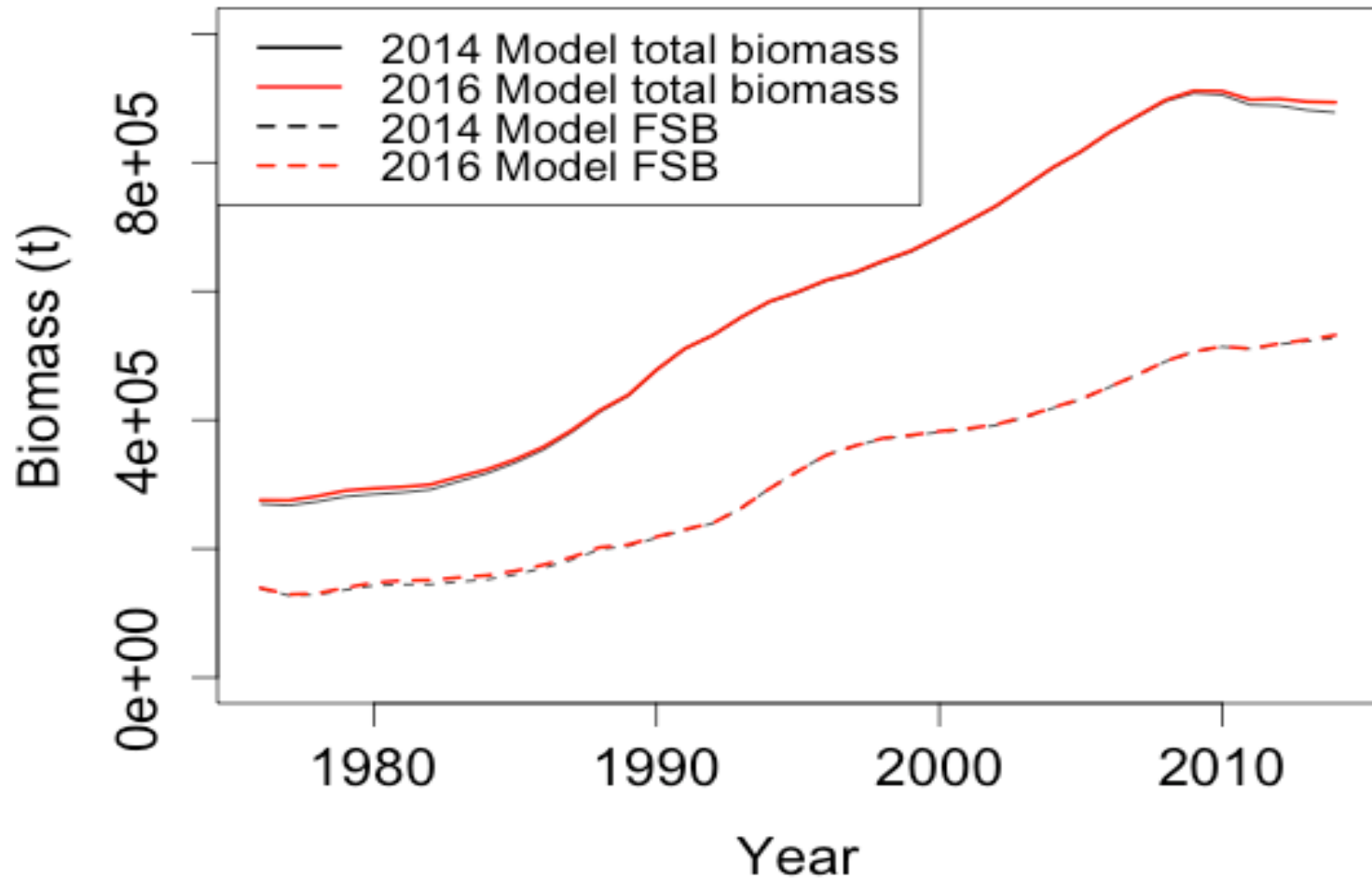


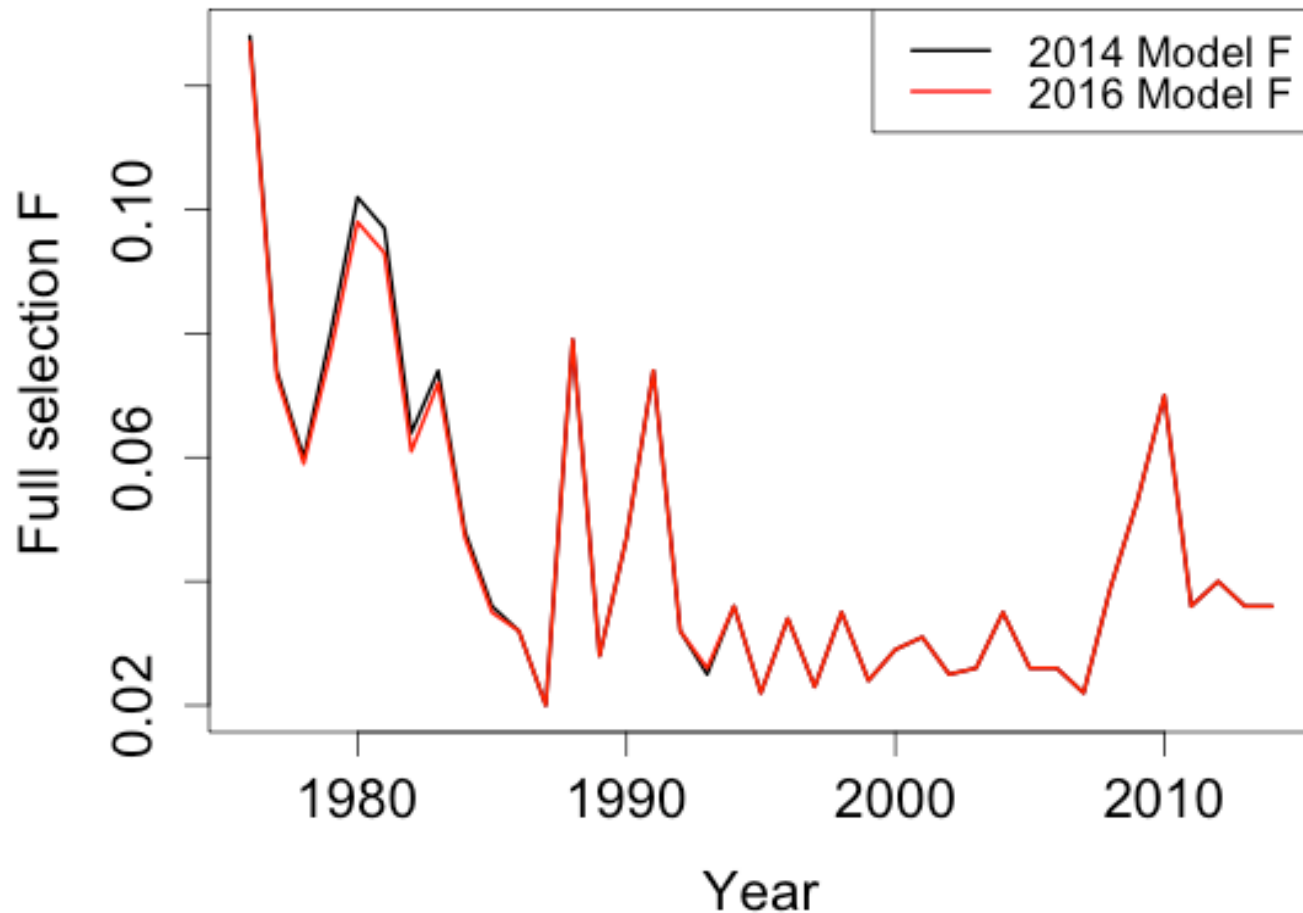
# Arrowtooth flounder model developments data weighting and length-age transition matrix

Ingrid Spies

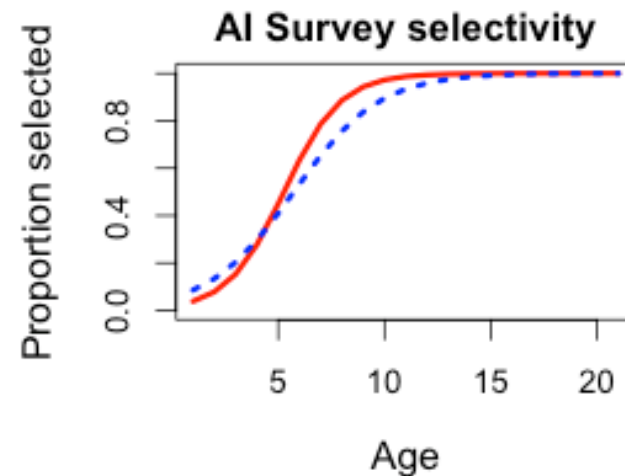
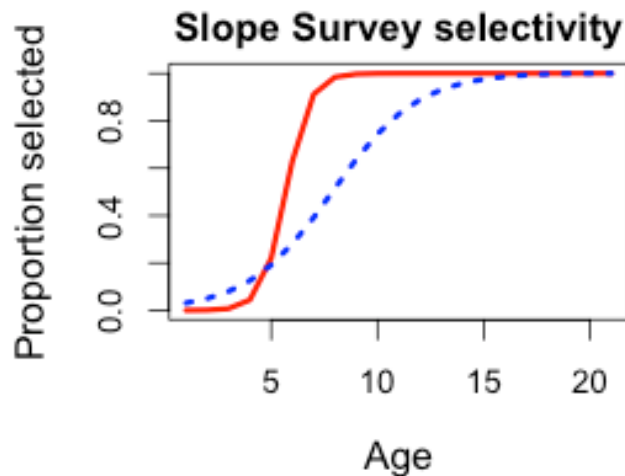
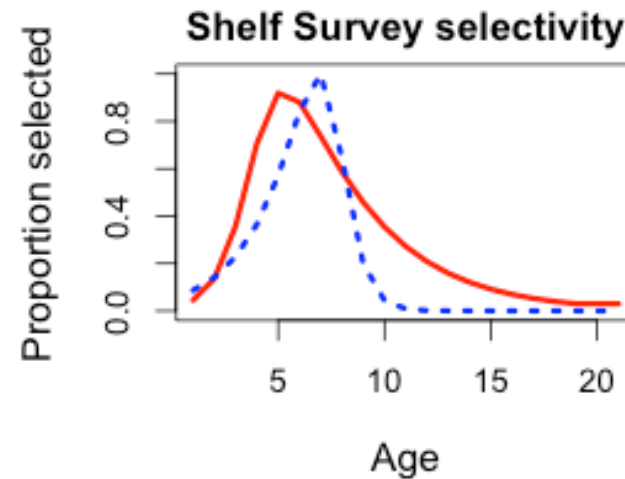
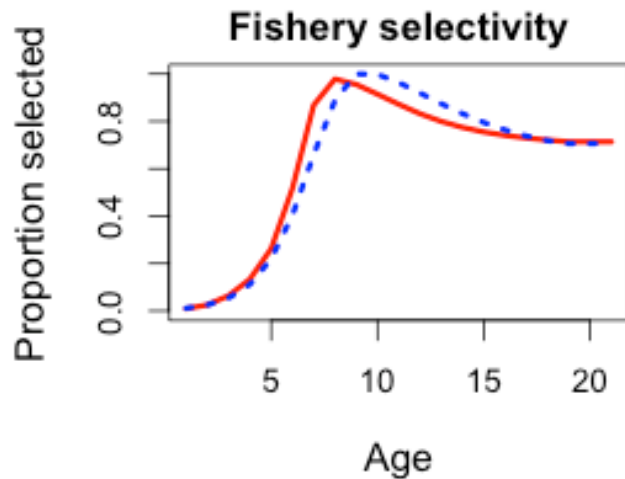
Total and female spawning biomass (FSB) for the 2014 model and the 2016 model (“combined” model).



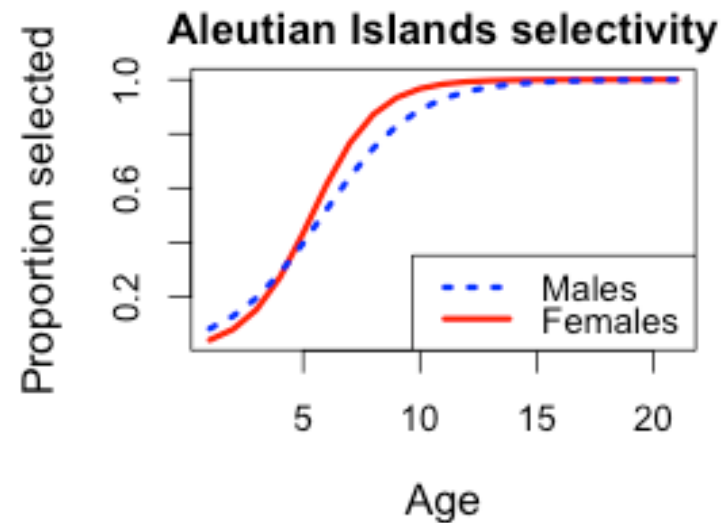
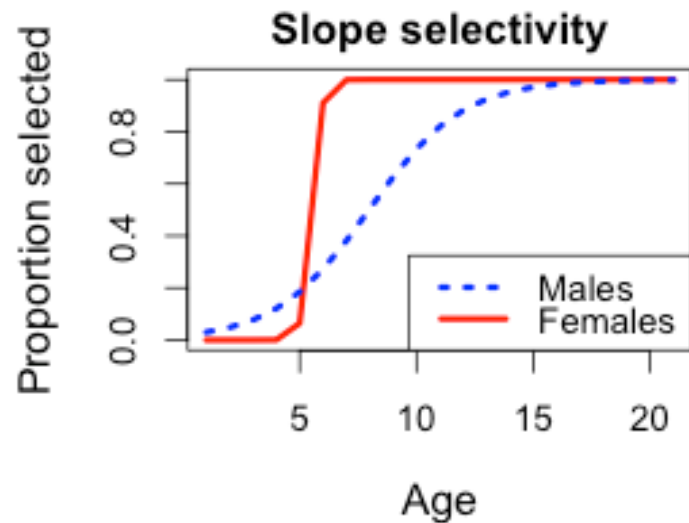
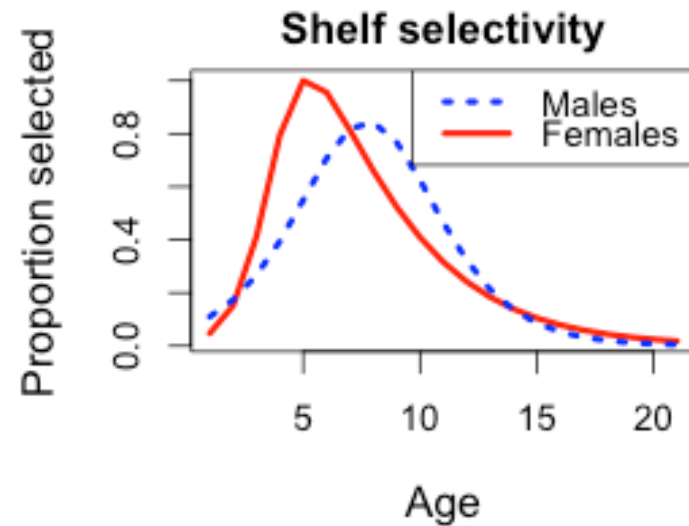
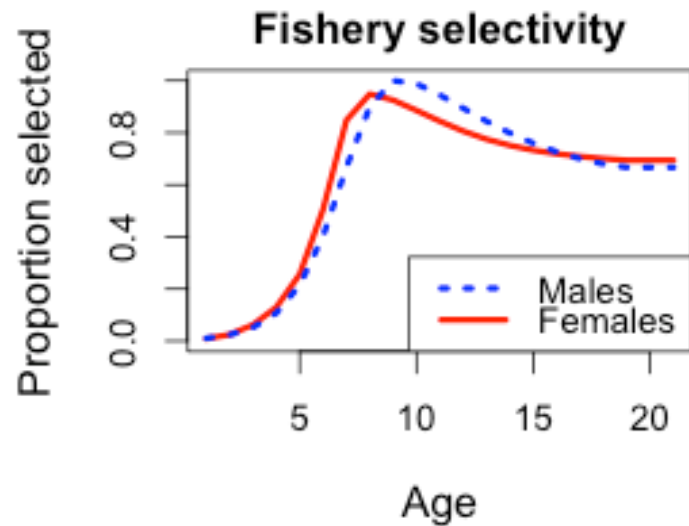
Full selection F (Fishing mortality rate on age 8 females, which are subject to the highest level of selectivity)



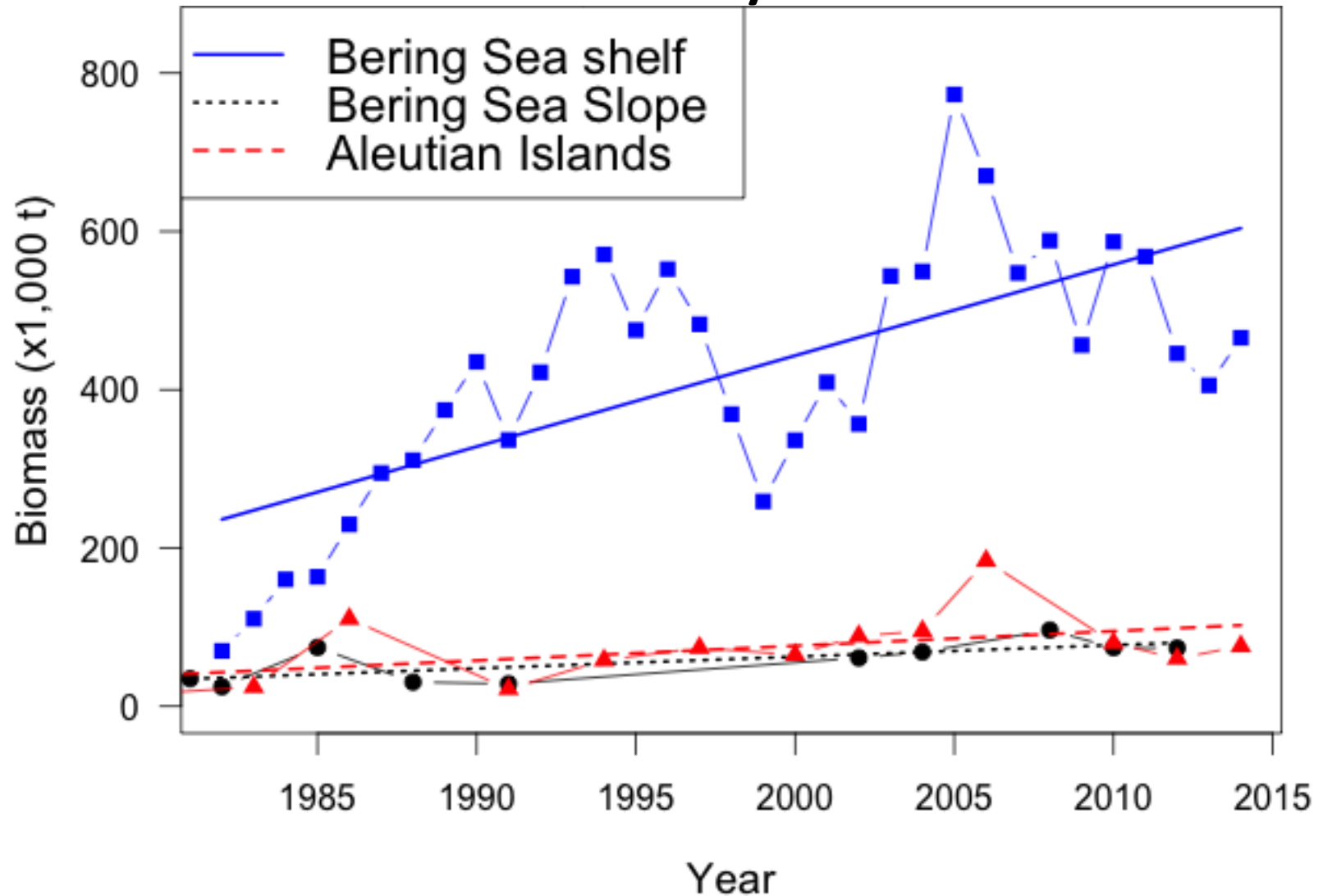
# Selectivity for the 2016 combined model



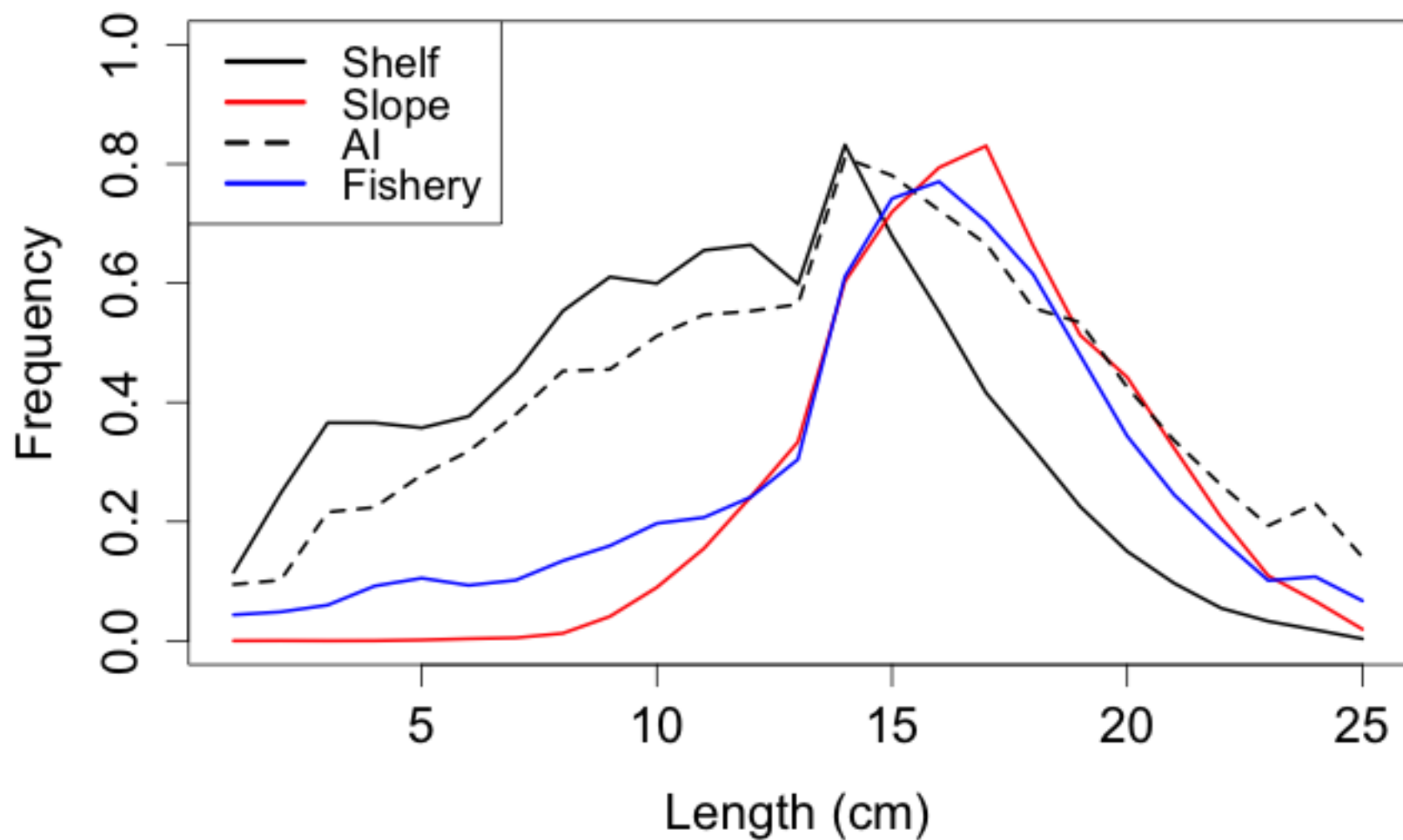
# Selectivity for the 2014 model.



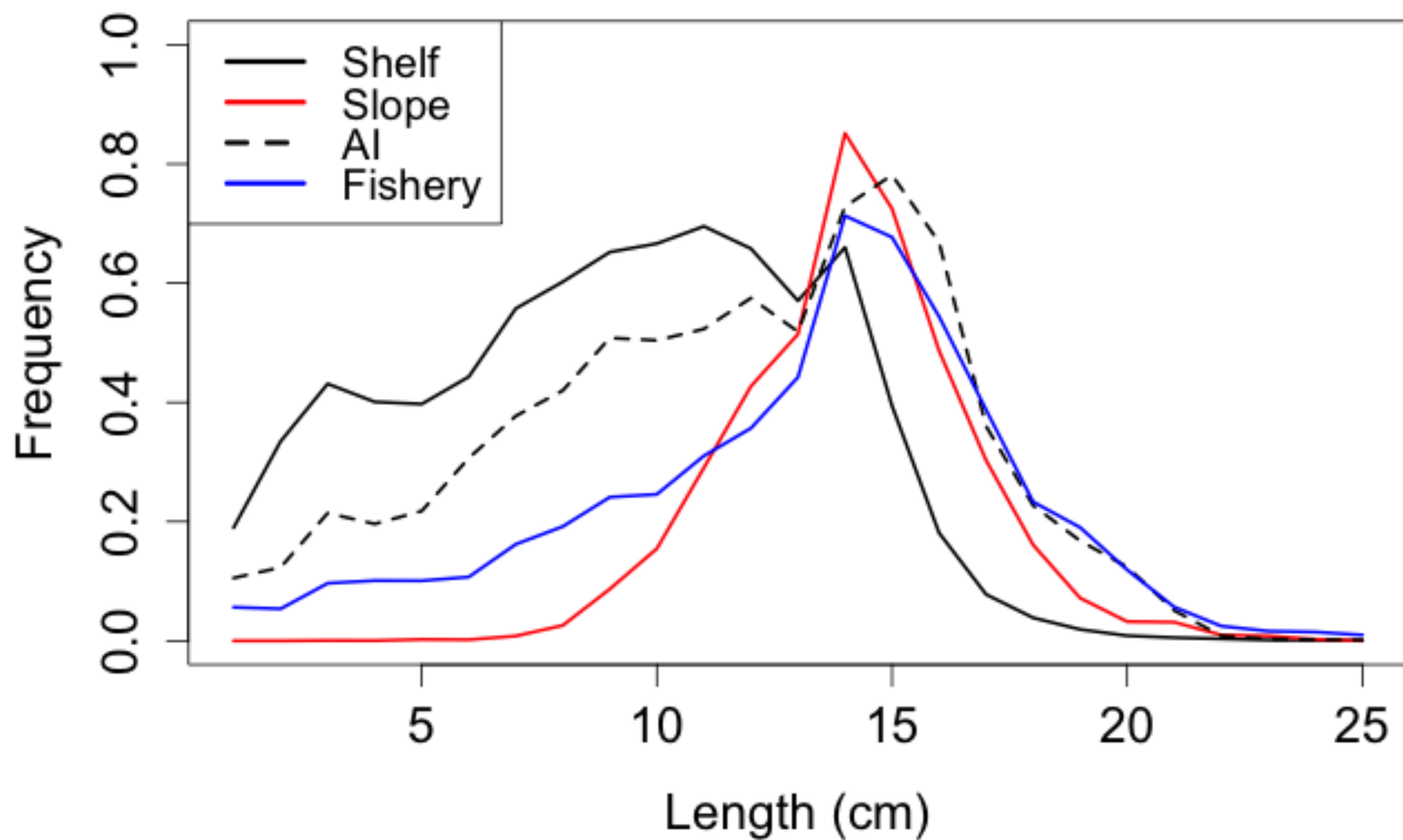
# BSAI assessment – based on data from 3 surveys.



## Female ATF length frequencies

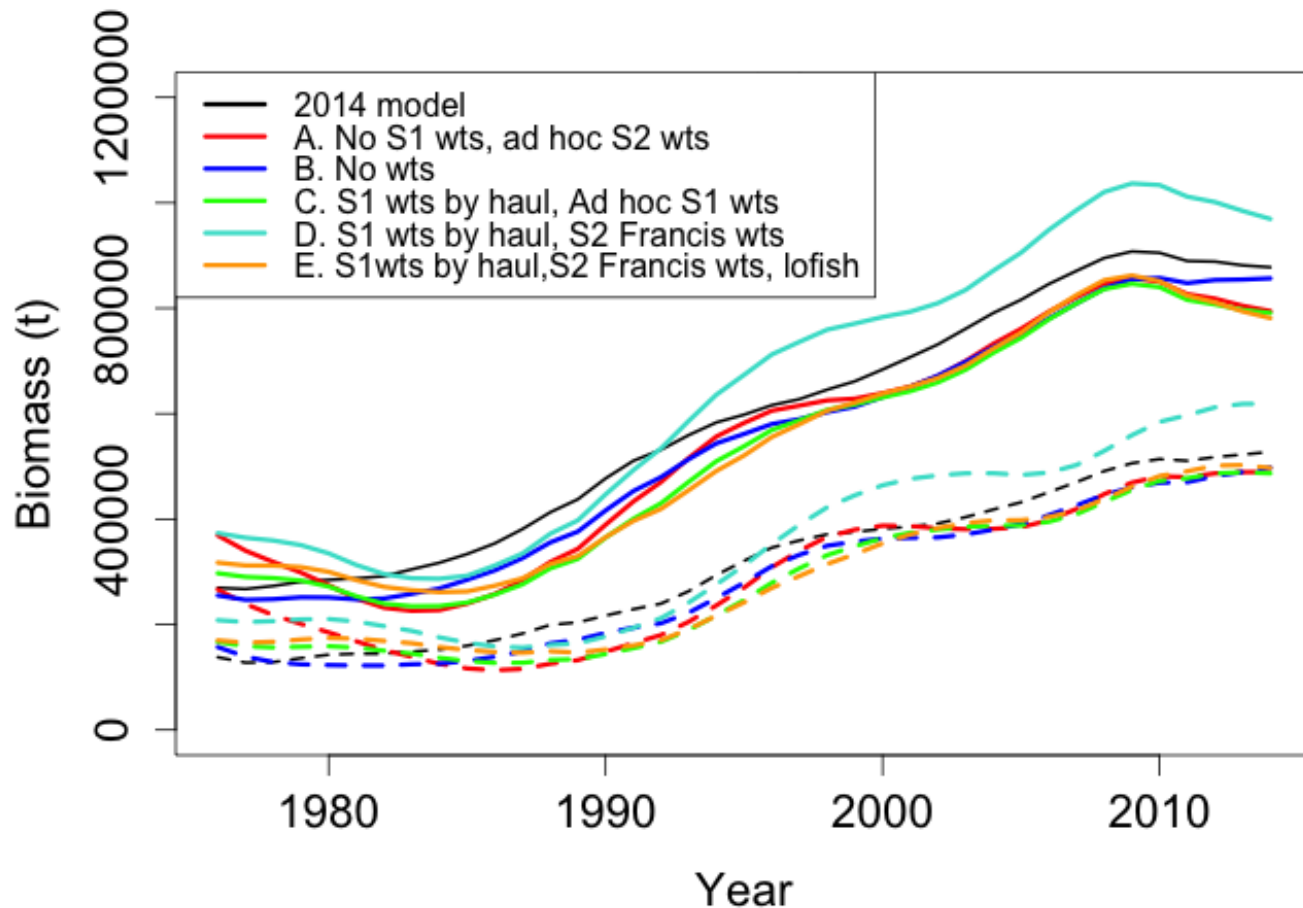


## Male ATF length frequencies





# Total (solid lines) and female spawning (biomass) by model.



# Data Weighting

- Applied stage 1 and stage 2 data weighting methods in Francis 2011.
- Previously length composition data was weighted the same for all survey and fishery years. Survey composition weights were 8 times higher than fishery.

# Likelihood components

- Selectivity (for fishery).
- Recruitment likelihood (lognormal).
- Size composition likelihood for the fishery, and three surveys (multinomial).
- Age composition likelihood for shelf and AI survey (multinomial).
- Survey biomass likelihood (lognormal with variances based on sampling error).
- Catch likelihood (lognormal assuming a value for CV).

# Catch likelihood weighting

- This is assumed – GOA pollock uses 5%.
- ATF might be slightly higher because discards are difficult to quantify
- Was 4%, I downweighted it to 6%

$$\text{Multiplier} = 1 / (2 * \text{assumed error}^2)$$

# Five weighting approaches

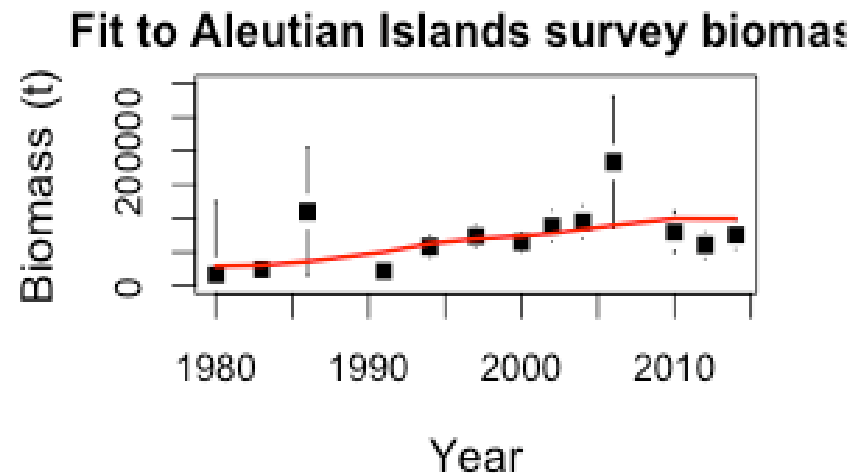
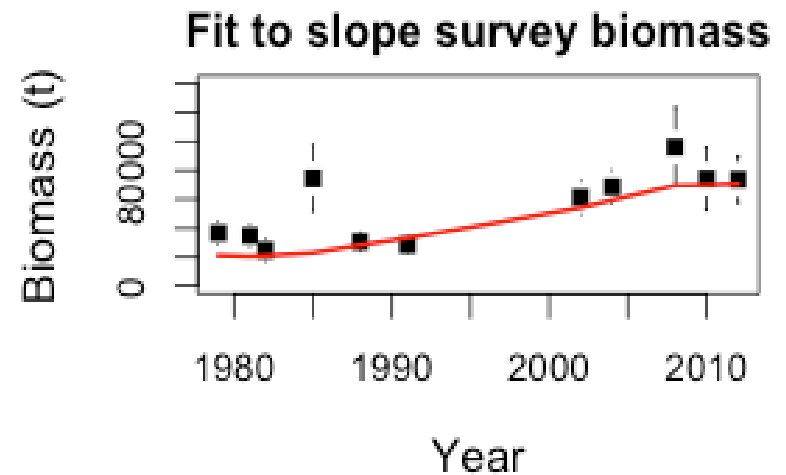
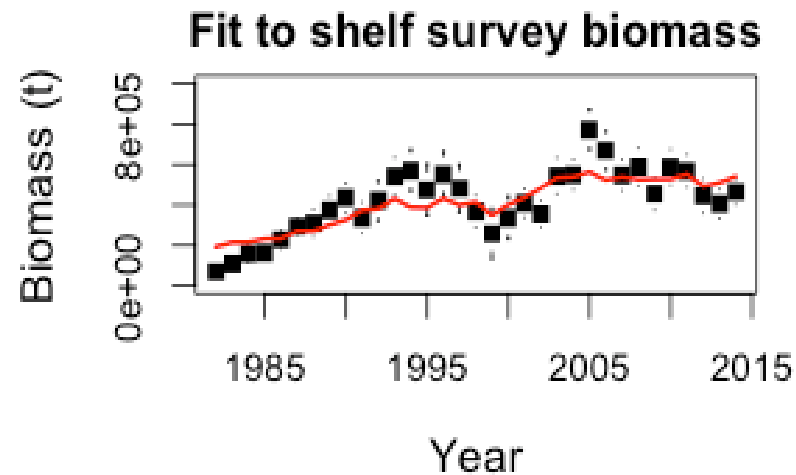
	Stage 1 weights	Shelf	Slope	AI	Shelf	Slope	AI	Fishery
	Comp. data	Biomass data			Length composition data			
A	No	12	3	5	1	1	1	1/8
B	No	1	1	1	1	1	1	1/8
C	Yes (#hauls)	12	3	5	1	1	1	1
D	Yes (#hauls)	3.3	1.3	2.4	0.46	0.28	0.16	0.11
E	Yes (#hauls)	3.3	1.3	2.4	0.46	0.28	0.16	0.011

# Likelihood

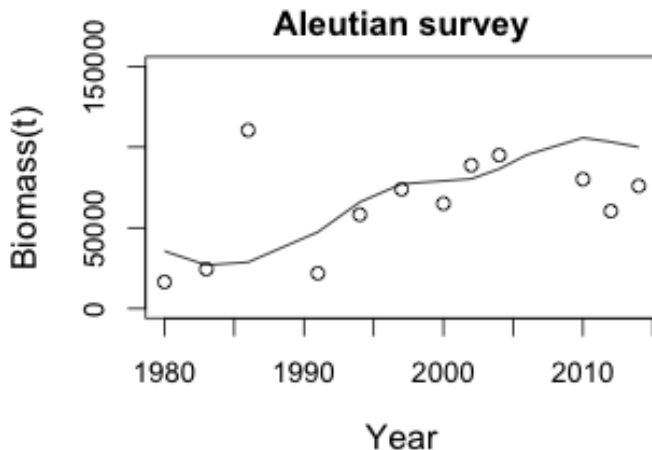
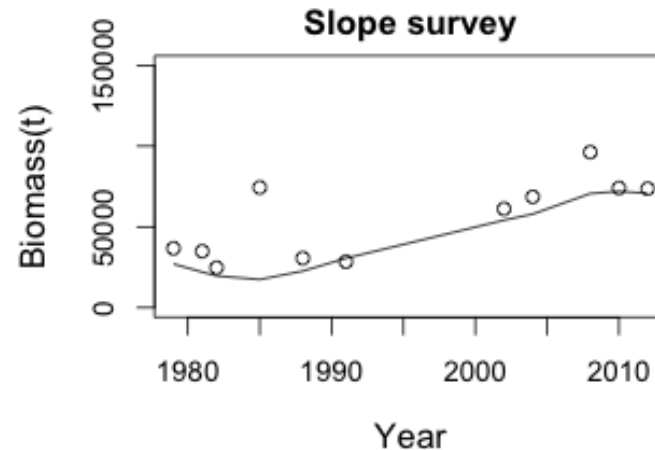
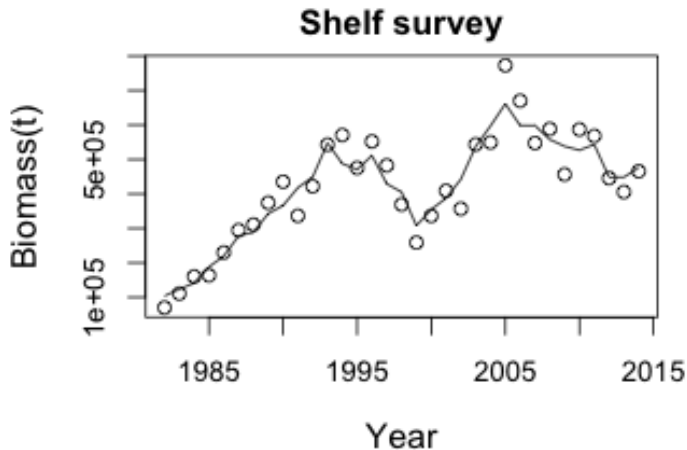
	Catch	Shelf Biomass	Slope Biomass	AI Biomass	Biomass fem.	Mono. fishery	Mono. fishery mal.
A	0.034	29.00	66.40	43.07		15.64	8.62
B	0.009	125.65	71.57	50.38		11.56	7.54
C	0.108	46.68	60.71	41.40		100.93	119.05
D	0.048	34.91	38.40	30.49		114.17	122.55
E	0.025	88.51	44.04	36.64		103.36	123.93

	Age shelf	Age AI	Recruitment	Fishery length	Survey length
A	209.51	110.32	24.25	424.09	1168.12
B	175.72	104.69	26.92	409.14	1144.81
C	268.09	102.08	29.25	5333.31	1430.29
D	275.69	77.02	29.22	5329.85	1484.05
E	231.79	79.64	26.76	5106.28	1490.07

# Fit before Francis reweighting



# A. No S1 wts, Ad hoc wts.

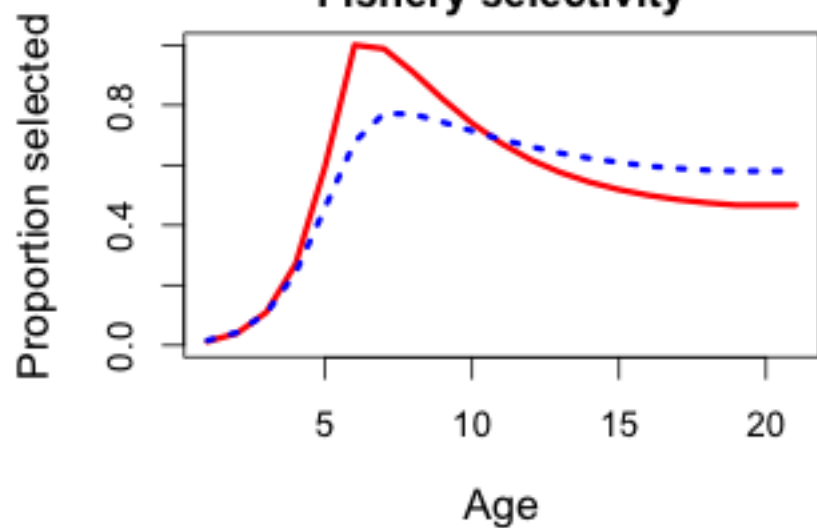


Standard deviation of  
normalized residuals  
Shelf 1.347542 (Goal: 1.21)  
Slope 2.718593 (Goal: 1.37)  
AI 2.526962 (Goal: 1.34)

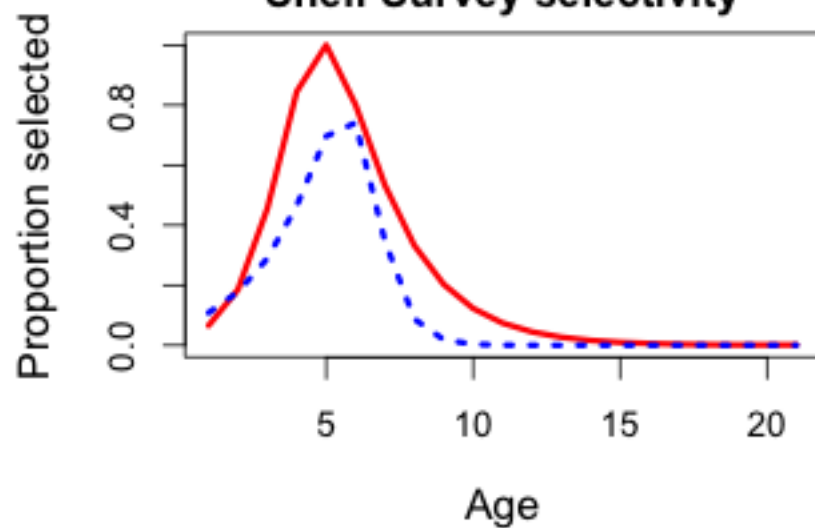


A.

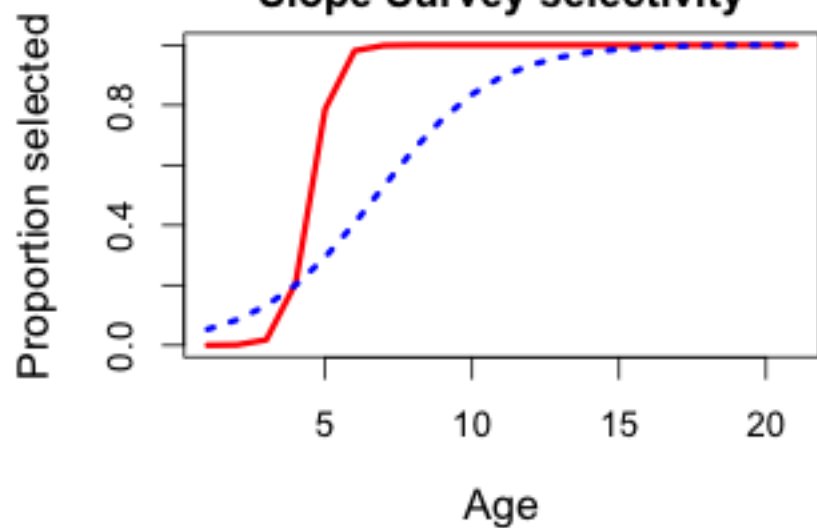
**Fishery selectivity**



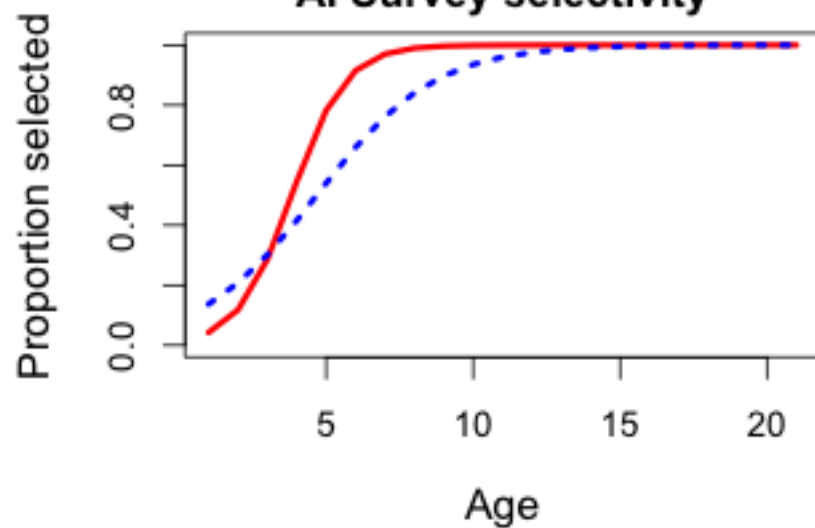
**Shelf Survey selectivity**



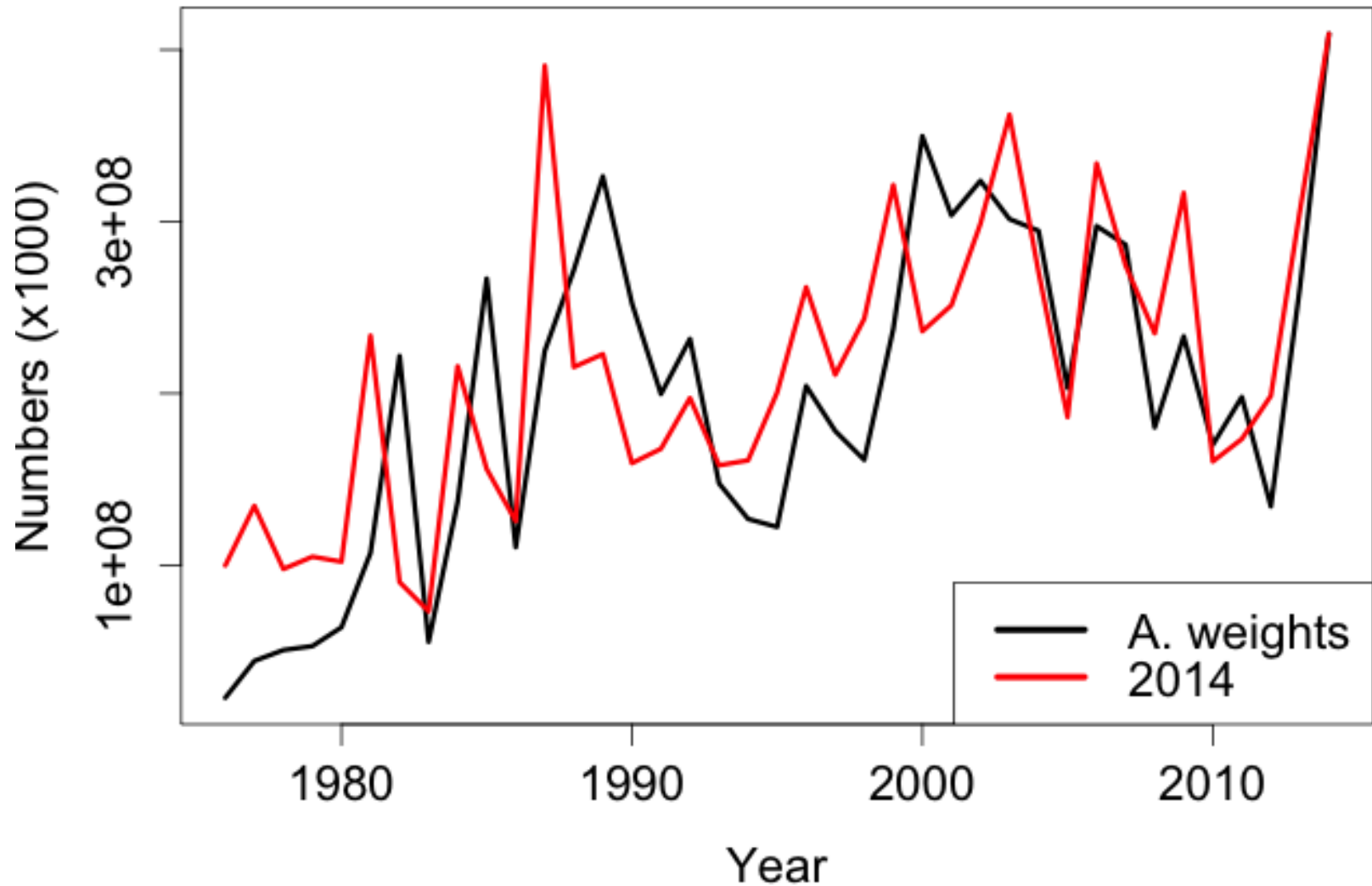
**Slope Survey selectivity**



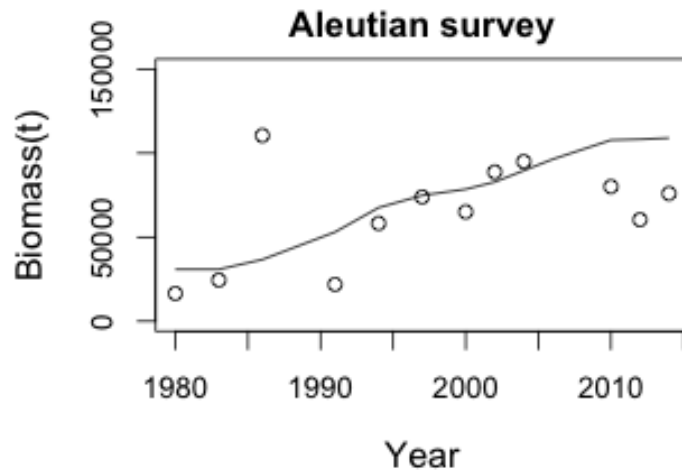
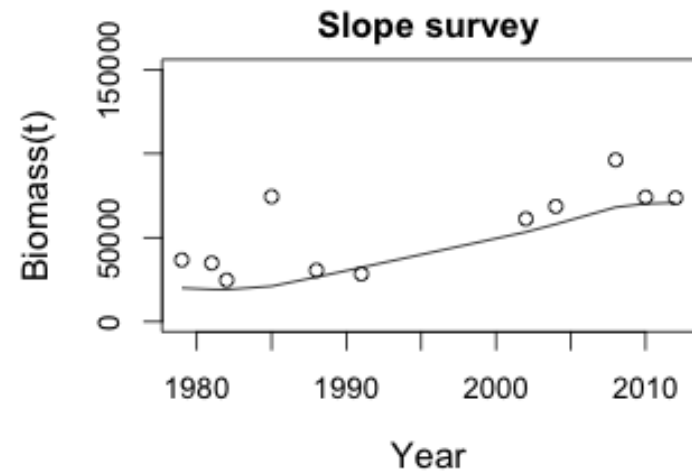
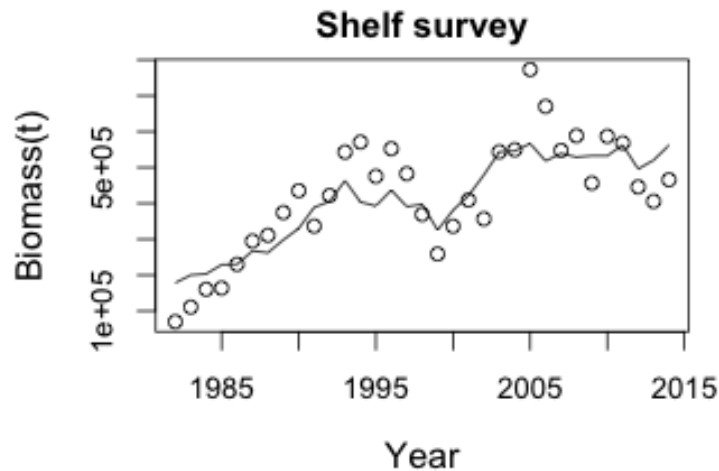
**AI Survey selectivity**



# Recruitment

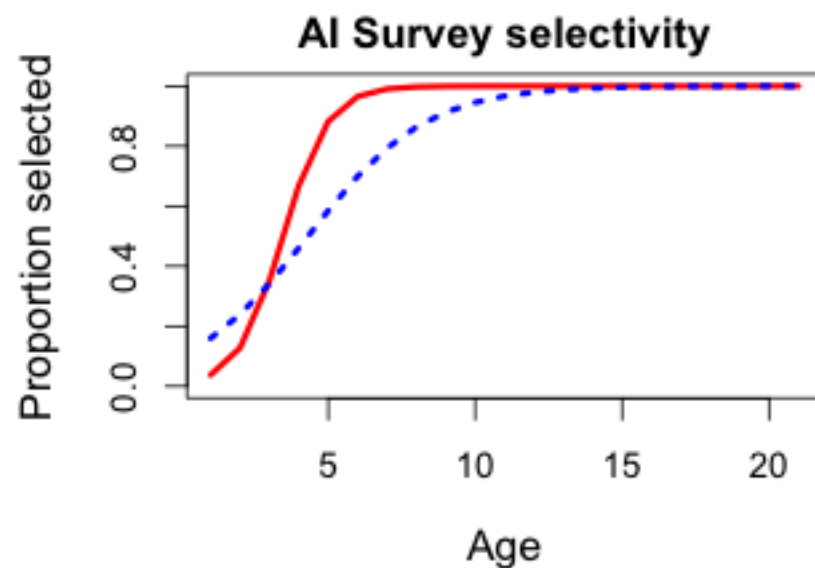
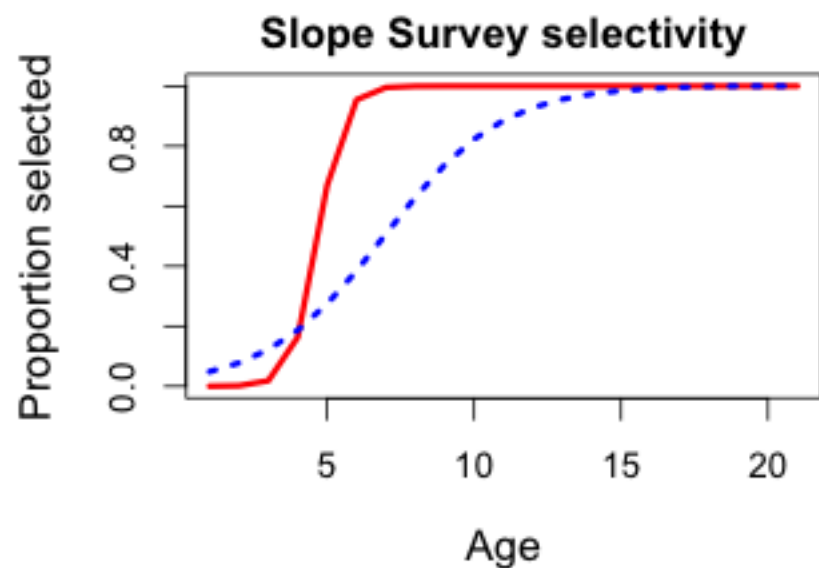
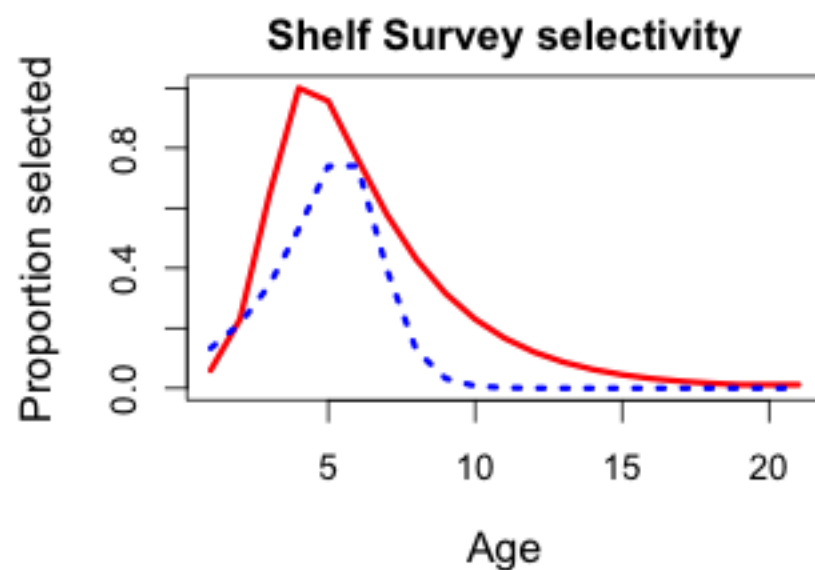
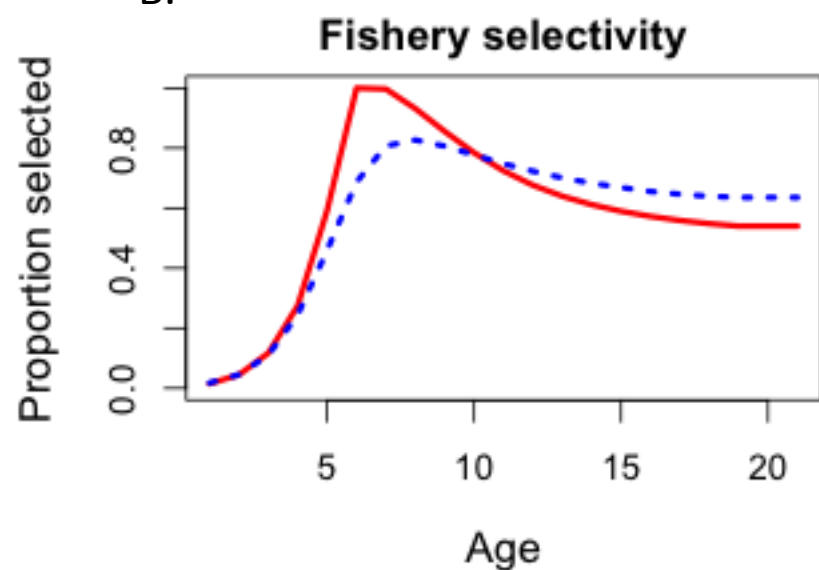


## B. No S1 wts, No S2 wts

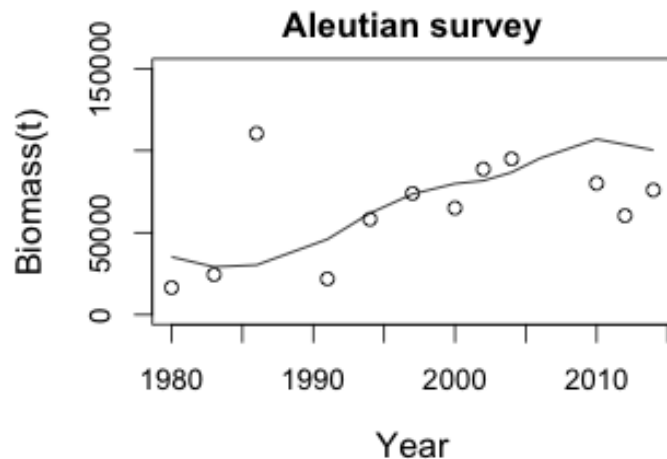
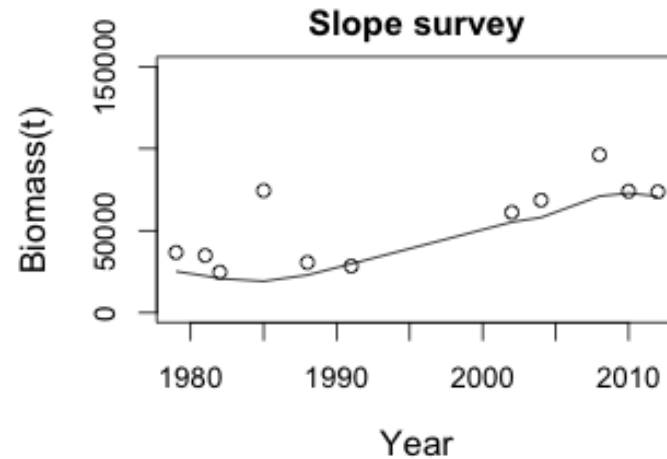
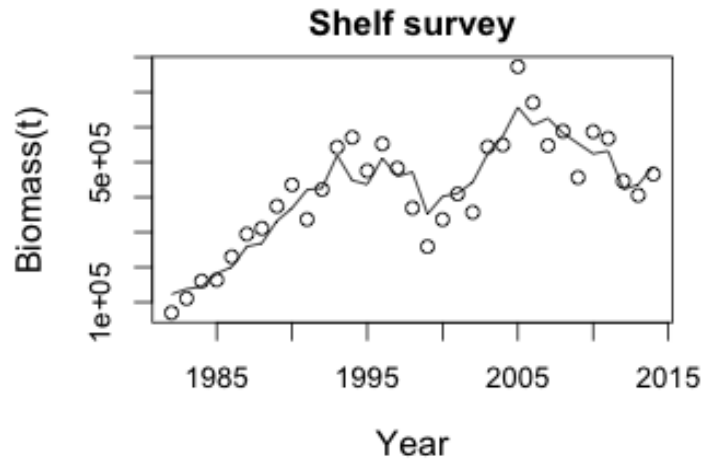


Standard deviation of  
normalized residuals  
Shelf 2.804994 (Goal: 1.21)  
Slope 2.781307 (Goal: 1.37)  
AI 2.64127 (Goal: 1.34)

B.

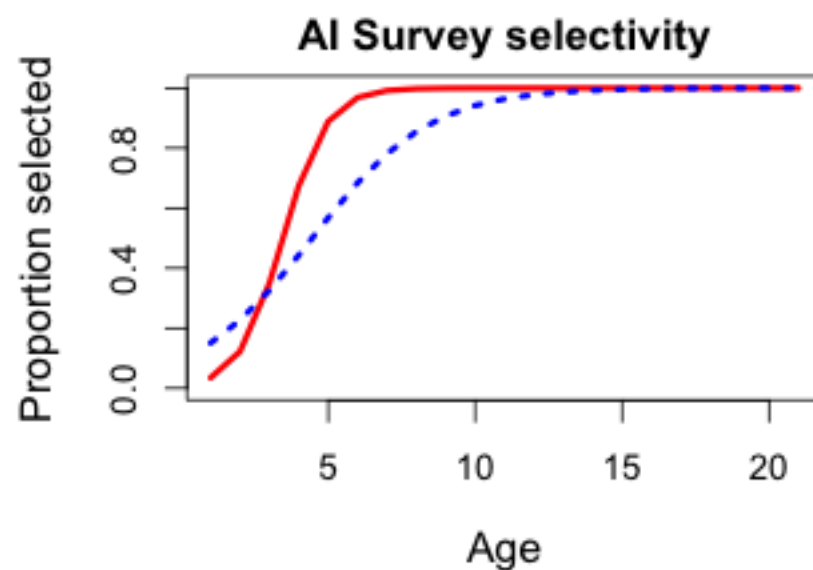
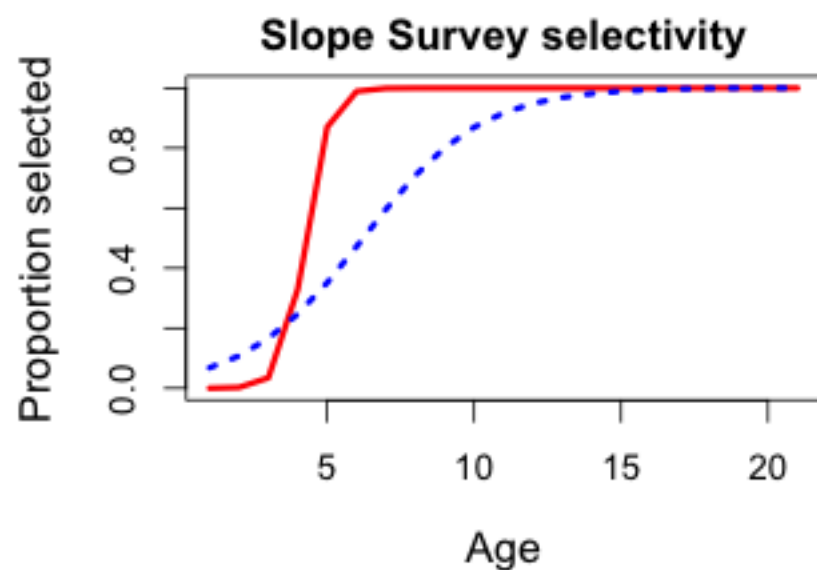
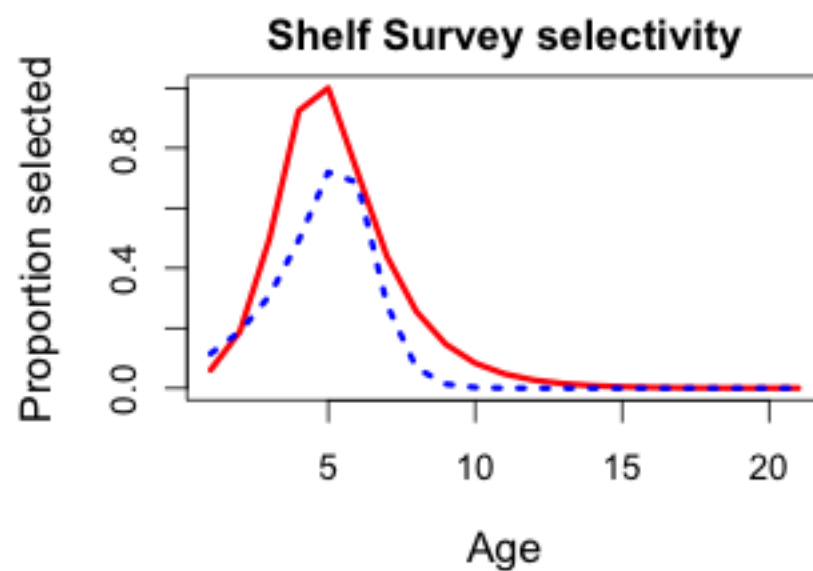
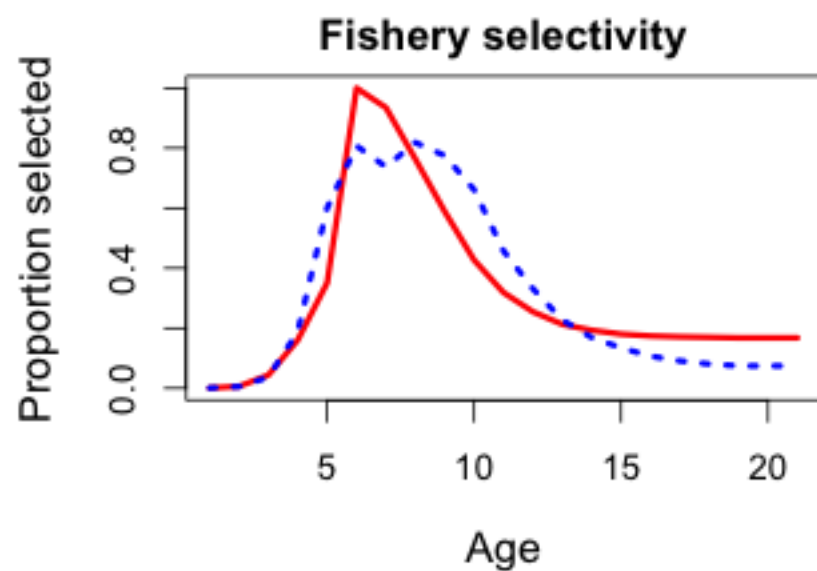


## C. S1 wts by haul, S2 Ad hoc weights

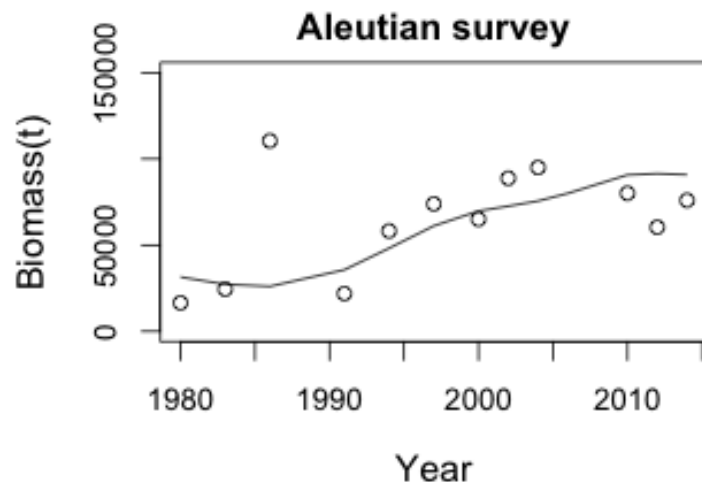
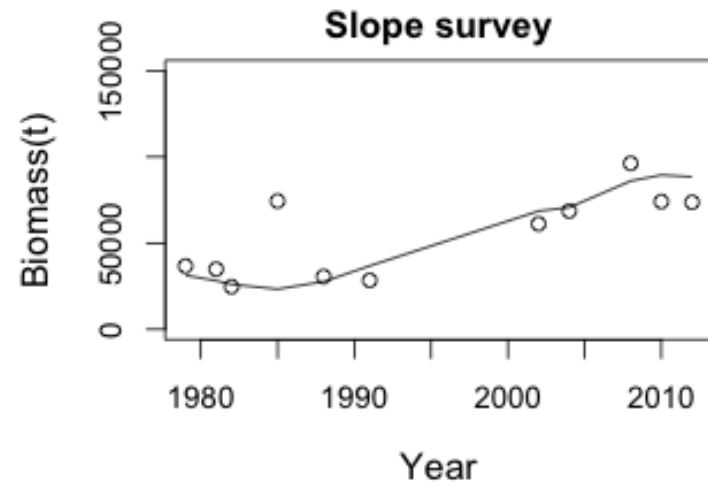
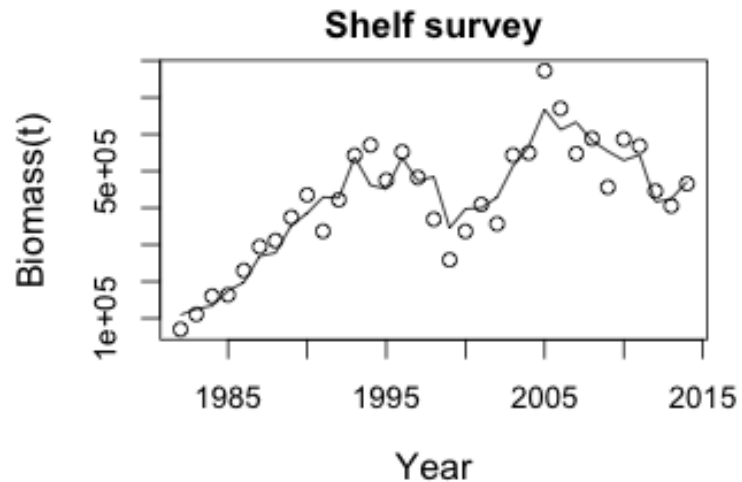


Standard deviation of  
normalized residuals  
Shelf 1.7094 (Goal: 1.21)  
Slope 2.567149 (Goal: 1.37)  
AI 2.474156 (Goal: 1.34)

C.

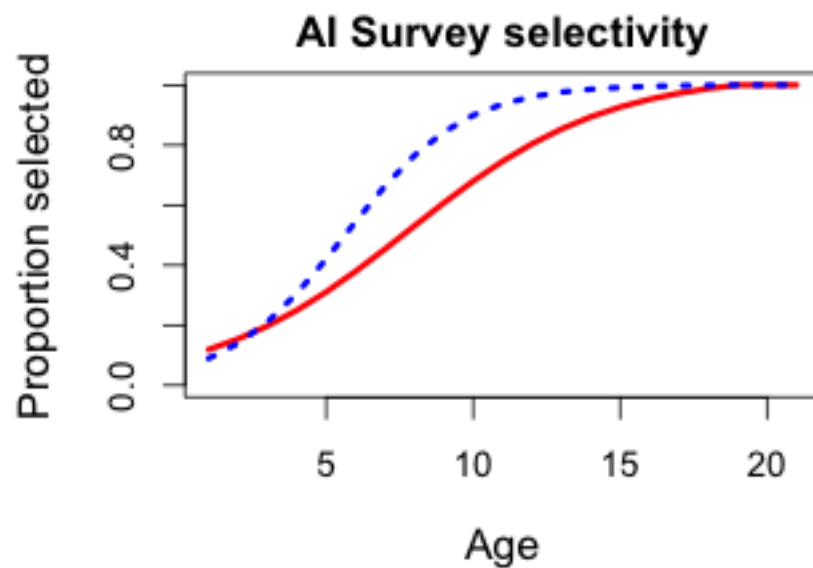
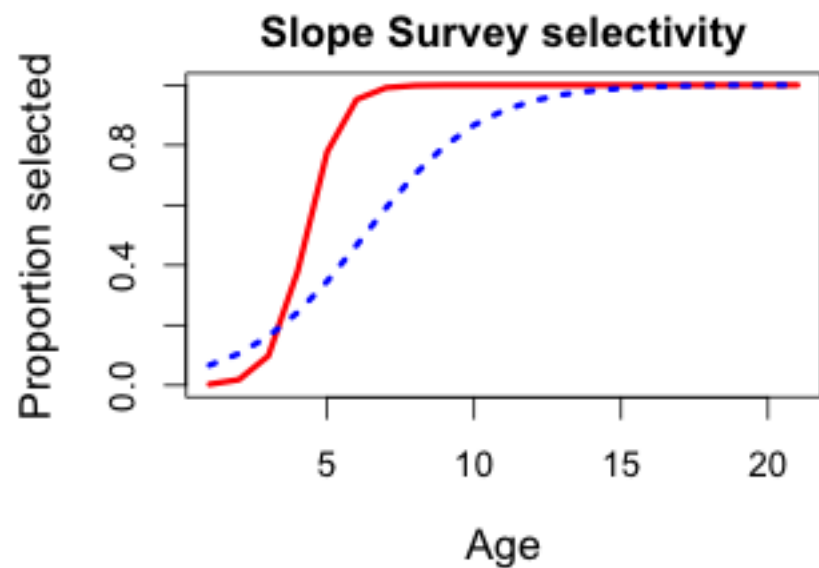
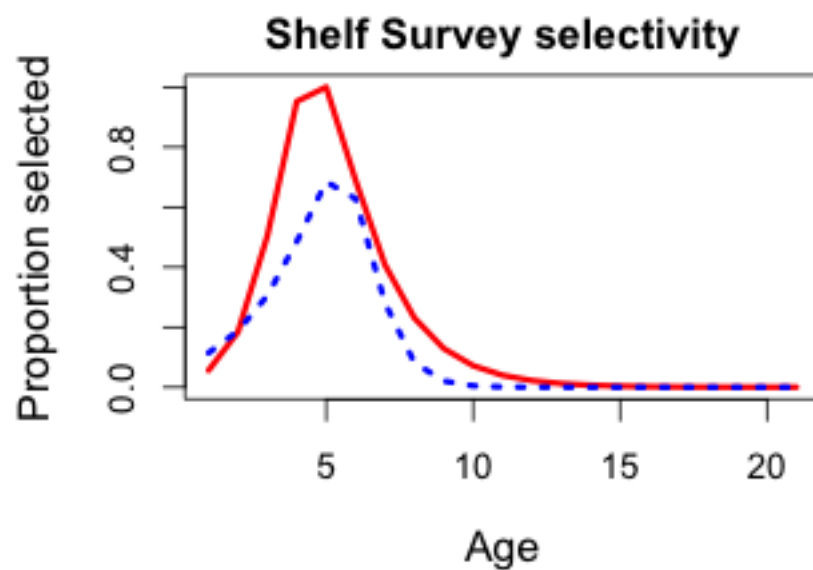
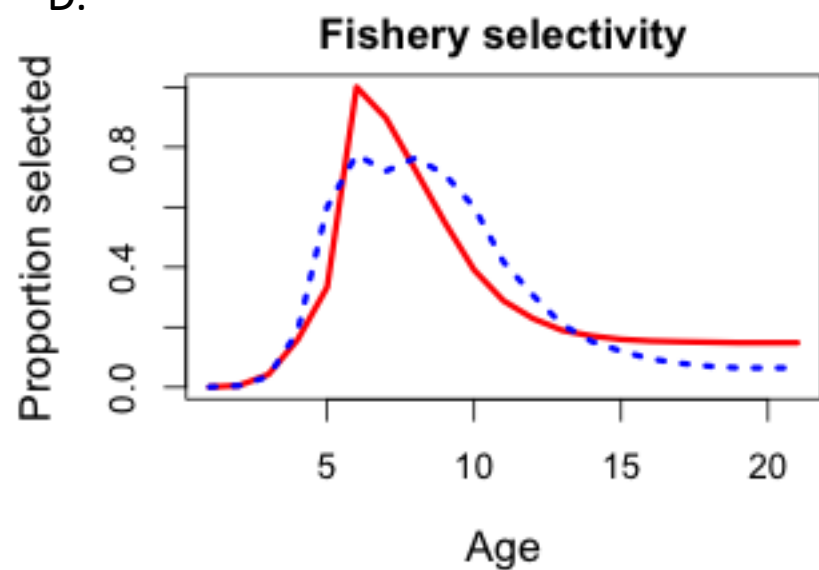


## D. S1 wts by haul, Francis wts.



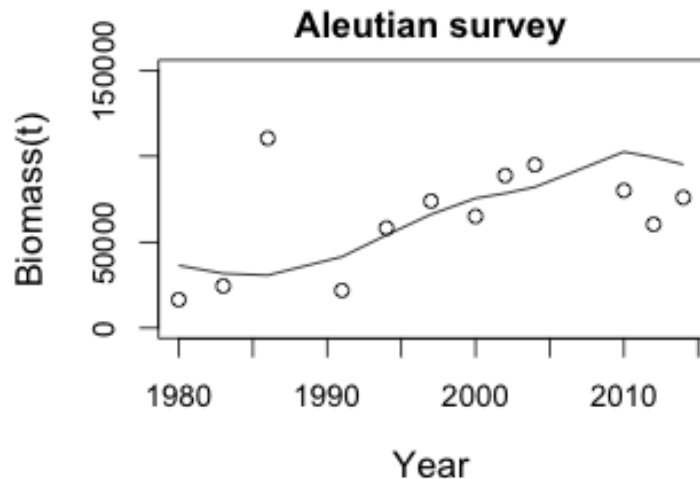
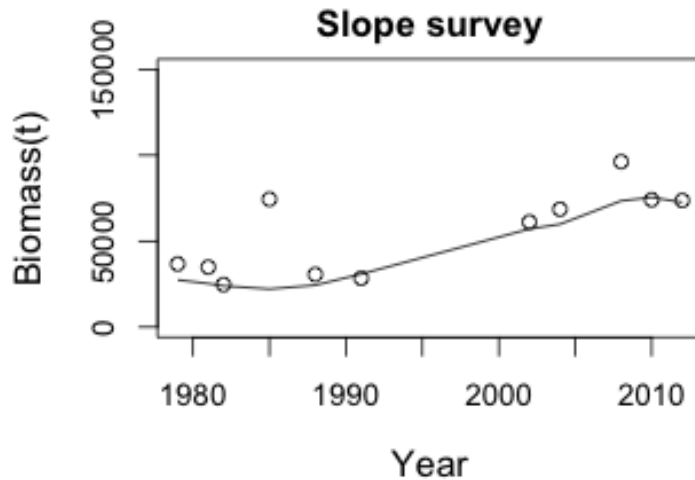
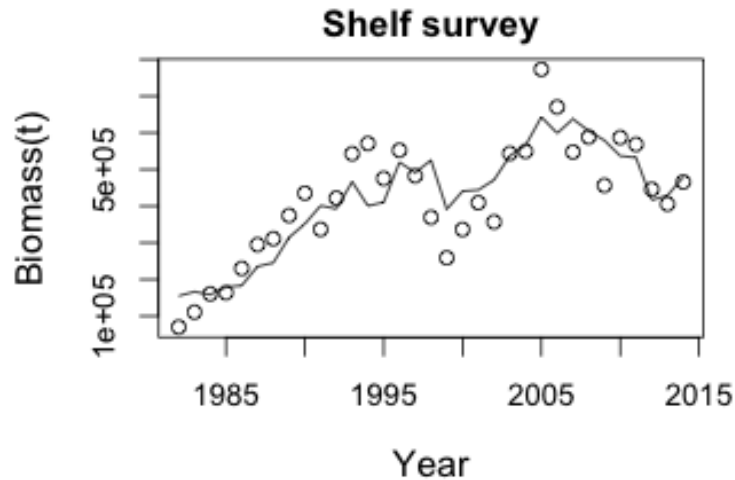
Standard deviation of  
normalized residuals  
Shelf 1.47 (Goal: 1.21)  
Slope 2.744973 (Goal: 1.37)  
AI 2.28753 (Goal: 1.34)

D.



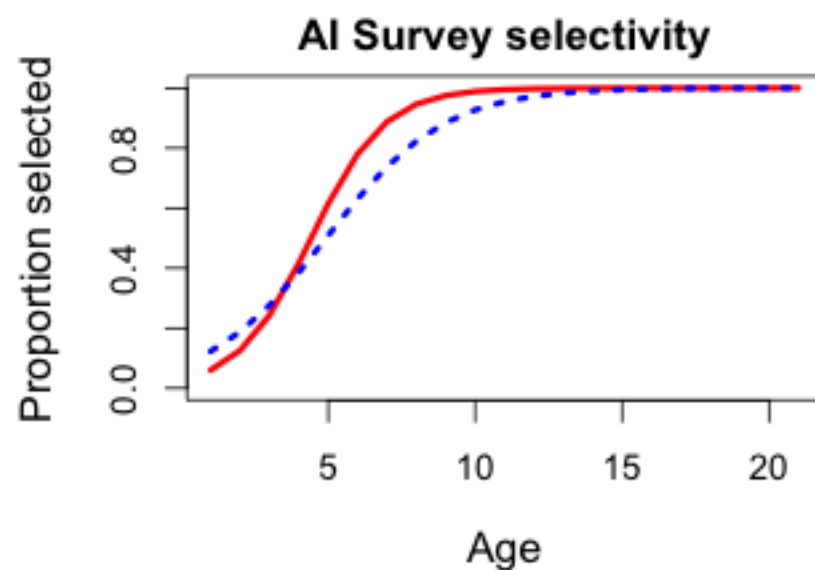
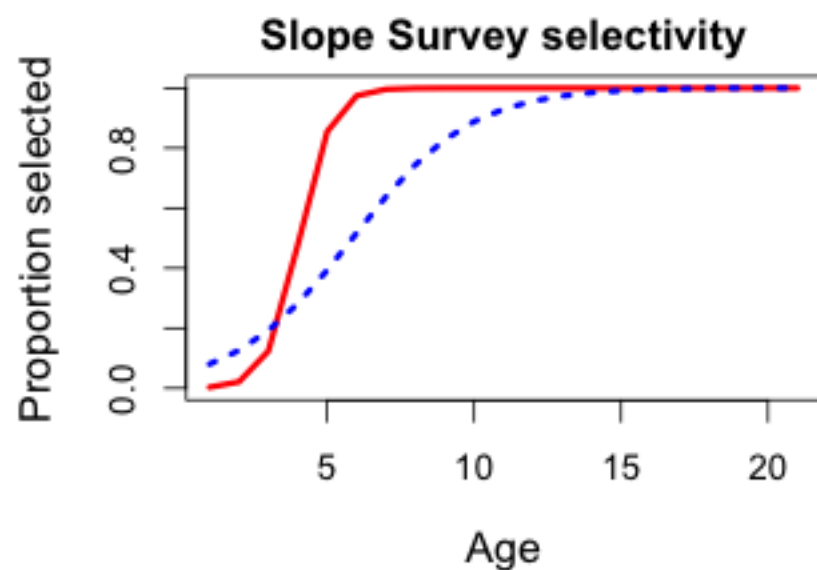
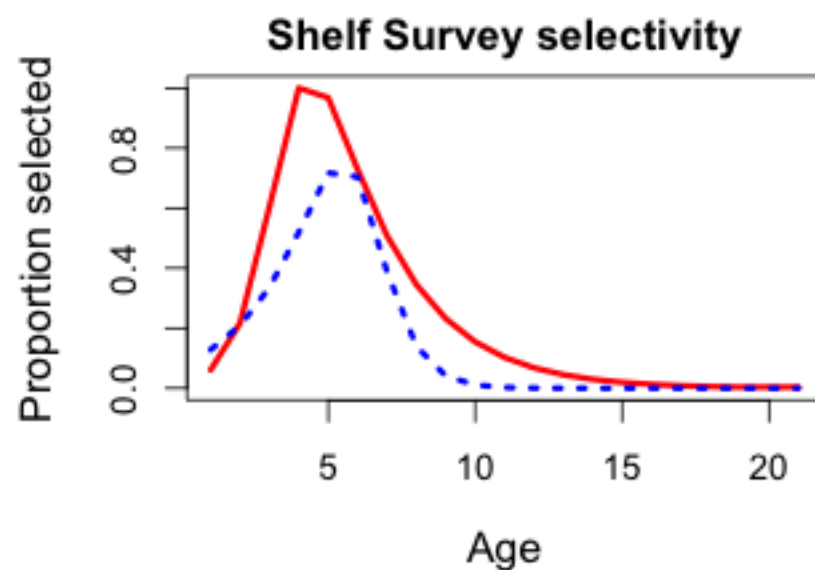
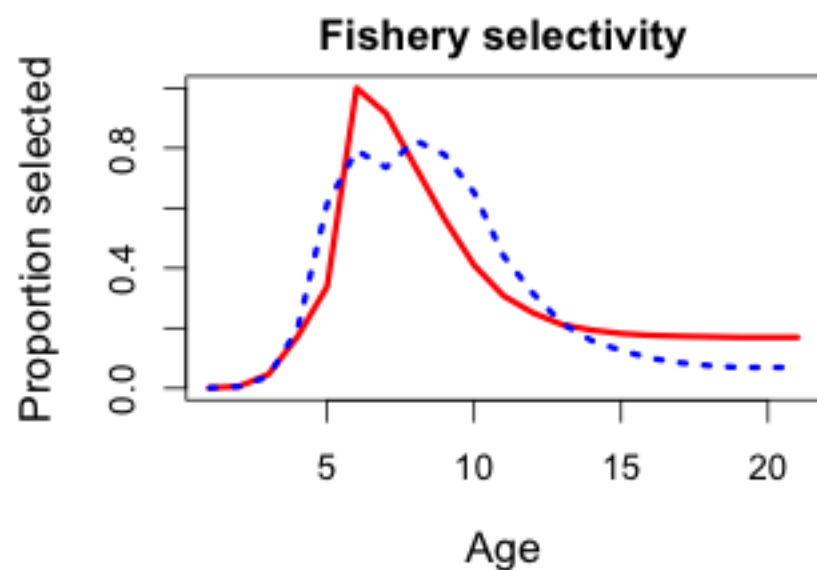


# E. S1 wts by haul, S2 Francis wts, lower fishery likelihood



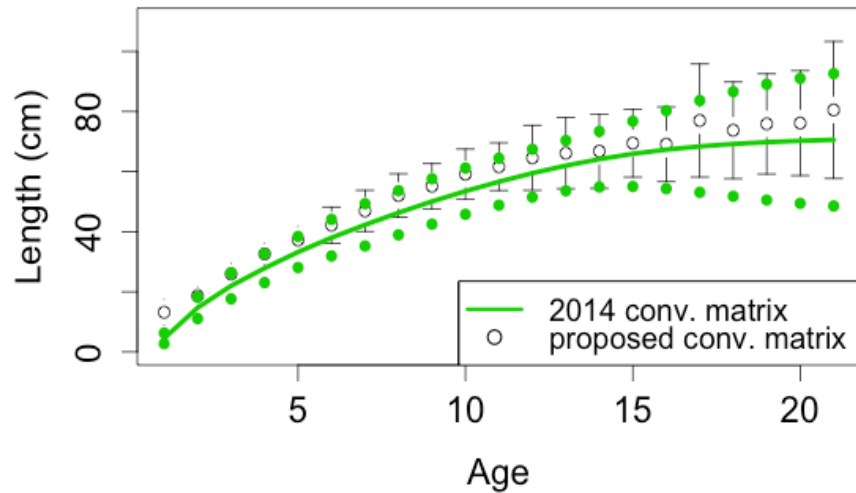
Standard deviation of  
normalized residuals  
Shelf 2.35 (Goal: 1.21)  
Slope 2.37 (Goal: 1.37)  
AI 2.42 (Goal: 1.34)

E.

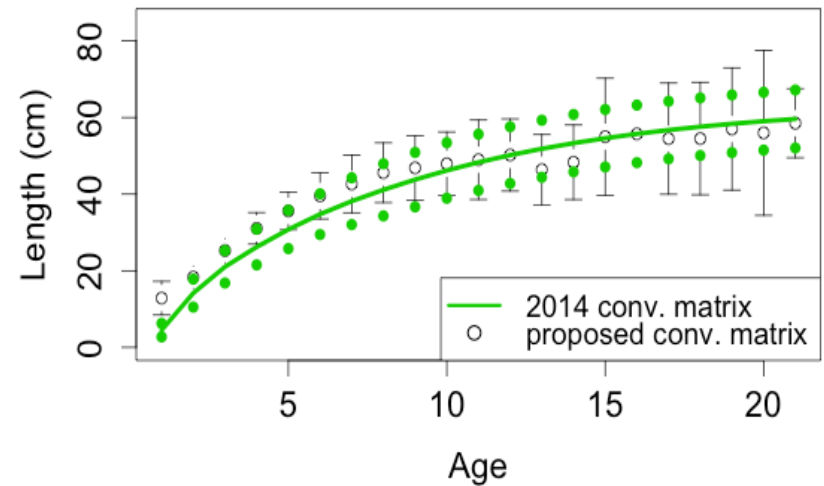


# New, old transition matrix

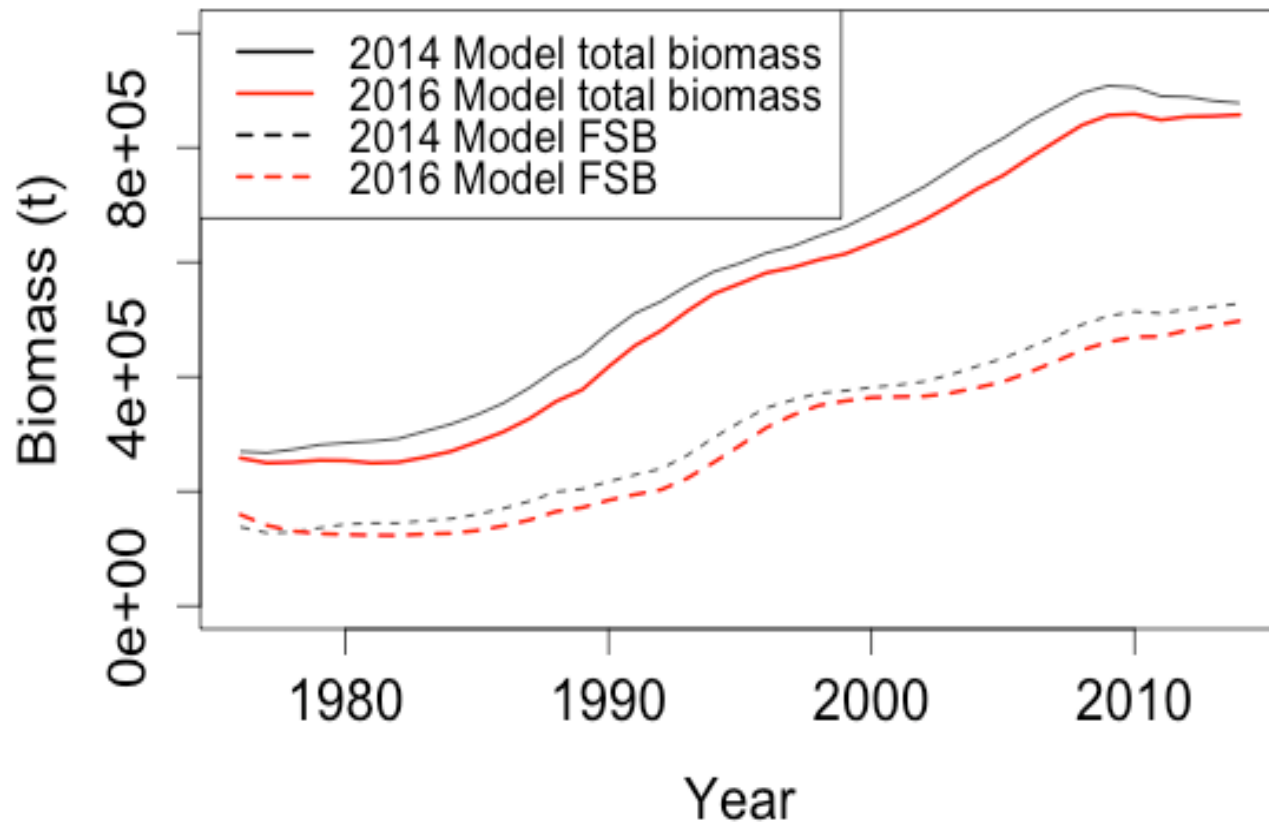
**Females**



**Males**



# New transition matrix reduces estimate of biomass slightly



# Conclusions

- Data weighting allowed a better fit to shelf survey data.
- Transition data with more age data also (presumably) will provide better model accuracy.

# Catchability

## BSAI

- Catchability ( $q$ ) has been found to vary with shelf survey bottom temperature ( $T$ ):

$$q = e^{-a+bT},$$

where  $\alpha$  and  $\beta$  are parameters estimated by the model.

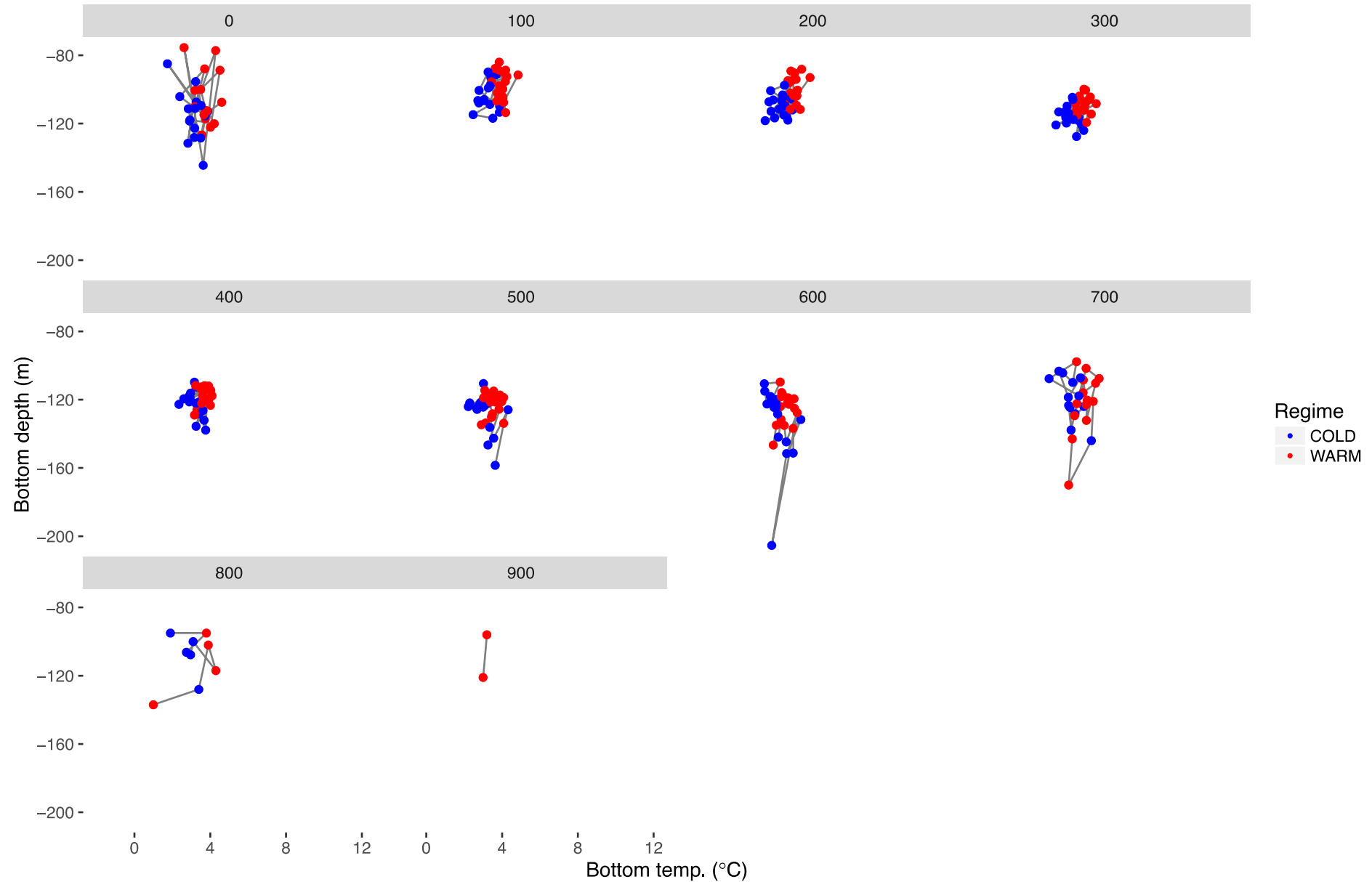
## GOA

- Catchability  $q=1$ .

Stachura et al (2014) ATF abundance recruitment associated with cross-shelf transport not SST.

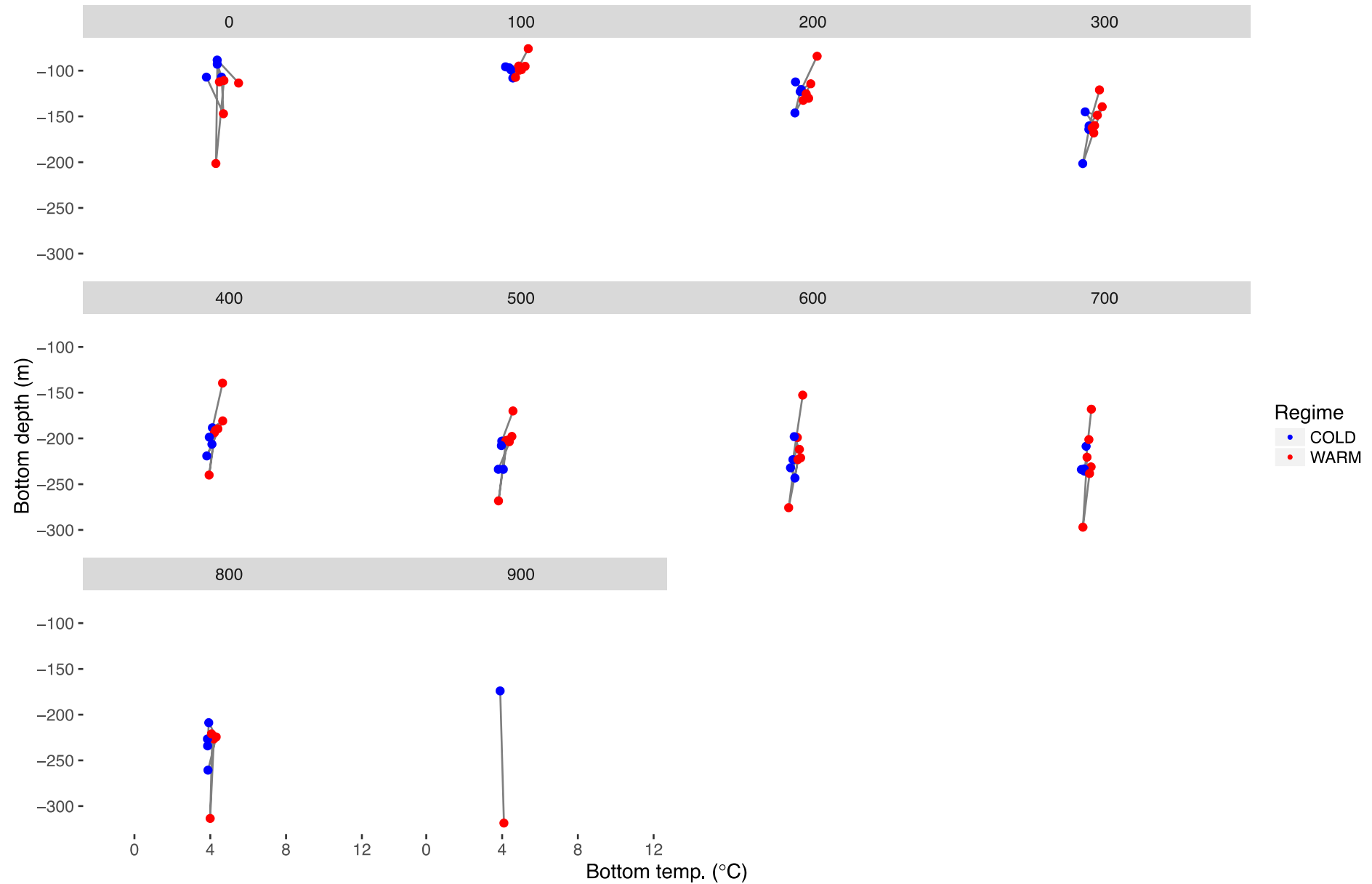
# Eastern Bering Sea

arrowtooth flounder (*Atheresthes stomias*)



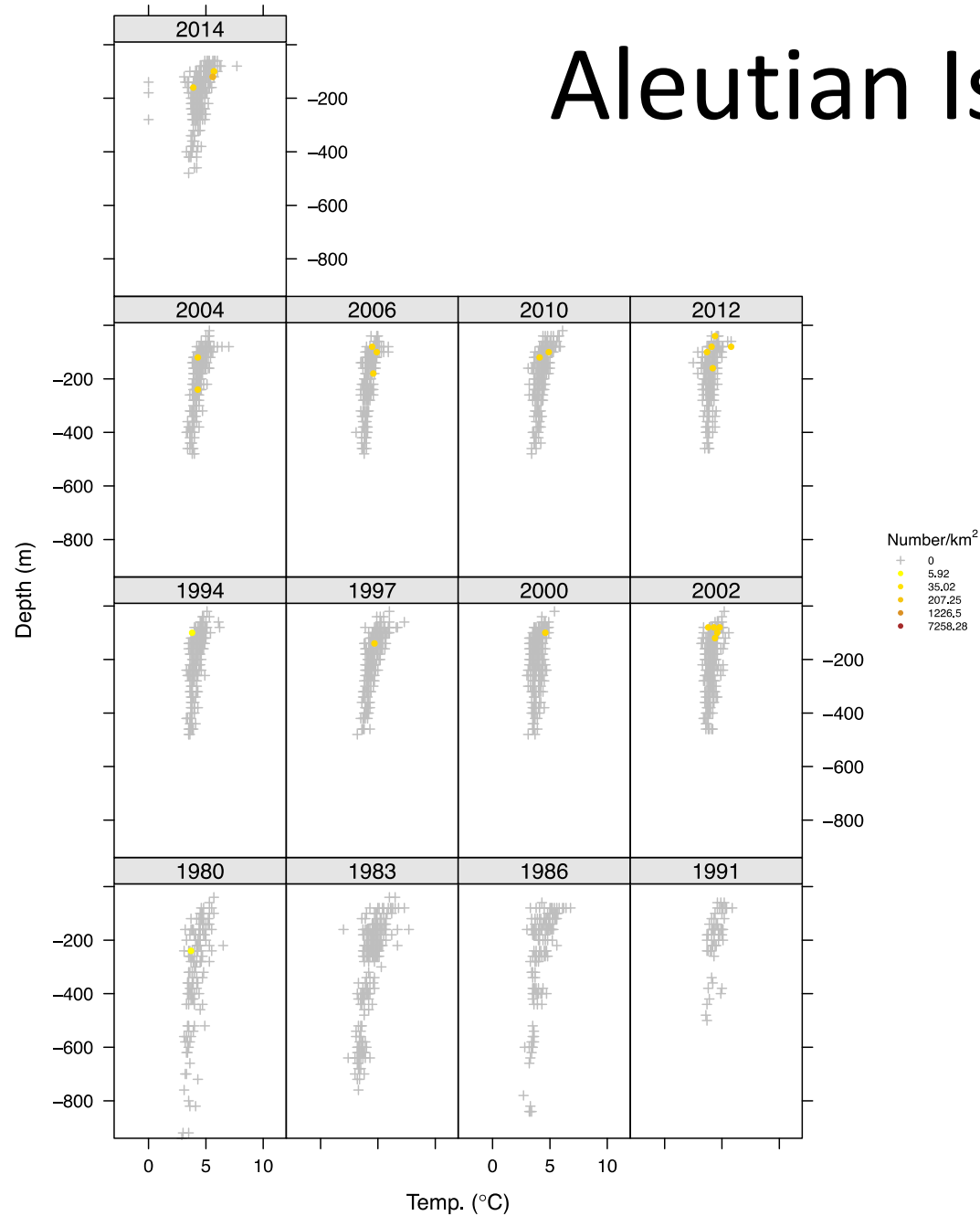
# Aleutian Islands

arrowtooth flounder (*Atheresthes stomias*)

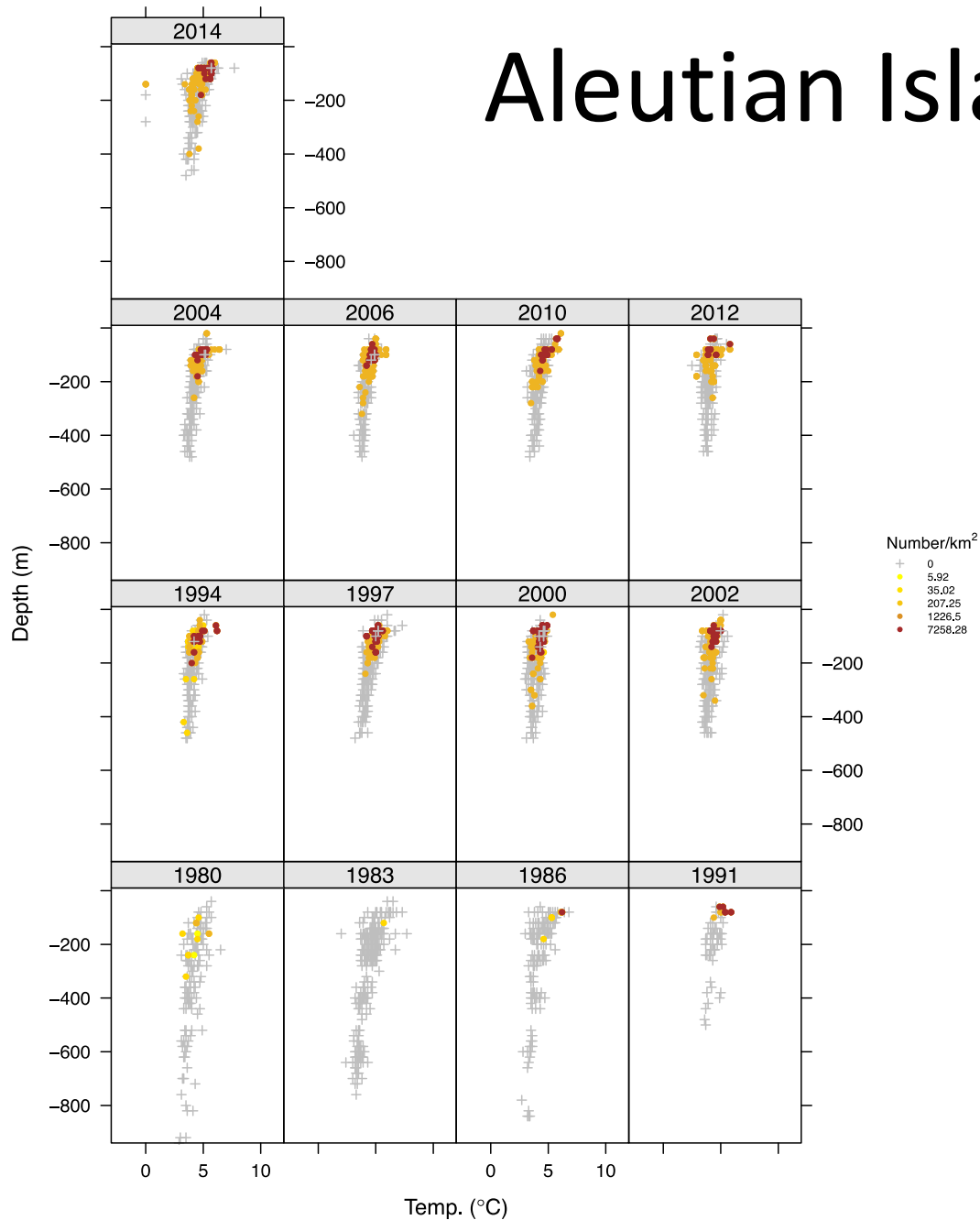




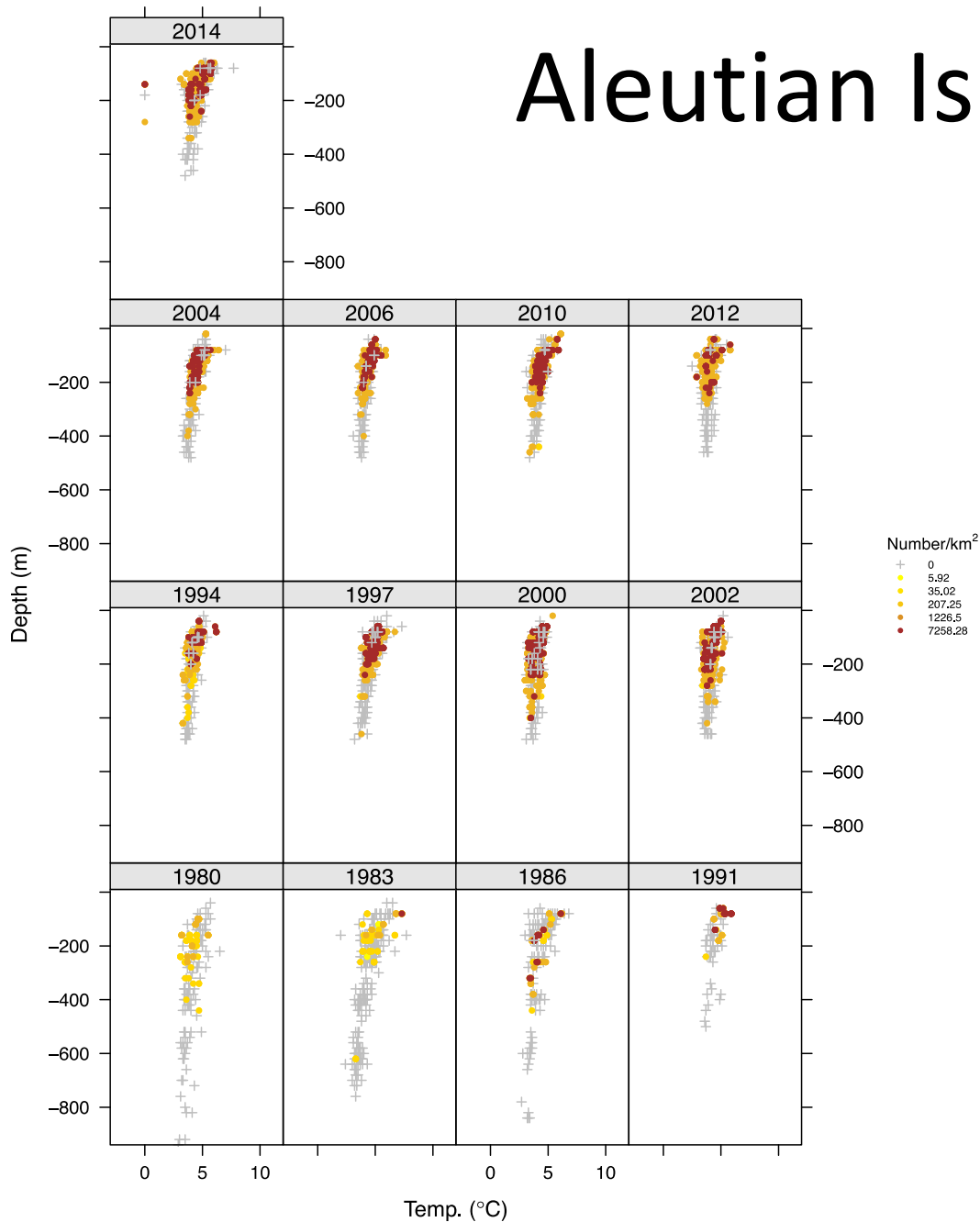
# Aleutian Islands, 0-100mm



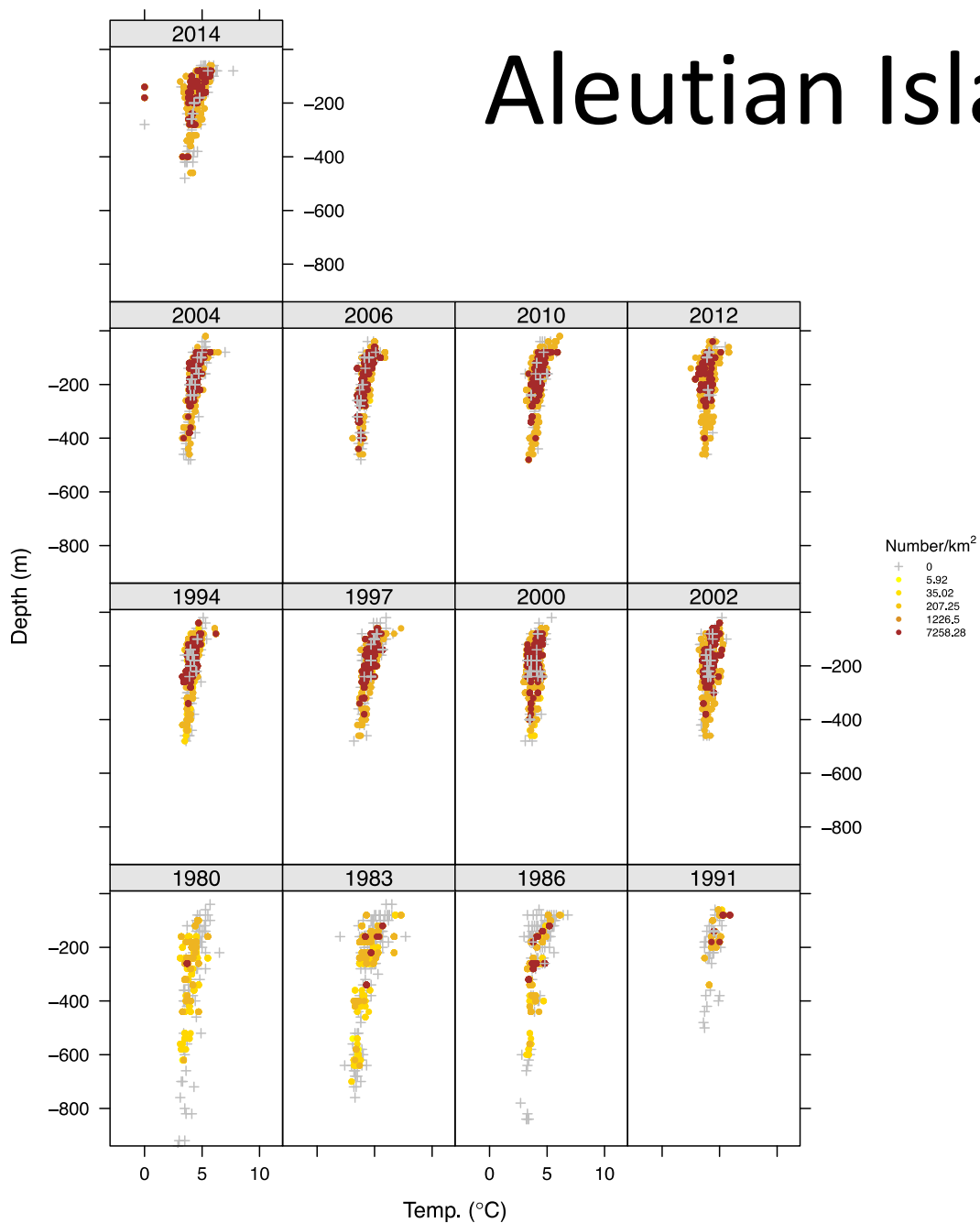
# Aleutian Islands, 100-200mm



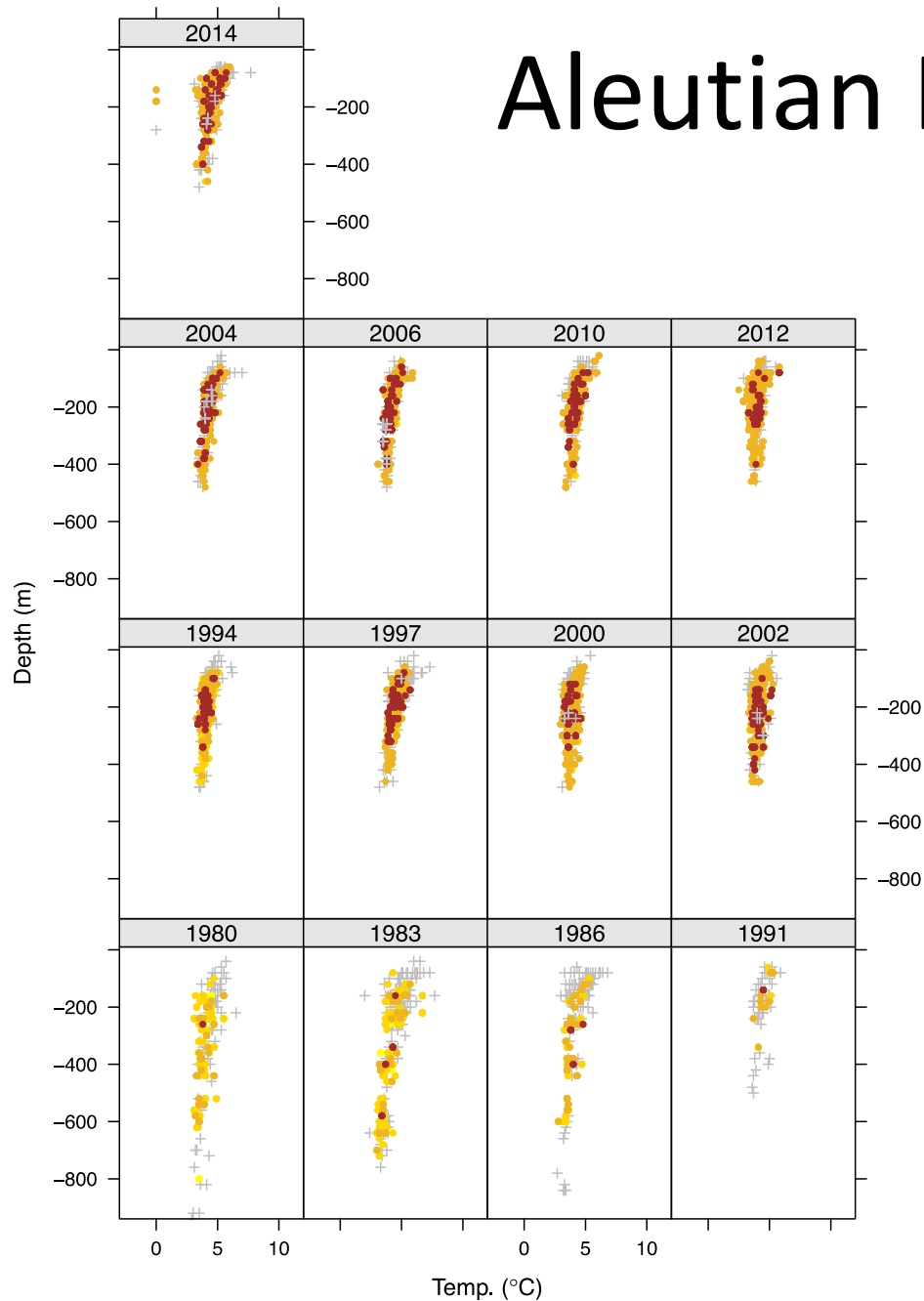
# Aleutian Islands, 200-300m



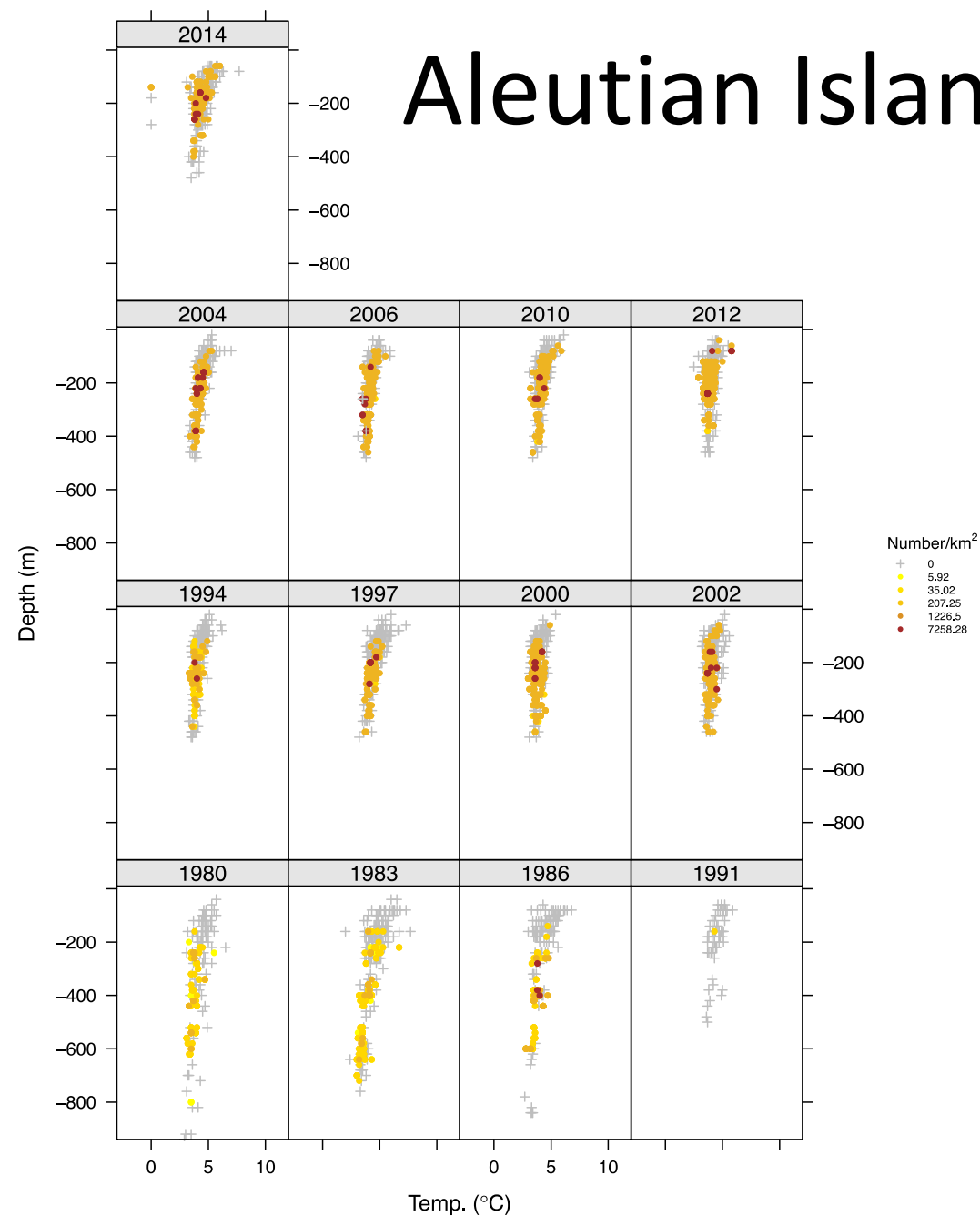
# Aleutian Islands, 300-500mm



# Aleutian Islands, 500-700mm

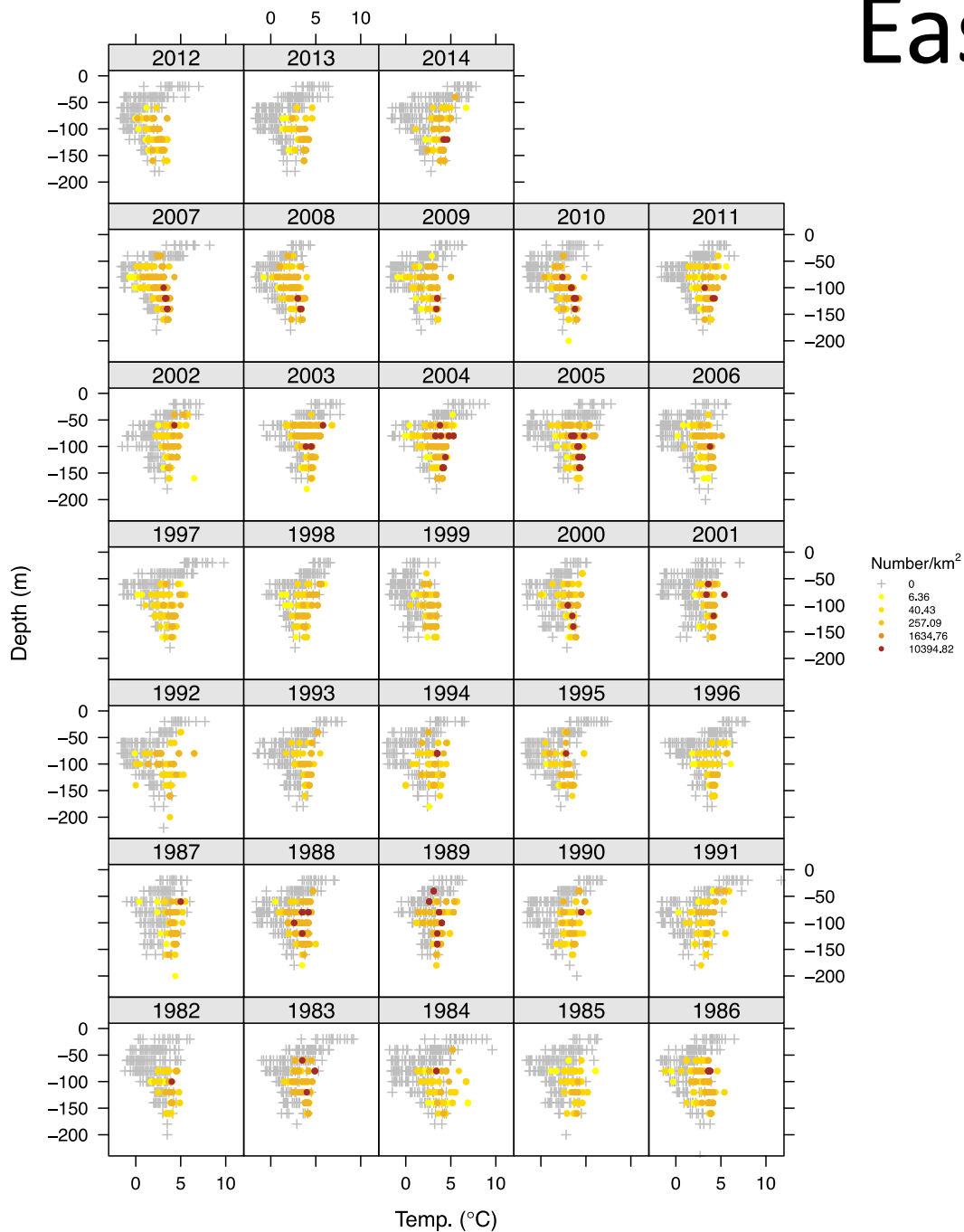


# Aleutian Islands, 700-1,500mm



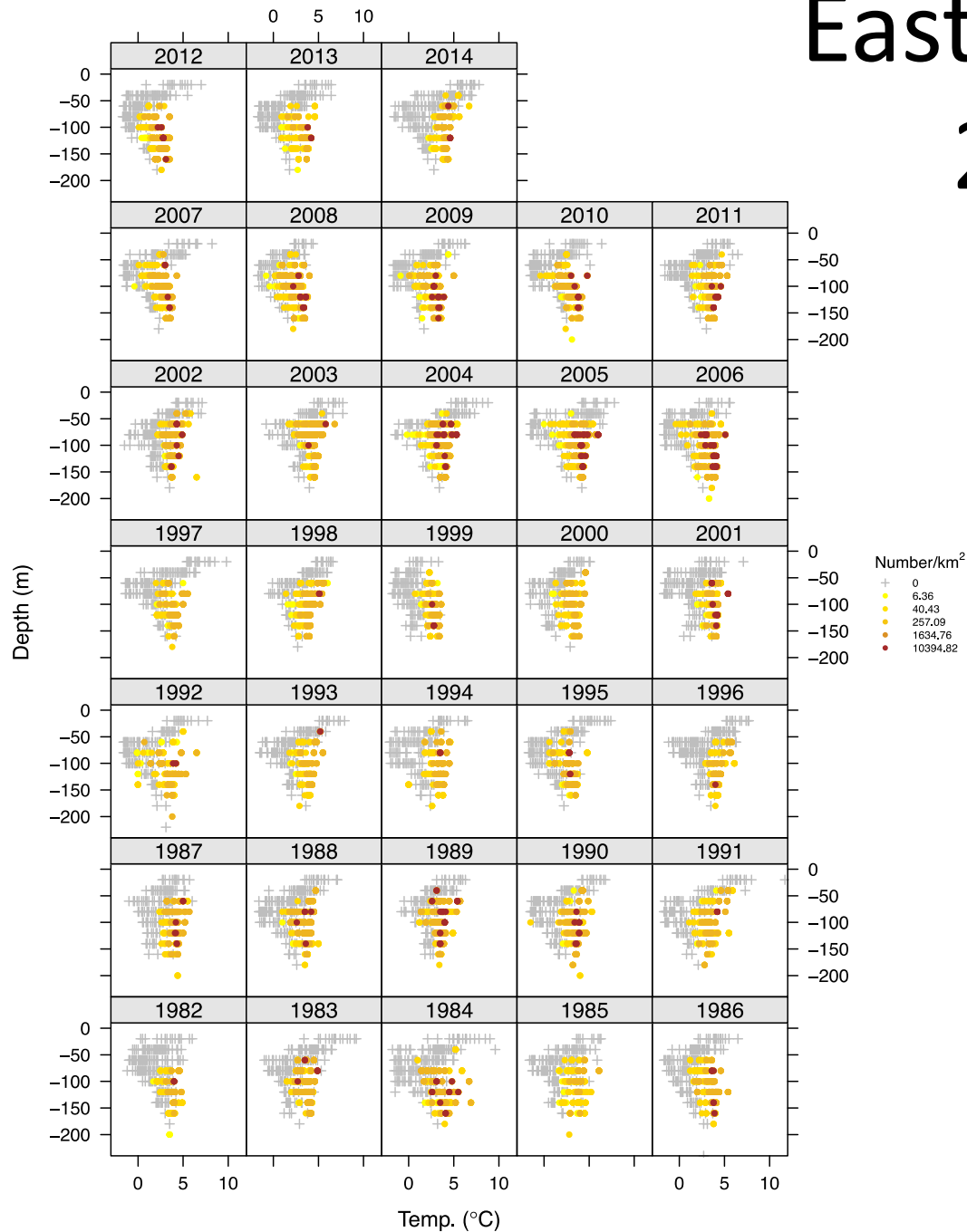
# arrowtooth flounder between 100 and 200 mm

# Eastern Bering Sea, 100-200mm



arrowtooth flounder between 200 and 300 mm

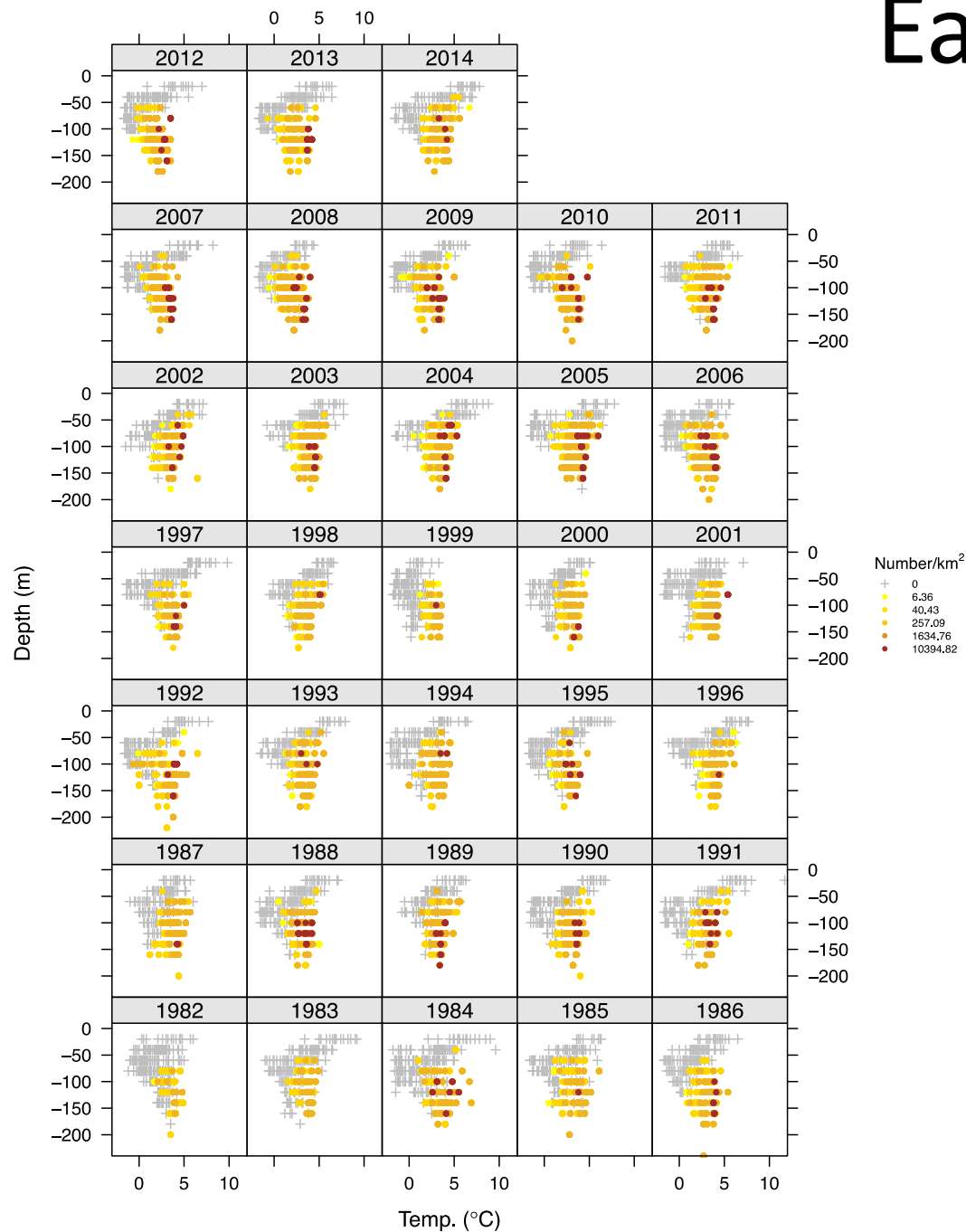
# Eastern Bering Sea, 200-300mm





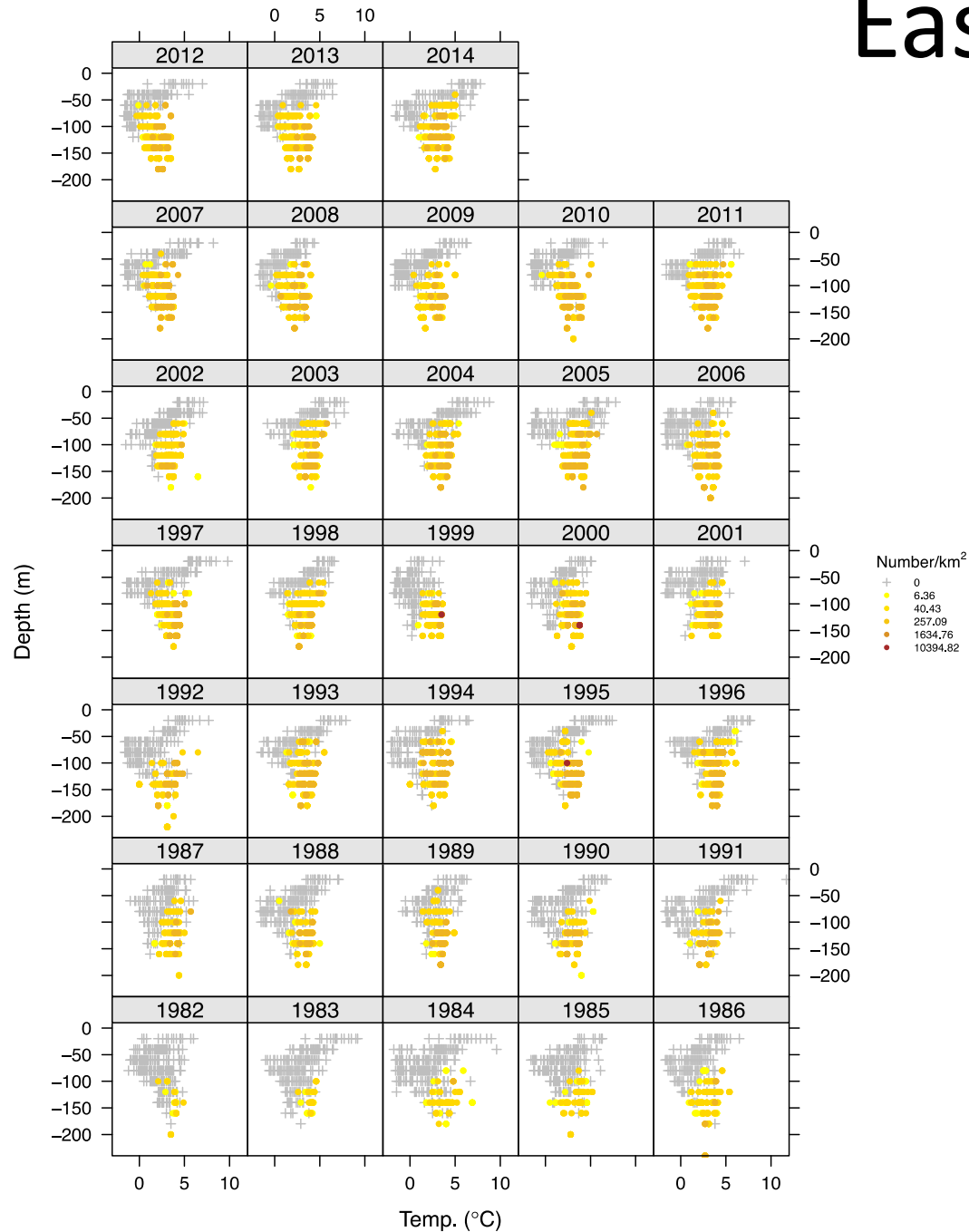
# arrowtooth flounder between 300 and 500 mm

# Eastern Bering Sea, 300-500mm



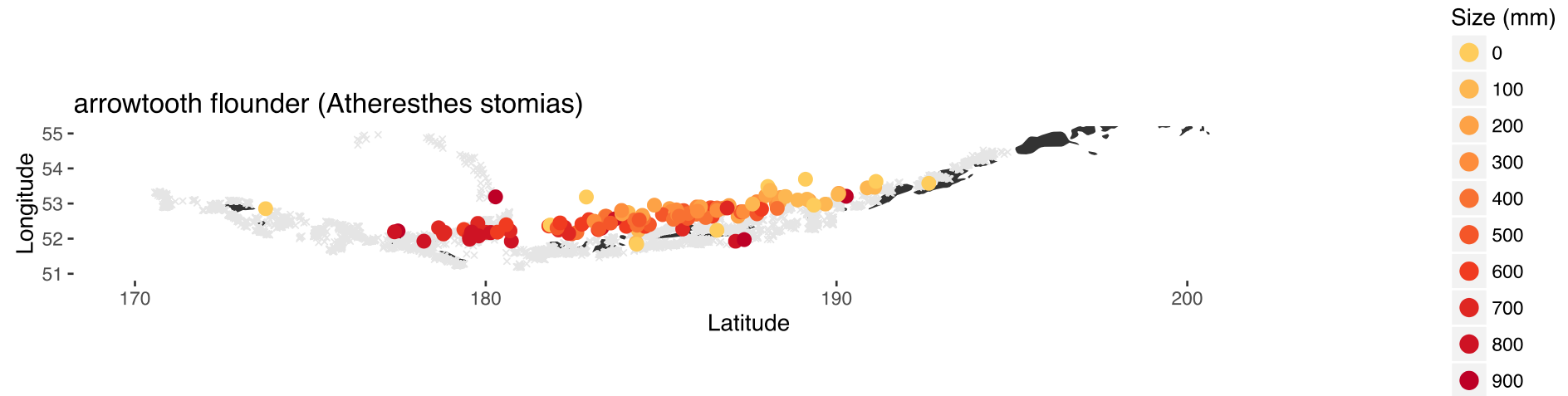
arrowtooth flounder between 500 and 700 mm

# Eastern Bering Sea, 500-700mm



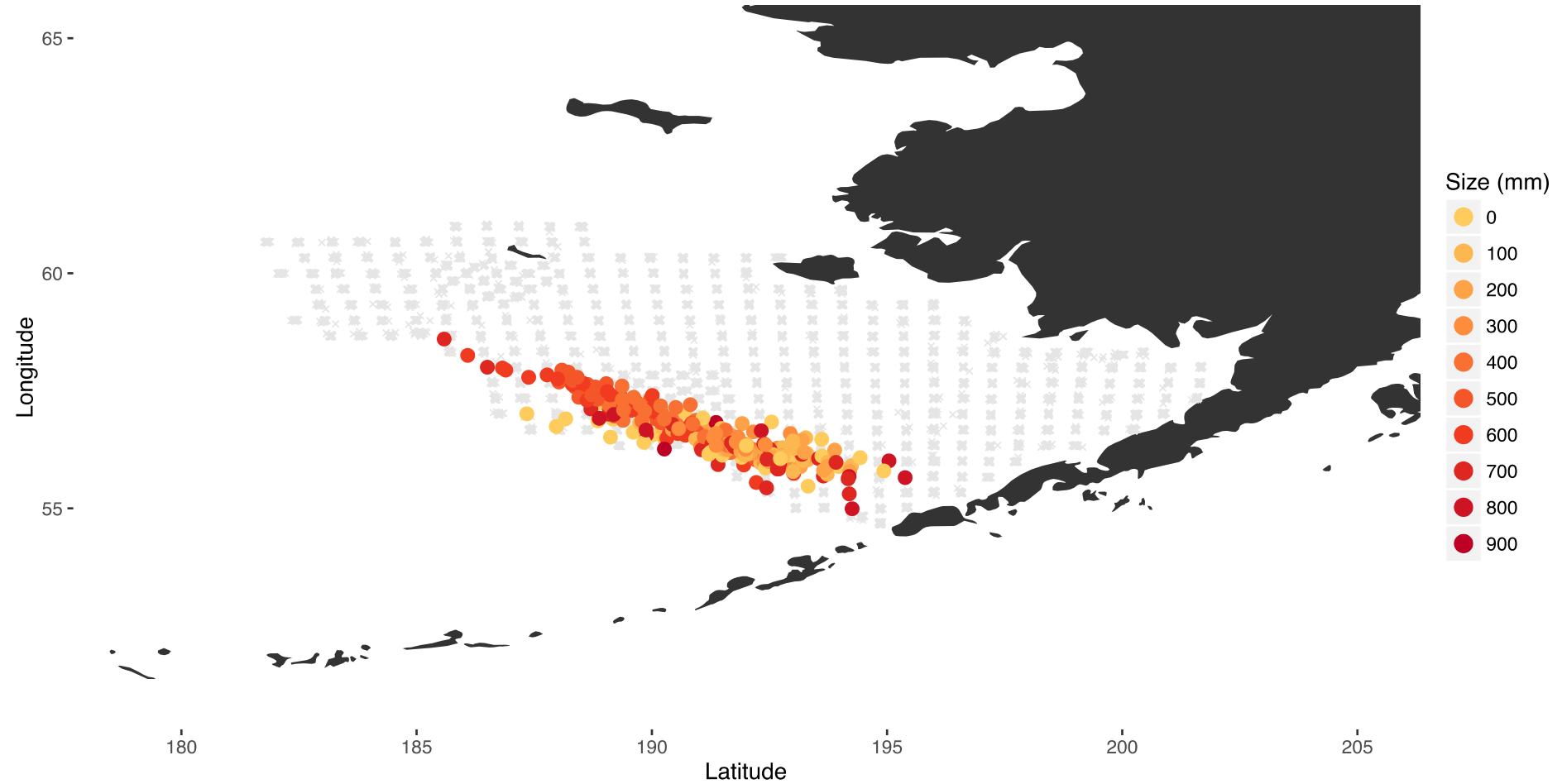
# Aleutian Islands

arrowtooth flounder (*Atheresthes stomias*)



# Eastern Bering Sea

arrowtooth flounder (*Atheresthes stomias*)



# Bering Sea bottom temperature and recruitment anomalies

