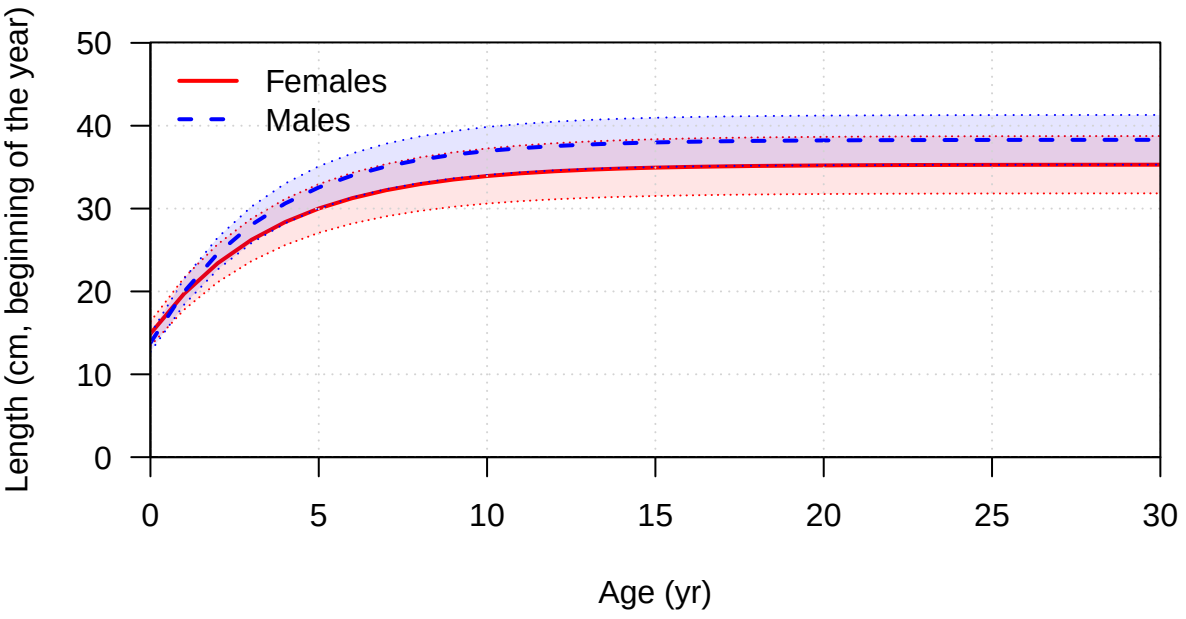
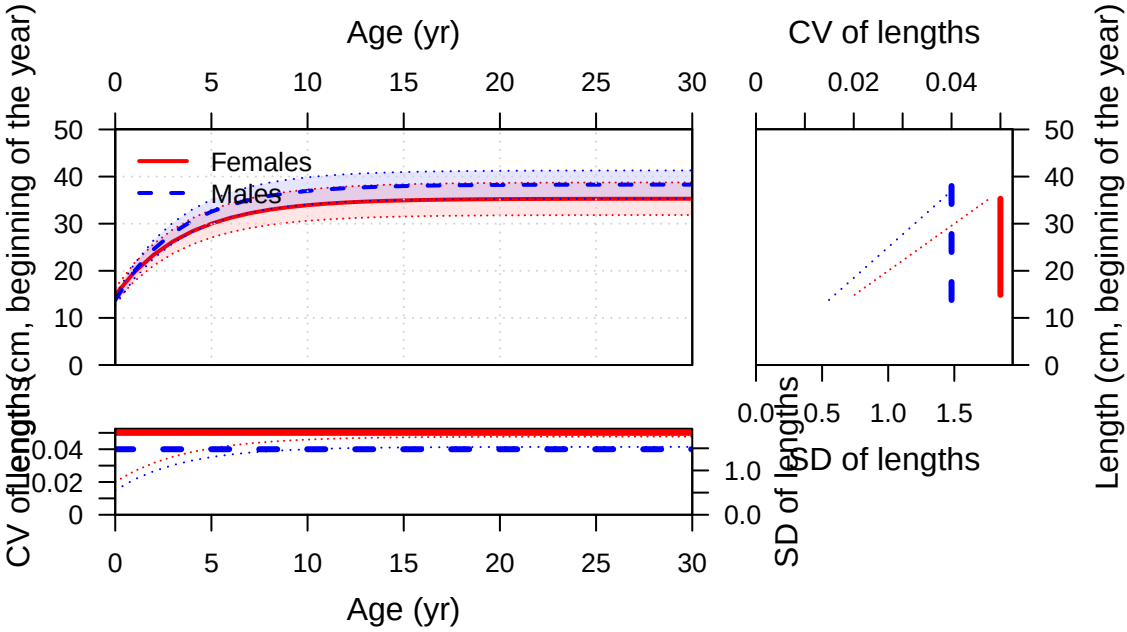
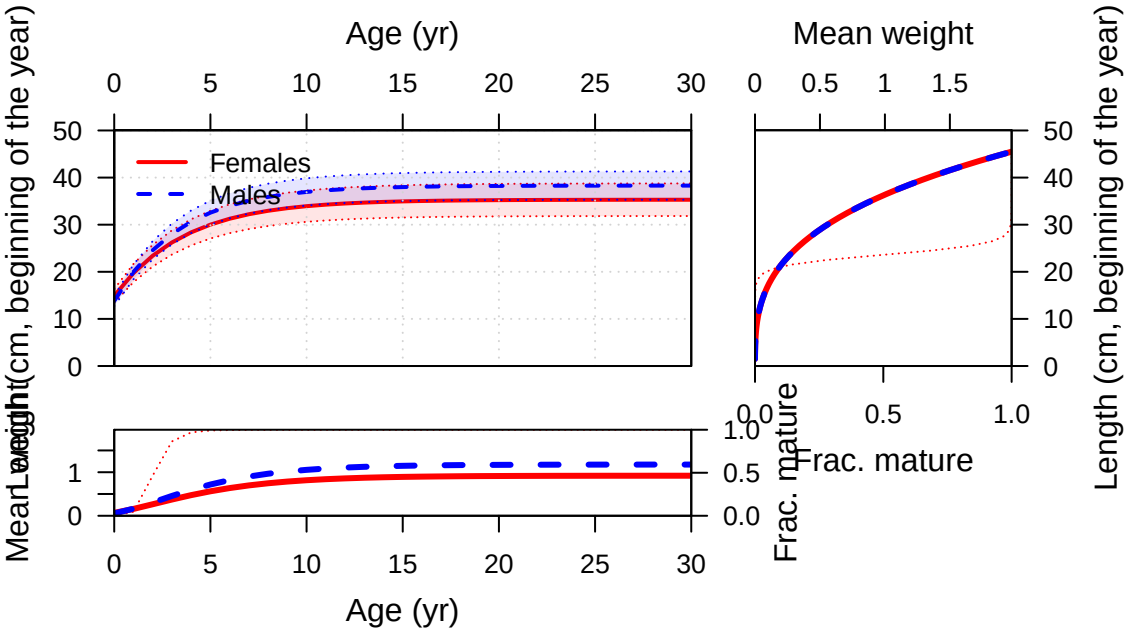
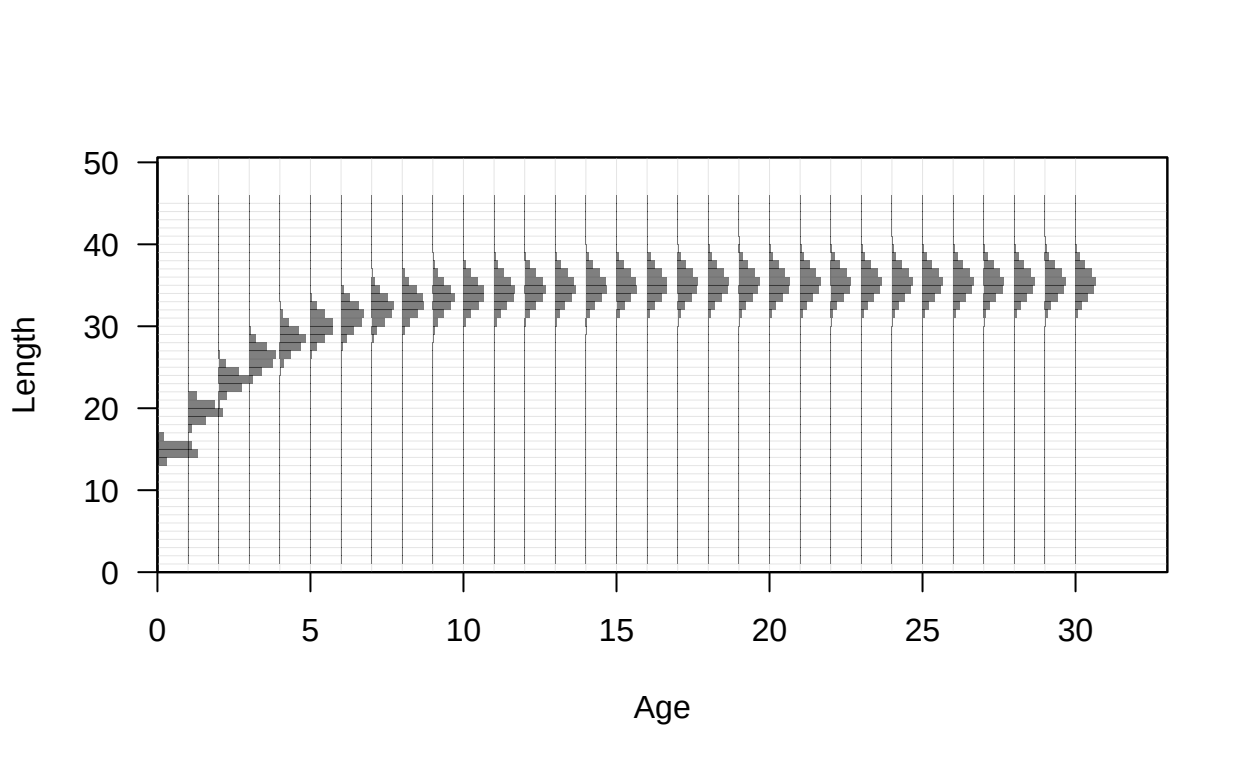
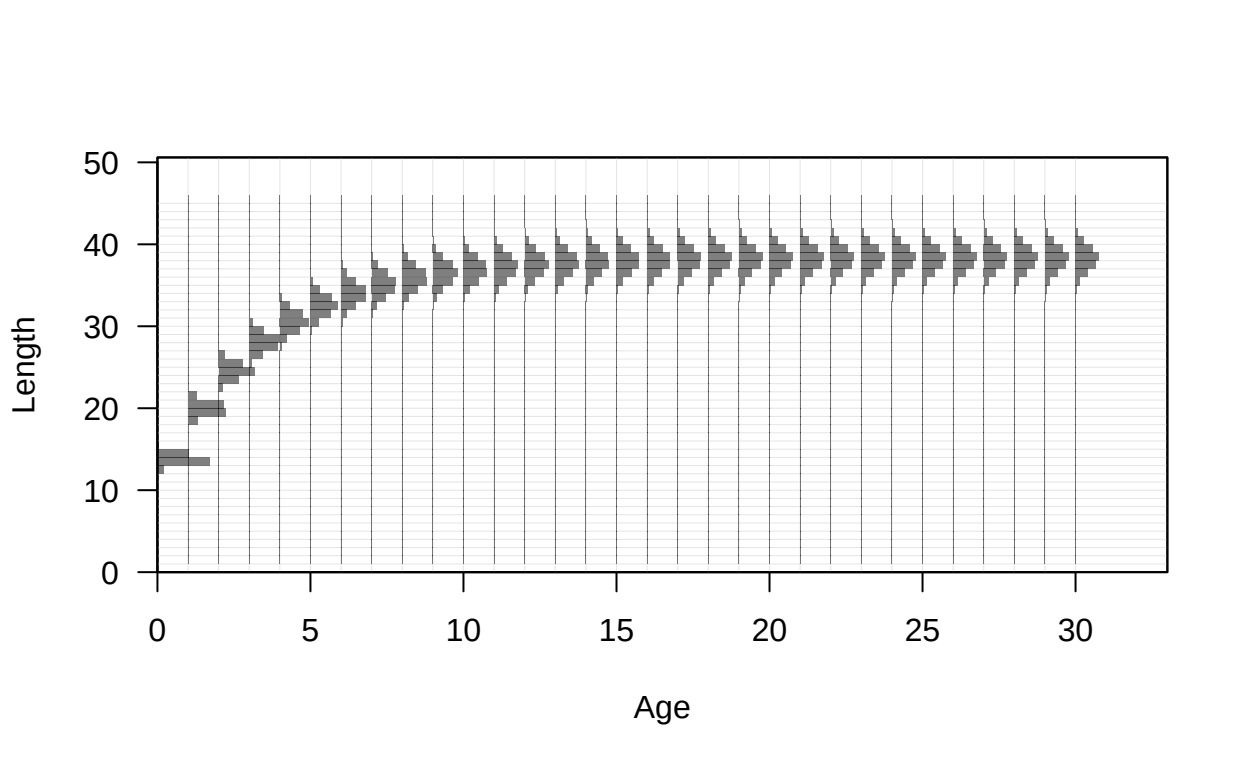
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.19.0
StartTime: Wed Jul 20 08:31:48 2022
Data_File: data.ss
Control_File: control.ss

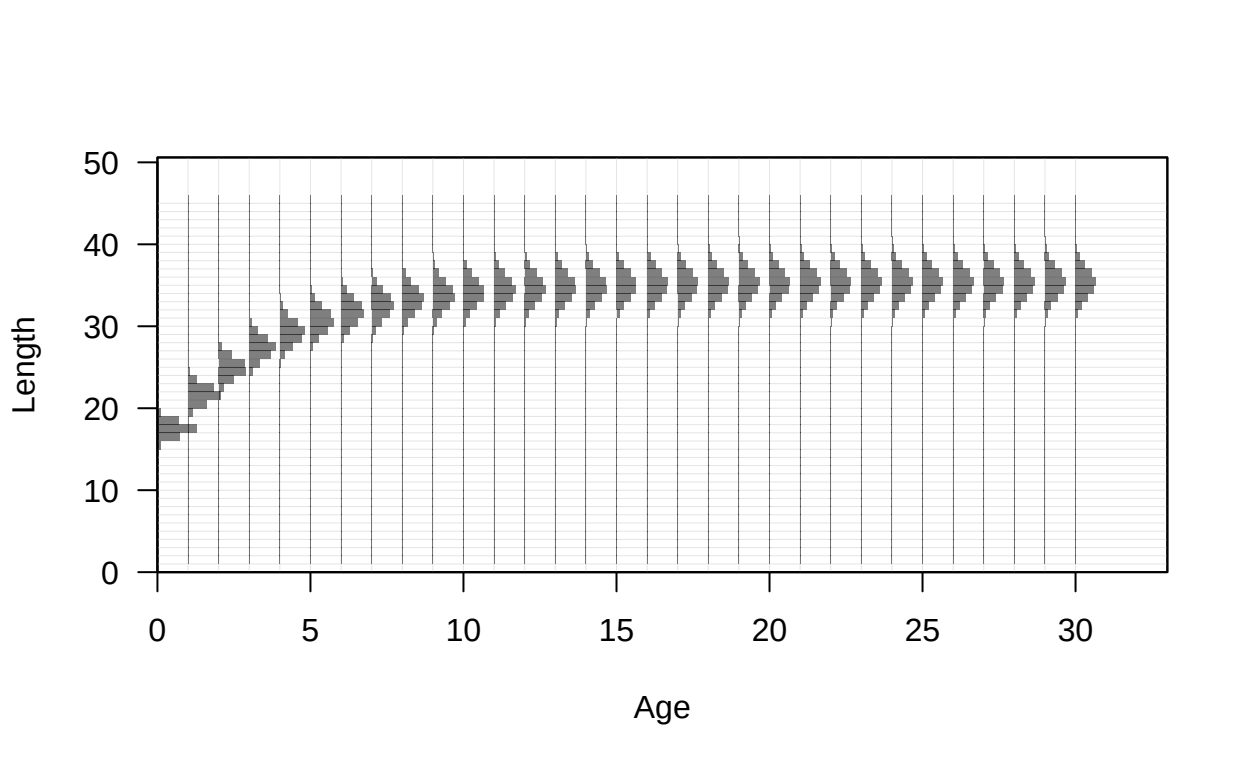

Females
Males
Length (cm, beginning of the year)
Age (yr)
0
10
20
30
40
50
0
5
10
15
20
25
30

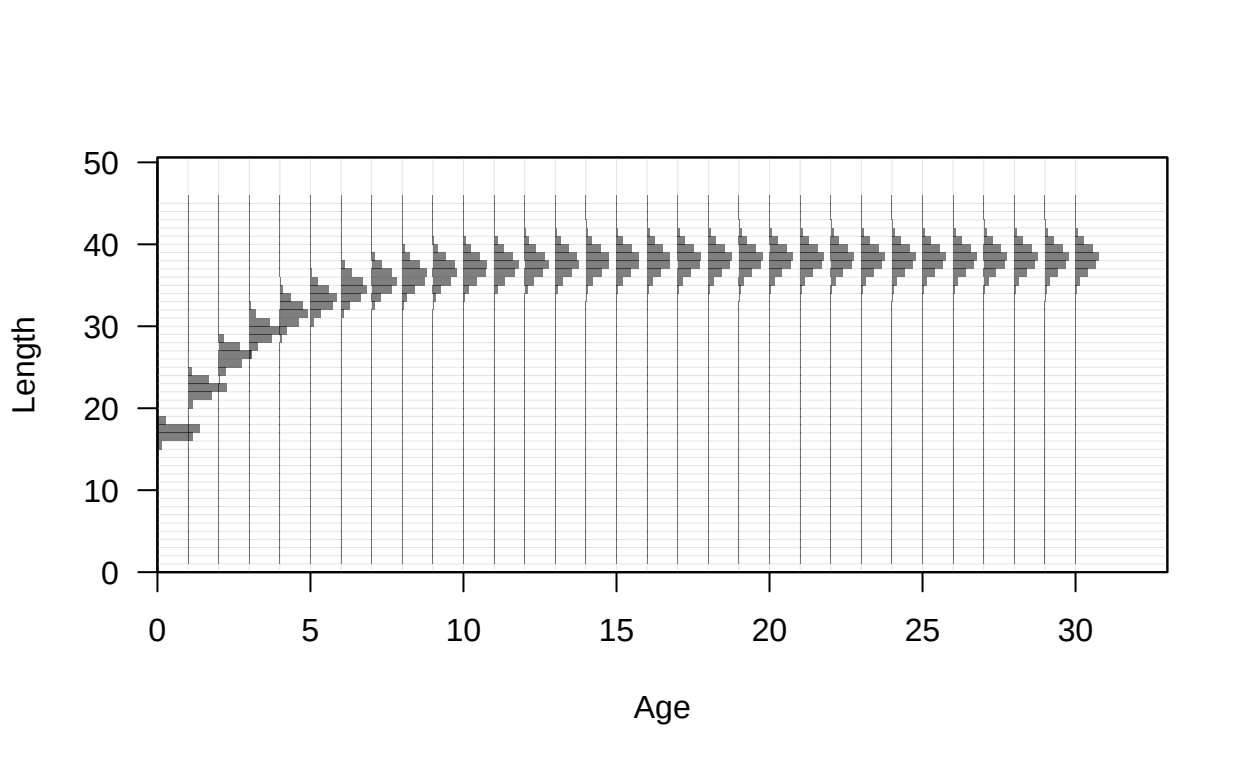

Age (yr)
0
5
10
15
20
25
30
Females
Males
Length (cm, beginning of the year)
50
40
30
20
10
0
CV of lengths
0.04
0.02
0
CV of lengths
Age (yr)
CV of lengths
0
0.02
0.04
SD of lengths
0.0
0.5
1.0
1.5
SD of lengths
1.0
0.0
Length (cm, beginning of the year)

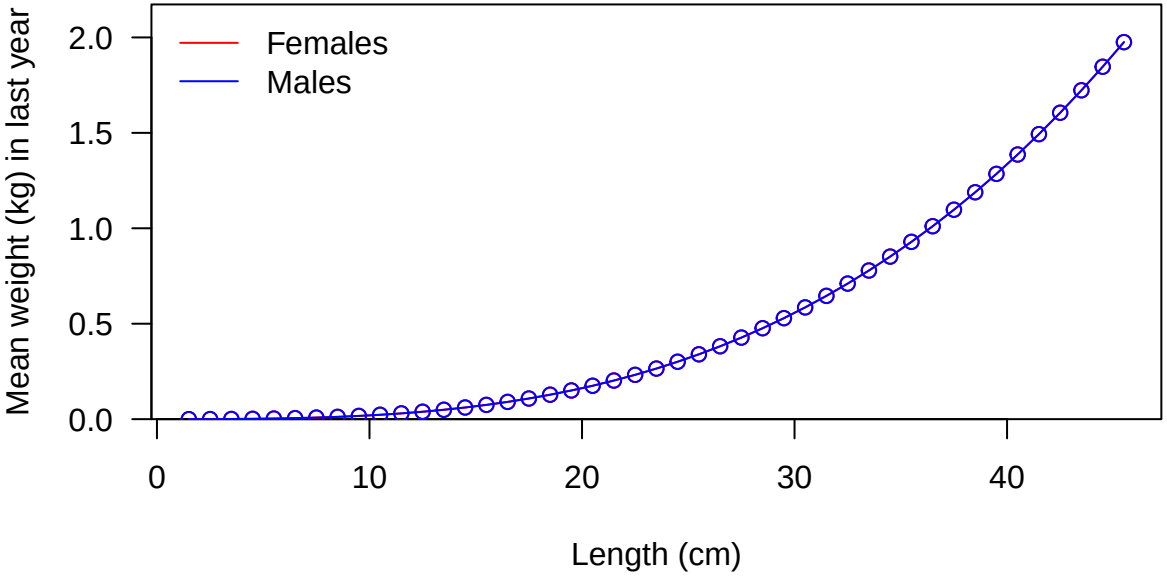

Age (yr)
Mean weight
Length (cm, beginning of the year)
Females
Males
Frac. mature
Age (yr)

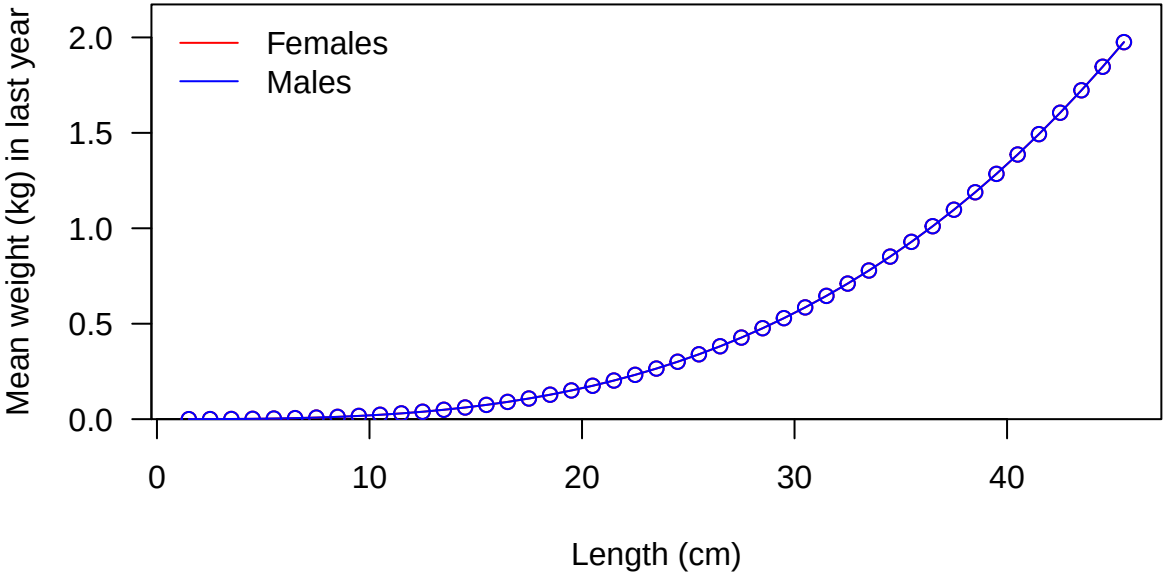

Length
Age
0
10
20
30
40
50
0
5
10
15
20
25
30

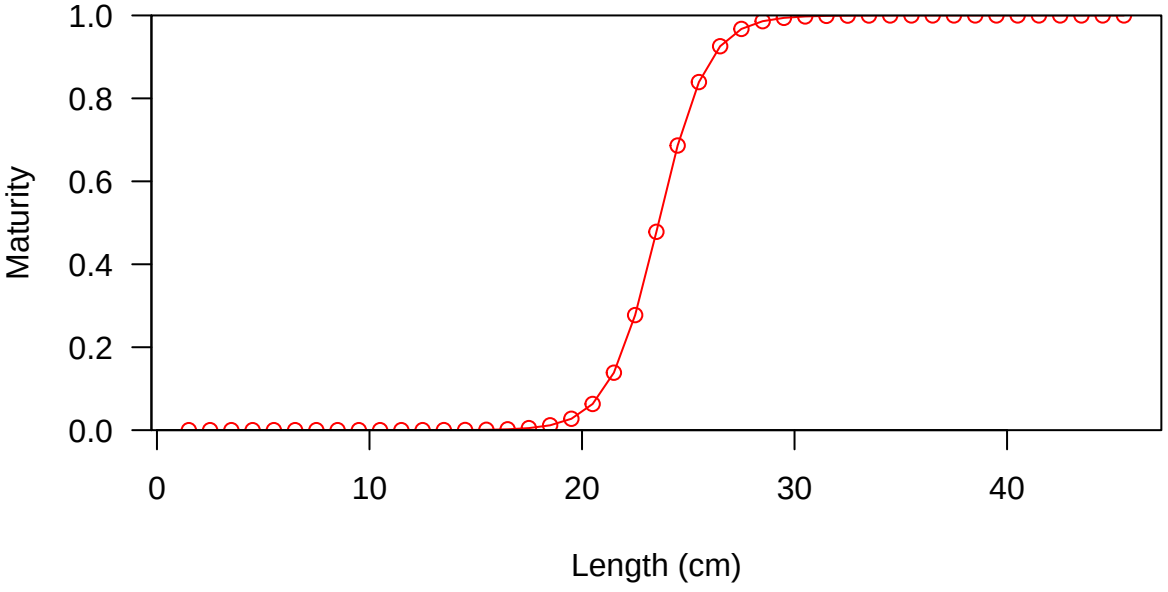

50
40
30
20
10
0
Length
0
5
10
15
20
25
30
Age

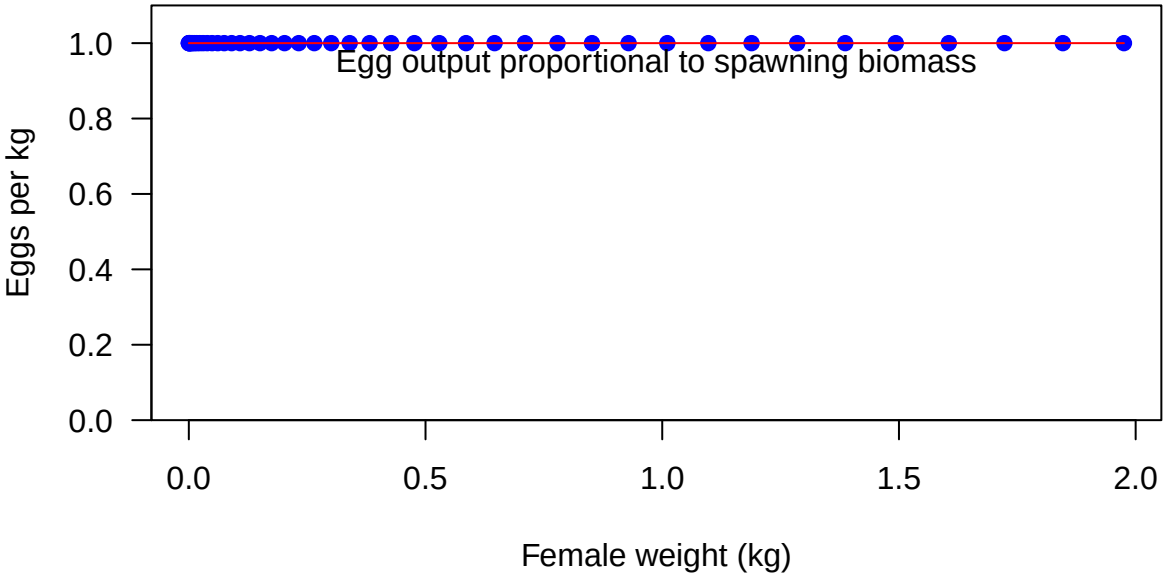

50
40
30
20
10
0
Length
0
5
10
15
20
25
30
Age

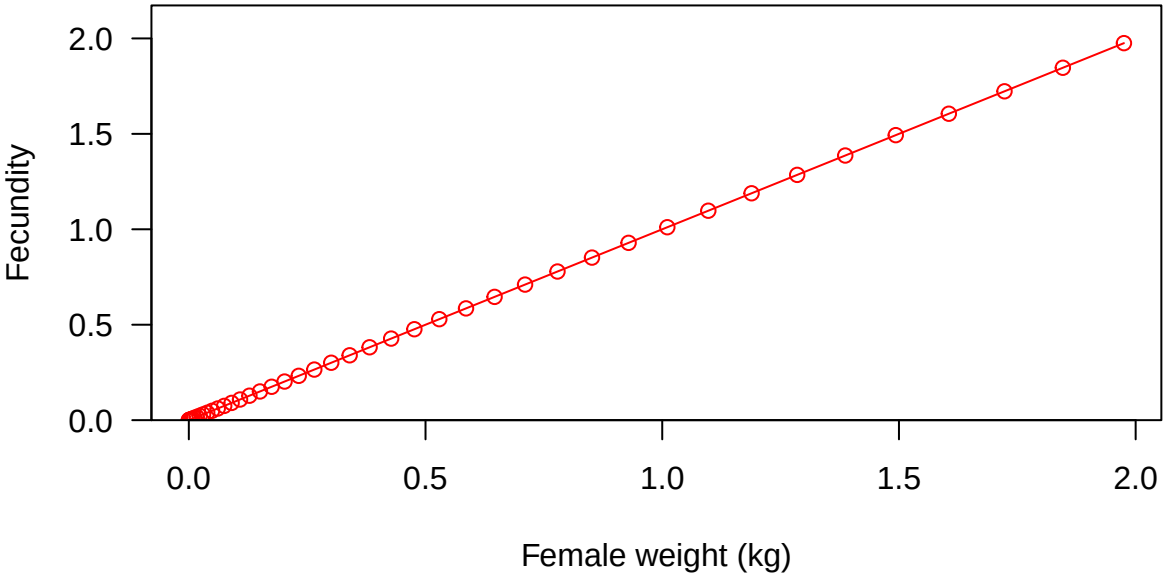

50
40
30
20
10
0
Length
0
5
10
15
20
25
30
Age

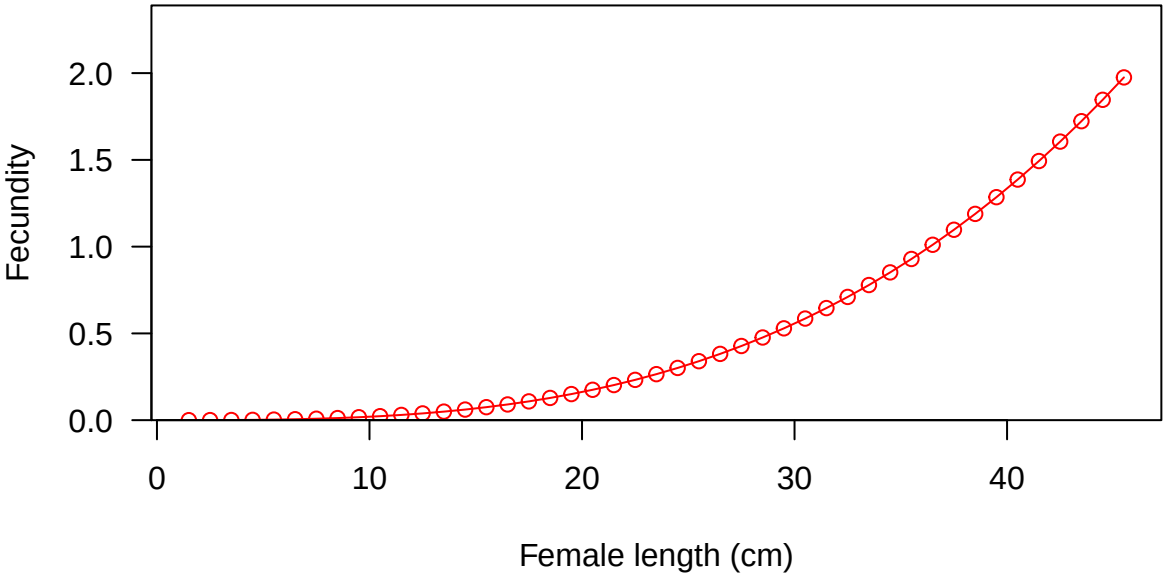

Females
Males
Mean weight (kg) in last year
0.0
0.5
1.0
1.5
2.0
0
10
20
30
40
Length (cm)

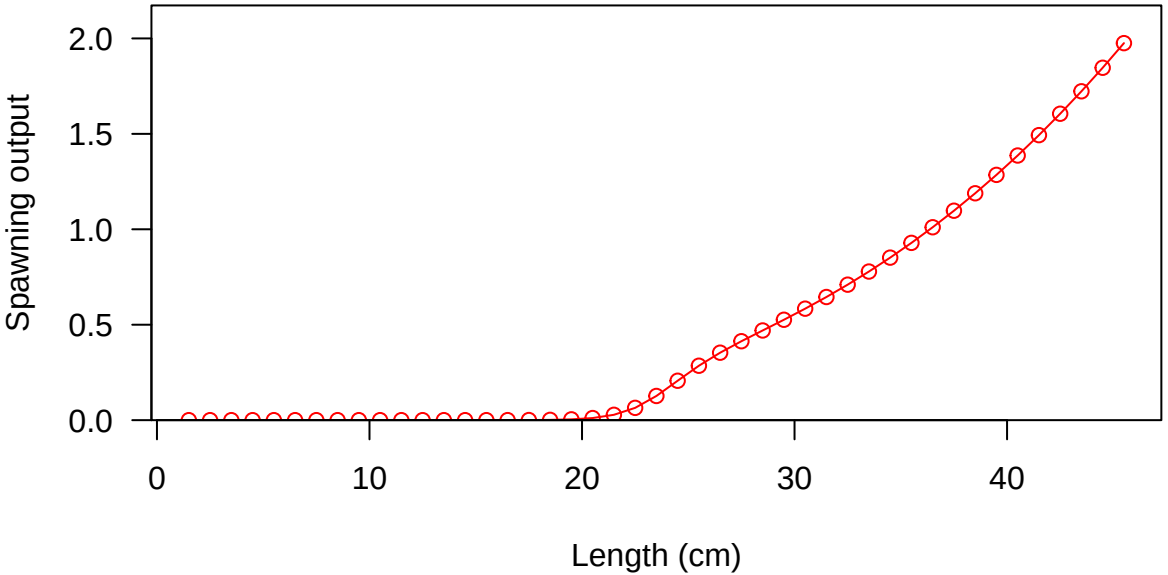

Females
Males
Mean weight (kg) in last year
0.0
0.5
1.0
1.5
2.0
0
10
20
30
40
Length (cm)

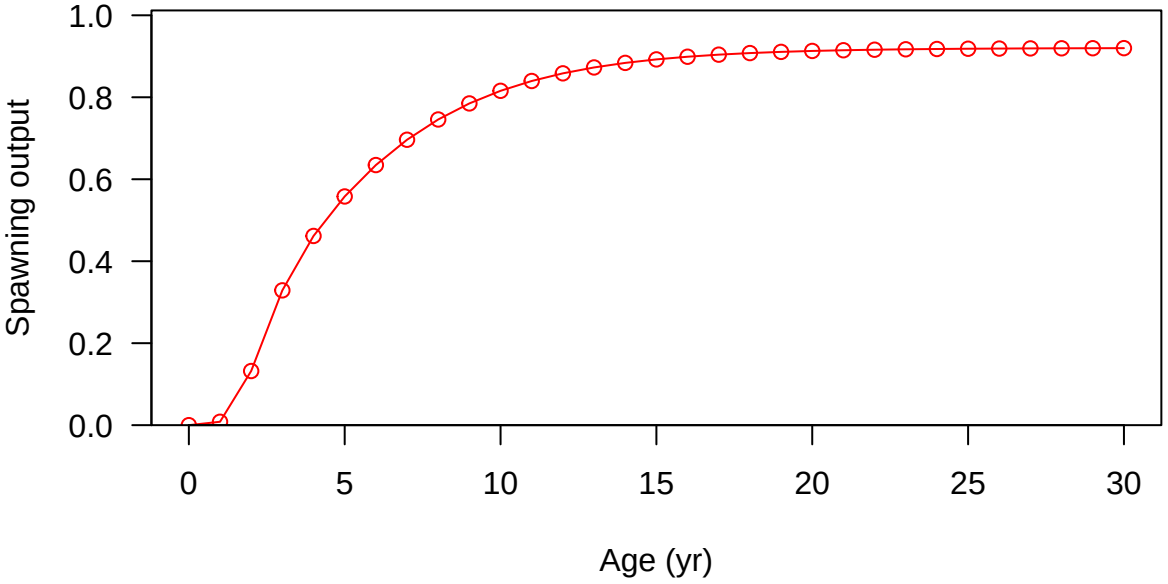

1.0
0.8
0.6
0.4
0.2
0.0
Maturity
0
10
20
30
40
Length (cm)

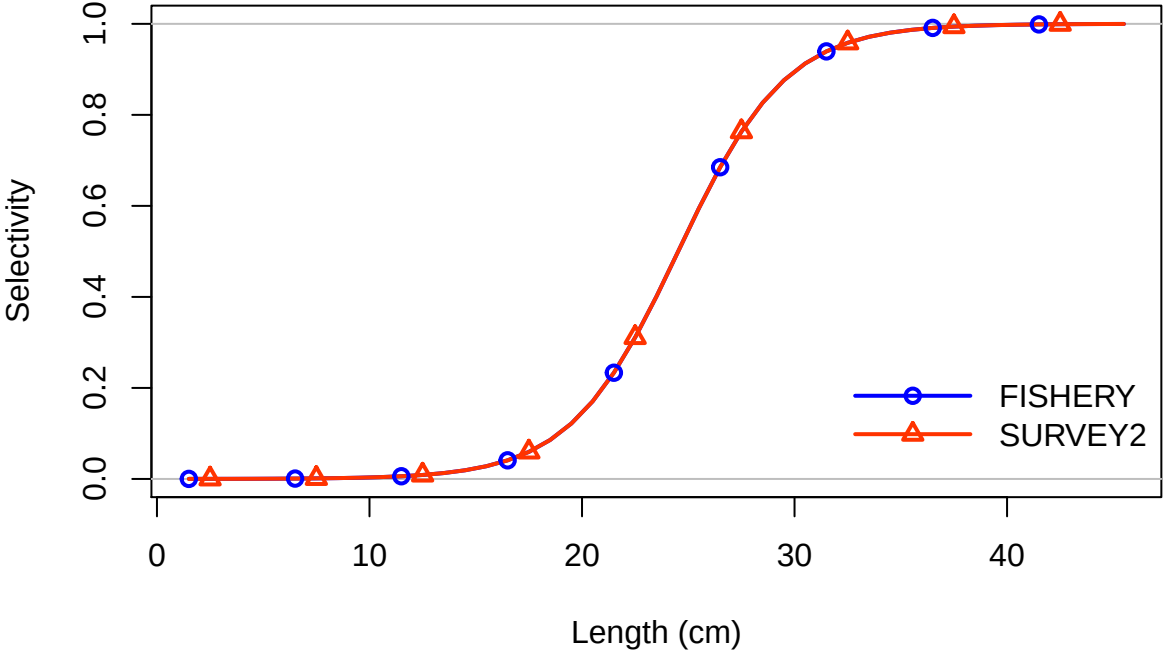

Egg output proportional to spawning biomass
Eggs per kg
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Female weight (kg)

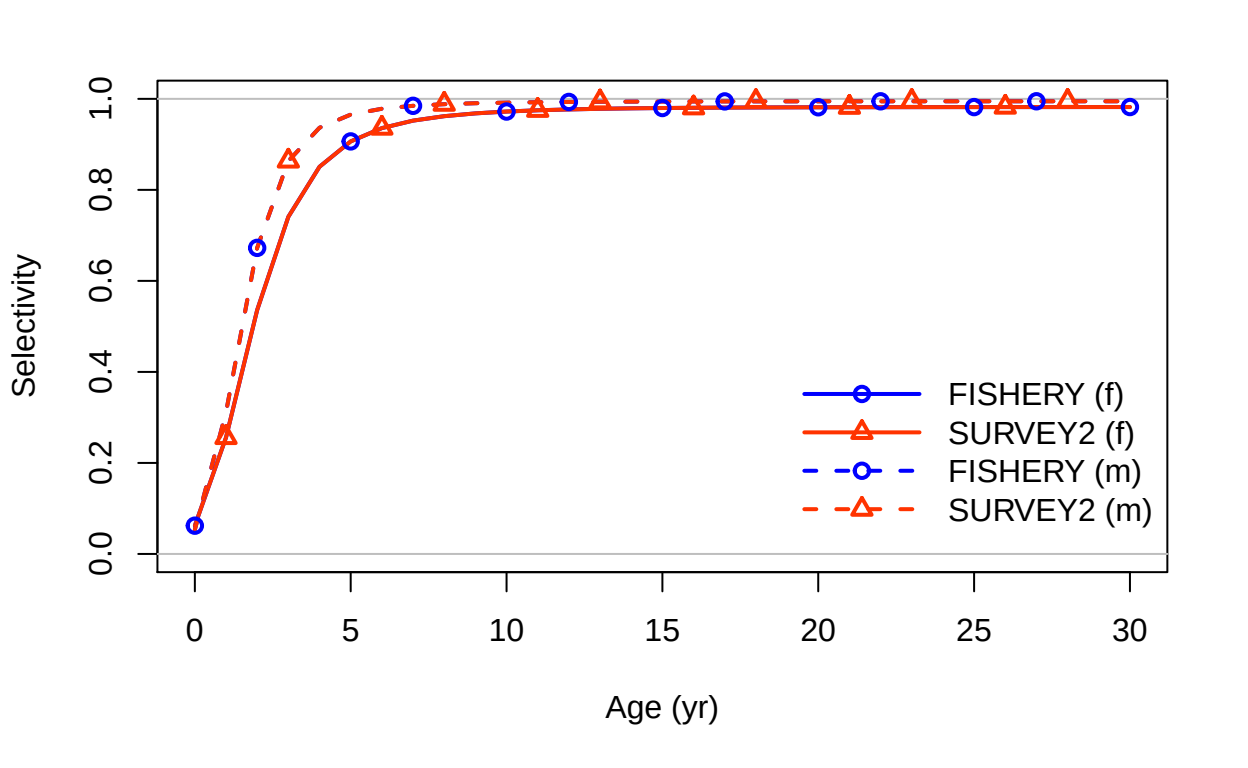

Fecundity
0.0
0.5
1.0
1.5
2.0
0.0
0.5
1.0
1.5
2.0
Female weight (kg)

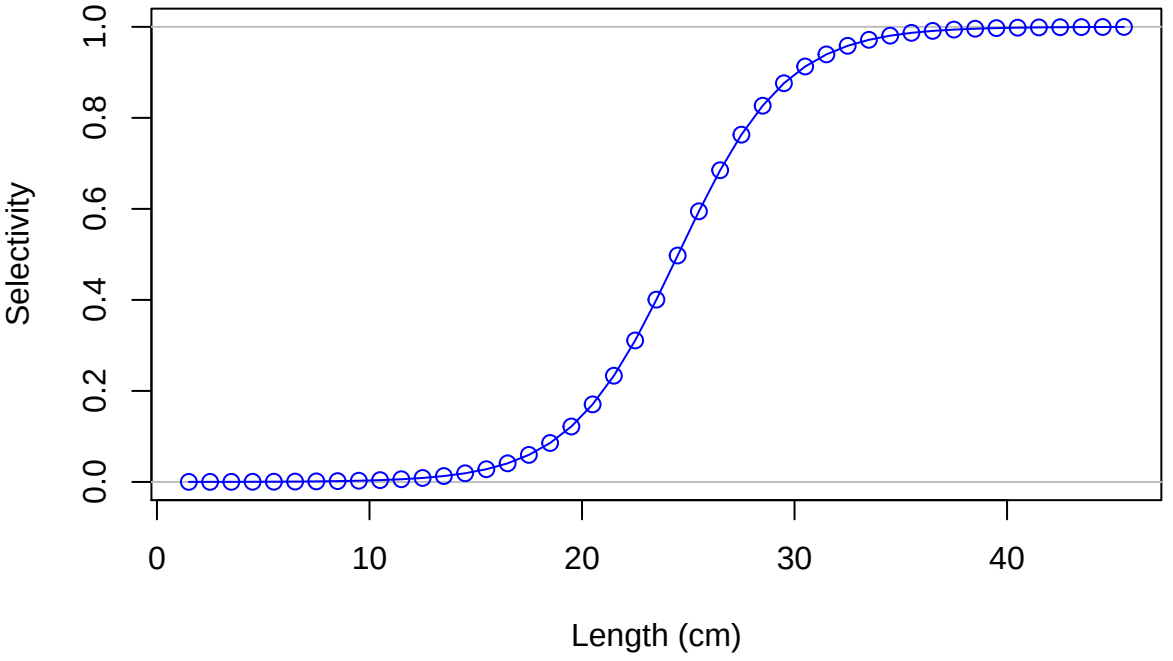

Fecundity
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Female length (cm)

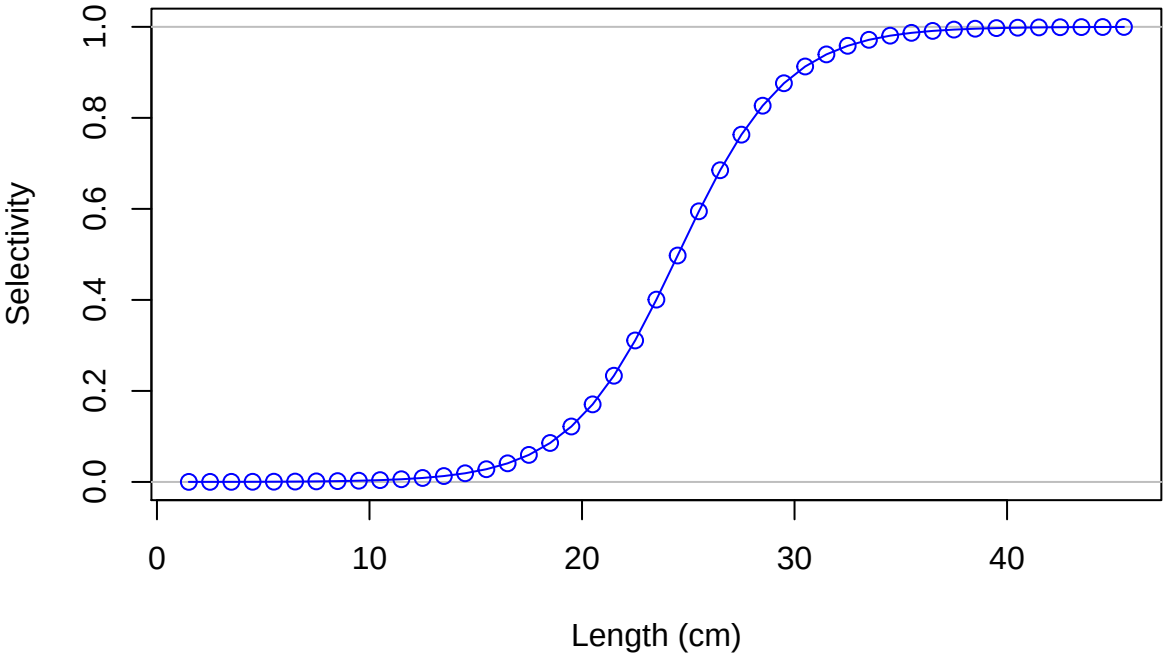

Spawning output
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
Length (cm)

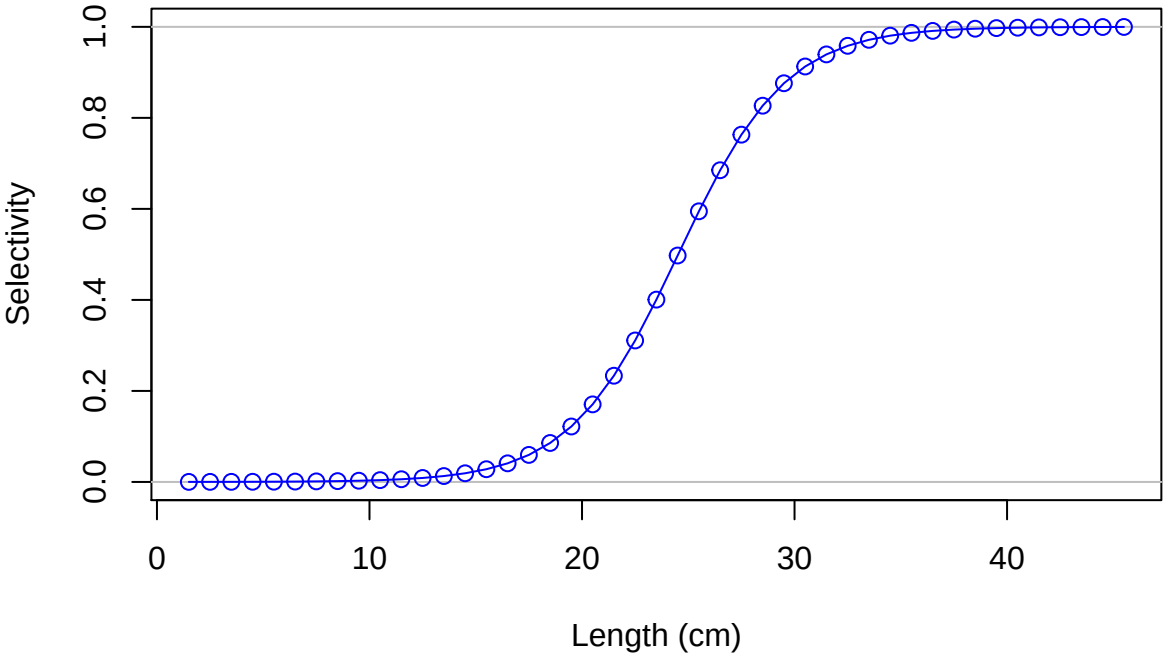

1.0
0.8
0.6
0.4
0.2
0.0
Spawning output
0
5
10
15
20
25
30
Age (yr)

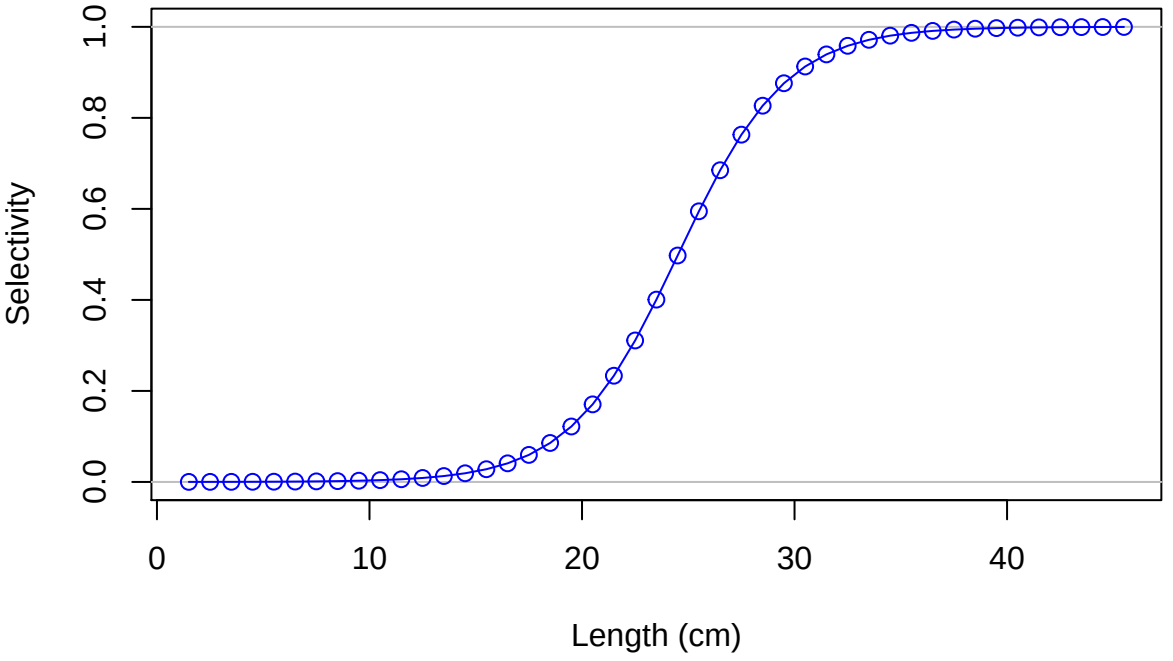

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)
FISHERY
SURVEY2

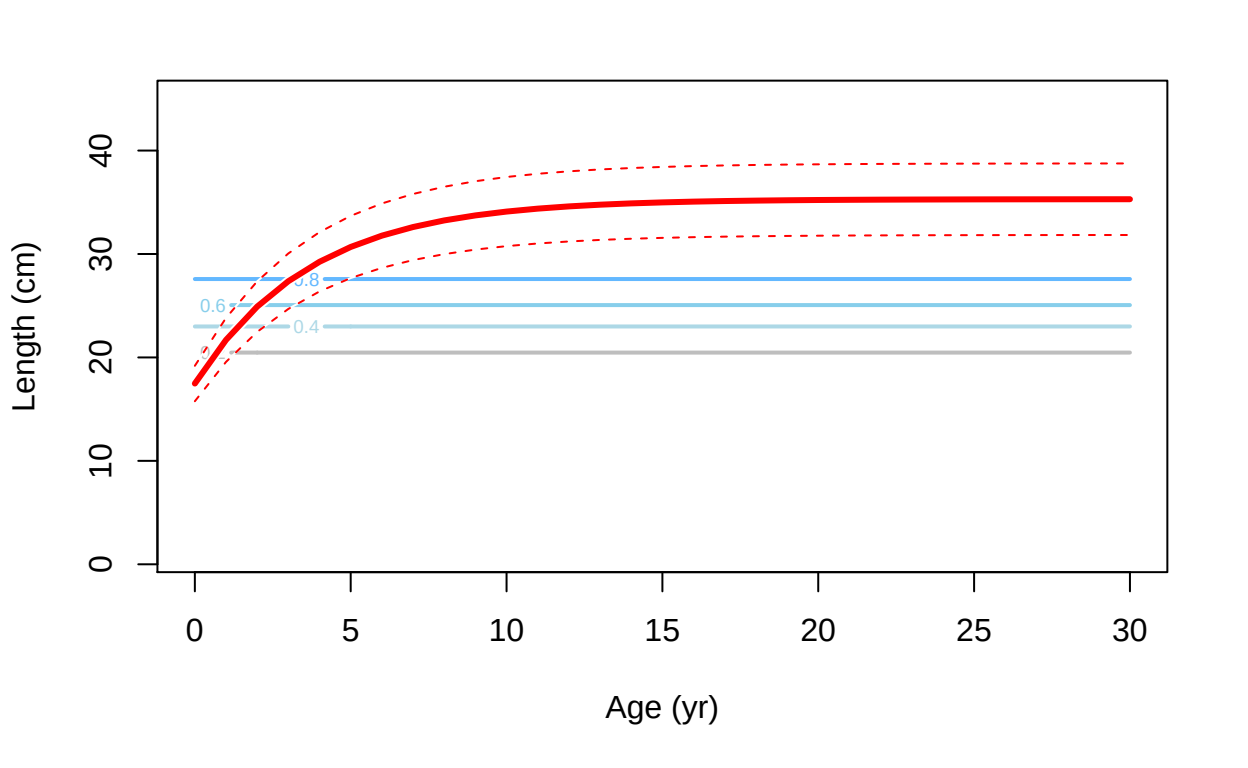

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Age (yr)
FISHERY (f)
SURVEY2 (f)
FISHERY (m)
SURVEY2 (m)

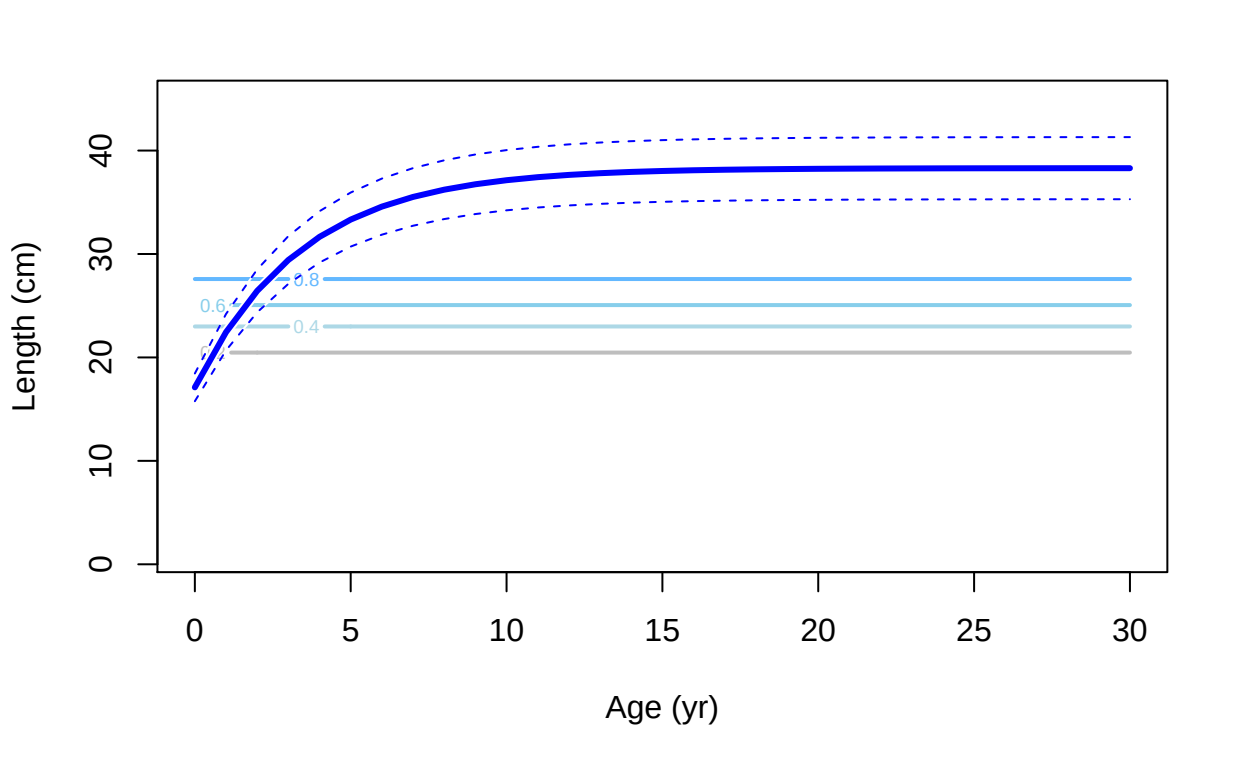

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

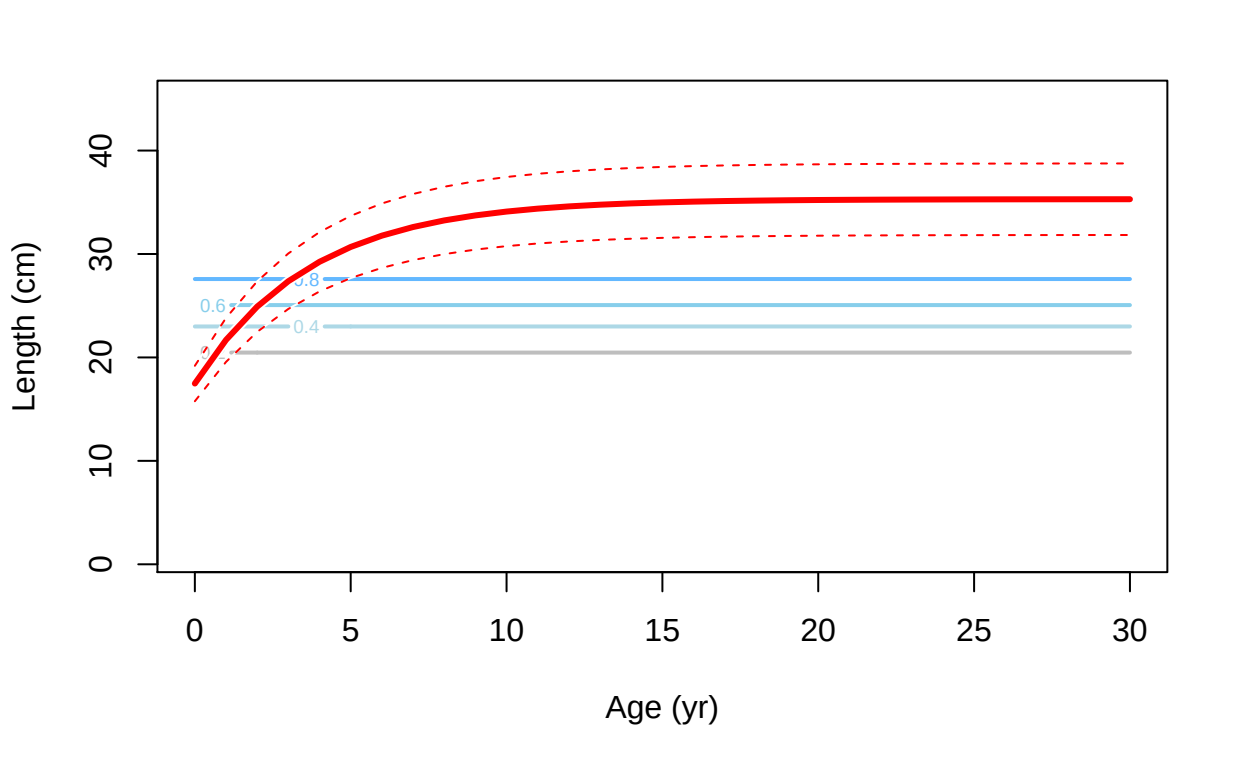

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

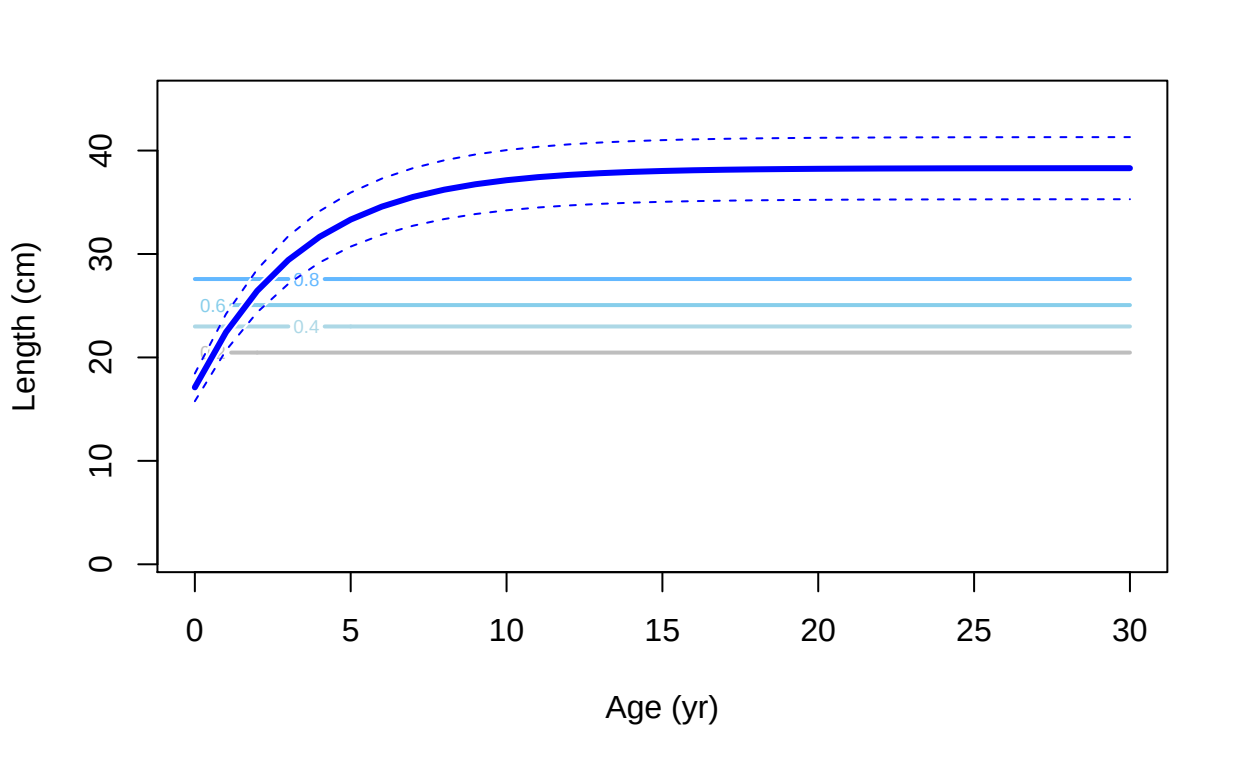

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

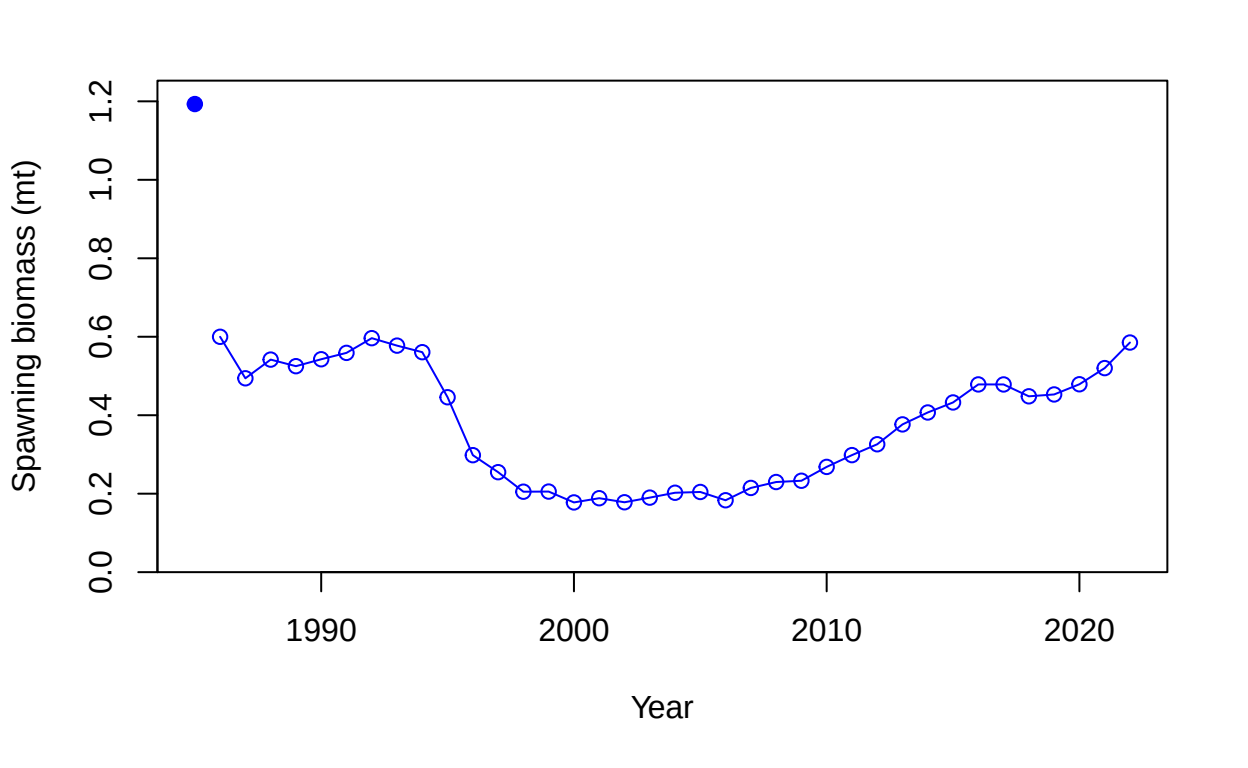

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
Length (cm)

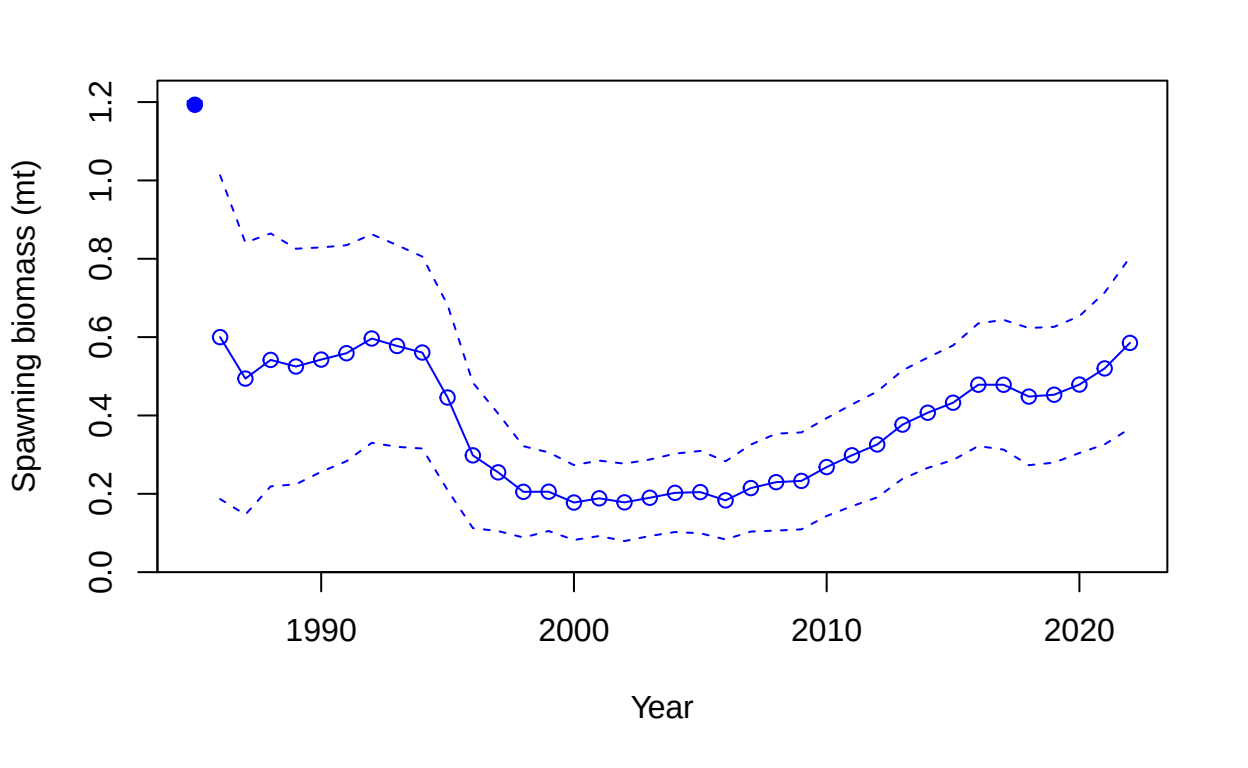

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4

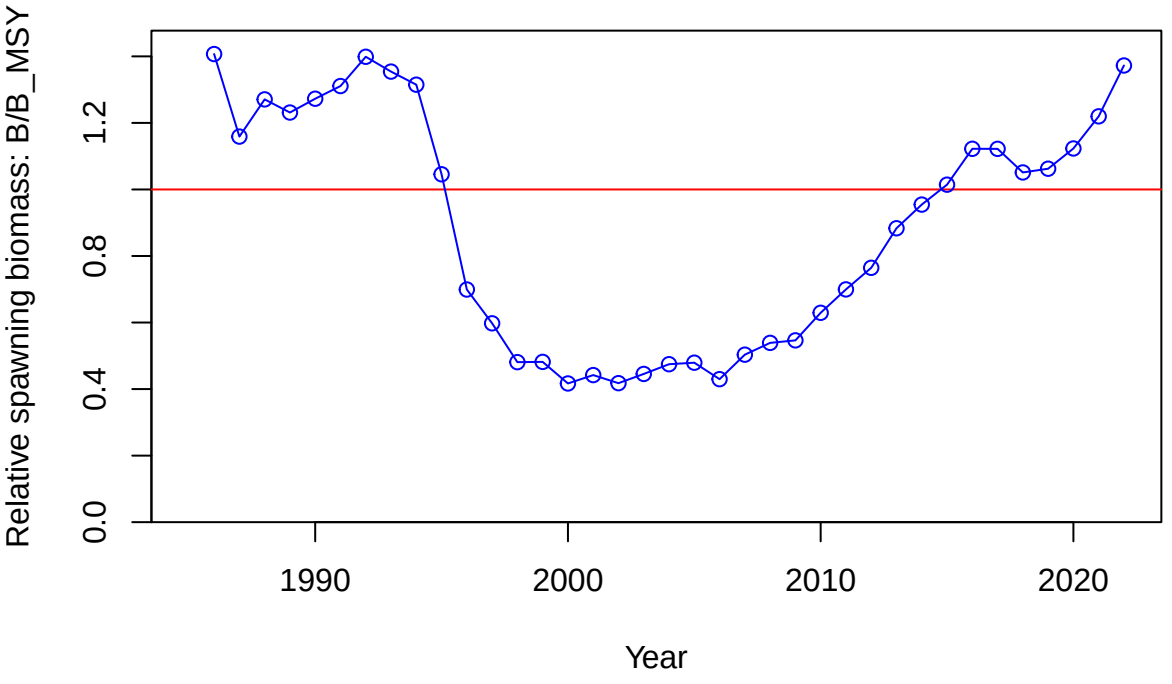

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4

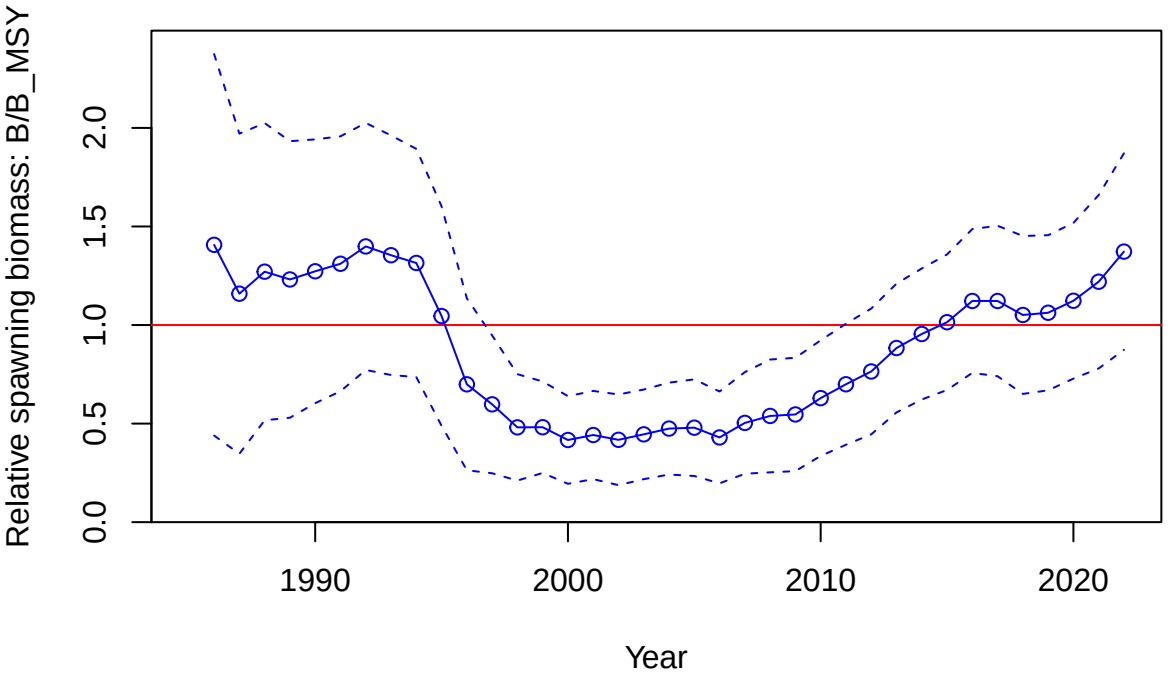

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4

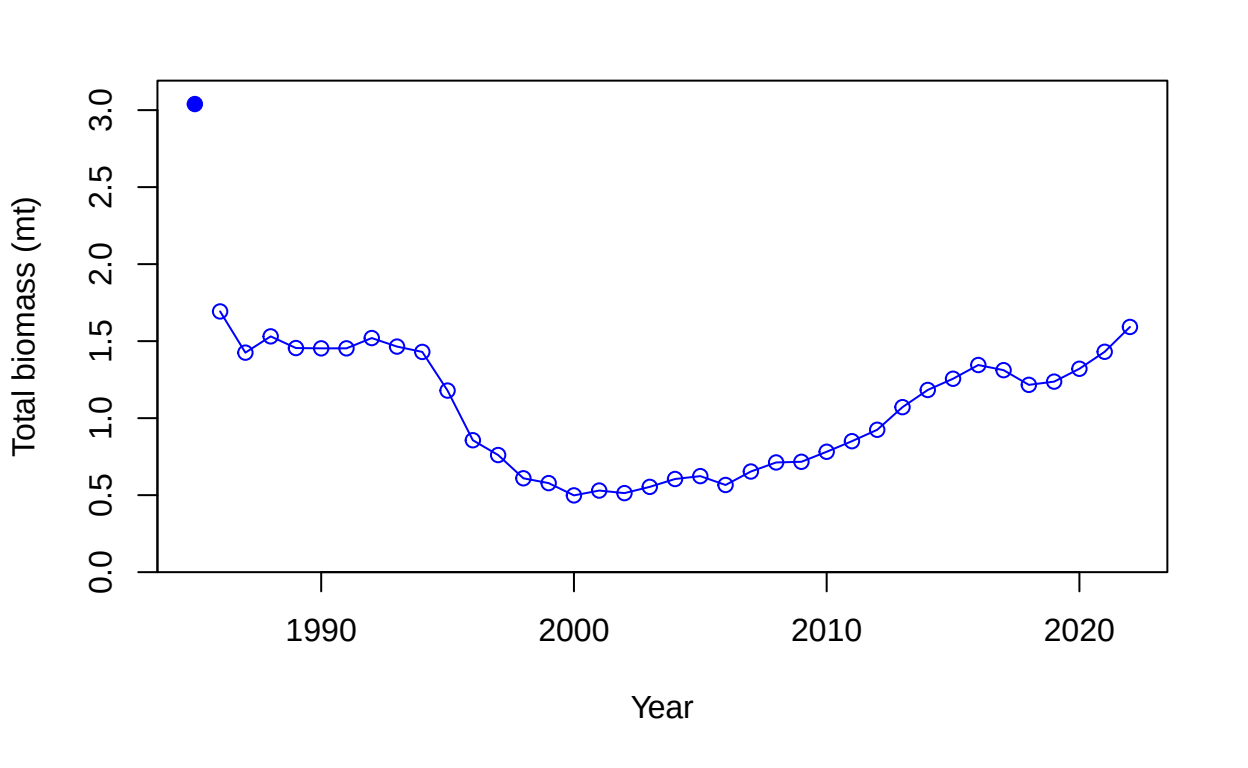

Length (cm)
0
10
20
30
40
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4

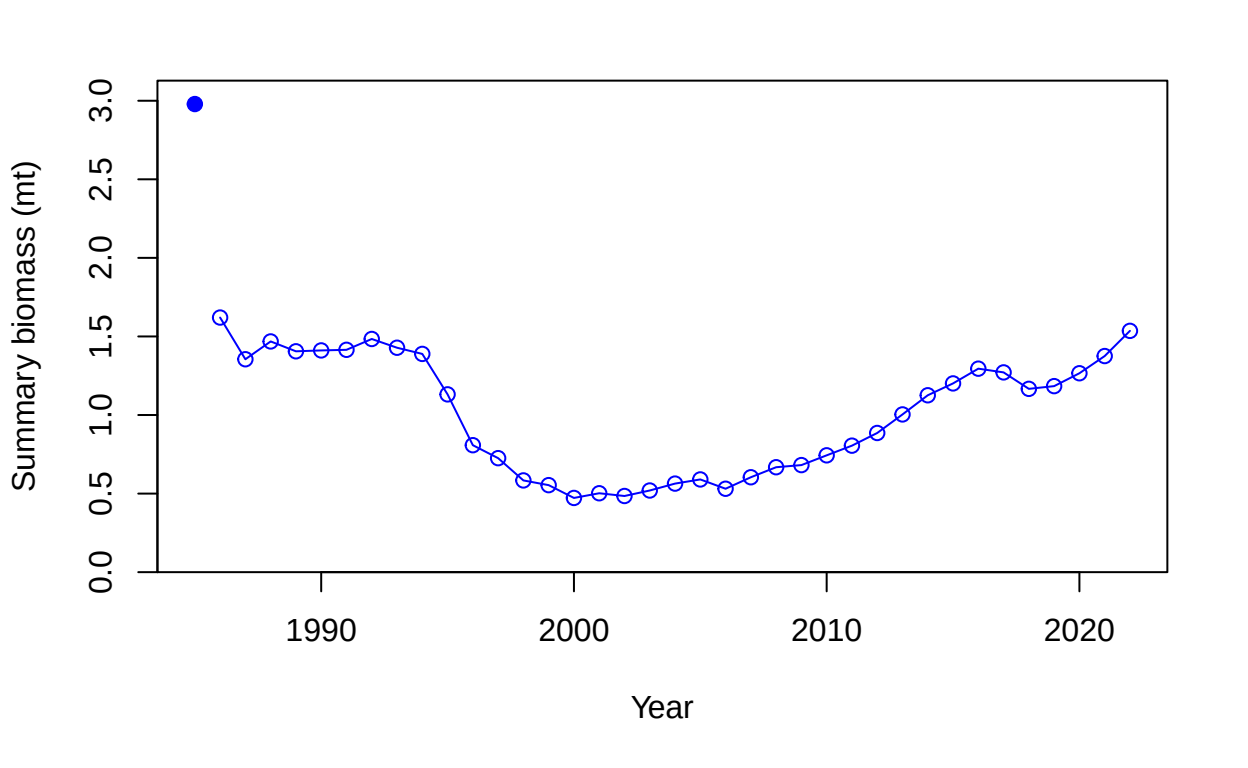

Spawning biomass (mt)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1990
2000
2010
2020
Year

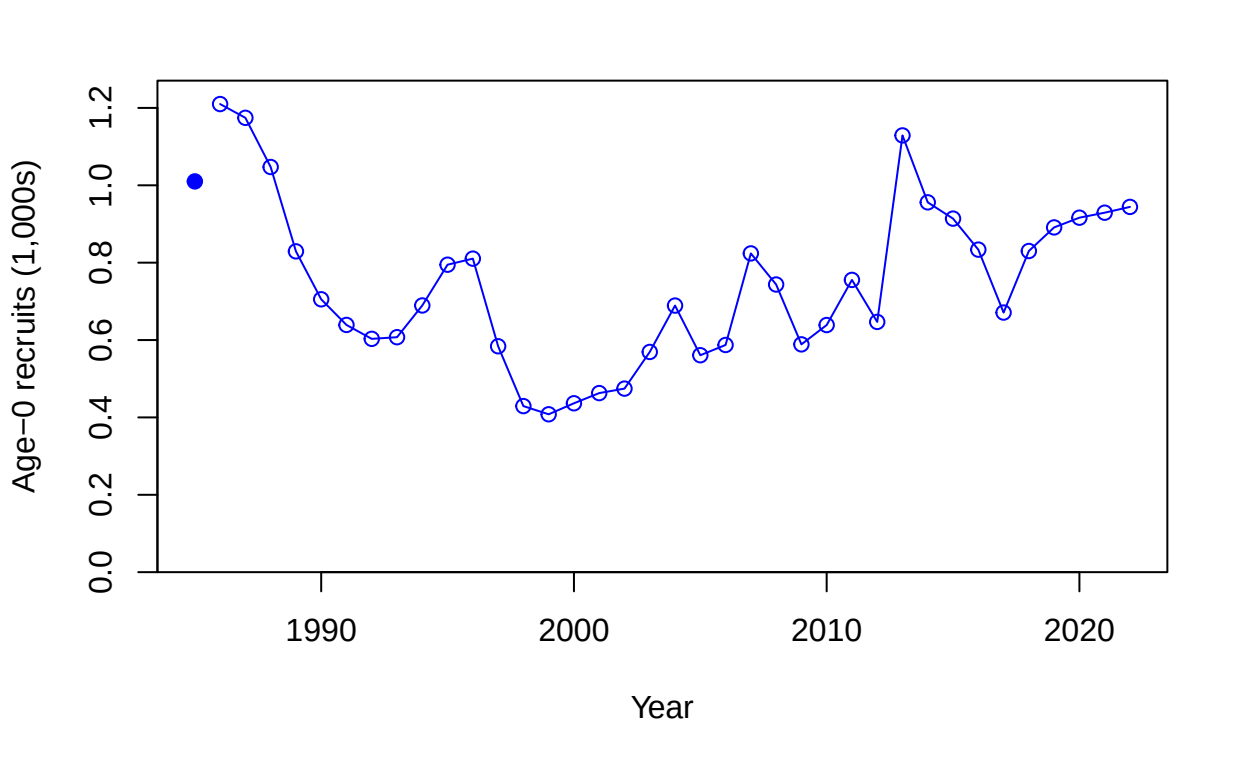

Spawning biomass (mt)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1990
2000
2010
2020
Year

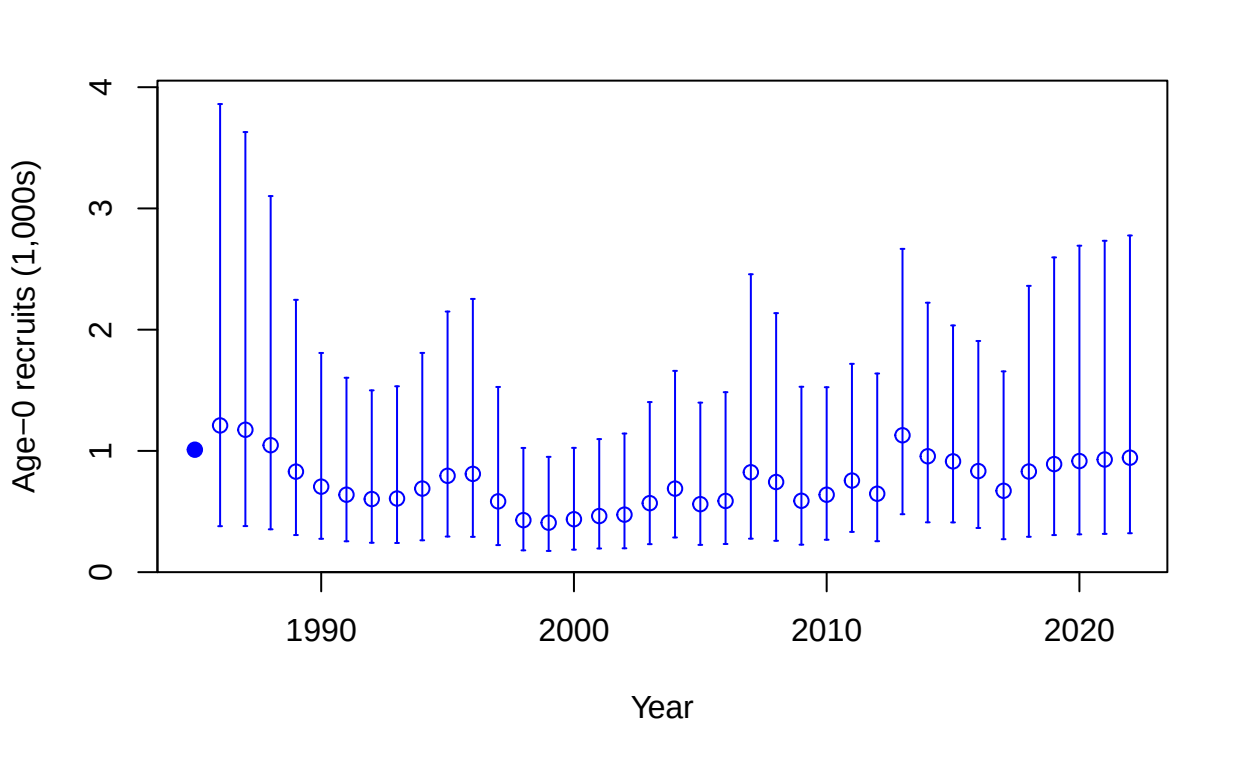

Relative spawning biomass: B/B_MSY
0.0
0.4
0.8
1.2
1990
2000
2010
2020
Year

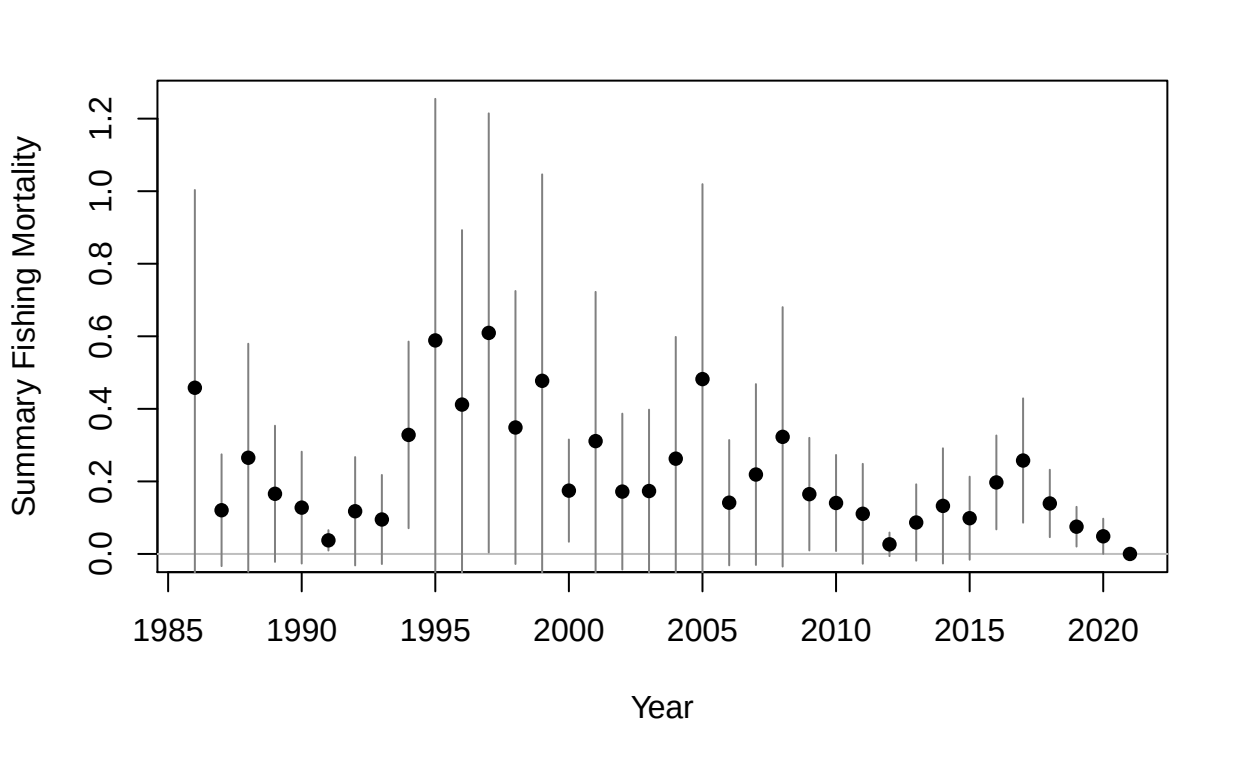

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
1990
2000
2010
2020
Year

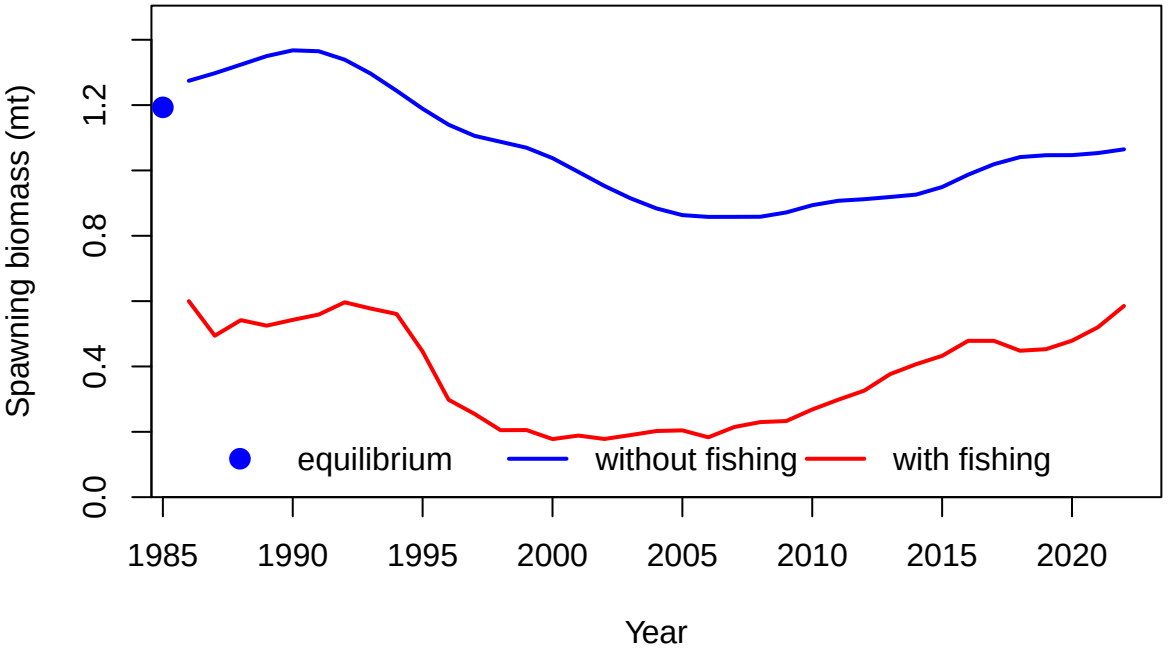

Total biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1990
2000
2010
2020
Year

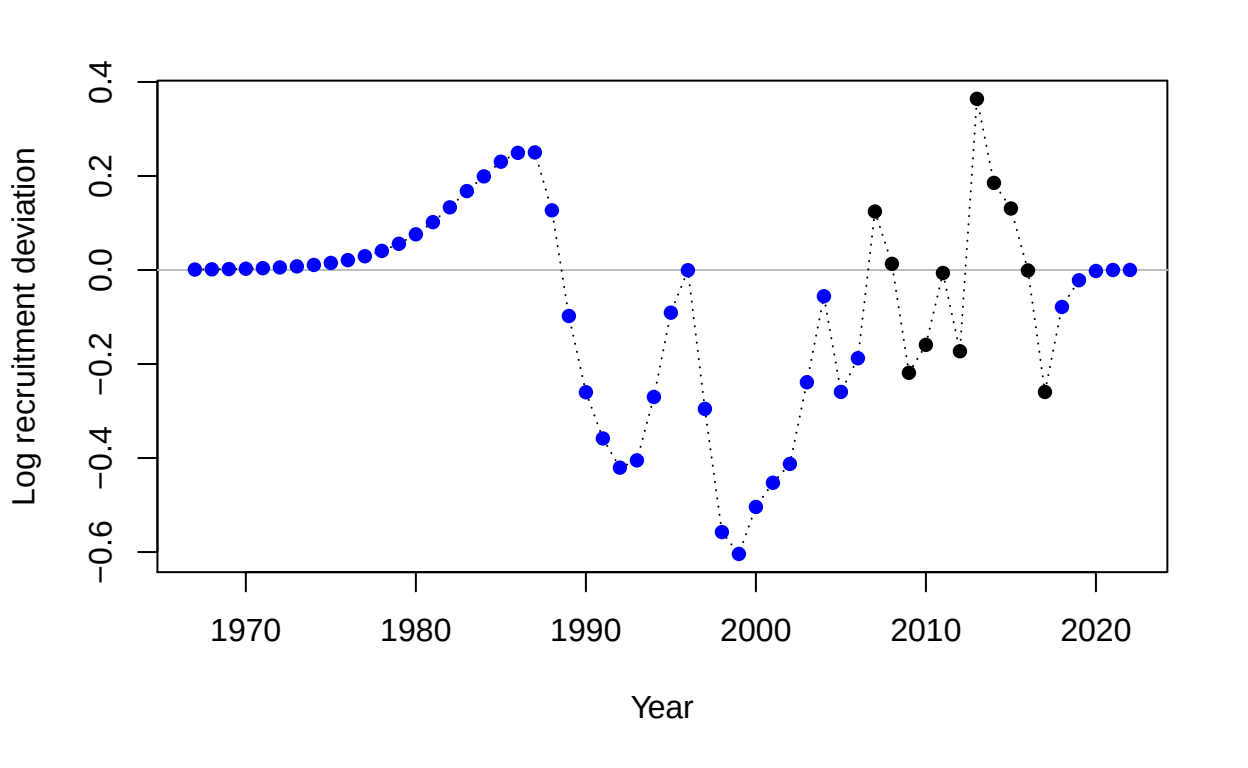

Summary biomass (mt)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1990
2000
2010
2020
Year

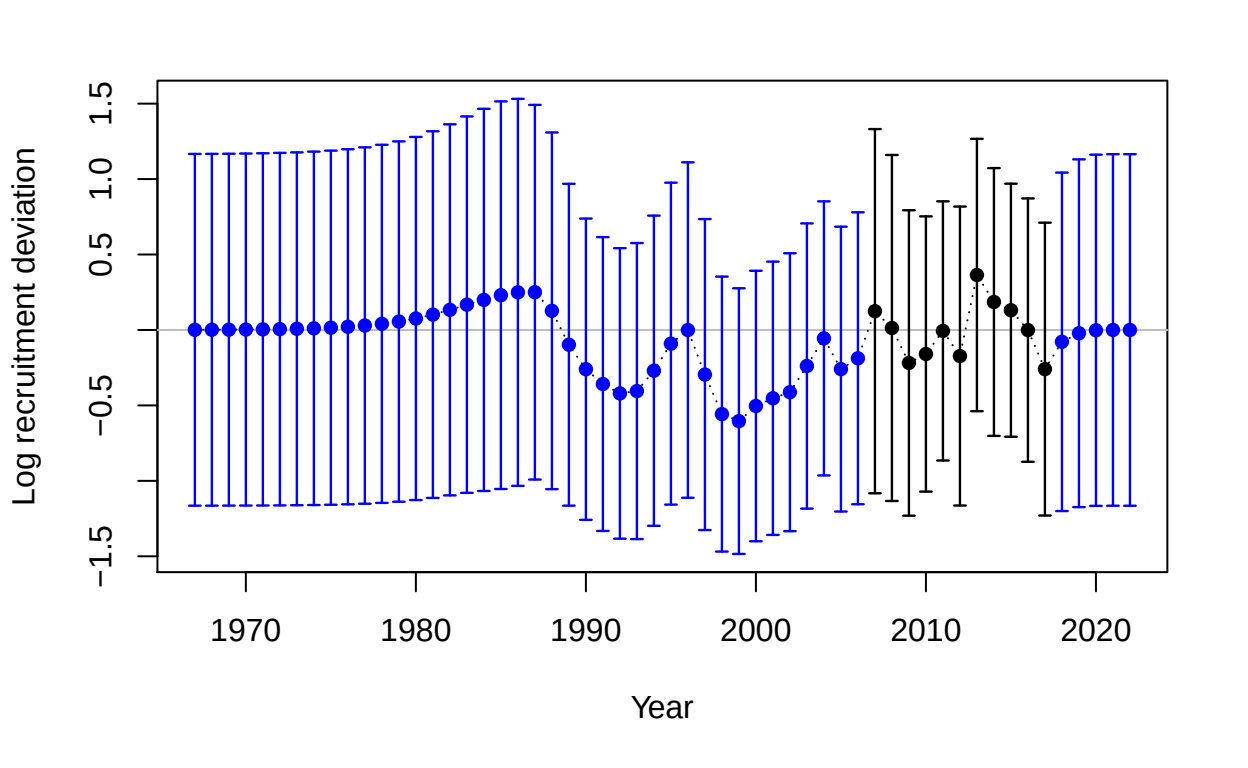

Age−0 recruits (1,000s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1990
2000
2010
2020
Year

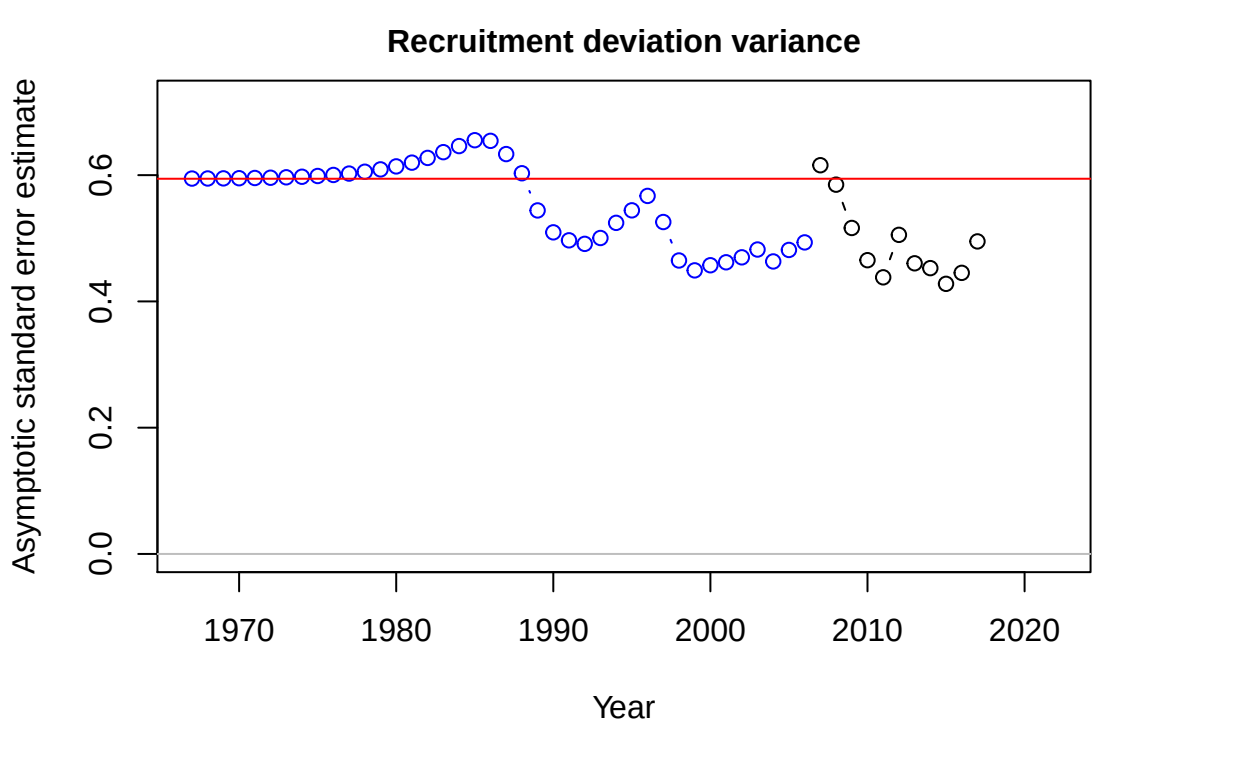

Age−0 recruits (1,000s)
0
1
2
3
4
1990
2000
2010
2020
Year

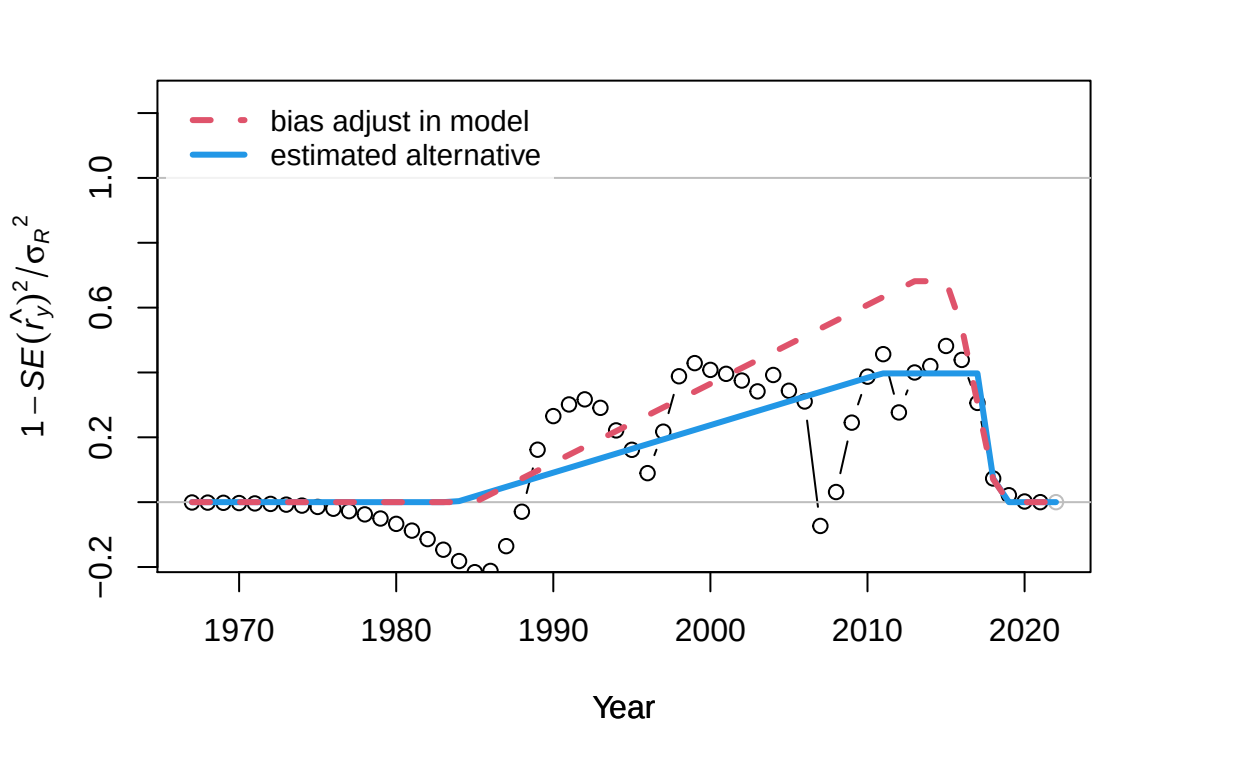

Summary Fishing Mortality
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1985
1990
1995
2000
2005
2010
2015
2020
Year

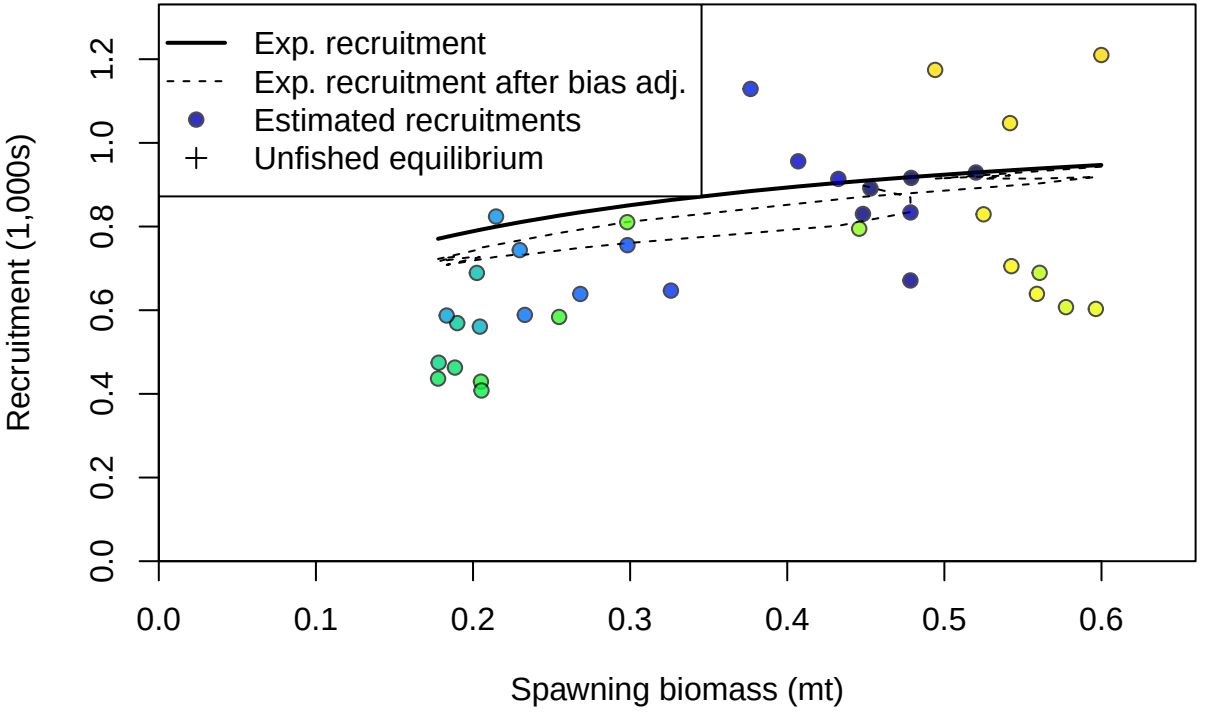

Spawning biomass (mt)
0.0
0.4
0.8
1.2
1985
1990
1995
2000
2005
2010
2015
2020
Year
equilibrium
without fishing
with fishing

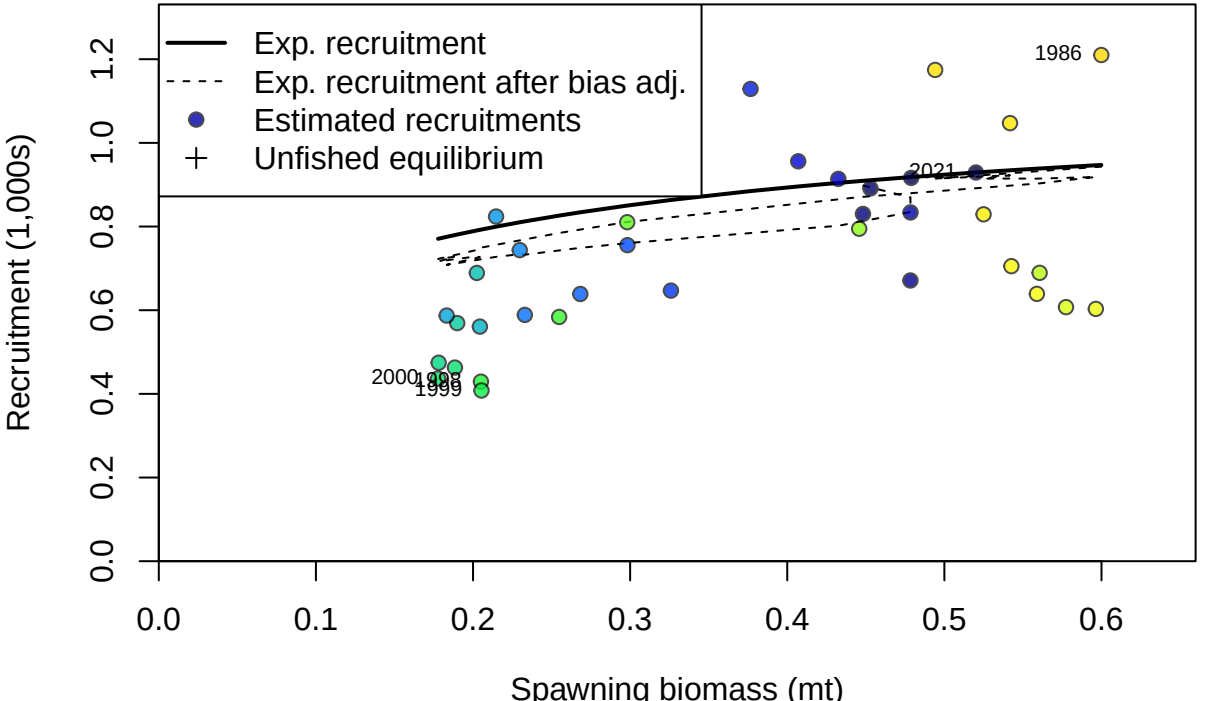

Log recruitment deviation
0.4
0.2
0.0
−0.2
−0.4
−0.6
1970
1980
1990
2000
2010
2020
Year

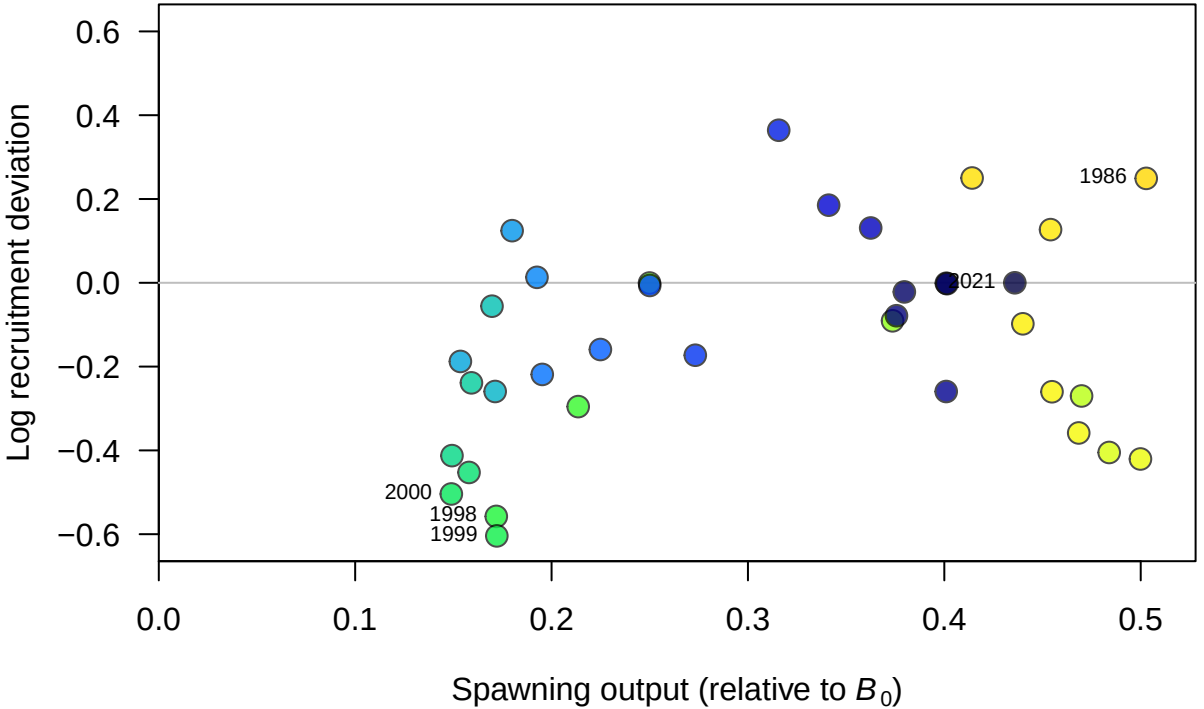

Log recruitment deviation
1.5
1.0
0.5
−0.5
−1.5
1970
1980
1990
2000
2010
2020
Year

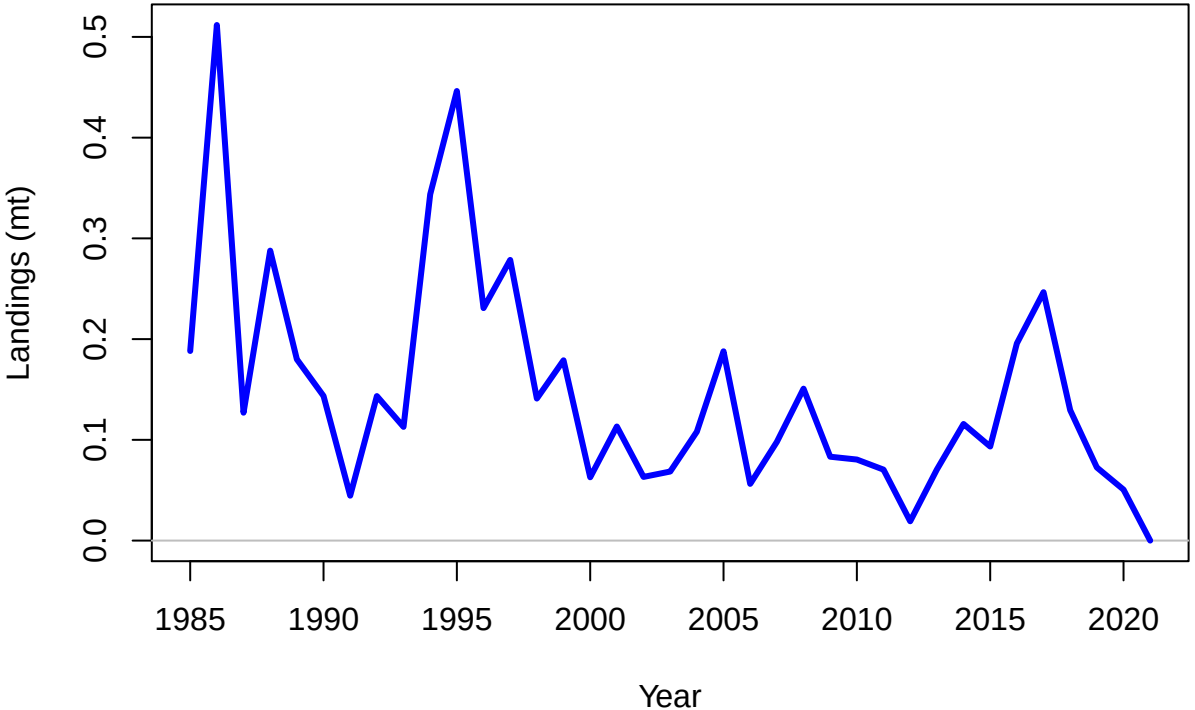

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.2
0.4
0.6
1970
1980
1990
2000
2010
2020
Year

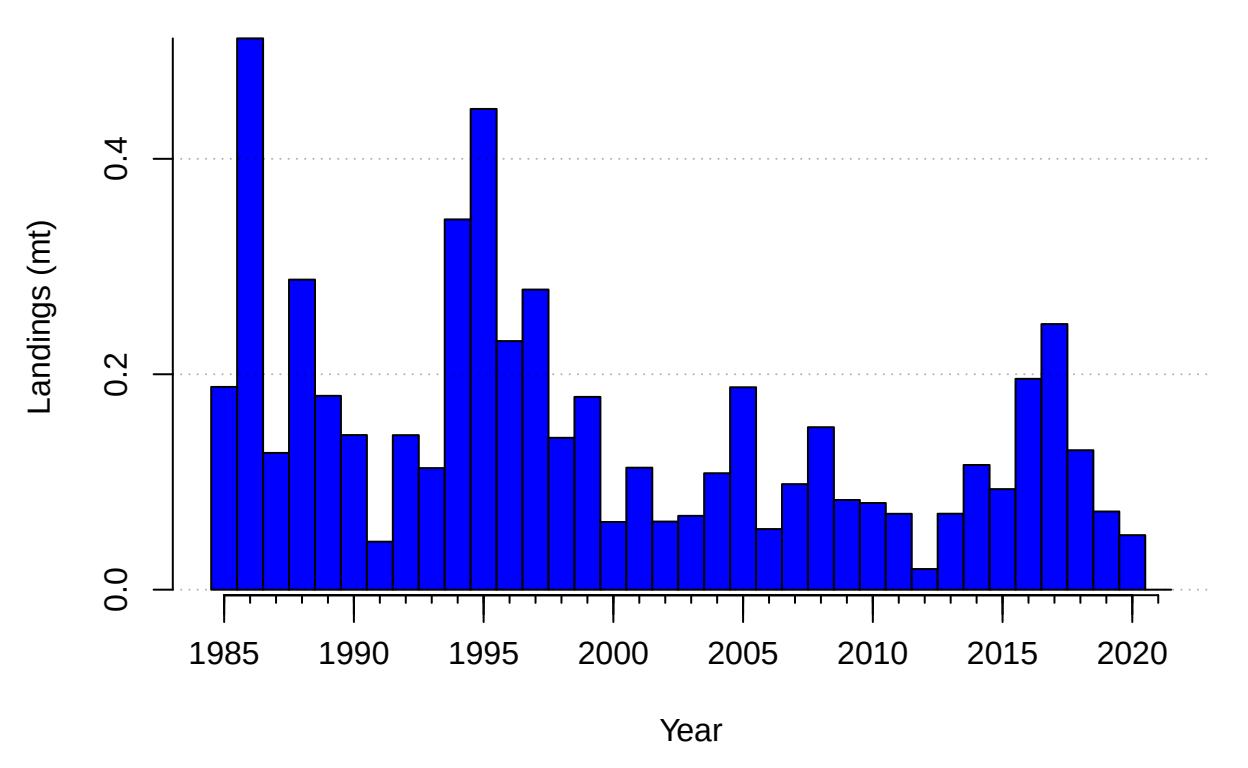

bias adjust in model
estimated alternative
$1 - SE(\hat{r_y})^2/\sigma_R^2$
1.0
0.6
0.2
−0.2
1970
1980
1990
2000
2010
2020
Year

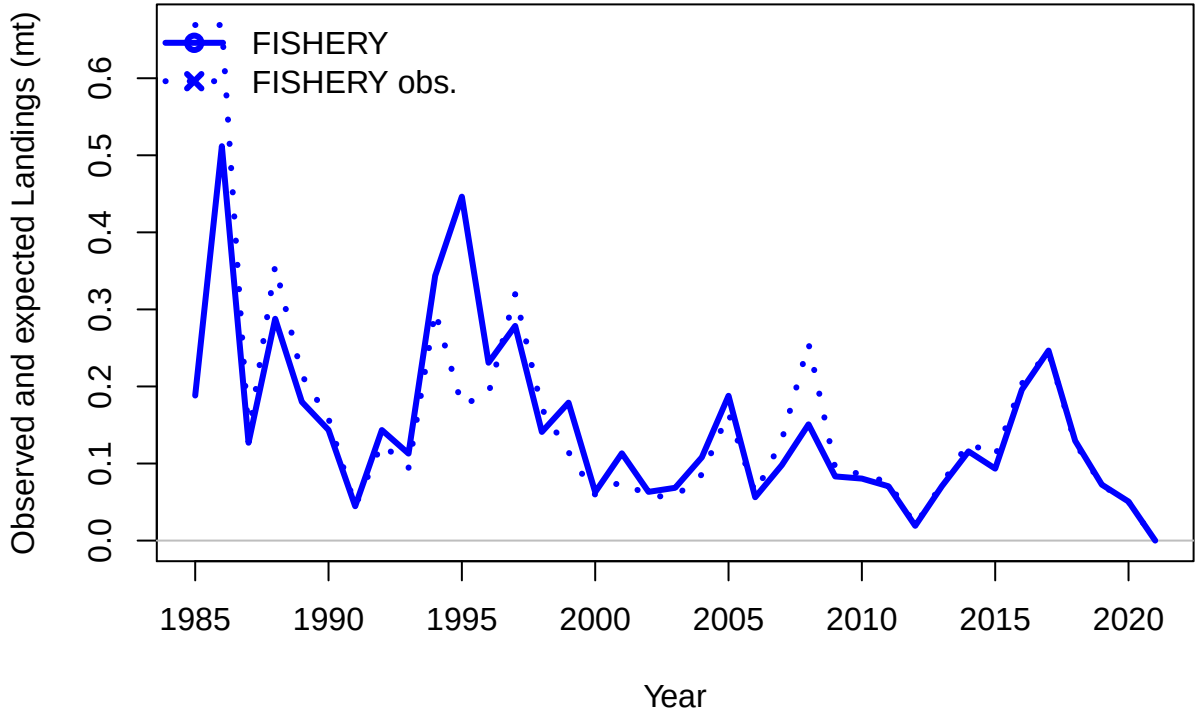

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
Recruitment (1,000s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Spawning biomass (mt)

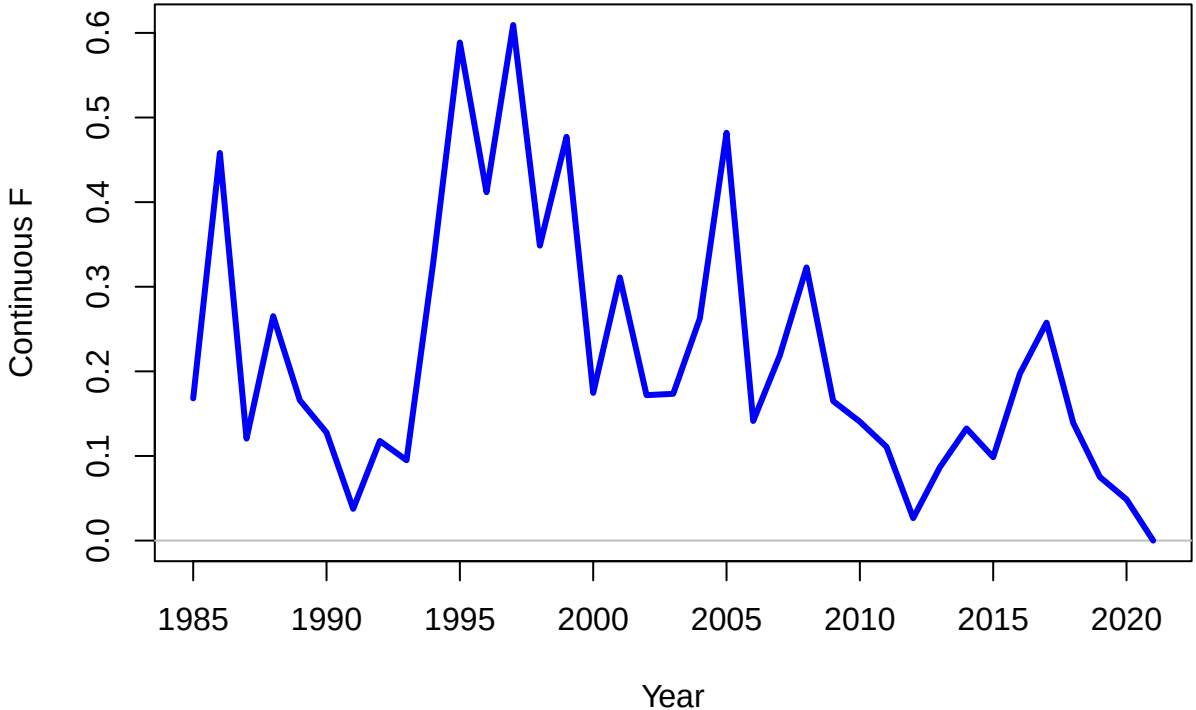

Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium
1986
2021
2000
1999
Recruitment (1,000s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Spawning biomass (mt)

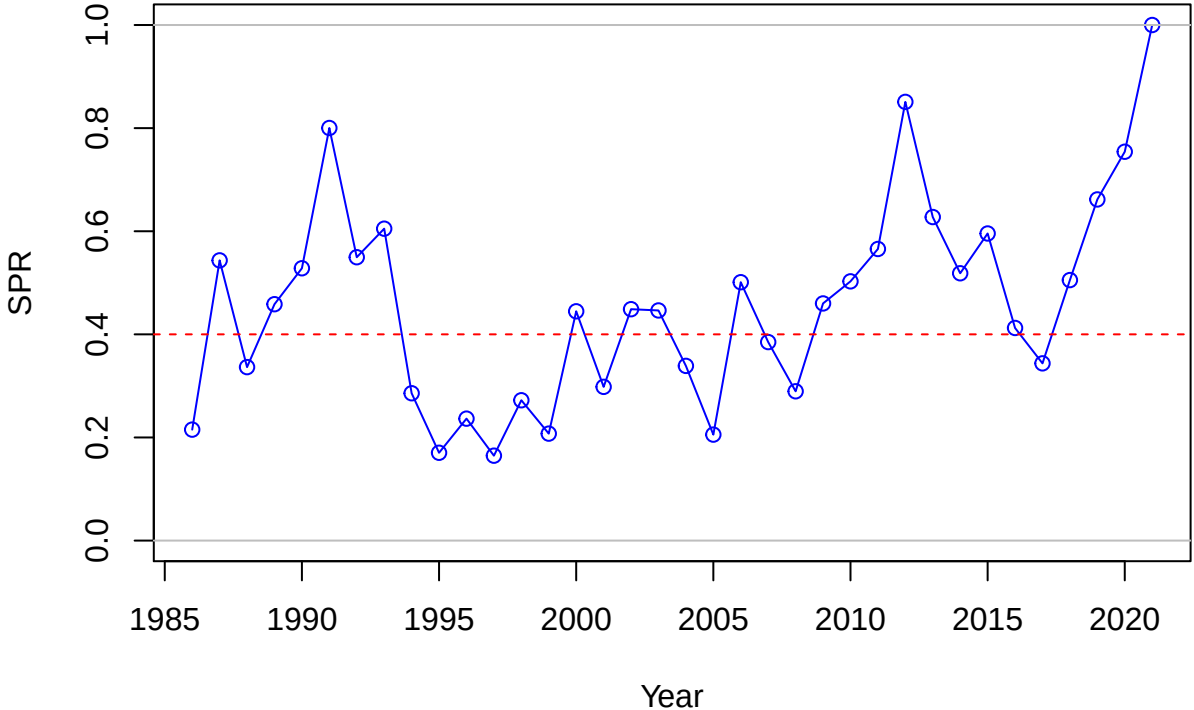

Log recruitment deviation
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
0.0
0.1
0.2
0.3
0.4
0.5
Spawning output (relative to B_0)
1986
2021
2000
1998
1999

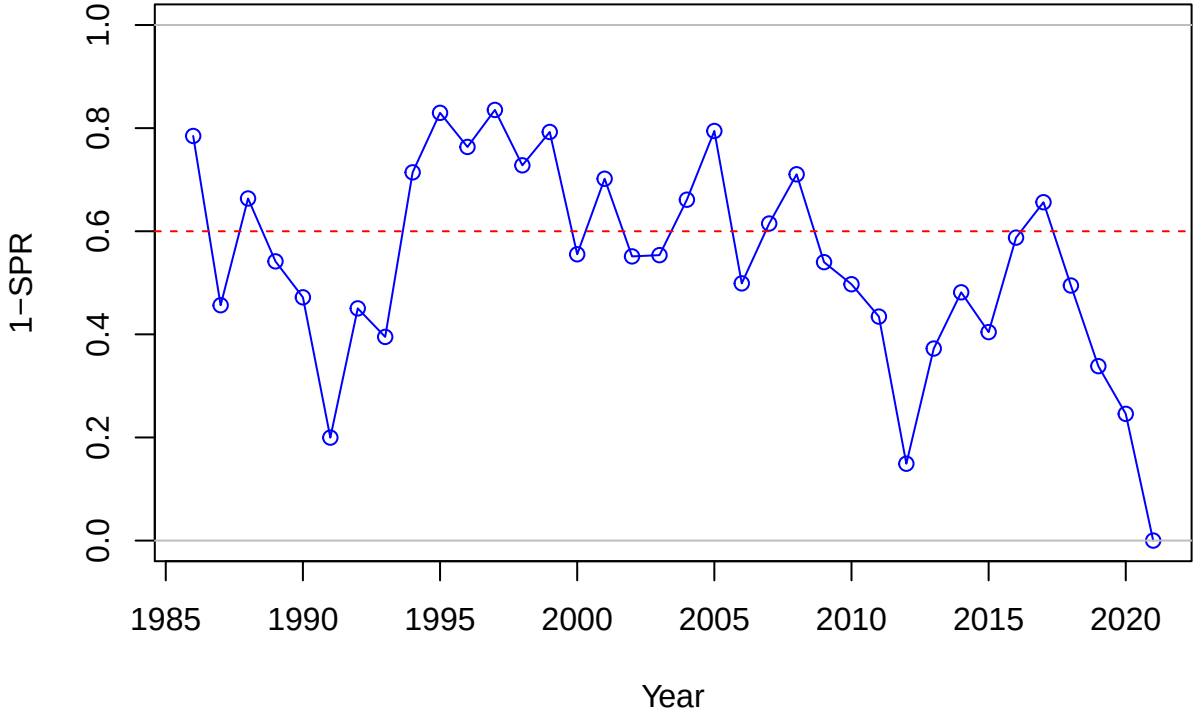

Landings (mt)
0.0
0.1
0.2
0.3
0.4
0.5
1985
1990
1995
2000
2005
2010
2015
2020
Year

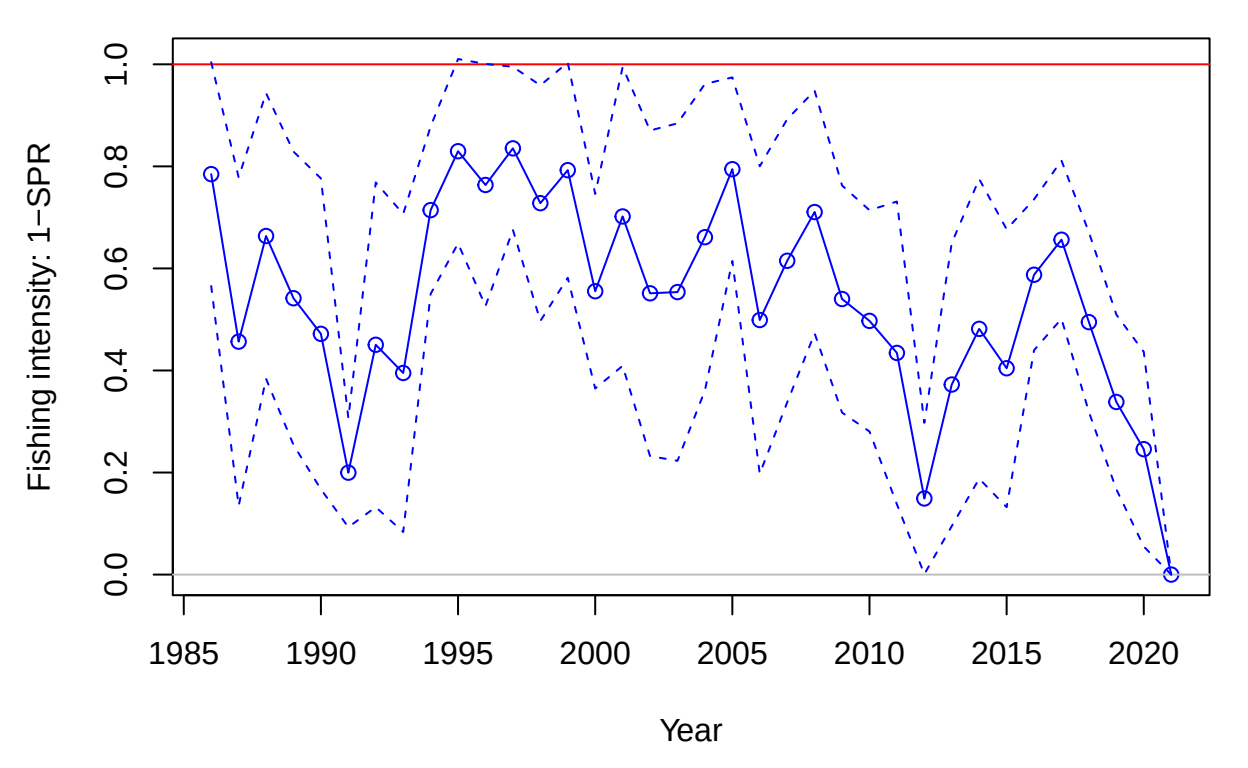

Landings (mt)
0.0
0.2
0.4
1985
1990
1995
2000
2005
2010
2015
2020
Year

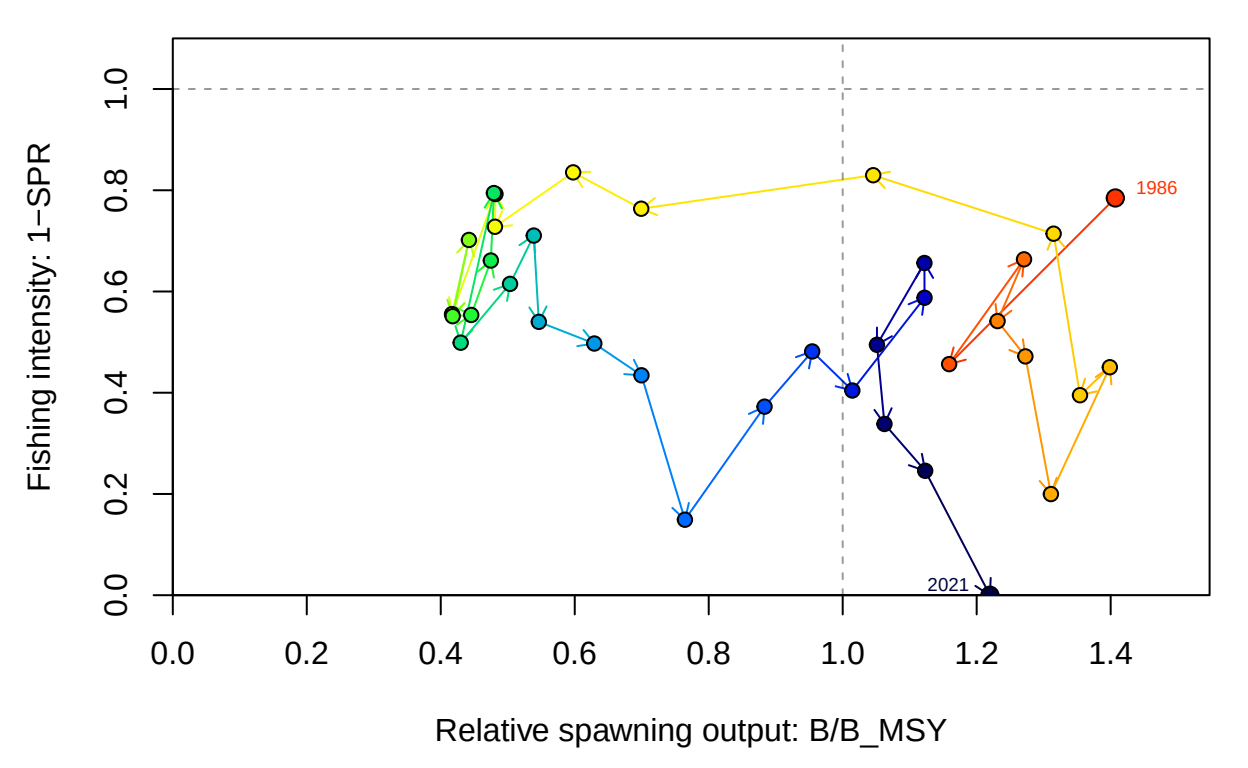

FISHERY
FISHERY obs.
Observed and expected Landings (mt)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1985
1990
1995
2000
2005
2010
2015
2020
Year

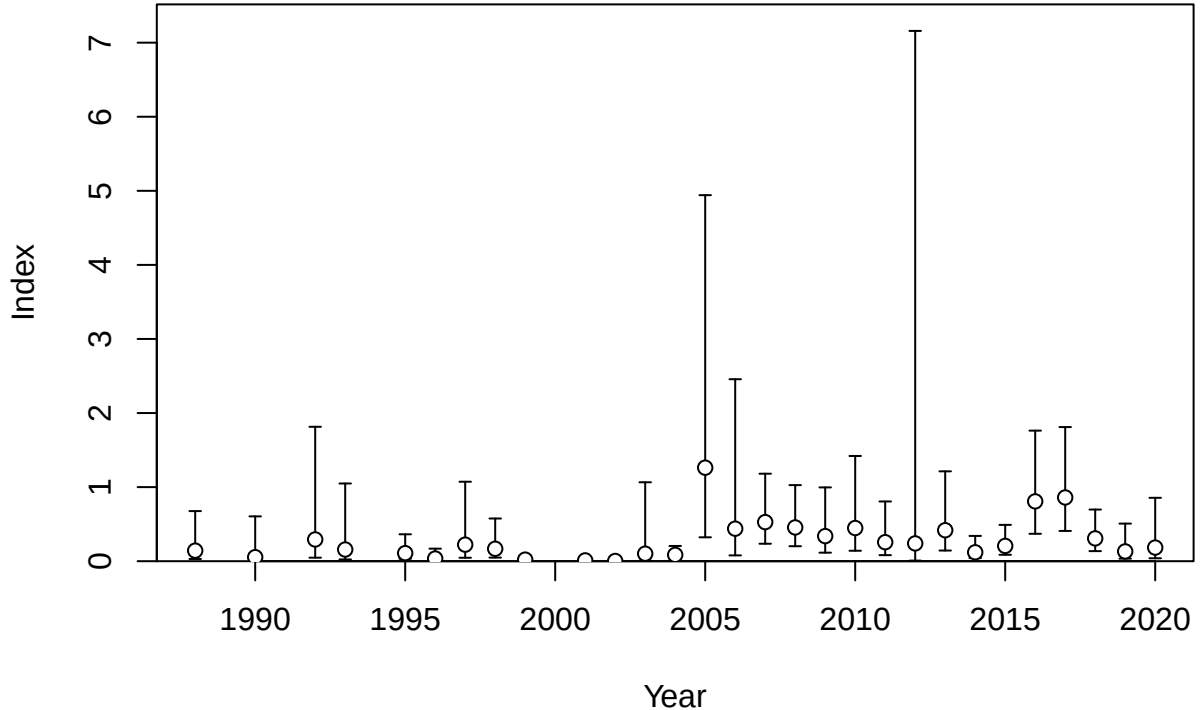

Continuous F
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1985
1990
1995
2000
2005
2010
2015
2020
Year

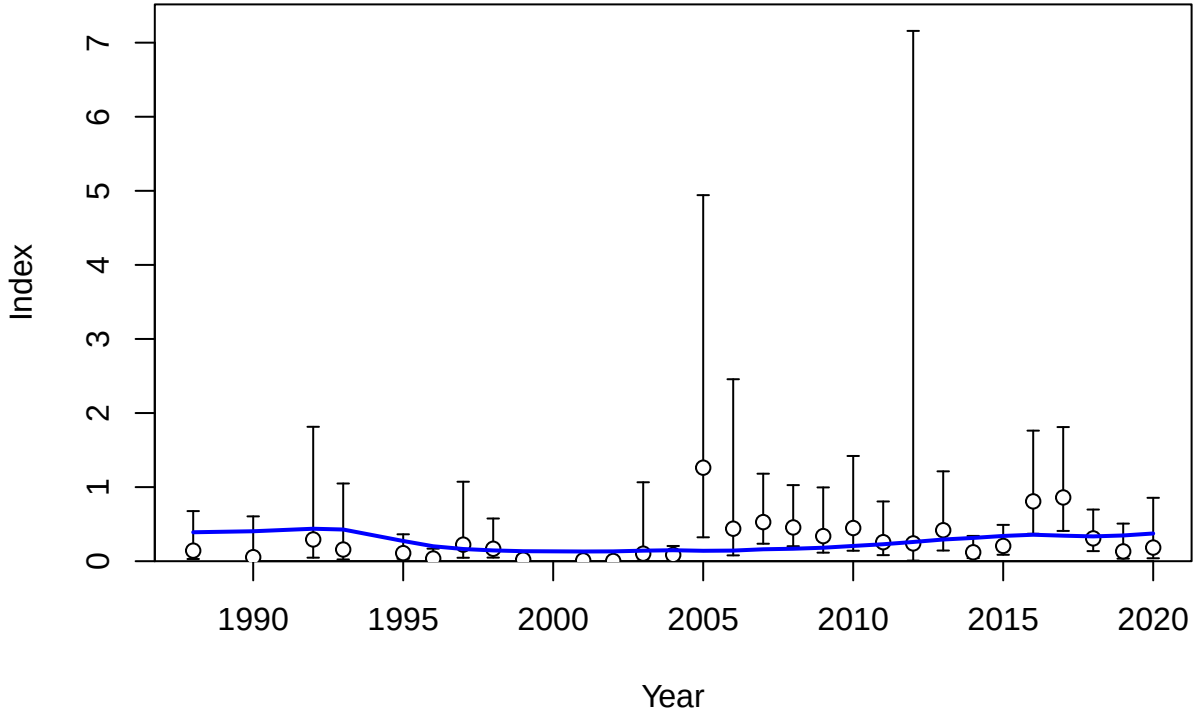

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

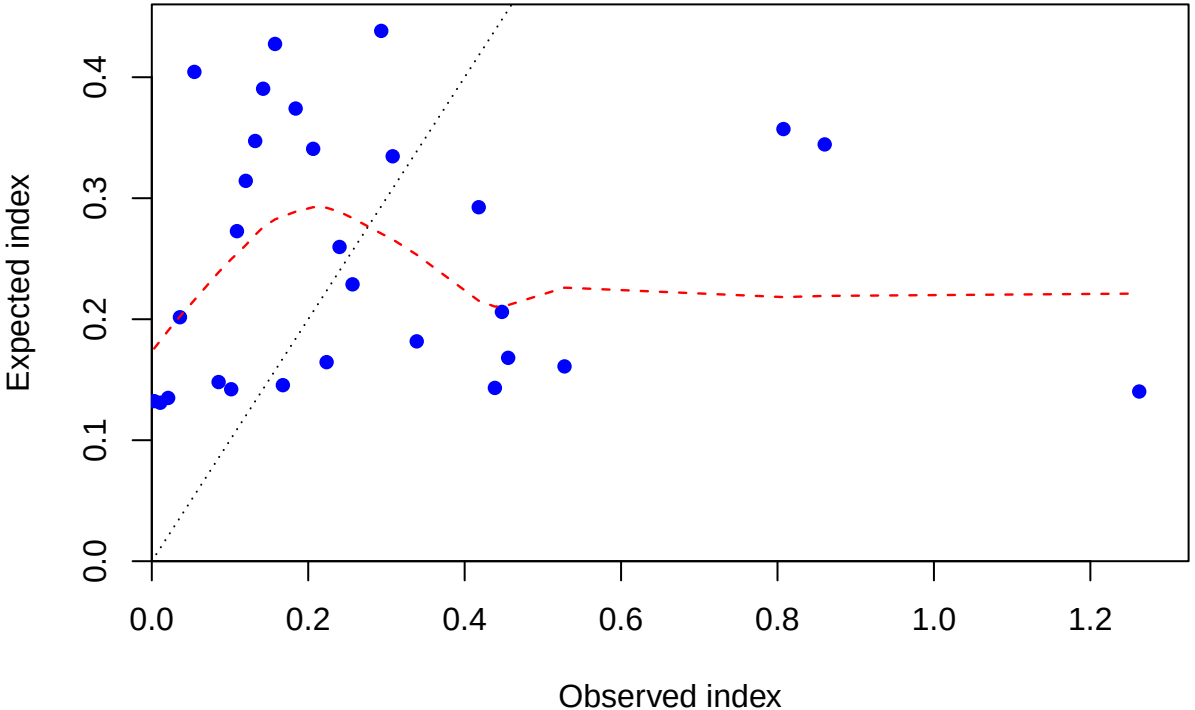

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

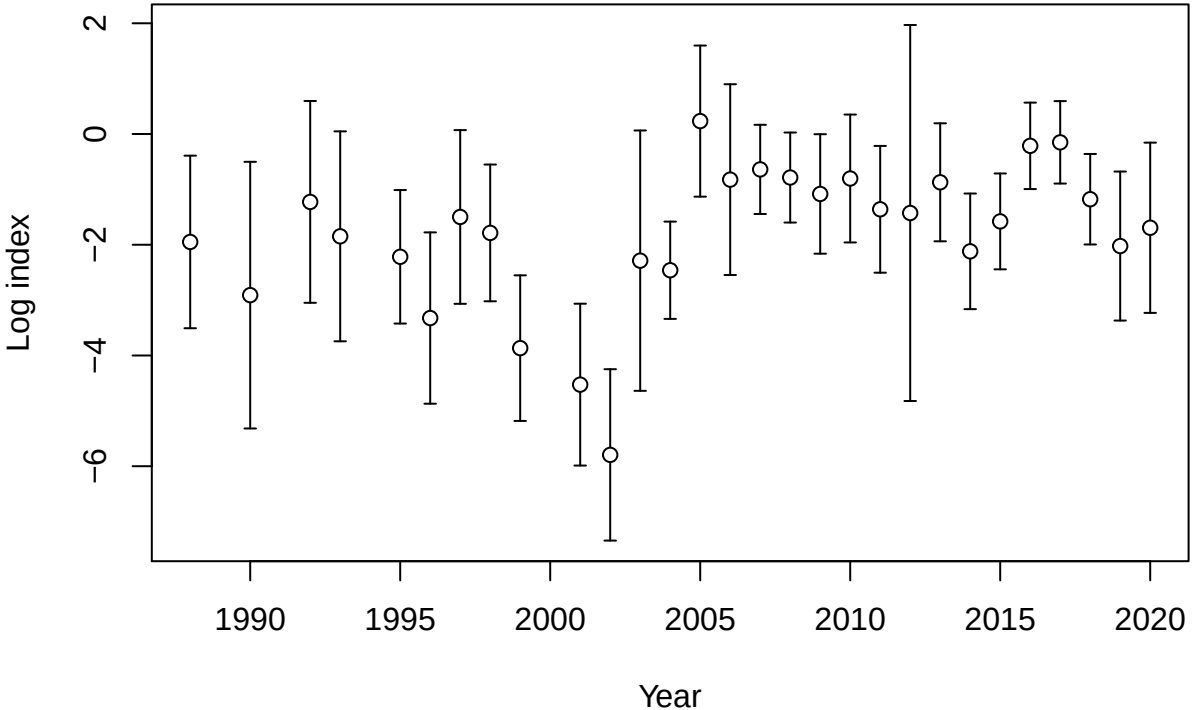

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1985
1990
1995
2000
2005
2010
2015
2020
Year

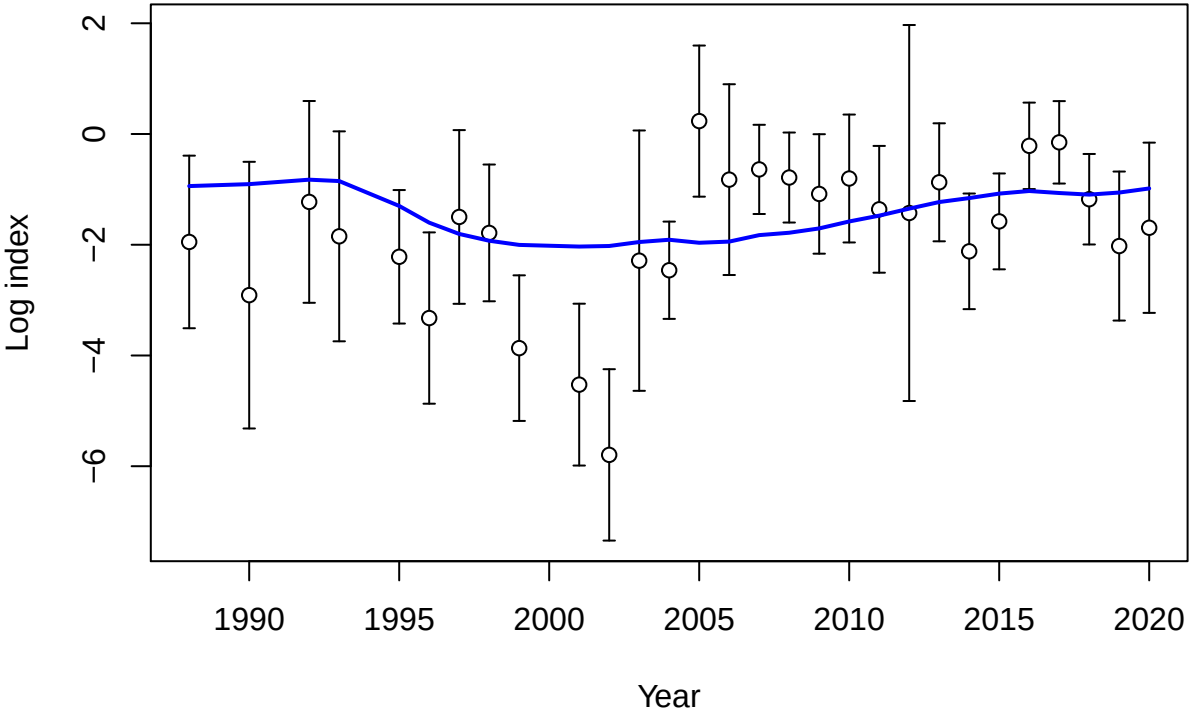

Fishing intensity: 1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
Relative spawning output: B/B_MSY
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1986
2021

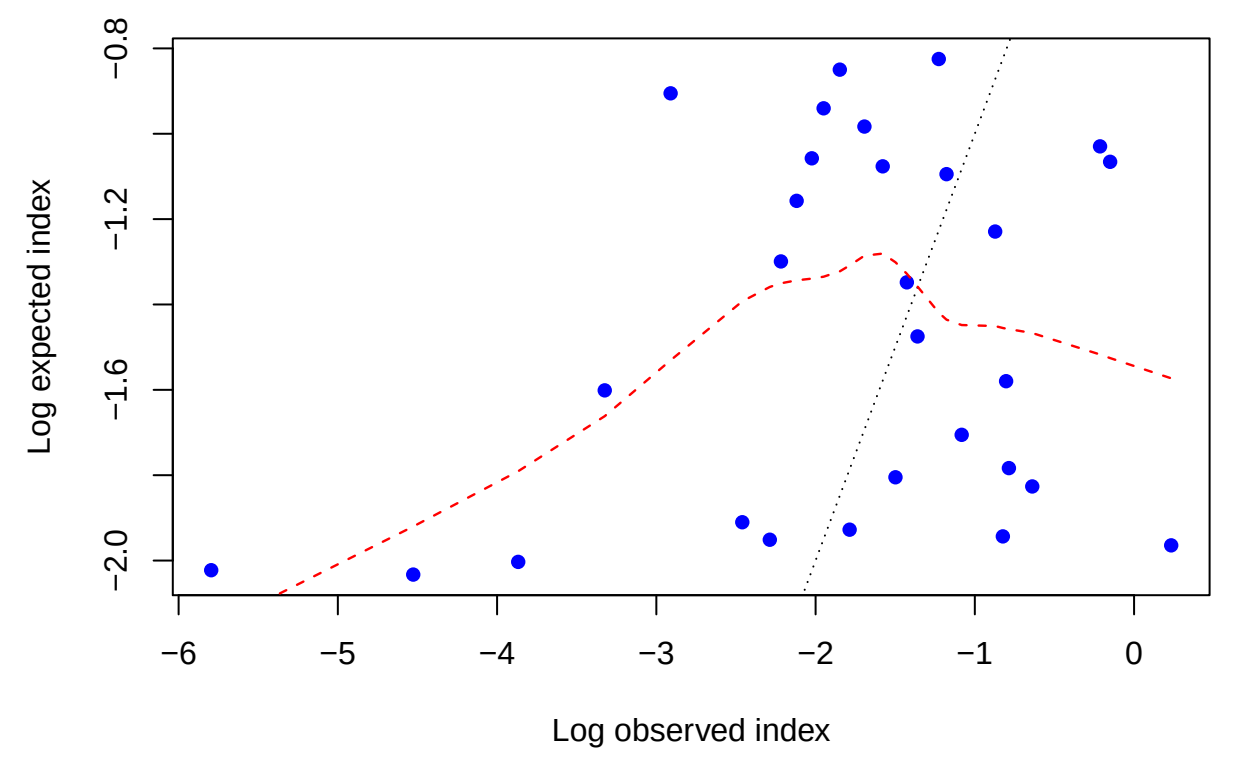

Index
0
1
2
3
4
5
6
7
1990
1995
2000
2005
2010
2015
2020
Year

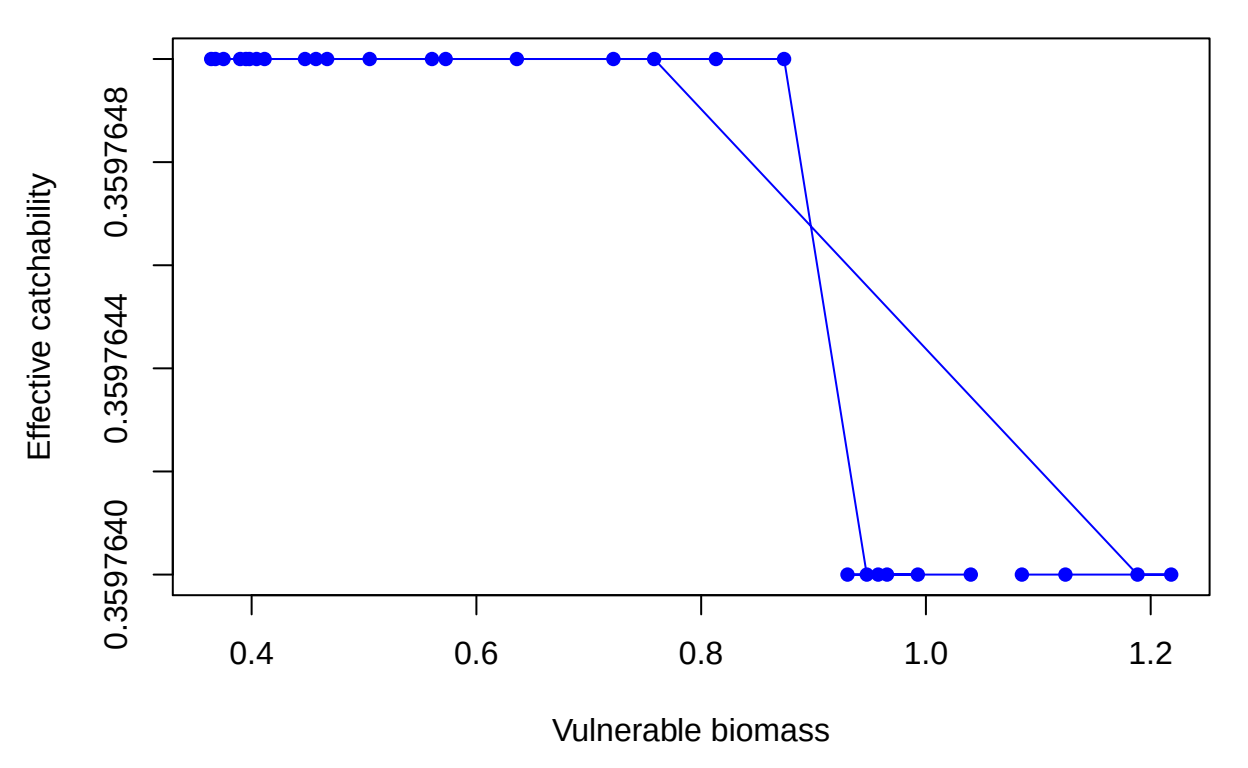

Index
0
1
2
3
4
5
6
7
1990
1995
2000
2005
2010
2015
2020
Year

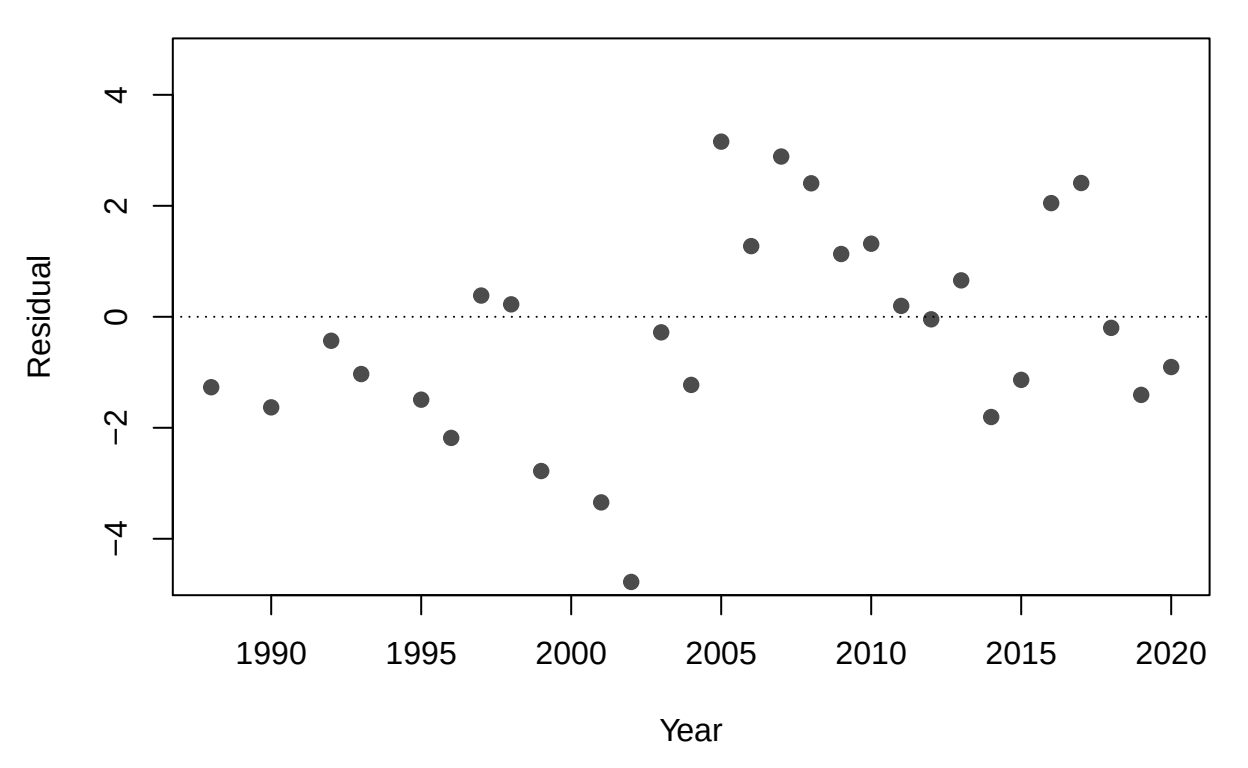

Expected index
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Observed index

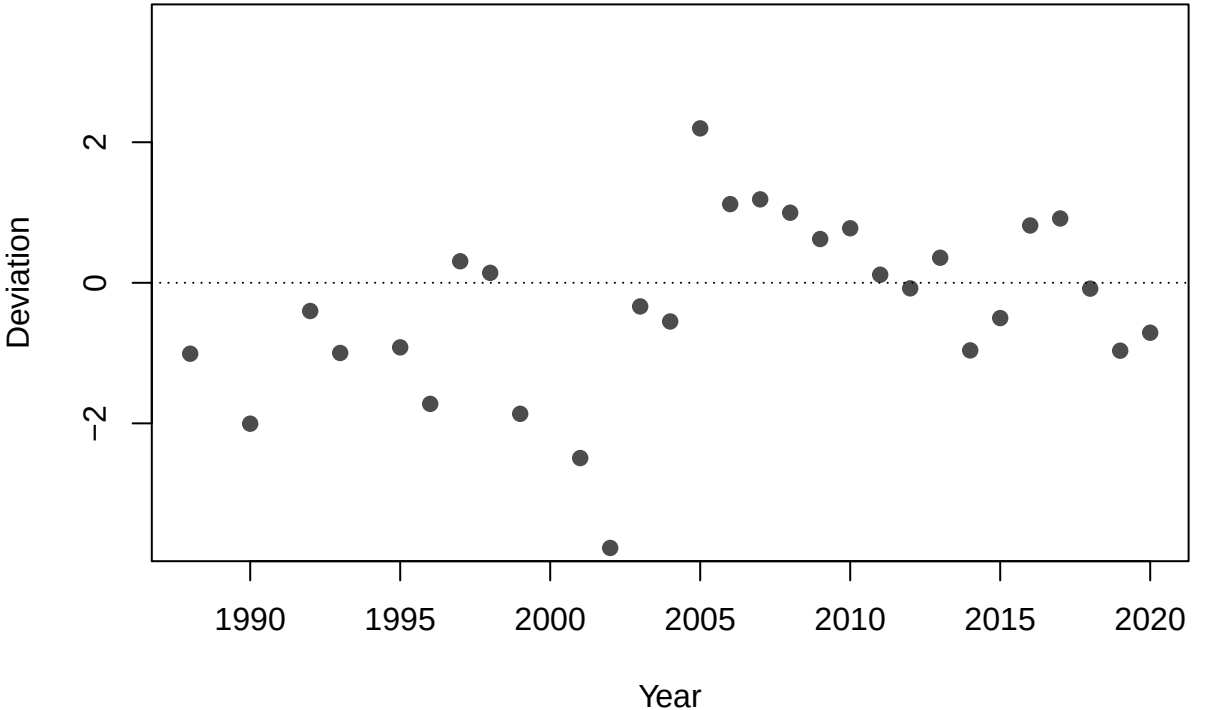

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

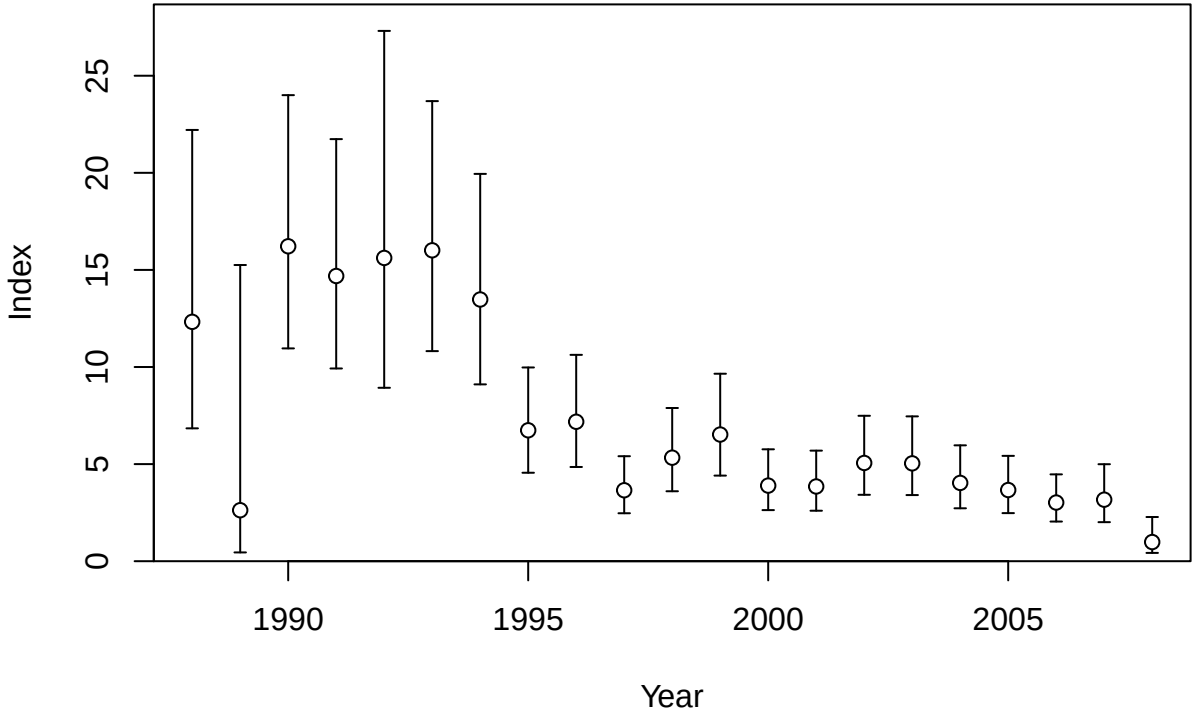

Log index
2
0
−2
−4
−6
1990
1995
2000
2005
2010
2015
2020
Year

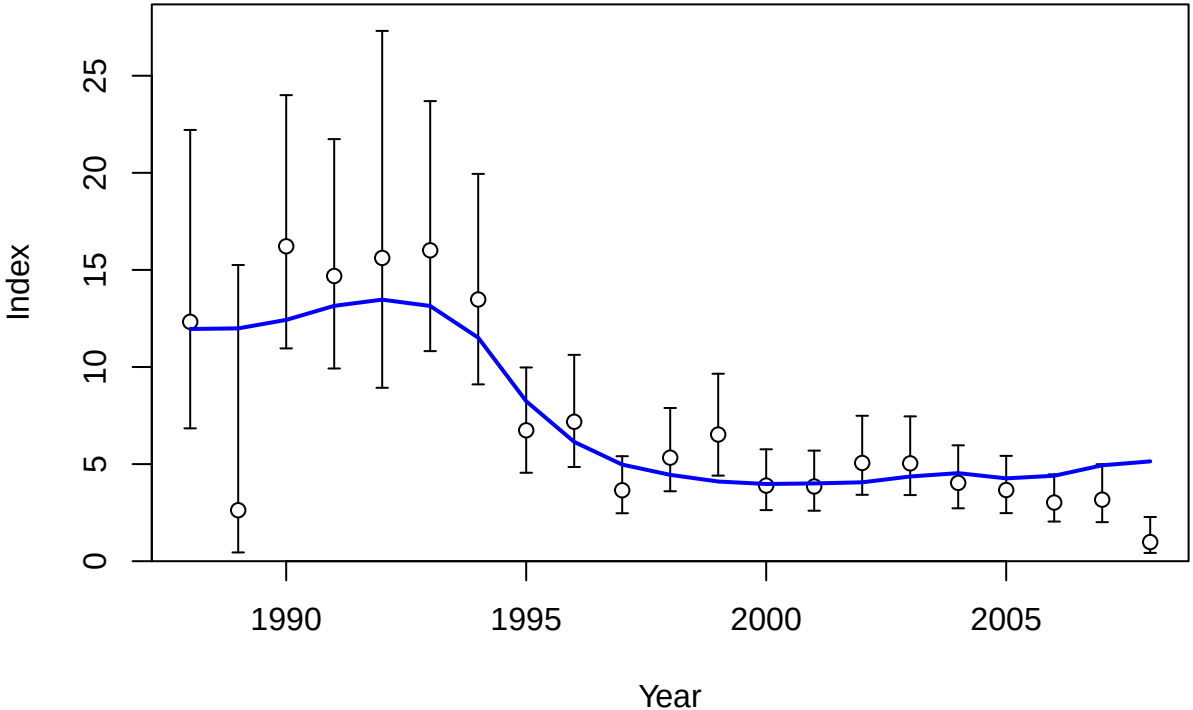

Log expected index
−0.8
−1.2
−1.6
−2.0
−6
−5
−4
−3
−2
−1
0
Log observed index

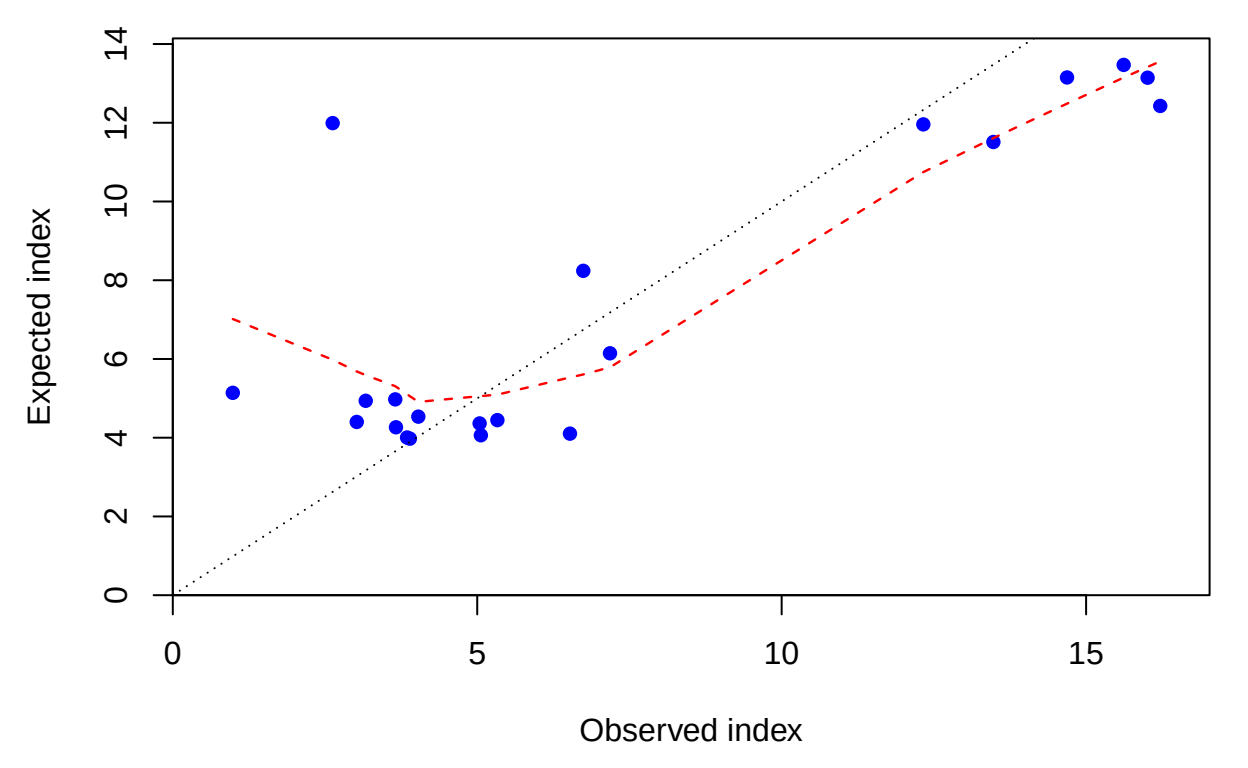

Effective catchability
0.3597640
0.3597644
0.3597648
0.4
0.6
0.8
1.0
1.2
Vulnerable biomass

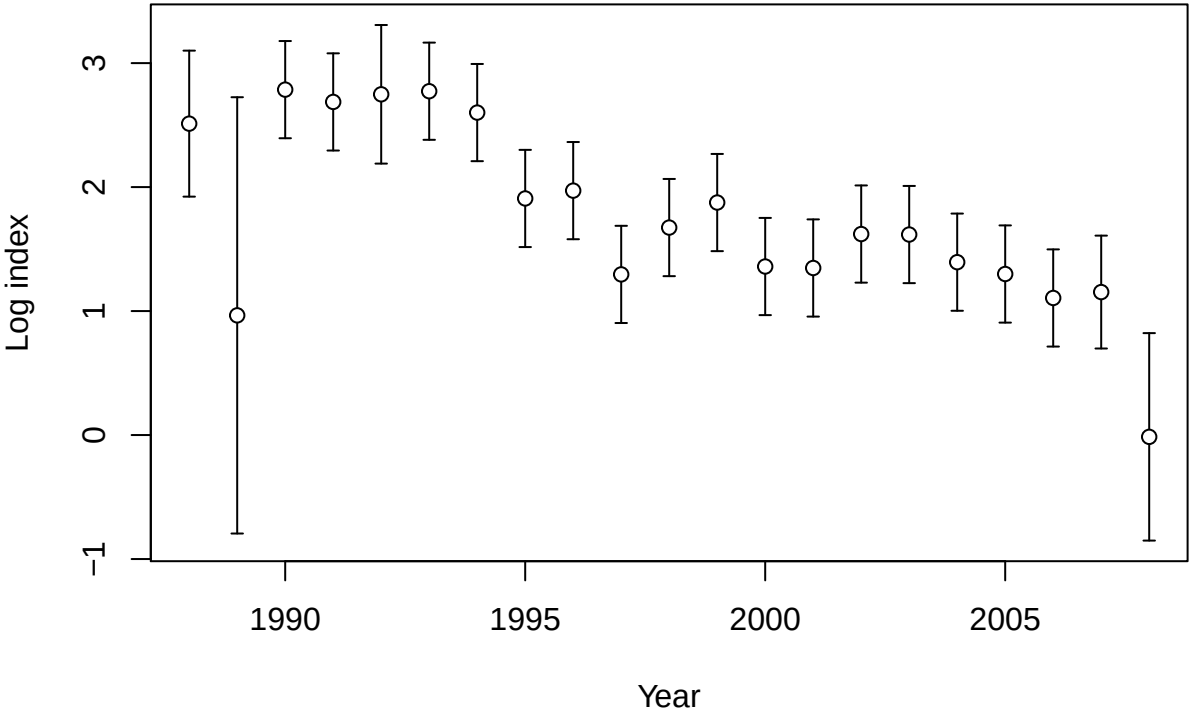

Residual
4
2
0
−2
−4
1990
1995
2000
2005
2010
2015
2020
Year

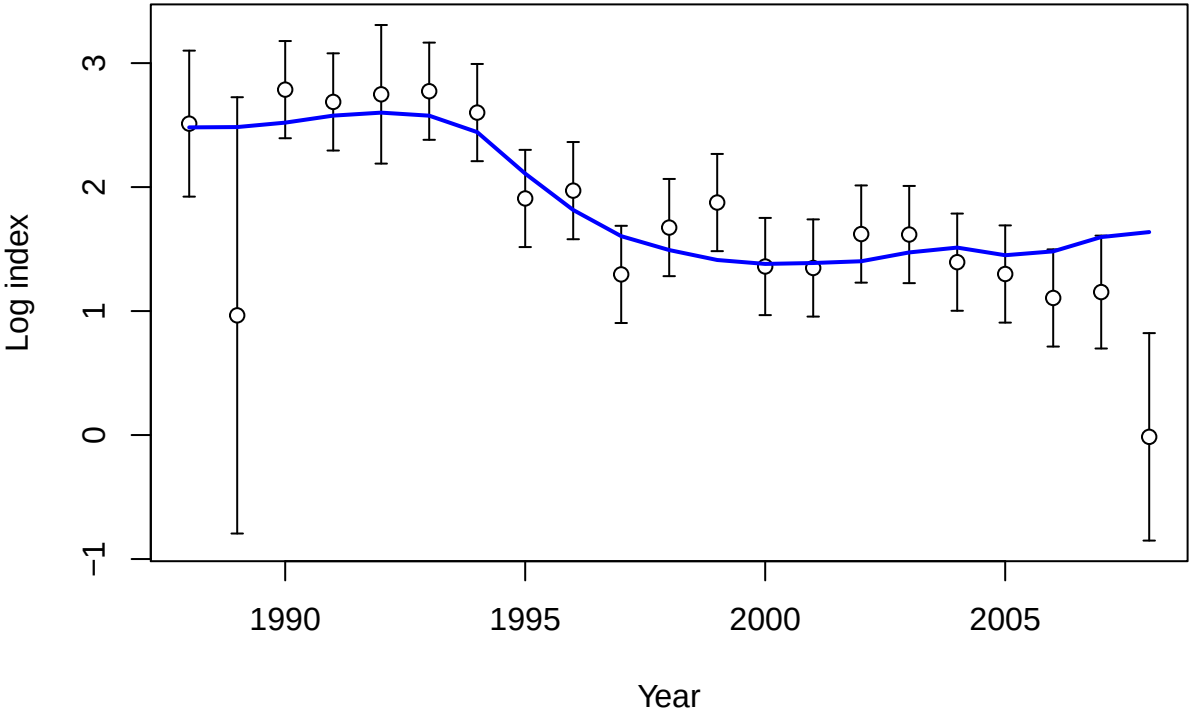

Deviation
2
0
−2
1990
1995
2000
2005
2010
2015
2020
Year

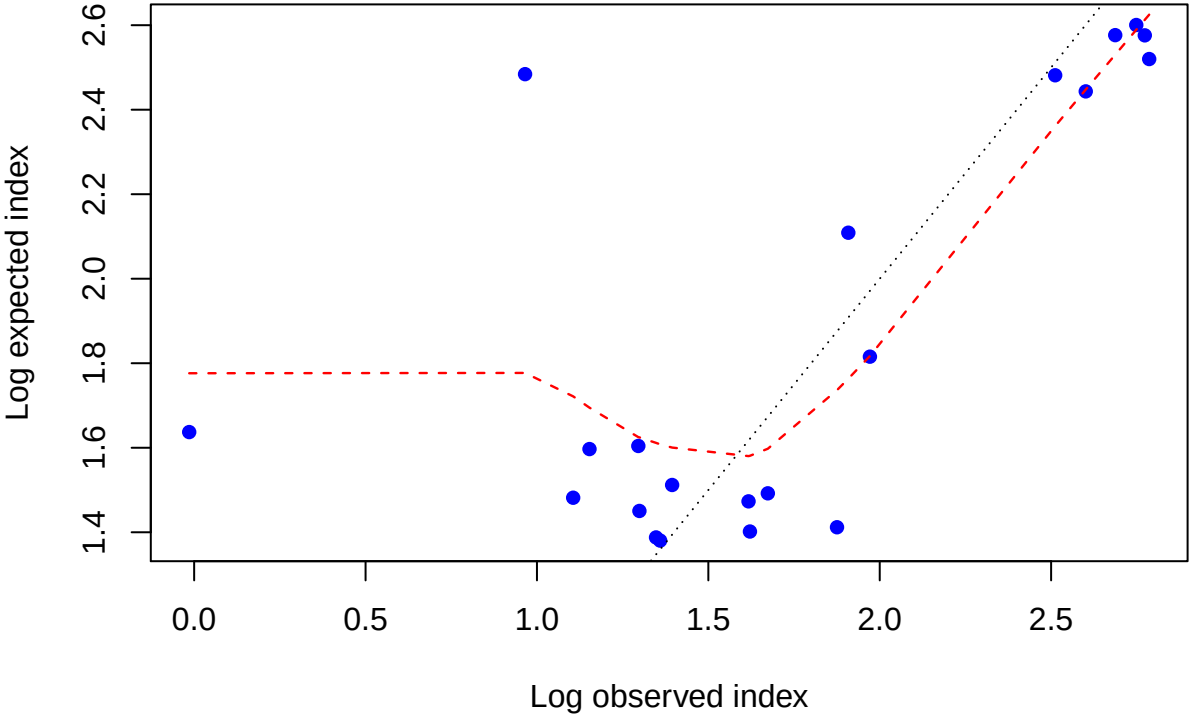

Index
0
5
10
15
20
25
1990
1995
2000
2005
Year

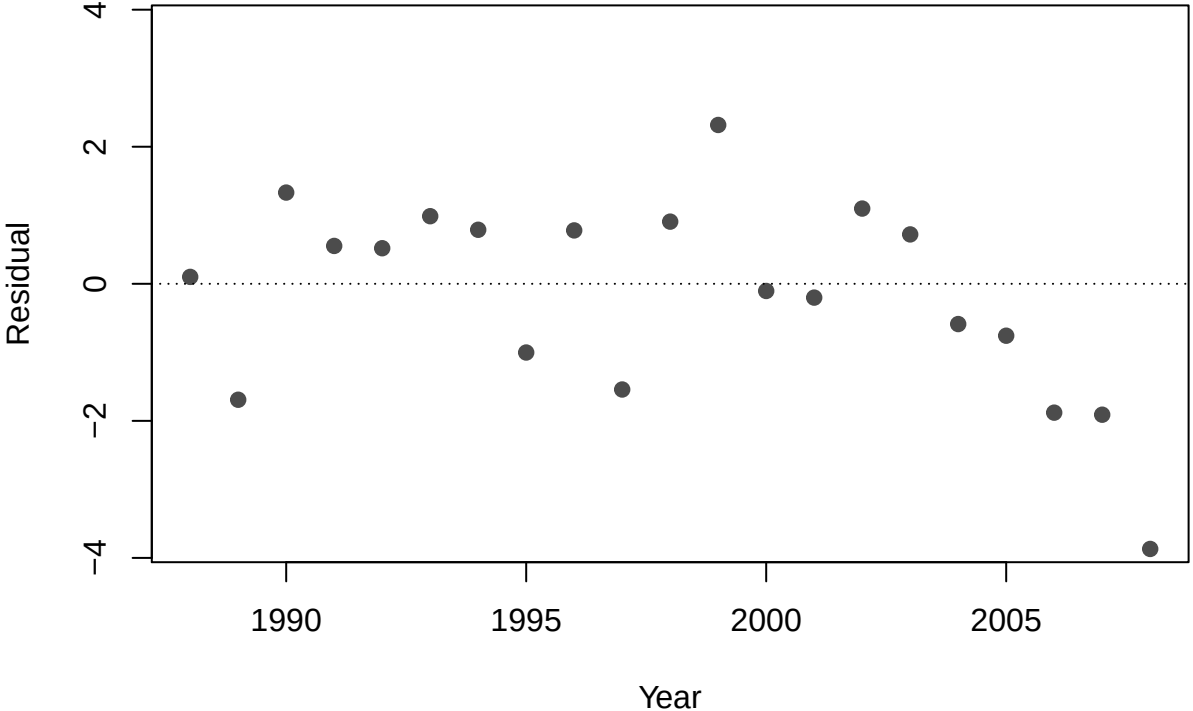

Index
0
5
10
15
20
25
1990
1995
2000
2005
Year

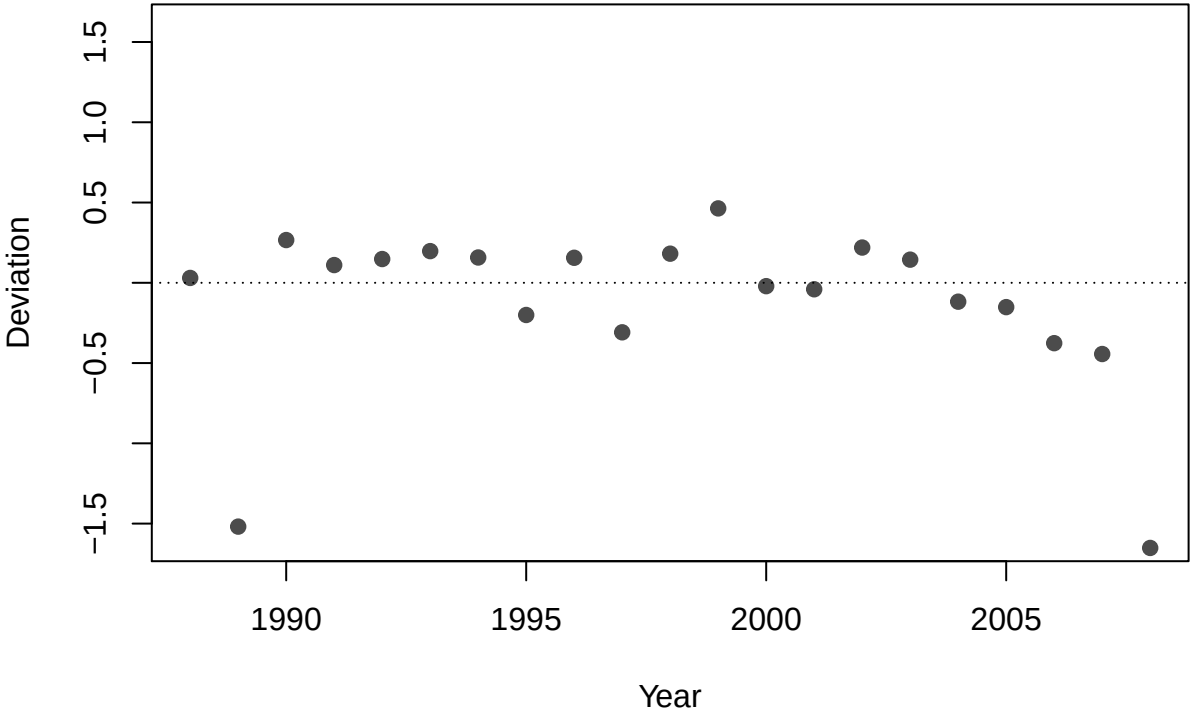

Expected index
Observed index
0
2
4
6
8
10
12
14
0
5
10
15

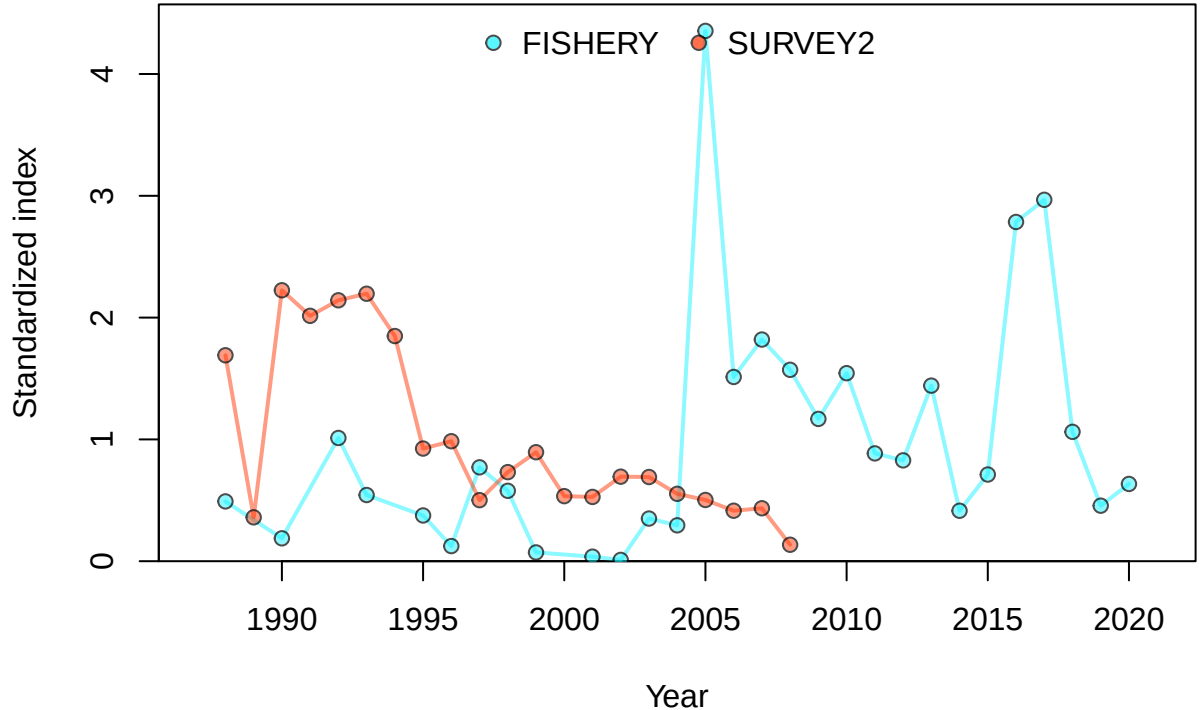

Log index
−1
0
1
2
3
1990
1995
2000
2005
Year

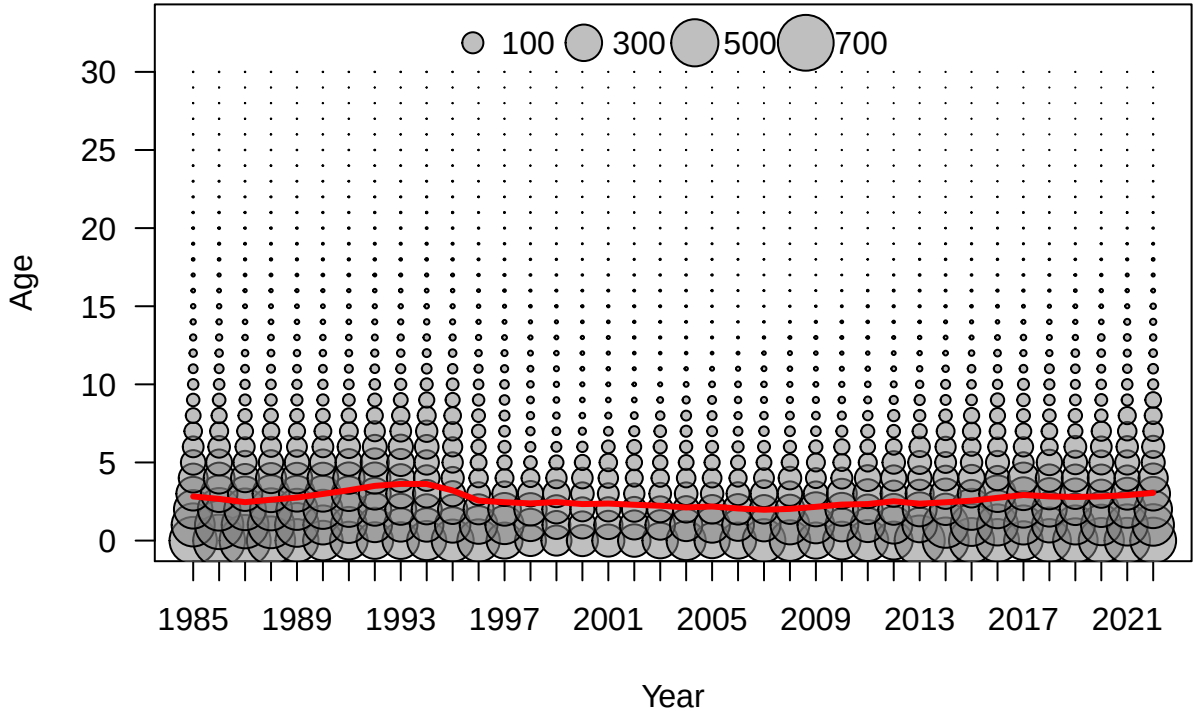

Log index
3
2
1
0
−1
1990
1995
2000
2005
Year

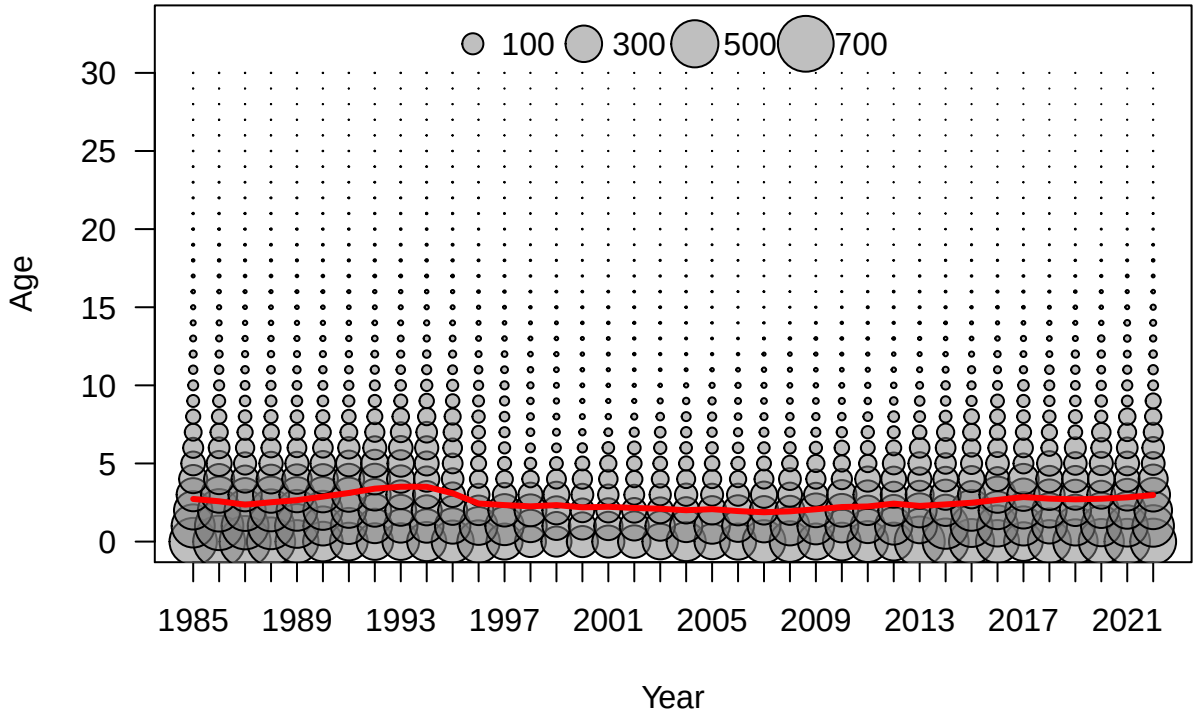

Log expected index
1.4
1.6
1.8
2.0
2.2
2.4
2.6
0.0
0.5
1.0
1.5
2.0
2.5
Log observed index

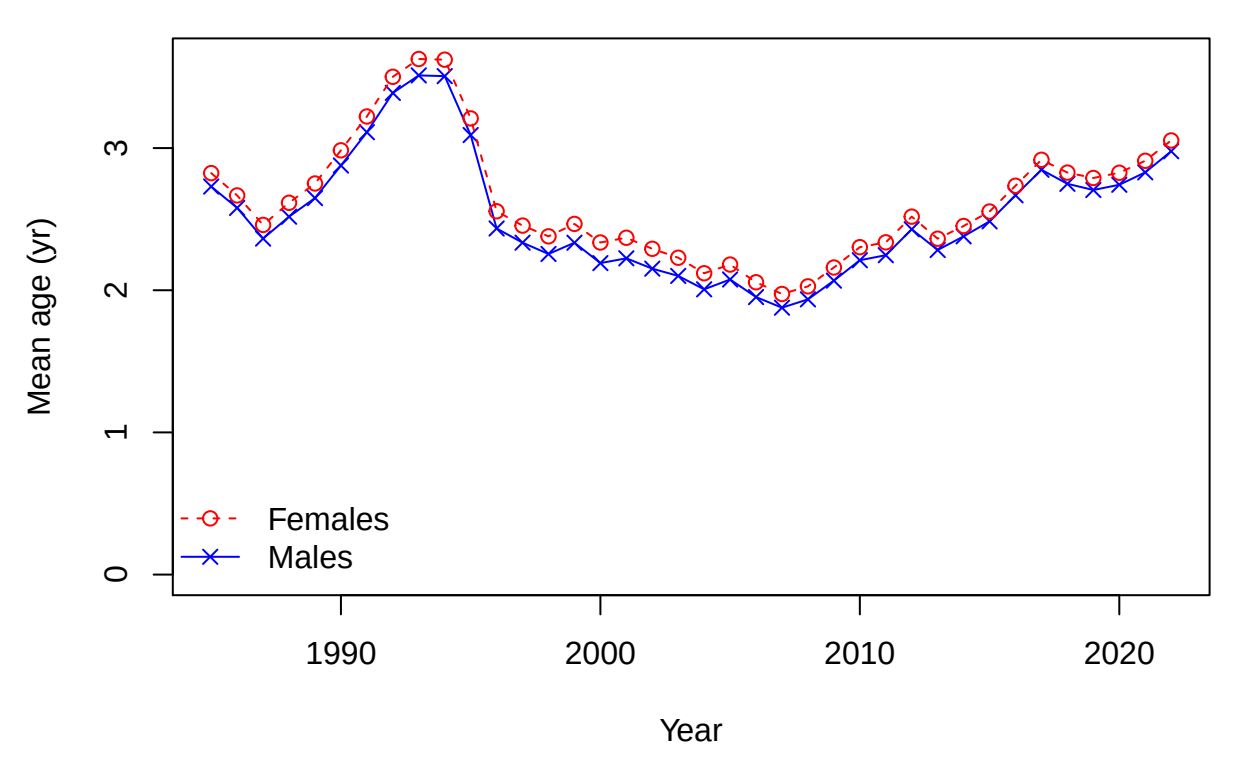

Residual
4
2
0
−2
−4
1990
1995
2000
2005
Year

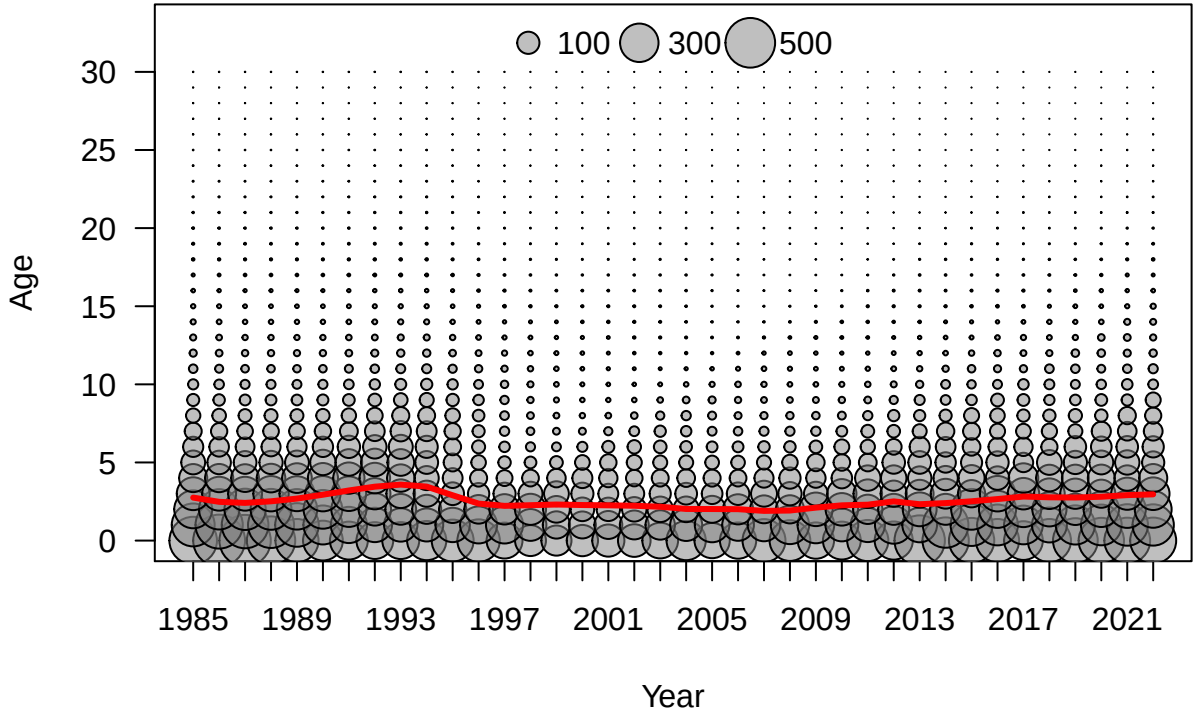

Deviation
1.5
1.0
0.5
−0.5
−1.5
1990
1995
2000
2005
Year

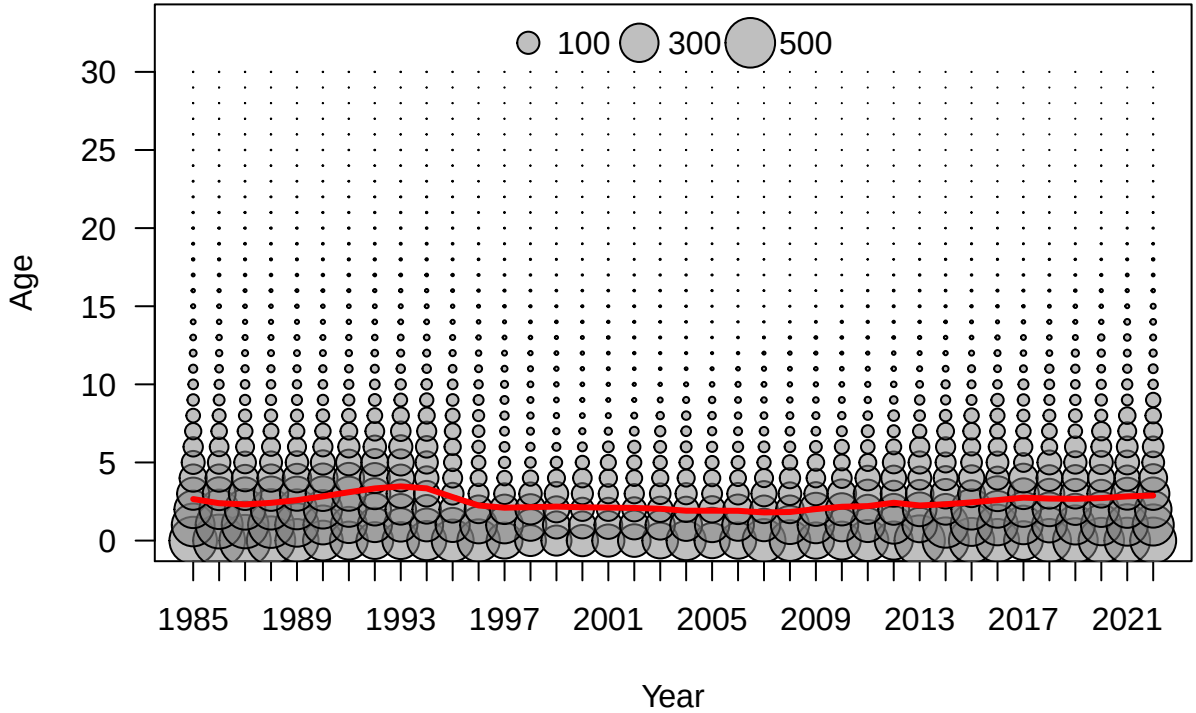

FISHERY
SURVEY2
Standardized index
0
1
2
3
4
1990
1995
2000
2005
2010
2015
2020
Year

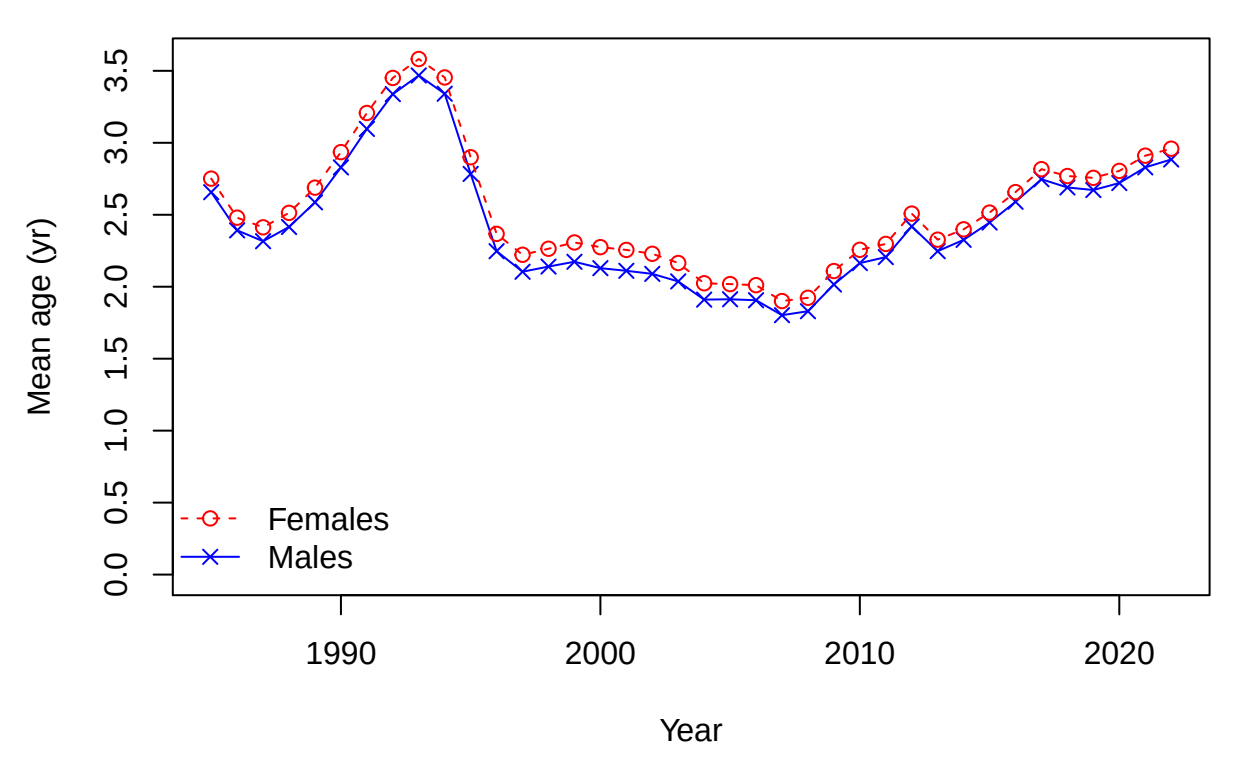

100
300
500
700
Age
30
25
20
15
10
5
0
1985
1989
1993
1997
2001
2005
2009
2013
2017
2021
Year

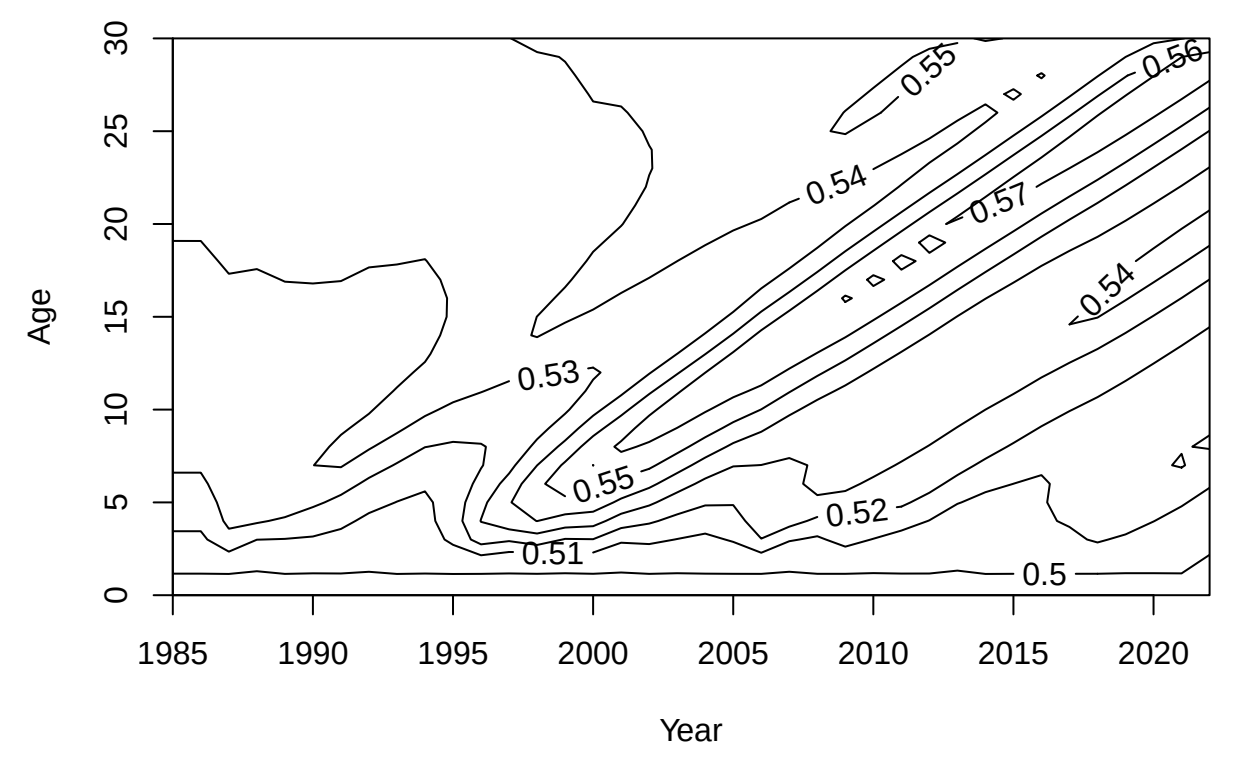

100
300
500
700
Age
30
25
20
15
10
5
0
1985
1989
1993
1997
2001
2005
2009
2013
2017
2021
Year

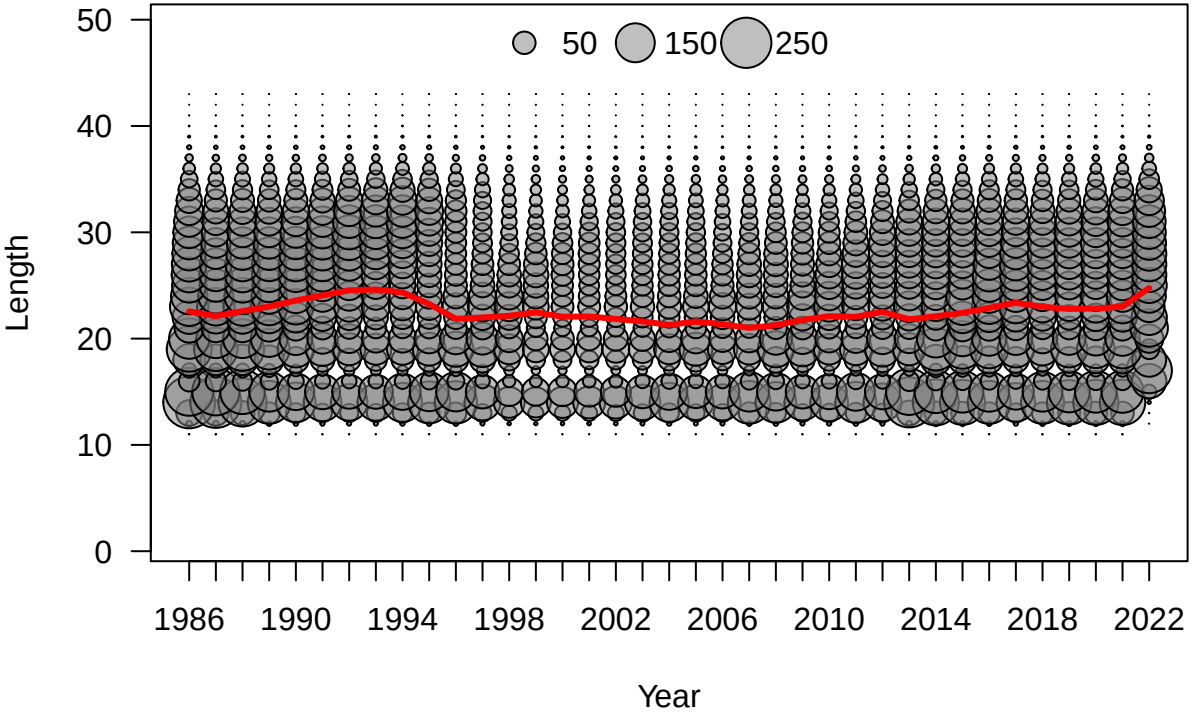

Mean age (yr)
0
1
2
3
1990
2000
2010
2020
Year
Females
Males

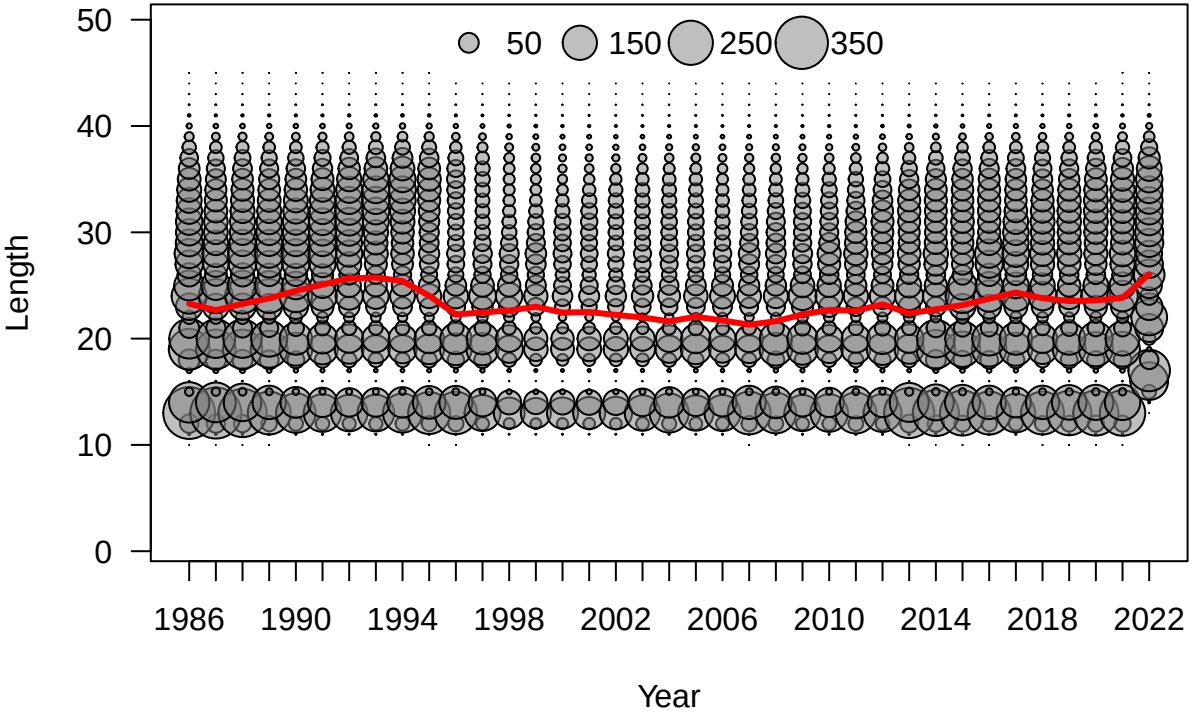

100
300
500
Age
30
25
20
15
10
5
0
1985
1989
1993
1997
2001
2005
2009
2013
2017
2021
Year

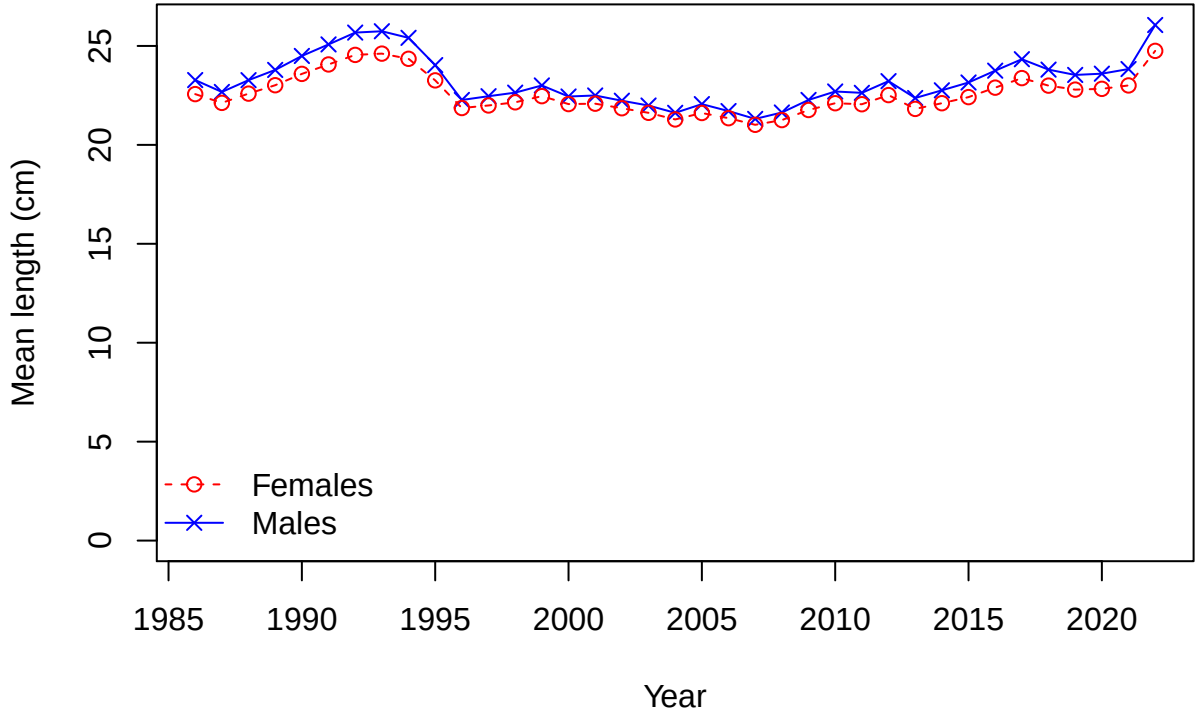

100
300
500
Age
30
25
20
15
10
5
0
1985
1989
1993
1997
2001
2005
2009
2013
2017
2021
Year

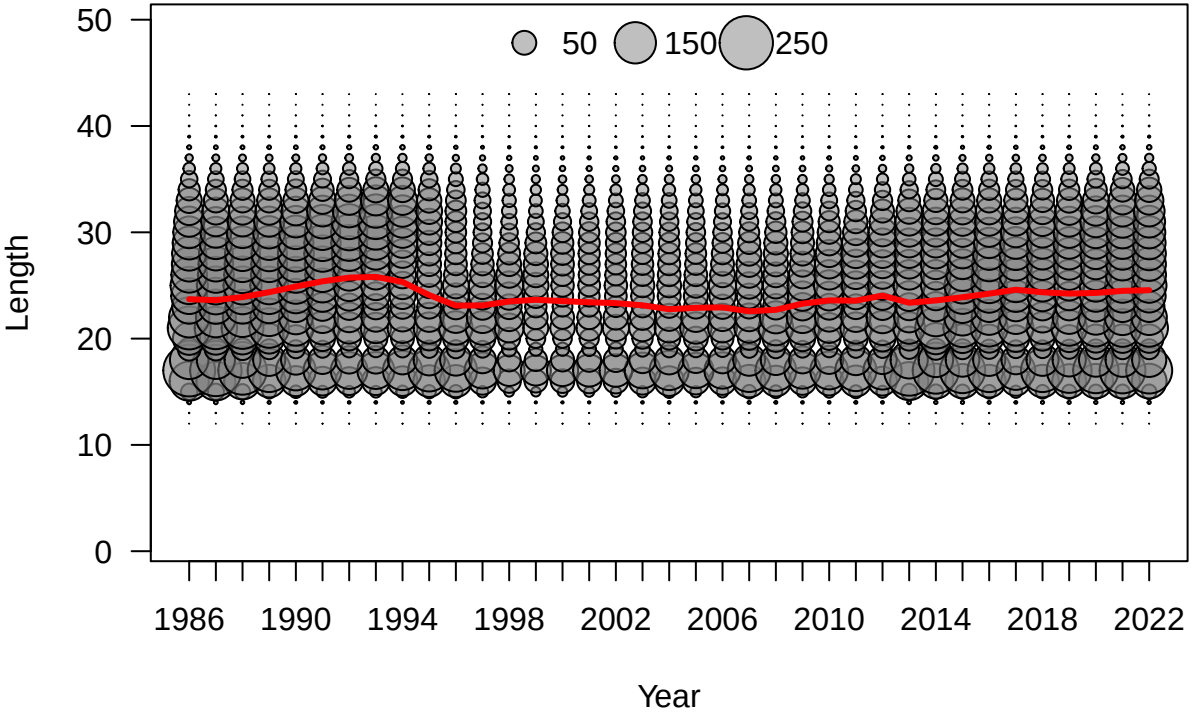

Mean age (yr)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1990
2000
2010
2020
Year
Females
Males

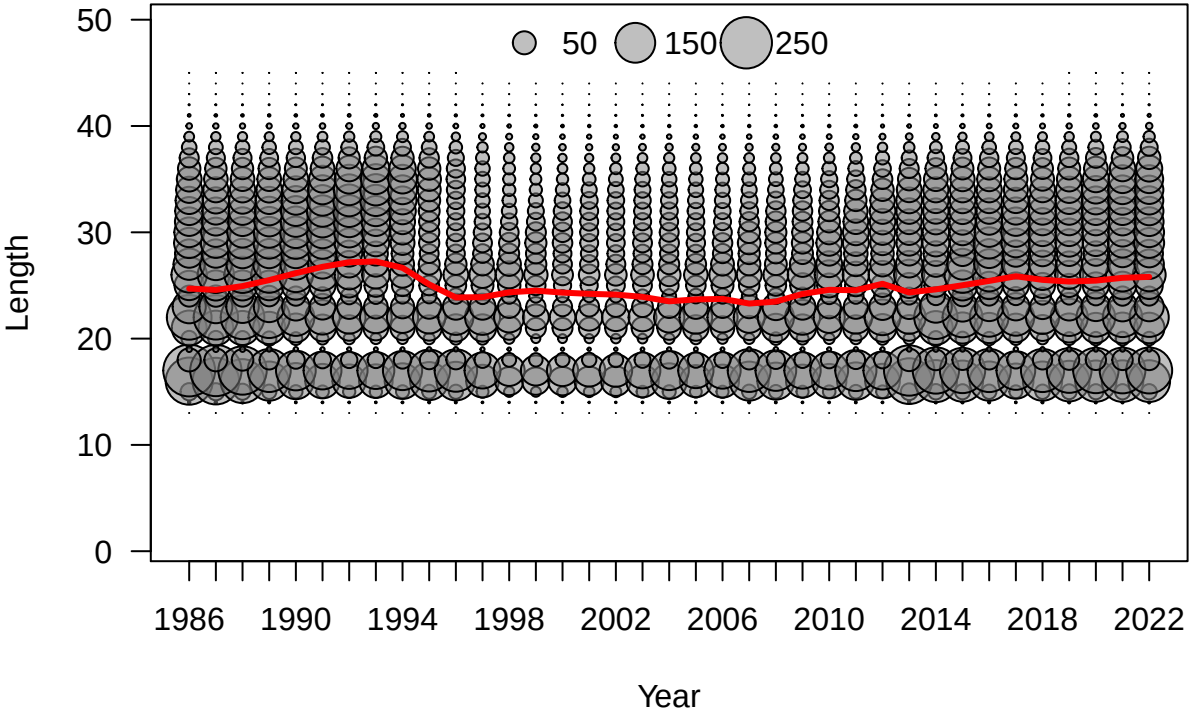

Age
Year
0
5
10
15
20
25
30
1985
1990
1995
2000
2005
2010
2015
2020
0.5
0.51
0.52
0.53
0.54
0.55
0.56
0.57

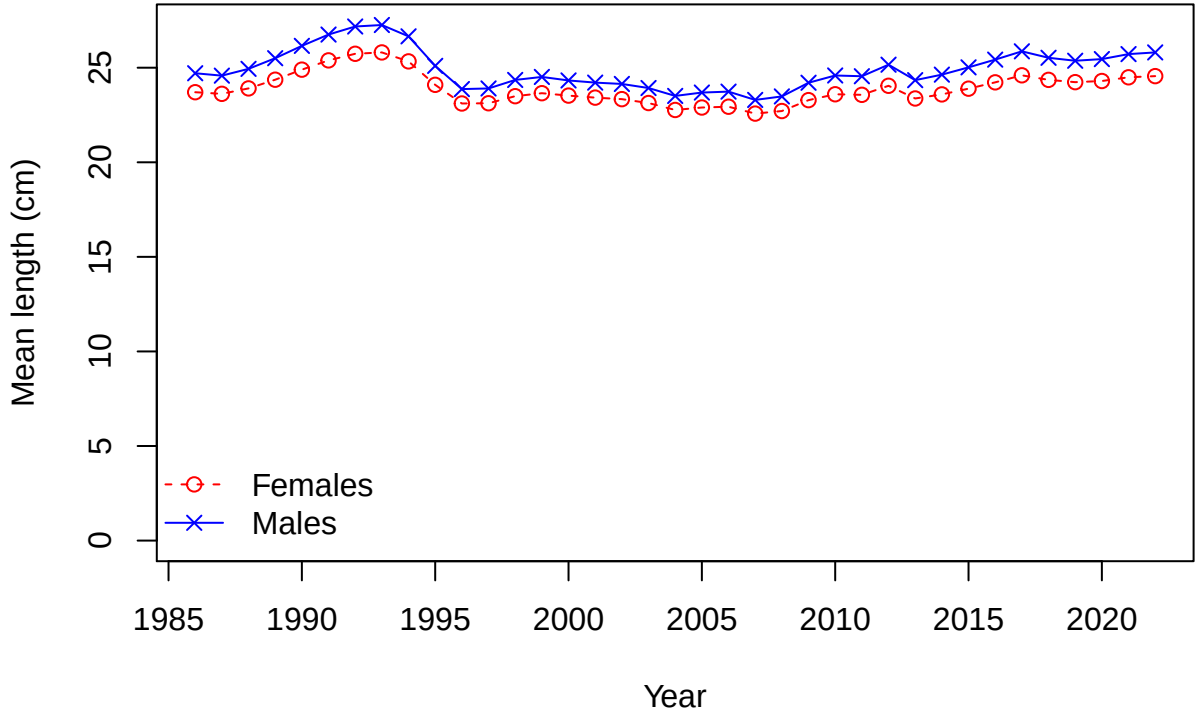

50
150
250
Length
0
10
20
30
40
50
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year

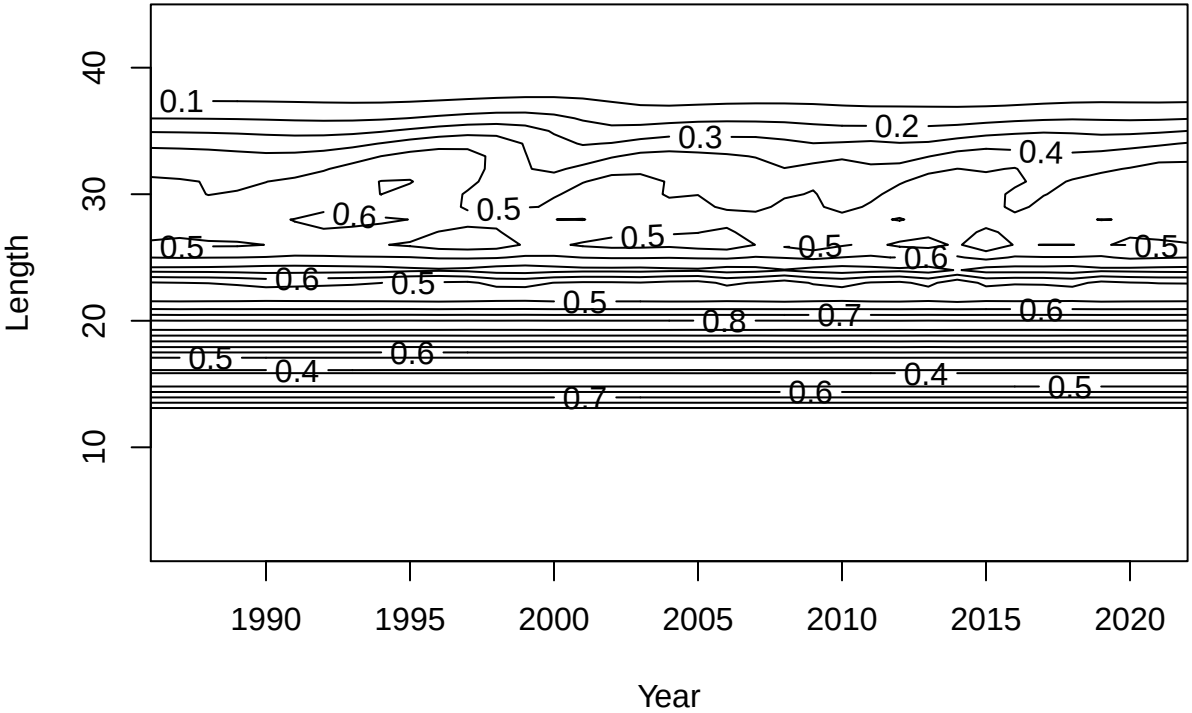

50
150
250
350
Length
0
10
20
30
40
50
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year

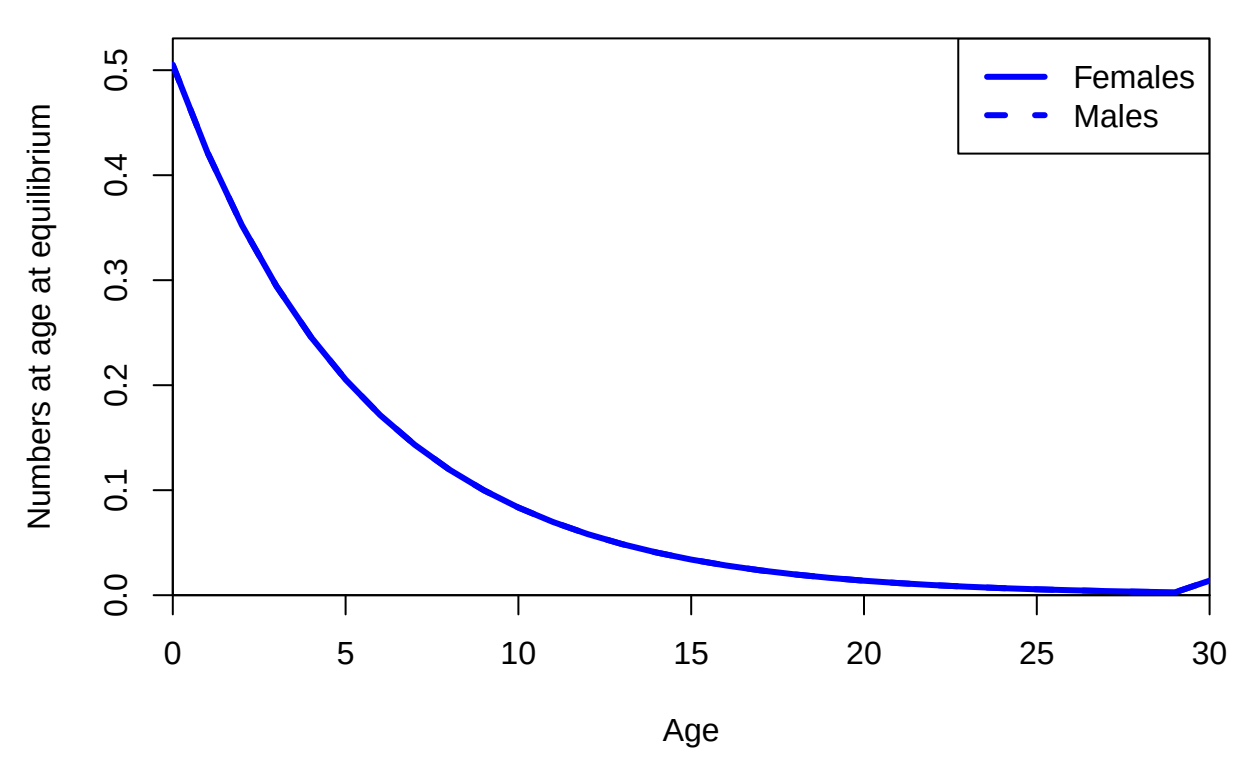

Mean length (cm)
0
5
10
15
20
25
1985
1990
1995
2000
2005
2010
2015
2020
Year
Females
Males

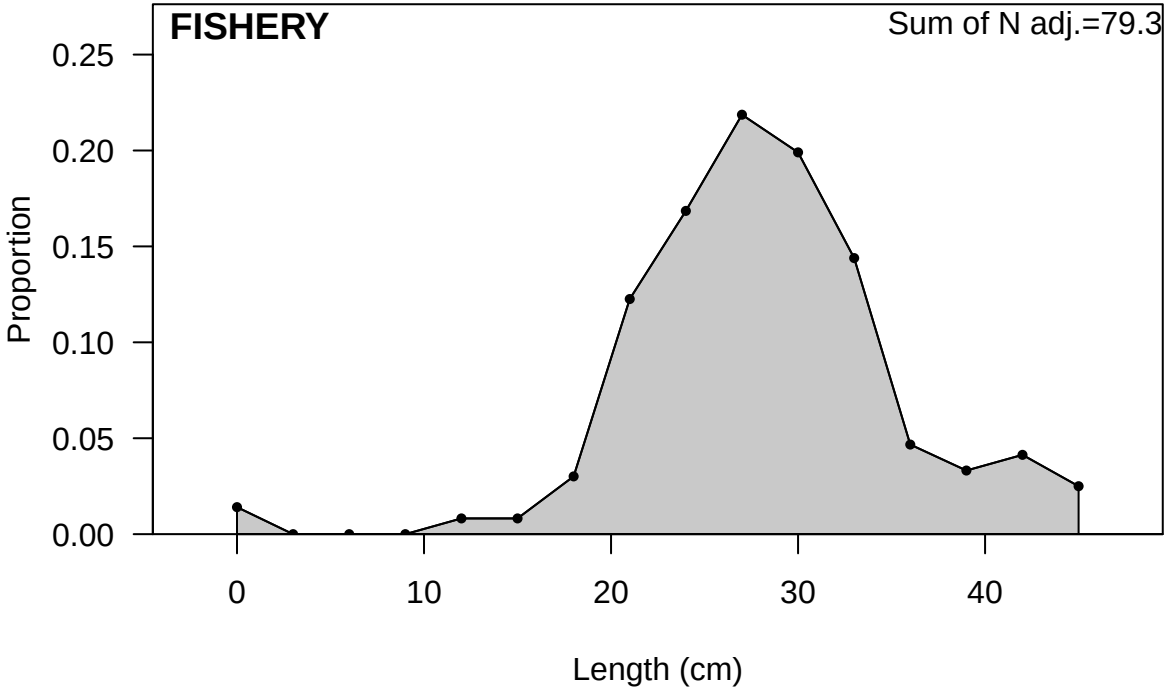

50
150
250
Length
0
10
20
30
40
50
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year

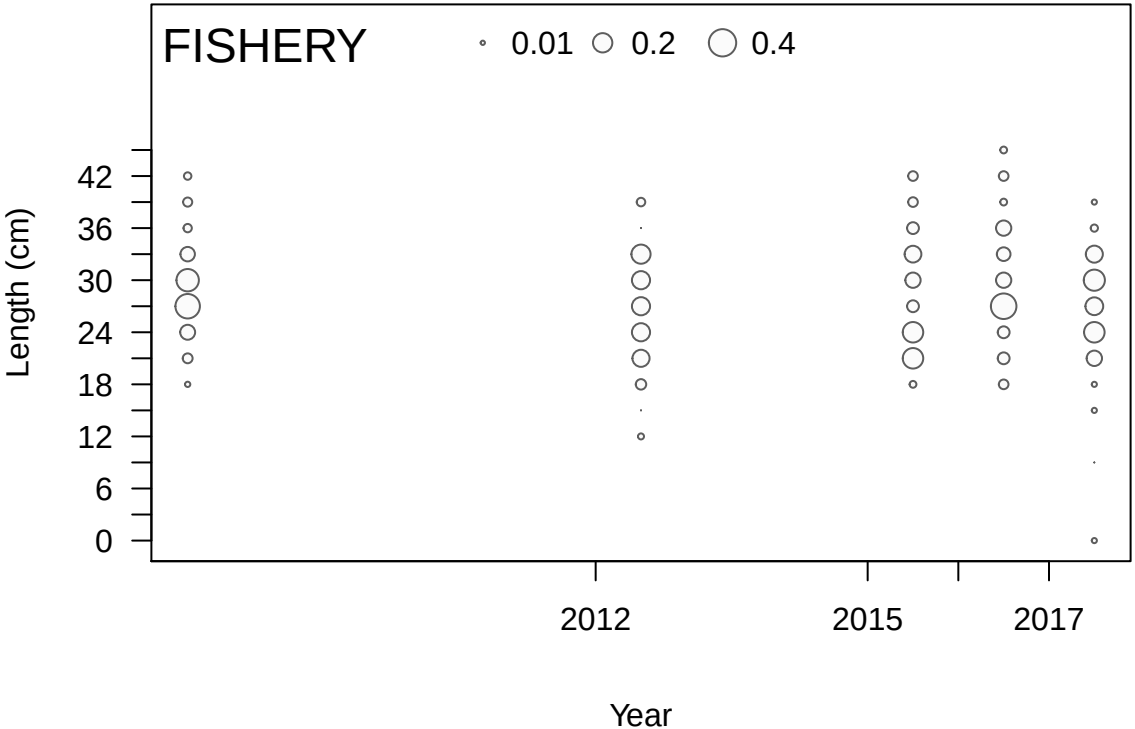

50
150
250
Length
0
10
20
30
40
50
1986
1990
1994
1998
2002
2006
2010
2014
2018
2022
Year

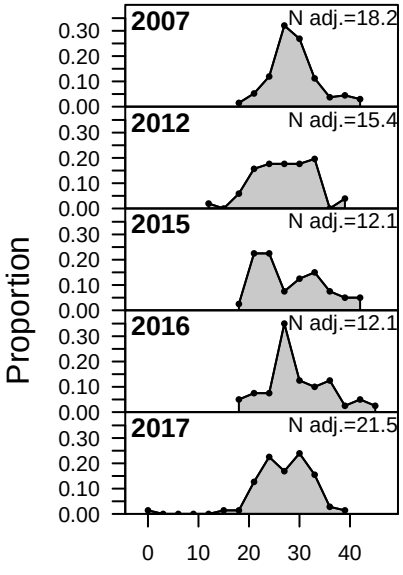

Mean length (cm)
0
5
10
15
20
25
1985
1990
1995
2000
2005
2010
2015
2020
Year
Females
Males

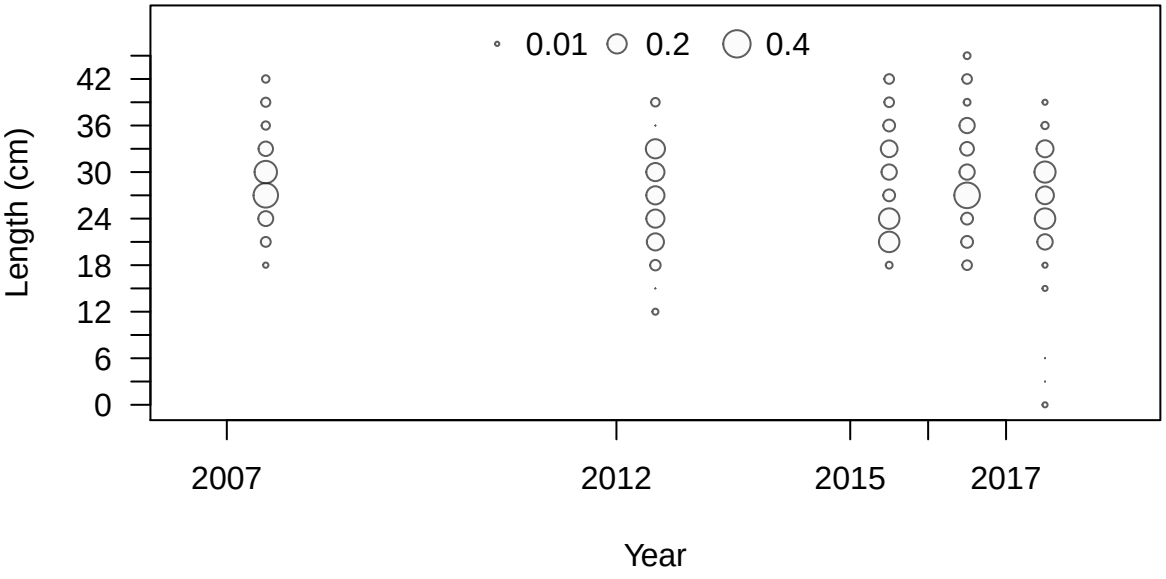

Length
10
20
30
40
Year
1990
1995
2000
2005
2010
2015
2020
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

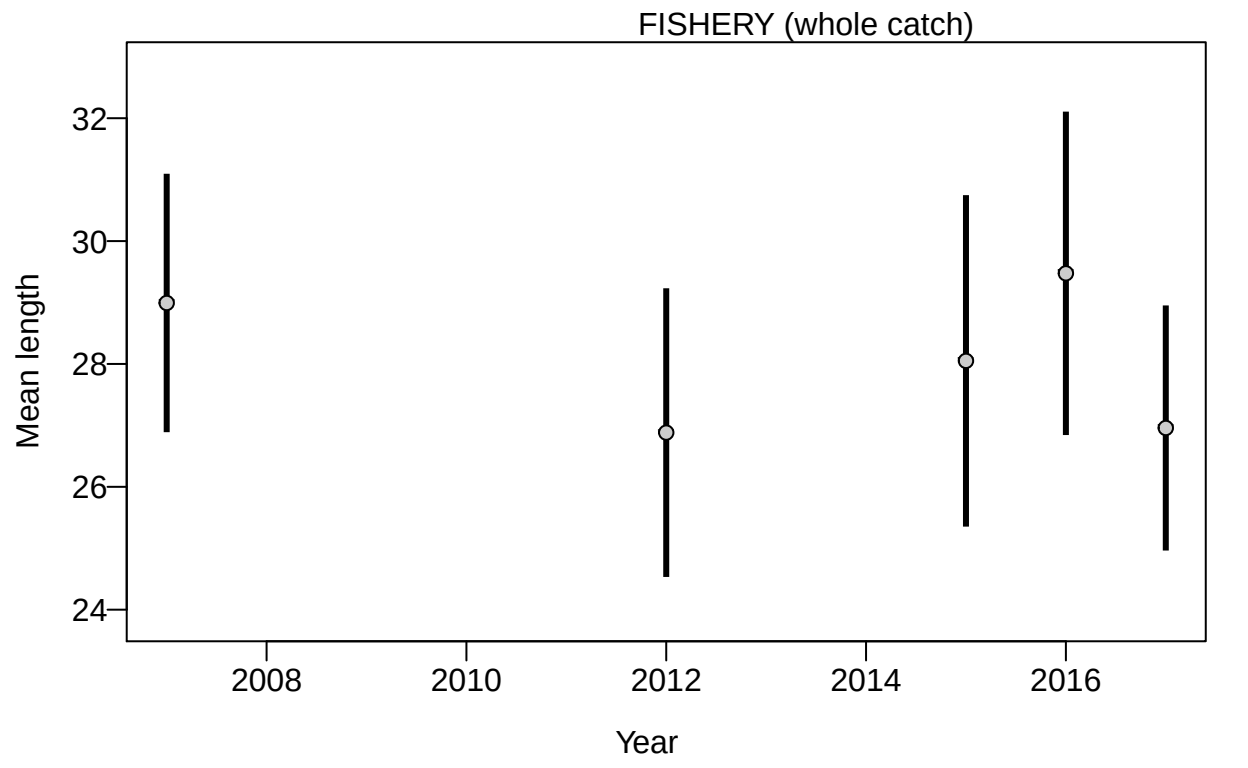

Females
Males
Numbers at age at equilibrium
0.0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
30
Age

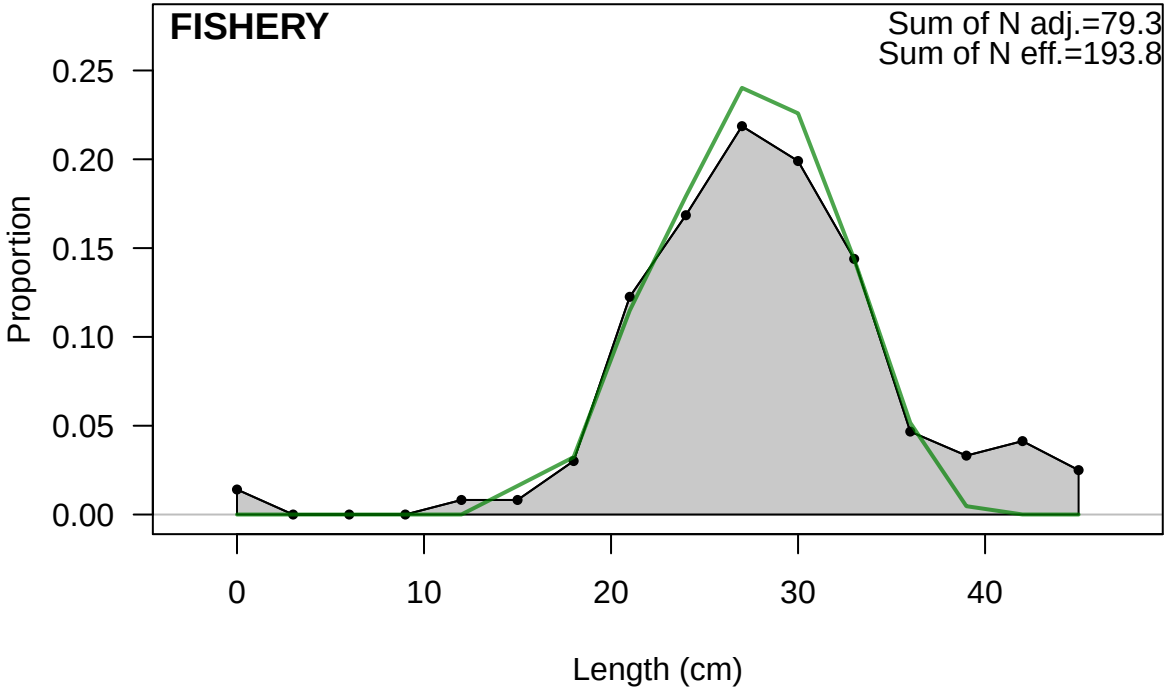

FISHERY
Sum of N adj.=79.3
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
Length (cm)

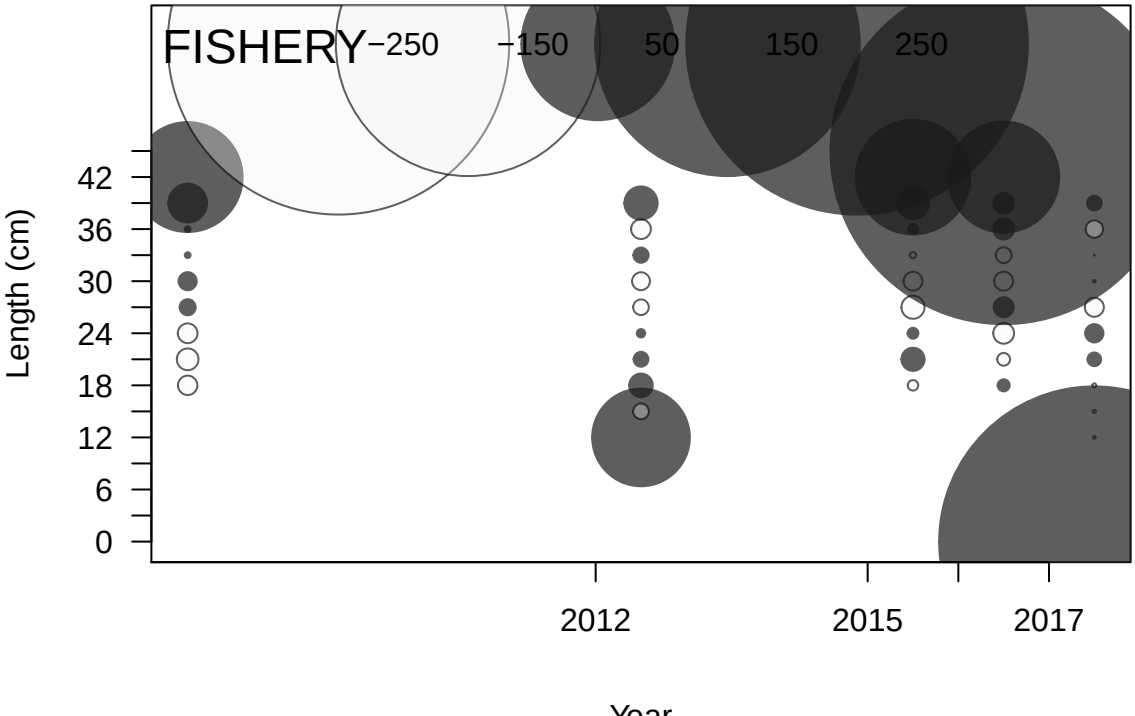

FISHERY
0.01
0.2
0.4
Length (cm)
42
36
30
24
18
12
6
0
2012
2015
2017
Year

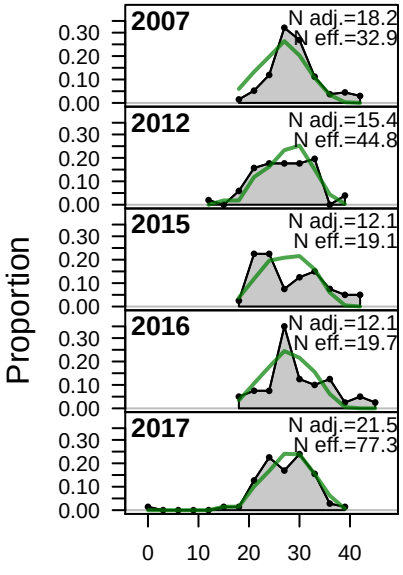

2007
N adj.=18.2
2012
N adj.=15.4
2015
N adj.=12.1
2016
N adj.=12.1
2017
N adj.=21.5
Proportion
0.00
0.10
0.20
0.30
0
10
20
30
40
Length (cm)

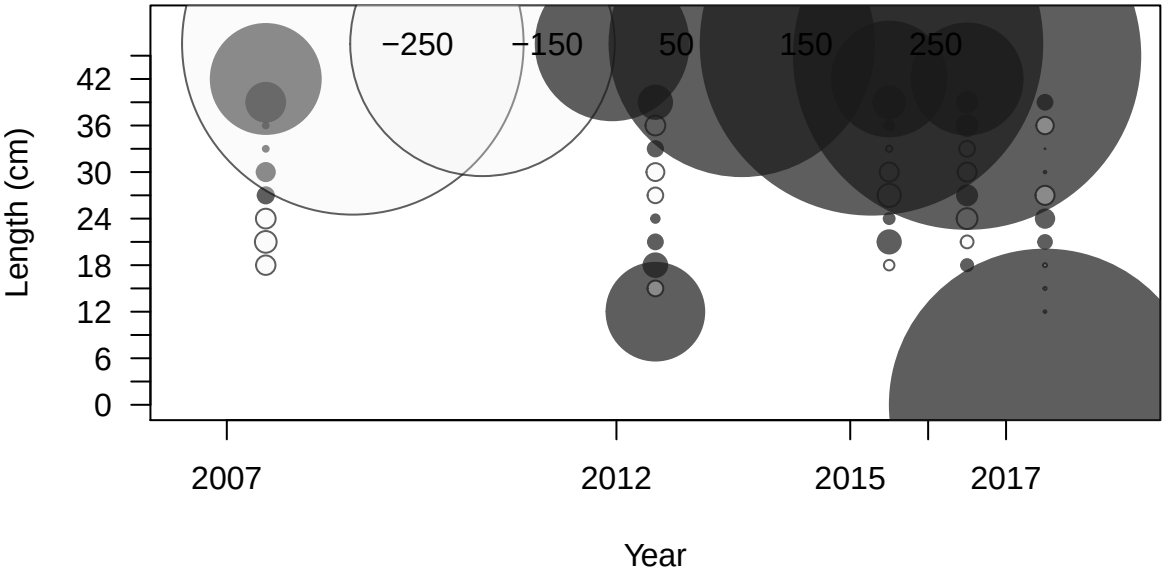

0.01
0.2
0.4
Length (cm)
0
6
12
18
24
30
36
42
2007
2012
2015
2017
Year

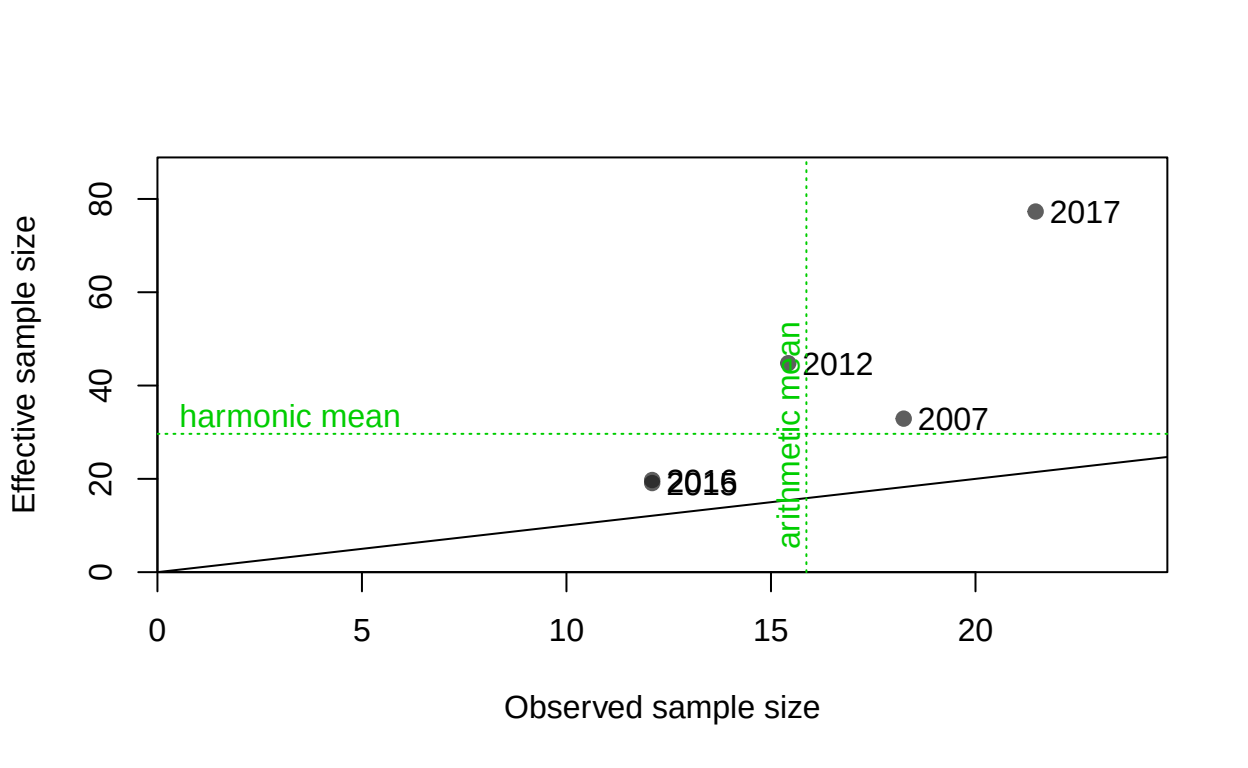

FISHERY (whole catch)
Mean length
32
30
28
26
24
2008
2010
2012
2014
2016
Year

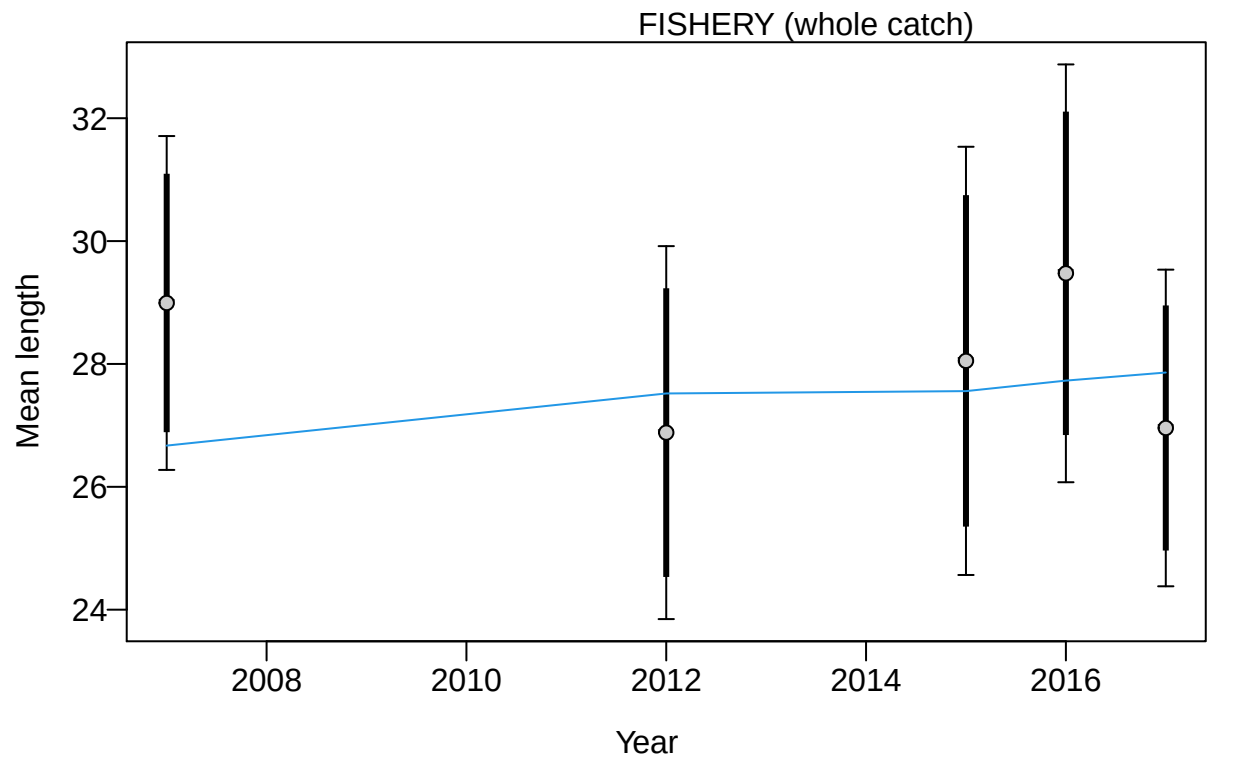

FISHERY
Sum of N adj.=79.3
Sum of N eff.=193.8
Proportion
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
Length (cm)

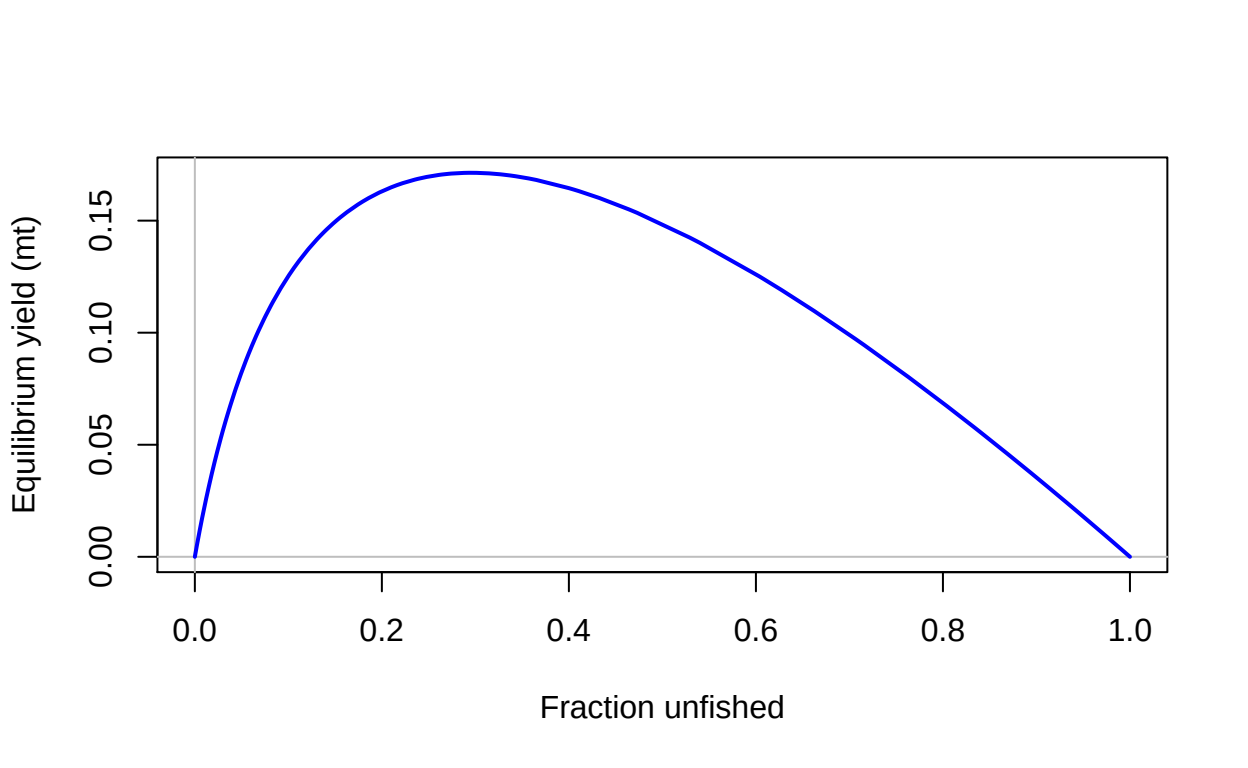

FISHERY
−250
−150
50
150
250
Length (cm)
42
36
30
24
18
12
6
0
2012
2015
2017
Year

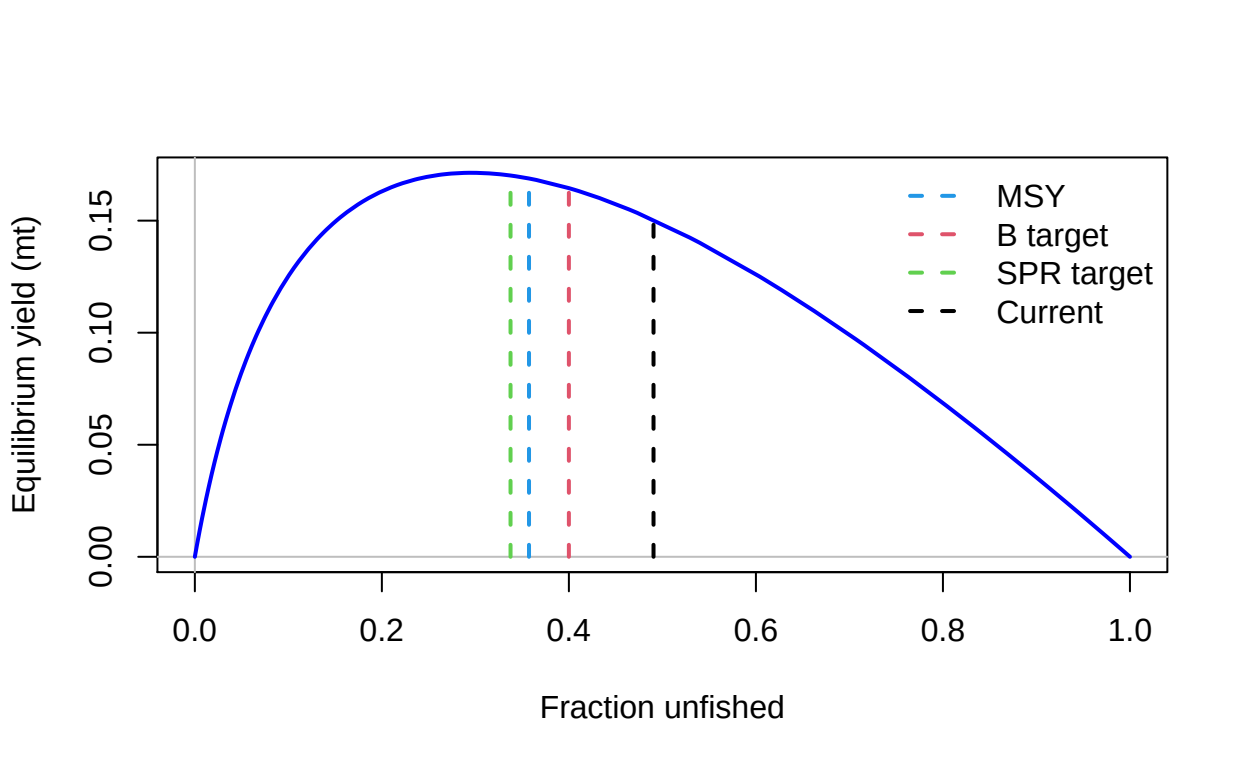

2007
N adj.=18.2
N eff.=32.9
2012
N adj.=15.4
N eff.=44.8
2015
N adj.=12.1
N eff.=19.1
2016
N adj.=12.1
N eff.=19.7
2017
N adj.=21.5
N eff.=77.3
Proportion
0.00
0.10
0.20
0.30
0
10
20
30
40
Length (cm)

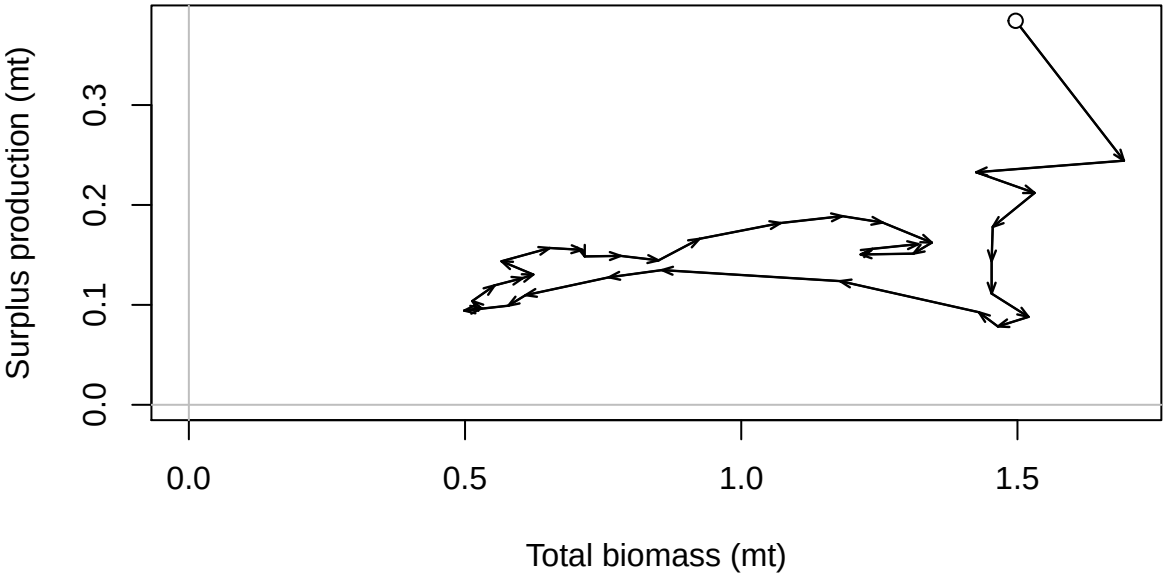

−250
−150
50
150
250
Length (cm)
0
6
12
18
24
30
36
42
2007
2012
2015
2017
Year

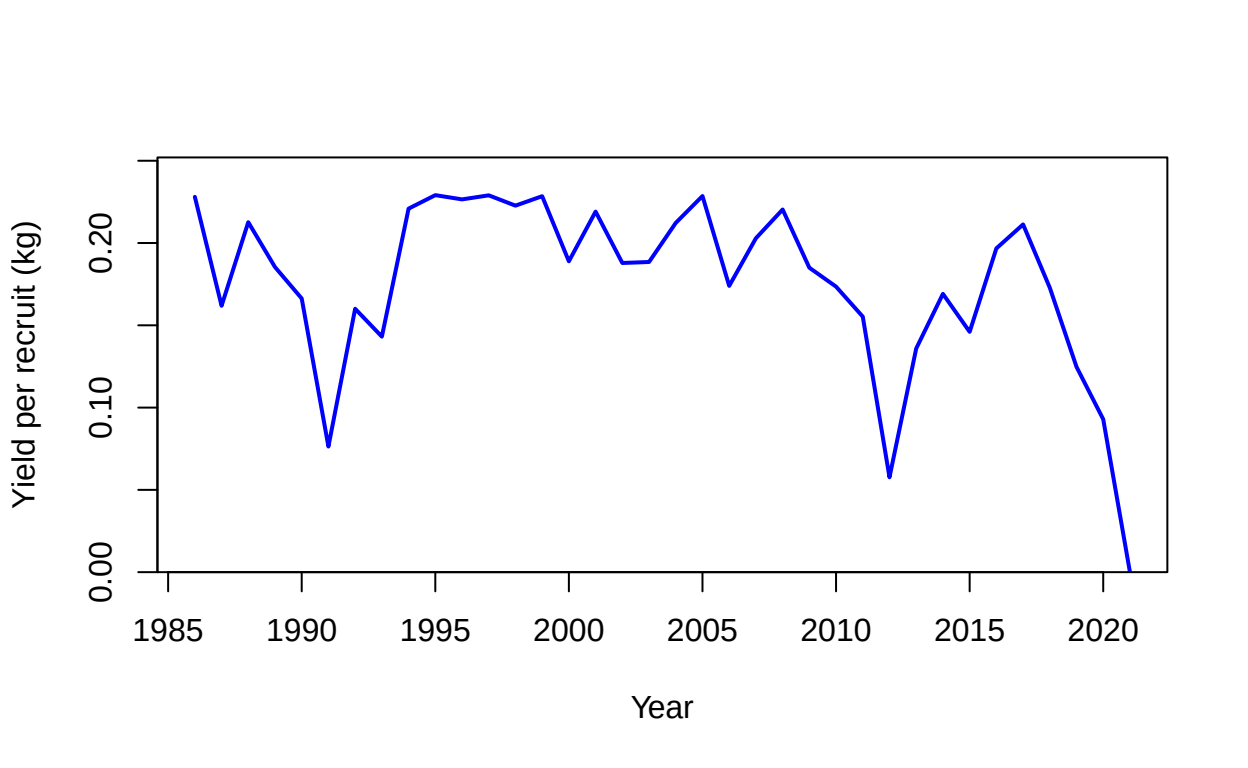

Effective sample size
0
20
40
60
80
0
5
10
15
20
Observed sample size
harmonic mean
arithmetic mean
2017
2012
2007
2016

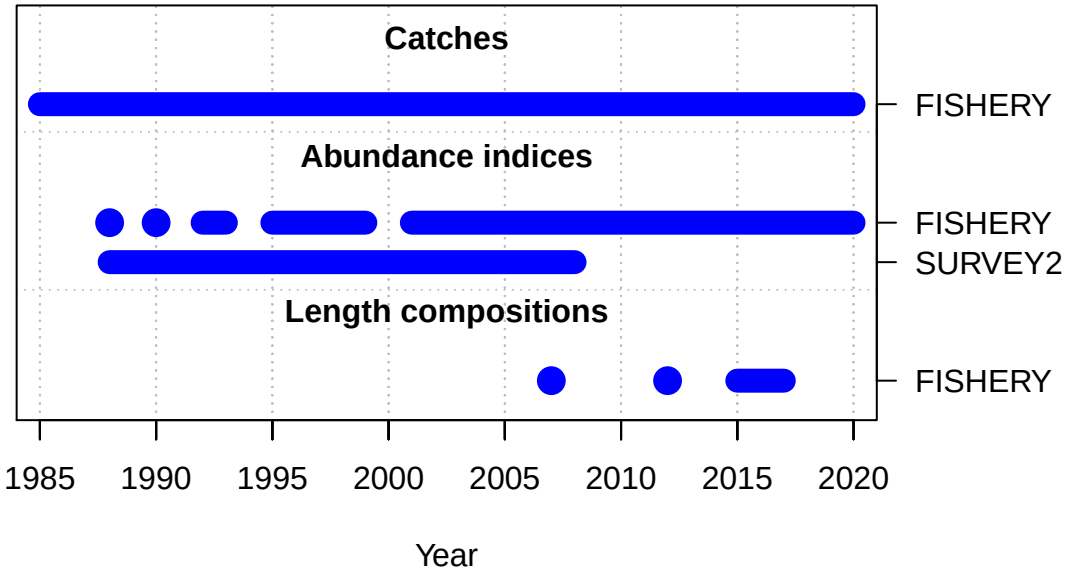

FISHERY (whole catch)
Mean length
32
30
28
26
24
2008
2010
2012
2014
2016
Year

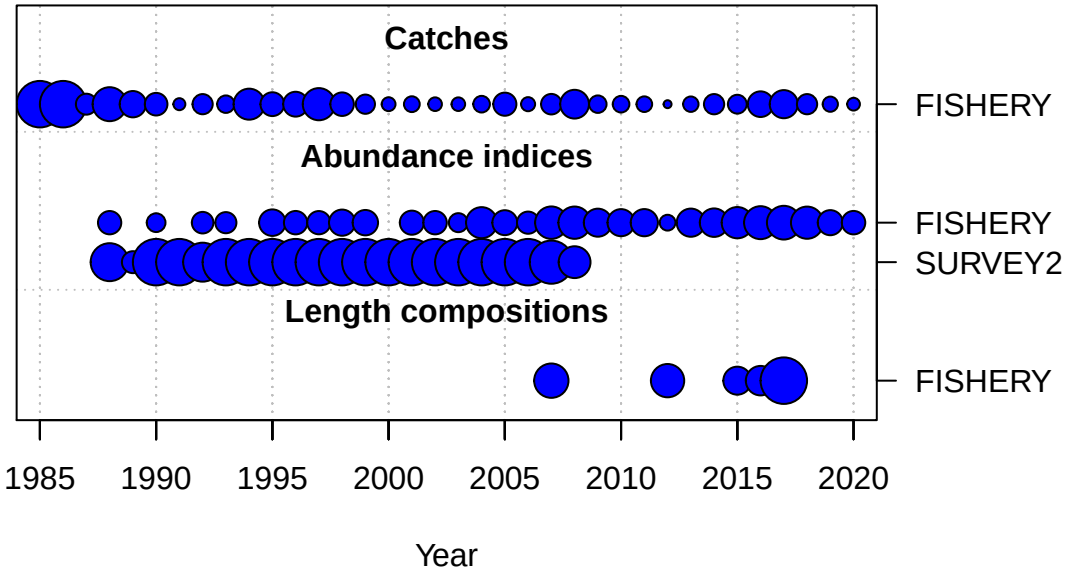

Equilibrium yield (mt)
0.00
0.05
0.10
0.15
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

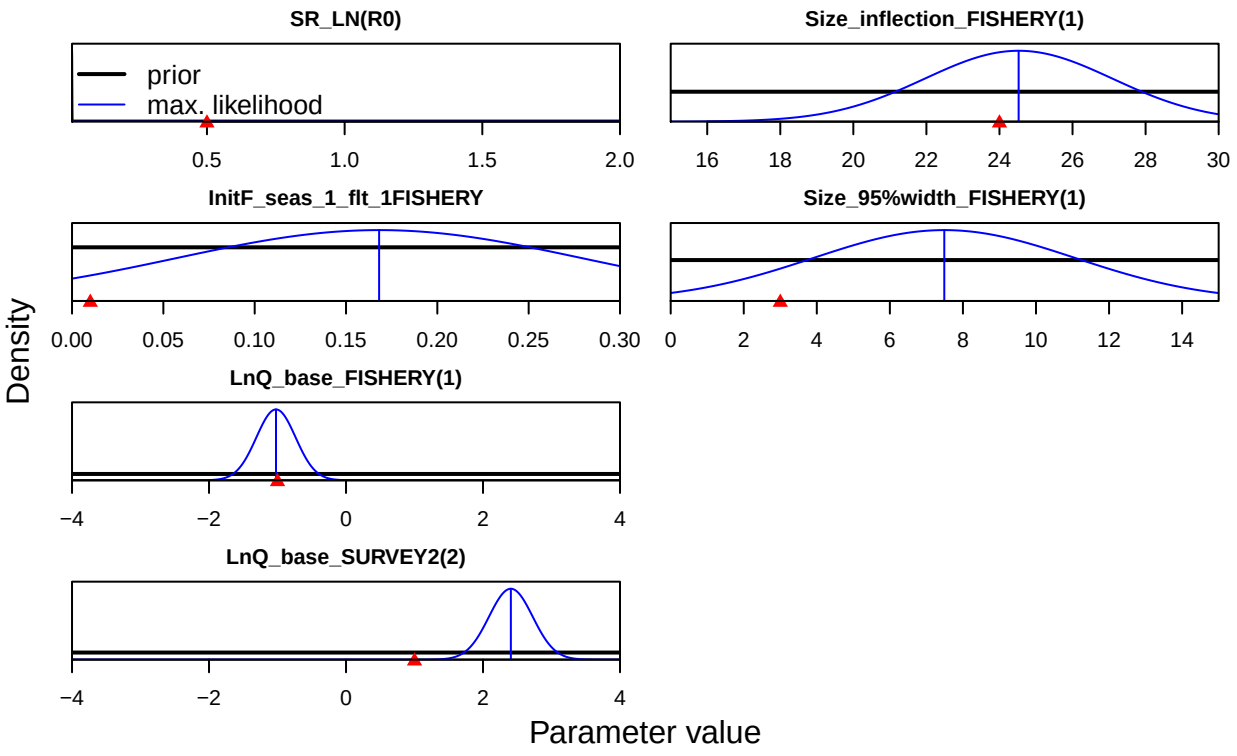

Equilibrium yield (mt)
0.00
0.05
0.10
0.15
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
B target
SPR target
Current


Surplus production (mt)
0.0
0.1
0.2
0.3
0.0
0.5
1.0
1.5
Total biomass (mt)


Yield per recruit (kg)
0.00
0.10
0.20
1985
1990
1995
2000
2005
2010
2015
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1985
1990
1995
2000
2005
2010
2015
2020
Year


Catches
FISHERY
Abundance indices
FISHERY
SURVEY2
Length compositions
FISHERY
1985
1990
1995
2000
2005
2010
2015
2020
Year


SR_LN(R0)
prior
max. likelihood
0.5
1.0
1.5
2.0
Size_inflection_FISHERY(1)
16
18
20
22
24
26
28
30
InitF_seas_1_flt_1FISHERY
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Size_95%width_FISHERY(1)
0
2
4
6
8
10
12
14
LnQ_base_FISHERY(1)
−4
−2
0
2
4
LnQ_base_SURVEY2(2)
−4
−2
0
2
4
Density
Parameter value