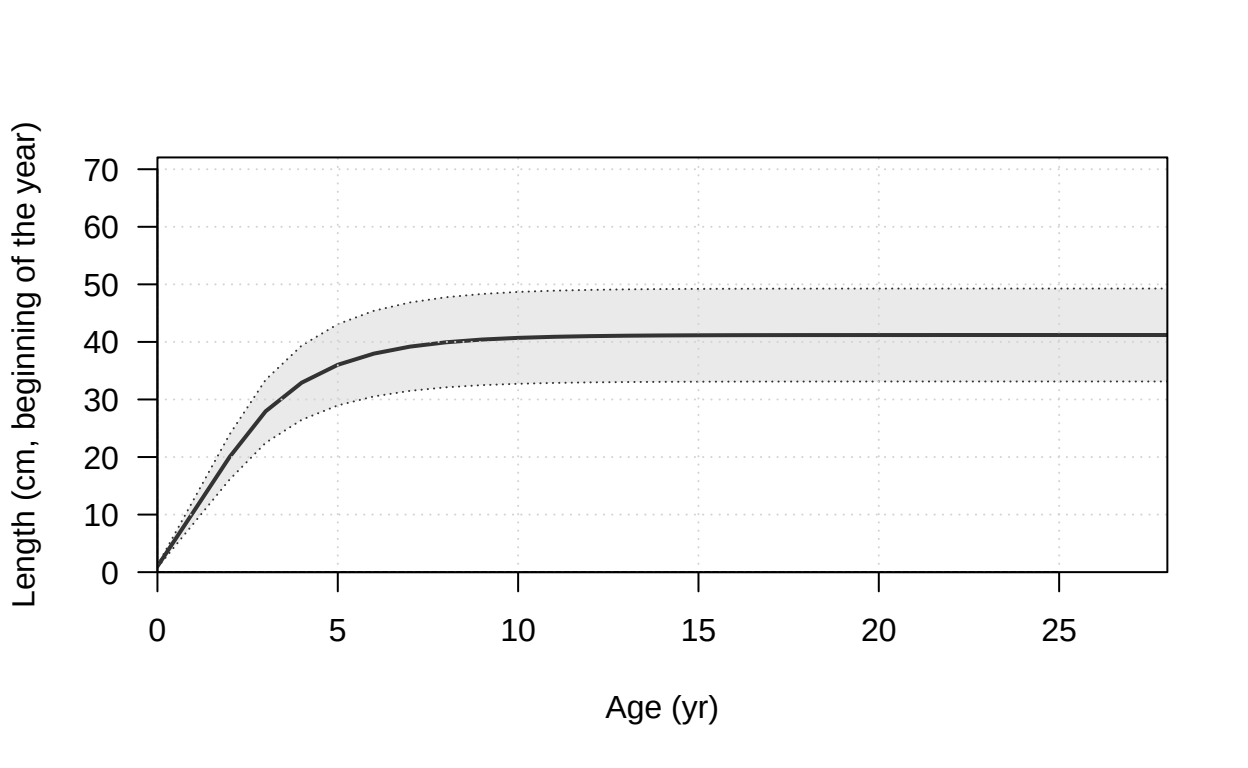
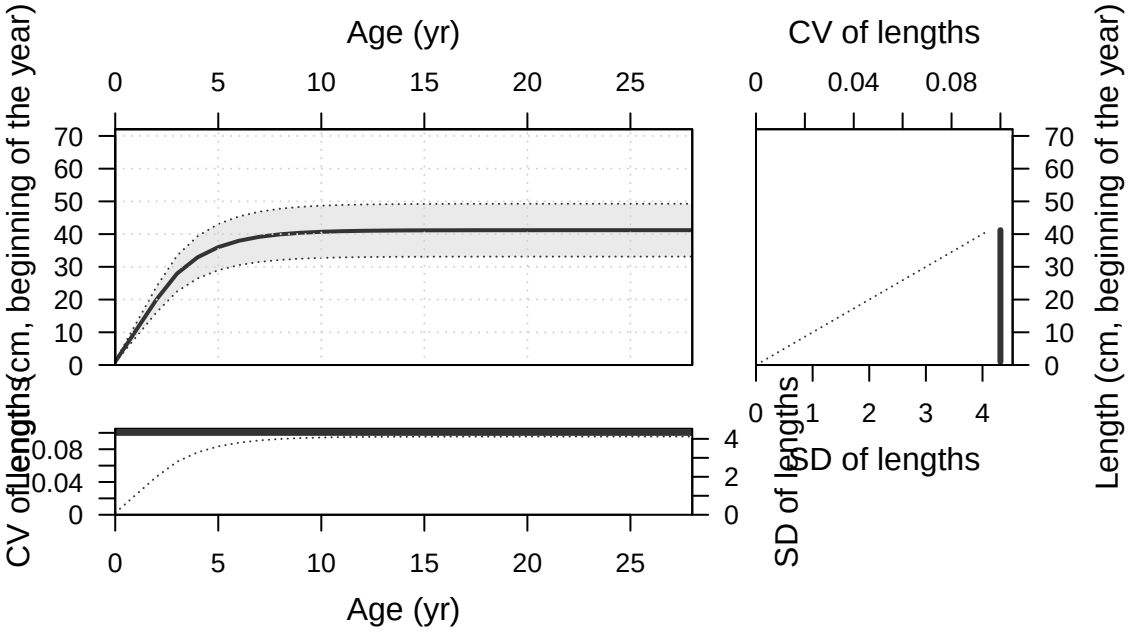
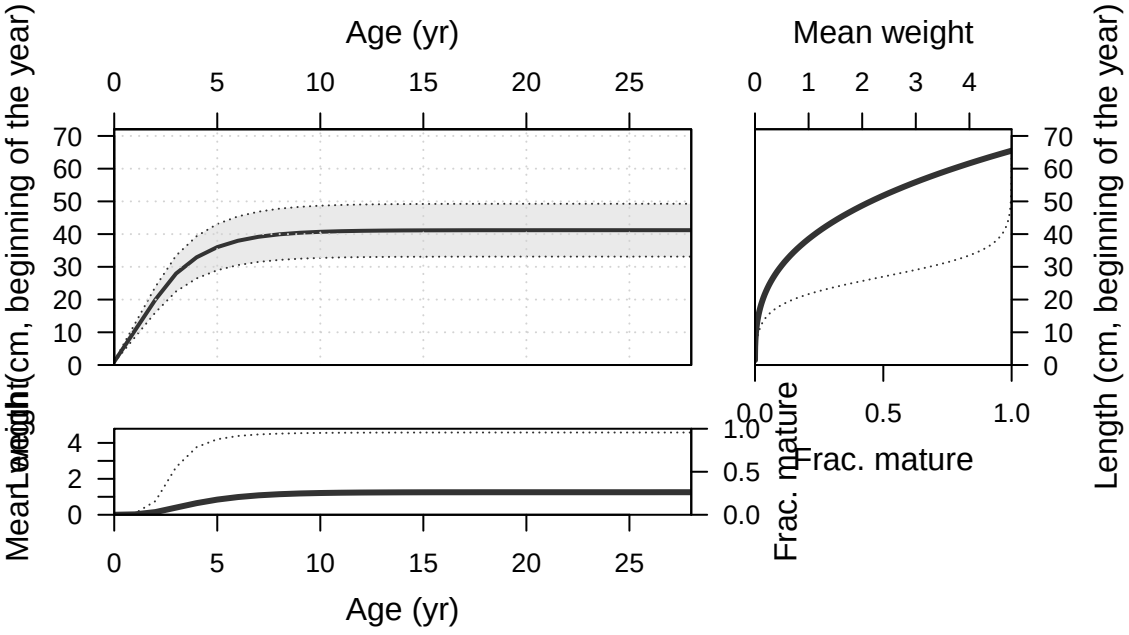
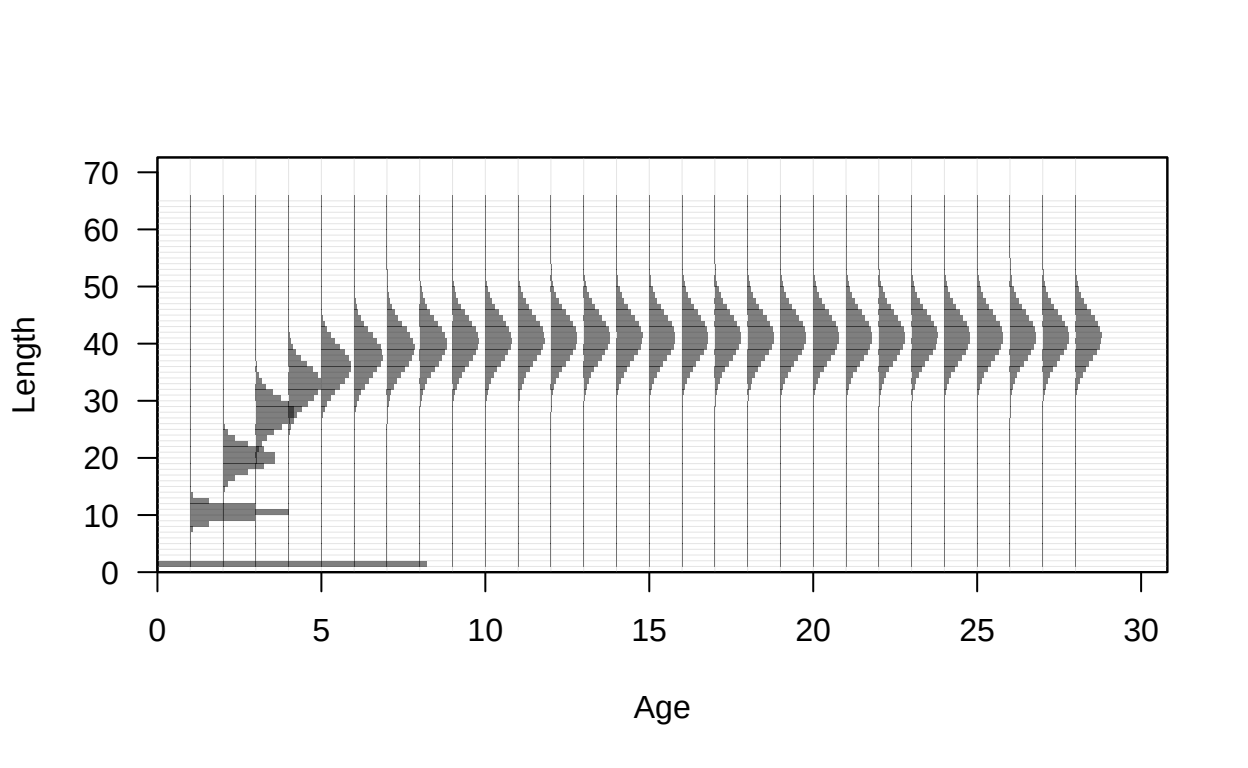
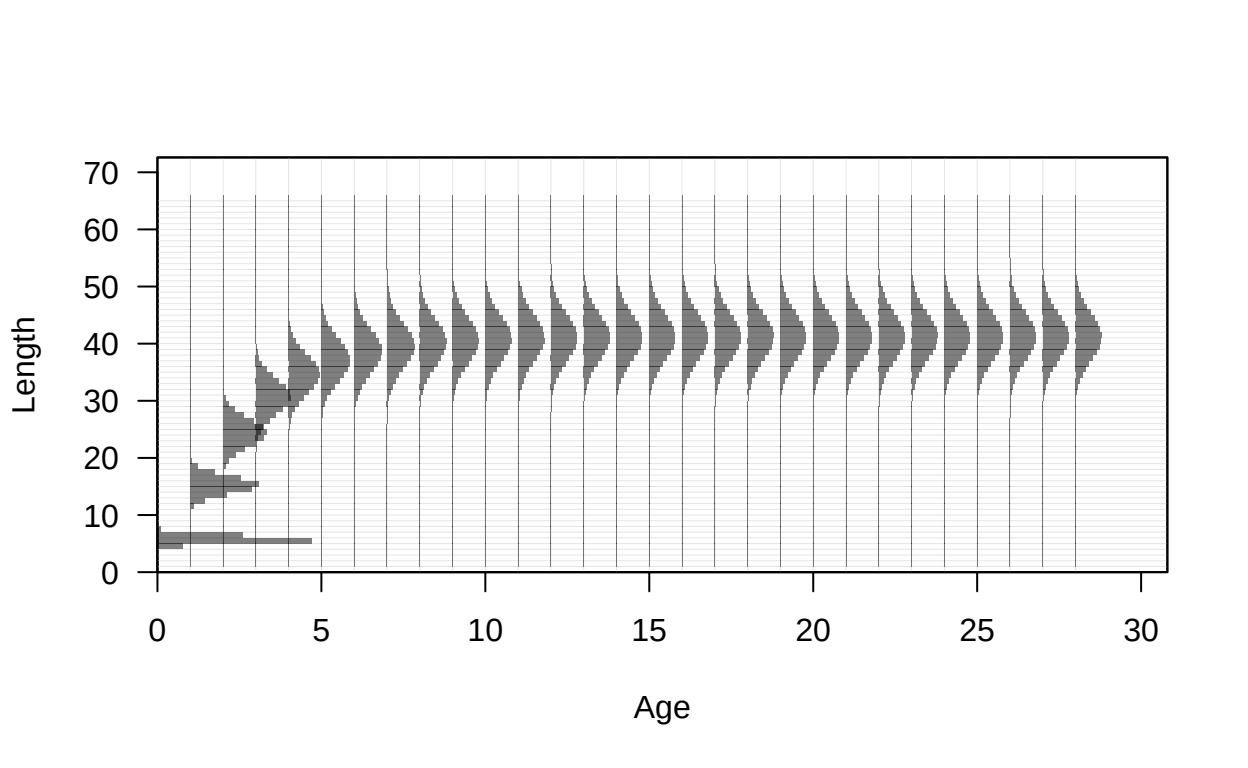
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Wed Jun 29 15:31:48 2022
Data_File: data.ss
Control_File: control.ss

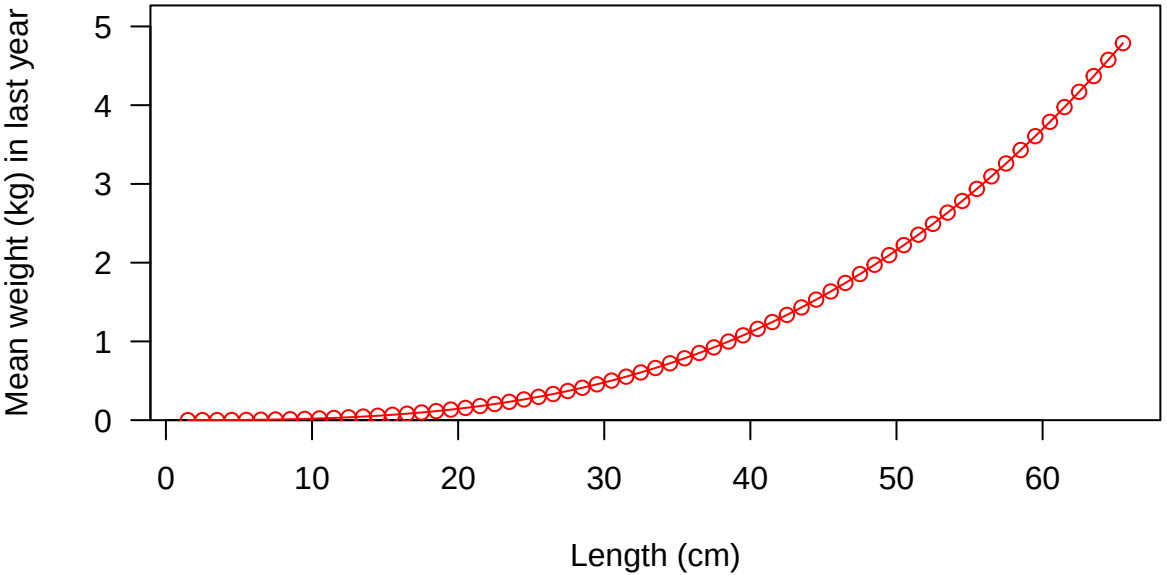

Length (cm, beginning of the year)
70
60
50
40
30
20
10
0
0
5
10
15
20
25
Age (yr)

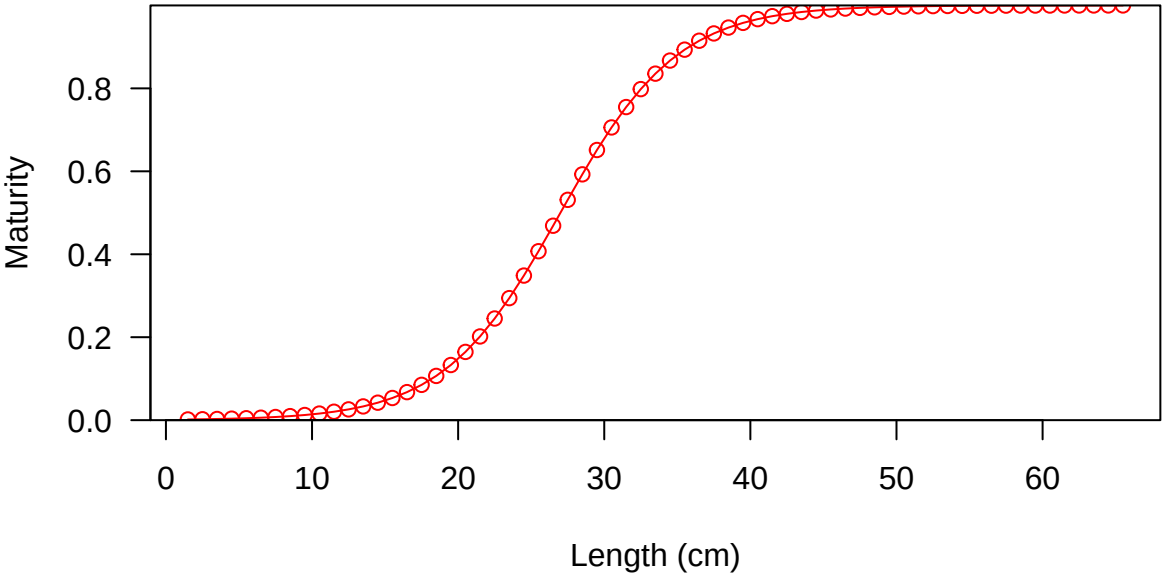

Age (yr)
0
5
10
15
20
25
Length (cm, beginning of the year)
70
60
50
40
30
20
10
0
CV of lengths
0.08
0.04
0
SD of lengths
4
2
0
CV of lengths
0.04
0.08
0
1
2
3
4
SD of lengths
Length (cm, beginning of the year)
Age (yr)

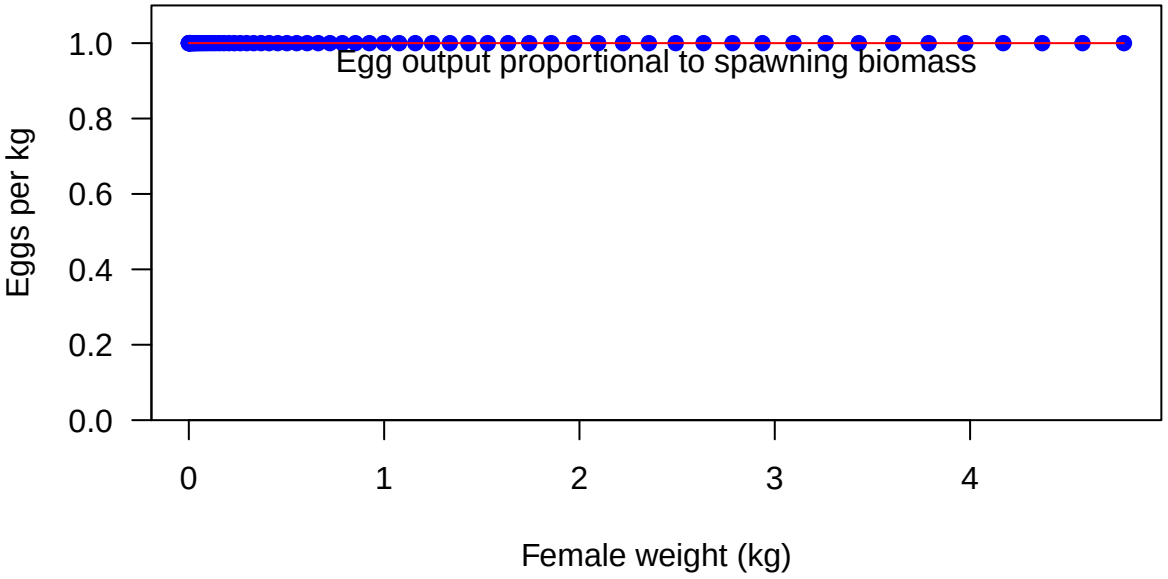

Age (yr)
Mean weight
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)

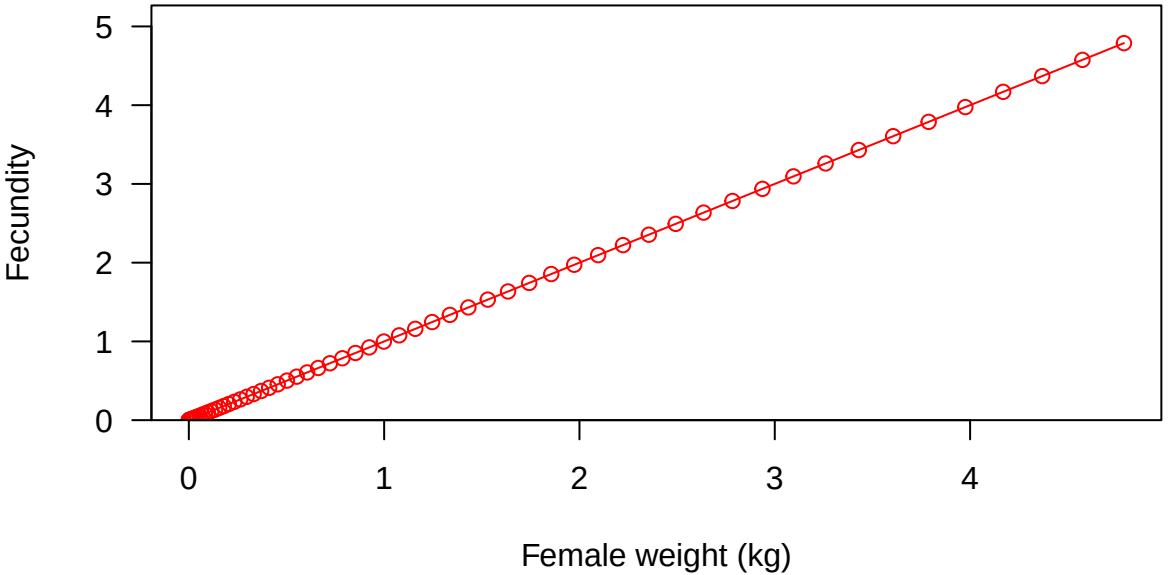

Length
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Age

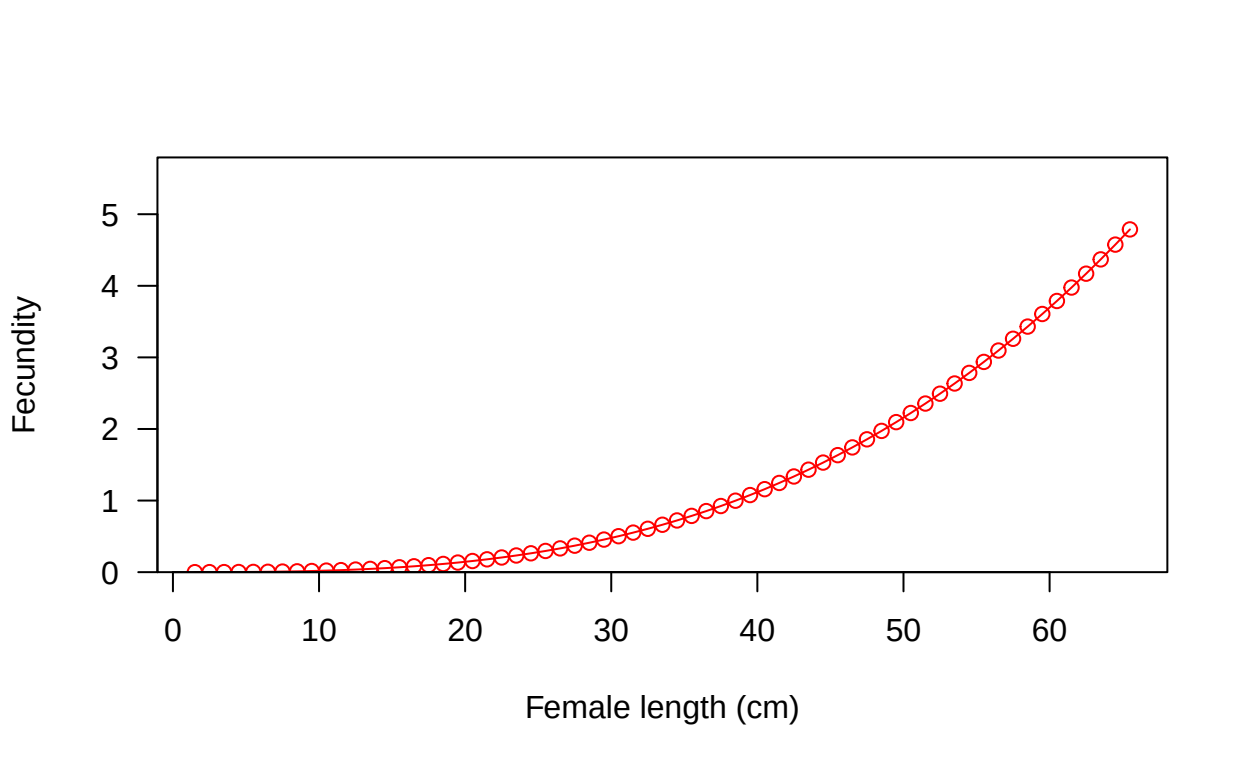

Length
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Age

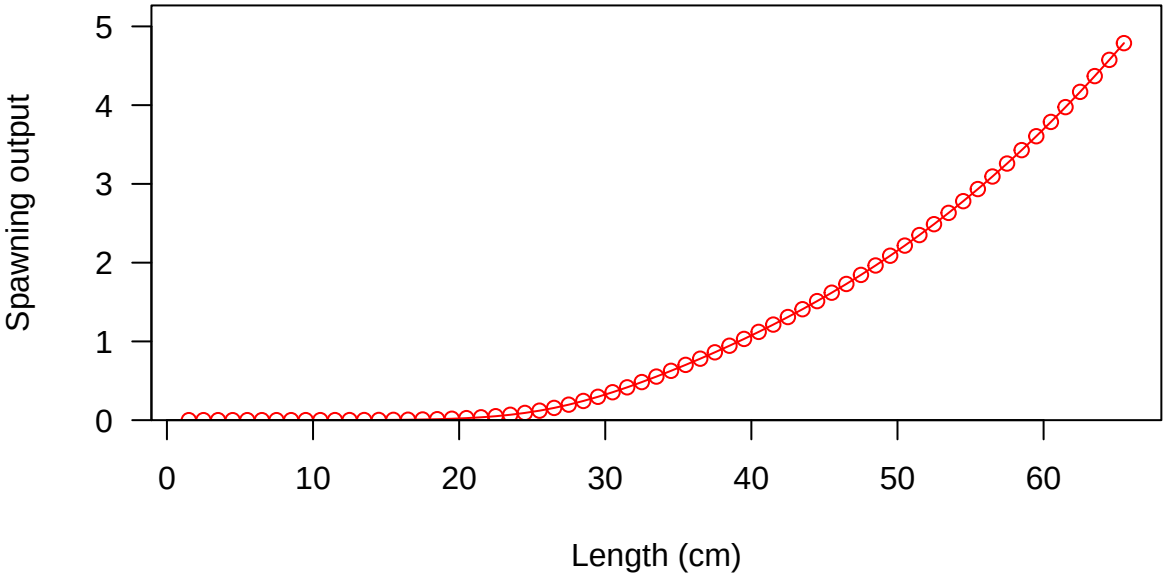

Mean weight (kg) in last year
0
1
2
3
4
5
0
10
20
30
40
50
60
Length (cm)

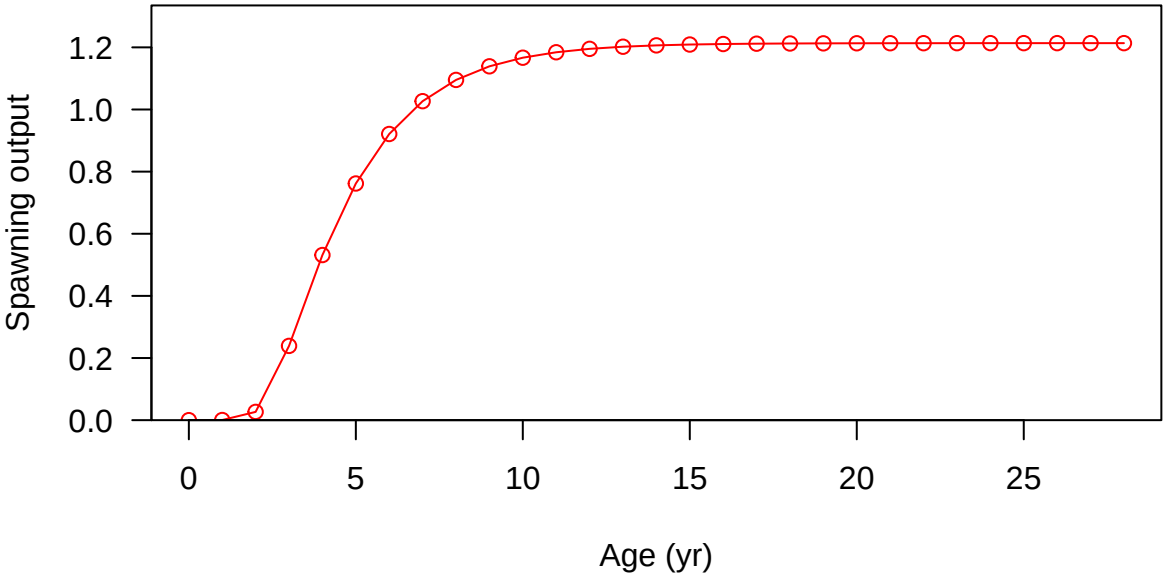

Maturity
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
50
60
Length (cm)

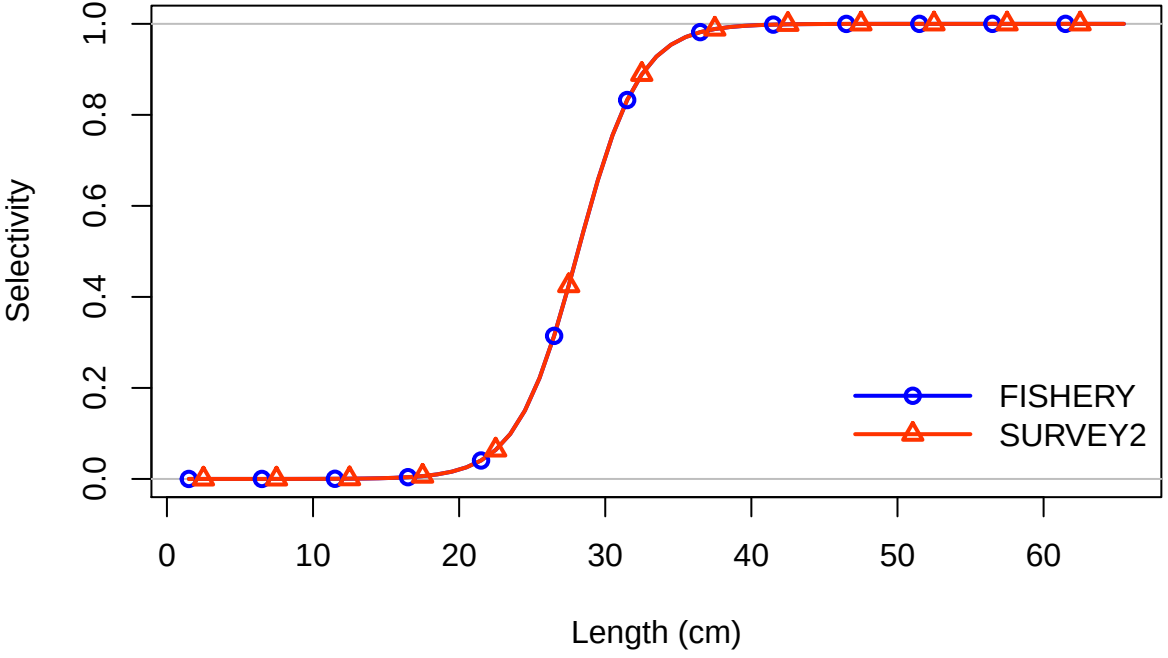

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
Female weight (kg)

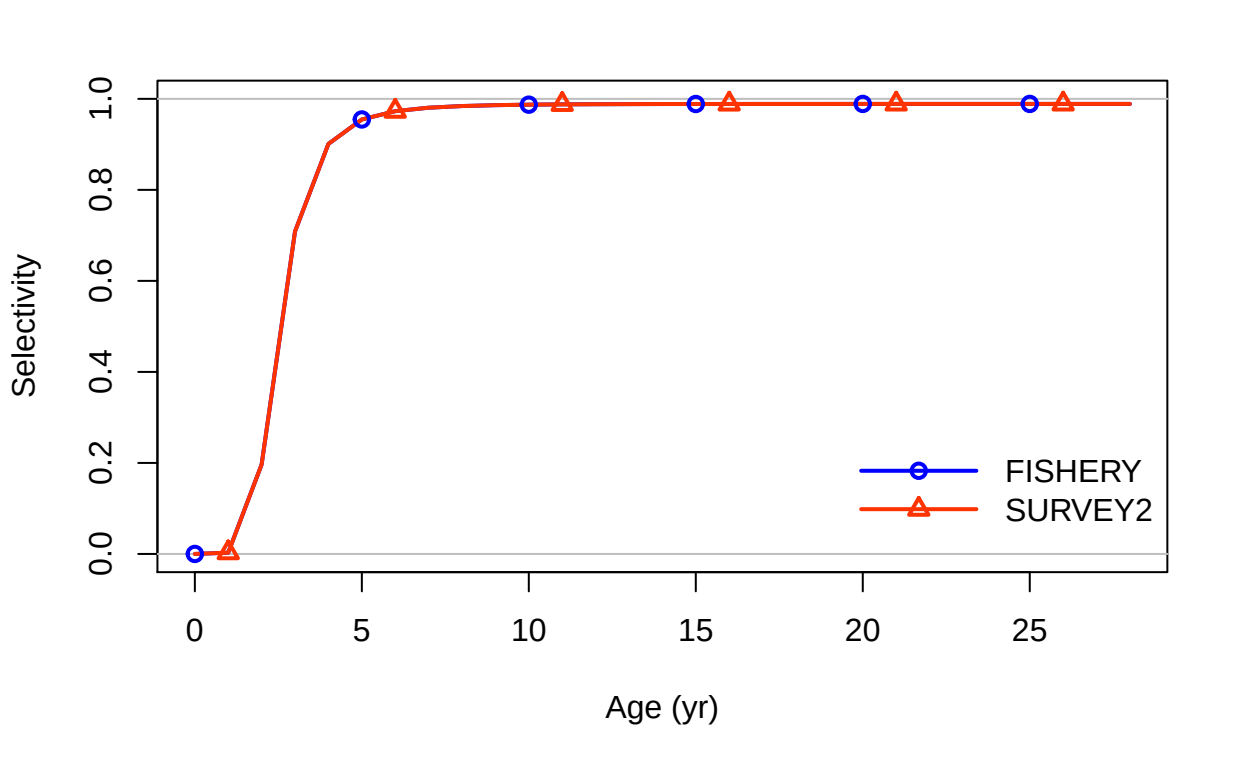

Fecundity
0
1
2
3
4
5
0
1
2
3
4
Female weight (kg)

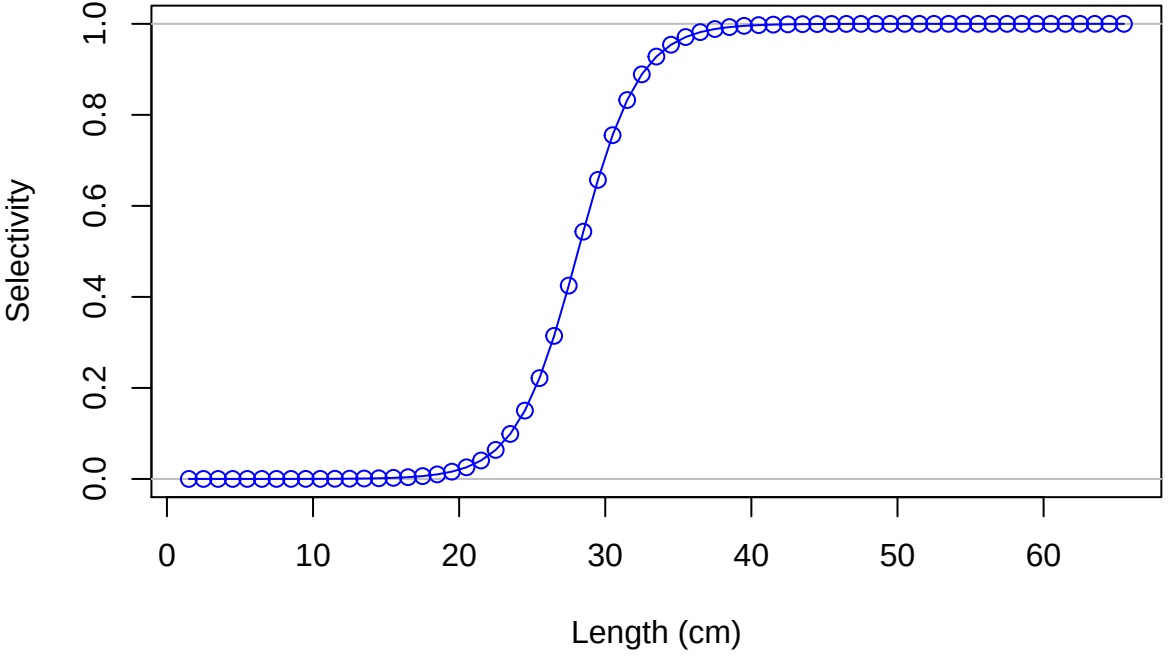

Fecundity
0
1
2
3
4
5
0
10
20
30
40
50
60
Female length (cm)

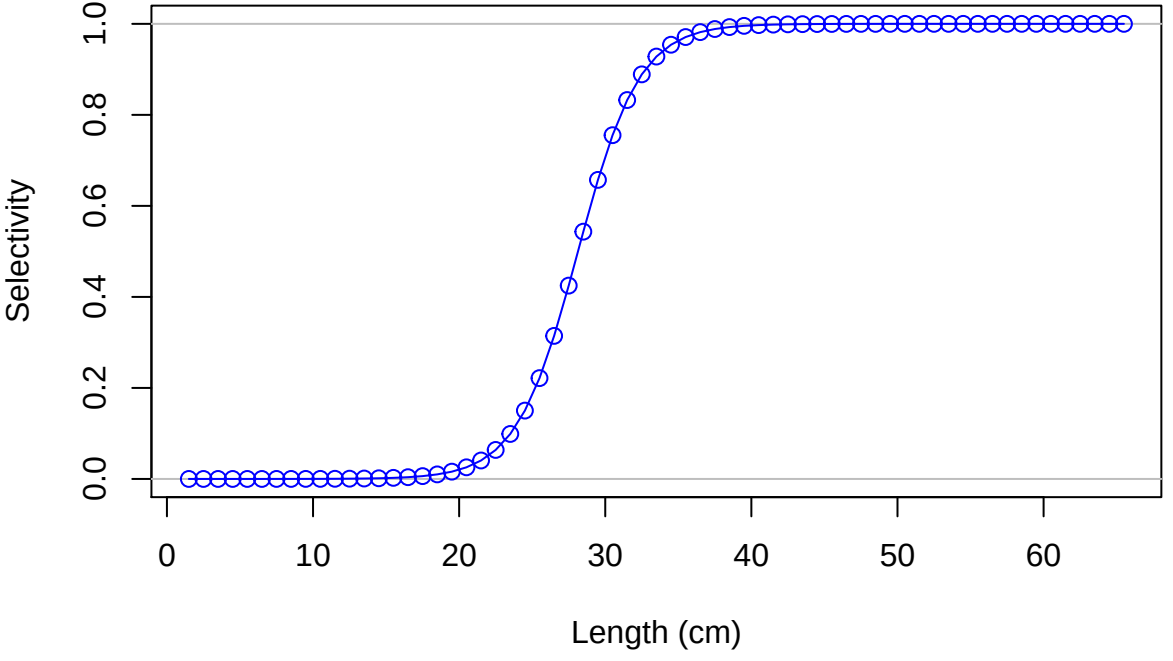

Spawning output
0
1
2
3
4
5
0
10
20
30
40
50
60
Length (cm)

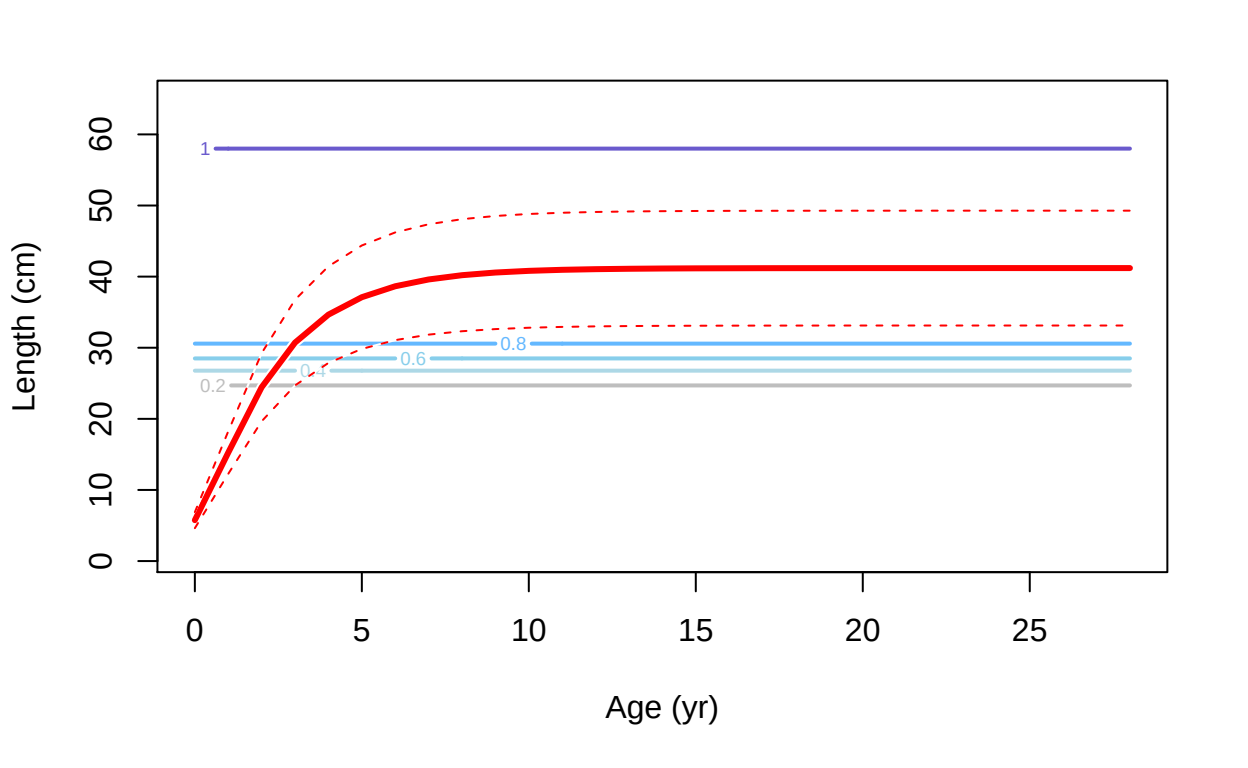

Spawning output
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
Age (yr)

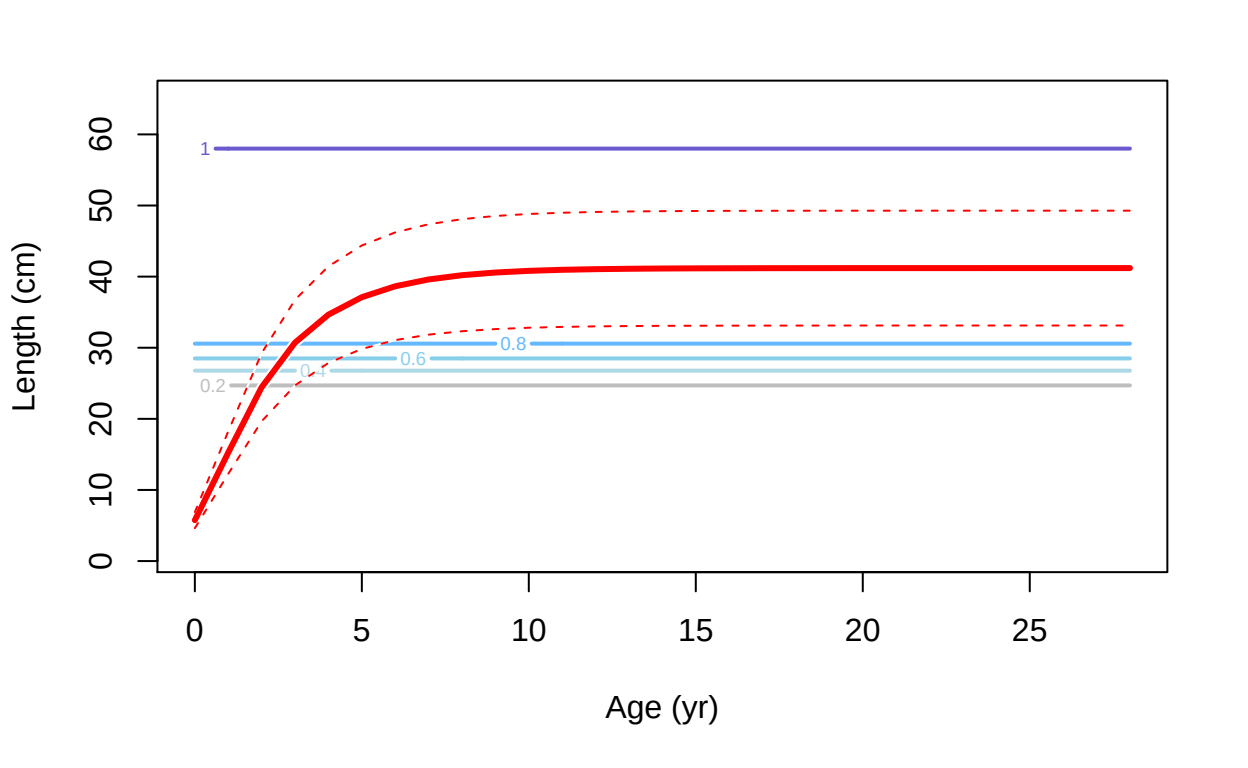

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
Length (cm)
FISHERY
SURVEY2

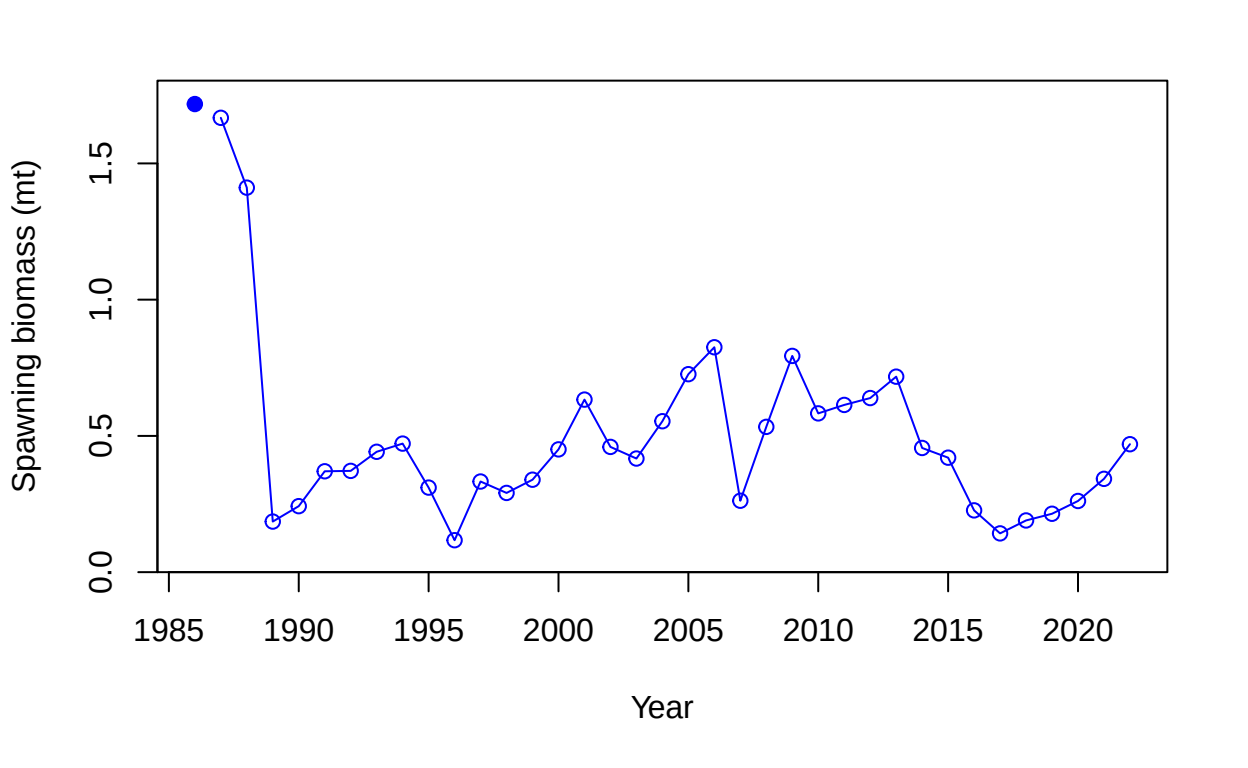

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
Age (yr)
FISHERY
SURVEY2

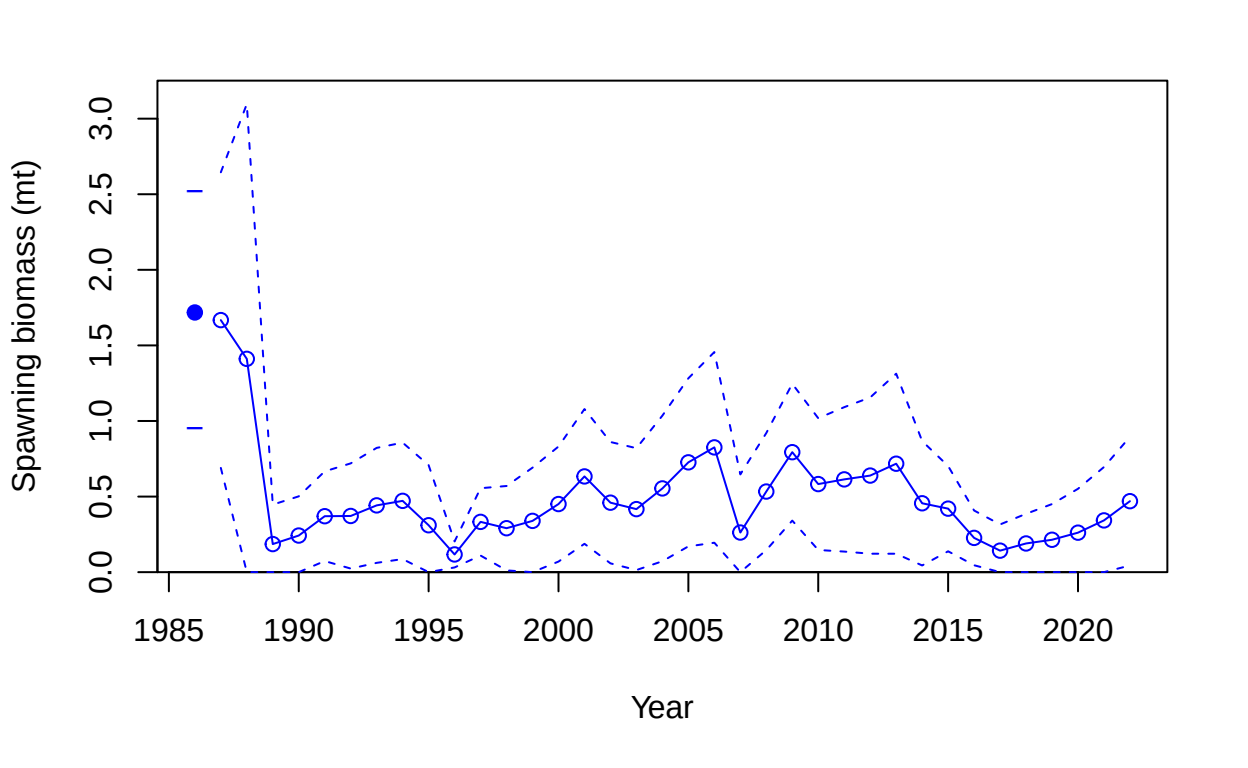

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
Length (cm)

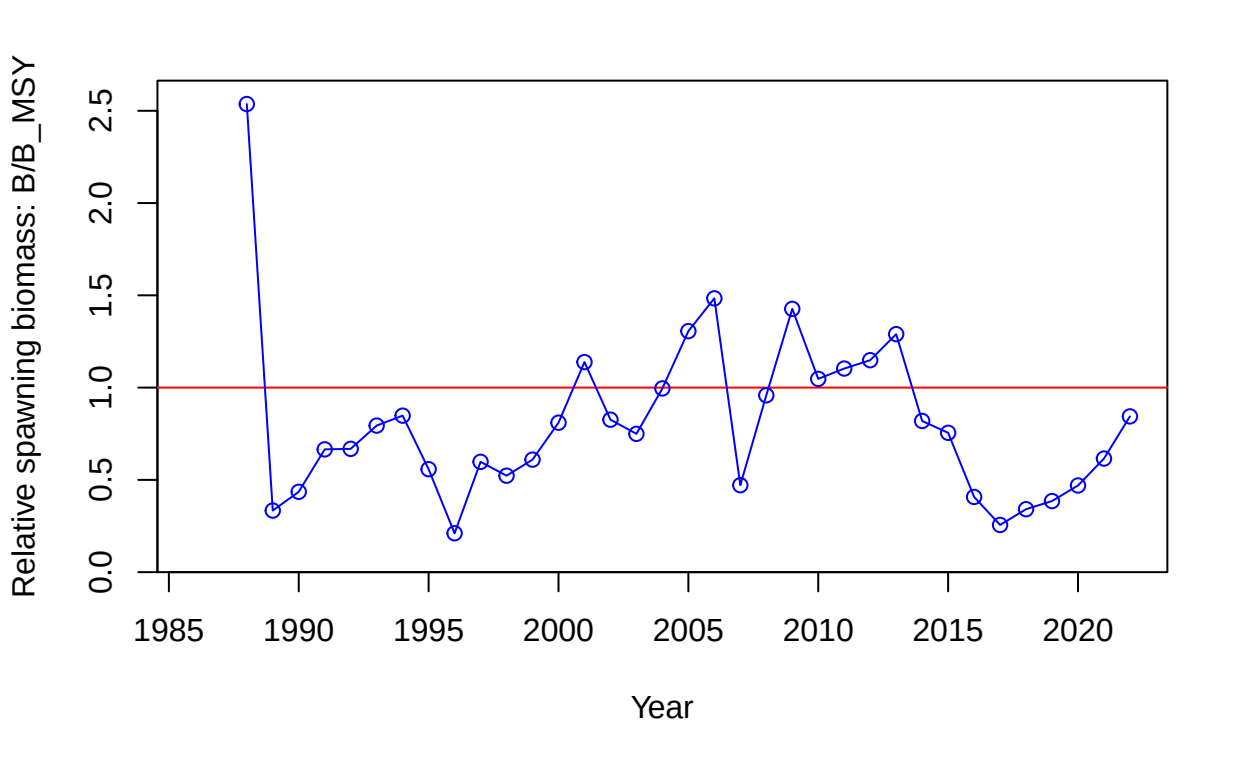

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
Length (cm)

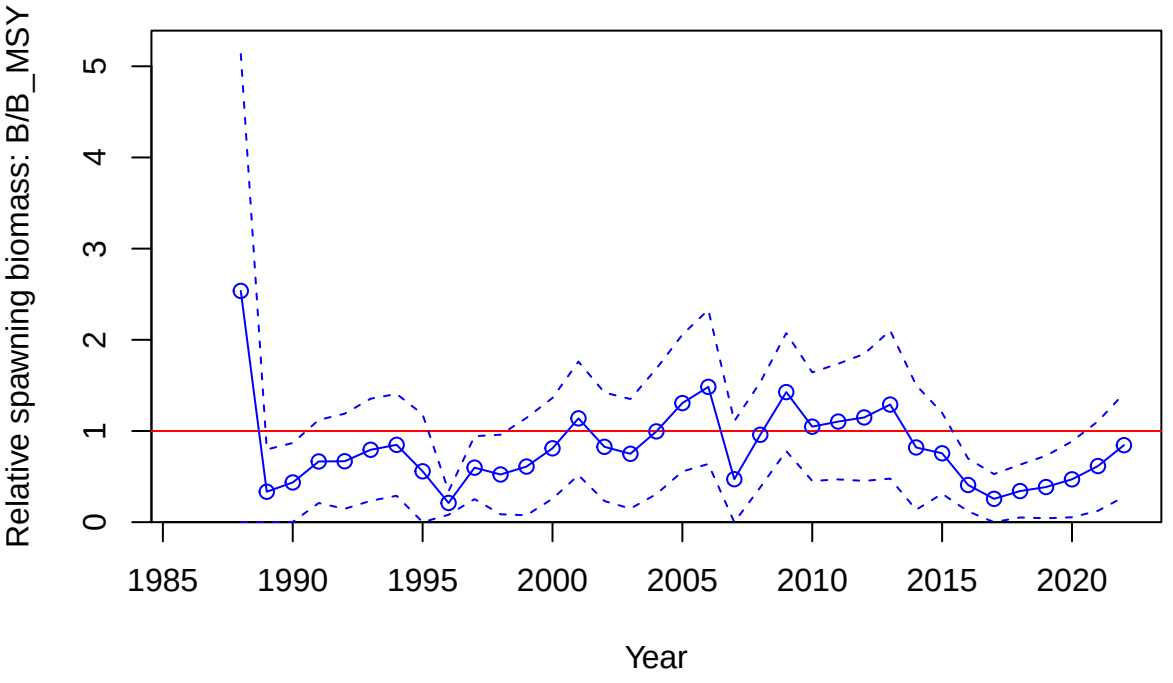

Length (cm)
0
10
20
30
40
50
60
Age (yr)
0
5
10
15
20
25
1
0.8
0.6
0.4
0.2

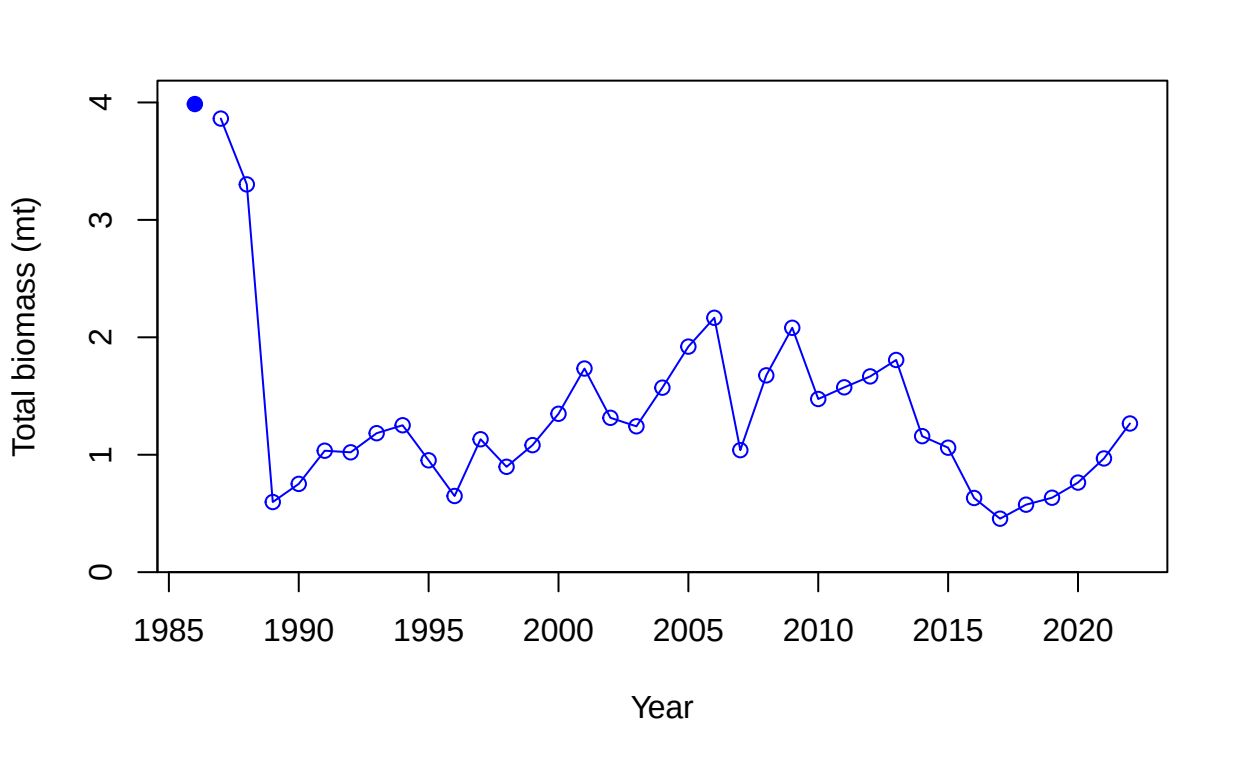

Length (cm)
0
10
20
30
40
50
60
Age (yr)
0
5
10
15
20
25
1
0.8
0.6
0.4
0.2

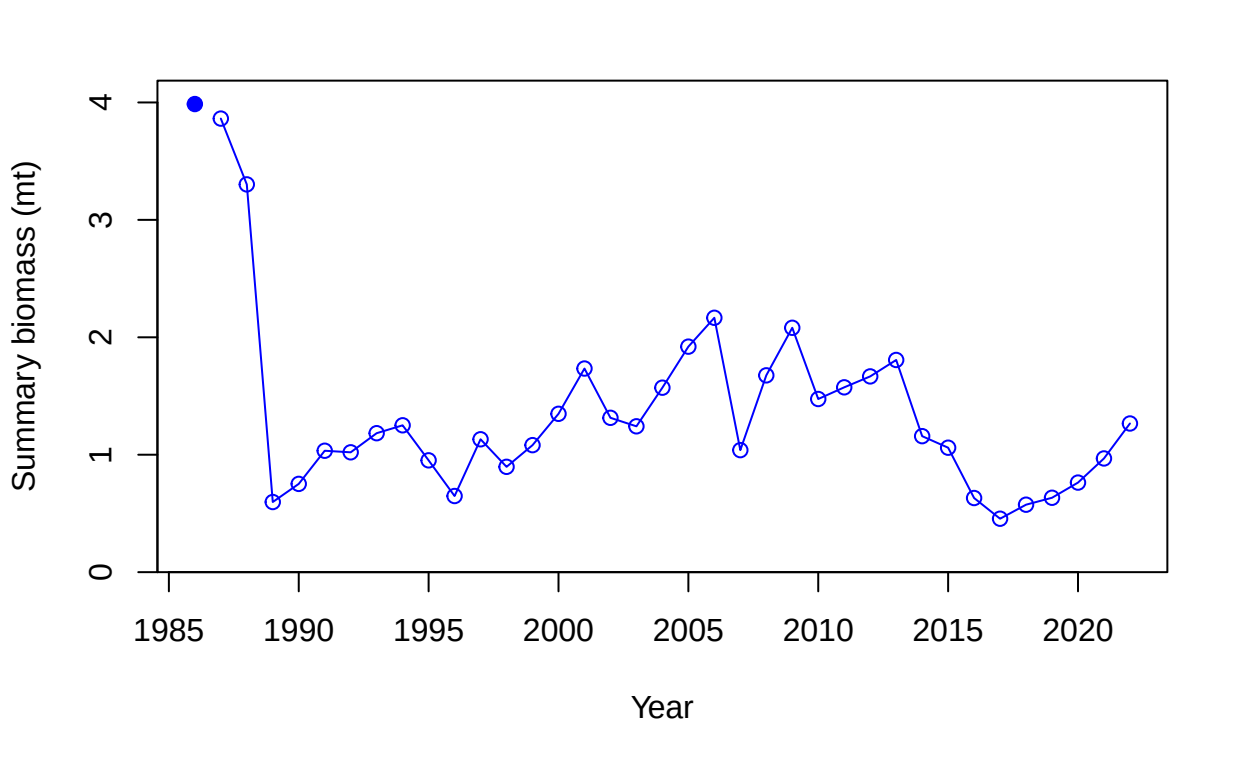

Spawning biomass (mt)
0.0
0.5
1.0
1.5
1985
1990
1995
2000
2005
2010
2015
2020
Year

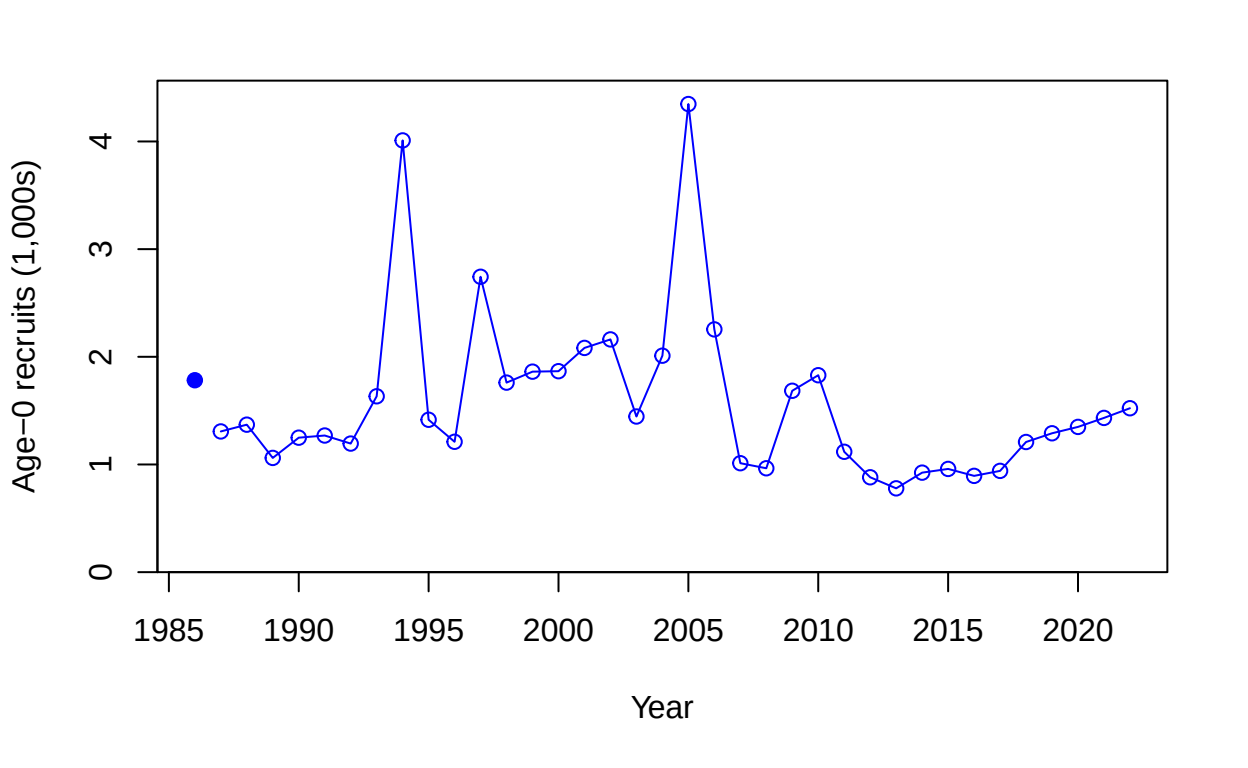

Spawning biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

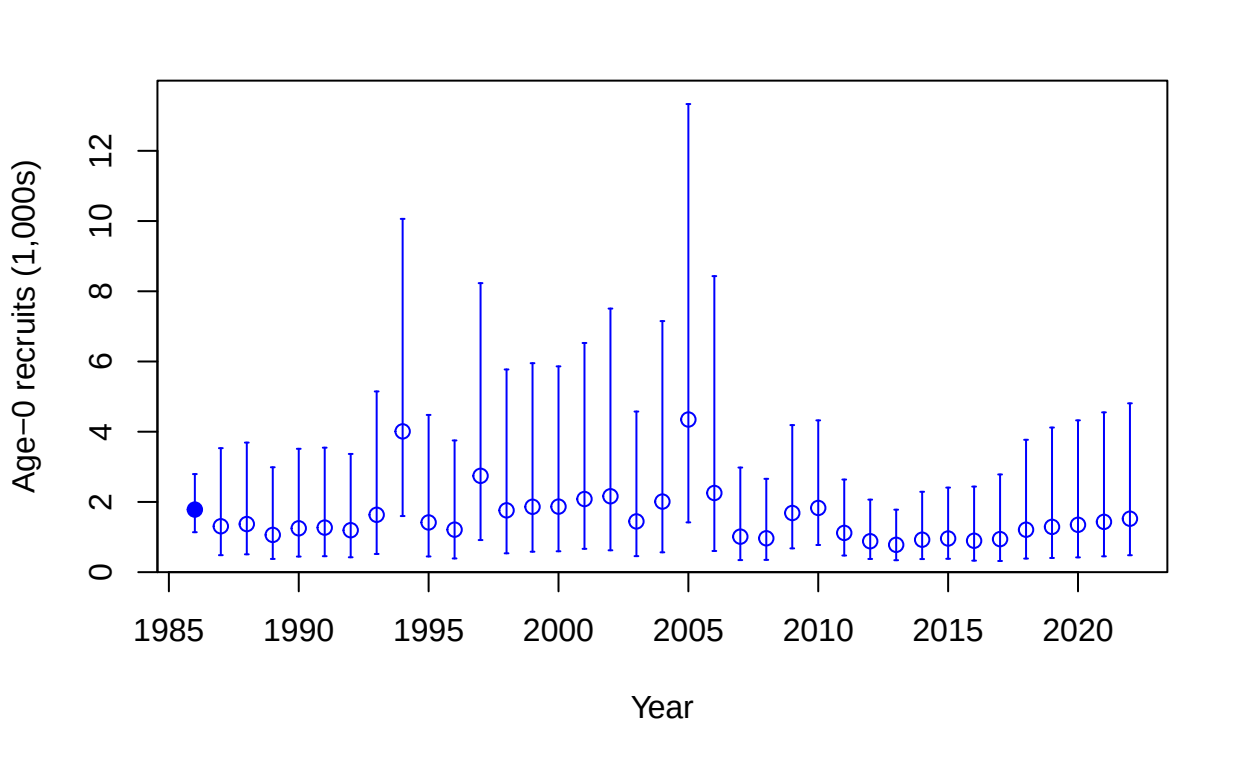

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
1985
1990
1995
2000
2005
2010
2015
2020
Year

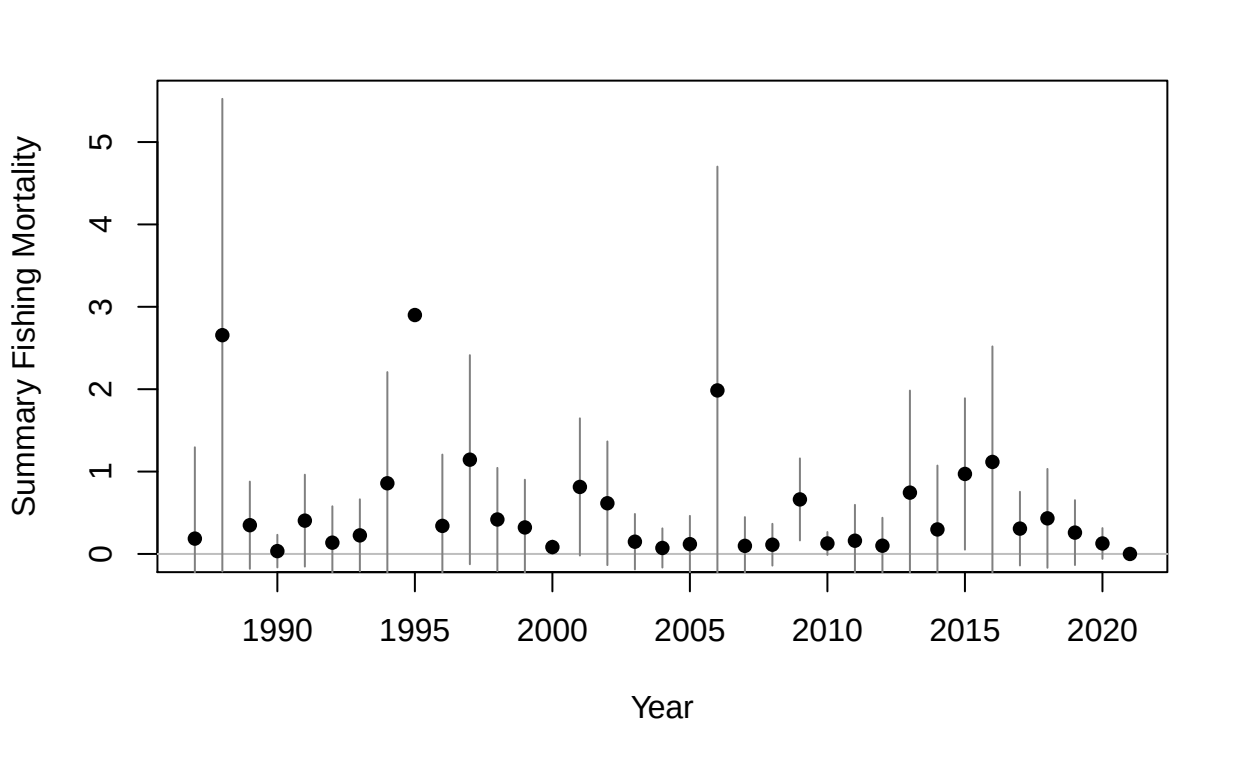

Relative spawning biomass: B/B_MSY
0
1
2
3
4
5
1985
1990
1995
2000
2005
2010
2015
2020
Year

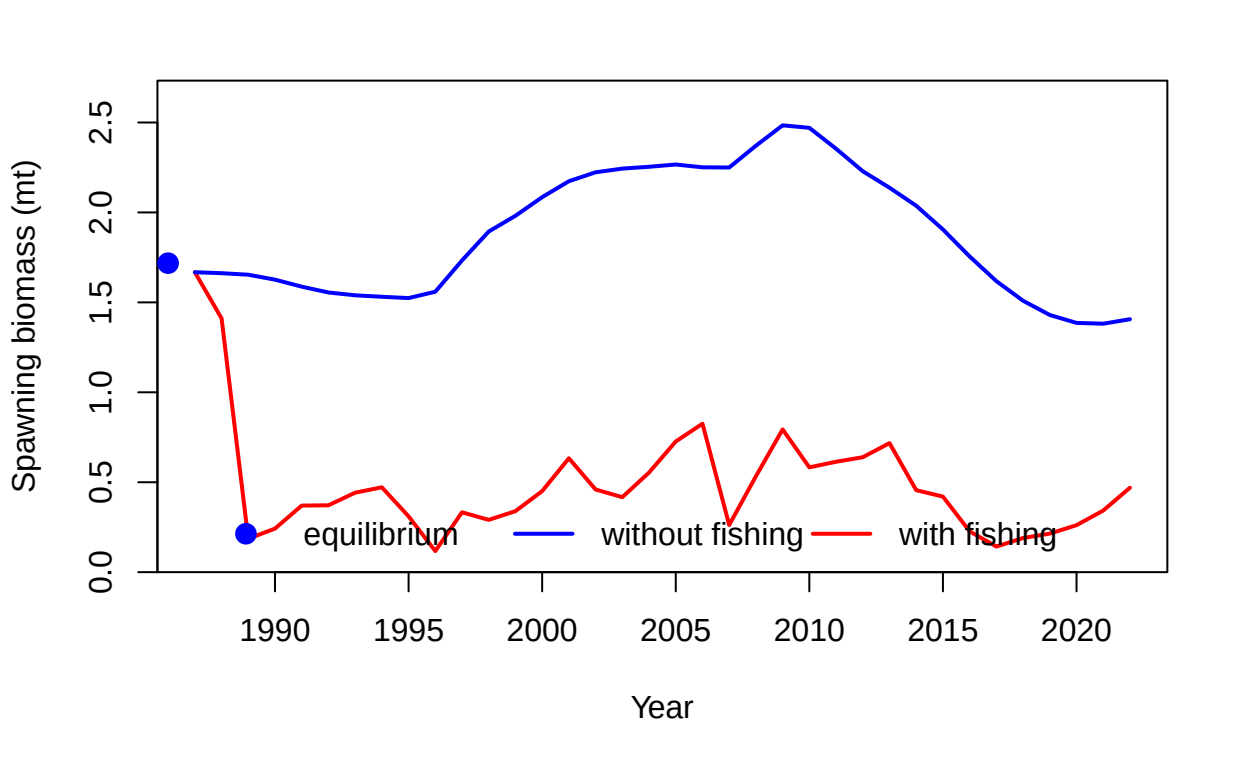

Total biomass (mt)
0
1
2
3
4
1985
1990
1995
2000
2005
2010
2015
2020
Year

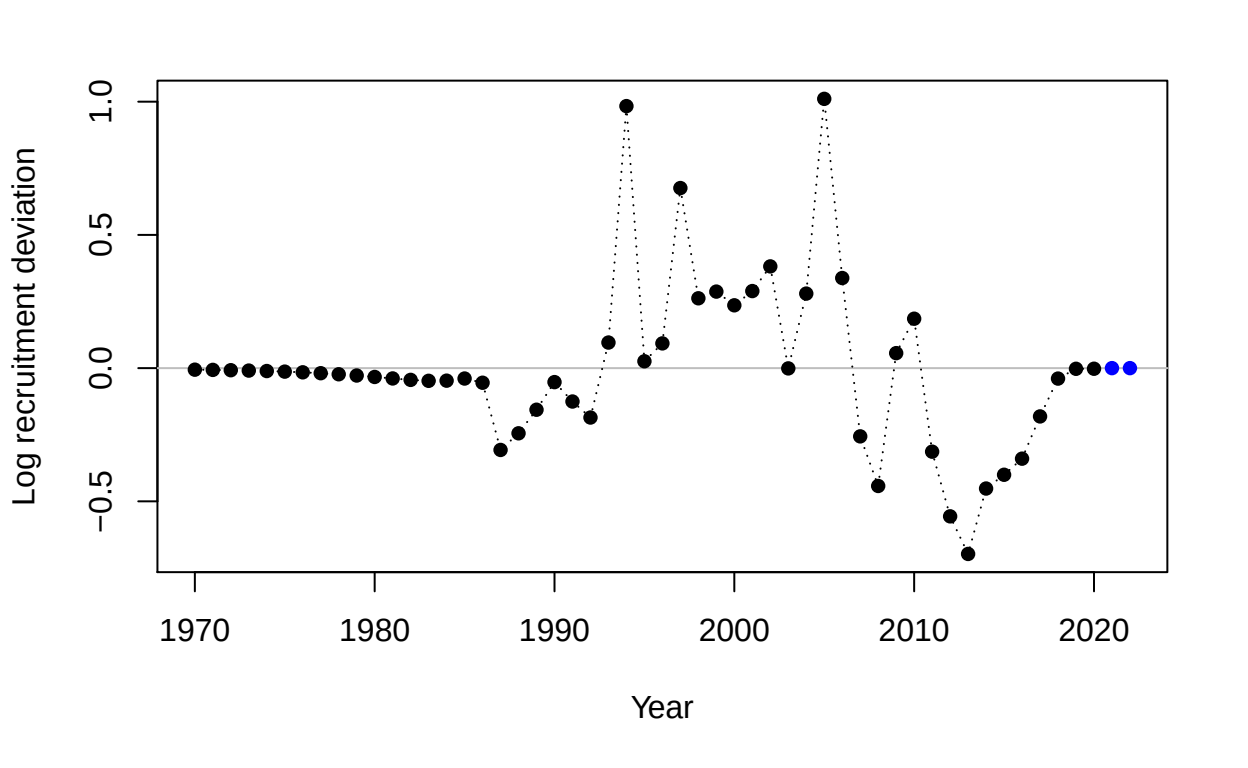

Summary biomass (mt)
0
1
2
3
4
1985
1990
1995
2000
2005
2010
2015
2020
Year

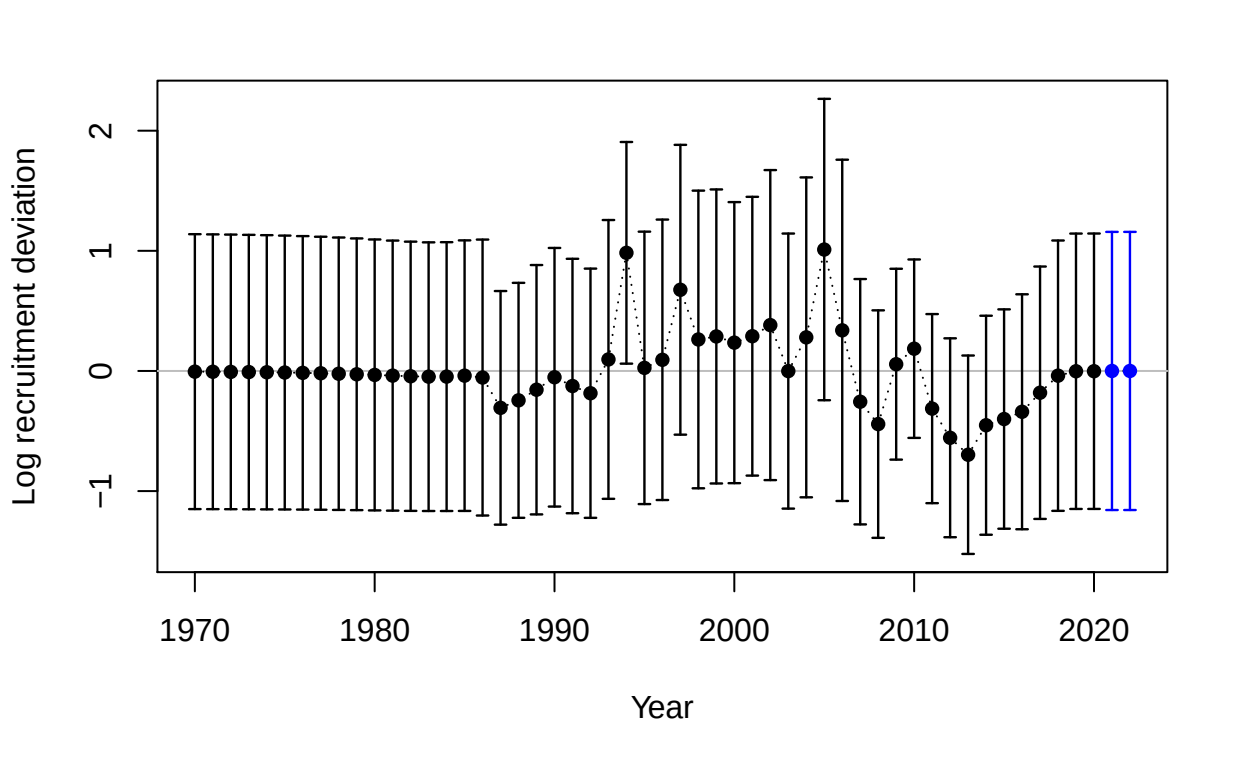

Age−0 recruits (1,000s)
0
1
2
3
4
1985
1990
1995
2000
2005
2010
2015
2020
Year

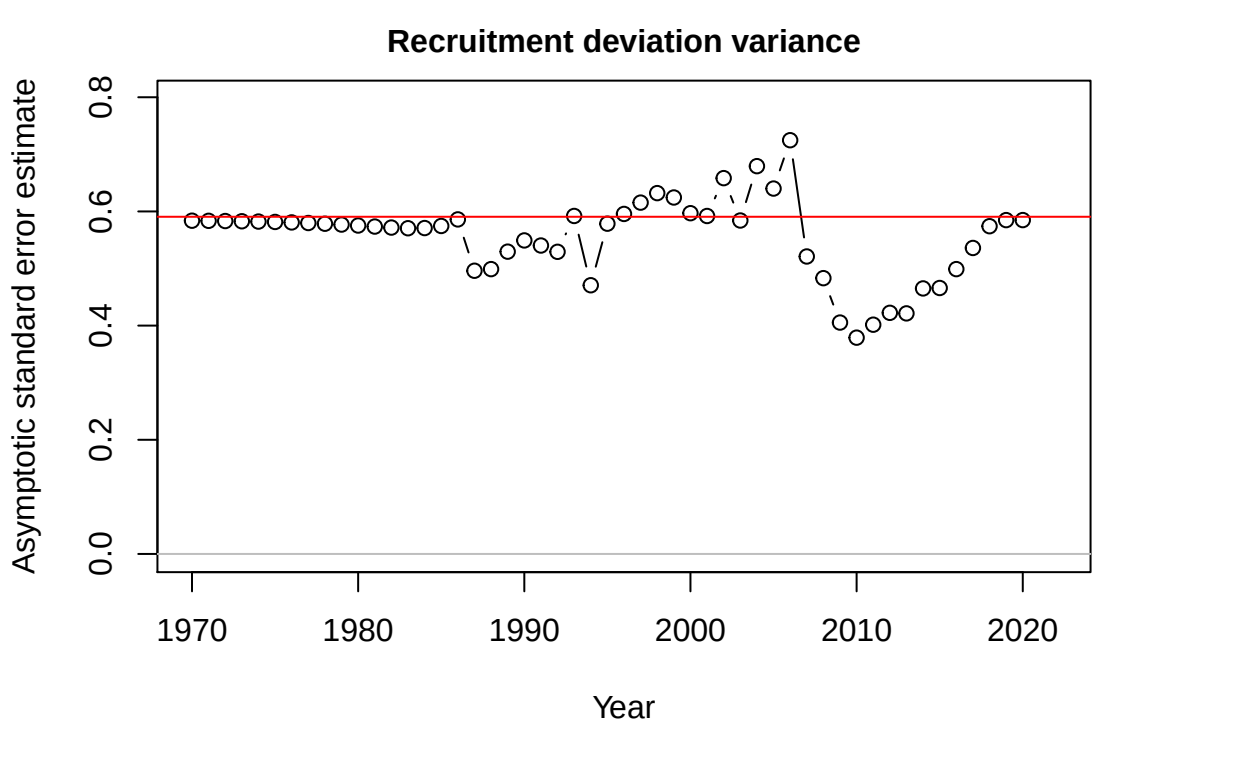

Age−0 recruits (1,000s)
0
2
4
6
8
10
12
1985
1990
1995
2000
2005
2010
2015
2020
Year

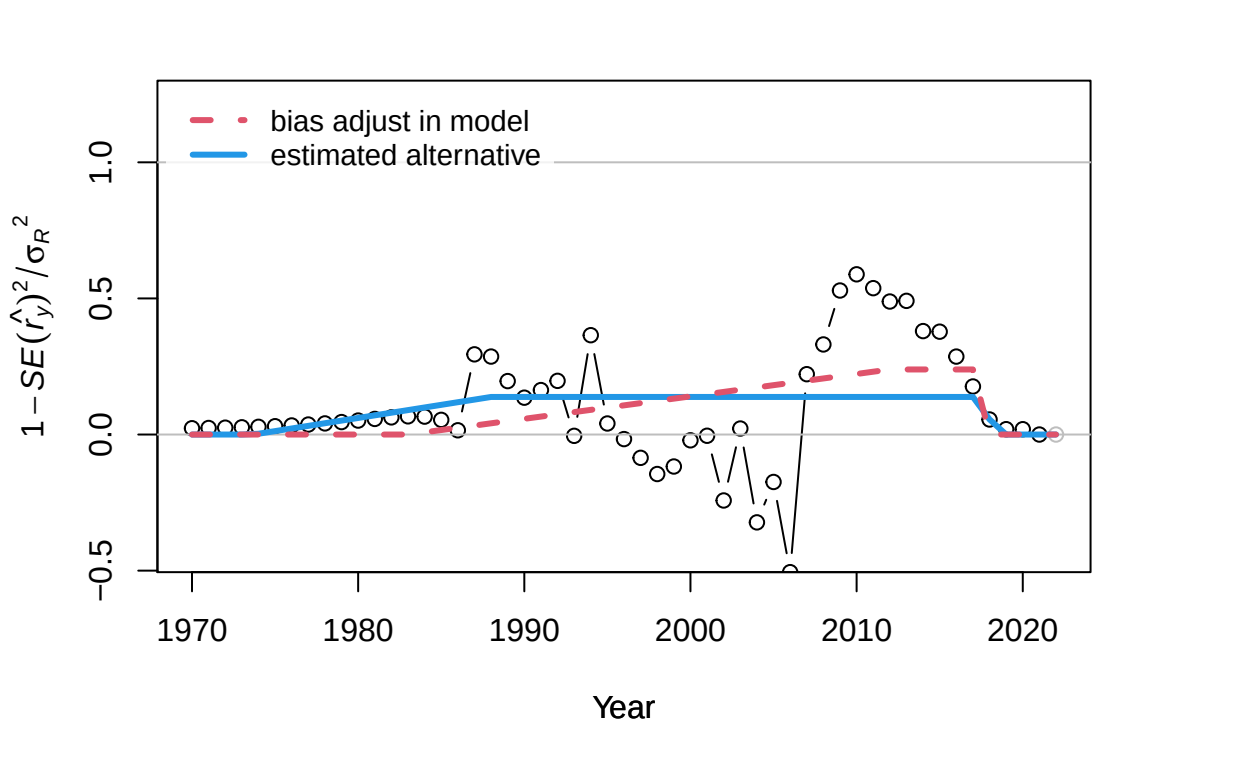

Summary Fishing Mortality
0
1
2
3
4
5
1990
1995
2000
2005
2010
2015
2020
Year

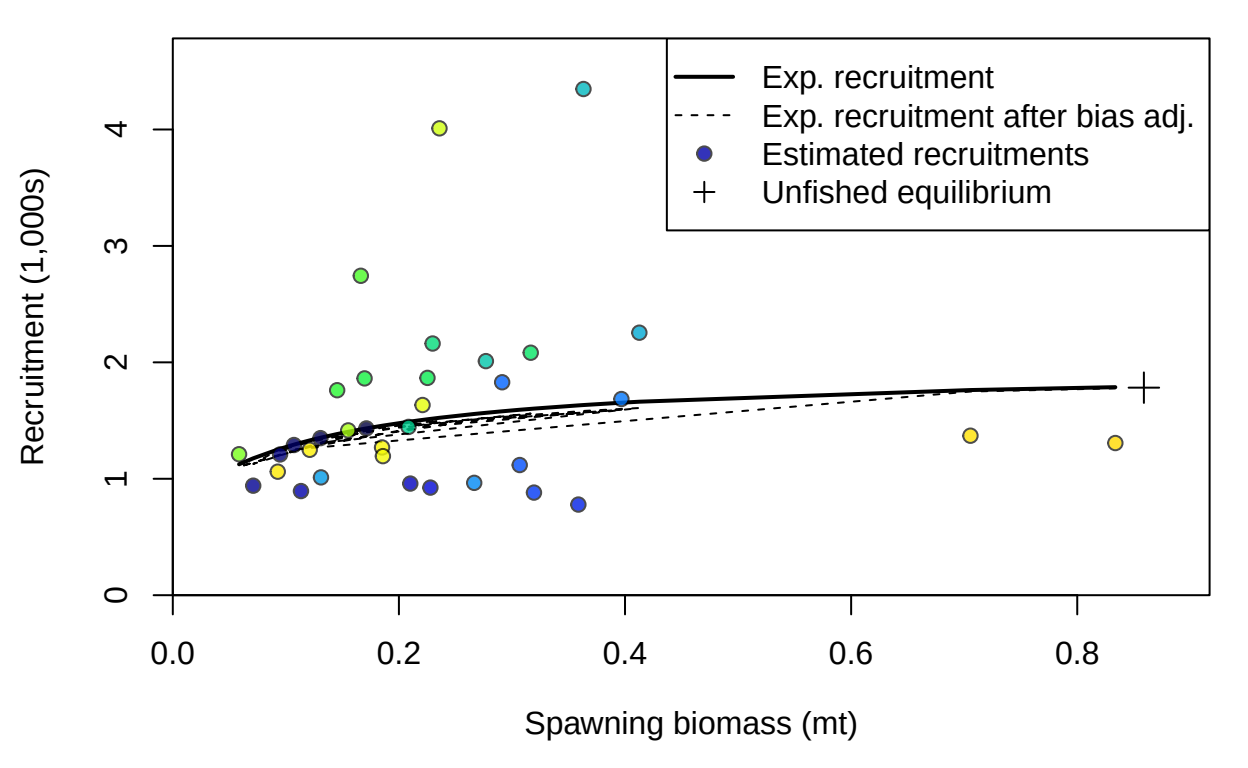

Spawning biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
1990
1995
2000
2005
2010
2015
2020
Year
equilibrium
without fishing
with fishing

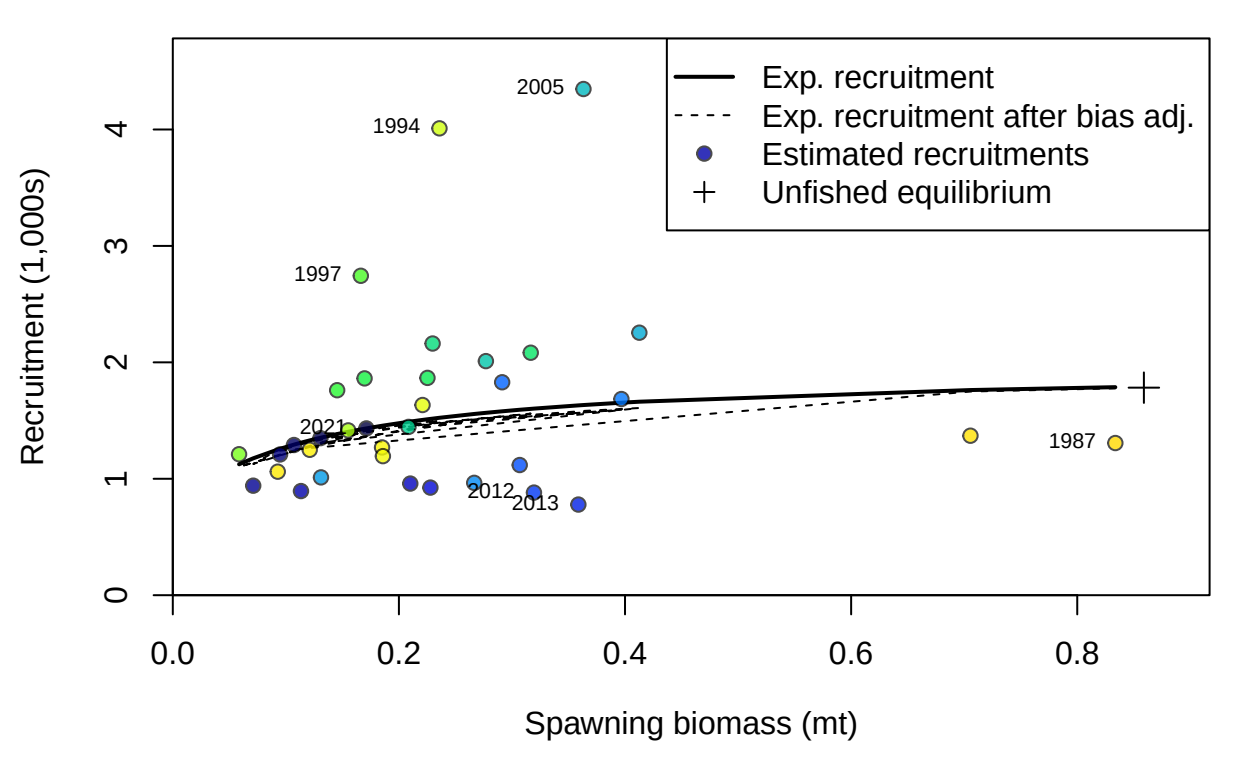

Log recruitment deviation
1.0
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year

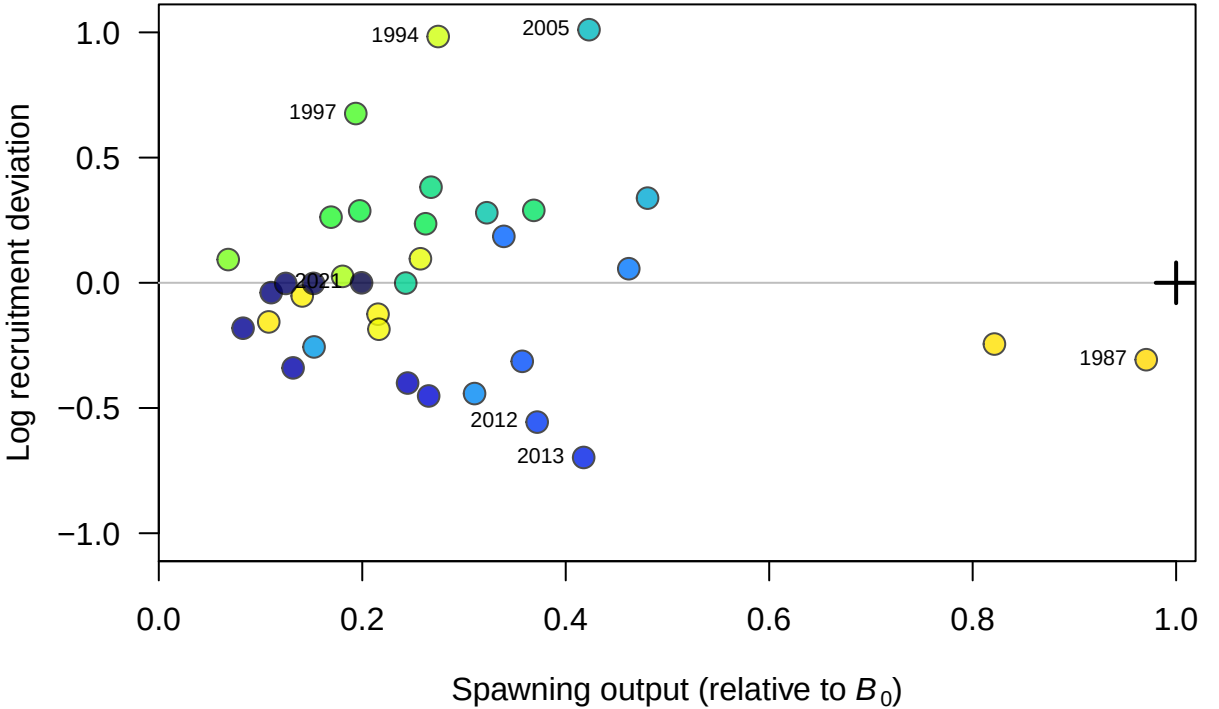

Log recruitment deviation
2
1
0
−1
1970
1980
1990
2000
2010
2020
Year

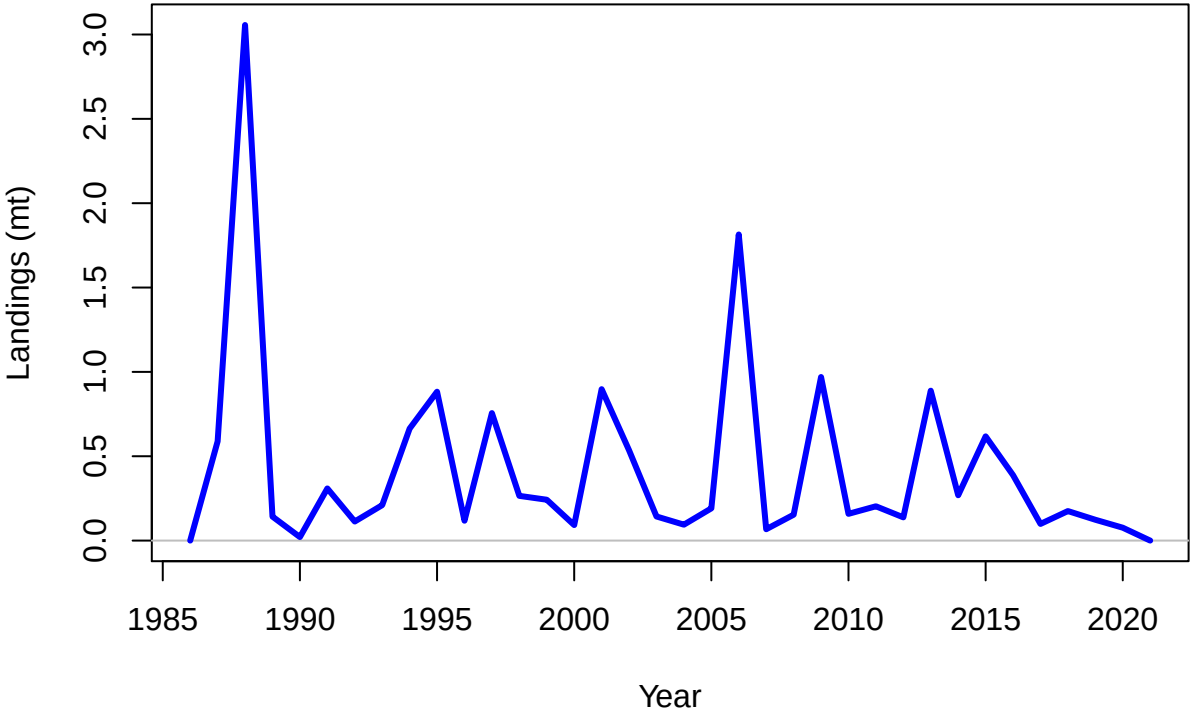

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
0.8
1970
1980
1990
2000
2010
2020
Year

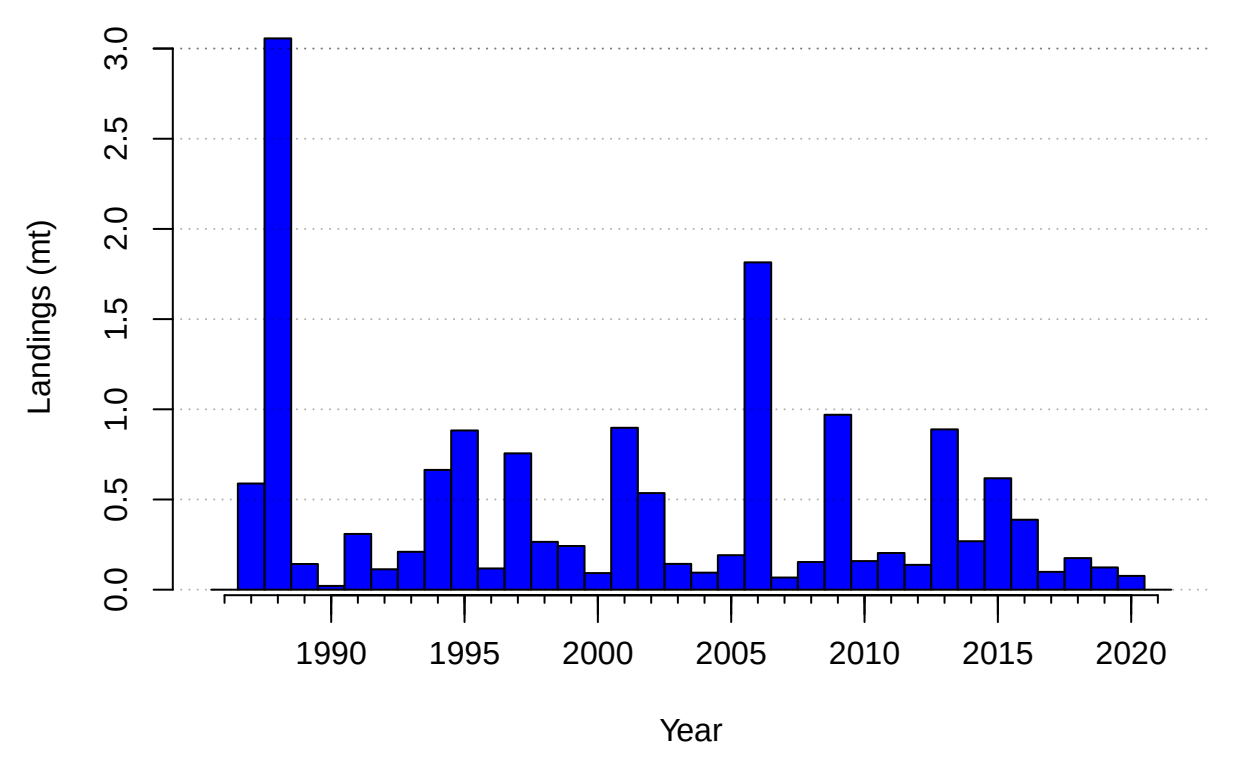

bias adjust in model
estimated alternative
1.0
0.5
0.0
−0.5
$1-SE(\hat{r_y})^2/\sigma_R{}^2$
1970
1980
1990
2000
2010
2020
Year

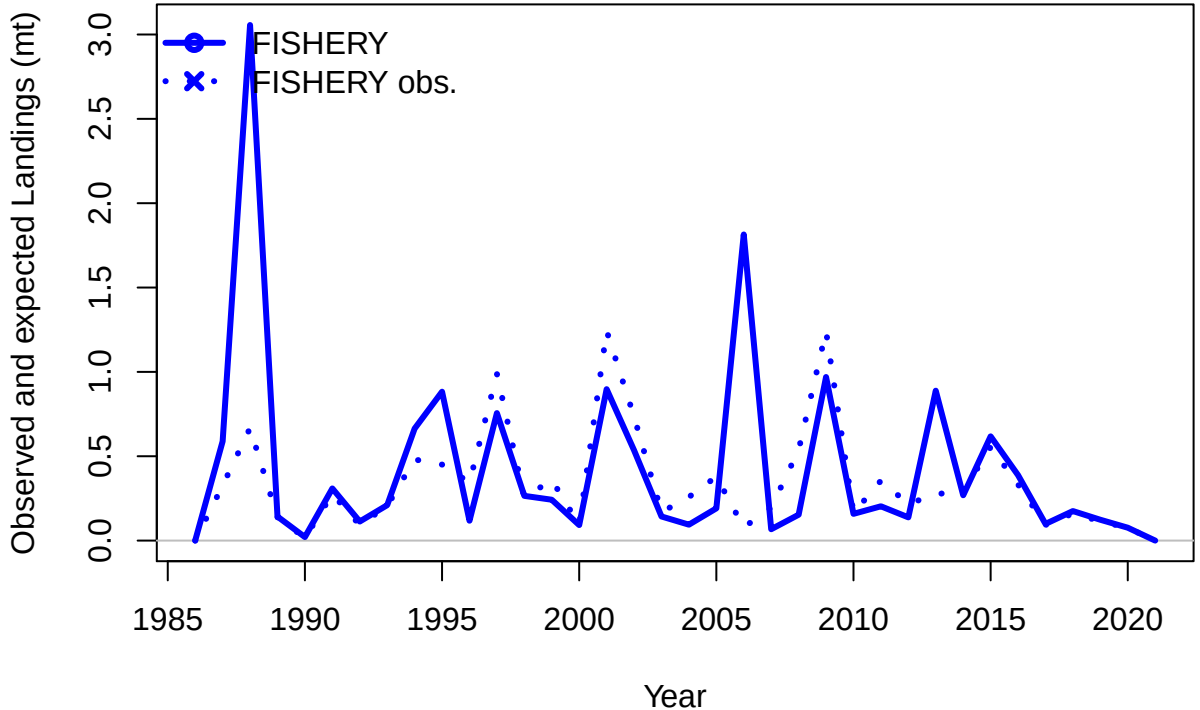

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
Spawning biomass (mt)

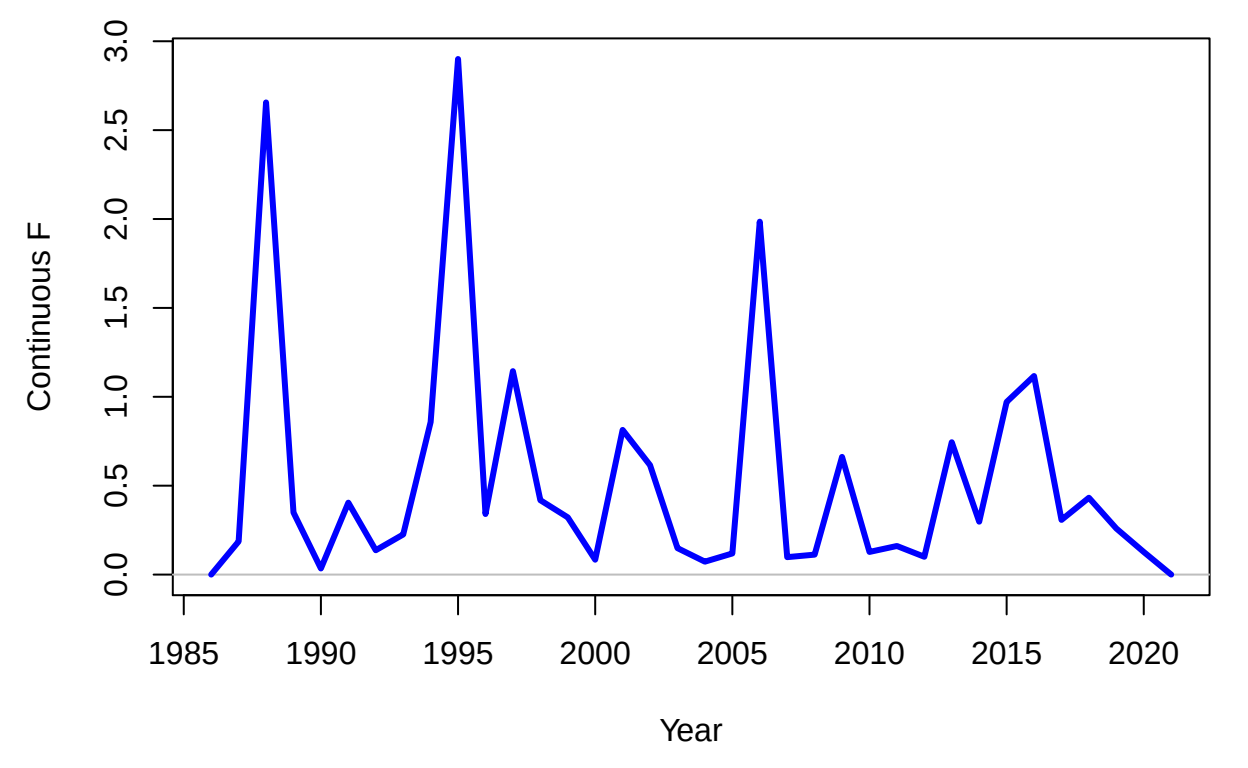

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
2005
1994
1997
2021
1987
2012
2013
Recruitment (1,000s)
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
Spawning biomass (mt)

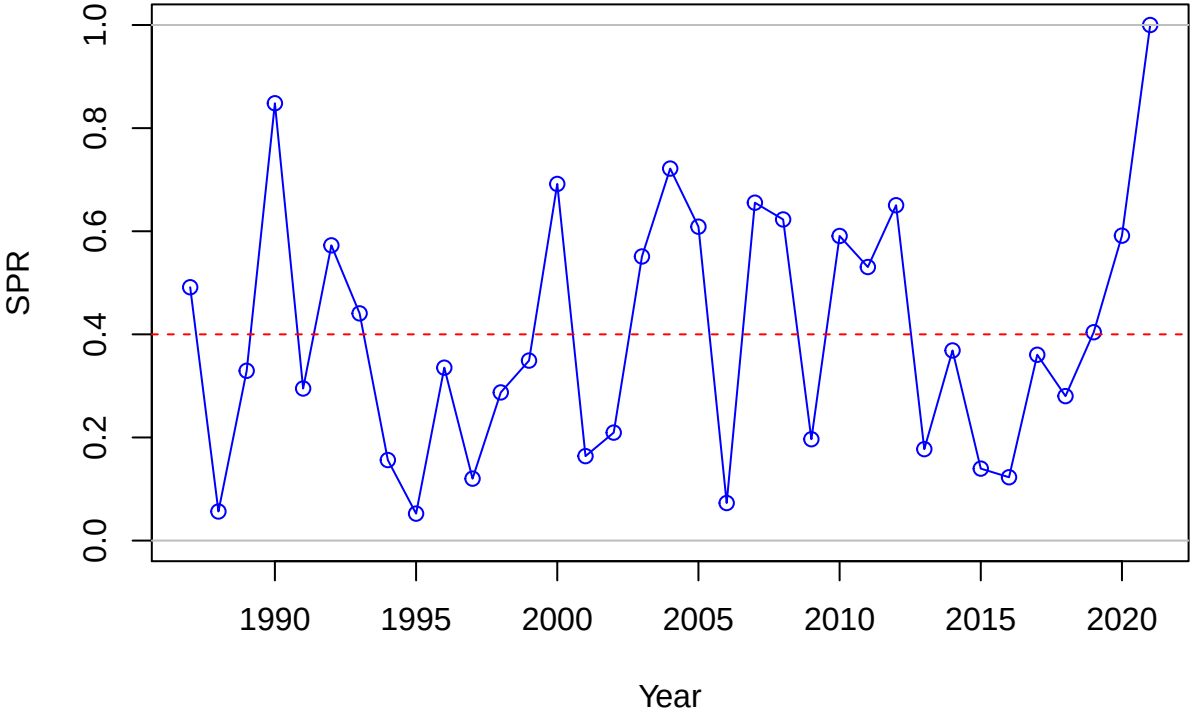

1994
2005
1997
2021
1987
2012
2013
1.0
0.5
0.0
−0.5
−1.0
0.0
0.2
0.4
0.6
0.8
1.0
Log recruitment deviation
Spawning output (relative to B_0)

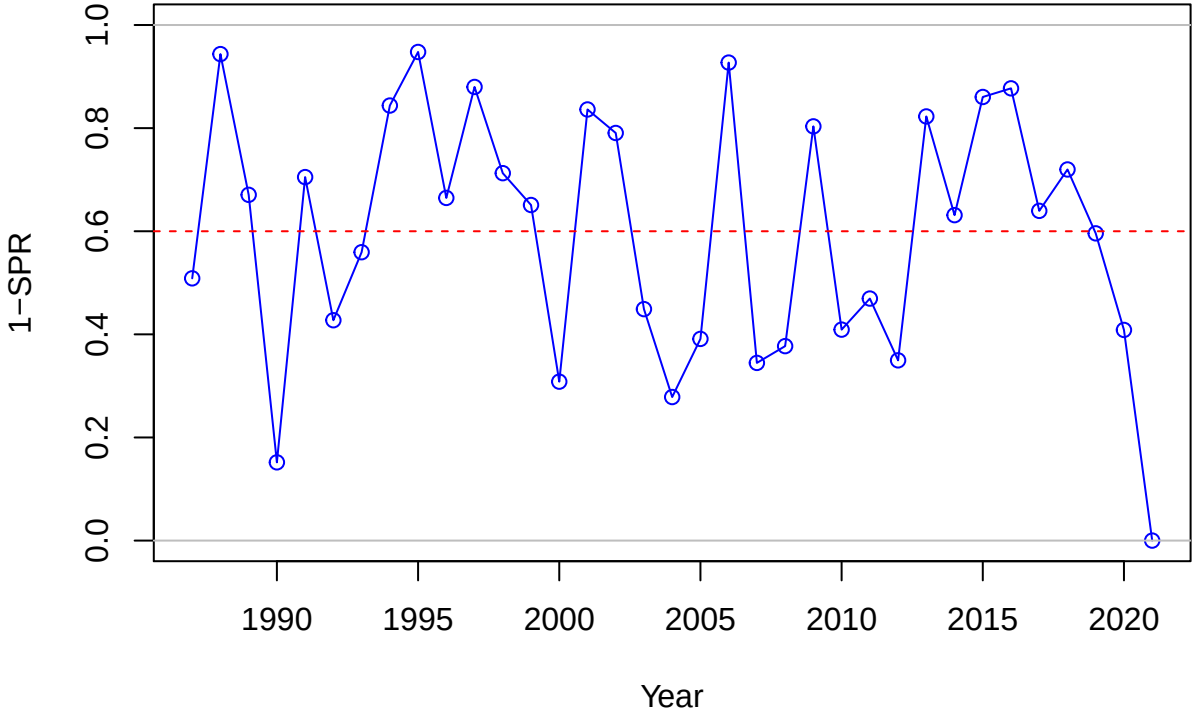

Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

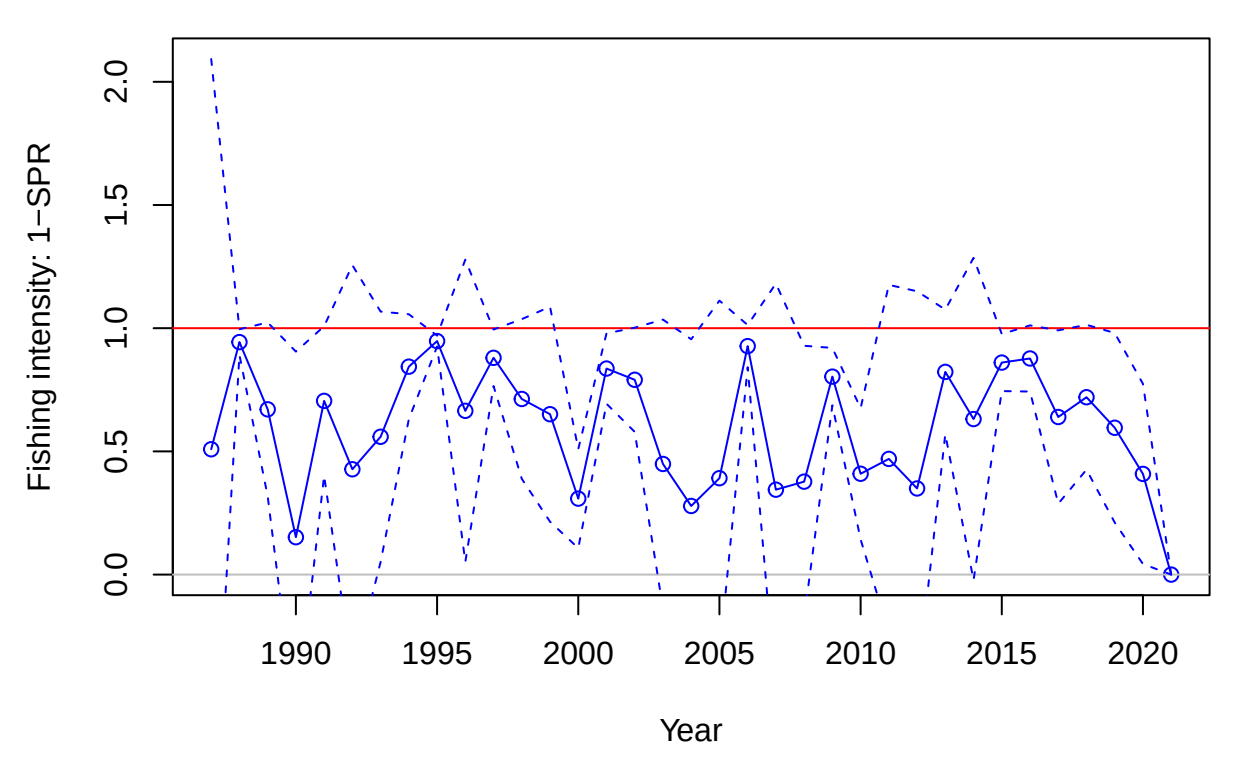

Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1990
1995
2000
2005
2010
2015
2020
Year

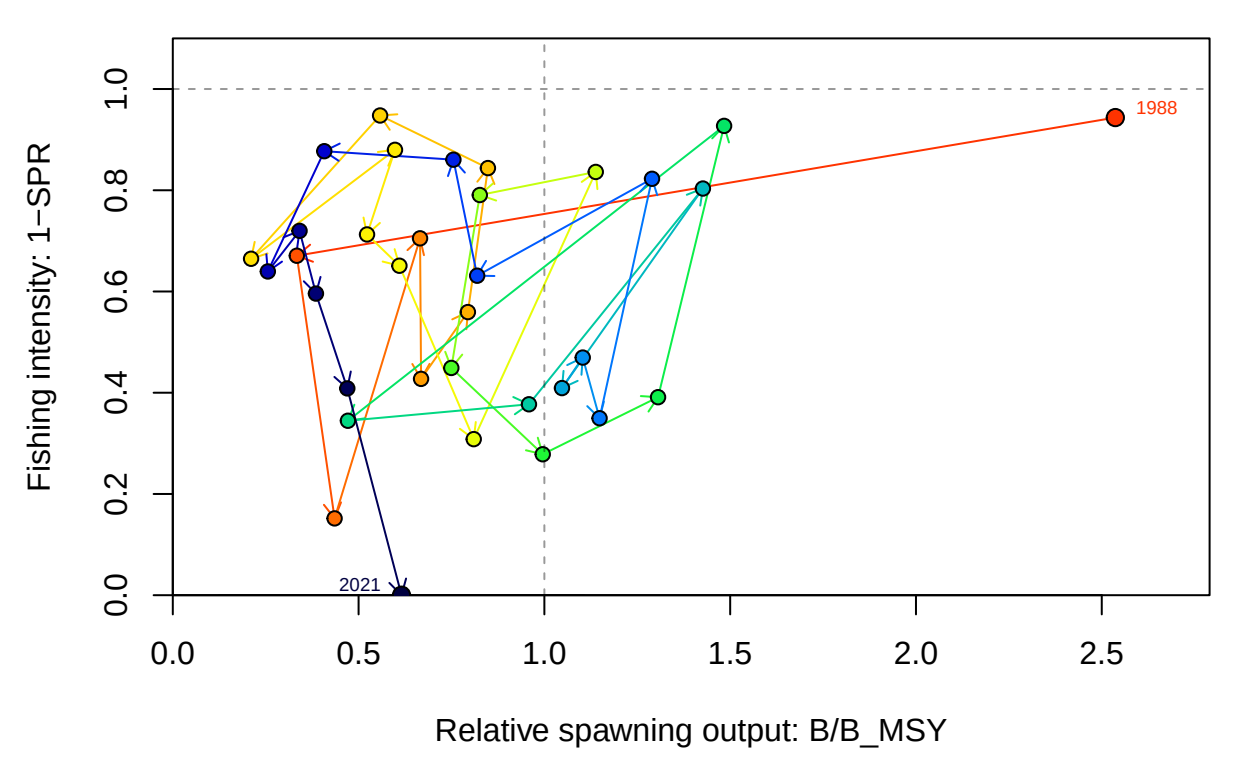

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

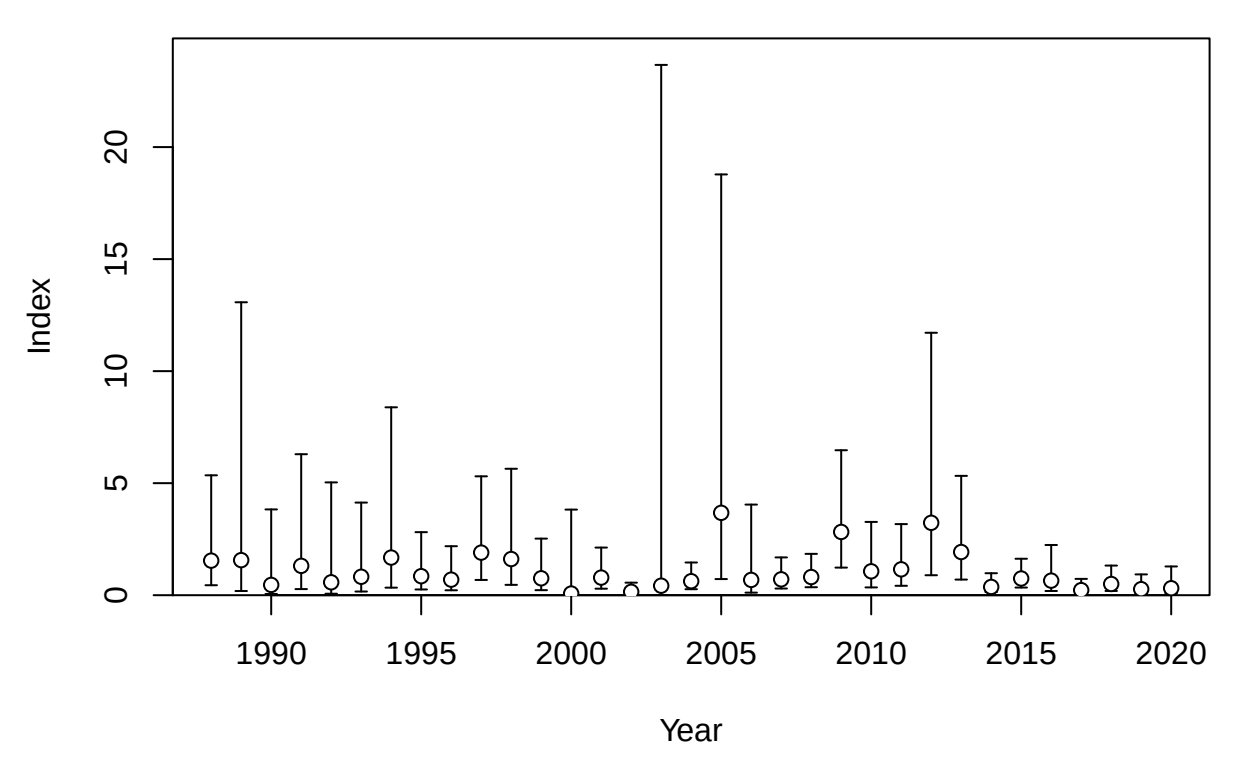

Continuous F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

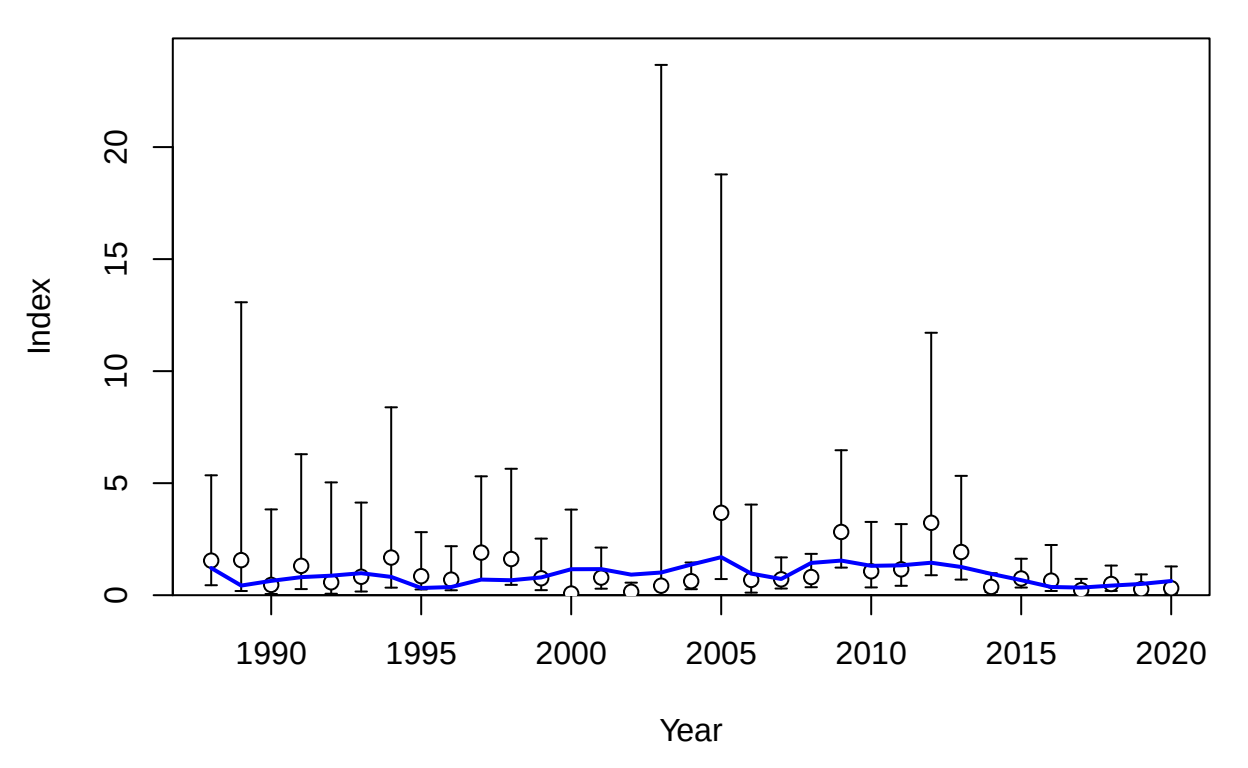

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1990
1995
2000
2005
2010
2015
2020
Year

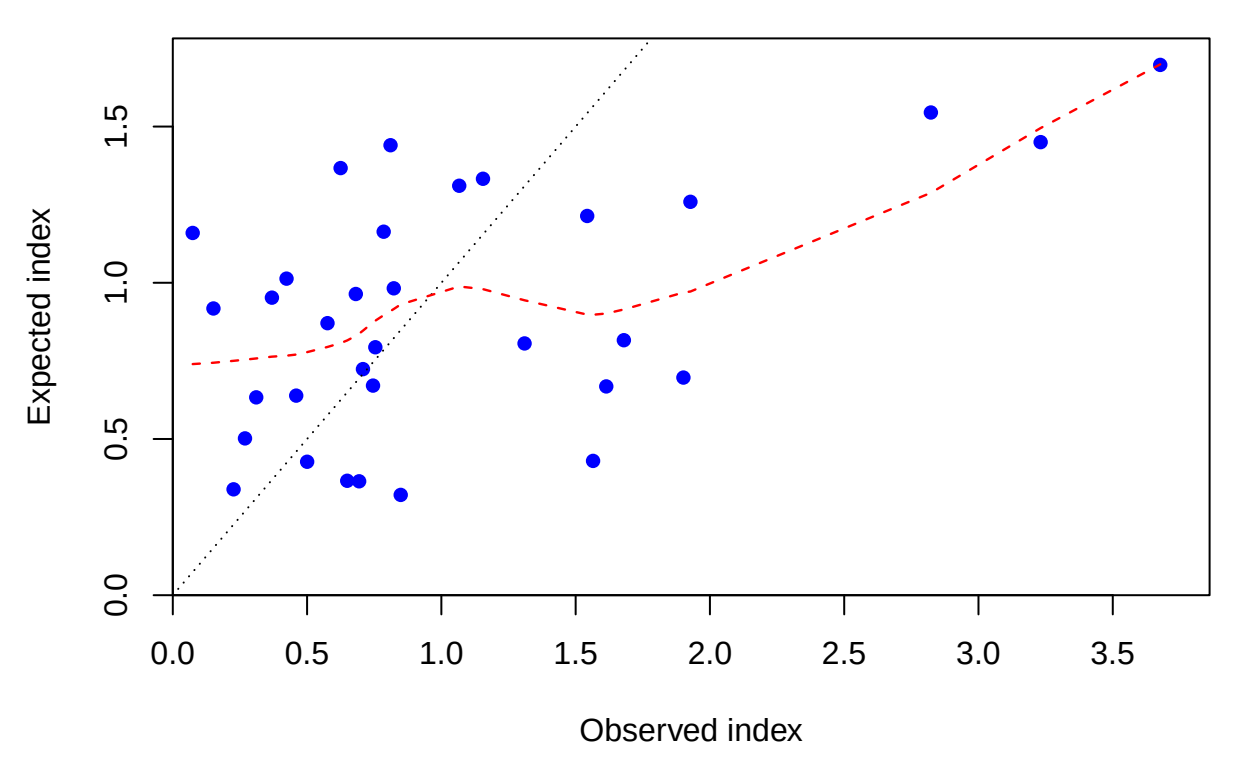

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1990
1995
2000
2005
2010
2015
2020
Year

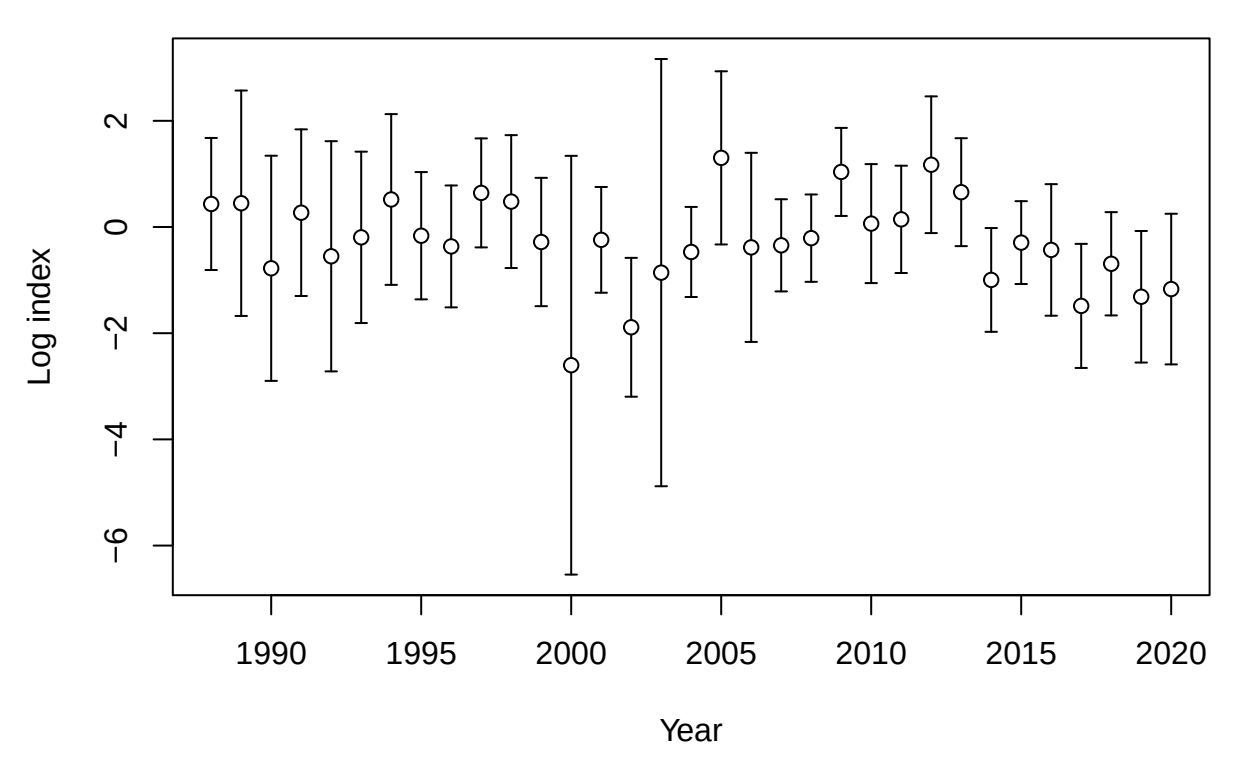

Fishing intensity: 1−SPR
0.0
0.5
1.0
1.5
2.0
1990
1995
2000
2005
2010
2015
2020
Year

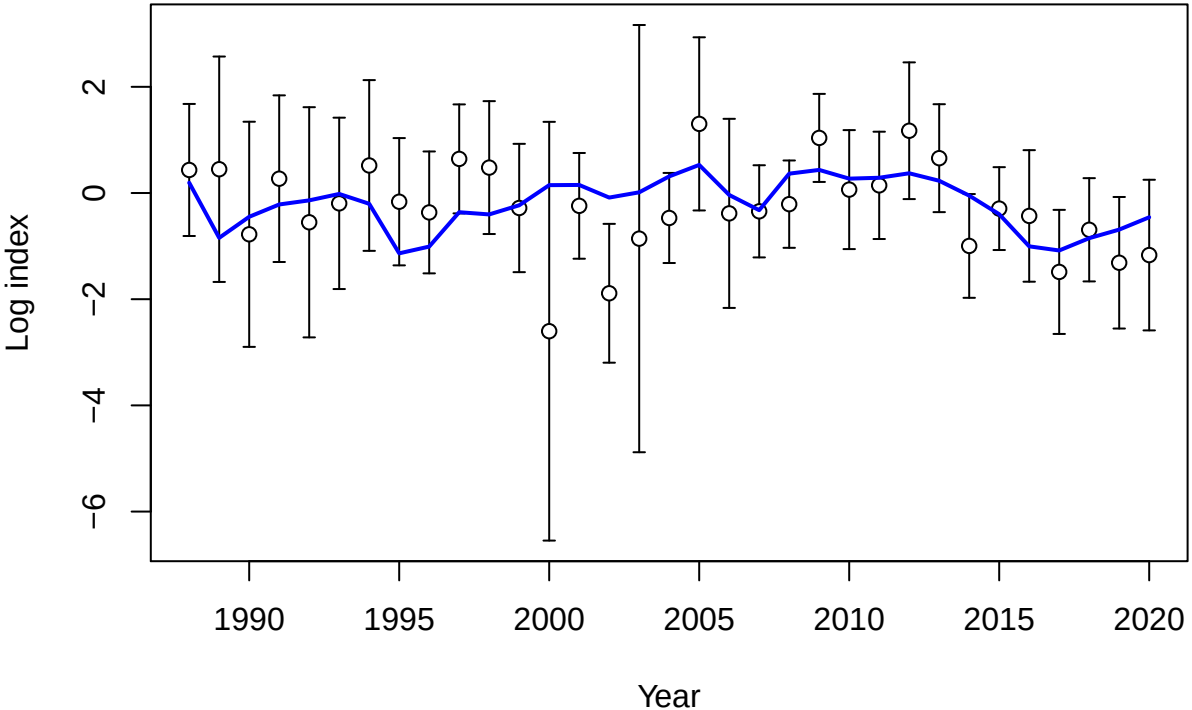

Fishing intensity: 1−SPR
Relative spawning output: B/B_MSY
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
1988
2021

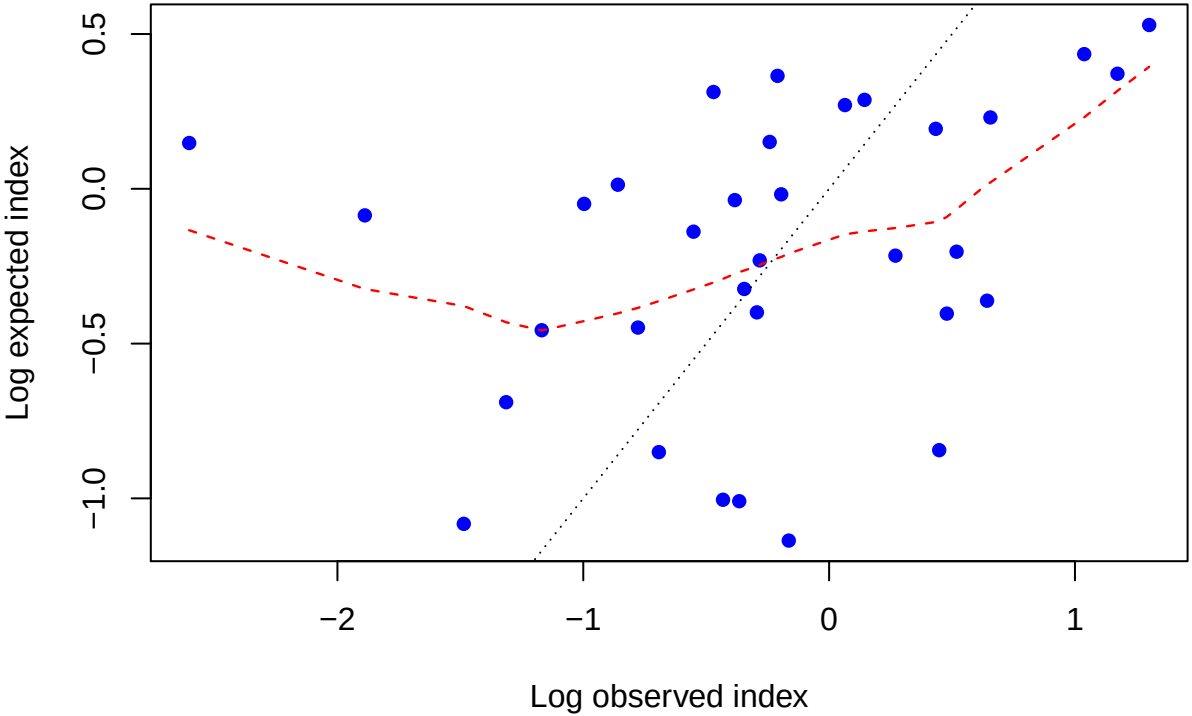

Index
0
5
10
15
20
1990
1995
2000
2005
2010
2015
2020
Year

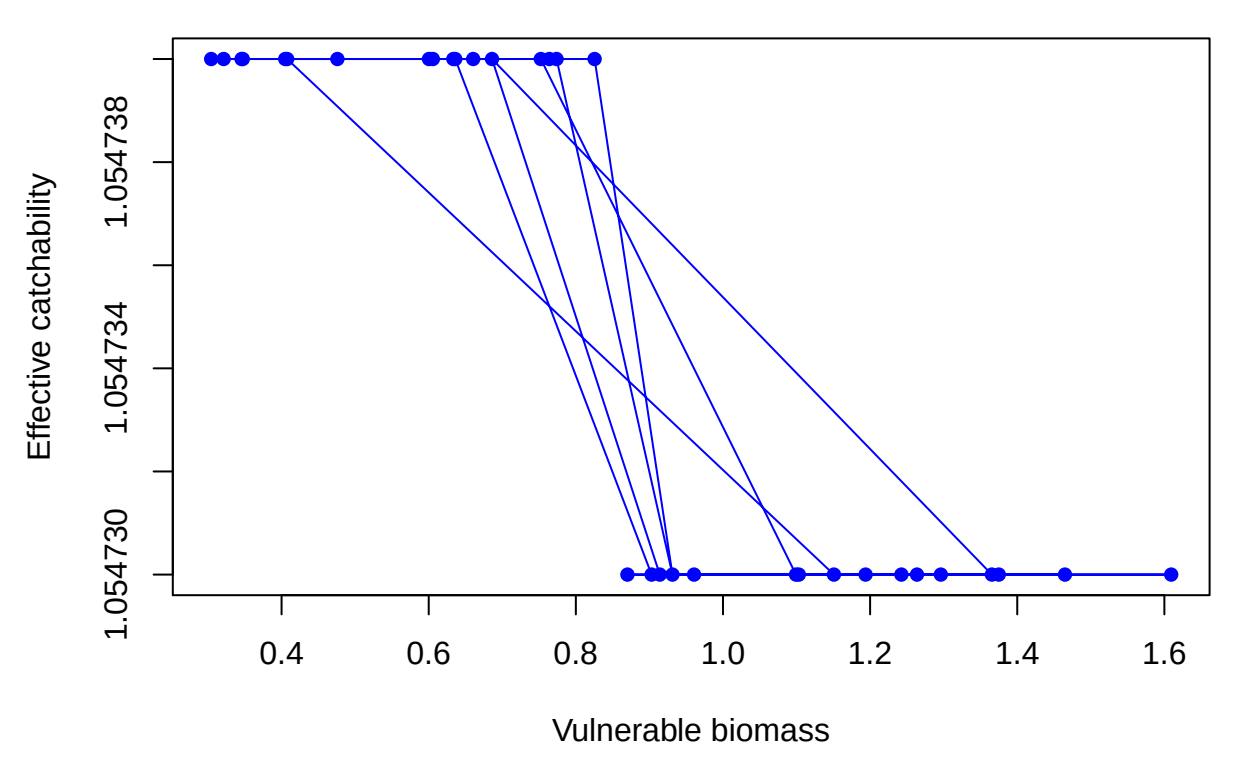

Index
0
5
10
15
20
1990
1995
2000
2005
2010
2015
2020
Year

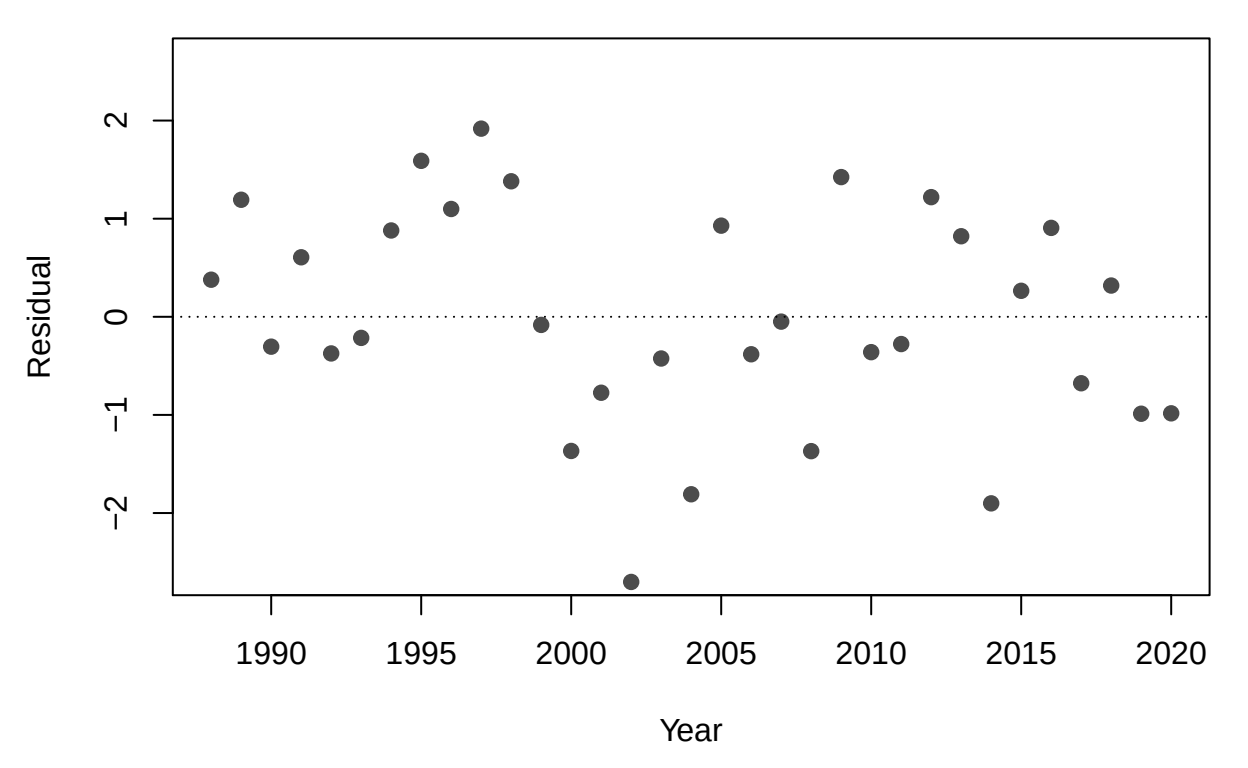

Expected index
0.0
0.5
1.0
1.5
Observed index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5

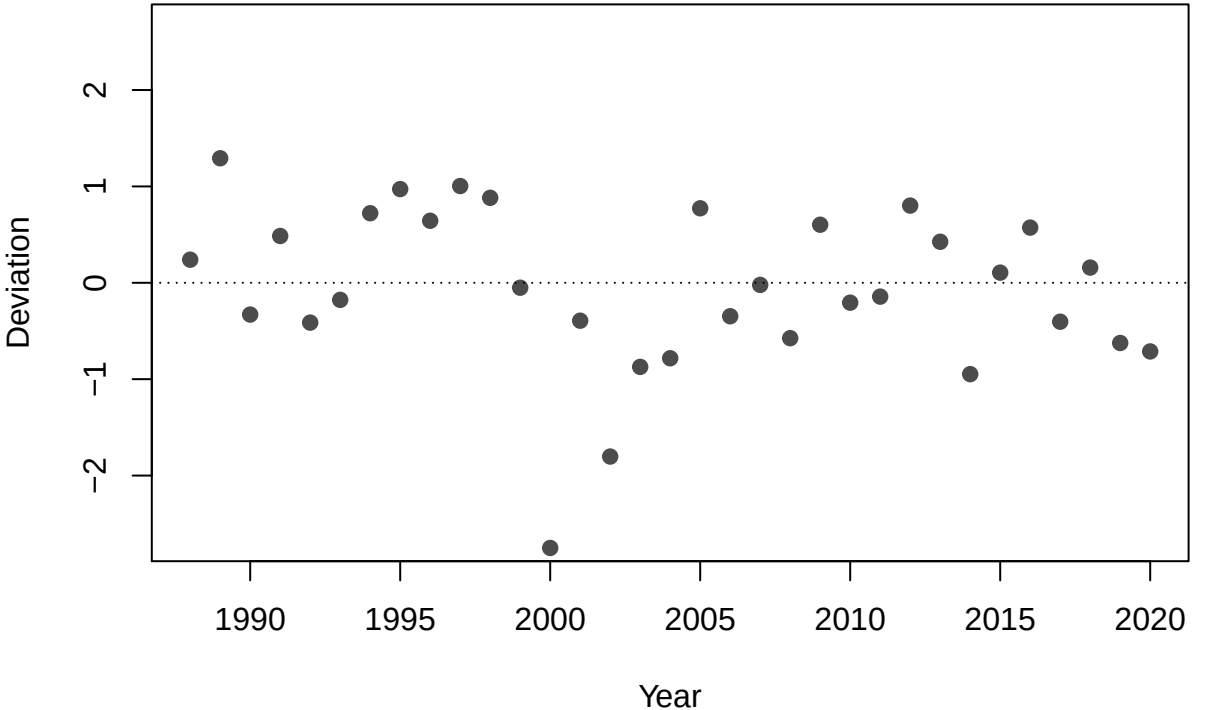

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

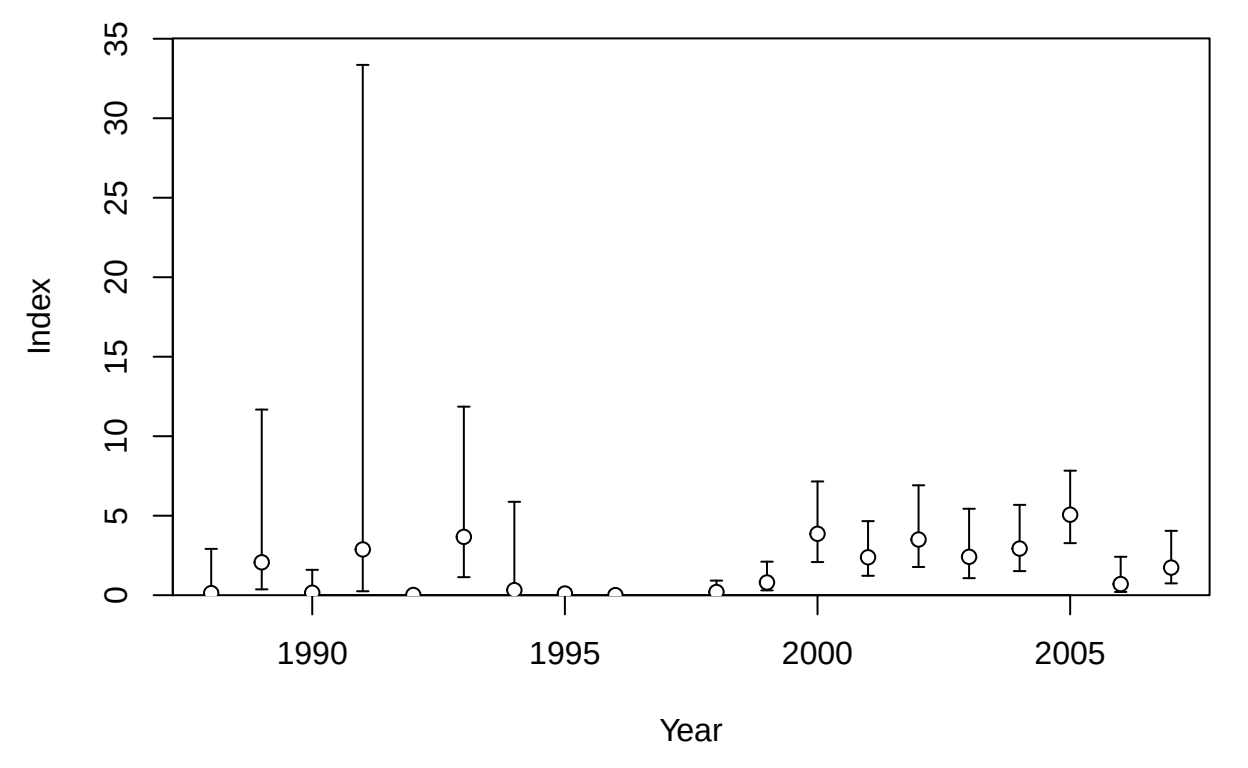

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

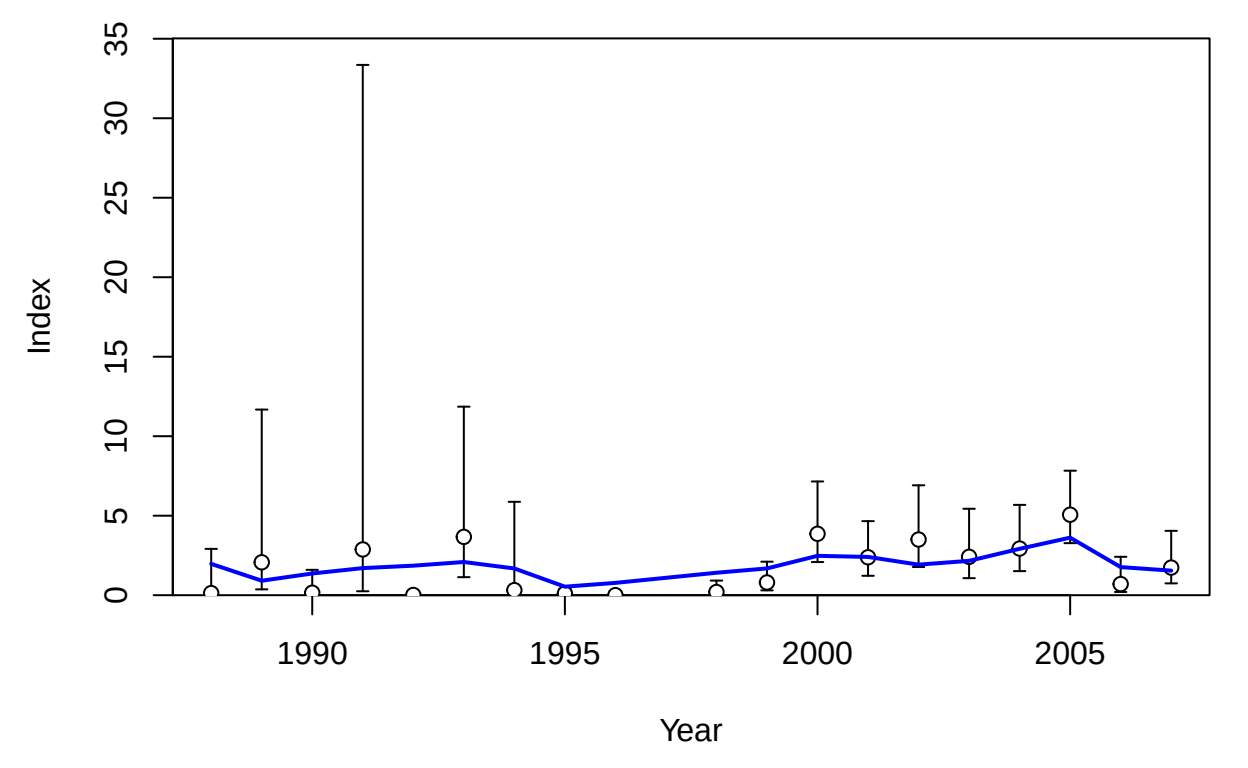

Log expected index
0.5
0.0
−0.5
−1.0
−2
−1
0
1
Log observed index

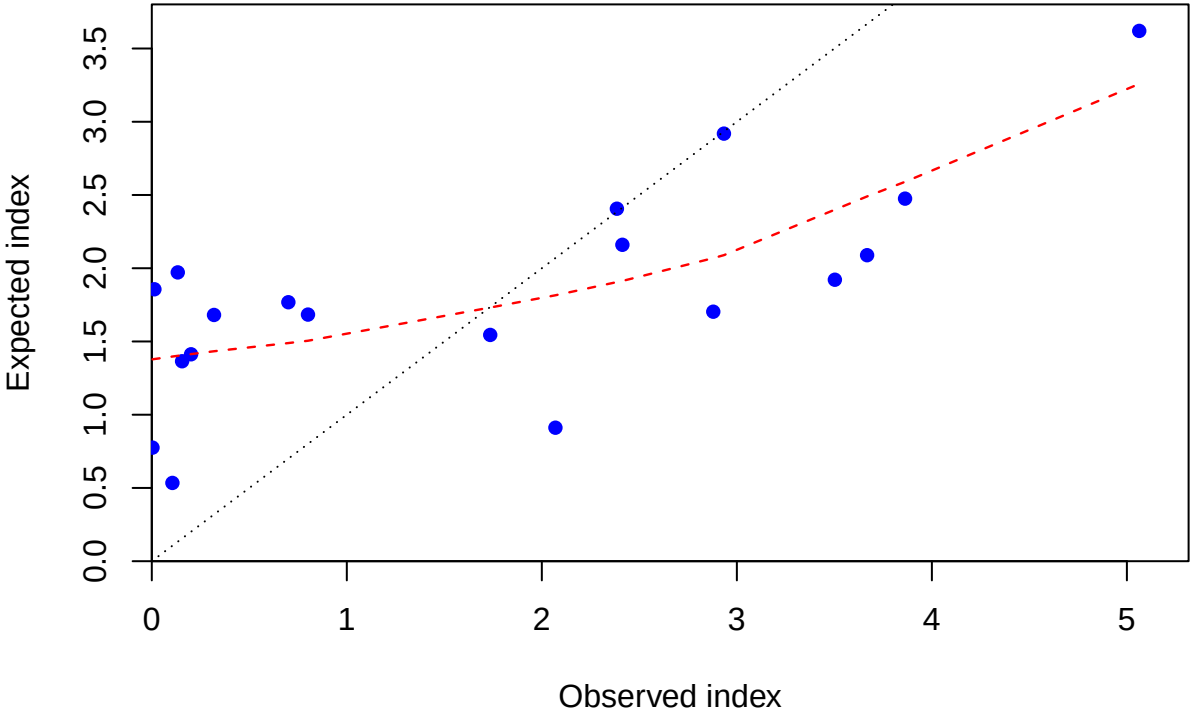

Effective catchability
1.054730
1.054734
1.054738
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Vulnerable biomass

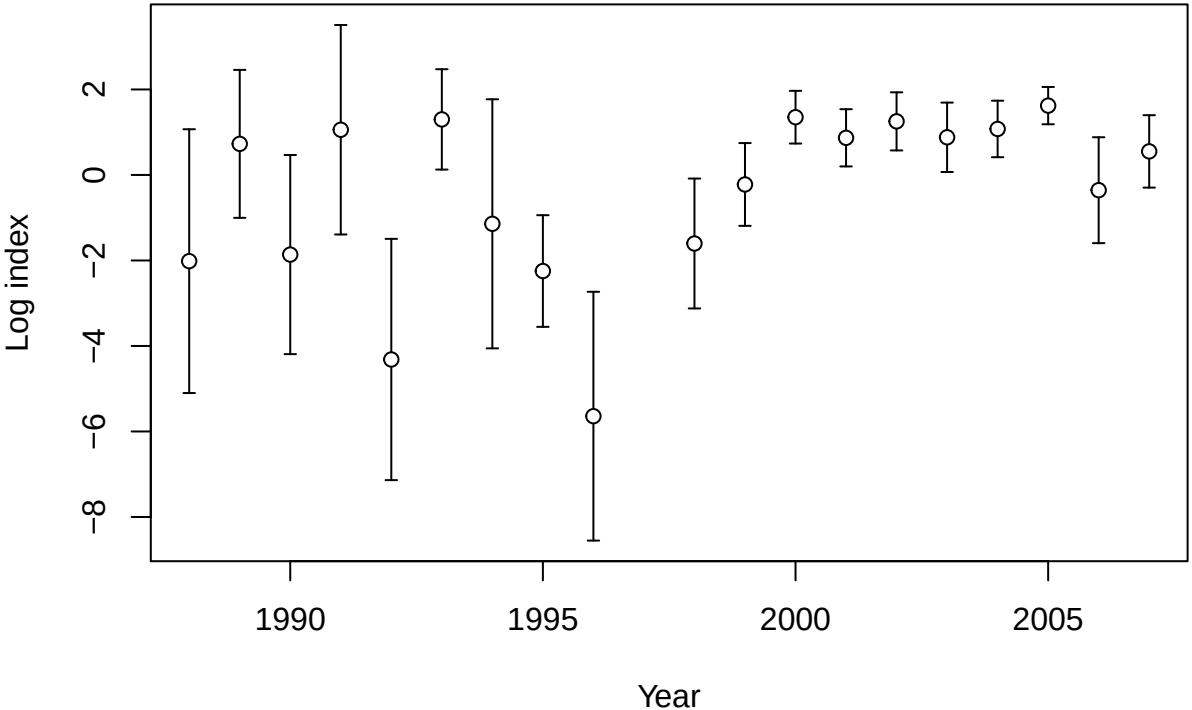

Residual
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

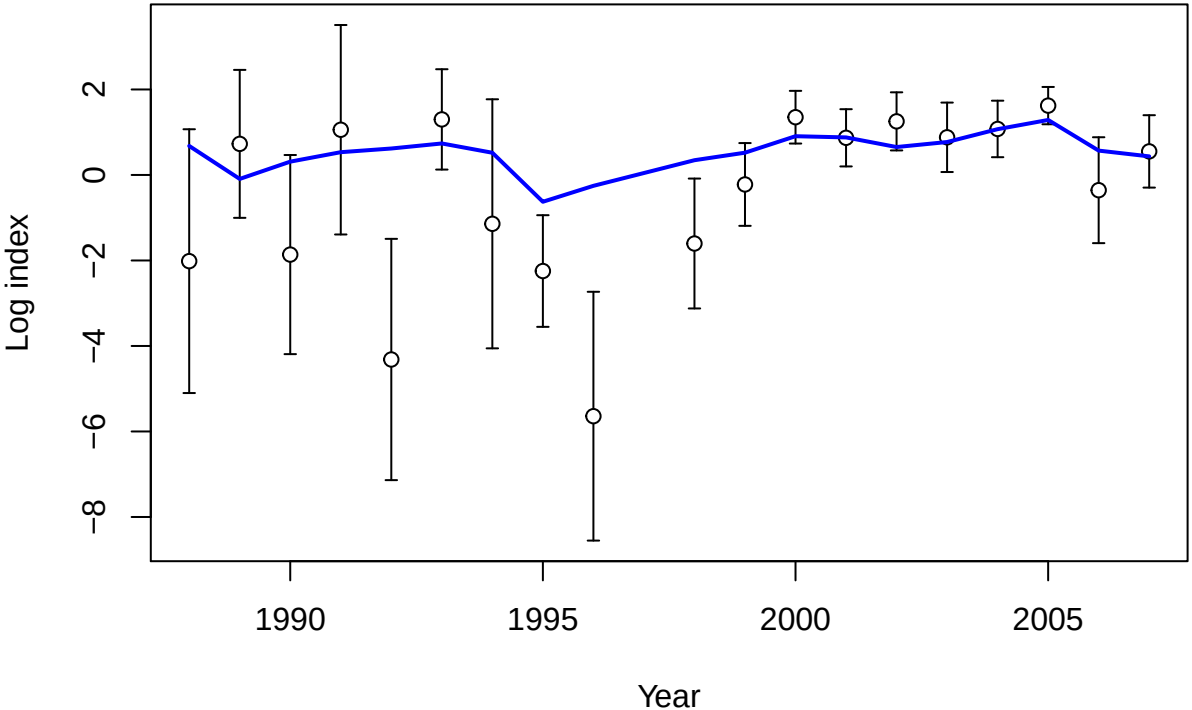

Deviation
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

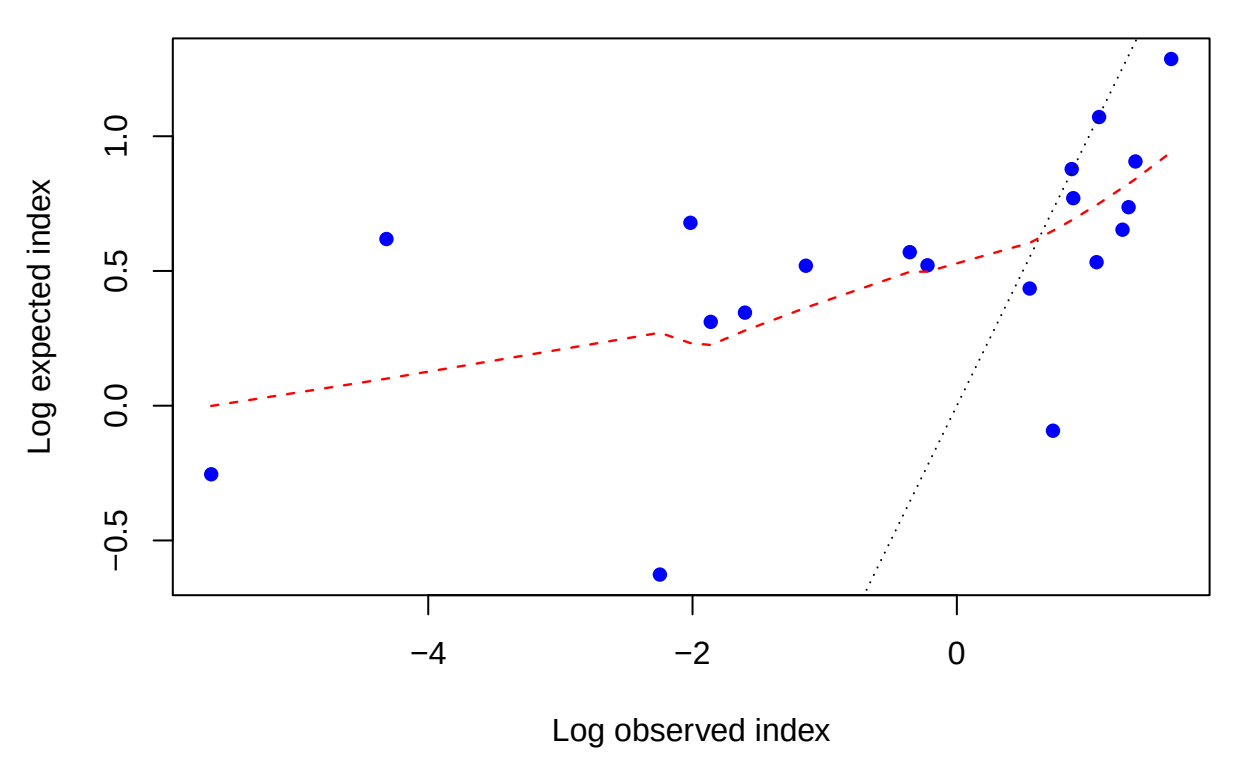

Index
0
5
10
15
20
25
30
35
1990
1995
2000
2005
Year

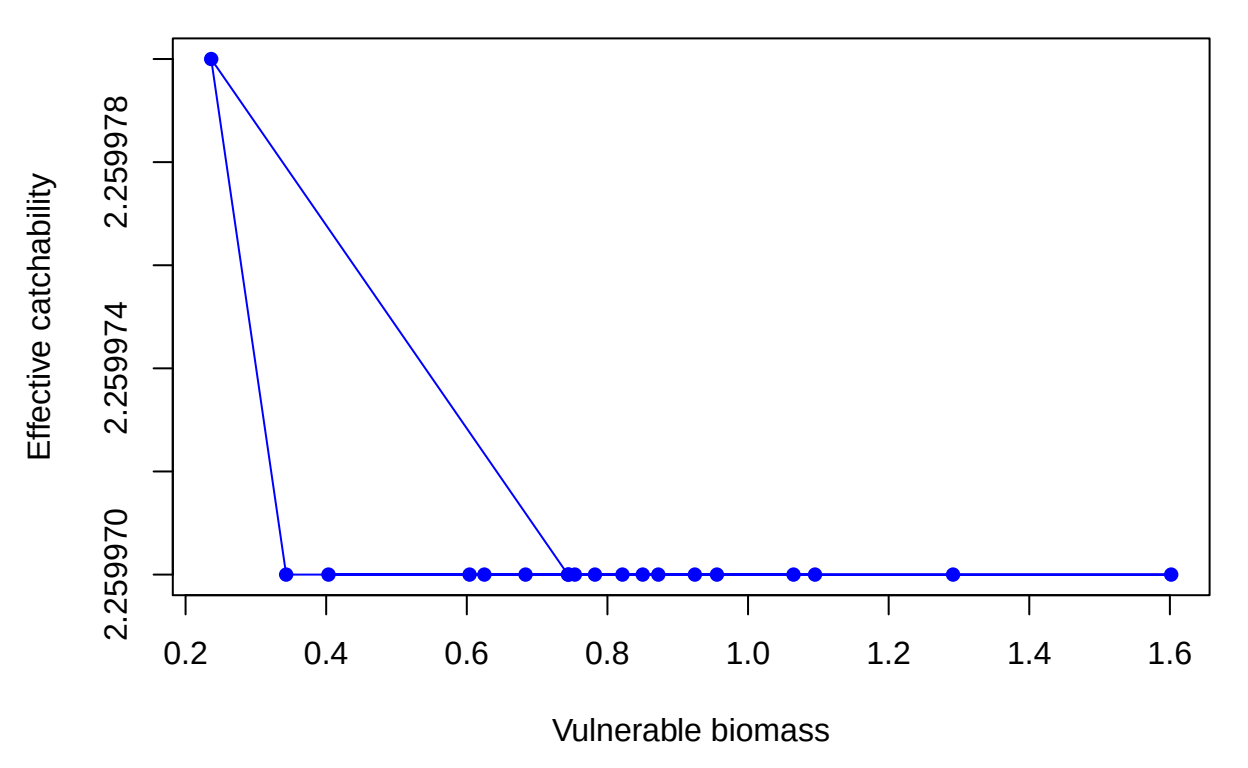

Index
0
5
10
15
20
25
30
35
1990
1995
2000
2005
Year

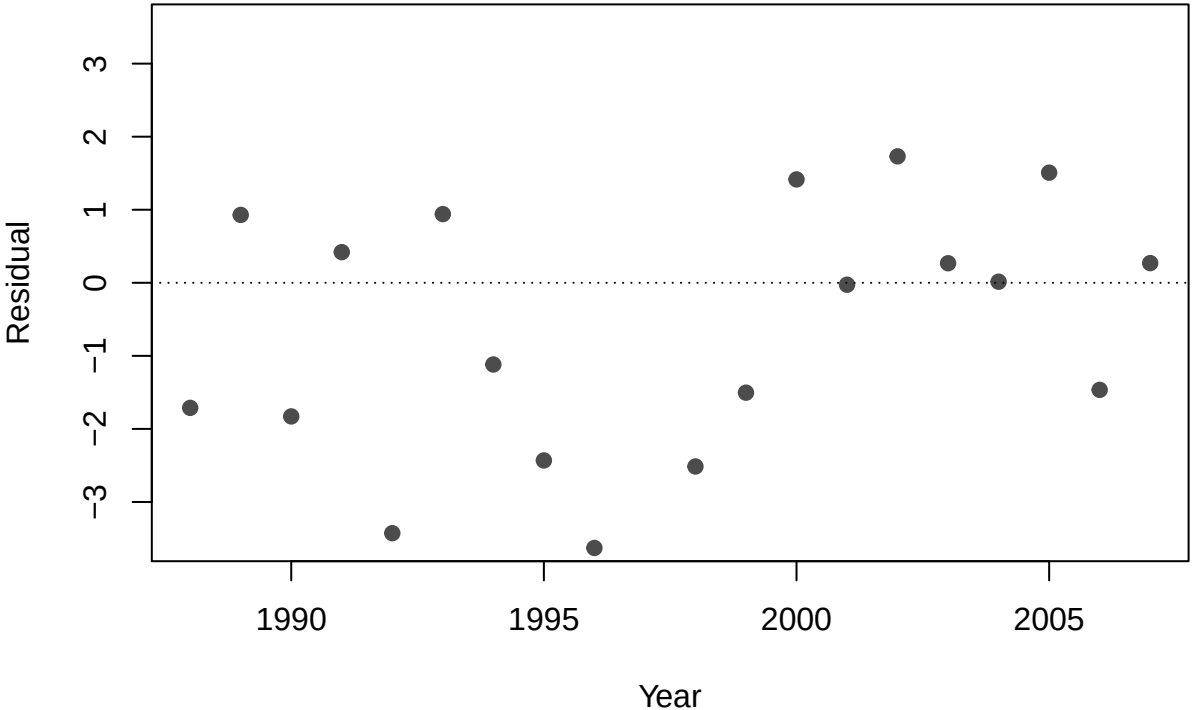

Expected index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
1
2
3
4
5
Observed index

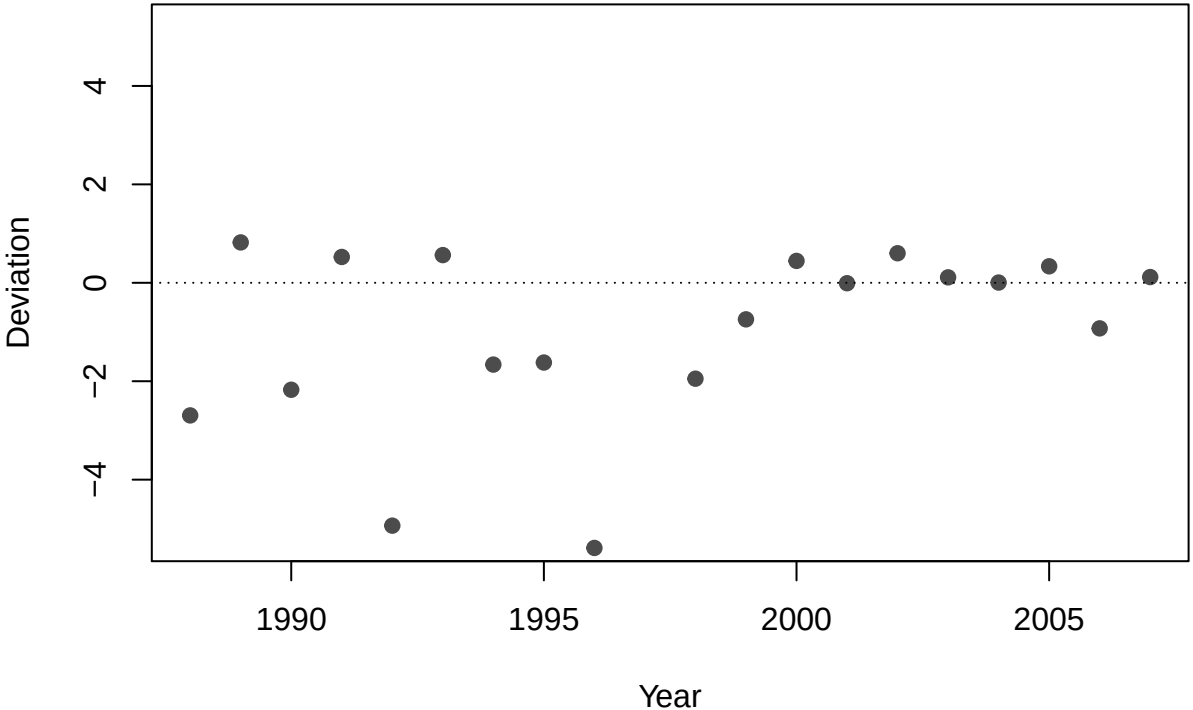

Log index
2
0
−2
−4
−6
−8
1990
1995
2000
2005
Year

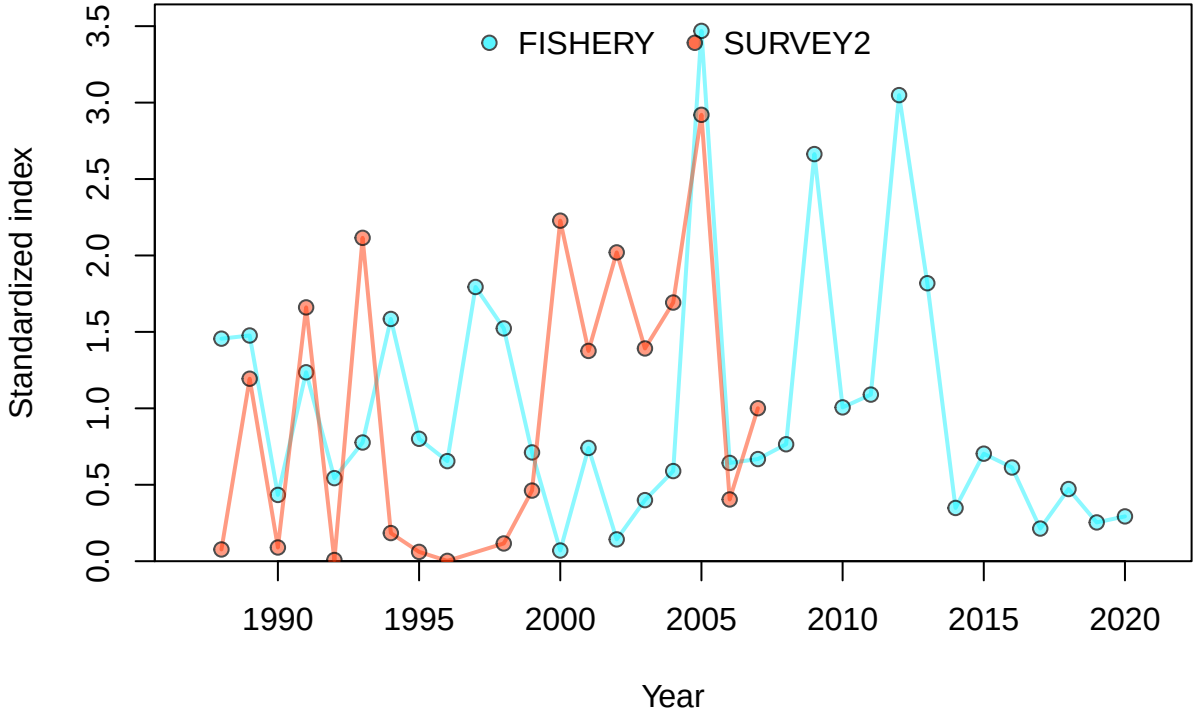

Log index
2
0
−2
−4
−6
−8
1990
1995
2000
2005
Year

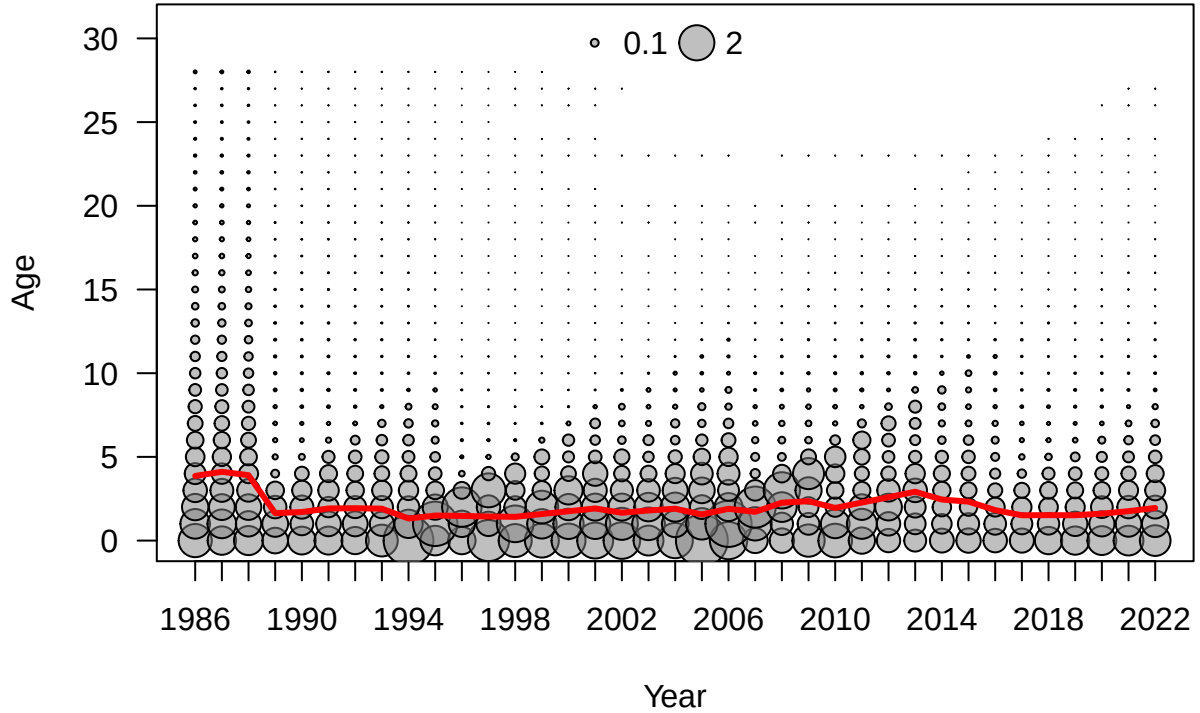

Log expected index
1.0
0.5
0.0
−0.5
−4
−2
0
Log observed index

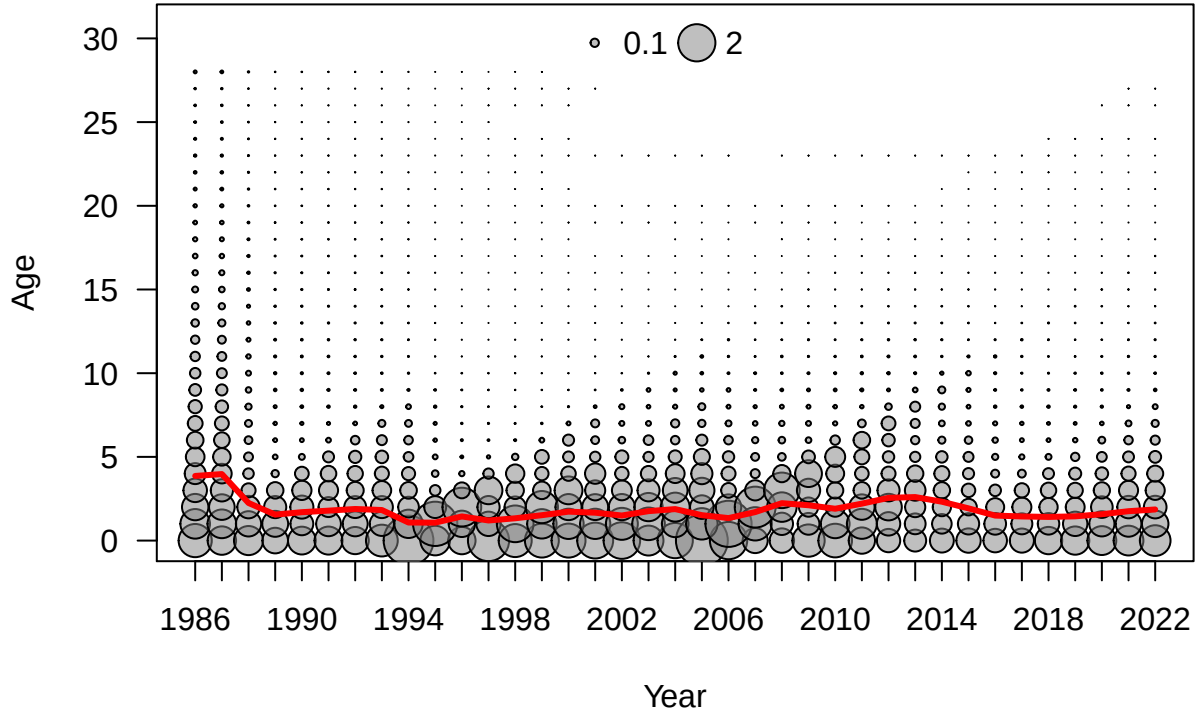

Effective catchability
2.259978
2.259974
2.259970
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Vulnerable biomass

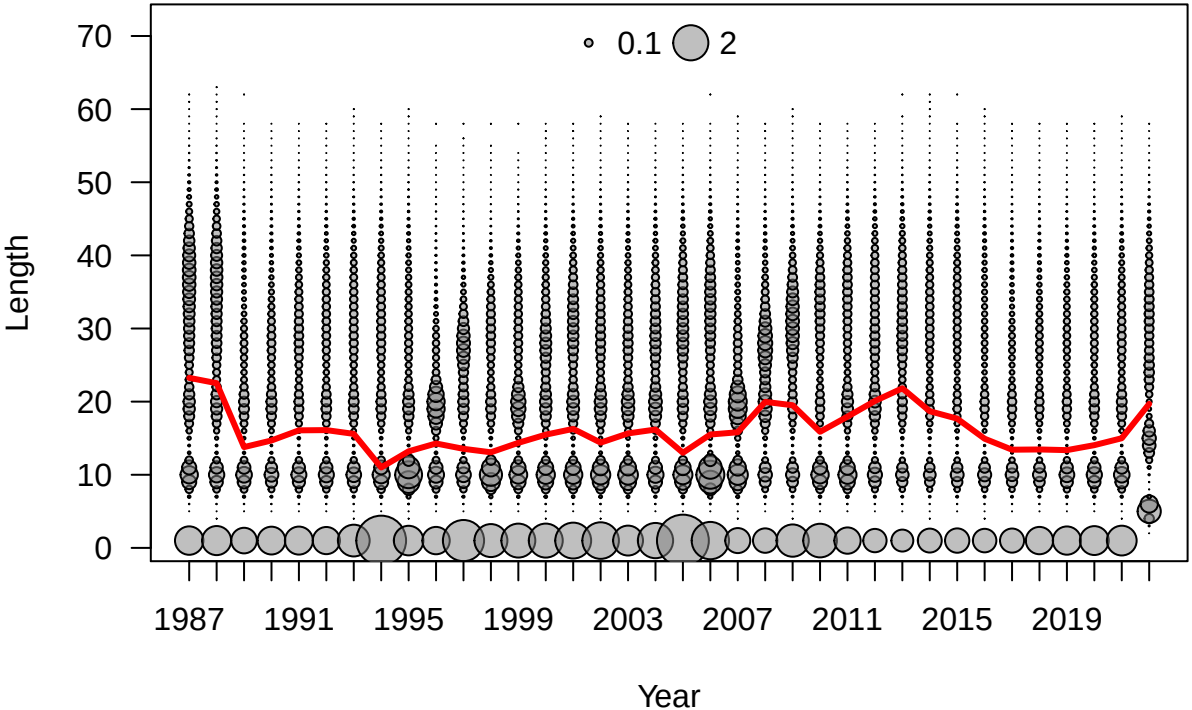

Residual
3
2
1
0
−1
−2
−3
1990
1995
2000
2005
Year

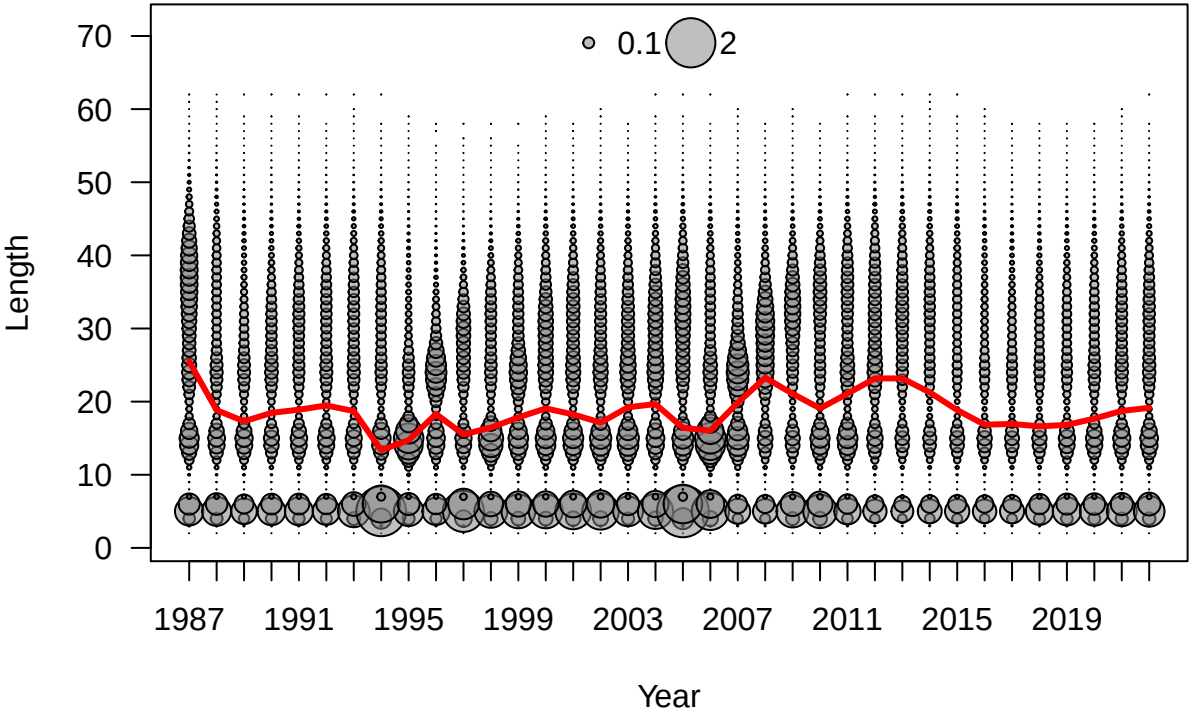

Deviation
4
2
0
−2
−4
1990
1995
2000
2005
Year

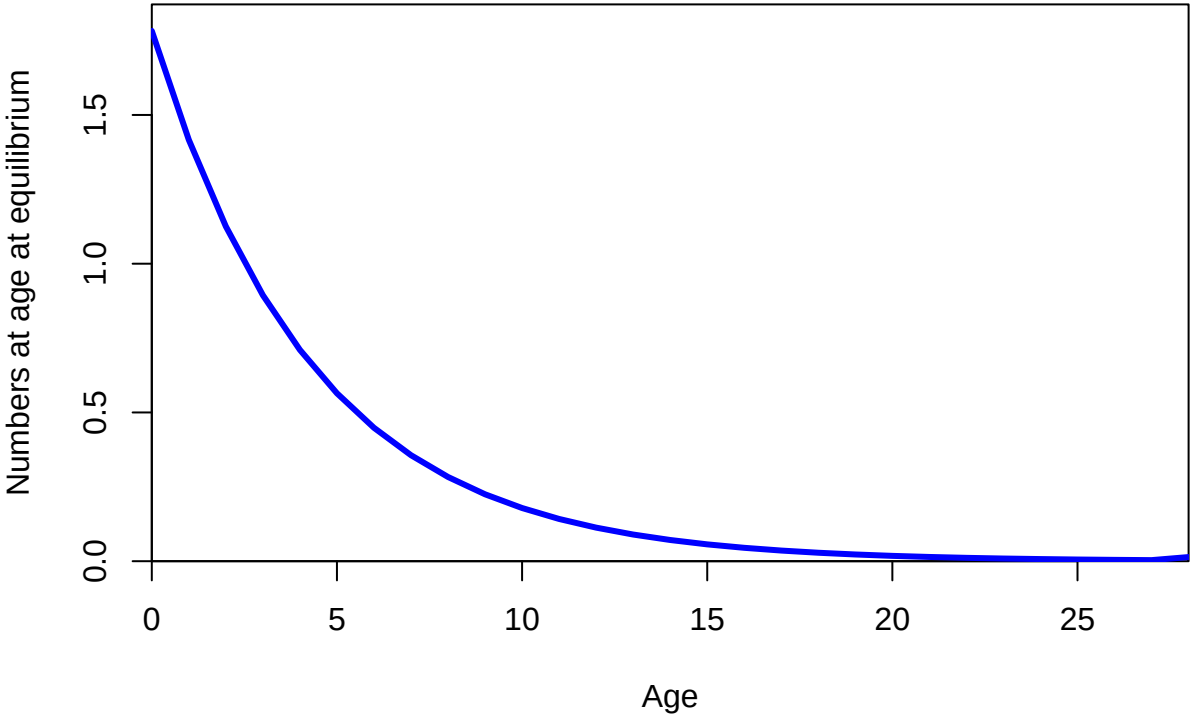

FISHERY
SURVEY2
Standardized index
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1990
1995
2000
2005
2010
2015
2020
Year

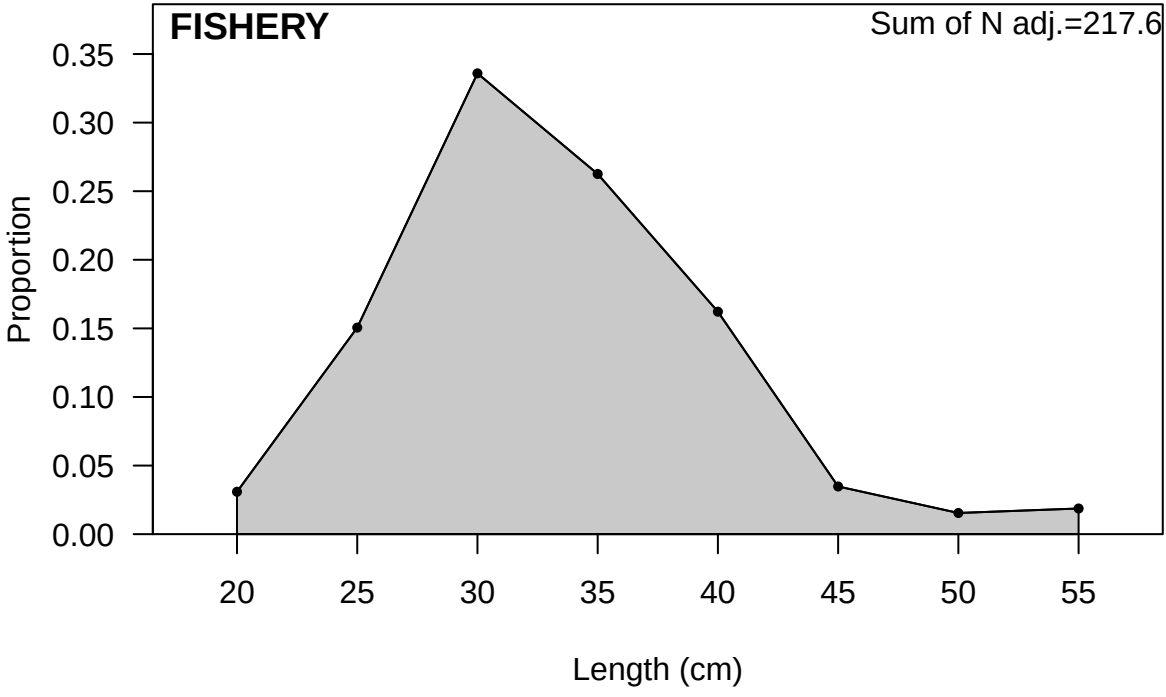

0.1
2
Age
Year
0
5
10
15
20
25
30
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022

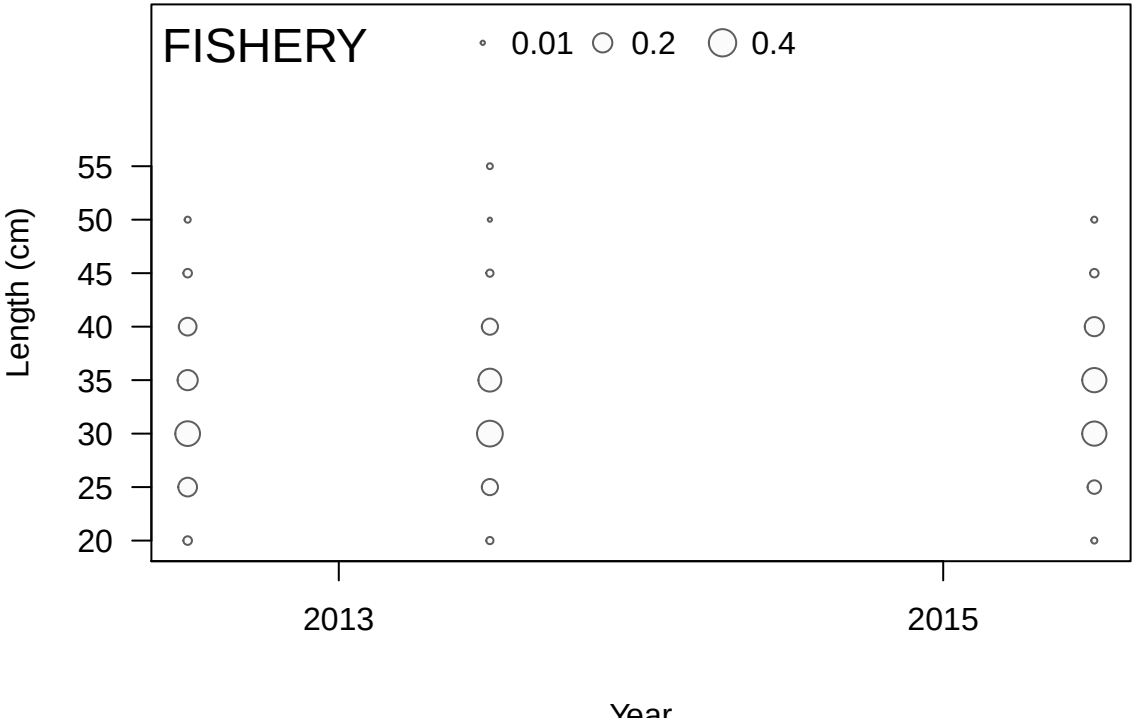

0.1
2
30
25
20
15
10
5
0
Age
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year

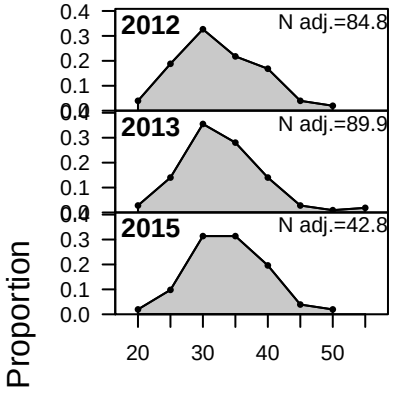

0.1
2
70
60
50
40
30
20
10
0
Length
1987
1991
1995
1999
2003
2007
2011
2015
2019
Year

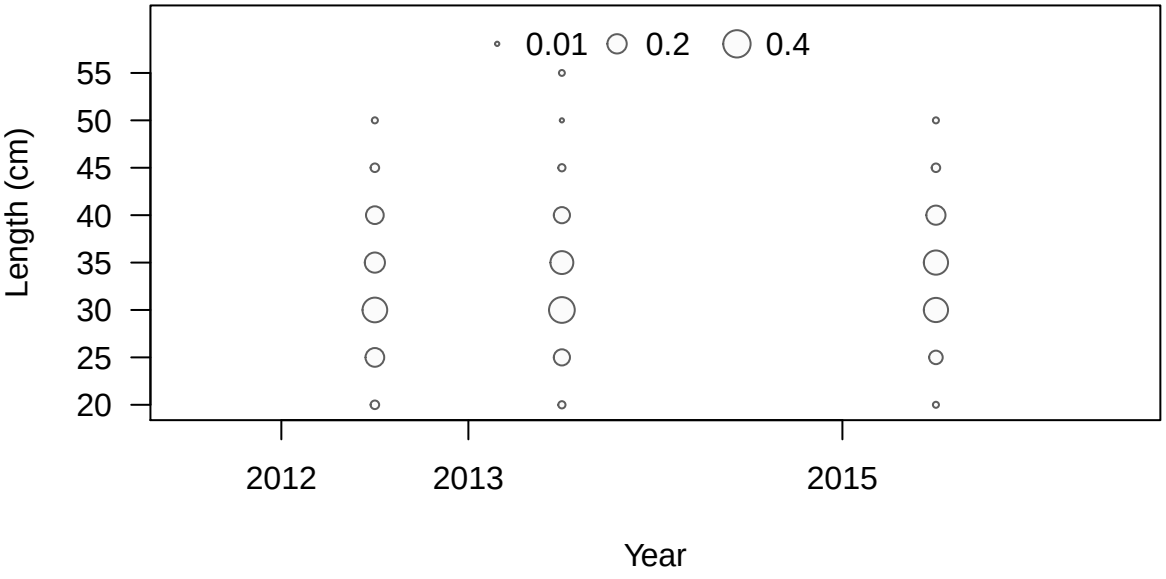

0.1
2
70
60
50
40
30
20
10
0
Length
1987
1991
1995
1999
2003
2007
2011
2015
2019
Year

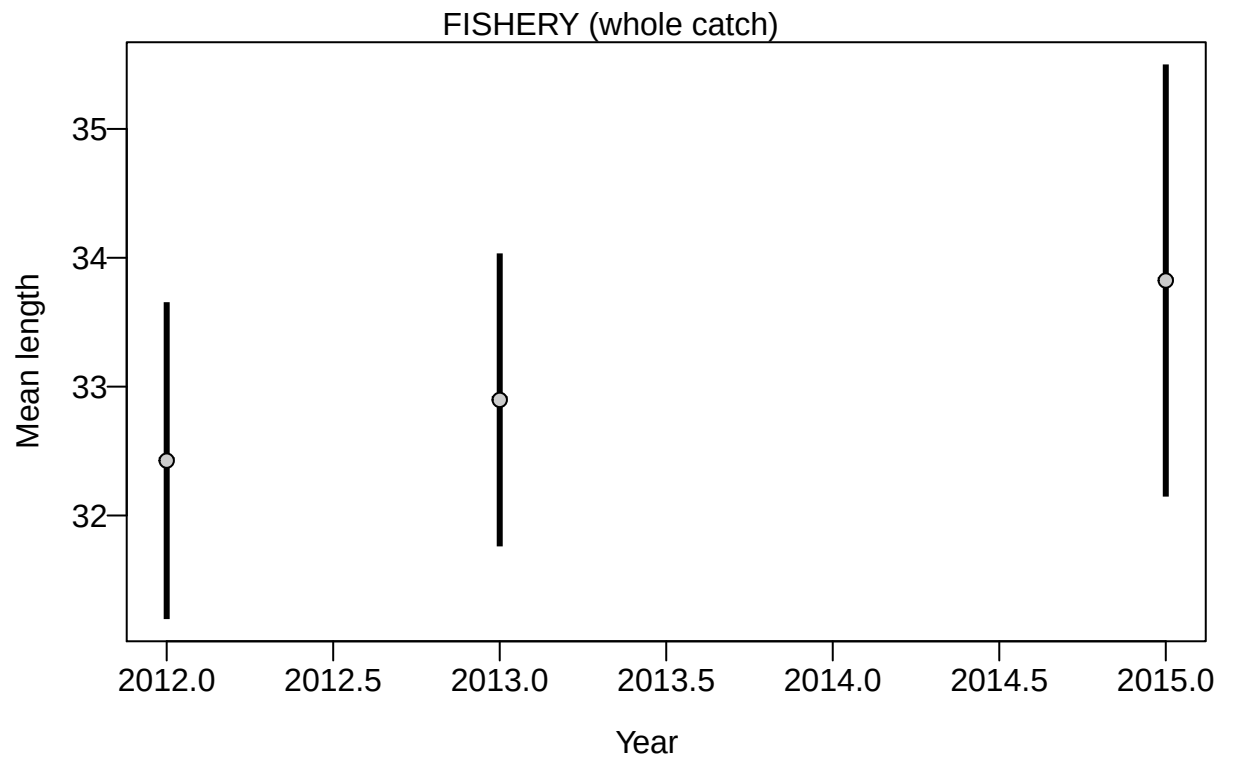

Numbers at age at equilibrium
0.0
0.5
1.0
1.5
0
5
10
15
20
25
Age

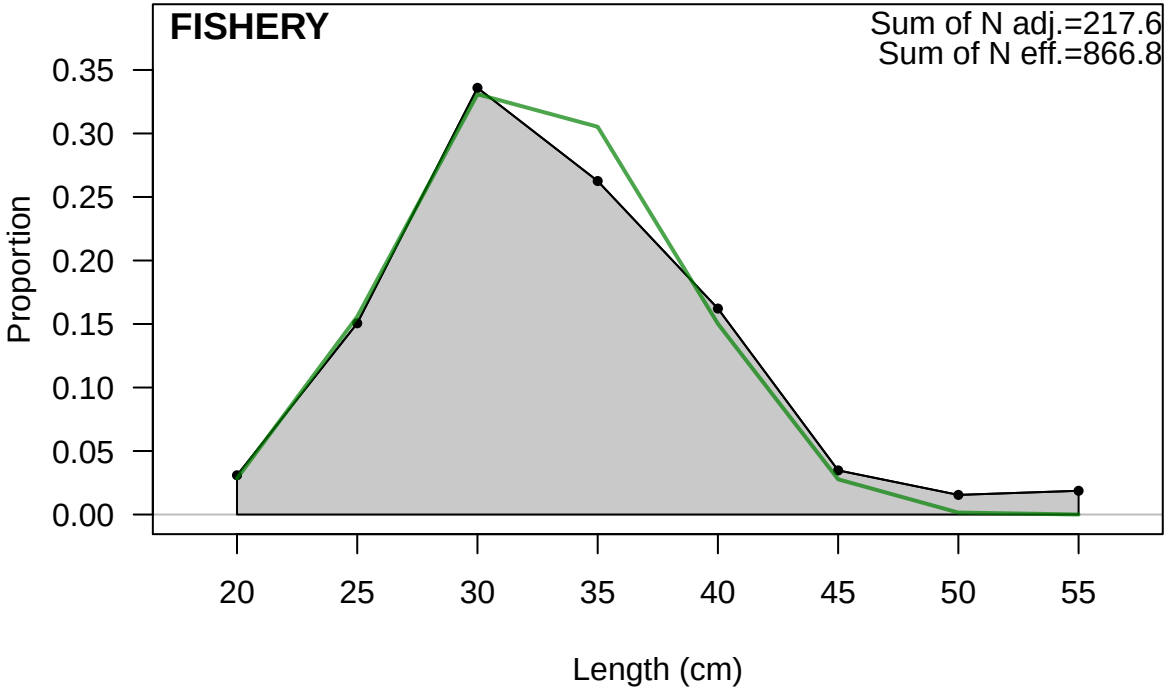

FISHERY
Sum of N adj.=217.6
Proportion
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
20
25
30
35
40
45
50
55
Length (cm)

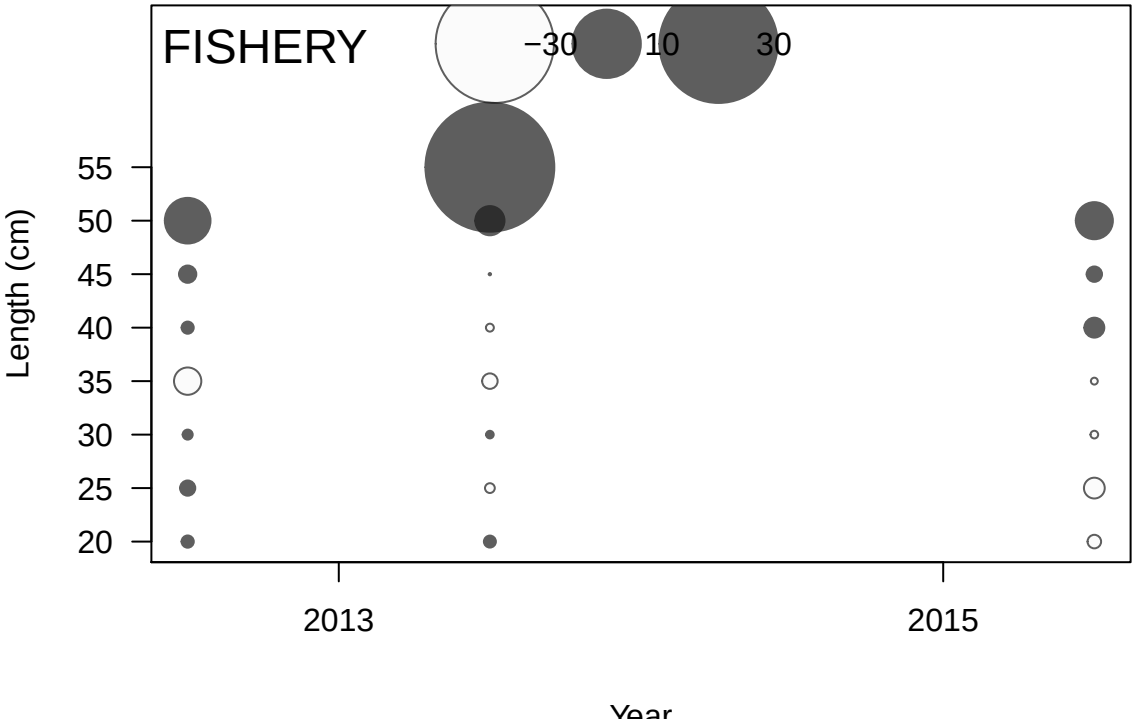

FISHERY
0.01
0.2
0.4
Length (cm)
55
50
45
40
35
30
25
20
2013
2015
Year

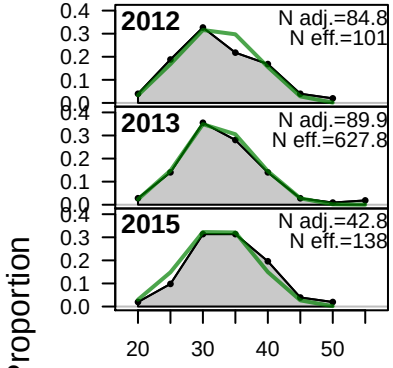

2012
N adj.=84.8
2013
N adj.=89.9
2015
N adj.=42.8
0.0
0.1
0.2
0.3
0.4
20
30
40
50
Proportion
Length (cm)

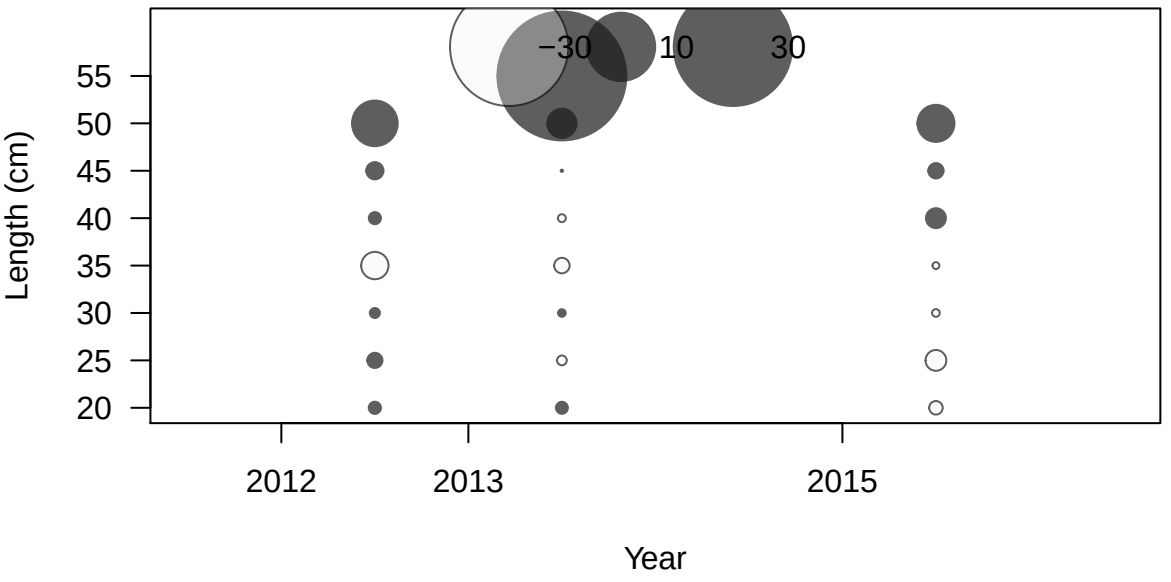

0.01
0.2
0.4
55
50
45
40
35
30
25
20
Length (cm)
2012
2013
2015
Year

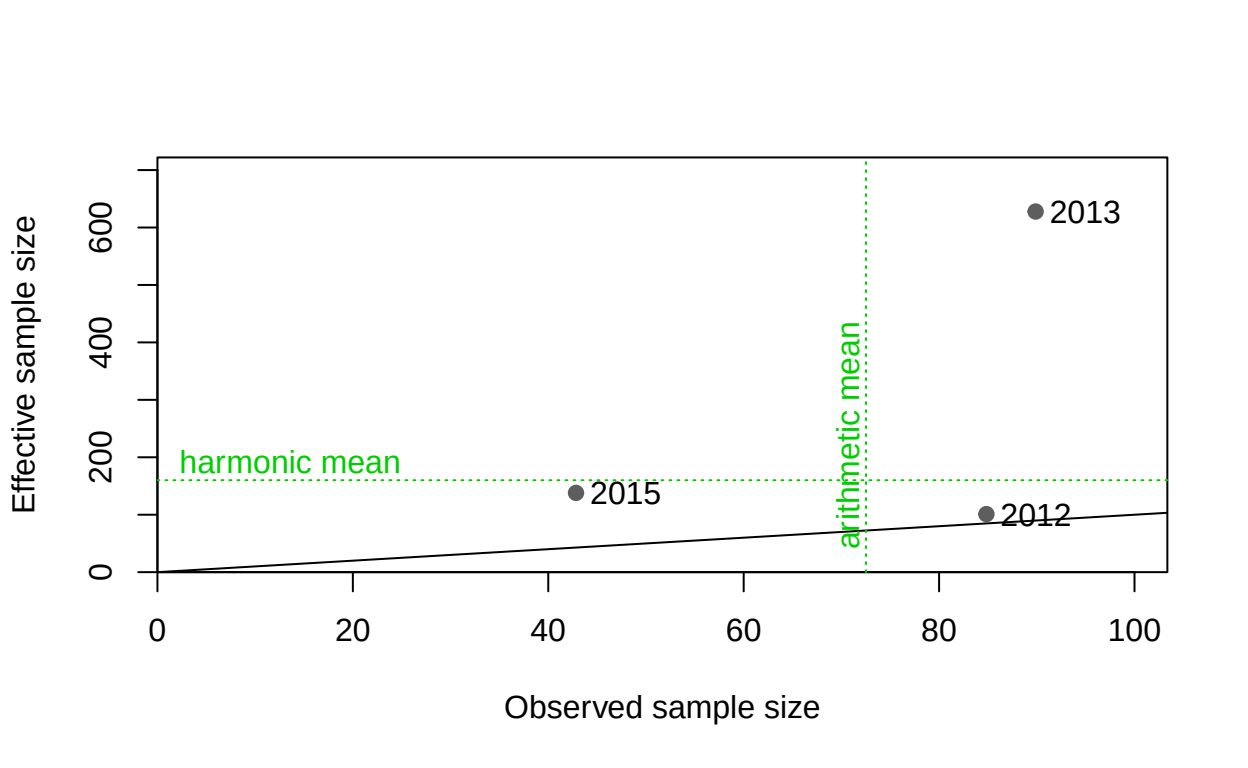

FISHERY (whole catch)
35
34
33
32
Mean length
2012.0
2012.5
2013.0
2013.5
2014.0
2014.5
2015.0
Year

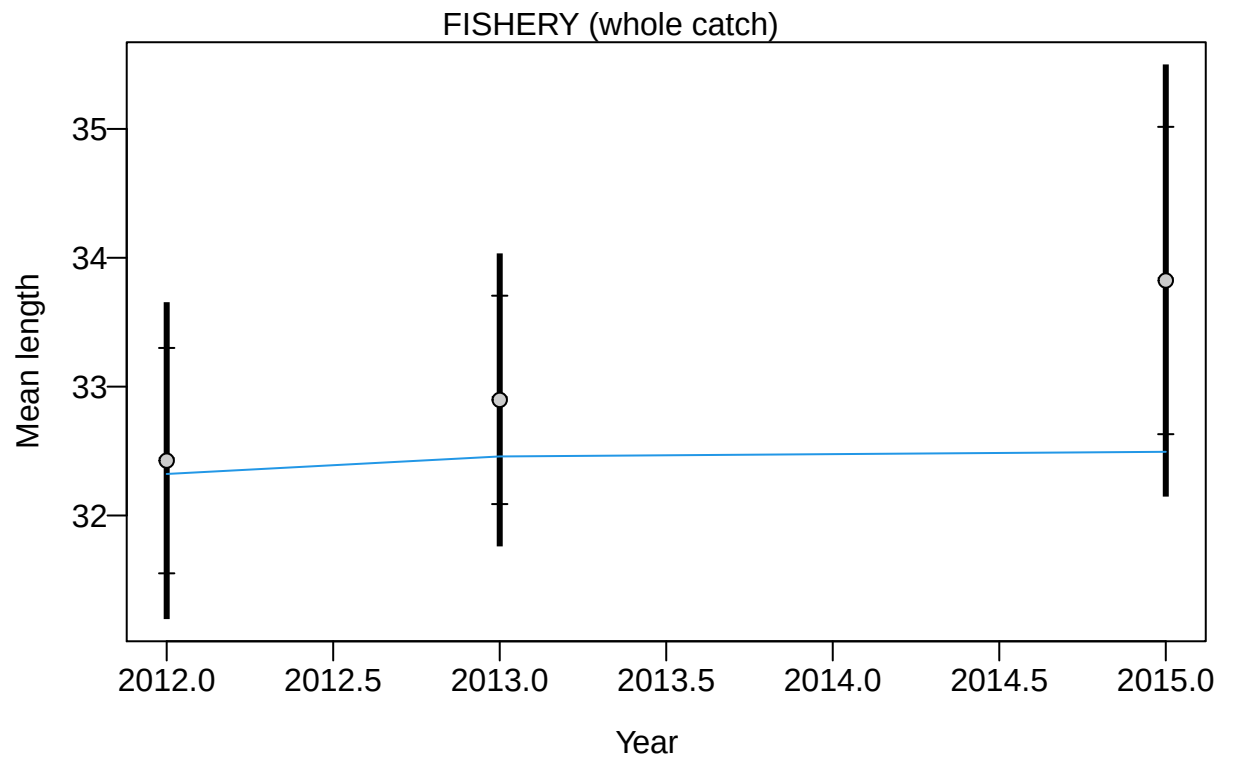

FISHERY
Sum of N adj.=217.6
Sum of N eff.=866.8
Proportion
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
20
25
30
35
40
45
50
55
Length (cm)

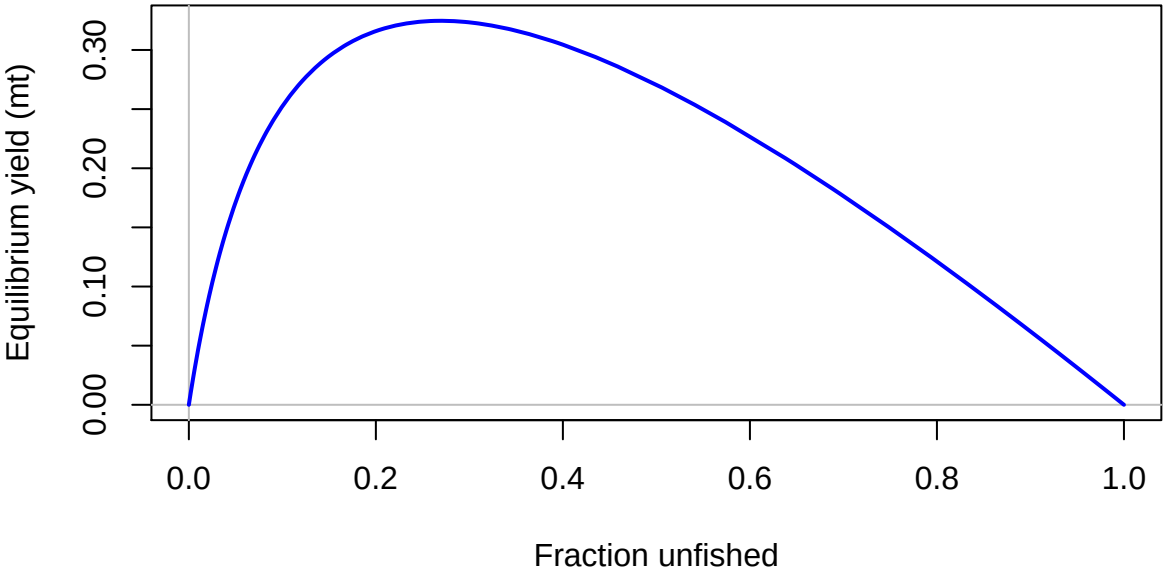

FISHERY
−30
10
30
55
50
45
40
35
30
25
20
Length (cm)
2013
2015
Year

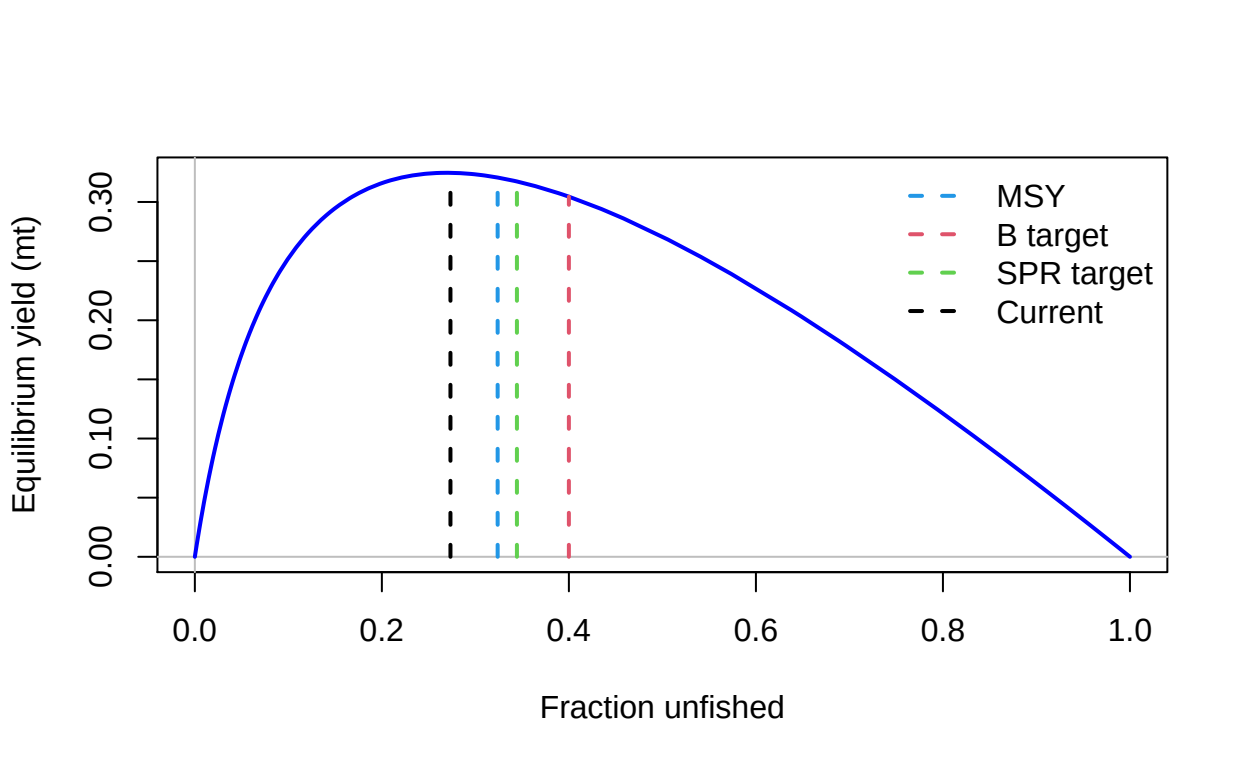

2012
N adj.=84.8
N eff.=101
2013
N adj.=89.9
N eff.=627.8
2015
N adj.=42.8
N eff.=138
0.0
0.1
0.2
0.3
0.4
20
30
40
50
Proportion
Length (cm)

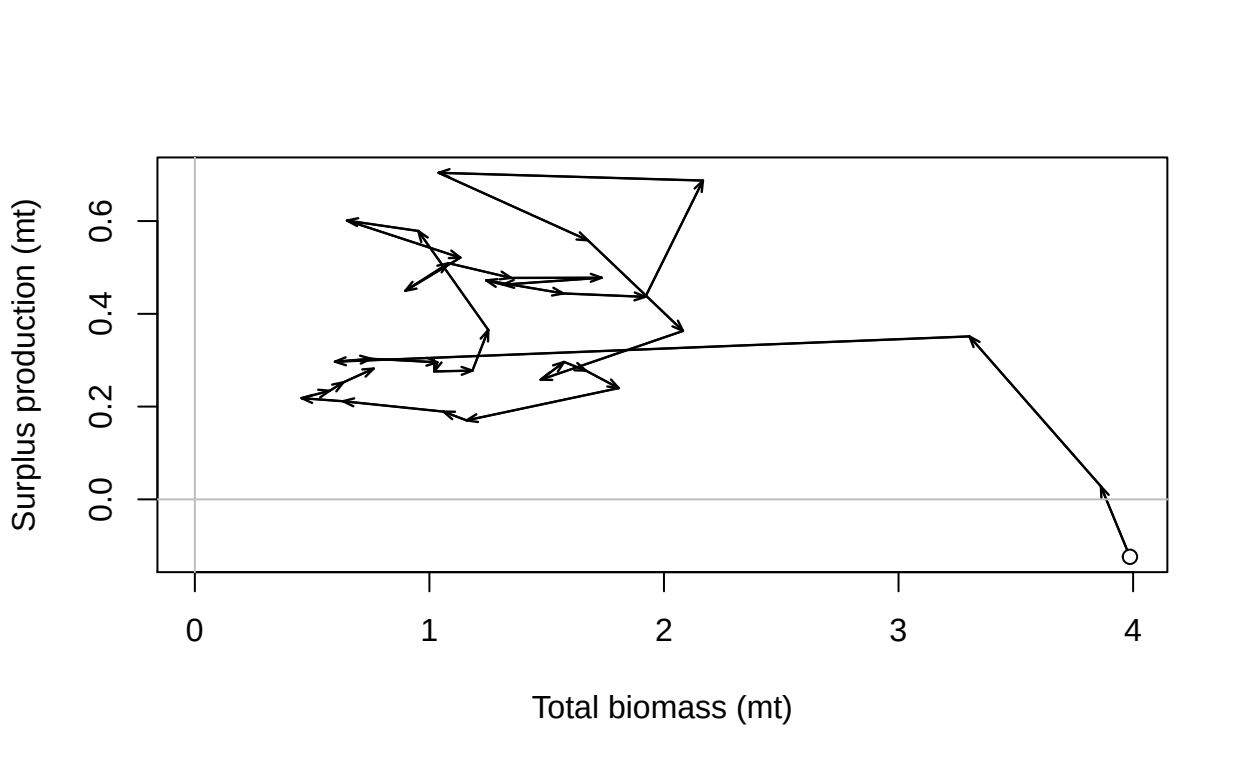

−30
10
30
55
50
45
40
35
30
25
20
Length (cm)
2012
2013
2015
Year

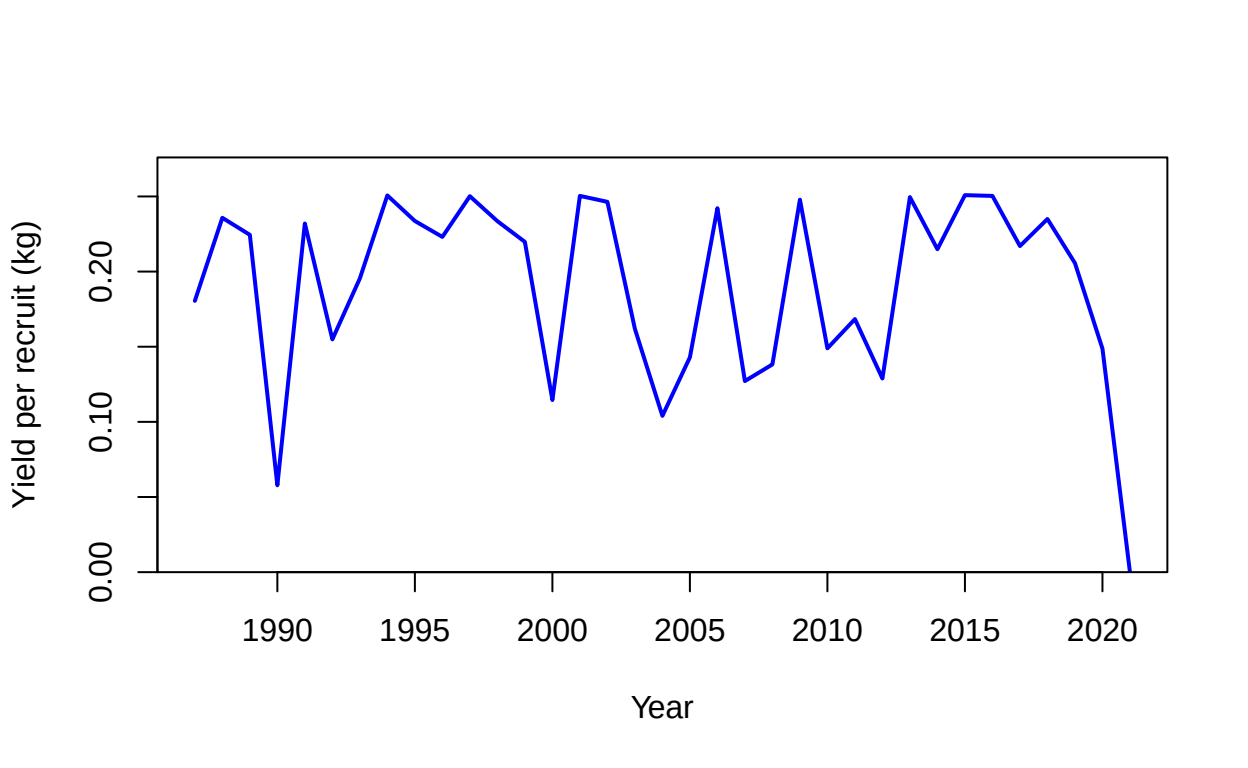

Effective sample size
0
200
400
600
0
20
40
60
80
100
Observed sample size
harmonic mean
arithmetic mean
2013
2015
2012

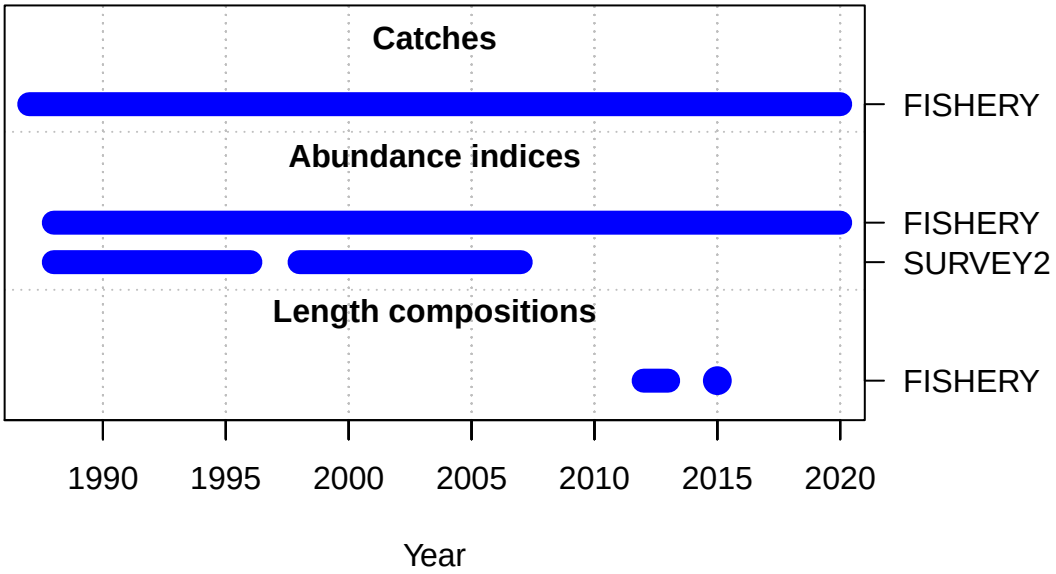

FISHERY (whole catch)
Mean length
35
34
33
32
2012.0
2012.5
2013.0
2013.5
2014.0
2014.5
2015.0
Year

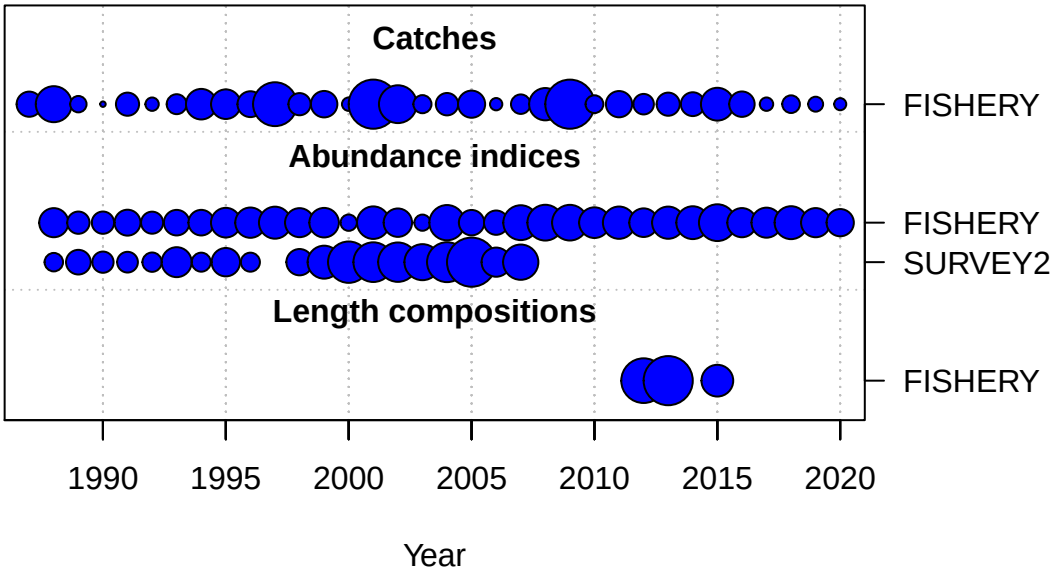

Equilibrium yield (mt)
0.00
0.10
0.20
0.30
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

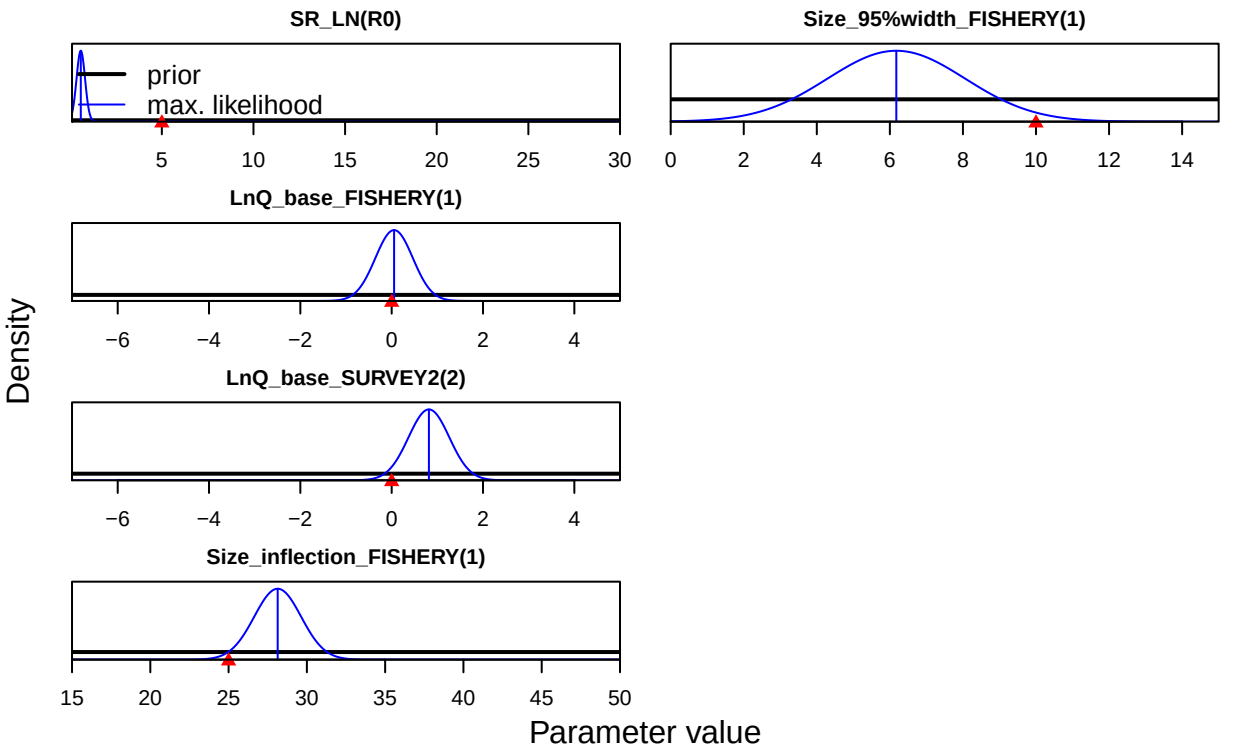

Equilibrium yield (mt)
0.00
0.10
0.20
0.30
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0.0
0.2
0.4
0.6
0
1
2
3
4
Total biomass (mt)


Yield per recruit (kg)
0.00
0.10
0.20
1990
1995
2000
2005
2010
2015
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1990
1995
2000
2005
2010
2015
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1990
1995
2000
2005
2010
2015
2020
Year


SR_LN(R0)
prior
max. likelihood
5
10
15
20
25
30
Size_95%width_FISHERY(1)
0
2
4
6
8
10
12
14
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
45
50
Density
Parameter value