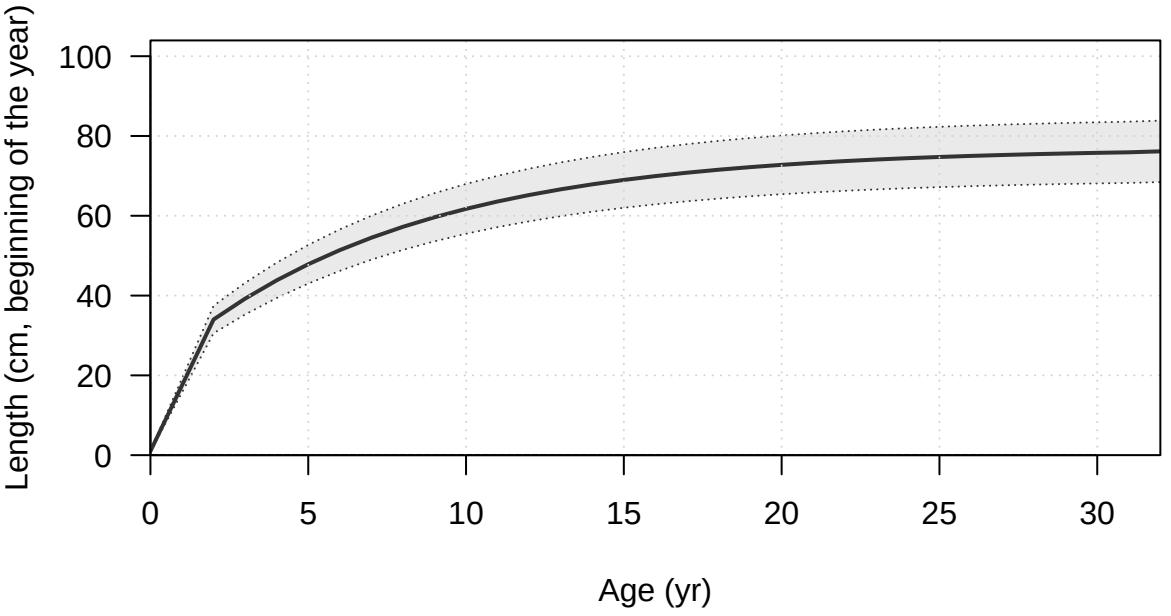
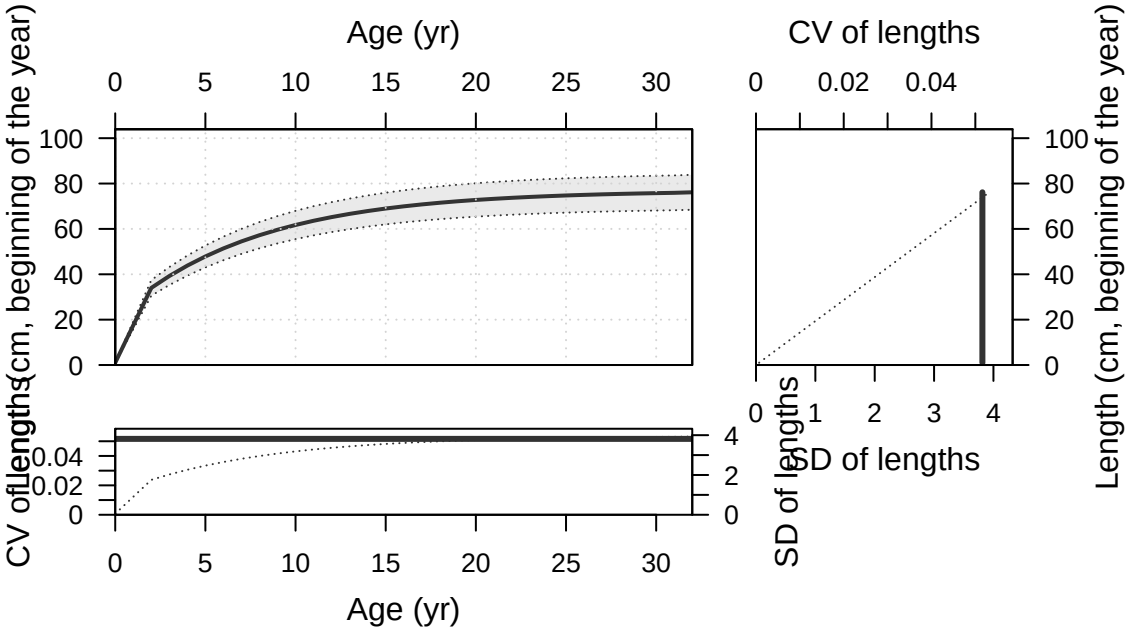
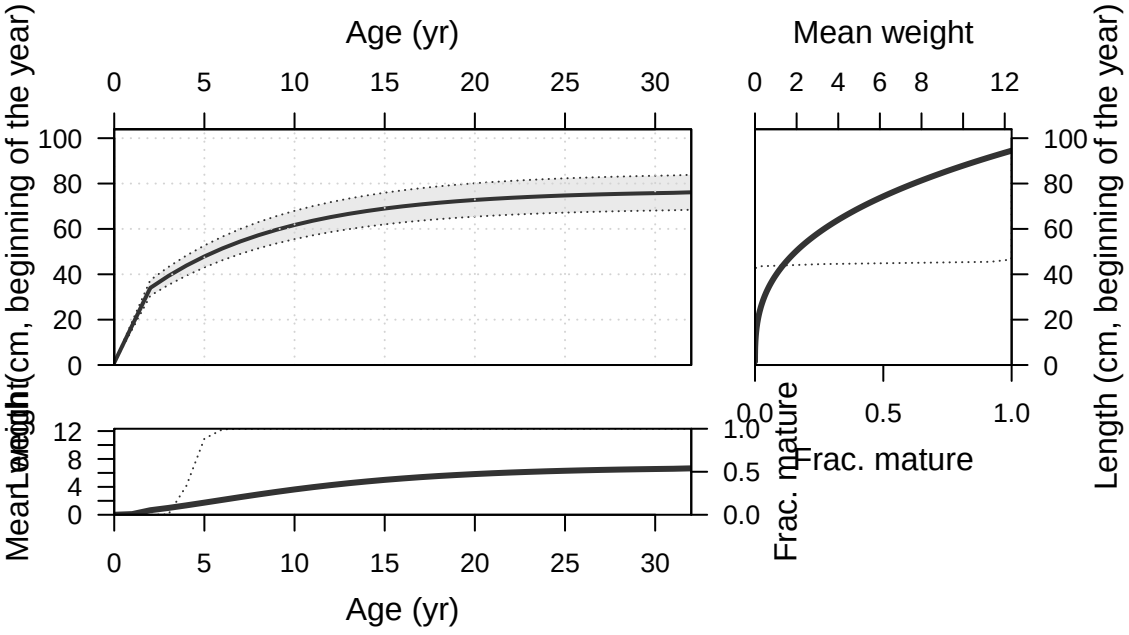
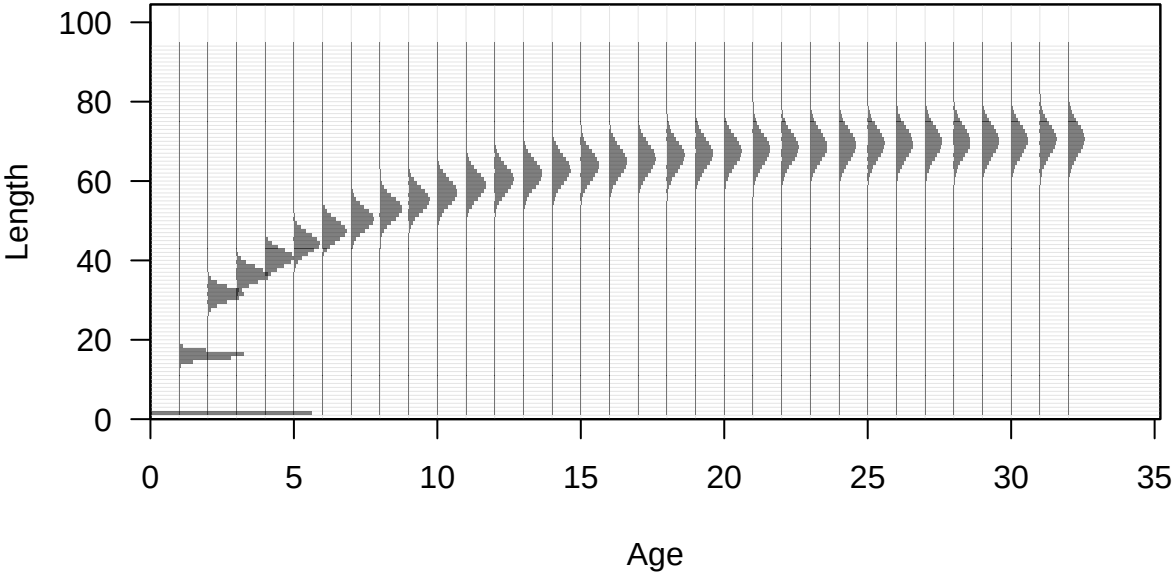
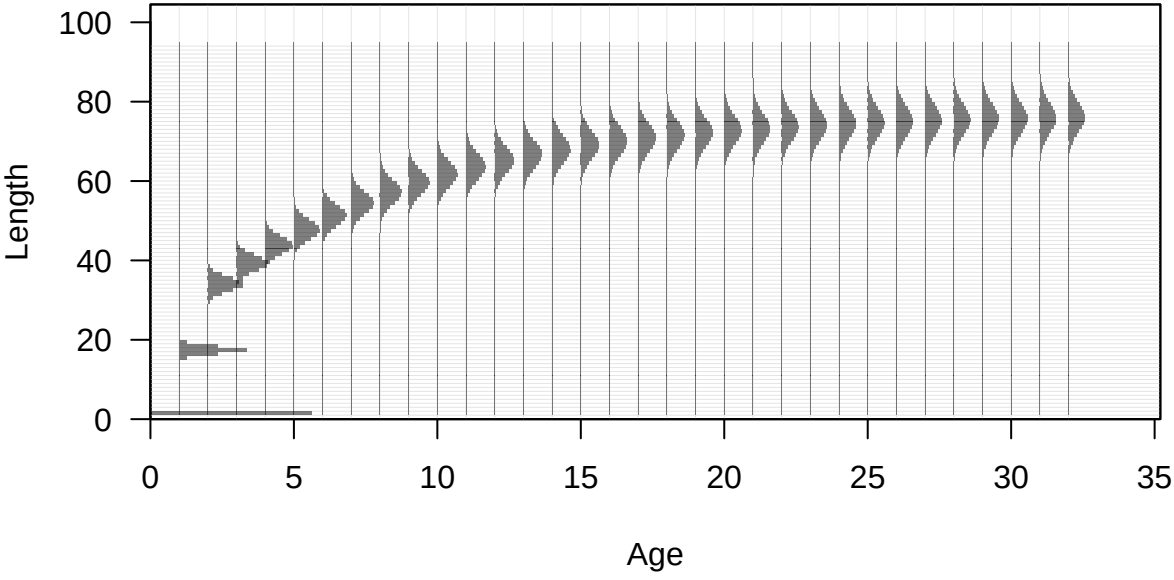
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Tue Feb 14 14:15:40 2023
Data_File: data.ss
Control_File: control.ss

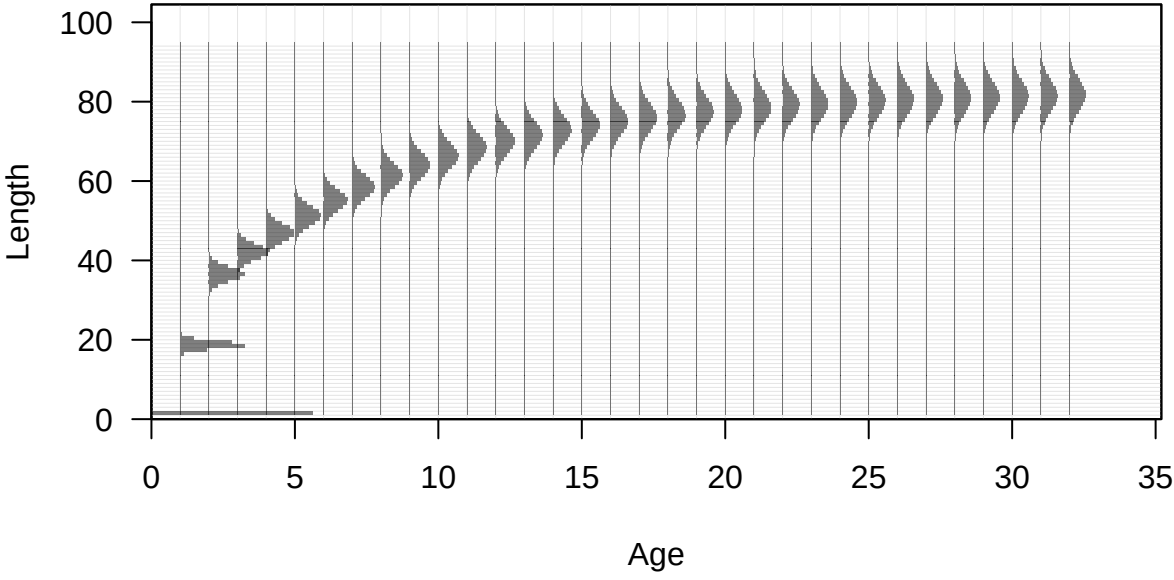

Length (cm, beginning of the year)
100
80
60
40
20
0
0
5
10
15
20
25
30
Age (yr)

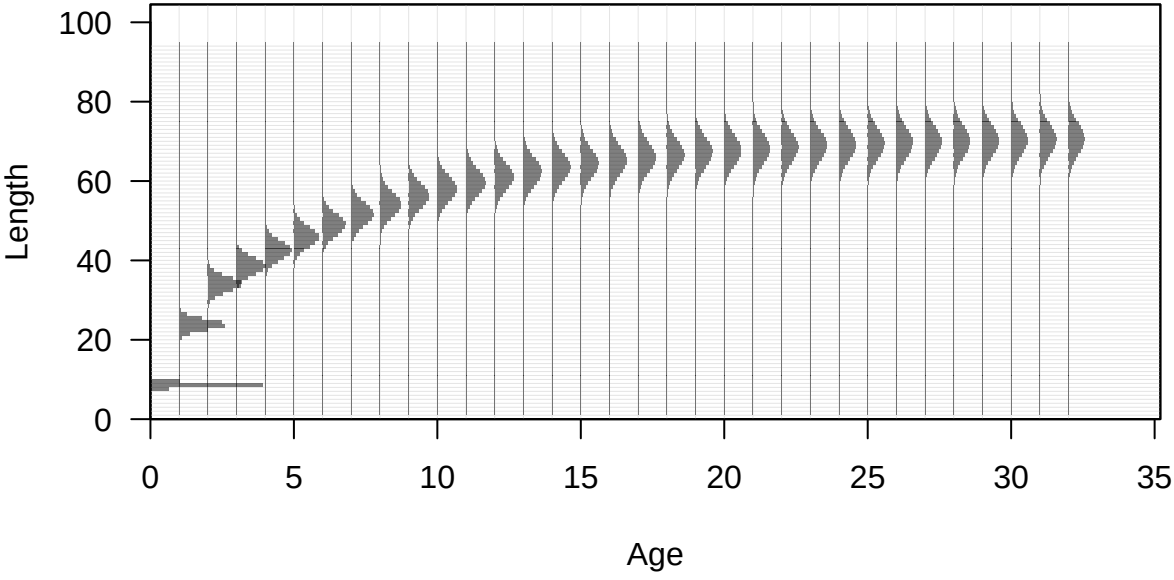

Age (yr)
0
5
10
15
20
25
30
100
80
60
40
20
0
Length (cm, beginning of the year)
CV of lengths
0.04
0.02
0
4
2
0
SD of lengths
Age (yr)
CV of lengths
0
0.02
0.04
0
1
2
3
4
SD of lengths
Length (cm, beginning of the year)

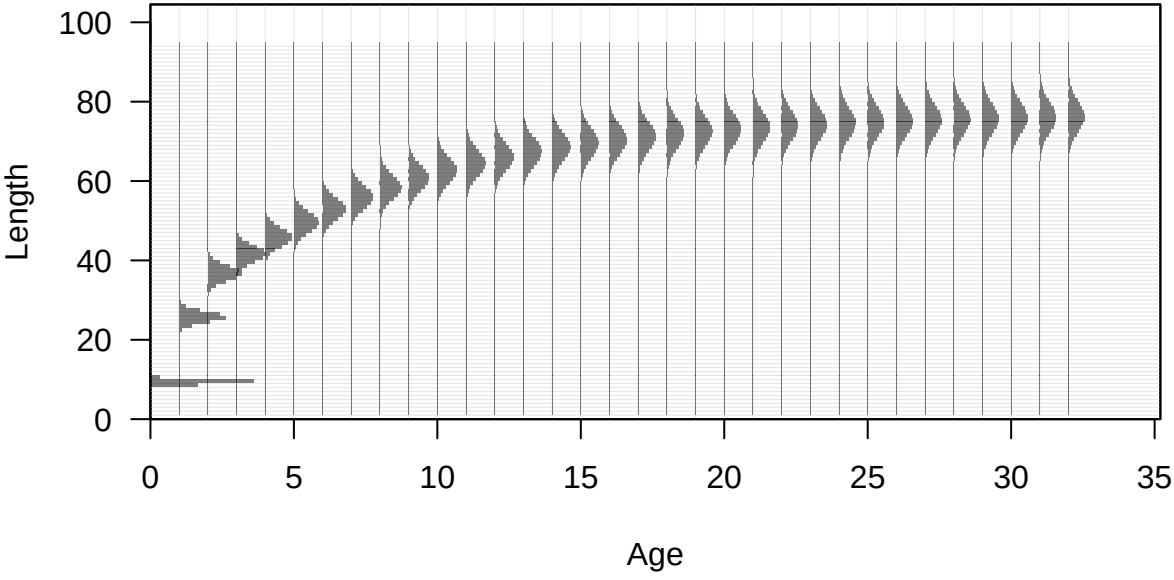

Age (yr)
Mean weight
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)
Frac. mature
Length (cm, beginning of the year)

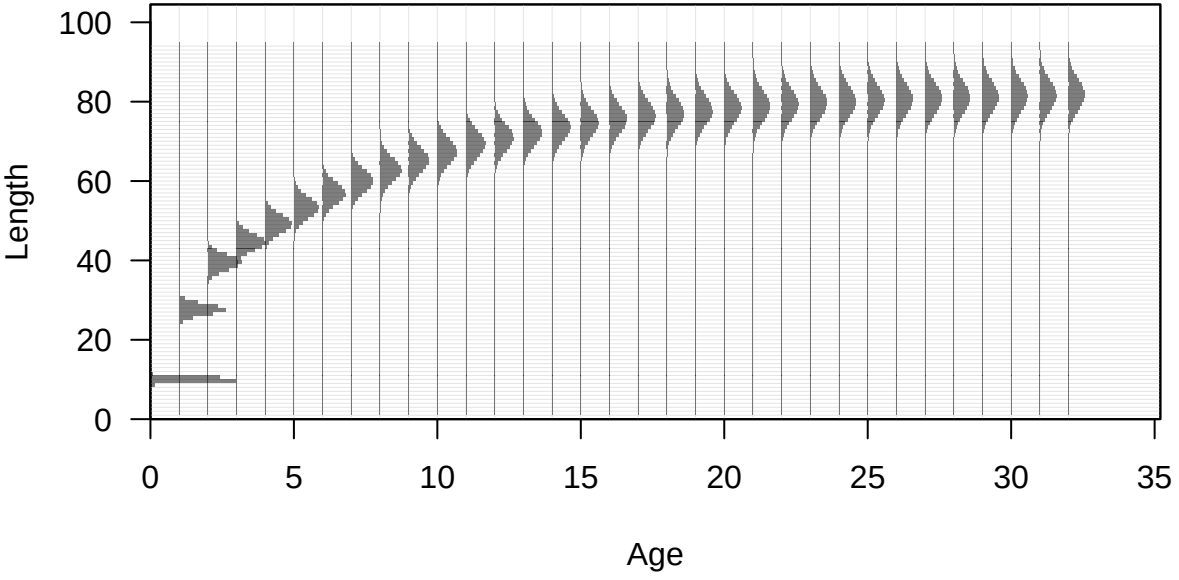

Length
100
80
60
40
20
0
0
5
10
15
20
25
30
35
Age

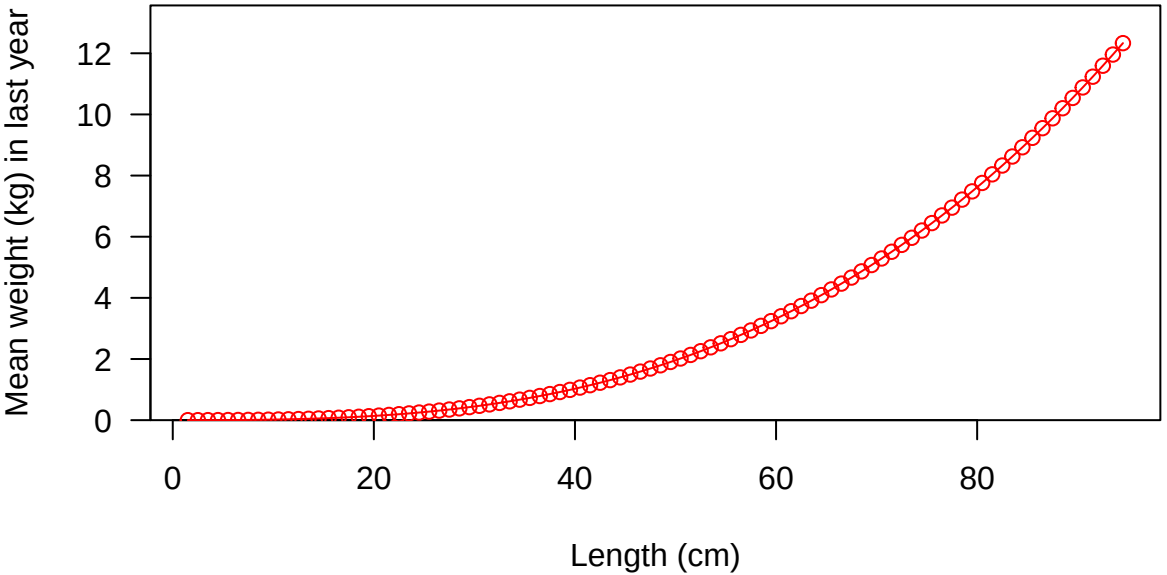

Length
100
80
60
40
20
0
0
5
10
15
20
25
30
35
Age

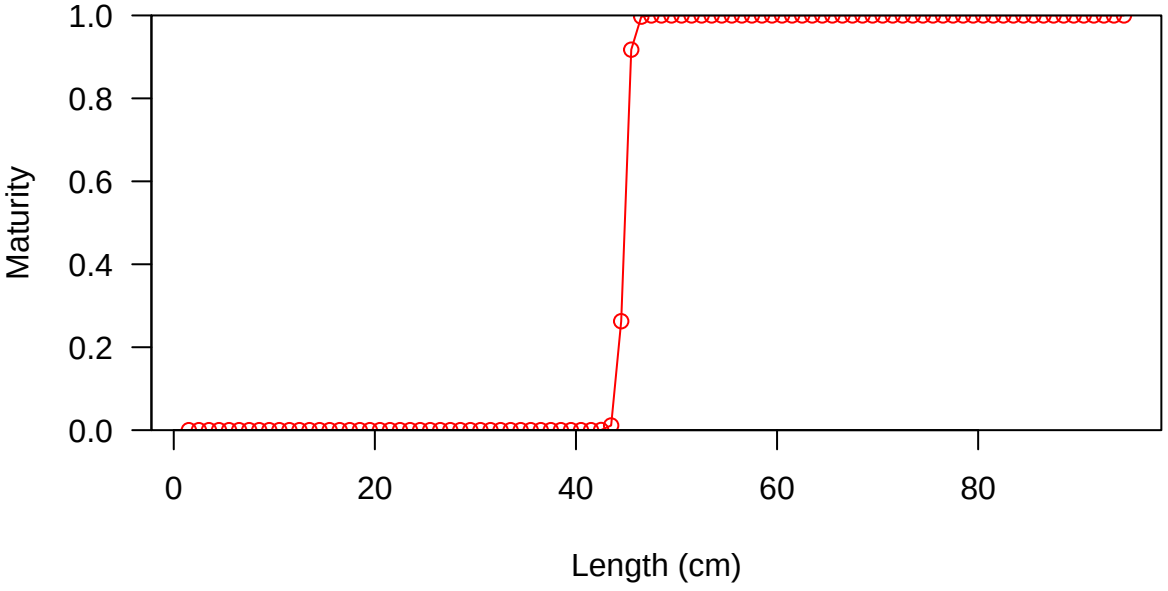

100
80
60
40
20
0
Length
0
5
10
15
20
25
30
35
Age

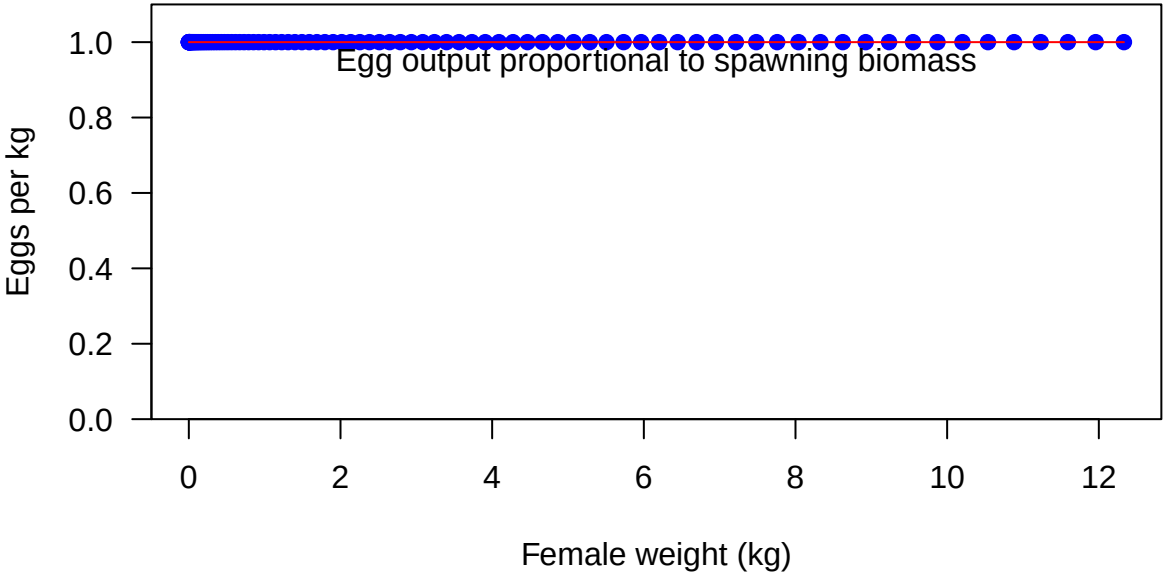

Length
100
80
60
40
20
0
0
5
10
15
20
25
30
35
Age

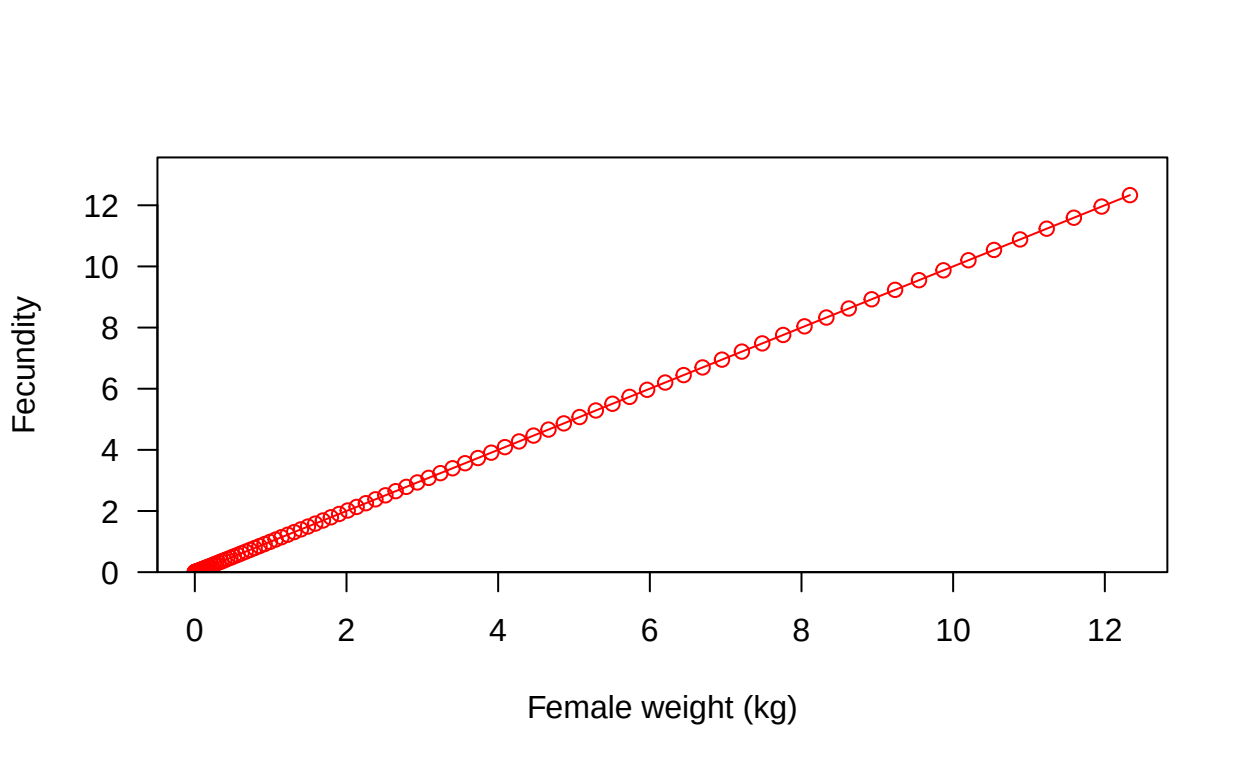

Length
100
80
60
40
20
0
0
5
10
15
20
25
30
35
Age

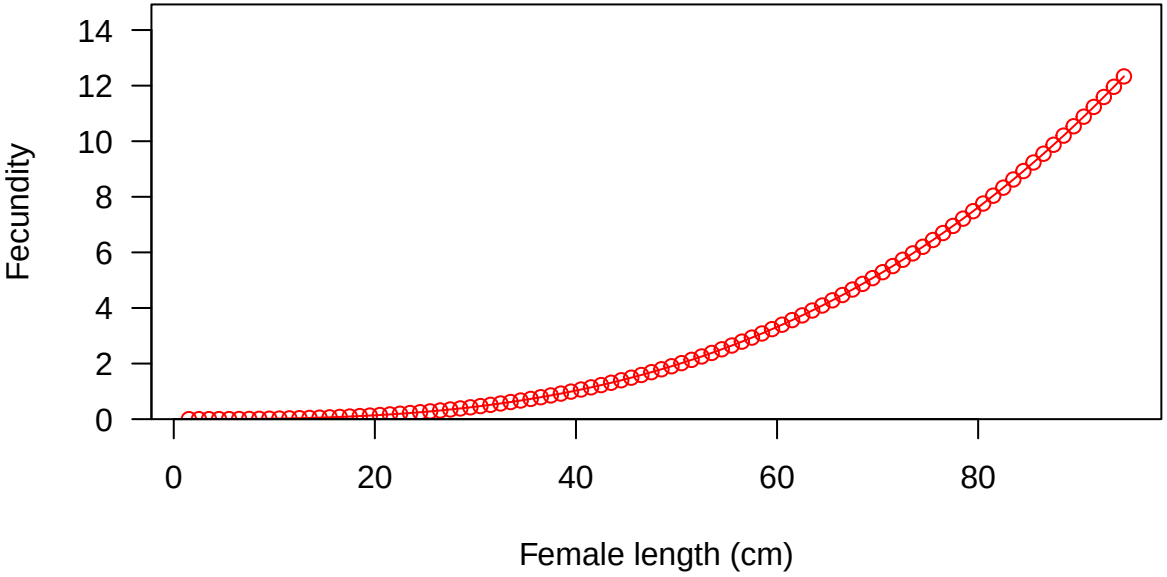

Length
100
80
60
40
20
0
0
5
10
15
20
25
30
35
Age

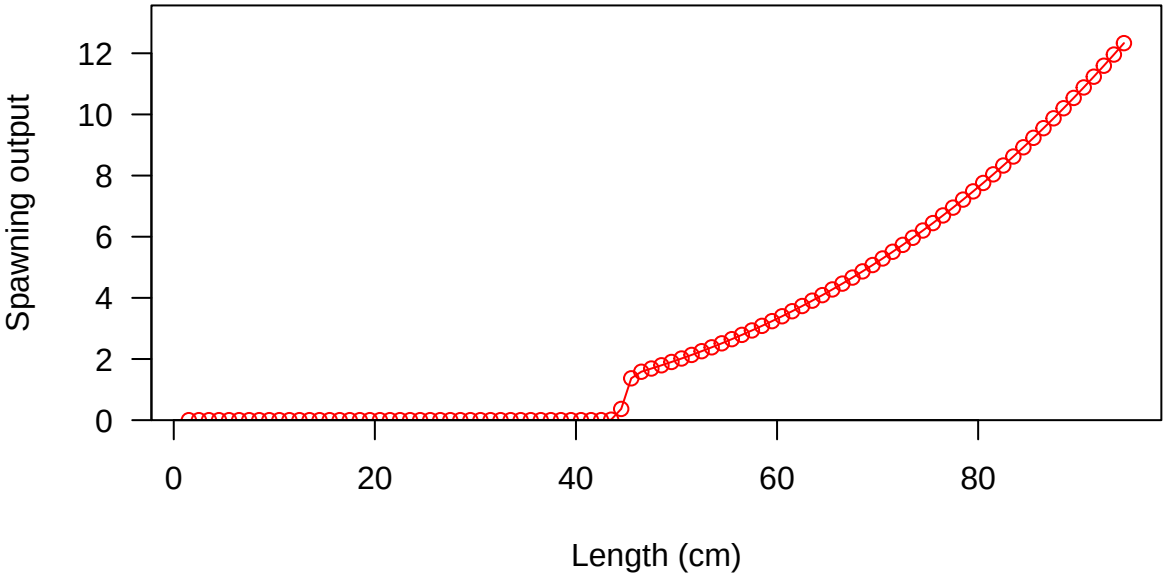

Mean weight (kg) in last year
0
2
4
6
8
10
12
0
20
40
60
80
Length (cm)

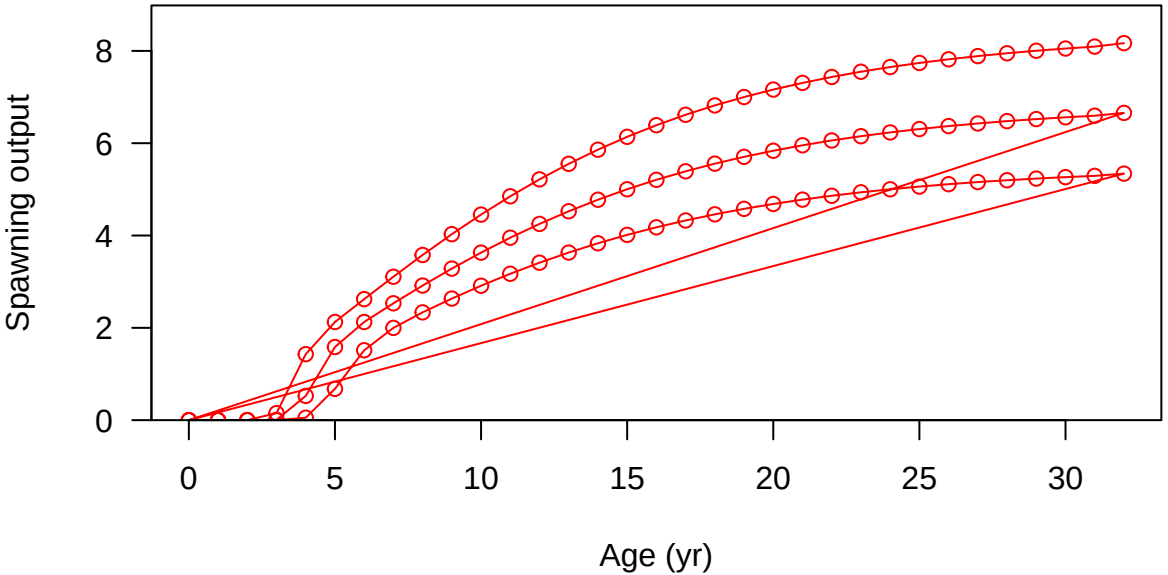

1.0
0.8
0.6
0.4
0.2
0.0
Maturity
0
20
40
60
80
Length (cm)

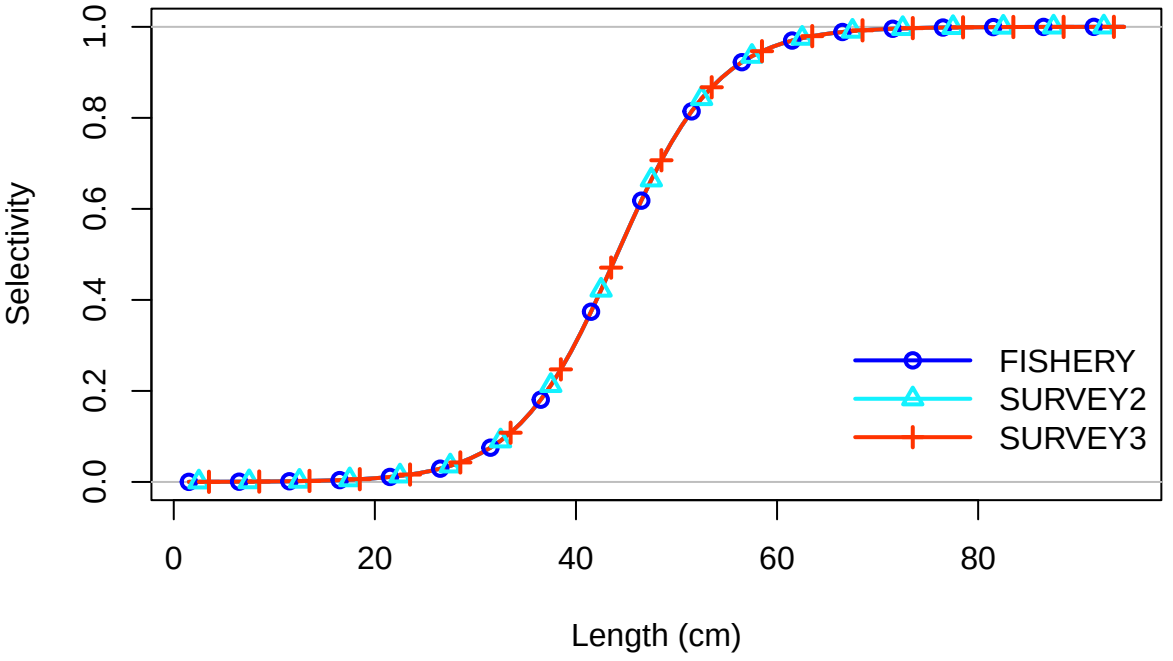

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
Female weight (kg)

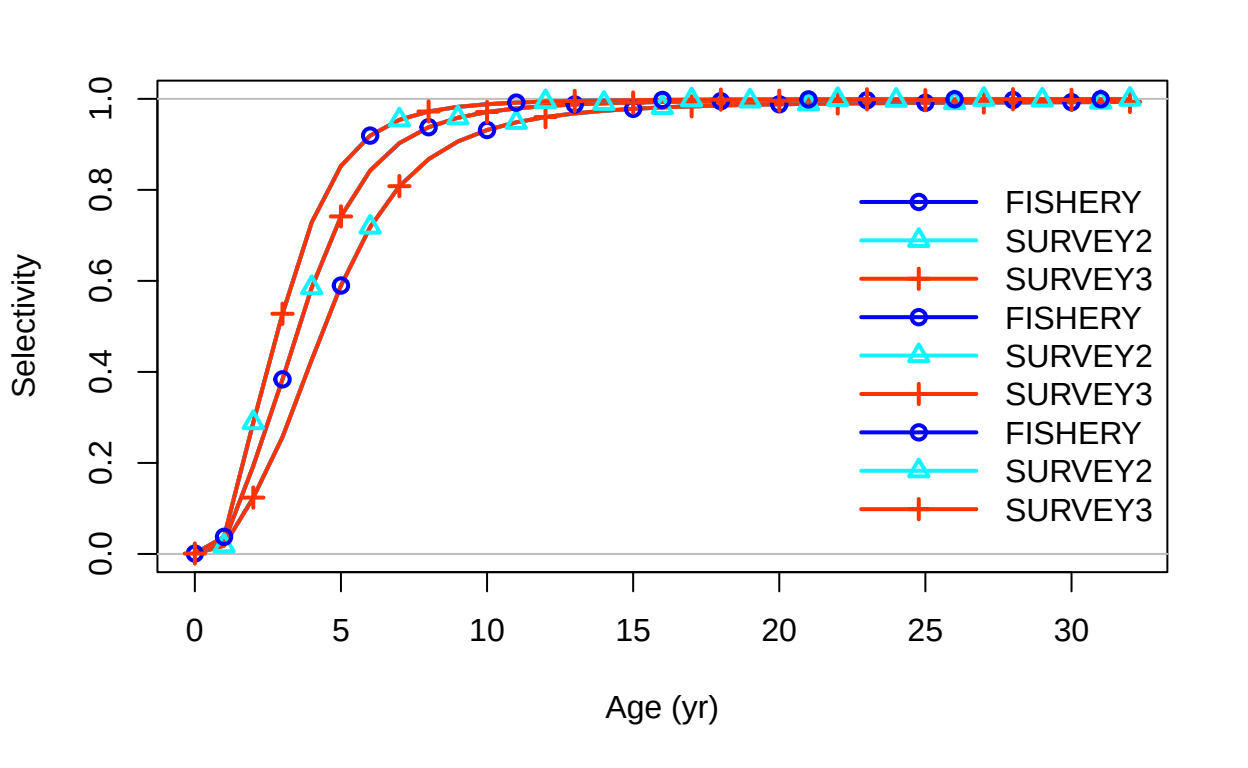

Fecundity
0
2
4
6
8
10
12
0
2
4
6
8
10
12
Female weight (kg)

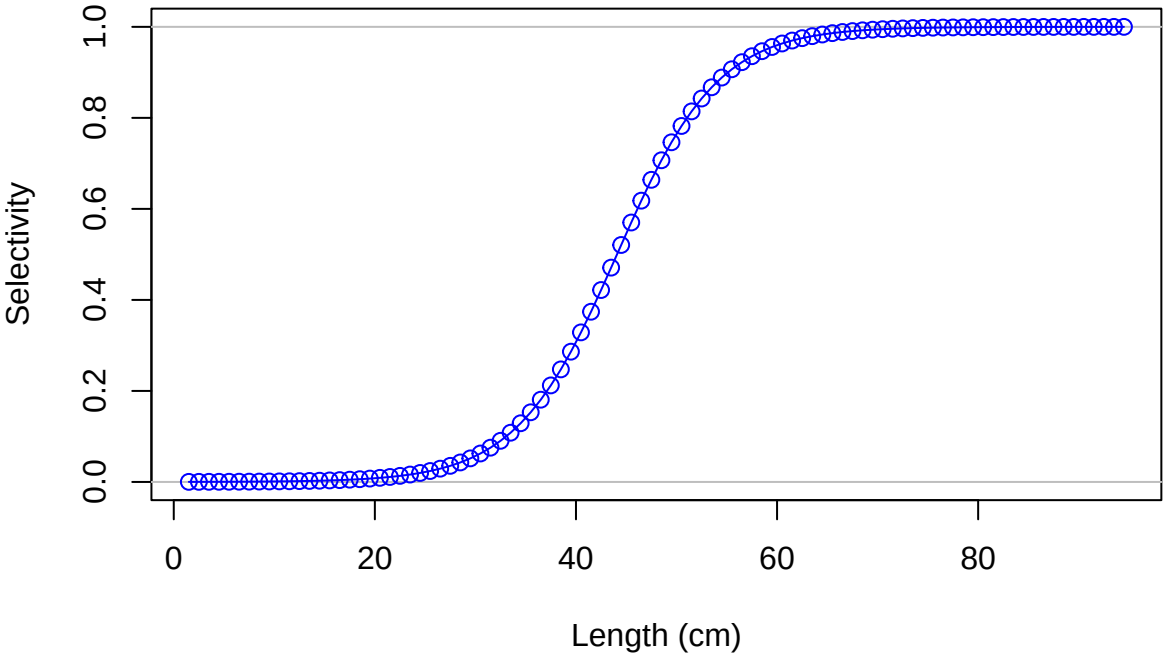

Fecundity
0
2
4
6
8
10
12
14
0
20
40
60
80
Female length (cm)

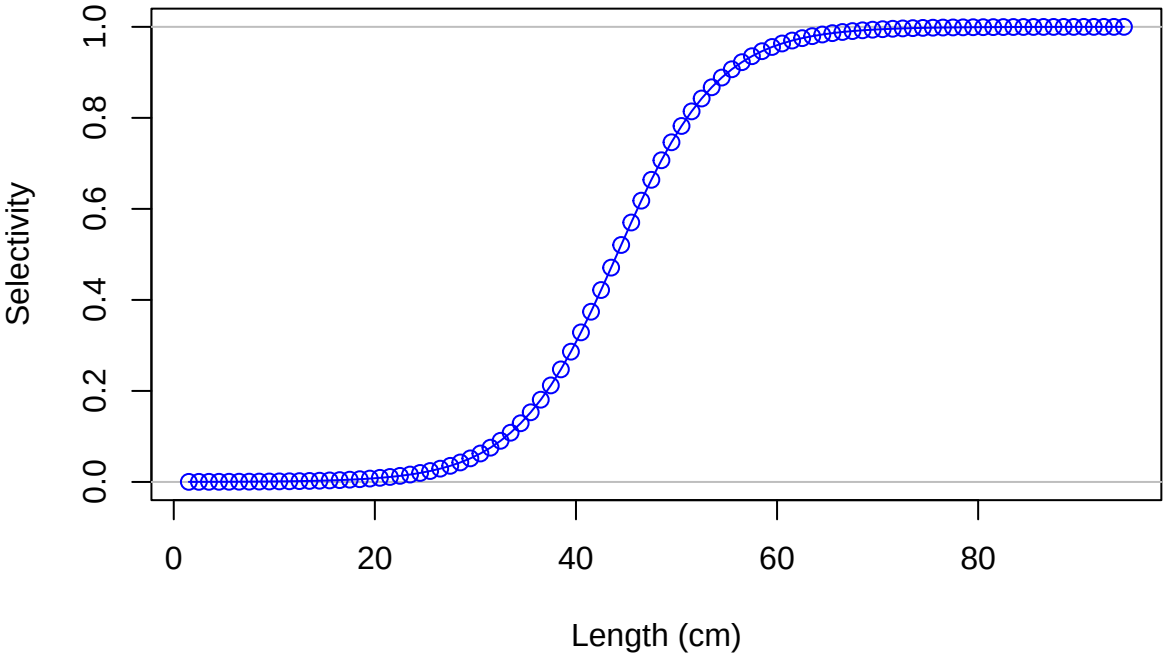

Spawning output
0
2
4
6
8
10
12
0
20
40
60
80
Length (cm)

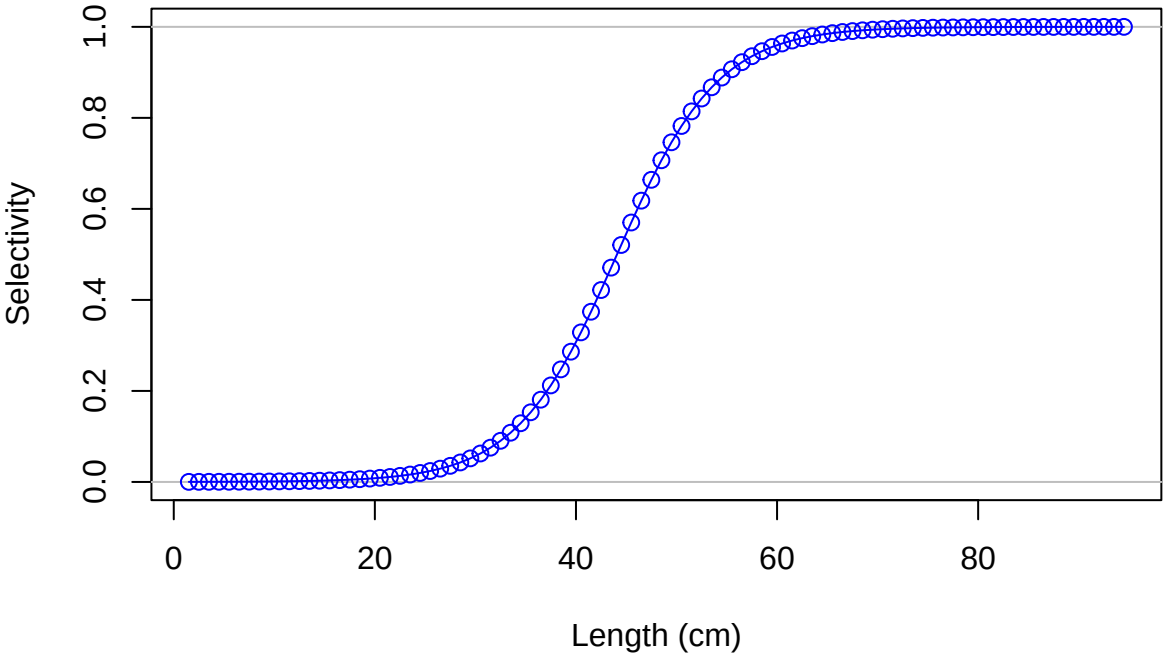

Spawning output
0
2
4
6
8
0
5
10
15
20
25
30
Age (yr)

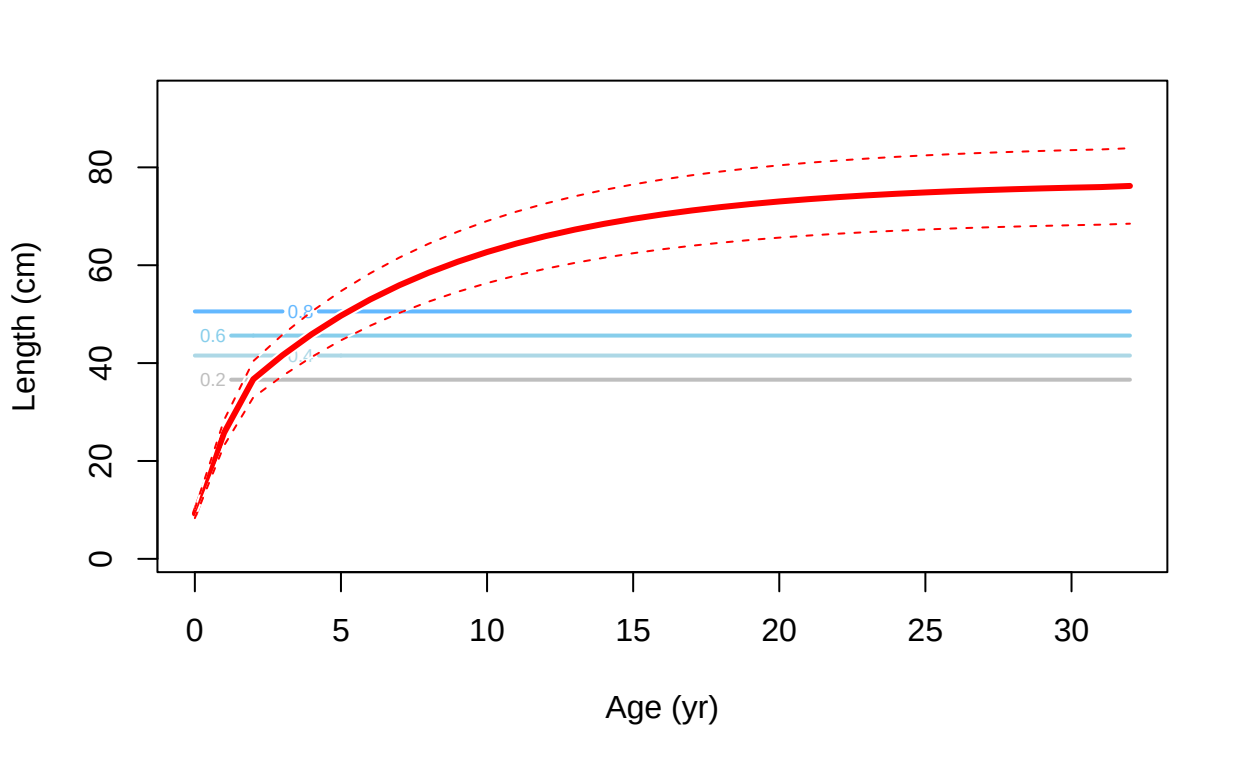

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)
FISHERY
SURVEY2
SURVEY3

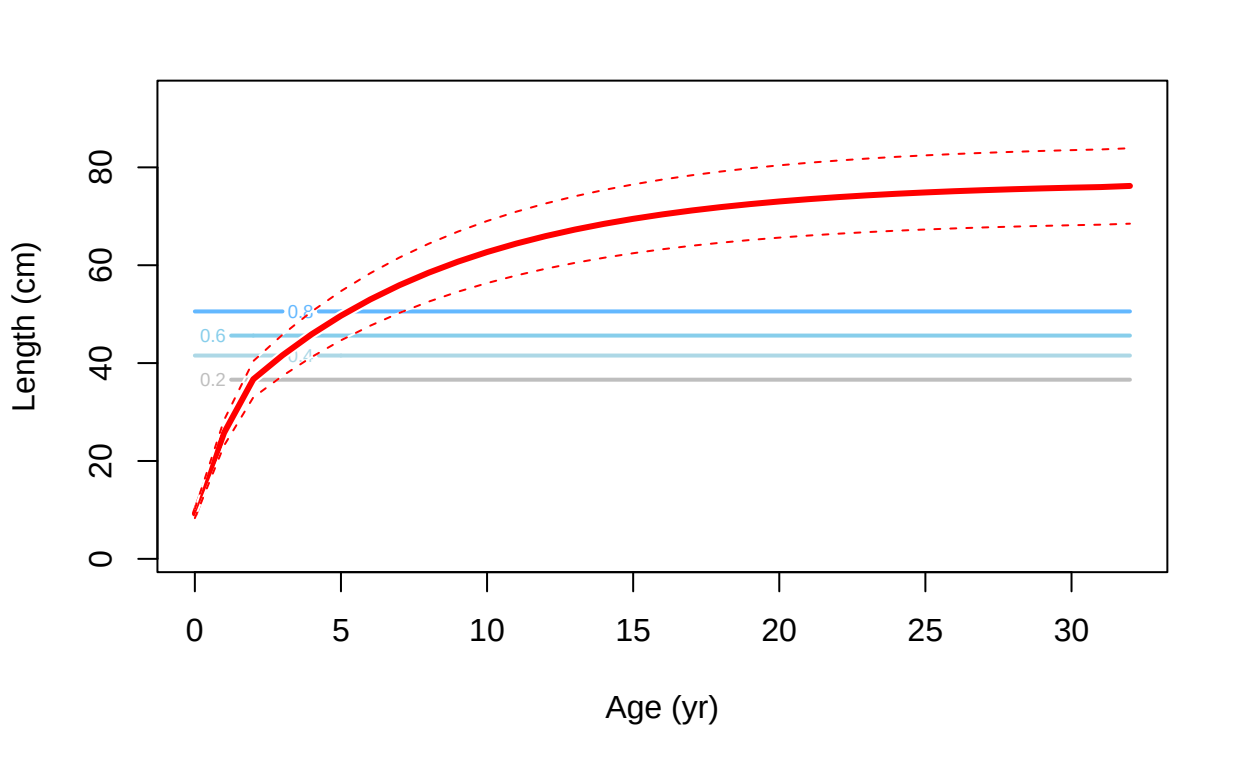

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Age (yr)
FISHERY
SURVEY2
SURVEY3
FISHERY
SURVEY2
SURVEY3
FISHERY
SURVEY2
SURVEY3

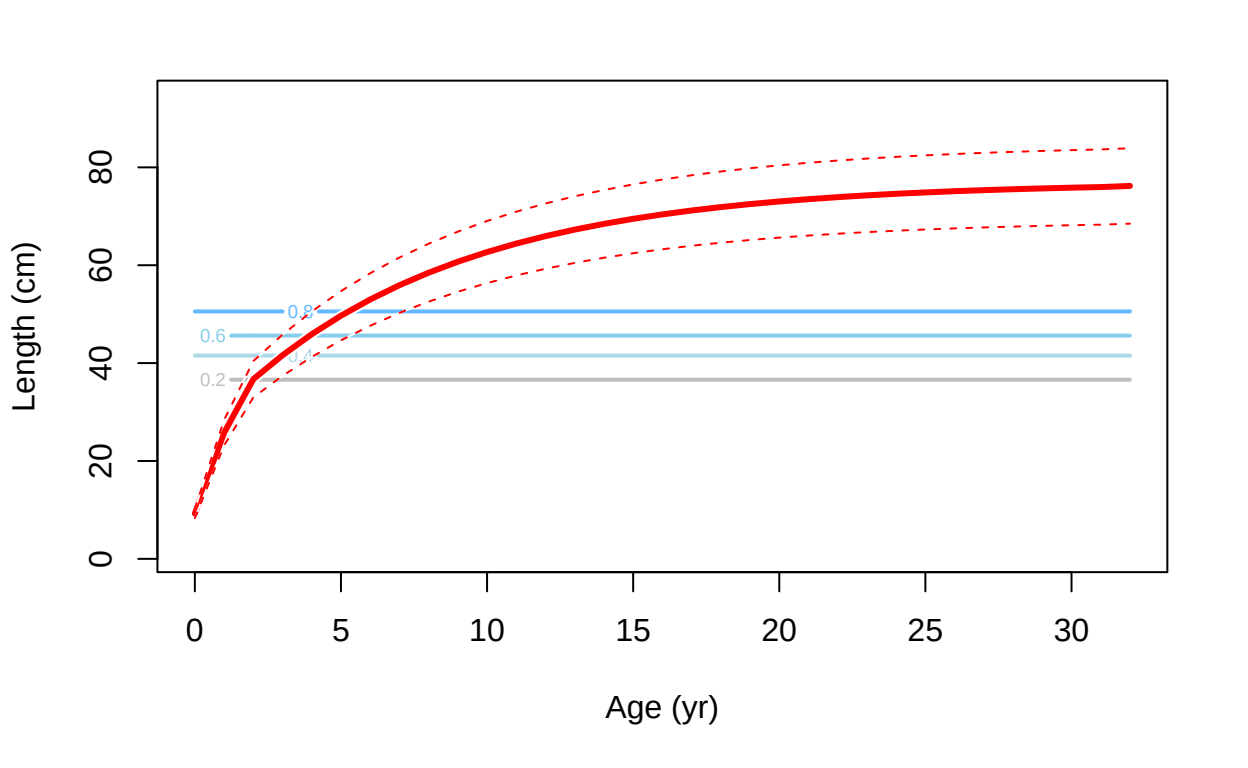

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)

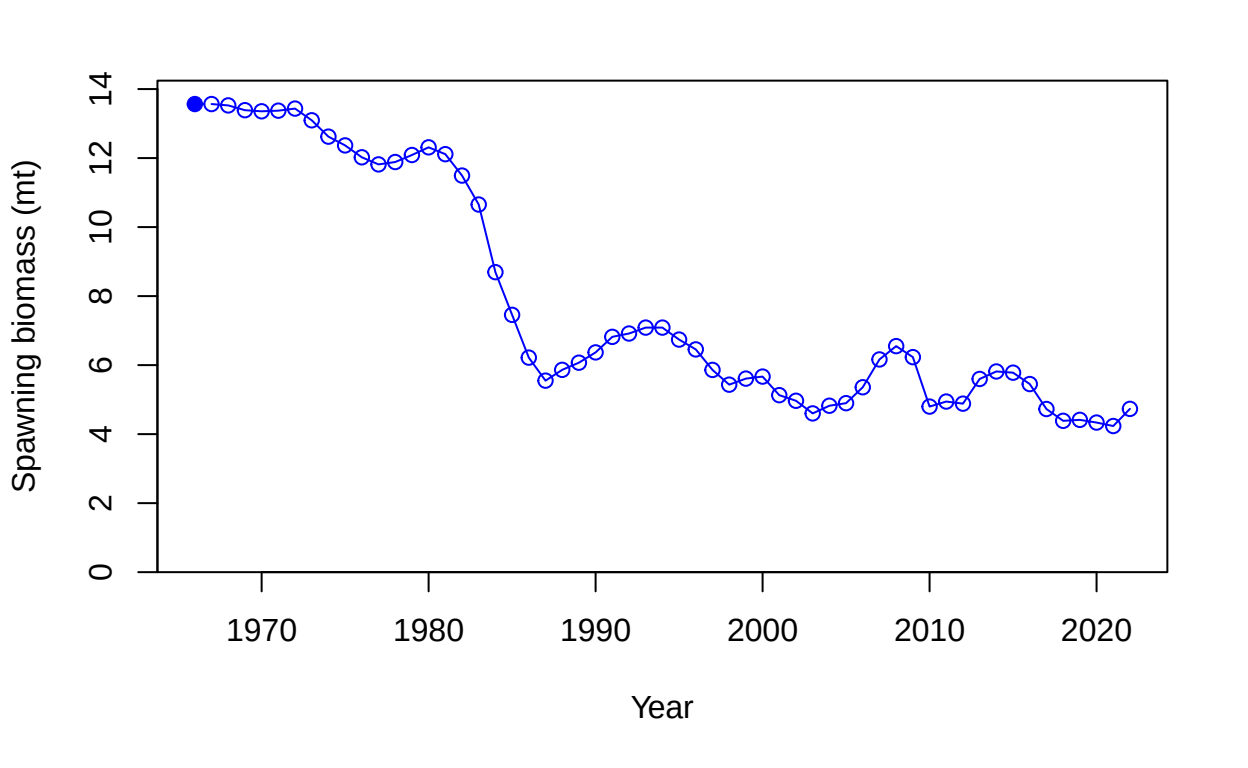

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)

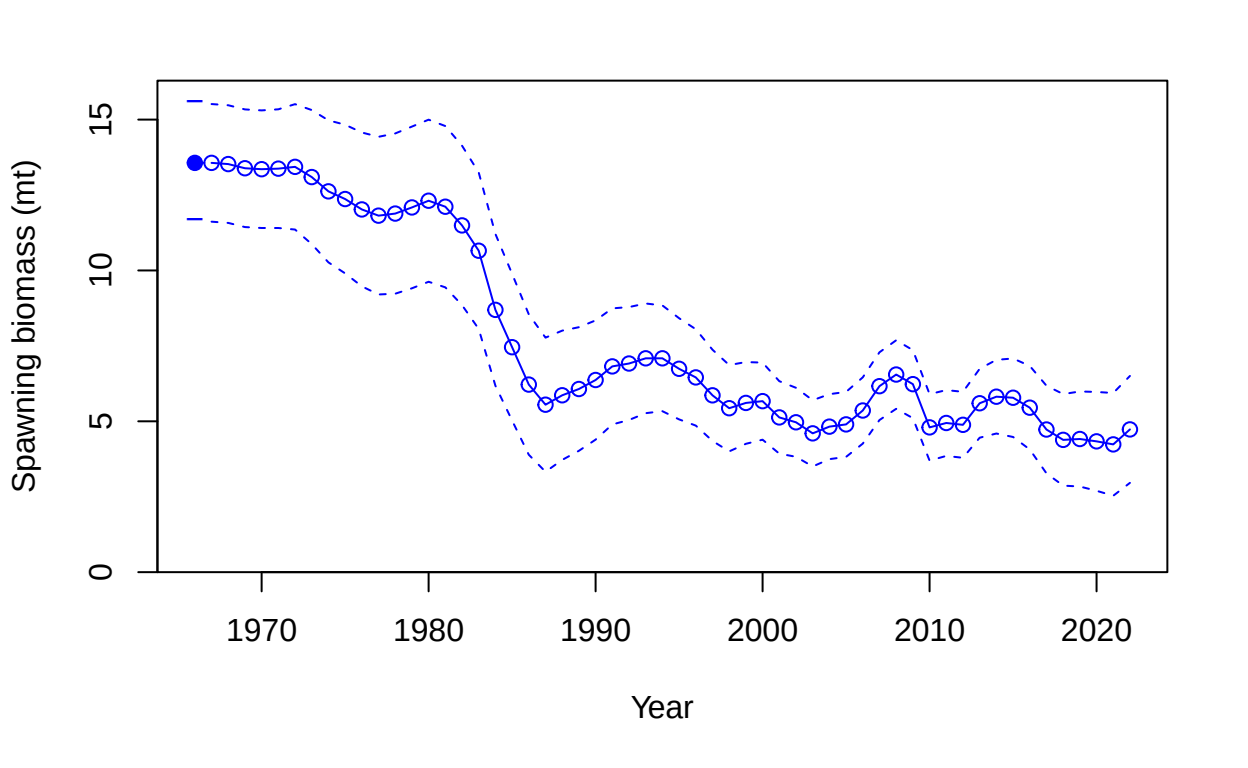

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)

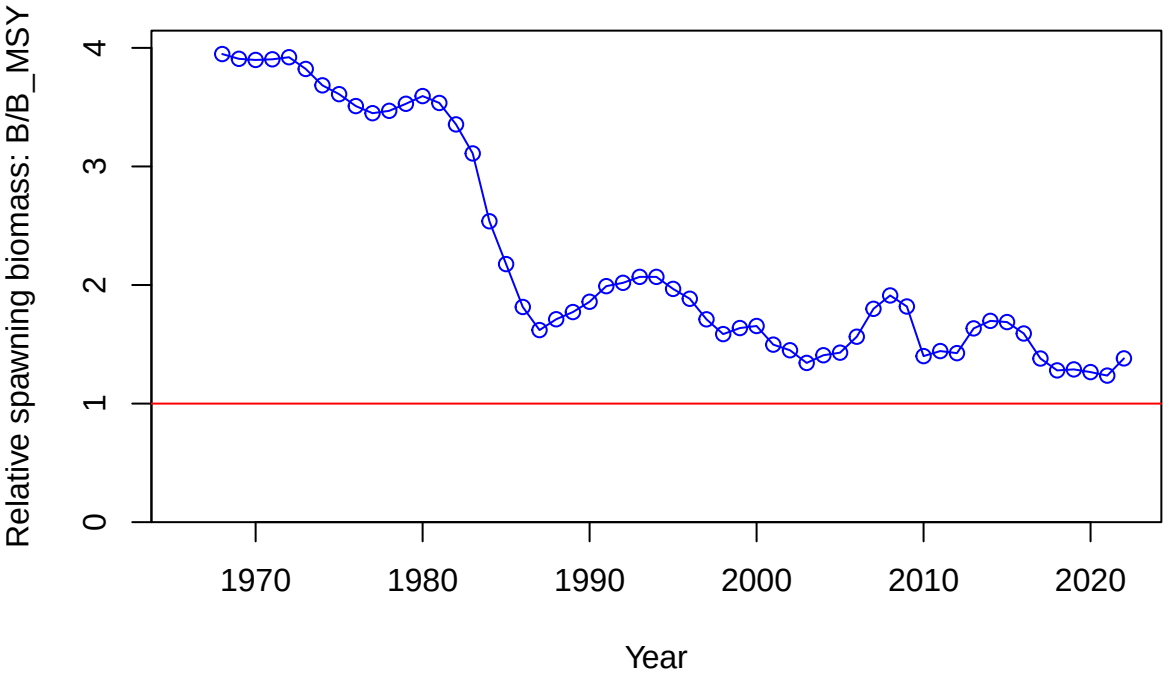

Length (cm)
0
20
40
60
80
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

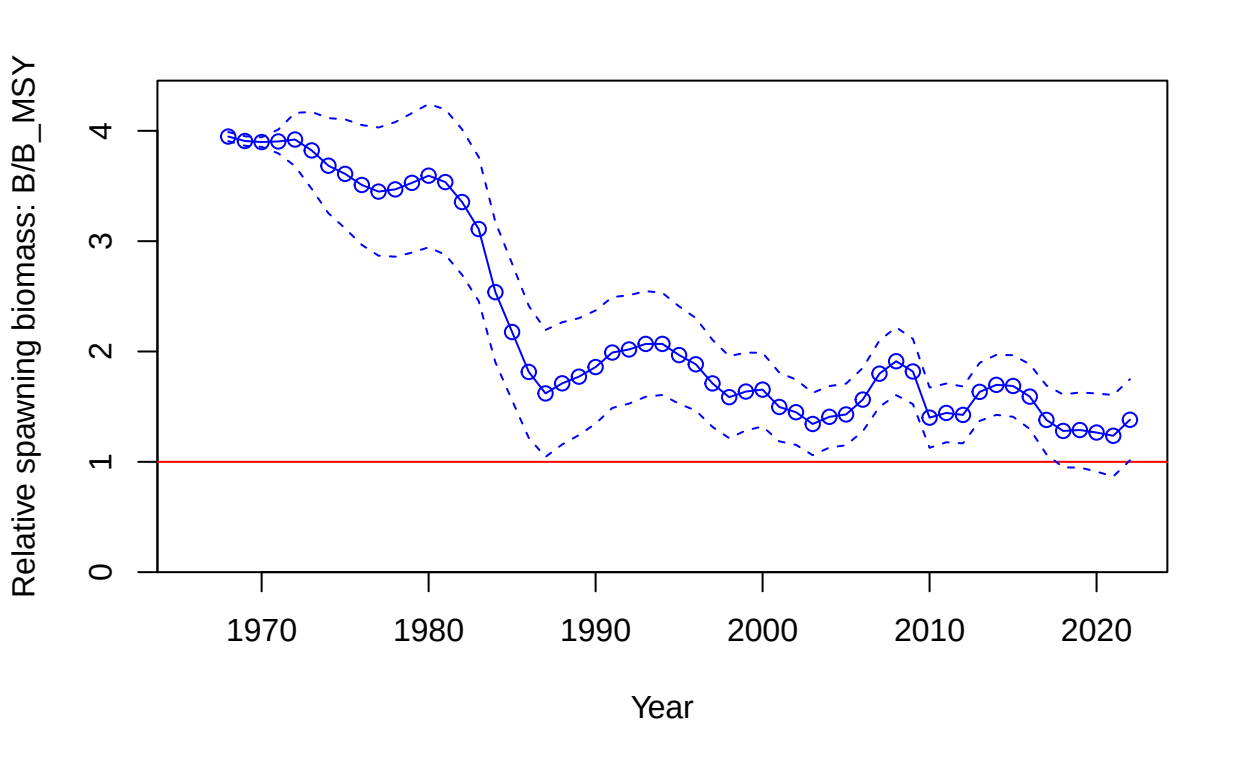

Length (cm)
0
20
40
60
80
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

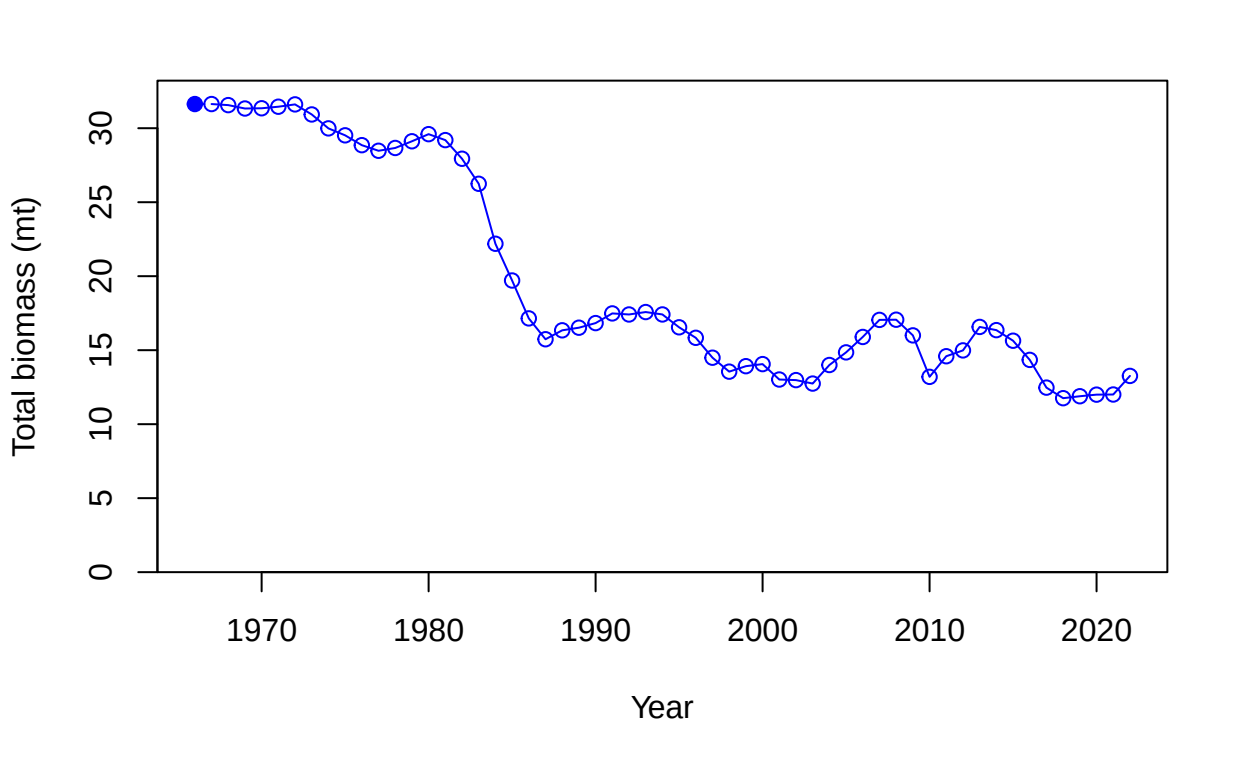

Length (cm)
0
20
40
60
80
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

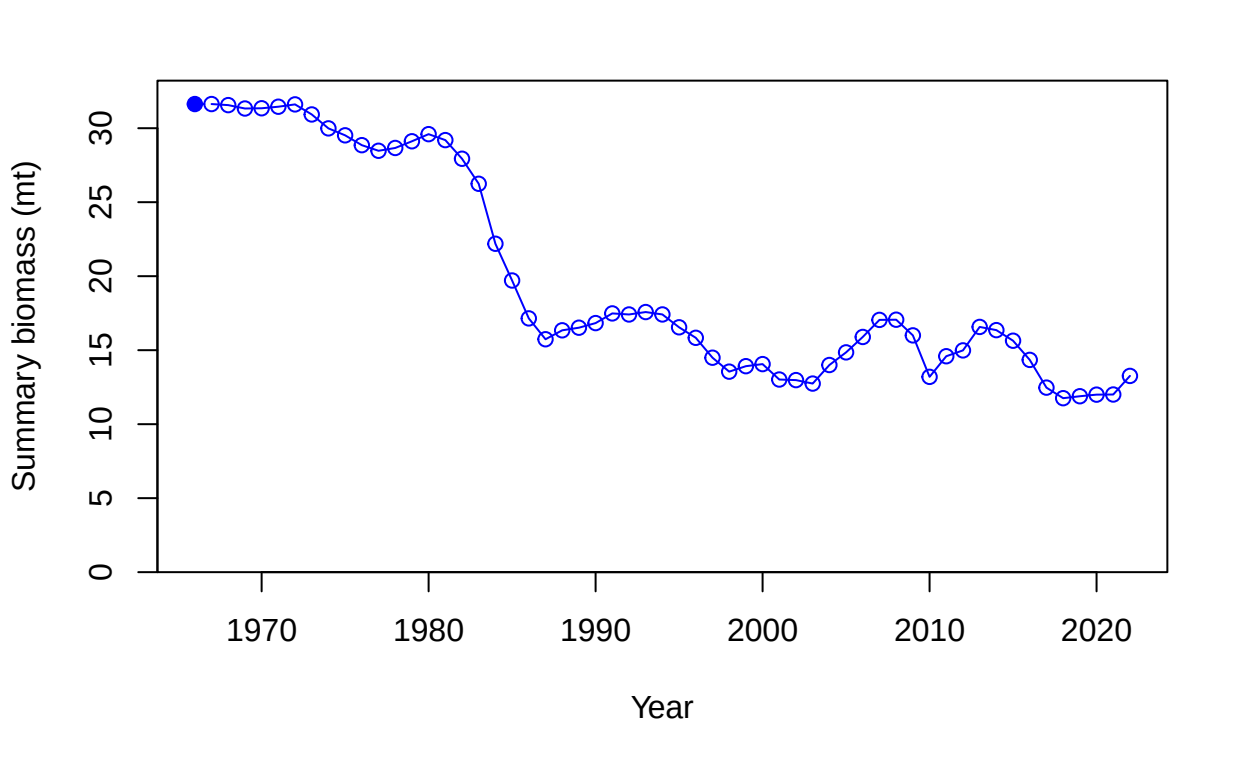

Spawning biomass (mt)
0
2
4
6
8
10
12
14
1970
1980
1990
2000
2010
2020
Year

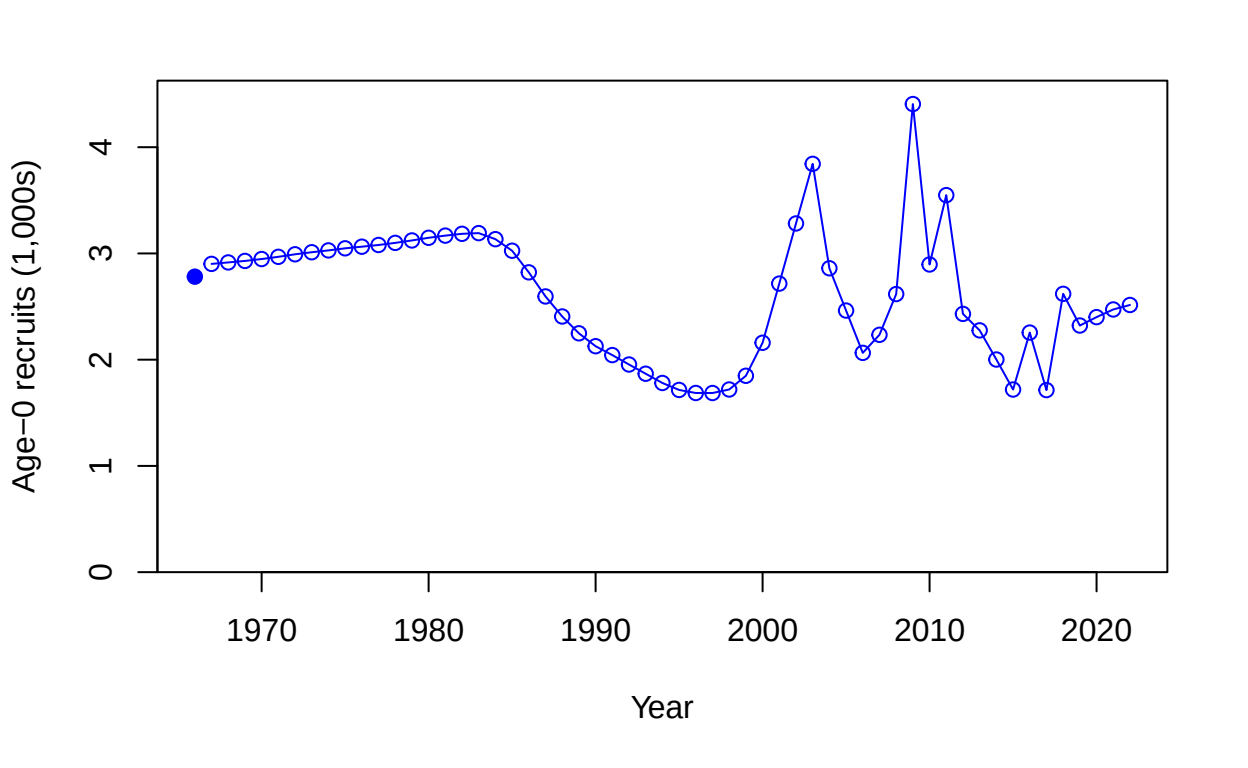

Spawning biomass (mt)
0
5
10
15
1970
1980
1990
2000
2010
2020
Year

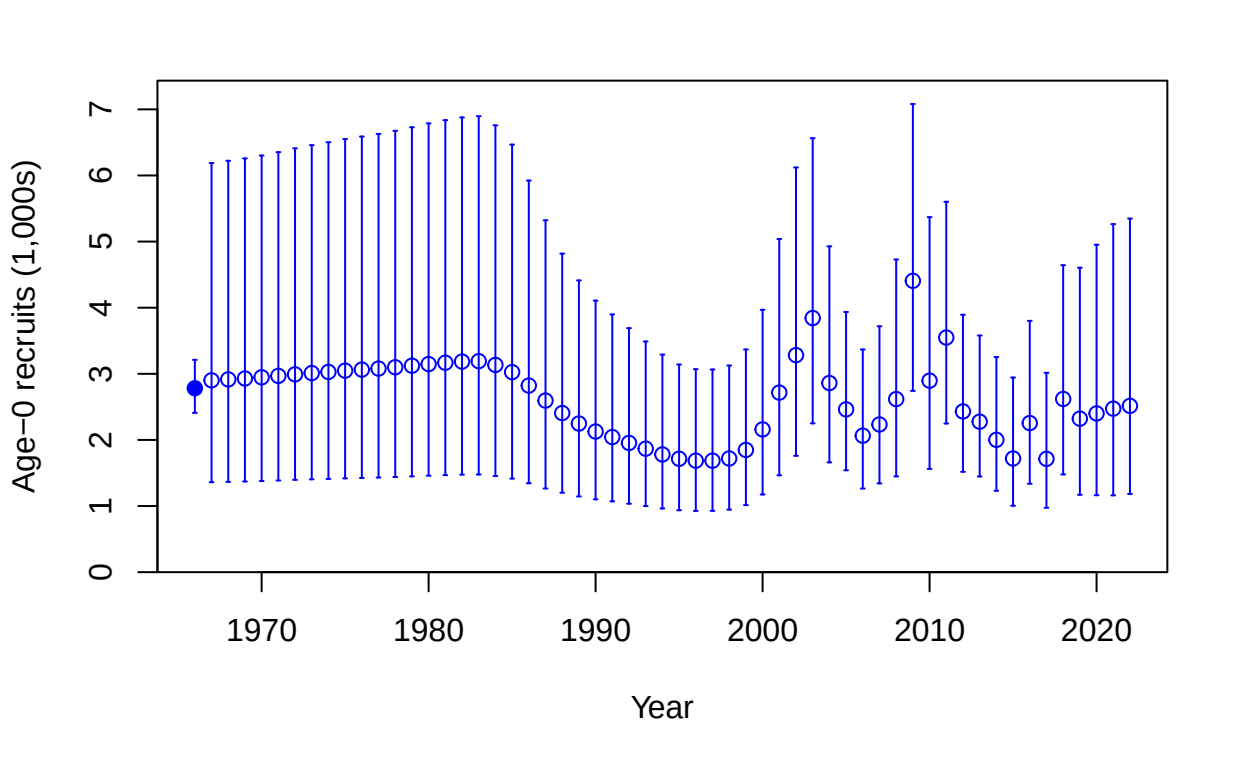

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

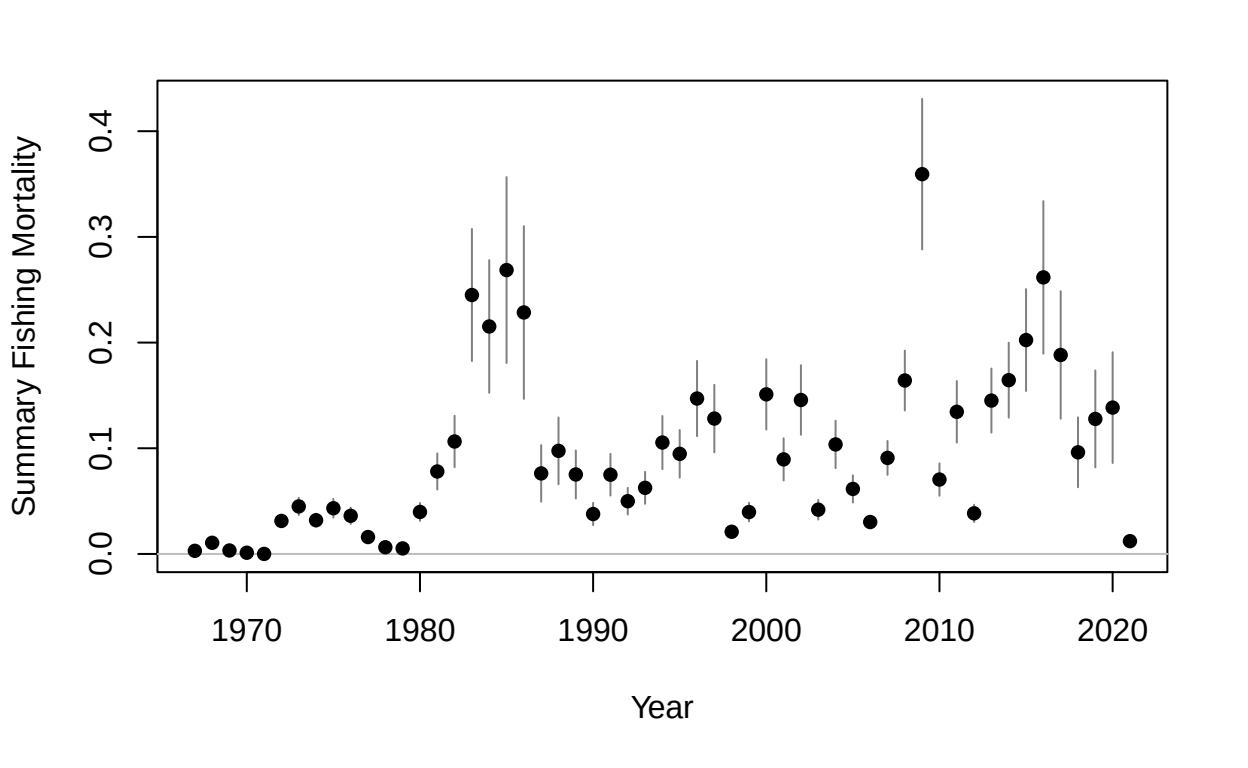

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

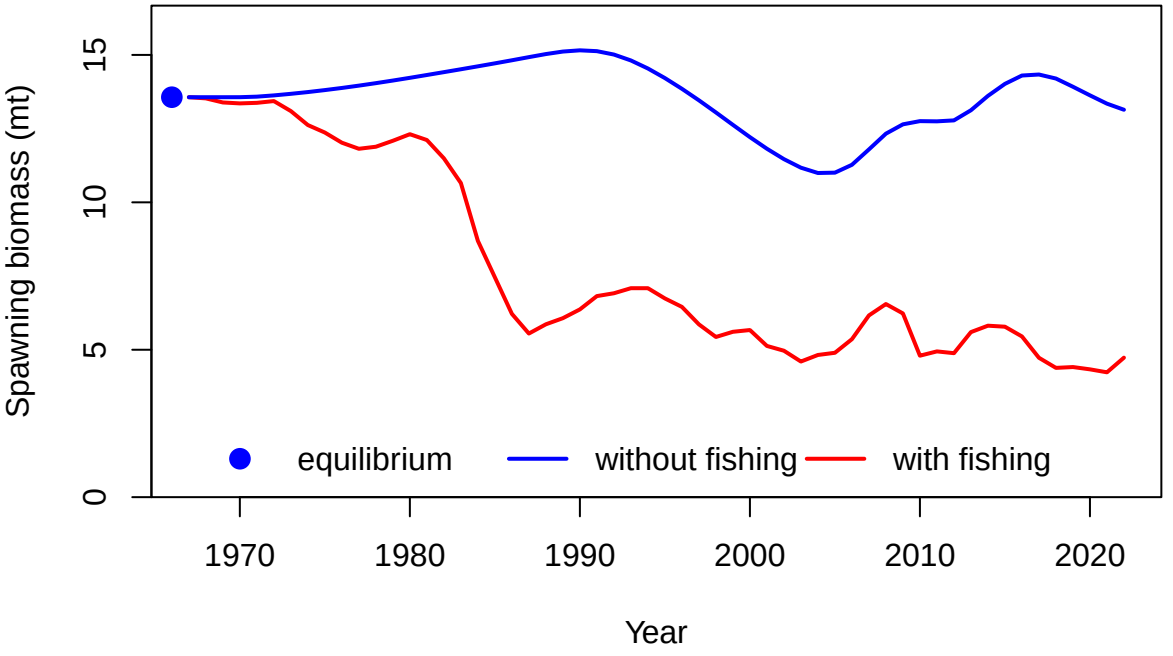

Total biomass (mt)
0
5
10
15
20
25
30
1970
1980
1990
2000
2010
2020
Year

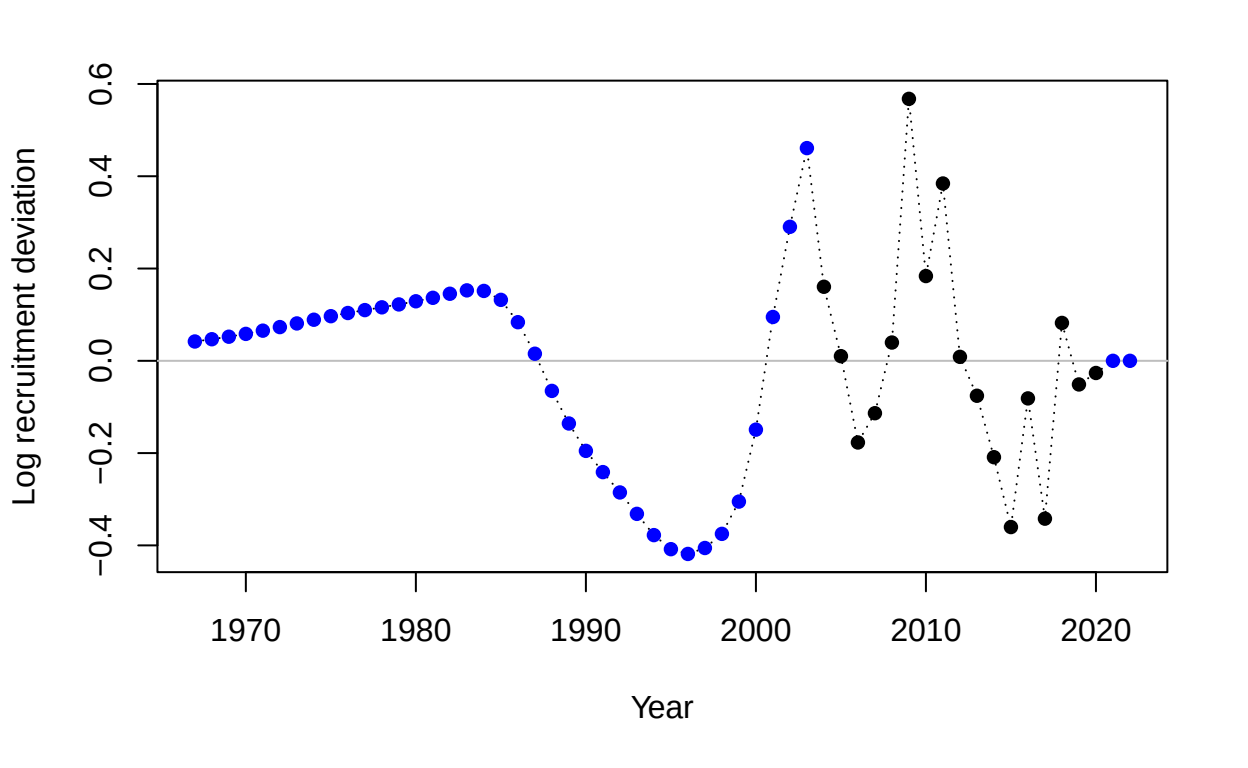

Summary biomass (mt)
0
5
10
15
20
25
30
1970
1980
1990
2000
2010
2020
Year

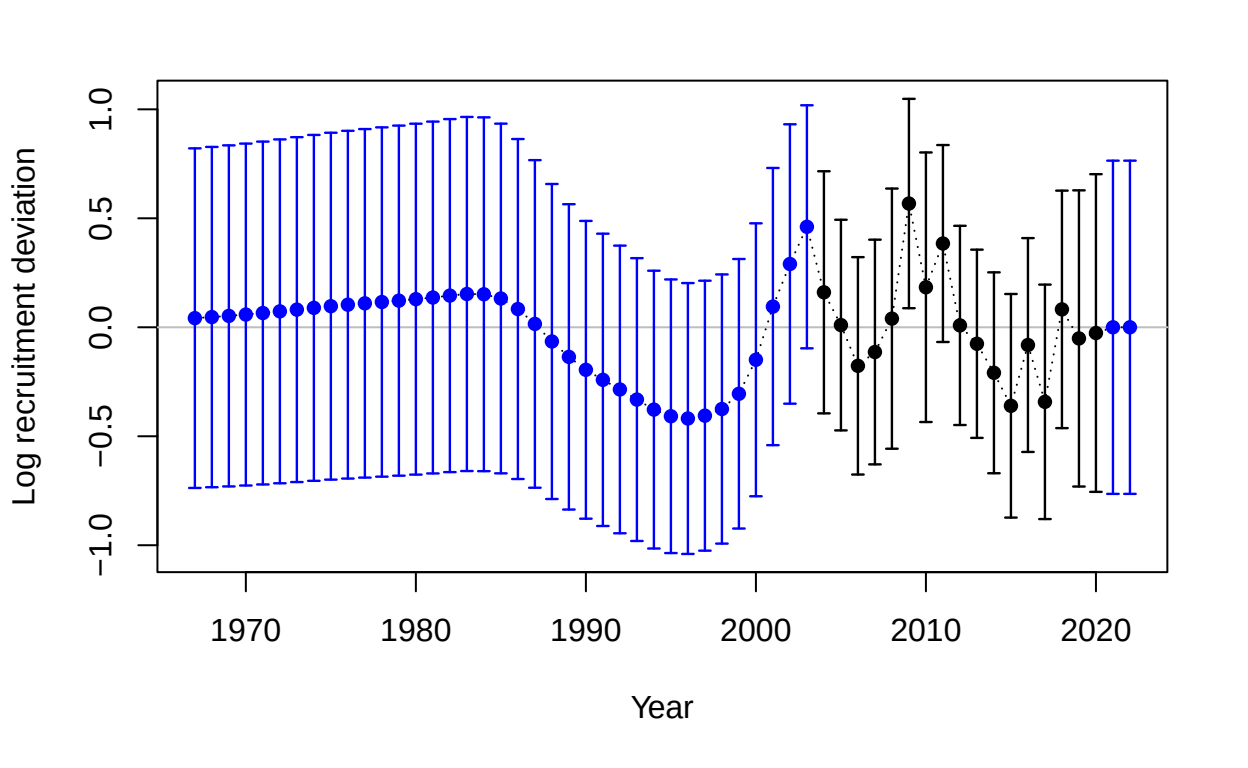

Age−0 recruits (1,000s)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

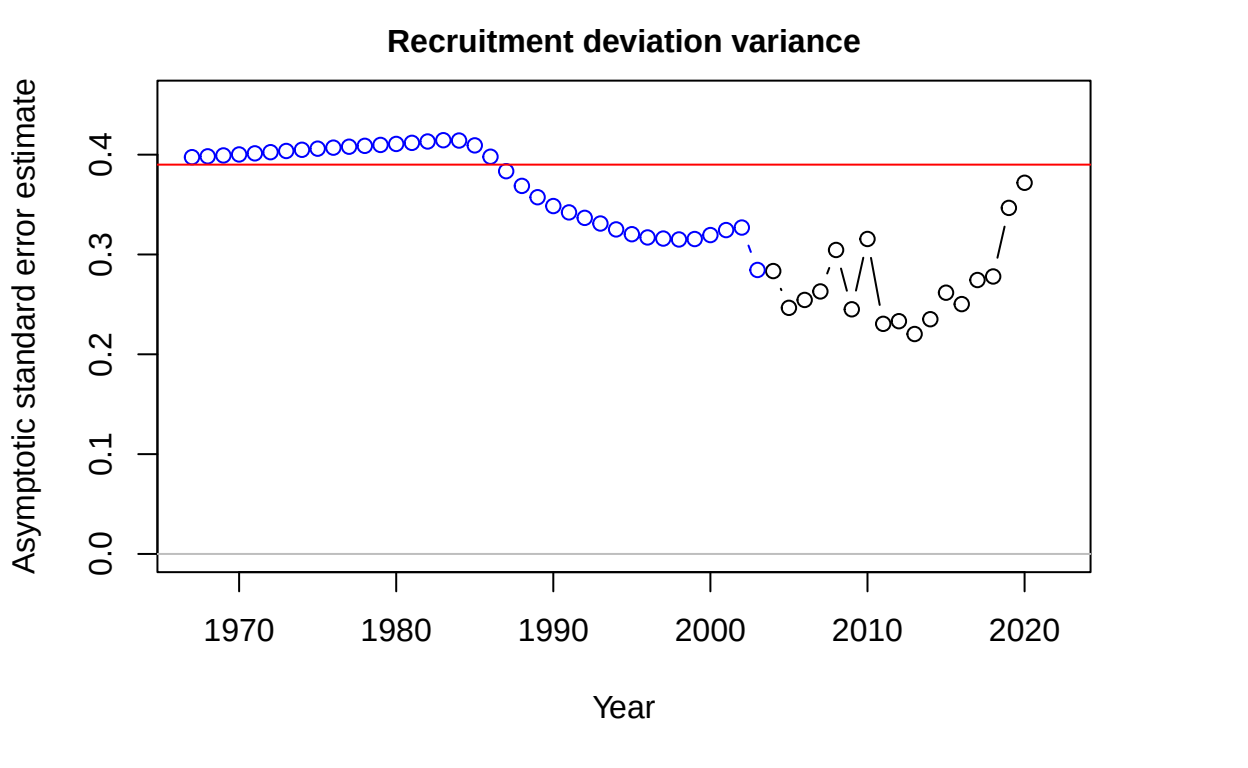

Age−0 recruits (1,000s)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

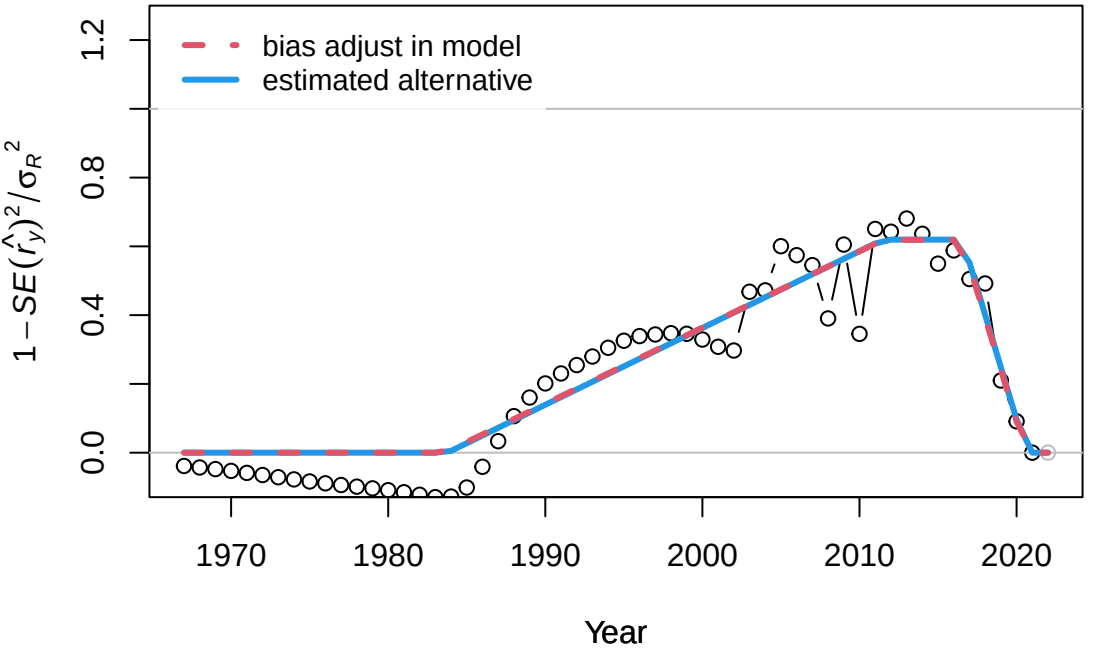

Summary Fishing Mortality
0.0
0.1
0.2
0.3
0.4
1970
1980
1990
2000
2010
2020
Year

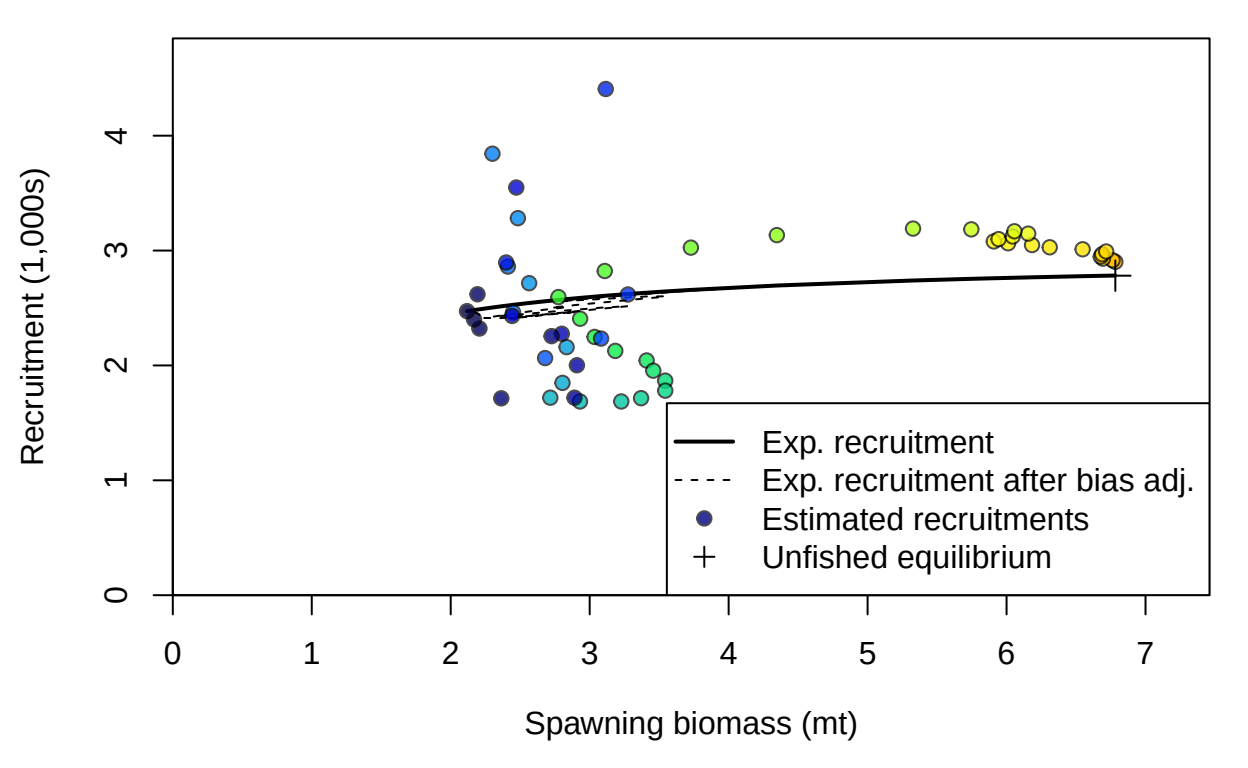

Spawning biomass (mt)
0
5
10
15
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

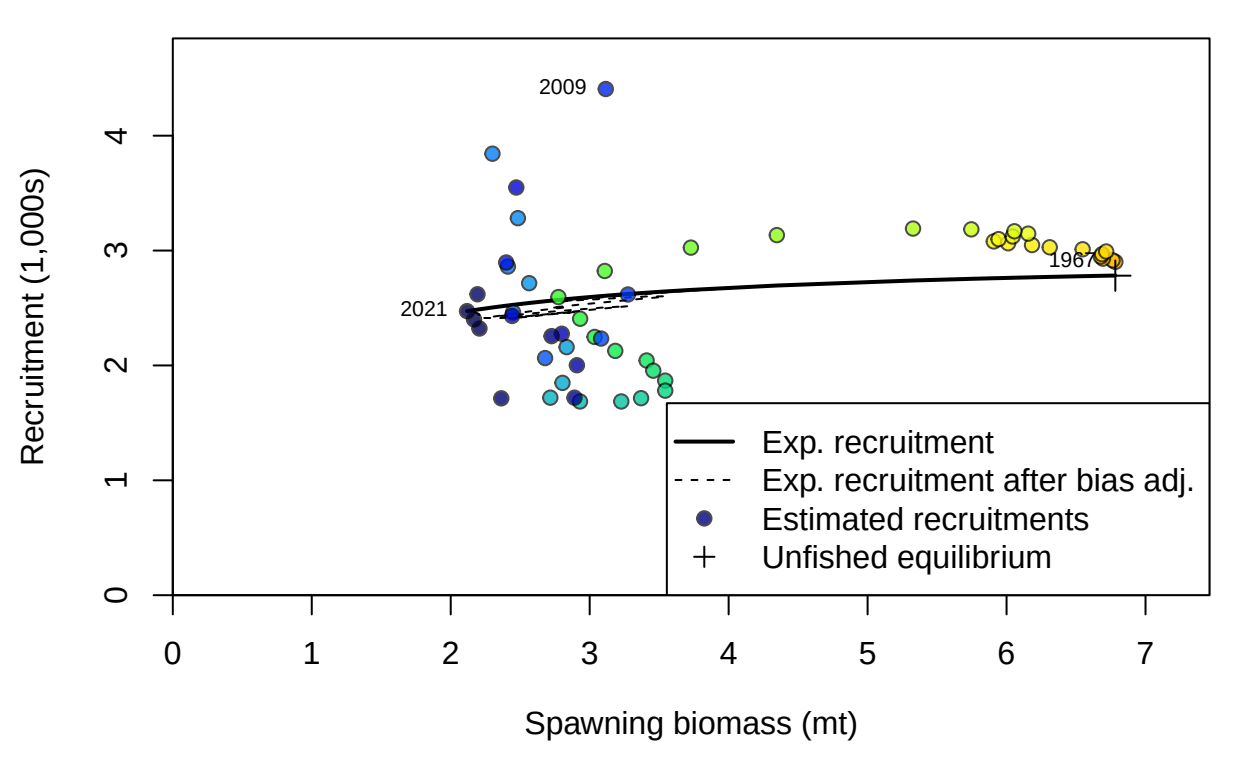

Log recruitment deviation
0.6
0.4
0.2
0.0
−0.2
−0.4
1970
1980
1990
2000
2010
2020
Year

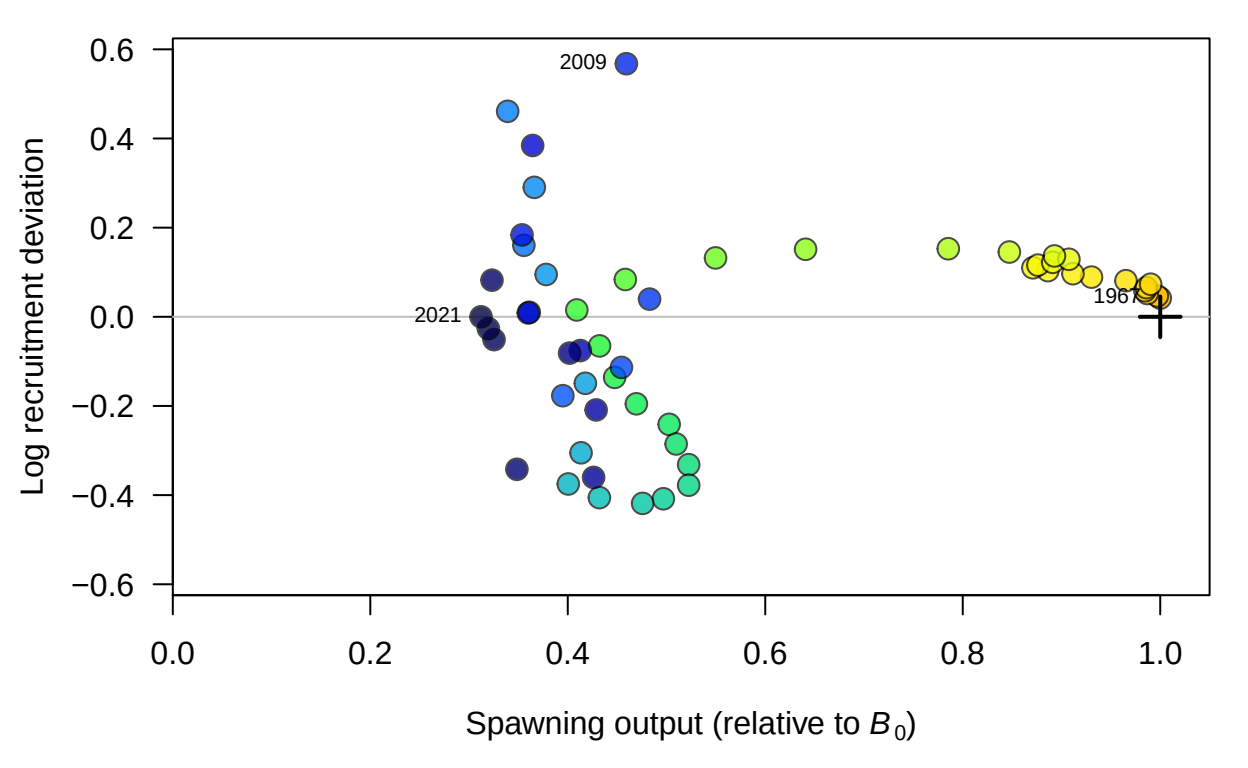

Log recruitment deviation
1.0
0.5
0.0
−0.5
−1.0
1970
1980
1990
2000
2010
2020
Year

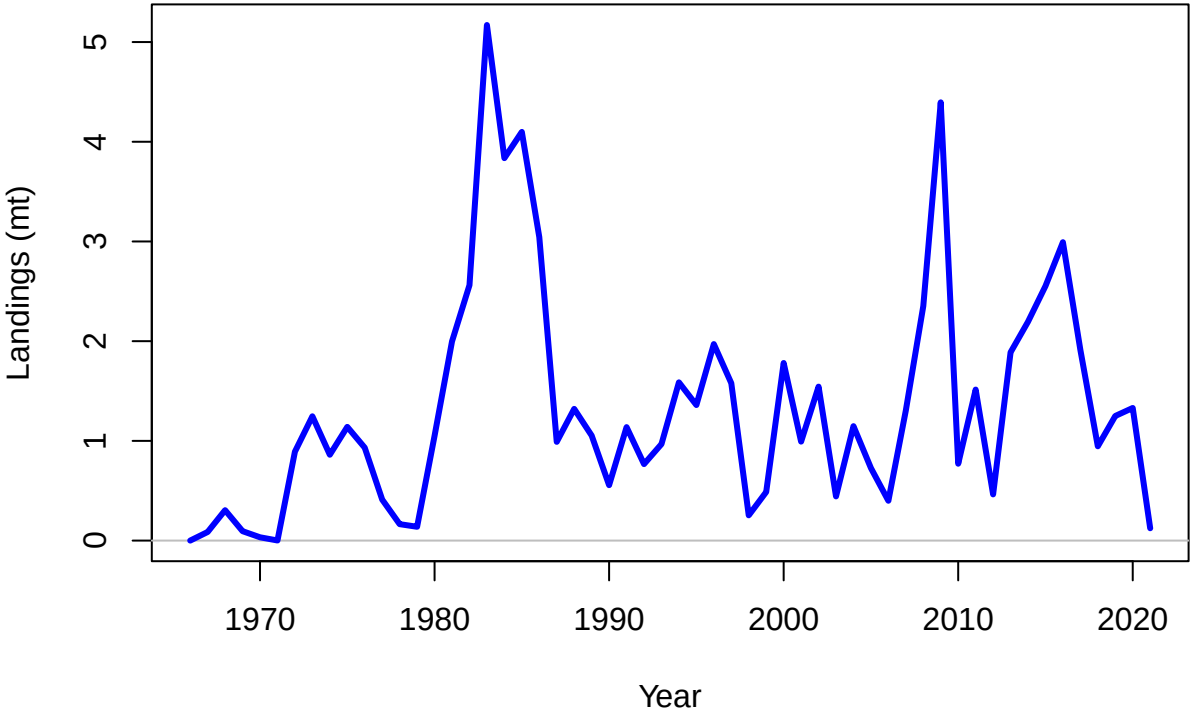

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.1
0.2
0.3
0.4
1970
1980
1990
2000
2010
2020
Year

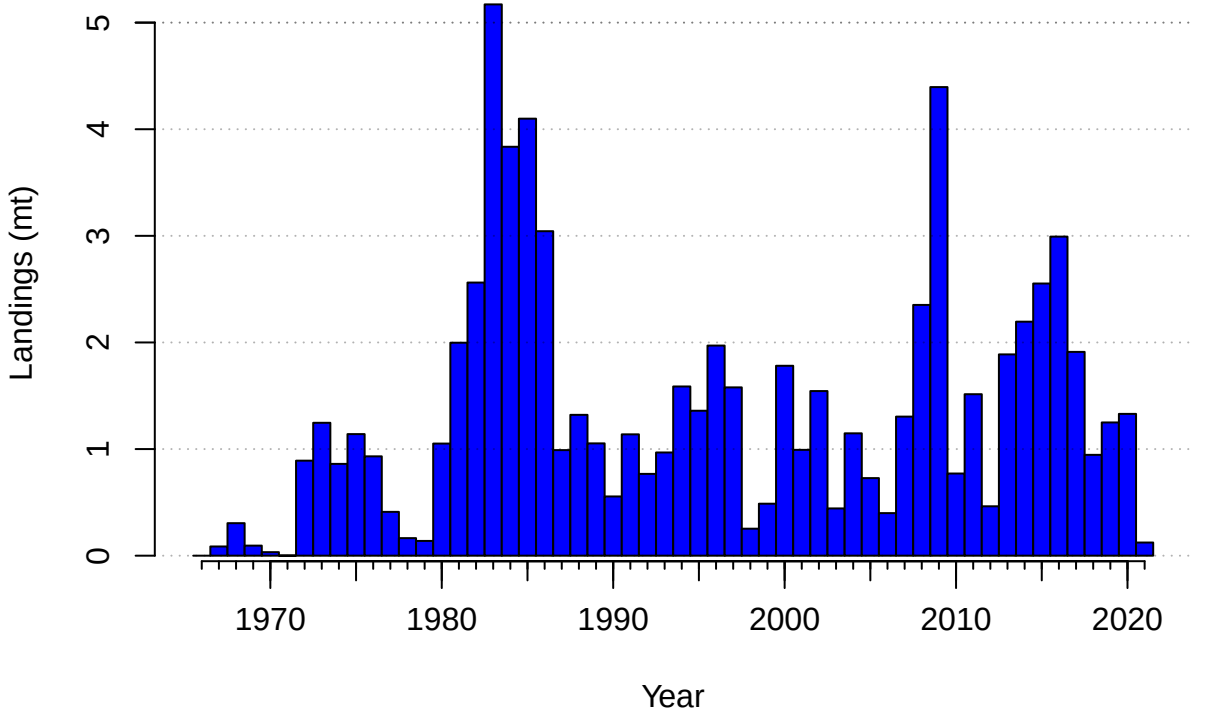

bias adjust in model
estimated alternative
1.2
0.8
0.4
0.0
$1-SE(\hat{r_y})^2/\sigma_R{}^2$
1970
1980
1990
2000
2010
2020
Year

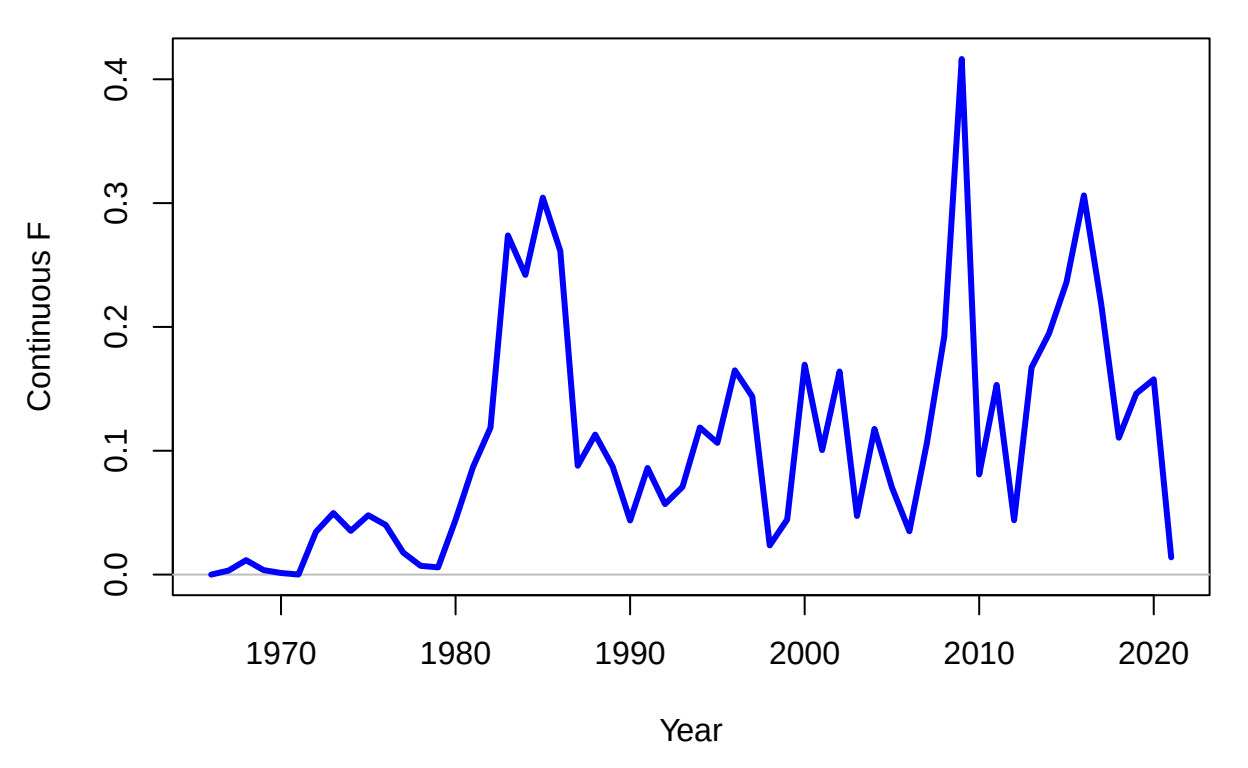

Recruitment (1,000s)
0
1
2
3
4
Spawning biomass (mt)
0
1
2
3
4
5
6
7
Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium

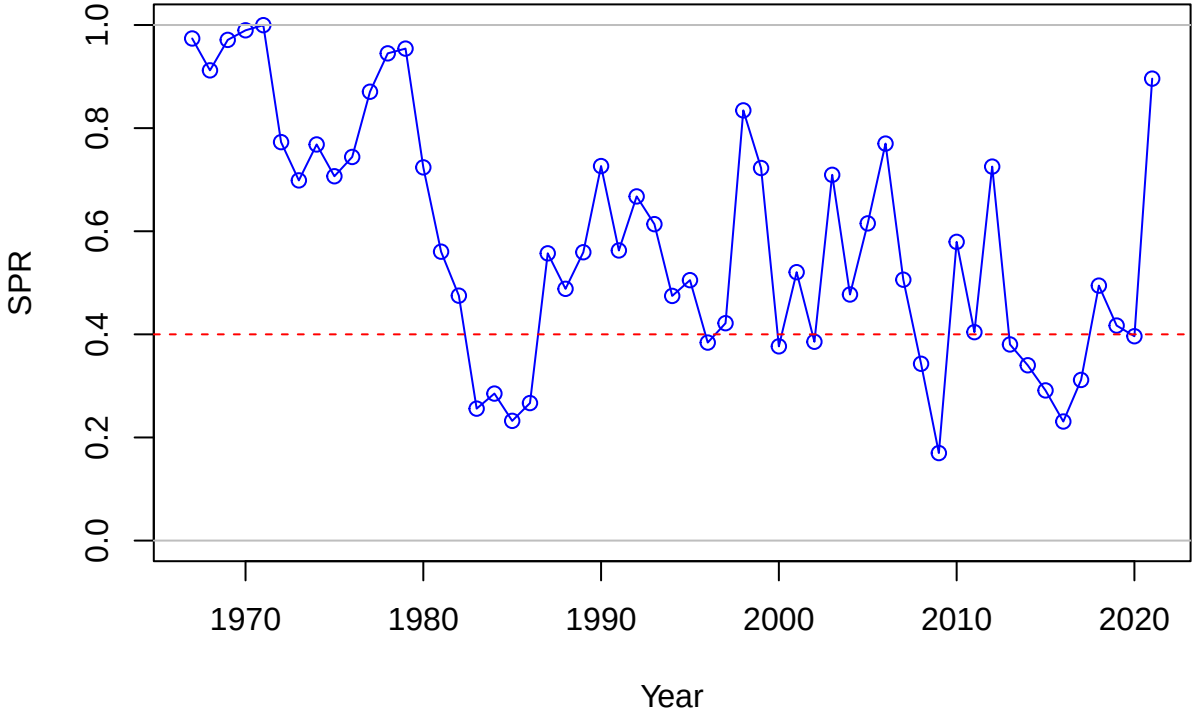

Recruitment (1,000s)
Spawning biomass (mt)
0
1
2
3
4
5
6
7
2009
2021
1967
Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium

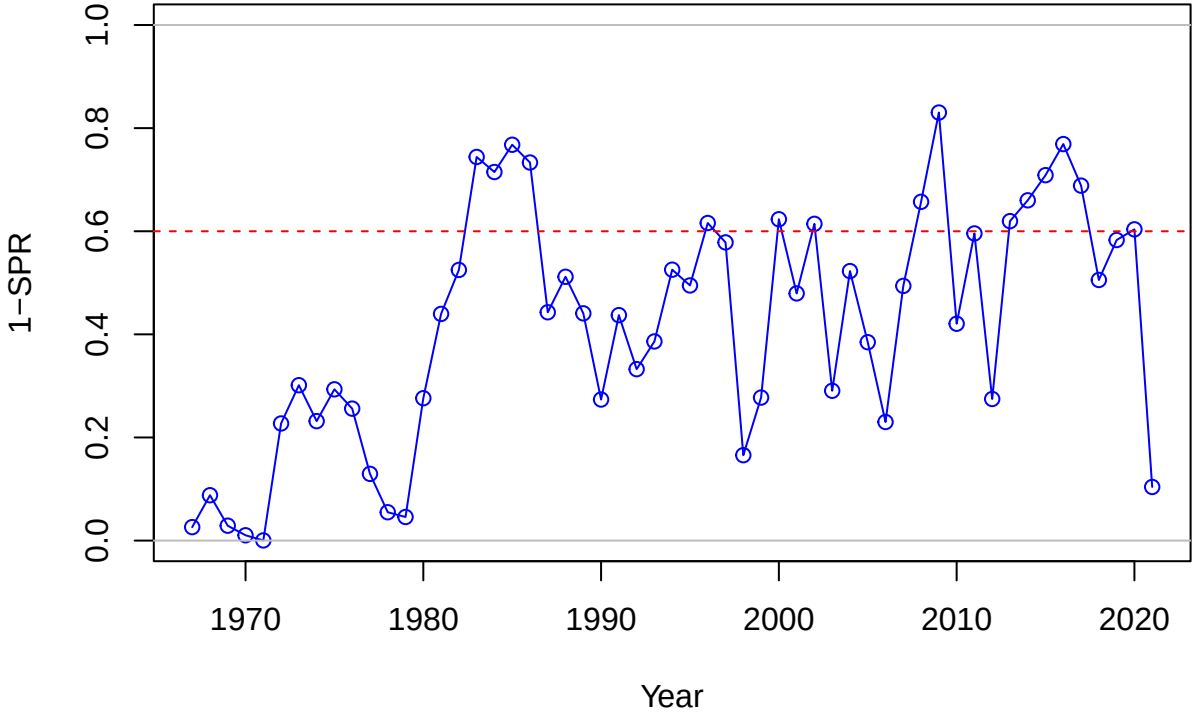

2009
2021
1967
Log recruitment deviation
Spawning output (relative to B_0)
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
0.0
0.2
0.4
0.6
0.8
1.0

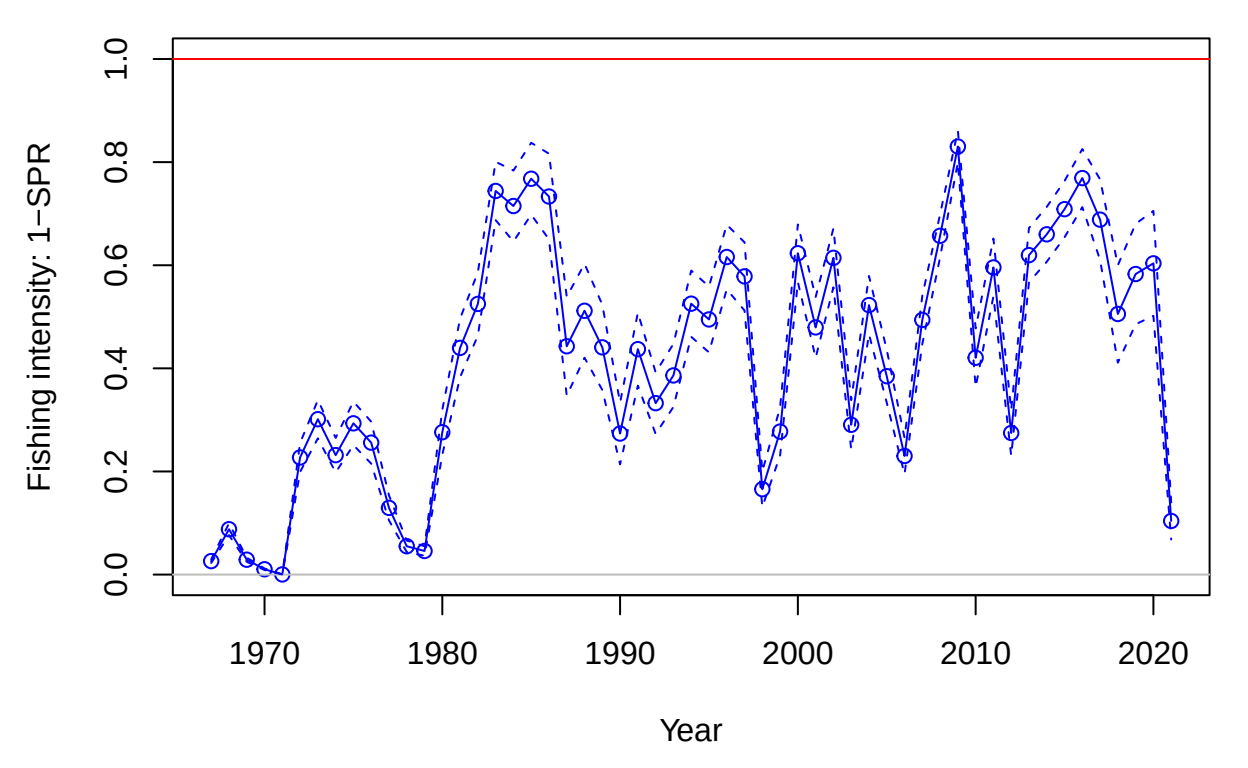

Landings (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

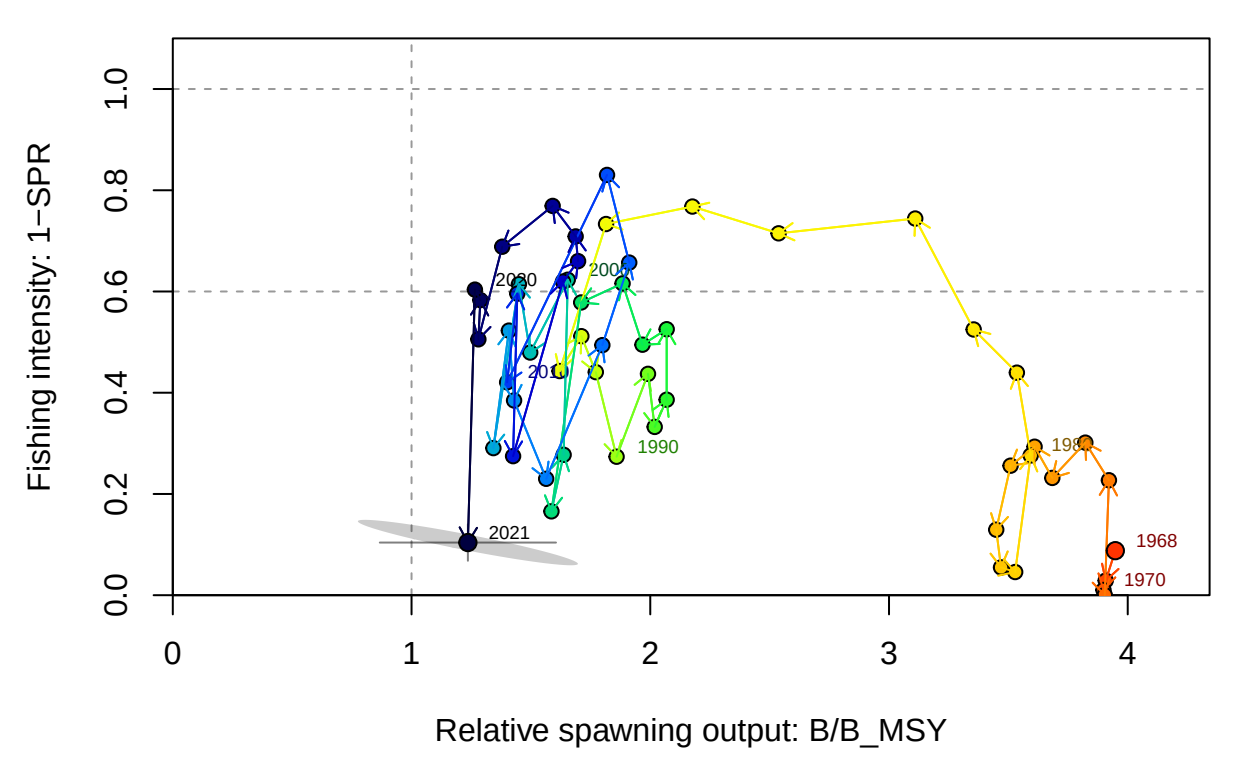

Landings (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

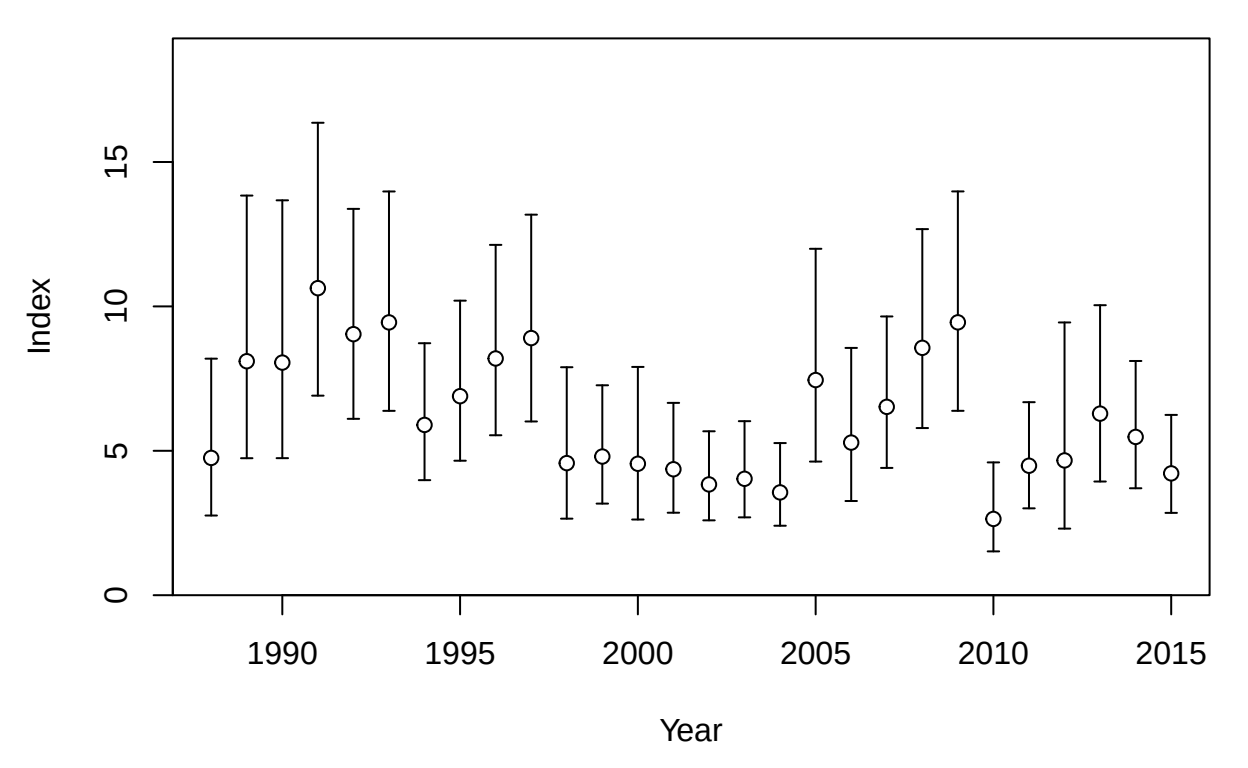

Continuous F
0.0
0.1
0.2
0.3
0.4
1970
1980
1990
2000
2010
2020
Year

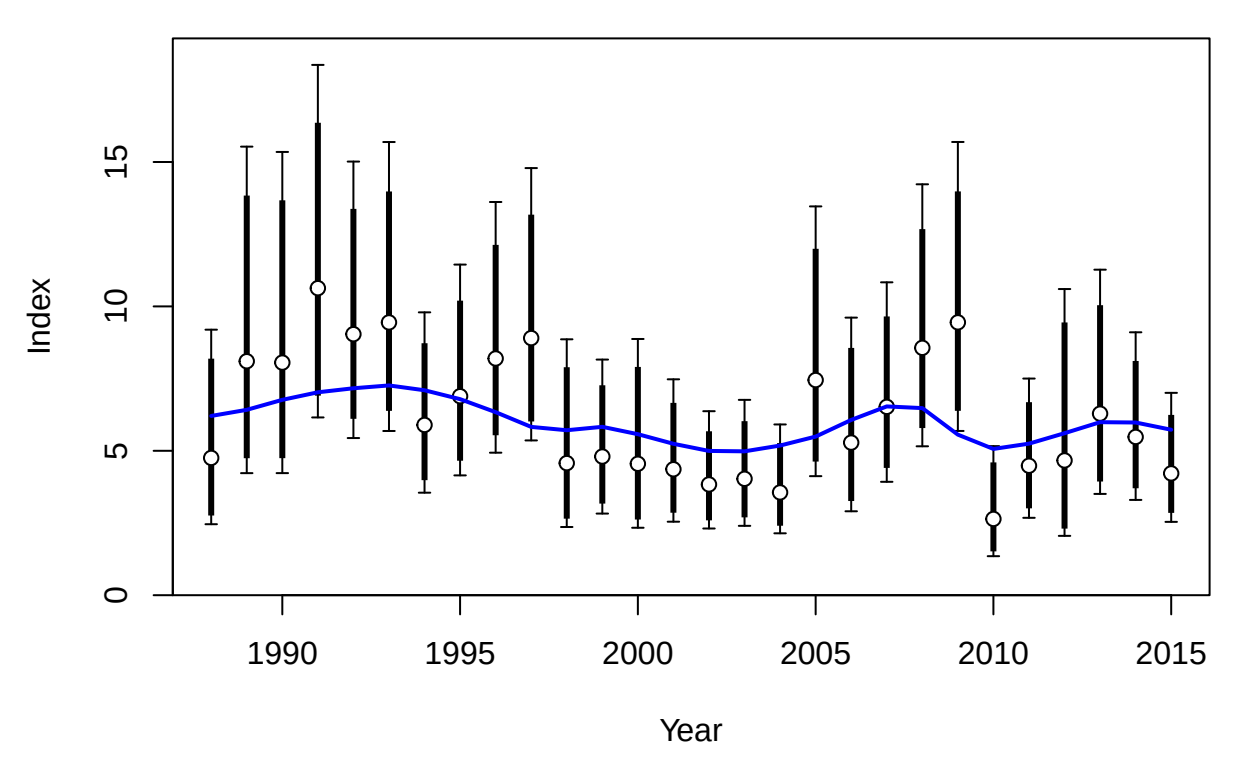

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

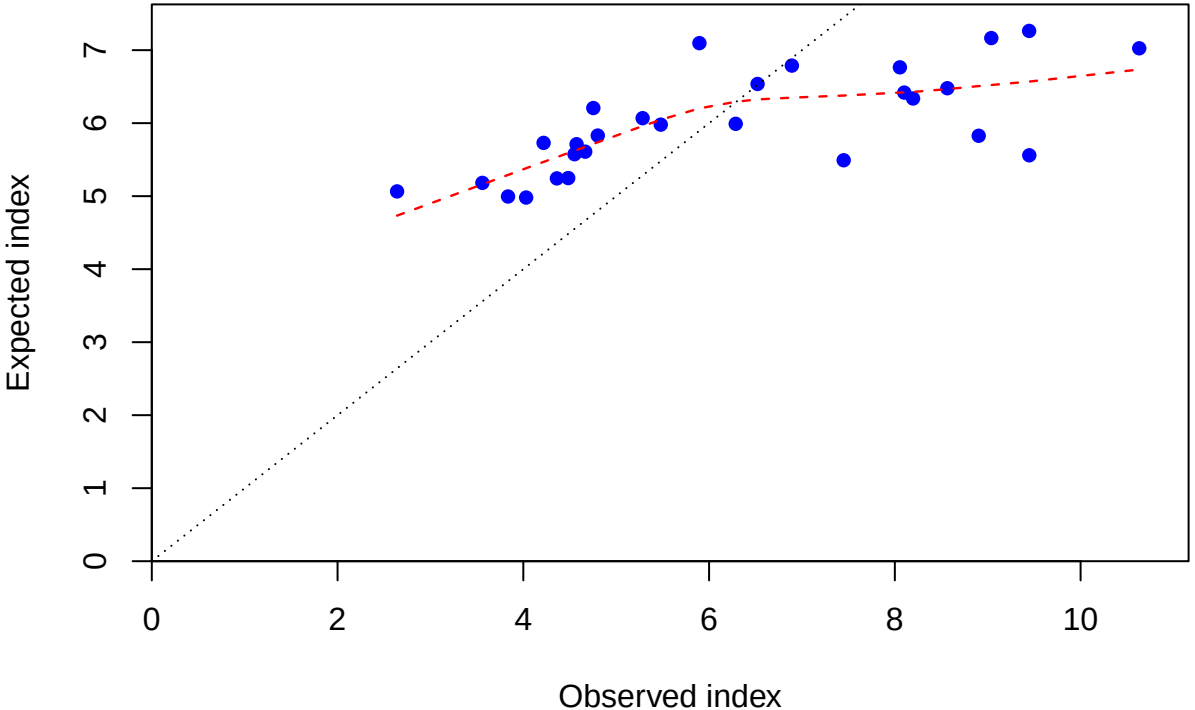

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

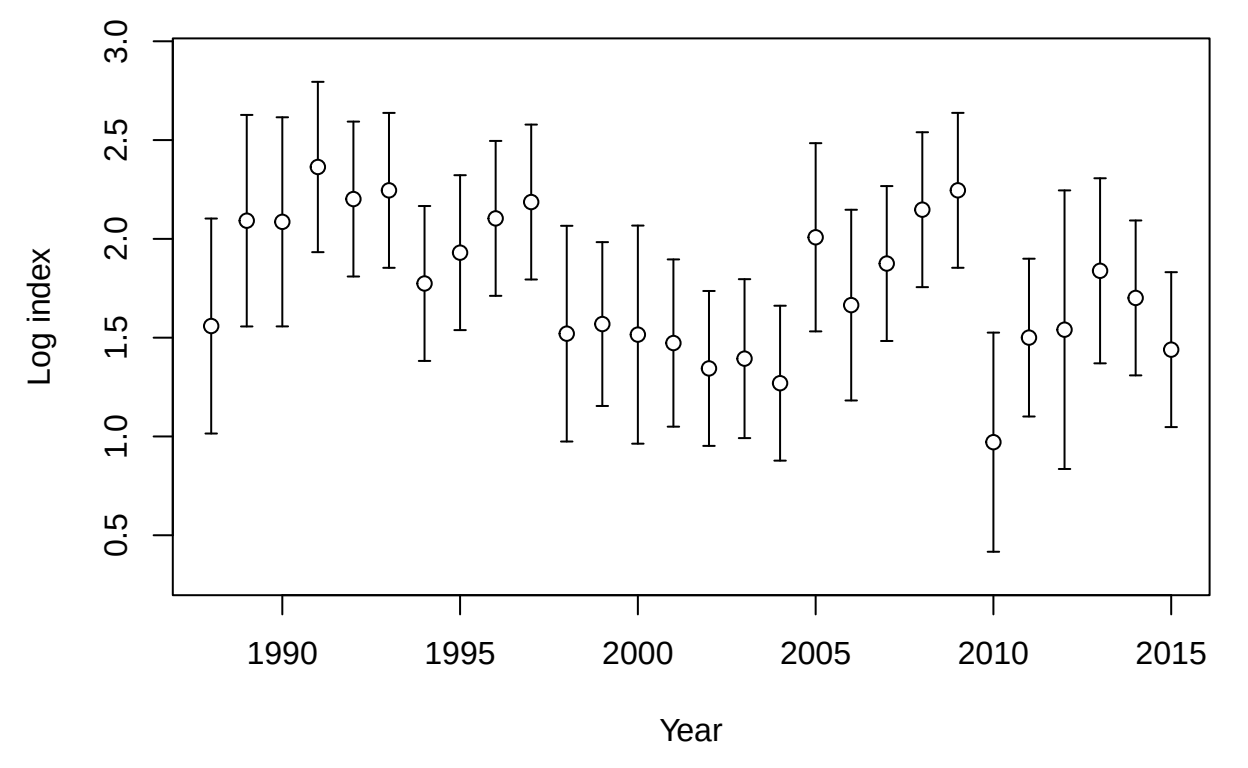

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

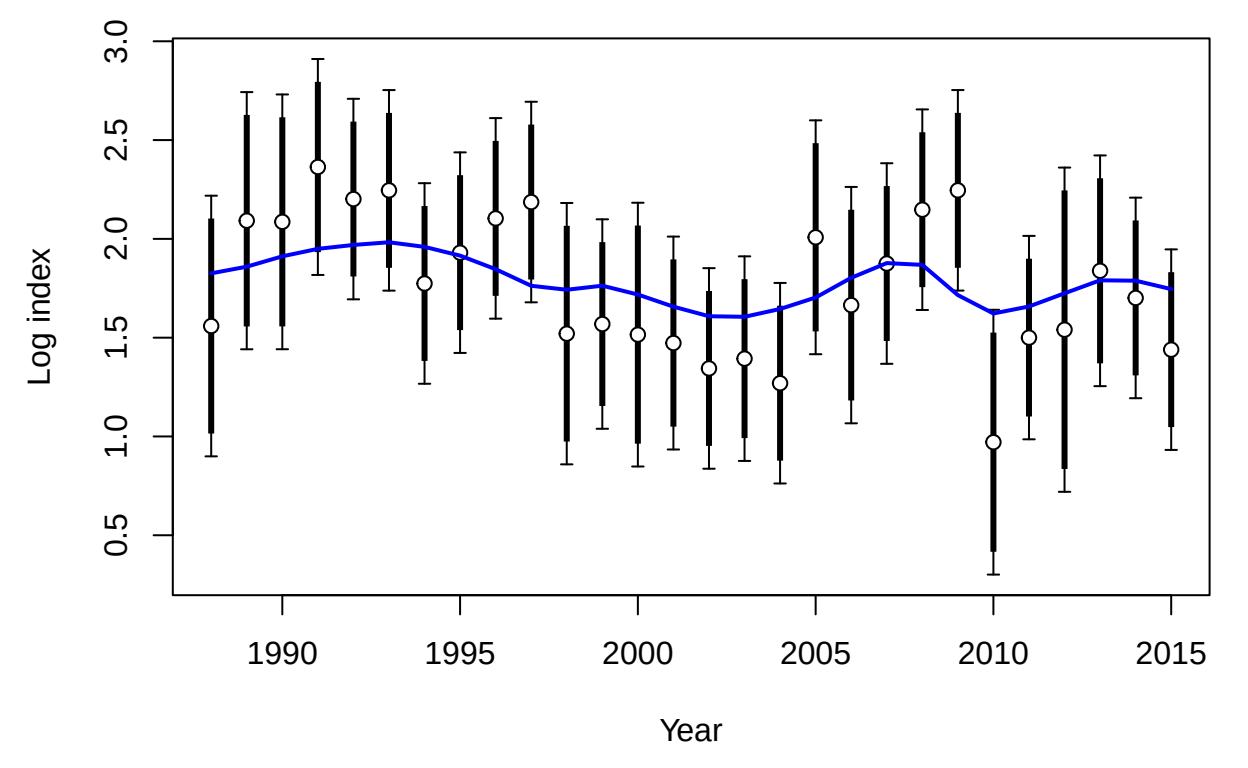

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
Relative spawning output: B/B_MSY
2020
2000
2010
1990
2021
1968
1970

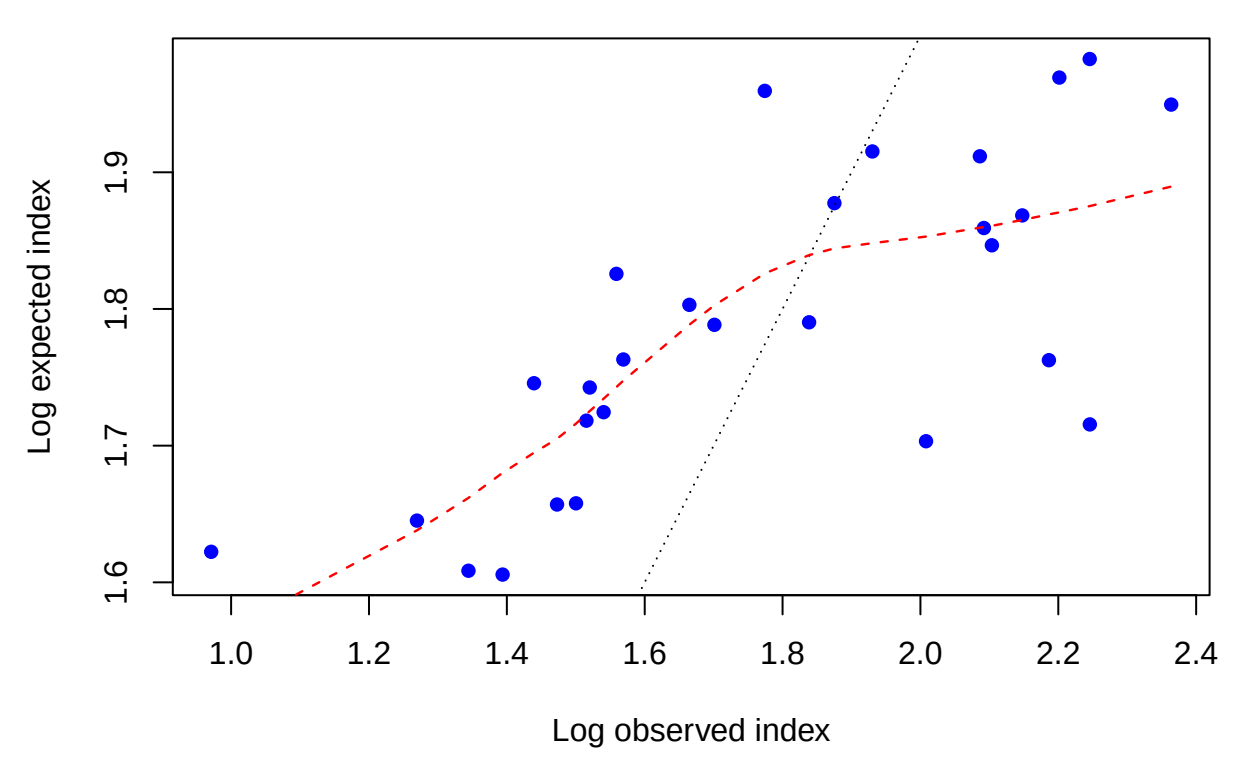

Index
0
5
10
15
1990
1995
2000
2005
2010
2015
Year

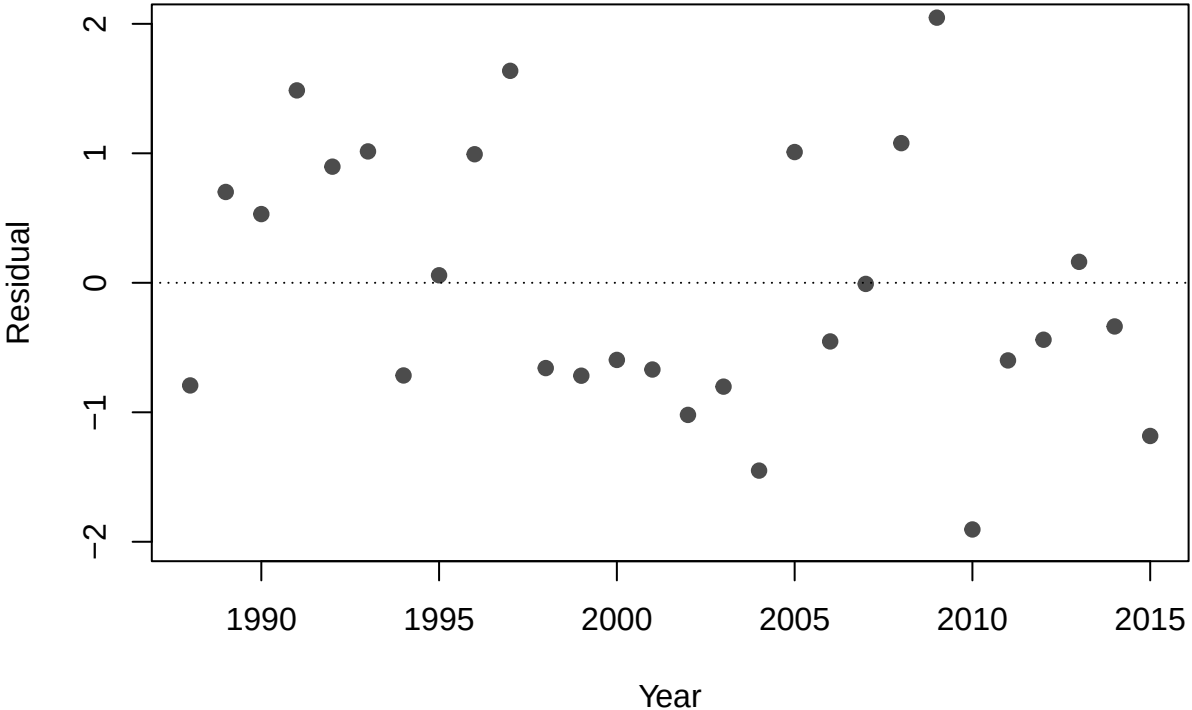

Index
0
5
10
15
1990
1995
2000
2005
2010
2015
Year

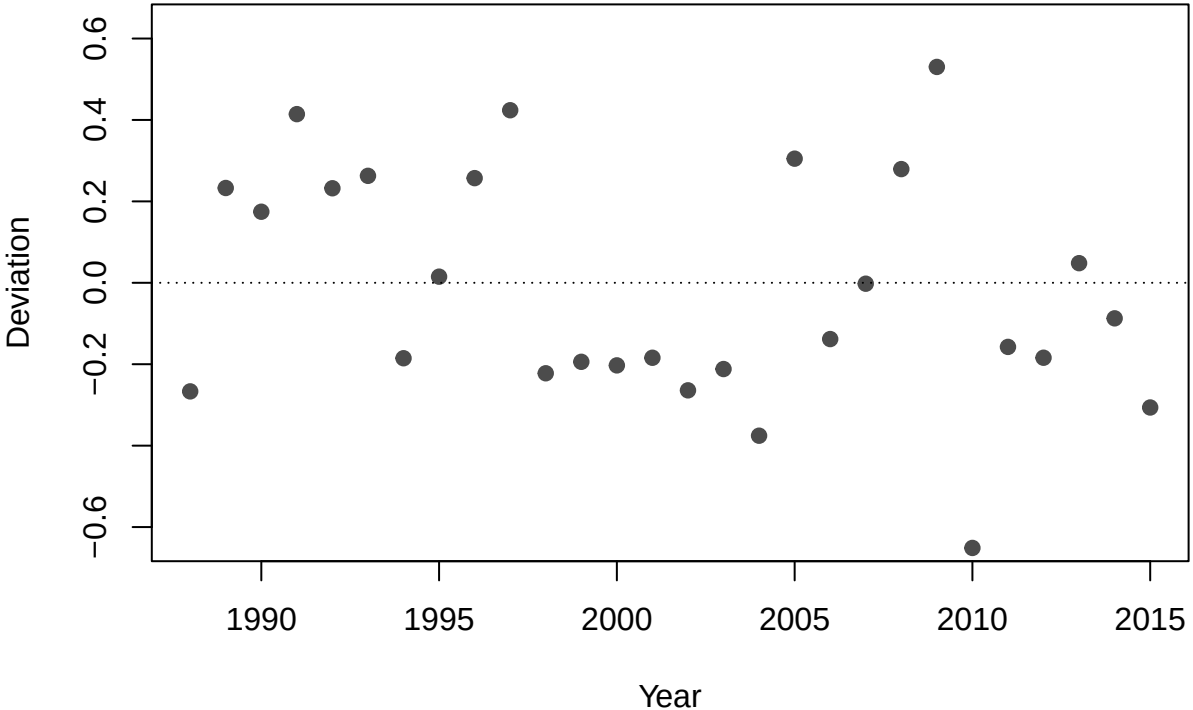

Expected index
0
1
2
3
4
5
6
7
0
2
4
6
8
10
Observed index

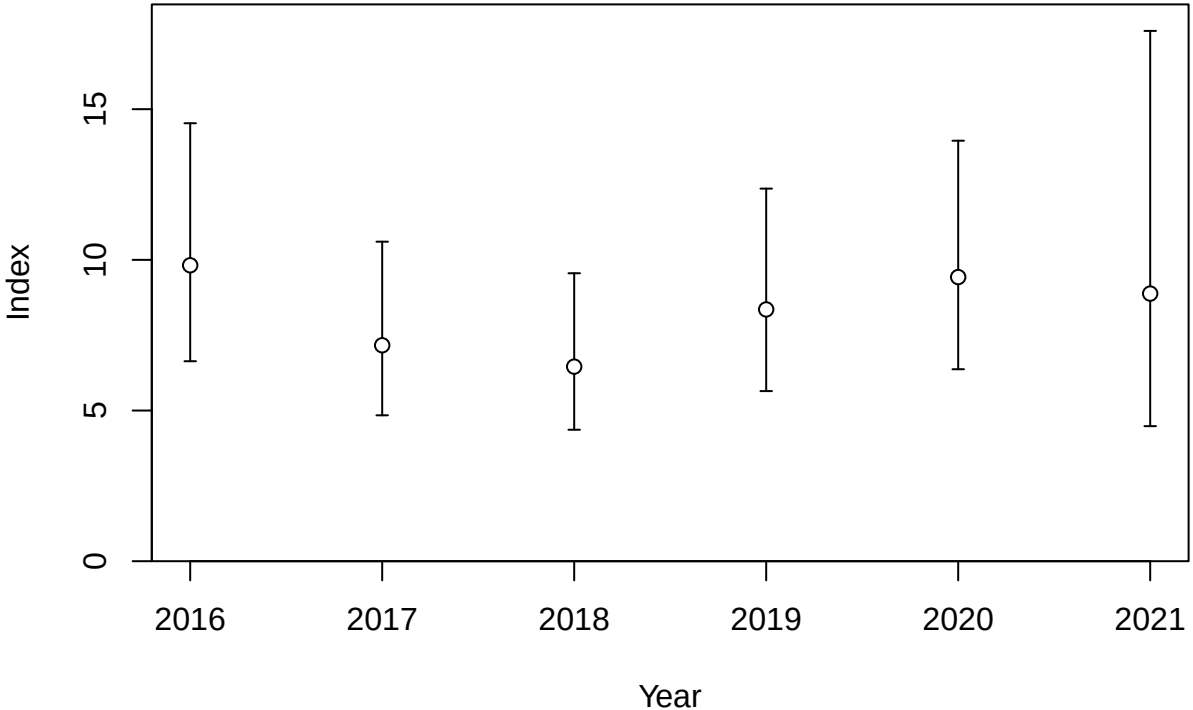

Log index
0.5
1.0
1.5
2.0
2.5
3.0
1990
1995
2000
2005
2010
2015
Year

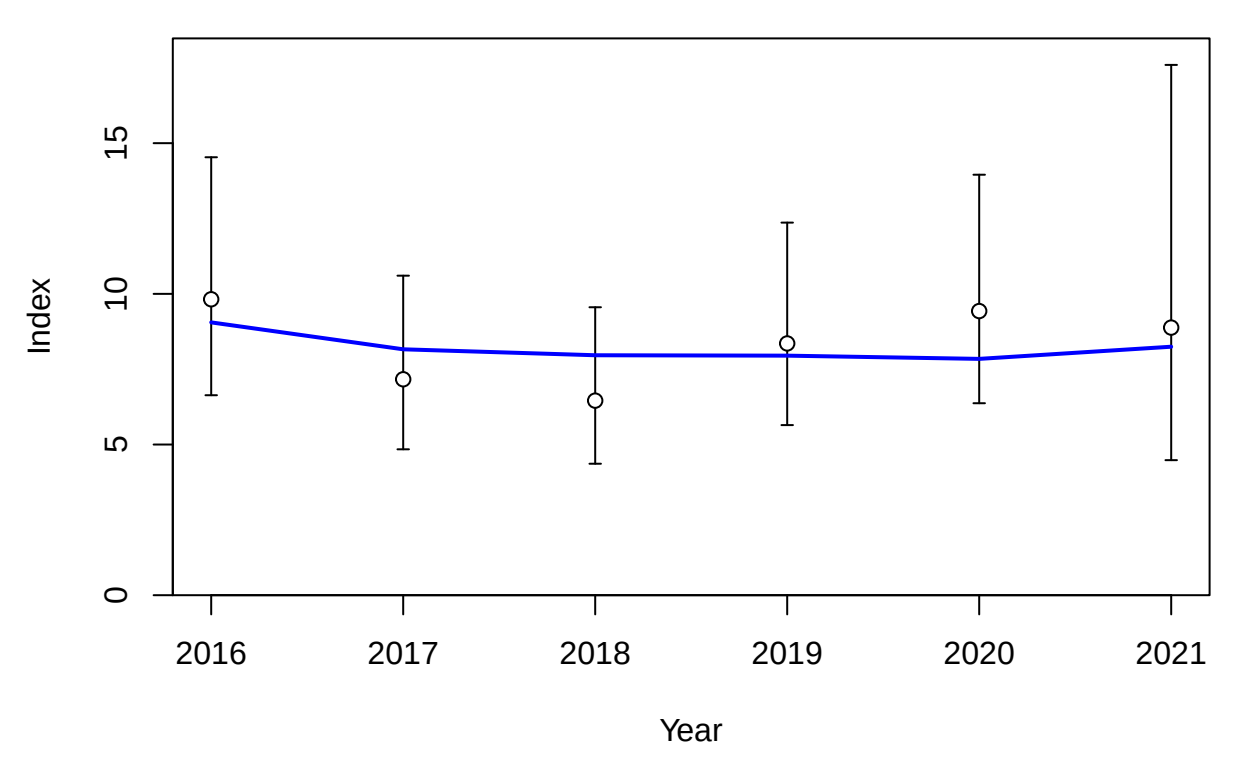

Log index
0.5
1.0
1.5
2.0
2.5
3.0
1990
1995
2000
2005
2010
2015
Year

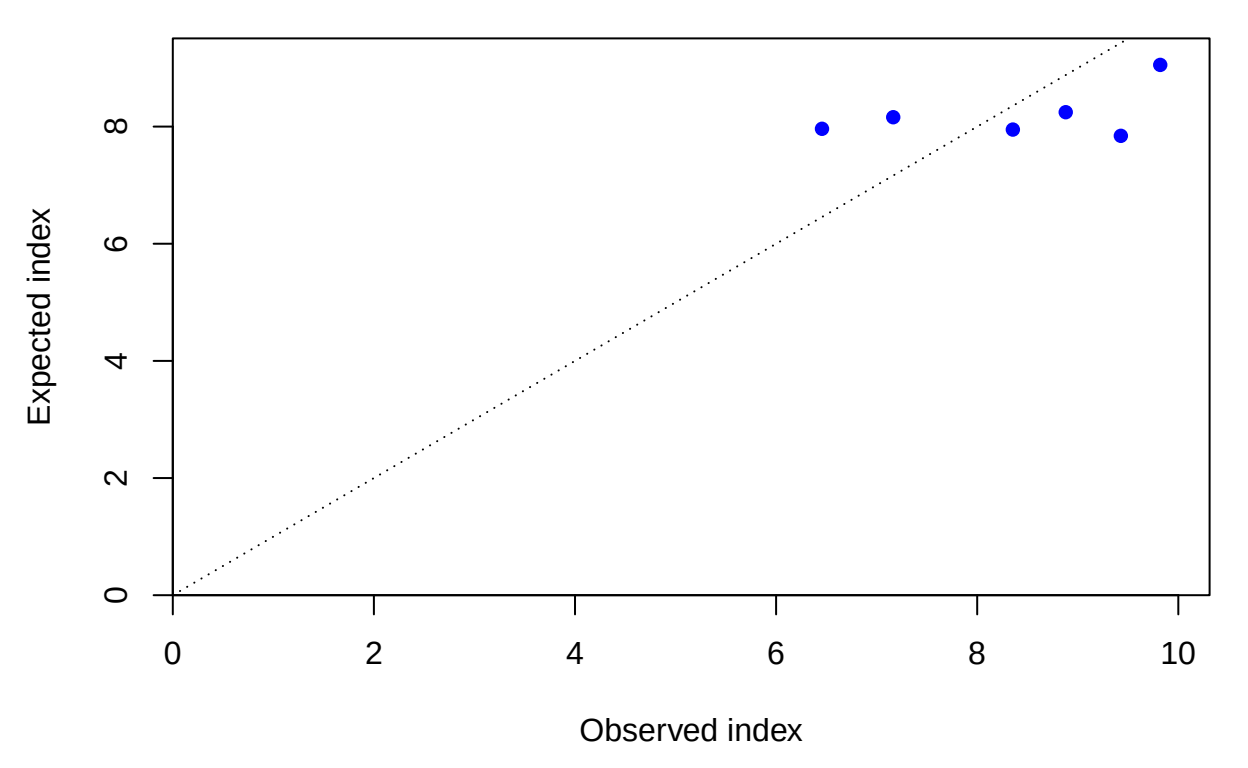

Log expected index
1.6
1.7
1.8
1.9
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
Log observed index

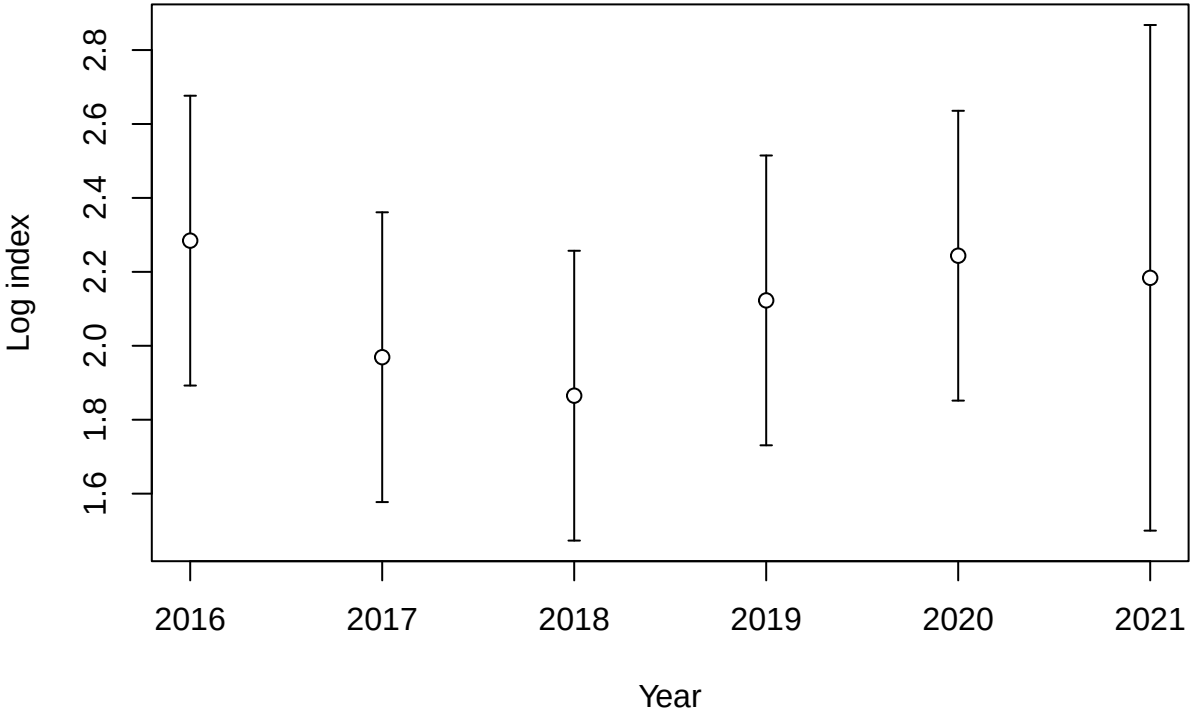

Residual
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
Year

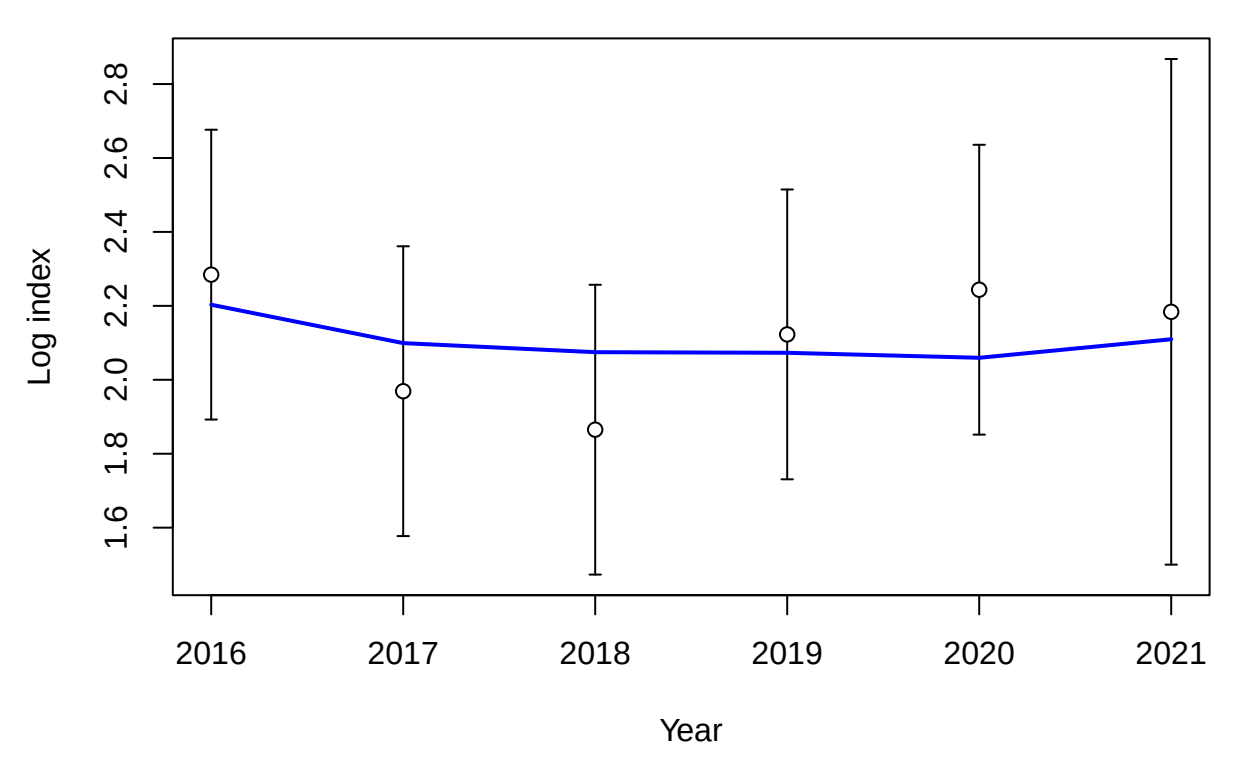

Deviation
0.6
0.4
0.2
0.0
−0.2
−0.6
1990
1995
2000
2005
2010
2015
Year

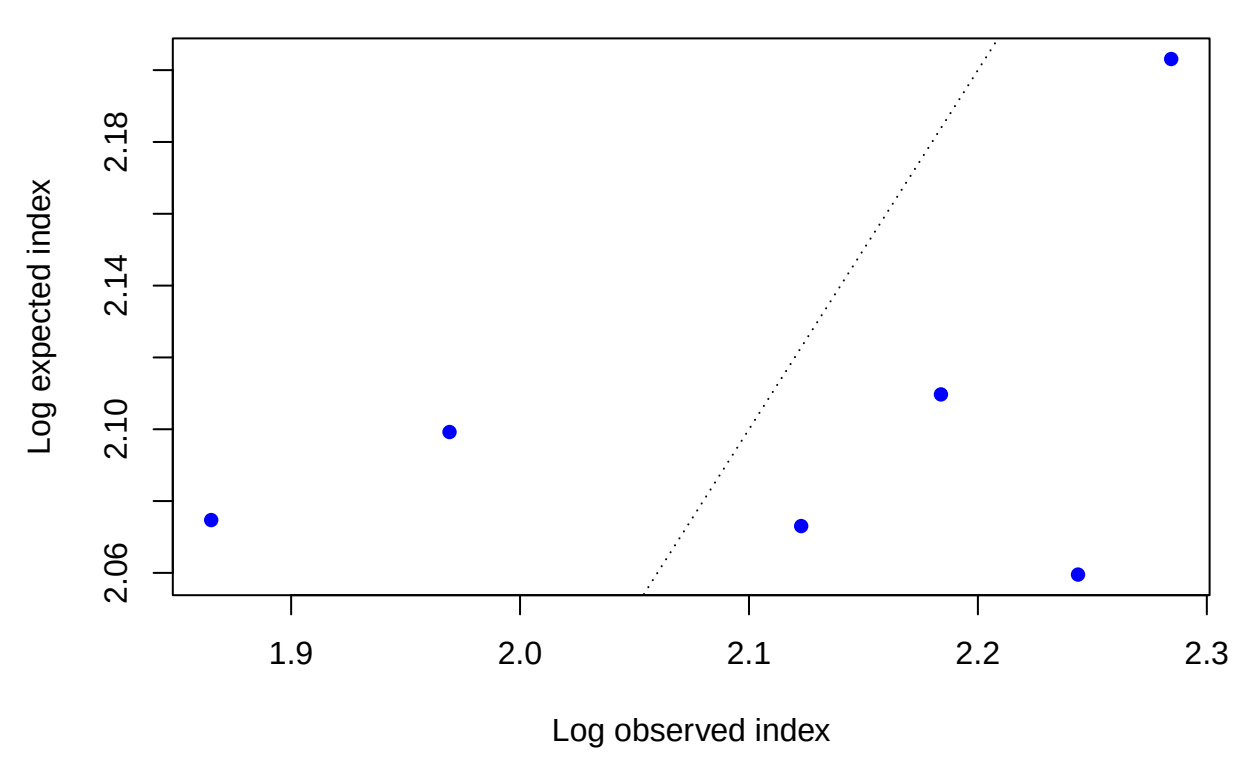

Index
0
5
10
15
2016
2017
2018
2019
2020
2021
Year

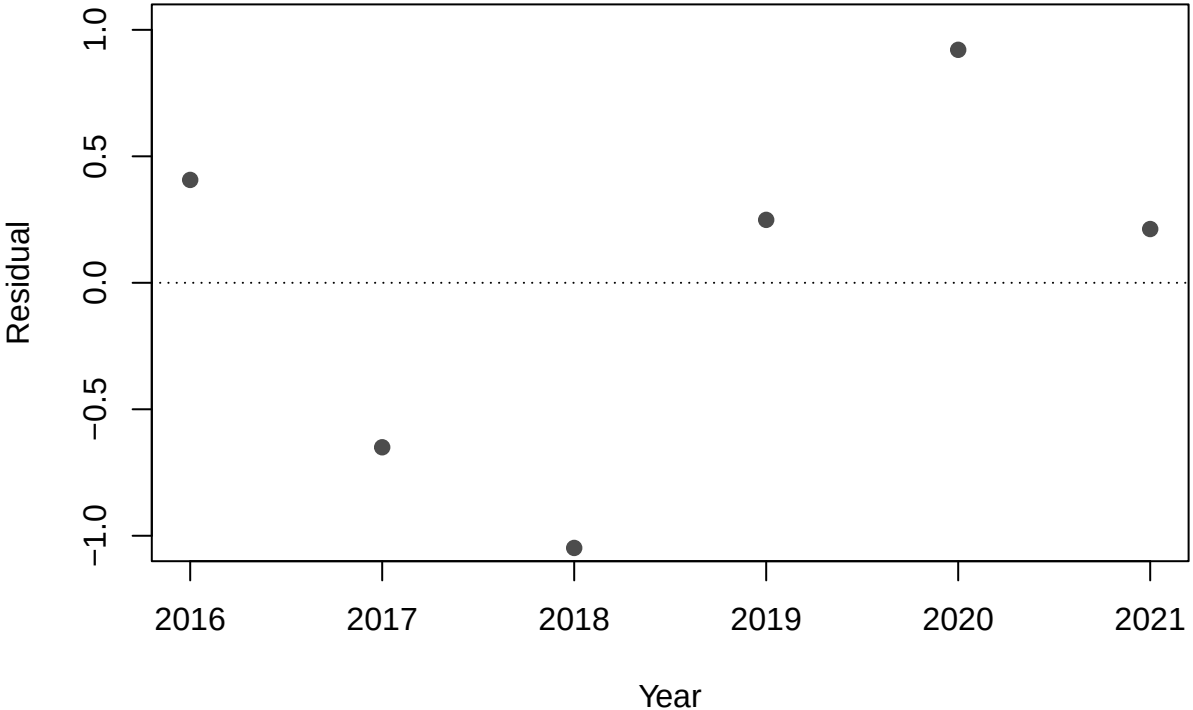

Index
0
5
10
15
2016
2017
2018
2019
2020
2021
Year

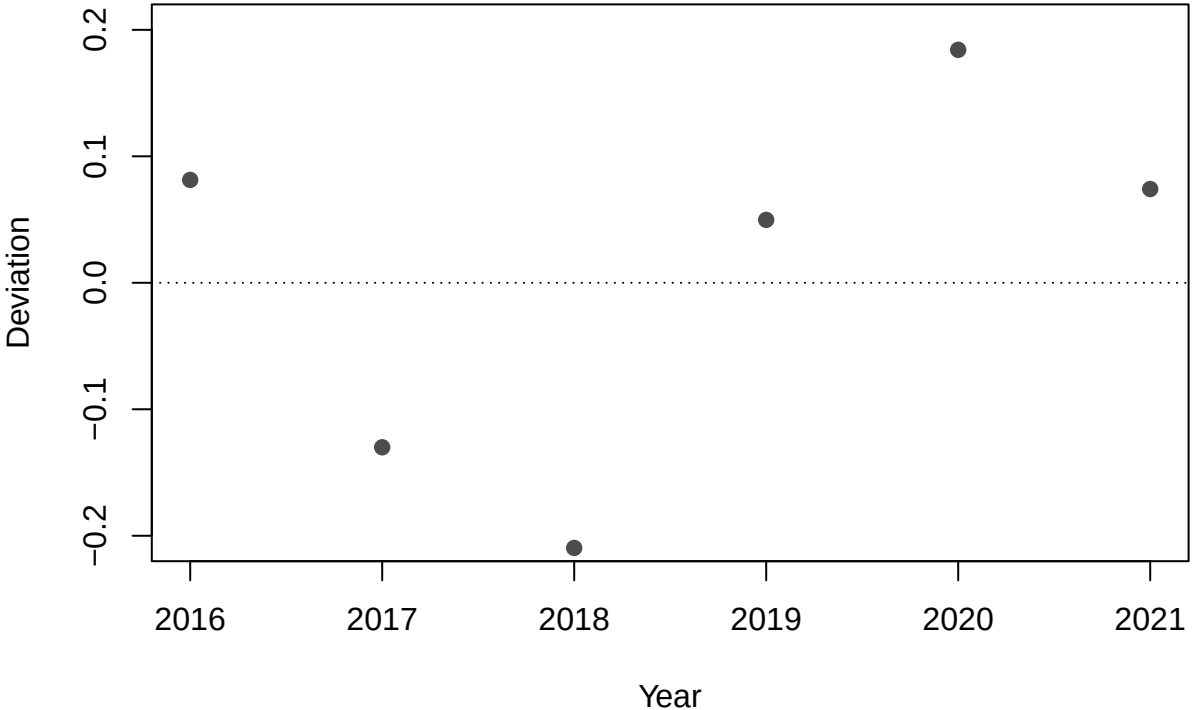

Expected index
0
2
4
6
8
0
2
4
6
8
10
Observed index

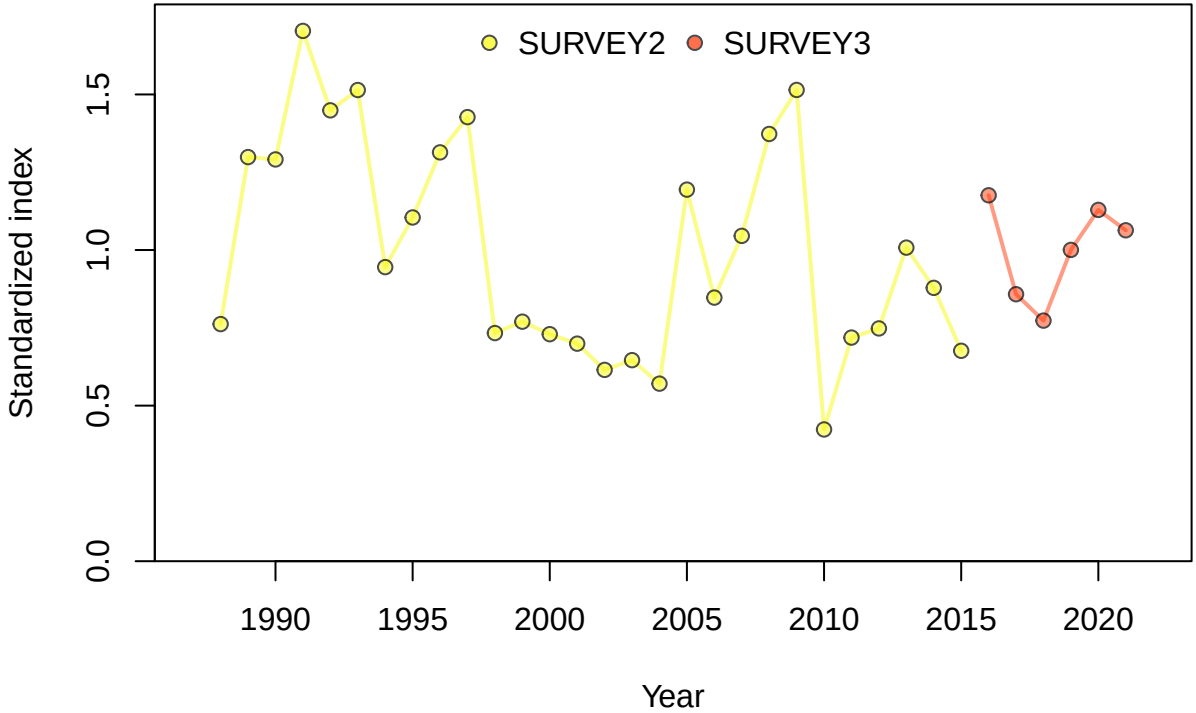

Log index
1.6
1.8
2.0
2.2
2.4
2.6
2.8
2016
2017
2018
2019
2020
2021
Year

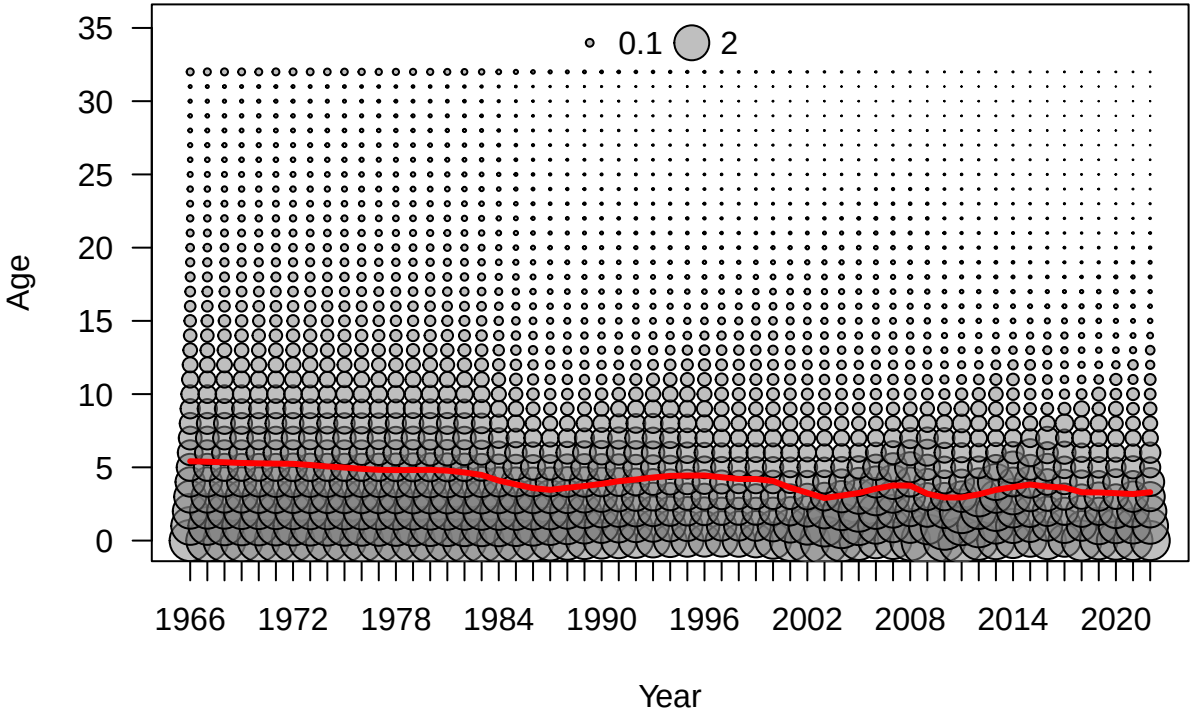

Log index
1.6
1.8
2.0
2.2
2.4
2.6
2.8
2016
2017
2018
2019
2020
2021
Year

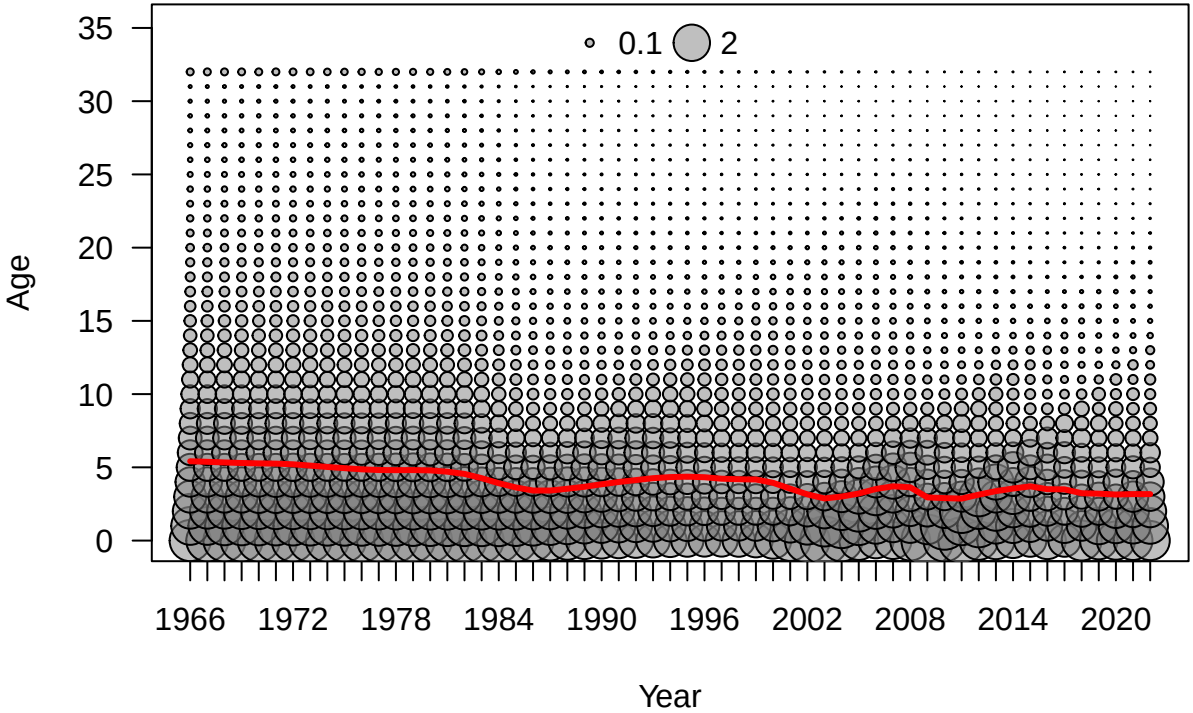

Log expected index
2.06
2.10
2.14
2.18
1.9
2.0
2.1
2.2
2.3
Log observed index

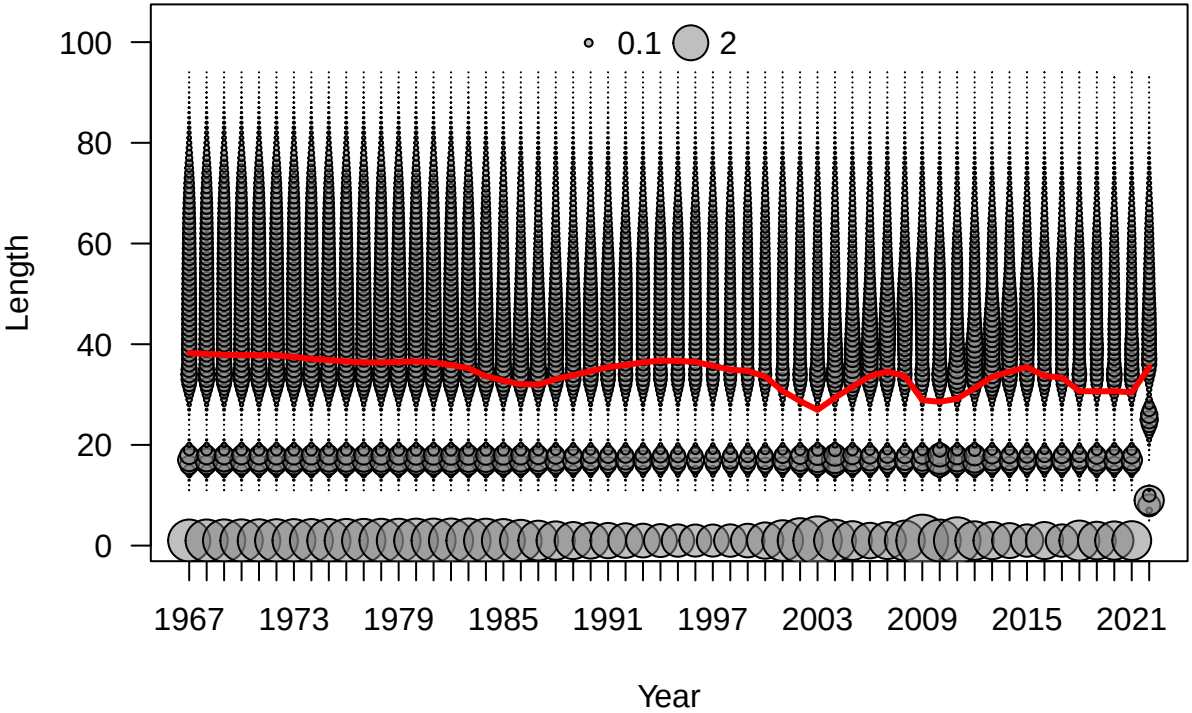

Residual
1.0
0.5
0.0
−0.5
−1.0
2016
2017
2018
2019
2020
2021
Year

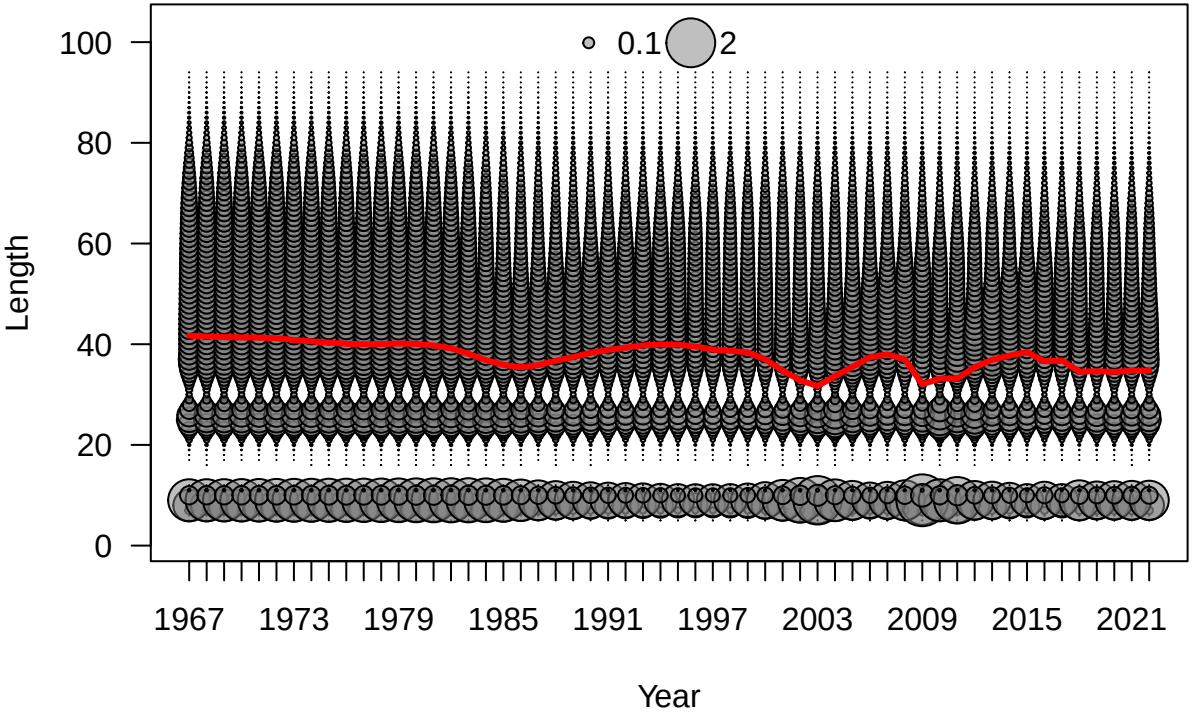

Deviation
0.2
0.1
0.0
−0.1
−0.2
2016
2017
2018
2019
2020
2021
Year

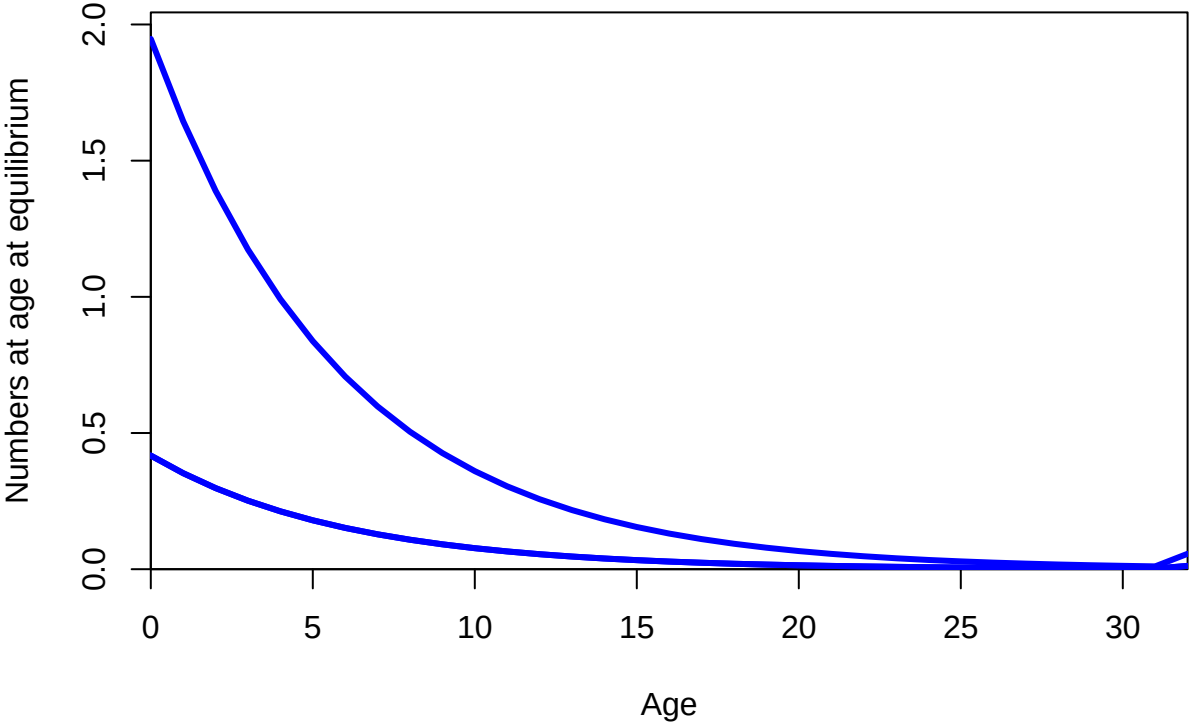

SURVEY2
SURVEY3
Standardized index
0.0
0.5
1.0
1.5
1990
1995
2000
2005
2010
2015
2020
Year

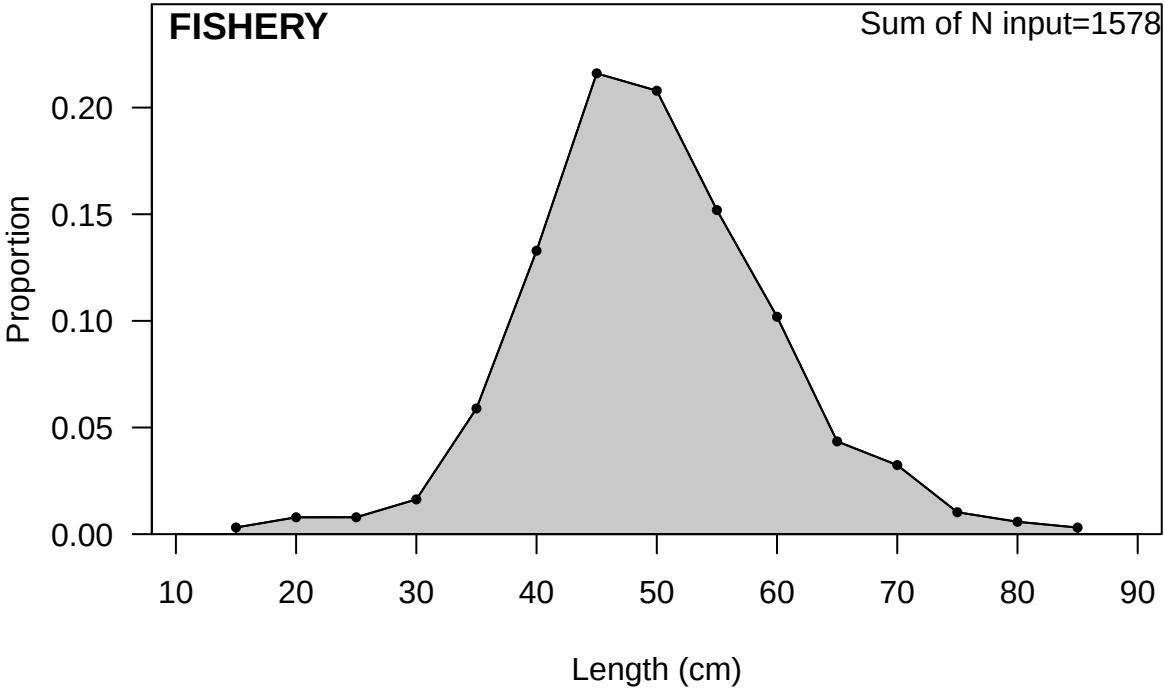

0.1
2
Age
Year
0
5
10
15
20
25
30
35
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020

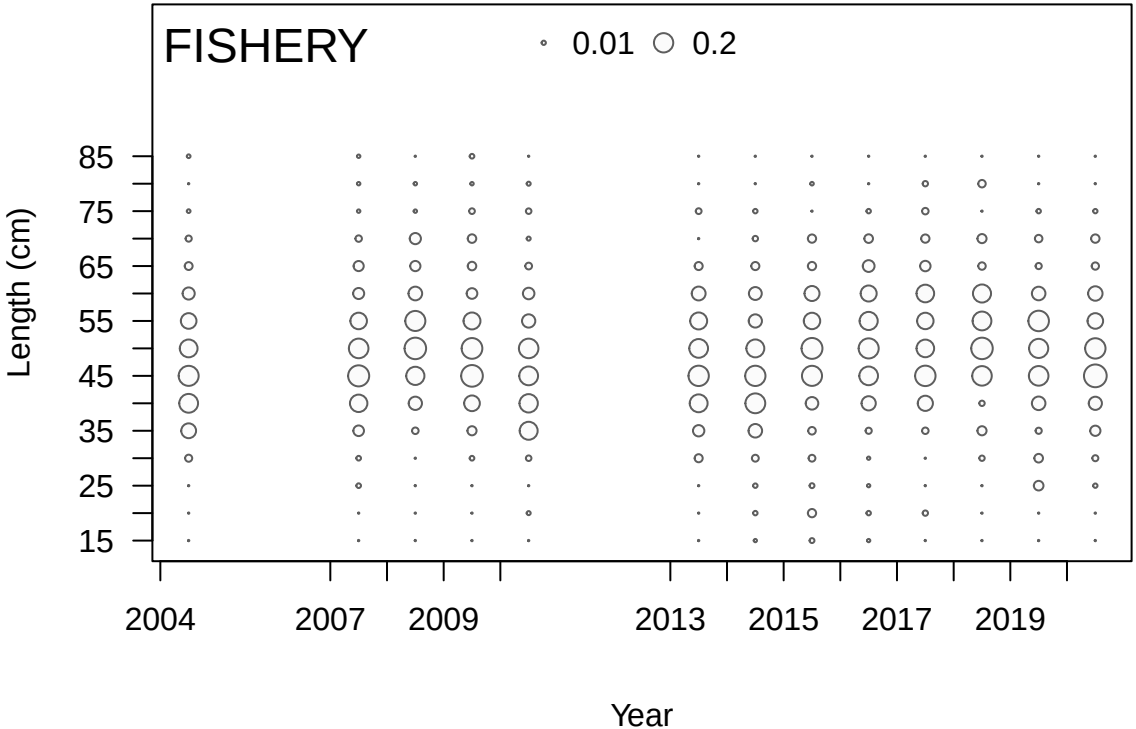

0.1
2
35
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

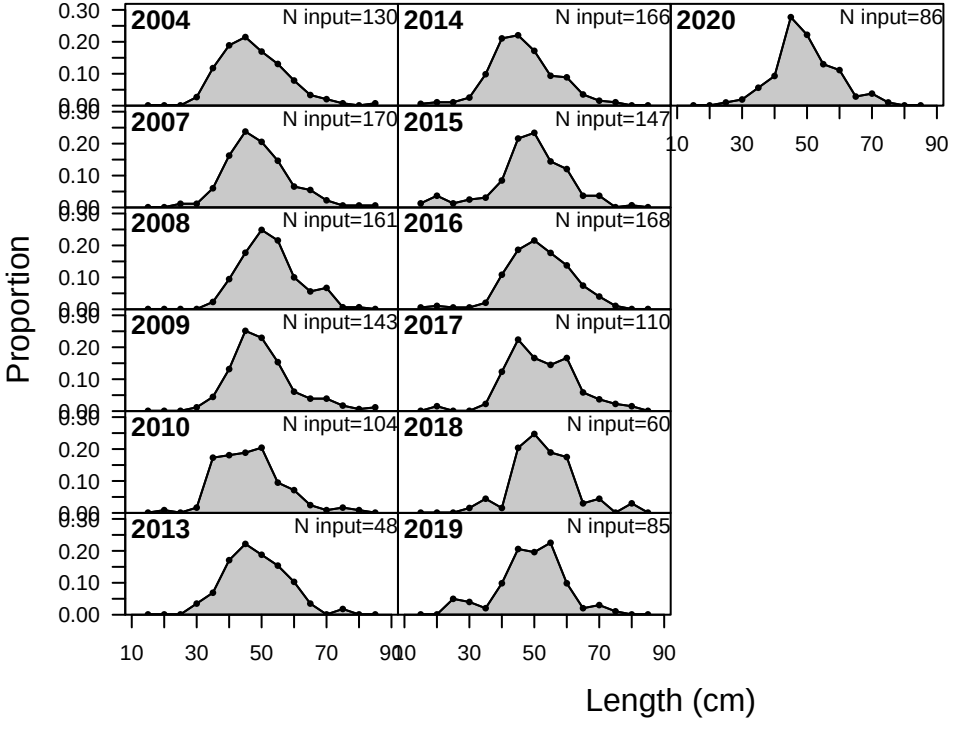

0.1
2
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

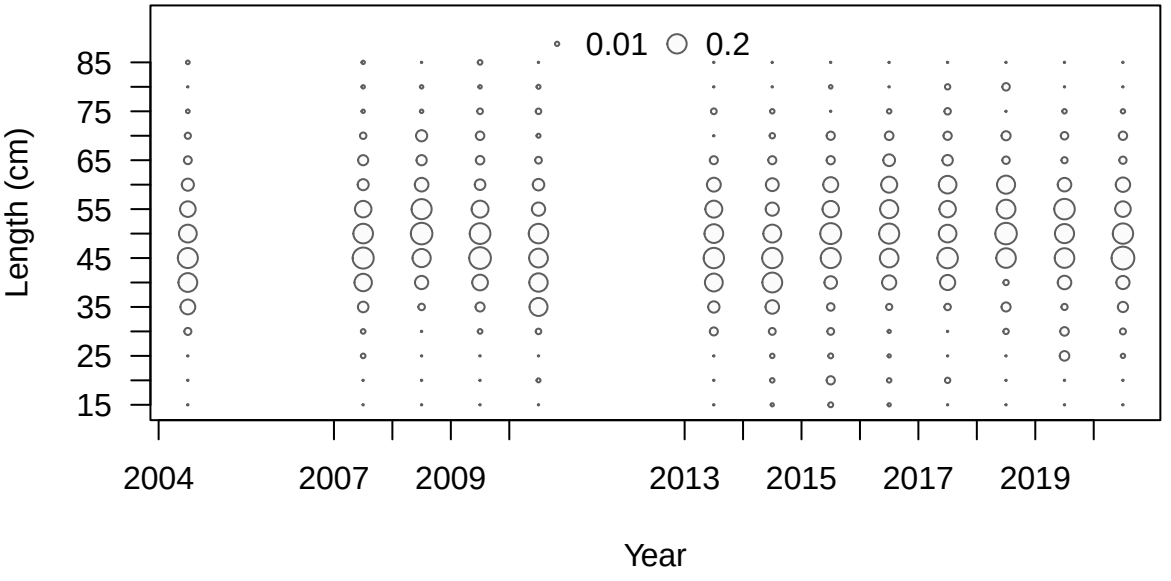

0.1
2
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

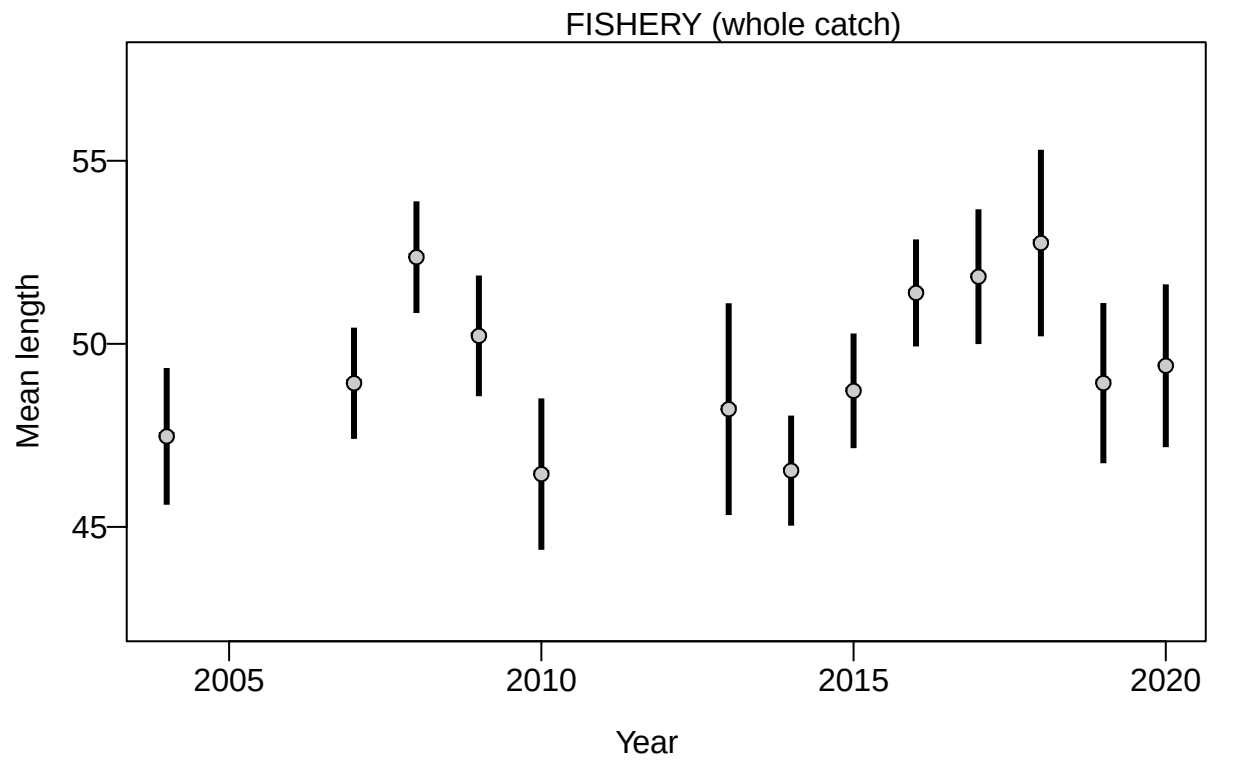

Numbers at age at equilibrium
0.0
0.5
1.0
1.5
2.0
0
5
10
15
20
25
30
Age

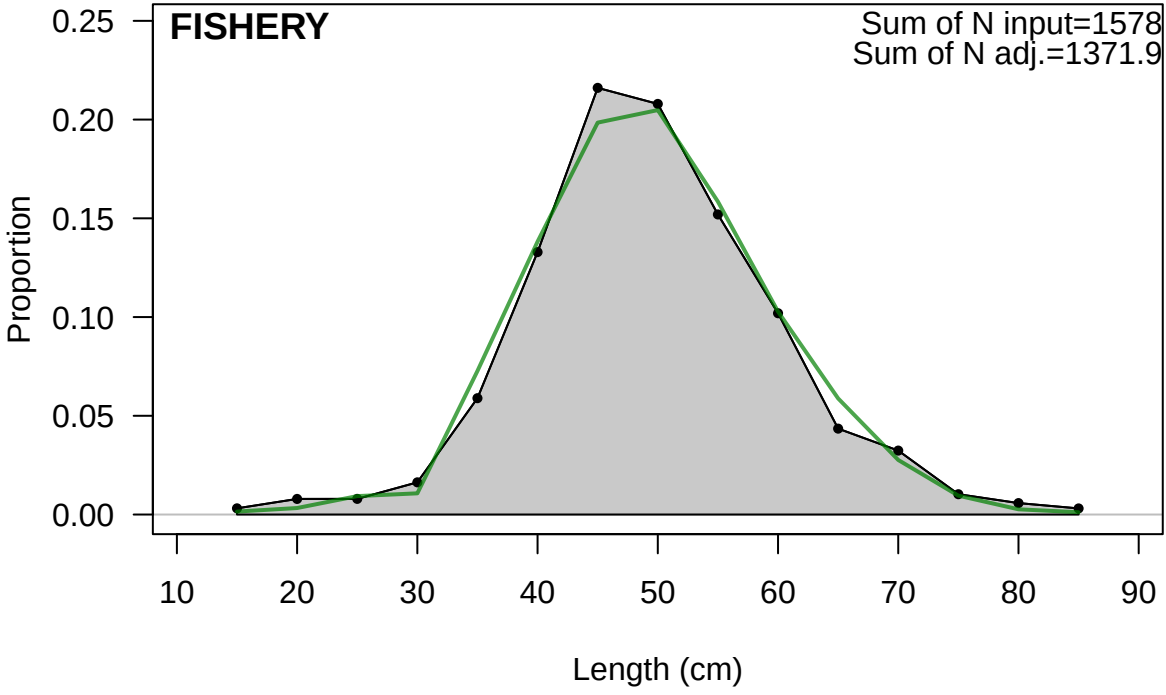

FISHERY
Sum of N input=1578
Proportion
0.00
0.05
0.10
0.15
0.20
10
20
30
40
50
60
70
80
90
Length (cm)

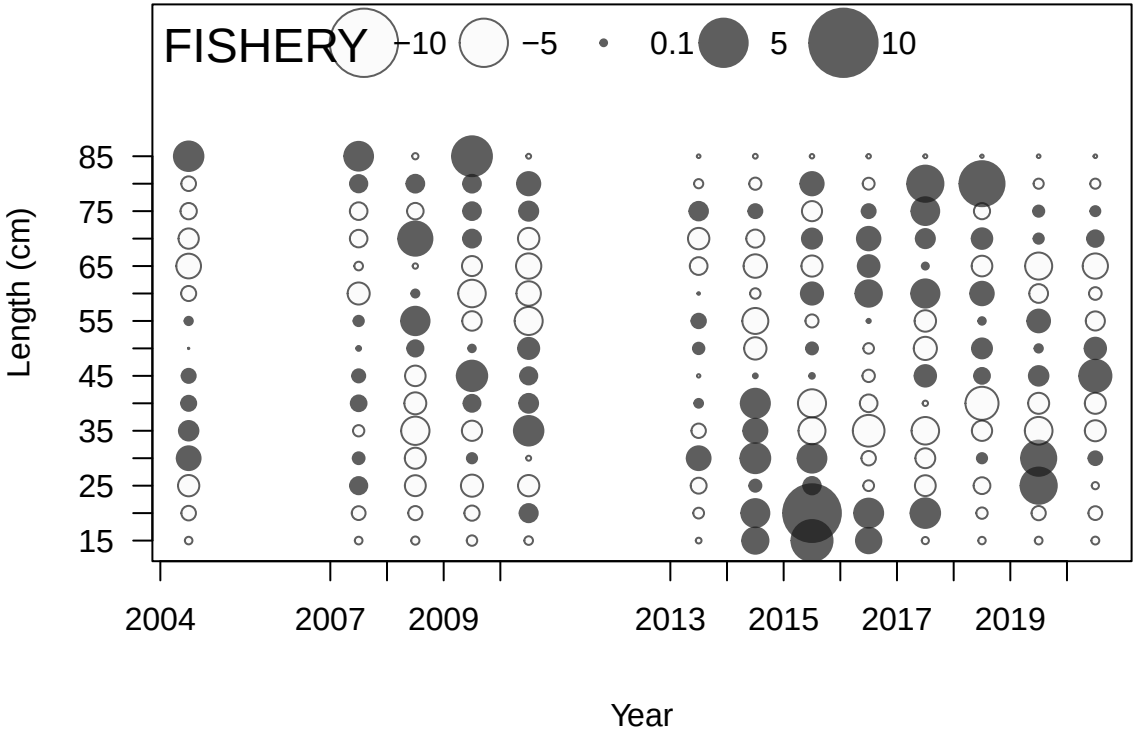

FISHERY
0.01
0.2
Length (cm)
85
75
65
55
45
35
25
15
2004
2007
2009
2013
2015
2017
2019
Year

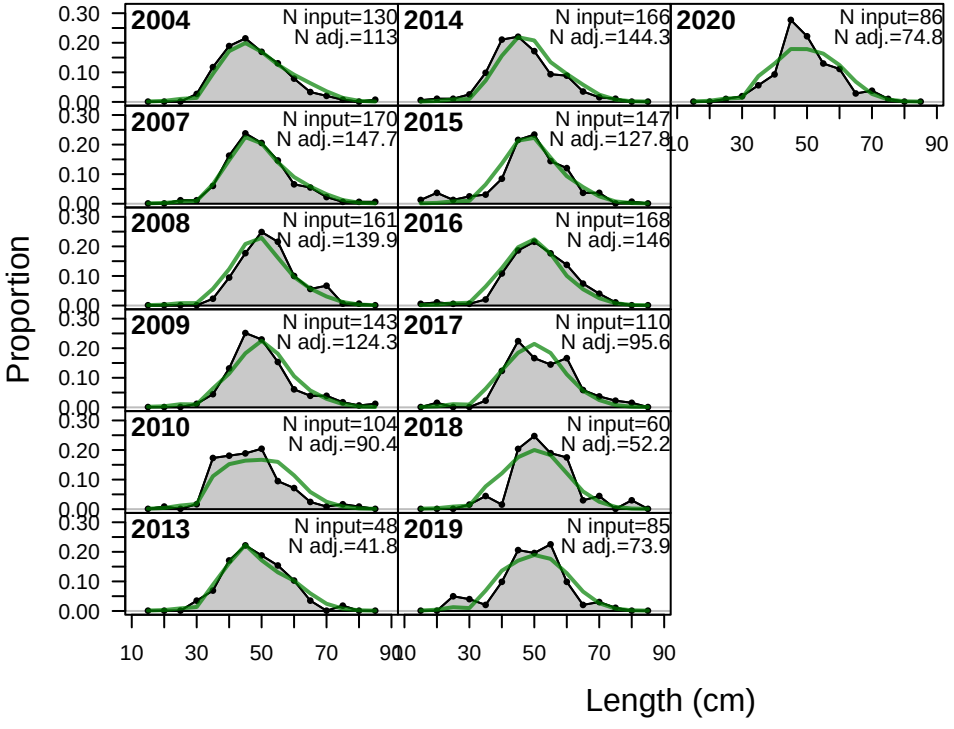

2004
N input=130
2014
N input=166
2020
N input=86
2007
N input=170
2015
N input=147
2008
N input=161
2016
N input=168
2009
N input=143
2017
N input=110
2010
N input=104
2018
N input=60
2013
N input=48
2019
N input=85
0.30
0.20
0.10
0.00
10
30
50
70
90
Proportion
Length (cm)

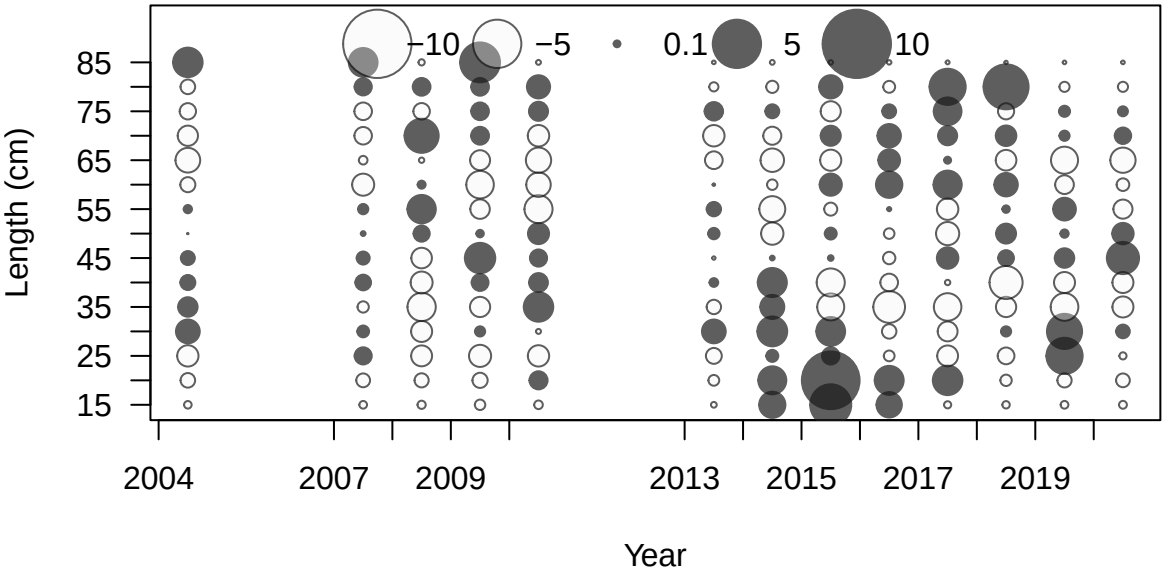

0.01
0.2
Length (cm)
85
75
65
55
45
35
25
15
2004
2007
2009
2013
2015
2017
2019
Year

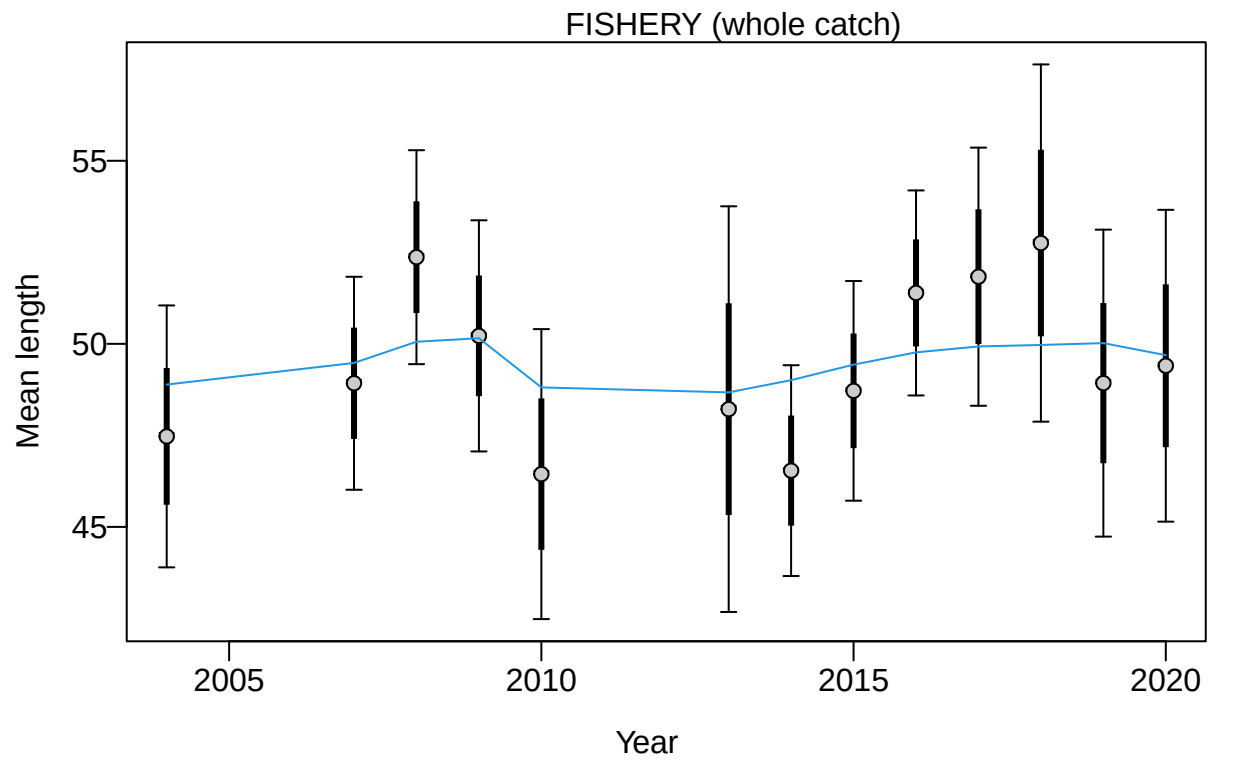

FISHERY (whole catch)
Mean length
55
50
45
2005
2010
2015
2020
Year

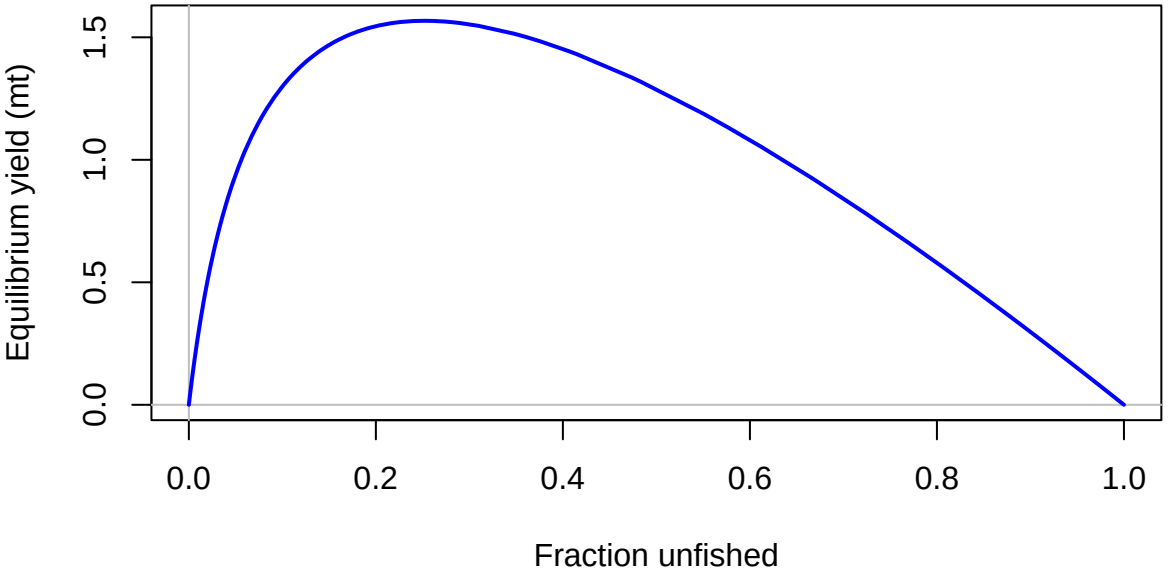

FISHERY
Sum of N input=1578
Sum of N adj.=1371.9
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
10
20
30
40
50
60
70
80
90
Length (cm)

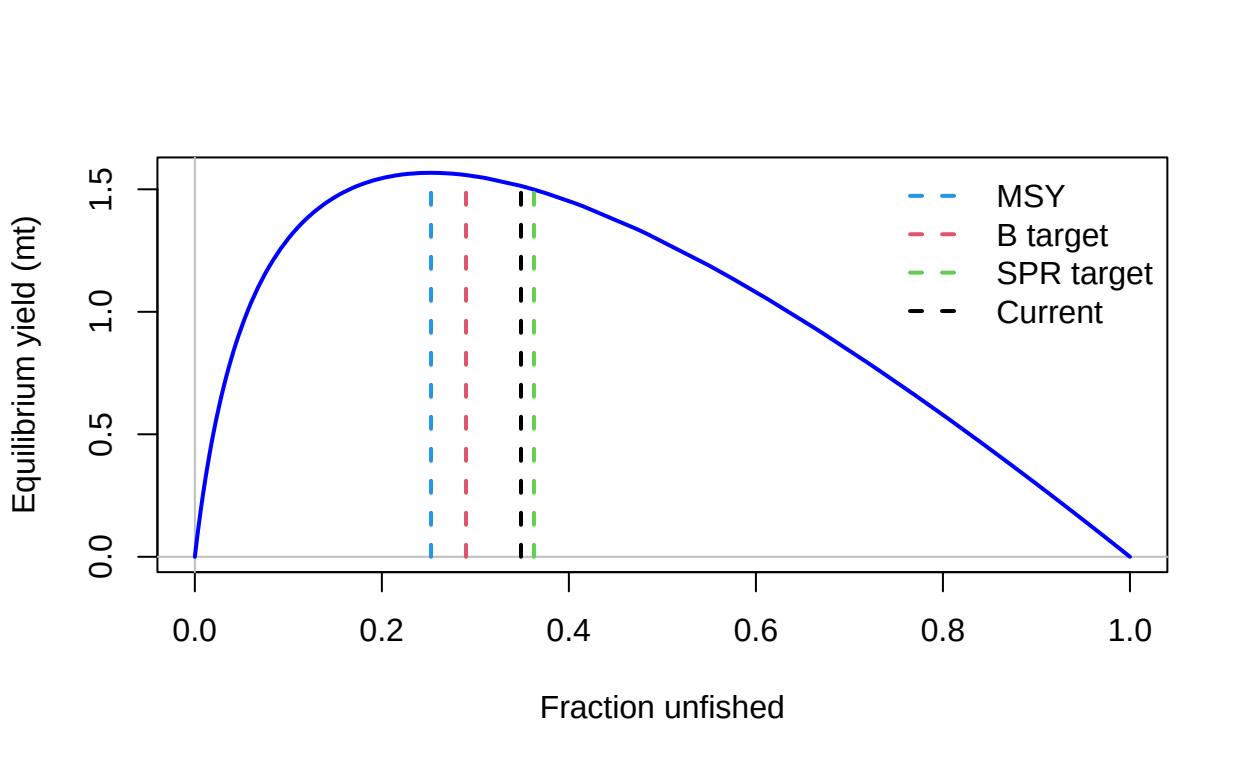

FISHERY
−10
−5
0.1
5
10
Length (cm)
85
75
65
55
45
35
25
15
2004
2007
2009
2013
2015
2017
2019
Year

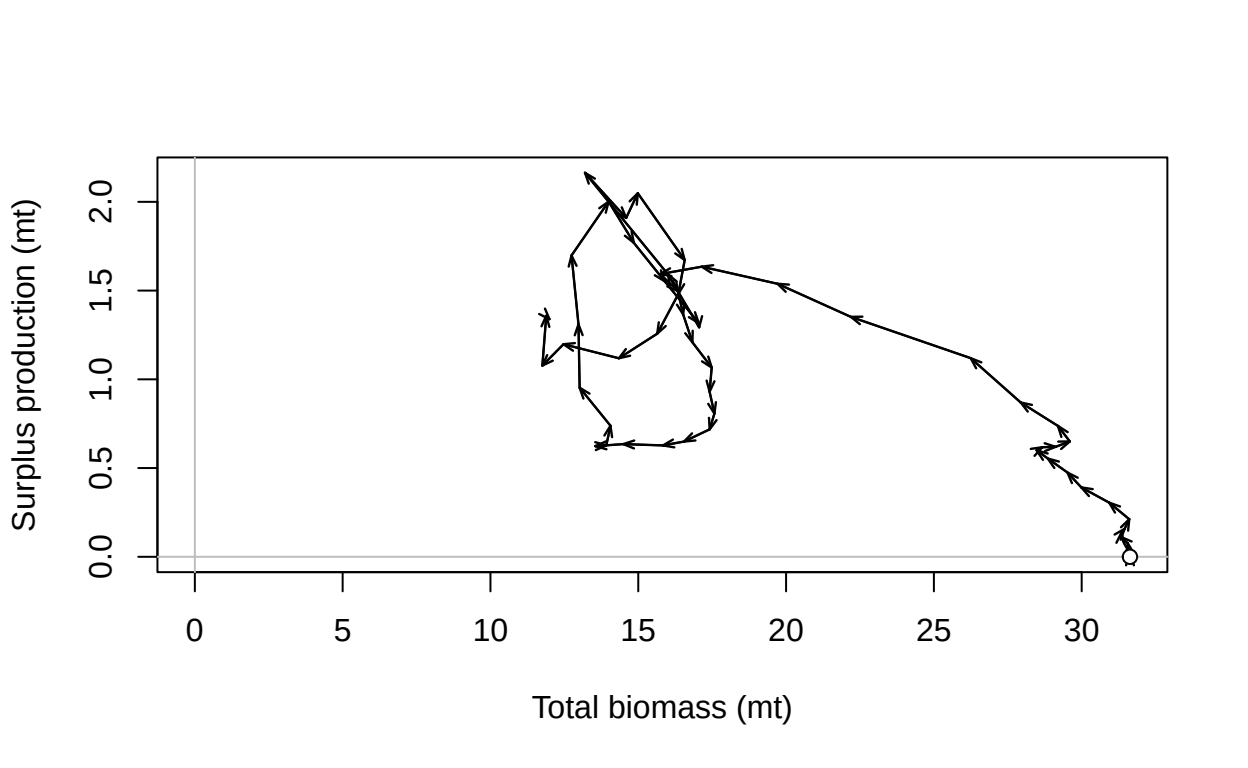

2004
N input=130
N adj.=113
2014
N input=166
N adj.=144.3
2020
N input=86
N adj.=74.8
2007
N input=170
N adj.=147.7
2015
N input=147
N adj.=127.8
2008
N input=161
N adj.=139.9
2016
N input=168
N adj.=146
2009
N input=143
N adj.=124.3
2017
N input=110
N adj.=95.6
2010
N input=104
N adj.=90.4
2018
N input=60
N adj.=52.2
2013
N input=48
N adj.=41.8
2019
N input=85
N adj.=73.9
Proportion
0.00
0.10
0.20
0.30
10
30
50
70
90
Length (cm)

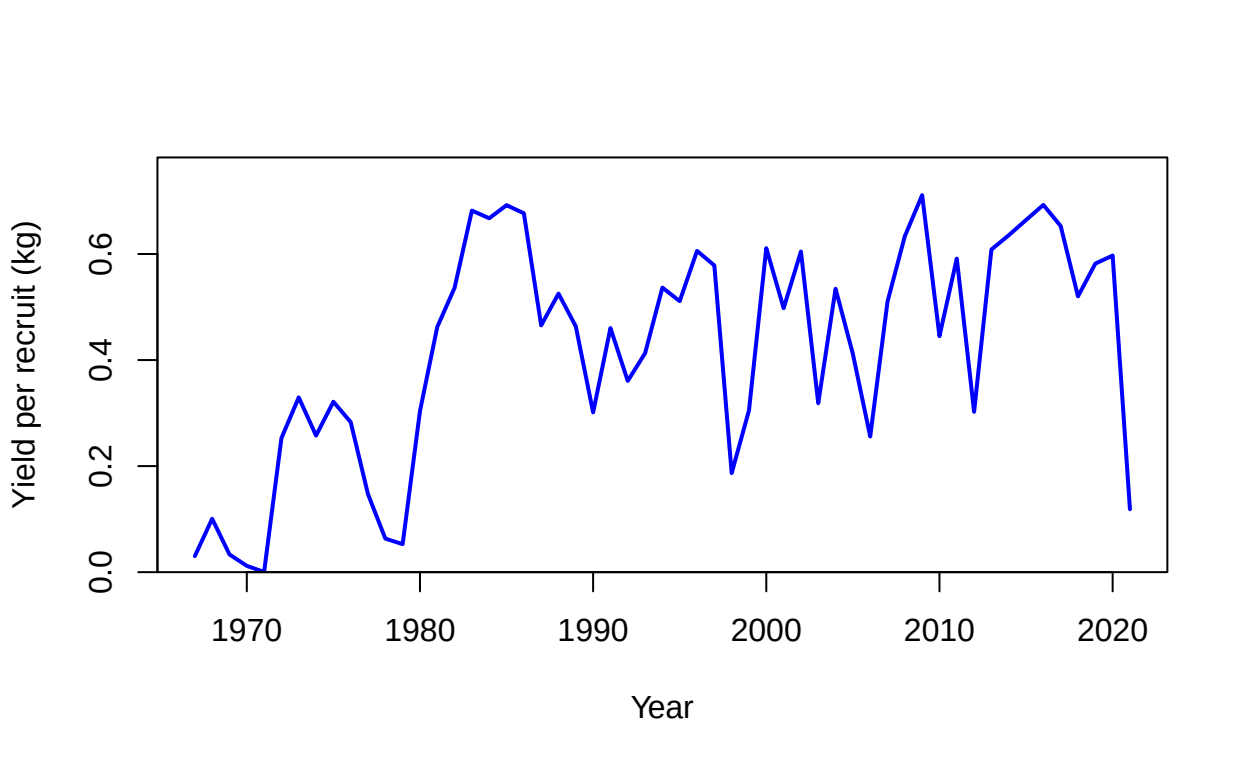

−10
−5
0.1
5
10
85
75
65
55
45
35
25
15
Length (cm)
2004
2007
2009
2013
2015
2017
2019
Year

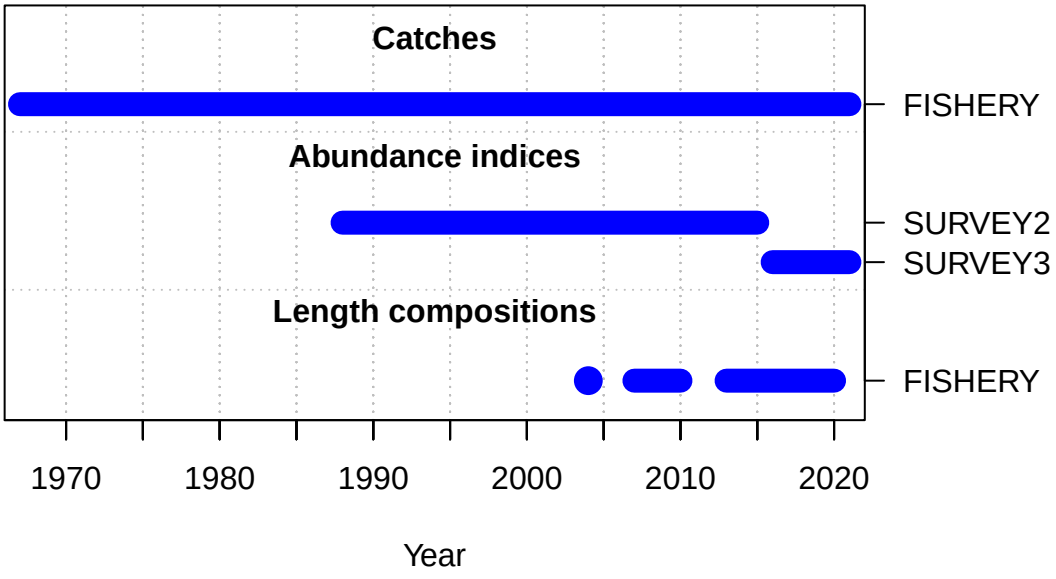

FISHERY (whole catch)
Mean length
55
50
45
2005
2010
2015
2020
Year

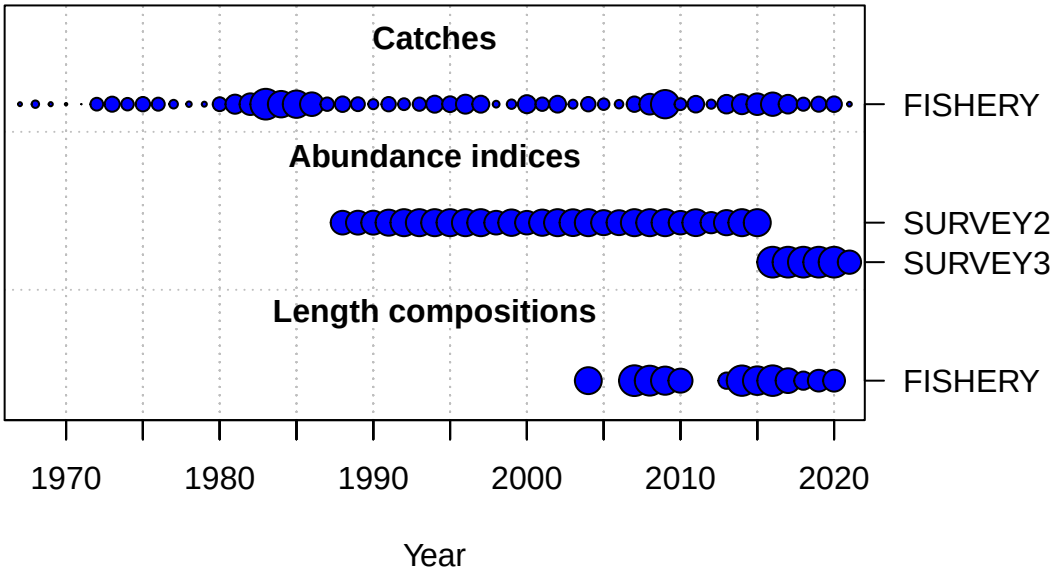

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

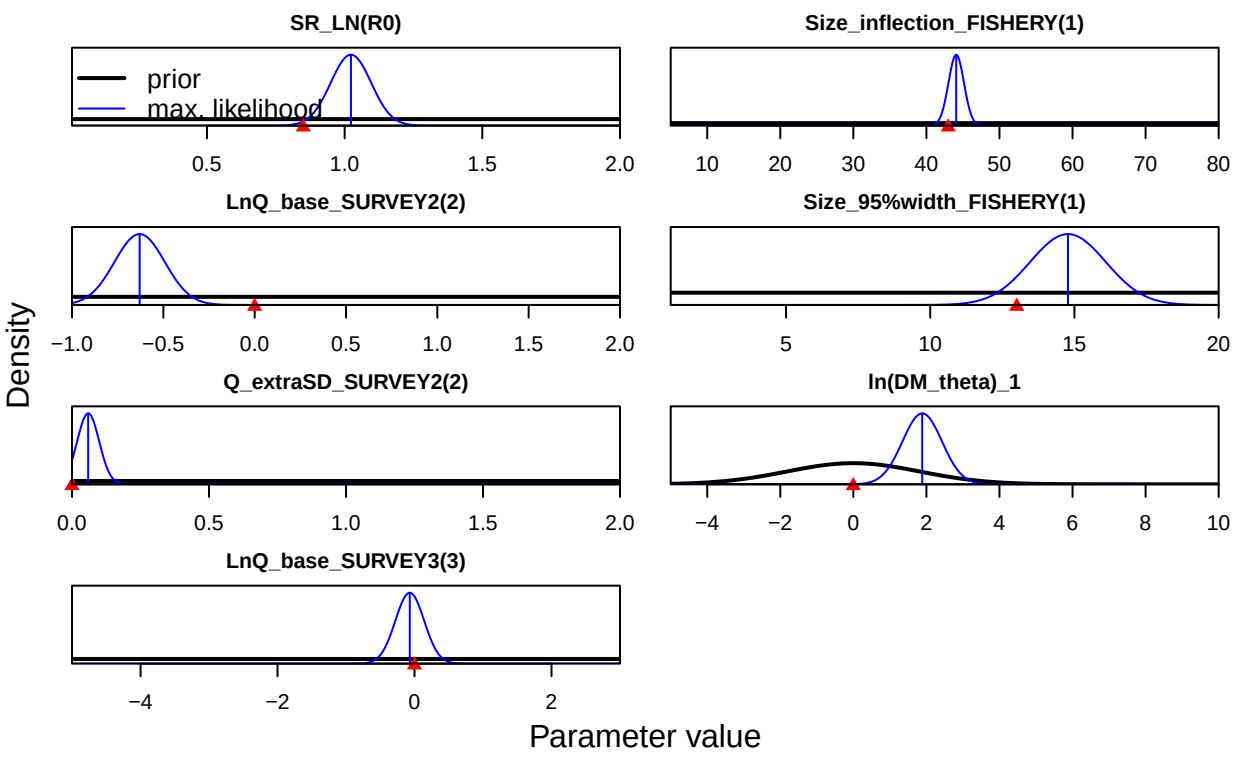

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0.0
0.5
1.0
1.5
2.0
0
5
10
15
20
25
30
Total biomass (mt)


Yield per recruit (kg)
0.0
0.2
0.4
0.6
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
1.0
1.5
2.0
Size_inflection_FISHERY(1)
10
20
30
40
50
60
70
80
LnQ_base_SURVEY2(2)
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
Size_95%width_FISHERY(1)
5
10
15
20
Q_extraSD_SURVEY2(2)
0.0
0.5
1.0
1.5
2.0
ln(DM_theta)_1
−4
−2
0
2
4
6
8
10
LnQ_base_SURVEY3(3)
−4
−2
0
2
Density
Parameter value