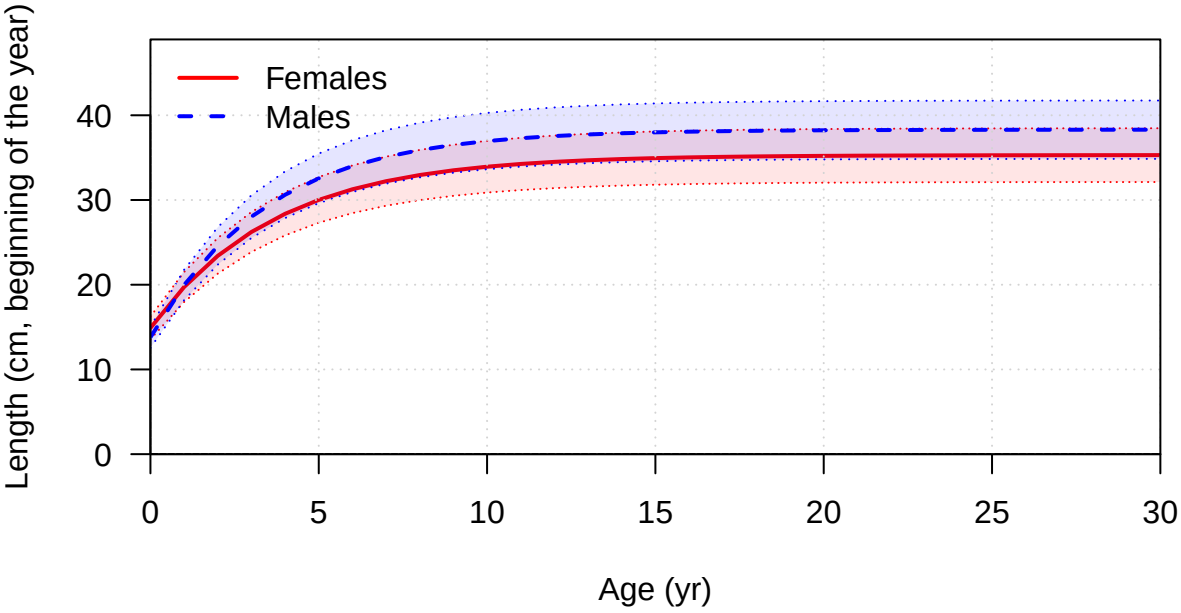
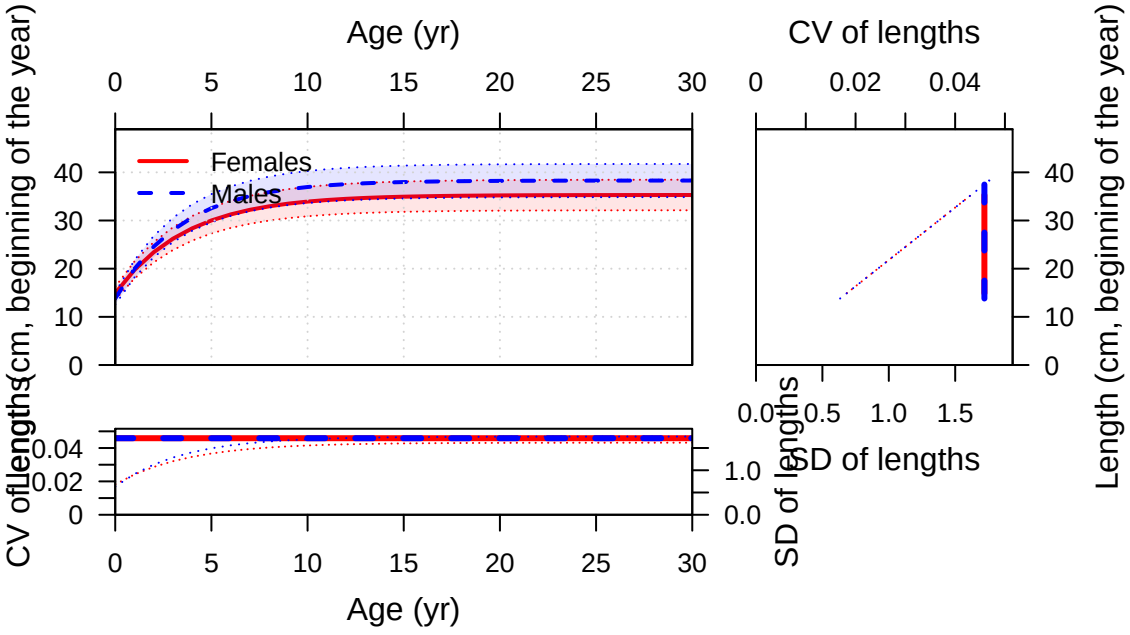
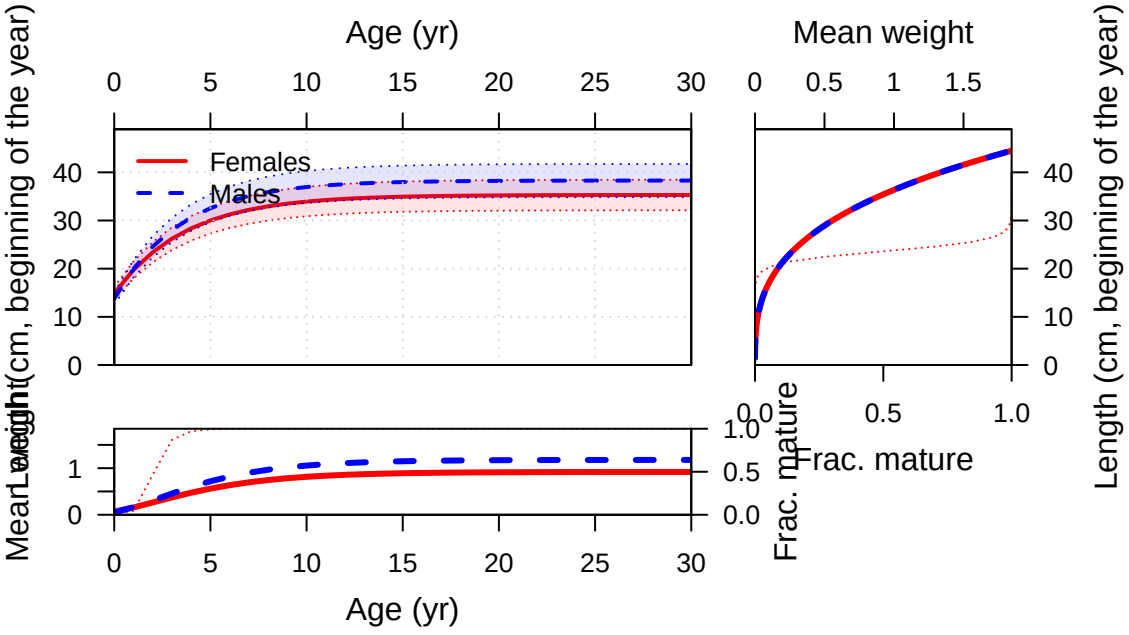
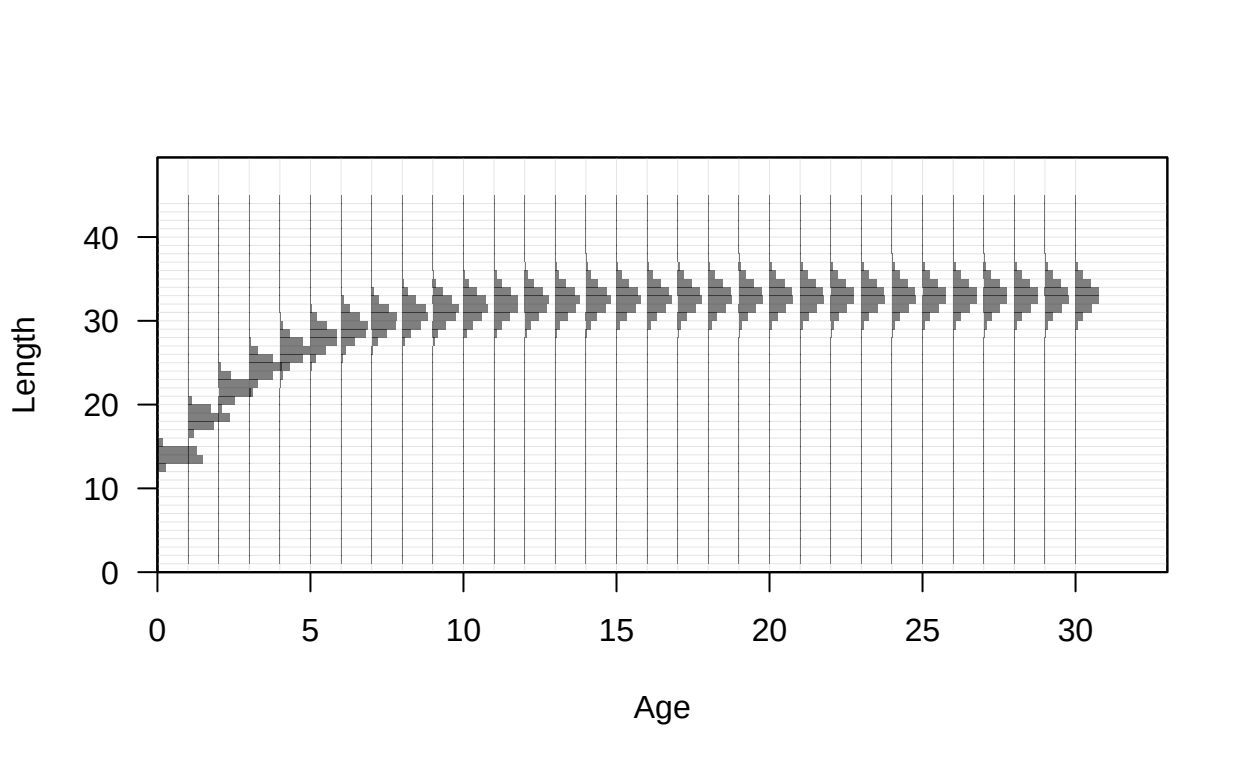
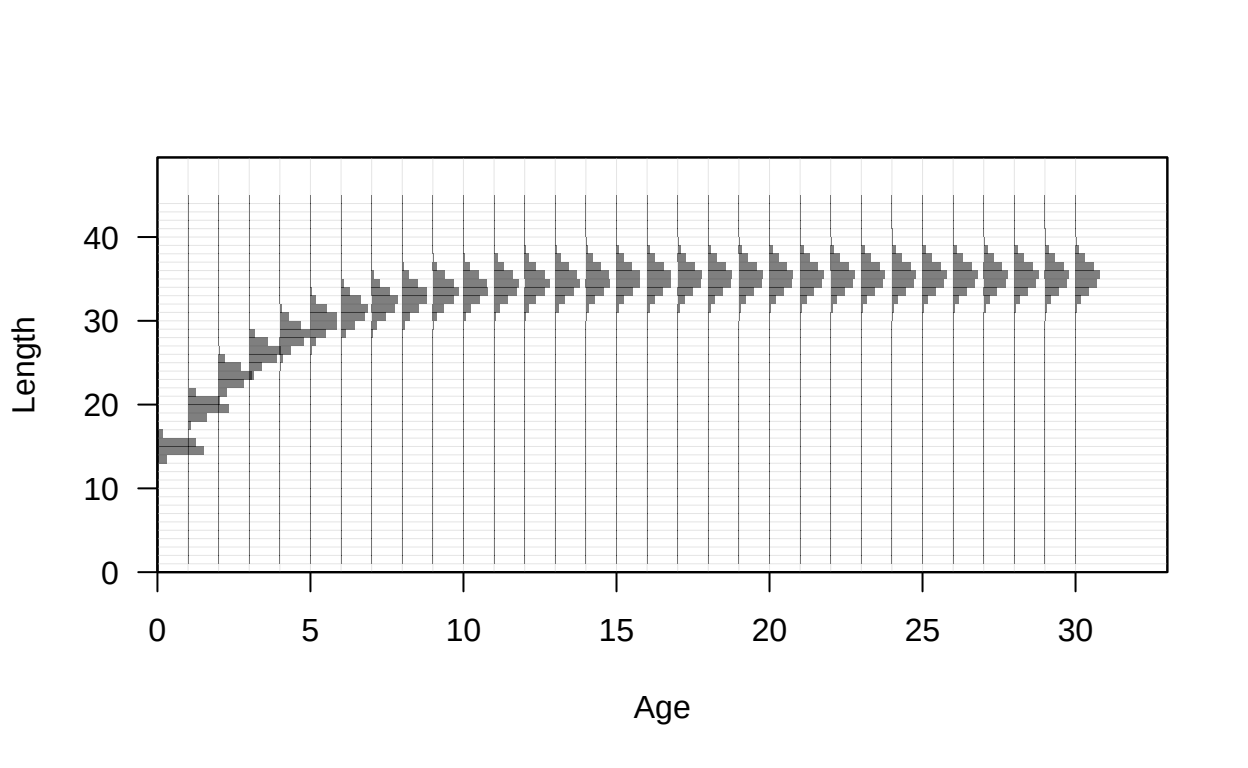
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Tue Feb 14 15:08:29 2023
Data_File: data.ss
Control_File: control.ss

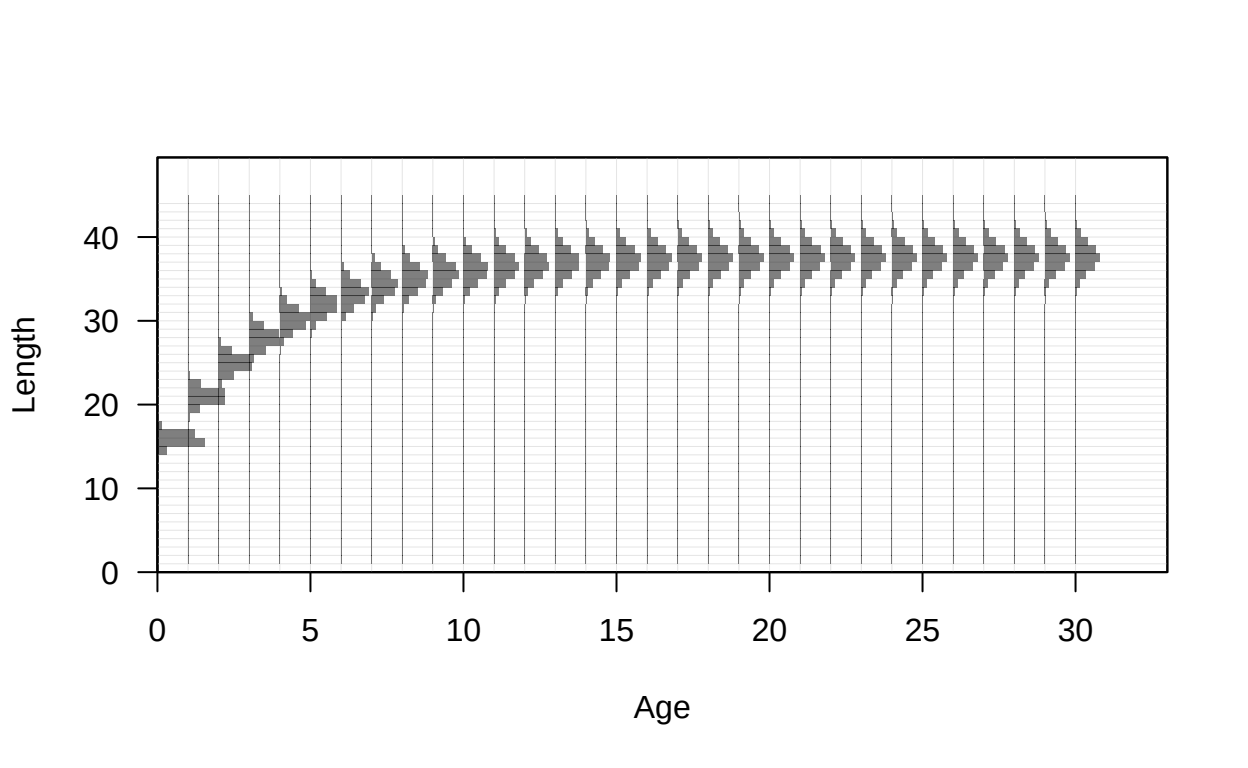

Females
Males
Length (cm, beginning of the year)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)

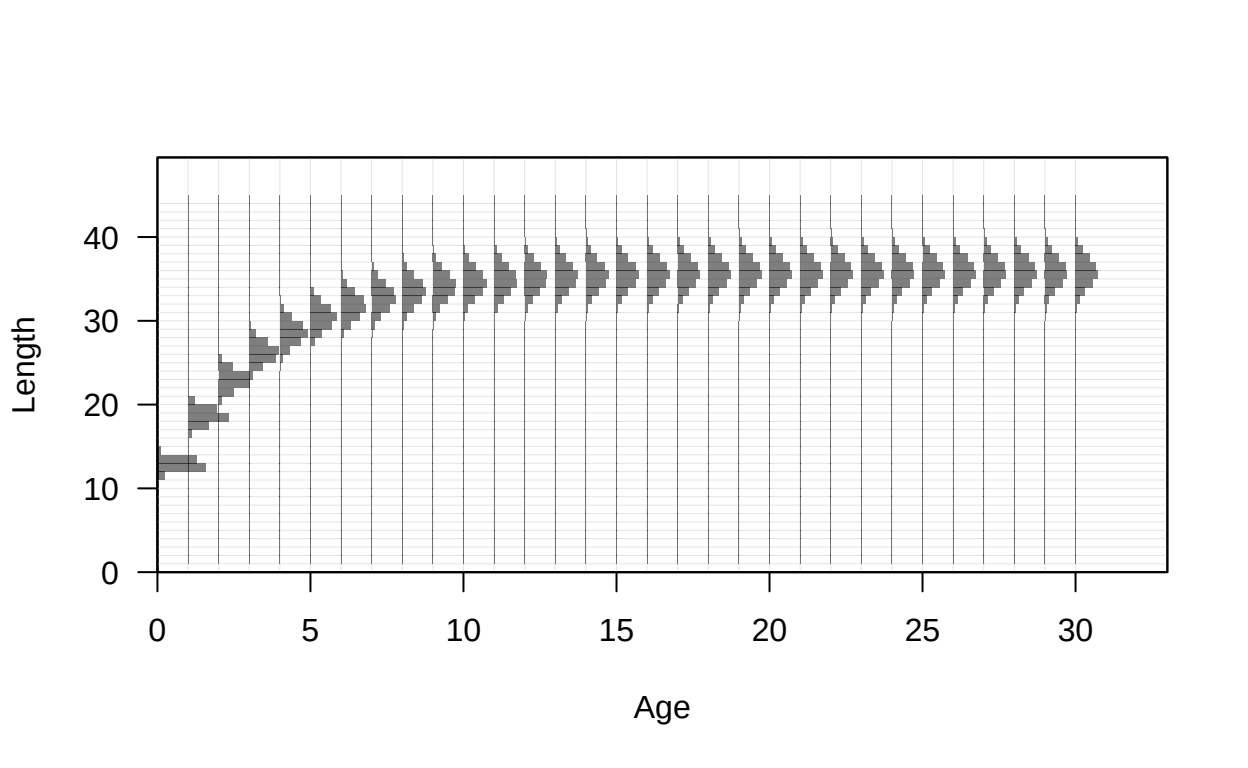

Age (yr)
0
5
10
15
20
25
30
Females
Males
Length (cm, beginning of the year)
40
30
20
10
0
CV of lengths
0.04
0.02
0
SD of lengths
1.0
0.0
0.5
1.5

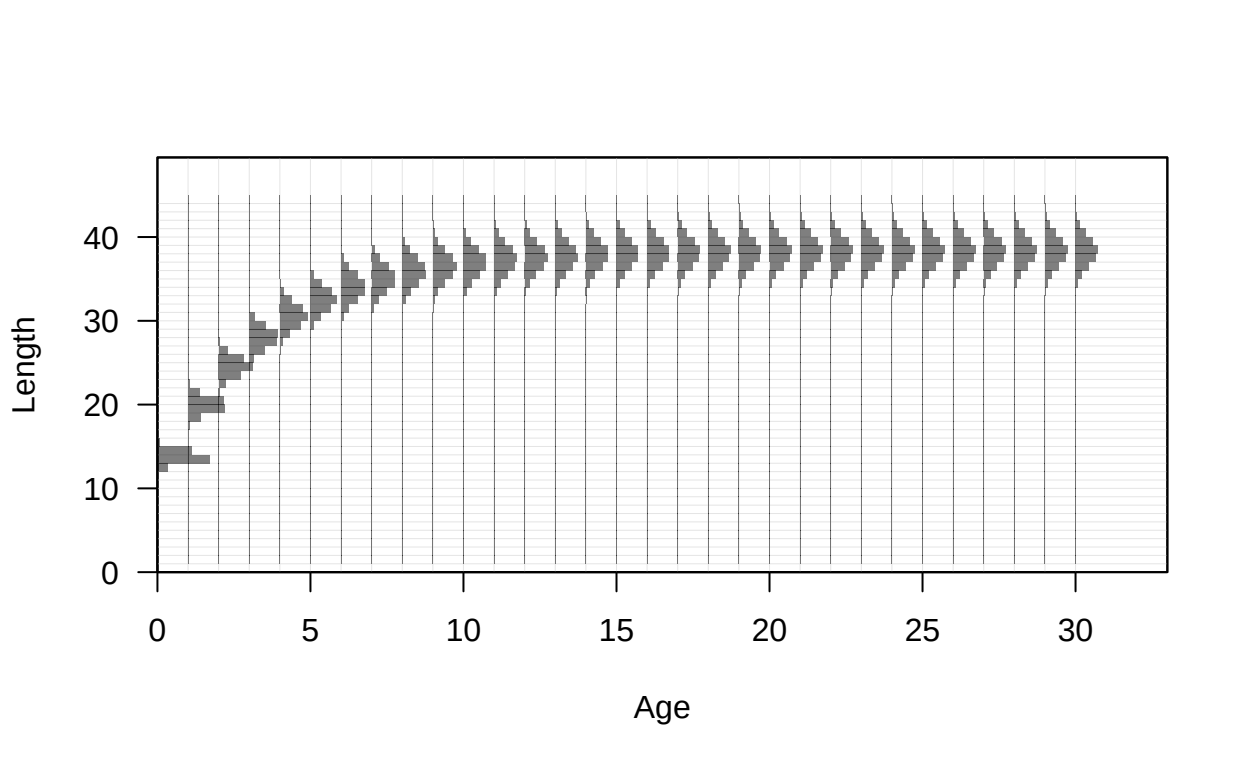

Age (yr)
Mean weight
Length (cm, beginning of the year)
Females
Males
Frac. mature
Age (yr)

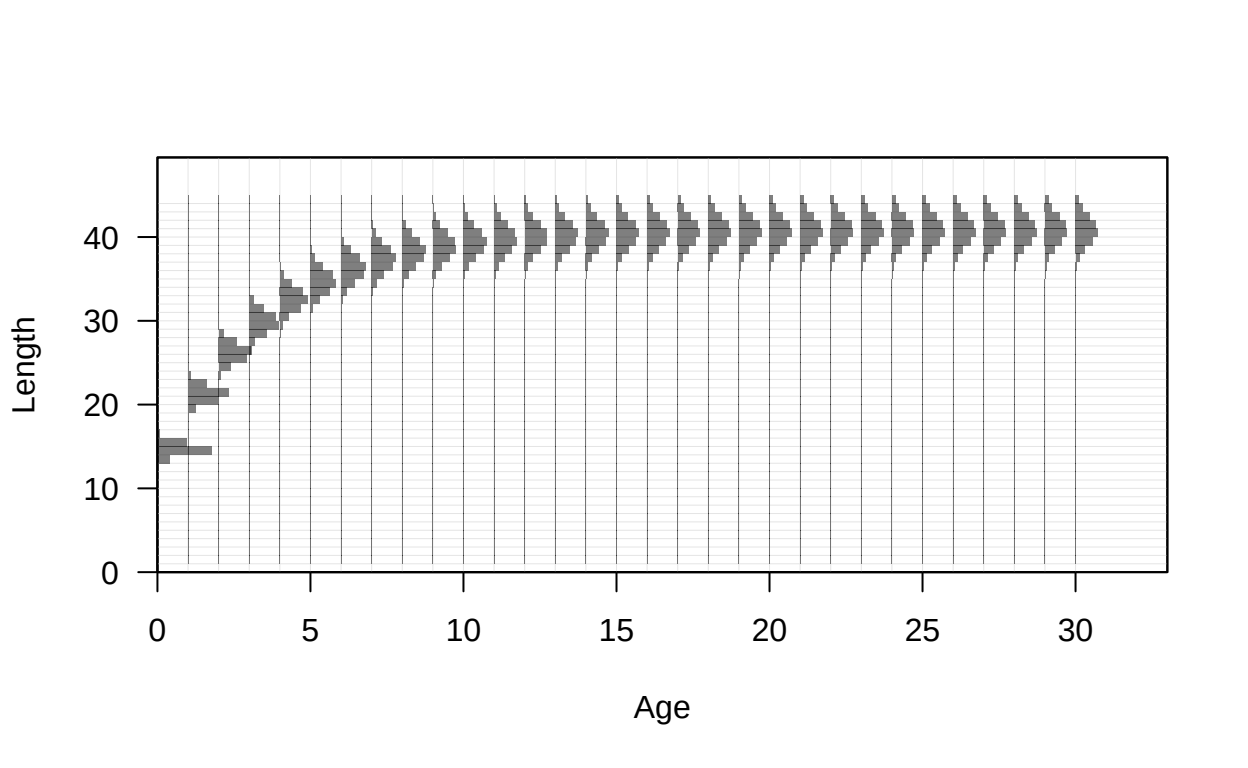

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

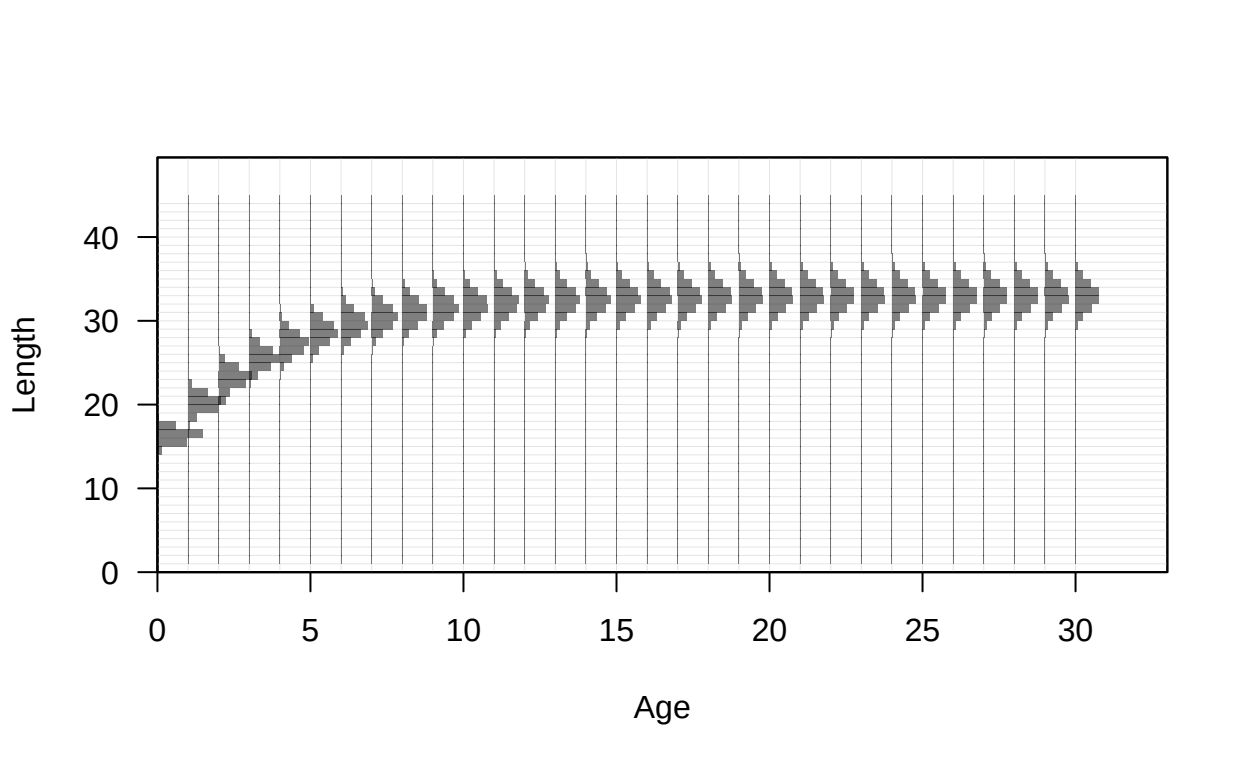

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

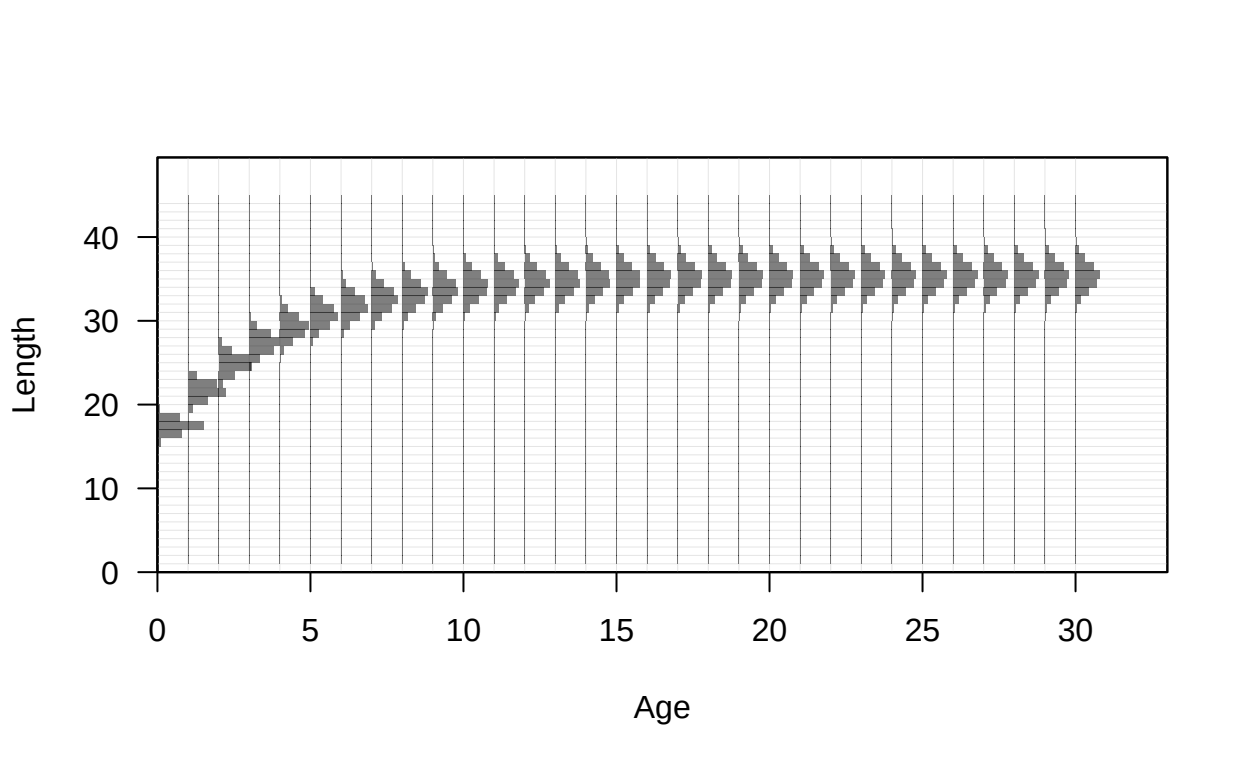

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

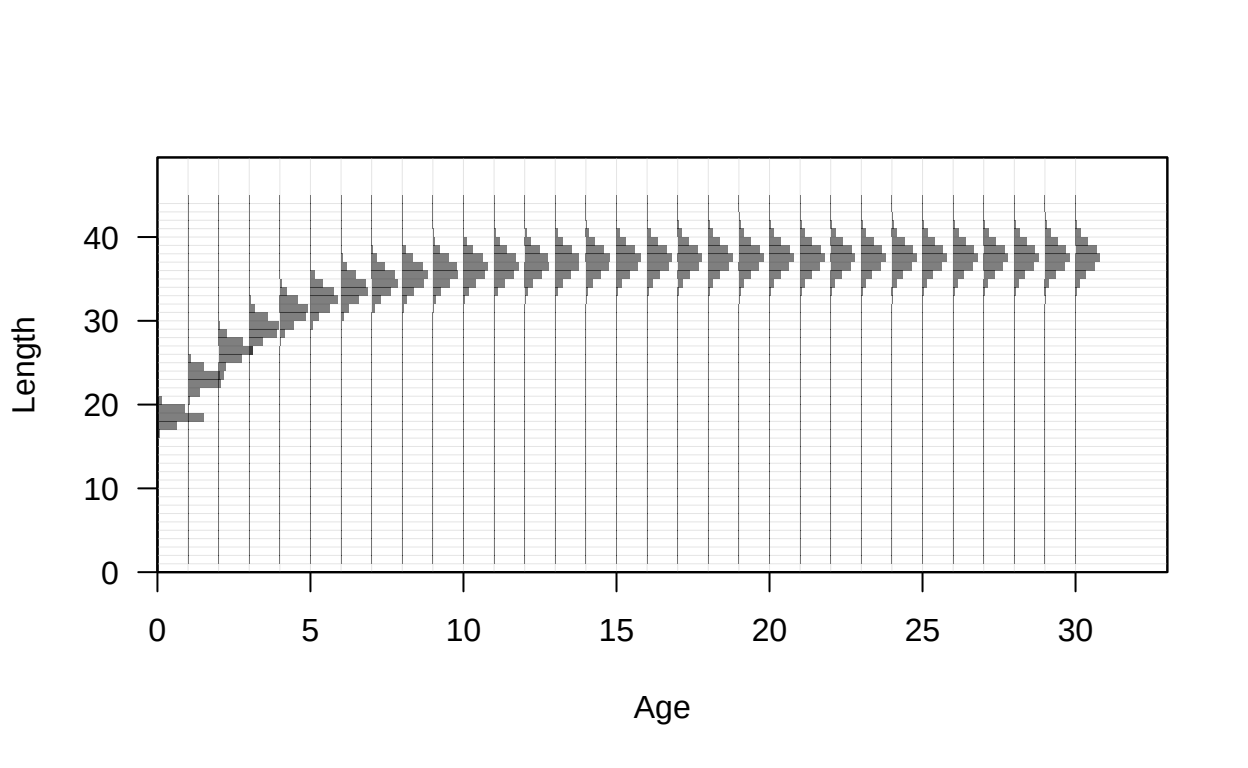

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

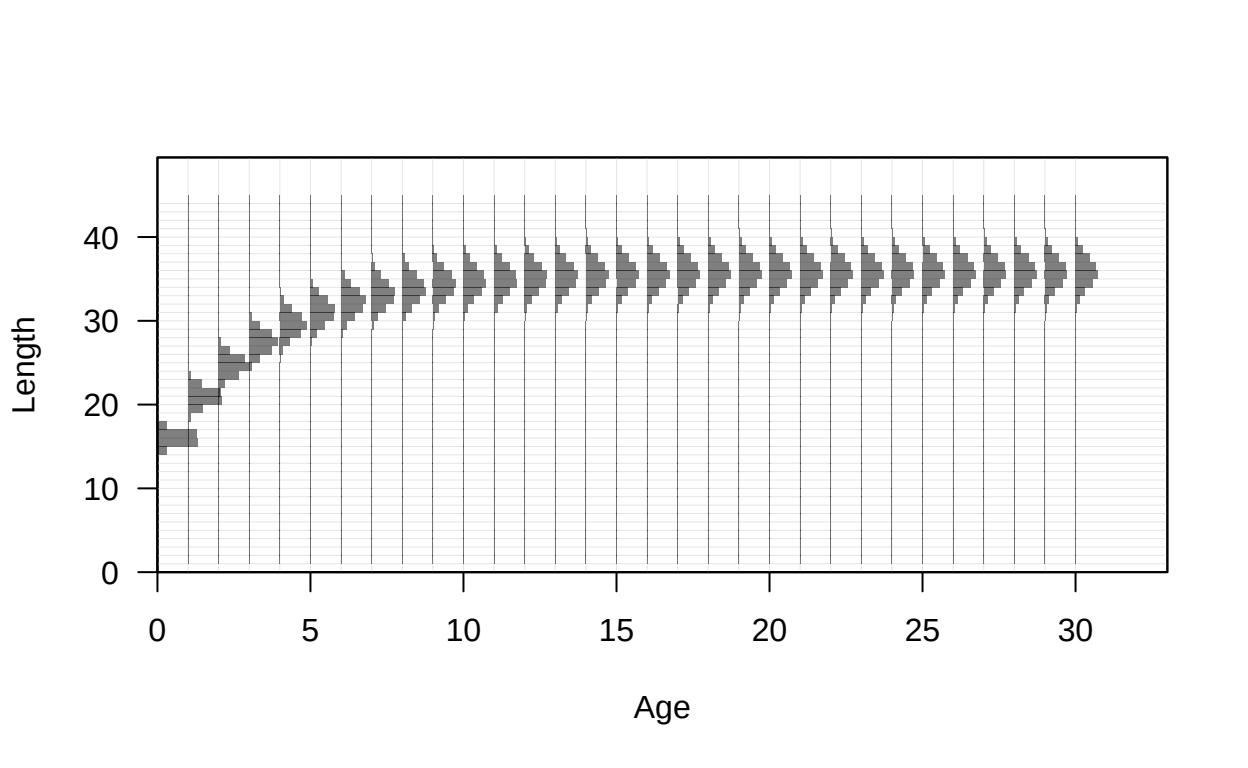

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

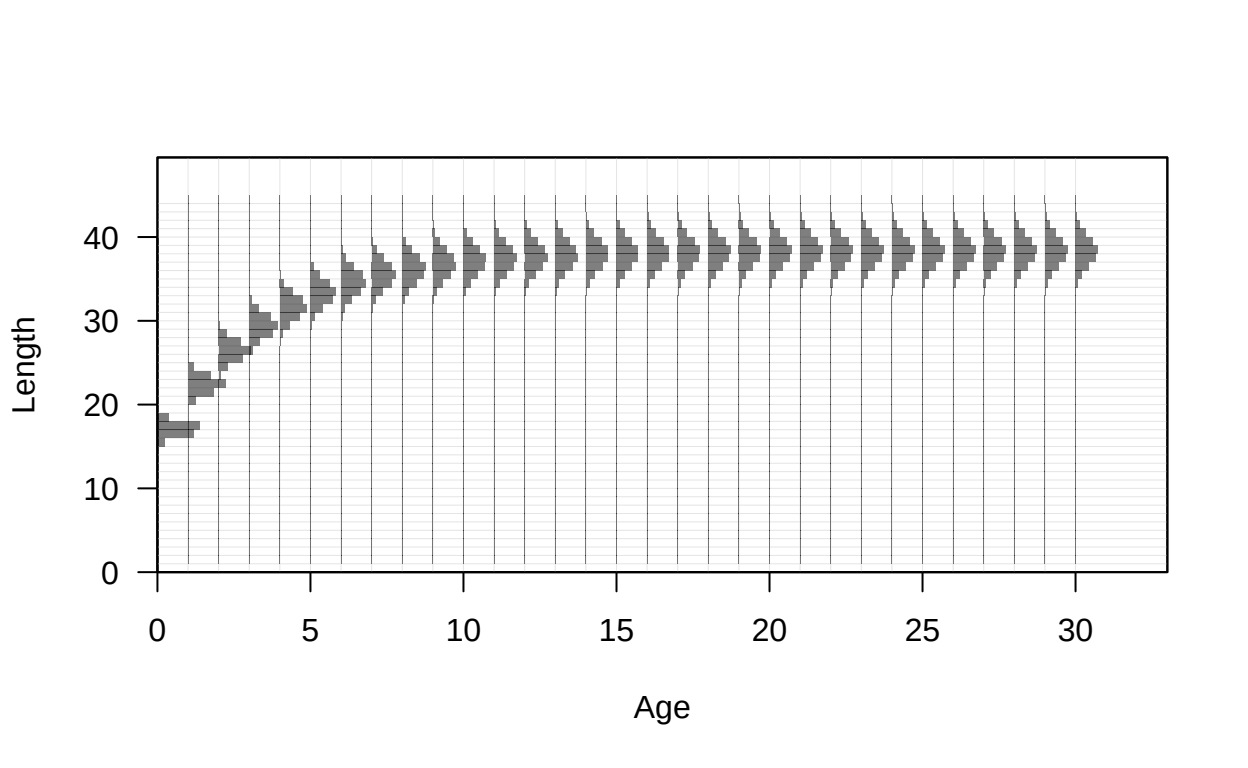

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

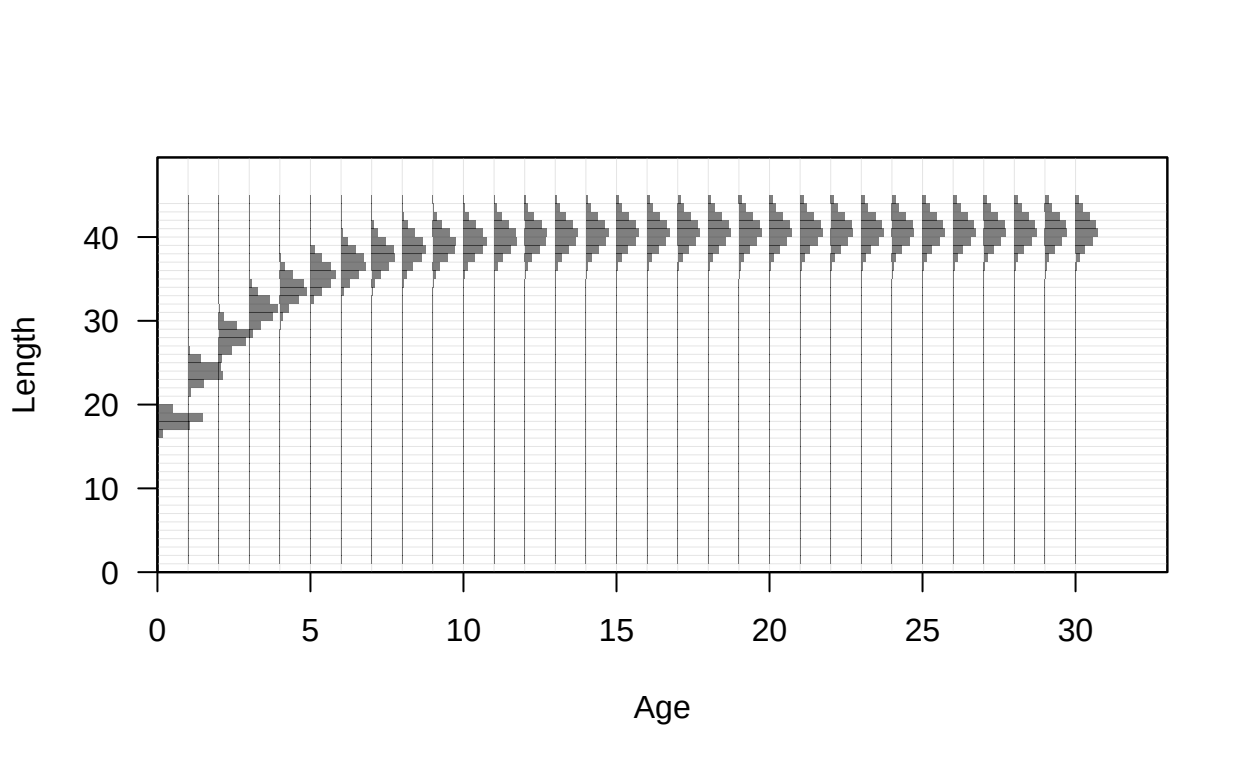

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

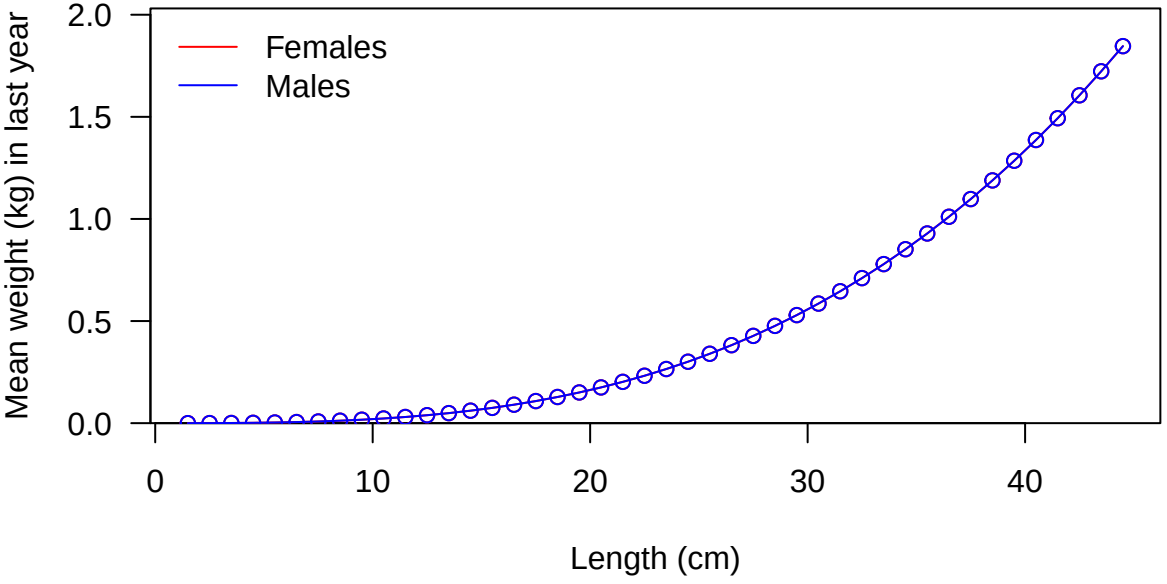

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

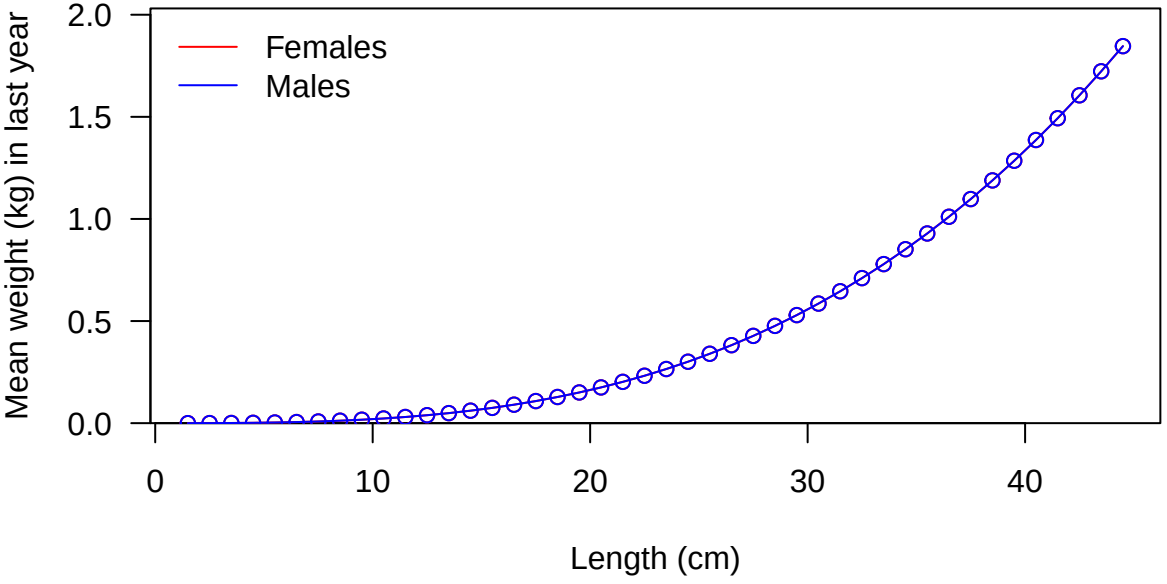

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

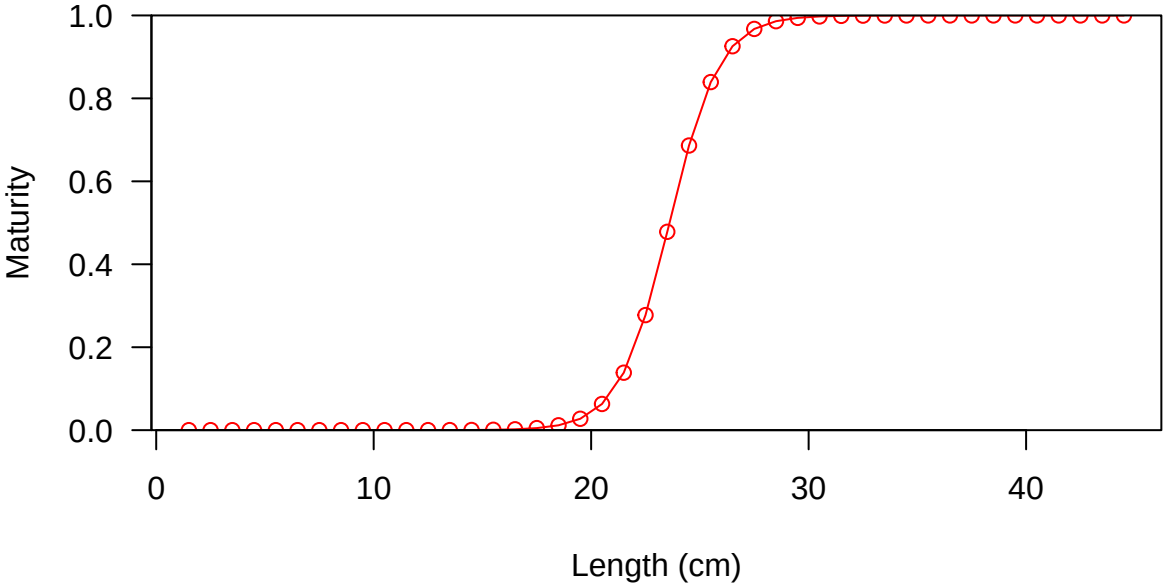

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

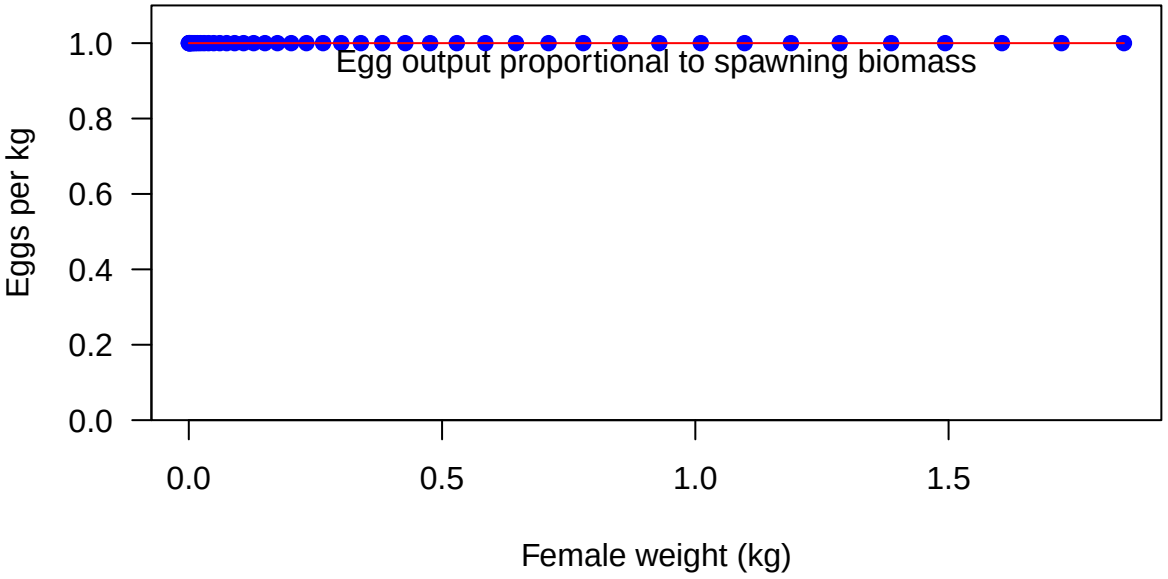

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

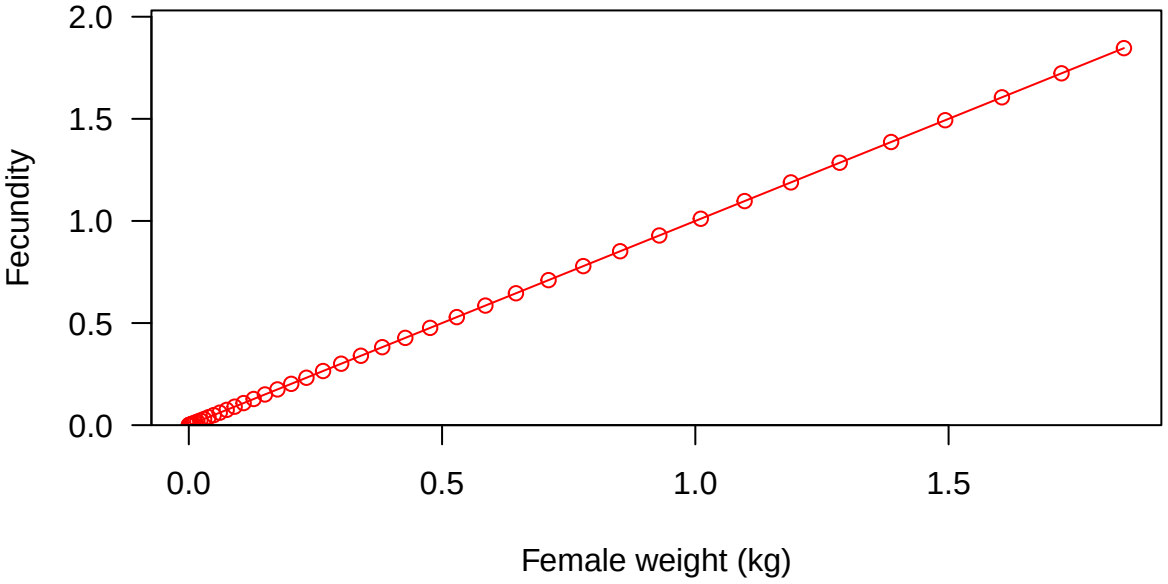

Length
0
10
20
30
40
0
5
10
15
20
25
30
Age

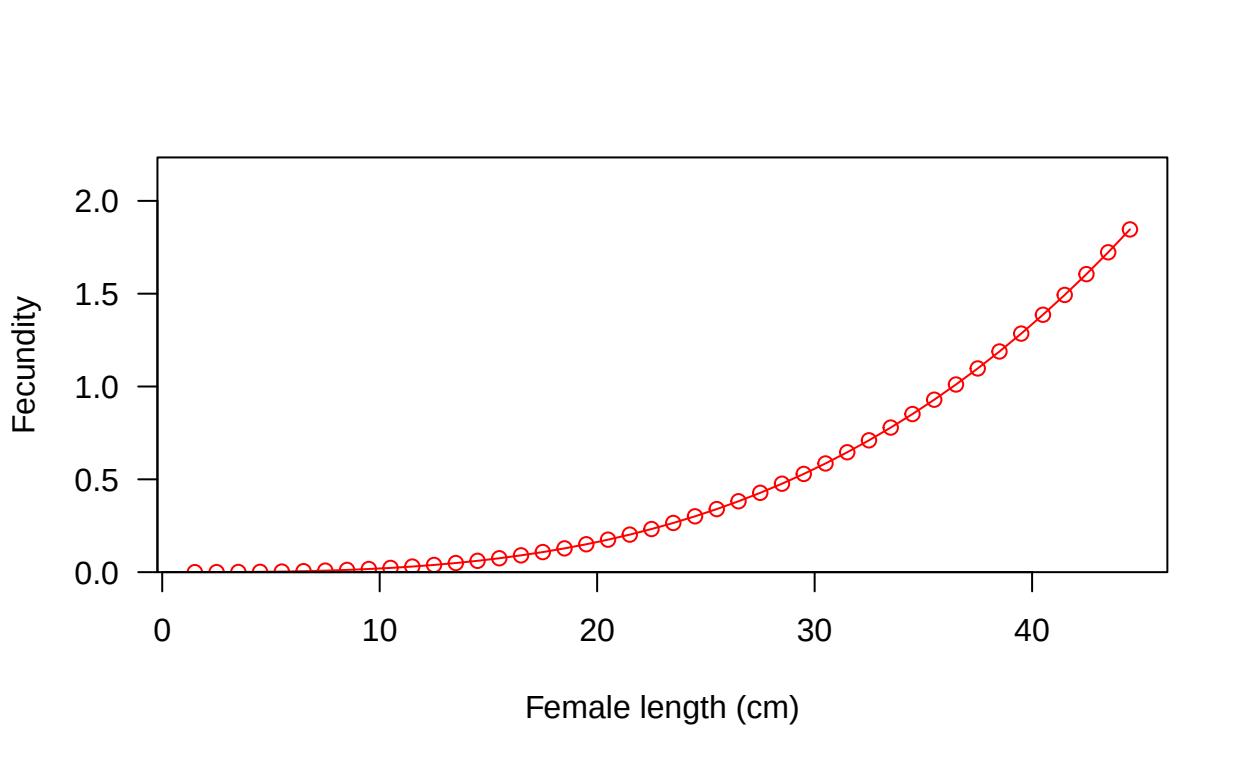

Females
Males
Mean weight (kg) in last year
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Length (cm)

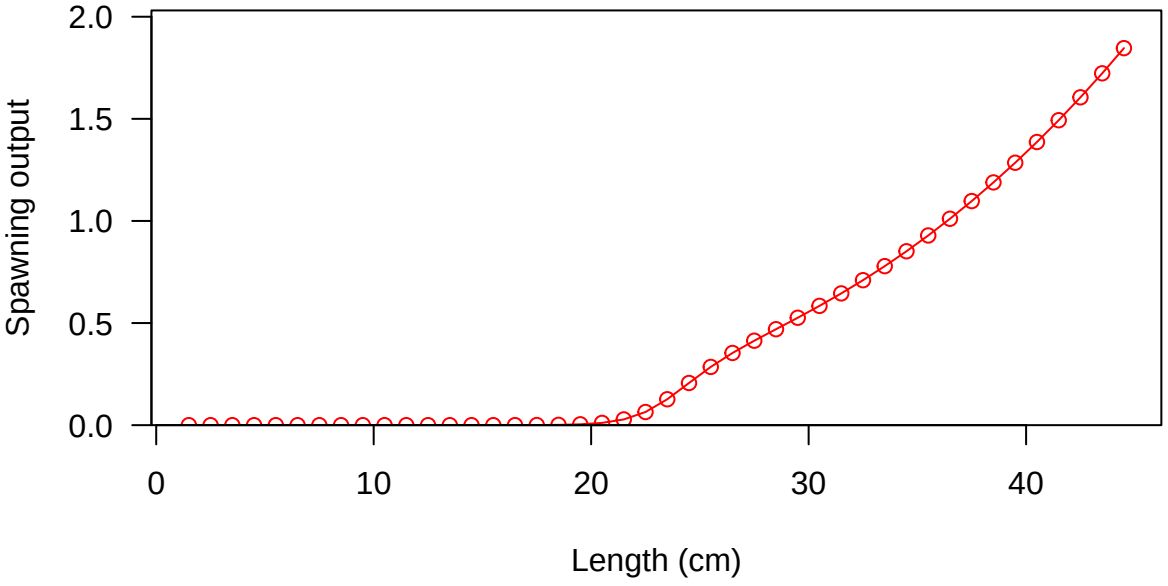

Females
Males
Mean weight (kg) in last year
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Length (cm)

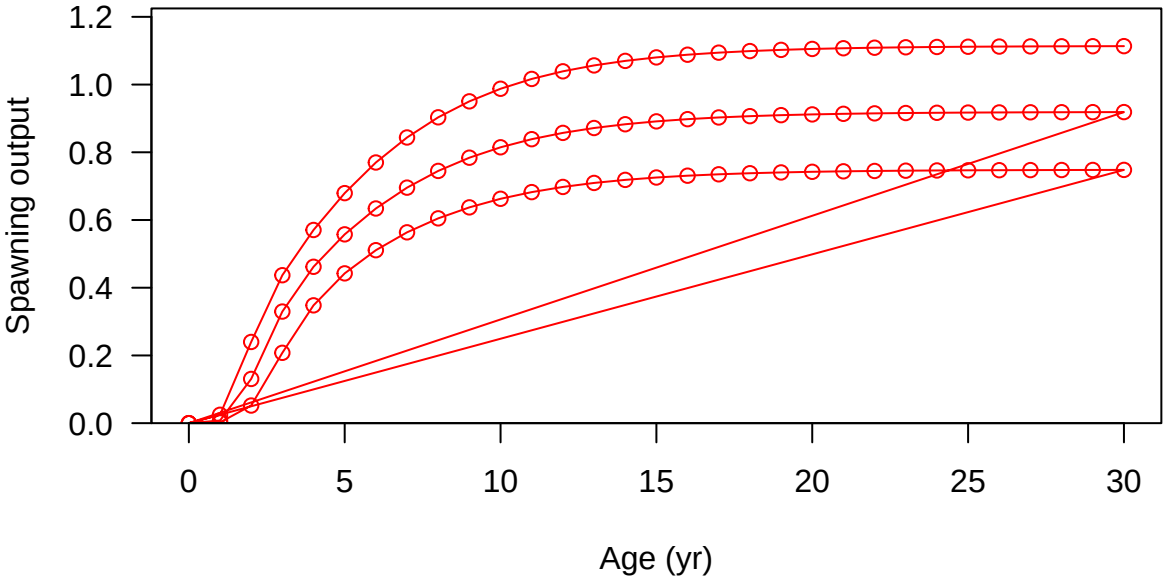

1.0
0.8
0.6
0.4
0.2
0.0
Maturity
0
10
20
30
40
Length (cm)

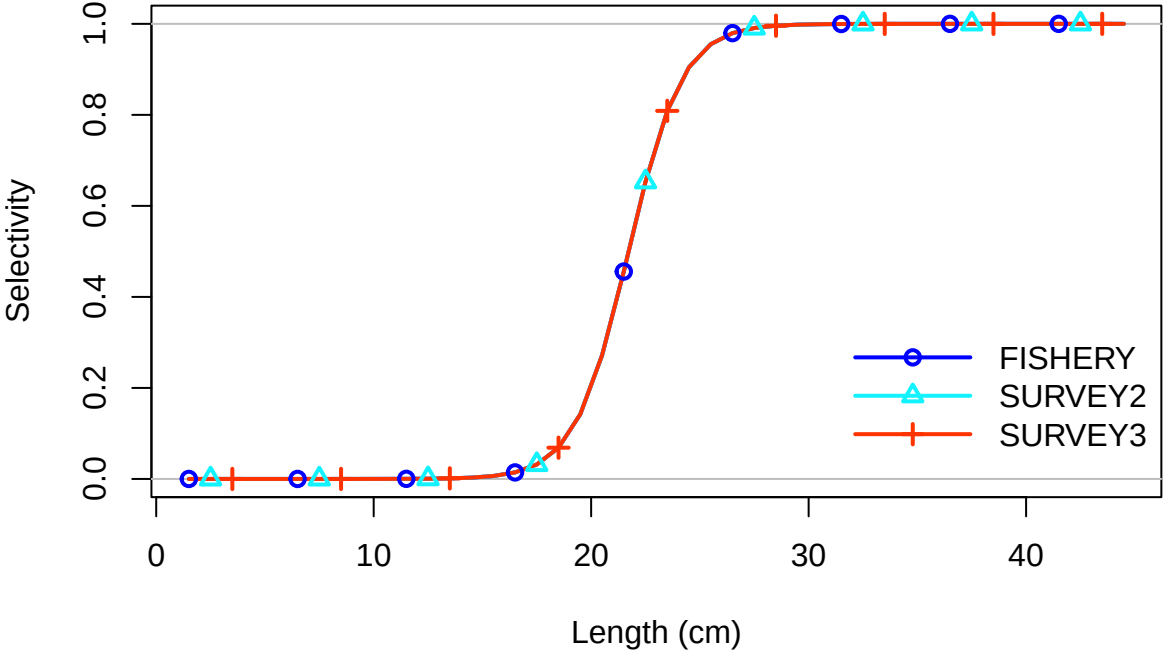

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
Female weight (kg)

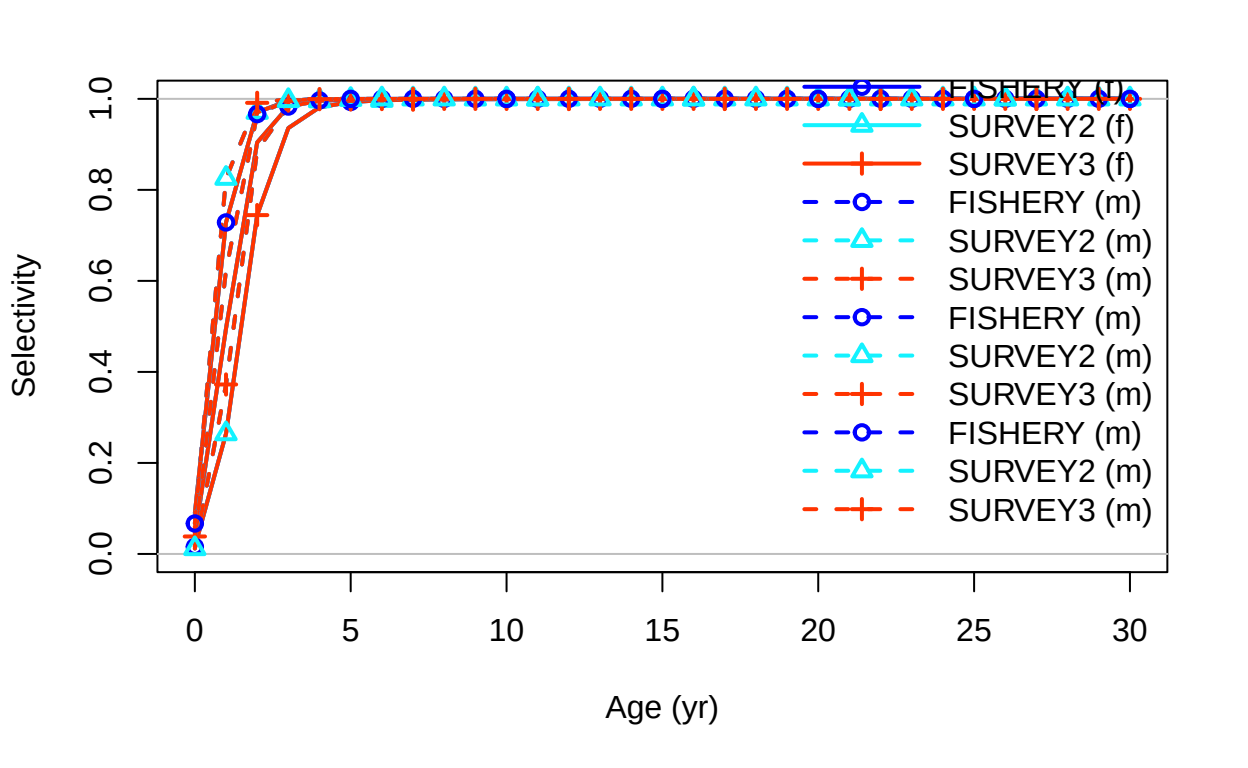

2.0
1.5
1.0
0.5
0.0
Fecundity
0.0
0.5
1.0
1.5
Female weight (kg)

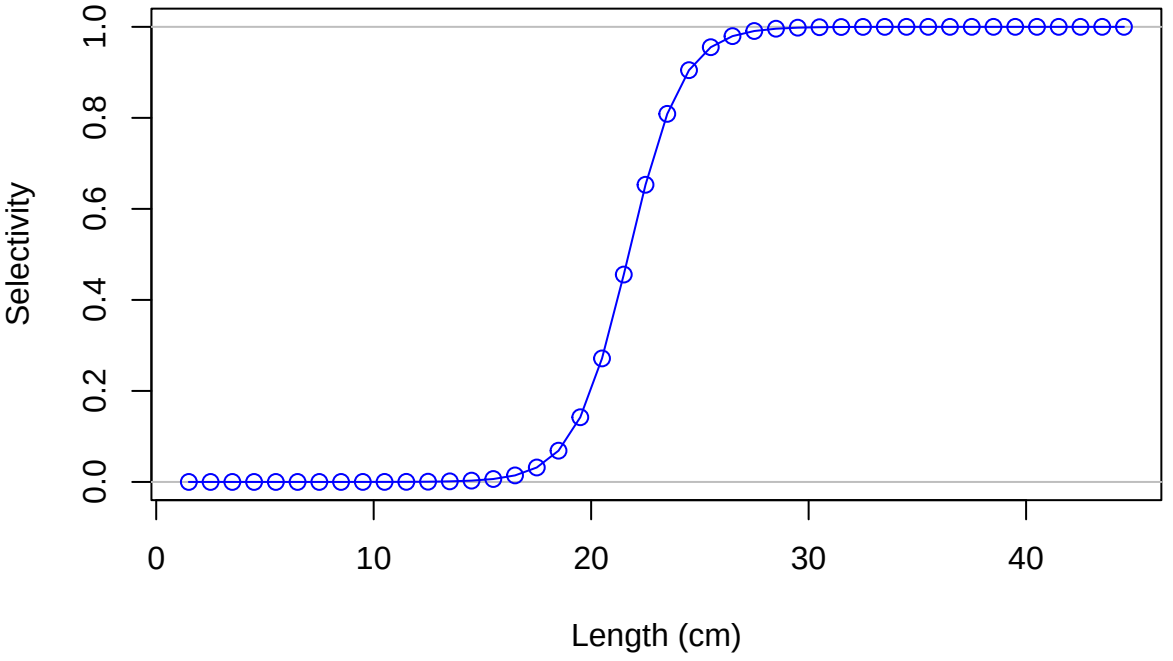

Fecundity
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Female length (cm)

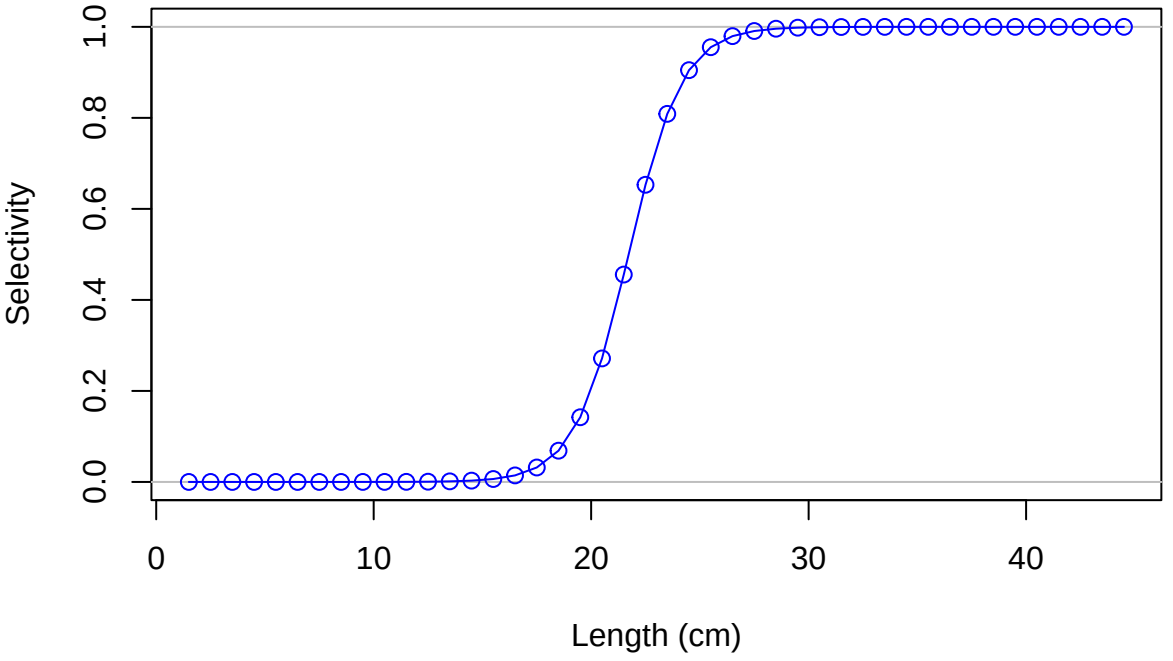

2.0
1.5
1.0
0.5
0.0
Spawning output
0
10
20
30
40
Length (cm)

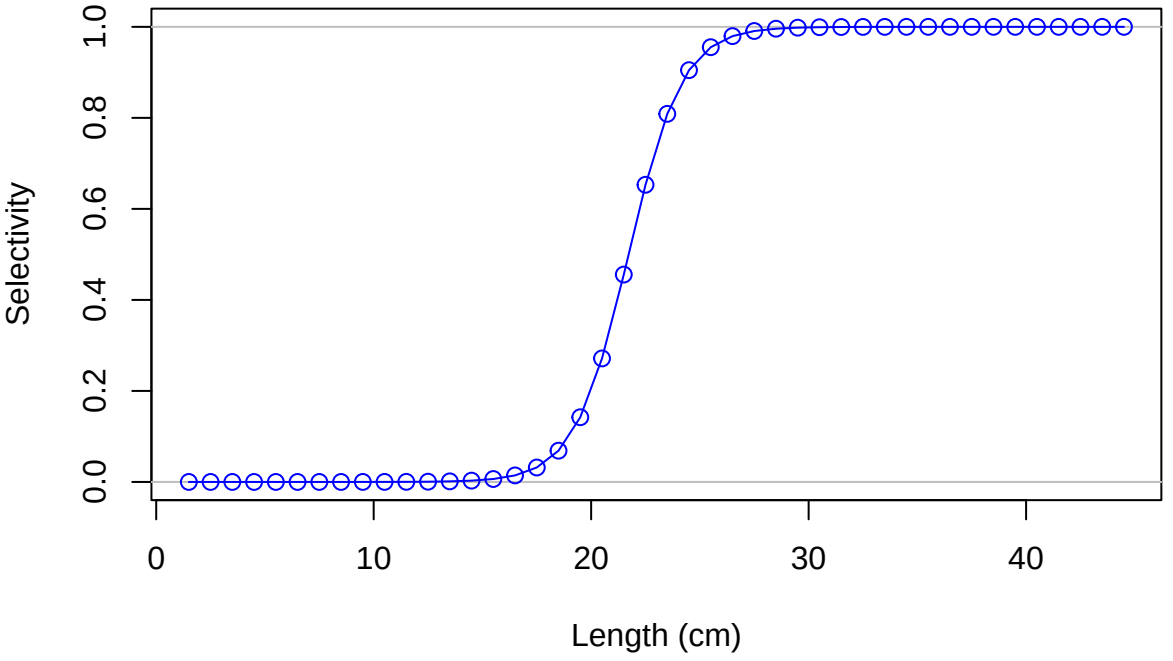

Spawning output
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
Age (yr)

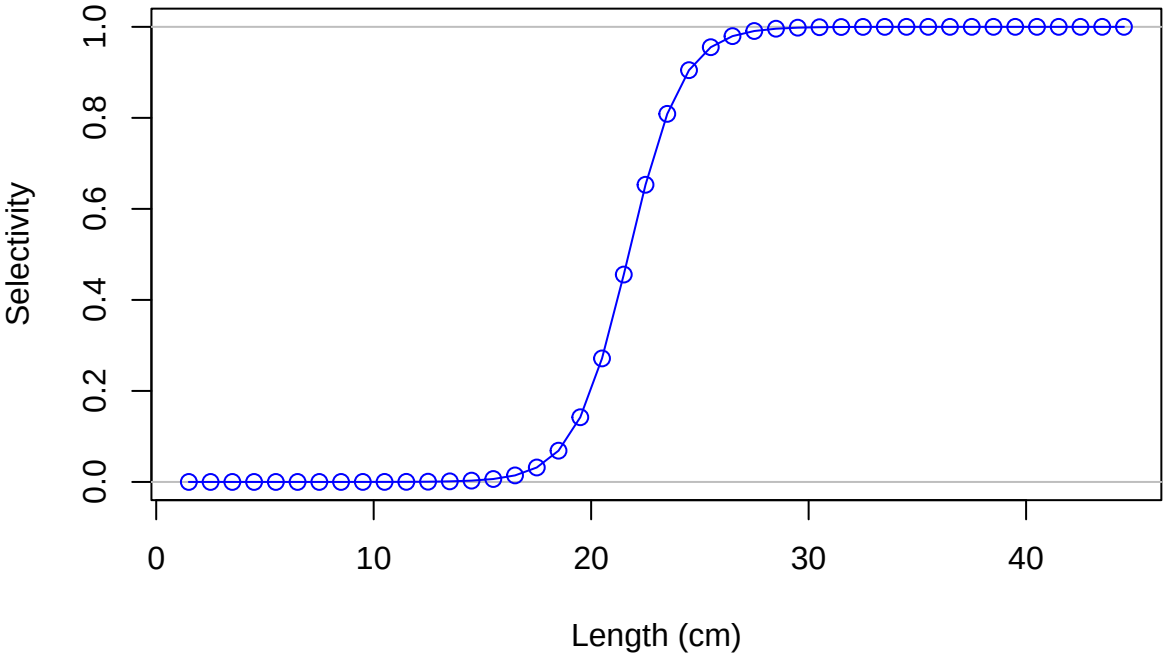

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)
FISHERY
SURVEY2
SURVEY3

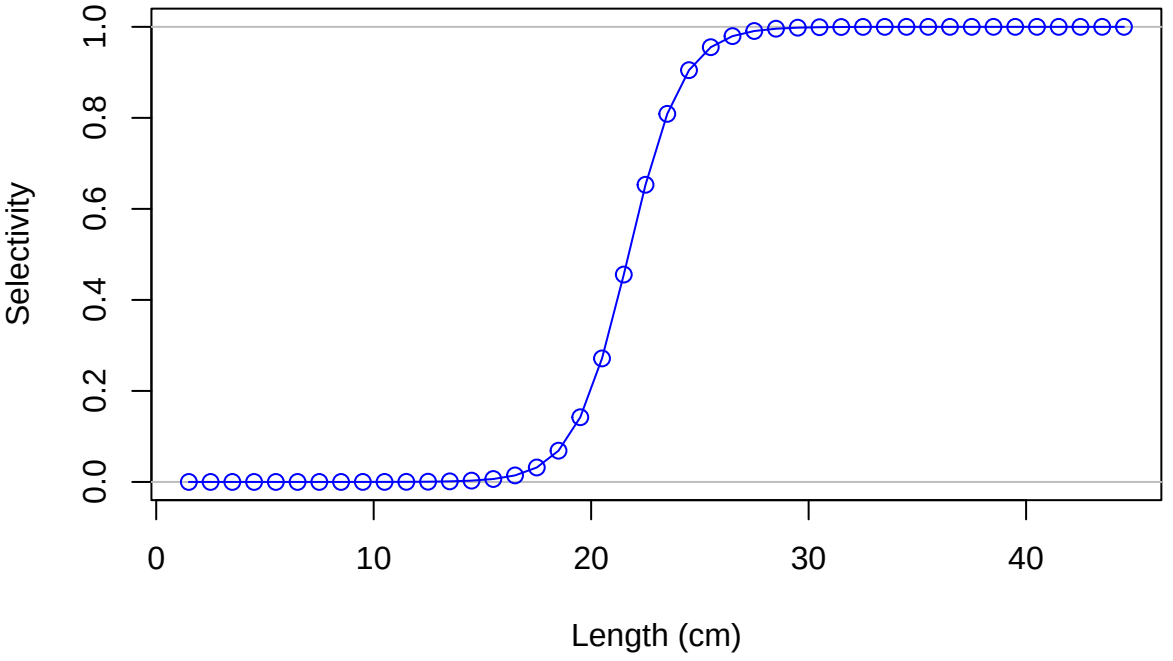

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Age (yr)
FISHERY (f)
SURVEY2 (f)
SURVEY3 (f)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)

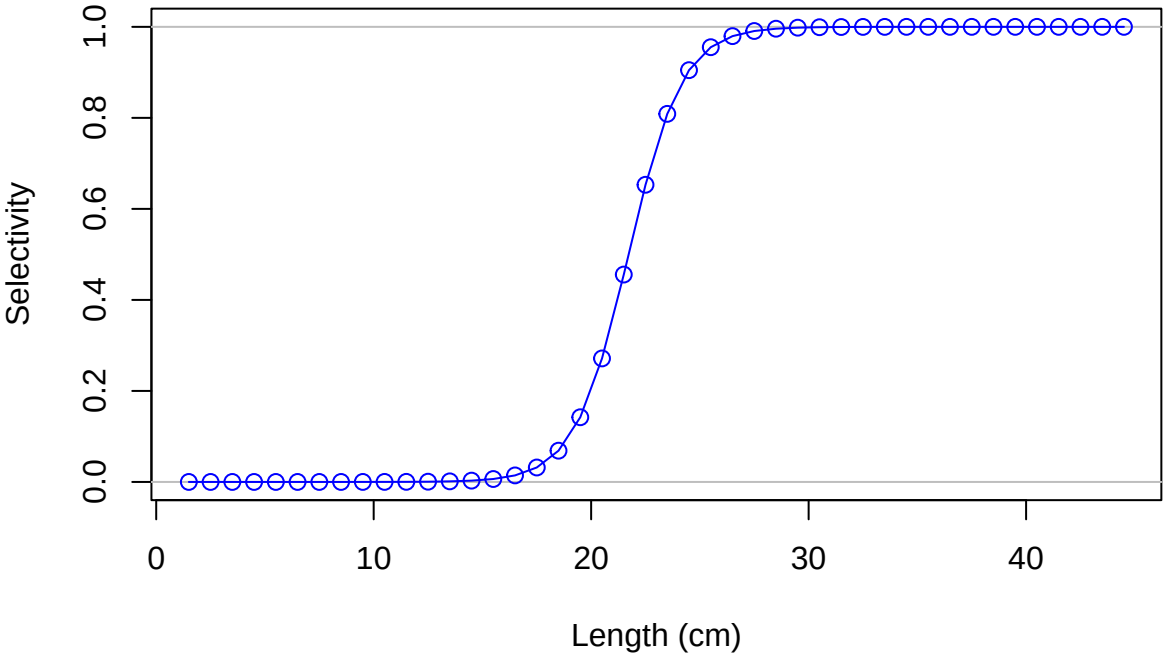

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

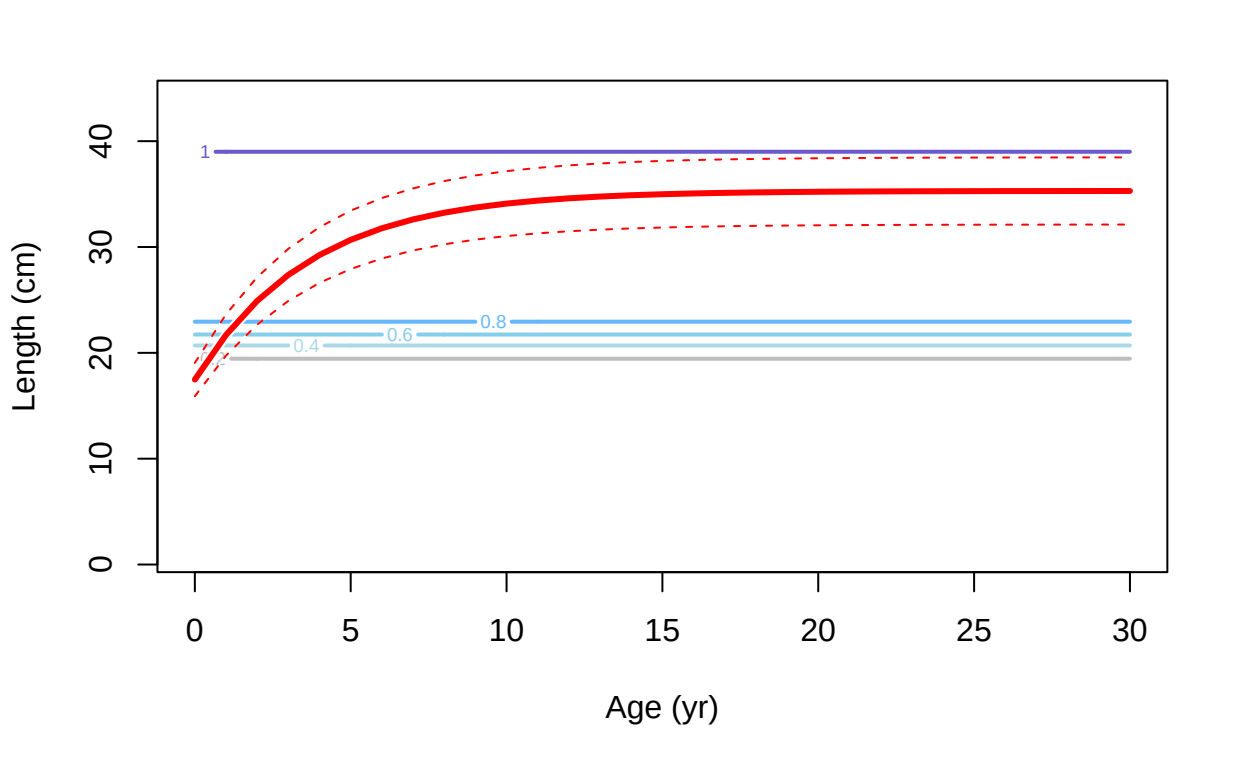

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

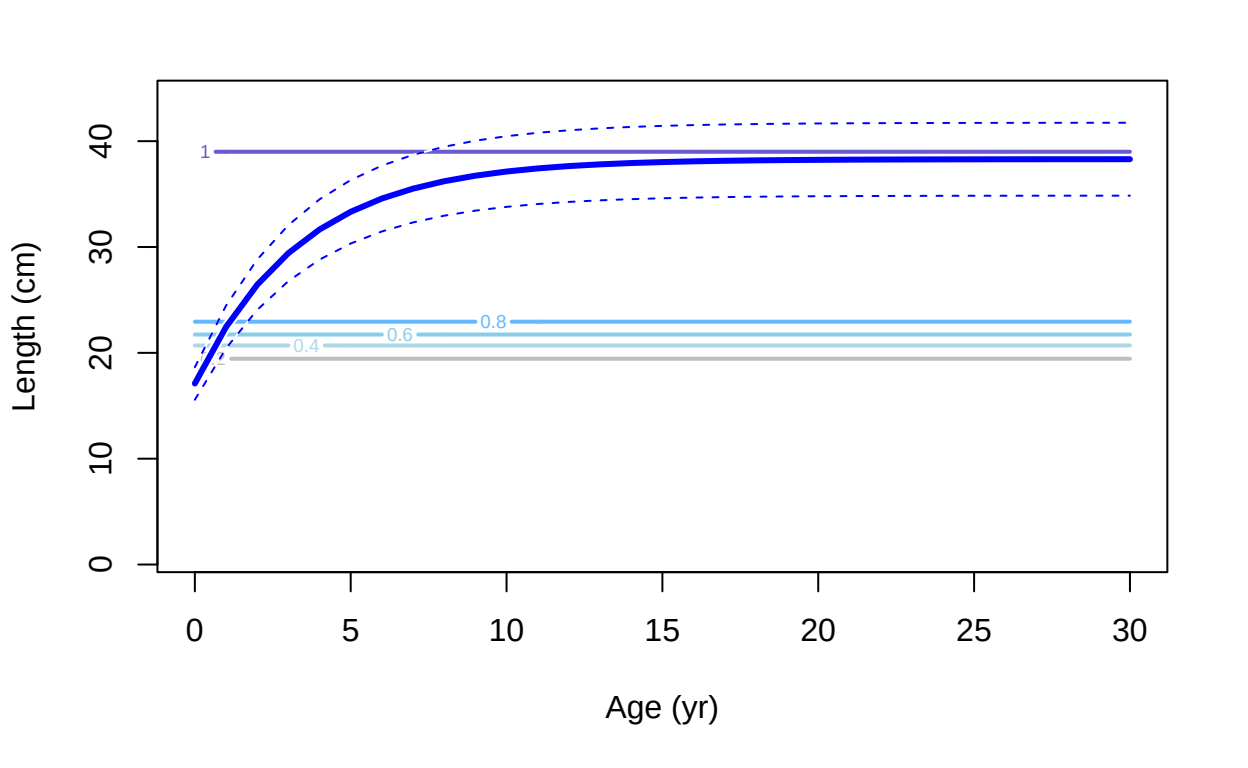

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

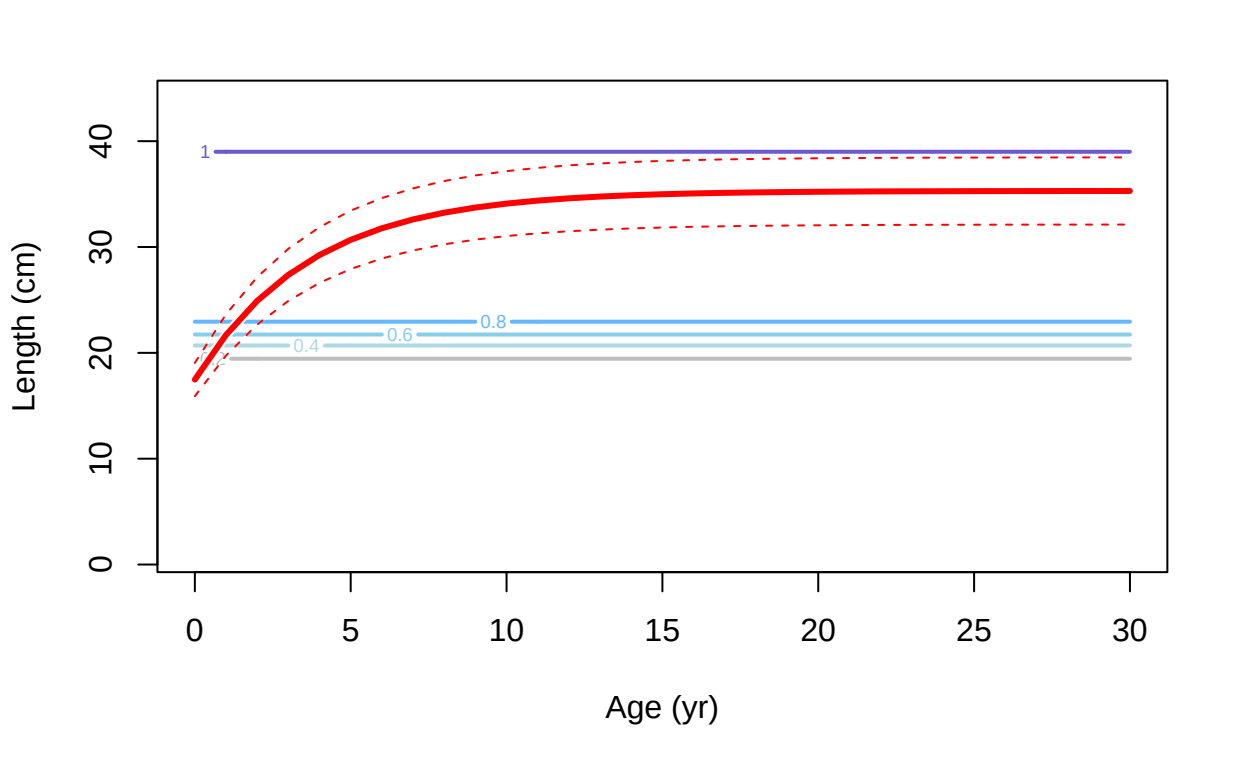

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

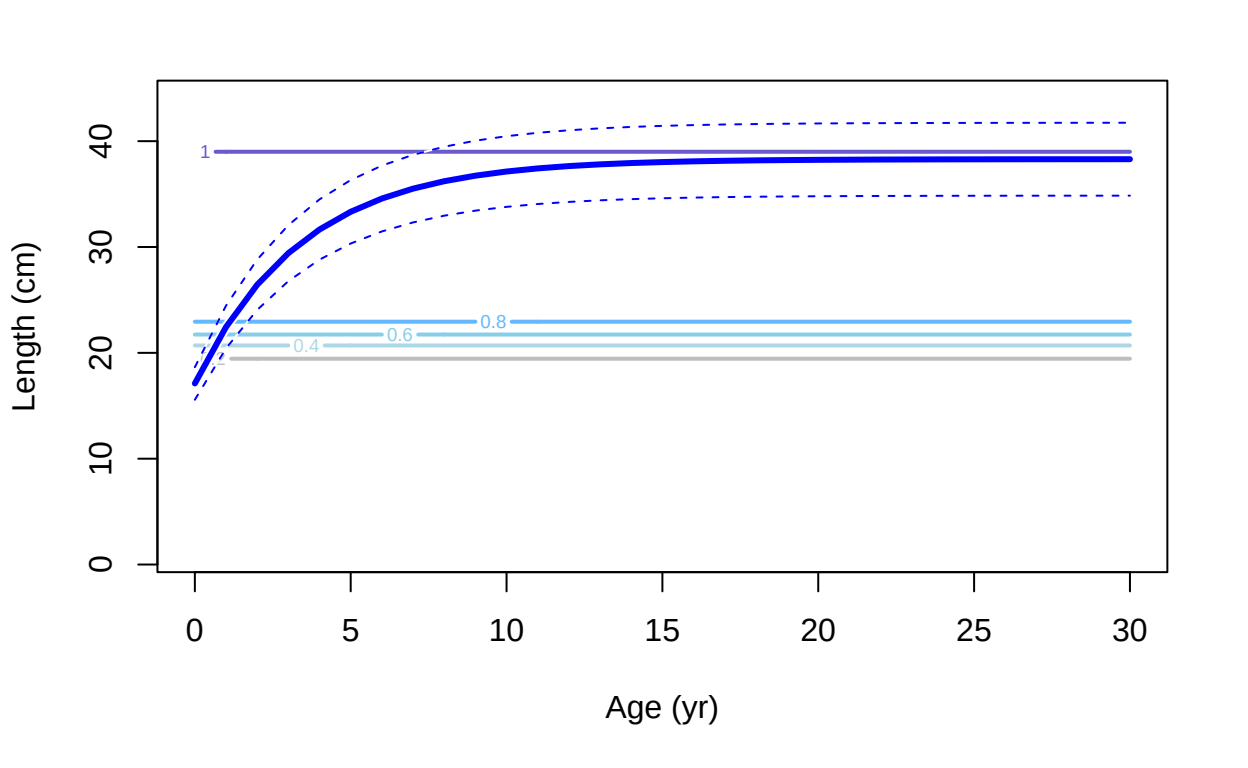

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

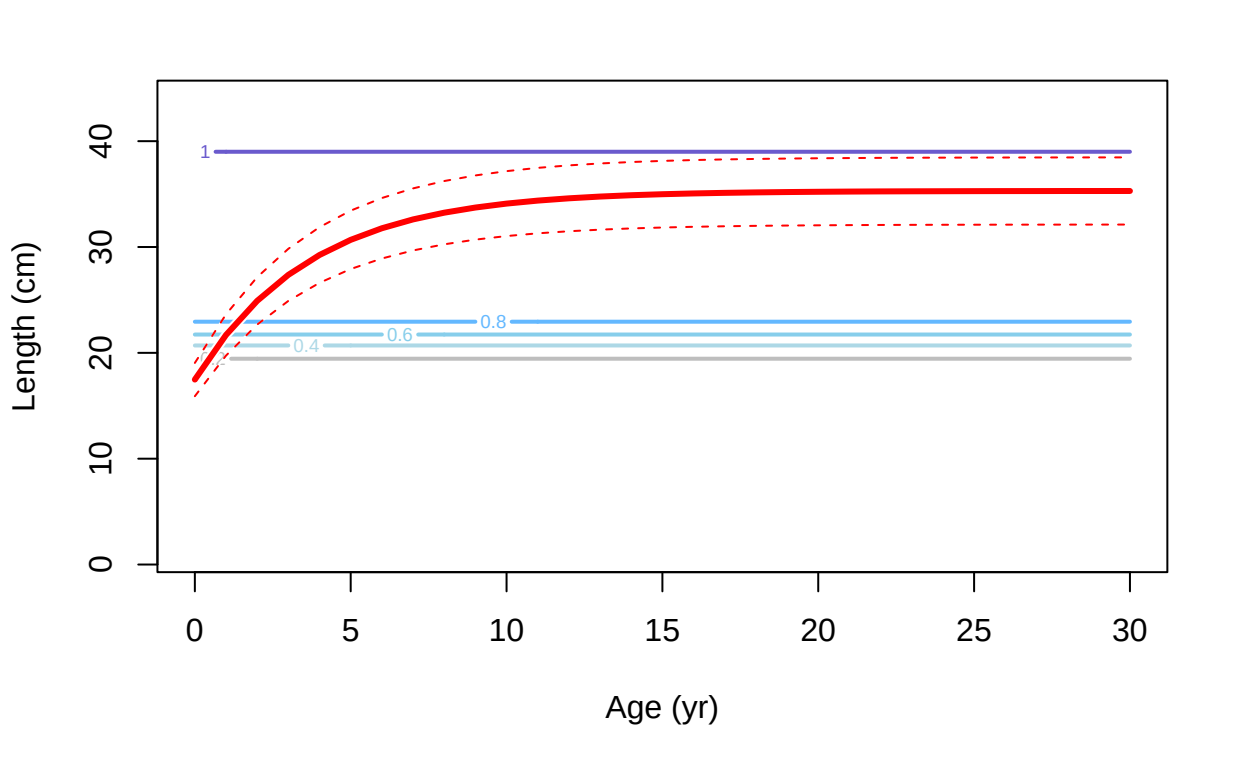

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

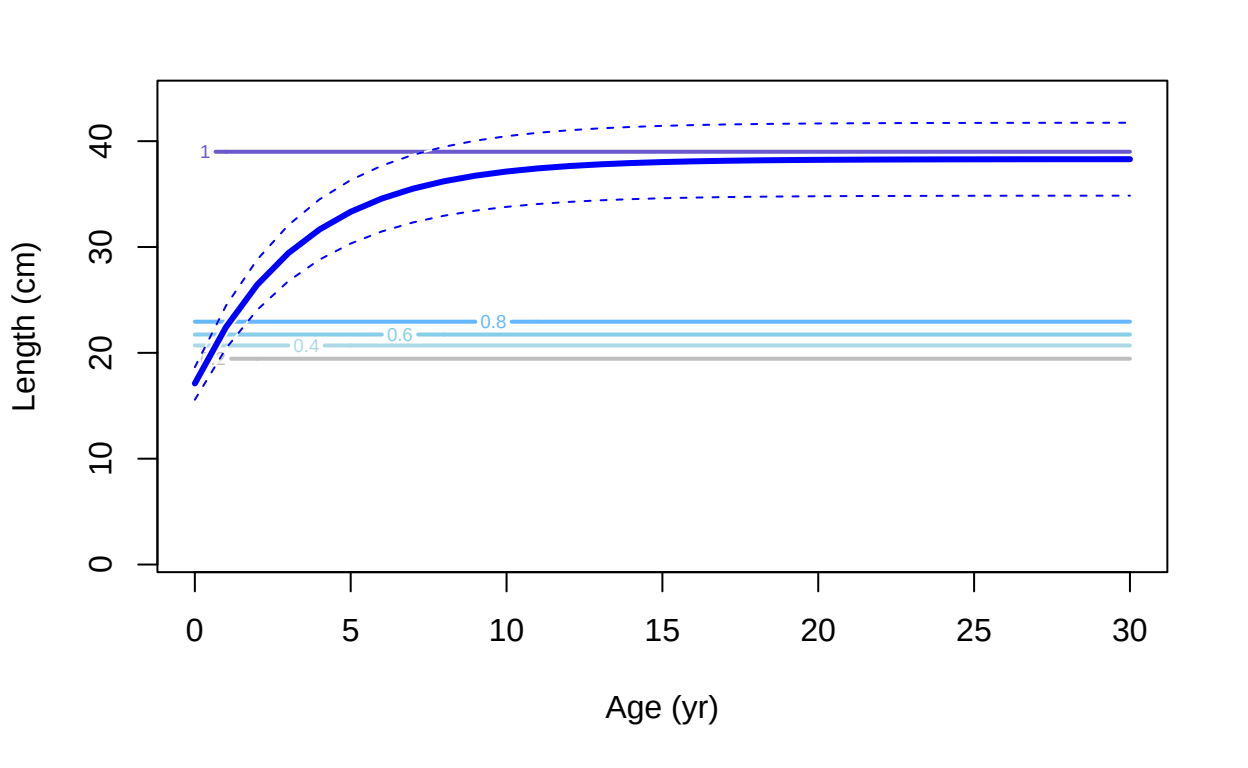

Length (cm)
0
10
20
30
40
1
0.8
0.6
0.4
0
5
10
15
20
25
30
Age (yr)

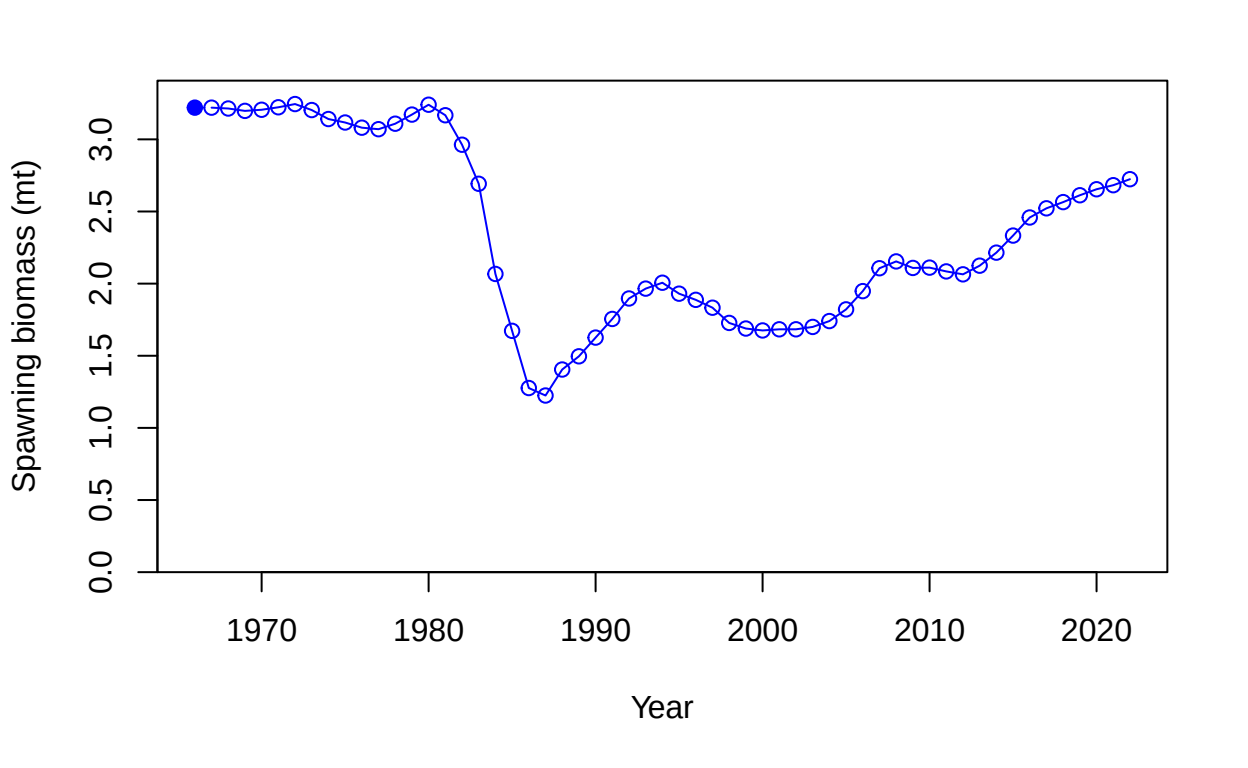

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
1
0.8
0.6
0.4

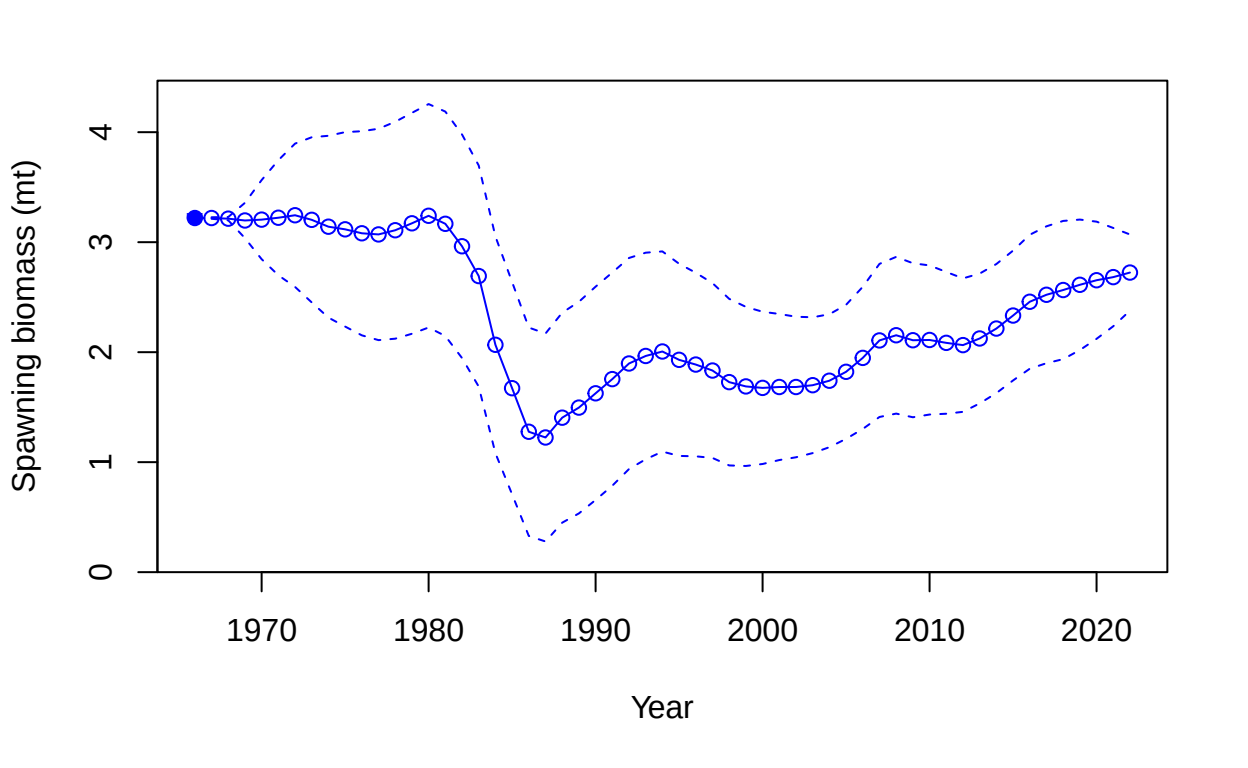

Length (cm)
0
10
20
30
40
1
0.8
0.6
0.4
0
5
10
15
20
25
30
Age (yr)

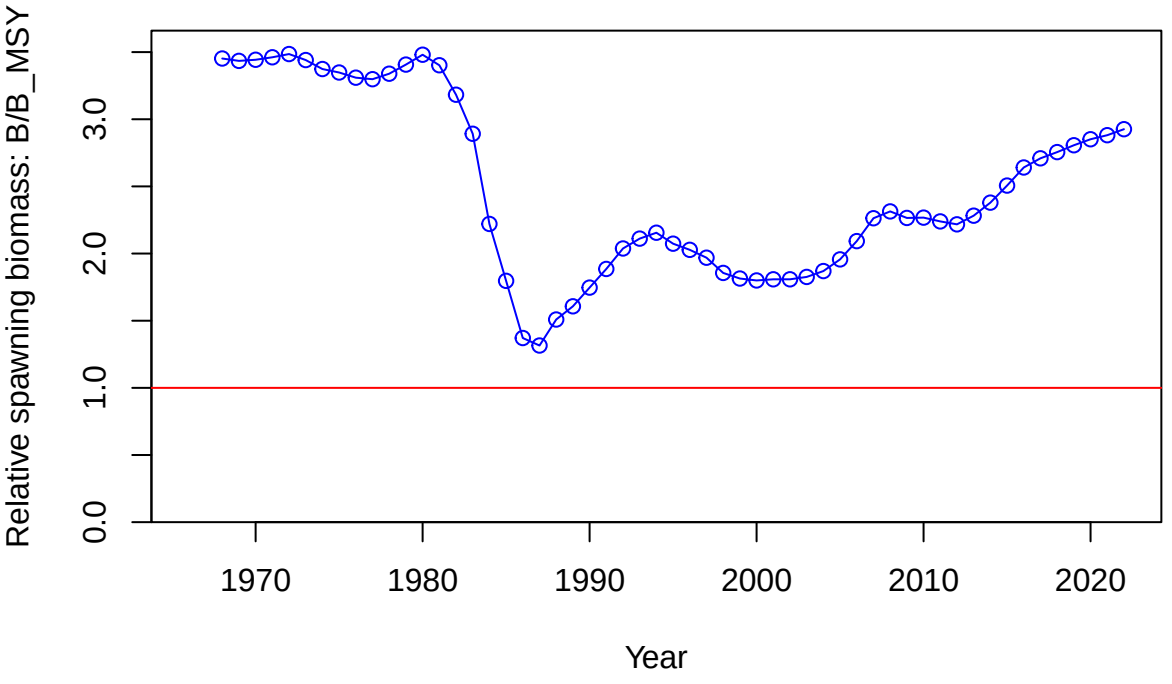

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
1
0.8
0.6
0.4

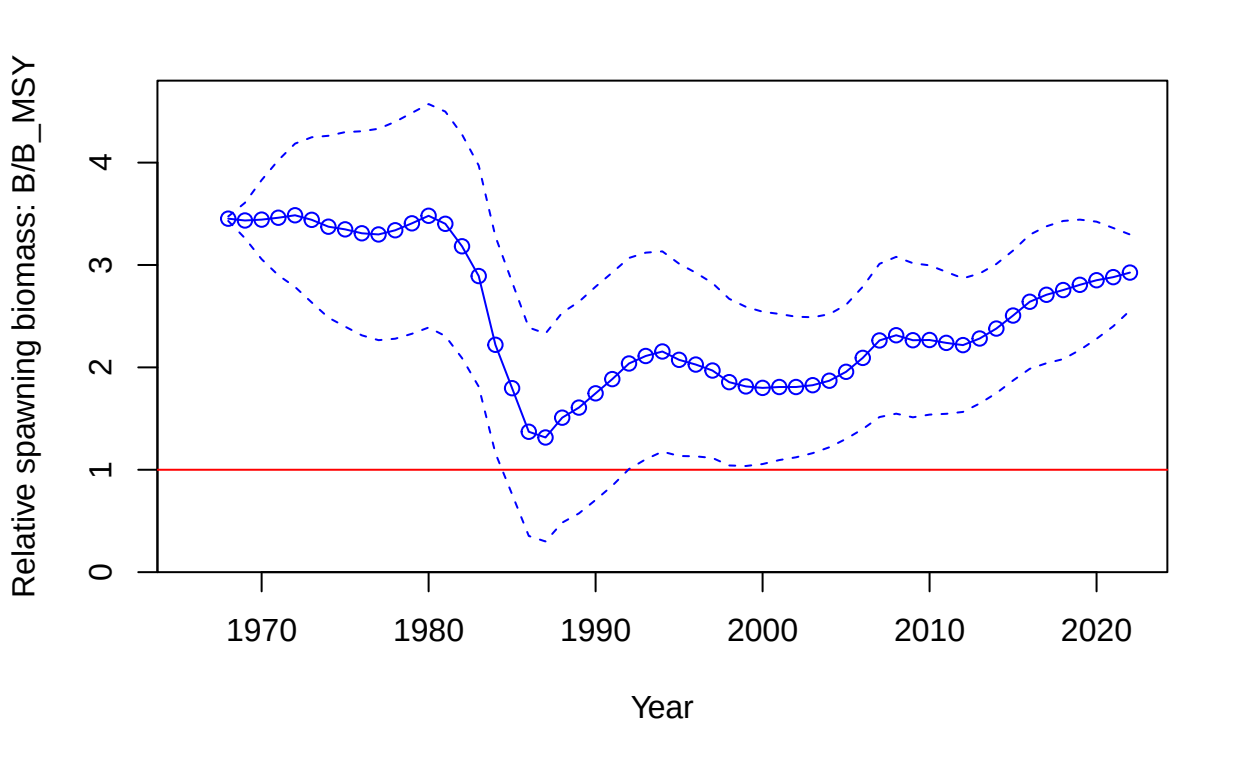

Length (cm)
0
10
20
30
40
1
0.8
0.6
0.4
0
5
10
15
20
25
30
Age (yr)

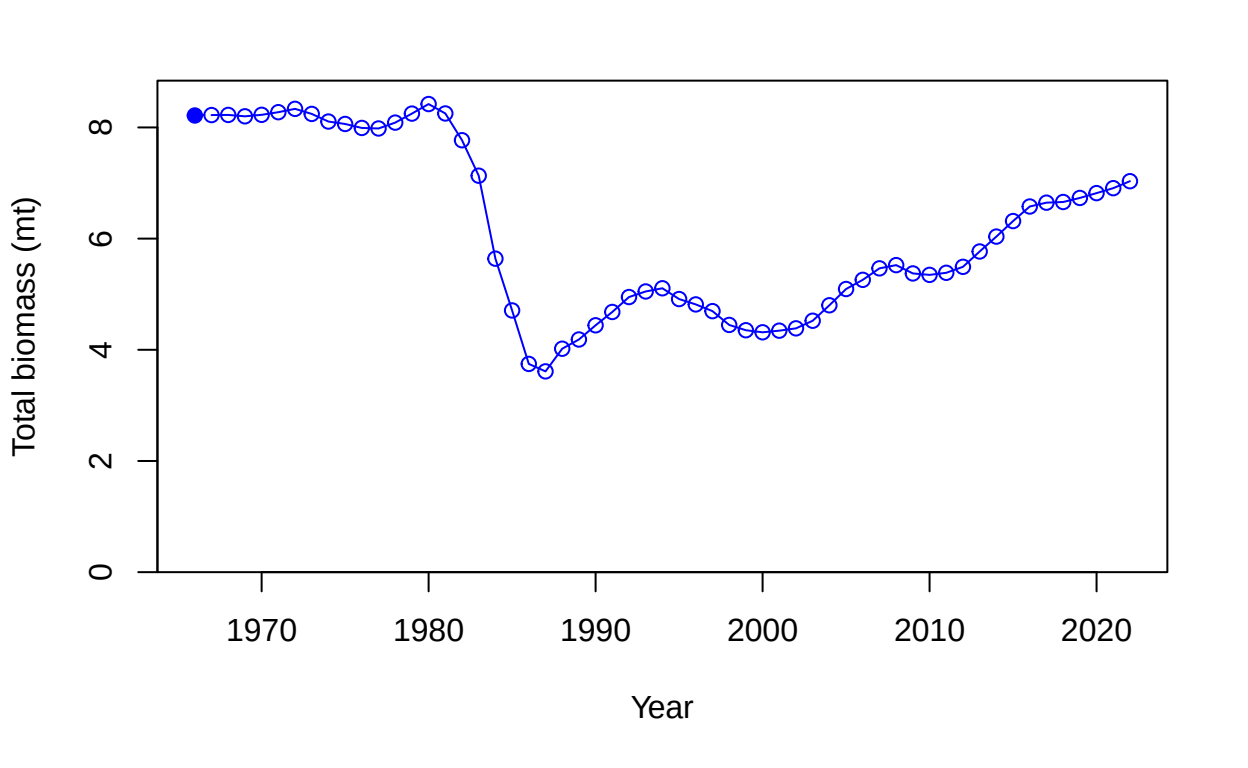

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
1
0.8
0.6
0.4

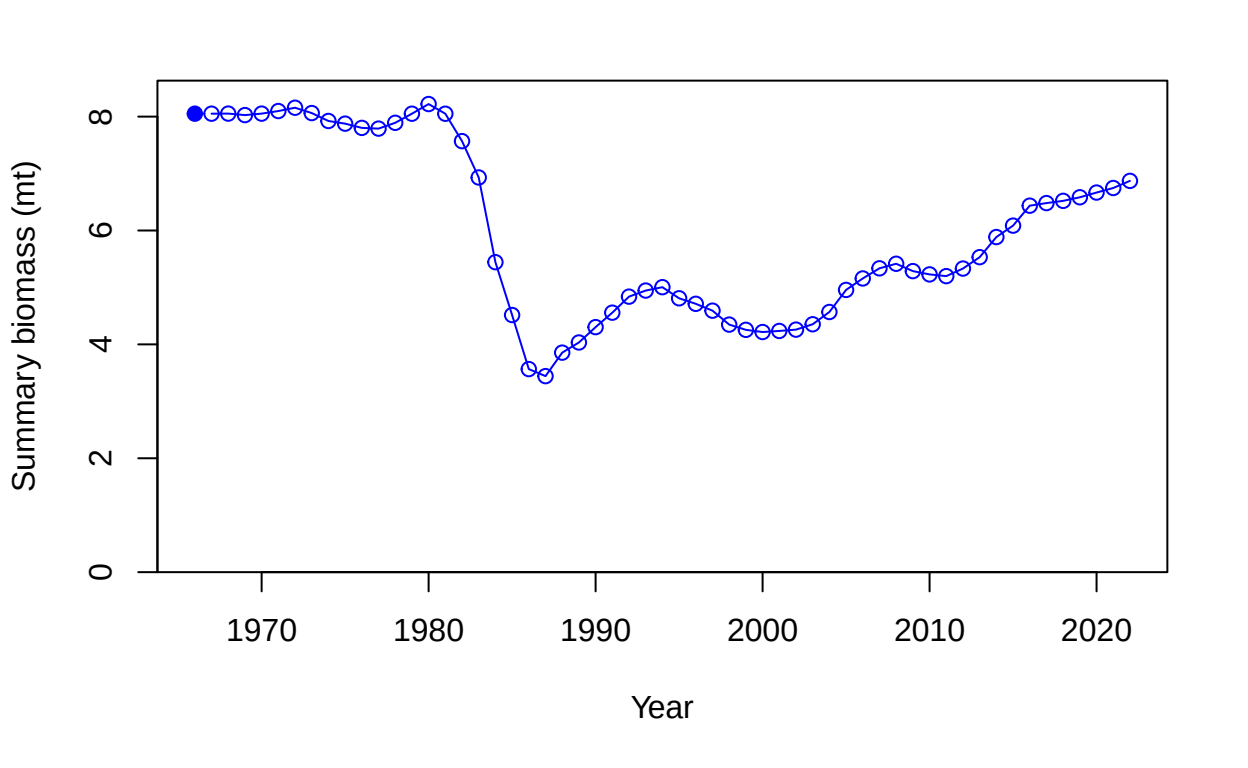

Spawning biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

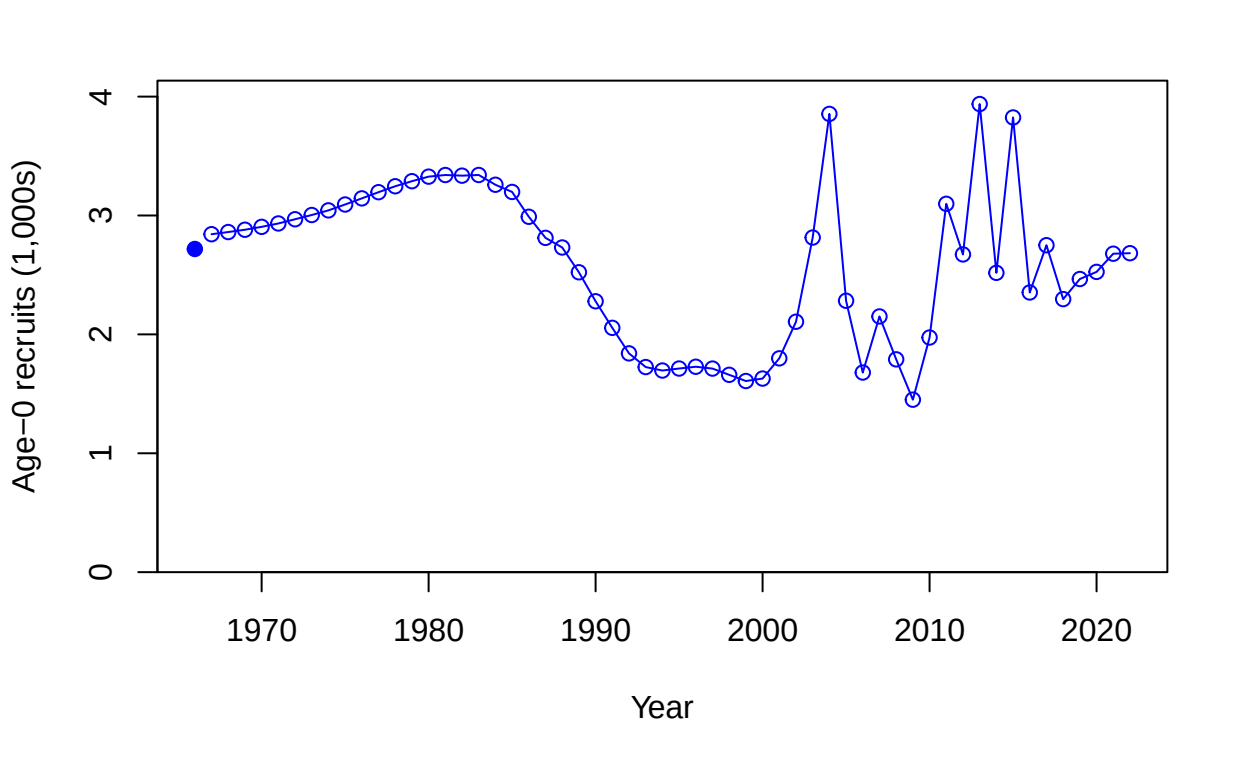

Spawning biomass (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

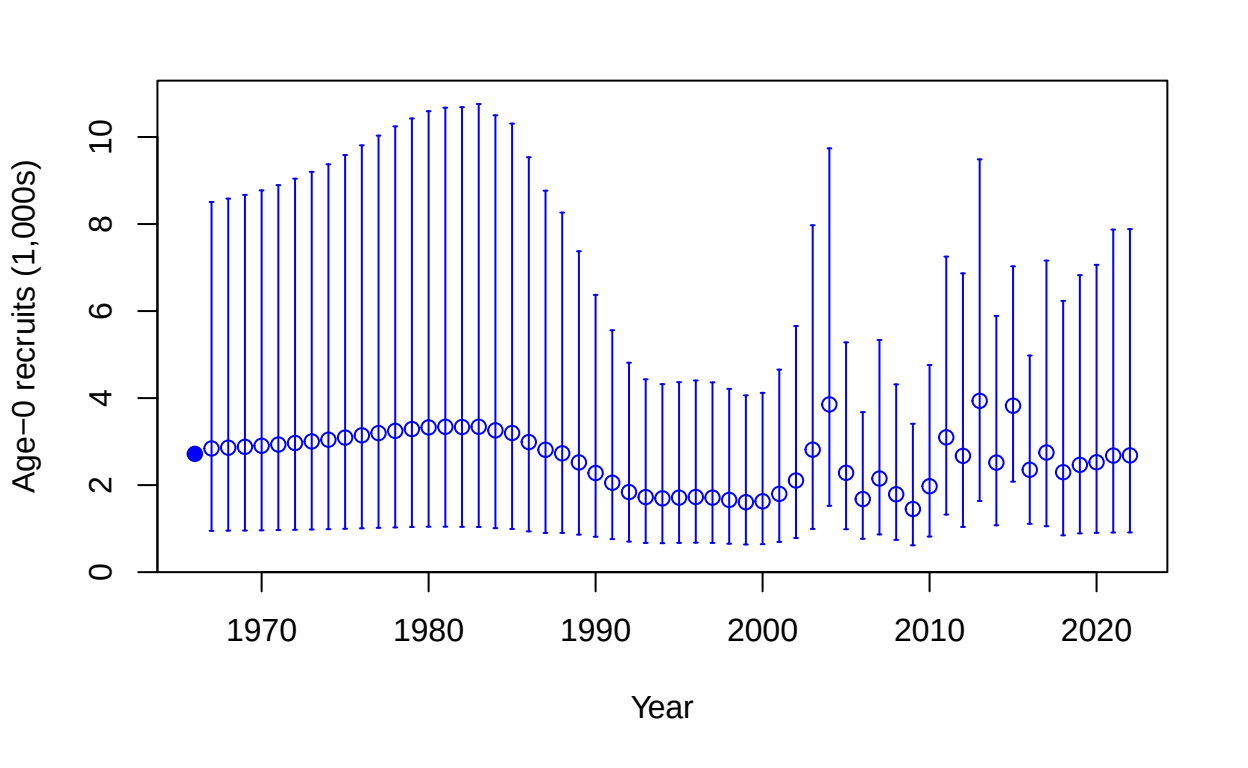

Relative spawning biomass: B/B_MSY
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

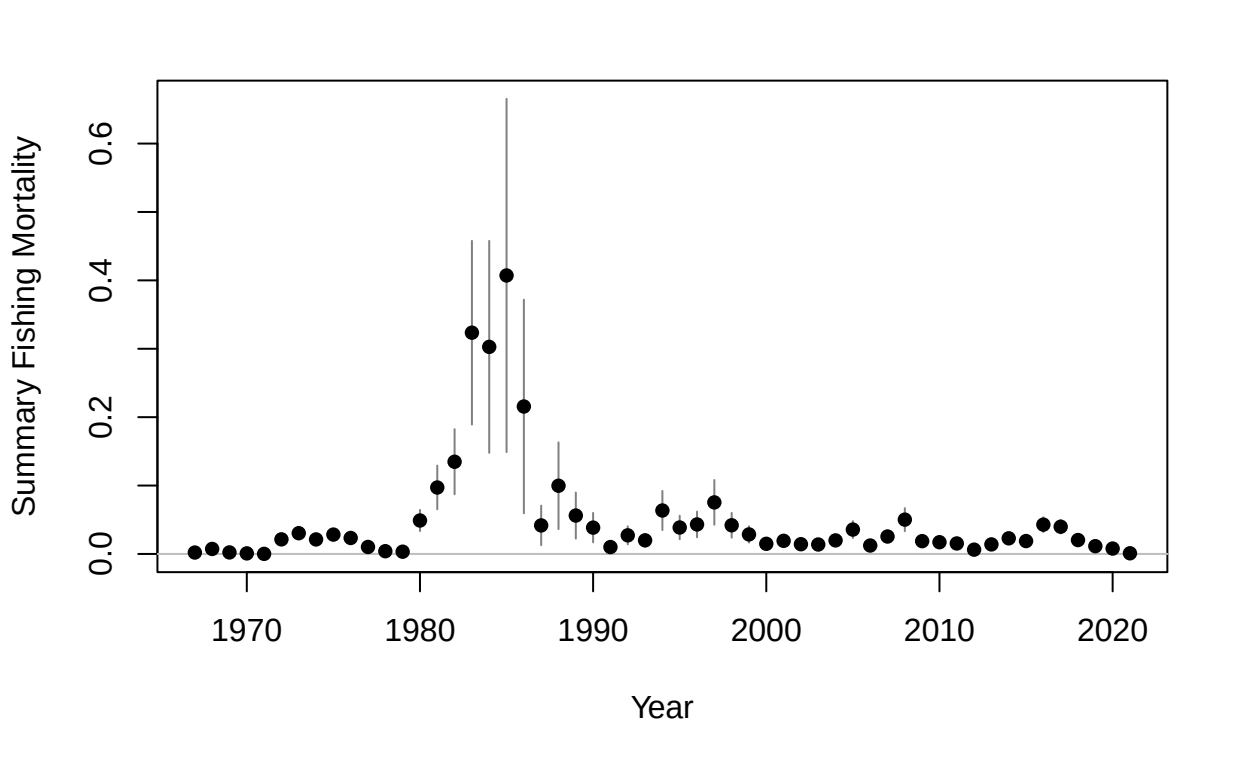

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

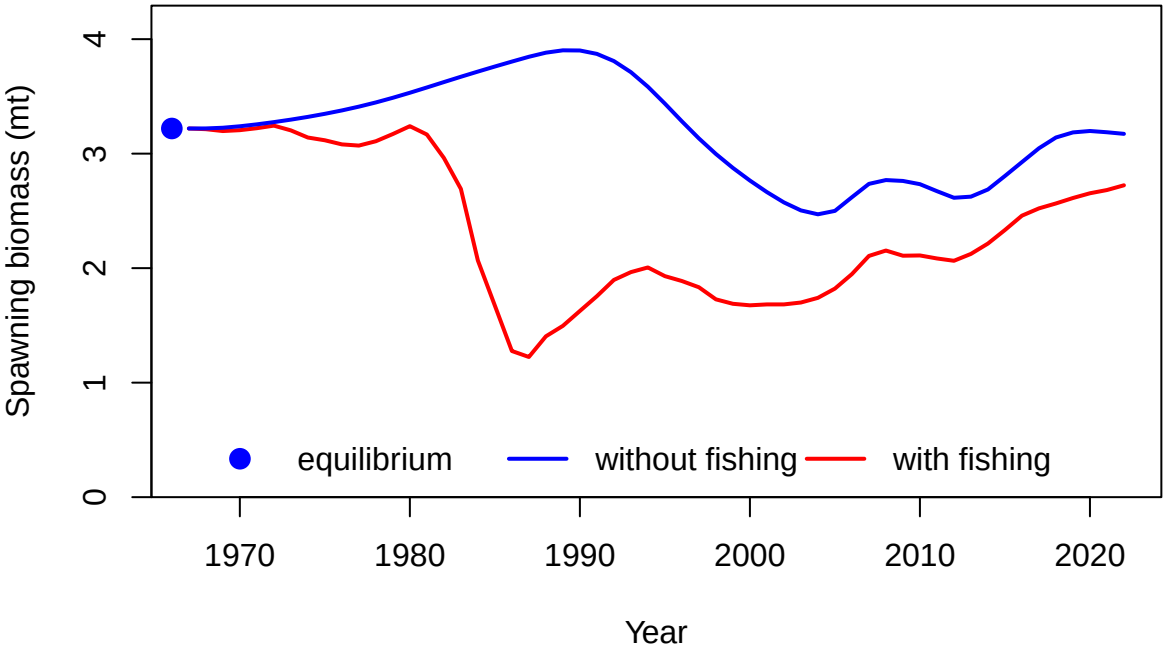

Total biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

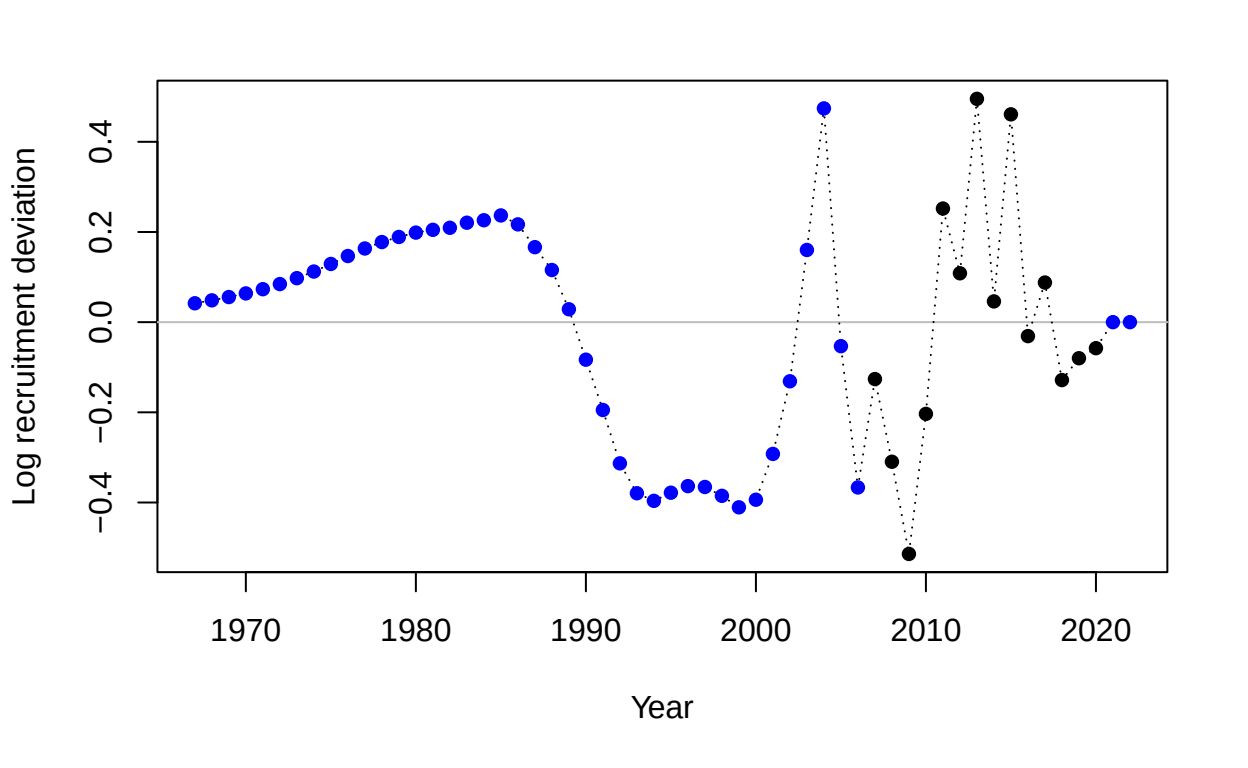

Summary biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

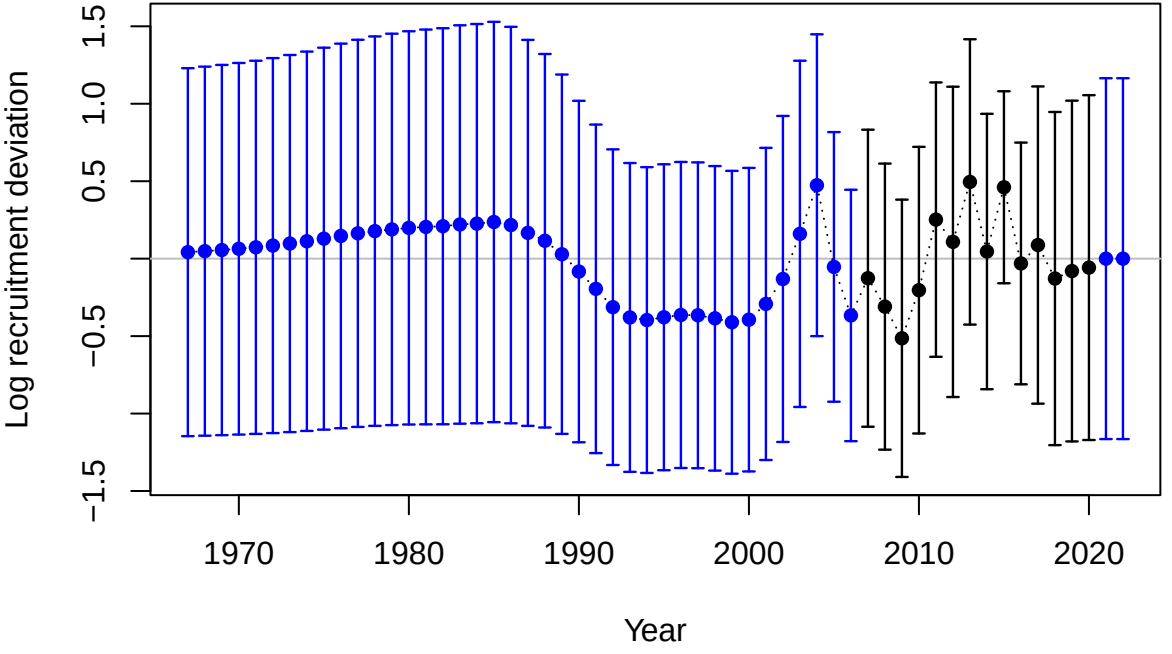

Age−0 recruits (1,000s)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

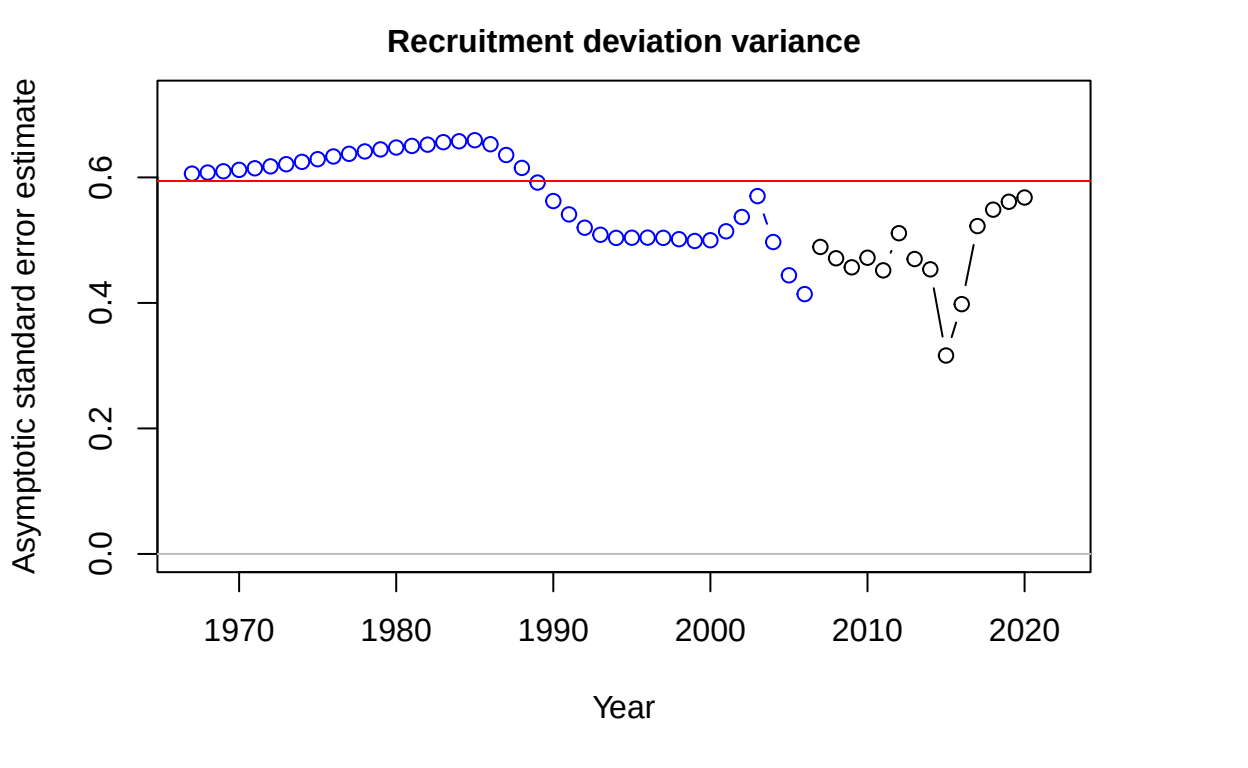

Age−0 recruits (1,000s)
0
2
4
6
8
10
1970
1980
1990
2000
2010
2020
Year

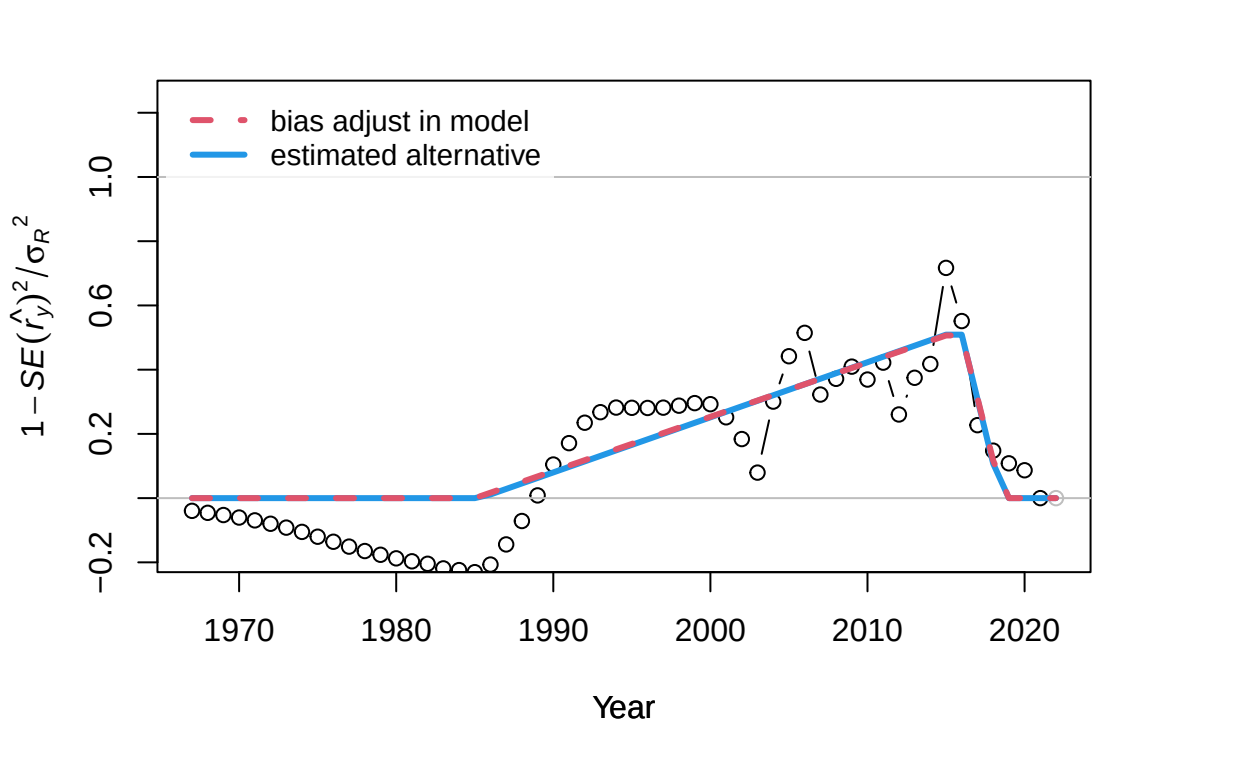

Summary Fishing Mortality
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

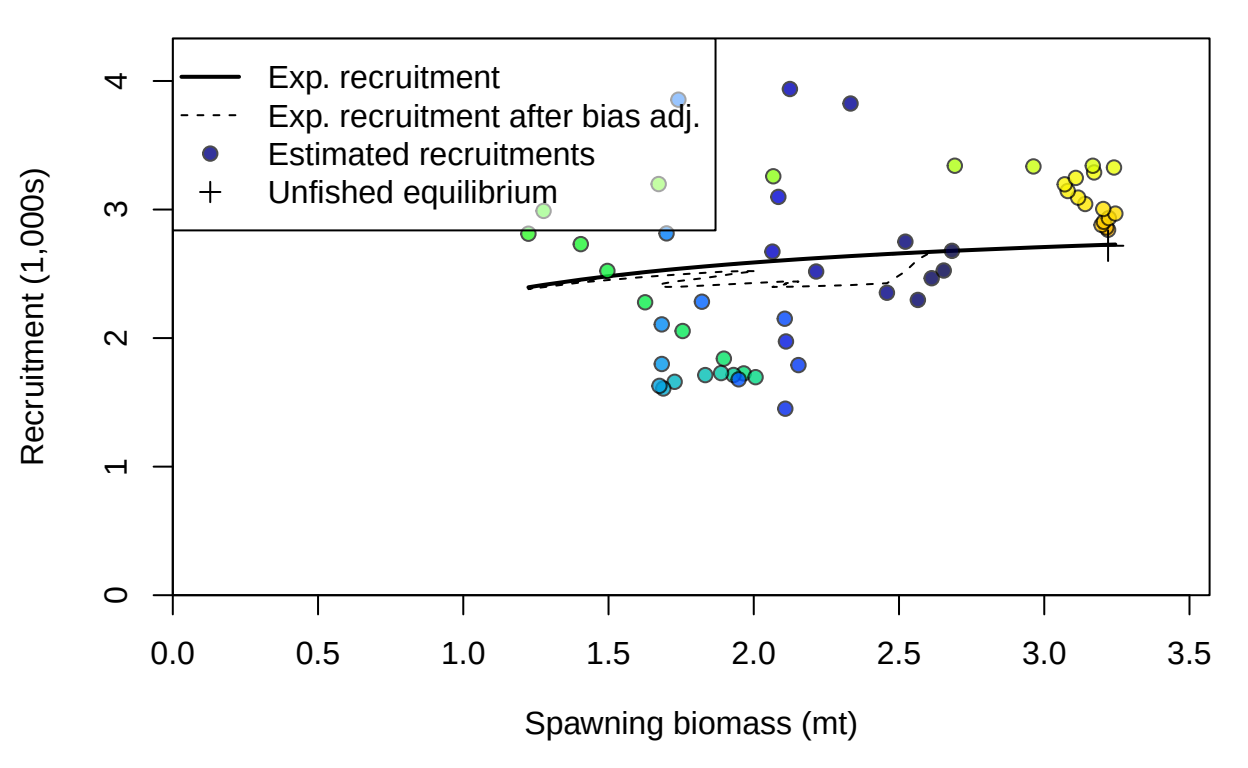

Spawning biomass (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

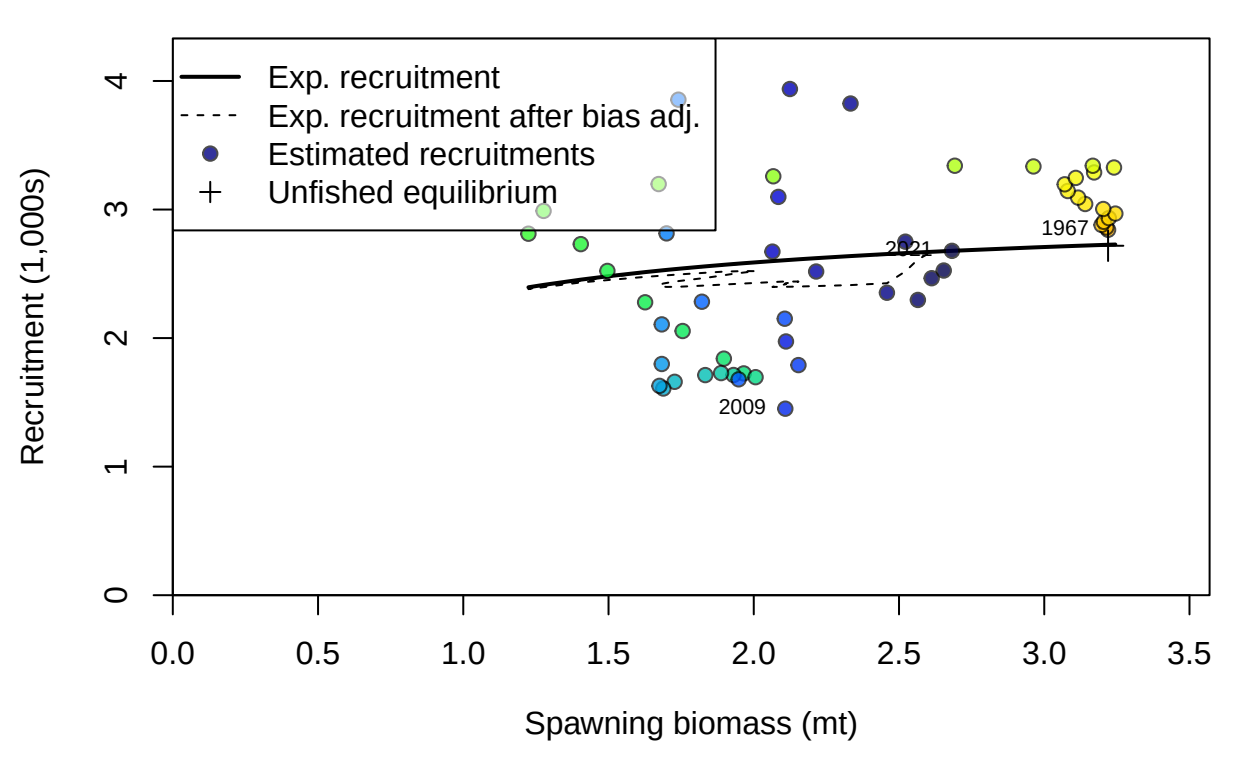

Log recruitment deviation
0.4
0.2
0.0
−0.2
−0.4
1970
1980
1990
2000
2010
2020
Year

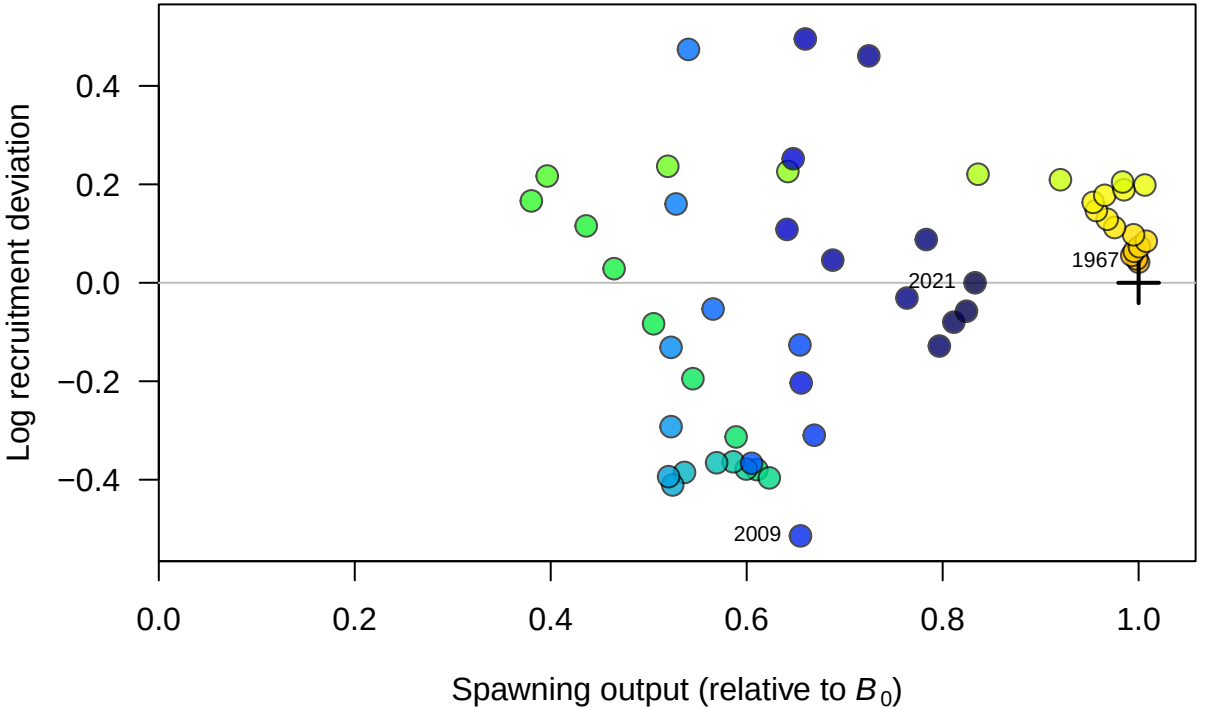

Log recruitment deviation
1.5
1.0
0.5
−0.5
−1.5
1970
1980
1990
2000
2010
2020
Year

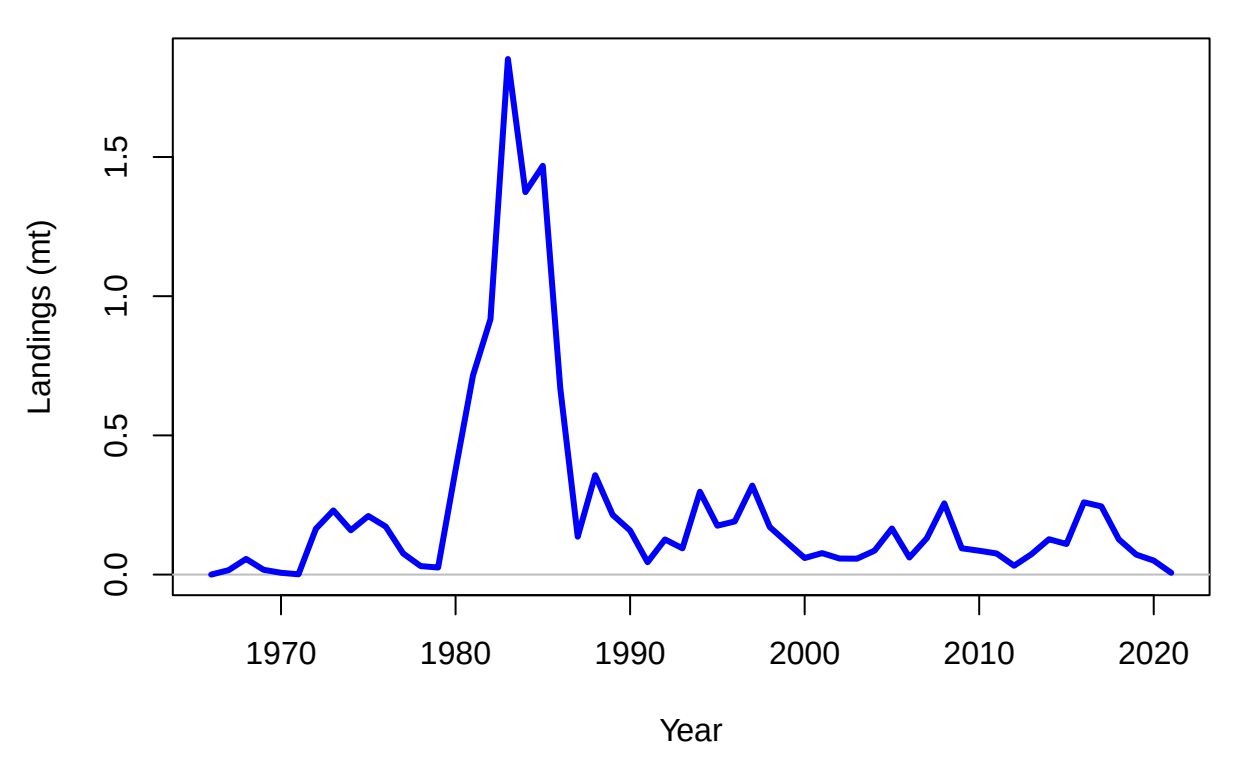

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

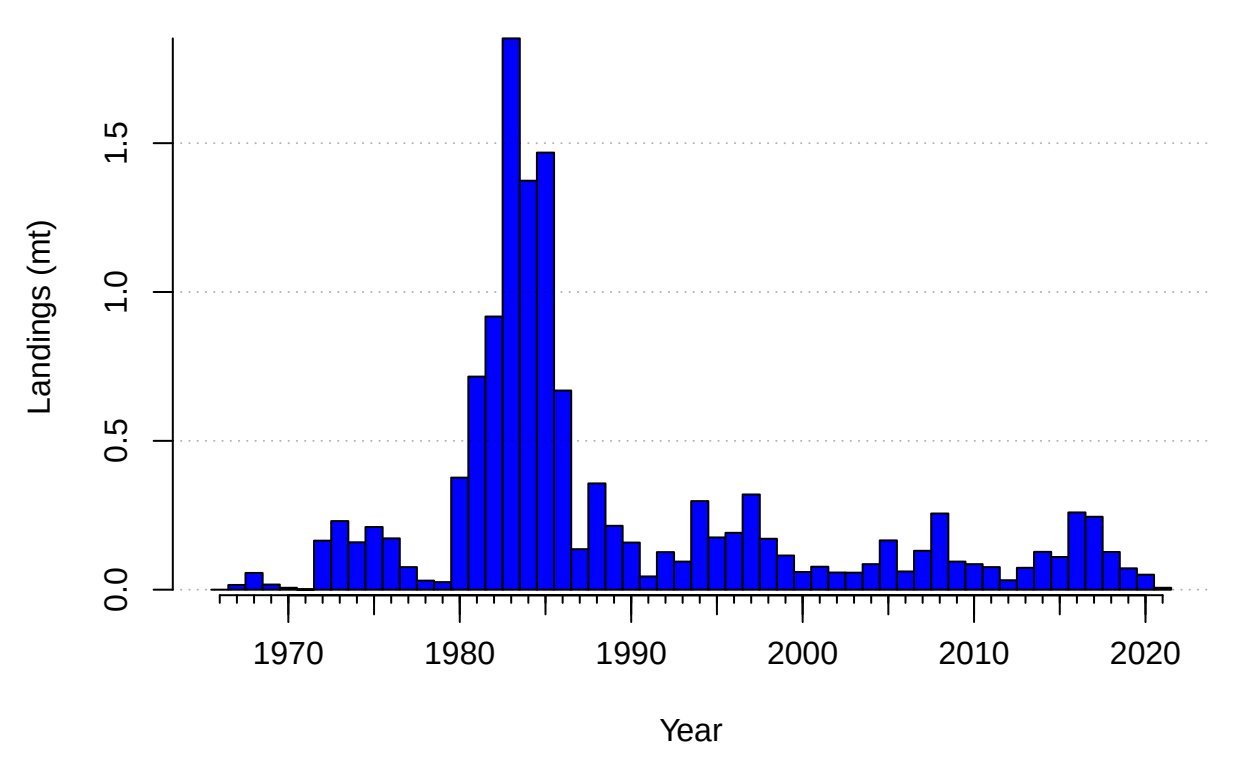

bias adjust in model
estimated alternative
$1 - SE(\hat{r_y})^2/\sigma_R^2$
1.0
0.6
0.2
−0.2
1970
1980
1990
2000
2010
2020
Year

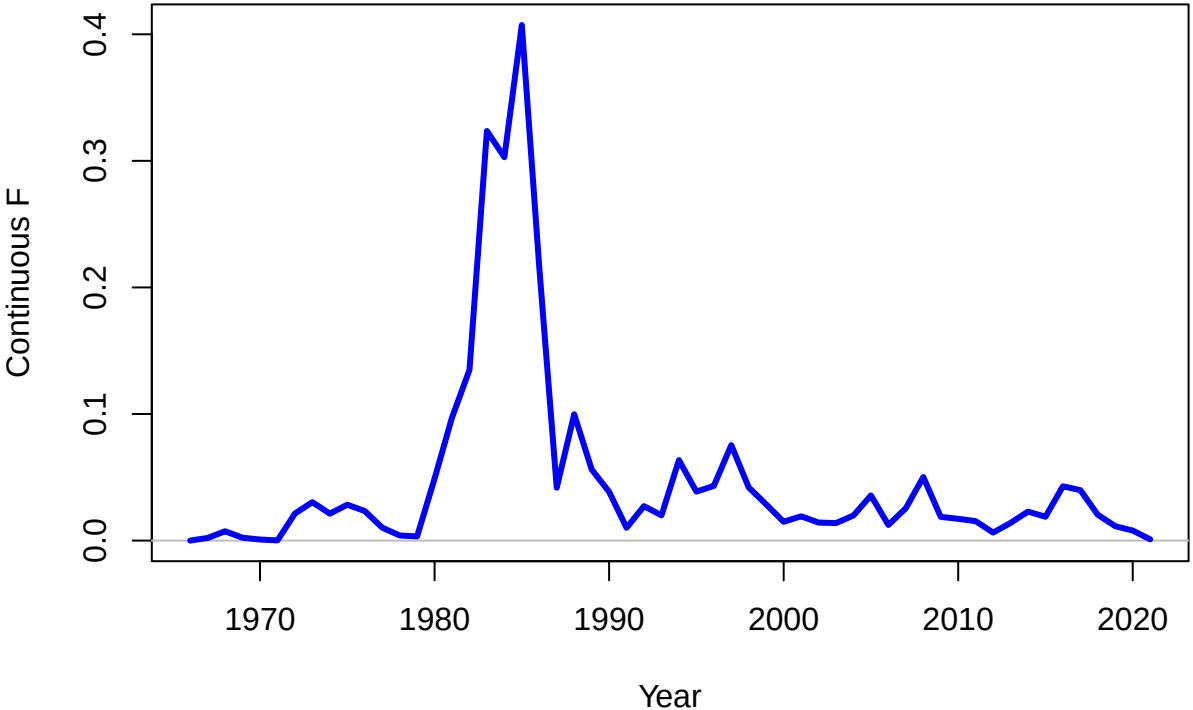

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
1
2
3
4
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Spawning biomass (mt)

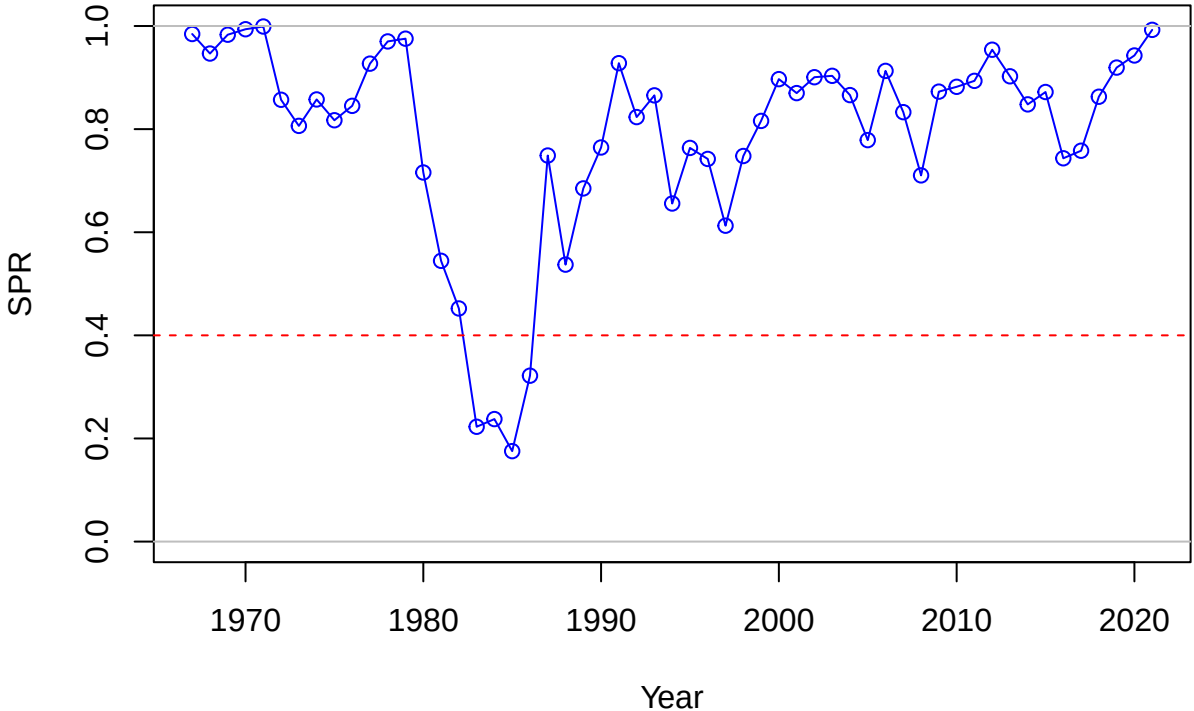

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
1967
2021
2009
Recruitment (1,000s)
0
1
2
3
4
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Spawning biomass (mt)

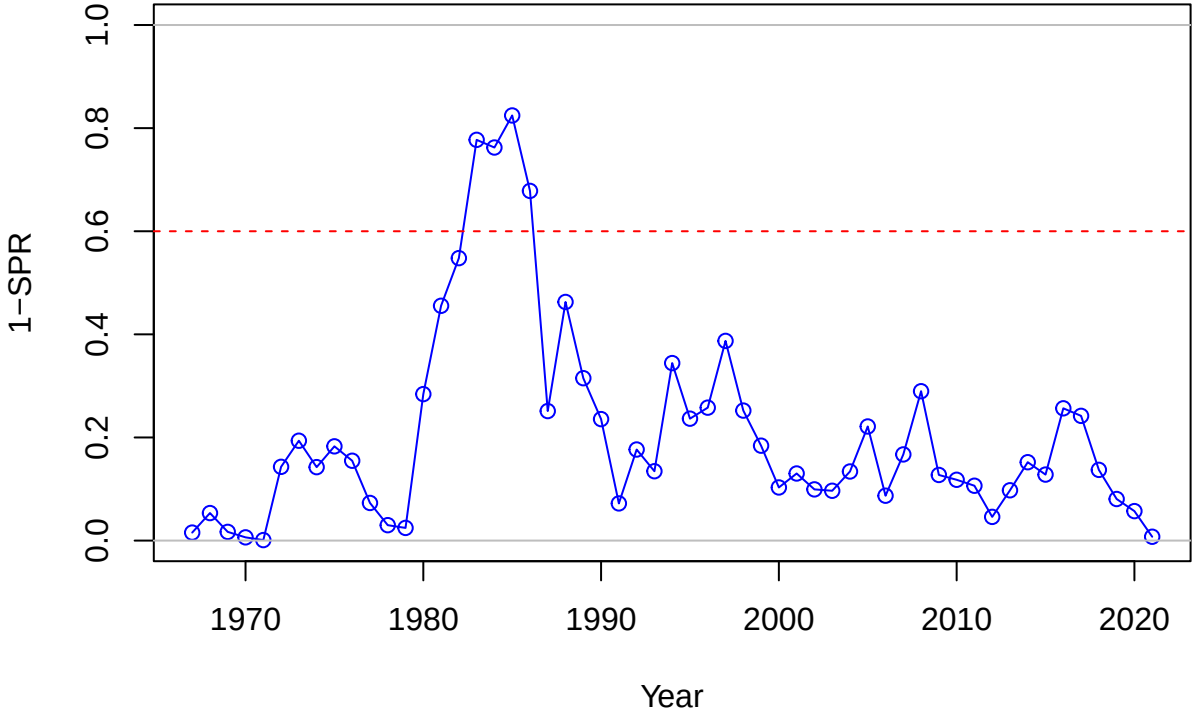

Log recruitment deviation
0.4
0.2
0.0
−0.2
−0.4
2009
2021
1967
0.0
0.2
0.4
0.6
0.8
1.0
Spawning output (relative to B_0)

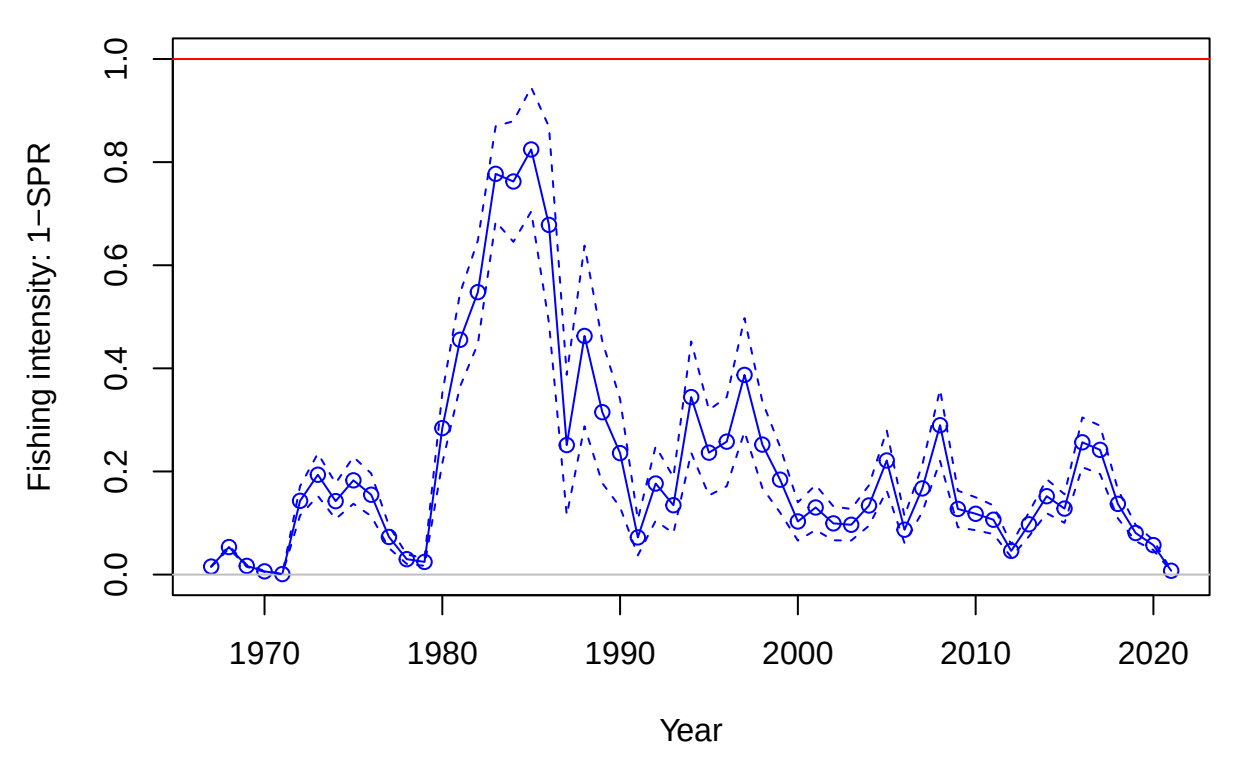

Landings (mt)
0.0
0.5
1.0
1.5
1970
1980
1990
2000
2010
2020
Year

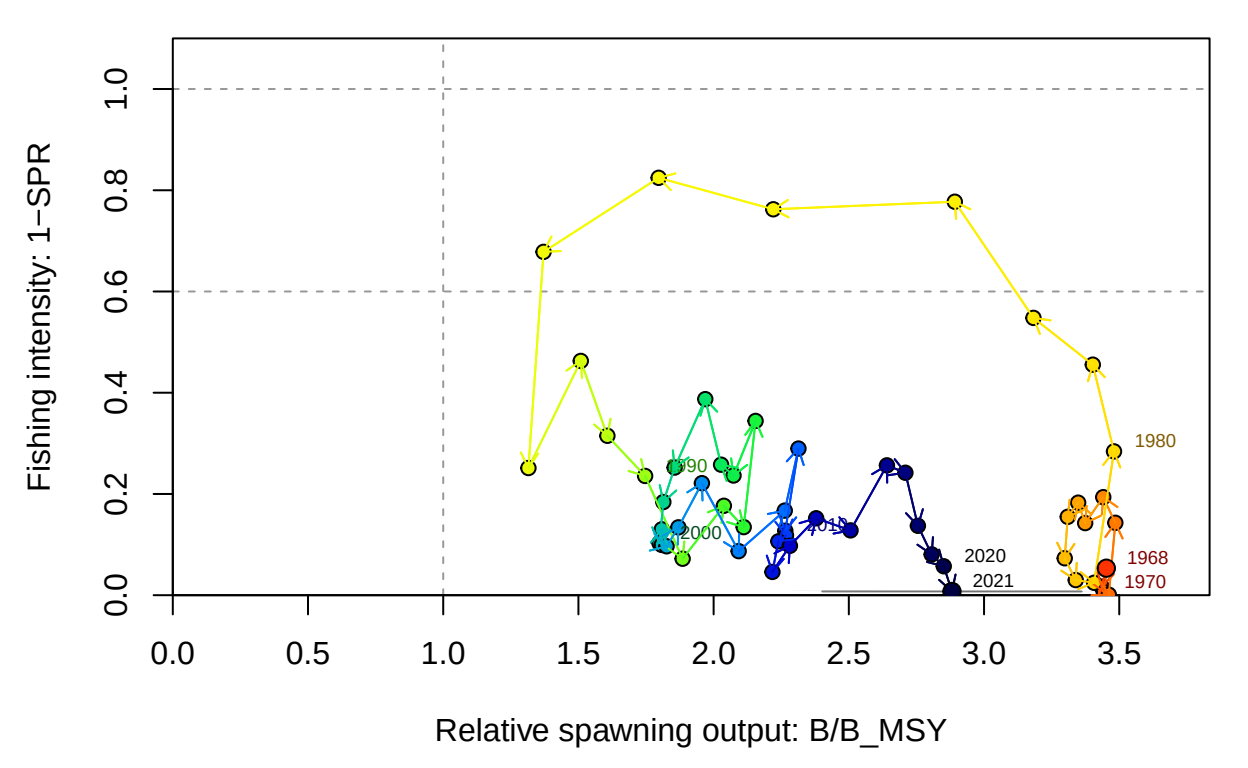

Landings (mt)
0.0
0.5
1.0
1.5
1970
1980
1990
2000
2010
2020
Year

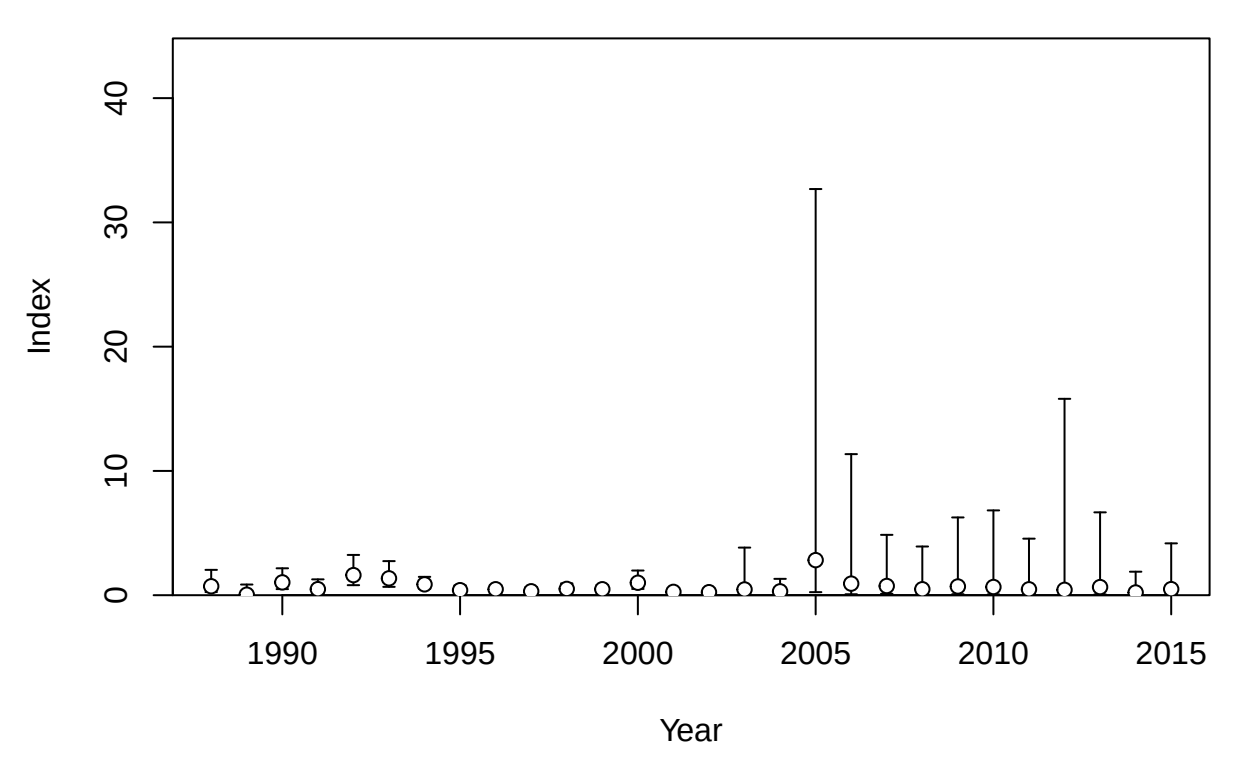

Continuous F
0.0
0.1
0.2
0.3
0.4
1970
1980
1990
2000
2010
2020
Year

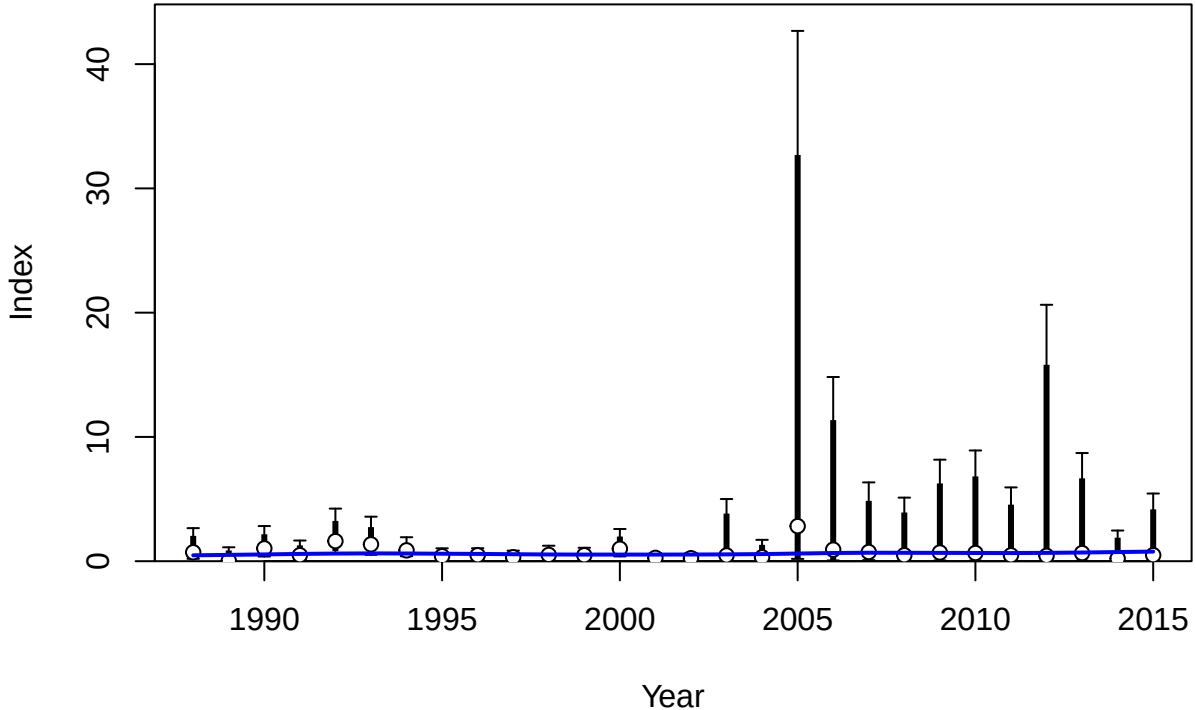

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

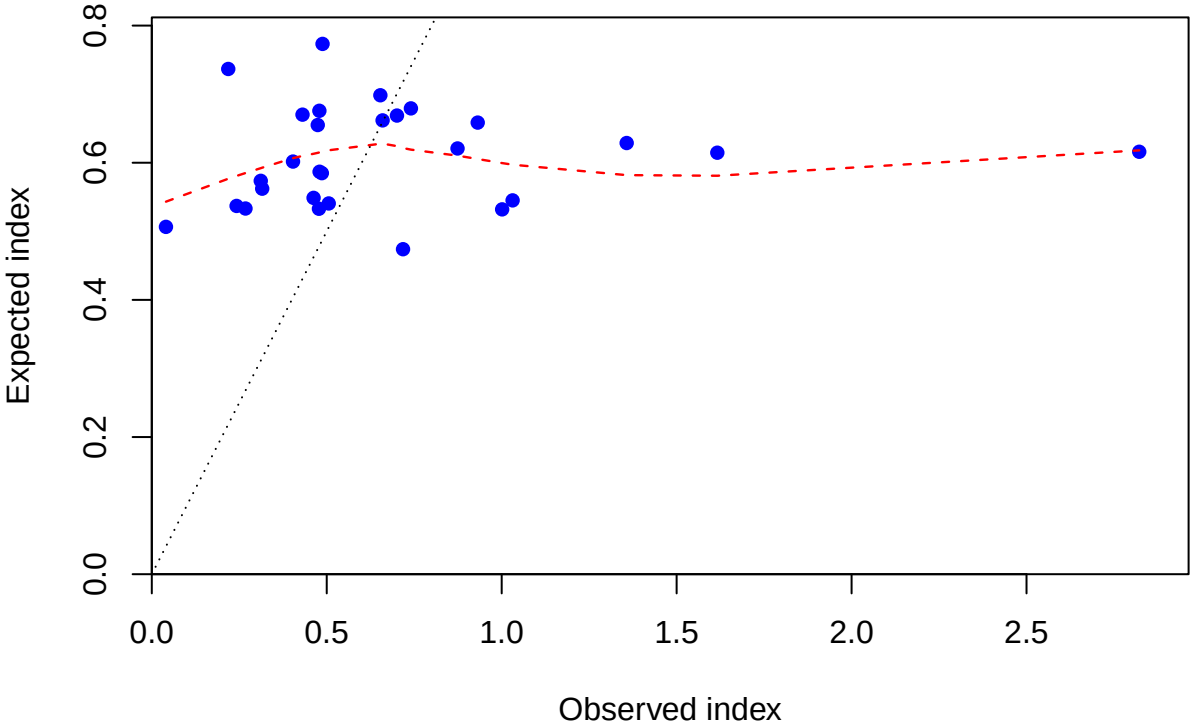

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

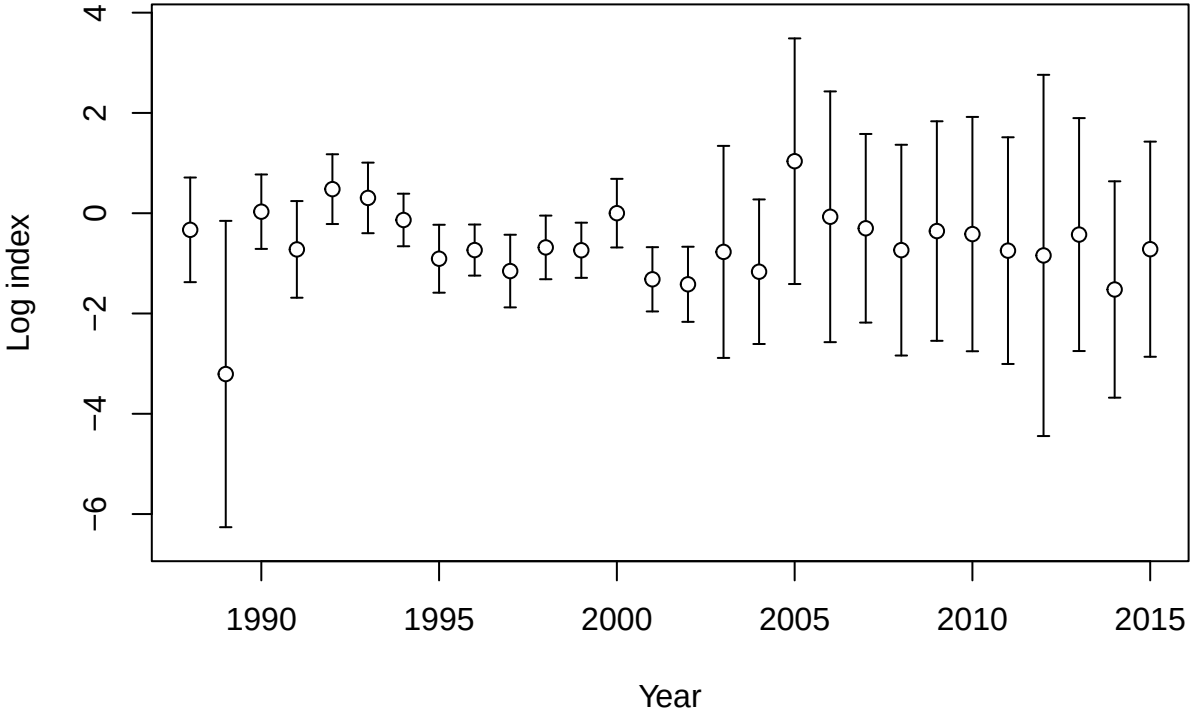

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

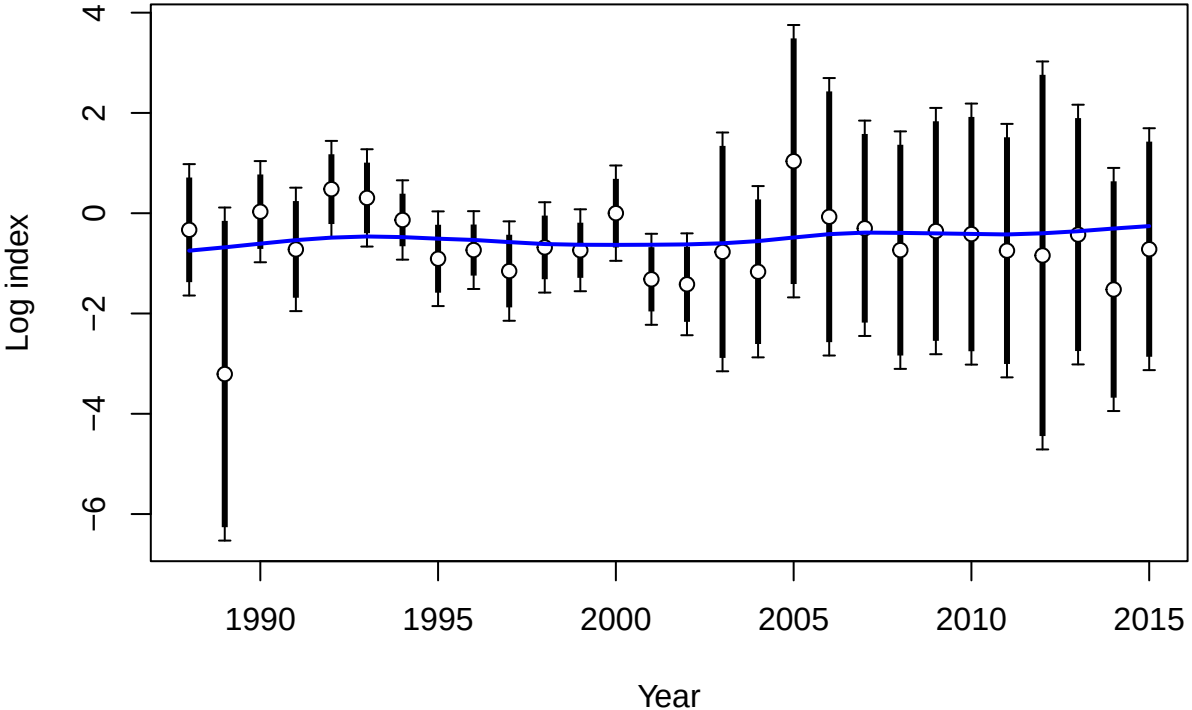

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Relative spawning output: B/B_MSY
1980
1990
2000
2010
2020
2021
1968
1970

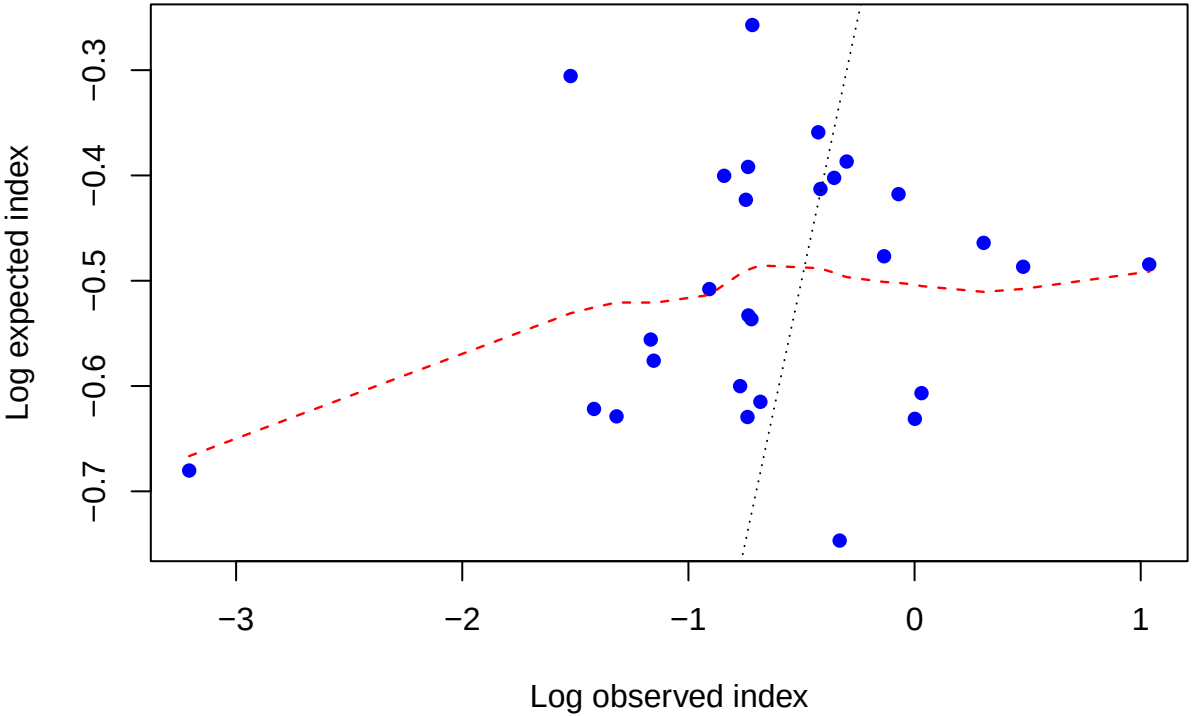

Index
0
10
20
30
40
1990
1995
2000
2005
2010
2015
Year

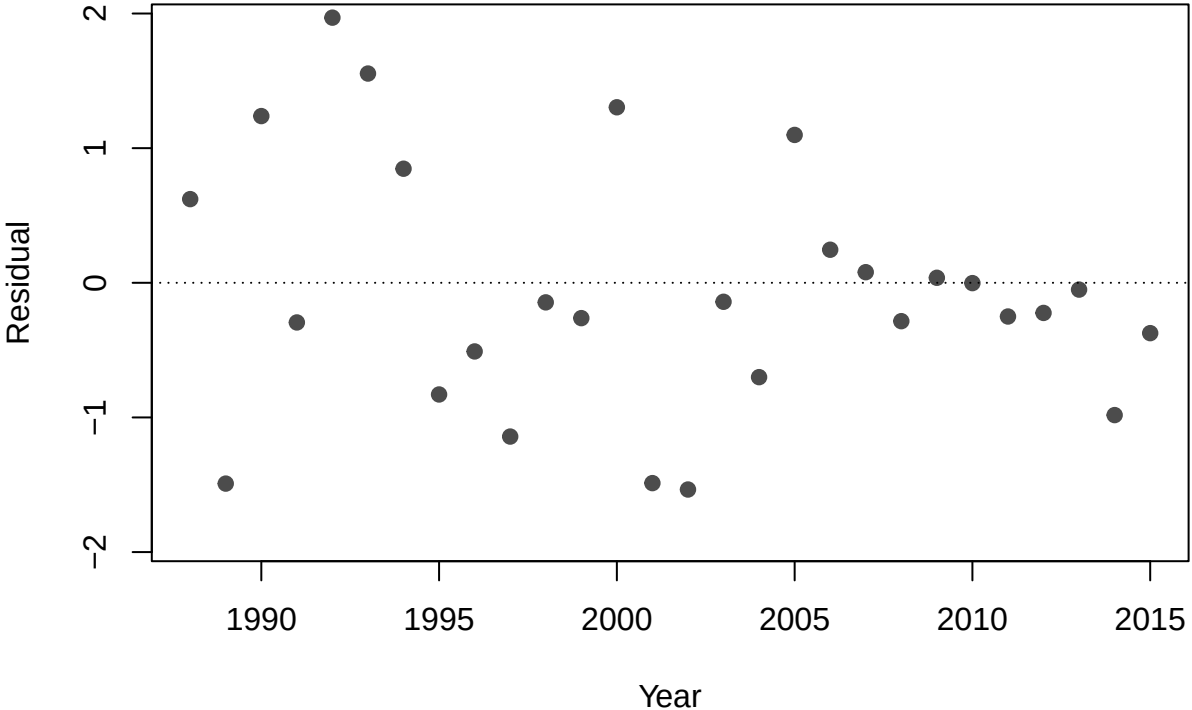

Index
0
10
20
30
40
1990
1995
2000
2005
2010
2015
Year

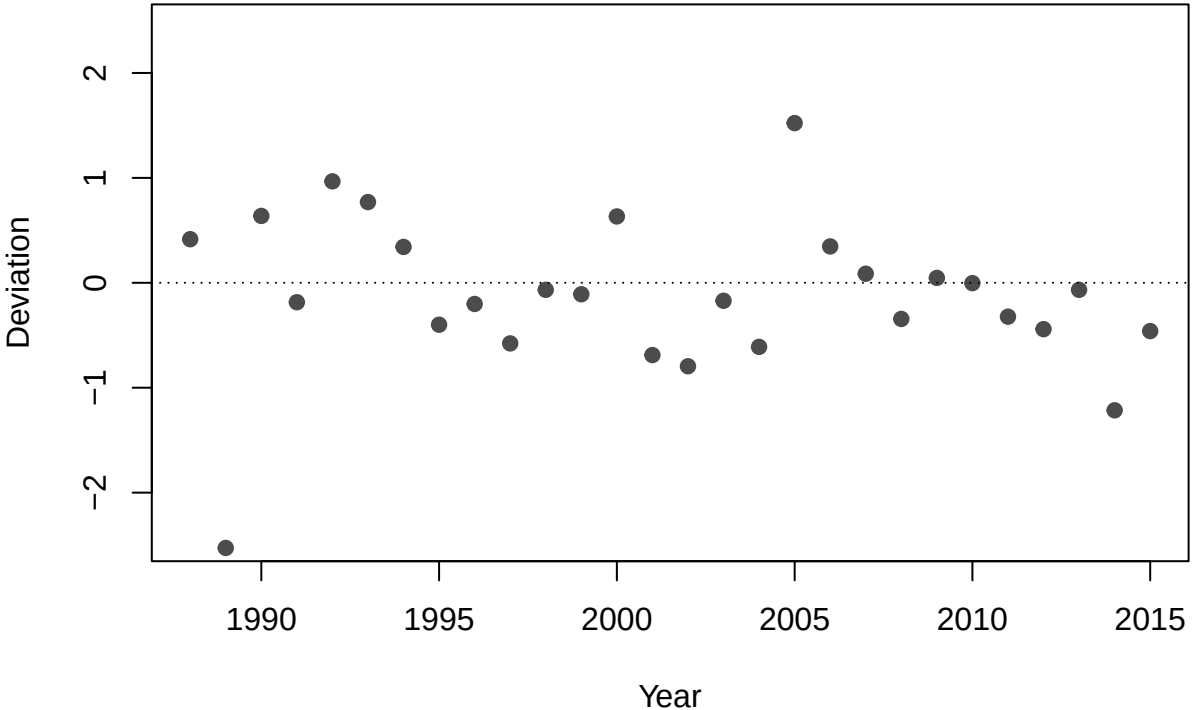

Expected index
0.0
0.2
0.4
0.6
0.8
0.0
0.5
1.0
1.5
2.0
2.5
Observed index

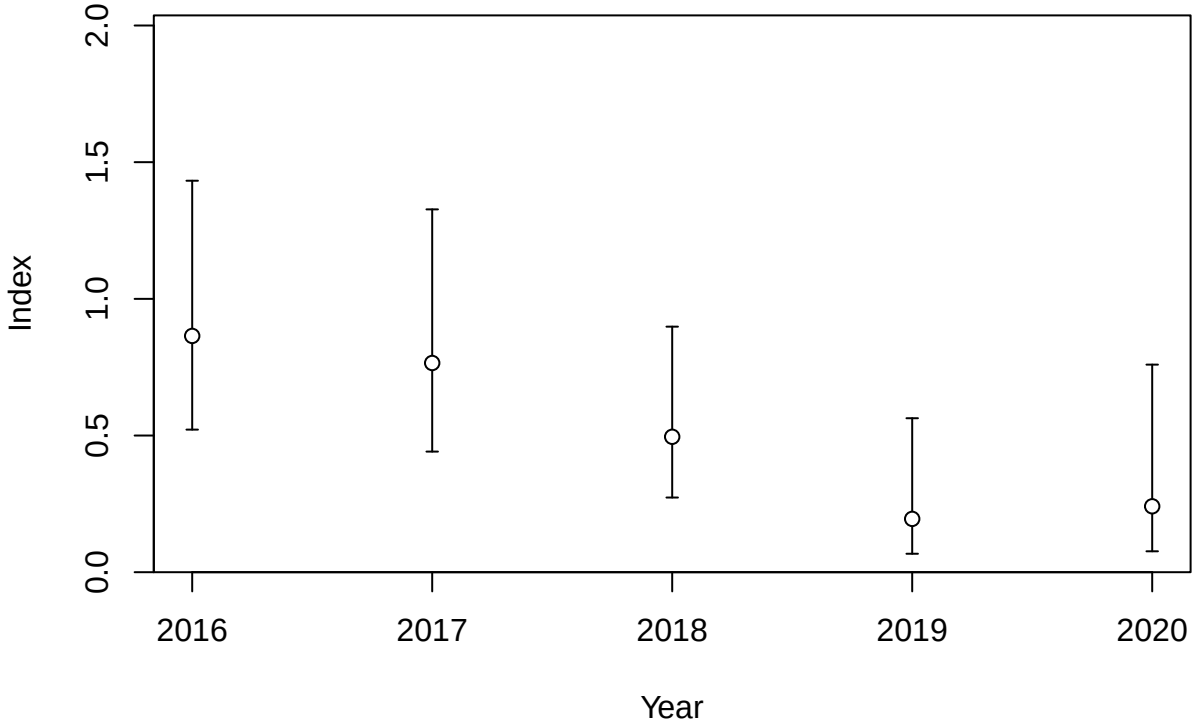

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
Year

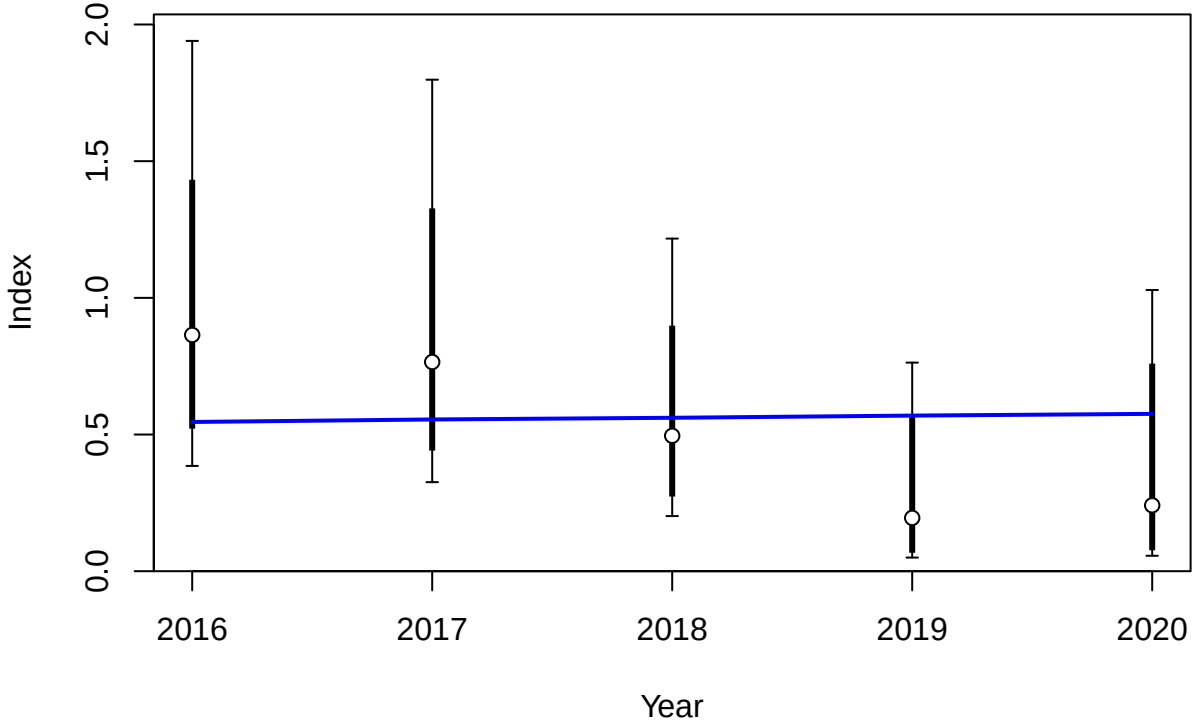

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
Year

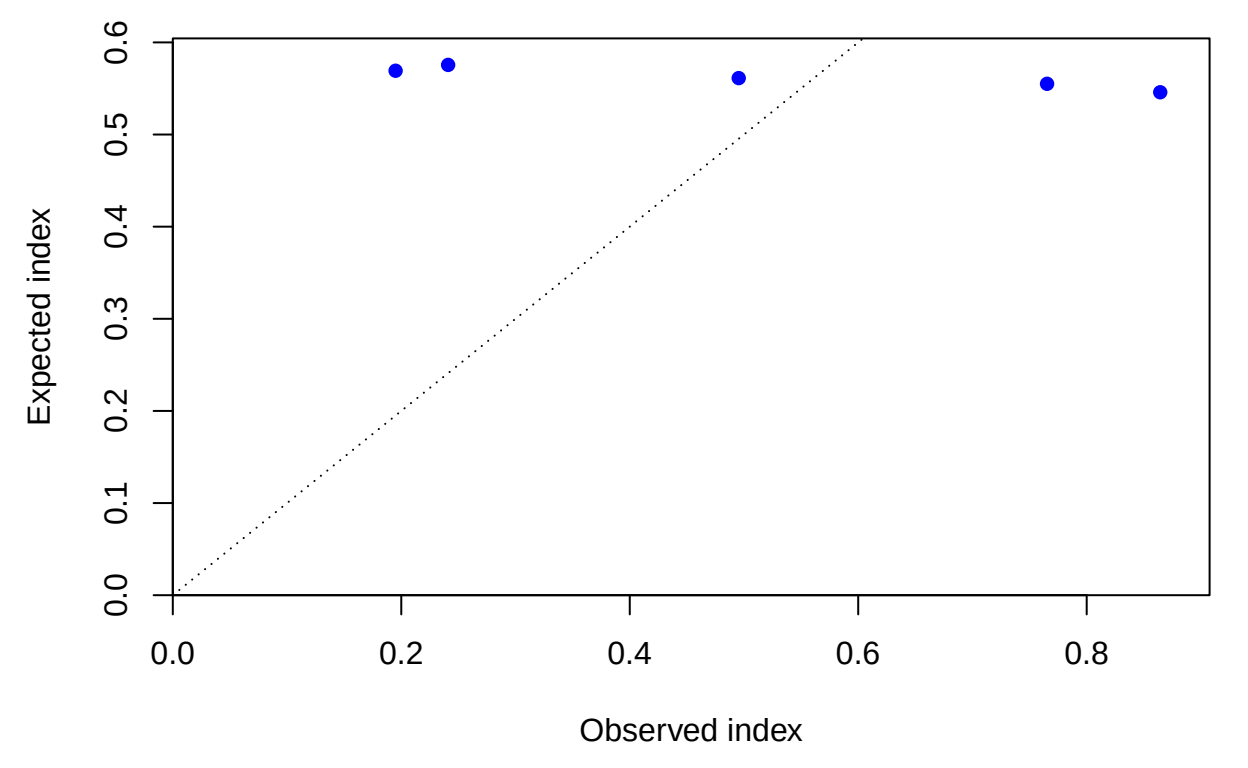

Log expected index
−0.3
−0.4
−0.5
−0.6
−0.7
−3
−2
−1
0
1
Log observed index

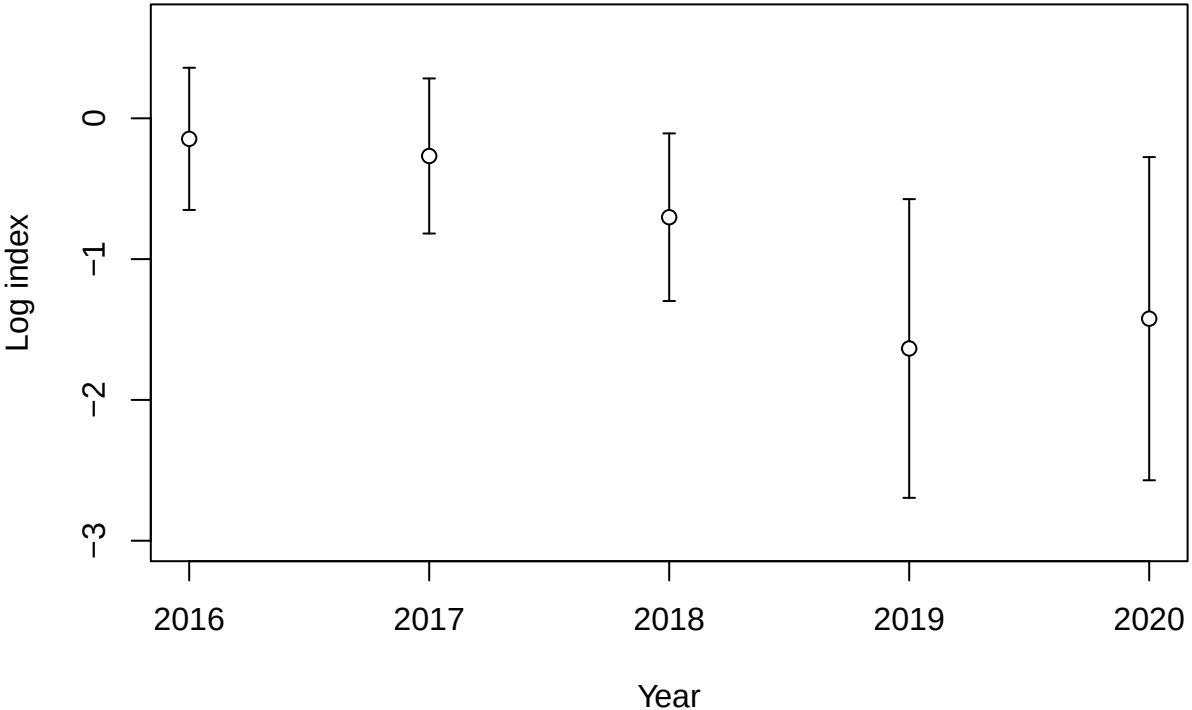

Residual
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
Year

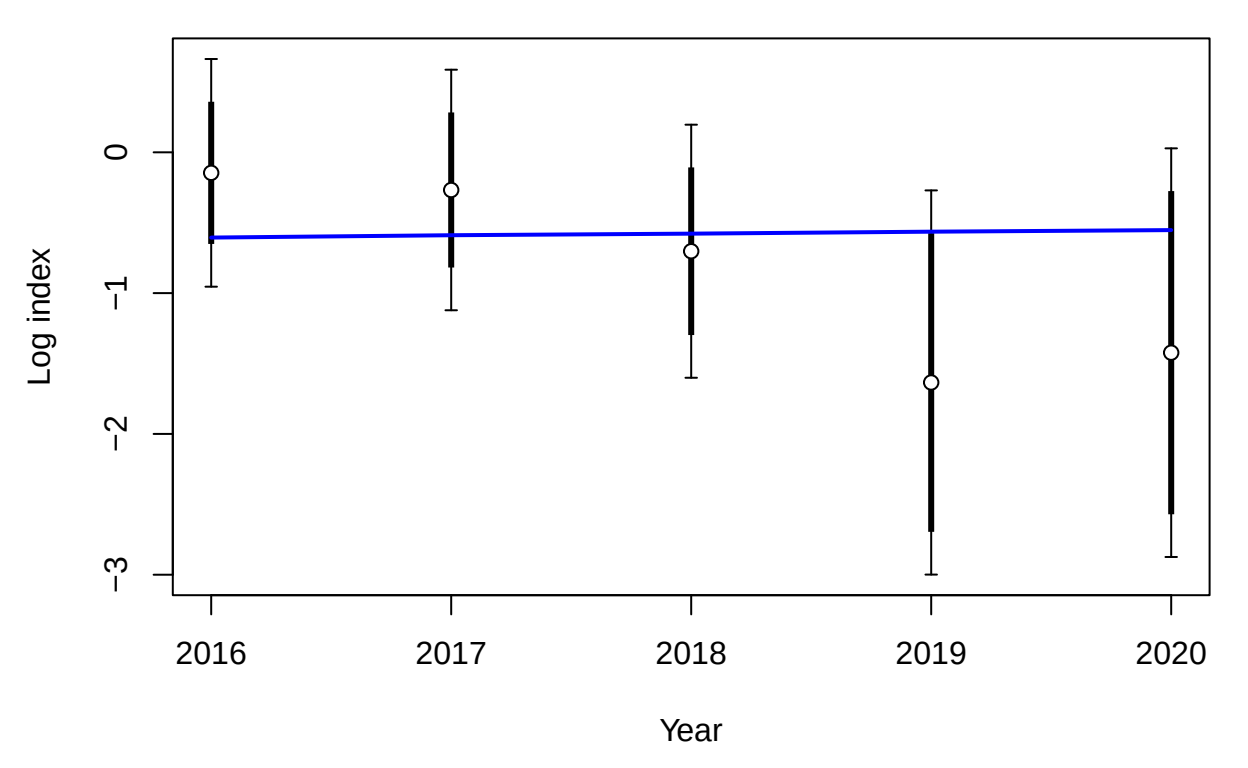

Deviation
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
Year

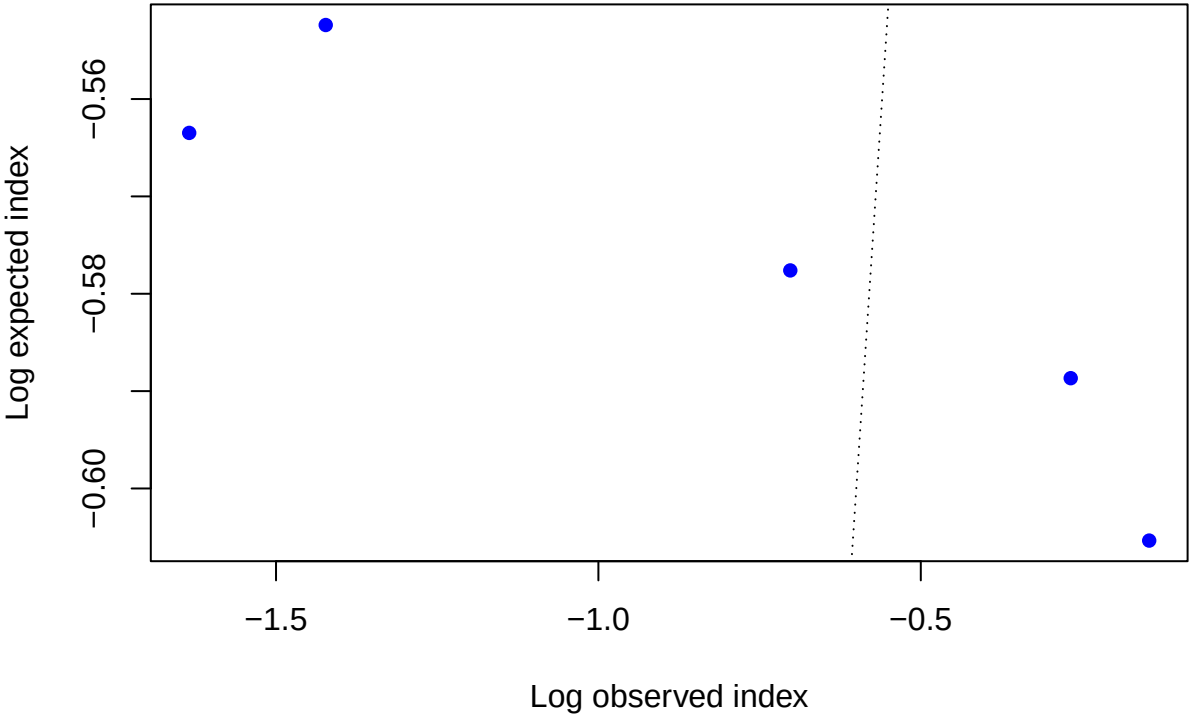

Index
0.0
0.5
1.0
1.5
2.0
2016
2017
2018
2019
2020
Year

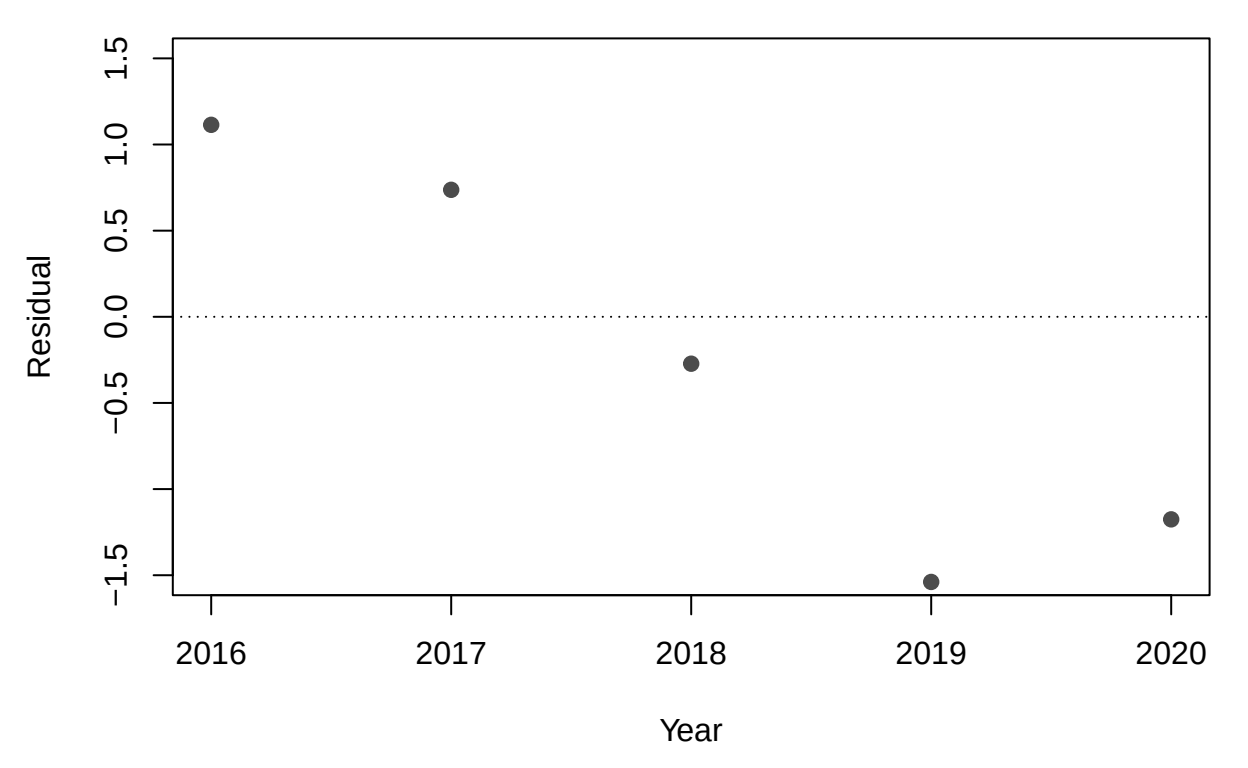

Index
0.0
0.5
1.0
1.5
2.0
2016
2017
2018
2019
2020
Year

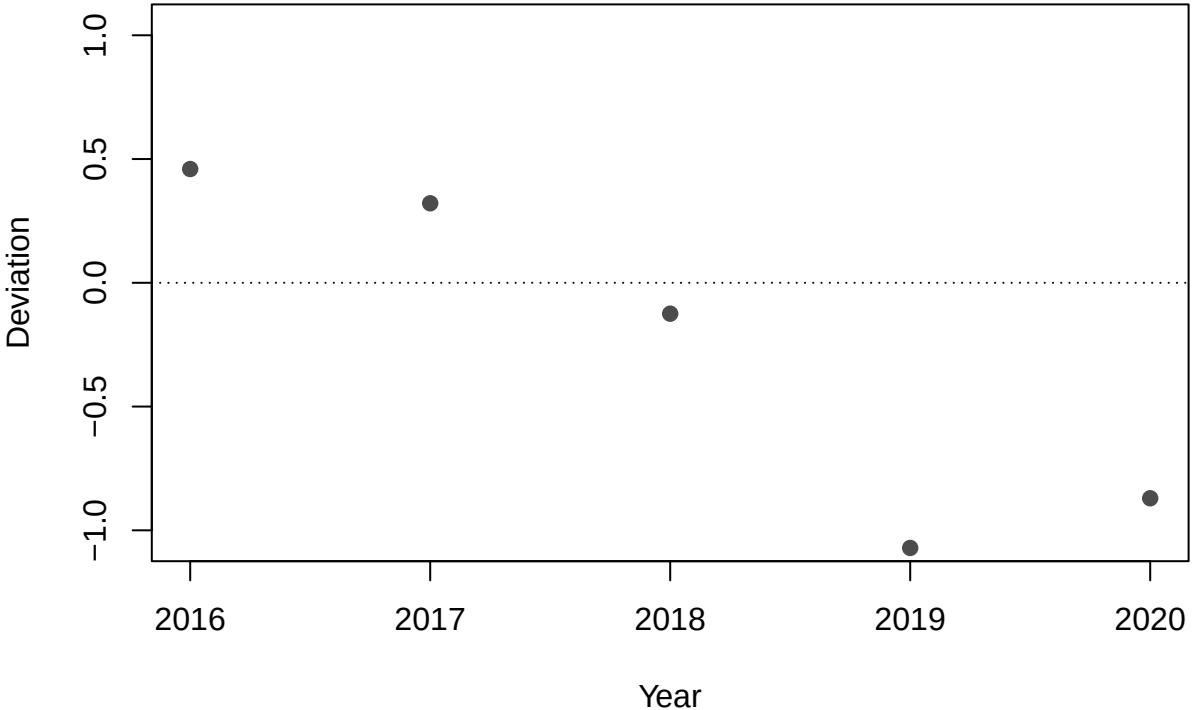

Expected index
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.0
0.2
0.4
0.6
0.8
Observed index

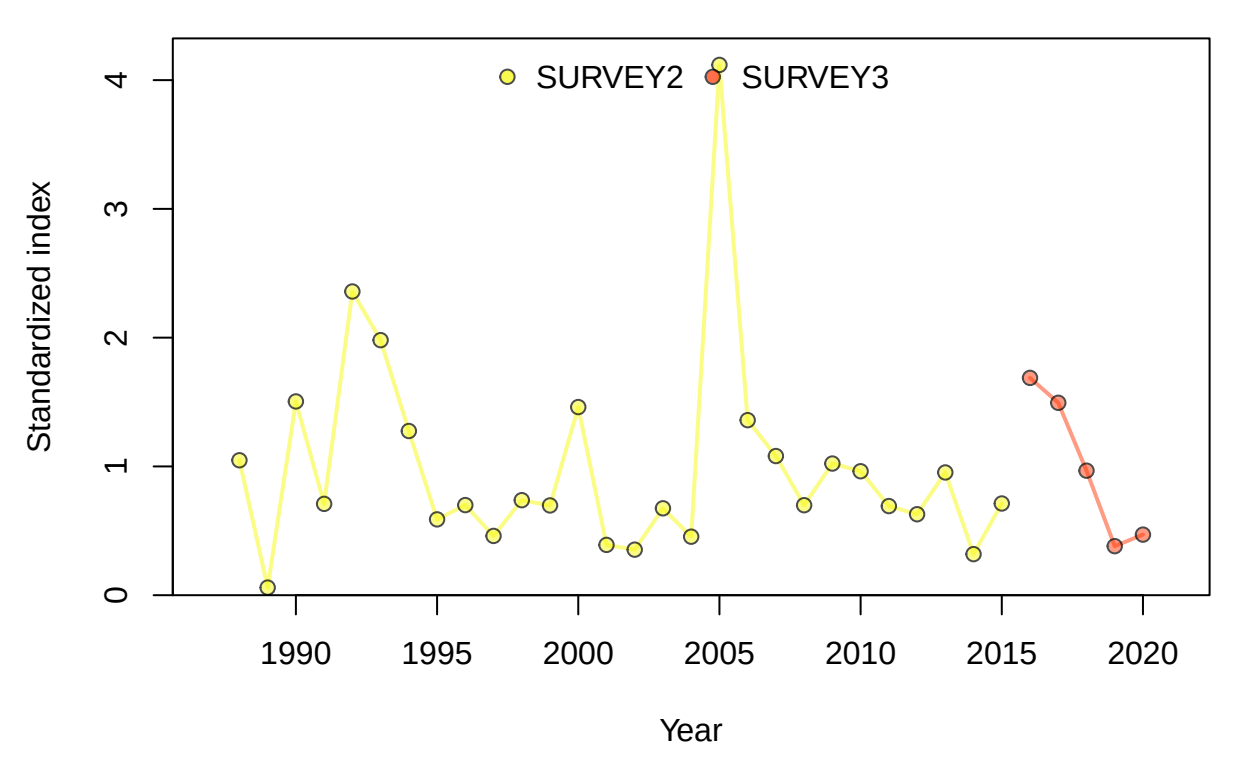

Log index
0
−1
−2
−3
2016
2017
2018
2019
2020
Year

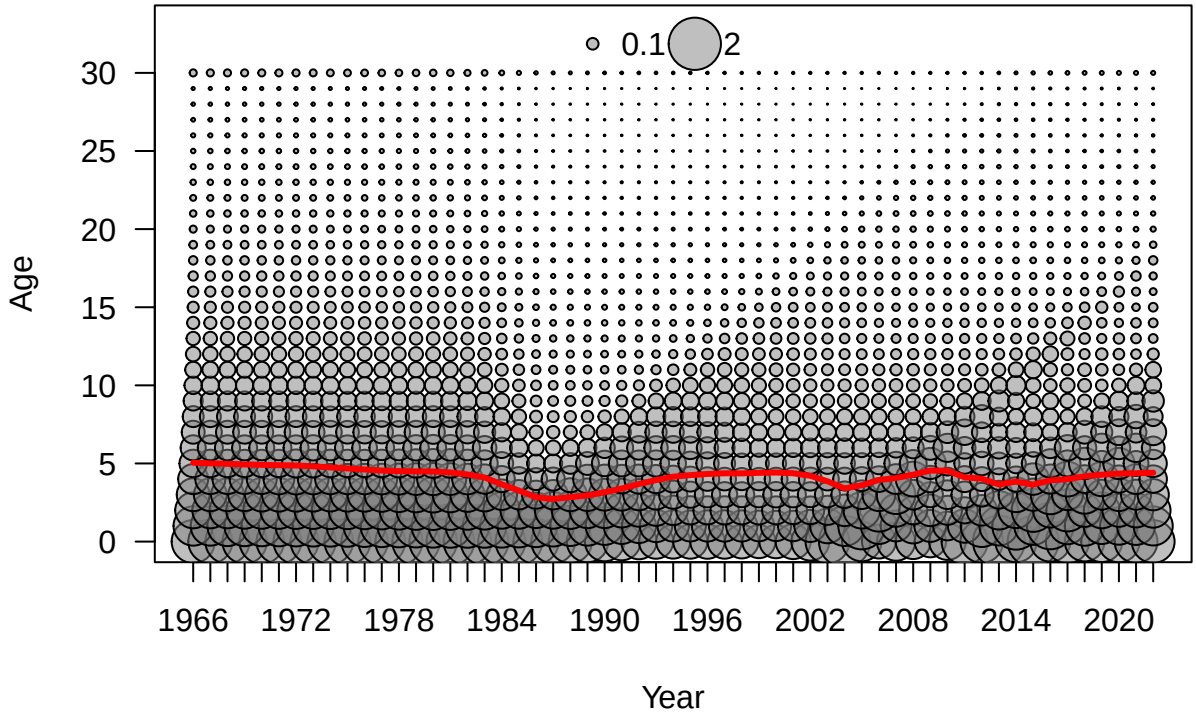

Log index
0
−1
−2
−3
2016
2017
2018
2019
2020
Year

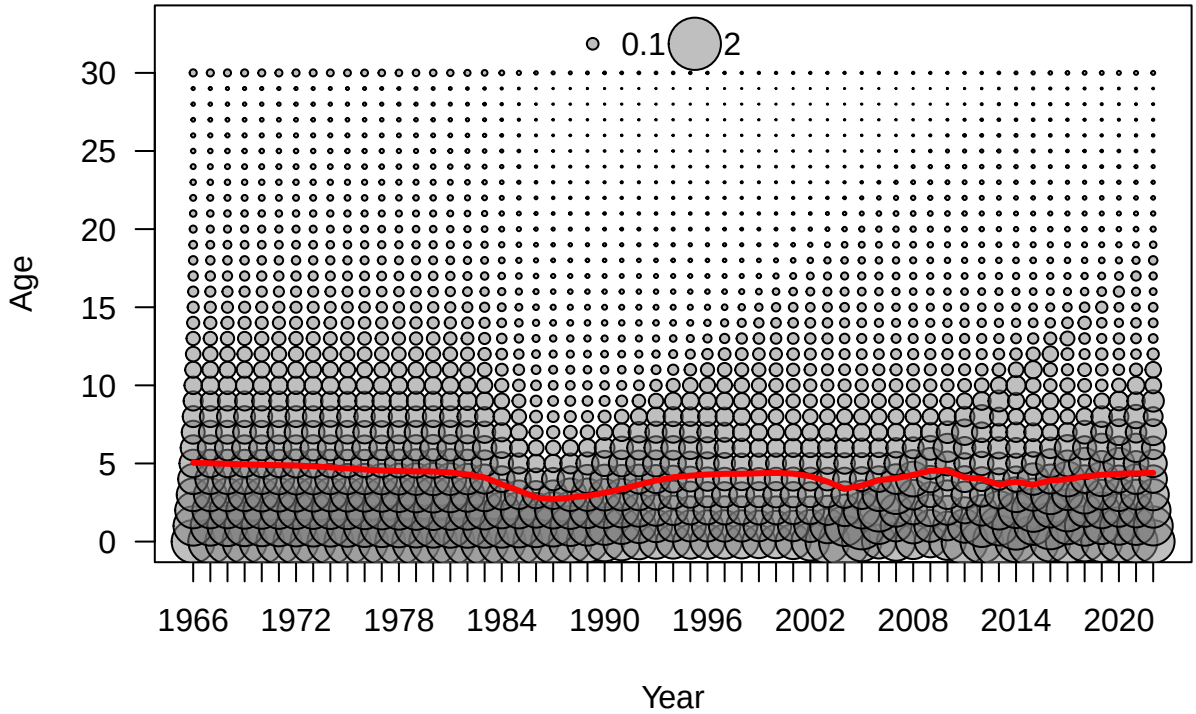

Log expected index
−0.56
−0.58
−0.60
−1.5
−1.0
−0.5
Log observed index

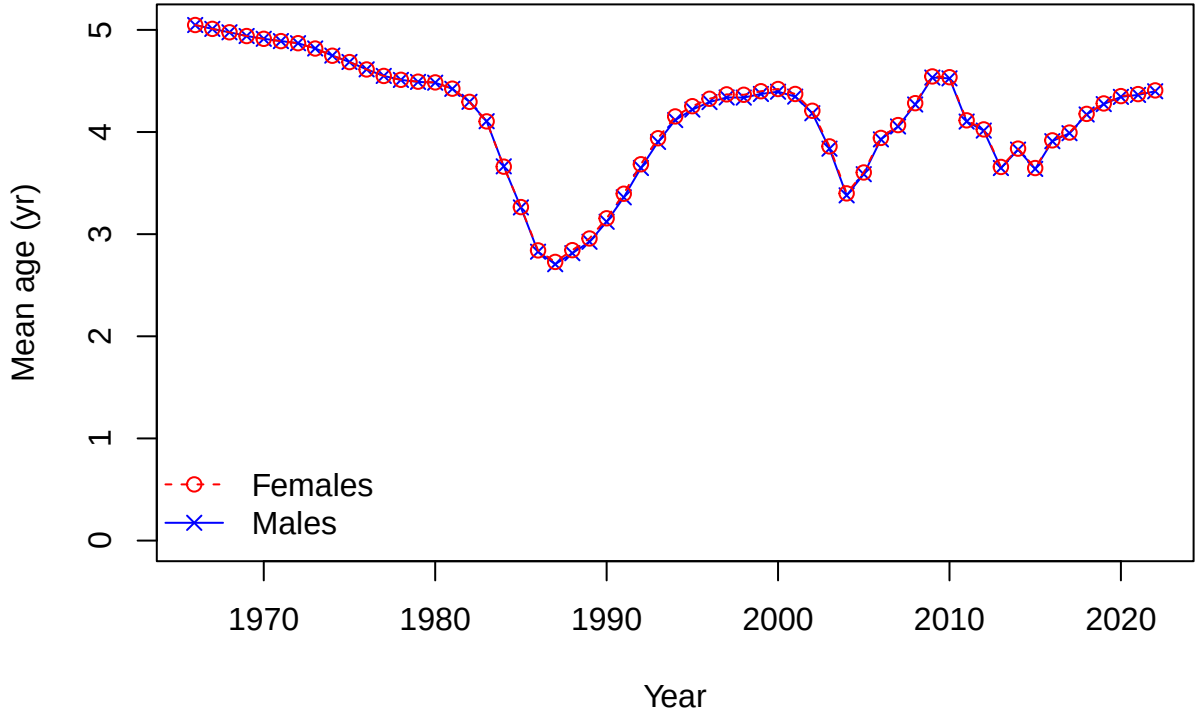

Residual
1.5
1.0
0.5
0.0
−0.5
−1.5
2016
2017
2018
2019
2020
Year

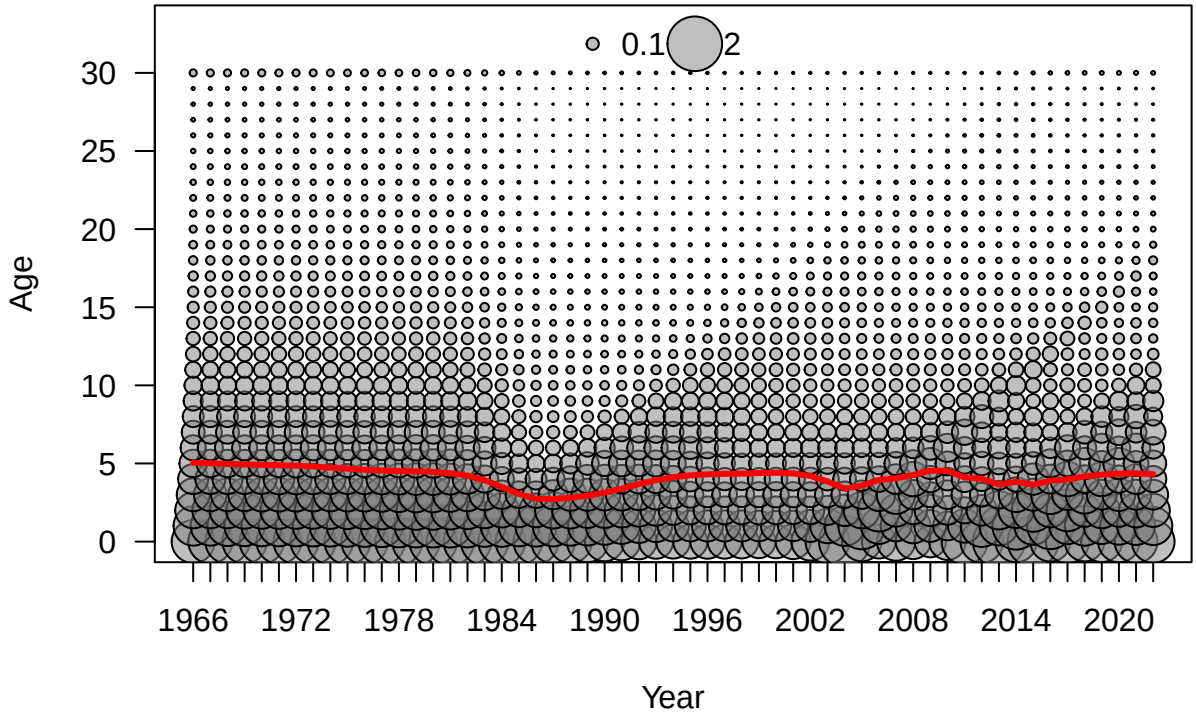

Deviation
1.0
0.5
0.0
−0.5
−1.0
2016
2017
2018
2019
2020
Year

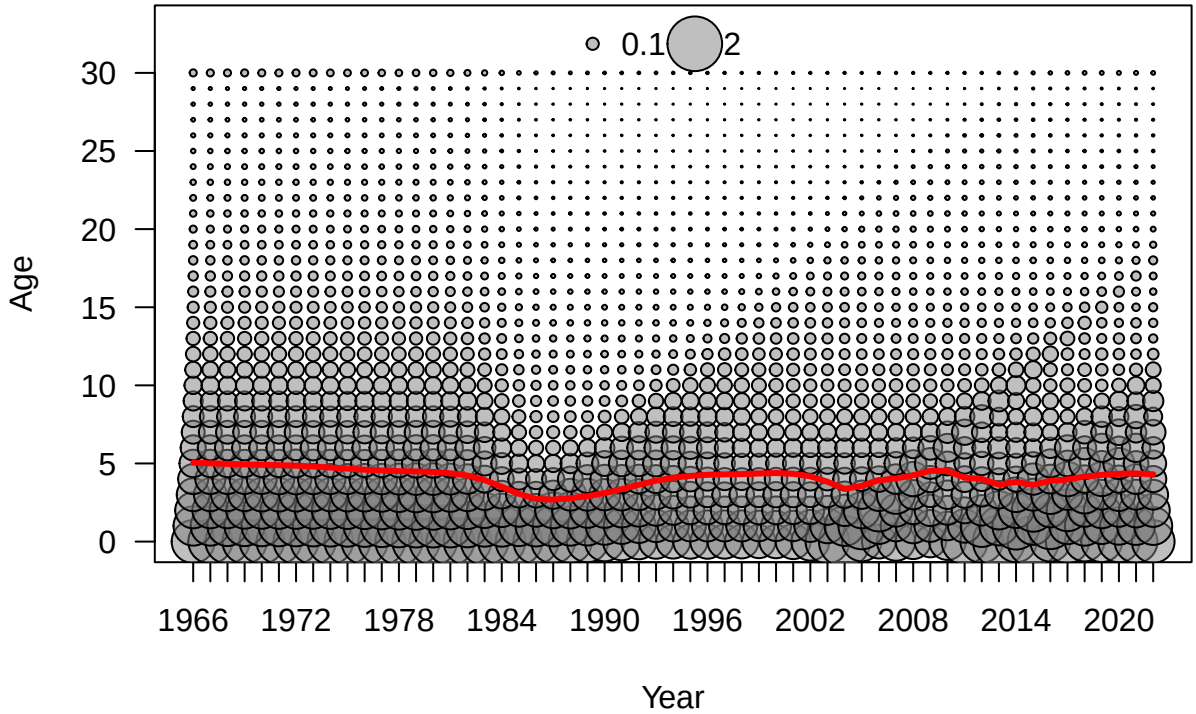

SURVEY2
SURVEY3
Standardized index
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

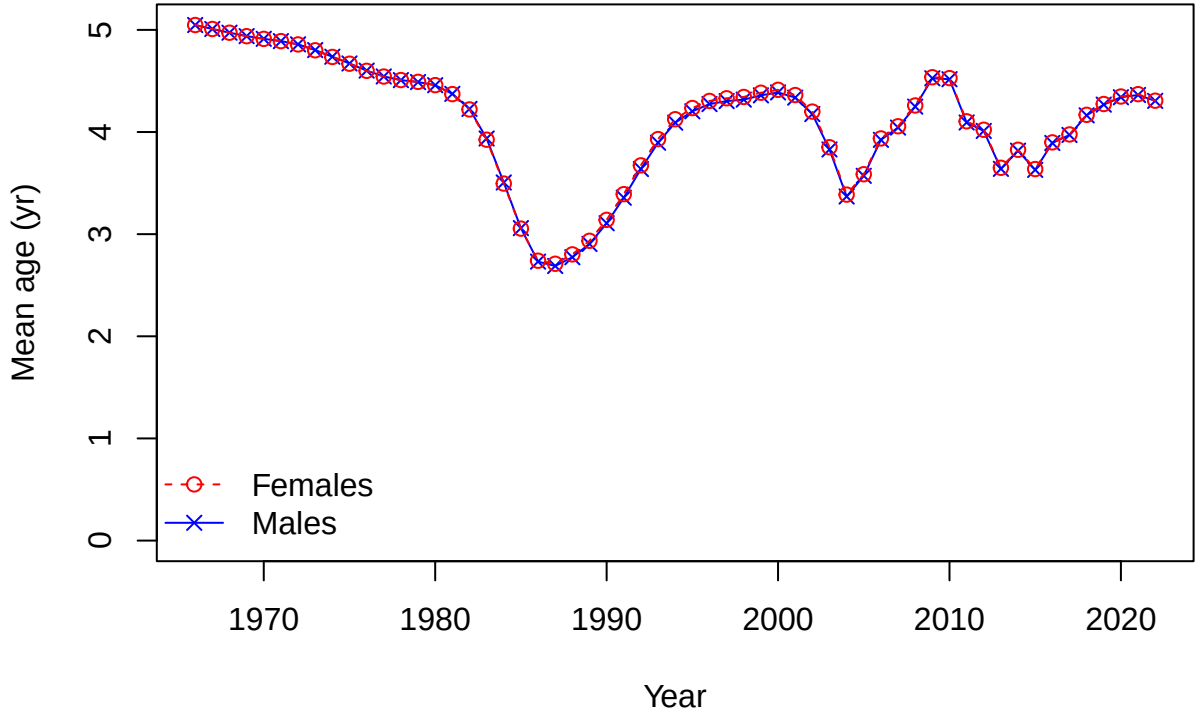

0.1
2
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

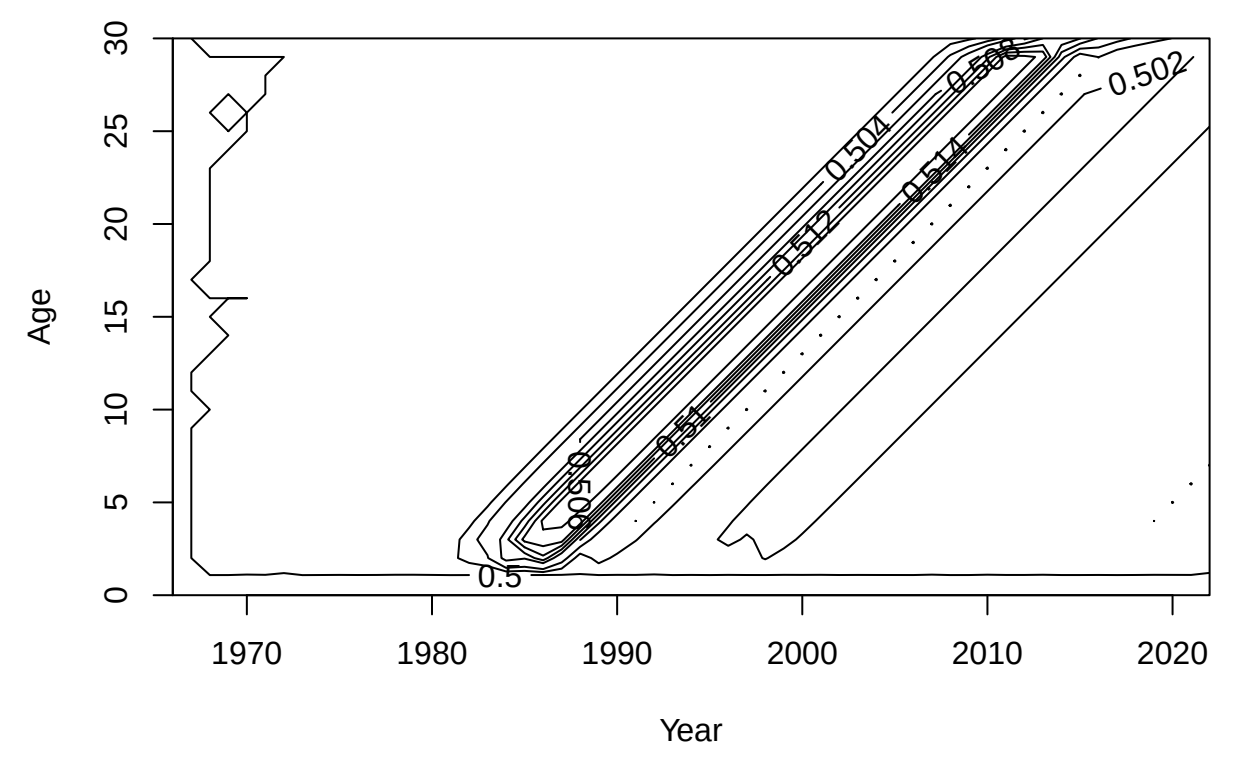

0.1
2
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

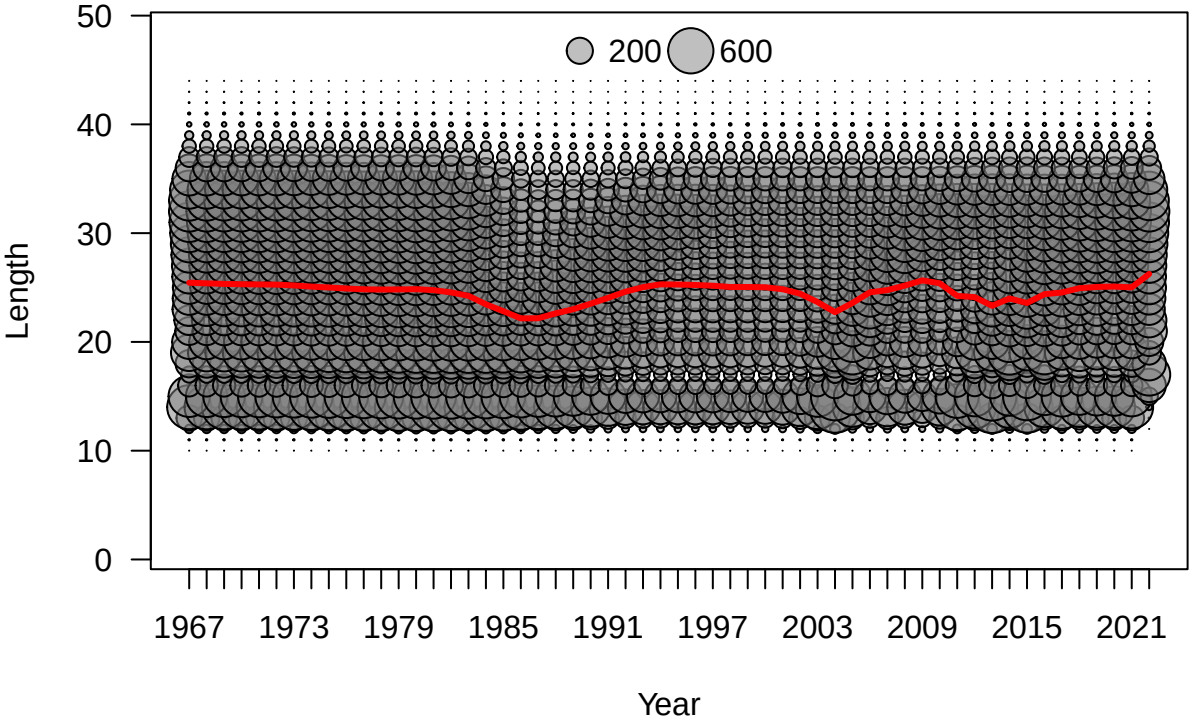

Mean age (yr)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year
Females
Males

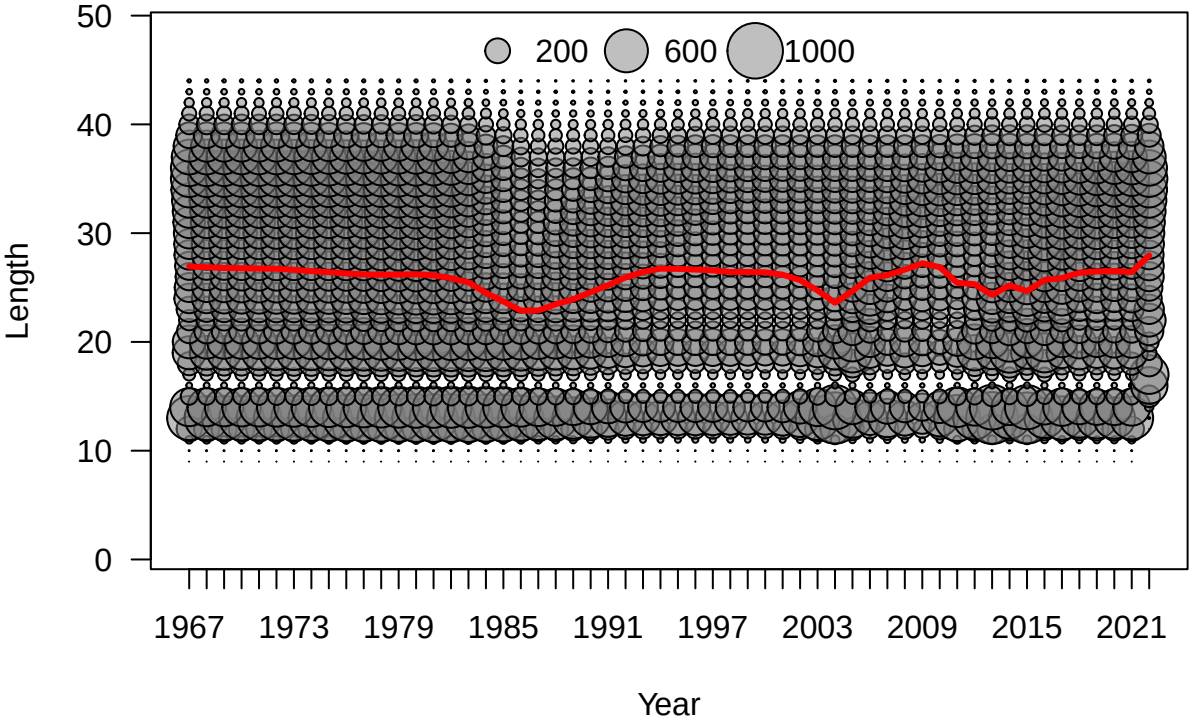

0.1
2
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

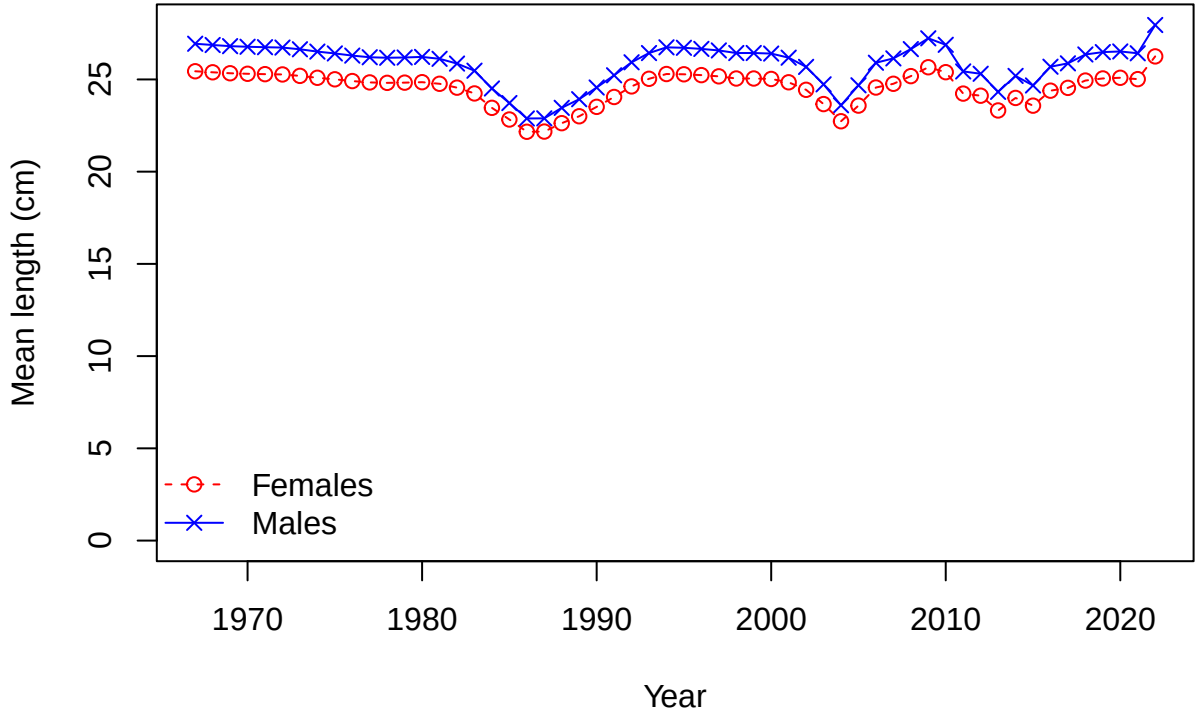

0.1
2
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

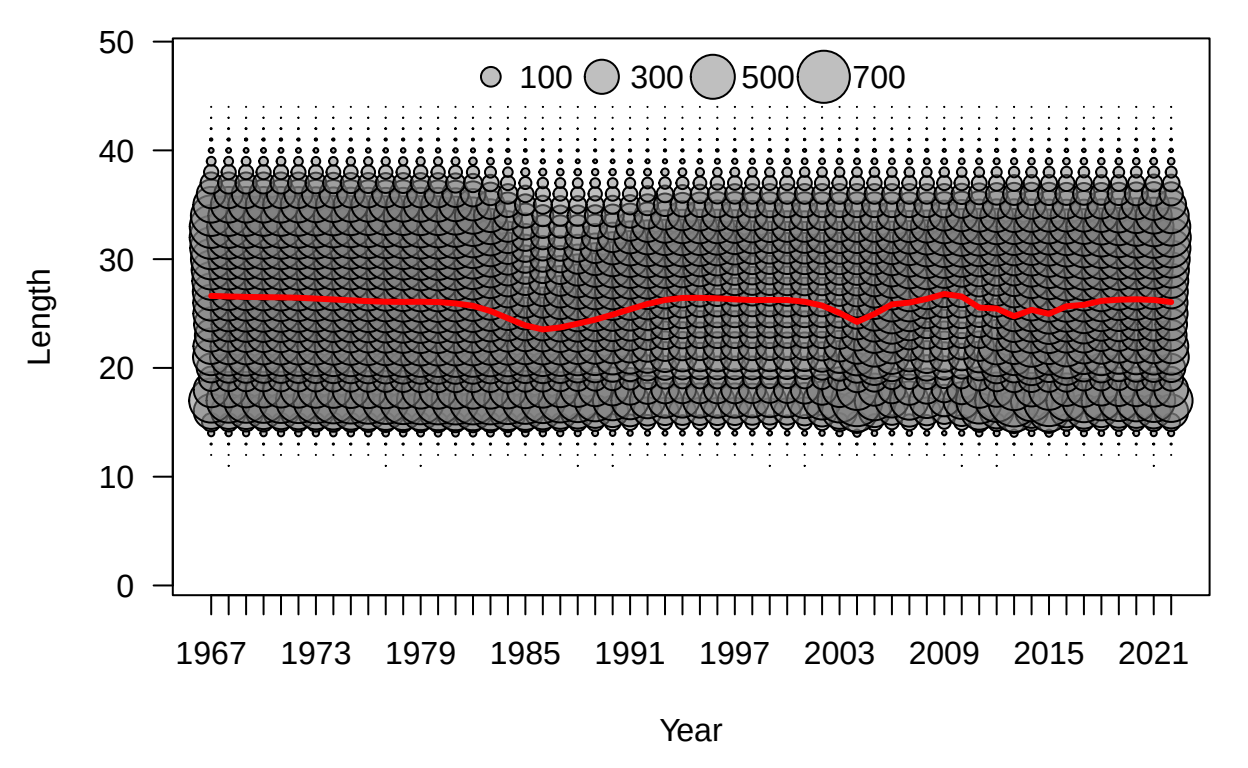

Mean age (yr)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year
Females
Males

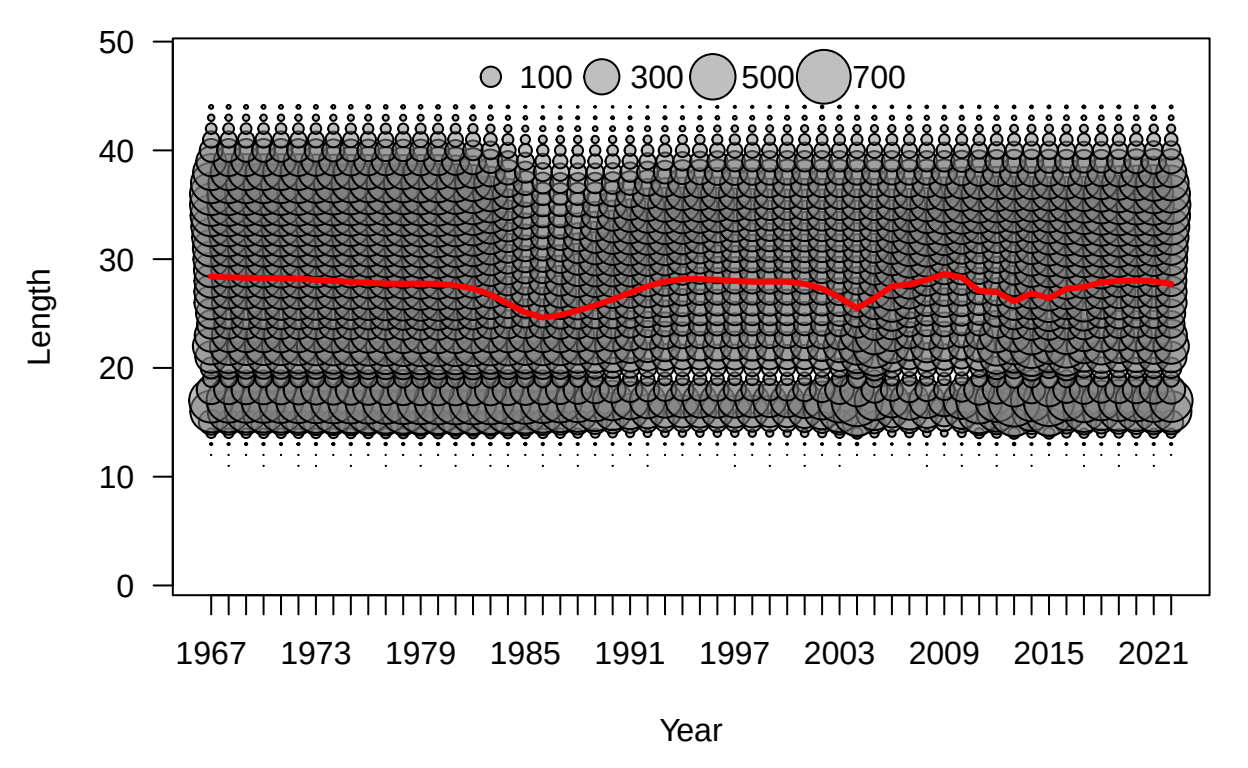

Age
Year
0
5
10
15
20
25
30
1970
1980
1990
2000
2010
2020
0.5
0.502
0.504
0.506
0.508
0.51
0.512
0.514

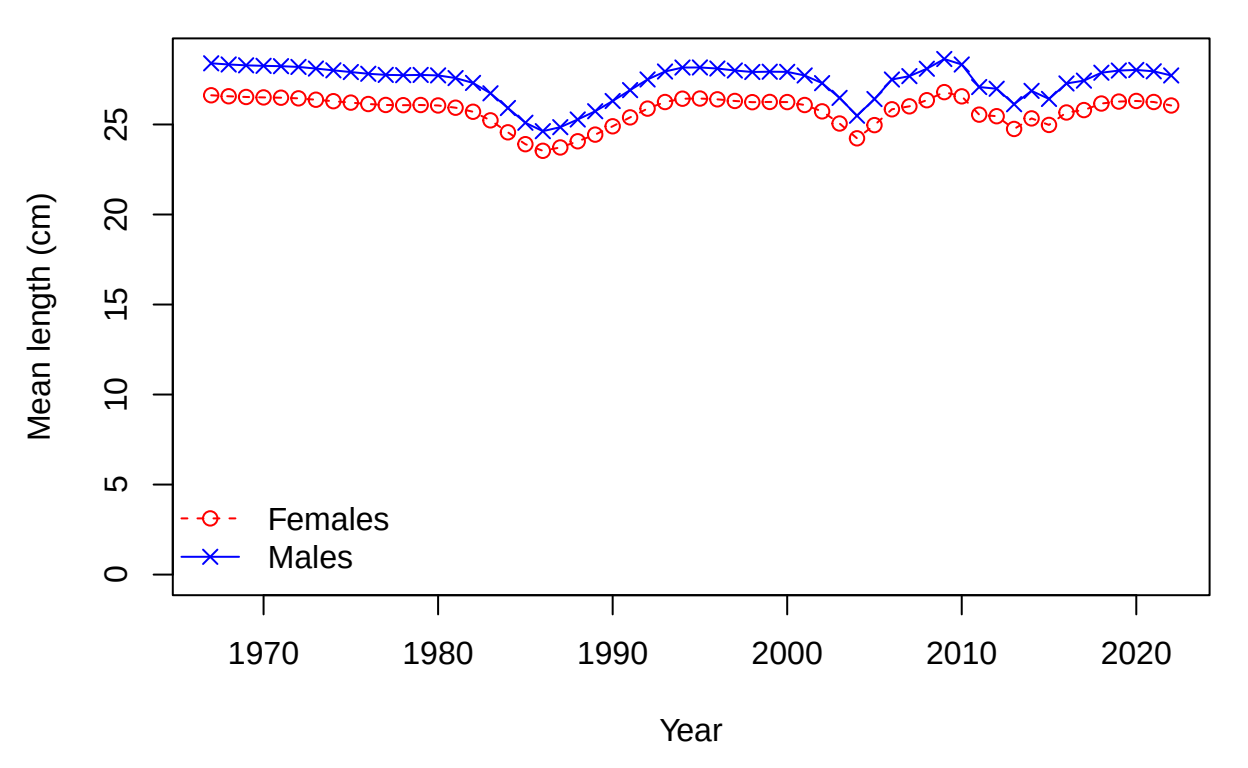

200
600
50
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

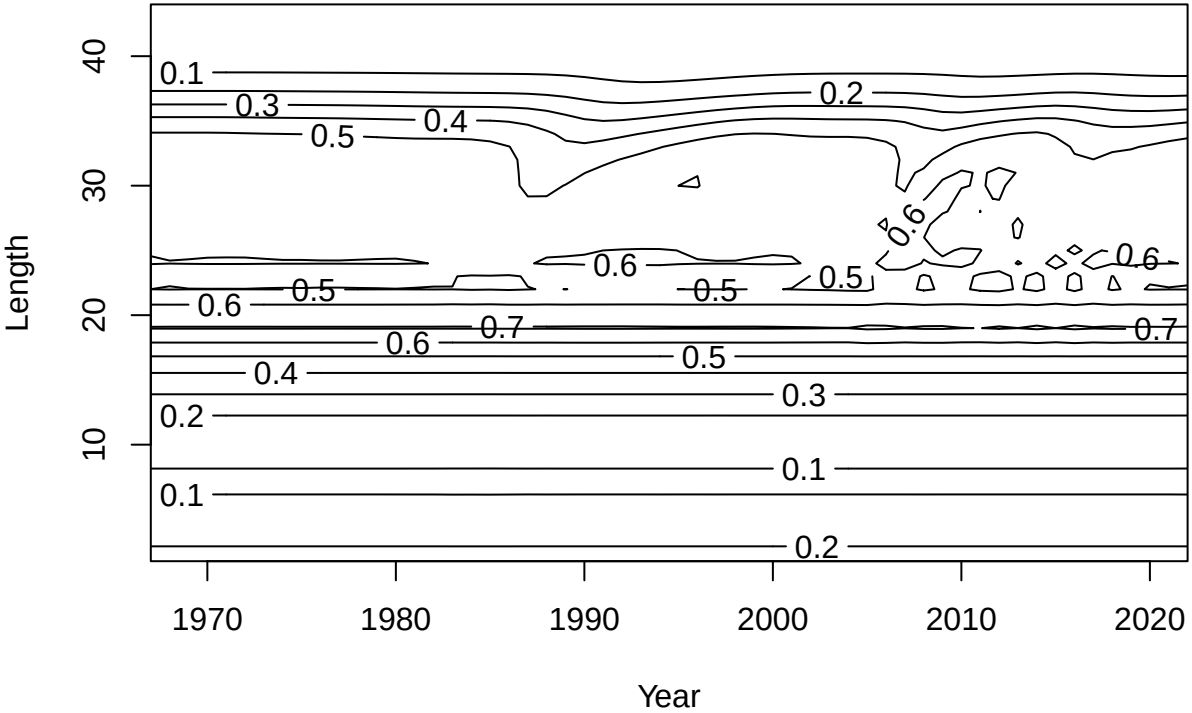

200
600
1000
50
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

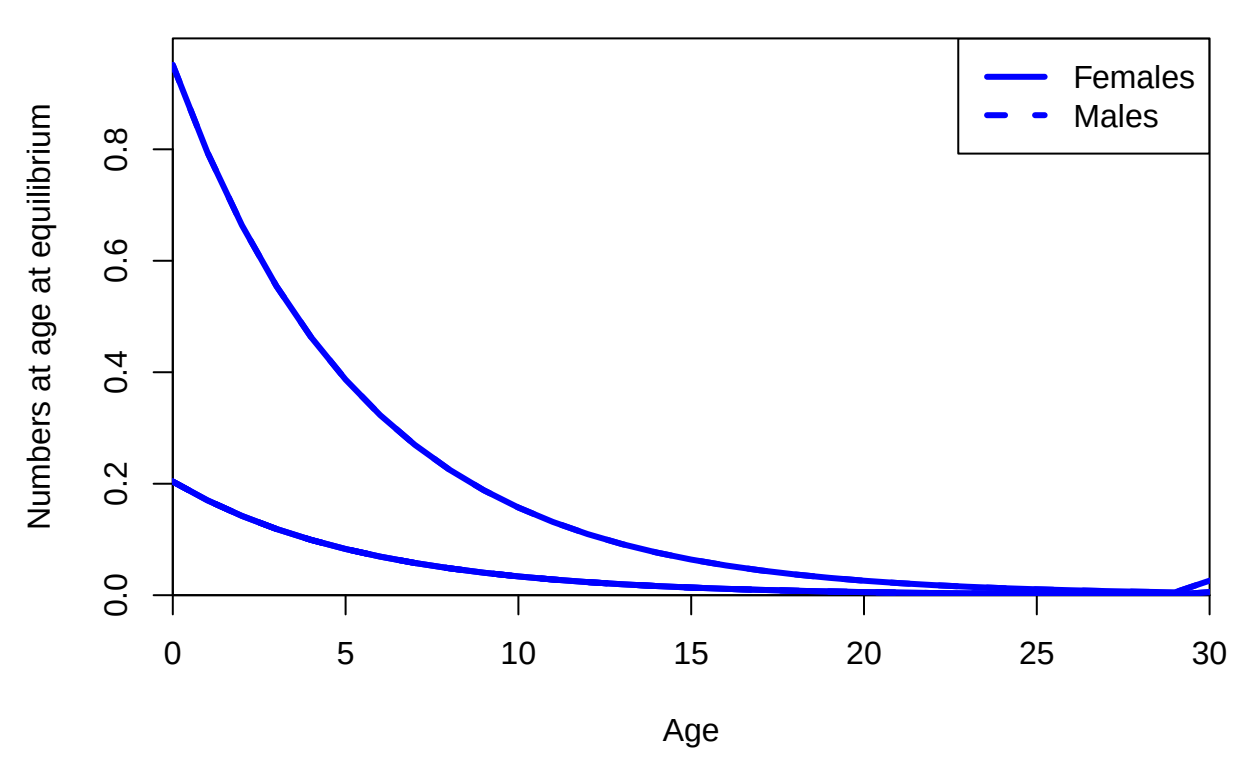

Mean length (cm)
0
5
10
15
20
25
1970
1980
1990
2000
2010
2020
Year
Females
Males

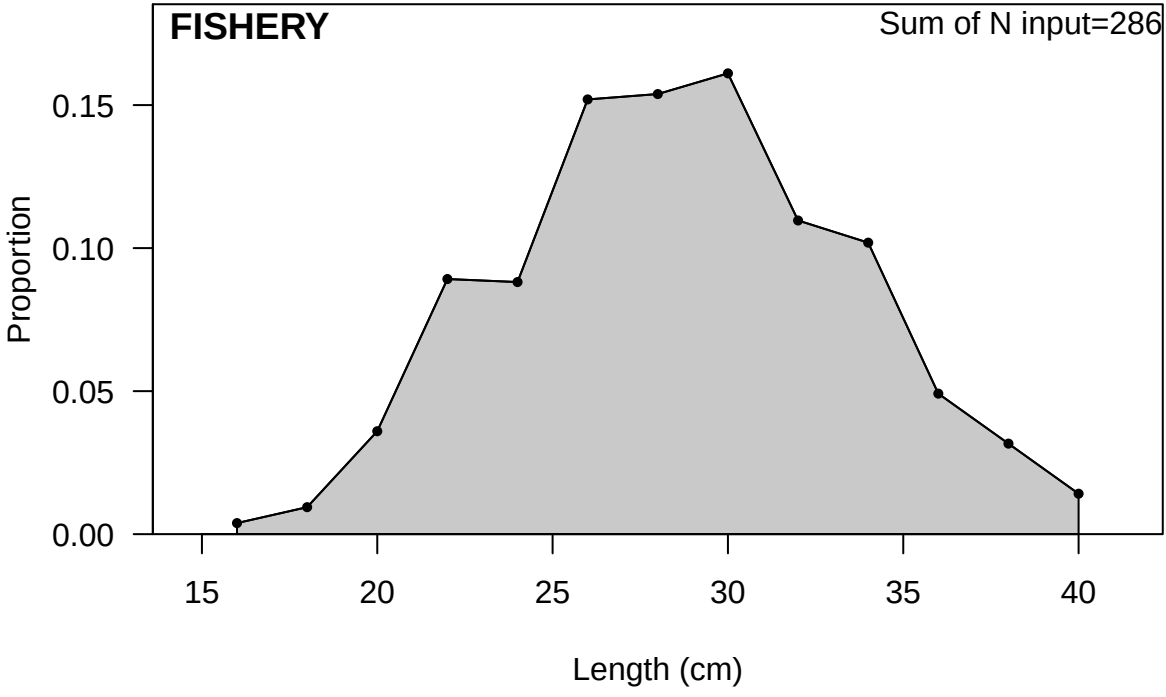

100
300
500
700
50
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year


100
300
500
700
50
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

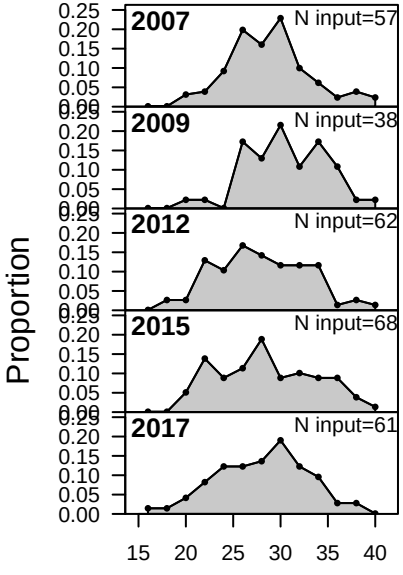

Mean length (cm)
0
5
10
15
20
25
1970
1980
1990
2000
2010
2020
Year
Females
Males

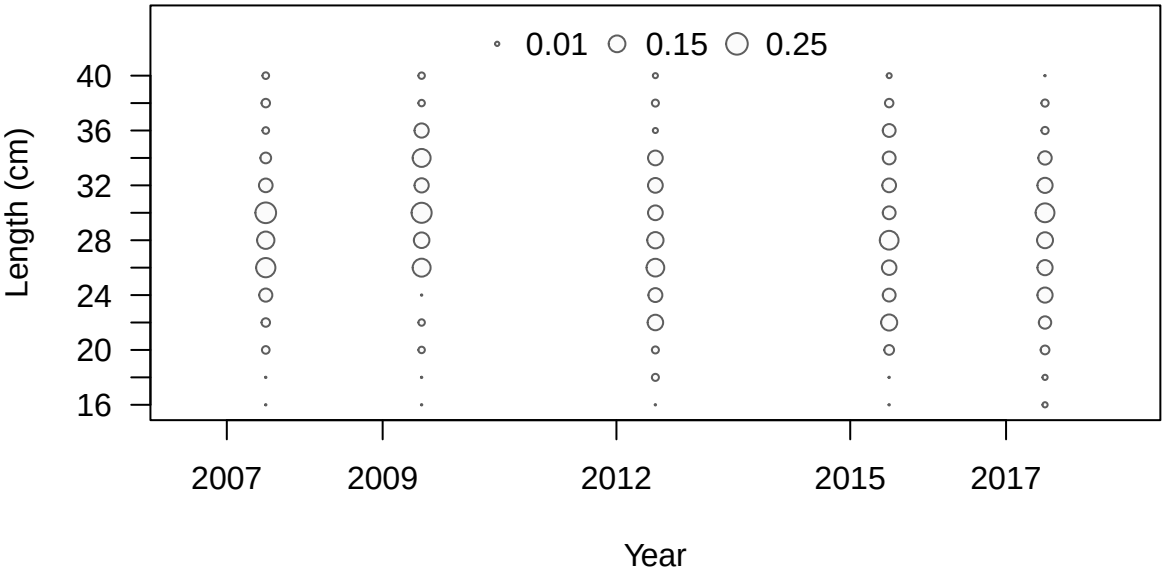

Length
40
30
20
10
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1970
1980
1990
2000
2010
2020
Year

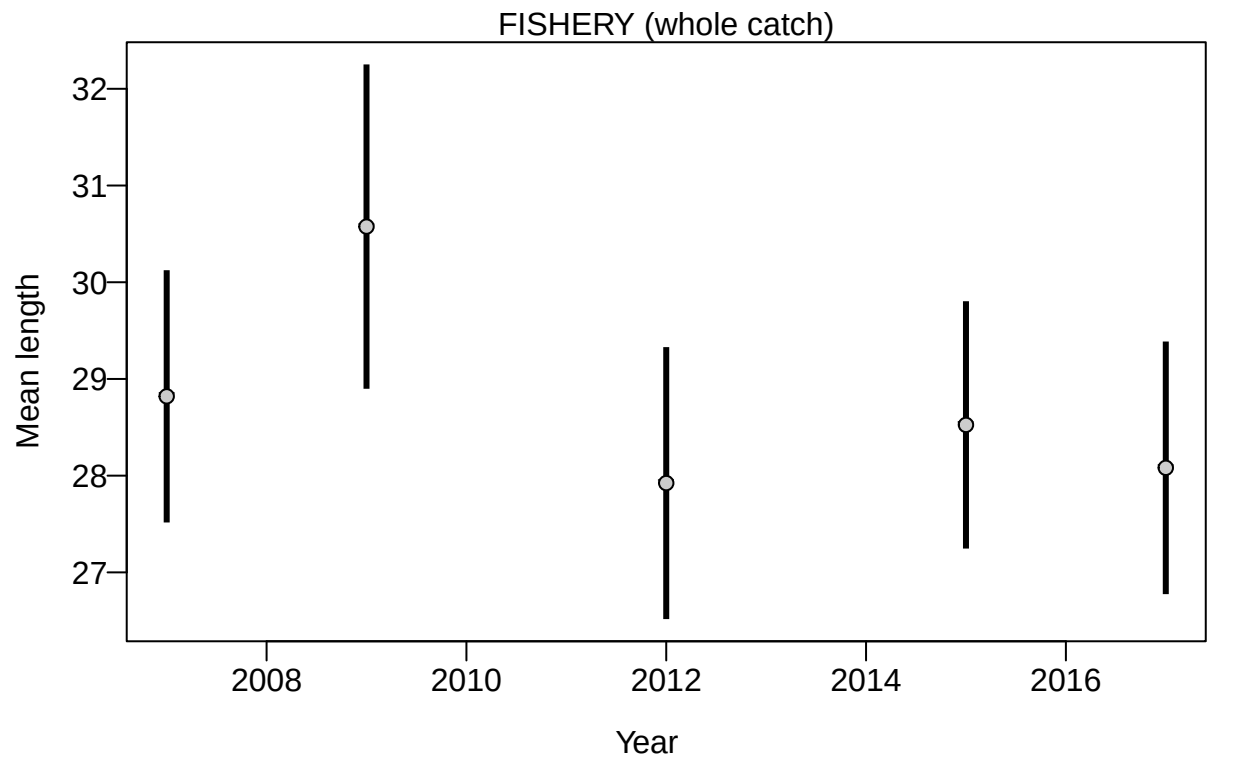

Females
Males
Numbers at age at equilibrium
0.0
0.2
0.4
0.6
0.8
0
5
10
15
20
25
30
Age

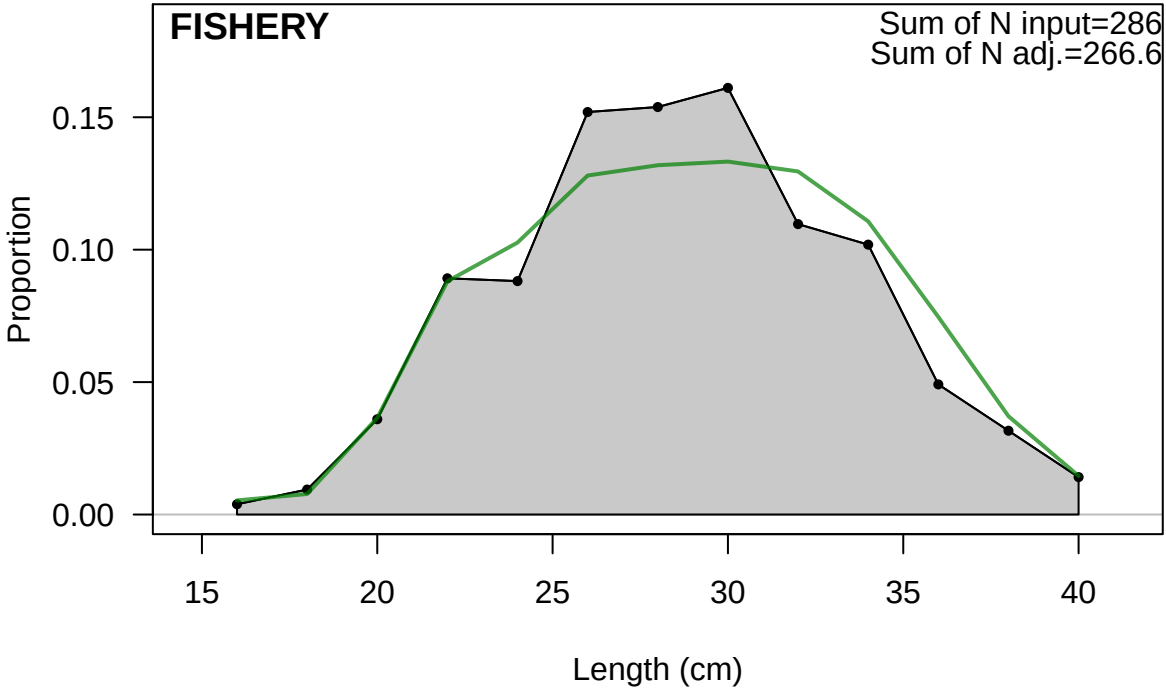

FISHERY
Sum of N input=286
Proportion
0.00
0.05
0.10
0.15
15
20
25
30
35
40
Length (cm)

FISHERY
0.01
0.15
0.25
Length (cm)
40
38
36
34
32
30
28
26
24
22
20
18
16
2009
2012
2015
2017
Year

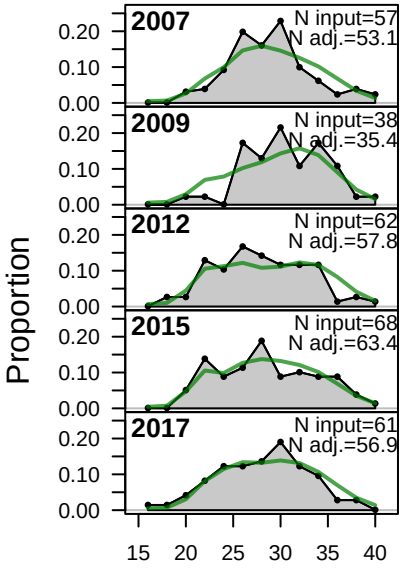

2007
N input=57
2009
N input=38
2012
N input=62
2015
N input=68
2017
N input=61
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
15
20
25
30
35
40
Length (cm)

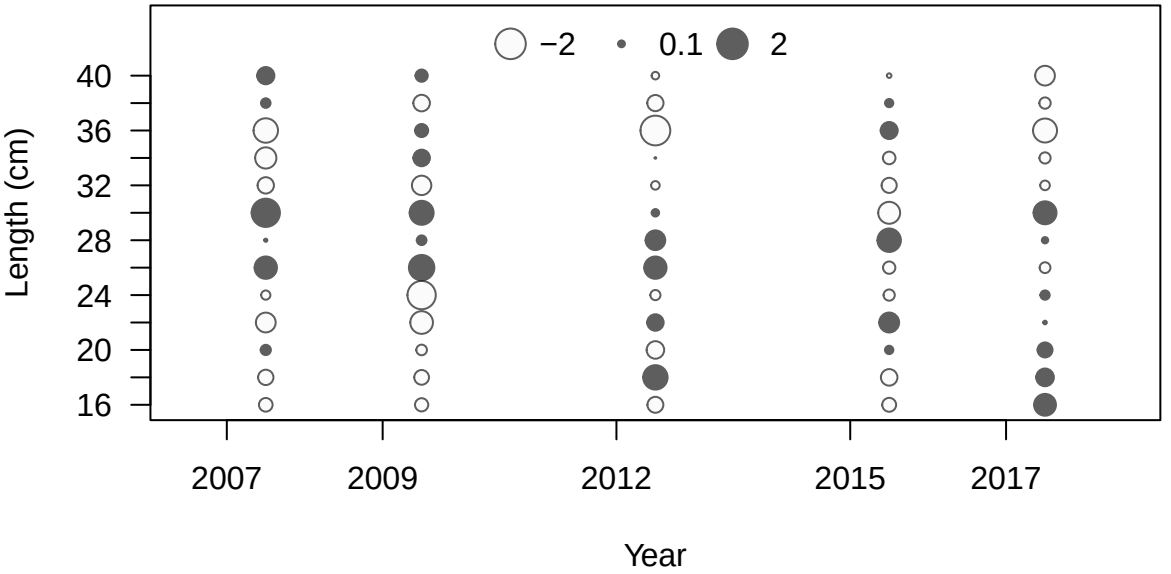

0.01
0.15
0.25
Length (cm)
40
36
32
28
24
20
16
2007
2009
2012
2015
2017
Year

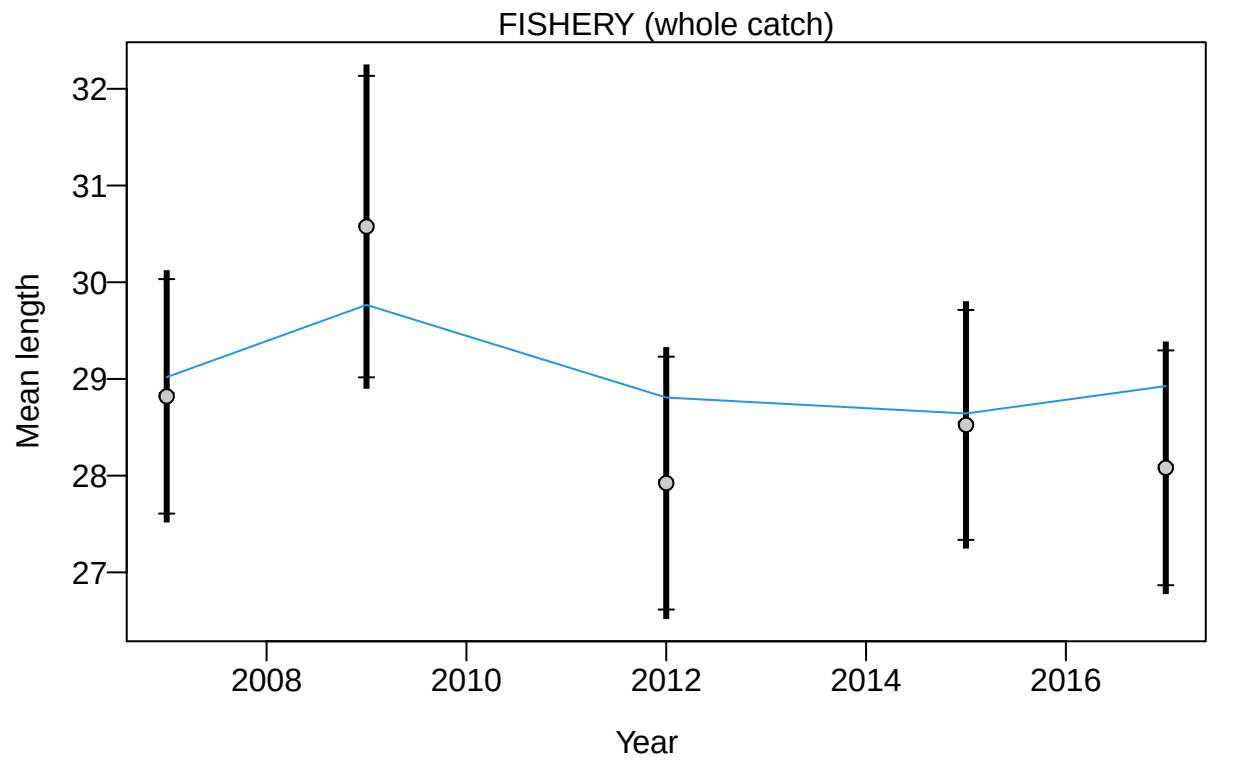

FISHERY (whole catch)
32
31
30
29
28
27
Mean length
2008
2010
2012
2014
2016
Year

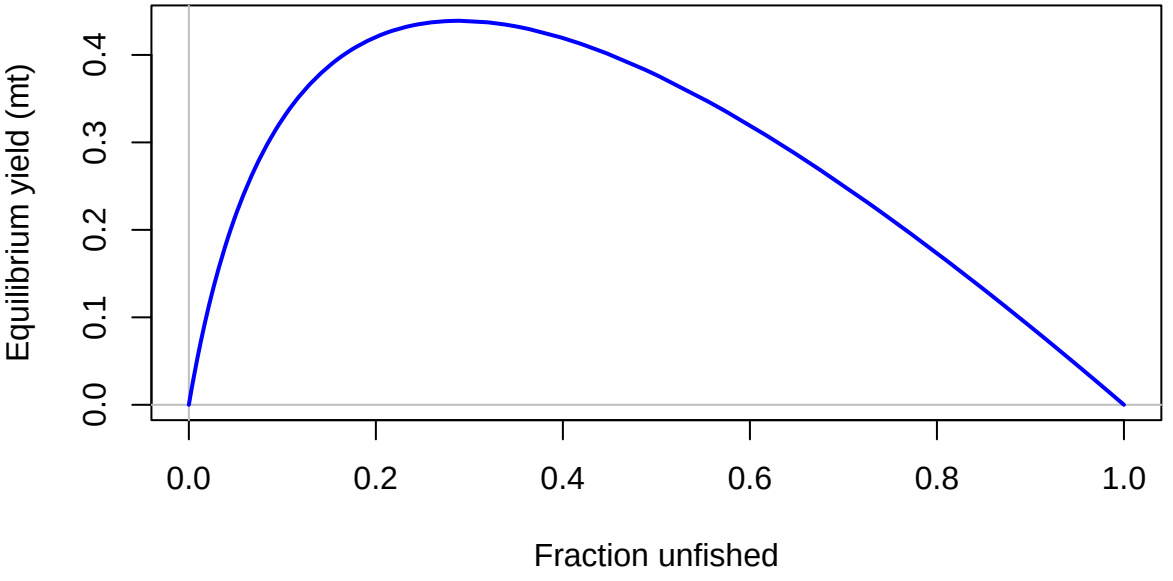

FISHERY
Sum of N input=286
Sum of N adj.=266.6
Proportion
0.00
0.05
0.10
0.15
15
20
25
30
35
40
Length (cm)

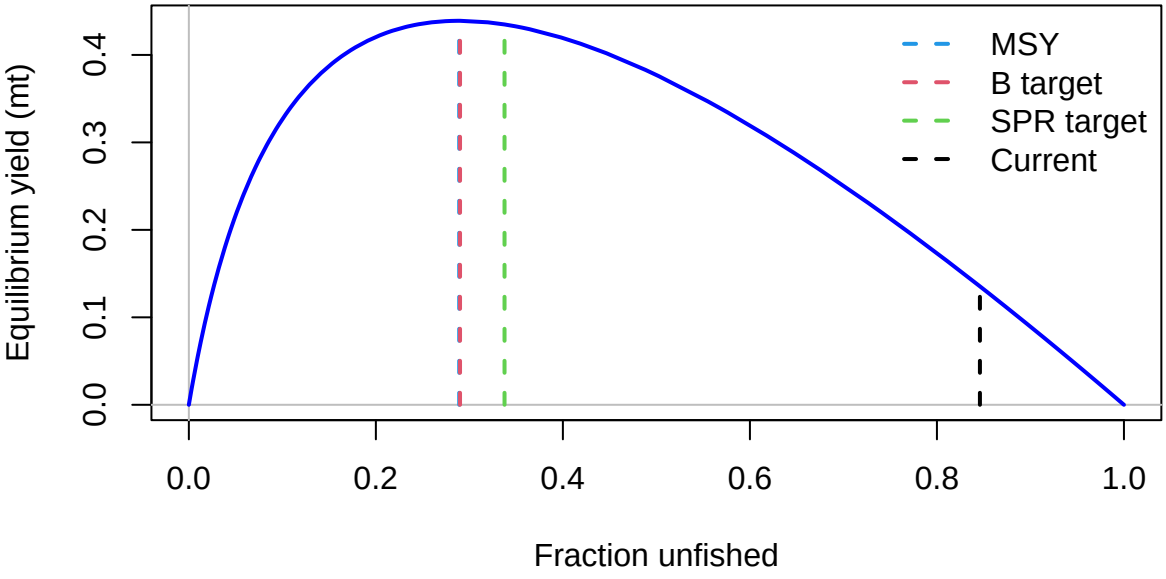
FISHERY
−2
0.1
2
Length (cm)
40
38
36
34
32
30
28
26
24
22
20
18
16
2009
2012
2015
2017
Year

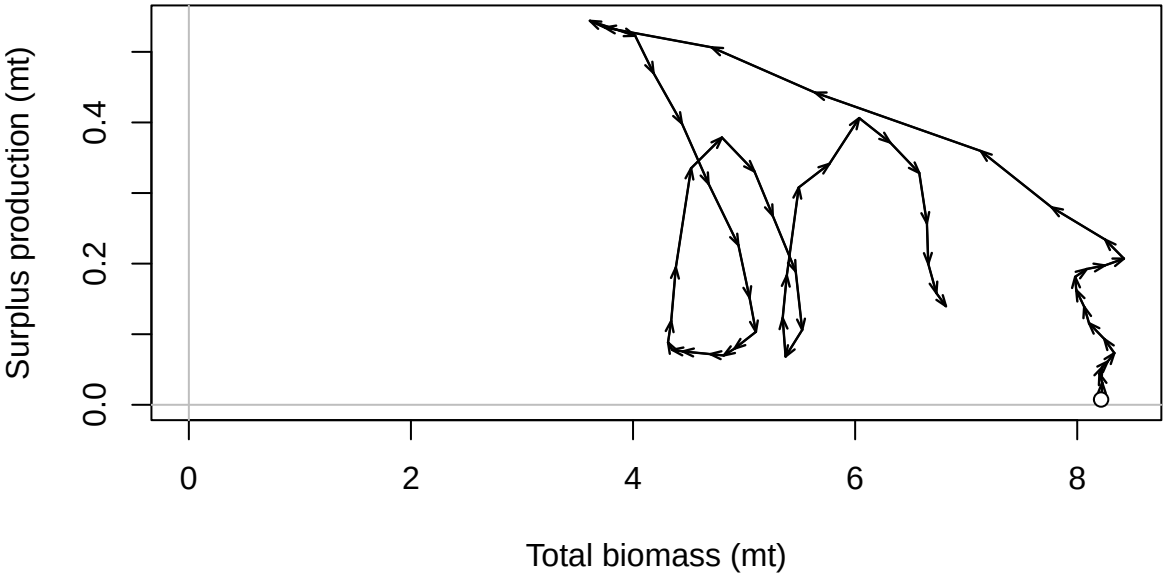

2007
N input=57
N adj.=53.1
2009
N input=38
N adj.=35.4
2012
N input=62
N adj.=57.8
2015
N input=68
N adj.=63.4
2017
N input=61
N adj.=56.9
0.00
0.10
0.20
15
20
25
30
35
40
Proportion
Length (cm)

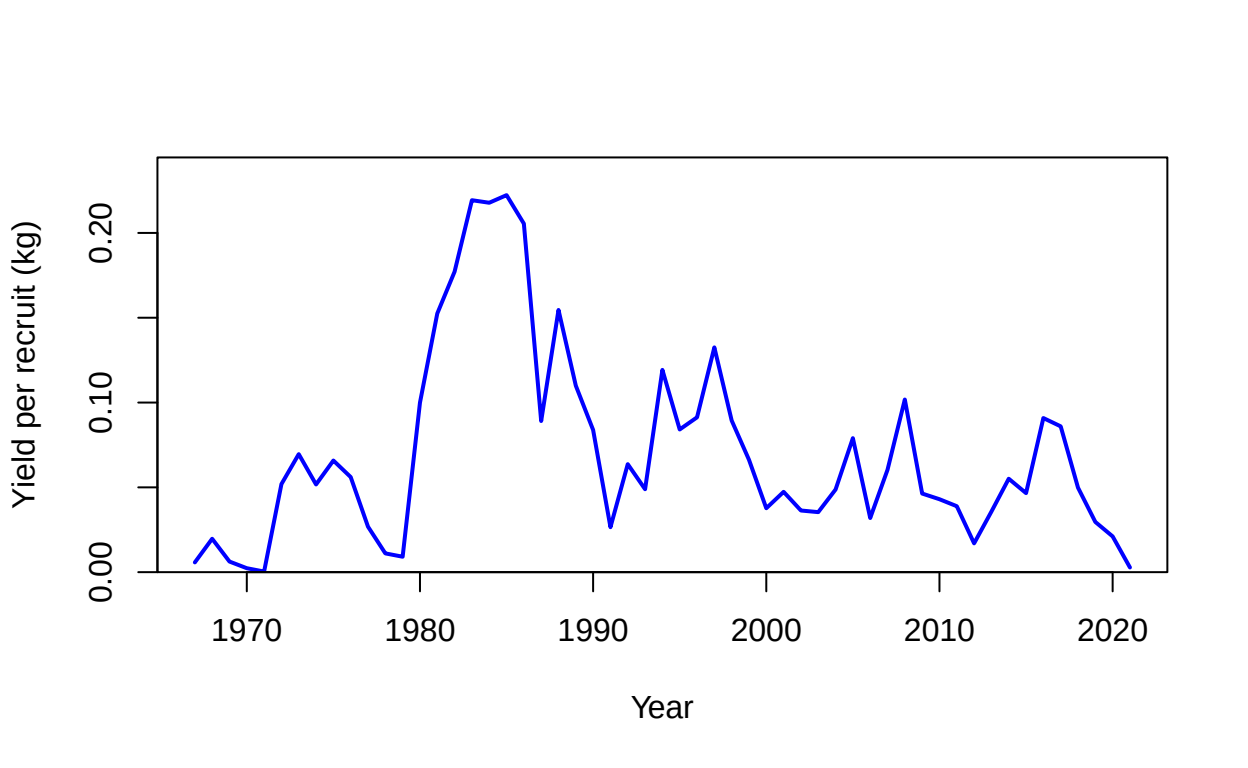

−2
0.1
2
Length (cm)
40
36
32
28
24
20
16
2007
2009
2012
2015
2017
Year

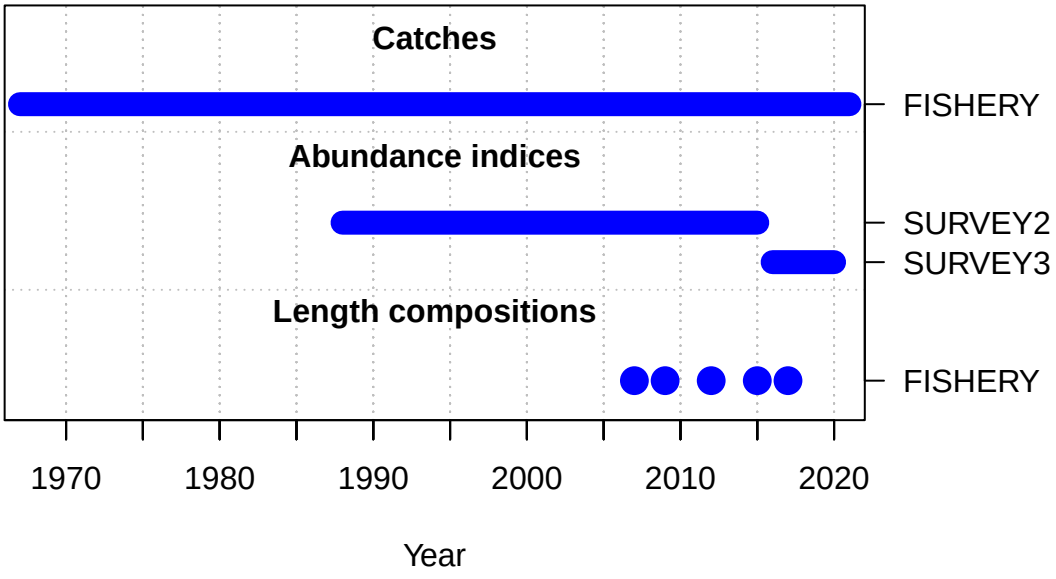

FISHERY (whole catch)
Mean length
32
31
30
29
28
27
2008
2010
2012
2014
2016
Year

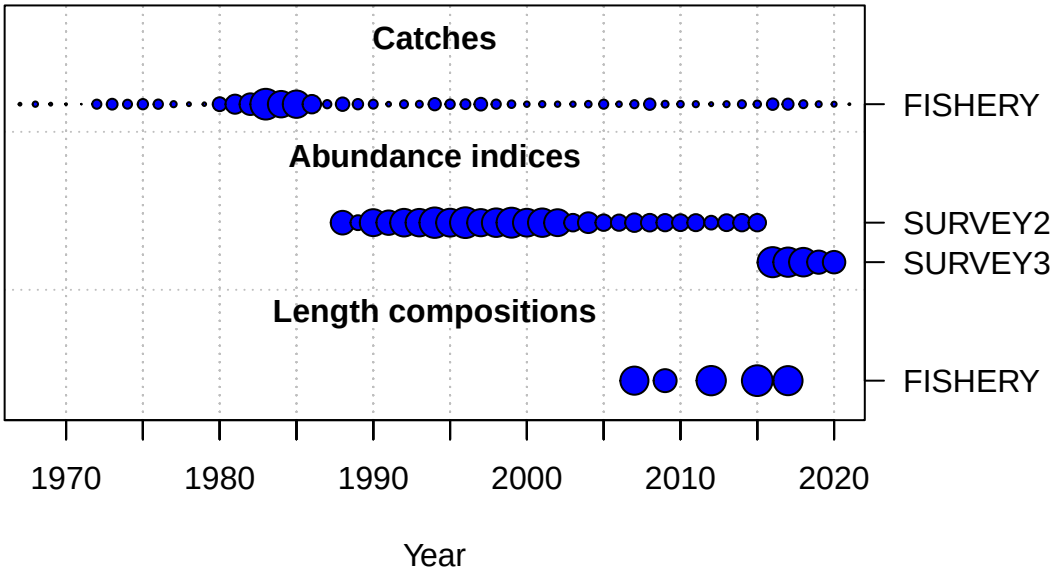

Equilibrium yield (mt)
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

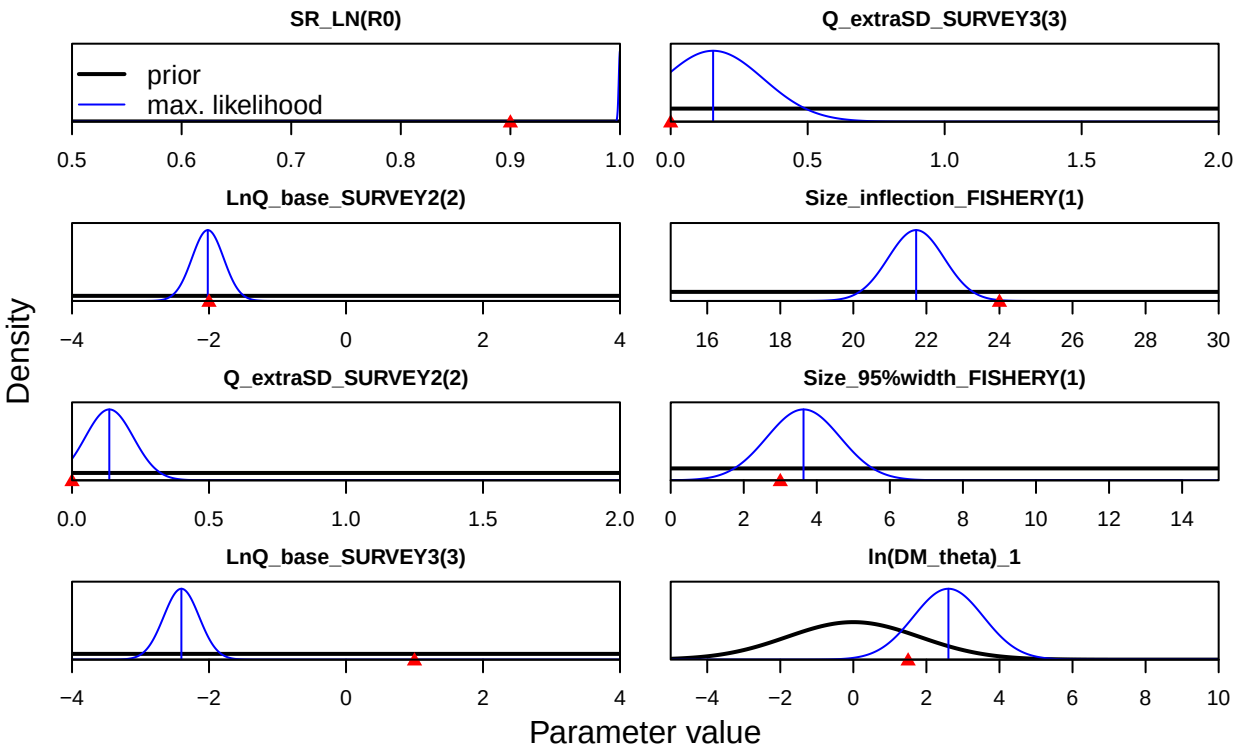

Equilibrium yield (mt)
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0.0
0.2
0.4
0
2
4
6
8
Total biomass (mt)


Yield per recruit (kg)
0.00
0.10
0.20
1970
1980
1990
2000
2010
2020
Year


Catches
FISHERY
Abundance indices
SURVEY2
SURVEY3
Length compositions
FISHERY
1970
1980
1990
2000
2010
2020
Year


Catches
FISHERY
Abundance indices
SURVEY2
SURVEY3
Length compositions
FISHERY
1970
1980
1990
2000
2010
2020
Year


SR_LN(R0)
prior
max. likelihood
0.5 0.6 0.7 0.8 0.9 1.0
Q_extraSD_SURVEY3(3)
0.0 0.5 1.0 1.5 2.0
LnQ_base_SURVEY2(2)
−4 −2 0 2 4
Size_inflection_FISHERY(1)
16 18 20 22 24 26 28 30
Q_extraSD_SURVEY2(2)
0.0 0.5 1.0 1.5 2.0
Size_95%width_FISHERY(1)
0 2 4 6 8 10 12 14
LnQ_base_SURVEY3(3)
−4 −2 0 2 4
ln(DM_theta)_1
−4 −2 0 2 4 6 8 10
Density
Parameter value