NORTHERN ROCK SOLE

BY

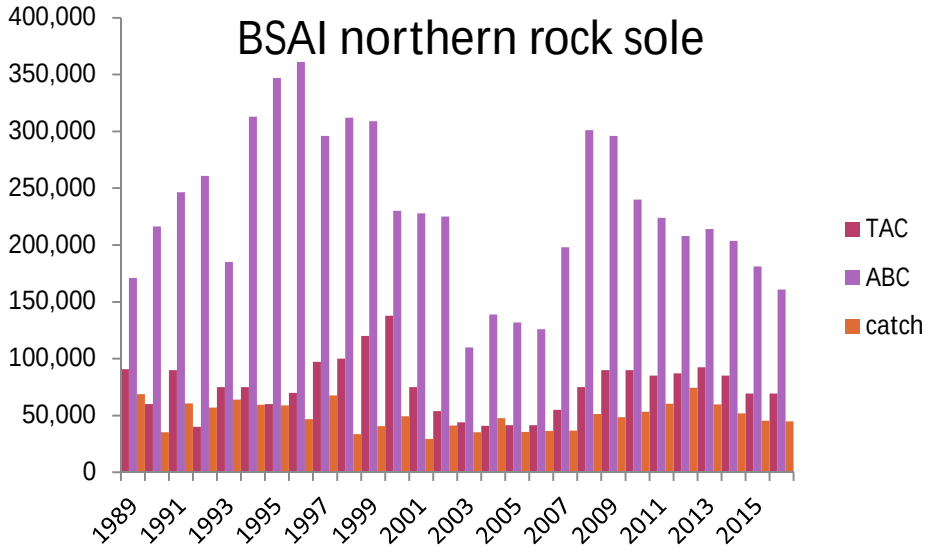
WILDERBUER, NICHOL AND IANELLI

CHANGES IN THE ASSESSMENT BETWEEN 2015 AND 2016

The assessment model was run to include the new 2016 survey biomass and 2015 age composition information from the survey and fishery.

No new changes in the methodology are presented.

Survey biomass increased 4% increased from 2015

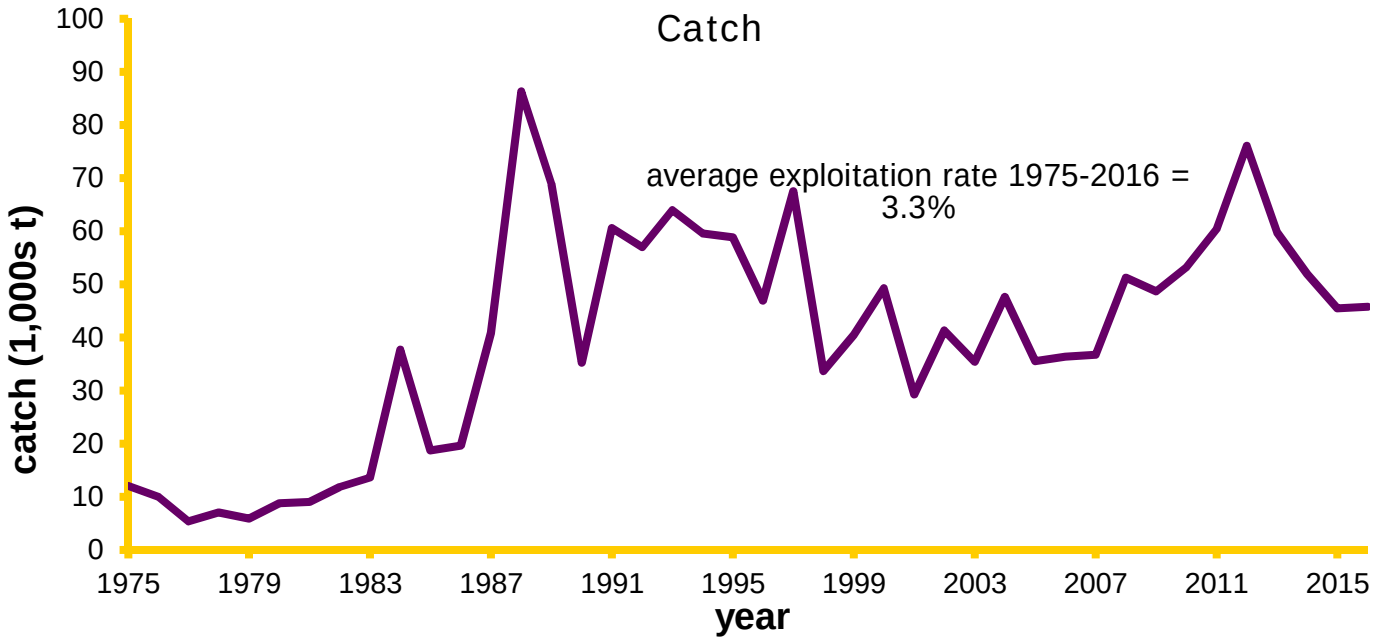

BSAI northern rock sole
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
TAC
ABC
catch

SUMMARY

Model 1_2016

Quantity	As estimated or specified last year for:		As estimated or recommended this year for:	
	2016	2017	2017	2018
M (natural mortality rate)	0.15	0.15	0.15	0.15
Tier	1a	1a	1a	1a
Projected total (age 6+) biomass (t)	1,085,200	977,200	1,000,600	923,200
Female spawning biomass (t)	584,400	522,600	539,500	472,200
Projected				
B_0	682,800		918,500	
B_{MSY}	257,000	257,000	257,000	257,000
F_{OFL}	0.152	0.152	0.160	0.160
$maxF_{ABC}$	0.148	0.148	0.155	0.155
F_{ABC}	0.148	0.148	0.155	0.155
OFL (t)	165,900	149,400	159,700	147,300
maxABC (t)	161,000	145,000	155,100	143,100
ABC (t)	161,000	145,000	155,100	143,100
Status	As determined last year for:		As determined this year for:	
	2014	2015	2015	2016
Overfishing	No	No	No	No
Overfished	No	No	No	No
Approaching overfished	No	No	No	No

2016 CATCH = 44,873 T (THROUGH 11/8/15)
AVERAGE 1975-2016 EXPLOITATION RATE = 3.3%



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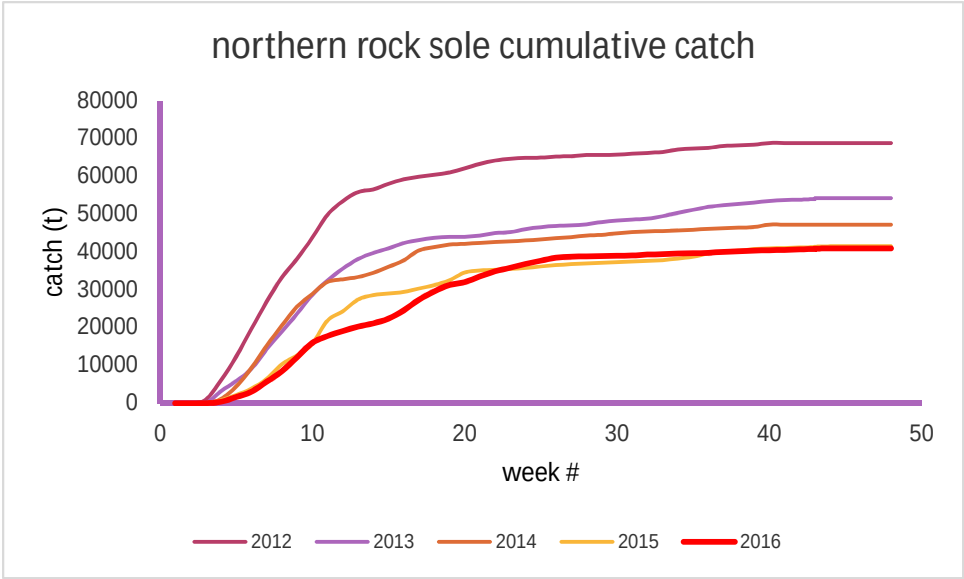
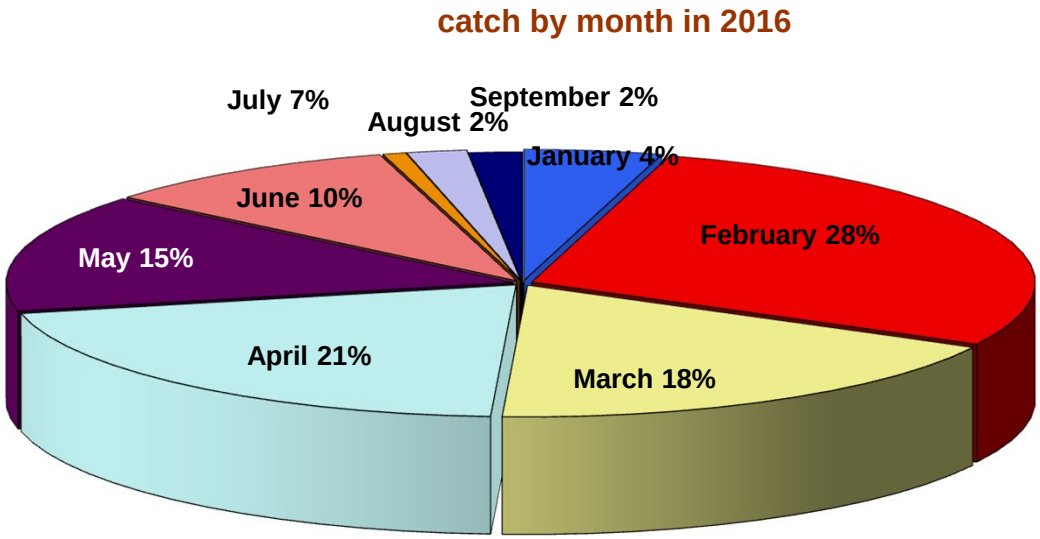


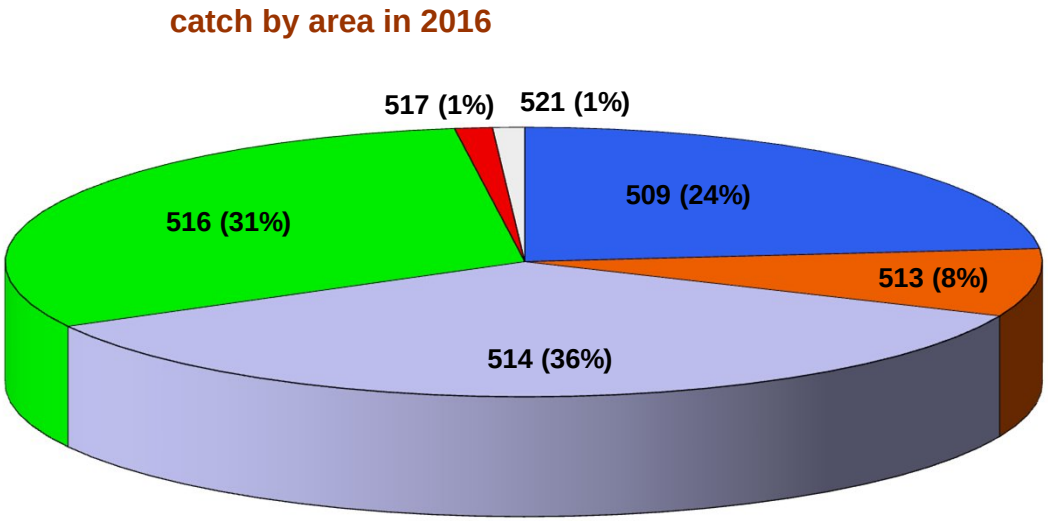
NORTHERN ROCK SOLE

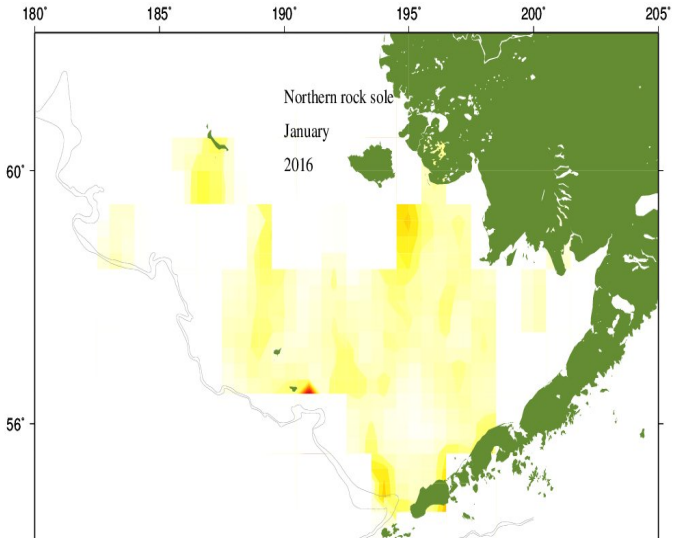
CATCH BY MONTH IN 2015

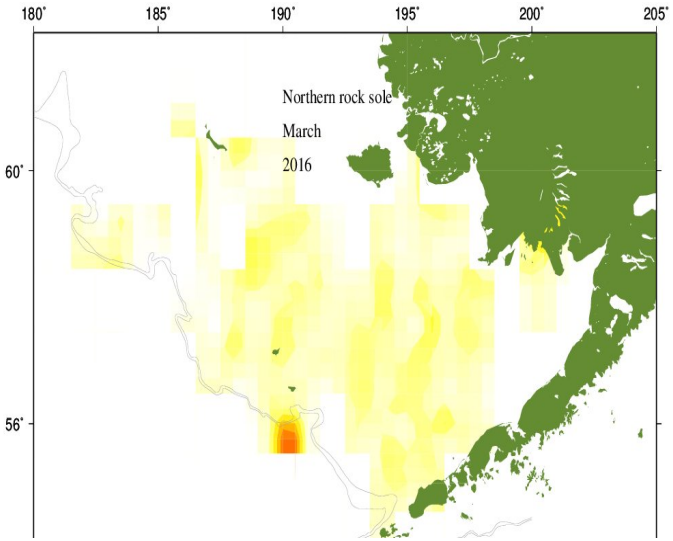


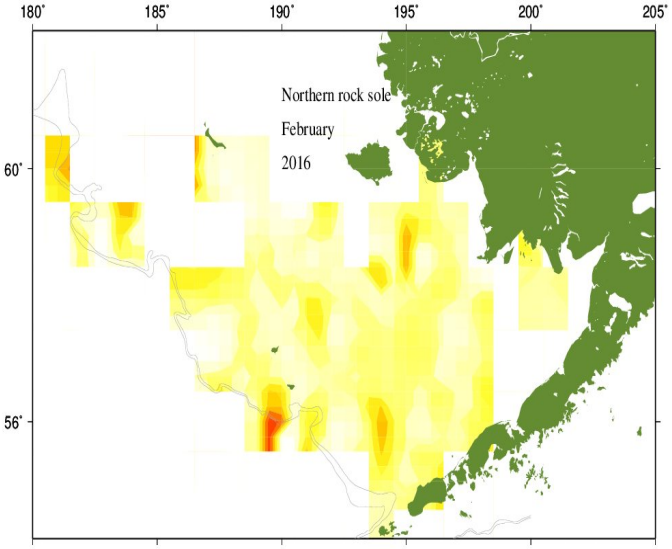
NORTHERN ROCK SOLE

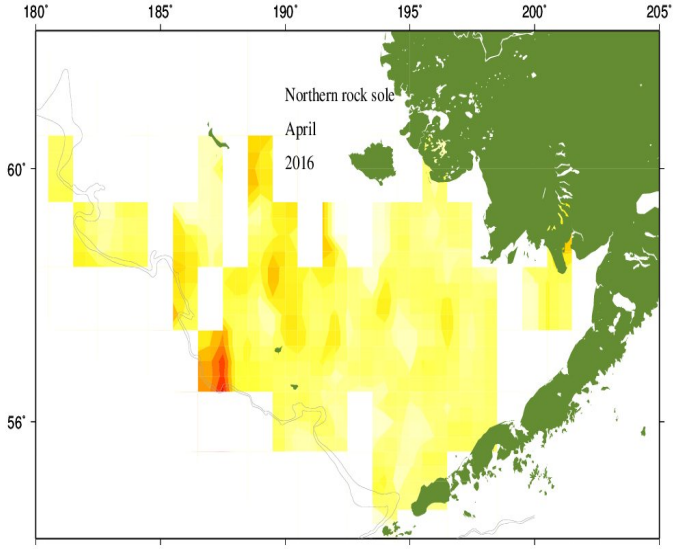
CATCH BY AREA IN 2015

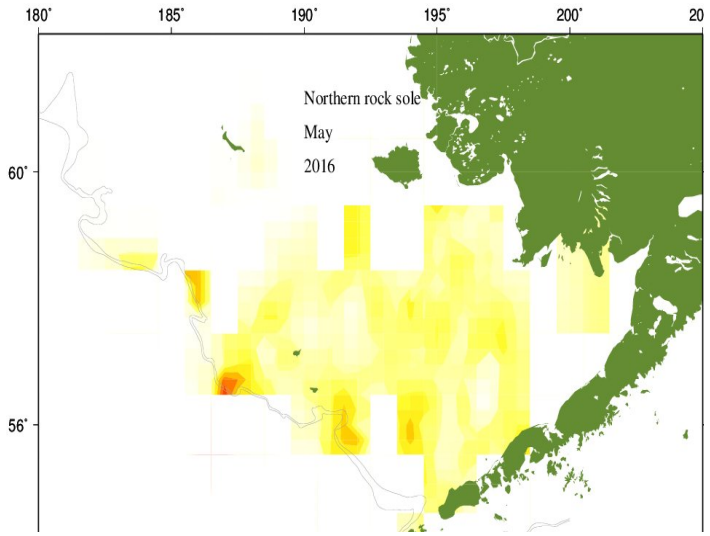


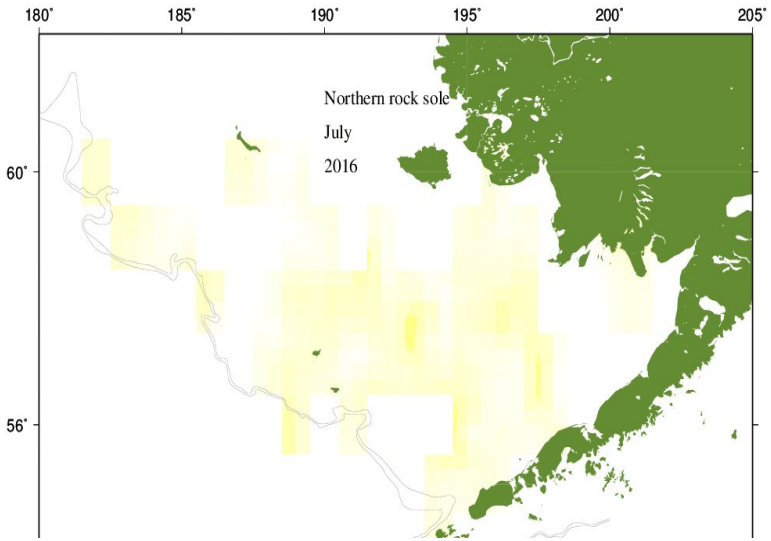

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
January
2016

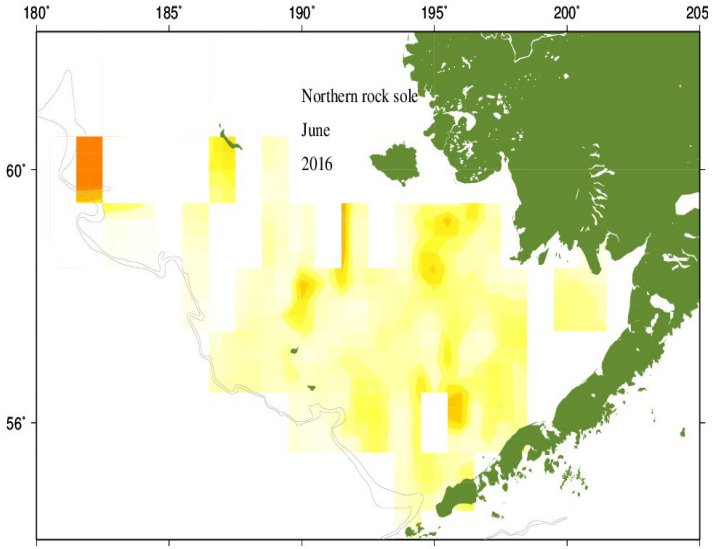

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
March
2016

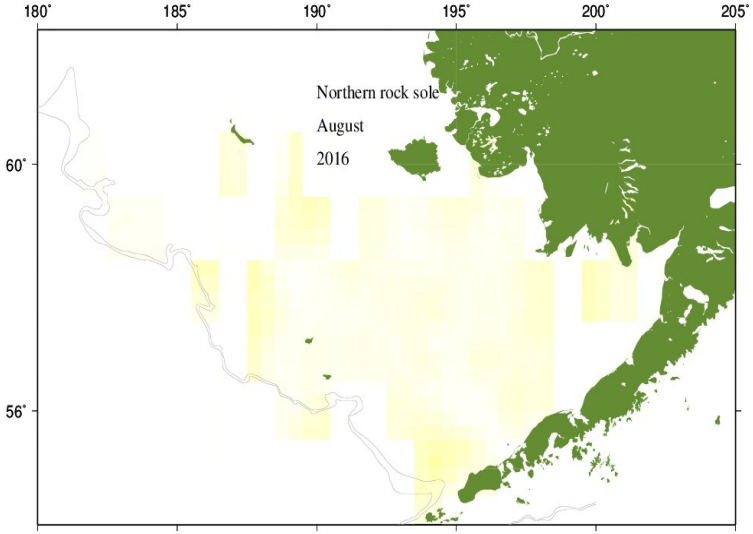

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
February
2016

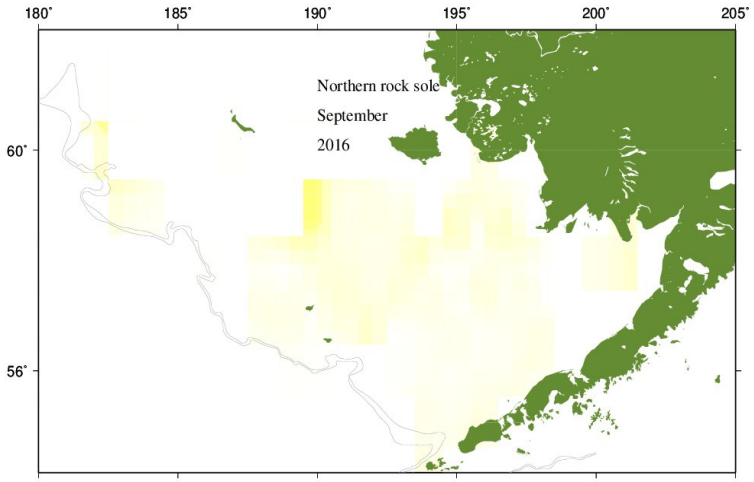

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
April
2016


180°
185°
190°
195°
200°
60°
56°
Northern rock sole
May
2016

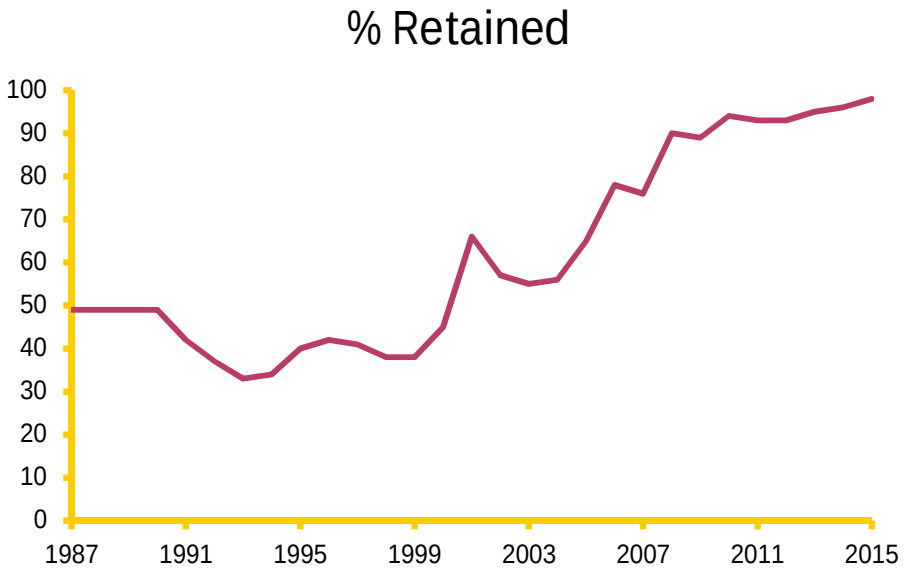

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
July
2016


180°
185°
190°
195°
200°
205
60°
56°
Northern rock sole
June
2016

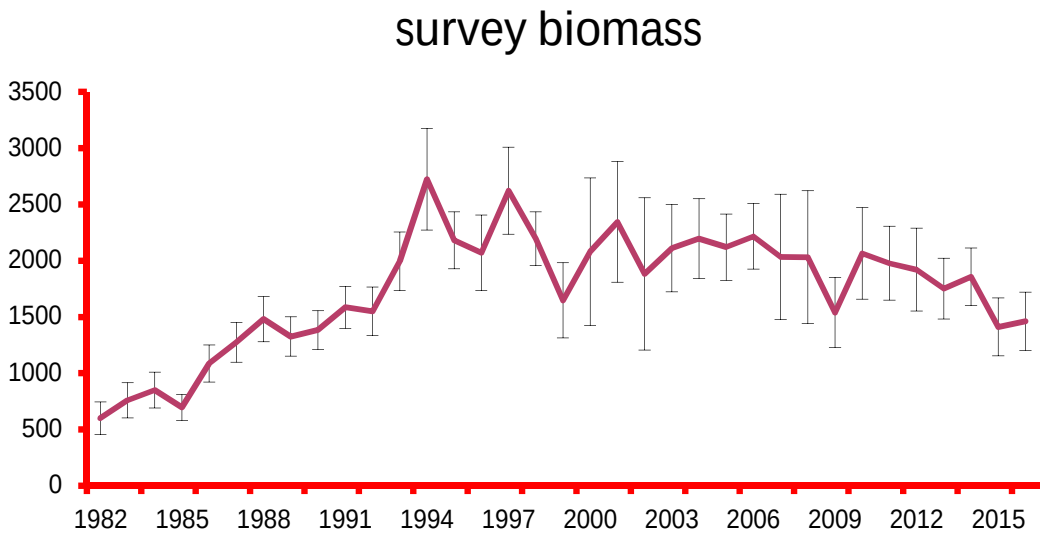

180°
185°
190°
195°
200°
205°
60°
56°
Northern rock sole
August
2016


180˚
185˚
190˚
195˚
200˚
205˚
60˚
56˚
Northern rock sole
September
2016

98% RETAINED IN 2015

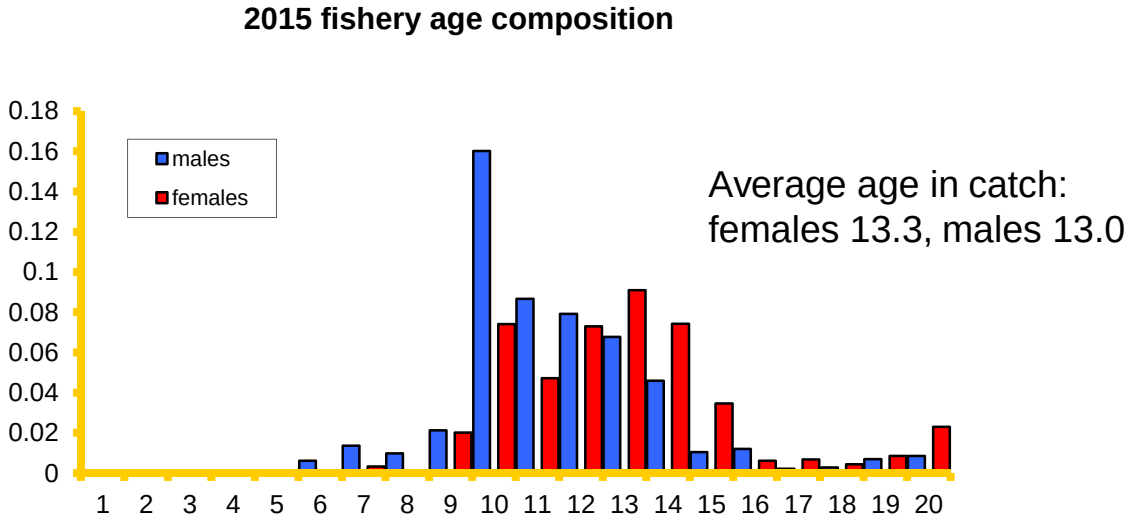


SURVEY BIOMASS:
4% INCREASE FROM 2015 TO 2016

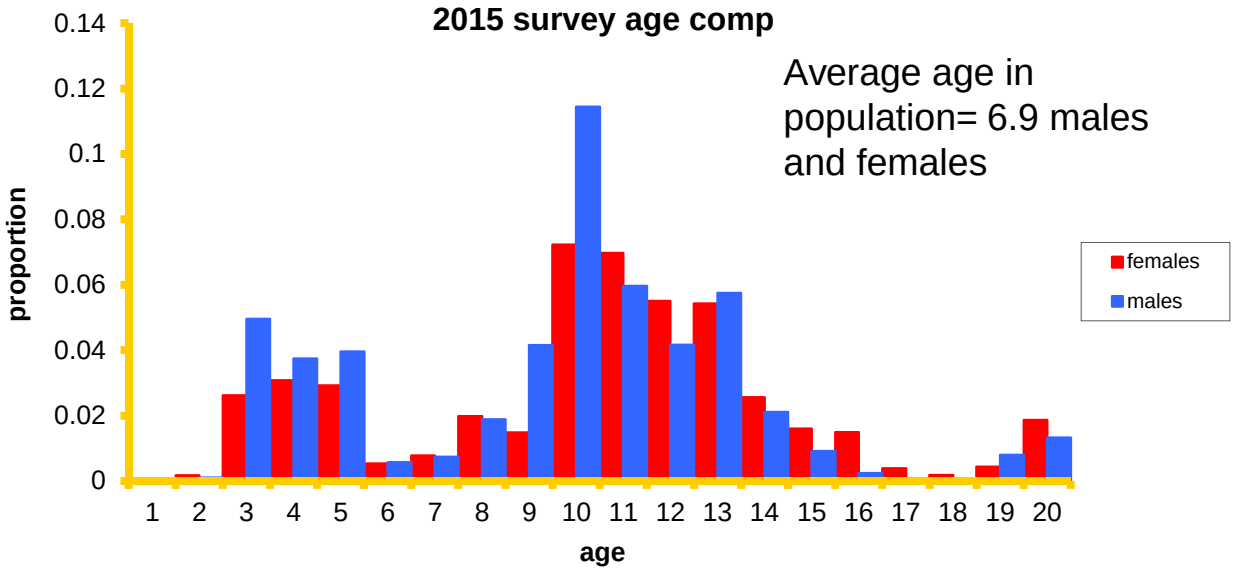


2015 was lowest survey biomass estimate since 1990

2015 AGE COMPOSITIONS

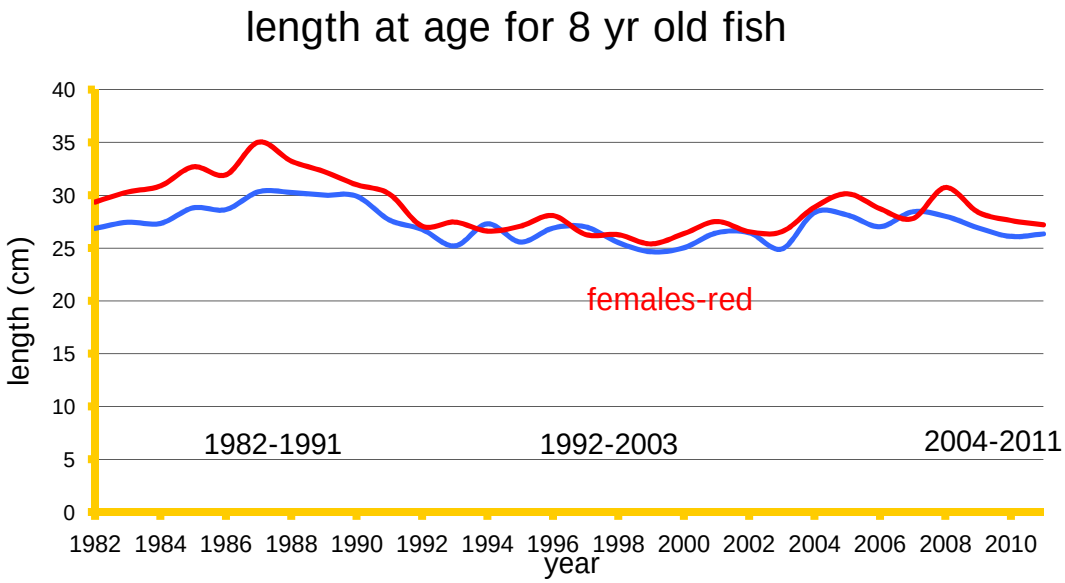


Average age in catch: females 13.3, males 13.0

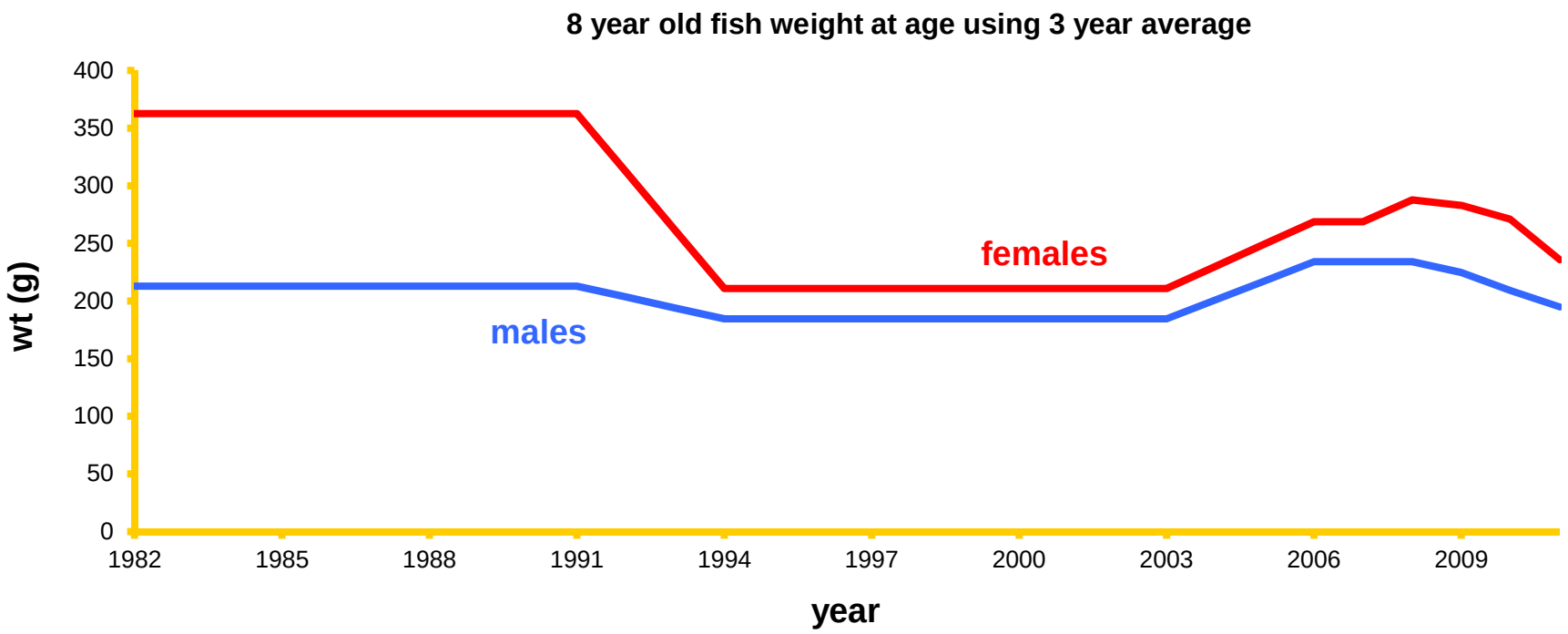


Average age in population= 6.9 males and females

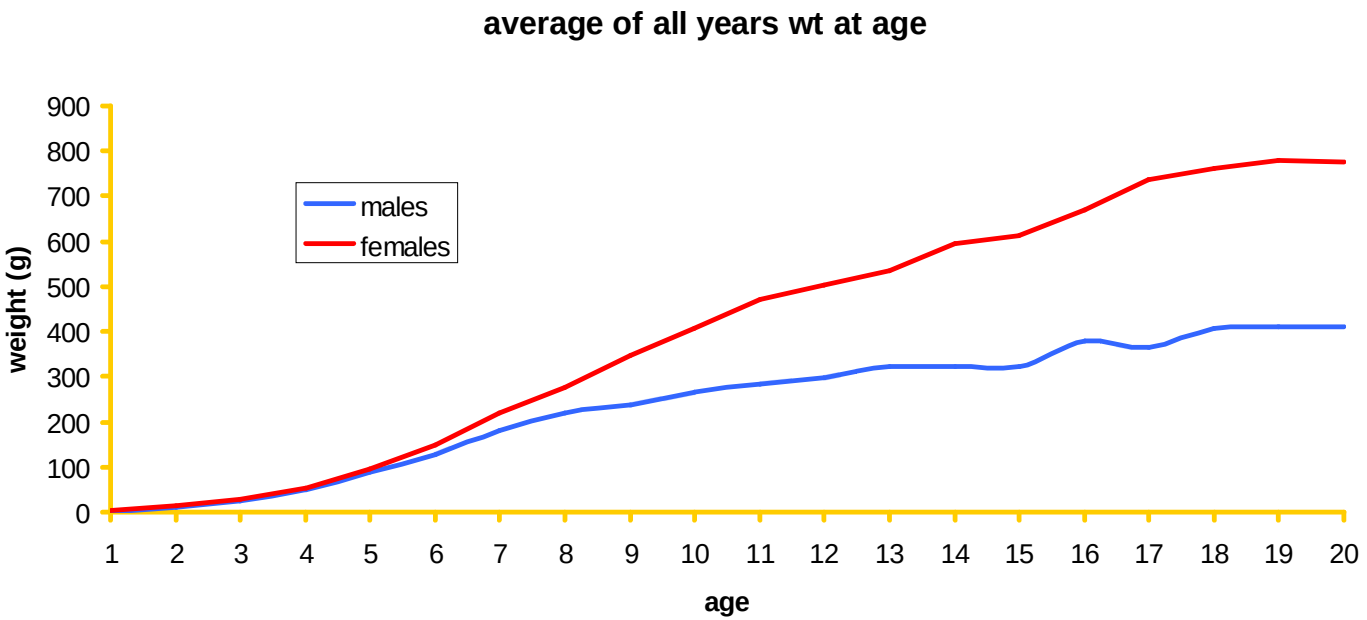
LENGTH AT AGE FROM SURVEY AGE COMPOSITIONS



WEIGHT AT AGE FROM SURVEY AGE COMPOSITIONS USING A THREE YEAR MOVING AVERAGE



WEIGHT AT AGE FROM SURVEY AGE COMPOSITIONS



FLATFISH SPLIT-SEX MODEL

input:

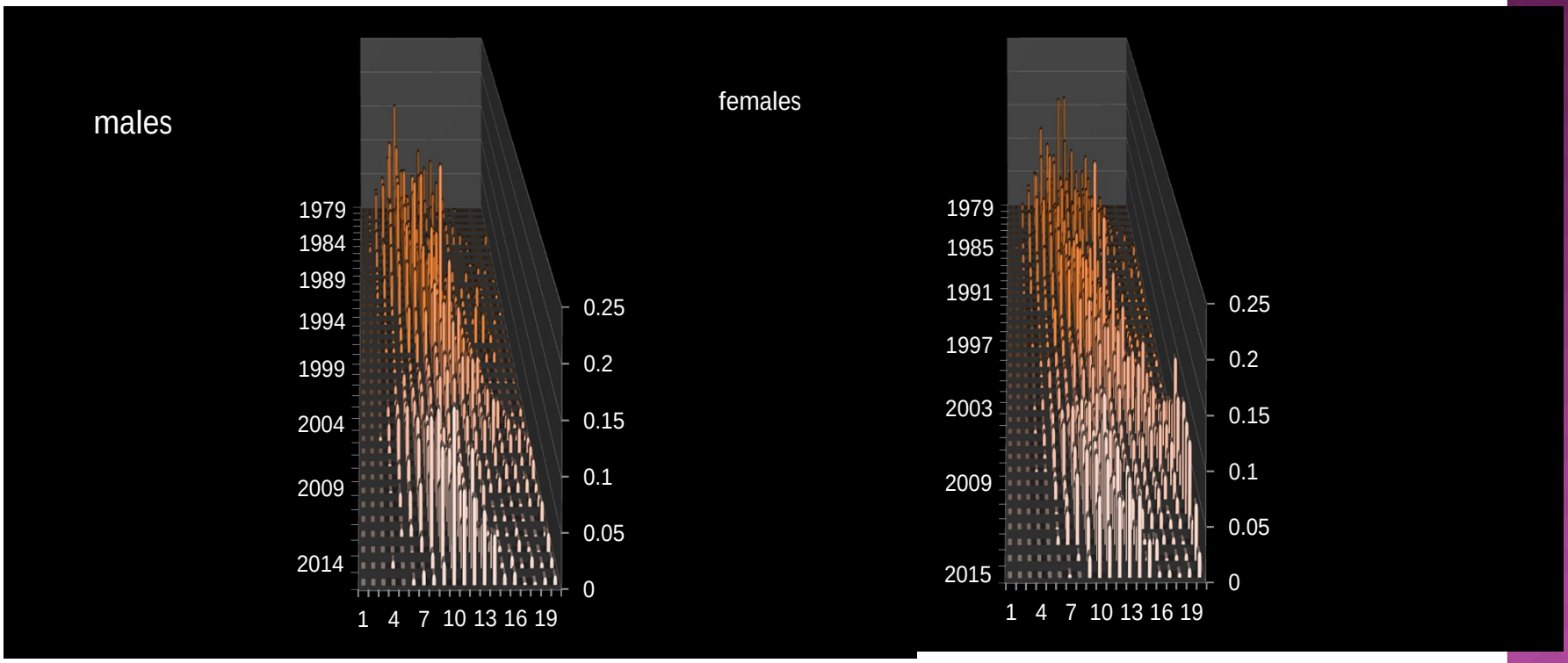
sex-specific estimates of fishery and survey age composition and weight at age

output:

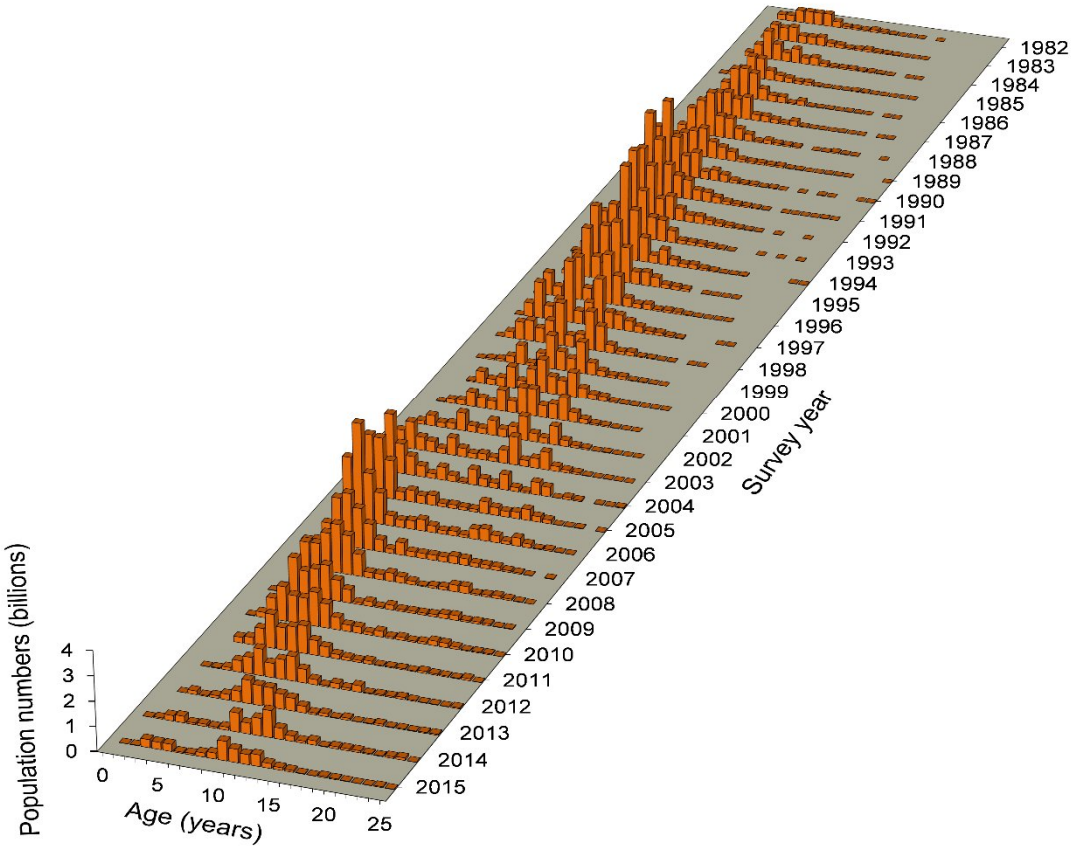
Sex-specific estimates of population number, fishing mortality, selectivity, fishery and survey age composition.

Allows for estimation of sex-specific natural mortality

FISHERY AGE COMPOSITION

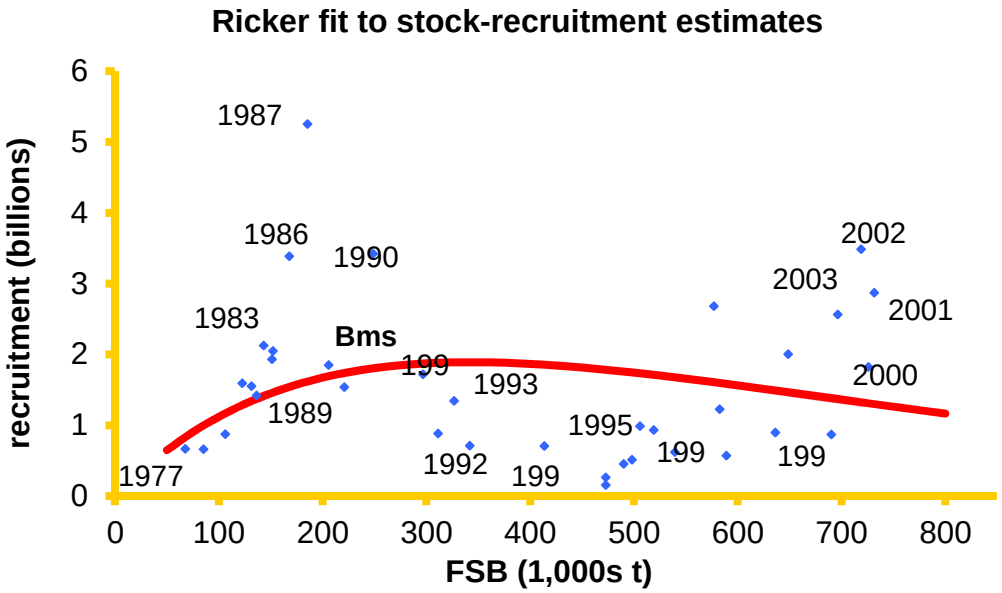


Survey age composition



STOCK ASSESSMENT MODEL

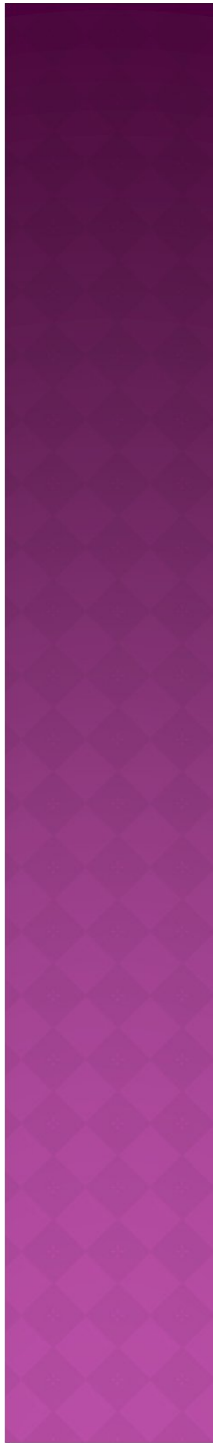
- Data components include fishery and trawl survey age compositions and survey biomass and standard error
- Split-sex model, selectivity is fixed asymptotic for older fish
- Ricker form of the stock-recruitment curve is fit inside the model
- Gender-specific time-variant fishery selectivity
- Catchability (q) is constrained to a value near the estimate of q from a trawl herding experiment using the shelf survey trawl (Somerton and Munro 2001)
- Natural mortality is estimated as free parameters in some model runs and fixed at 0.15 in other runs



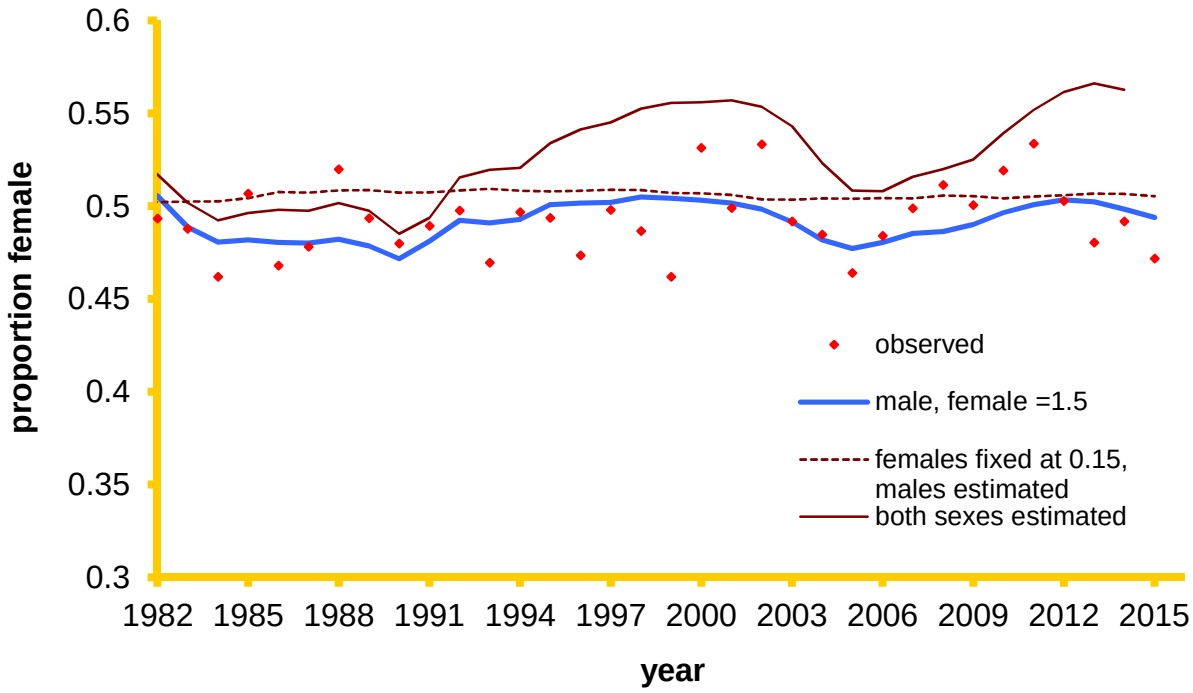
Data fit: 1978-2010

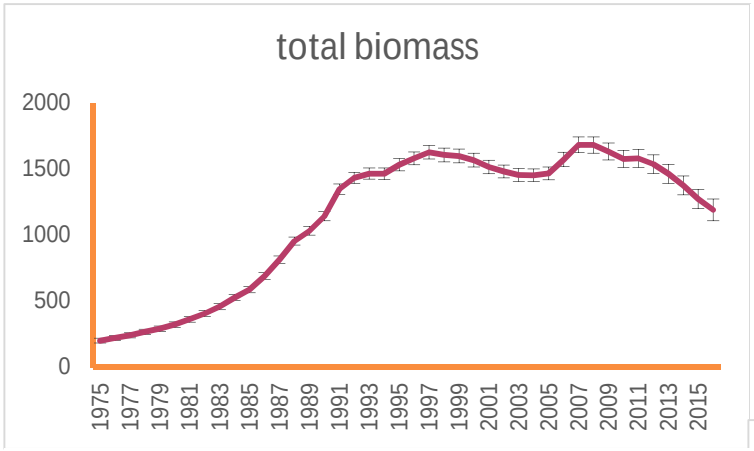
Bmsy=257,000 t

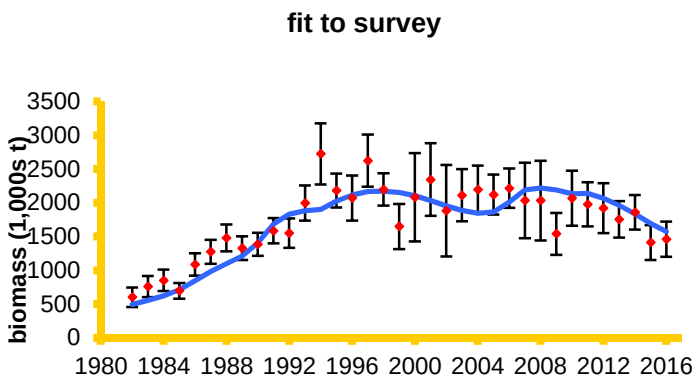
Model exploration	Q	female M	male M	2017 FSB	2017 ABC	F_{ABC}
Model 15.1 q fixed at 1.5, male and female M fixed at 0.15	1.5	0.15	0.15	539,500	155,100	0.155
Model 16.2 q fixed at 1.5, female M fixed at 0.15 and male M estimated	1.5	0.15	0.18	594,500	153,000	0.159
Model 16.3 q fixed at 1.5, female M and male M estimated	1.5	0.164	0.192	542,900	141,000	0.157
Model 16.4 q estimated, Female and male M fixed at 0.15	2.22	0.15	0.15	320,300	101,200	0.168
Model 16.5 q estimated, female M fixed at 0.15 and male M estimated	1.98	0.15	0.177	409,500	112,700	0.166
Model 16.6 q, female M and male M all estimated as free parameters	2.17	0.140	0.17	378,800	106,400	0.17
Model 16.7 q fixed at 1.5 but allowed to vary annually with bottom temperature relationship, male and female M fixed at 0.15	1.5	0.15	0.15	540,000	155,300	0.155

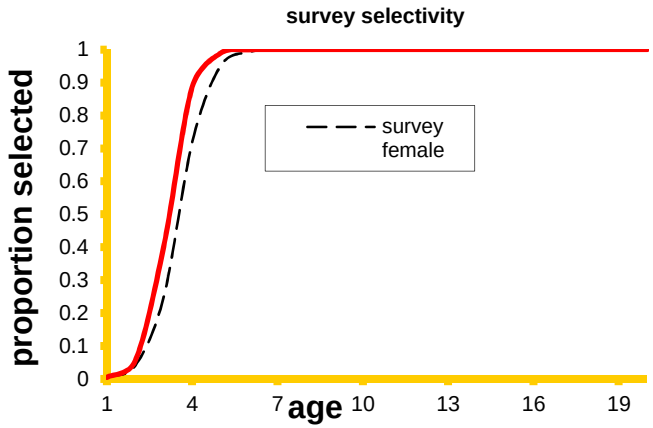


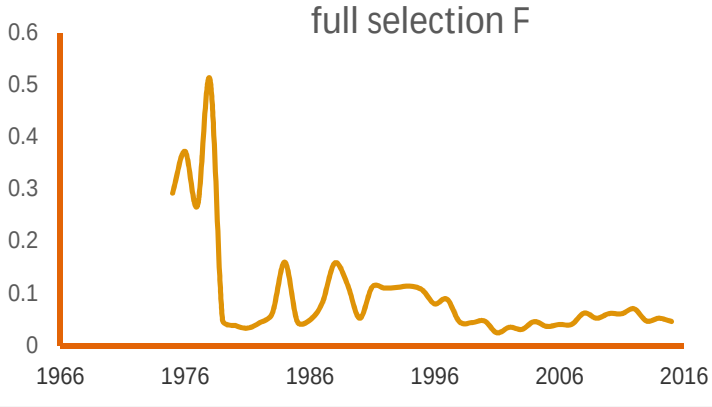
FITS TO SURVEY SEX RATIO FROM MODELS 1, 2 AND 3.

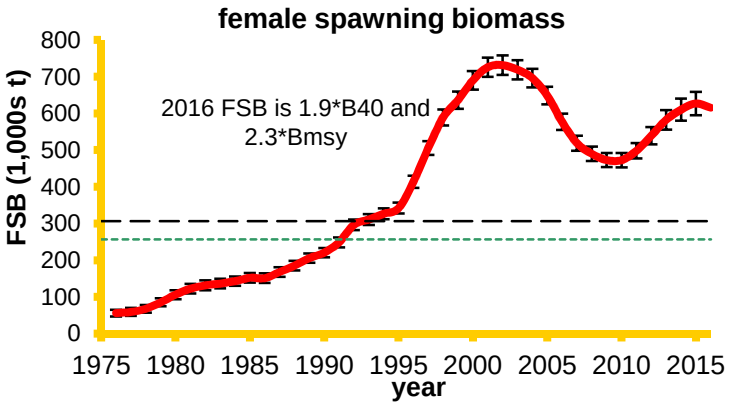


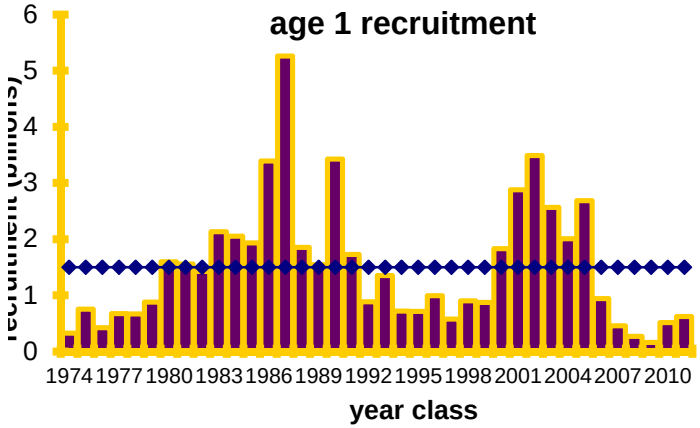

total biomass
2000
1500
1000
500
0
1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015


fit to survey
biomass (1,000s t)
3500
3000
2500
2000
1500
1000
500
0
1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

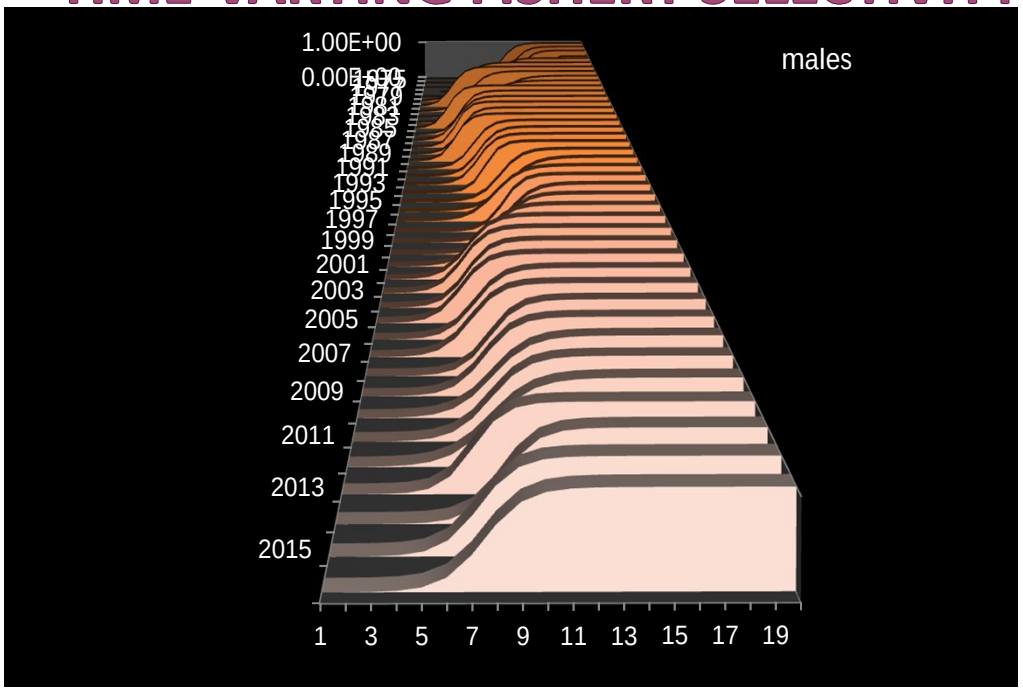

survey selectivity
proportion selected
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
survey
female
1 4 7 10 13 16 19
age

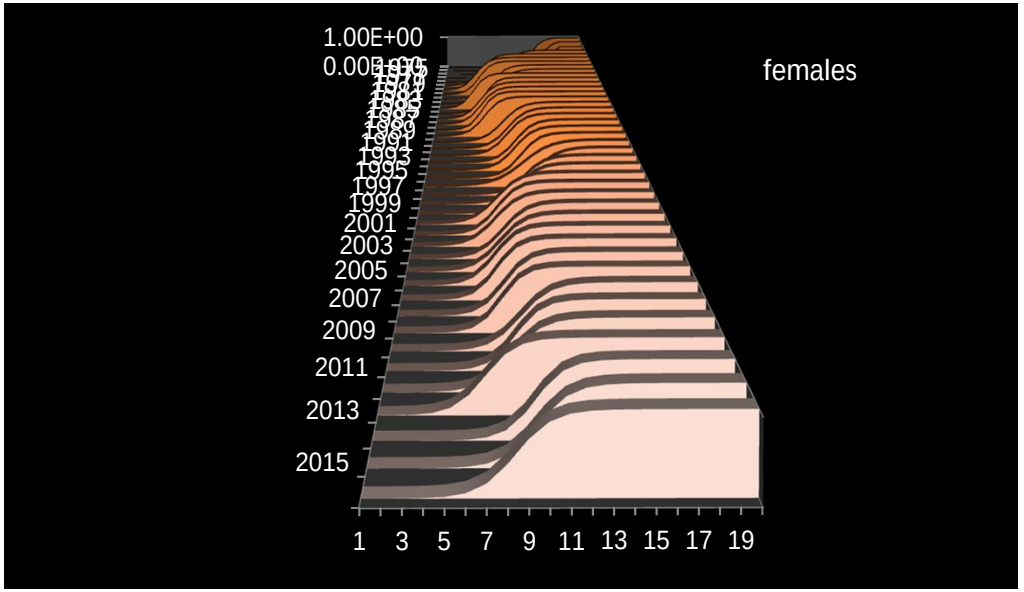

full selection F
0.6
0.5
0.4
0.3
0.2
0.1
0
1966 1976 1986 1996 2006 2016


female spawning biomass
FSB (1,000s t)
800
700
600
500
400
300
200
100
0
2016 FSB is 1.9*B40 and
2.3*Bmsy
1975 1980 1985 1990 1995 2000 2005 2010 2015
year

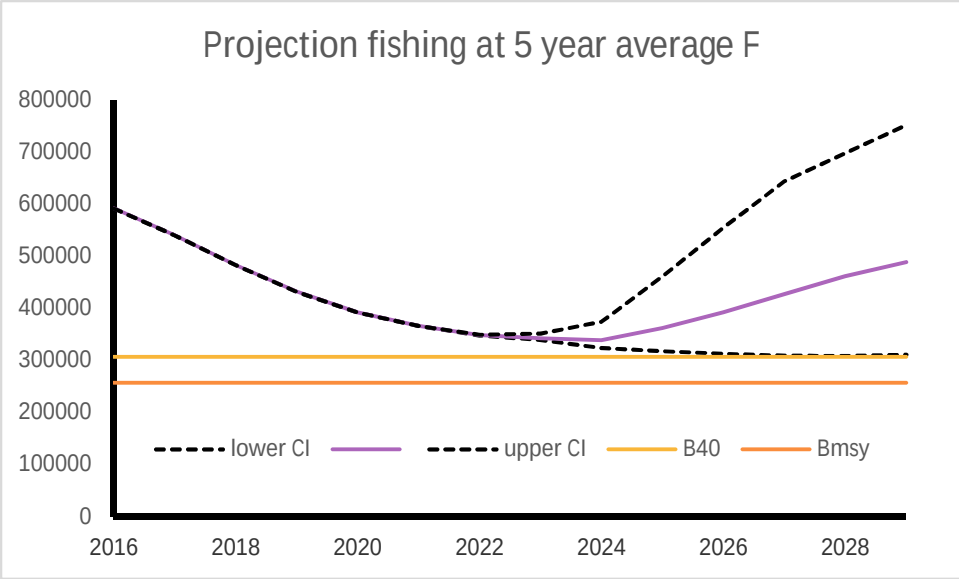

age 1 recruitment
6
5
4
3
2
1
0
1974 1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010
year class

TIME-VARYING FISHERY SELECTIVITY

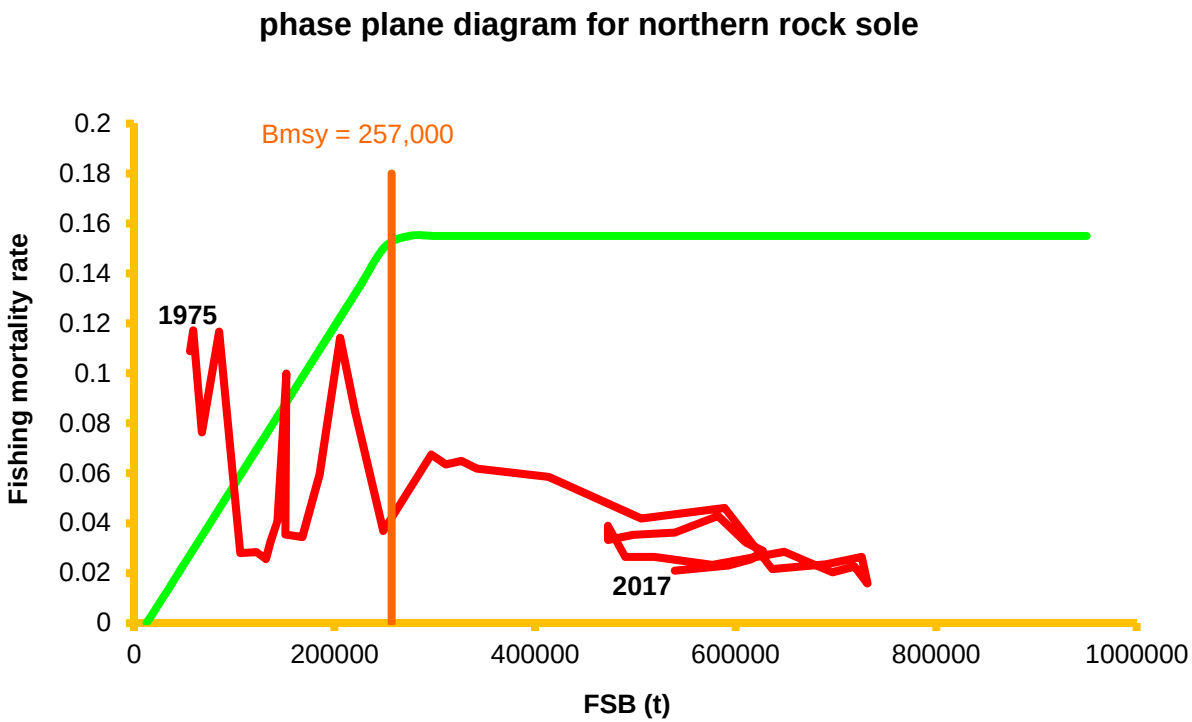




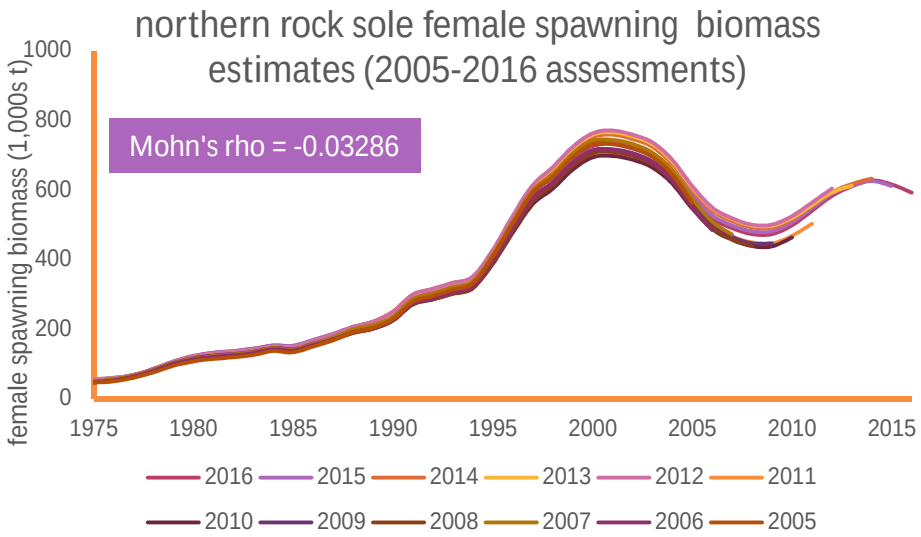
PROJECTED FEMALE SPAWNING BIOMASS



FSB AND F HISTORY RELATIVE TO B_{MSY}



BSAI NORTHERN ROCK SOLE



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