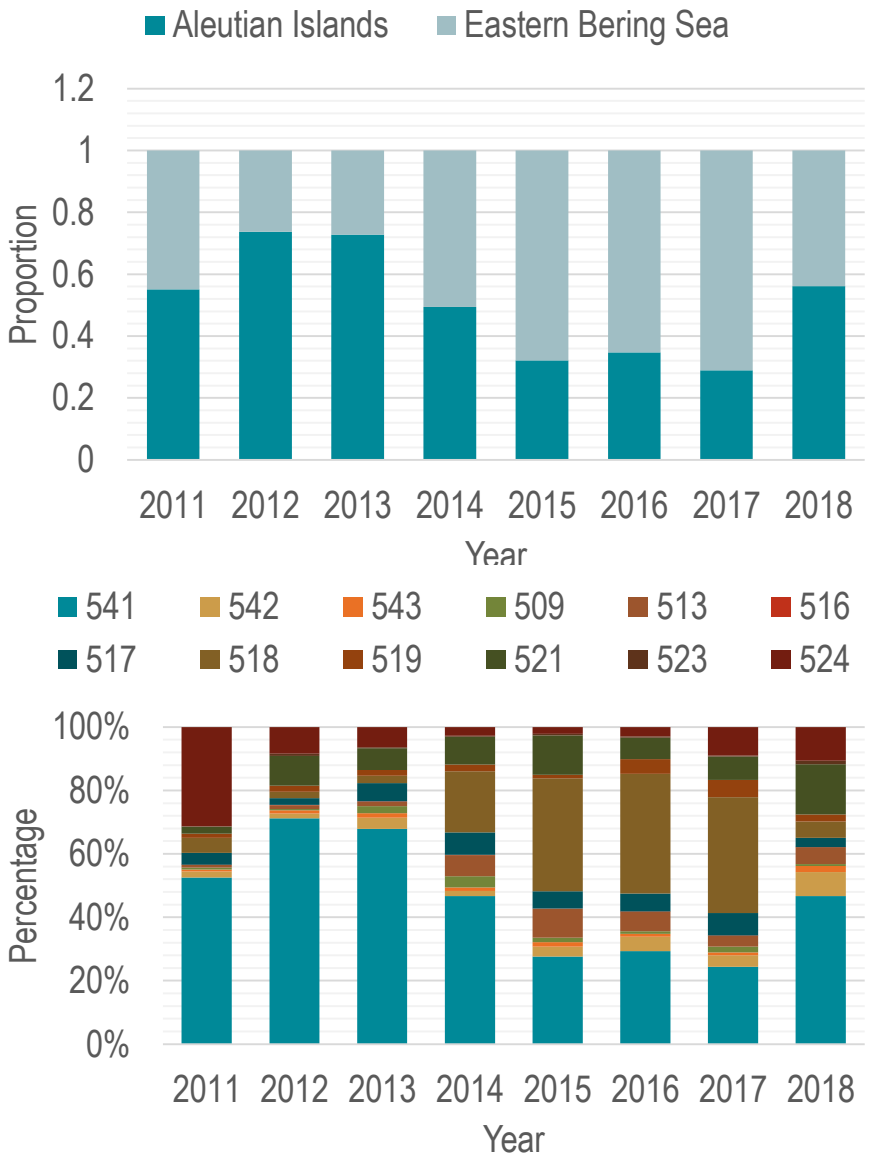
Data

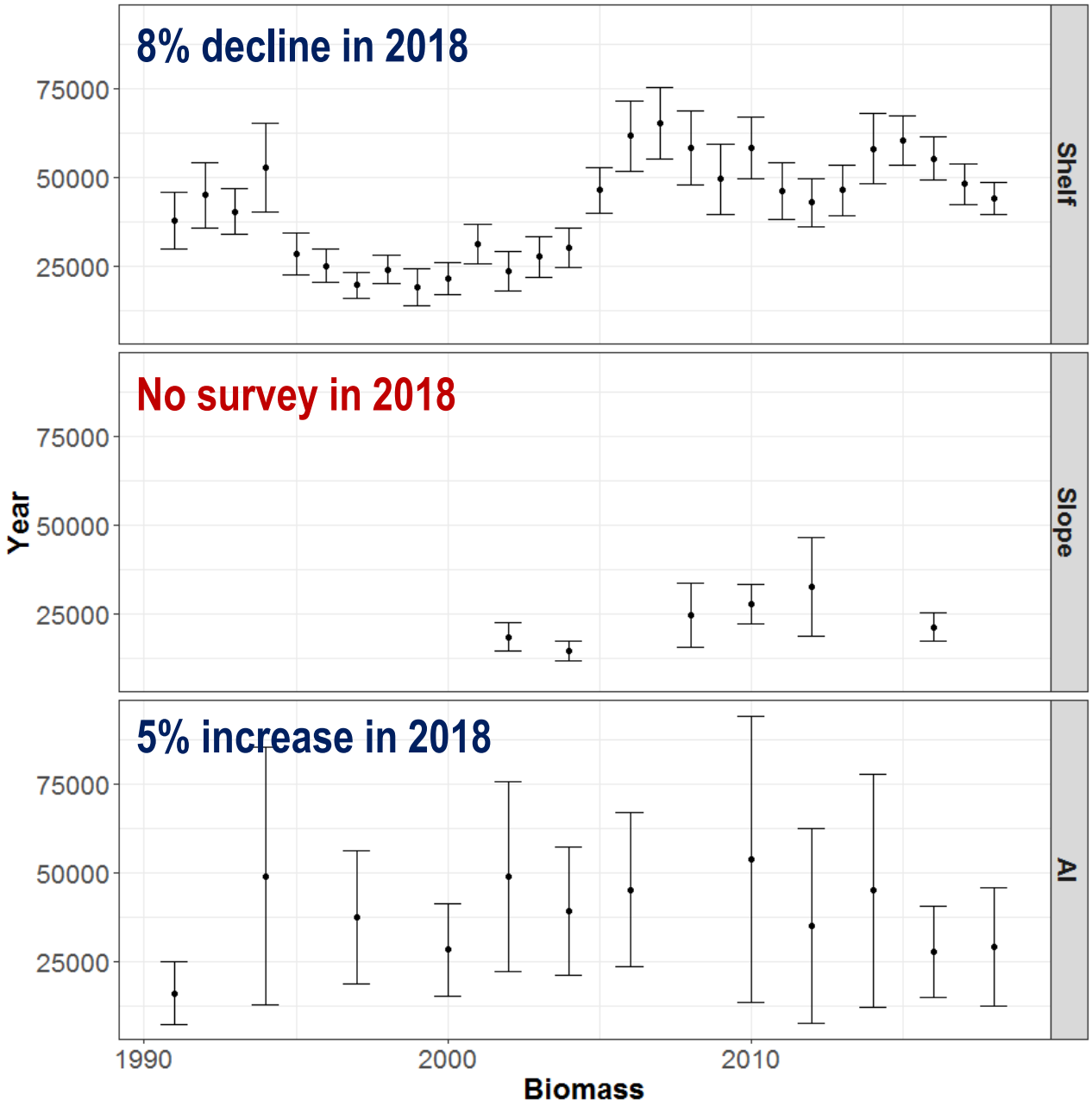
Data Source	Years
Fishery catch	1991 - 2018
Fishery lengths	2008-2011, 2018
Survey biomass	
EBS shelf	1991-2018
EBS slope	2002, 2004, 2008, 2010, 2012, 2016
Aleutian Islands	1991, 1994, 1997, 2000-2018 (biennial)
Survey length composition	
EBS shelf	1991-2018
EBS slope	2004, 2008, 2010, 2016
Aleutian Islands	Same as above without 2010
Survey age composition	
EBS slope	2002, 2012
Aleutian Islands	2010

Catch


• 1991 -2007: 10% of Arrow/ Kam catch
• 2008: 31%
• 2009: 45%
• 2010: 55%
• 2011-2018: As reported
Catch (MT)
20000
15000
10000
5000
0
1990
2000
2010
Year

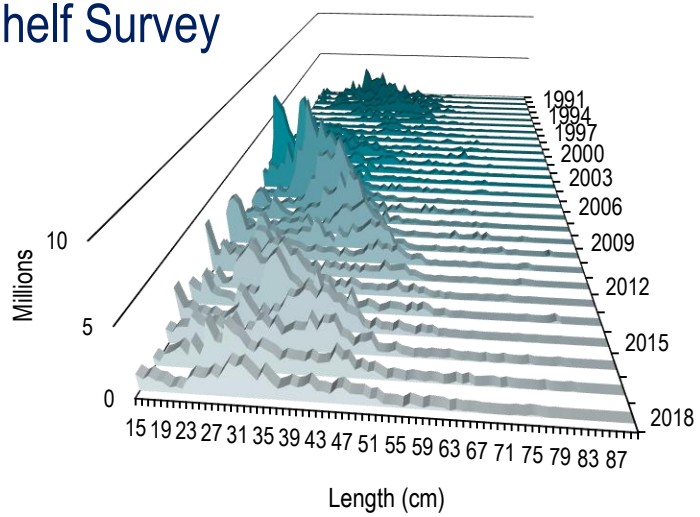

Aleutian Islands
Eastern Bering Sea
Proportion
1.2
1
0.8
0.6
0.4
0.2
0
2011 2012 2013 2014 2015 2016 2017 2018
Year
541 542 543 509 513 516
517 518 519 521 523 524
Percentage
100%
80%
60%
40%
20%
0%
2011 2012 2013 2014 2015 2016 2017 2018
Year

Survey biomass

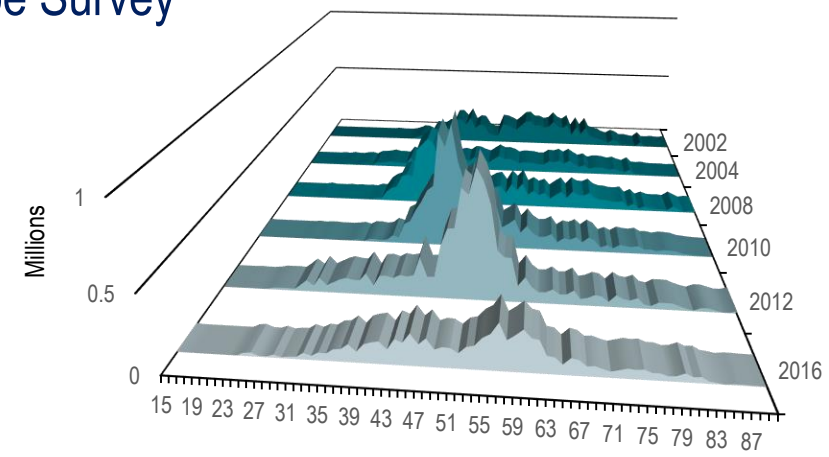


Female length composition

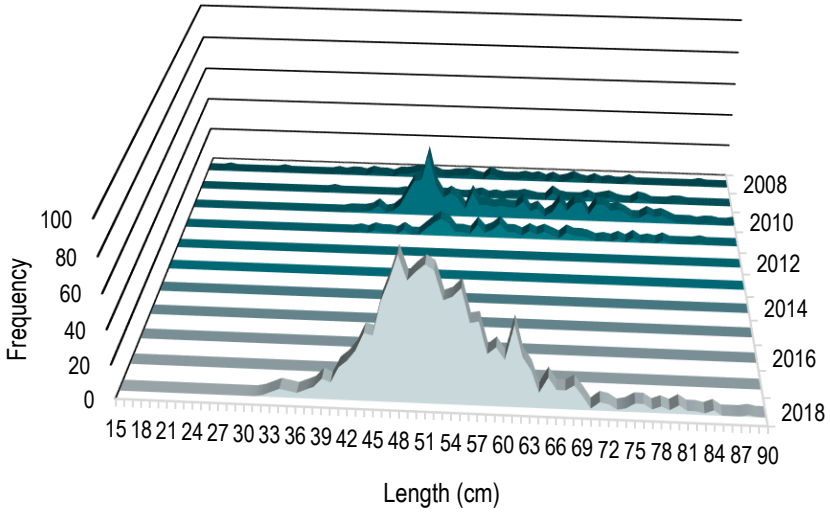
Shelf Survey



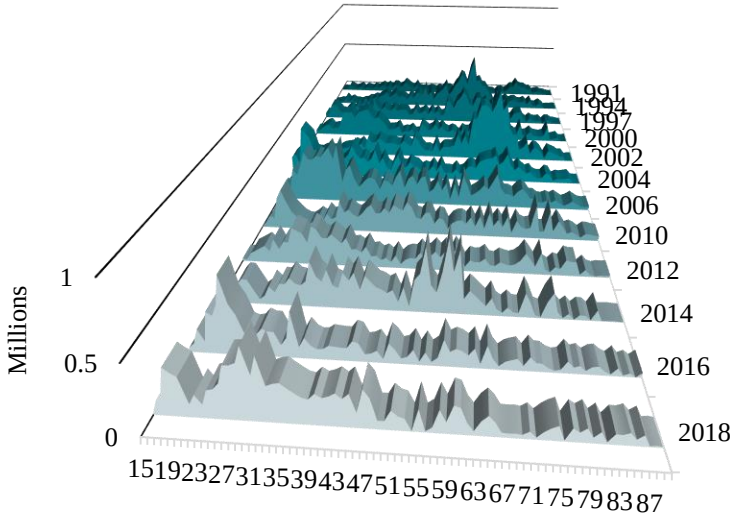
Slope Survey



Fishery

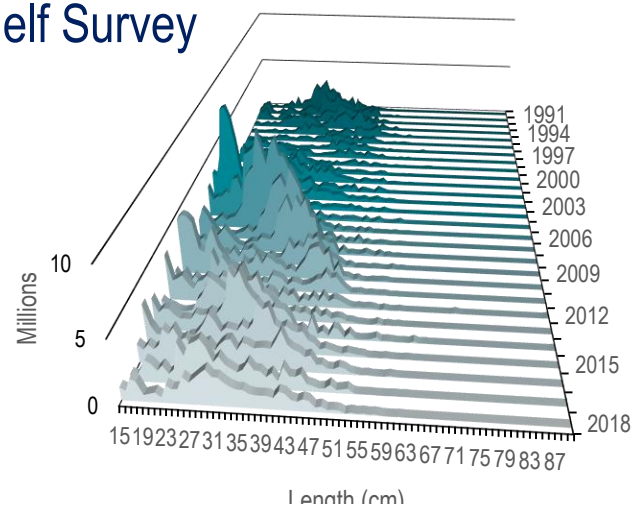


AI Survey

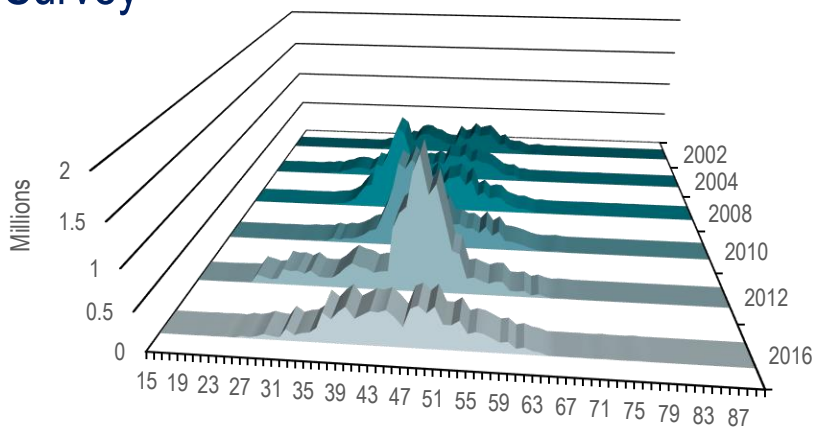


Male length composition

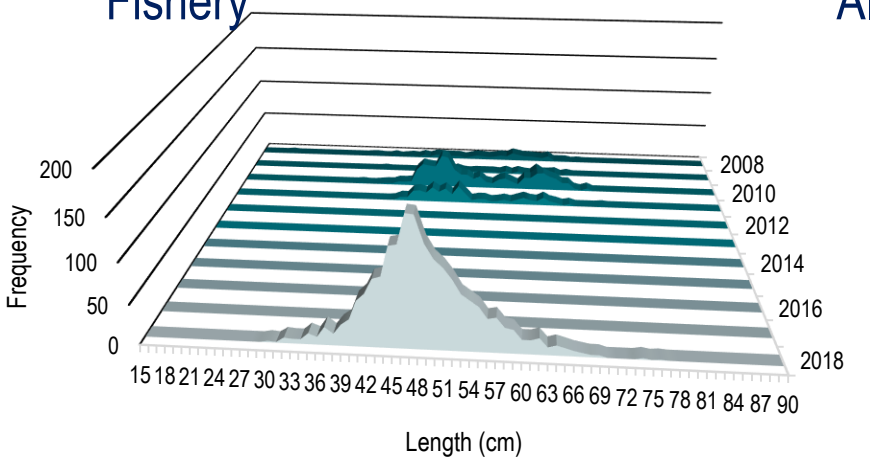
Shelf Survey



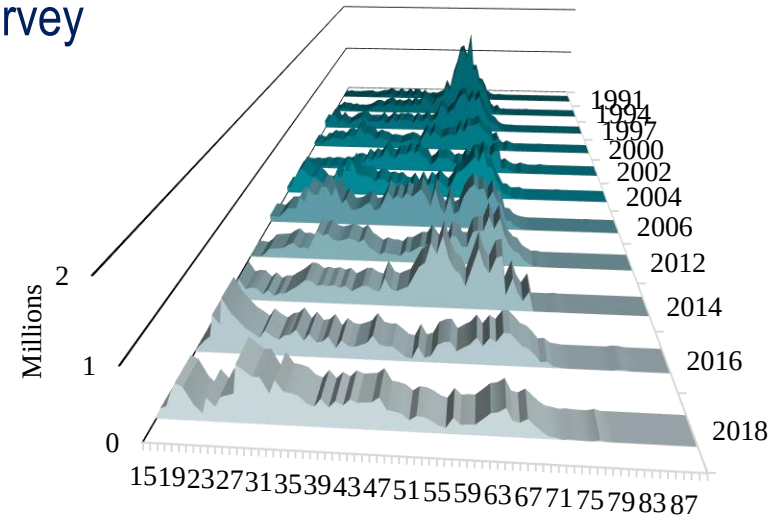
Slope Survey



Fishery

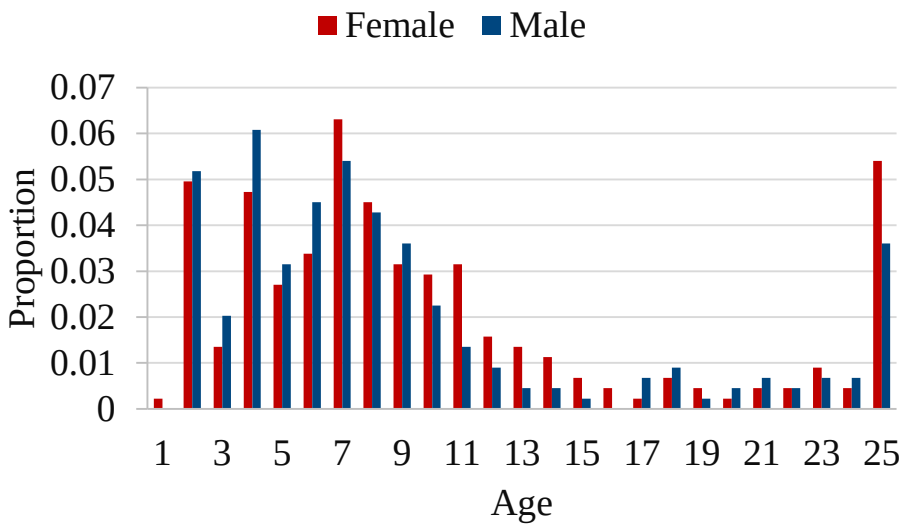


AI Survey

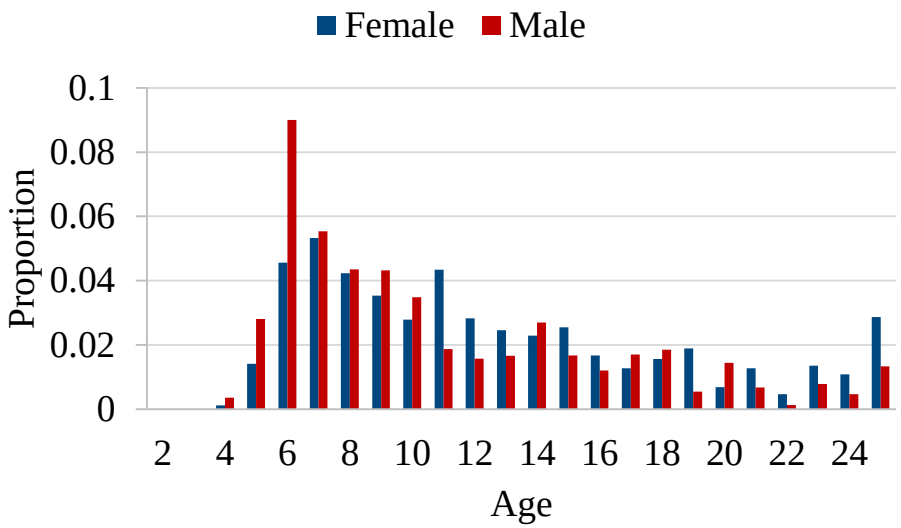


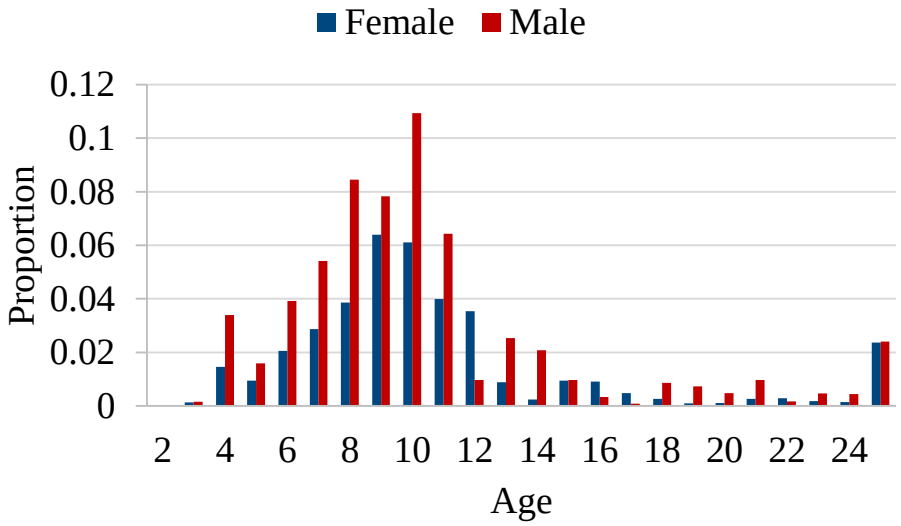
Age composition

Aleutian Islands 2010



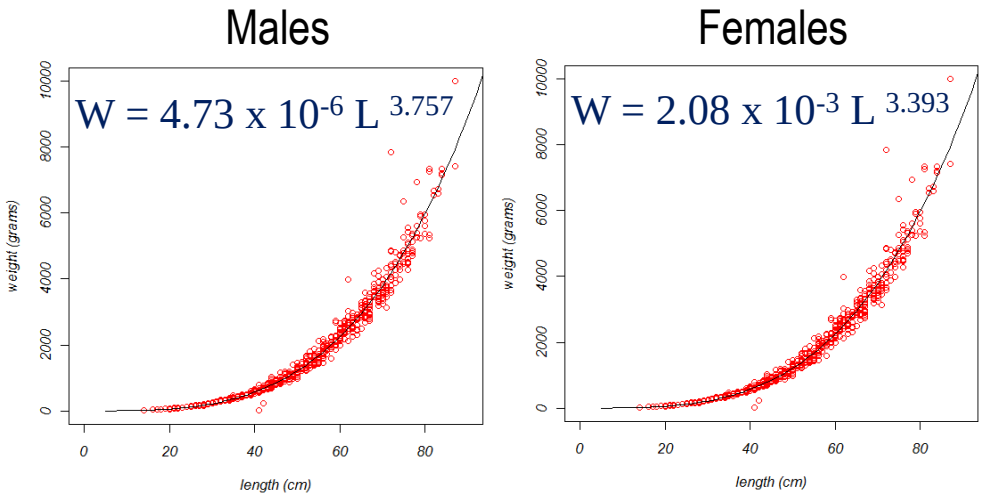
EBS slope survey 2002 and 2012

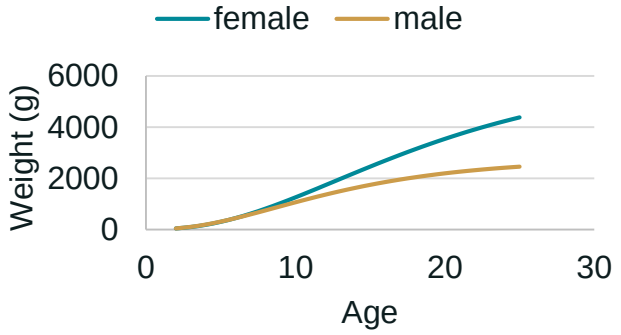


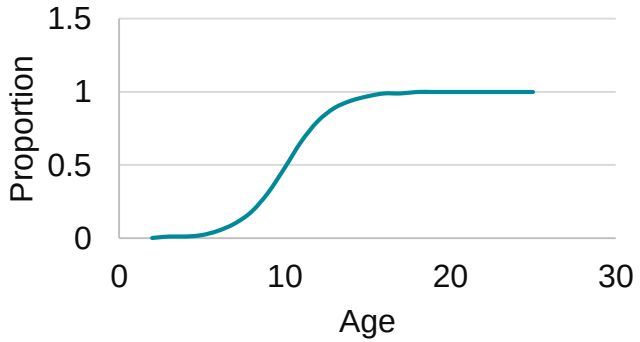


Base model structure

- Model developed in AD Model Builder
- Age structured model
  - Sex-specific
  - Fishery and survey length observations were transformed by an age-length transition matrix
    - Growth estimated outside of the model
  - Fixed parameters
    - Maturity (Stark, 2011)
    - Length-weight
    - Weight-at-age
    - Natural mortality – 0.11







Base model

- Aged based selectivity
  - Logistic pattern
    - Fishery
      - Slope parameter fixed
      - Inflection parameter estimated
    - EBS slope survey
      - Slope and inflection parameters estimated
    - Aleutian Islands survey
      - Slope and inflection parameters estimated
  - Double logistic
    - EBS shelf survey
      - Allowed for dome-shaped selectivity
      - All parameters were estimated
- Catchability
  - EBS shelf and Aleutian Islands surveys – estimated
  - EBS slope fixed at 0.18

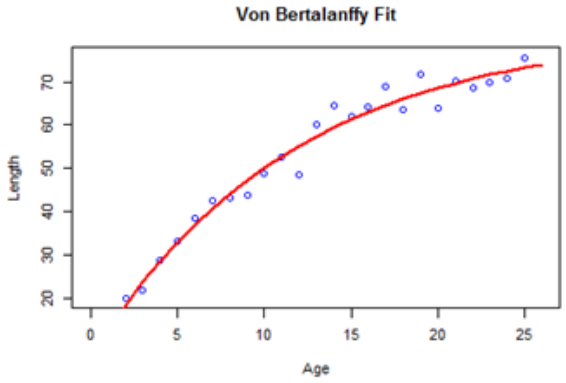
Base model

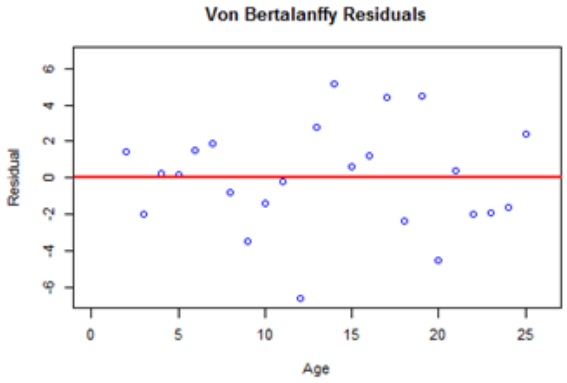
- Recruitment
  - Mean log recruitment and recruitment deviations are estimated
- Fishing mortality
  - Mean and annual deviations are estimated
- Data weighting
  - Catch data emphasized to reduce observation error
  - Fishery length data down weighted relative to survey length data
    - Input sample size for fishery was 25
    - Input sample size for surveys was 200

Alternative models

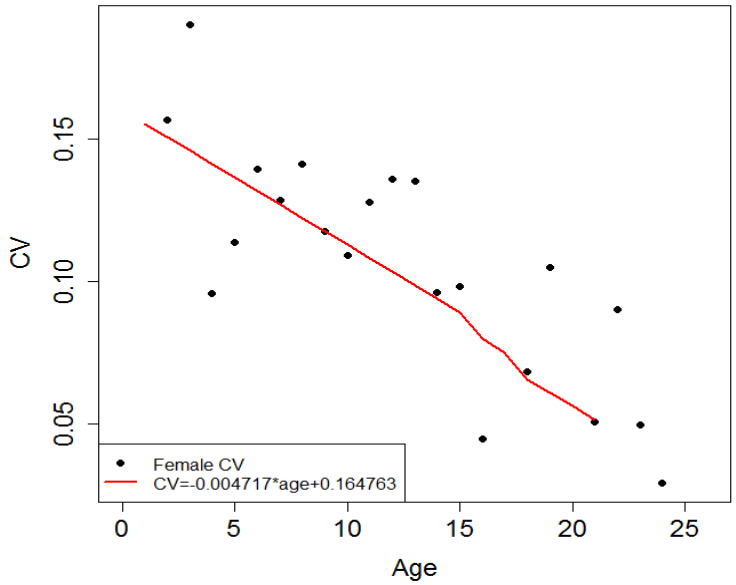
- Model 16.0a
  - Underlying structure the same as model 16.0
  - All data were updated
- Model 16.0b
  - Underlying structure the same as model 16.0
  - All data were updated
  - Age-length transition matrix
    - CV declined with age

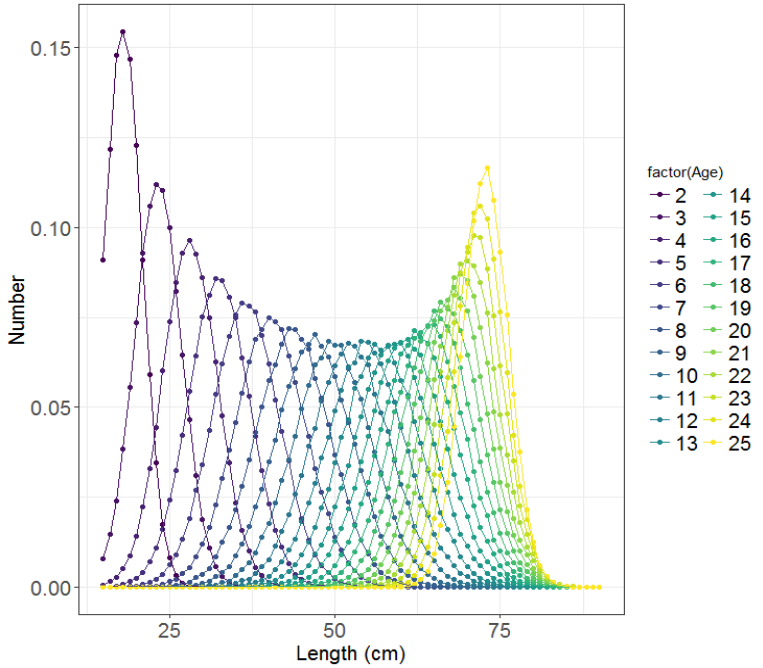
Age-length transition matrices: Female



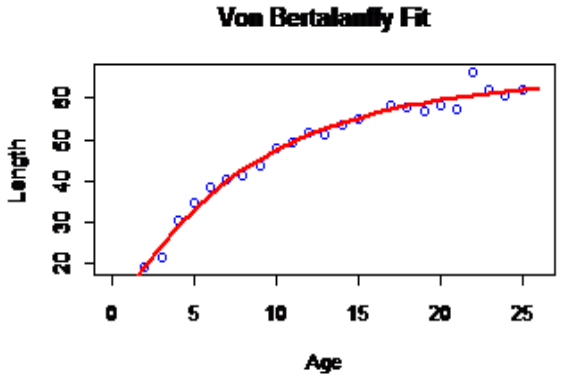


Year	L_∞	k	t_0
2018	82.59	0.084	-1.10
2016	82.00	0.086	-0.97

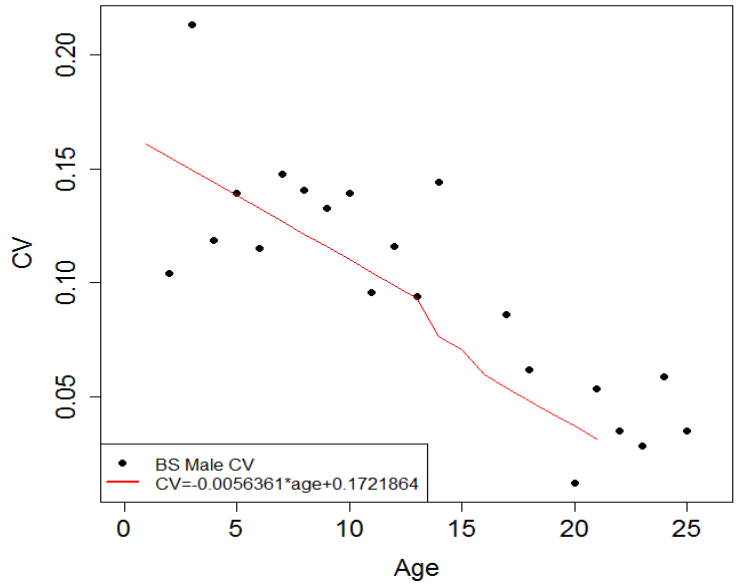


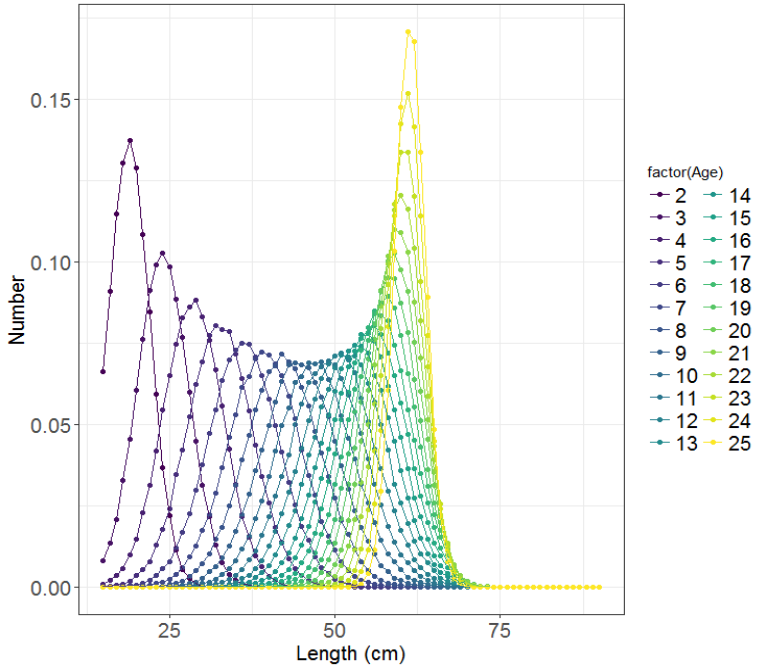


Age-length transition matrices: Male



Year	L_∞	k	t_0
2018	64.68	0.120	-0.96
2016	63.72	0.122	-0.92



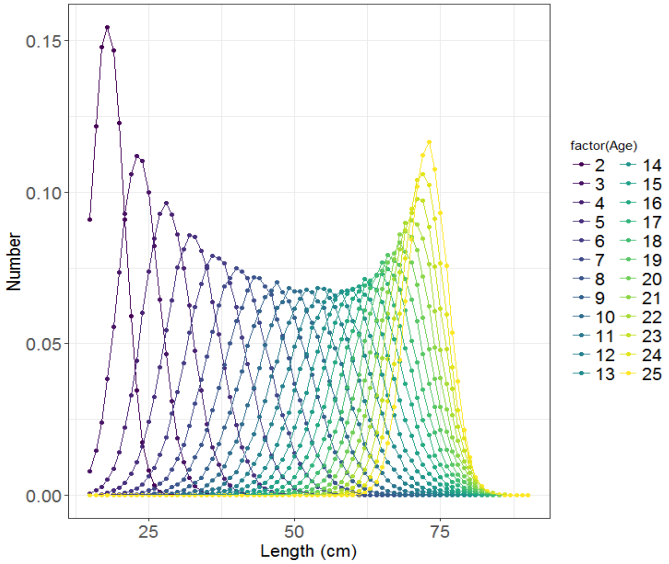


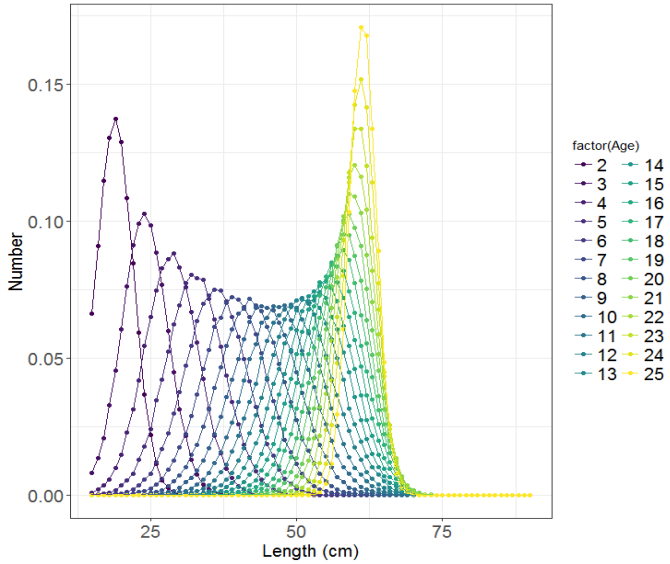
Transition matrix comparison

Female

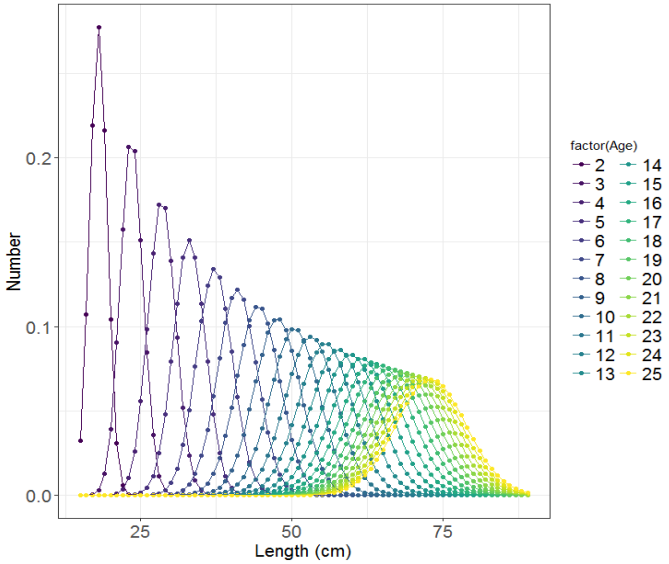
Male

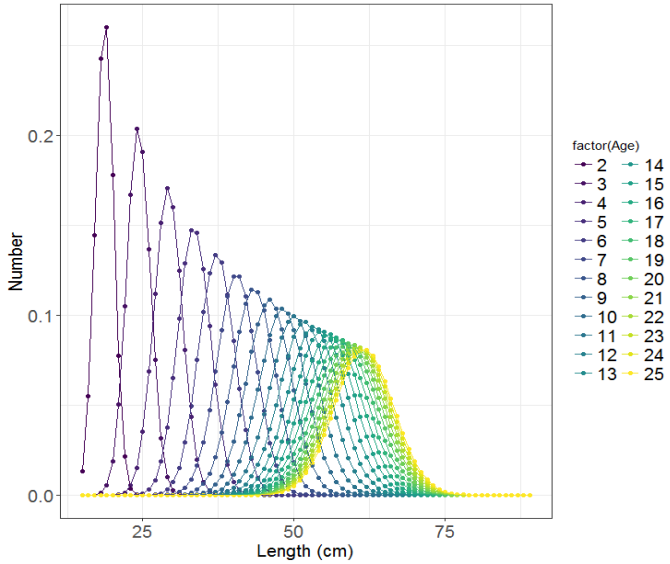
Model 16.0b



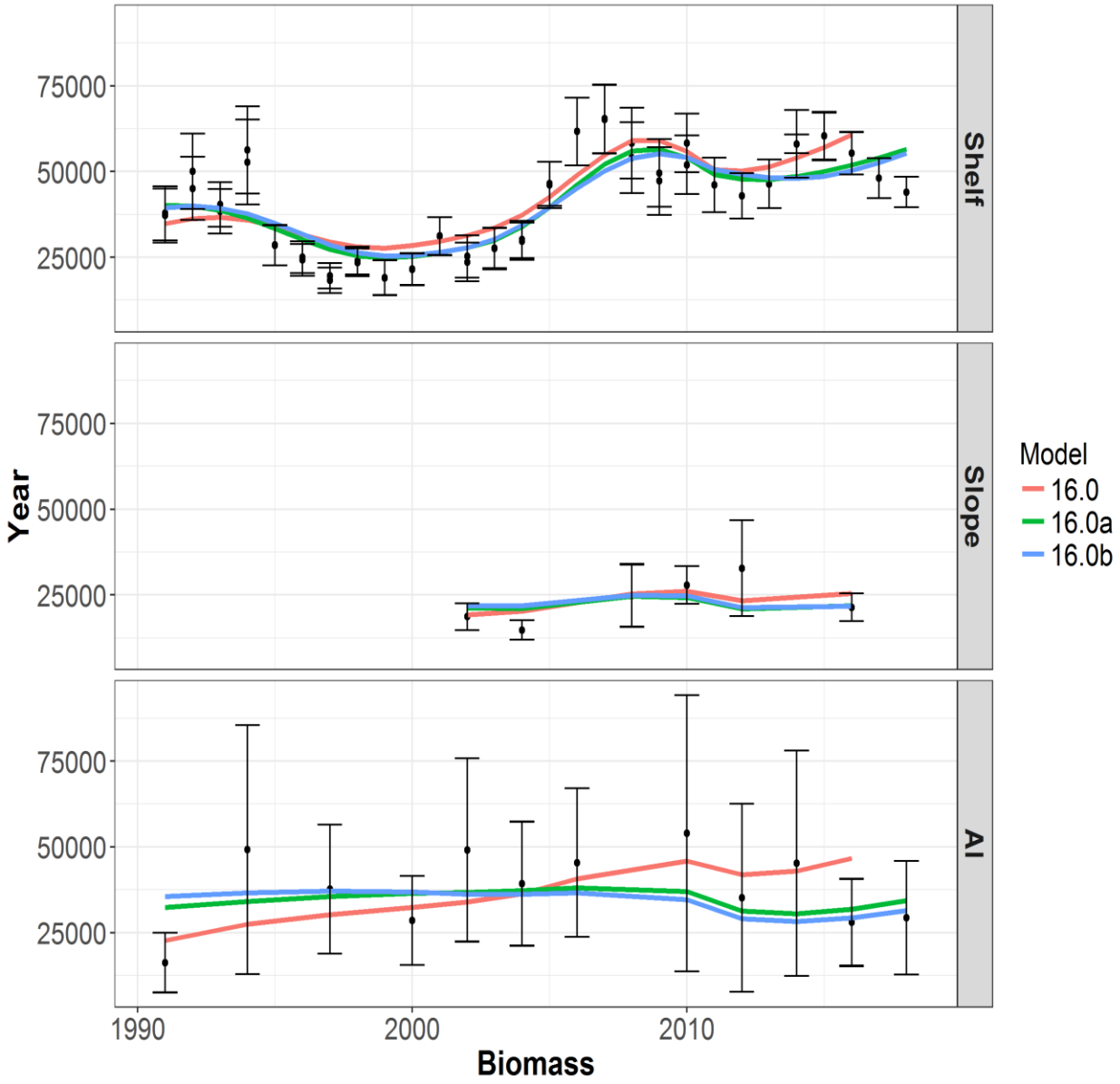


Model 16.0a



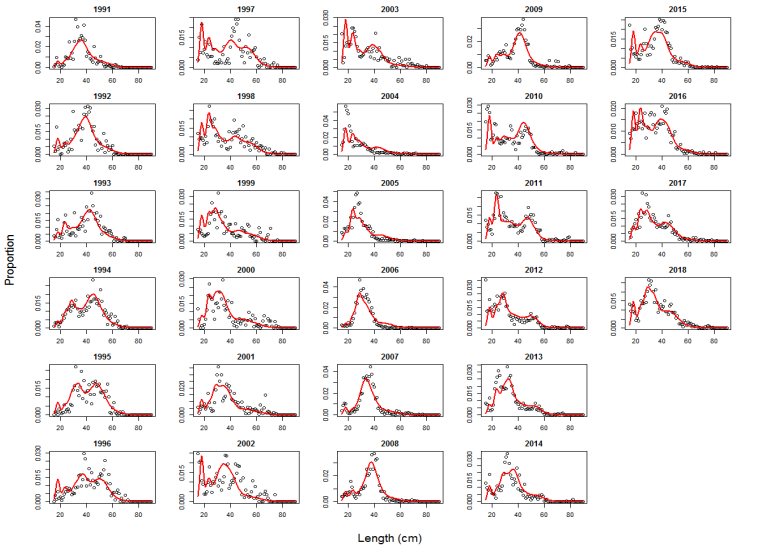


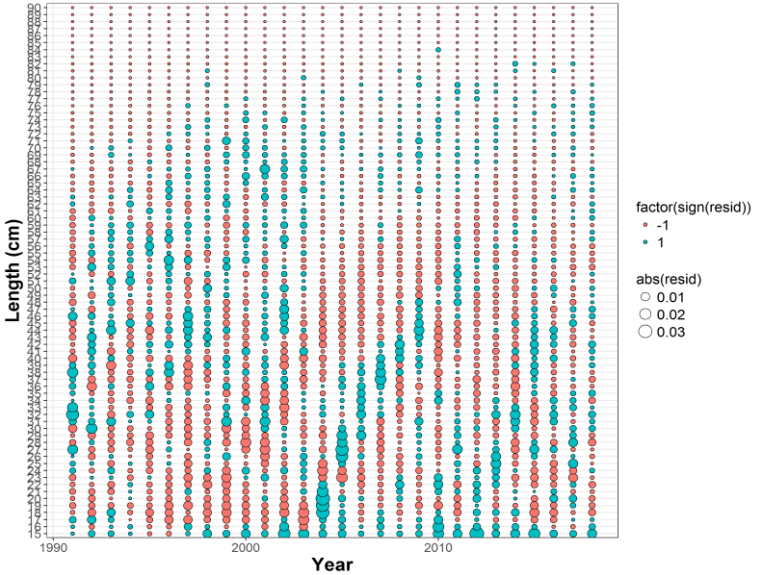
Model fit to survey biomass indices



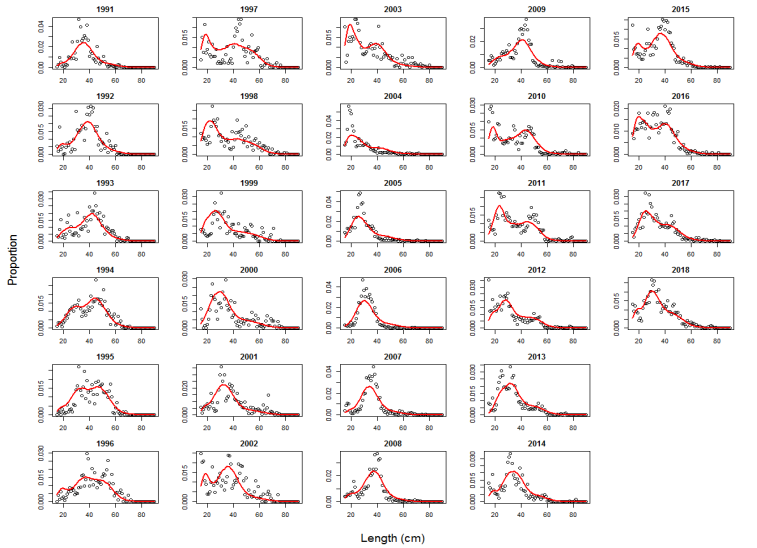
EBS shelf survey length estimates: Females

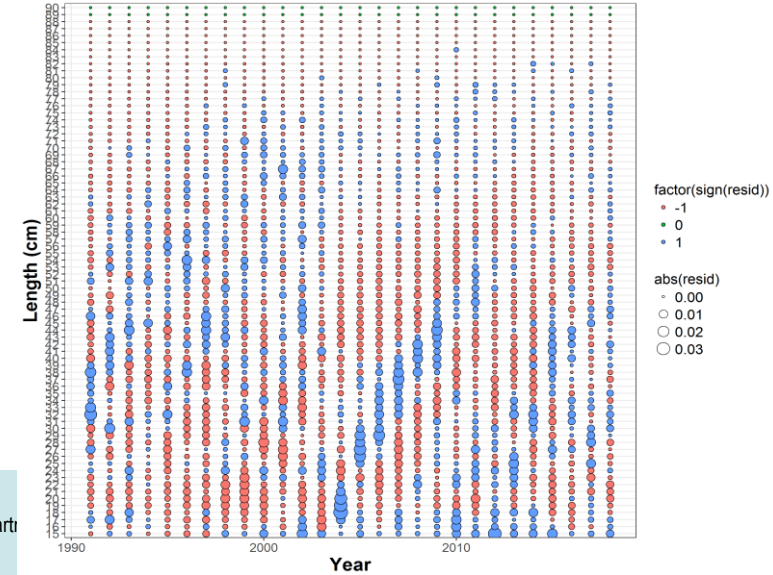
Model 16.0a





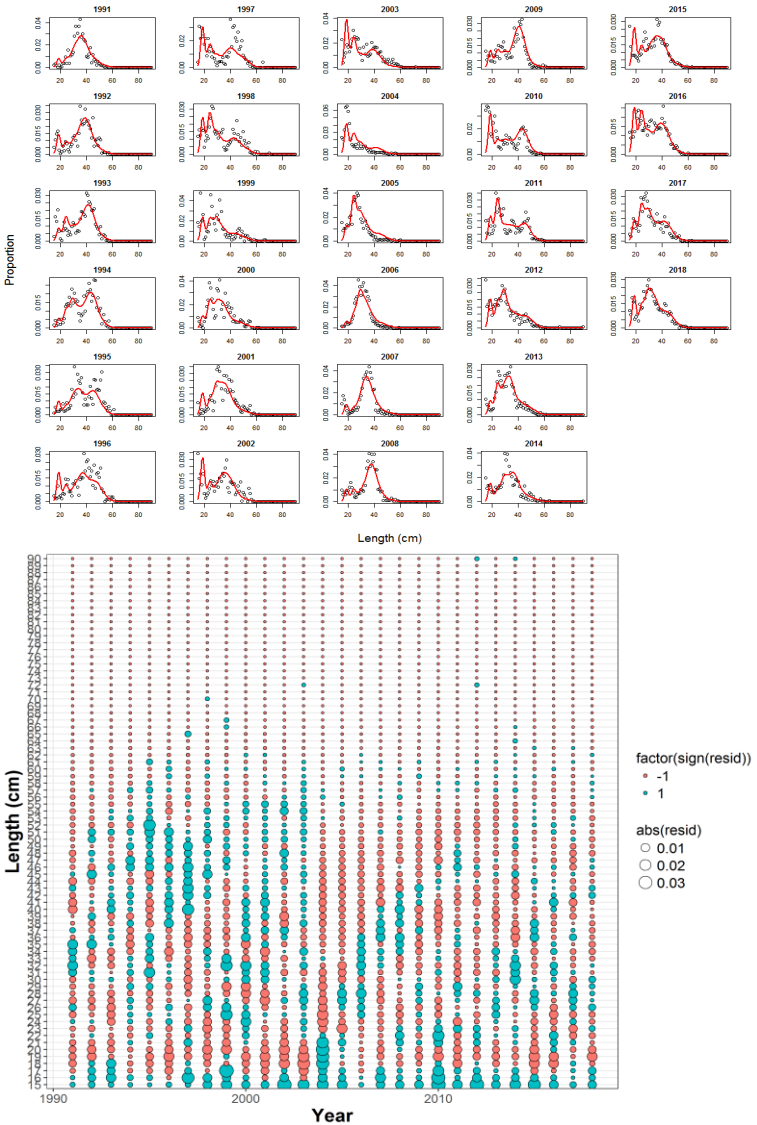
Model 16.0b



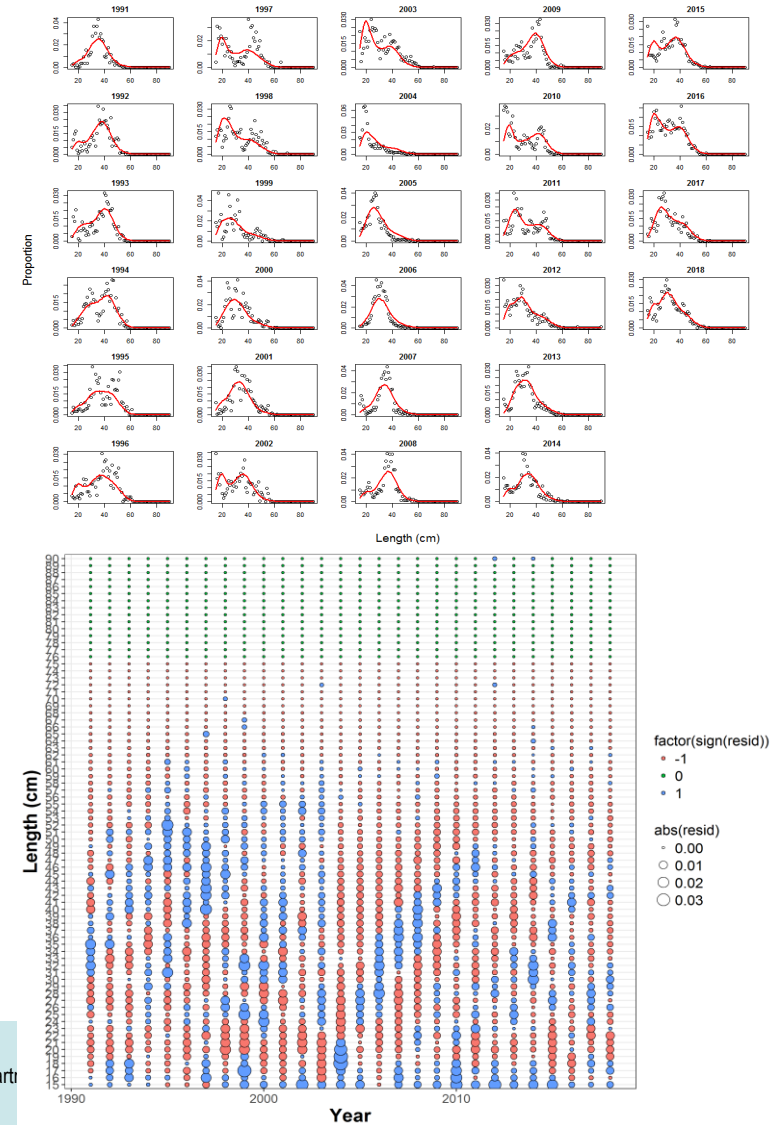


EBS shelf survey length estimates: Males

Model 16.0a

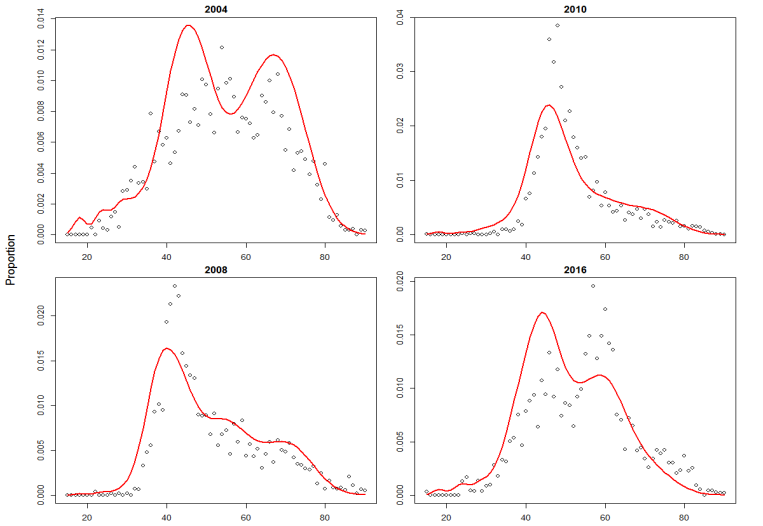


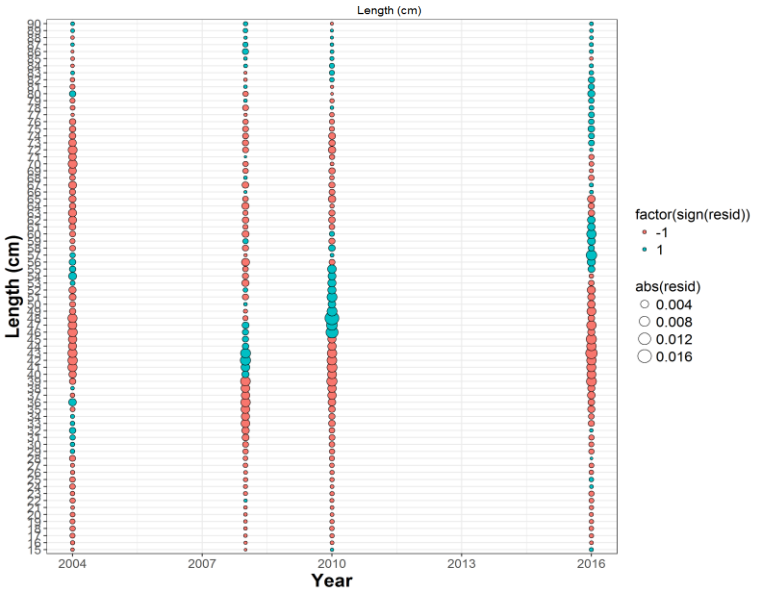
Model 16.0b



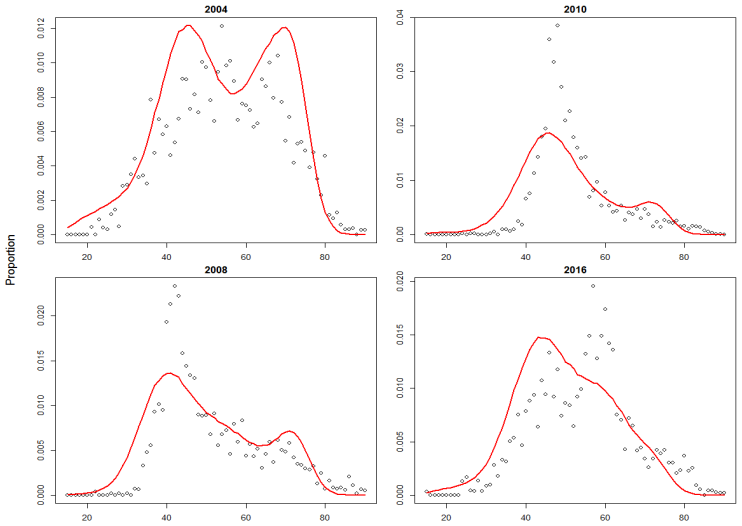
EBS slope survey length estimates:Females

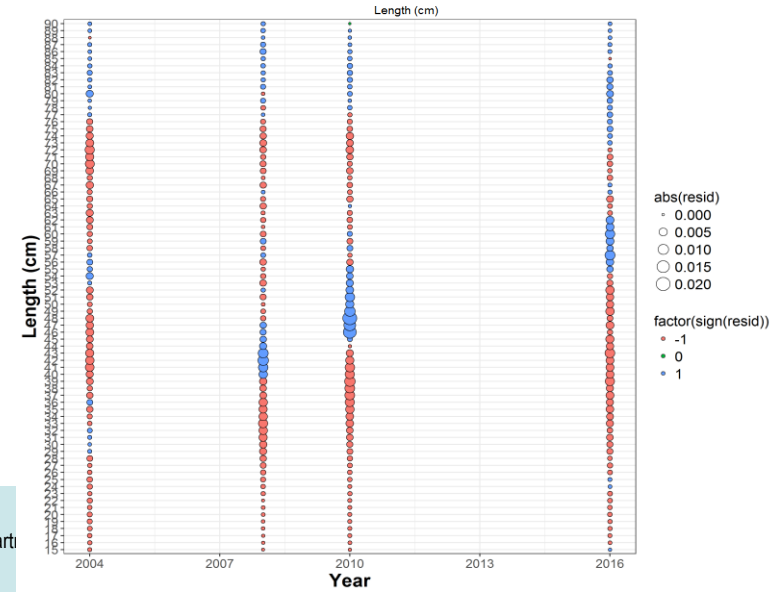
Model 16.0a





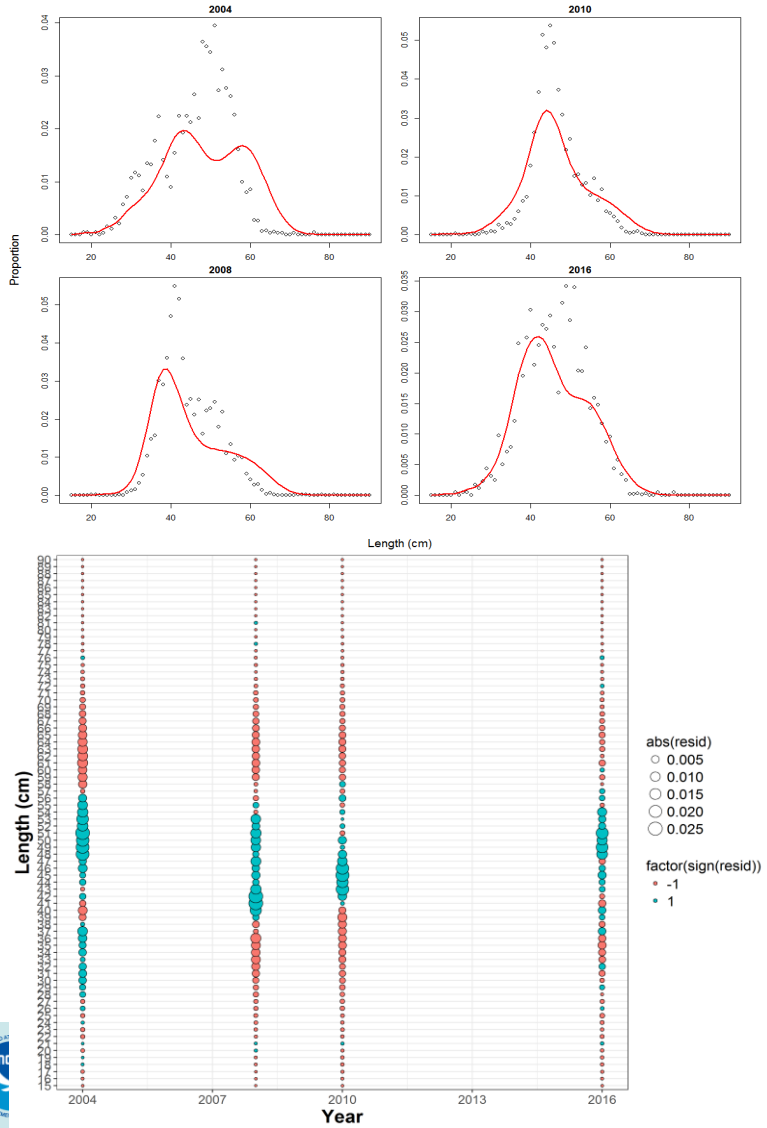
Model 16.0b



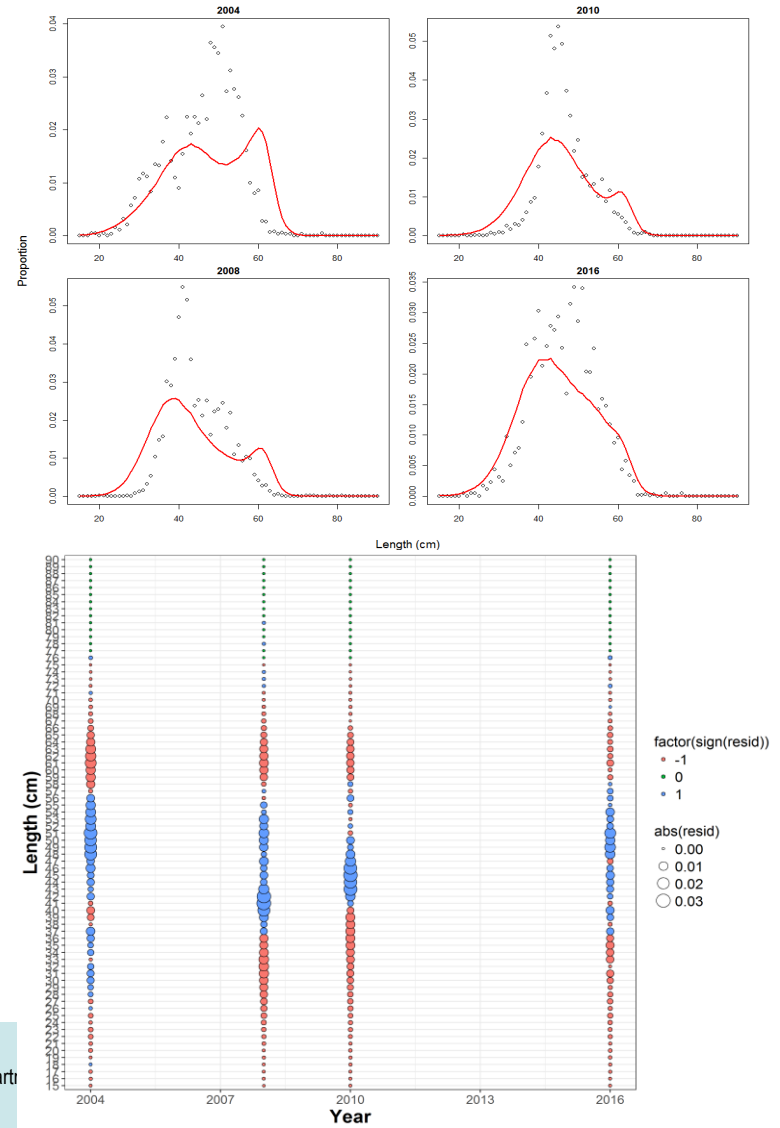


EBS slope survey length estimates: Males

Model 16.0a

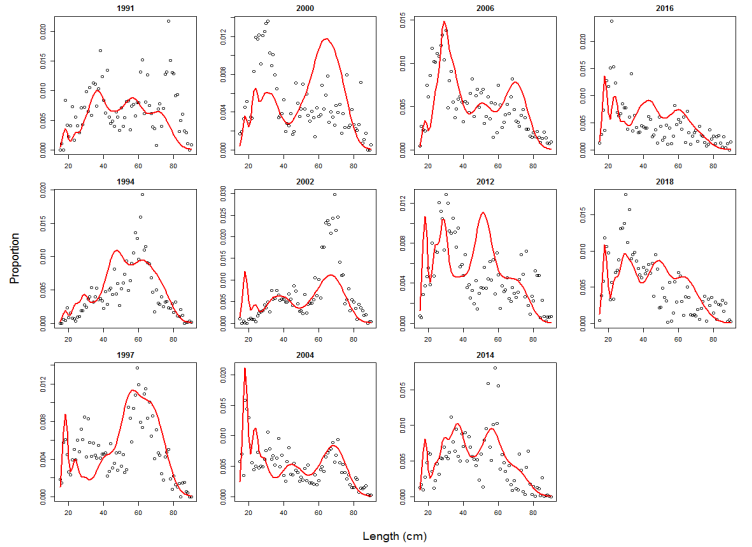


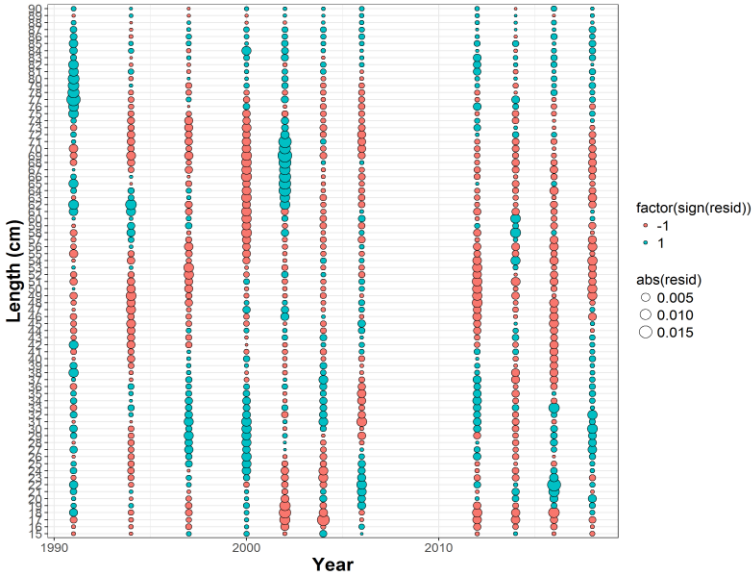
Model 16.0b



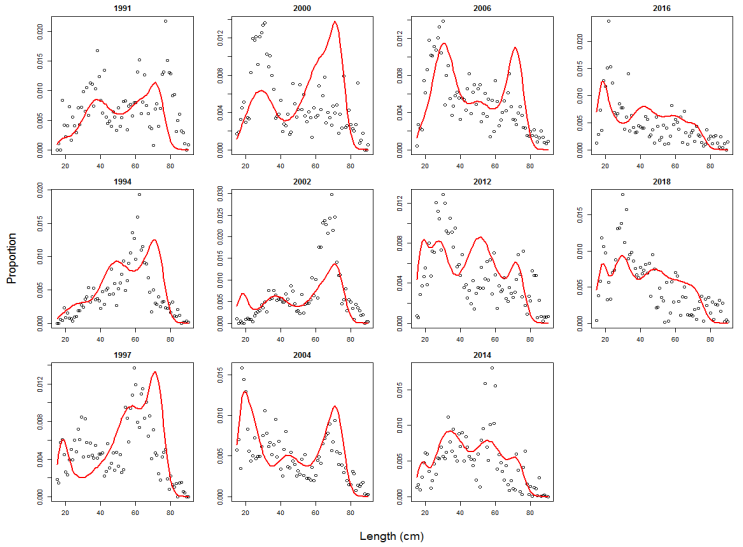
Aleutian Islands survey length estimates: Females

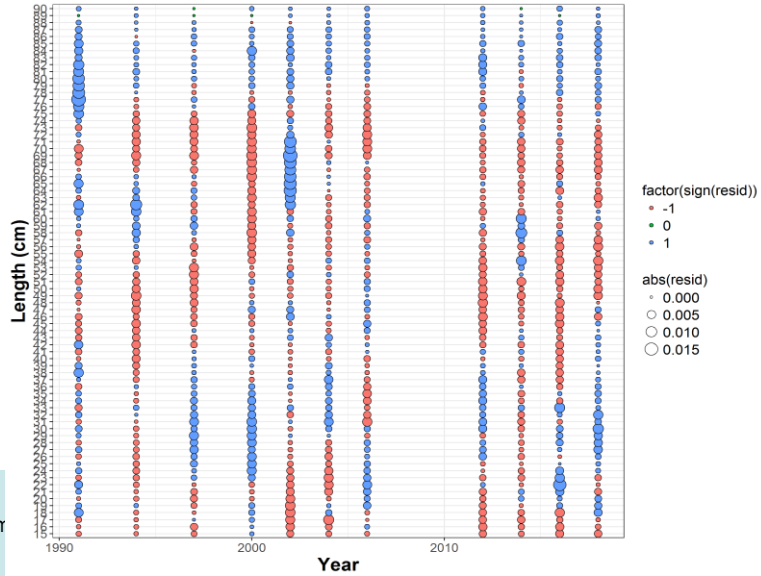
Model 16.0a





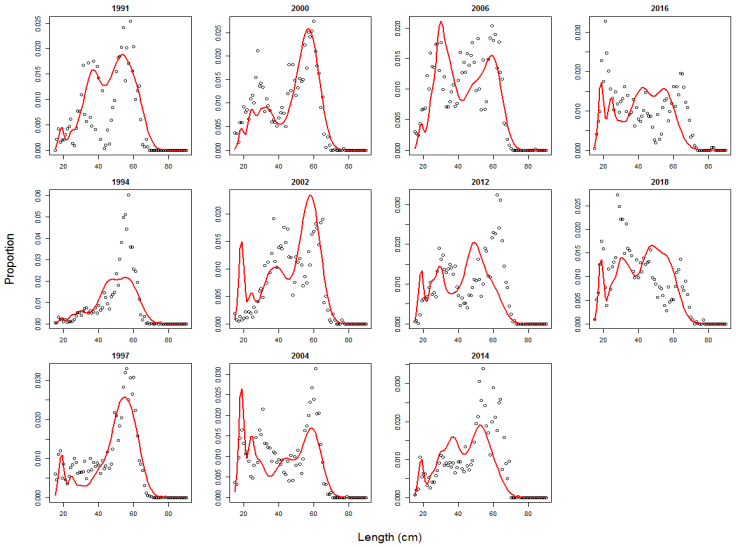
Model 16.0b

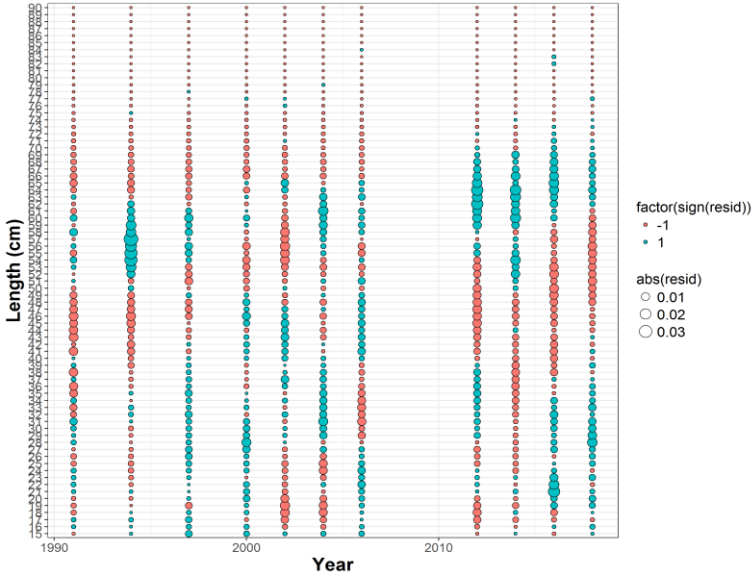




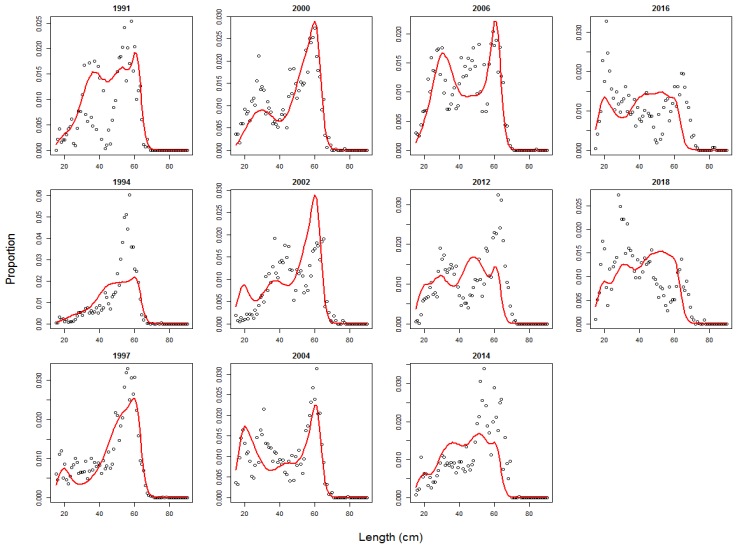
Aleutian Islands survey length estimates: Males

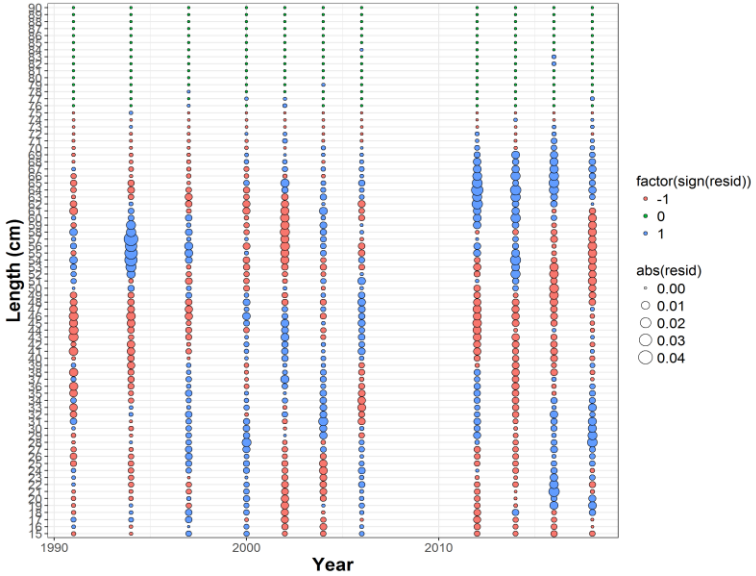
Model 16.0a



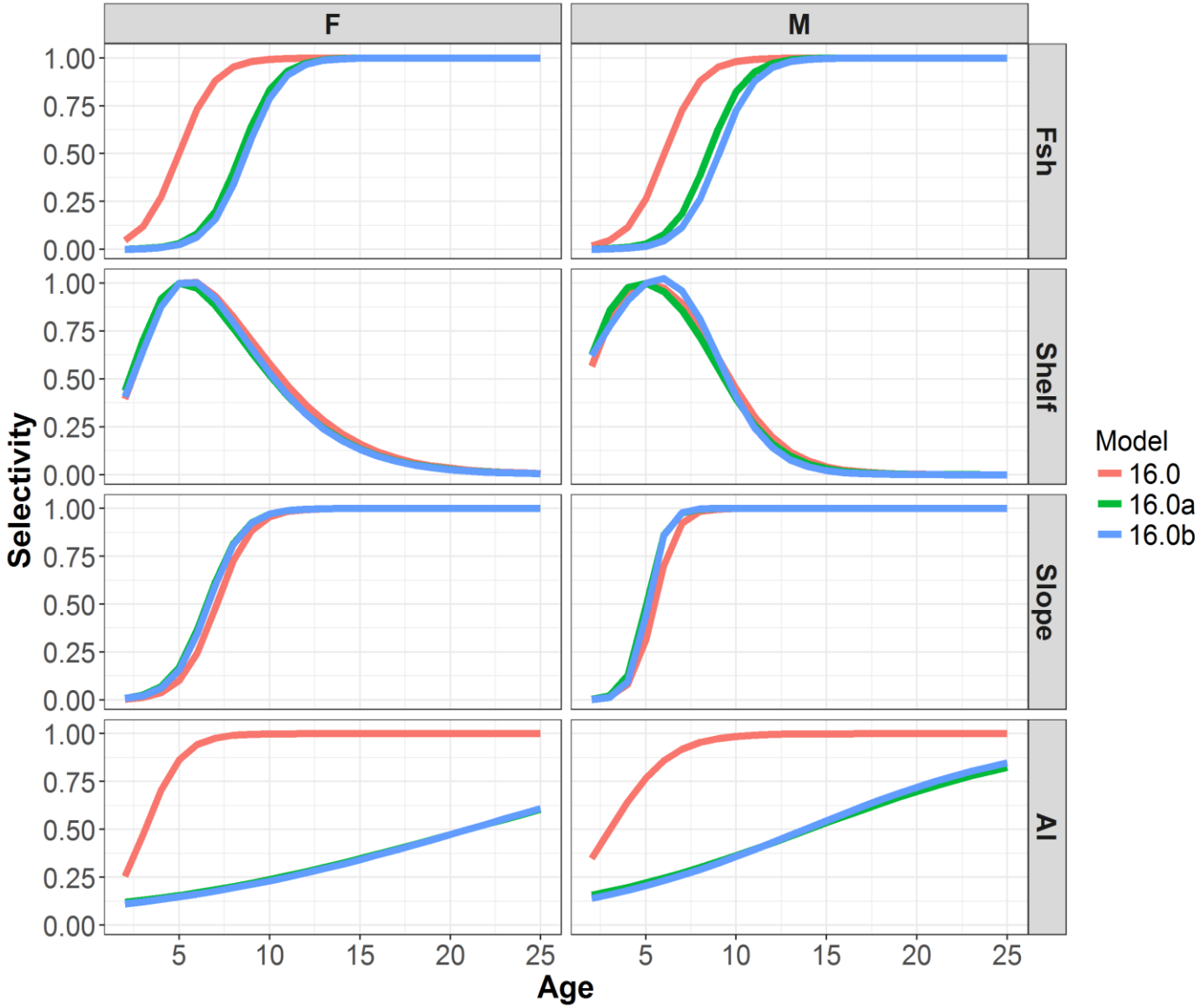


Model 16.0b





Selectivity

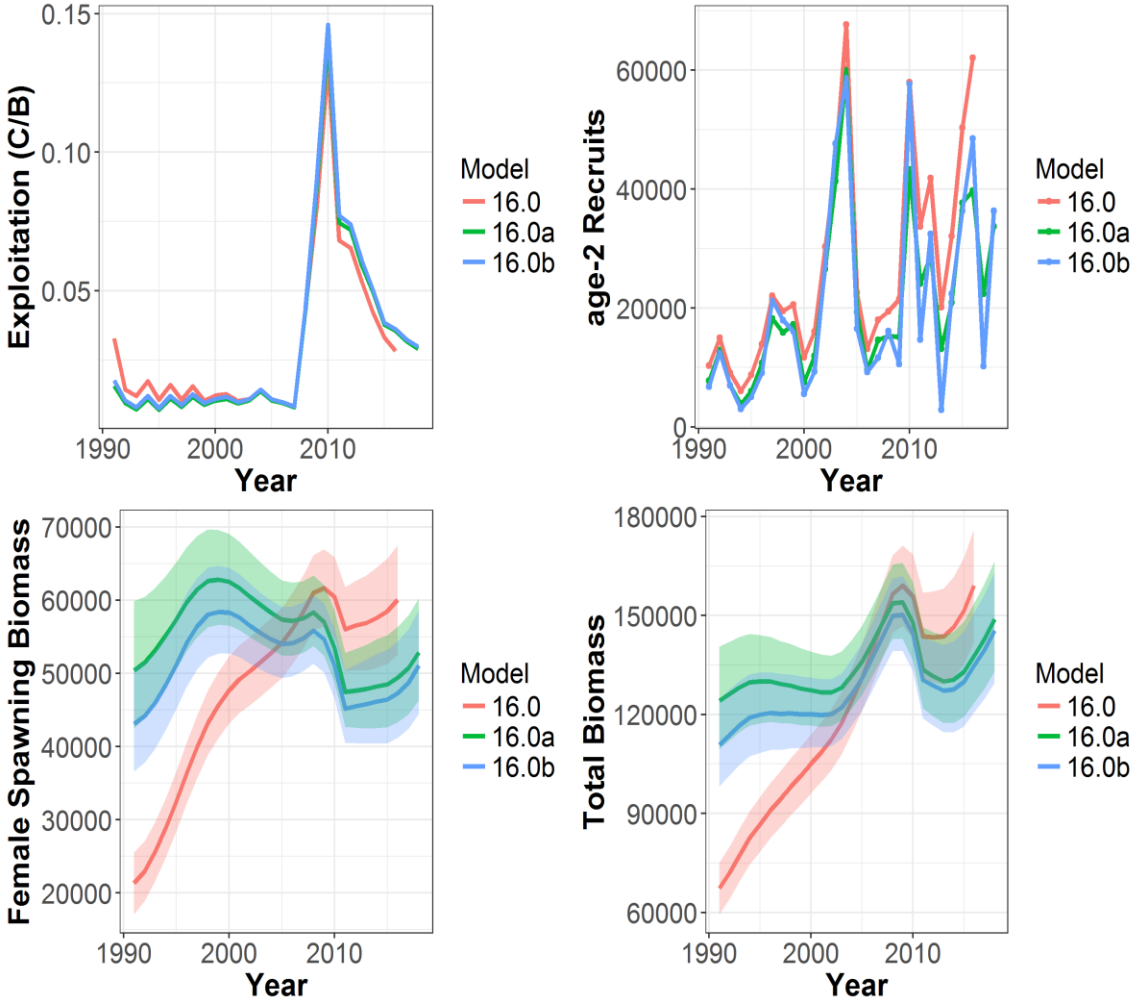


Likeihood comparison

Likelihood component	Model 16.0a	Model 16.0b
Total	5940	5944
Survey		
Shelf	58.35	51.75
Slope	10.48	8.91
AI	6.52	5.68
Length composition		
Shelf	5048.79	4993.08
Slope	701.05	737.19
AI	1884.99	1884.24
Fishery	84.30	93.25
Catch	0.00	0.00
Age composition		
Slope	-560.71	-546.84
AI	-1315.03	-1305.49

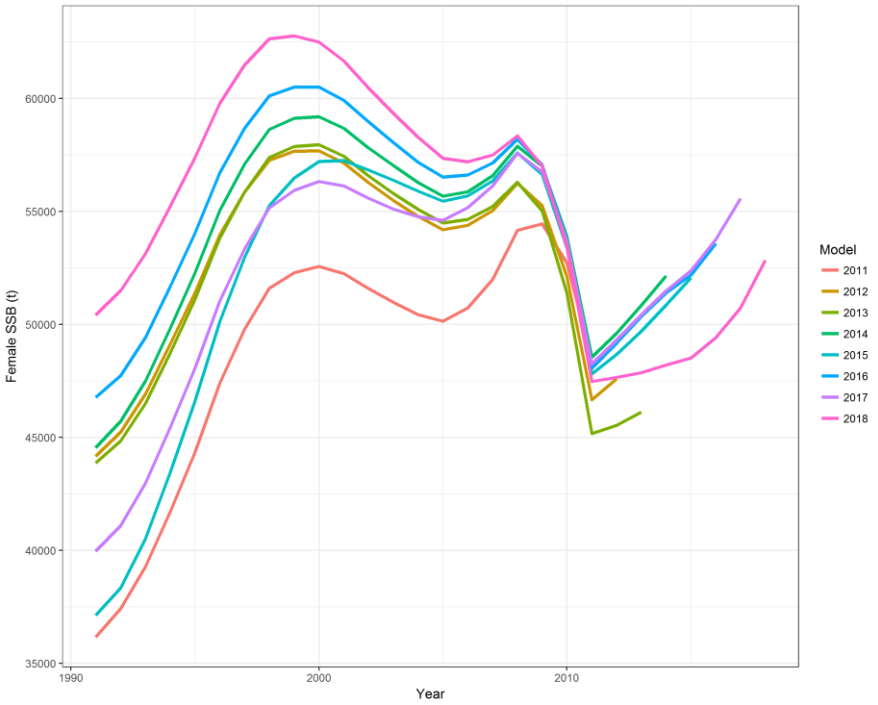
- Model 16.0a has a lower total likelihood
- Trade-offs are apparent
  - Model 16.0b has a better fit to survey biomass
  - Model 16.0a has a better fit to the slope length composition estimates
  - Model 16.0a better fits the shelf and fishery length data
  - Model 16.0a has a better fit to the age composition data

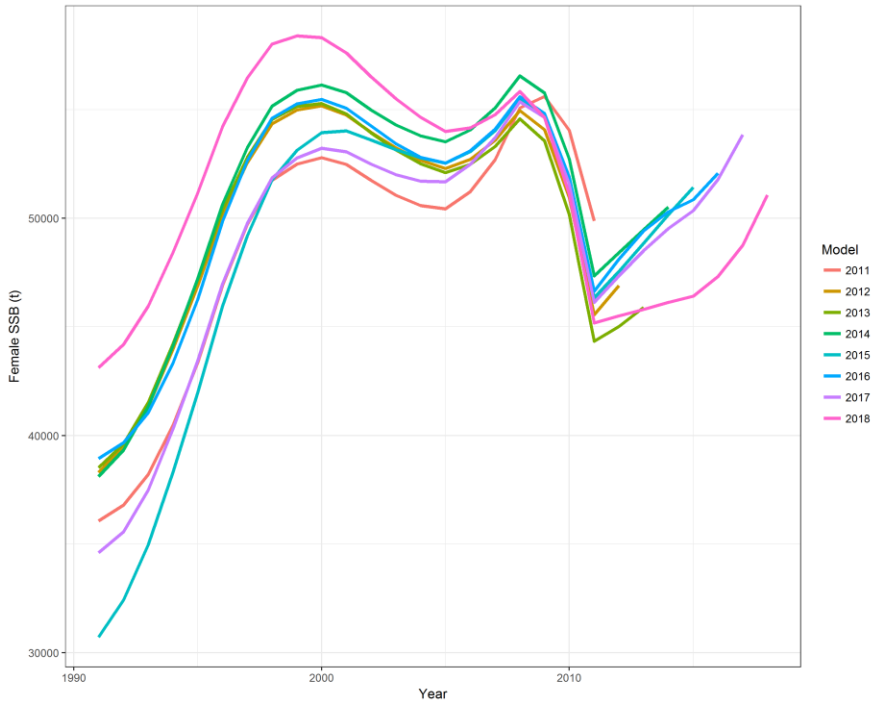
Assessment outcomes



- Early biomass estimates are now higher than previous assessment
  - New fishery selectivity delayed age at 50% selectivity and full capture
- Decline in 2010 is associated with the increase in F due to increased targeting
- Biomass estimates follow the trend in the model fit to the Aleutian Islands biomass estimates
  - Recent increase due to a recruitment signal in survey length data

Retrospective analysis: Female spawning biomass





- Mohn's rho
  - Model 16.0a – 0.1
  - Model 16.0b – 0.24

Recommendation

- Model 16.0a is preferred
  - Results from models 16.0a and 16.0b were similar
  - Likelihood and retrospective values were somewhat better for model 16.0a

Projections

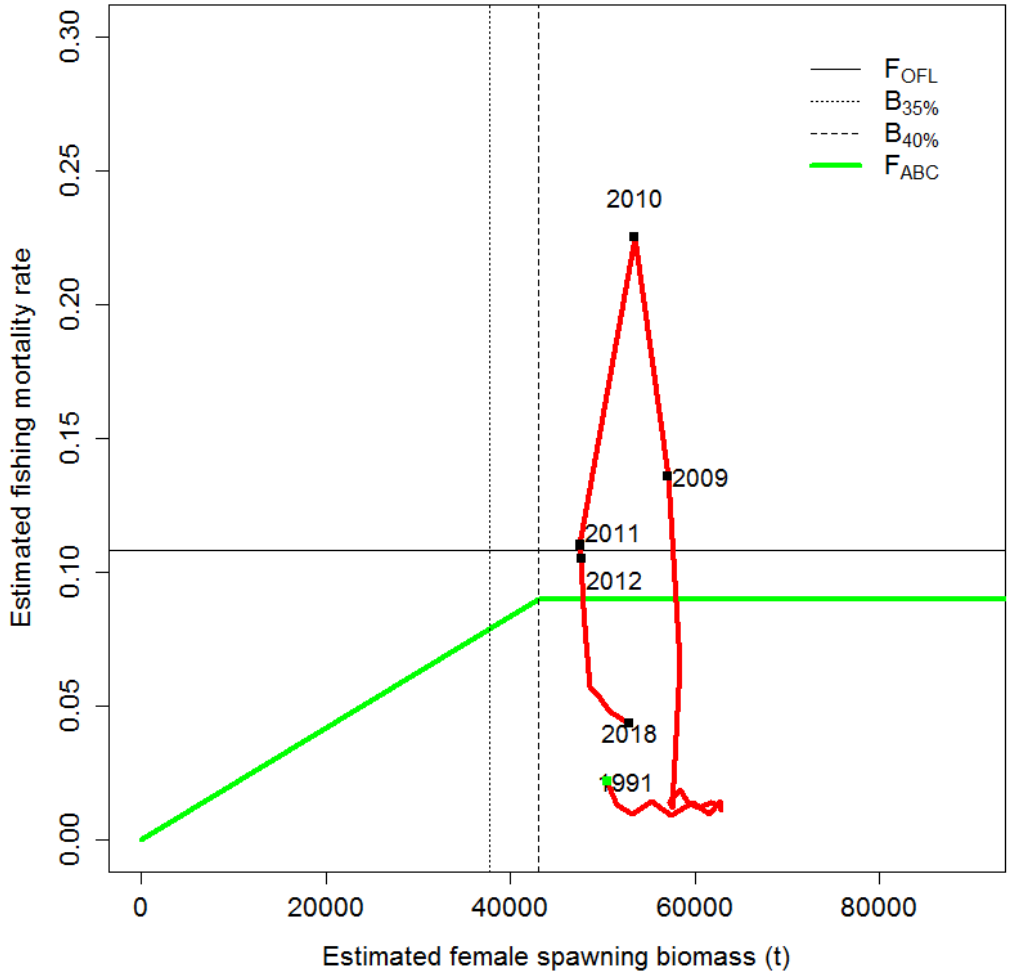
- Based on assessment results from model 16.0a
- Recruitment time-series
  - Age-2 recruits
  - 1991 – 2016
- Catch
  - 2018: average proportion of TAC caught over the last five years
  - 2019: average catch from 2013-2017

Harvest recommendations

Quantity	As estimated last year for 2018	As estimated last year for 2019	As estimated this year for 2019	As estimated this year for 2020
M (natural mortality rate)	0.11	0.11	0.11	0.11
Tier	3a	3a	3a	3a
Projected total (age 2+) biomass (t)	189,868	199,223	155,251	156,450
Projected female spawning biomass (t)	63,718	67,390	54,779	56,675
$B_{100\%}$	126,954	126,954	107,673	107,673
$B_{40\%}$	50,782	50,782	43,069	43,069
$B_{35\%}$	44,434	44,434	37,685	37,685
F_{OFL}	0.075	0.075	0.108	0.108
maxF_{ABC}	0.064	0.064	0.090	0.090
F_{ABC}	0.064	0.064	0.090	0.090
OFL (t)	11,347	12,022	**10,965**	11,260
maxABC (t)	9,737	10,317	**9,260**	9,509
ABC (t)	9,737	10,317	**9,260**	9,509
Status	As determined *last* year for: 2016	2017	As determined *this* year for: 2017	2018
Overfishing	no	n/a	no	n/a
Overfished	n/a	no	n/a	no
Approaching overfished	n/a	no	n/a	no

Phase plot

- Spawning biomass has been above $B_{40\%}$ and $B_{35\%}$
- Fishing mortality was above:
  - F_{OFL} 2009-2011
  - F_{ABC} 2012



Future directions

- The ability to better estimate fishery selectivity would benefit from an increase in the amount of Kamchatka flounder length data collected by the observer program.
- The incorporation of age data from the survey programs as they become available is expected to improve estimates of age-based selectivity.
- The age-length transition matrix should be modified to include all available age and length data from the survey programs and the relationship between CV and age should be re-evaluated.

Divider Title

Additional Divider Information