# Assessment of the Kamchatka Flounder stock in the Bering Sea and Aleutian Islands

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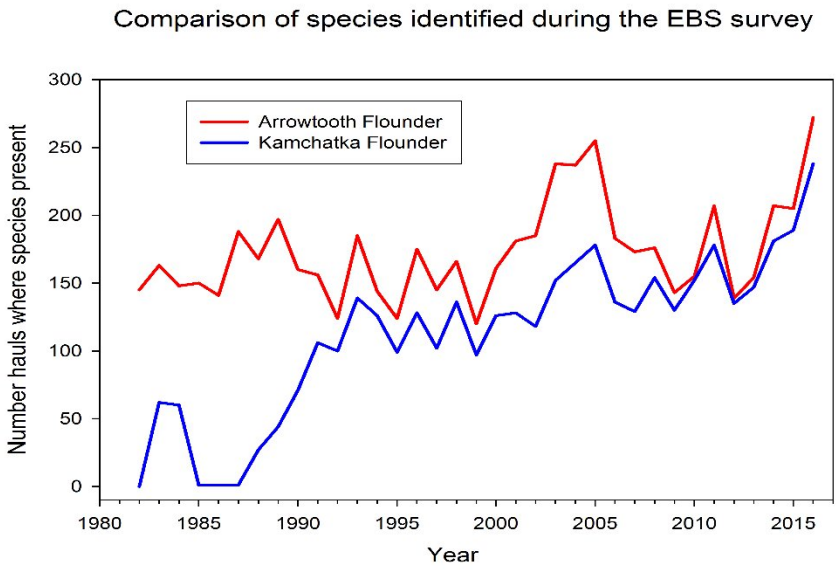
## Summary of changes to the assessment input

1) Estimate of catch for 2015 and 2016. The estimated 2016 catch of 4,530 t was used as the catch value for the 2017 and 2018 ABC and OFL projections.
2) 2016 slope survey biomass and standard error estimates.
3) 2015 and 2016 shelf survey length composition
4) 2016 and 2016 shelf survey biomass and standard error estimates.
5) 2015 Aleutian Islands survey biomass and standard error.
6) 2016 Aleutian Islands survey length composition.
7) 2016 slope survey length composition.

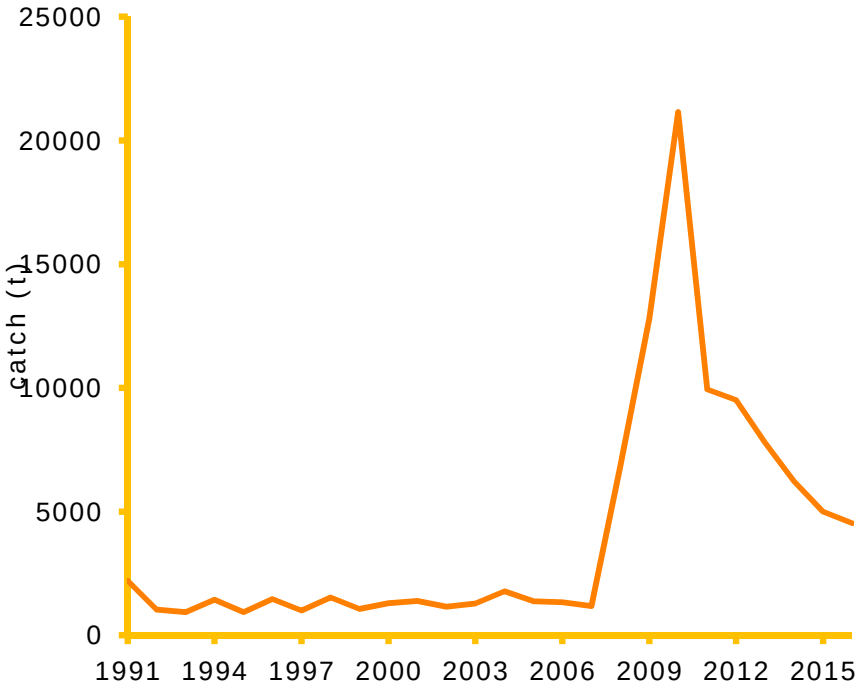
No changes were made to the assessment methodology.

| | Tier 3 assessment model | | | |
|---|---|---|---|---|
| | As estimated last year for | | As estimated this year for | |
| Quantity | 2016 | 2017 | 2017 | 2018 |
| M (natural mortality rate) | 0.11 | 0.11 | 0.11 | 0.11 |
| Tier | 3 | 3 | 3 | 3 |
| Projected total (age 2+) biomass (t) | 136,600 | 138,700 | 170,300 | 181,000 |
| Projected female spawning biomass (t) | | | | |
| Projected | 50,400 | 50,100 | 60,300 | 62,200 |
| $B_{100\%}$ | 115,200 | 115,200 | 127,000 | 127,000 |
| $B_{40\%}$ | 46,100 | 46,100 | 50,800 | 50,800 |
| $B_{35\%}$ | 40,300 | 40,300 | 44,400 | 44,400 |
| $F_{OFL}$ | 0.073 | 0.073 | 0.078 | 0.078 |
| $maxF_{ABC}$ | 0.063 | 0.063 | 0.066 | 0.066 |
| $F_{ABC}$ | 0.063 | 0.063 | 0.066 | 0.066 |
| OFL (t) | 8,270 | 8,500 | 10,360 | 10,700 |
| maxABC (t) | 7,100 | 7,300 | 8,880 | 9,200 |
| ABC (t) | 7,100 | 7,300 | 8,880 | 9,200 |
| | As determined last year for: | | As determined this year for: | |
| Status | 2014 | 2015 | 2015 | 2016 |
| Overfishing | no | n/a | no | n/a |
| Overfished | n/a | no | n/a | no |
| Approaching overfished | n/a | no | n/a | no |


Comparison of species identified during the EBS survey
Arrowtooth Flounder
Kamchatka Flounder
Number hauls where species present
300
250
200
150
100
50
0
1980
1985
1990
1995
2000
2005
2010
2015
Year

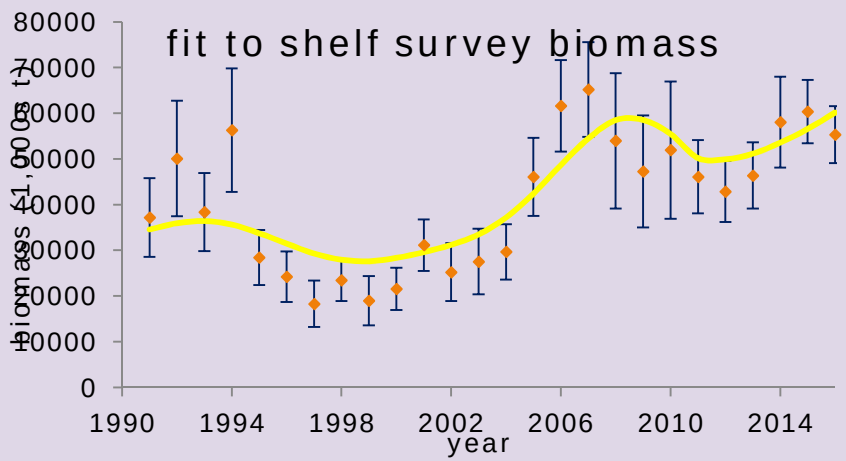
# Fishery catch

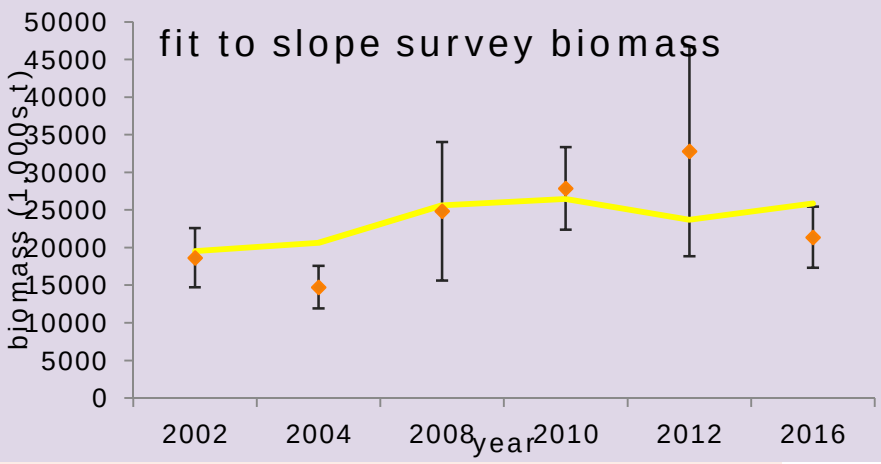
Fishery catch from 2007-2016 were included in the model from direct identification of Kamchatka flounder. Catches from 1991-2006, years when Kamchatka and arrowtooth flounder were not identified to species, were calculated by assuming that Kamchatka flounder comprised 10% of the catch during that time period.

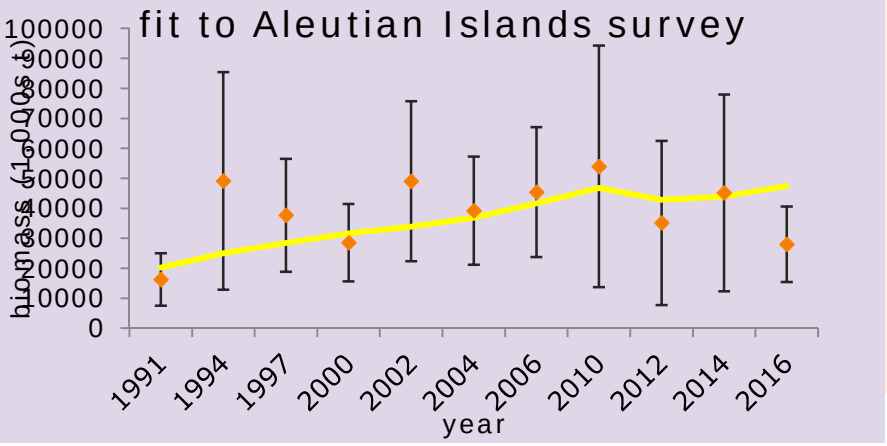


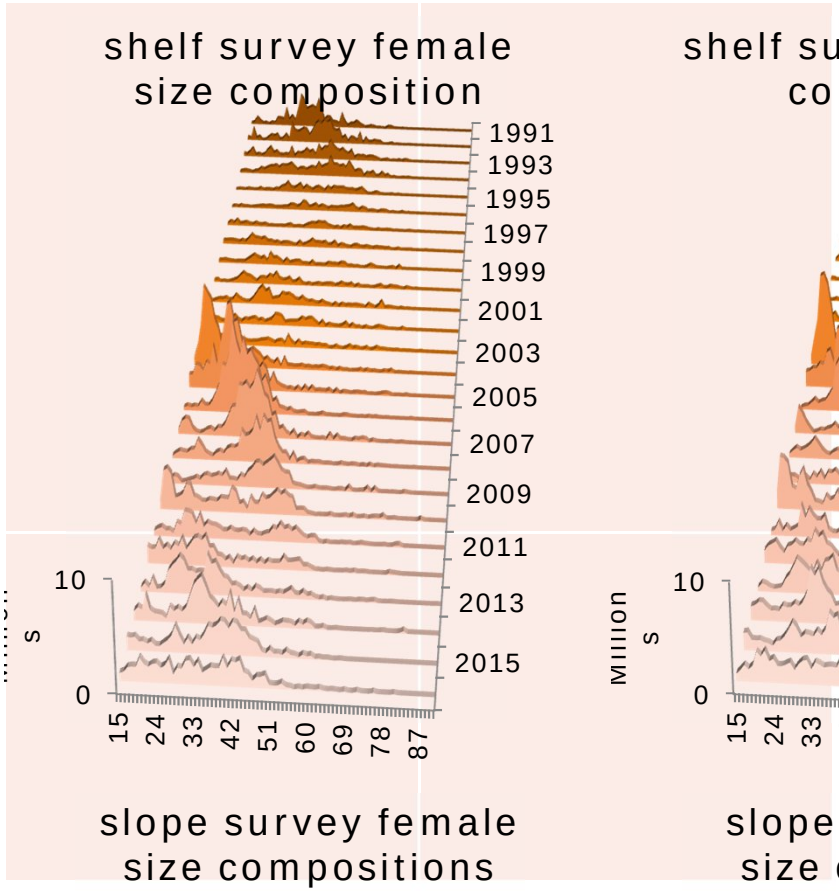

2016 catch is 48% of the ABC of 9,500 t

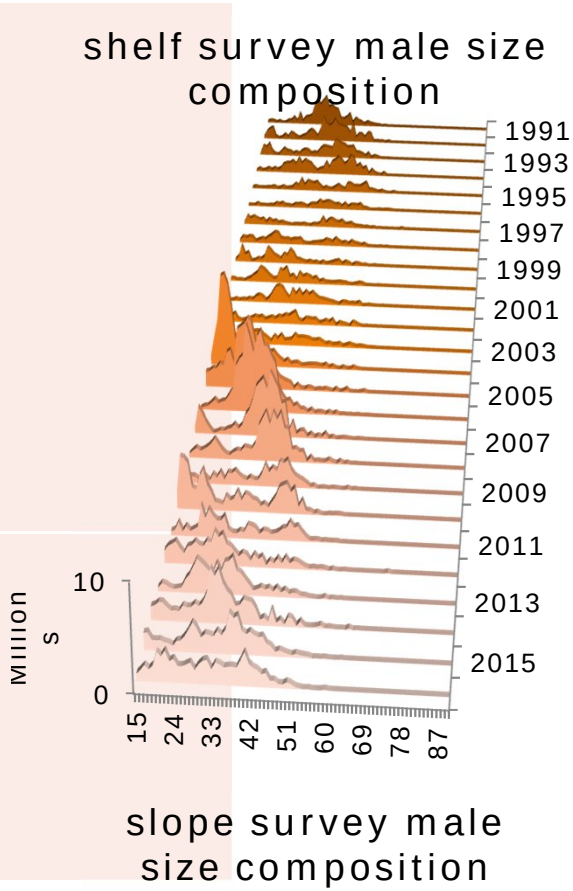
# surveys

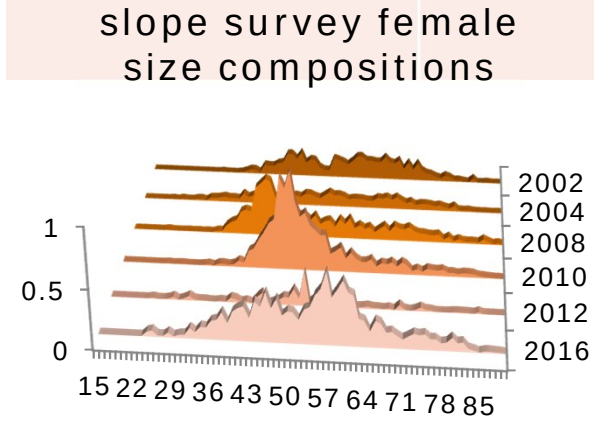

fit to shelf survey biomass
biomass (1,000s t)
80000
70000
60000
50000
40000
30000
20000
10000
0
1990
1994
1998
2002
2006
2010
2014
year

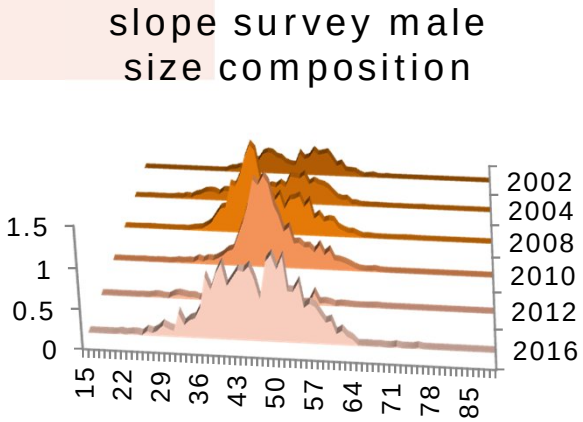

fit to slope survey biomass
biomass (1,000s t)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2002
2004
2008
2010
2012
2016
year

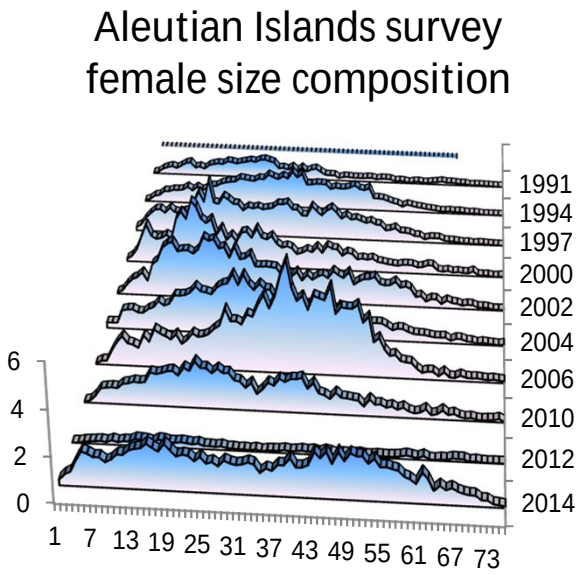

fit to Aleutian Islands survey
biomass (1,000s t)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1991
1994
1997
2000
2002
2004
2006
2010
2012
2014
2016
year

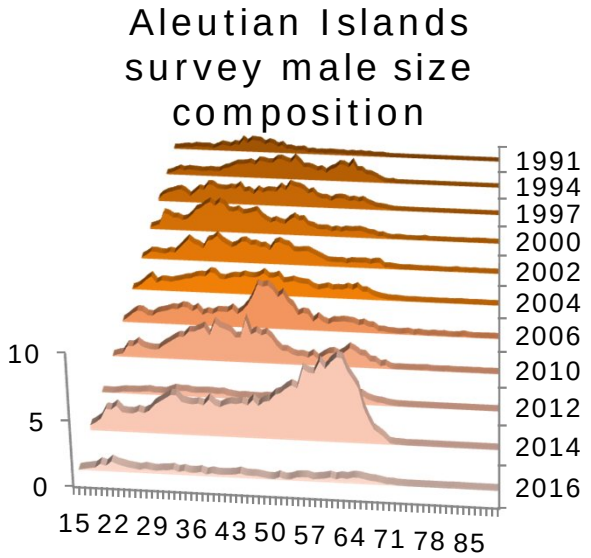

shelf survey female size composition
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
10
0
15 24 33 42 51 60 69 78 87

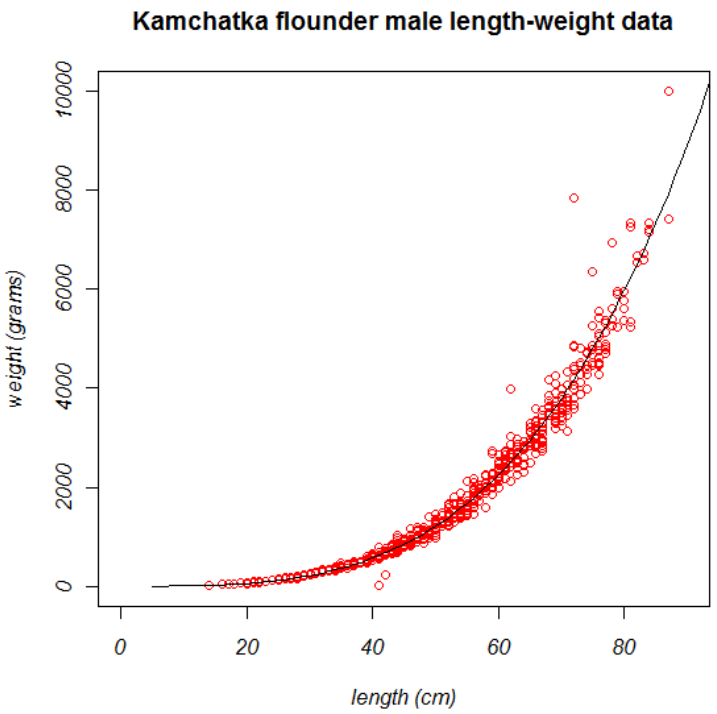

shelf survey male size composition
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
10
0
15 24 33 42 51 60 69 78 87

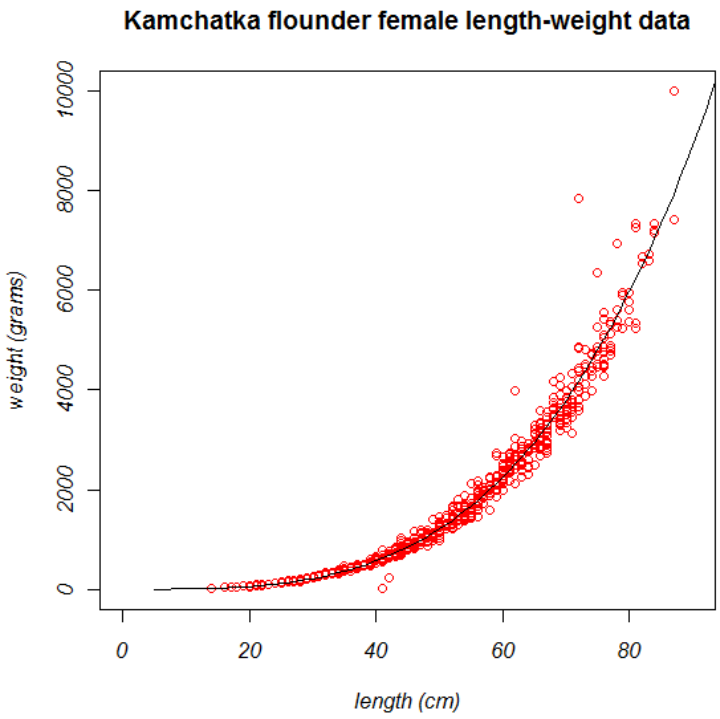

slope survey female size compositions
2002
2004
2008
2010
2012
2016
1
0.5
0
15 22 29 36 43 50 57 64 71 78 85

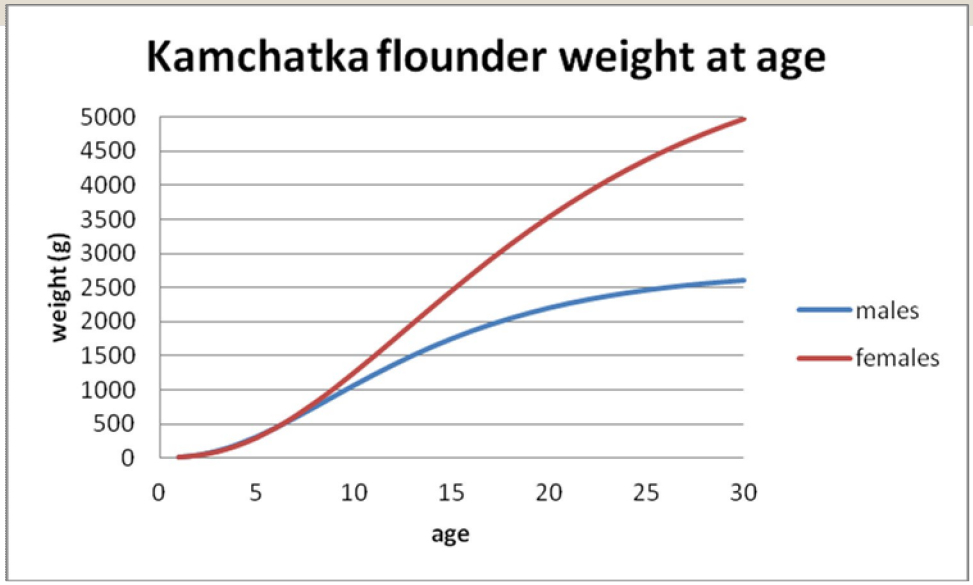

slope survey male size composition
2002
2004
2008
2010
2012
2016
1.5
1
0.5
0
15 22 29 36 43 50 57 64 71 78 85

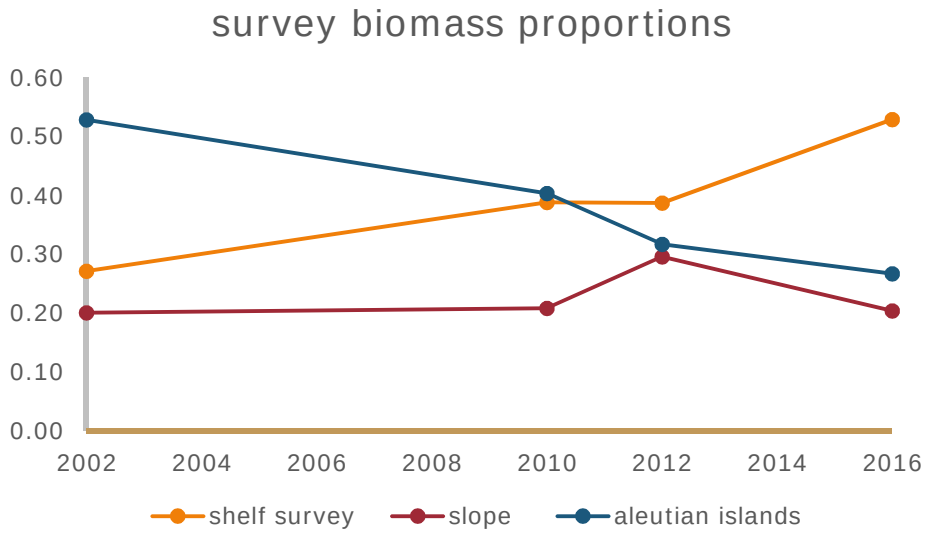

Aleutian Islands survey female size composition
1991
1994
1997
2000
2002
2004
2006
2010
2012
2014
6
4
2
0
1 7 13 19 25 31 37 43 49 55 61 67 73


Aleutian Islands survey male size composition
1991
1994
1997
2000
2002
2004
2006
2010
2012
2014
2016
10
5
0
15 22 29 36 43 50 57 64 71 78 85

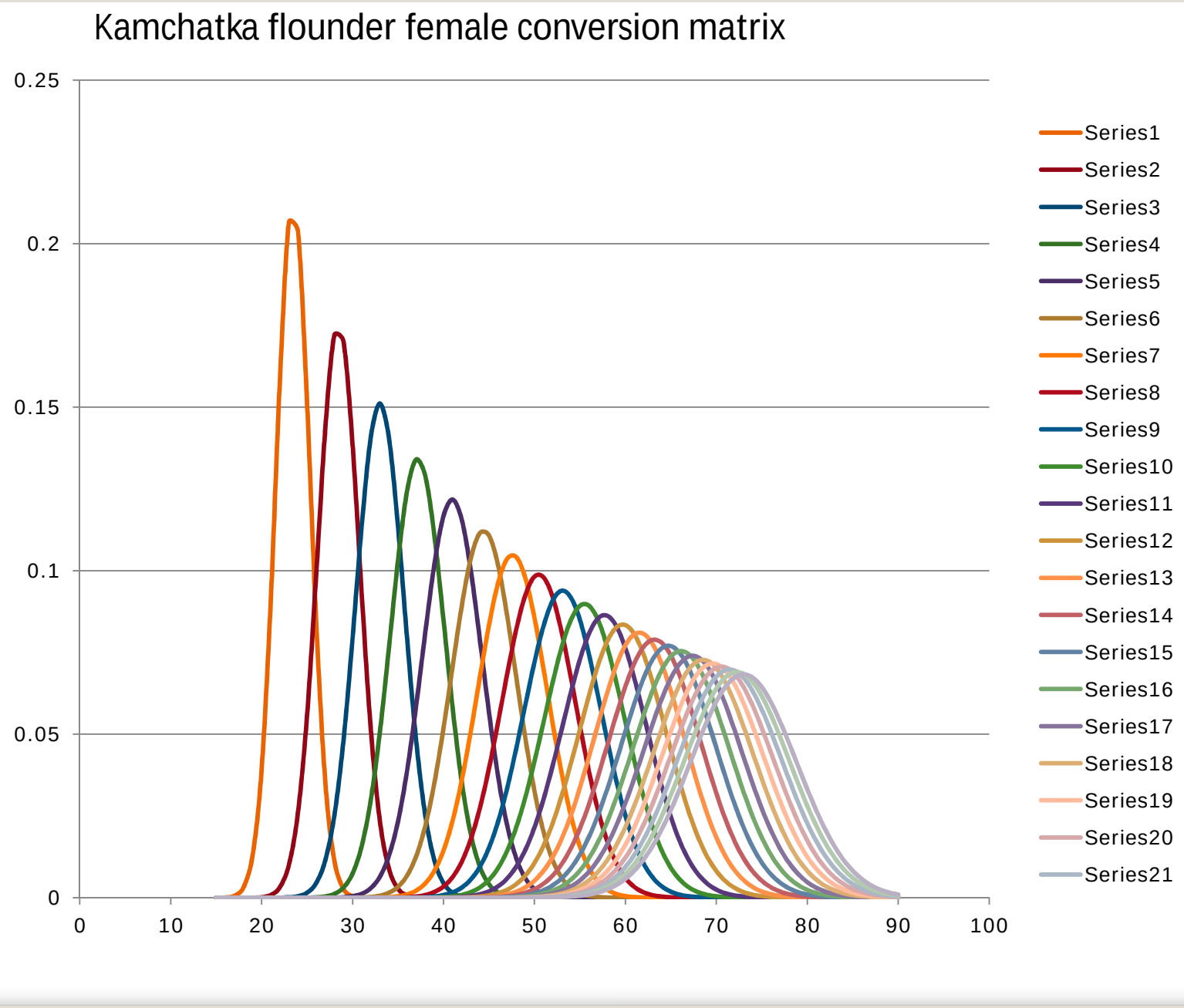

Kamchatka flounder male length-weight data
weight (grams)
0
2000
4000
6000
8000
10000
0
20
40
60
80
length (cm)


Kamchatka flounder female length-weight data
weight (grams)
0
2000
4000
6000
8000
10000
0
20
40
60
80
length (cm)




22 year average = 37% shelf, 20% slope and 42% in the Aleutian Islands


Kamchatka flounder female conversion matrix
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
70
80
90
100
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10
Series11
Series12
Series13
Series14
Series15
Series16
Series17
Series18
Series19
Series20
Series21

The suite of parameters estimated by the base model are classified by the following likelihood components:

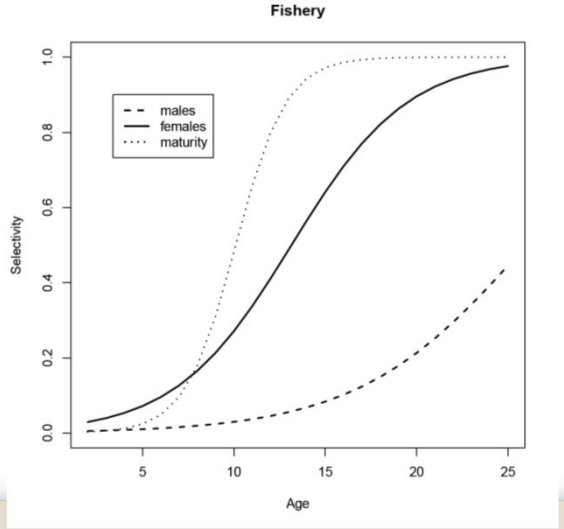
| Data Component | Distribution assumption |
|---|---|
| Trawl fishery size composition | Multinomial |
| Shelf survey population size composition | Multinomial |
| Slope survey population size composition | Multinomial |
| Slope survey age composition (2002 and 2012) | Multinomial |
| Aleutian Islands survey size composition | Multinomial |
| Aleutian Islands age composition (2010) | Multinomial |
| Trawl survey biomass estimates and S.E. | Log normal |
| Slope survey biomass estimates and S.E. | Log normal |
| Aleutian Islands biomass estimates and S.E. | Log normal |

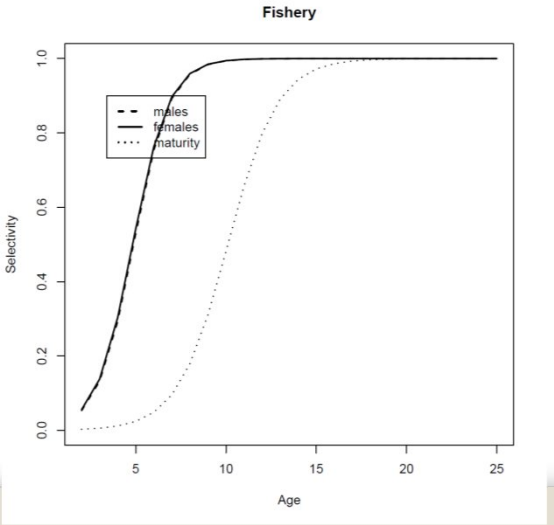
Parameters estimated:

| Fishing mortality | Selectivity | Aleutian Island and shelf survey-q | Year class strength | Total |
|---|---|---|---|---|
| 27 | 16 | 2 | 50 | 95 |

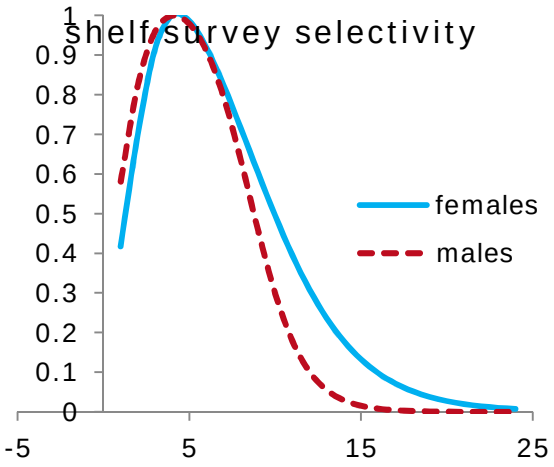
Started with q's (catchability) apportioned by their relative survey biomass estimates for the three survey areas.

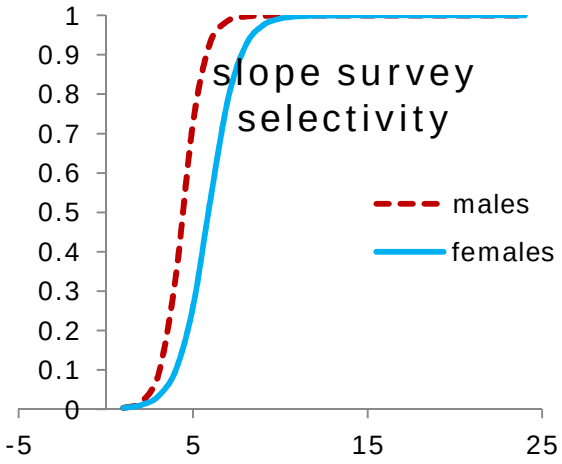
Examination of the results from the initial model run indicated that fishery selectivity is poorly determined (presumably due to the low sample sizes) and that there are males present in the length records that are larger than those observed in any survey data. It is suspected that this is the result of some mis-sexing of Kamchatka flounder in the commercial fishery sampling. This was resolved by fixing the slope of the logistic curve (age at 50% selection is still estimated for each sex) which produced more sensible results and estimated reference F values similar to other Bering Sea flatfish species.

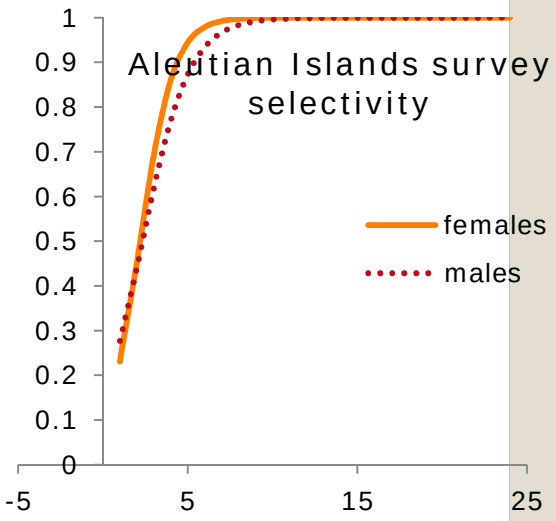


Based on selectivity patterns, the shelf survey showed big differences in the ages of fish available to these different surveys. The slope survey selectivity estimates seemed most stable hence: Alternative values of q were fixed for the slope survey and freely estimated the q values for the shelf and Aleutian Islands surveys.

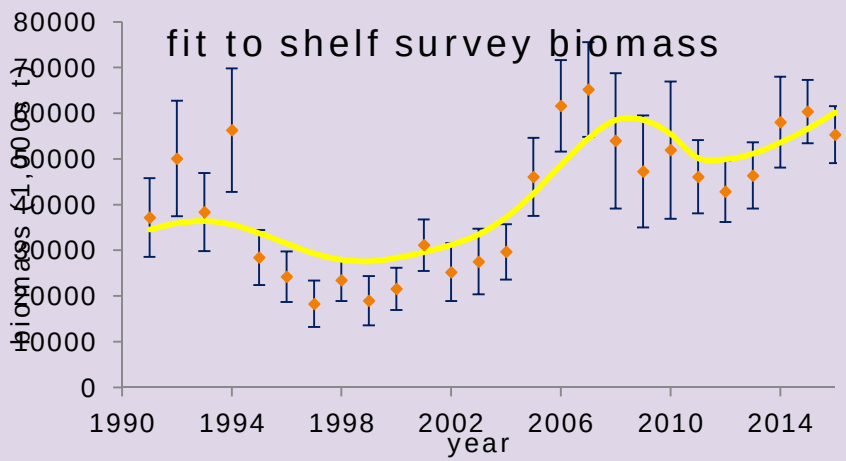


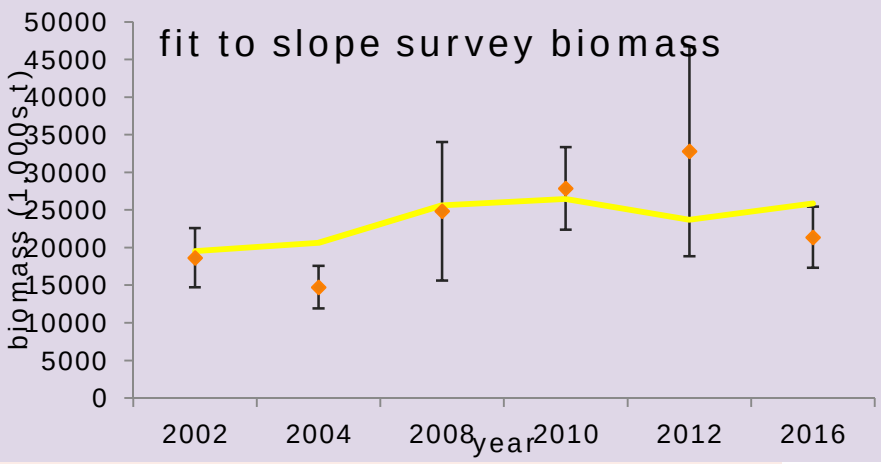



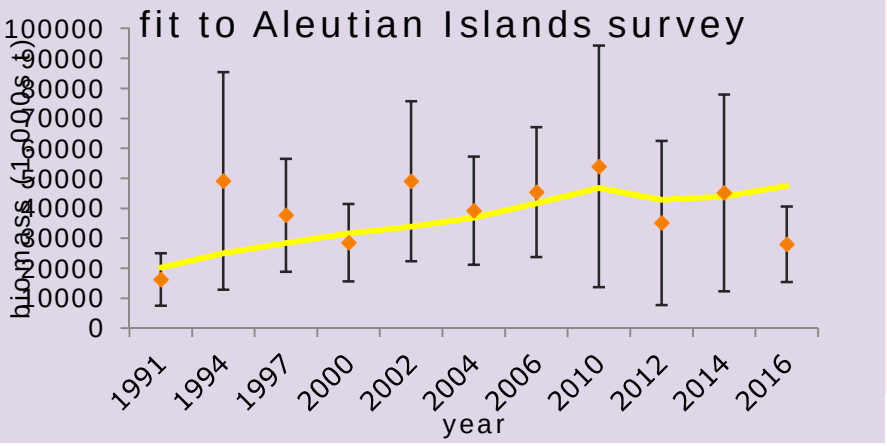




M is confounded with q and was discerned through profiling to have a value around 0.11. With the model configured in this way (slope survey q=0.18, M = 0.13 and fishery selectivity logistic slope fixed) the model was run to estimate the status and the population dynamics of the Kamchatka flounder stock over the period 1991-2014.

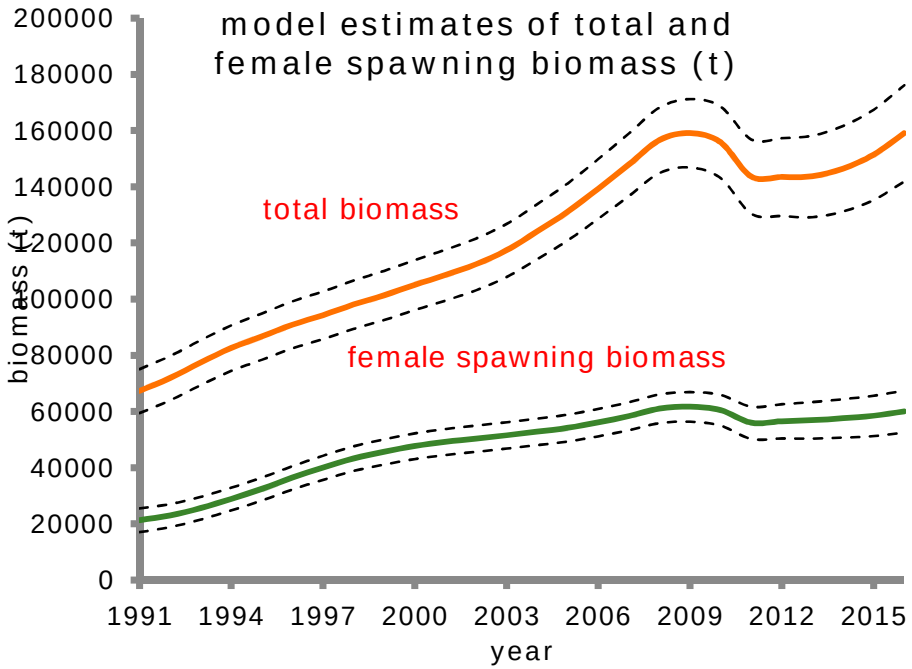
# surveys

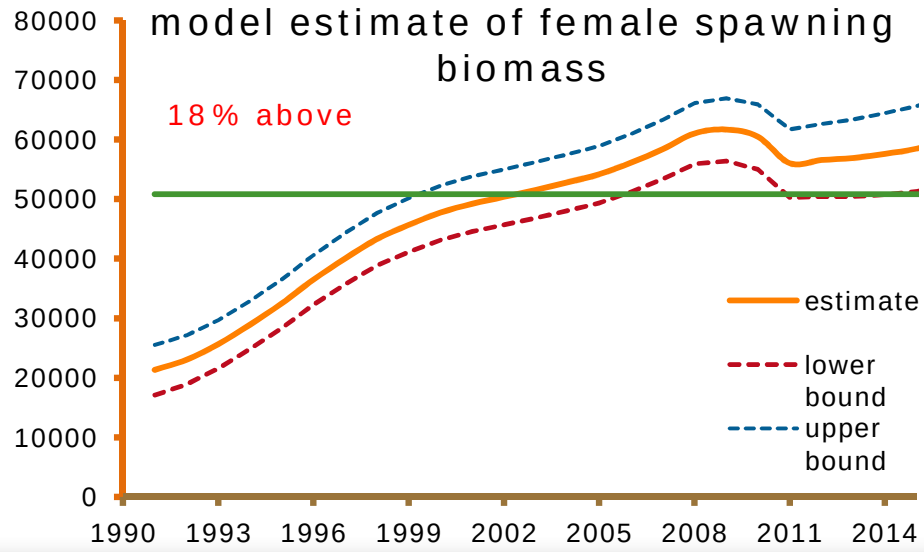

fit to shelf survey biomass
biomass (1,000s t)
80000
70000
60000
50000
40000
30000
20000
10000
0
1990
1994
1998
2002
2006
2010
2014
year


fit to slope survey biomass
biomass (1,000s t)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2002
2004
2008
2010
2012
2016
year


fit to Aleutian Islands survey
biomass (1,000s t)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1991
1994
1997
2000
2002
2004
2006
2010
2012
2014
2016
year

# Model Results



# Model results

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