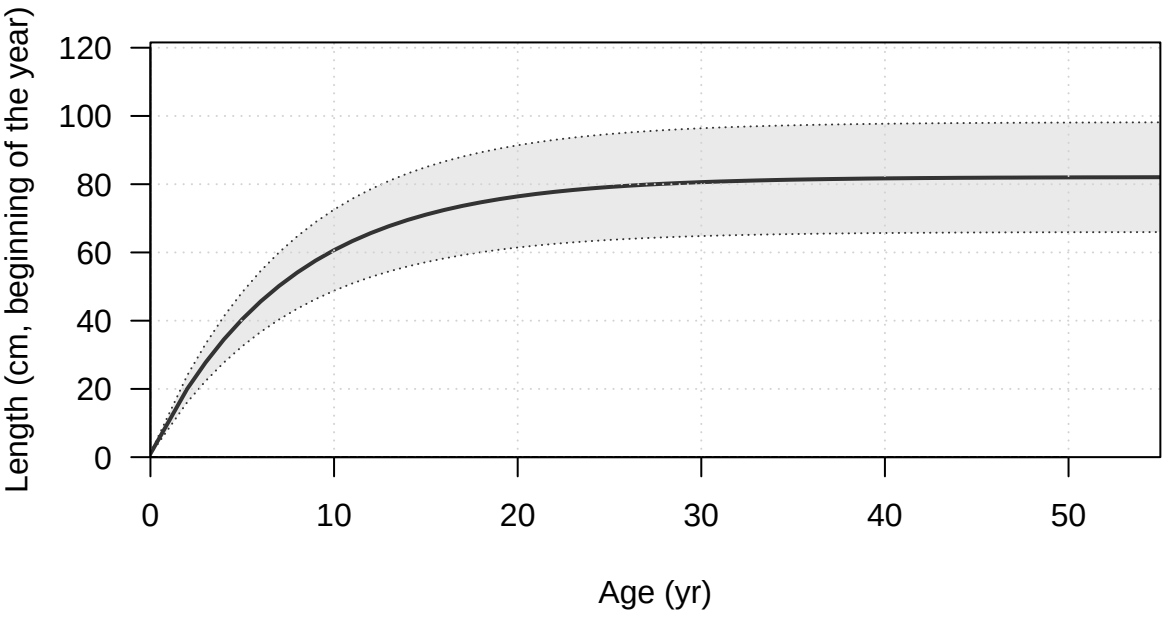
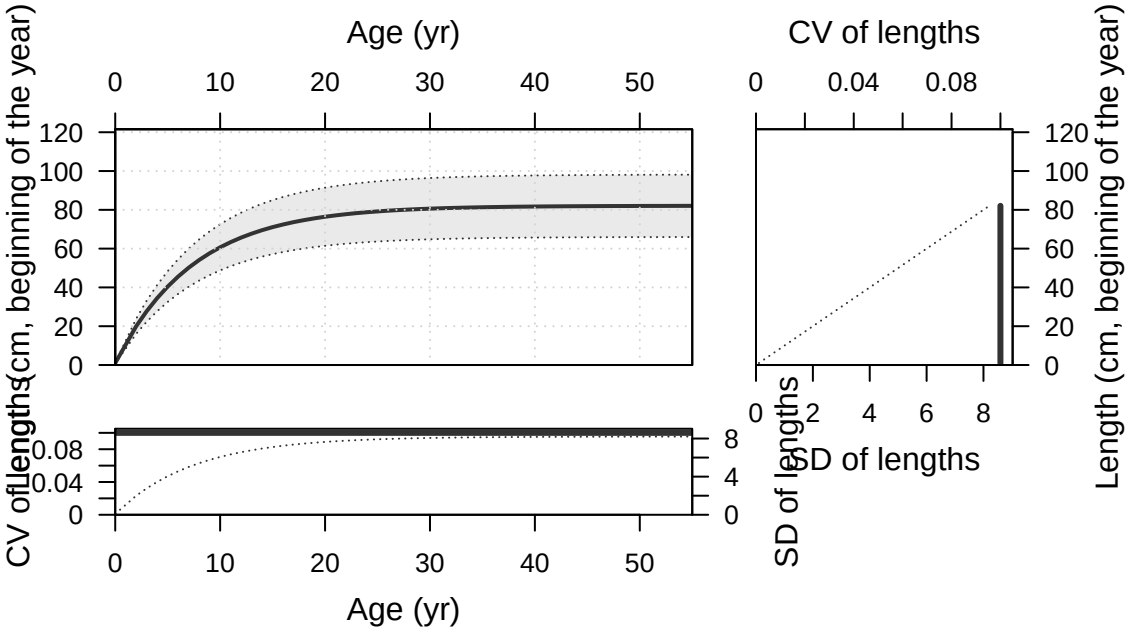
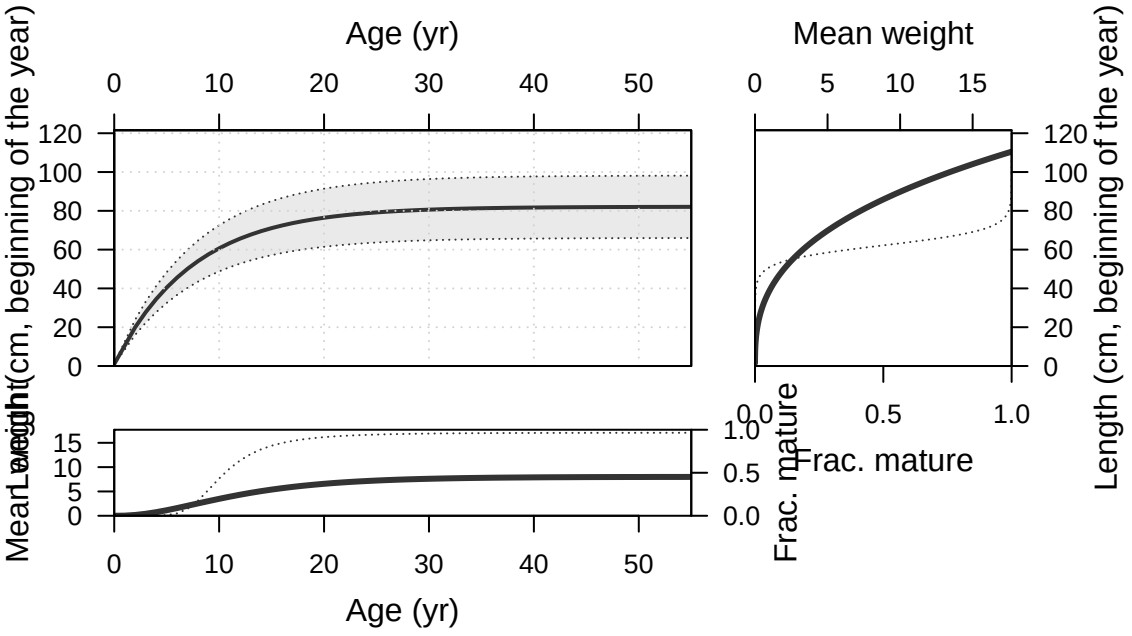
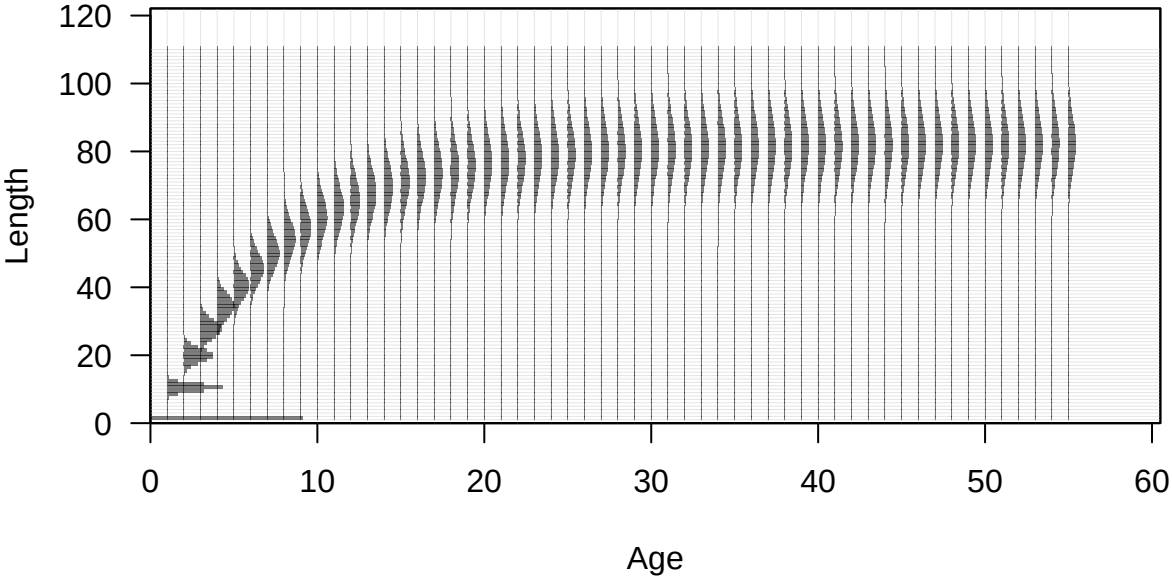
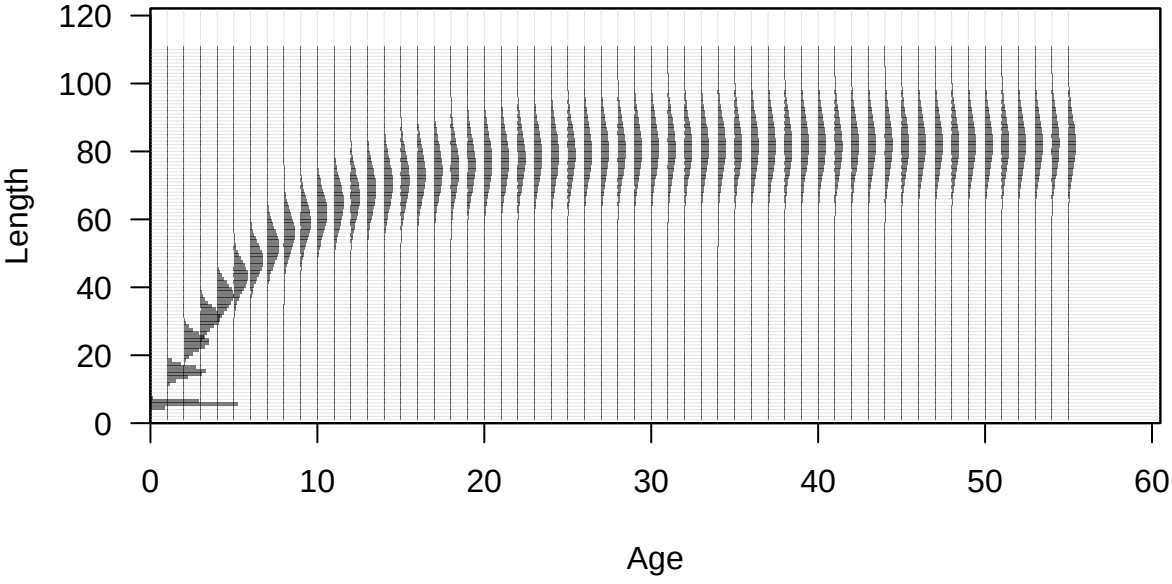
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Mon Jul 18 12:01:41 2022
Data_File: data.ss
Control_File: control.ss

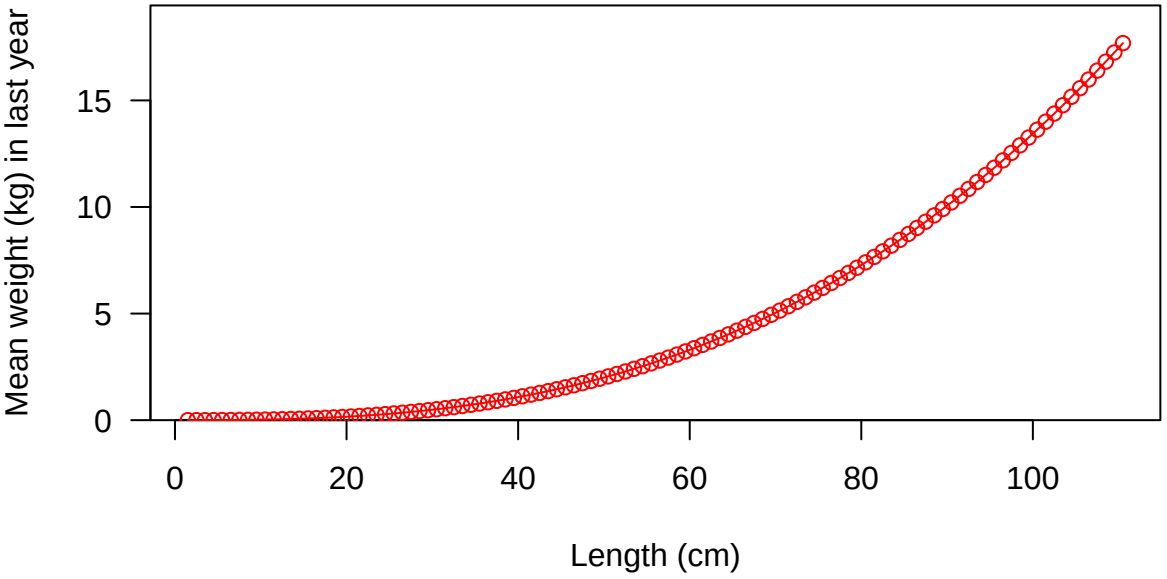

Length (cm, beginning of the year)
120
100
80
60
40
20
0
0
10
20
30
40
50
Age (yr)

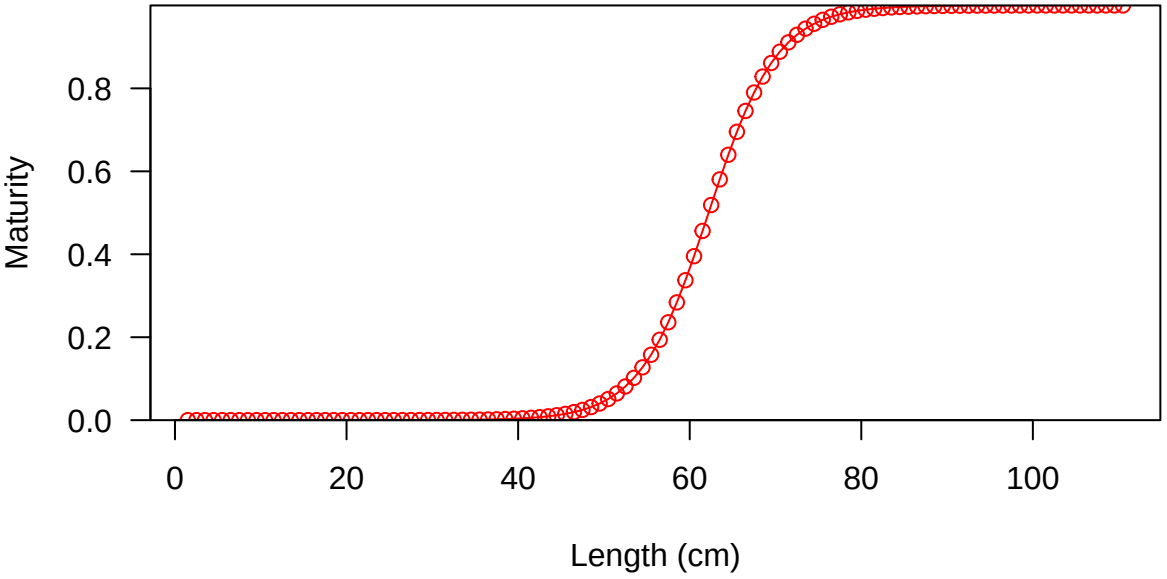

Age (yr)
0
10
20
30
40
50
Length (cm, beginning of the year)
120
100
80
60
40
20
0
CV of lengths
0.08
0.04
0
SD of lengths
8
4
0
CV of lengths
0.04
0.08
0
2
4
6
8
SD of lengths
Length (cm, beginning of the year)
Age (yr)

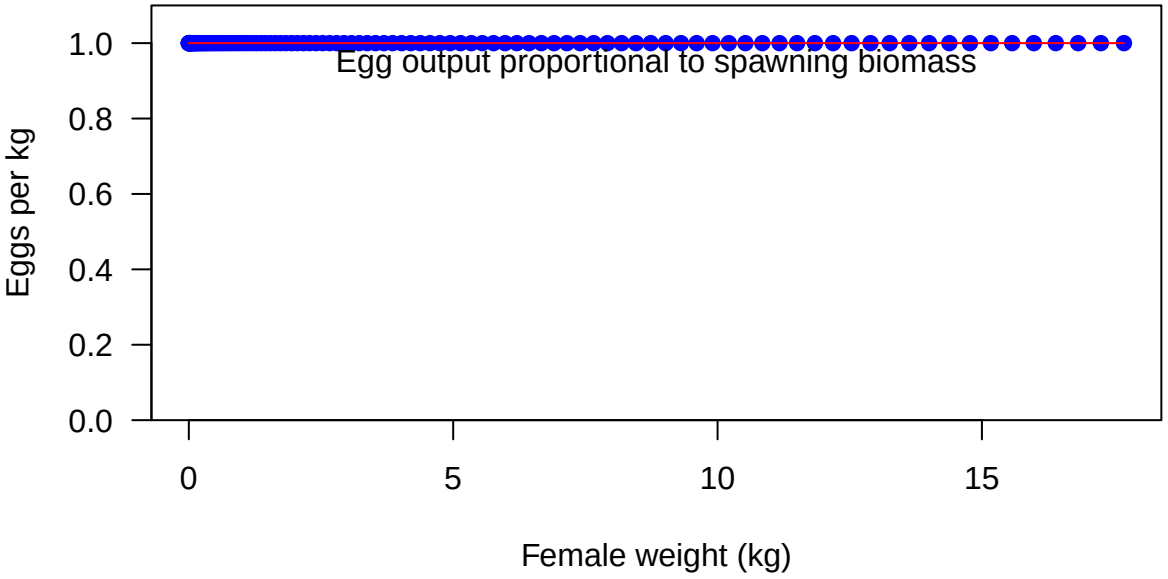

Age (yr)
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)
Mean weight
Frac. mature
Length (cm, beginning of the year)

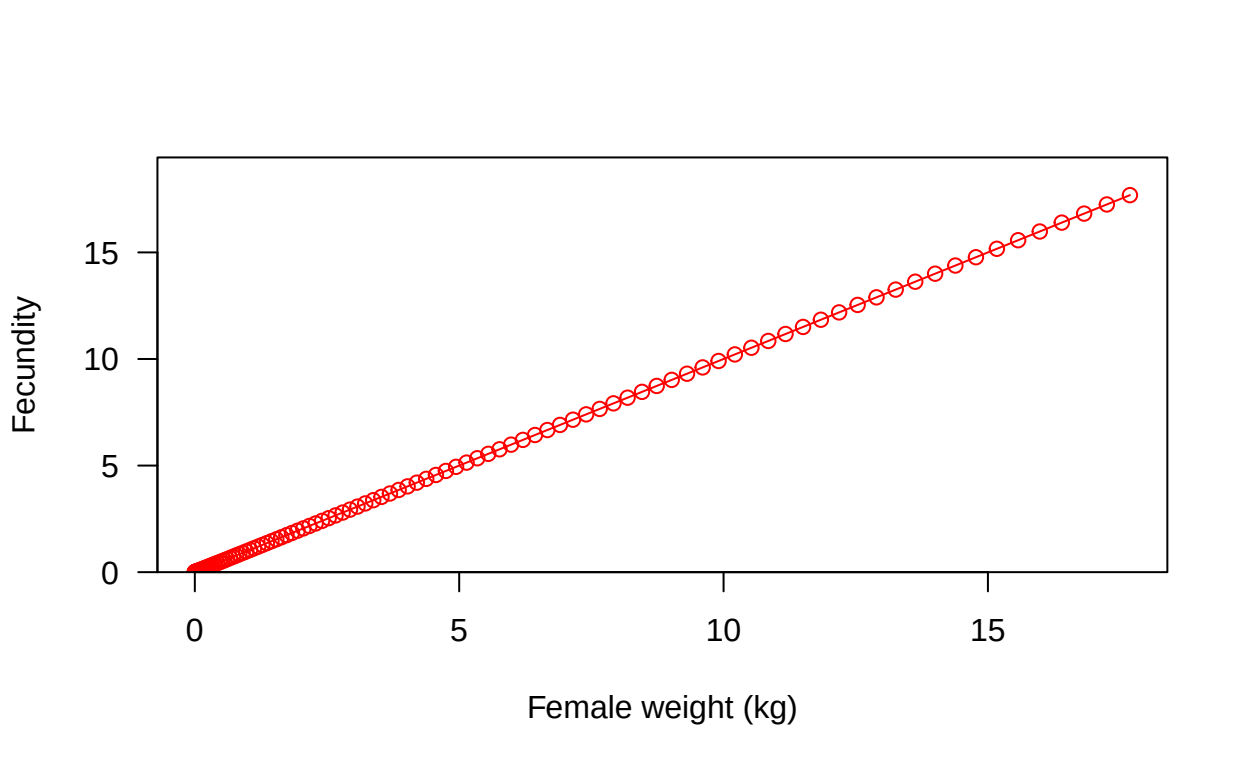

120
100
80
60
40
20
0
Length
0
10
20
30
40
50
60
Age

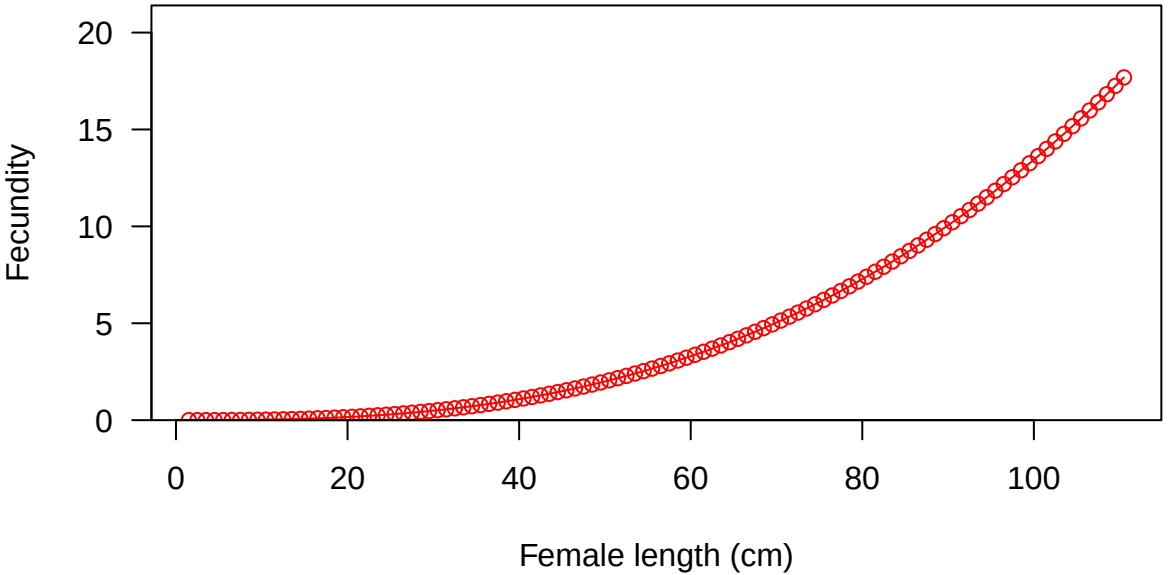

120
100
80
60
40
20
0
Length
0
10
20
30
40
50
60
Age

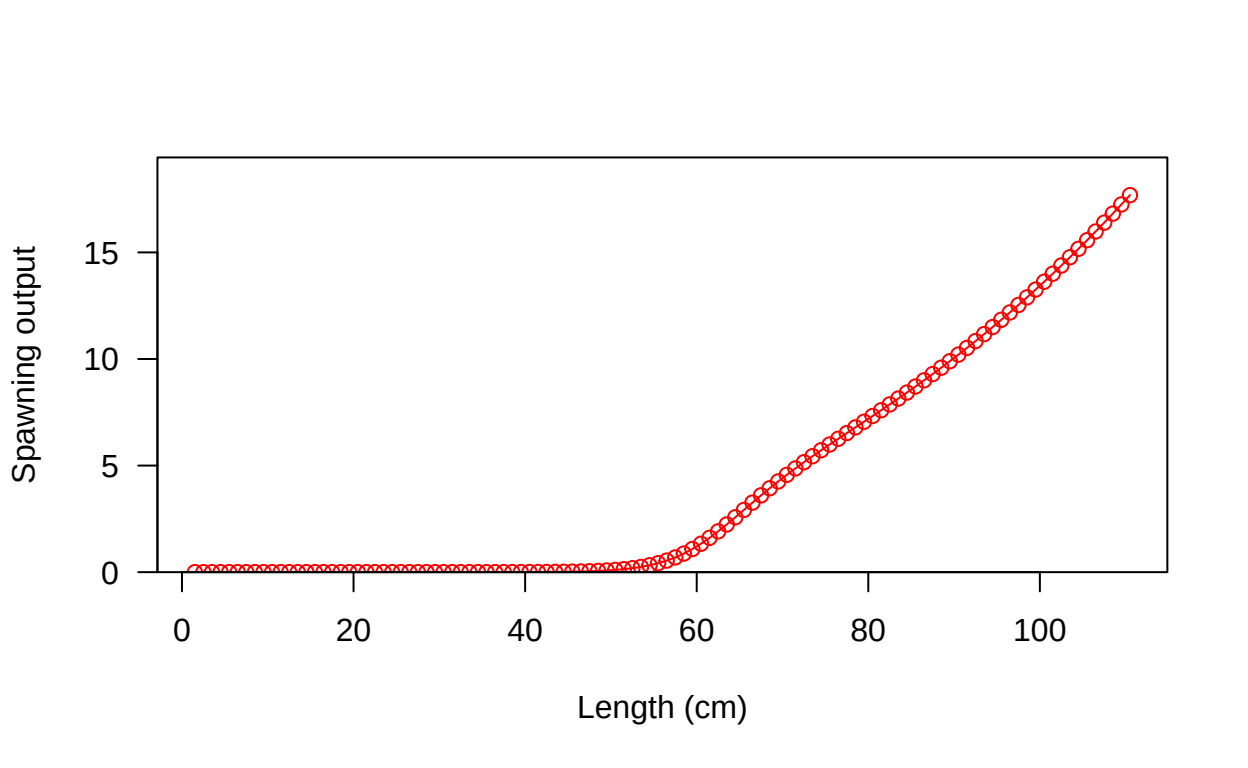

Mean weight (kg) in last year
0
5
10
15
0
20
40
60
80
100
Length (cm)

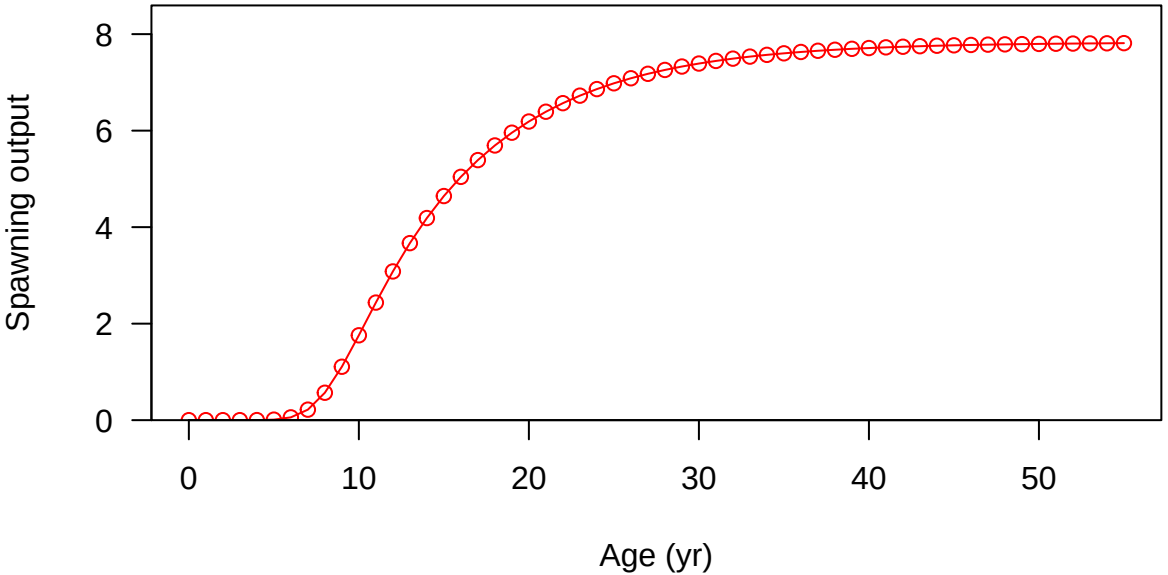

Maturity
0.0
0.2
0.4
0.6
0.8
0
20
40
60
80
100
Length (cm)

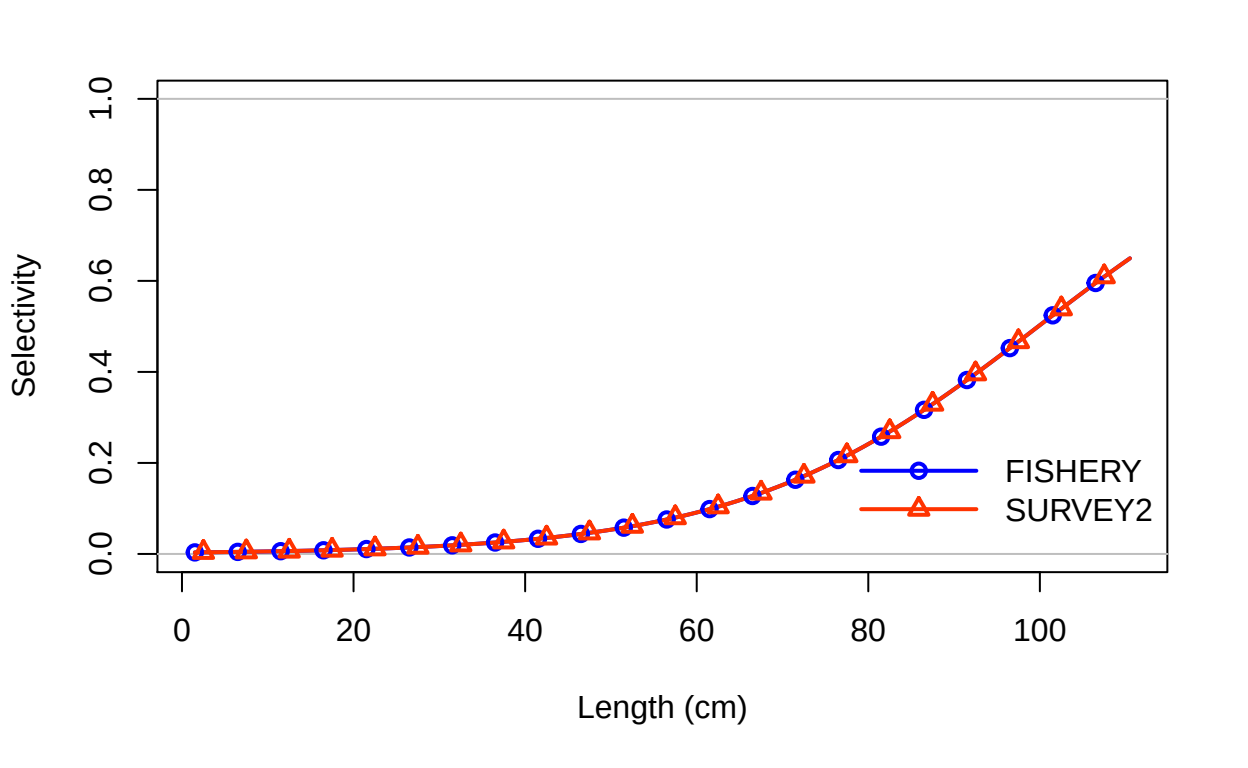

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
Female weight (kg)

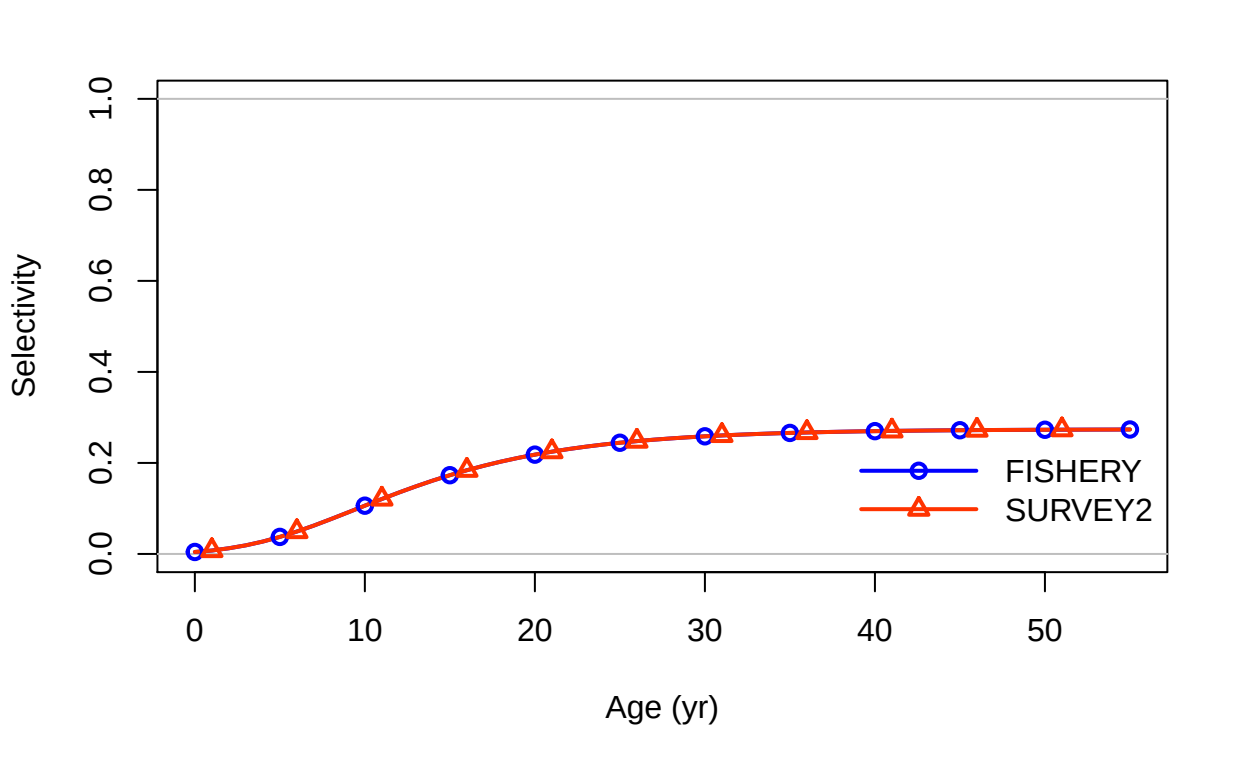

Fecundity
0
5
10
15
0
5
10
15
Female weight (kg)

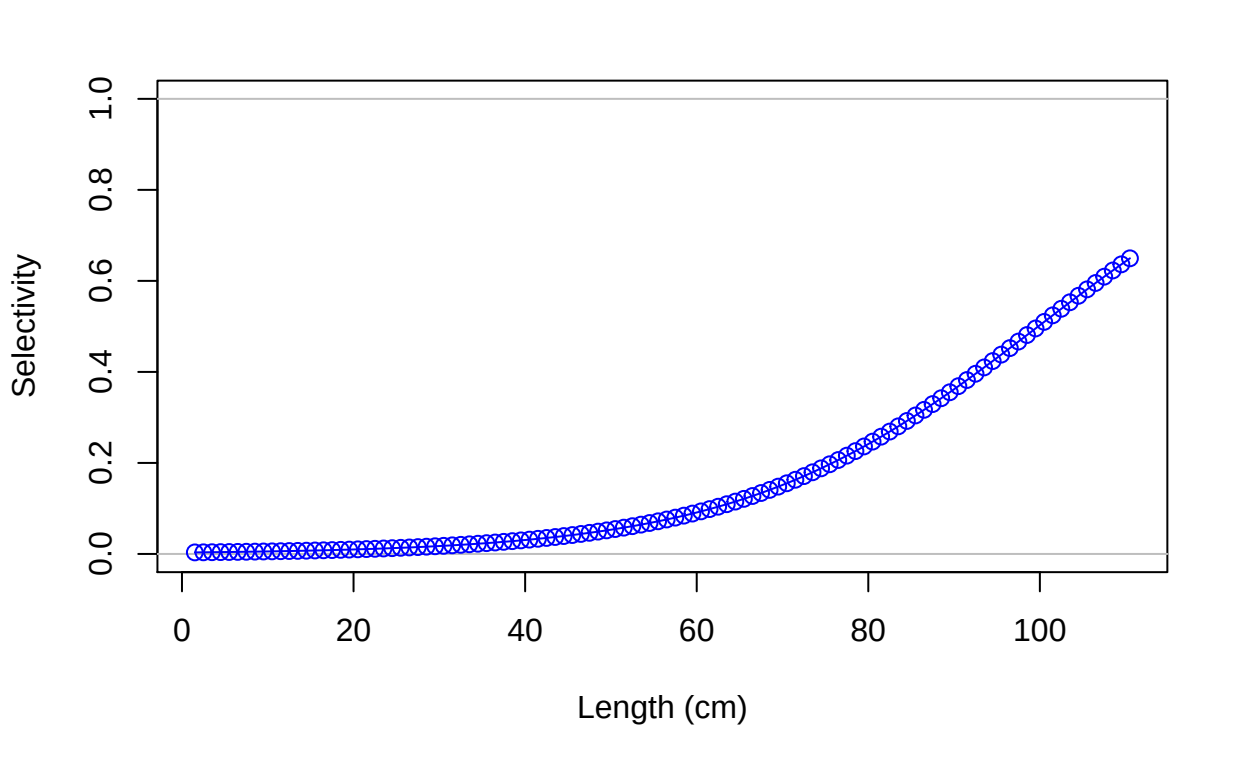

Fecundity
0
5
10
15
20
0
20
40
60
80
100
Female length (cm)

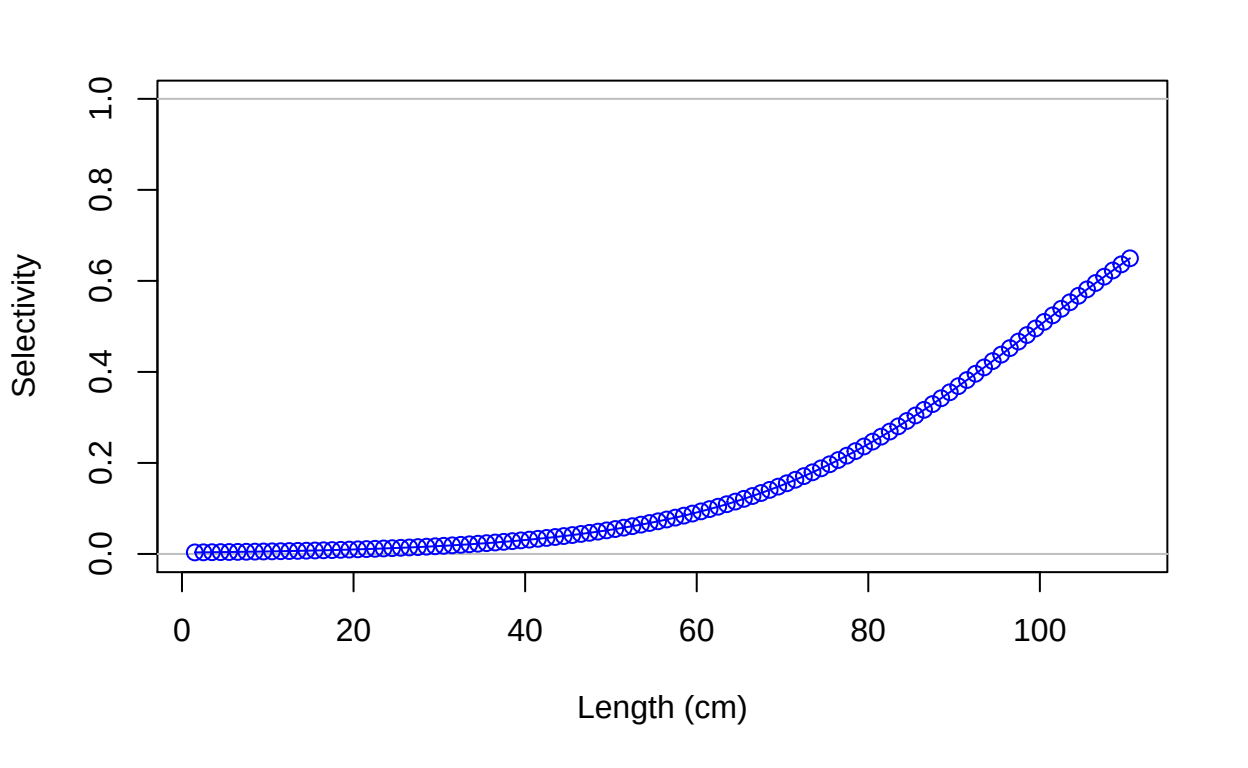

Spawning output
0
5
10
15
0
20
40
60
80
100
Length (cm)

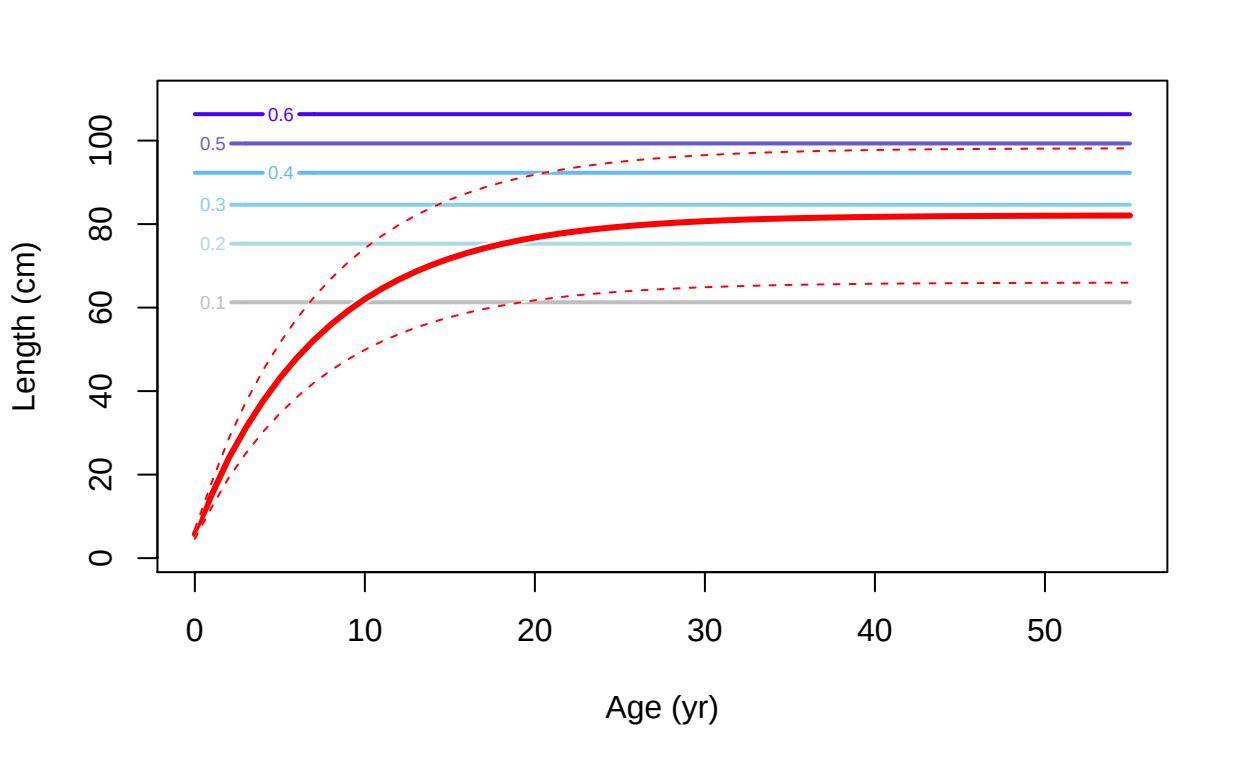

Spawning output
0
2
4
6
8
0
10
20
30
40
50
Age (yr)

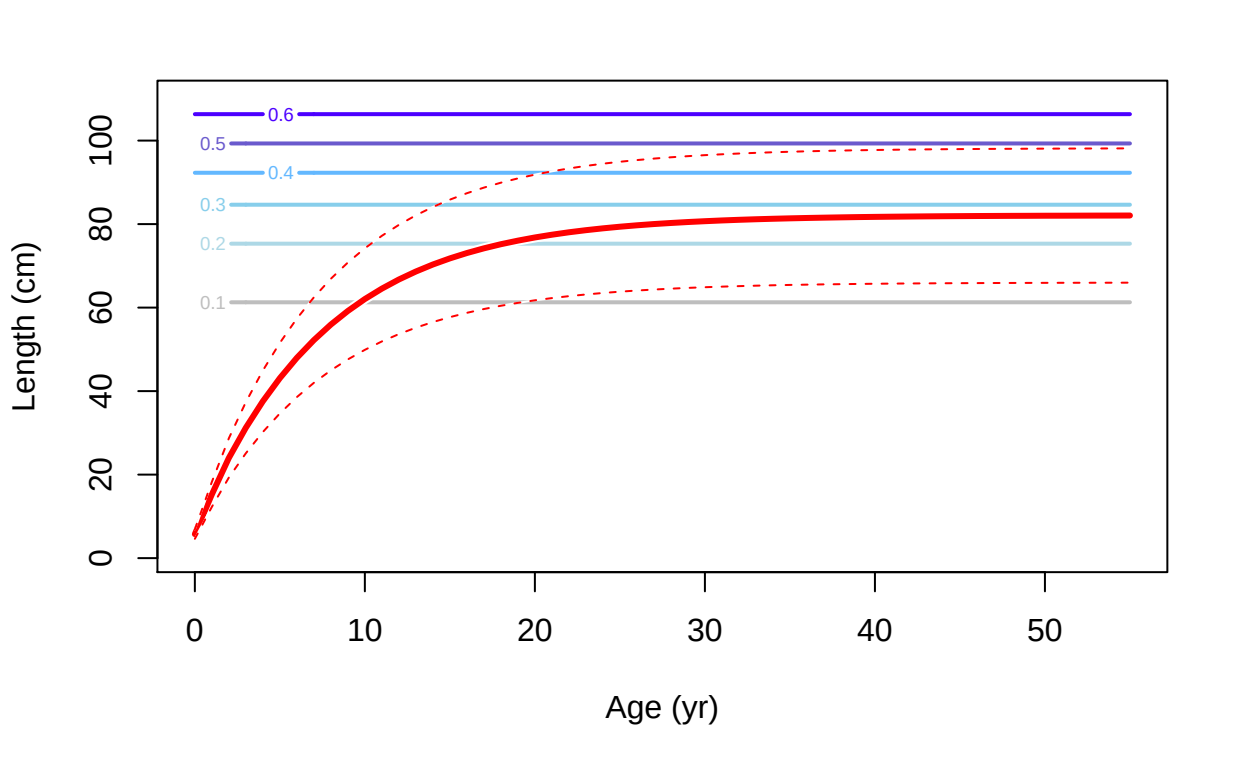

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)
FISHERY
SURVEY2

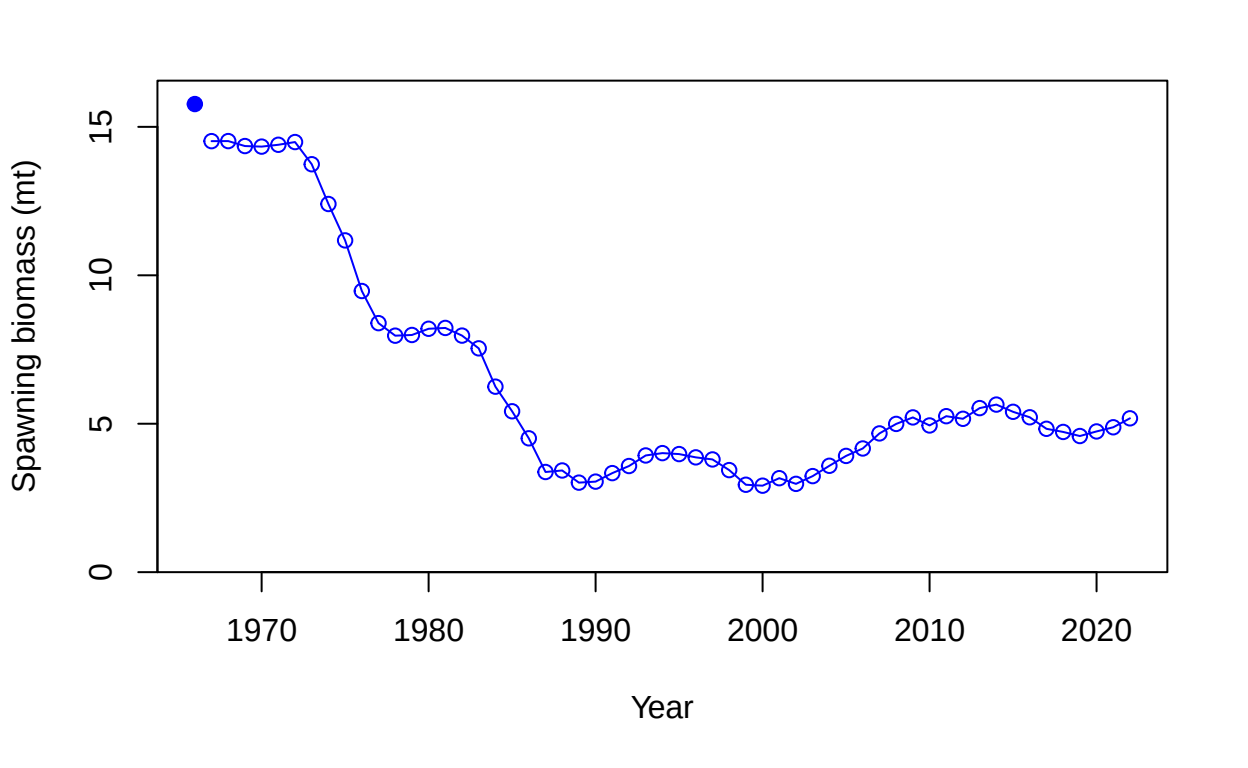

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Age (yr)
FISHERY
SURVEY2

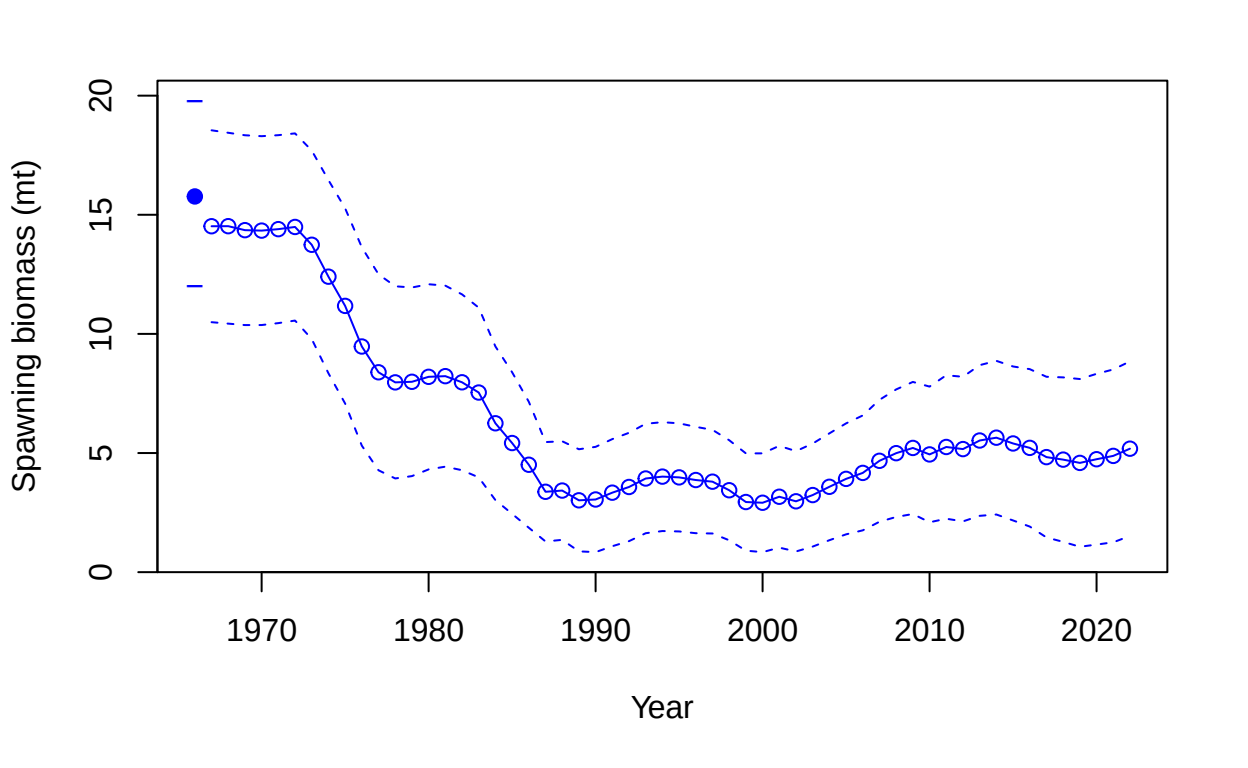

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

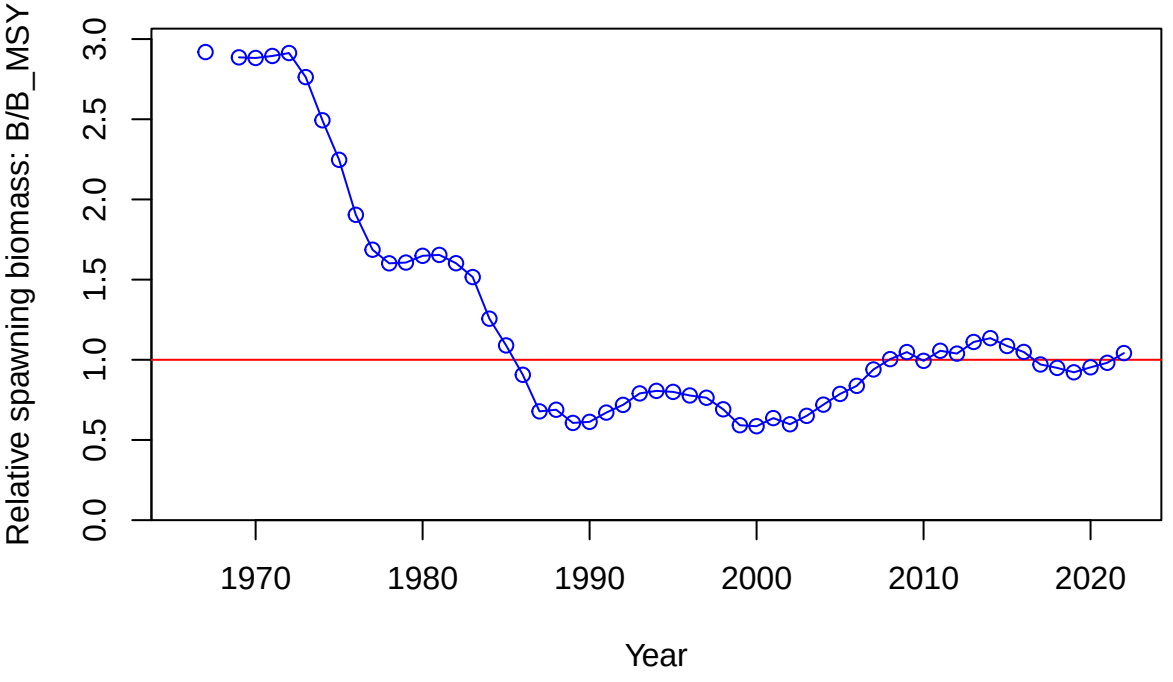

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

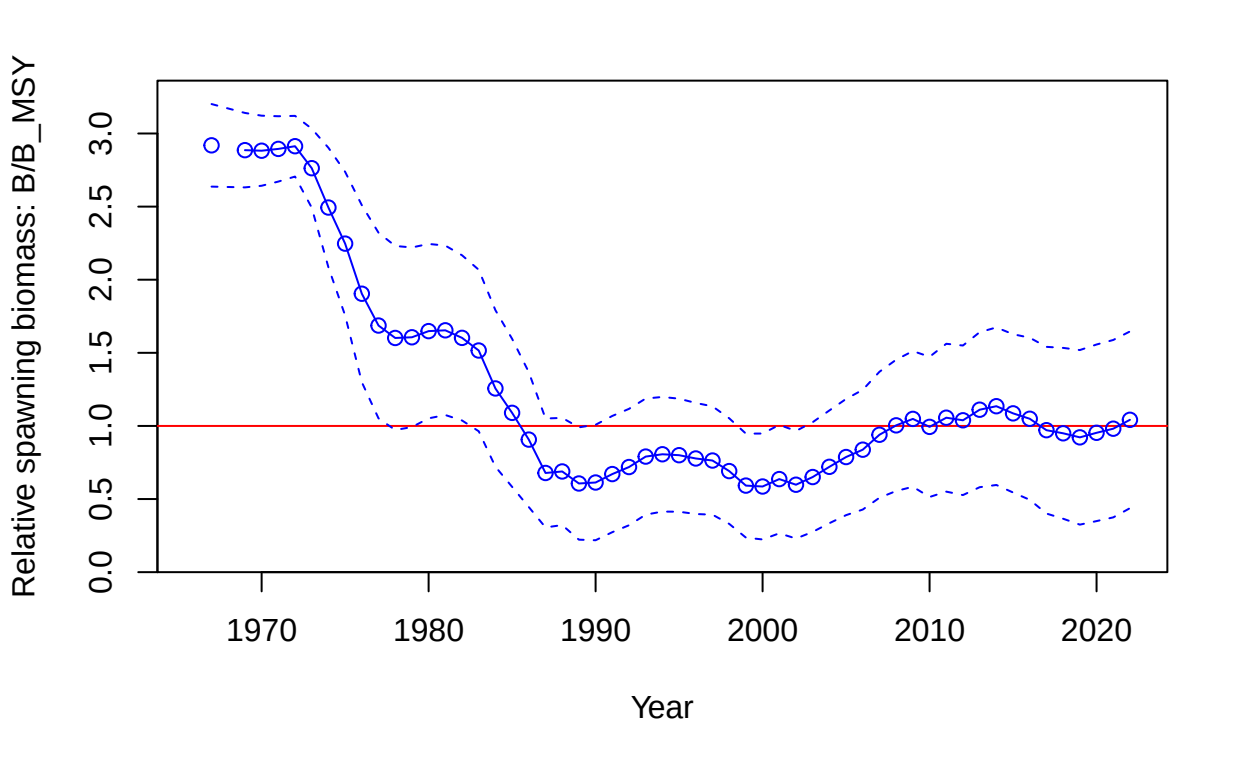

Length (cm)
0
20
40
60
80
100
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
Age (yr)

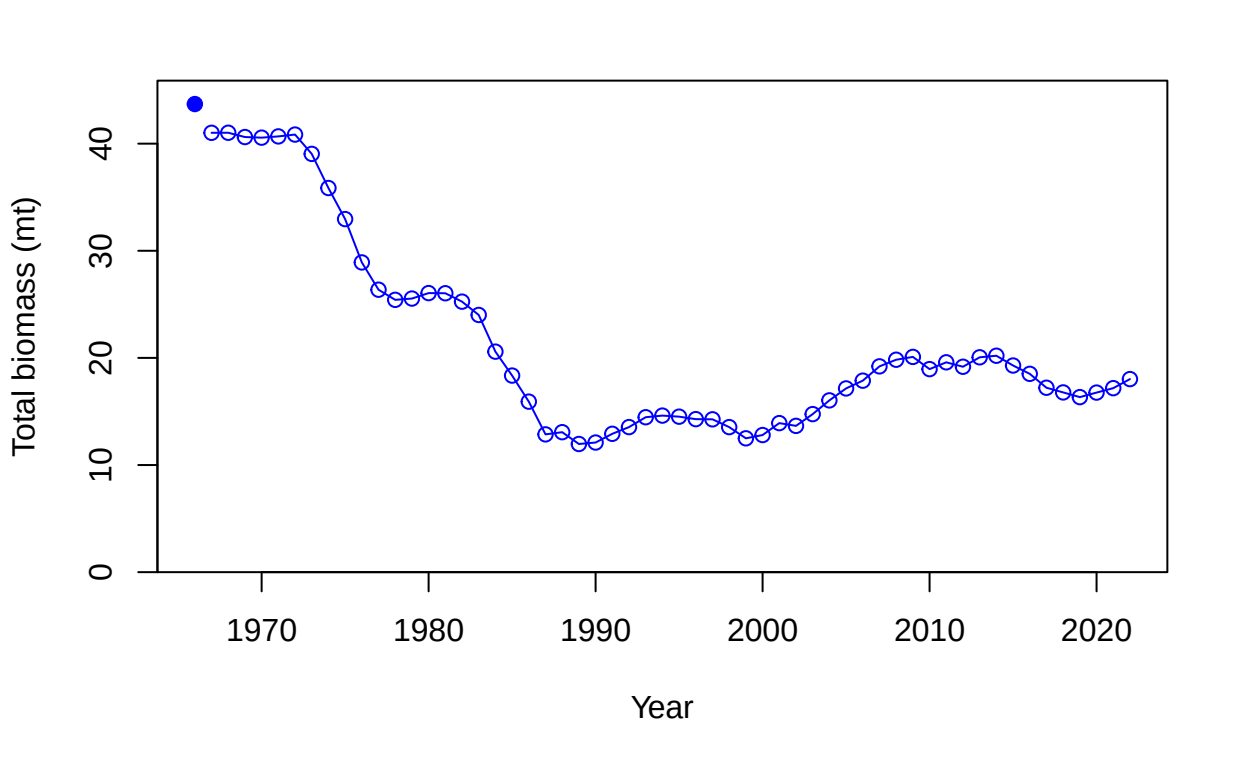

Length (cm)
0
20
40
60
80
100
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
Age (yr)

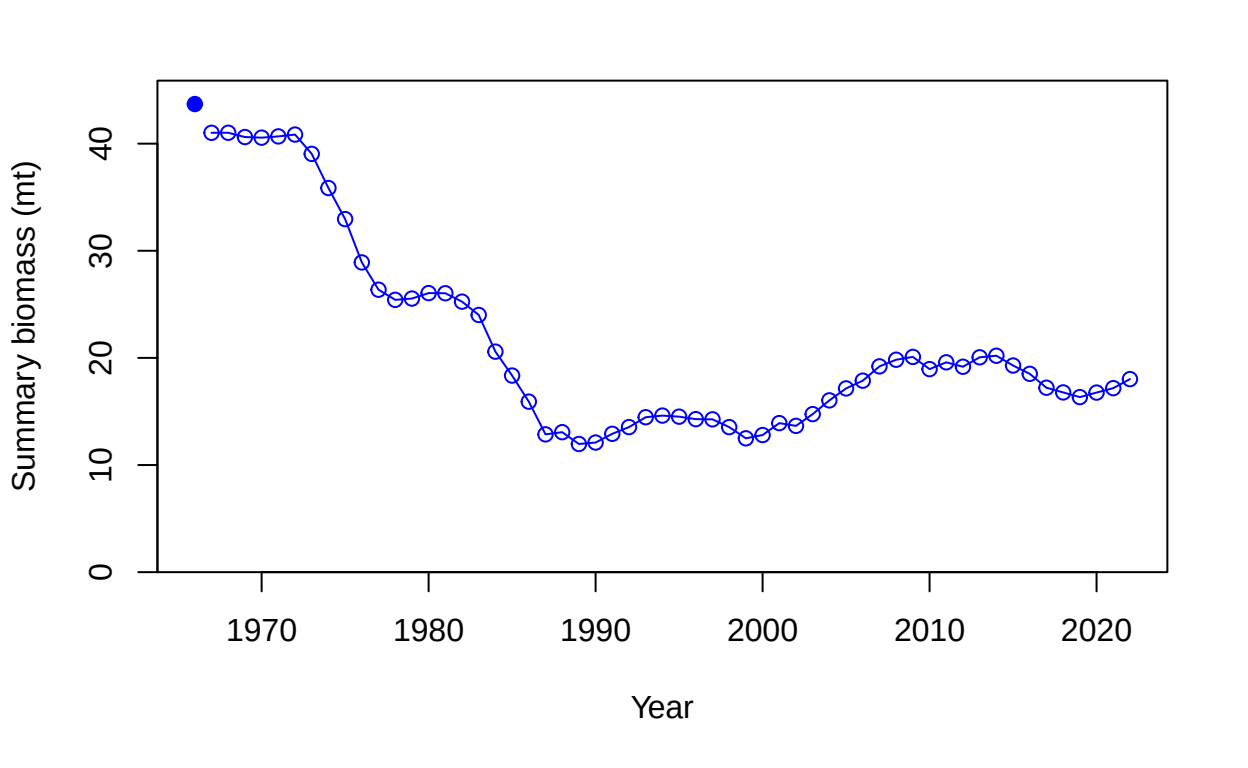

Spawning biomass (mt)
0
5
10
15
1970
1980
1990
2000
2010
2020
Year

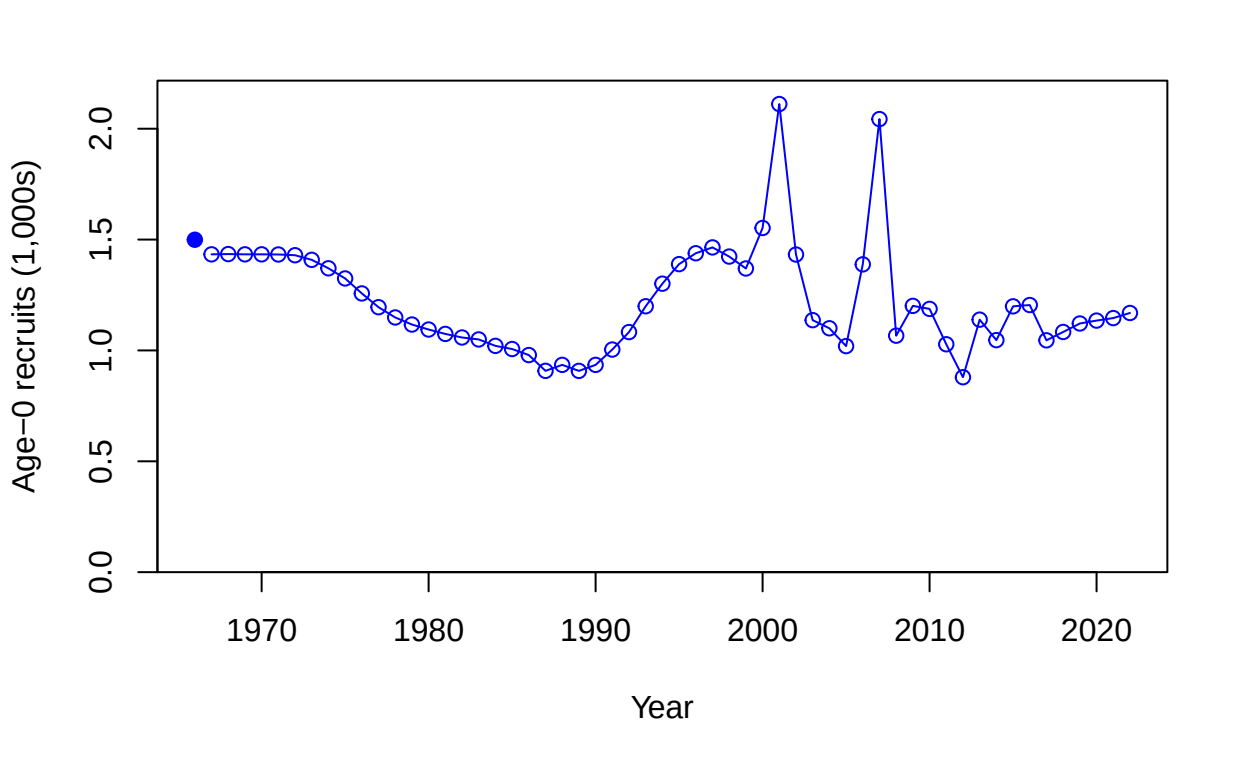

Spawning biomass (mt)
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Year

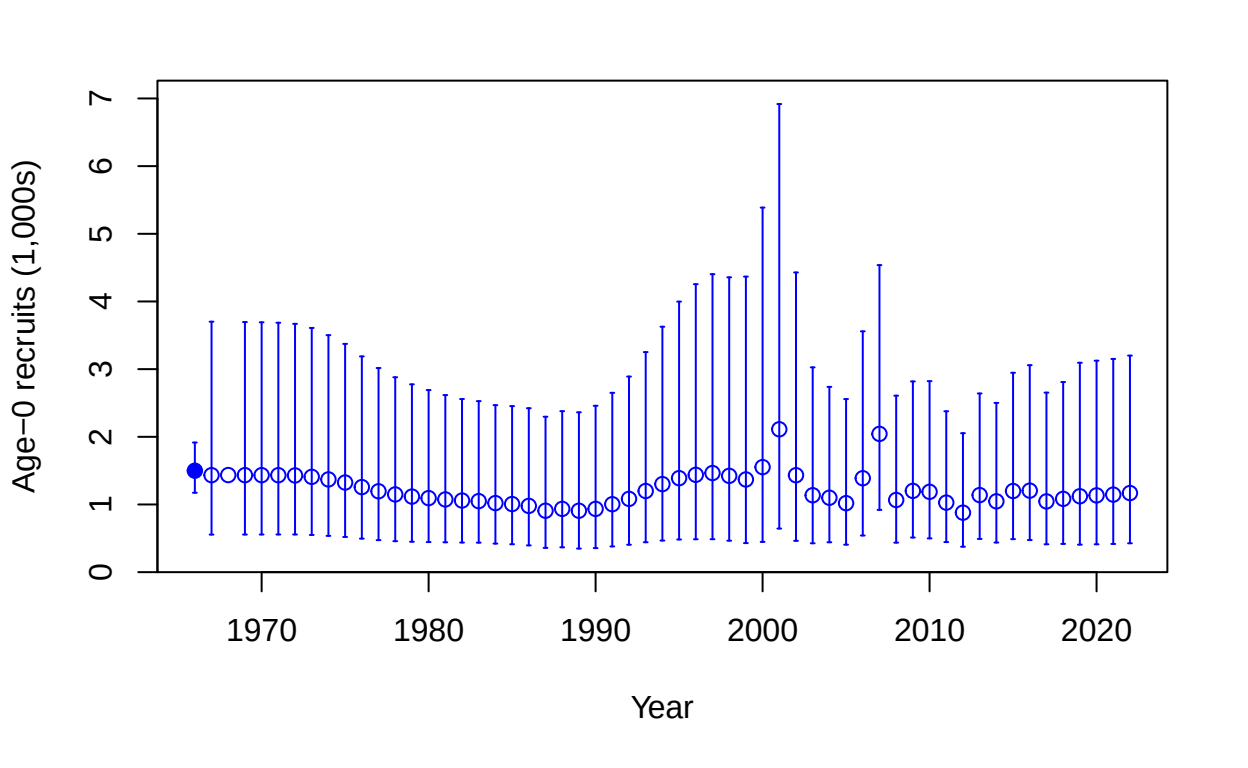

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

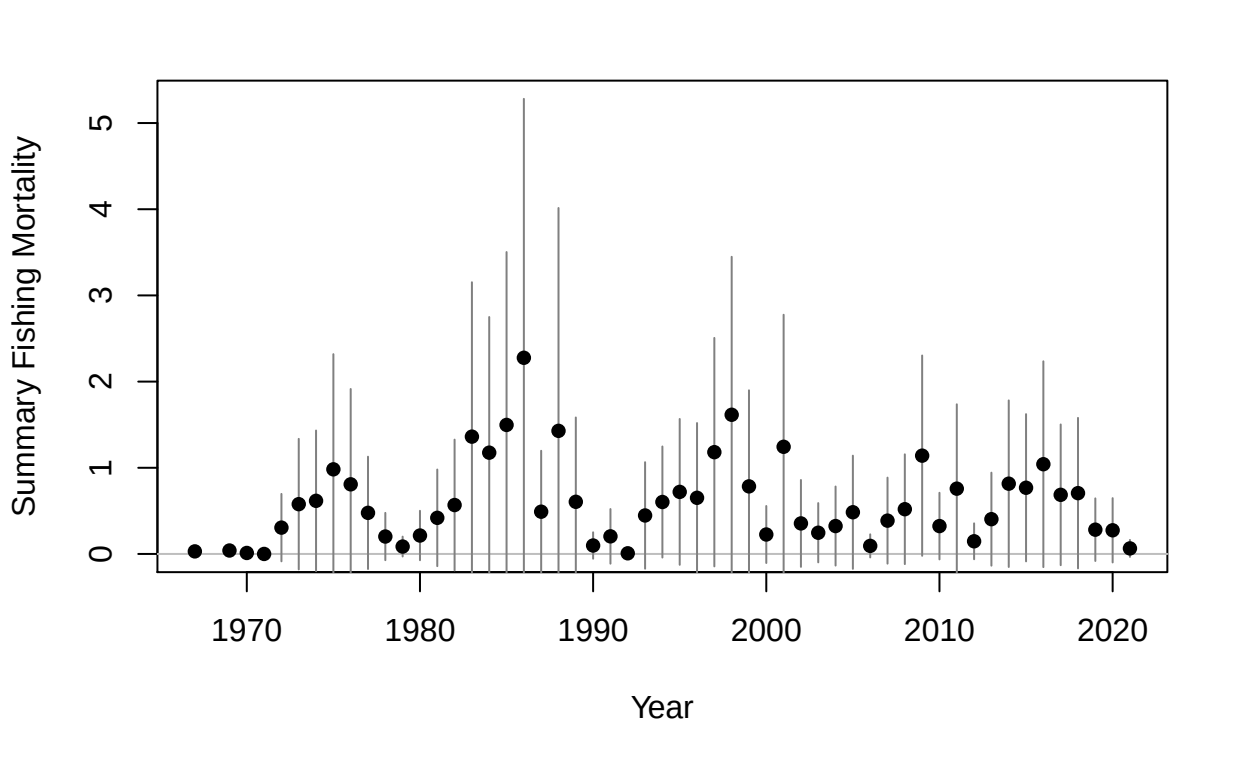

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

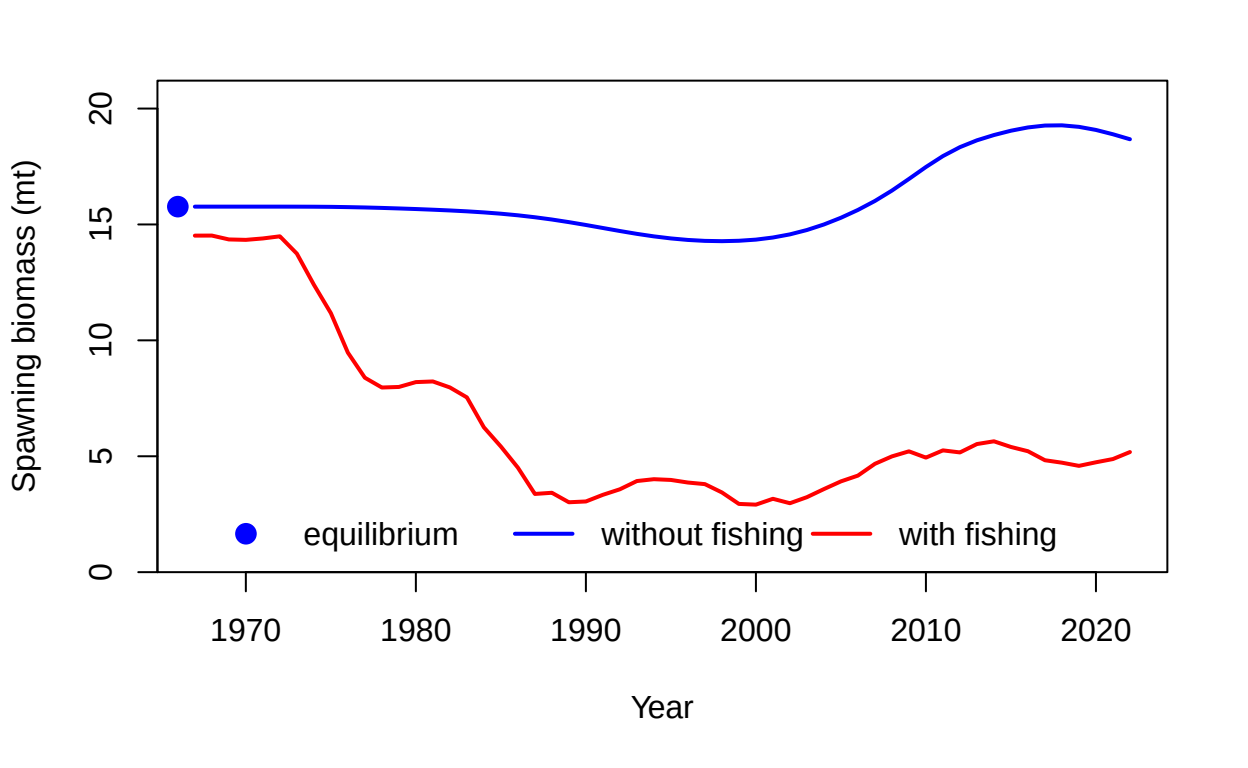

Total biomass (mt)
0
10
20
30
40
1970
1980
1990
2000
2010
2020
Year

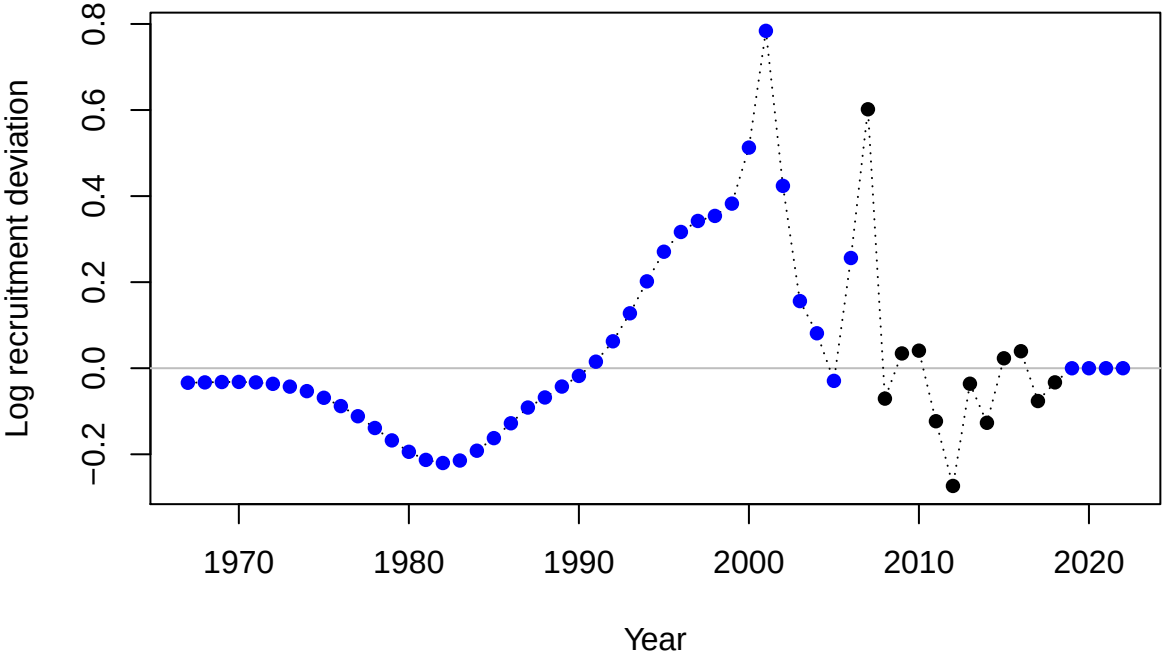

Summary biomass (mt)
0
10
20
30
40
1970
1980
1990
2000
2010
2020
Year

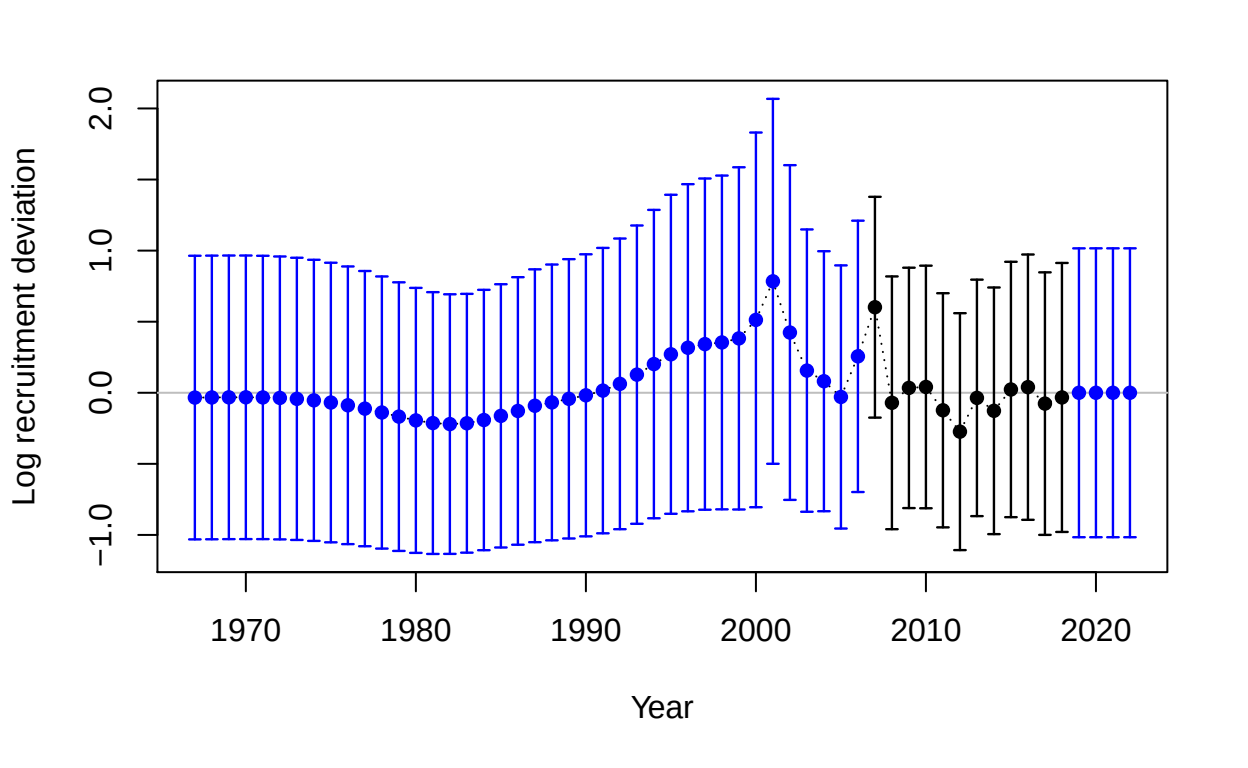

Age−0 recruits (1,000s)
0.0
0.5
1.0
1.5
2.0
1970
1980
1990
2000
2010
2020
Year

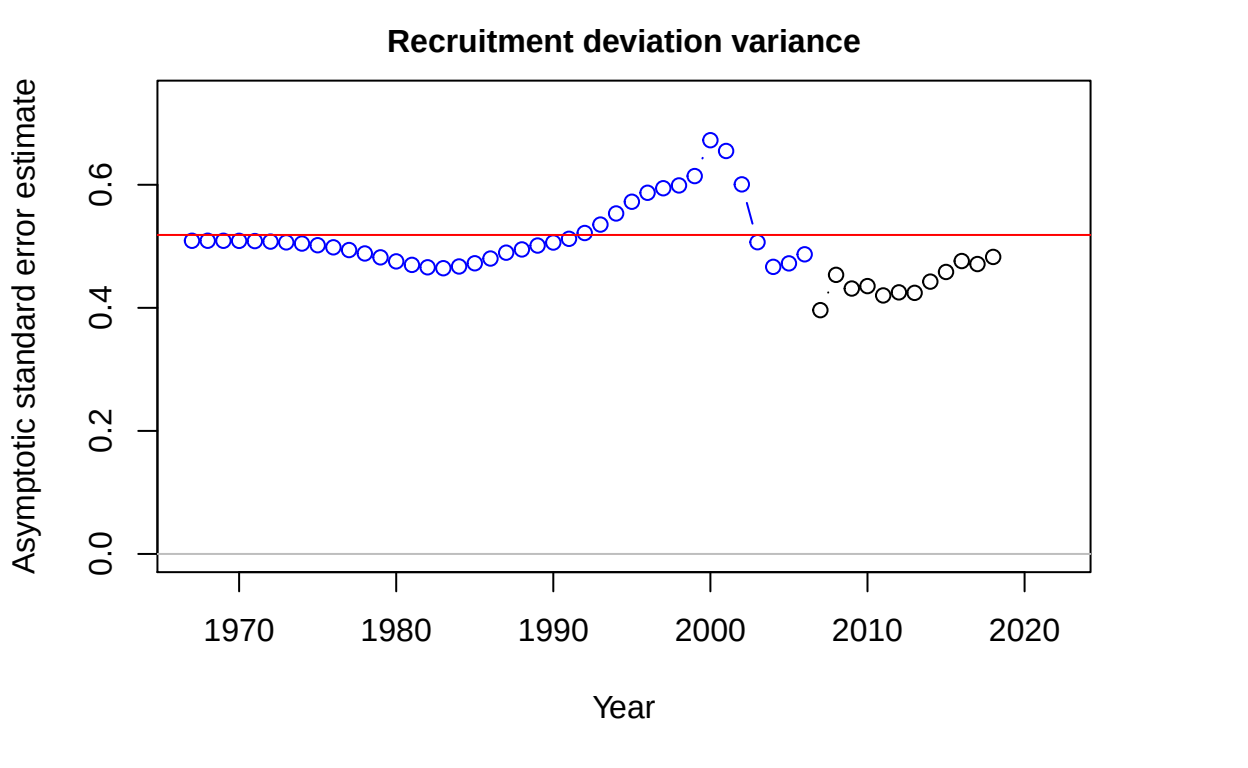

Age−0 recruits (1,000s)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

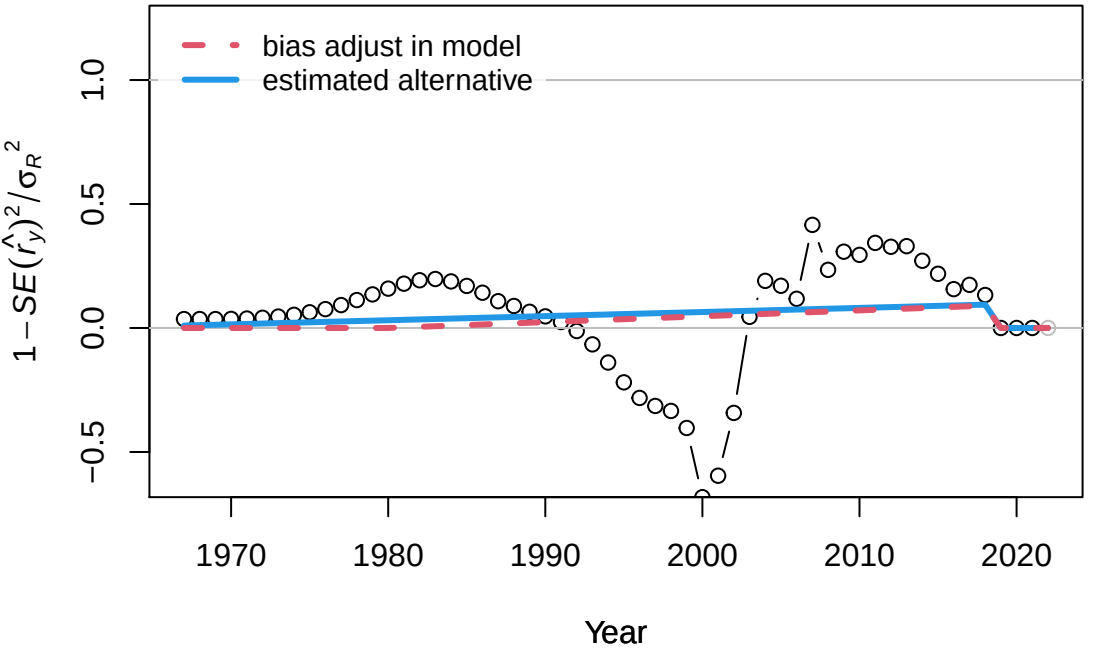

Summary Fishing Mortality
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

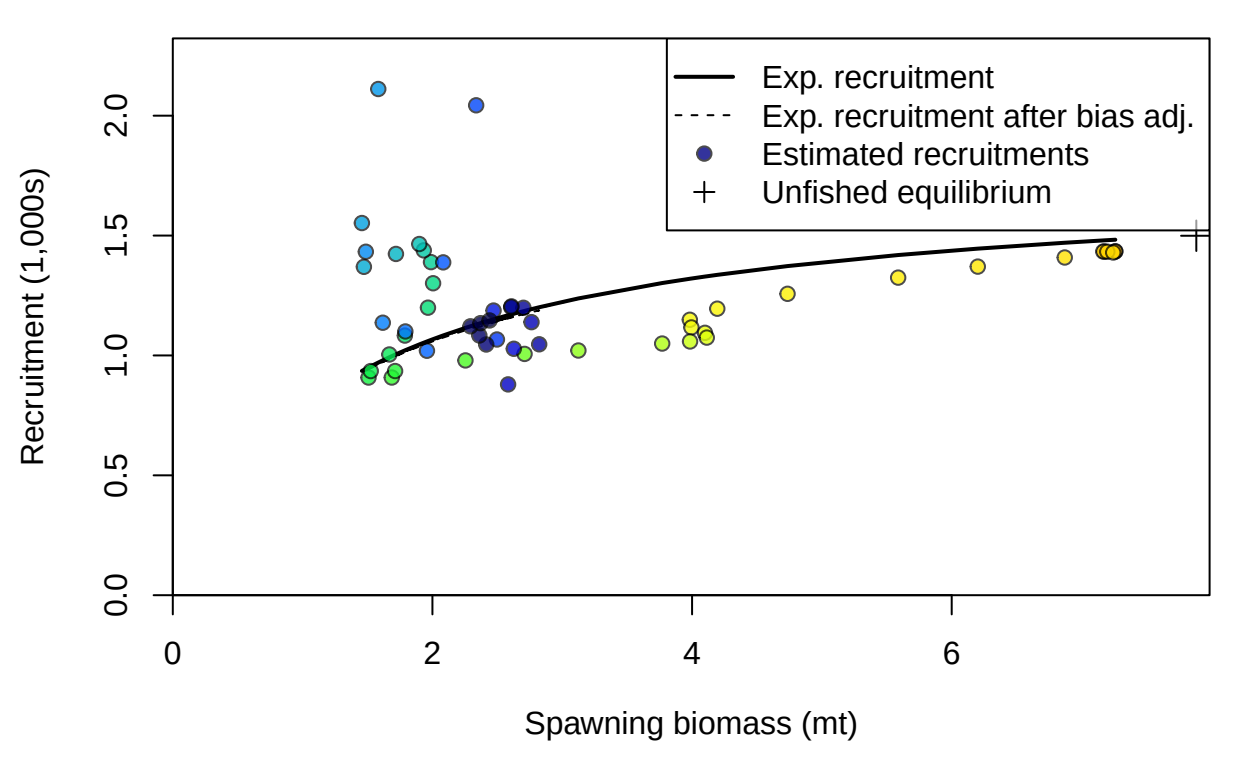

Spawning biomass (mt)
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

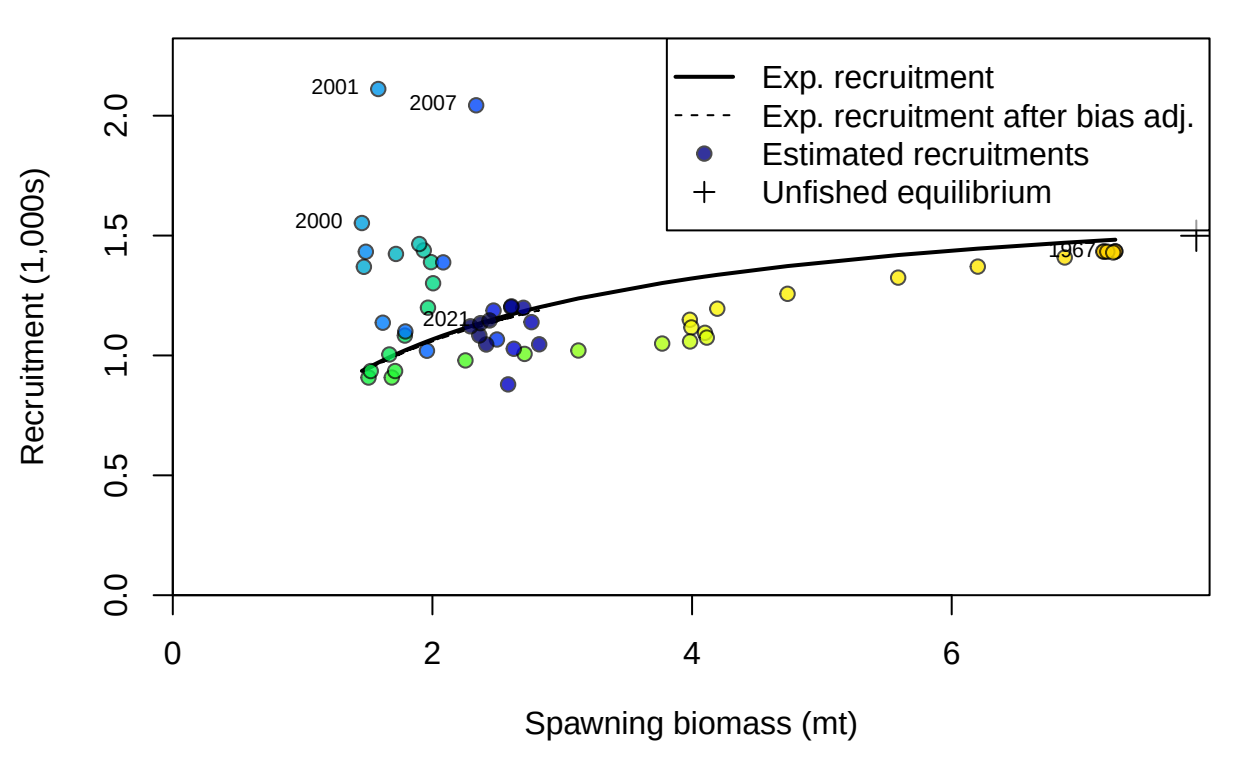

Log recruitment deviation
−0.2
0.0
0.2
0.4
0.6
0.8
1970
1980
1990
2000
2010
2020
Year

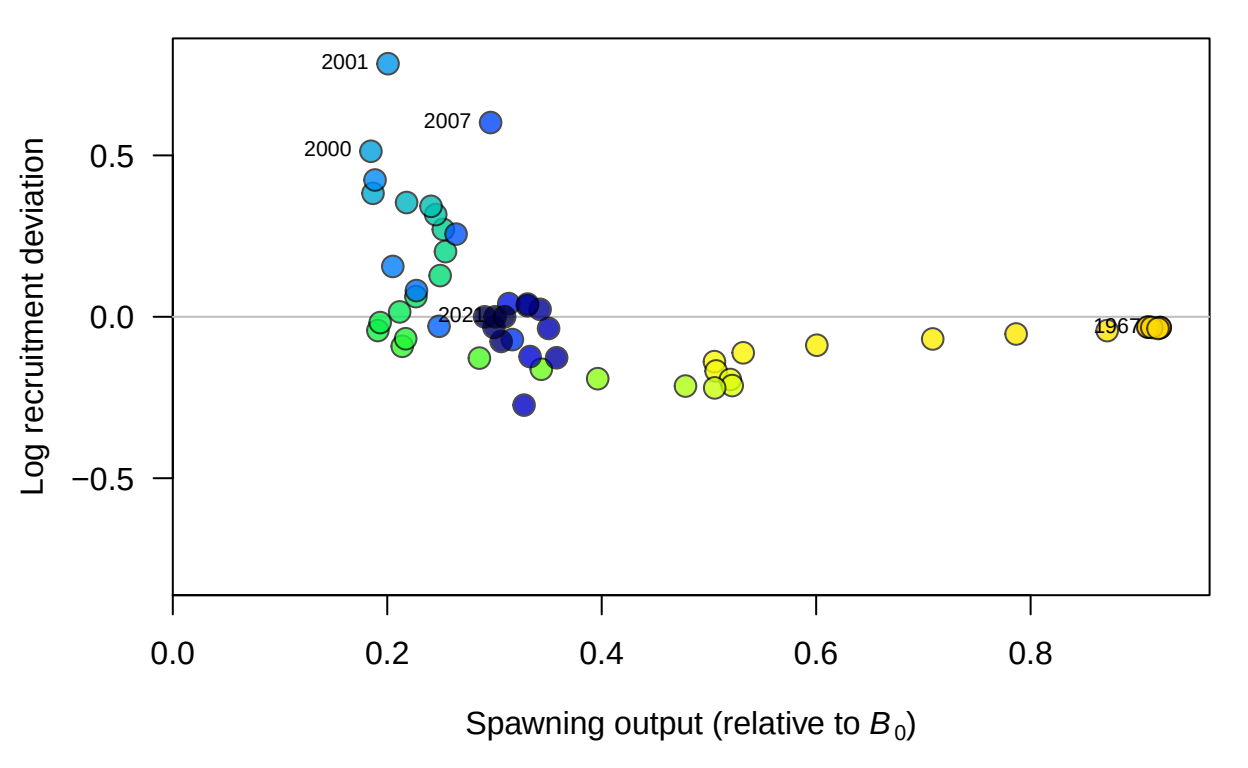

Log recruitment deviation
2.0
1.0
0.0
−1.0
1970
1980
1990
2000
2010
2020
Year

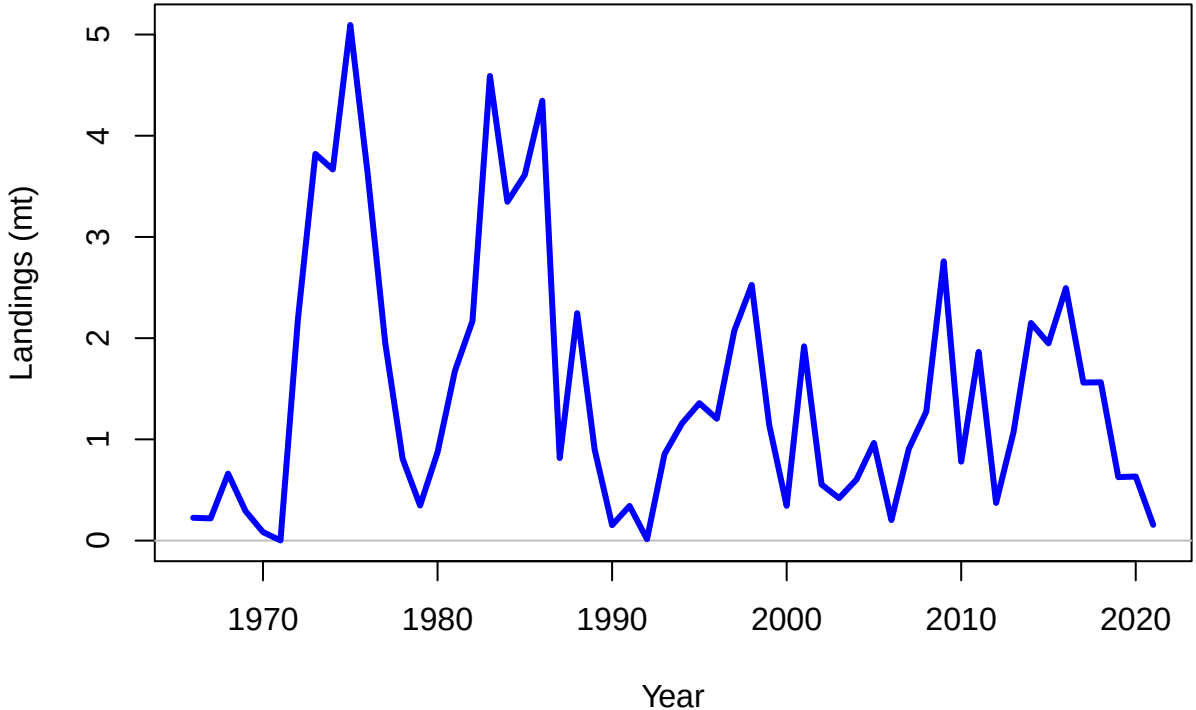

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

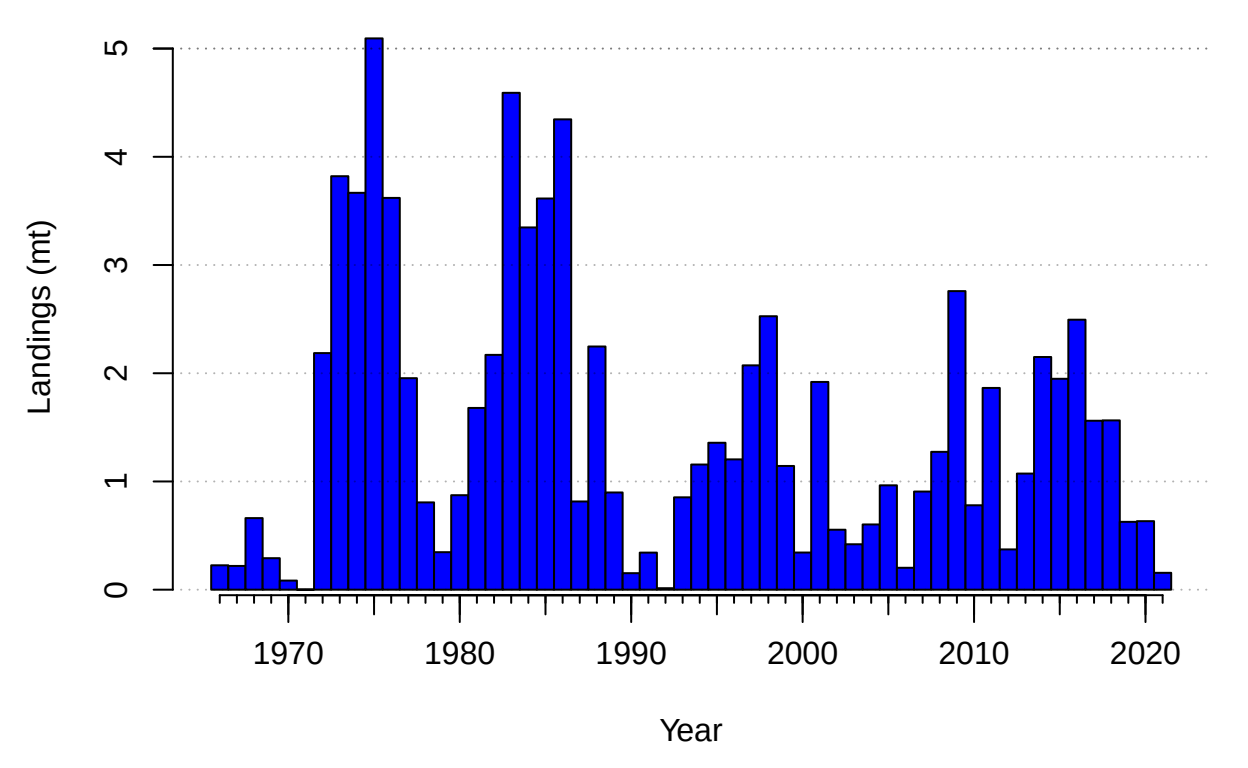

bias adjust in model
estimated alternative
1.0
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year
$1-SE(\hat{r}_y)^2/\sigma_R^2$

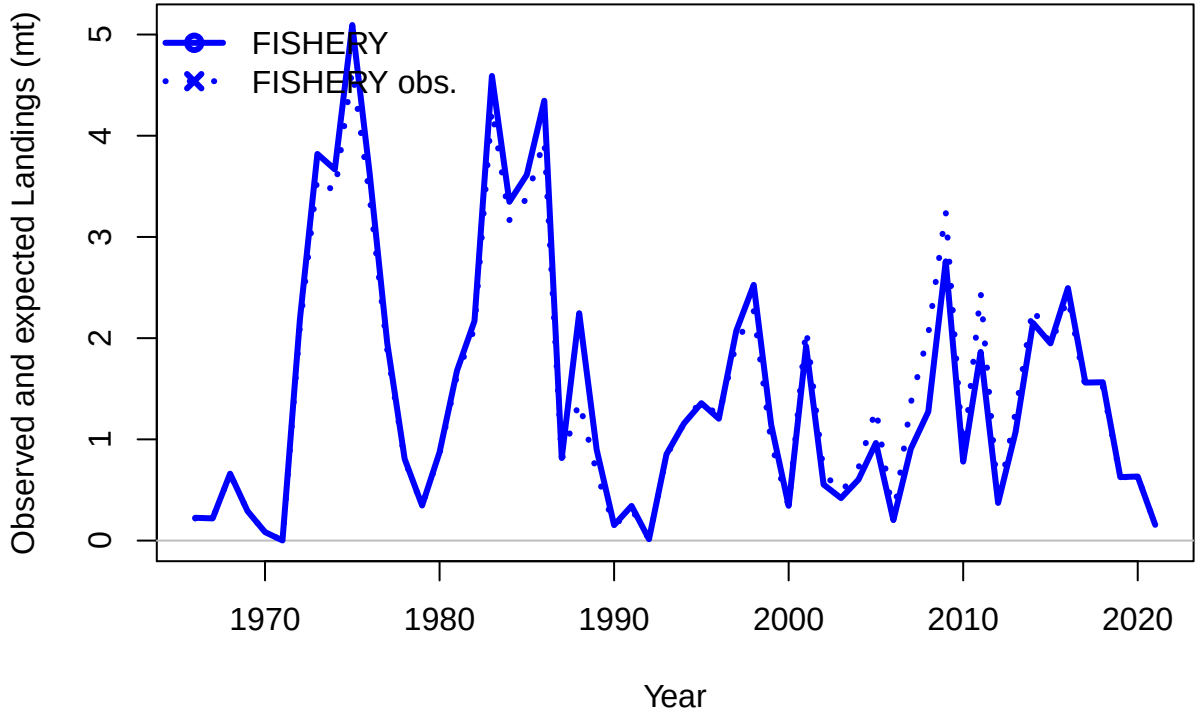

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0.0
0.5
1.0
1.5
2.0
0
2
4
6
Spawning biomass (mt)

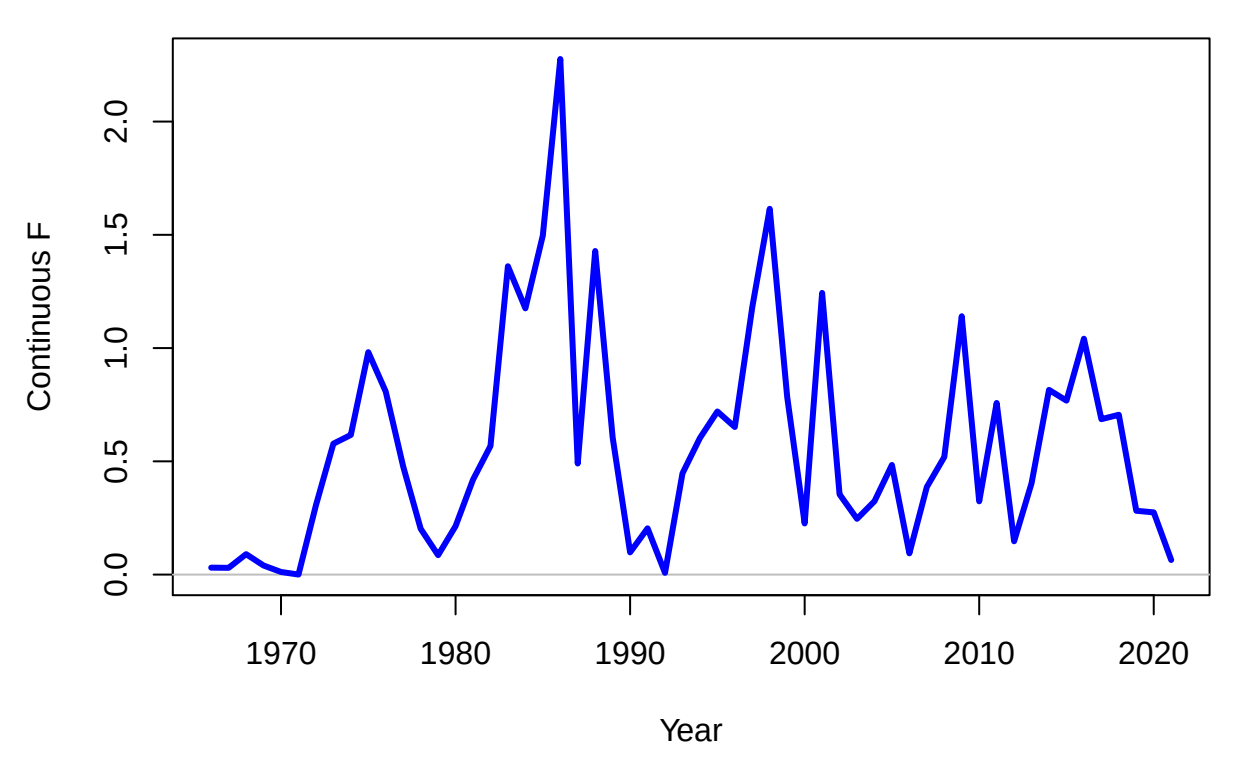

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
2001
2007
2000
2021
1967
Recruitment (1,000s)
0.0
0.5
1.0
1.5
2.0
0
2
4
6
Spawning biomass (mt)

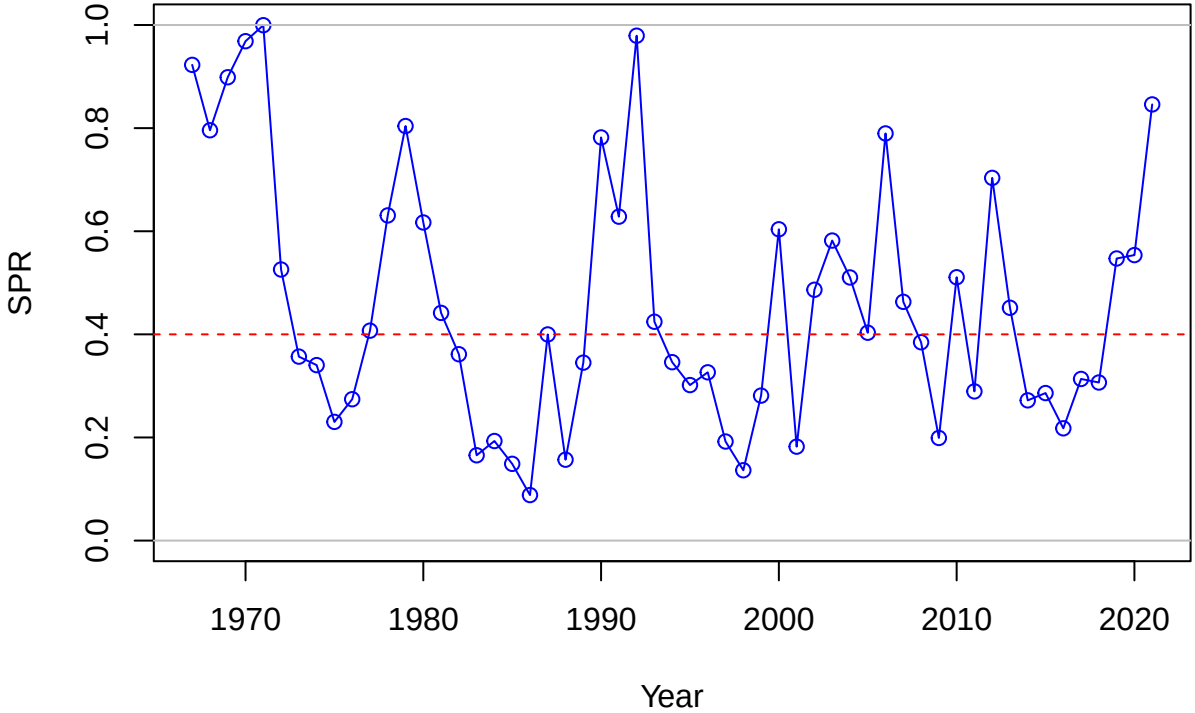

2001
2007
2000
2021
1967
0.5
0.0
−0.5
Log recruitment deviation
0.0
0.2
0.4
0.6
0.8
Spawning output (relative to B_0)

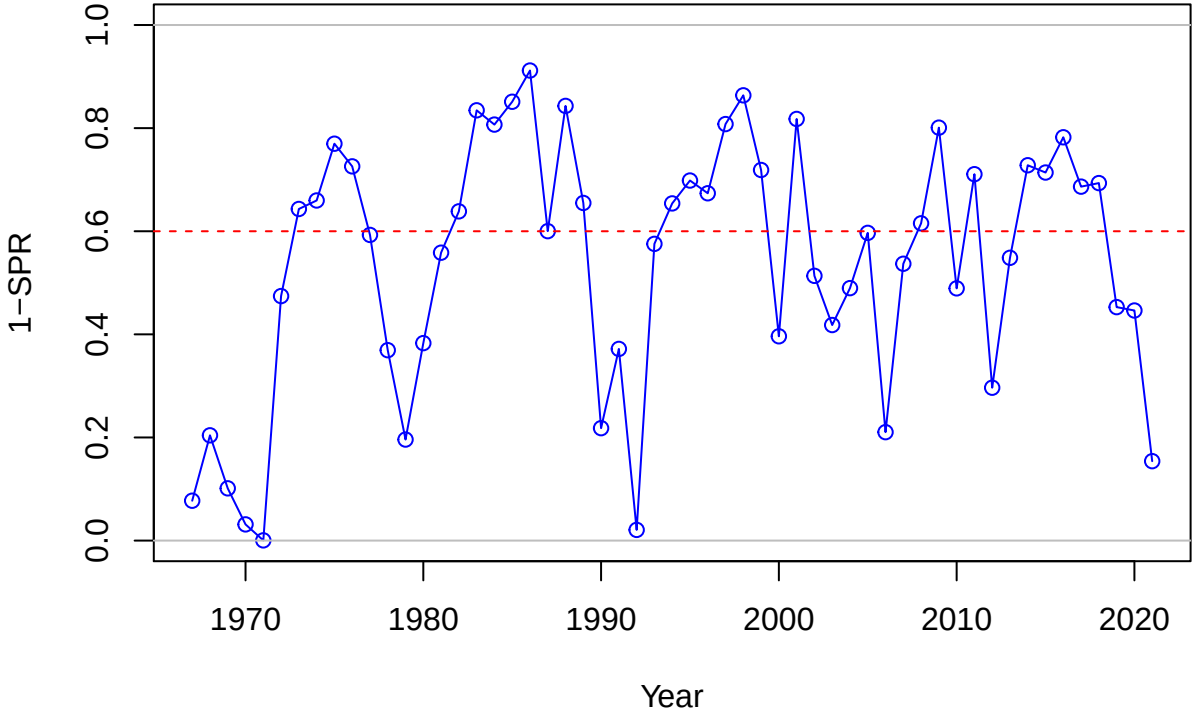

Landings (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

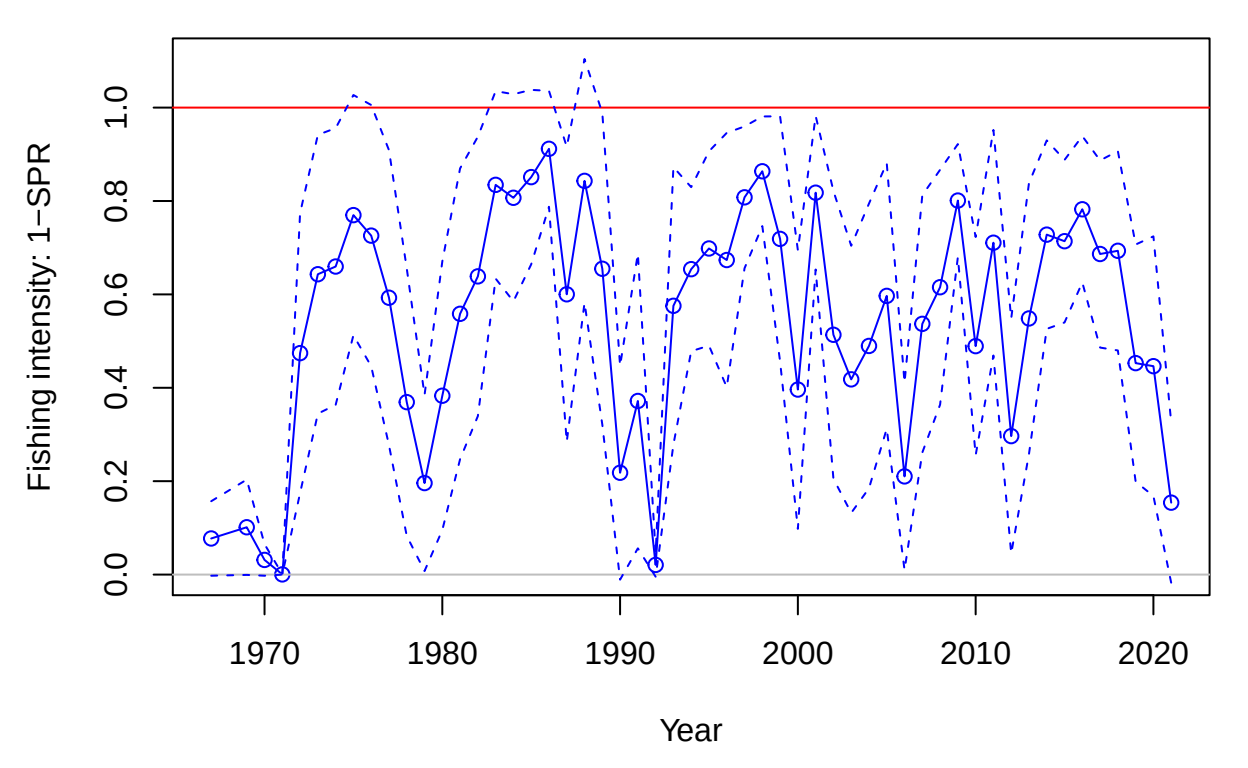

Landings (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

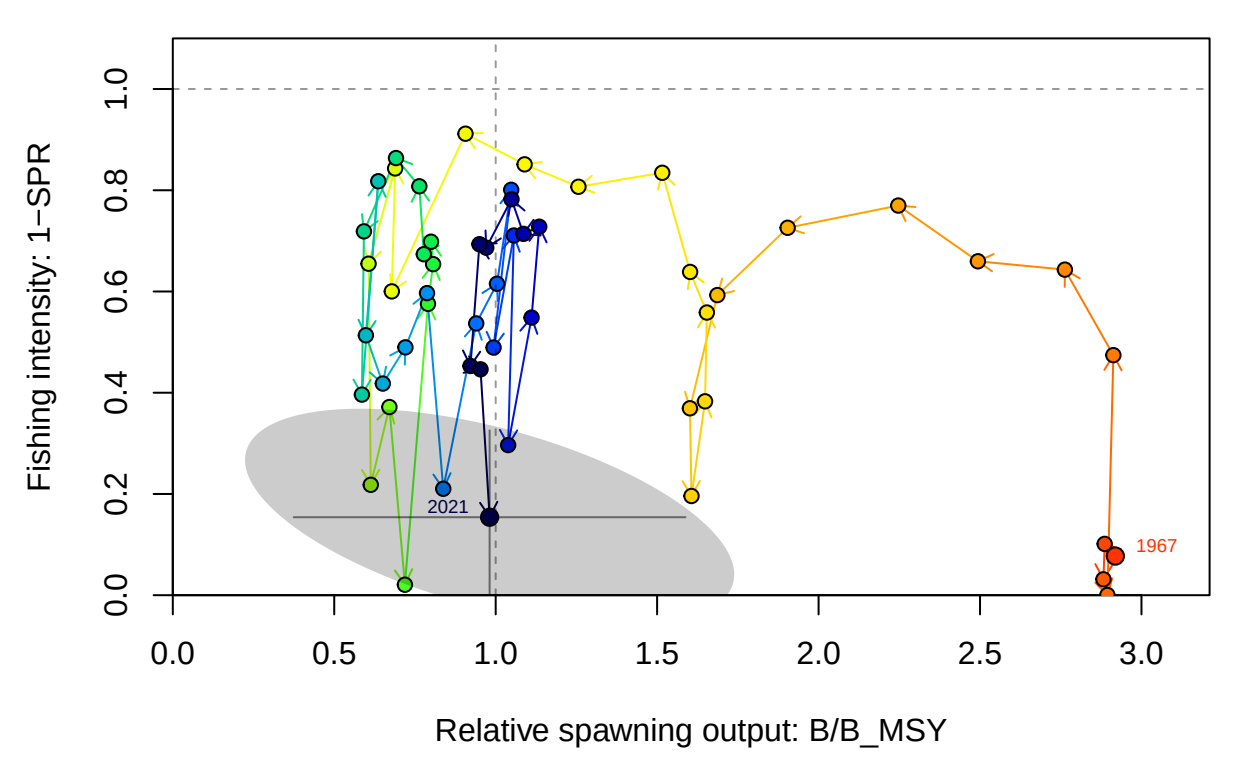

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

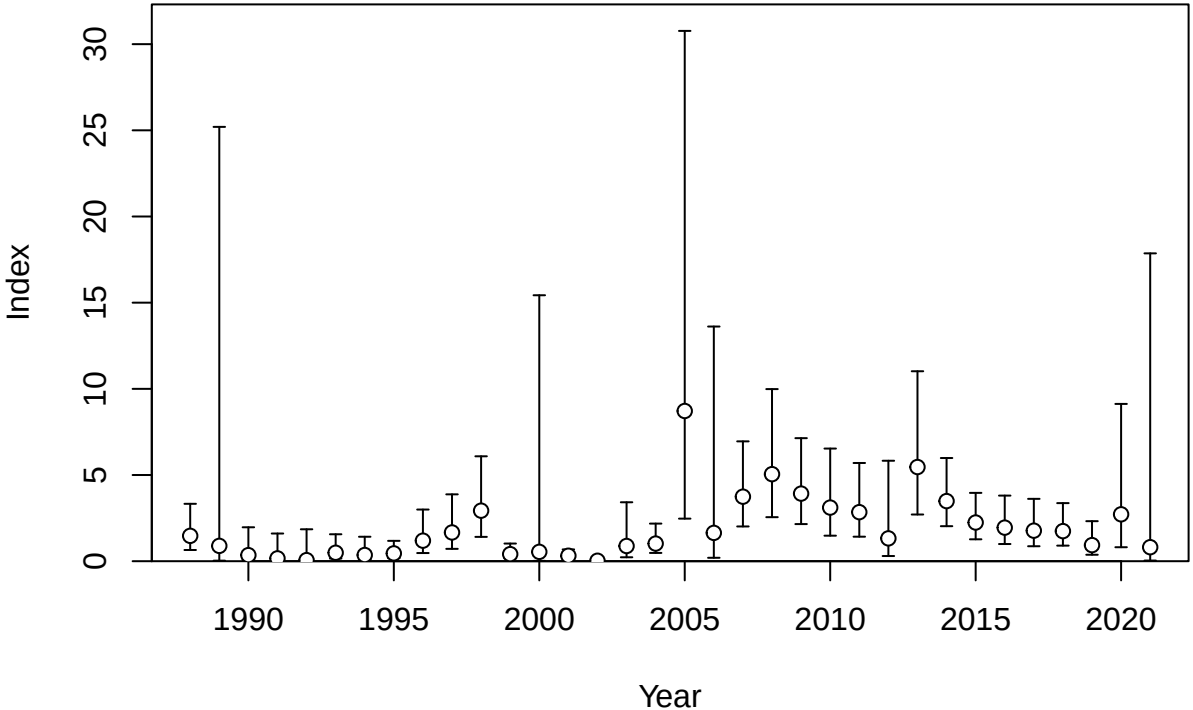

Continuous F
0.0
0.5
1.0
1.5
2.0
1970
1980
1990
2000
2010
2020
Year

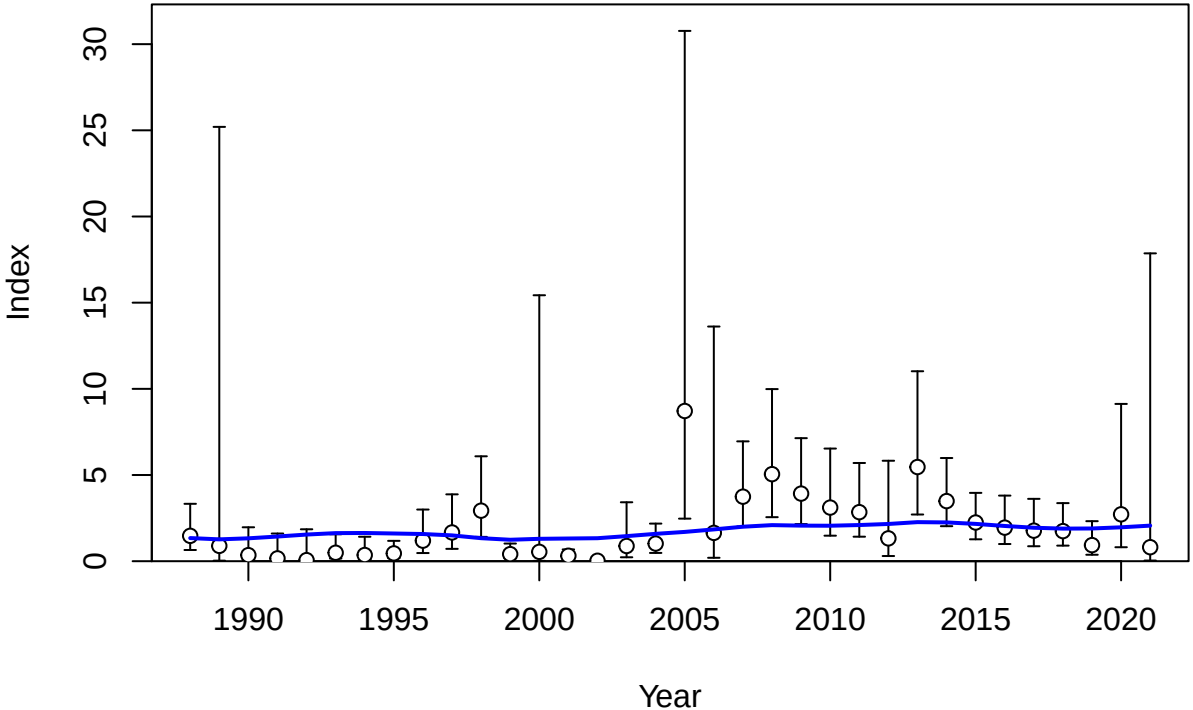

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

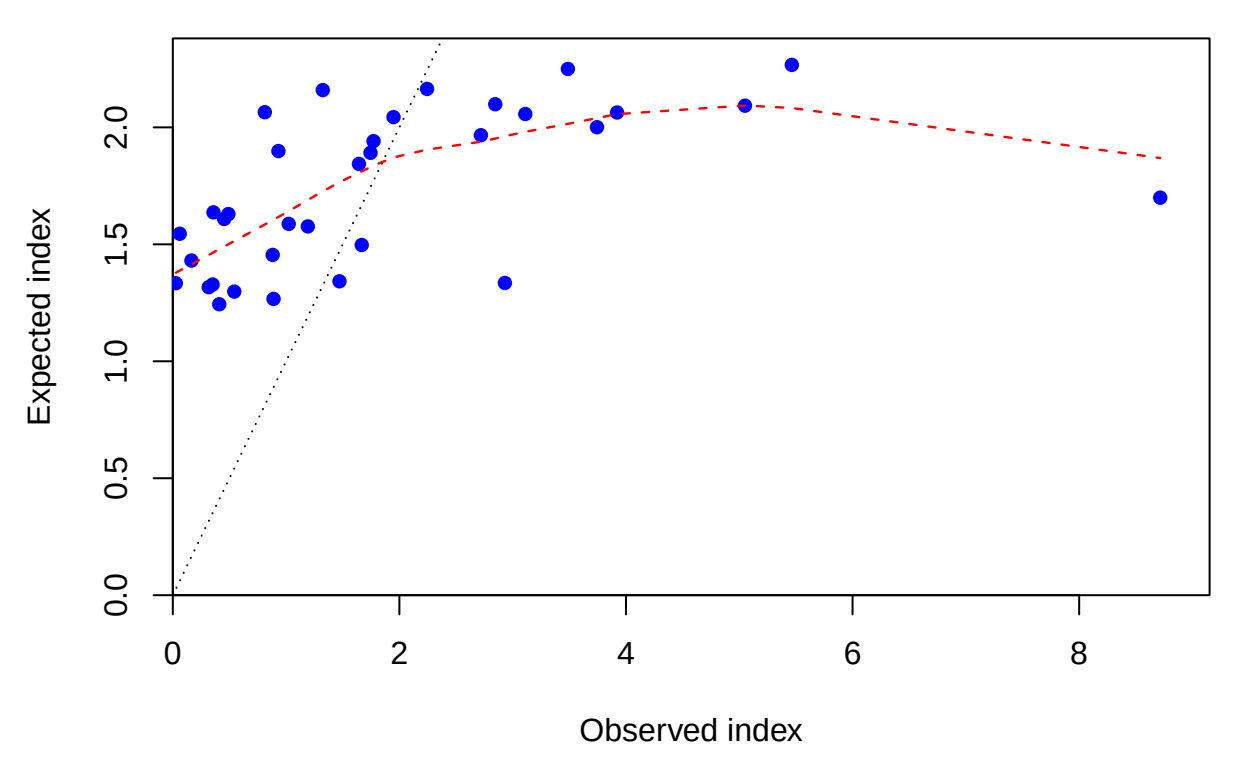

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

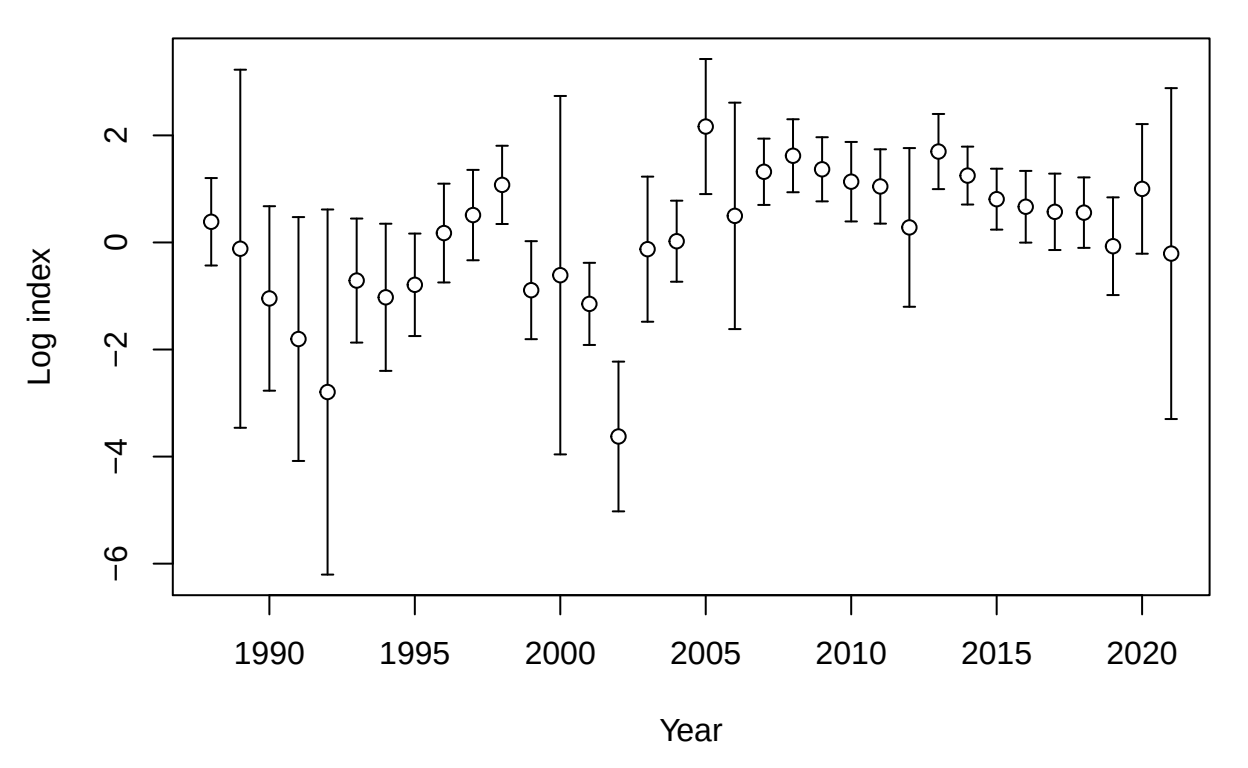

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

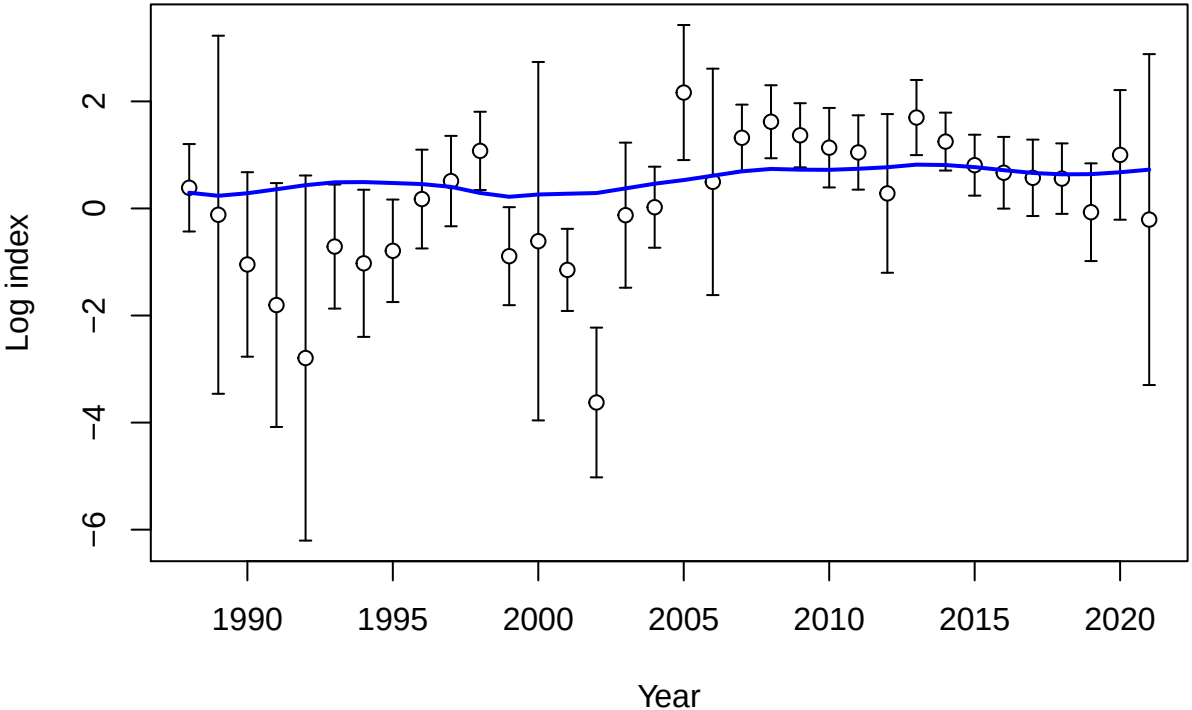

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Relative spawning output: B/B_MSY
2021
1967

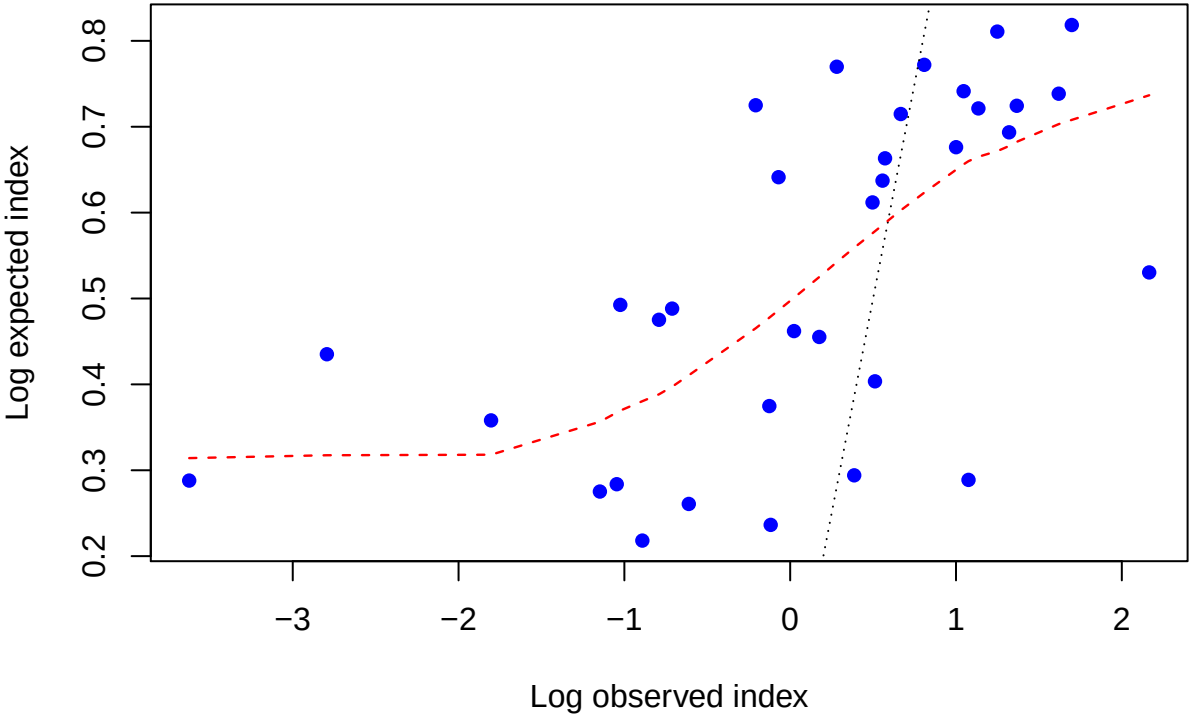

Index
0
5
10
15
20
25
30
1990
1995
2000
2005
2010
2015
2020
Year

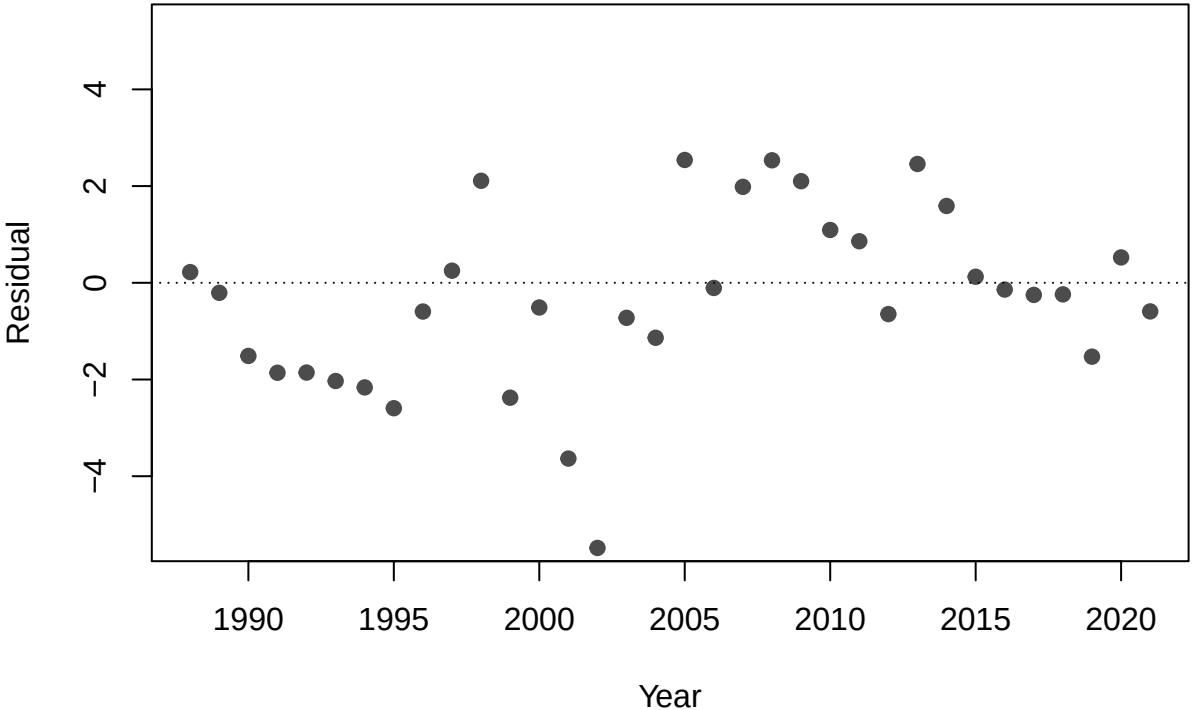

Index
0
5
10
15
20
25
30
1990
1995
2000
2005
2010
2015
2020
Year

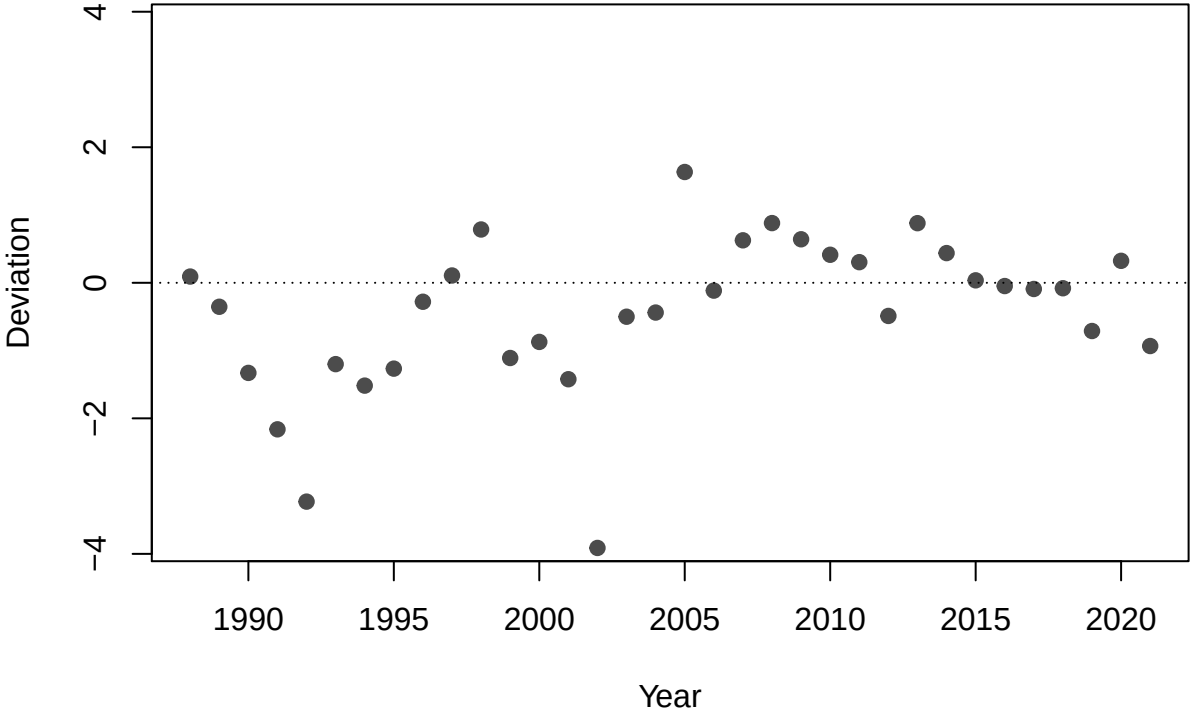

Expected index
0.0
0.5
1.0
1.5
2.0
0
2
4
6
8
Observed index

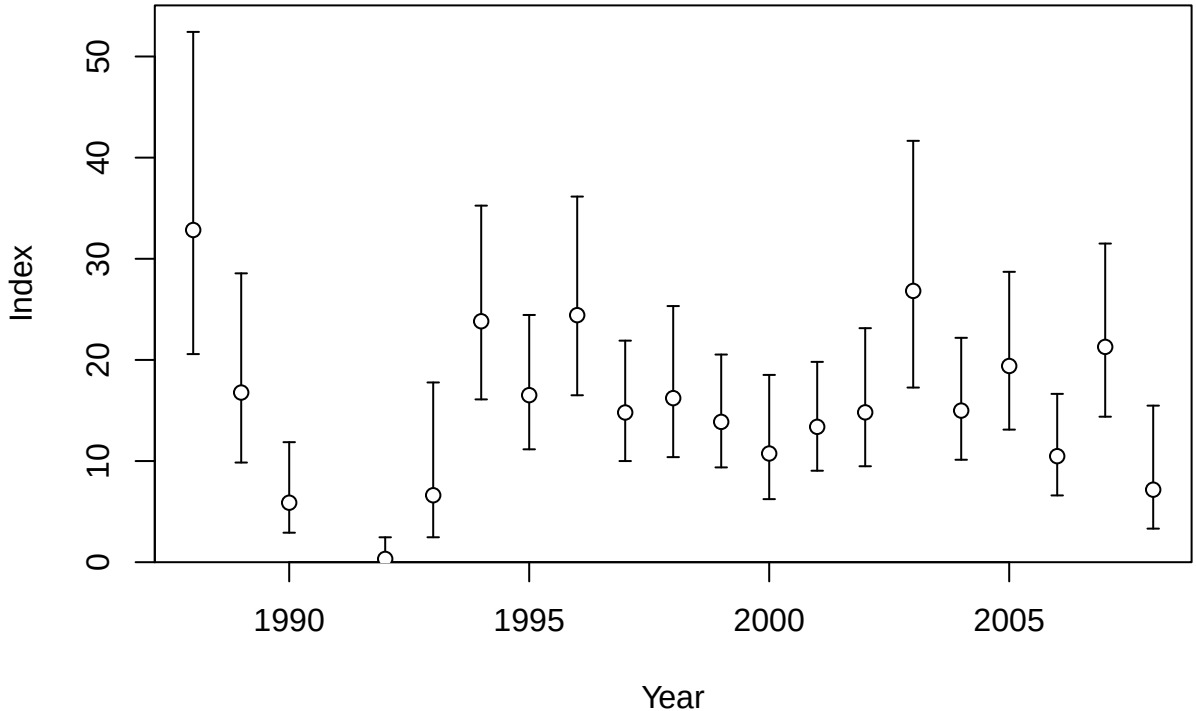

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

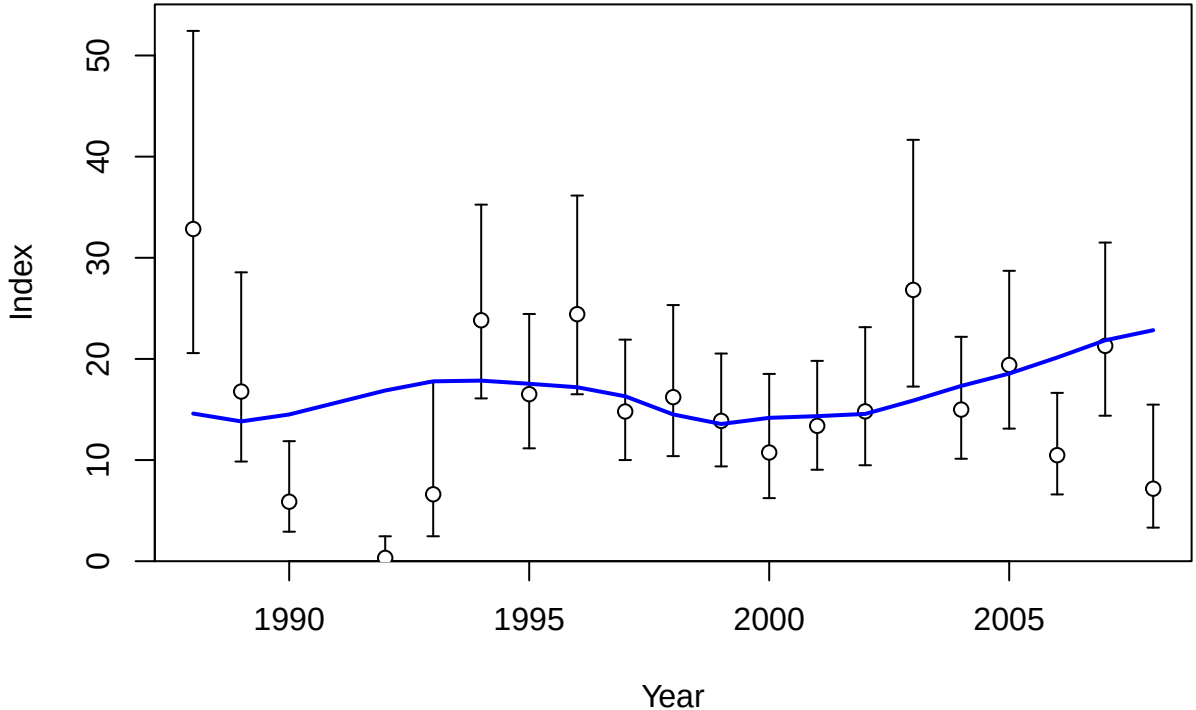

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

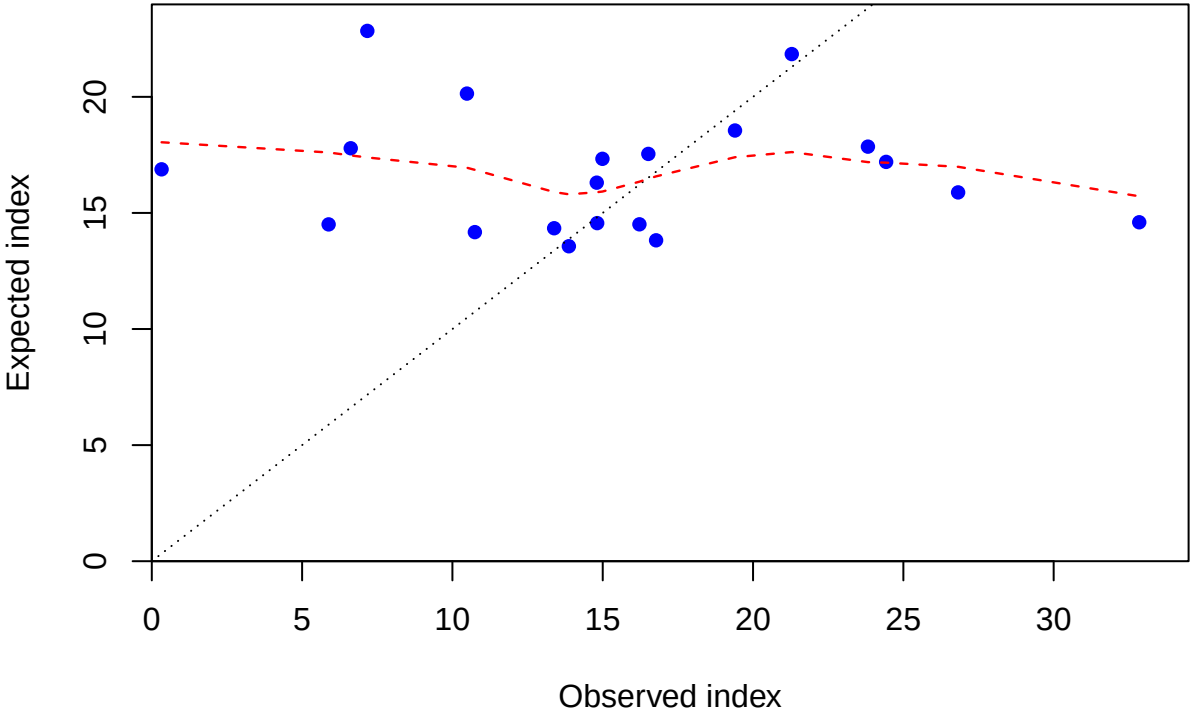

Log expected index
0.2
0.3
0.4
0.5
0.6
0.7
0.8
−3
−2
−1
0
1
2
Log observed index

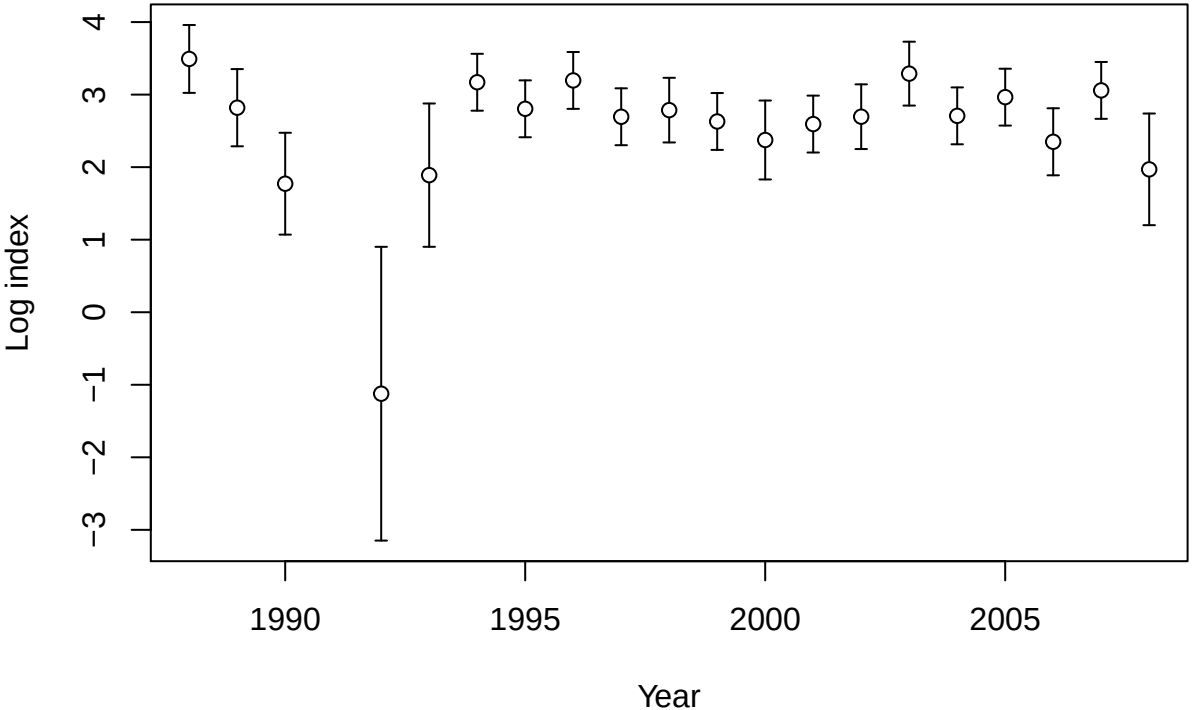

Residual
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

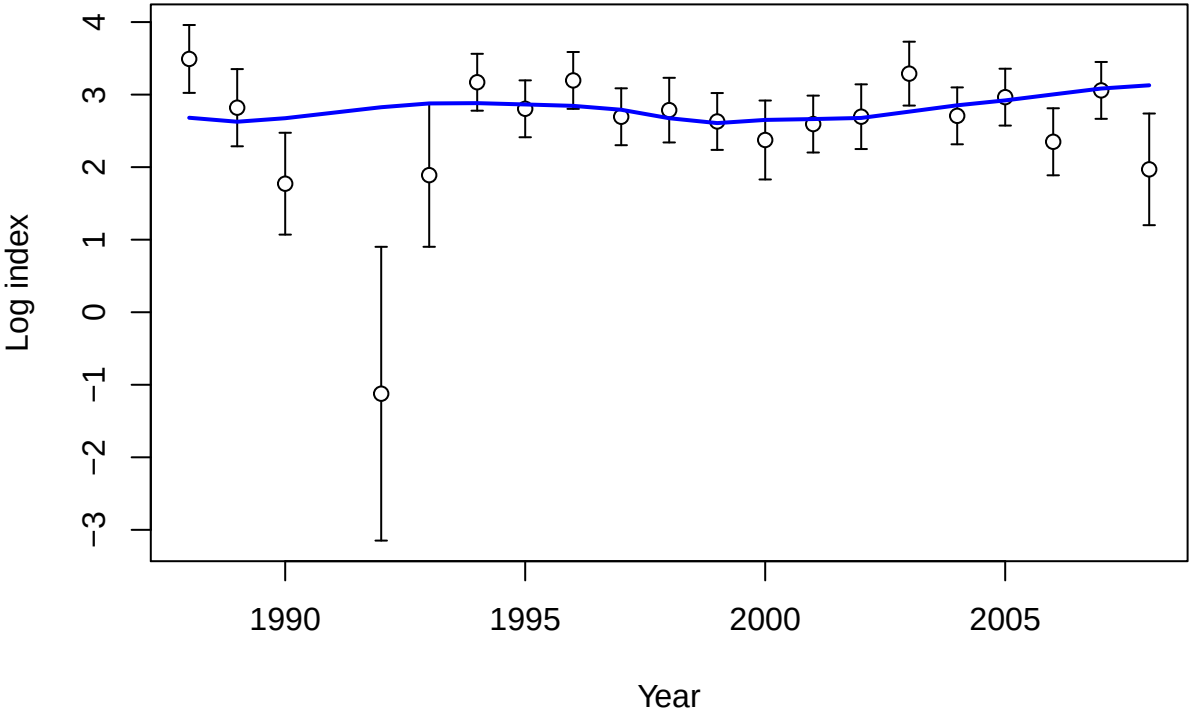

Deviation
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

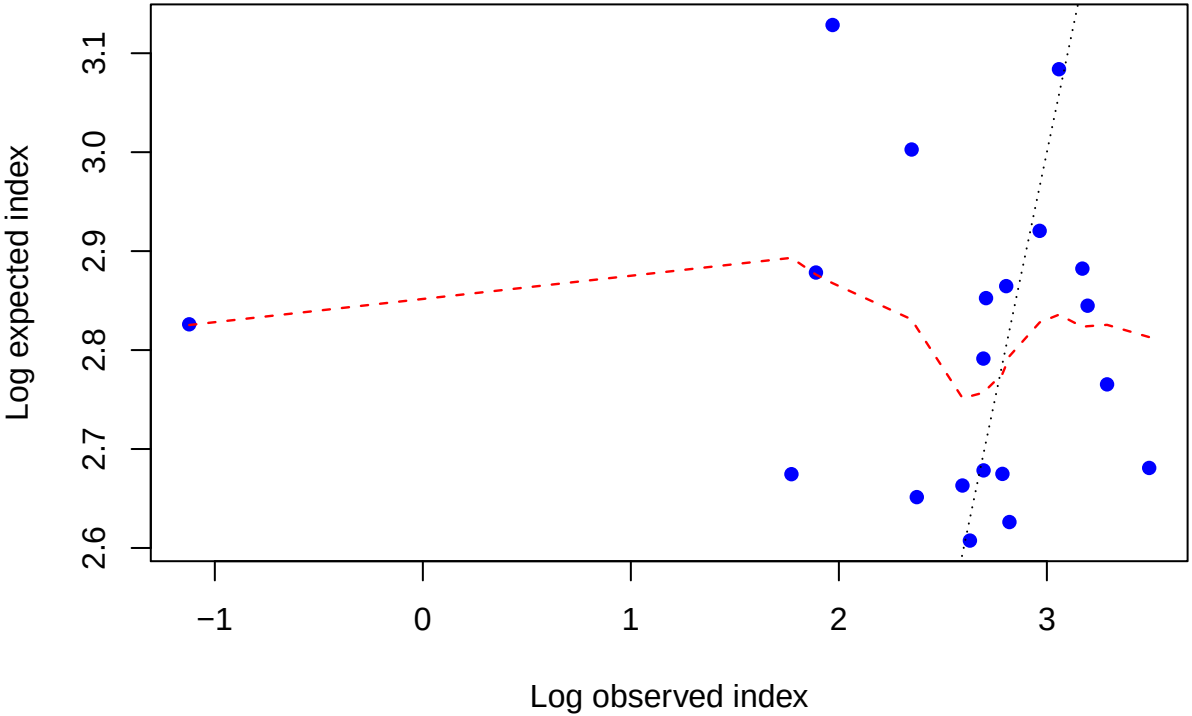

Index
0
10
20
30
40
50
1990
1995
2000
2005
Year

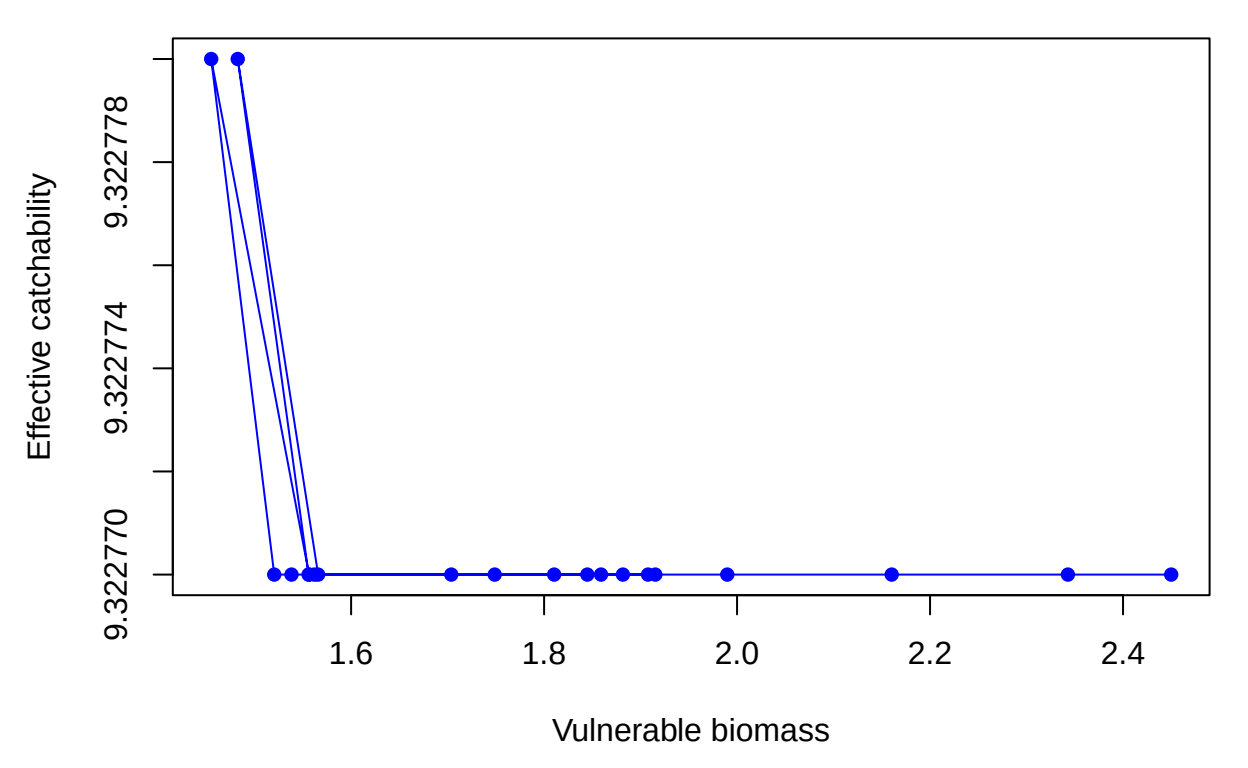

Index
0
10
20
30
40
50
1990
1995
2000
2005
Year

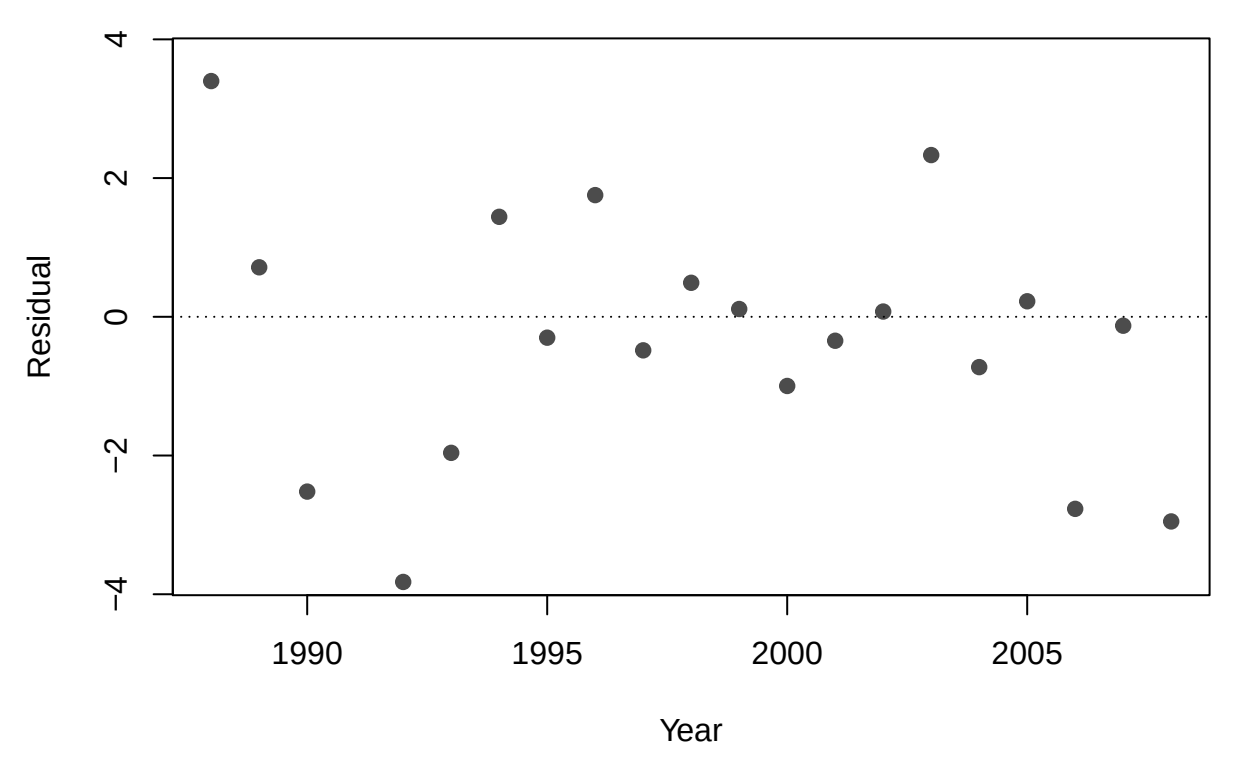

Expected index
0
5
10
15
20
0
5
10
15
20
25
30
Observed index

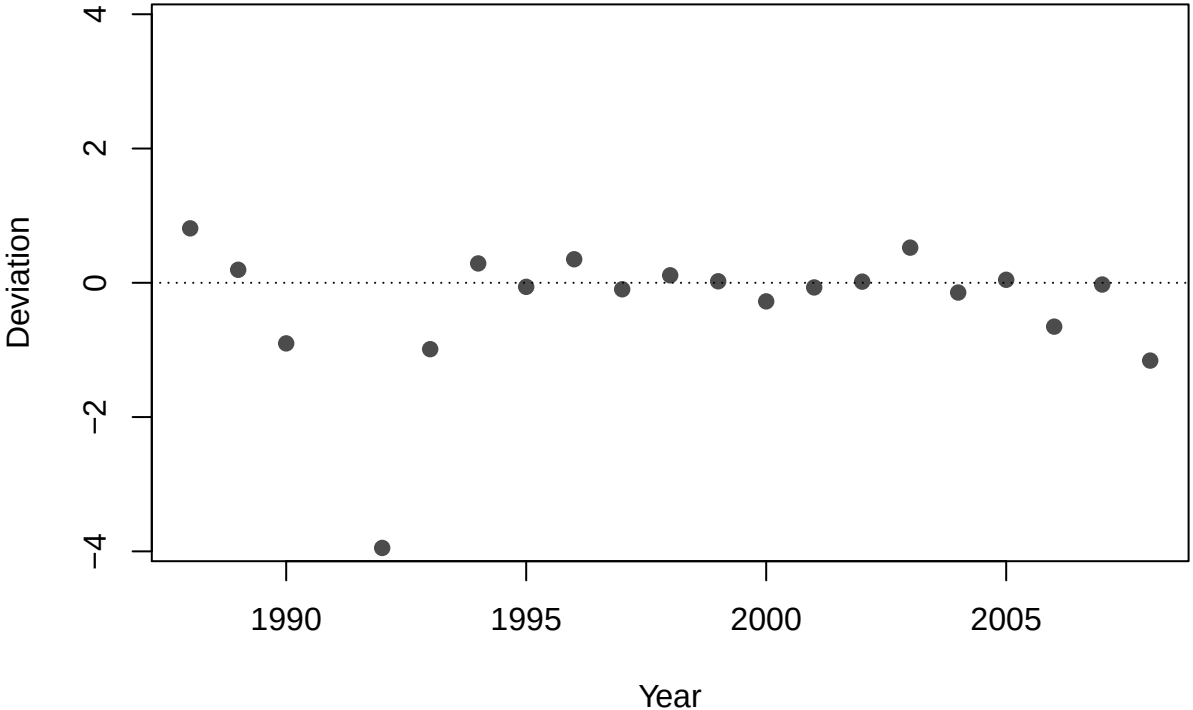

Log index
4
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
Year

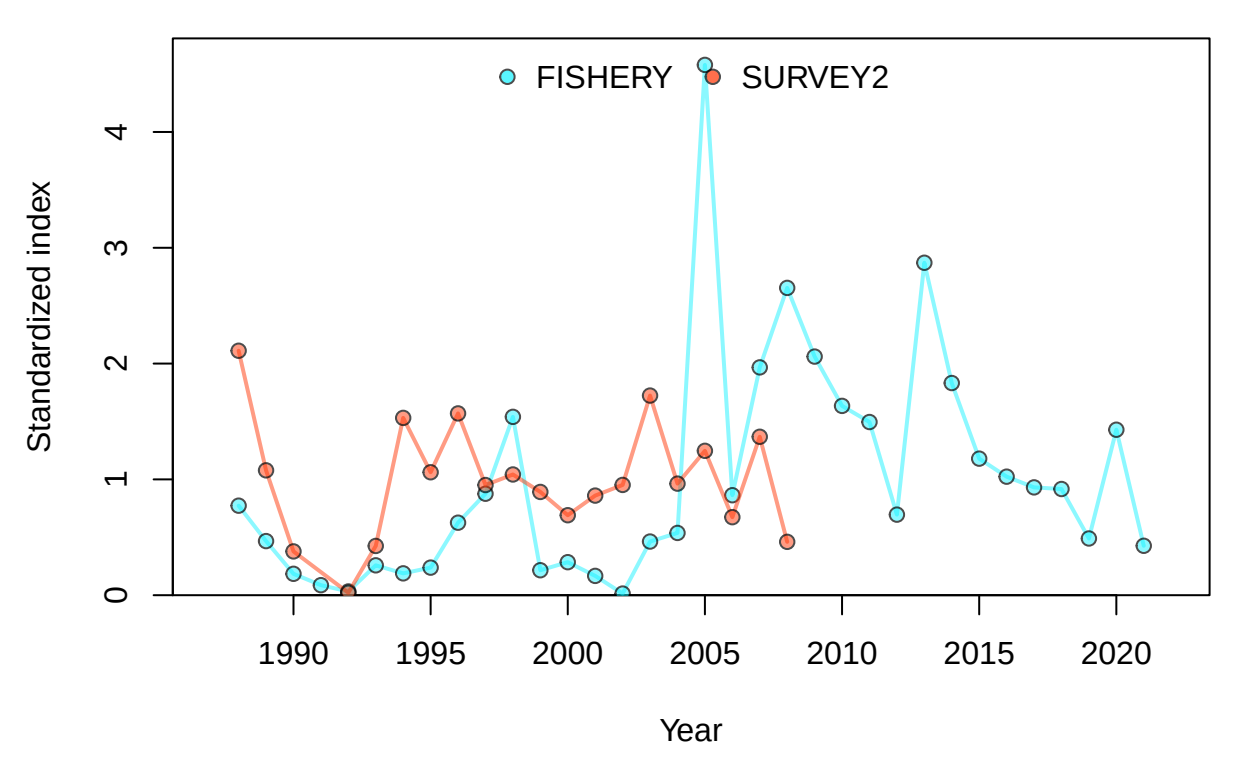

Log index
4
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
Year

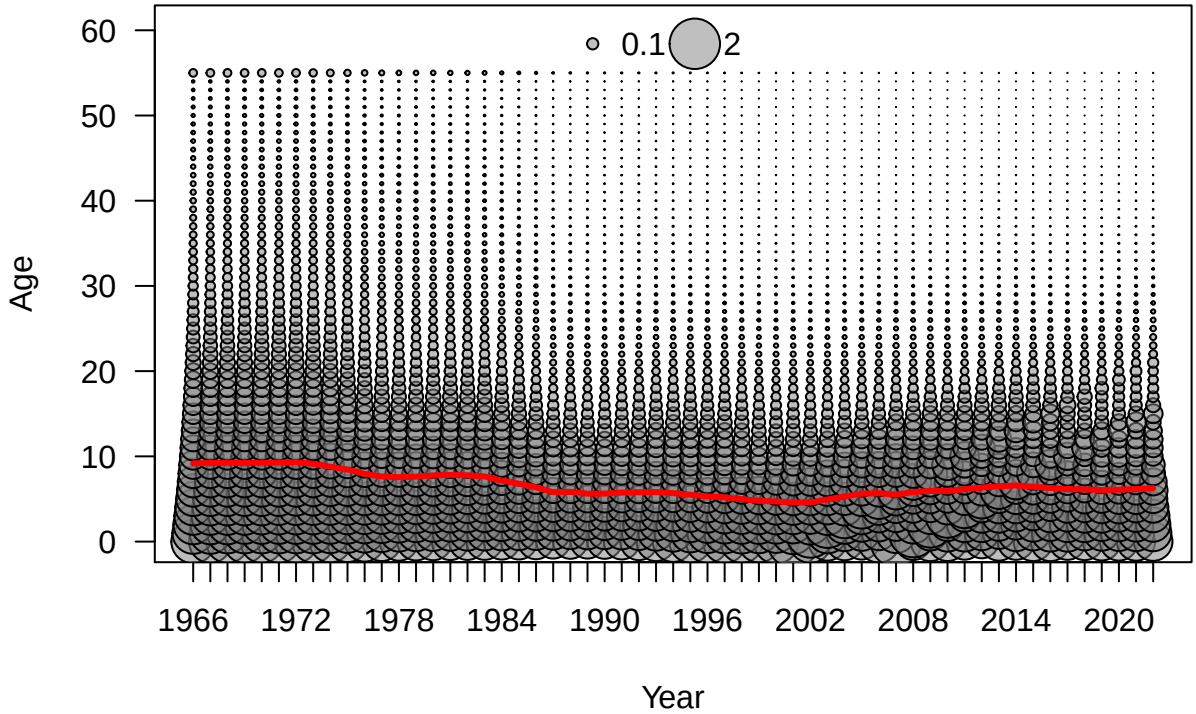

Log expected index
3.1
3.0
2.9
2.8
2.7
2.6
−1
0
1
2
3
Log observed index

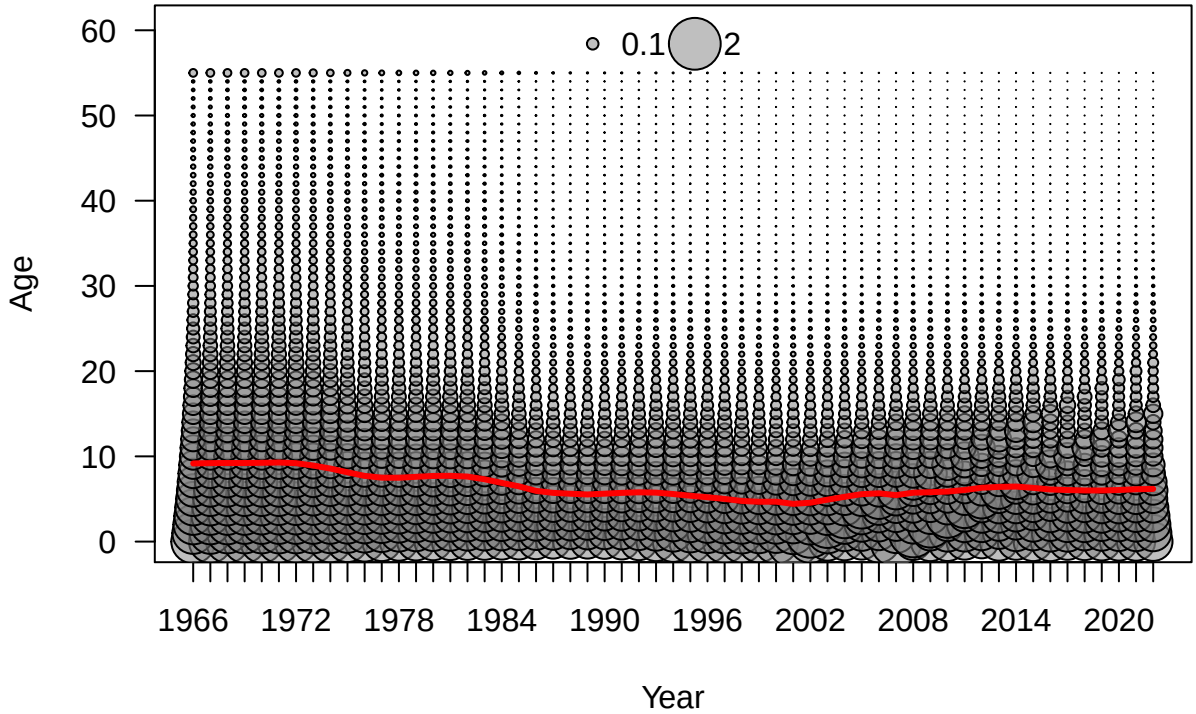

Effective catchability
9.322770
9.322774
9.322778
1.6
1.8
2.0
2.2
2.4
Vulnerable biomass

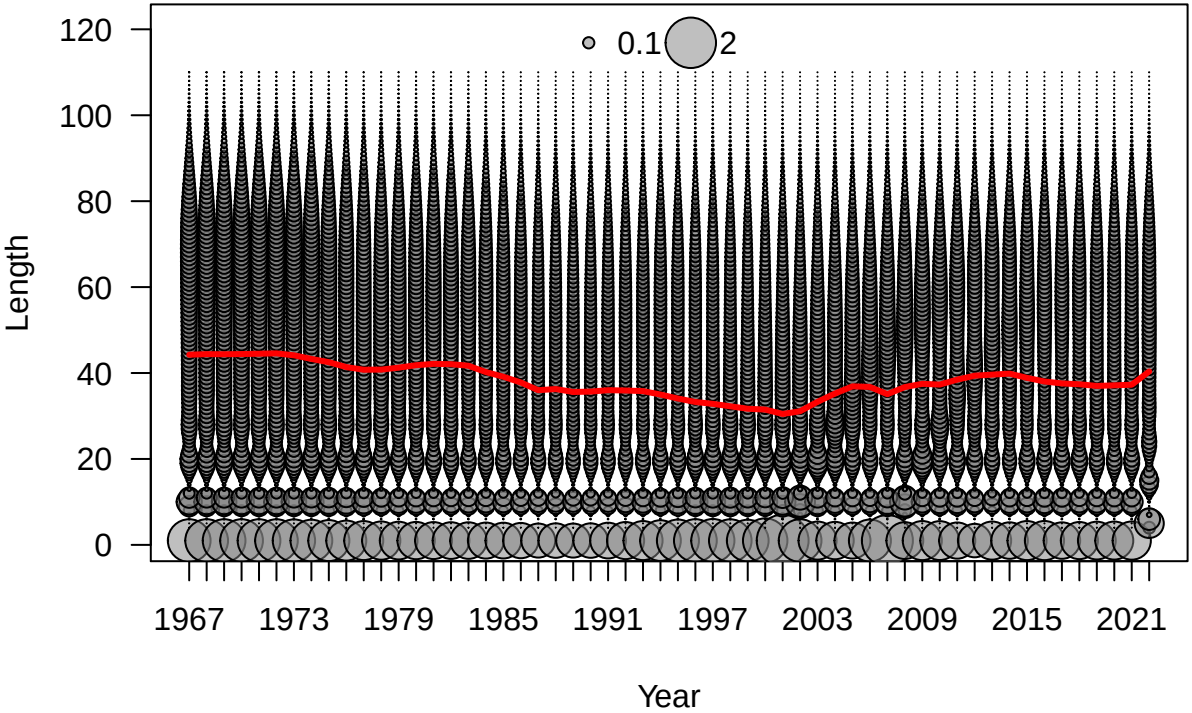

Residual
4
2
0
−2
−4
1990
1995
2000
2005
Year

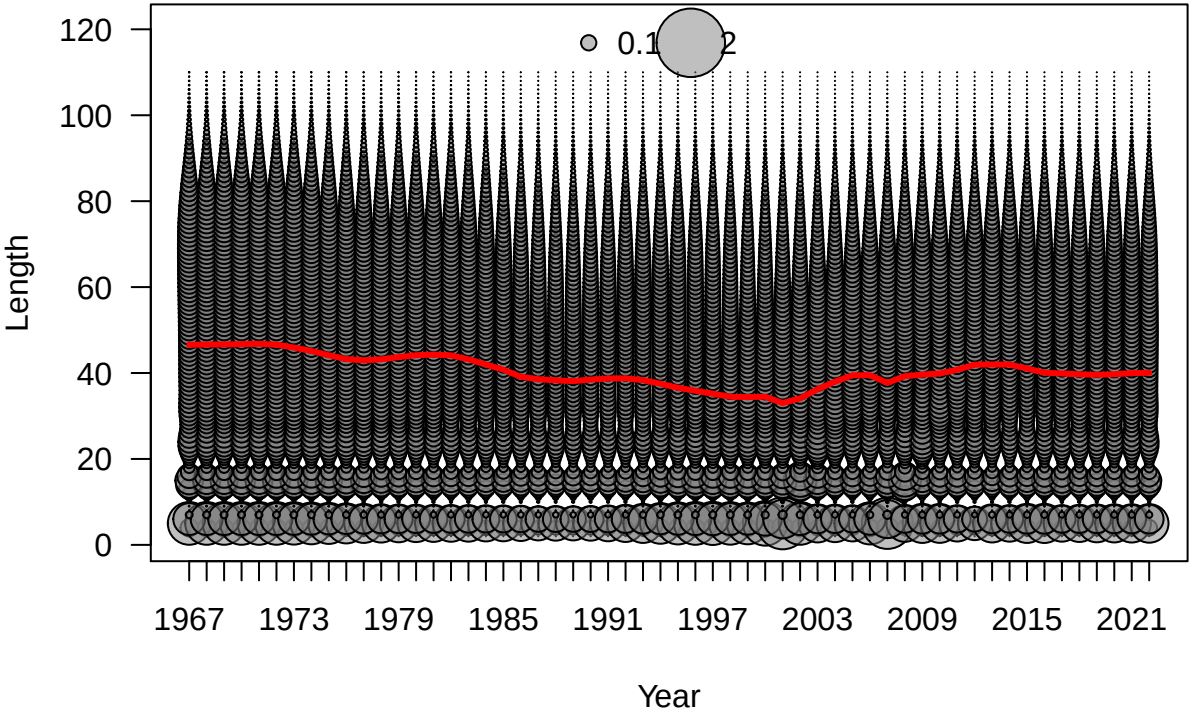

Deviation
4
2
0
−2
−4
1990
1995
2000
2005
Year

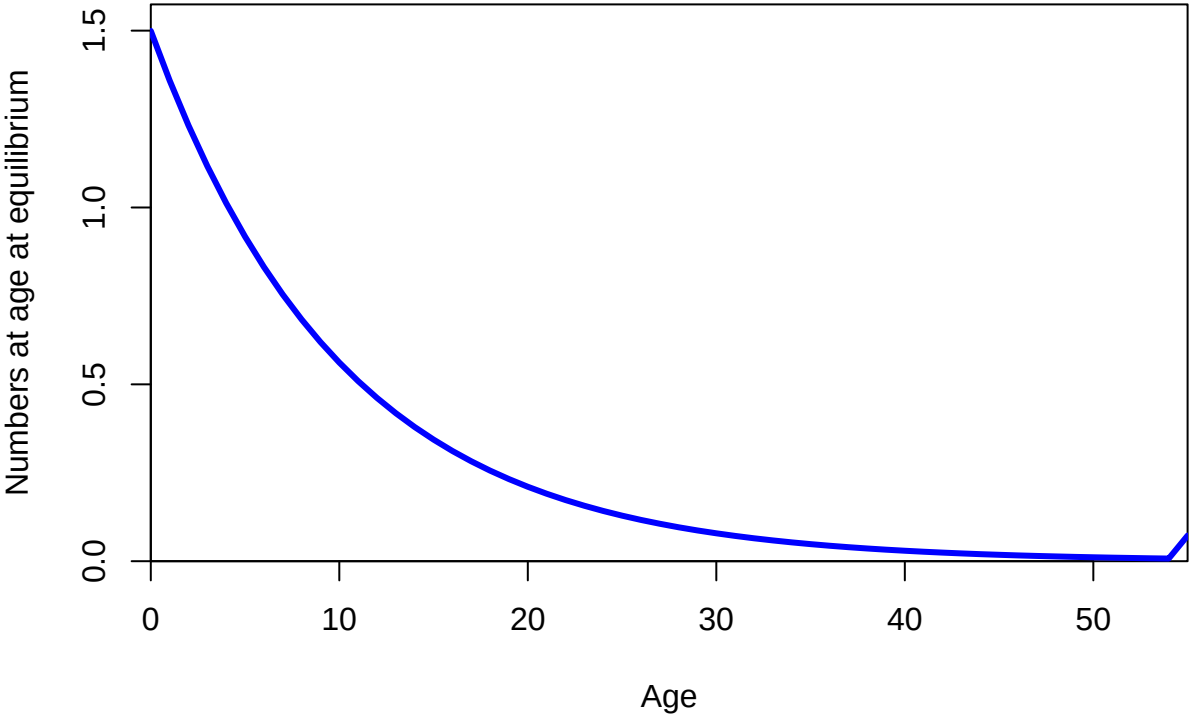

FISHERY
SURVEY2
Standardized index
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

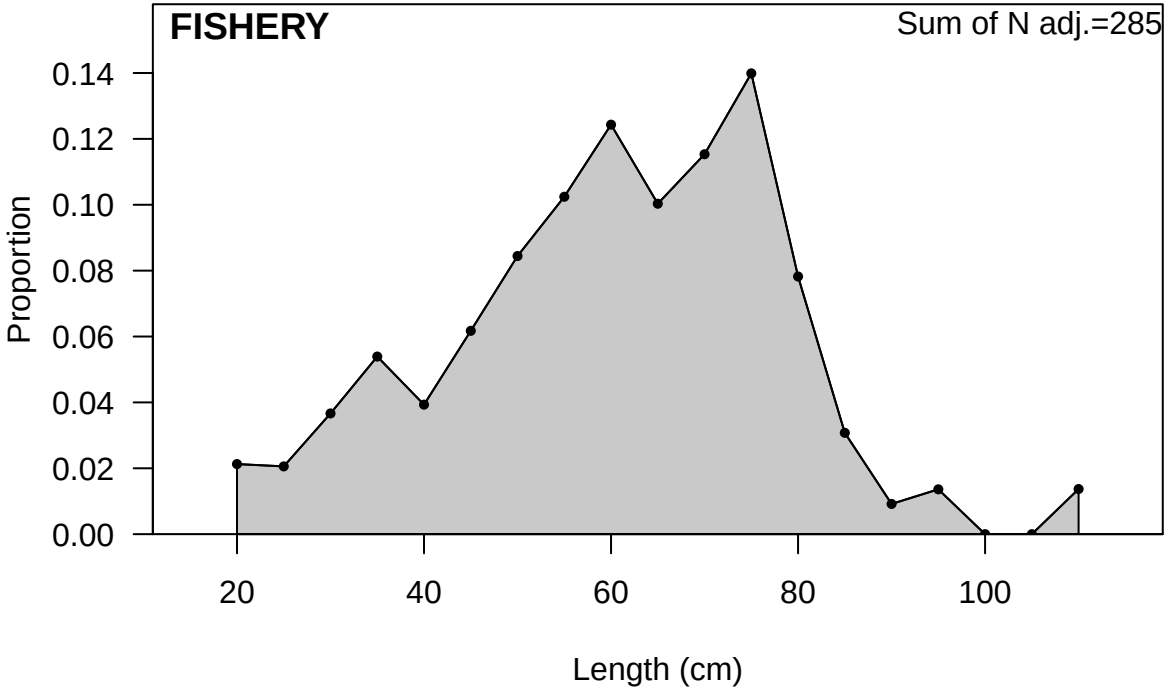

0.1
2
Age
Year
0
10
20
30
40
50
60
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020

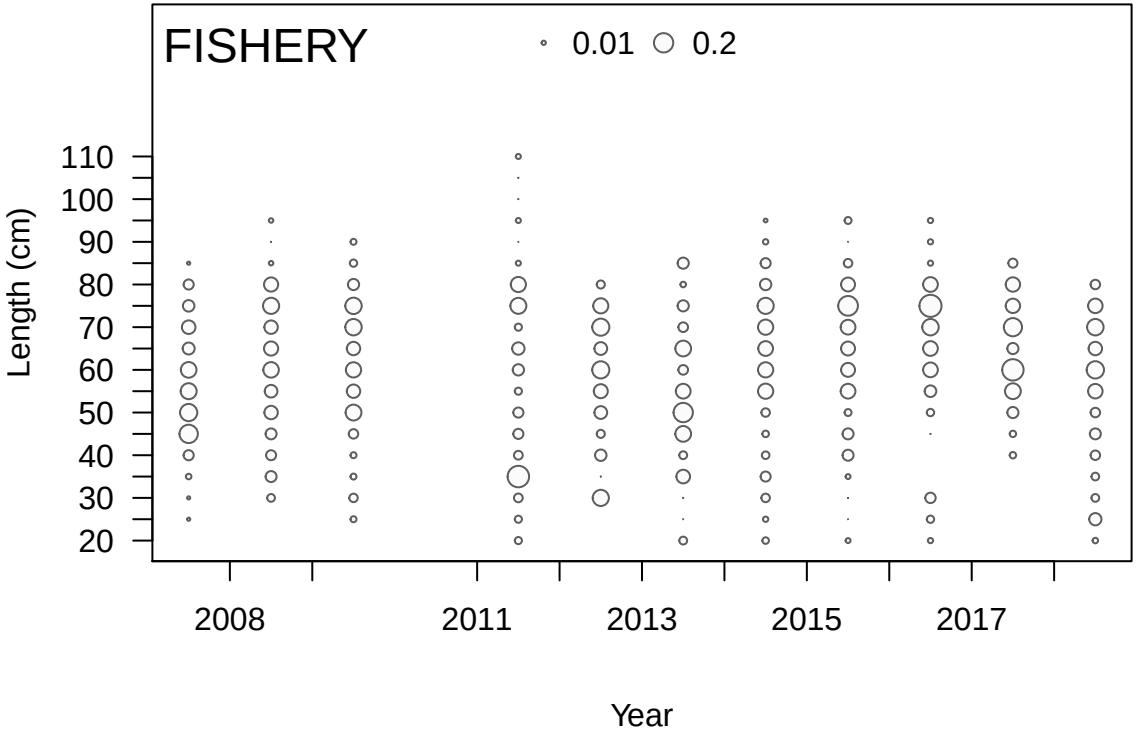

0.1
2
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

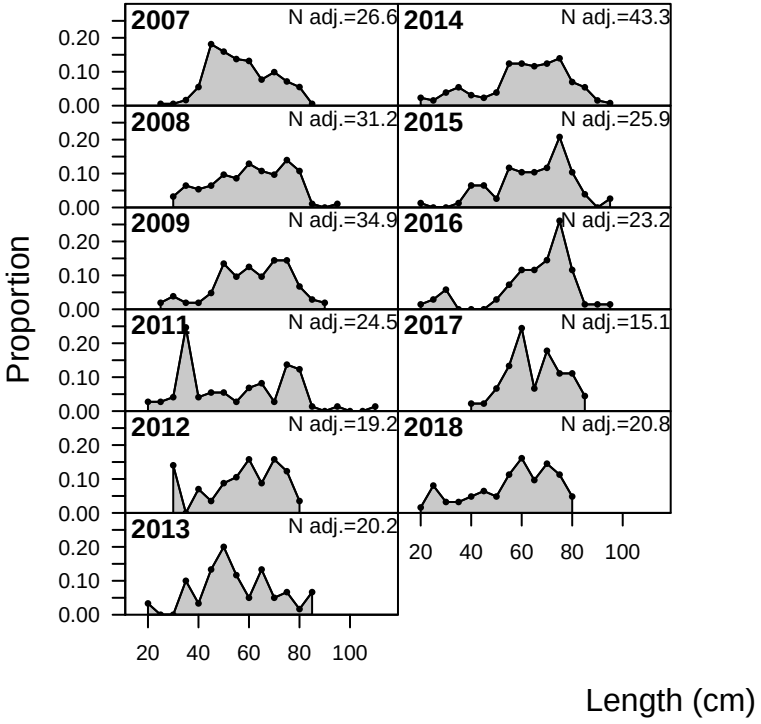

0.1
2
120
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

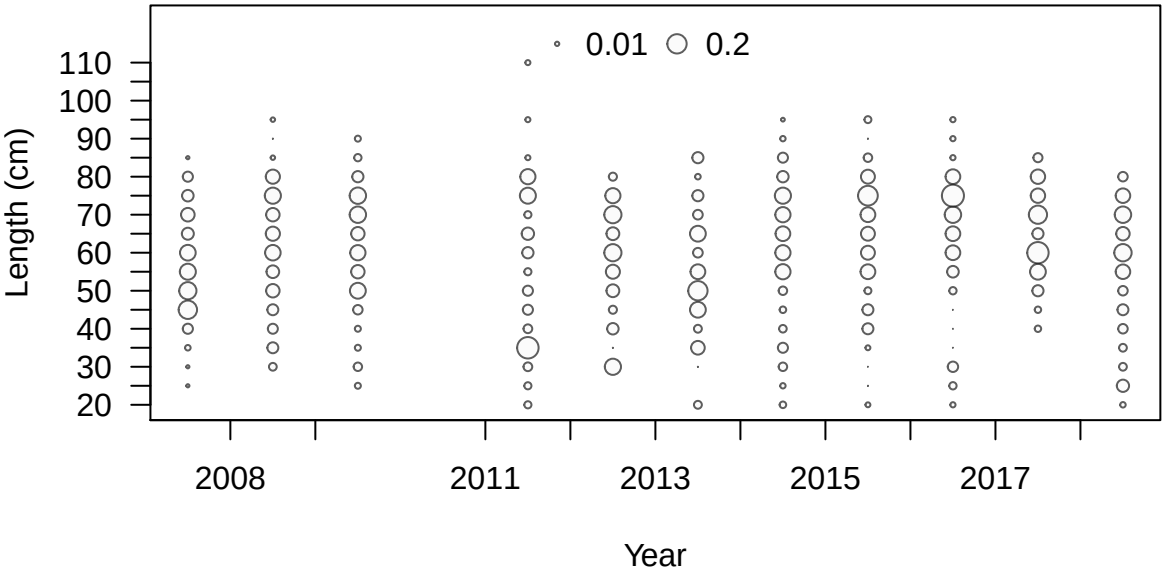

0.1
2
120
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

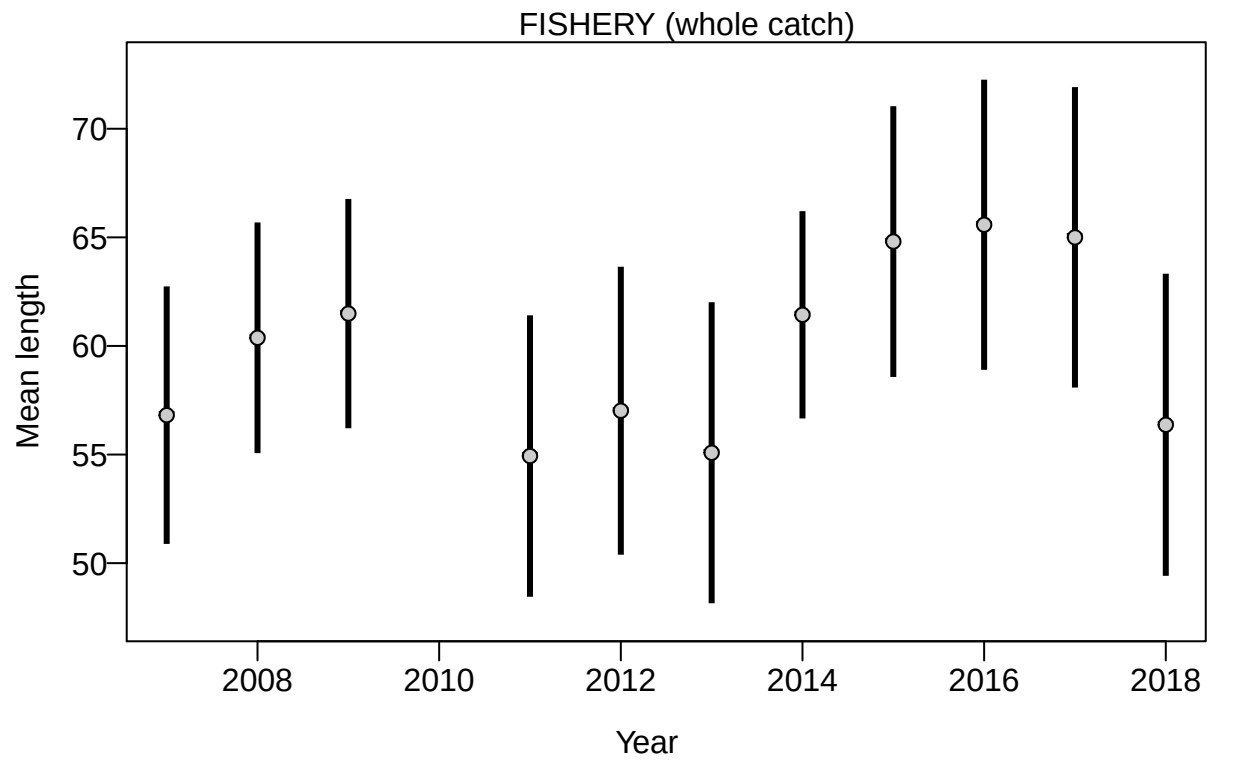

Numbers at age at equilibrium
0.0
0.5
1.0
1.5
0
10
20
30
40
50
Age

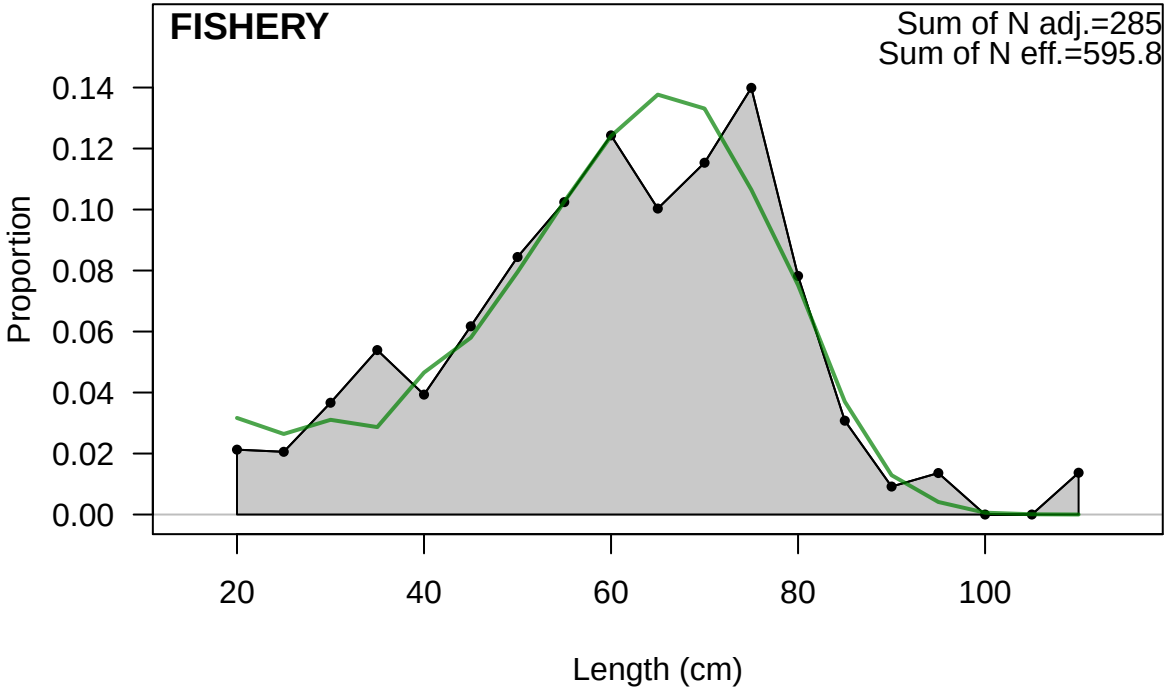

FISHERY
Sum of N adj.=285
Proportion
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
20
40
60
80
100
Length (cm)

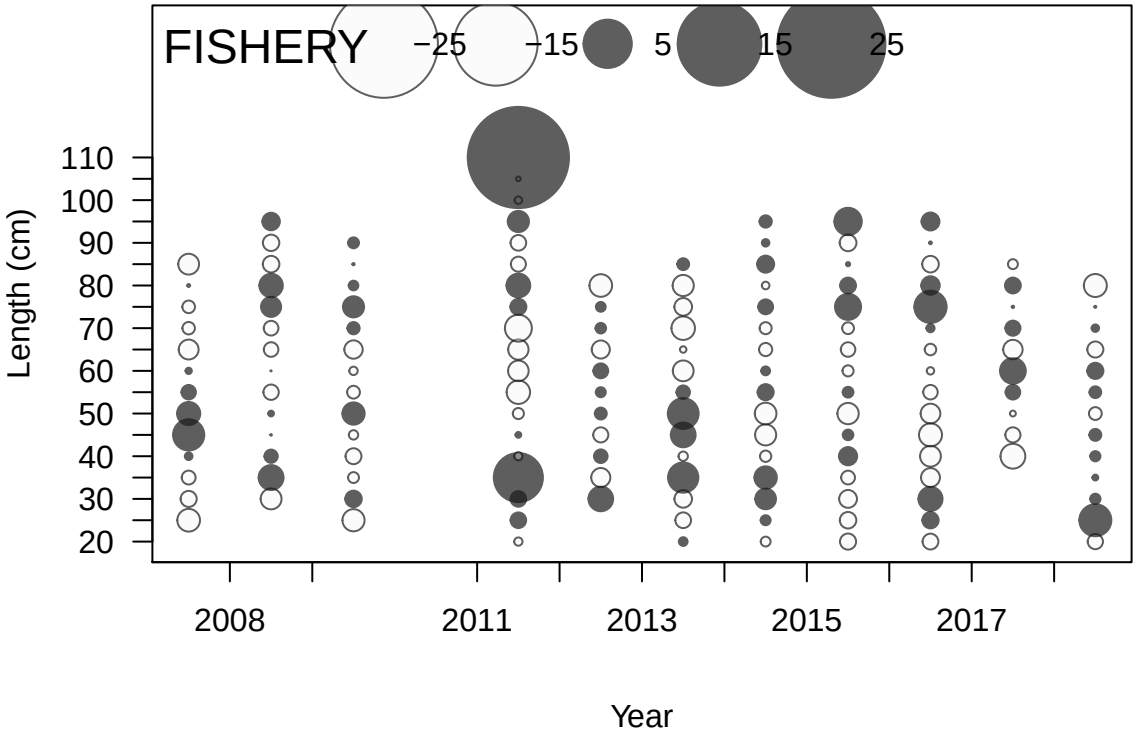

FISHERY
0.01
0.2
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

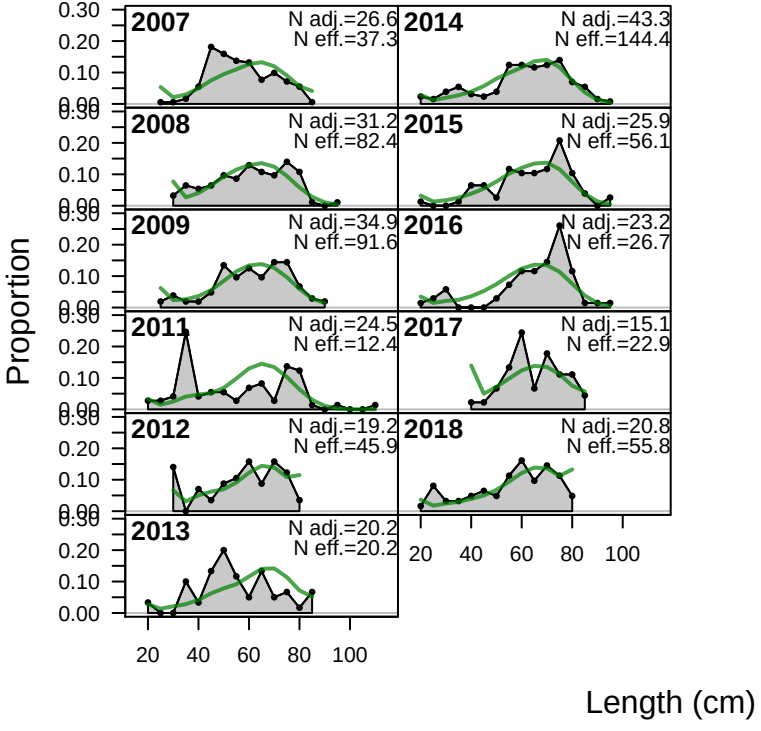

2007
N adj.=26.6
2014
N adj.=43.3
2008
N adj.=31.2
2015
N adj.=25.9
2009
N adj.=34.9
2016
N adj.=23.2
2011
N adj.=24.5
2017
N adj.=15.1
2012
N adj.=19.2
2018
N adj.=20.8
2013
N adj.=20.2
0.00
0.10
0.20
20
40
60
80
100
Proportion
Length (cm)

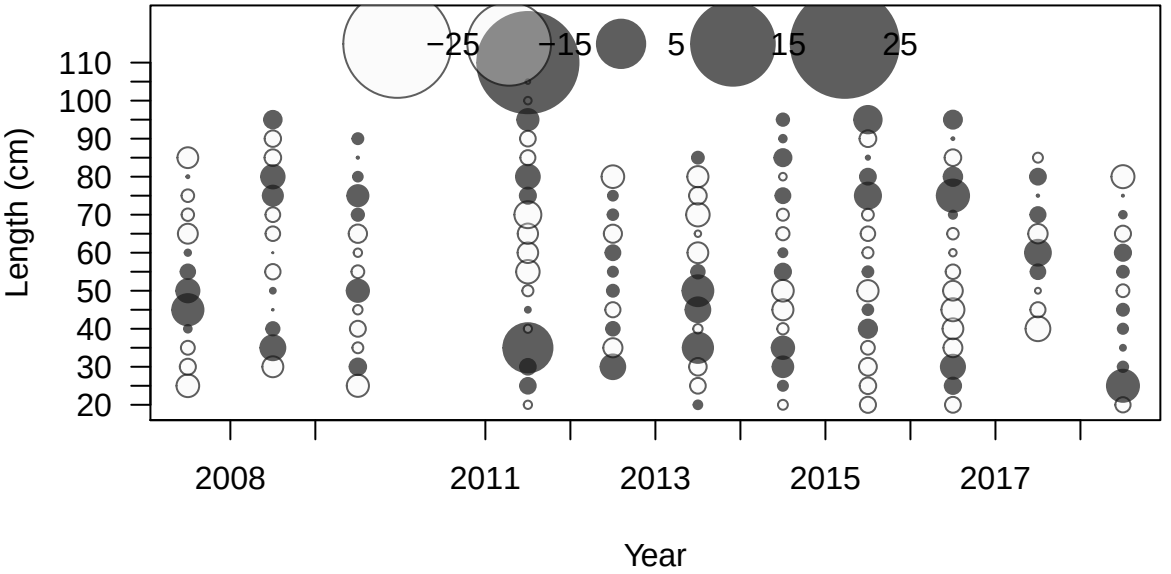

0.01
0.2
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

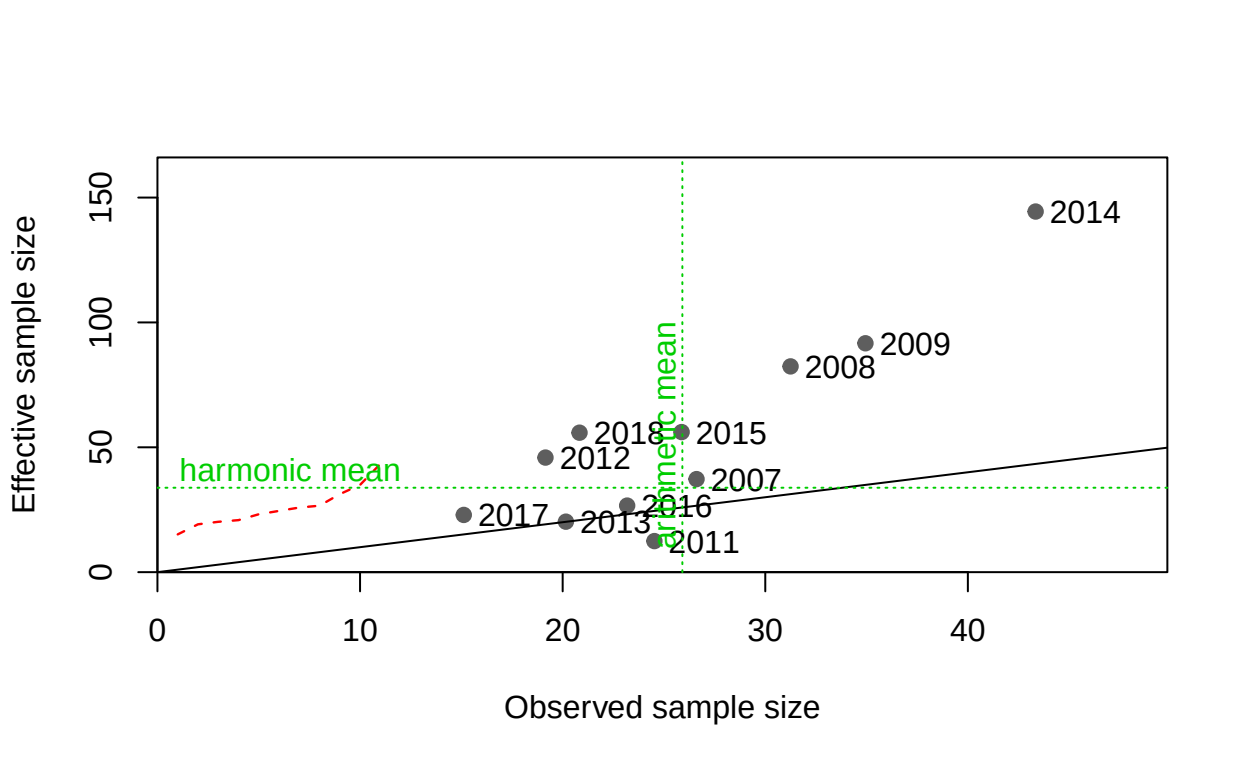

FISHERY (whole catch)
Mean length
70
65
60
55
50
2008
2010
2012
2014
2016
2018
Year

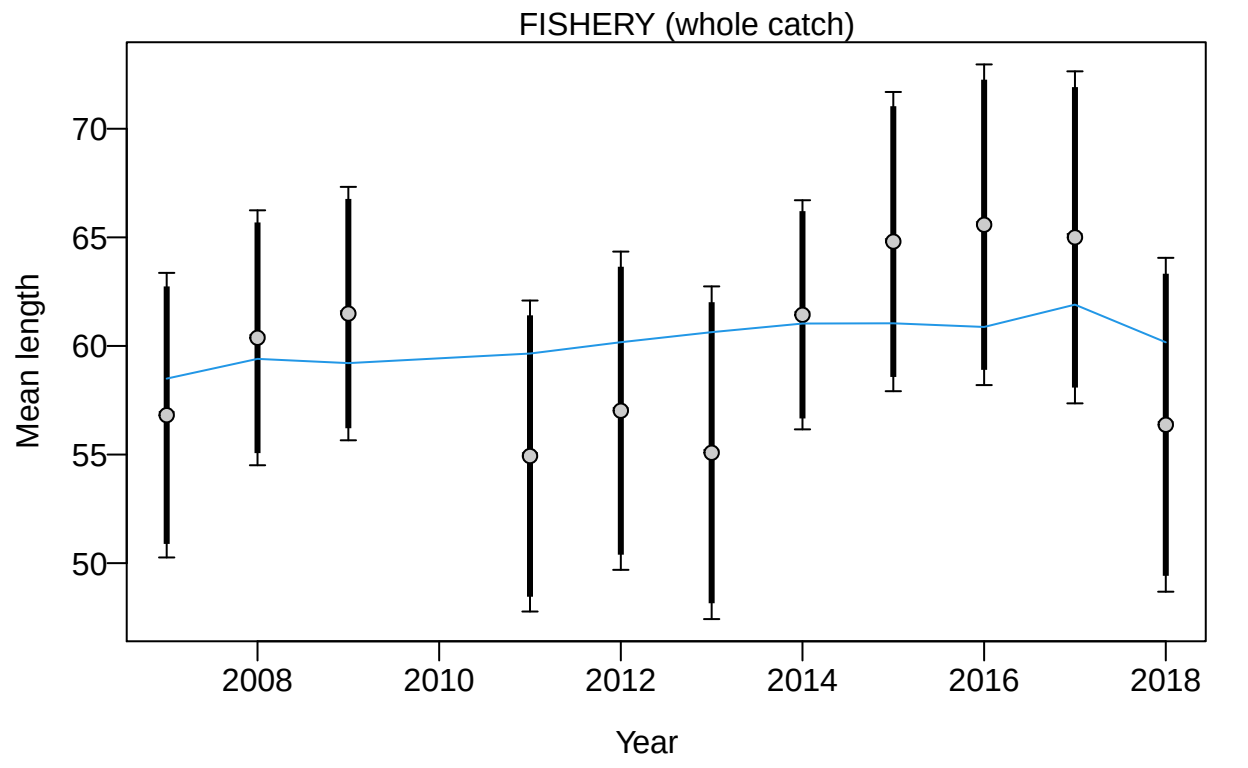

FISHERY
Sum of N adj.=285
Sum of N eff.=595.8
Proportion
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
20
40
60
80
100
Length (cm)

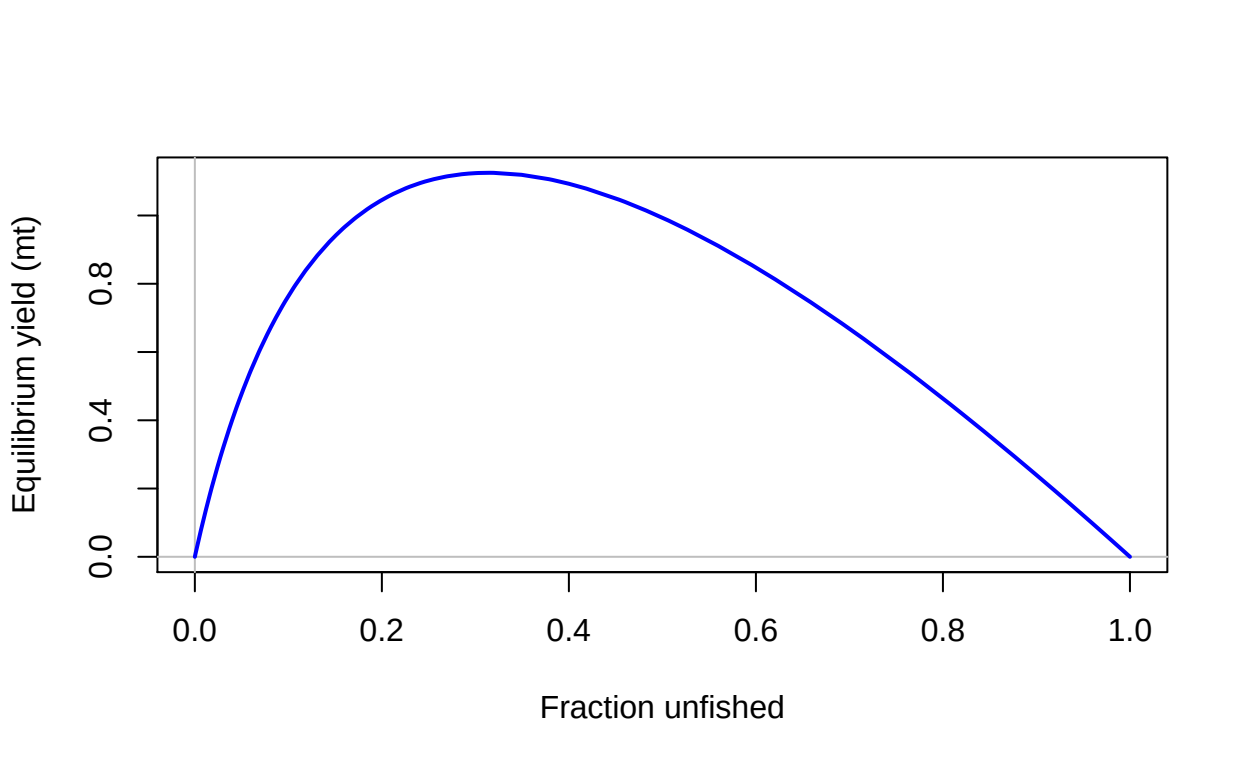

FISHERY
−25
−15
5
15
25
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

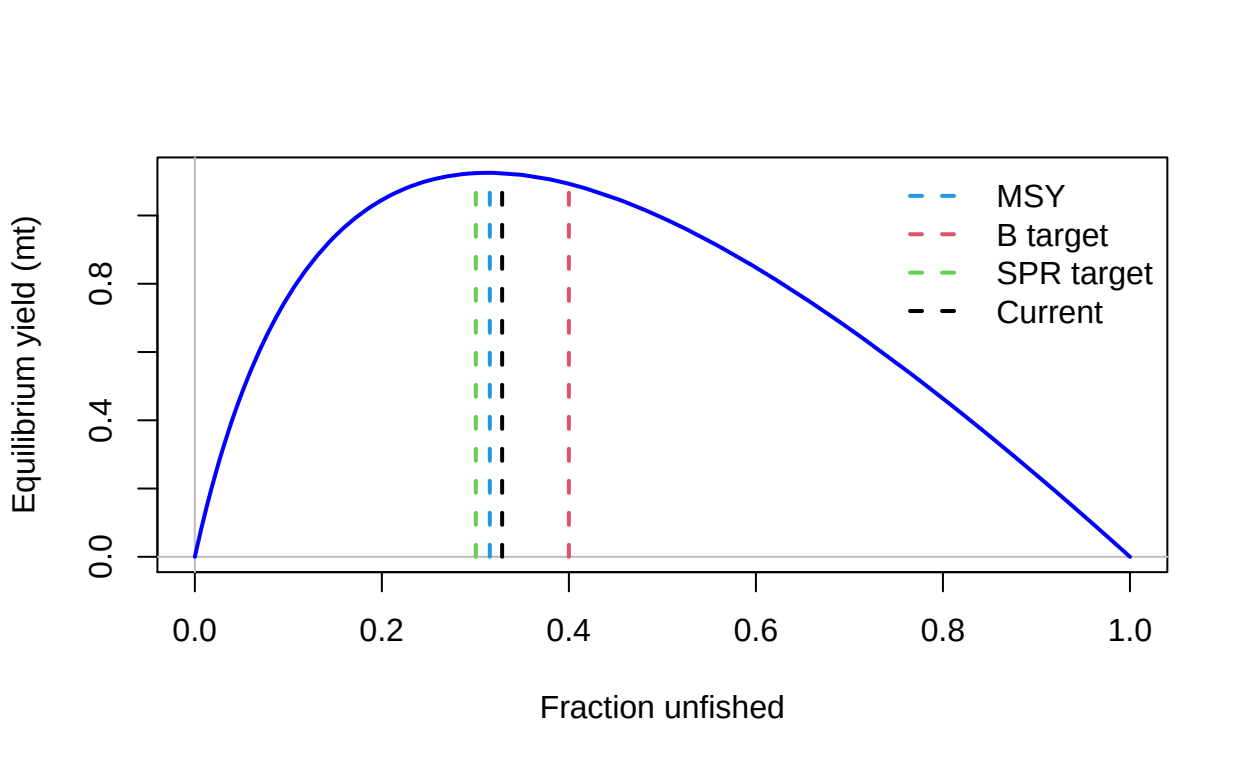

2007
N adj.=26.6
N eff.=37.3
2014
N adj.=43.3
N eff.=144.4
2008
N adj.=31.2
N eff.=82.4
2015
N adj.=25.9
N eff.=56.1
2009
N adj.=34.9
N eff.=91.6
2016
N adj.=23.2
N eff.=26.7
2011
N adj.=24.5
N eff.=12.4
2017
N adj.=15.1
N eff.=22.9
2012
N adj.=19.2
N eff.=45.9
2018
N adj.=20.8
N eff.=55.8
2013
N adj.=20.2
N eff.=20.2
0.30
0.20
0.10
0.00
20
40
60
80
100
Proportion
Length (cm)

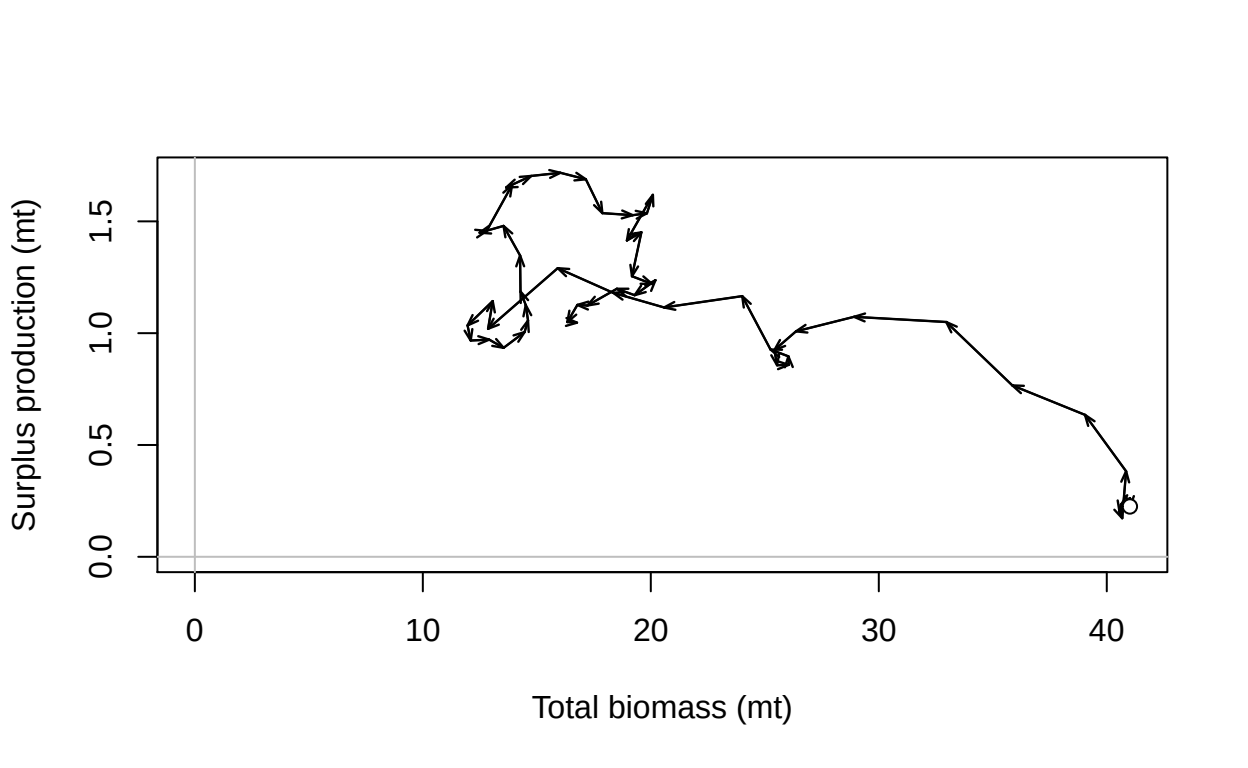

−25
−15
5
15
25
110
100
90
80
70
60
50
40
30
20
Length (cm)
2008
2011
2013
2015
2017
Year

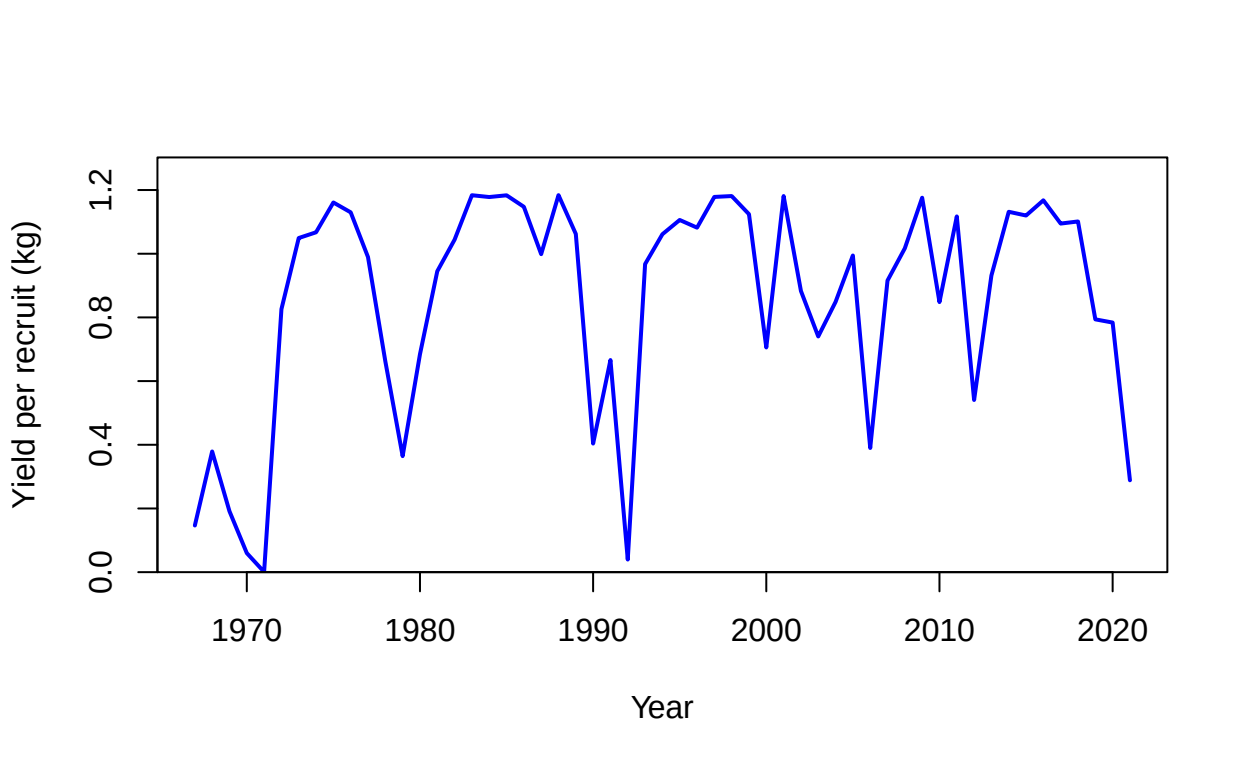

Effective sample size
0
50
100
150
0
10
20
30
40
Observed sample size
harmonic mean
arithmetic mean
2014
2009
2008
2018
2015
2012
2007
2017
2013
2016
2011

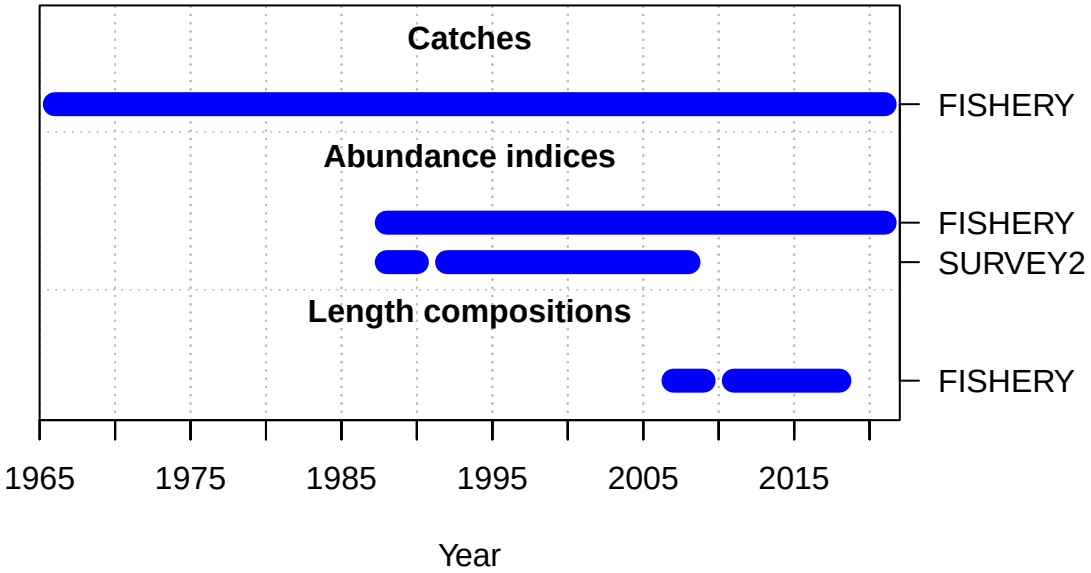

FISHERY (whole catch)
Mean length
70
65
60
55
50
2008
2010
2012
2014
2016
2018
Year

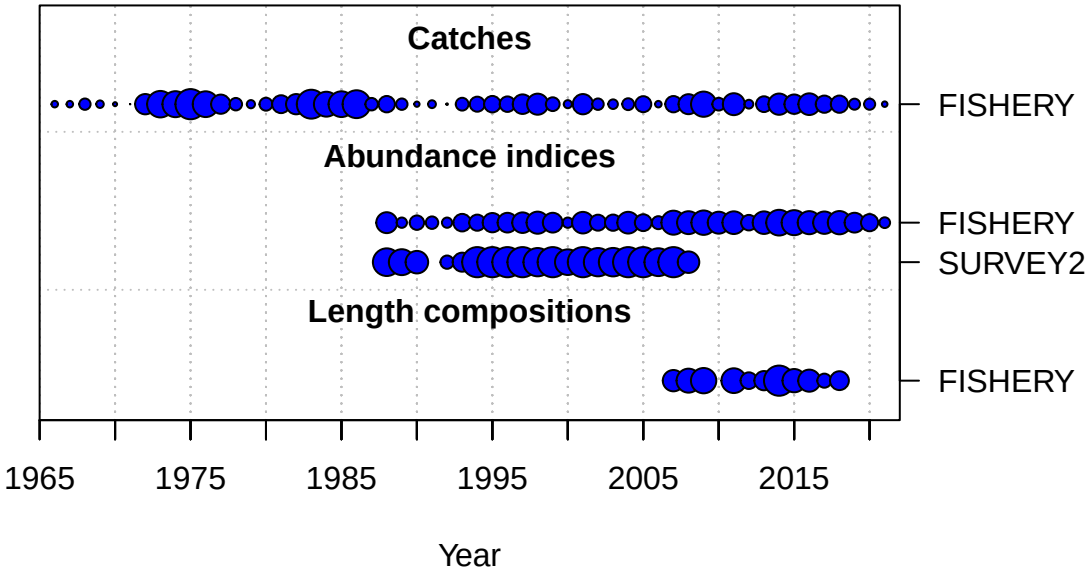

Equilibrium yield (mt)
0.0
0.4
0.8
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished


Equilibrium yield (mt)
0.0
0.4
0.8
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
0
10
20
30
40
Total biomass (mt)


Yield per recruit (kg)
0.0
0.4
0.8
1.2
1970
1980
1990
2000
2010
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1965
1975
1985
1995
2005
2015
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1965
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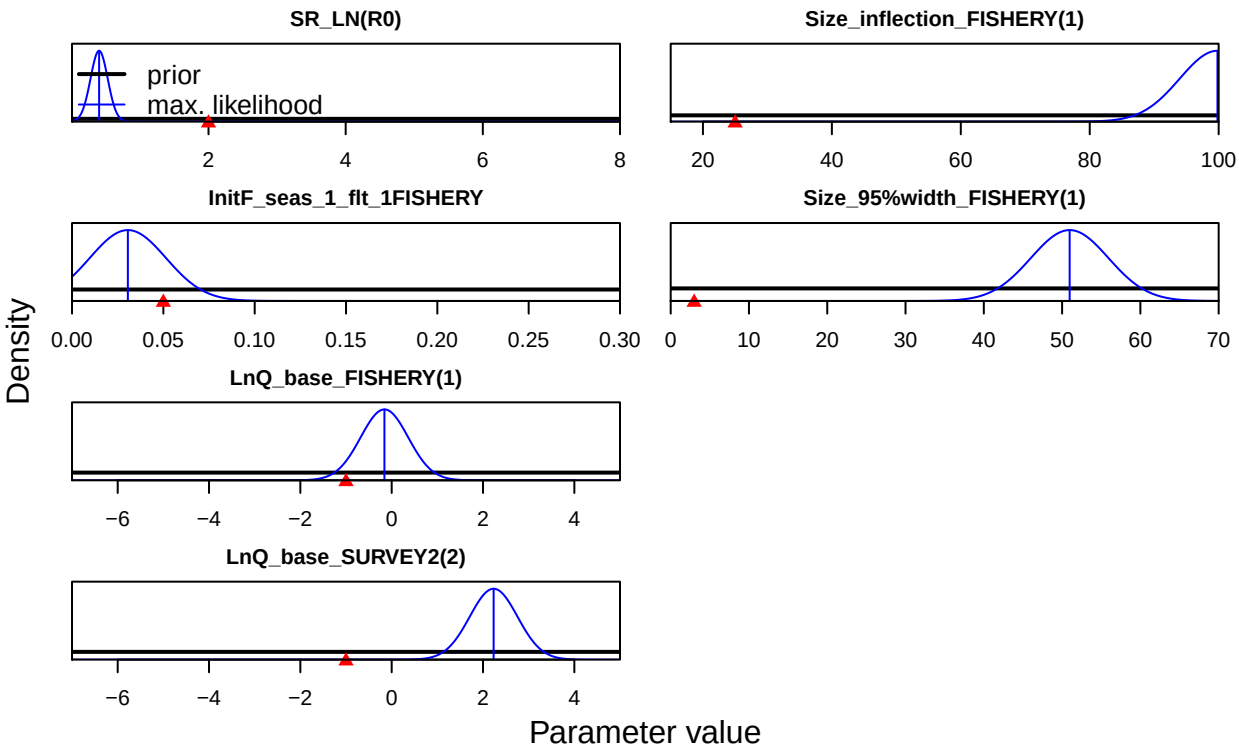
1995
2005
2015
Year


SR_LN(R0)
prior
max. likelihood
2
4
6
8
Size_inflection_FISHERY(1)
20
40
60
80
100
InitF_seas_1_flt_1FISHERY
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Size_95%width_FISHERY(1)
0
10
20
30
40
50
60
70
Density
LnQ_base_FISHERY(1)
−6
−4
−2
0
2
4
LnQ_base_SURVEY2(2)
−6
−4
−2
0
2
4
Parameter value