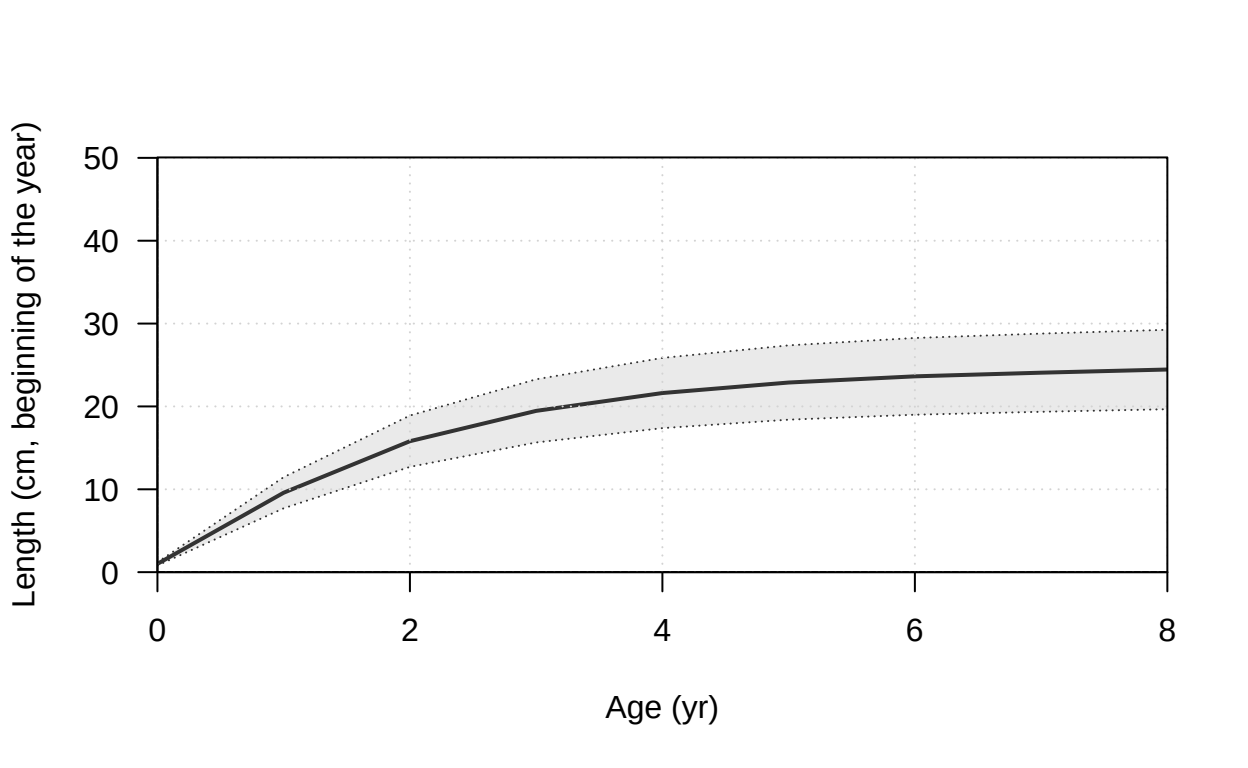
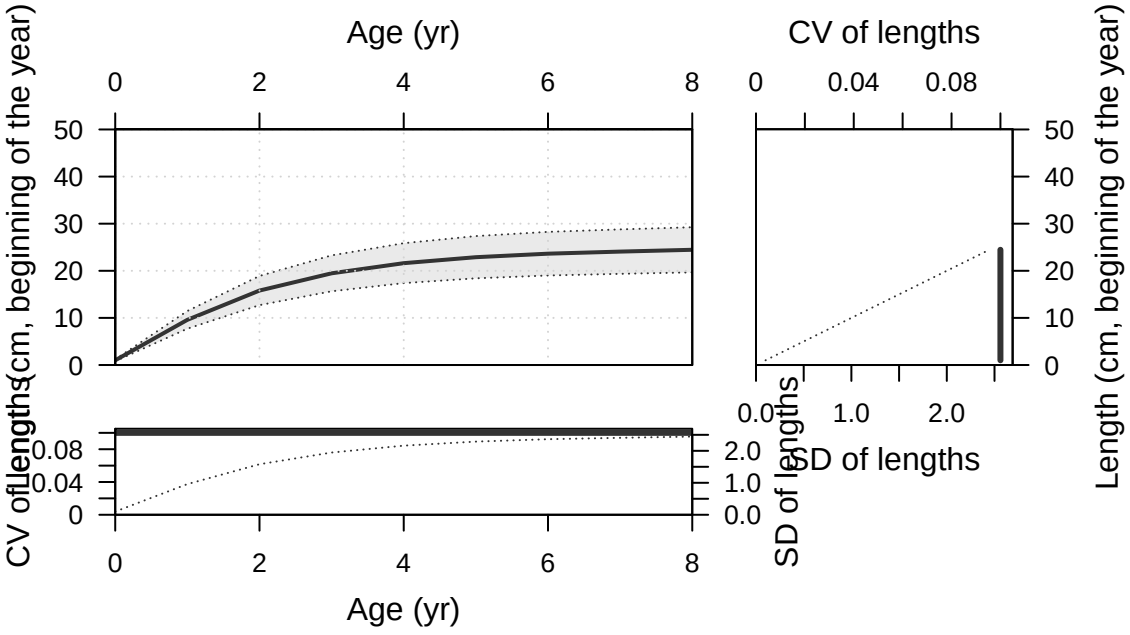
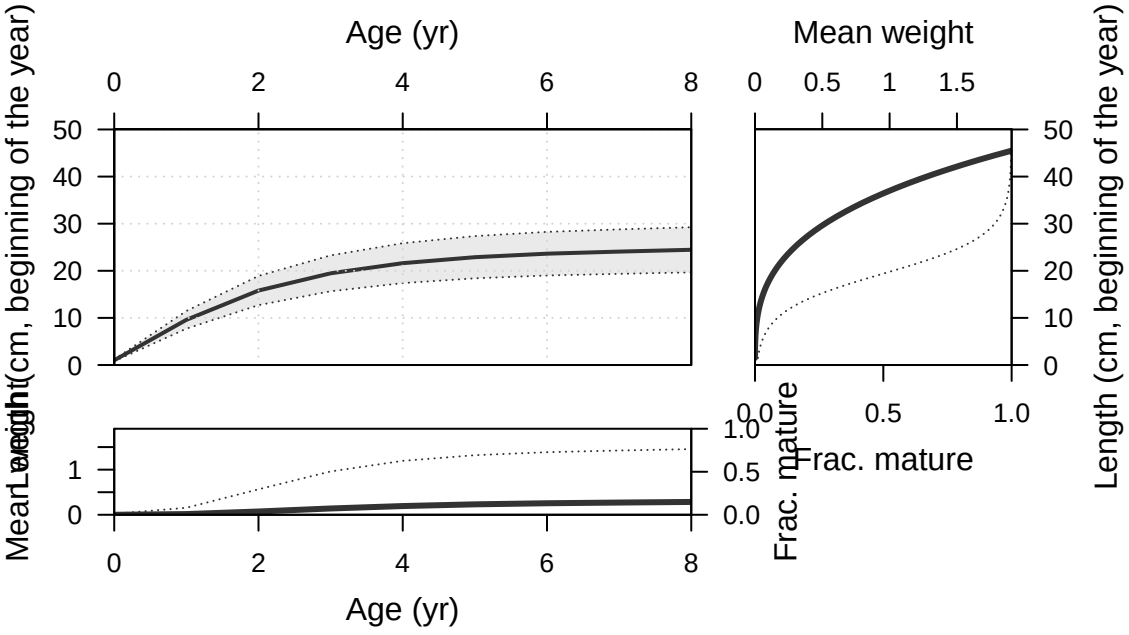
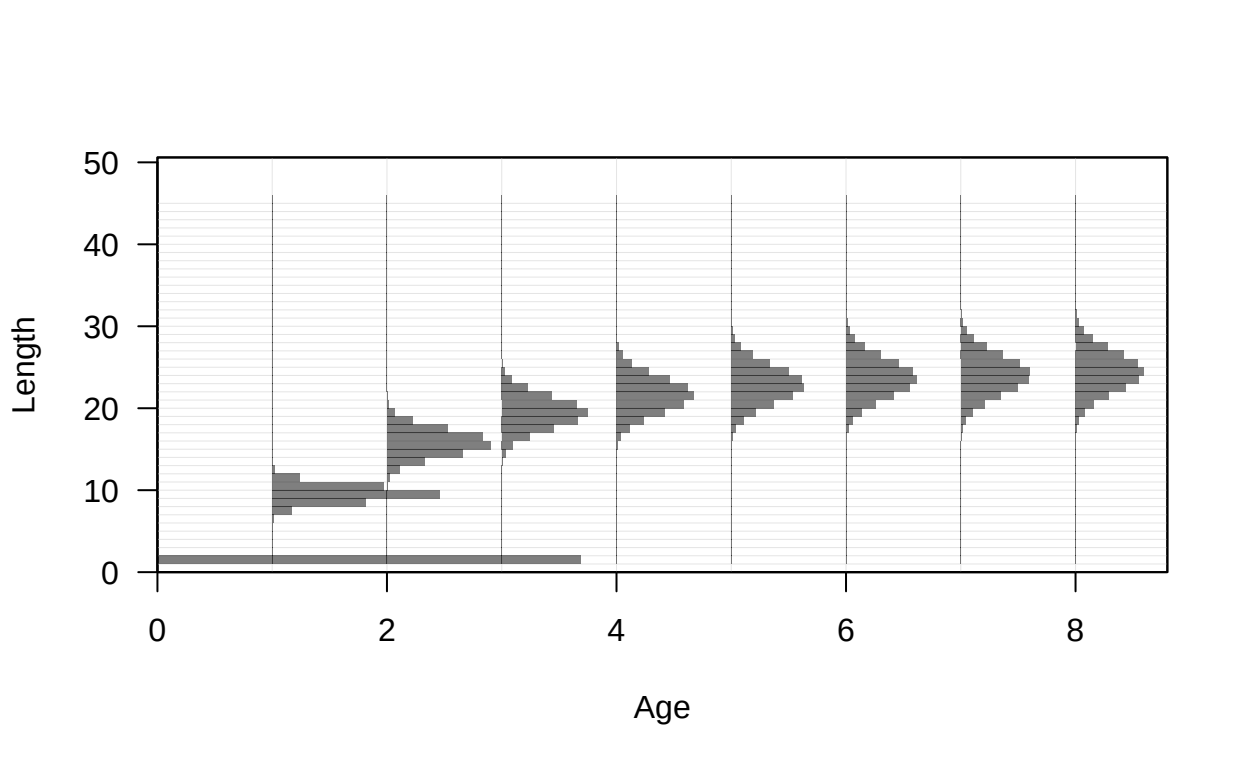
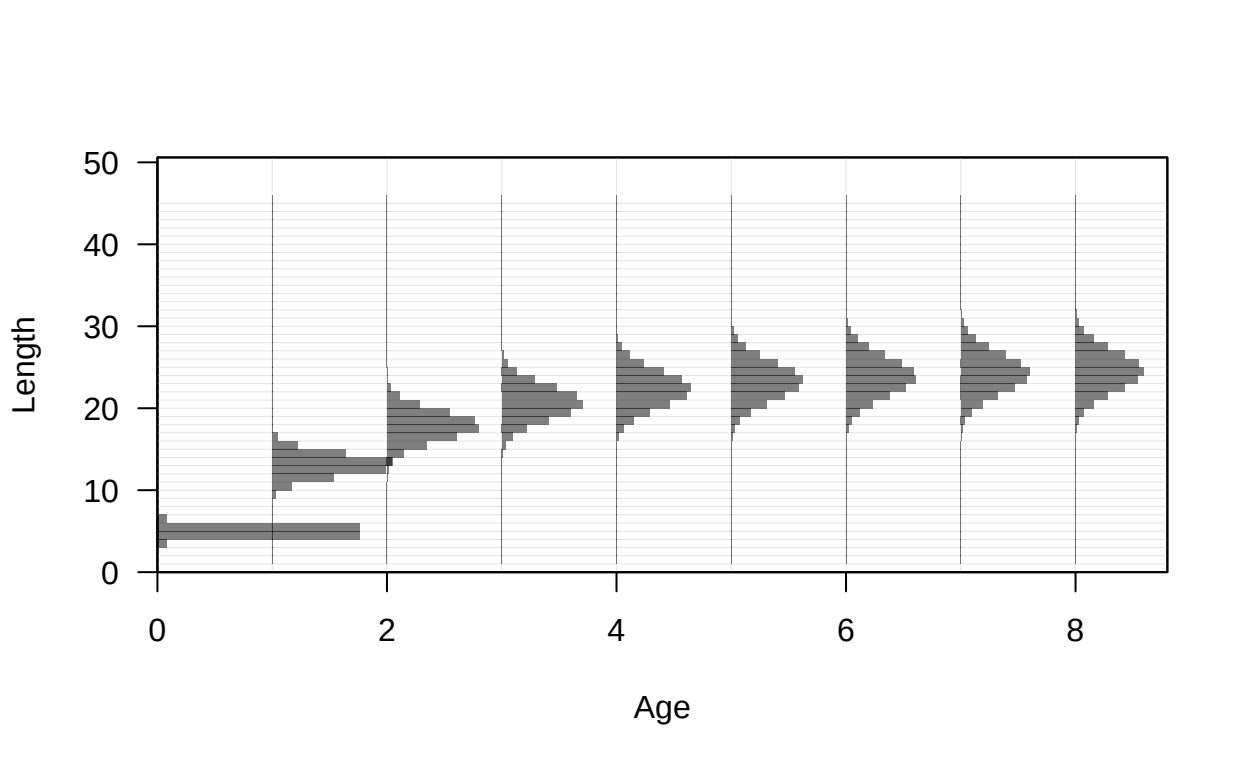
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Wed Jun 29 15:08:35 2022
Data_File: data.ss
Control_File: control.ss

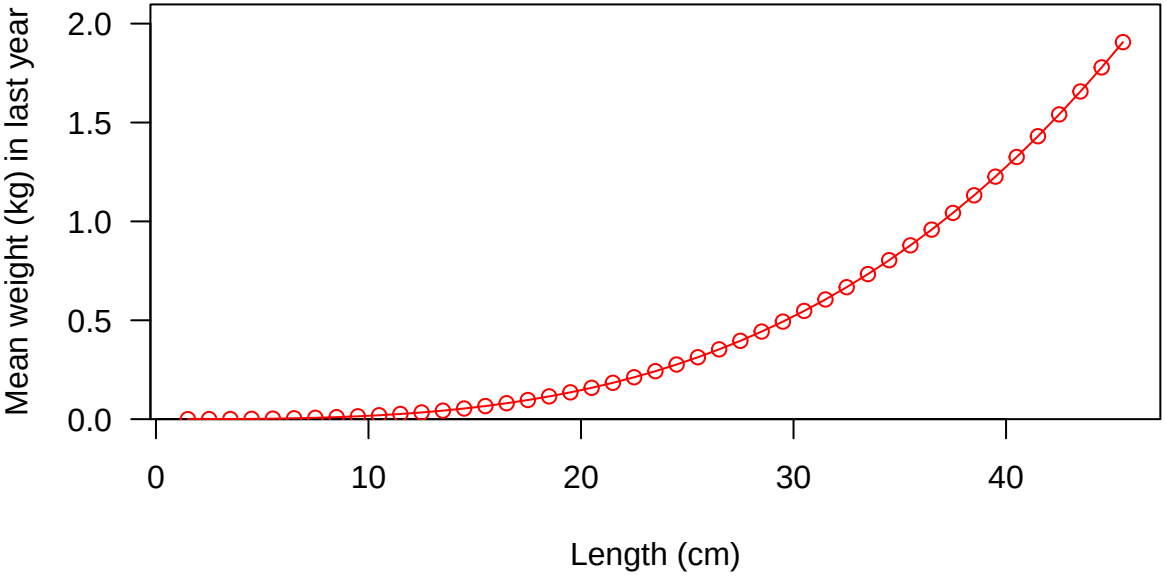

Length (cm, beginning of the year)
50
40
30
20
10
0
0
2
4
6
8
Age (yr)

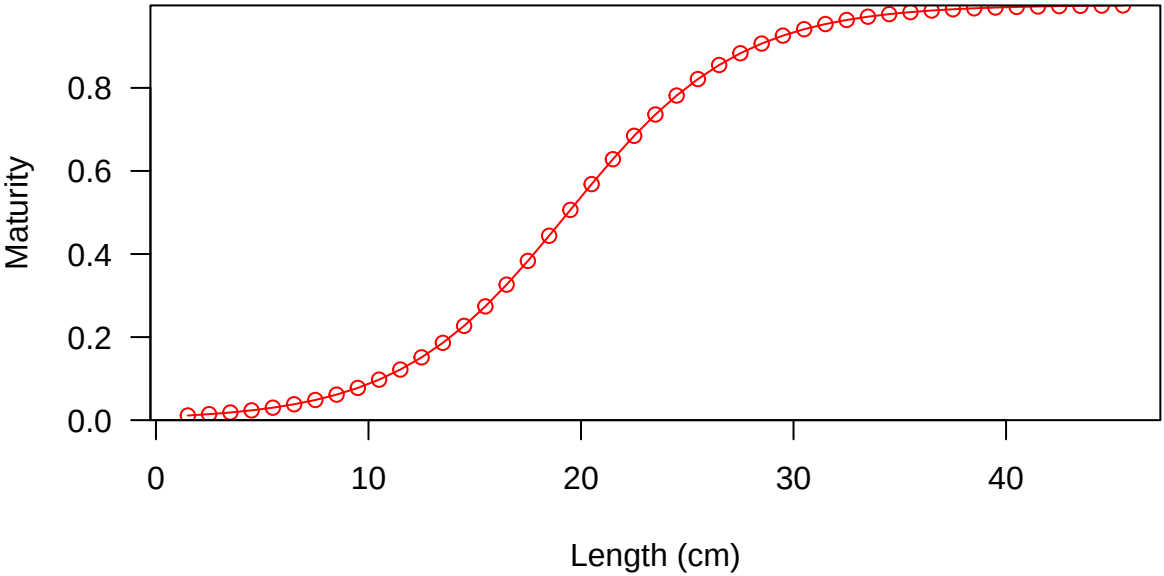

Age (yr)
0
2
4
6
8
CV of lengths
0
0.04
0.08
Length (cm, beginning of the year)
50
40
30
20
10
0
SD of lengths
0.0
1.0
2.0
Age (yr)

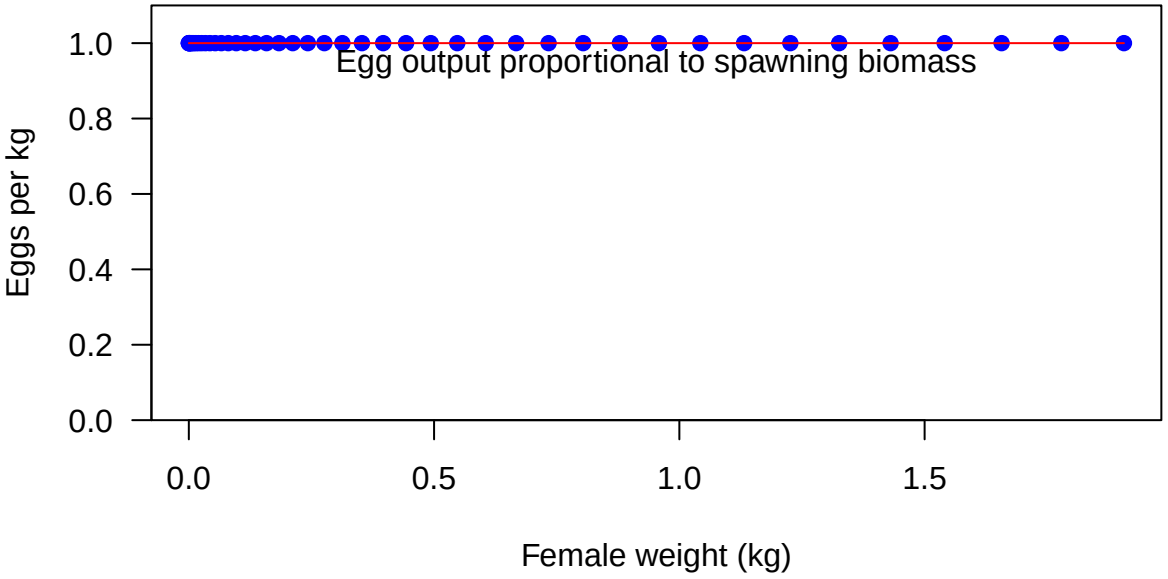

Age (yr)
Mean weight
Length (cm, beginning of the year)
Frac. mature
Age (yr)
Frac. mature
Length (cm, beginning of the year)

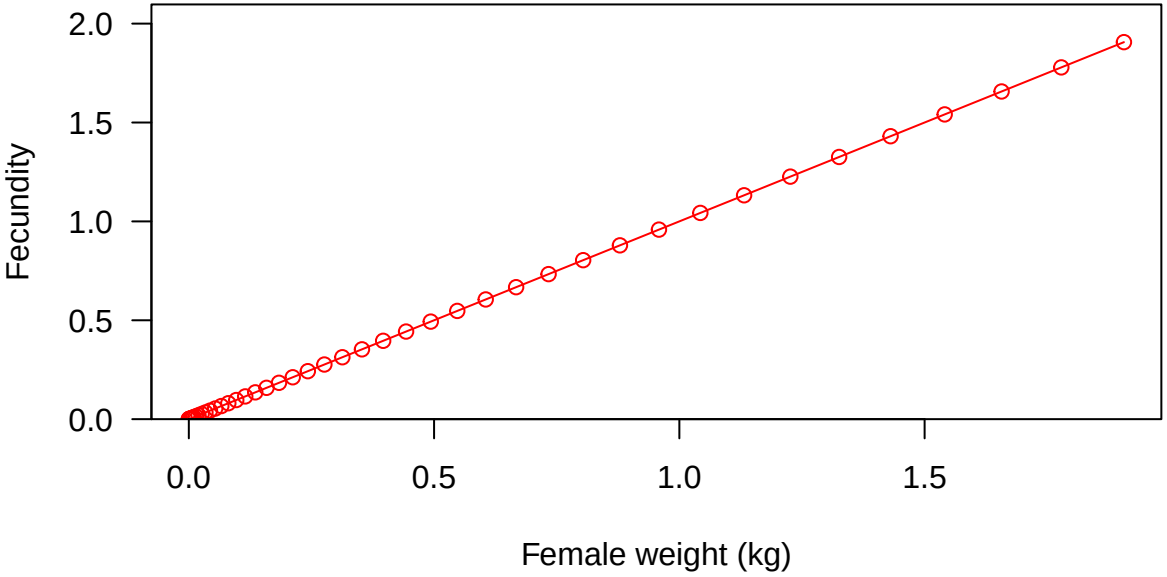

50
40
30
20
10
0
Length
0
2
4
6
8
Age

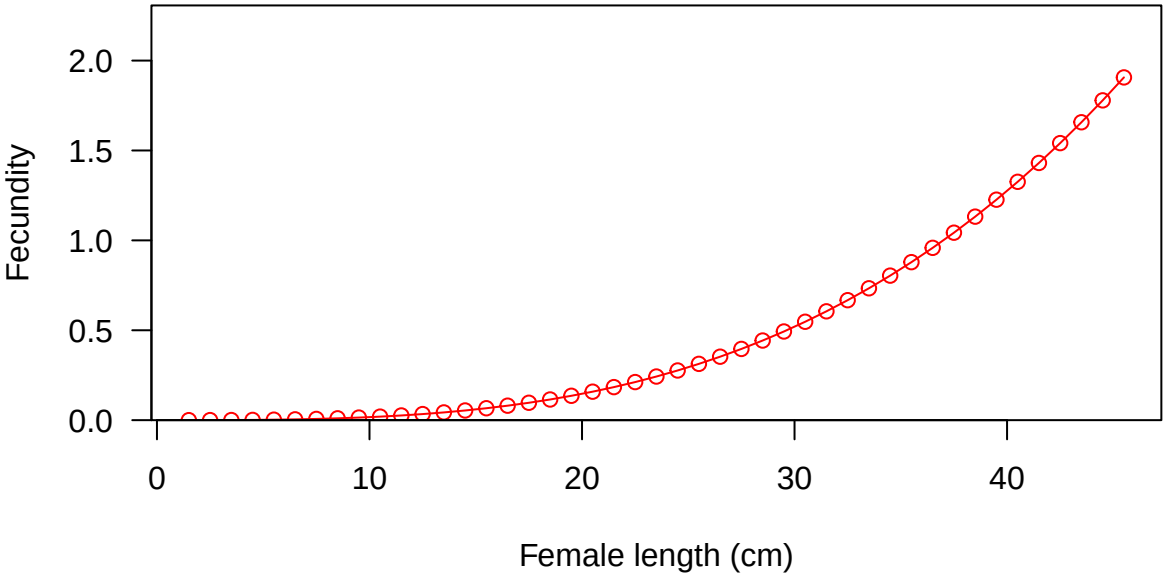

50
40
30
20
10
0
Length
0
2
4
6
8
Age

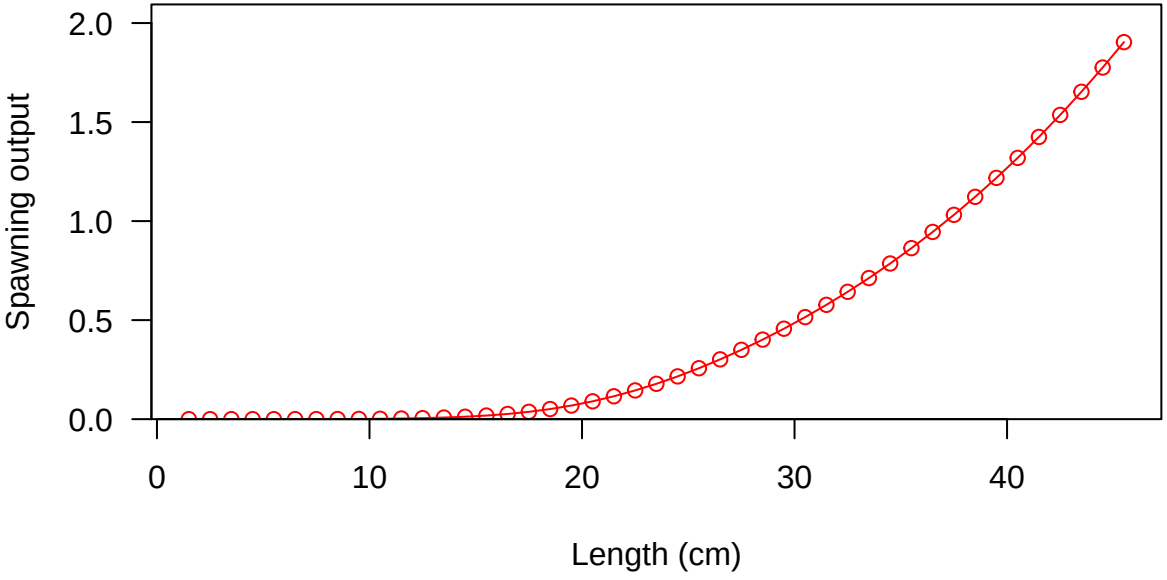

Mean weight (kg) in last year
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Length (cm)

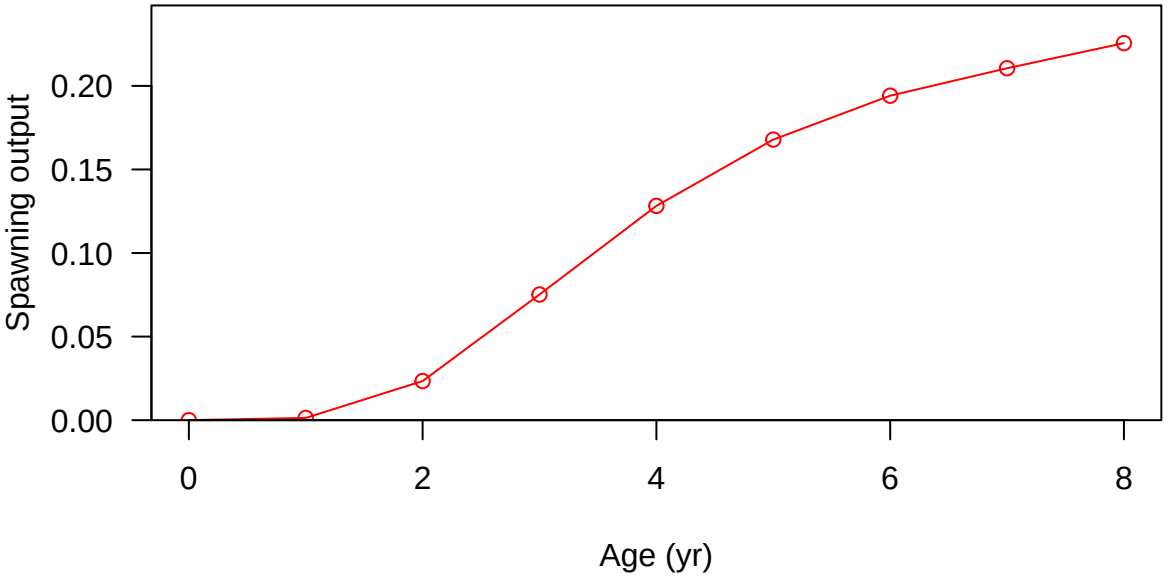

Maturity
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
Length (cm)

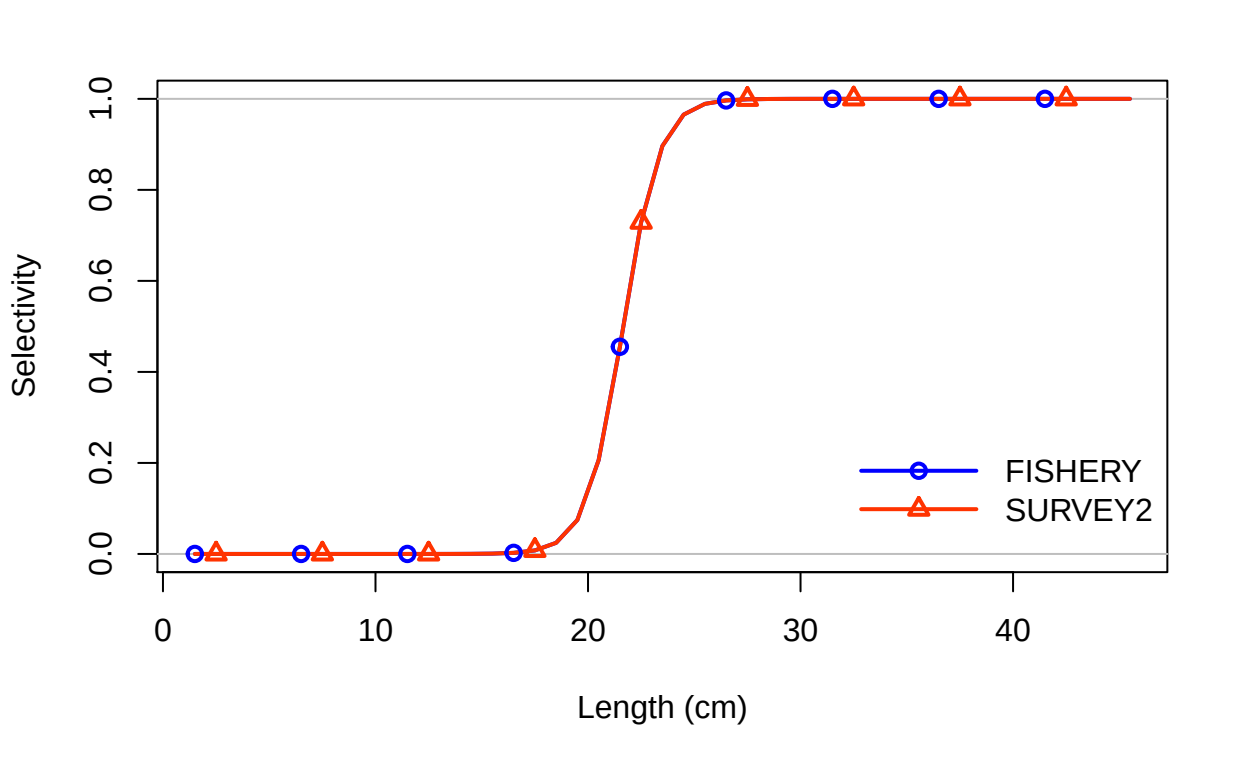

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
Female weight (kg)

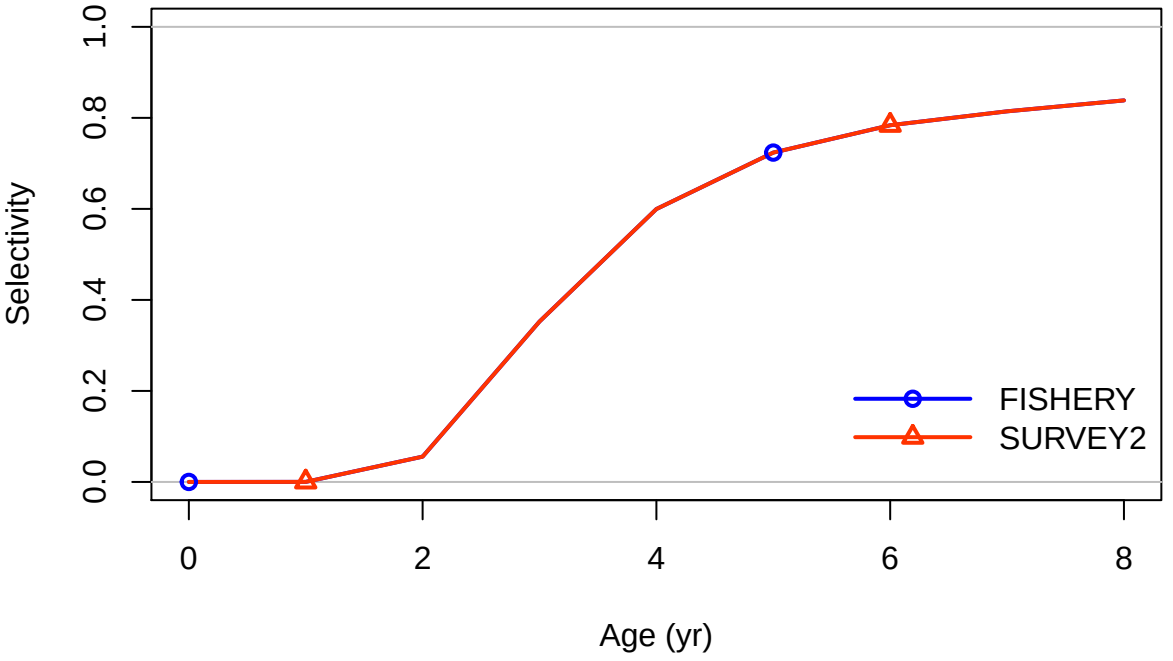

2.0
1.5
1.0
0.5
0.0
Fecundity
0.0
0.5
1.0
1.5
Female weight (kg)

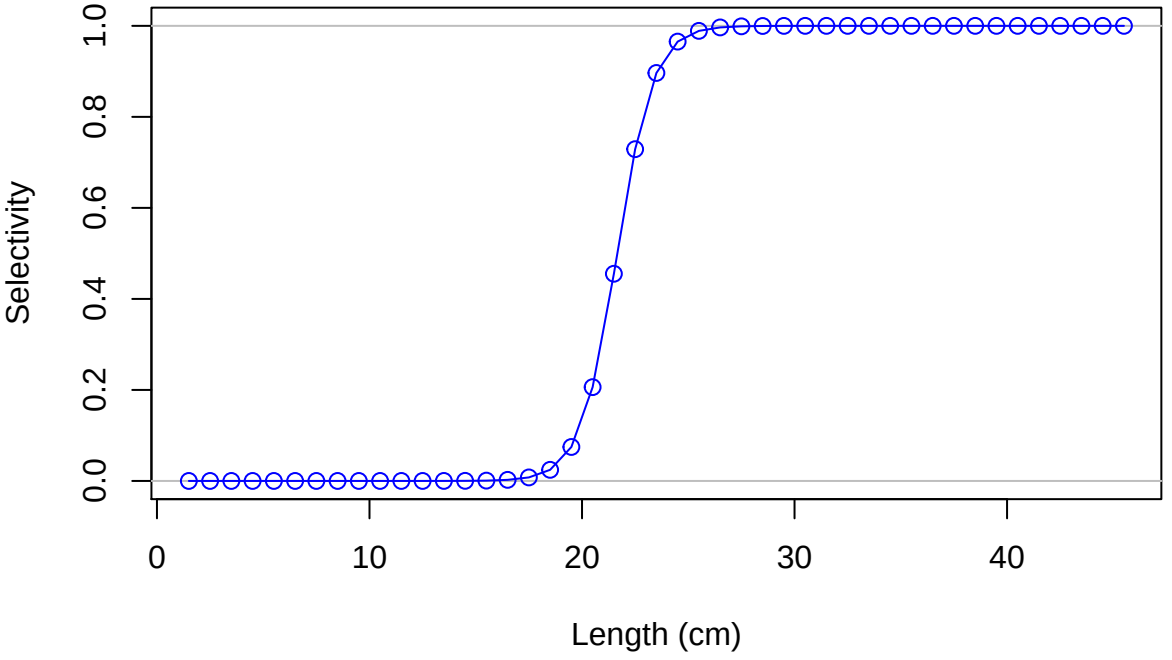

Fecundity
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Female length (cm)

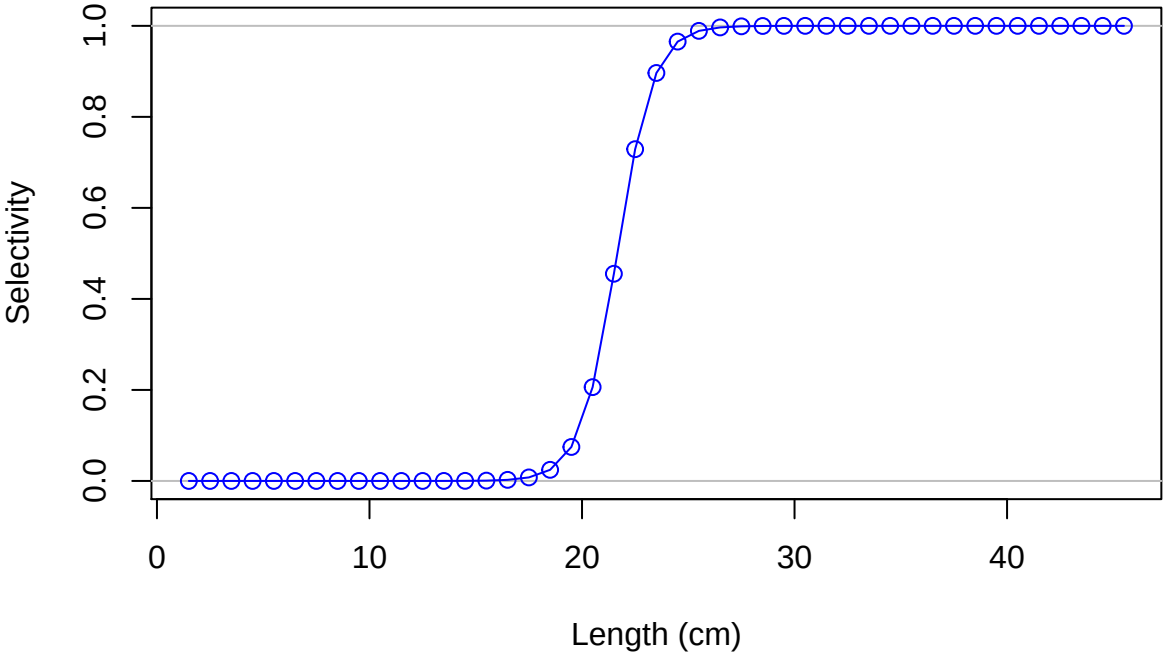

Spawning output
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Length (cm)

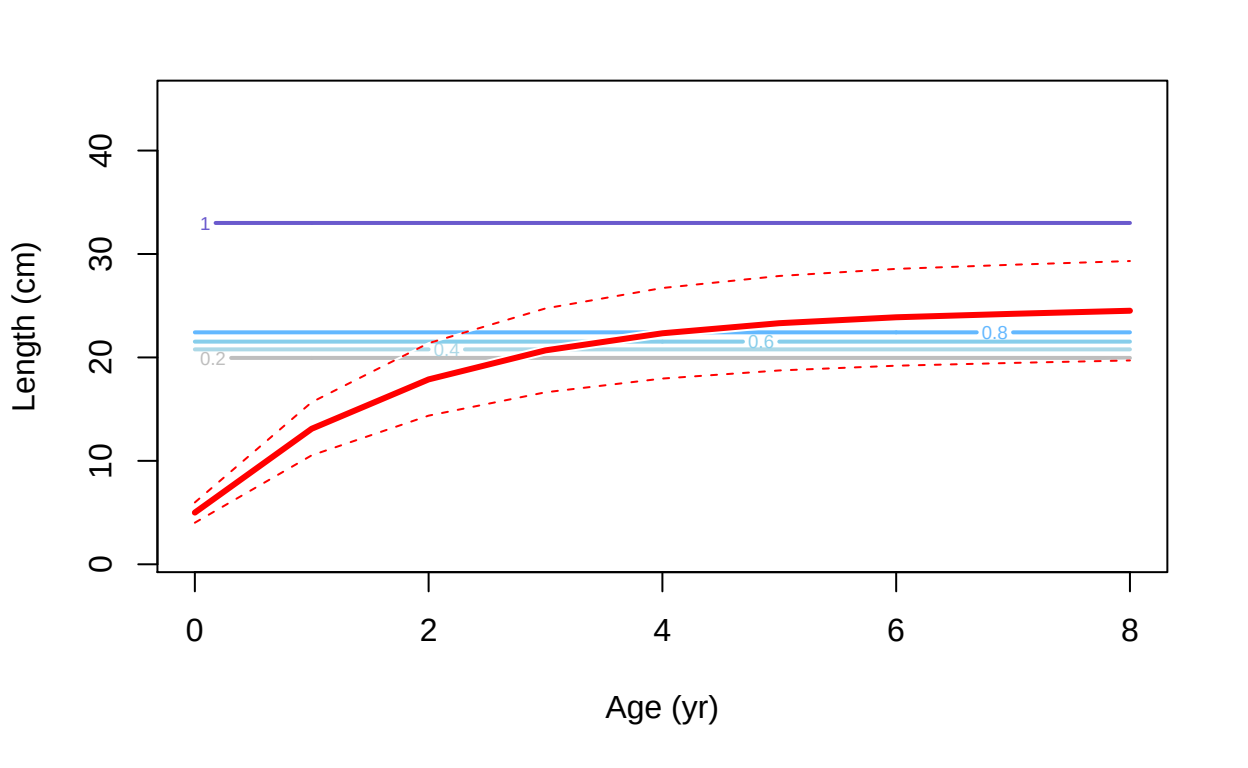

Spawning output
0.00
0.05
0.10
0.15
0.20
0
2
4
6
8
Age (yr)

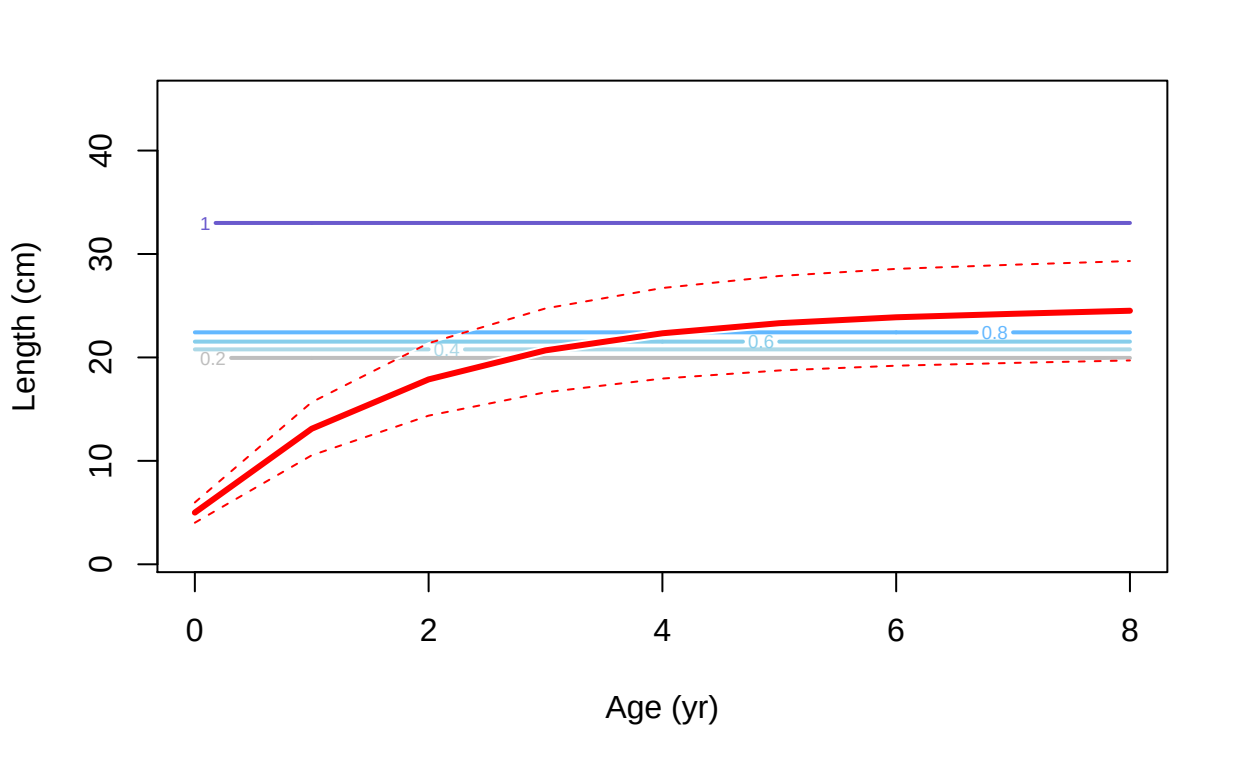

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)
FISHERY
SURVEY2

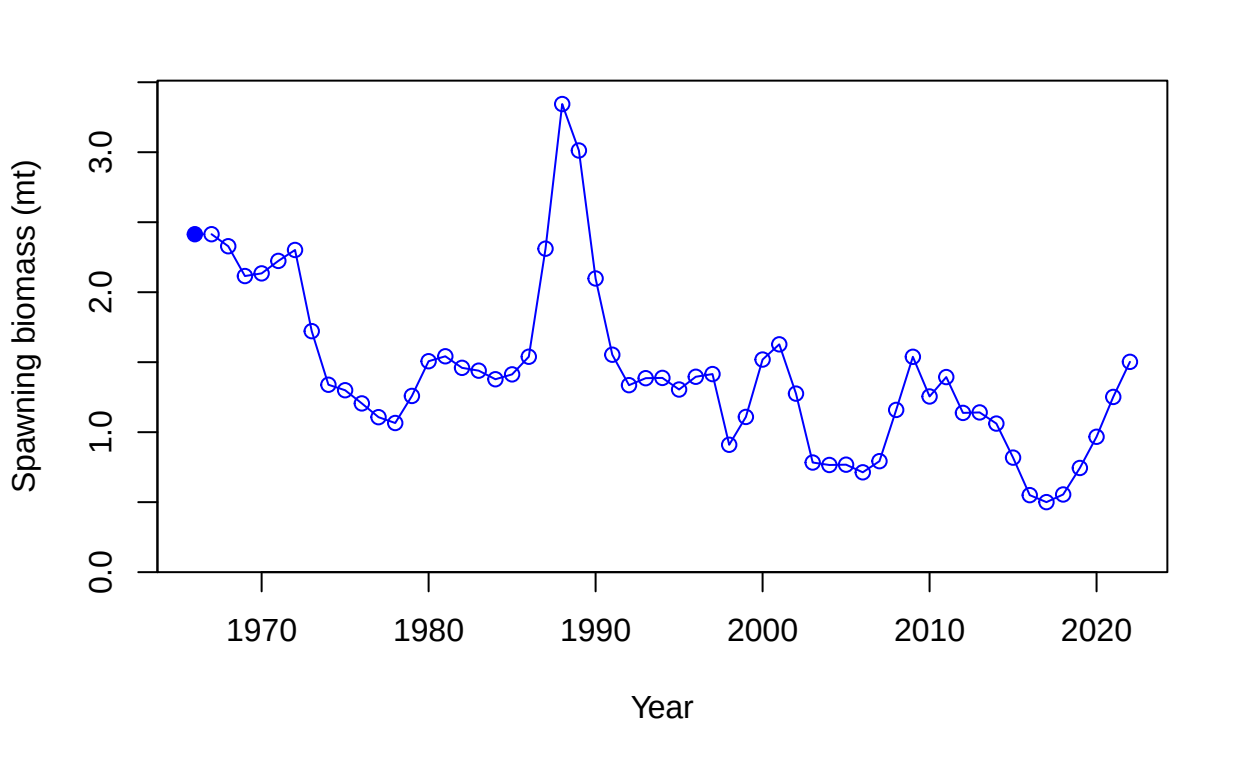

Selectivity
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
Age (yr)
FISHERY
SURVEY2

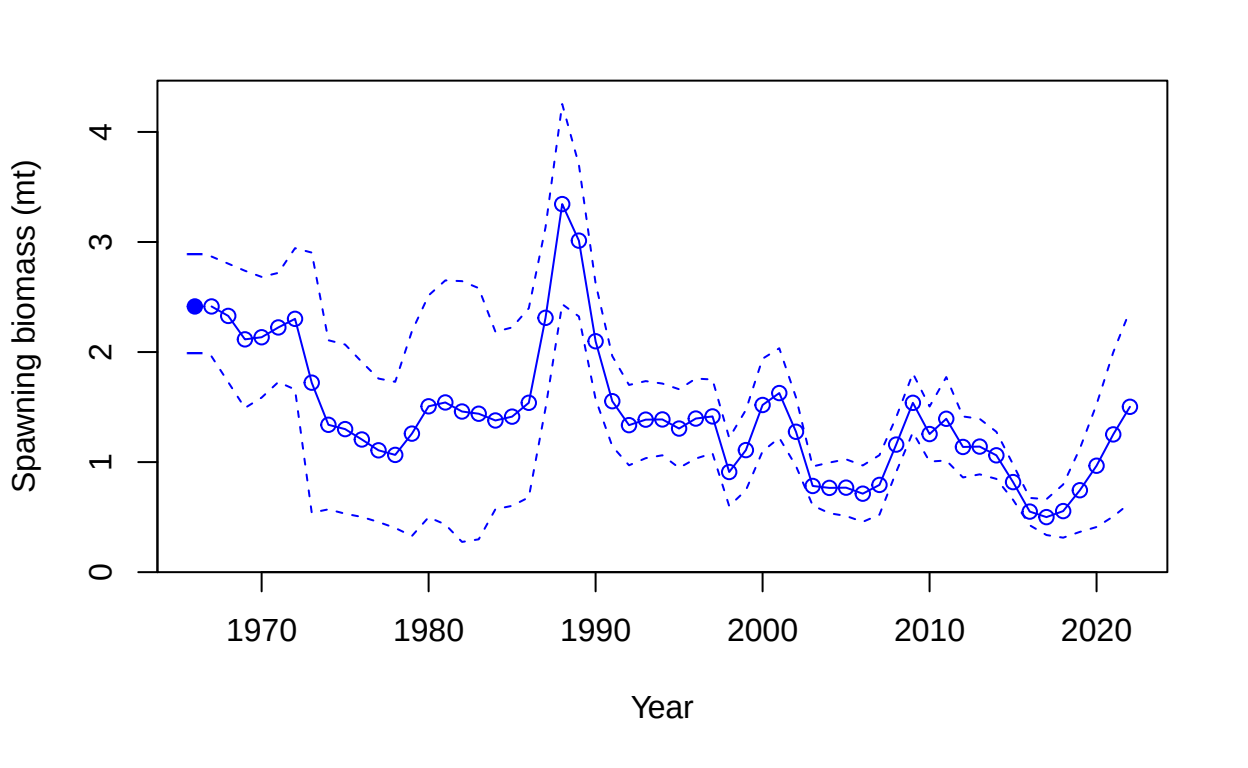

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

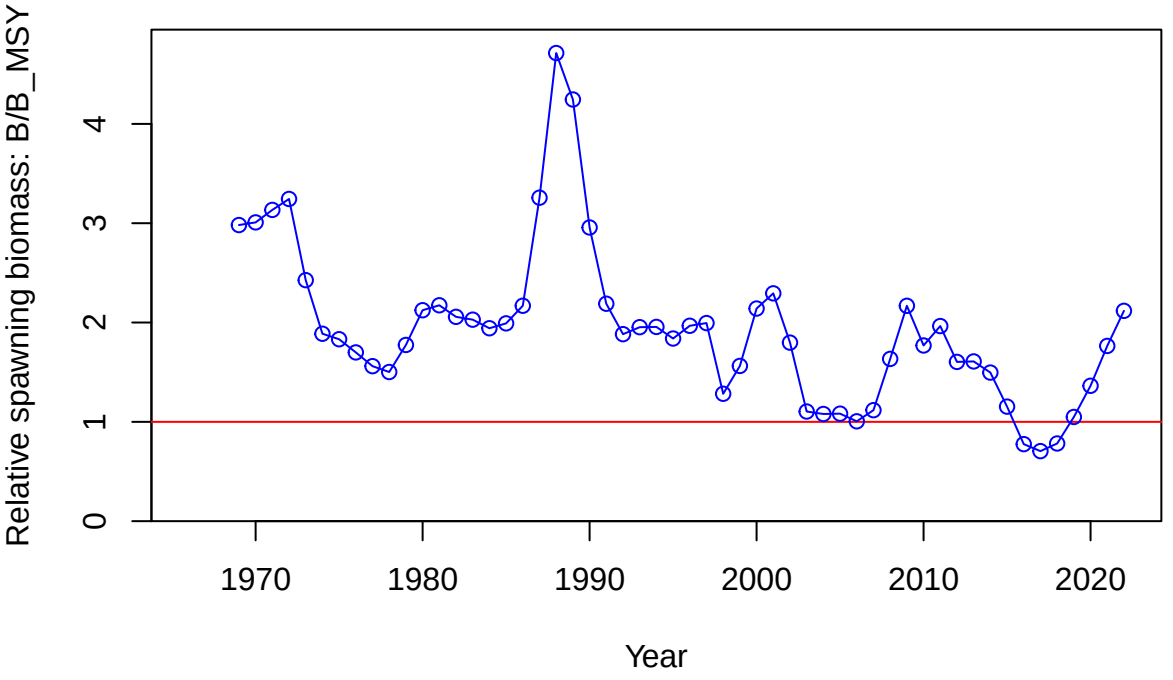

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

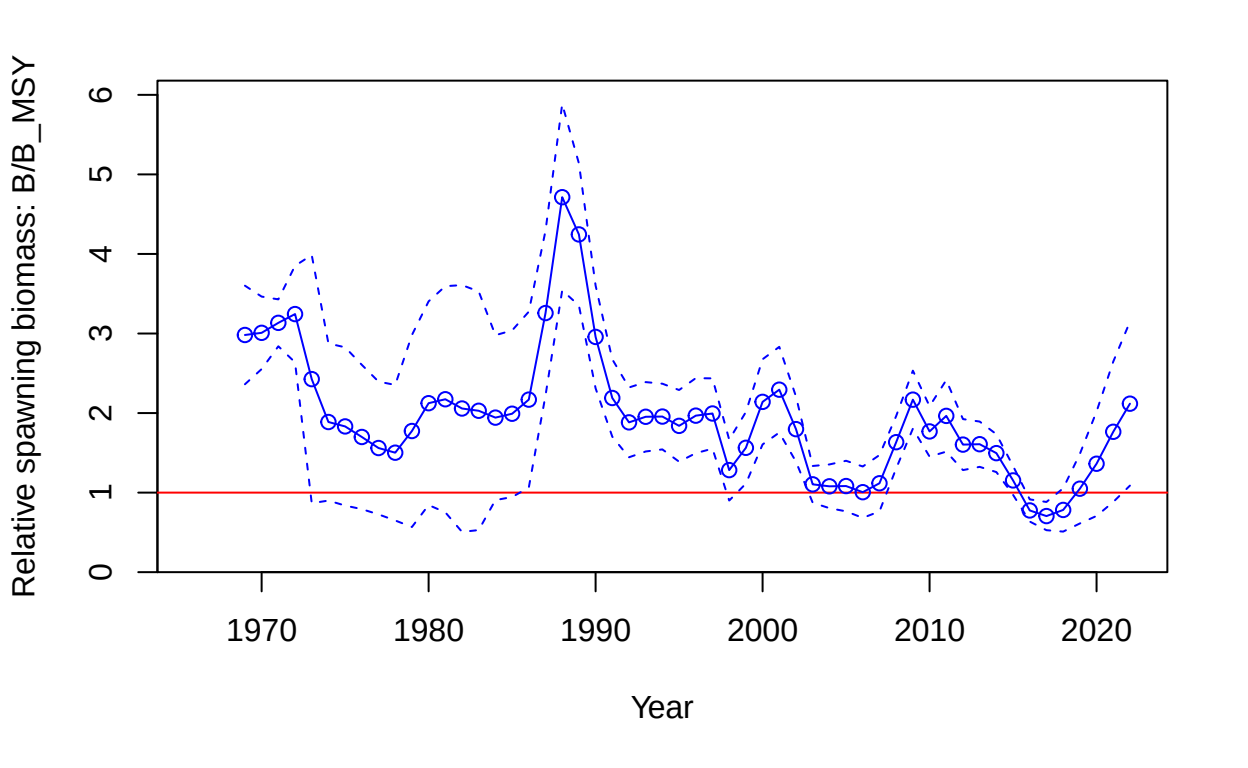

Length (cm)
0
10
20
30
40
Age (yr)
0
2
4
6
8
1
0.8
0.6
0.4
0.2

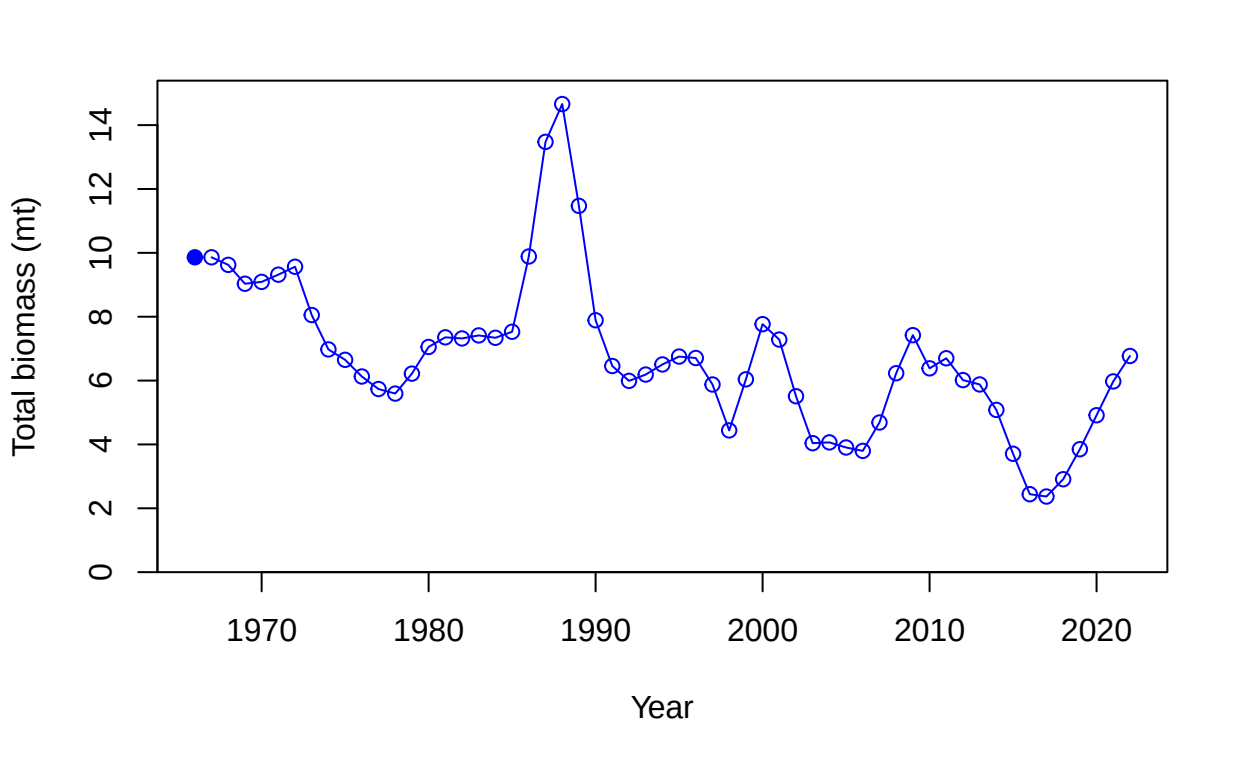

Length (cm)
0
10
20
30
40
Age (yr)
0
2
4
6
8
1
0.8
0.6
0.4
0.2

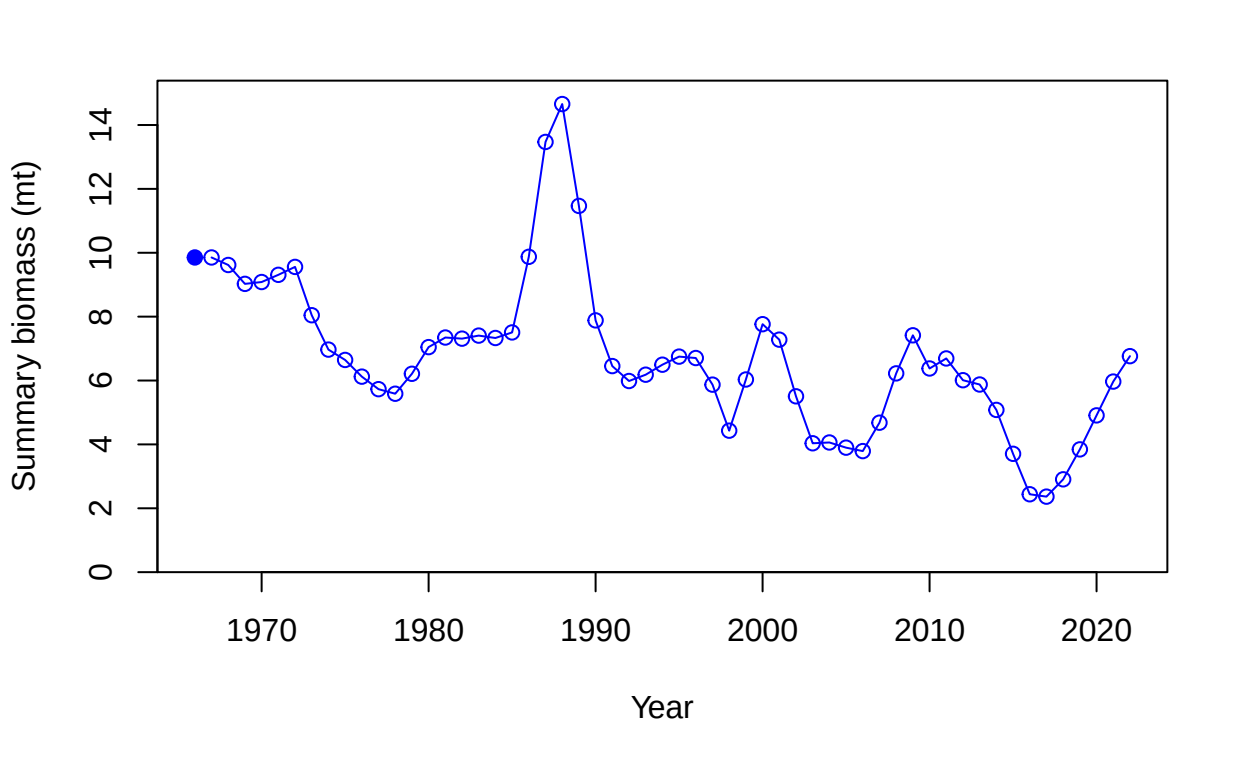

Spawning biomass (mt)
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

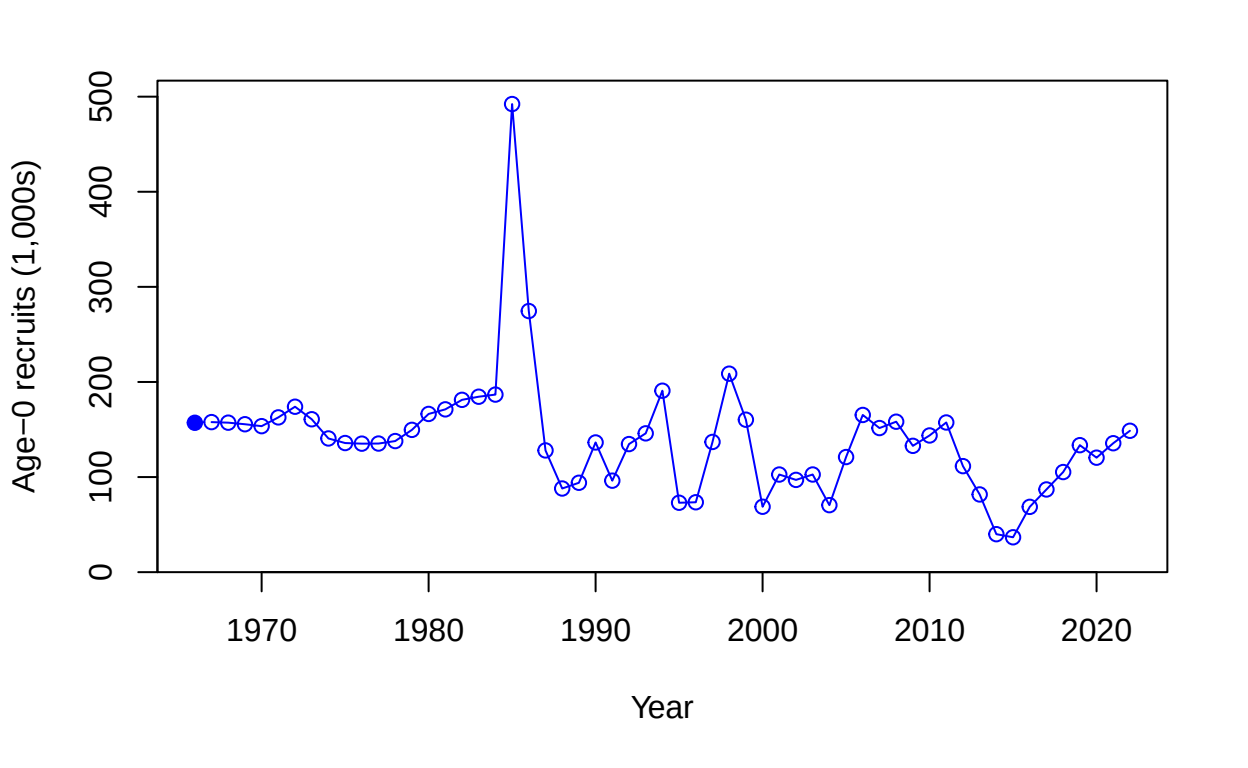

Spawning biomass (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

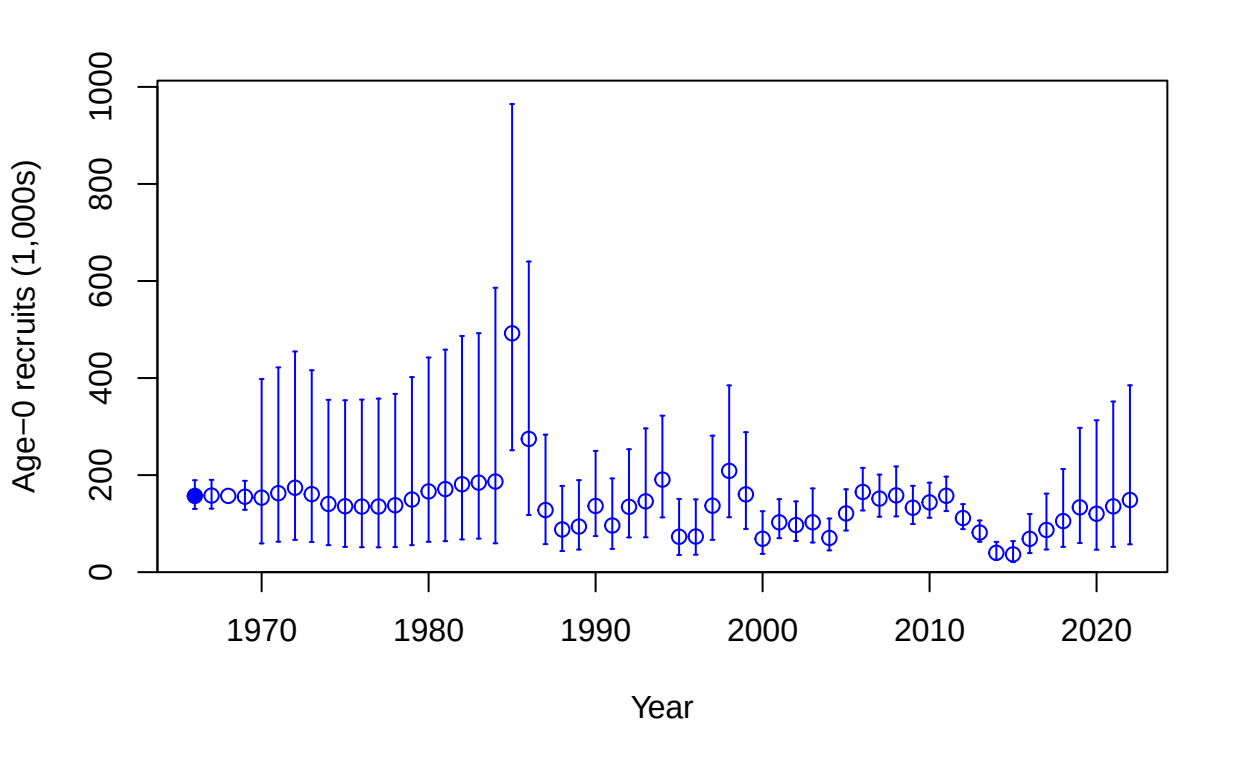

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

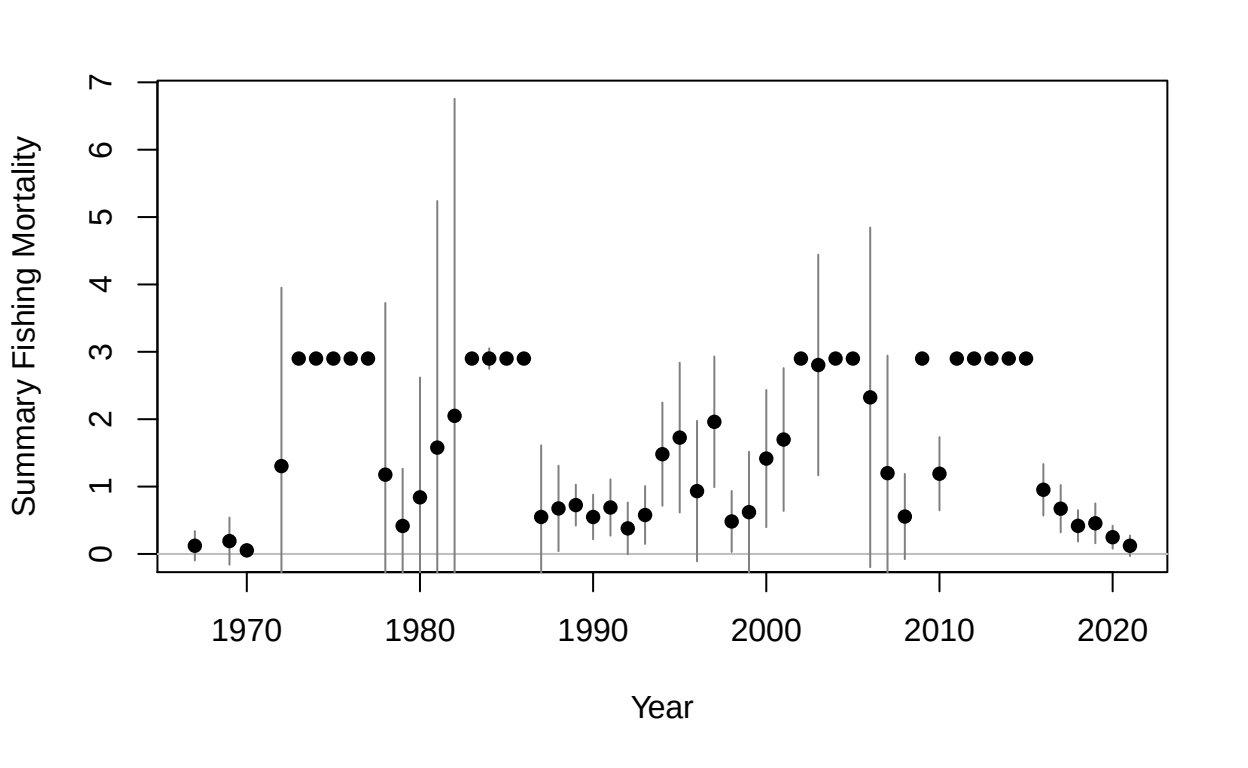

Relative spawning biomass: B/B_MSY
0
1
2
3
4
5
6
1970
1980
1990
2000
2010
2020
Year

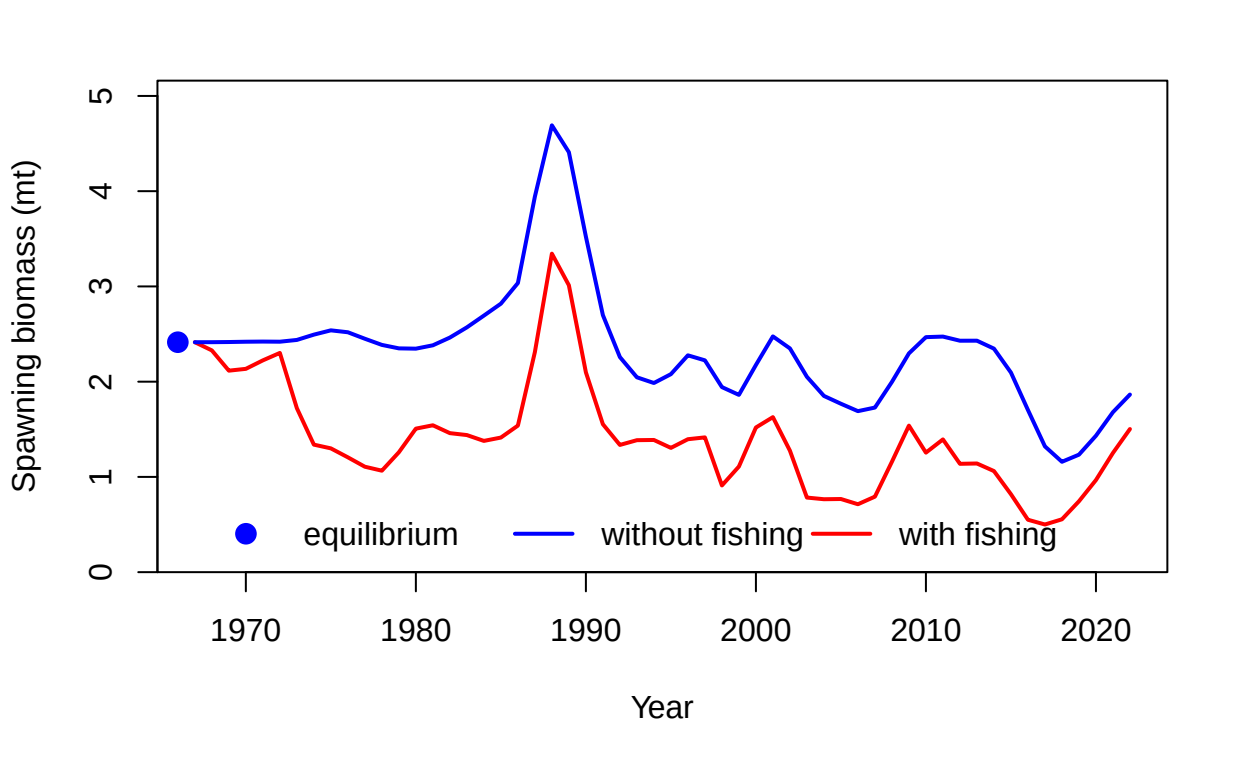

Total biomass (mt)
0
2
4
6
8
10
12
14
1970
1980
1990
2000
2010
2020
Year

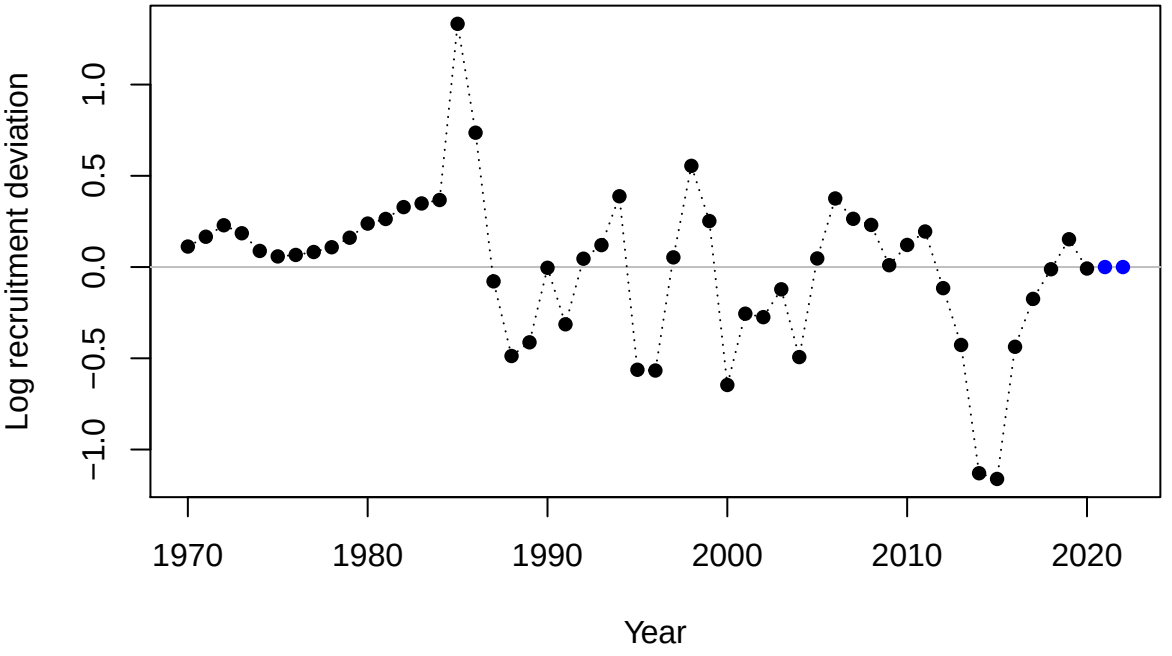

Summary biomass (mt)
0
2
4
6
8
10
12
14
1970
1980
1990
2000
2010
2020
Year

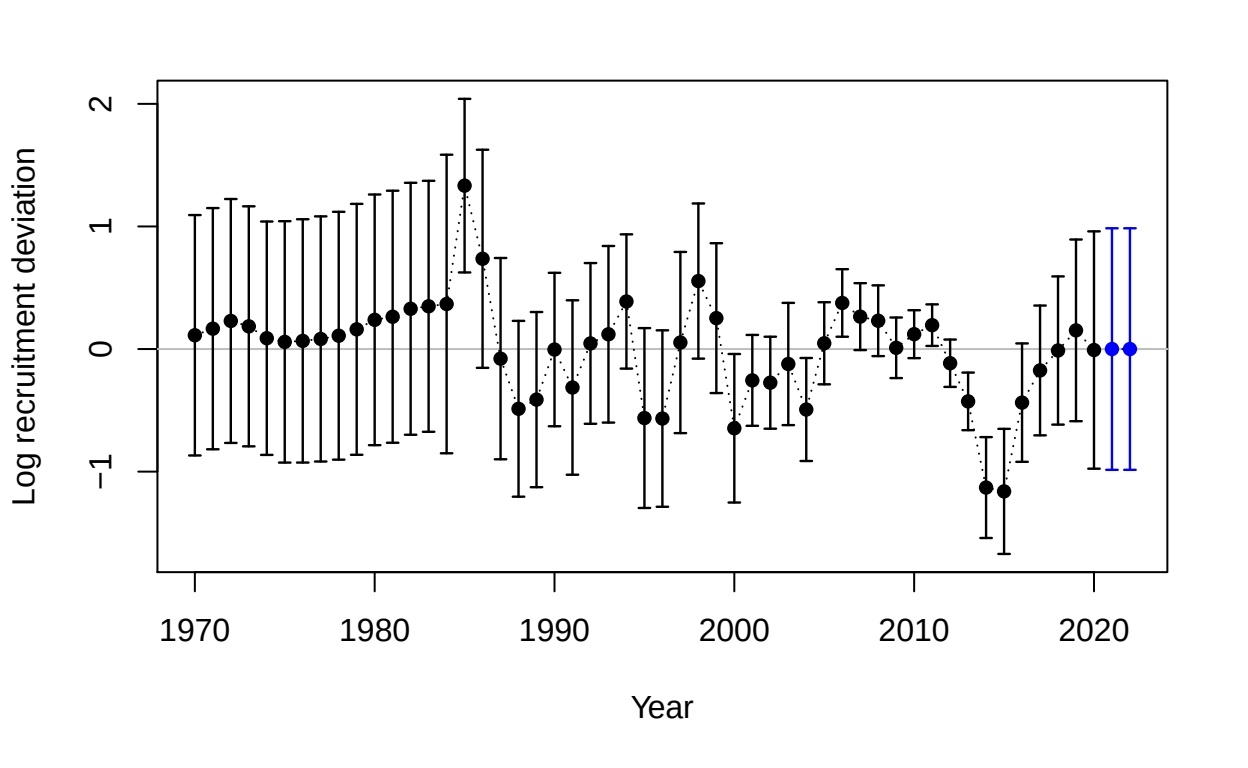

Age−0 recruits (1,000s)
0
100
200
300
400
500
1970
1980
1990
2000
2010
2020
Year

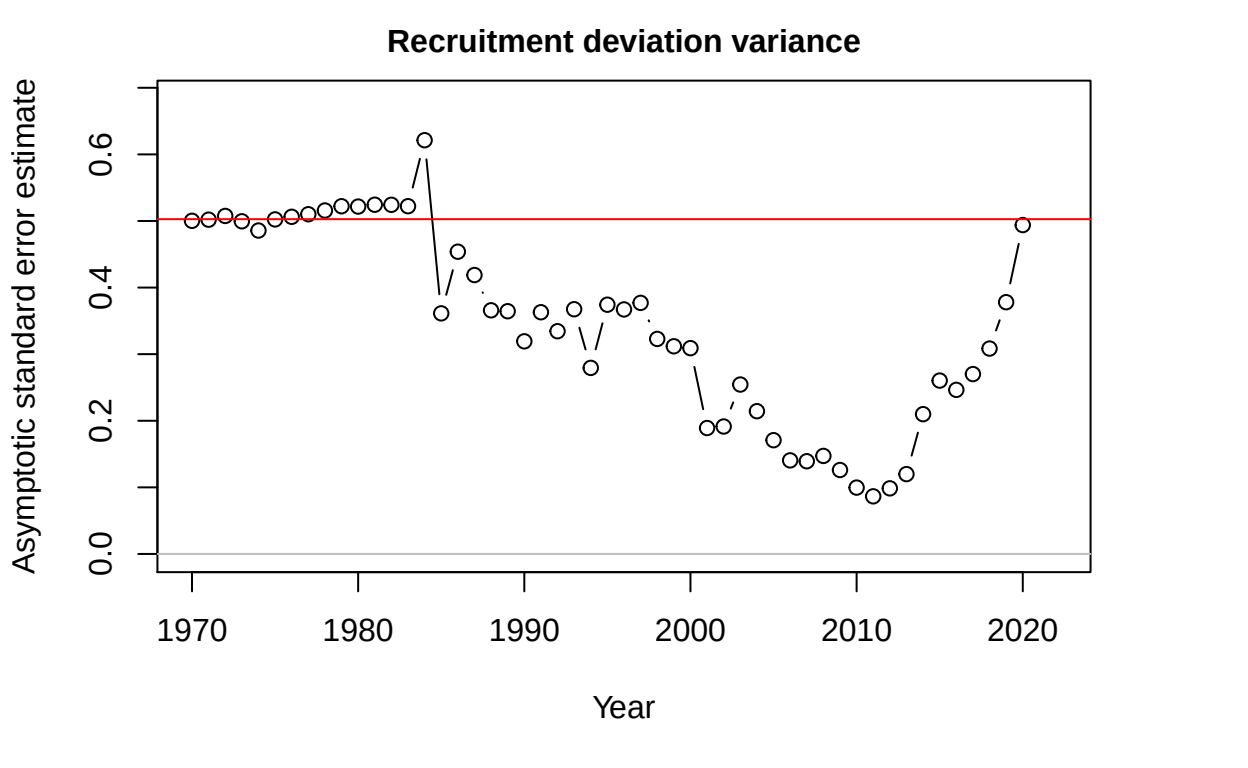

Age−0 recruits (1,000s)
0
200
400
600
800
1000
1970
1980
1990
2000
2010
2020
Year

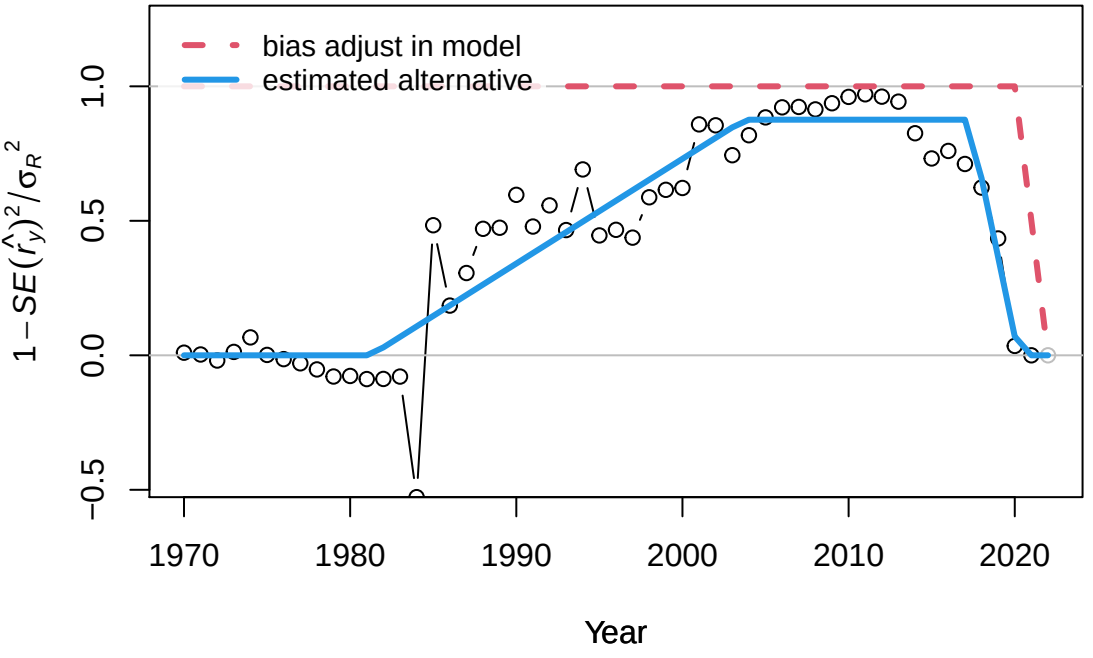

Summary Fishing Mortality
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

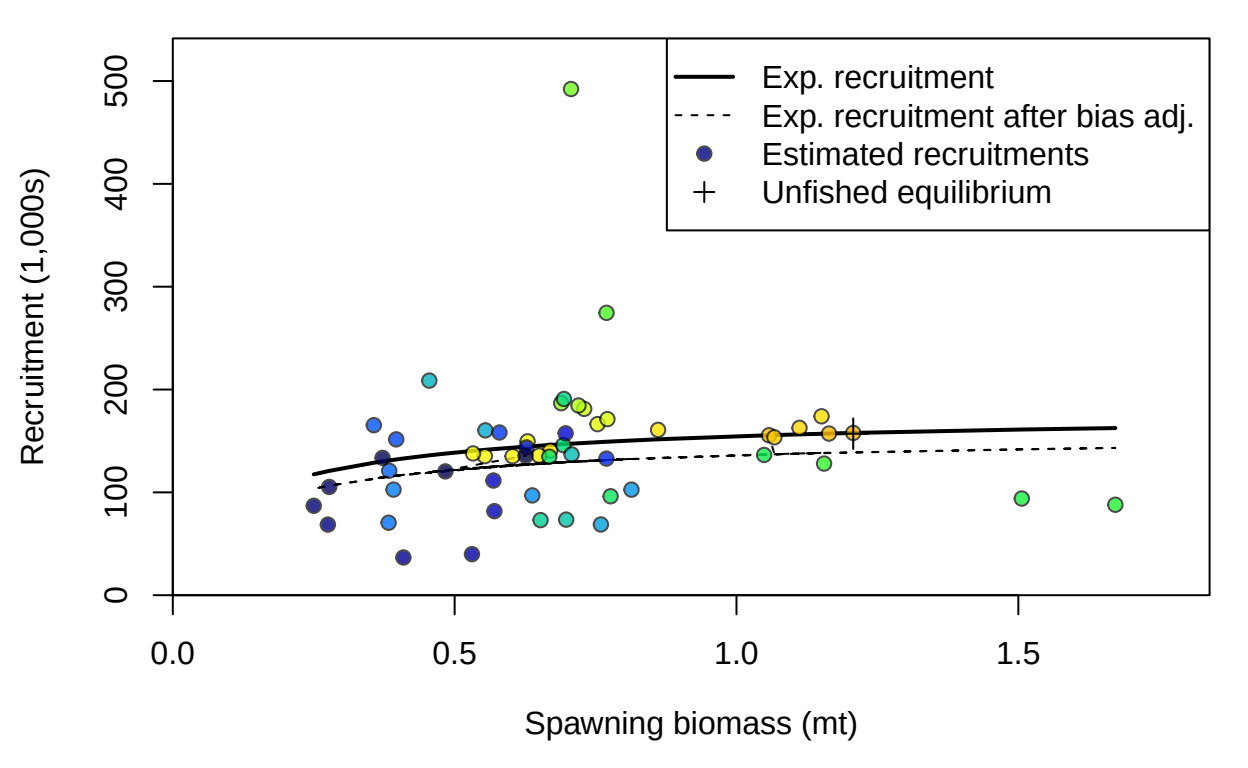

Spawning biomass (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

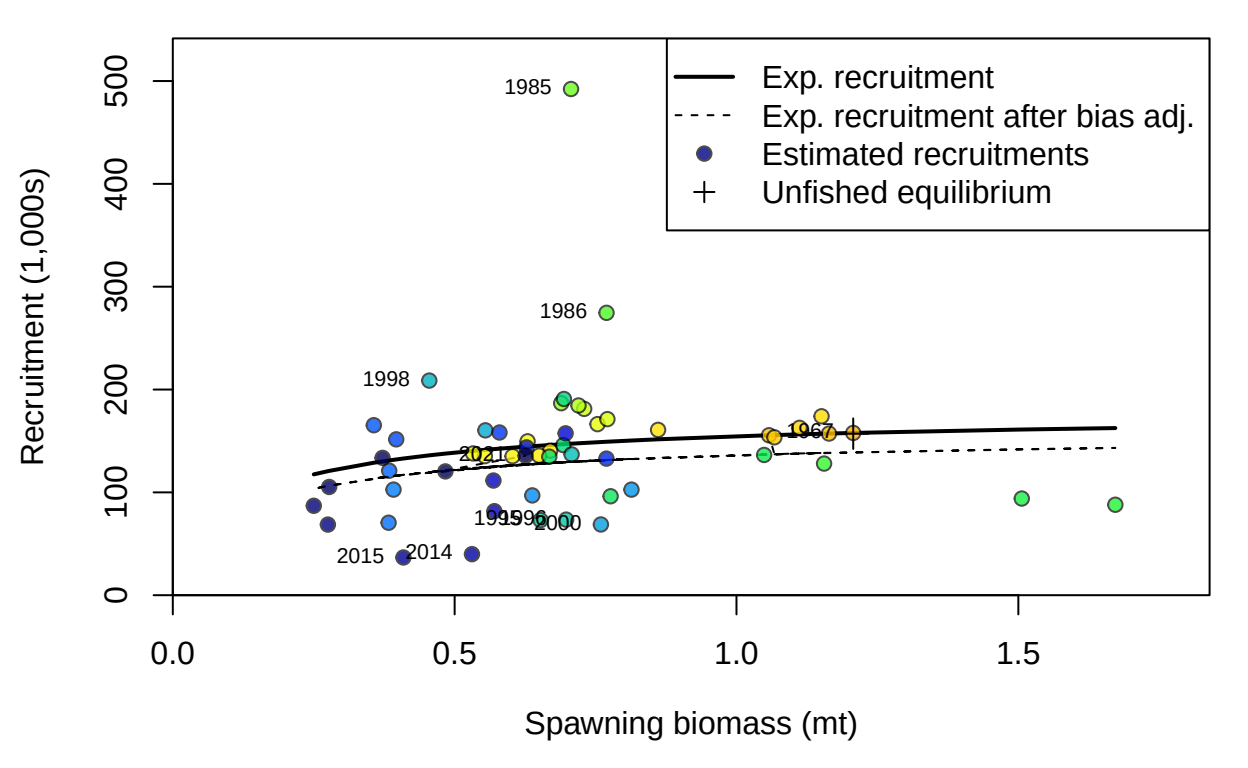

Log recruitment deviation
−1.0
−0.5
0.0
0.5
1.0
1970
1980
1990
2000
2010
2020
Year

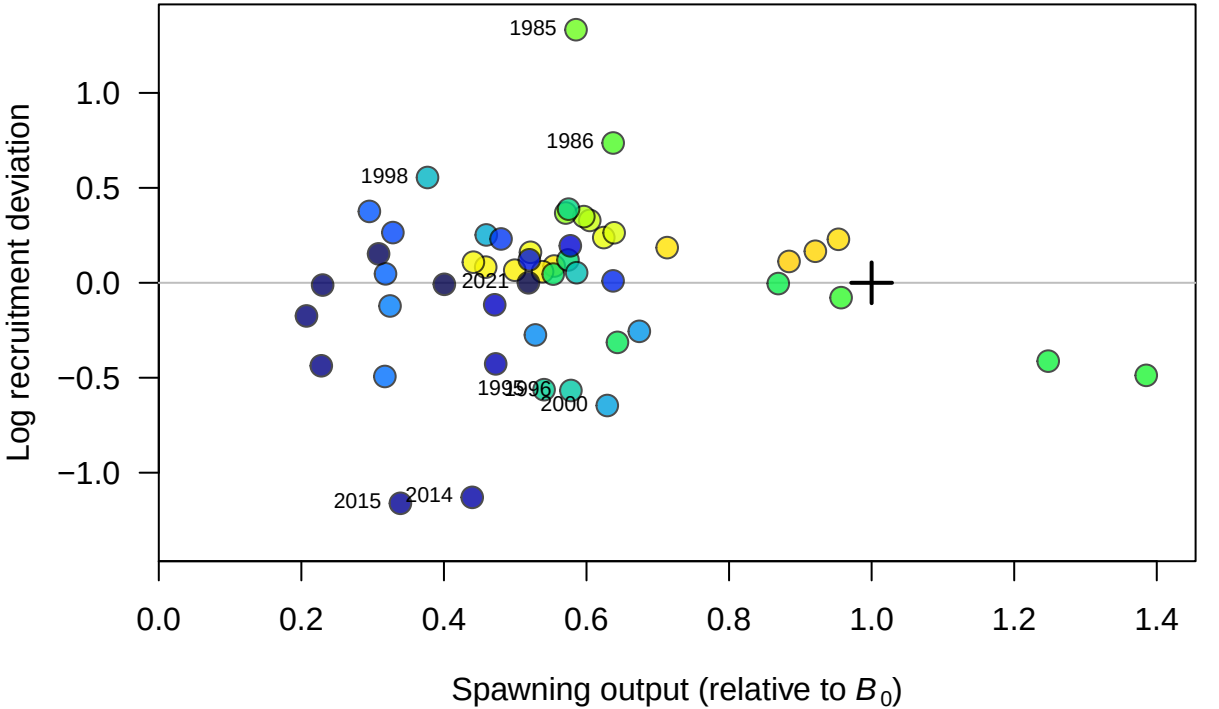

Log recruitment deviation
2
1
0
−1
1970
1980
1990
2000
2010
2020
Year

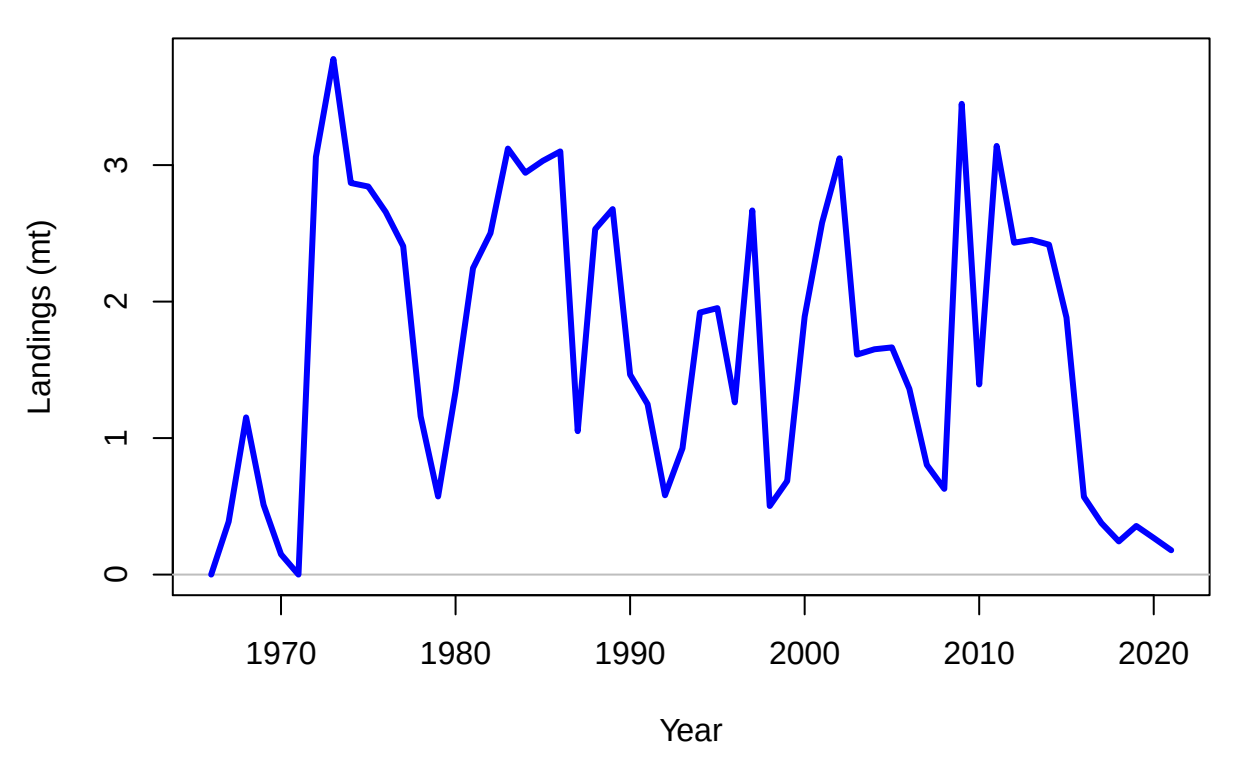

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

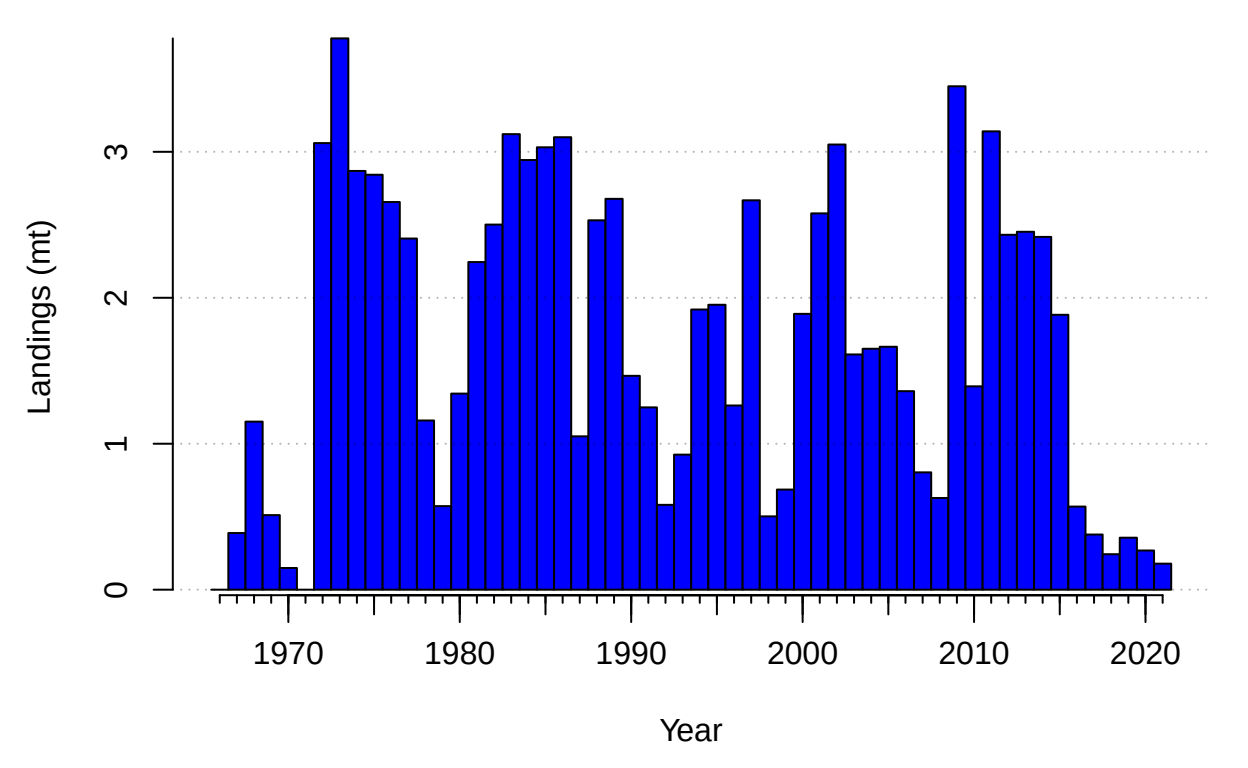

bias adjust in model
estimated alternative
1.0
0.5
0.0
−0.5
$1 - SE(\hat{r}_y)^2/\sigma_R^2$
1970
1980
1990
2000
2010
2020
Year

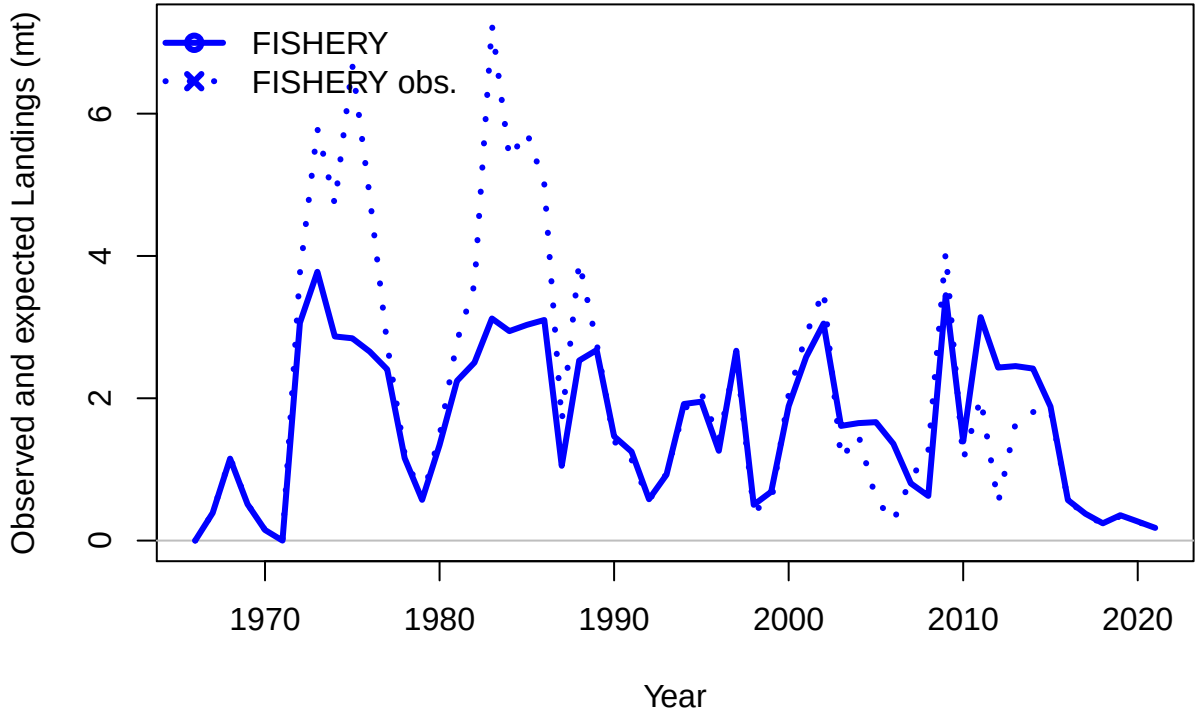

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
100
200
300
400
500
0.0
0.5
1.0
1.5
Spawning biomass (mt)

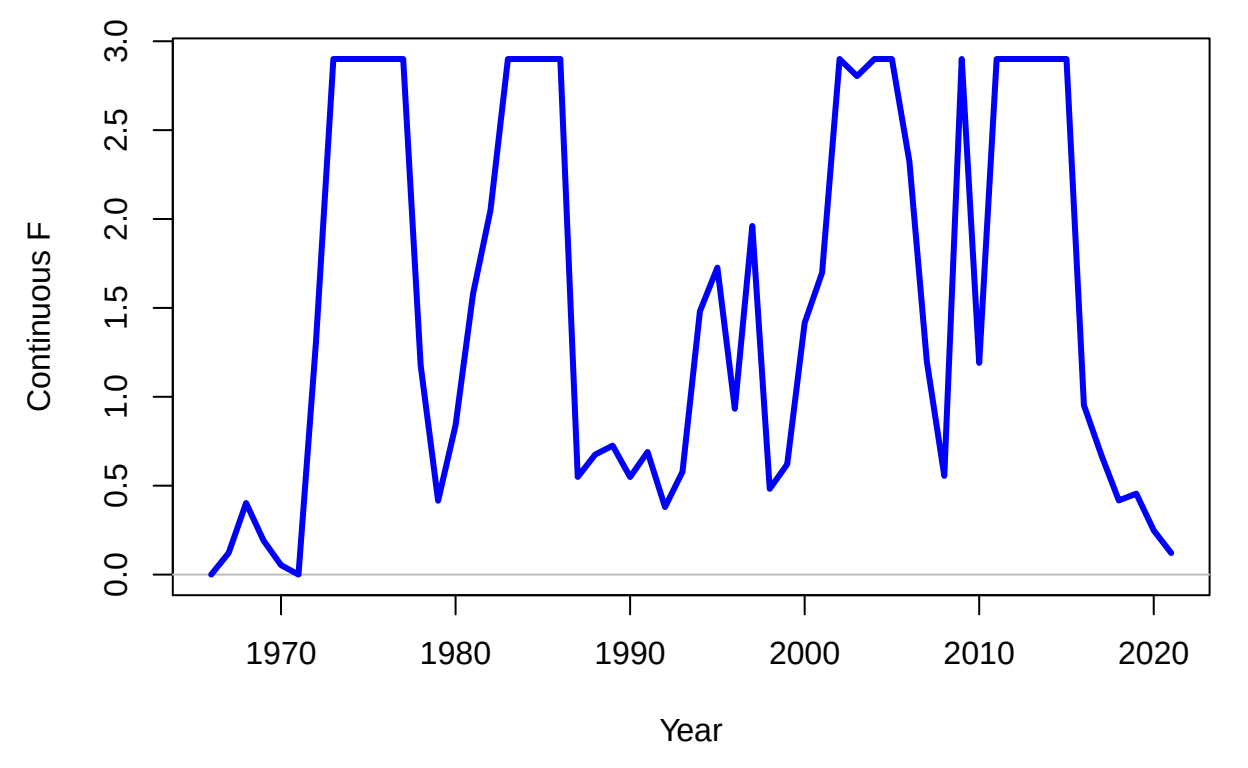

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
1985
1986
1998
1967
2021
2000
2015
2014
Recruitment (1,000s)
0
100
200
300
400
500
0.0
0.5
1.0
1.5
Spawning biomass (mt)

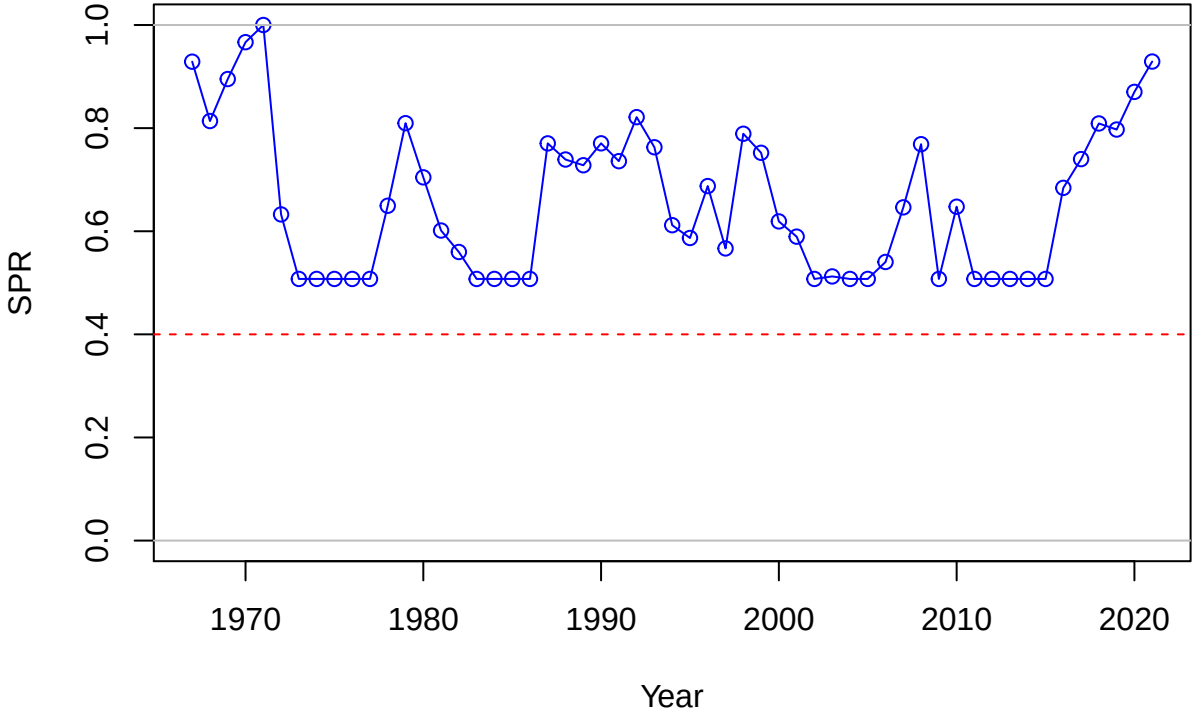

1985
1986
1998
2021
2000
2015
2014
1.0
0.5
0.0
−0.5
−1.0
Log recruitment deviation
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Spawning output (relative to B_0)

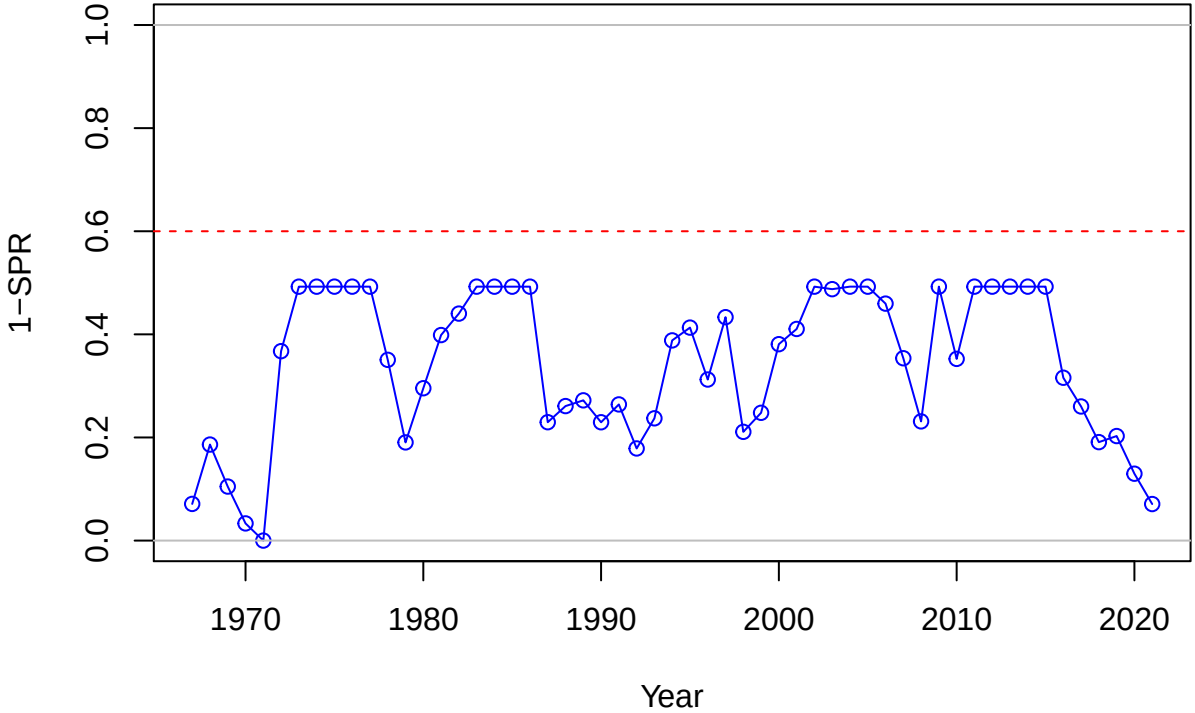

Landings (mt)
0
1
2
3
1970
1980
1990
2000
2010
2020
Year

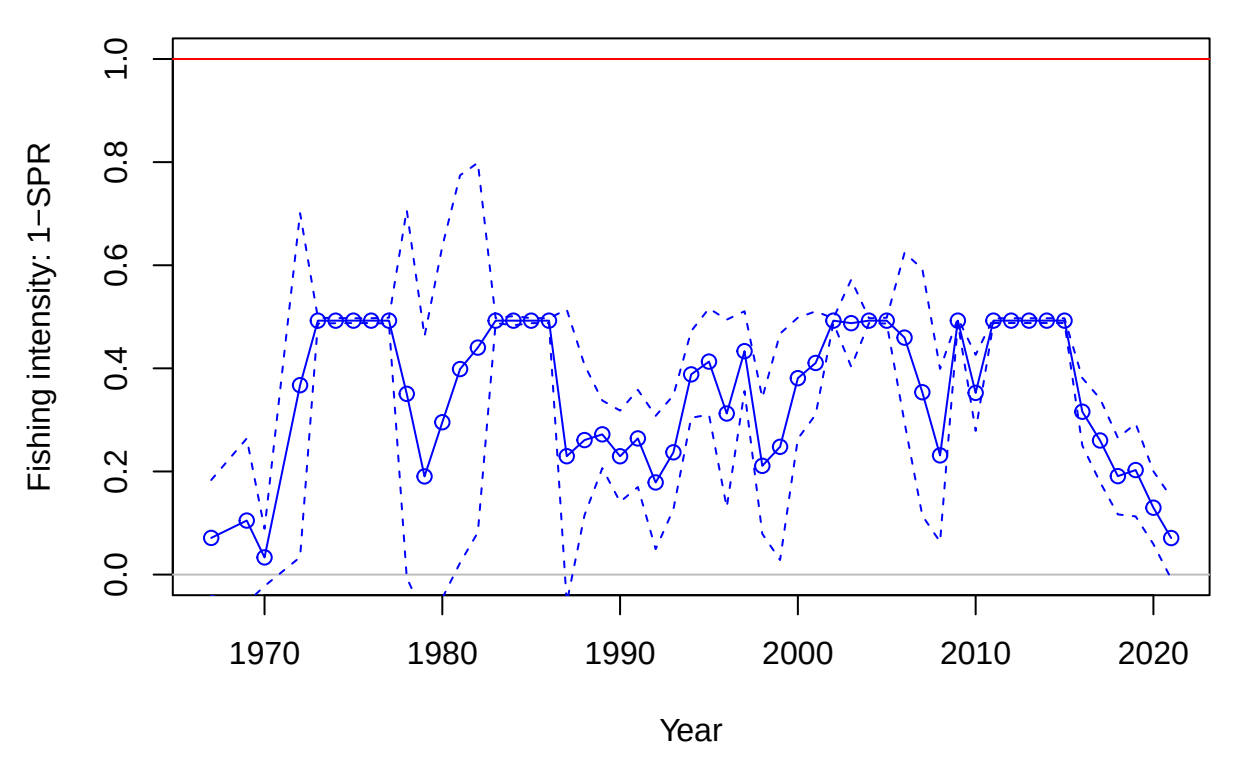

Landings (mt)
0
1
2
3
1970
1980
1990
2000
2010
2020
Year

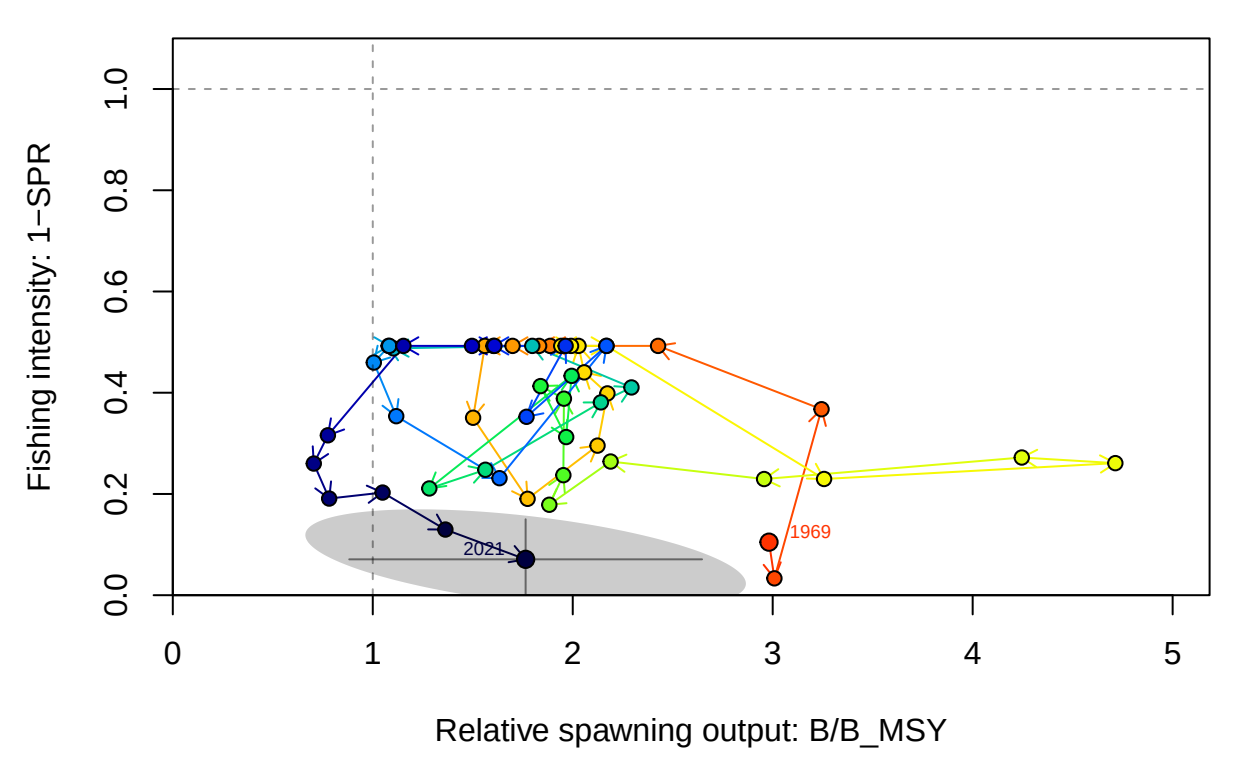

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0
2
4
6
1970
1980
1990
2000
2010
2020
Year

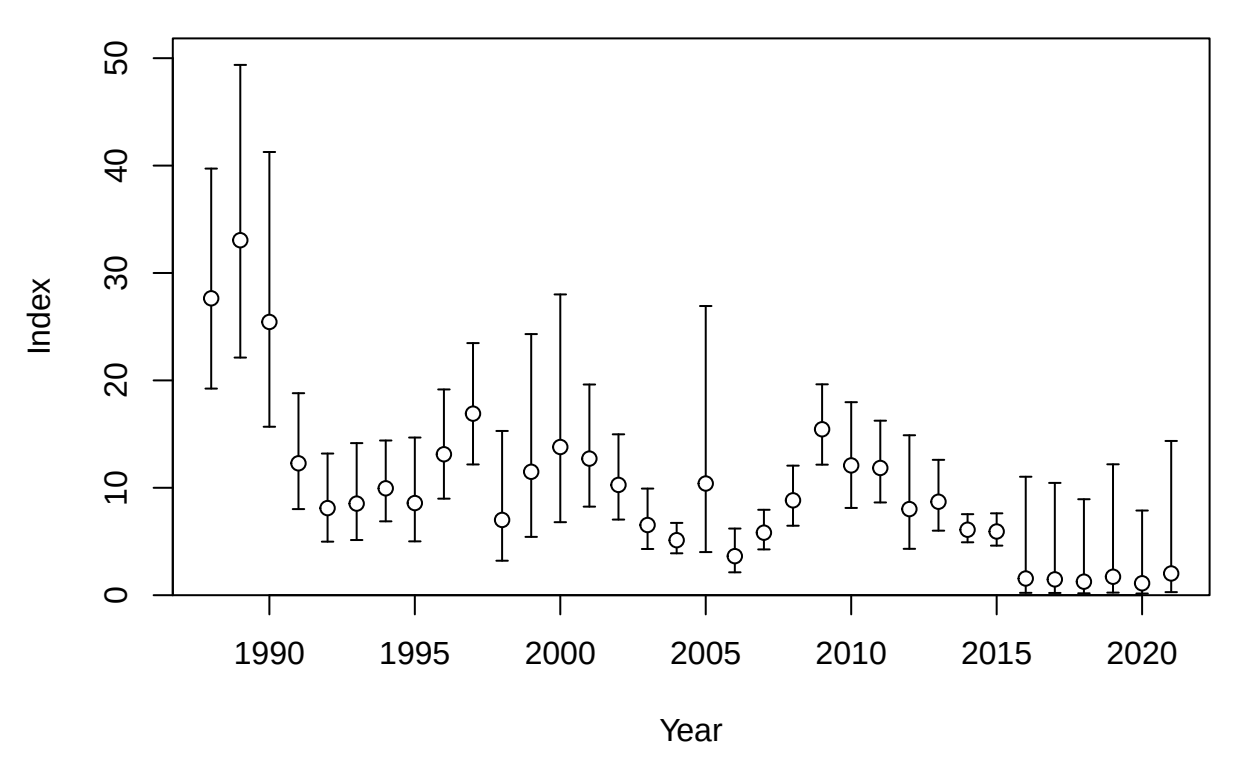

Continuous F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

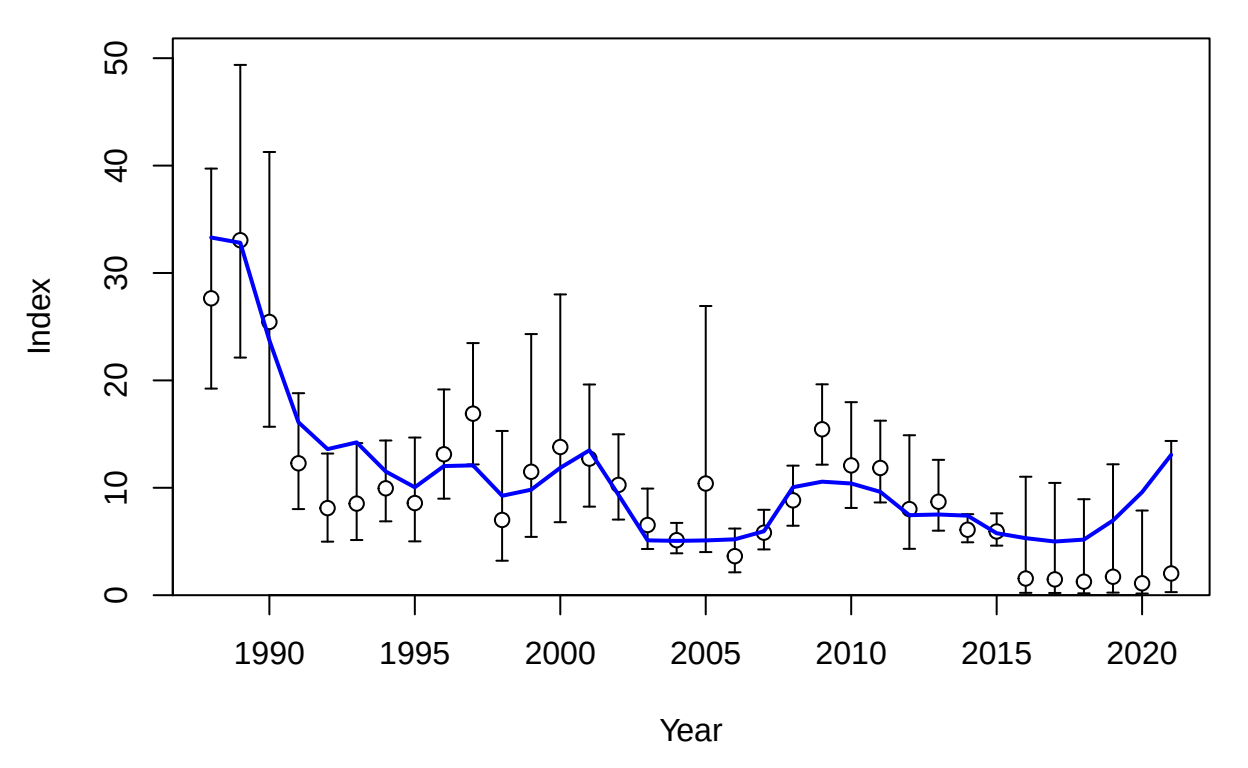

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

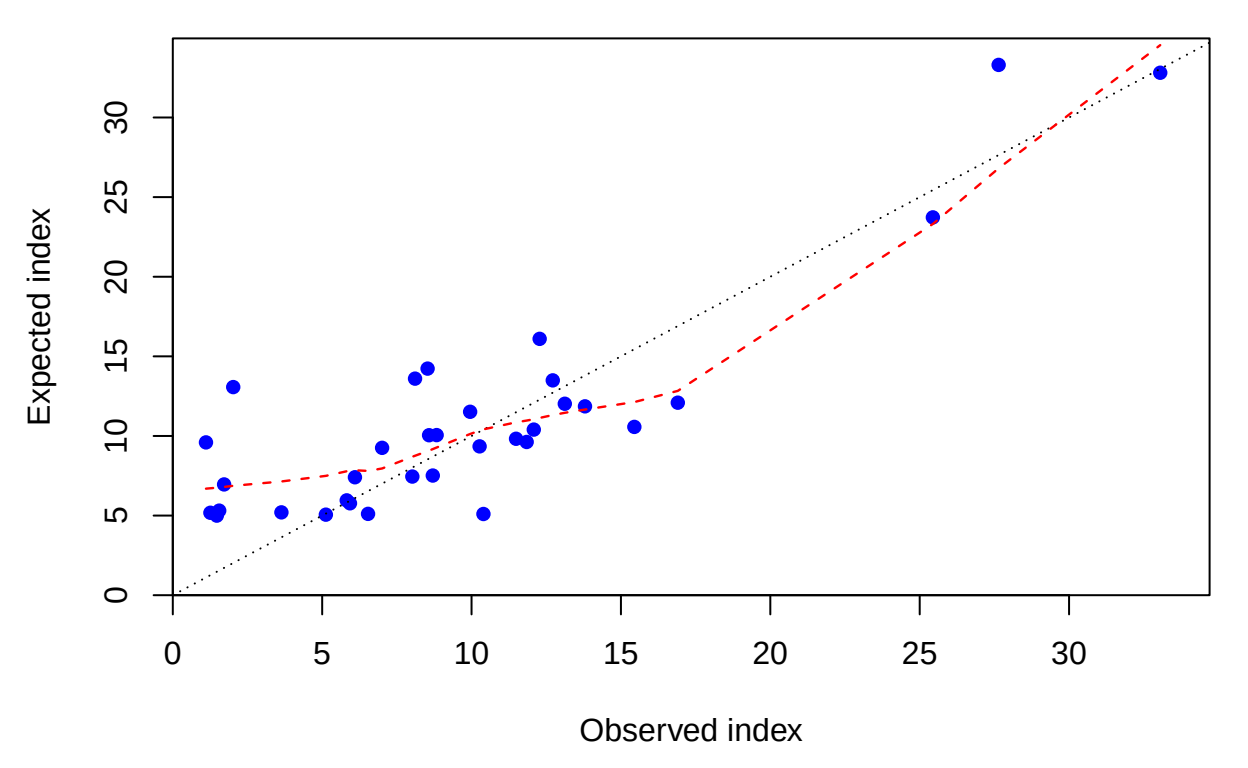

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

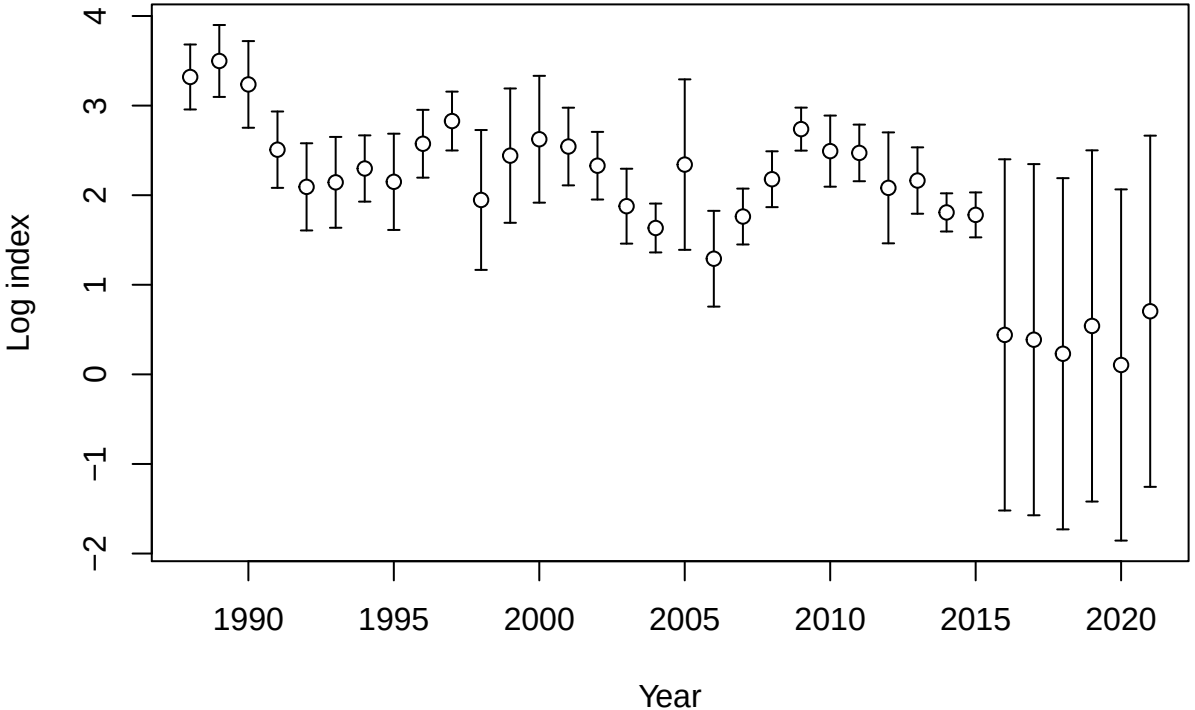

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

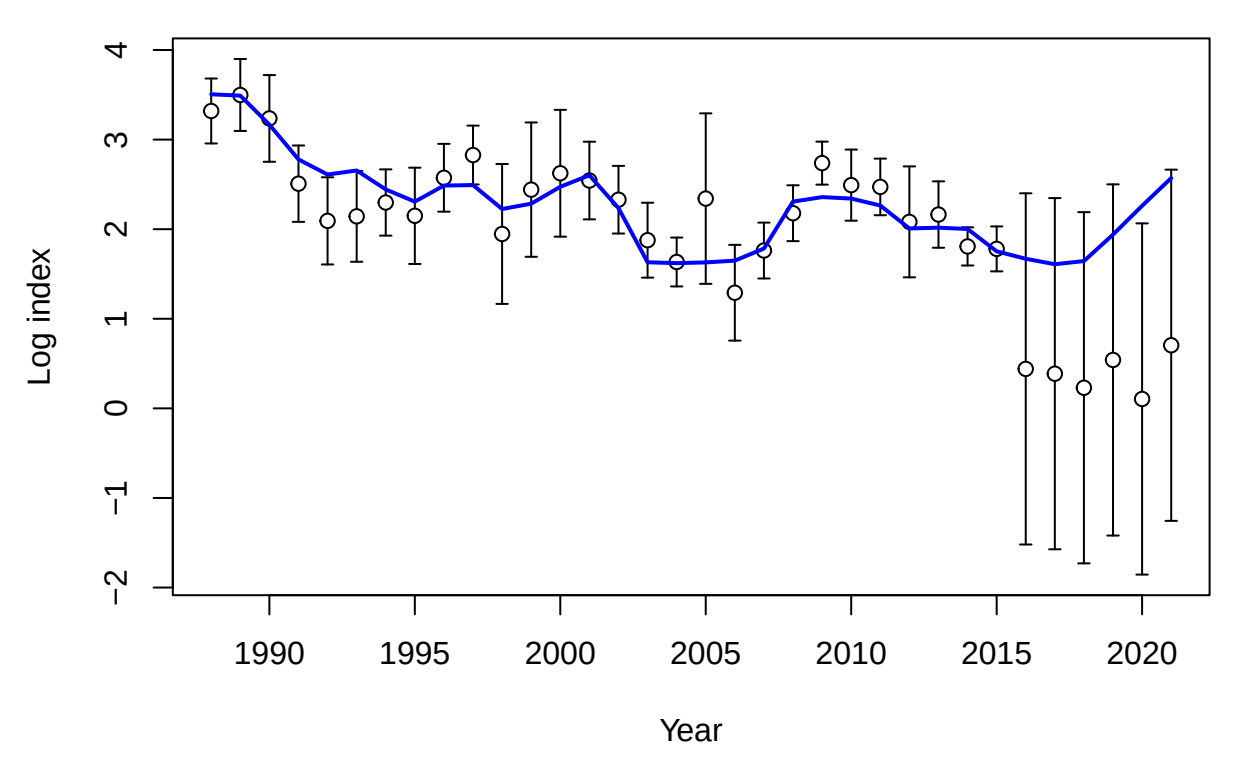

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
5
Relative spawning output: B/B_MSY
2021
1969

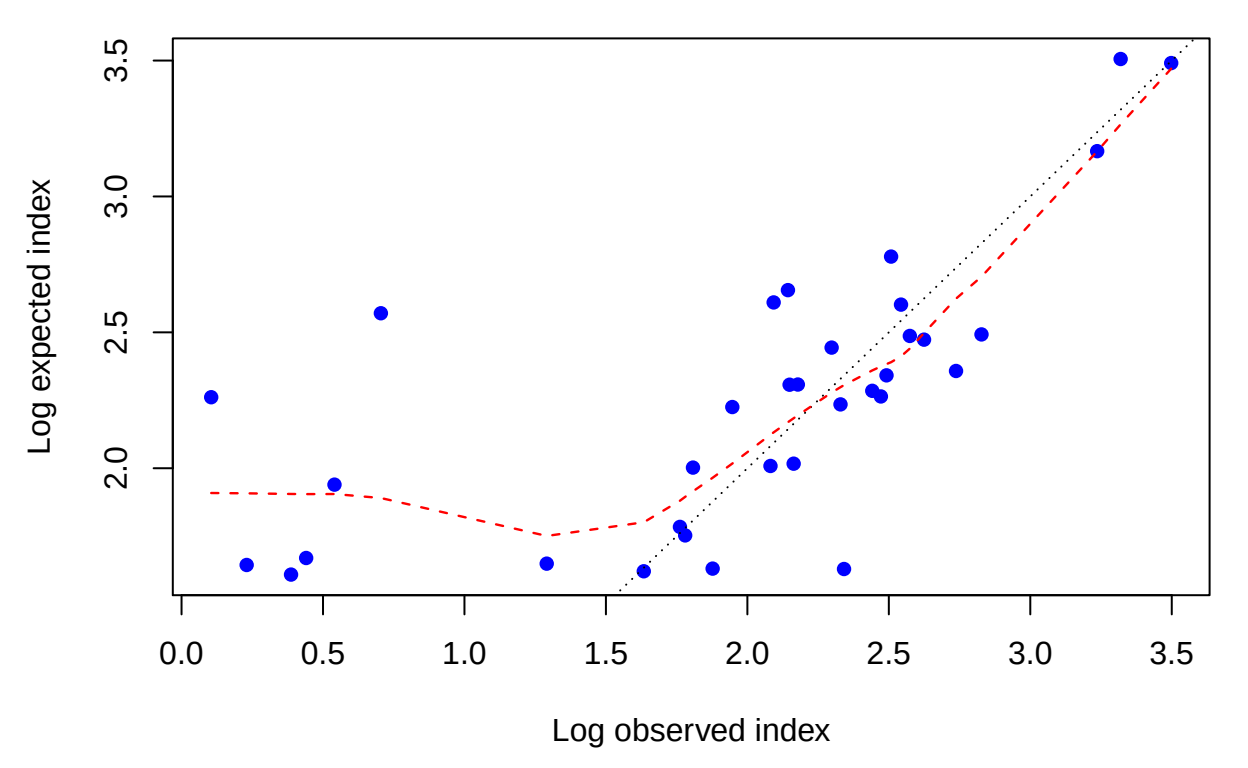

Index
0
10
20
30
40
50
1990
1995
2000
2005
2010
2015
2020
Year

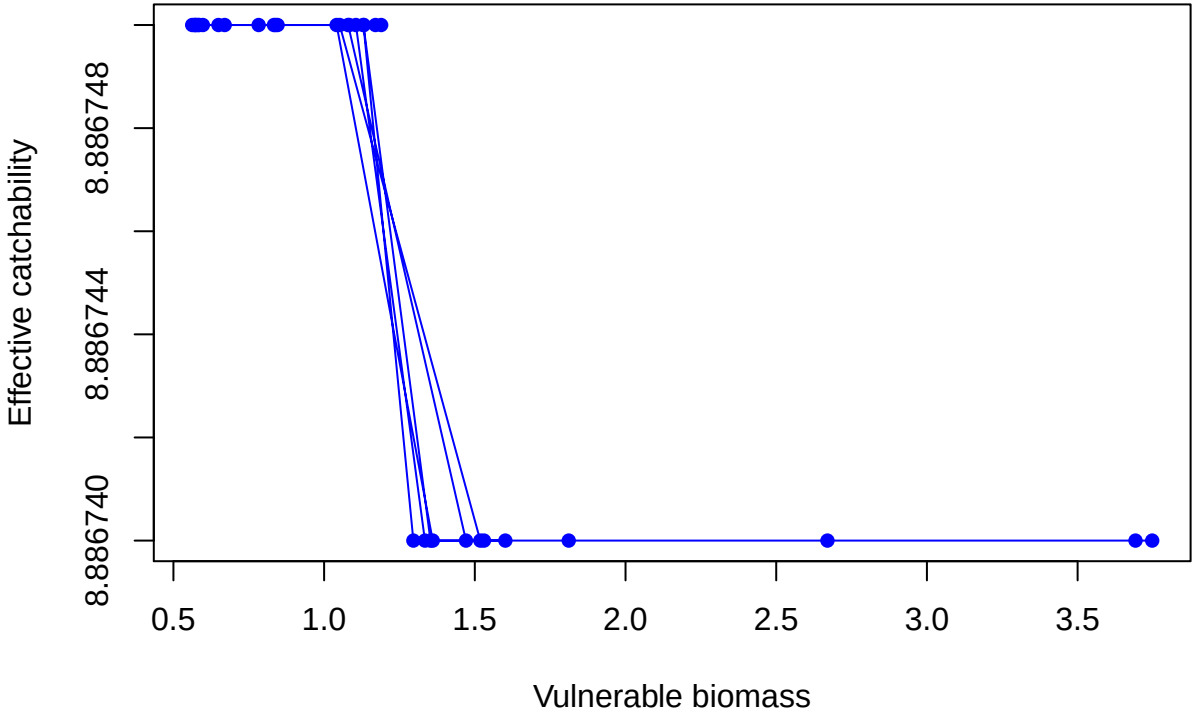

Index
0
10
20
30
40
50
1990
1995
2000
2005
2010
2015
2020
Year

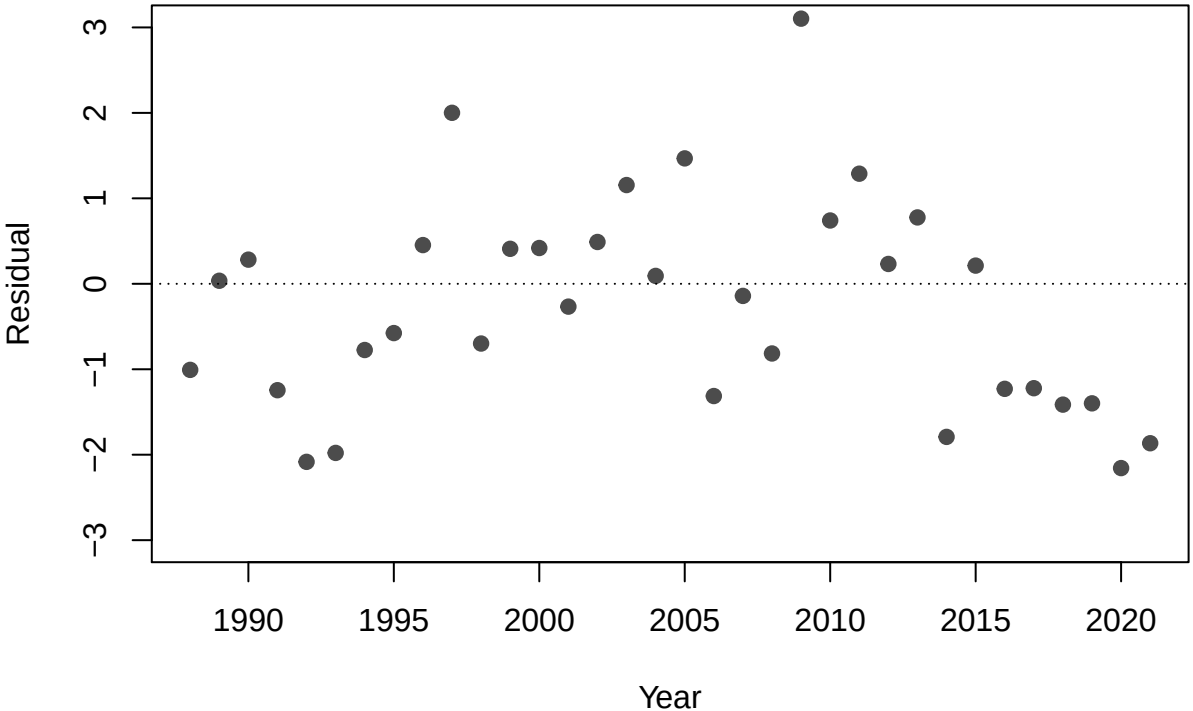

Expected index
Observed index
0
5
10
15
20
25
30

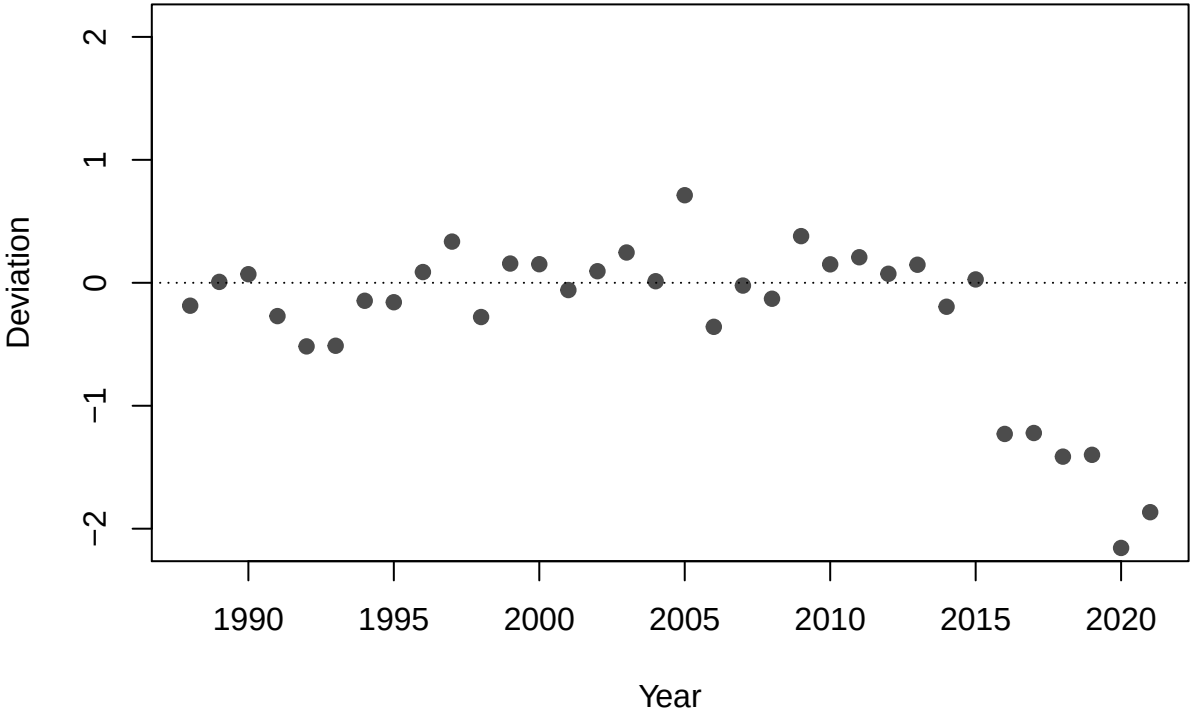

Log index
4
3
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

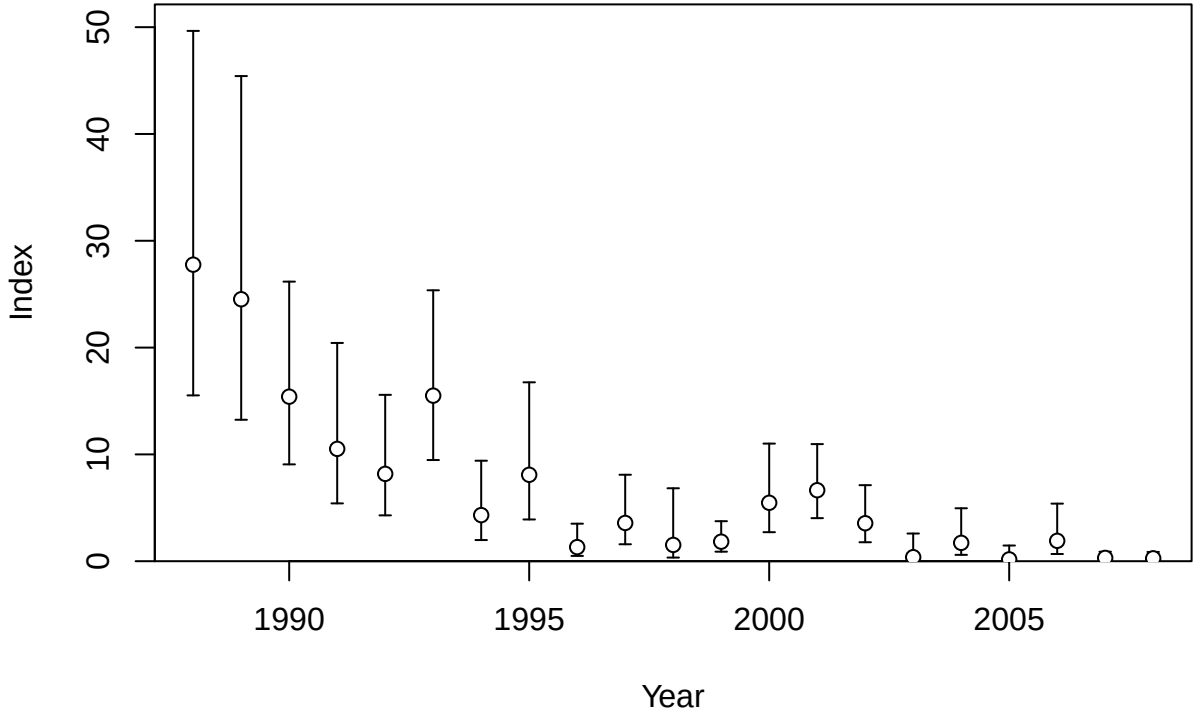

Log index
4
3
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

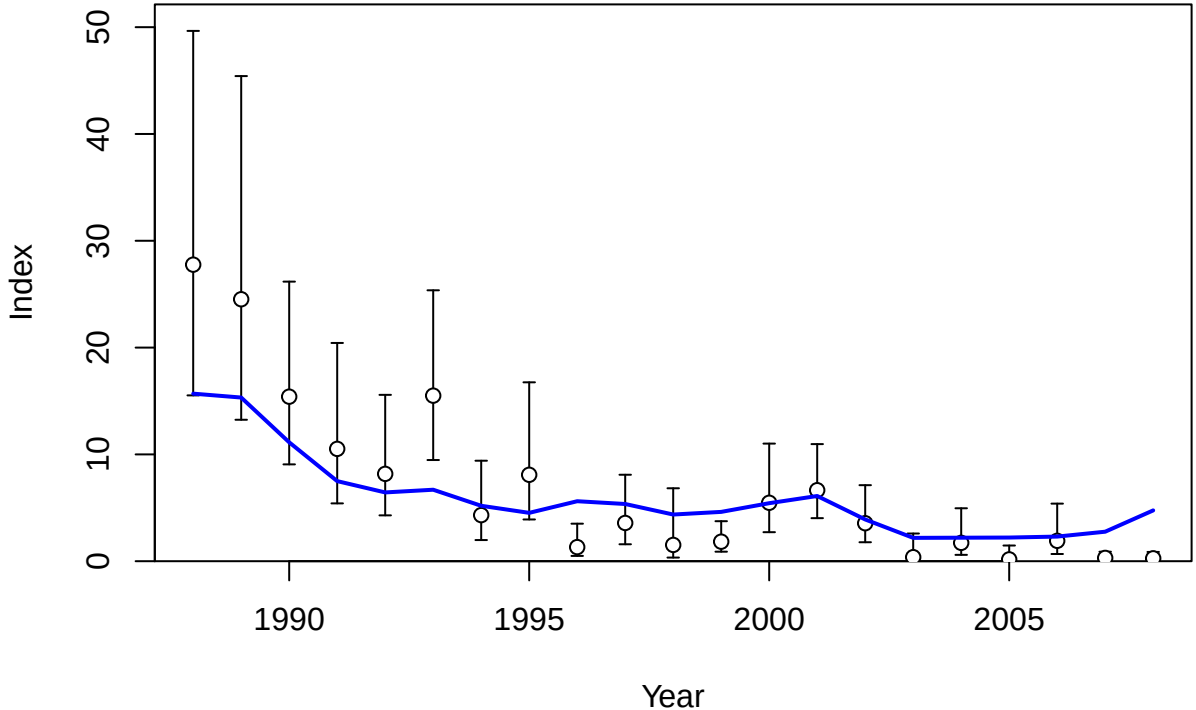

Log expected index
Log observed index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2.0
2.5
3.0
3.5

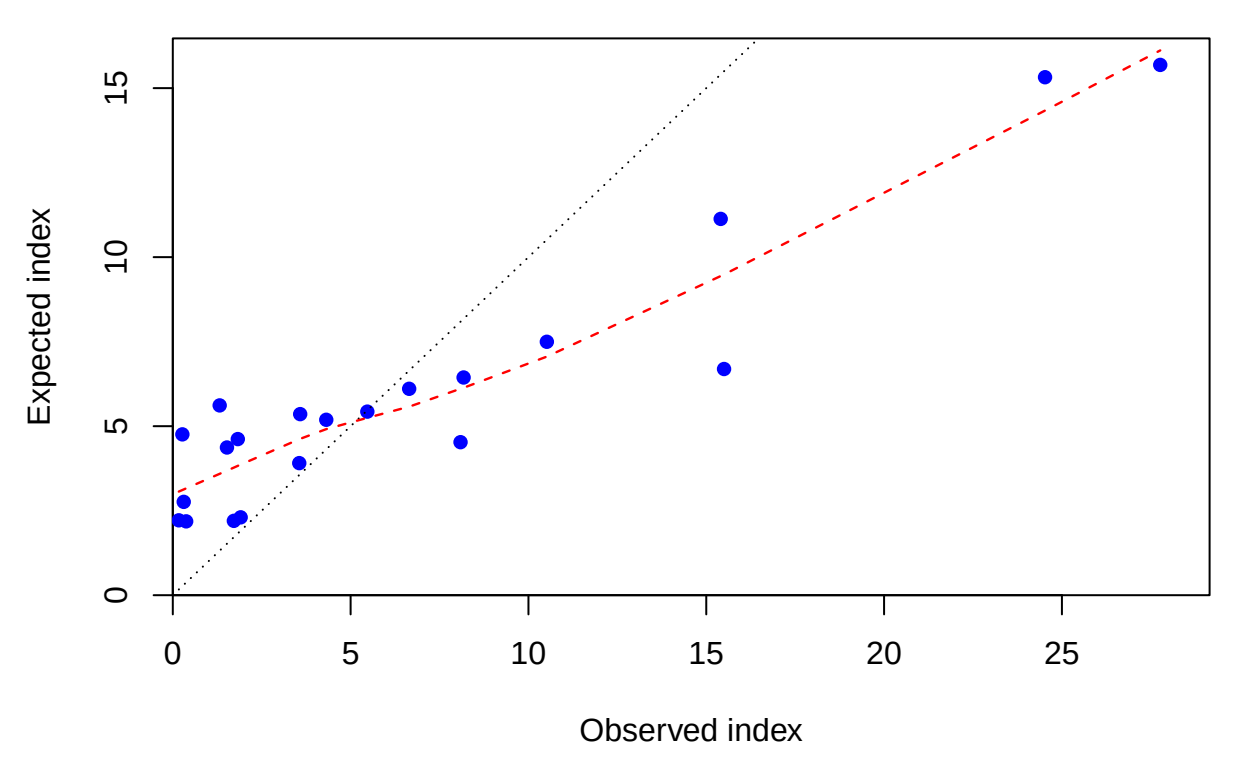

Effective catchability
8.886748
8.886744
8.886740
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Vulnerable biomass

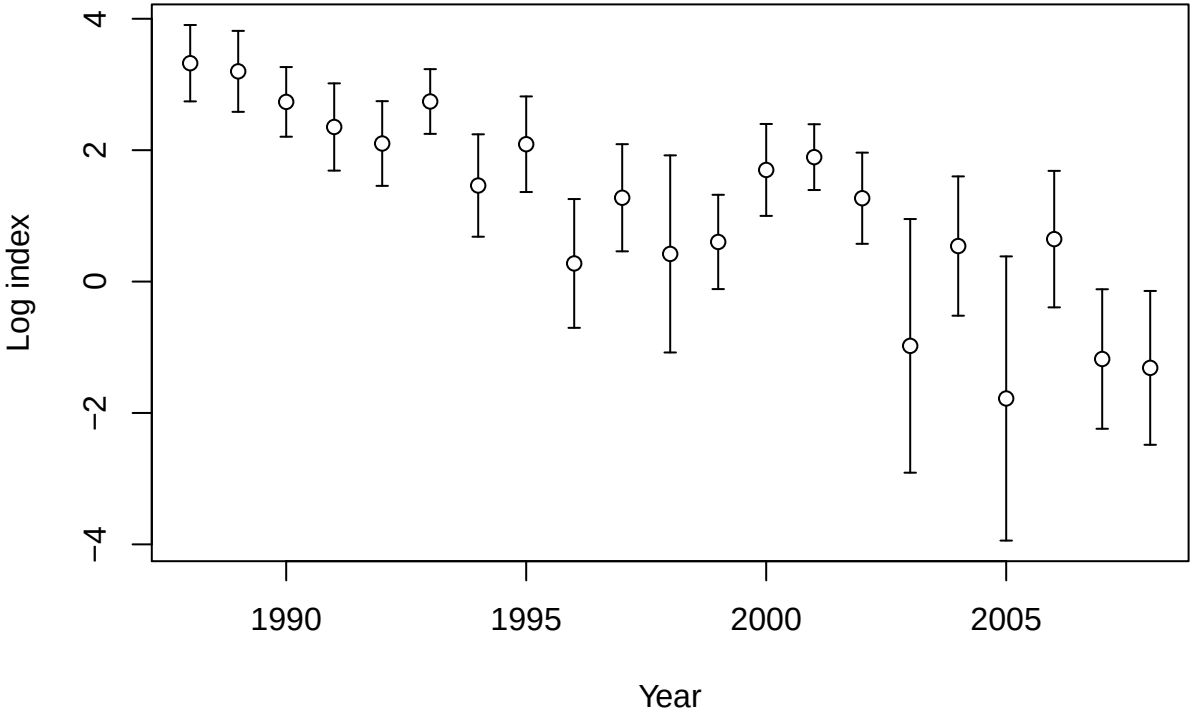

Residual
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
2010
2015
2020
Year

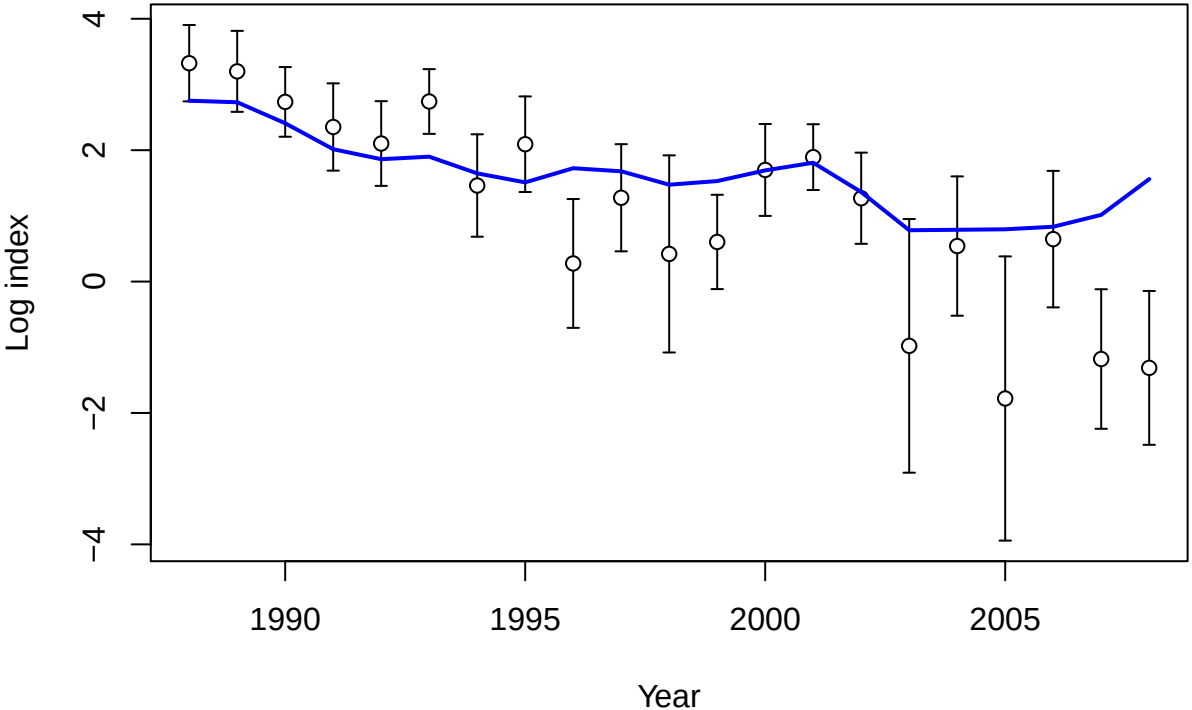

Deviation
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

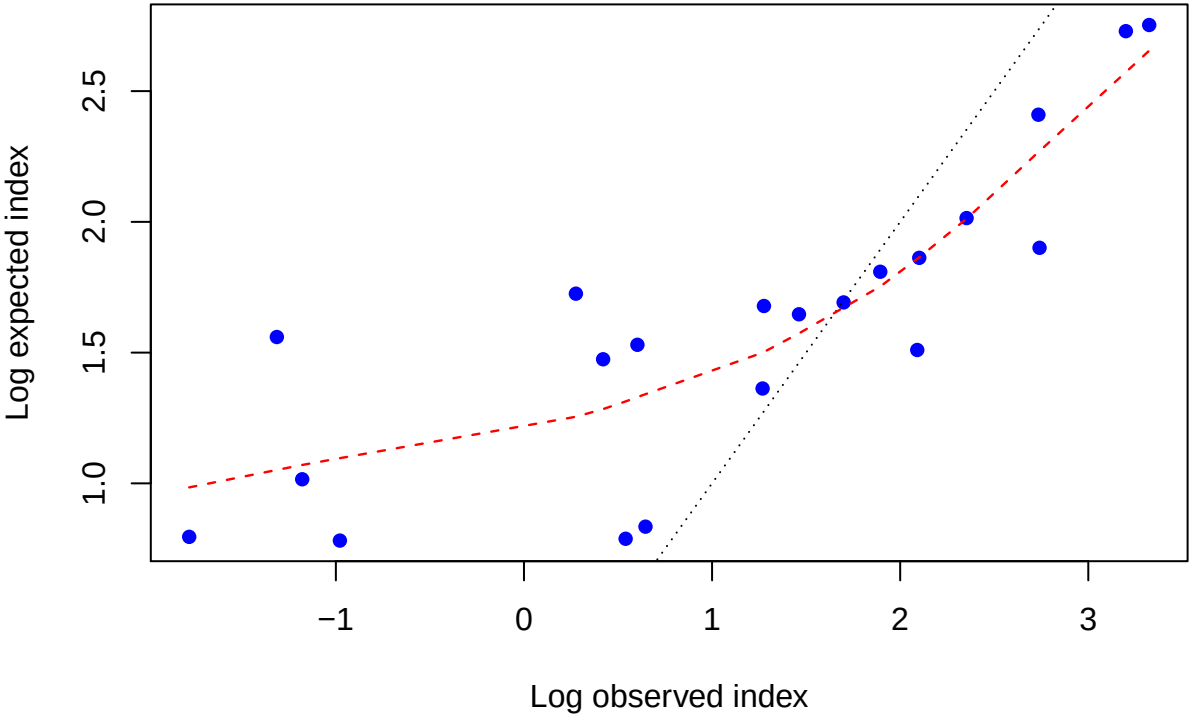

Index
0
10
20
30
40
50
1990
1995
2000
2005
Year

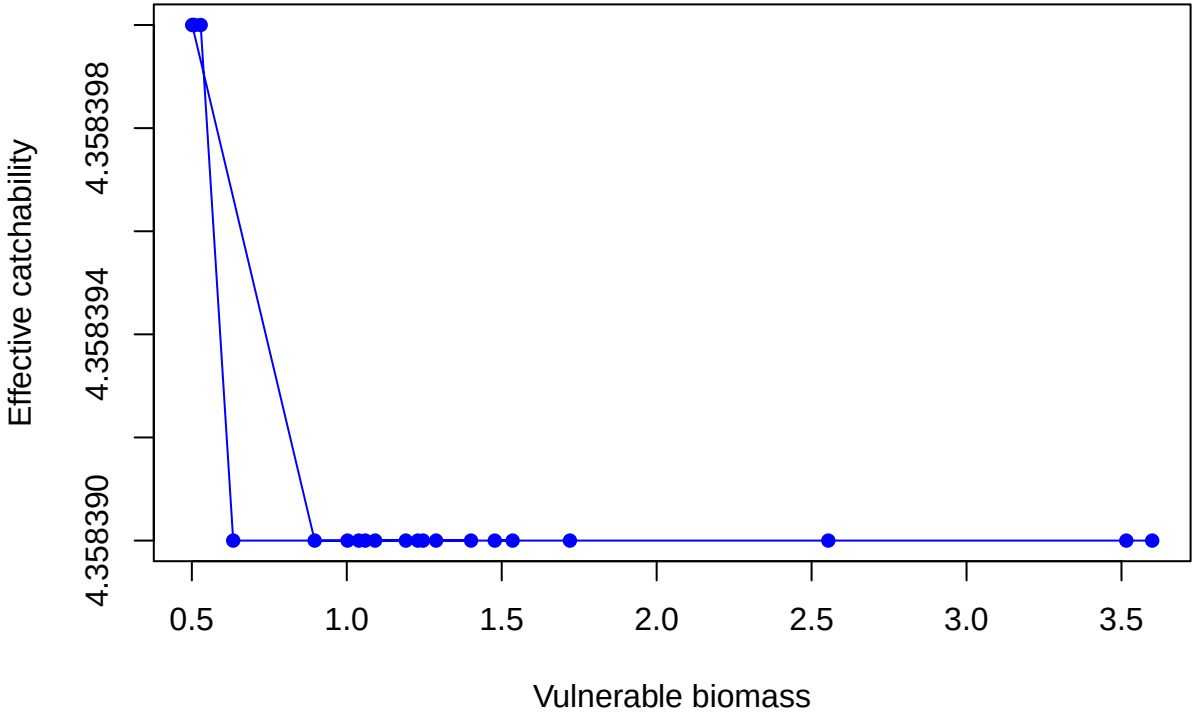

Index
0
10
20
30
40
50
1990
1995
2000
2005
Year

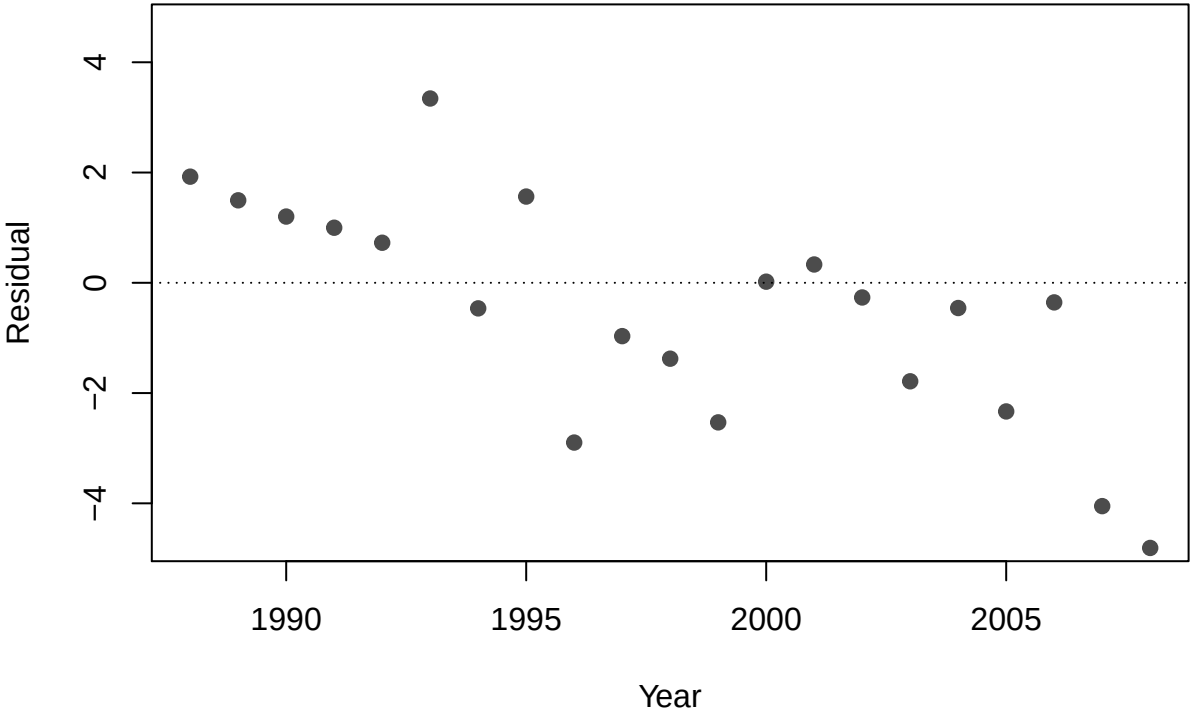

Expected index
0
5
10
15
0
5
10
15
20
25
Observed index

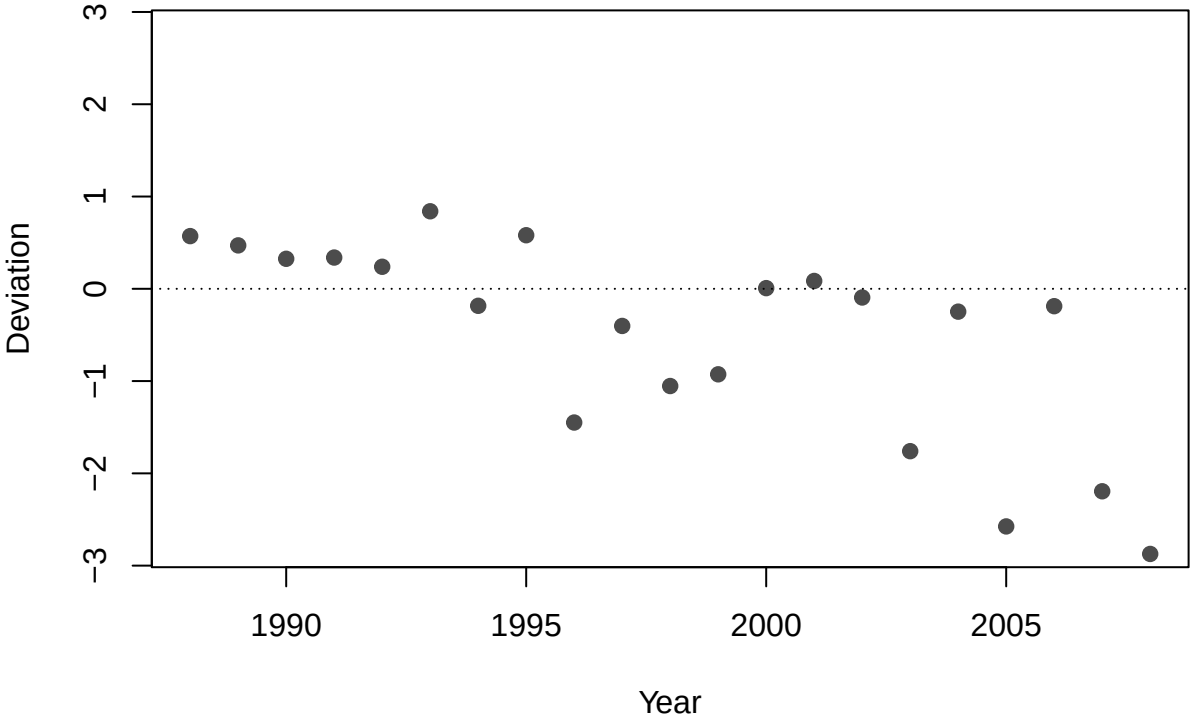

Log index
4
2
0
−2
−4
1990
1995
2000
2005
Year

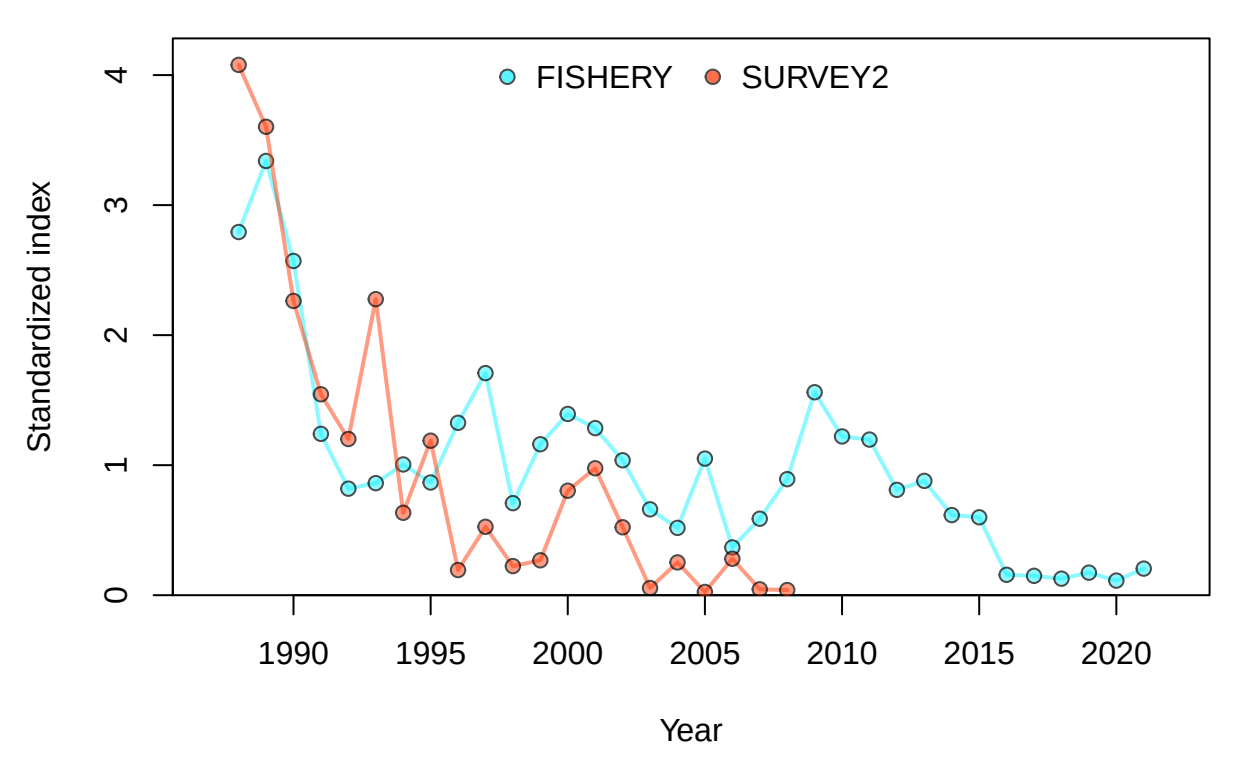

Log index
4
2
0
−2
−4
1990
1995
2000
2005
Year

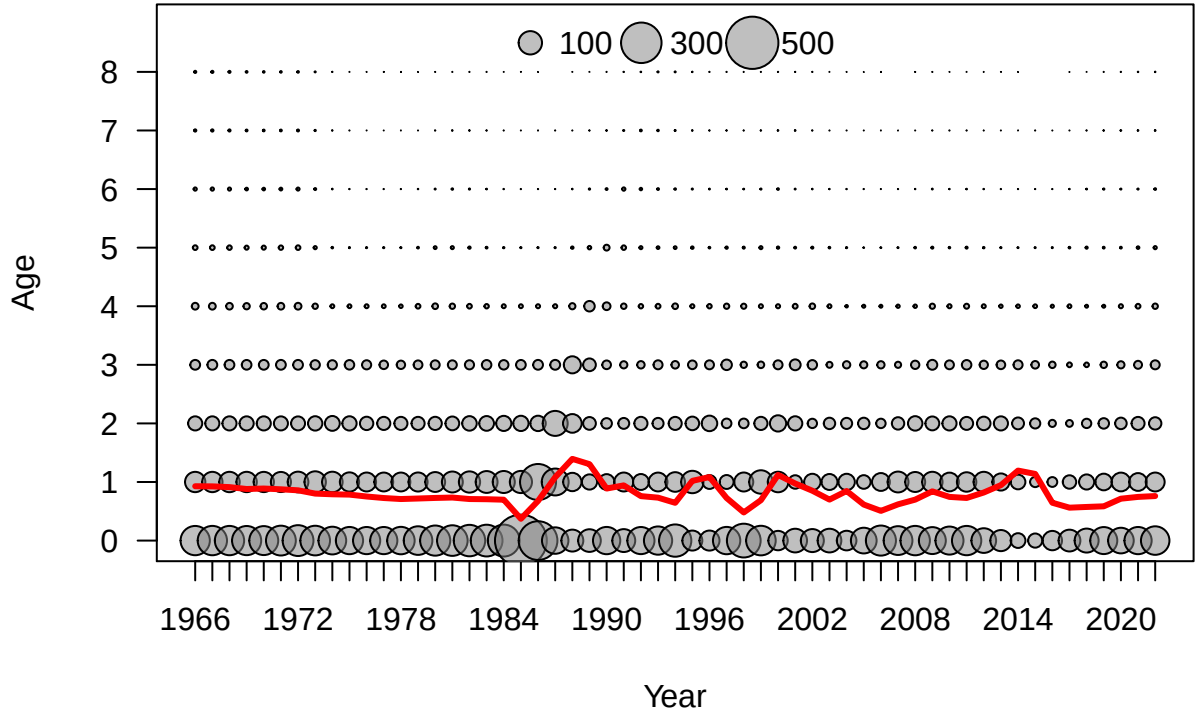

Log expected index
1.0
1.5
2.0
2.5
−1
0
1
2
3
Log observed index

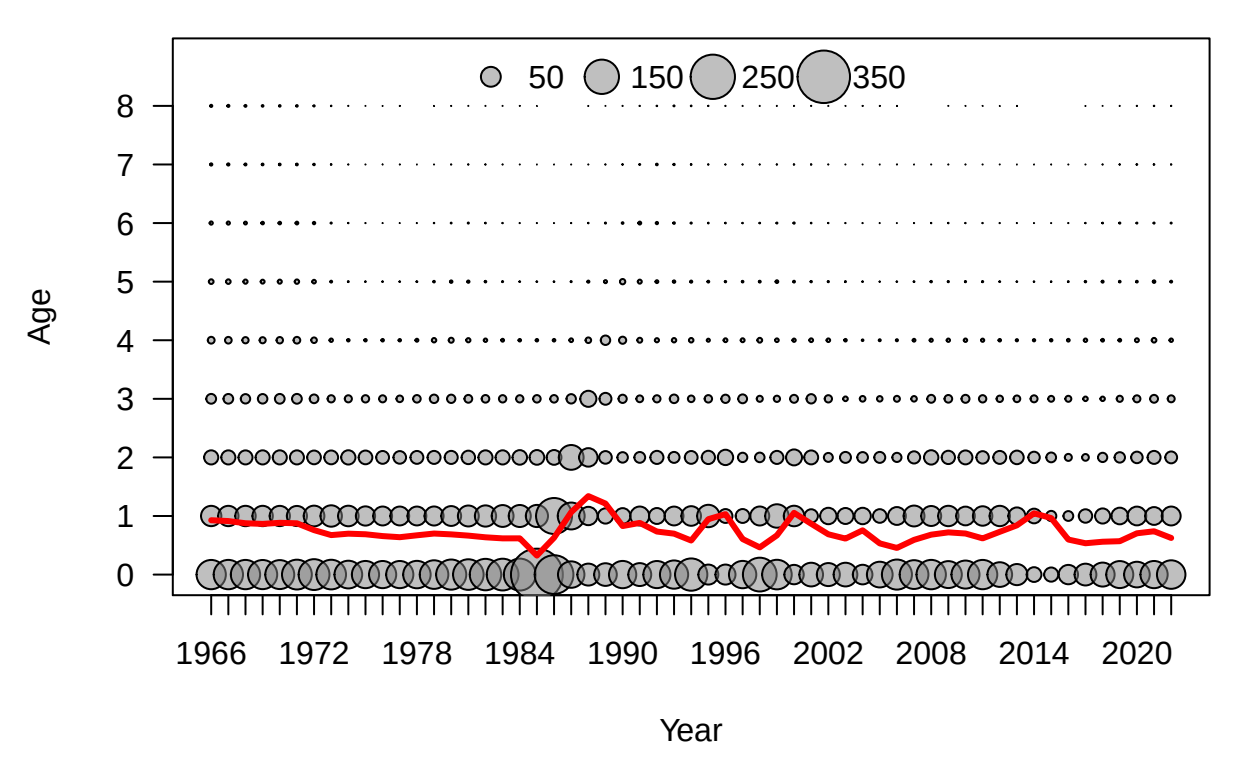

Effective catchability
4.358398
4.358394
4.358390
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Vulnerable biomass

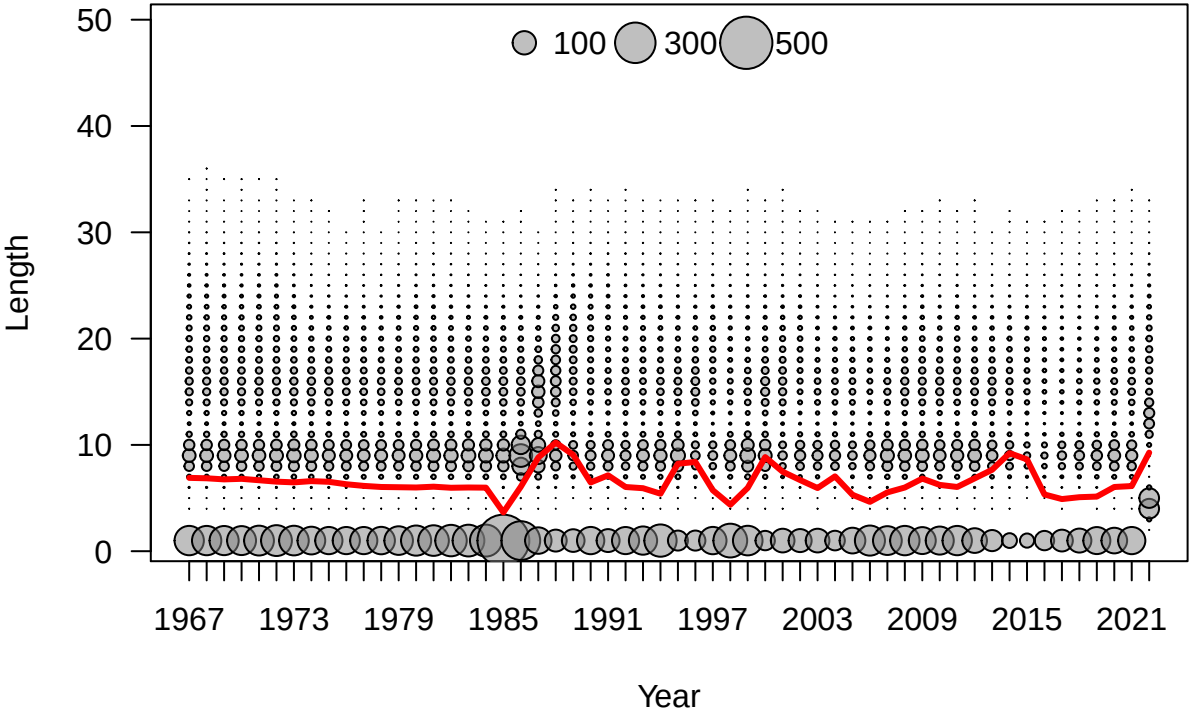

Residual
4
2
0
−2
−4
1990
1995
2000
2005
Year

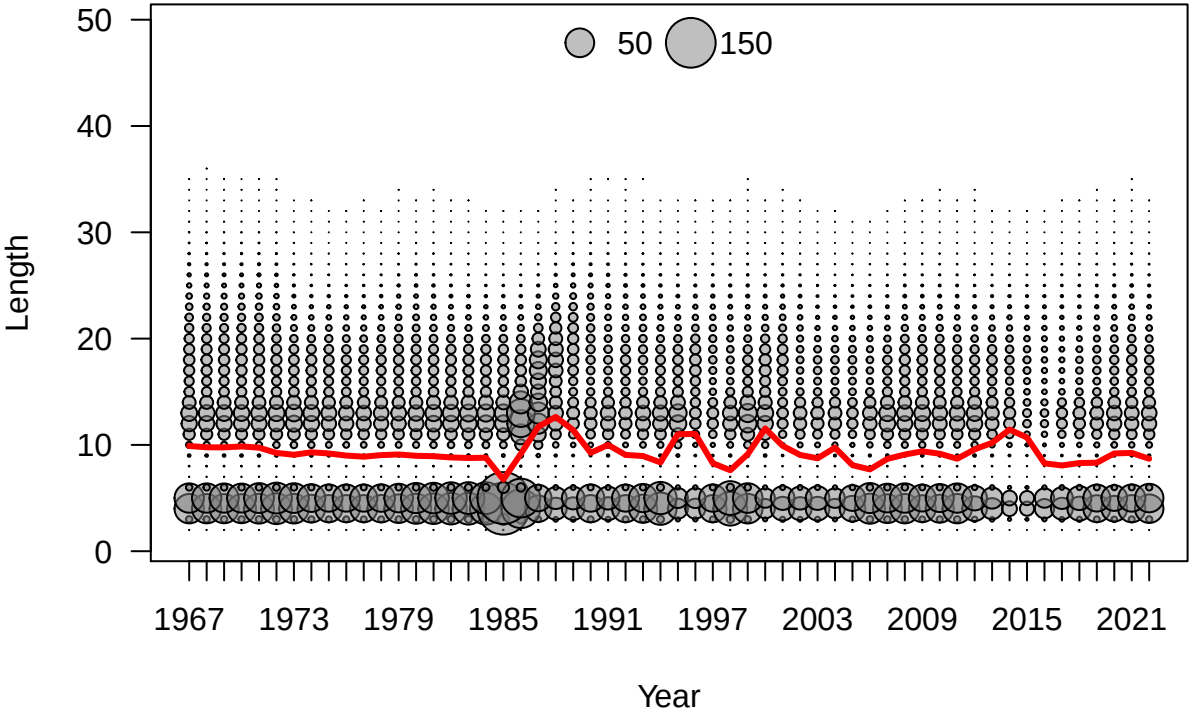

Deviation
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
Year

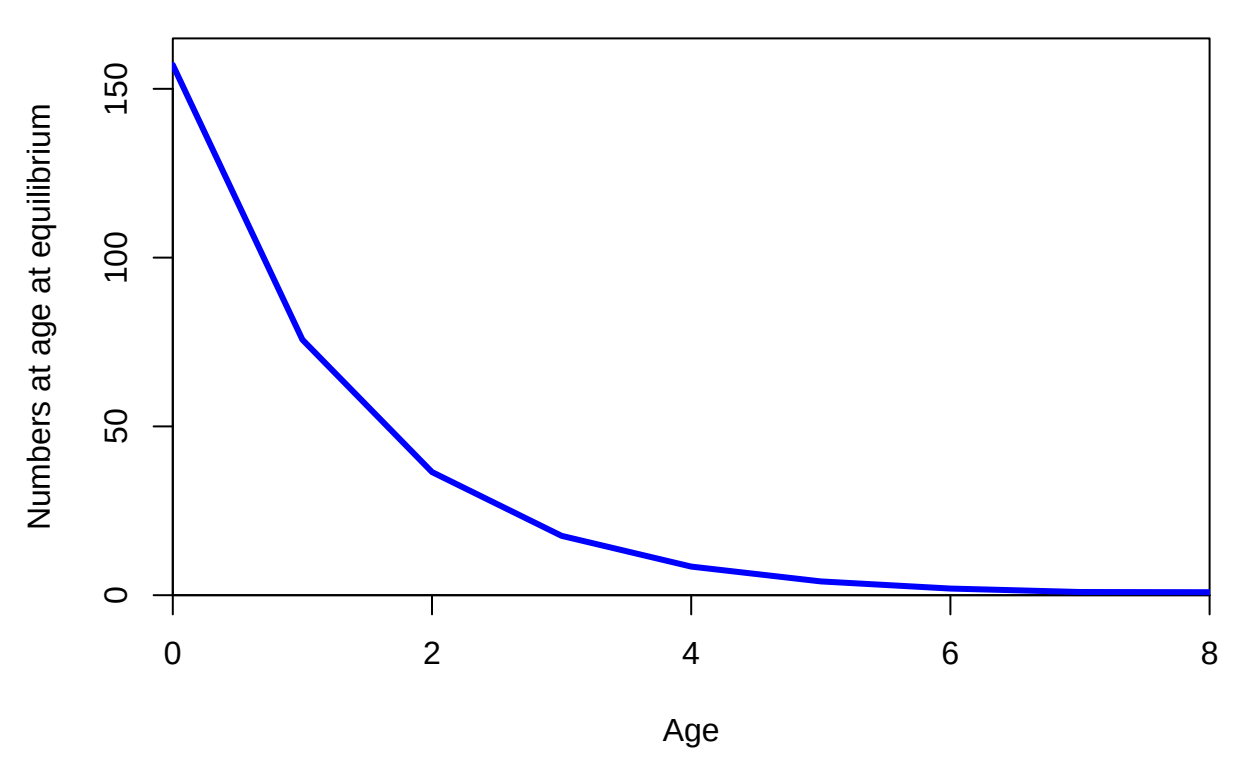

FISHERY
SURVEY2
Standardized index
Year
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020

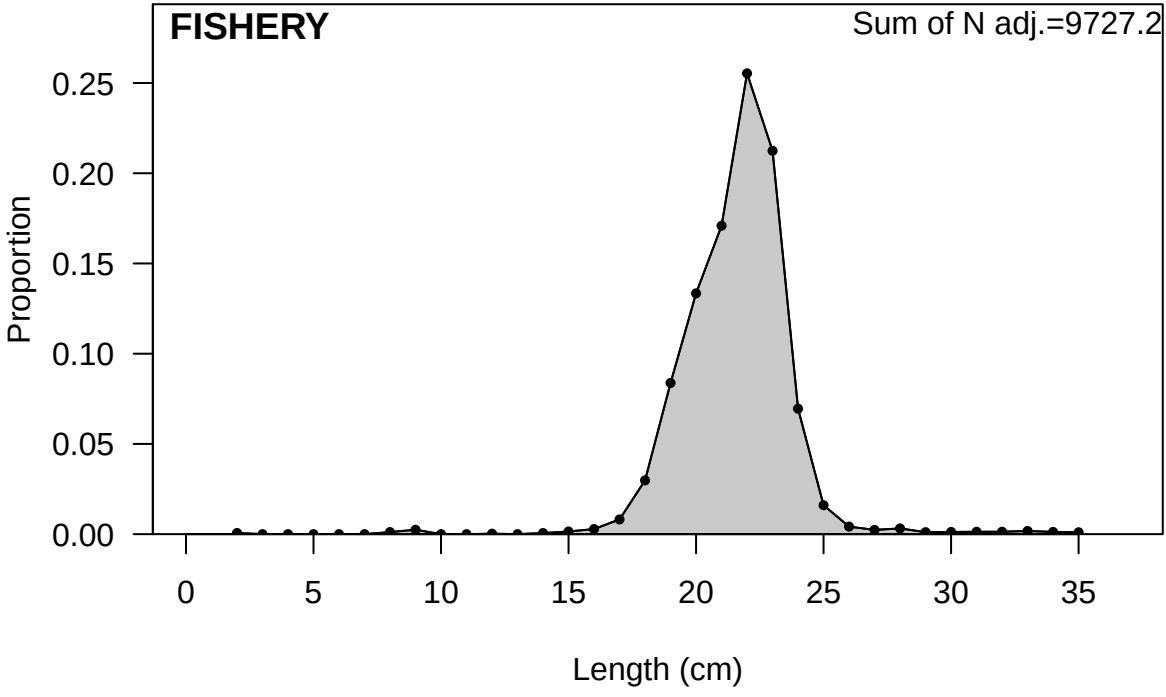

100
300
500
Age
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

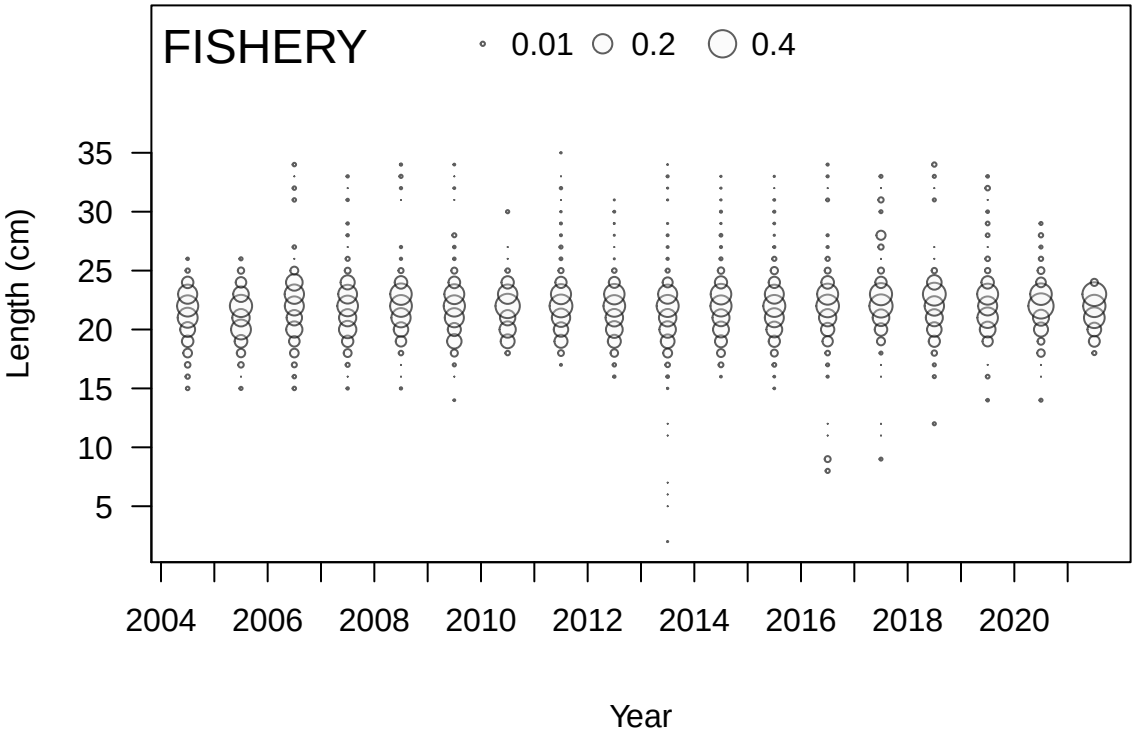

50
150
250
350
Age
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

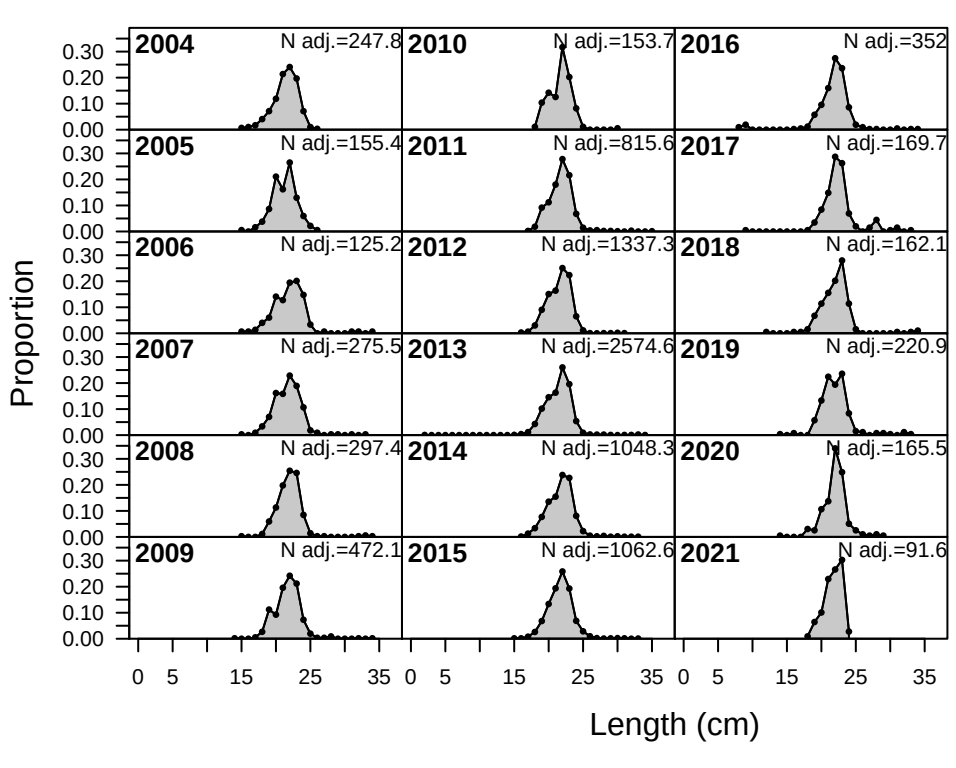

100
300
500
Length
50
40
30
20
10
0
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

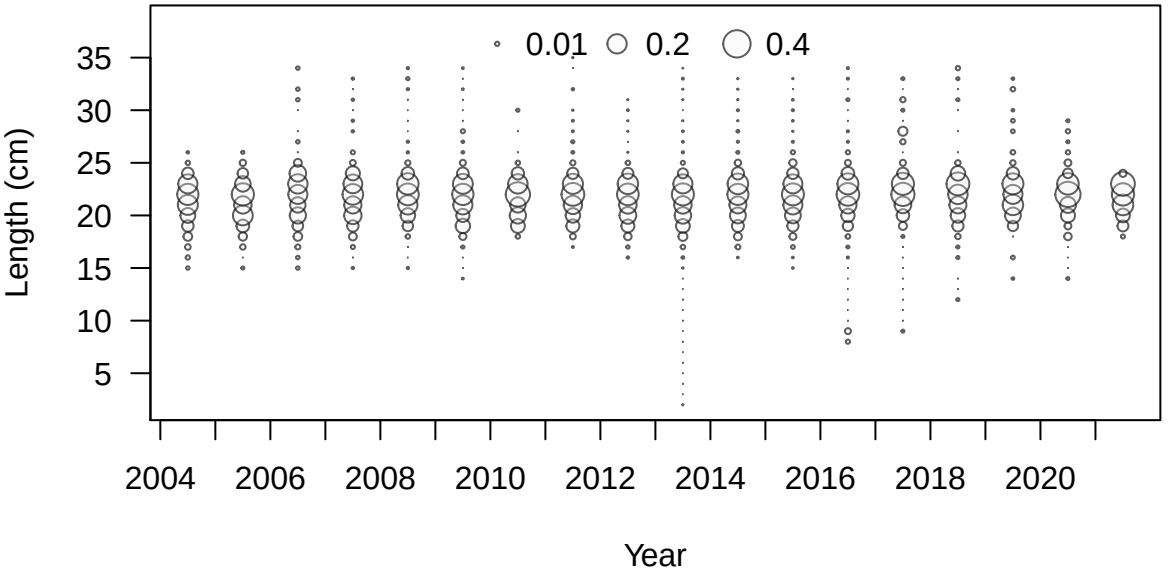

50
150
Length
Year
0
10
20
30
40
50
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021

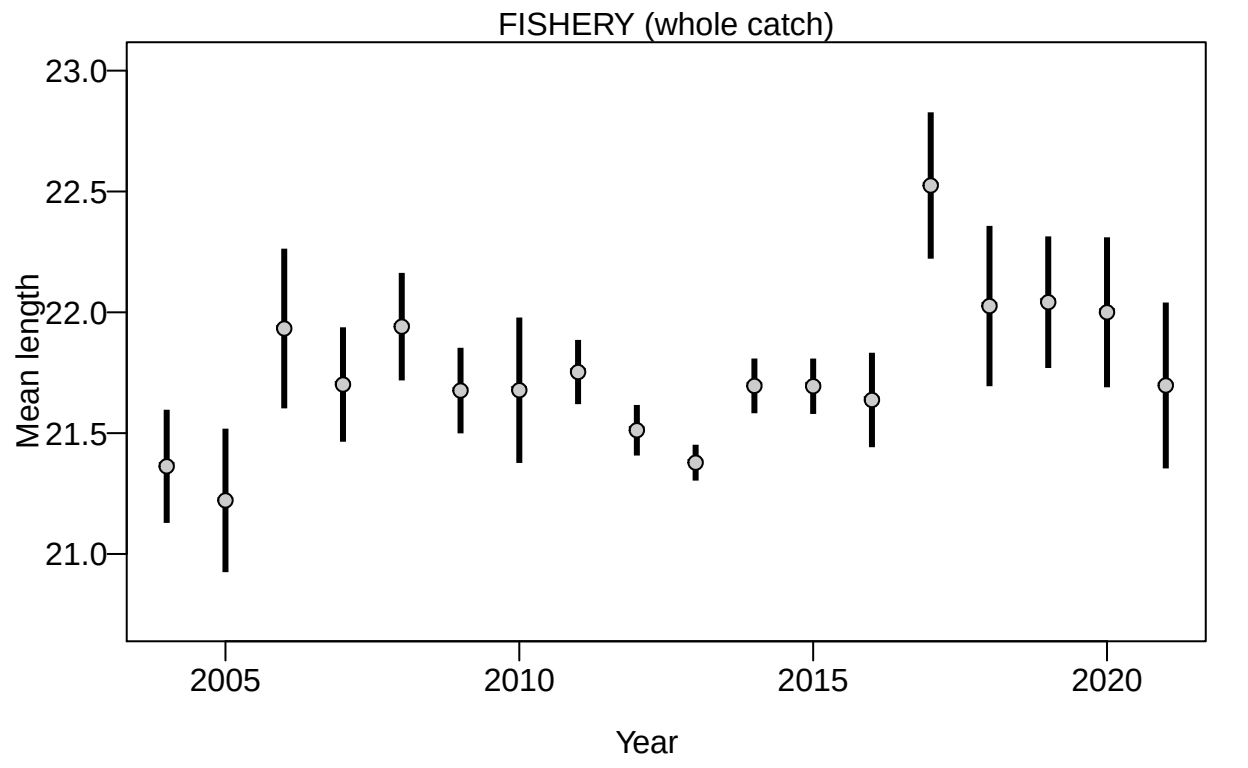

Numbers at age at equilibrium
0
50
100
150
0
2
4
6
8
Age

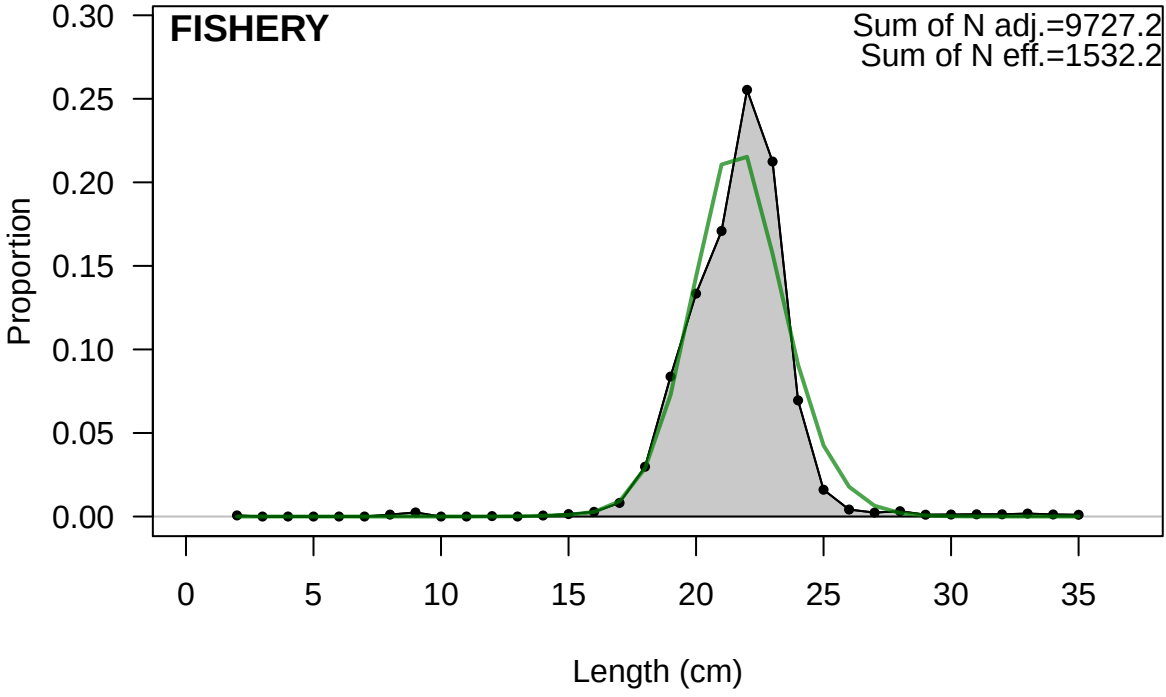

FISHERY
Sum of N adj.=9727.2
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25
30
35
Length (cm)

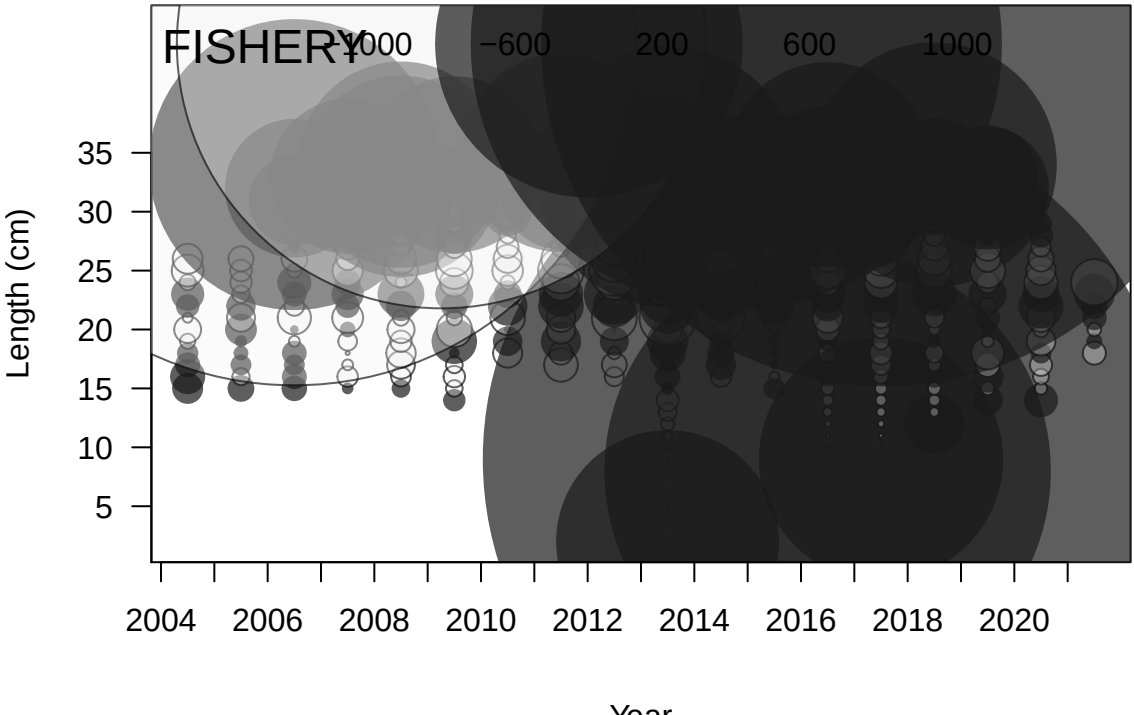

FISHERY
0.01
0.2
0.4
Length (cm)
35
30
25
20
15
10
5
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

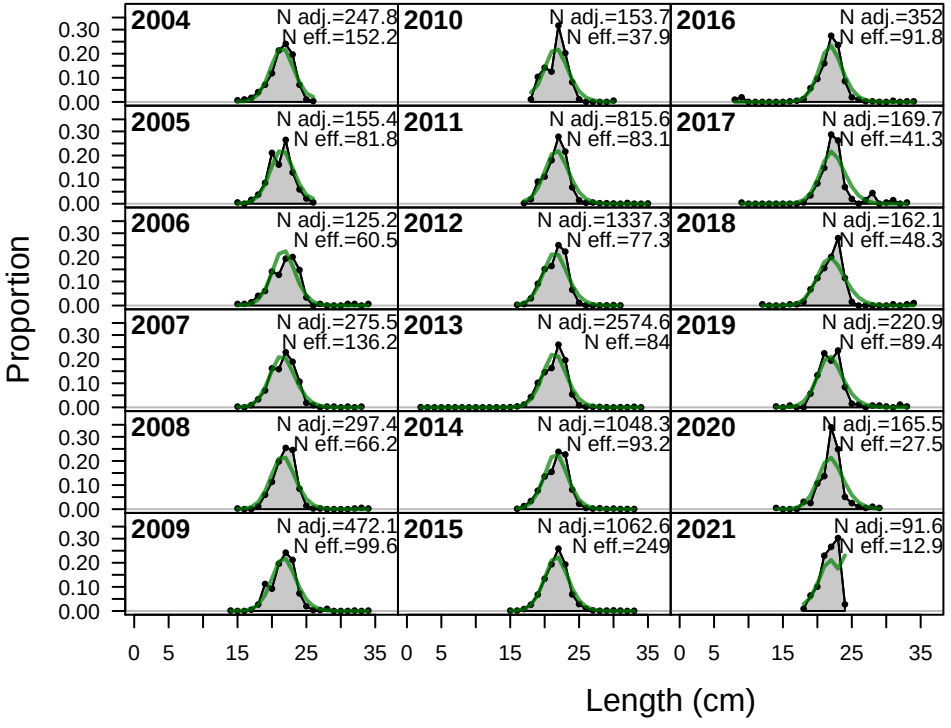

2004
N adj.=247.8
2010
N adj.=153.7
2016
N adj.=352
2005
N adj.=155.4
2011
N adj.=815.6
2017
N adj.=169.7
2006
N adj.=125.2
2012
N adj.=1337.3
2018
N adj.=162.1
2007
N adj.=275.5
2013
N adj.=2574.6
2019
N adj.=220.9
2008
N adj.=297.4
2014
N adj.=1048.3
2020
N adj.=165.5
2009
N adj.=472.1
2015
N adj.=1062.6
2021
N adj.=91.6
Proportion
0.00
0.10
0.20
0.30
0 5 15 25 35
Length (cm)

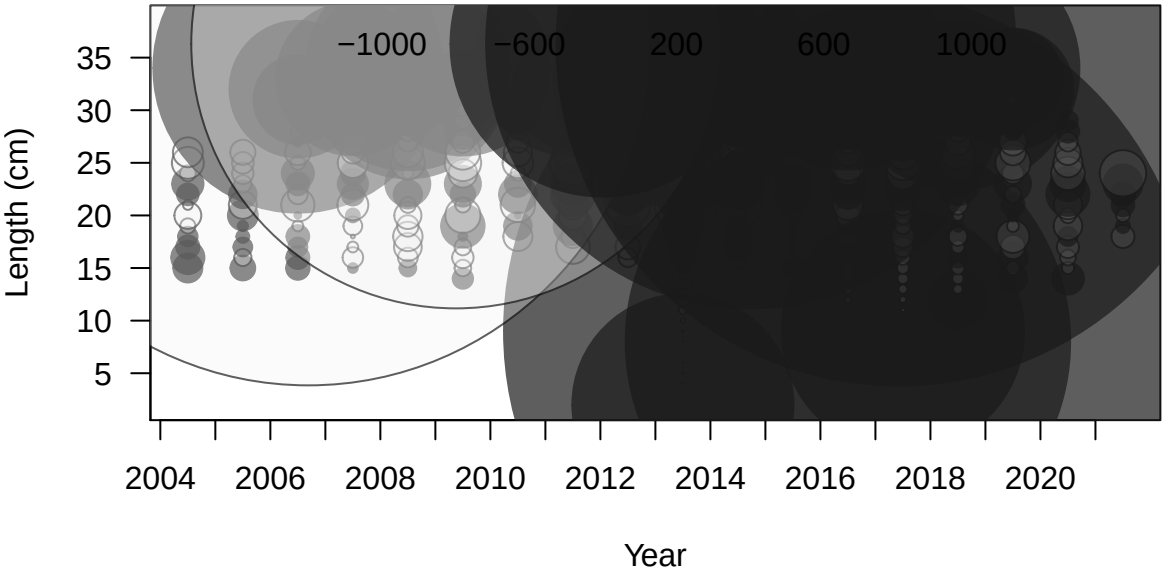

0.01
0.2
0.4
35
30
25
20
15
10
5
Length (cm)
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

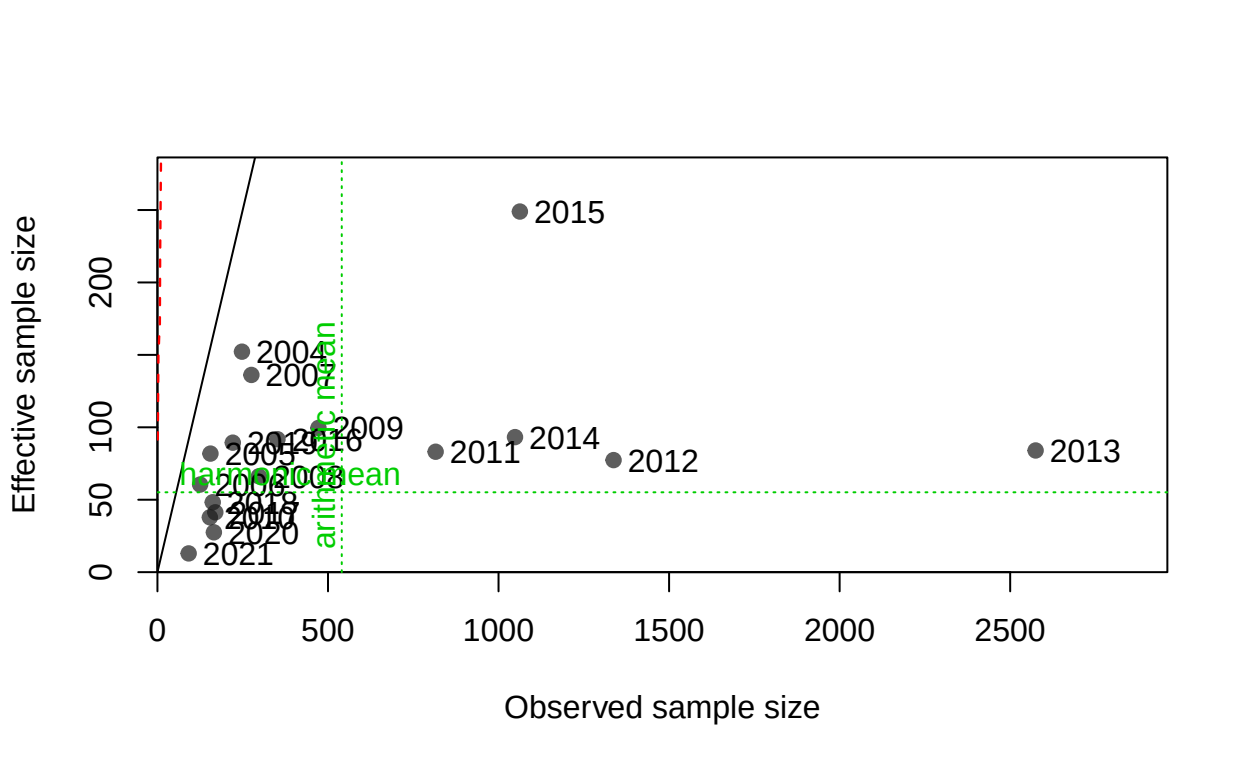

FISHERY (whole catch)
23.0
22.5
22.0
21.5
21.0
Mean length
2005
2010
2015
2020
Year

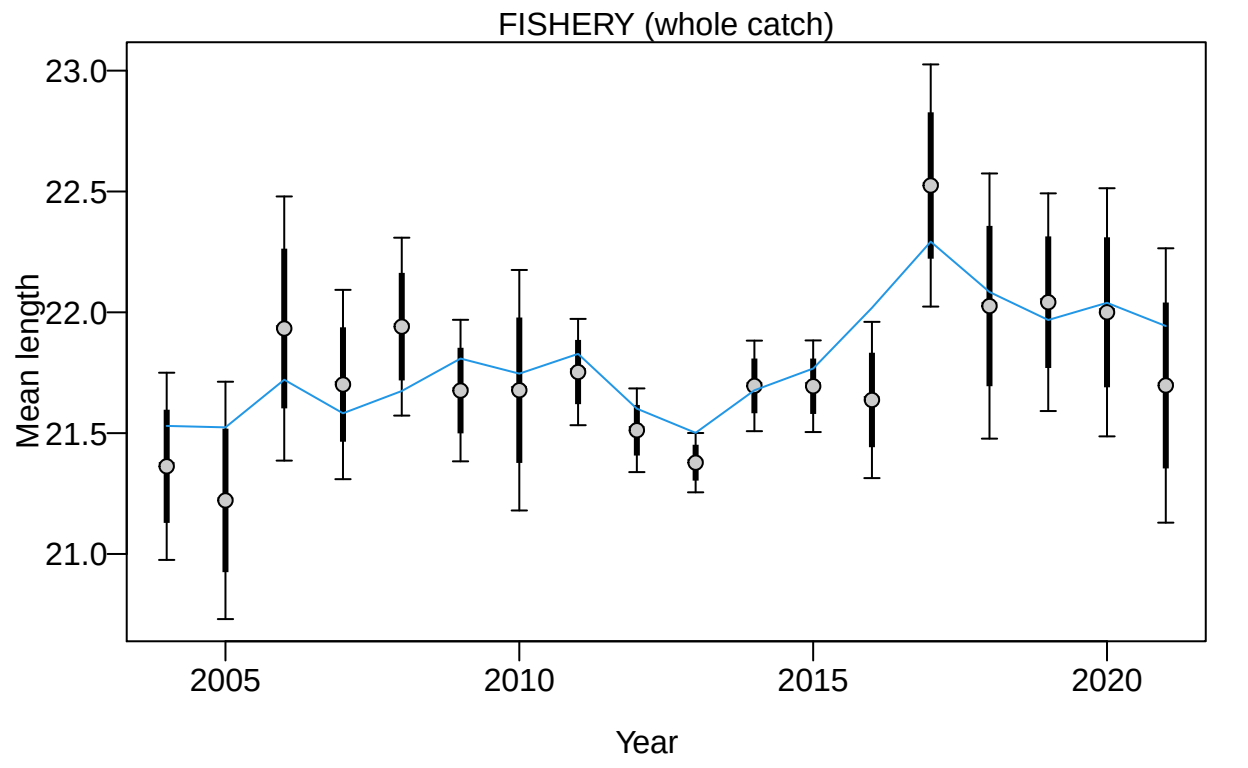

FISHERY
Sum of N adj.=9727.2
Sum of N eff.=1532.2
Proportion
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
25
30
35
Length (cm)

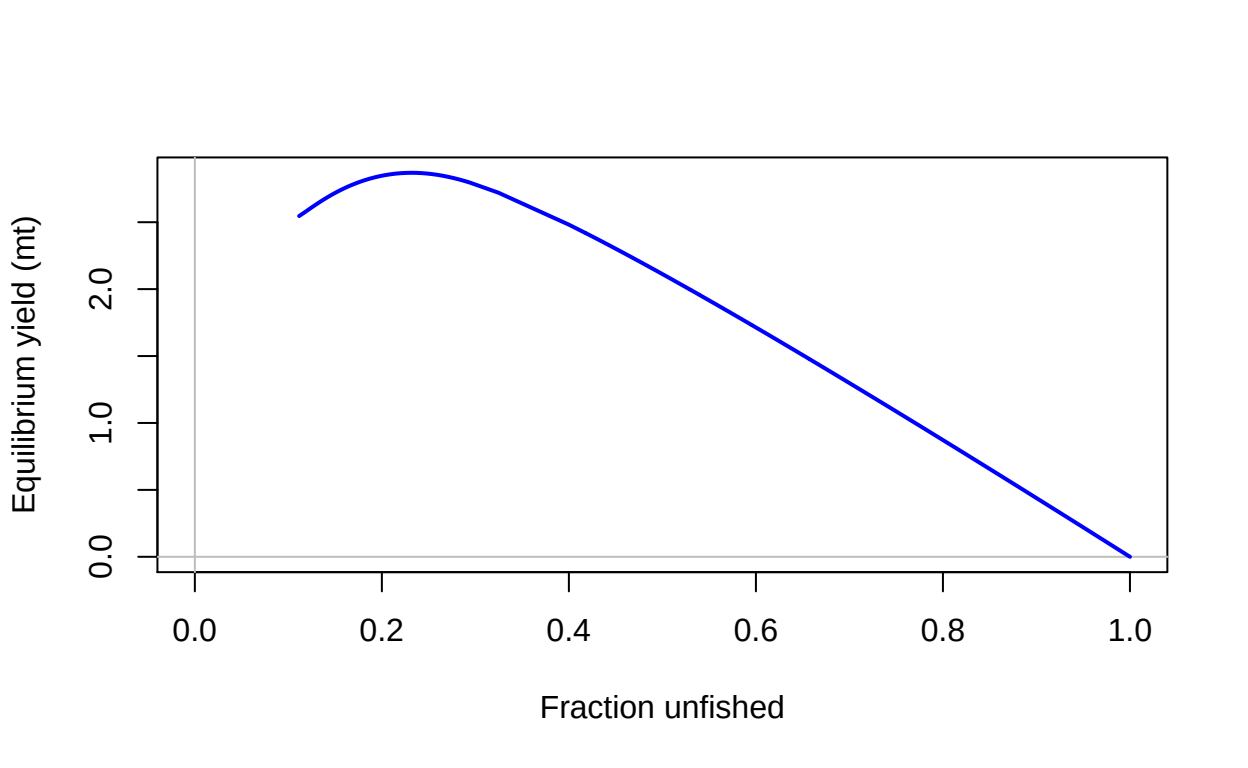

FISHERY
−1000
−600
200
600
1000
35
30
25
20
15
10
5
Length (cm)
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

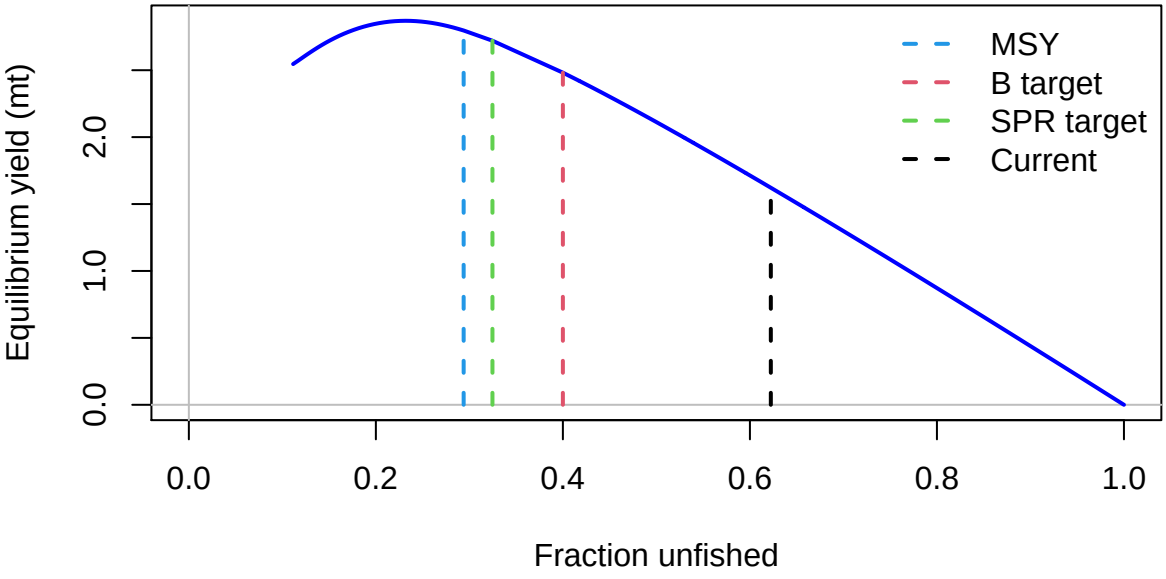

2004
N adj.=247.8
N eff.=152.2
2010
N adj.=153.7
N eff.=37.9
2016
N adj.=352
N eff.=91.8
2005
N adj.=155.4
N eff.=81.8
2011
N adj.=815.6
N eff.=83.1
2017
N adj.=169.7
N eff.=41.3
2006
N adj.=125.2
N eff.=60.5
2012
N adj.=1337.3
N eff.=77.3
2018
N adj.=162.1
N eff.=48.3
2007
N adj.=275.5
N eff.=136.2
2013
N adj.=2574.6
N eff.=84
2019
N adj.=220.9
N eff.=89.4
2008
N adj.=297.4
N eff.=66.2
2014
N adj.=1048.3
N eff.=93.2
2020
N adj.=165.5
N eff.=27.5
2009
N adj.=472.1
N eff.=99.6
2015
N adj.=1062.6
N eff.=249
2021
N adj.=91.6
N eff.=12.9
Proportion
0.00
0.10
0.20
0.30
0 5 15 25 35
Length (cm)

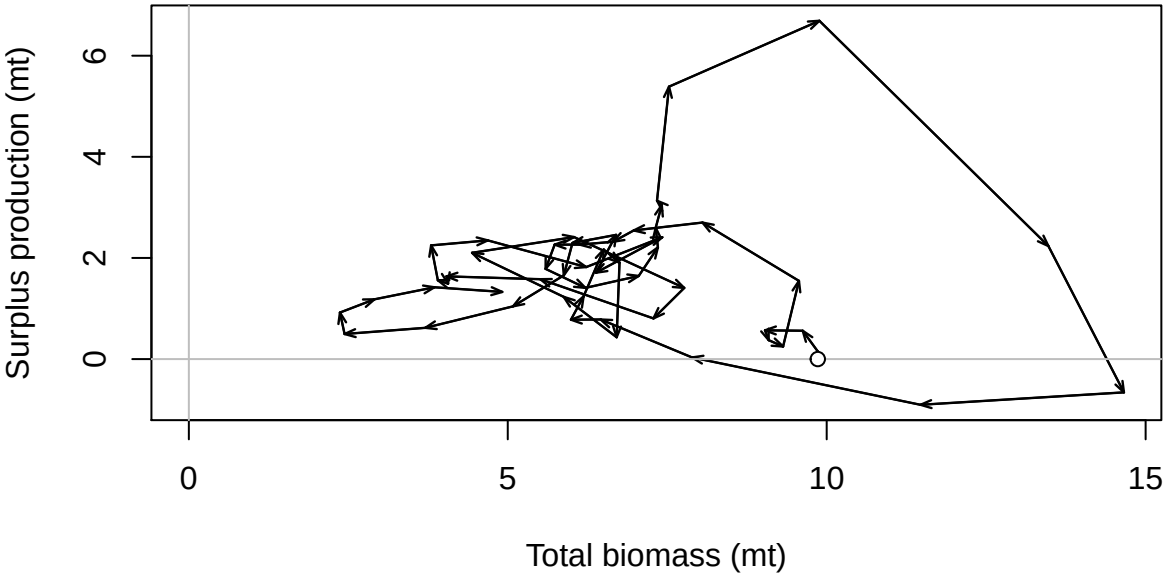

−1000
−600
200
600
1000
35
30
25
20
15
10
5
Length (cm)
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

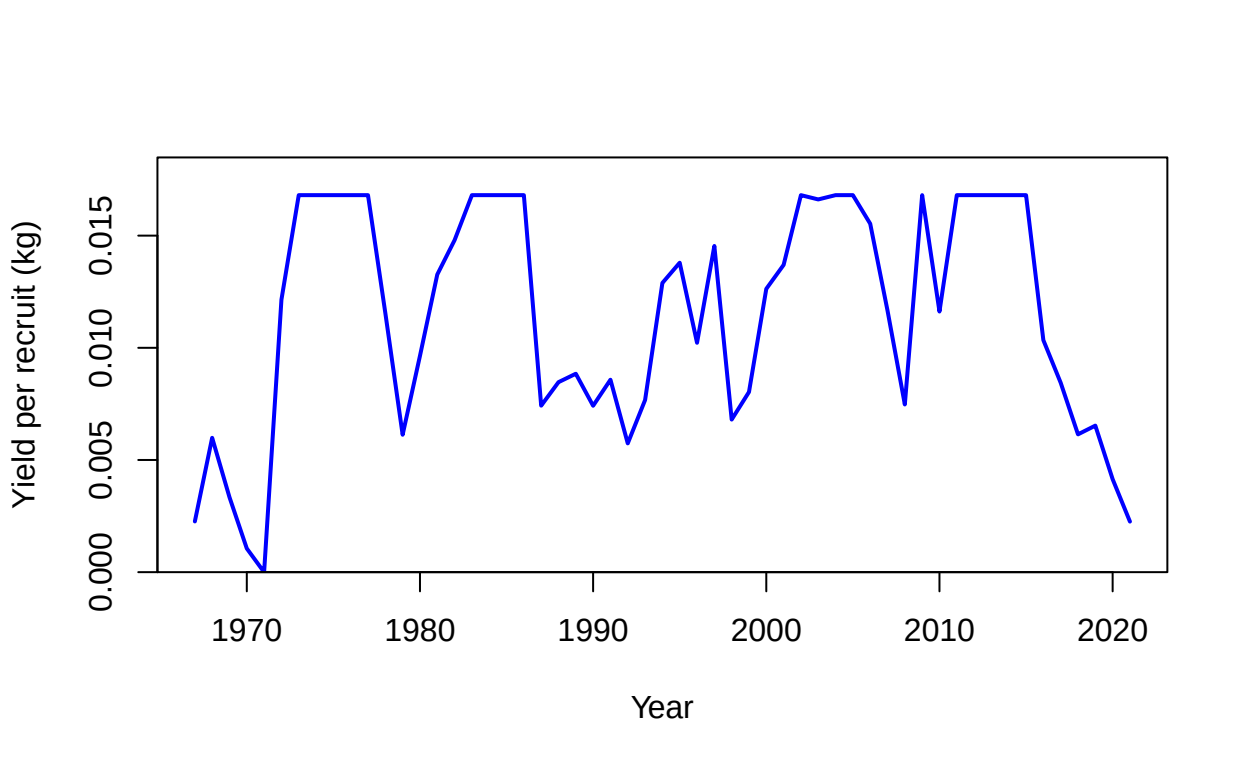

Effective sample size
Observed sample size
0
50
100
200
0
500
1000
1500
2000
2500
2015
2004
2009
2014
2011
2012
2013
2021
2020
arithmetic mean
harmonic mean

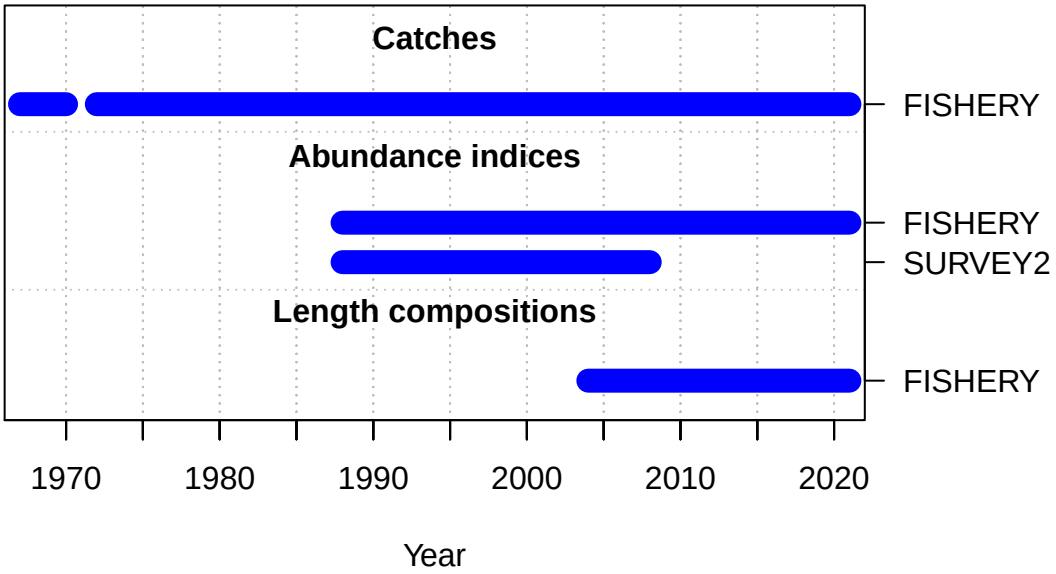

FISHERY (whole catch)
23.0
22.5
22.0
21.5
21.0
Mean length
2005
2010
2015
2020
Year

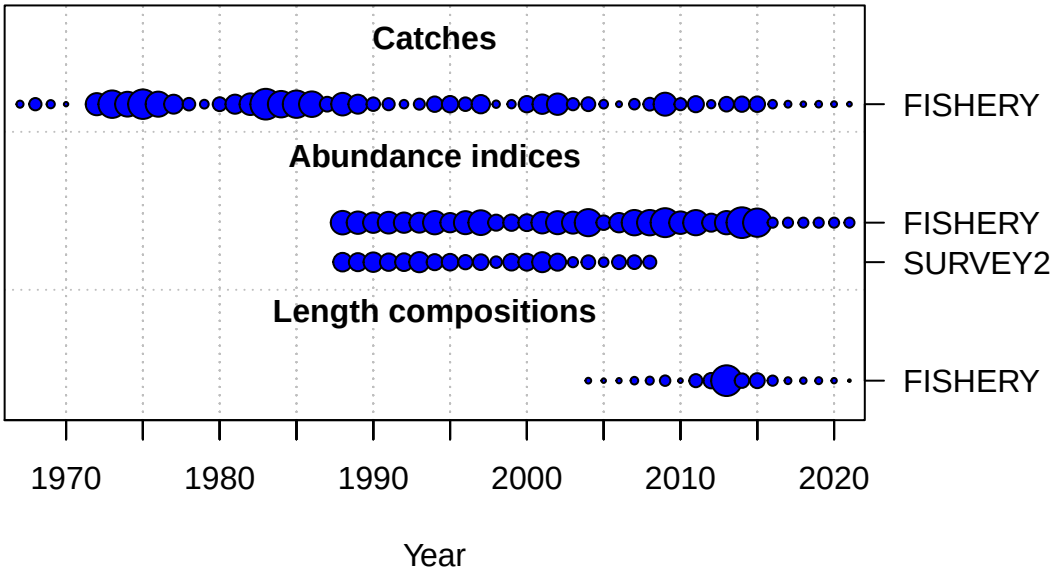

Equilibrium yield (mt)
0.0
1.0
2.0
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

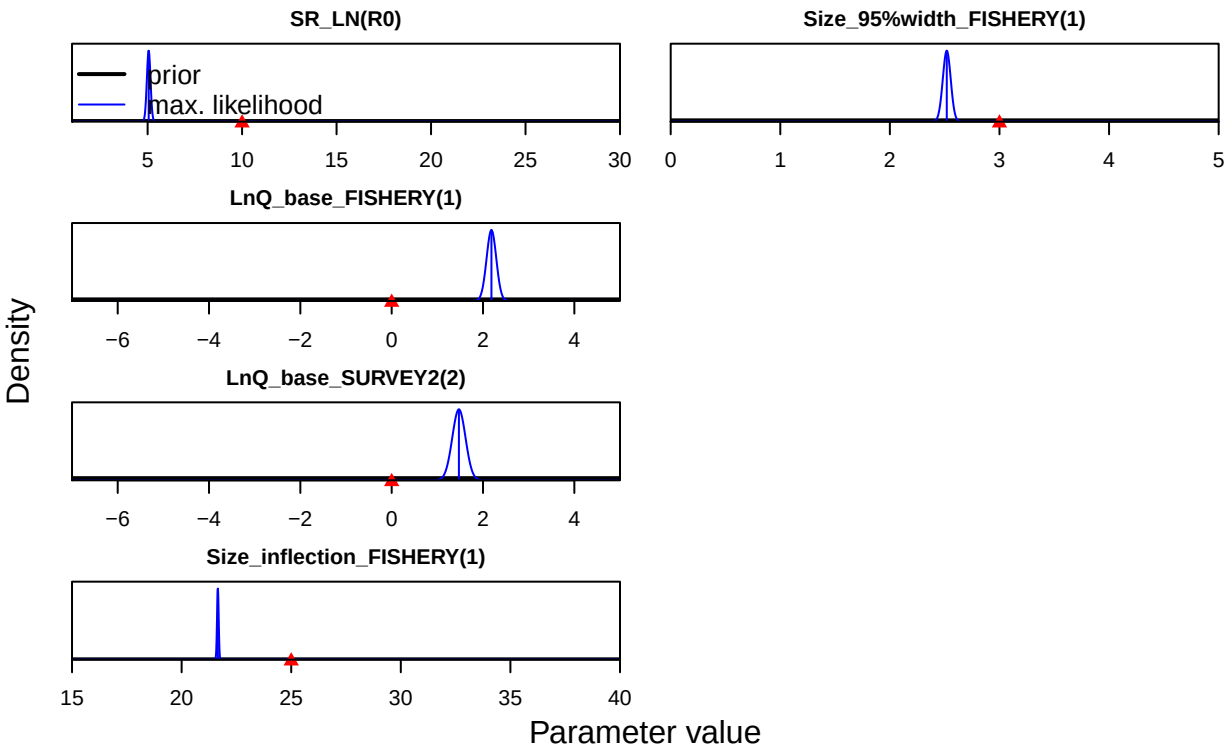

MSY
B target
SPR target
Current
Equilibrium yield (mt)
0.0
1.0
2.0
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished


Surplus production (mt)
0
2
4
6
0
5
10
15
Total biomass (mt)


Yield per recruit (kg)
0.000
0.005
0.010
0.015
1970
1980
1990
2000
2010
2020
Year


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


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


SR_LN(R0)
prior
max. likelihood
5
10
15
20
25
30
Size_95%width_FISHERY(1)
0
1
2
3
4
5
LnQ_base_FISHERY(1)
−6
−4
−2
0
2
4
LnQ_base_SURVEY2(2)
−6
−4
−2
0
2
4
Size_inflection_FISHERY(1)
15
20
25
30
35
40
Density
Parameter value