

Gulf of Alaska Arrowtooth flounder

Ingrid Spies

September 2017

CIE review main points

- Fewer parameters.
- More age data.
- Explore male/female natural mortality.
- “The main weakness of the assessment in terms of assessing stock status is in understanding the stock dynamics immediately preceding the assessment period.”

Plan Team - consider the following recommendations:

- Fit growth curves and age-length transition matrix such that the effect of length-stratified otolith sampling on estimated size at age is removed.
- Evaluate models which allow time-varying size at age.
- Evaluate standardizing the surveys from the 1960 and 1970 with the more recent NMFS trawl survey estimates or, alternatively, removing the older surveys from the model.

Plan Team - consider the following recommendations:

- Investigate if the IPhC longline survey data could be used as an additional tuning index.
- Re-evaluate sex ratios and sex-specific natural mortality rates. M for one sex could be fixed and the other estimated. Re-examine hypothesis that males are in deeper water and thus less available to the survey and fishery.

Plan Team - consider the following recommendations:

- The trawl survey biomass estimates are obtained from several sources, including IPHC surveys in the 1960s and exploratory NMFS surveys in the 1970s. The estimated variances for several survey biomass estimates appear to be small.
- Evaluate additional variance components as the design-based variances may be underestimates.
- Examine potential for iteratively reweighting age and length composition data, potentially with one of the methods described in Francis (2011).

Age-length conversion matrix

GOA Bottom Trawl Surveys

1984 1987 1990 1993 1996 1999 2001 2003 2005 2007 2009
2011 2013 2015

$$P(\text{Length} | \text{Age}) = P(\text{Age} | \text{Length}) * P(\text{Length}) / P(\text{Age})$$

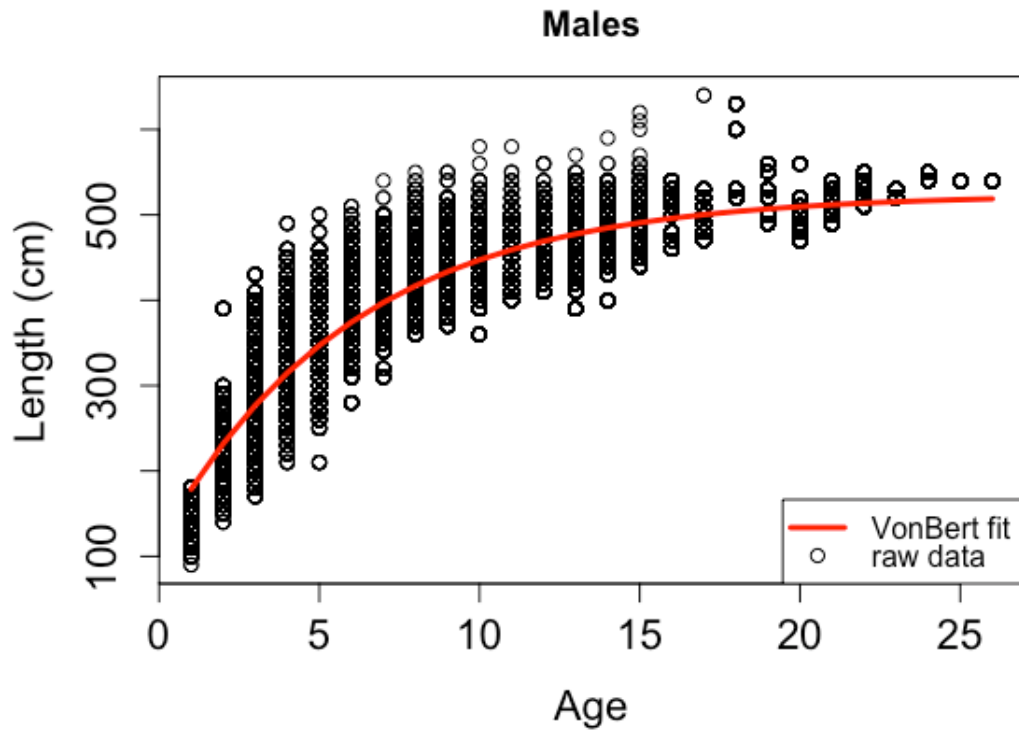
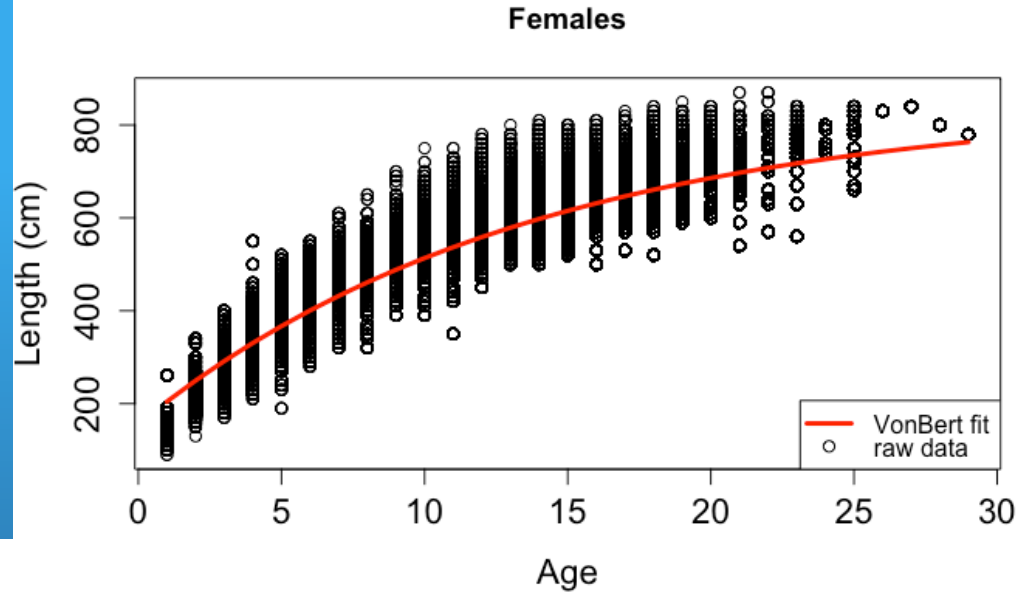
Dorn, M.W., 1992. Detecting environmental covariates of Pacific whiting *Merluccius productus* growth using a growth-increment regression model. *Fishery Bulletin* 90: 260-275.

Number of ages and ageing method (did not use 1977, 1978)

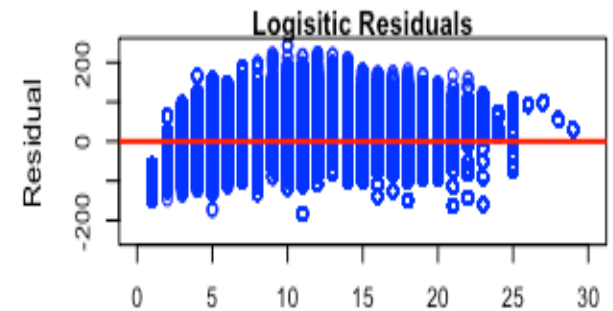
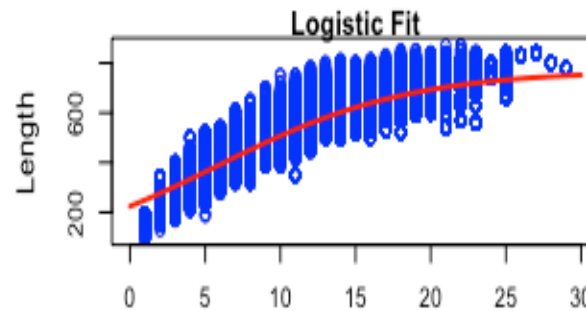
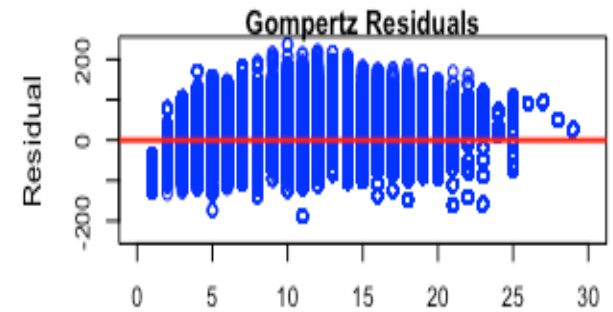
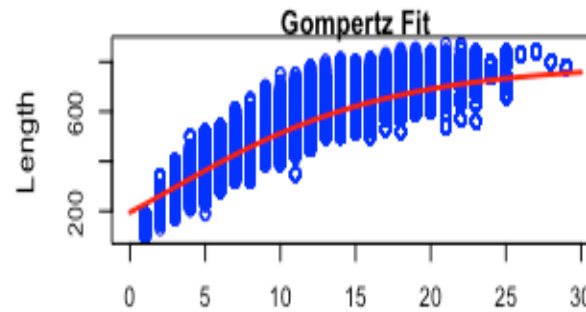
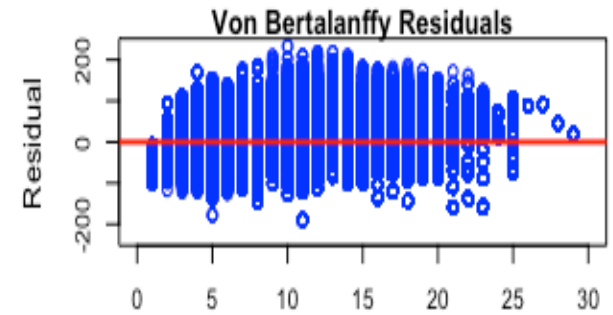
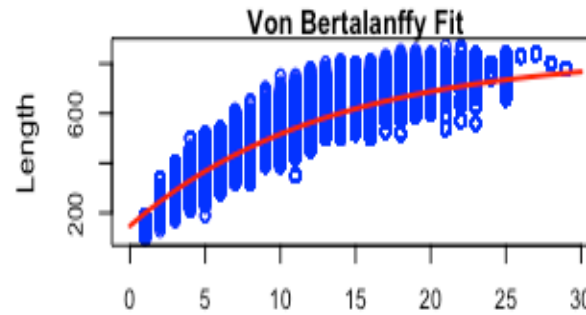
1. No method specified, 3. Otolith surface reading, 4. Break and burn, 5. Think section, 6. Break burn toasted, 7. Break no burn, 9. Oven bake flame burn.

	1	3	4	6	7	9	sum
1977	285						285
1978	888						888
1984	1293						1293
1987		353	625	423	133		1534
1990			325				325
1993			1043				1043
1996			706				706
1999			931				931
2001			1384				1384
2003			1034				1034
2005		230	1	449	20	29	729
2007		38	3	724	21		786
2009		212	590		20		822
2011		77	52	739	29	2	899
2013		254	1	551	16		822

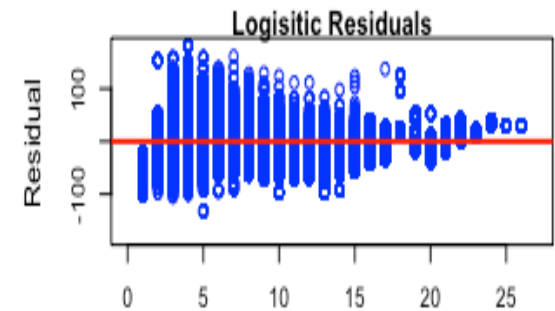
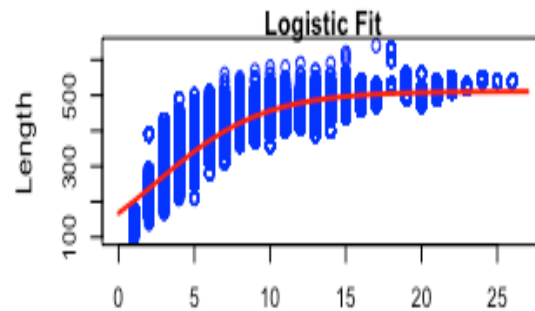
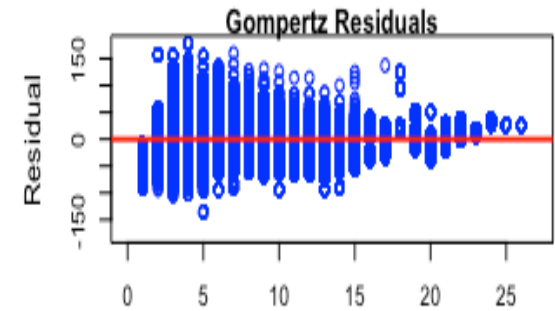
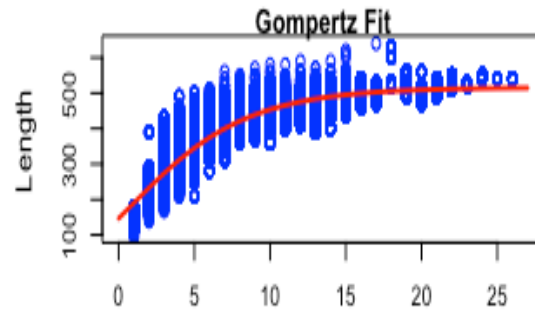
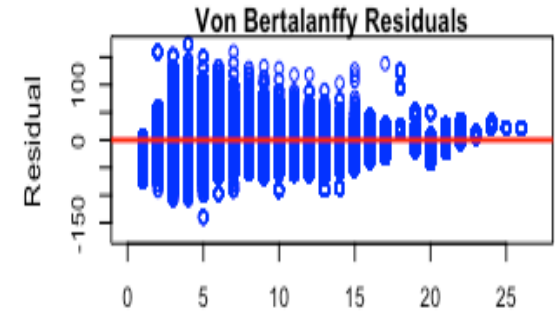
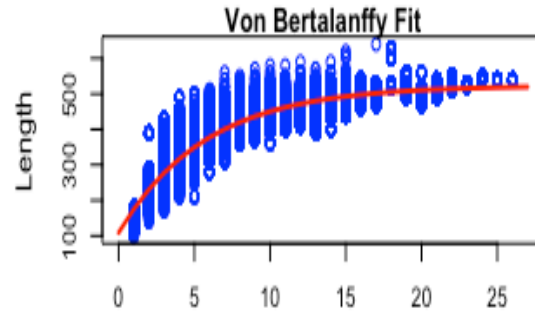
VonBertalanffy y fit to the data



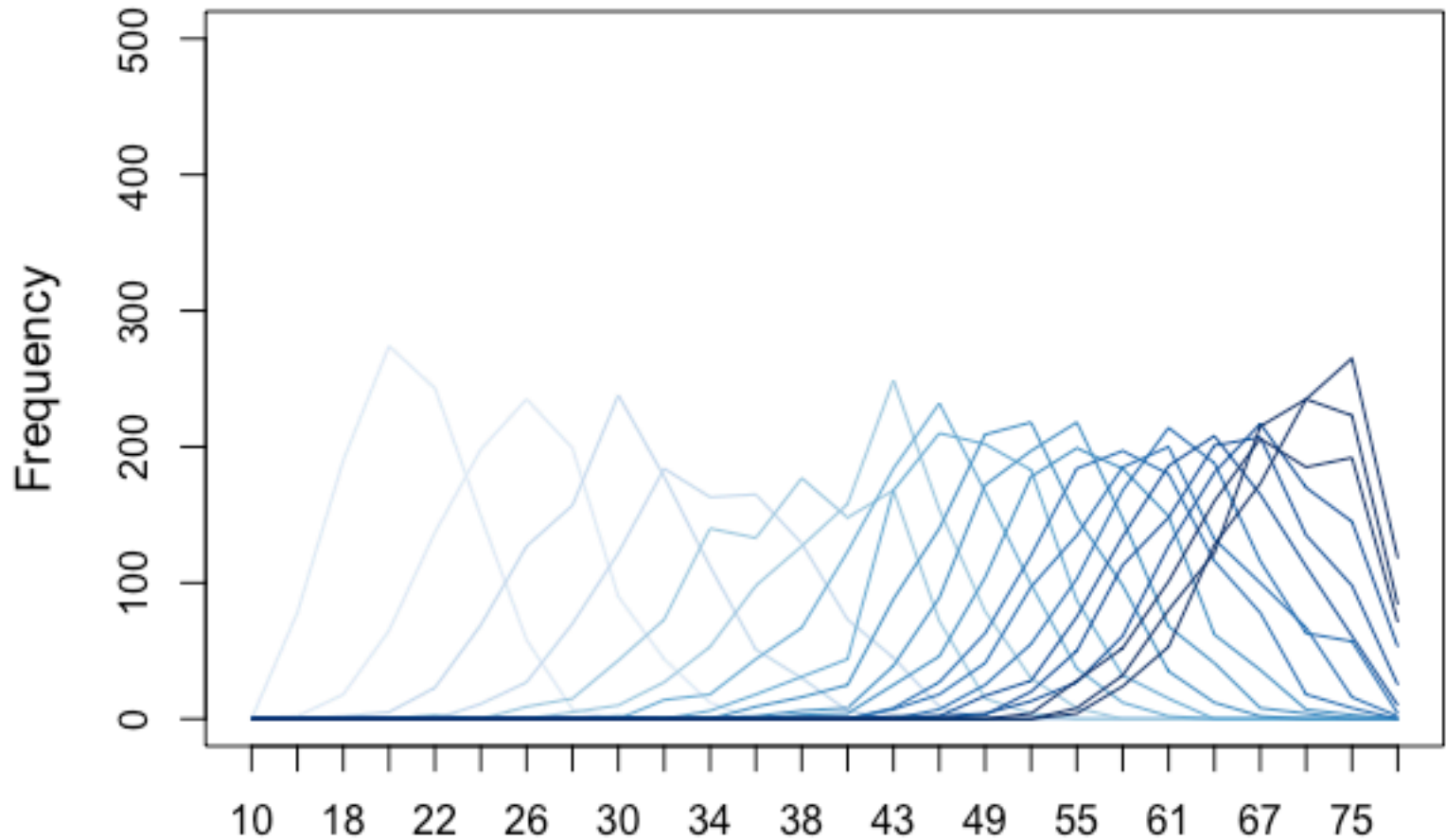
Diagnostic VonBertalanffy plots - females



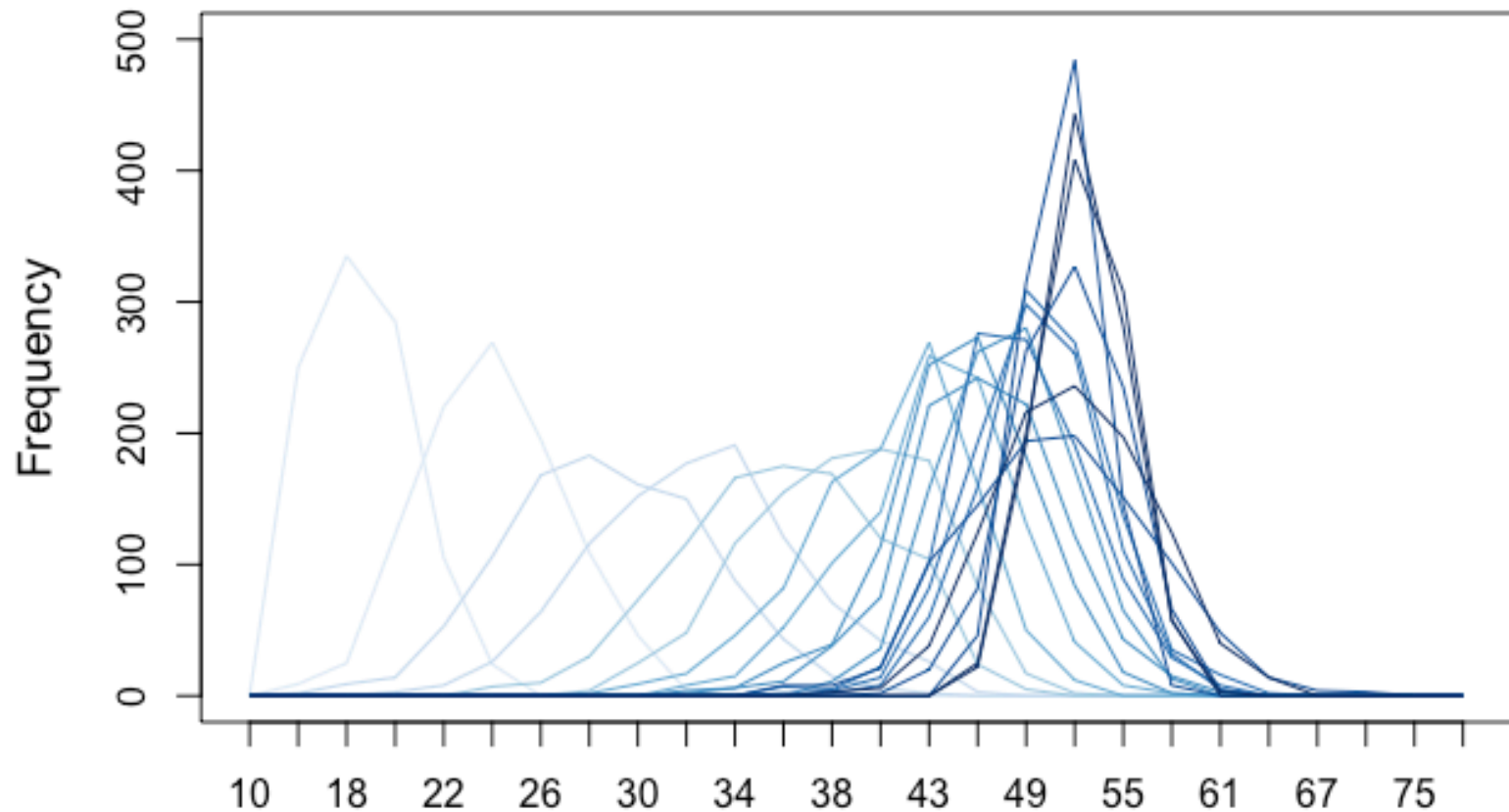
Diagnostic VonBertalanffy plots - males



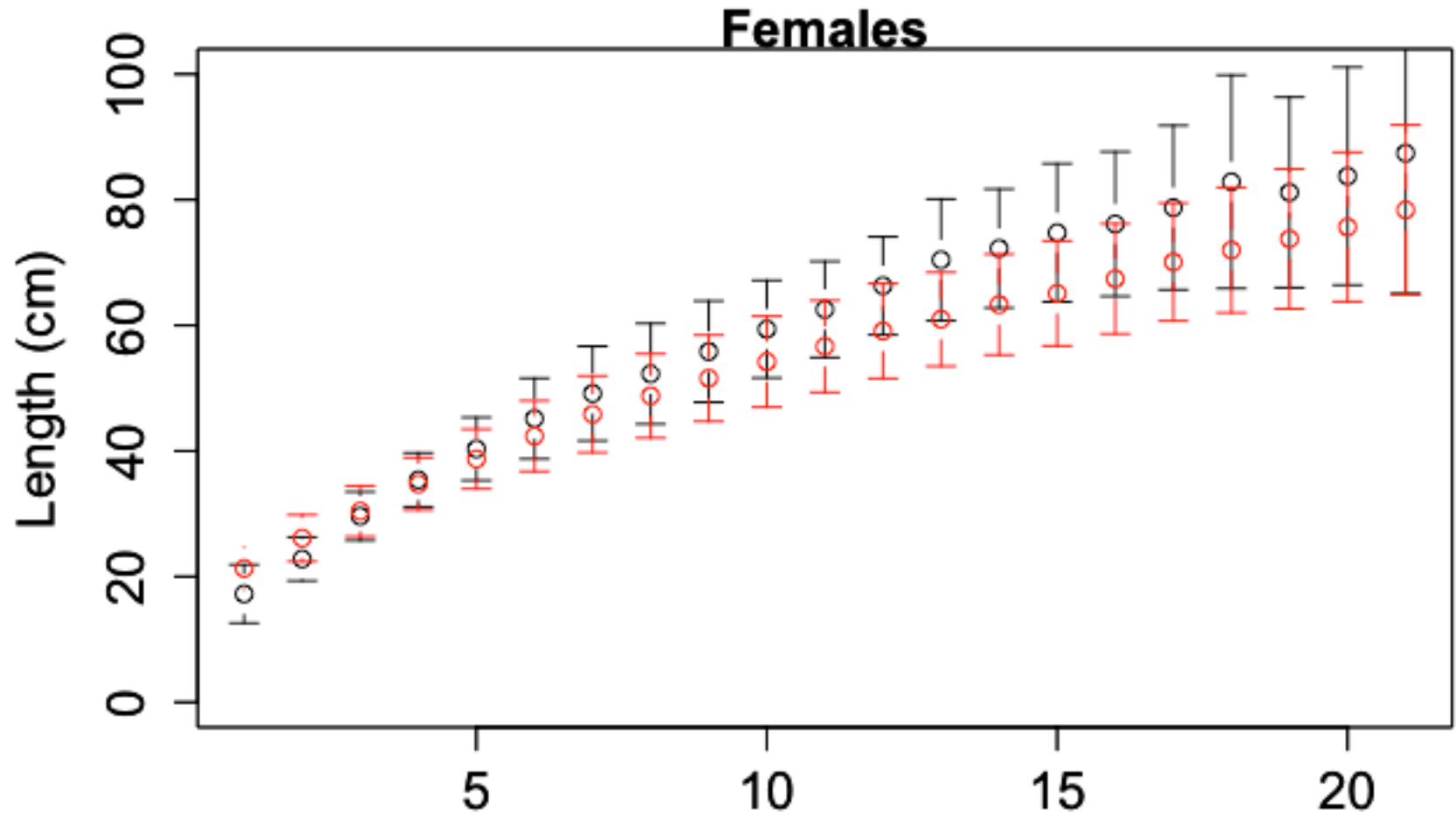
Female length age conversion matrix



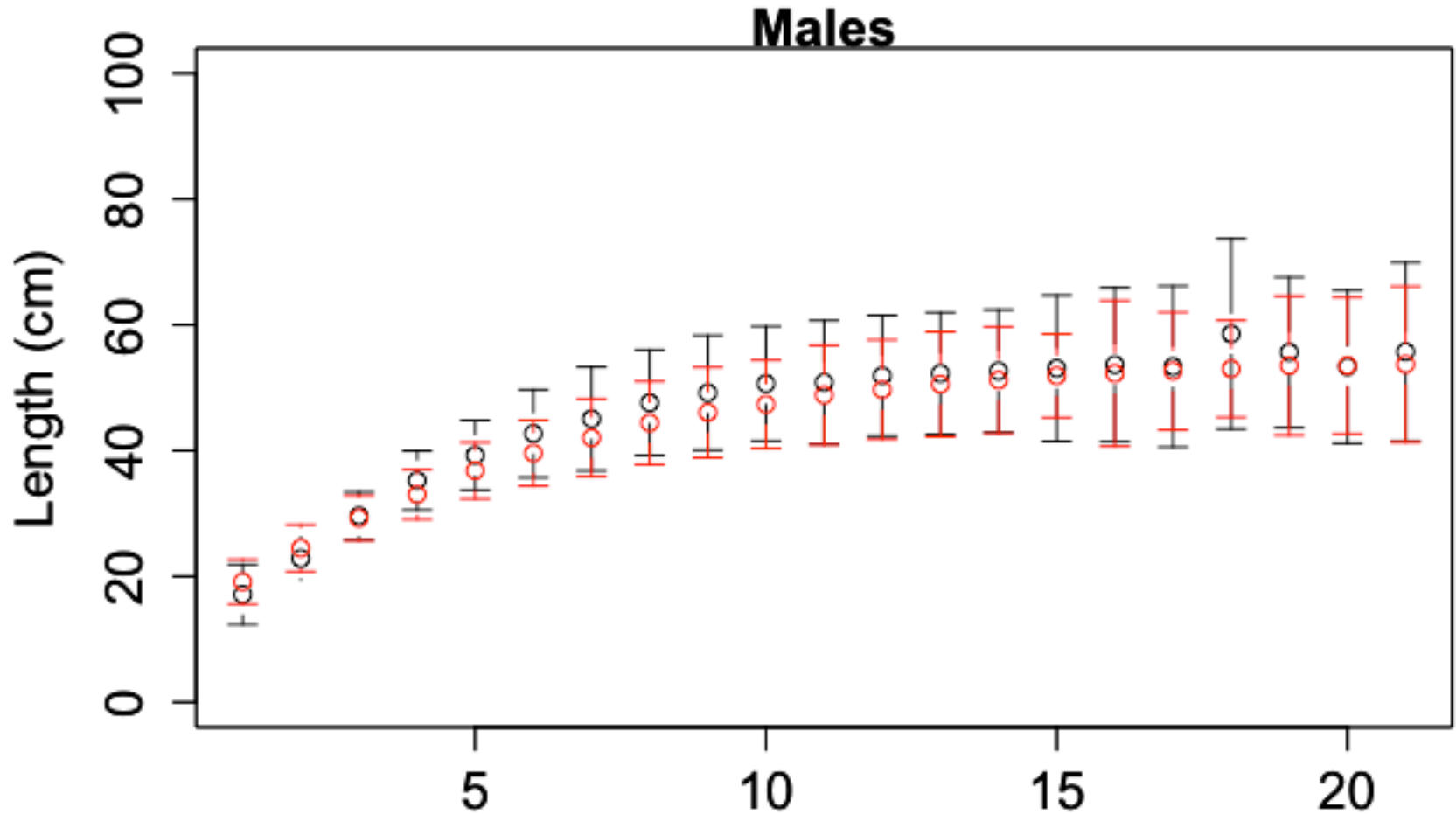
Male length age conversion matrix



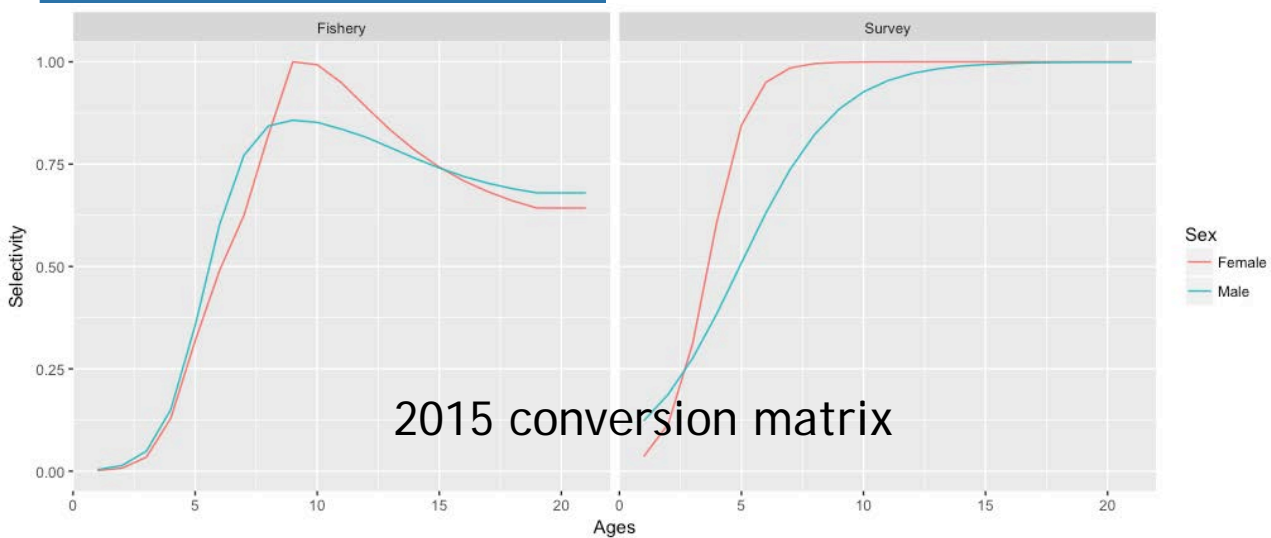
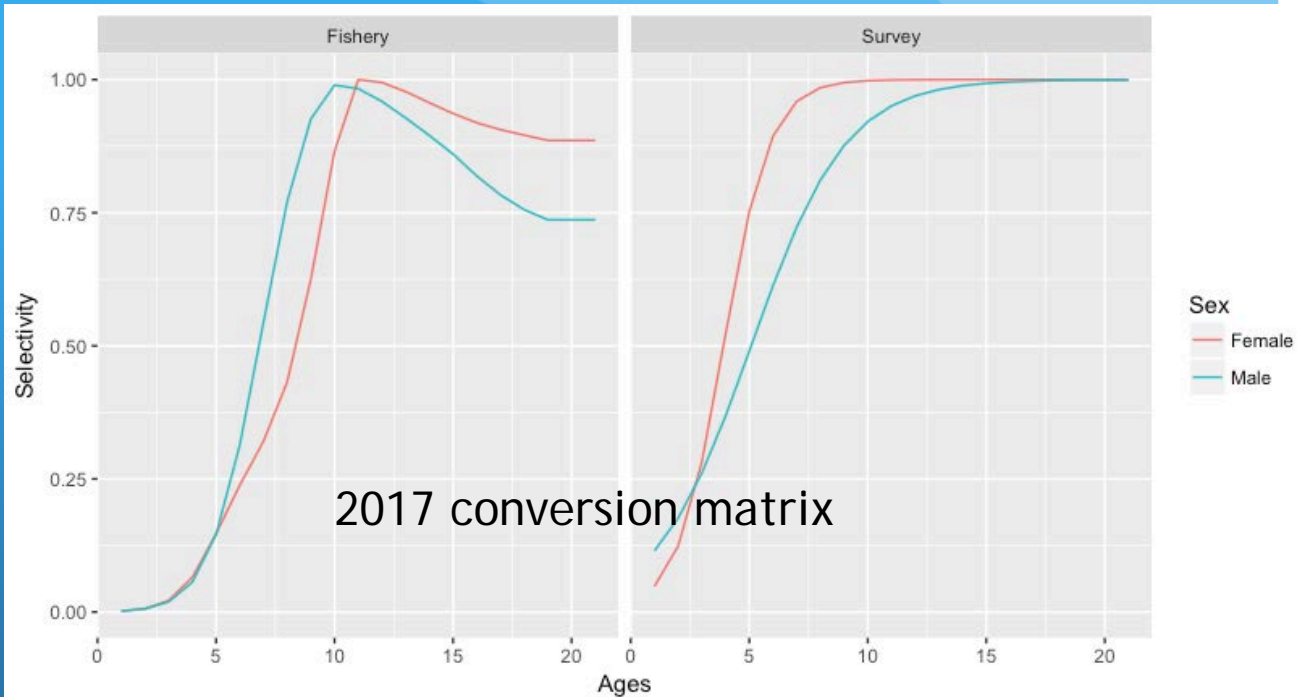
Conversion matrix comparion - females (red 2017, black 2015)



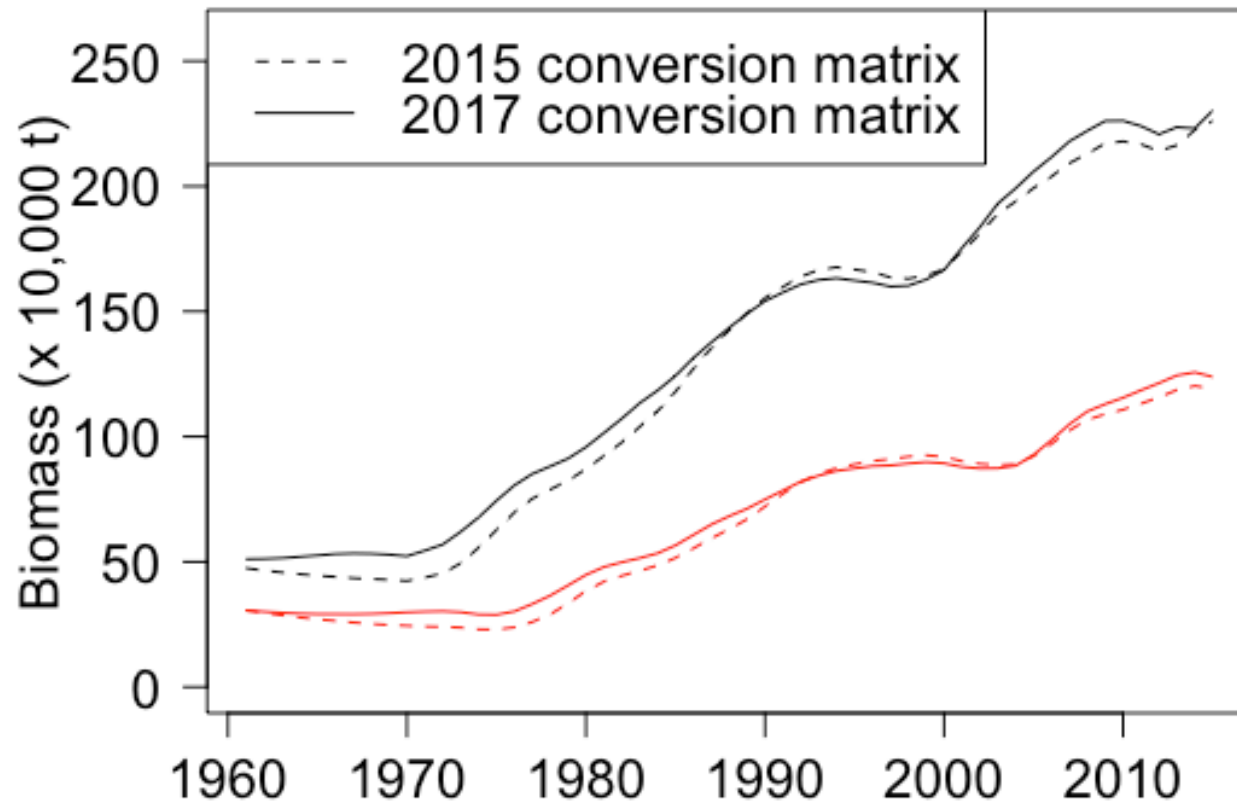
Conversion matrix comparison - males (red 2017, black 2015)



Selectivity



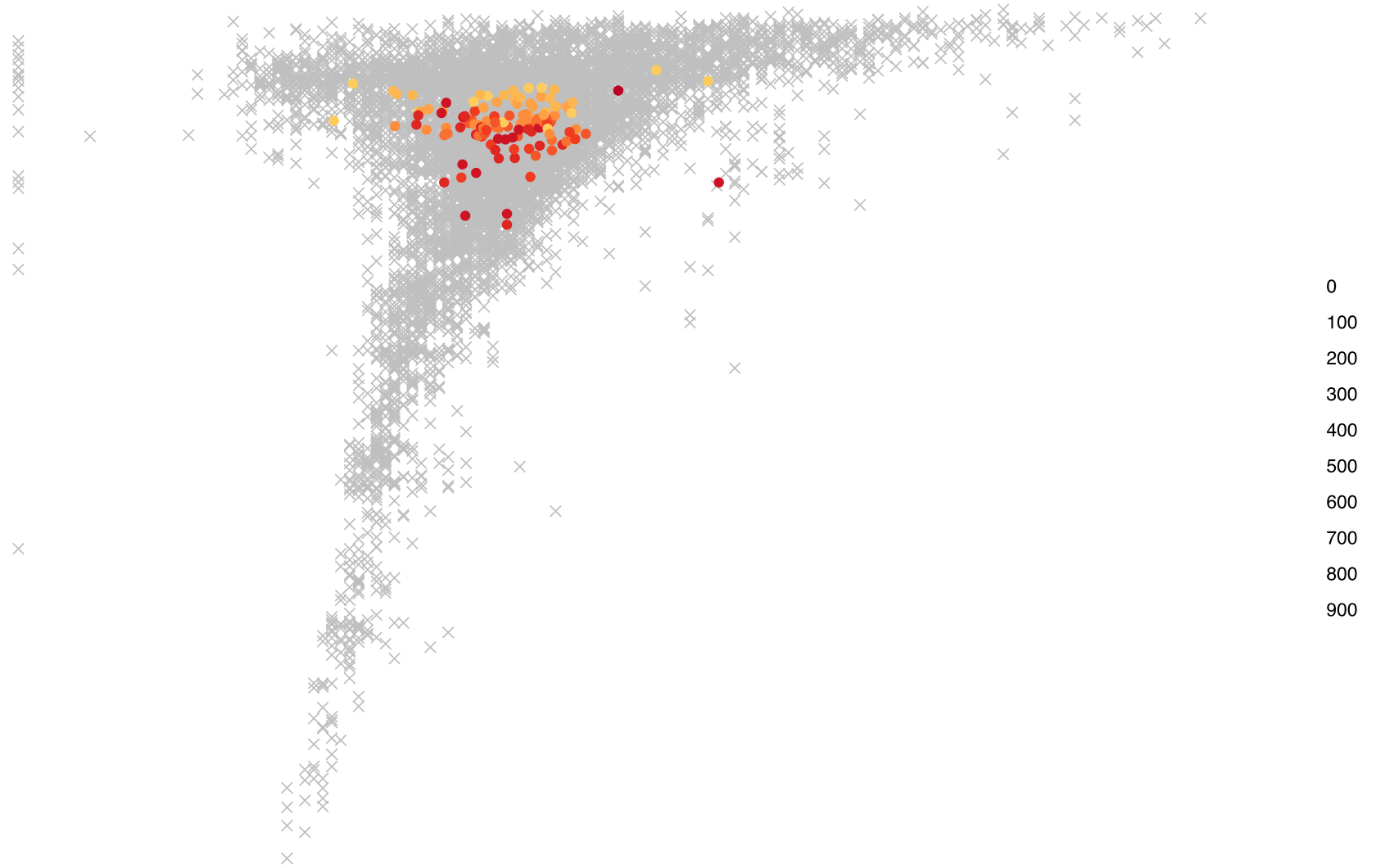
Biomass - conversion matrix comparison



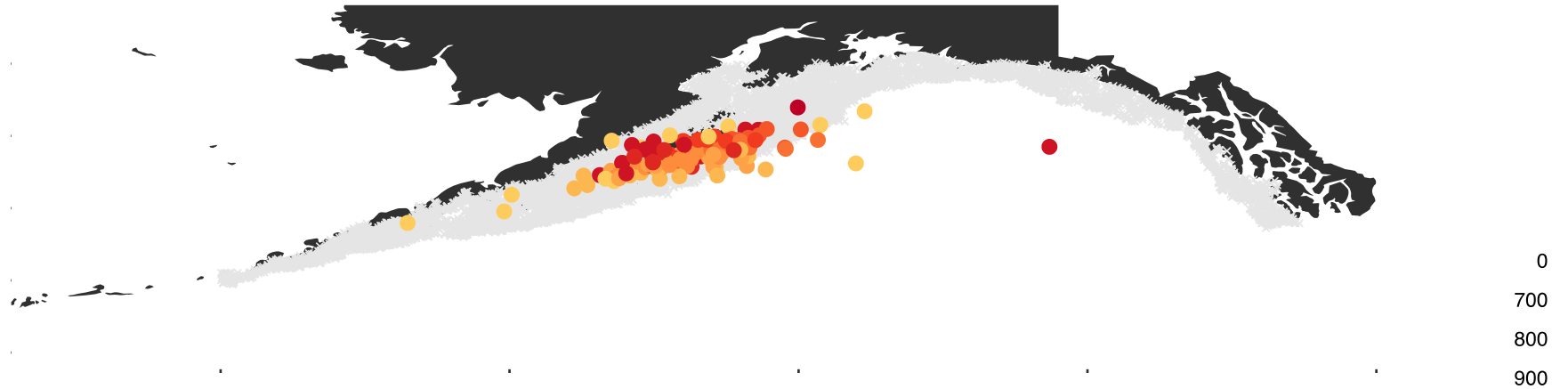
Explore male/female natural mortality (CIE, Plan Team)

- Consider Lorenzen (1996) mortality equation, mortality as a function of weight.
- Impose same M for males and females and look at selectivity.
- Plot distribution of males and females.

arrowtooth flounder (*Atheresthes stomias*)



arrowtooth flounder (*Atheresthes stomias*)



Gulf of Alaska

arrowtooth flounder (*Atheresthes stomias*)

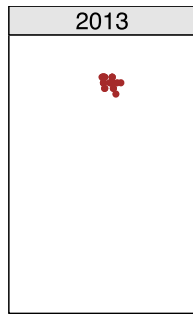


Sex
FEMALE
MALE

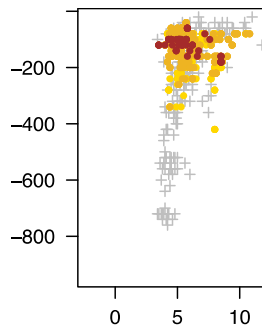
C)

Bottom depth (m)

Gulf of Alaska, 200-300mm



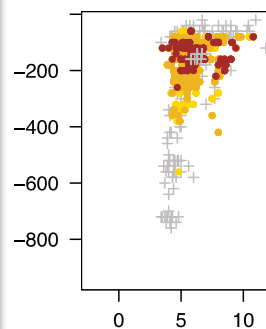
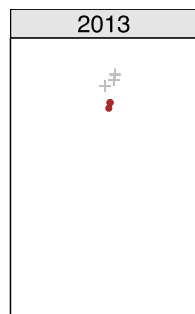
Depth (m)



Temp. (°C)

arrowtooth flounder between 300 and 500 mm

Gulf of Alaska, 300-500mm

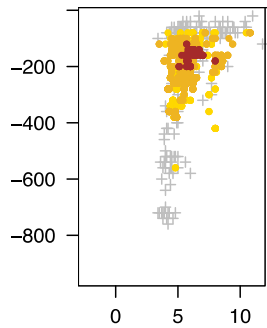


Temp. (°C)



Gulf of Alaska, 500-700mm

Depth (m)

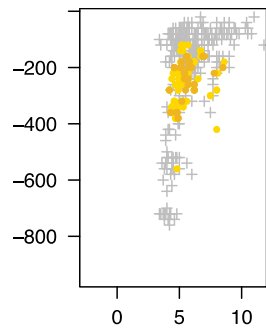


Temp. (°C)

9.37
87.78
822.47
7705.94
72199.11

Gulf of Alaska, 700-1,500mm

Depth (m)



Temp. (°C)

2199.11



Reduce the number of parameters (CIE)

- GOA has only 1 survey.

More age data from the fishery (CIE)

- Worked with the Observer group to add ATF otoliths to the observer collection manual for the BSAI and the GOA.

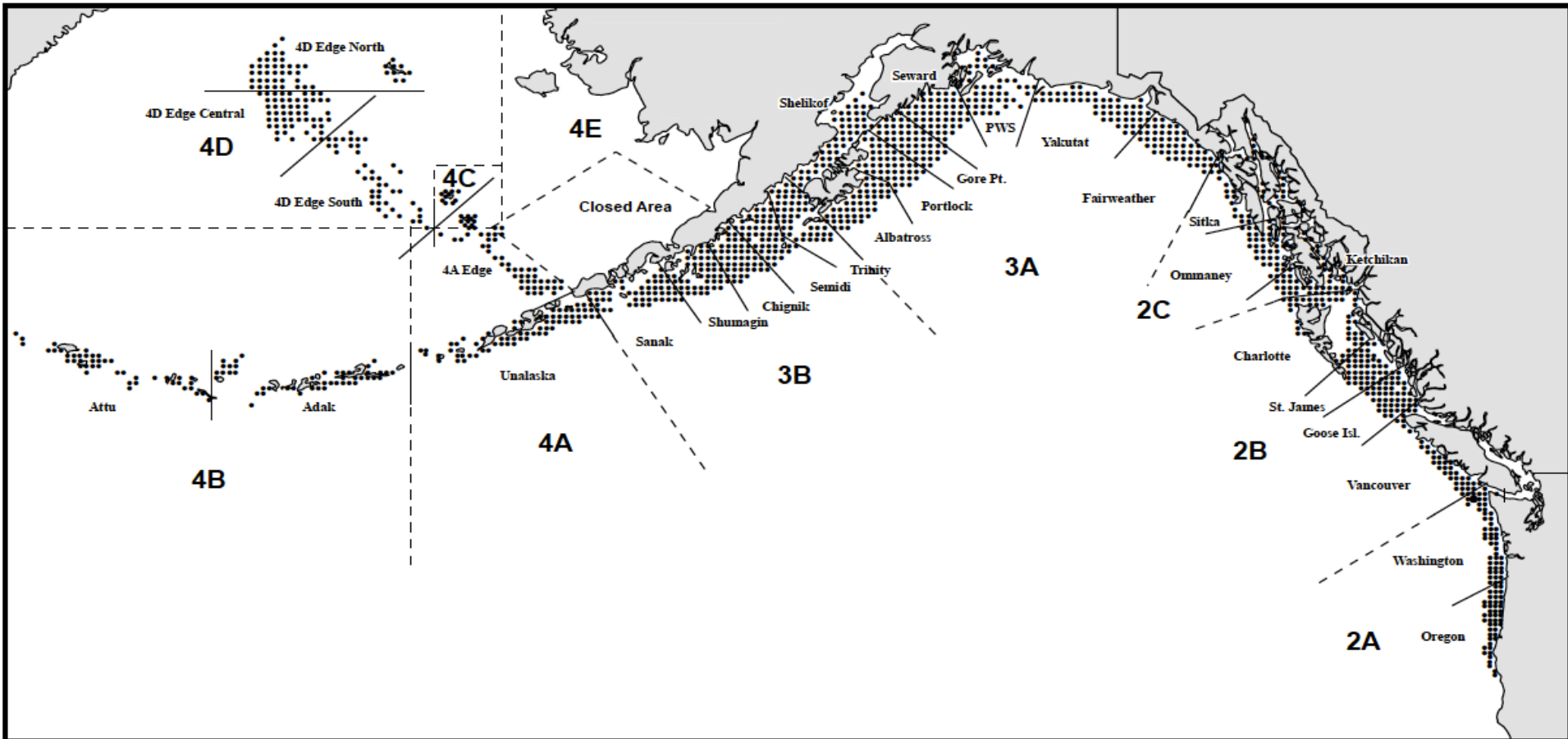
Evaluate standardizing the surveys from the 1960 and 1970 with the more recent NMFS trawl survey estimates or, alternatively, removing the older surveys from the model (Plan Team).

- “The main weakness of the assessment in terms of assessing stock status is in understanding the stock dynamics immediately preceding the assessment period.” (CIE)

Investigate if the IPHC longline survey data could be used as an additional tuning index (Plan Team).









- Hook size (6) large for ATF.

IPHC Regulatory Areas

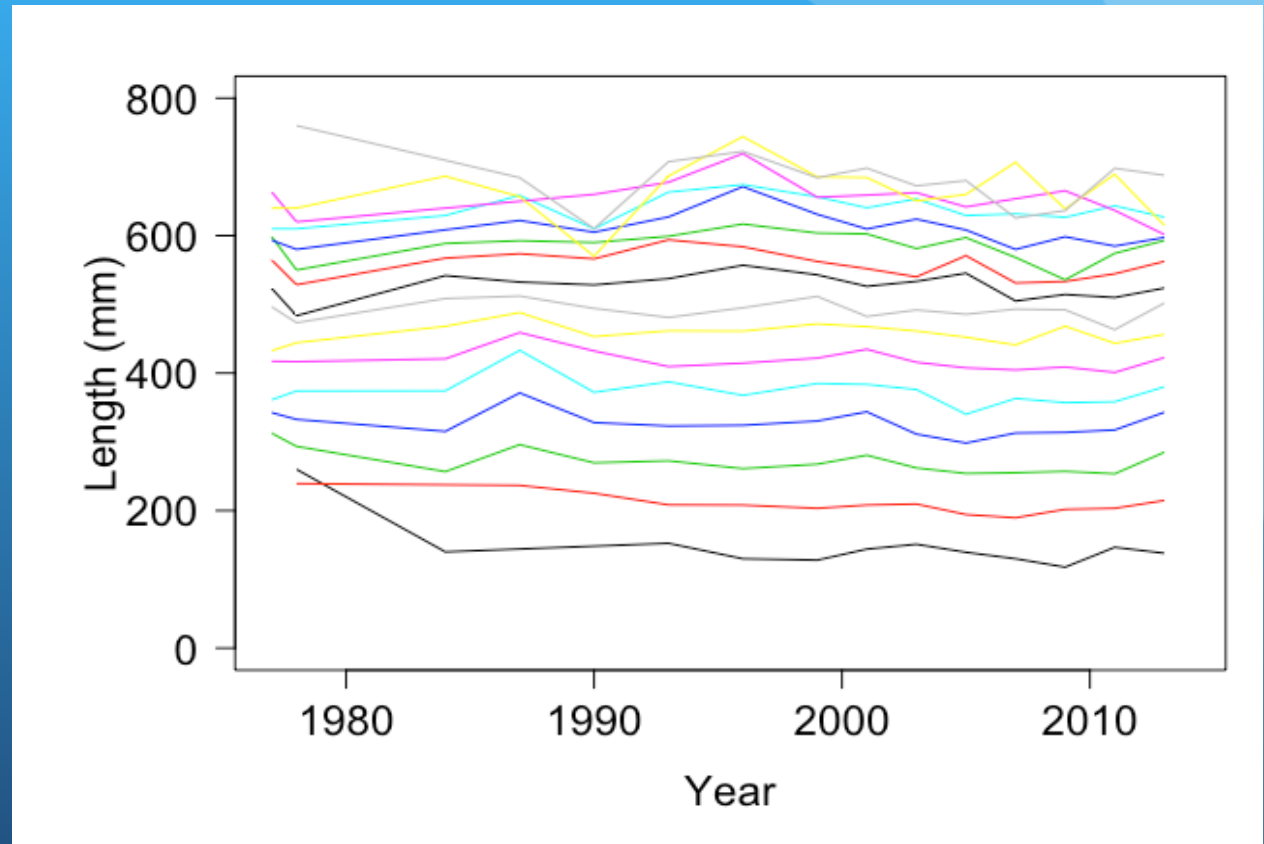


IPHC arrowtooth flounder data

(numbers per standardized 100-hook skate)

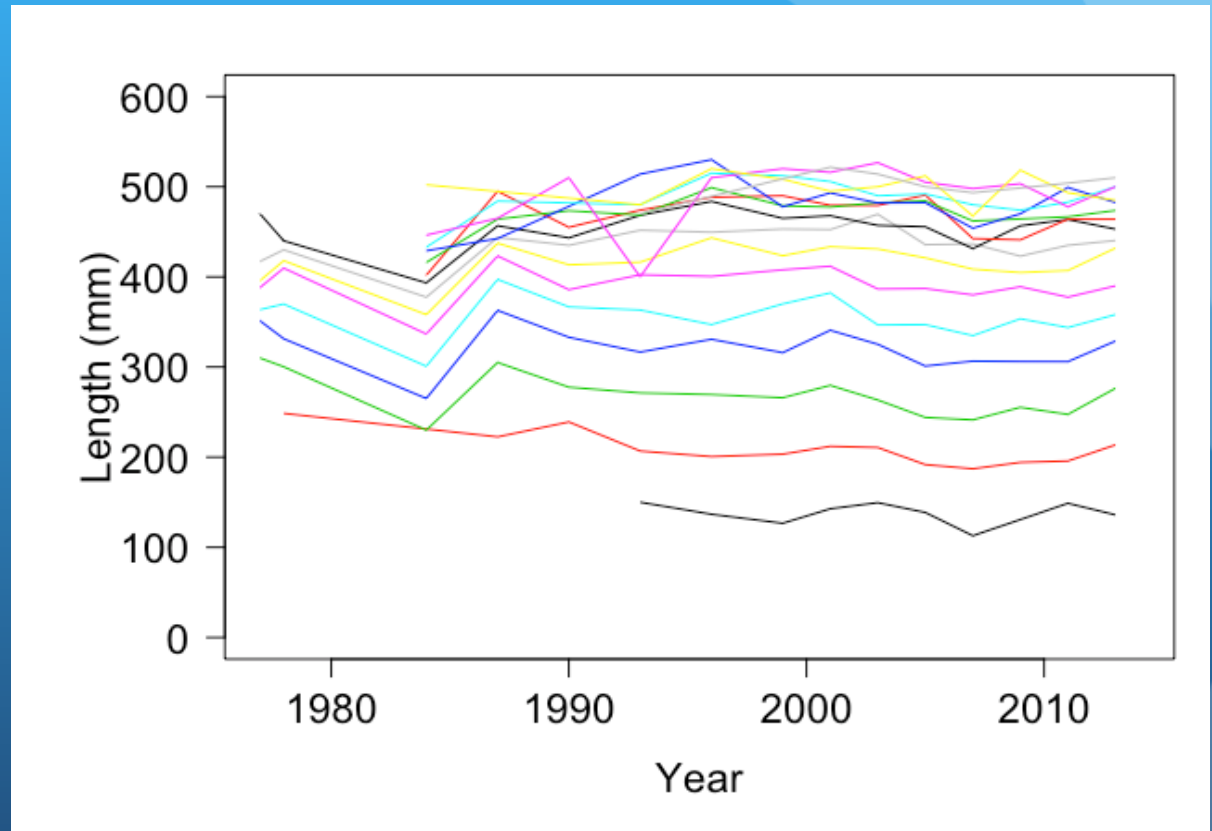
Regulatory Area	Trend	Arrowtooth flounder									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2A		0.12	0.16	0.13	0.11	0.05	0.14	0.25	0.07	0.07	0.08
2B		0.83	1.31	1.59	1.46	1.18	1	0.72	0.76	0.74	0.81
2C		1.18	1.53	1.69	1.36	0.96	1.21	0.88	0.87	0.75	0.42
3A		1.42	1.32	1.73	1.2	1.25	1.35	0.95	1.07	0.88	0.44
3B		2.21	2.32	1.23	1.45	1.34	0.56	0.76	1.24	0.97	0.92
4A		0.97	1.92	2.02	0.97	1.14	1.2	0.58	0.83	1.03	1.13
4B		1.09	1.1	0.94	1.35	1.23	0.28	0.78	0.48	0.86	0.71
4D		2.42	3.26	1.69	1.4	2.48	1.75	1.05	0.74	1.88	1.29

Evaluate models which allow time-varying size at age - Females



Average length of female arrowtooth flounder sampled in the Gulf of Alaska from 1977-2016 (1977, 1978, 1987, 1990, 1993, 1996, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015) for ages 1-16. Average length at age of females declined significantly age these ages (1,2,3)

Evaluate models which allow time-varying size at age - Males



Average length of male arrowtooth flounder sampled in the Gulf of Alaska from 1977-2016 (1977, 1978, 1987, 1990, 1993, 1996, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015) for ages 1-16. The average length at age of males declined significantly age these ages (2,3,5)

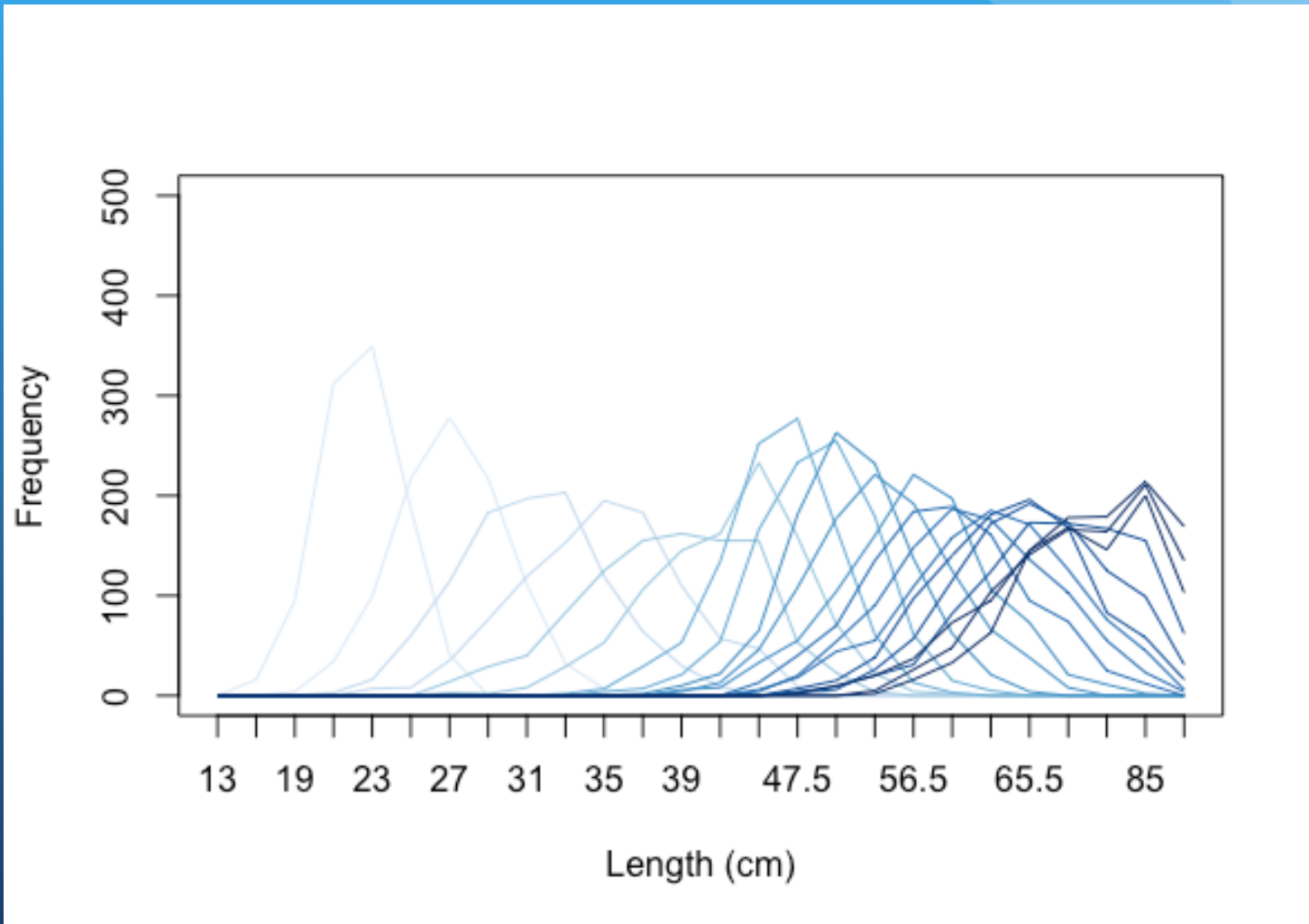
Plan Team - variance, weighting

- The trawl survey biomass estimates are obtained from several sources, including IPHC surveys in the 1960s and exploratory NMFS surveys in the 1970s. The estimated variances for several survey biomass estimates appear to be small.
- Evaluate additional variance components as the design-based variances may be underestimates.
- Examine potential for iteratively reweighting age and length composition data, potentially with one of the methods described in Francis (2011).

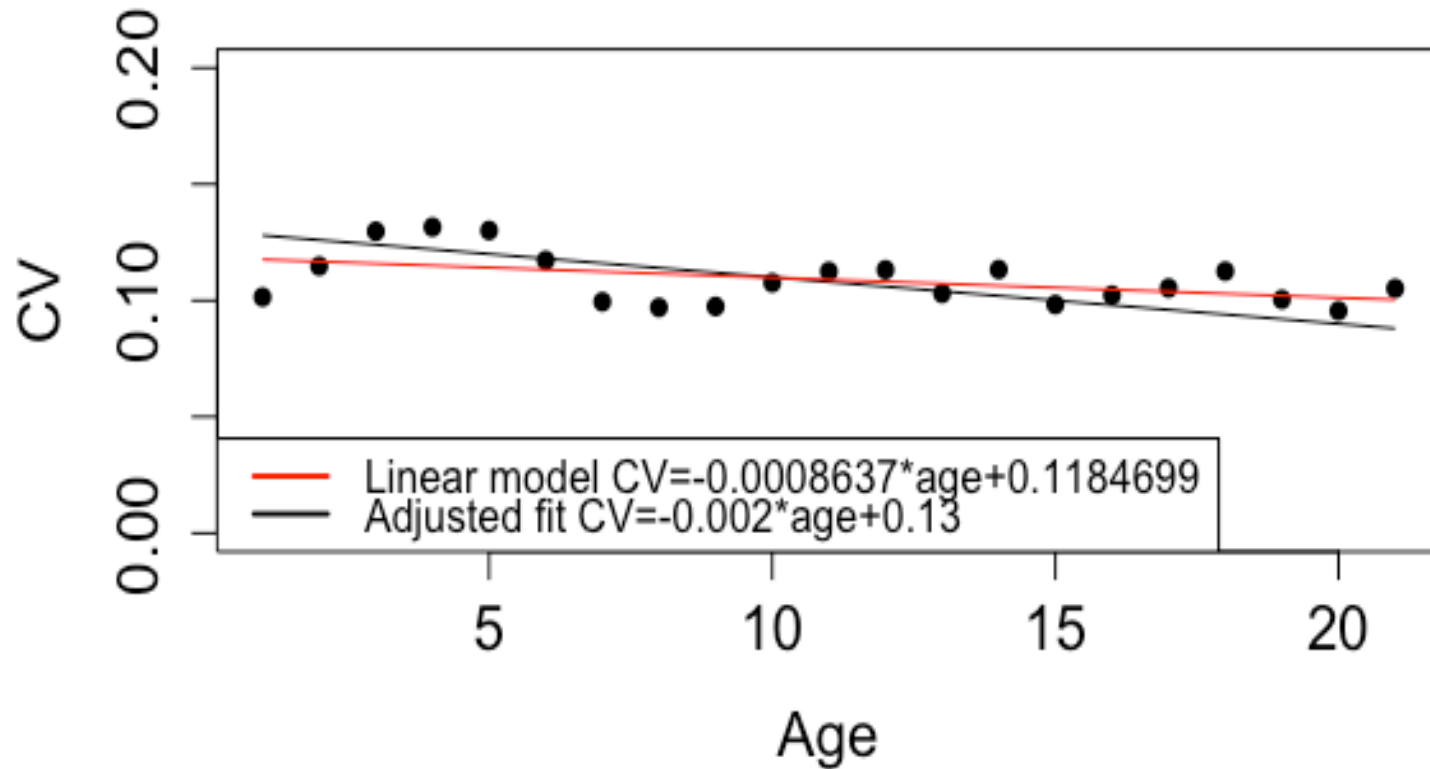
Conclusions

- Data weighting, variance.
- Conversion matrix
- M by weight
- Parameter reduction (no?)
- IPHC survey (no?)
- Time-varying size at age (no?)

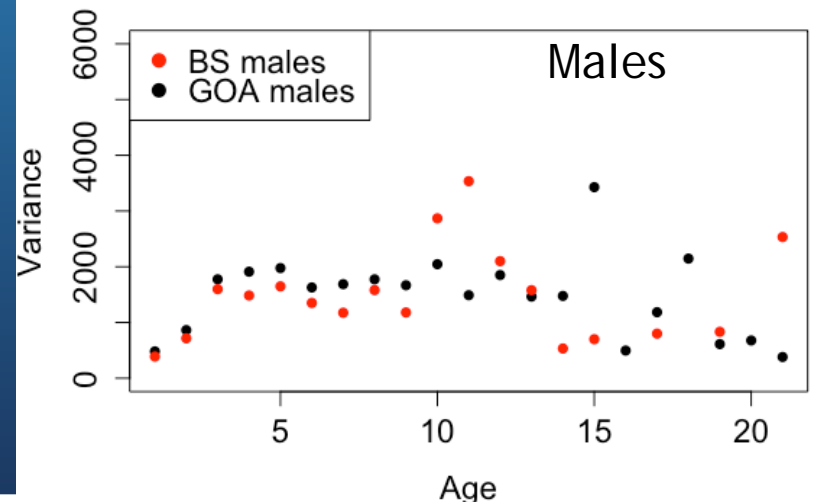
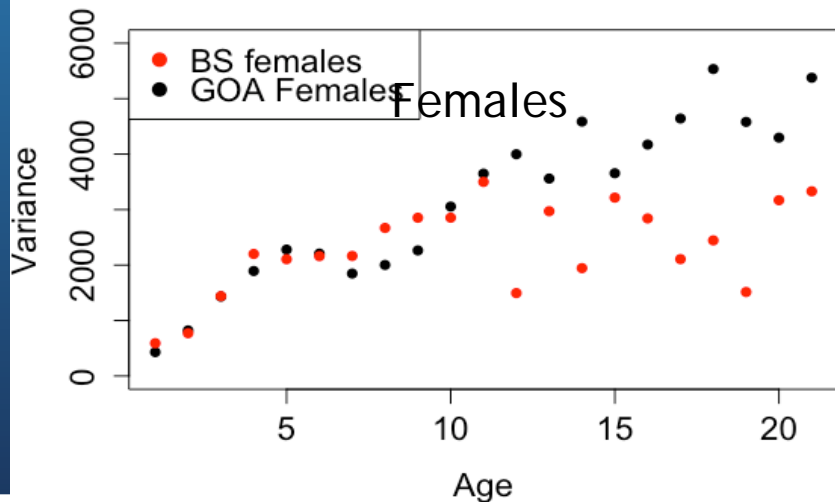
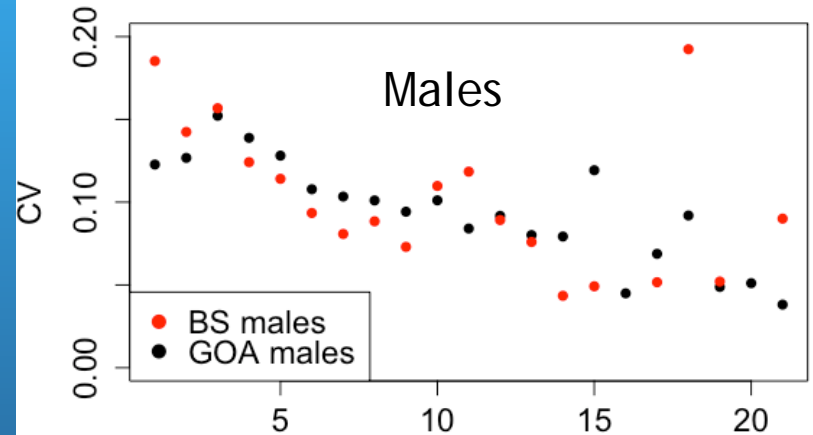
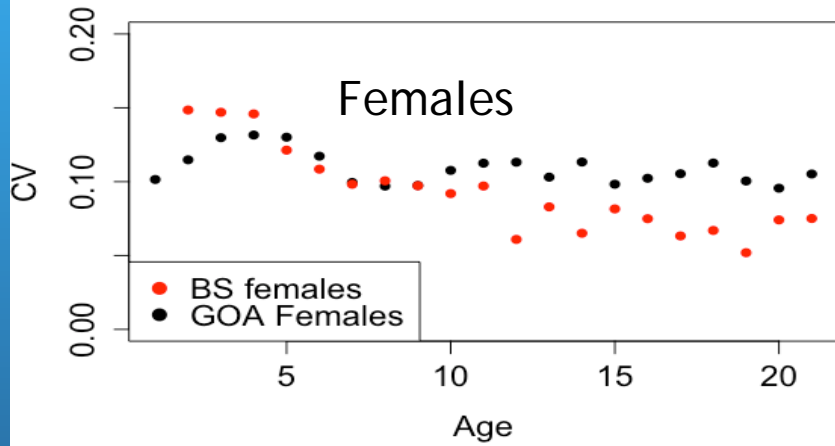
Female transition distribution
was larger than observed lengths.



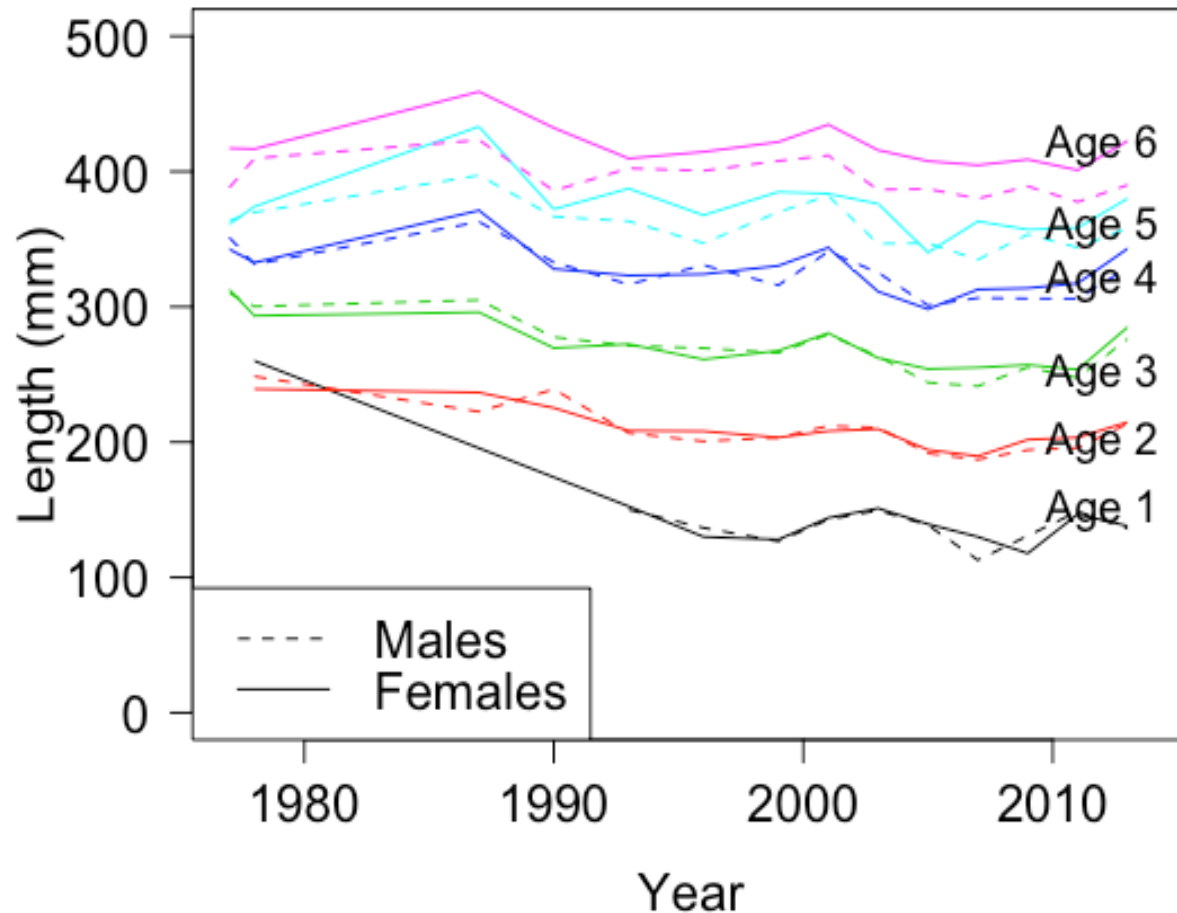
Fit a line through GOA female CV



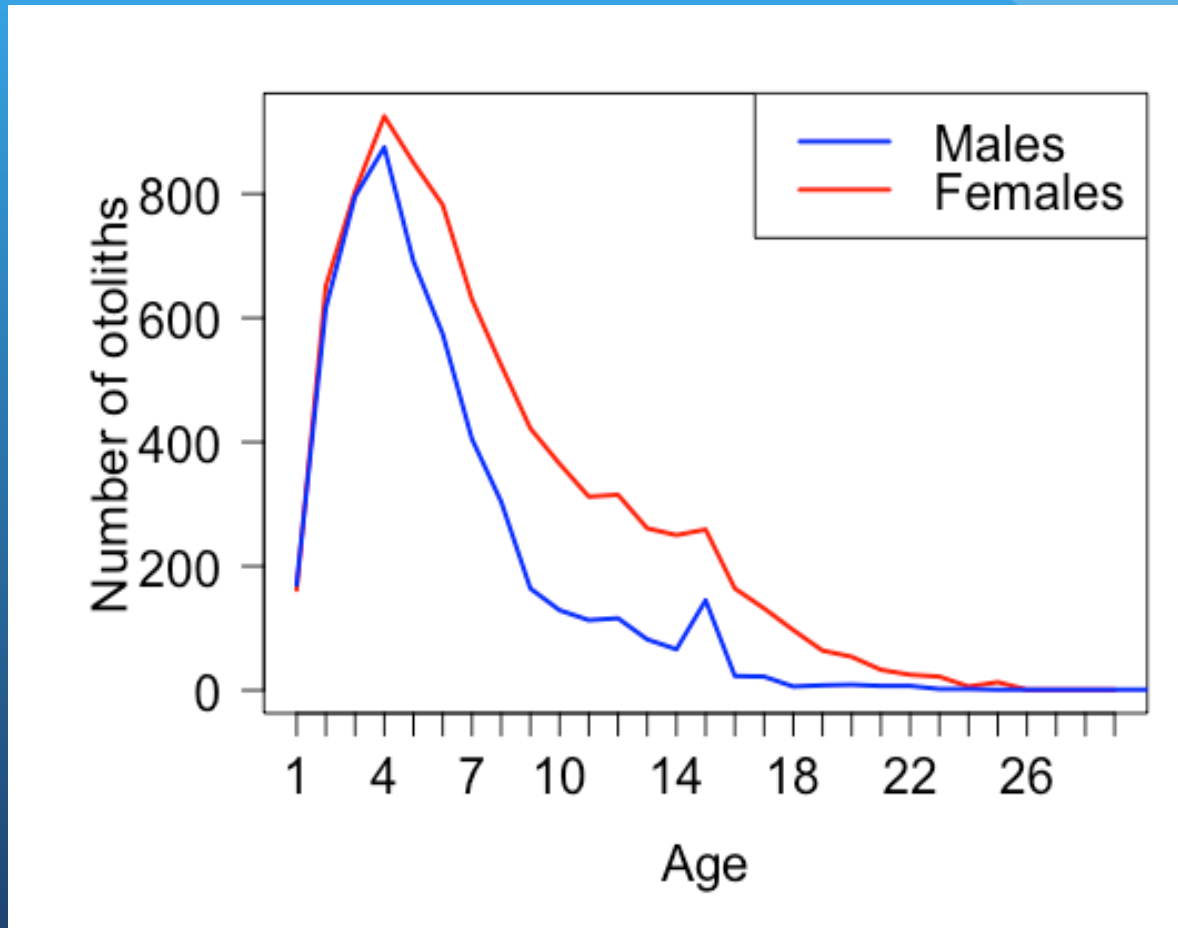
Variance, CV associated with lengths at age



Growth differences appear around age 5 ~ sexual maturity



Distribution of otoliths aged, males and females



Bayesian correction for length age conversion matrix

Estimation of mean length-at-age

An unbiased estimate of \bar{l}_j is given by

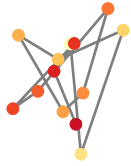
$$\bar{l}_j = \sum_i l_i q_{ij},$$

where q_{ij} is the probability of length i given age j . An expression for q_{ij} is obtained using Bayes theorem,

$$q_{ij} = \frac{q_i q'_{ij}}{\sum_i q_i q'_{ij}}.$$

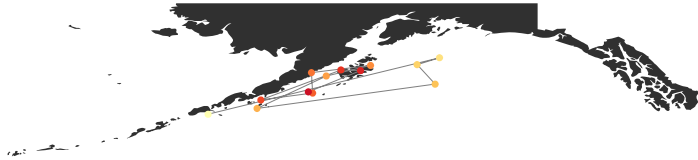
Gulf of Alaska

eresthes stomias)



Gulf of Alaska

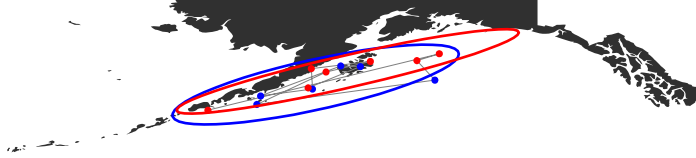
arrowtooth flounder (*Atheresthes stomias*)



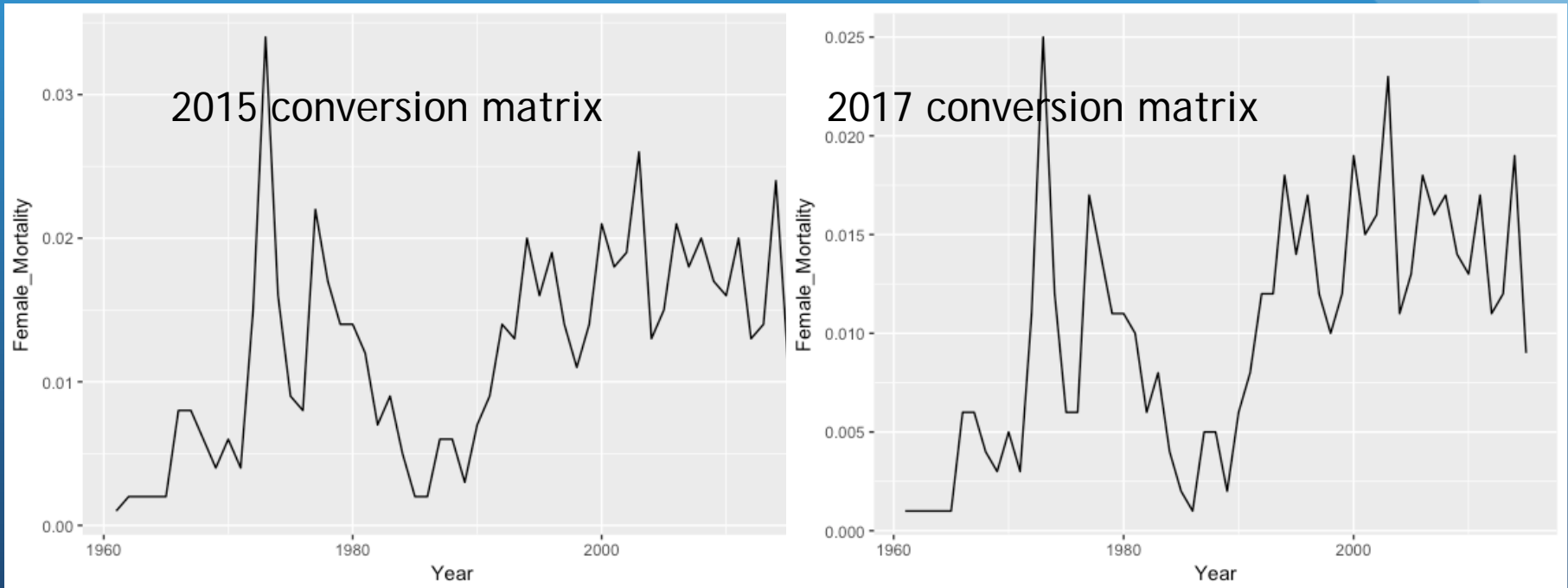
- 1984
- 1987
- 1990
- 1993
- 1996
- 1999
- 2001
- 2003
- 2005
- 2007
- 2009
- 2011
- 2013
- 2015

Gulf of Alaska

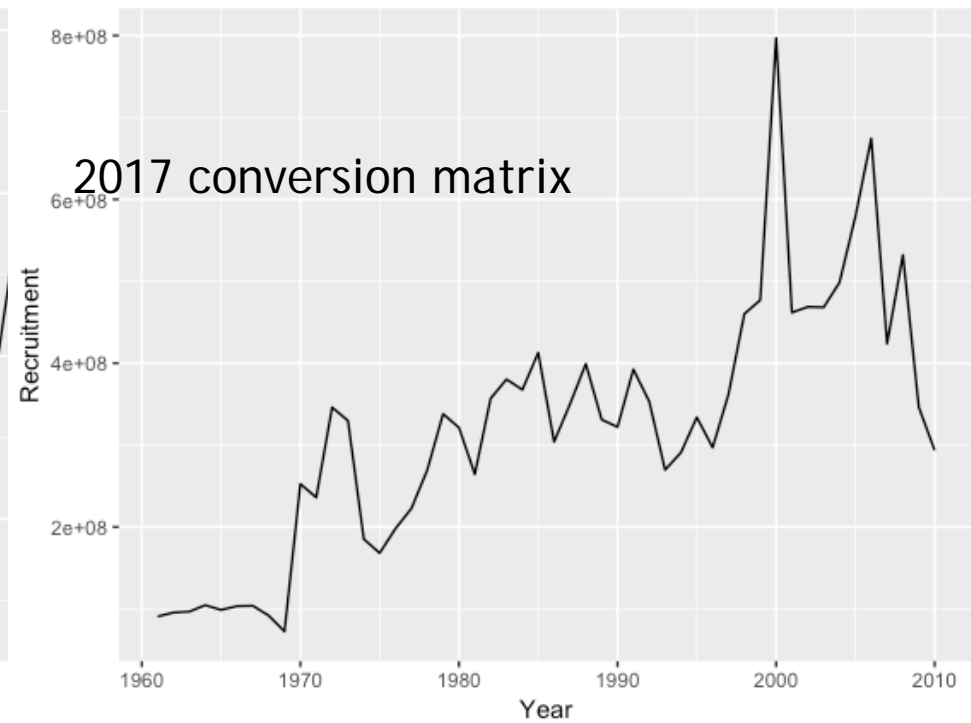
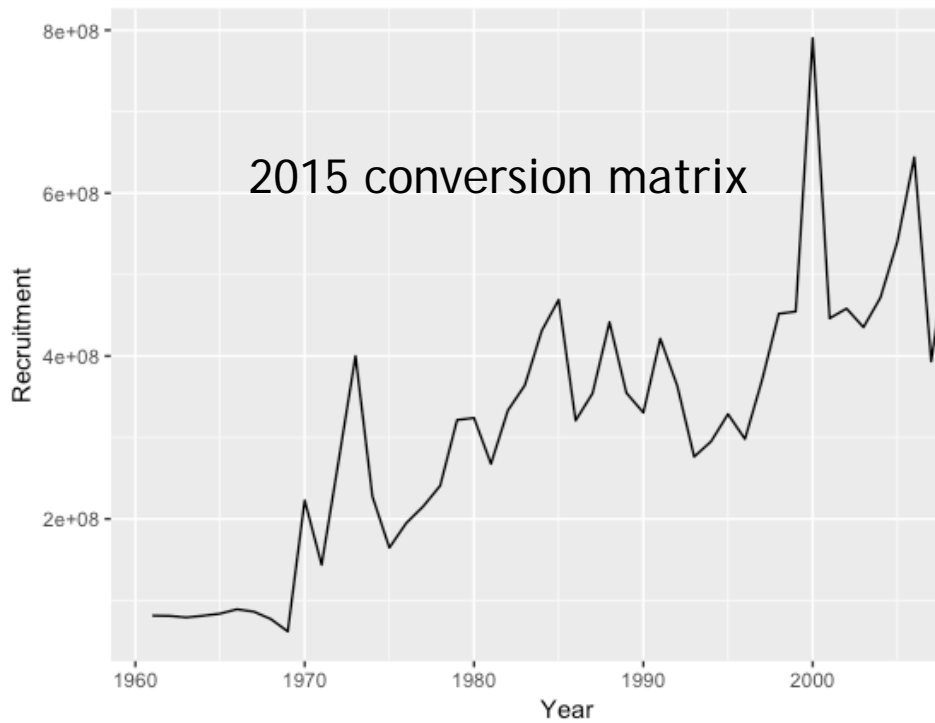
arrowtooth flounder (*Atheresthes stomias*)



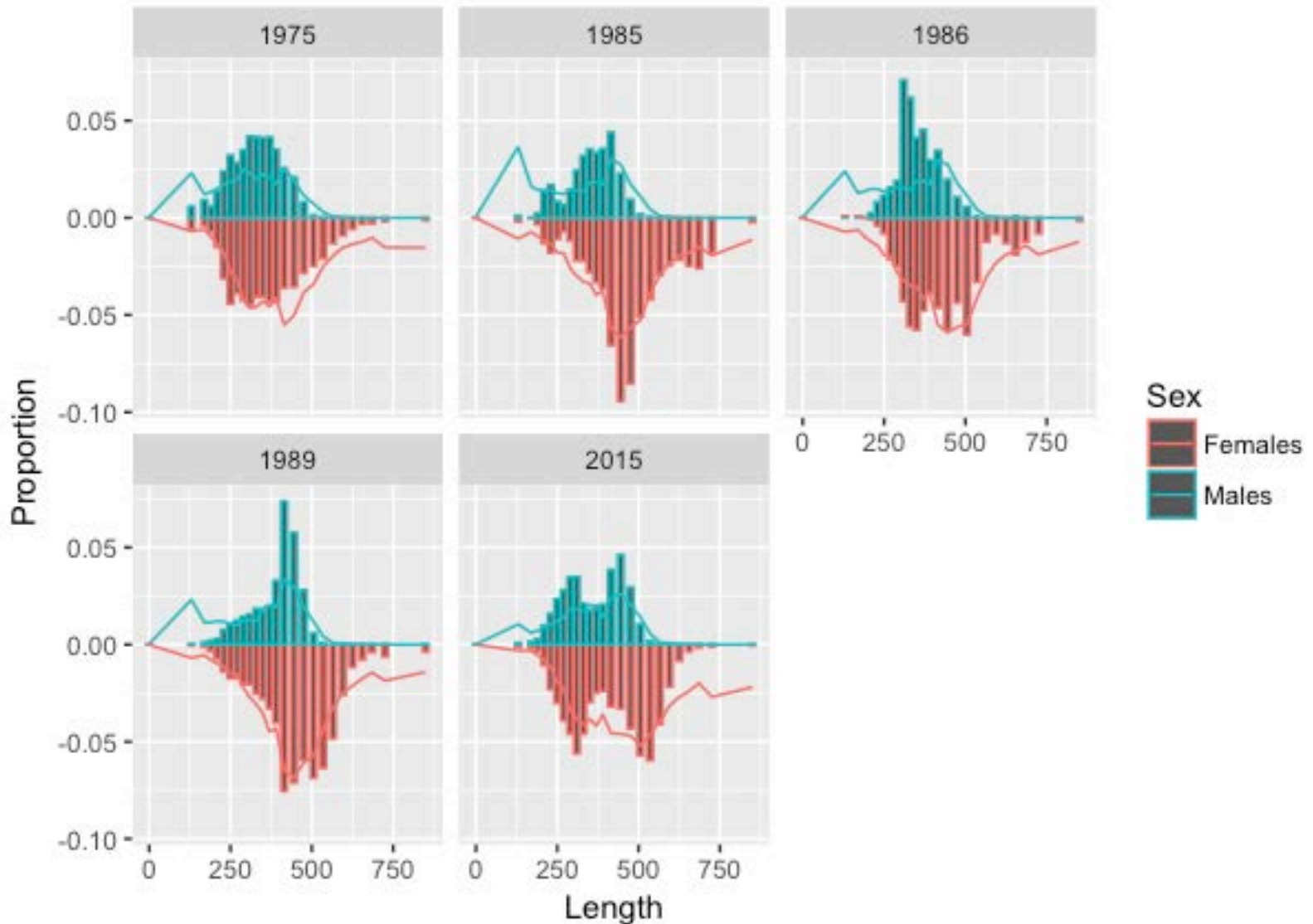
Female fishing mortality



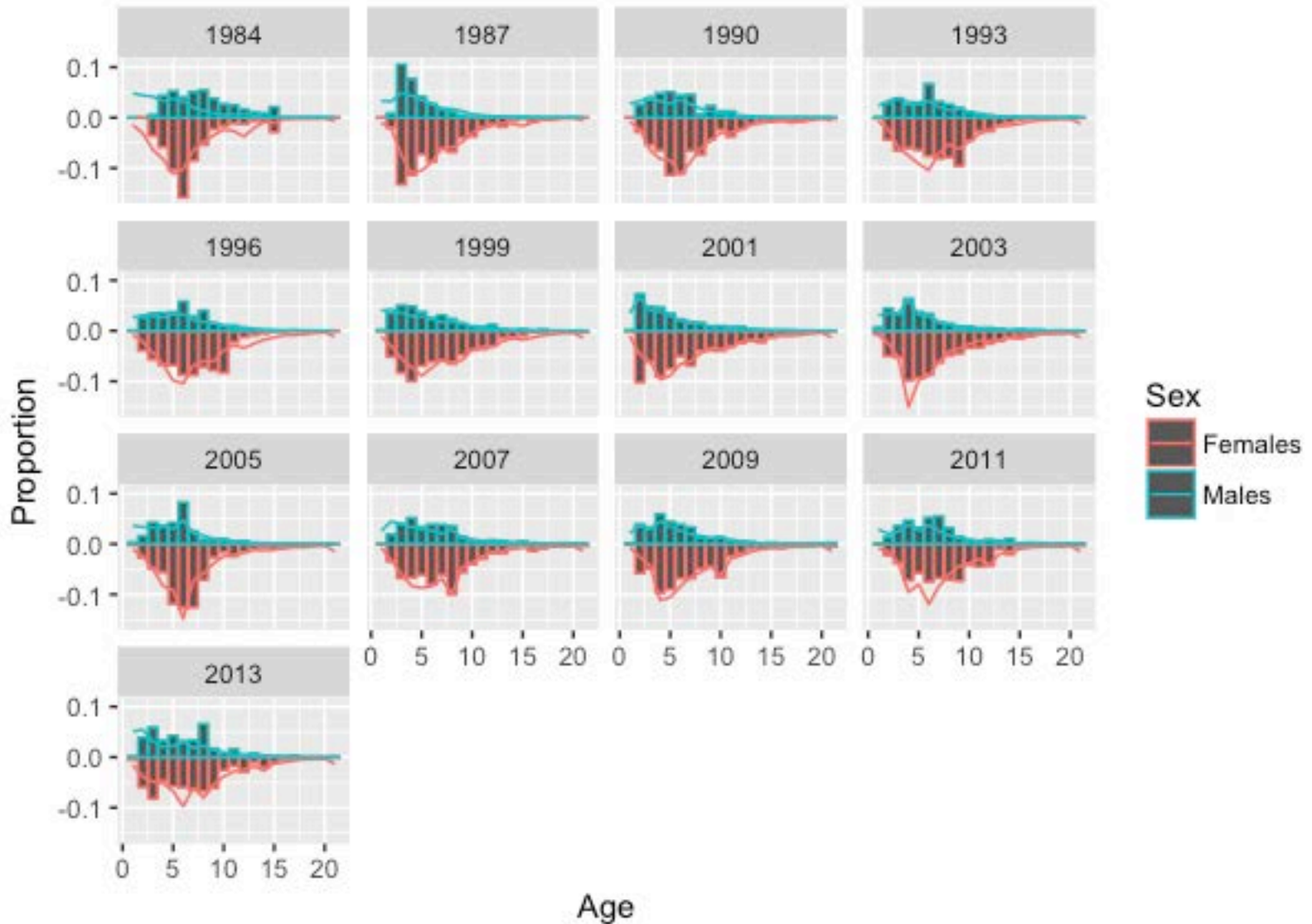
Recruitment



Length frequencies - GOA survey



GOA survey fit to age data



GOA - larger adults move deeper in warm years

