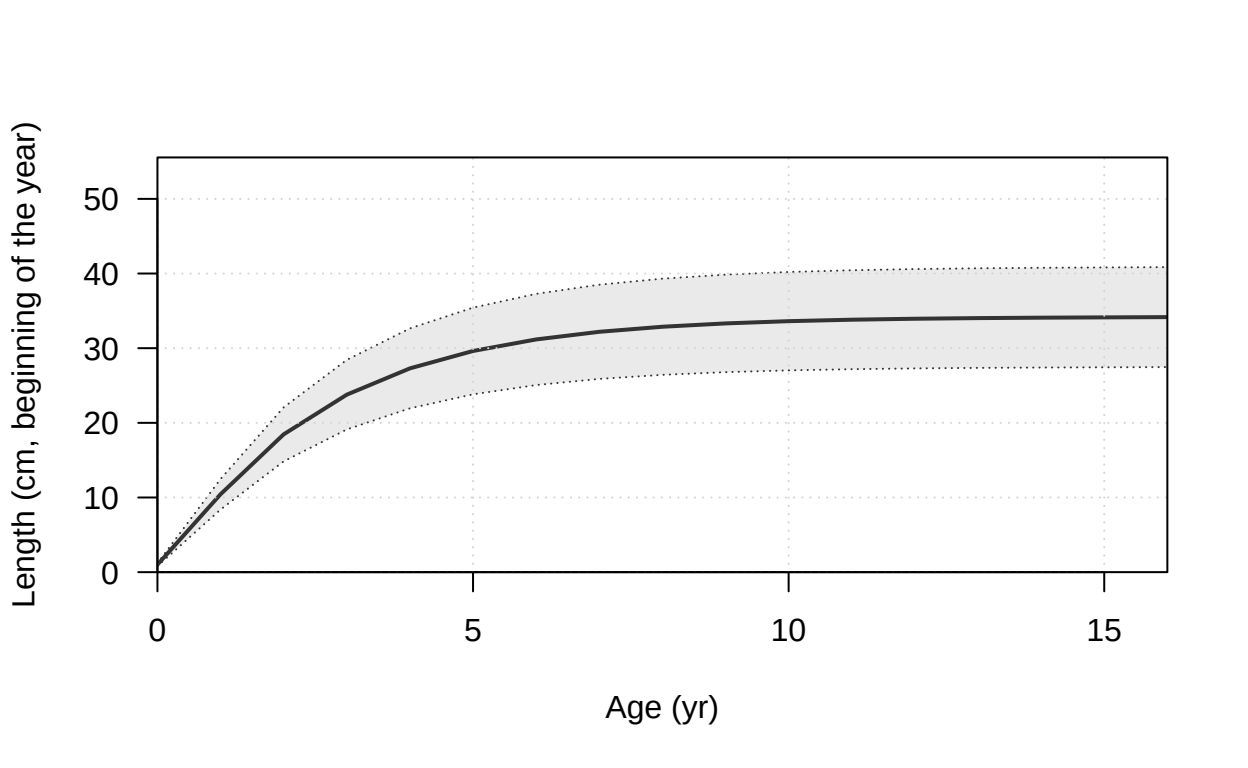
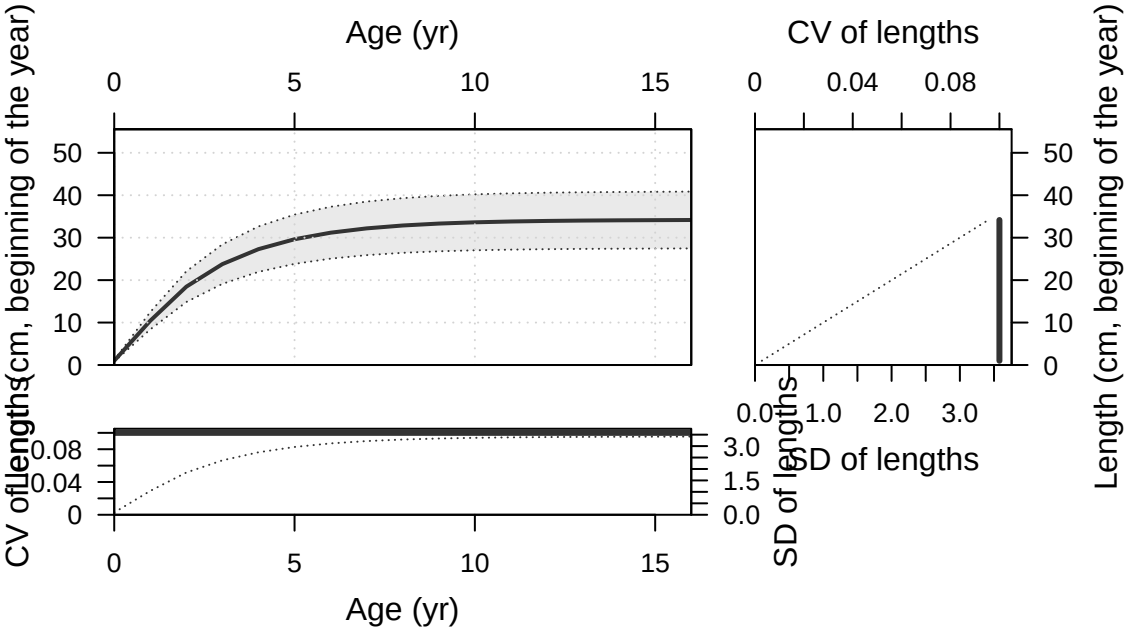
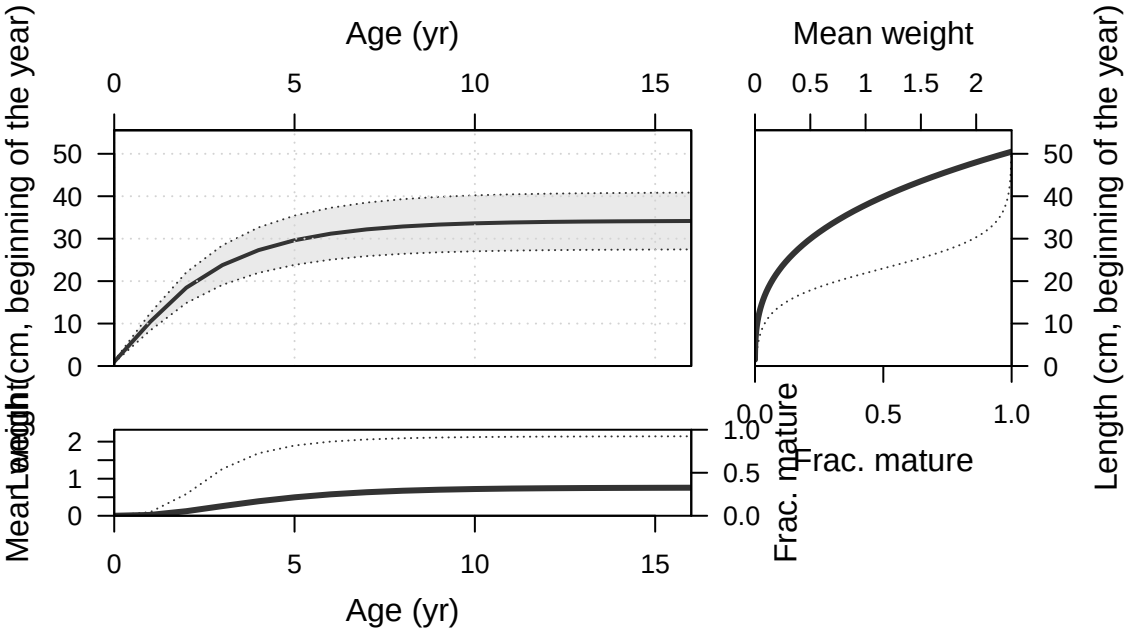
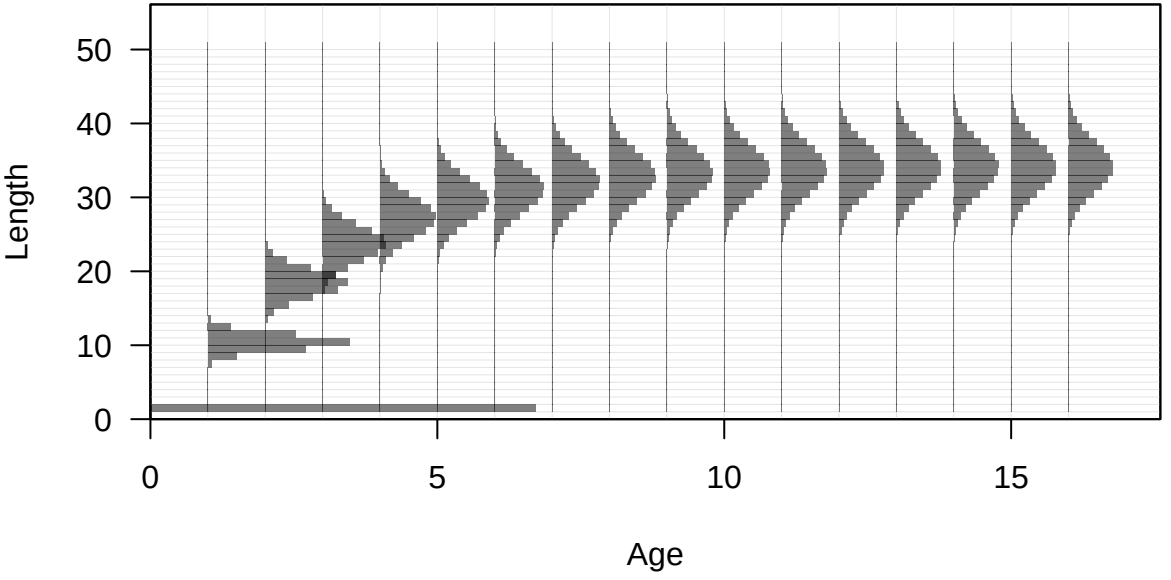
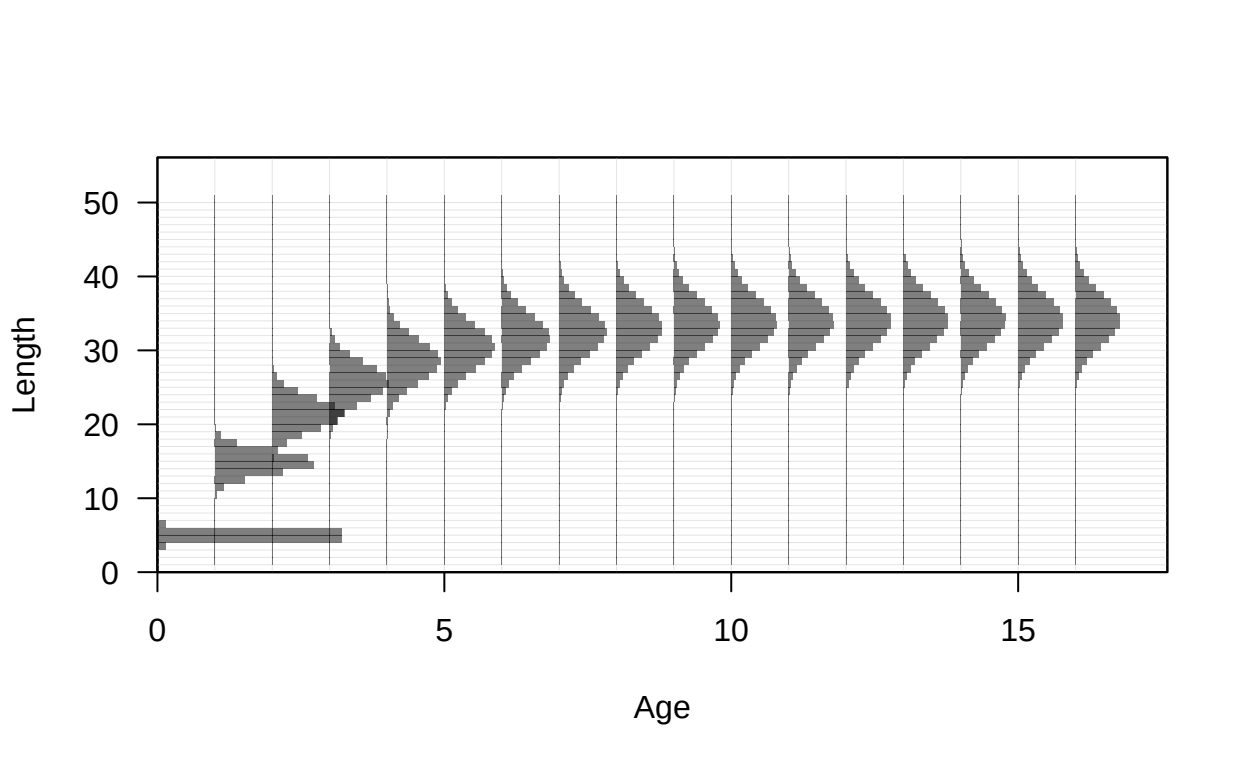
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Fri Jul 01 08:11:28 2022
Data_File: data.ss
Control_File: control.ss

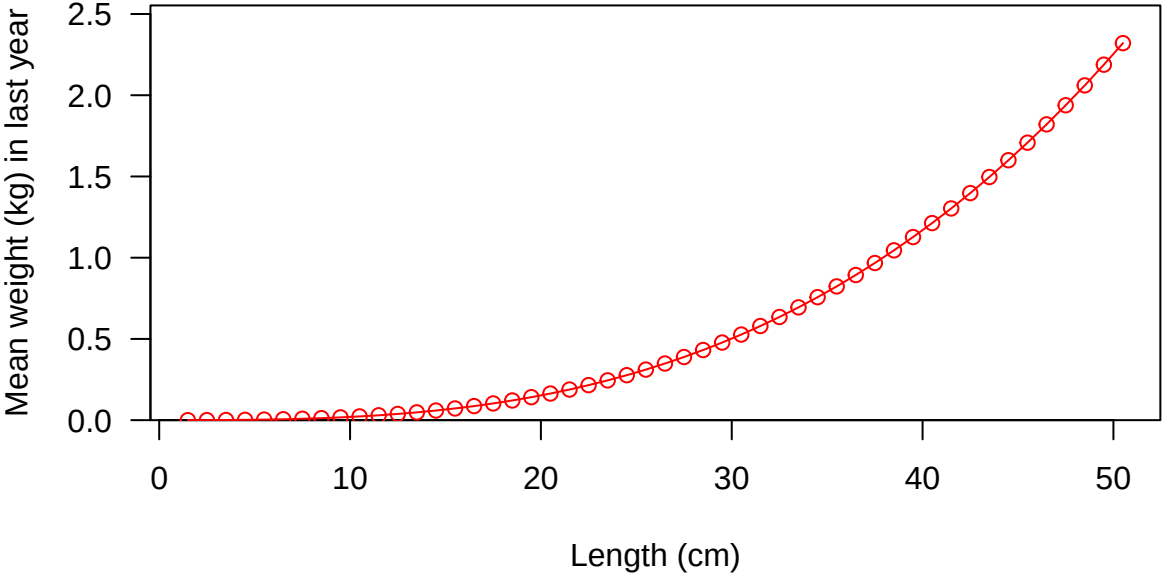

Length (cm, beginning of the year)
50
40
30
20
10
0
0
5
10
15
Age (yr)

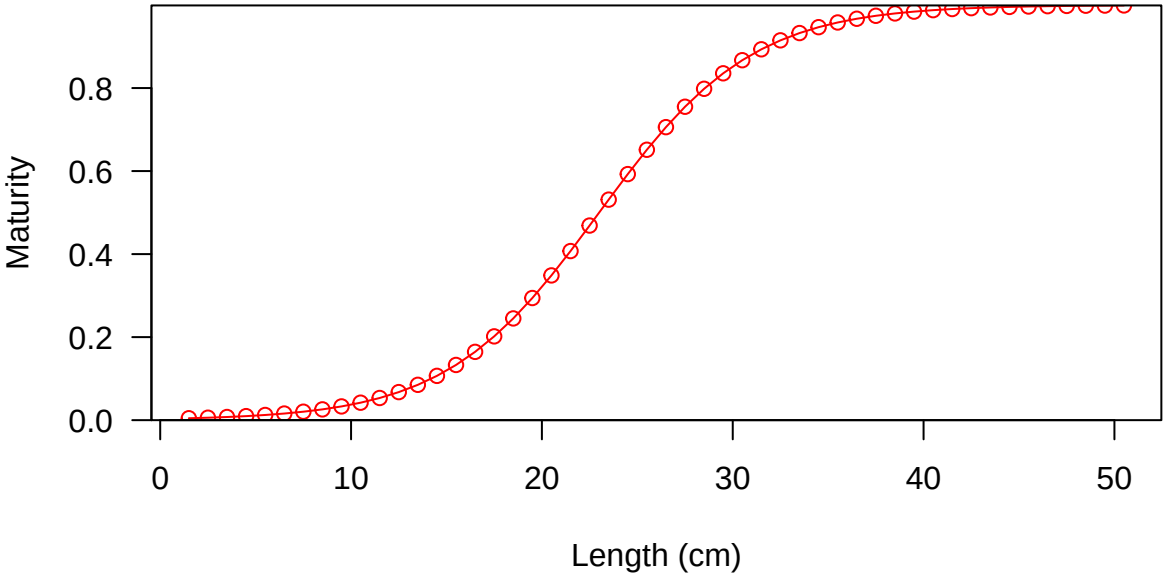

Age (yr)
0
5
10
15
Length (cm, beginning of the year)
0
10
20
30
40
50
CV of lengths
0.04
0.08
SD of lengths
1.0
2.0
3.0
1.5
0.0

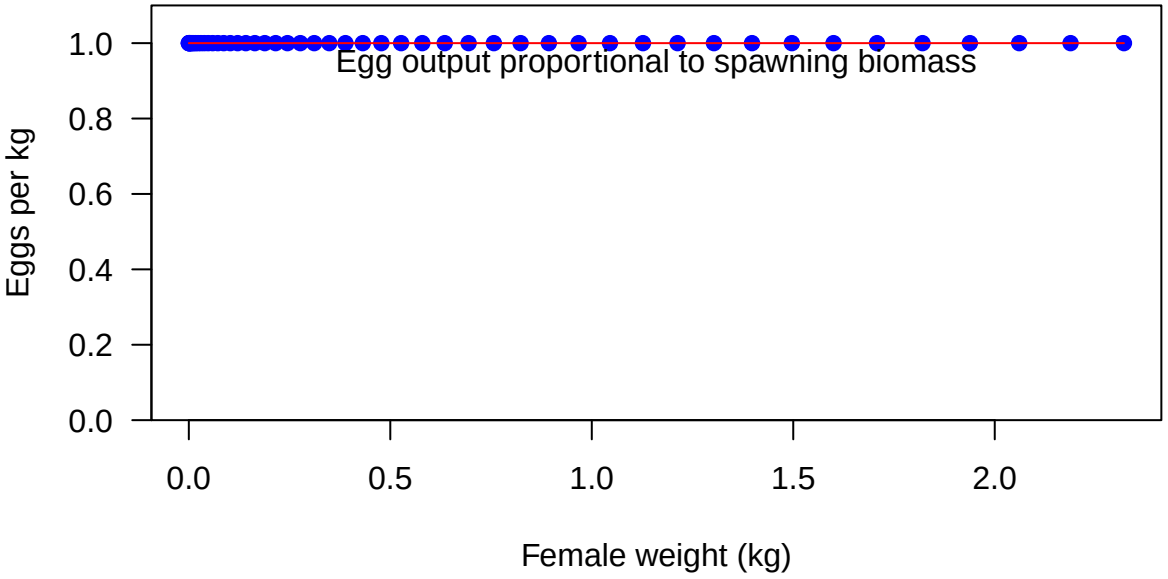

Age (yr)
0
5
10
15
Length (cm, beginning of the year)
0
10
20
30
40
50
Mean weight
0
0.5
1
1.5
2
Frac. mature
0.0
0.5
1.0
Age (yr)

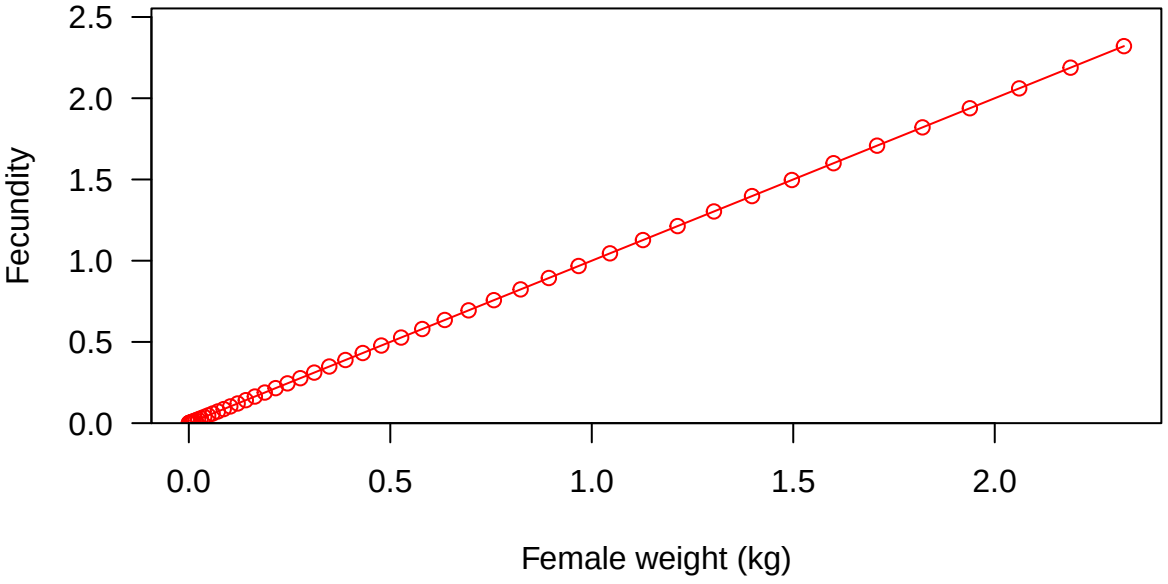

Length
50
40
30
20
10
0
0
5
10
15
Age

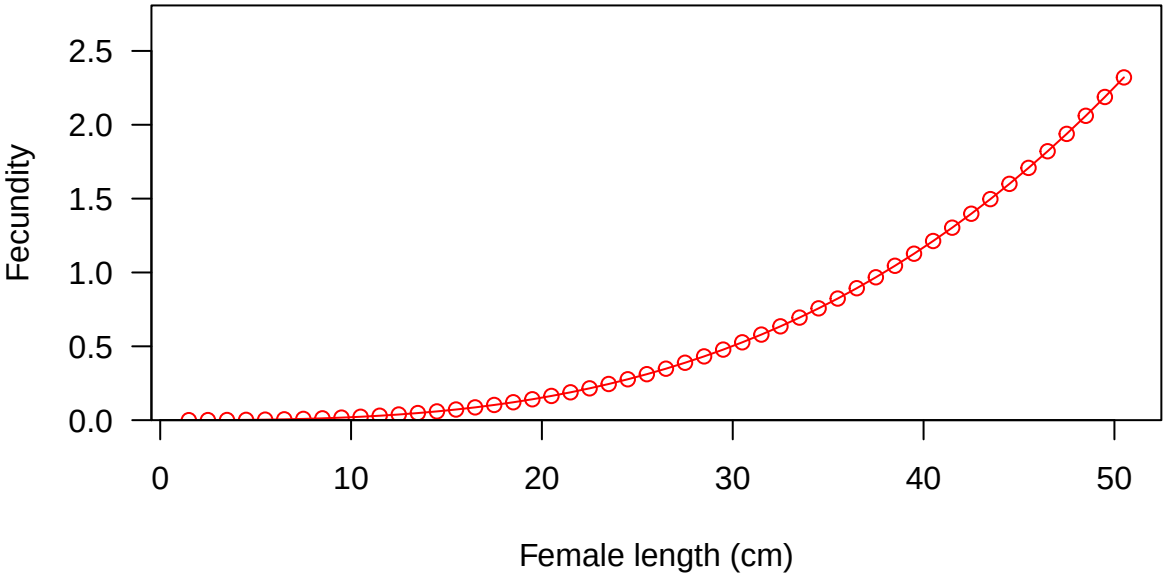

Length
50
40
30
20
10
0
0
5
10
15
Age

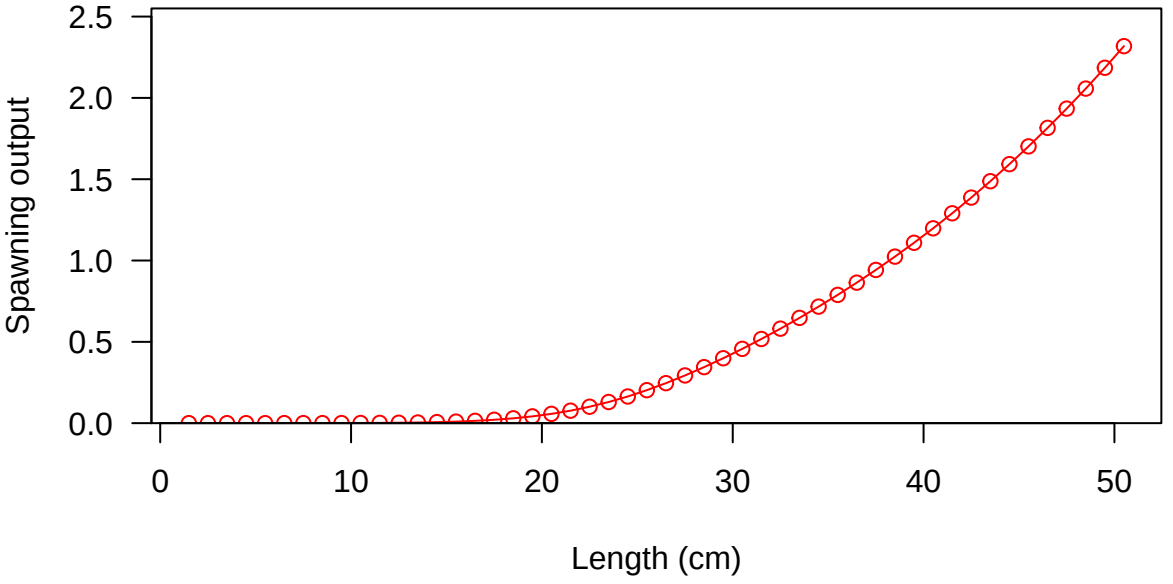

Mean weight (kg) in last year
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
Length (cm)

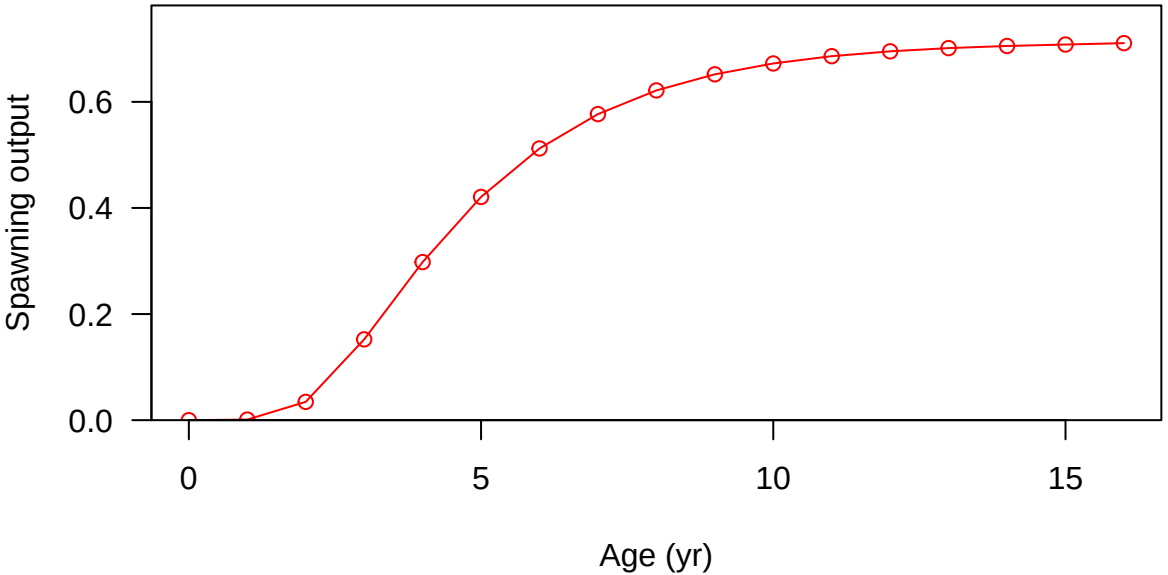

Maturity
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
50
Length (cm)

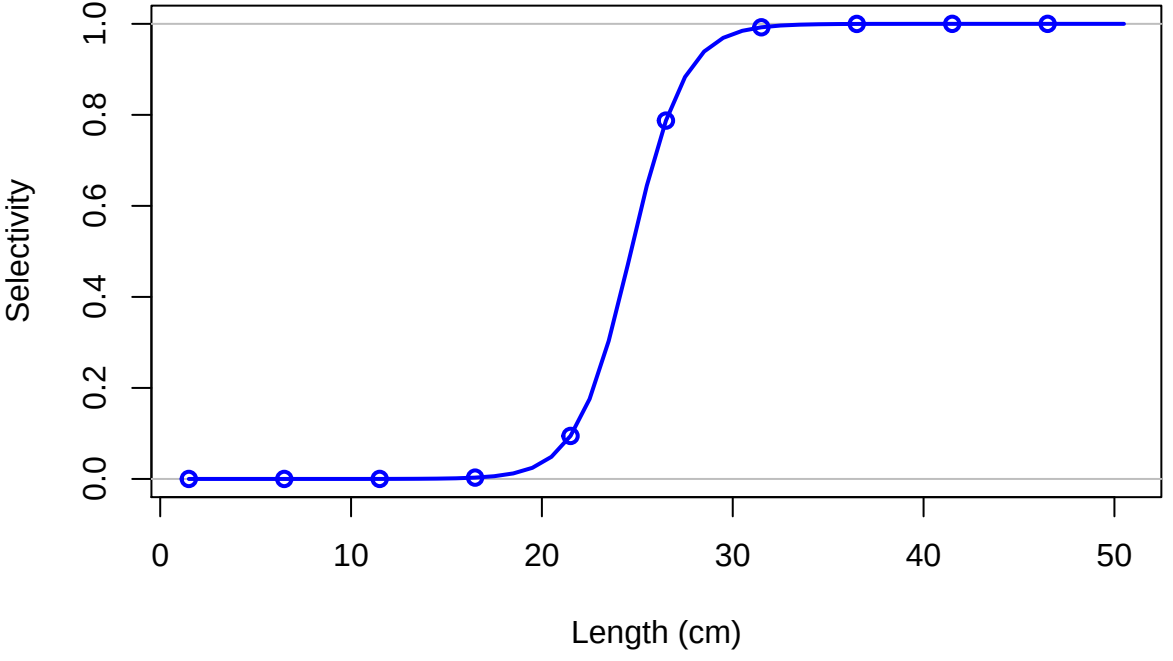

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Female weight (kg)

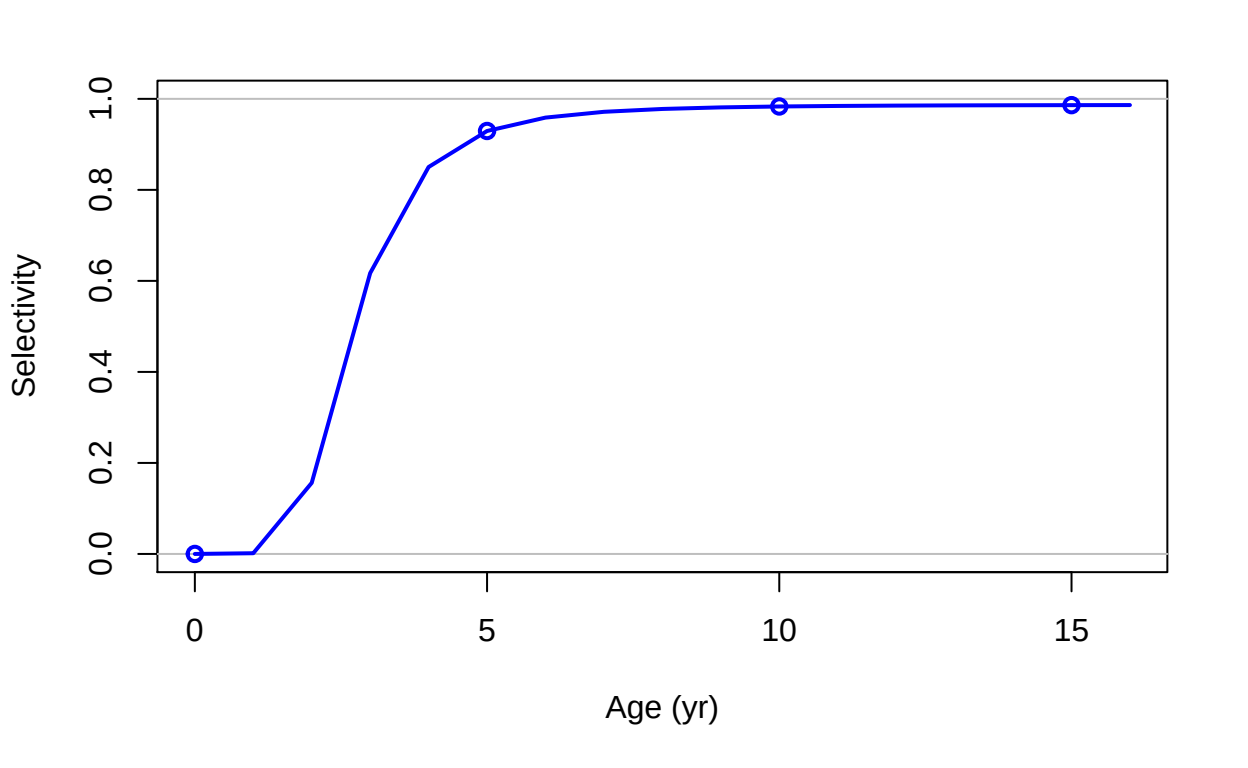

2.5
2.0
1.5
1.0
0.5
0.0
Fecundity
0.0
0.5
1.0
1.5
2.0
Female weight (kg)

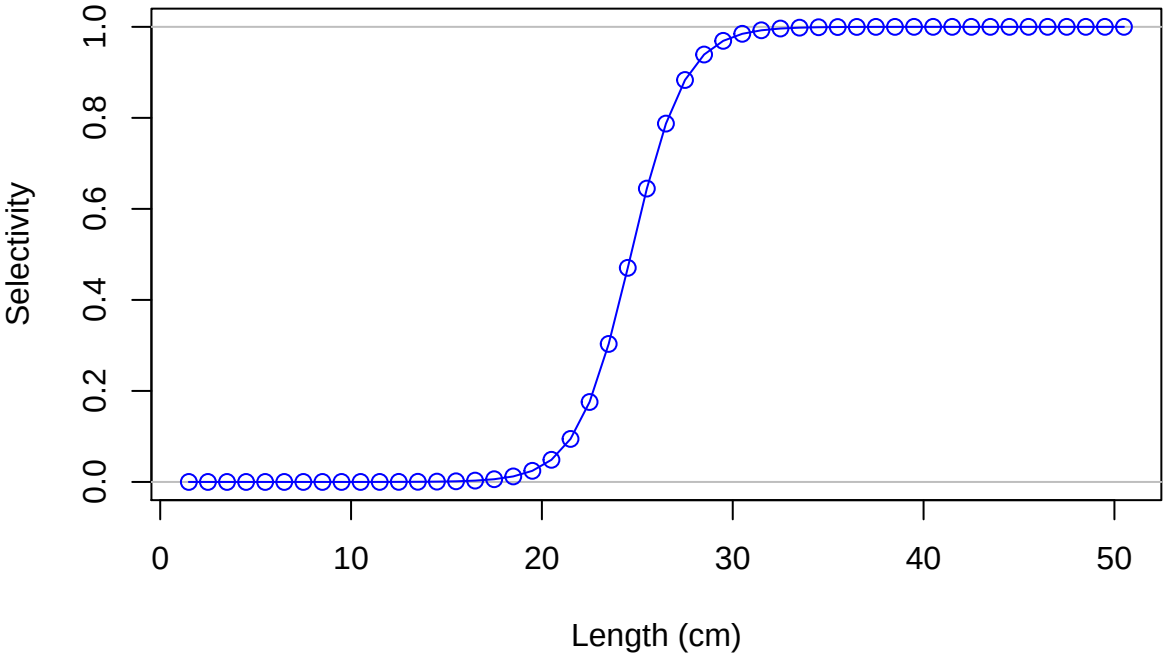

Fecundity
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
Female length (cm)

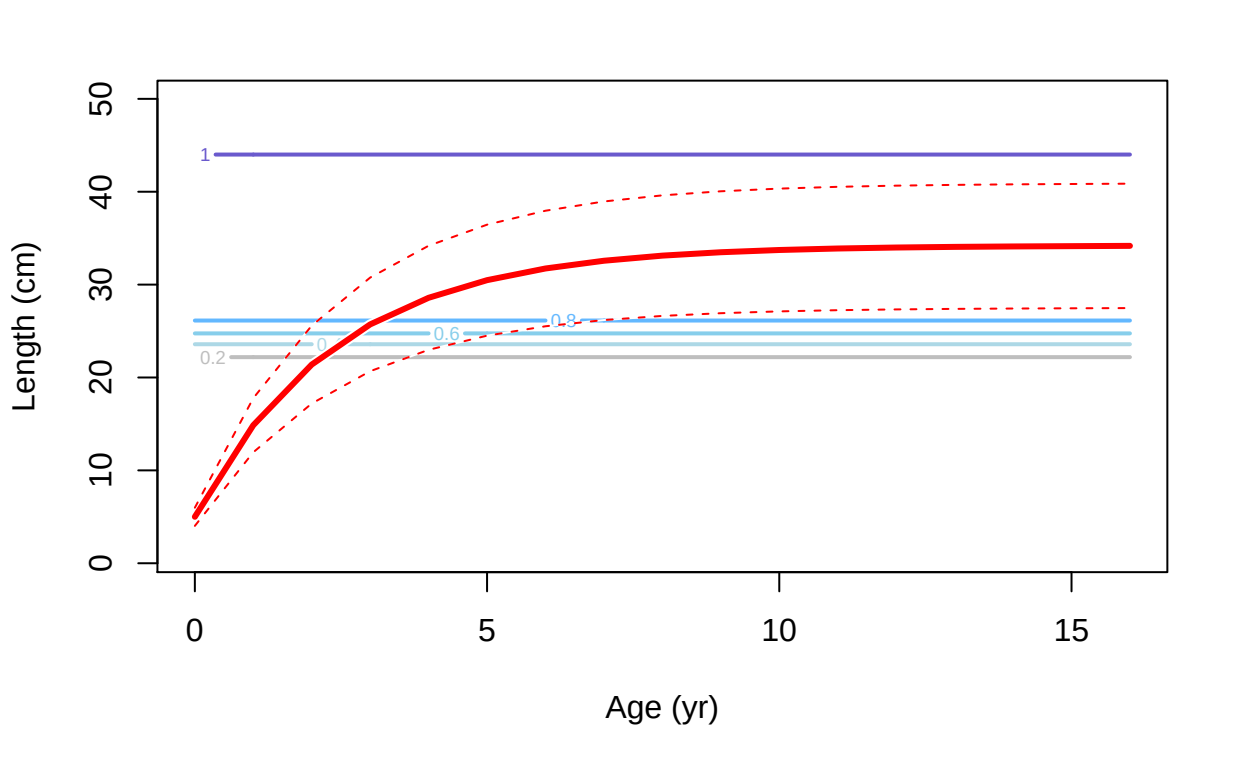

Spawning output
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
Length (cm)

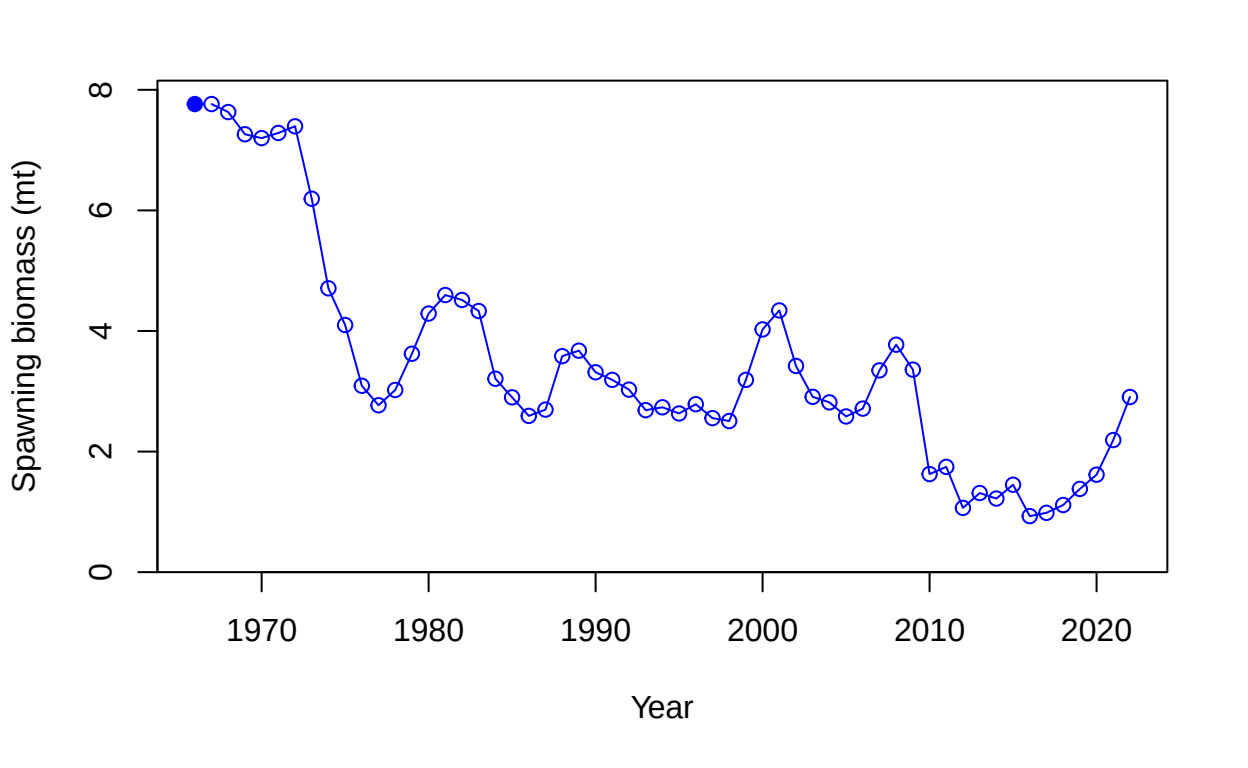

Spawning output
0.0
0.2
0.4
0.6
0
5
10
15
Age (yr)

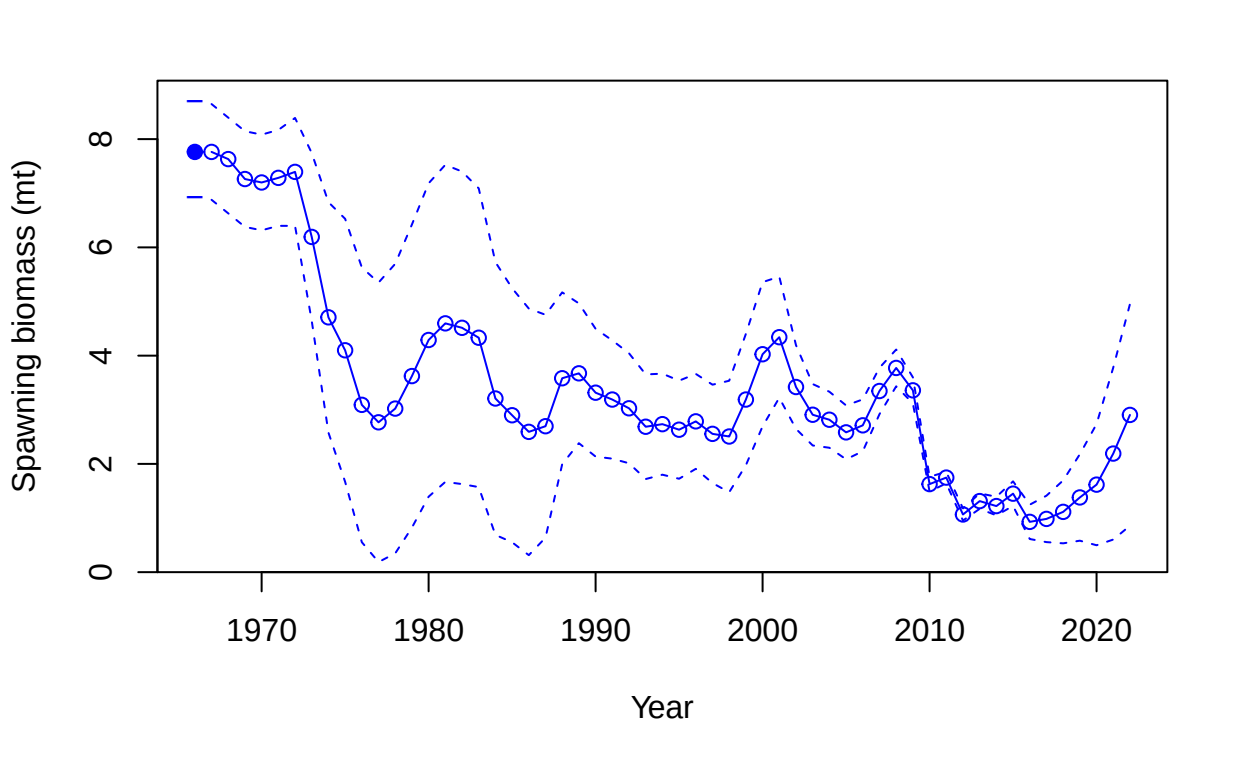

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Length (cm)

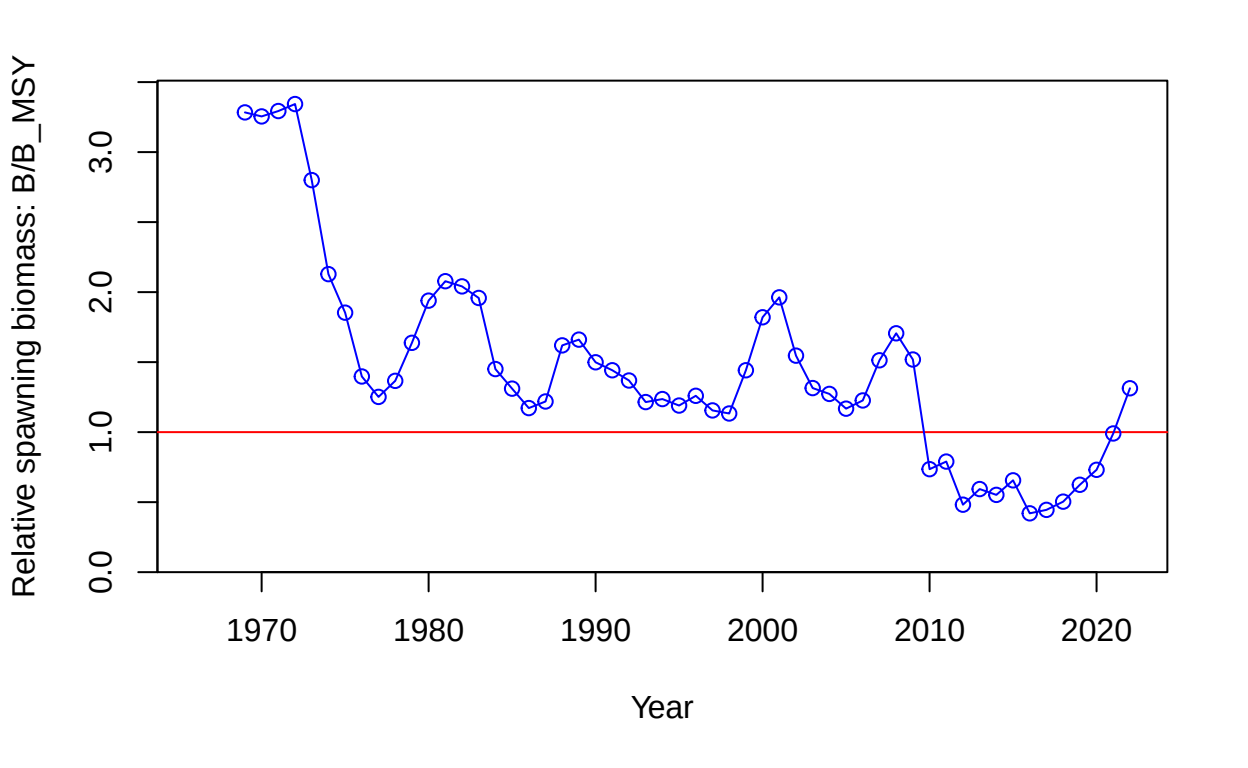

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
Age (yr)

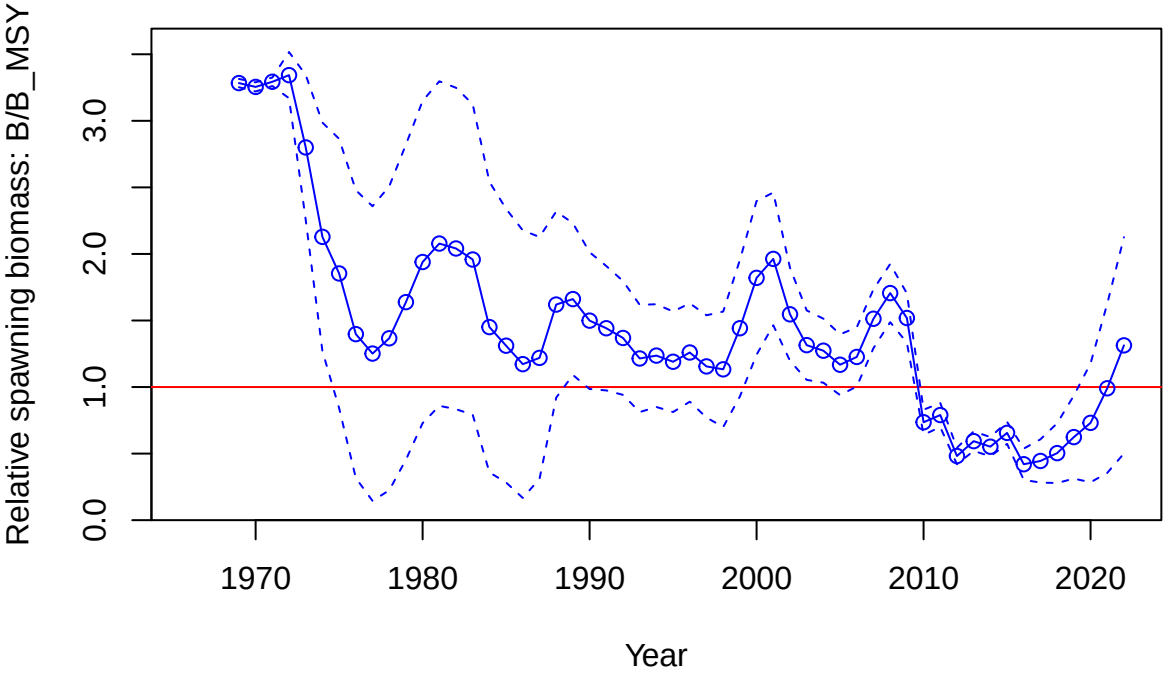

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Length (cm)

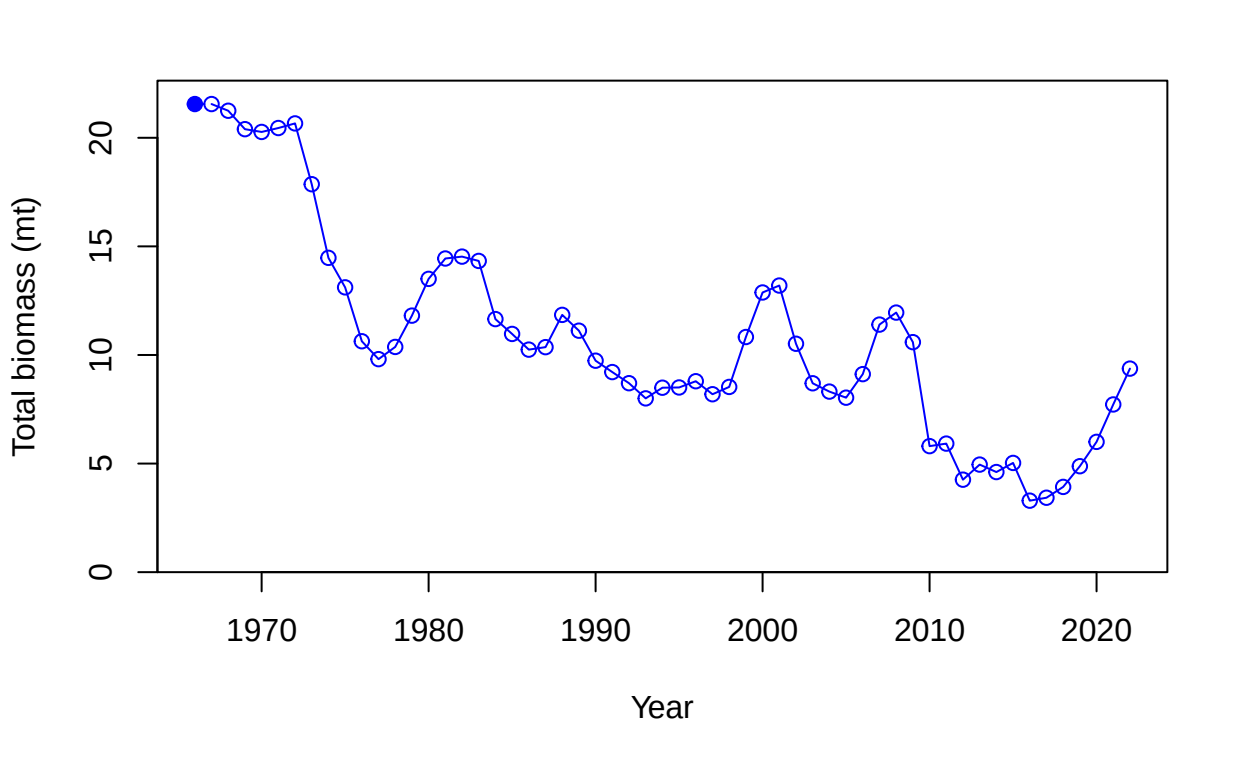

Length (cm)
0
10
20
30
40
50
0
5
10
15
Age (yr)
1
0.8
0.6
0
0.2

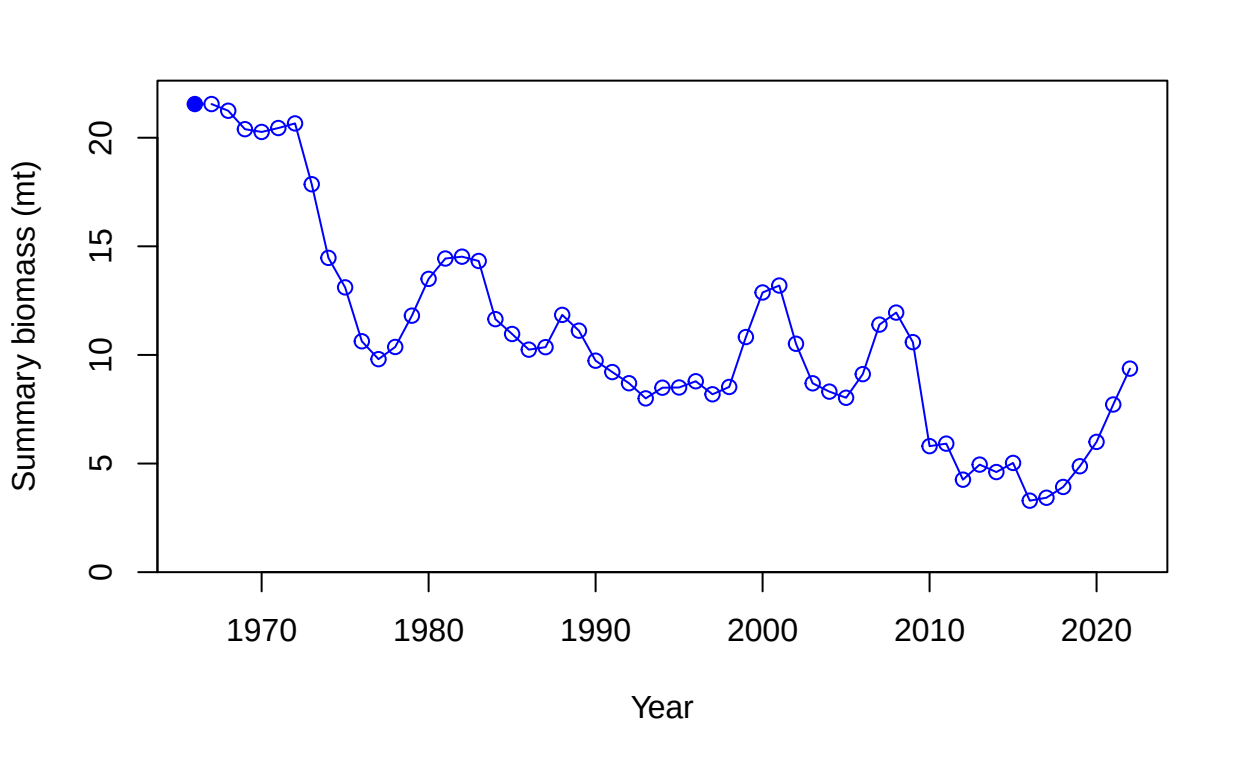

Spawning biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

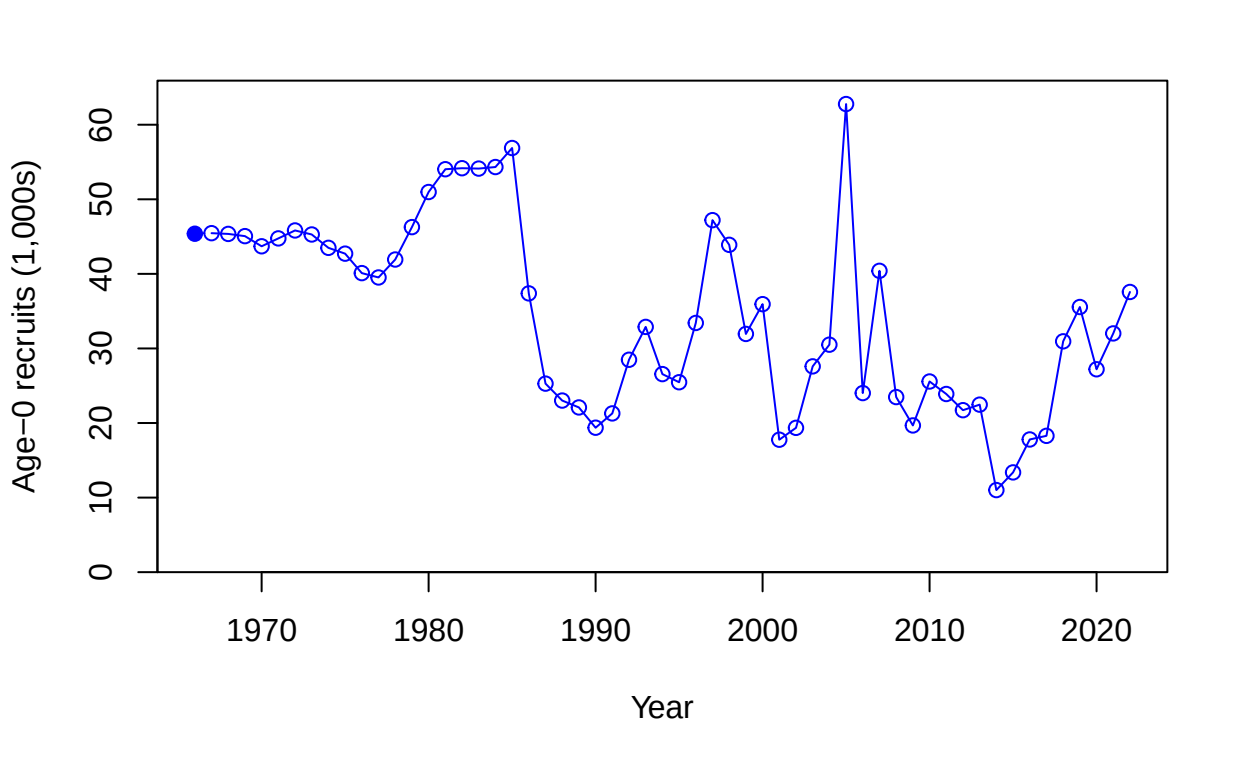

Spawning biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

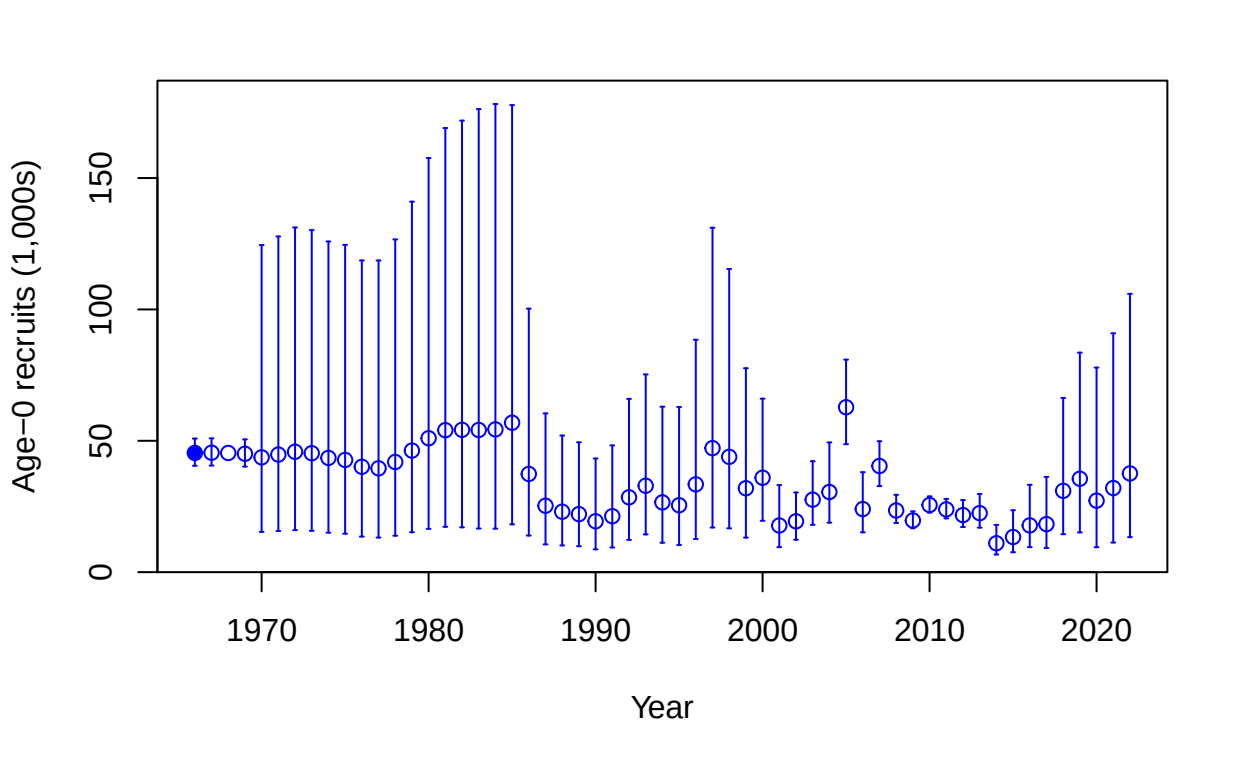

Relative spawning biomass: B/B_MSY
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

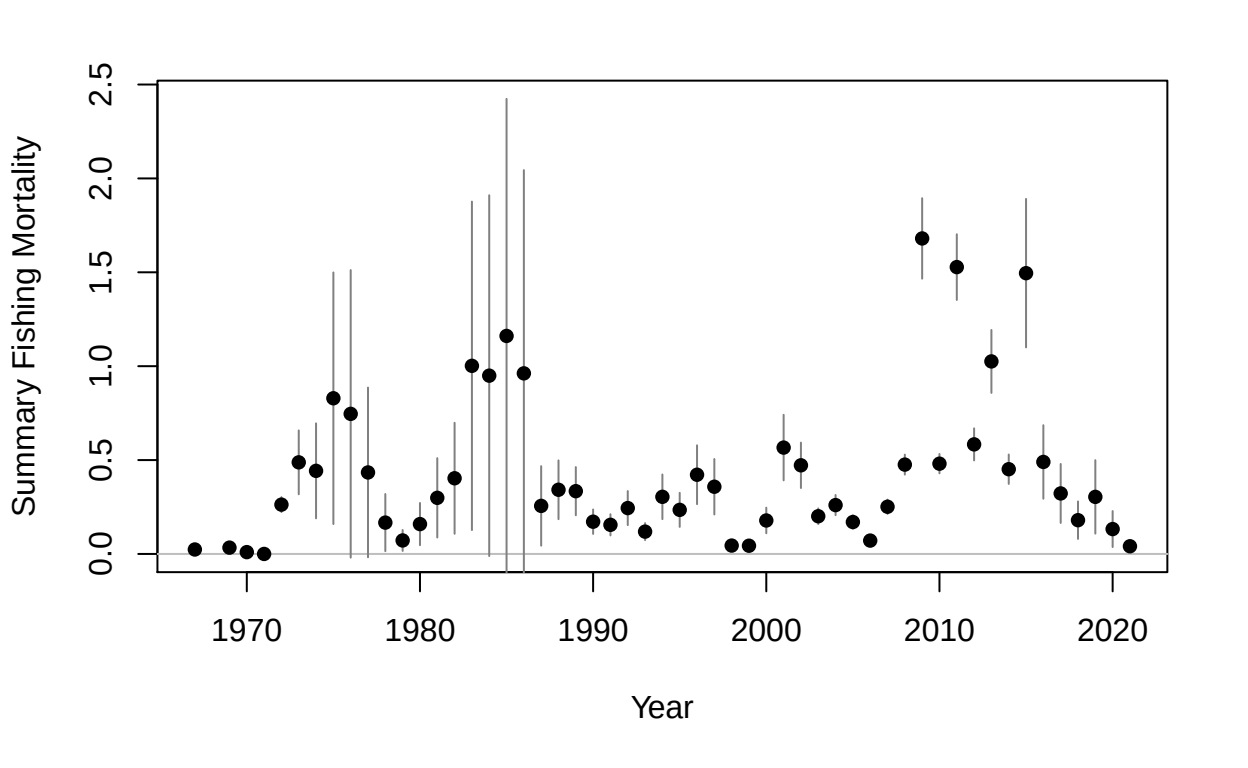

Relative spawning biomass: B/B_MSY
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

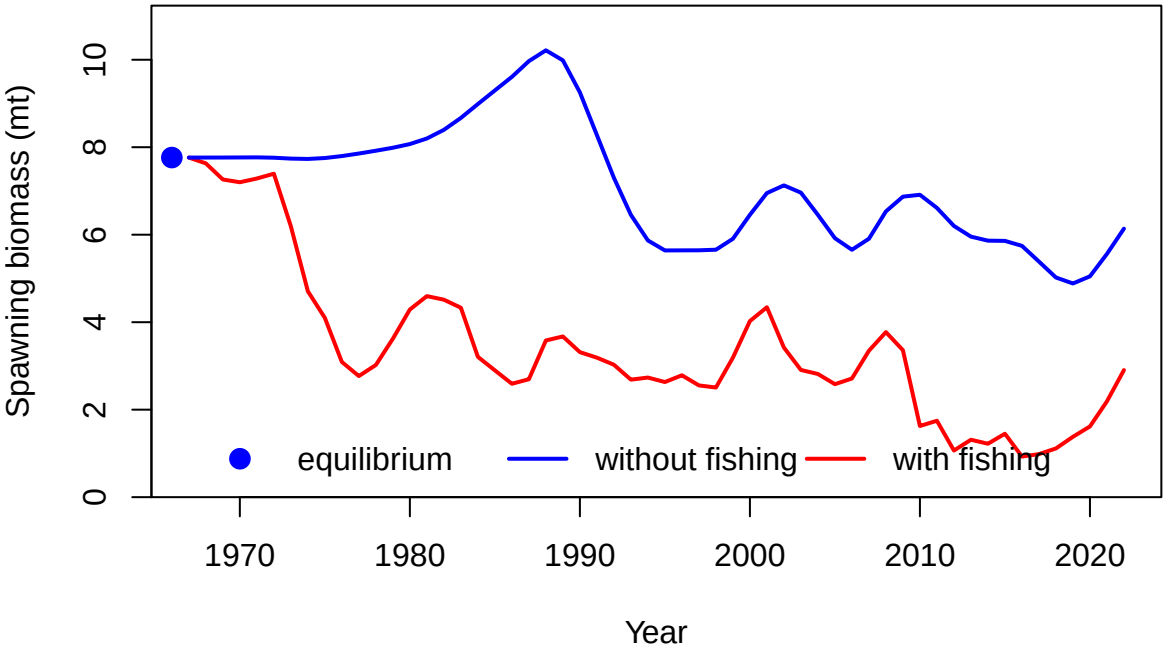

Total biomass (mt)
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Year

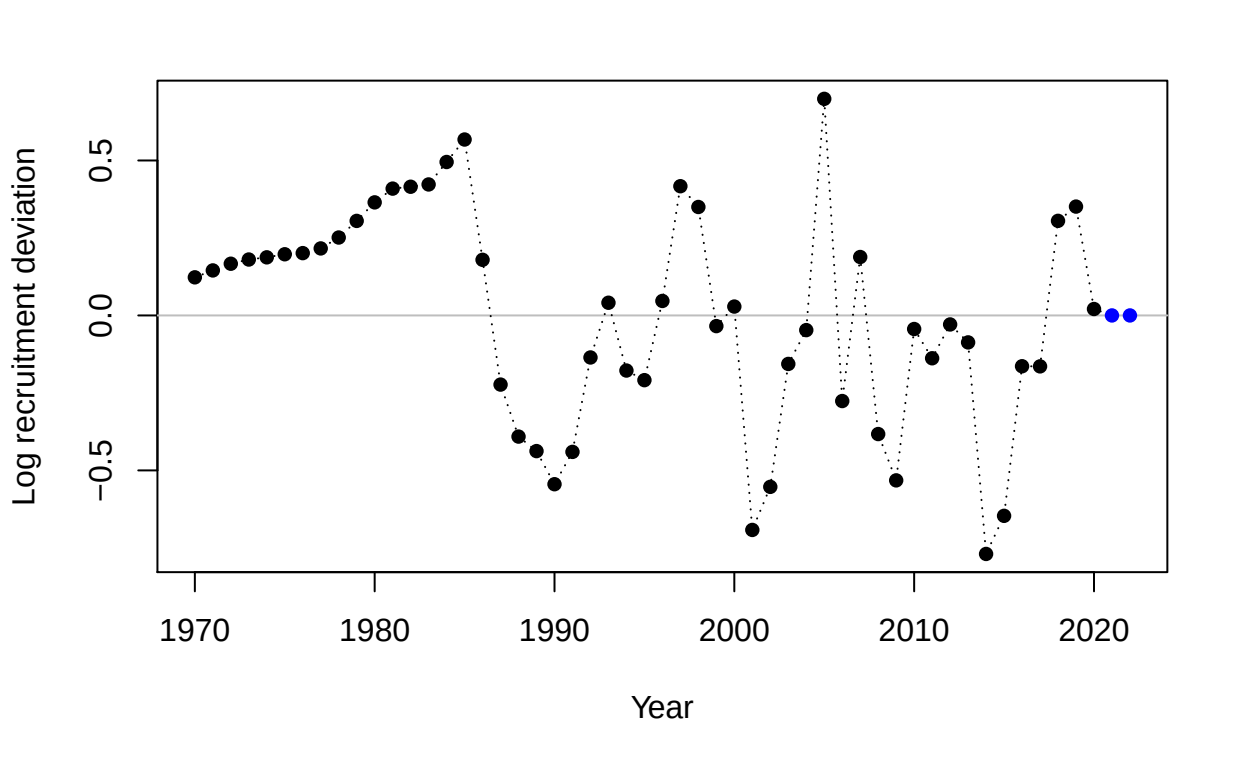

Summary biomass (mt)
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Year

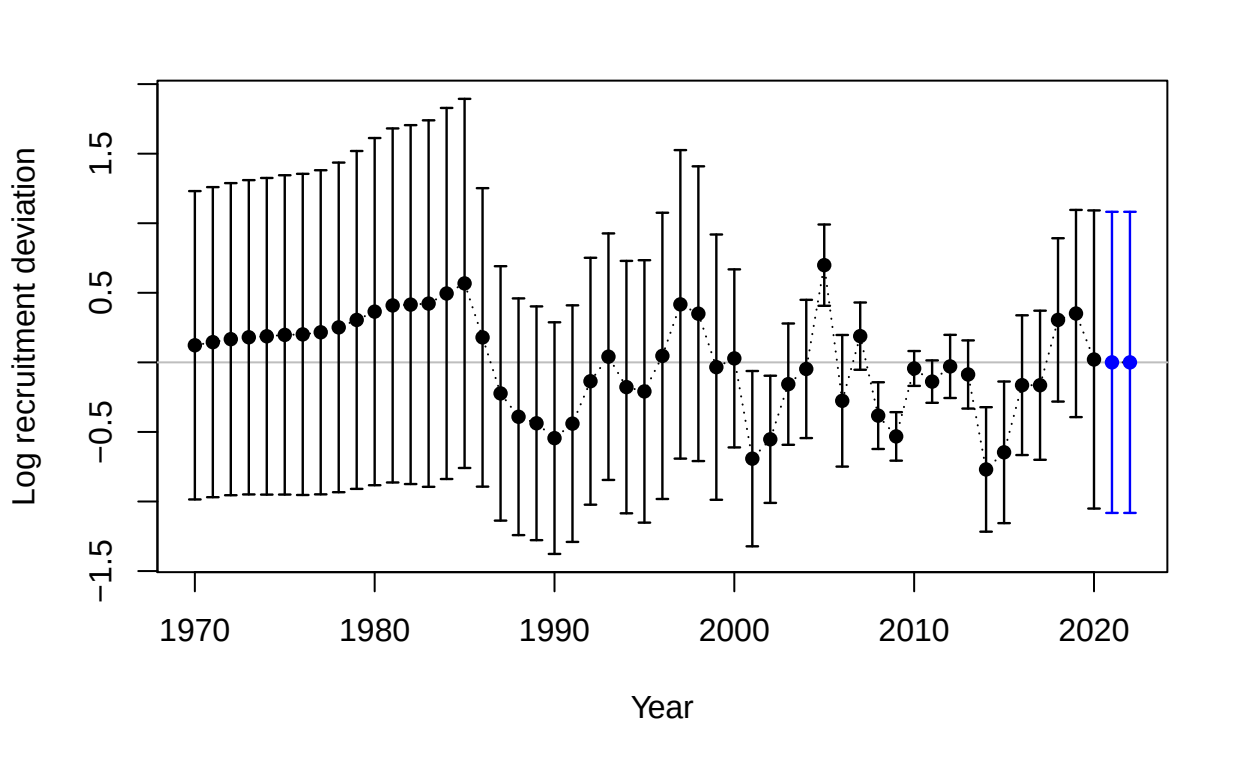

Age−0 recruits (1,000s)
0
10
20
30
40
50
60
1970
1980
1990
2000
2010
2020
Year

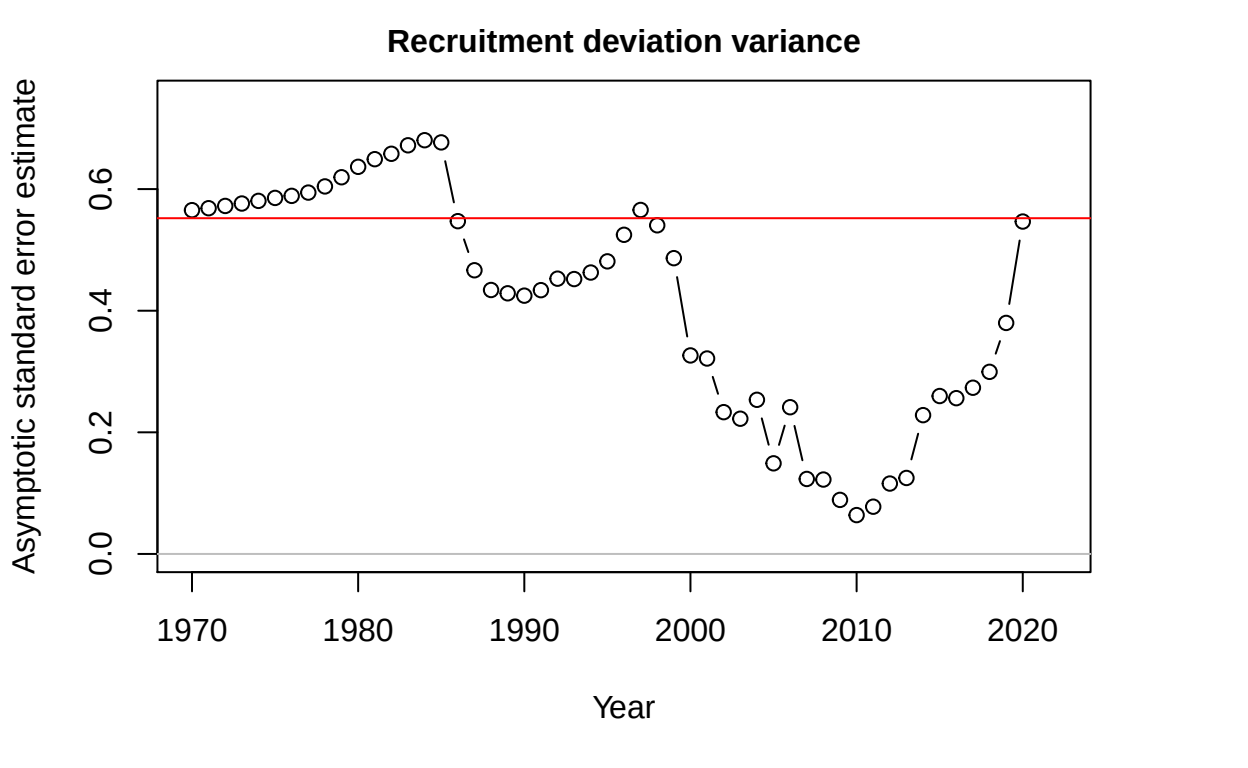

Age−0 recruits (1,000s)
0
50
100
150
1970
1980
1990
2000
2010
2020
Year

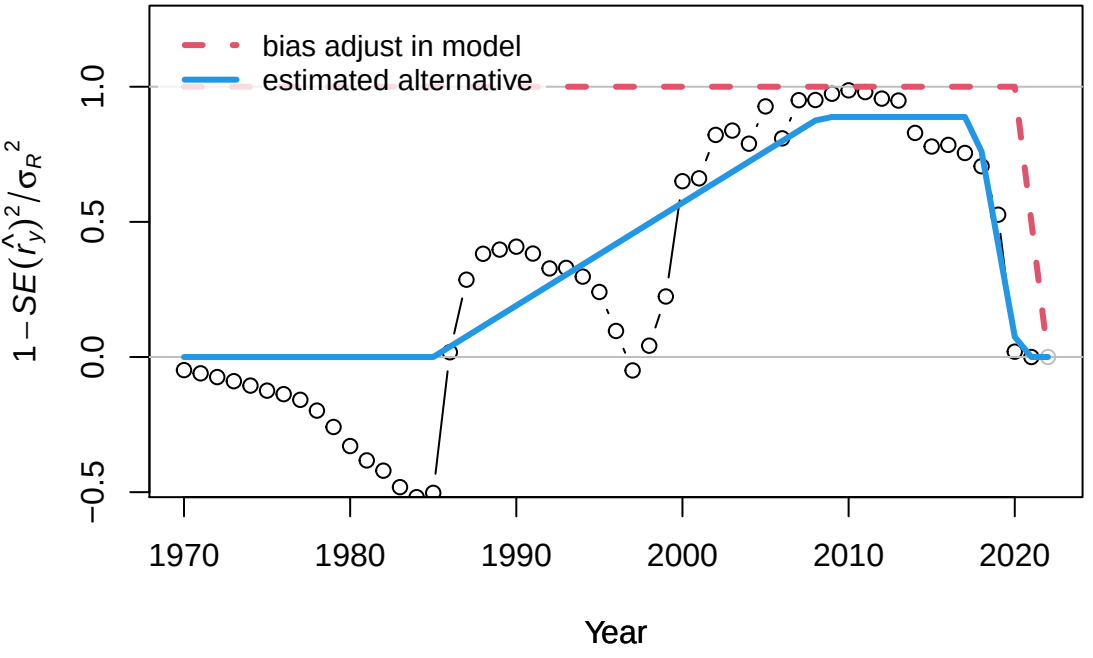

Summary Fishing Mortality
0.0
0.5
1.0
1.5
2.0
2.5
1970
1980
1990
2000
2010
2020
Year

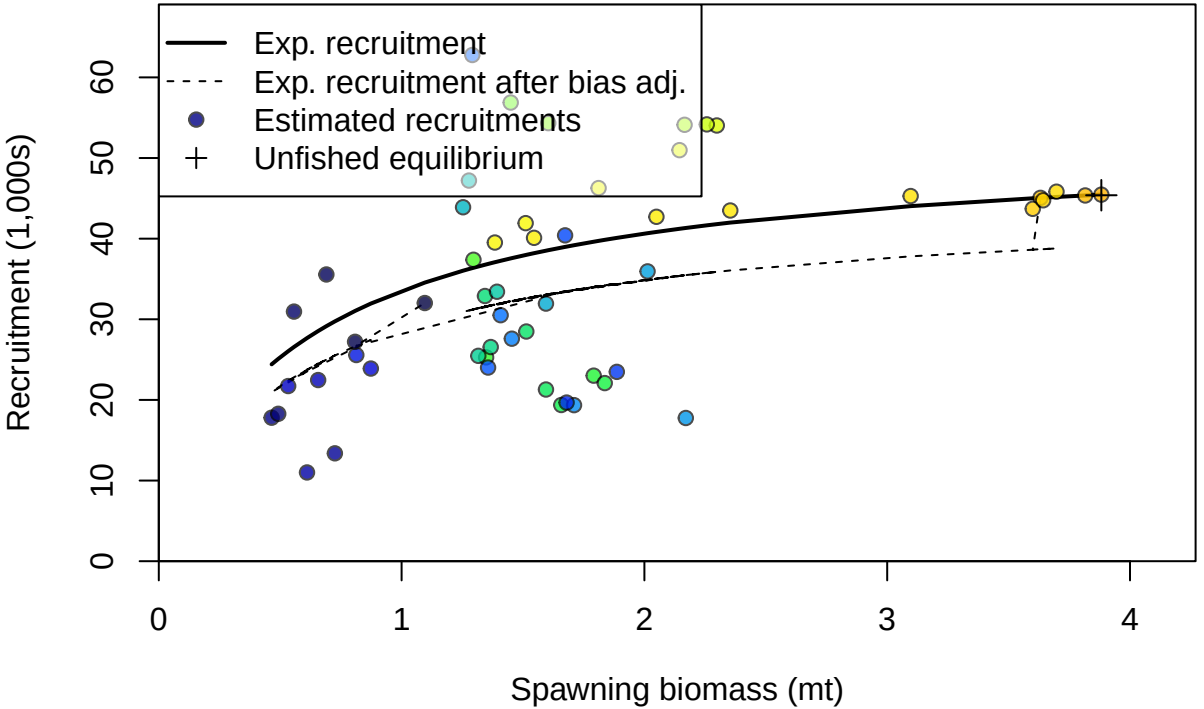

Spawning biomass (mt)
0
2
4
6
8
10
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

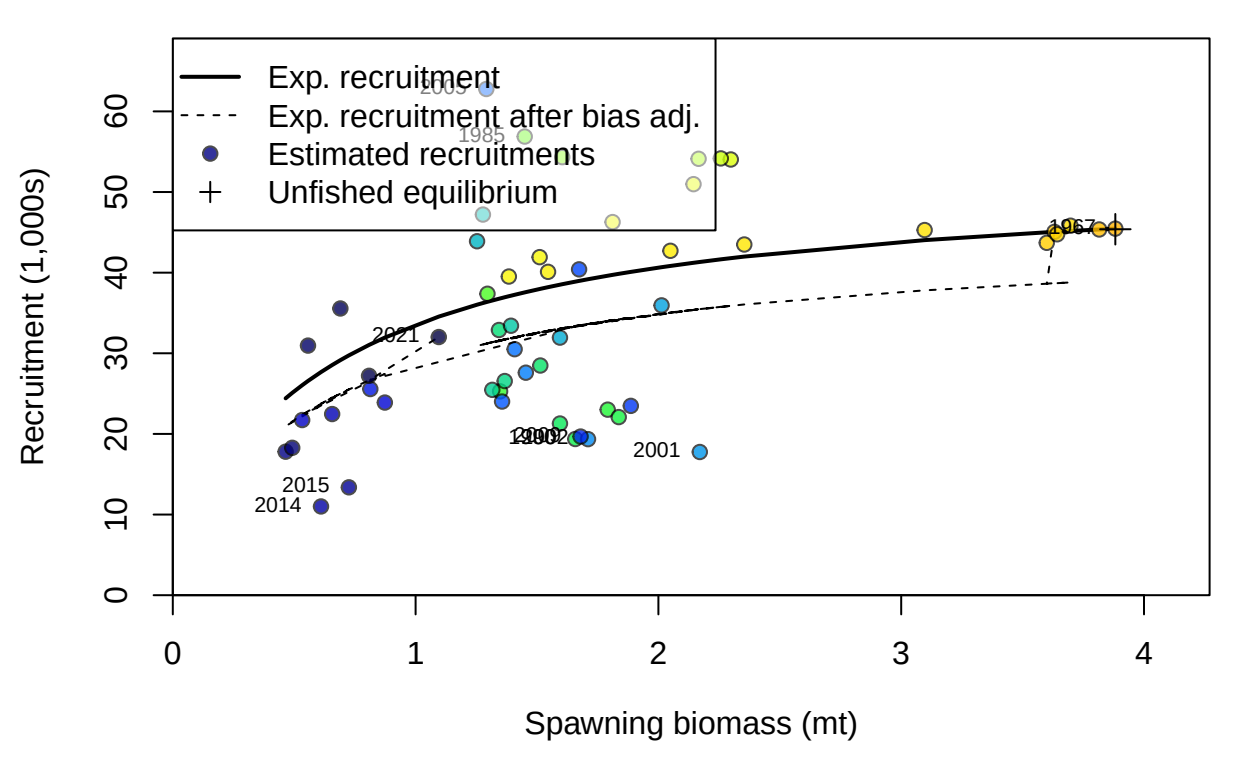

Log recruitment deviation
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year

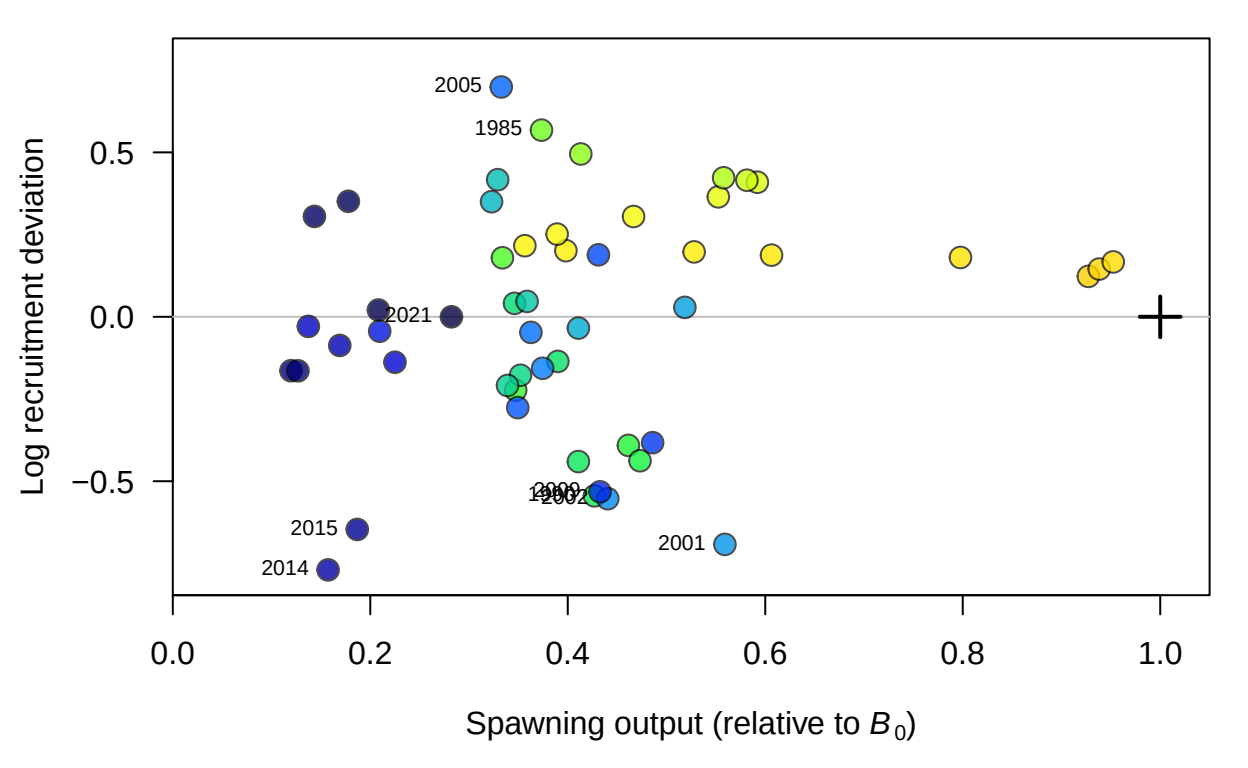

Log recruitment deviation
1.5
0.5
−0.5
−1.5
1970
1980
1990
2000
2010
2020
Year

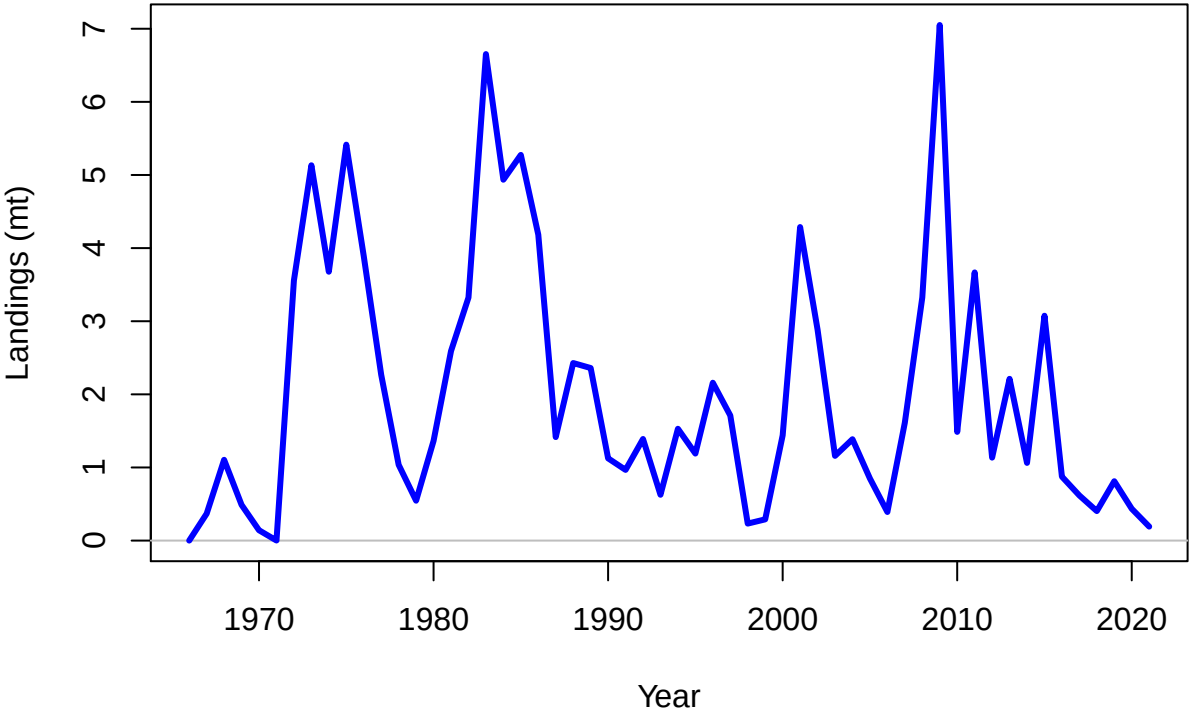

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

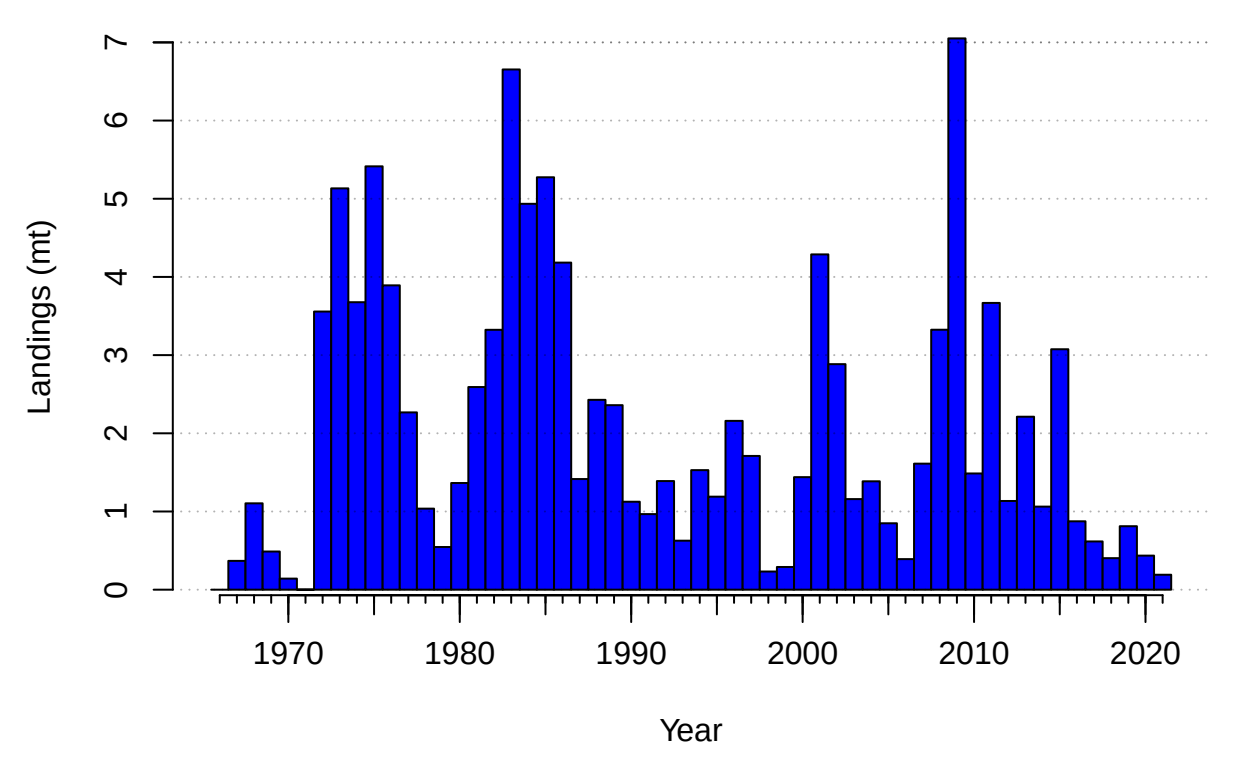

bias adjust in model
estimated alternative
1.0
0.5
0.0
−0.5
$1-SE(\hat{r}_y)^2/\sigma_R^2$
1970
1980
1990
2000
2010
2020
Year

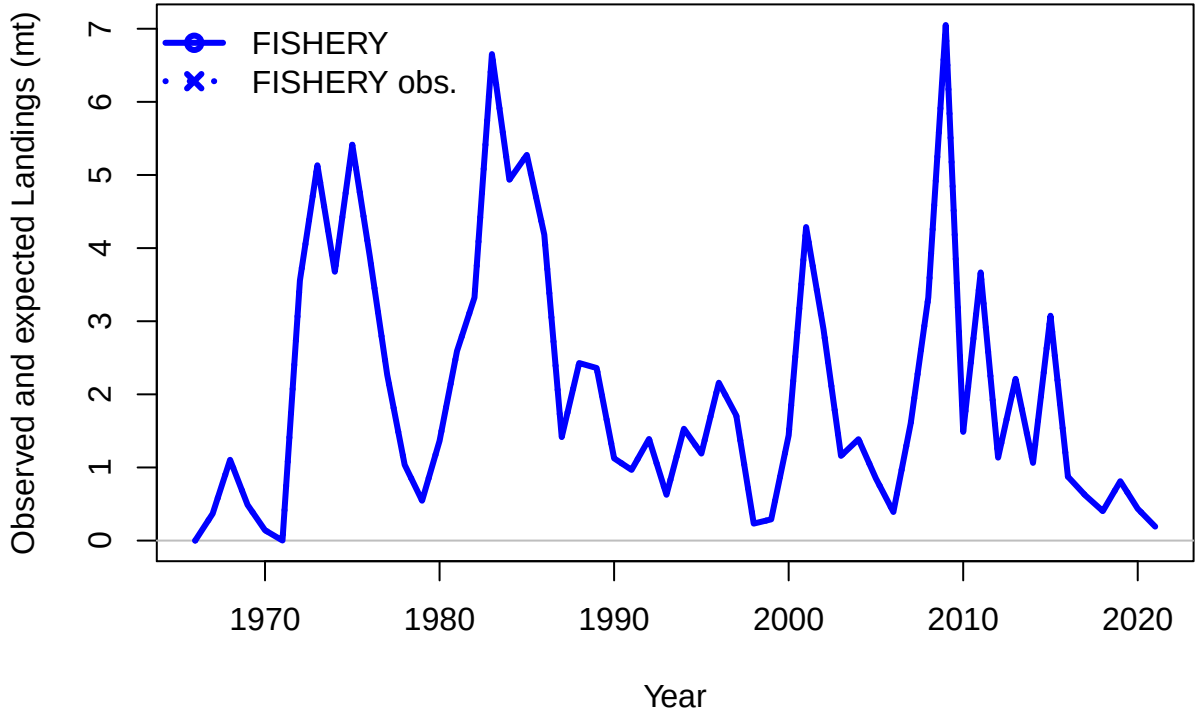

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
10
20
30
40
50
60
0
1
2
3
4
Spawning biomass (mt)

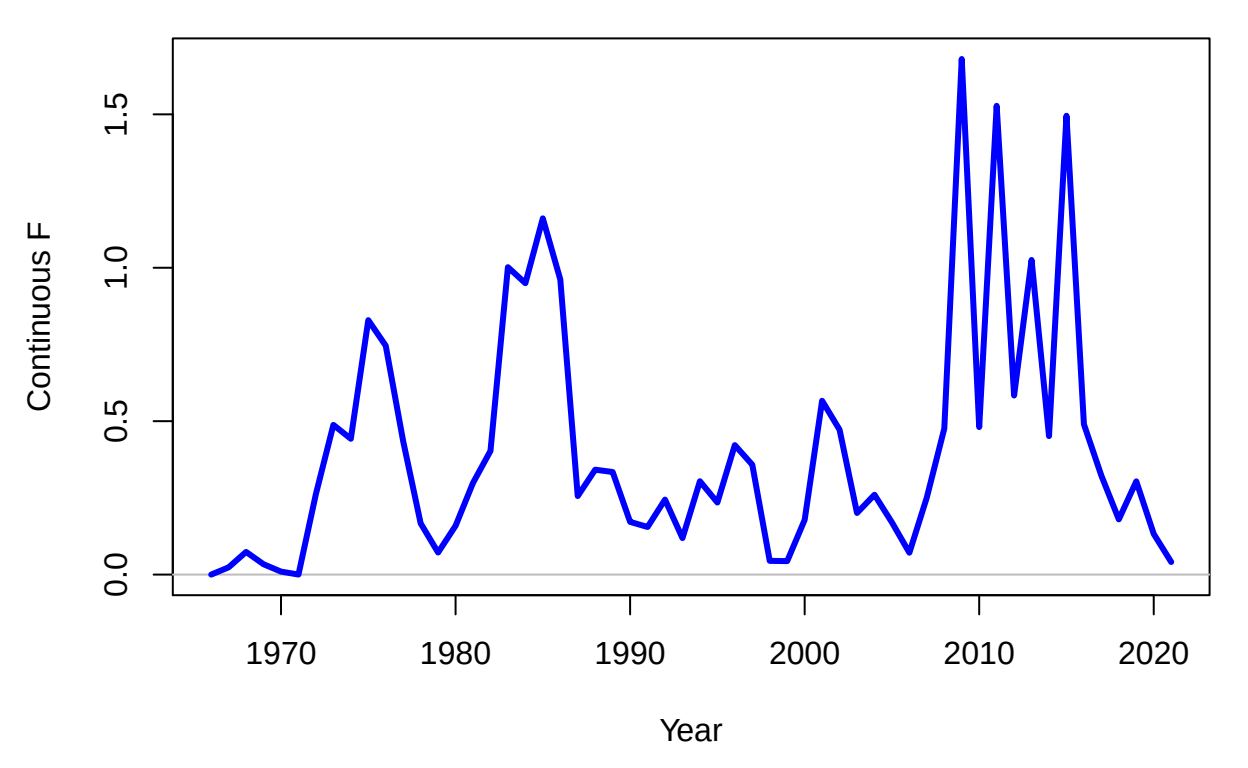

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
Spawning biomass (mt)
0
10
20
30
40
50
60
0
1
2
3
4
1985
2021
2001
2015
2014

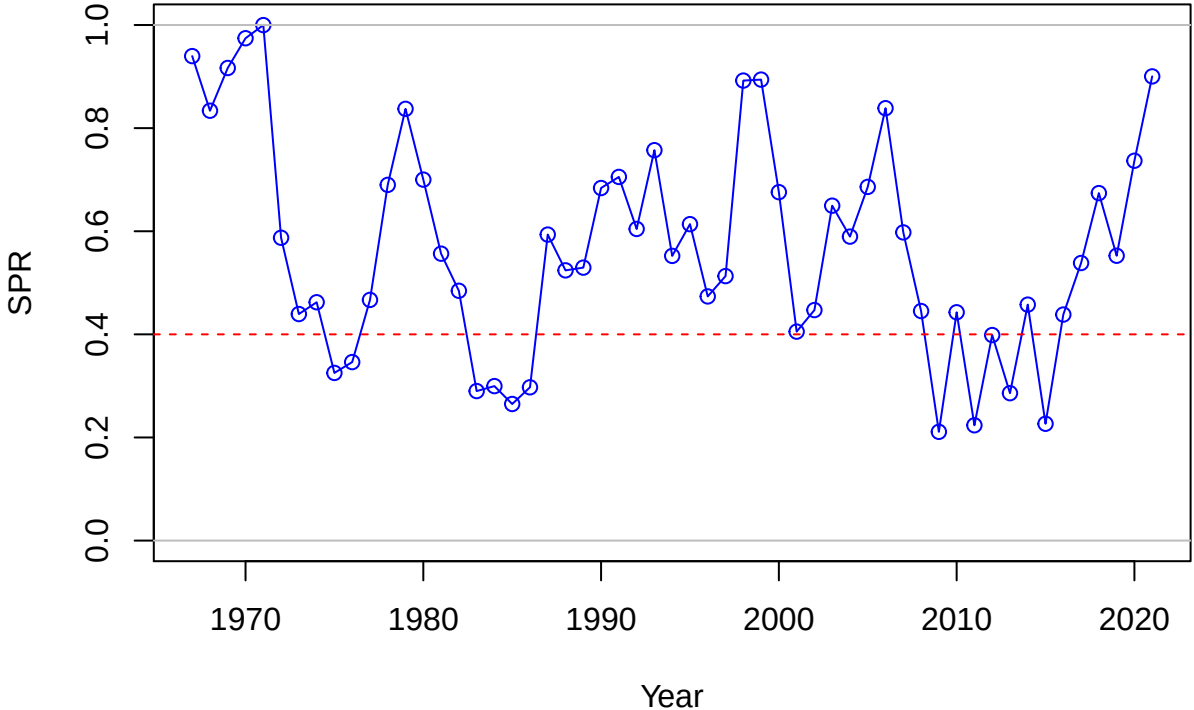

2005
1985
2021
2015
2014
2001
0.5
0.0
−0.5
0.0
0.2
0.4
0.6
0.8
1.0
Log recruitment deviation
Spawning output (relative to B_0)

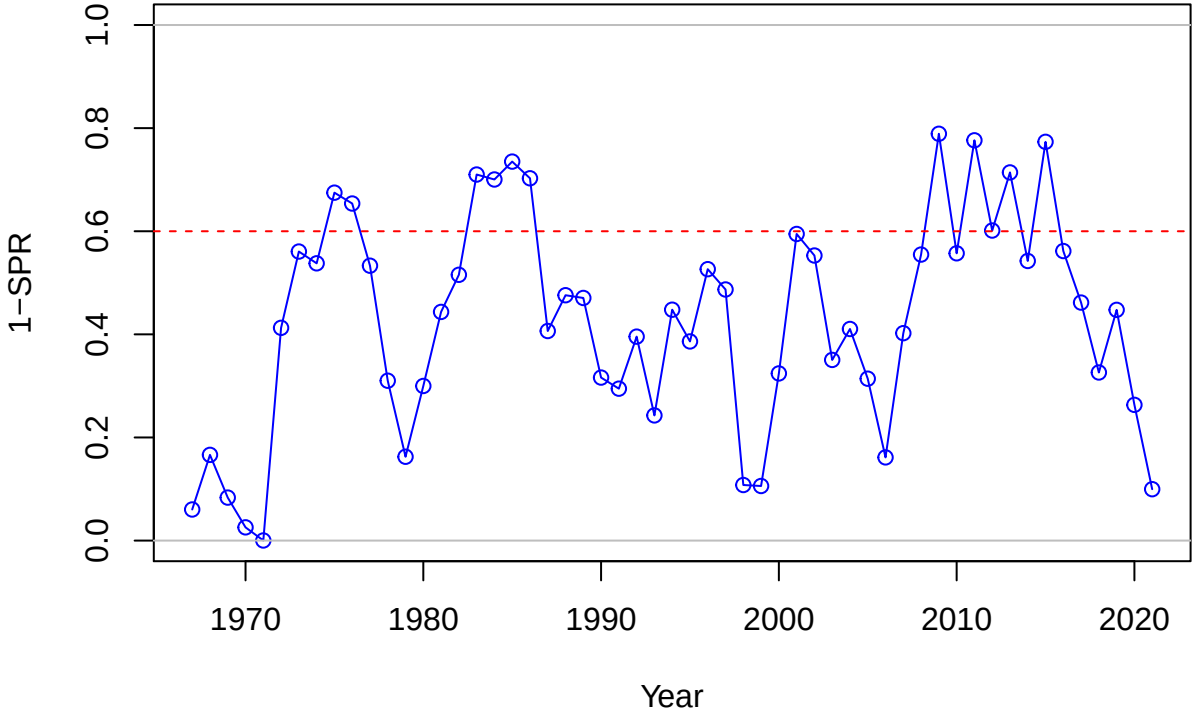

Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

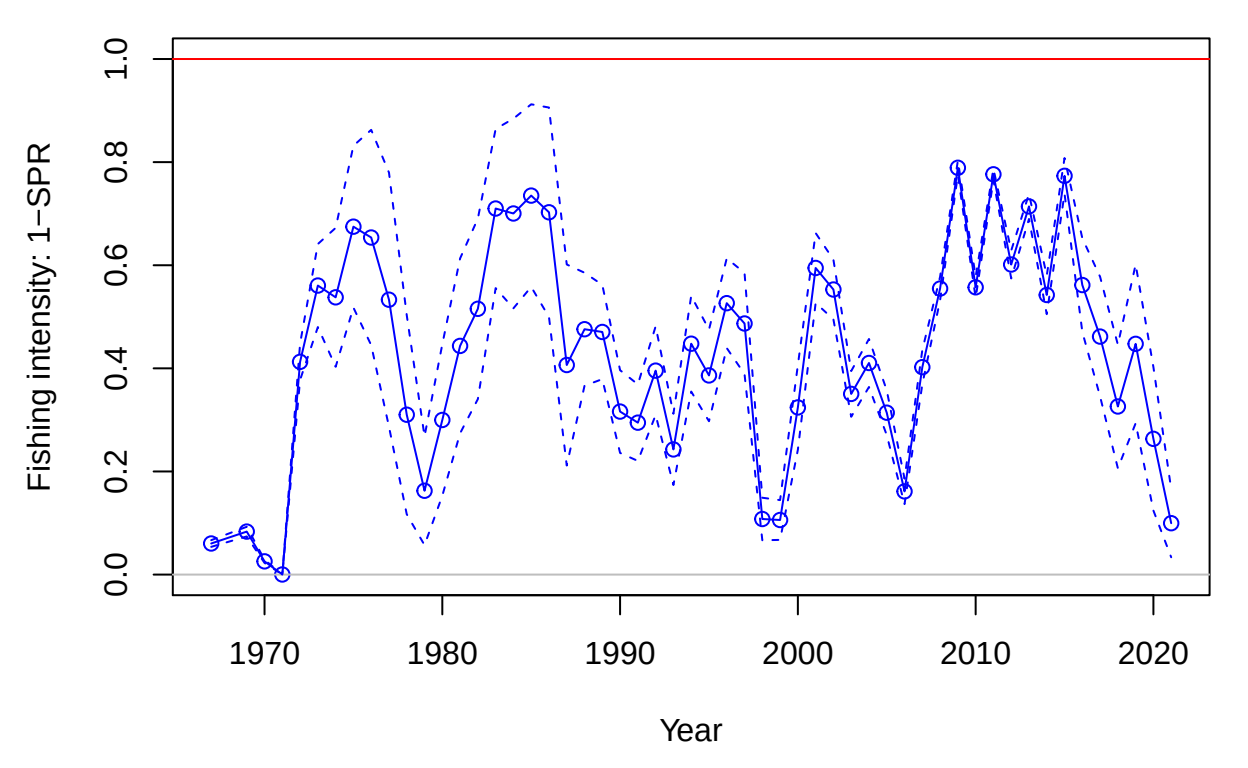

Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

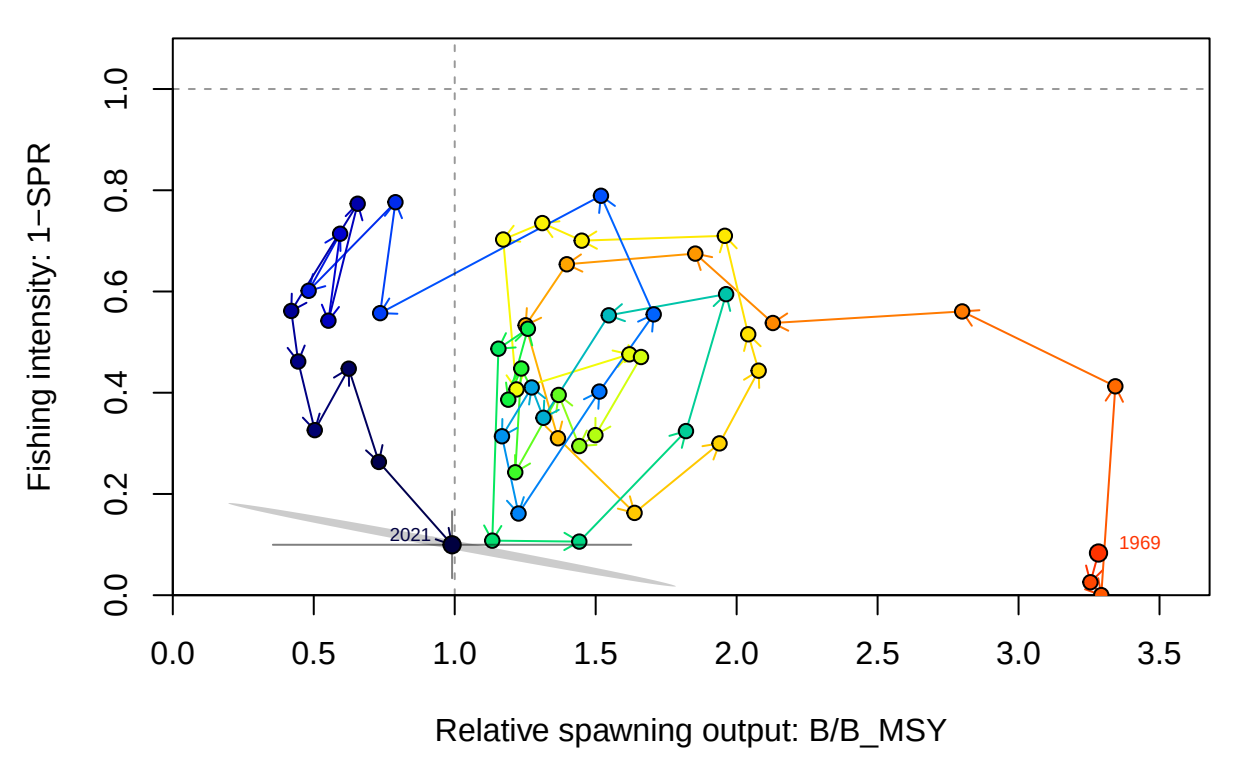

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

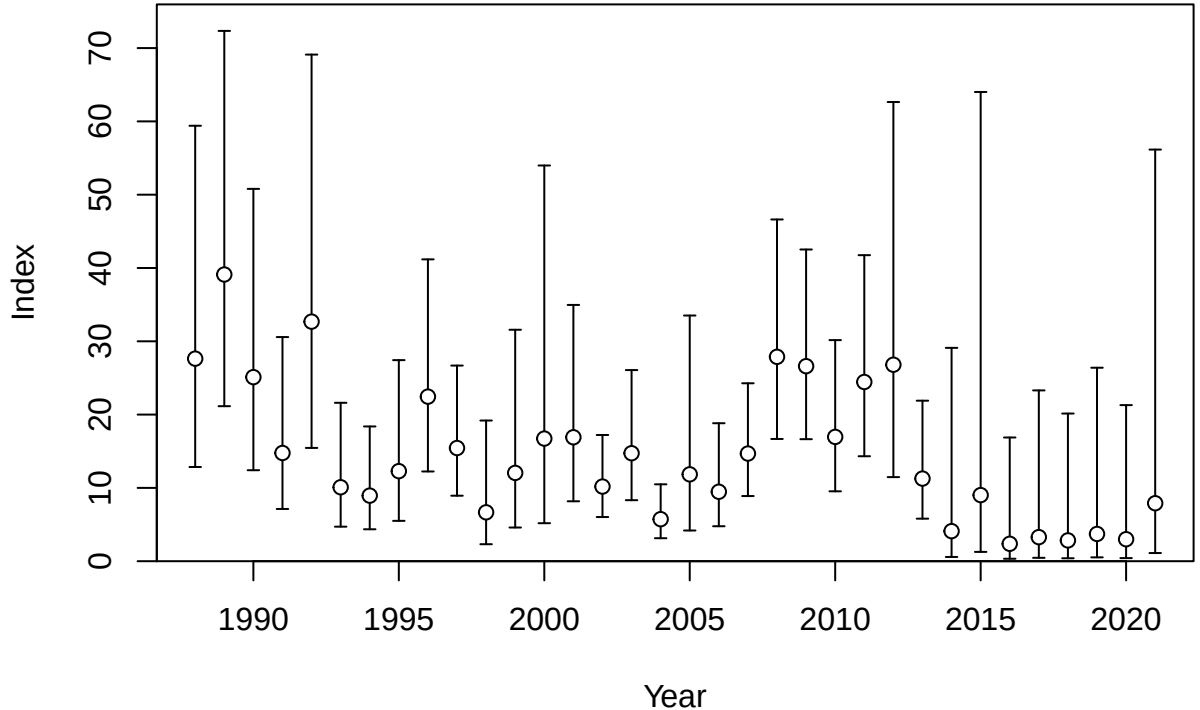

Continuous F
0.0
0.5
1.0
1.5
1970
1980
1990
2000
2010
2020
Year

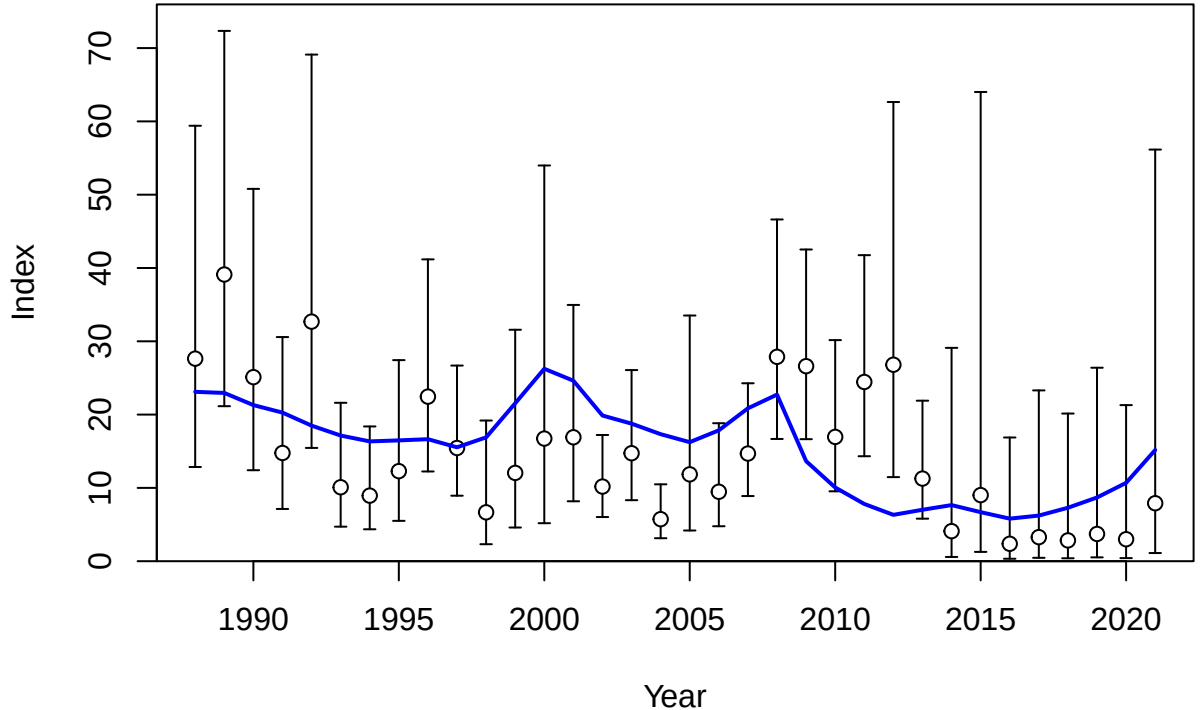

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

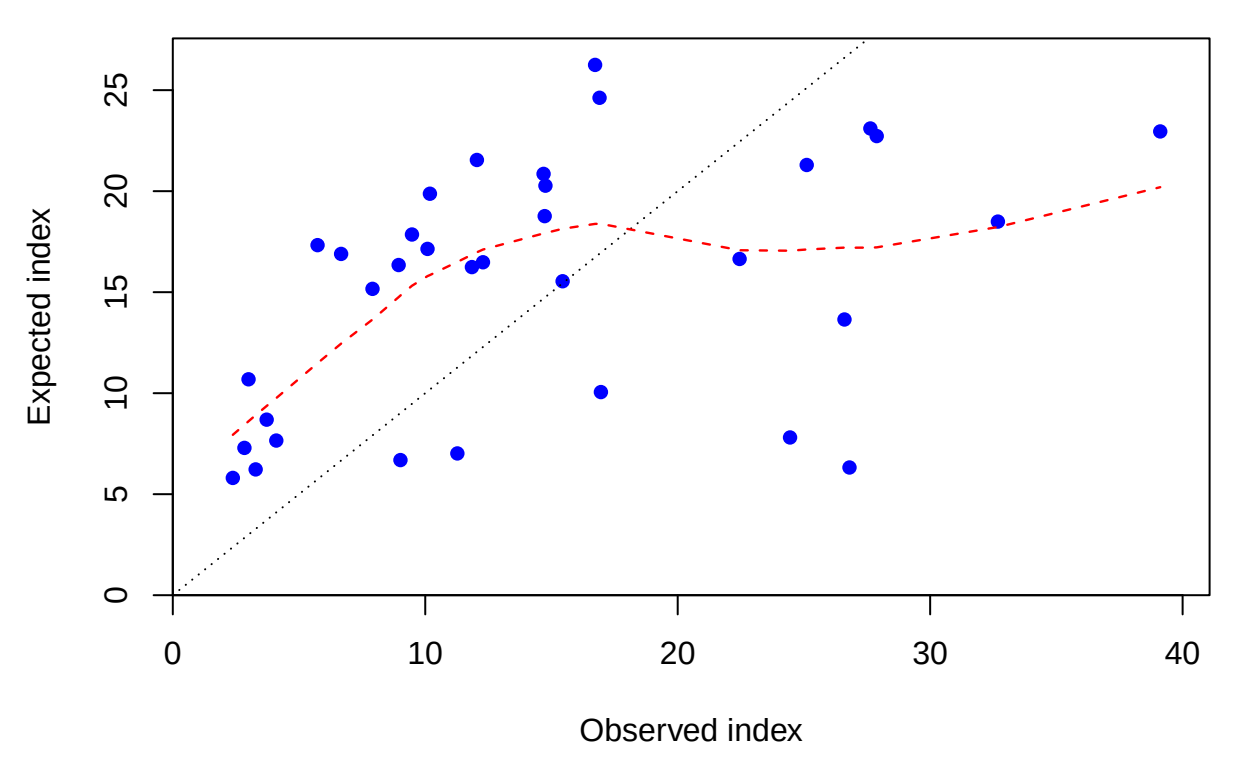

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

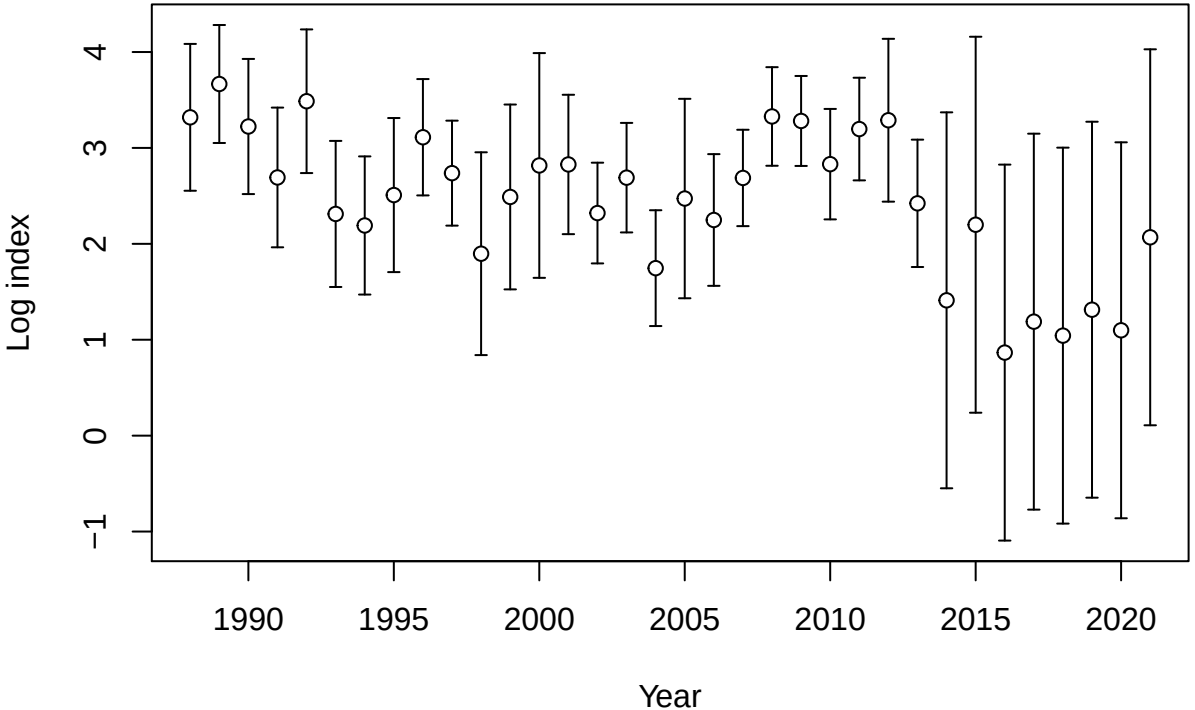

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

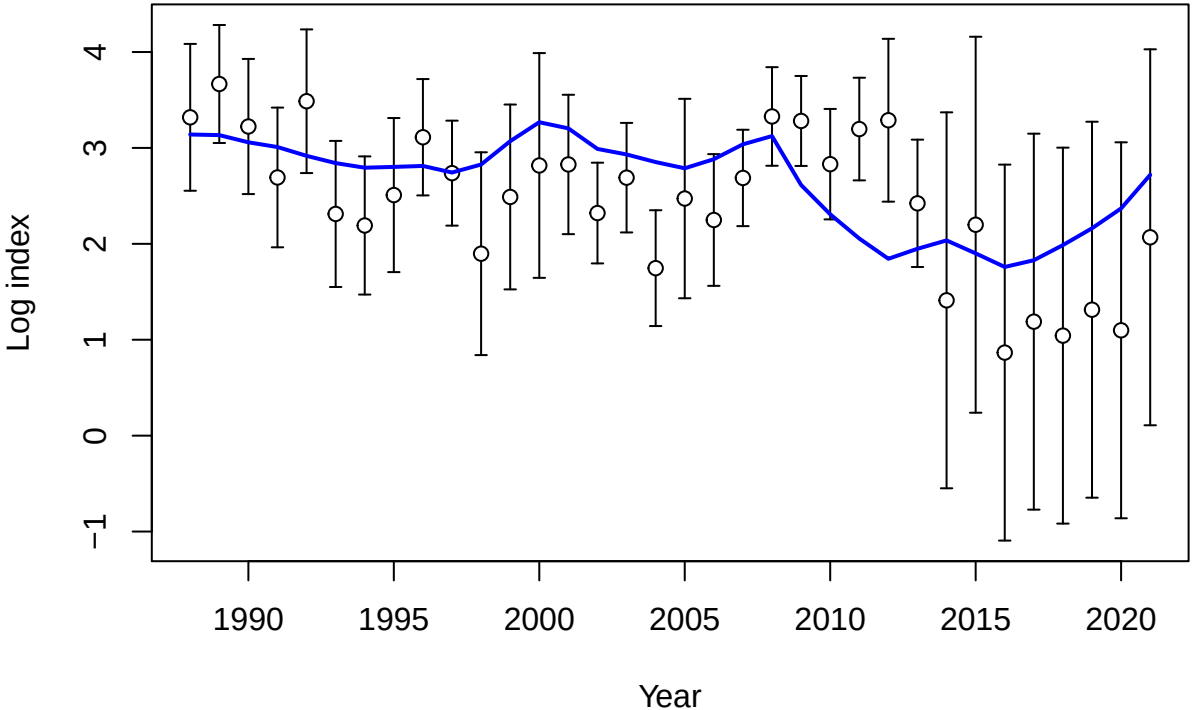

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Relative spawning output: B/B_MSY
2021
1969

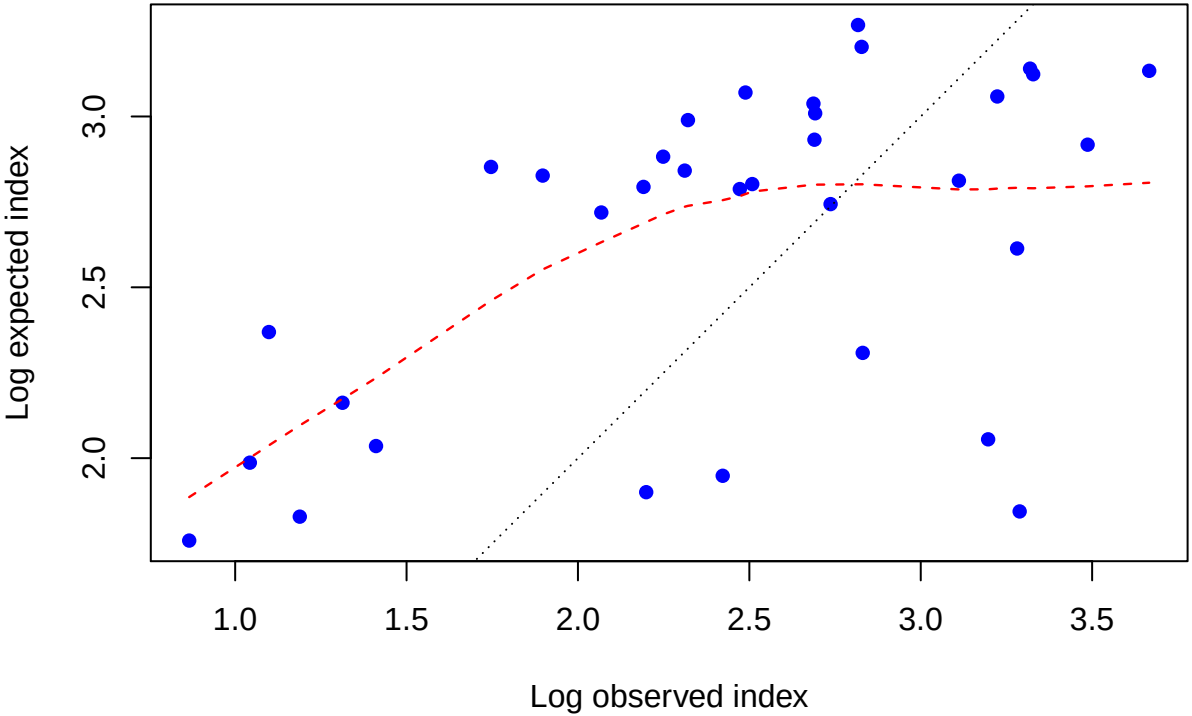

Index
0
10
20
30
40
50
60
70
1990
1995
2000
2005
2010
2015
2020
Year

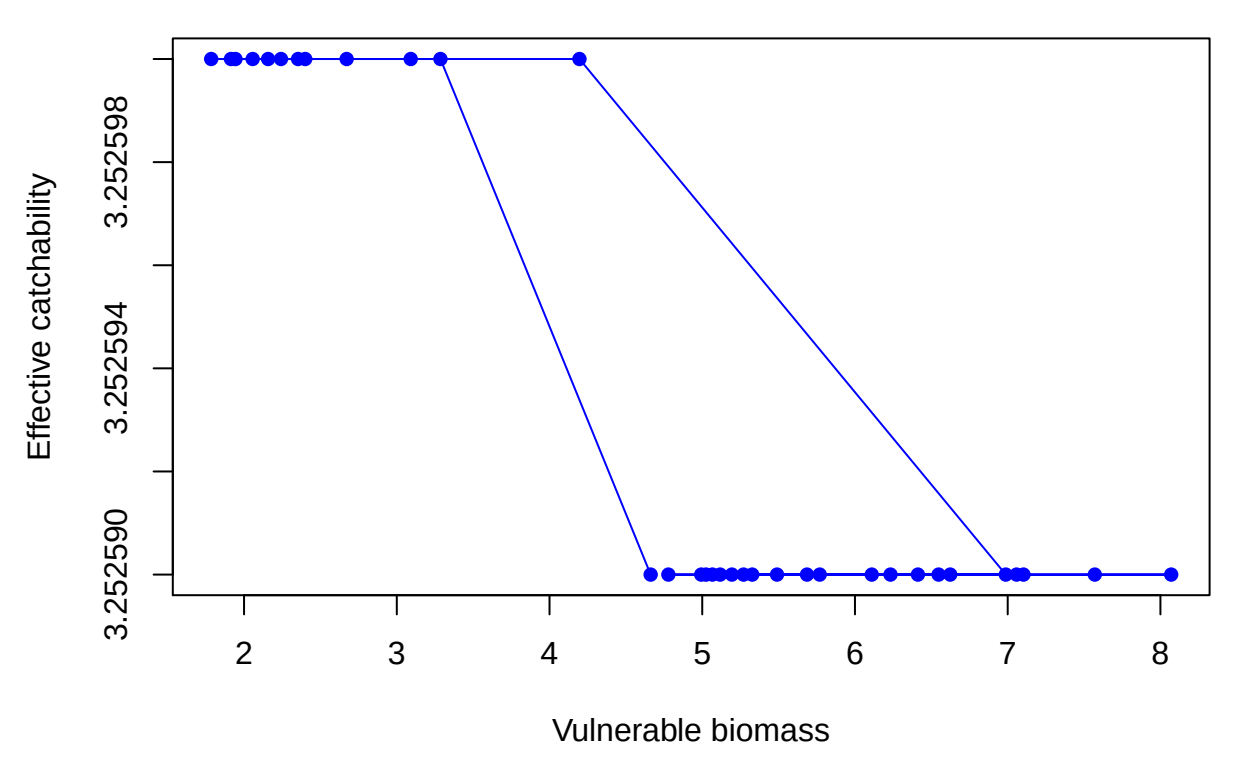

Index
0
10
20
30
40
50
60
70
1990
1995
2000
2005
2010
2015
2020
Year

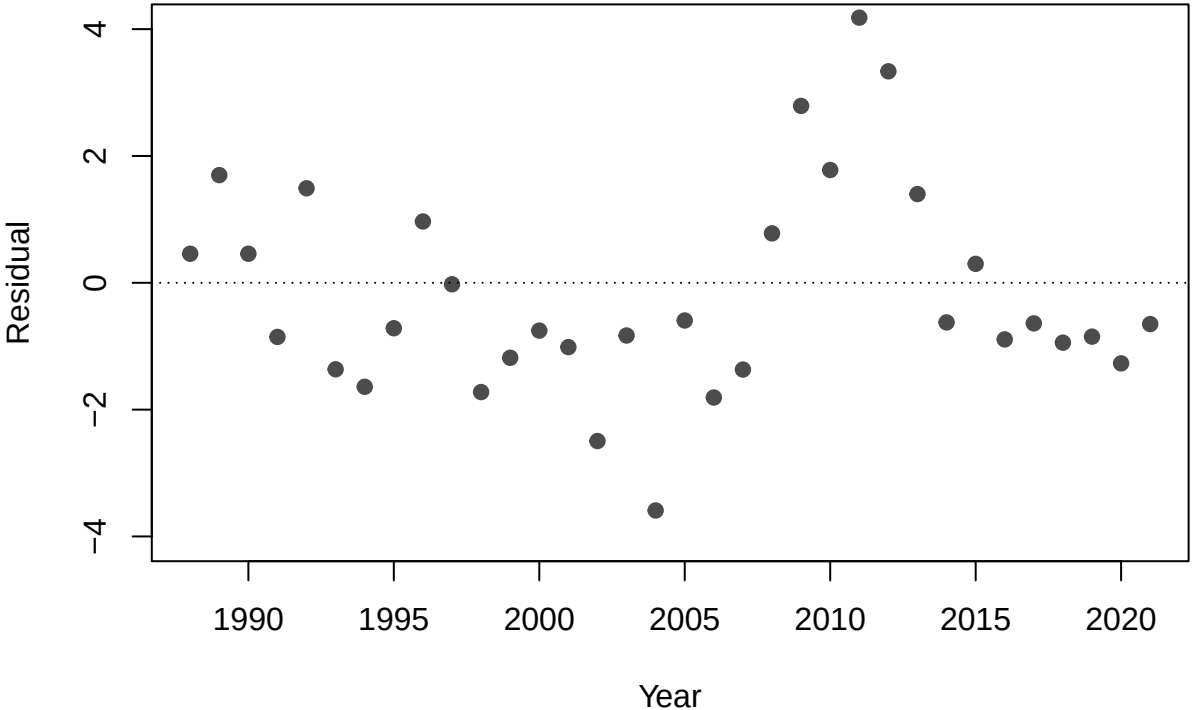

Expected index
Observed index
0
5
10
15
20
25
0
10
20
30
40

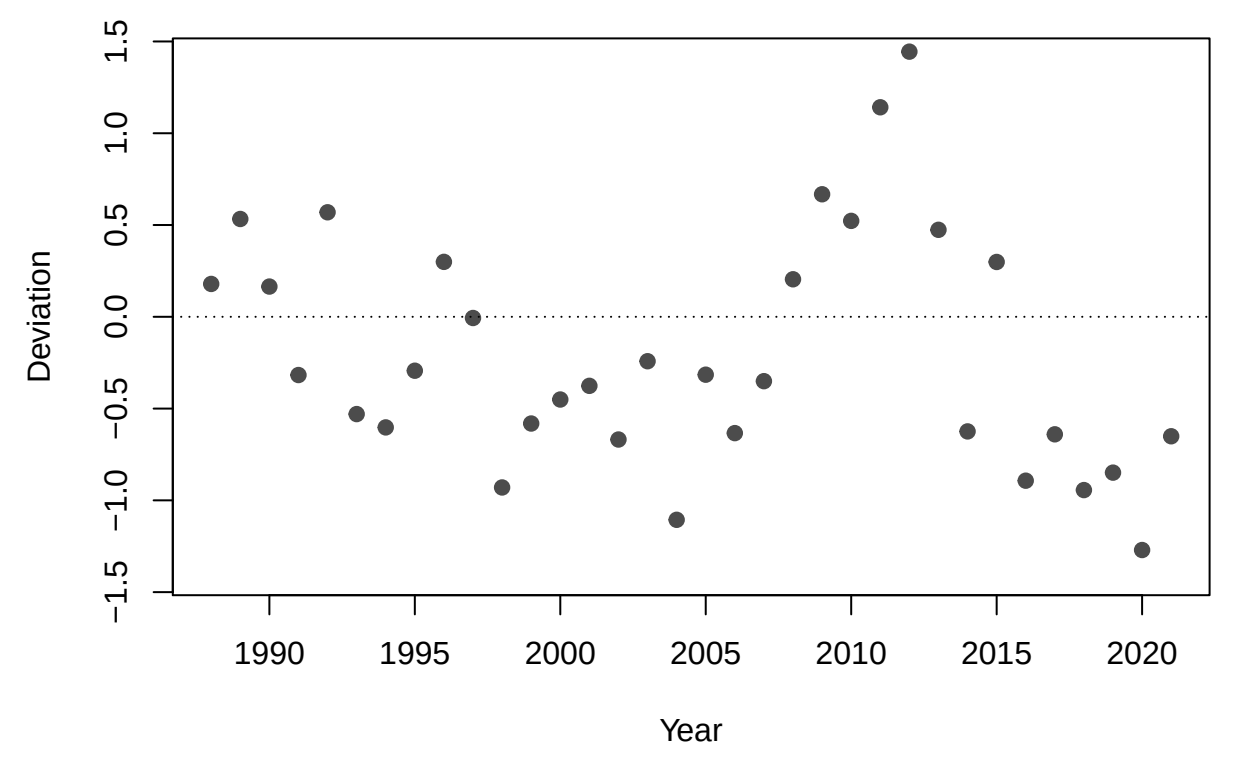

Log index
−1
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

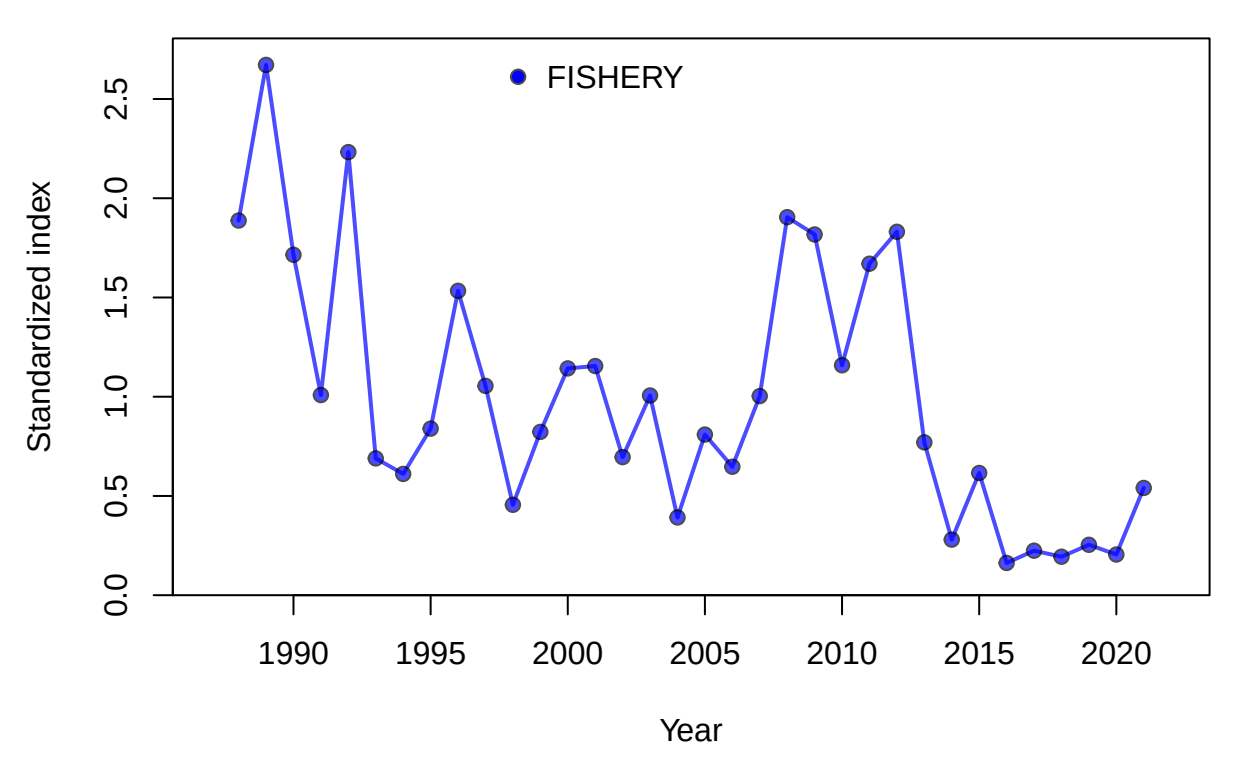

Log index
−1
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

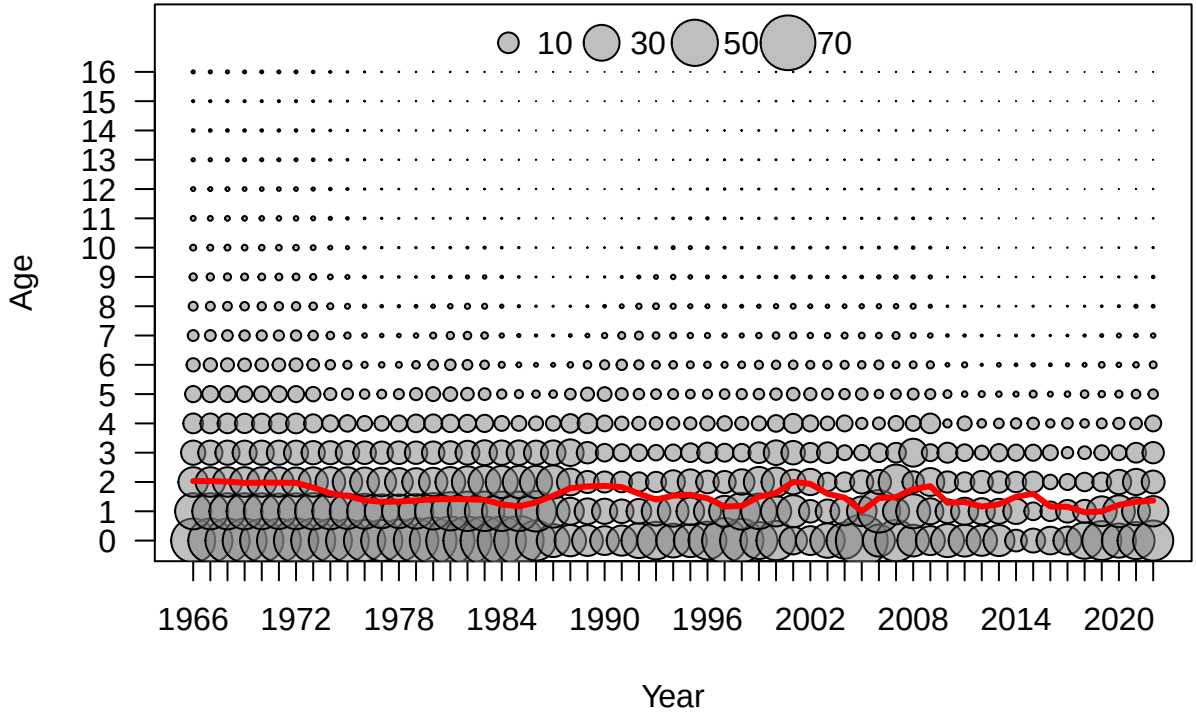

Log expected index
2.0
2.5
3.0
1.0
1.5
2.0
2.5
3.0
3.5
Log observed index

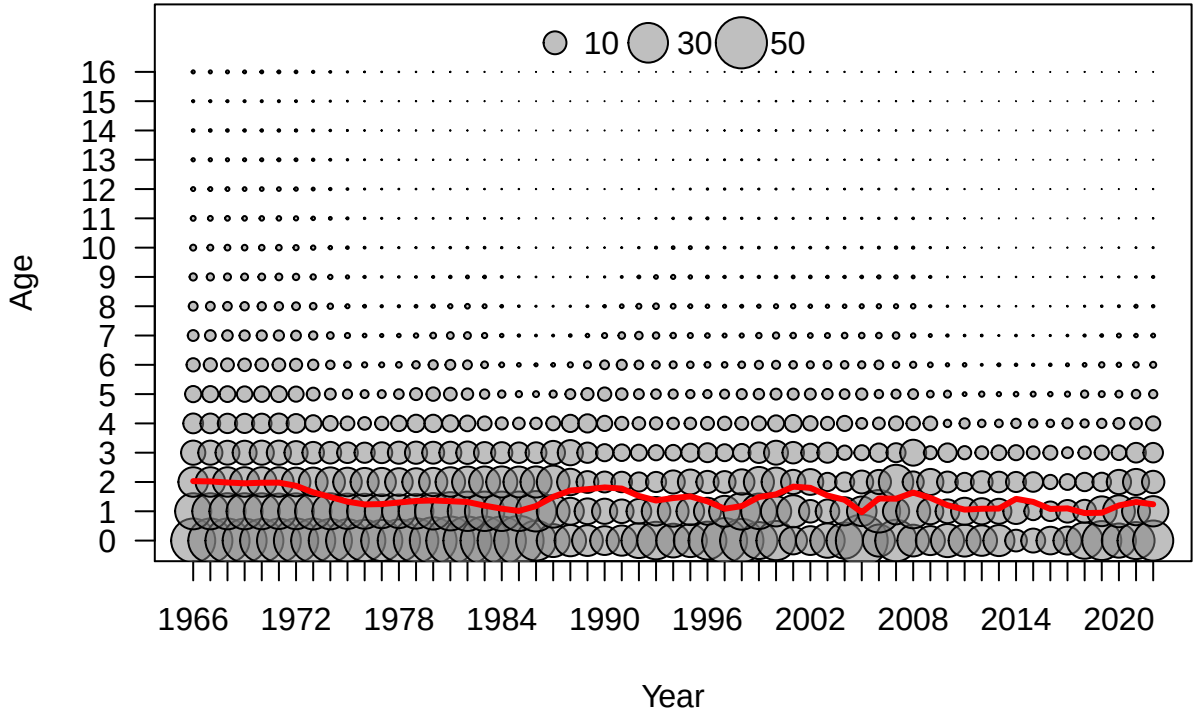

Effective catchability
3.252598
3.252594
3.252590
2
3
4
5
6
7
8
Vulnerable biomass

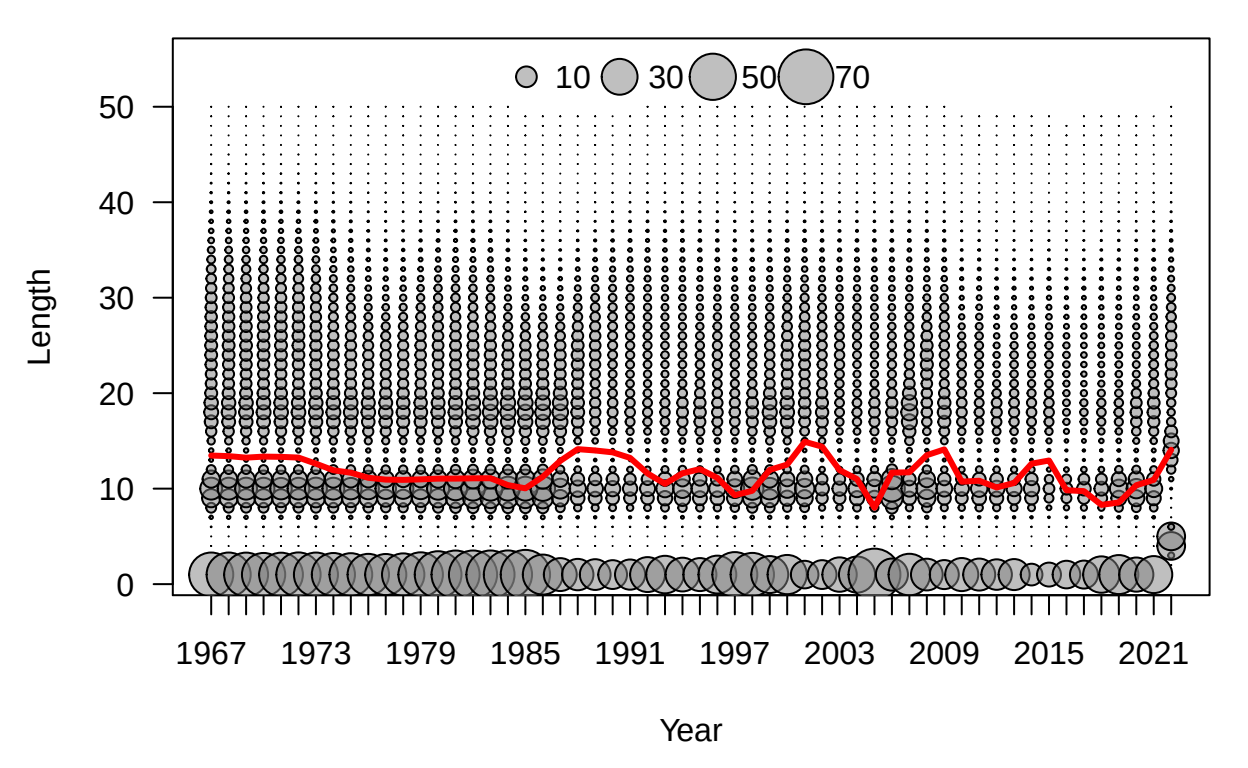

Residual
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

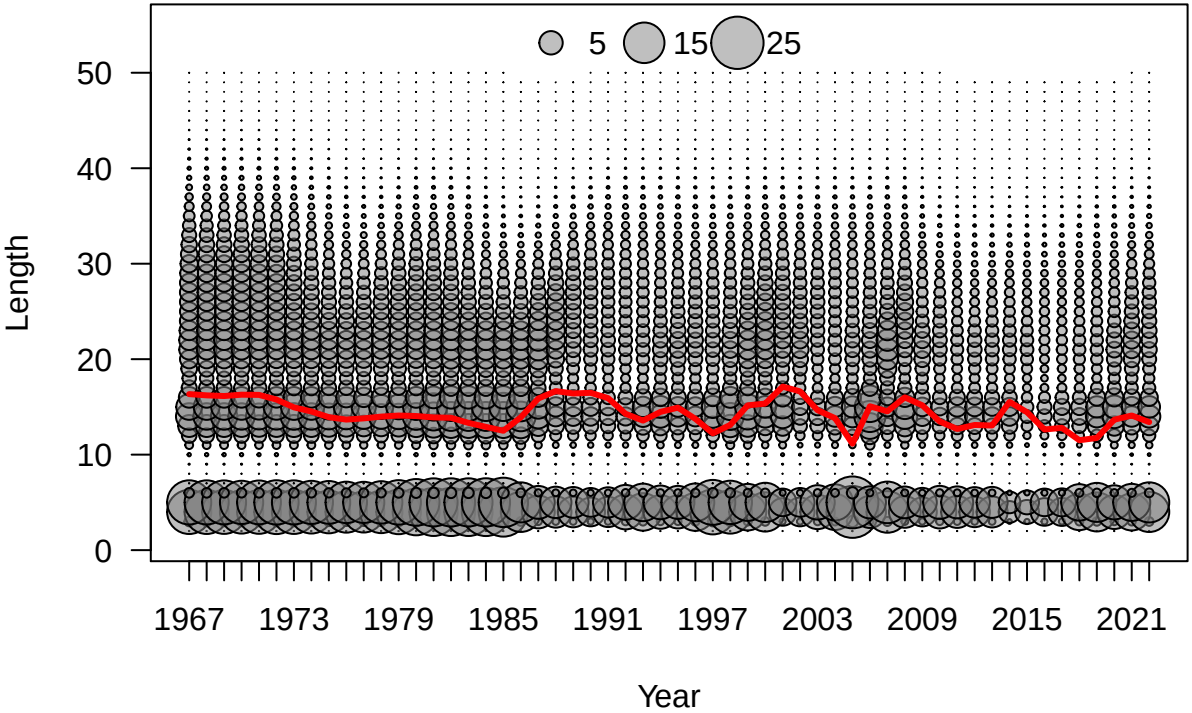

Deviation
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
1990
1995
2000
2005
2010
2015
2020
Year

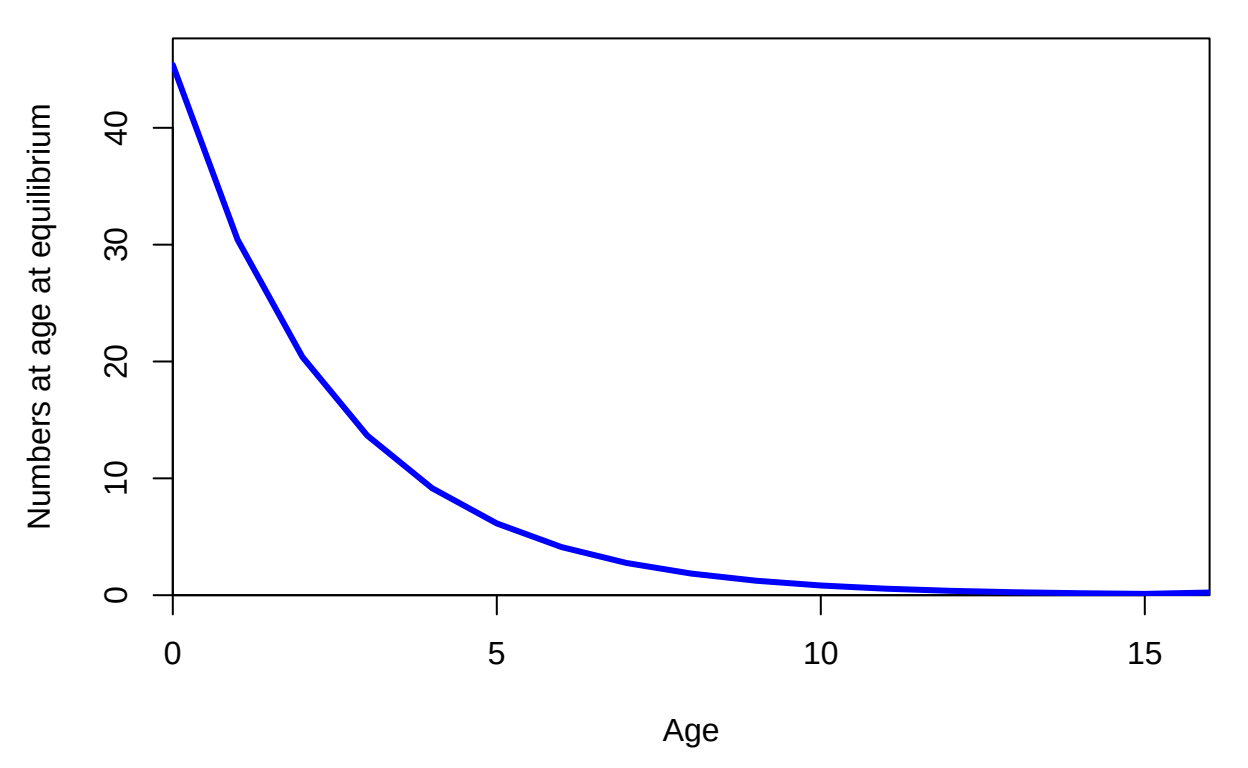

FISHERY
Standardized index
0.0
0.5
1.0
1.5
2.0
2.5
1990
1995
2000
2005
2010
2015
2020
Year

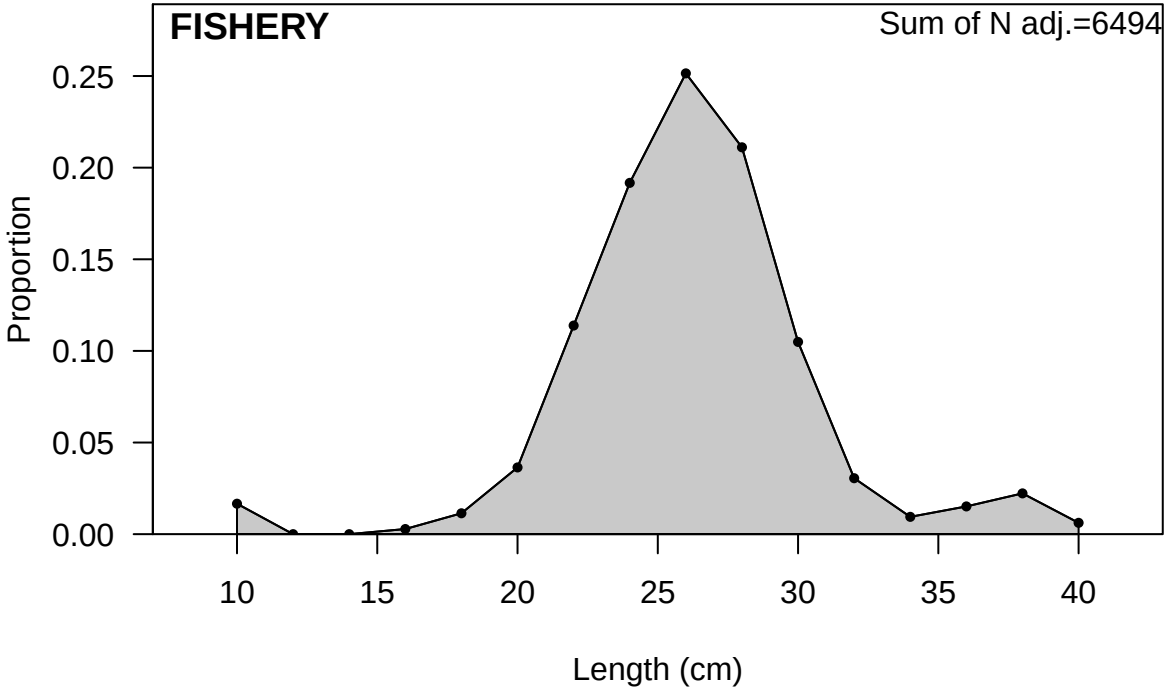

10
30
50
70
Age
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

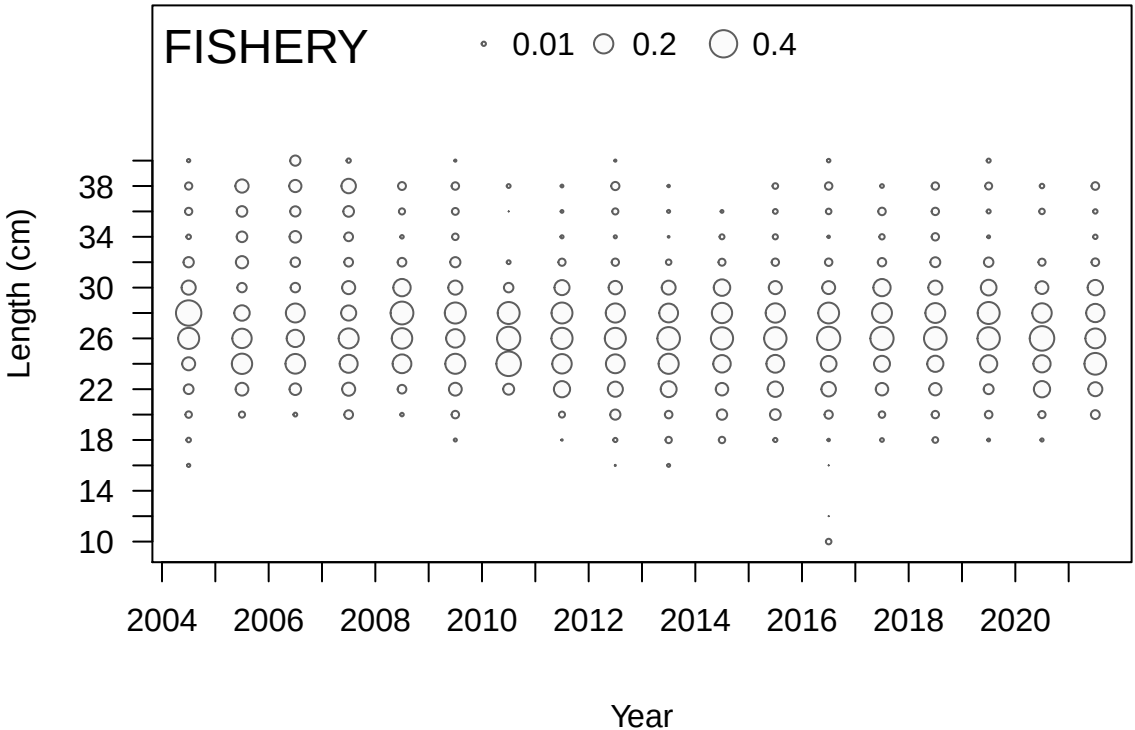

10
30
50
Age
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

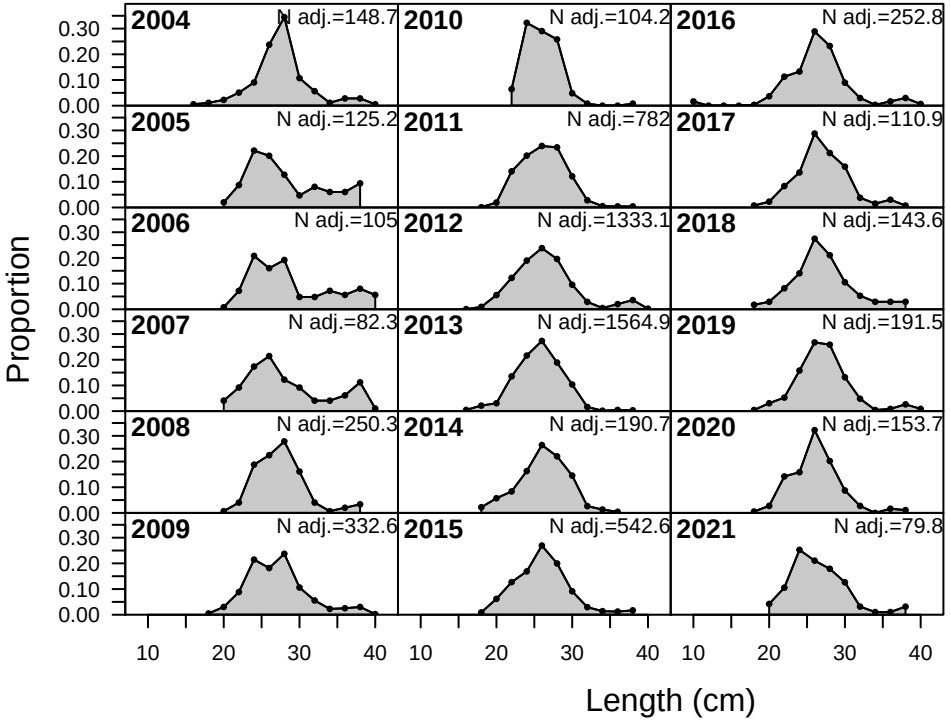

10
30
50
70
Length
0
10
20
30
40
50
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

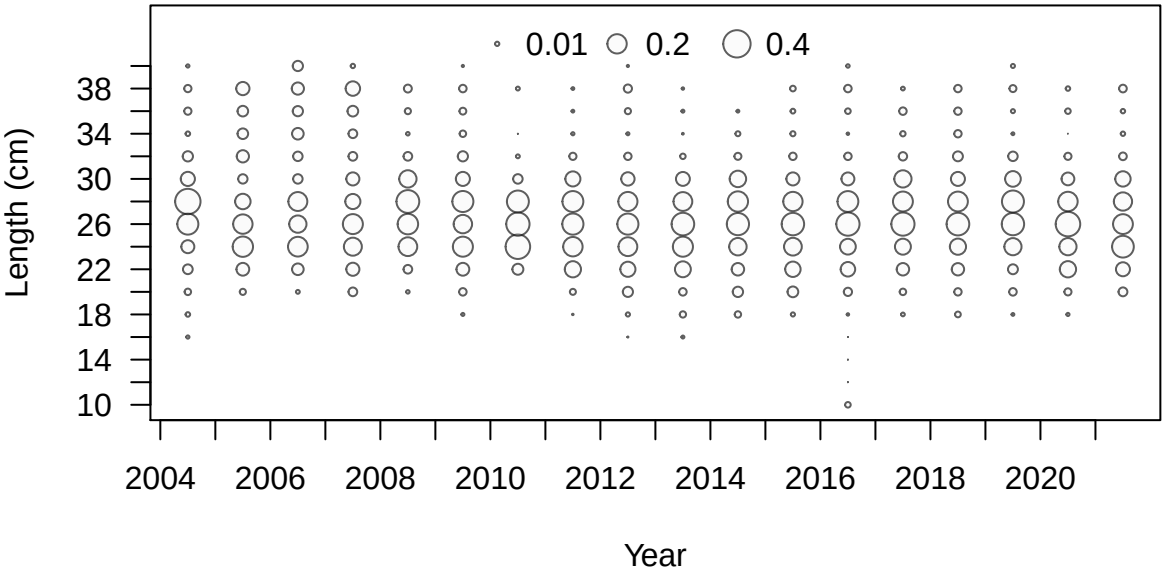

5
15
25
50
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

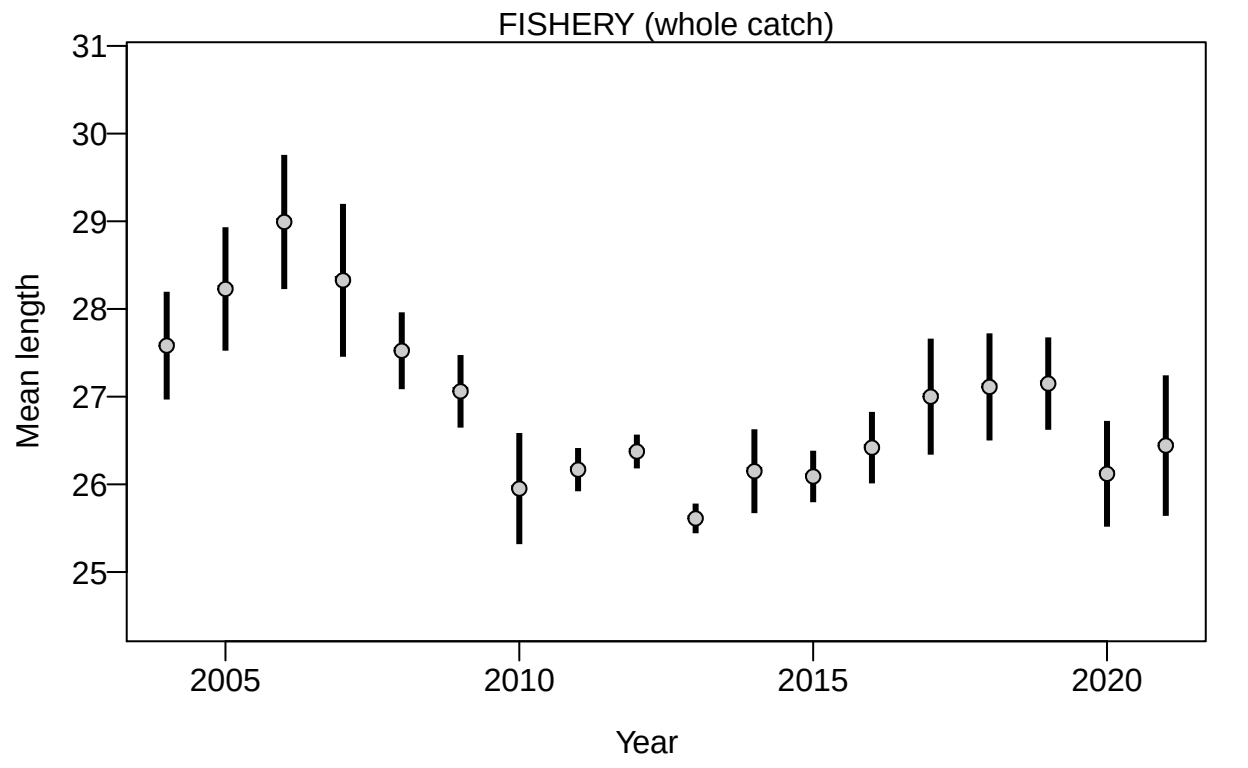

Numbers at age at equilibrium
0
10
20
30
40
0
5
10
15
Age

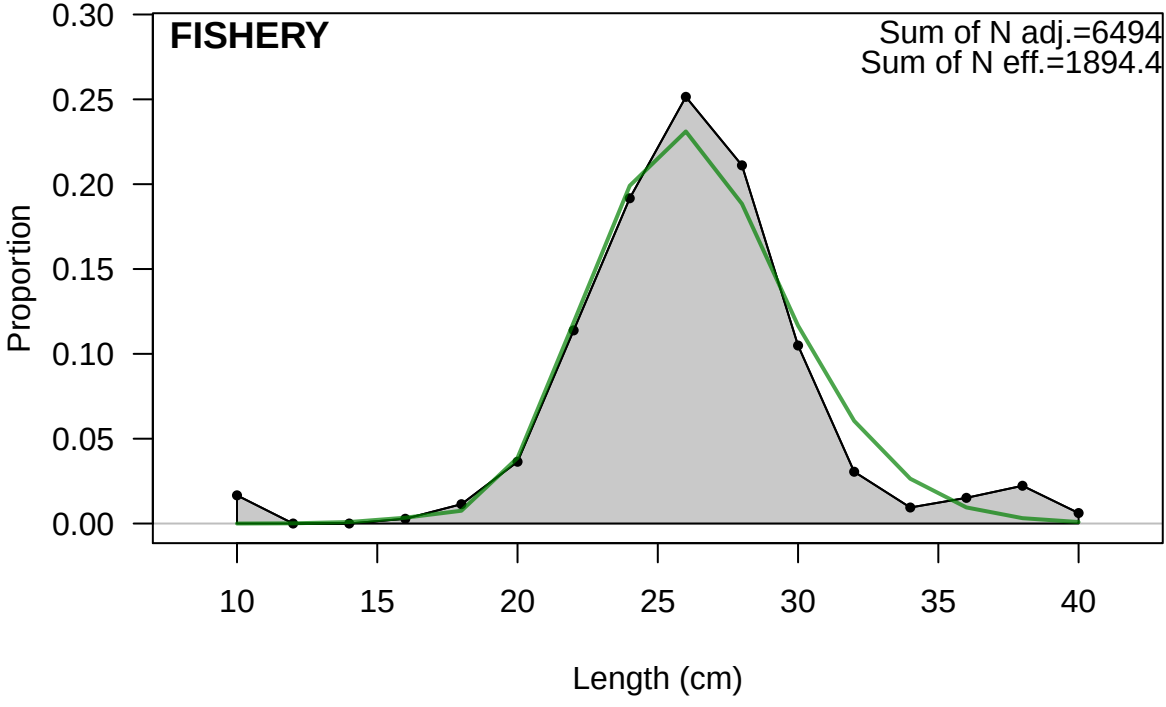

FISHERY
Sum of N adj.=6494
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
10
15
20
25
30
35
40
Length (cm)

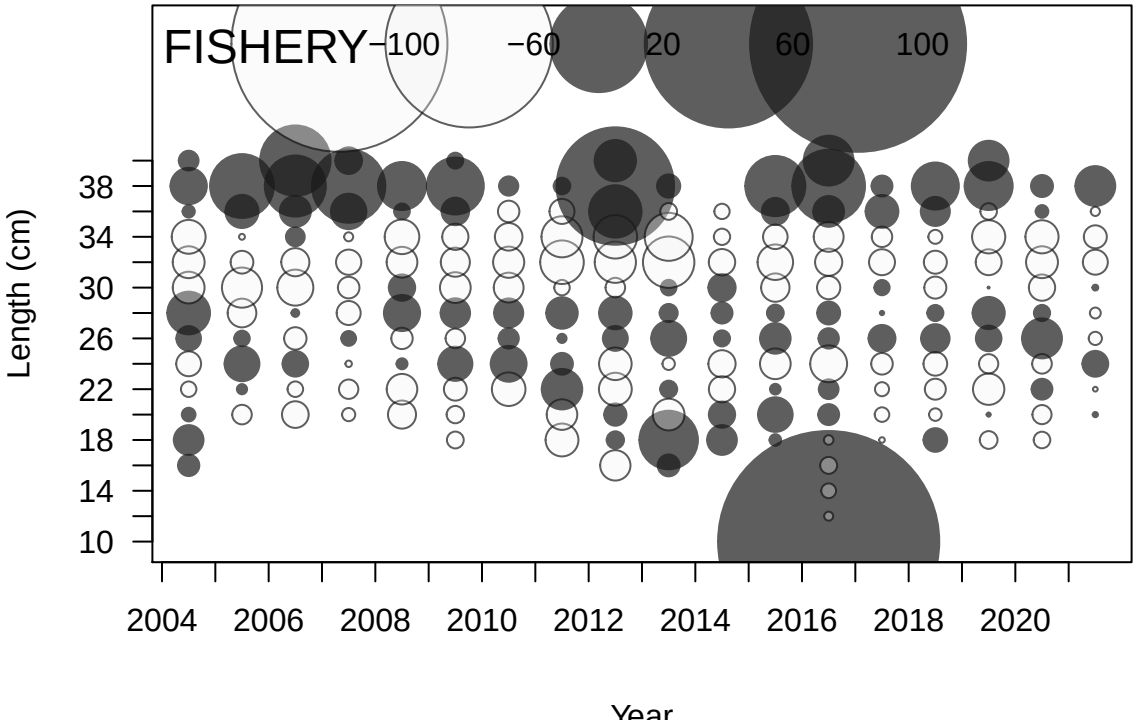

FISHERY
0.01
0.2
0.4
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

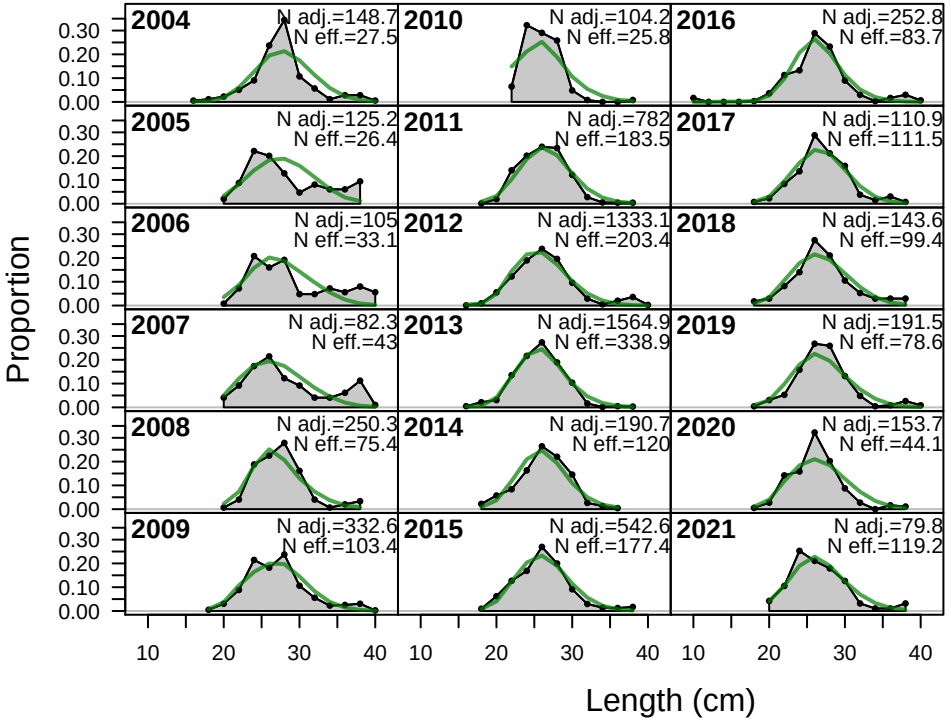

2004
N adj.=148.7
2010
N adj.=104.2
2016
N adj.=252.8
2005
N adj.=125.2
2011
N adj.=782
2017
N adj.=110.9
2006
N adj.=105
2012
N adj.=1333.1
2018
N adj.=143.6
2007
N adj.=82.3
2013
N adj.=1564.9
2019
N adj.=191.5
2008
N adj.=250.3
2014
N adj.=190.7
2020
N adj.=153.7
2009
N adj.=332.6
2015
N adj.=542.6
2021
N adj.=79.8
Proportion
0.00
0.10
0.20
0.30
10
20
30
40
Length (cm)

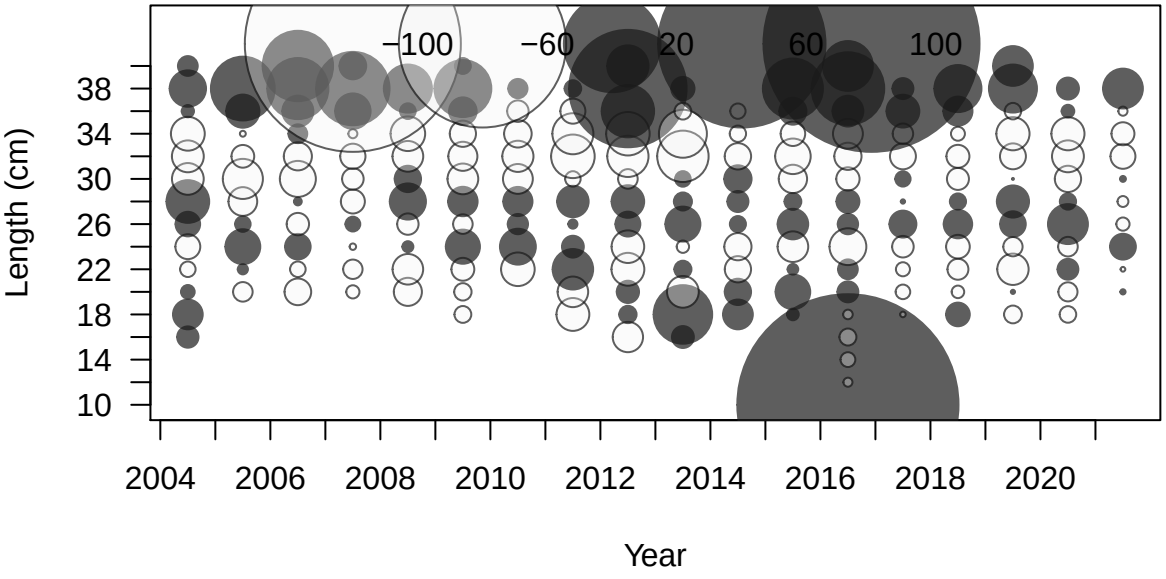

0.01
0.2
0.4
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

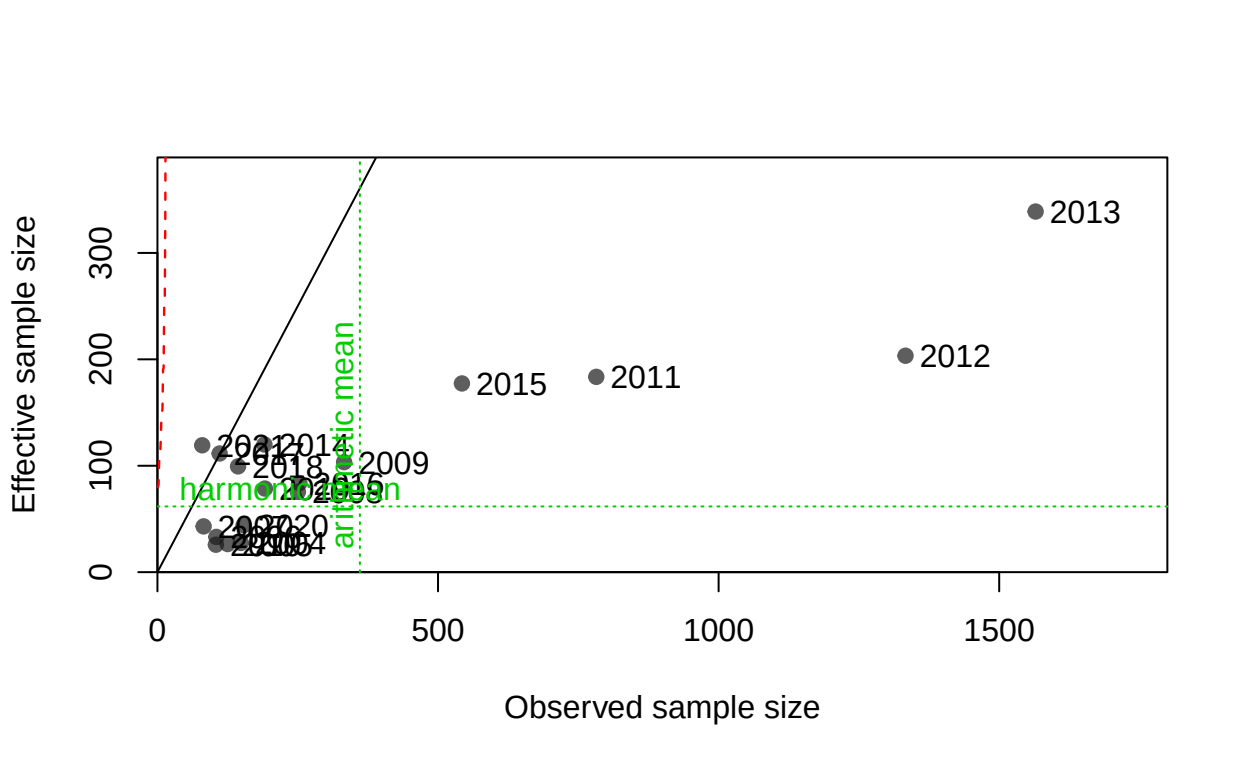

FISHERY (whole catch)
31
30
29
28
27
26
25
Mean length
2005
2010
2015
2020
Year

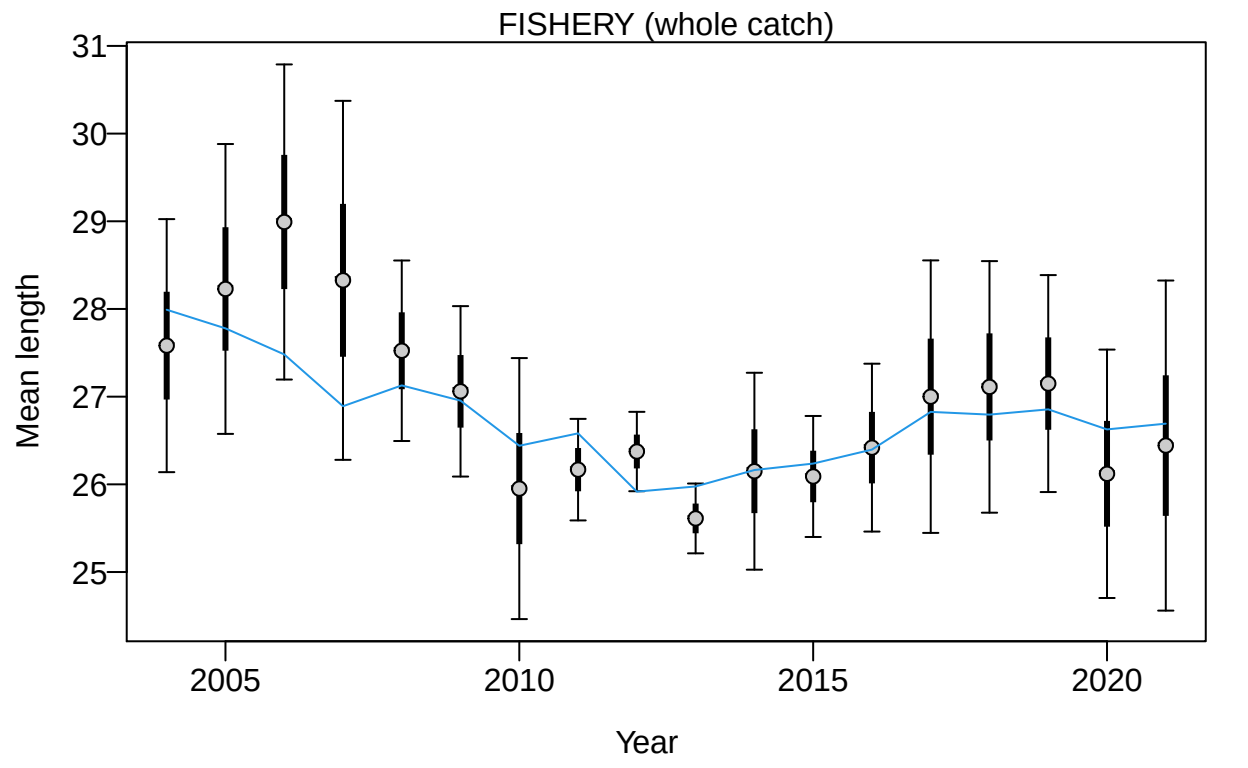

FISHERY
Sum of N adj.=6494
Sum of N eff.=1894.4
Proportion
0.30
0.25
0.20
0.15
0.10
0.05
0.00
10
15
20
25
30
35
40
Length (cm)

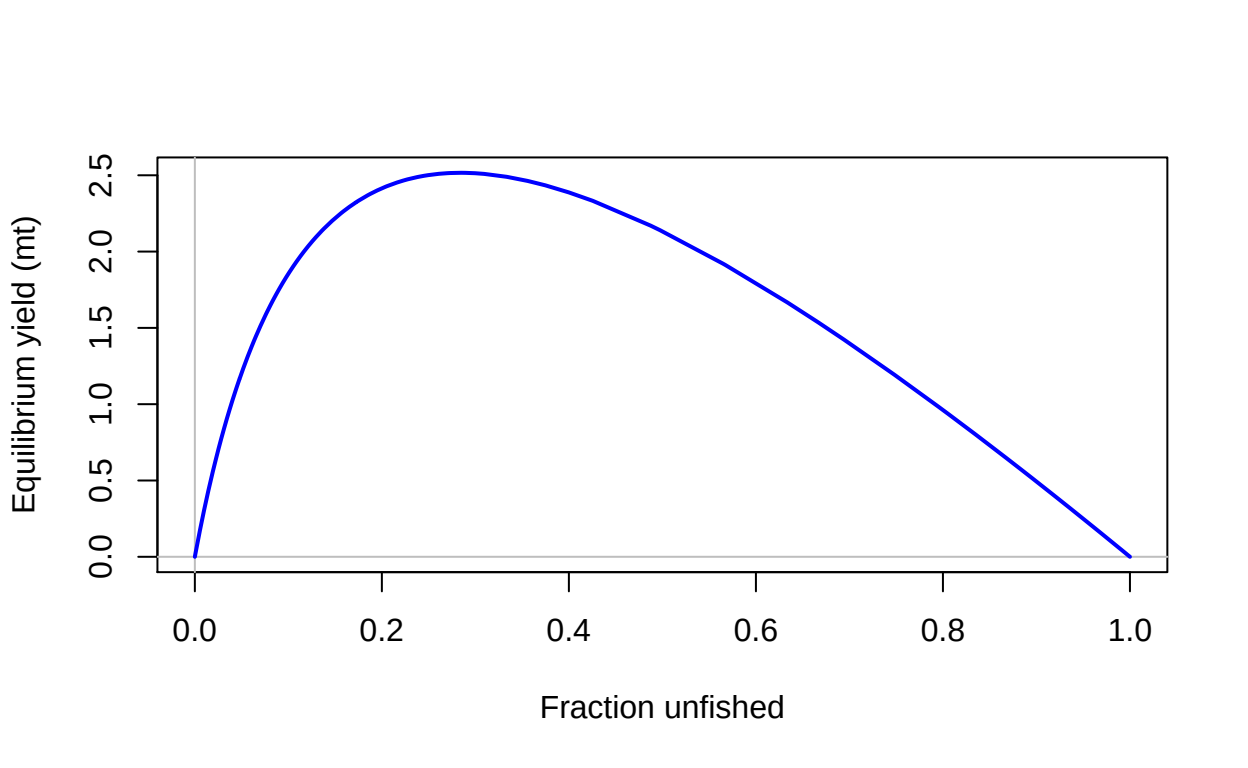

FISHERY
−100
−60
20
60
100
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

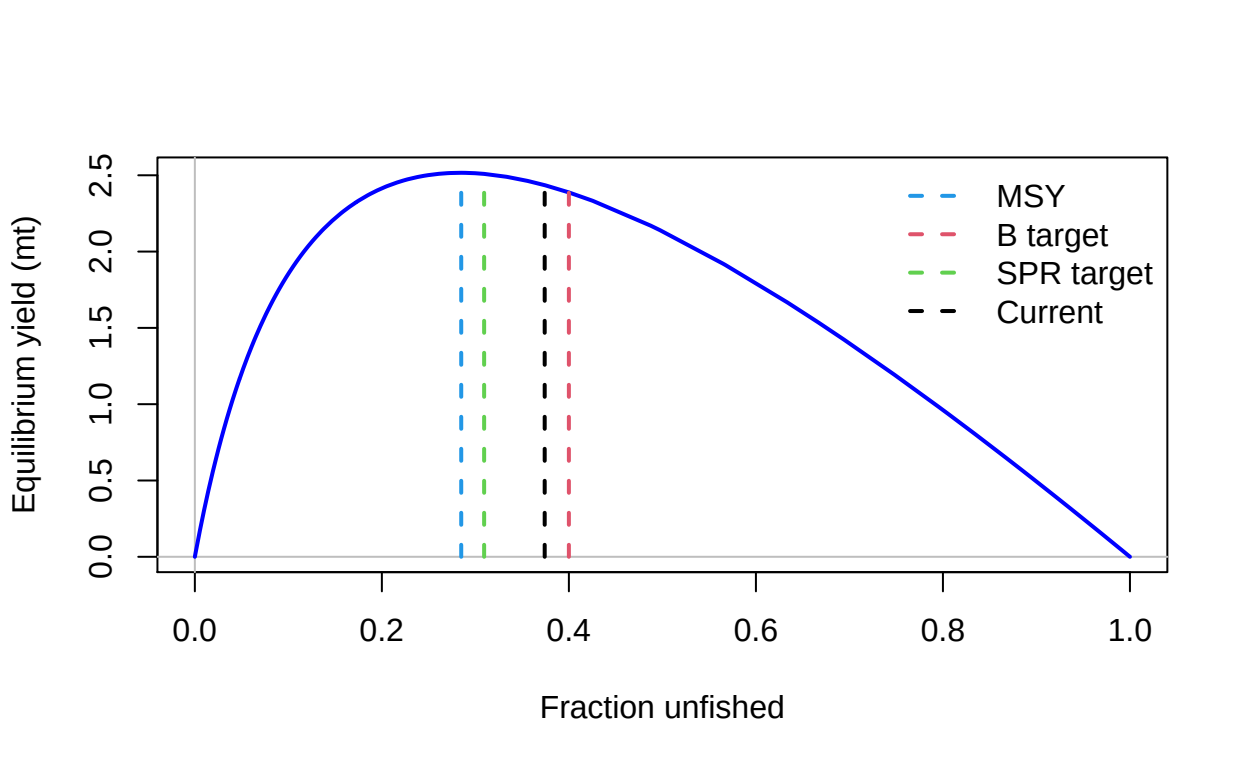

2004
N adj.=148.7
N eff.=27.5
2010
N adj.=104.2
N eff.=25.8
2016
N adj.=252.8
N eff.=83.7
2005
N adj.=125.2
N eff.=26.4
2011
N adj.=782
N eff.=183.5
2017
N adj.=110.9
N eff.=111.5
2006
N adj.=105
N eff.=33.1
2012
N adj.=1333.1
N eff.=203.4
2018
N adj.=143.6
N eff.=99.4
2007
N adj.=82.3
N eff.=43
2013
N adj.=1564.9
N eff.=338.9
2019
N adj.=191.5
N eff.=78.6
2008
N adj.=250.3
N eff.=75.4
2014
N adj.=190.7
N eff.=120
2020
N adj.=153.7
N eff.=44.1
2009
N adj.=332.6
N eff.=103.4
2015
N adj.=542.6
N eff.=177.4
2021
N adj.=79.8
N eff.=119.2
Proportion
0.00
0.10
0.20
0.30
10
20
30
40
Length (cm)

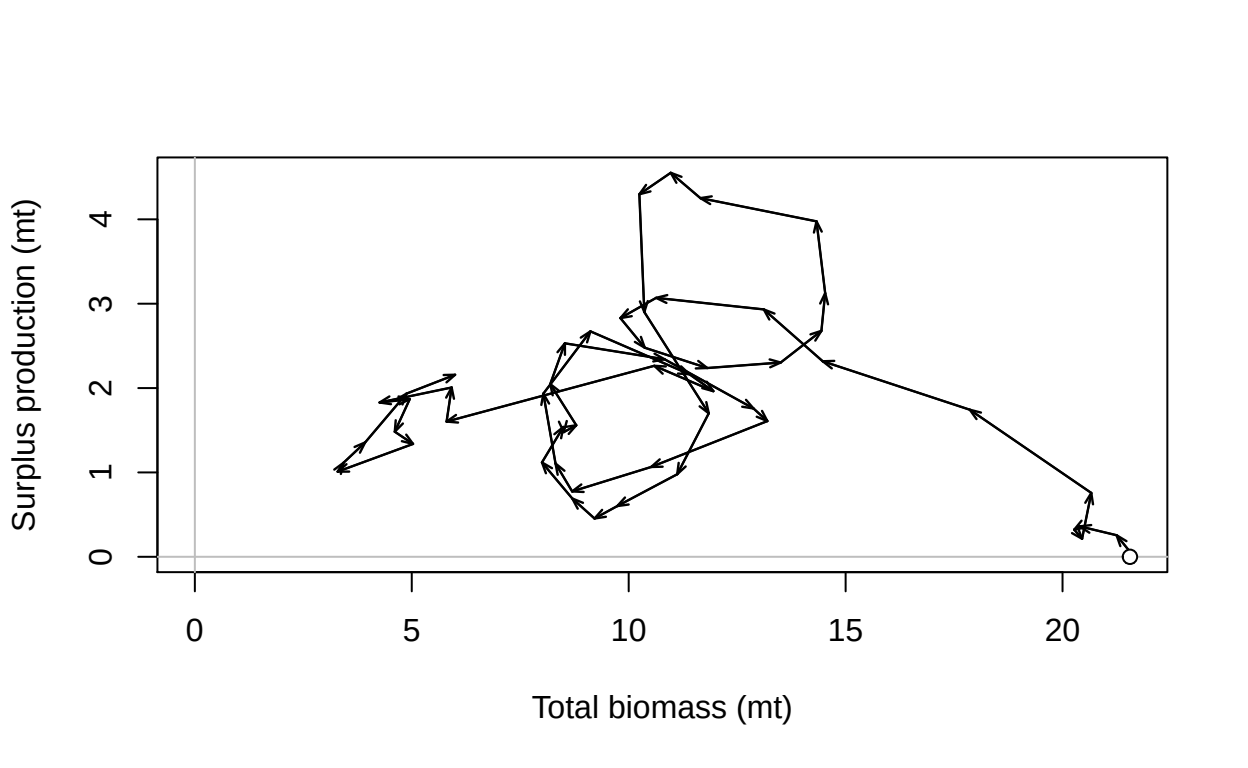

−100
−60
20
60
100
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

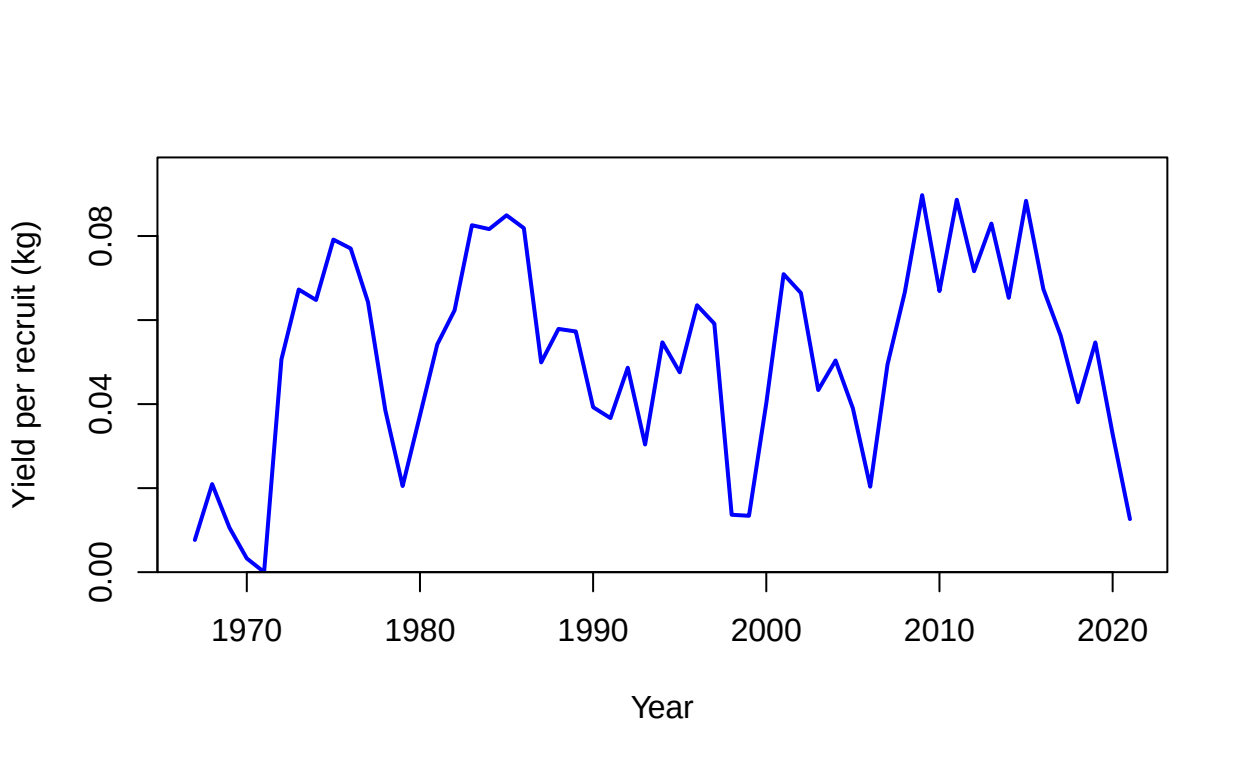

Effective sample size
0
100
200
300
0
500
1000
1500
Observed sample size
2013
2012
2015
2011
2009
2018
harmonic mean
arithmetic mean

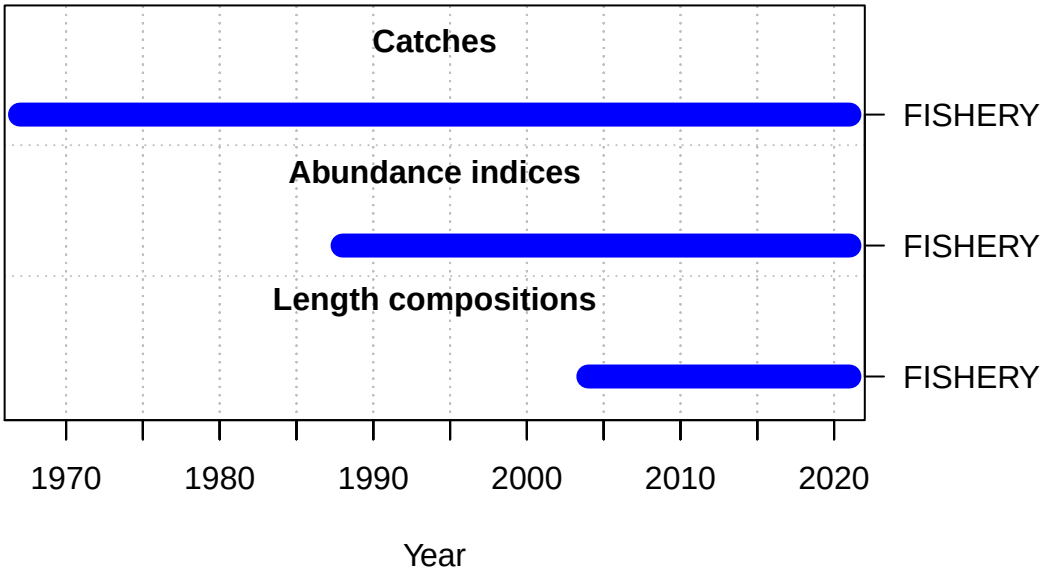

FISHERY (whole catch)
Mean length
31
30
29
28
27
26
25
2005
2010
2015
2020
Year

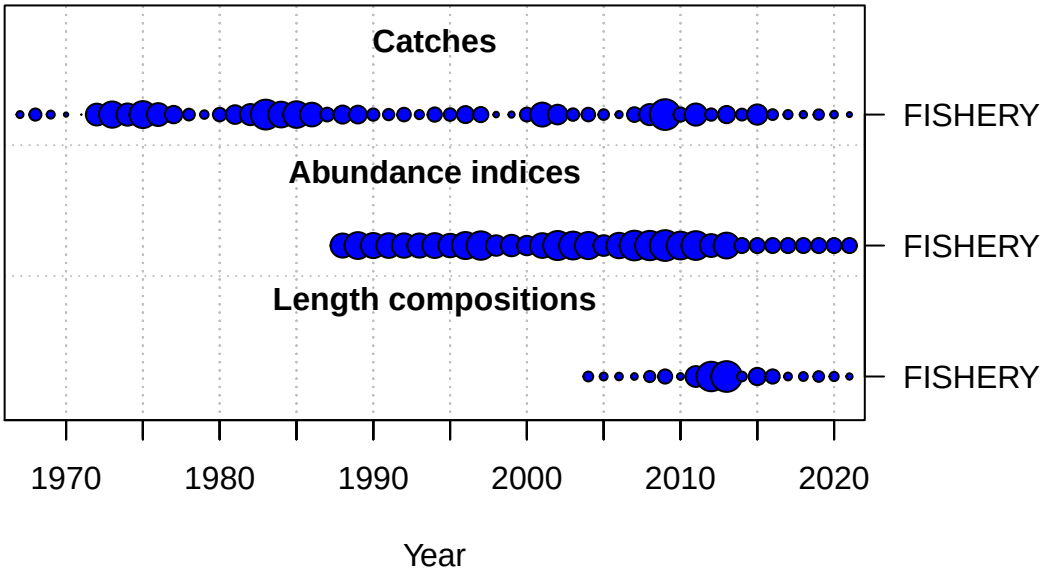

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

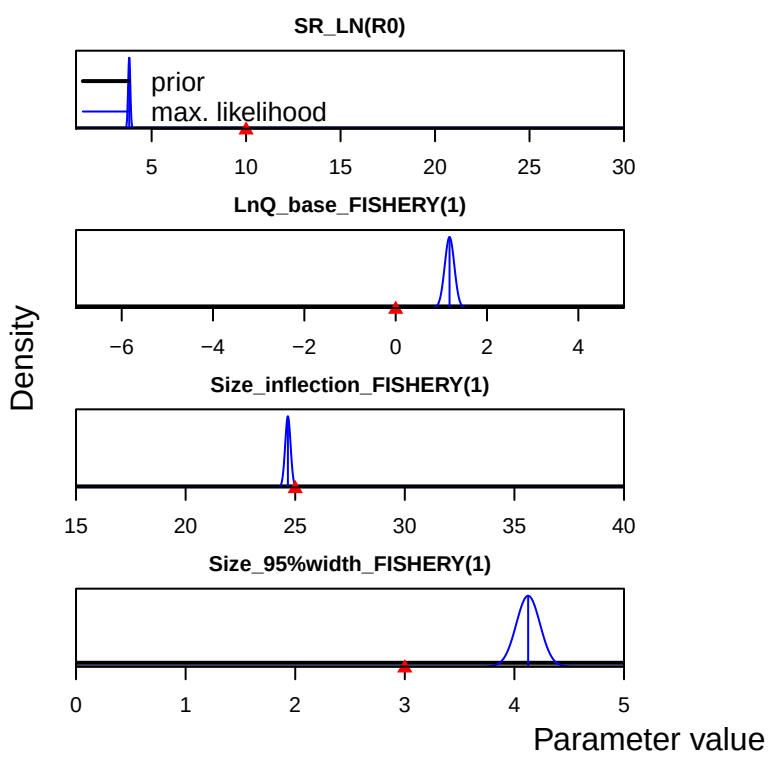

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0
1
2
3
4
0
5
10
15
20
Total biomass (mt)


Yield per recruit (kg)
0.00
0.04
0.08
1970
1980
1990
2000
2010
2020
Year


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


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


SR_LN(R0)
prior
max. likelihood
5
10
15
20
25
30
LnQ_base_FISHERY(1)
−6
−4
−2
0
2
4
Size_inflection_FISHERY(1)
15
20
25
30
35
40
Size_95%width_FISHERY(1)
0
1
2
3
4
5
Density
Parameter value