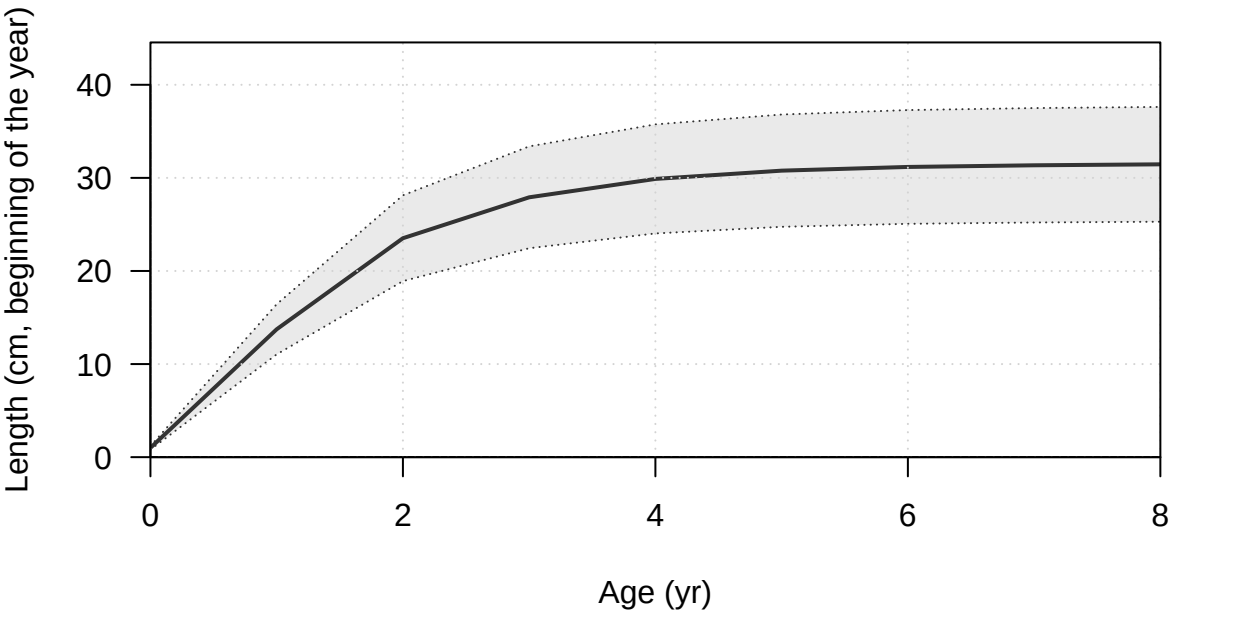
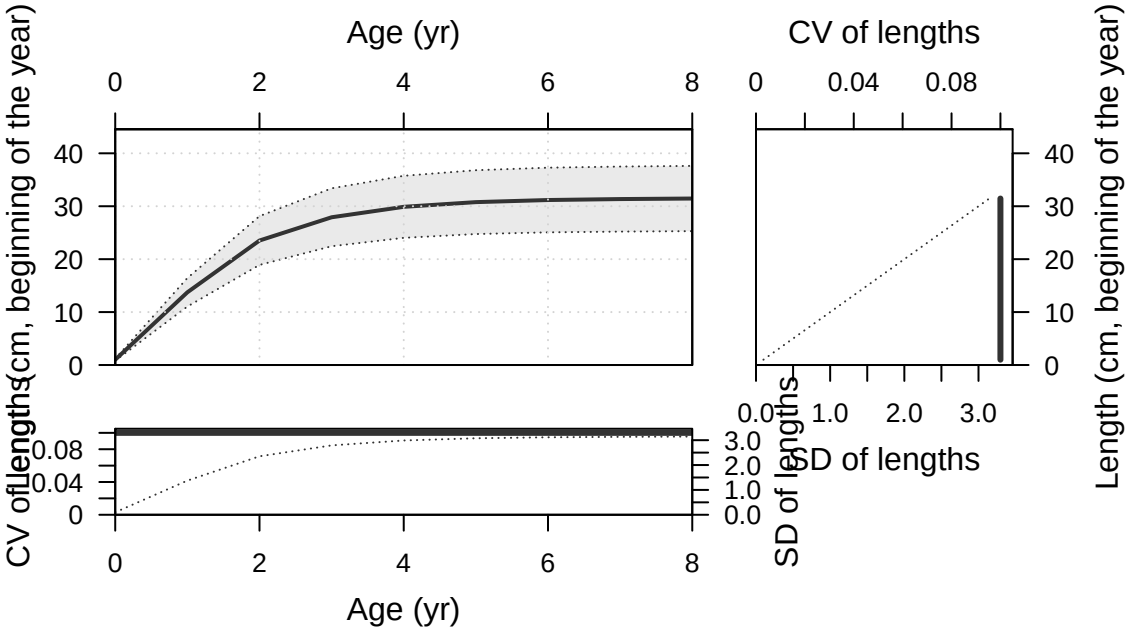
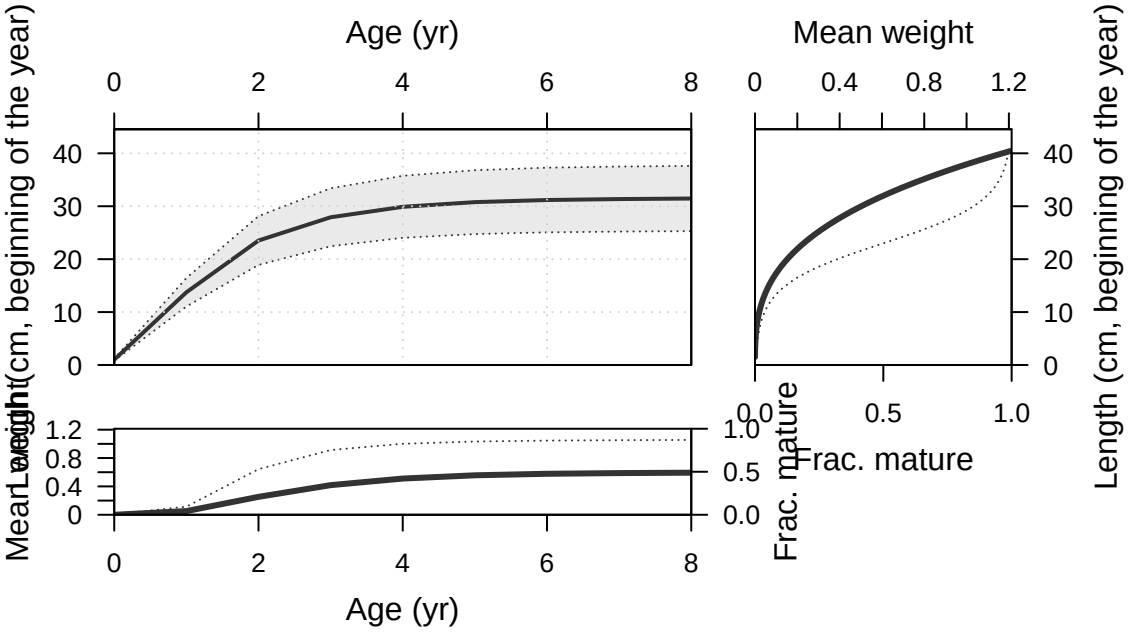
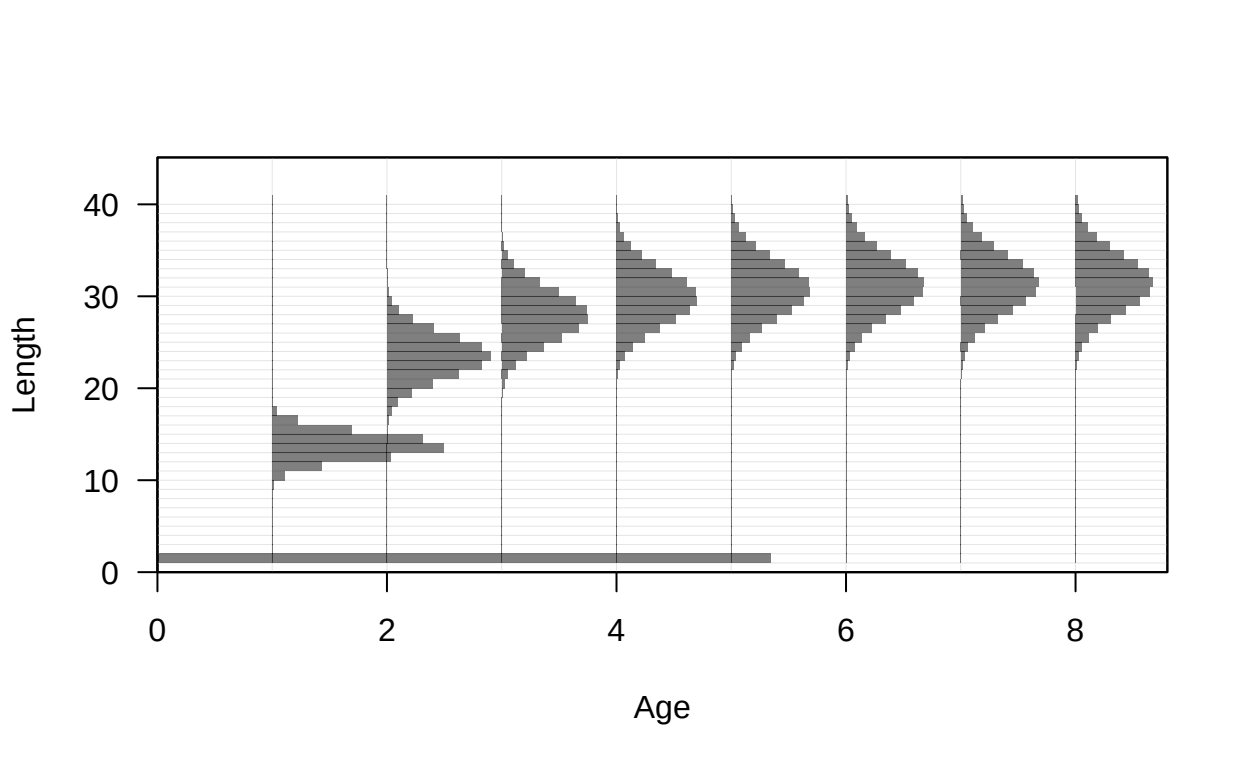
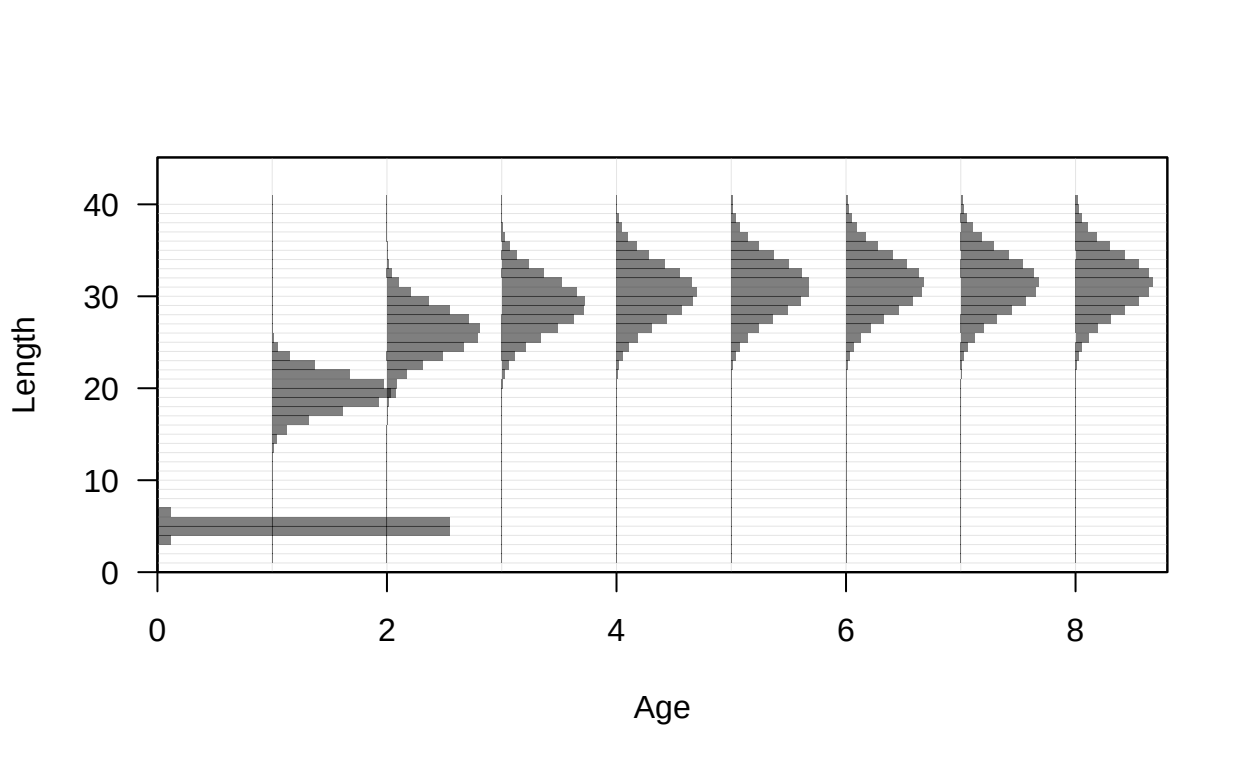
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Wed Jul 13 12:53:34 2022
Data_File: data.ss
Control_File: control.ss

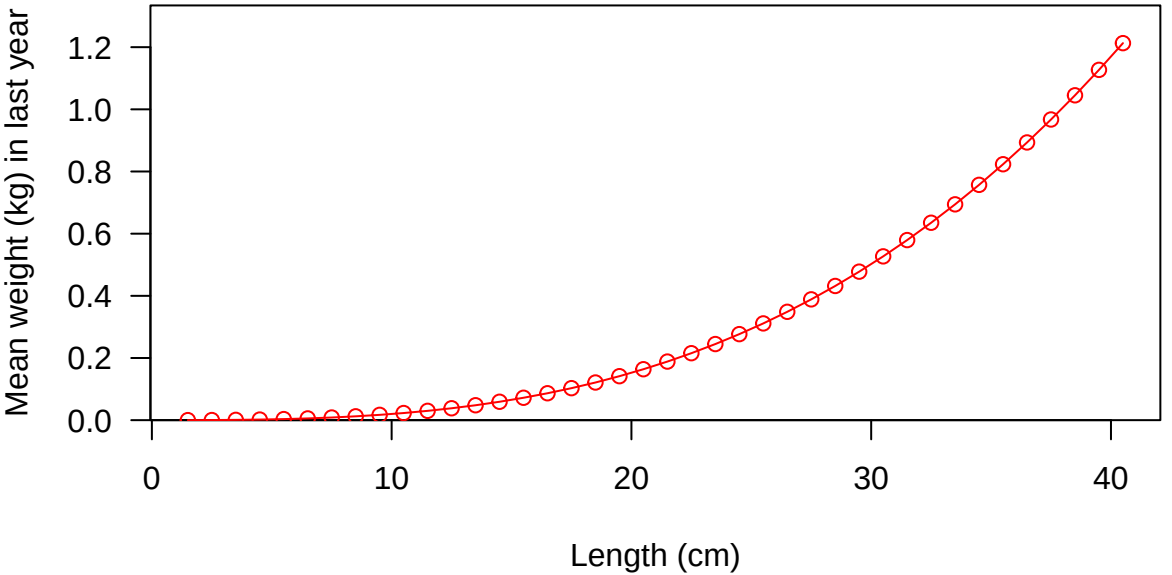

Length (cm, beginning of the year)
0
10
20
30
40
0
2
4
6
8
Age (yr)

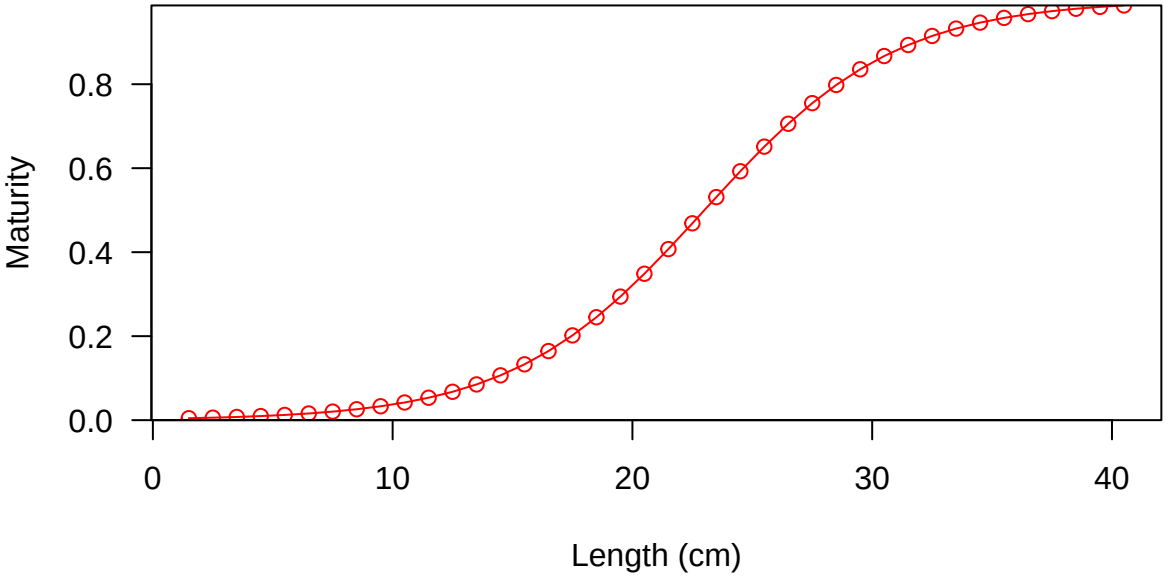

Age (yr)
0
2
4
6
8
Length (cm, beginning of the year)
0
10
20
30
40
CV of lengths
0
0.04
0.08
SD of lengths
0.0
1.0
2.0
3.0

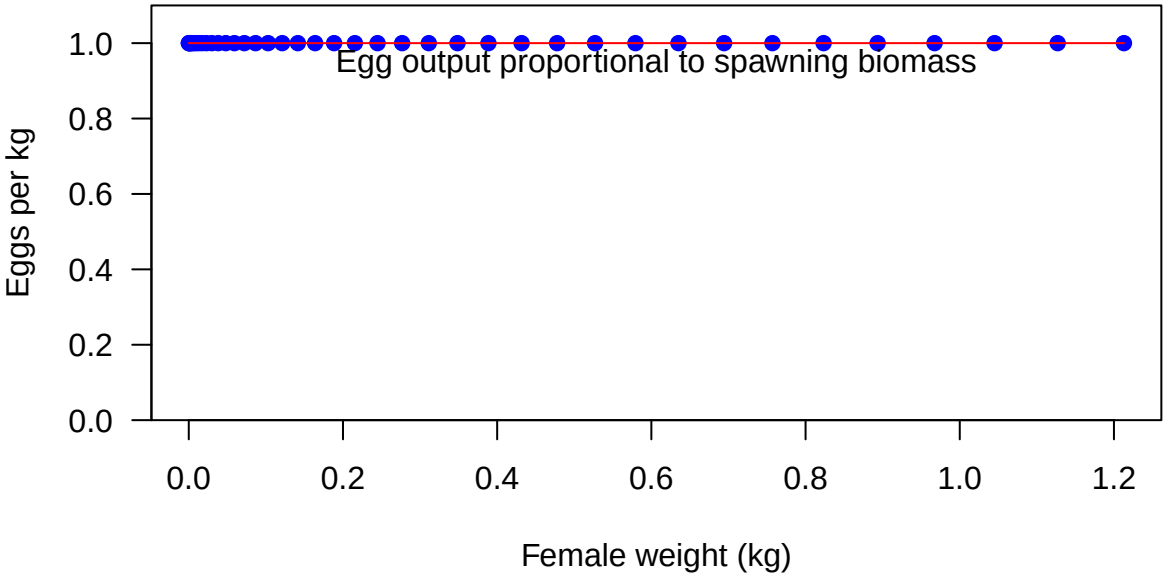

Age (yr)
0
2
4
6
8
Length (cm, beginning of the year)
0
10
20
30
40
Mean weight
0
0.4
0.8
1.2
Frac. mature
0.0
0.5
1.0
Age (yr)

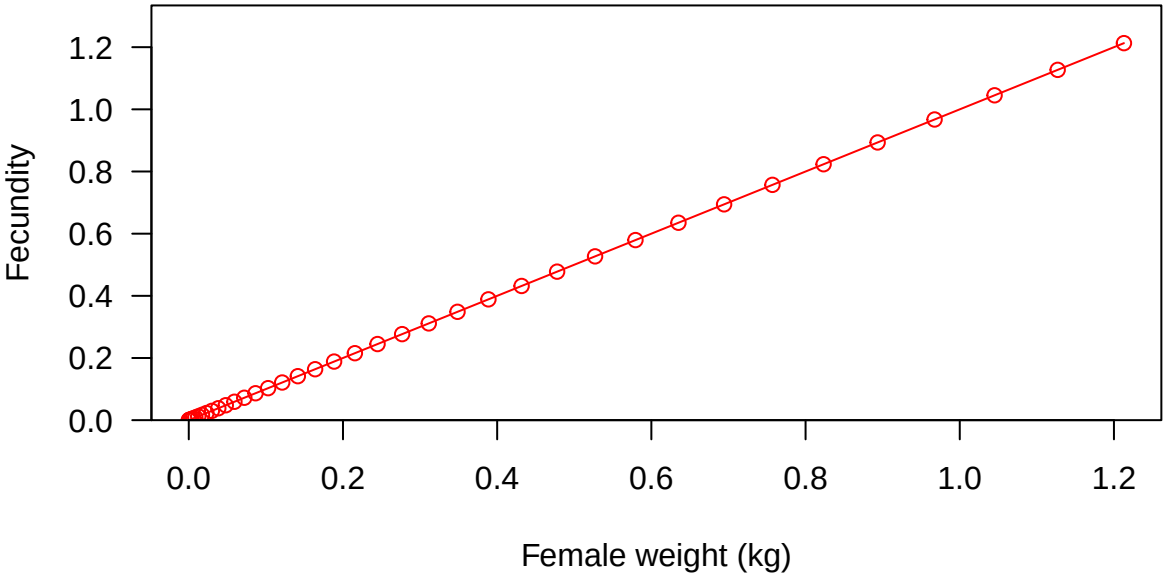

Length
40
30
20
10
0
0
2
4
6
8
Age

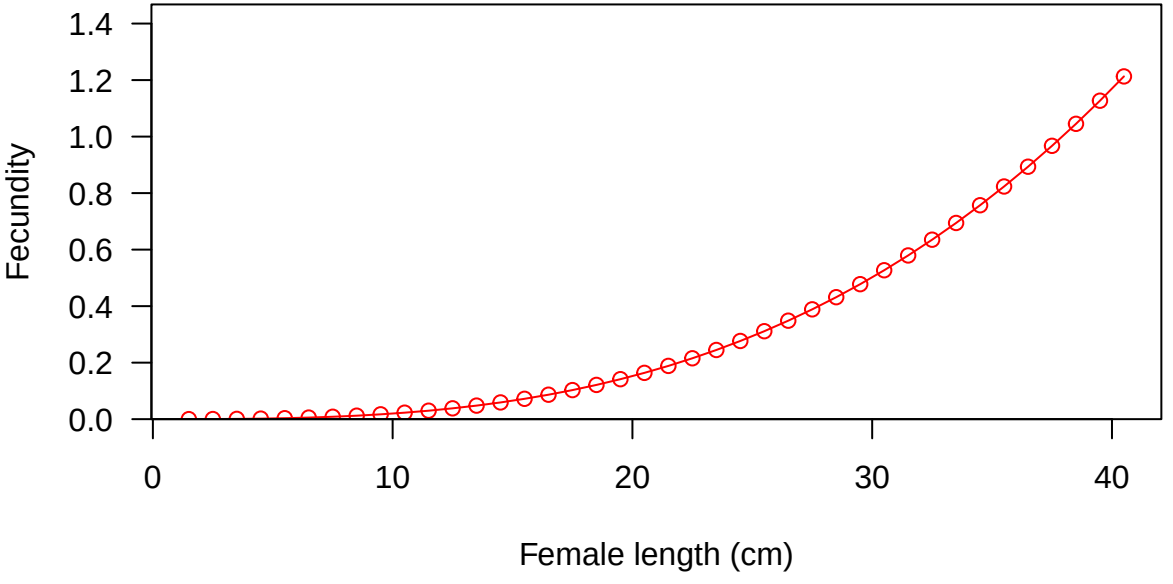

Length
40
30
20
10
0
0
2
4
6
8
Age

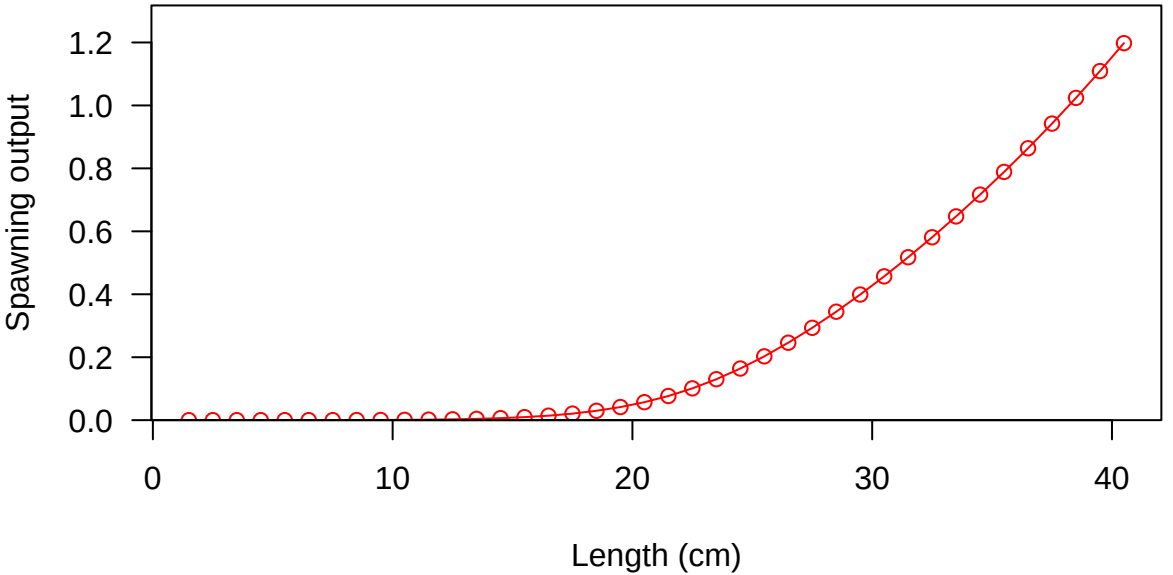

Mean weight (kg) in last year
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
10
20
30
40
Length (cm)

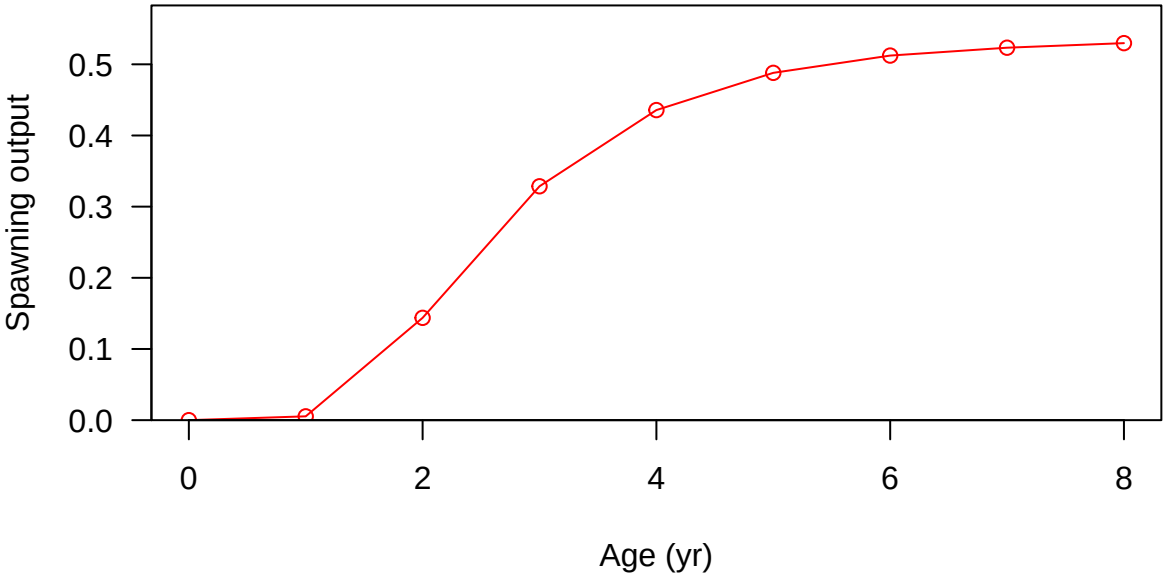

Maturity
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
Length (cm)

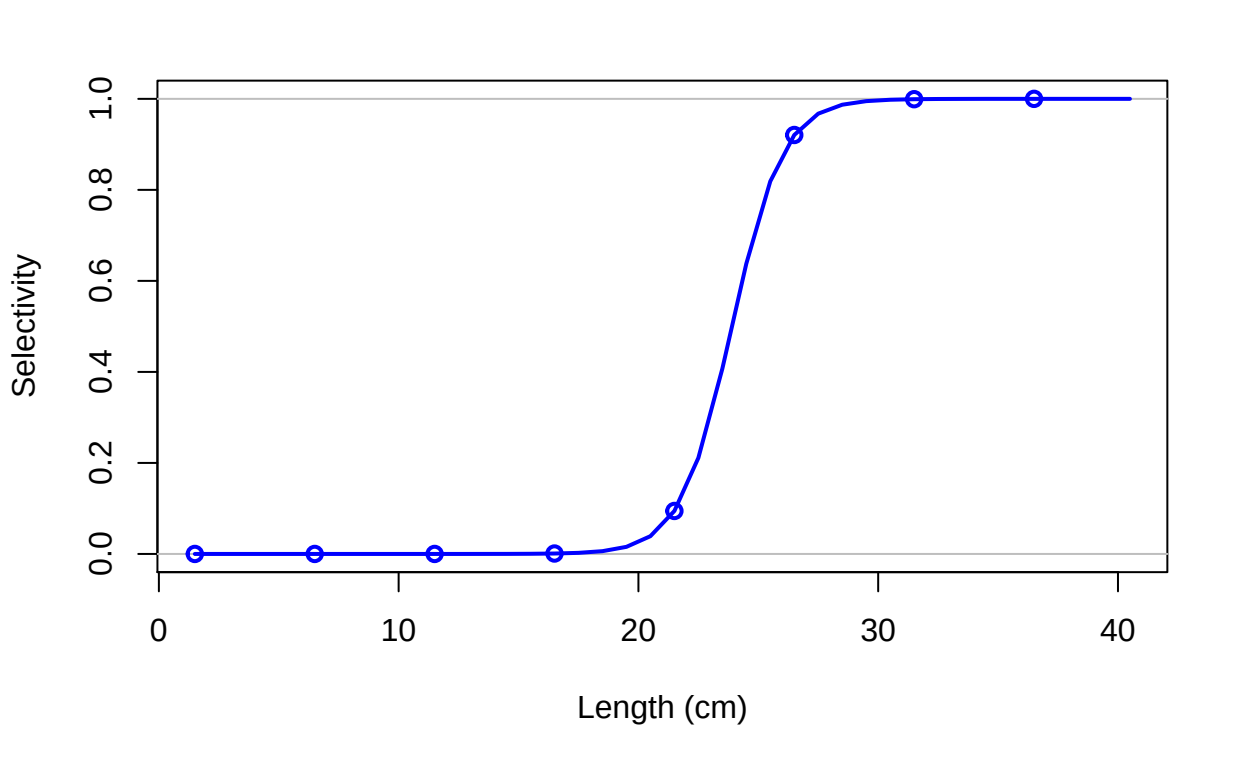

Egg output proportional to spawning biomass
Eggs per kg
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Female weight (kg)

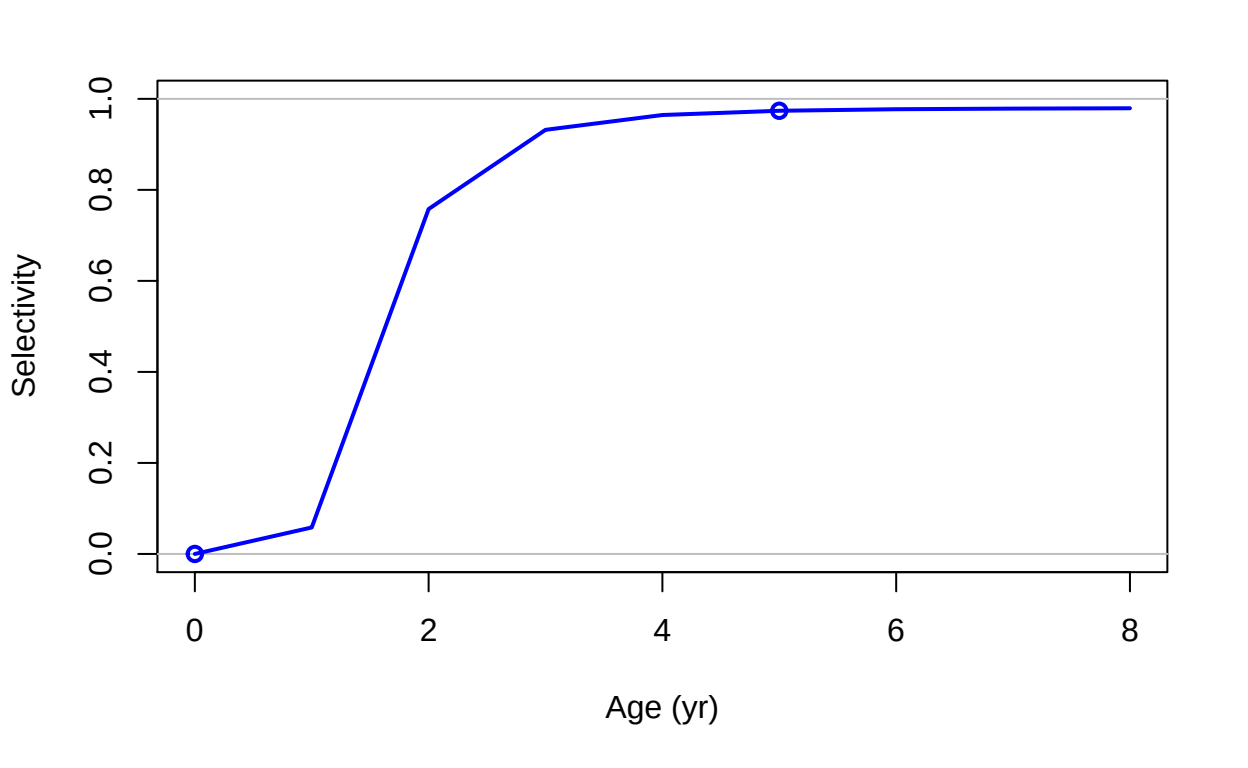

Fecundity
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Female weight (kg)

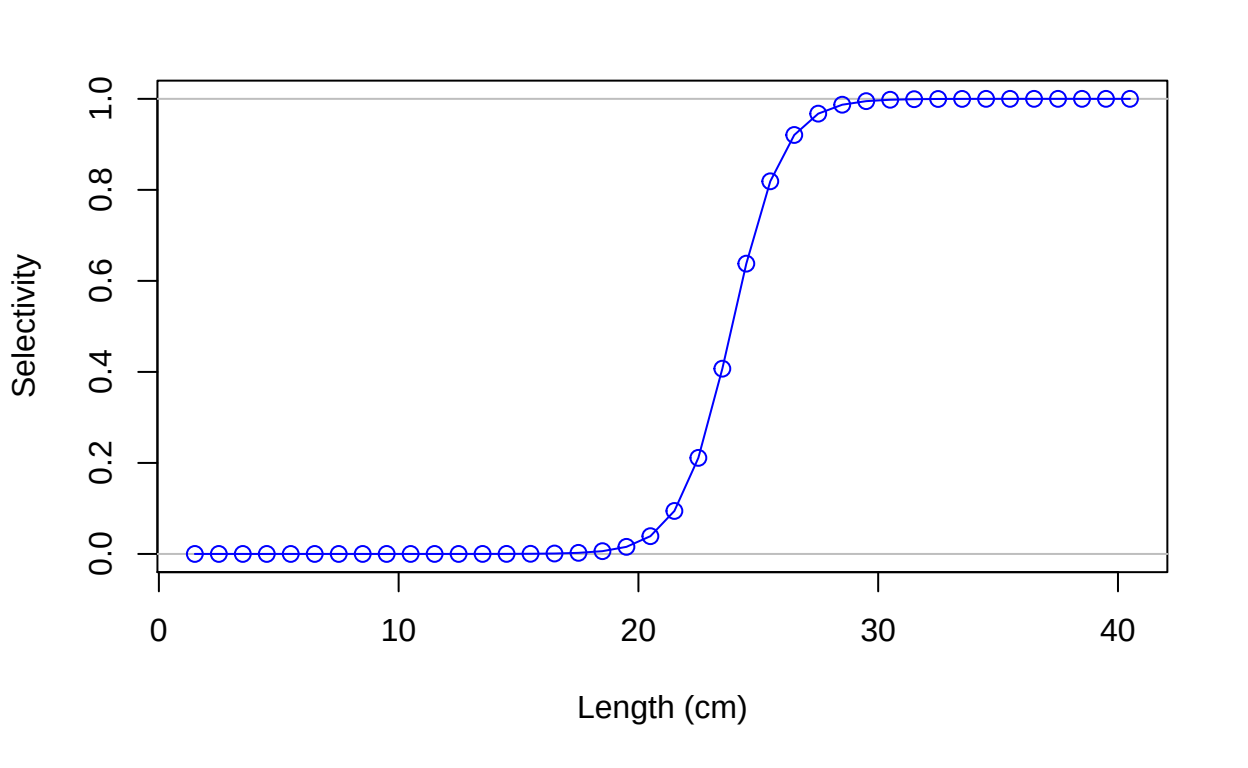

Fecundity
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
Female length (cm)

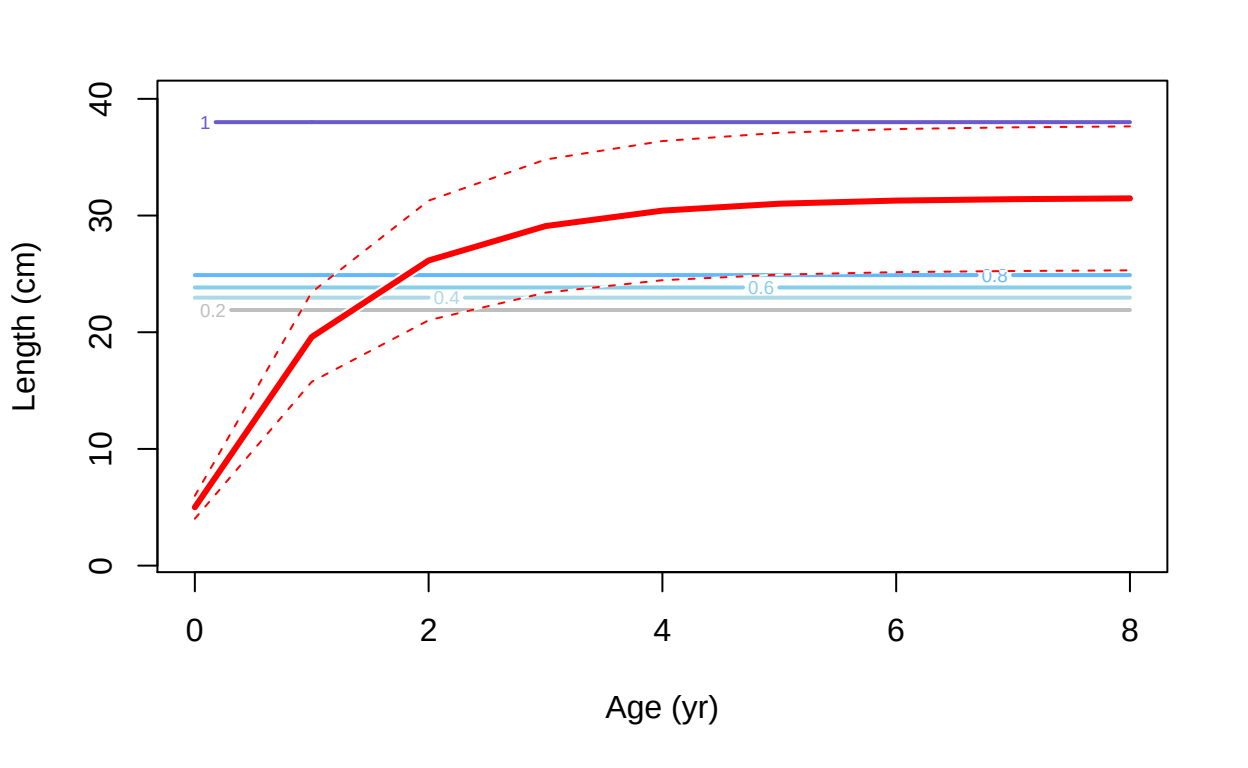

Spawning output
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
Length (cm)

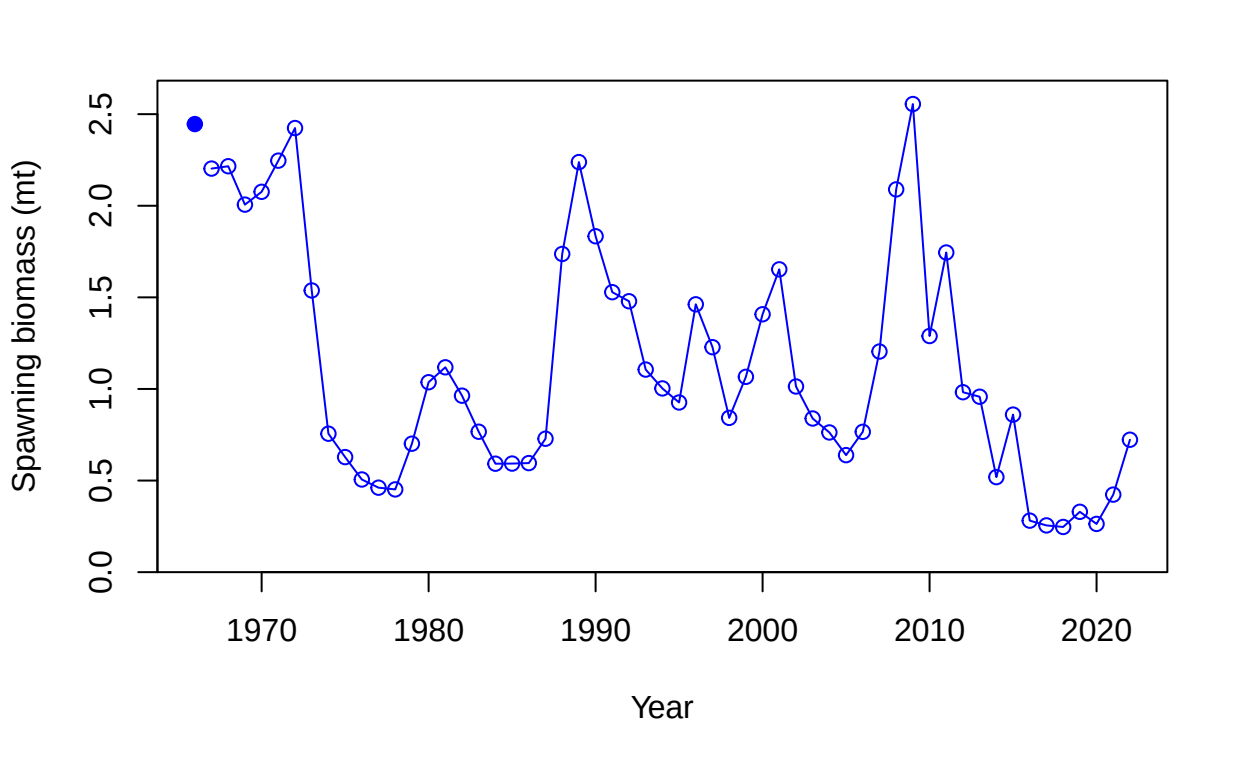

Spawning output
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
Age (yr)

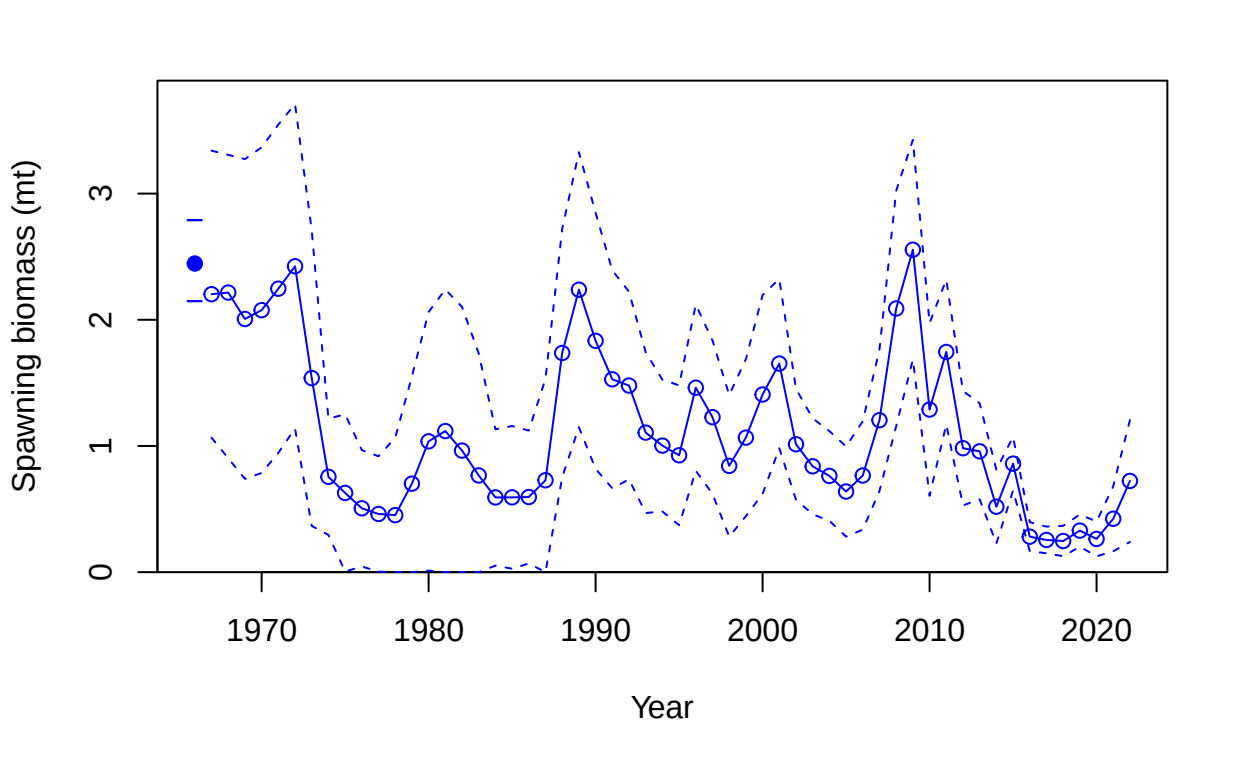

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

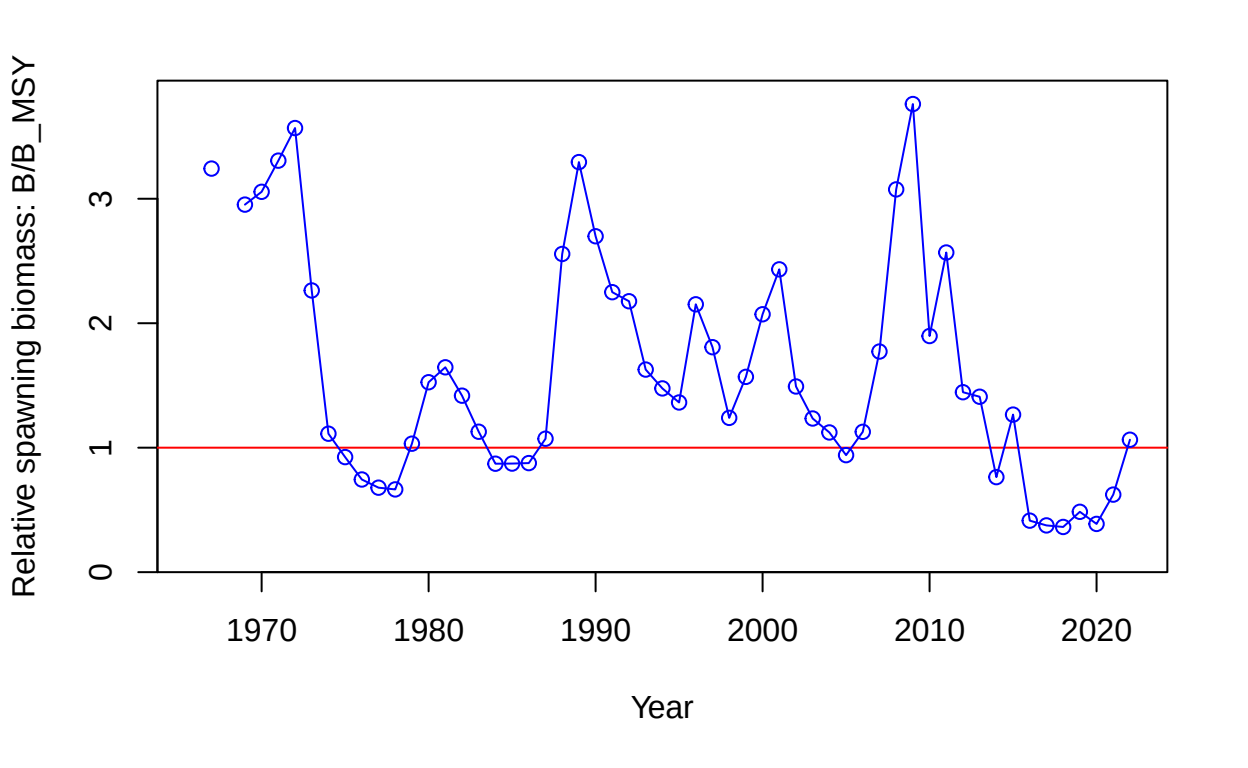

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
Age (yr)

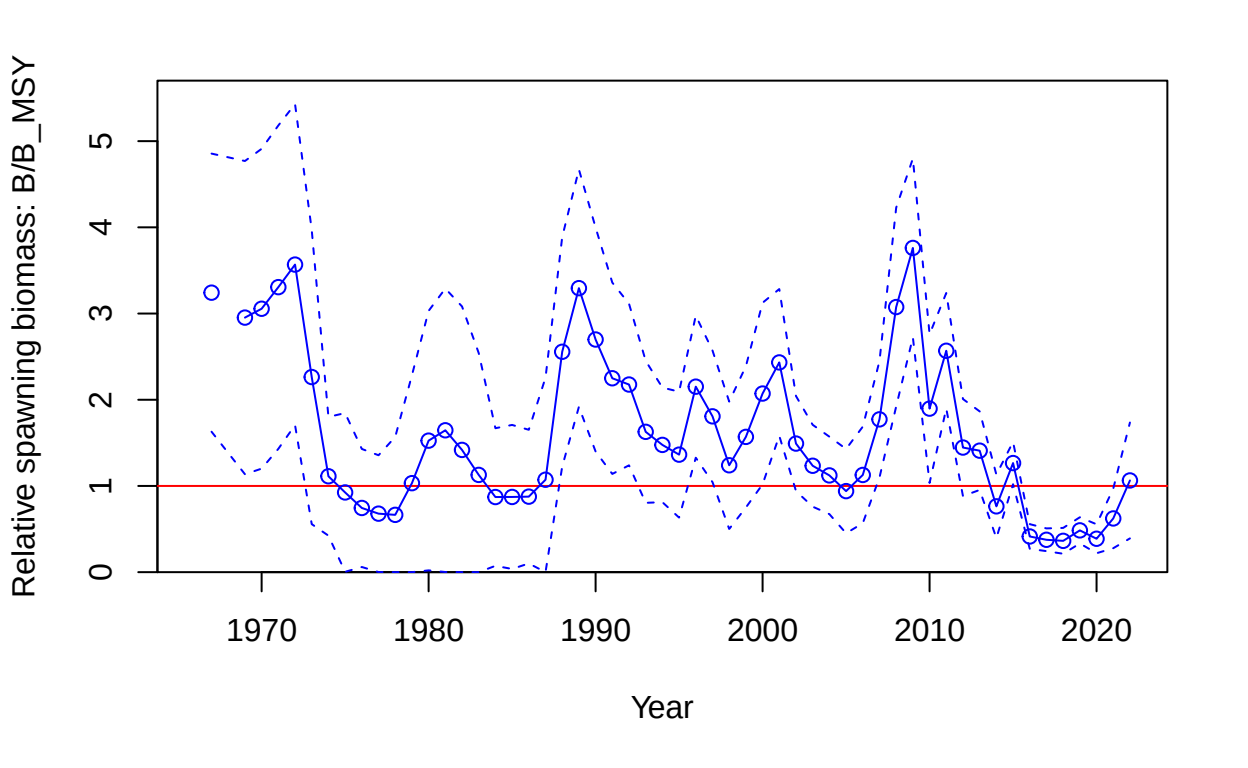

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

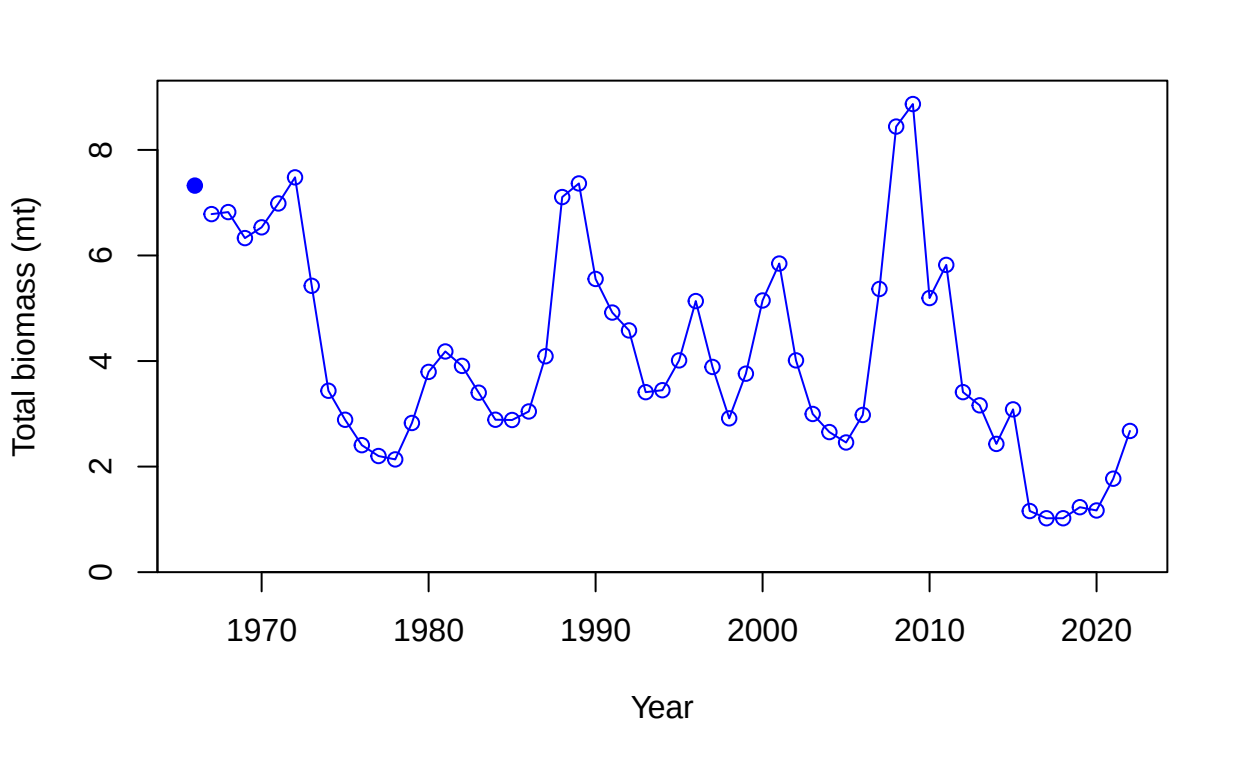

Length (cm)
0
10
20
30
40
0
2
4
6
8
Age (yr)
1
0.8
0.6
0.4
0.2

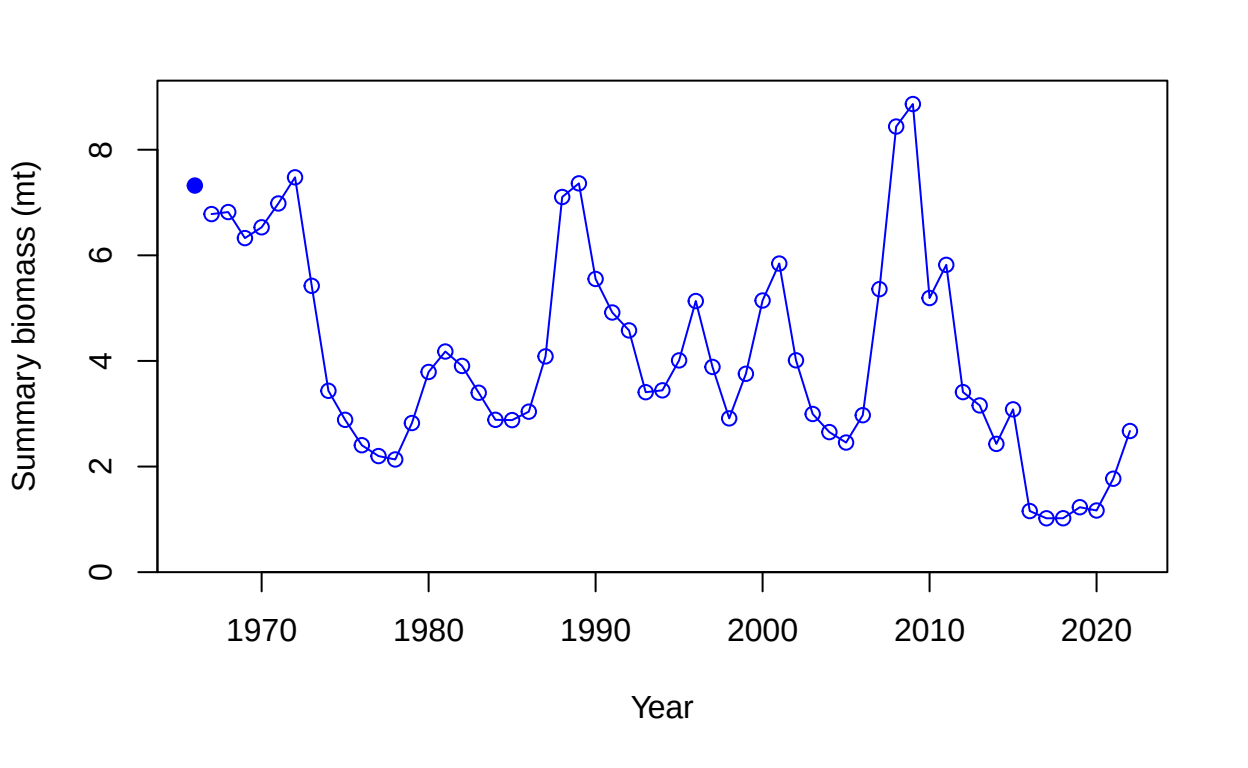

Spawning biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
1970
1980
1990
2000
2010
2020
Year

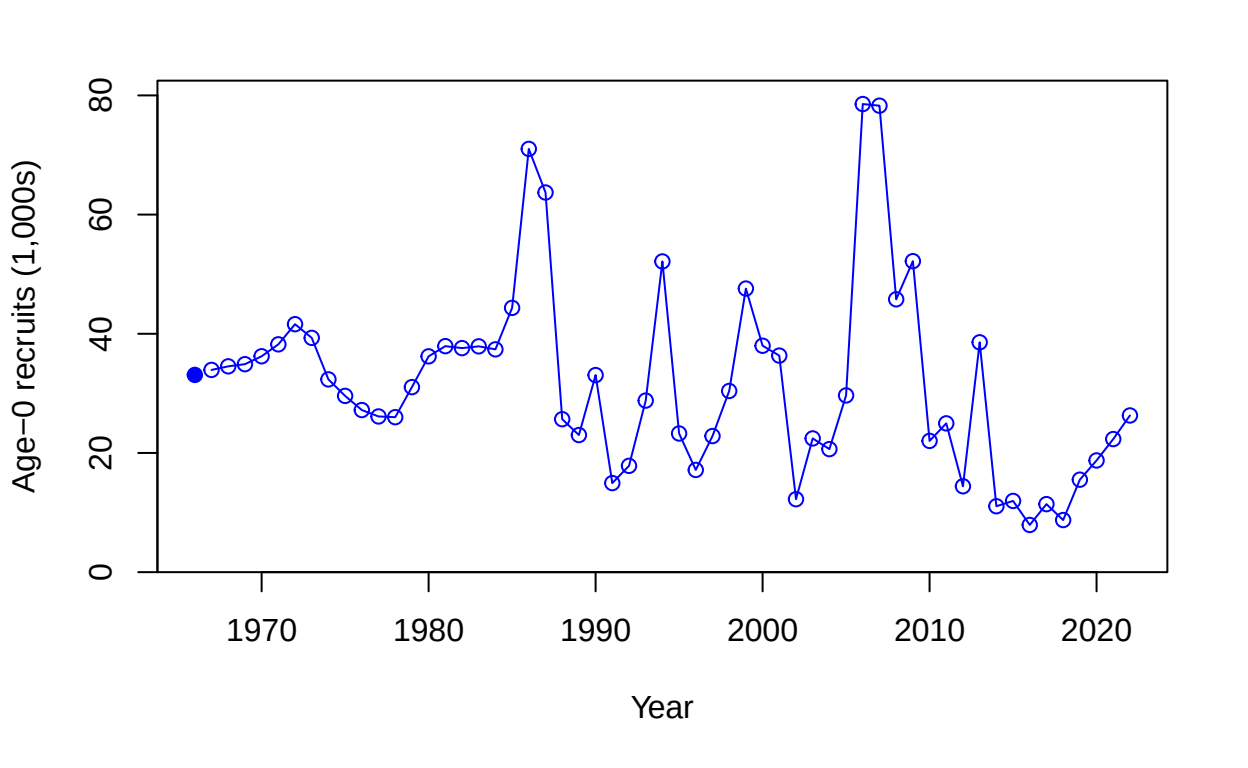

Spawning biomass (mt)
0
1
2
3
1970
1980
1990
2000
2010
2020
Year

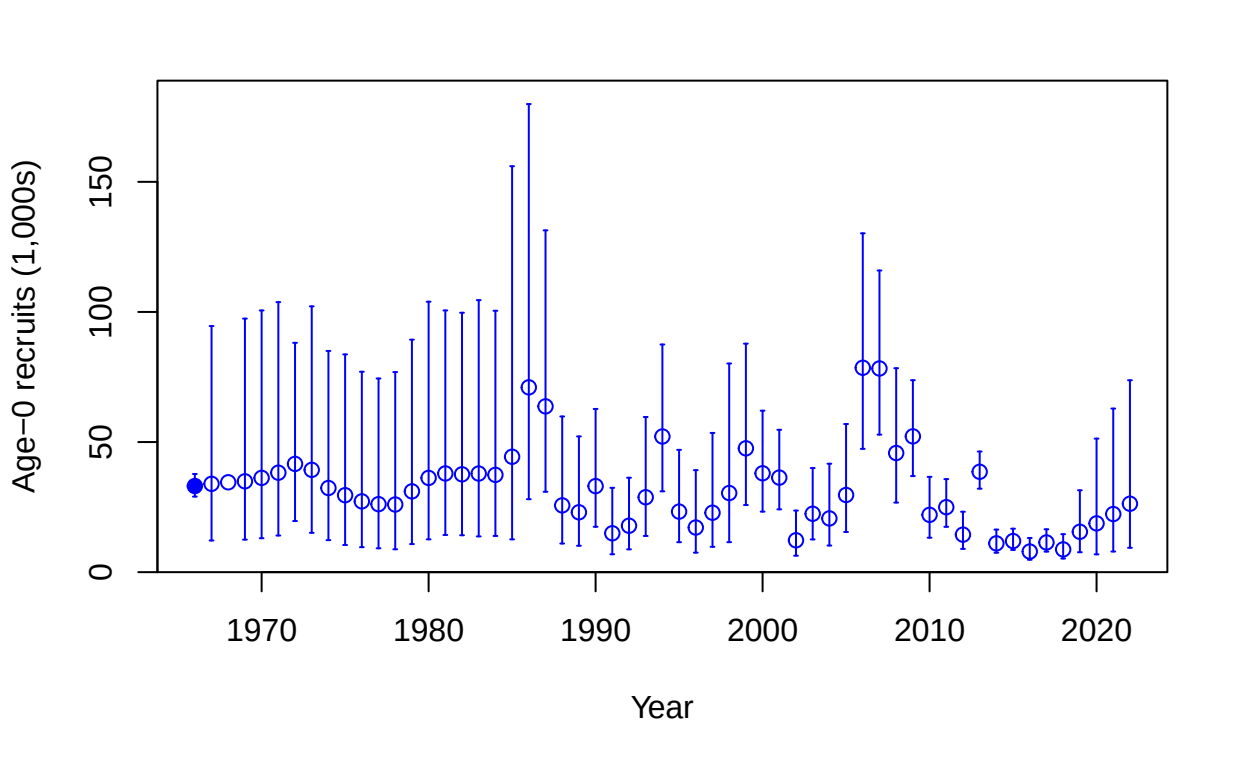

Relative spawning biomass: B/B_MSY
0
1
2
3
1970
1980
1990
2000
2010
2020
Year

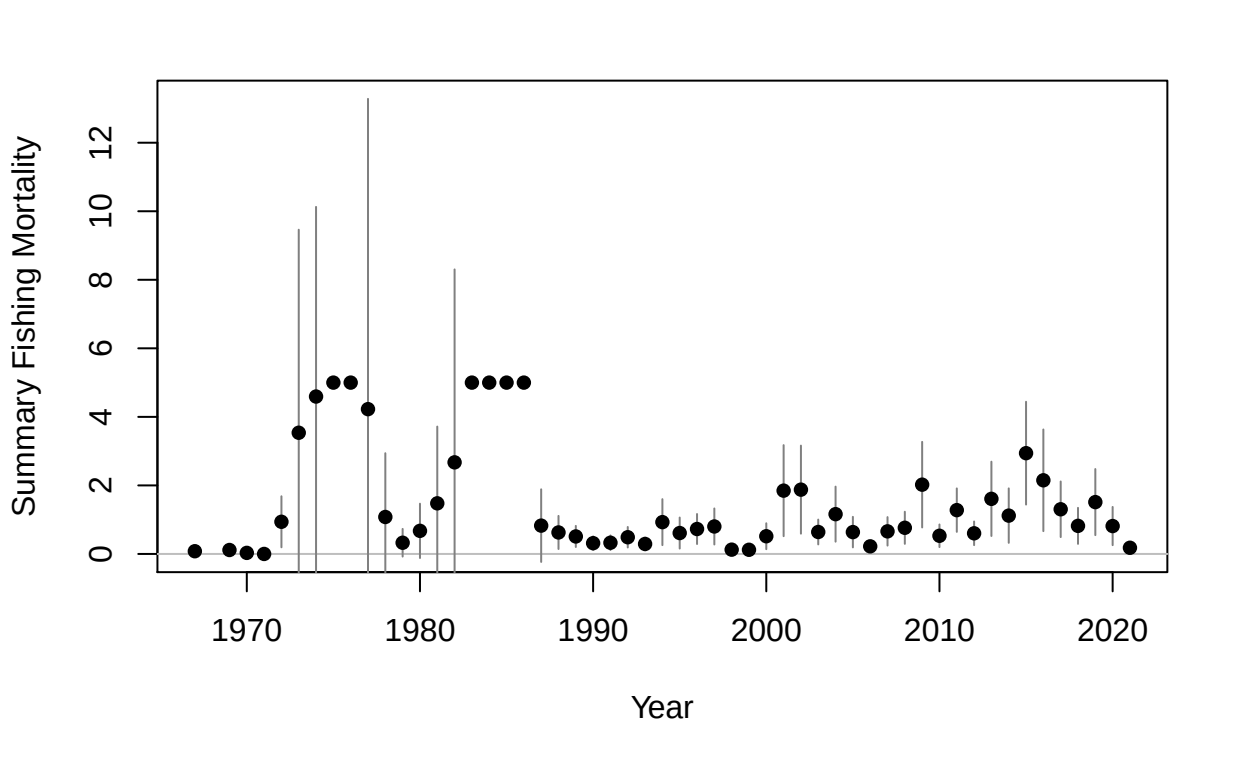

Relative spawning biomass: B/B_MSY
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

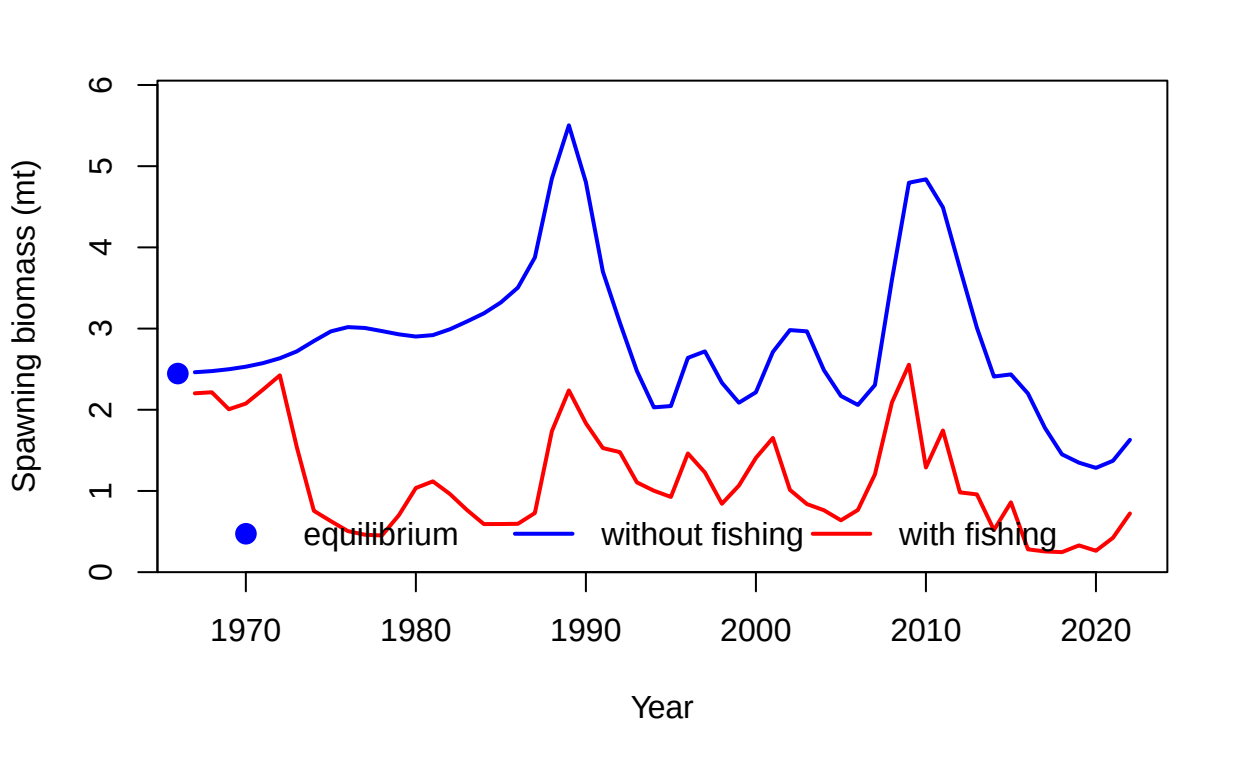

Total biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

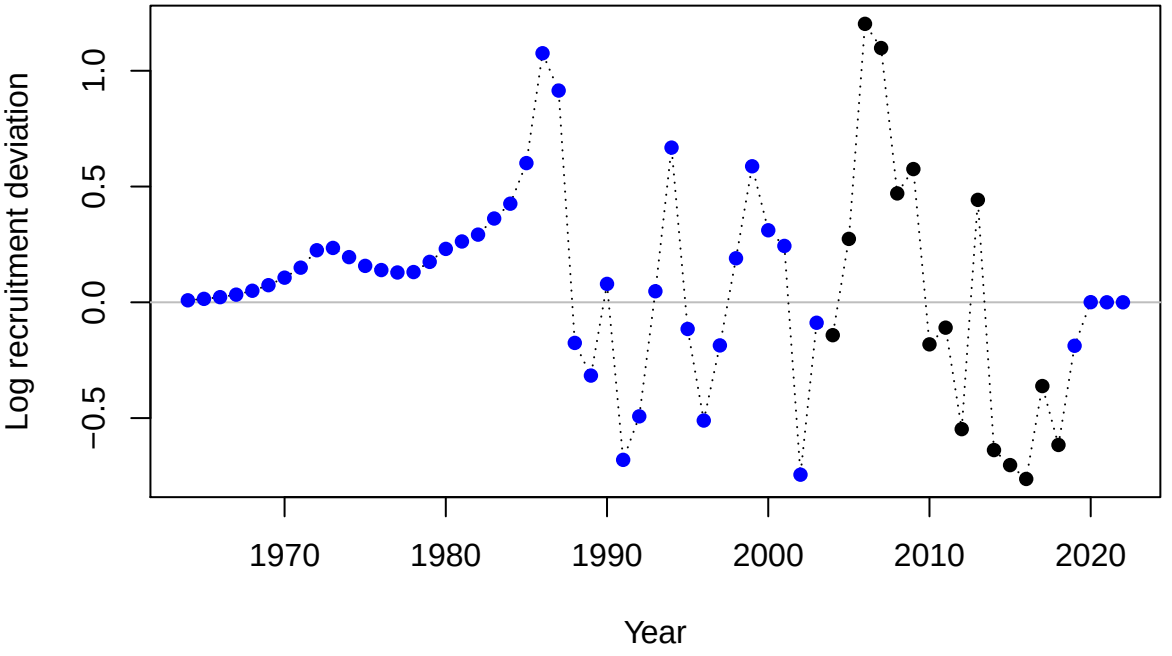

Summary biomass (mt)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

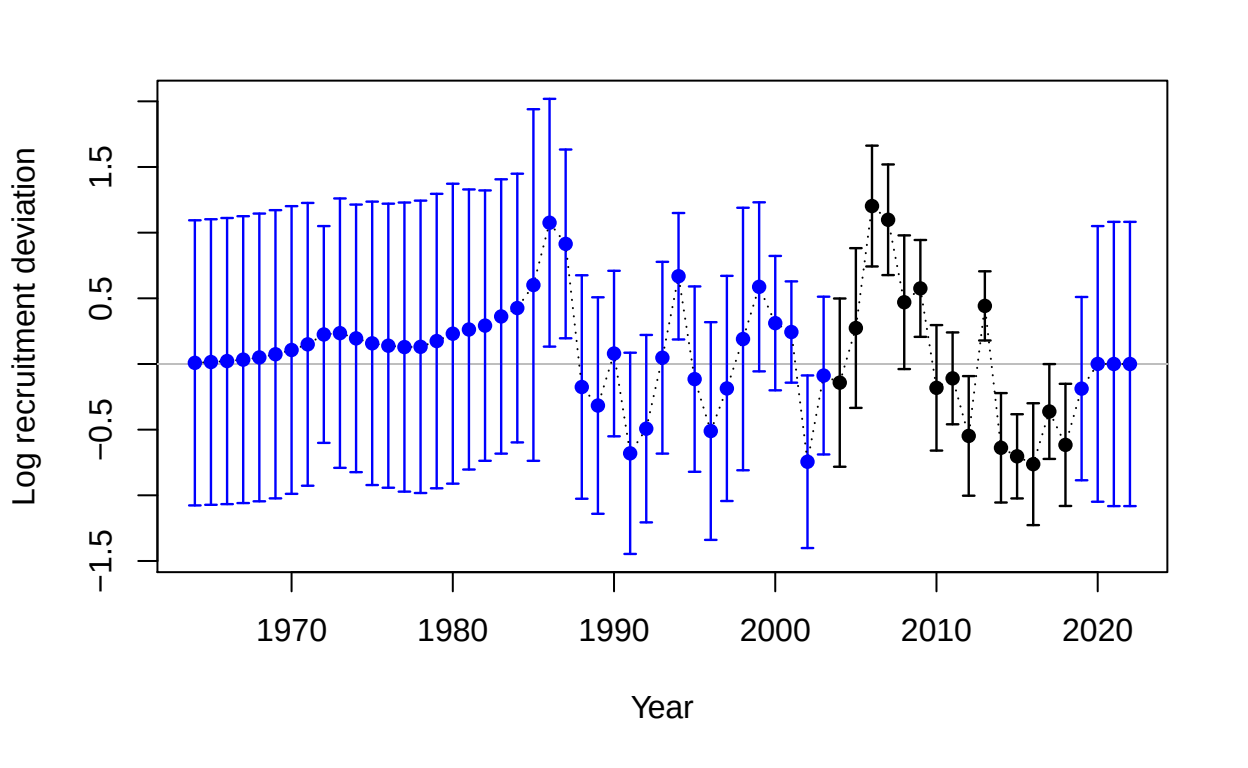

Age−0 recruits (1,000s)
0
20
40
60
80
1970
1980
1990
2000
2010
2020
Year

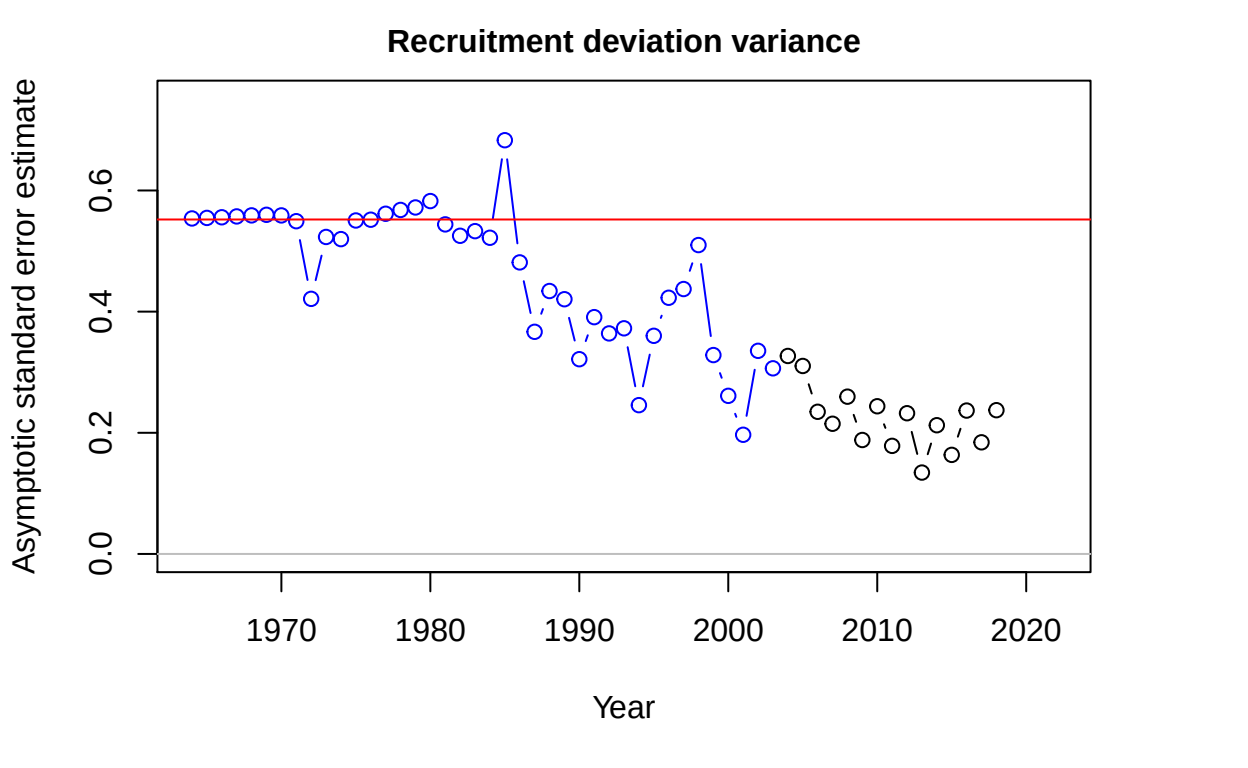

Age−0 recruits (1,000s)
0
50
100
150
1970
1980
1990
2000
2010
2020
Year

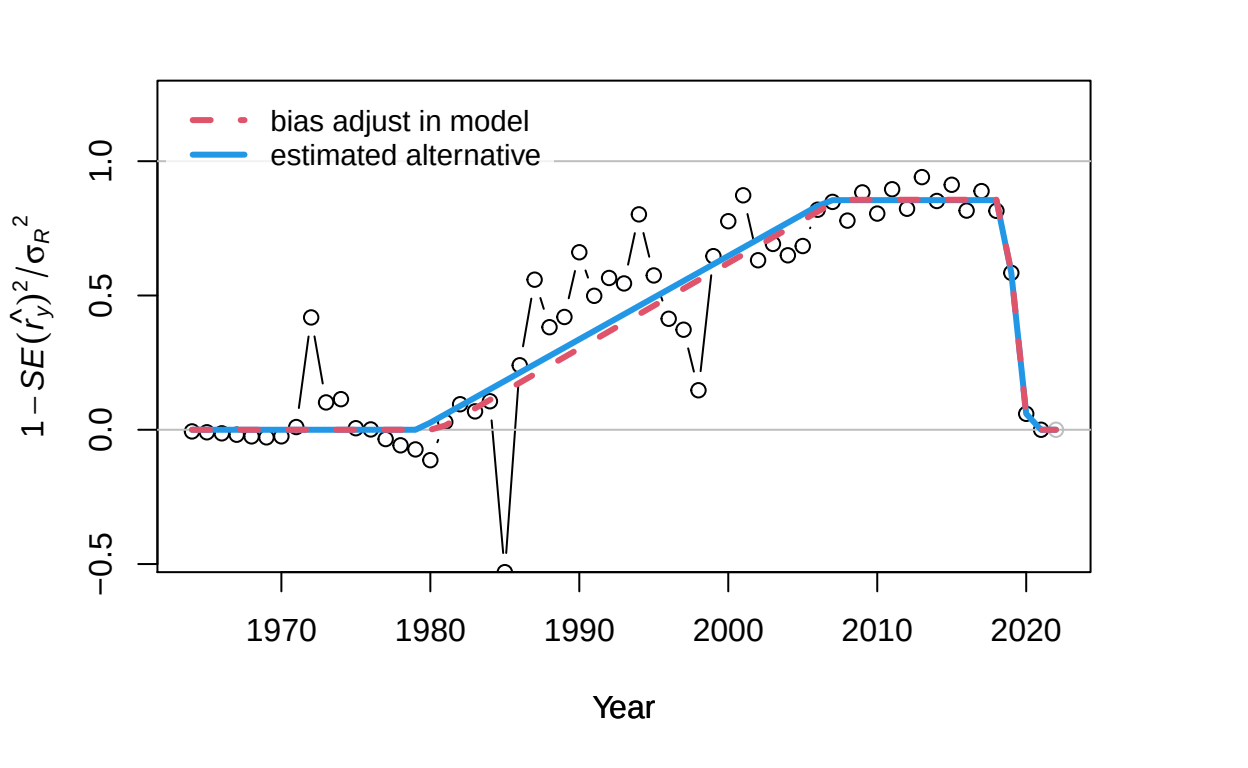

Summary Fishing Mortality
0
2
4
6
8
10
12
1970
1980
1990
2000
2010
2020
Year

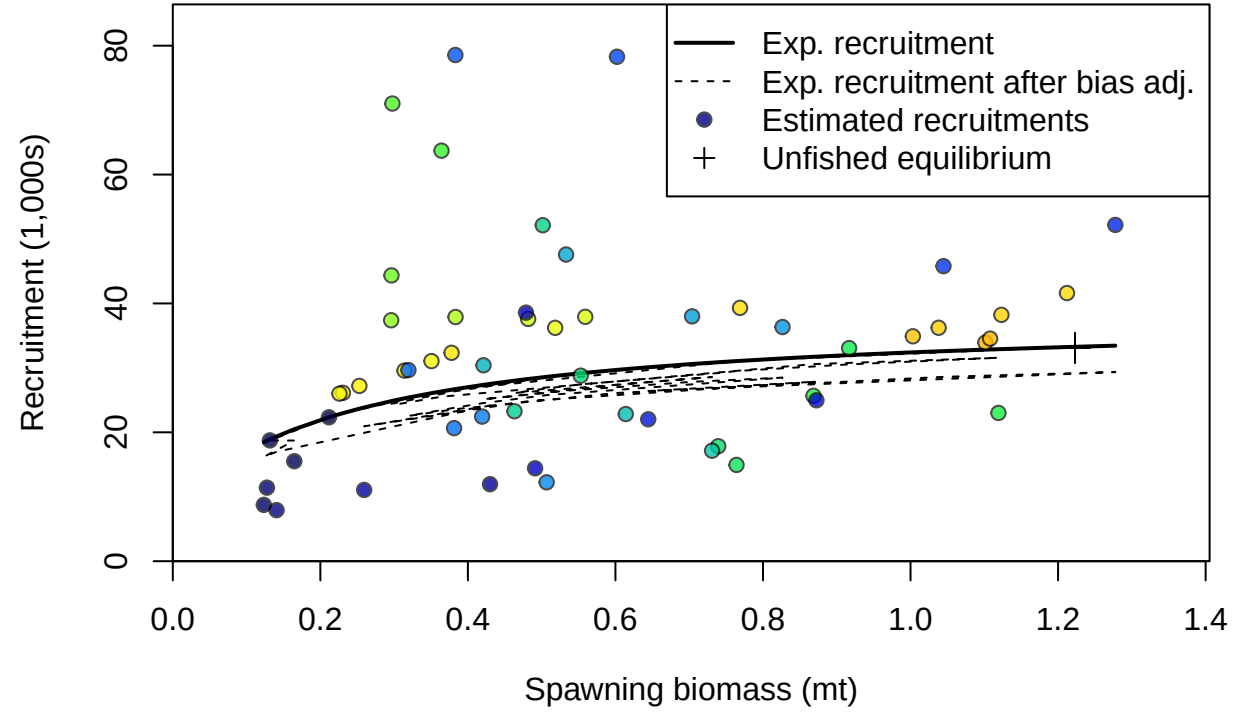

Spawning biomass (mt)
0
1
2
3
4
5
6
1970
1980
1990
2000
2010
2020
Year
equilibrium
without fishing
with fishing

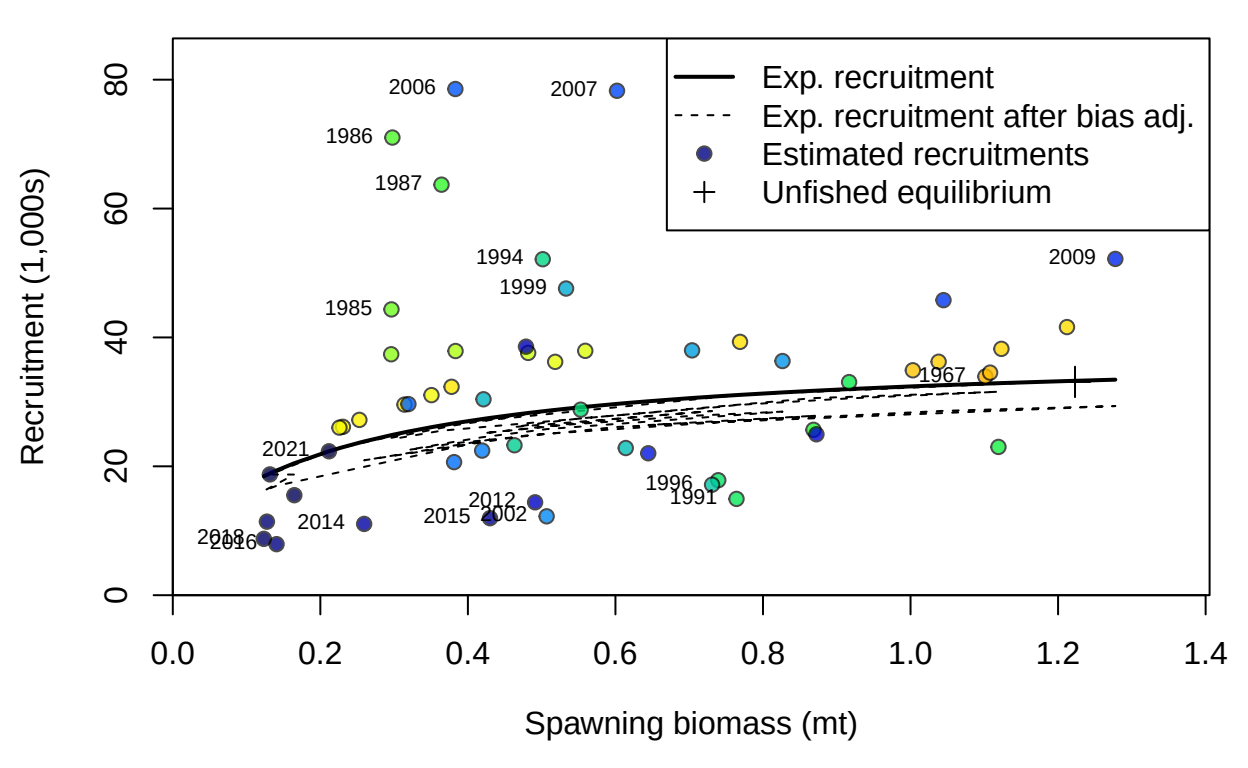

Log recruitment deviation
−0.5
0.0
0.5
1.0
1970
1980
1990
2000
2010
2020
Year

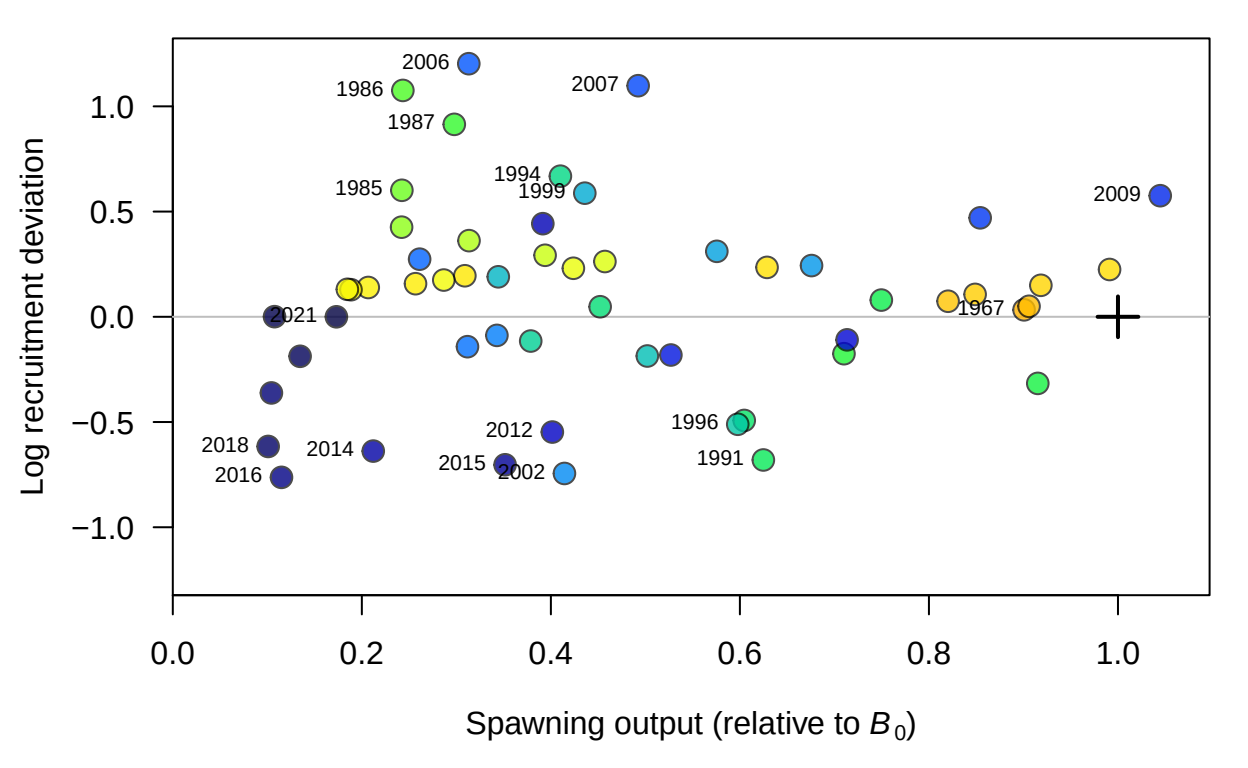

Log recruitment deviation
1.5
0.5
−0.5
−1.5
1970
1980
1990
2000
2010
2020
Year

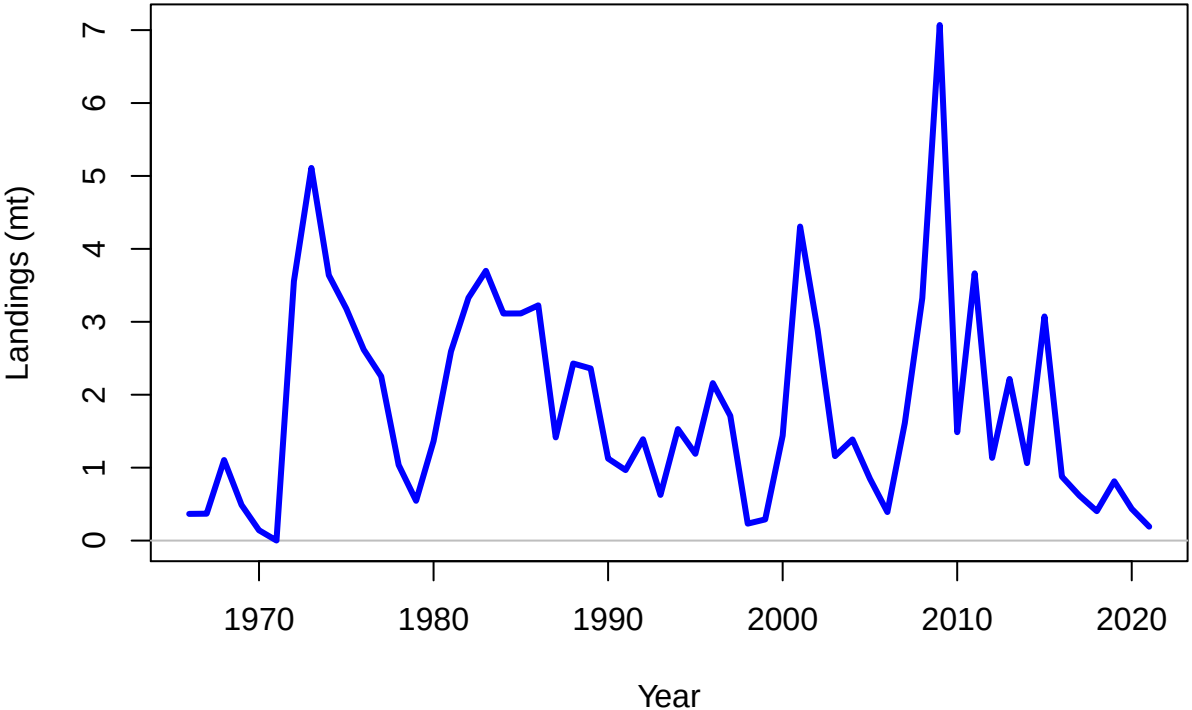

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

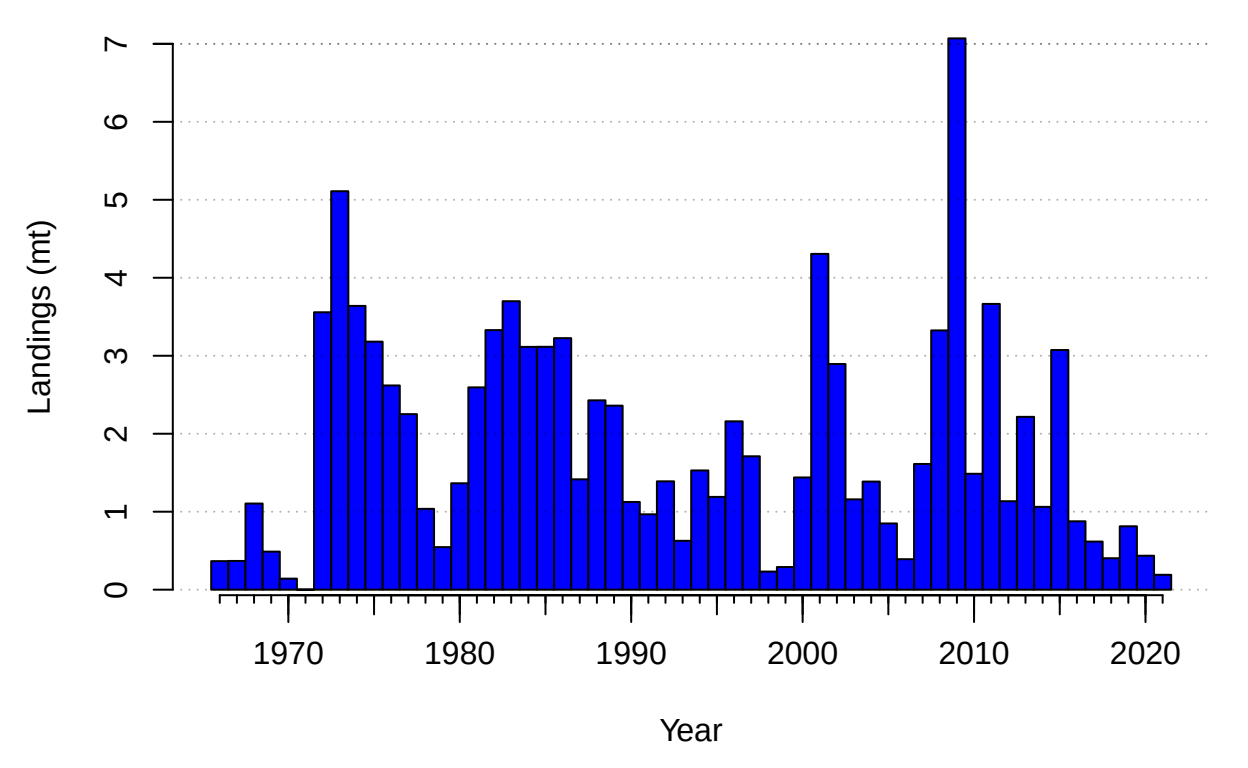

bias adjust in model
estimated alternative
$1 - SE(\hat{r}_y)^2/\sigma_R^2$
1.0
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year

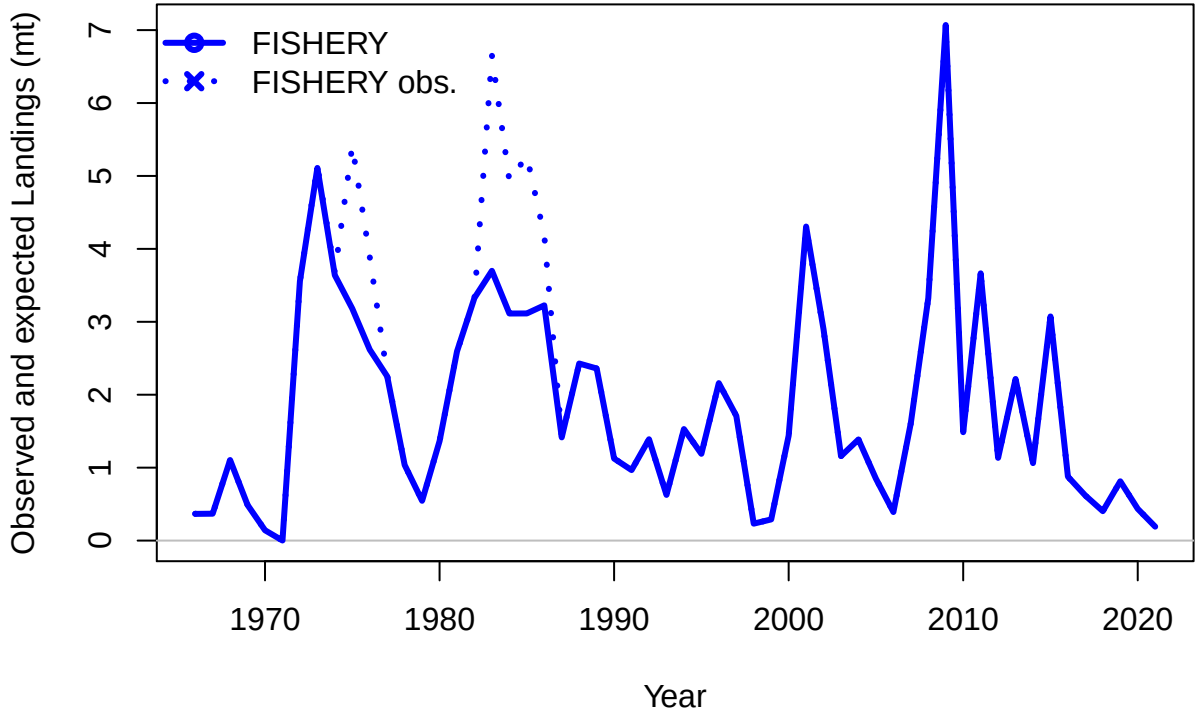

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Spawning biomass (mt)

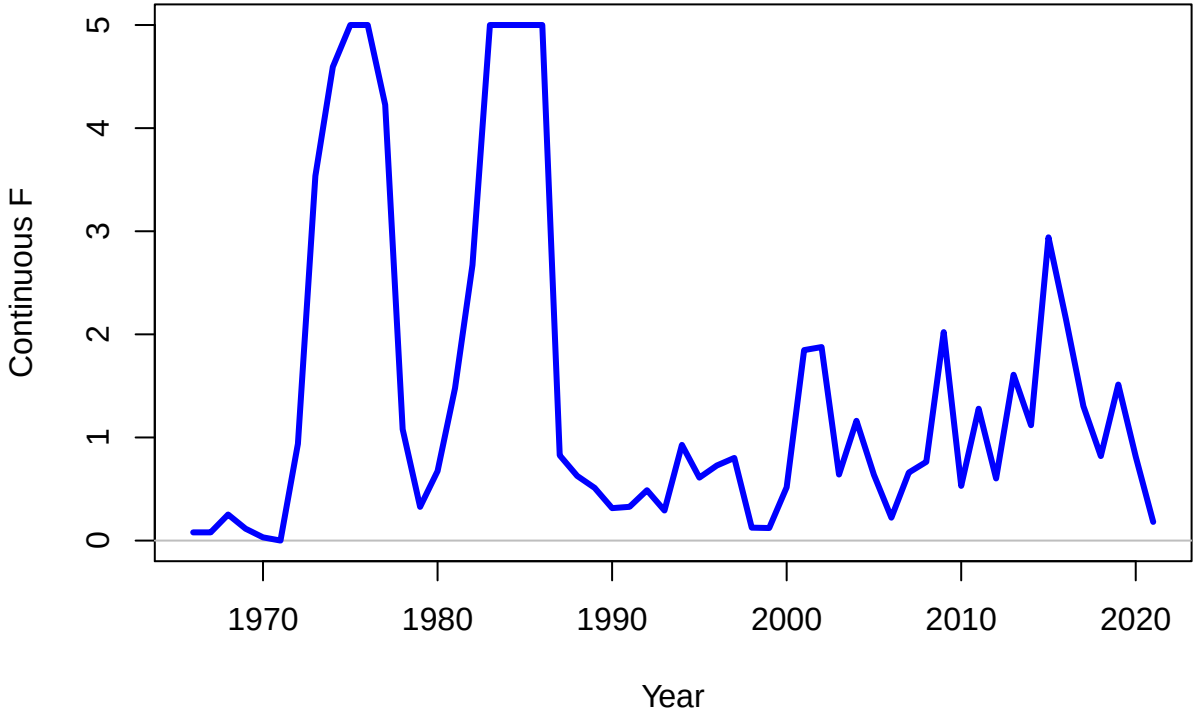

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
Spawning biomass (mt)
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
2006
2007
1986
1987
1994
1999
2009
1985
1967
2021
1996
1991
2012
2015
2002
2014
2018
2016

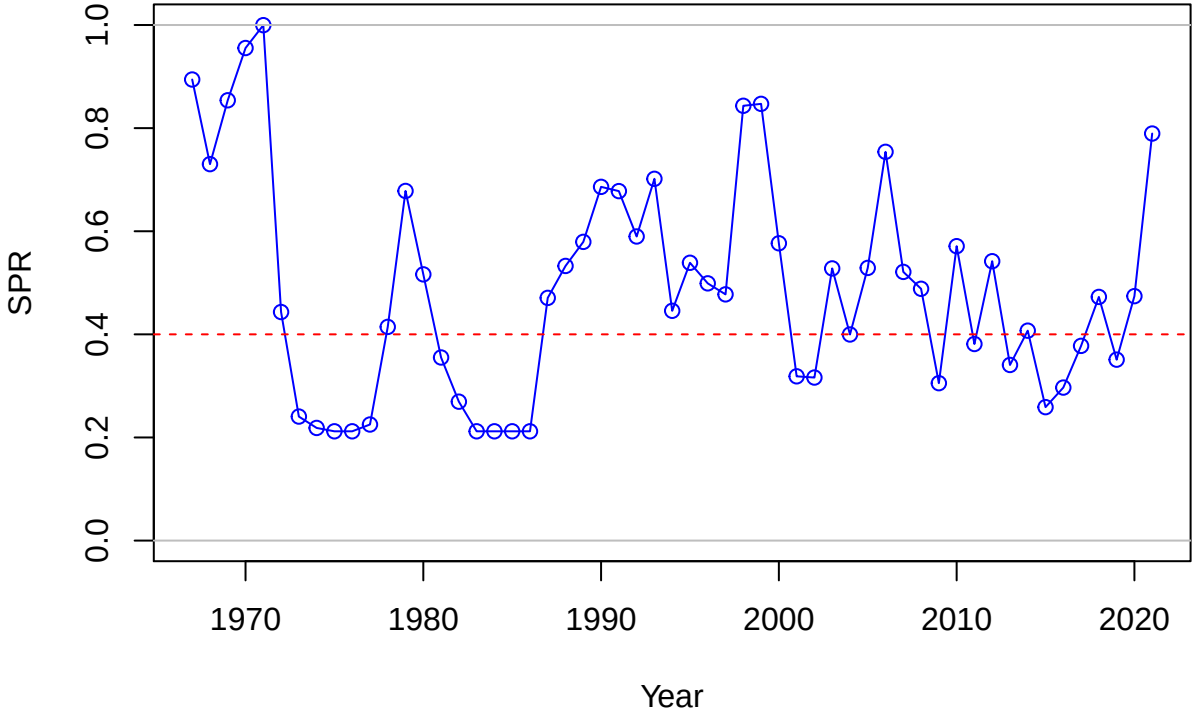

Log recruitment deviation
1.0
0.5
0.0
−0.5
−1.0
0.0
0.2
0.4
0.6
0.8
1.0
Spawning output (relative to B_0)
2006
1986
2007
1987
1994
1985
1999
2009
1967
2021
2018
2014
2016
2012
2015
2002
1996
1991

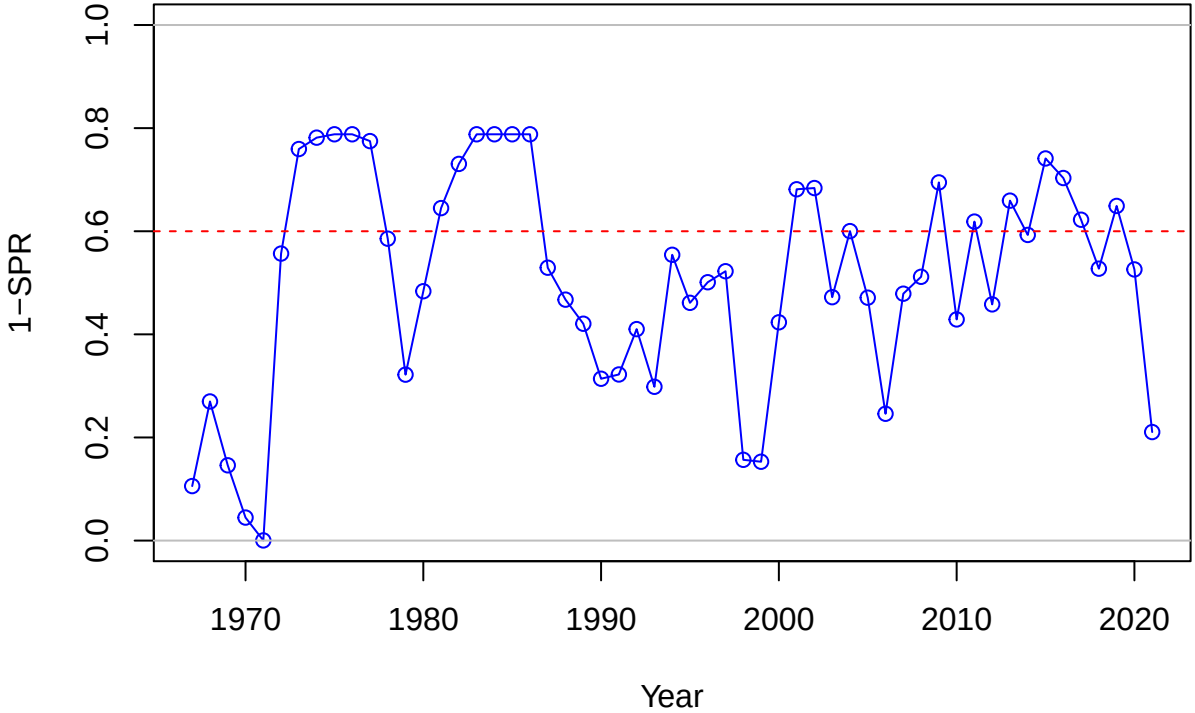

Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

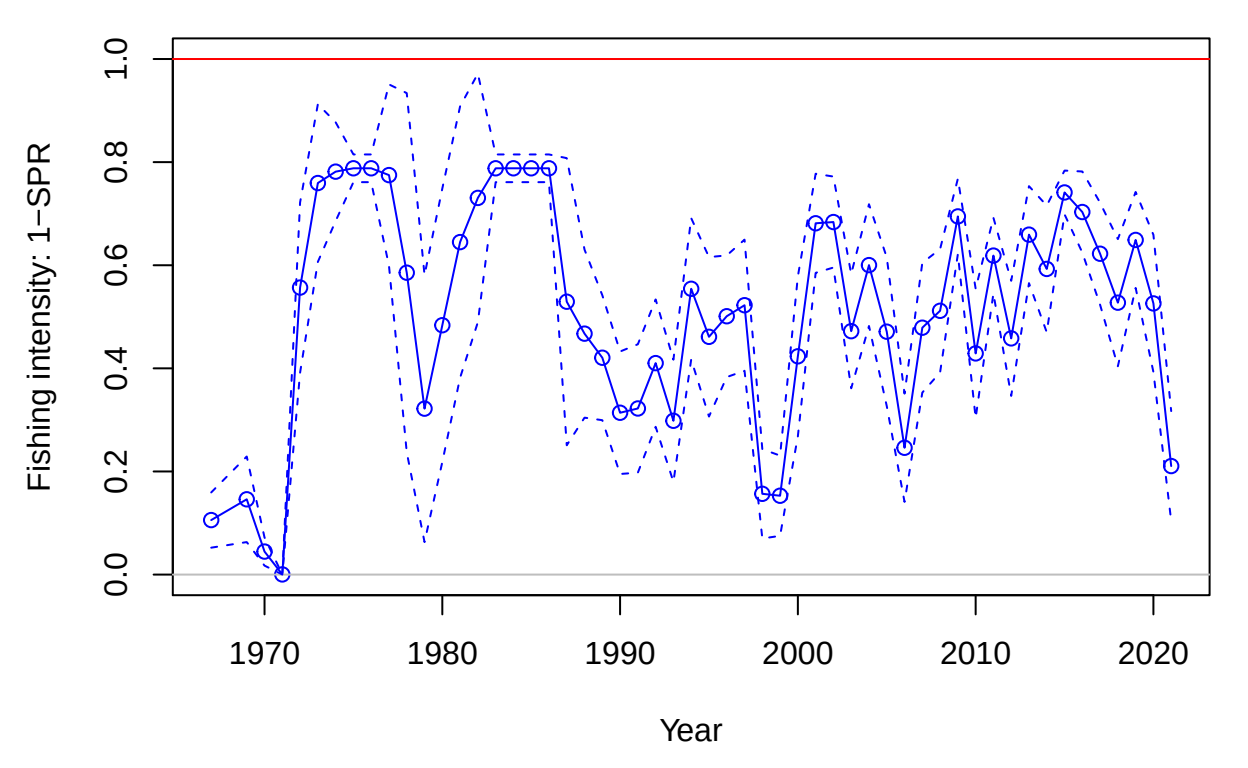

Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

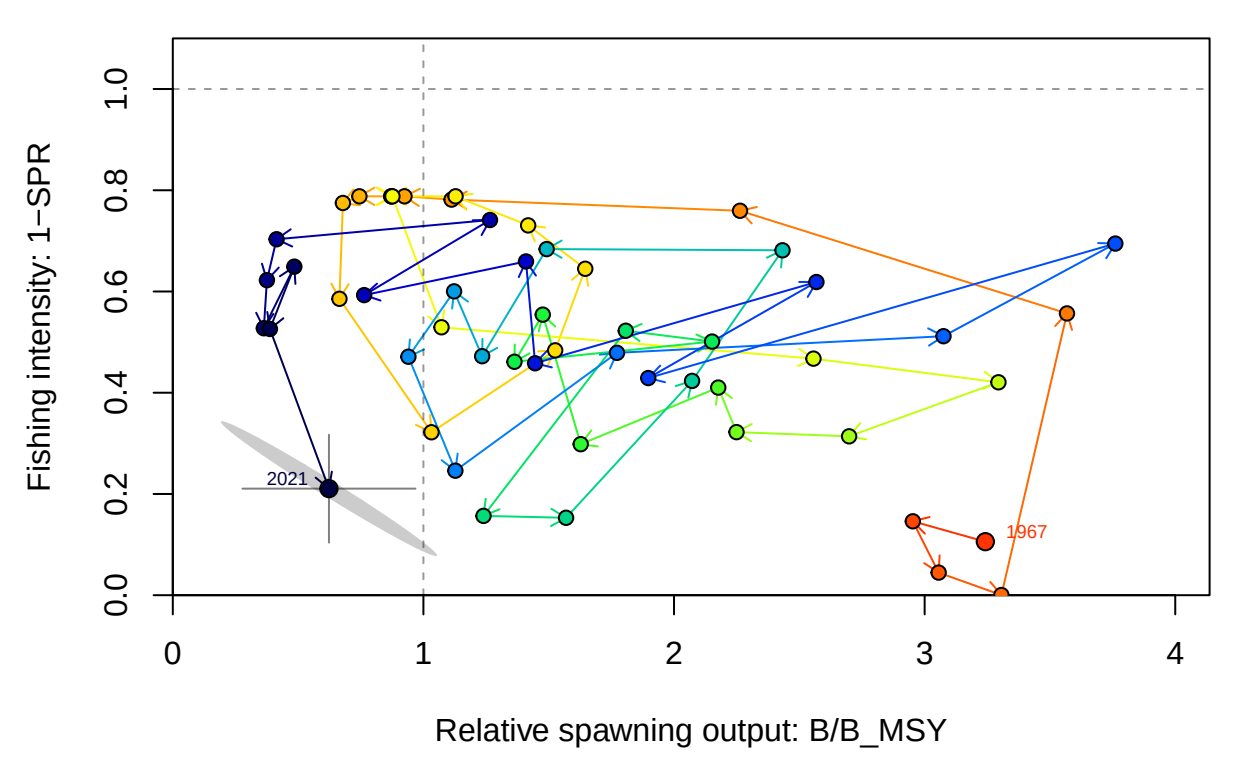

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0
1
2
3
4
5
6
7
1970
1980
1990
2000
2010
2020
Year

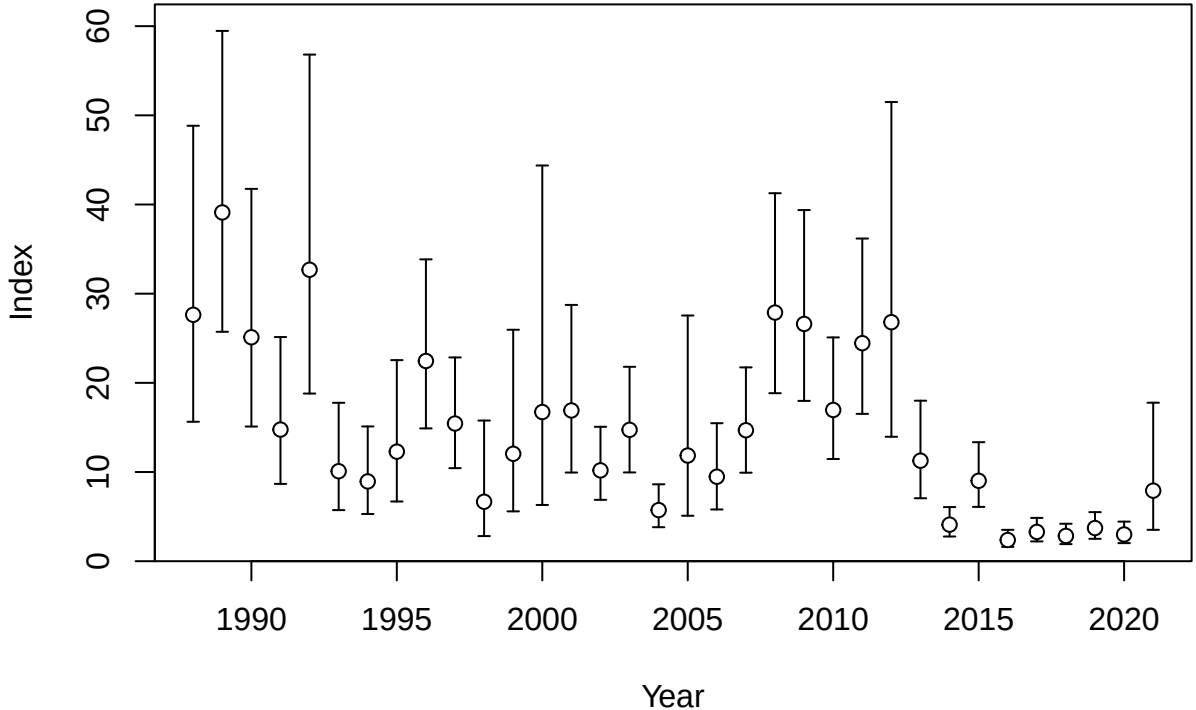

Continuous F
0
1
2
3
4
5
1970
1980
1990
2000
2010
2020
Year

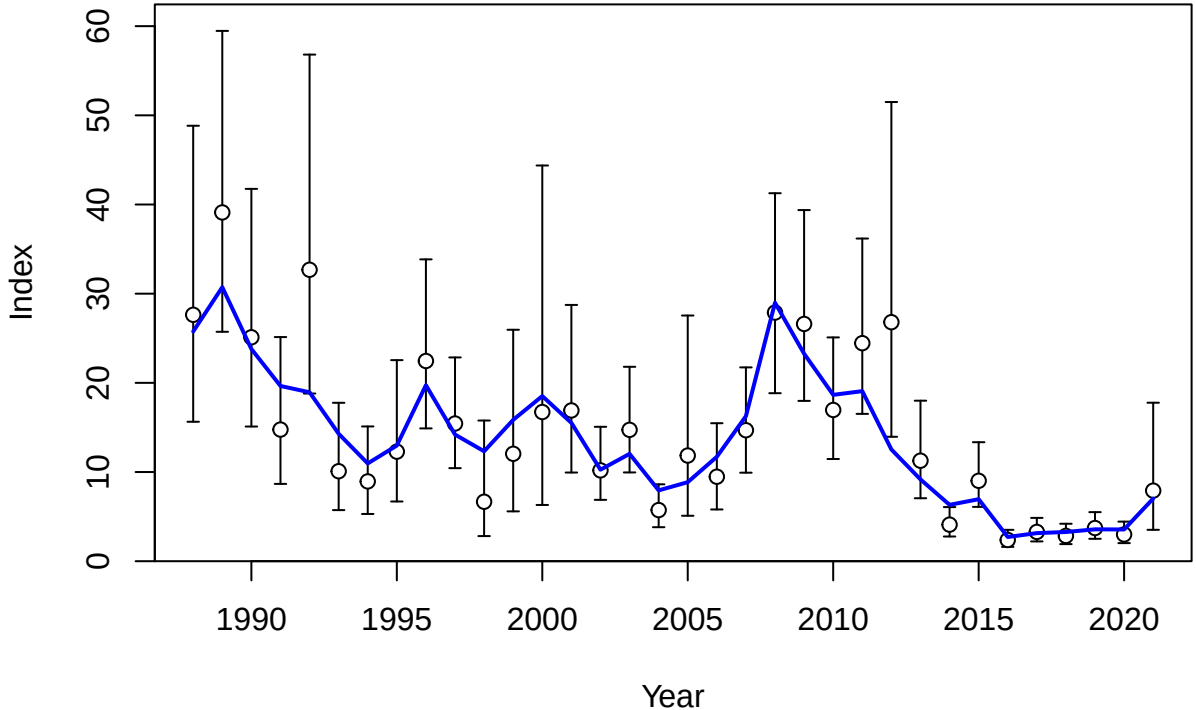

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

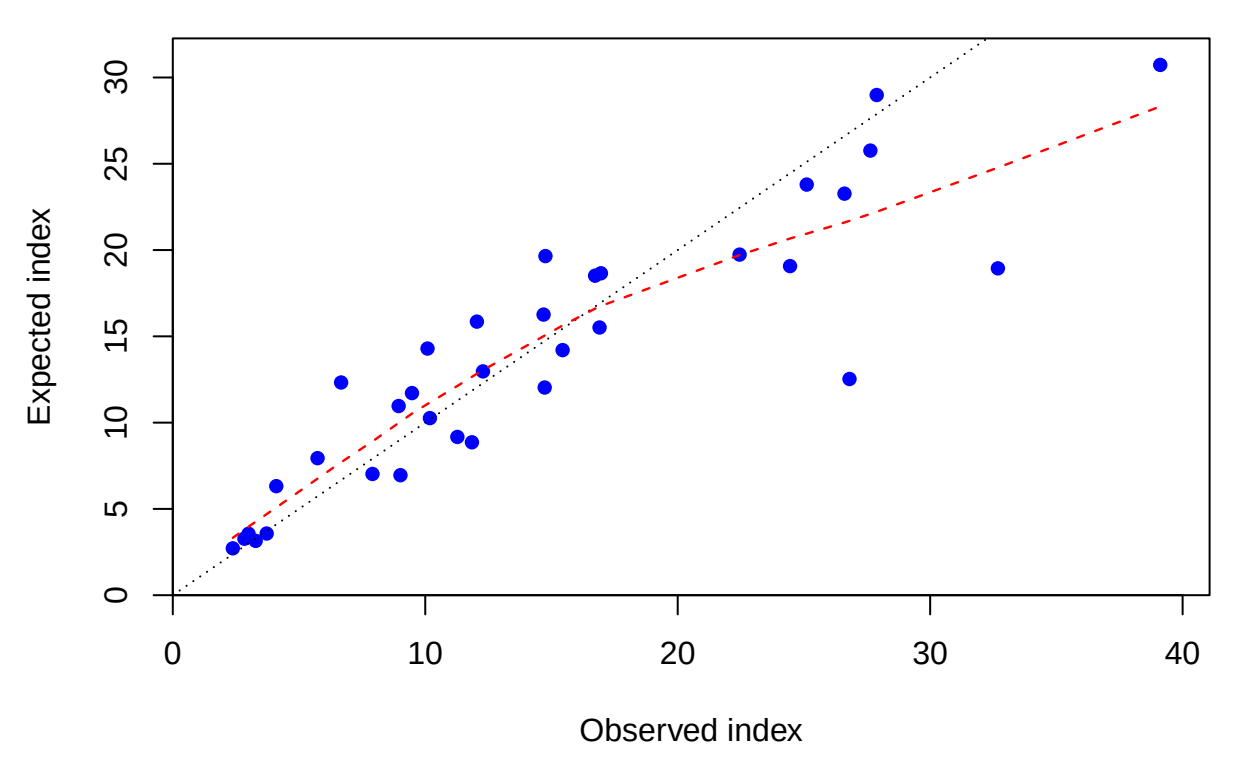

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

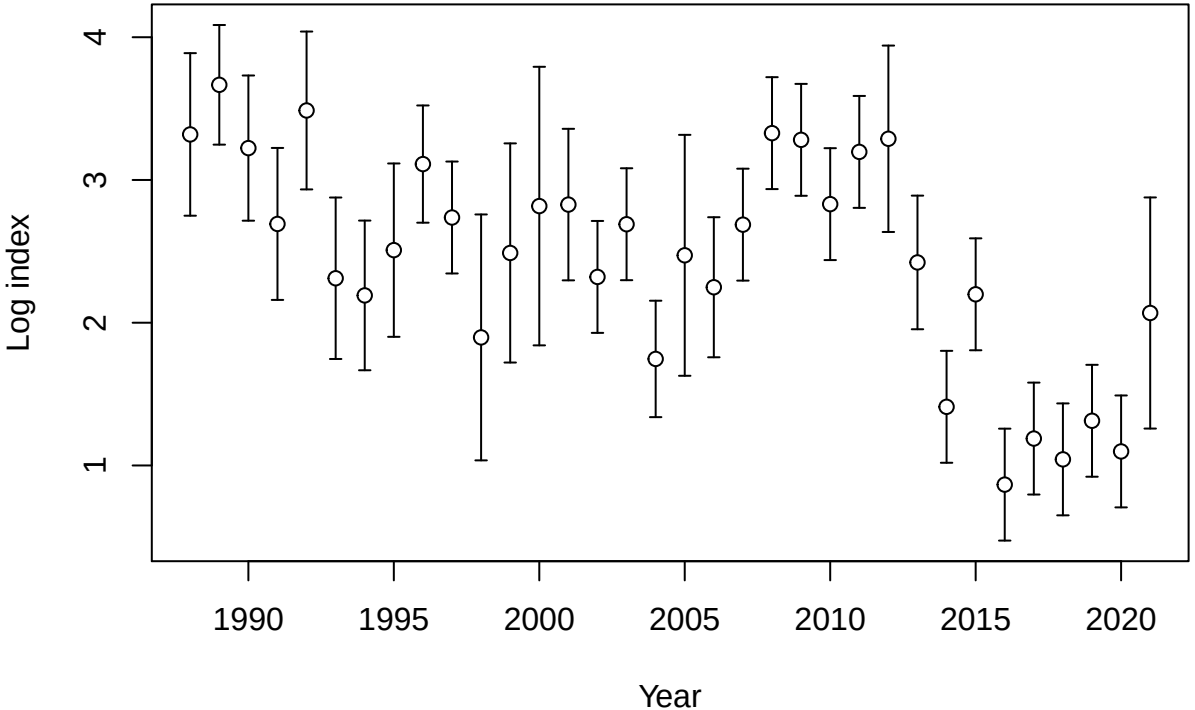

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

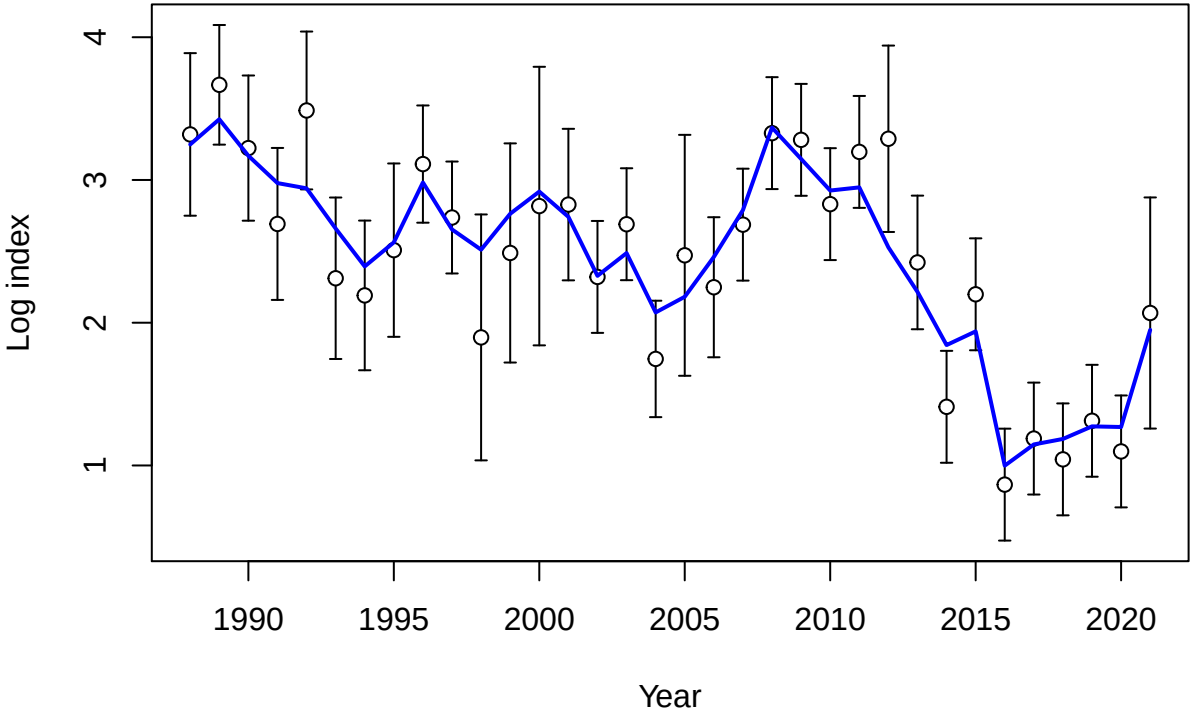

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
Relative spawning output: B/B_MSY
2021
1967

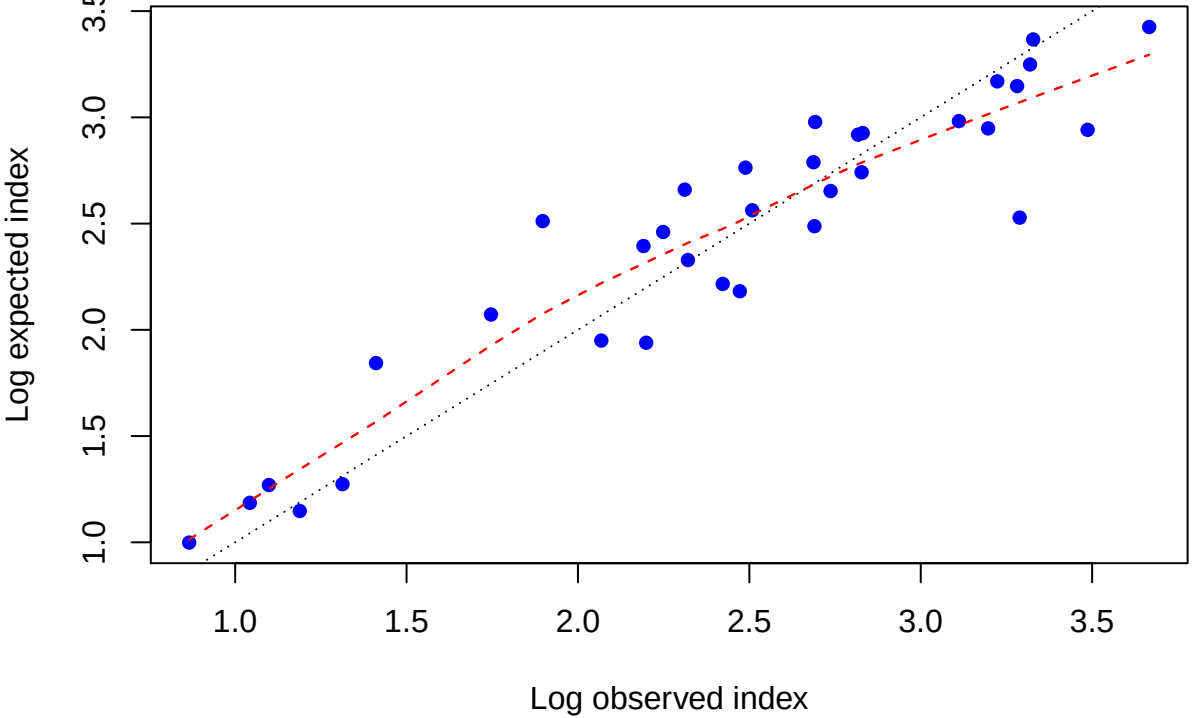

Index
0
10
20
30
40
50
60
1990
1995
2000
2005
2010
2015
2020
Year

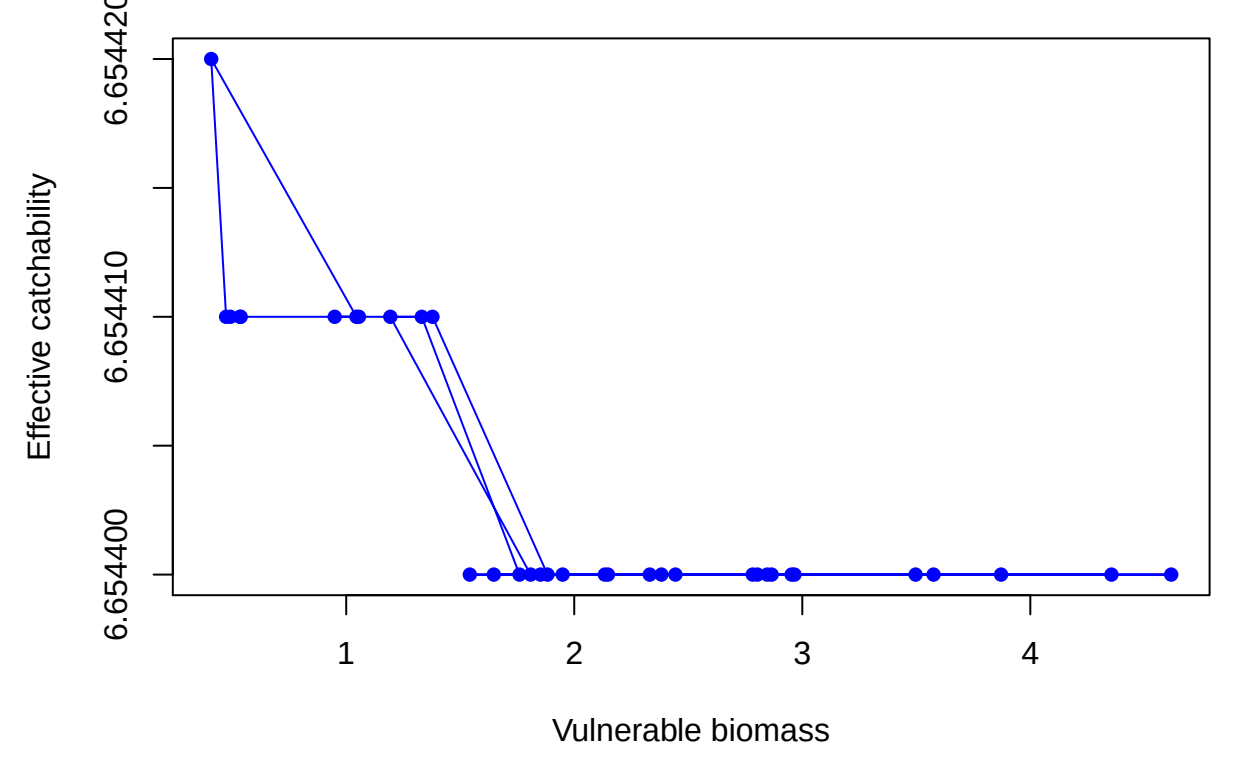

Index
0
10
20
30
40
50
60
1990
1995
2000
2005
2010
2015
2020
Year

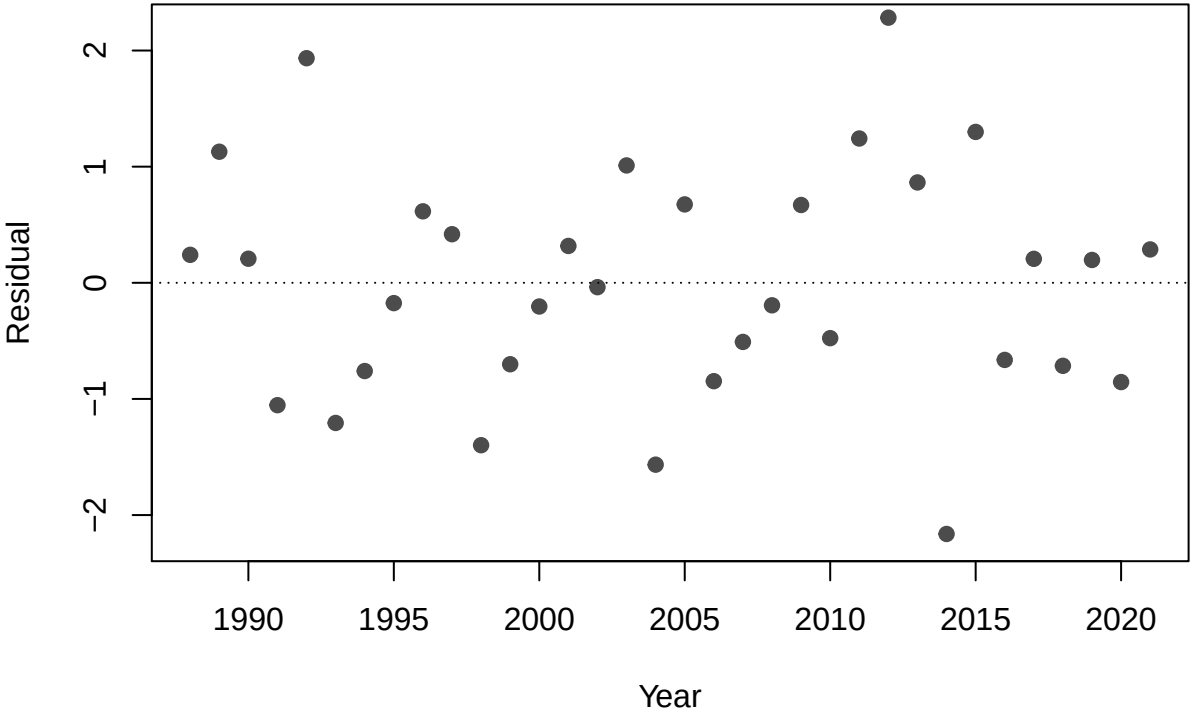

Expected index
Observed index
0
5
10
15
20
25
30
0
10
20
30
40

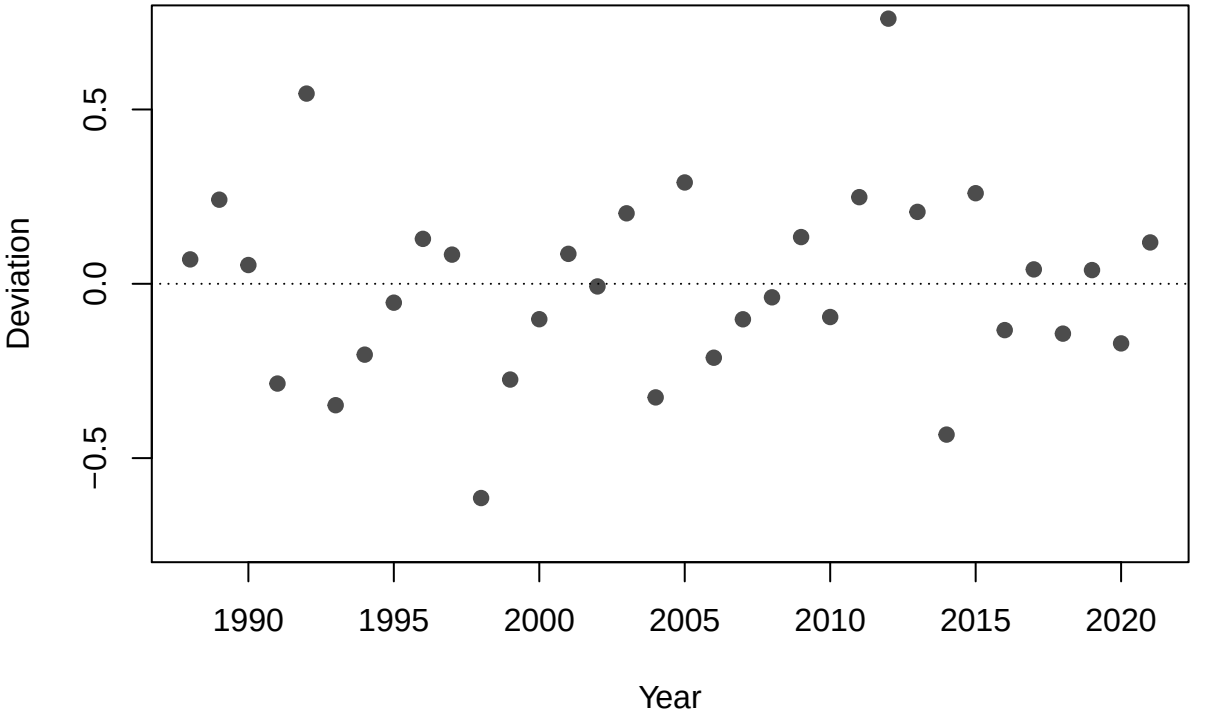

Log index
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

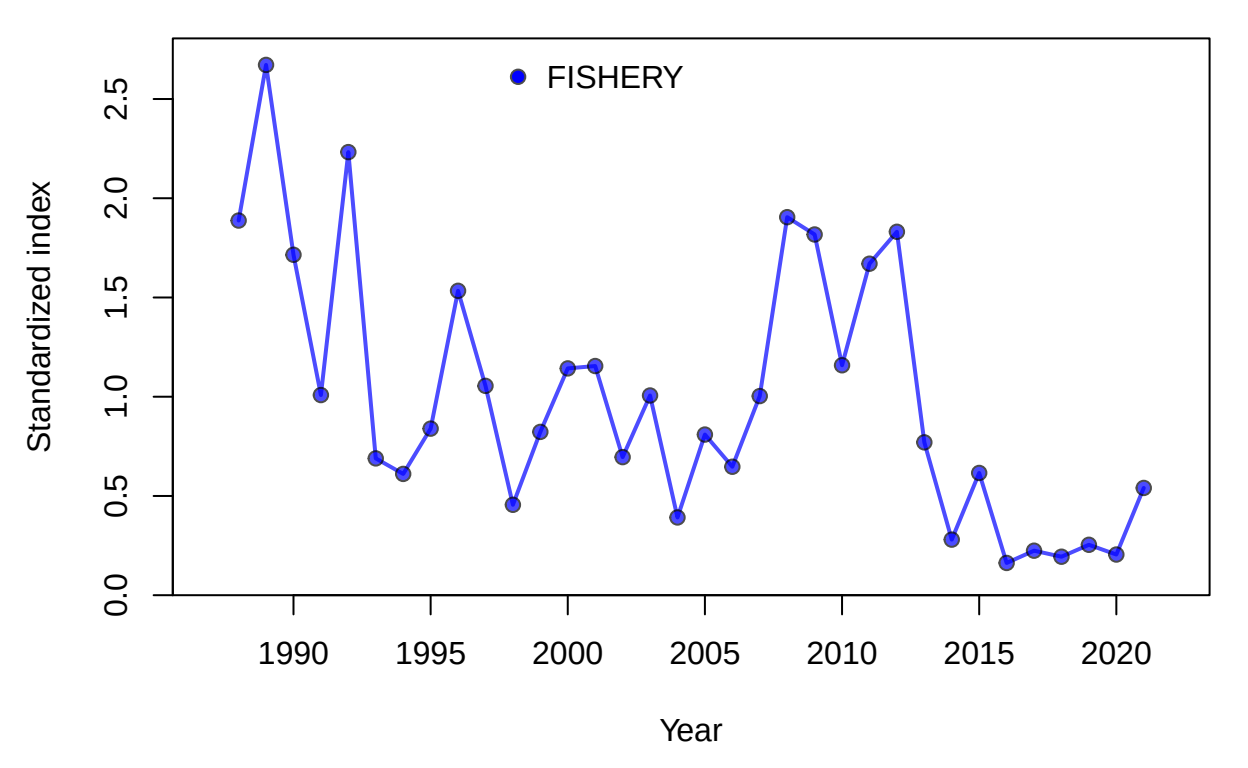

Log index
4
3
2
1
1990
1995
2000
2005
2010
2015
2020
Year

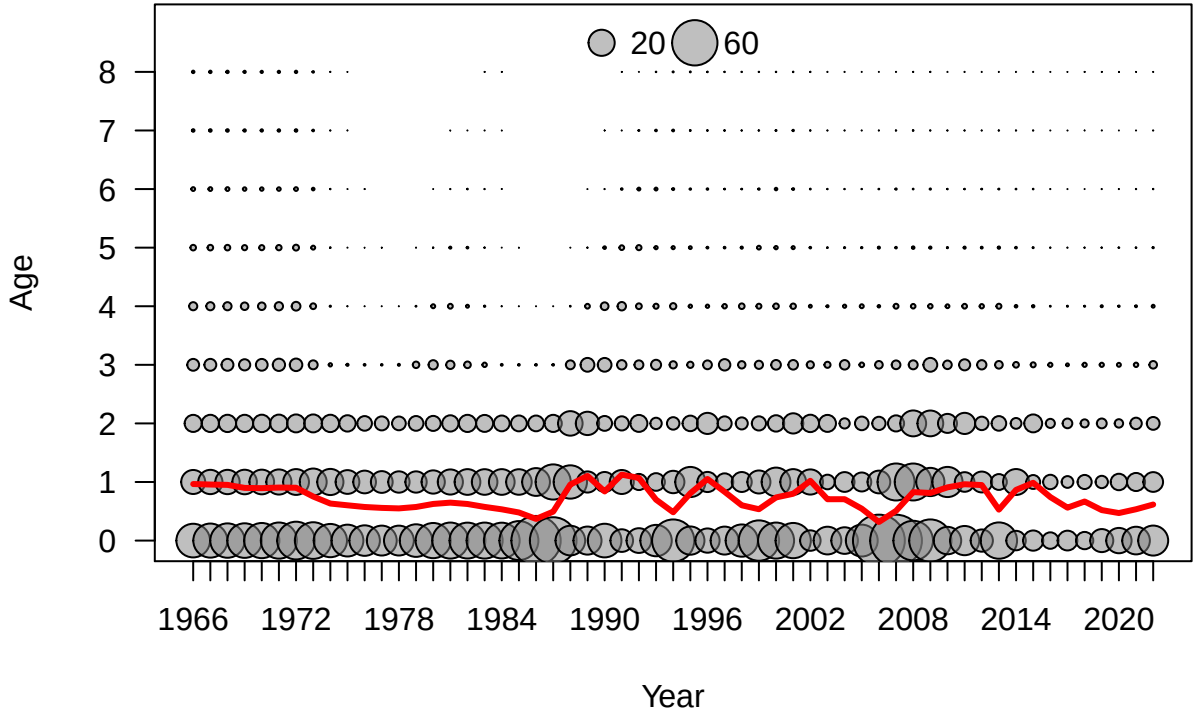

Log expected index
Log observed index
1.0
1.5
2.0
2.5
3.0
3.5

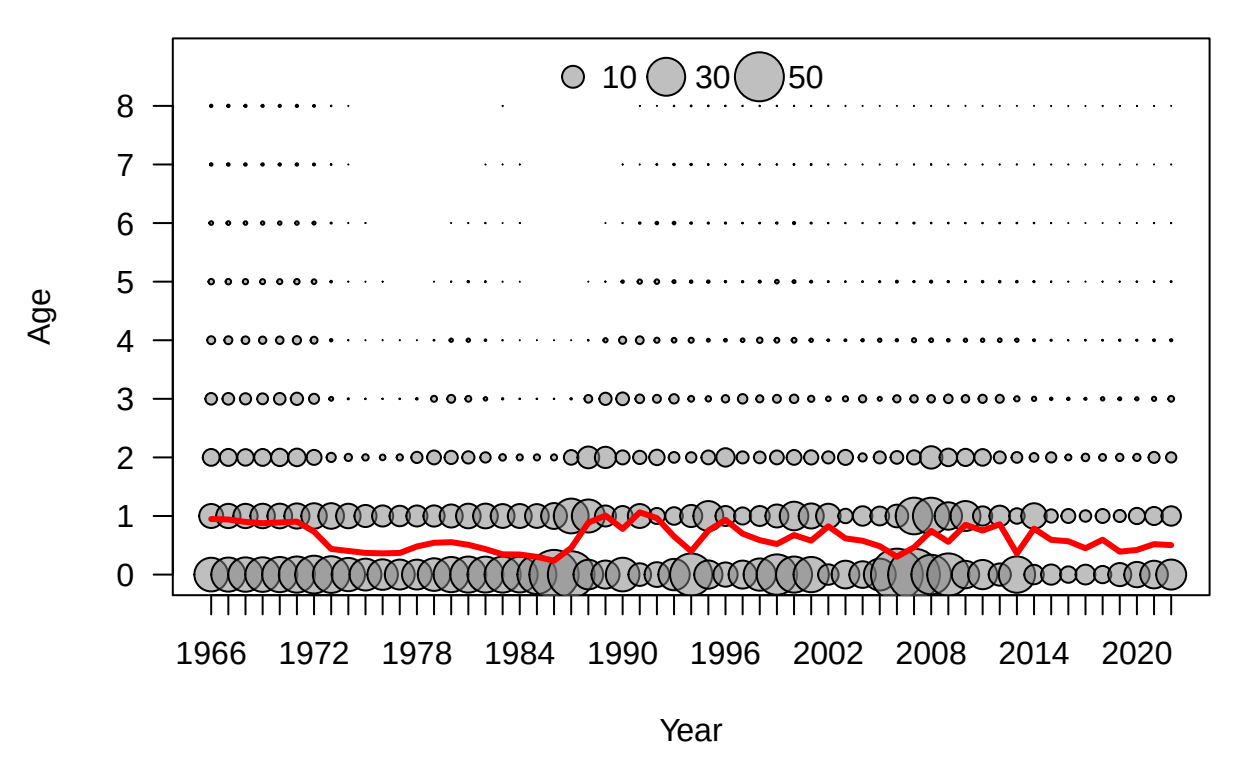

Effective catchability
6.654420
6.654410
6.654400
1
2
3
4
Vulnerable biomass

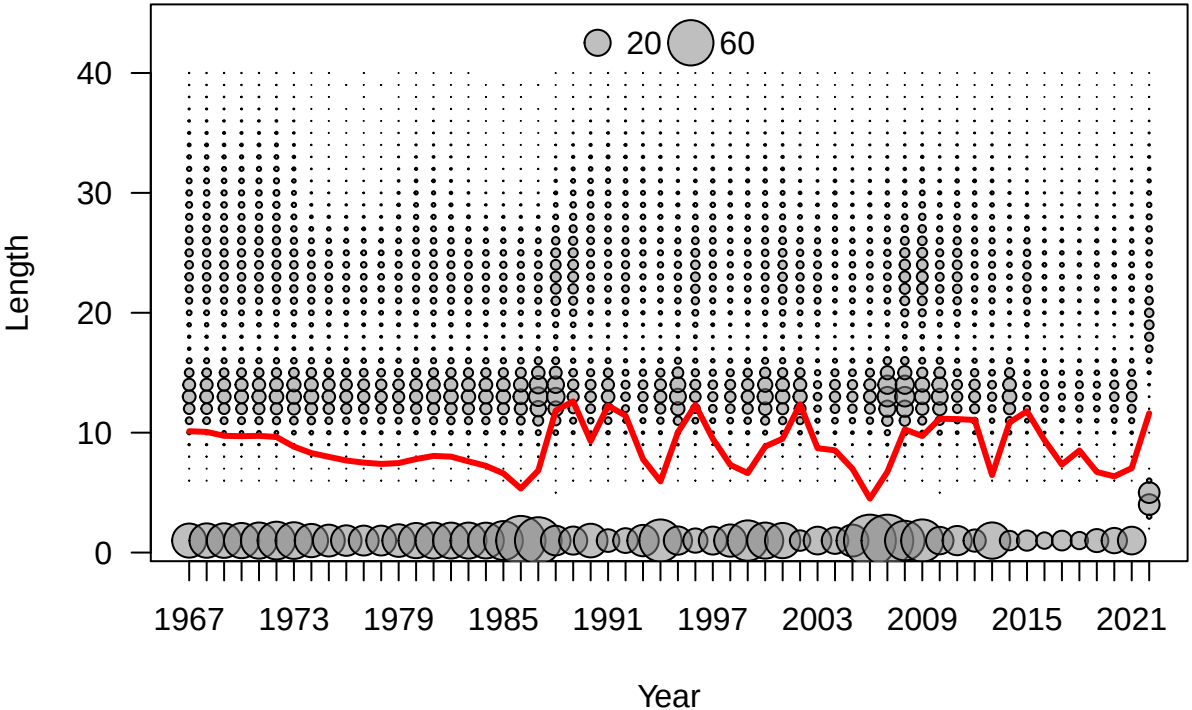

Residual
2
1
0
−1
−2
1990
1995
2000
2005
2010
2015
2020
Year

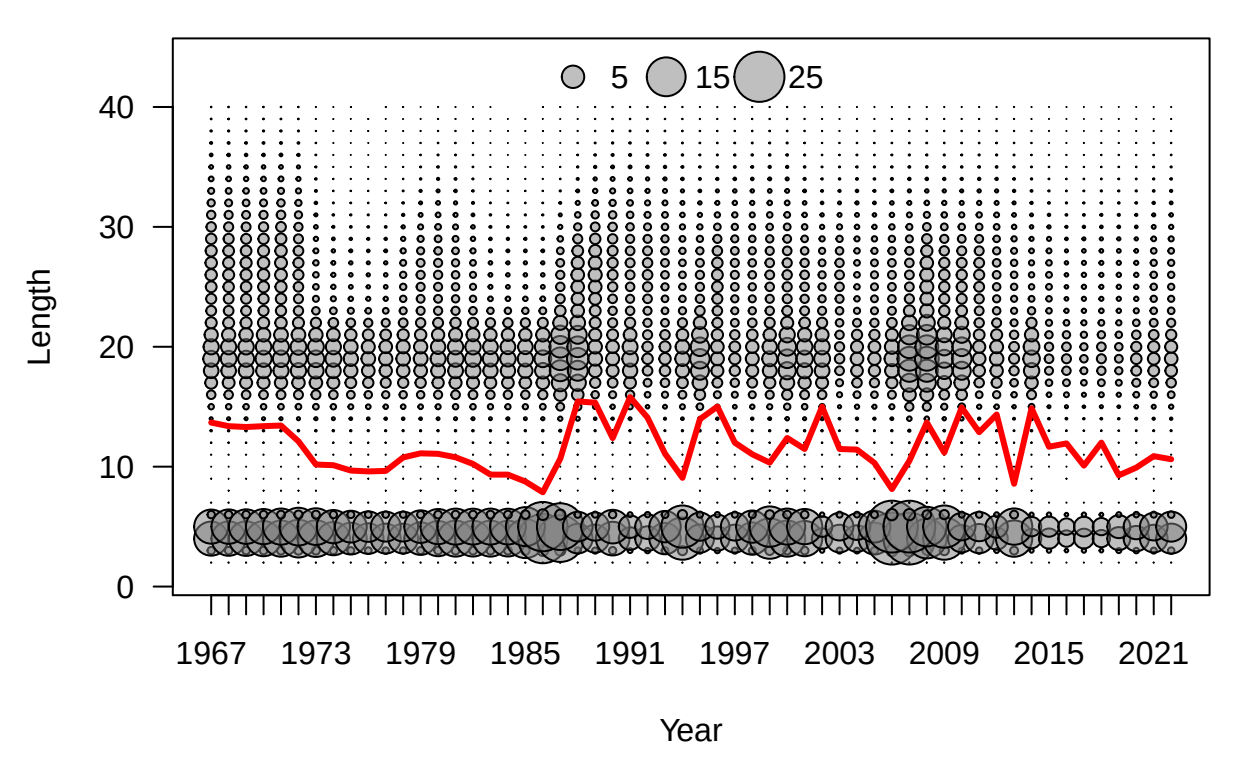

Deviation
0.5
0.0
−0.5
1990
1995
2000
2005
2010
2015
2020
Year

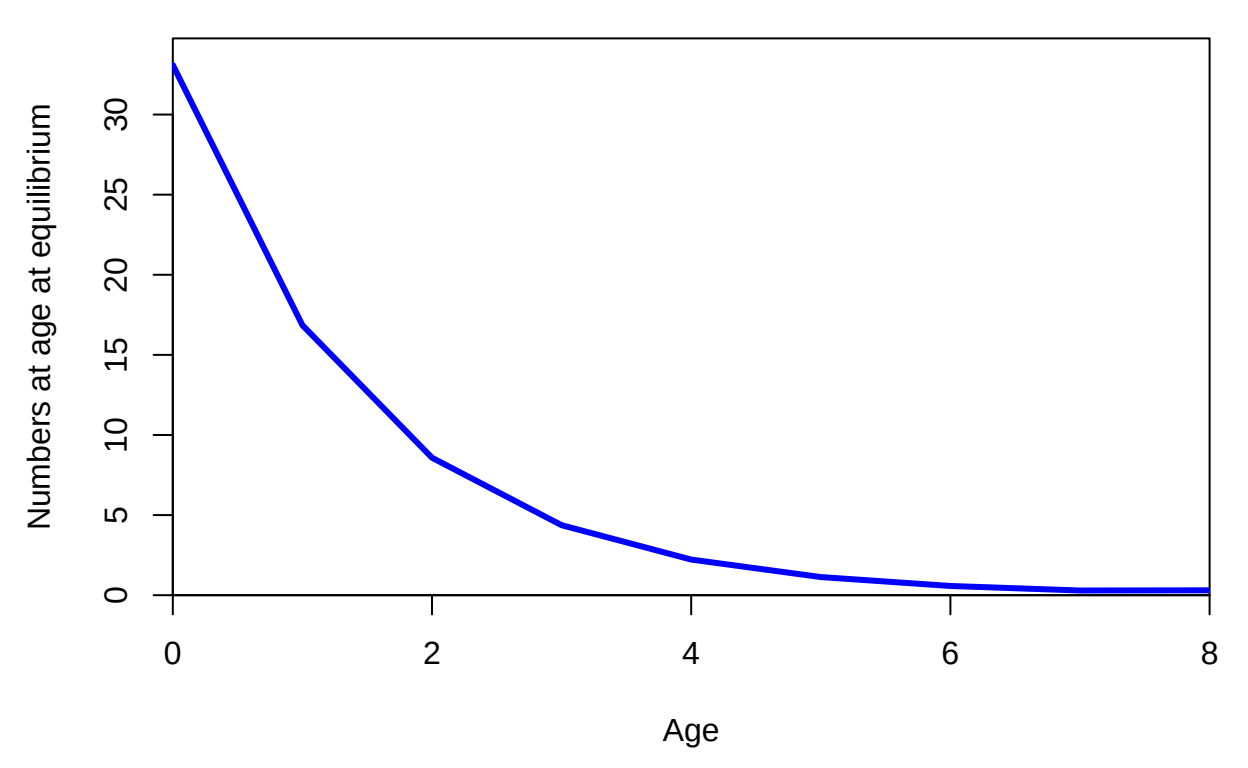

FISHERY
Standardized index
0.0
0.5
1.0
1.5
2.0
2.5
1990
1995
2000
2005
2010
2015
2020
Year

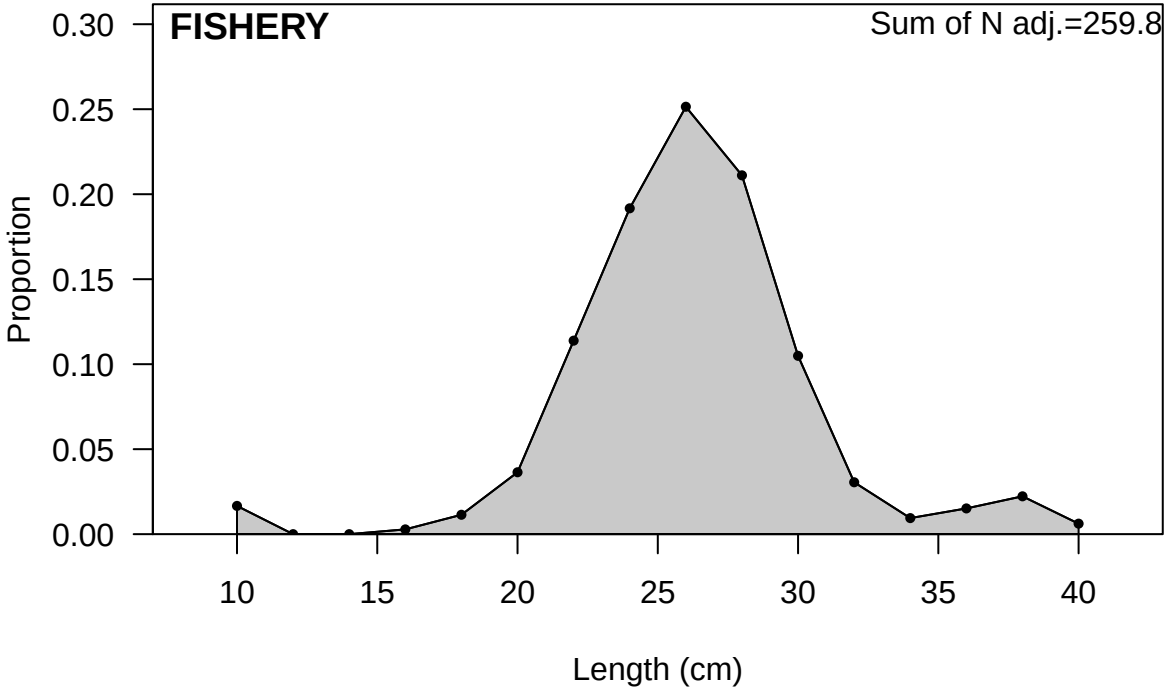

20
60
Age
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

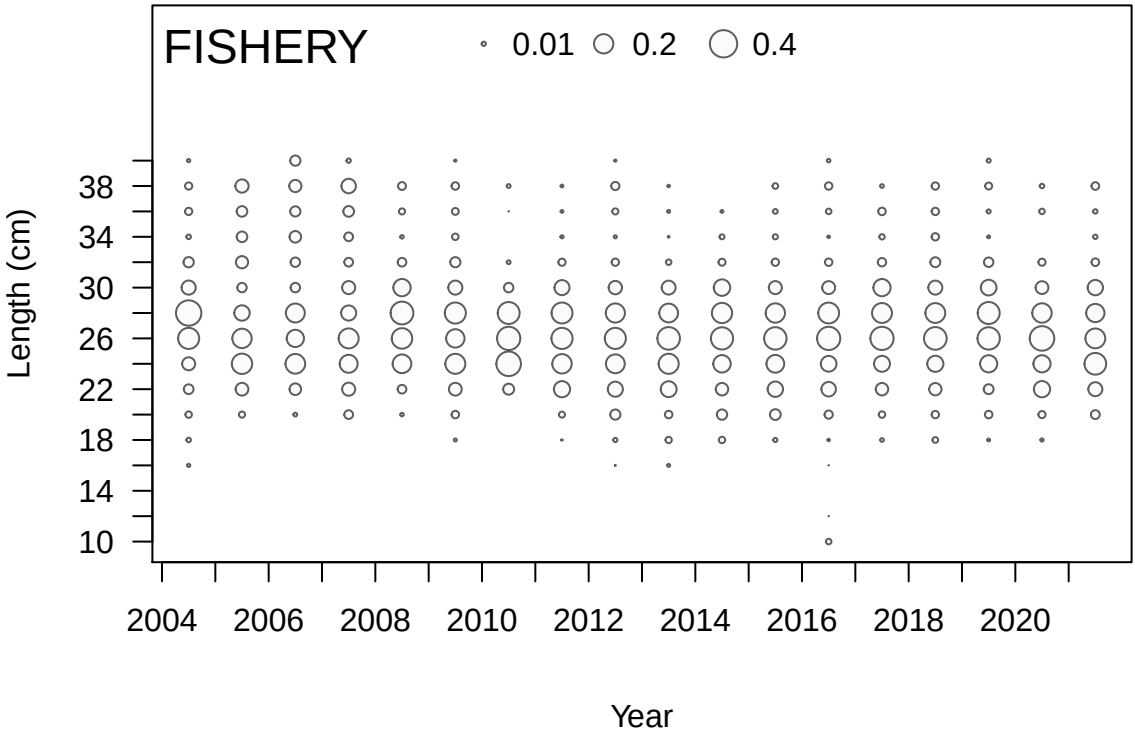

10
30
50
Age
8
7
6
5
4
3
2
1
0
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

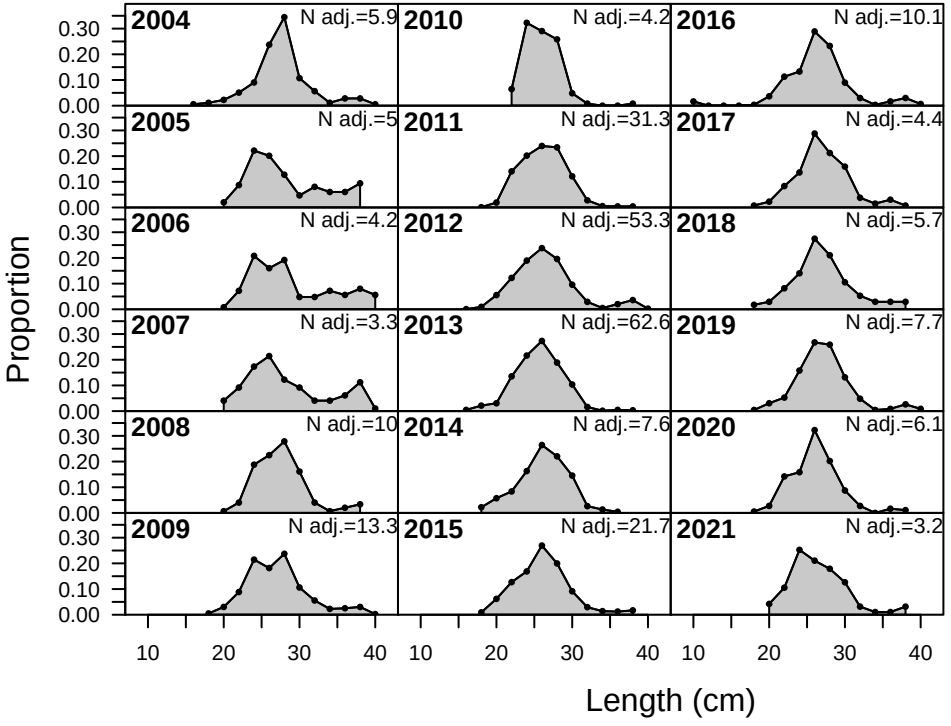

20
60
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

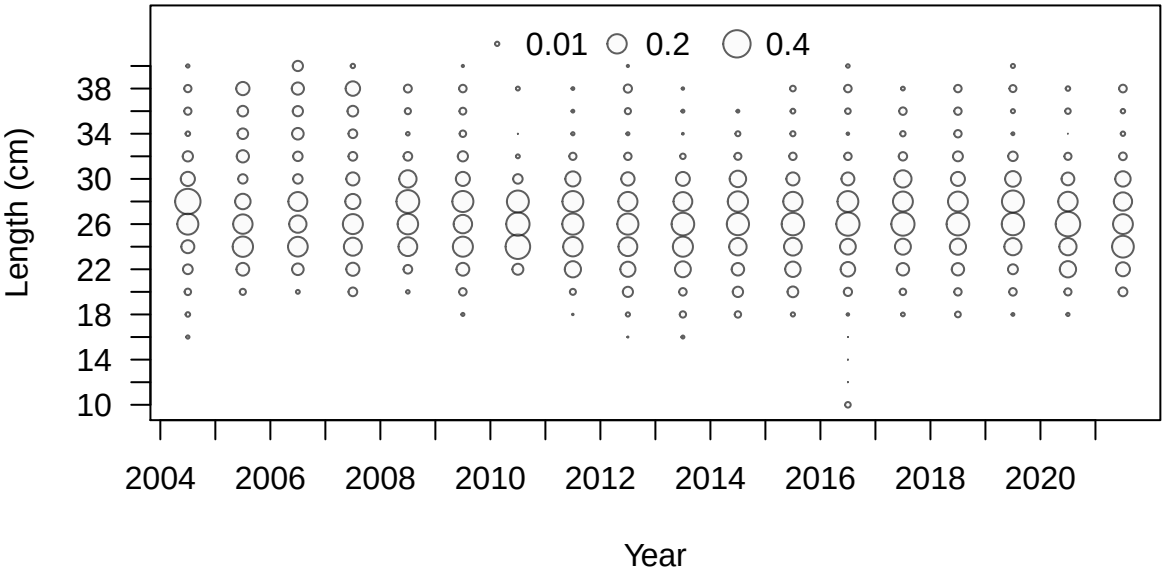

5
15
25
40
30
20
10
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

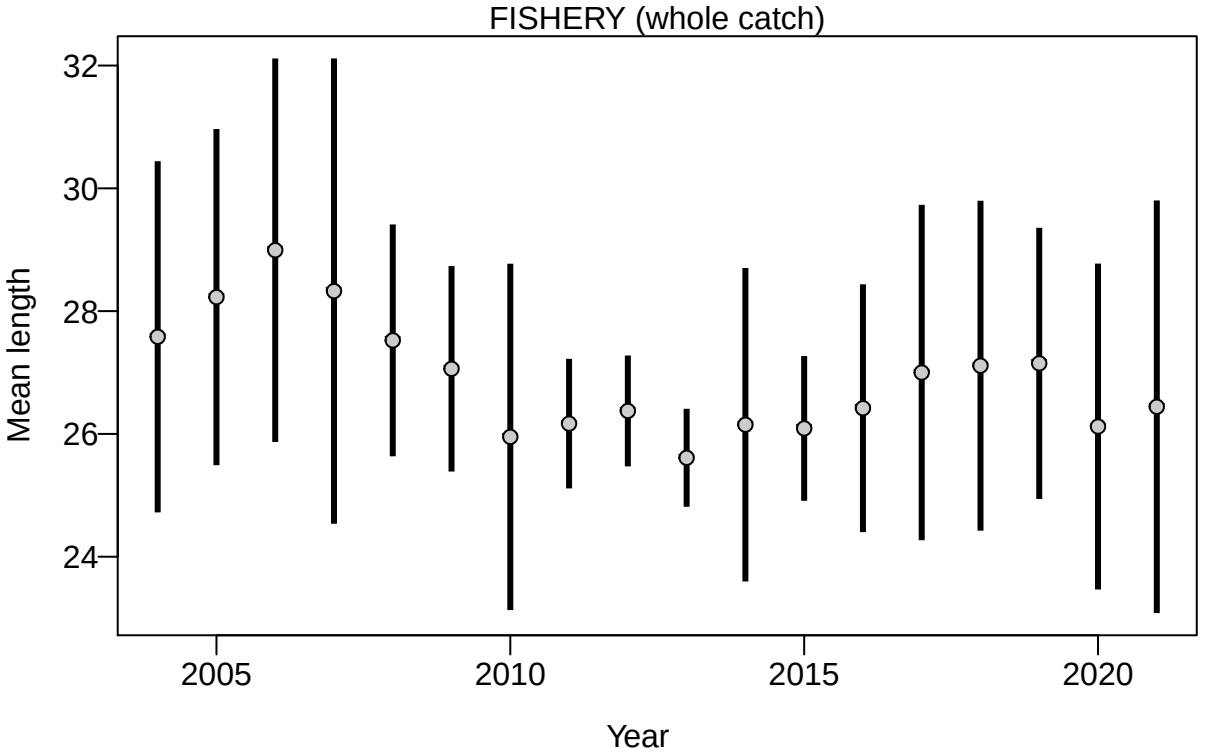

Numbers at age at equilibrium
0
5
10
15
20
25
30
0
2
4
6
8
Age

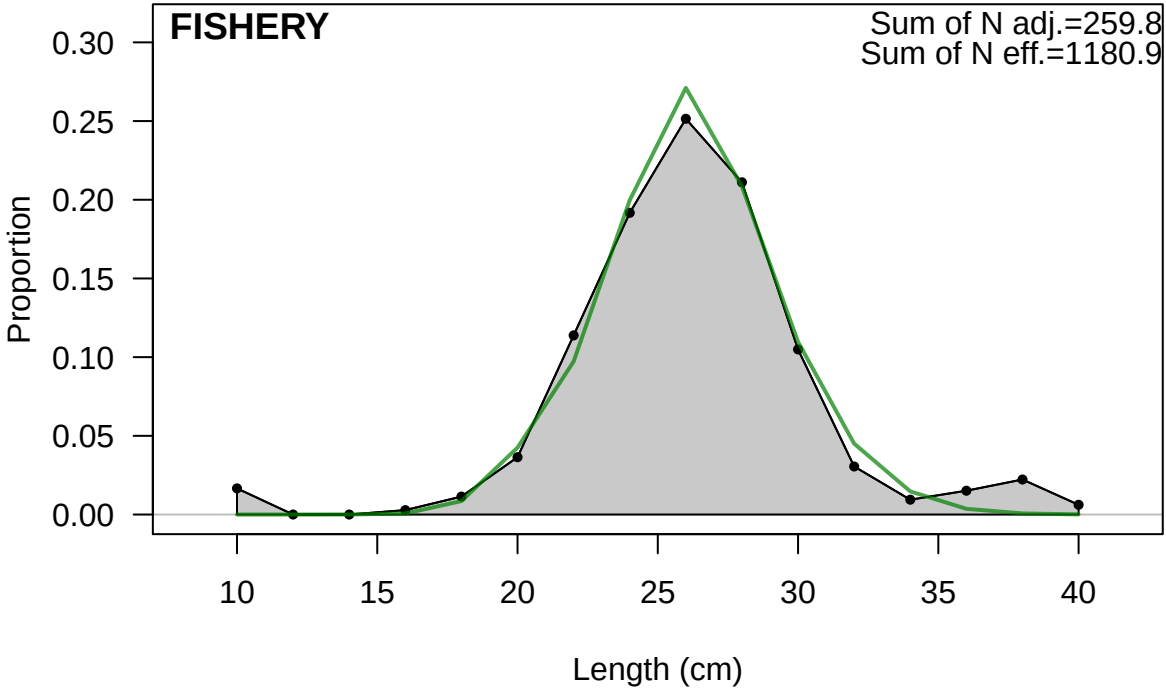

FISHERY
Sum of N adj.=259.8
Proportion
0.30
0.25
0.20
0.15
0.10
0.05
0.00
10
15
20
25
30
35
40
Length (cm)

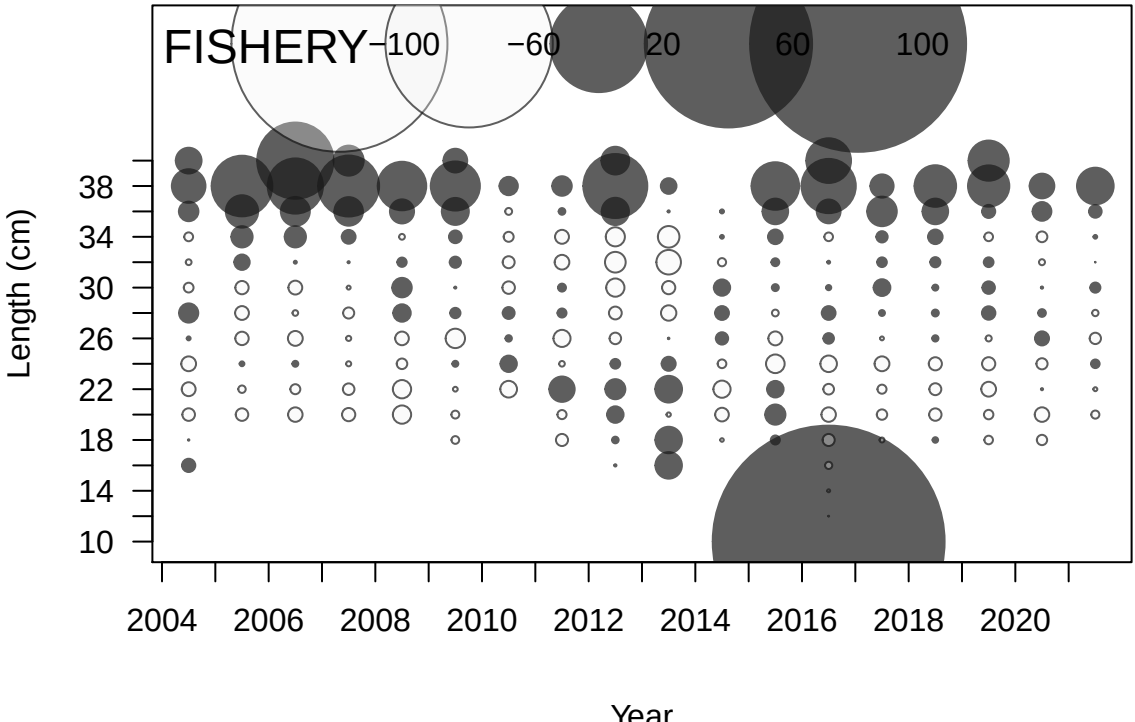

FISHERY
0.01
0.2
0.4
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

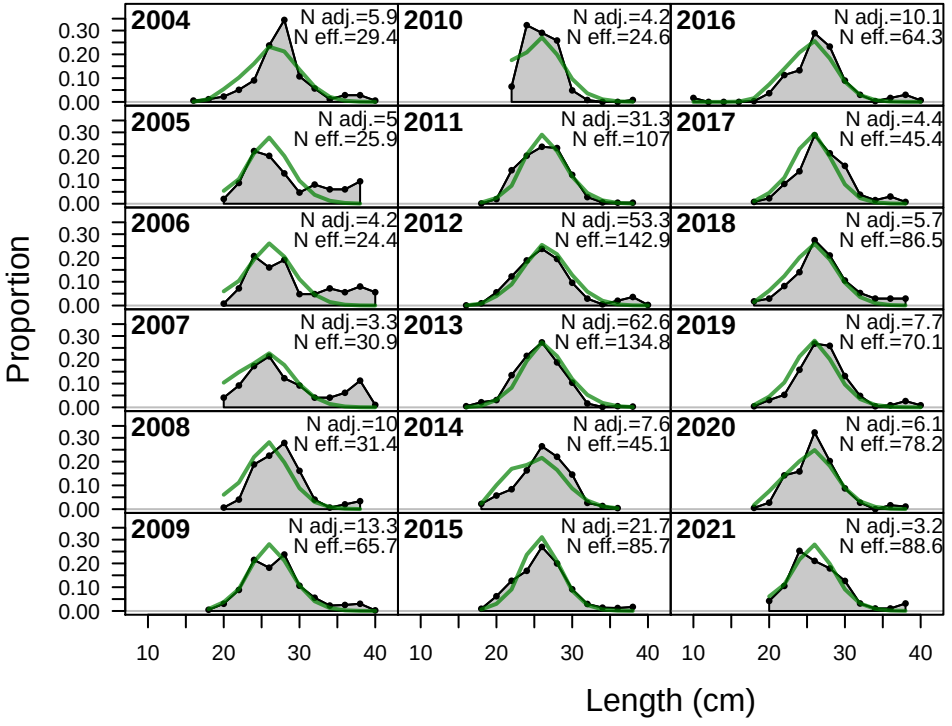

2004
N adj.=5.9
2010
N adj.=4.2
2016
N adj.=10.1
2005
N adj.=5
2011
N adj.=31.3
2017
N adj.=4.4
2006
N adj.=4.2
2012
N adj.=53.3
2018
N adj.=5.7
2007
N adj.=3.3
2013
N adj.=62.6
2019
N adj.=7.7
2008
N adj.=10
2014
N adj.=7.6
2020
N adj.=6.1
2009
N adj.=13.3
2015
N adj.=21.7
2021
N adj.=3.2
Proportion
0.00
0.10
0.20
0.30
10
20
30
40
Length (cm)

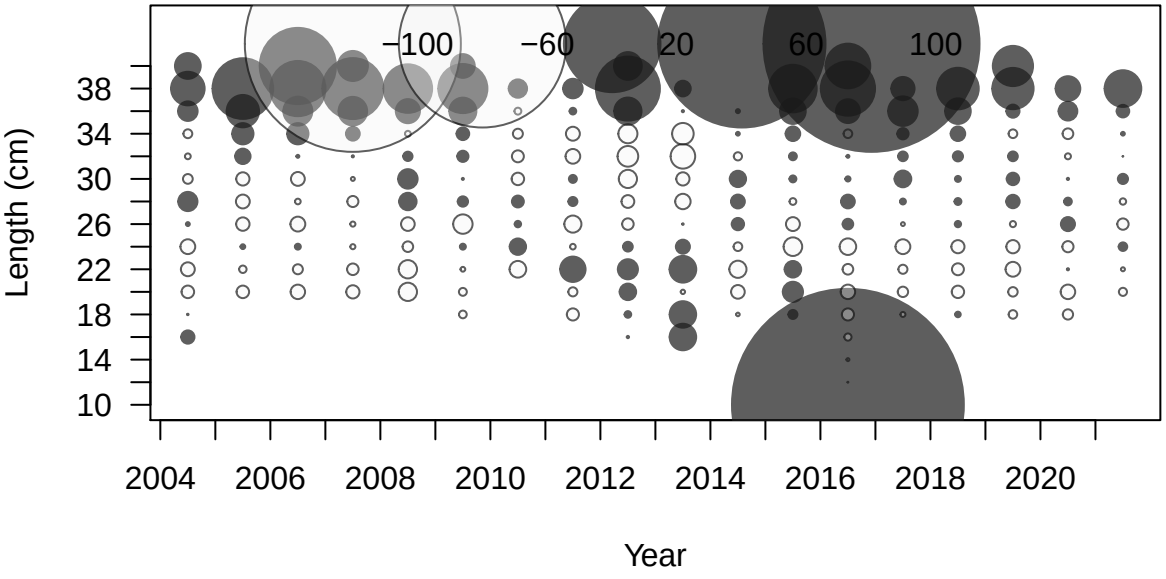

0.01
0.2
0.4
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

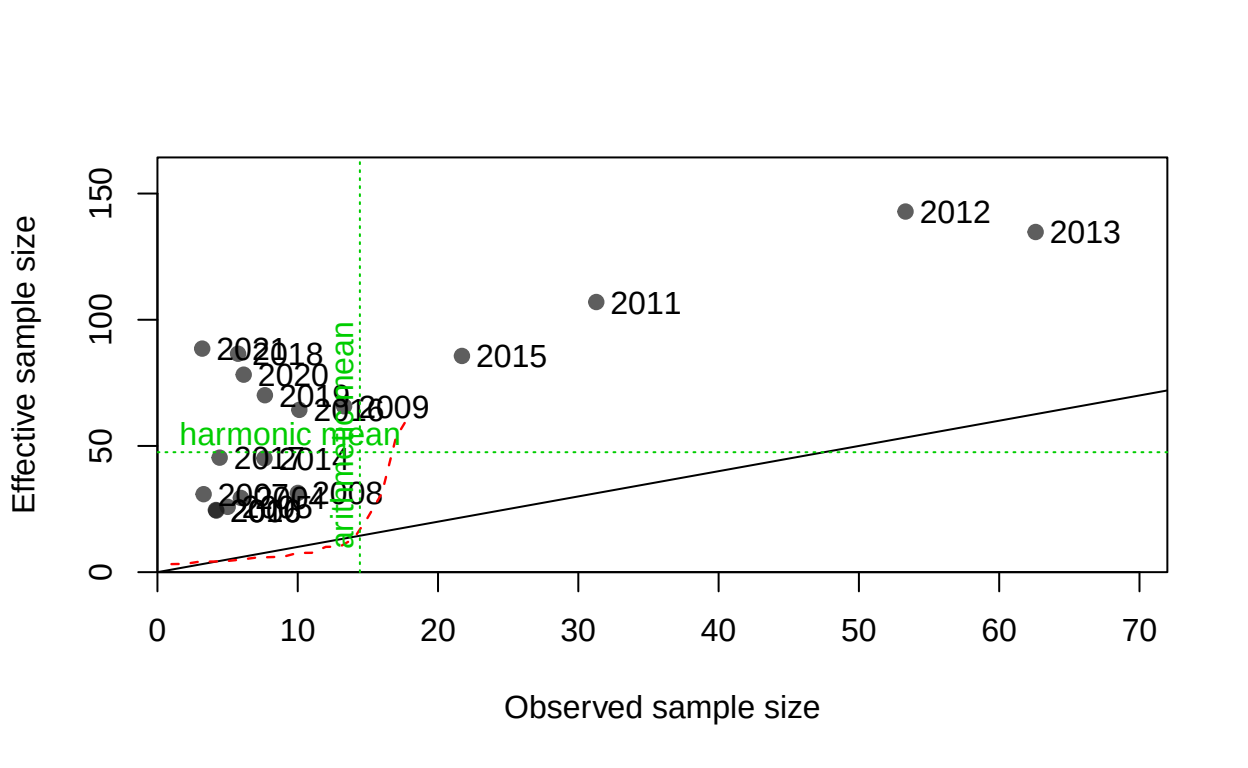

FISHERY (whole catch)
32
30
28
26
24
Mean length
2005
2010
2015
2020
Year

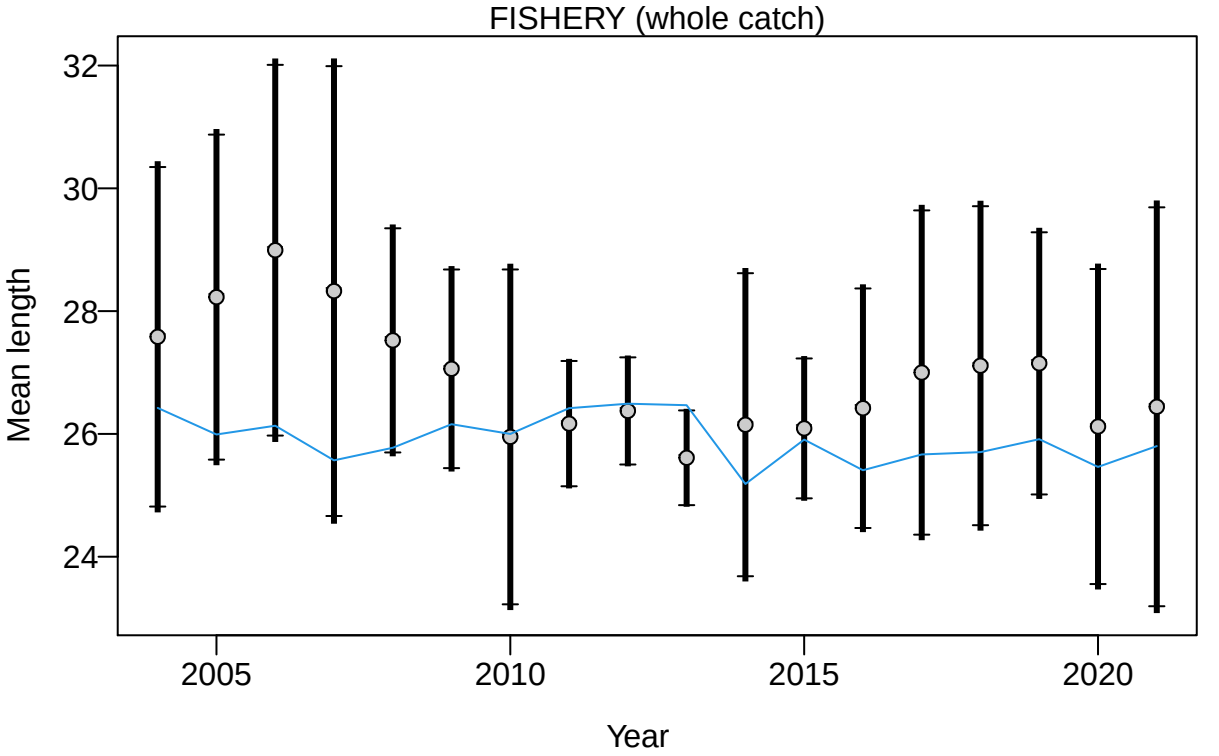

FISHERY
Sum of N adj.=259.8
Sum of N eff.=1180.9
Proportion
0.30
0.25
0.20
0.15
0.10
0.05
0.00
10
15
20
25
30
35
40
Length (cm)

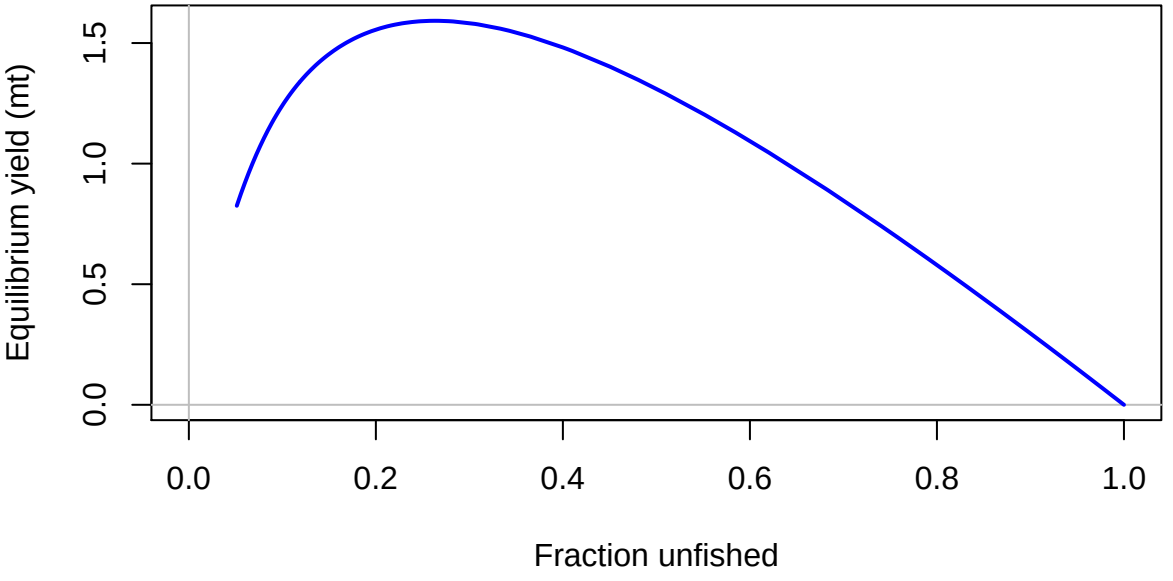

FISHERY
−100
−60
20
60
100
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

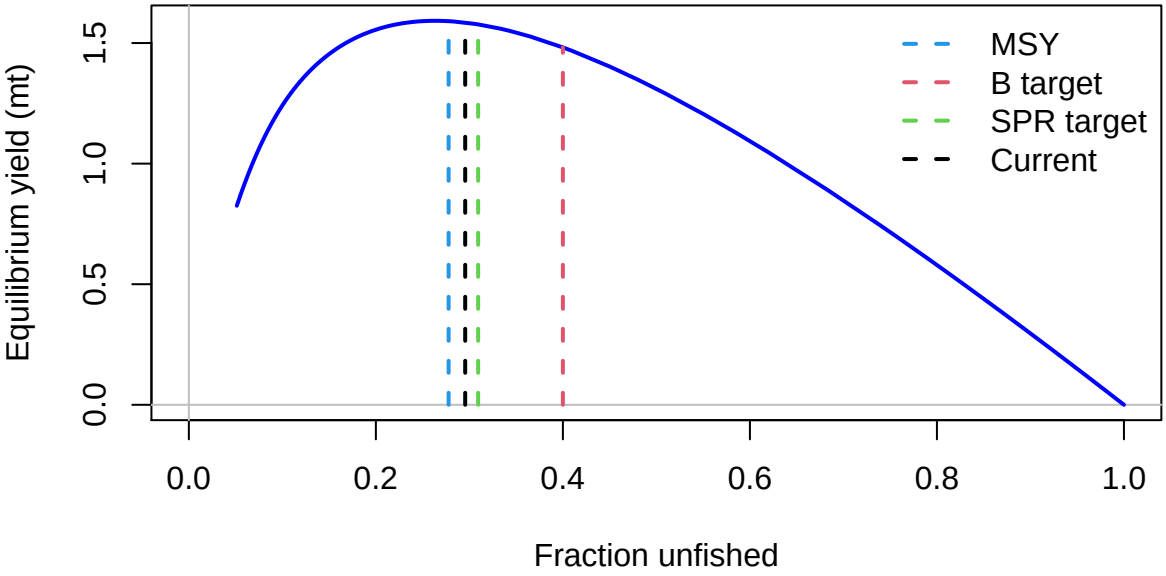

2004
N adj.=5.9
N eff.=29.4
2010
N adj.=4.2
N eff.=24.6
2016
N adj.=10.1
N eff.=64.3
2005
N adj.=5
N eff.=25.9
2011
N adj.=31.3
N eff.=107
2017
N adj.=4.4
N eff.=45.4
2006
N adj.=4.2
N eff.=24.4
2012
N adj.=53.3
N eff.=142.9
2018
N adj.=5.7
N eff.=86.5
2007
N adj.=3.3
N eff.=30.9
2013
N adj.=62.6
N eff.=134.8
2019
N adj.=7.7
N eff.=70.1
2008
N adj.=10
N eff.=31.4
2014
N adj.=7.6
N eff.=45.1
2020
N adj.=6.1
N eff.=78.2
2009
N adj.=13.3
N eff.=65.7
2015
N adj.=21.7
N eff.=85.7
2021
N adj.=3.2
N eff.=88.6
Proportion
0.00
0.10
0.20
0.30
10
20
30
40
Length (cm)

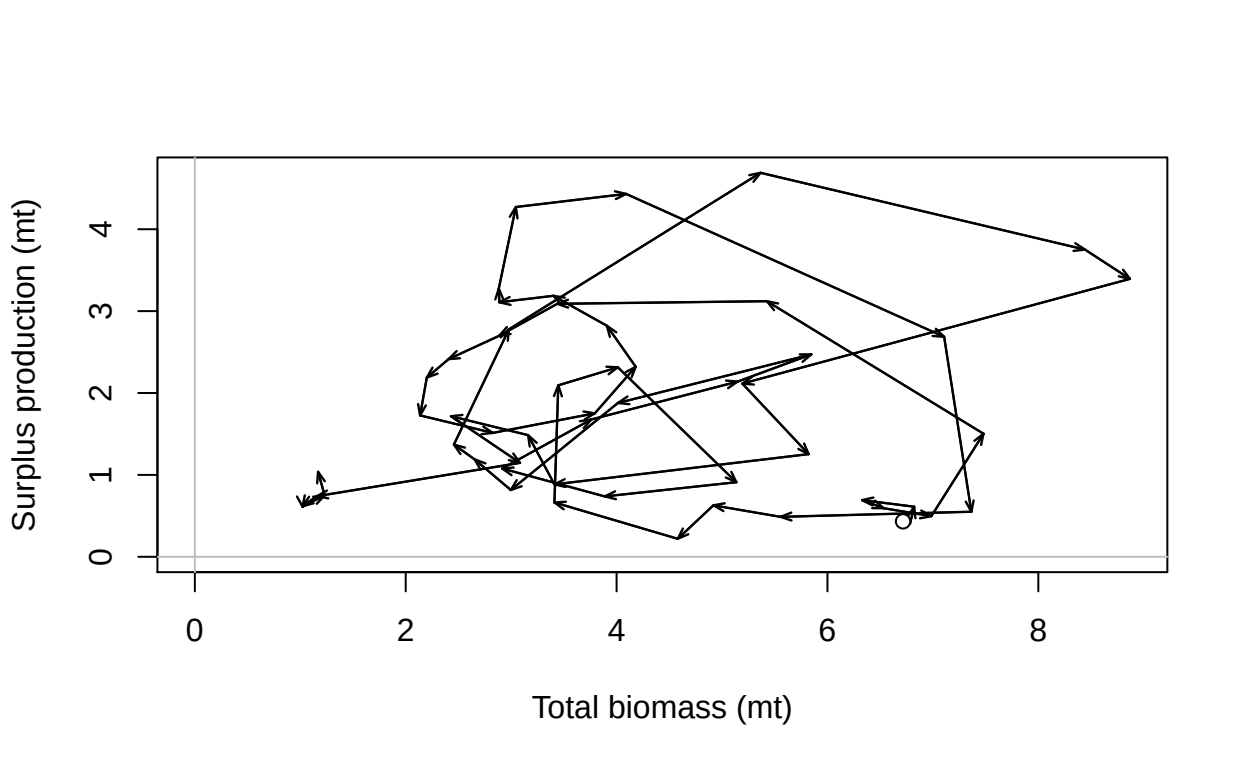

−100
−60
20
60
100
Length (cm)
38
34
30
26
22
18
14
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
Year

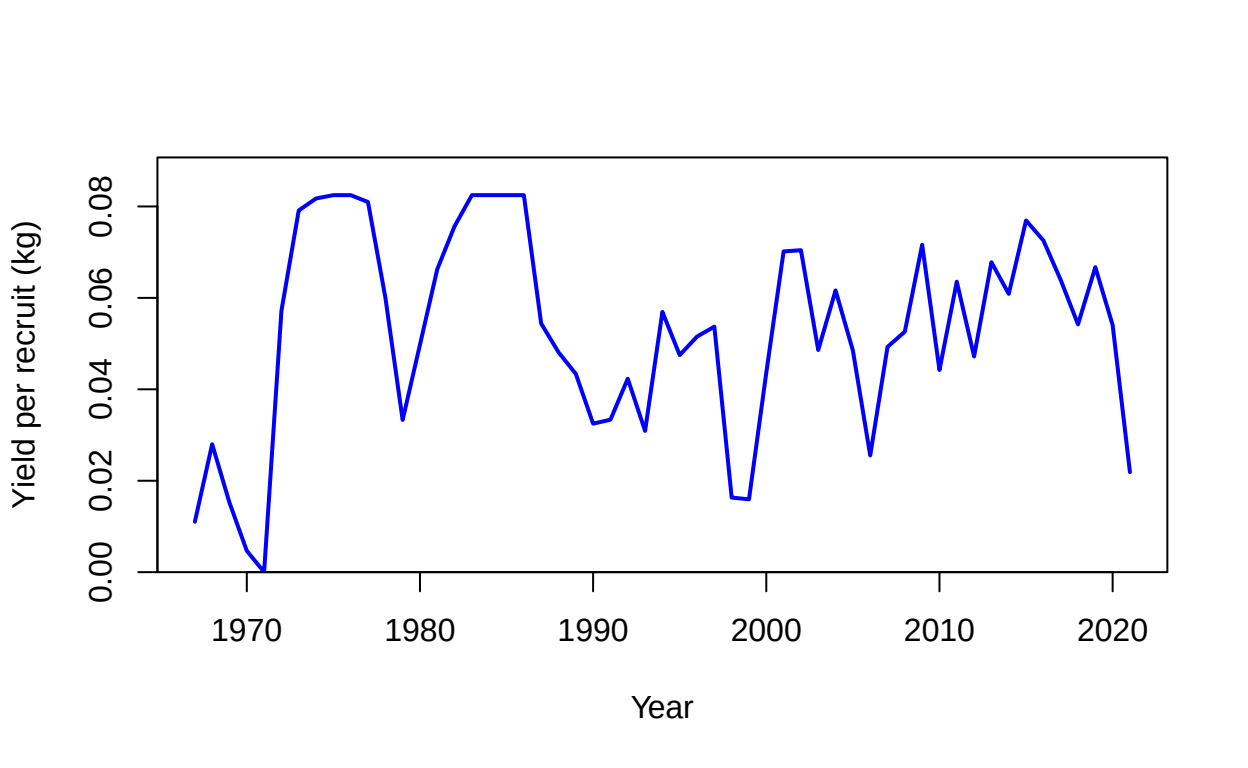

Effective sample size
Observed sample size
0
50
100
150
0
10
20
30
40
50
60
70
2012
2013
2011
2015
2021
2018
2020
2009
harmonic mean
arithmetic mean

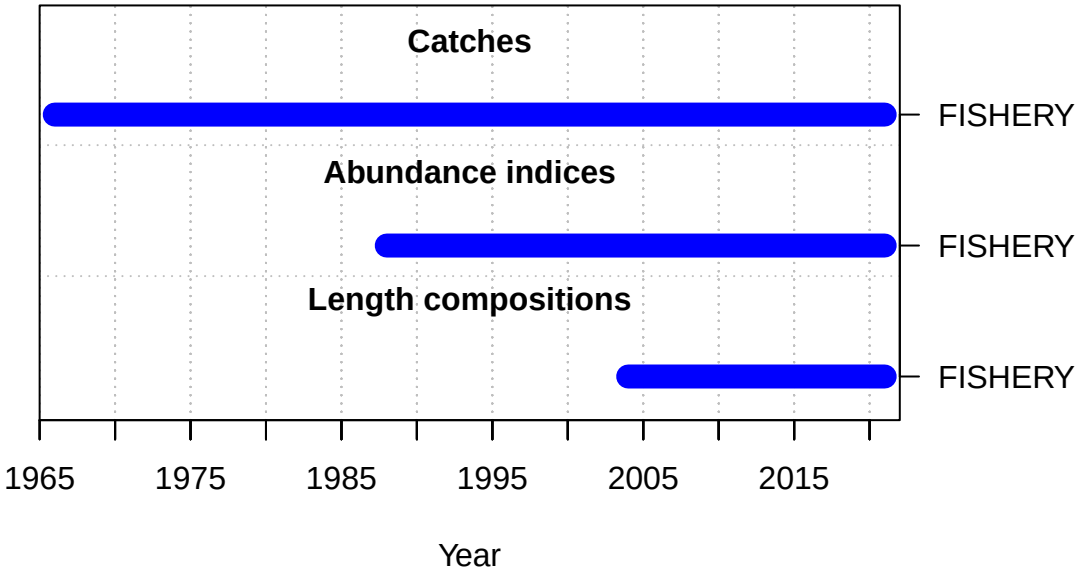

FISHERY (whole catch)
32
30
28
26
24
Mean length
2005
2010
2015
2020
Year

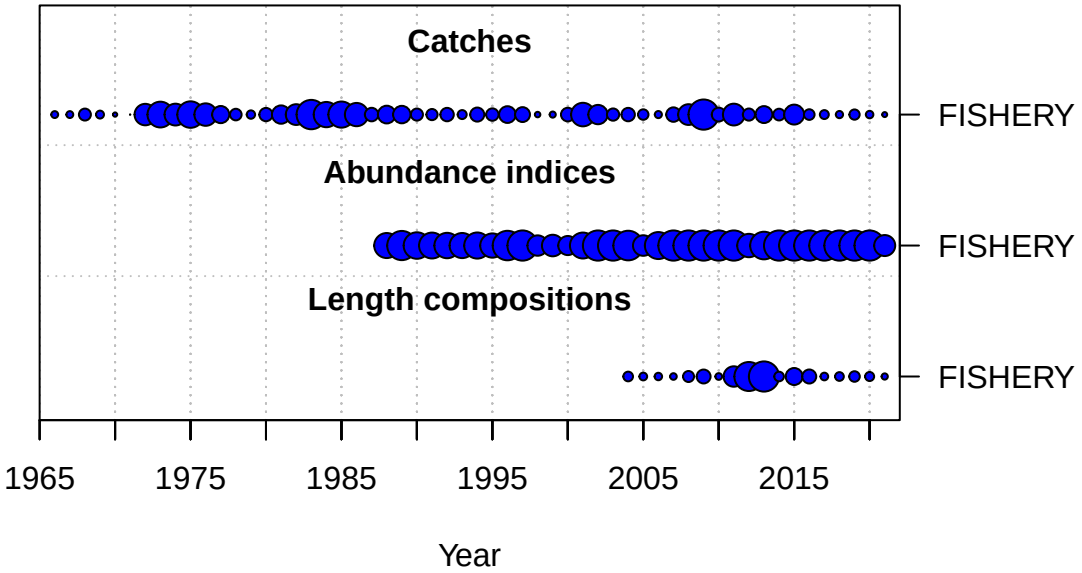

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

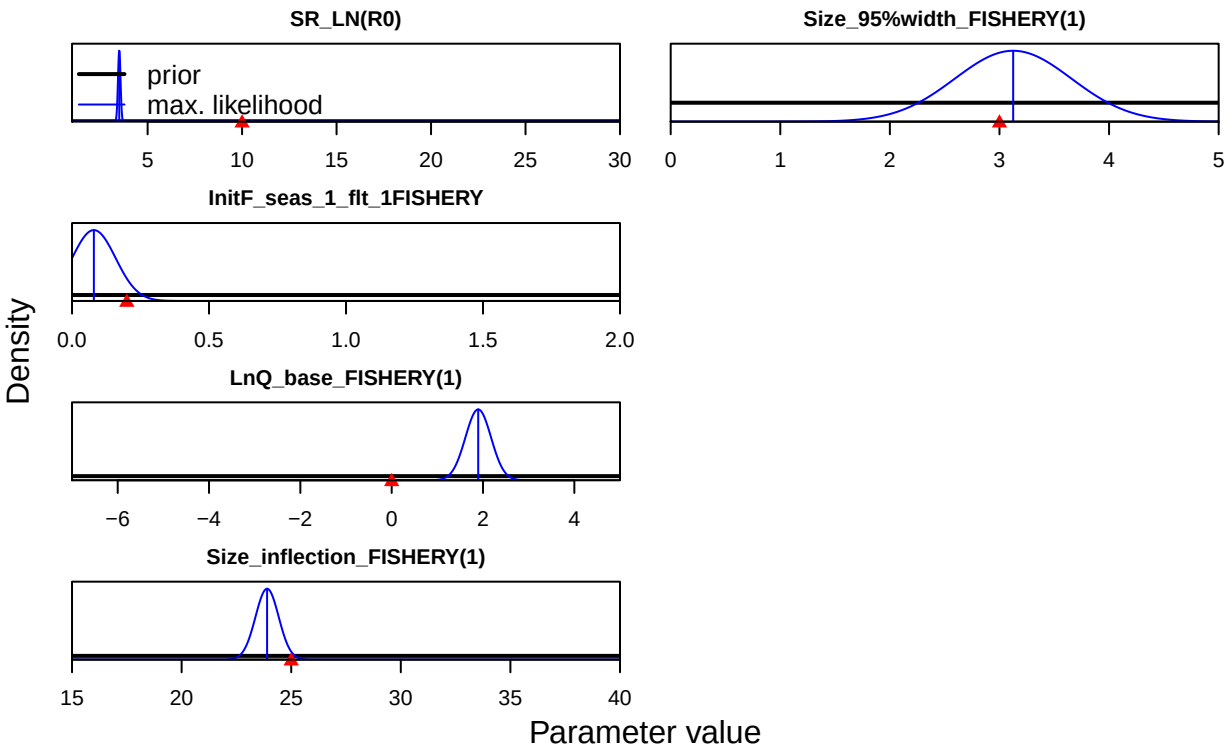

Equilibrium yield (mt)
0.0
0.5
1.0
1.5
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0
1
2
3
4
0
2
4
6
8
Total biomass (mt)


Yield per recruit (kg)
0.00
0.02
0.04
0.06
0.08
1970
1980
1990
2000
2010
2020
Year


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


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


SR_LN(R0)
prior
max. likelihood
5
10
15
20
25
30
Size_95%width_FISHERY(1)
0
1
2
3
4
5
InitF_seas_1_flt_1FISHERY
0.0
0.5
1.0
1.5
2.0
LnQ_base_FISHERY(1)
−6
−4
−2
0
2
4
Size_inflection_FISHERY(1)
15
20
25
30
35
40
Density
Parameter value