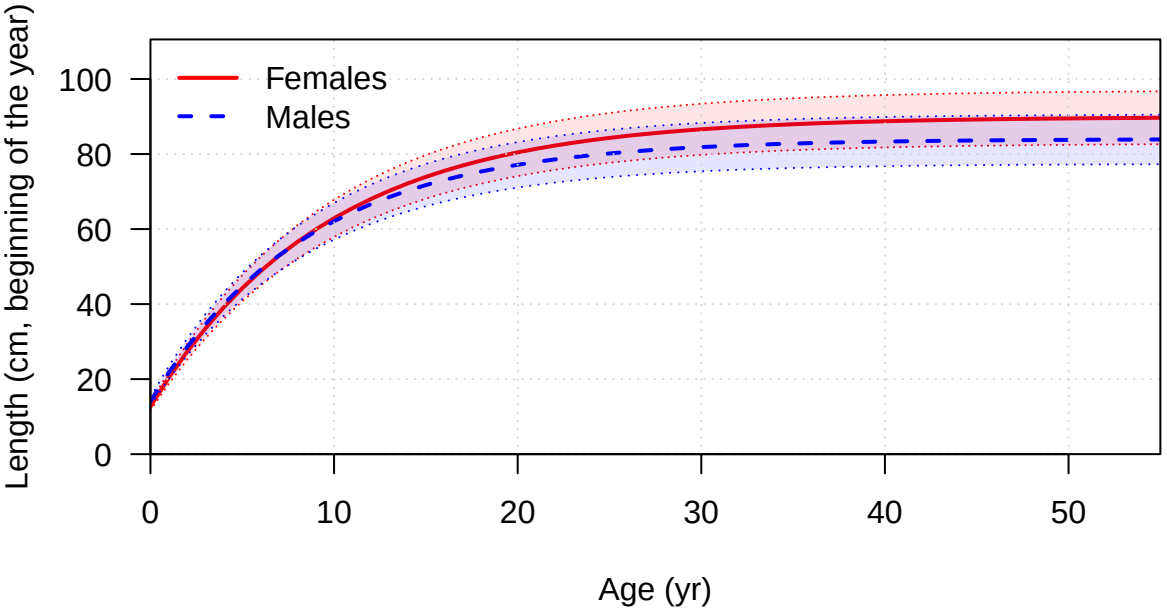
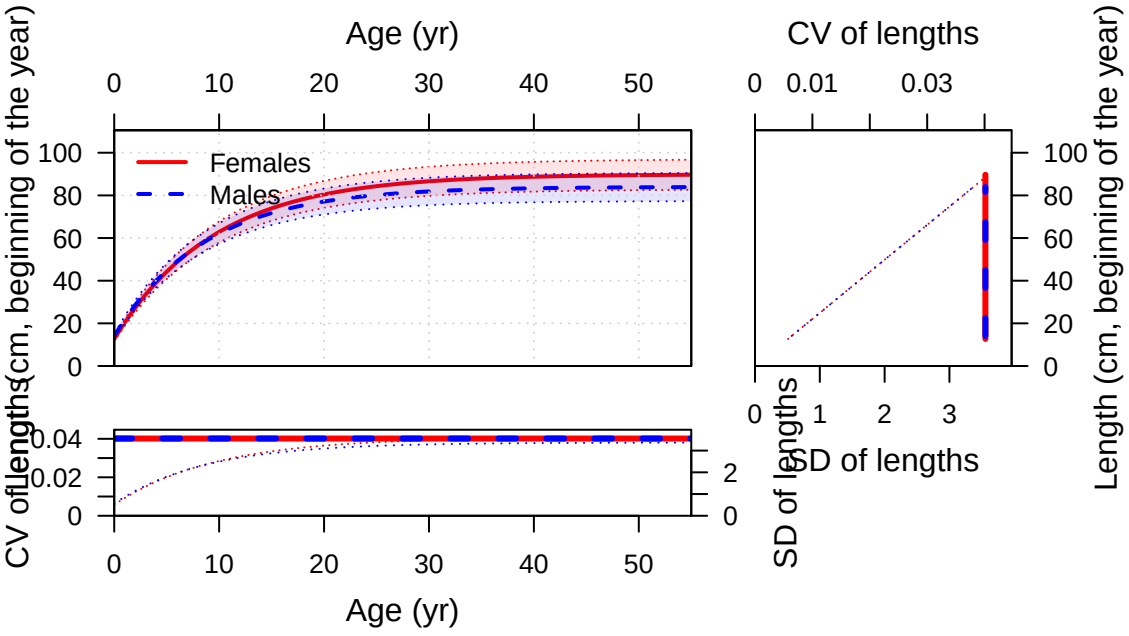
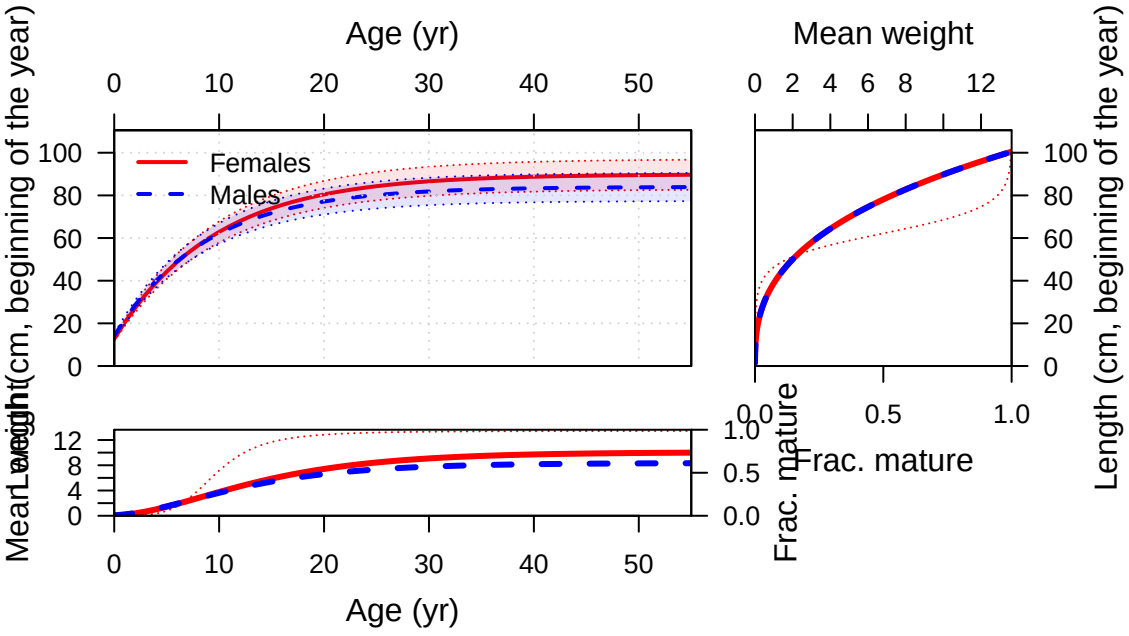
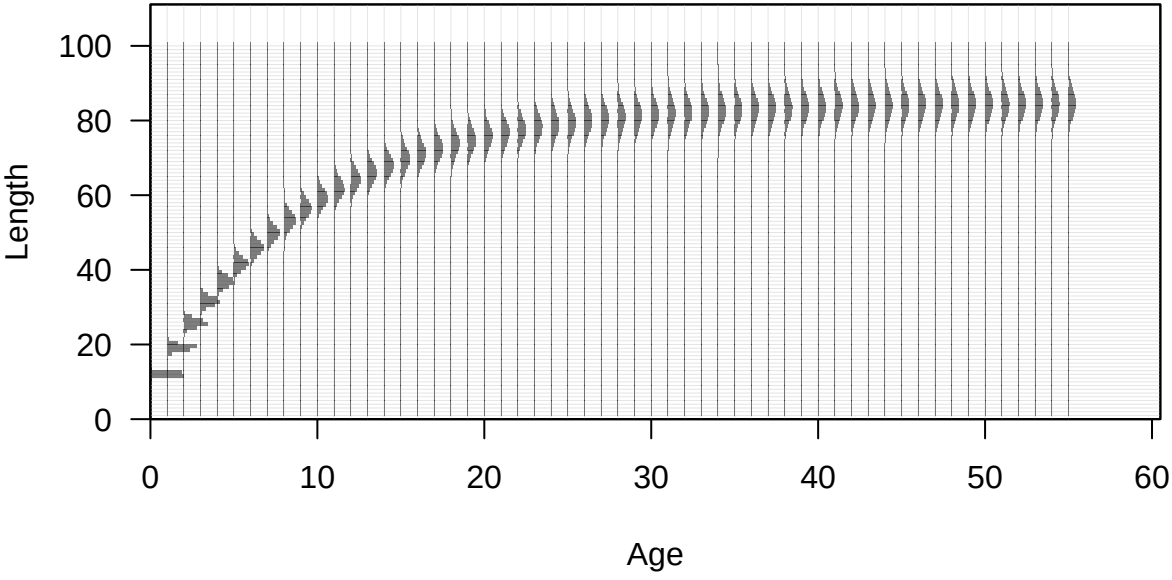
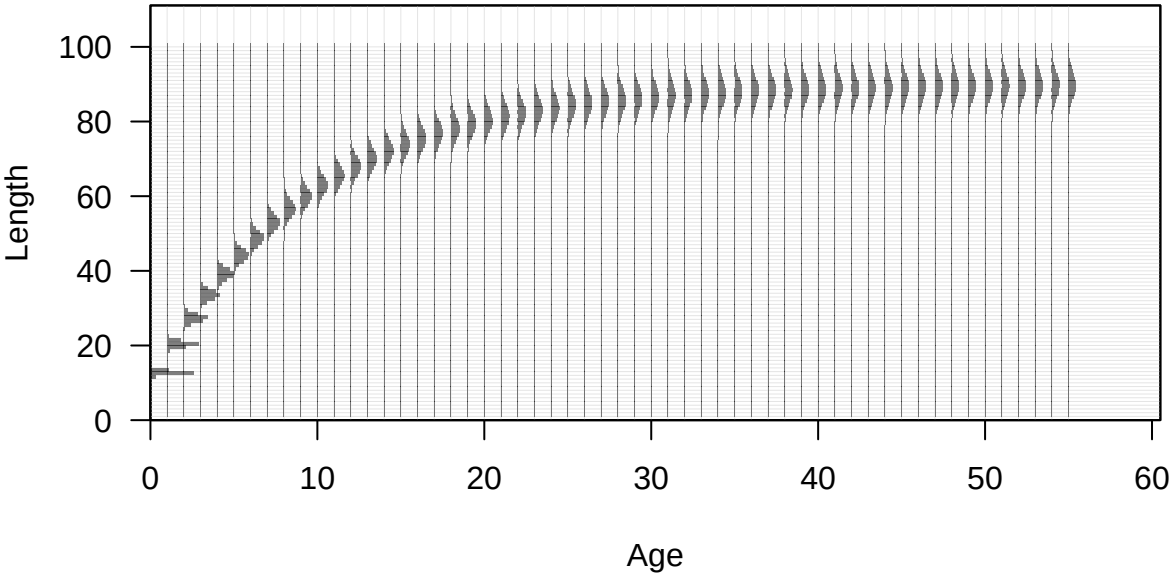
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Tue Feb 14 14:19:59 2023
Data_File: data.ss
Control_File: control.ss

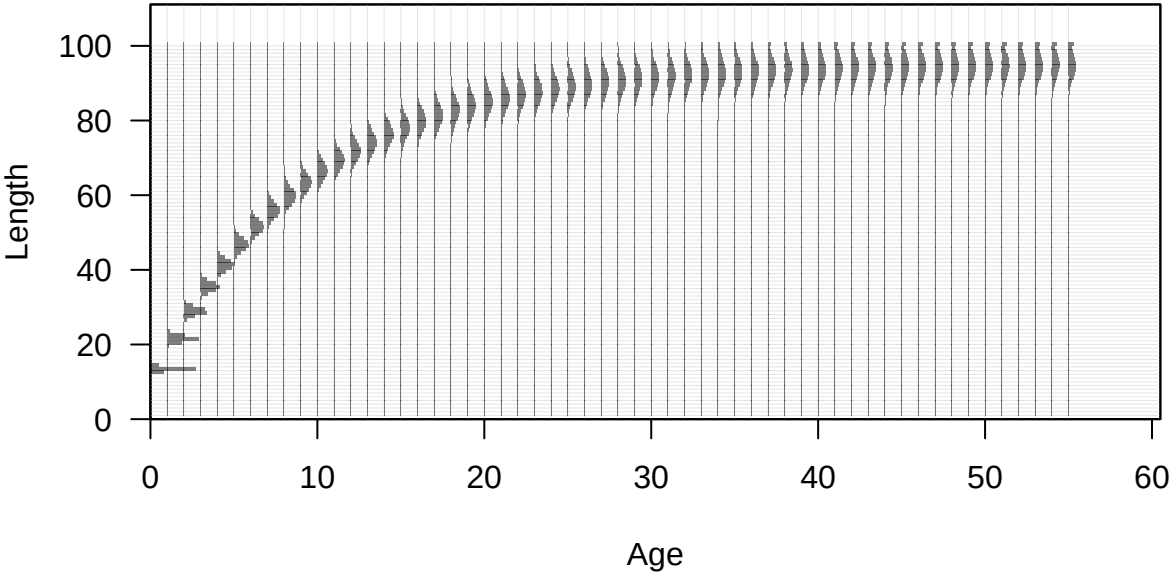

Females
Males
Length (cm, beginning of the year)
0
20
40
60
80
100
0
10
20
30
40
50
Age (yr)

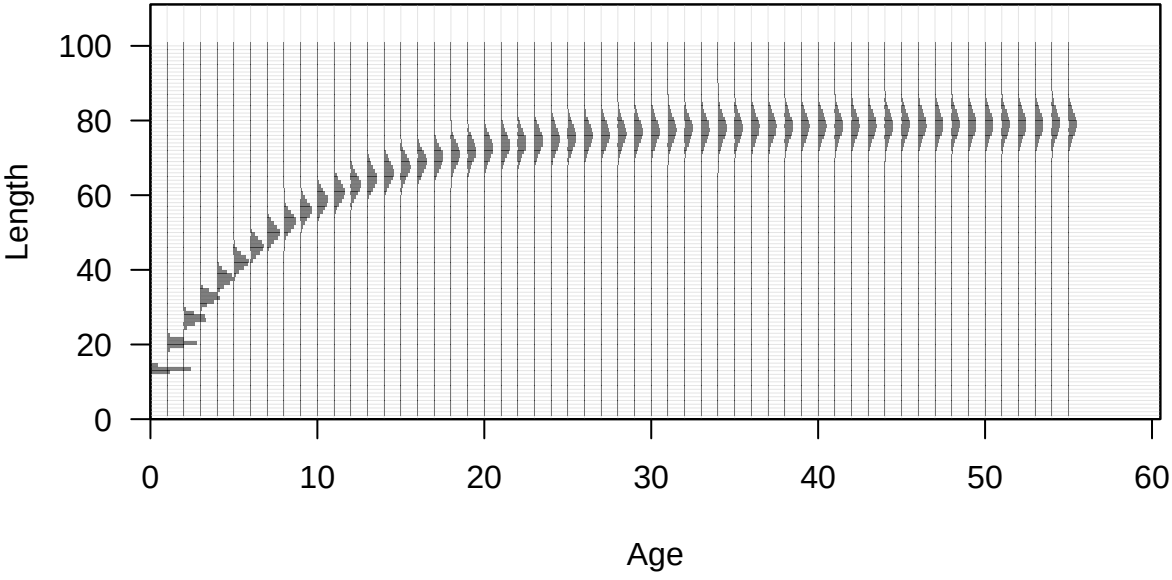

Age (yr)
0
10
20
30
40
50
Females
Males
Length (cm, beginning of the year)
100
80
60
40
20
0
CV of lengths
0.04
0.02
0
CV of lengths
Age (yr)
CV of lengths
0
0.01
0.03
SD of lengths
0
1
2
3
SD of lengths
2
0
Length (cm, beginning of the year)

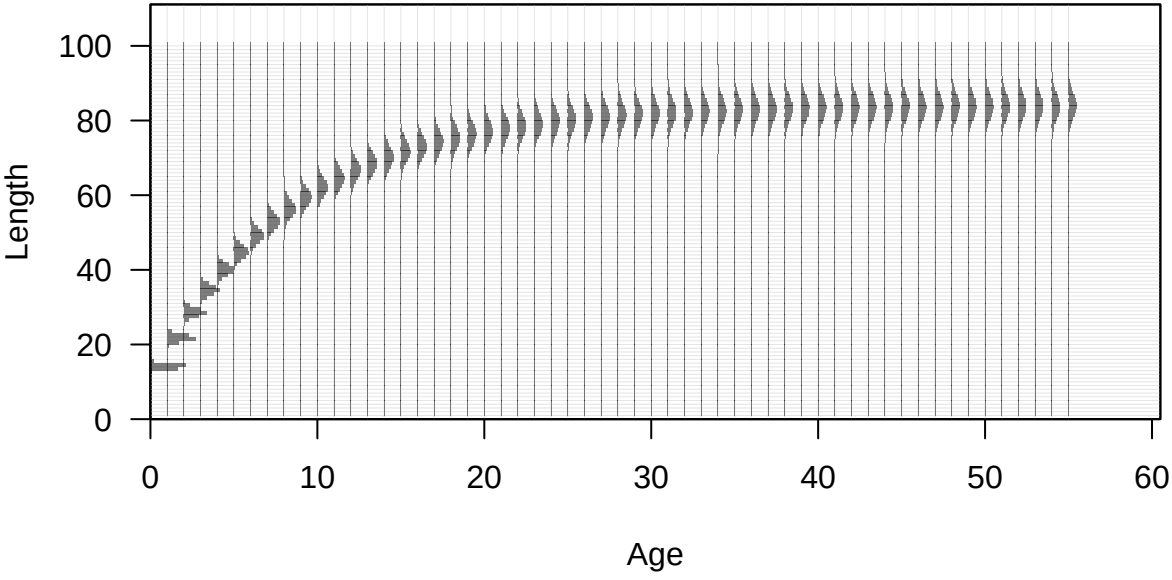

Age (yr)
Mean weight
Length (cm, beginning of the year)
Females
Males
Frac. mature
Age (yr)

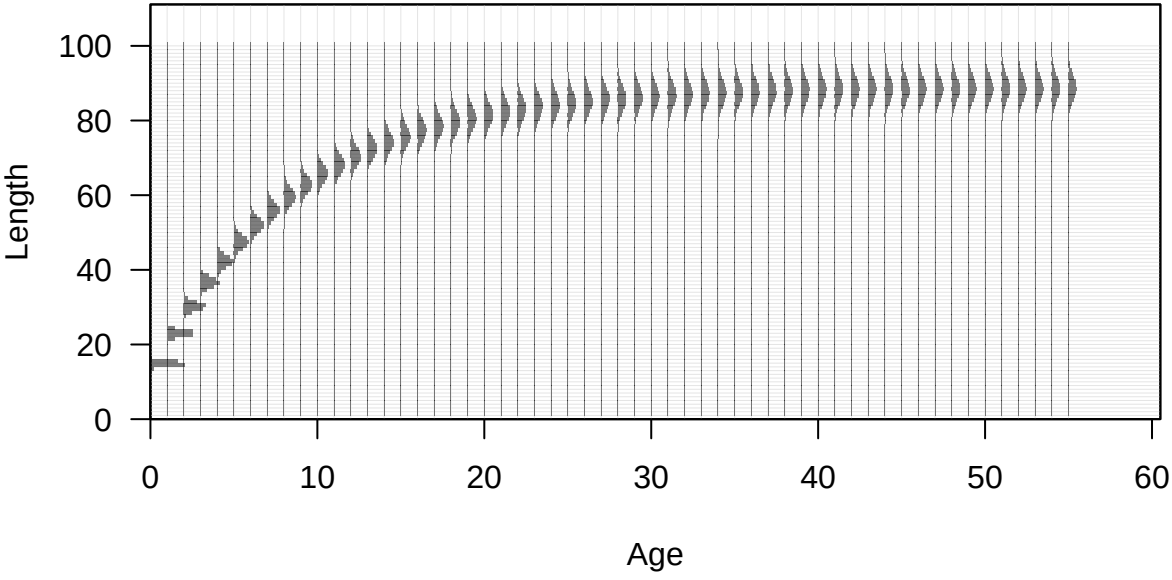

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

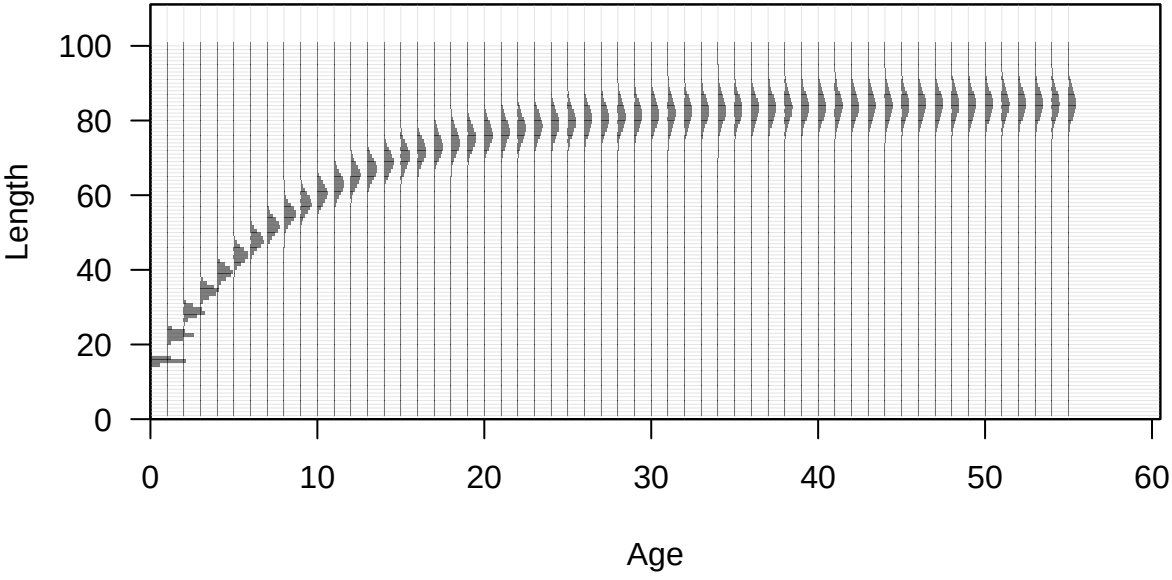

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

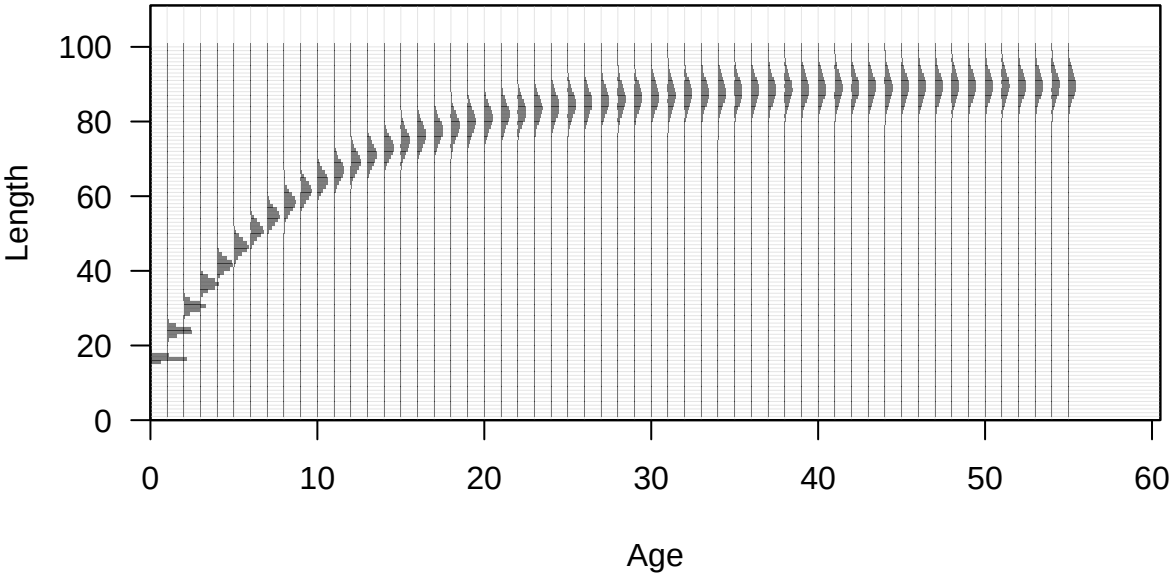

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

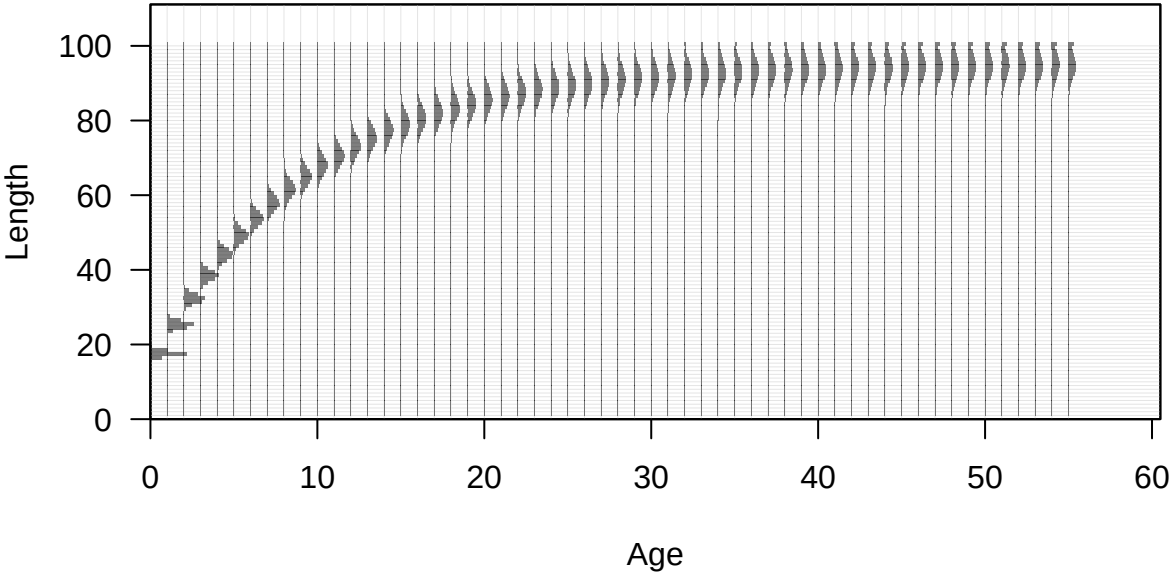

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

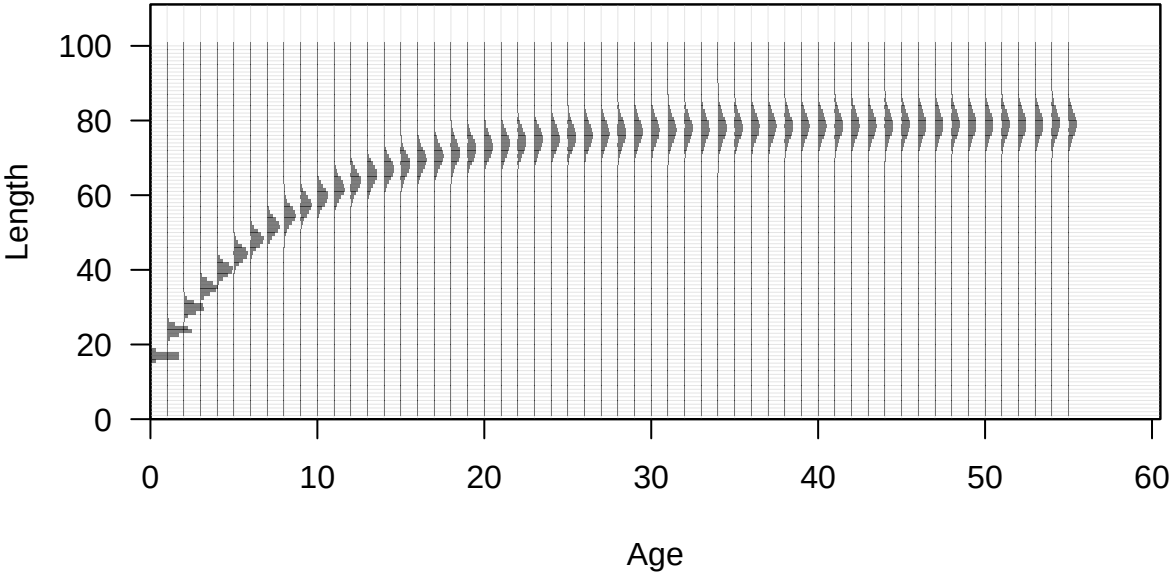

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

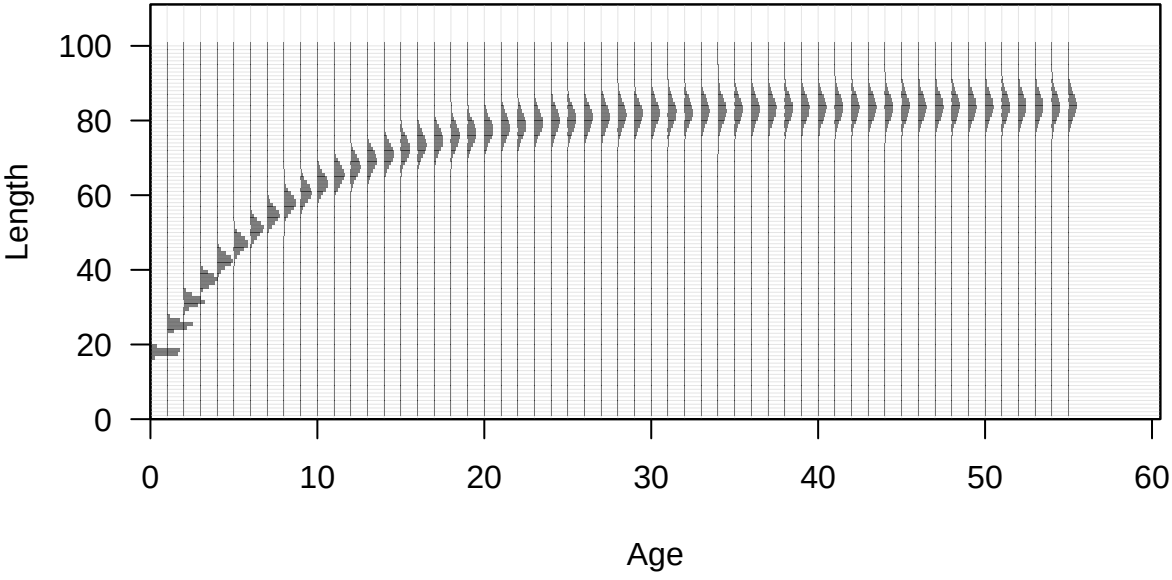

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

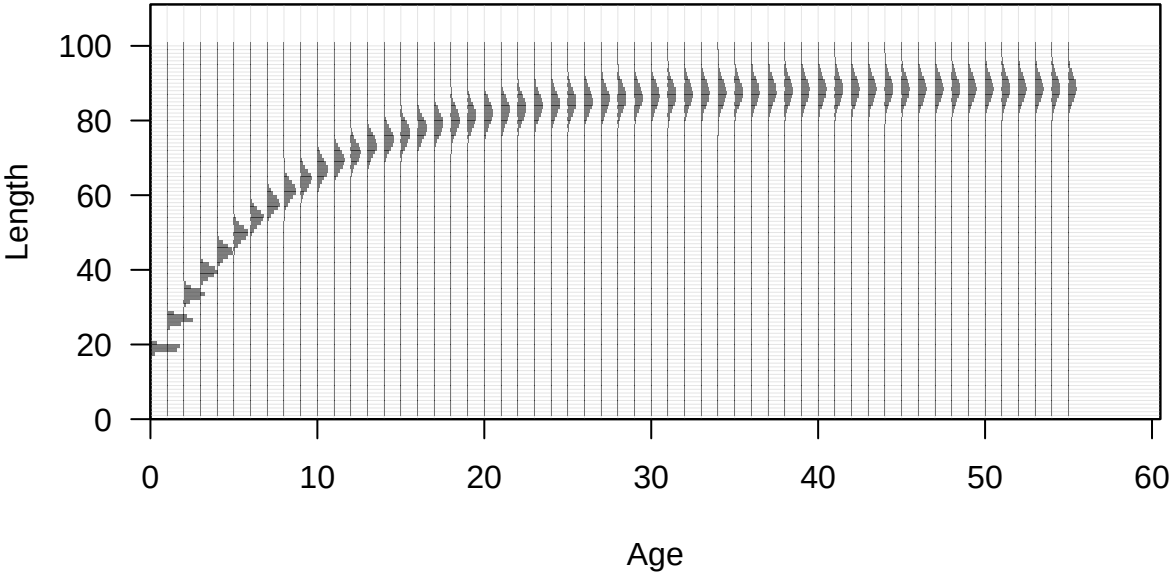

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

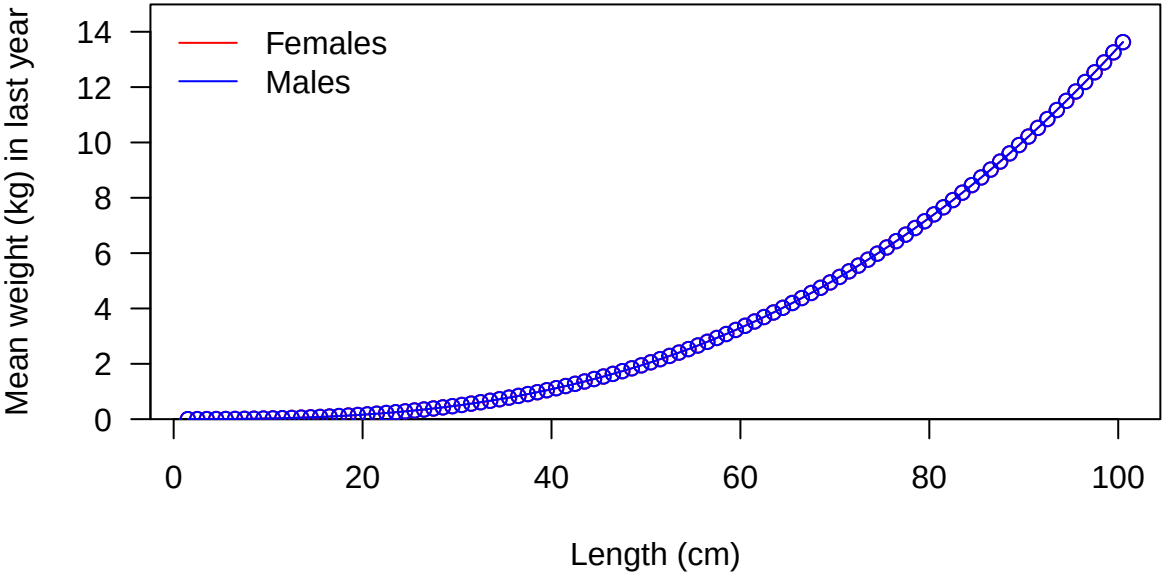

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

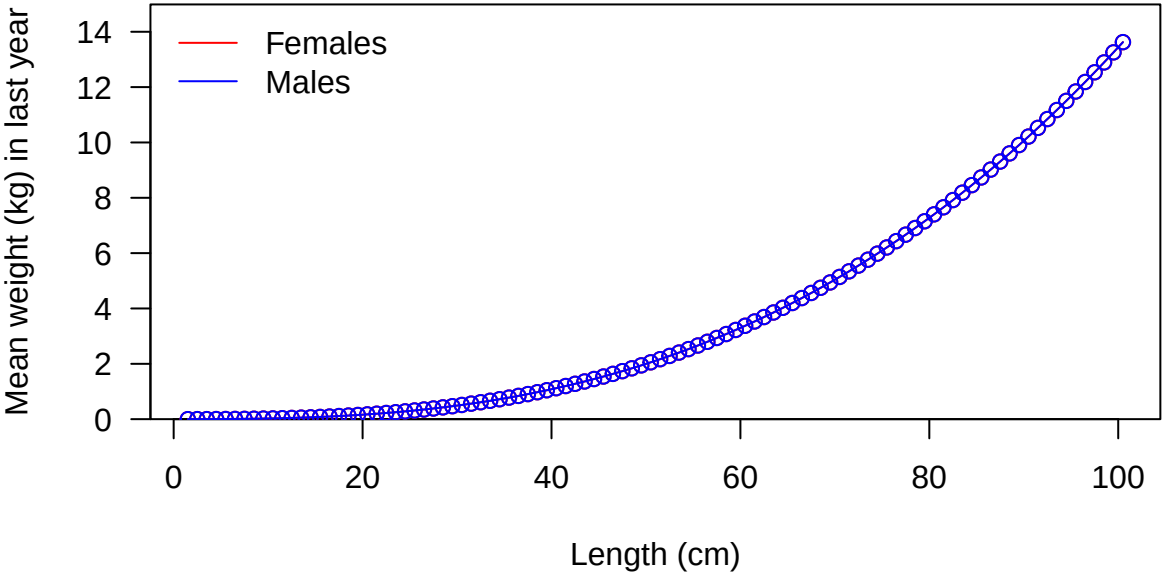

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

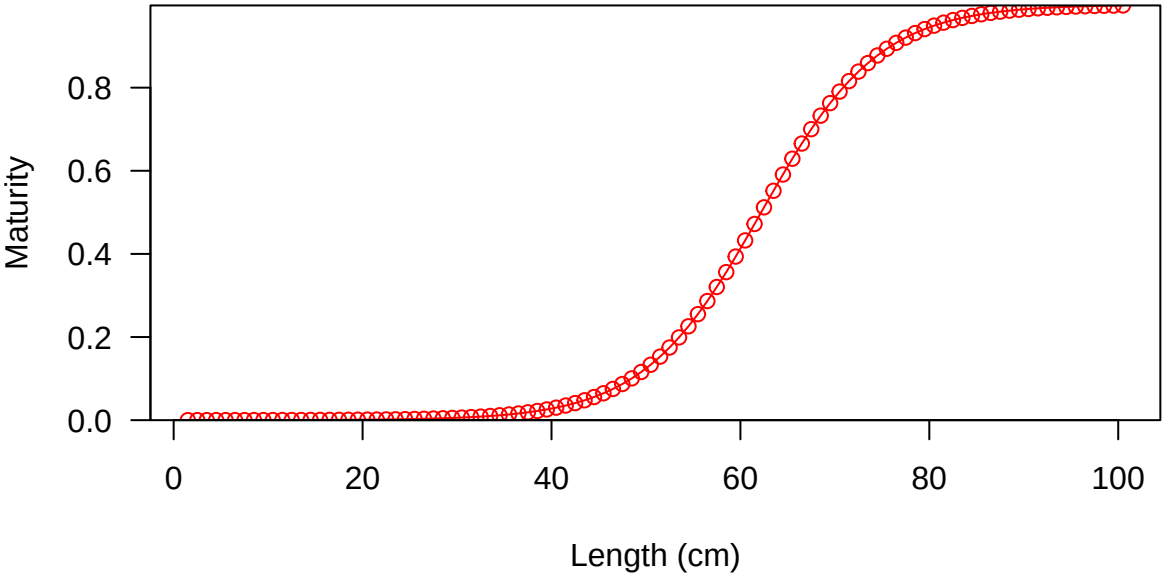

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

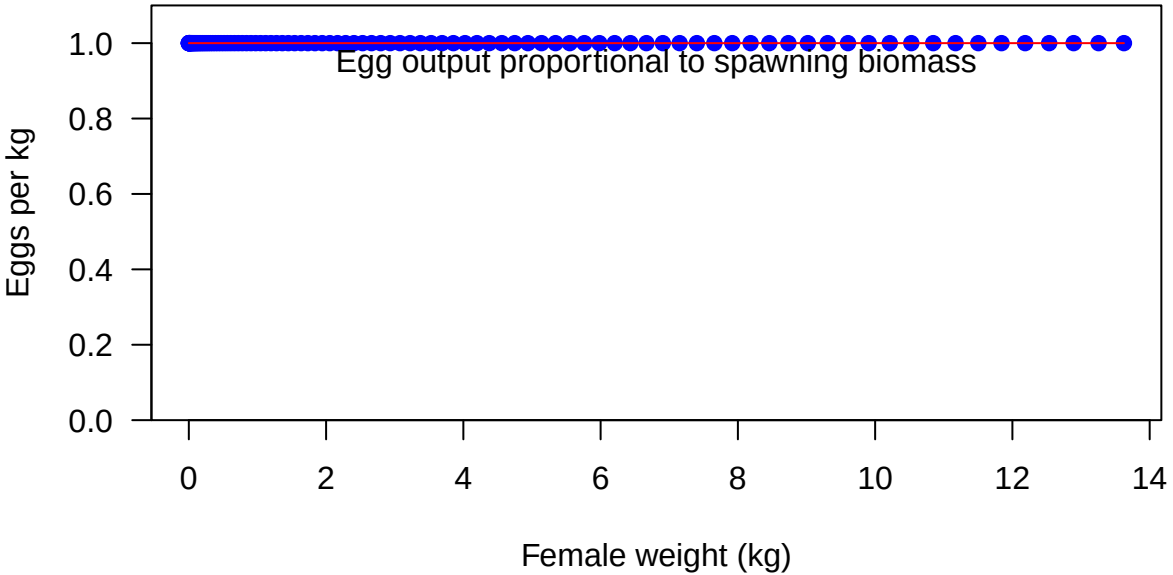

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

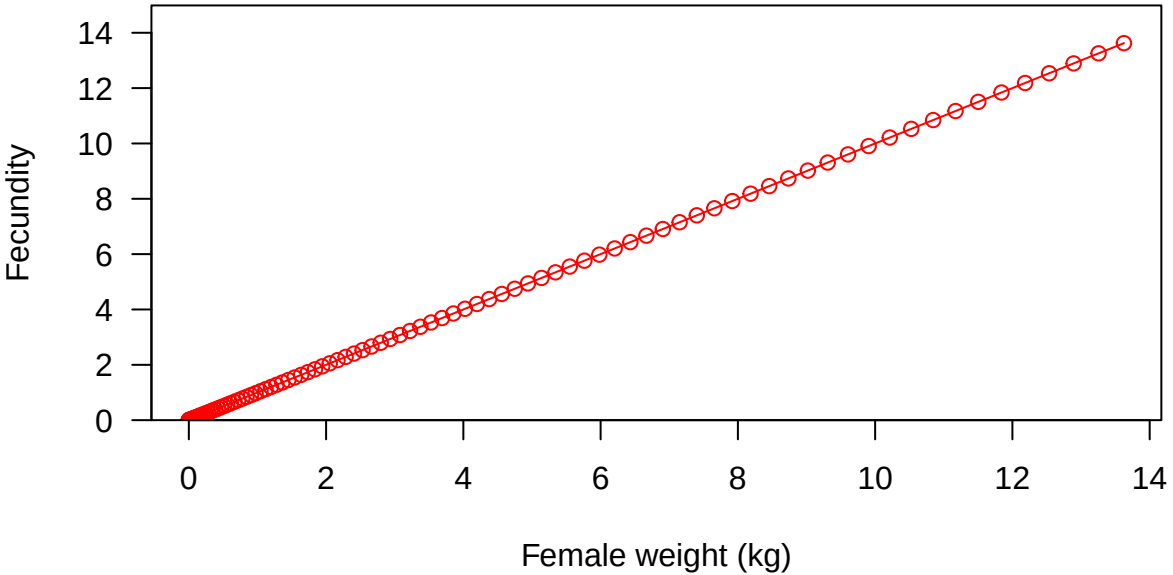

Length
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

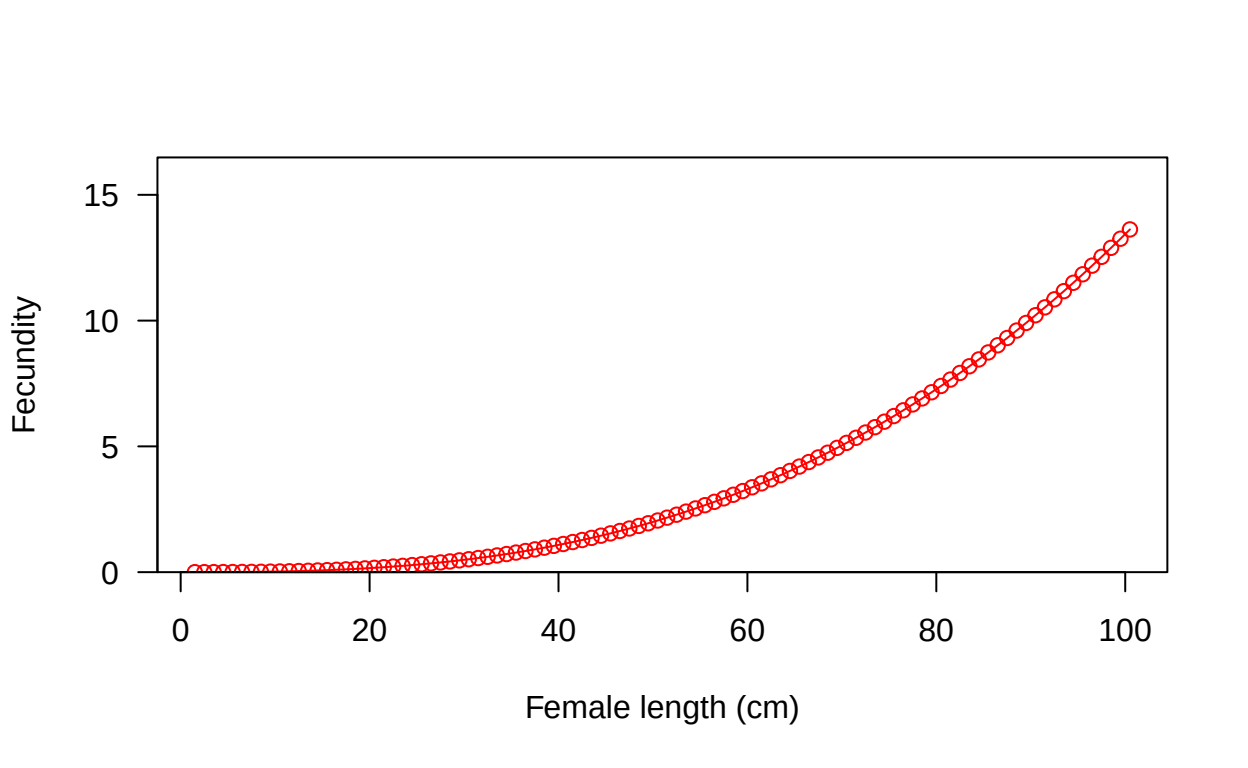

Females
Males
Mean weight (kg) in last year
0
2
4
6
8
10
12
14
0
20
40
60
80
100
Length (cm)

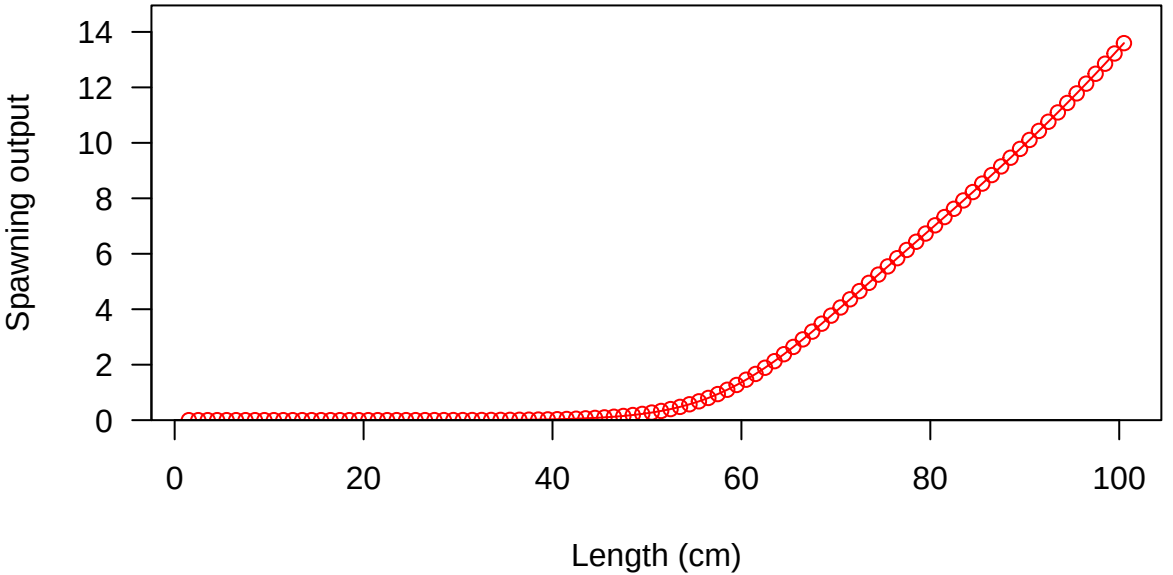

Females
Males
Mean weight (kg) in last year
0
2
4
6
8
10
12
14
0
20
40
60
80
100
Length (cm)

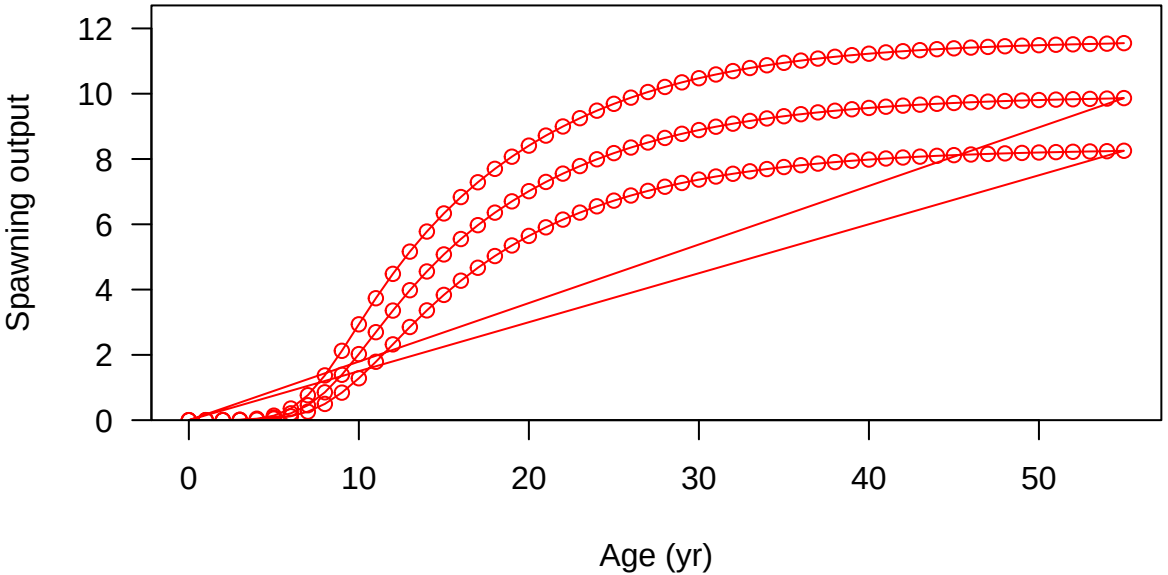

Maturity
0.0
0.2
0.4
0.6
0.8
0
20
40
60
80
100
Length (cm)

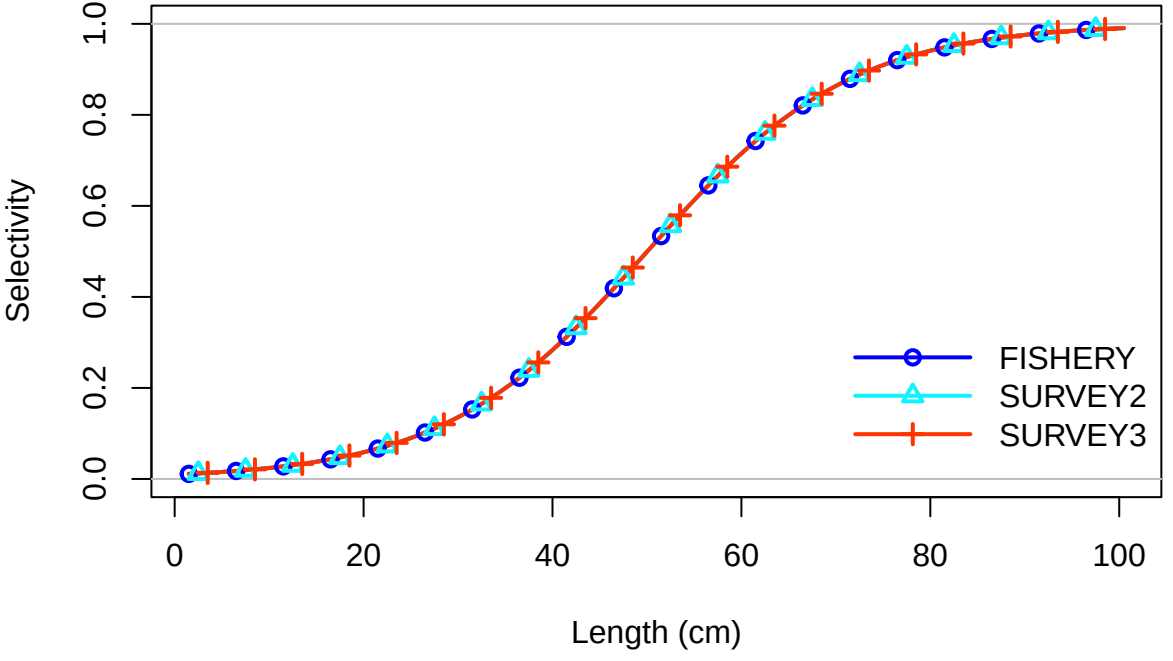

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
Female weight (kg)

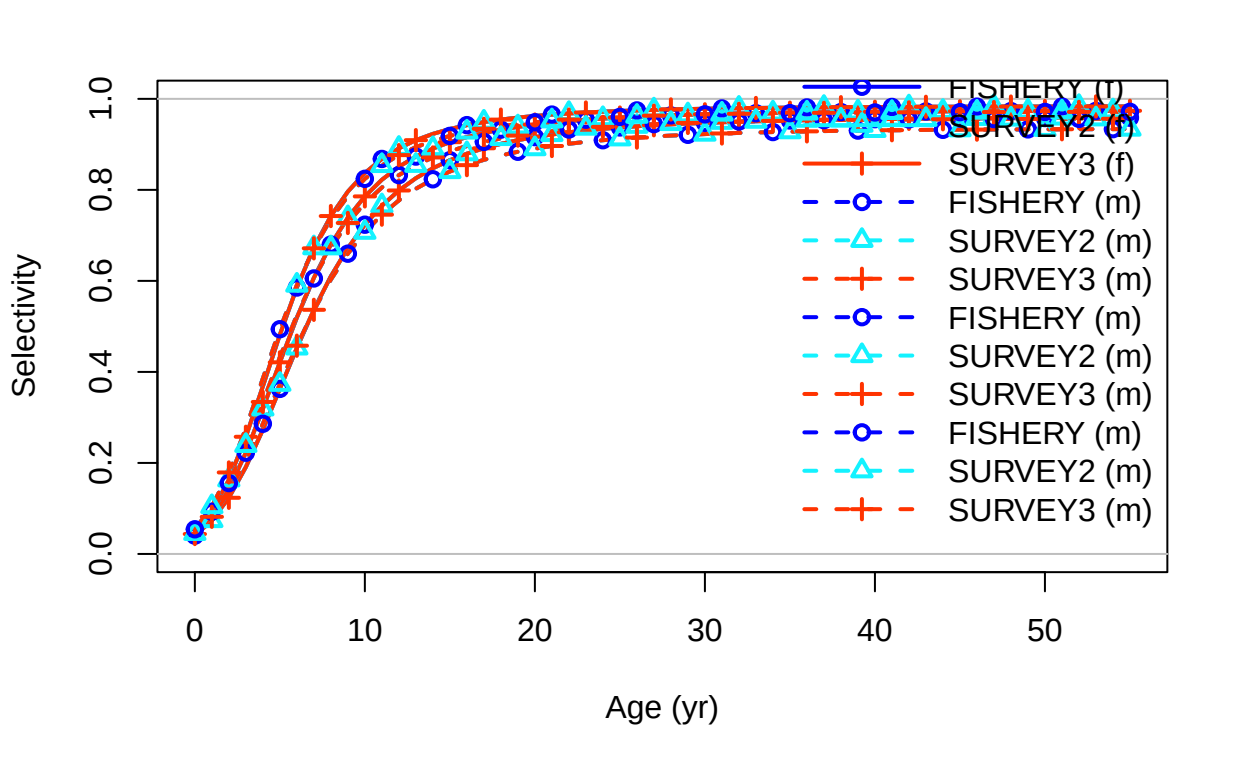

Fecundity
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
14
Female weight (kg)

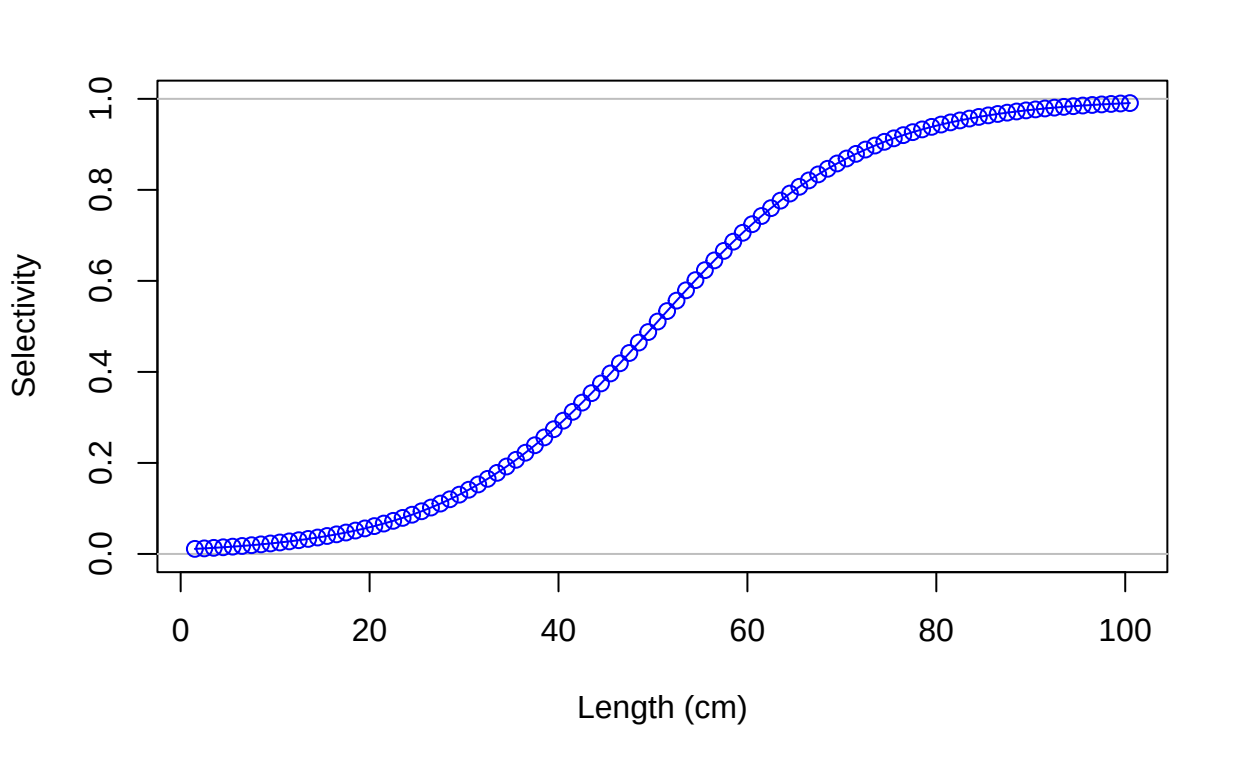

Fecundity
15
10
5
0
0
20
40
60
80
100
Female length (cm)

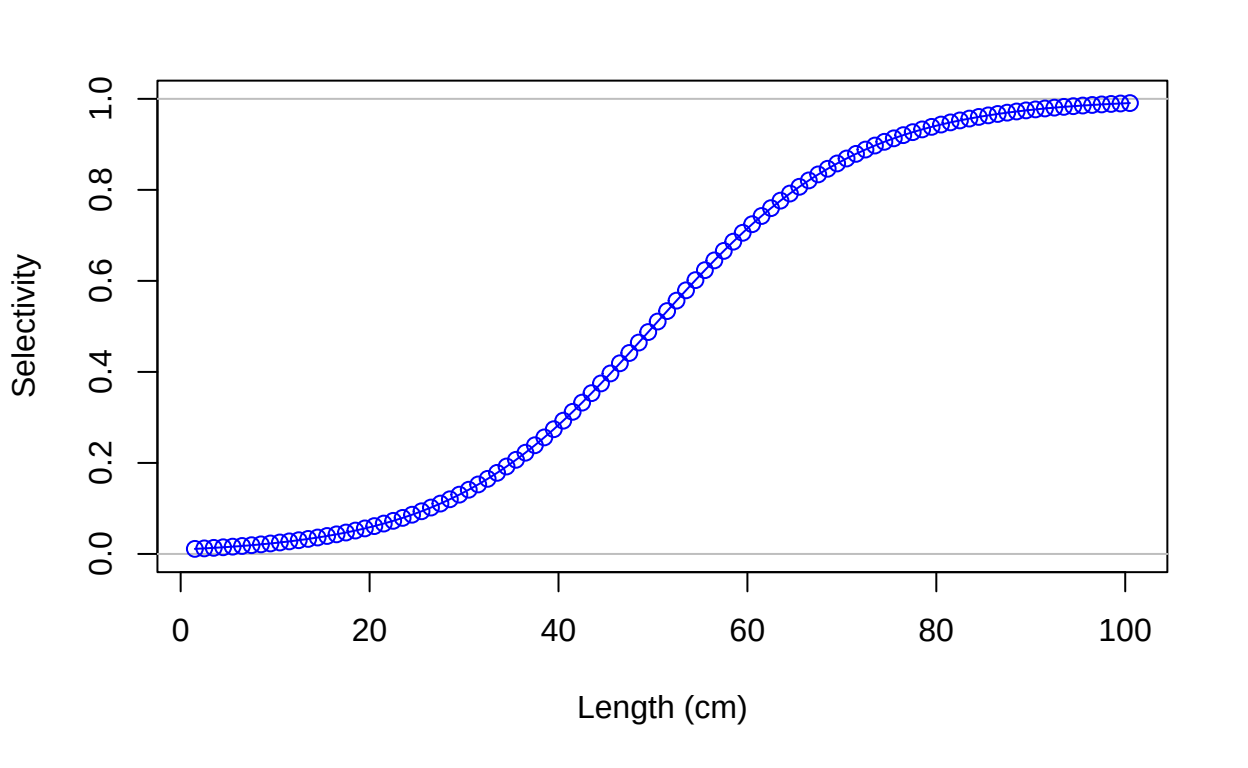

Spawning output
0
2
4
6
8
10
12
14
0
20
40
60
80
100
Length (cm)

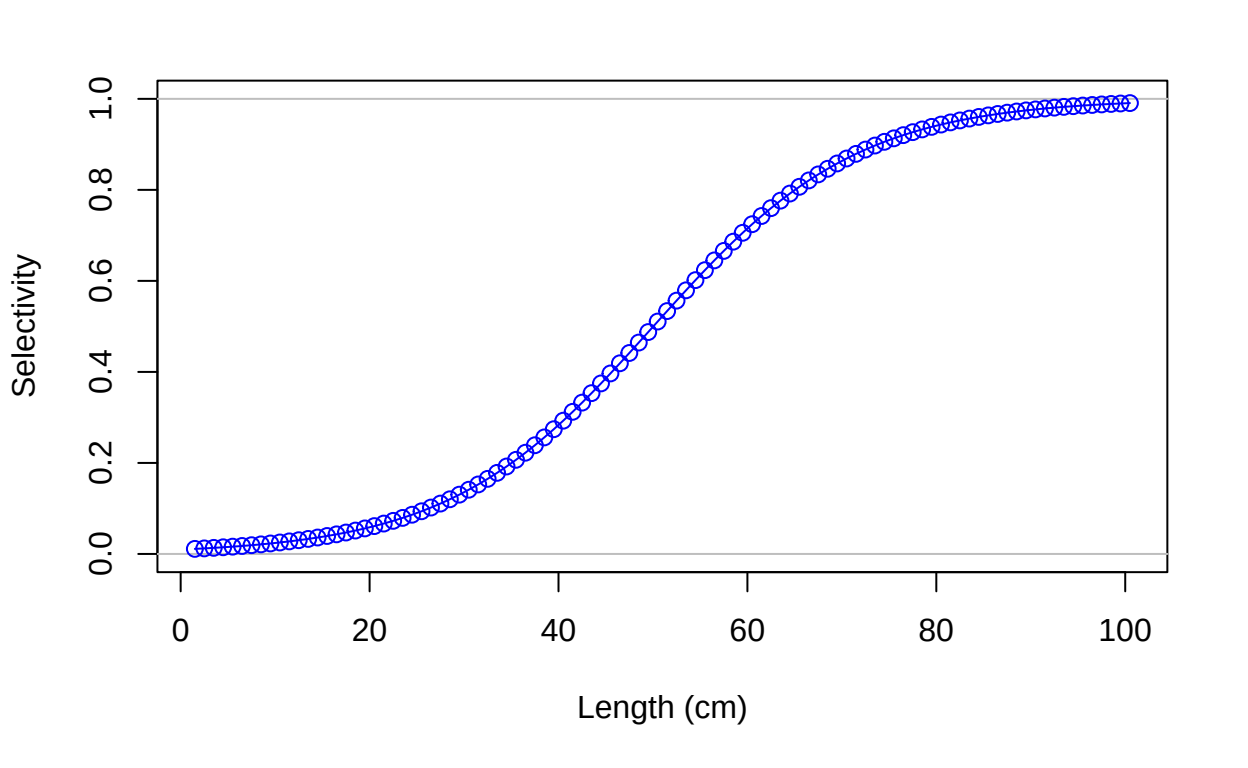

Spawning output
0
2
4
6
8
10
12
0
10
20
30
40
50
Age (yr)

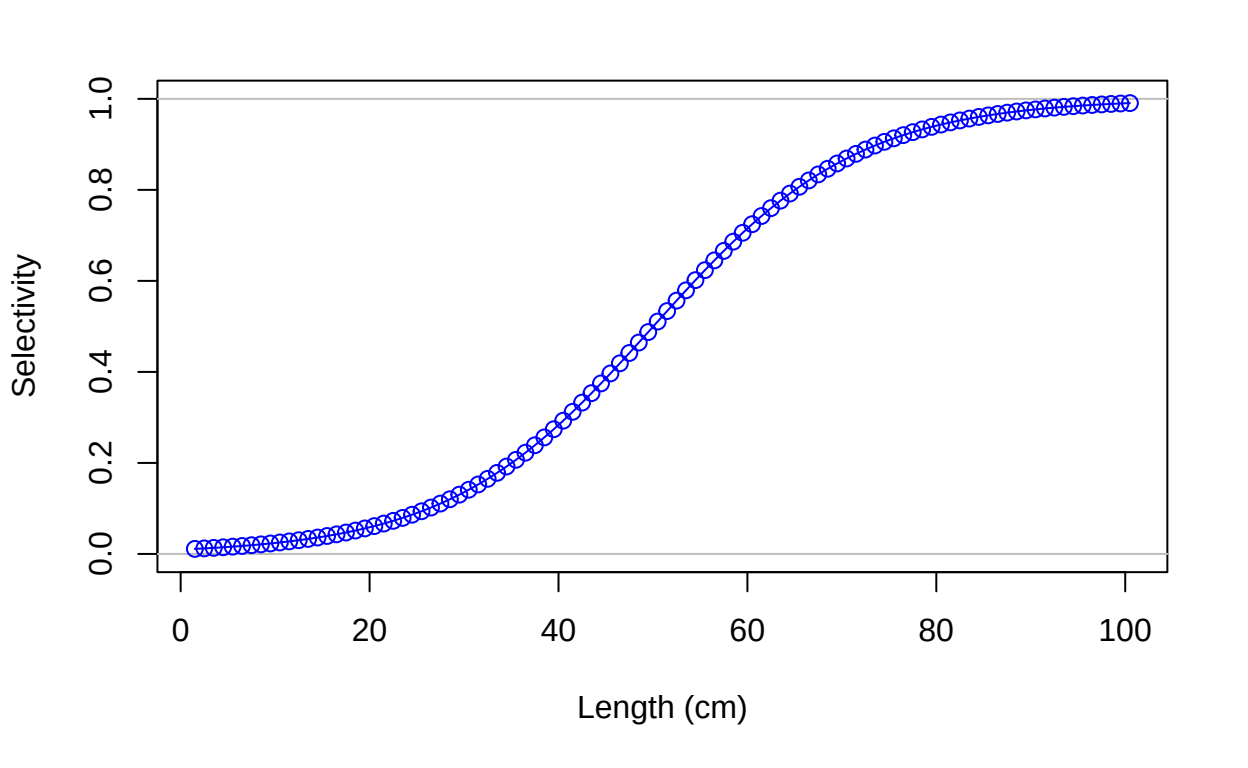

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)
FISHERY
SURVEY2
SURVEY3

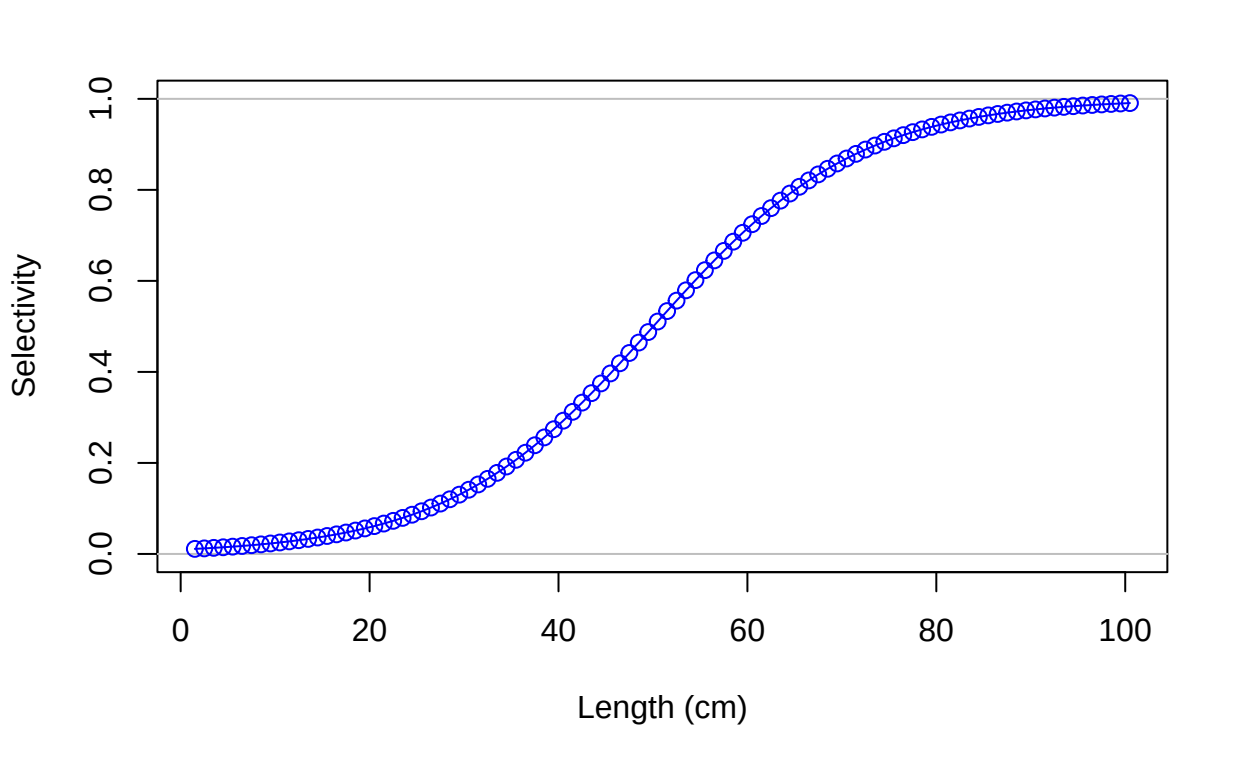

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Age (yr)
FISHERY (f)
SURVEY2 (f)
SURVEY3 (f)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)
FISHERY (m)
SURVEY2 (m)
SURVEY3 (m)

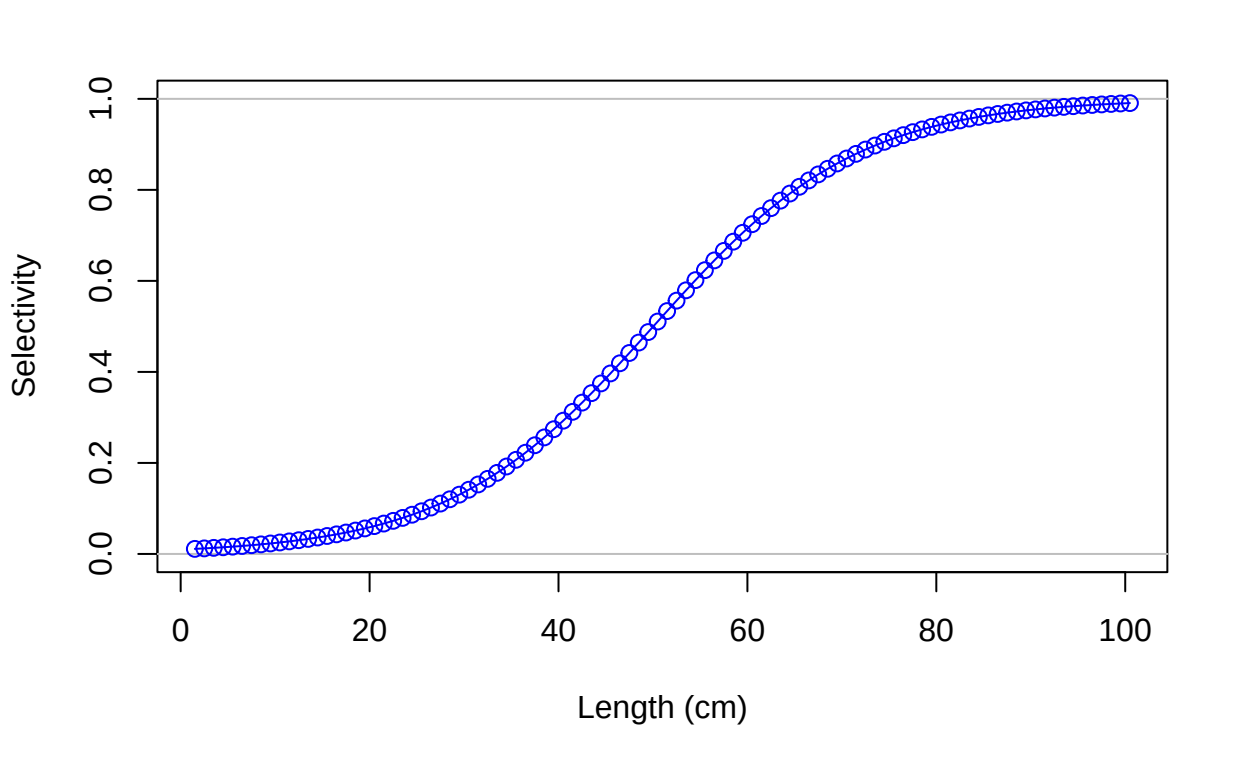

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

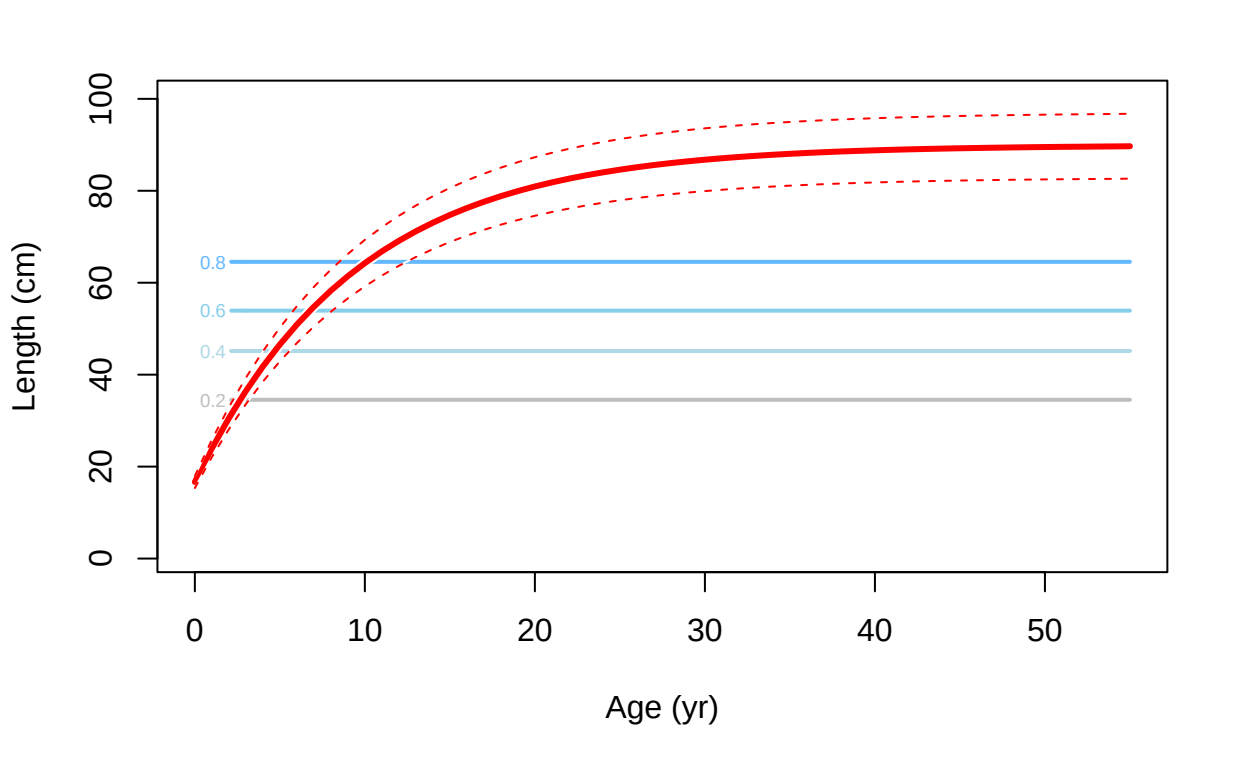

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

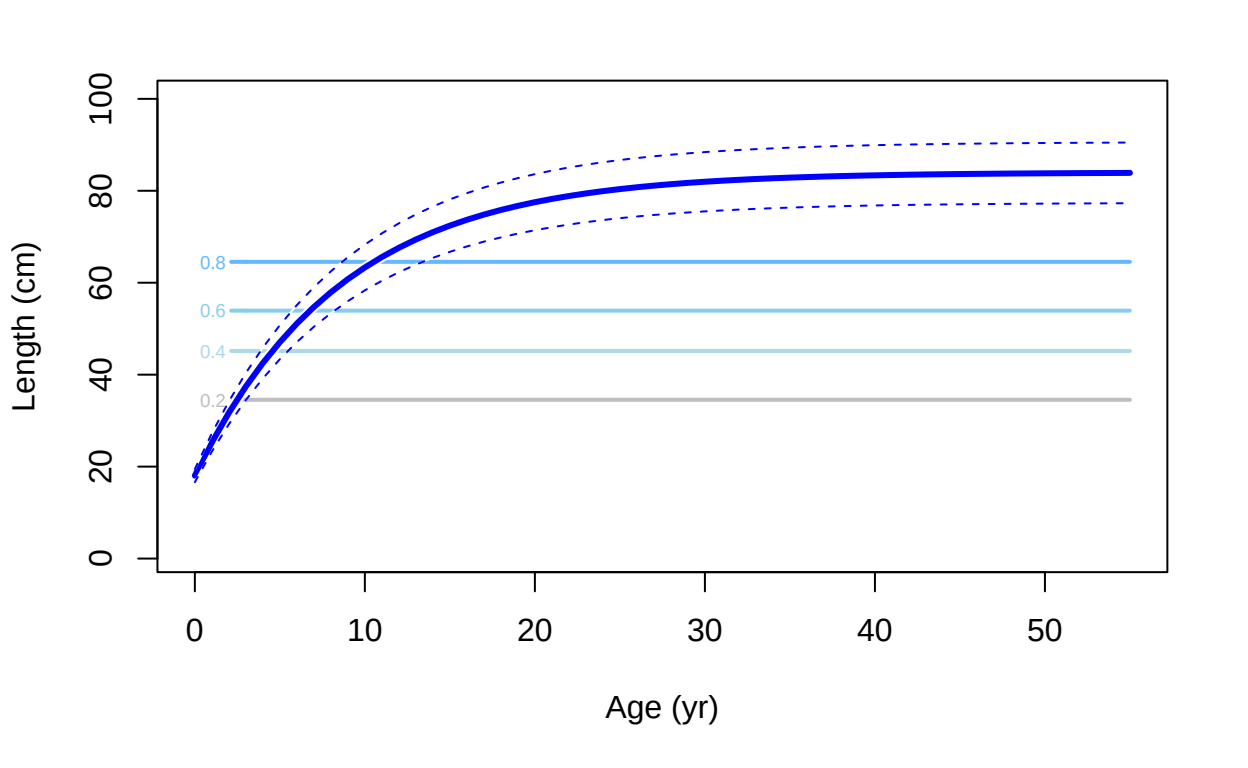

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

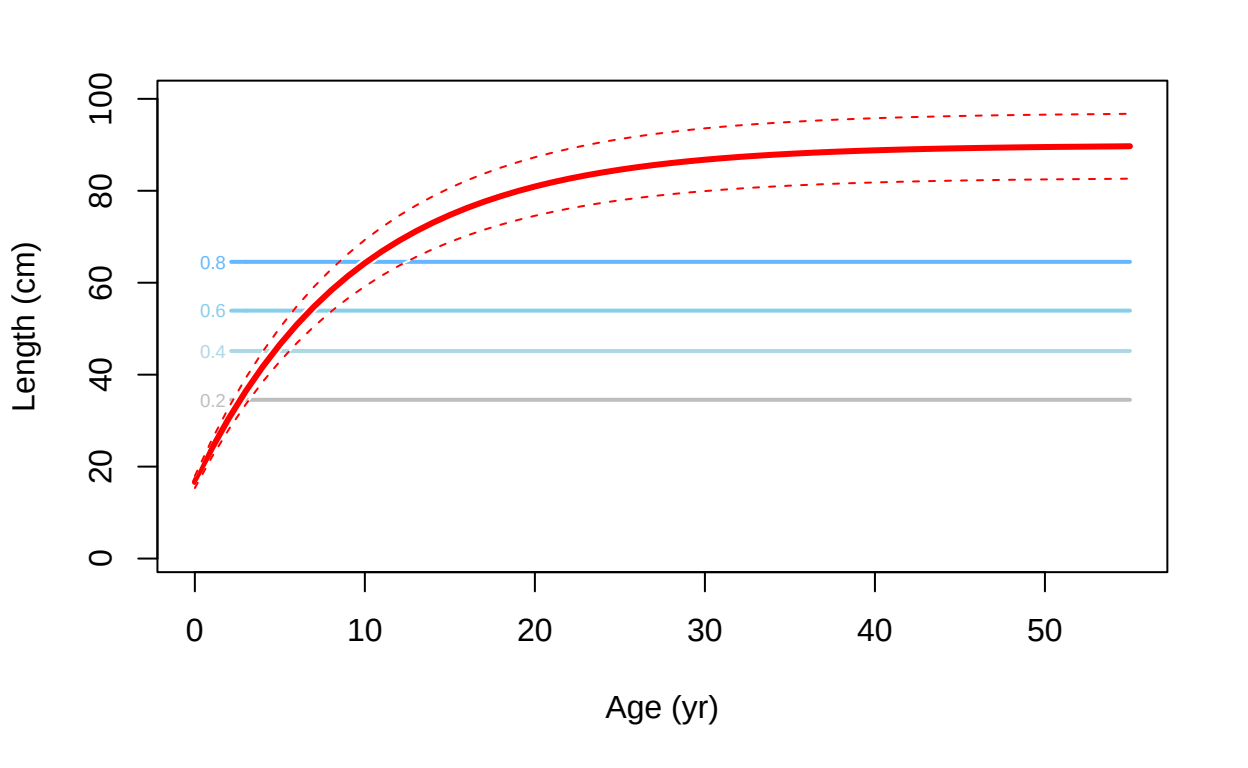

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

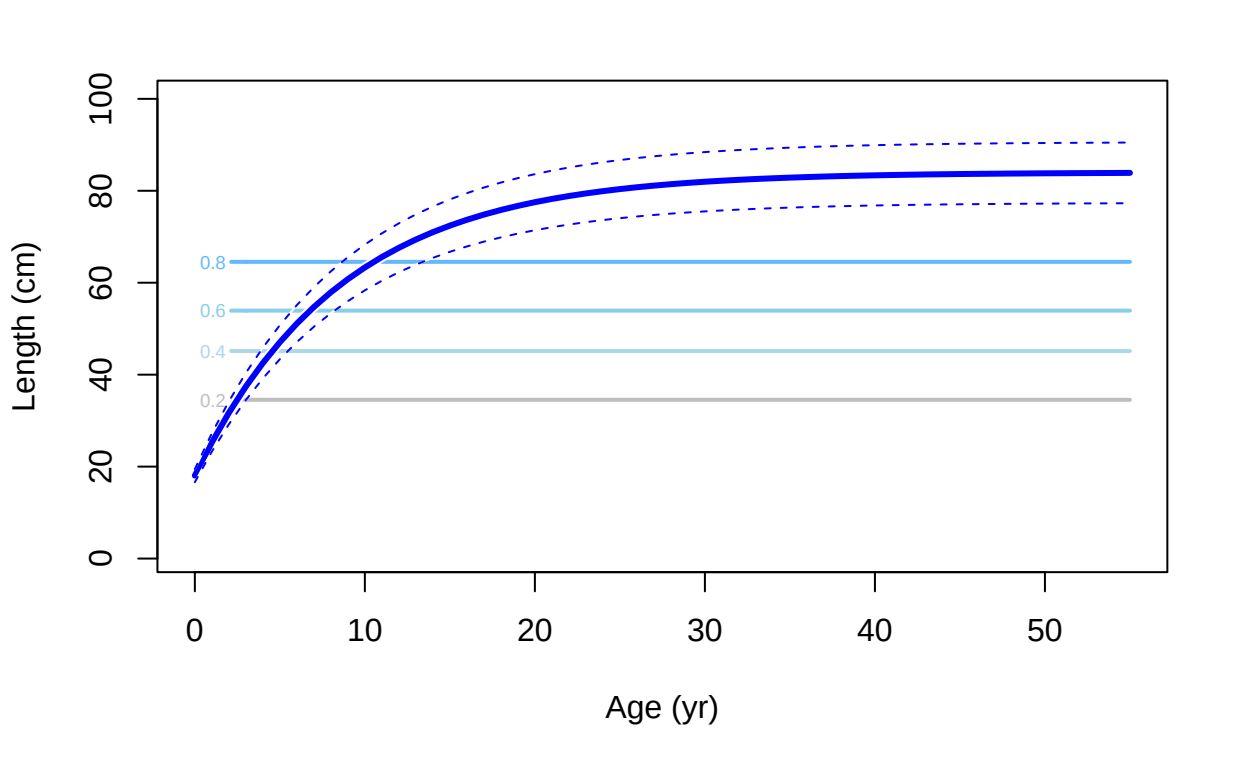

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

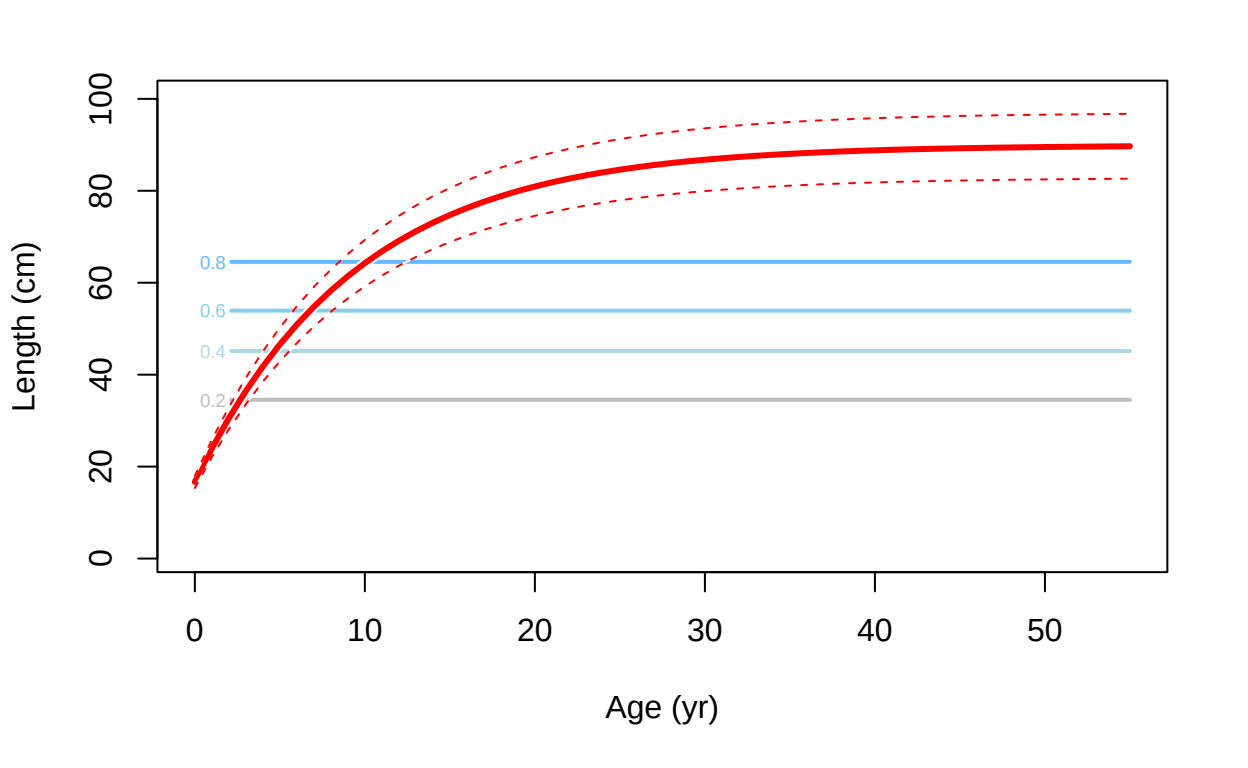

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

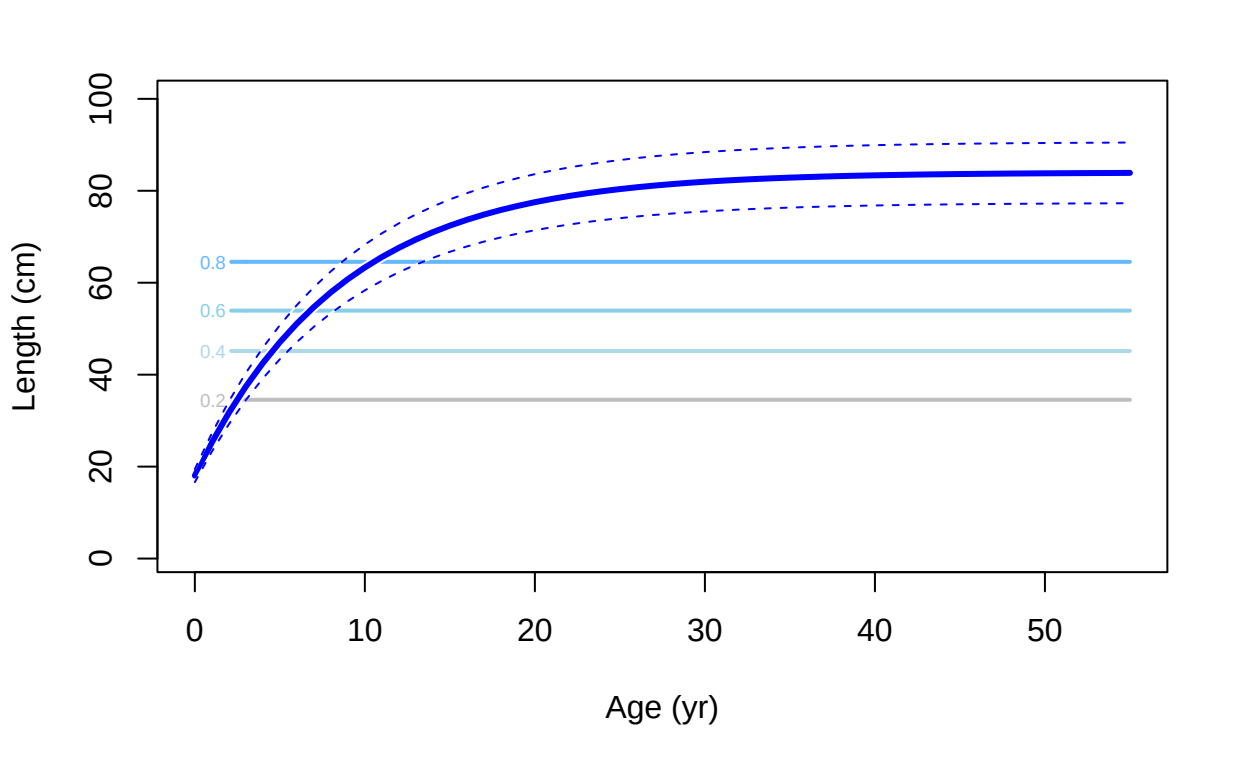

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

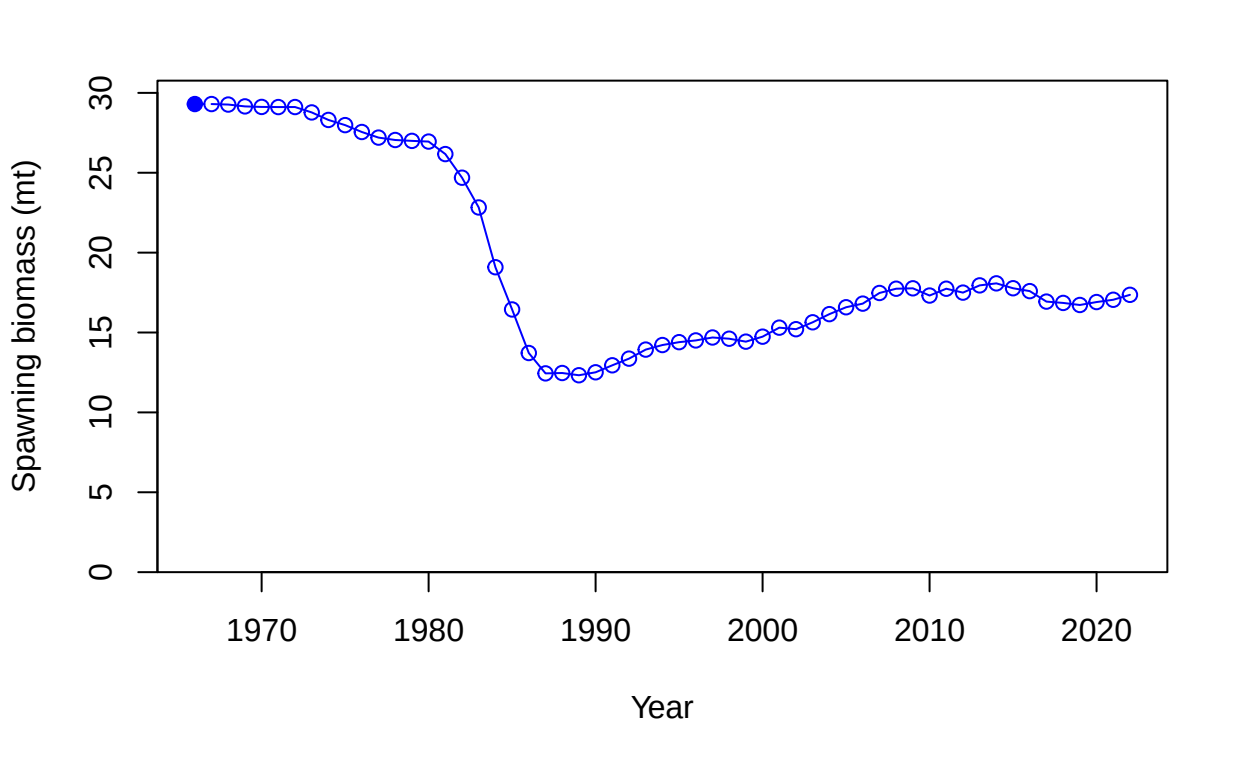

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

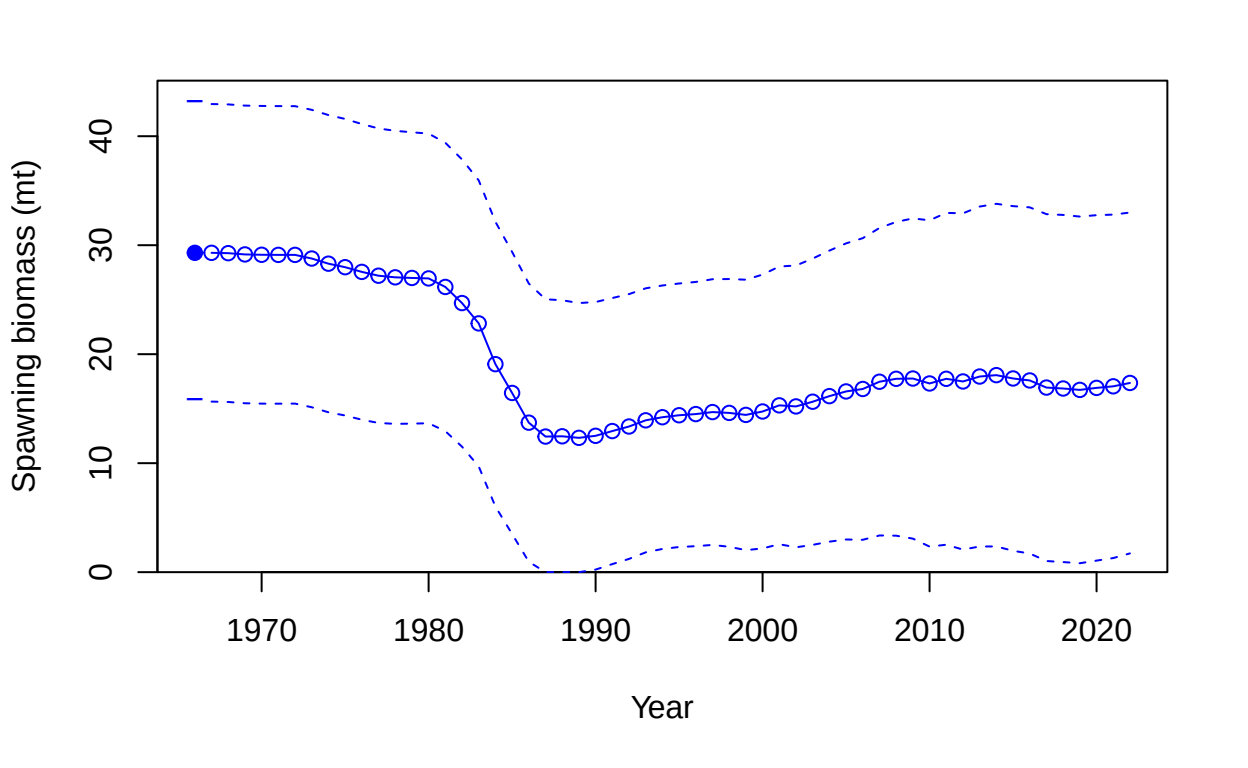

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

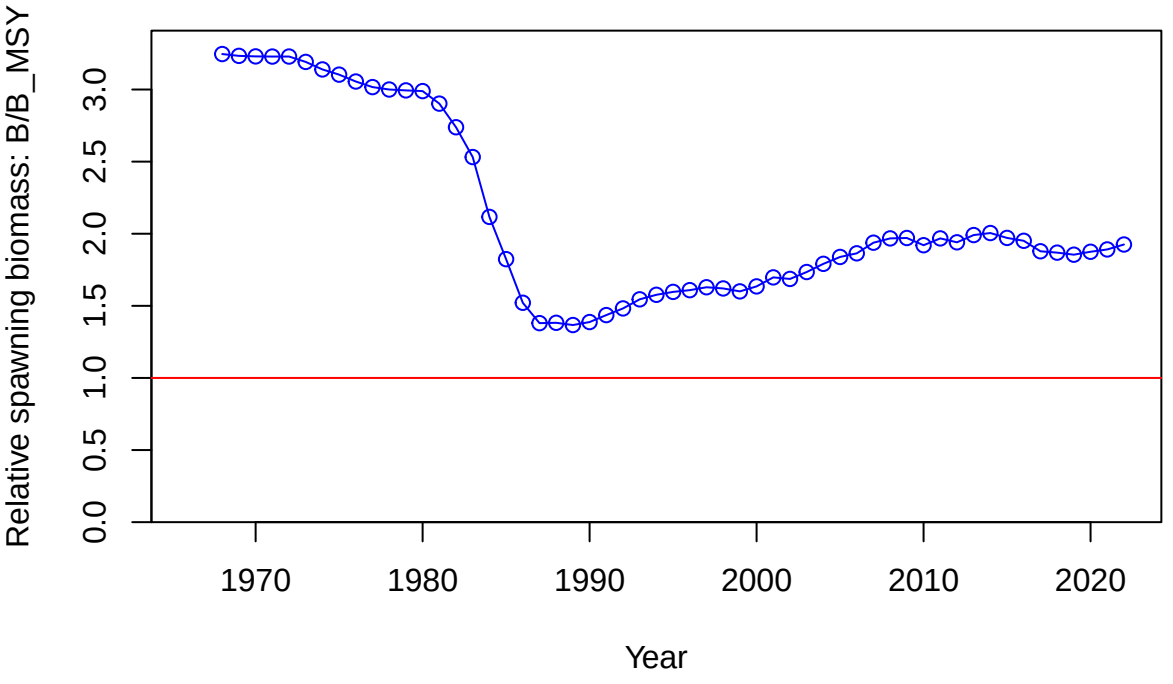

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

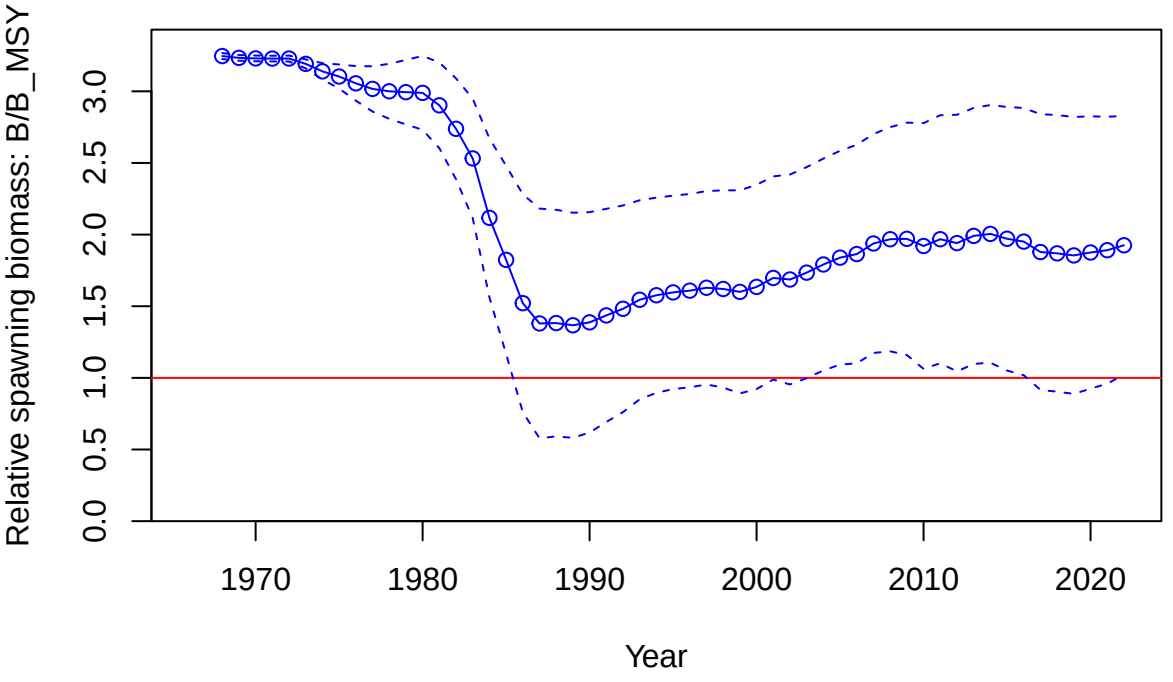

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

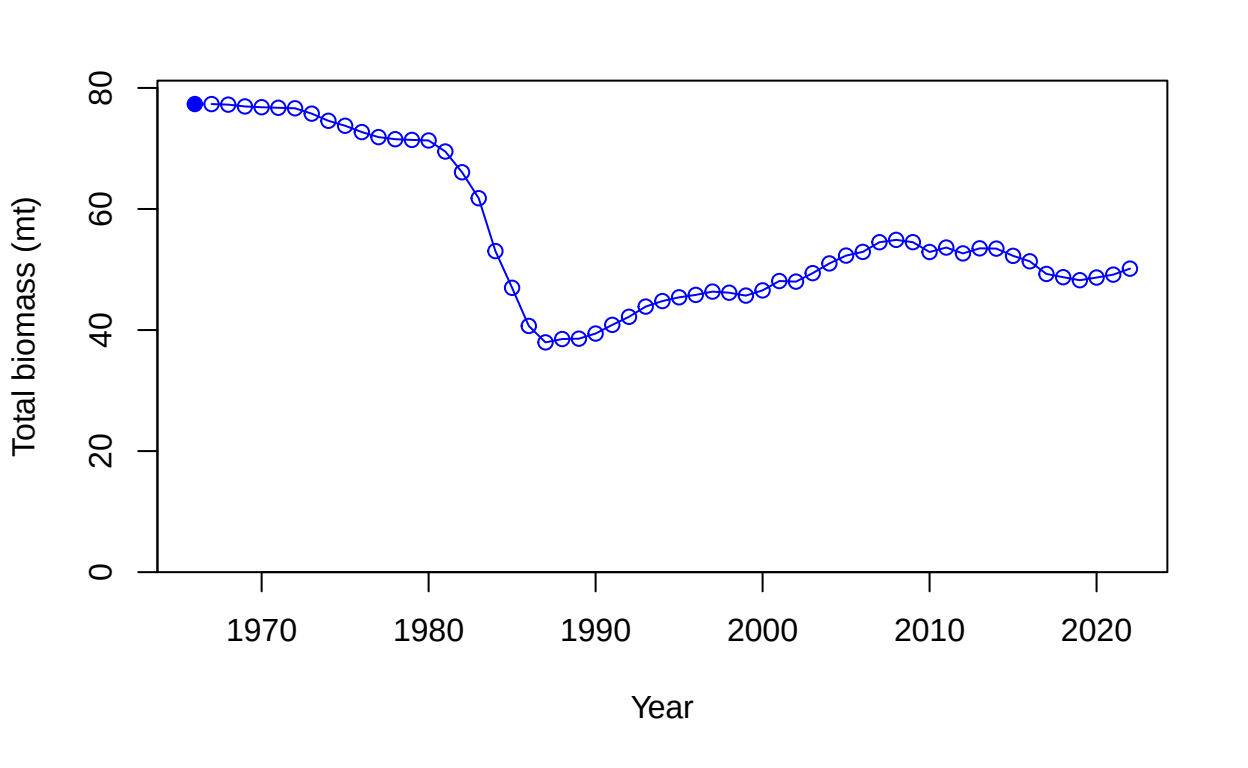

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
10
20
30
40
50
Age (yr)

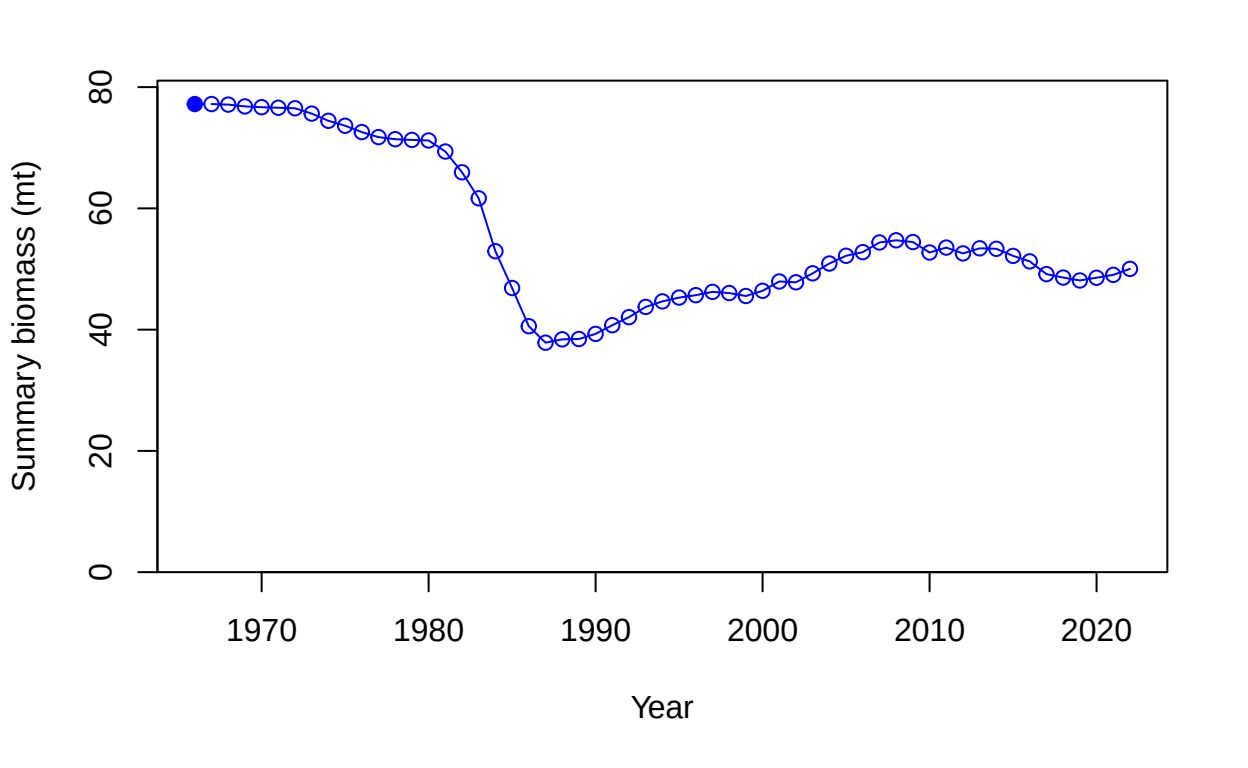

Spawning biomass (mt)
0
5
10
15
20
25
30
1970
1980
1990
2000
2010
2020
Year

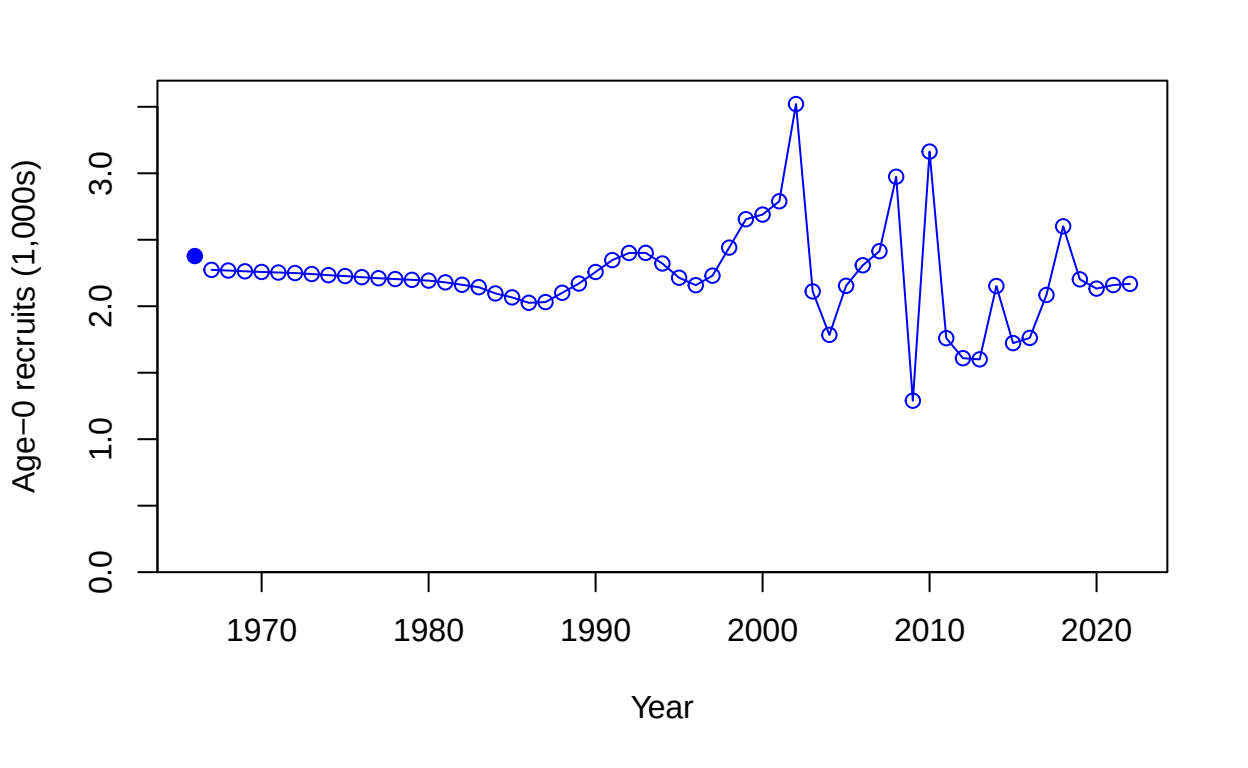

Spawning biomass (mt)
0
10
20
30
40
1970
1980
1990
2000
2010
2020
Year

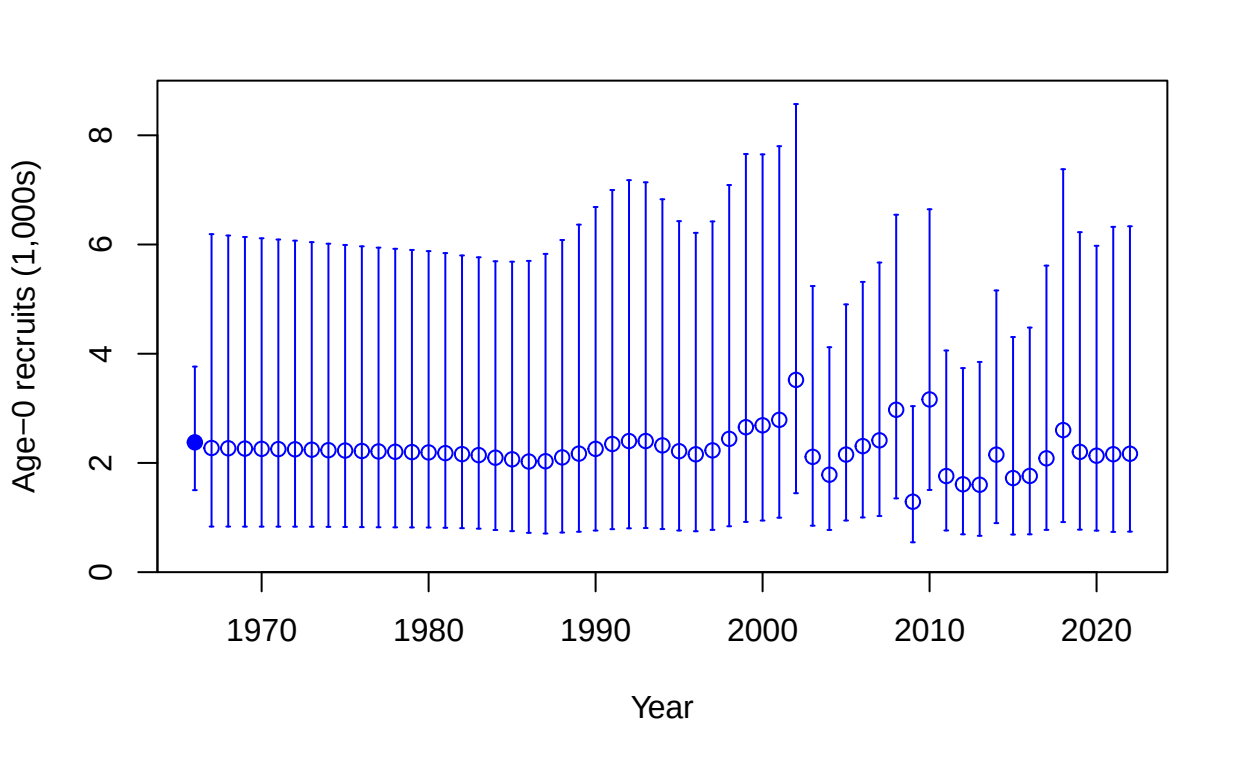

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

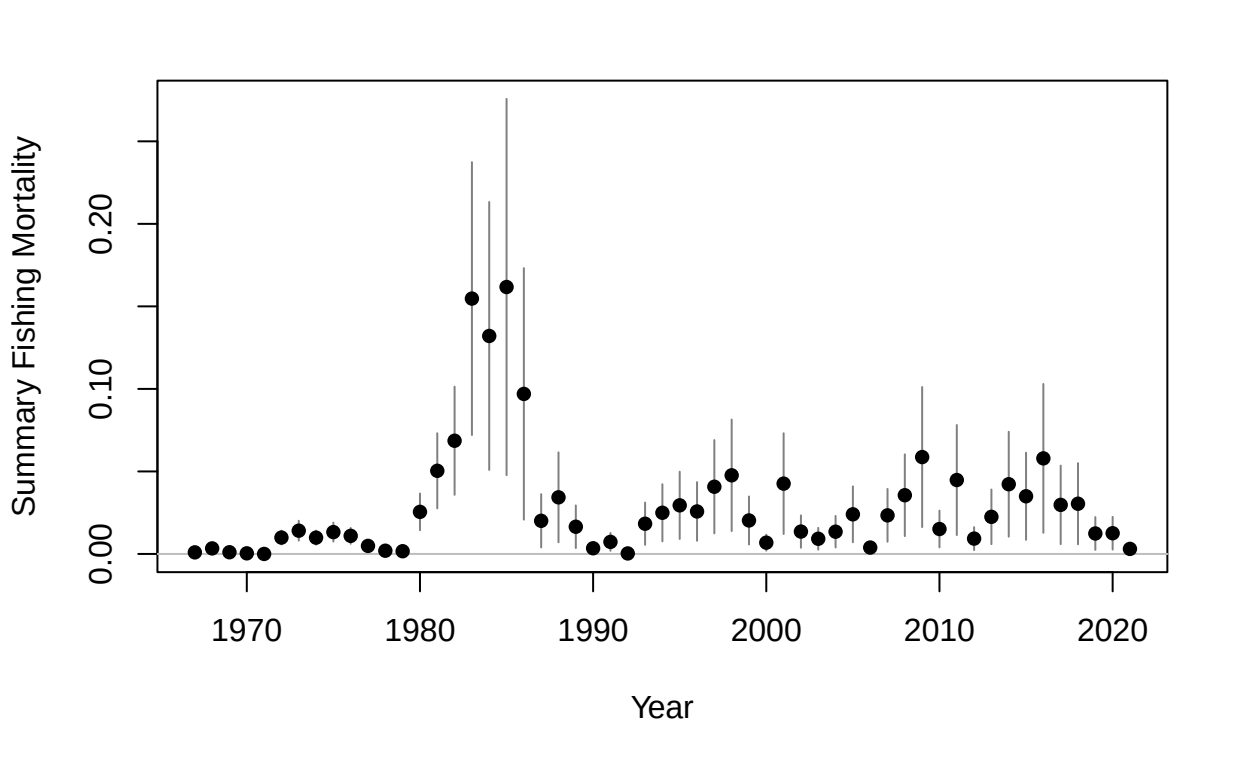

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

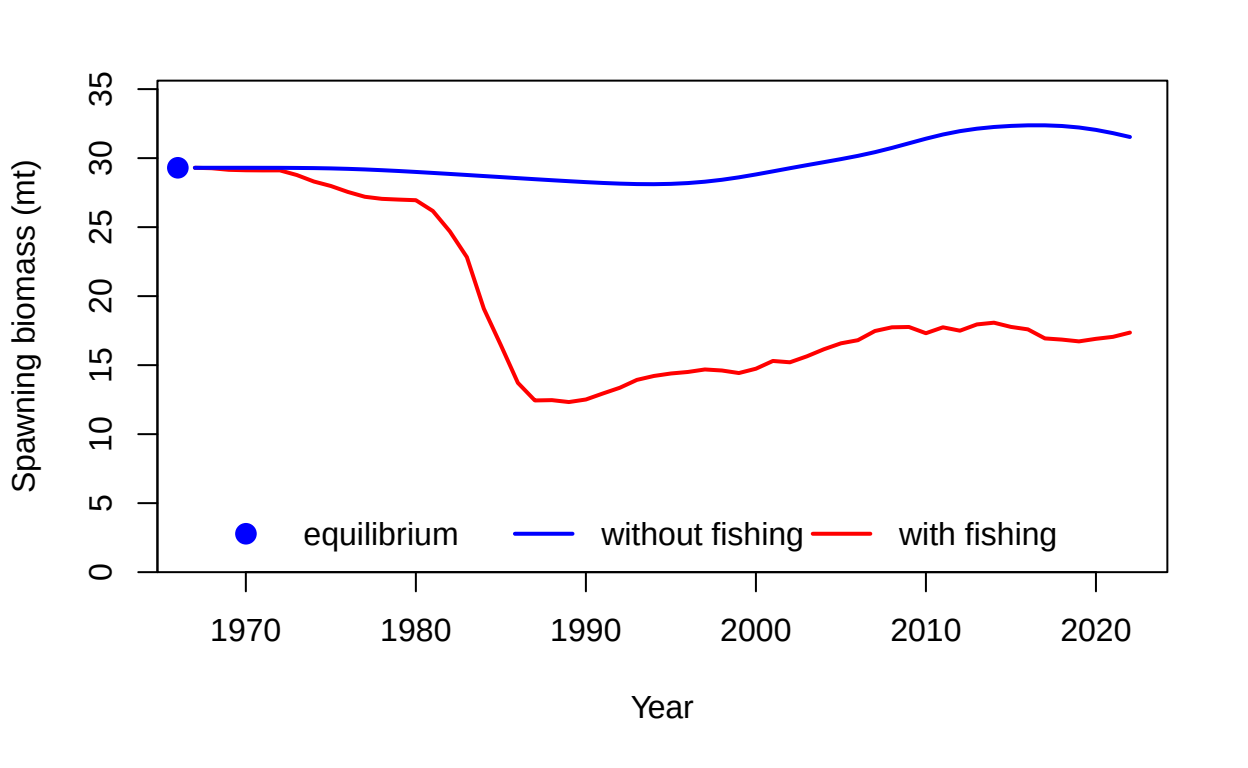

Total biomass (mt)
0
20
40
60
80
1970
1980
1990
2000
2010
2020
Year

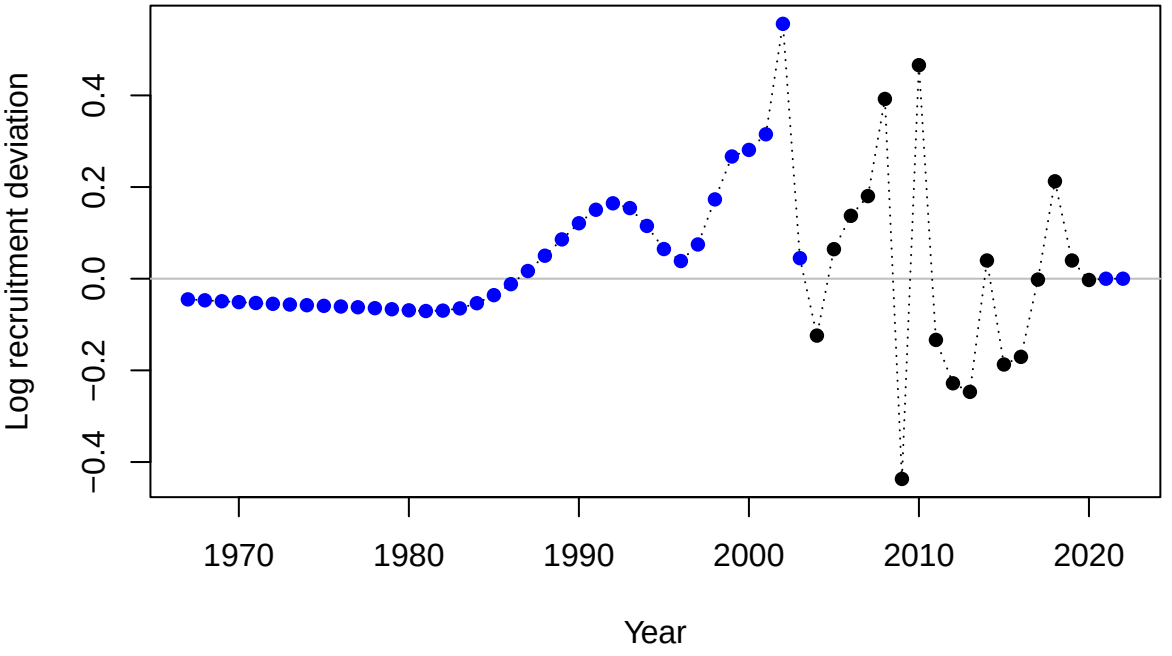

Summary biomass (mt)
0
20
40
60
80
1970
1980
1990
2000
2010
2020
Year

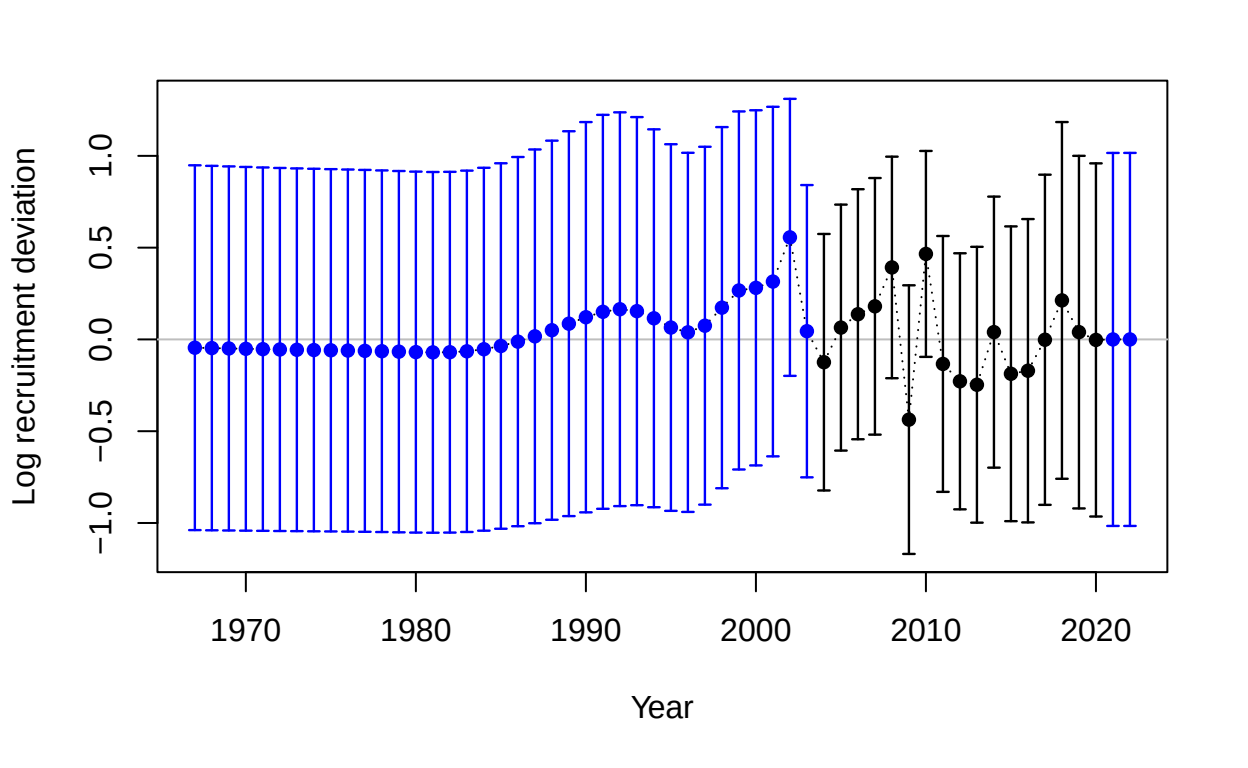

Age−0 recruits (1,000s)
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

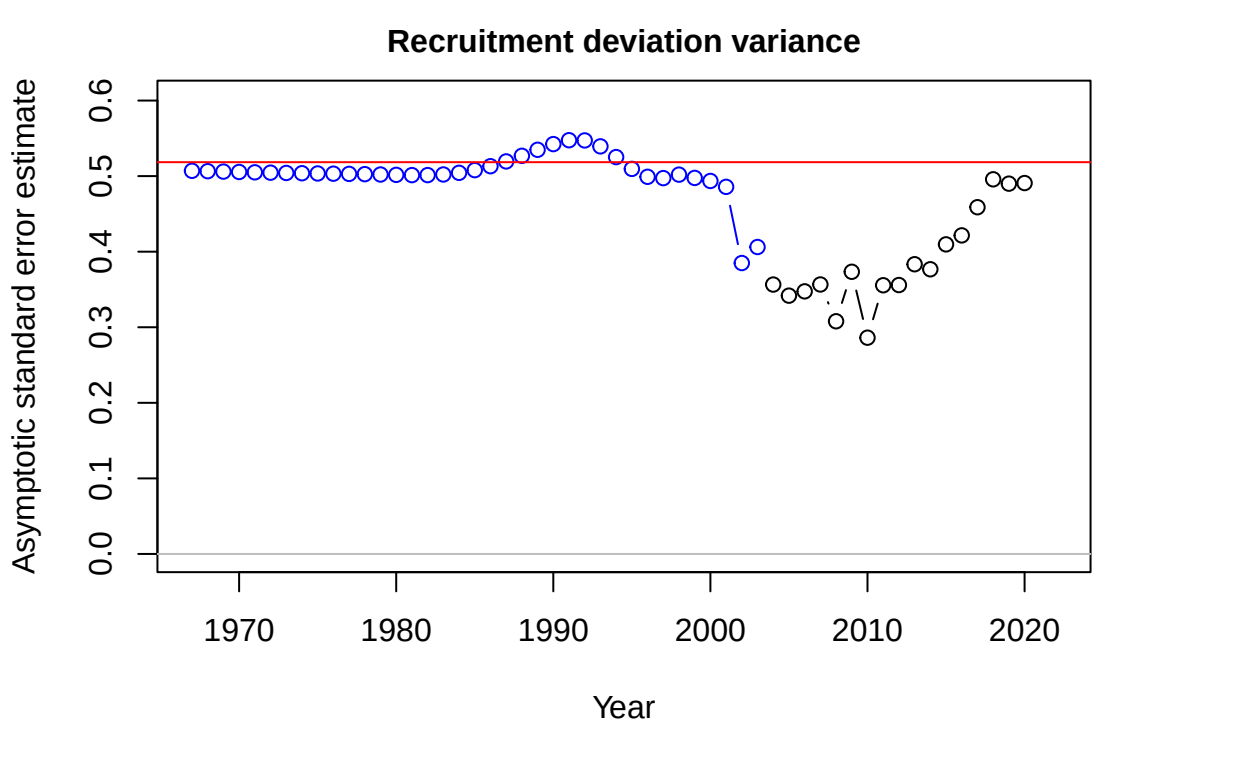

Age−0 recruits (1,000s)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

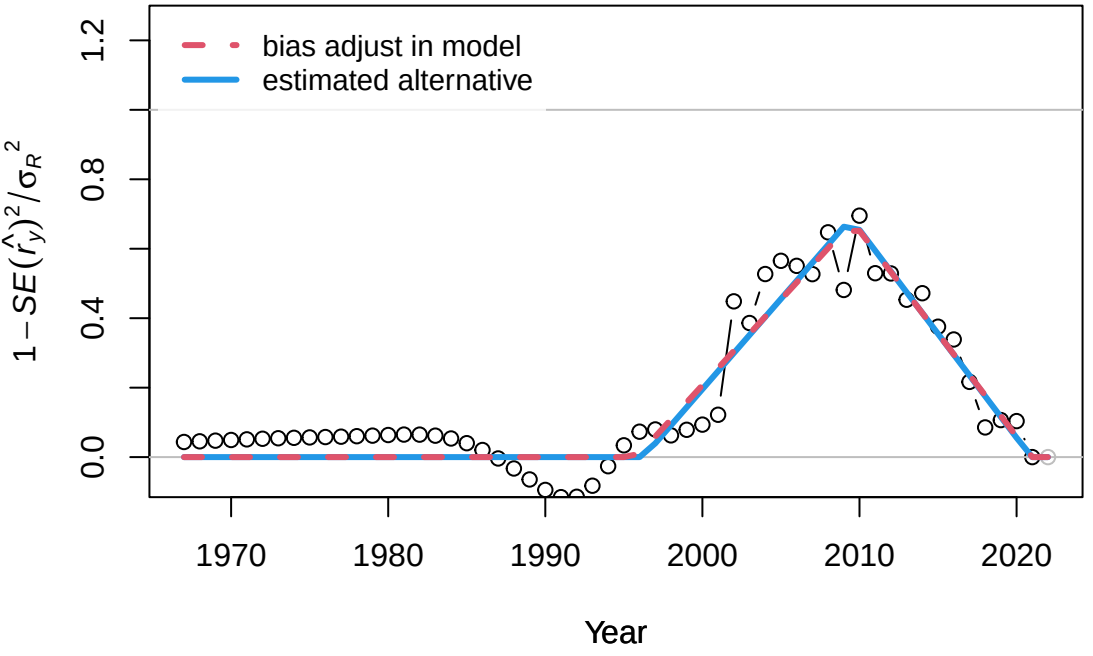

Summary Fishing Mortality
0.00
0.10
0.20
1970
1980
1990
2000
2010
2020
Year

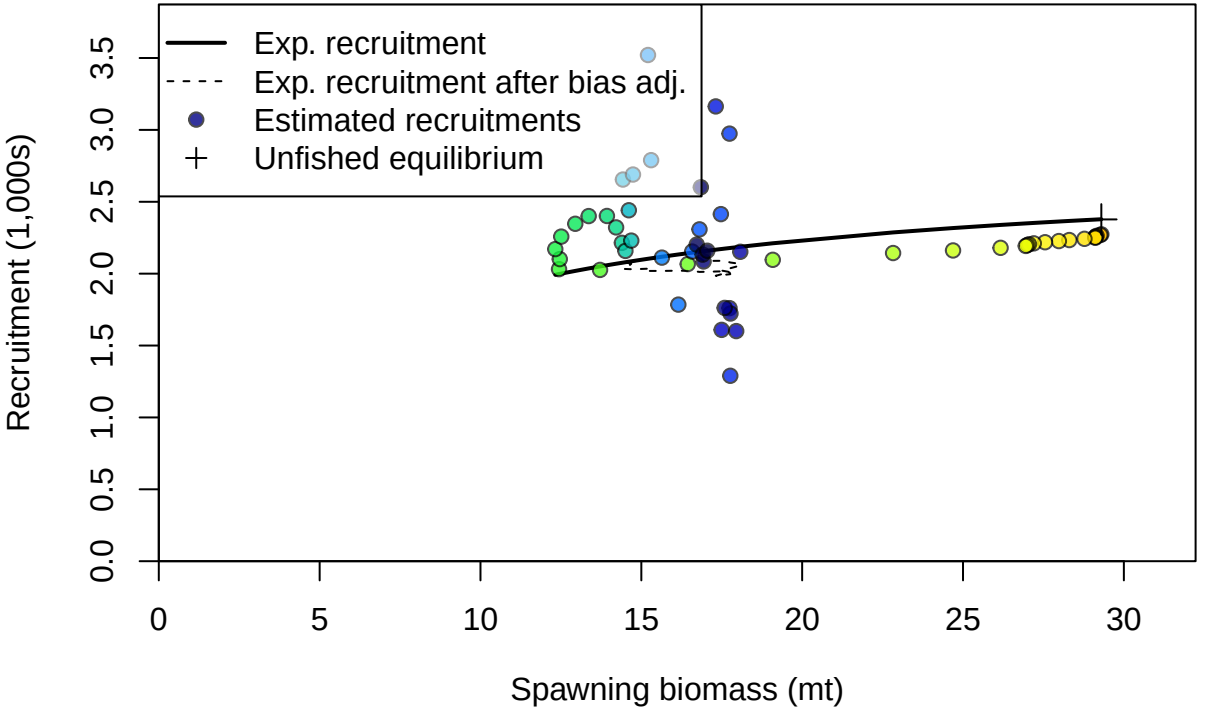

Spawning biomass (mt)
0
5
10
15
20
25
30
35
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

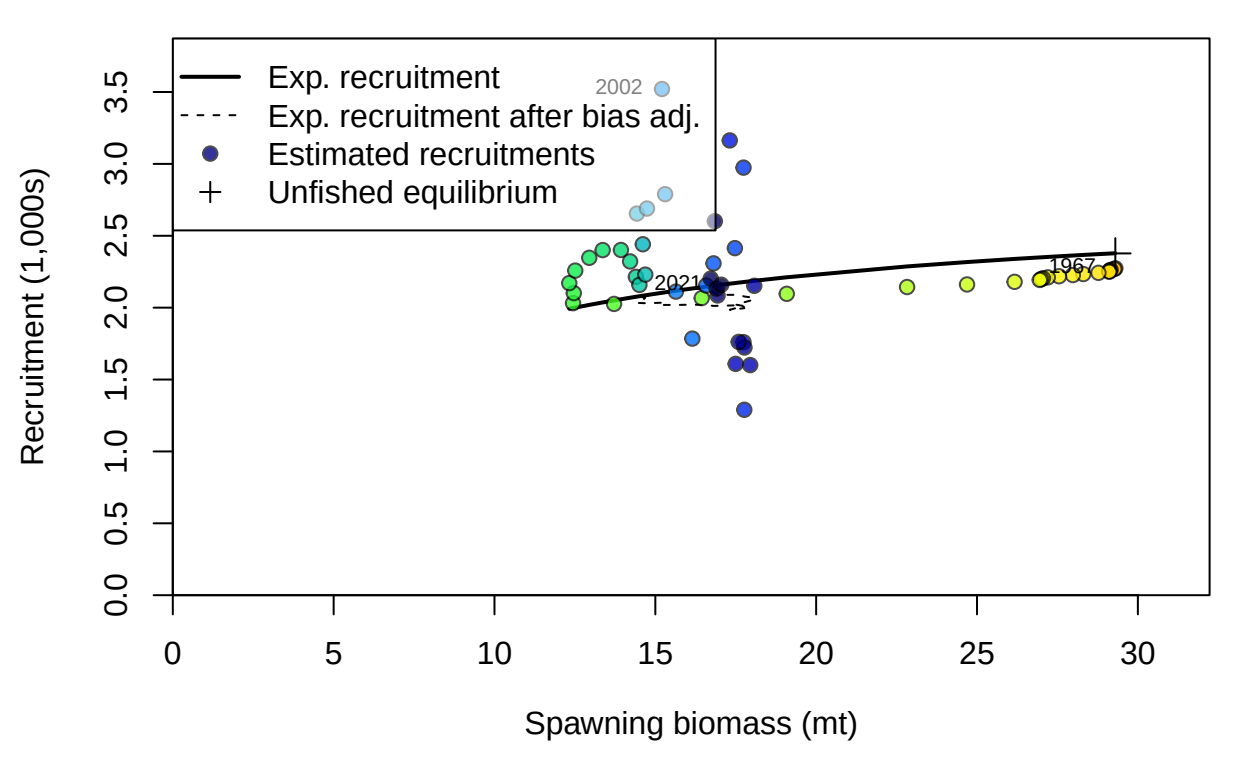

Log recruitment deviation
−0.4
−0.2
0.0
0.2
0.4
1970
1980
1990
2000
2010
2020
Year

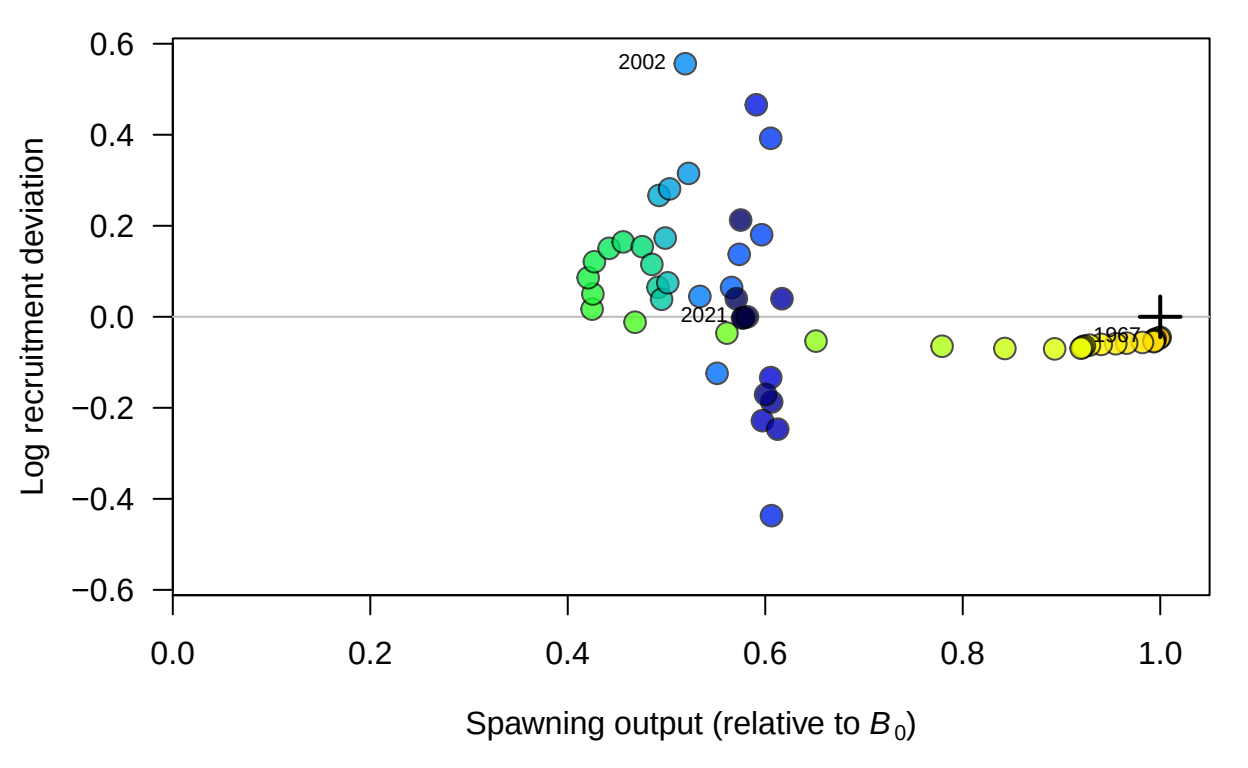

Log recruitment deviation
−1.0
−0.5
0.0
0.5
1.0
1970
1980
1990
2000
2010
2020
Year

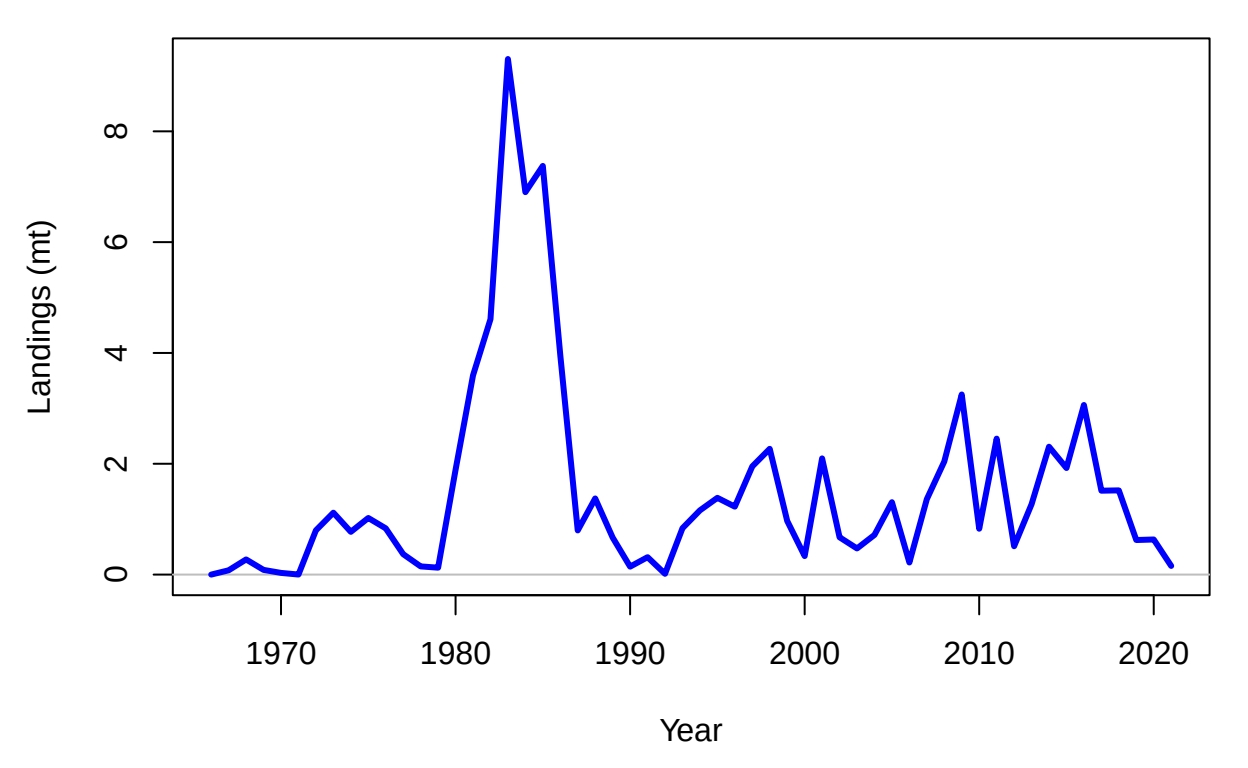

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1970
1980
1990
2000
2010
2020
Year

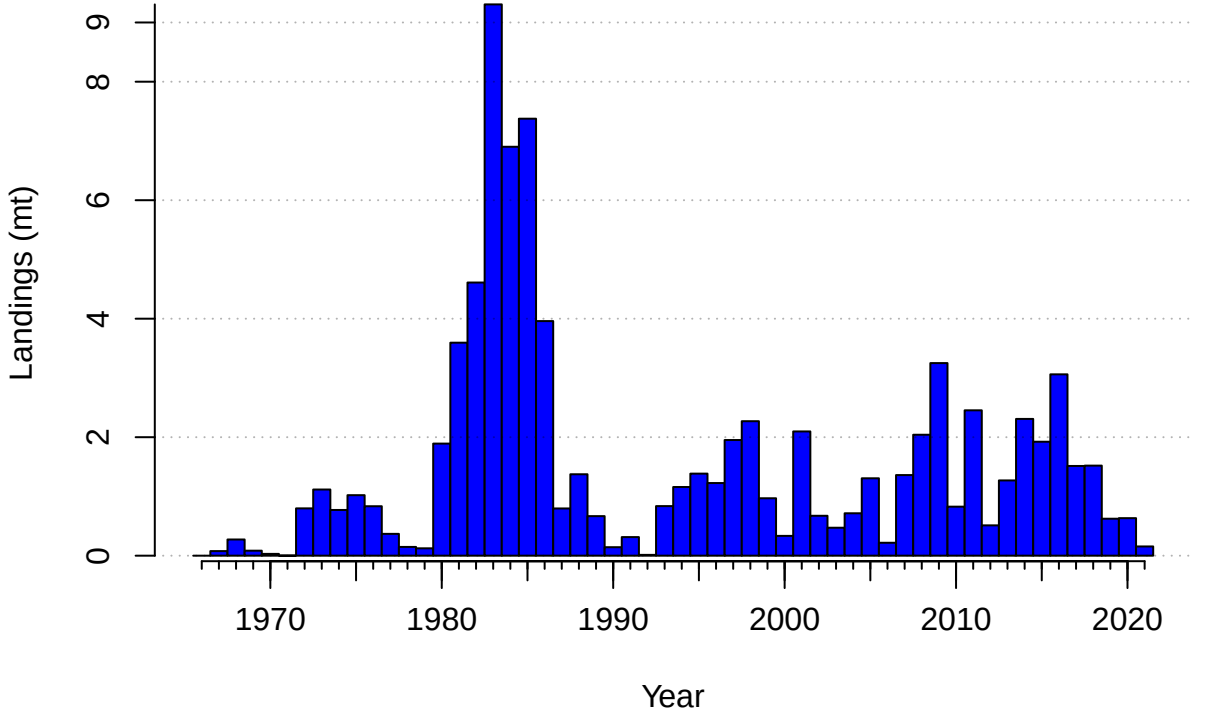

bias adjust in model
estimated alternative
$1 - SE(\hat{r_y})^2/\sigma_R^2$
0.0
0.4
0.8
1.2
1970
1980
1990
2000
2010
2020
Year

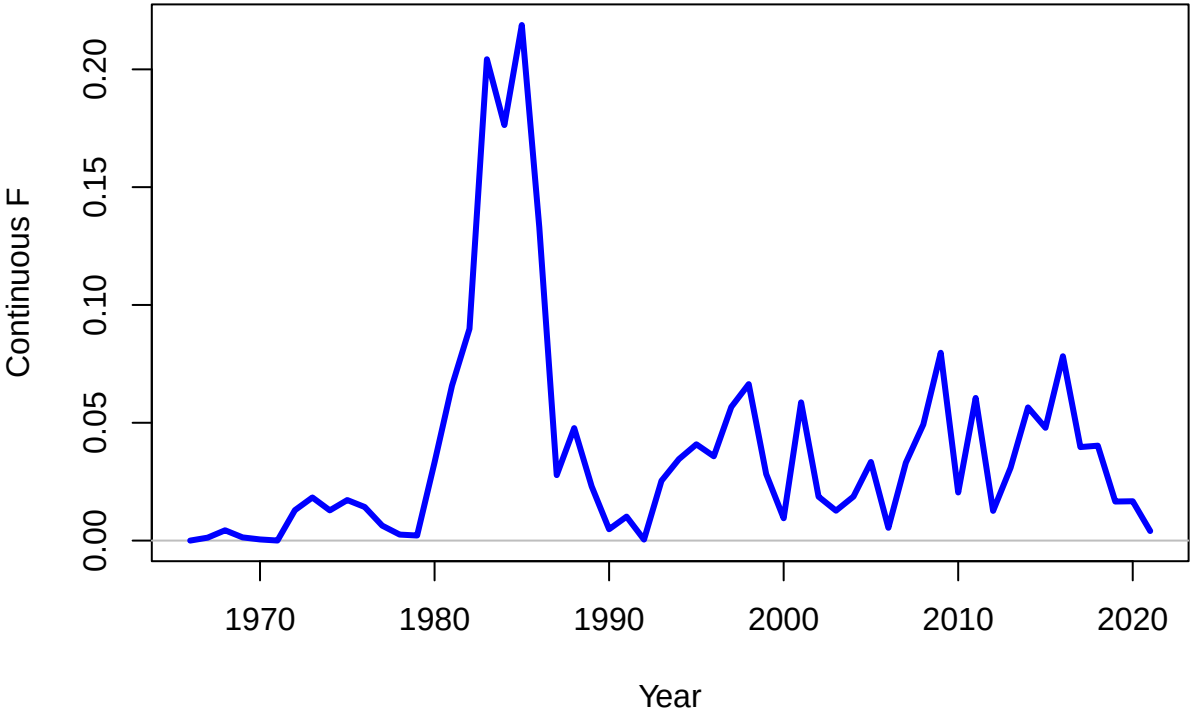

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
5
10
15
20
25
30
Spawning biomass (mt)

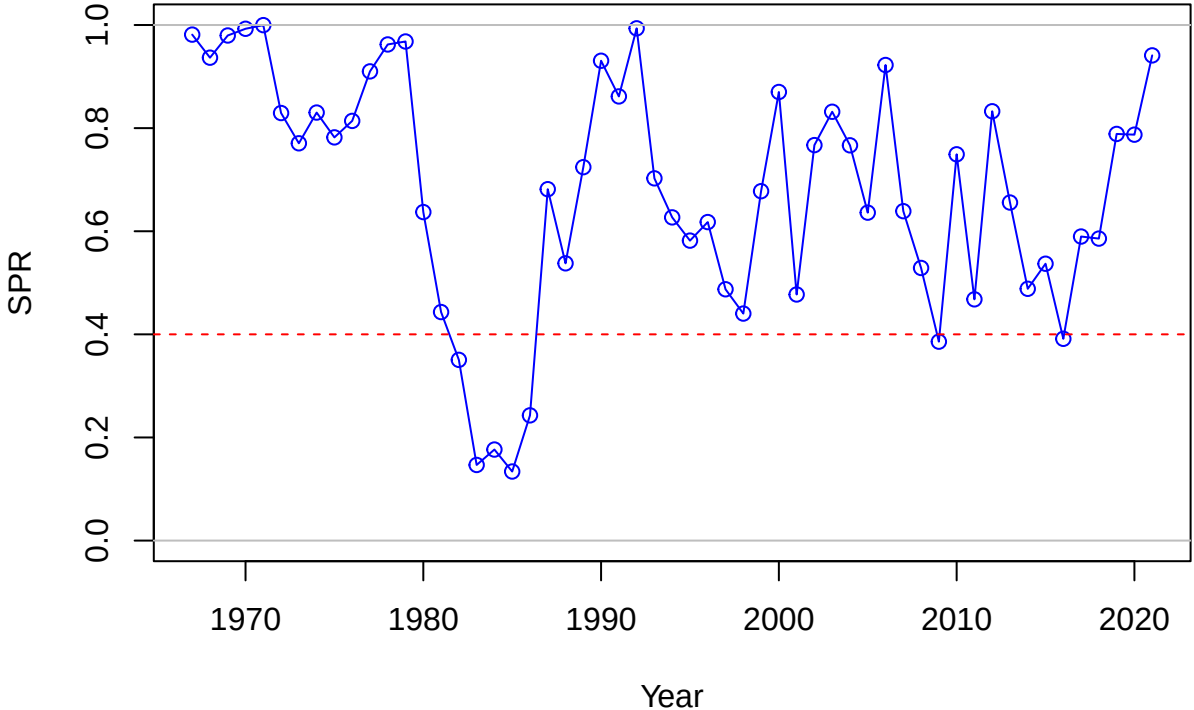

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
2002
2021
1967
Recruitment (1,000s)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
5
10
15
20
25
30
Spawning biomass (mt)

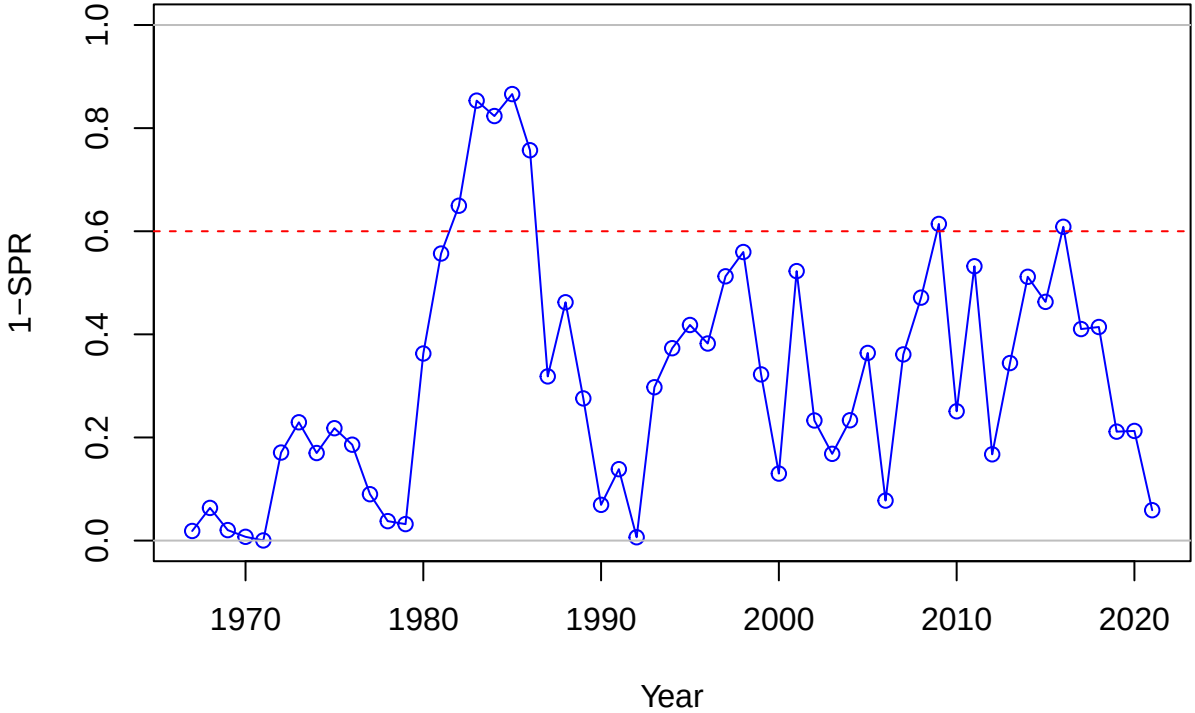

0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
Log recruitment deviation
2002
2021
1967
0.0
0.2
0.4
0.6
0.8
1.0
Spawning output (relative to B_0)

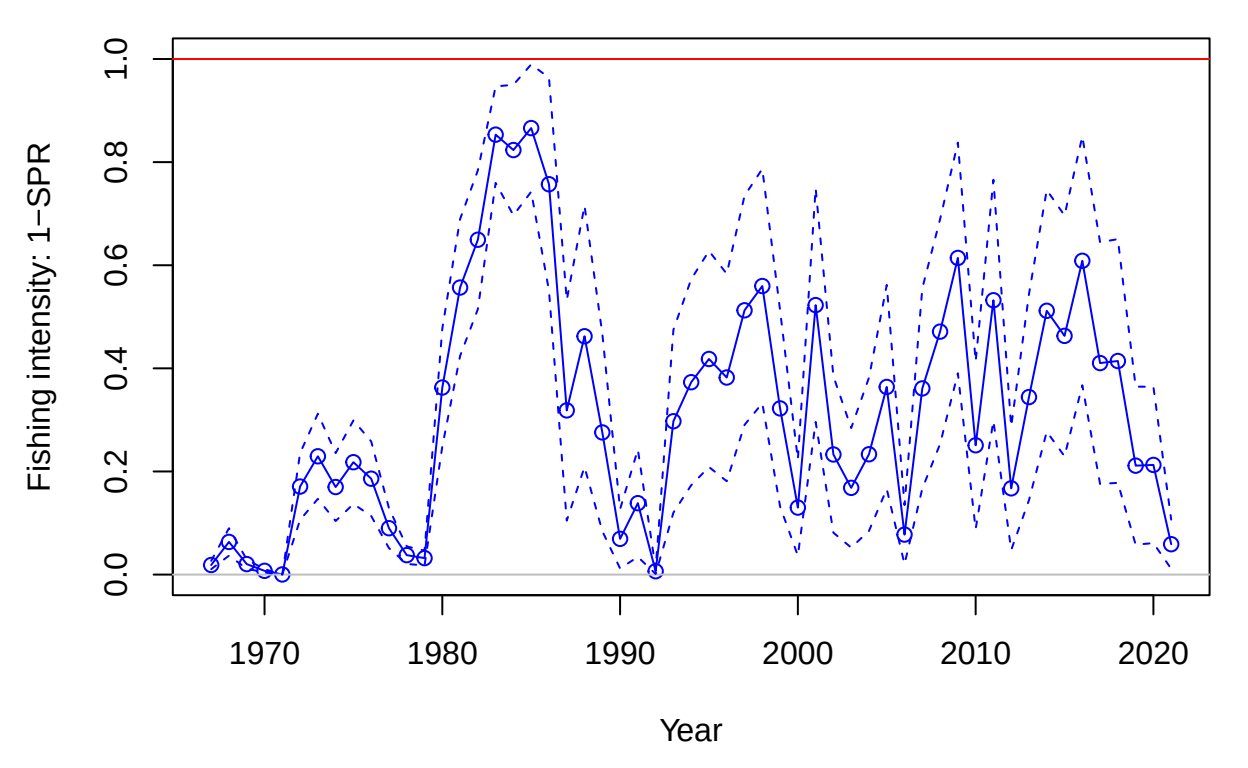

Landings (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

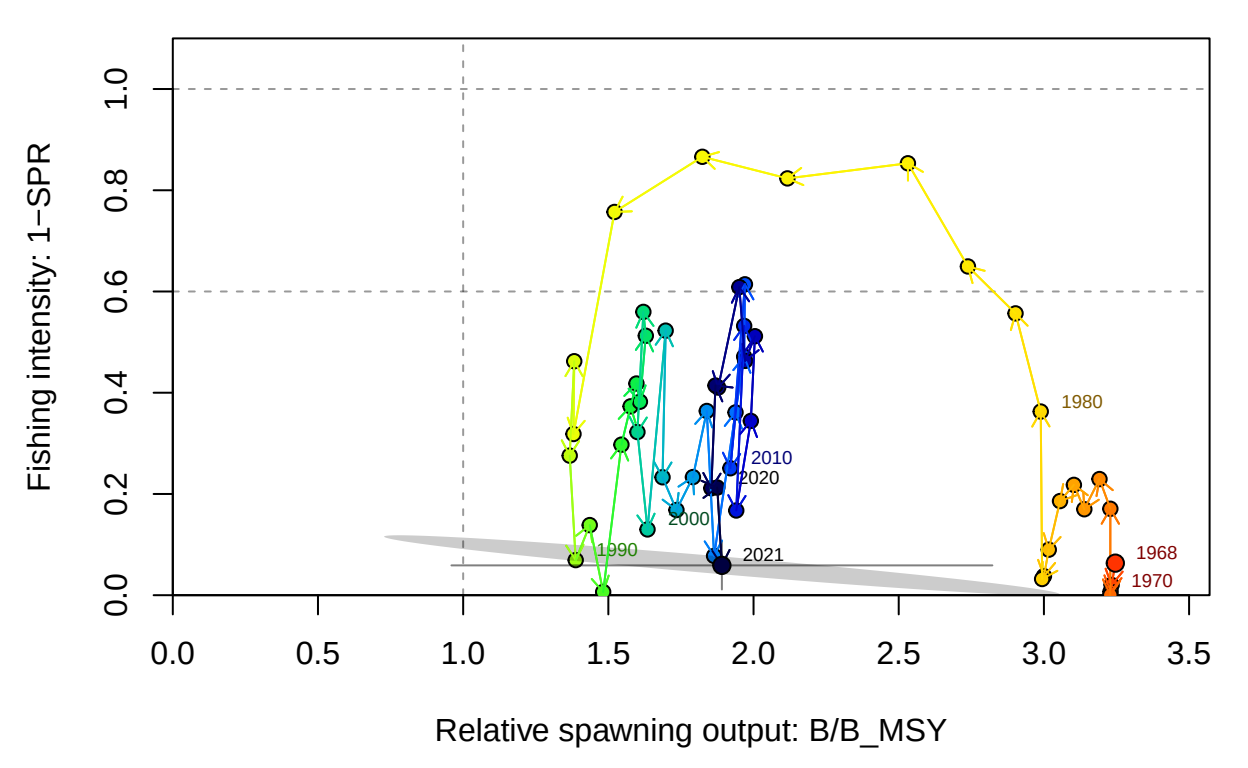

Landings (mt)
0
2
4
6
8
9
1970
1980
1990
2000
2010
2020
Year

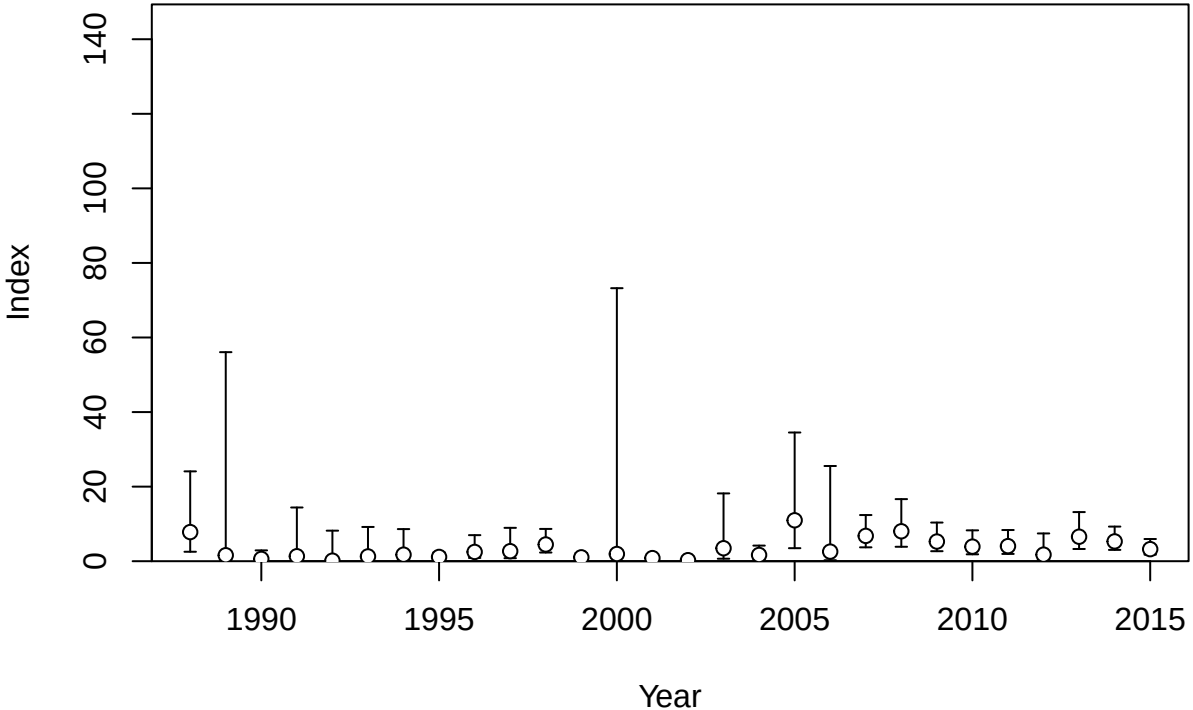

Continuous F
0.00
0.05
0.10
0.15
0.20
1970
1980
1990
2000
2010
2020
Year

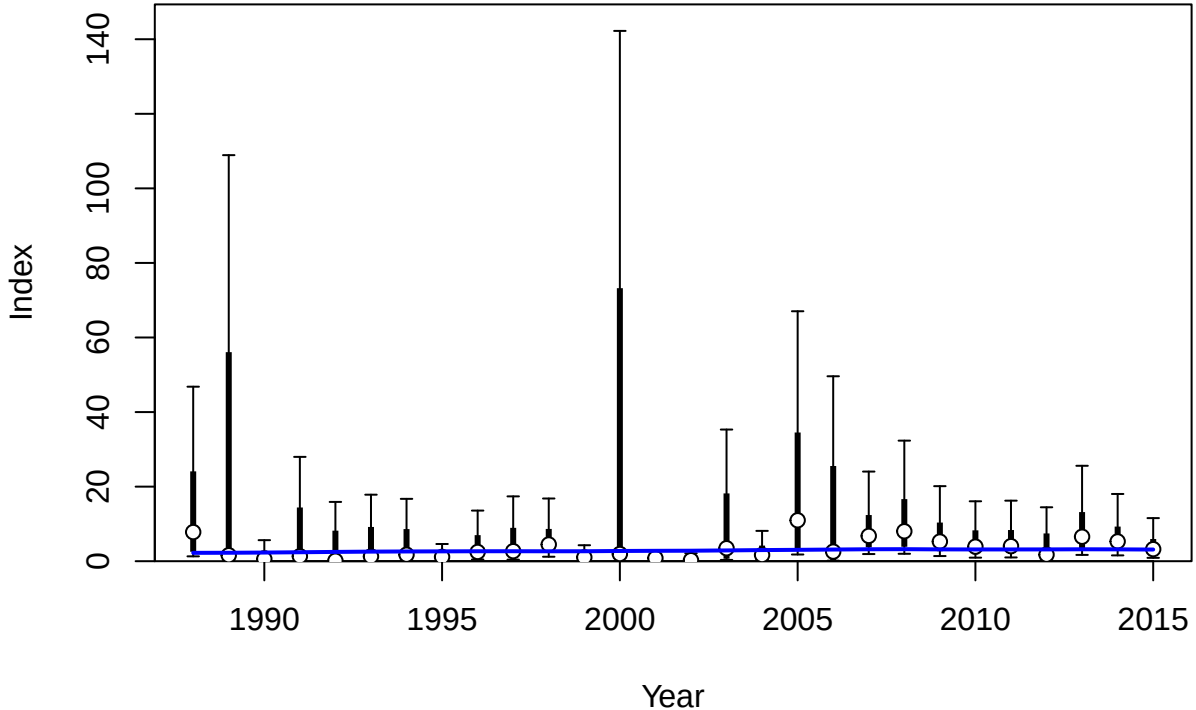

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

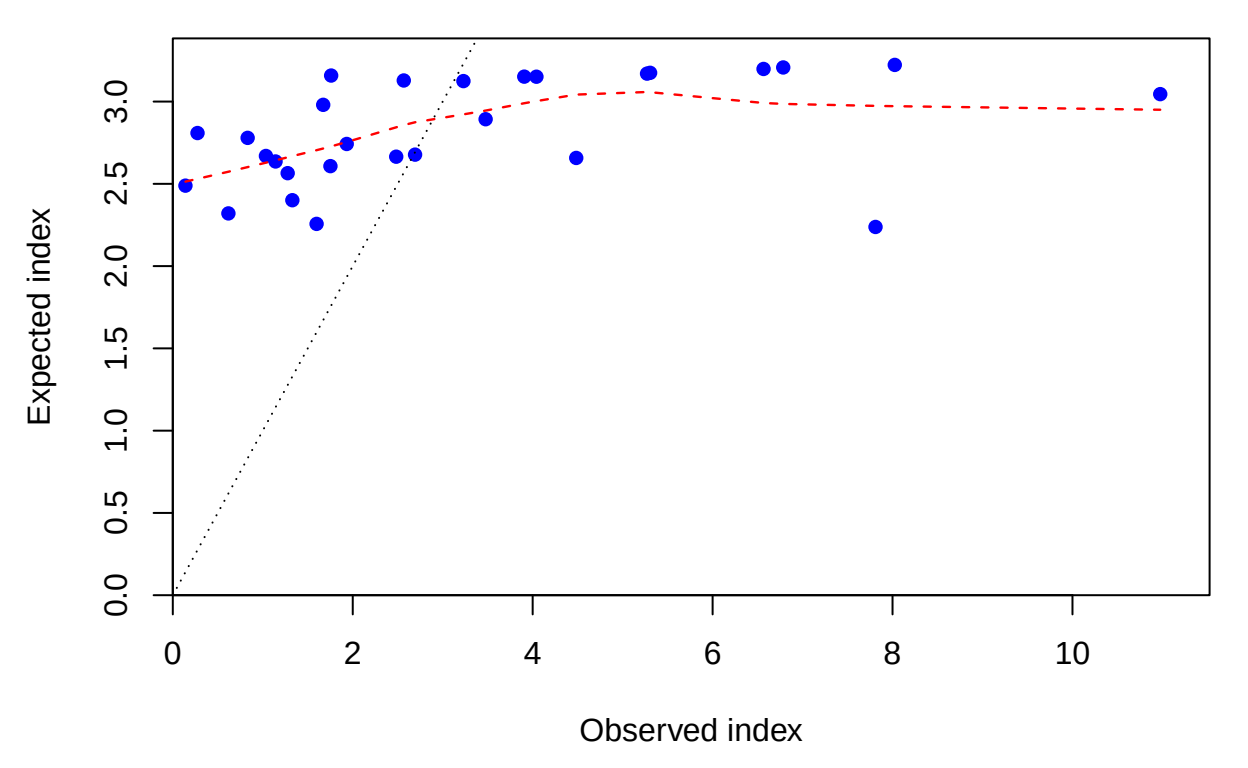

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

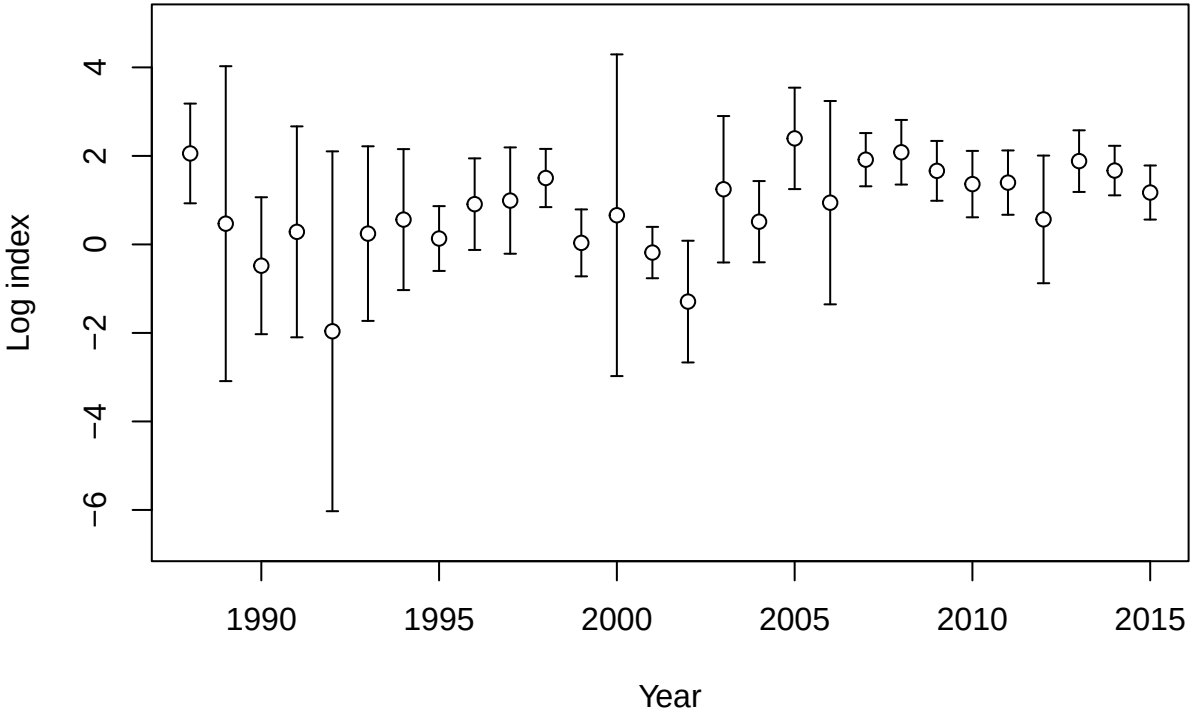

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

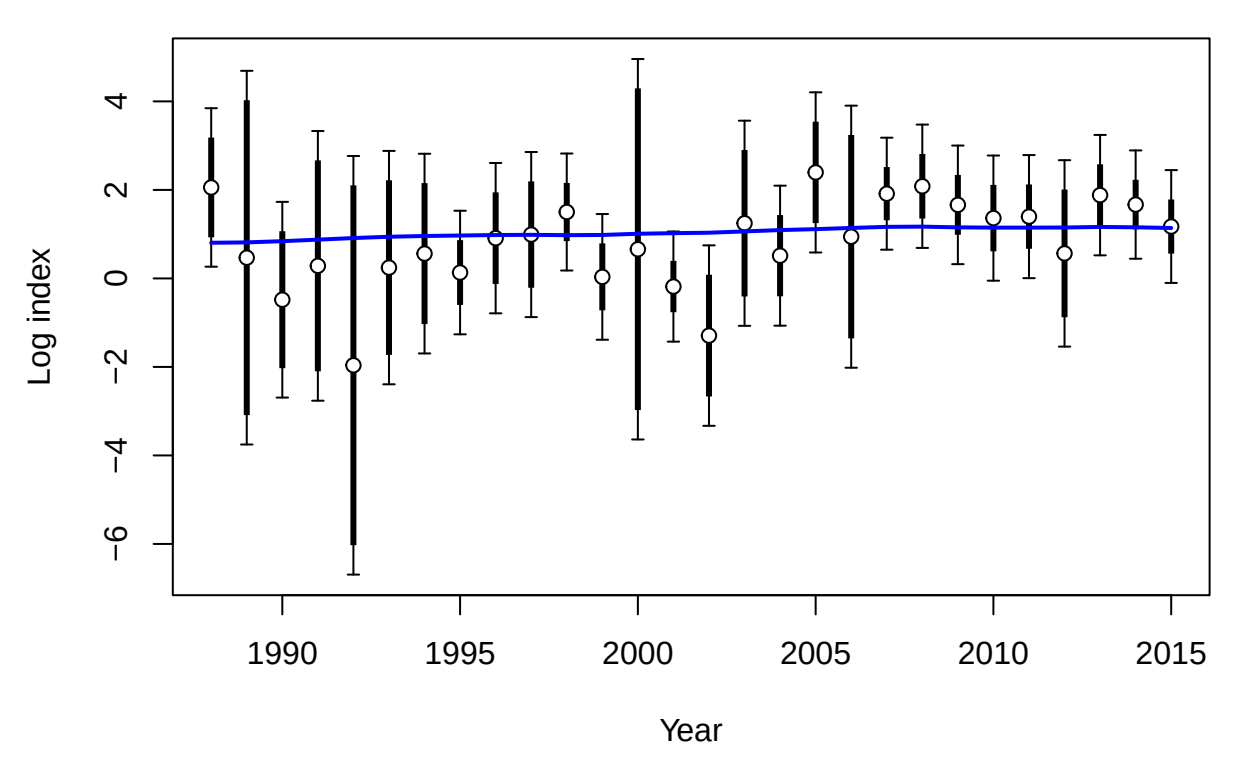

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Relative spawning output: B/B_MSY
1980
2010
2020
2000
1990
2021
1968
1970

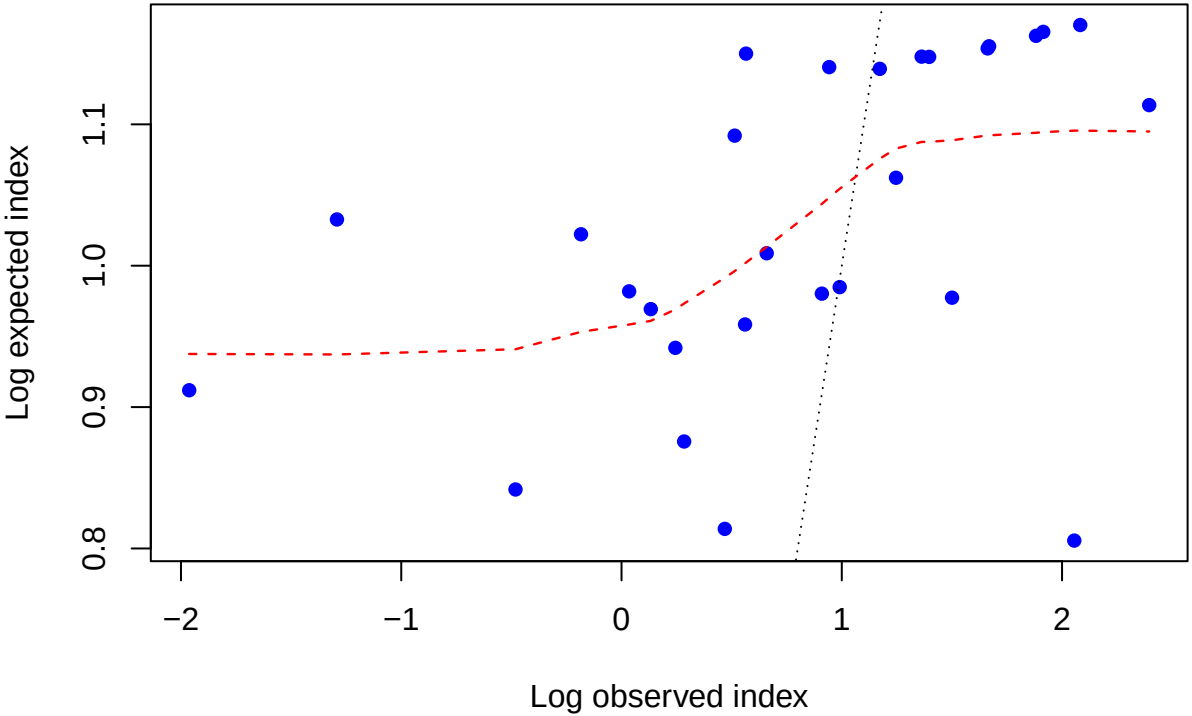

Index
0
20
40
60
80
100
140
1990
1995
2000
2005
2010
2015
Year

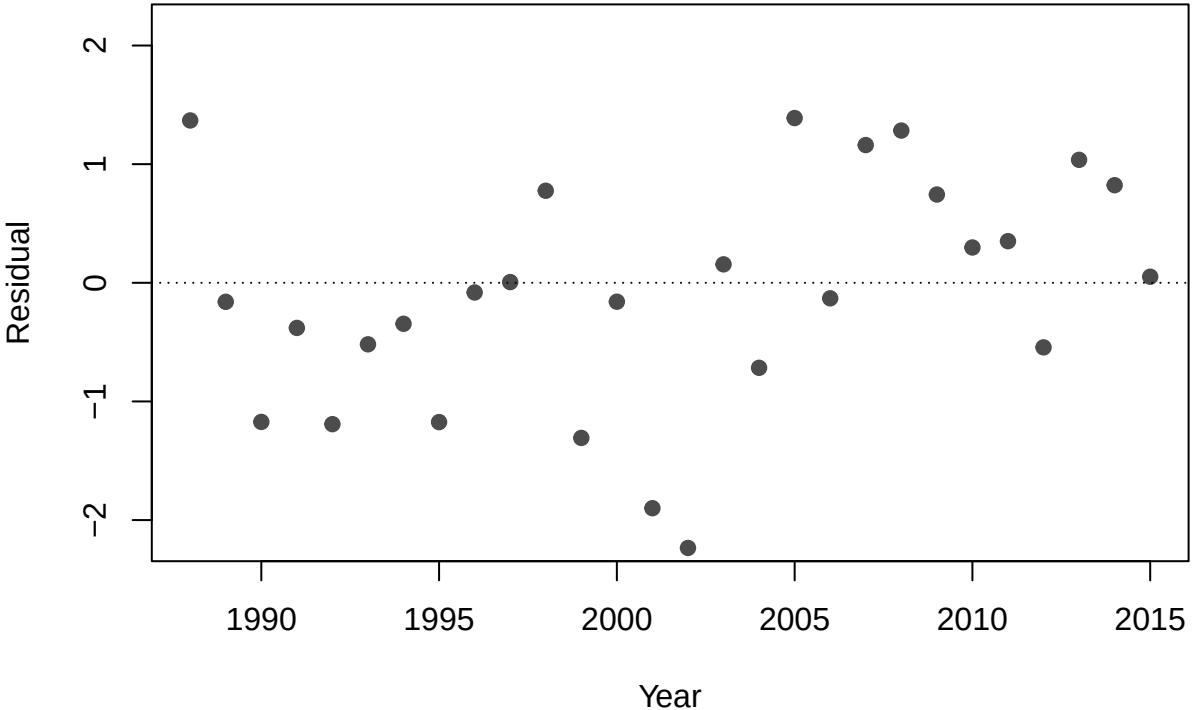

Index
0
20
40
60
80
100
140
1990
1995
2000
2005
2010
2015
Year

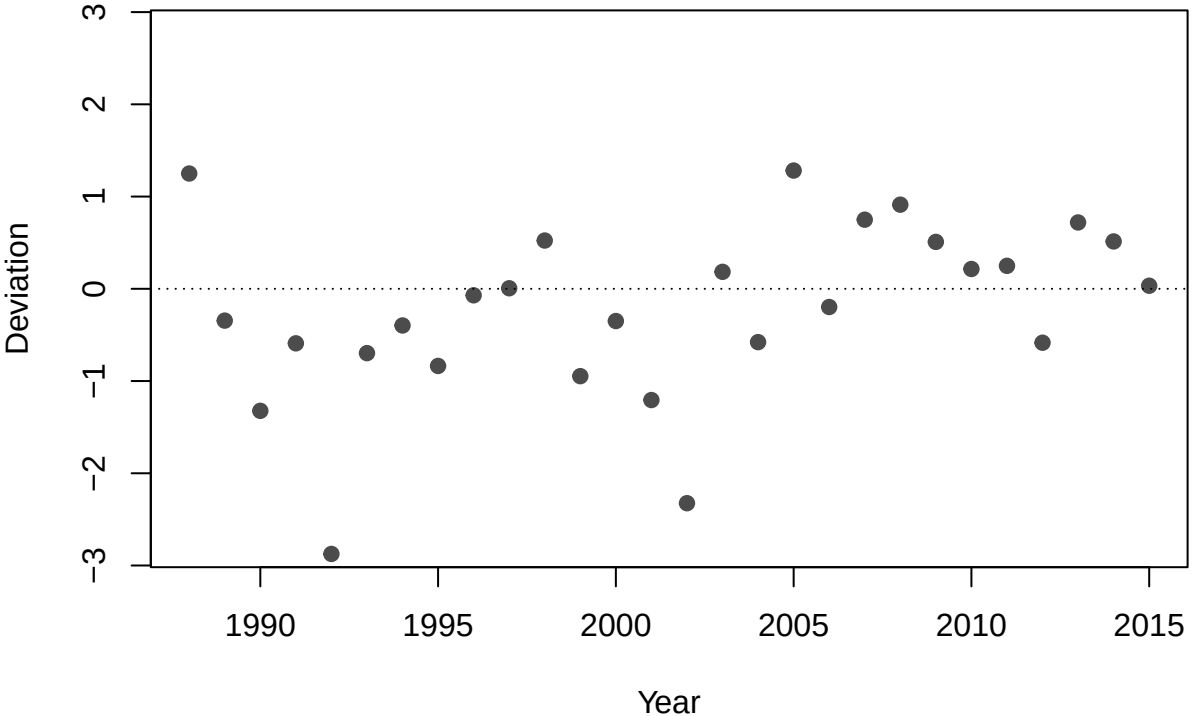

Expected index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
2
4
6
8
10
Observed index

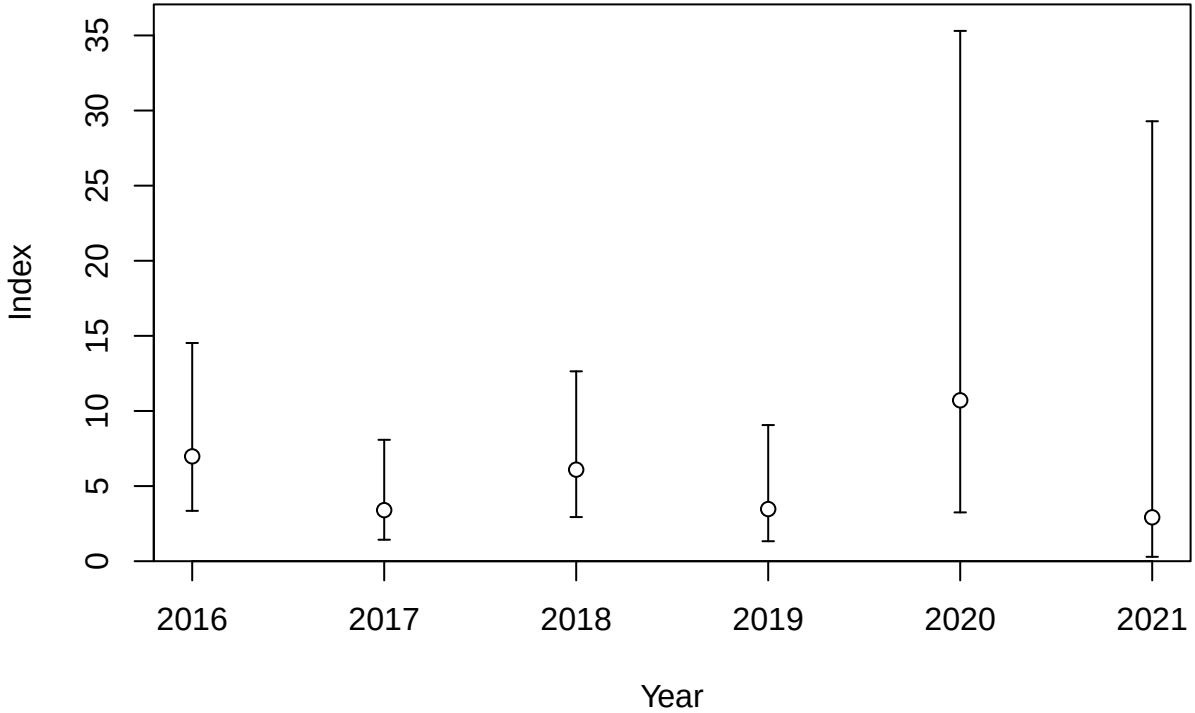

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
Year

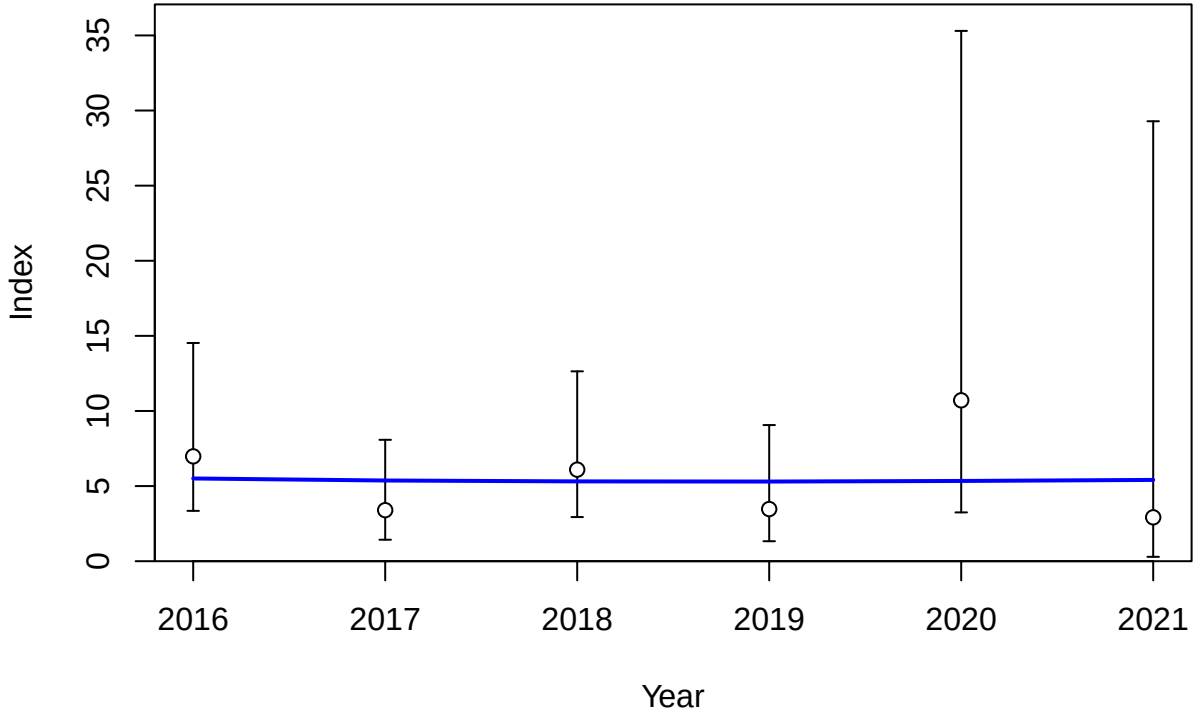

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
Year

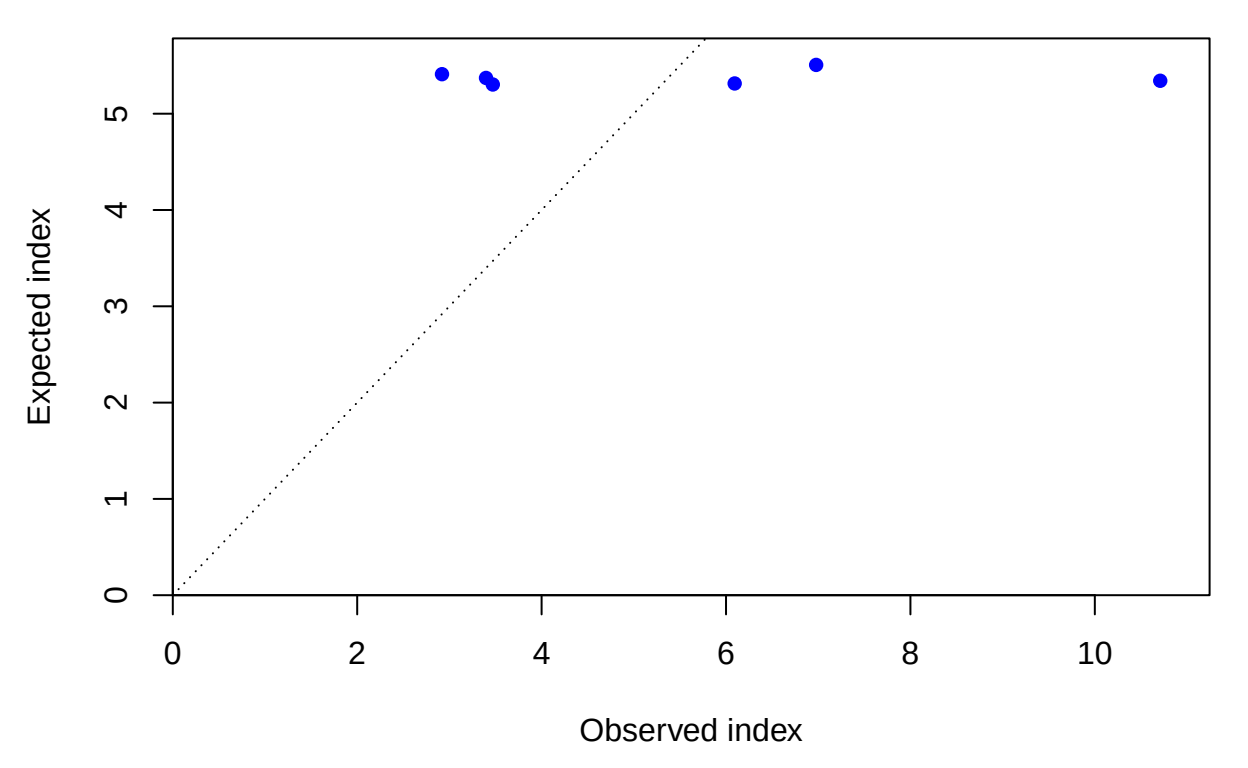

Log expected index
0.8
0.9
1.0
1.1
−2
−1
0
1
2
Log observed index

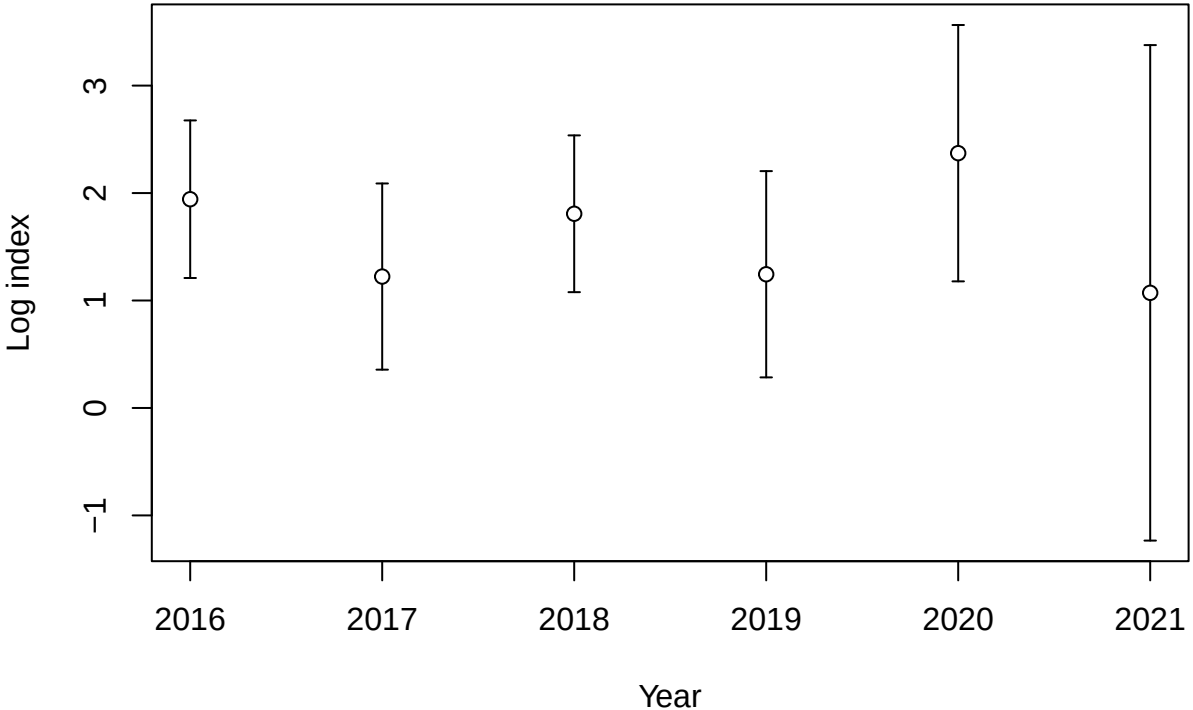

Residual
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
Year

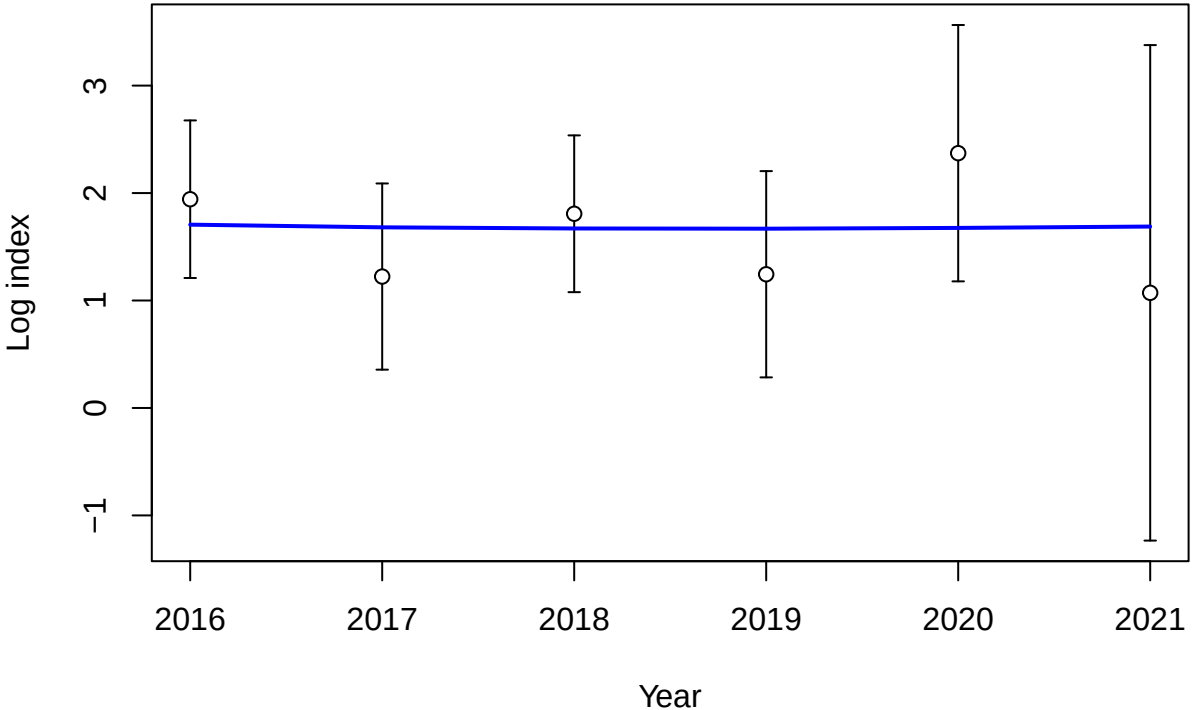

Deviation
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
2010
2015
Year

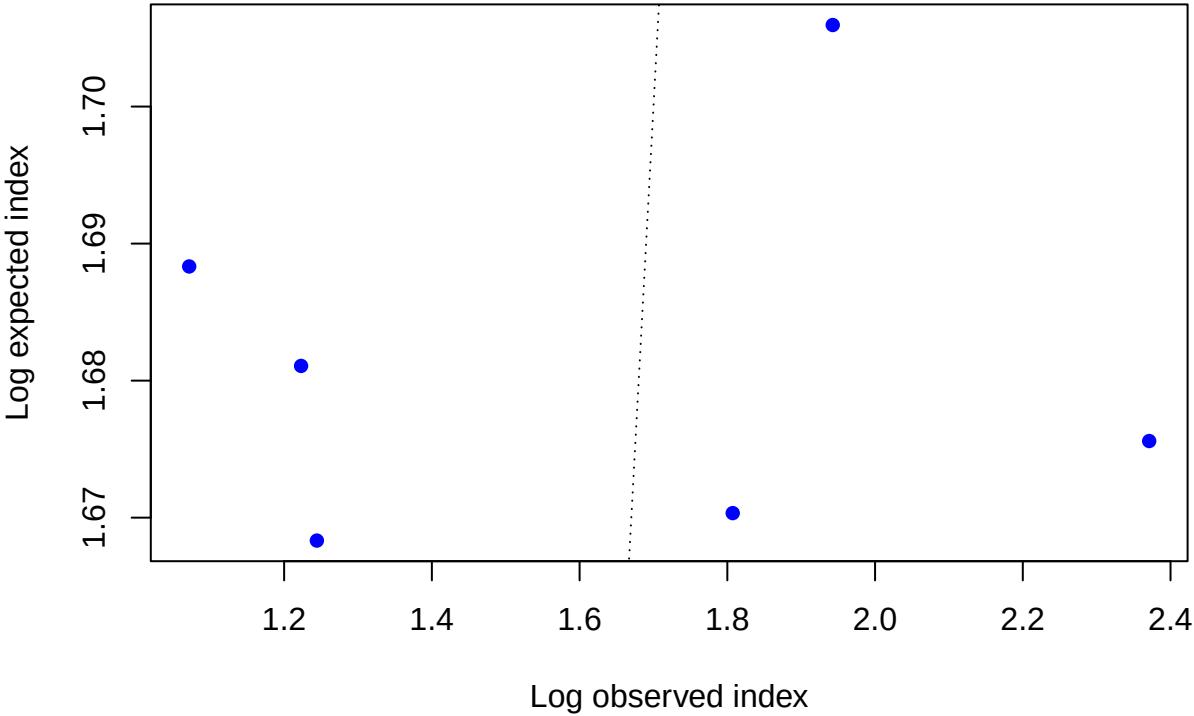

Index
0
5
10
15
20
25
30
35
2016
2017
2018
2019
2020
2021
Year

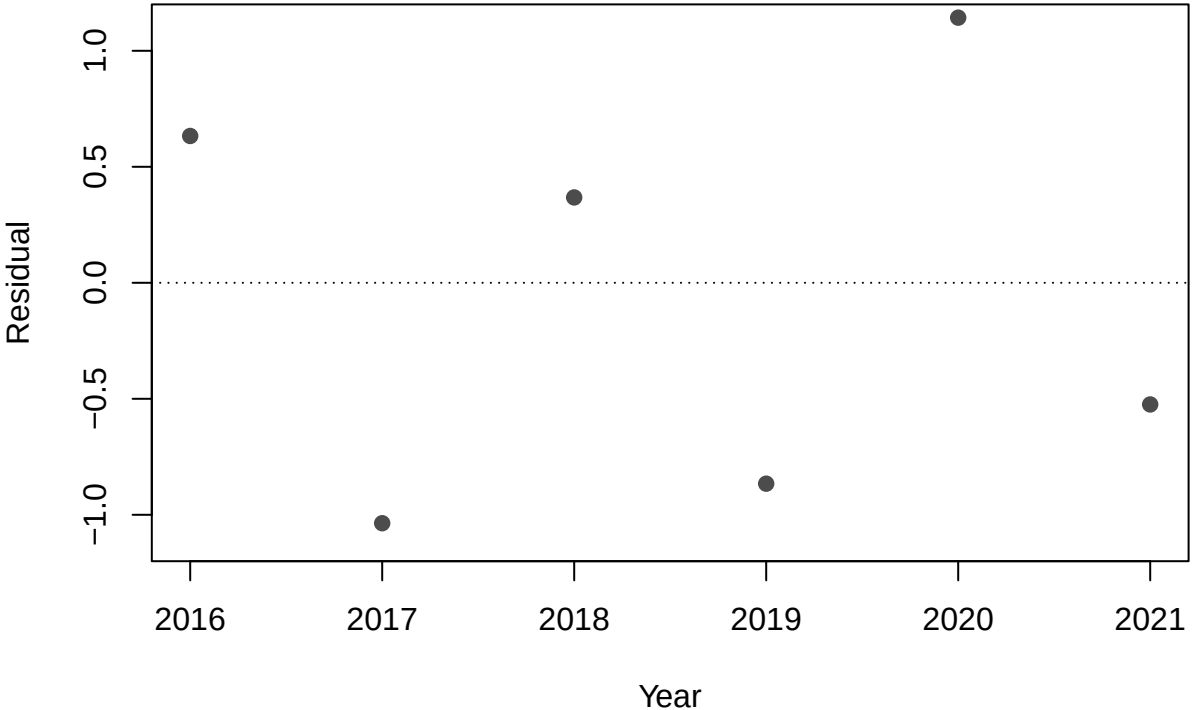

Index
0
5
10
15
20
25
30
35
2016
2017
2018
2019
2020
2021
Year

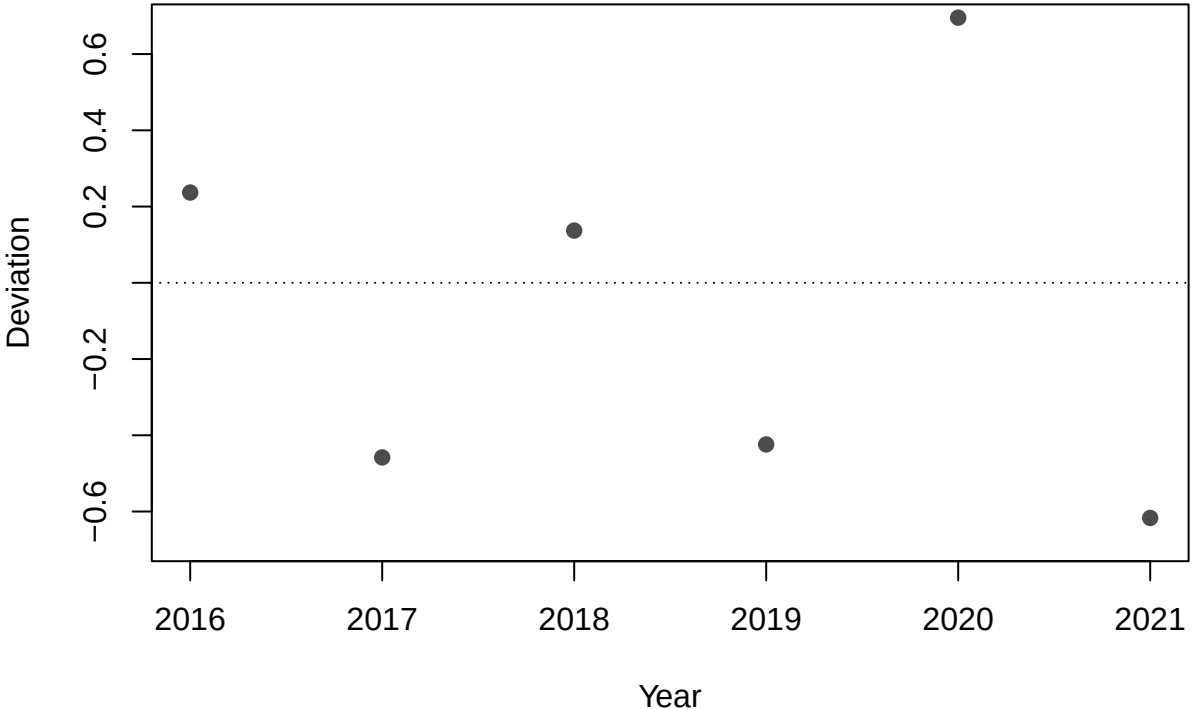

Expected index
0
1
2
3
4
5
0
2
4
6
8
10
Observed index

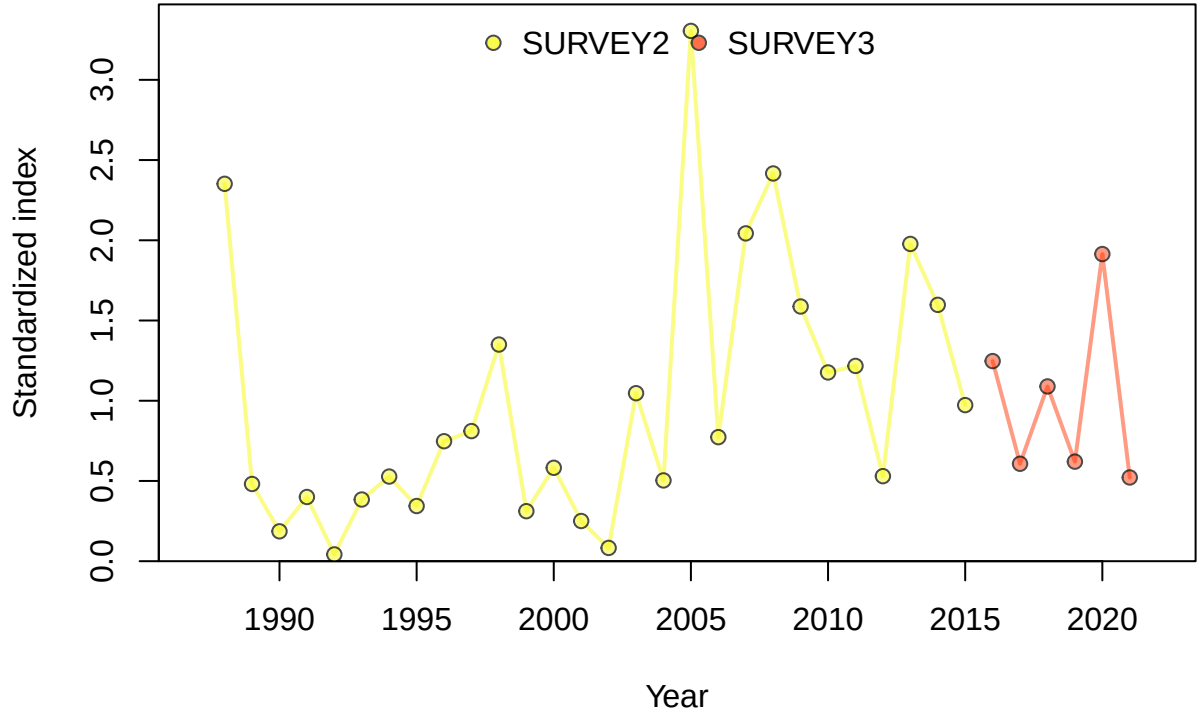

Log index
3
2
1
0
−1
2016
2017
2018
2019
2020
2021
Year

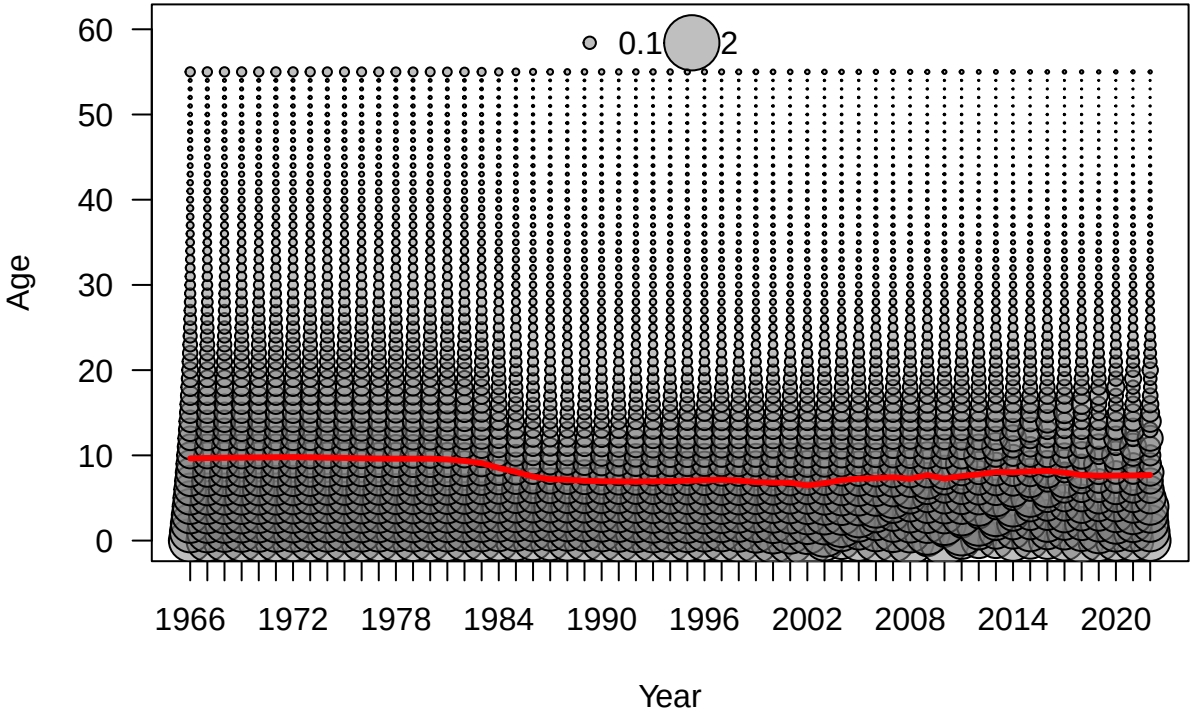

Log index
3
2
1
0
−1
2016
2017
2018
2019
2020
2021
Year

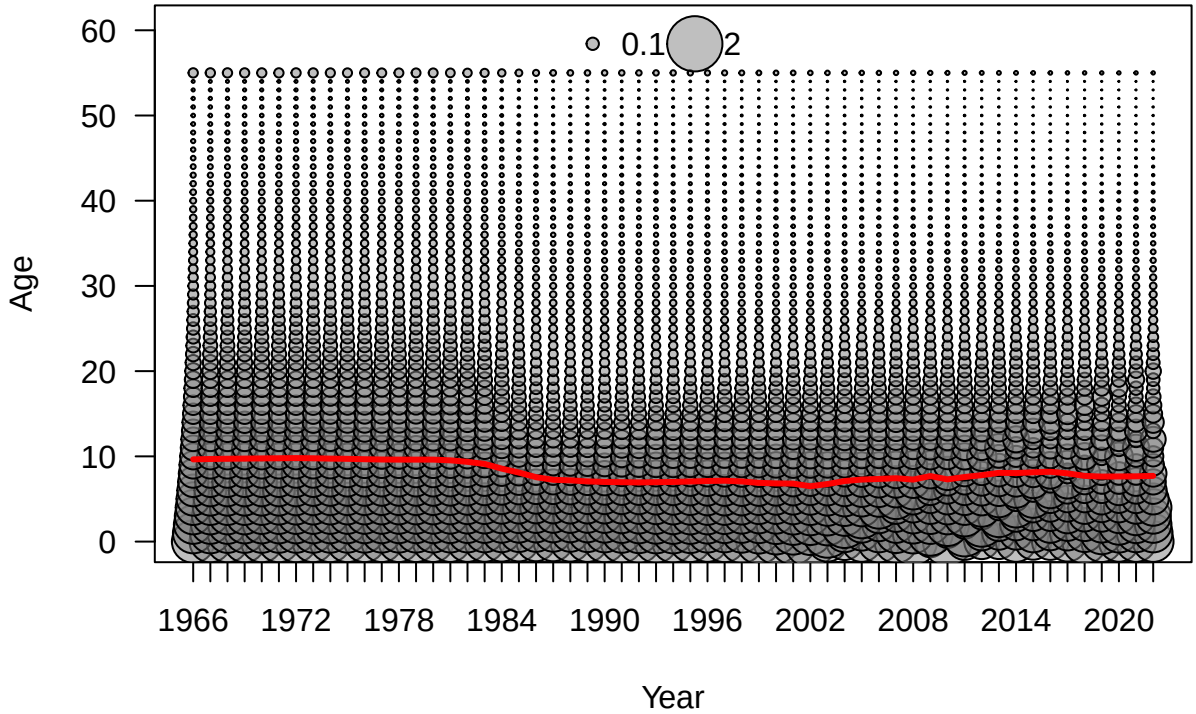

Log expected index
1.67
1.68
1.69
1.70
1.2
1.4
1.6
1.8
2.0
2.2
2.4
Log observed index

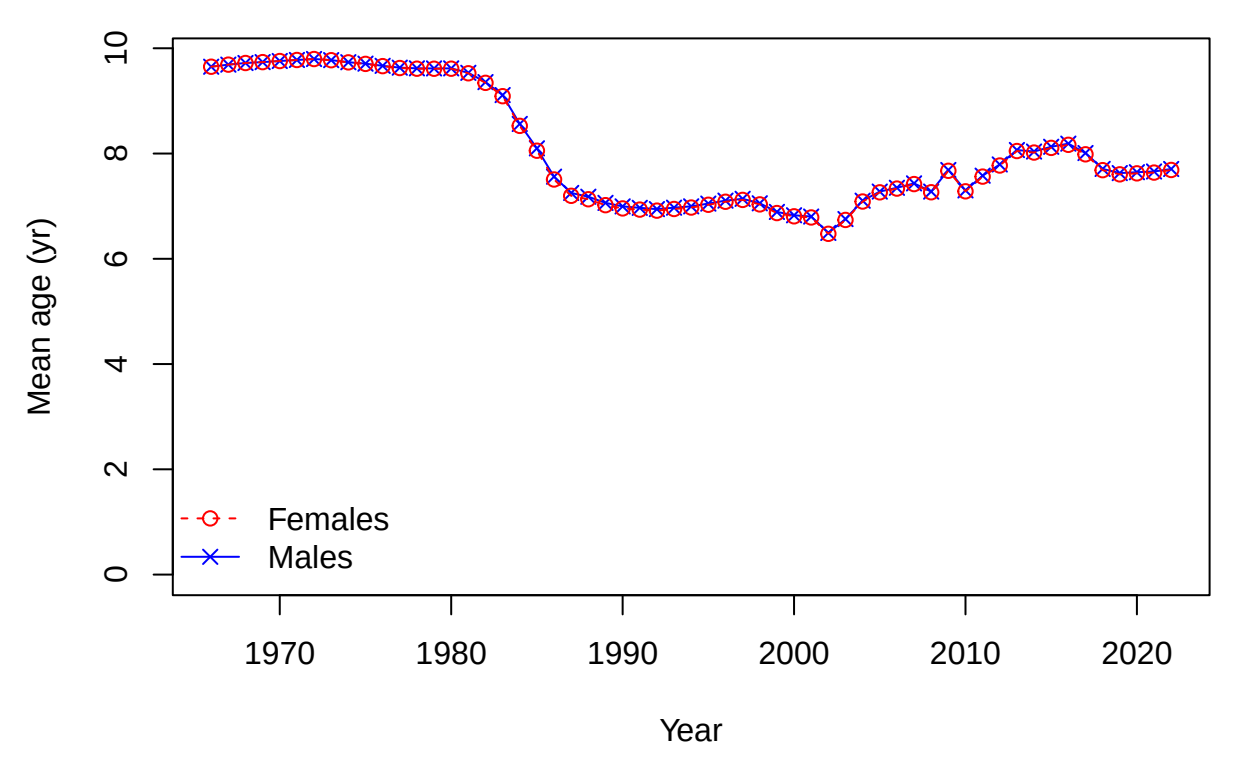

Residual
1.0
0.5
0.0
−0.5
−1.0
2016
2017
2018
2019
2020
2021
Year

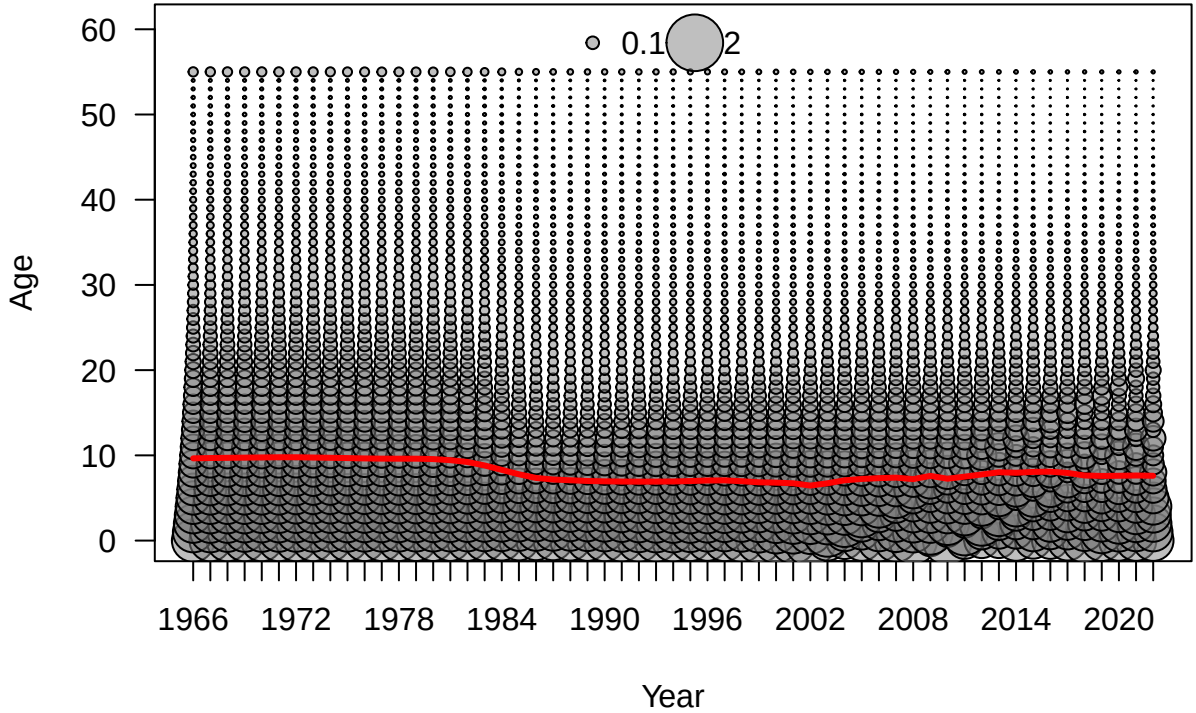

Deviation
0.6
0.4
0.2
−0.2
−0.6
2016
2017
2018
2019
2020
2021
Year

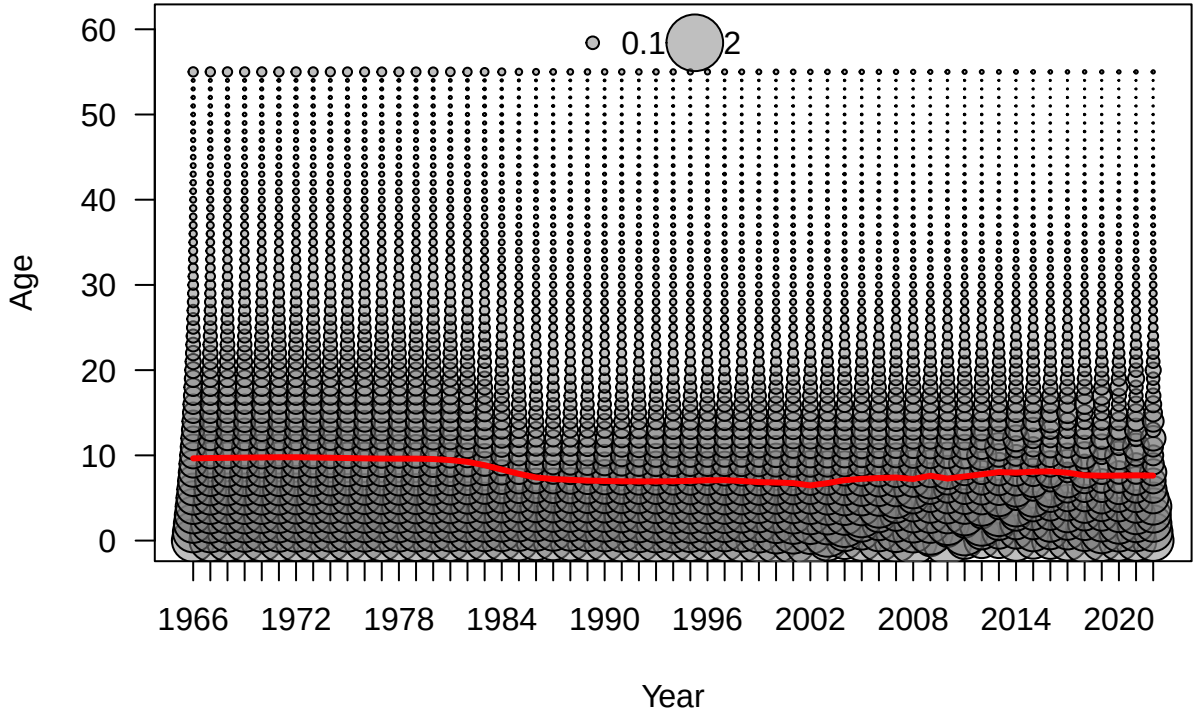

SURVEY2
SURVEY3
Standardized index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1990
1995
2000
2005
2010
2015
2020
Year

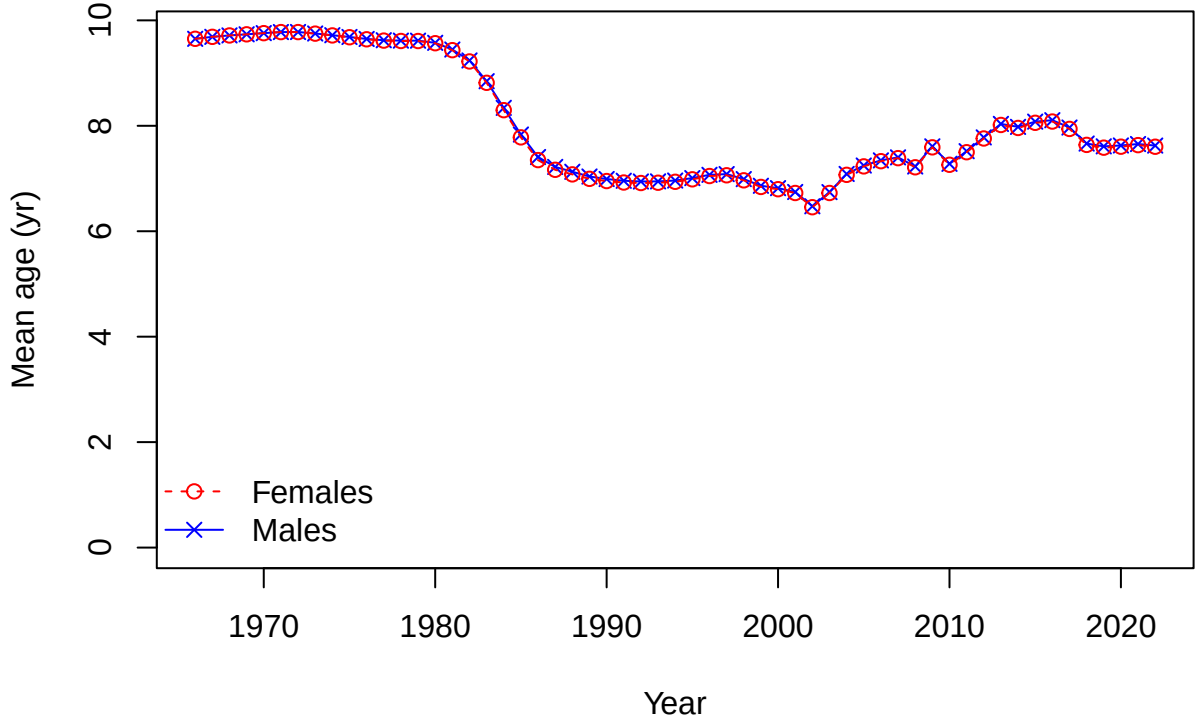

0.1
2
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

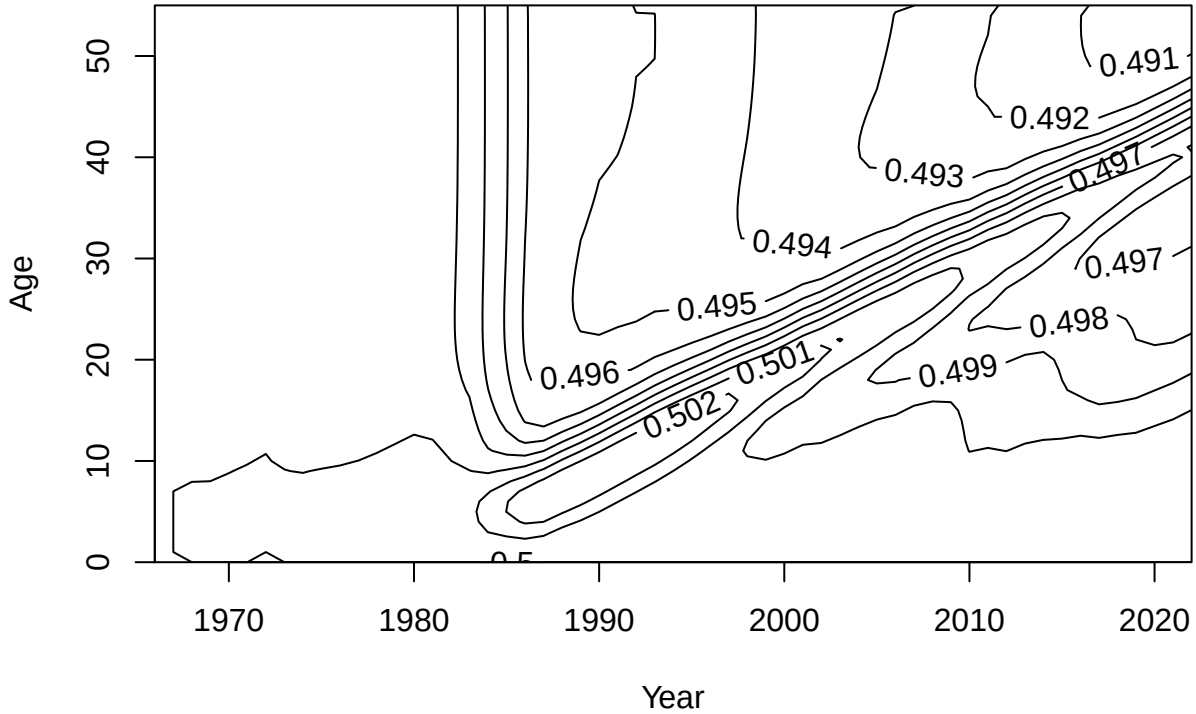

0.1
2
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

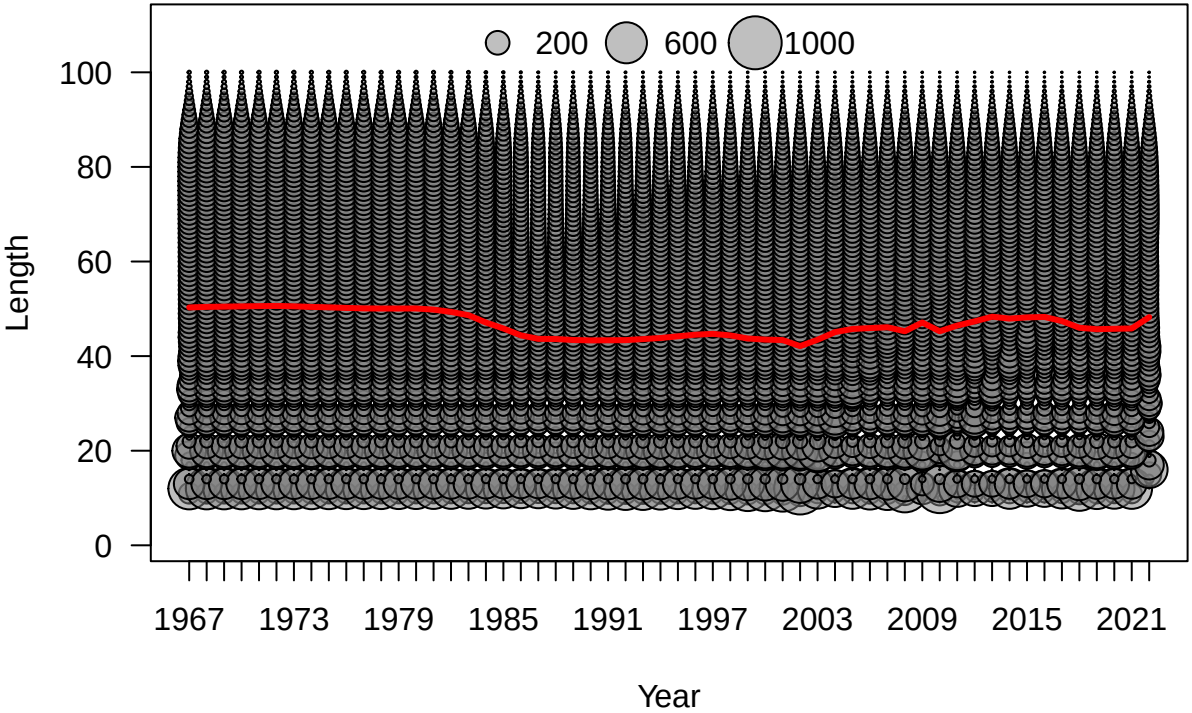

Mean age (yr)
0
2
4
6
8
10
1970
1980
1990
2000
2010
2020
Year
Females
Males

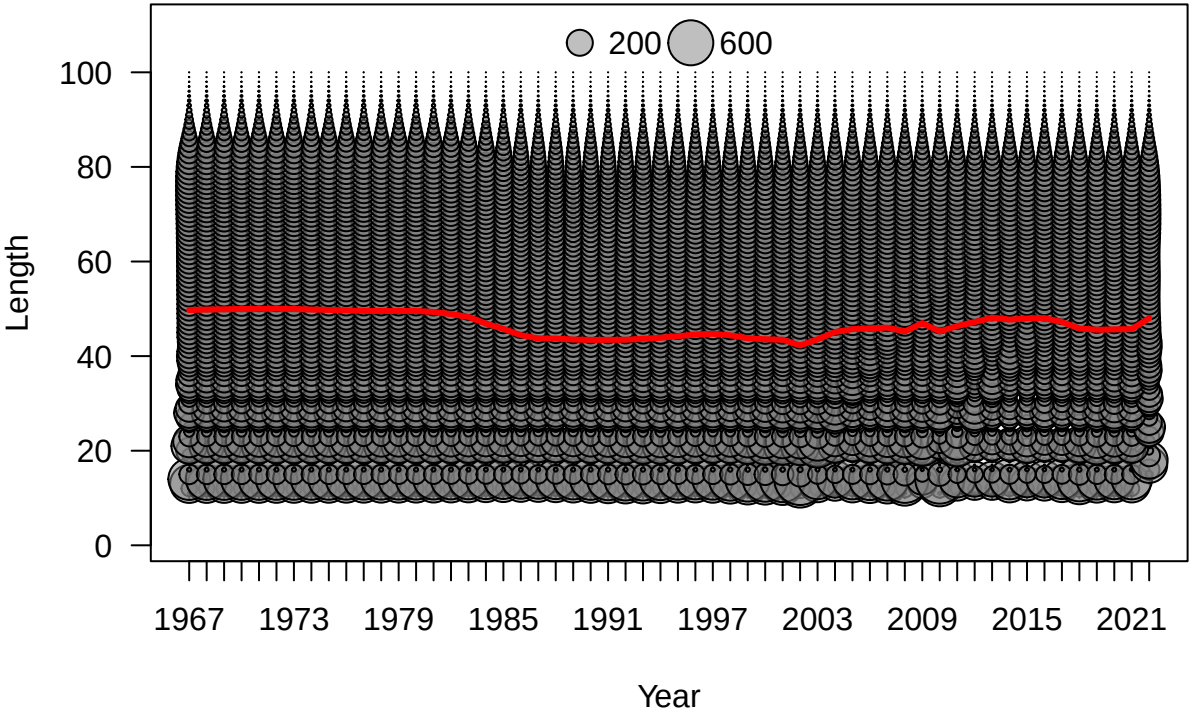

0.1
2
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

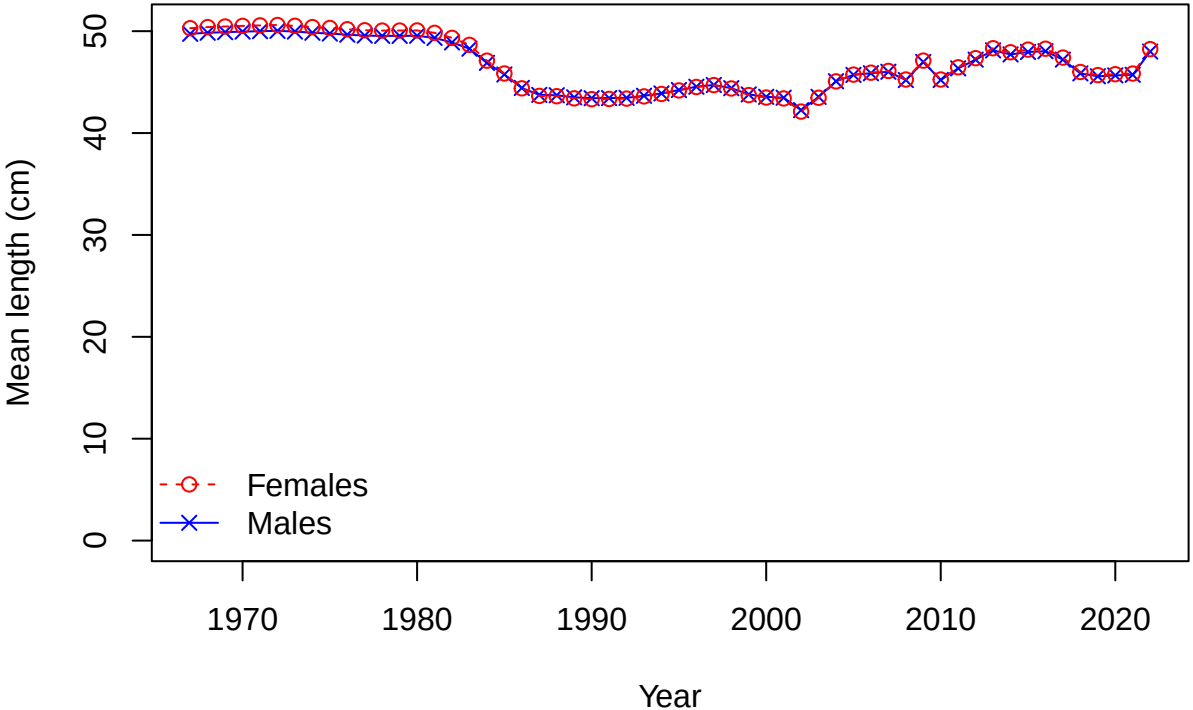

0.1
2
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

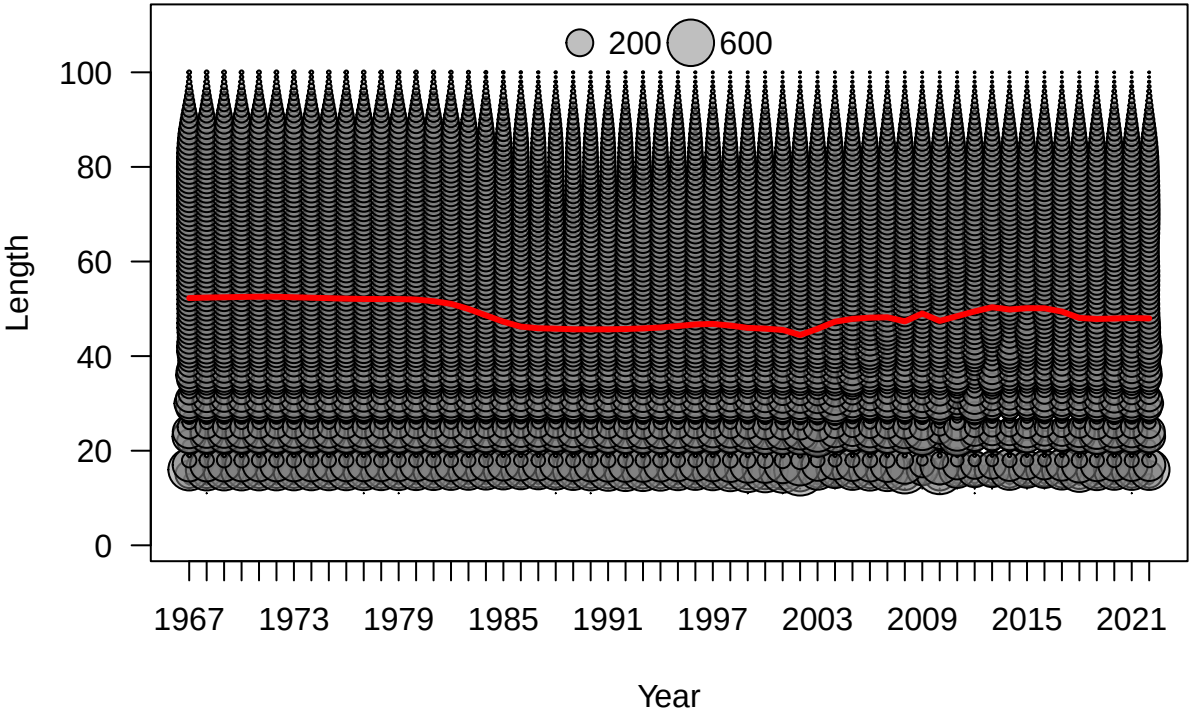

Mean age (yr)
0
2
4
6
8
10
1970
1980
1990
2000
2010
2020
Year
Females
Males

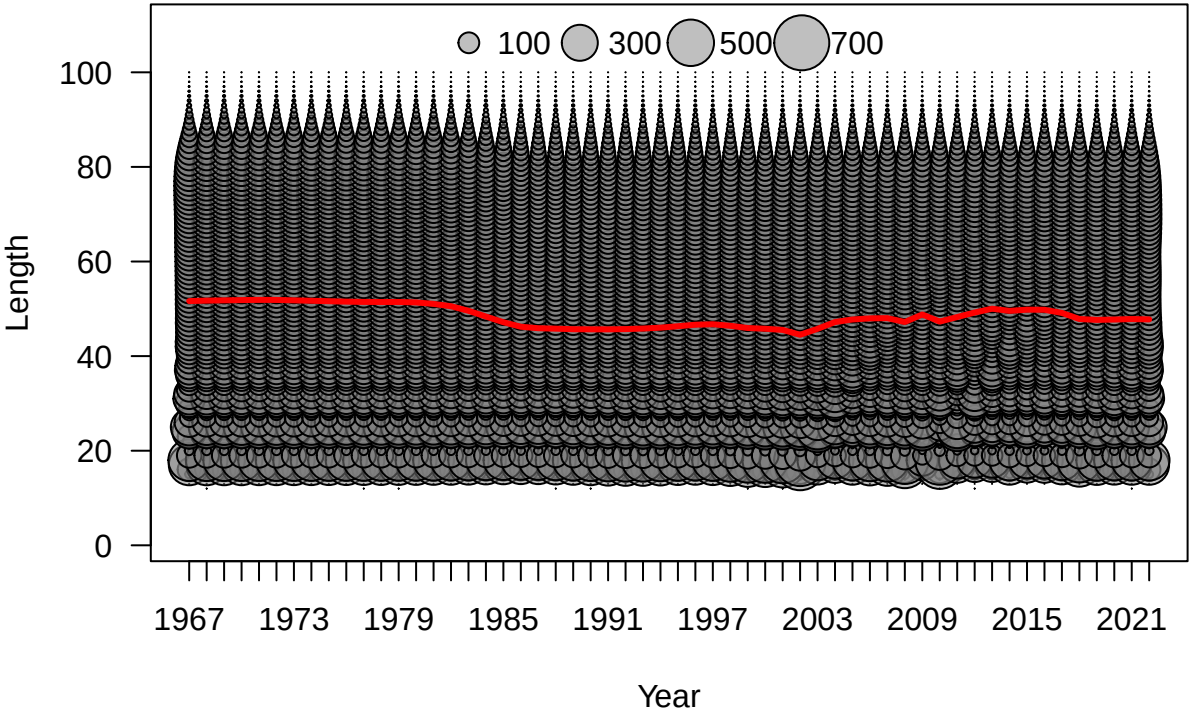

Age
0
10
20
30
40
50
1970
1980
1990
2000
2010
2020
Year
0.491
0.492
0.493
0.494
0.495
0.496
0.497
0.497
0.498
0.499
0.501
0.502
0.5

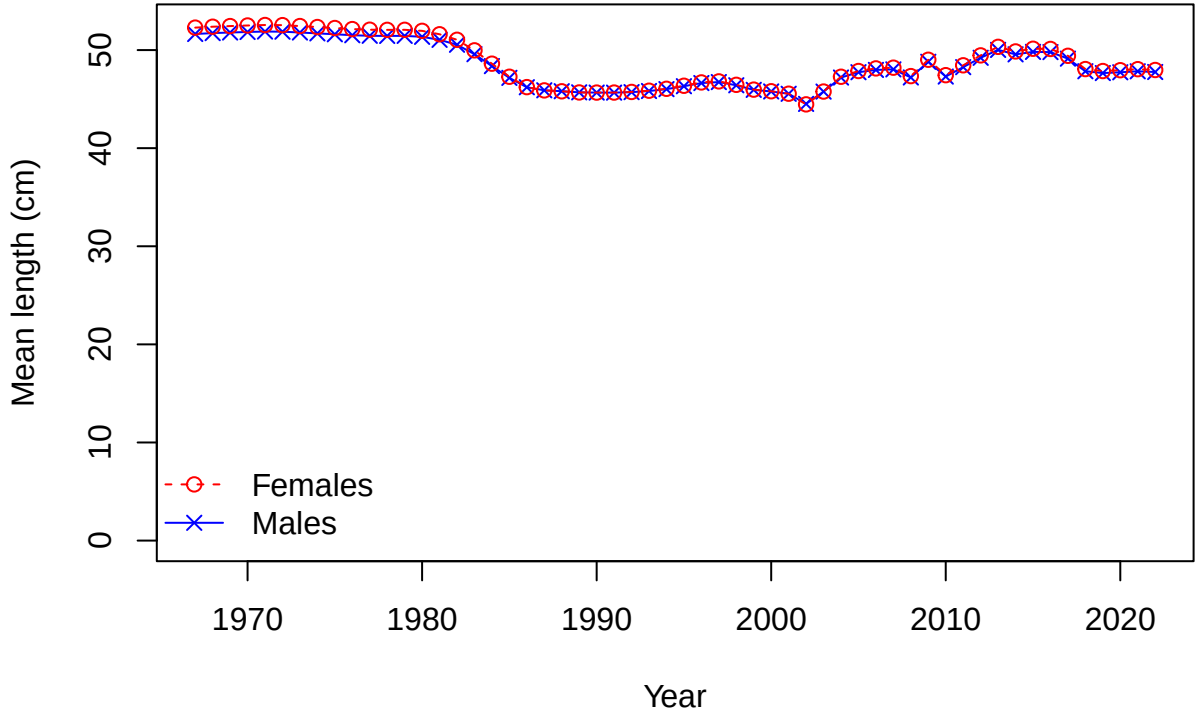

200
600
1000
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

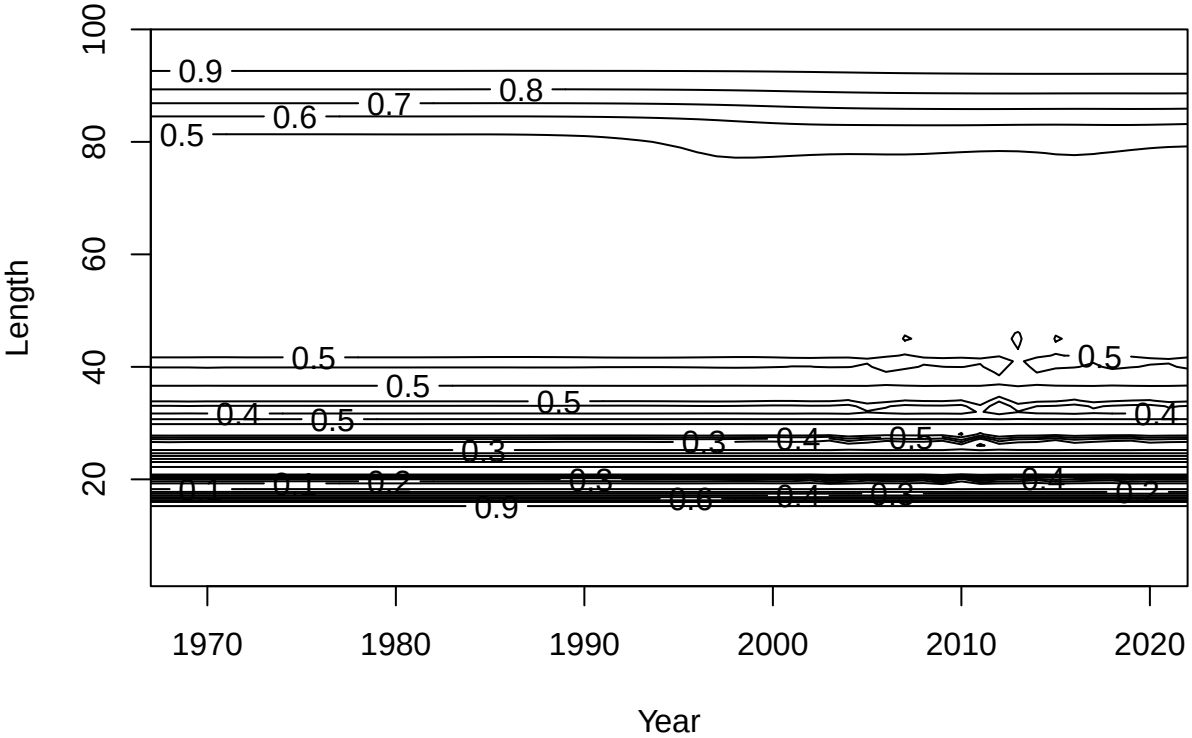

200
600
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year


Mean length (cm)
0
10
20
30
40
50
1970
1980
1990
2000
2010
2020
Year
Females
Males

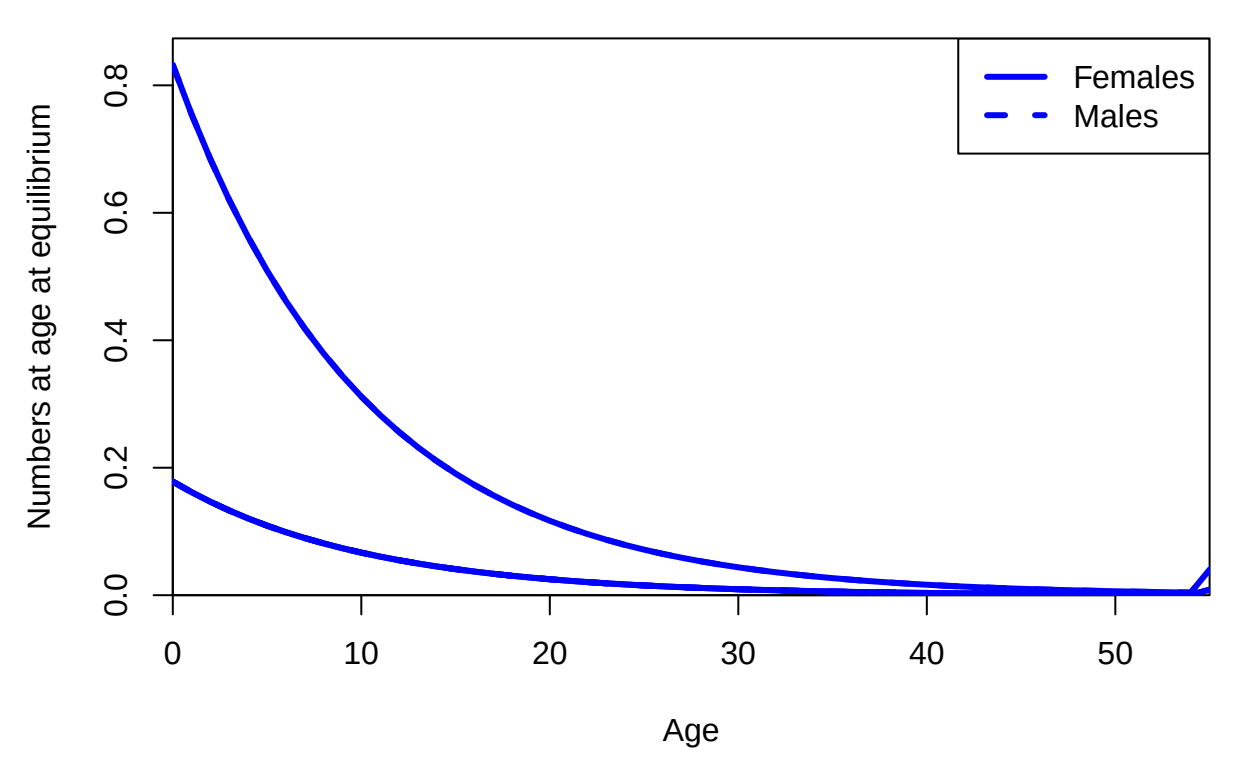

200
600
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

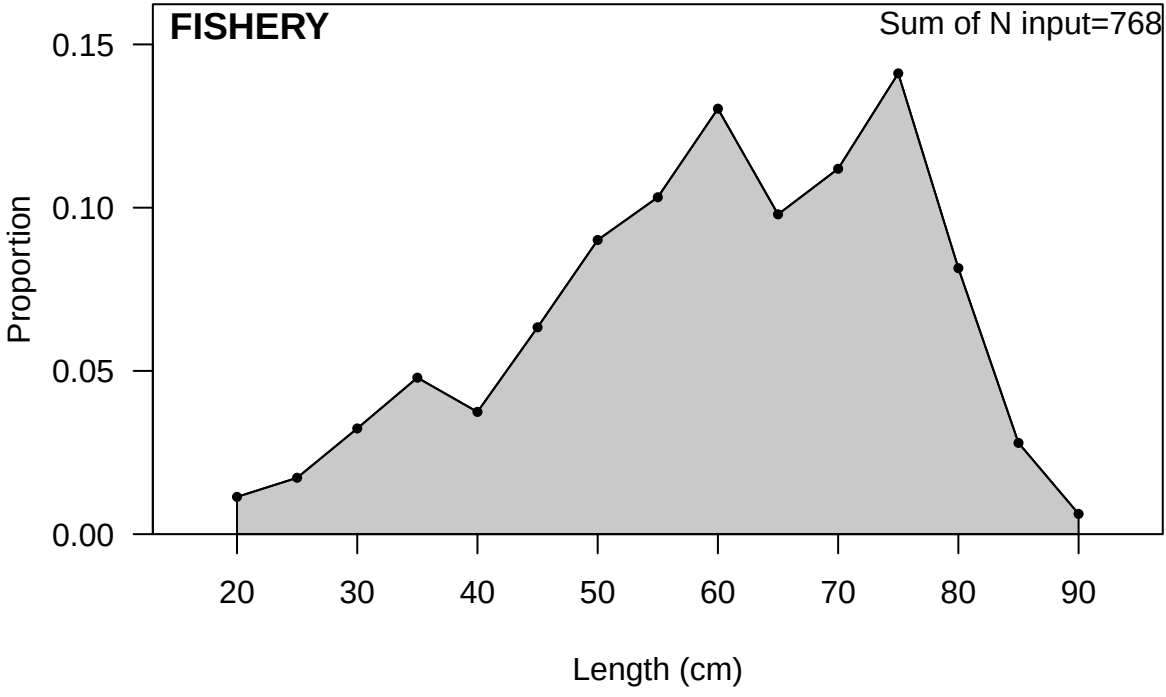

100
300
500
700
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

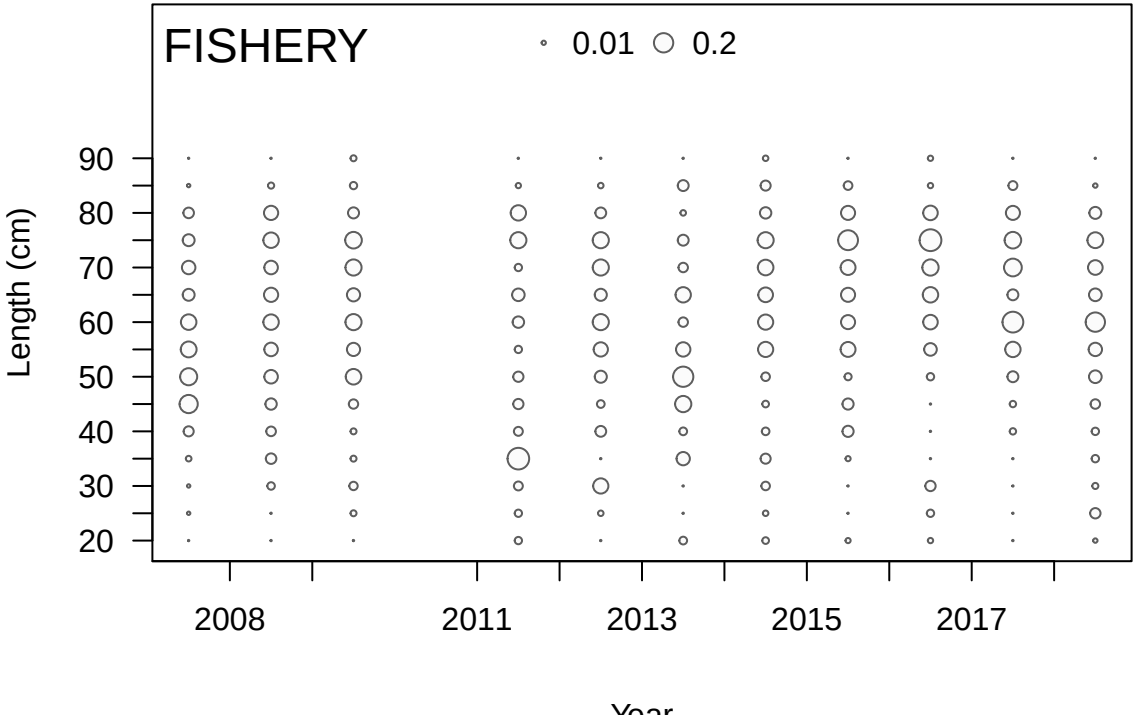

Mean length (cm)
0
10
20
30
40
50
1970
1980
1990
2000
2010
2020
Year
Females
Males

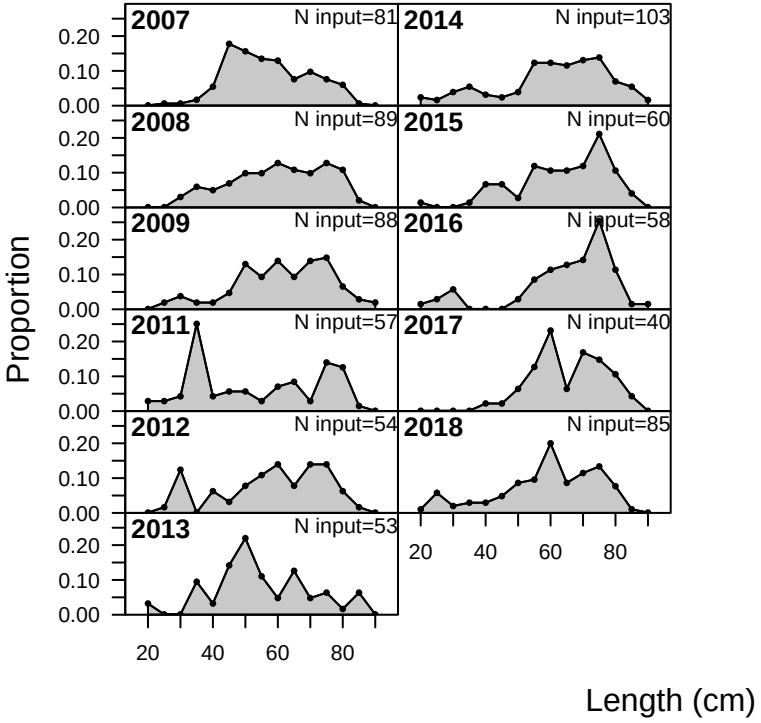


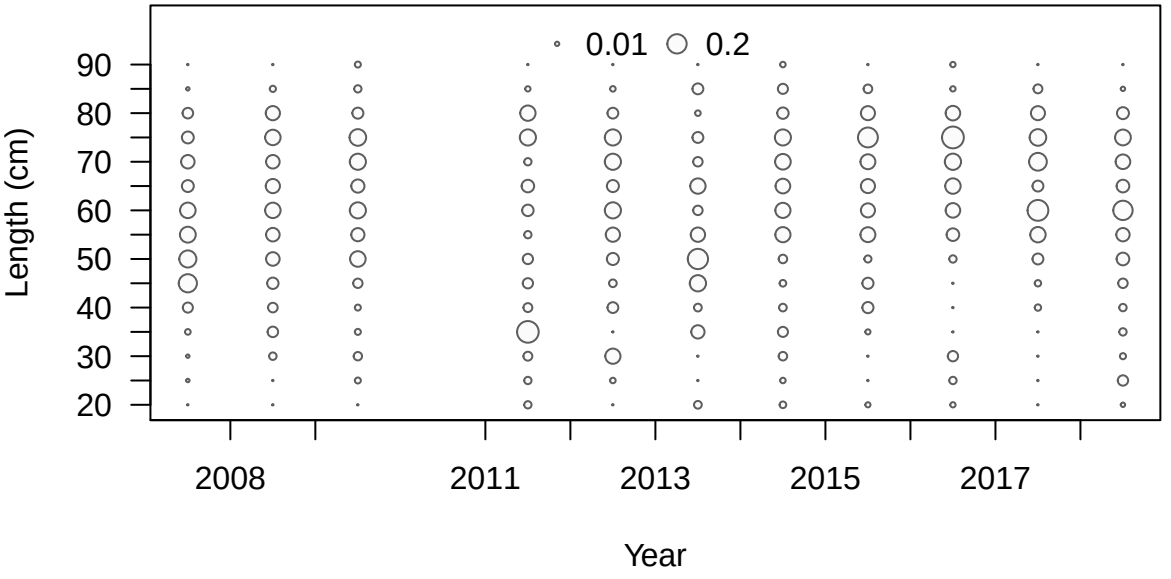
Length
Year
100
80
60
40
20
1970
1980
1990
2000
2010
2020
0.9
0.8
0.7
0.6
0.5
0.5
0.5
0.5
0.5
0.4
0.5
0.4
0.3
0.3
0.4
0.5
0.1
0.1
0.2
0.3
0.4
0.9
0.6
0.4
0.3
0.2

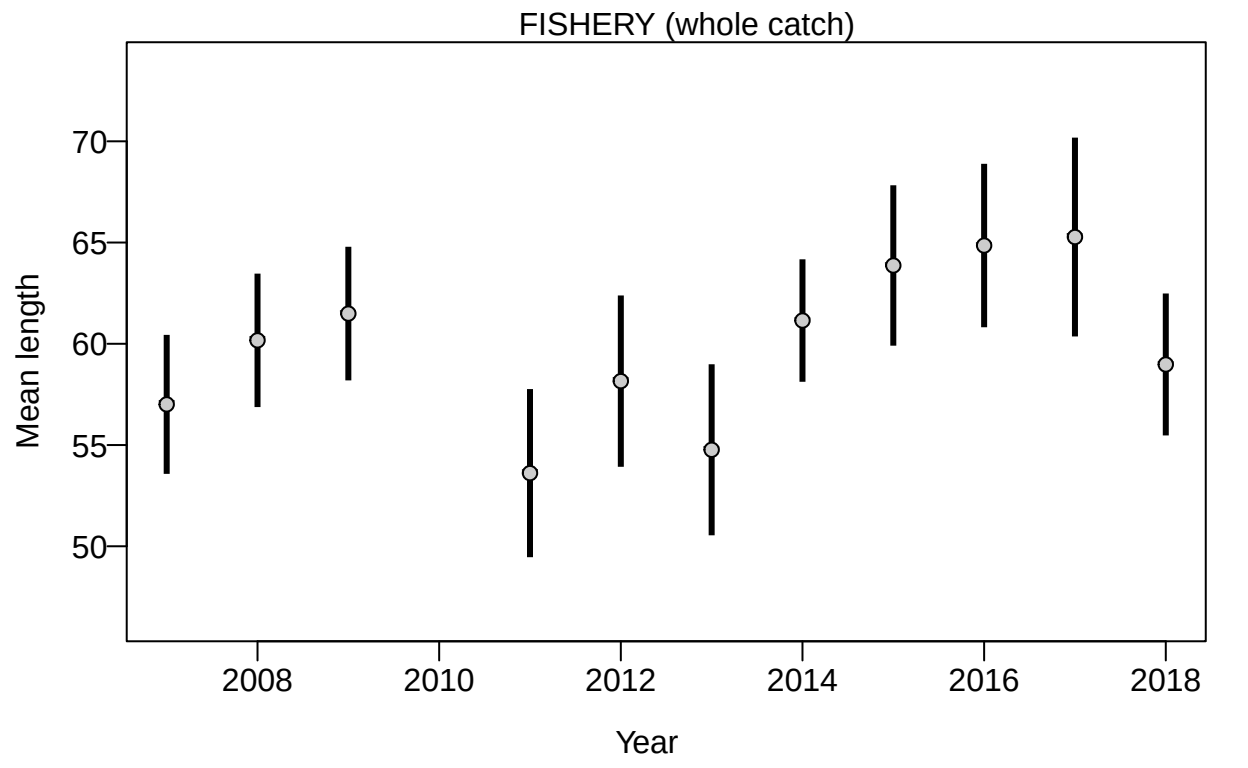

Numbers at age at equilibrium
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
50
Age
Females
Males

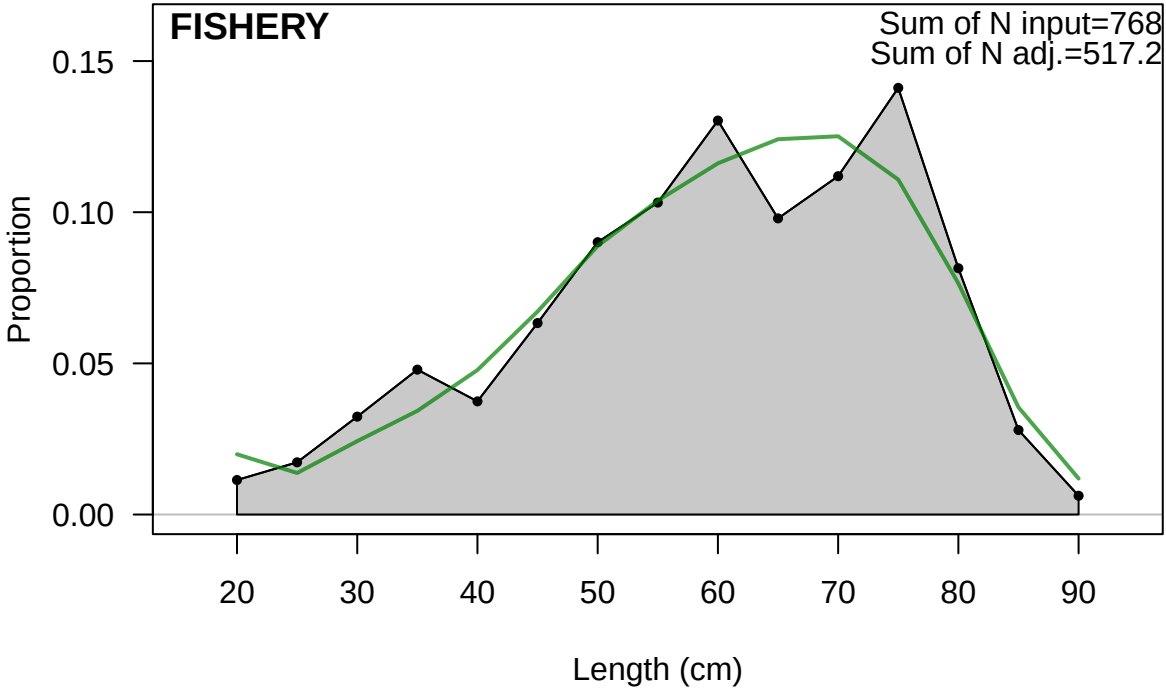

FISHERY
Sum of N input=768
0.15
0.10
0.05
0.00
Proportion
20
30
40
50
60
70
80
90
Length (cm)

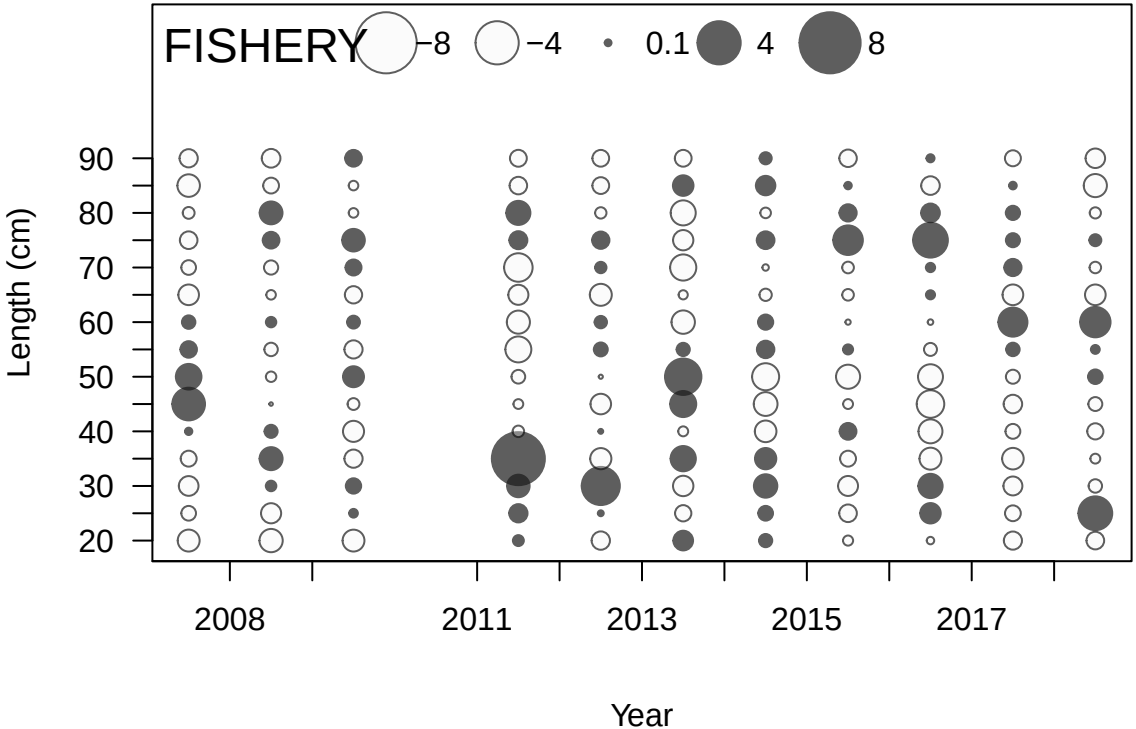

FISHERY
0.01
0.2
Length (cm)
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

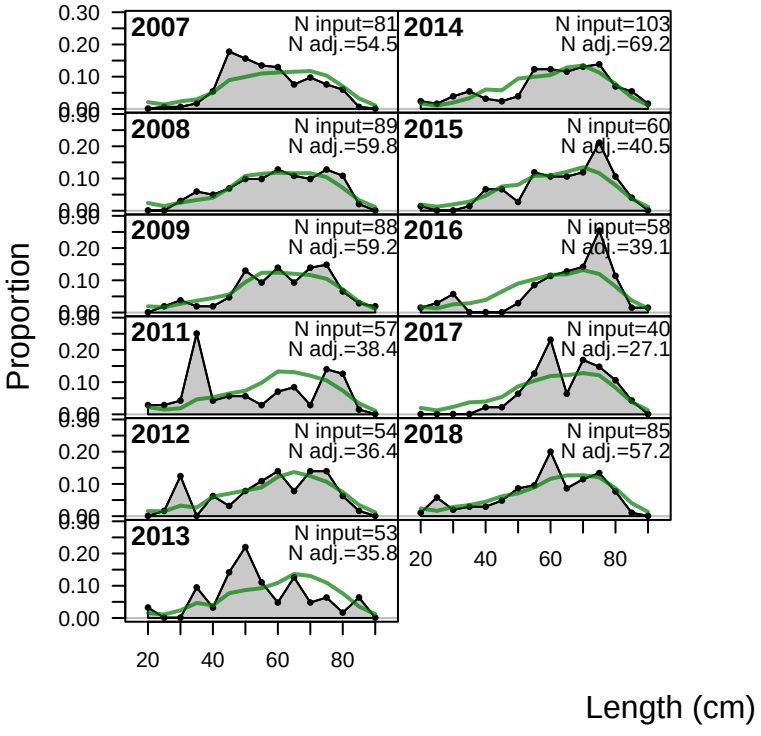

2007
N input=81
2014
N input=103
2008
N input=89
2015
N input=60
2009
N input=88
2016
N input=58
2011
N input=57
2017
N input=40
2012
N input=54
2018
N input=85
2013
N input=53
0.00
0.10
0.20
20
40
60
80
Proportion
Length (cm)

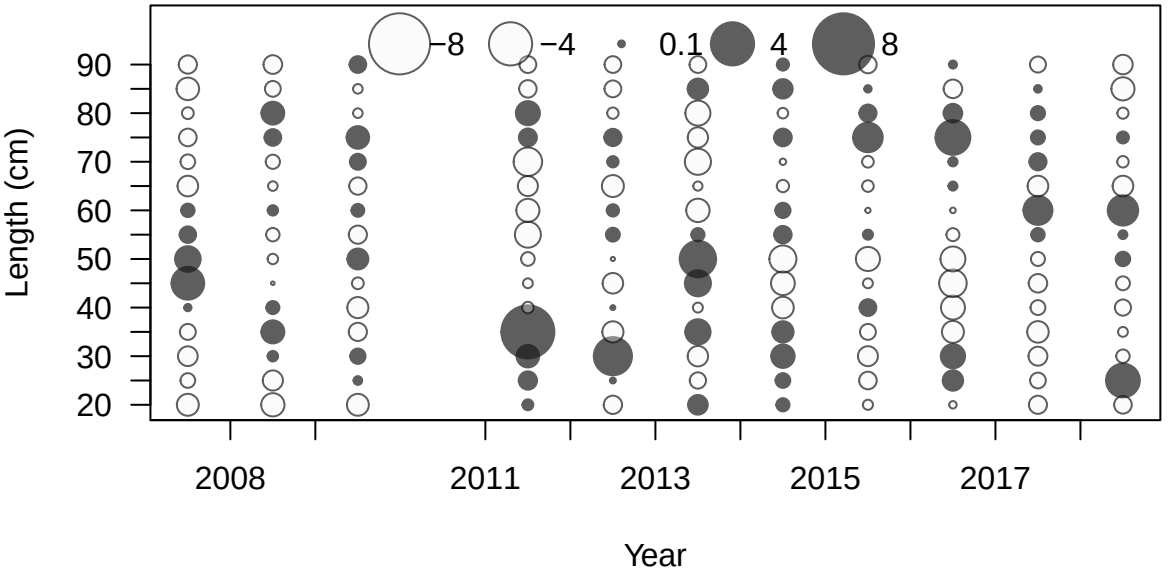

0.01
0.2
90
80
70
60
50
40
30
20
Length (cm)
2008
2011
2013
2015
2017
Year

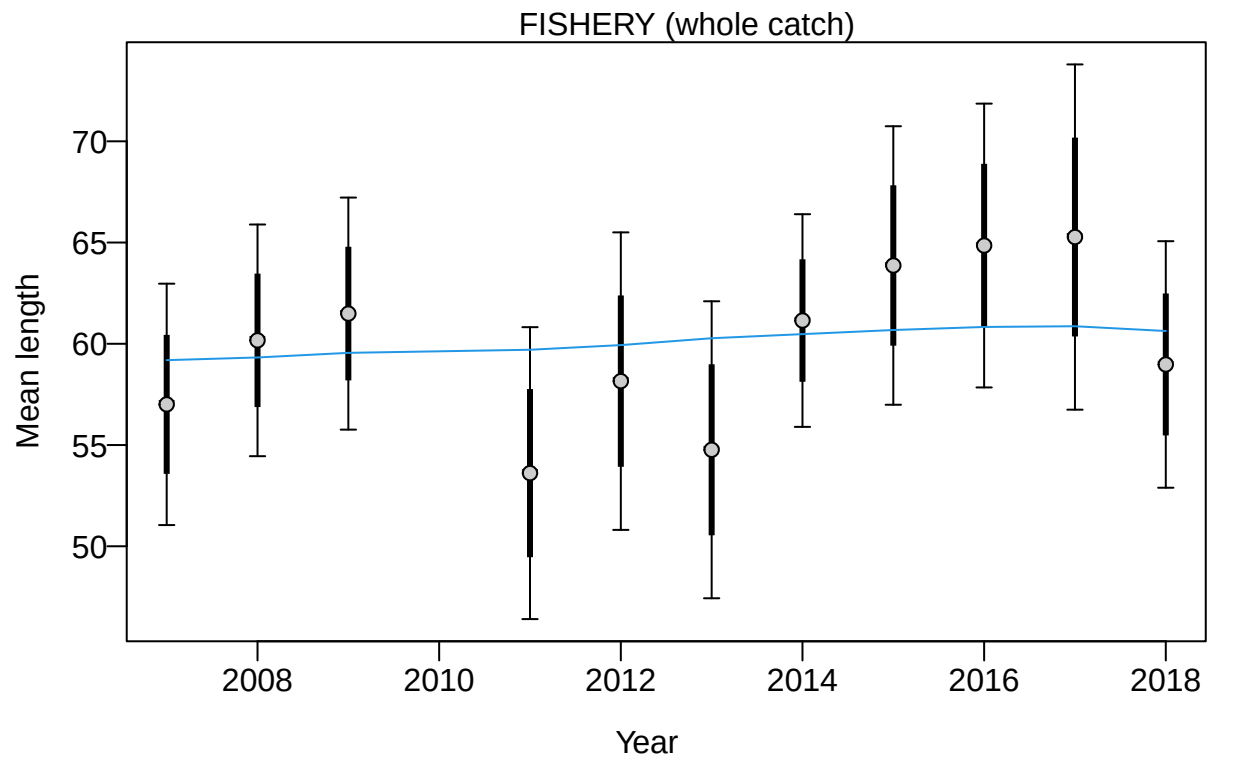

FISHERY (whole catch)
70
65
60
55
50
Mean length
2008
2010
2012
2014
2016
2018
Year

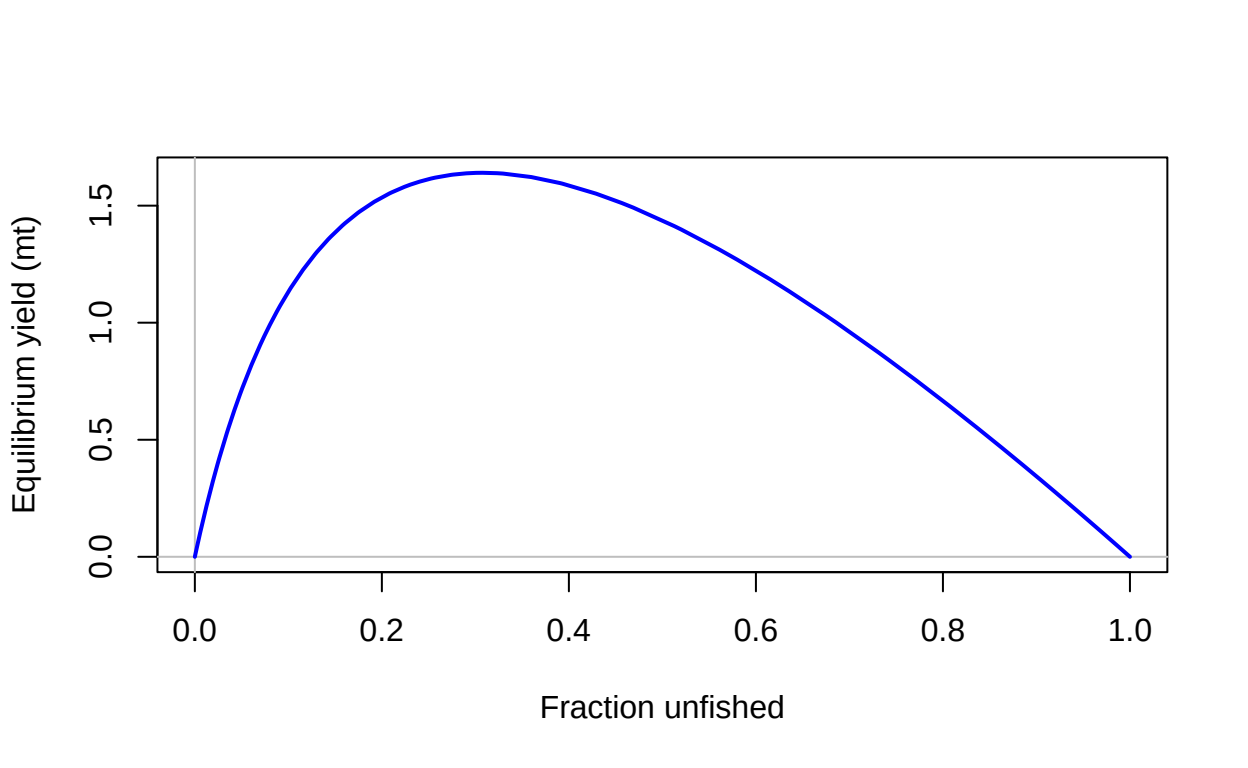

FISHERY
Sum of N input=768
Sum of N adj.=517.2
0.15
0.10
0.05
0.00
Proportion
20
30
40
50
60
70
80
90
Length (cm)

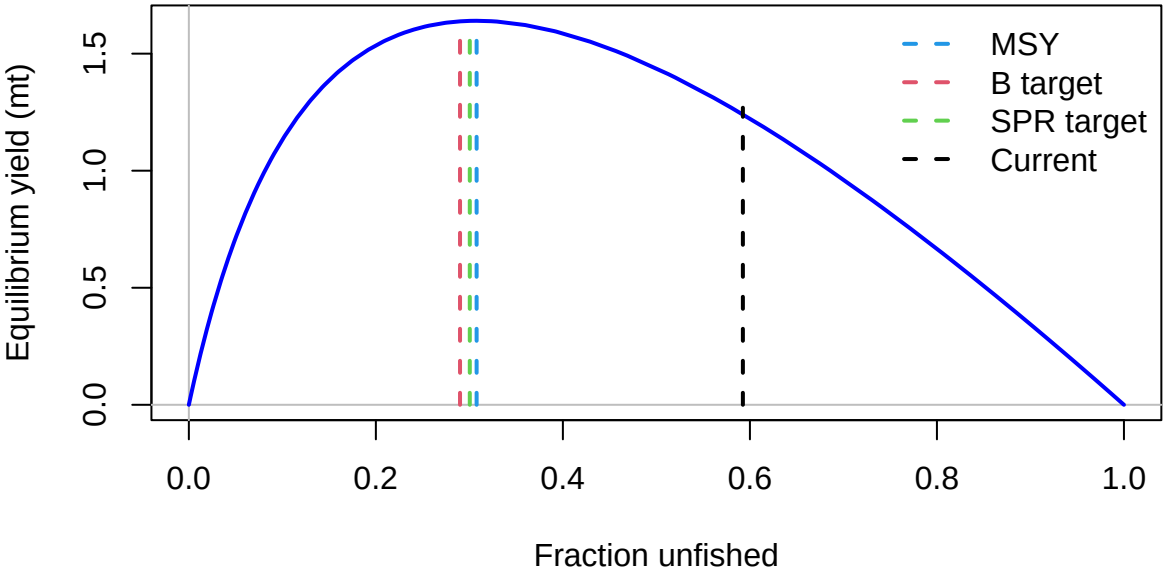

FISHERY
−8
−4
0.1
4
8
Length (cm)
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year


2007
N input=81
N adj.=54.5
2014
N input=103
N adj.=69.2
2008
N input=89
N adj.=59.8
2015
N input=60
N adj.=40.5
2009
N input=88
N adj.=59.2
2016
N input=58
N adj.=39.1
2011
N input=57
N adj.=38.4
2017
N input=40
N adj.=27.1
2012
N input=54
N adj.=36.4
2018
N input=85
N adj.=57.2
2013
N input=53
N adj.=35.8
0.30
0.20
0.10
0.00
20
40
60
80
Proportion
Length (cm)

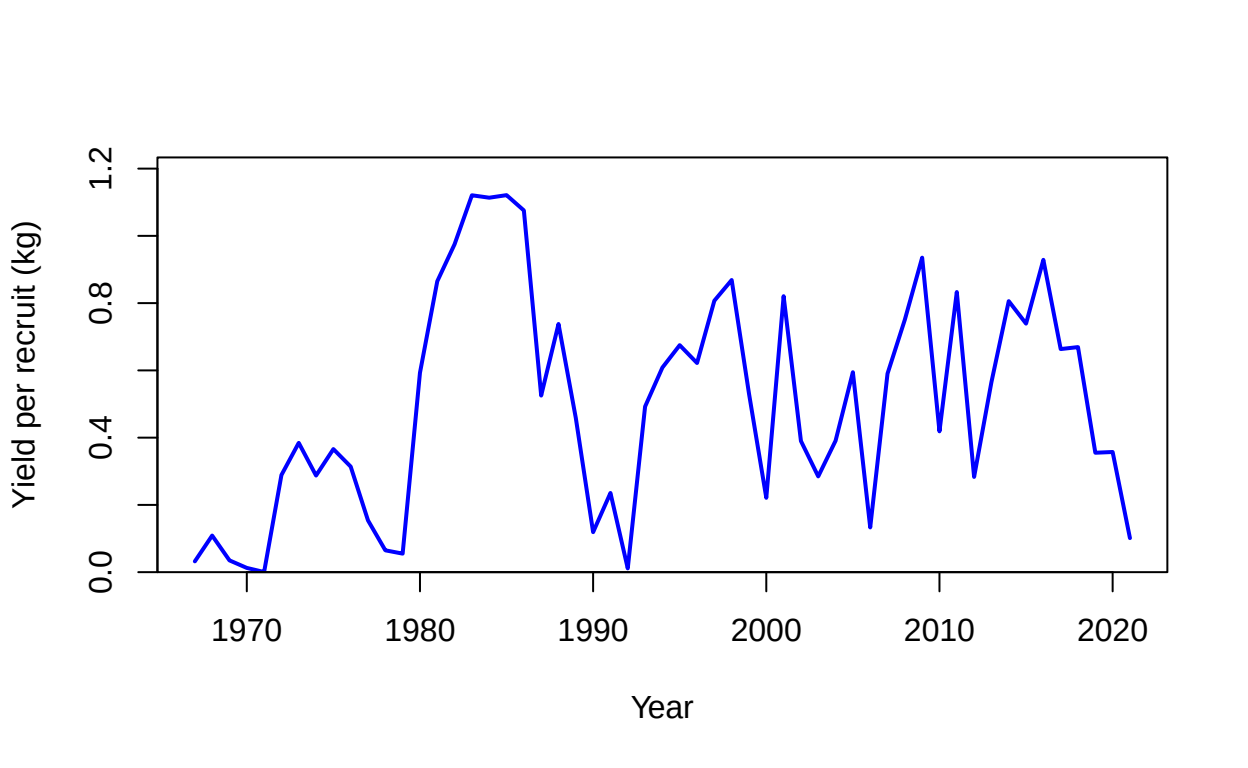

−8
−4
0.1
4
8
90
80
70
60
50
40
30
20
Length (cm)
2008
2011
2013
2015
2017
Year

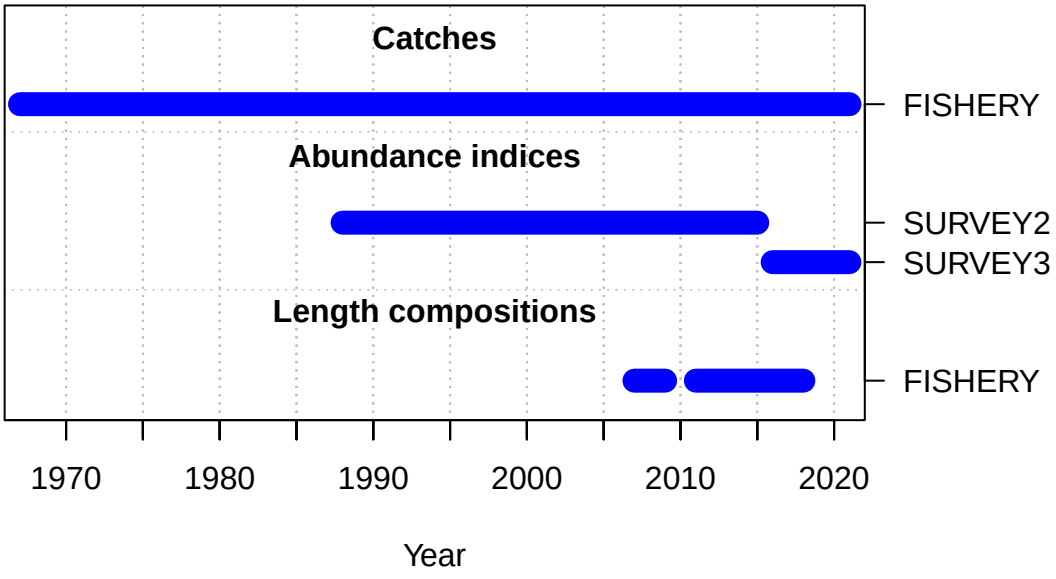

FISHERY (whole catch)
Mean length
70
65
60
55
50
2008
2010
2012
2014
2016
2018
Year

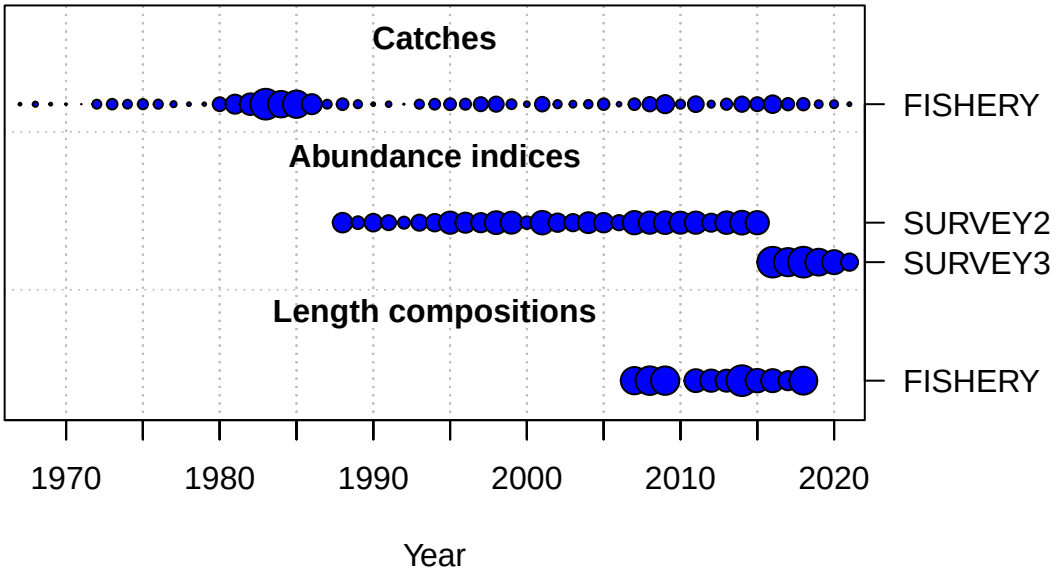

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

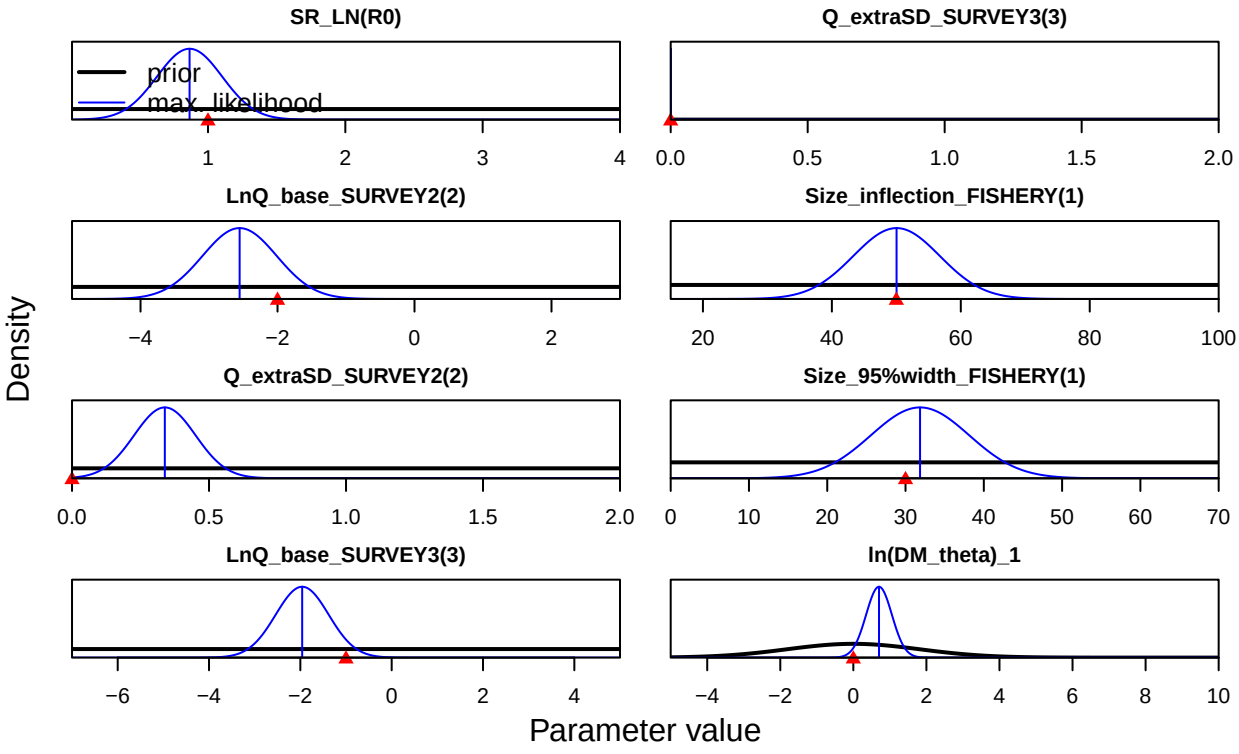

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current

Surplus production (mt)
0.0
0.5
1.0
1.5
2.0
0
20
40
60
80
Total biomass (mt)


Yield per recruit (kg)
0.0
0.4
0.8
1.2
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
1
2
3
4
Q_extraSD_SURVEY3(3)
0.0
0.5
1.0
1.5
2.0
LnQ_base_SURVEY2(2)
−4
−2
0
2
Size_inflection_FISHERY(1)
20
40
60
80
100
Q_extraSD_SURVEY2(2)
0.0
0.5
1.0
1.5
2.0
Size_95%width_FISHERY(1)
0
10
20
30
40
50
60
70
LnQ_base_SURVEY3(3)
−6
−4
−2
0
2
4
ln(DM_theta)_1
−4
−2
0
2
4
6
8
10
Density
Parameter value