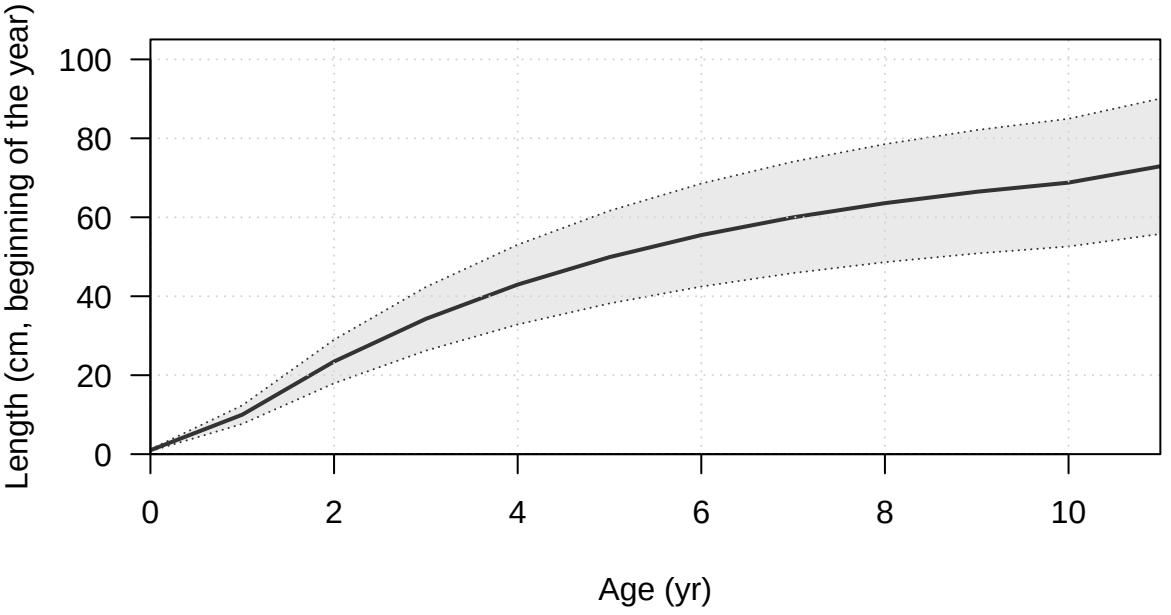
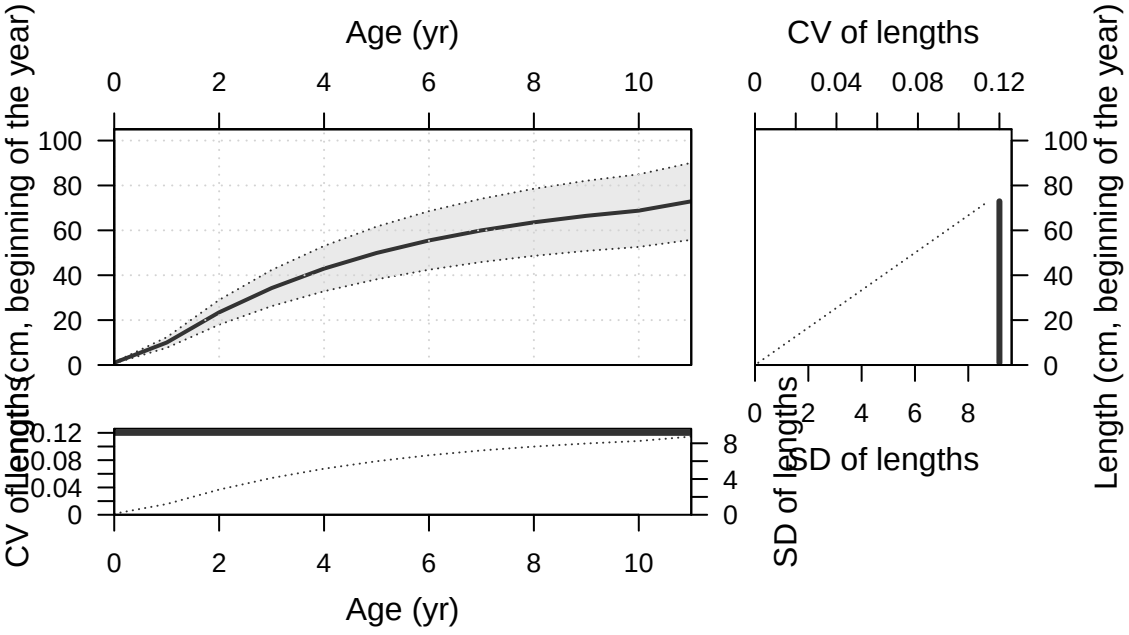
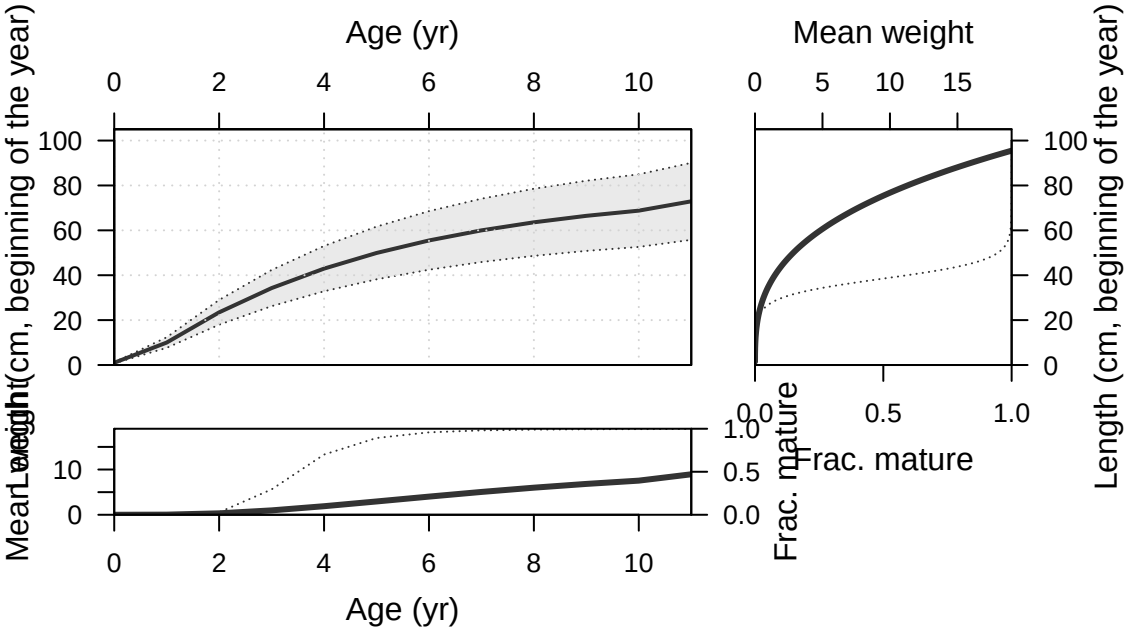
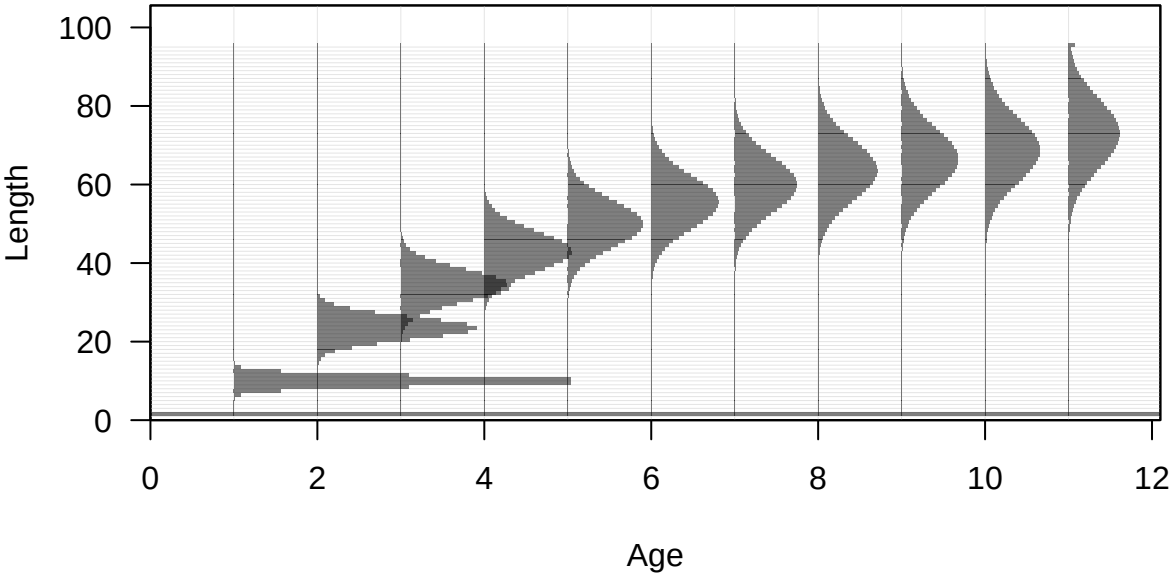
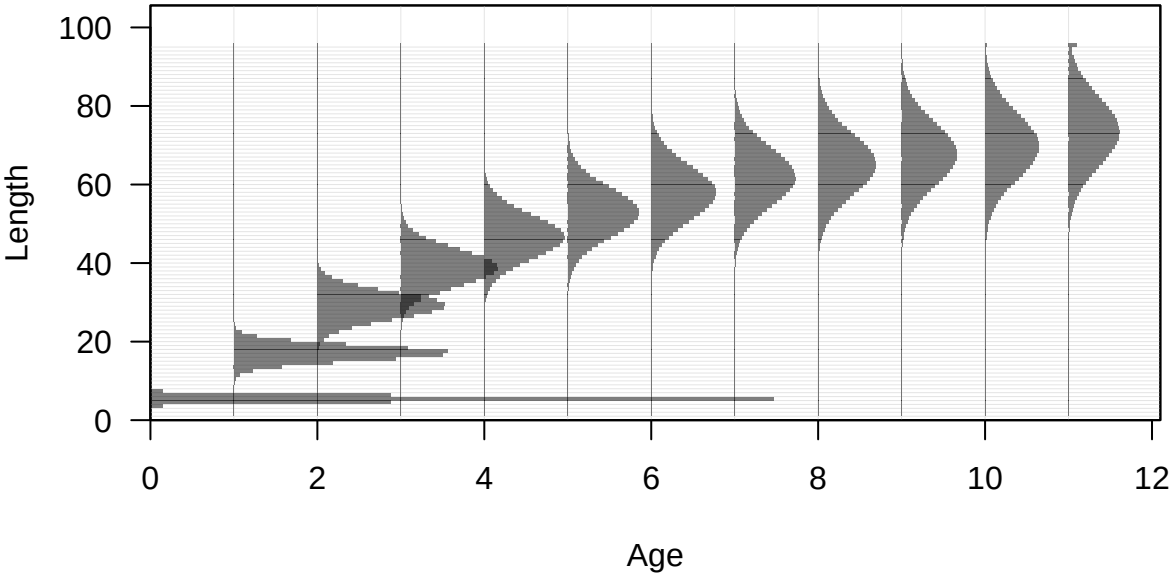
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Tue Jun 28 14:16:58 2022
Data_File: data.ss
Control_File: control.ss

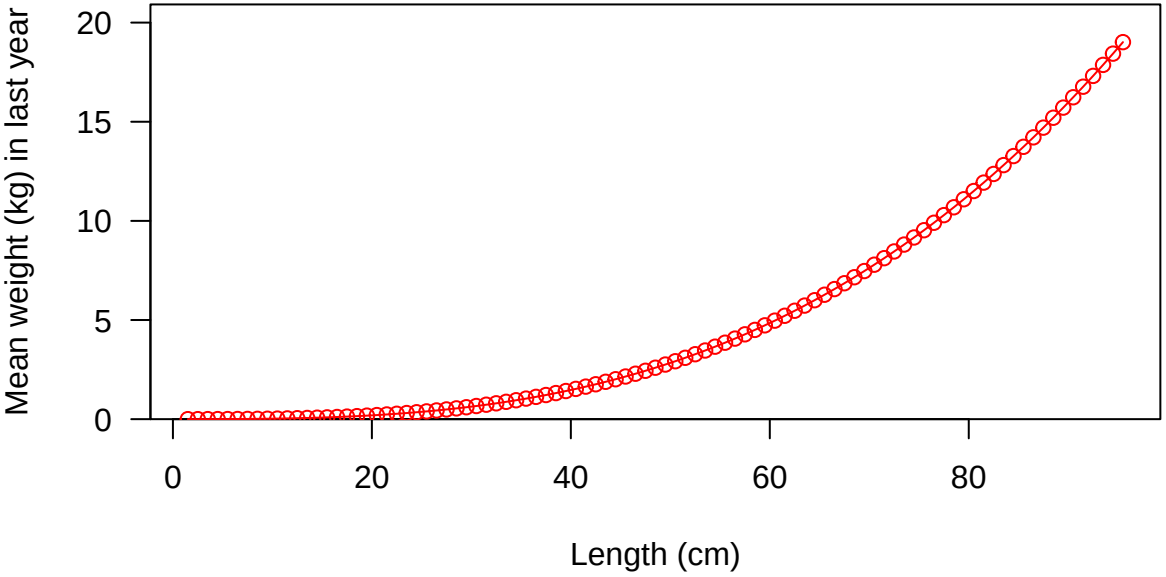

Length (cm, beginning of the year)
100
80
60
40
20
0
0
2
4
6
8
10
Age (yr)

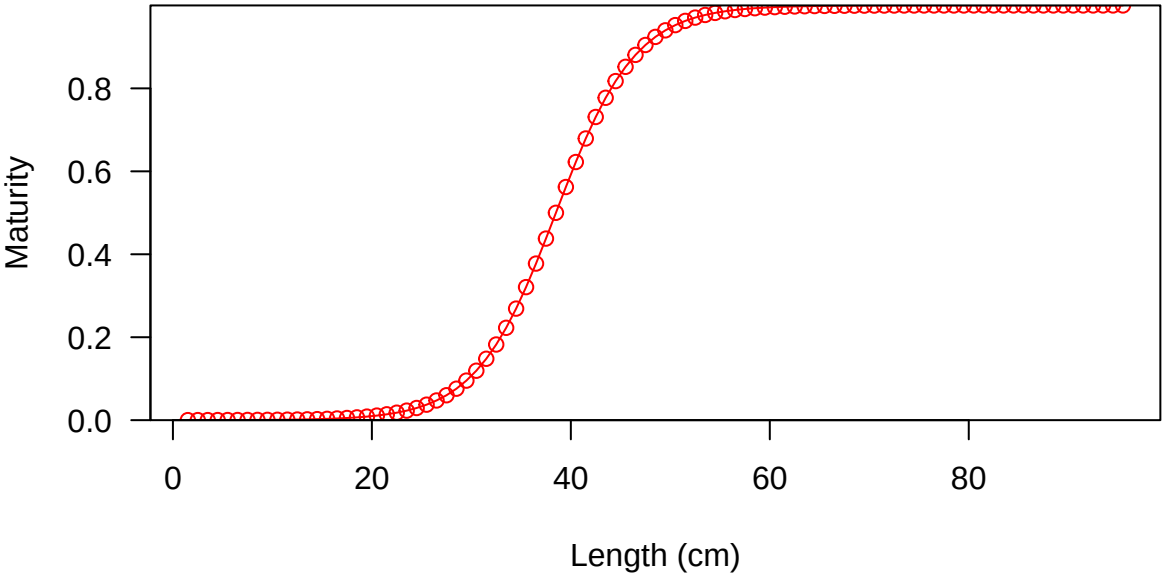

Age (yr)
0
2
4
6
8
10
Length (cm, beginning of the year)
100
80
60
40
20
0
CV of lengths
0.12
0.08
0.04
SD of lengths
8
4
Age (yr)

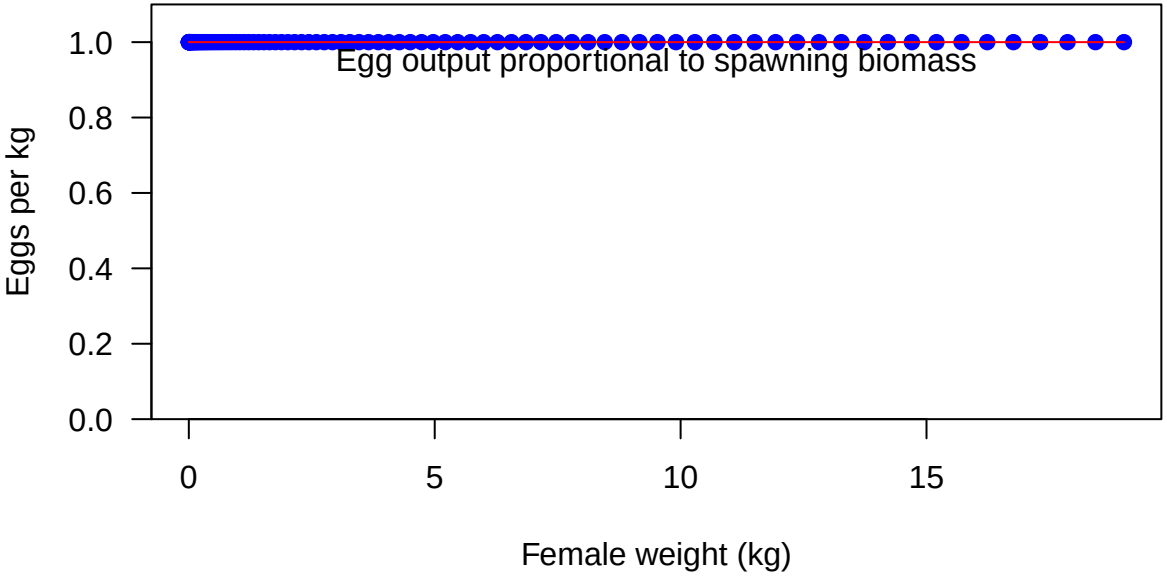

Age (yr)
Mean weight
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)
Frac. mature
Length (cm, beginning of the year)

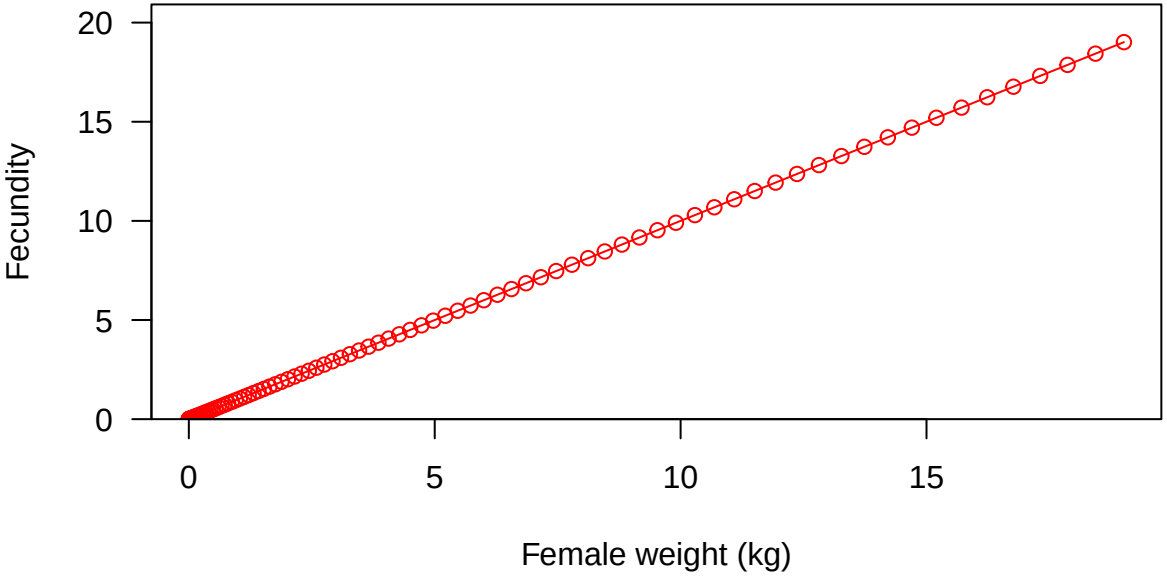

Length
100
80
60
40
20
0
0
2
4
6
8
10
12
Age

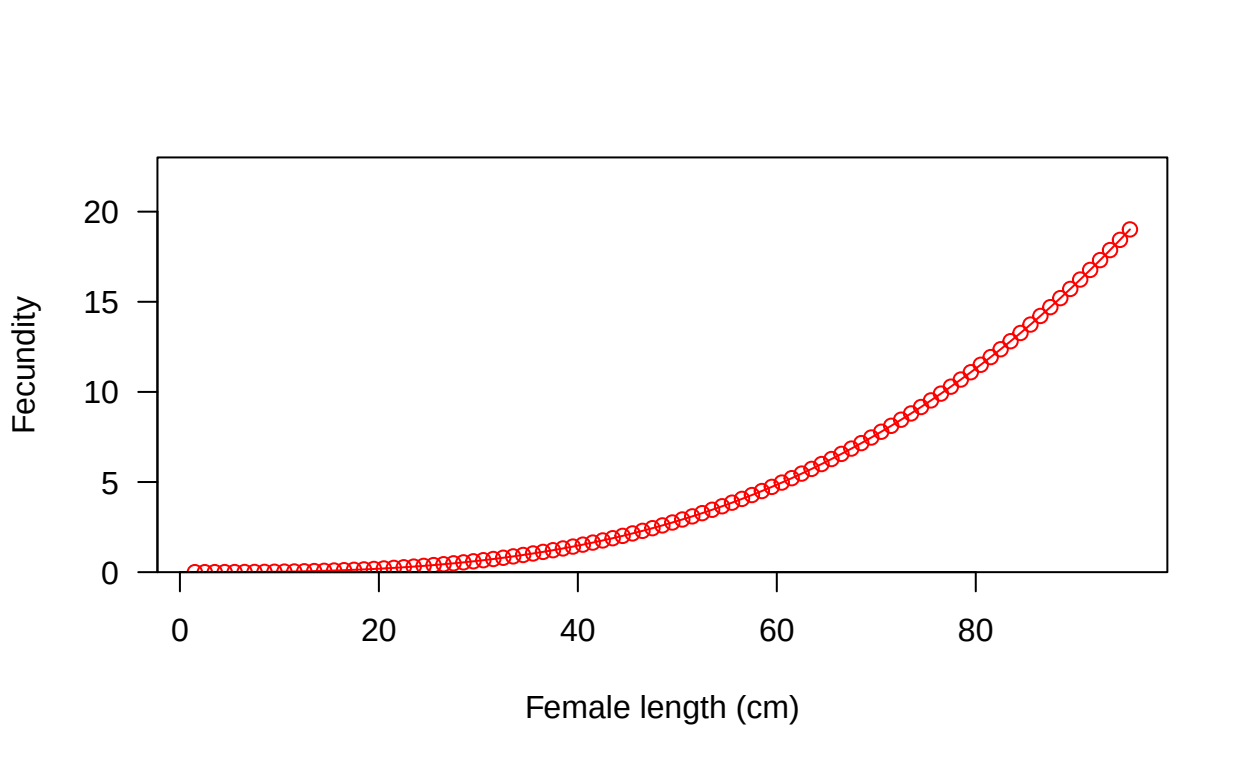

Length
100
80
60
40
20
0
0
2
4
6
8
10
12
Age

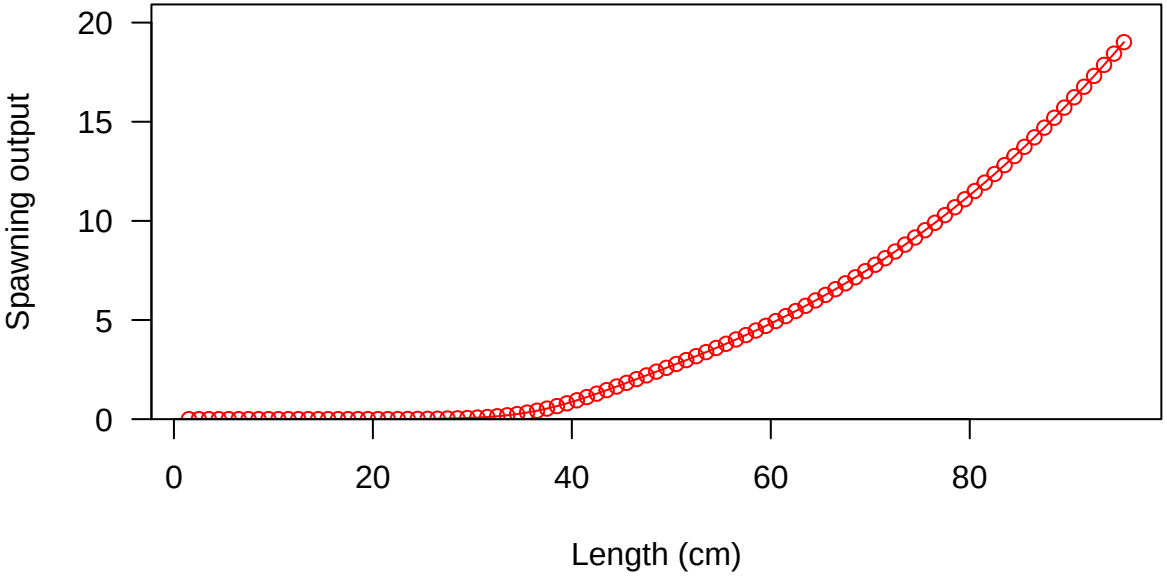

Mean weight (kg) in last year
20
15
10
5
0
0
20
40
60
80
Length (cm)

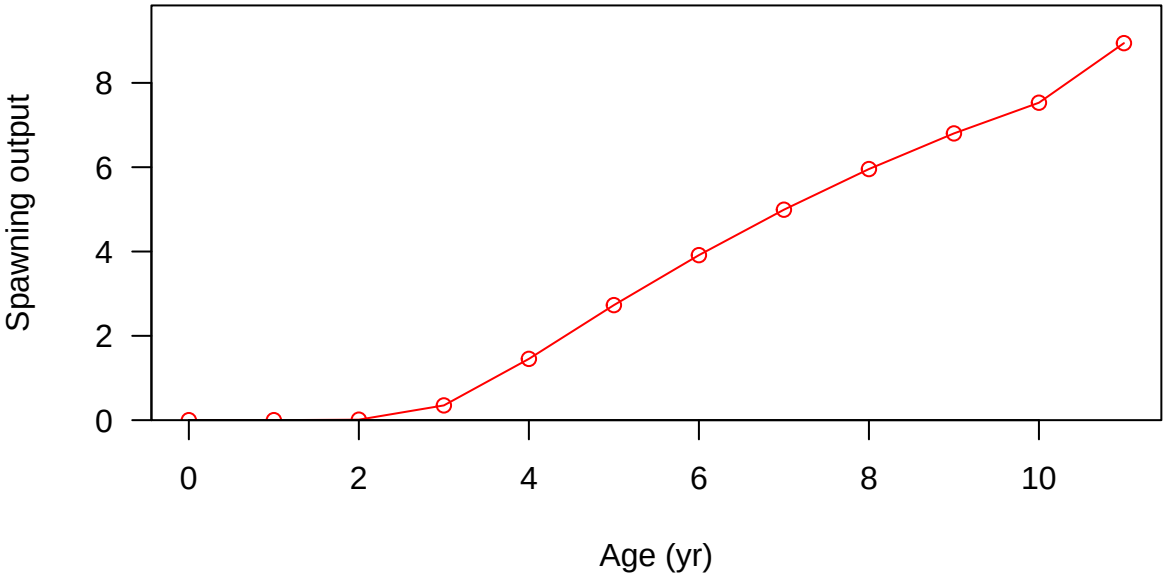

Maturity
0.0
0.2
0.4
0.6
0.8
0
20
40
60
80
Length (cm)

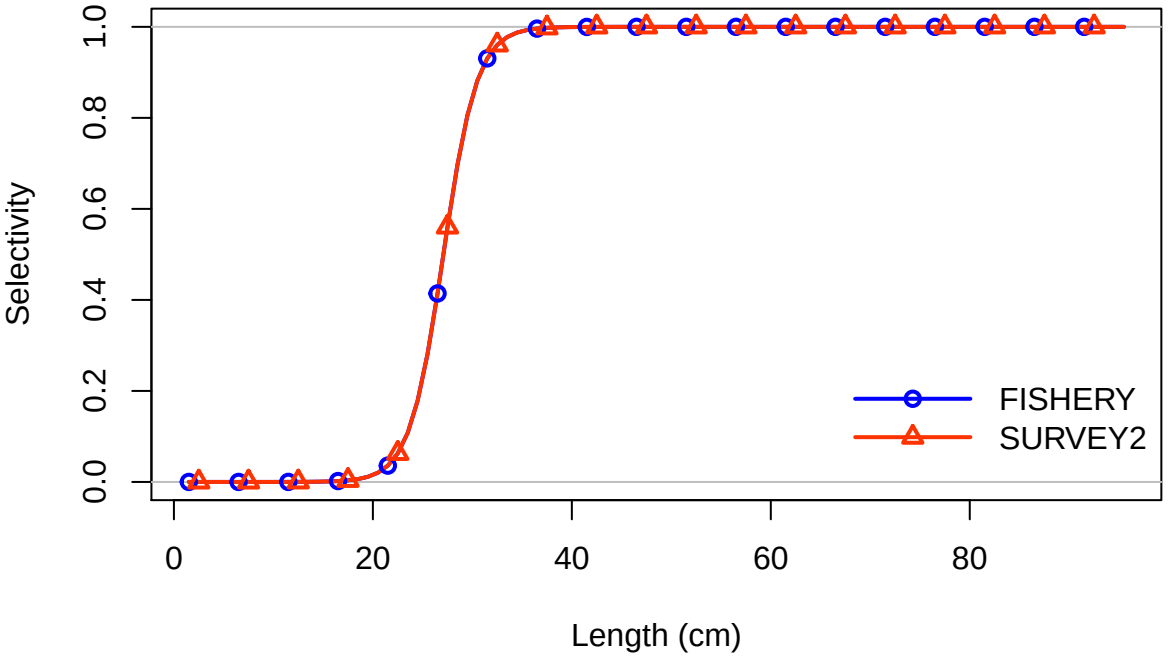

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
Female weight (kg)

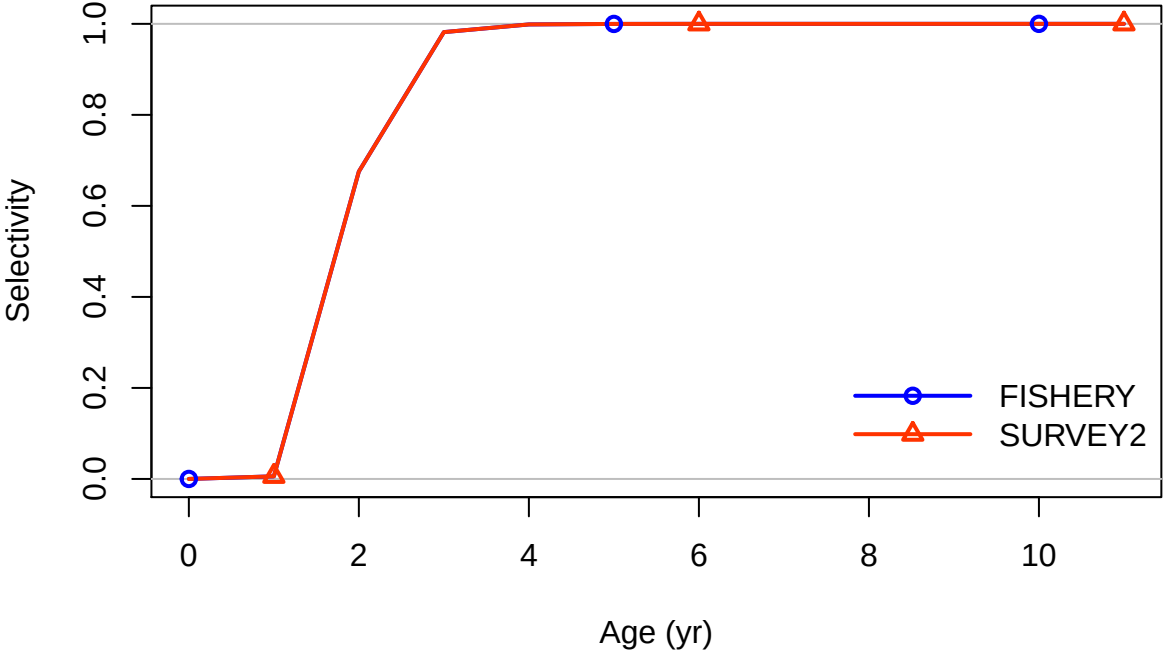

Fecundity
20
15
10
5
0
0
5
10
15
Female weight (kg)

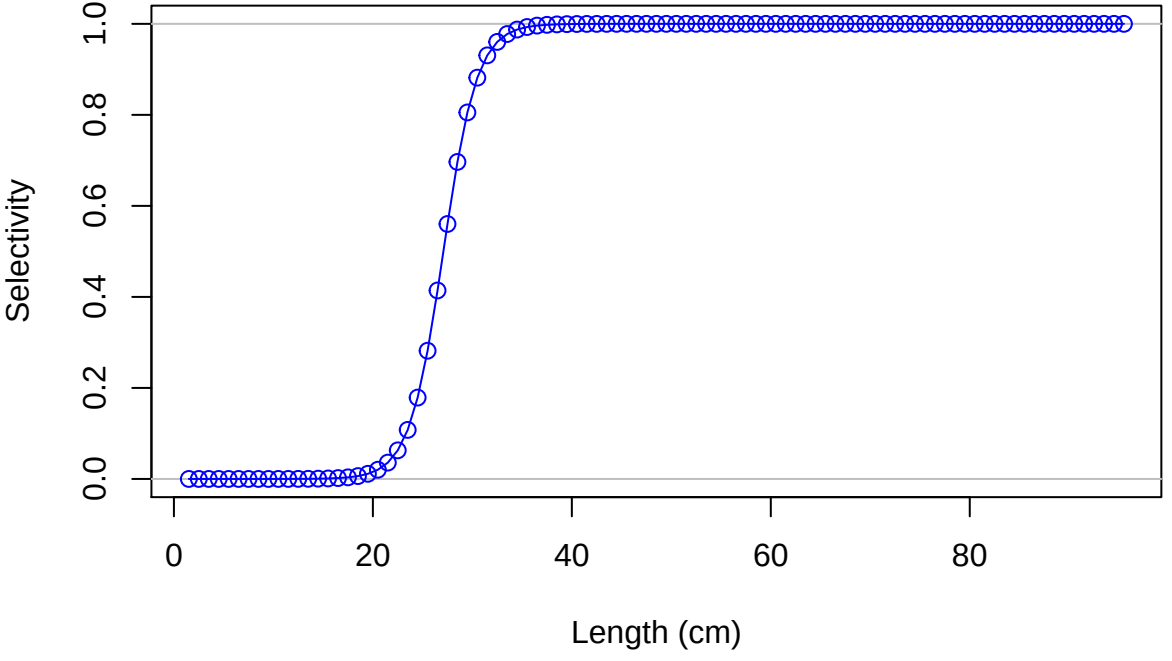

Fecundity
0
5
10
15
20
0
20
40
60
80
Female length (cm)

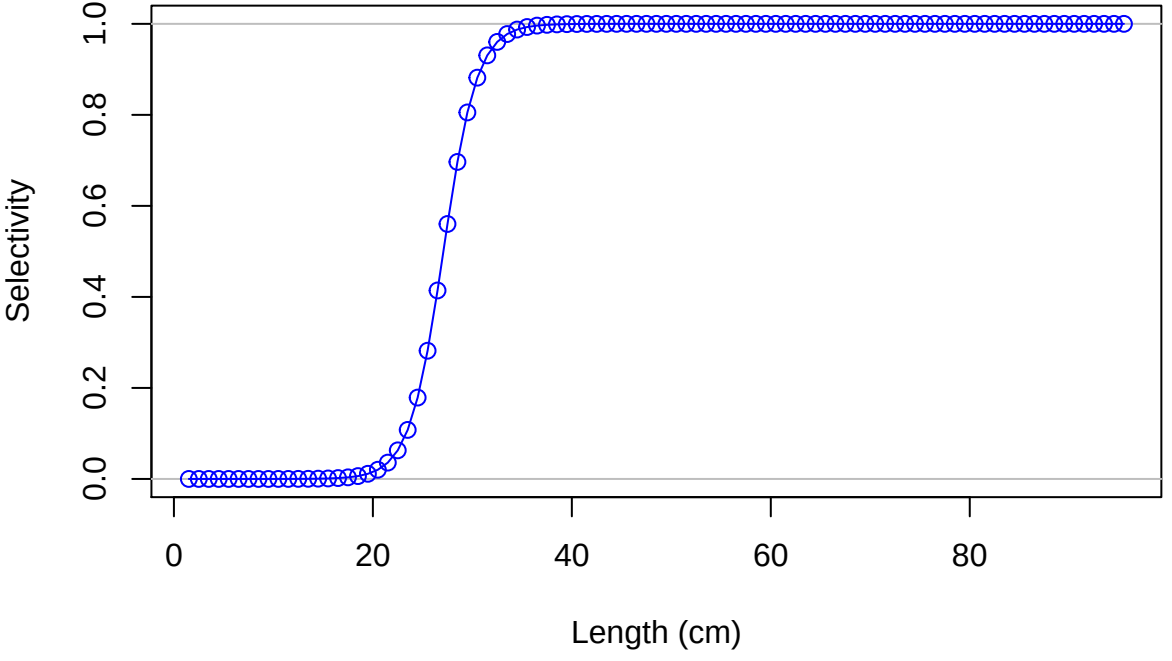

Spawning output
20
15
10
5
0
0
20
40
60
80
Length (cm)

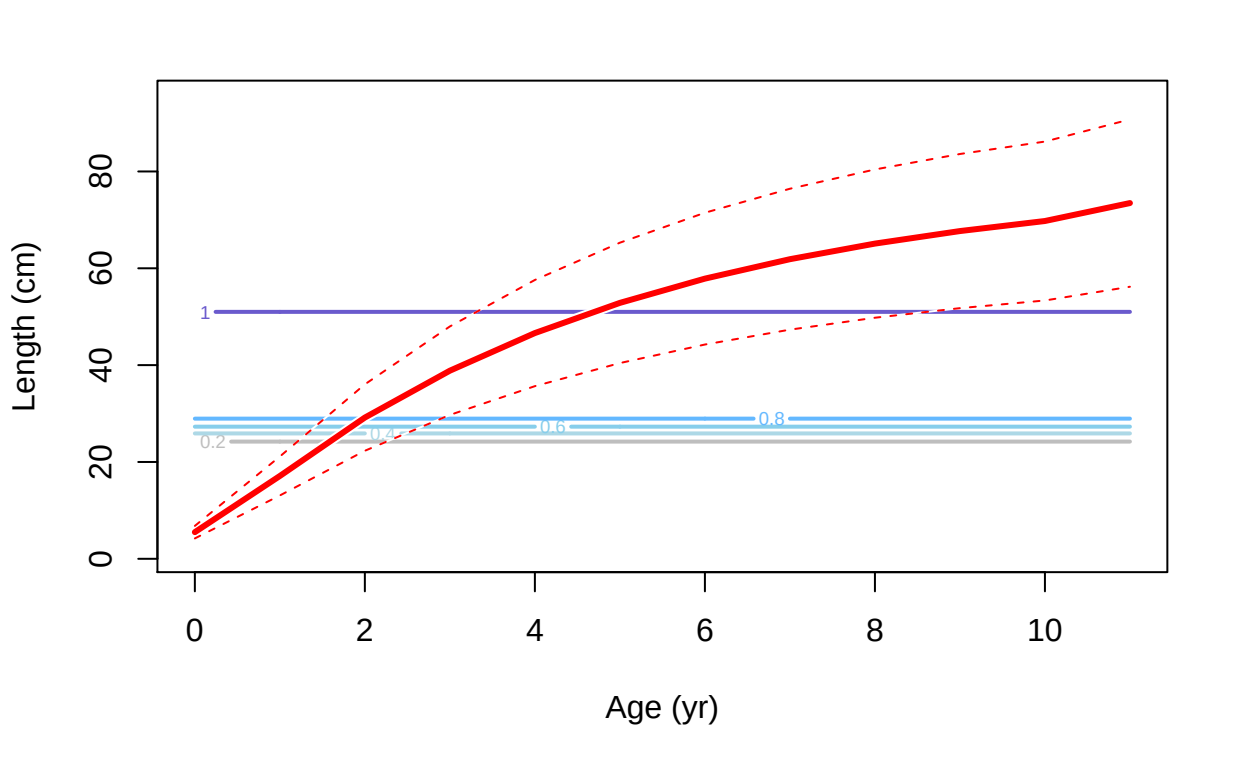

Spawning output
0
2
4
6
8
0
2
4
6
8
10
Age (yr)

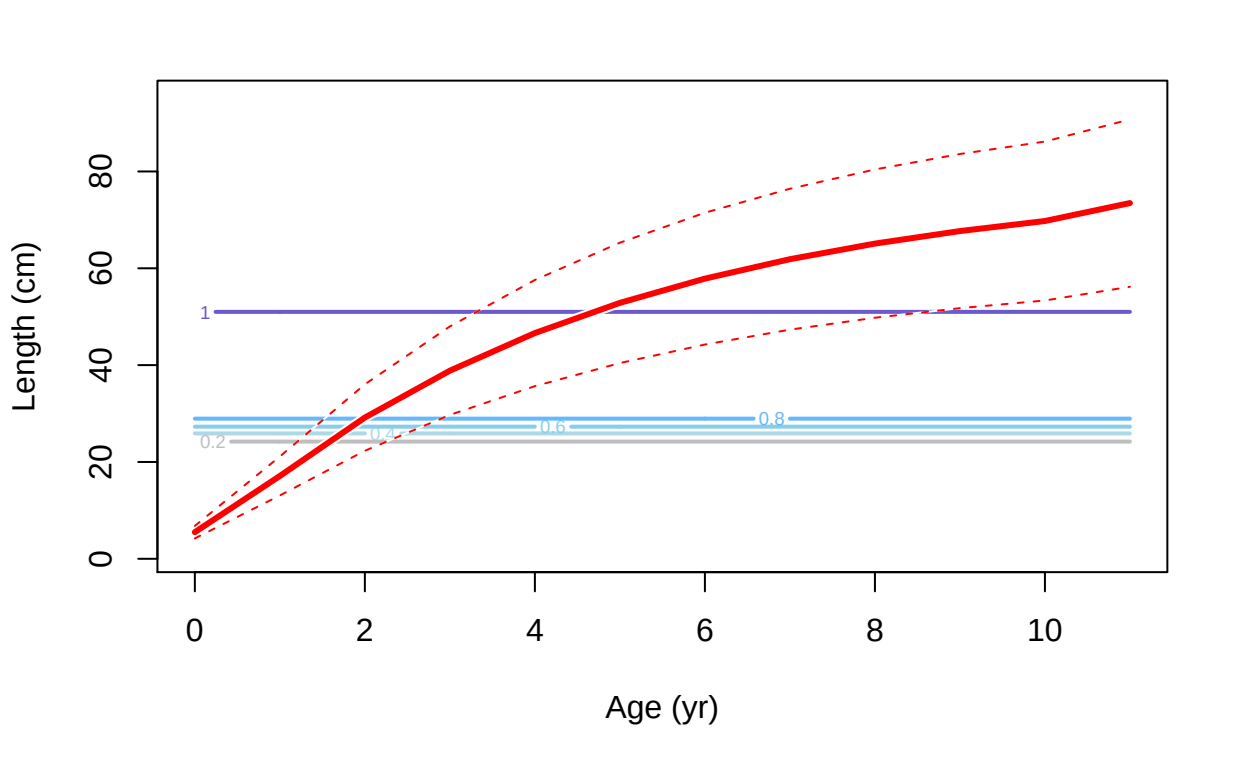

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)
FISHERY
SURVEY2

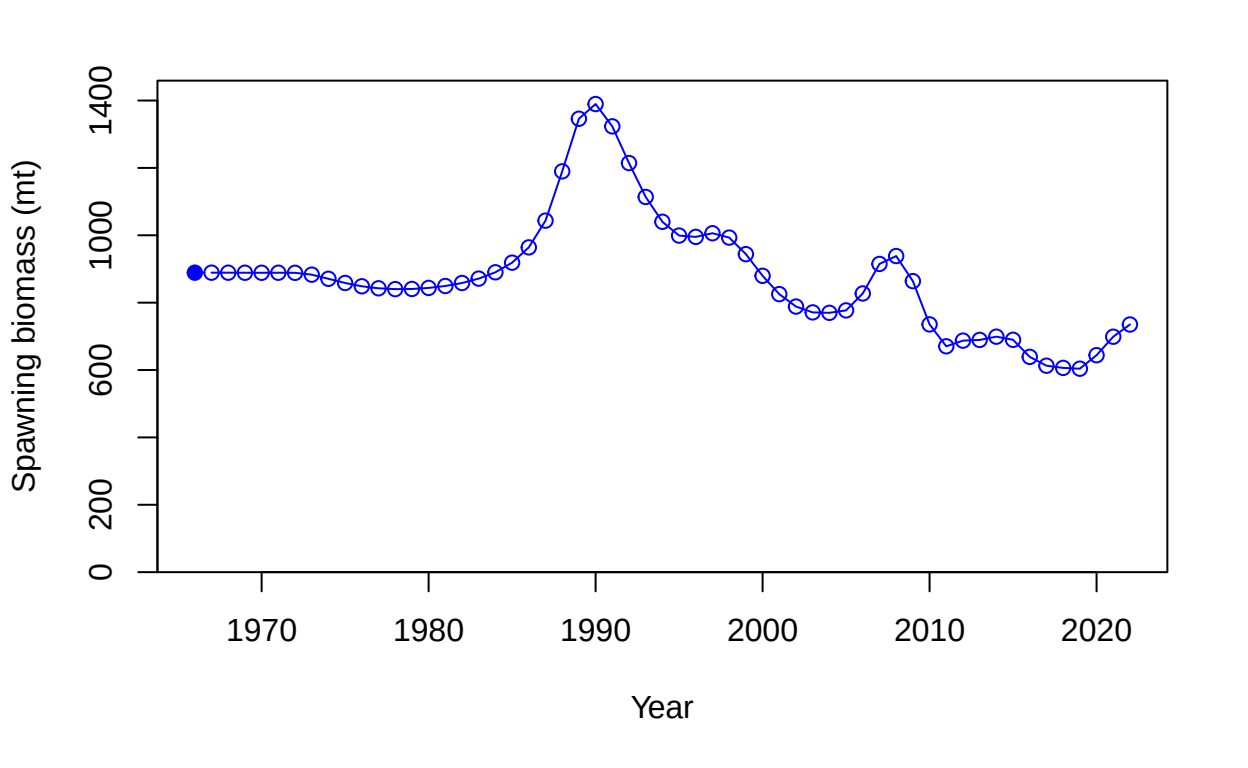

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
10
Age (yr)
FISHERY
SURVEY2

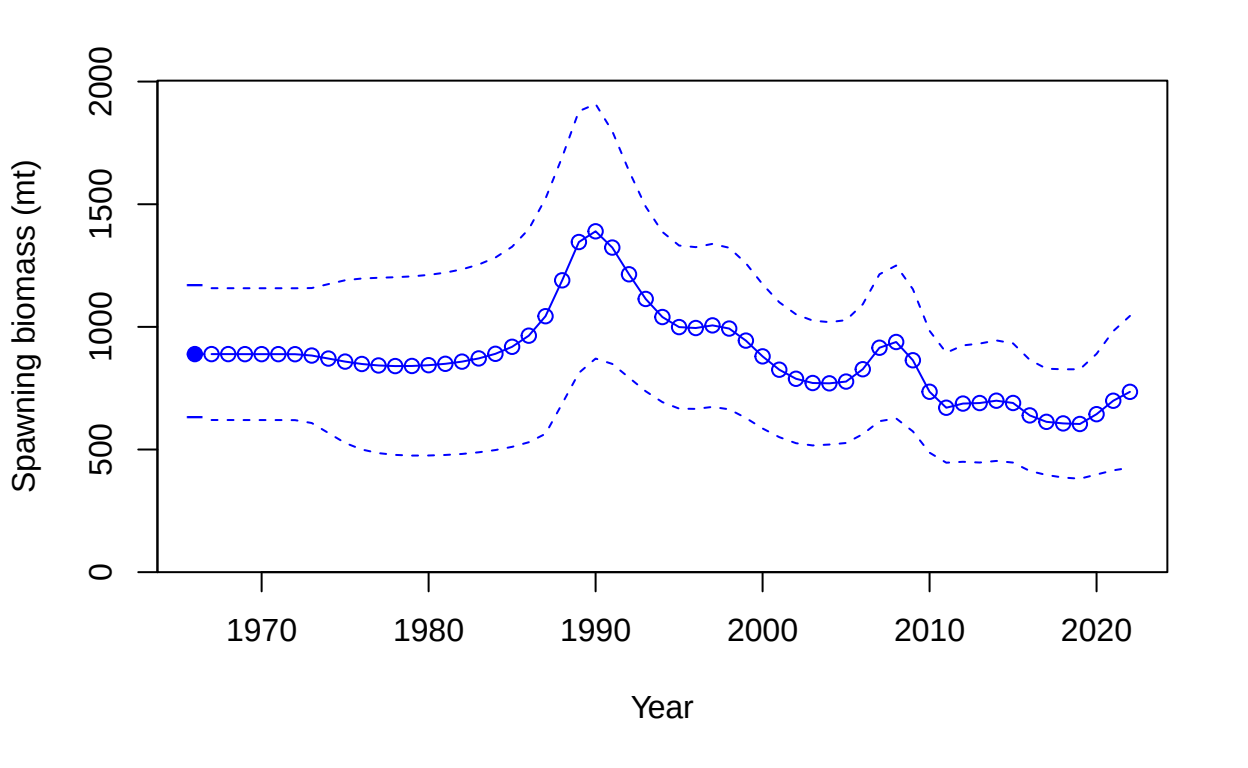

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)

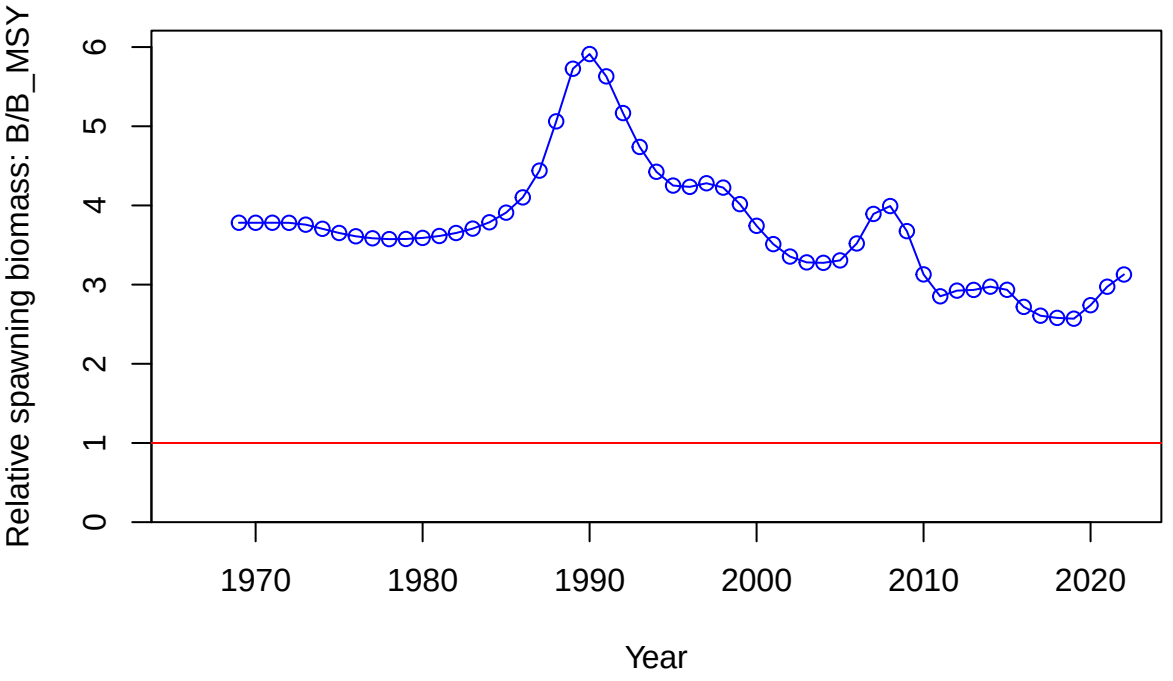

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
Length (cm)

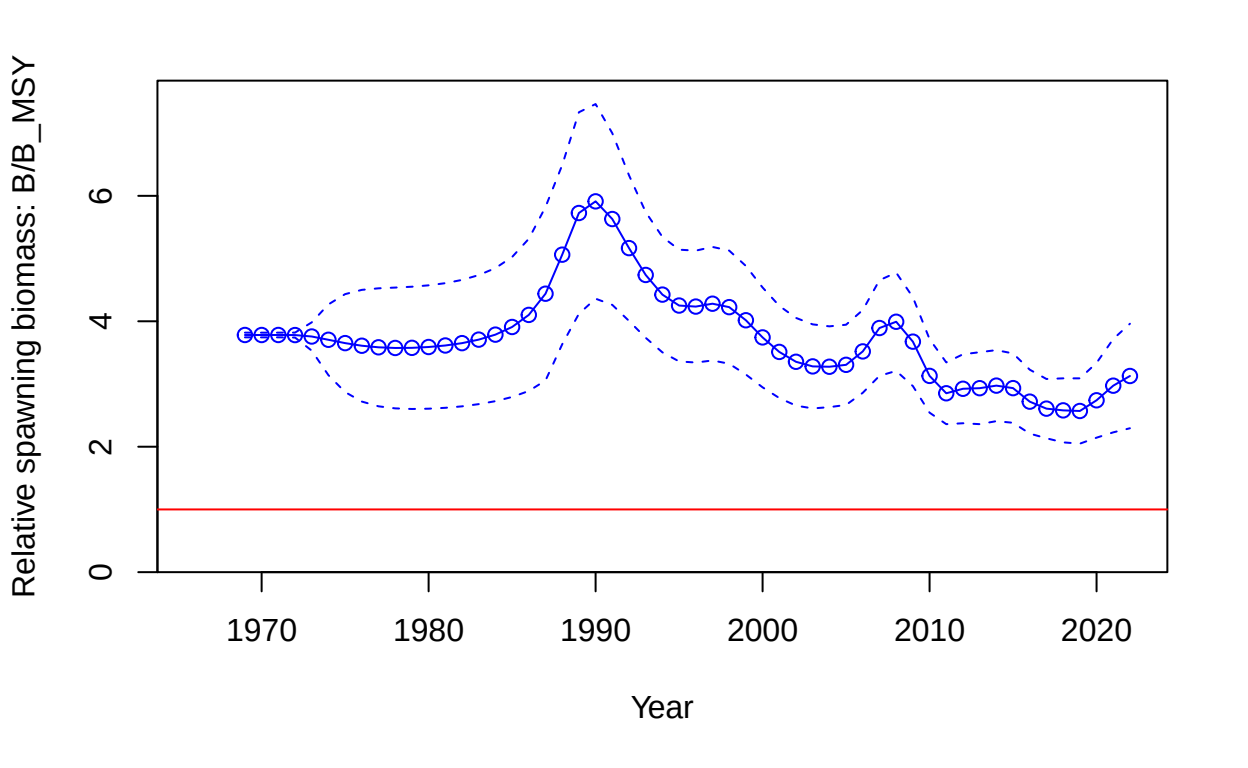

Length (cm)
0
20
40
60
80
0
2
4
6
8
10
Age (yr)
1
0.8
0.6
0.4
0.2

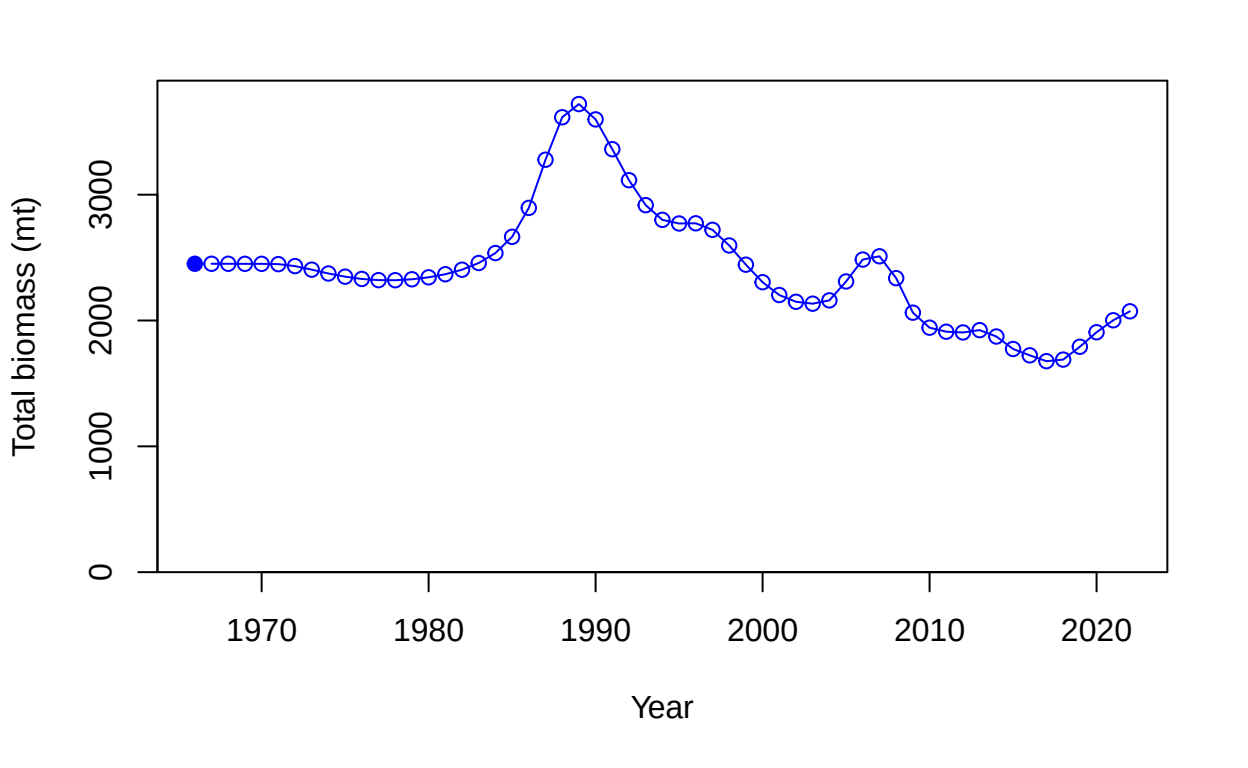

Length (cm)
0
20
40
60
80
0
2
4
6
8
10
Age (yr)
1
0.8
0.6
0.4
0.2

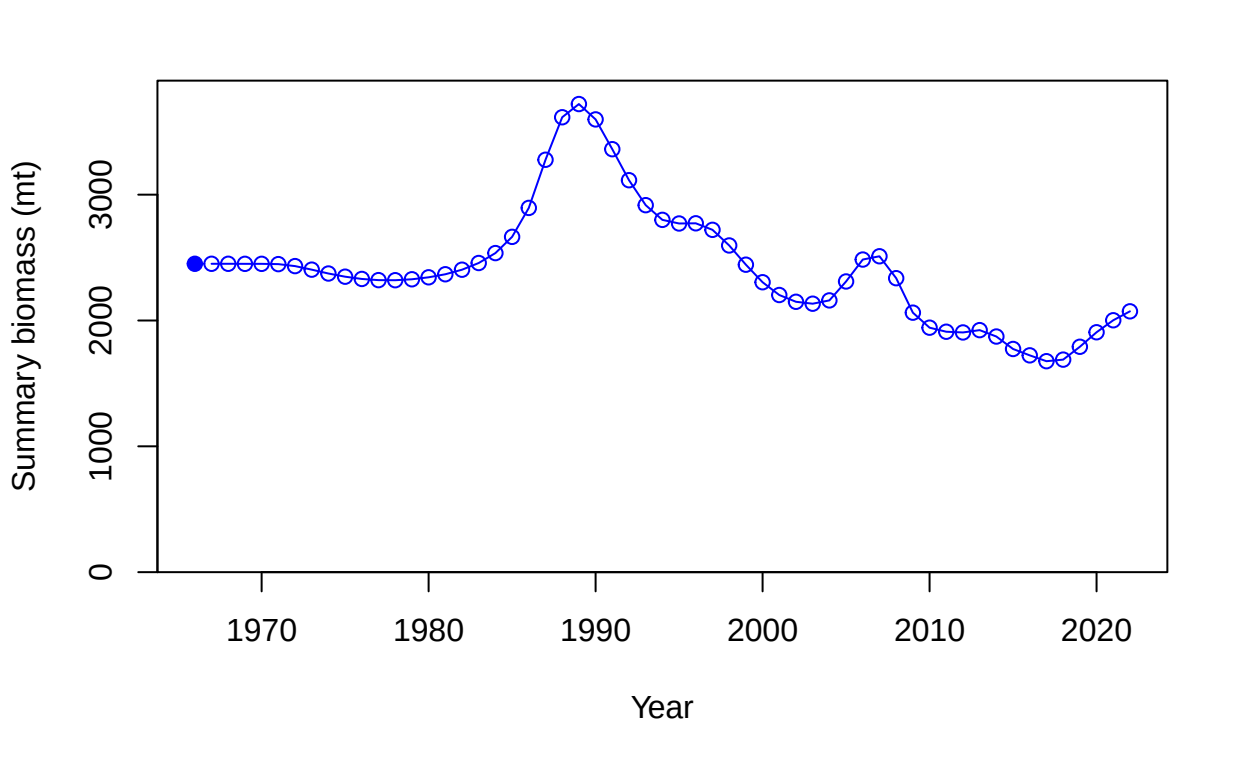

Spawning biomass (mt)
0
200
600
1000
1400
1970
1980
1990
2000
2010
2020
Year

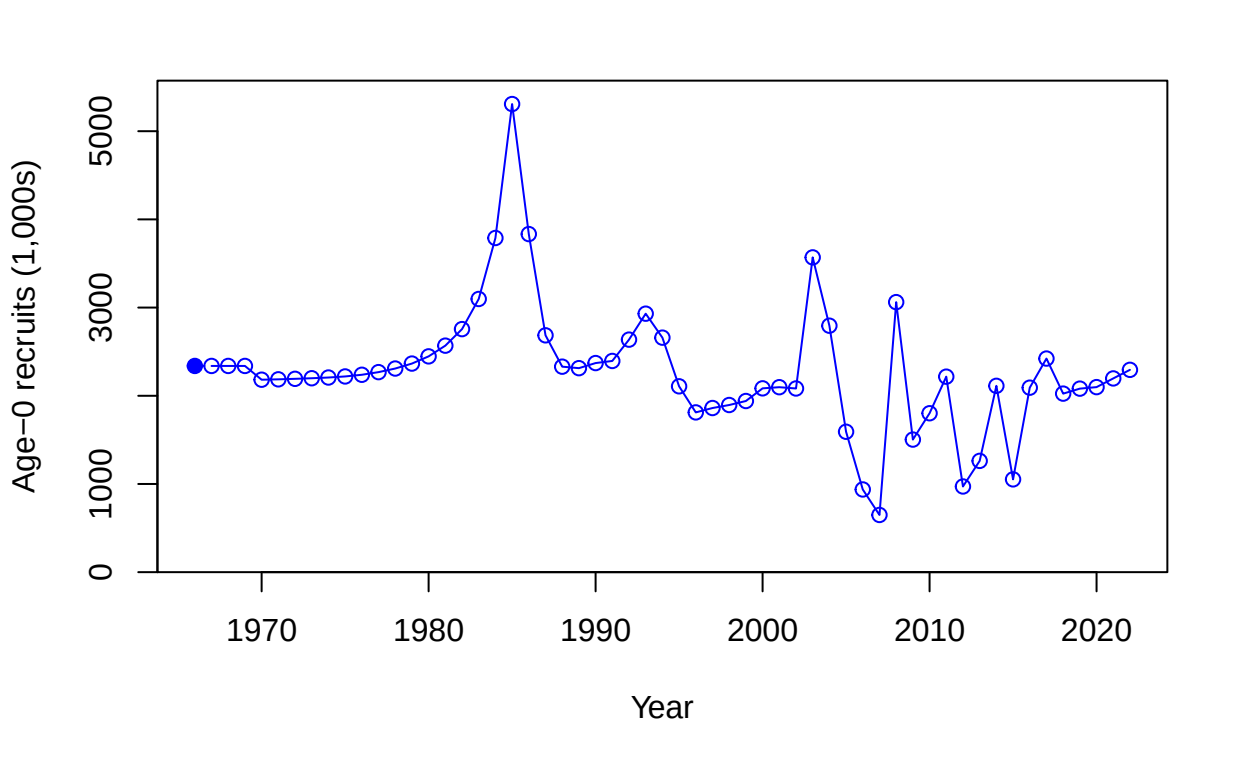

Spawning biomass (mt)
0
500
1000
1500
2000
1970
1980
1990
2000
2010
2020
Year

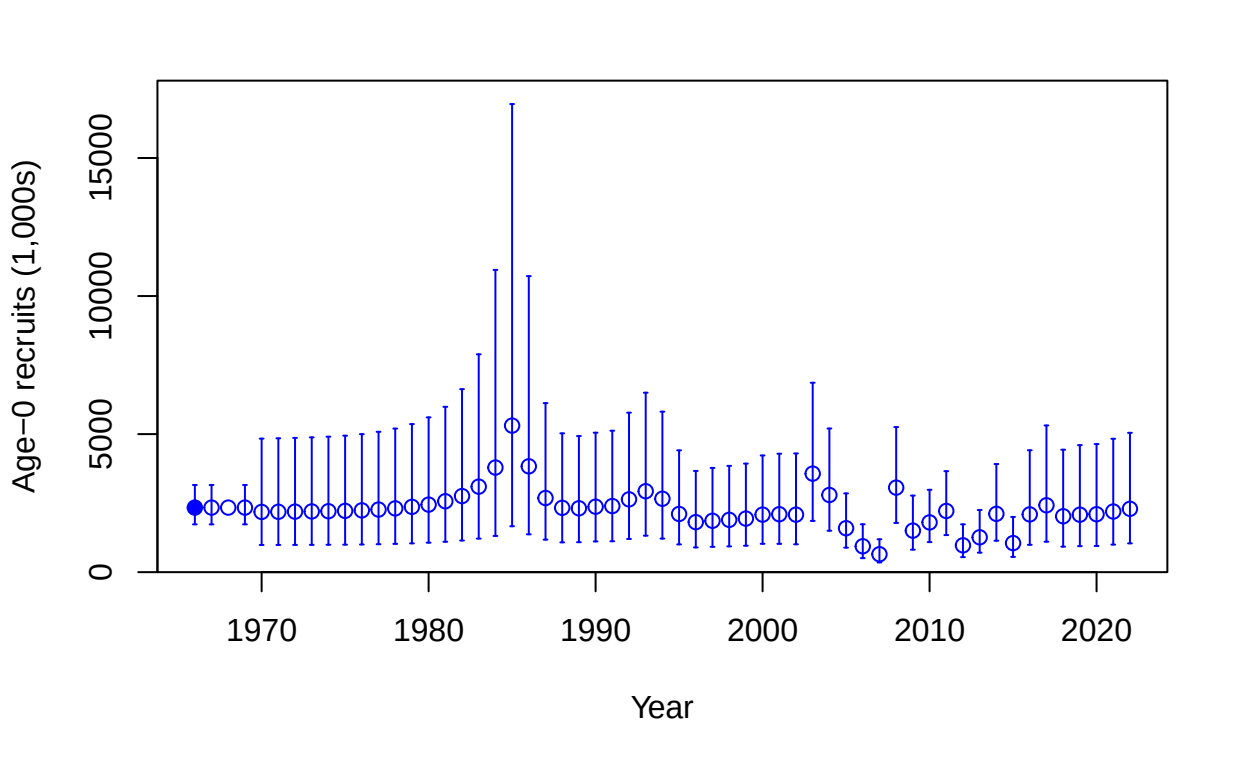

Relative spawning biomass: B/B_MSY
0
1
2
3
4
5
6
1970
1980
1990
2000
2010
2020
Year

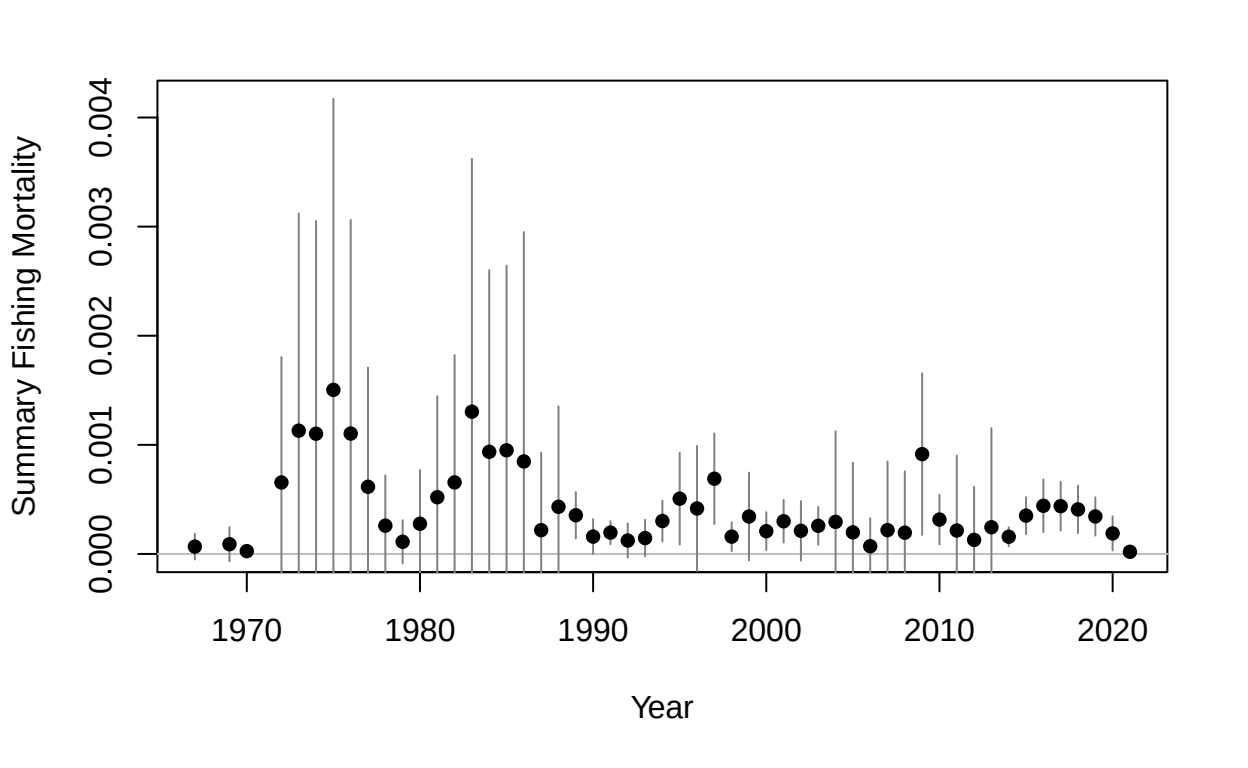

Relative spawning biomass: B/B_MSY
0
2
4
6
1970
1980
1990
2000
2010
2020
Year

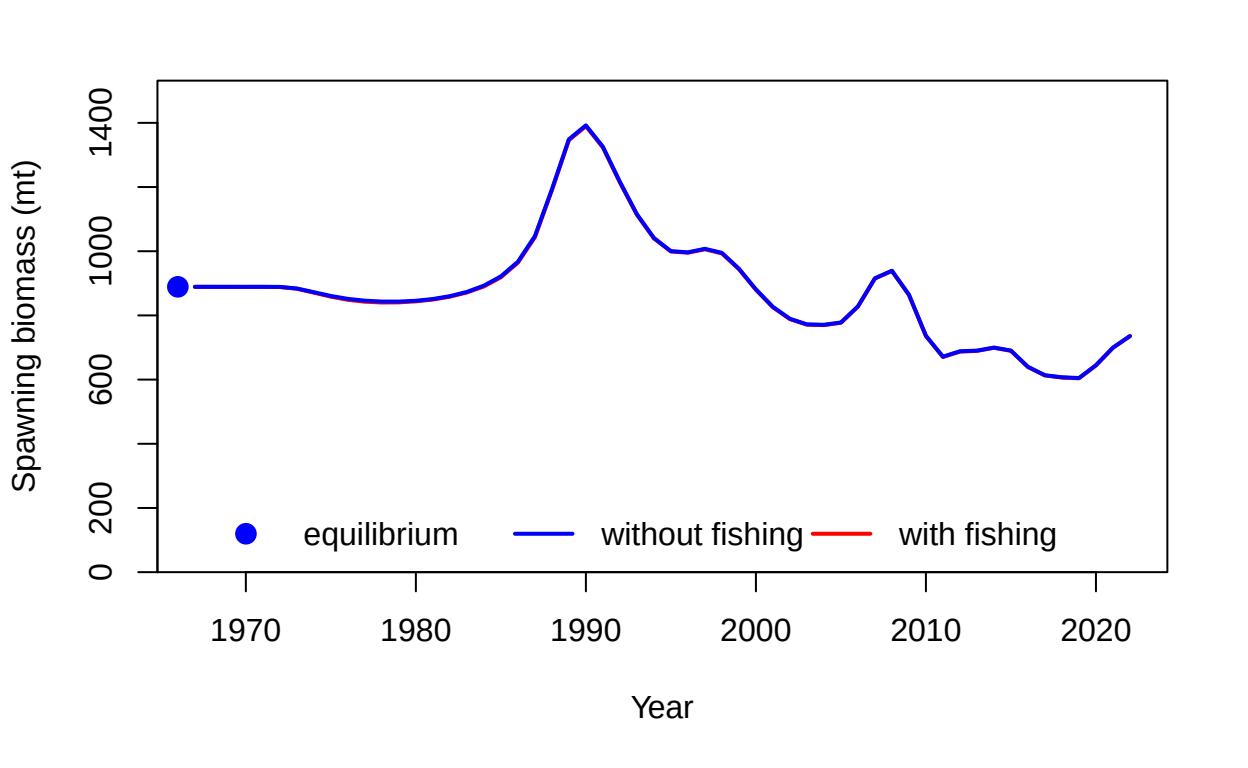

Total biomass (mt)
0
1000
2000
3000
1970
1980
1990
2000
2010
2020
Year

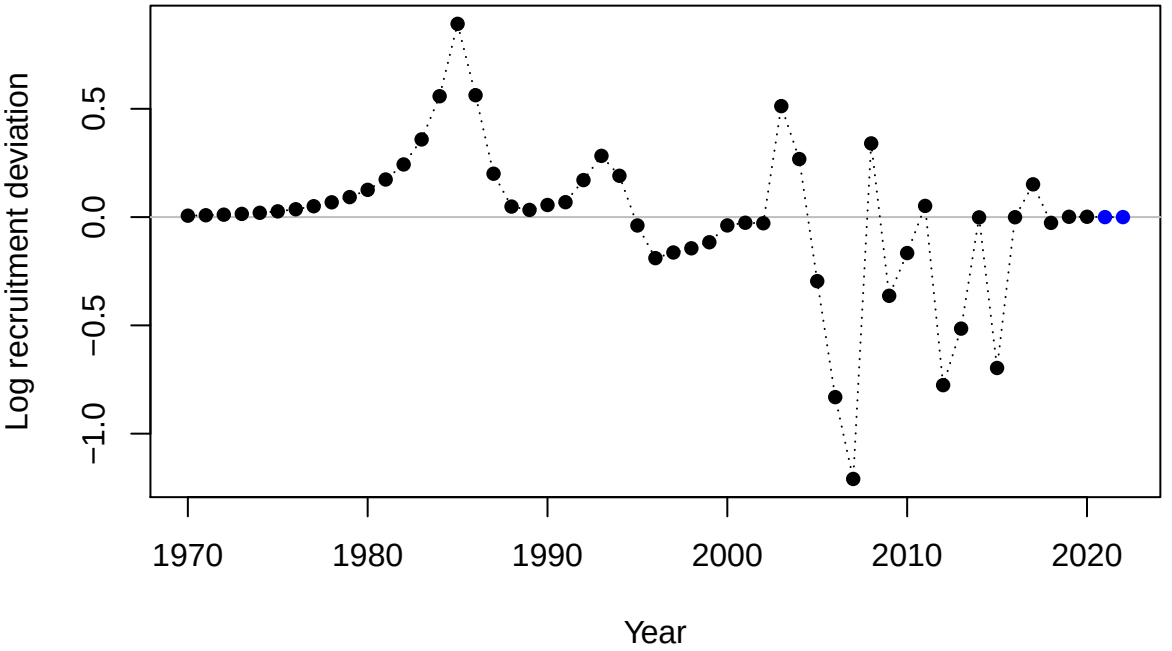

Summary biomass (mt)
0
1000
2000
3000
1970
1980
1990
2000
2010
2020
Year

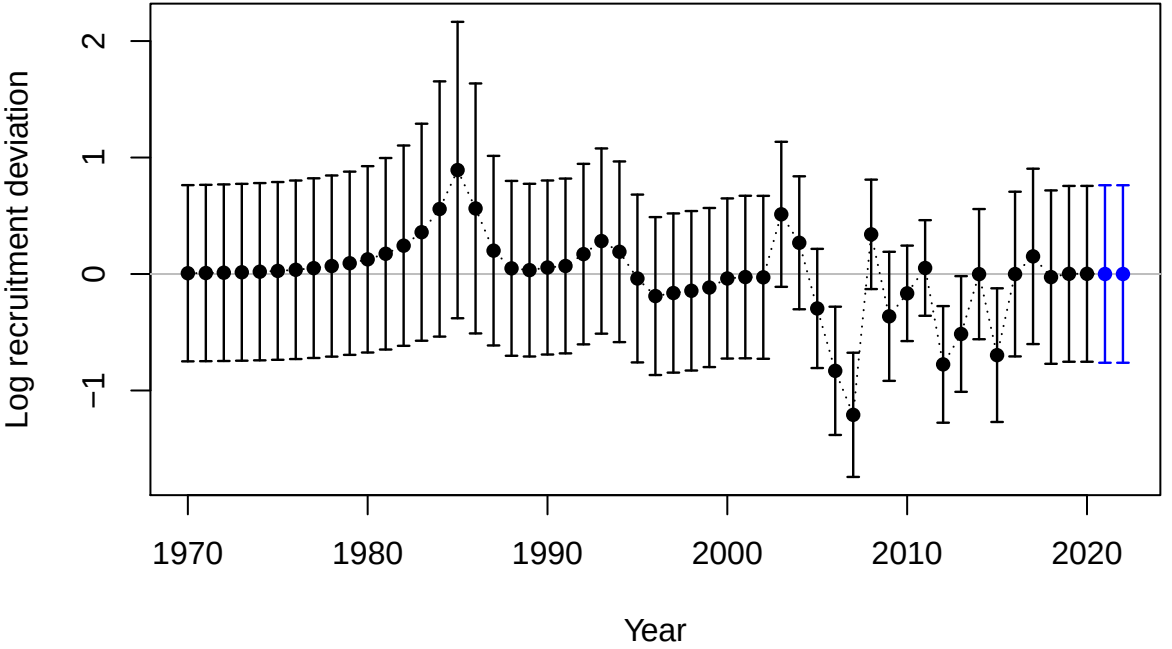

Age−0 recruits (1,000s)
0
1000
3000
5000
1970
1980
1990
2000
2010
2020
Year

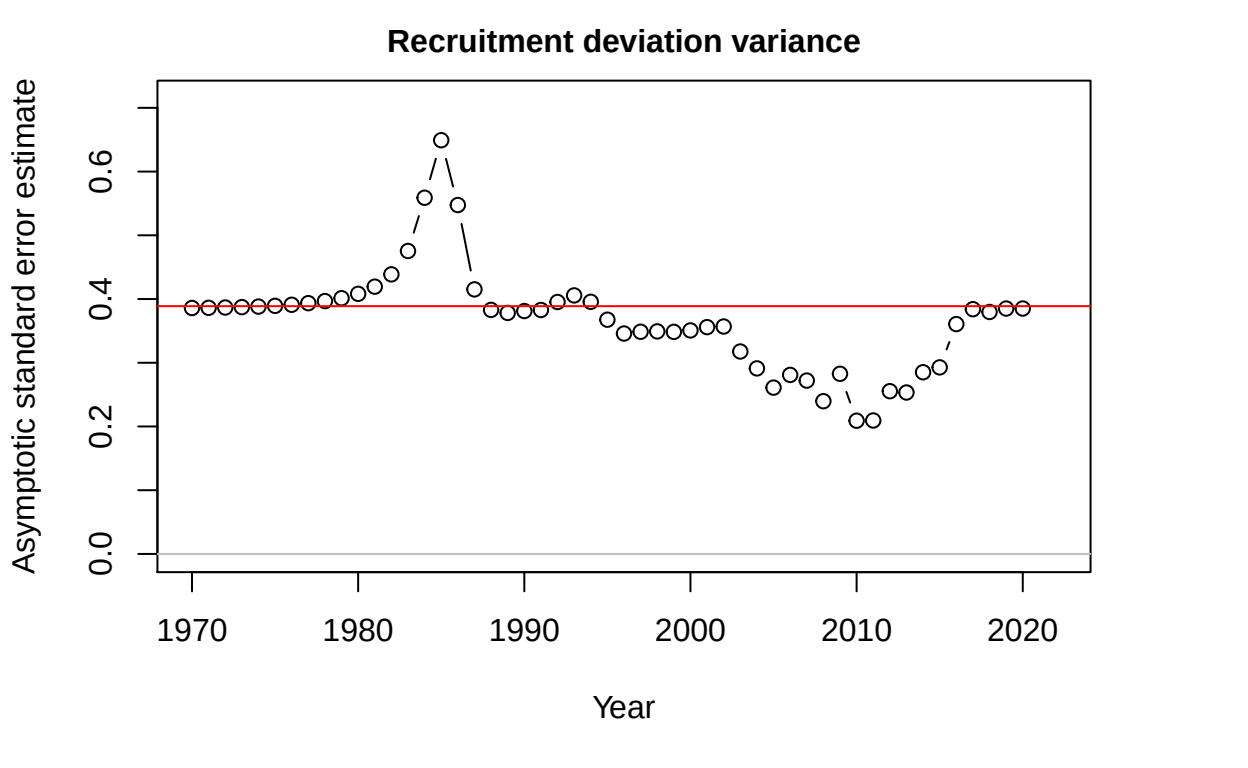

Age−0 recruits (1,000s)
0
5000
10000
15000
1970
1980
1990
2000
2010
2020
Year

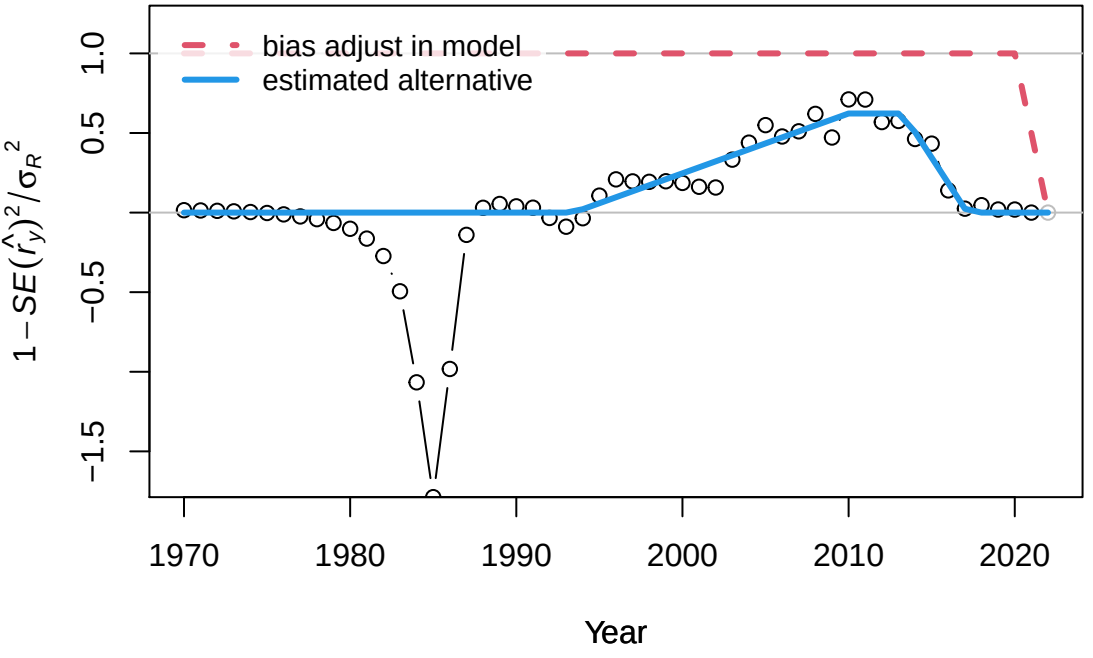

Summary Fishing Mortality
0.000
0.001
0.002
0.003
0.004
1970
1980
1990
2000
2010
2020
Year

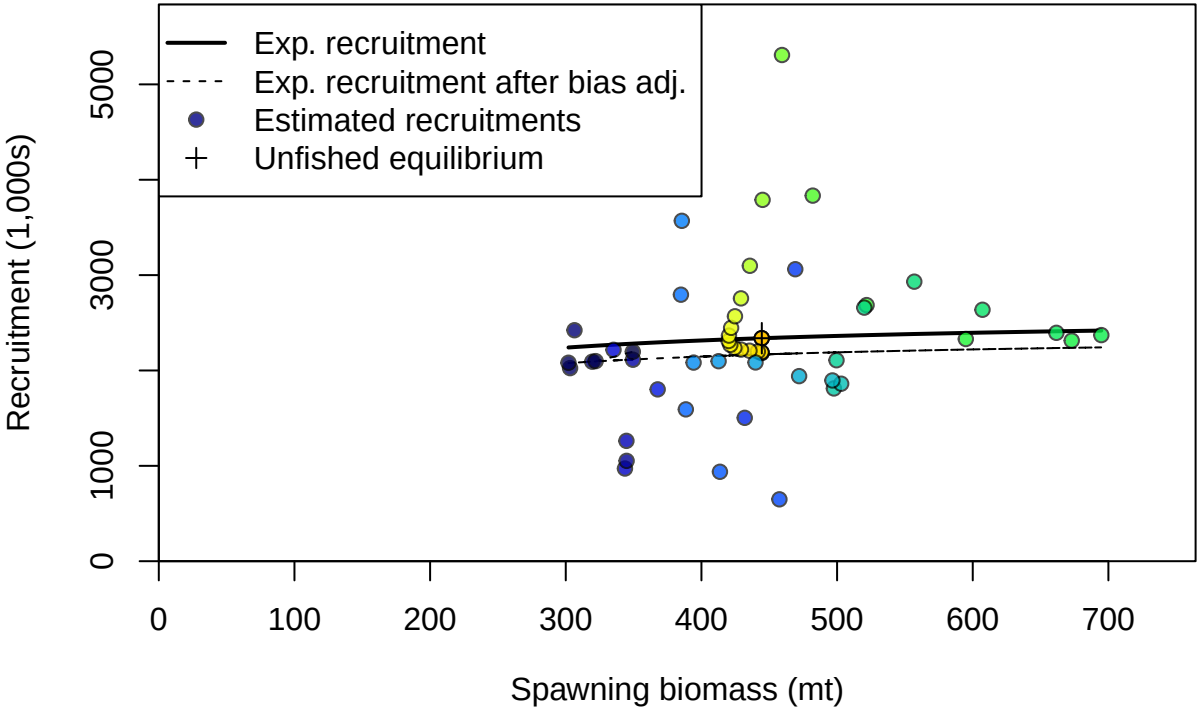

Spawning biomass (mt)
0
200
600
1000
1400
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

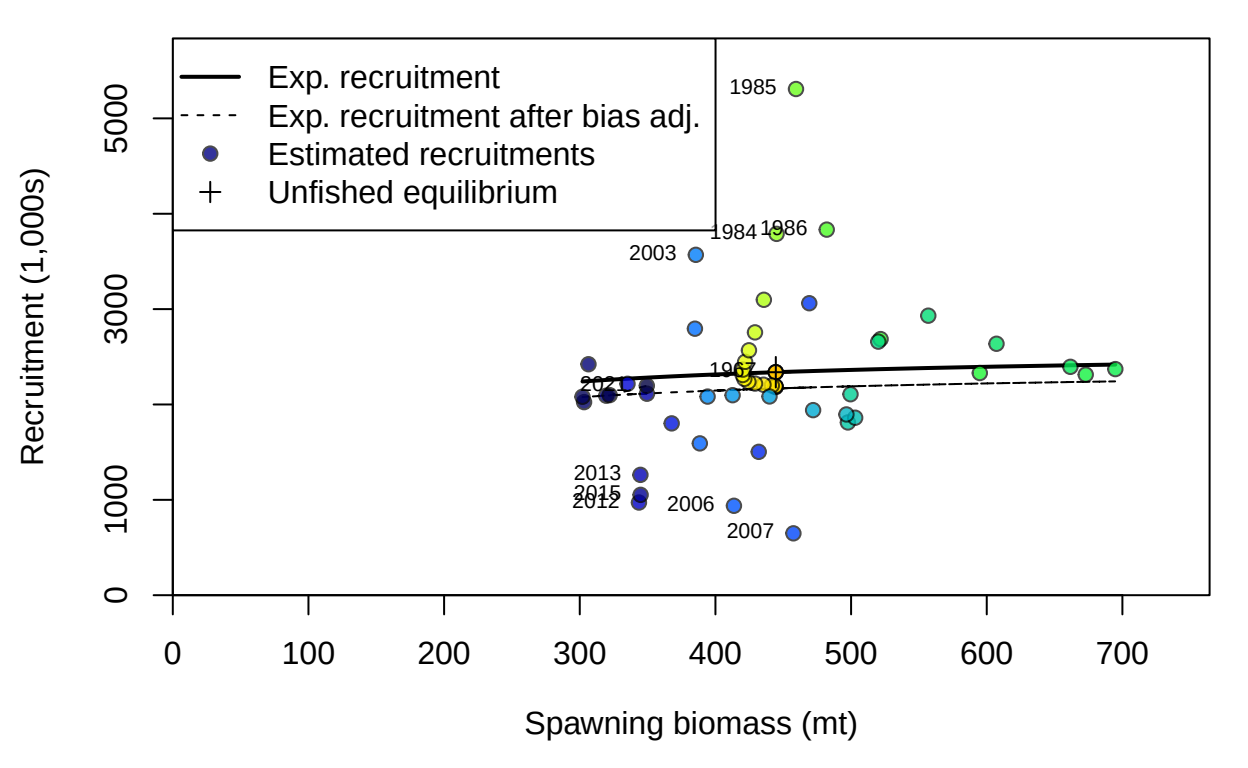

Log recruitment deviation
0.5
0.0
−0.5
−1.0
1970
1980
1990
2000
2010
2020
Year

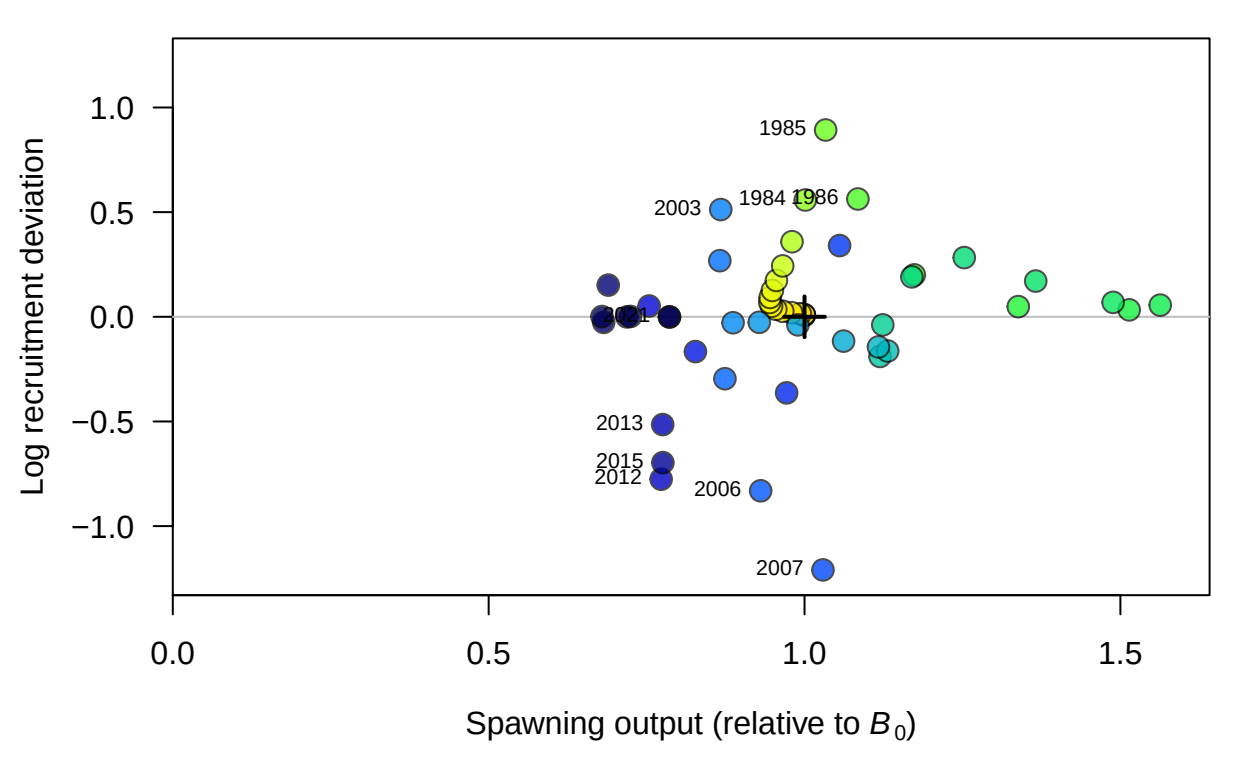

Log recruitment deviation
2
1
0
−1
1970
1980
1990
2000
2010
2020
Year

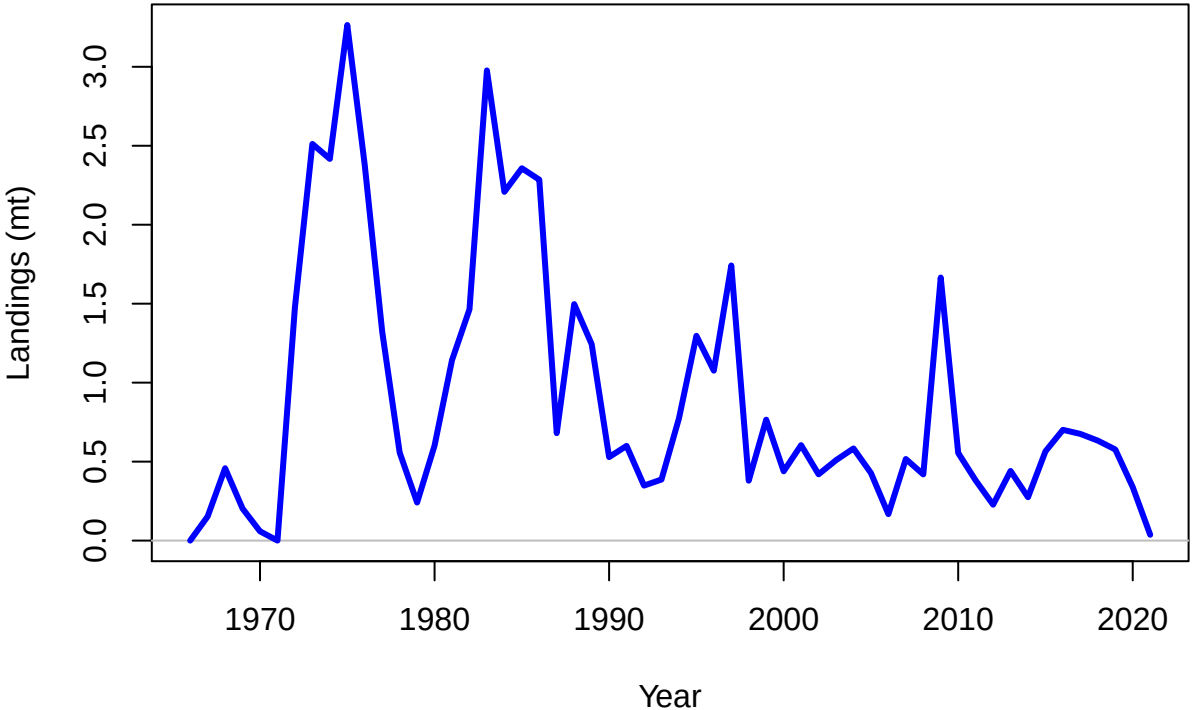

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

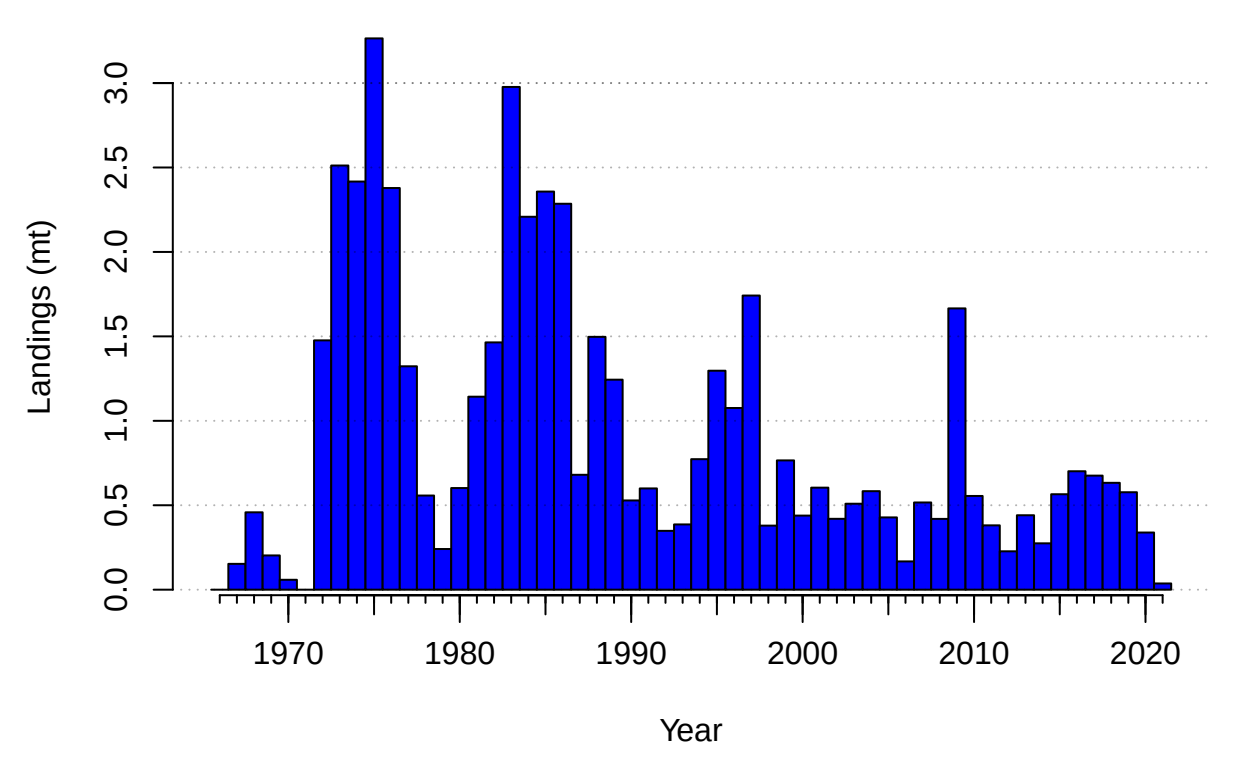

bias adjust in model
estimated alternative
1.0
0.5
−0.5
−1.5
1970
1980
1990
2000
2010
2020
Year
$1 - SE(\hat{r}_y)^2/\sigma_R{}^2$

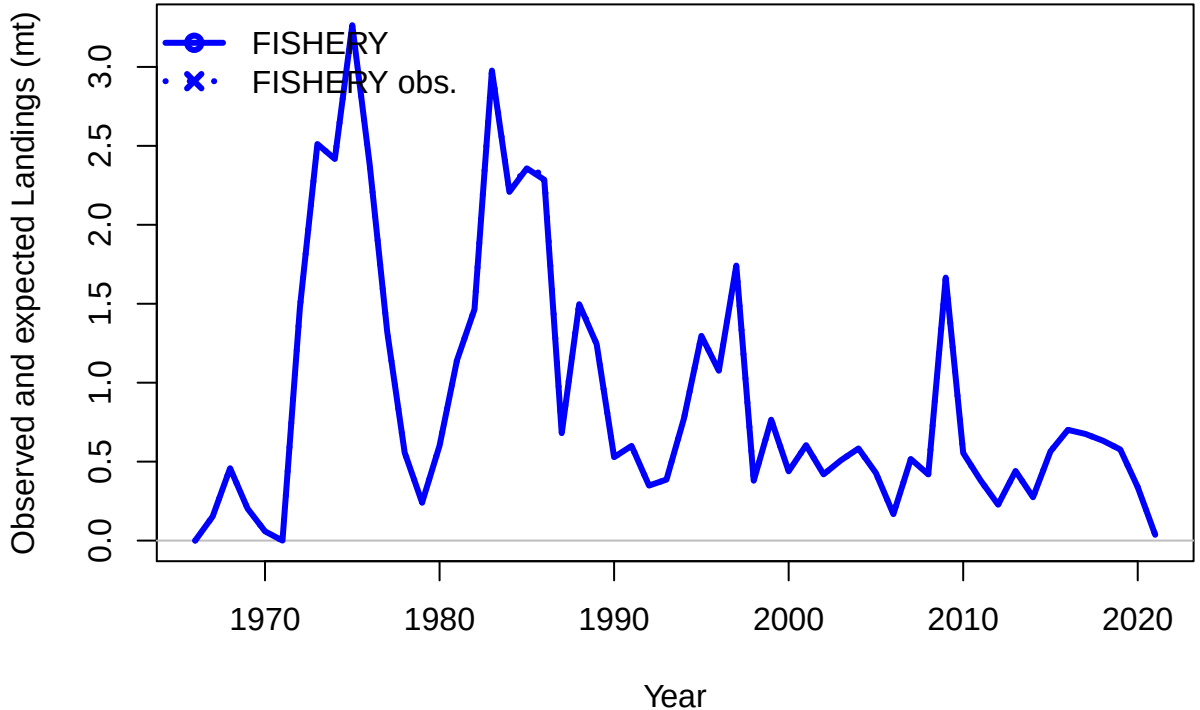

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
1000
3000
5000
0
100
200
300
400
500
600
700
Spawning biomass (mt)

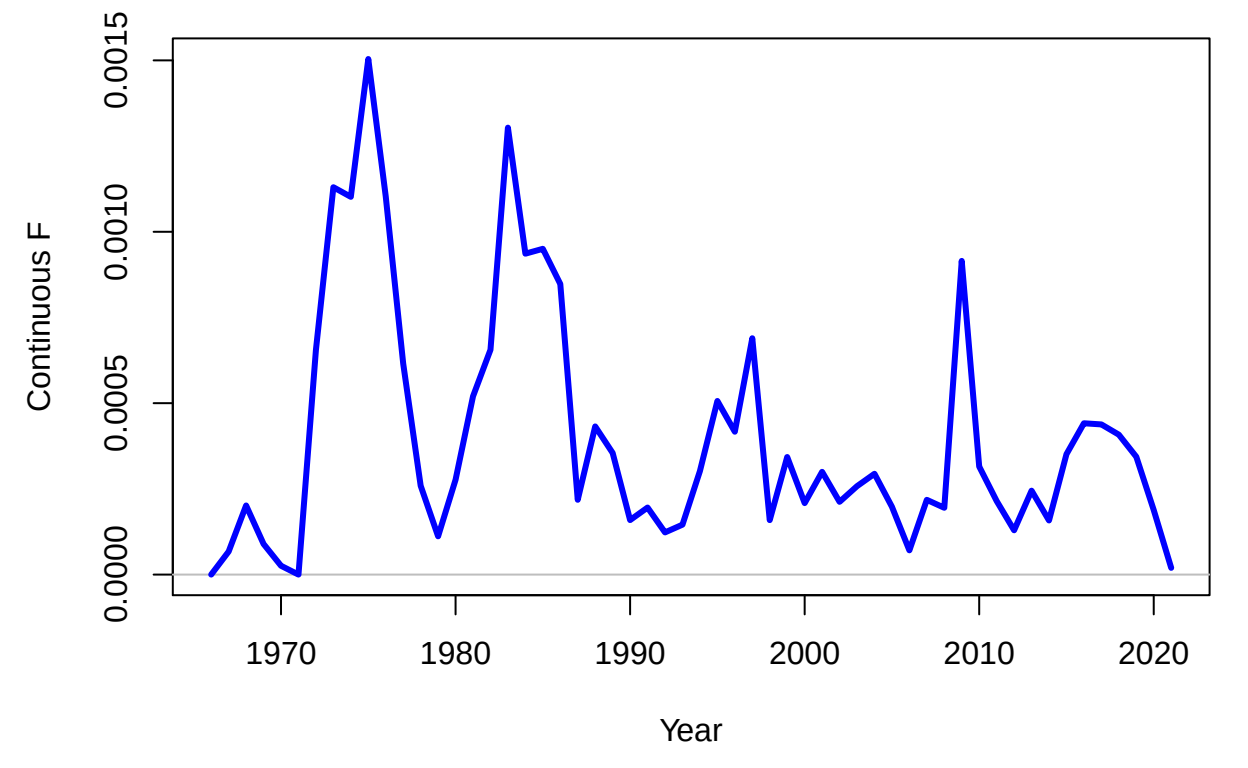

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
1000
3000
5000
0
100
200
300
400
500
600
700
Spawning biomass (mt)
1985
1984
1986
2003
2013
2015
2012
2006
2007

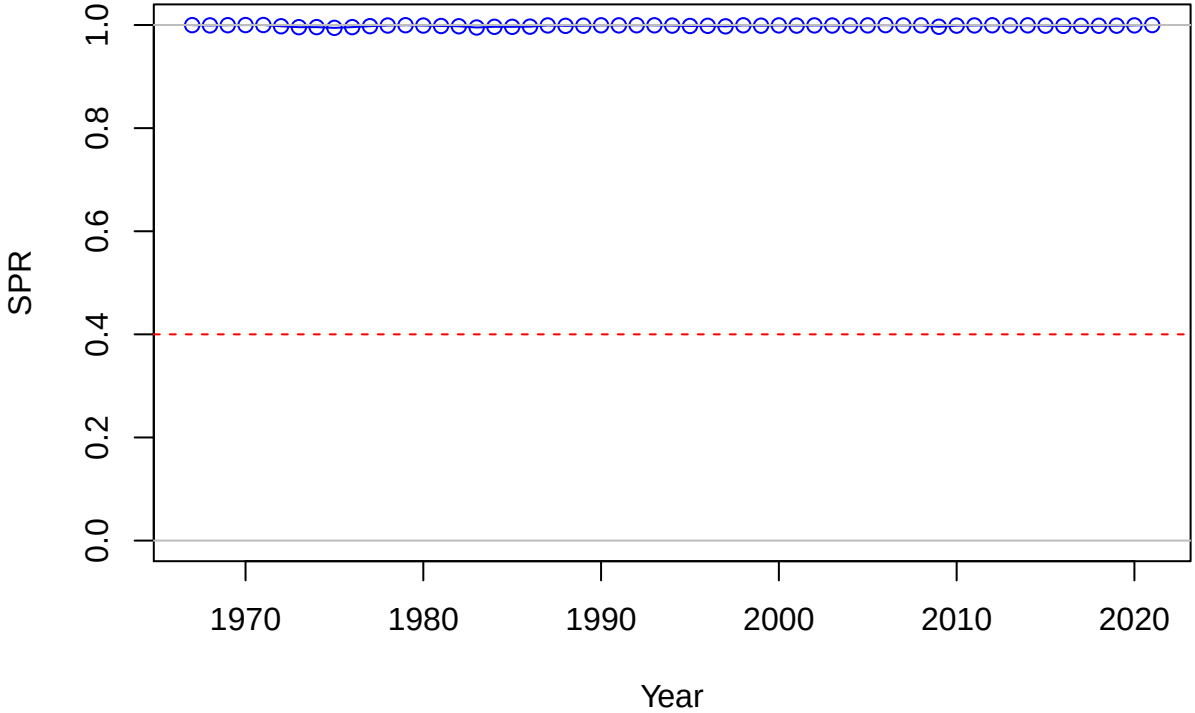

1.0
0.5
0.0
−0.5
−1.0
Log recruitment deviation
1985
2003
1984 1986
2021
2013
2015
2012
2006
2007
0.0
0.5
1.0
1.5
Spawning output (relative to B_0)

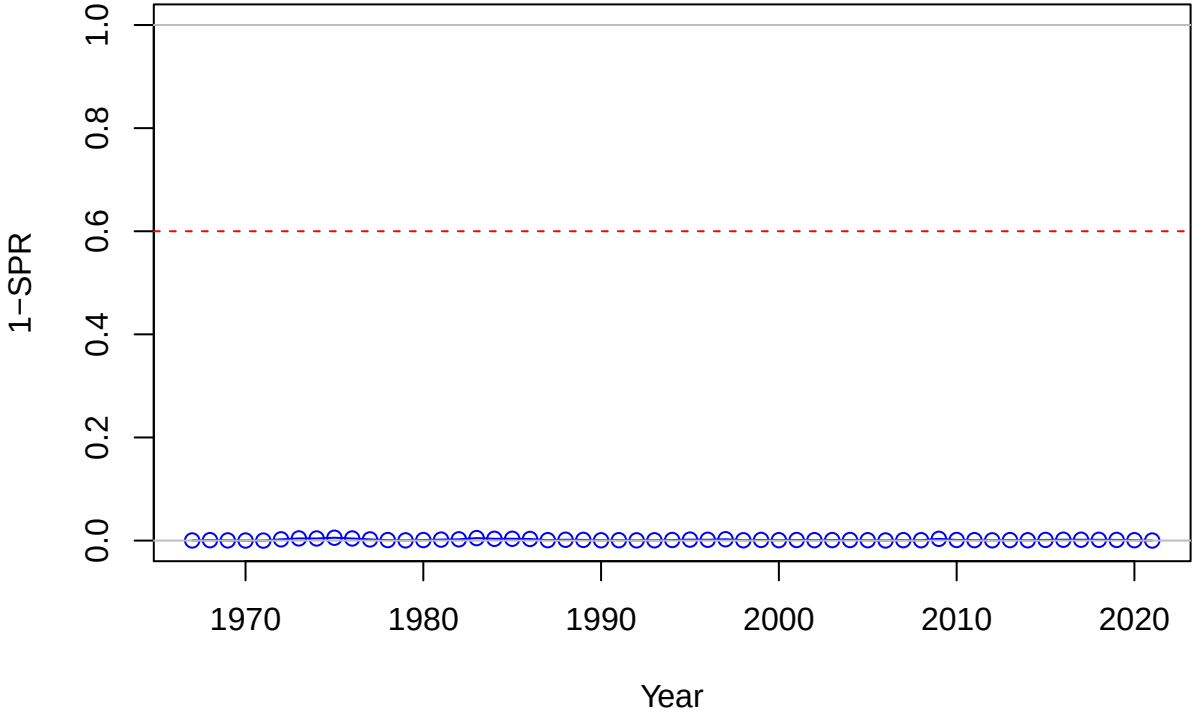

Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

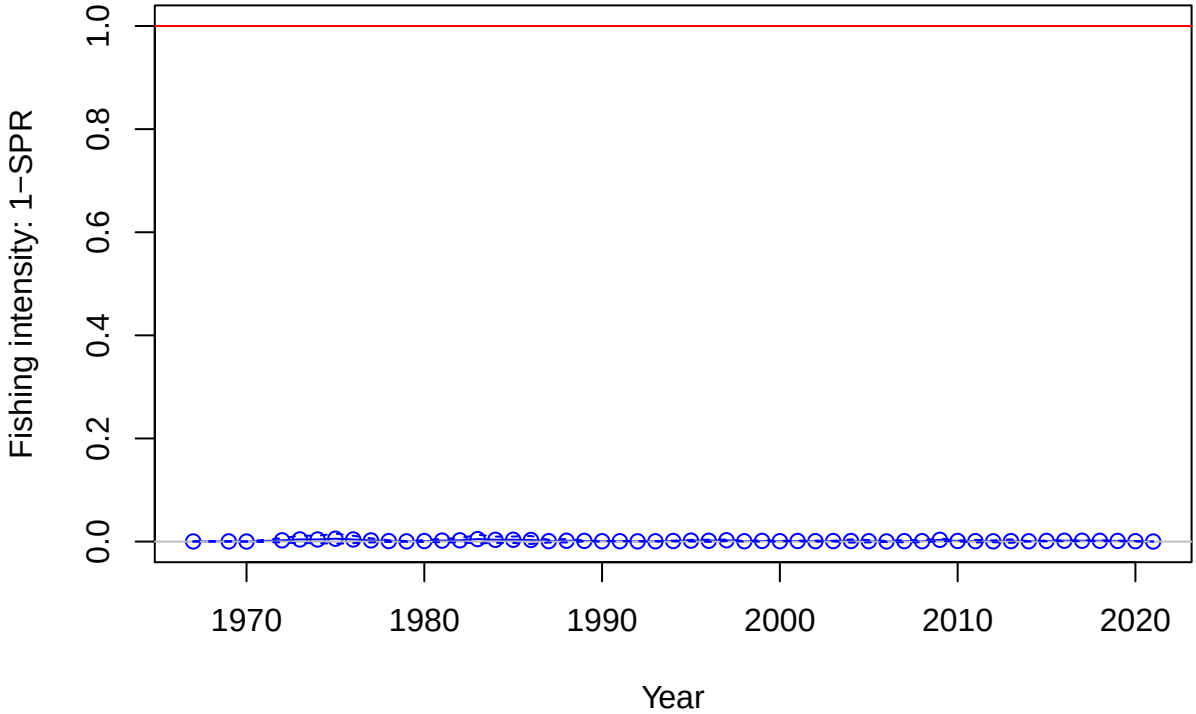

Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

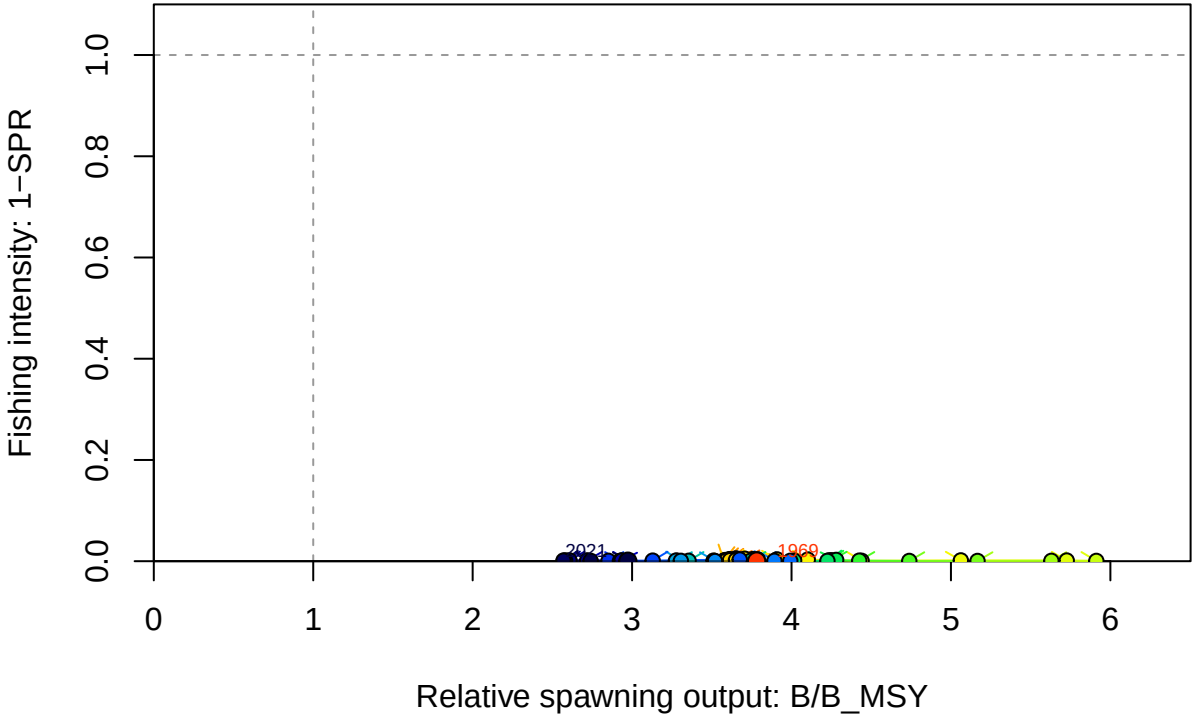

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

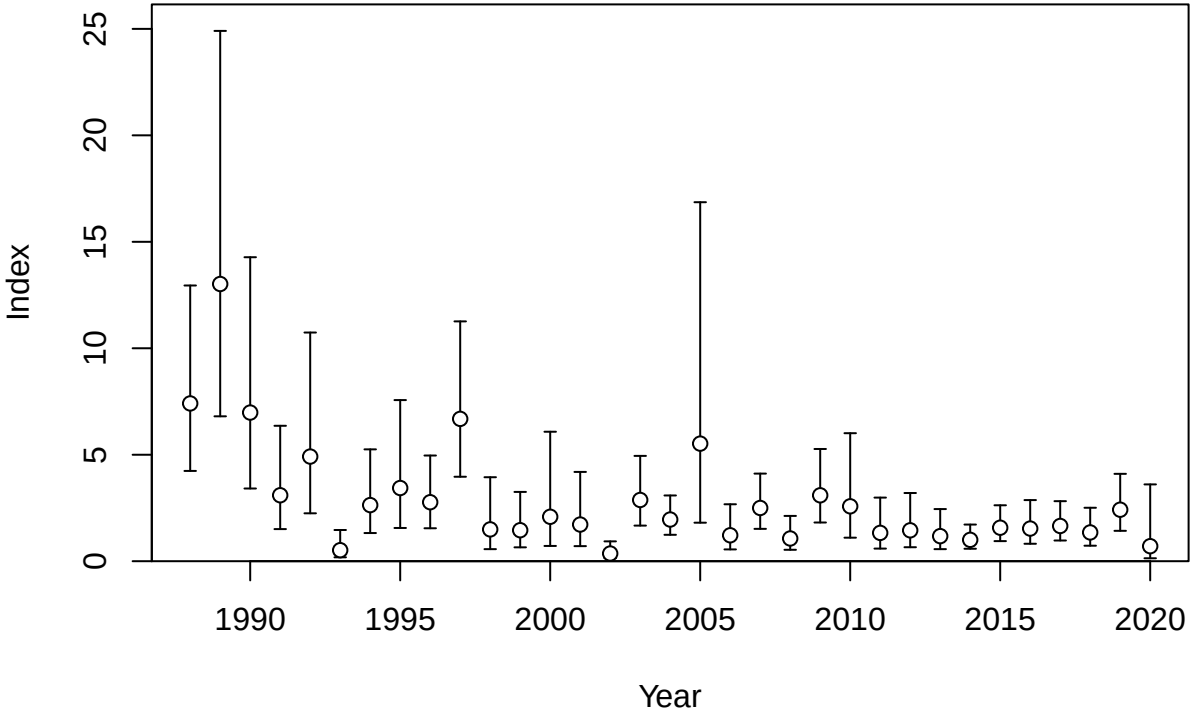

Continuous F
0.0000
0.0005
0.0010
0.0015
1970
1980
1990
2000
2010
2020
Year

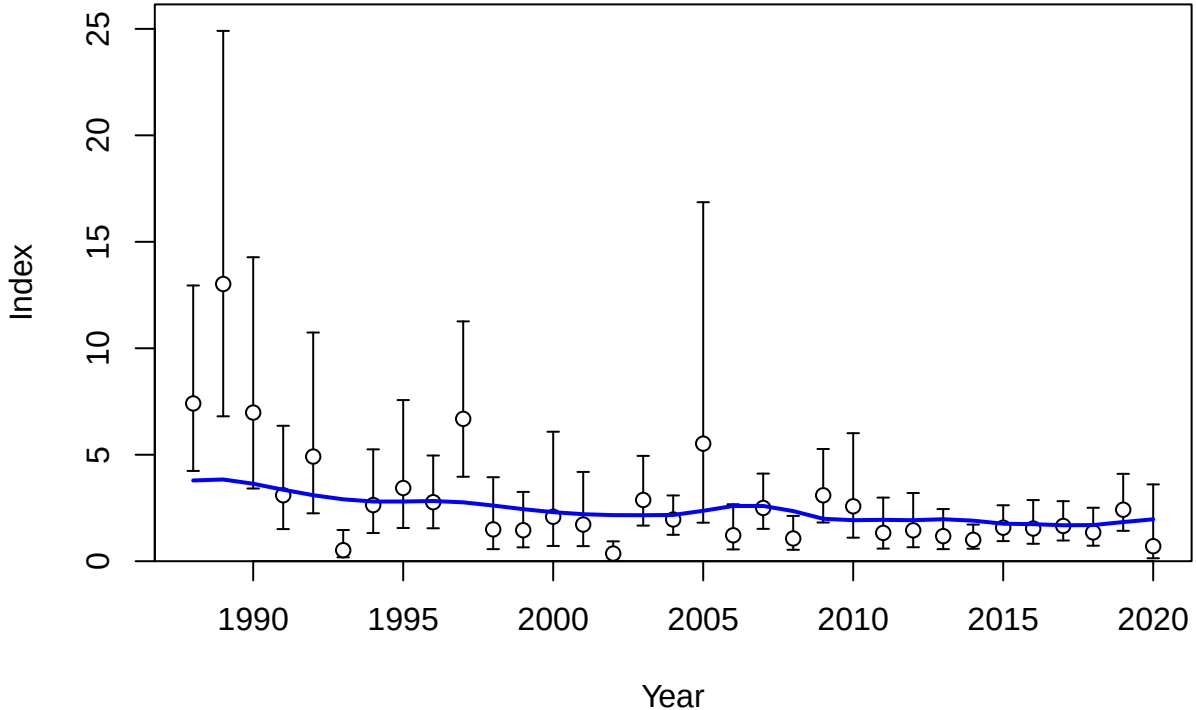

SPR
1.0
0.8
0.6
0.4
0.2
0.0
1970
1980
1990
2000
2010
2020
Year

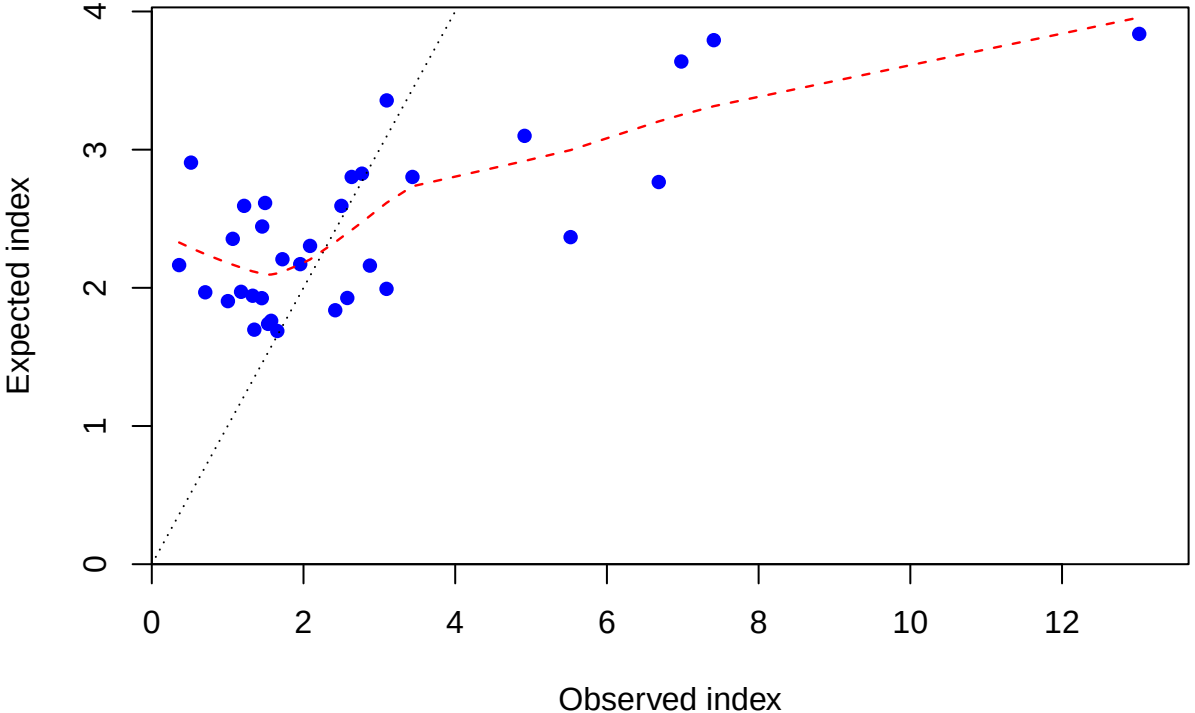

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

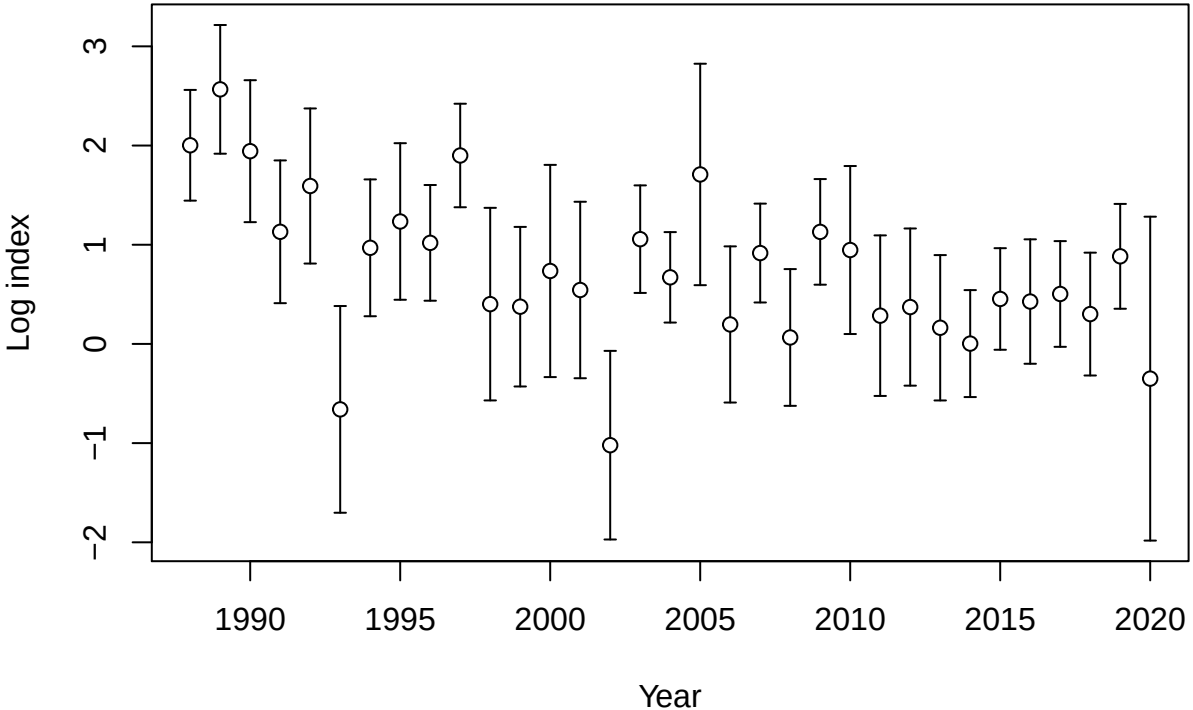

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

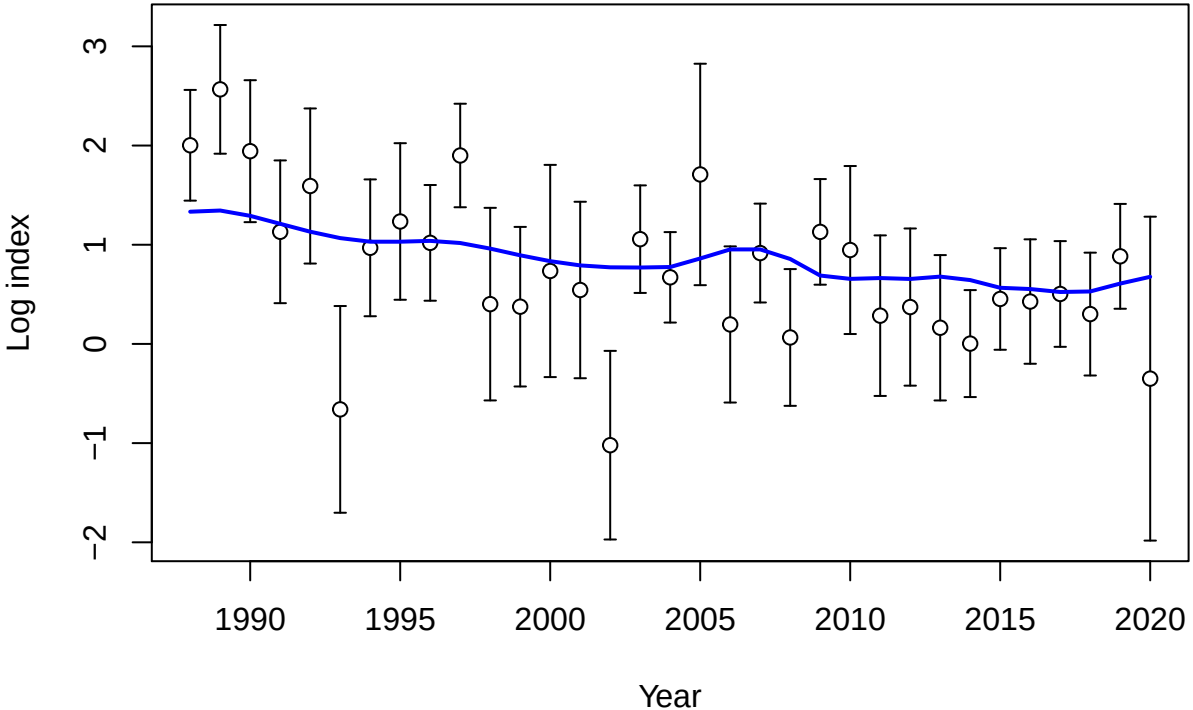

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
5
6
Relative spawning output: B/B_MSY
2021
1960

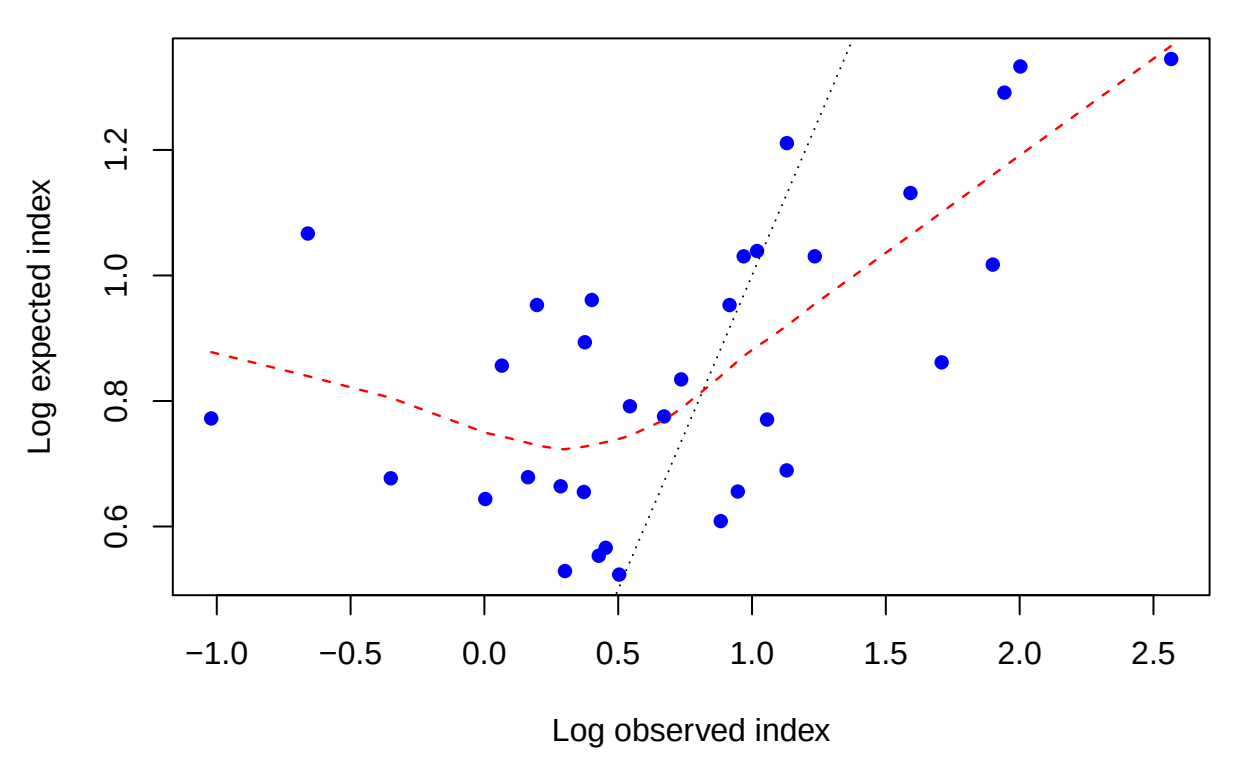

Index
0
5
10
15
20
25
1990
1995
2000
2005
2010
2015
2020
Year

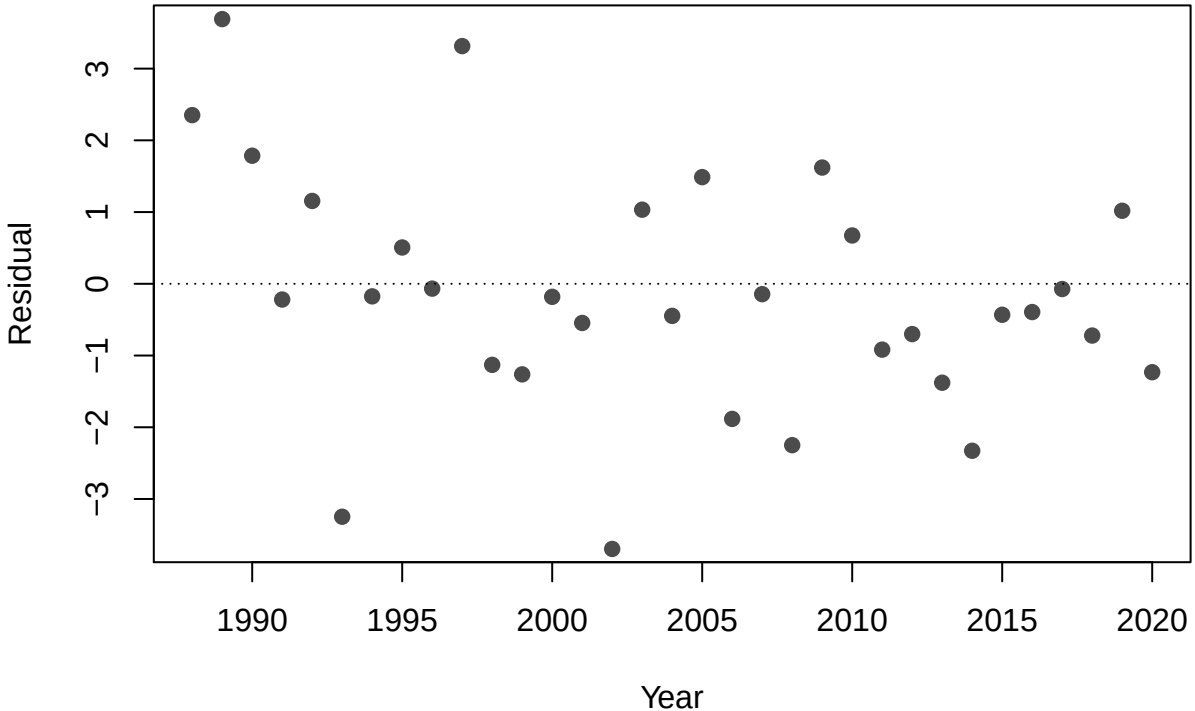

Index
0
5
10
15
20
25
1990
1995
2000
2005
2010
2015
2020
Year

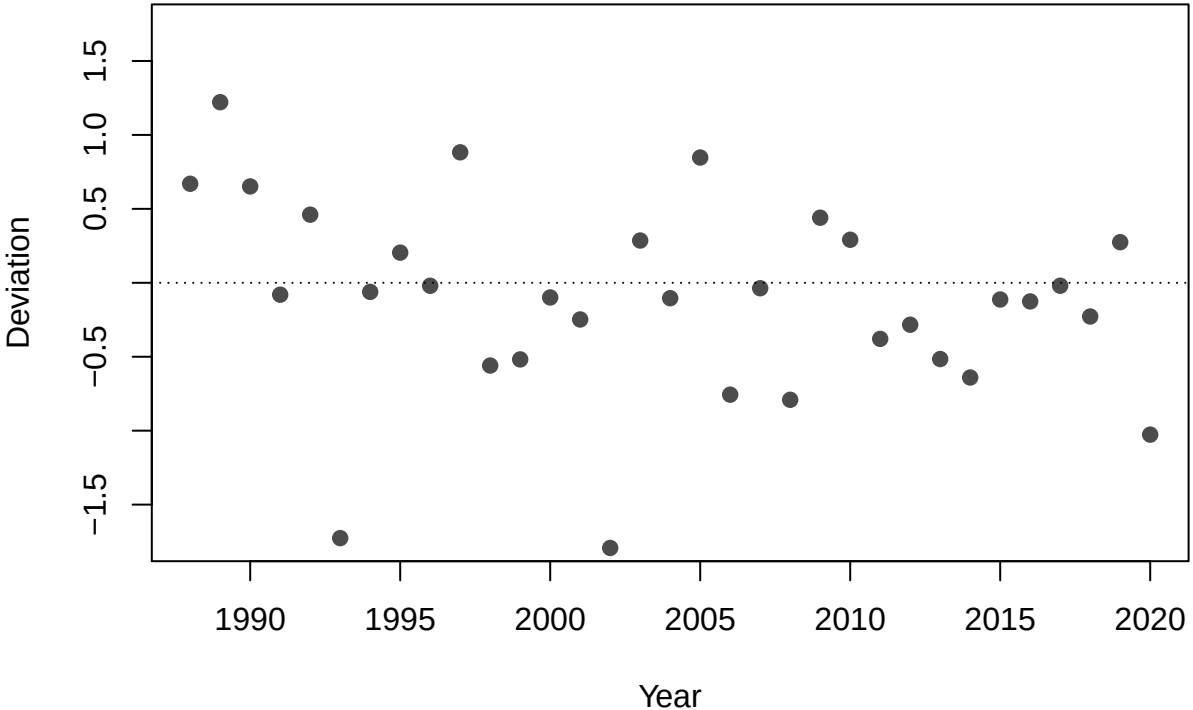

Expected index
Observed index
0
1
2
3
4
0
2
4
6
8
10
12

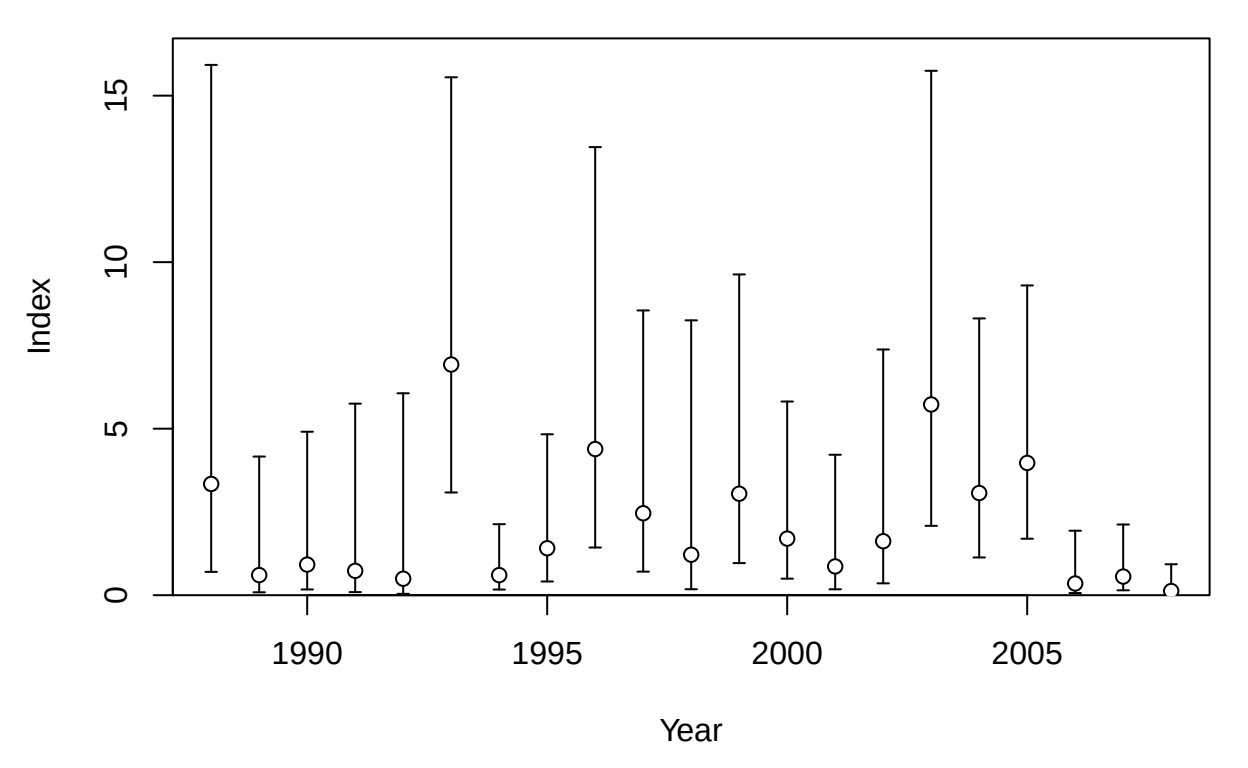

Log index
3
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

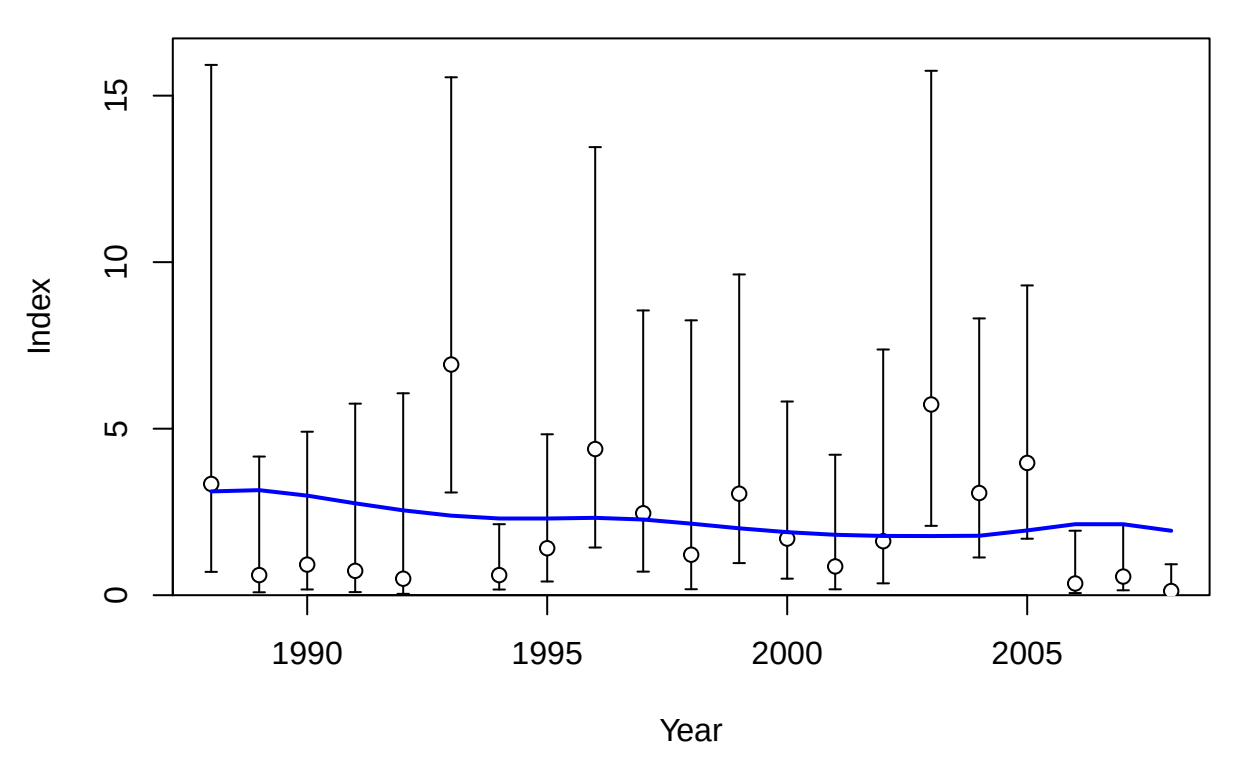

Log index
3
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

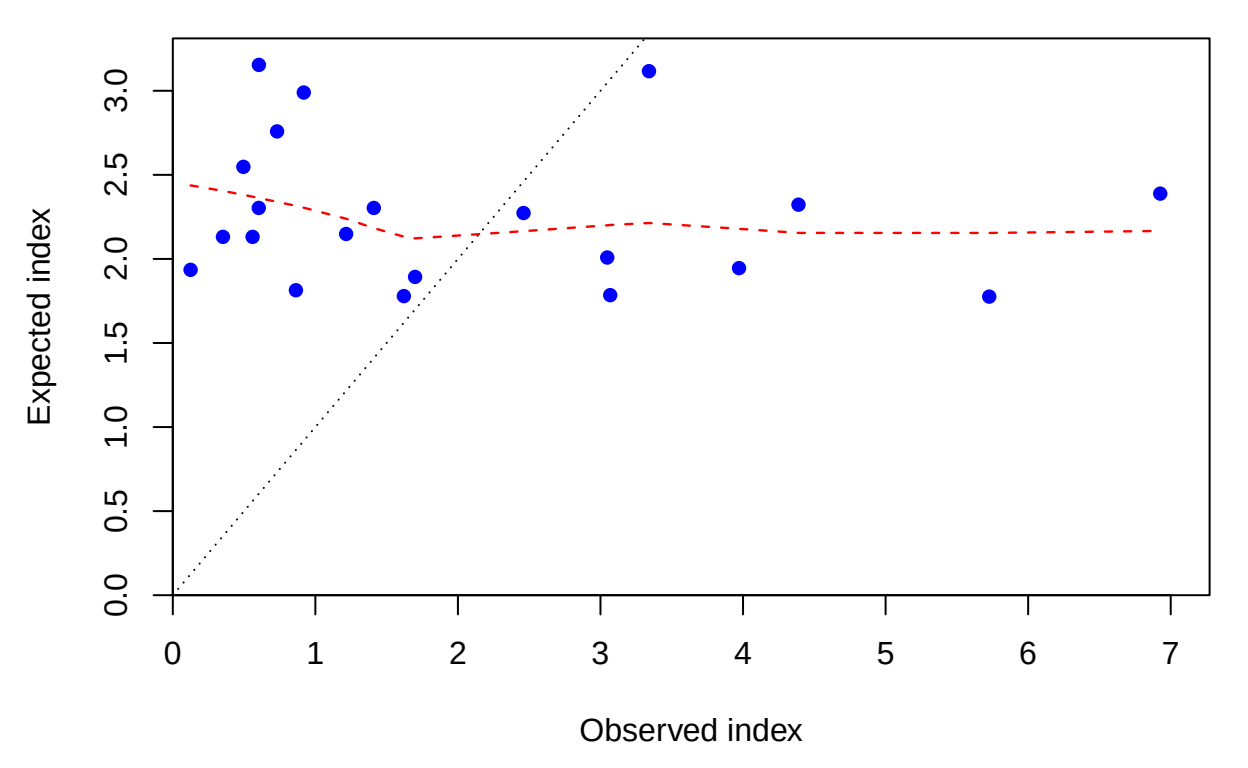

Log expected index
0.6
0.8
1.0
1.2
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
2.5
Log observed index

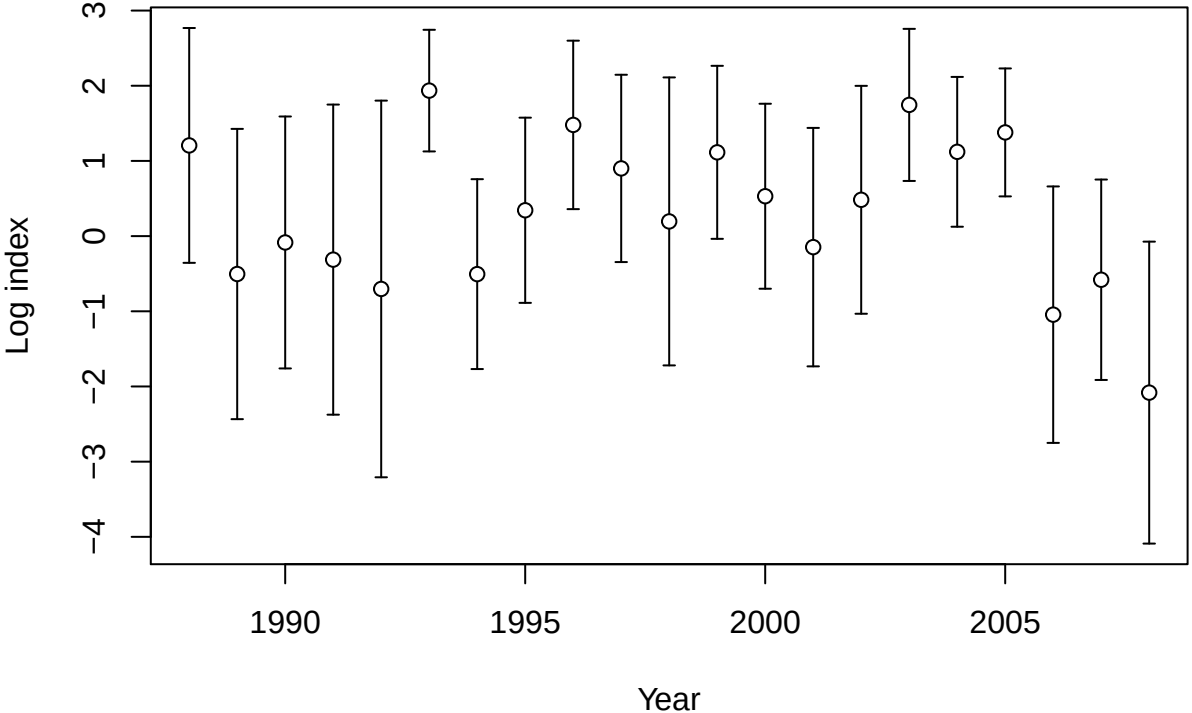

Residual
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
2010
2015
2020
Year

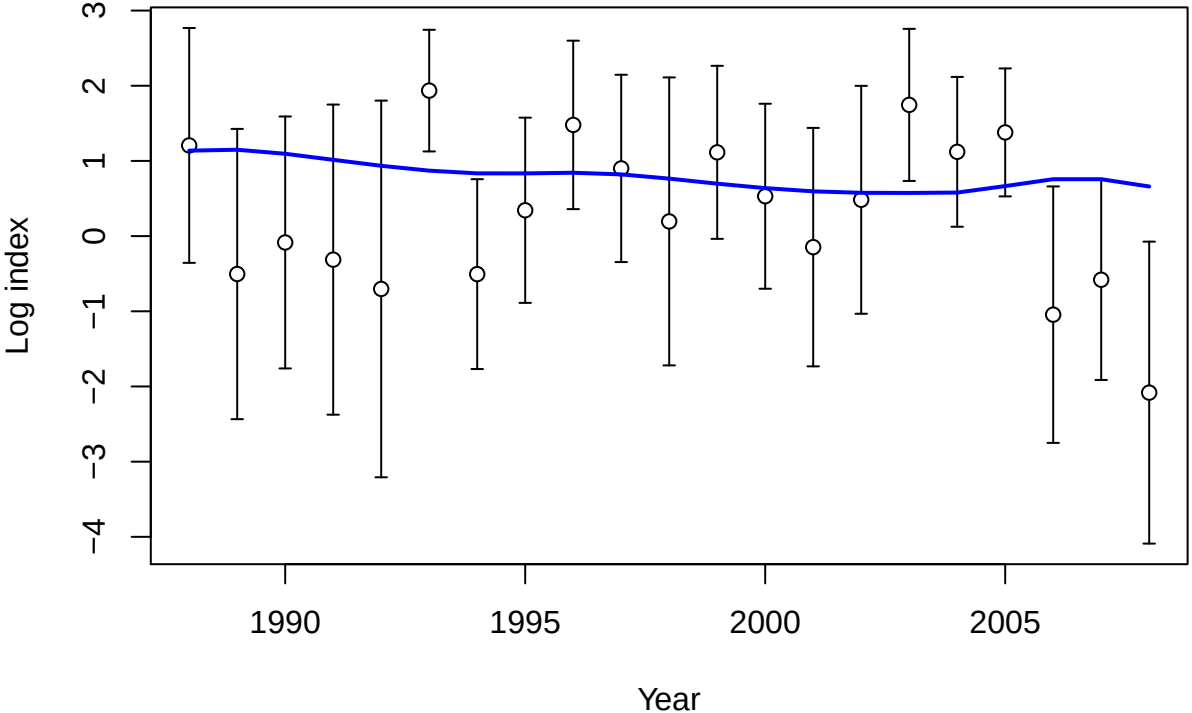

Deviation
1.5
1.0
0.5
−0.5
−1.5
1990
1995
2000
2005
2010
2015
2020
Year

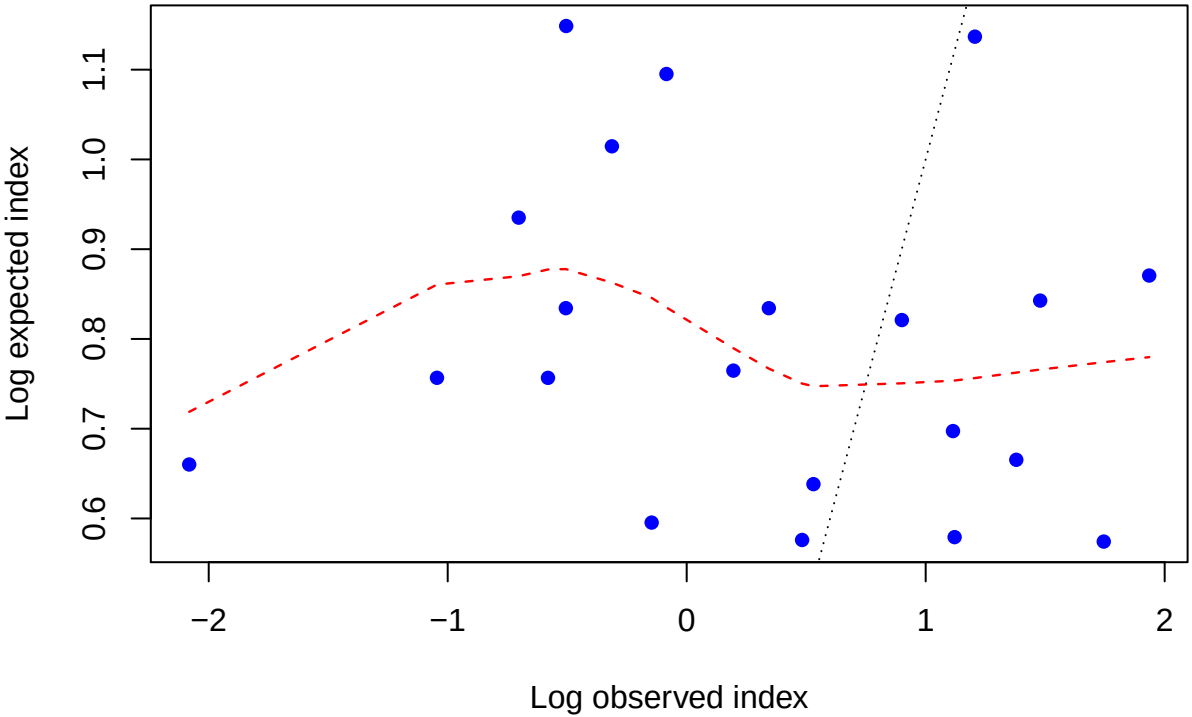

Index
0
5
10
15
1990
1995
2000
2005
Year

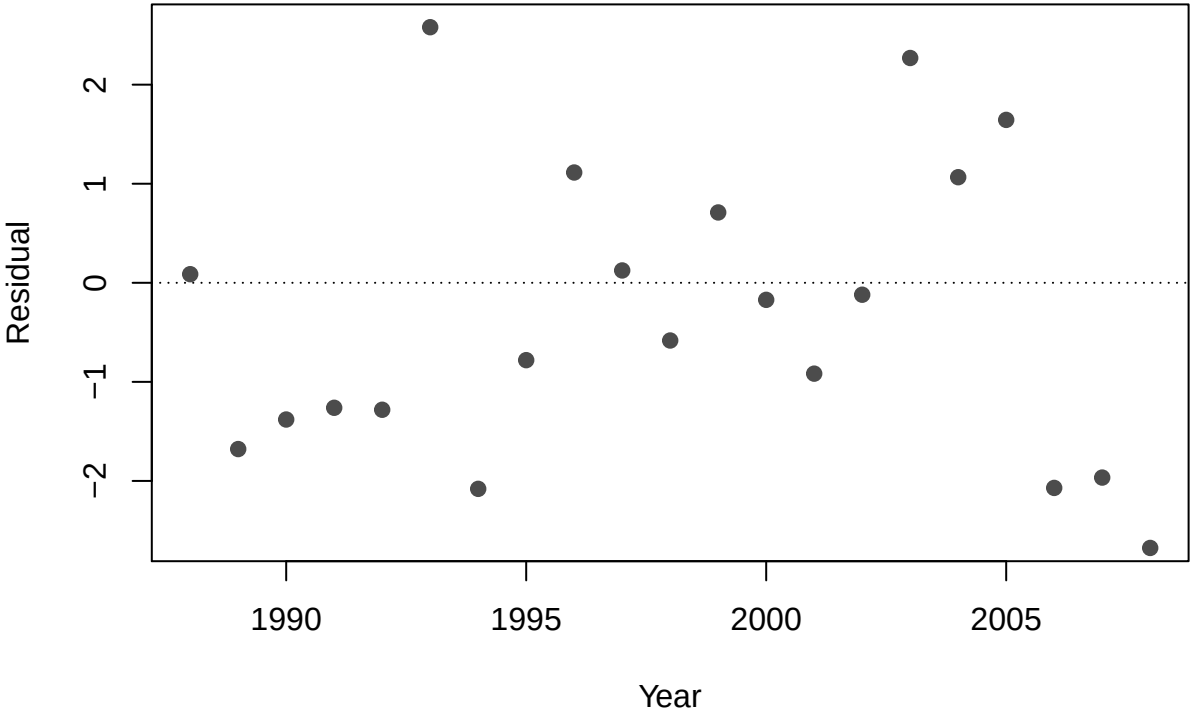

Index
0
5
10
15
1990
1995
2000
2005
Year

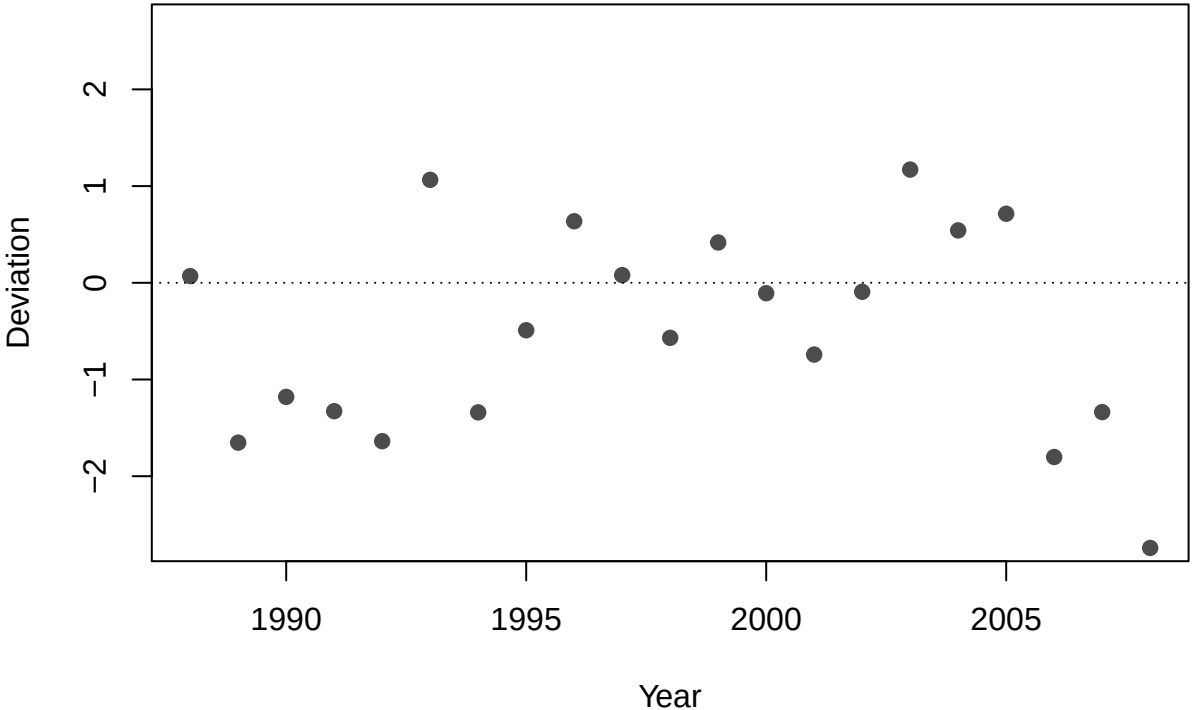

Expected index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
1
2
3
4
5
6
7
Observed index

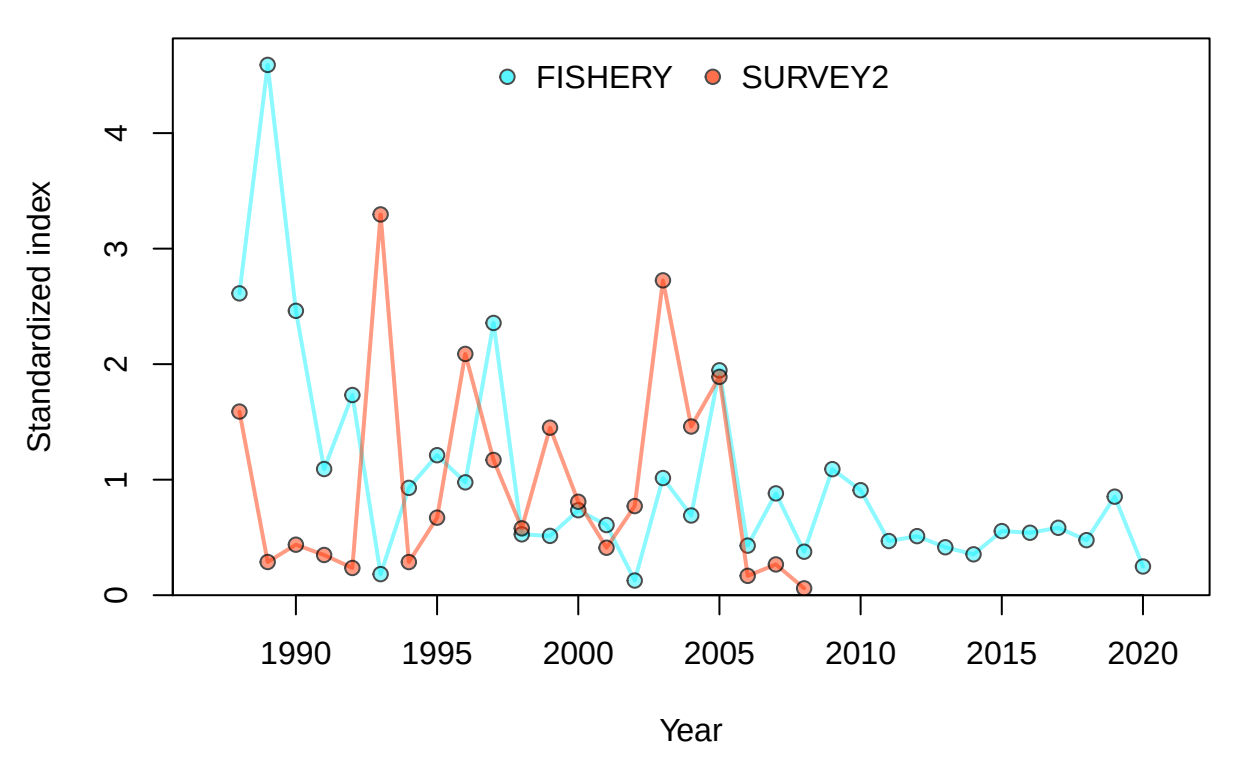

Log index
3
2
1
0
−1
−2
−3
−4
1990
1995
2000
2005
Year

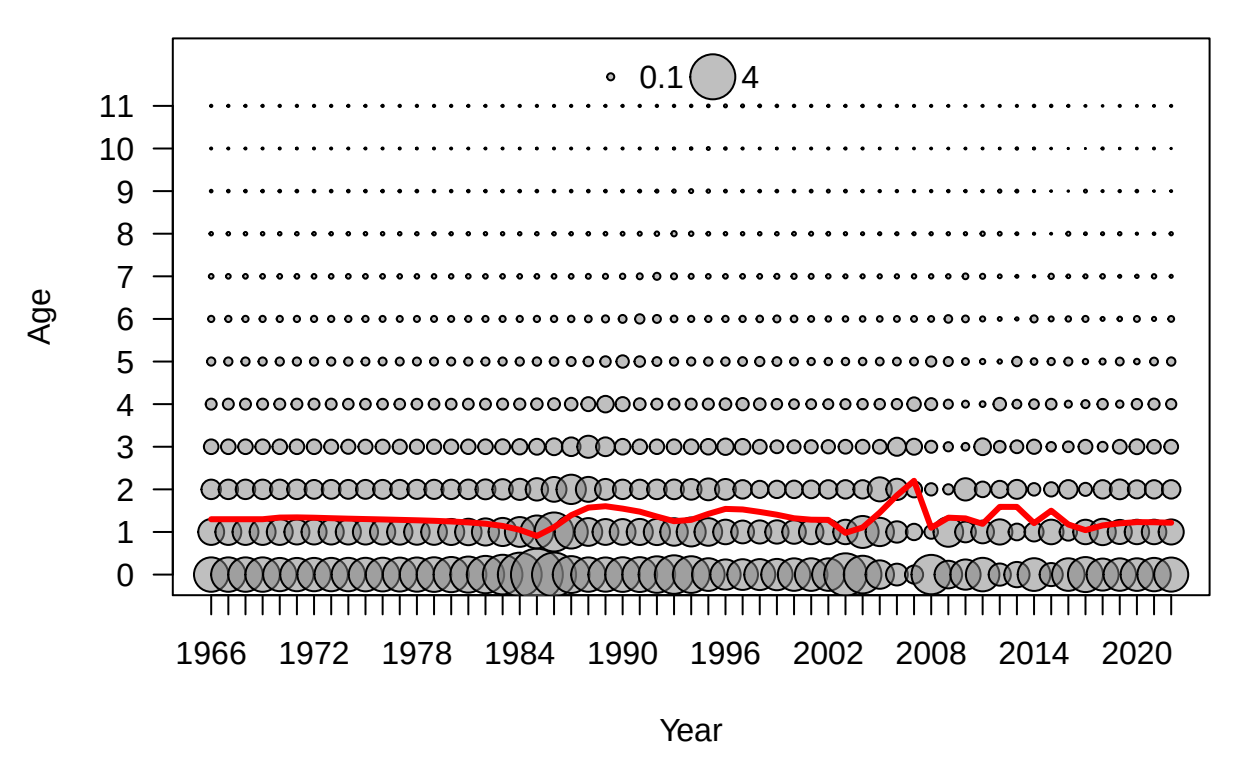

Log index
3
2
1
0
−1
−2
−3
−4
1990
1995
2000
2005
Year

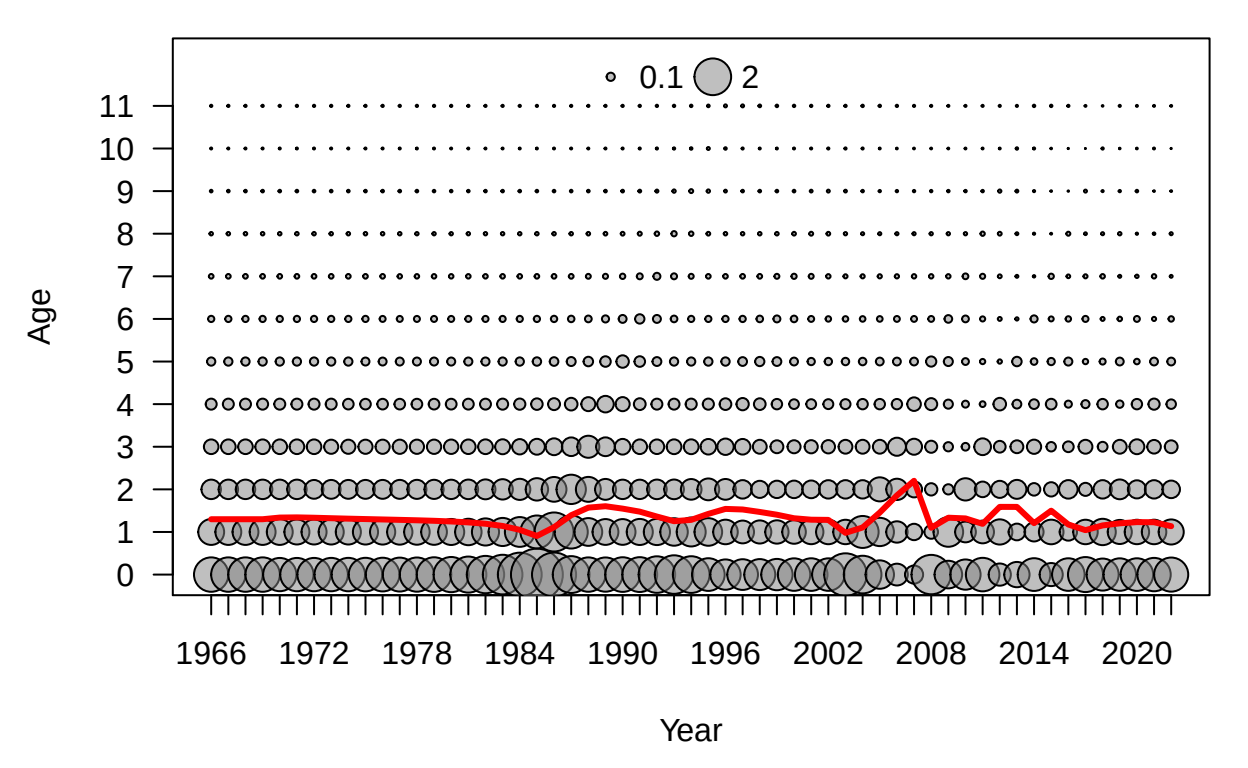

Log expected index
0.6
0.7
0.8
0.9
1.0
1.1
−2
−1
0
1
2
Log observed index

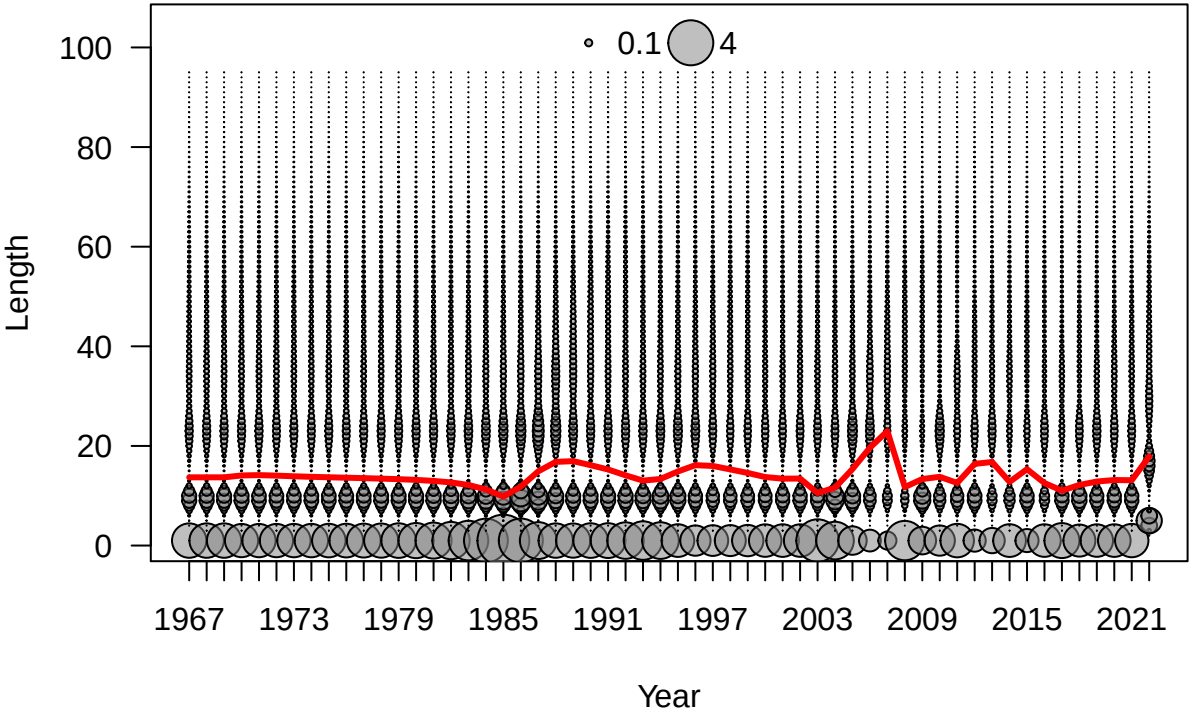

Residual
2
1
0
−1
−2
1990
1995
2000
2005
Year

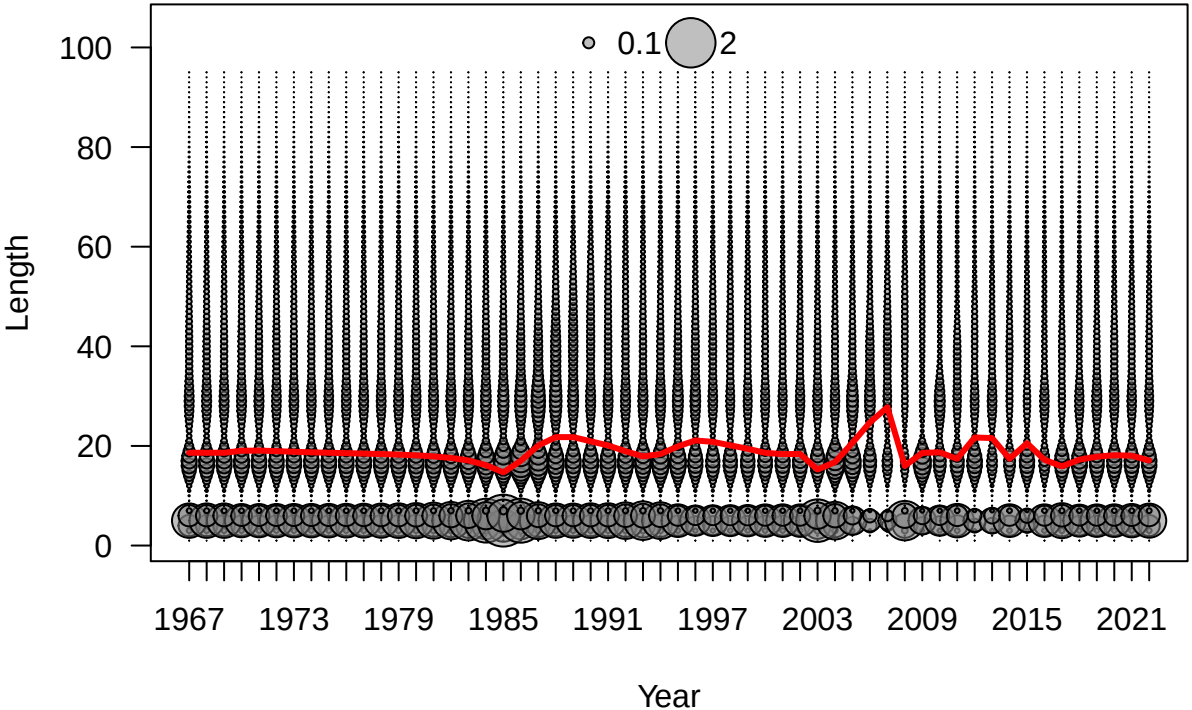

Deviation
2
1
0
−1
−2
1990
1995
2000
2005
Year

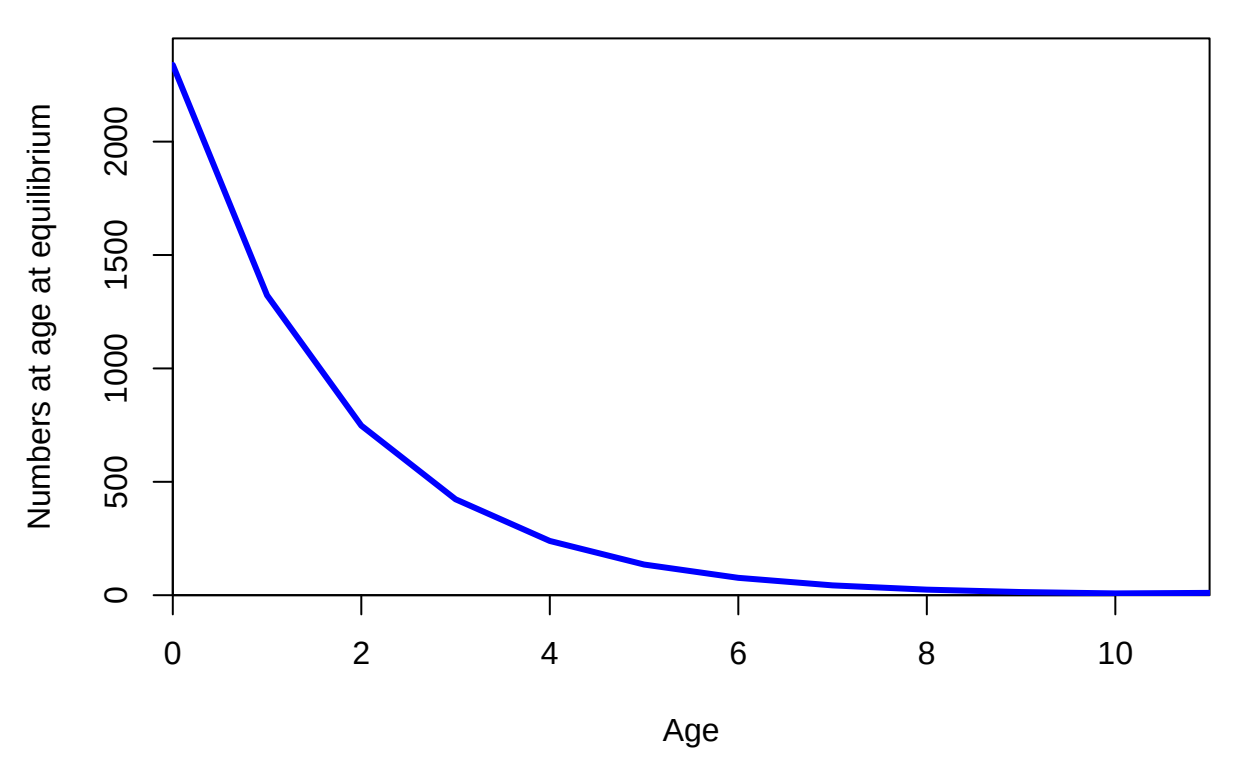

FISHERY
SURVEY2
Standardized index
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

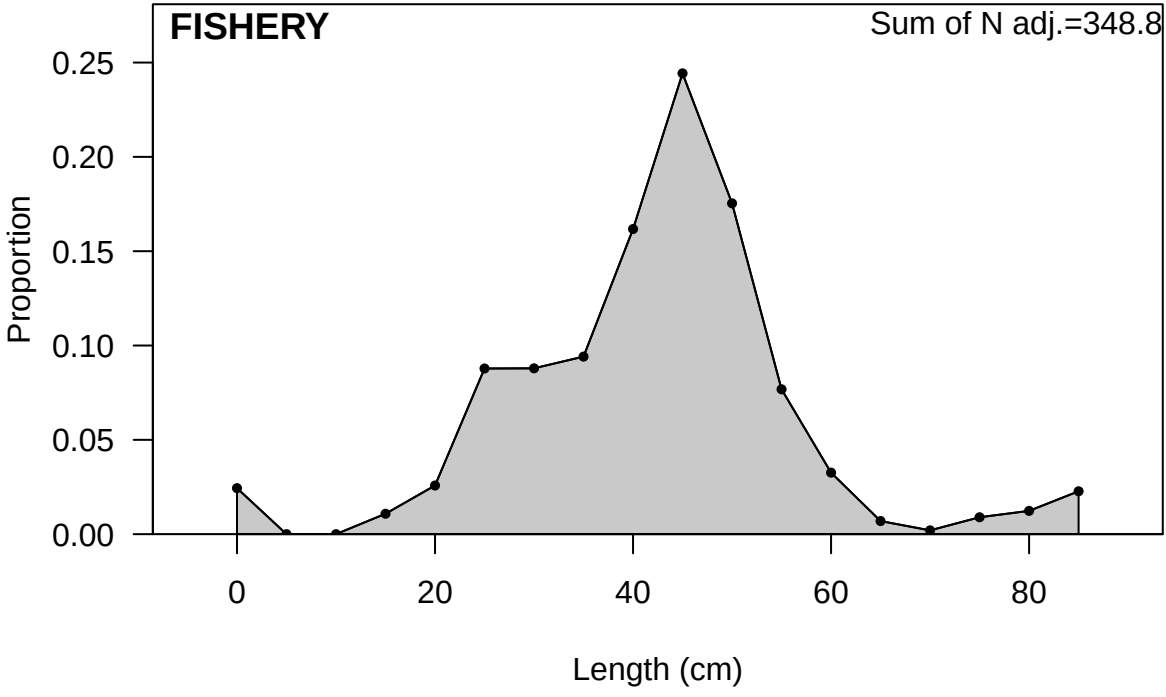

0.1
4
Age
11
10
9
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

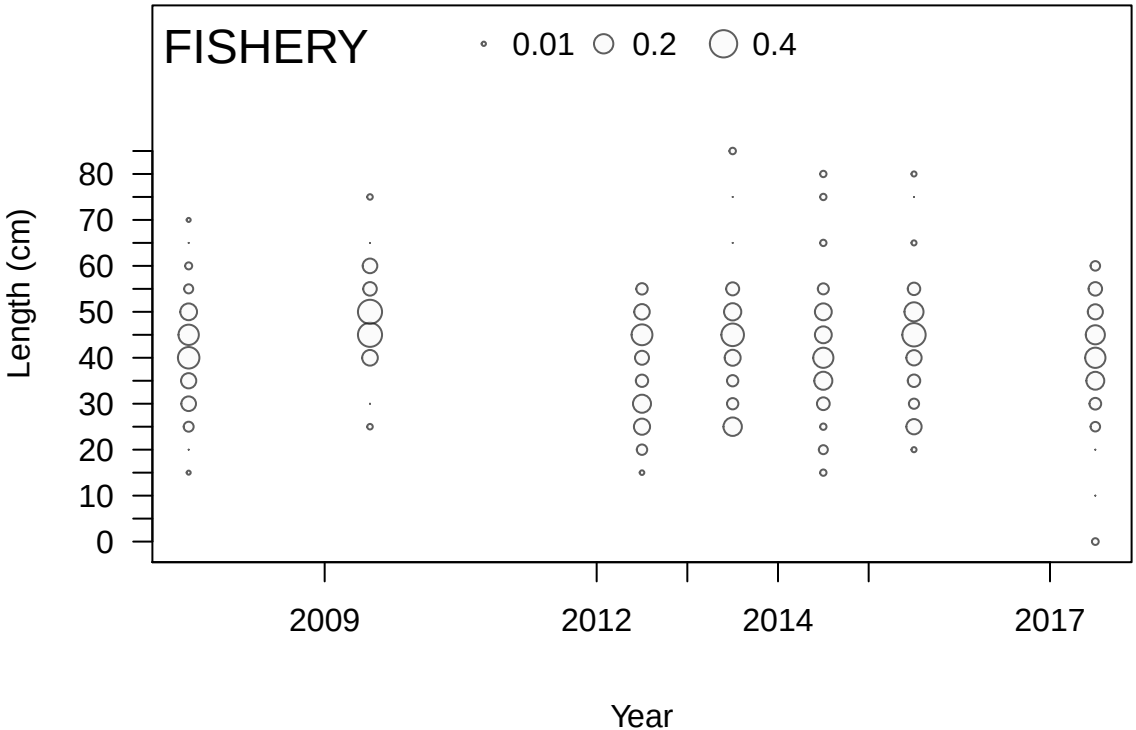

0.1
2
Age
11
10
9
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

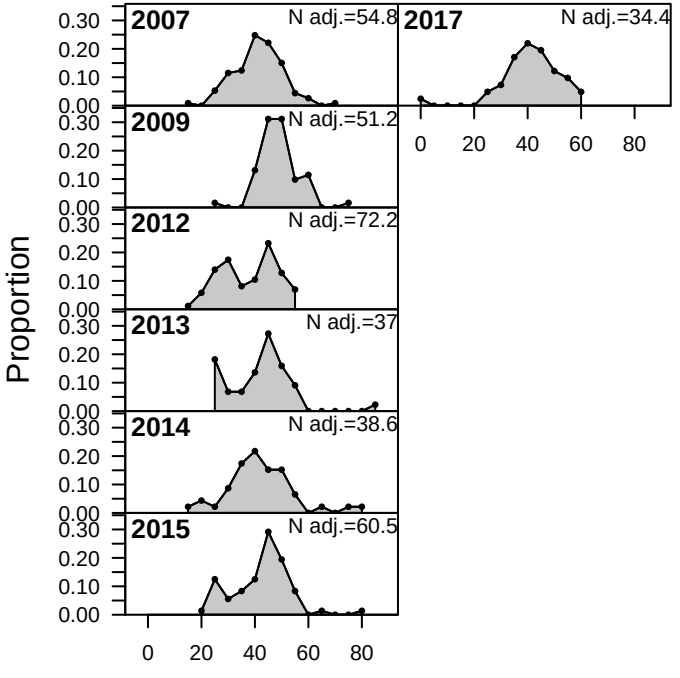

0.1
4
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

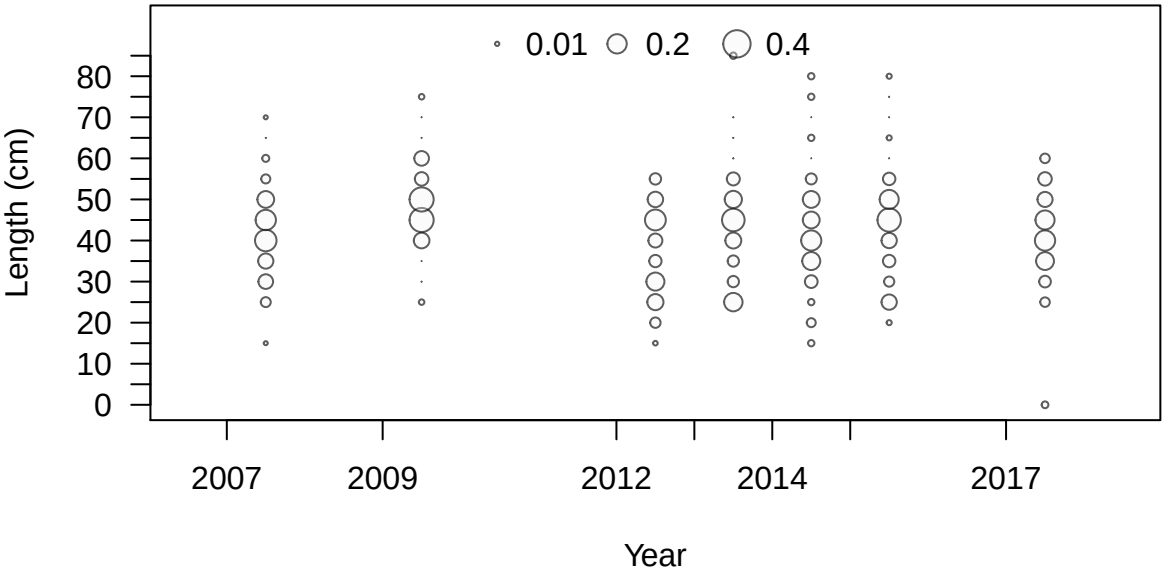

0.1
2
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

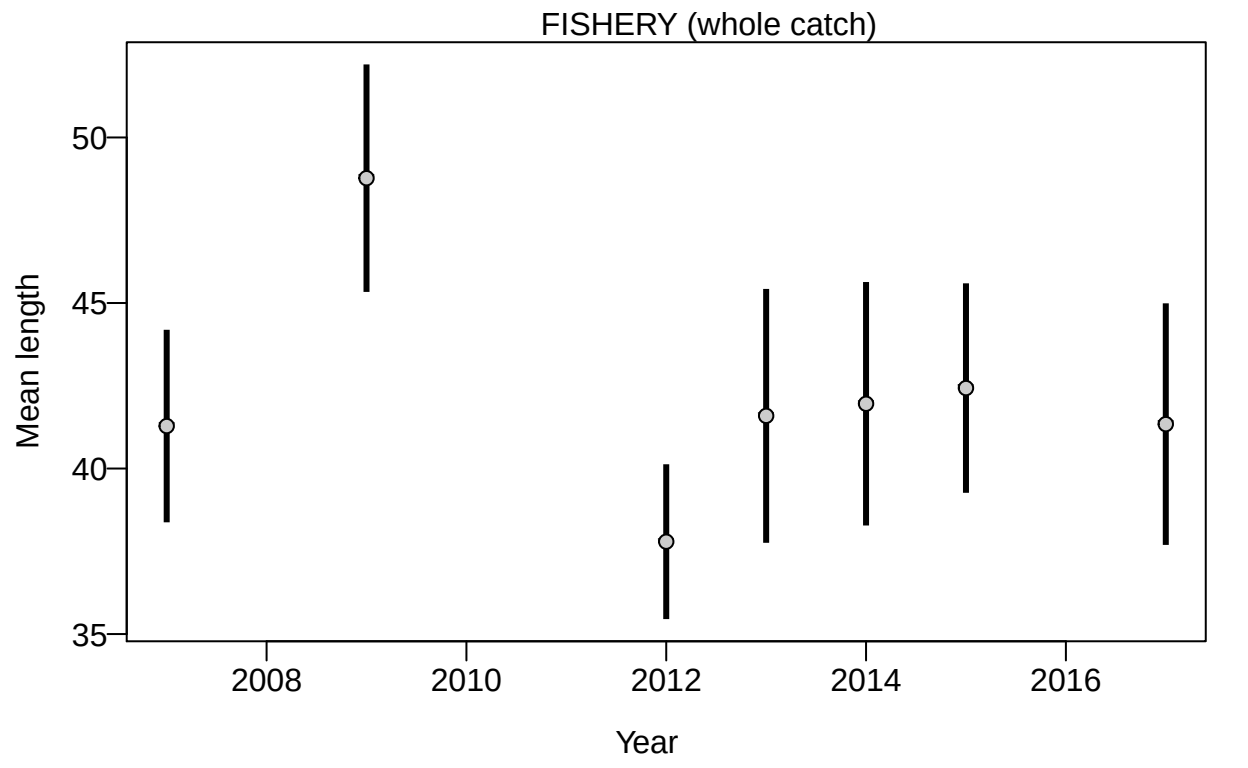

Numbers at age at equilibrium
0
500
1000
1500
2000
0
2
4
6
8
10
Age

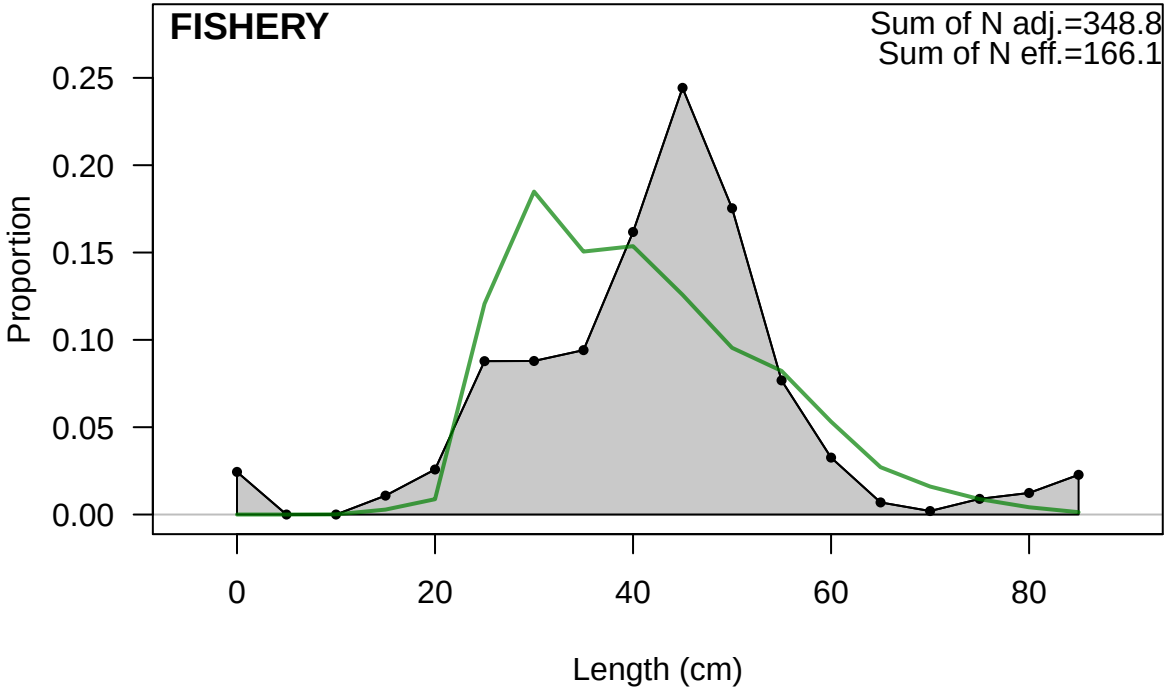

FISHERY
Sum of N adj.=348.8
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
20
40
60
80
Length (cm)

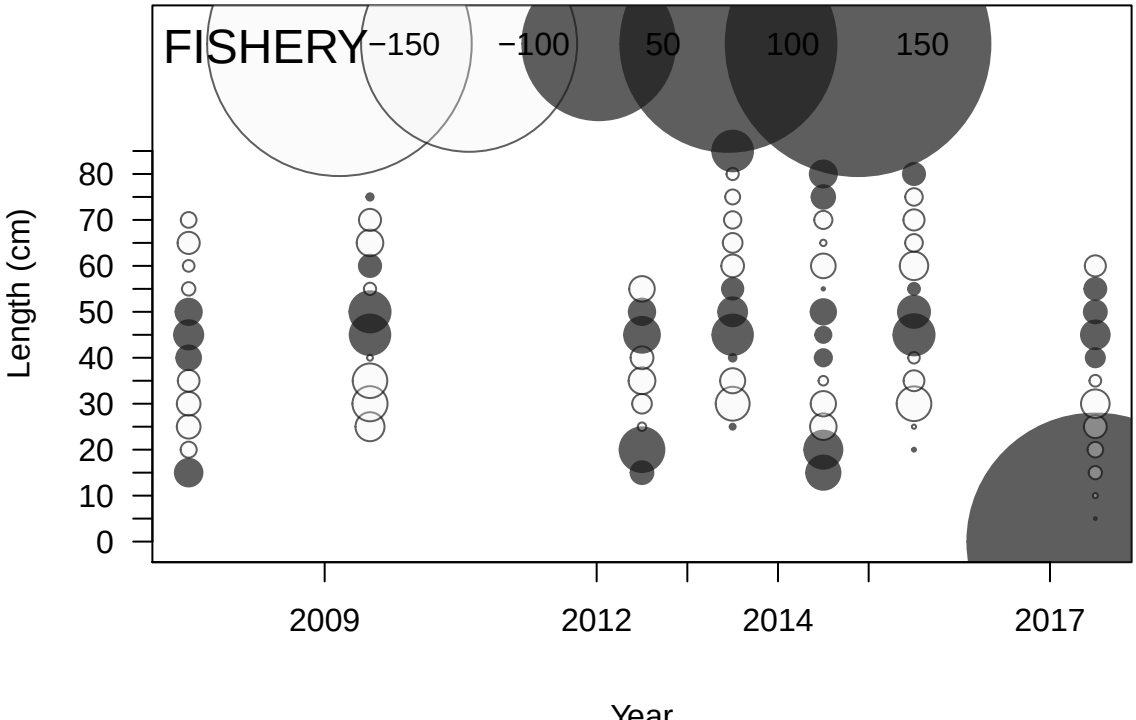

FISHERY
0.01
0.2
0.4
Length (cm)
0
10
20
30
40
50
60
70
80
2009
2012
2014
2017
Year

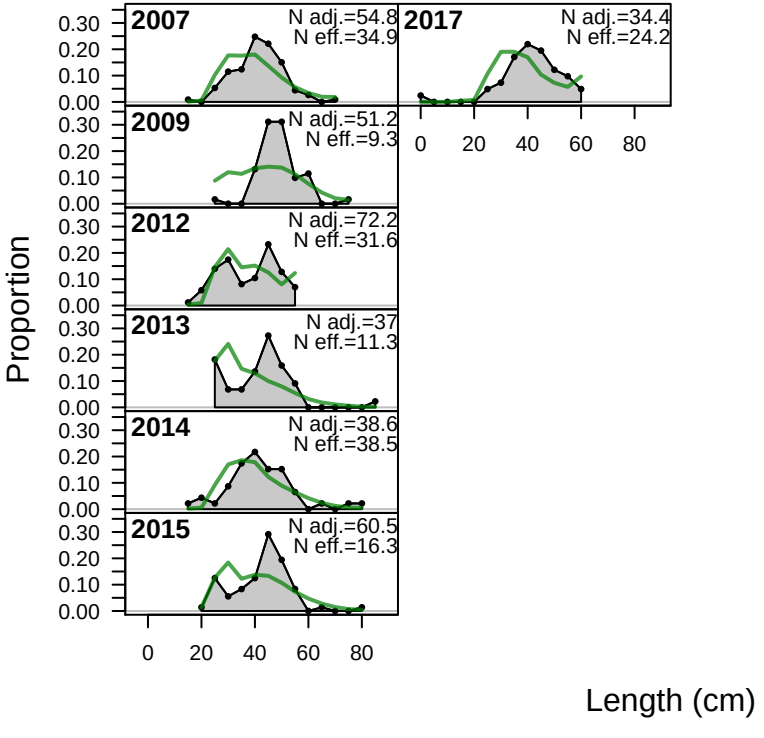

2007
N adj.=54.8
2017
N adj.=34.4
2009
N adj.=51.2
2012
N adj.=72.2
2013
N adj.=37
2014
N adj.=38.6
2015
N adj.=60.5
0.30
0.20
0.10
0.00
0
20
40
60
80
Proportion
Length (cm)

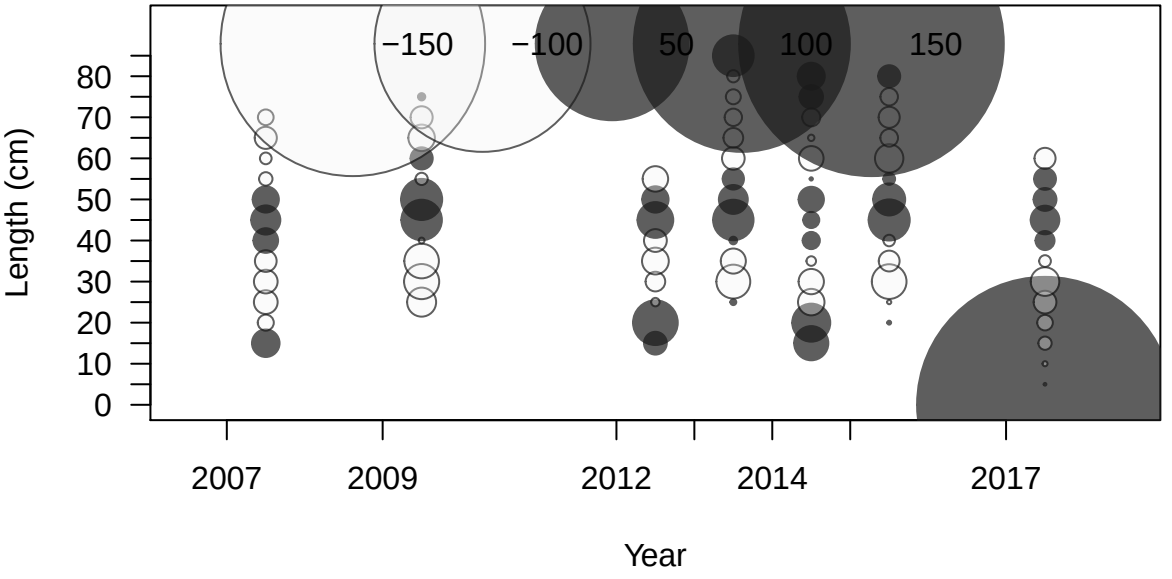

0.01
0.2
0.4
Length (cm)
0
10
20
30
40
50
60
70
80
2007
2009
2012
2014
2017
Year

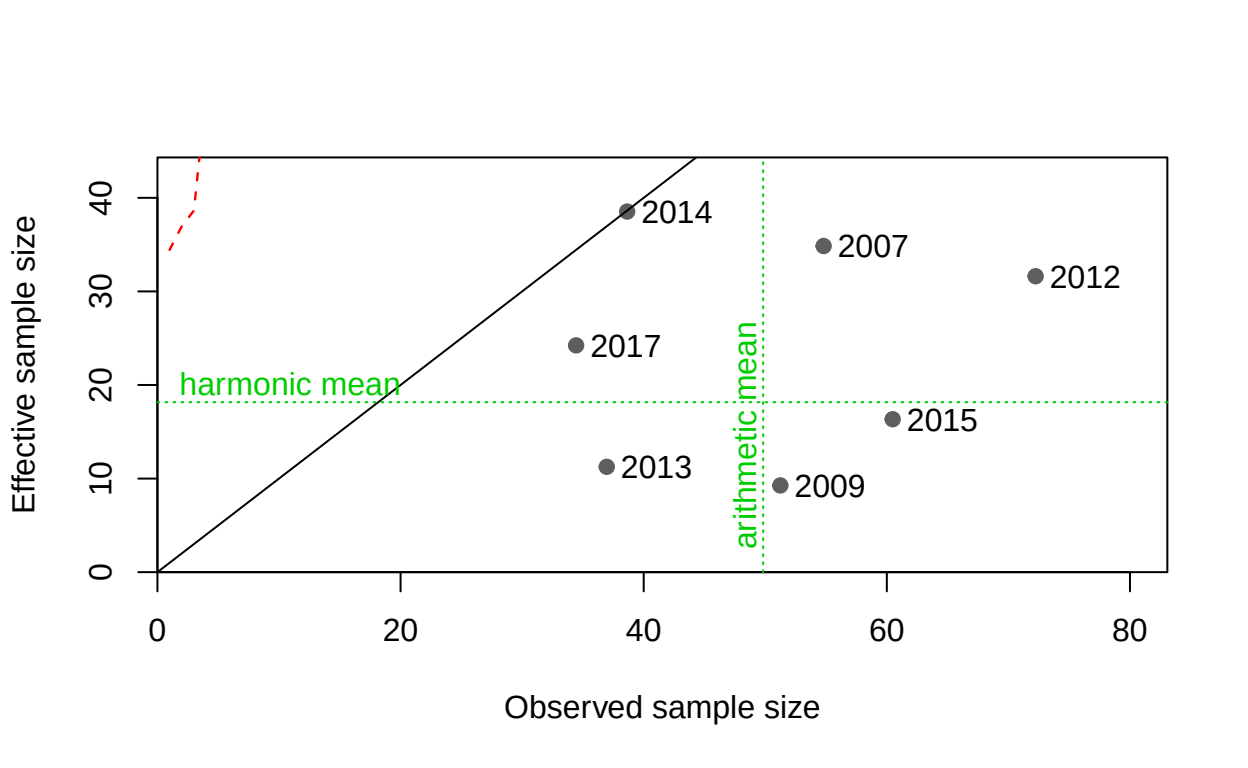

FISHERY (whole catch)
Mean length
50
45
40
35
2008
2010
2012
2014
2016
Year

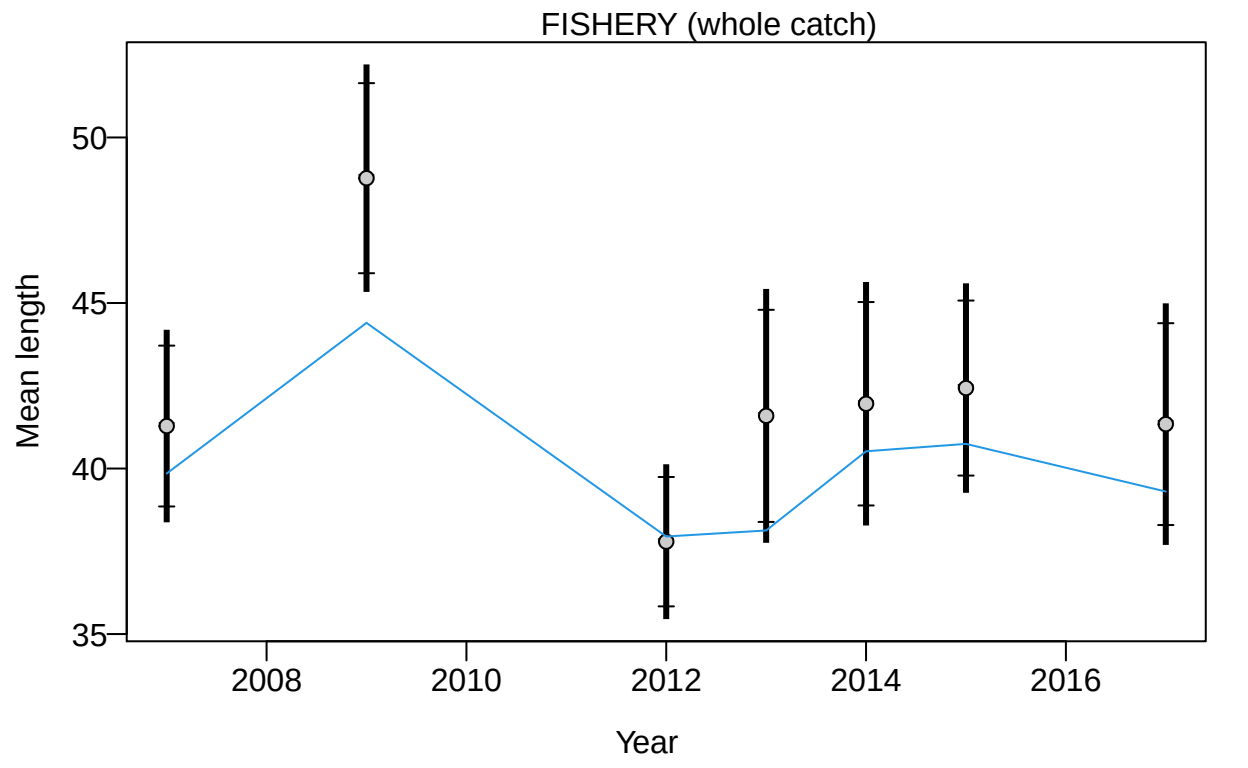

FISHERY
Sum of N adj.=348.8
Sum of N eff.=166.1
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
20
40
60
80
Length (cm)

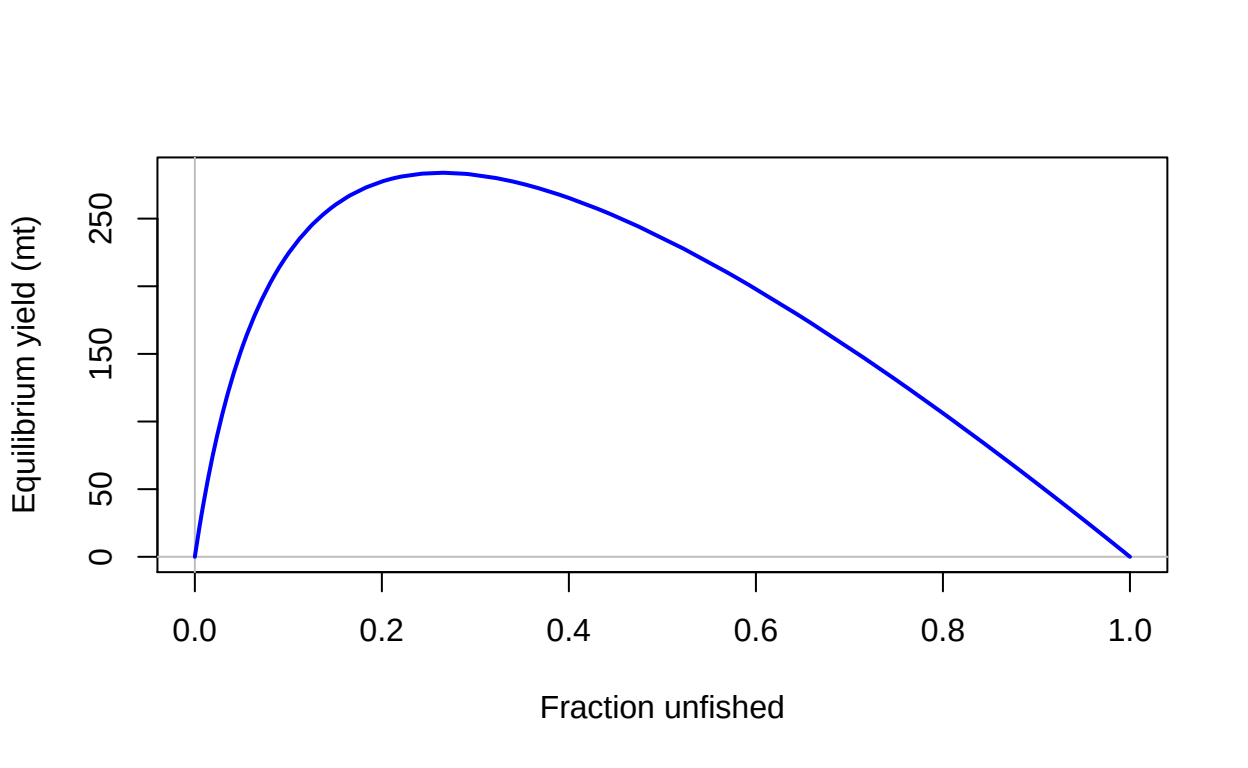

FISHERY
−150
−100
50
100
150
Length (cm)
0
10
20
30
40
50
60
70
80
2009
2012
2014
2017
Year

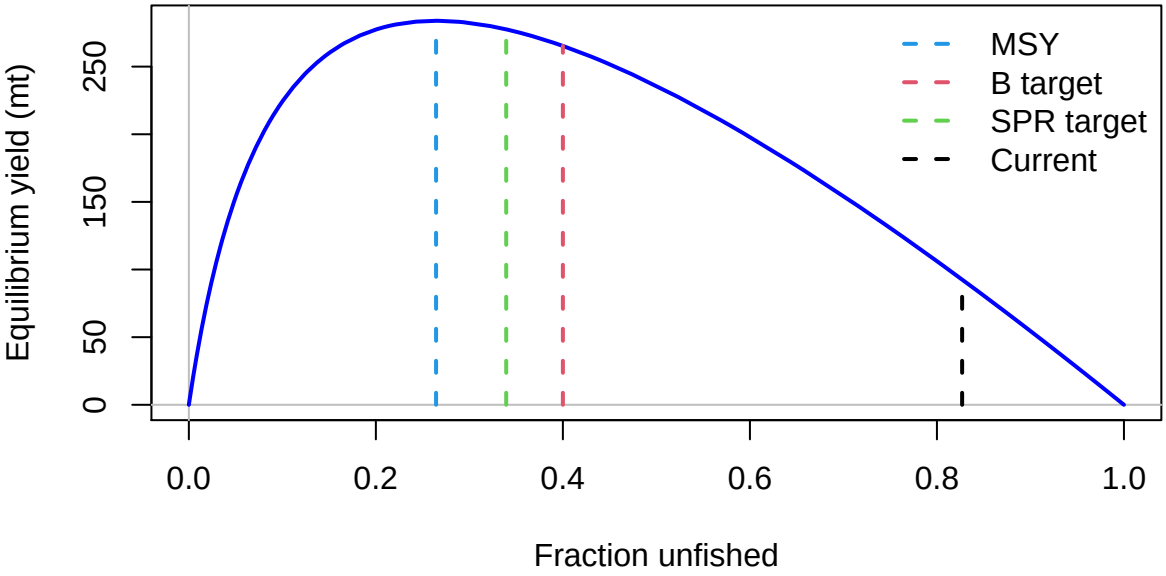

2007
N adj.=54.8
N eff.=34.9
2017
N adj.=34.4
N eff.=24.2
2009
N adj.=51.2
N eff.=9.3
2012
N adj.=72.2
N eff.=31.6
2013
N adj.=37
N eff.=11.3
2014
N adj.=38.6
N eff.=38.5
2015
N adj.=60.5
N eff.=16.3
Proportion
0.00
0.10
0.20
0.30
0
20
40
60
80
Length (cm)

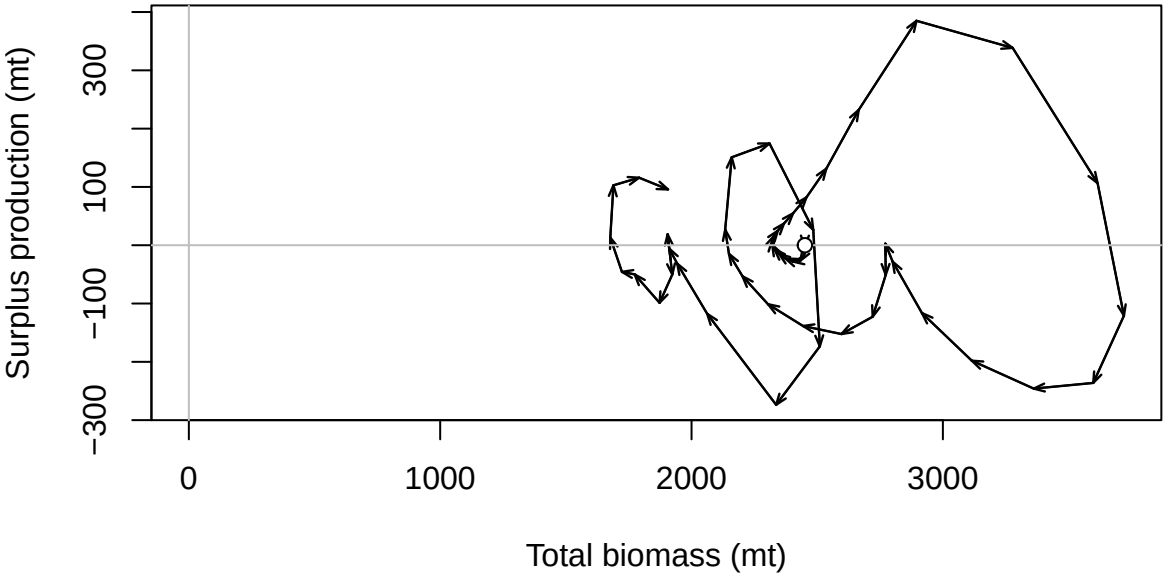

−150
−100
50
100
150
Length (cm)
0
10
20
30
40
50
60
70
80
2007
2009
2012
2014
2017
Year

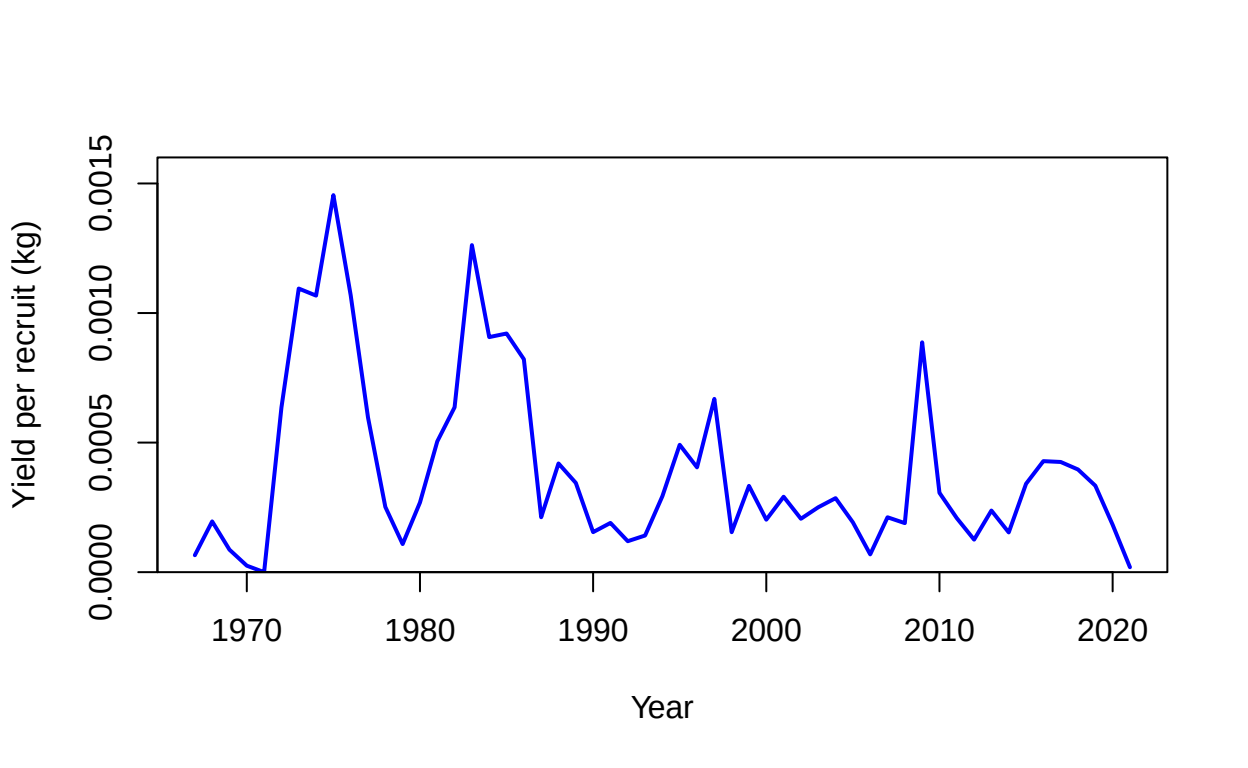

Effective sample size
0
10
20
30
40
0
20
40
60
80
Observed sample size
2014
2007
2012
2017
2015
2013
2009
harmonic mean
arithmetic mean

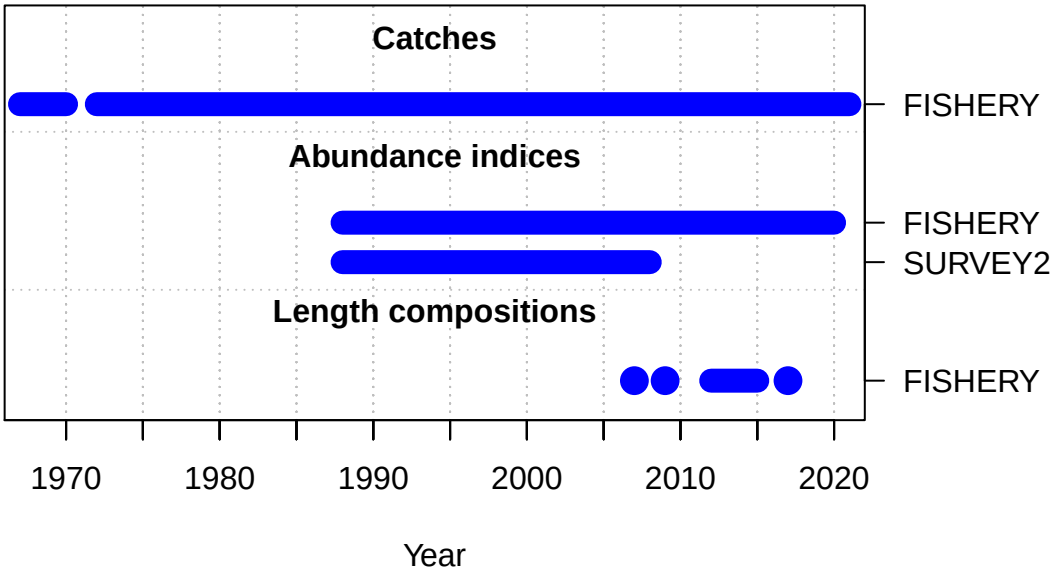

FISHERY (whole catch)
Mean length
50
45
40
35
2008
2010
2012
2014
2016
Year

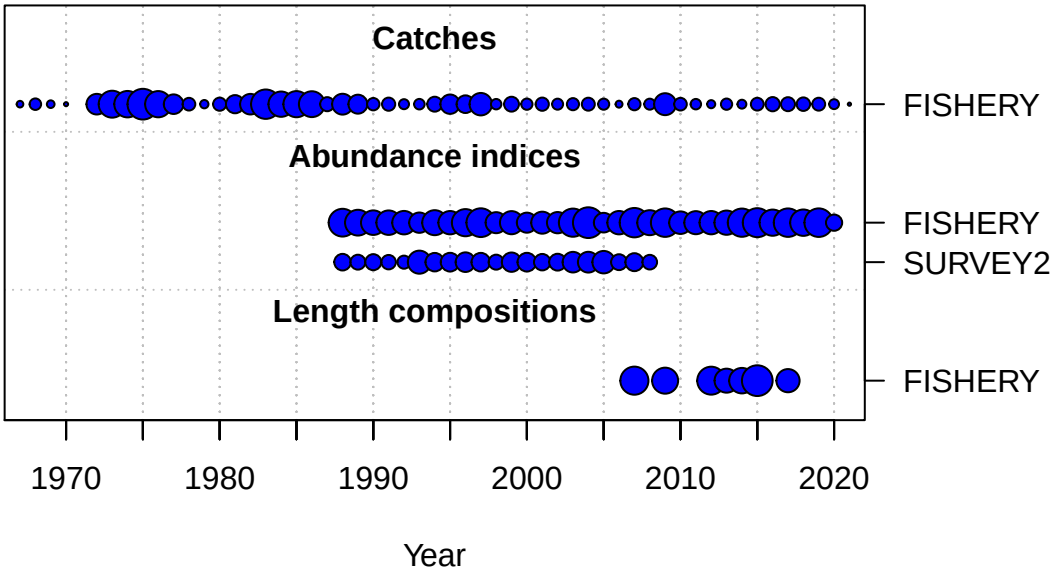

Equilibrium yield (mt)
0
50
150
250
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

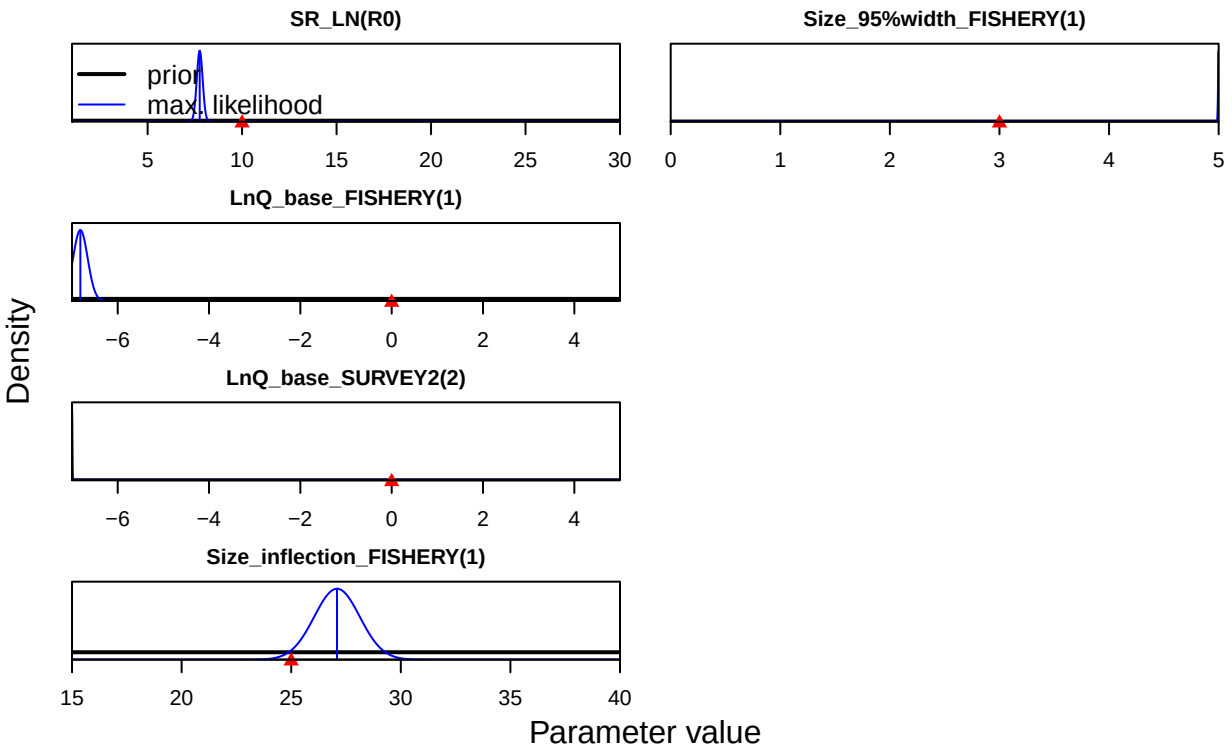

Equilibrium yield (mt)
0
50
150
250
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
300
100
−100
−300
0
1000
2000
3000
Total biomass (mt)


Yield per recruit (kg)
0.0000
0.0005
0.0010
0.0015
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