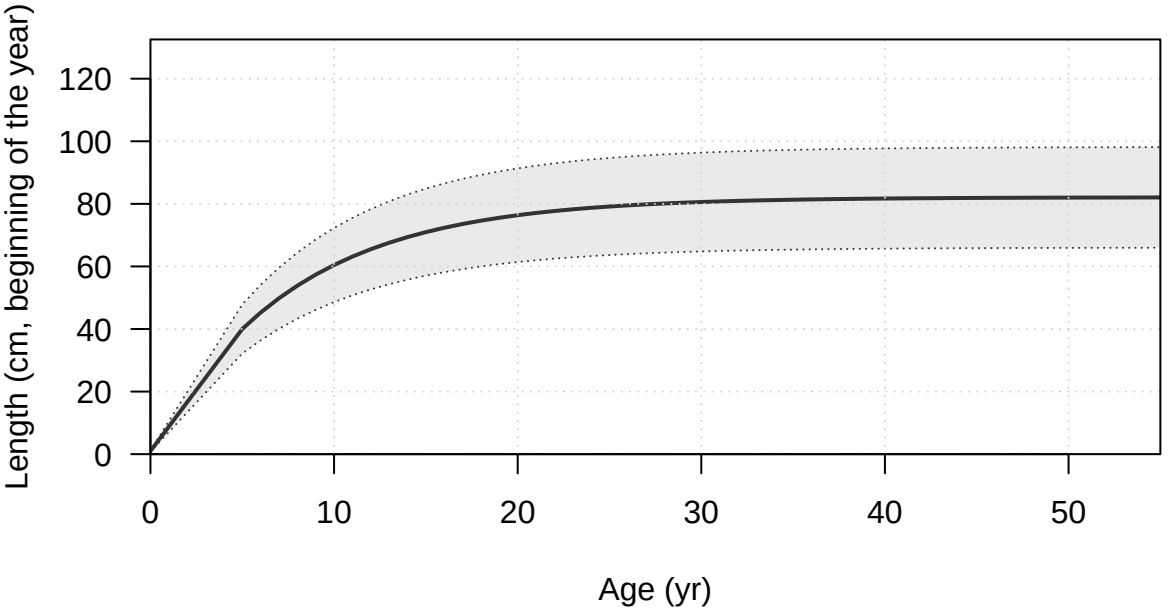
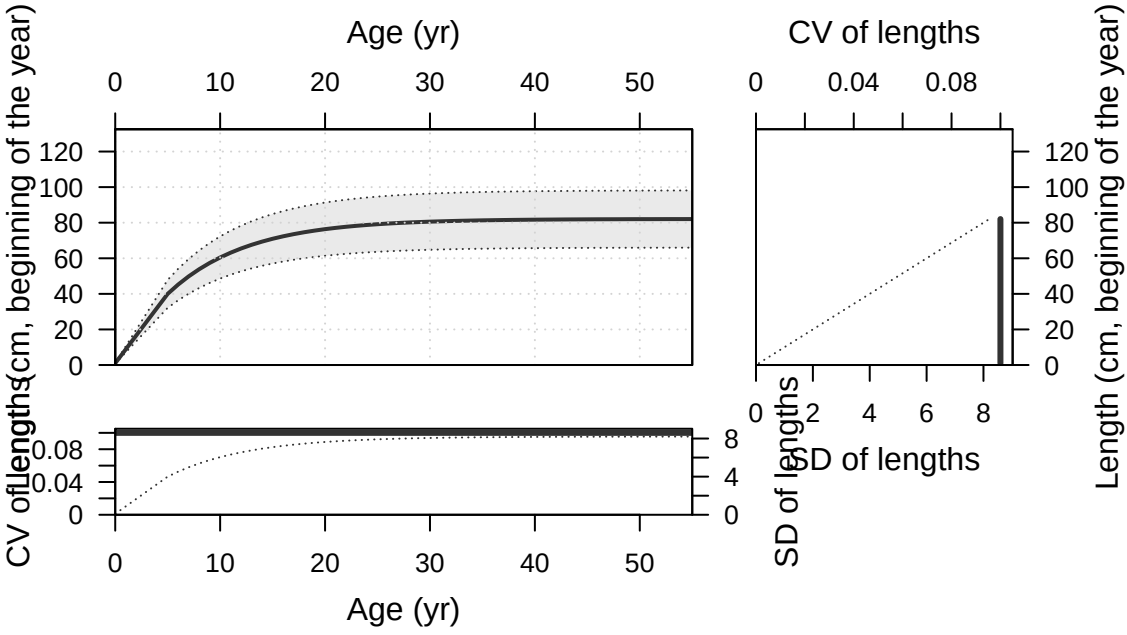
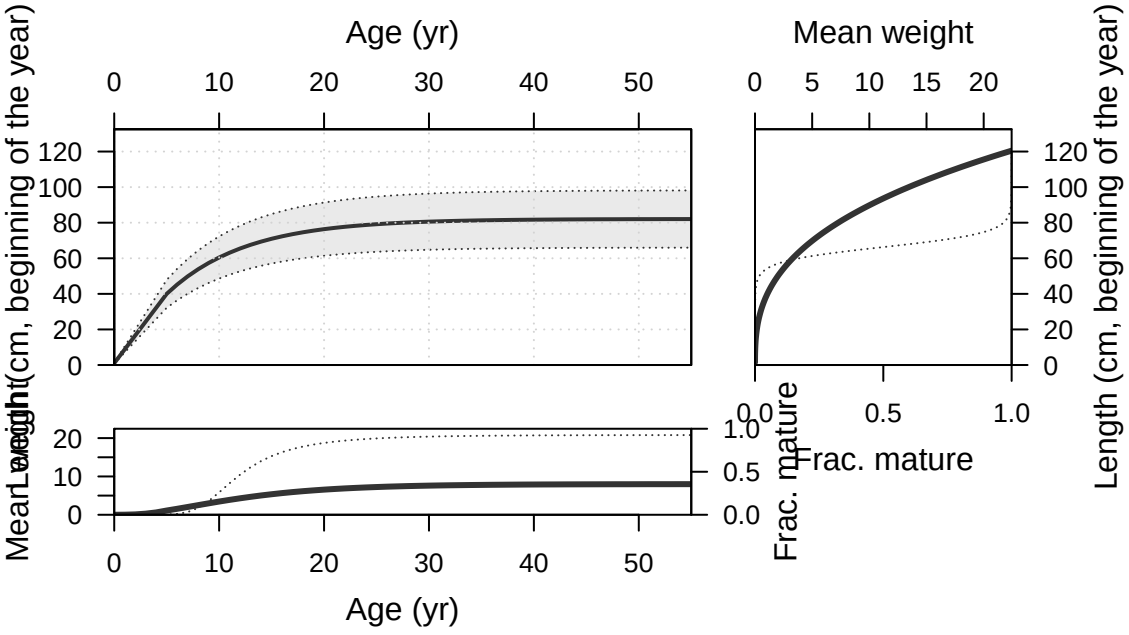
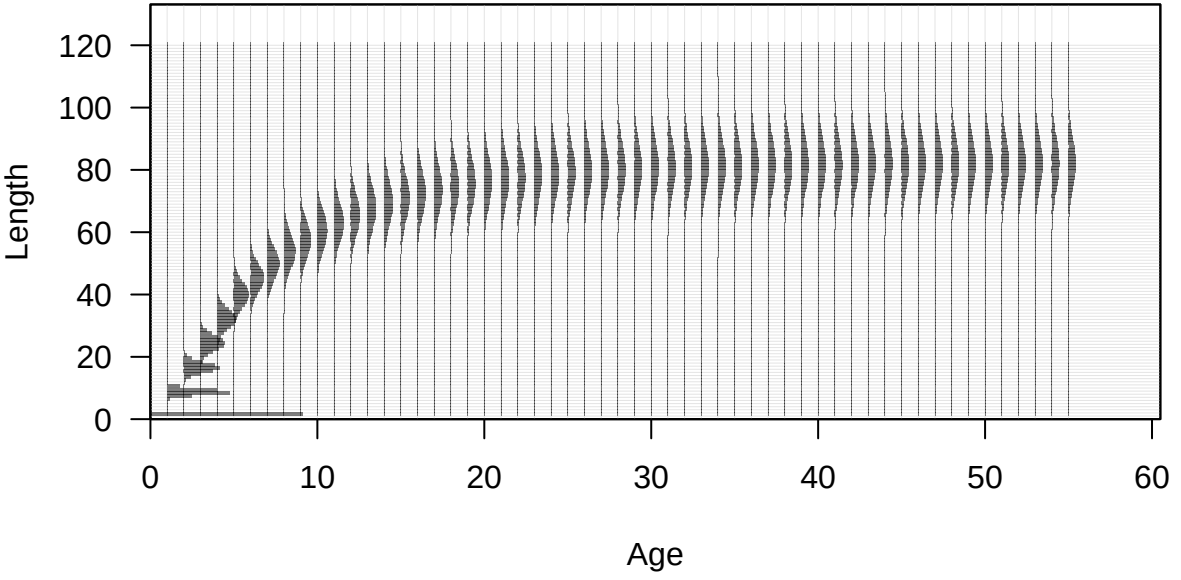
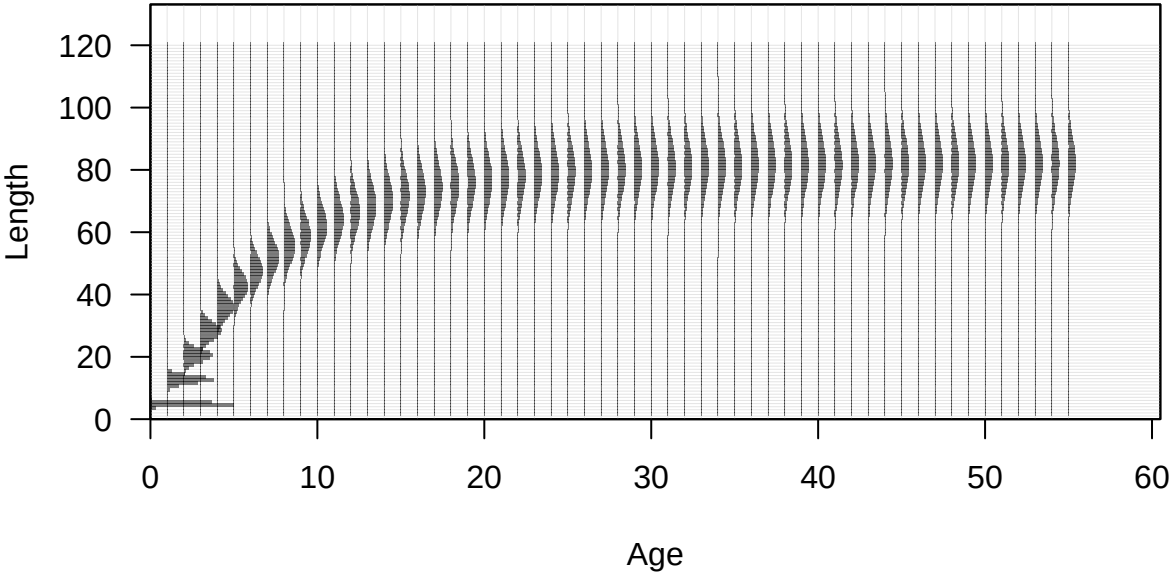
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Mon Jun 20 12:30:39 2022
Data_File: data.ss
Control_File: control.ss

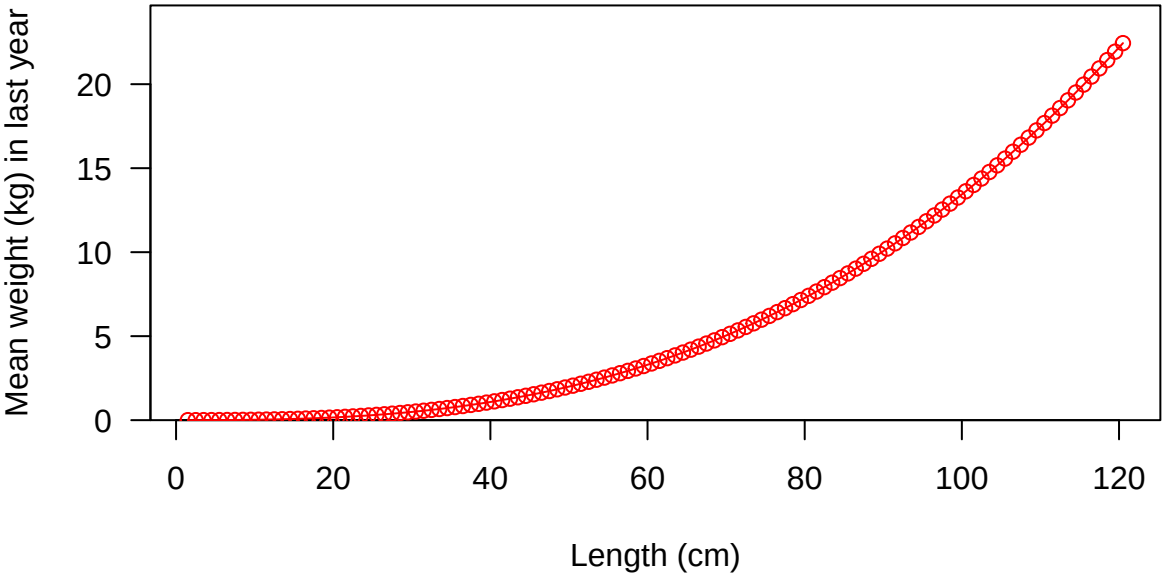

Length (cm, beginning of the year)
120
100
80
60
40
20
0
0
10
20
30
40
50
Age (yr)

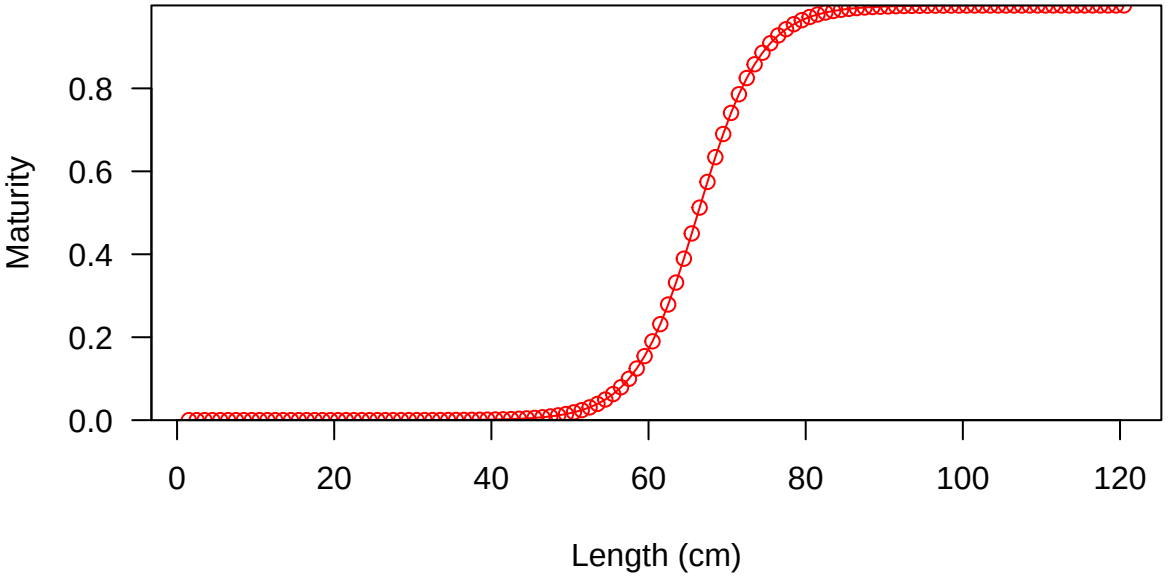

Age (yr)
0
10
20
30
40
50
Length (cm, beginning of the year)
120
100
80
60
40
20
0
CV of lengths
0.08
0.04
0
SD of lengths
8
4
0
CV of lengths
0.04
0.08
2
6

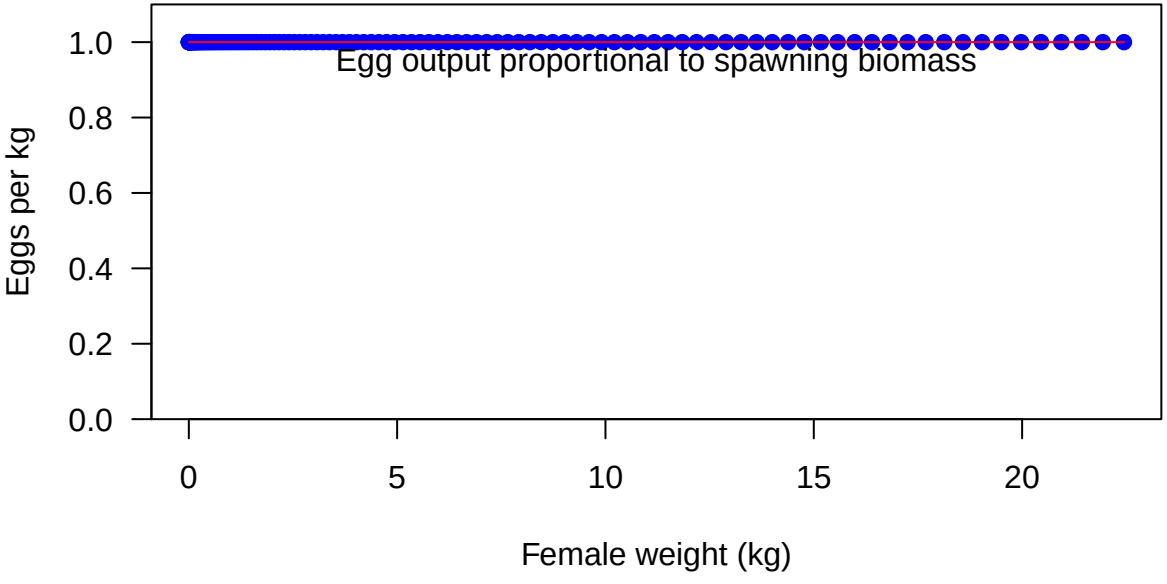

Age (yr)
Mean weight
Length (cm, beginning of the year)
Mean weight
Frac. mature
Age (yr)
Frac. mature
Length (cm, beginning of the year)

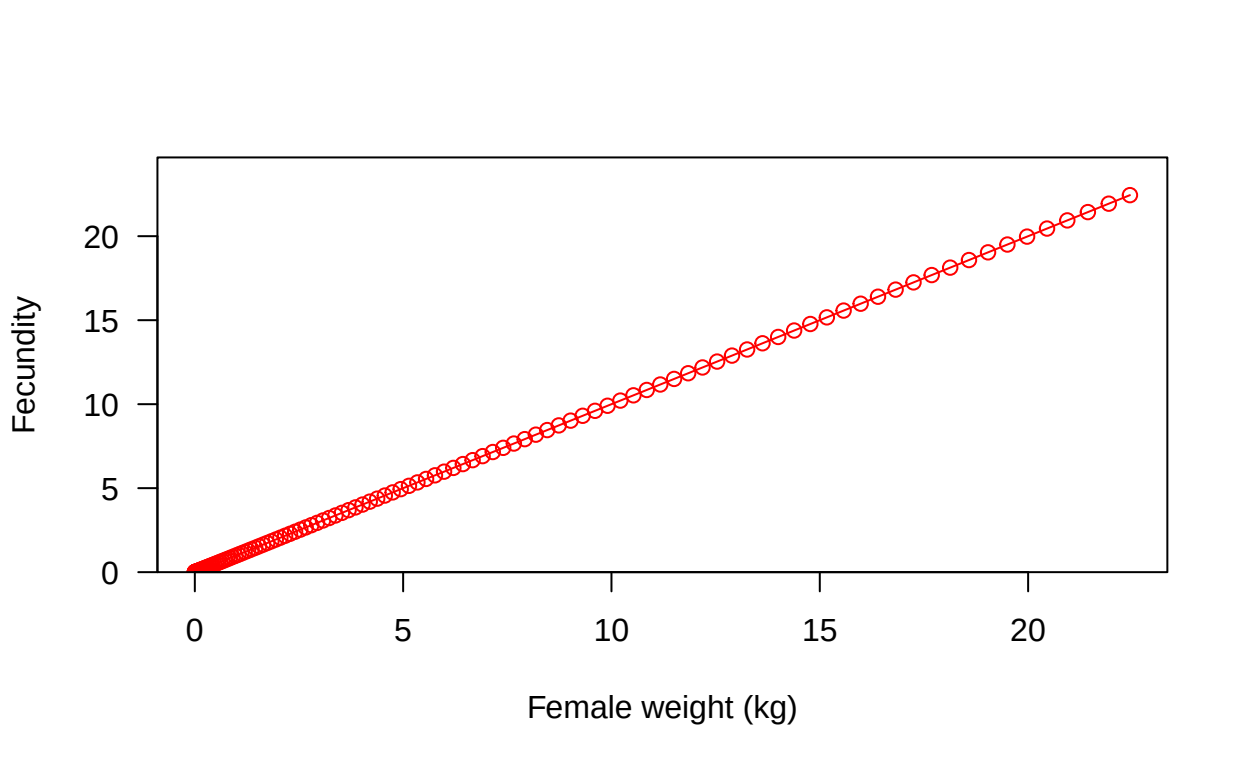

Length
120
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

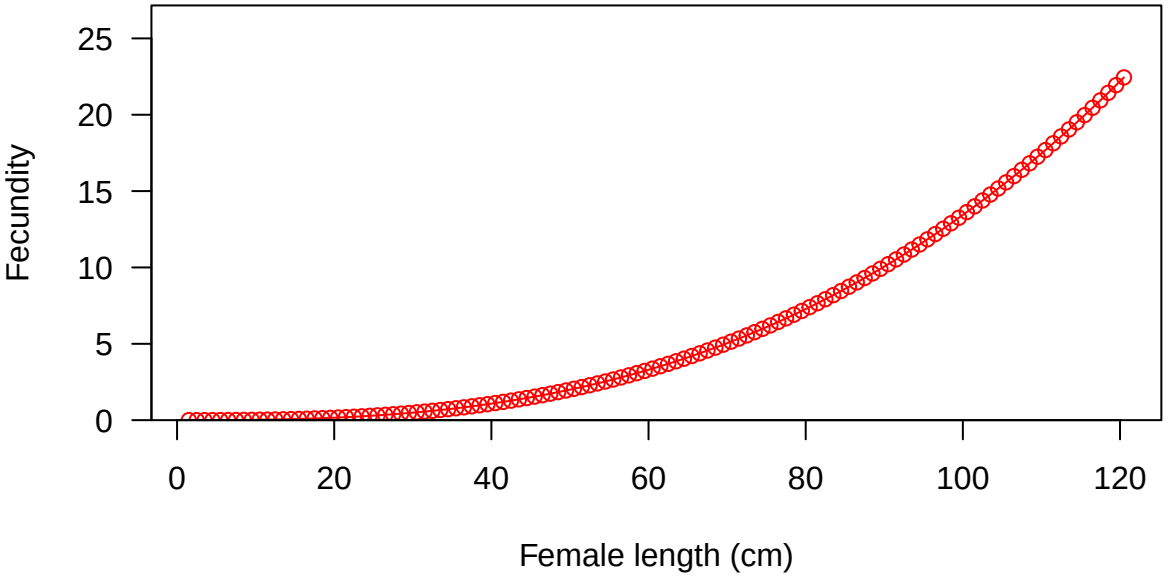

Length
120
100
80
60
40
20
0
0
10
20
30
40
50
60
Age

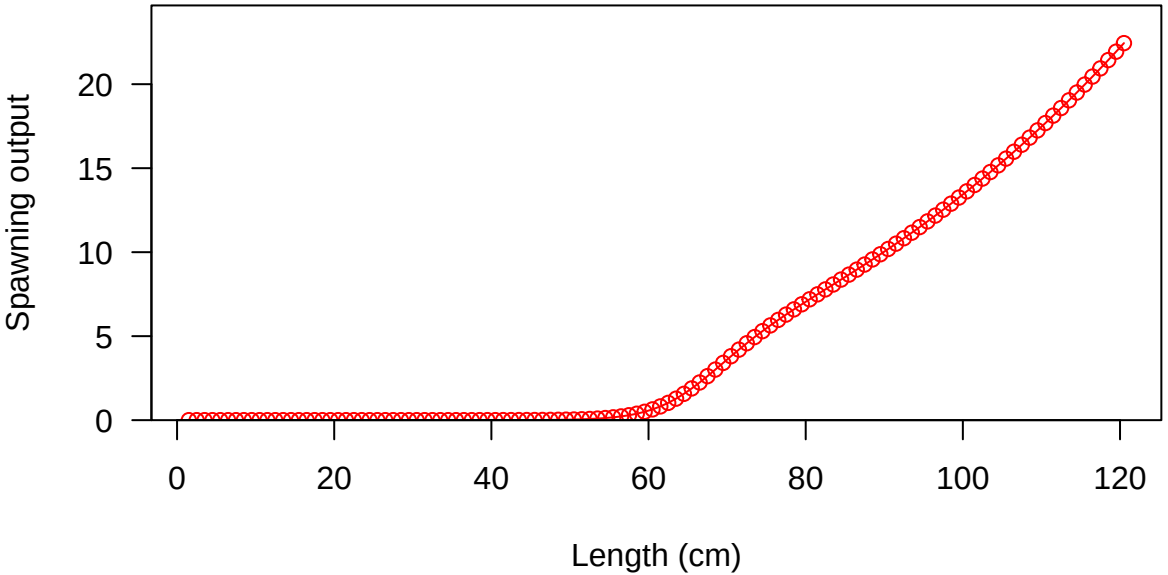

Mean weight (kg) in last year
0
5
10
15
20
0
20
40
60
80
100
120
Length (cm)

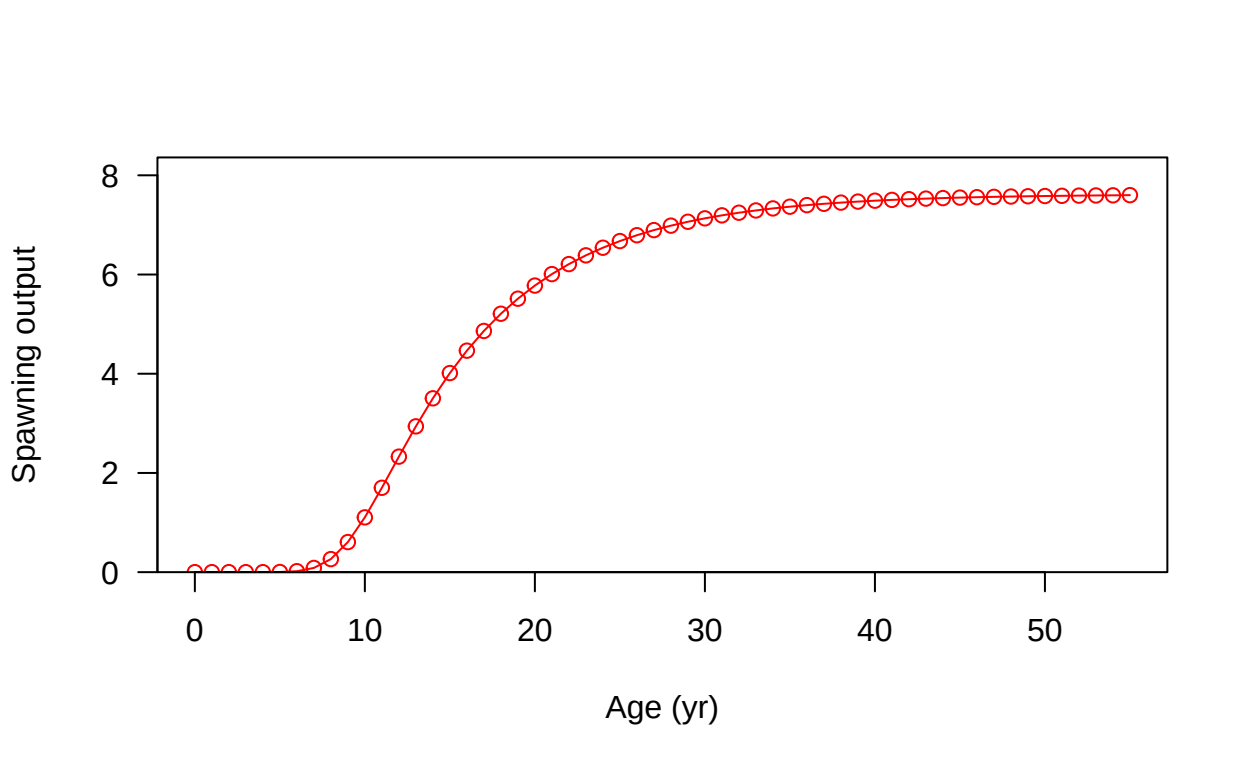

Maturity
0.0
0.2
0.4
0.6
0.8
0
20
40
60
80
100
120
Length (cm)

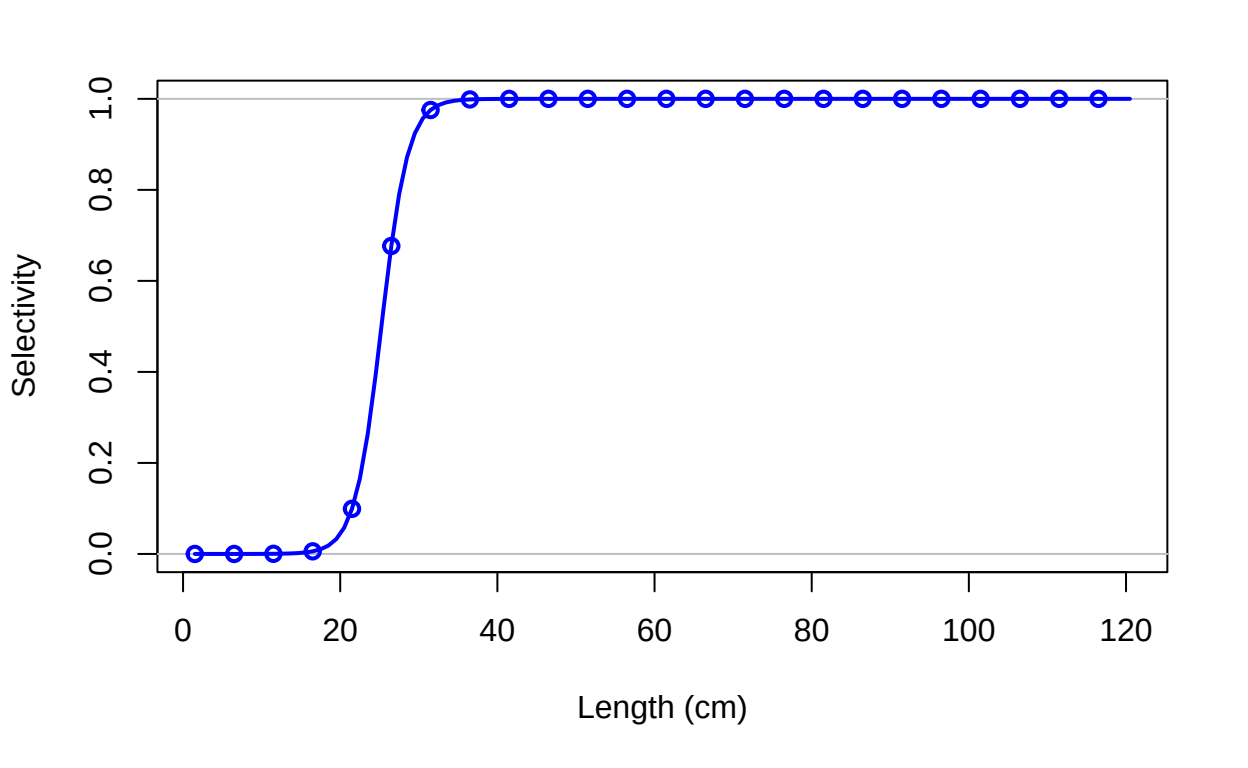

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
Female weight (kg)

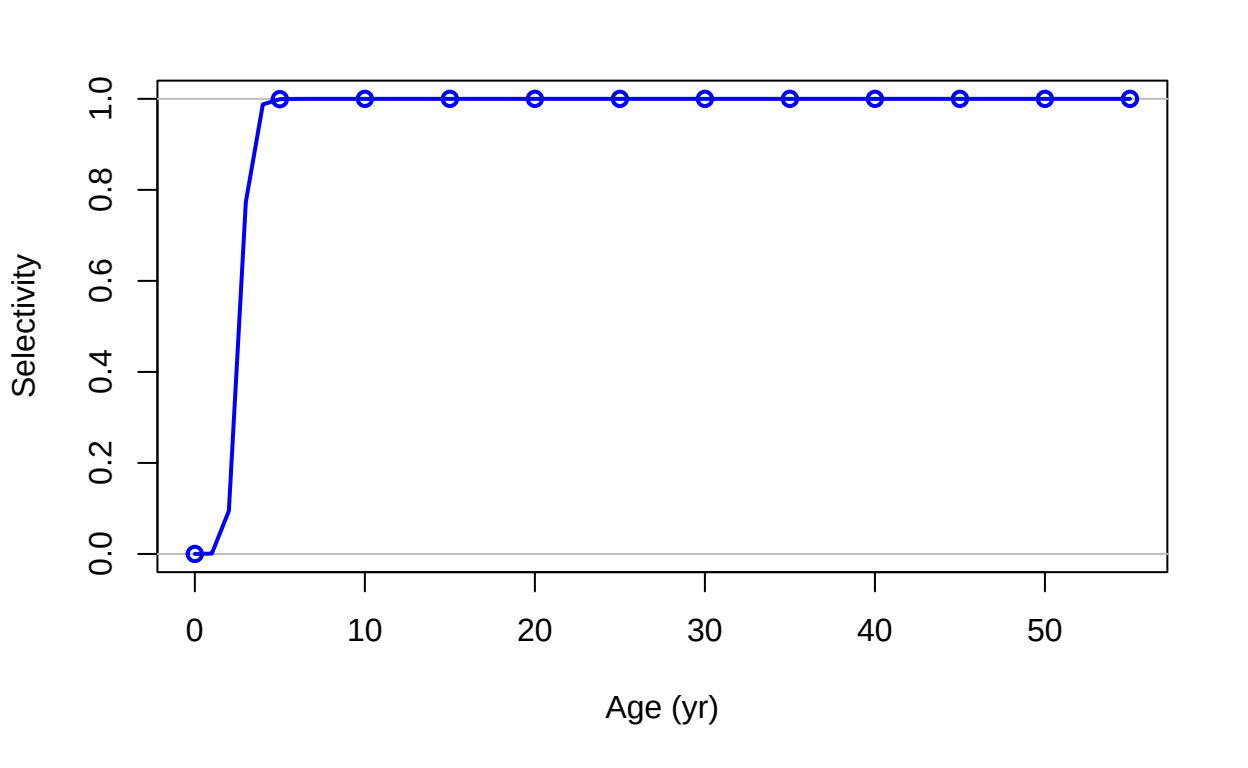

Fecundity
0
5
10
15
20
0
5
10
15
20
Female weight (kg)

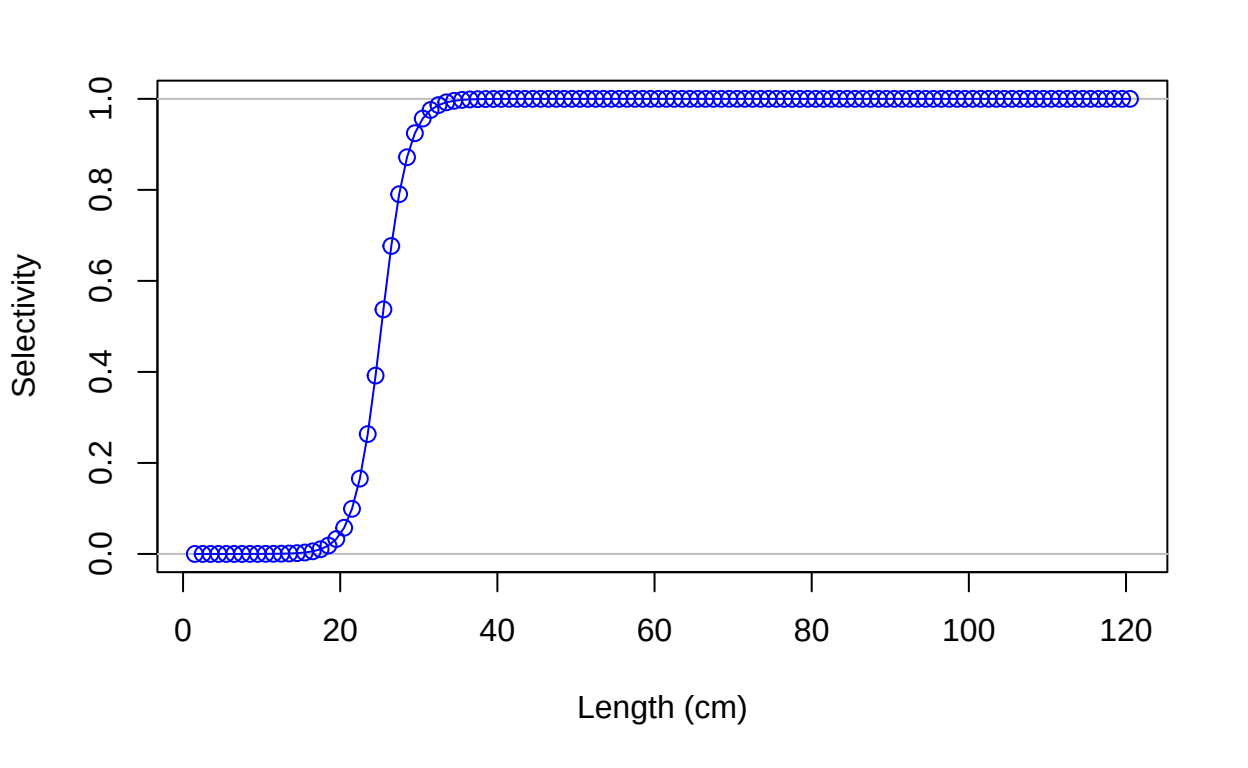

Fecundity
25
20
15
10
5
0
0
20
40
60
80
100
120
Female length (cm)

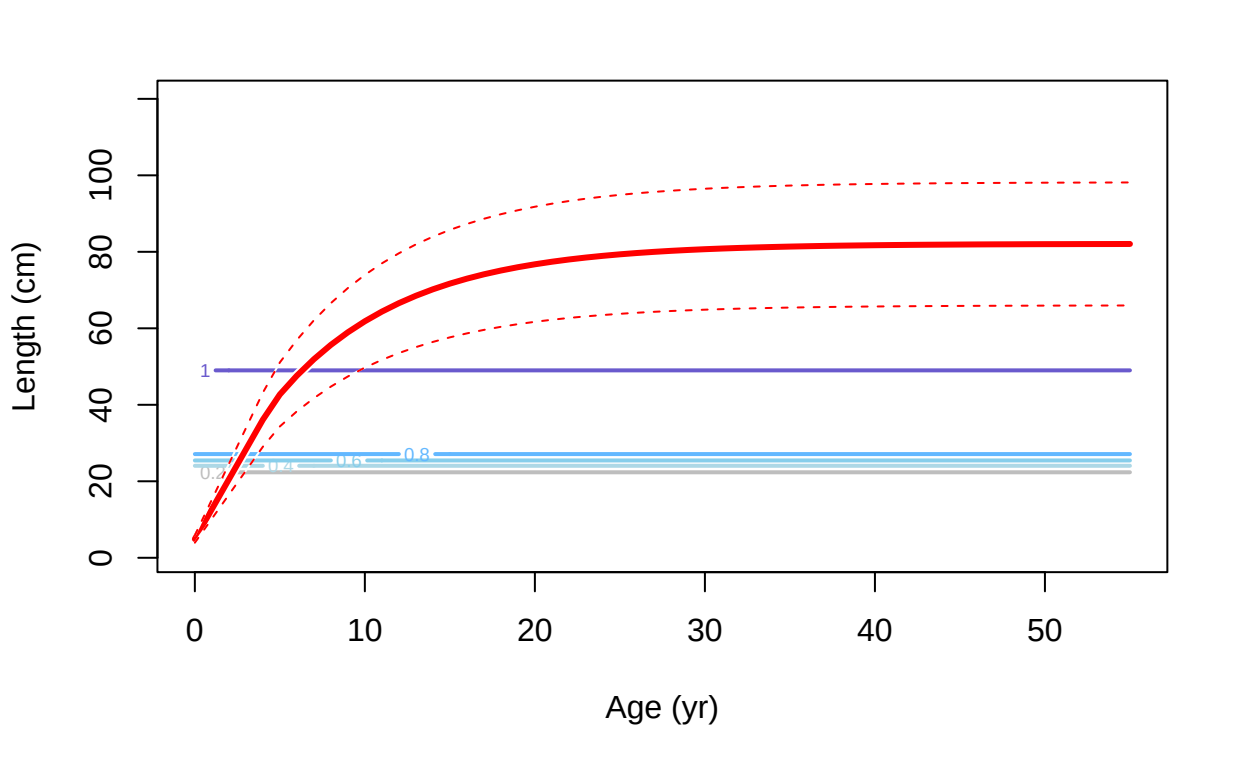

Spawning output
0
5
10
15
20
0
20
40
60
80
100
120
Length (cm)

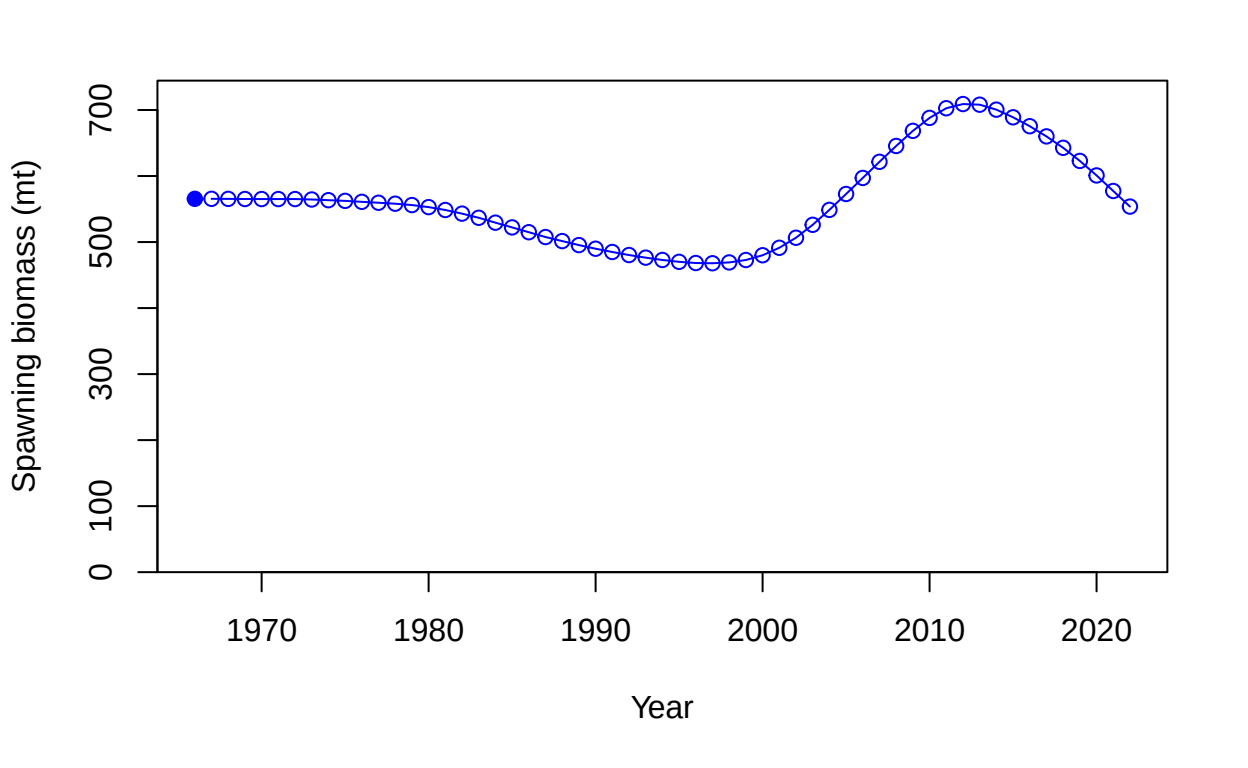

Spawning output
0
2
4
6
8
0
10
20
30
40
50
Age (yr)

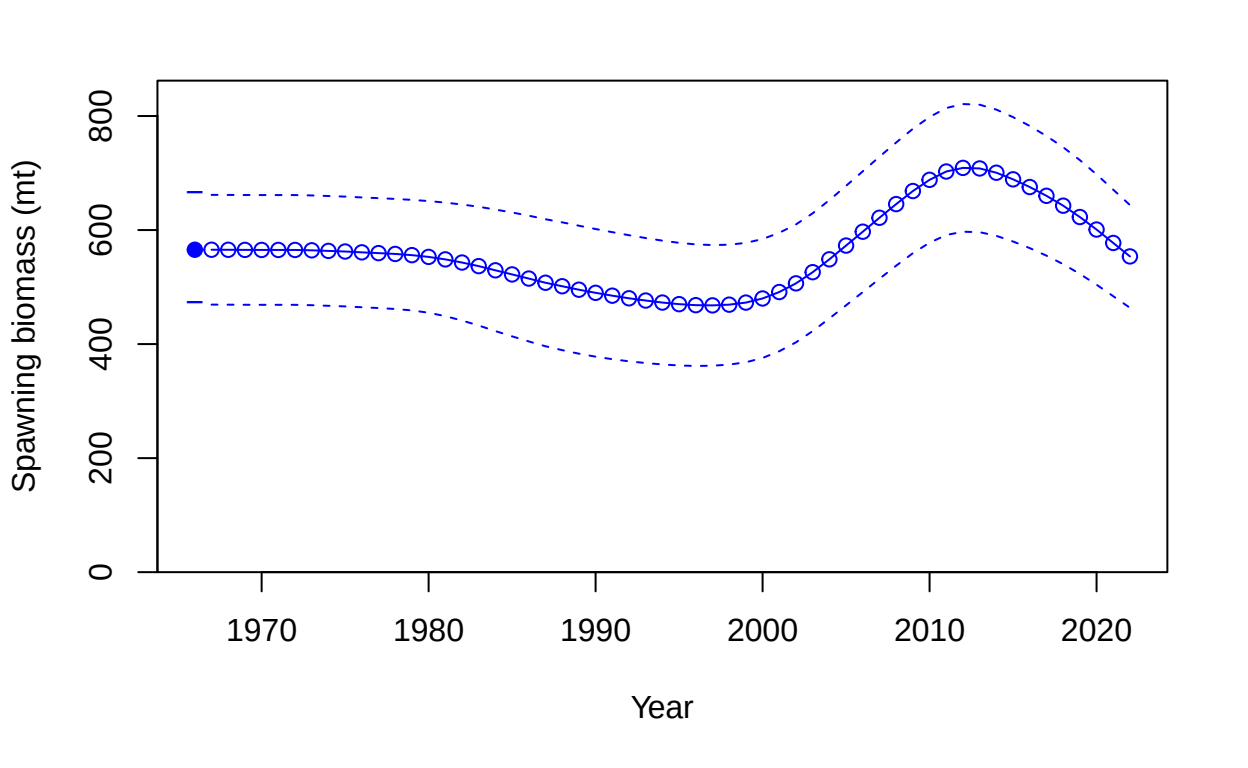

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
120
Length (cm)

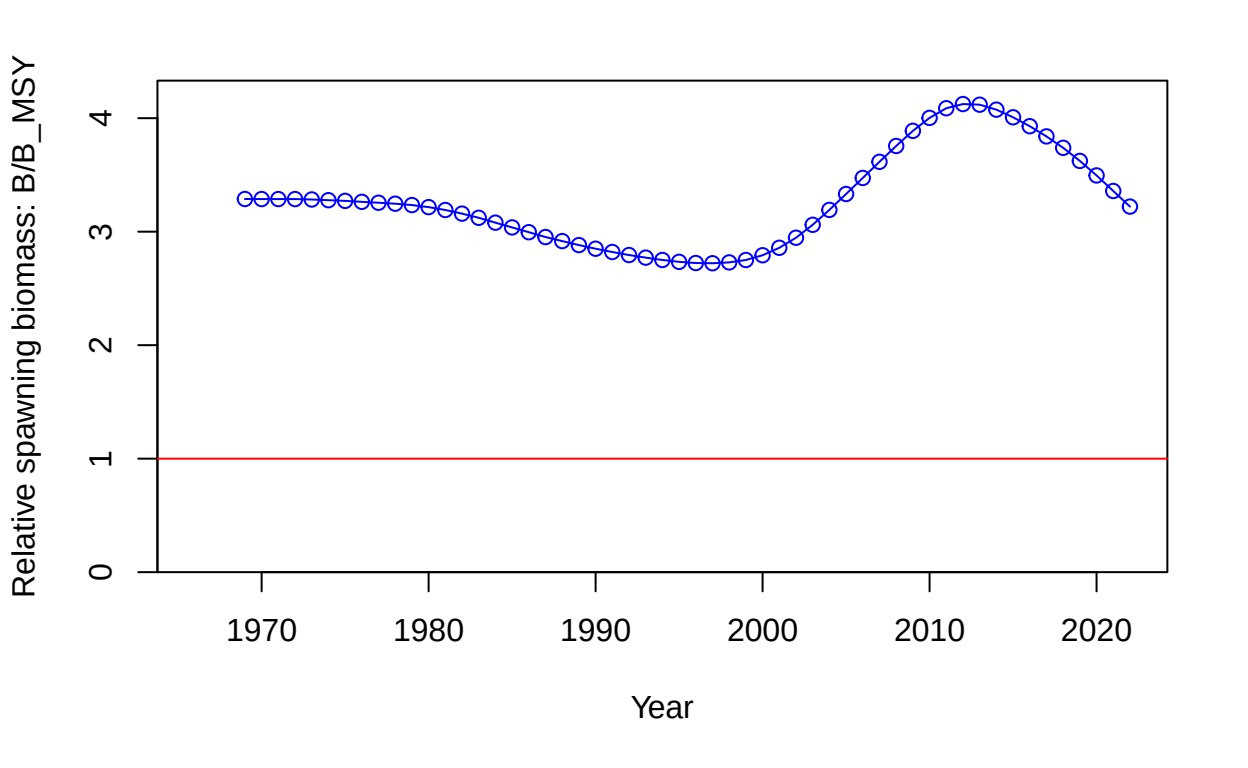

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
Age (yr)

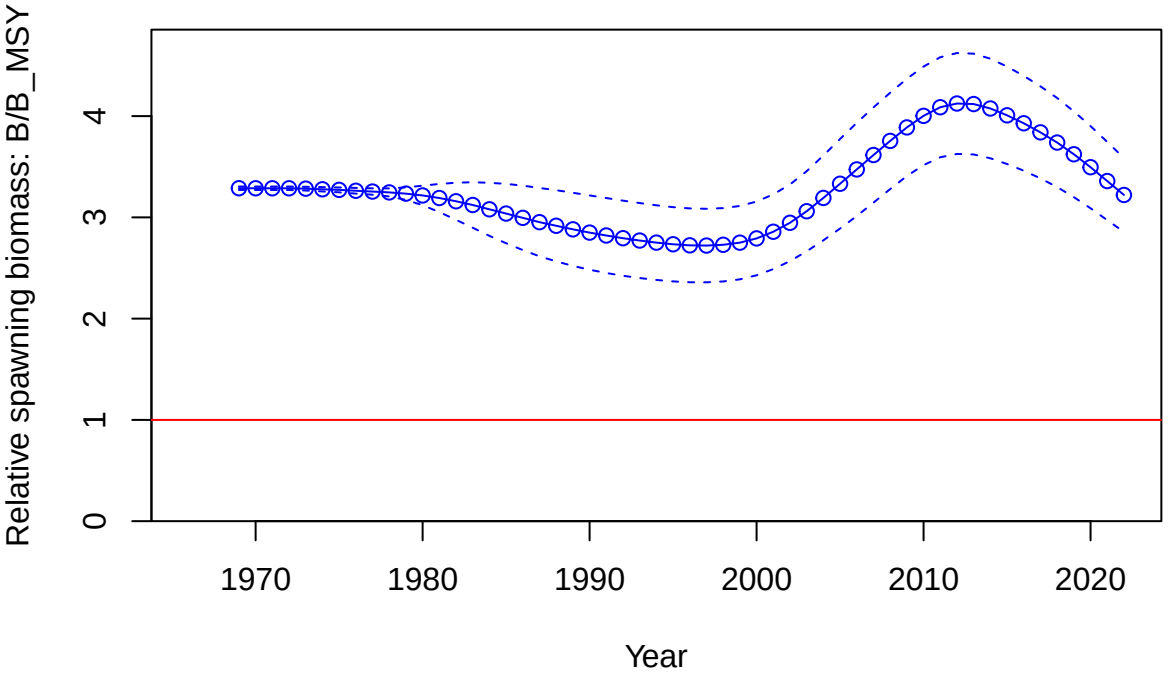

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
120
Length (cm)

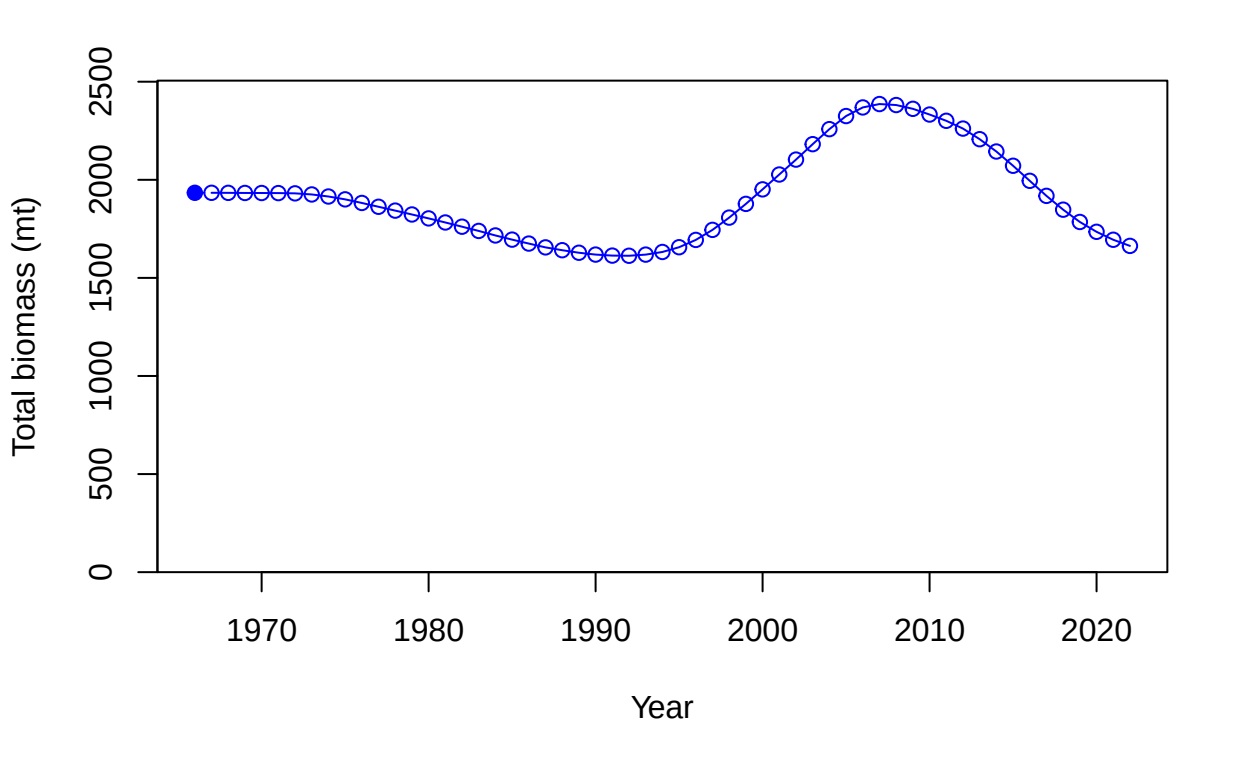

Length (cm)
0
20
40
60
80
100
0
10
20
30
40
50
Age (yr)
1
0.8
0.6
0.4
0.2

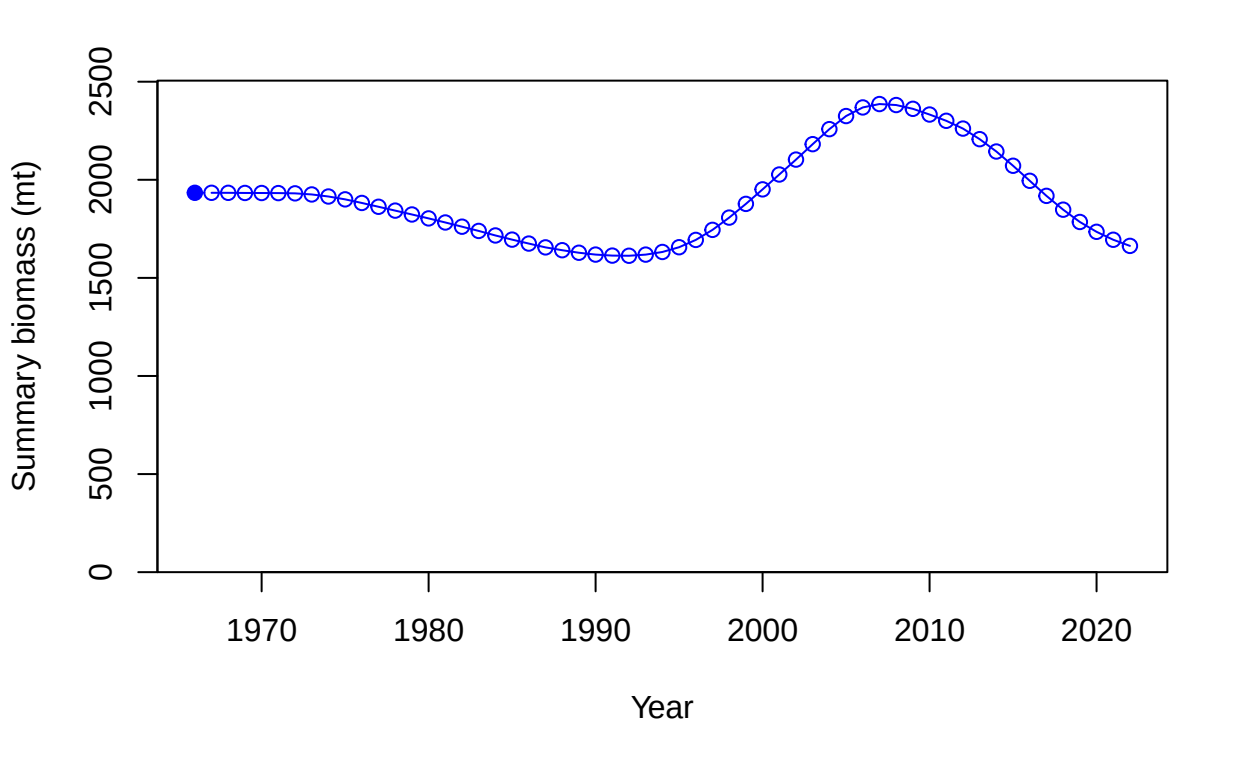

Spawning biomass (mt)
0
100
300
500
700
1970
1980
1990
2000
2010
2020
Year

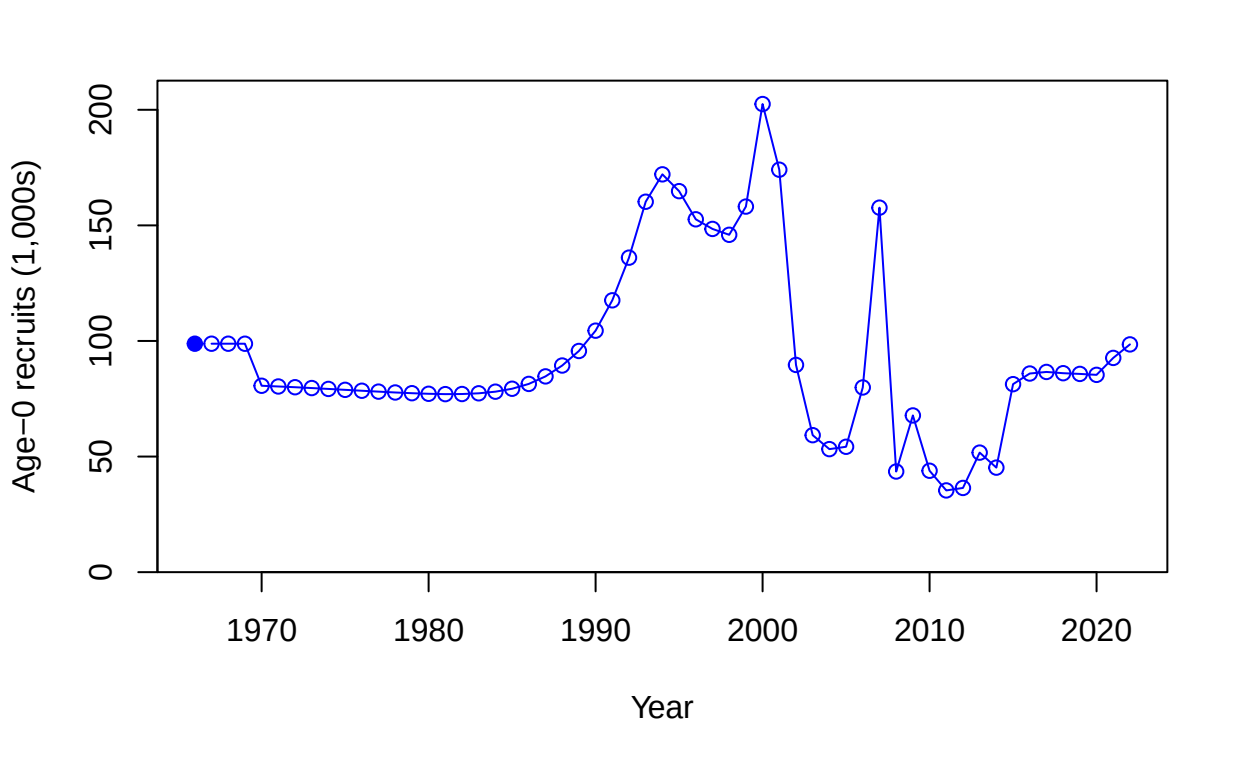

Spawning biomass (mt)
0
200
400
600
800
1970
1980
1990
2000
2010
2020
Year

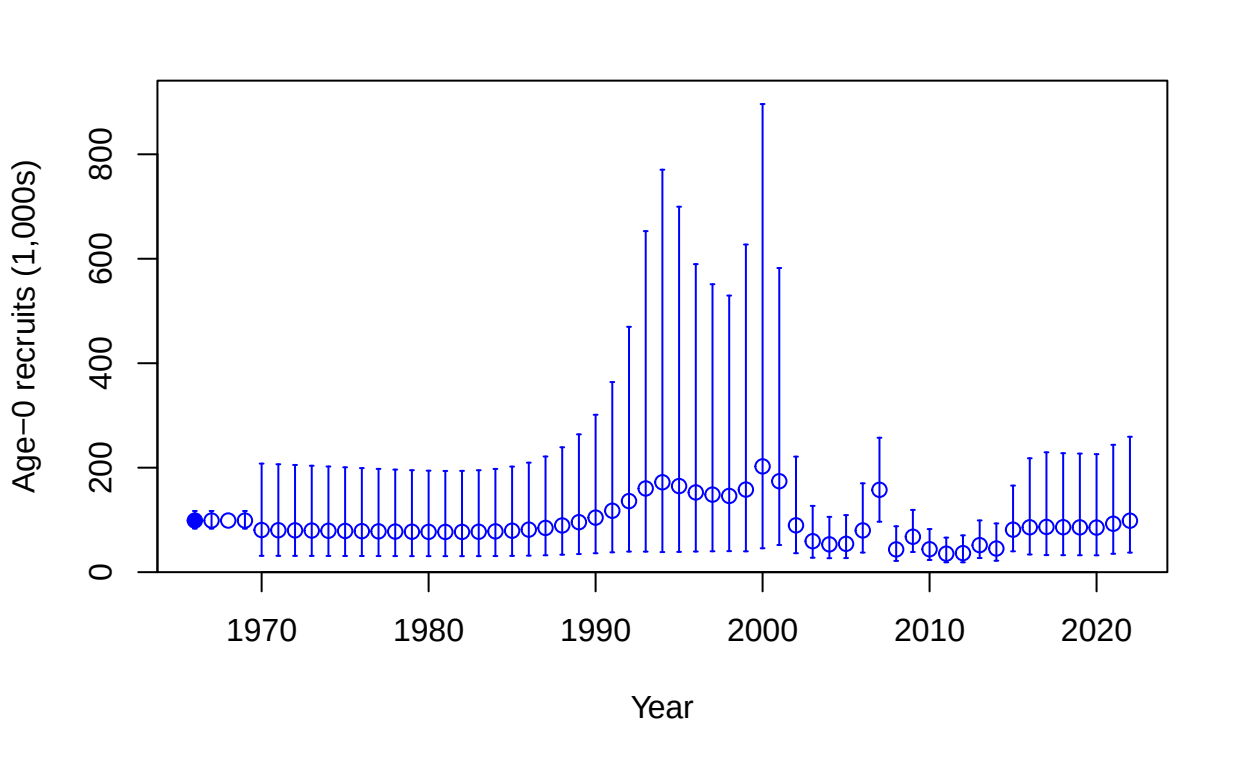

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

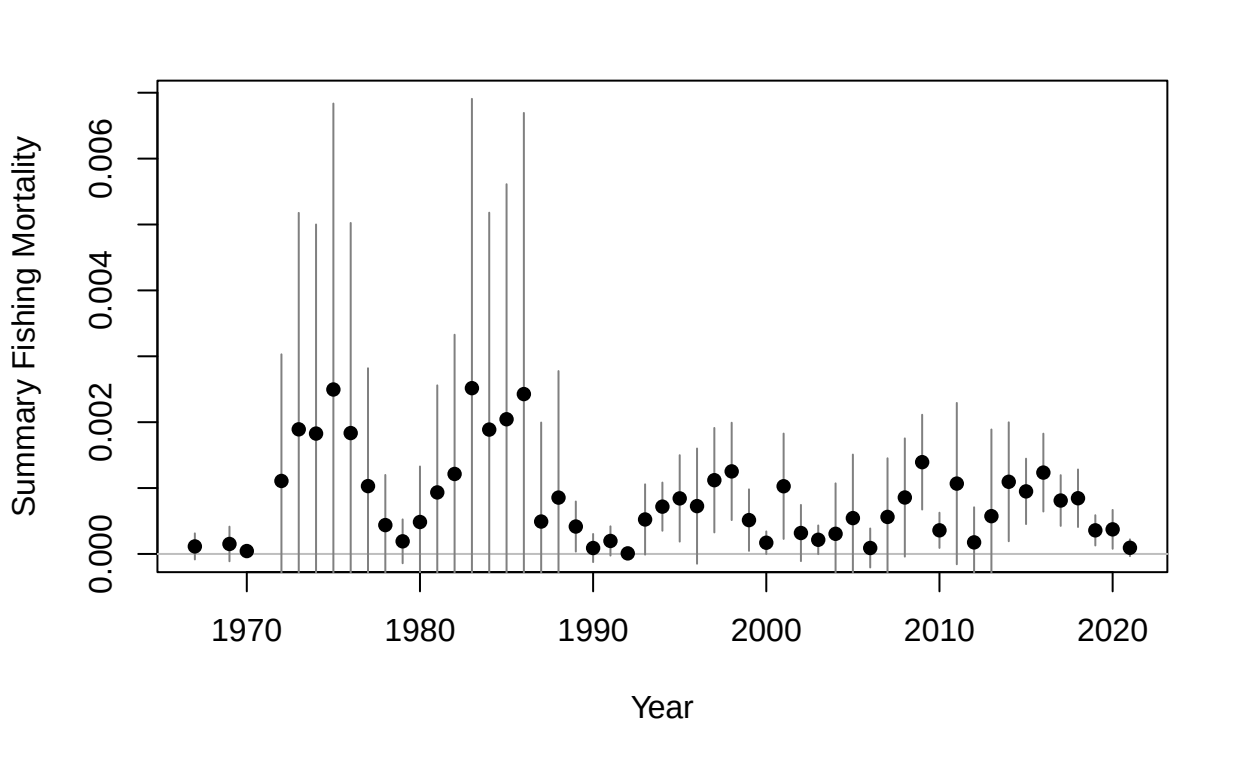

Relative spawning biomass: B/B_MSY
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

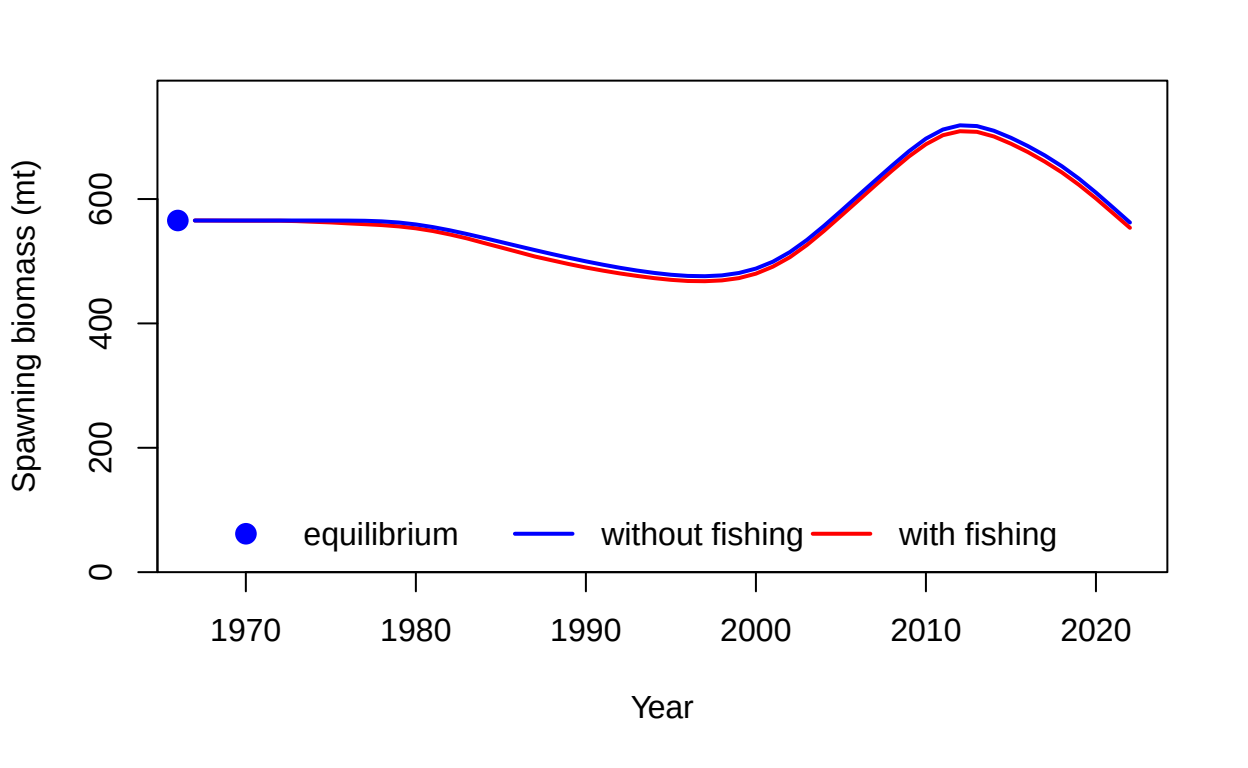

Total biomass (mt)
0
500
1000
1500
2000
2500
1970
1980
1990
2000
2010
2020
Year

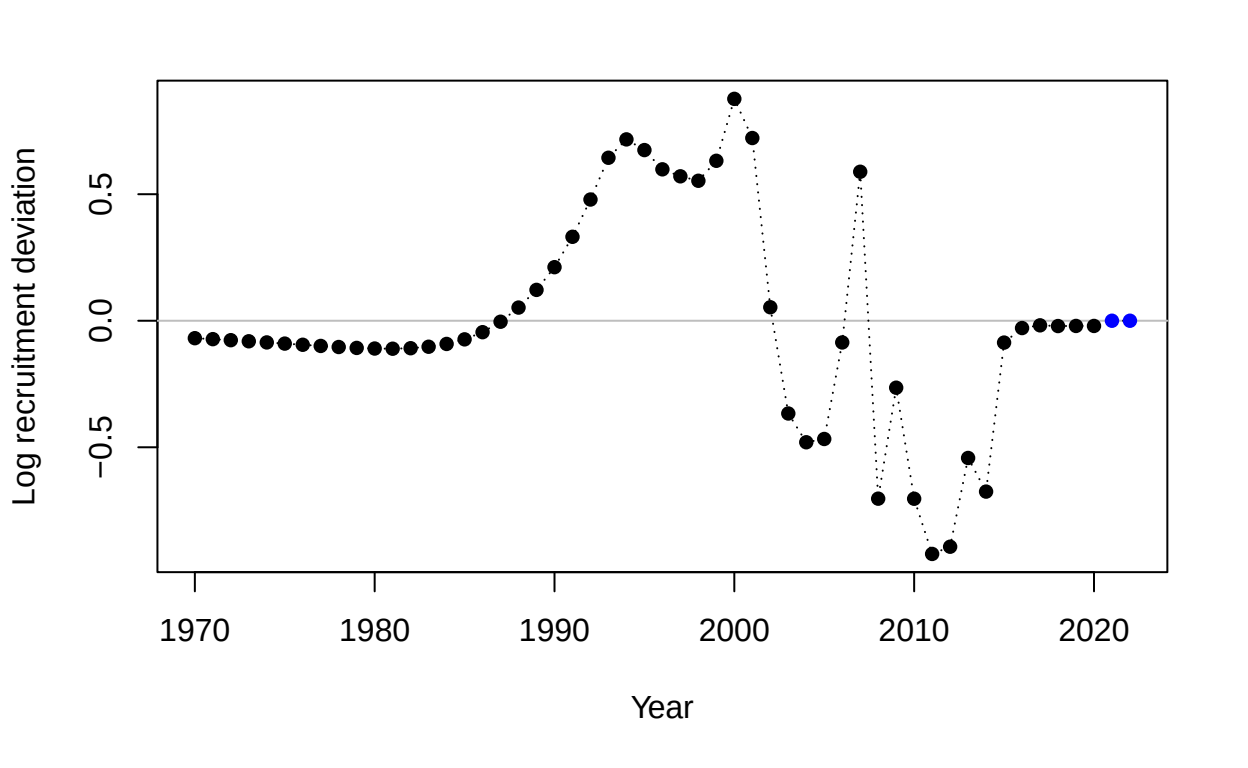

Summary biomass (mt)
0
500
1000
1500
2000
2500
1970
1980
1990
2000
2010
2020
Year

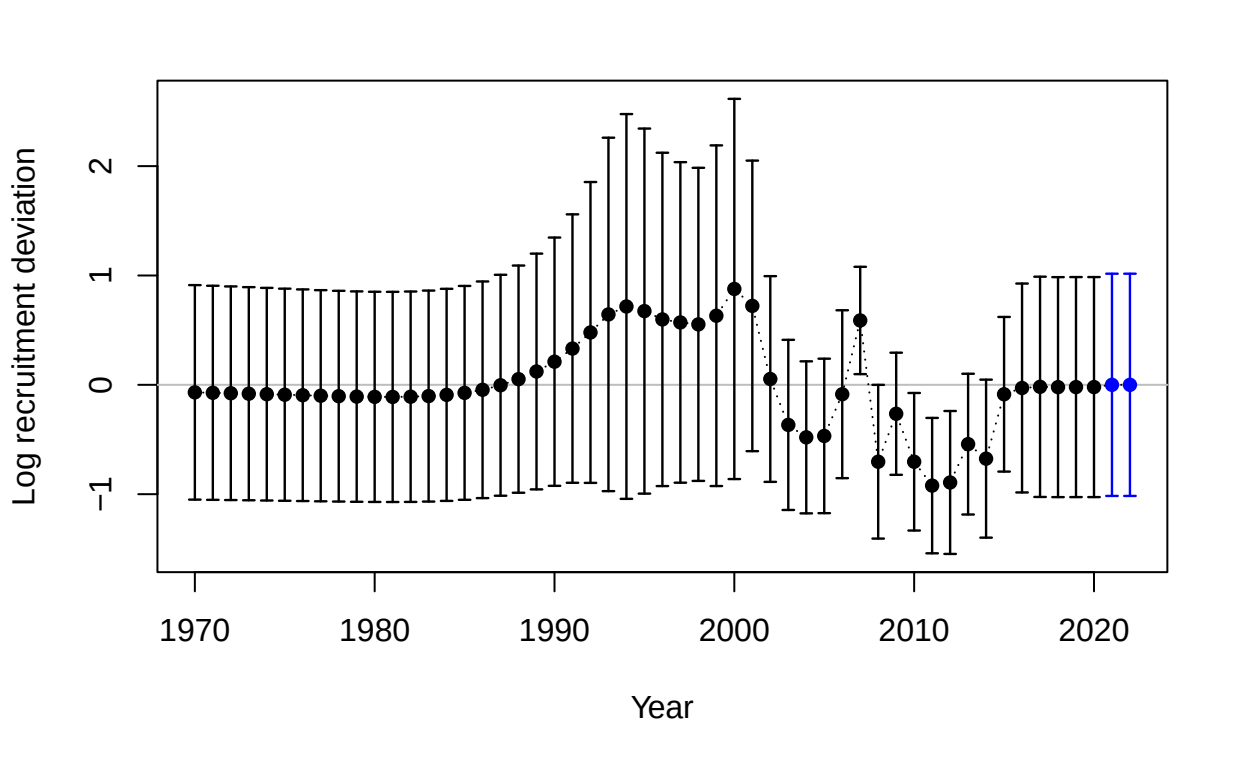

Age−0 recruits (1,000s)
0
50
100
150
200
1970
1980
1990
2000
2010
2020
Year

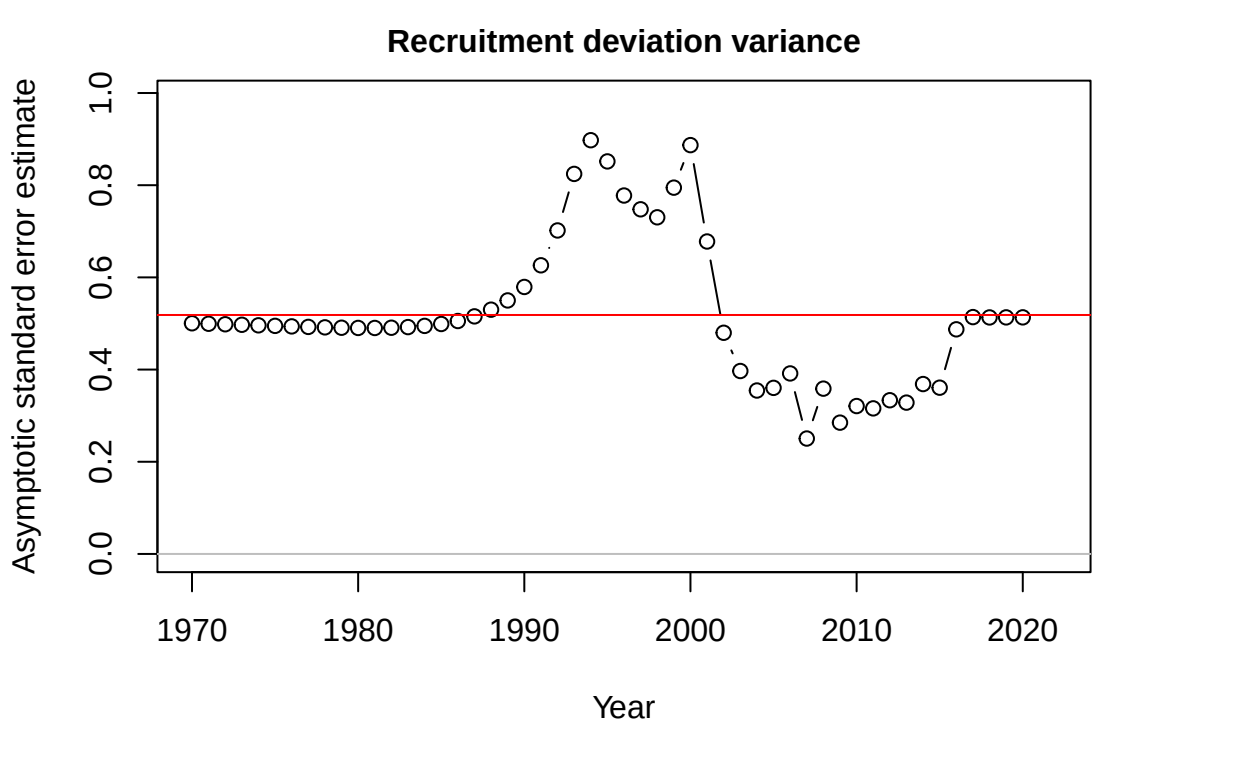

Age−0 recruits (1,000s)
0
200
400
600
800
1970
1980
1990
2000
2010
2020
Year

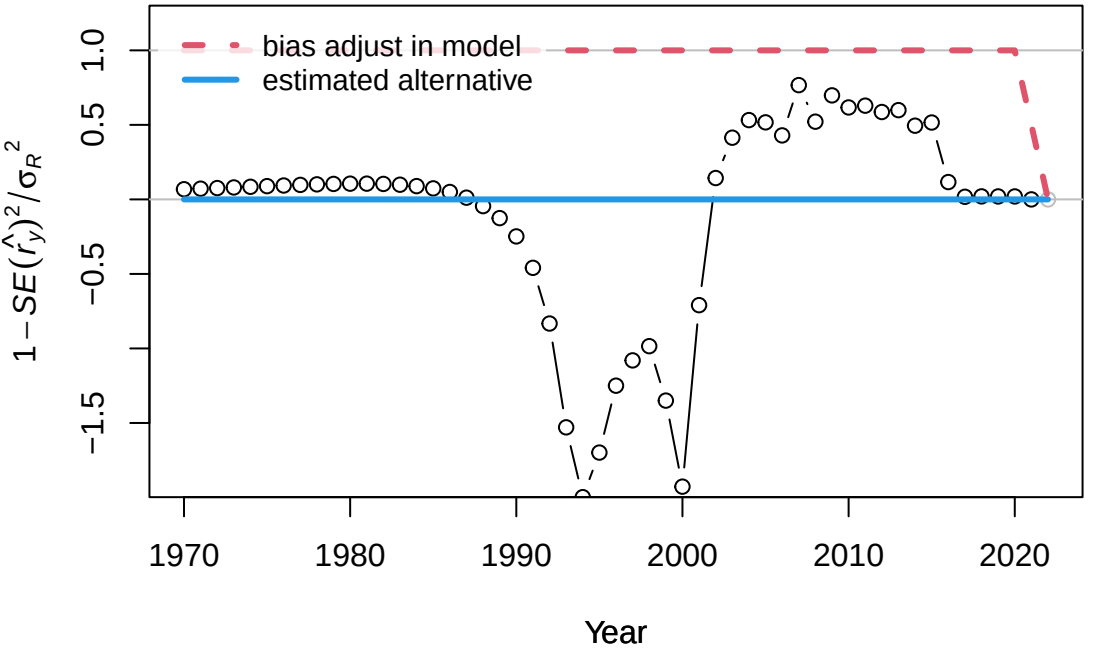

Summary Fishing Mortality
0.000
0.002
0.004
0.006
1970
1980
1990
2000
2010
2020
Year

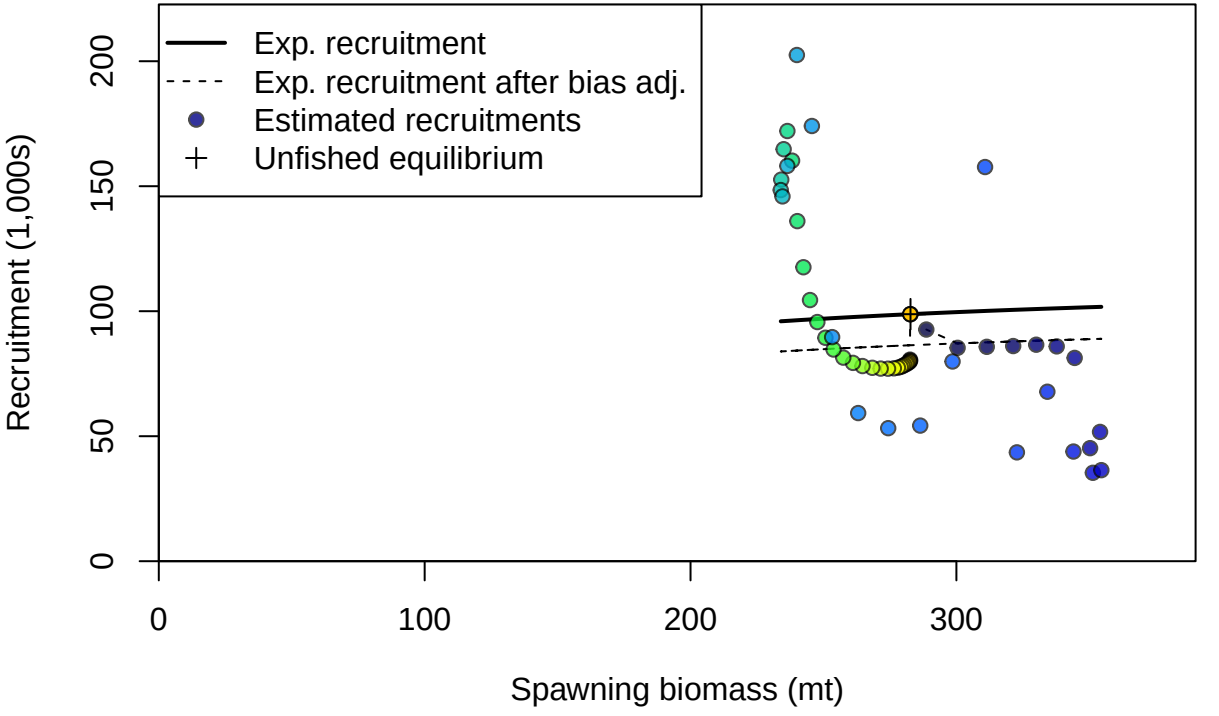

Spawning biomass (mt)
0
200
400
600
equilibrium
without fishing
with fishing
1970
1980
1990
2000
2010
2020
Year

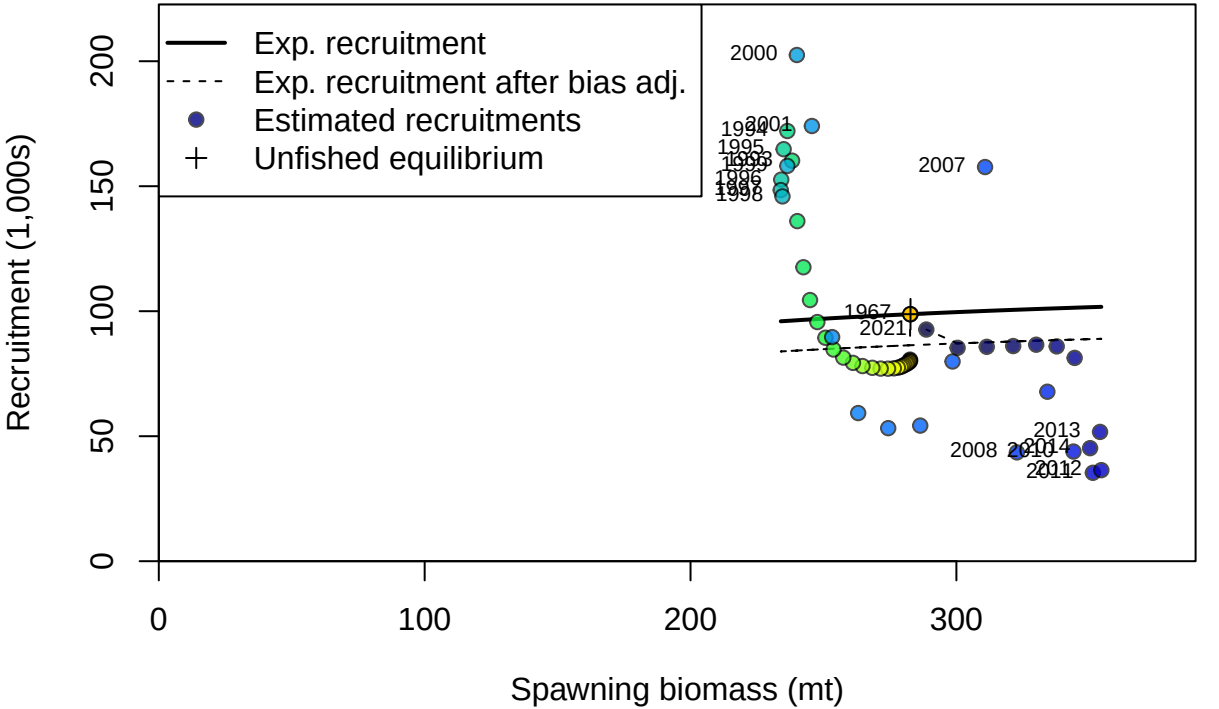

Log recruitment deviation
0.5
0.0
−0.5
1970
1980
1990
2000
2010
2020
Year


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

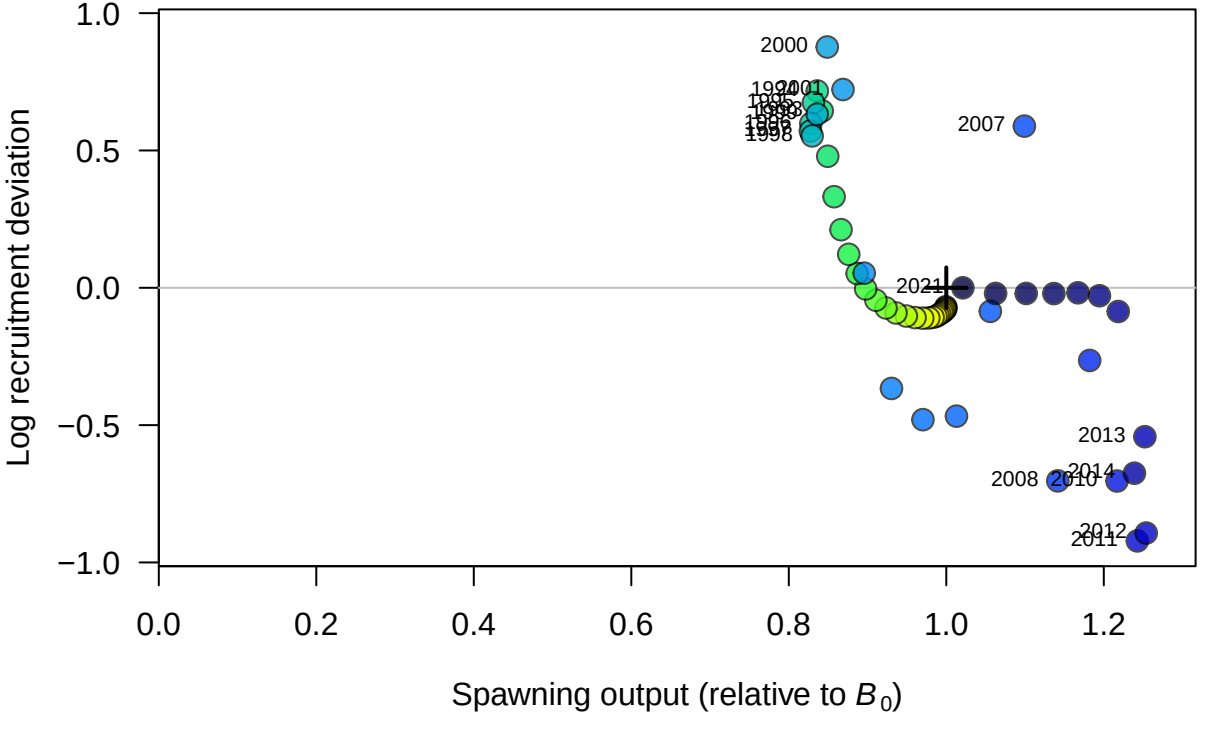

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

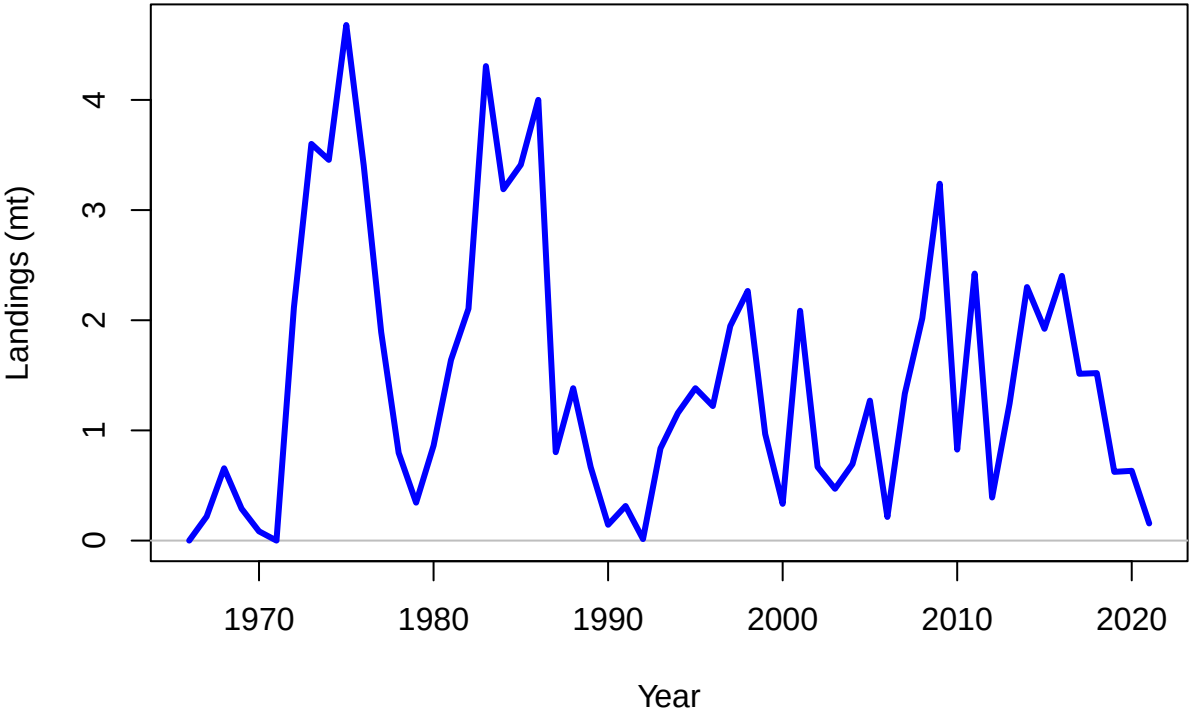

bias adjust in model
estimated alternative
1.0
0.5
−0.5
−1.5
$1-SE(\hat{r}_y)^2/\sigma_R{}^2$
1970
1980
1990
2000
2010
2020
Year

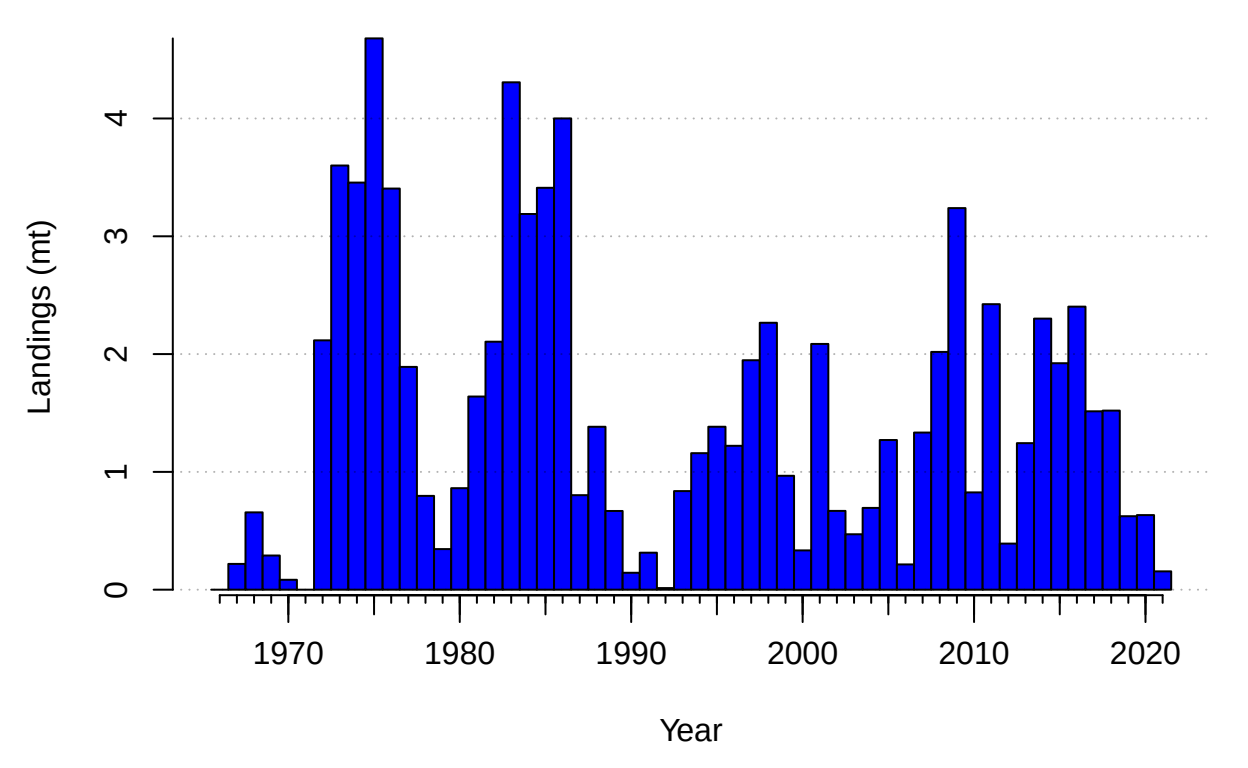

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0
50
100
150
200
0
100
200
300
Spawning biomass (mt)

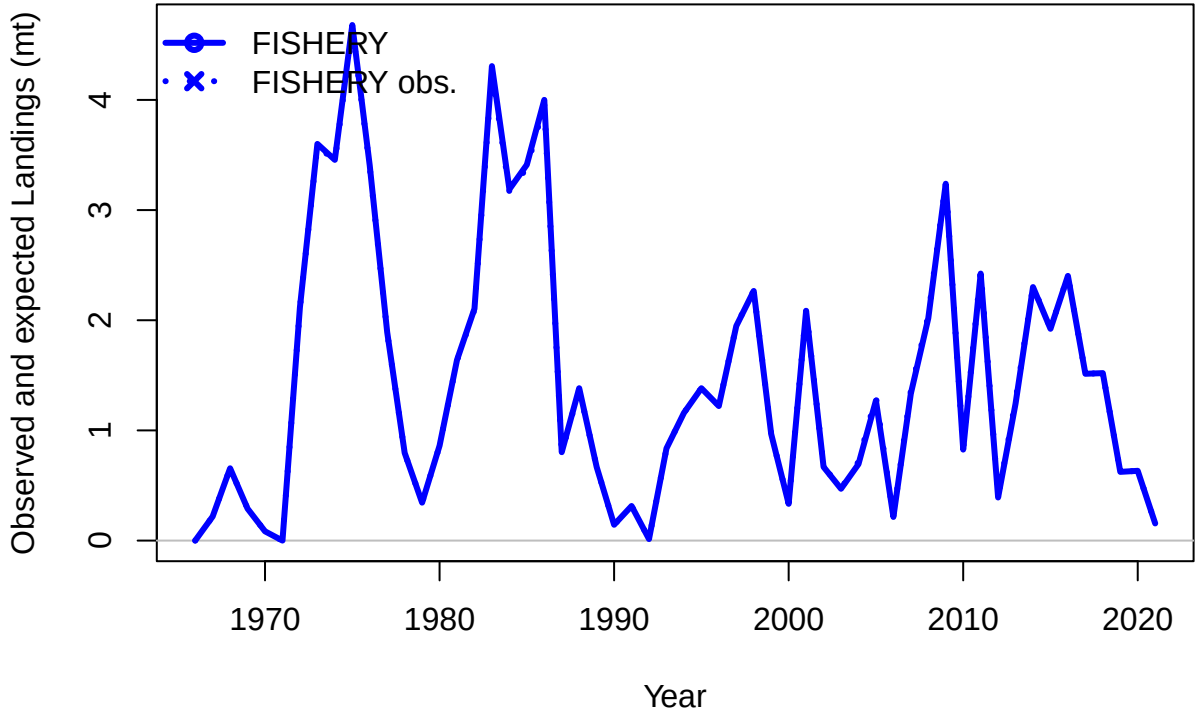


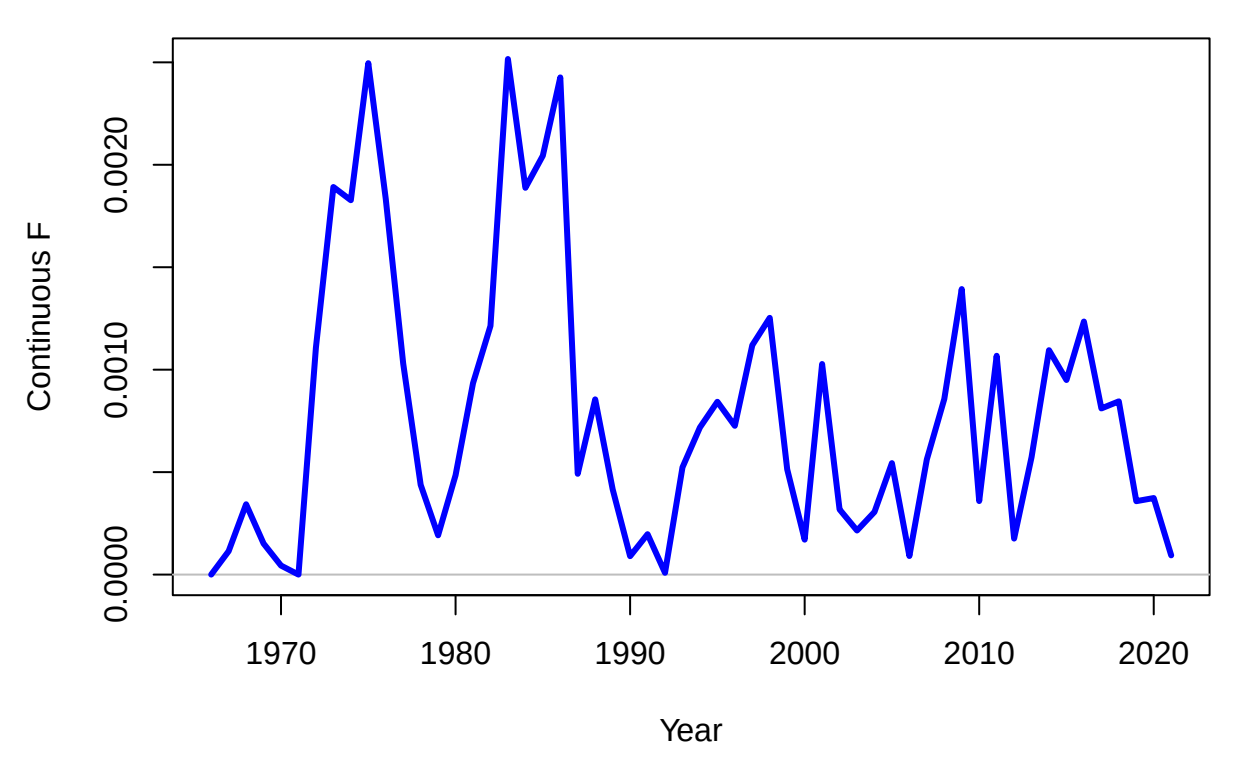
Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
Spawning biomass (mt)
0
50
100
150
200
0
100
200
300
2000
2001
1994
1995
1996
1998
2007
1967
2021
2013
2008
2014
2012
2011

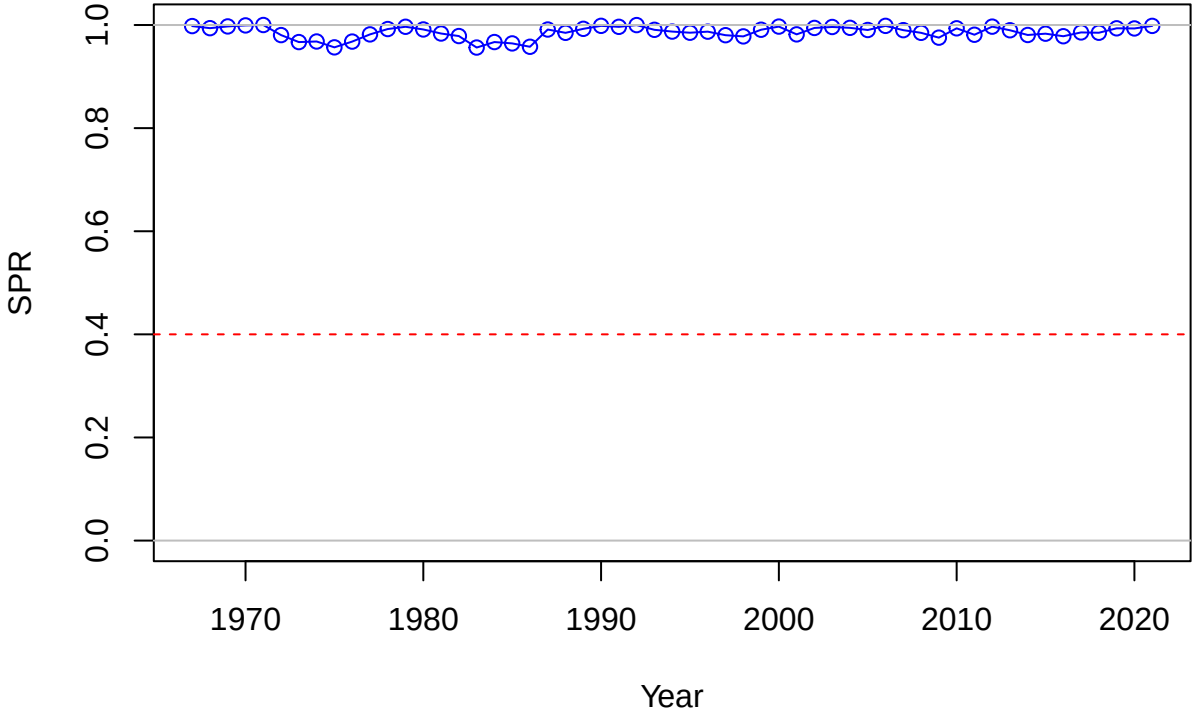

1.0
0.5
0.0
−0.5
−1.0
Log recruitment deviation
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Spawning output (relative to B_0)
2000
2007
2021
2013
2014
2008
2010
2012
2011

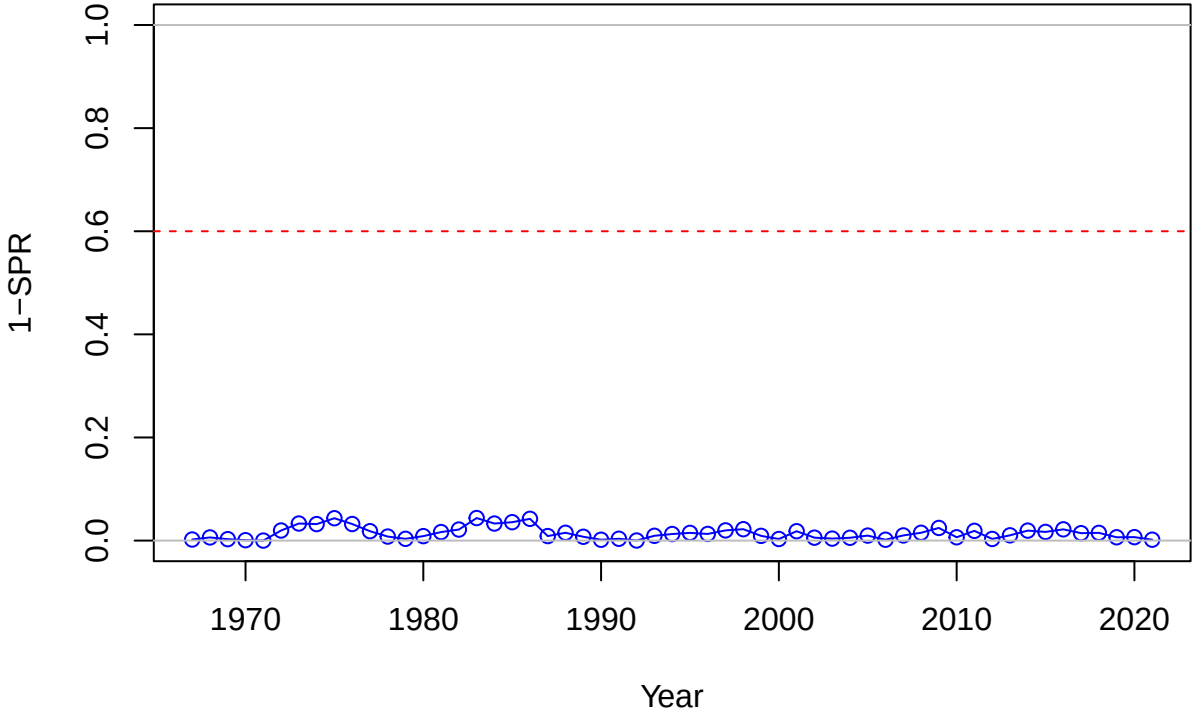

Landings (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

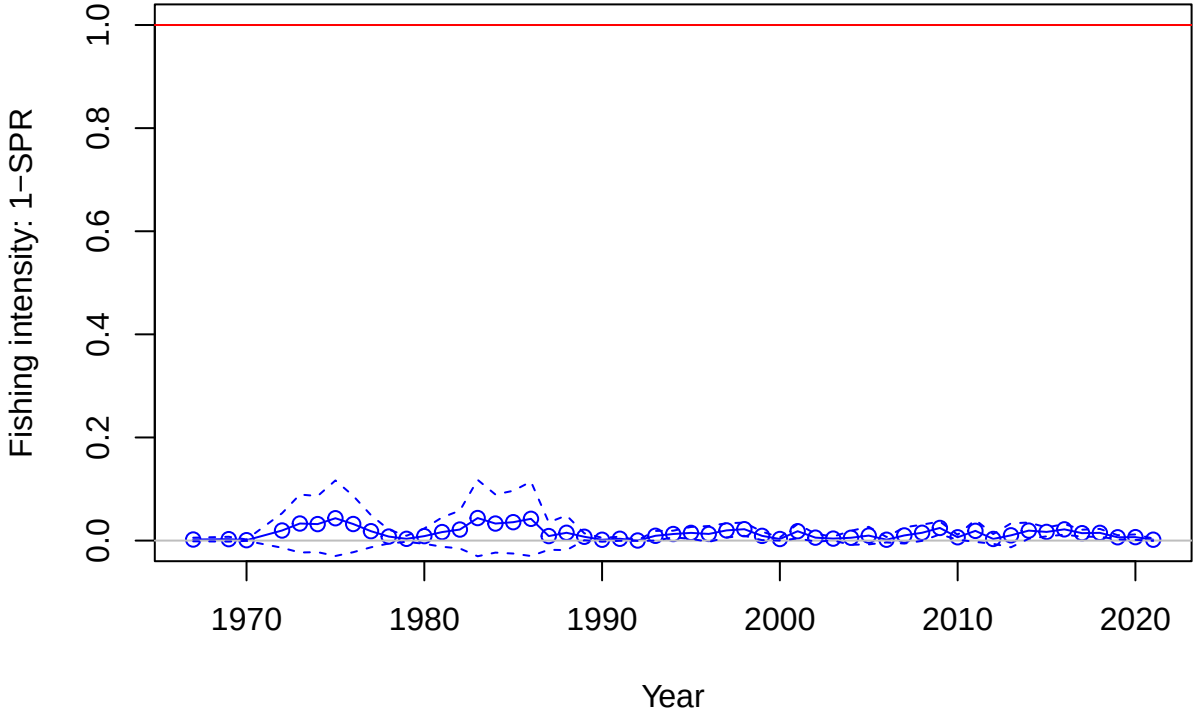

Landings (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

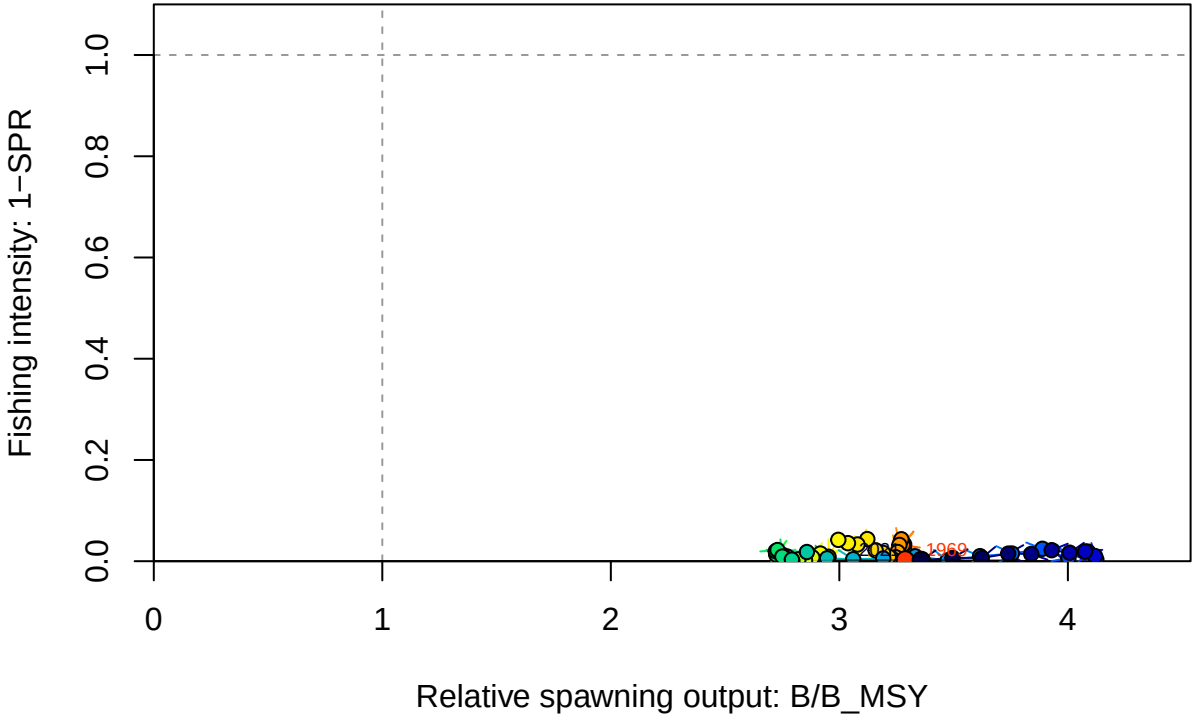

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0
1
2
3
4
1970
1980
1990
2000
2010
2020
Year

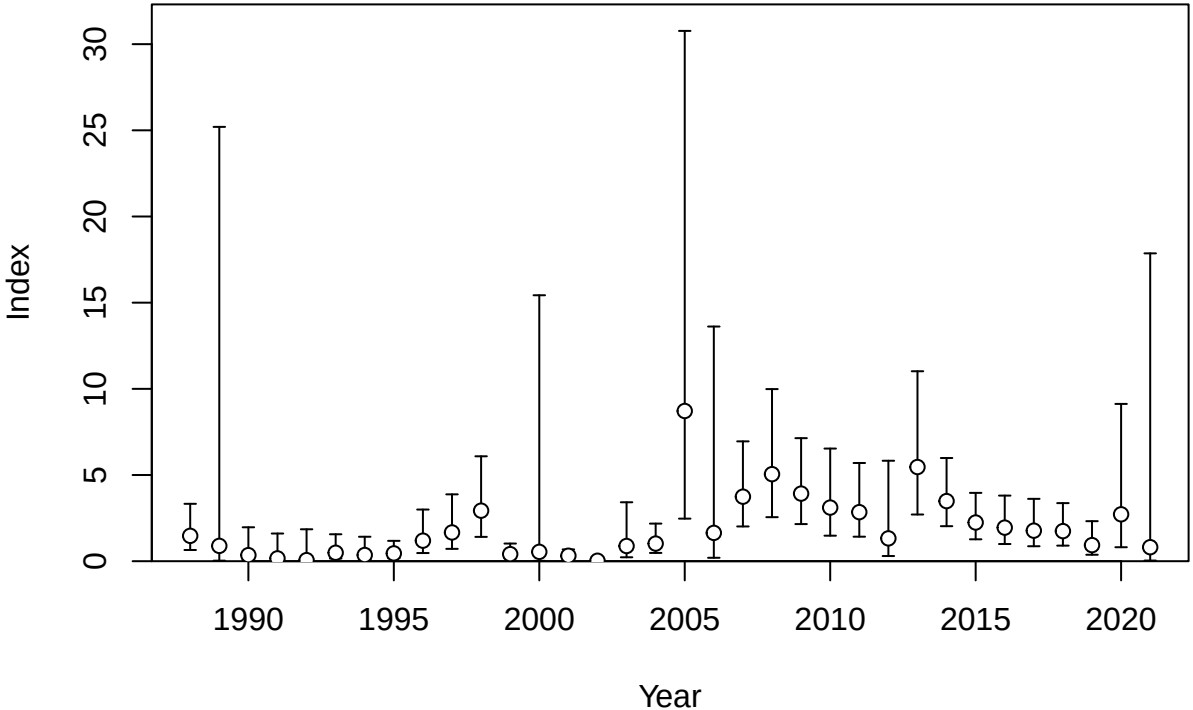

Continuous F
0.0000
0.0010
0.0020
1970
1980
1990
2000
2010
2020
Year

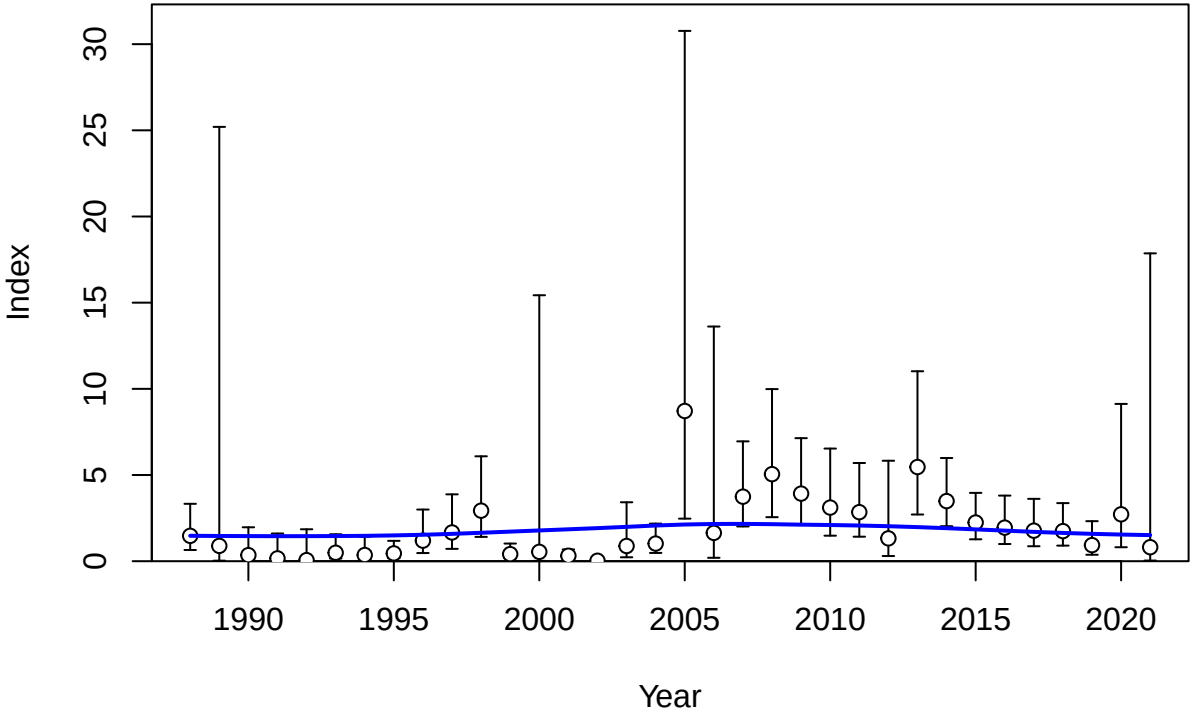

SPR
1.0
0.8
0.6
0.4
0.2
0.0
1970
1980
1990
2000
2010
2020
Year

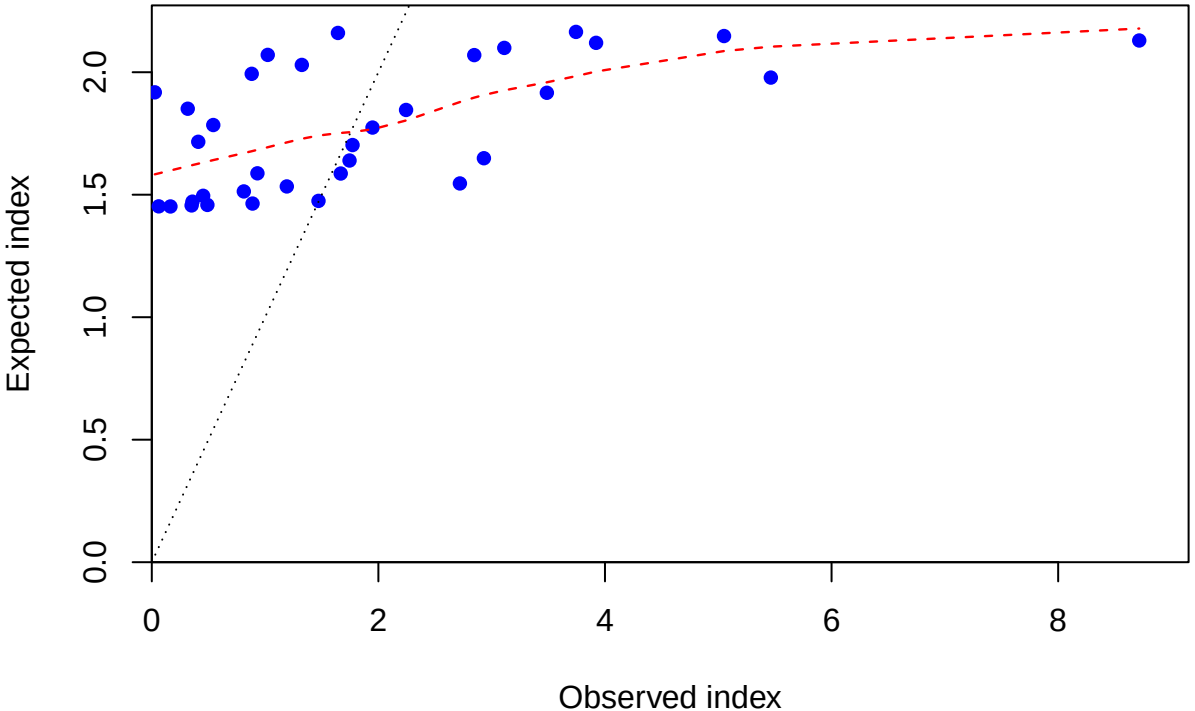

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

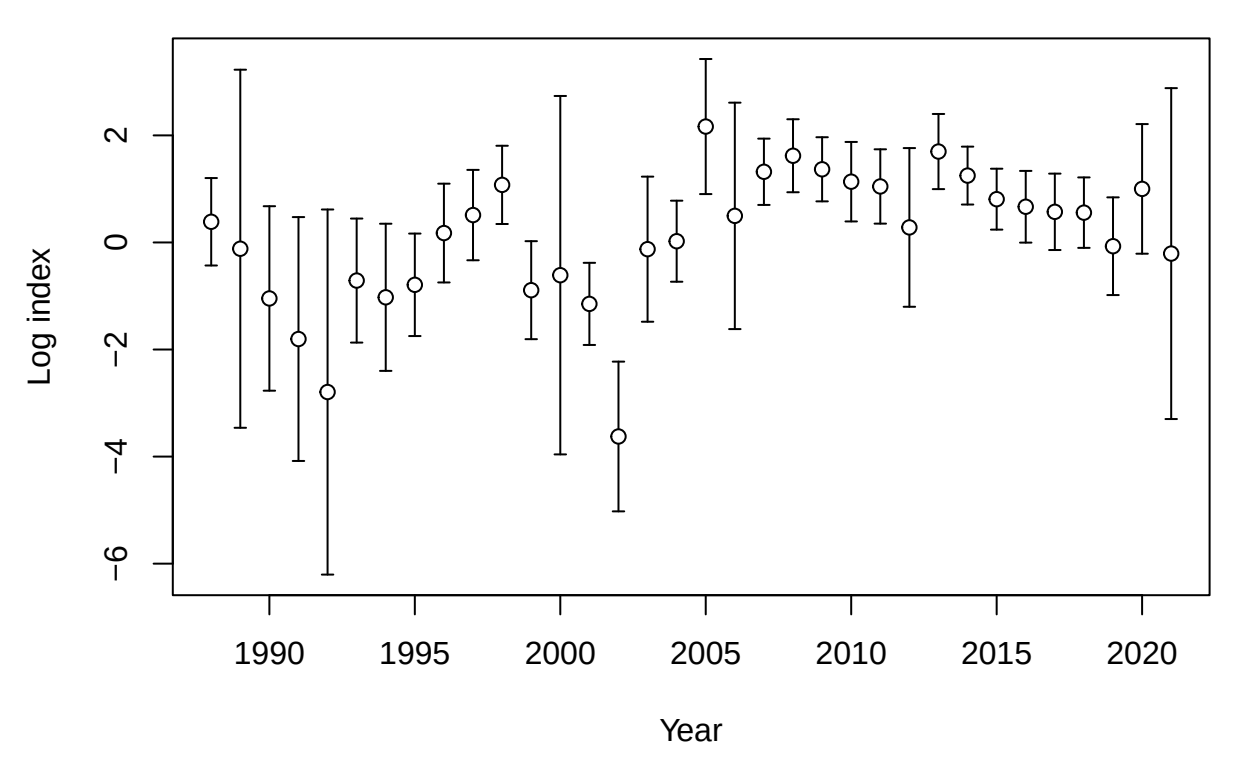

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1970
1980
1990
2000
2010
2020
Year

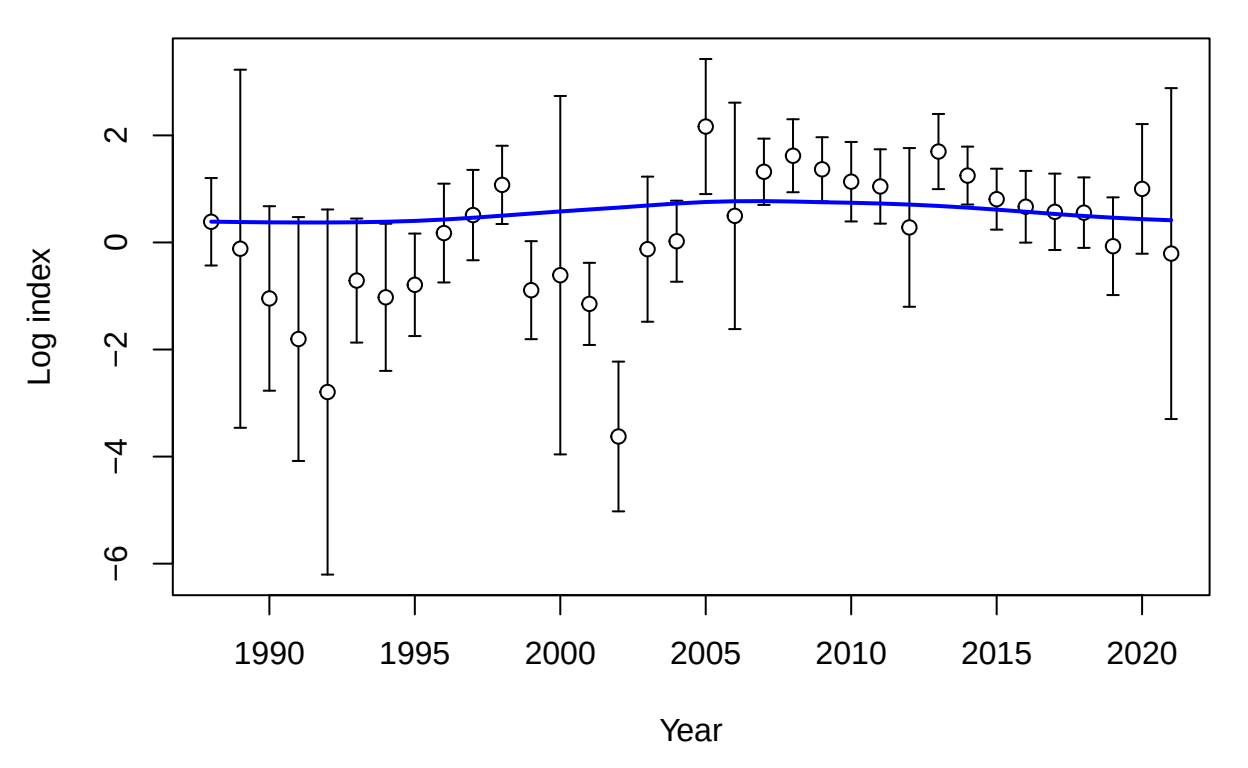

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
Relative spawning output: B/B_MSY
1969

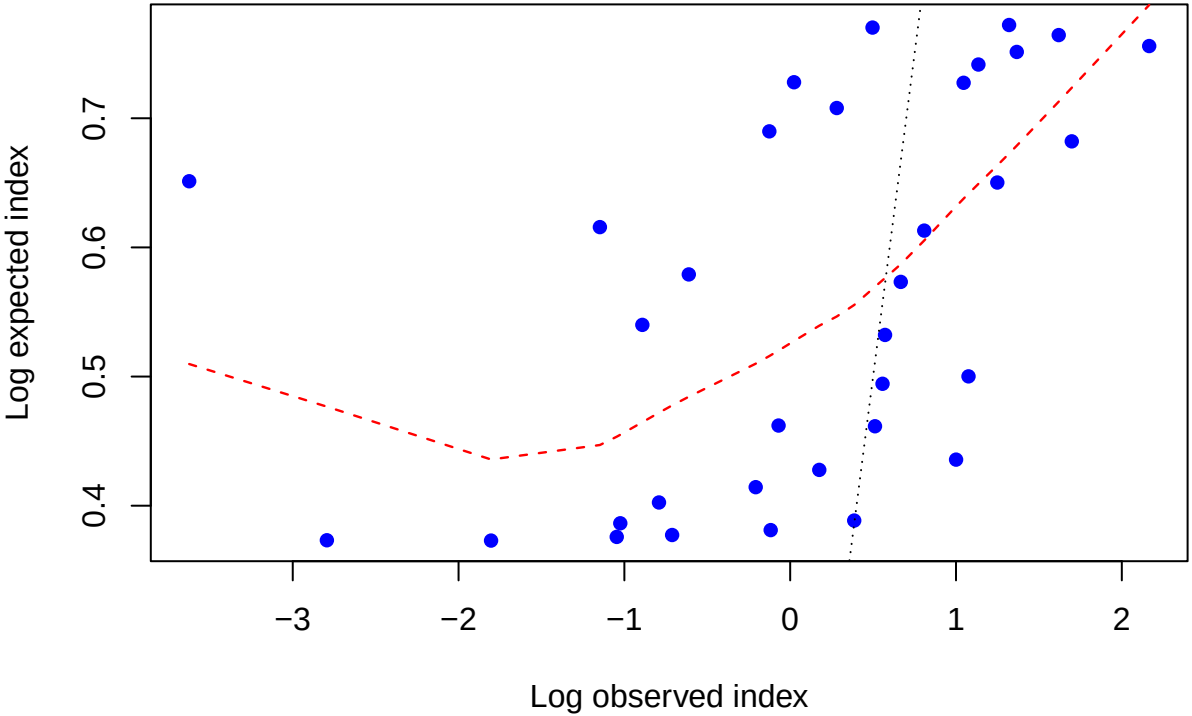

Index
0
5
10
15
20
25
30
1990
1995
2000
2005
2010
2015
2020
Year

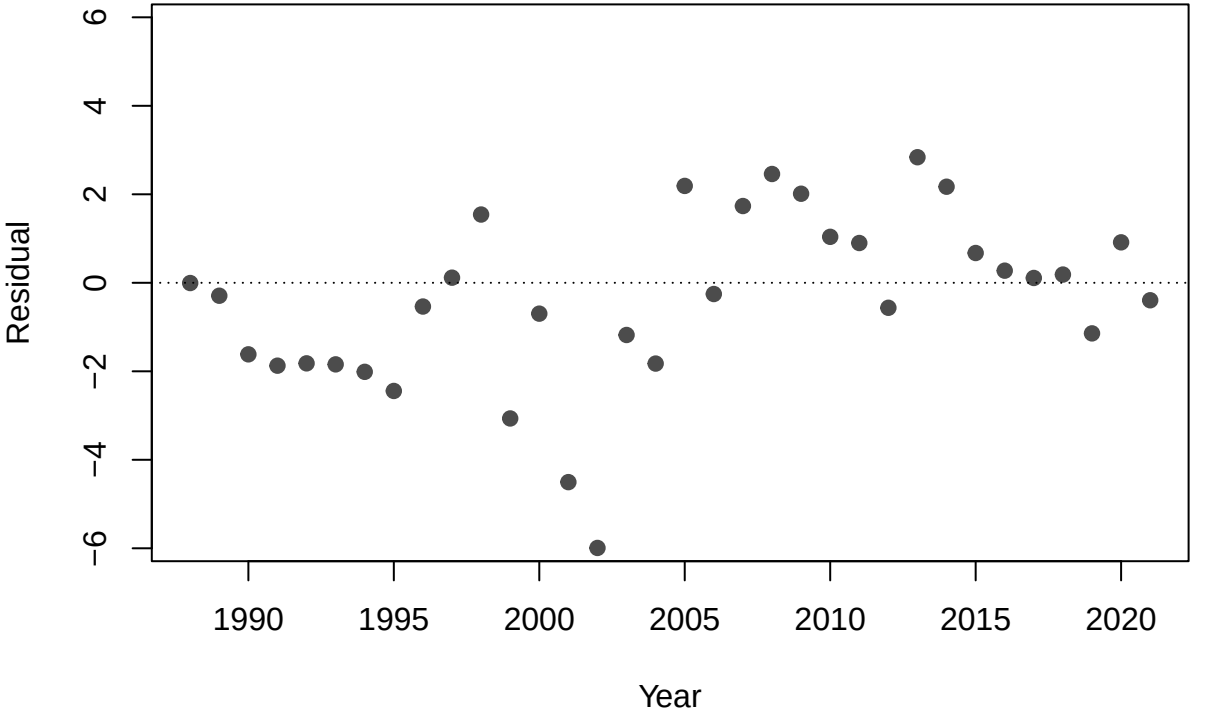

Index
0
5
10
15
20
25
30
1990
1995
2000
2005
2010
2015
2020
Year

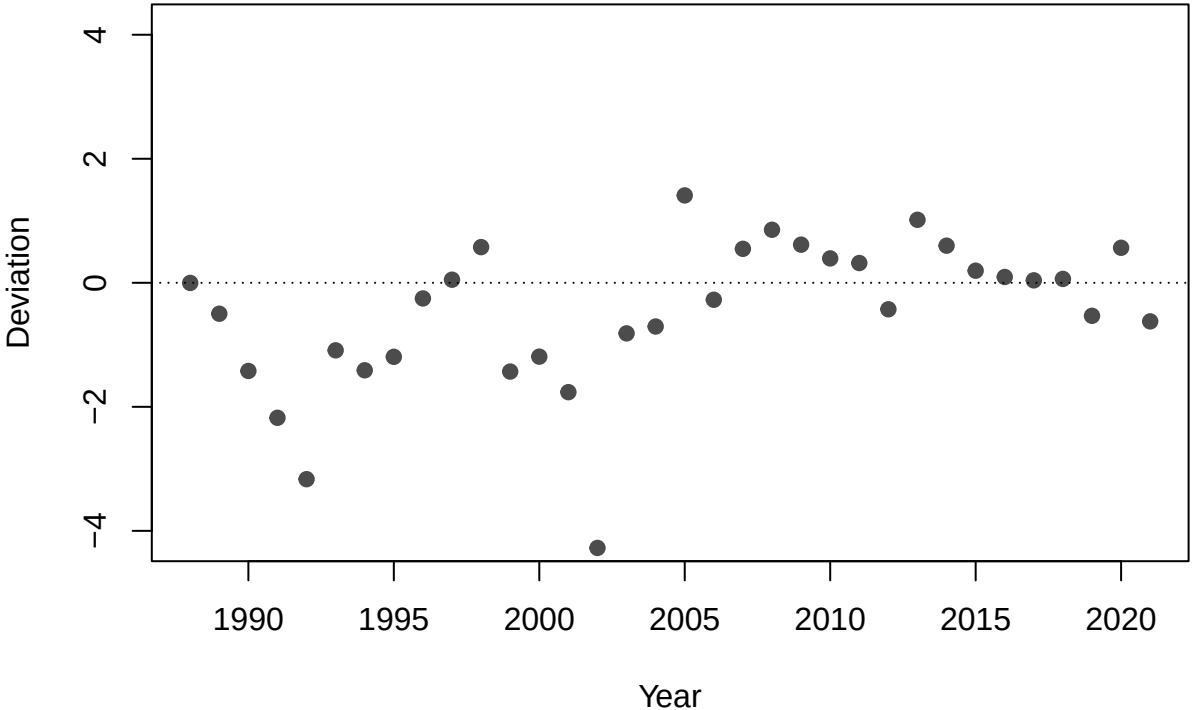

Expected index
0.0
0.5
1.0
1.5
2.0
0
2
4
6
8
Observed index

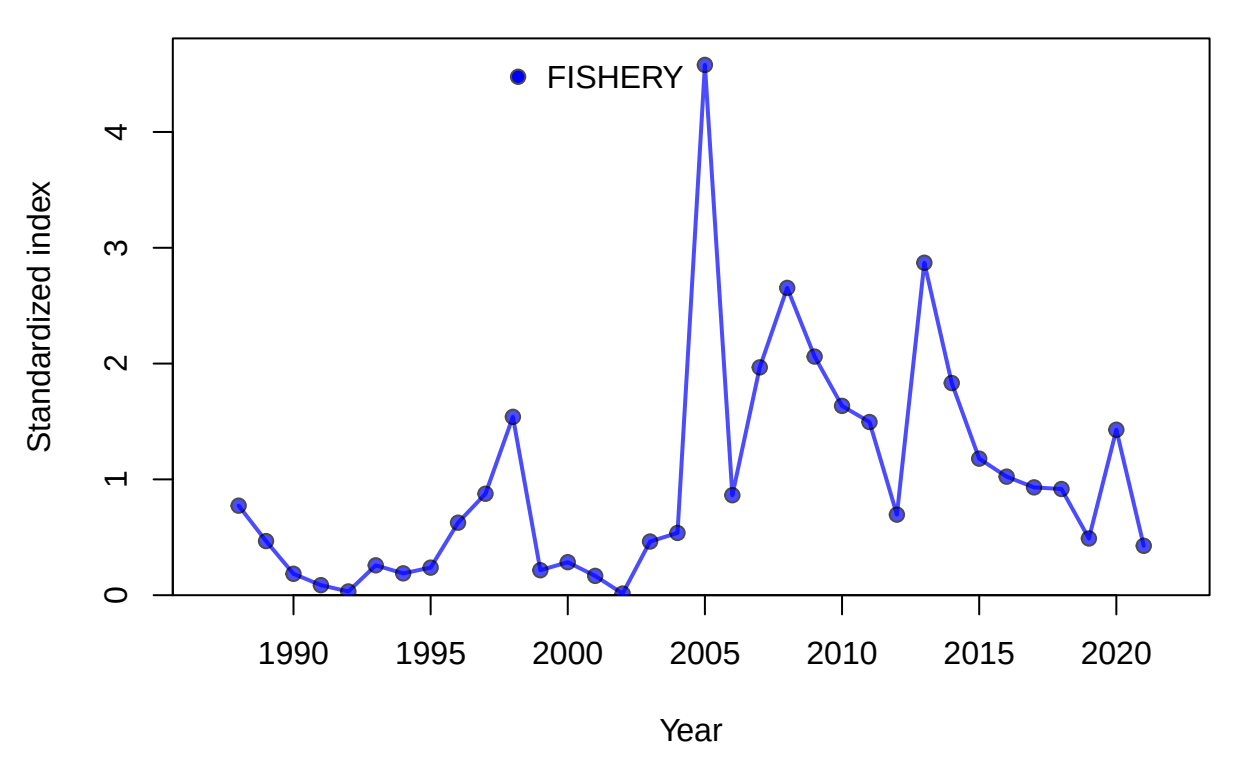

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

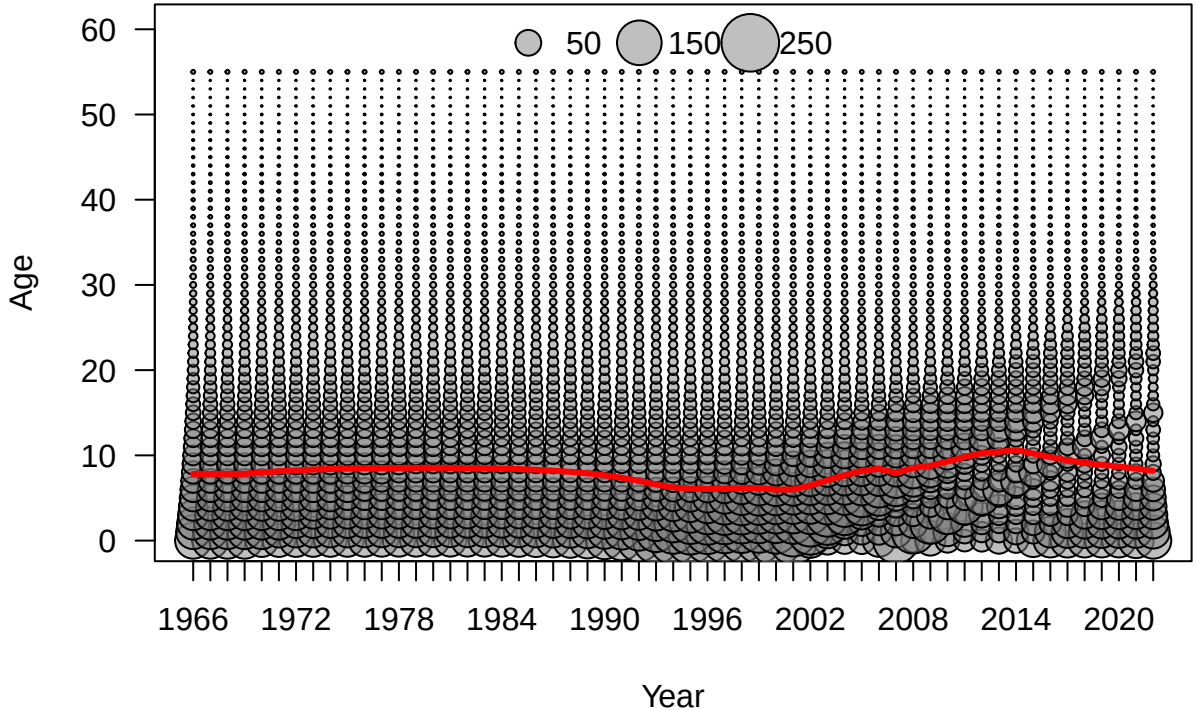

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

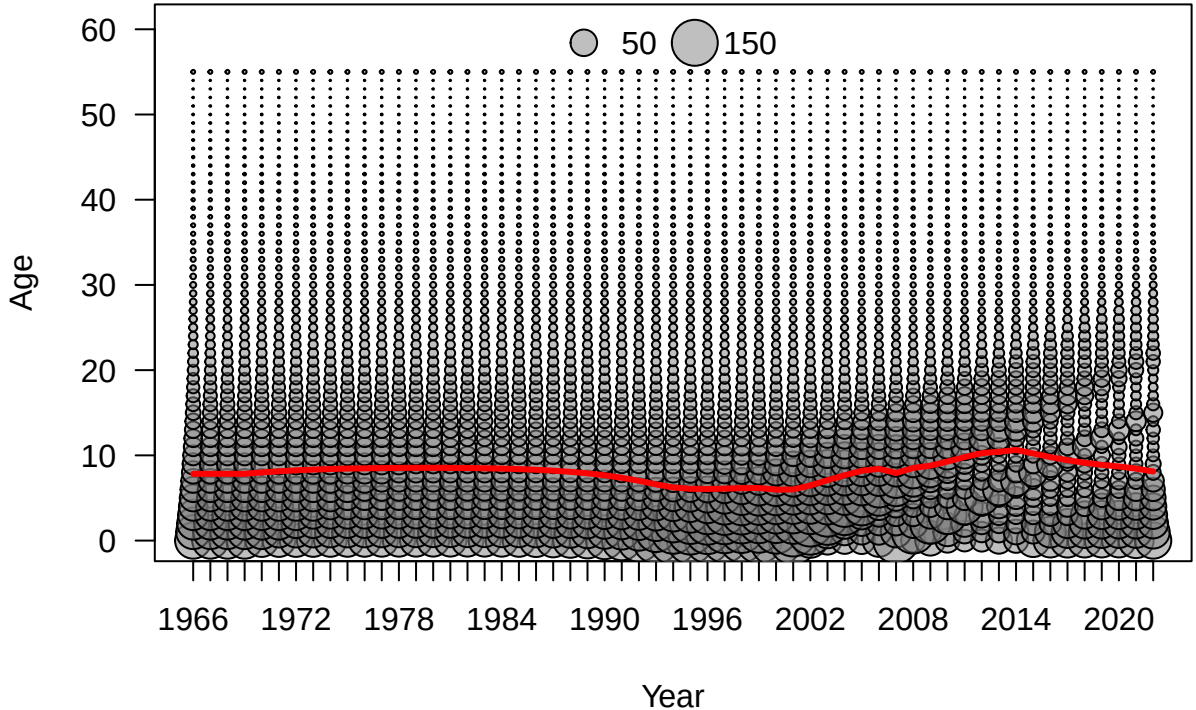

Log expected index
0.4
0.5
0.6
0.7
−3
−2
−1
0
1
2
Log observed index

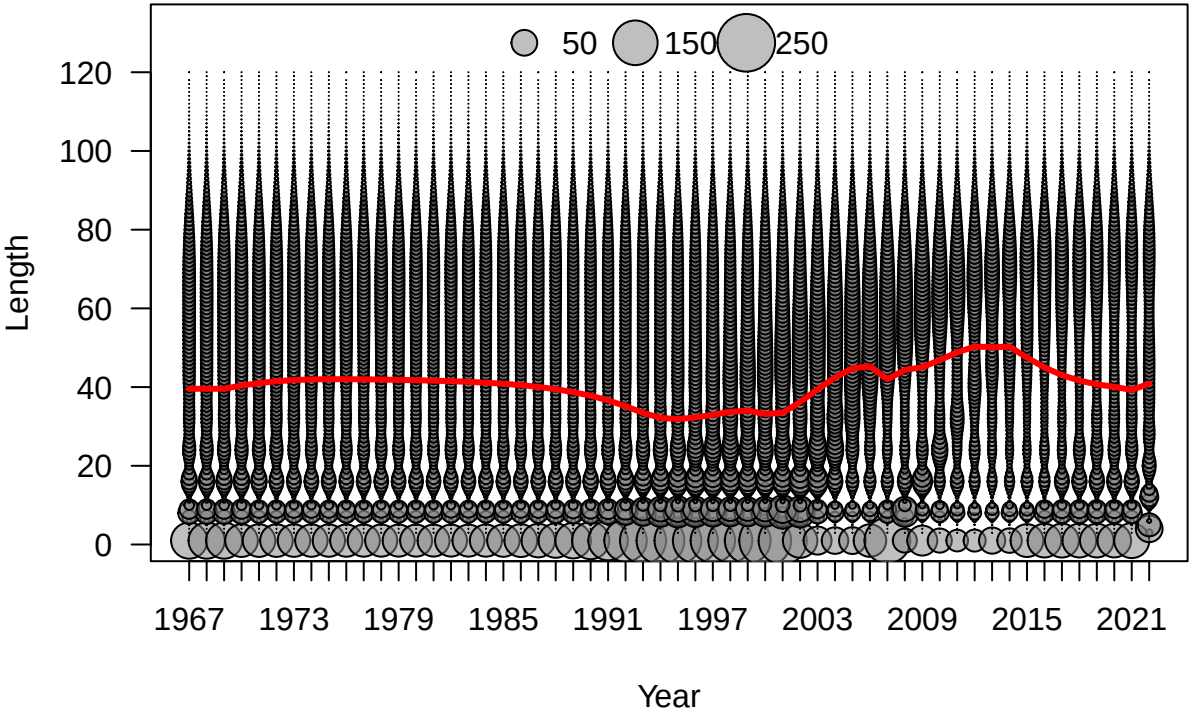

Residual
6
4
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

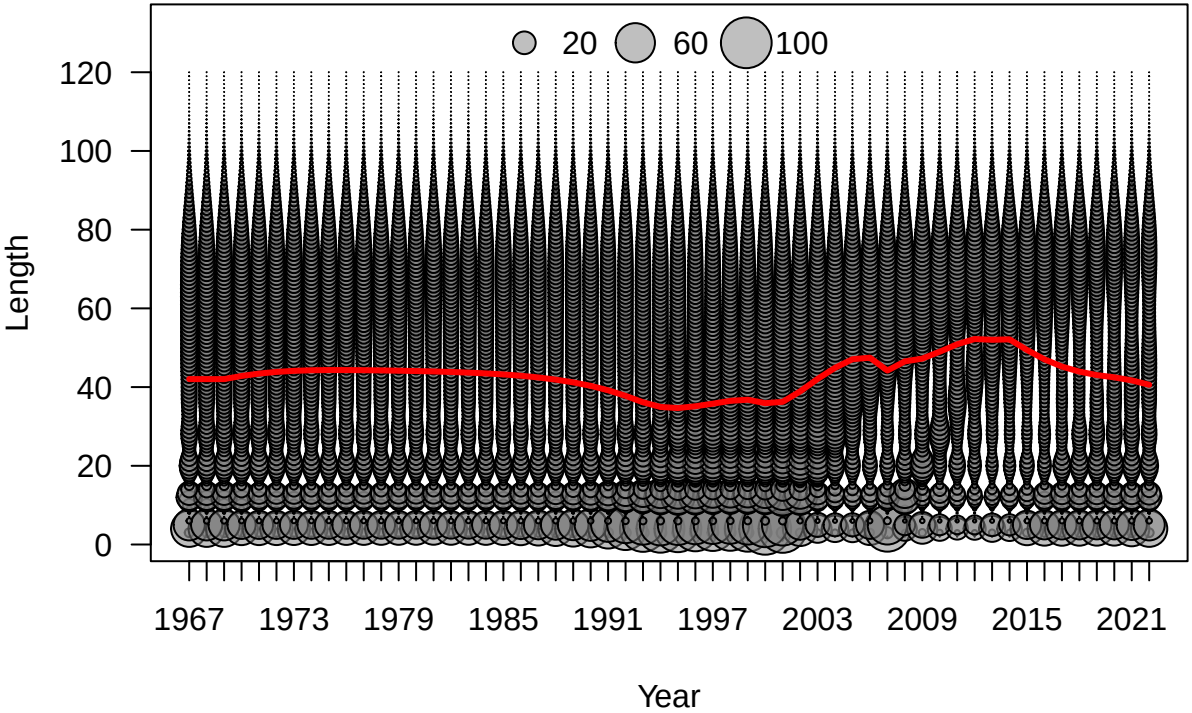

Deviation
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

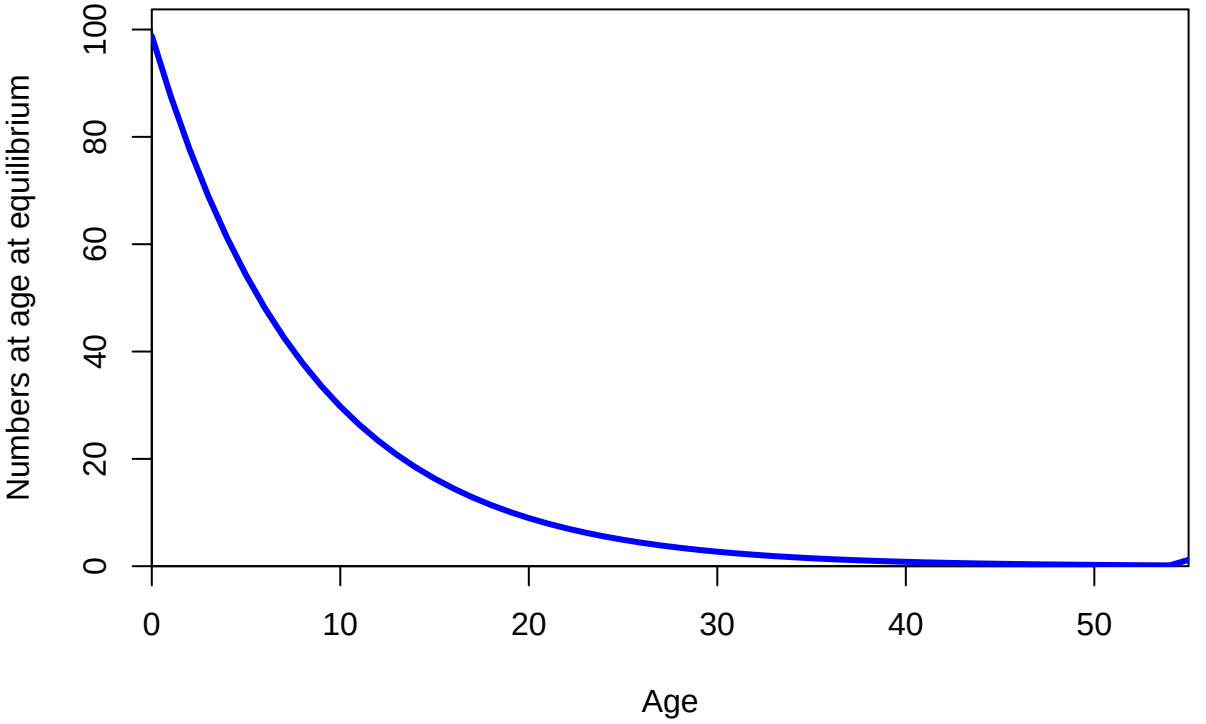

FISHERY
Standardized index
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

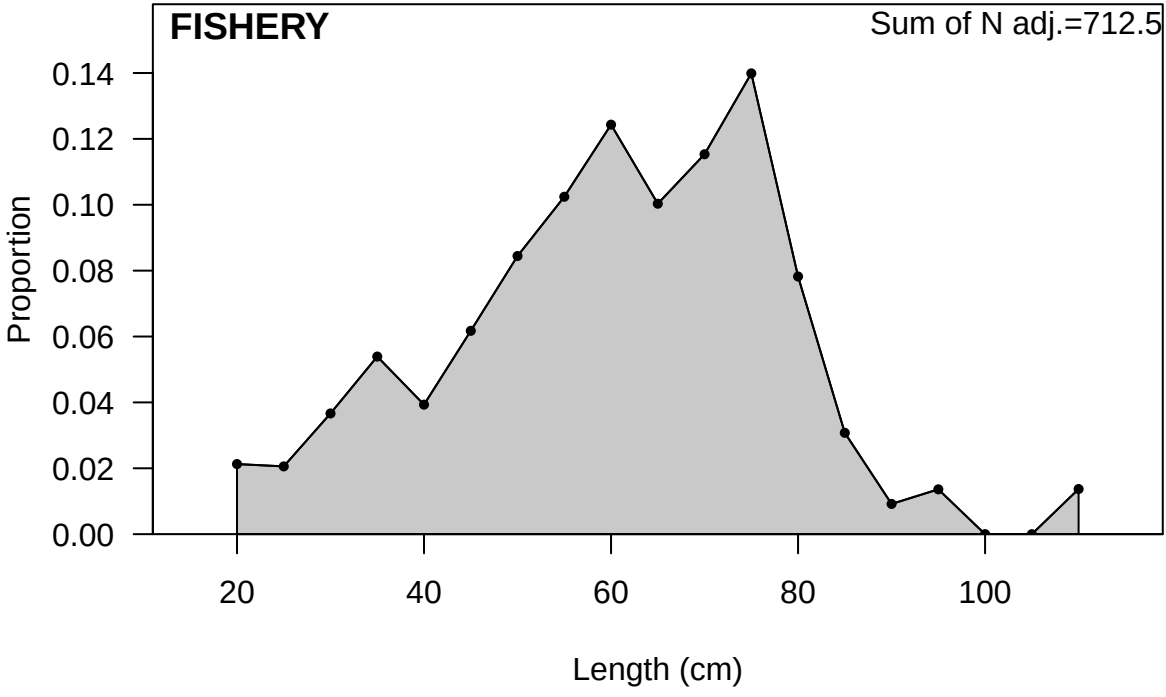

50
150
250
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

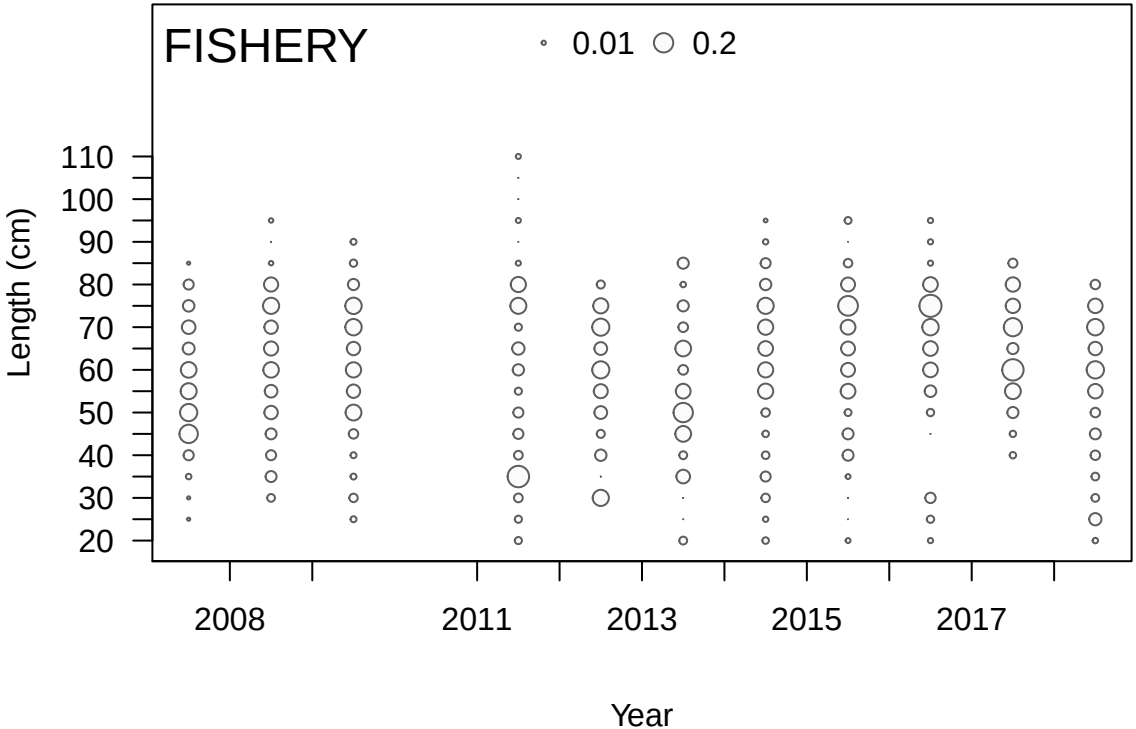

50
150
60
50
40
30
20
10
0
Age
1966
1972
1978
1984
1990
1996
2002
2008
2014
2020
Year

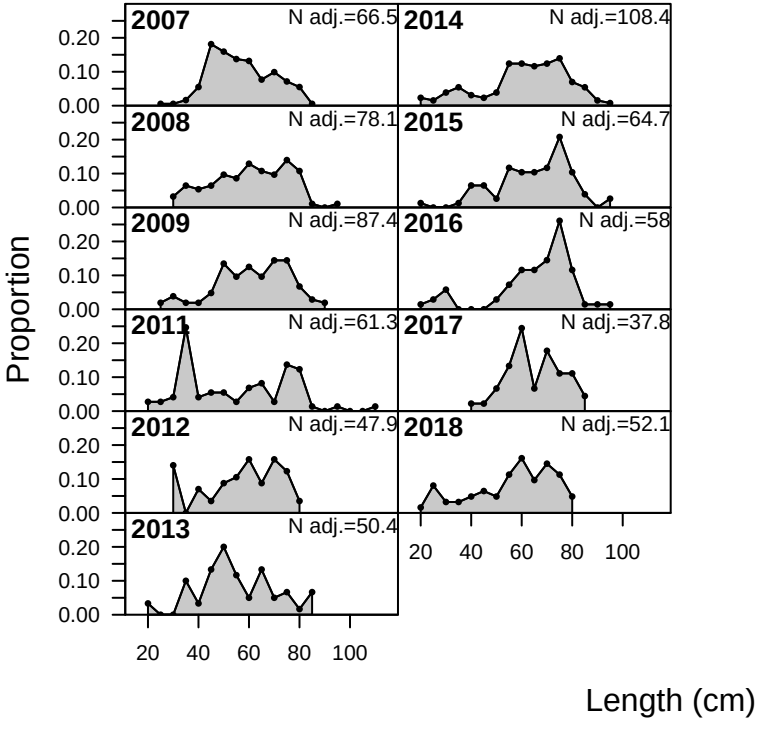

50
150
250
120
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

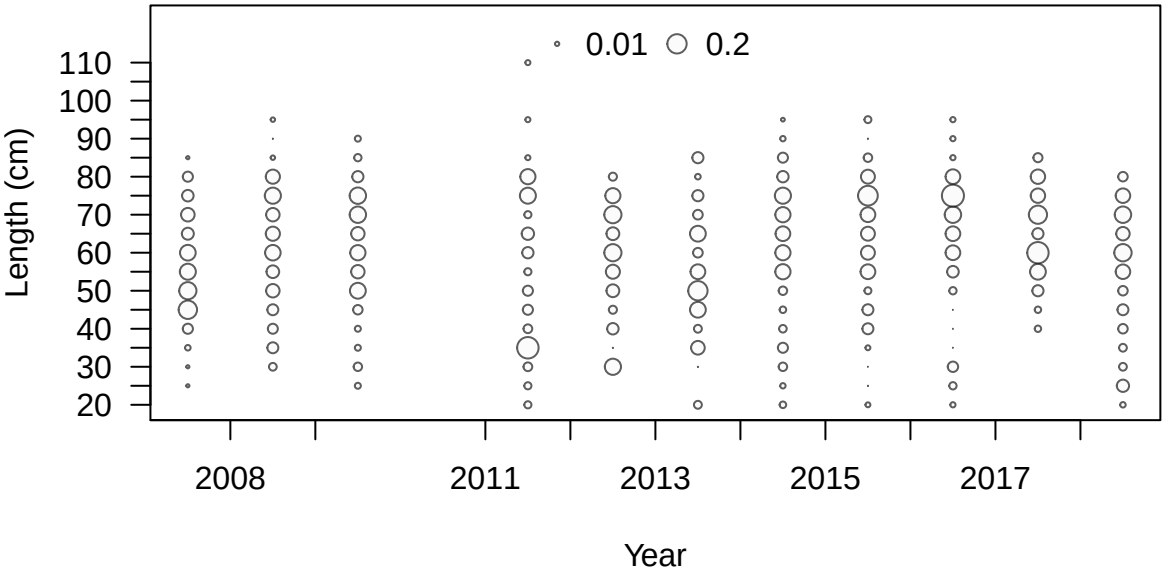

20
60
100
120
100
80
60
40
20
0
Length
1967
1973
1979
1985
1991
1997
2003
2009
2015
2021
Year

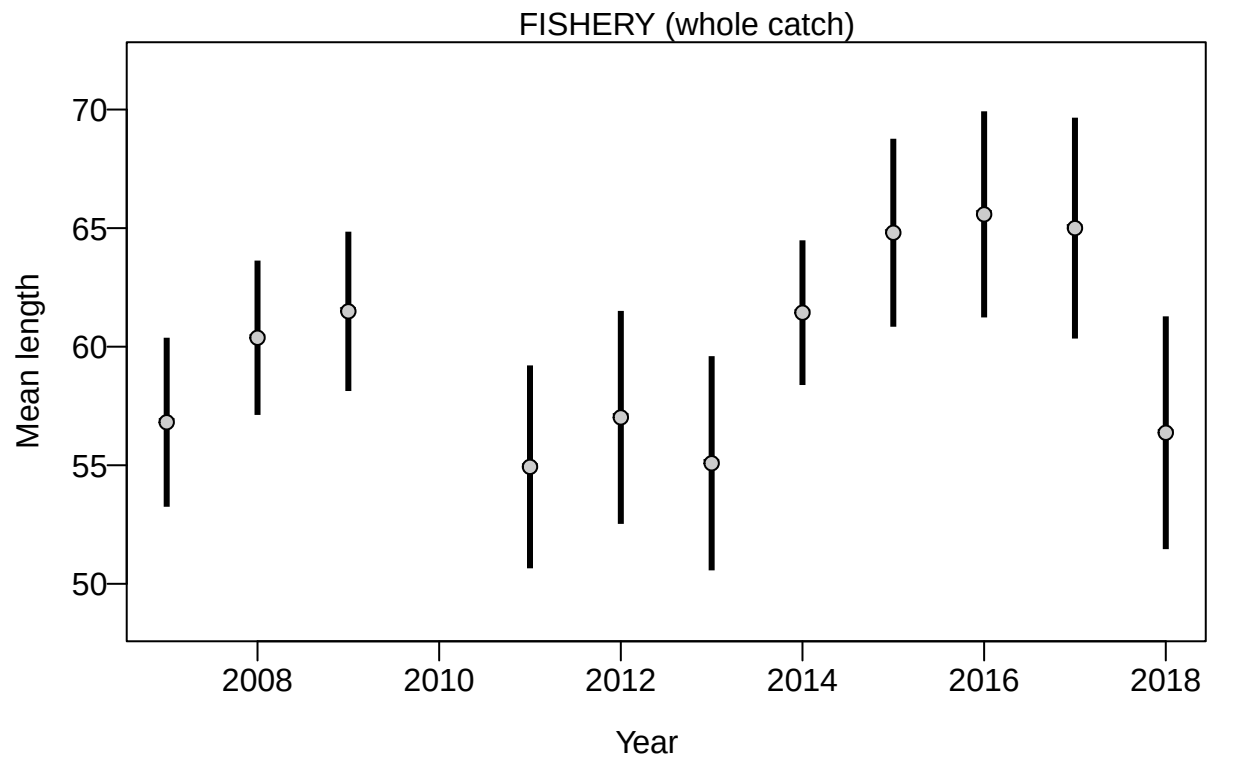

Numbers at age at equilibrium
0
20
40
60
80
100
0
10
20
30
40
50
Age

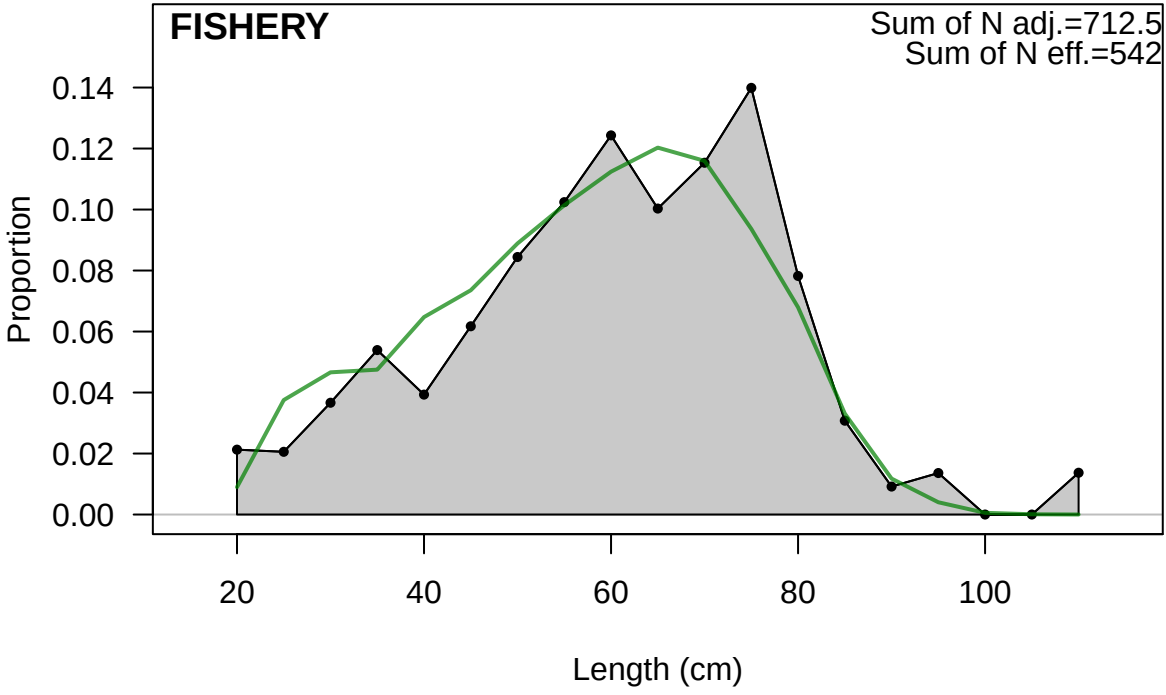

FISHERY
Sum of N adj.=712.5
Proportion
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
20
40
60
80
100
Length (cm)

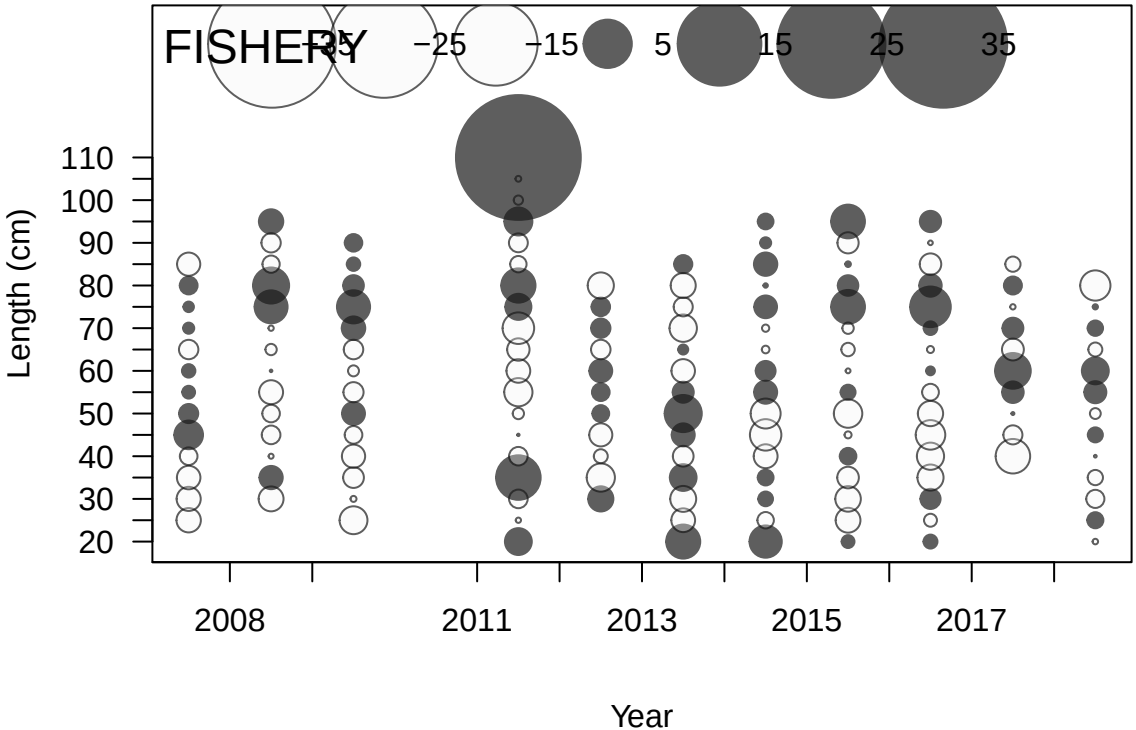

FISHERY
0.01
0.2
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

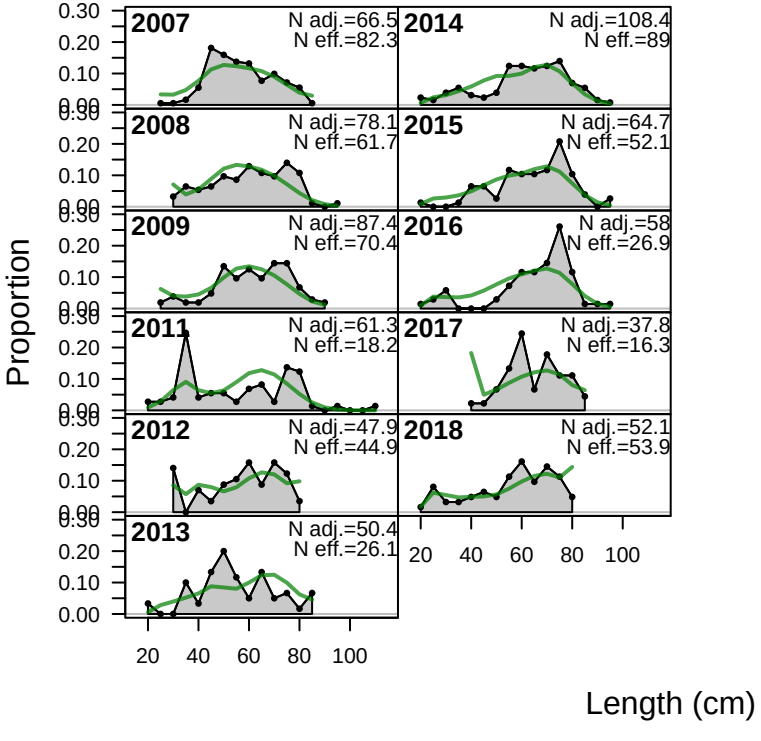

2007
N adj.=66.5
2014
N adj.=108.4
2008
N adj.=78.1
2015
N adj.=64.7
2009
N adj.=87.4
2016
N adj.=58
2011
N adj.=61.3
2017
N adj.=37.8
2012
N adj.=47.9
2018
N adj.=52.1
2013
N adj.=50.4
0.00
0.10
0.20
20
40
60
80
100
Proportion
Length (cm)

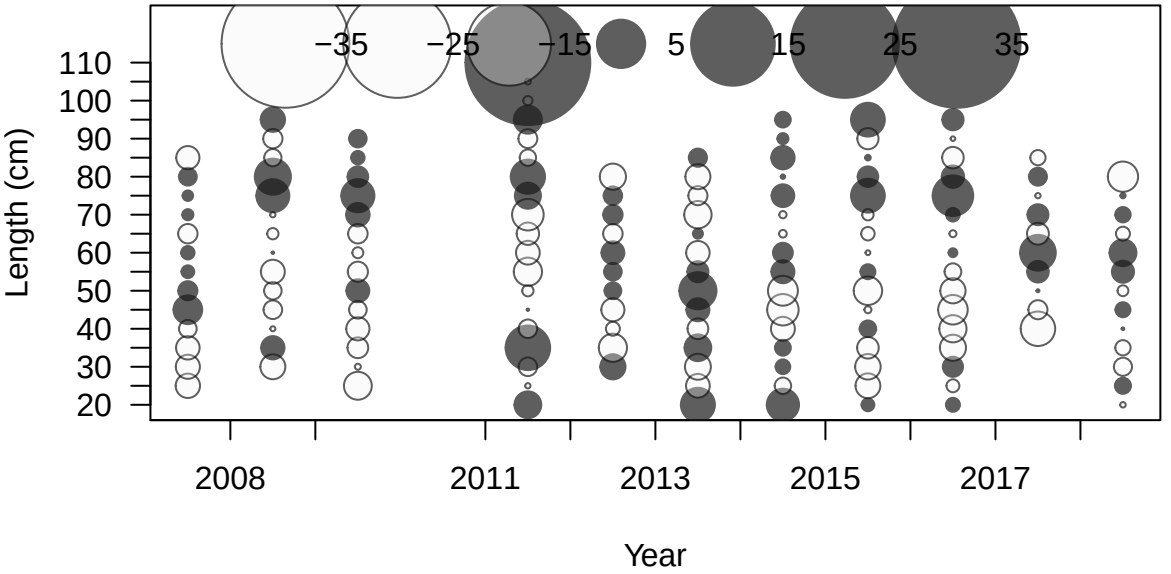

0.01
0.2
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

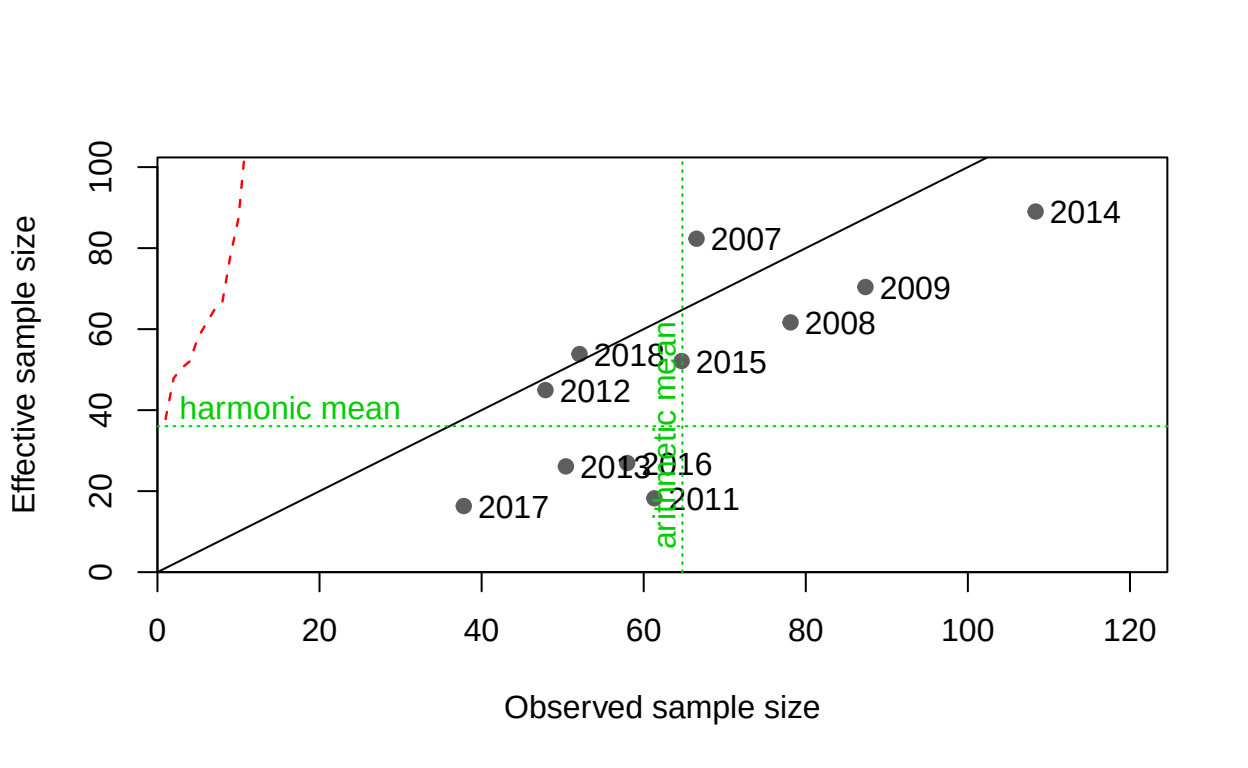

FISHERY (whole catch)
70
65
60
55
50
Mean length
2008
2010
2012
2014
2016
2018
Year

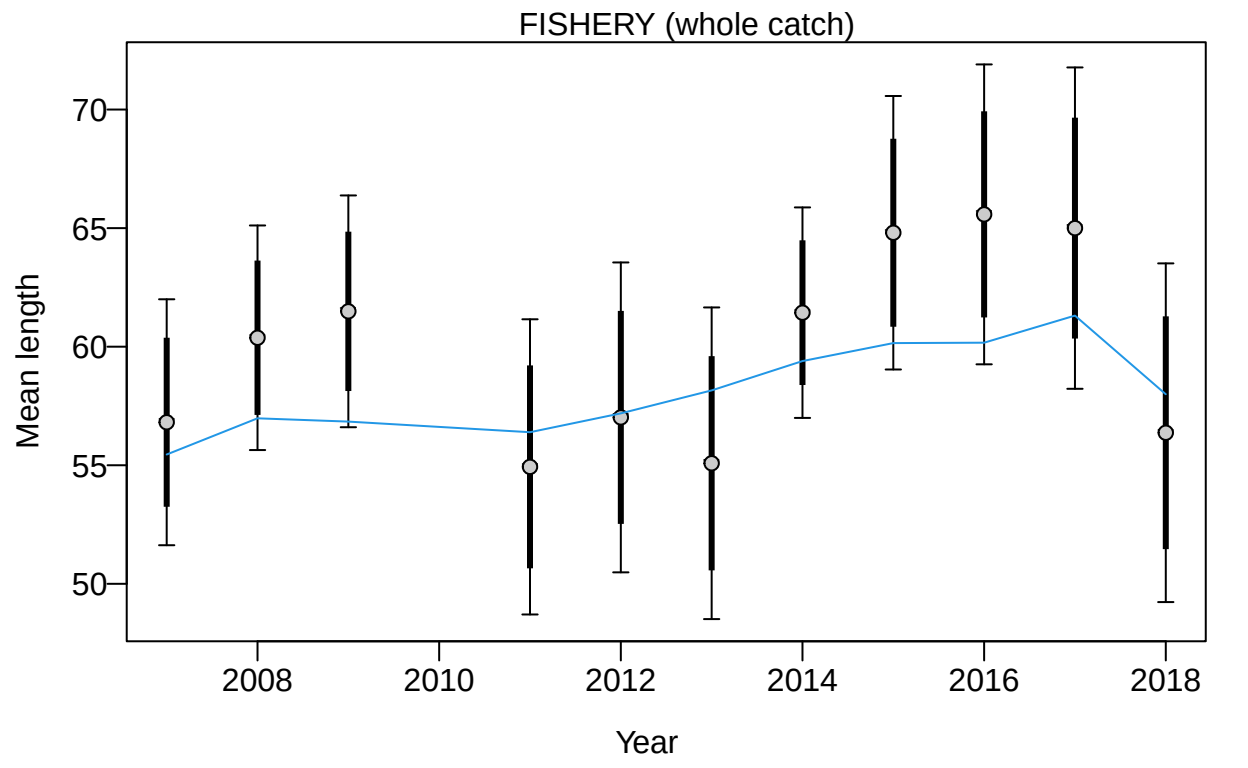

FISHERY
Sum of N adj.=712.5
Sum of N eff.=542
Proportion
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
20
40
60
80
100
Length (cm)

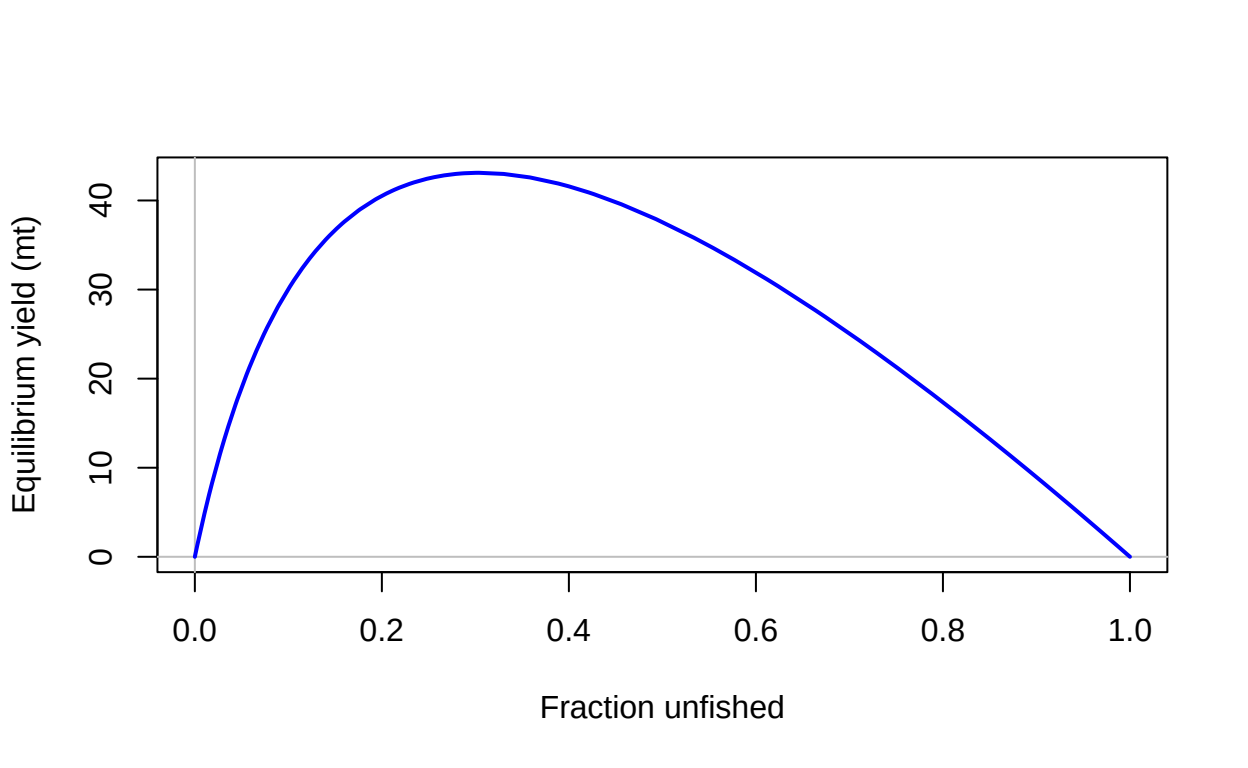

FISHERY
−35
−25
−15
5
15
25
35
Length (cm)
110
100
90
80
70
60
50
40
30
20
2008
2011
2013
2015
2017
Year

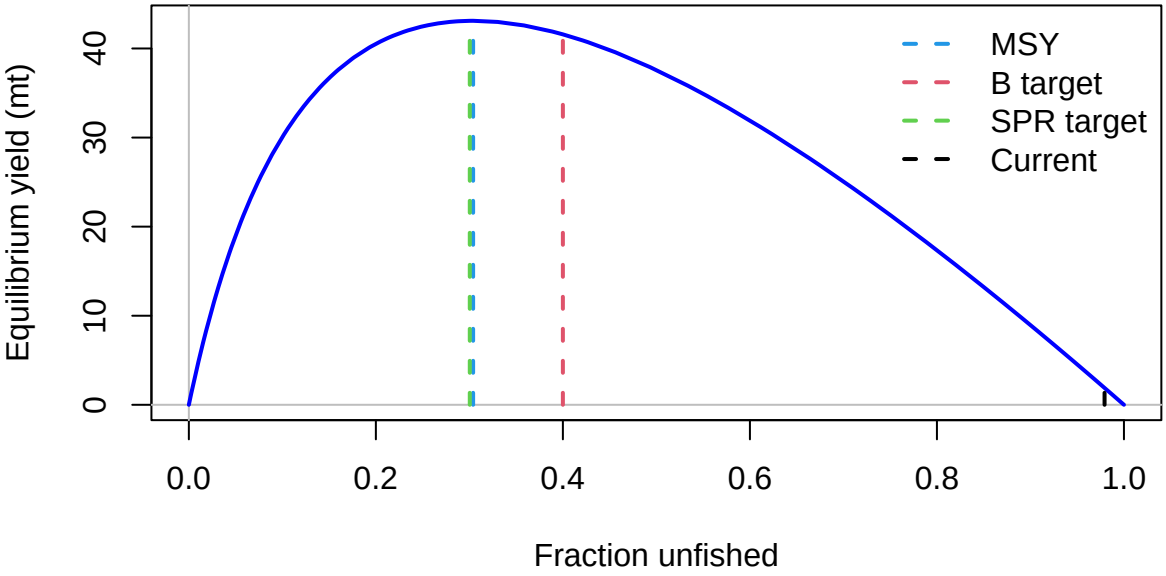

2007
N adj.=66.5
N eff.=82.3
2014
N adj.=108.4
N eff.=89
2008
N adj.=78.1
N eff.=61.7
2015
N adj.=64.7
N eff.=52.1
2009
N adj.=87.4
N eff.=70.4
2016
N adj.=58
N eff.=26.9
2011
N adj.=61.3
N eff.=18.2
2017
N adj.=37.8
N eff.=16.3
2012
N adj.=47.9
N eff.=44.9
2018
N adj.=52.1
N eff.=53.9
2013
N adj.=50.4
N eff.=26.1
0.30
0.20
0.10
0.00
20
40
60
80
100
Proportion
Length (cm)

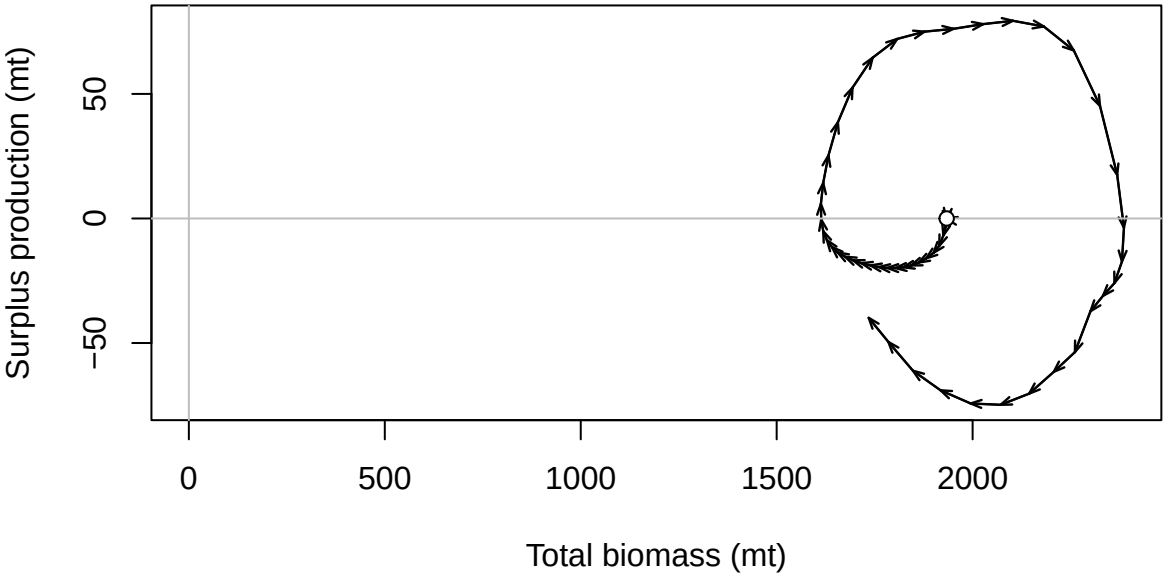

−35
−25
−15
5
15
25
35
110
100
90
80
70
60
50
40
30
20
Length (cm)
2008
2011
2013
2015
2017
Year

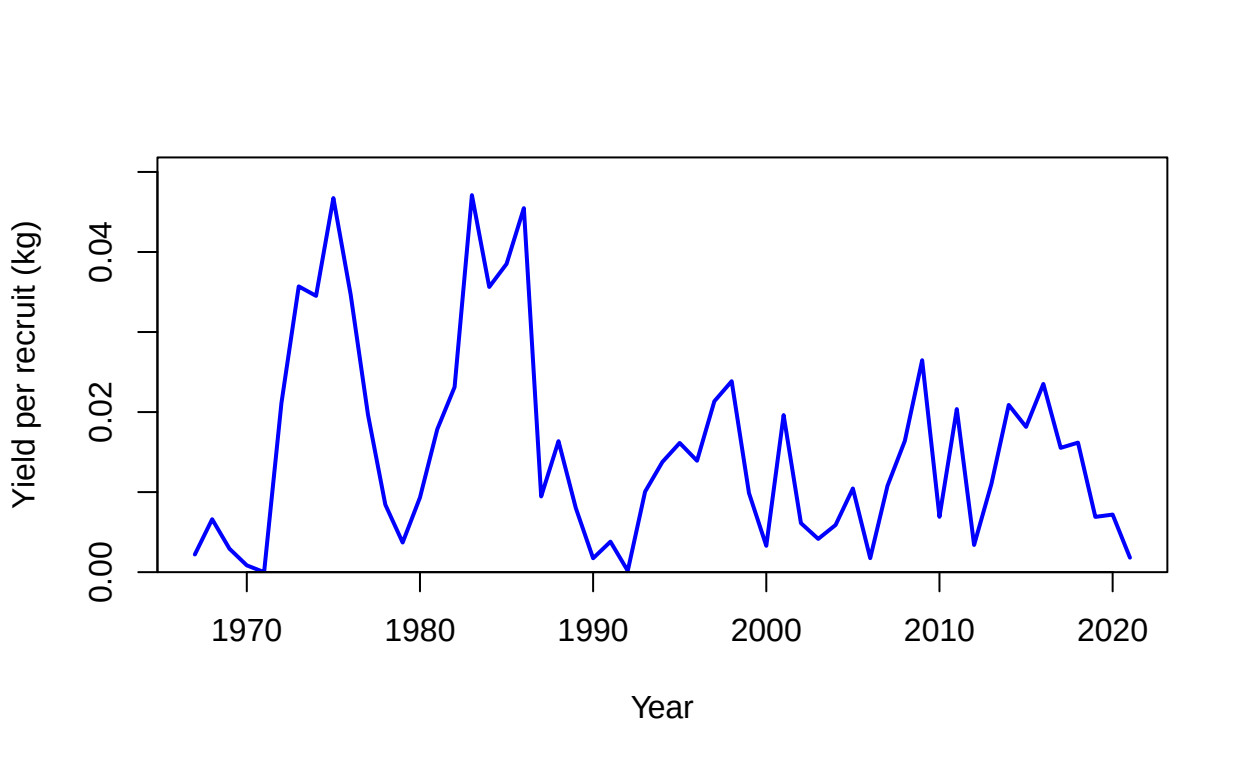

Effective sample size
Observed sample size
0
20
40
60
80
100
120
harmonic mean
arithmetic mean
2014
2007
2009
2008
2018
2015
2012
2013
2016
2017
2011

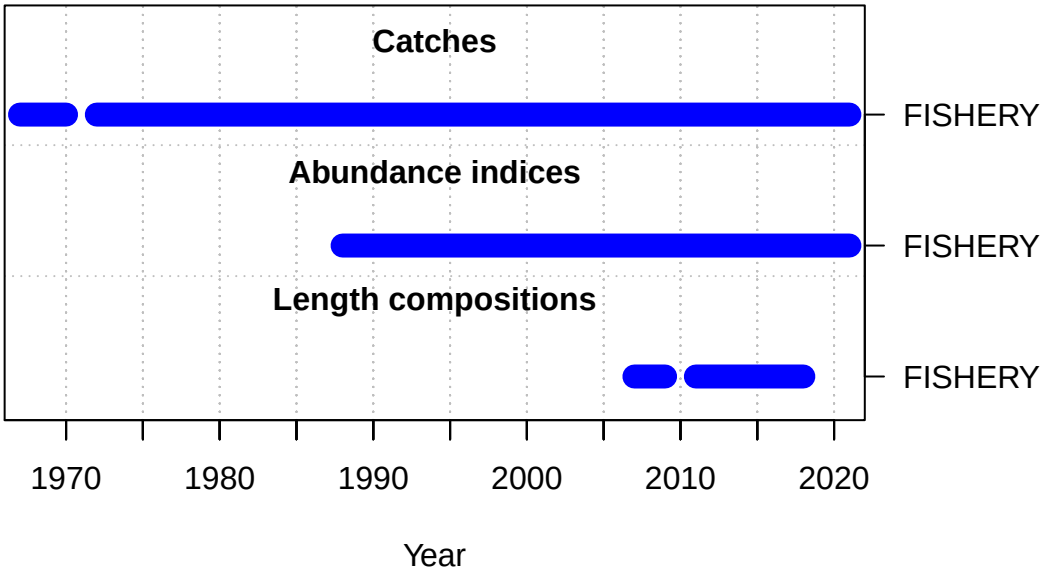

FISHERY (whole catch)
Mean length
70
65
60
55
50
2008
2010
2012
2014
2016
2018
Year

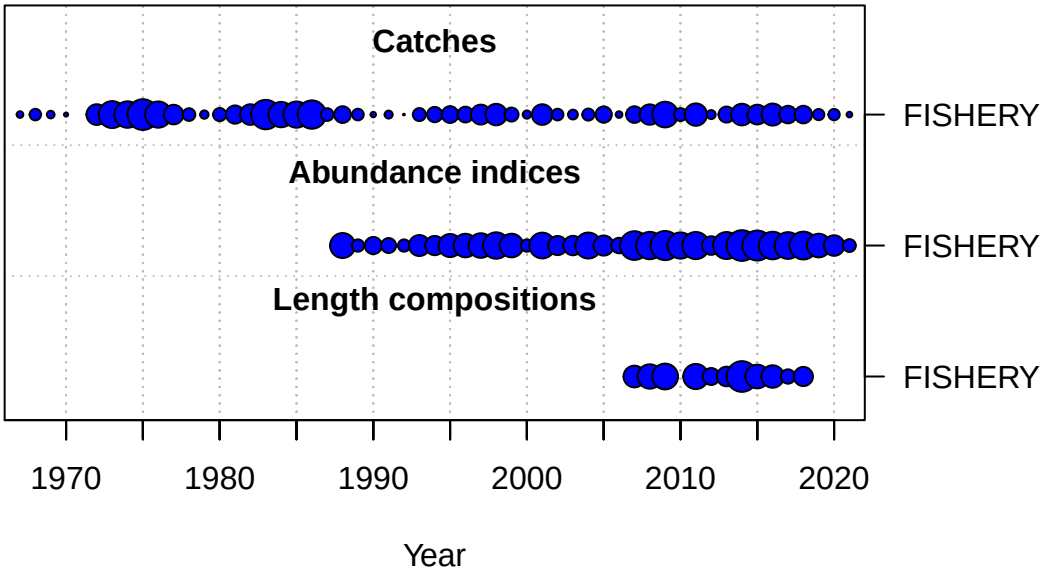

Equilibrium yield (mt)
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

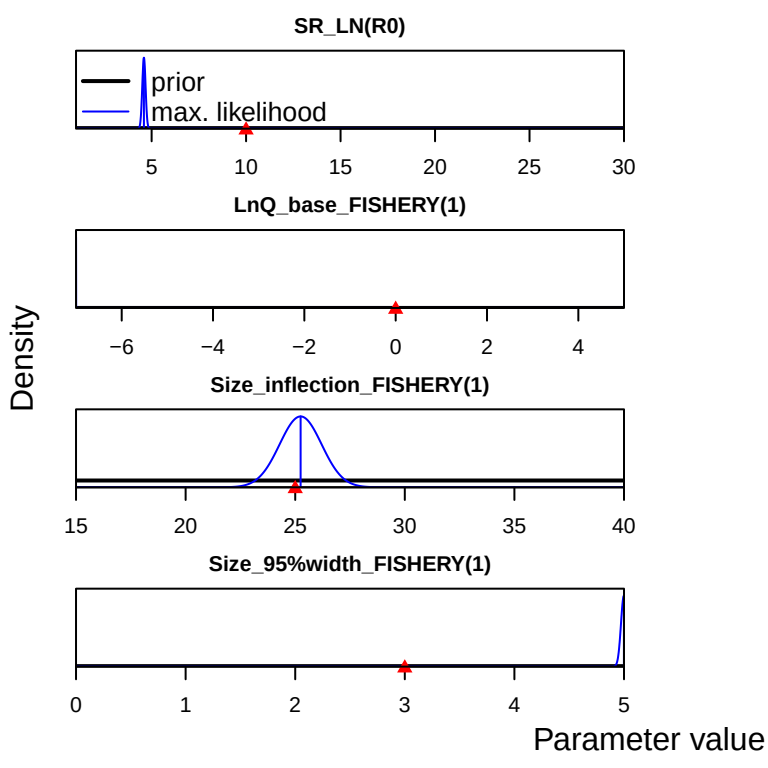

Equilibrium yield (mt)
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
50
0
−50
0
500
1000
1500
2000
Total biomass (mt)


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


Catches
FISHERY
Abundance indices
FISHERY
Length compositions
FISHERY
1970
1980
1990
2000
2010
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
Length compositions
FISHERY
1970
1980
1990
2000
2010
2020
Year


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