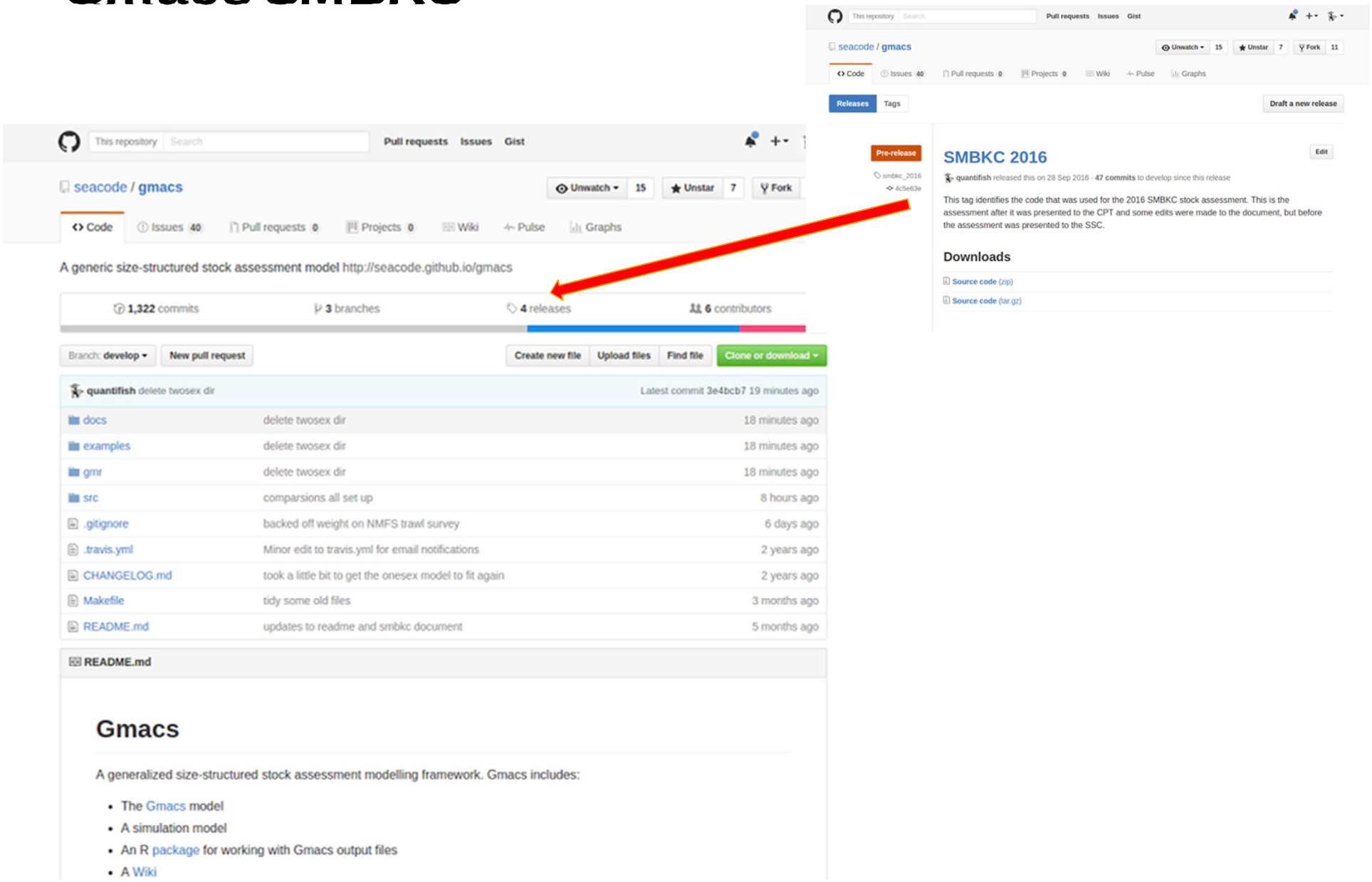
Status Report: Gmacs BBRKC

Darcy Webber • Jim Ianelli
January 2017

Gmacs SMBKC


This repository
Search
Pull requests
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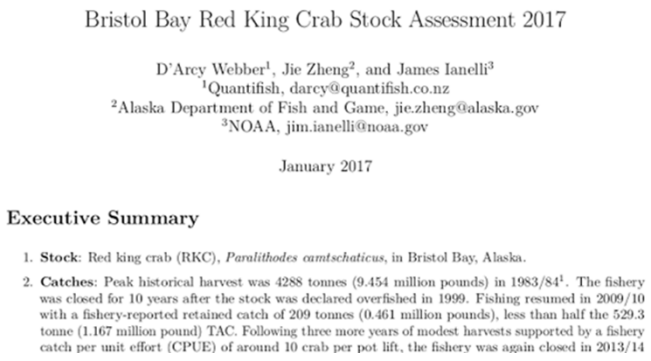
A generic size-structured stock assessment model http://seacode.github.io/gmacs
1,322 commits
3 branches
4 releases
6 contributors
Branch: develop
New pull request
Create new file
Upload files
Find file
Clone or download
quantifish delete twosex dir
Latest commit 3e4bcb7 19 minutes ago
docs delete twosex dir 18 minutes ago
examples delete twosex dir 18 minutes ago
gmr delete twosex dir 18 minutes ago
src comparsions all set up 8 hours ago
.gitignore backed off weight on NMFS trawl survey 6 days ago
.travis.yml Minor edit to travis.yml for email notifications 2 years ago
CHANGELOG.md took a little bit to get the onesex model to fit again 2 years ago
Makefile tidy some old files 3 months ago
README.md updates to readme and smbkc document 5 months ago
README.md
Gmacs
A generalized size-structured stock assessment modelling framework. Gmacs includes:
The Gmacs model
A simulation model
An R package for working with Gmacs output files
A Wiki
Releases
Tags
Draft a new release
Pre-release
SMBKC 2016
Edit
smbkc_2016
4c5e63e
quantifish released this on 28 Sep 2016 · 47 commits to develop since this release
This tag identifies the code that was used for the 2016 SMBKC stock assessment. This is the assessment after it was presented to the CPT and some edits were made to the document, but before the assessment was presented to the SSC.
Downloads
Source code (zip)
Source code (tar.gz)

Gmacs BBRKC Progress

- Sex-specific recruitment - uses a proportion m/f parameter that is logit transformed with normal prior (rather than 50/50 split)
- Sex-specific time-varying natural mortality
- Sex-specific custom growth matrices
- Sex-specific natural mortality rates by year (can be fixed-custom)

- Better numbers at length plots, selectivity plots, molt probability plots, etc

- Updated BBRKC model input data
- BBRKC model progress
- BBRKC document with comparisons in progress



Bristol Bay Red King Crab Stock Assessment 2017

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January 2017

Executive Summary

1. **Stock**: Red king crab (RKC), *Paralithodes camtschaticus*, in Bristol Bay, Alaska.
2. **Catches**: Peak historical harvest was 4288 tonnes (9.454 million pounds) in 1983/84[1]. The fishery was closed for 10 years after the stock was declared overfished in 1999. Fishing resumed in 2009/10 with a fishery-reported retained catch of 209 tonnes (0.461 million pounds), less than half the 529.3 tonne (1.167 million pound) TAC. Following three more years of modest harvests supported by a fishery catch per unit effort (CPUE) of around 10 crab per pot lift, the fishery was again closed in 2013/14

Problems Encountered

Gmacs

- Gmacs is slow (~15 minutes per BBRKC model run) - model flexibility adds excess baggage, be careful what you wish for
- Positive definite Hessian issues

2016 Model

- The 2016 model is initialised with no oldshell male crab in 1975. In 1976 they appear!
- The code is very difficult to follow. Figures in document can be misleading.

Gmacs BBRKC

- Had to fix initial numbers at those estimated in 2016 model for now as I cannot match this initialisation - this likely causes other problems
- Had to fix growth matrix to 2016 model matrix for now as I could not match - 2016 model derived differently
- Poor fit to NMFS survey - particularly the bulge in biomass around 1990
- Not fitting to BSFRF survey if q = 1

Model Dimensions & Why Gmacs is Slow

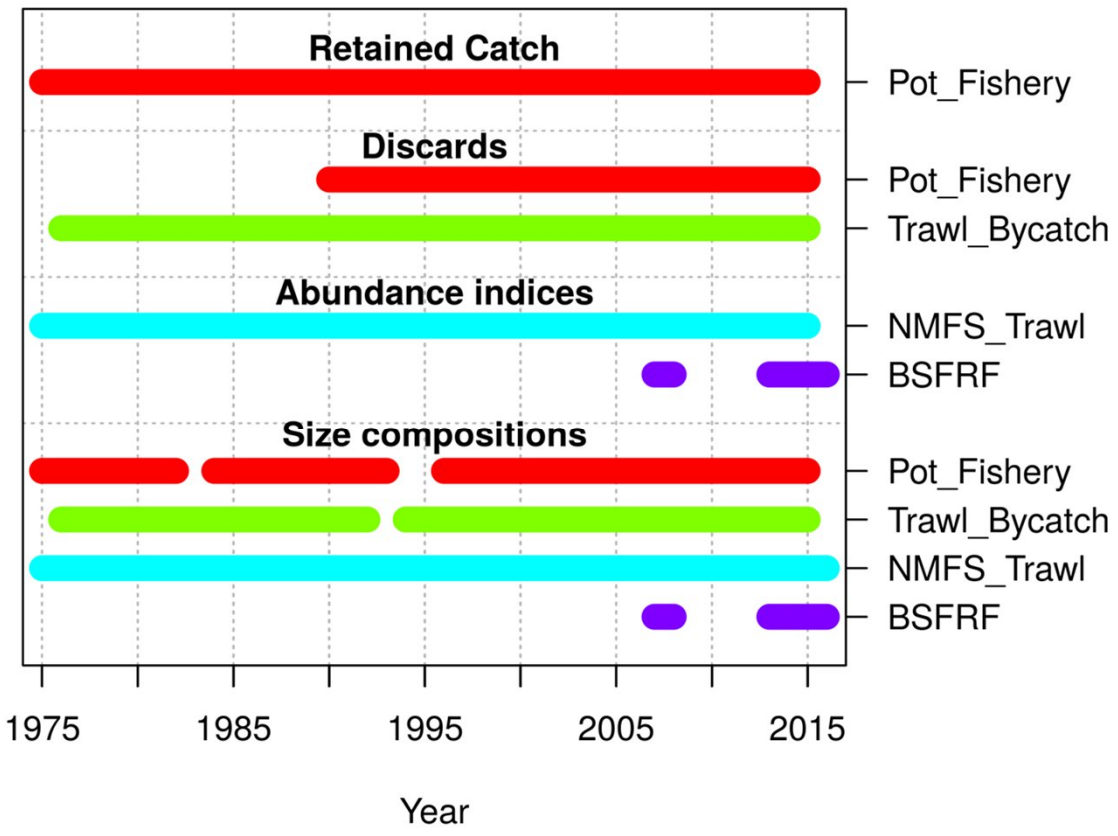
Size-classes	20	65-165
Sexes	2	Male, Female
Shell conditions	2	Oldshell, Newshell
Seasons	4	1-4
Years	42	1975-2016

20 x 2 x 2 x 4 x 42 = 13440 dimensions

c.f. a BBRKC-specific model
20 x 3 x 1 x 42 = 2520 dimensions

Data

1. Catch
   a. Pot fishery retained males
   b. Pot fishery discarded males
   c. Pot fishery discarded females
   d. Trawl bycatch males+females
2. Survey
   a. NMFS survey males
   b. NMFS survey females
   c. BSFRF survey males+females
3. Length-frequency
   a. Pot fishery retained males
   b. Pot fishery discarded males
   c. Pot fishery discarded females
   d. Trawl bycatch males
   e. Trawl bycatch females
   f. NMFS survey males
   g. NMFS survey females
   h. BSFRF survey males
   i. BSFRF survey females



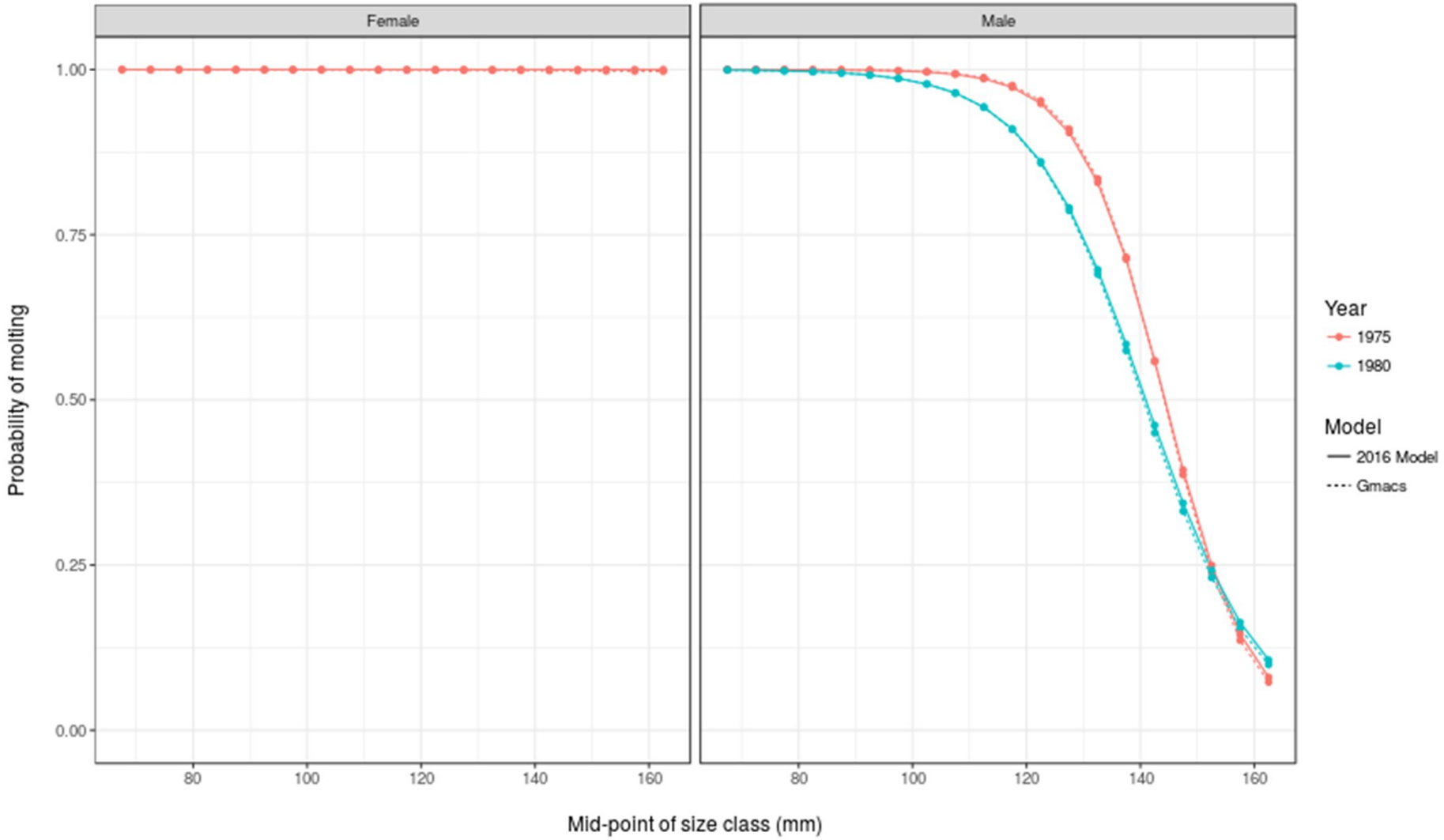
Timing

Four seasons defined to try to best match 2016 model dynamics

Season	What happens
1	Recruitment
2	Trawl bycatch fishery
3	Natural mortality, molting & growth, directed pot fishery, surveys (NMFS and BSFRF)
4	Calculate MMB

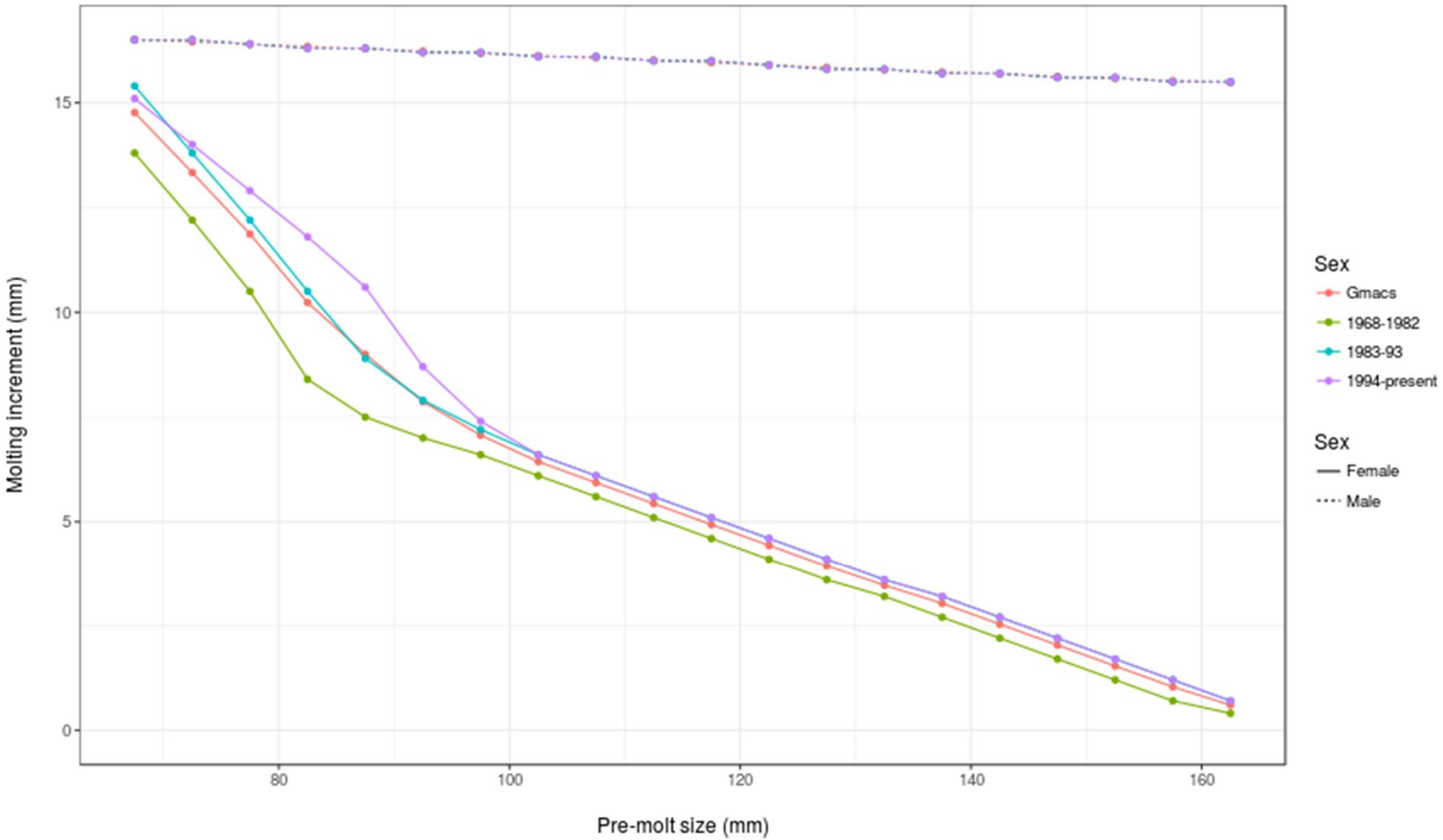
Molt Probability

- Females molt every year
- Gmacs is using time-varying molt probability - these match up well with 2016 model



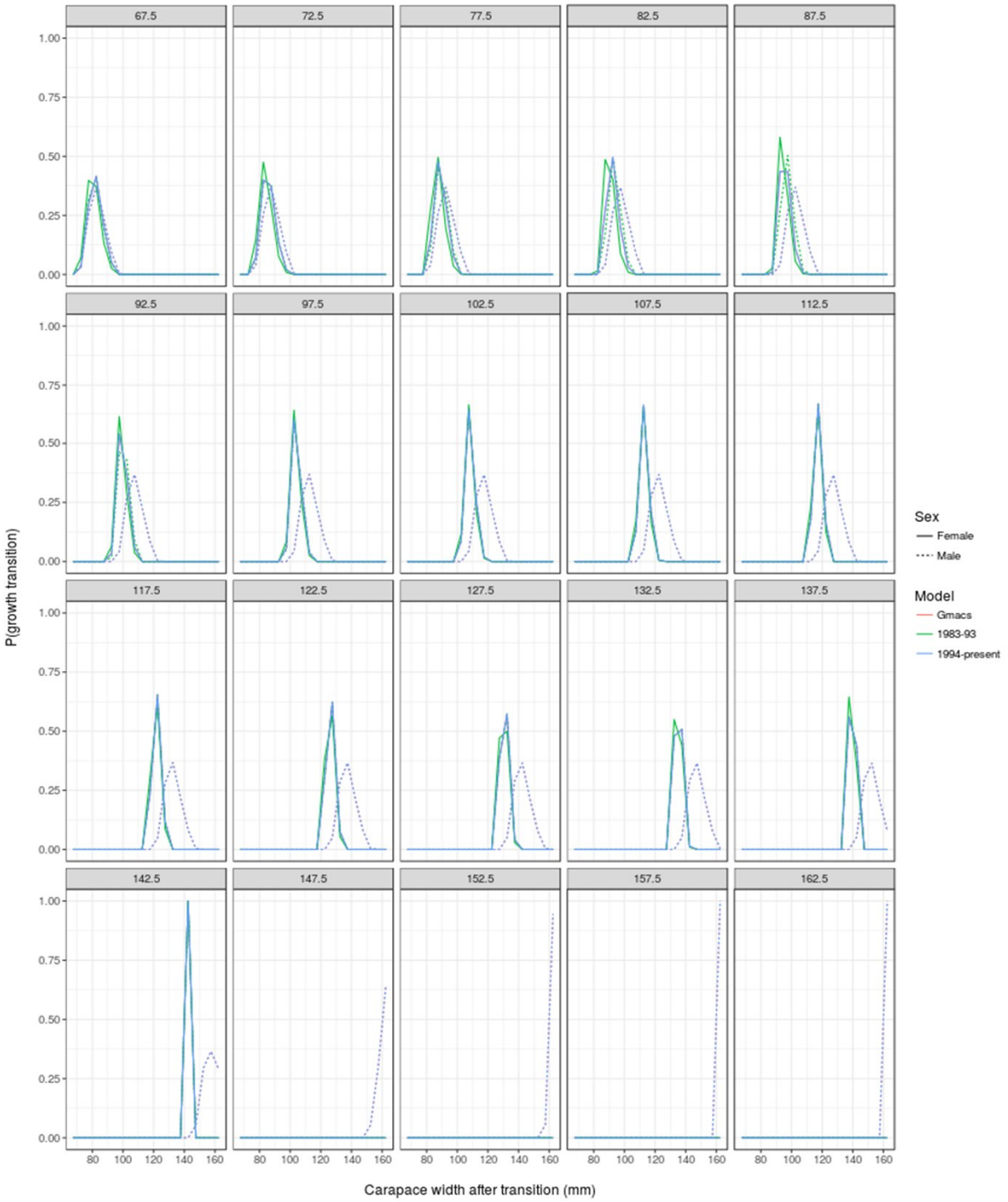
Growth Increment Each Molt

- Gmacs not using time-varying growth (for females), as there is little evidence to support doing so

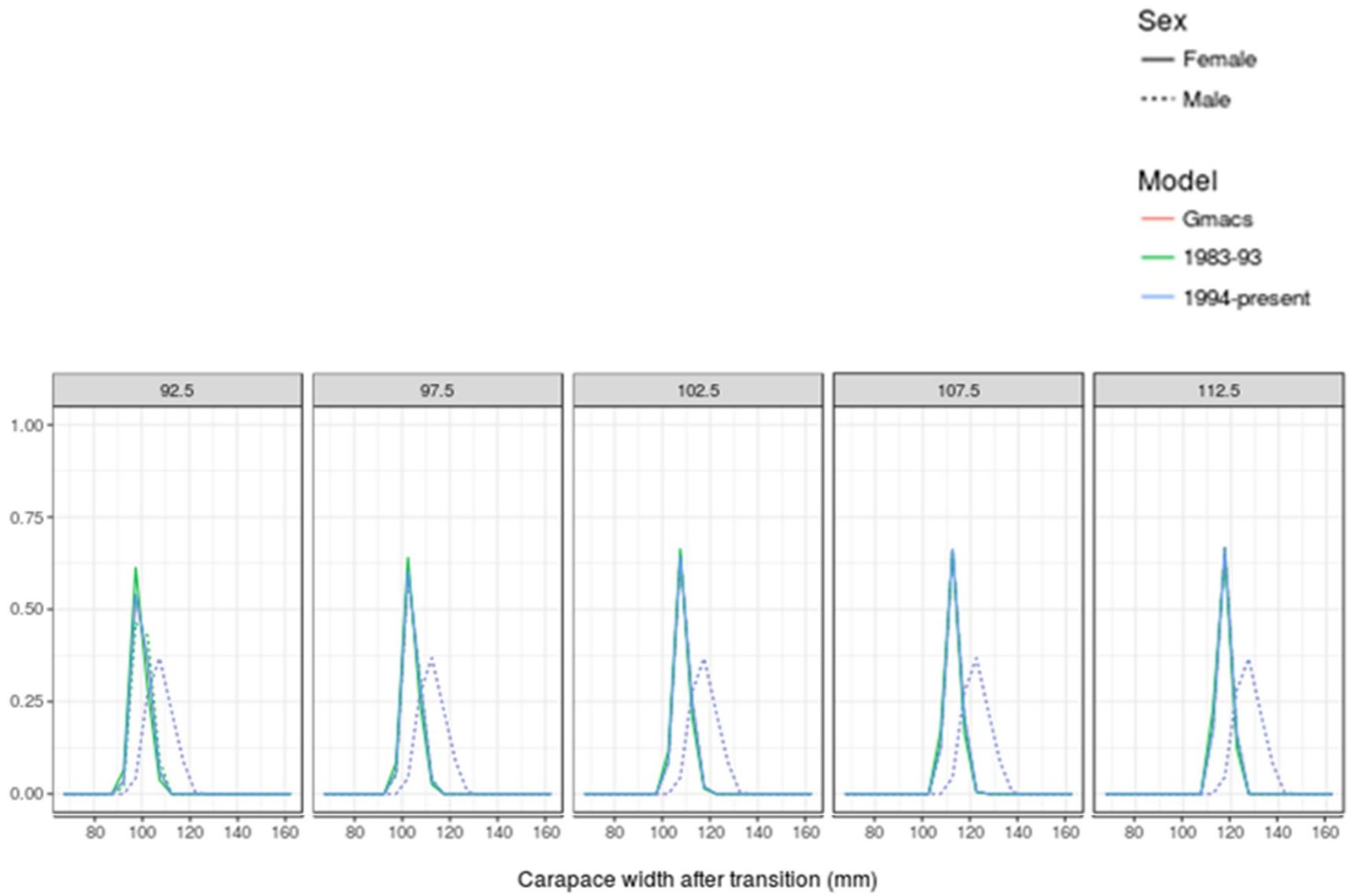


Growth Matrix

- Gmacs not using time-varying growth (for females), as there is little evidence to support doing so
- Gmacs has fixed the growth matrix to the 2016 model as a similar matrix could not be derived (given the growth increments on the previous slide)

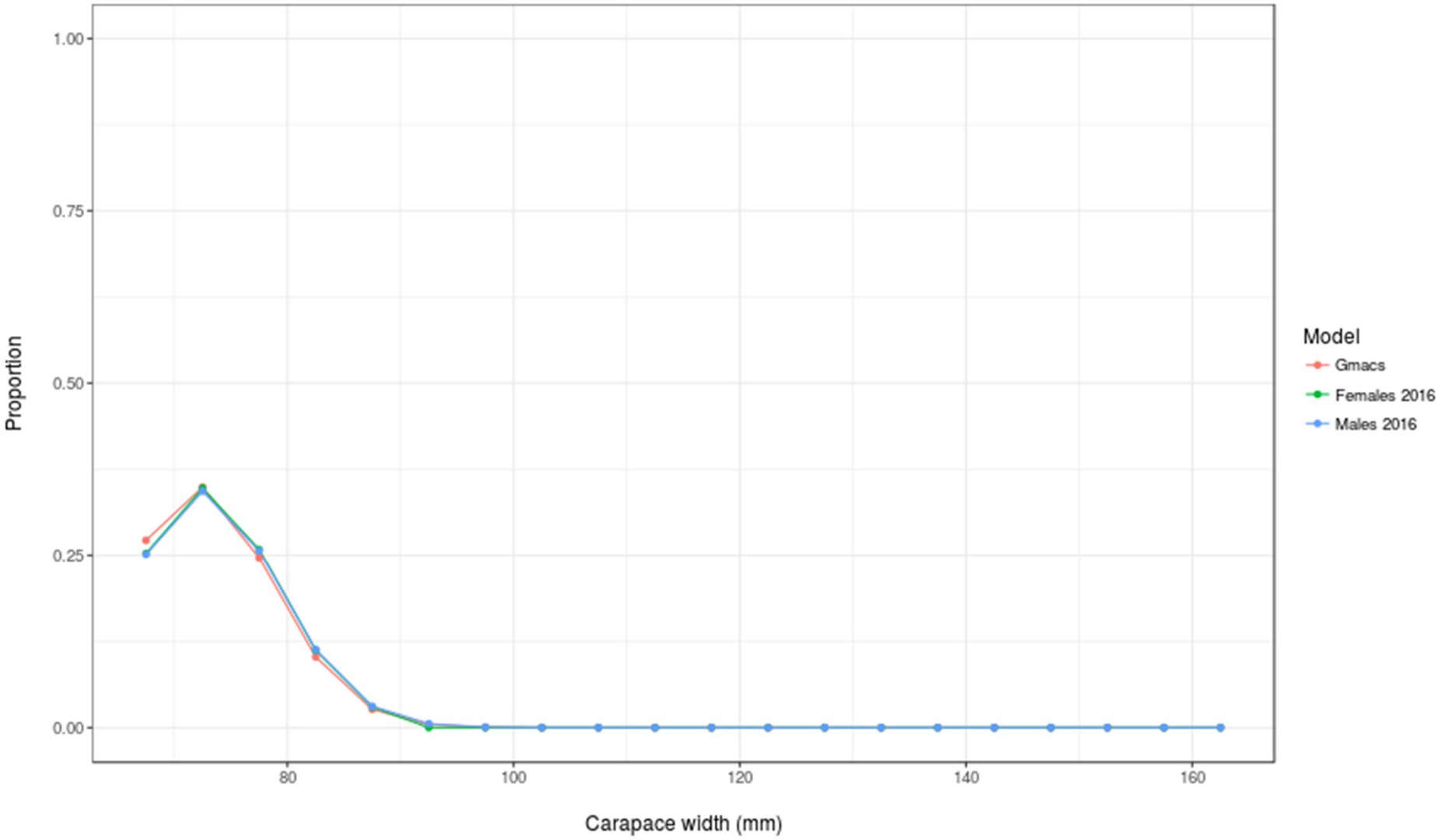


Growth Matrix



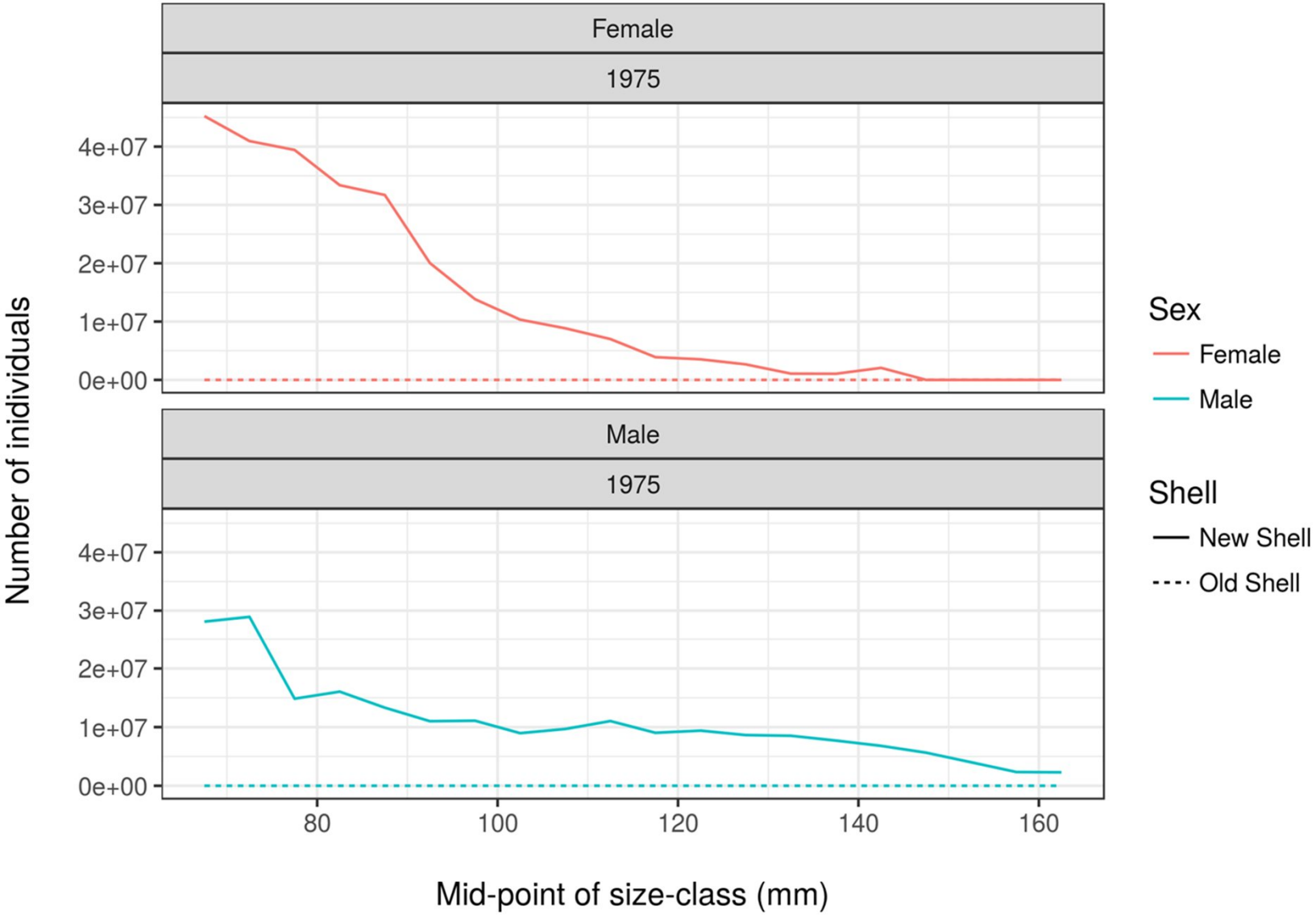
Recruitment Size

Gmacs not using sex-specific recruitment size--seems unnecessary



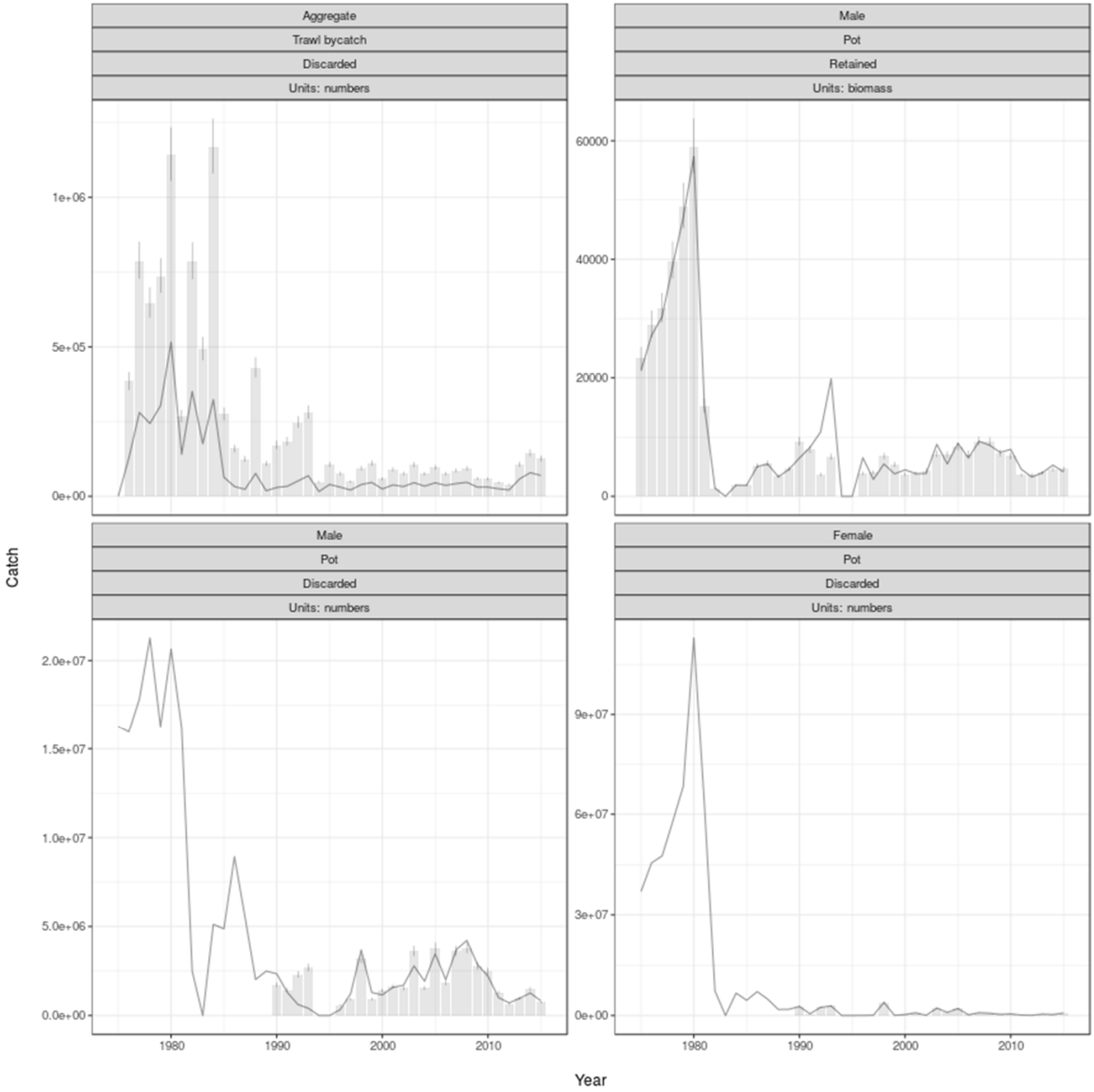
Initial Numbers (season 1)

Gmacs initial numbers fixed at those used in 2016 model - could not replicate this initialisation - but this seems to be causing problems



Catch

- Why is current model not using full catch time-series?

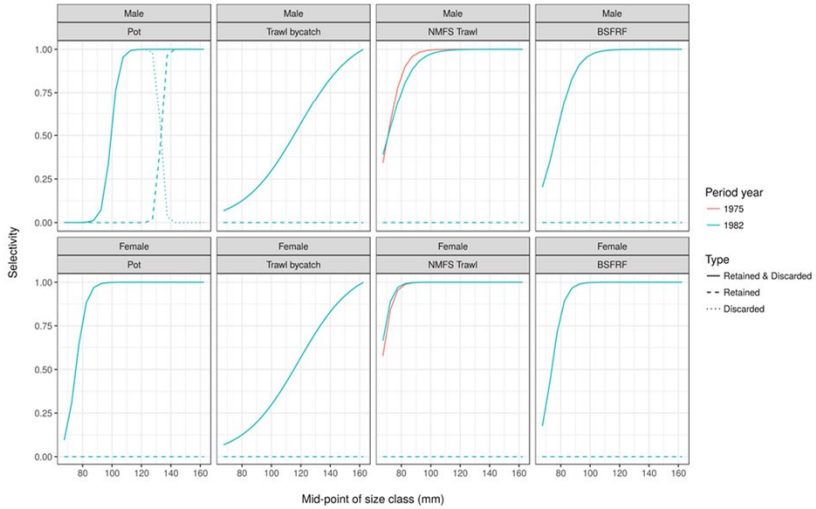


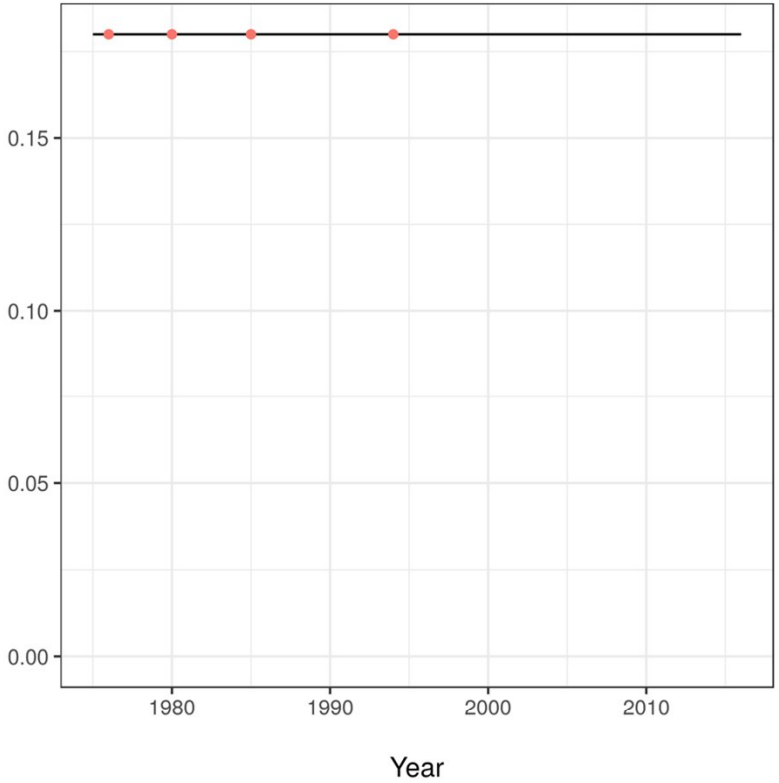
Gmacs BBRKC: Different Model Structures

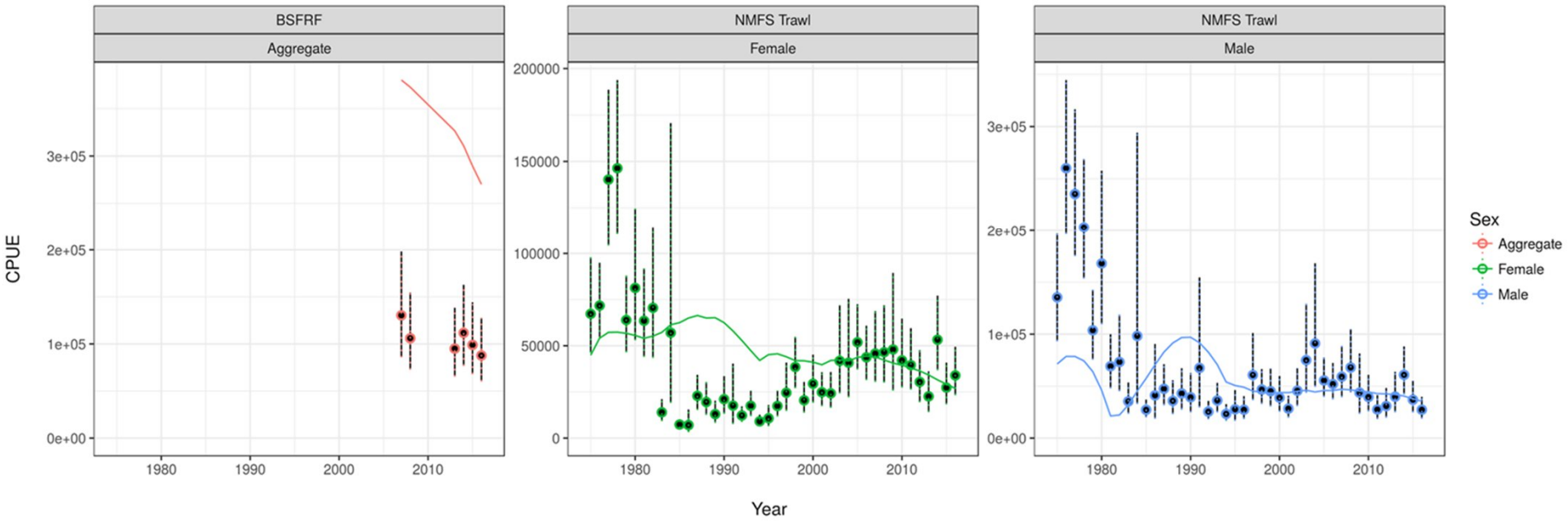
Different model structures

Model name	M	BSFRF q	NMFS Lambda
Constant M	Constant	Fixed at 1	1.0
Random Walk M	Random walk	Fixed at 1	1.0
Model M	At 2016 values	Fixed at 1	1.0
Estimate BSFRF q	At 2016 values	Estimated	1.0
NMFS Lambda=4	At 2016 values	Fixed at 1	4.0

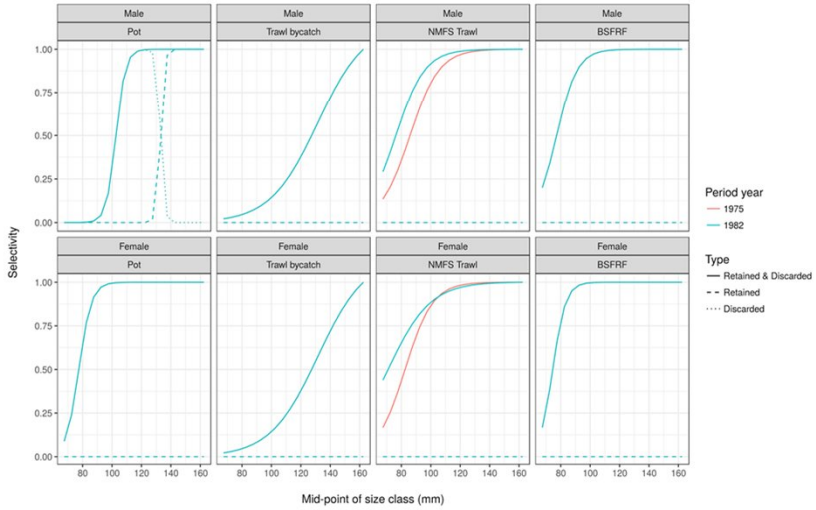
1.Constant M

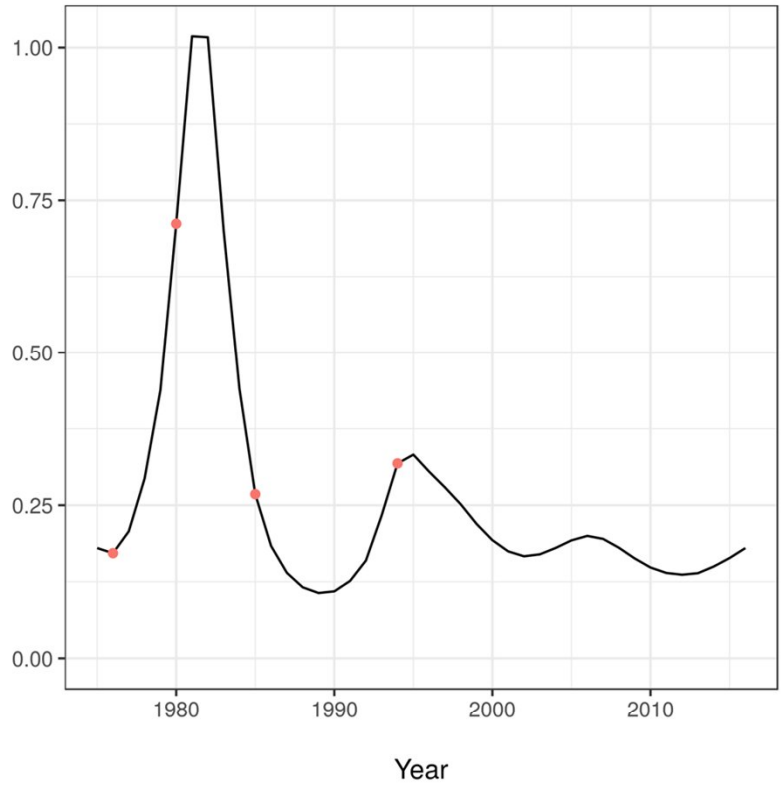

Male
Pot
Male
Trawl bycatch
Male
NMFS Trawl
Male
BSFRF
Female
Pot
Female
Trawl bycatch
Female
NMFS Trawl
Female
BSFRF
Selectivity
Mid-point of size class (mm)
Period year
1975
1982
Type
Retained & Discarded
Retained
Discarded

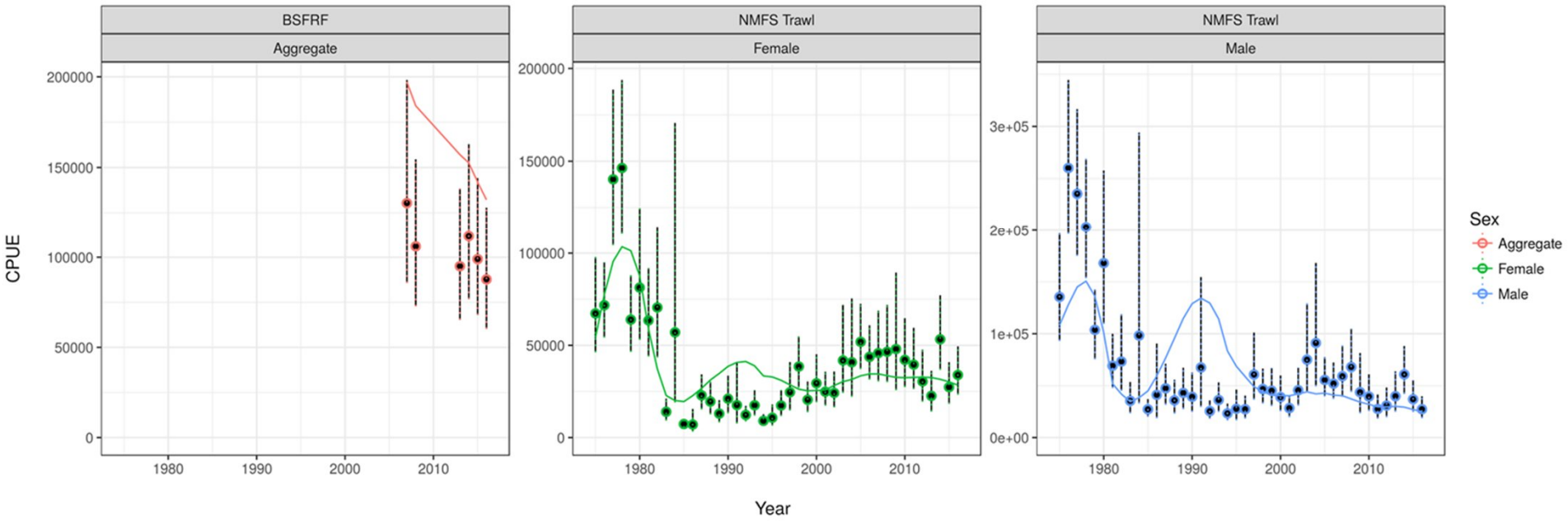

0.15
0.10
0.05
0.00
1980
1990
2000
2010
Year


BSFRF
Aggregate
NMFS Trawl
Female
NMFS Trawl
Male
CPUE
Year
Sex
Aggregate
Female
Male

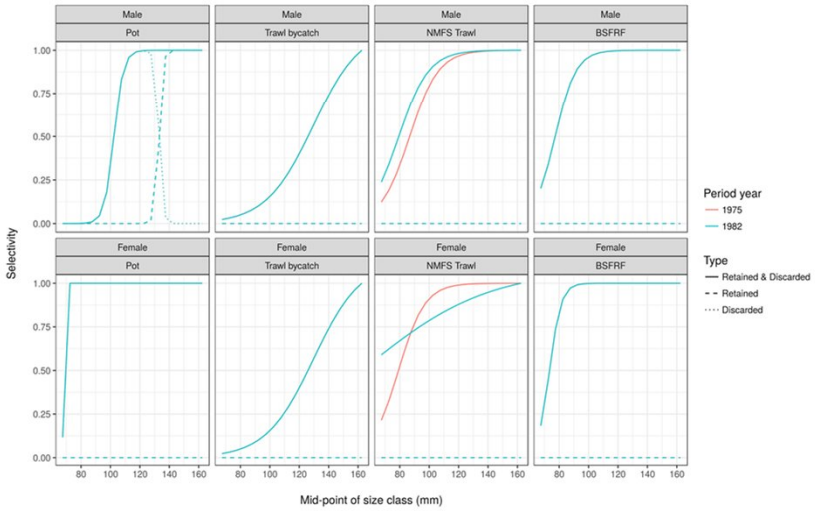
2. Random Walk M

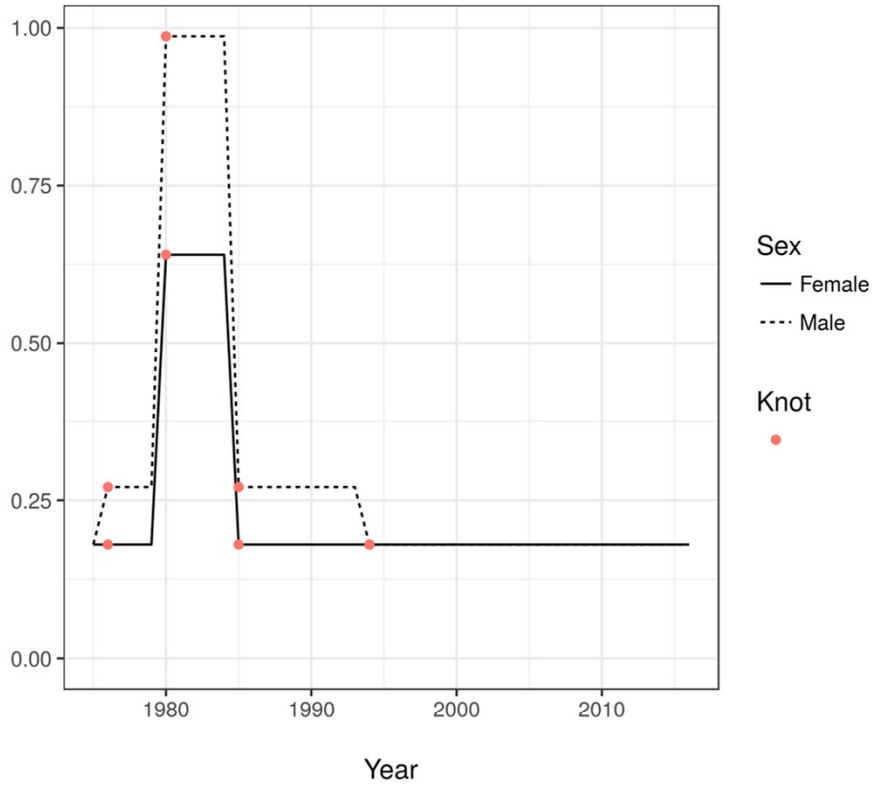


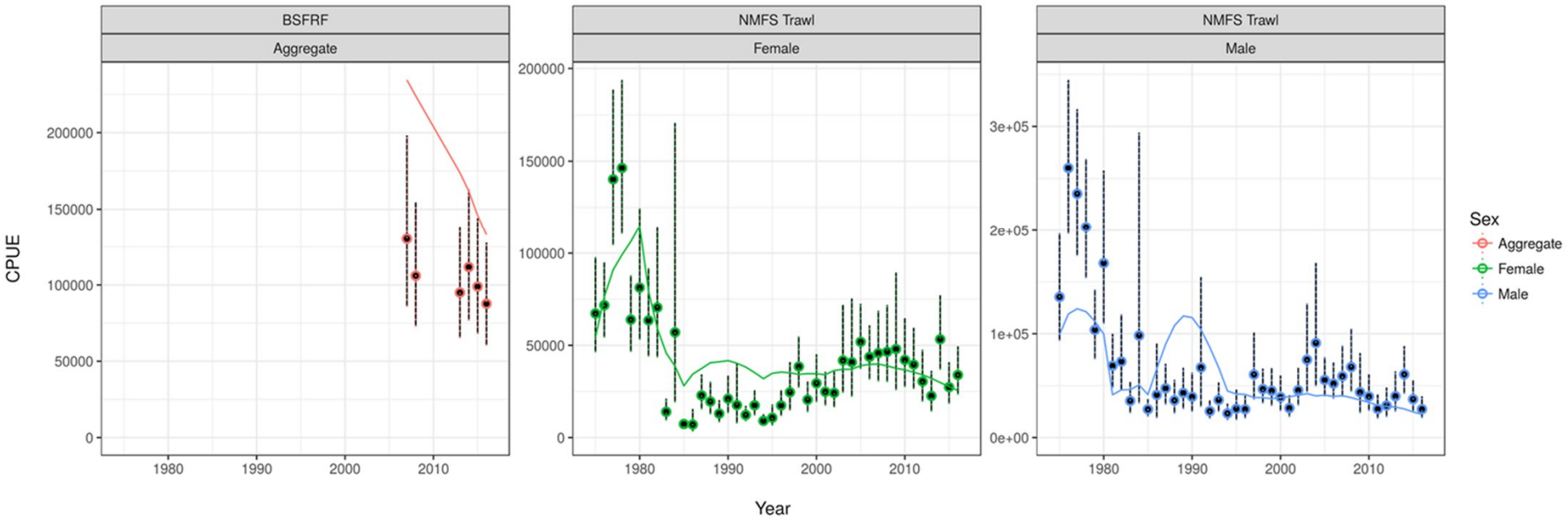




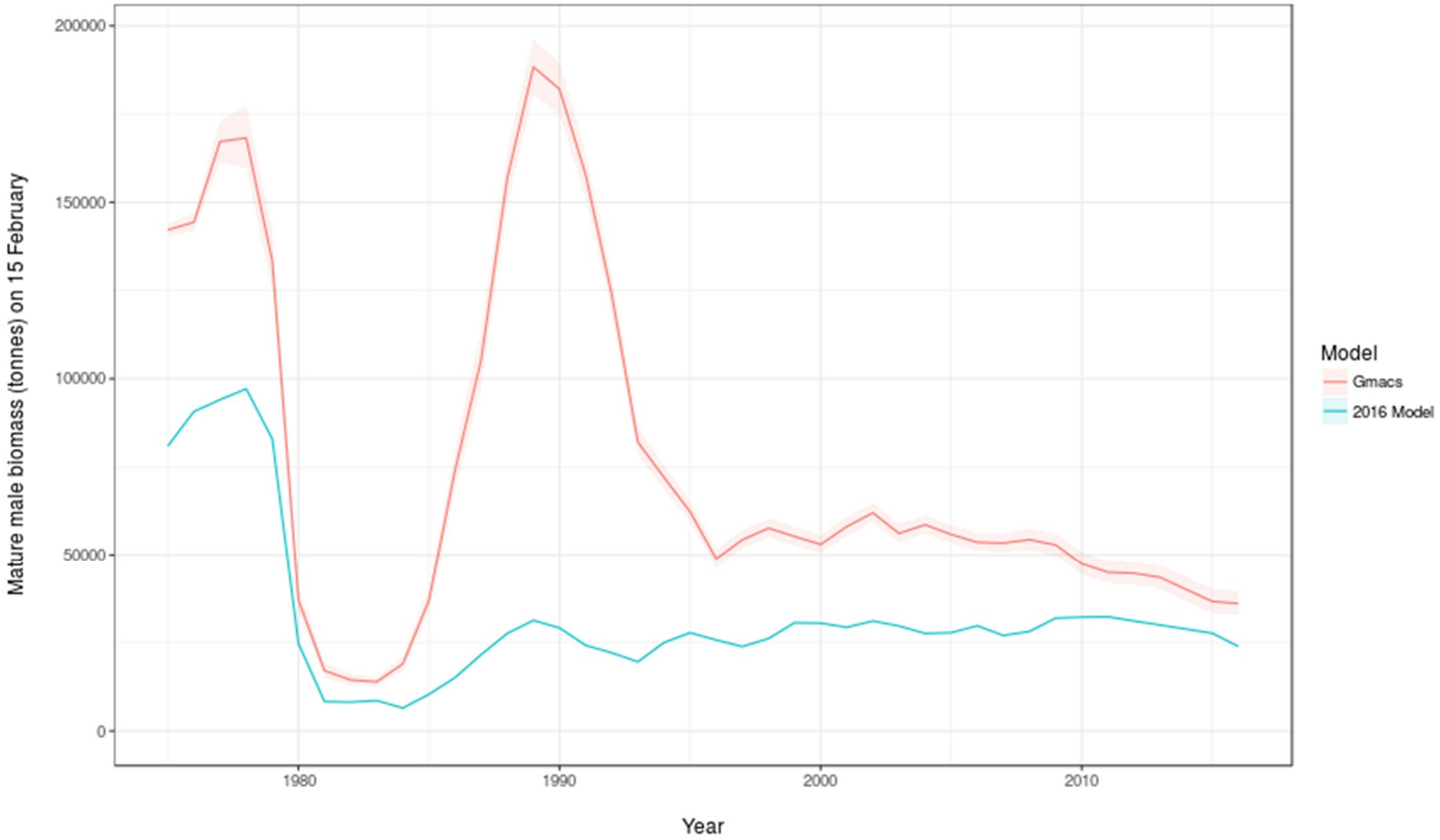
3. 2016 Model M



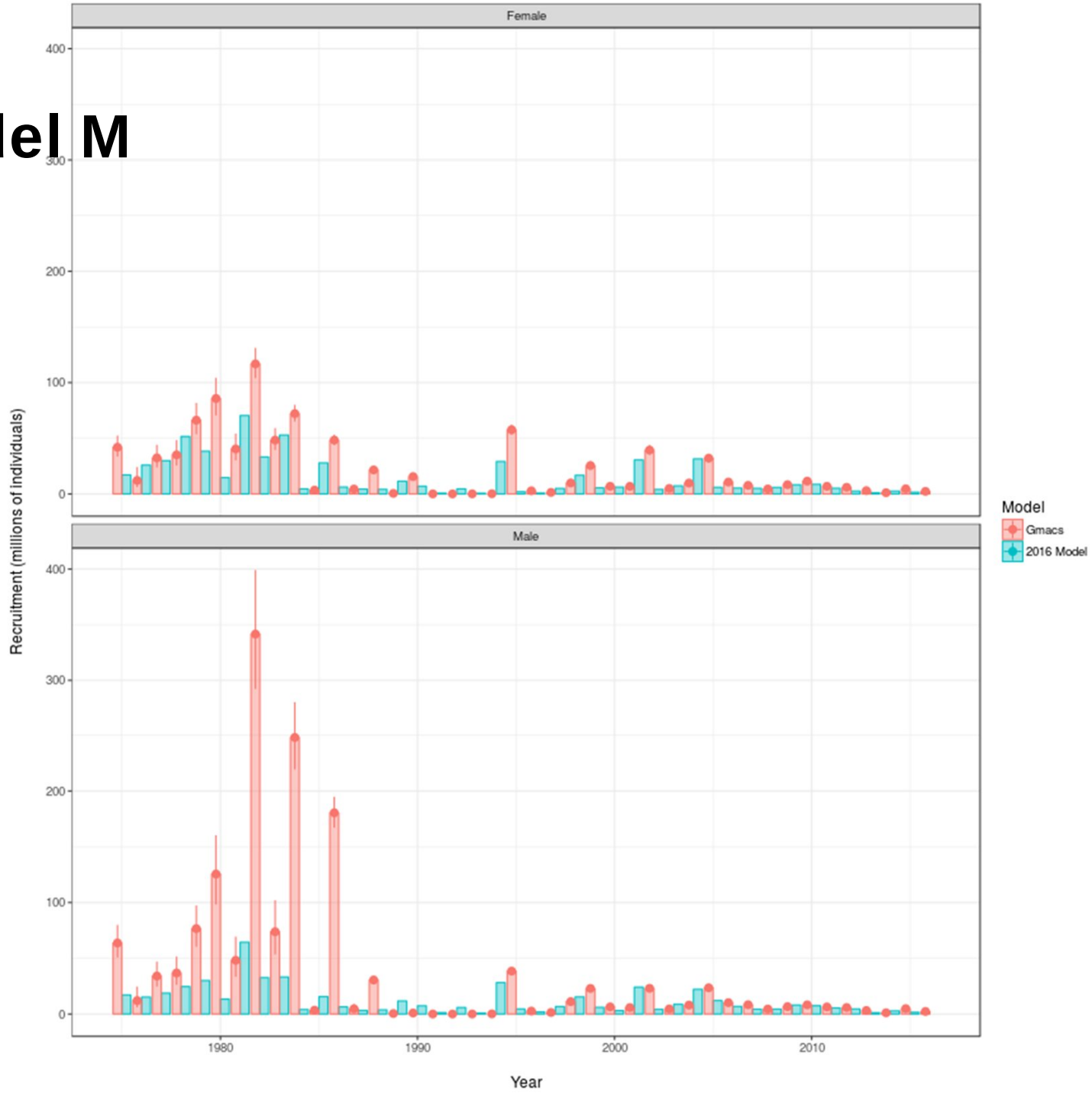




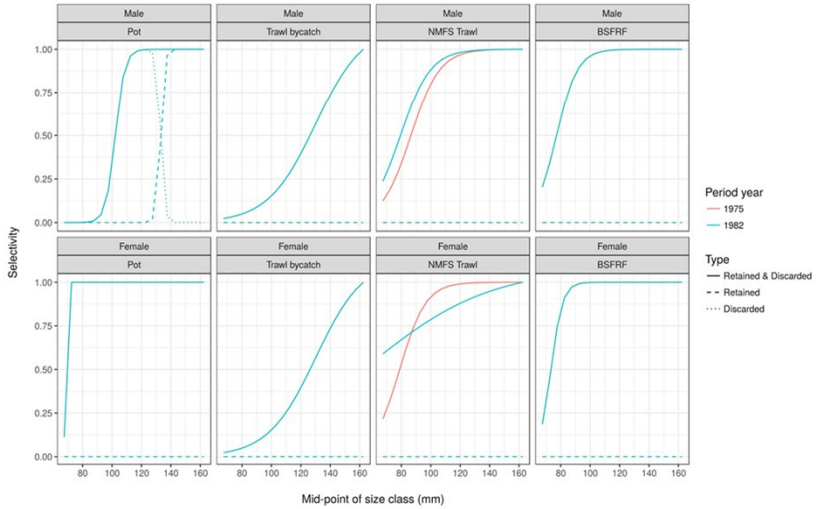
3. 2016 Model M

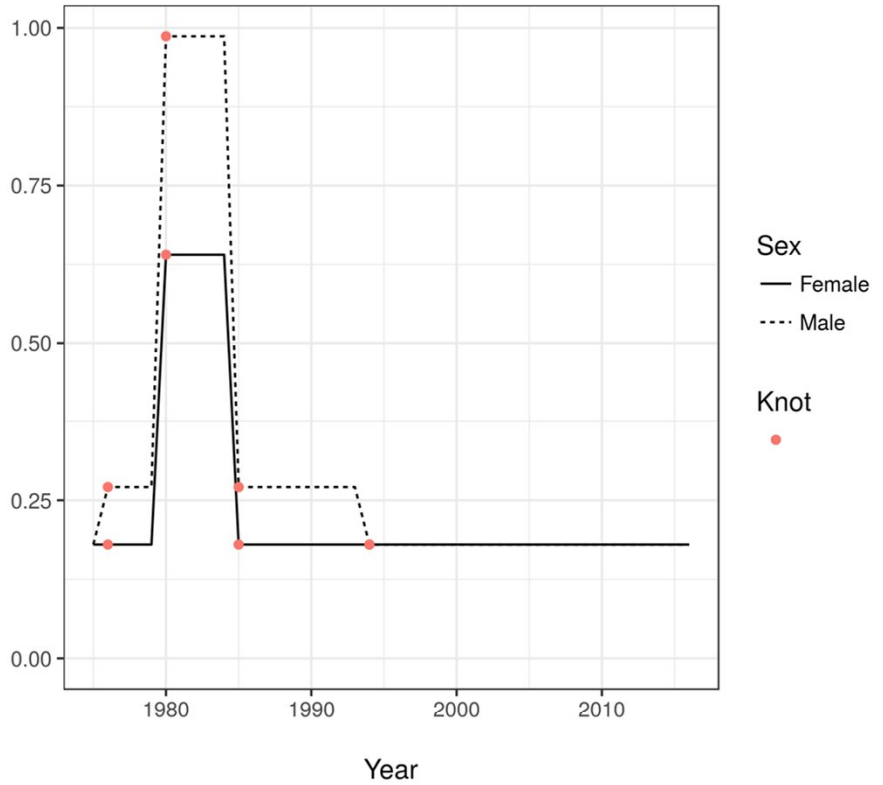


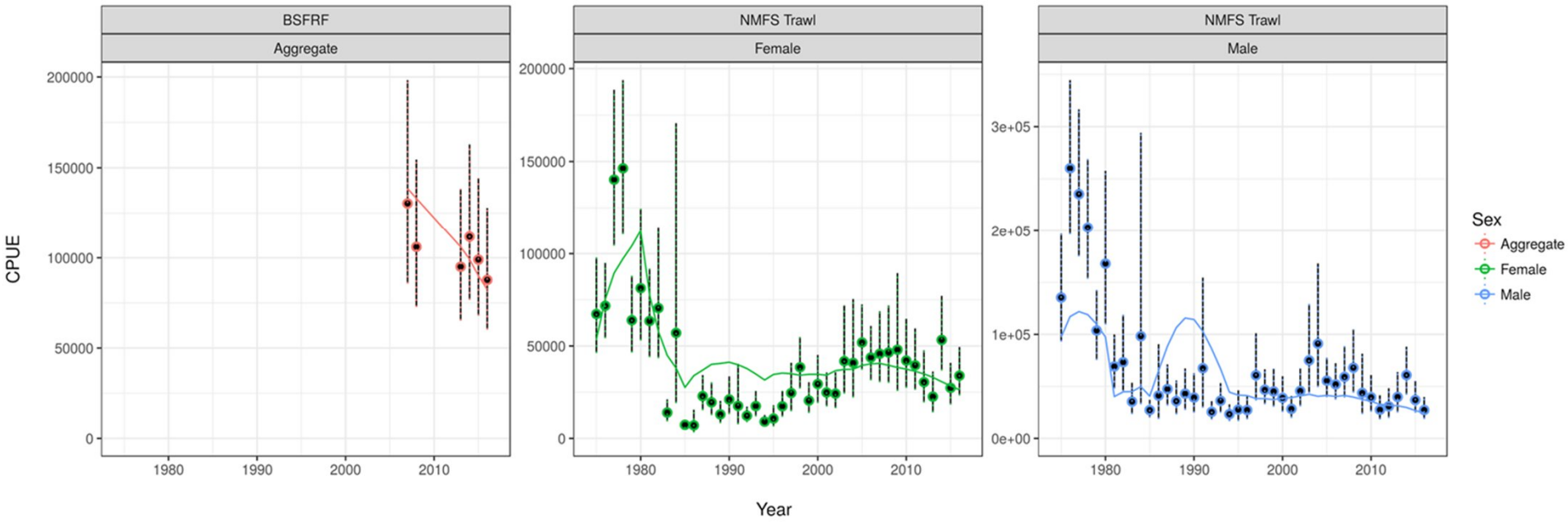
3. 2016 Model M



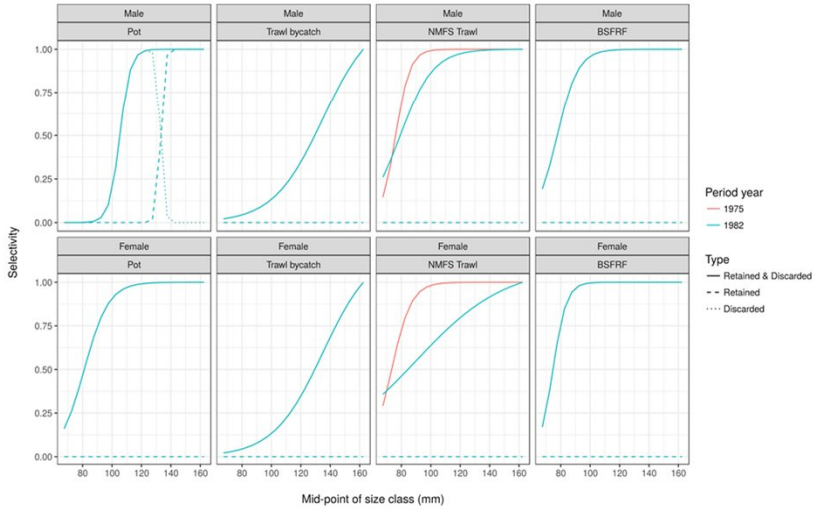
4. Estimate BSFRF q

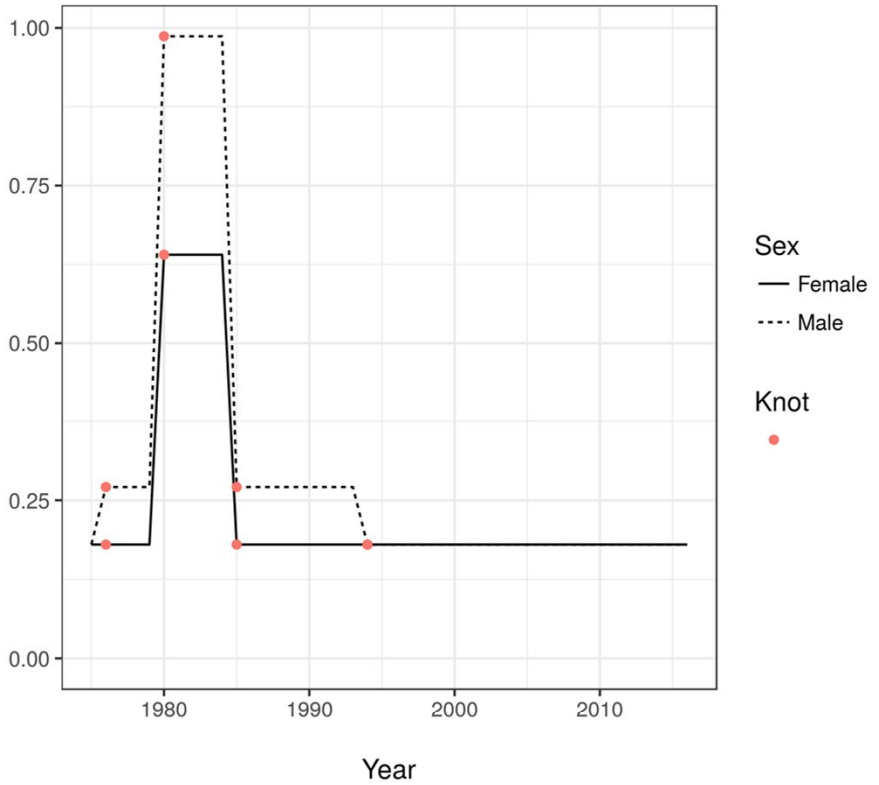


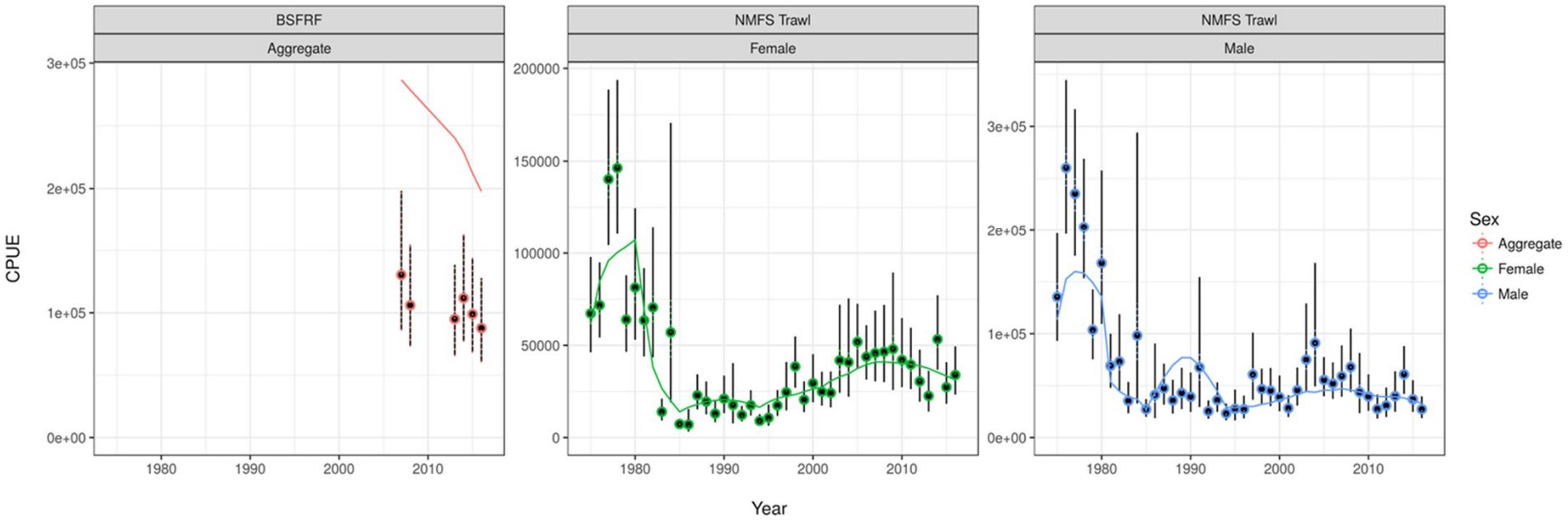




5. NMFS lambda = 4







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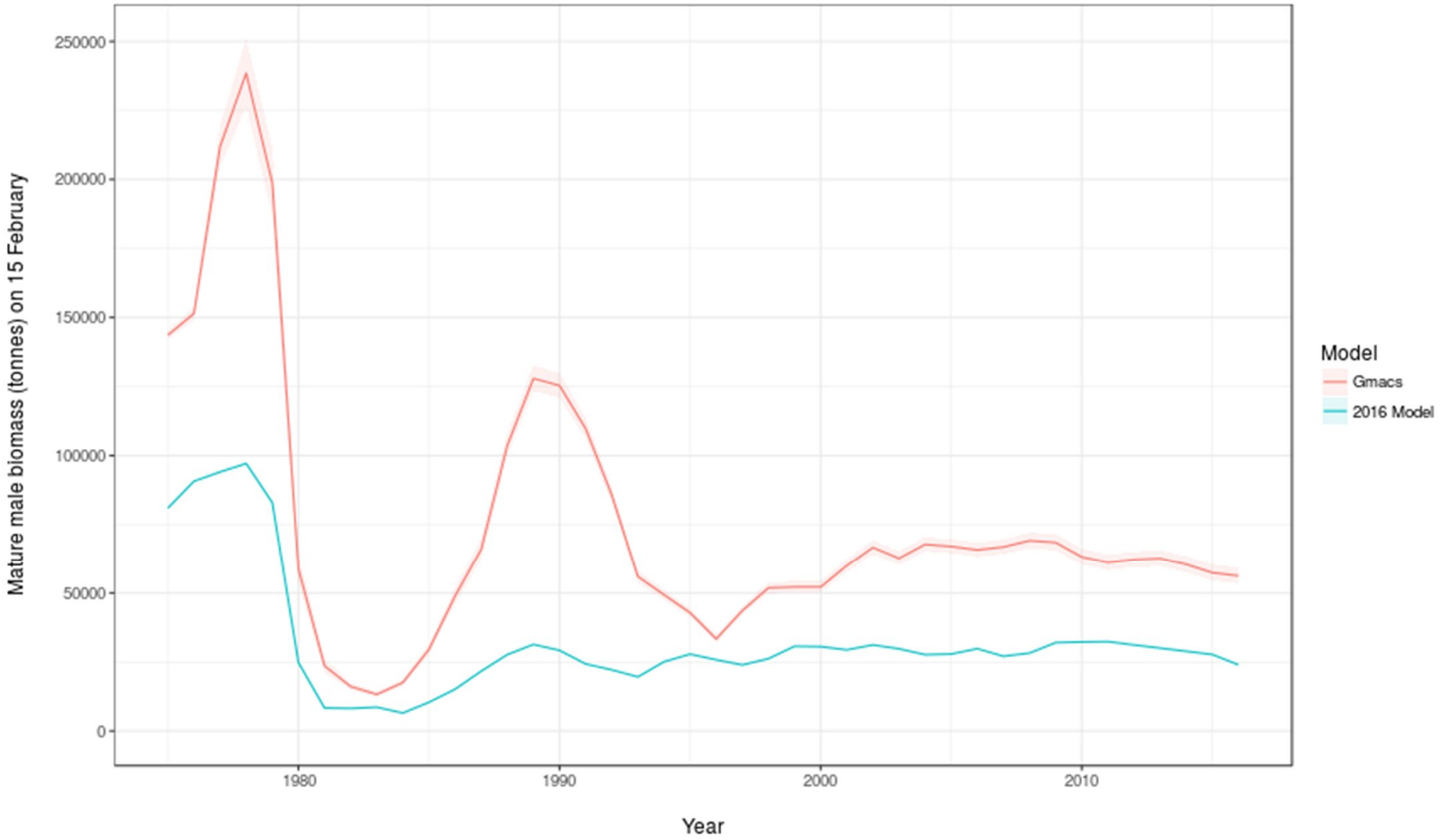
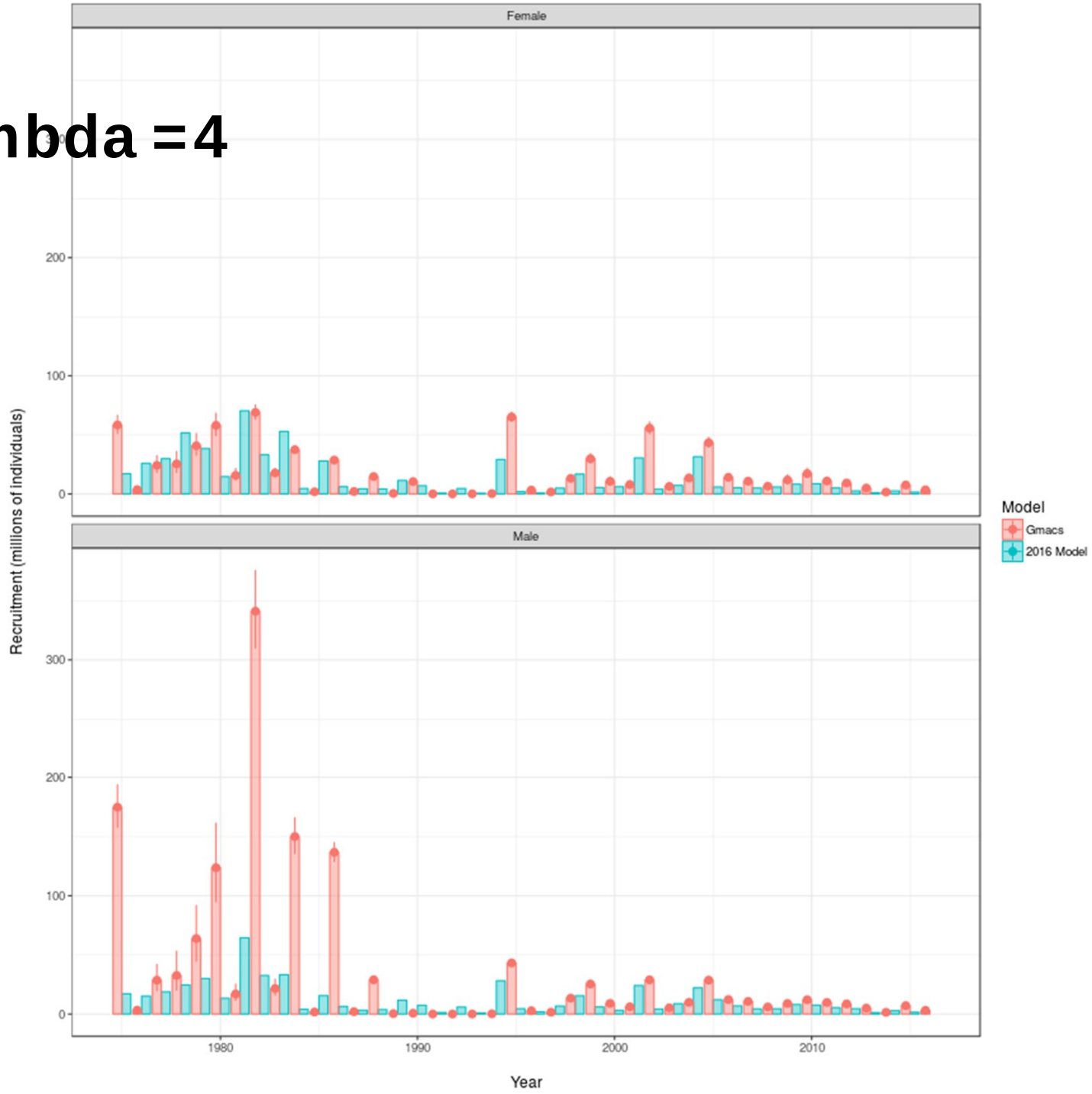
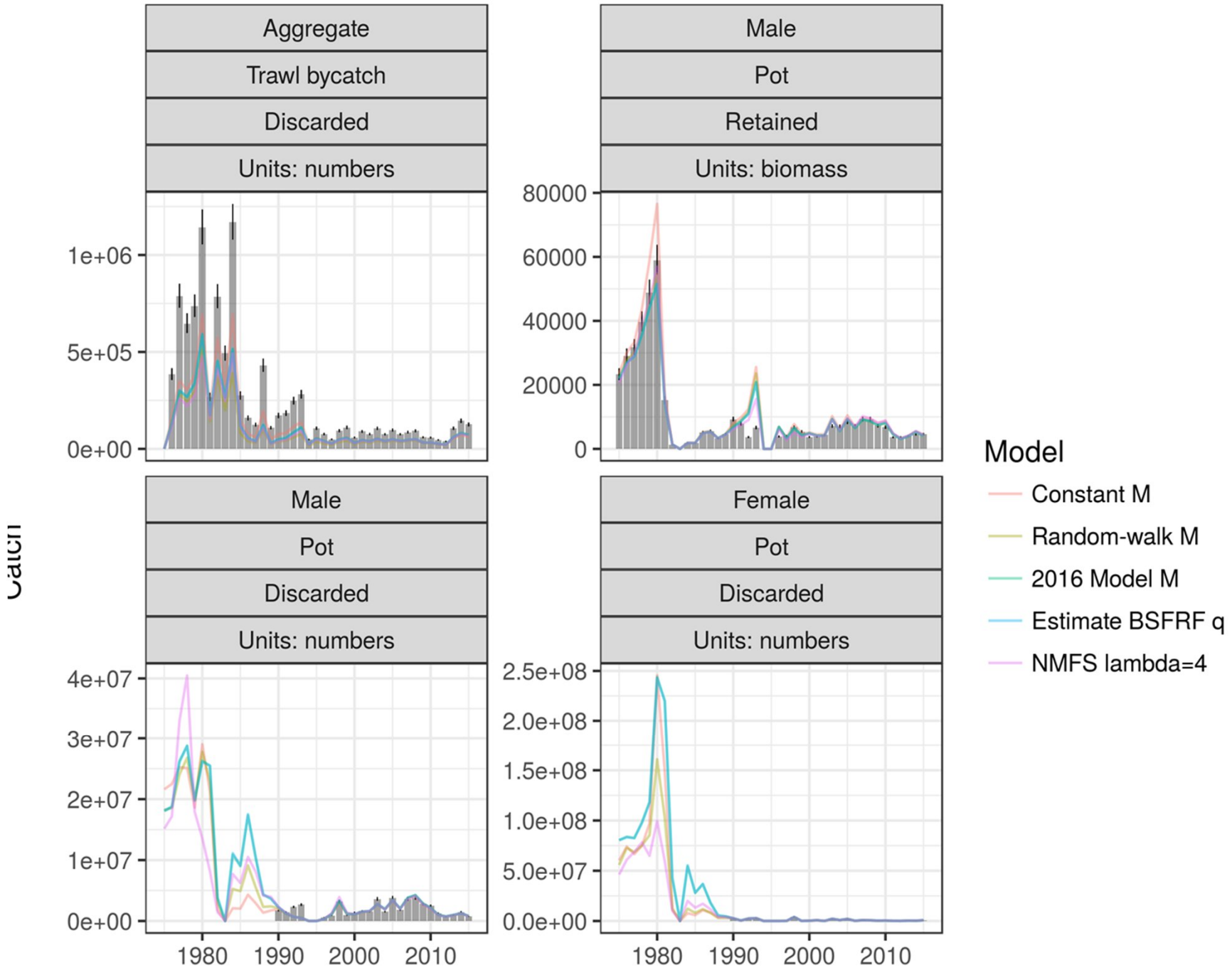
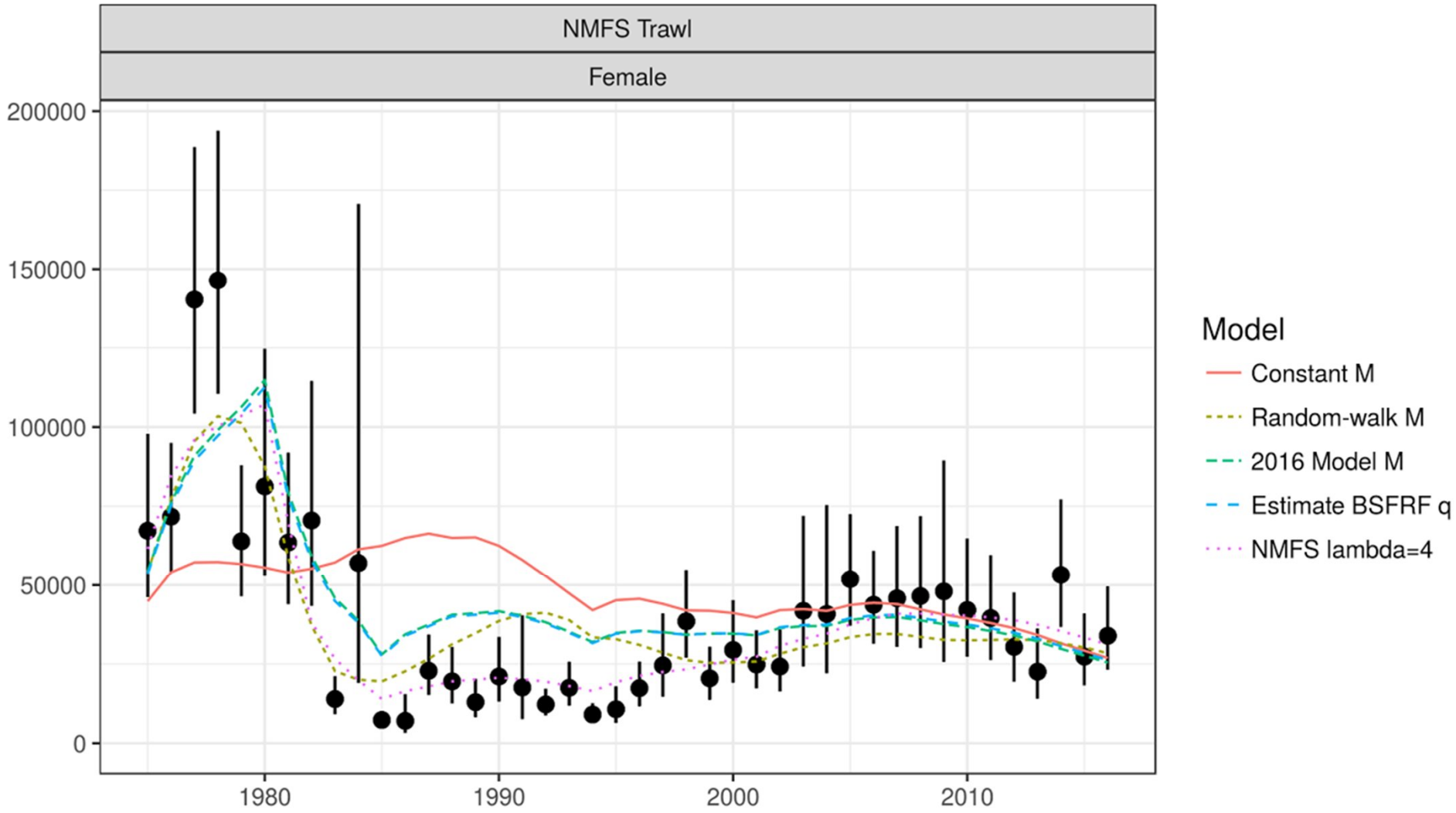


5. NMFS lambda = 4

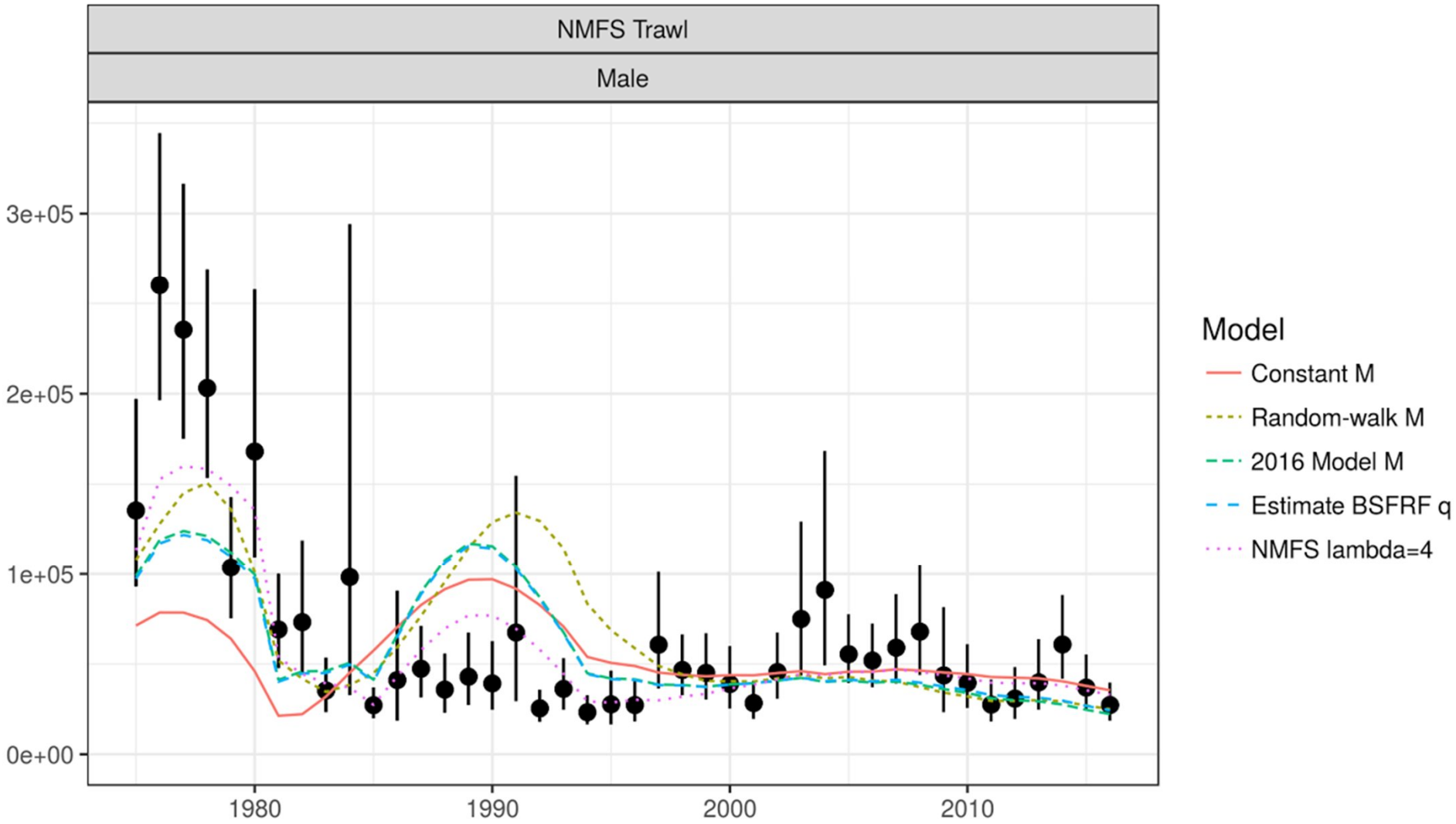


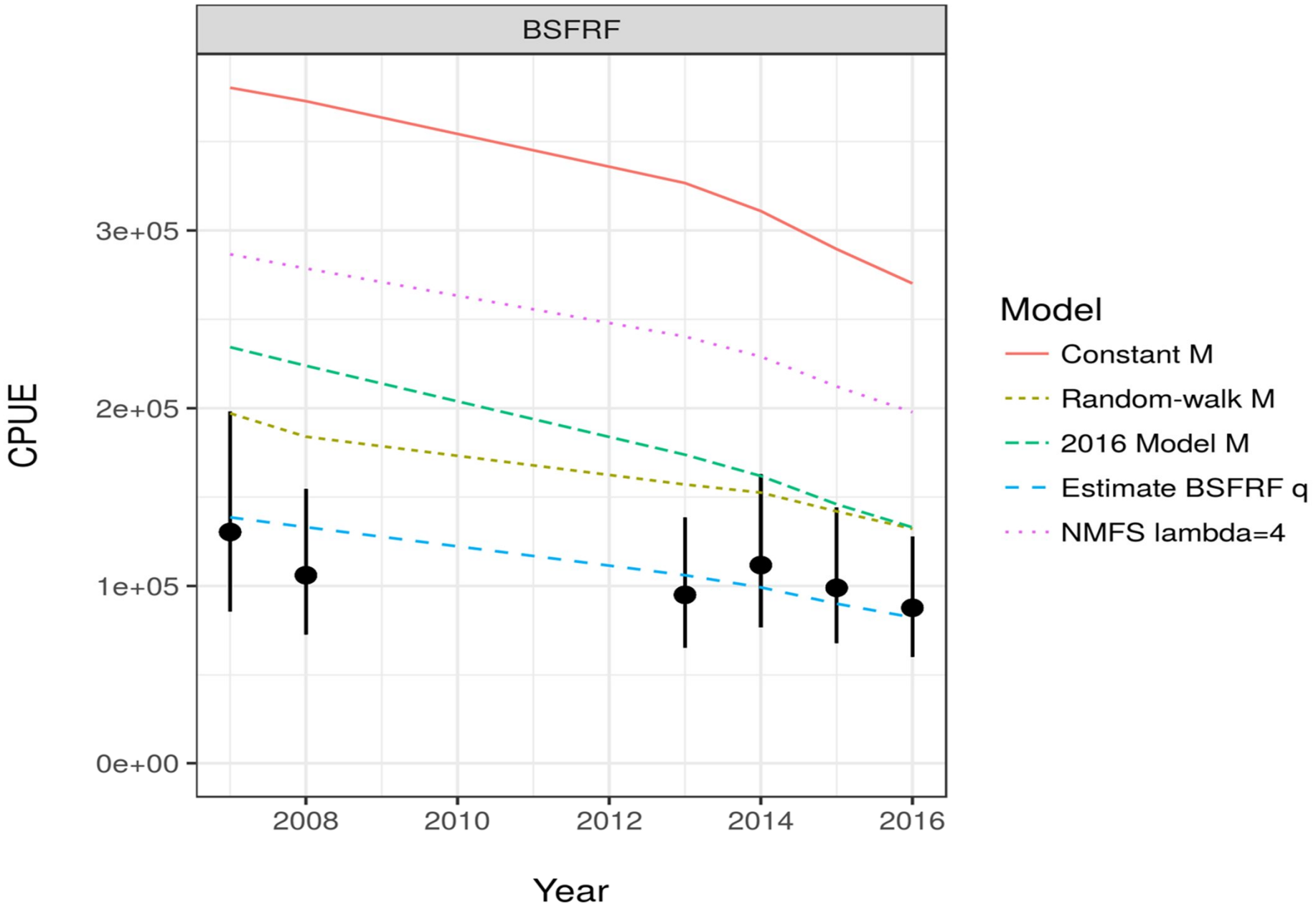

Aggregate
Trawl bycatch
Discarded
Units: numbers
Male
Pot
Retained
Units: biomass
Male
Pot
Discarded
Units: numbers
Female
Pot
Discarded
Units: numbers
Catch
1e+06
5e+05
0e+00
80000
60000
40000
20000
0
4e+07
3e+07
2e+07
1e+07
0e+00
2.5e+08
2.0e+08
1.5e+08
1.0e+08
5.0e+07
0.0e+00
1980
1990
2000
2010
Model
Constant M
Random-walk M
2016 Model M
Estimate BSFRF q
NMFS lambda=4

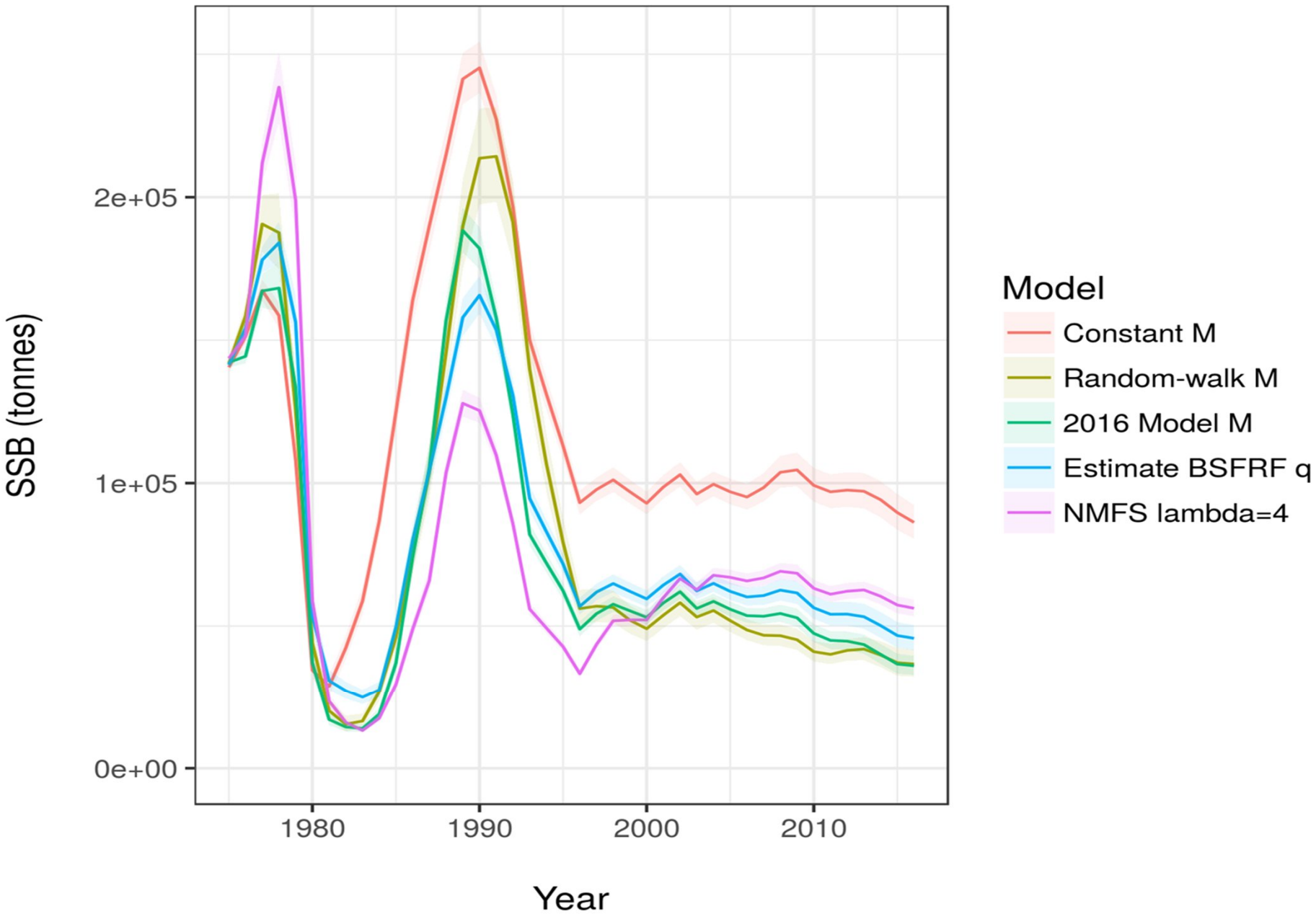
Model fits (Female)



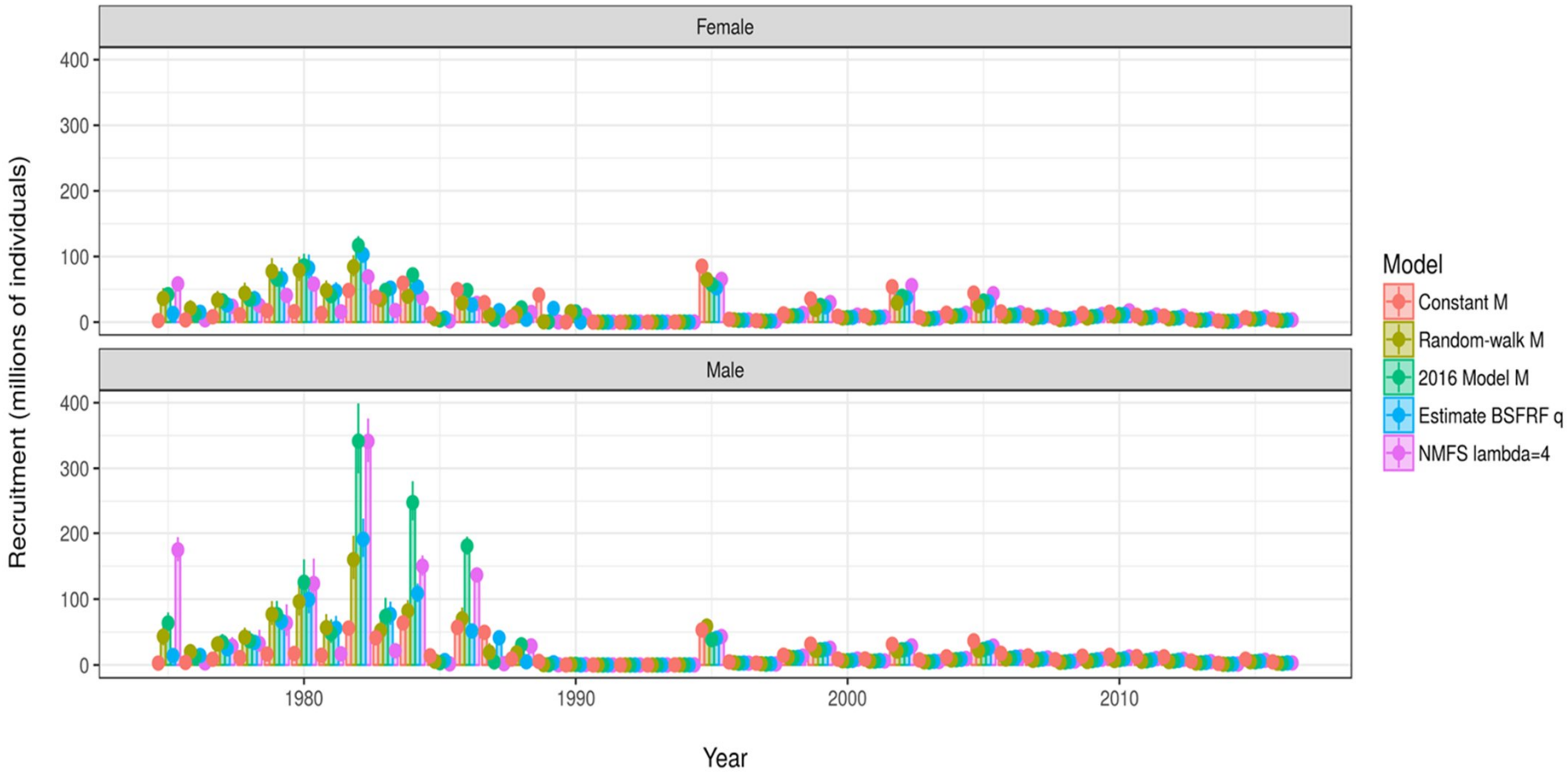
Model fits (male)



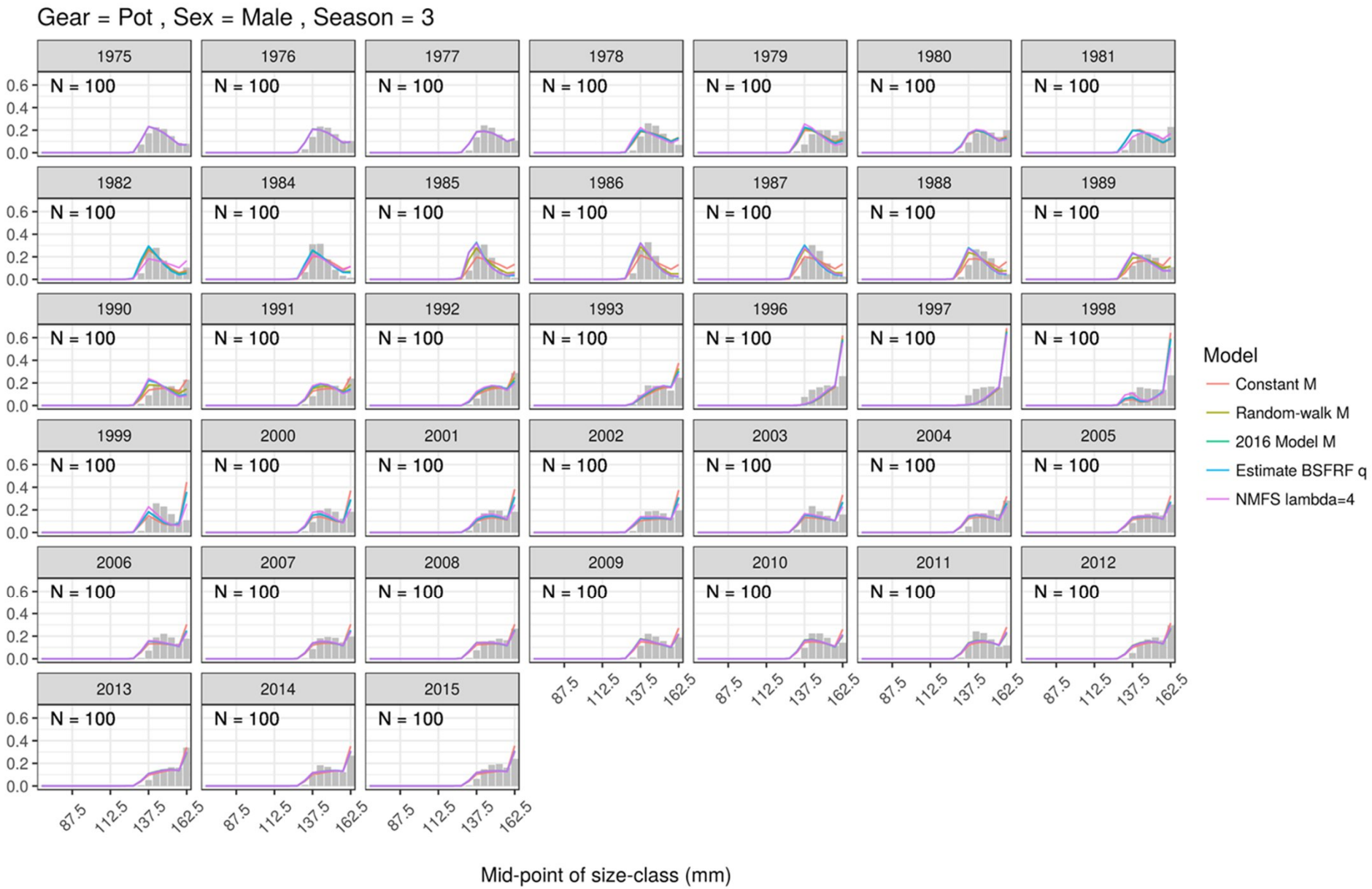

BSFRF
CPUE
3e+05
2e+05
1e+05
0e+00
2008
2010
2012
2014
2016
Year
Model
Constant M
Random-walk M
2016 Model M
Estimate BSFRF q
NMFS lambda=4


SSB (tonnes)
2e+05
1e+05
0e+00
1980
1990
2000
2010
Year
Model
Constant M
Random-walk M
2016 Model M
Estimate BSFRF q
NMFS lambda=4

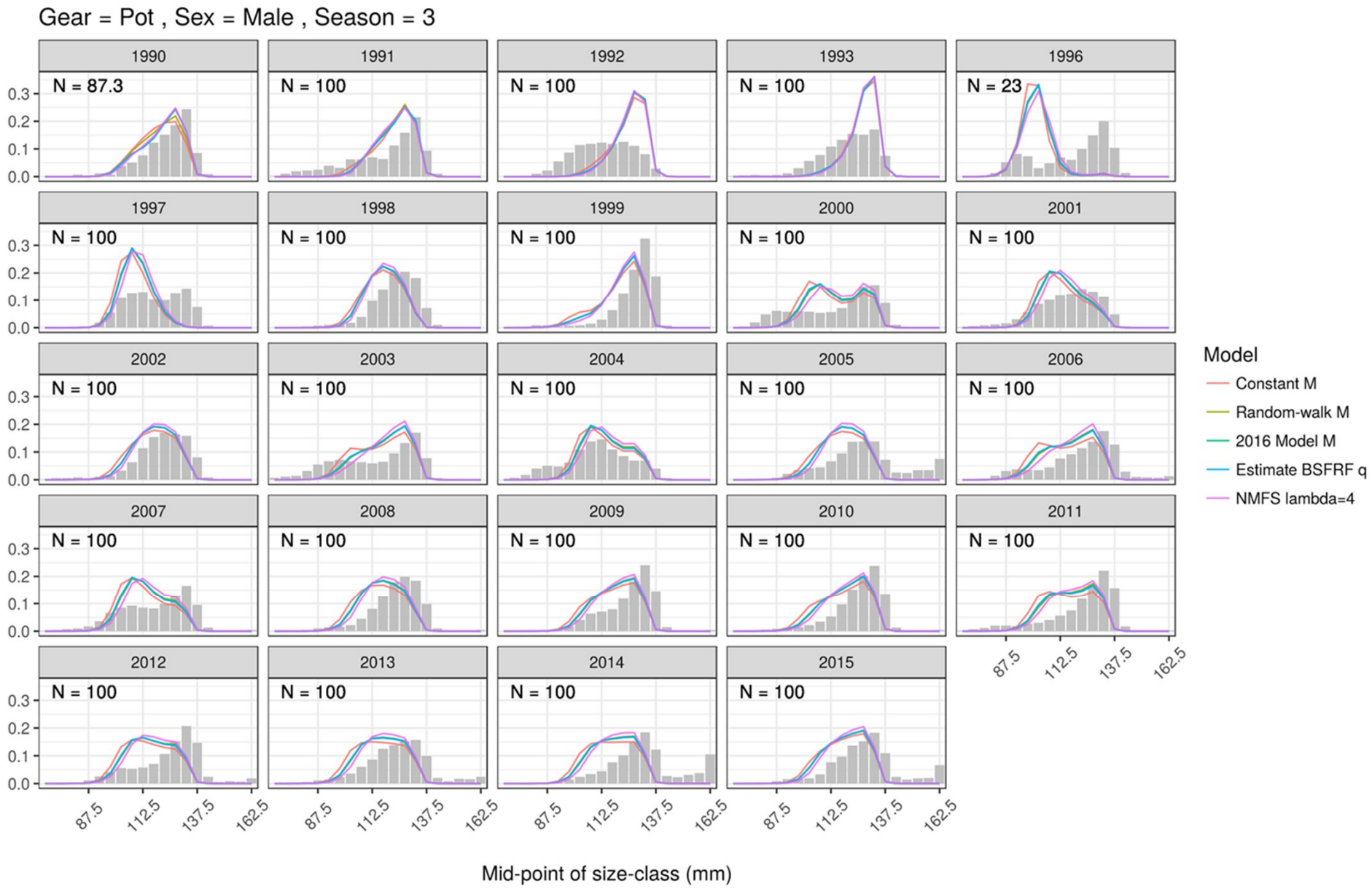
Recruitment



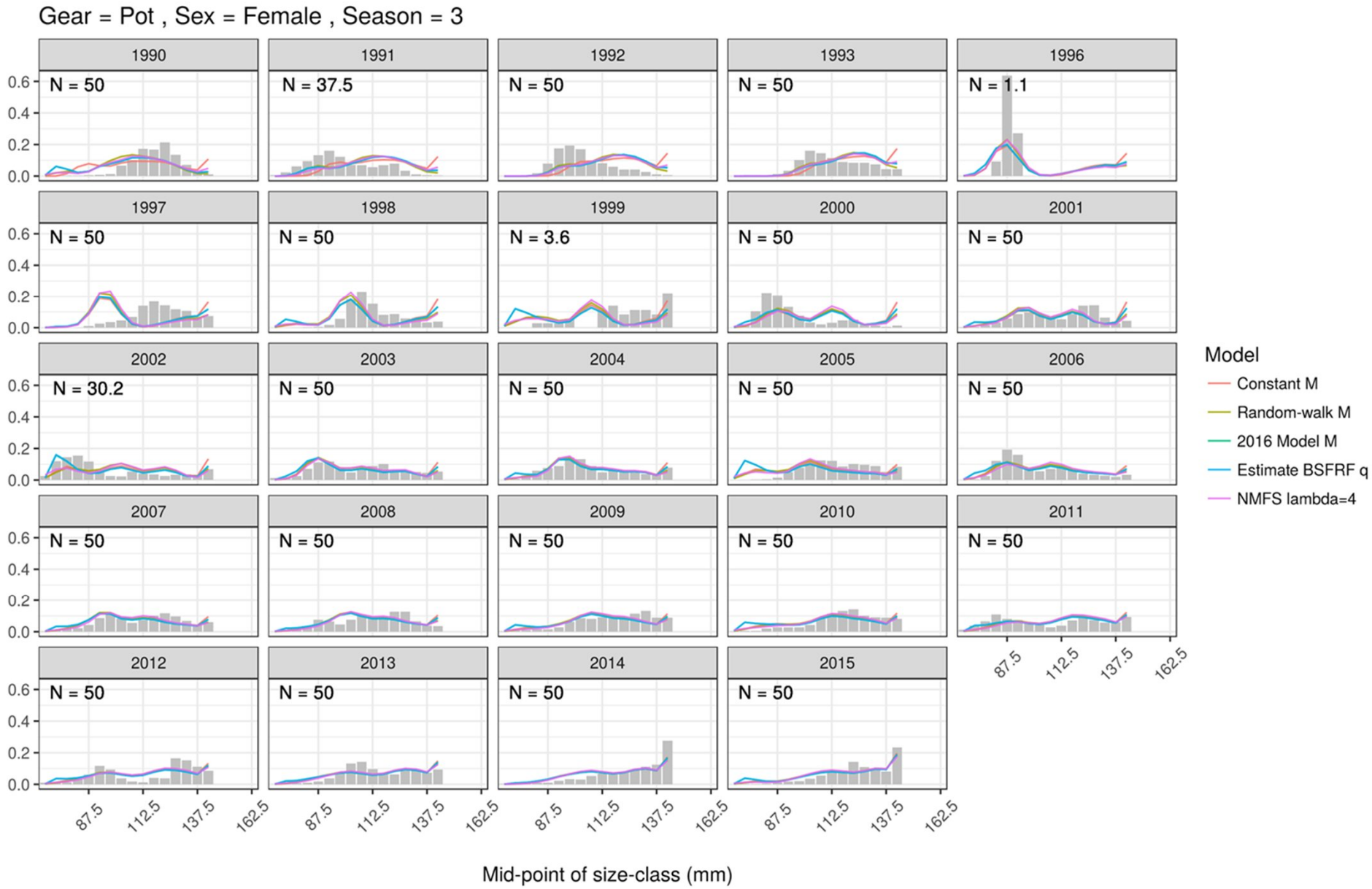
Retained Males



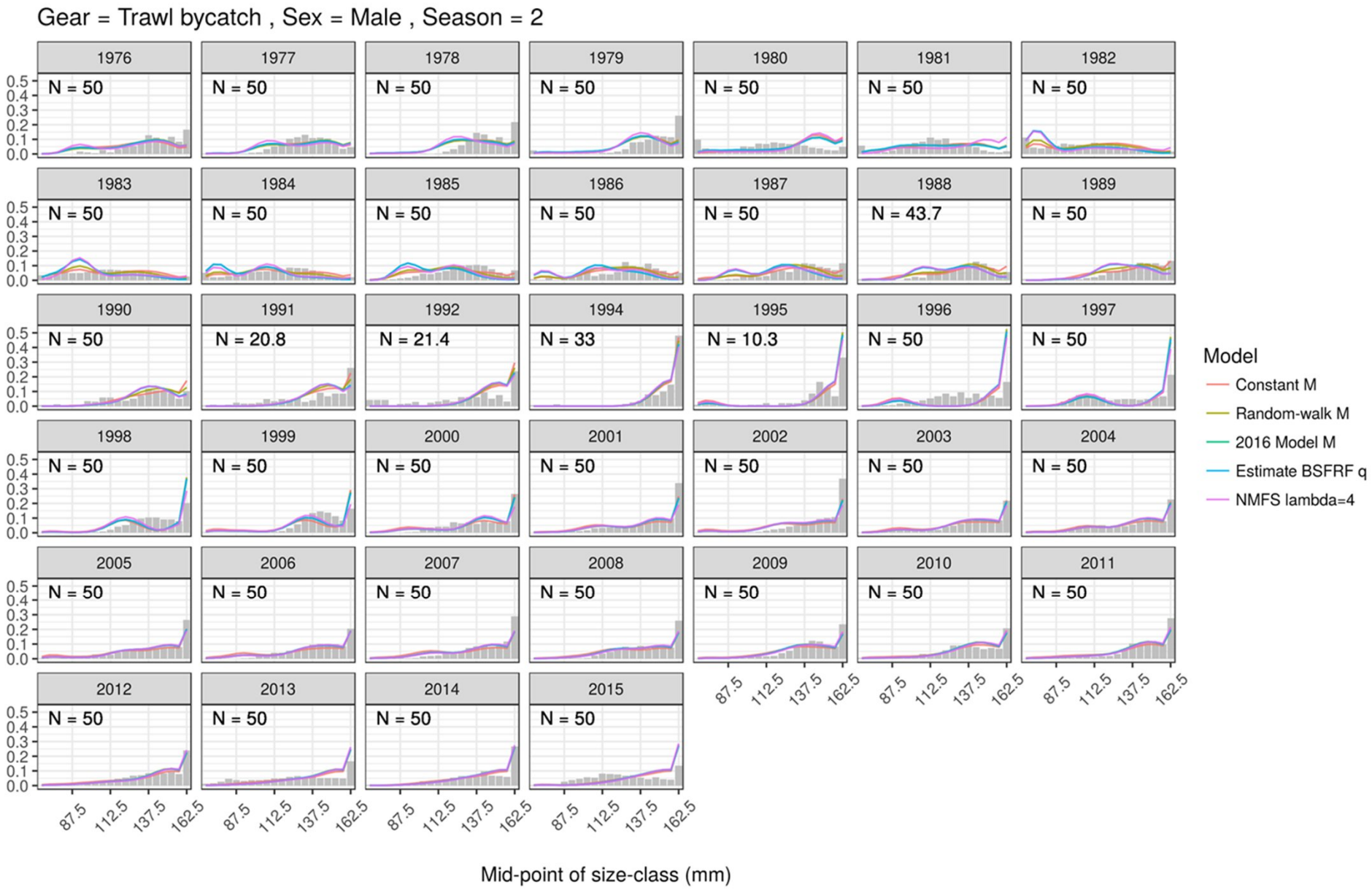
Discarded Males



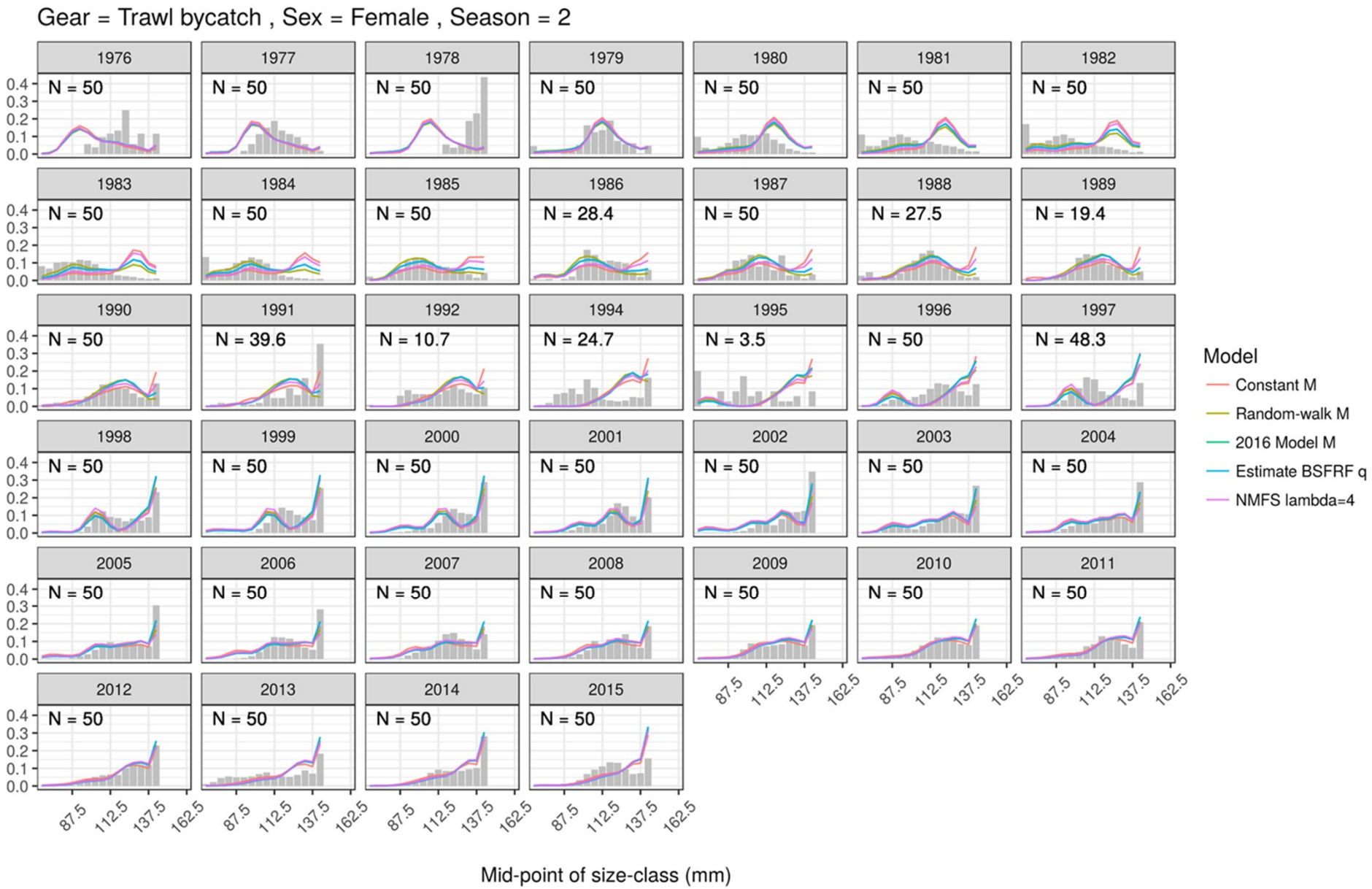
Discarded Females



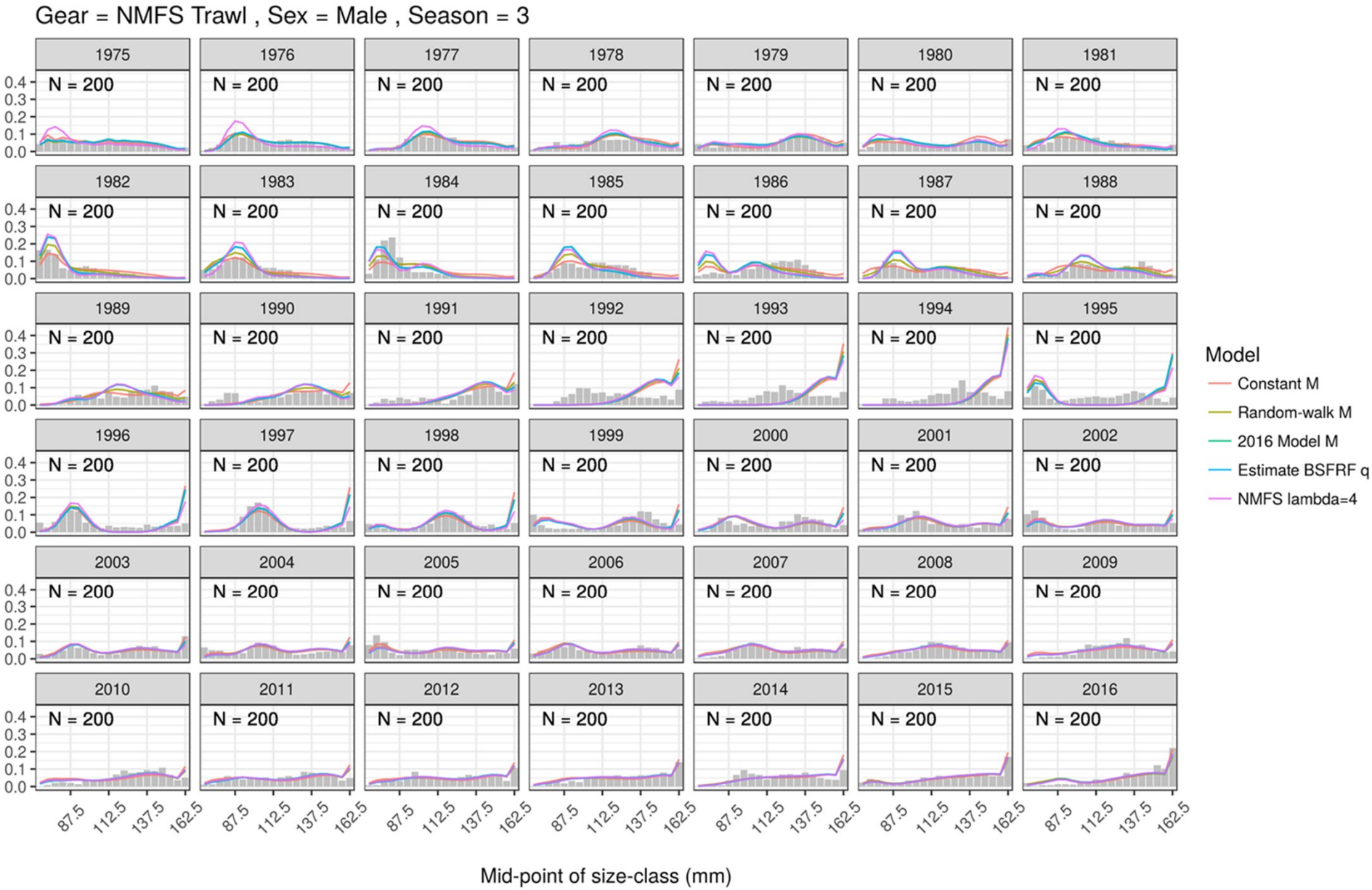
Trawl Bycatch Males



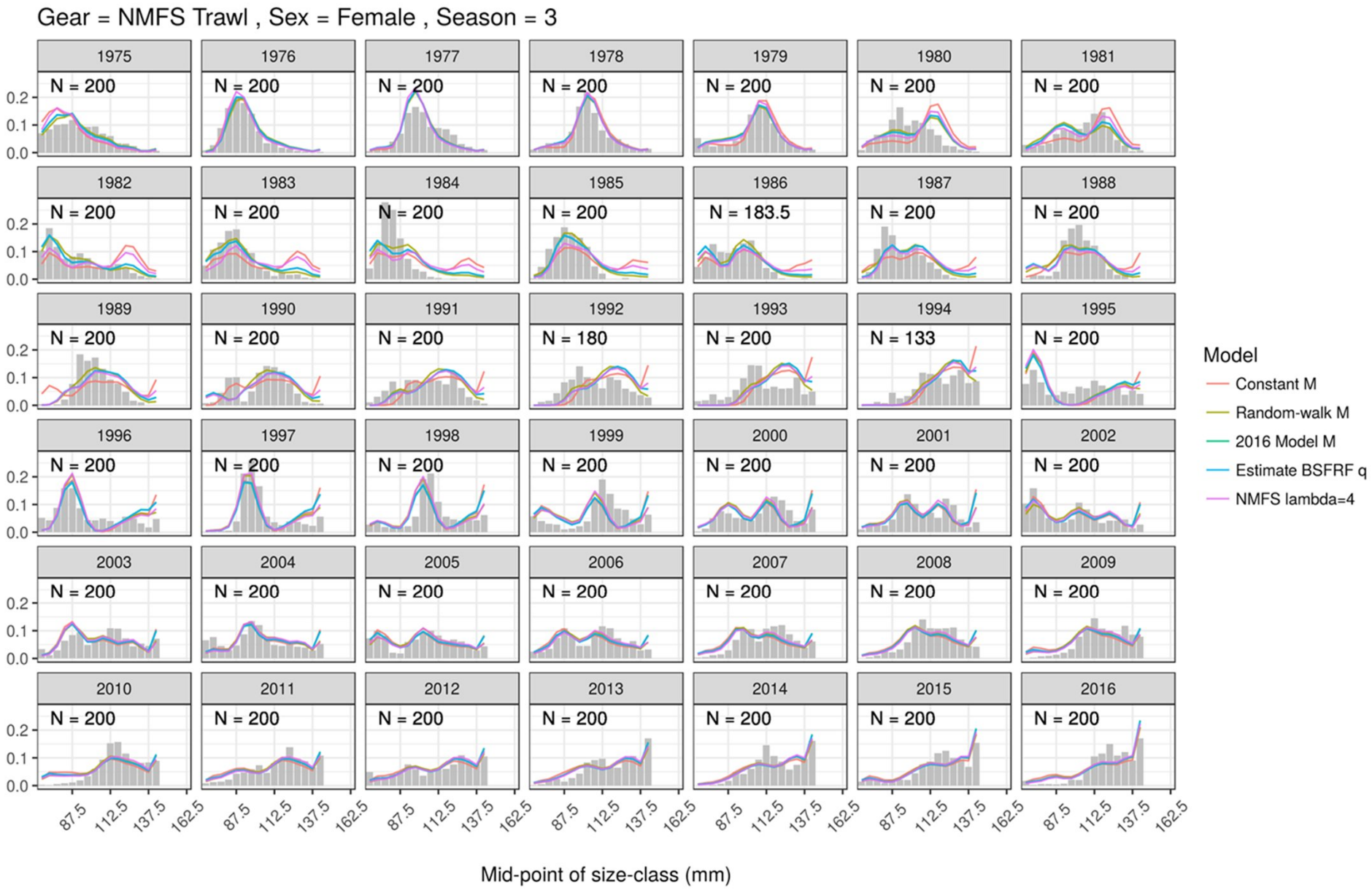
Trawl Bycatch Females



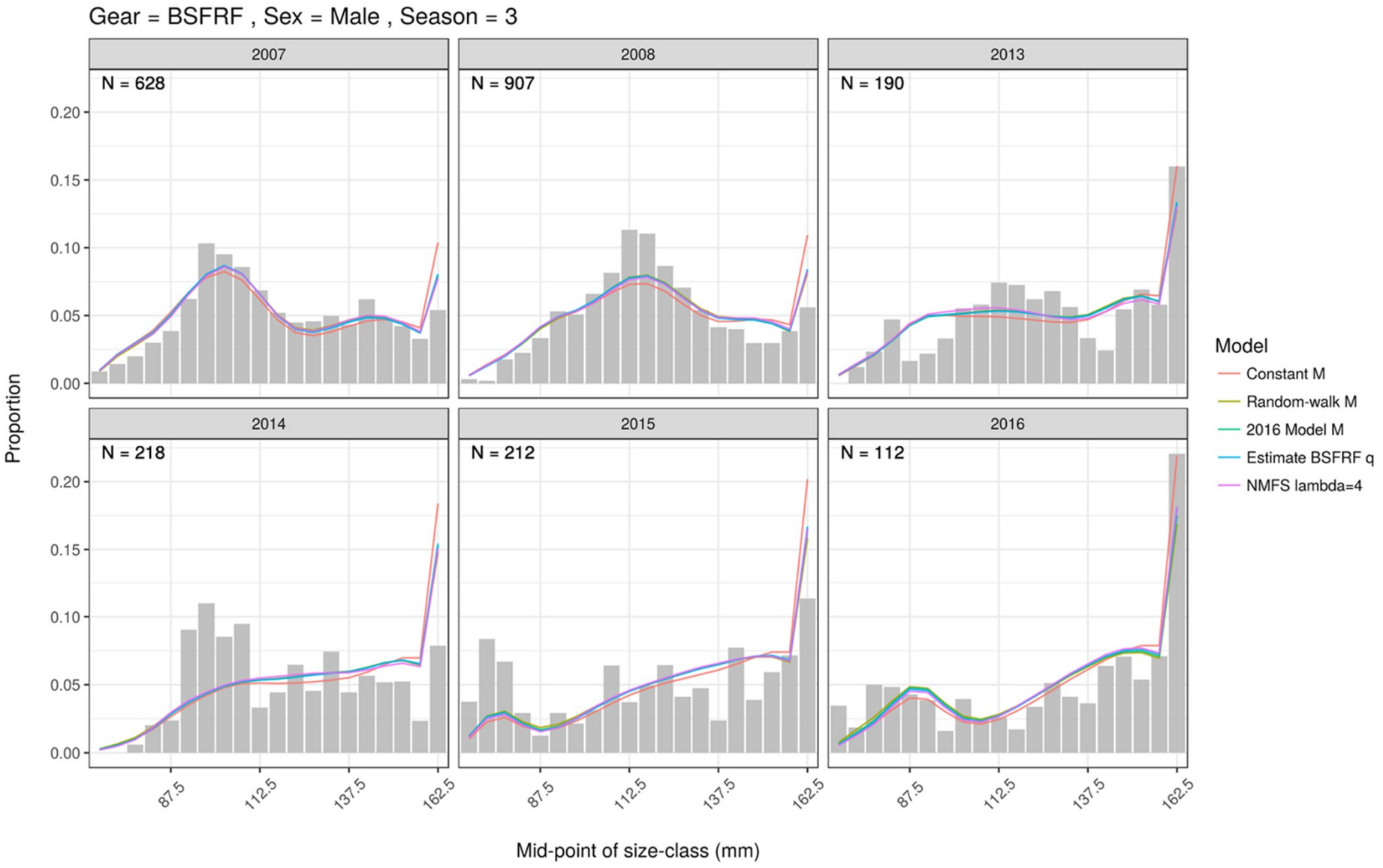
NMFS Trawl Males



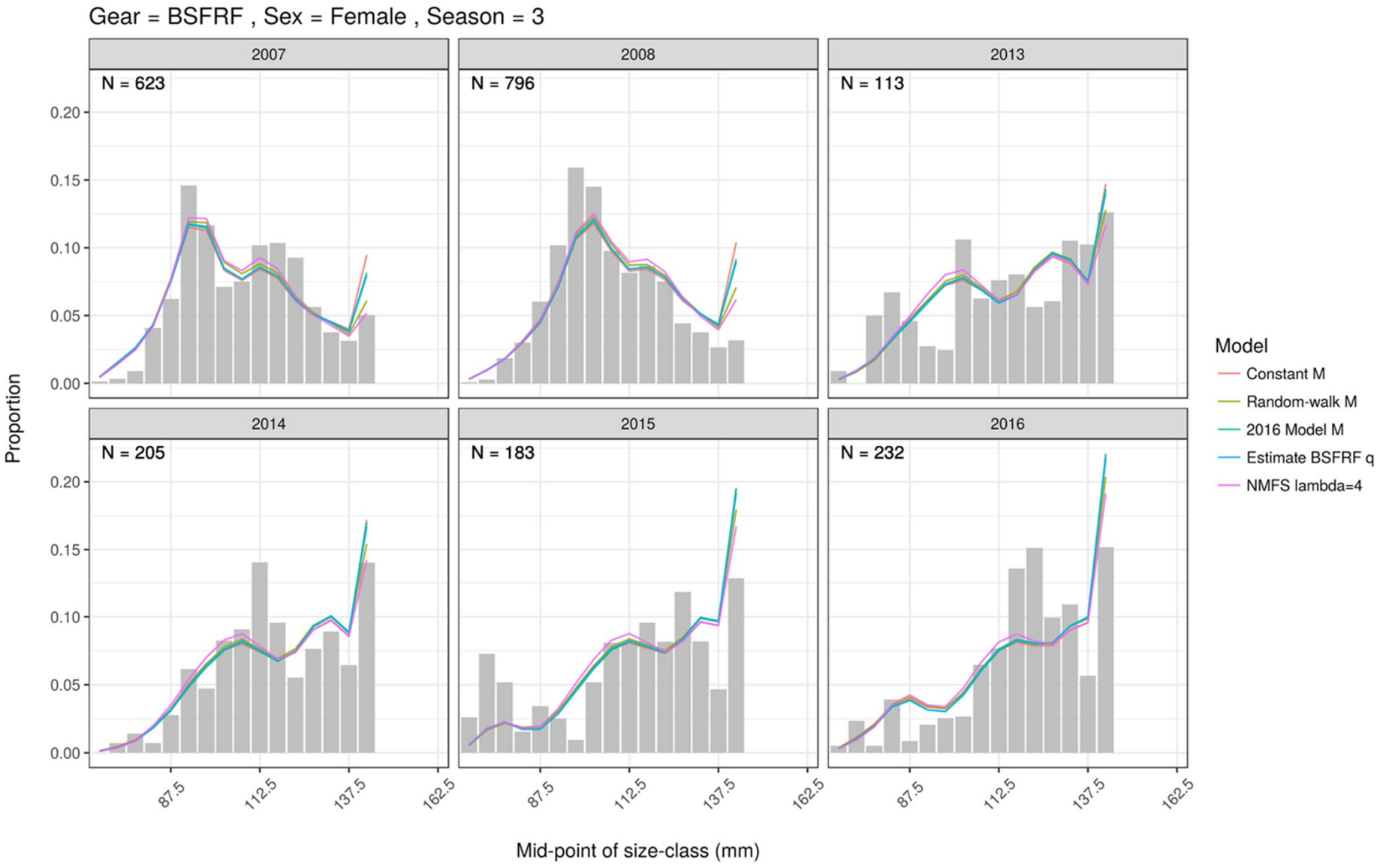
NMFS Trawl Females



BSFRF Males


Gear = BSFRF , Sex = Male , Season = 3
2007
N = 628
2008
N = 907
2013
N = 190
2014
N = 218
2015
N = 212
2016
N = 112
Proportion
0.00
0.05
0.10
0.15
0.20
87.5
112.5
137.5
162.5
Mid-point of size-class (mm)
Model
Constant M
Random-walk M
2016 Model M
Estimate BSFRF q
NMFS lambda=4

BSFRF Females

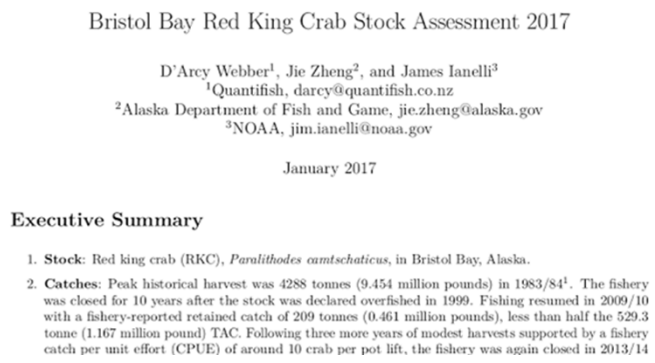


To do

1. Need to figure out what is going on with BBRKC initialisation - all of these issues likely stem from this
2. Same goes for growth matrix

This will hopefully result in better survey fits, then:

1. Write-up document



Bristol Bay Red King Crab Stock Assessment 2017

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Executive Summary

1. **Stock**: Red king crab (RKC), *Paralithodes camtschaticus*, in Bristol Bay, Alaska.
2. **Catches**: Peak historical harvest was 4288 tonnes (9.454 million pounds) in 1983/84[1]. The fishery was closed for 10 years after the stock was declared overfished in 1999. Fishing resumed in 2009/10 with a fishery-reported retained catch of 209 tonnes (0.461 million pounds), less than half the 529.3 tonne (1.167 million pound) TAC. Following three more years of modest harvests supported by a fishery catch per unit effort (CPUE) of around 10 crab per pot lift, the fishery was again closed in 2013/14