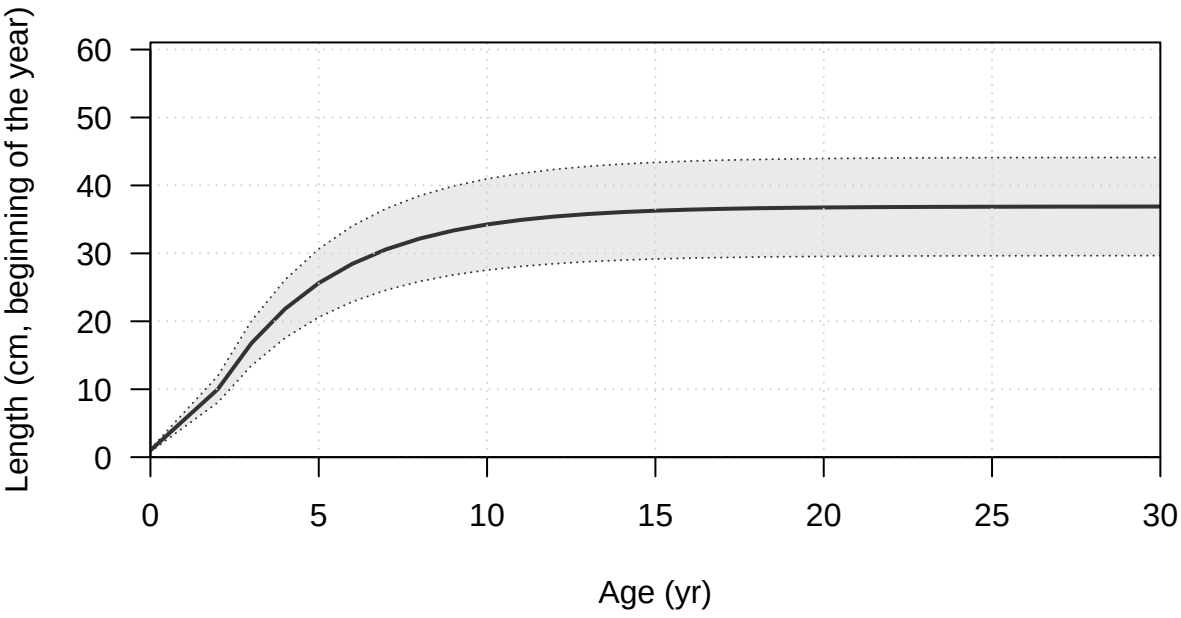
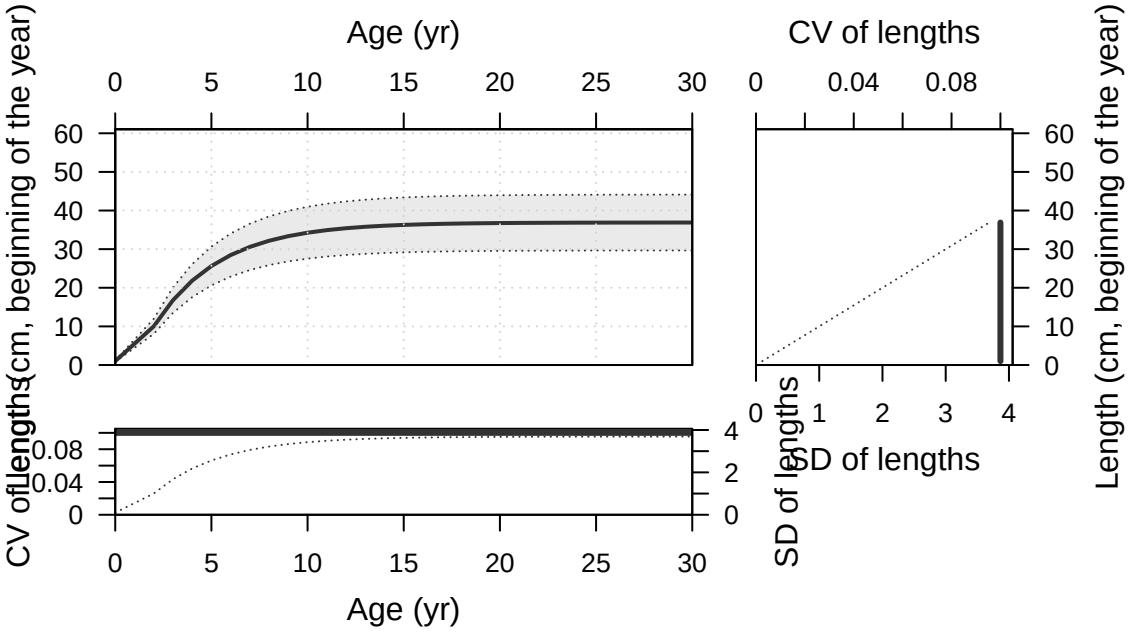
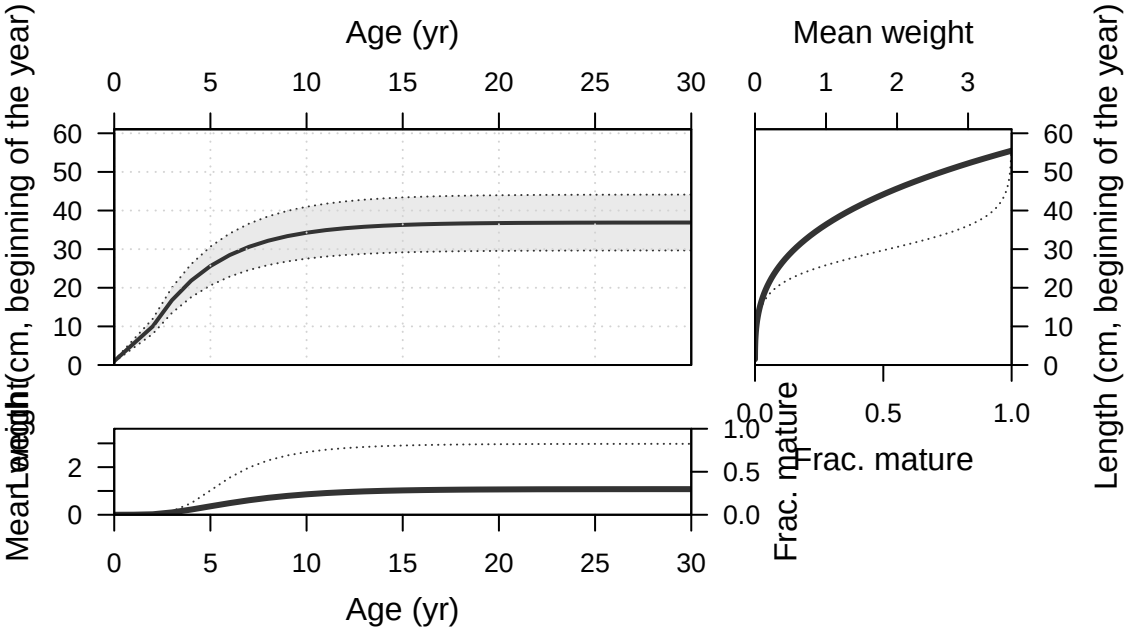
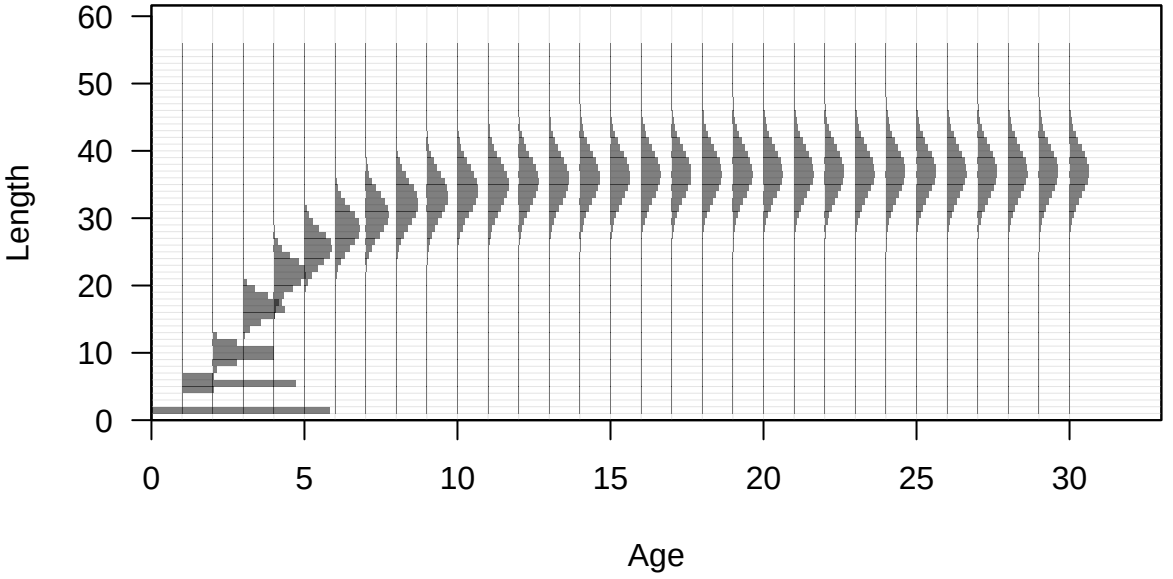
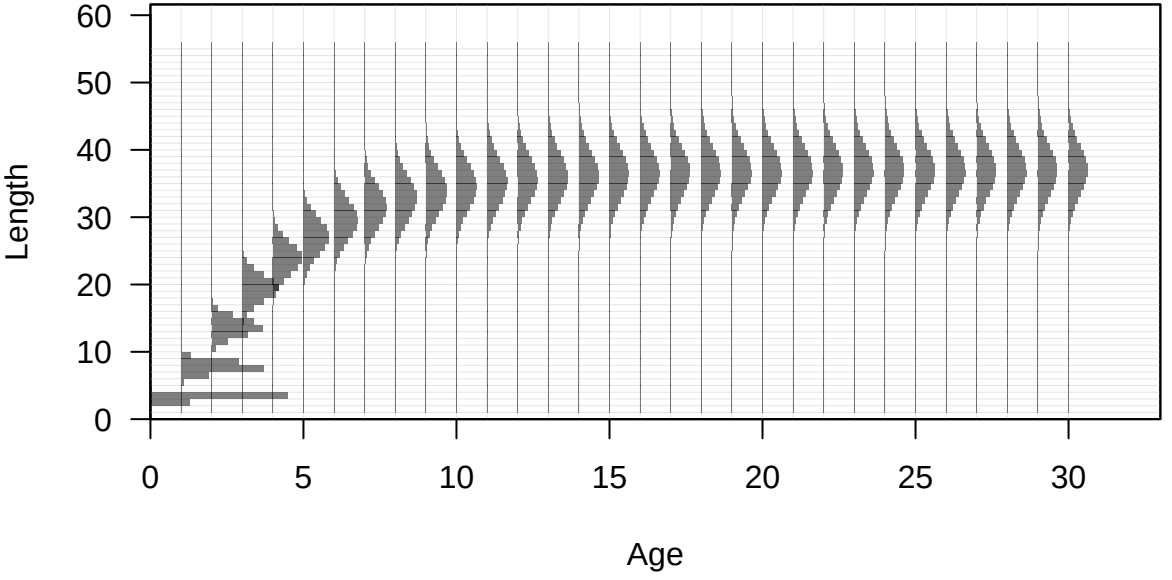
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Tue Jun 28 15:01:39 2022
Data_File: data.ss
Control_File: control.ss

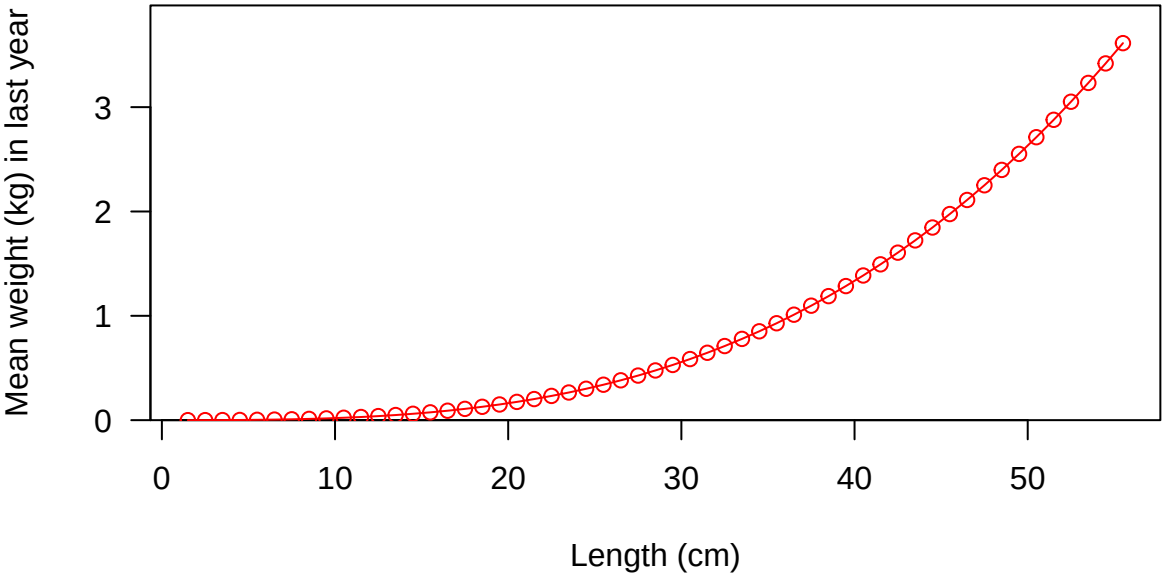

Length (cm, beginning of the year)
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Age (yr)

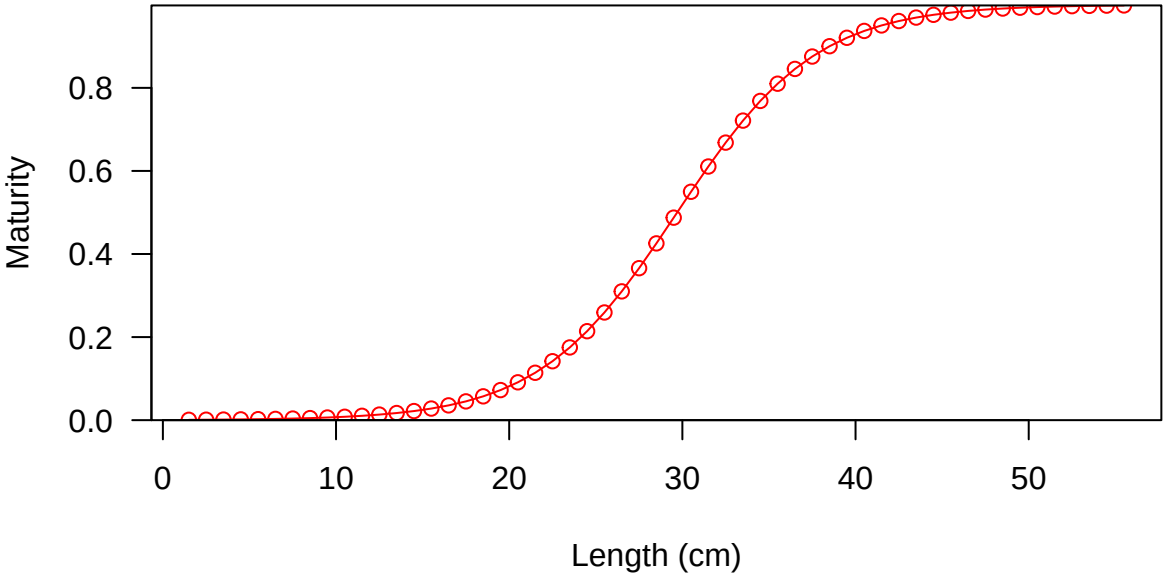

Age (yr)
0
5
10
15
20
25
30
Length (cm, beginning of the year)
60
50
40
30
20
10
0
CV of lengths
0.08
0.04
0
SD of lengths
4
2
0
CV of lengths
0.04
0.08
0
1
2
3
4
SD of lengths
Length (cm, beginning of the year)

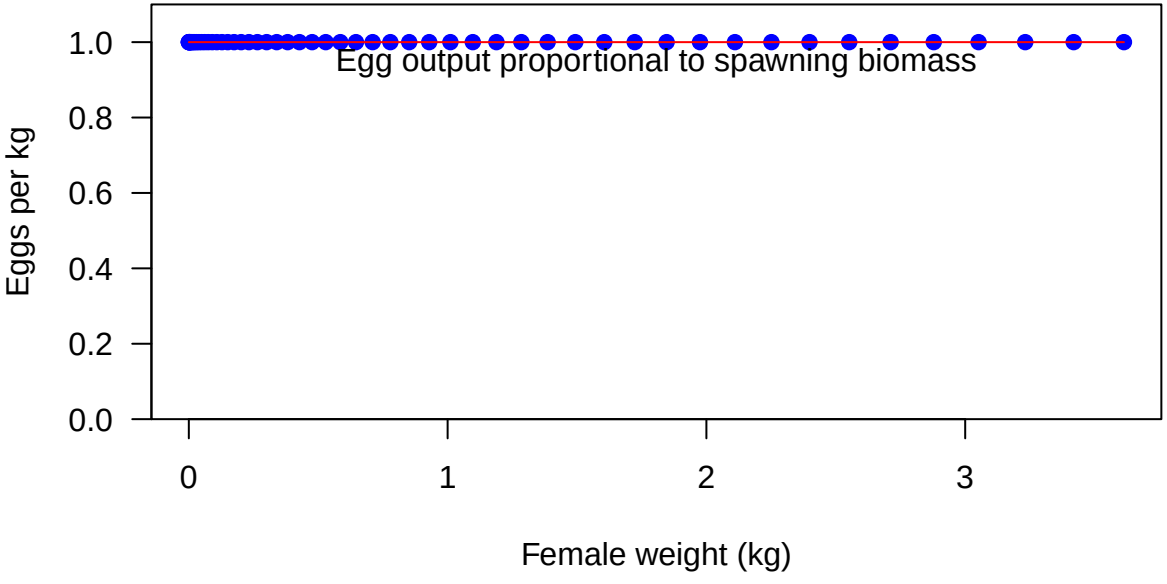

Age (yr)
Mean weight
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)

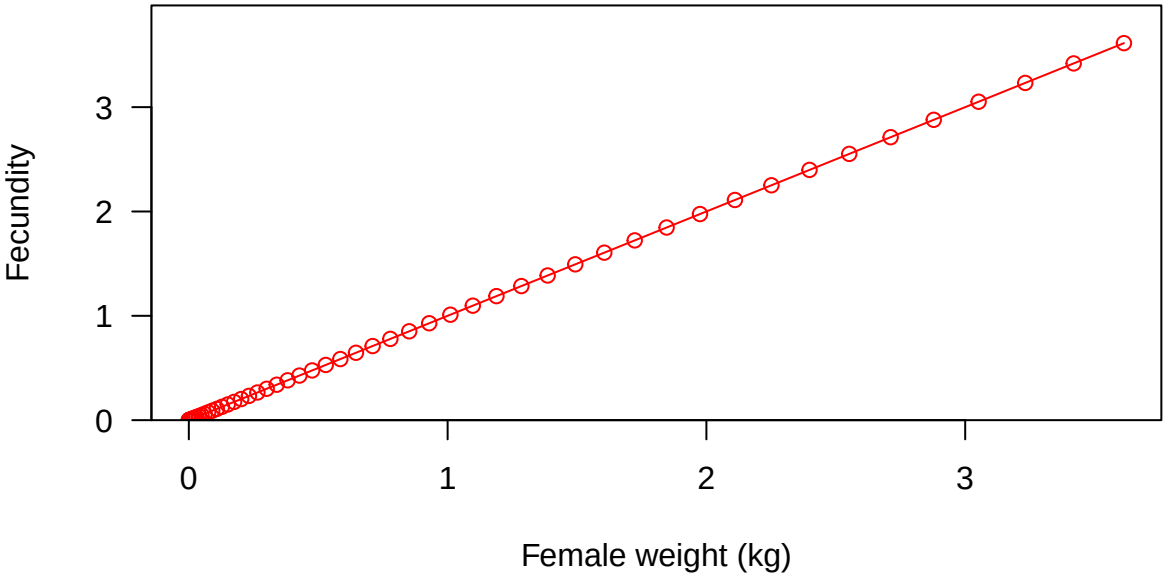

Length
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Age

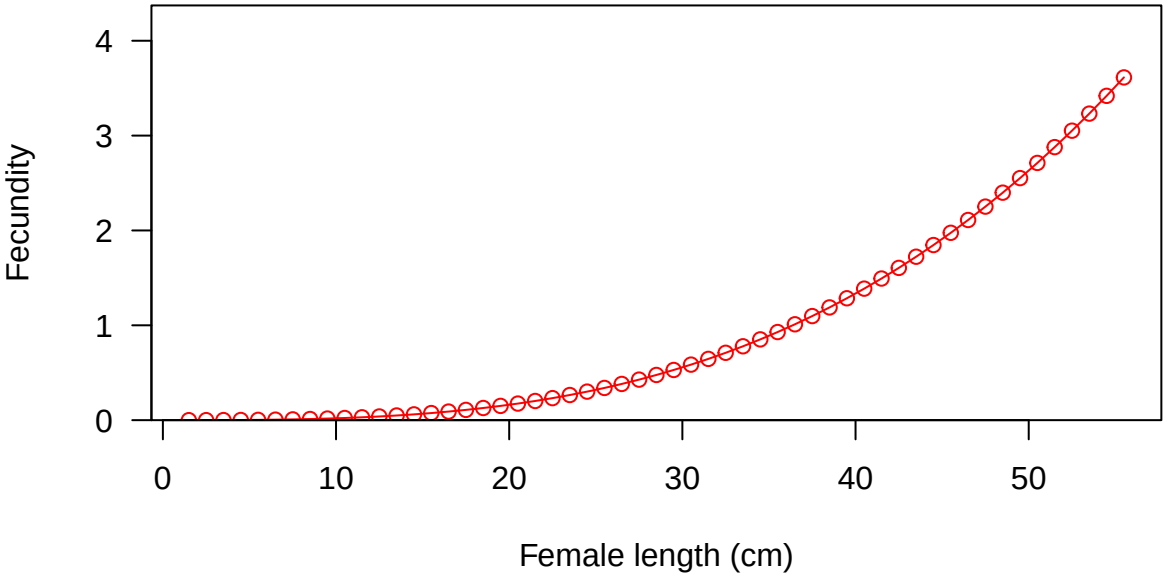

Length
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Age

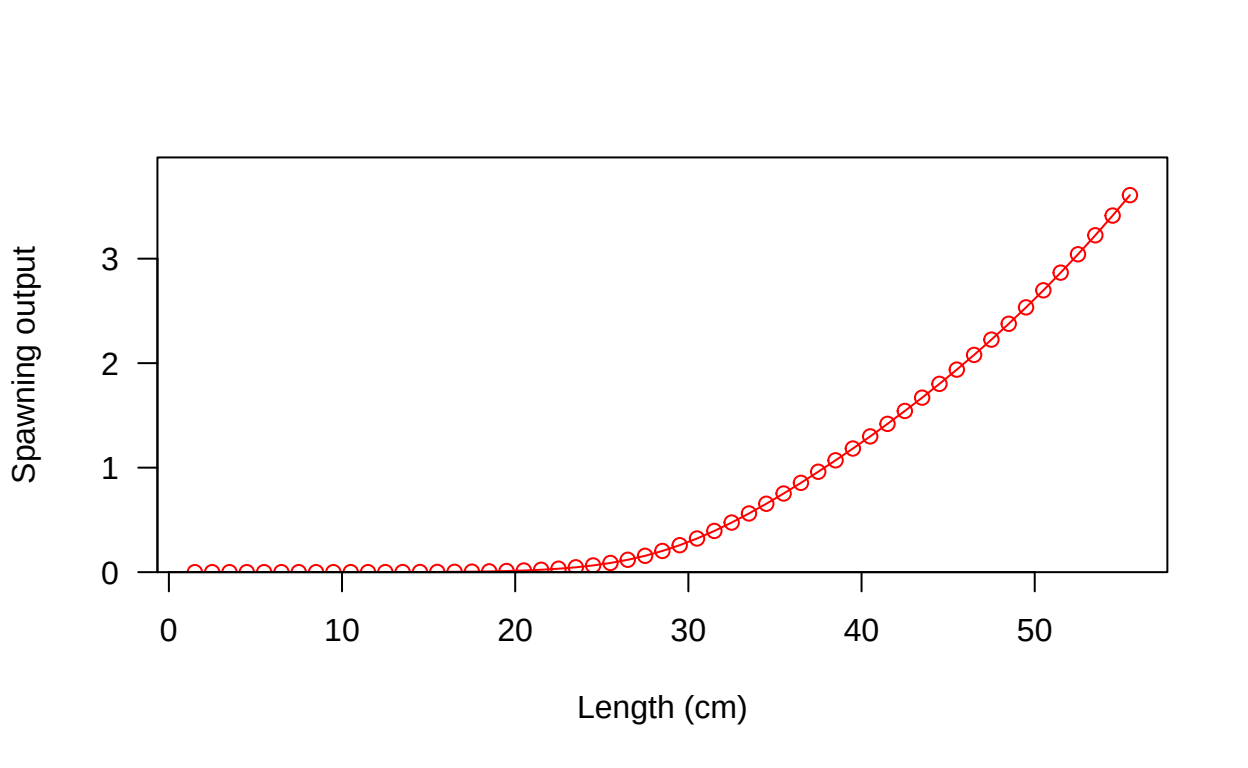

Mean weight (kg) in last year
0
1
2
3
0
10
20
30
40
50
Length (cm)

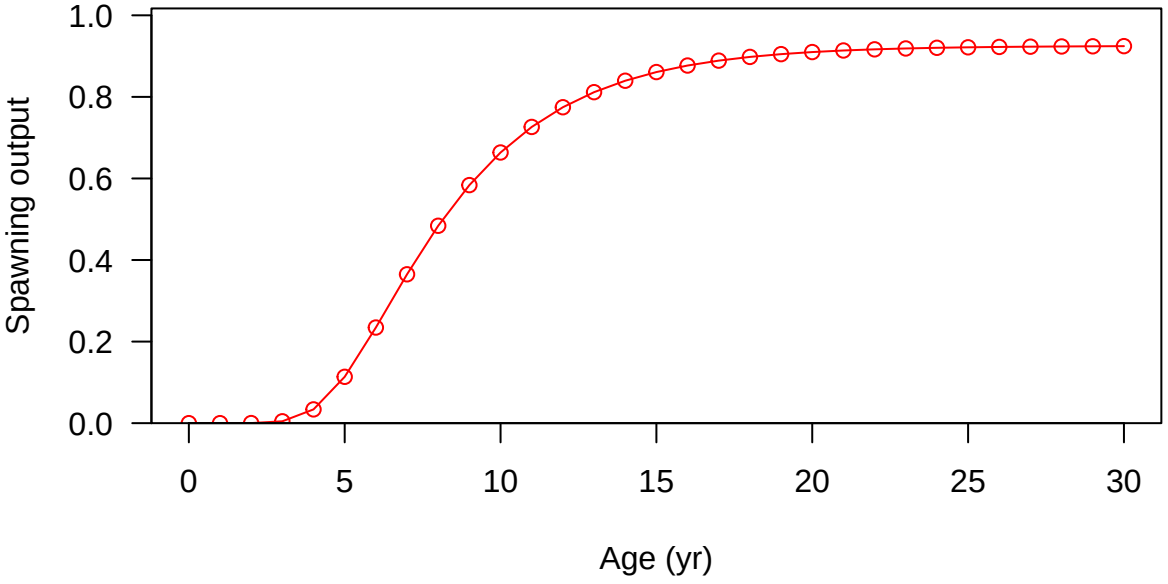

Maturity
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
50
Length (cm)

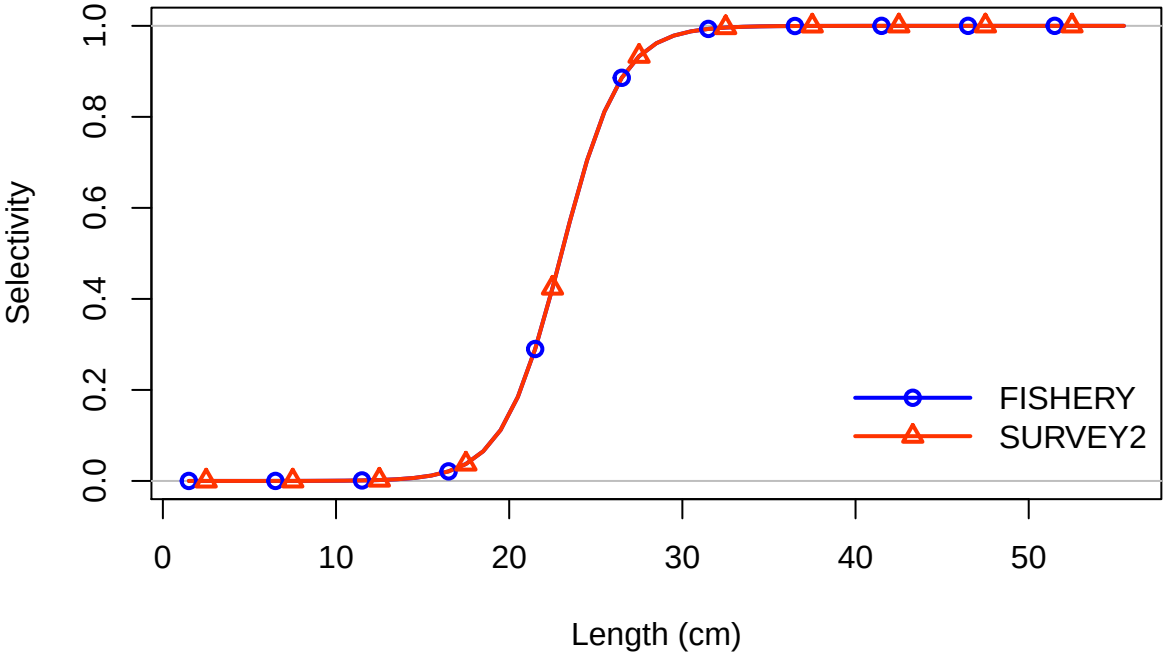

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
Female weight (kg)

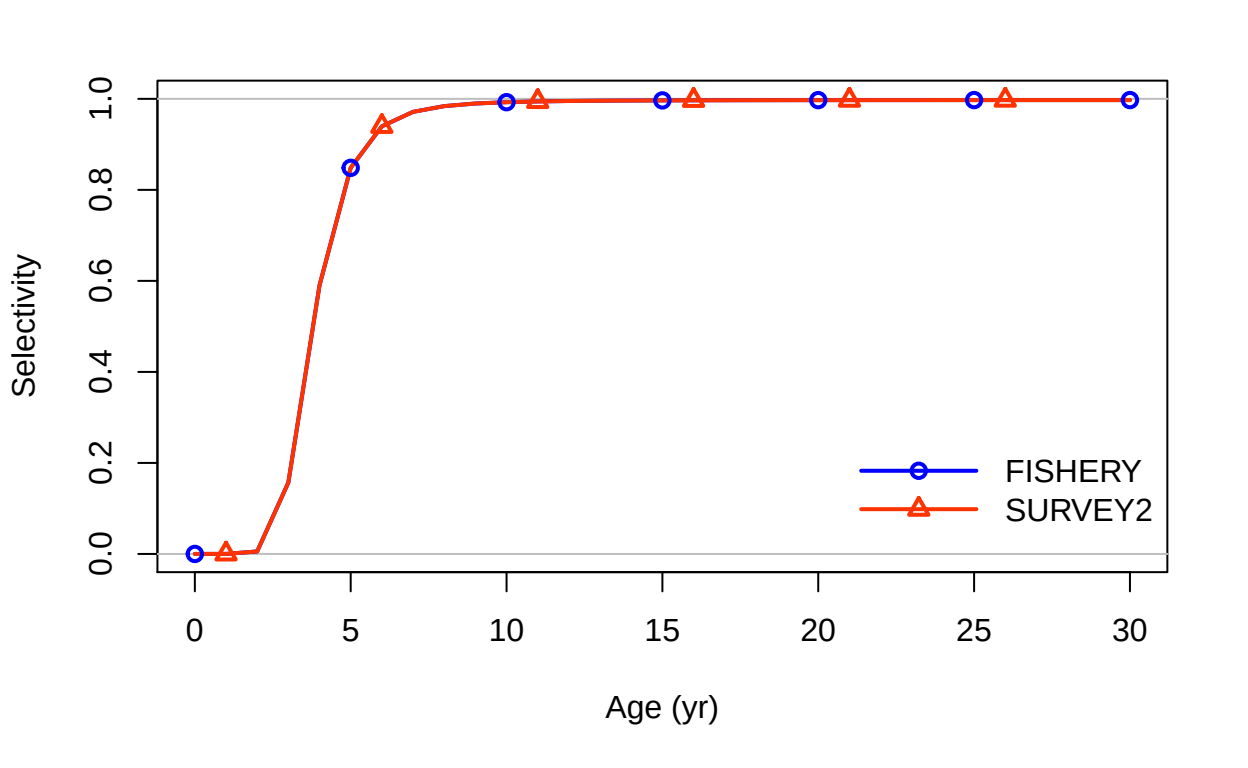

Fecundity
0
1
2
3
0
1
2
3
Female weight (kg)

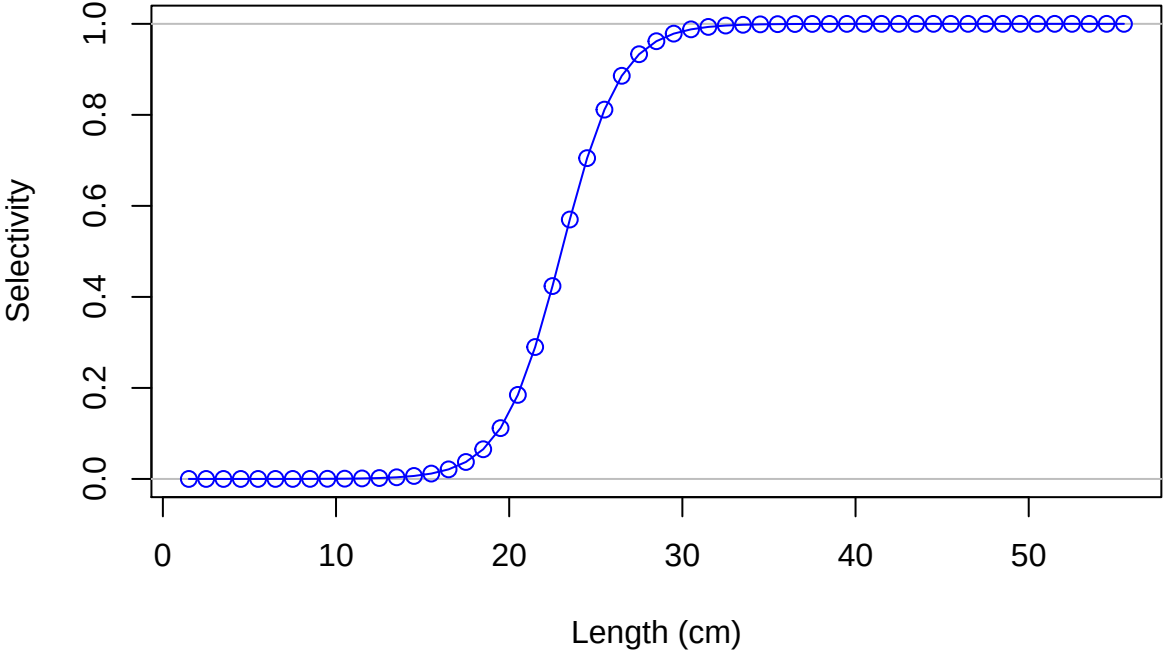

Fecundity
0
1
2
3
4
0
10
20
30
40
50
Female length (cm)

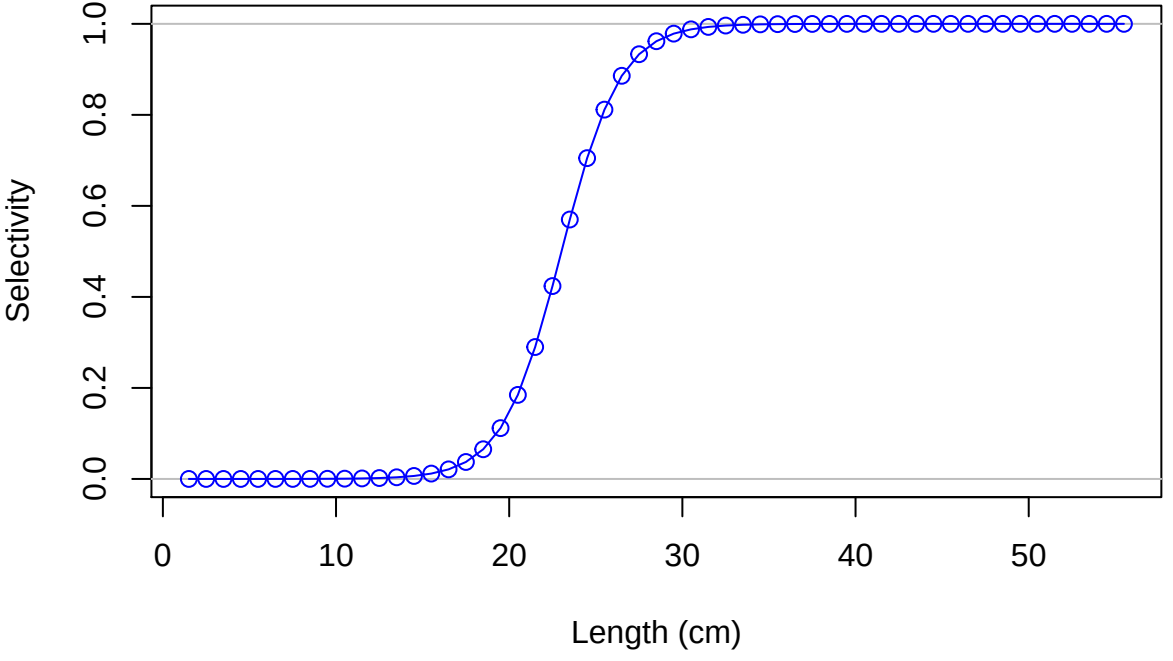

Spawning output
0
1
2
3
0
10
20
30
40
50
Length (cm)

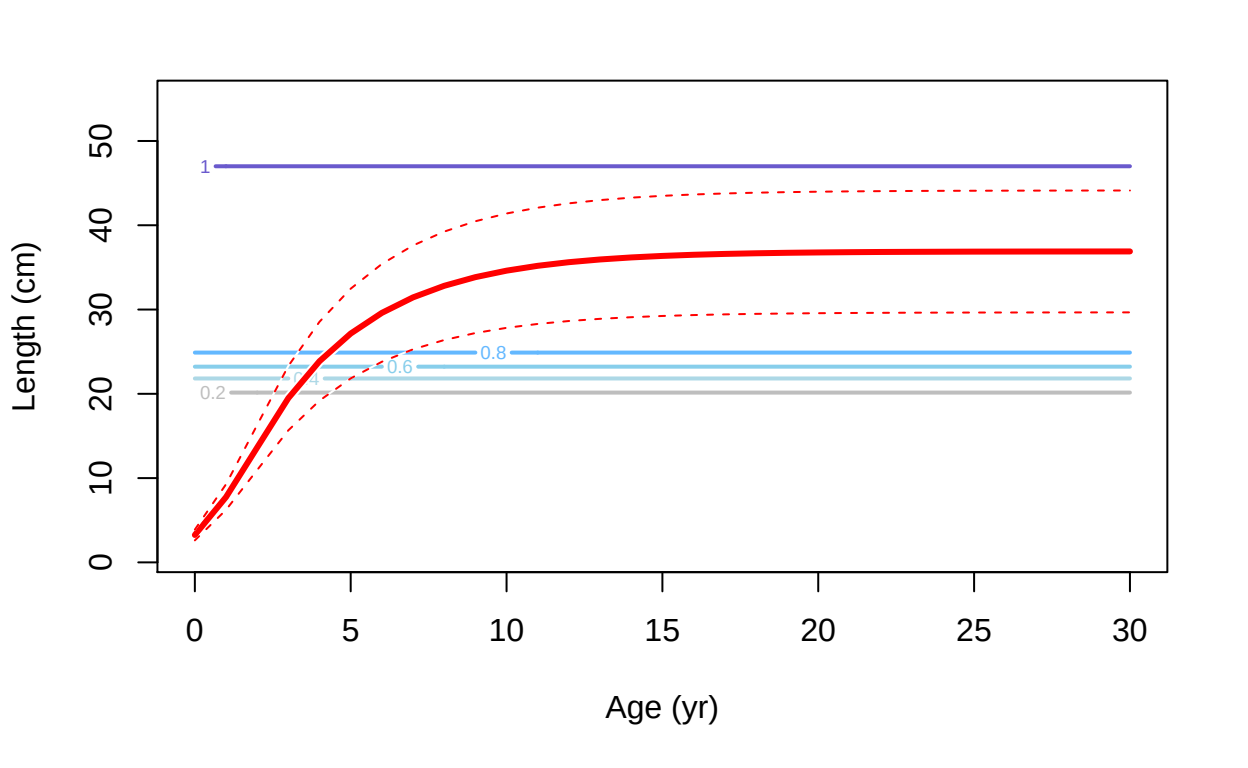

1.0
0.8
0.6
0.4
0.2
0.0
Spawning output
0
5
10
15
20
25
30
Age (yr)

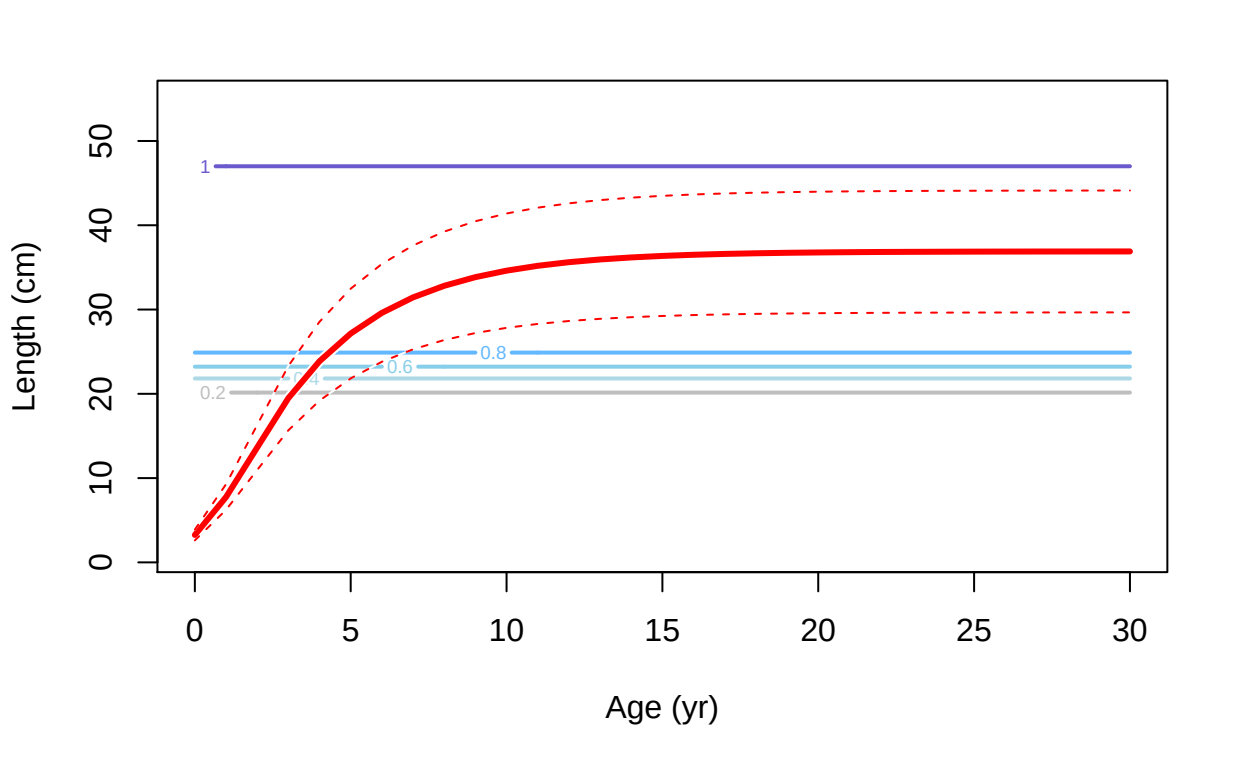

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Length (cm)
FISHERY
SURVEY2

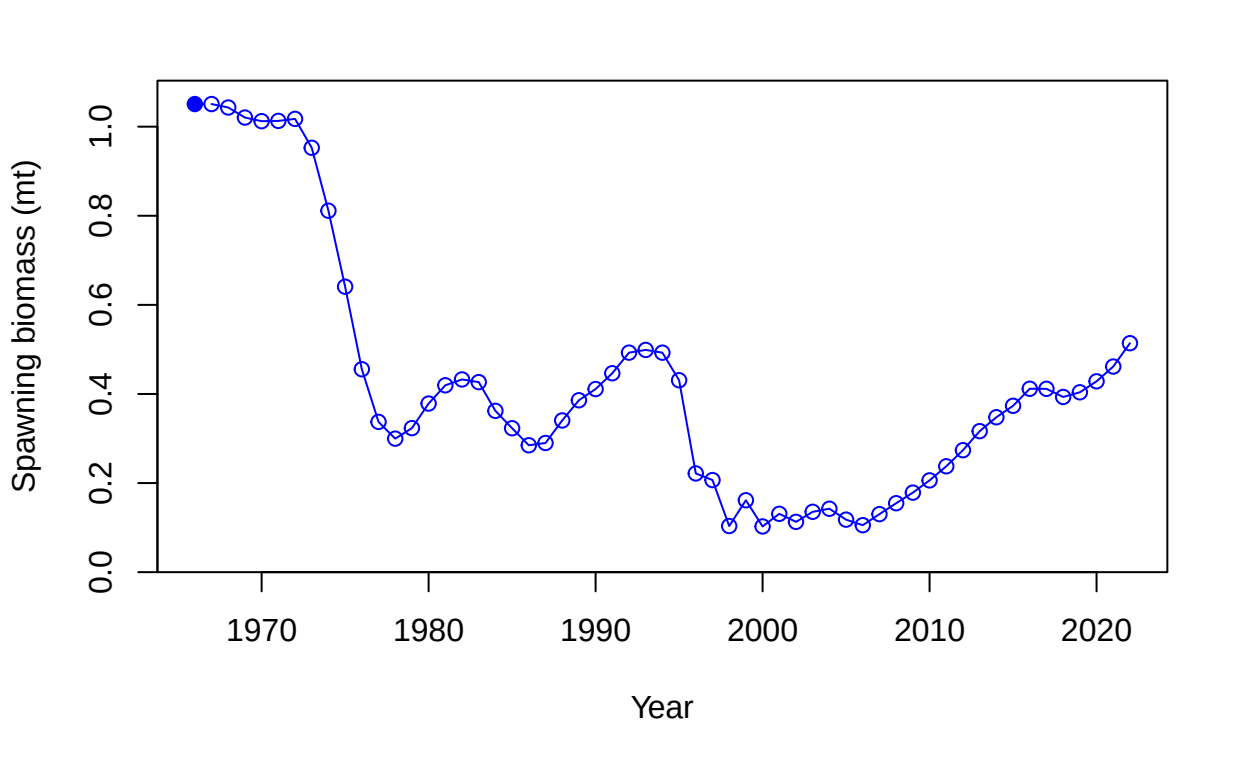

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Age (yr)
FISHERY
SURVEY2

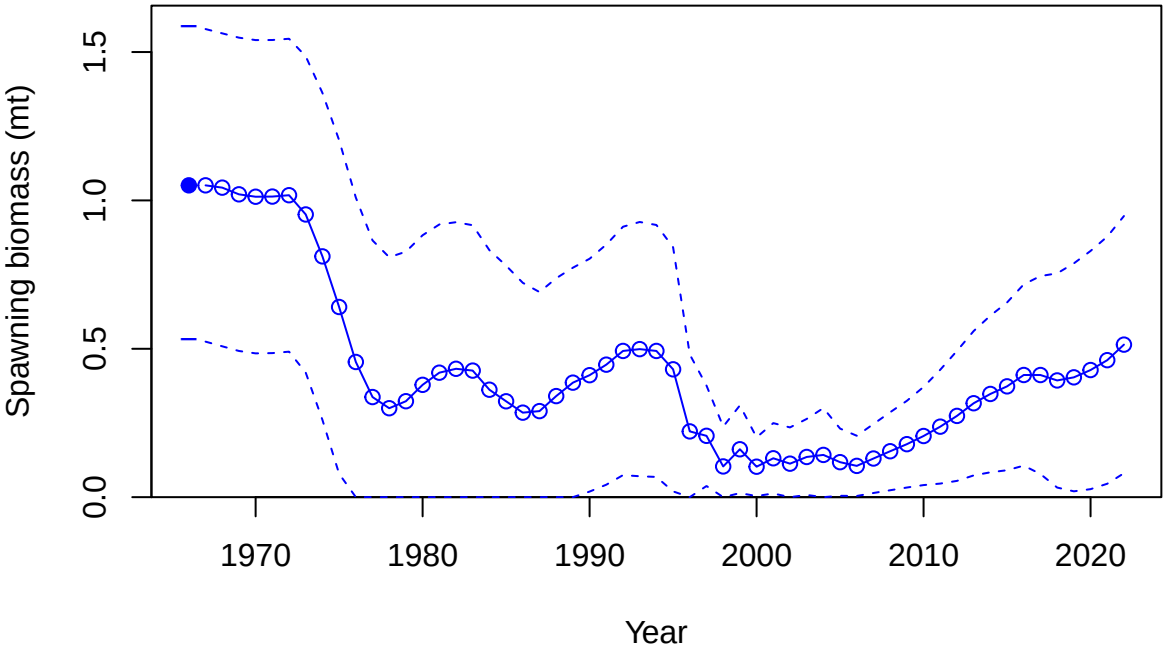

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Length (cm)

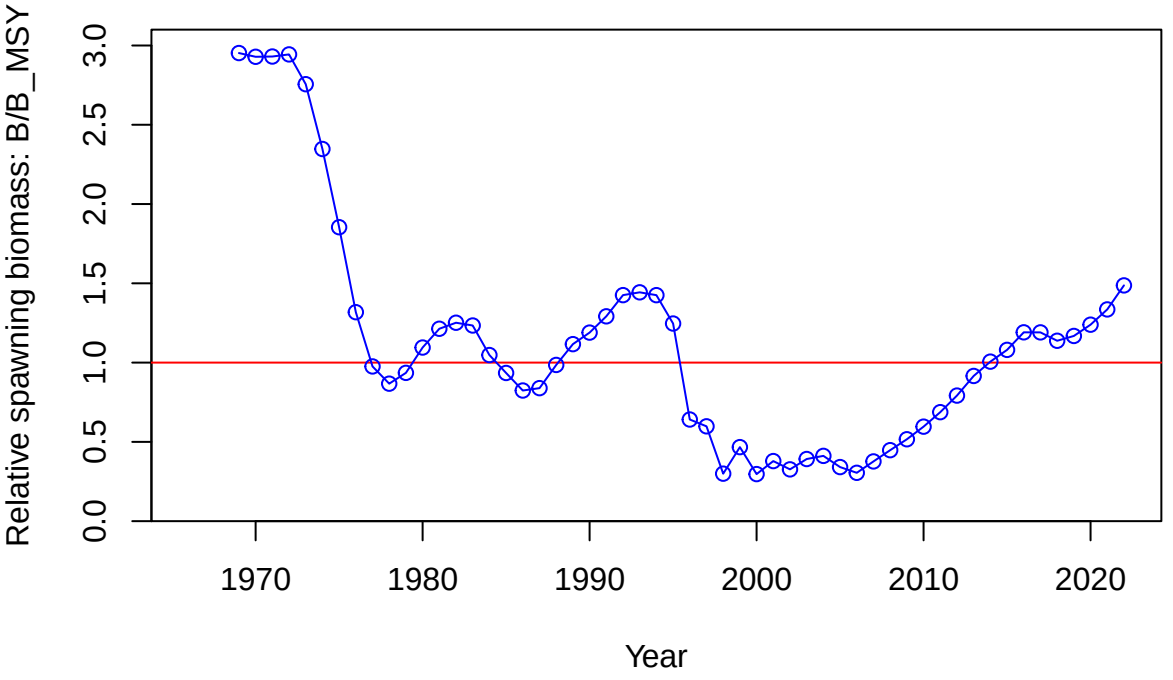

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Length (cm)

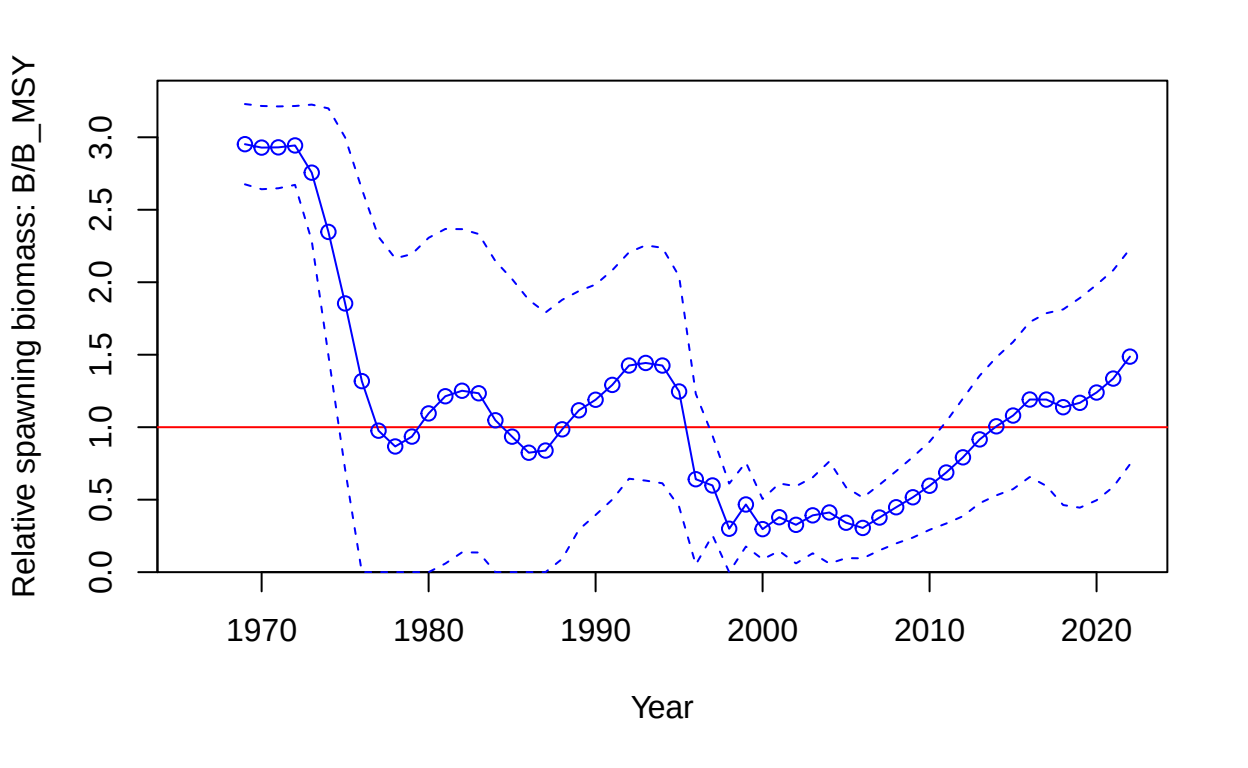

Length (cm)
0
10
20
30
40
50
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
Age (yr)

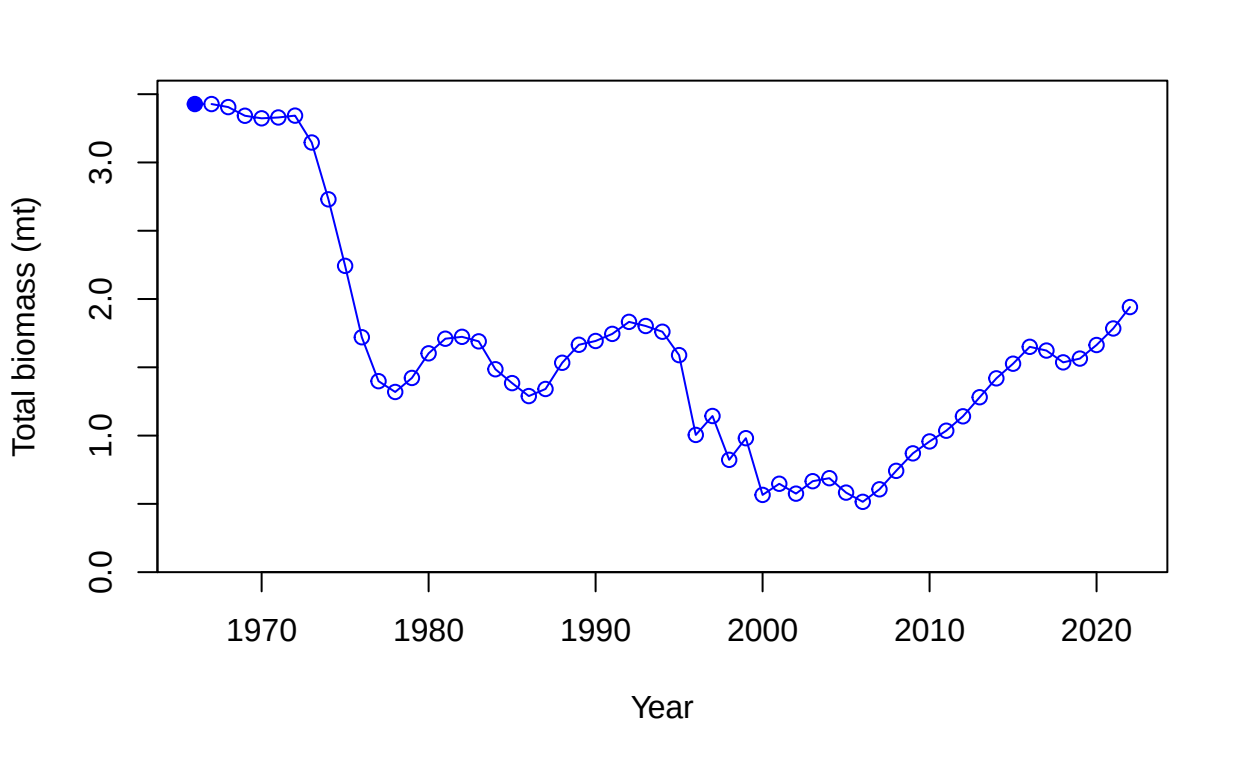

Length (cm)
0
10
20
30
40
50
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
Age (yr)

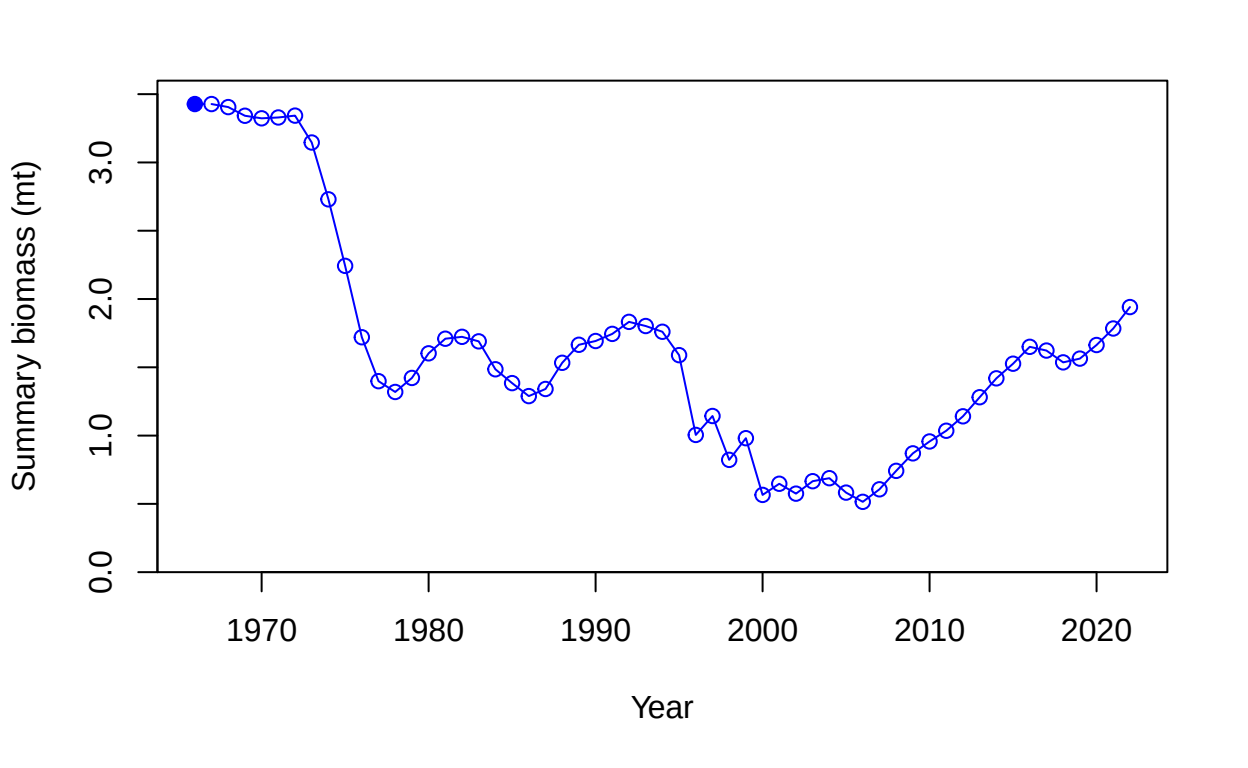

Spawning biomass (mt)
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

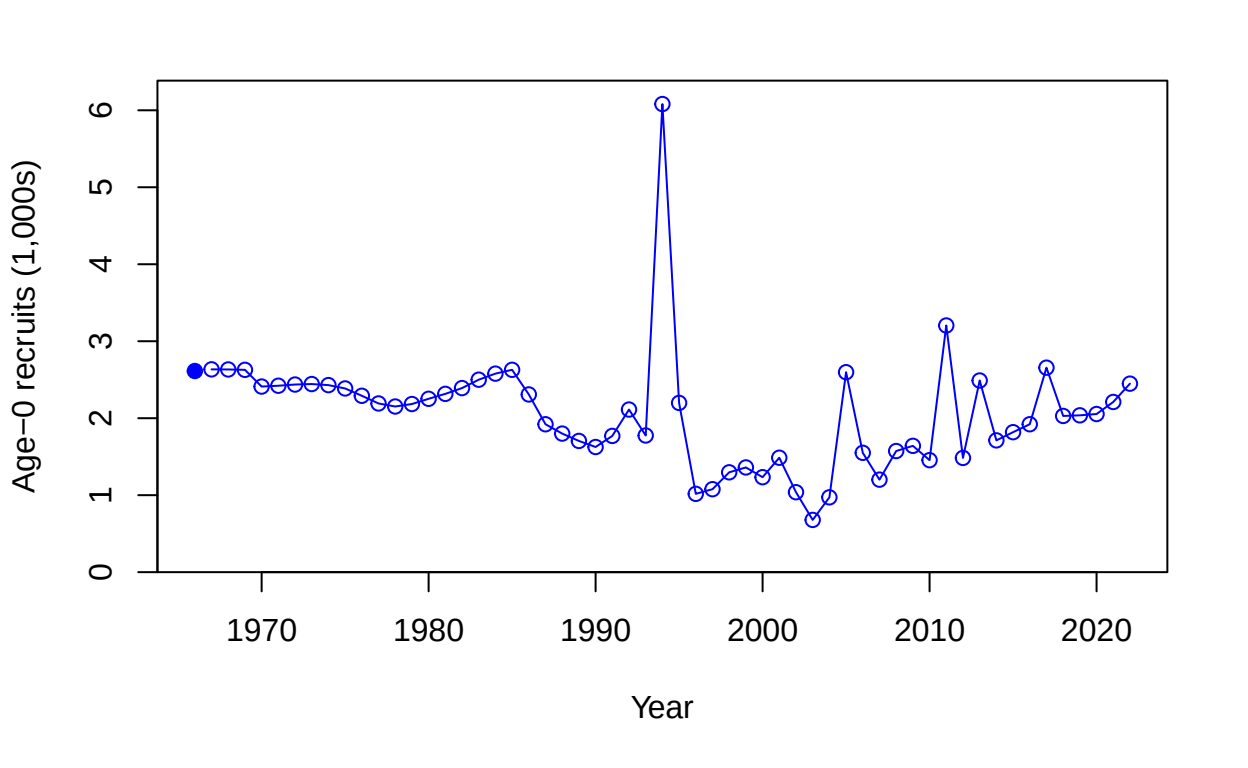

Spawning biomass (mt)
0.0
0.5
1.0
1.5
1970
1980
1990
2000
2010
2020
Year

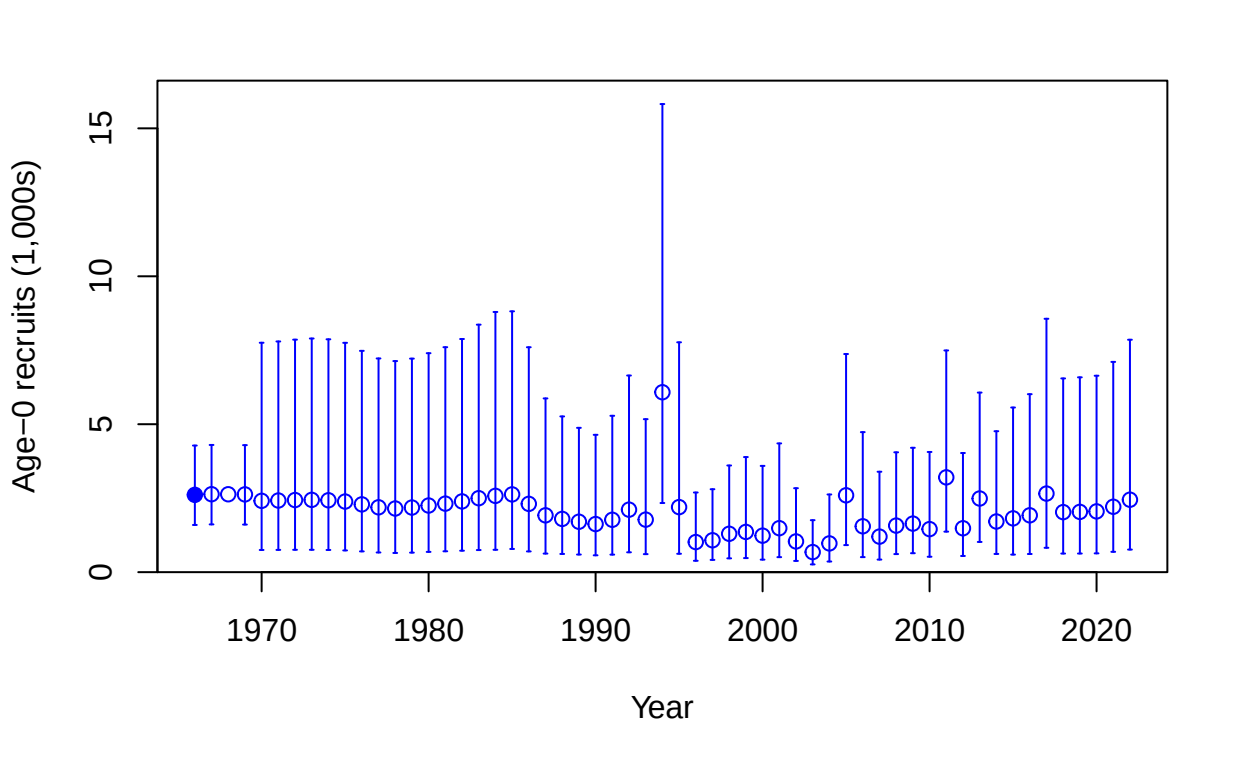

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

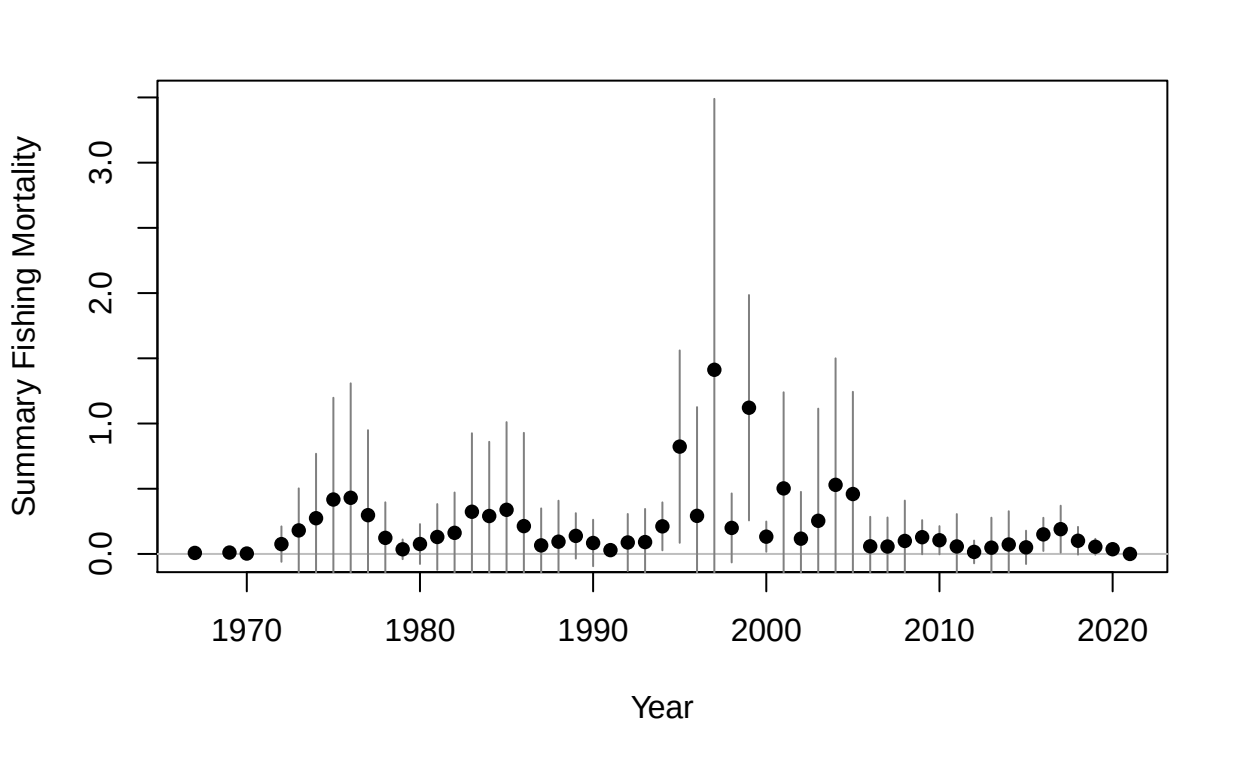

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1970
1980
1990
2000
2010
2020
Year

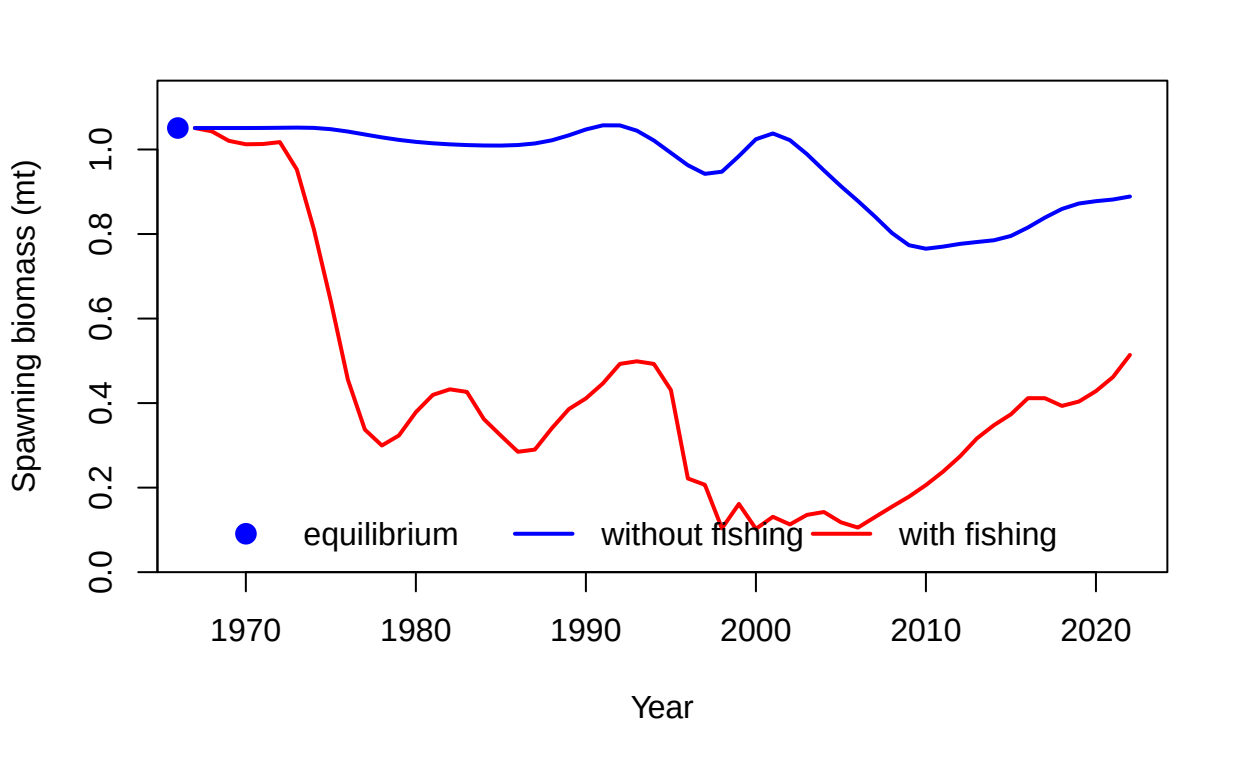

Total biomass (mt)
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

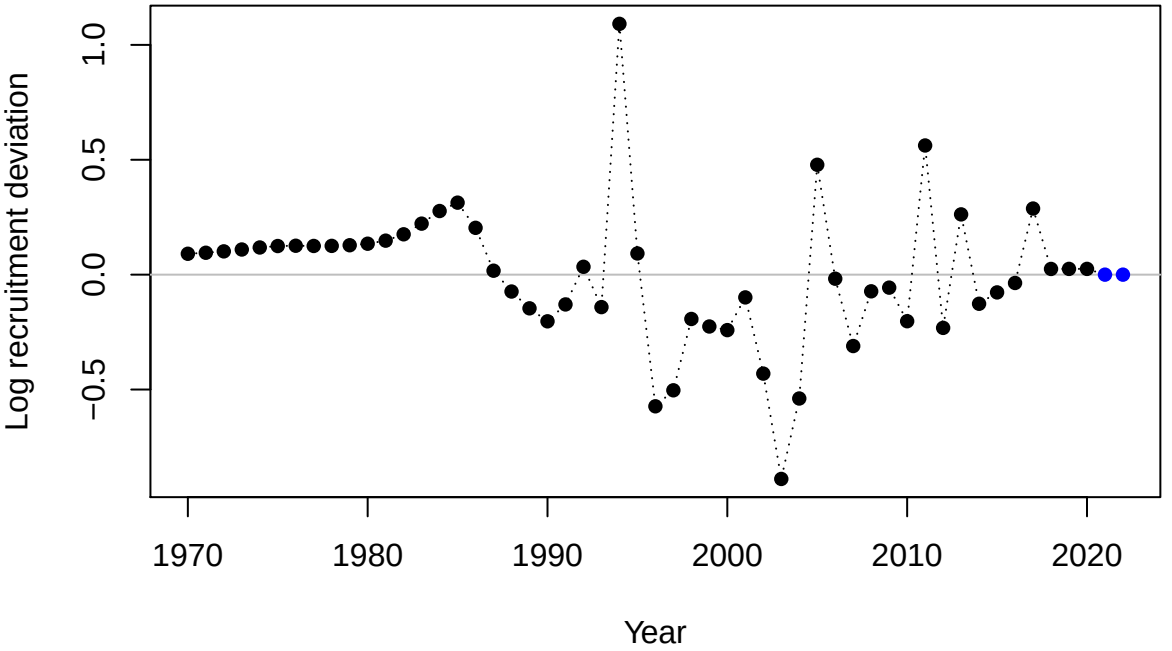

Summary biomass (mt)
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

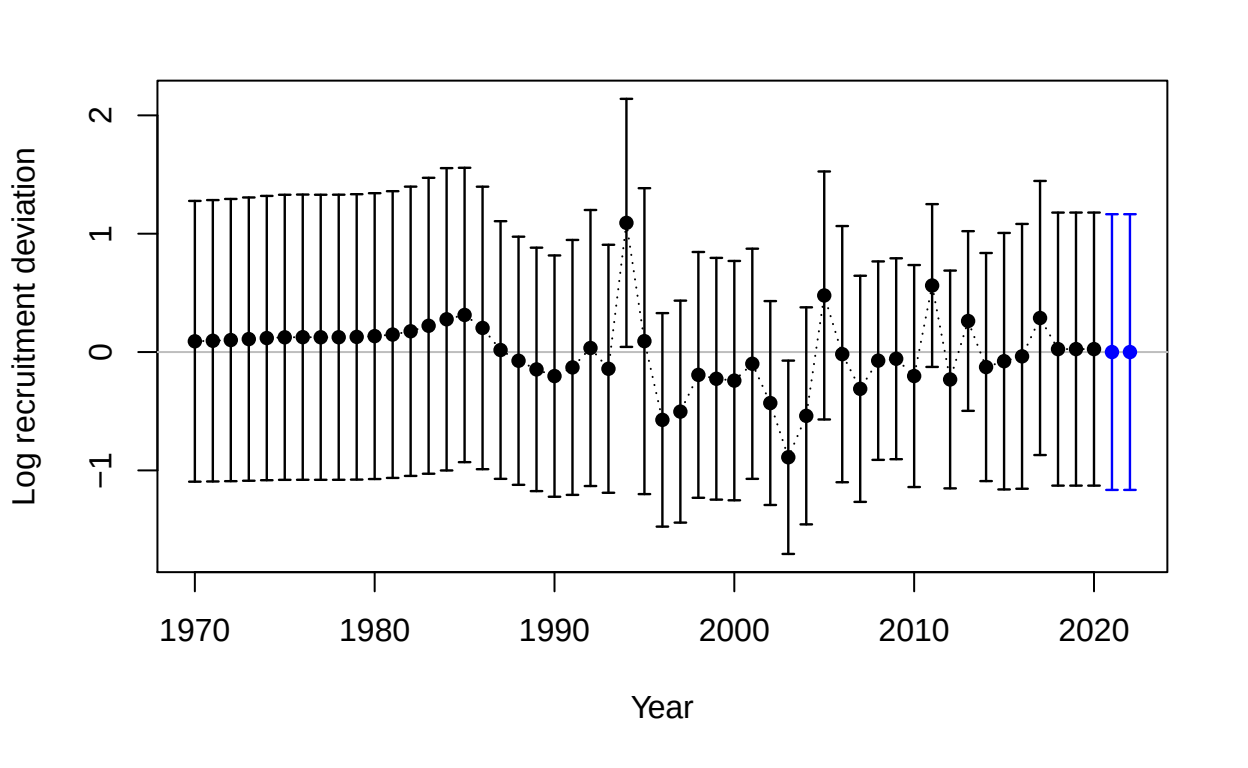

Age−0 recruits (1,000s)
0
1
2
3
4
5
6
1970
1980
1990
2000
2010
2020
Year

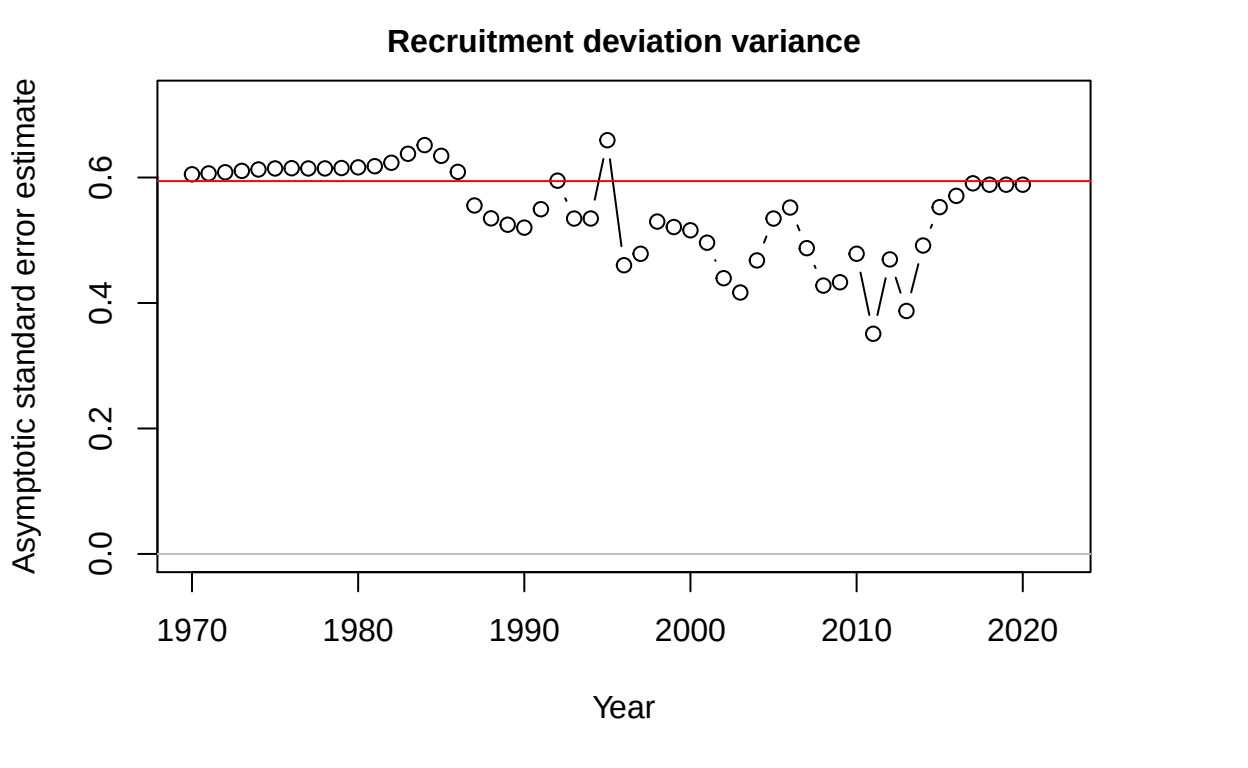

Age−0 recruits (1,000s)
0
5
10
15
1970
1980
1990
2000
2010
2020
Year

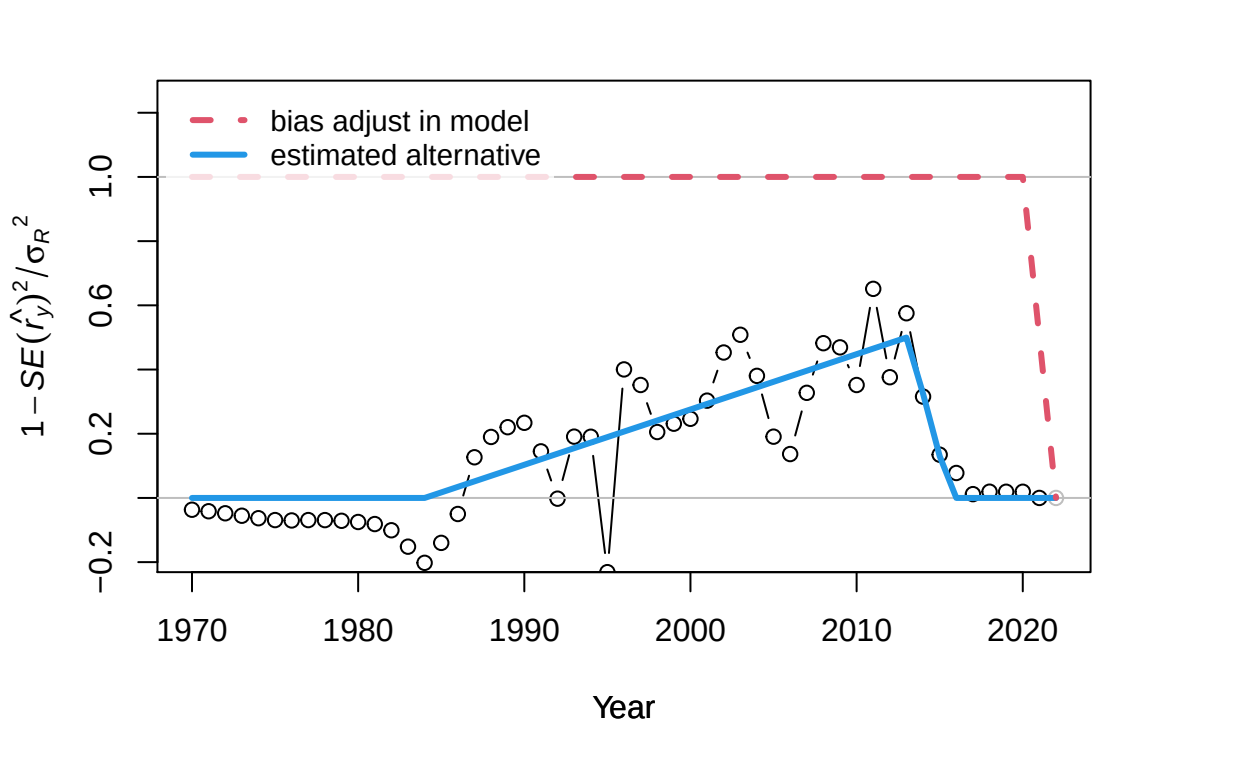

Summary Fishing Mortality
0.0
1.0
2.0
3.0
1970
1980
1990
2000
2010
2020
Year

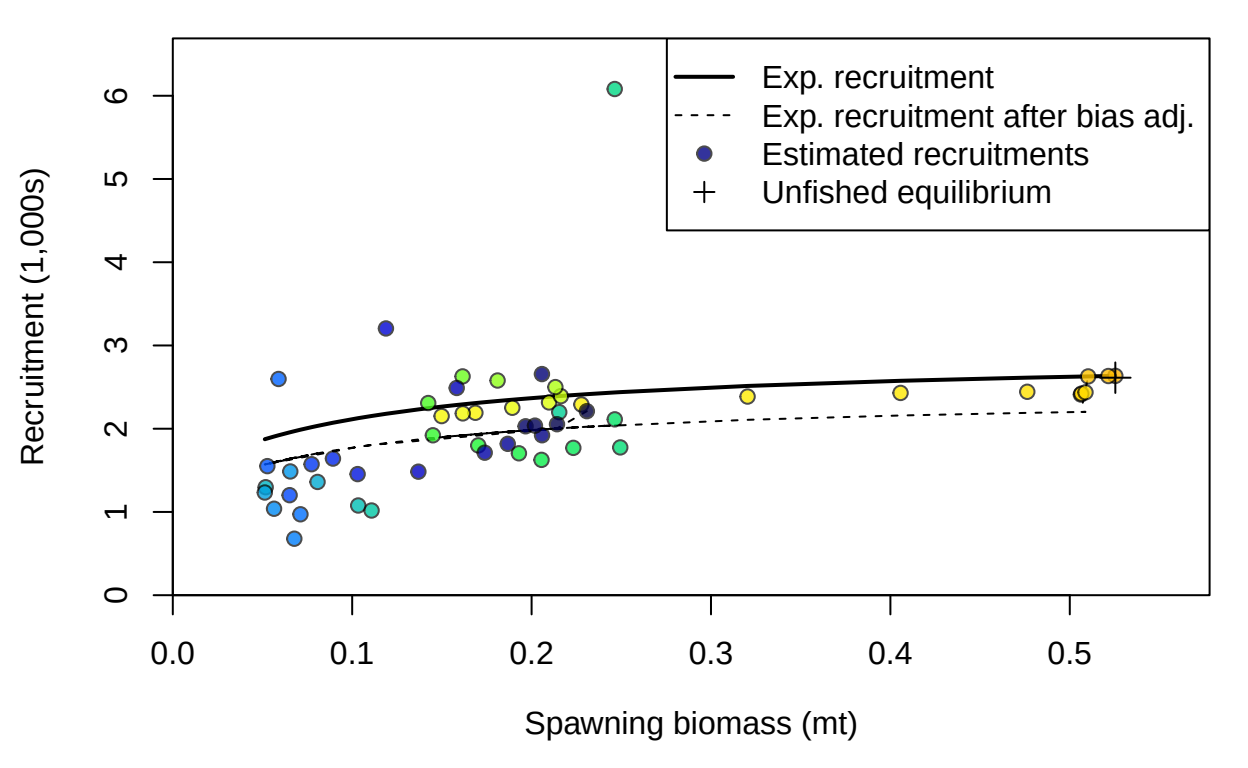

Spawning biomass (mt)
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

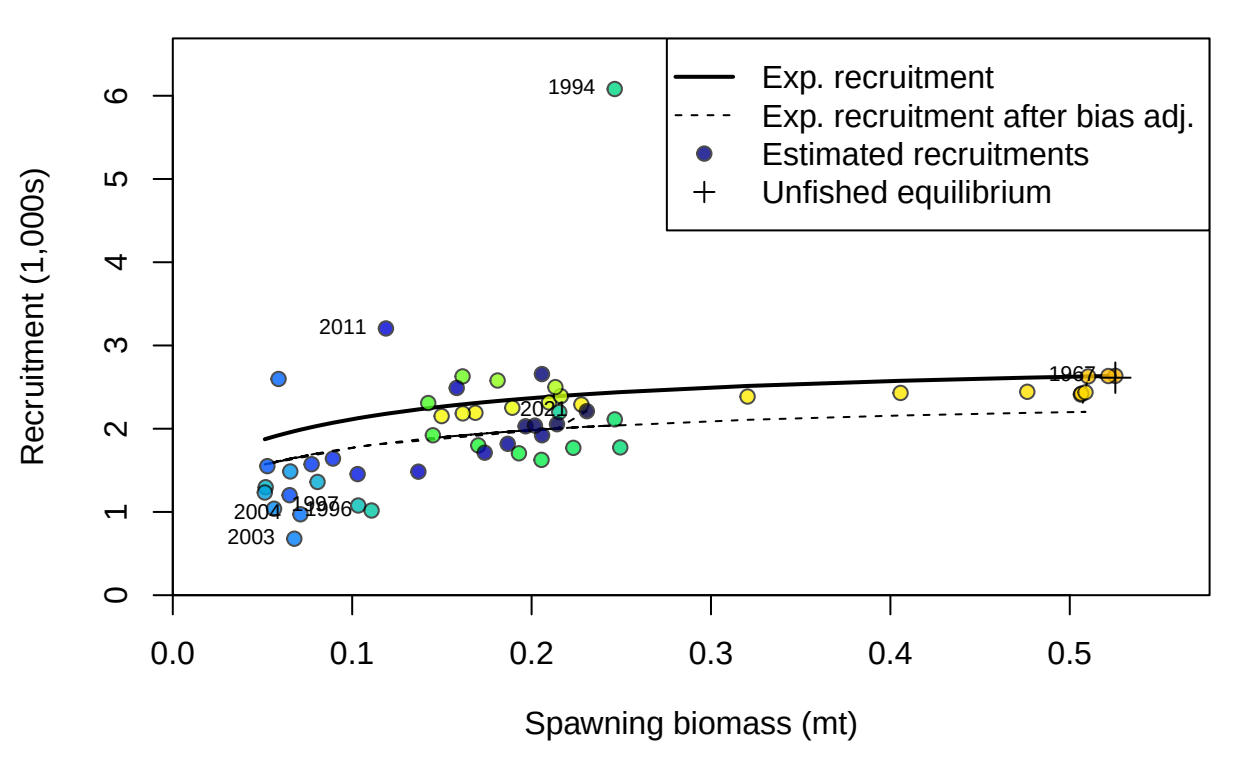

Log recruitment deviation
1.0
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year

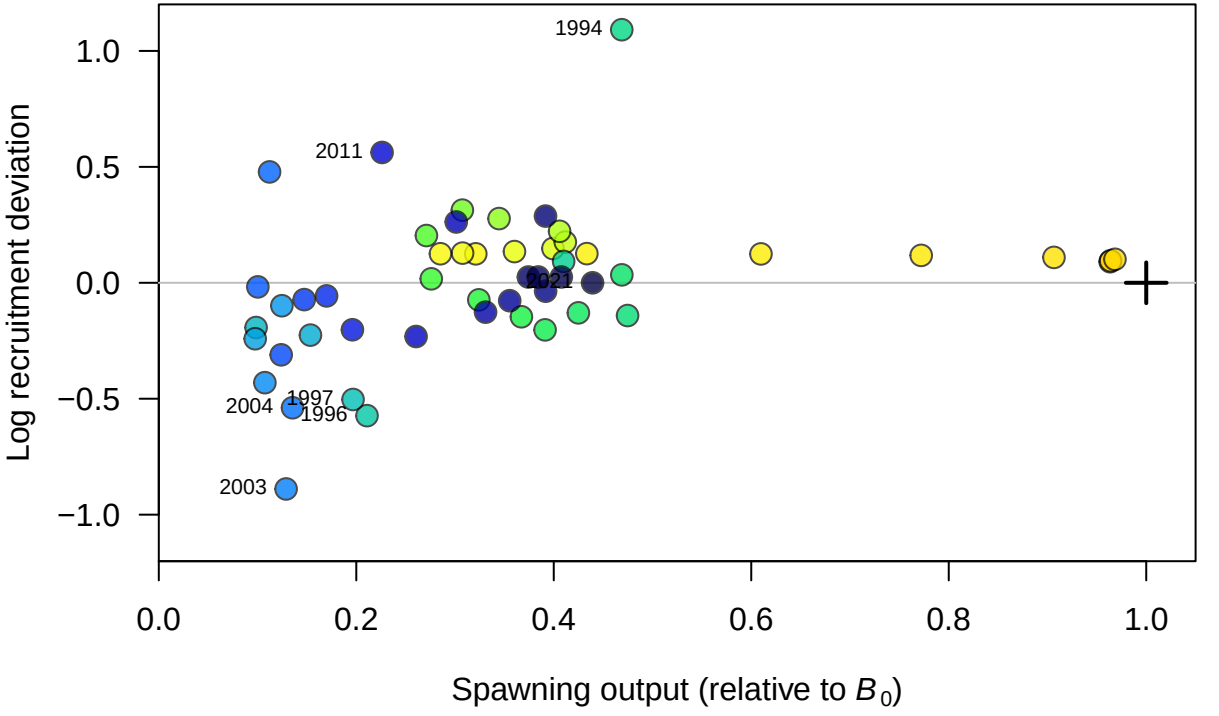

Log recruitment deviation
2
1
0
−1
1970
1980
1990
2000
2010
2020
Year

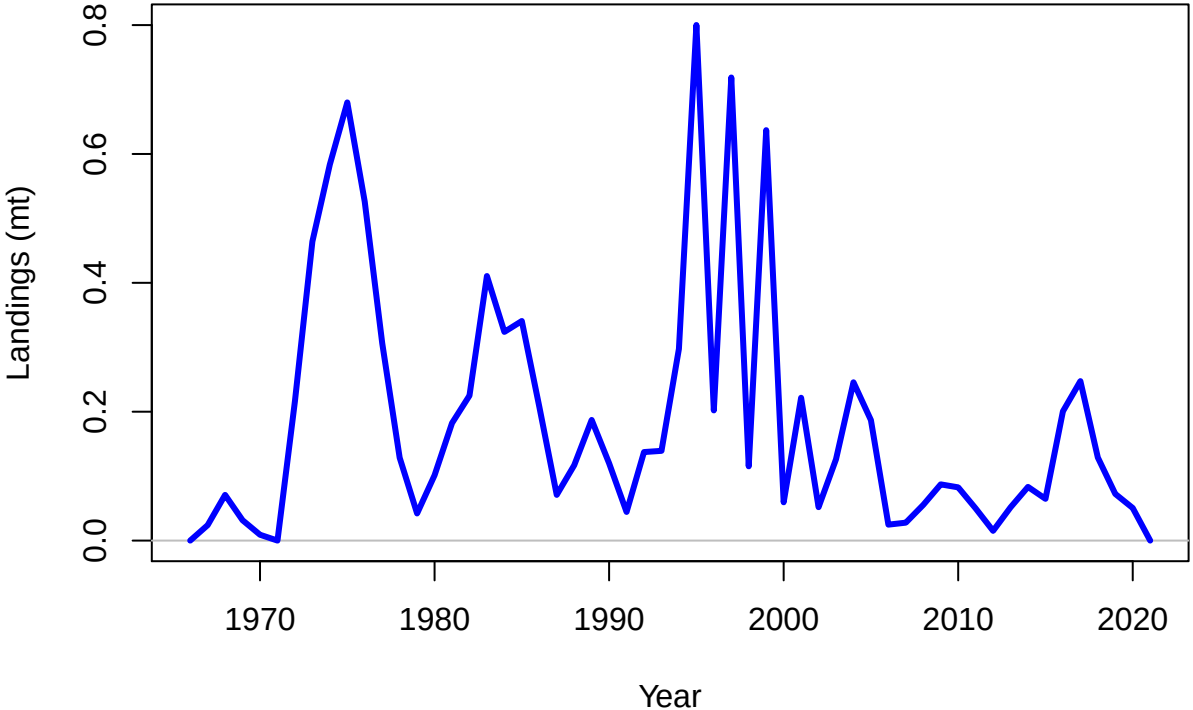

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

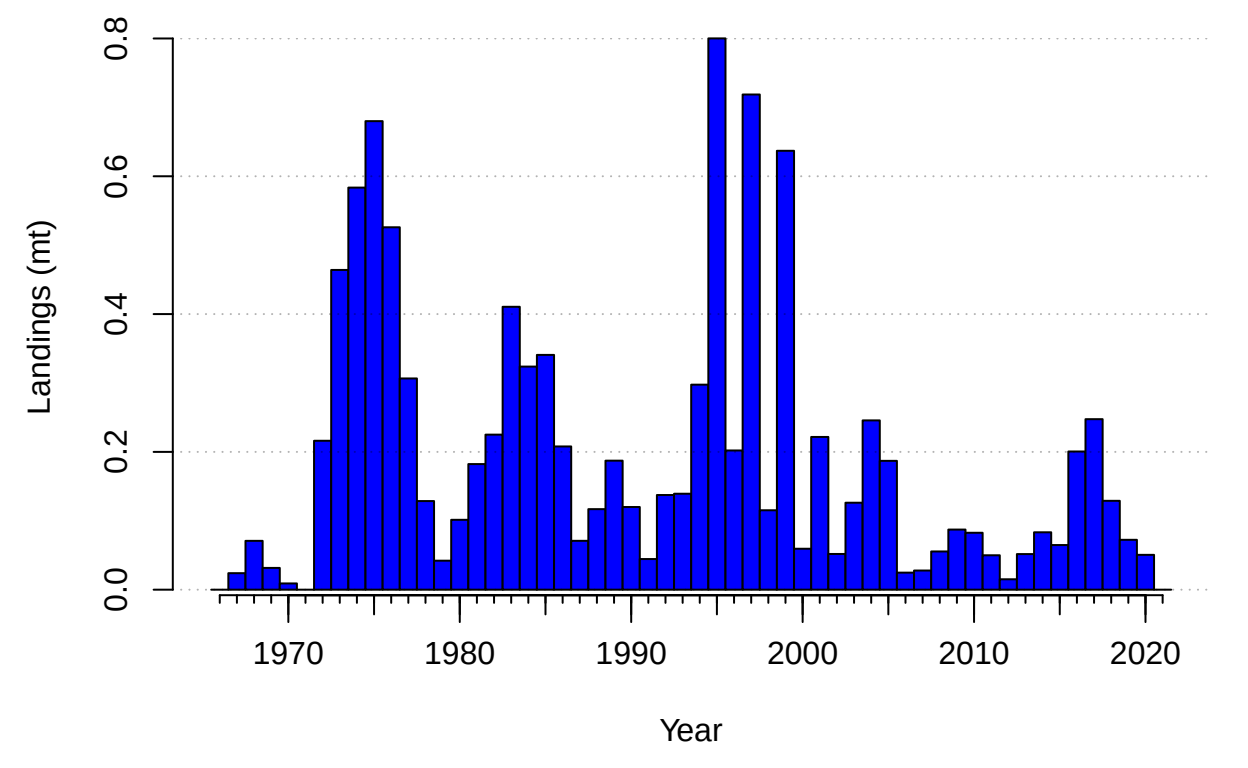

bias adjust in model
estimated alternative
1.0
0.6
0.2
−0.2
$1-SE(\hat{r}_y)^2/\sigma_R^2$
1970
1980
1990
2000
2010
2020
Year

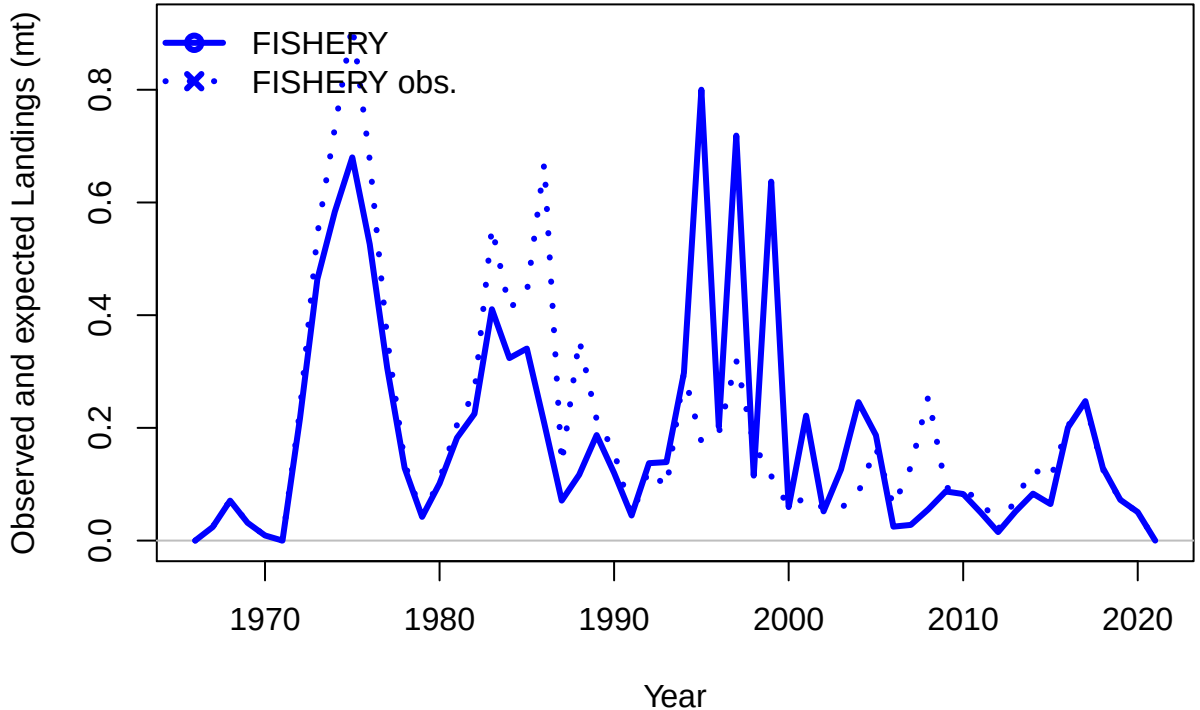

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
1
2
3
4
5
6
0.0
0.1
0.2
0.3
0.4
0.5
Spawning biomass (mt)

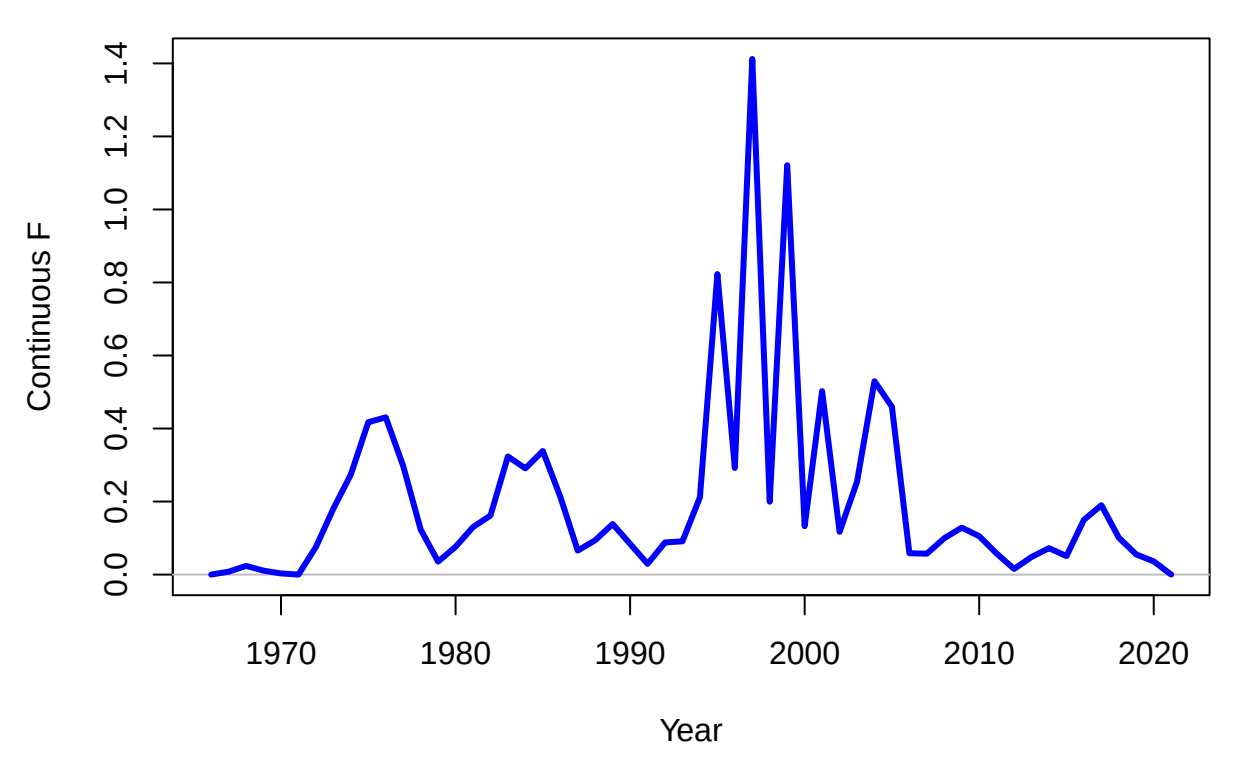

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
1994
2011
1967
2021
2004
1997
1996
2003
Recruitment (1,000s)
0
1
2
3
4
5
6
0.0
0.1
0.2
0.3
0.4
0.5
Spawning biomass (mt)

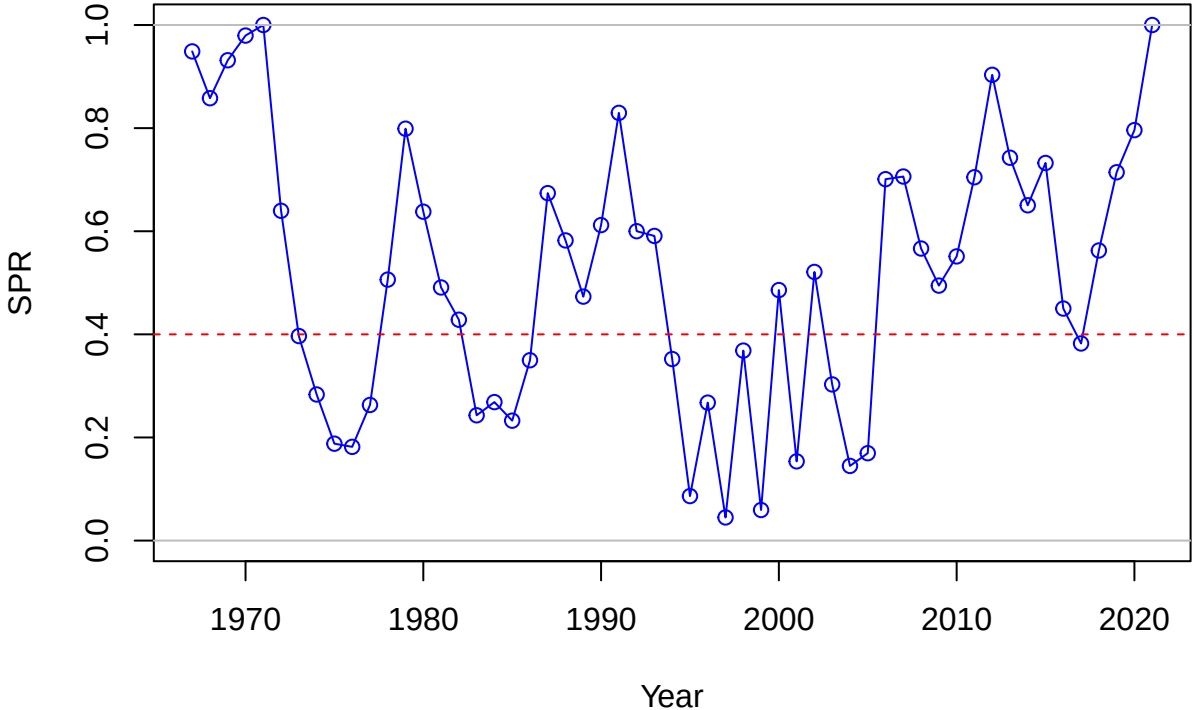

1994
2011
2021
2004
1997
1996
2003
1.0
0.5
0.0
−0.5
−1.0
Log recruitment deviation
0.0
0.2
0.4
0.6
0.8
1.0
Spawning output (relative to B_0)

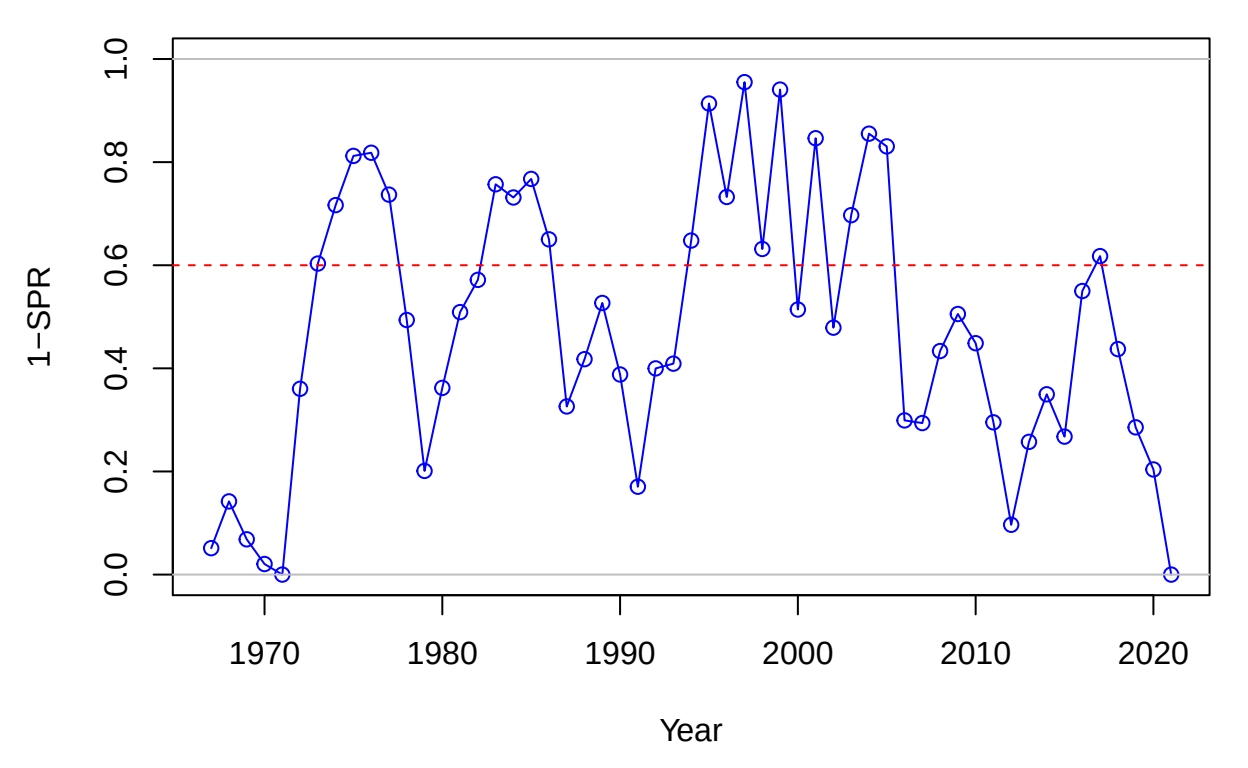

Landings (mt)
0.0
0.2
0.4
0.6
0.8
1970
1980
1990
2000
2010
2020
Year

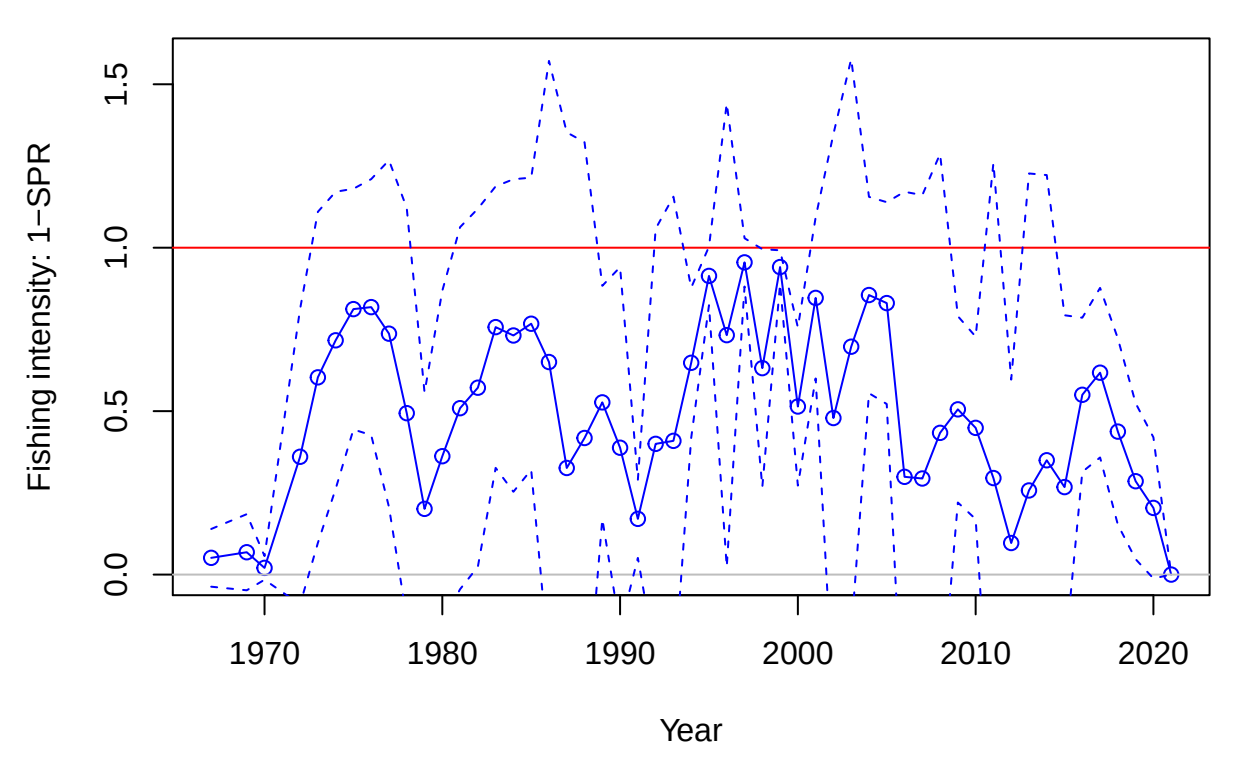

Landings (mt)
0.0
0.2
0.4
0.6
0.8
1970
1980
1990
2000
2010
2020
Year

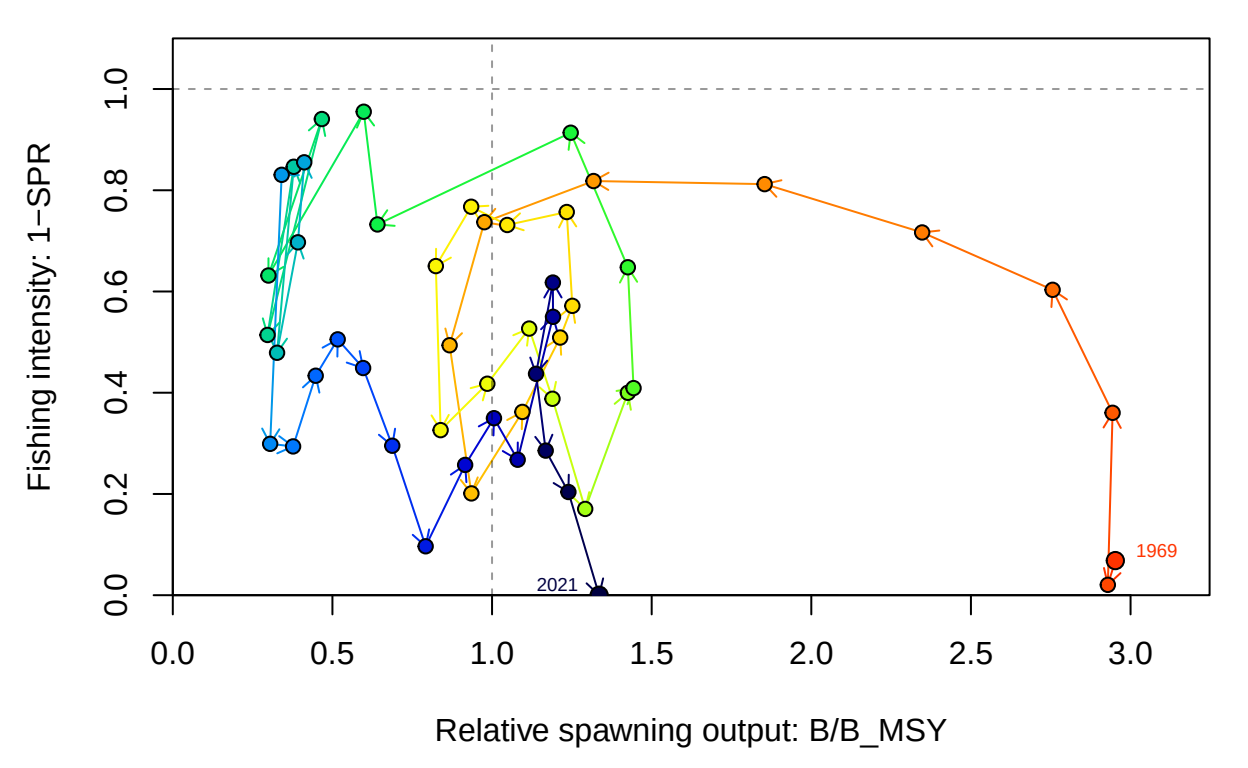

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0.0
0.2
0.4
0.6
0.8
1970
1980
1990
2000
2010
2020
Year

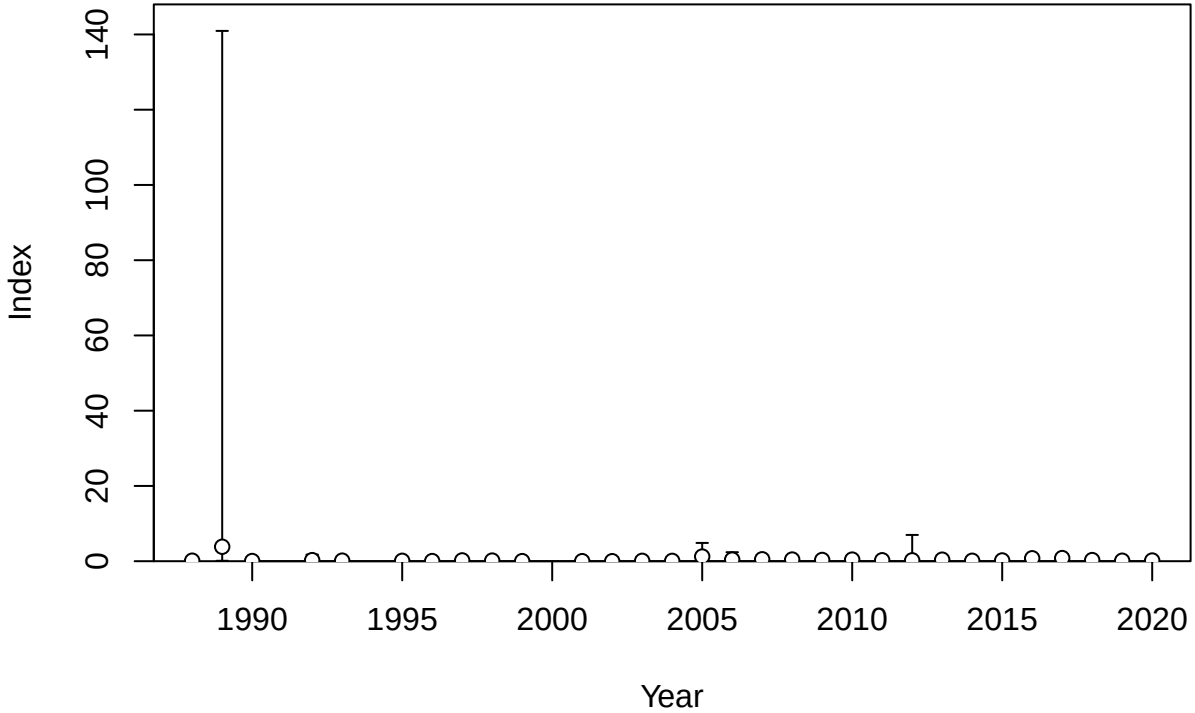

Continuous F
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1970
1980
1990
2000
2010
2020
Year

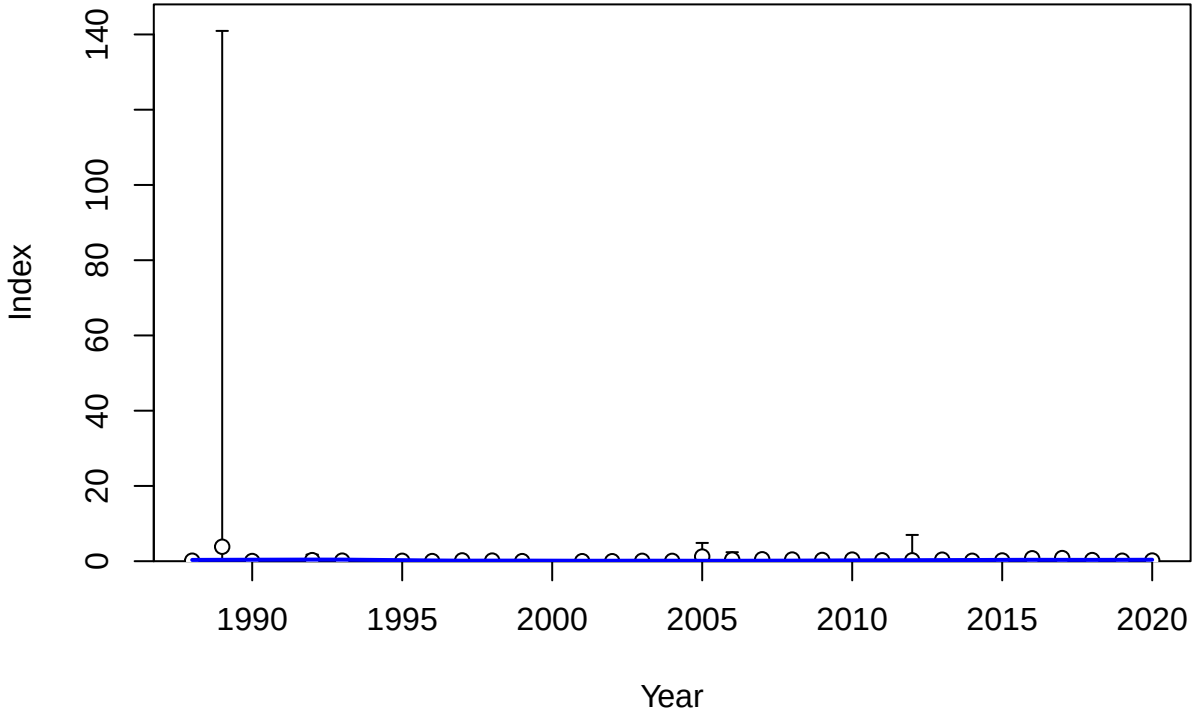

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

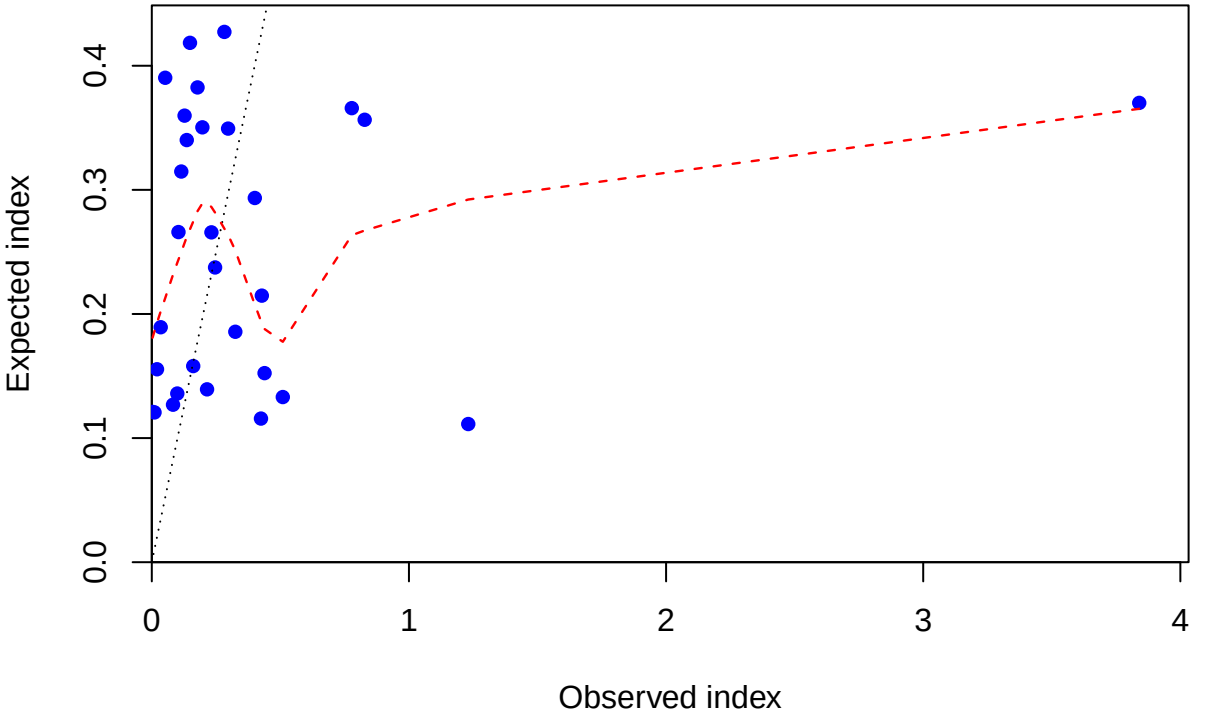

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

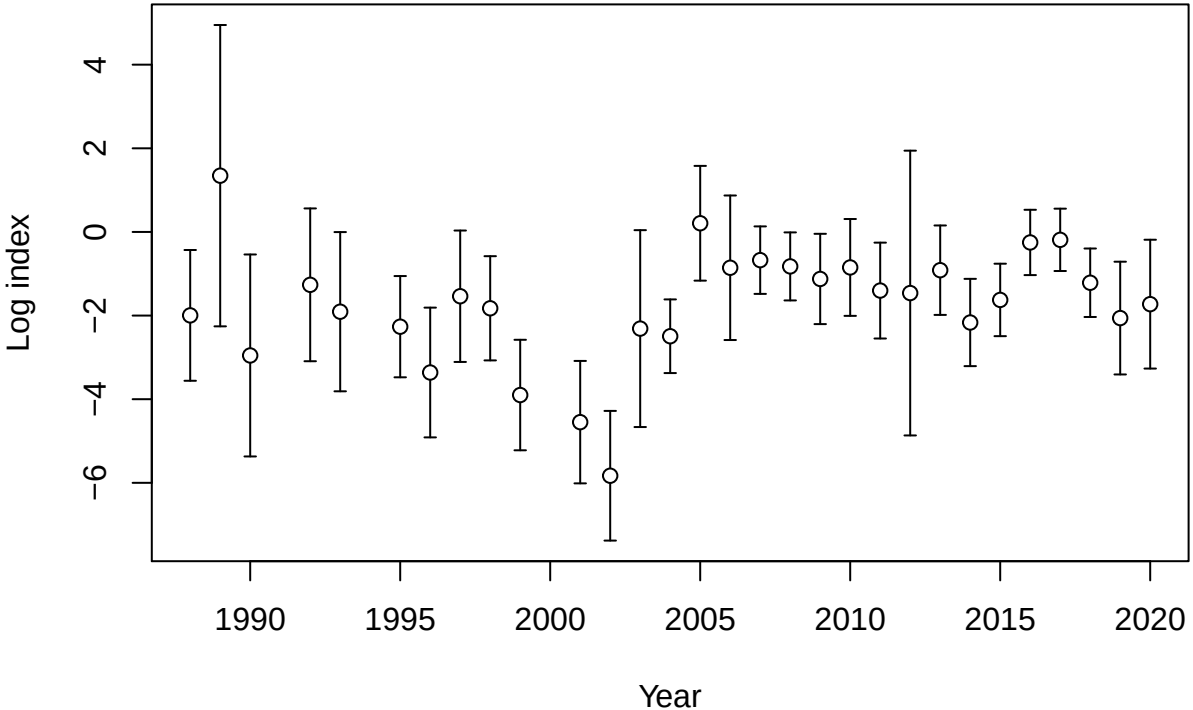

Fishing intensity: 1−SPR
0.0
0.5
1.0
1.5
1970
1980
1990
2000
2010
2020
Year

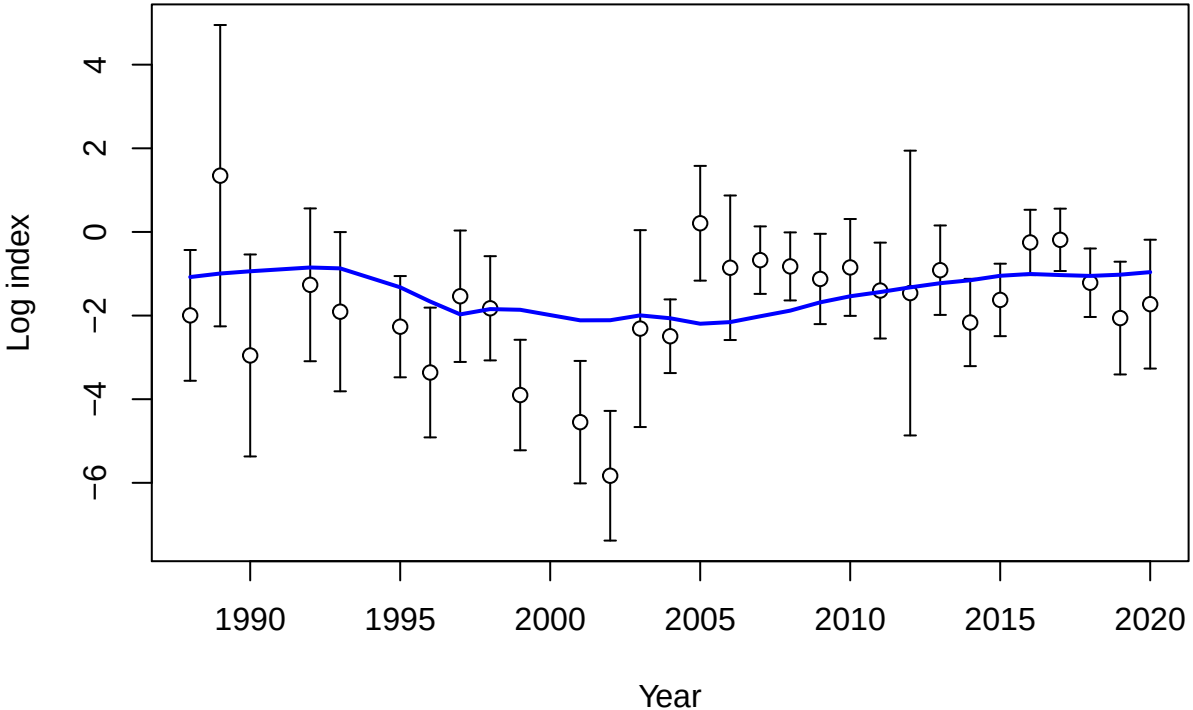

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Relative spawning output: B/B_MSY
1969
2021

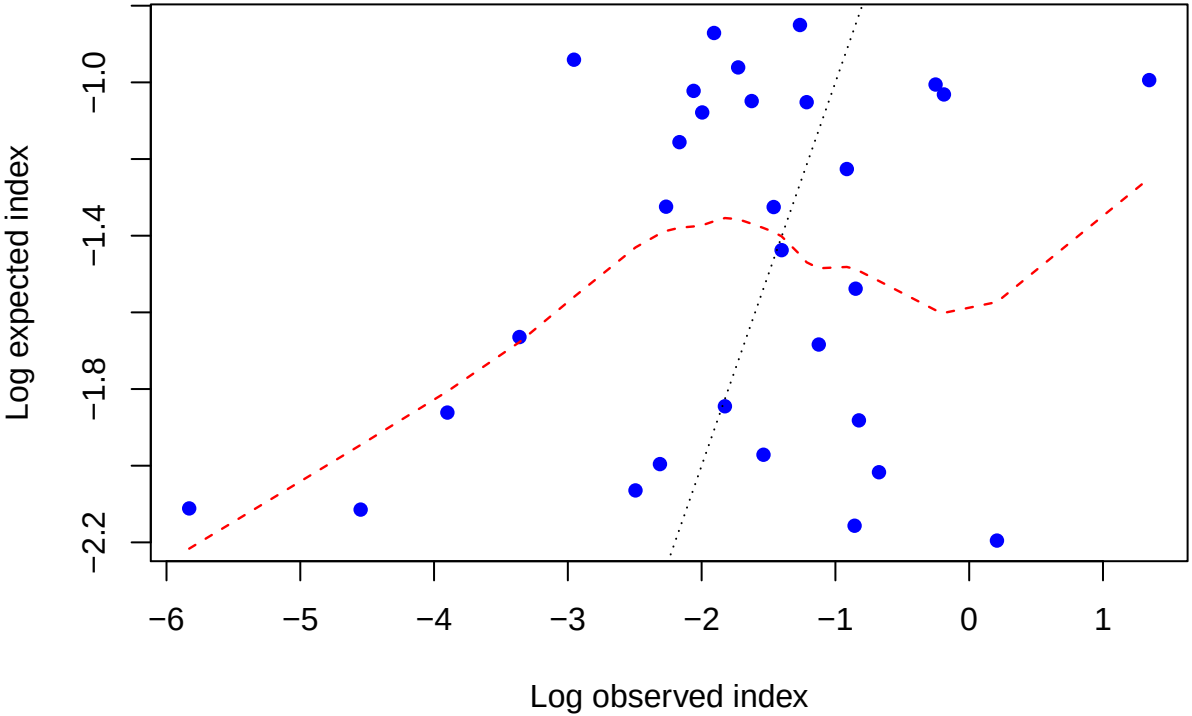

Index
0
20
40
60
80
100
140
1990
1995
2000
2005
2010
2015
2020
Year

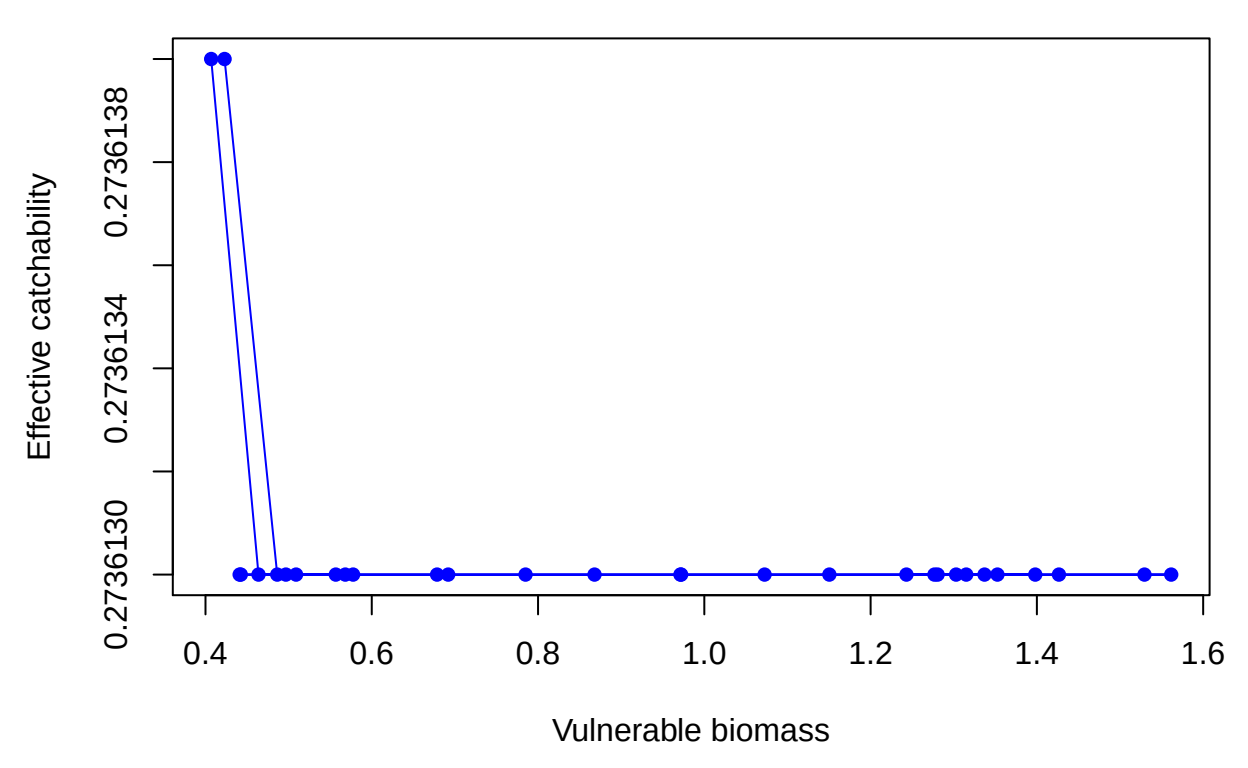

Index
0
20
40
60
80
100
140
1990
1995
2000
2005
2010
2015
2020
Year

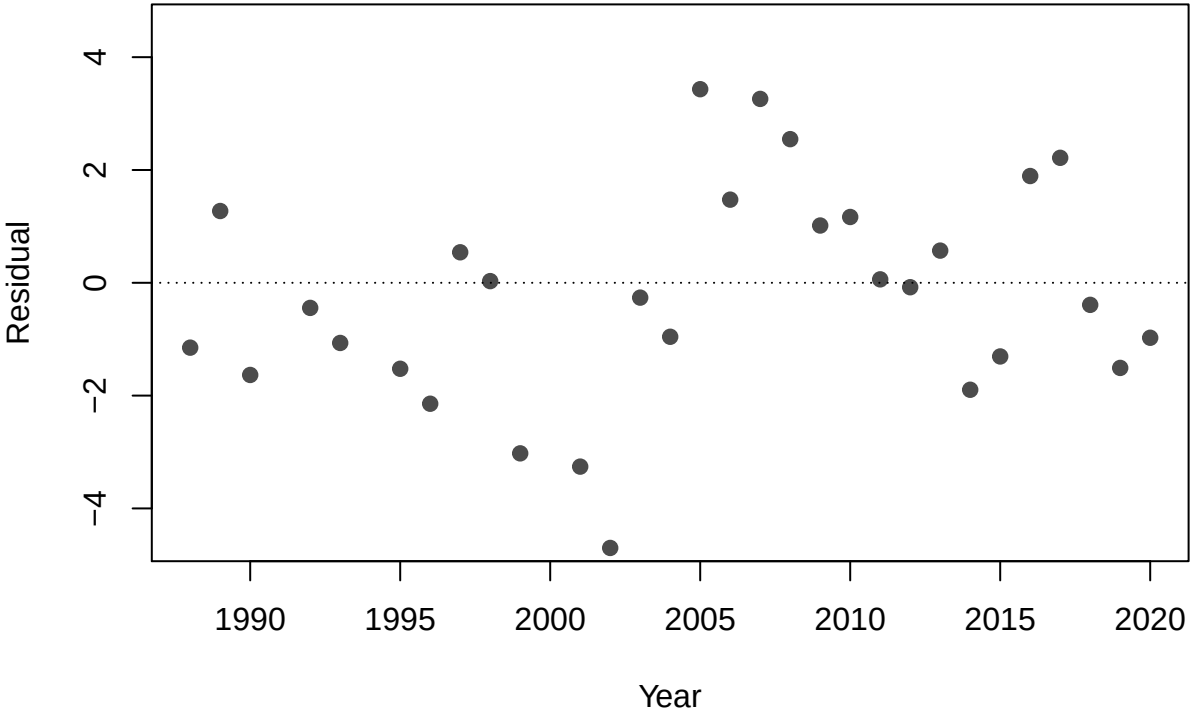

Expected index
0.0
0.1
0.2
0.3
0.4
0
1
2
3
4
Observed index

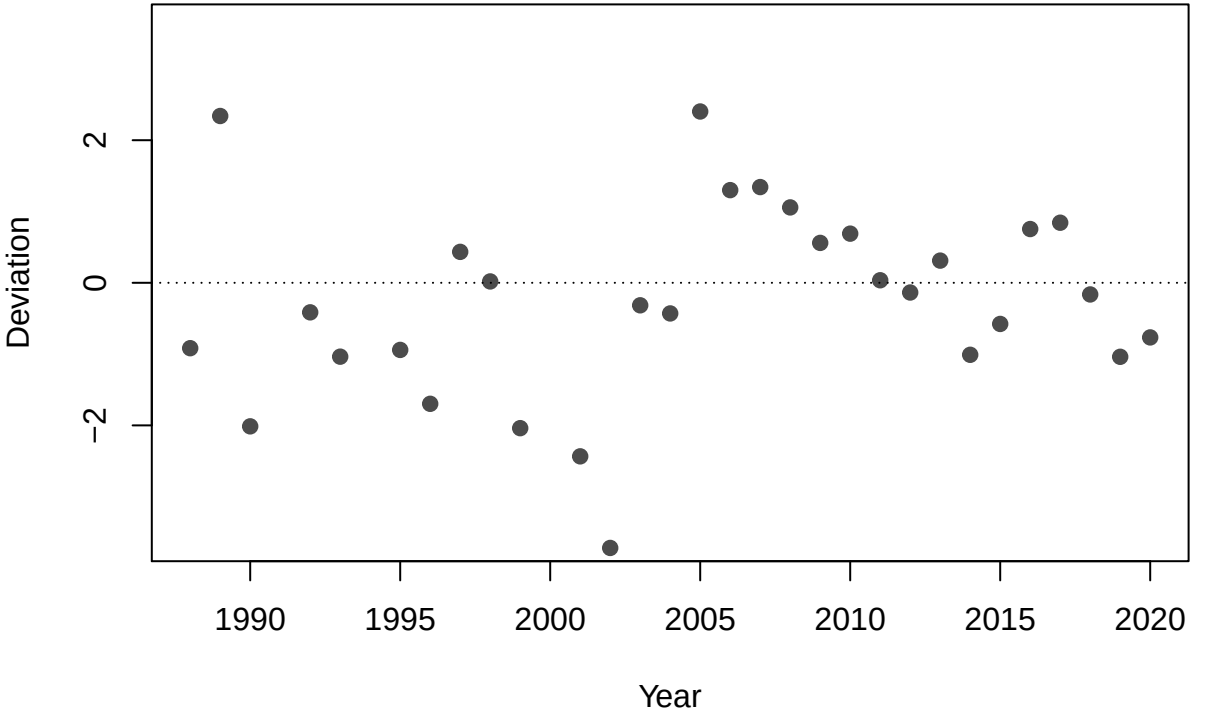

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

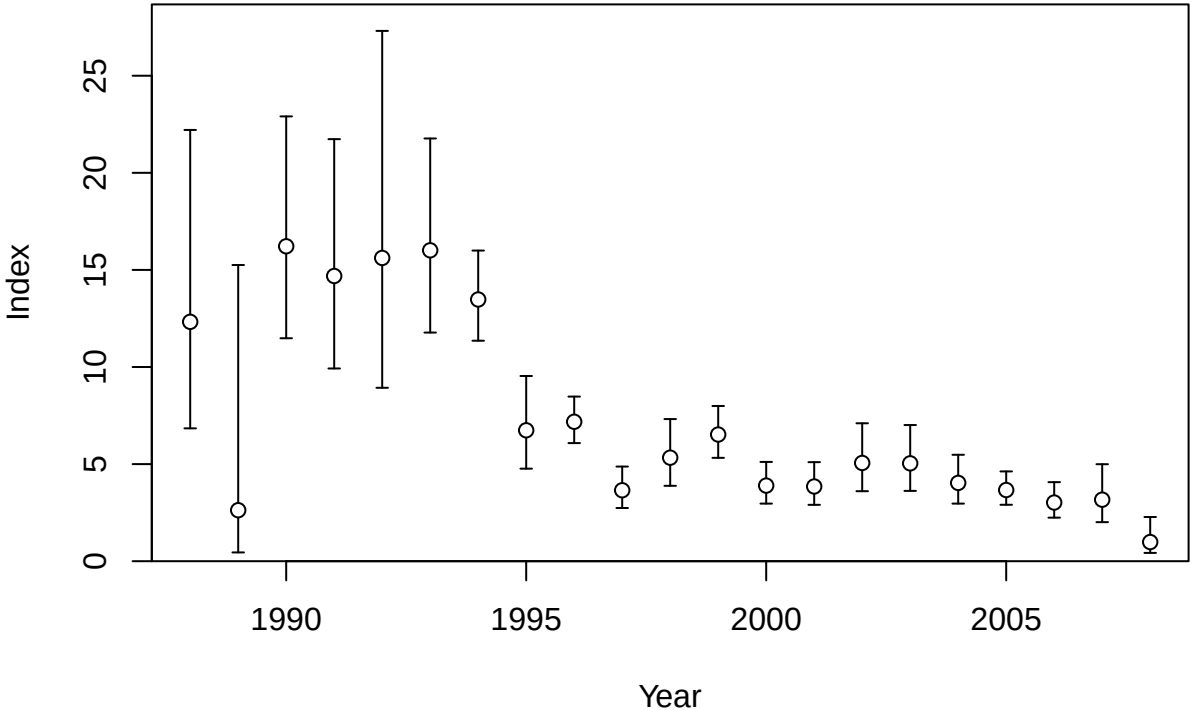

Log index
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

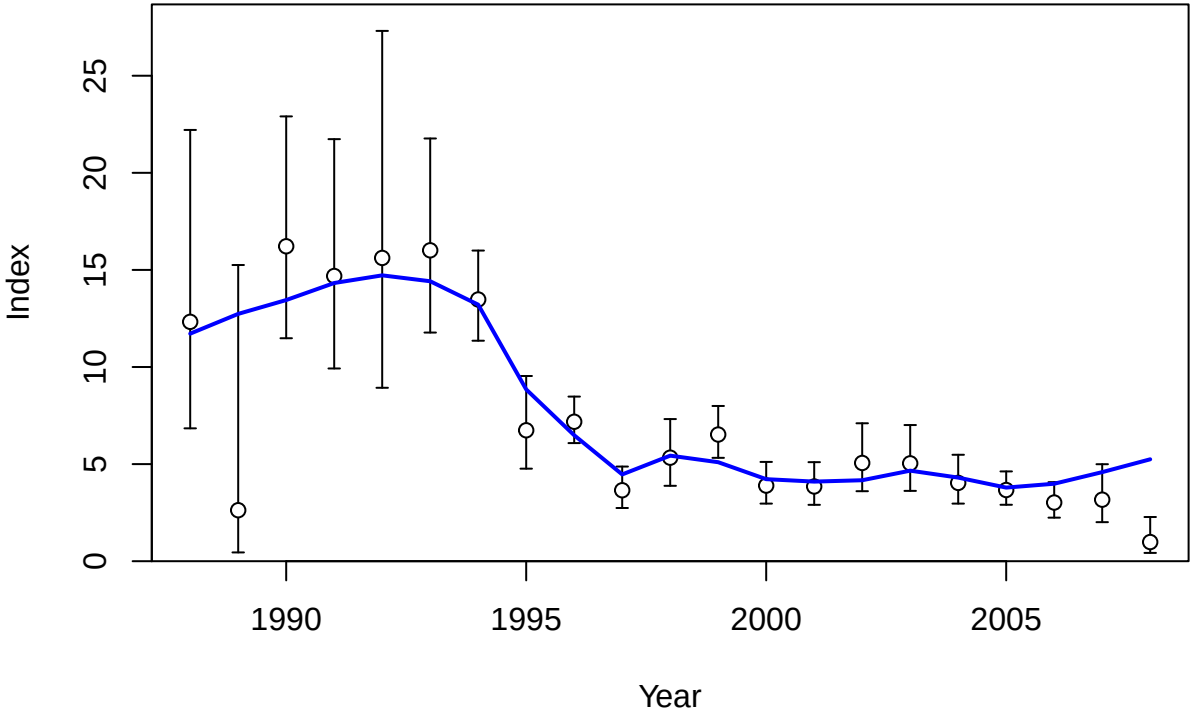

Log expected index
−1.0
−1.4
−1.8
−2.2
−6
−5
−4
−3
−2
−1
0
1
Log observed index

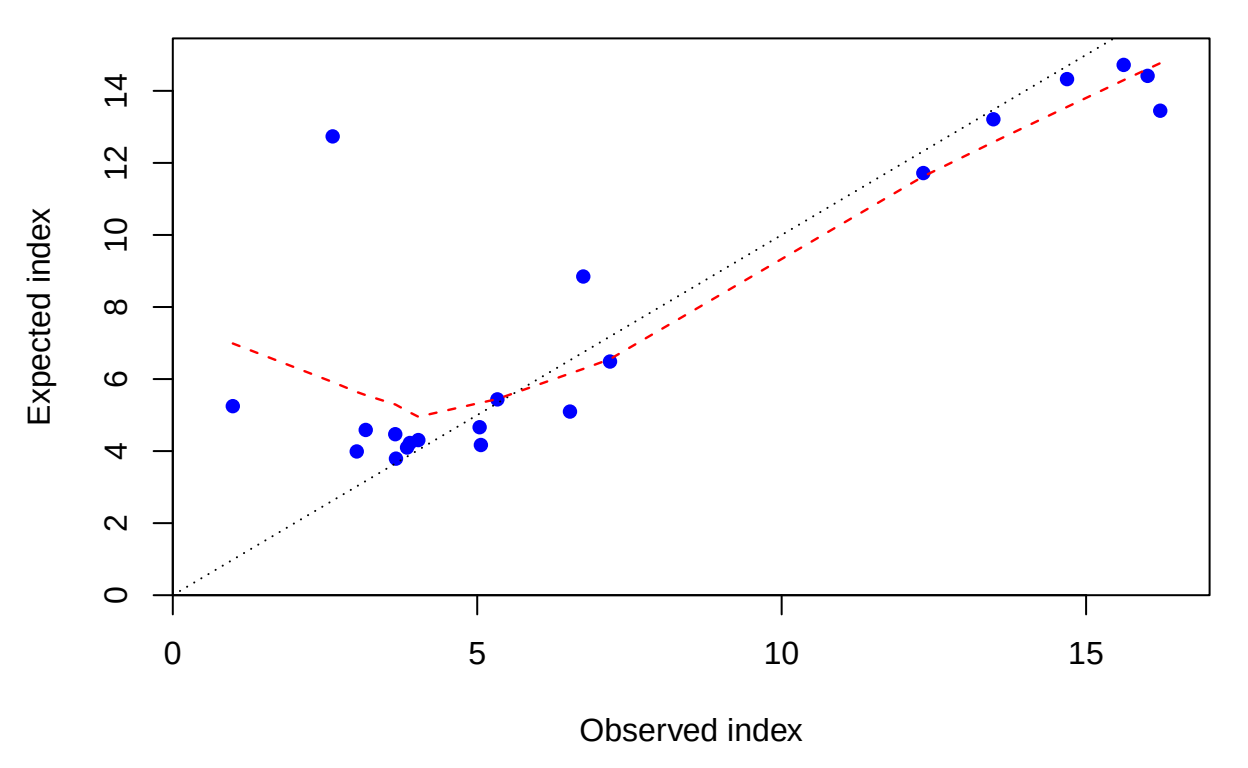

Effective catchability
0.2736130
0.2736134
0.2736138
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Vulnerable biomass

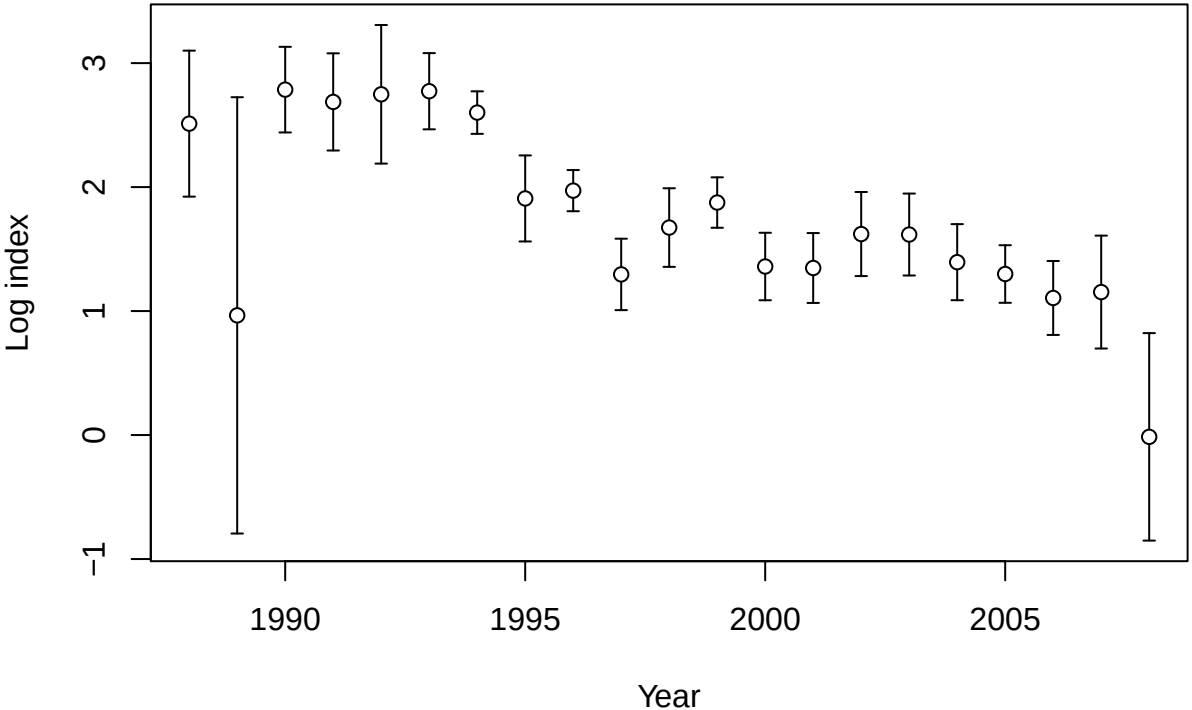

Residual
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

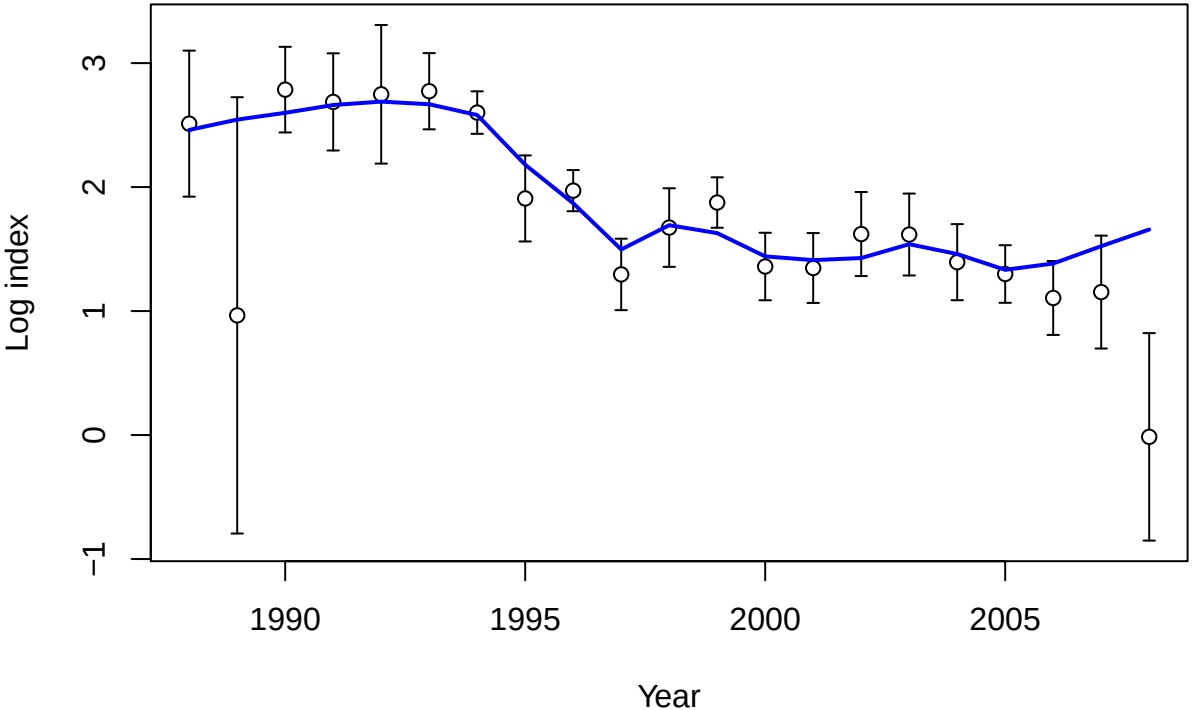

Deviation
2
0
−2
1990
1995
2000
2005
2010
2015
2020
Year

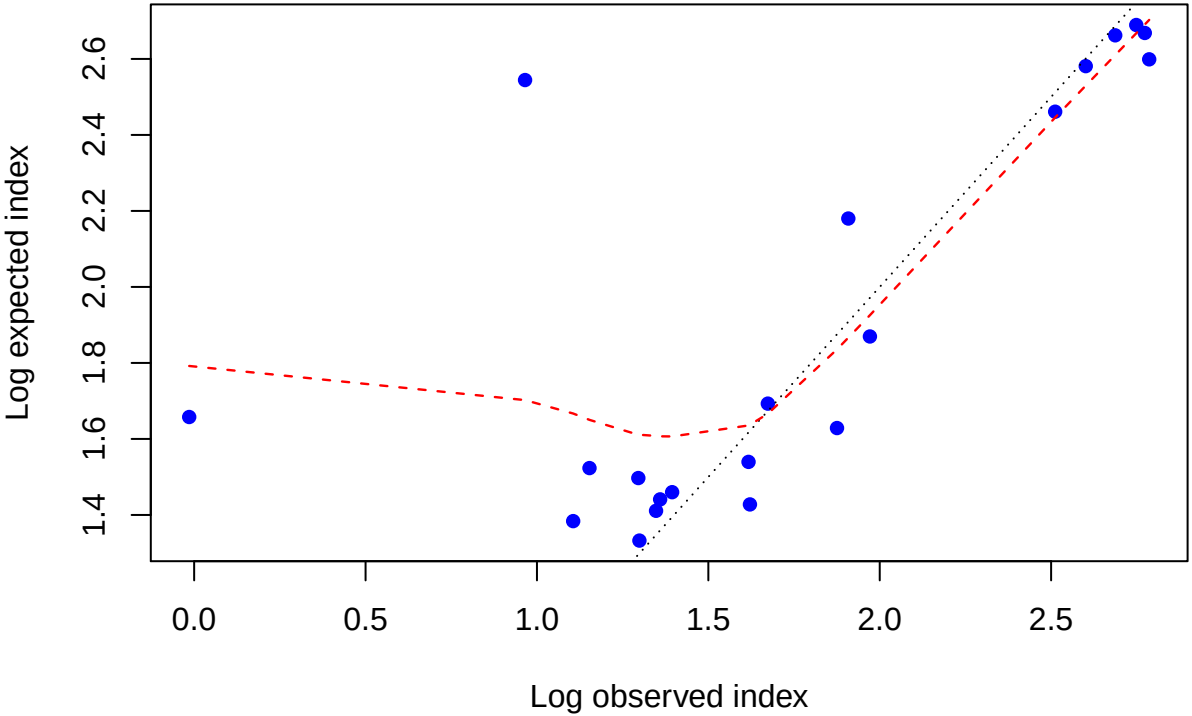

Index
0
5
10
15
20
25
1990
1995
2000
2005
Year

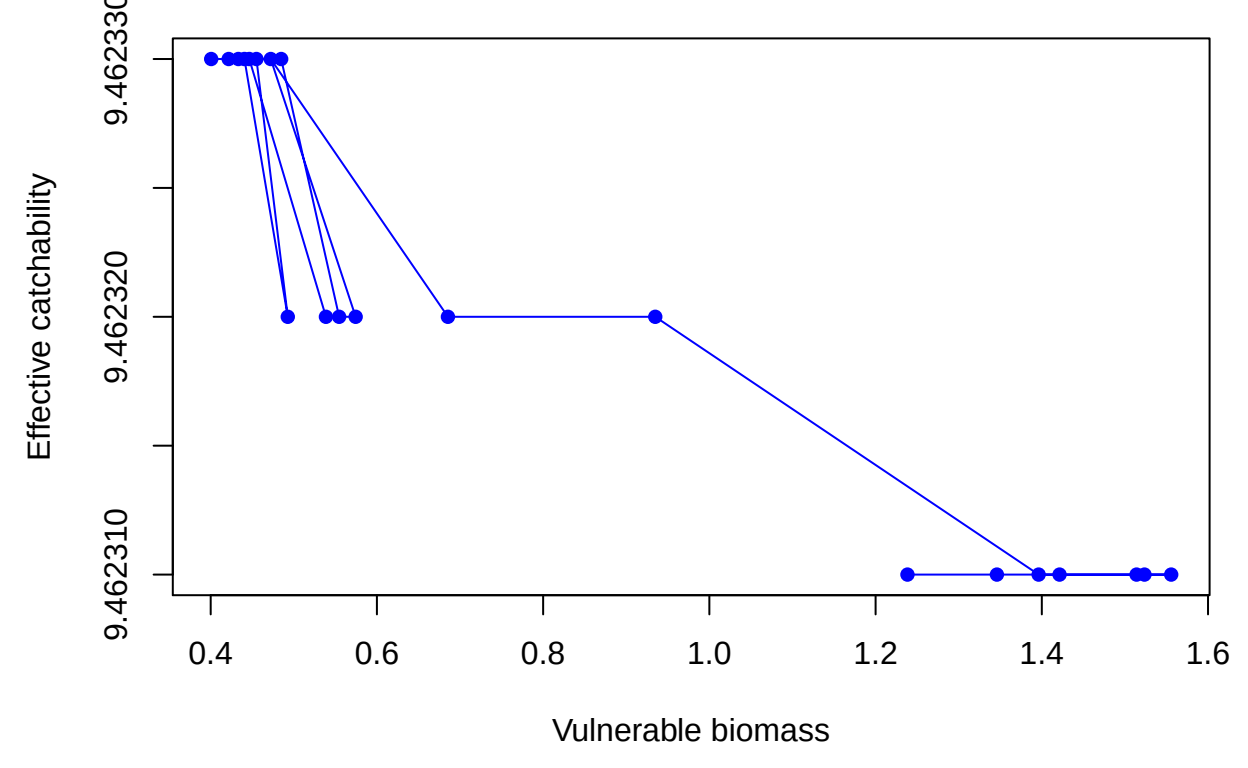

Index
0
5
10
15
20
25
1990
1995
2000
2005
Year

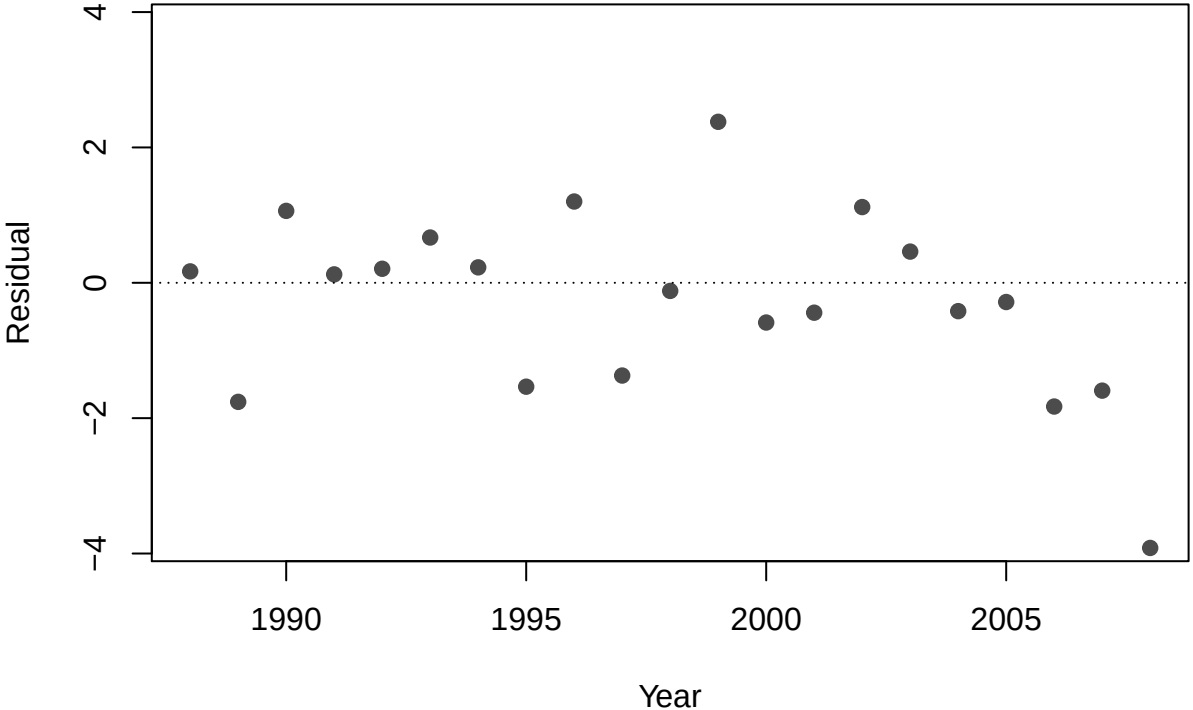

Expected index
0
2
4
6
8
10
12
14
0
5
10
15
Observed index

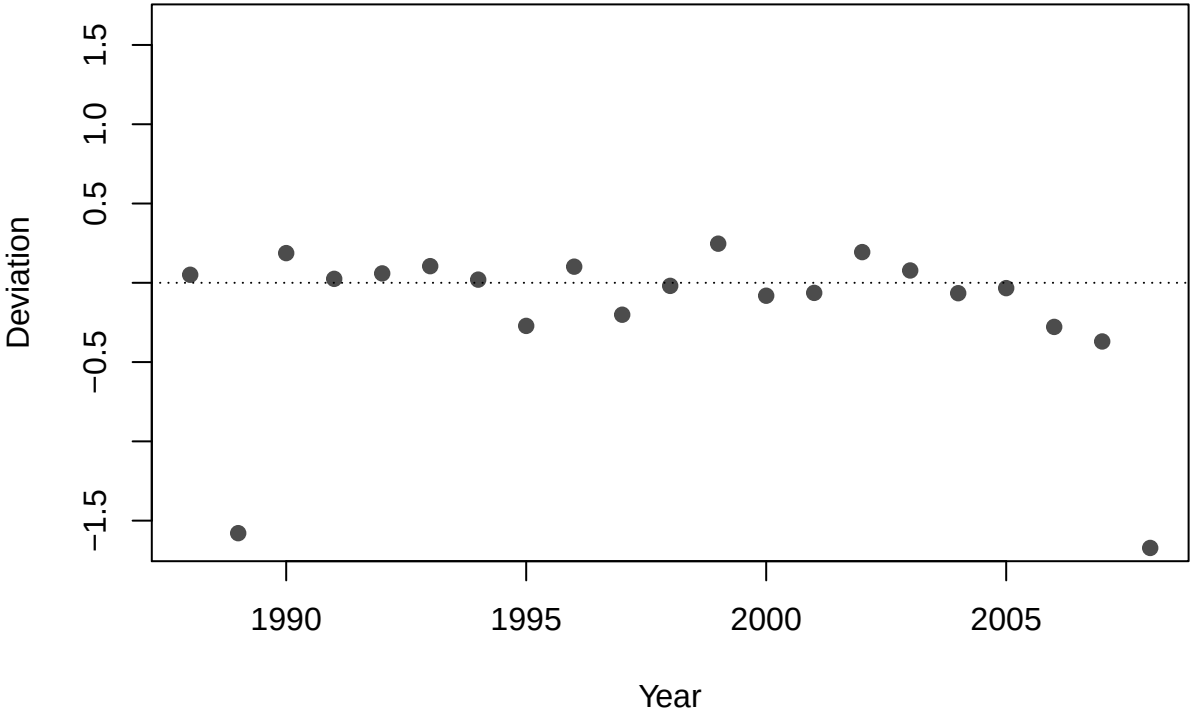

Log index
−1
0
1
2
3
1990
1995
2000
2005
Year

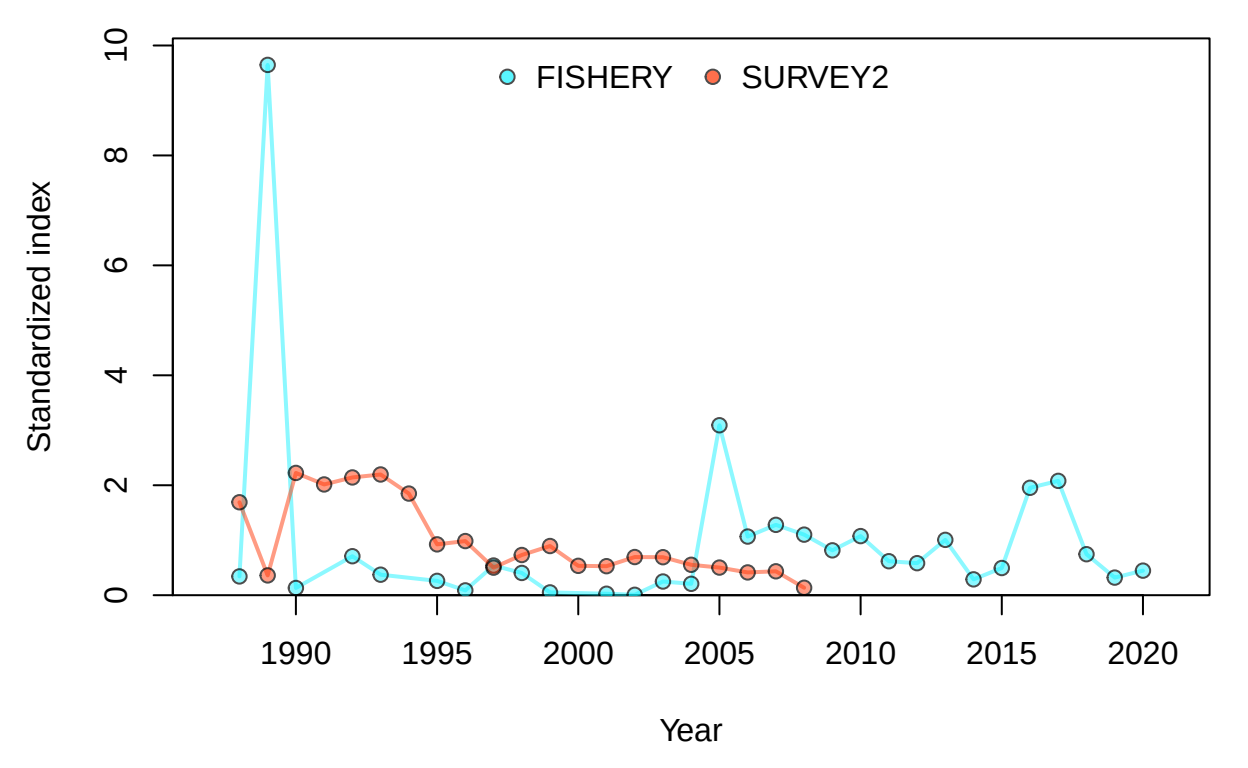

Log index
3
2
1
0
−1
1990
1995
2000
2005
Year

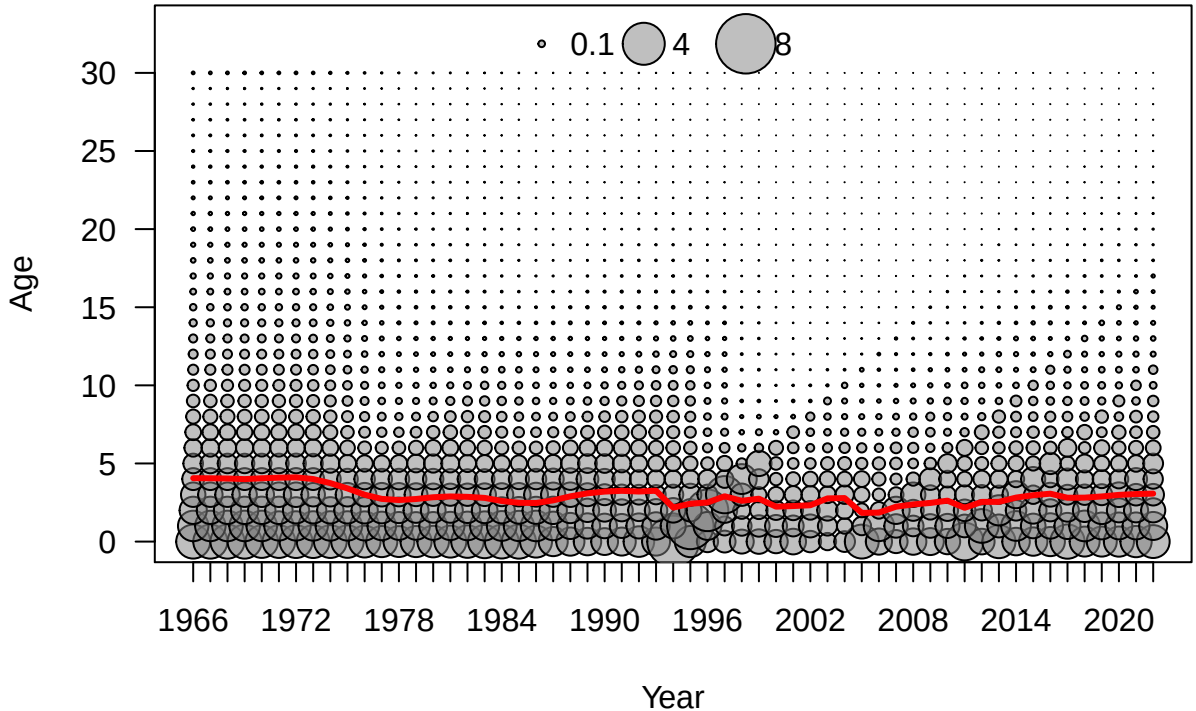

Log expected index
1.4
1.6
1.8
2.0
2.2
2.4
2.6
0.0
0.5
1.0
1.5
2.0
2.5
Log observed index

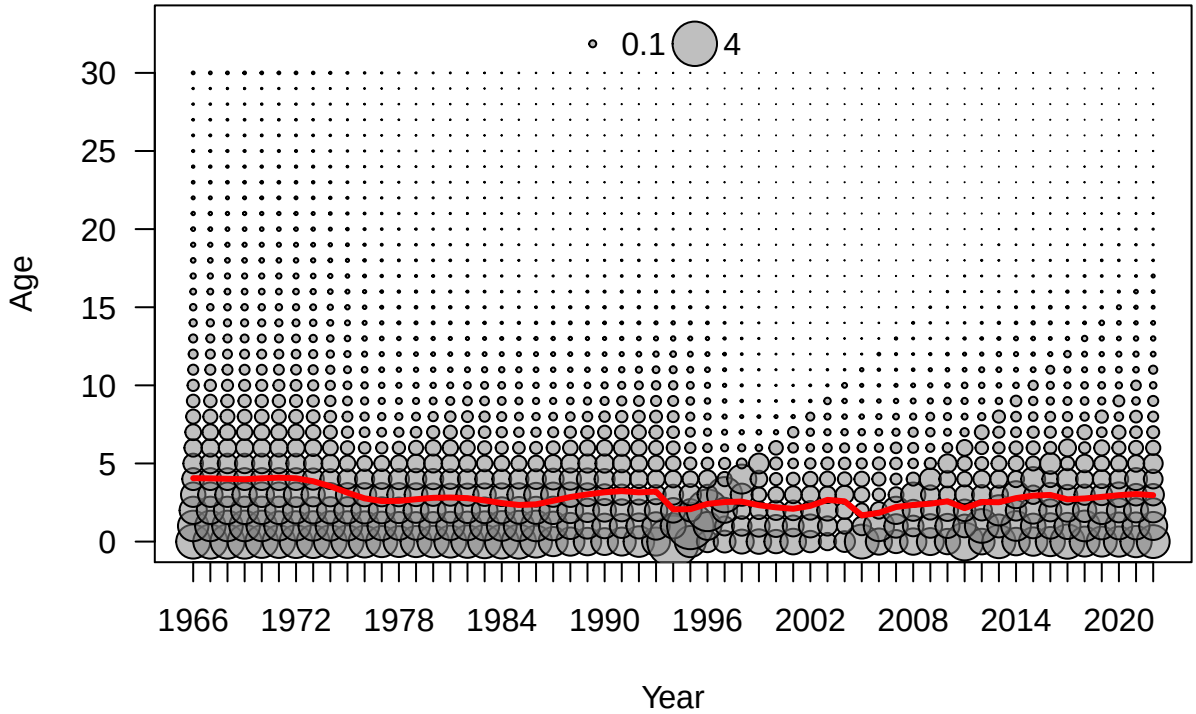

Effective catchability
9.462330
9.462320
9.462310
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Vulnerable biomass

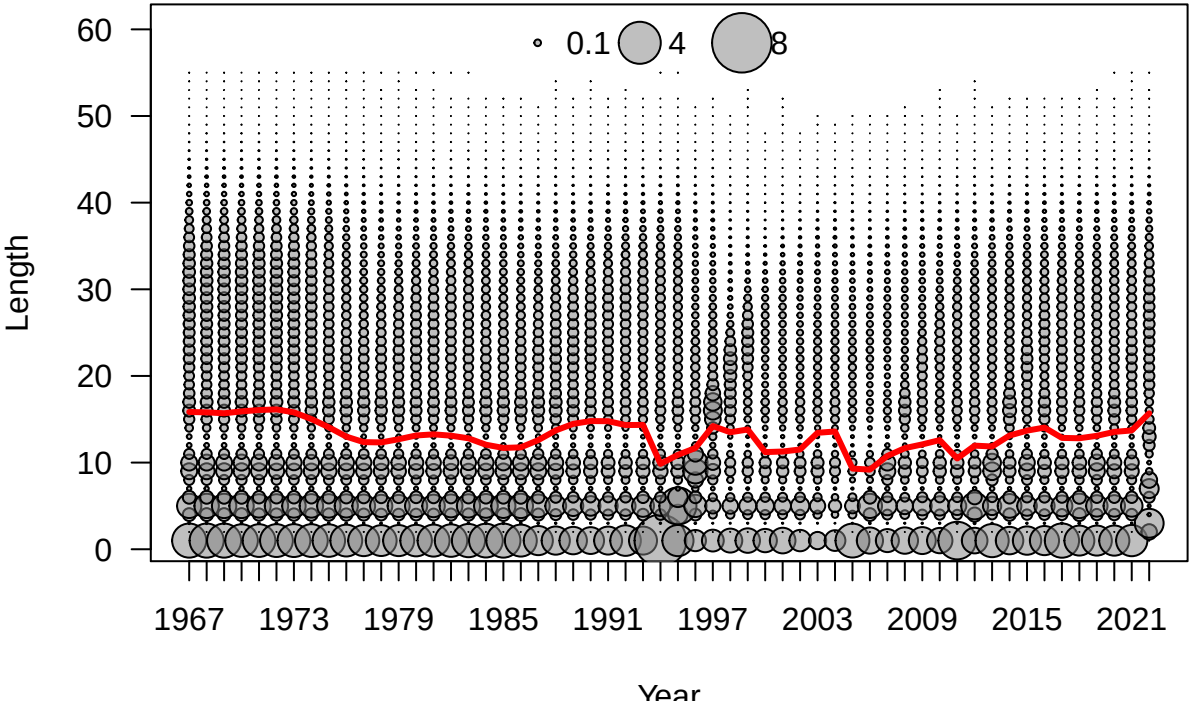

Residual
4
2
0
−2
−4
1990
1995
2000
2005
Year

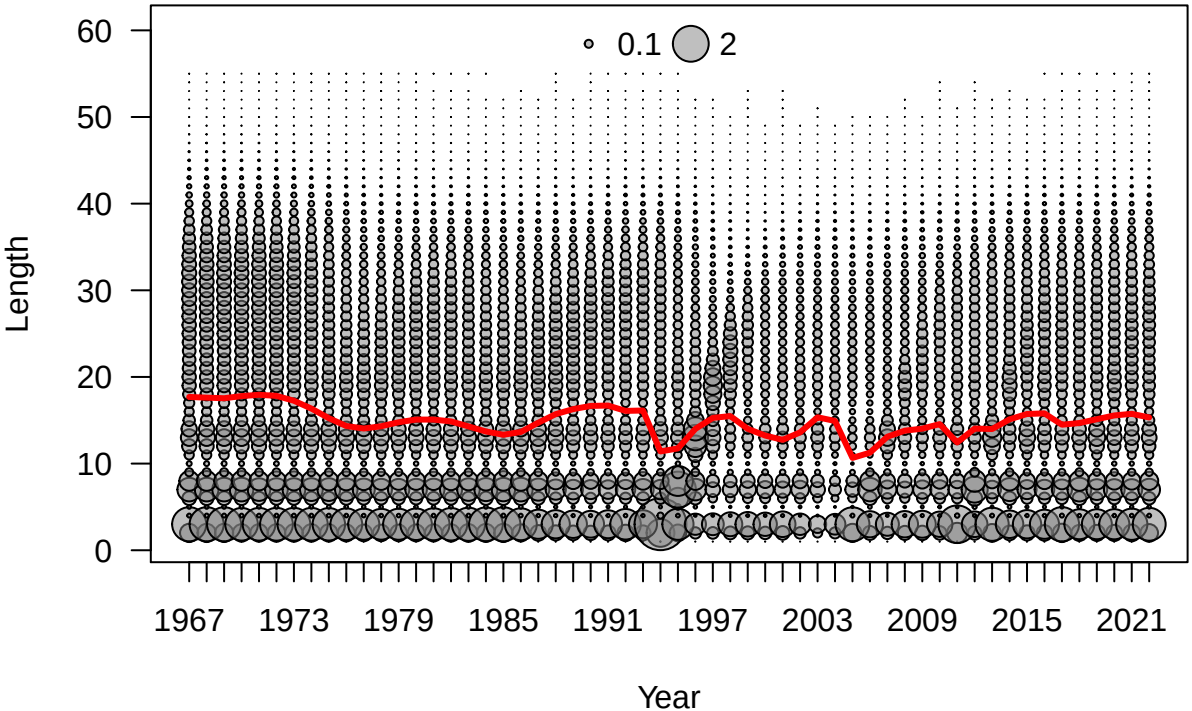

Deviation
1.5
1.0
0.5
−0.5
−1.5
1990
1995
2000
2005
Year

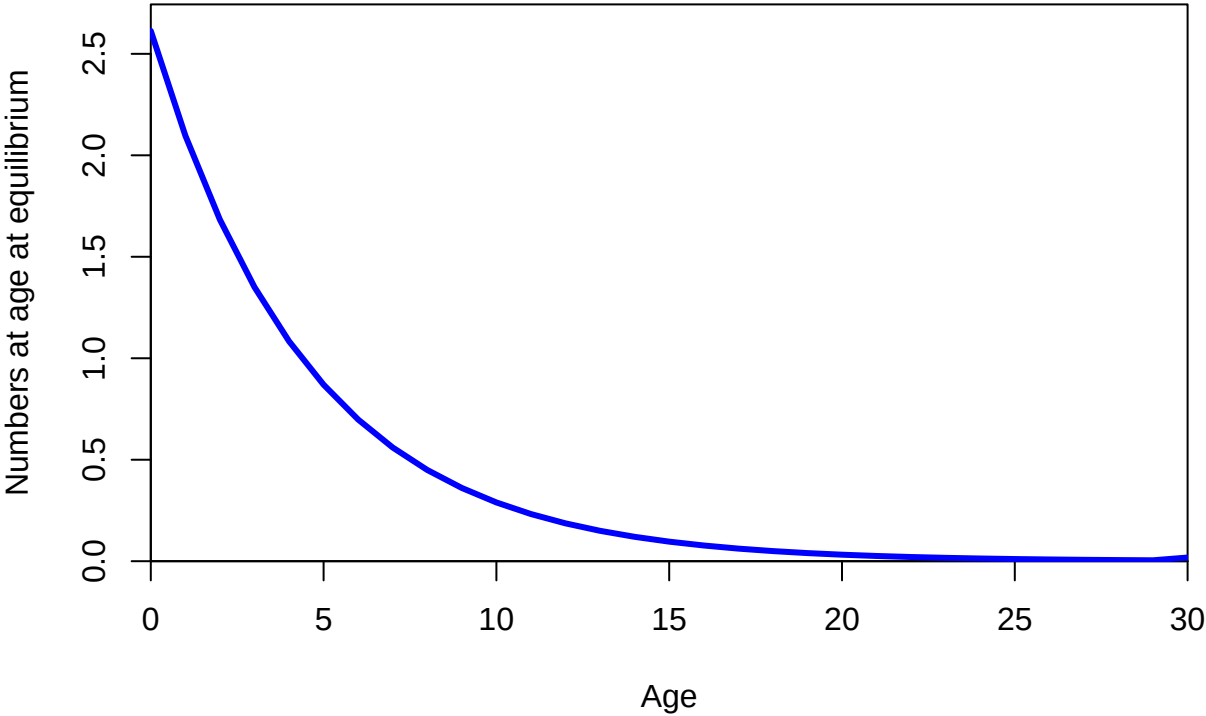

FISHERY
SURVEY2
Standardized index
Year
0
2
4
6
8
10
1990
1995
2000
2005
2010
2015
2020

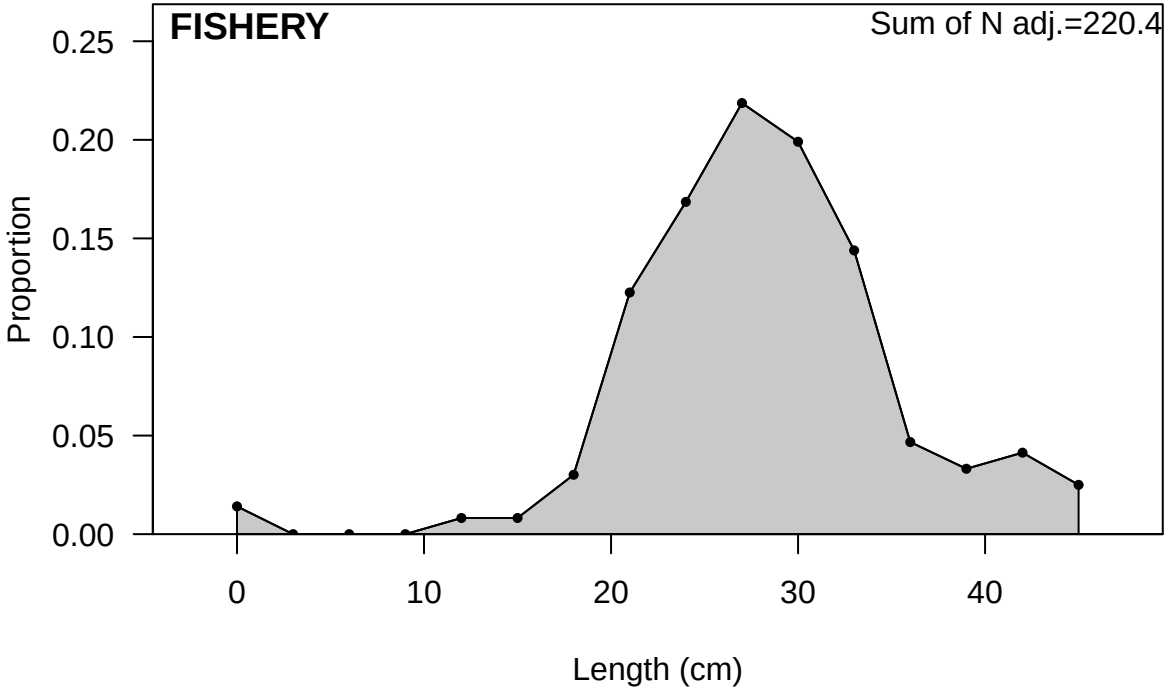

0.1
4
8
Age
30
25
20
15
10
5
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

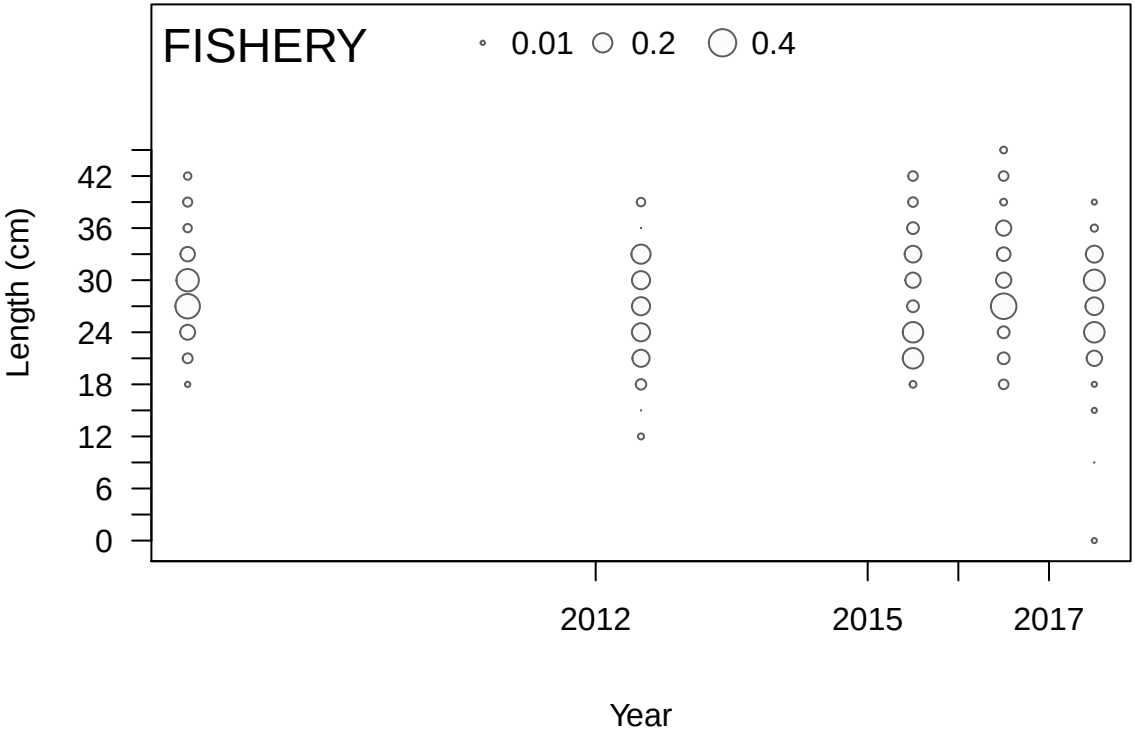

0.1
4
30
25
20
15
10
5
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

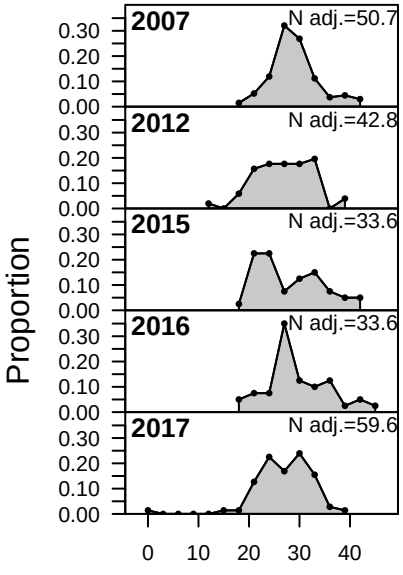

0.1
4
8
Length
Year
0
10
20
30
40
50
60
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021

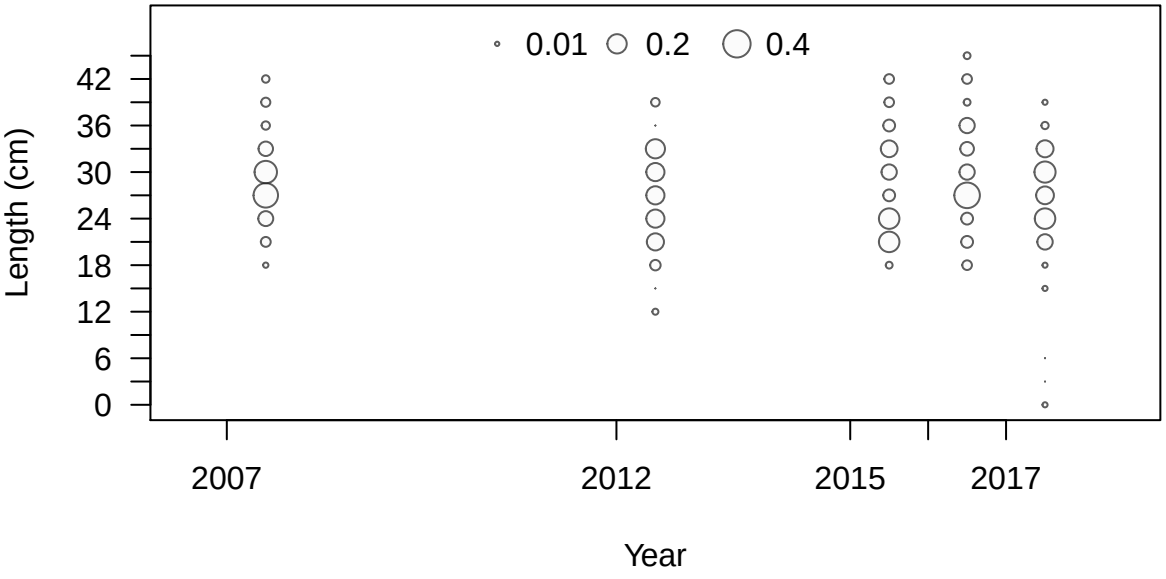

0.1
2
Length
Year
0
10
20
30
40
50
60
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021

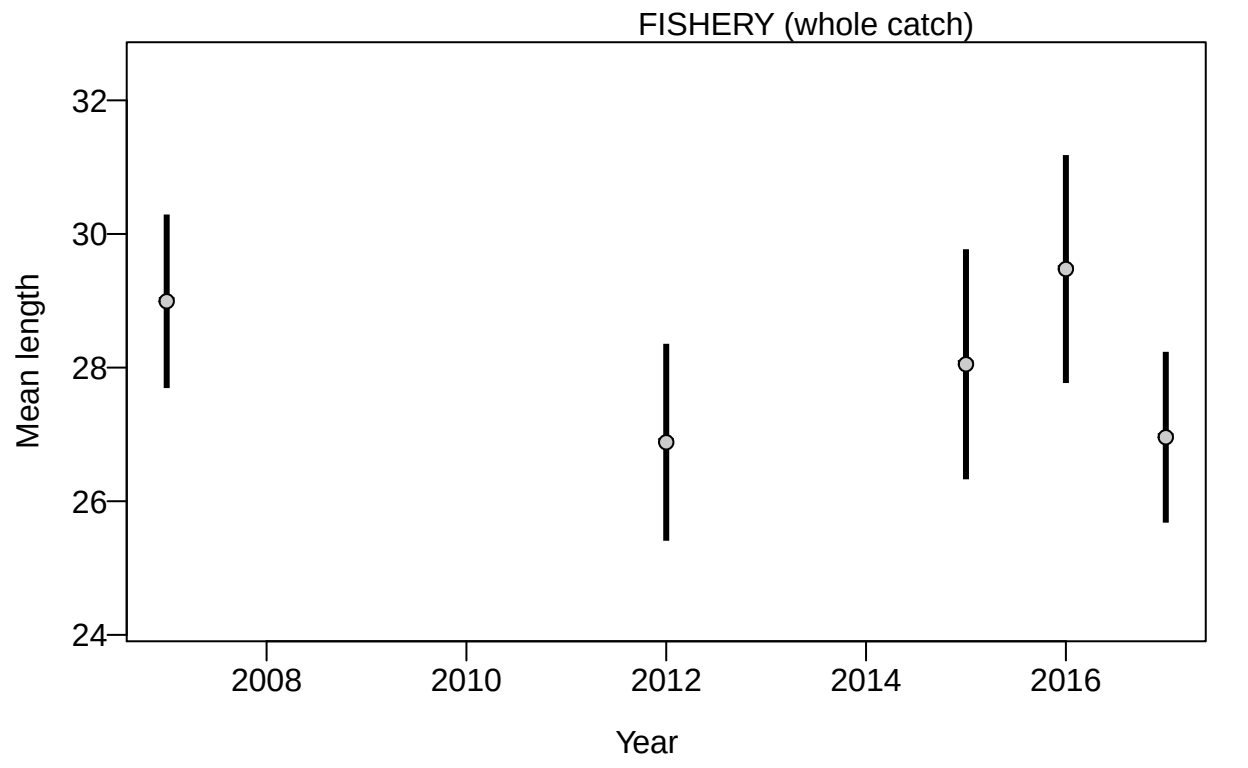

Numbers at age at equilibrium
0.0
0.5
1.0
1.5
2.0
2.5
0
5
10
15
20
25
30
Age

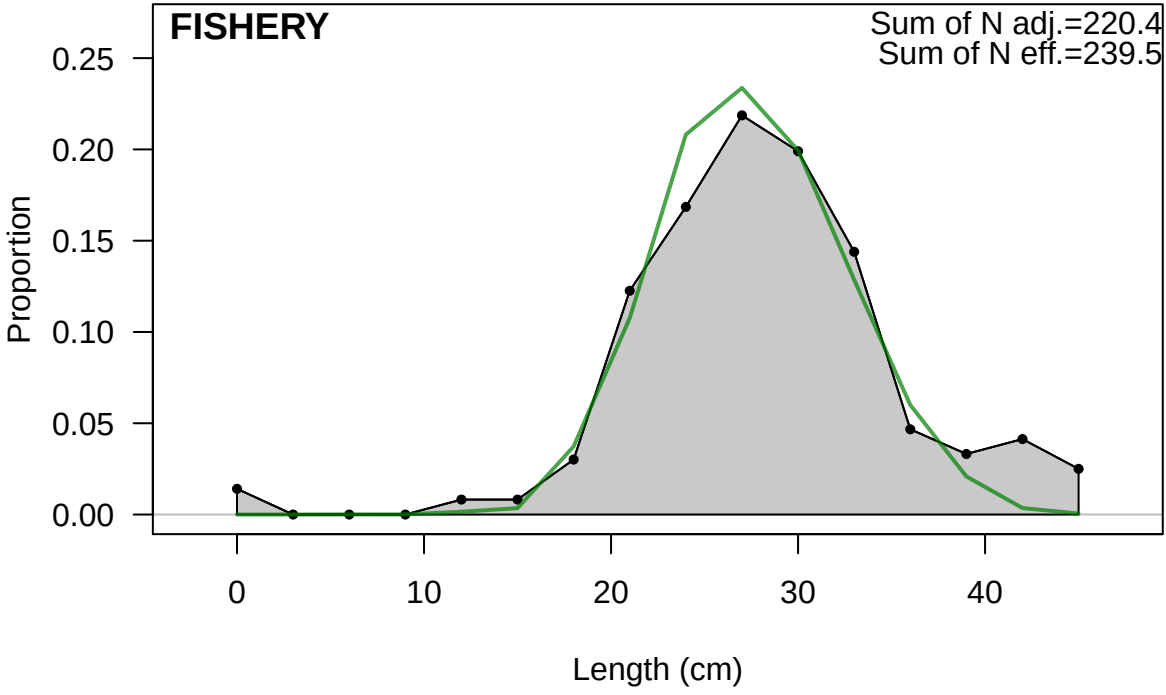

FISHERY
Sum of N adj.=220.4
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
Length (cm)


FISHERY
0.01
0.2
0.4
Length (cm)
42
36
30
24
18
12
6
0
2012
2015
2017
Year

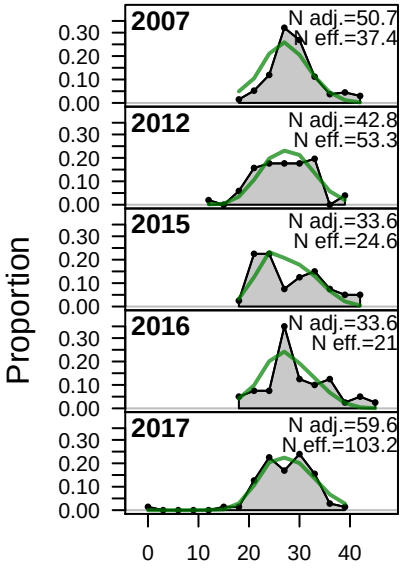

2007
N adj.=50.7
2012
N adj.=42.8
2015
N adj.=33.6
2016
N adj.=33.6
2017
N adj.=59.6
Proportion
0.00
0.10
0.20
0.30
0
10
20
30
40
Length (cm)

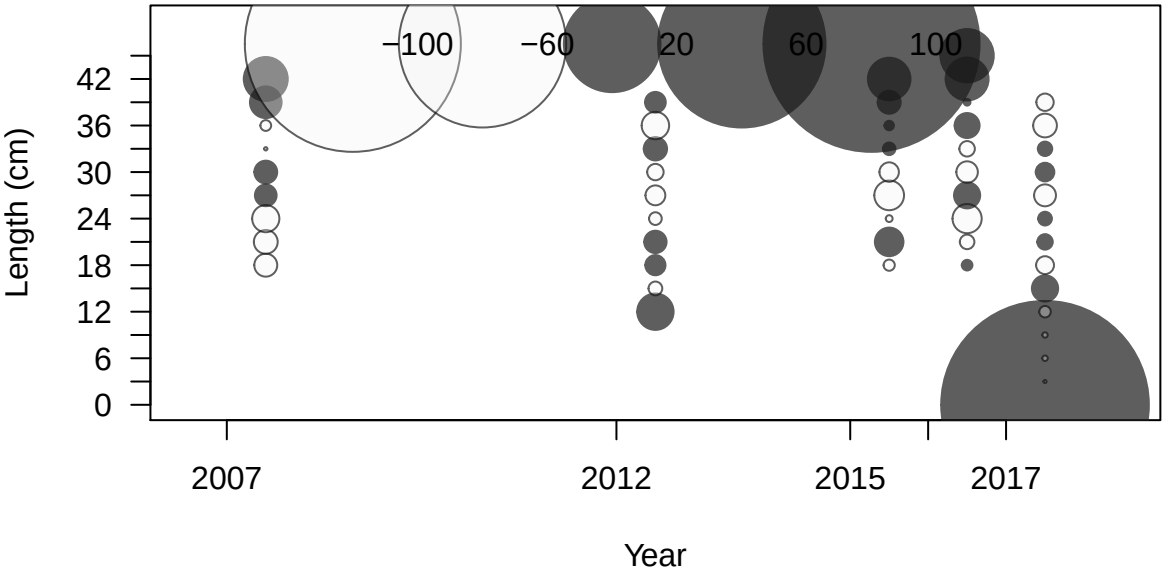

0.01
0.2
0.4
Length (cm)
0
6
12
18
24
30
36
42
2007
2012
2015
2017
Year

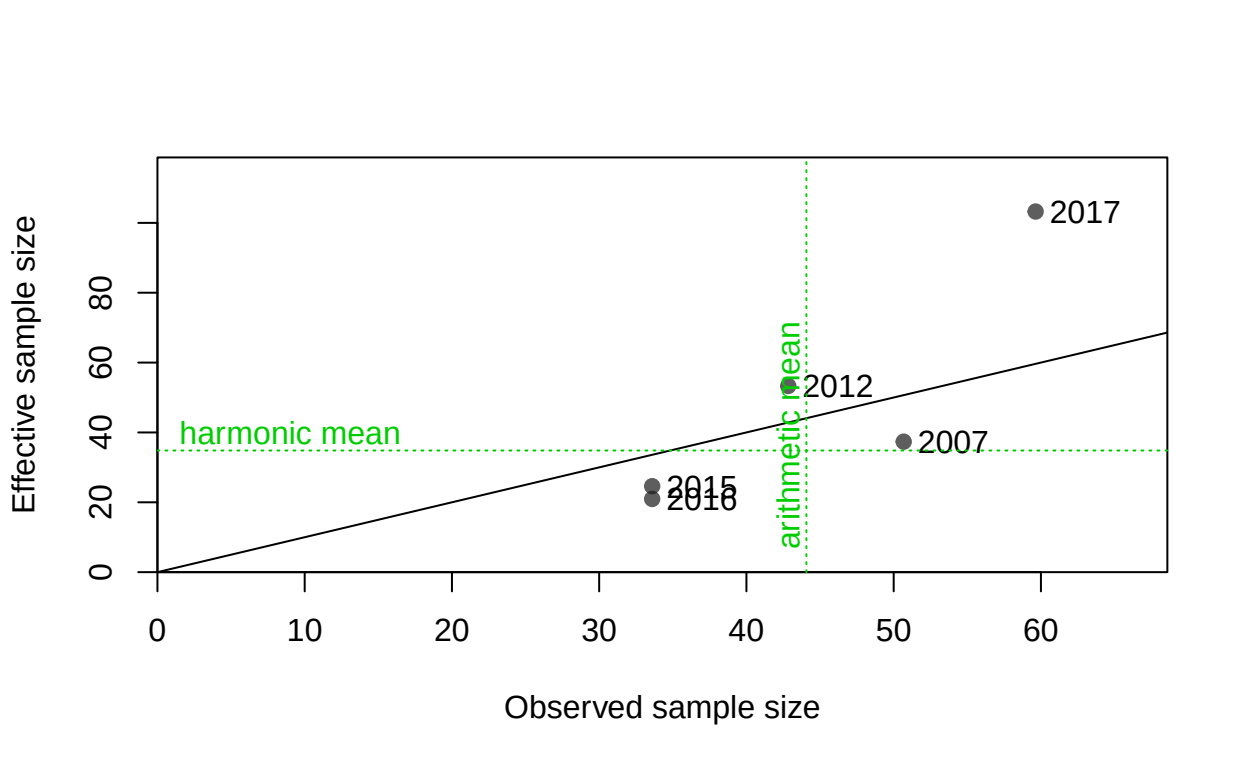

FISHERY (whole catch)
Mean length
32
30
28
26
24
2008
2010
2012
2014
2016
Year

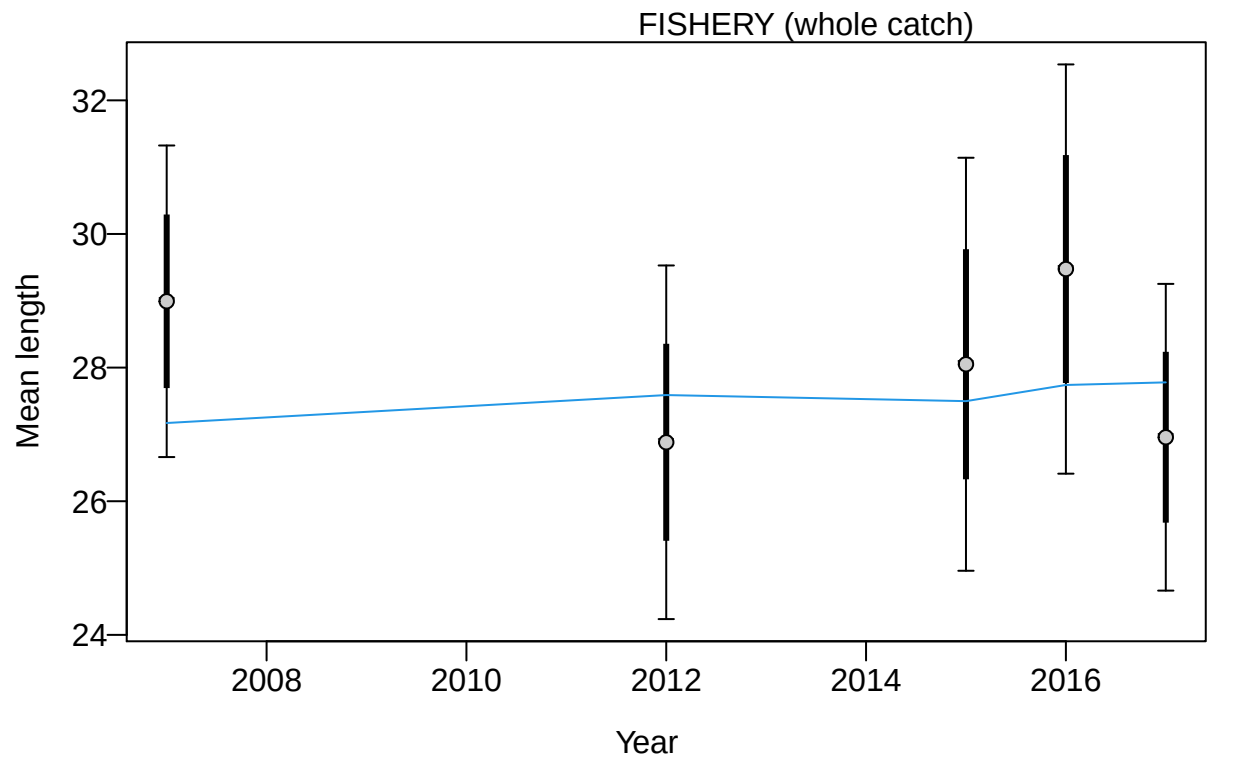

FISHERY
Sum of N adj.=220.4
Sum of N eff.=239.5
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
Length (cm)

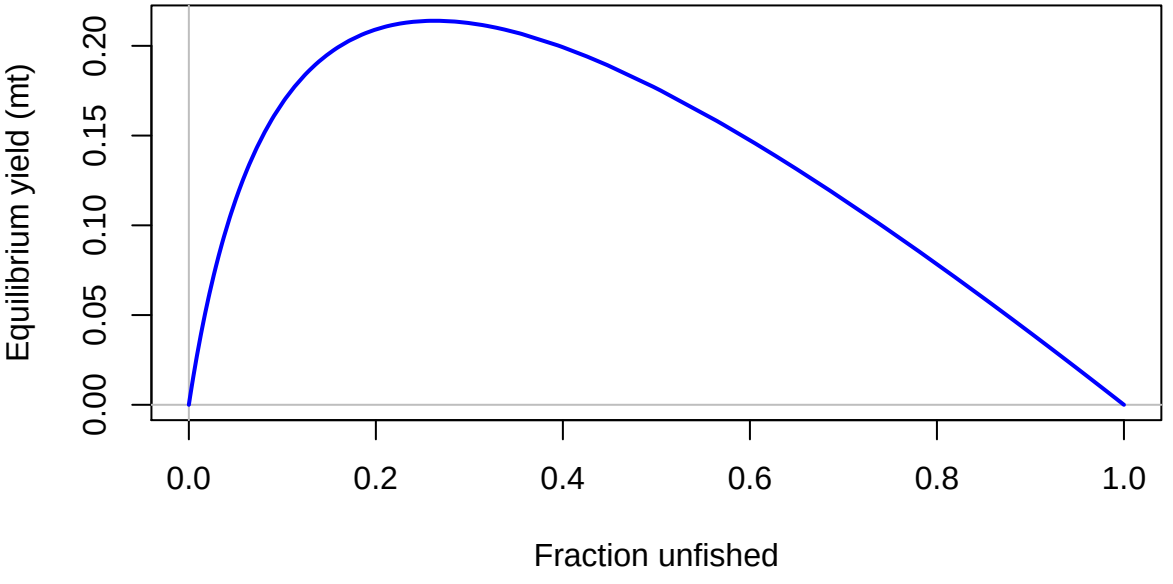
FISHERY
−100
−60
20
60
100
Length (cm)
42
36
30
24
18
12
6
0
2012
2015
2017
Year

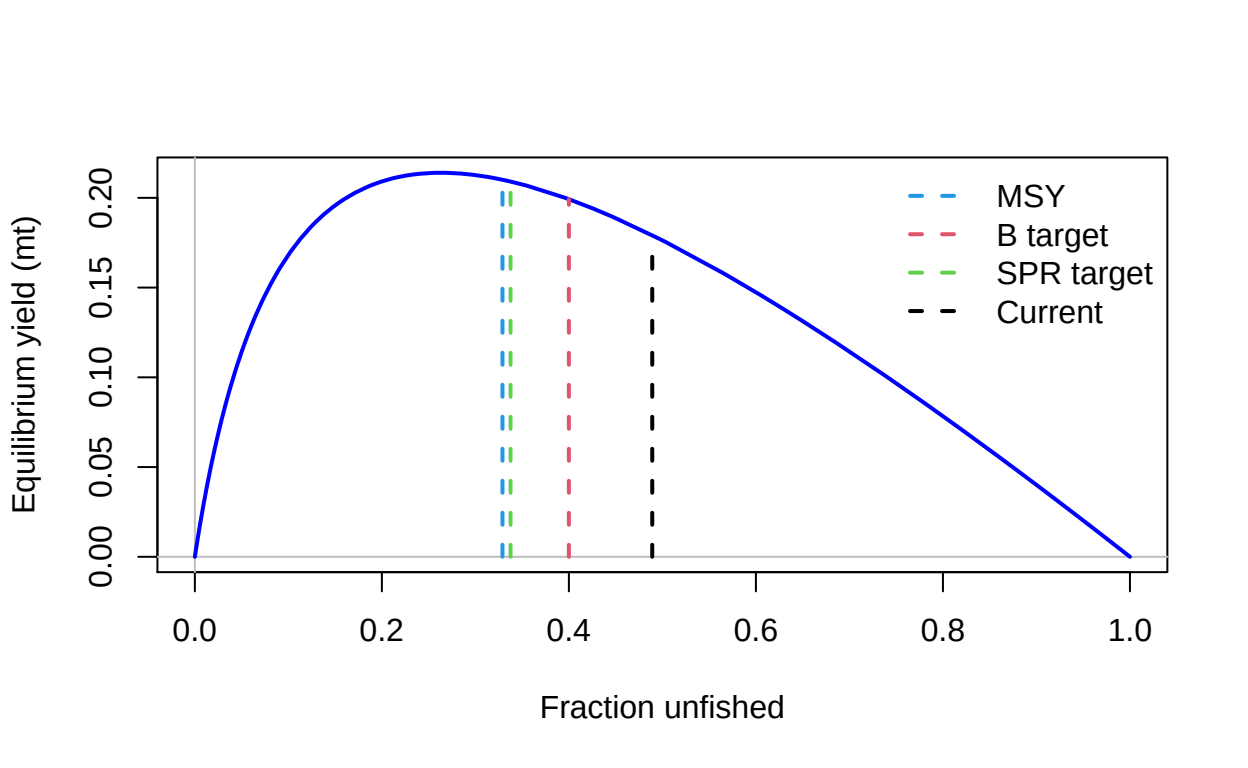

2007
N adj.=50.7
N eff.=37.4
2012
N adj.=42.8
N eff.=53.3
2015
N adj.=33.6
N eff.=24.6
2016
N adj.=33.6
N eff.=21
2017
N adj.=59.6
N eff.=103.2
0.00
0.10
0.20
0.30
0
10
20
30
40
Proportion
Length (cm)

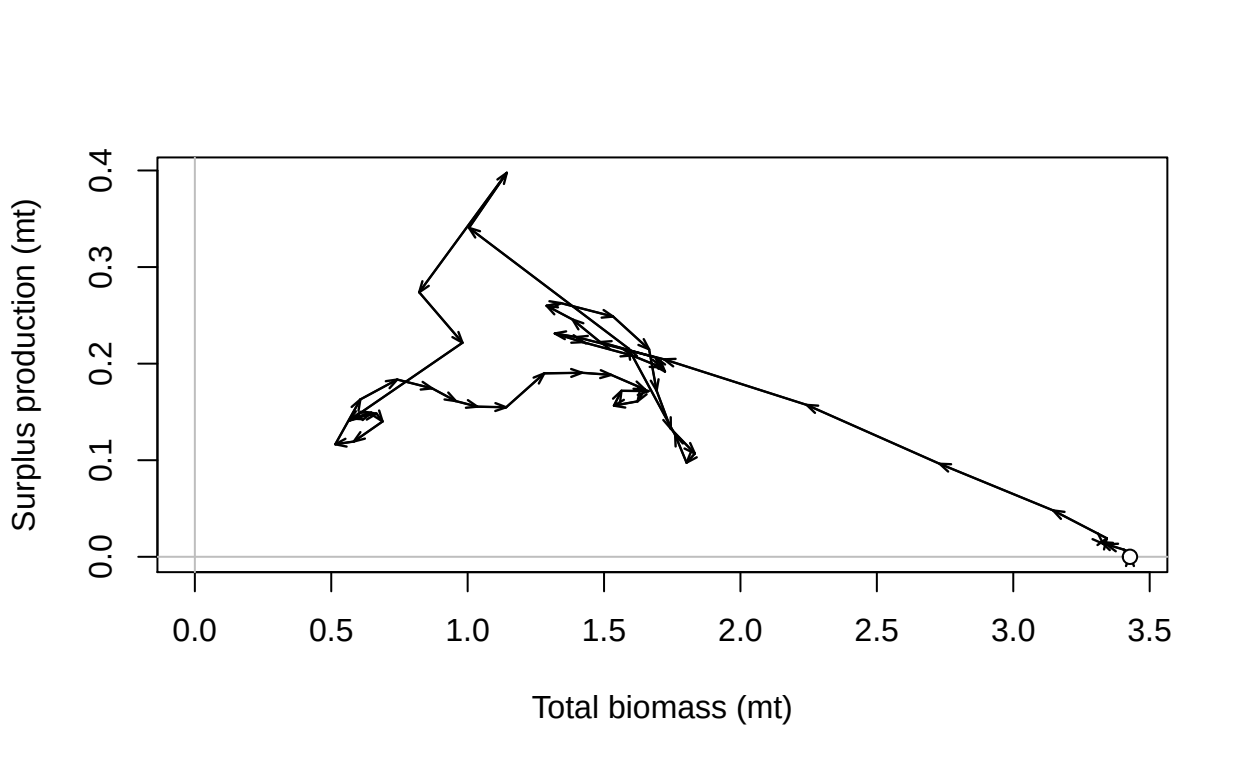

−100
−60
20
60
100
42
36
30
24
18
12
6
0
Length (cm)
2007
2012
2015
2017
Year

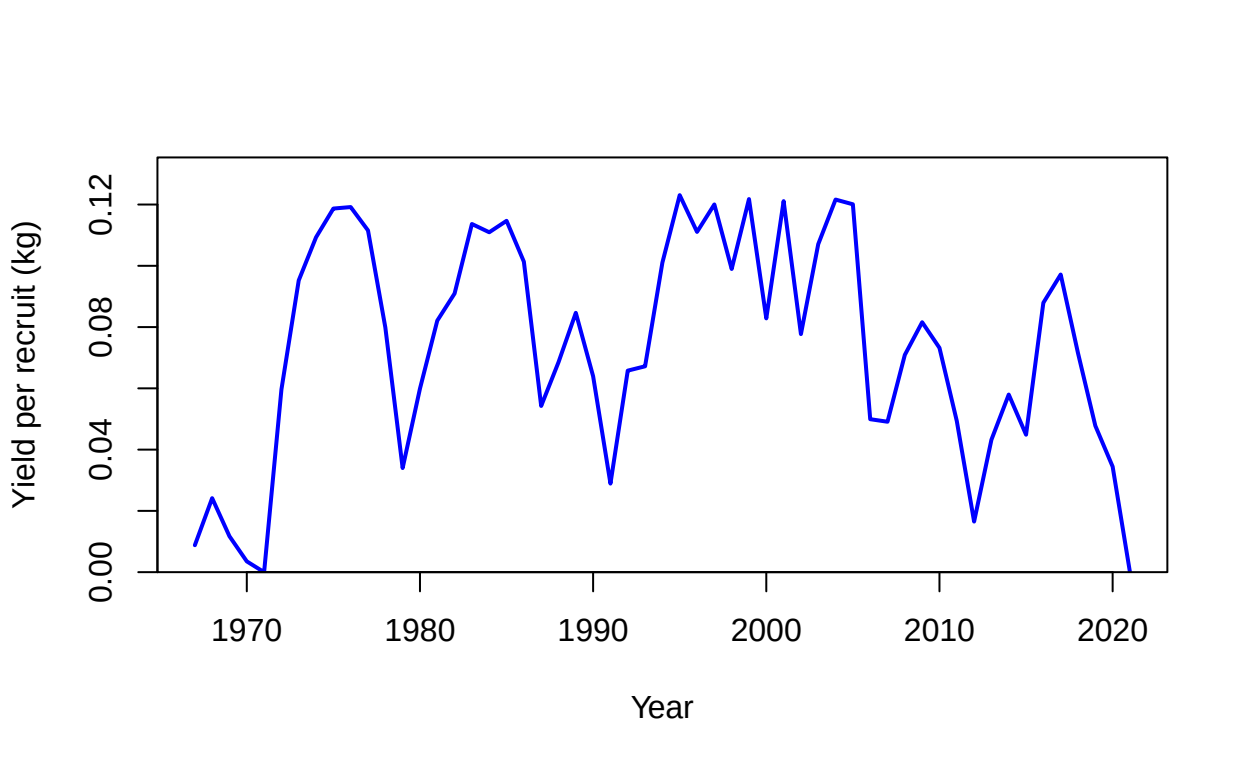

Effective sample size
0
20
40
60
80
0
10
20
30
40
50
60
Observed sample size
harmonic mean
arithmetic mean
2017
2012
2007
2015
2016

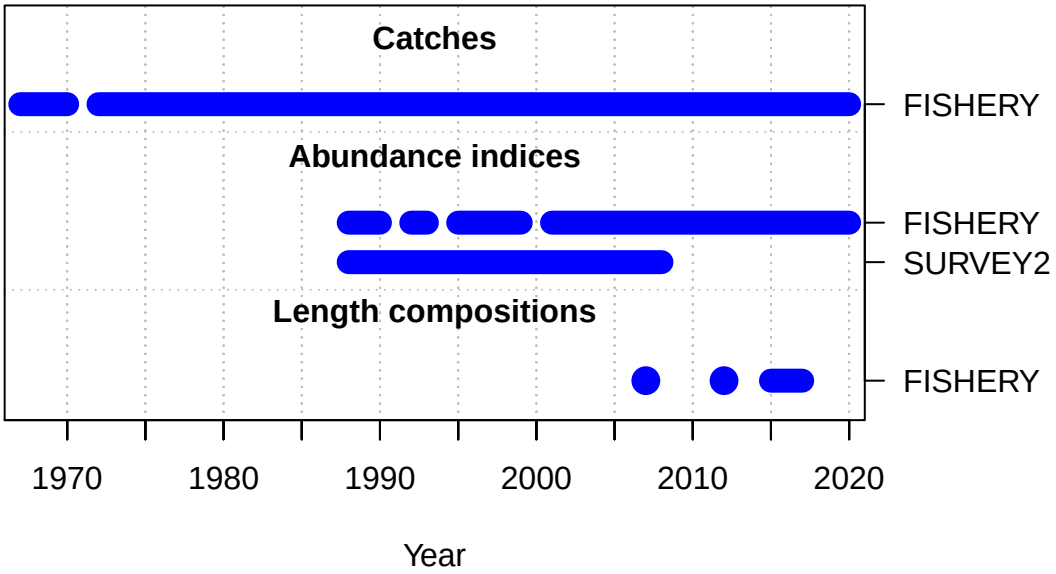

FISHERY (whole catch)
Mean length
32
30
28
26
24
2008
2010
2012
2014
2016
Year

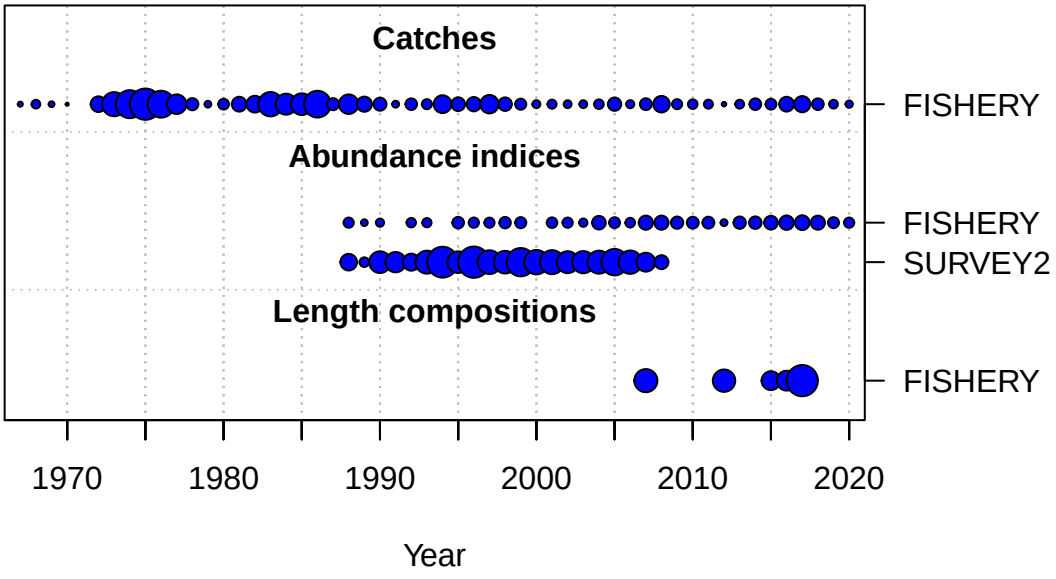

Equilibrium yield (mt)
0.00
0.05
0.10
0.15
0.20
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

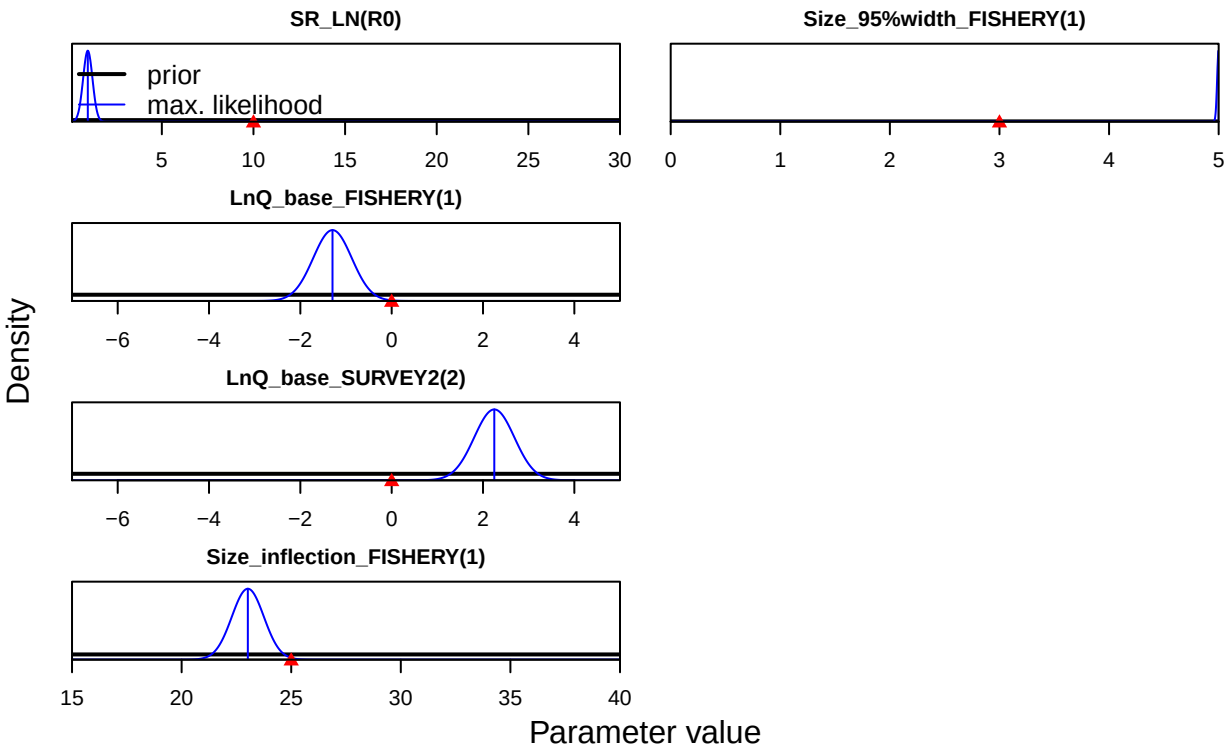

Equilibrium yield (mt)
0.00
0.05
0.10
0.15
0.20
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0.0
0.1
0.2
0.3
0.4
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Total biomass (mt)


Yield per recruit (kg)
0.00
0.04
0.08
0.12
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