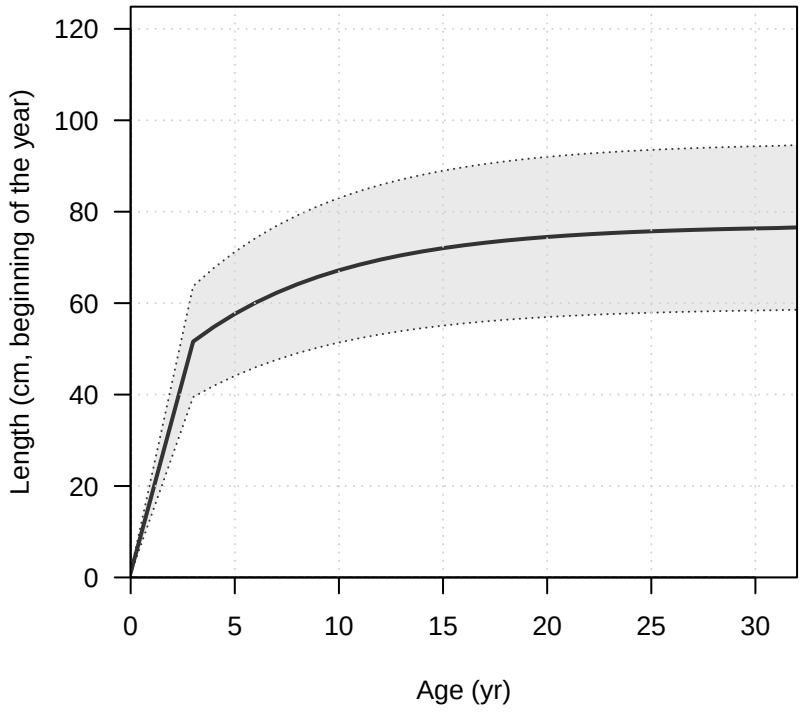
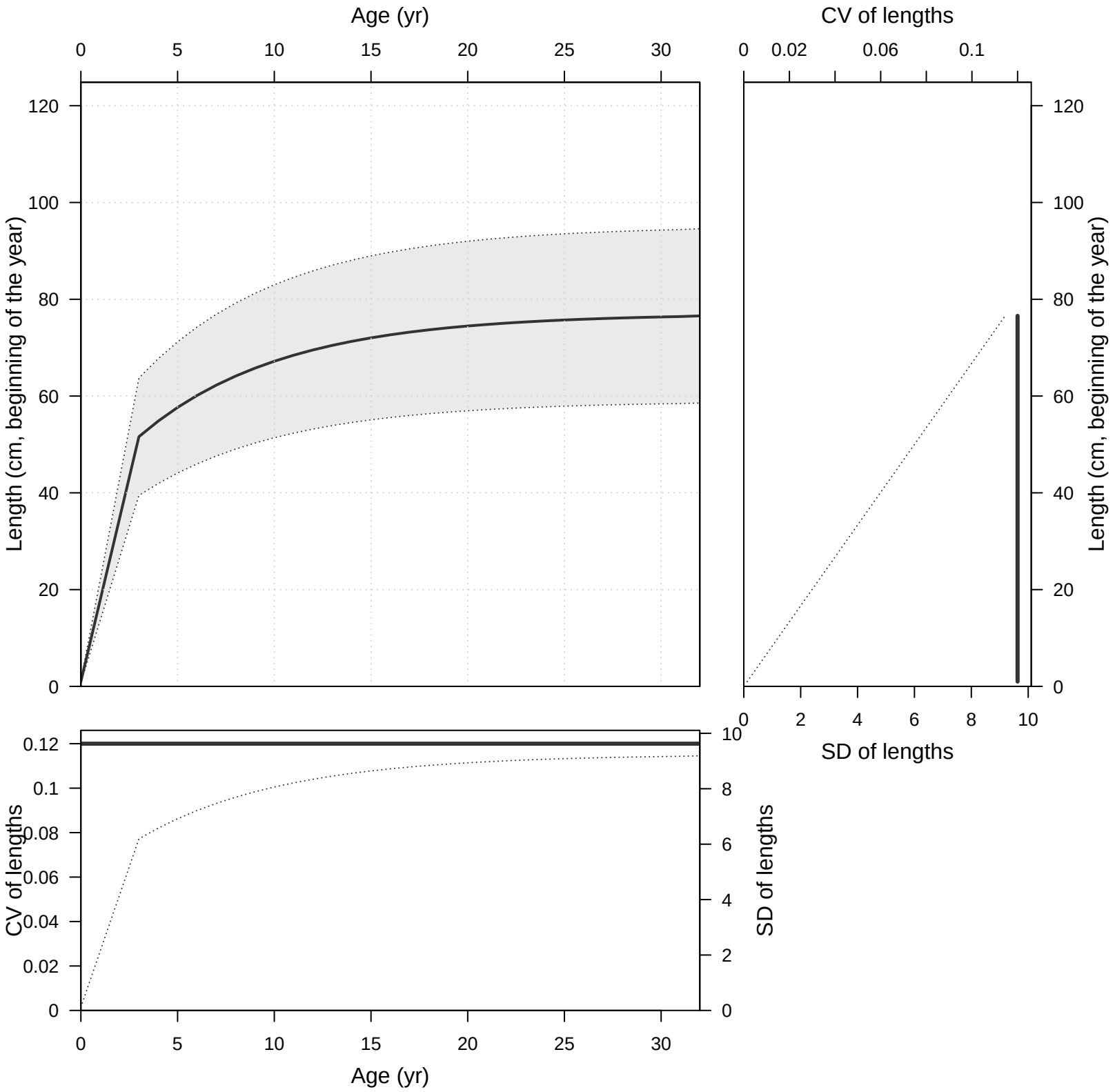
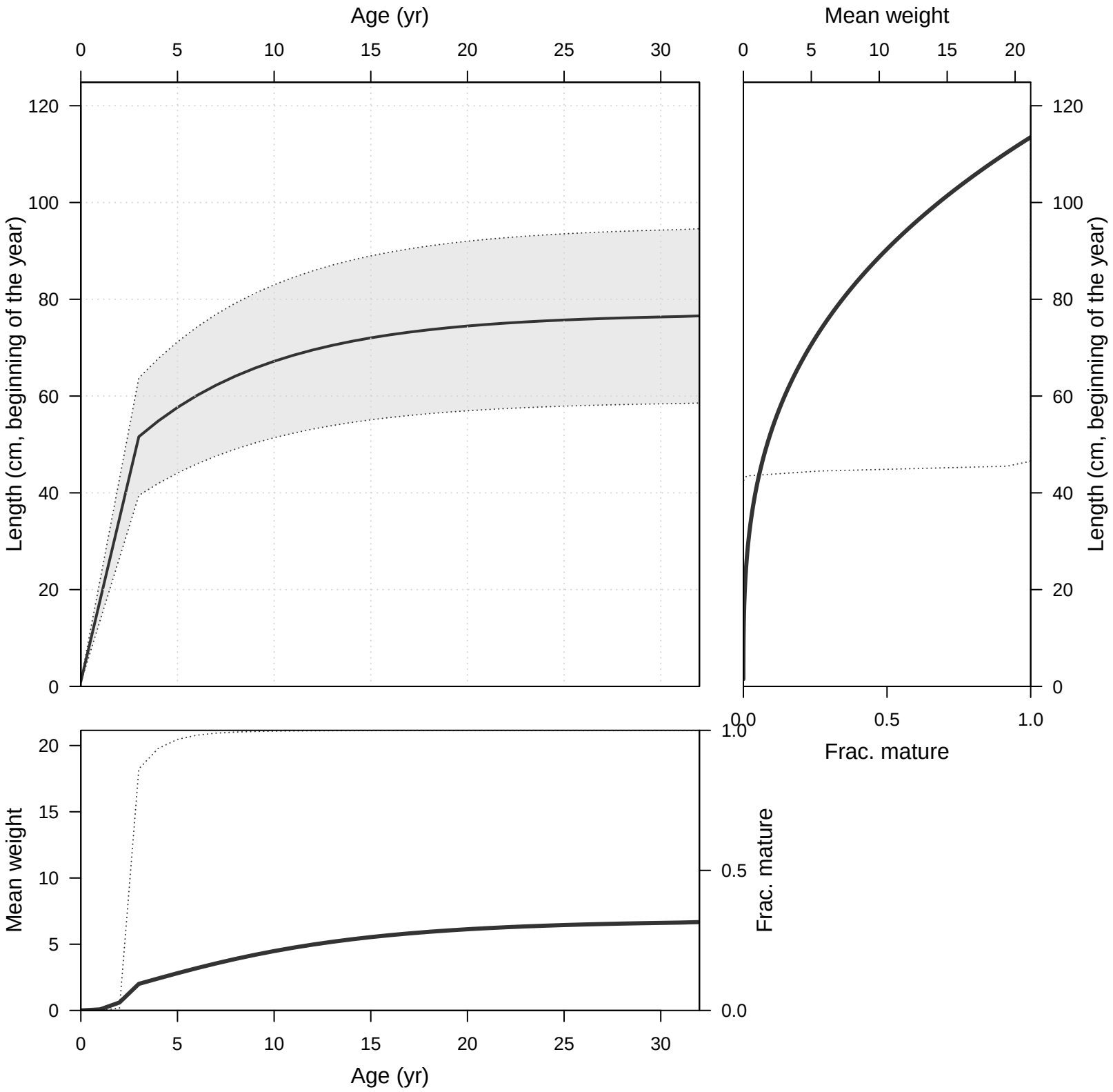
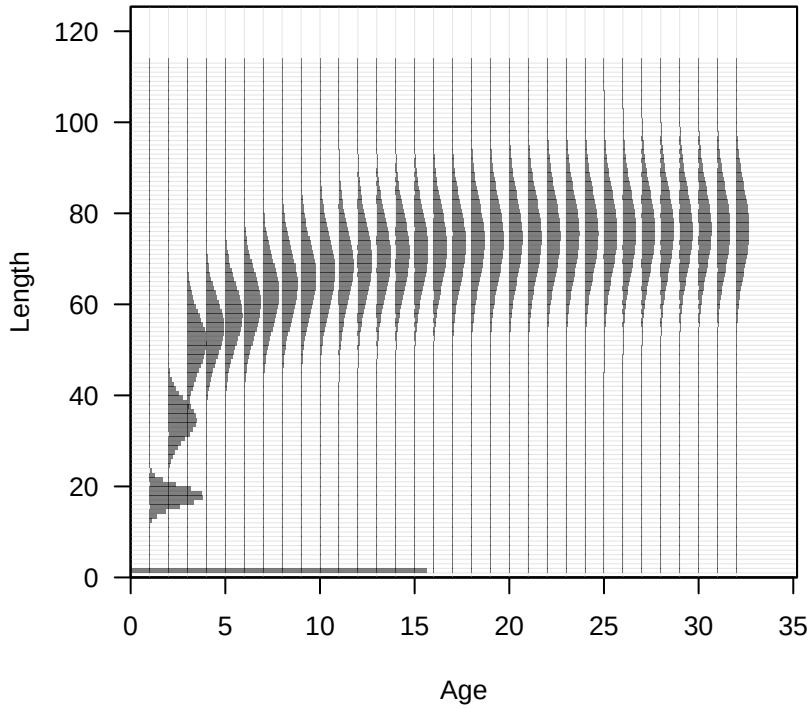
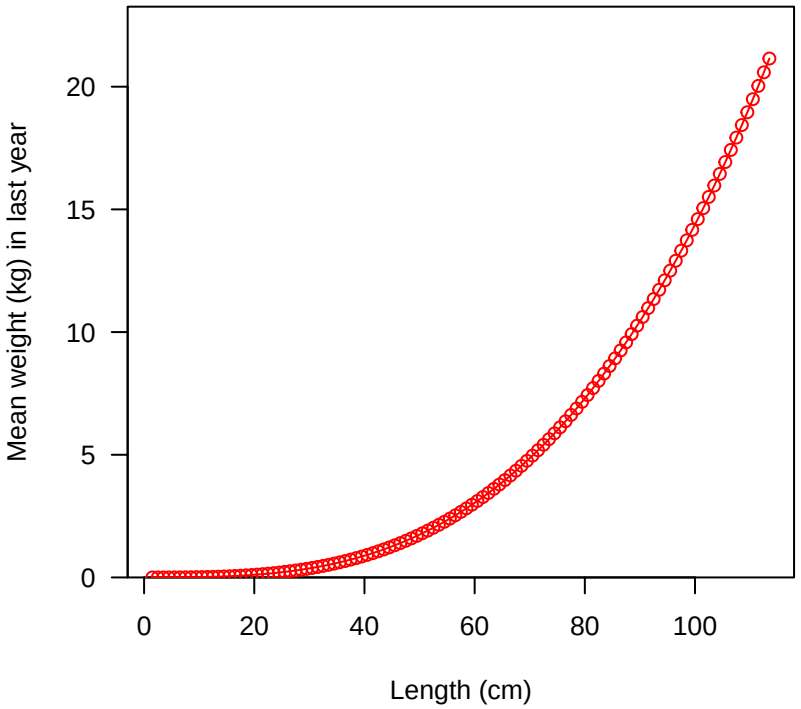
Plots created using the 'r4ss' package in R
Stock Synthesis version: 3.30.14.0
StartTime: Fri Mar 08 08:58:42 2024
Data_File: data.ss
Control_File: control.ss

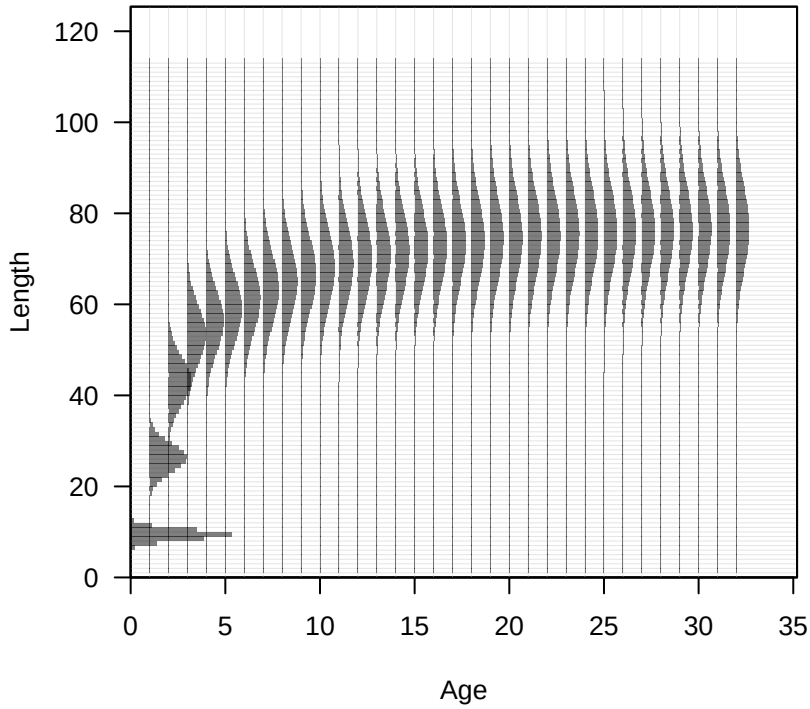


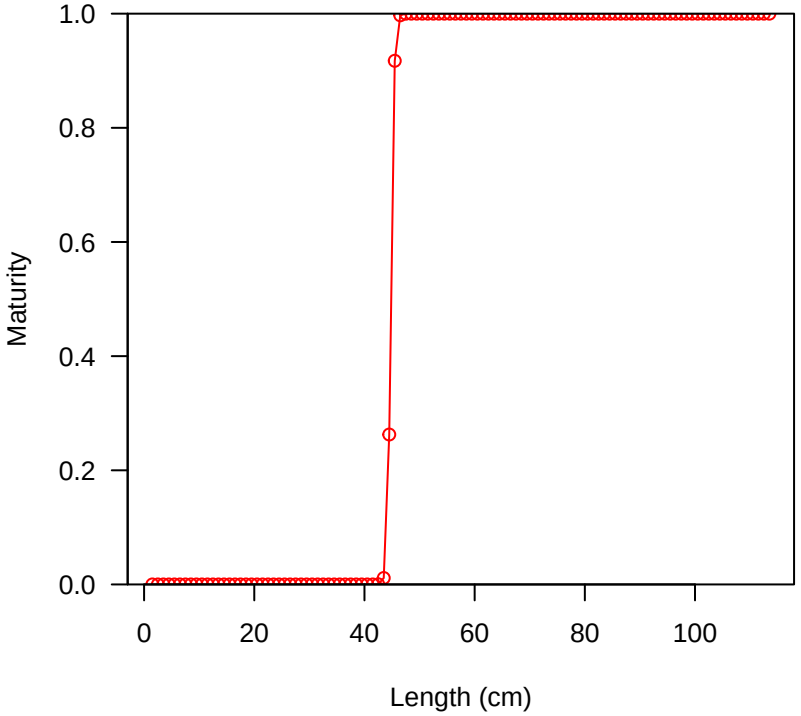

Age (yr)
0
5
10
15
20
25
30
Length (cm, beginning of the year)
0
20
40
60
80
100
120
CV of lengths
0
0.02
0.06
0.1
SD of lengths
0
2
4
6
8
10
CV of lengths
0
0.02
0.04
0.06
0.08
0.1
0.12
SD of lengths
0
2
4
6
8
10
Age (yr)

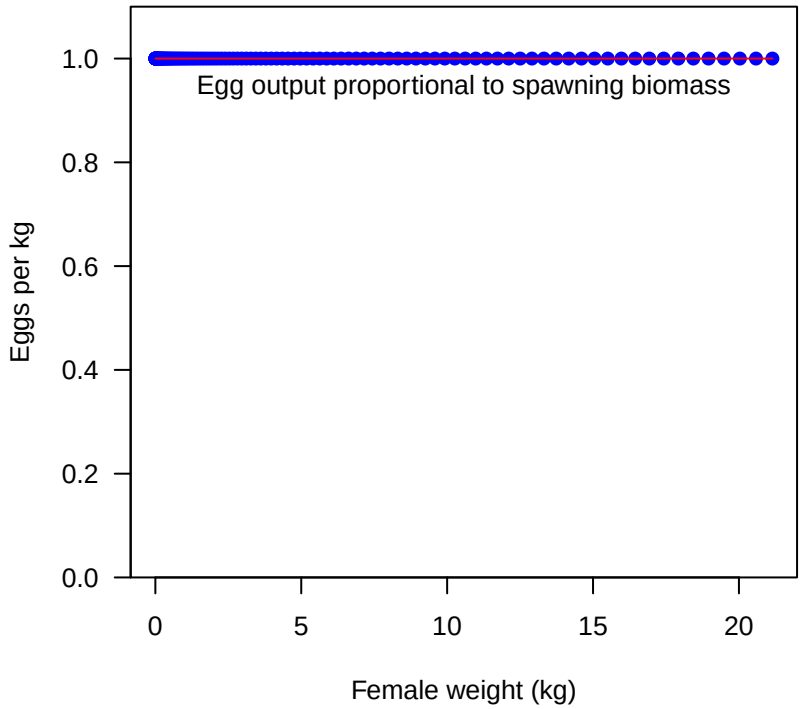

Age (yr)
0
5
10
15
20
25
30
Length (cm, beginning of the year)
0
20
40
60
80
100
120
Mean weight
0
5
10
15
20
Length (cm, beginning of the year)
0
20
40
60
80
100
120
0.0
0.5
1.0
Frac. mature
Mean weight
0
5
10
15
20
Frac. mature
0.0
0.5
1.0
Age (yr)
0
5
10
15
20
25
30

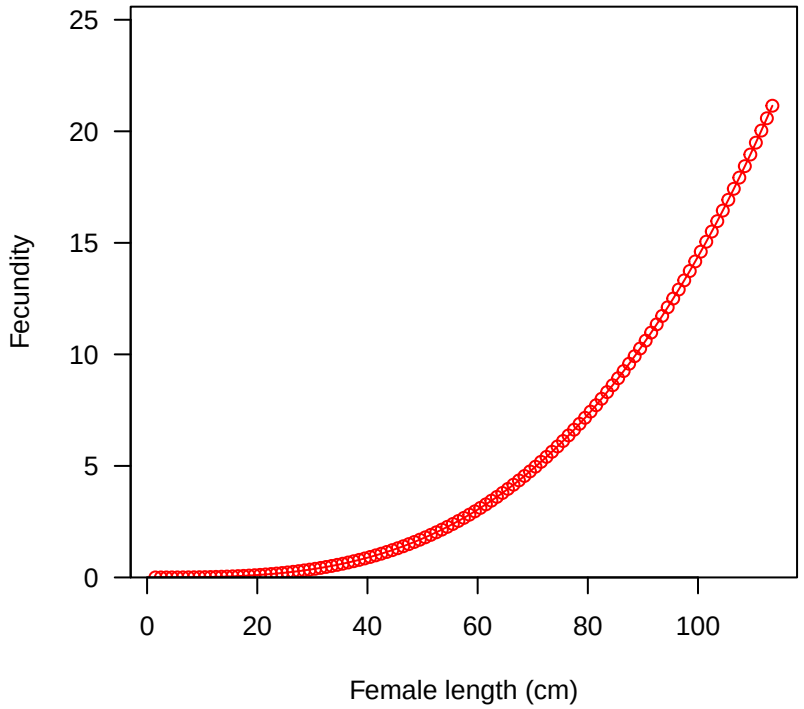

Length
Age
0
20
40
60
80
100
120
0
5
10
15
20
25
30
35

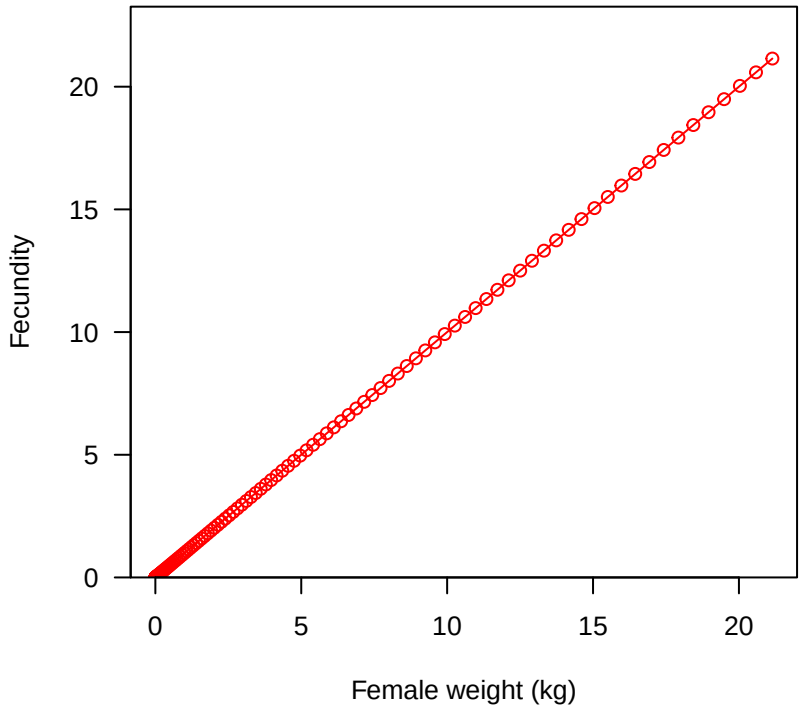

Mean weight (kg) in last year
Length (cm)
0
5
10
15
20
0
20
40
60
80
100

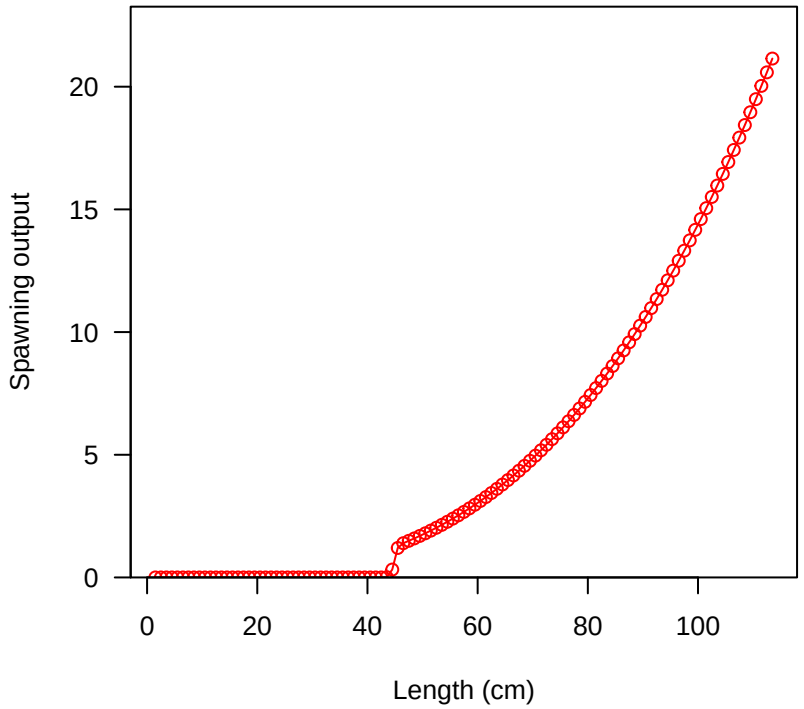

Length
Age
0
20
40
60
80
100
120
0
5
10
15
20
25
30
35

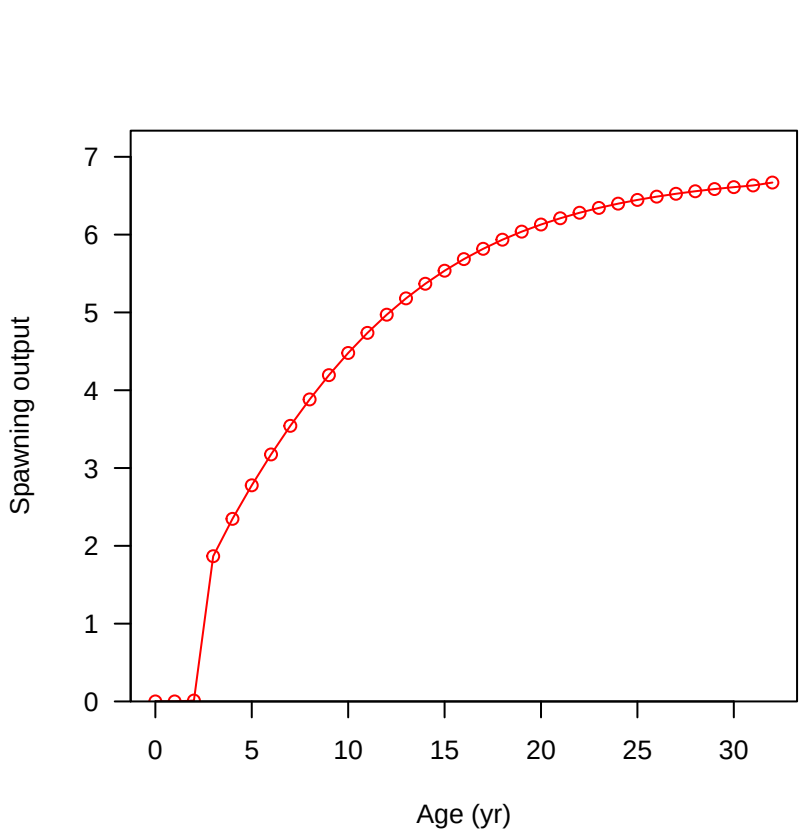

Maturity
Length (cm)
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100

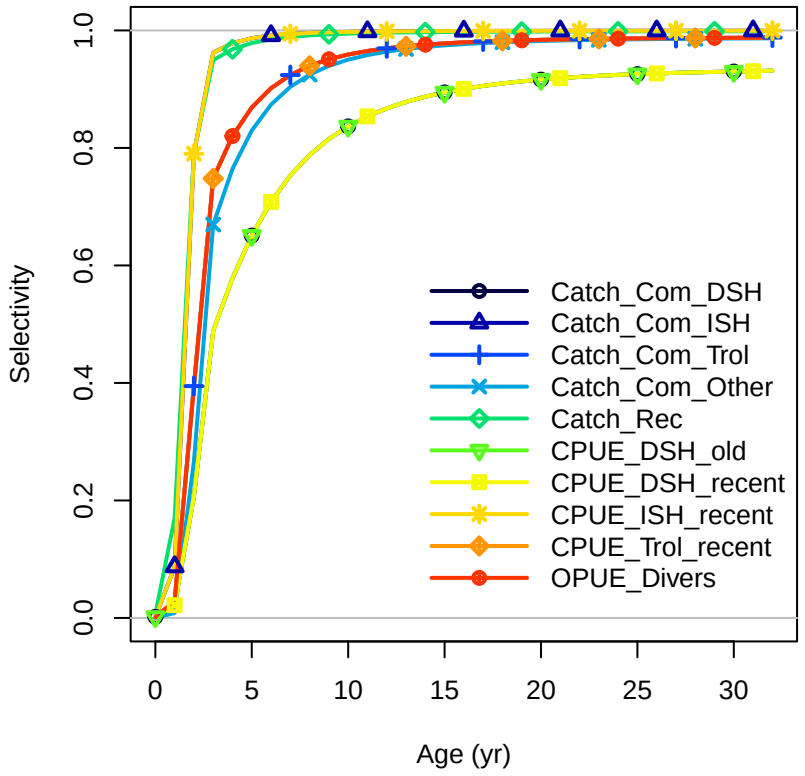

Egg output proportional to spawning biomass
Eggs per kg
Female weight (kg)
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20

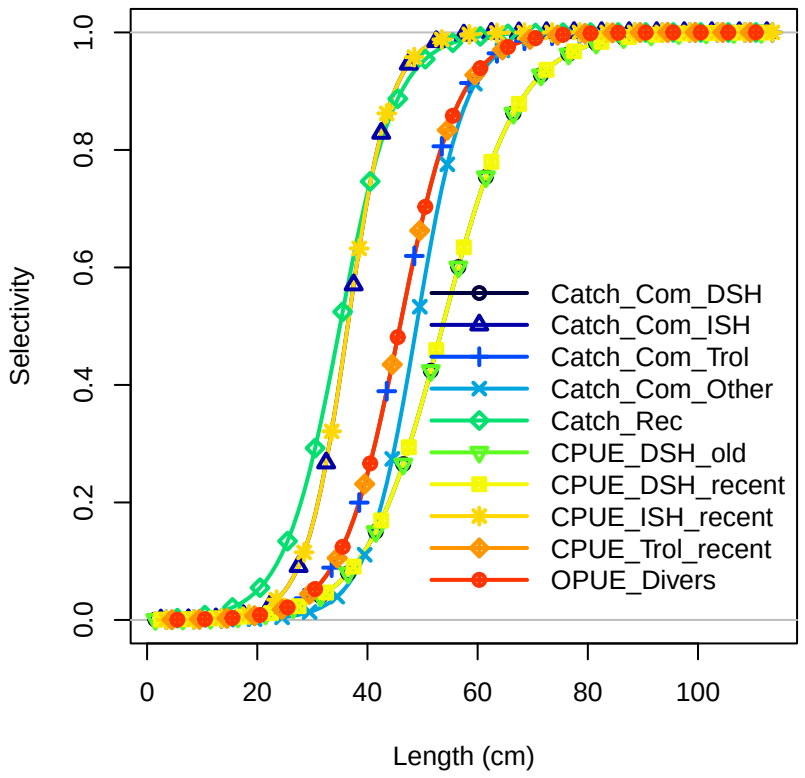

Fecundity
Female length (cm)
0
5
10
15
20
25
0
20
40
60
80
100

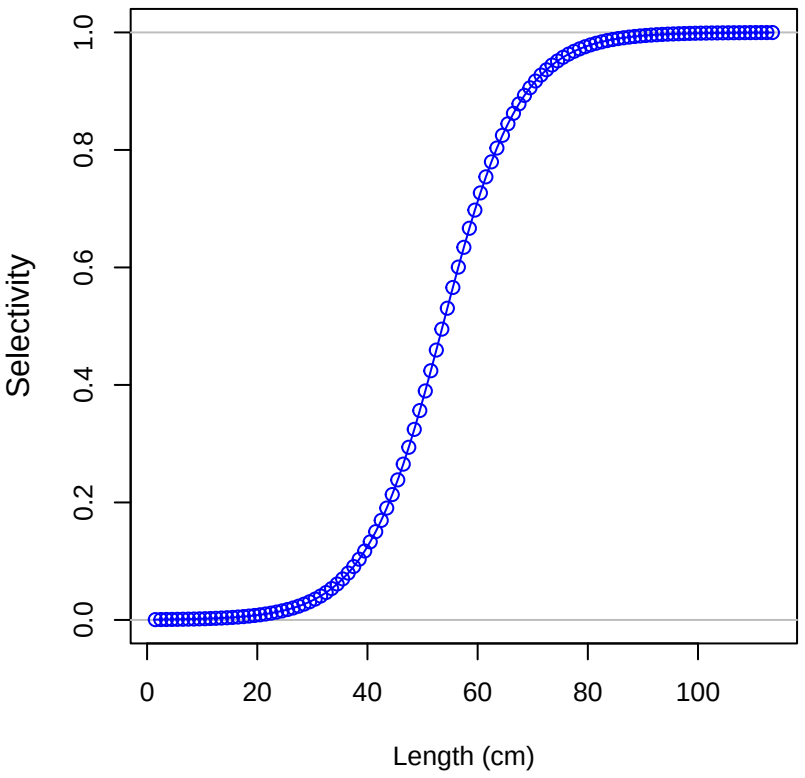

Fecundity
Female weight (kg)
0
5
10
15
20
0
5
10
15
20

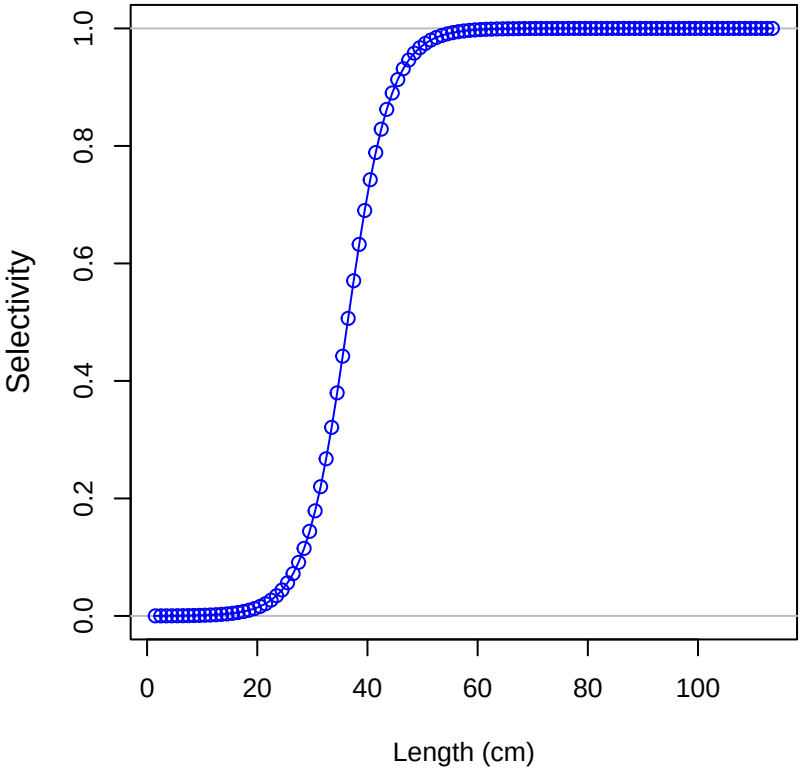

Spawning output
Length (cm)
0
5
10
15
20
0
20
40
60
80
100

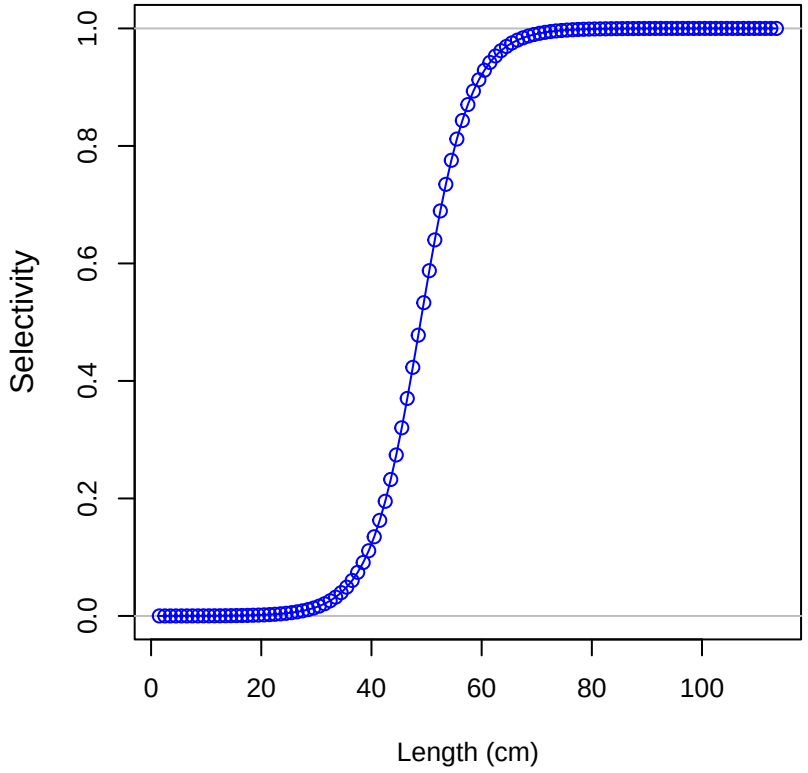

Spawning output
0
1
2
3
4
5
6
7
0
5
10
15
20
25
30
Age (yr)

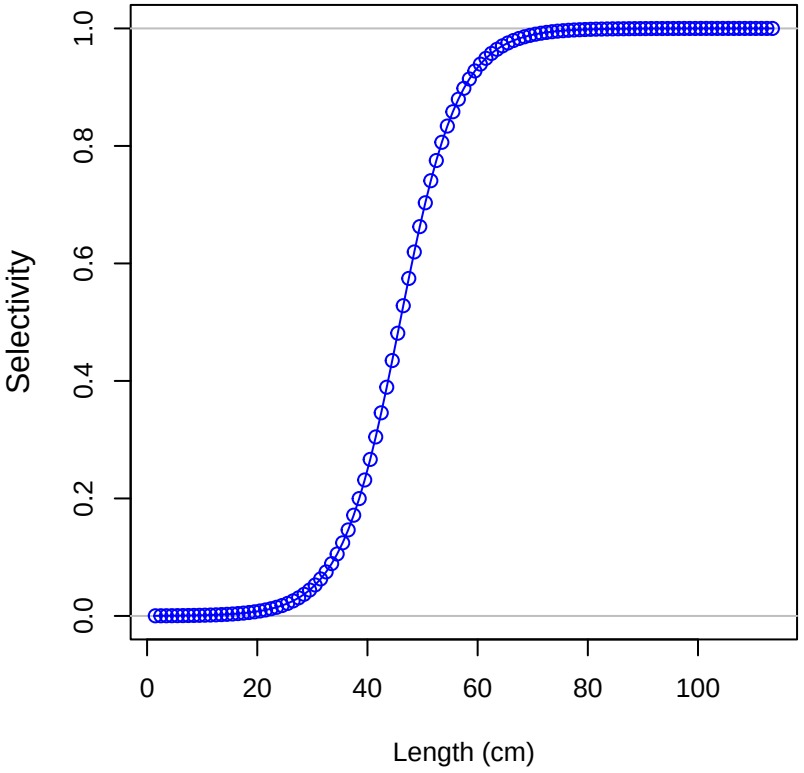

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
Age (yr)
Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
CPUE_DSH_old
CPUE_DSH_recent
CPUE_ISH_recent
CPUE_Trol_recent
OPUE_Divers

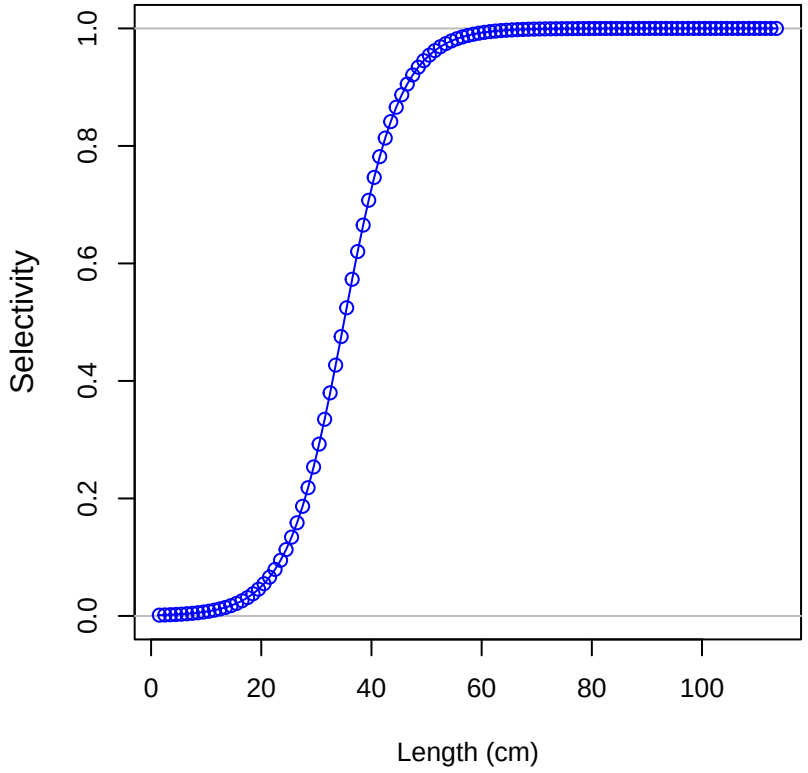

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)
Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
CPUE_DSH_old
CPUE_DSH_recent
CPUE_ISH_recent
CPUE_Trol_recent
OPUE_Divers

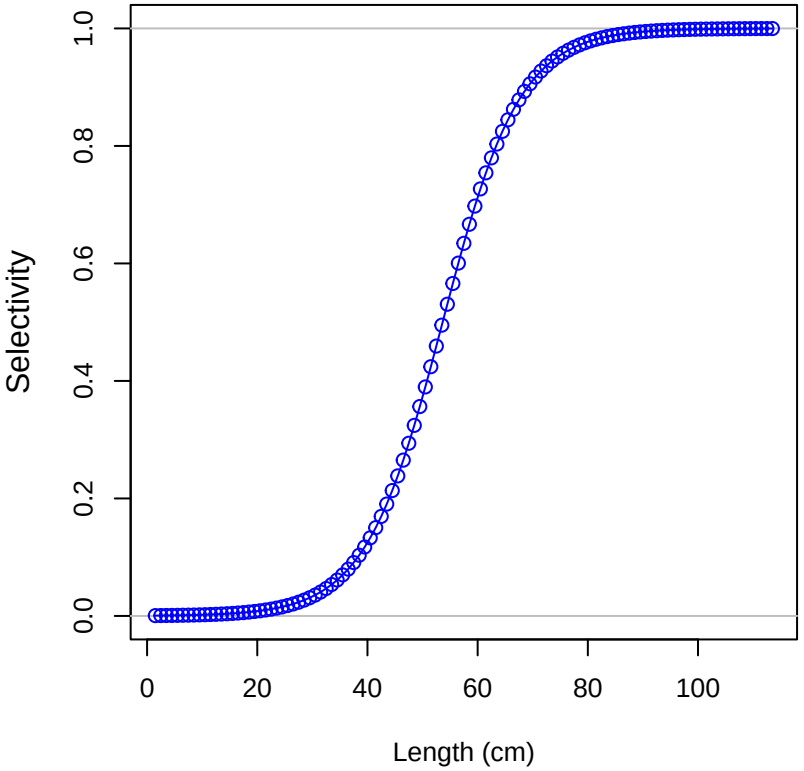

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

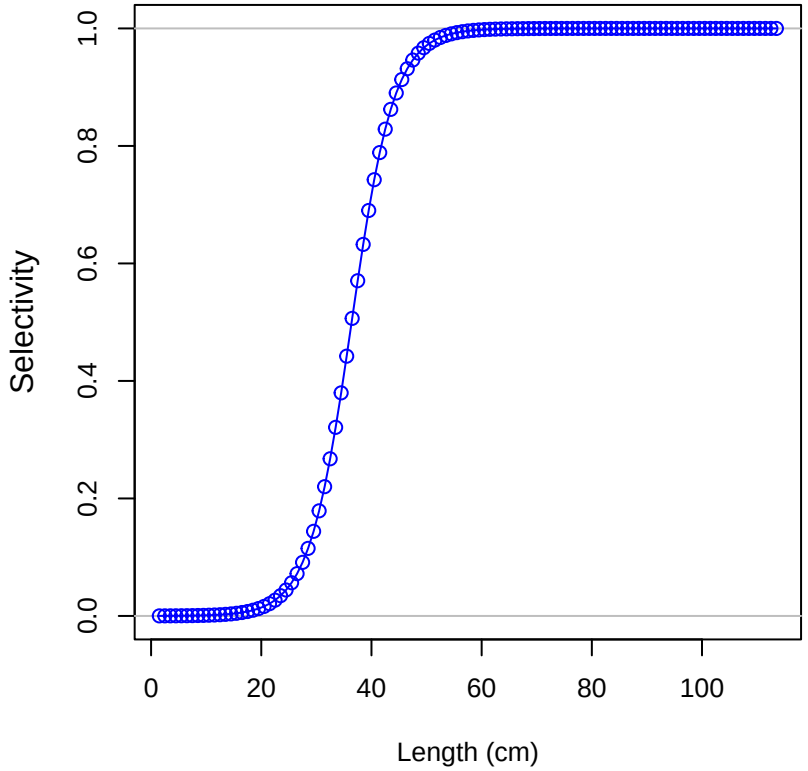

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

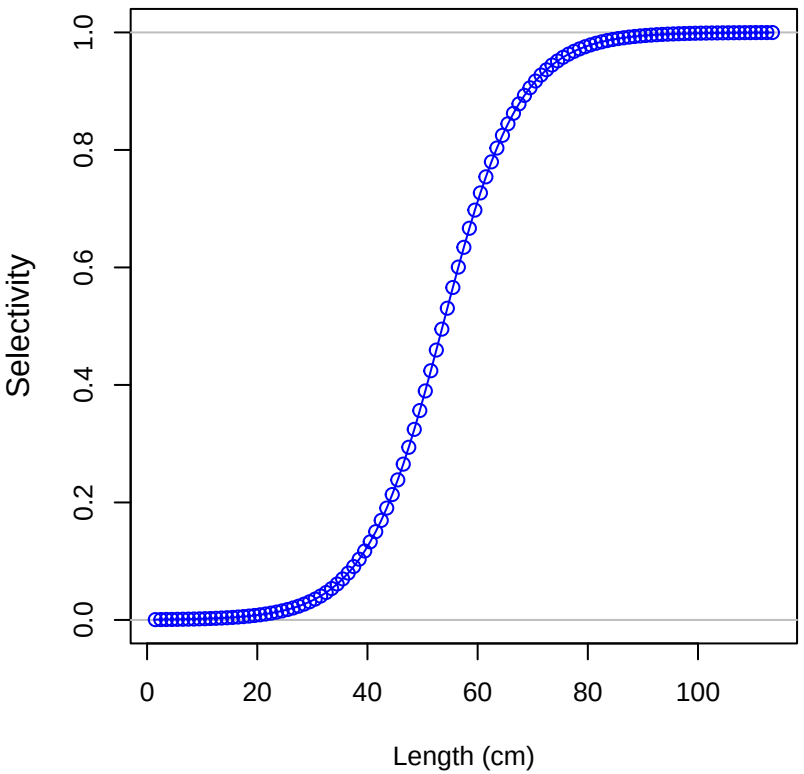

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

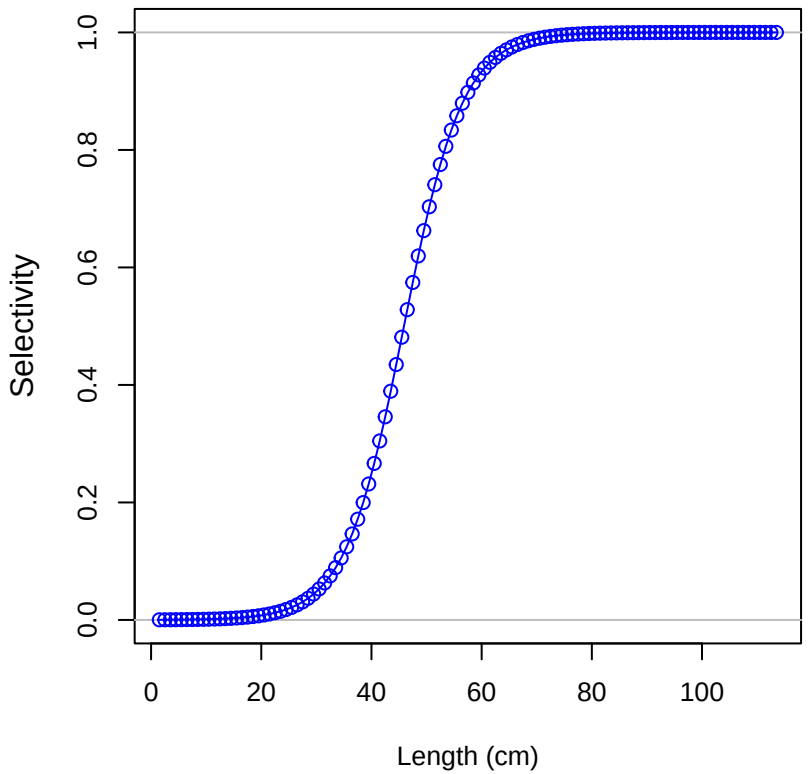

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

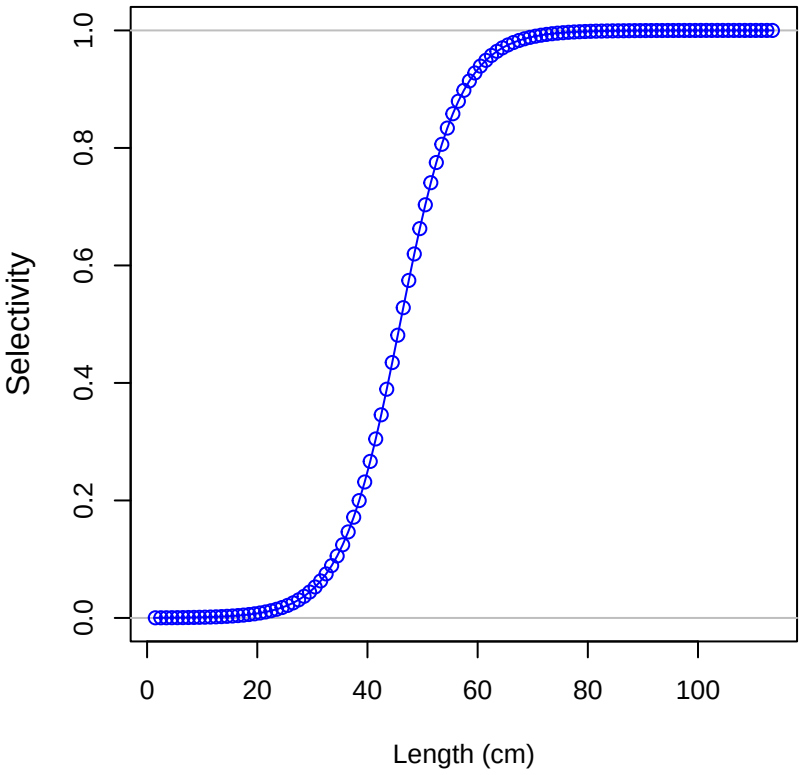

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

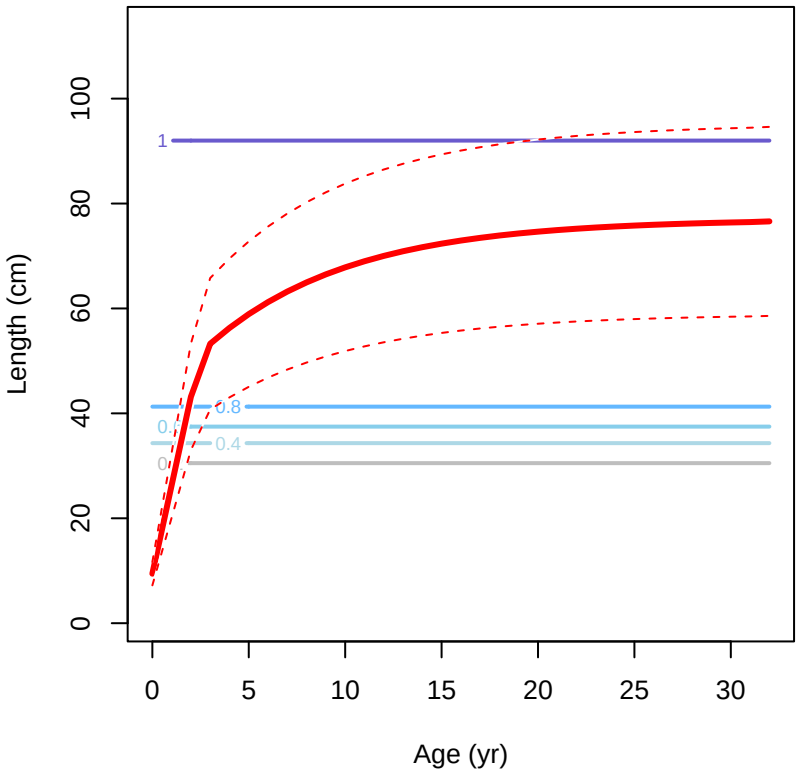

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

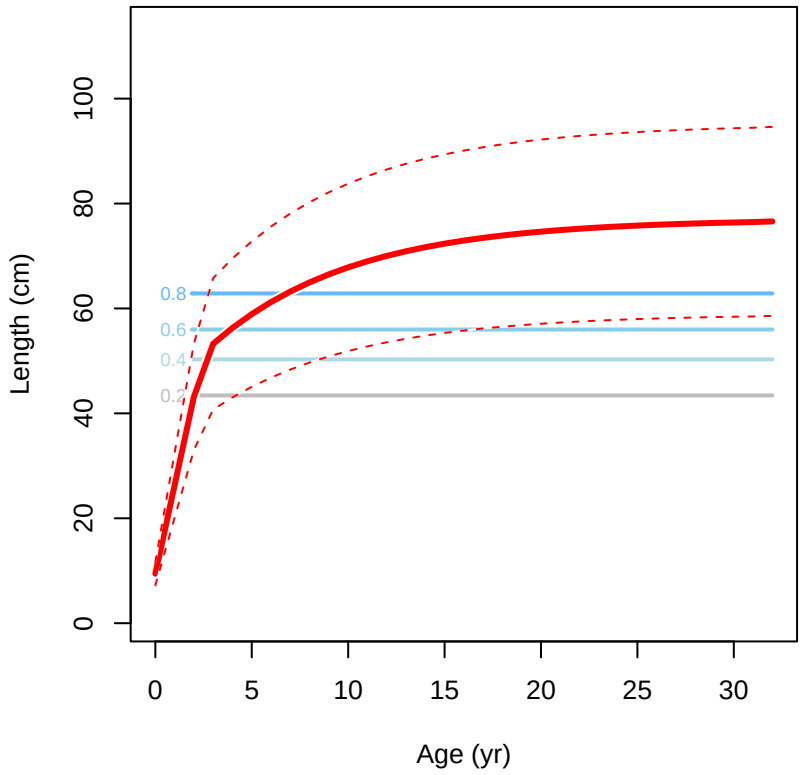

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

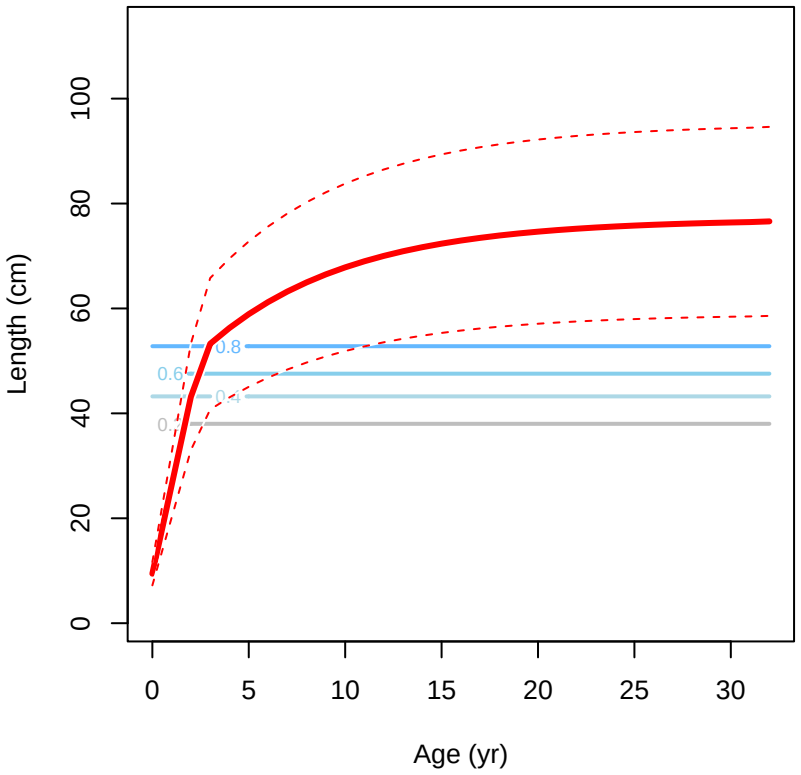

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

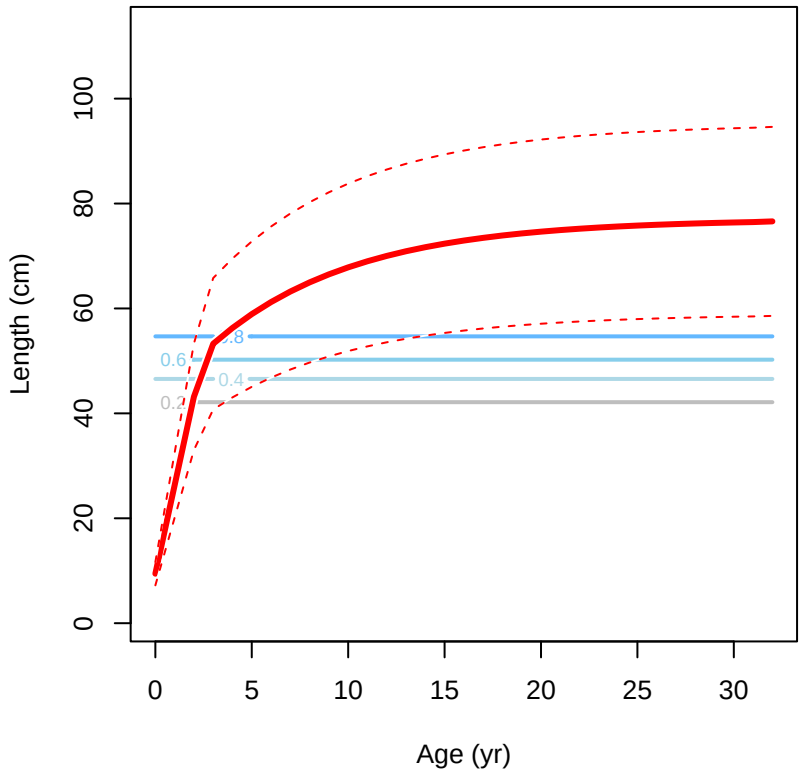

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

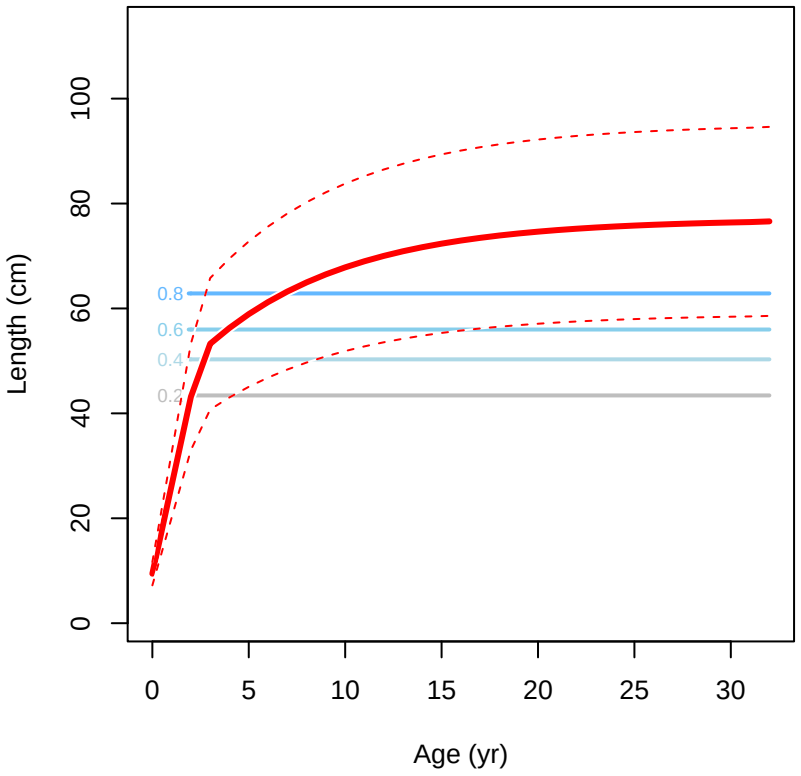

Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
Length (cm)

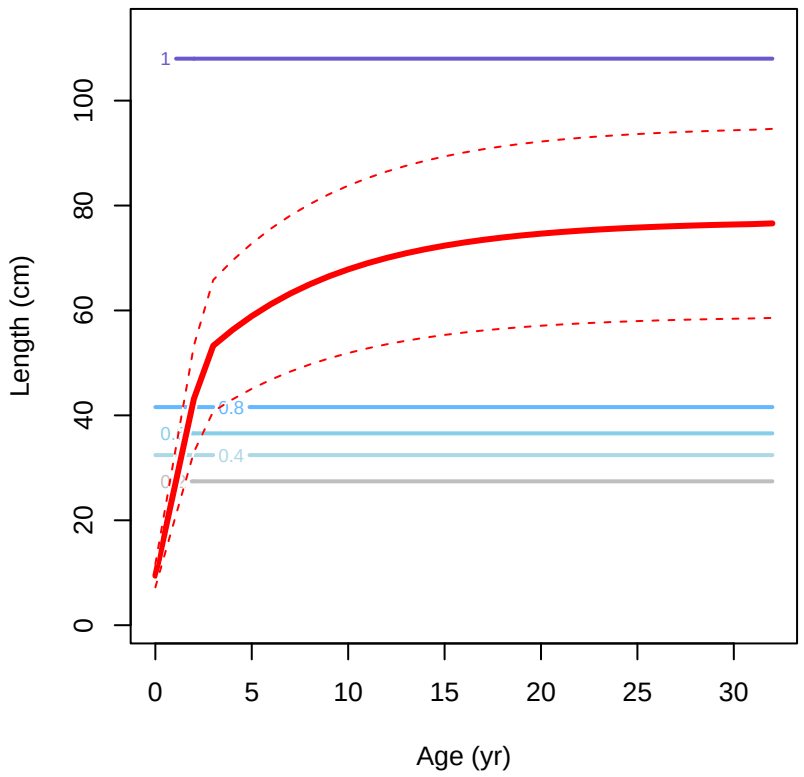

Length (cm)
0
20
40
60
80
100
1
0.8
0.4
0
0
5
10
15
20
25
30
Age (yr)

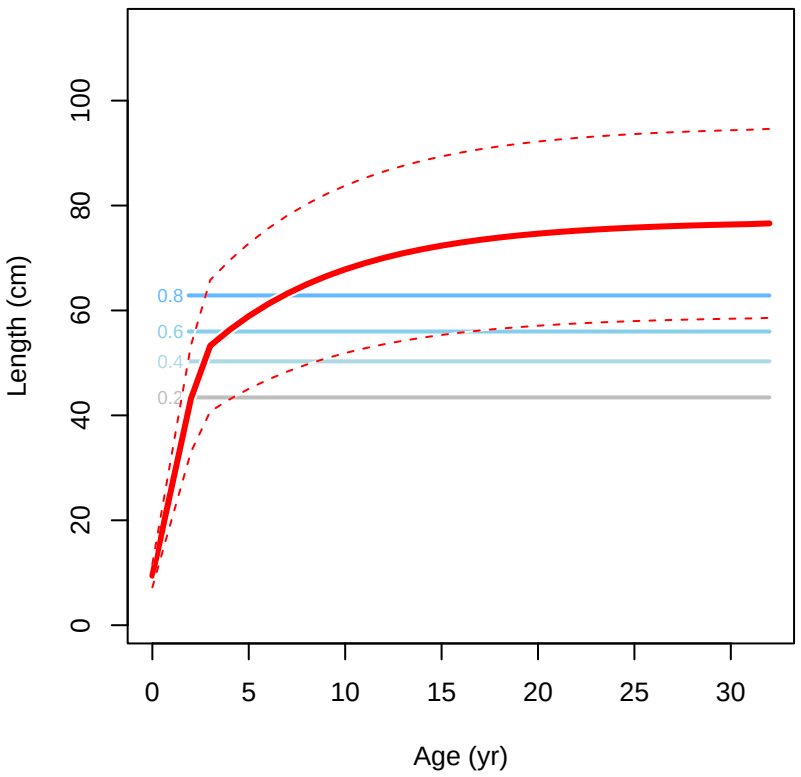

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
Age (yr)

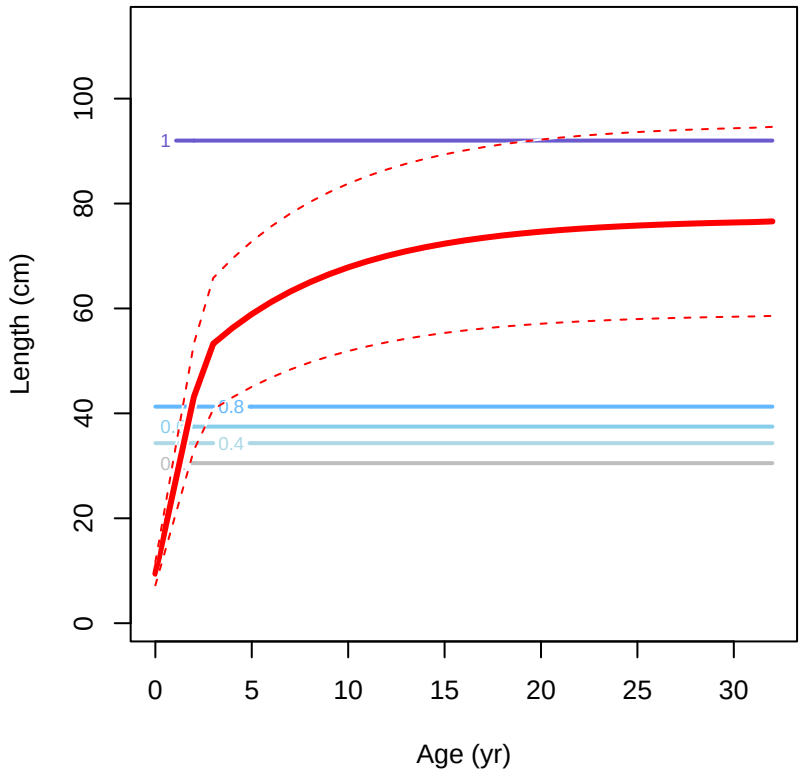

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0
0
5
10
15
20
25
30
Age (yr)

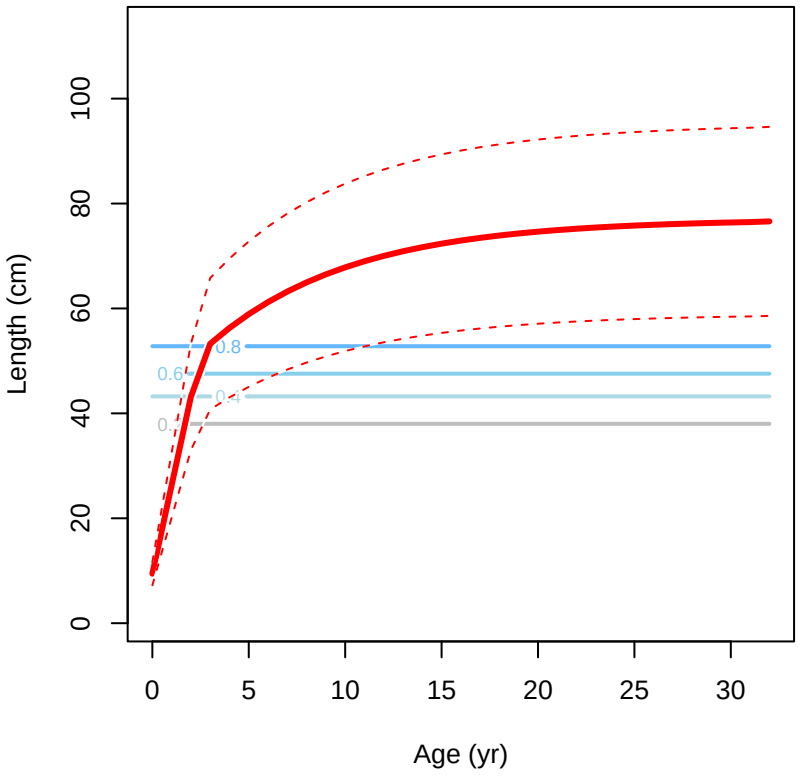

Length (cm)
0
20
40
60
80
100
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

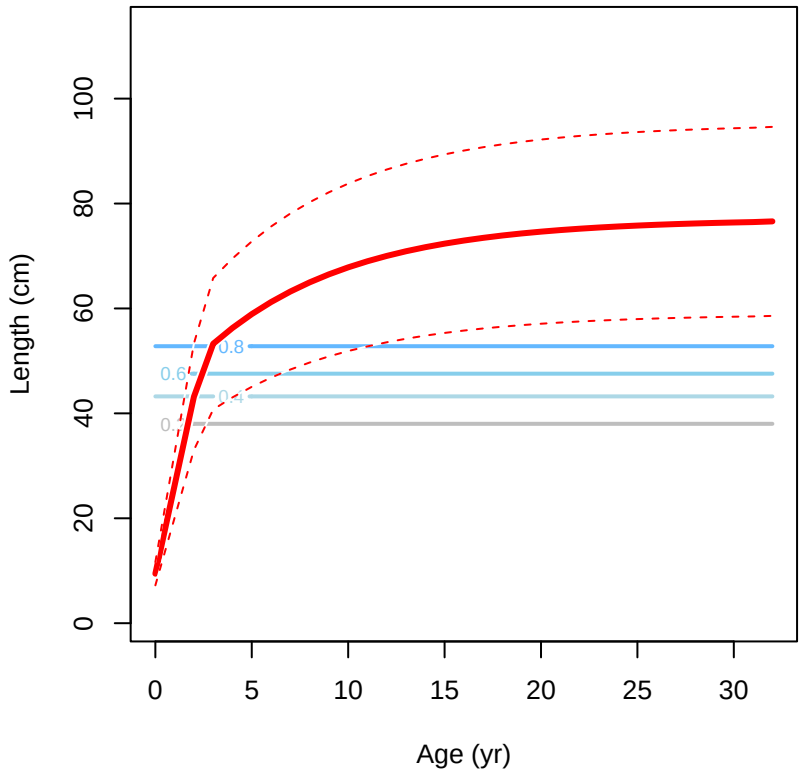

Length (cm)
0
20
40
60
80
100
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

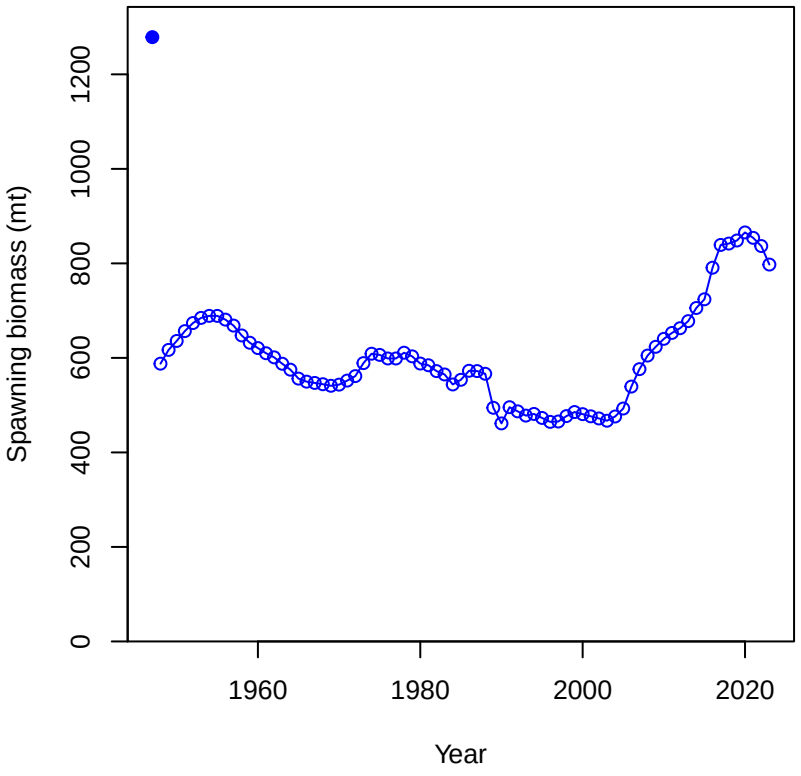

Length (cm)
0
20
40
60
80
100
0
5
10
15
20
25
30
Age (yr)
1
0.8
0.4

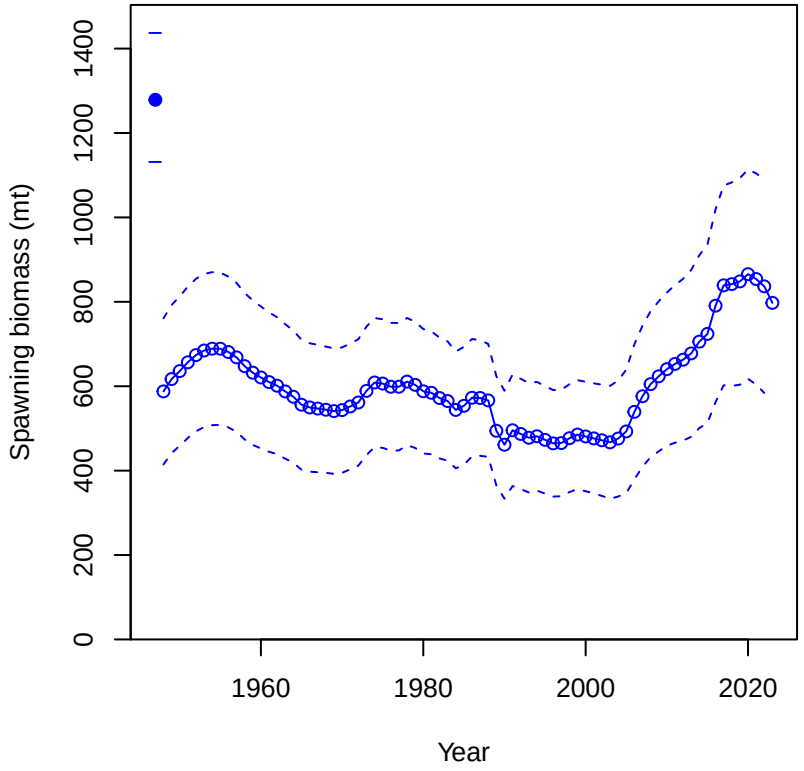

Length (cm)
0
20
40
60
80
100
0
5
10
15
20
25
30
Age (yr)
0.8
0.6
0.4
0.2

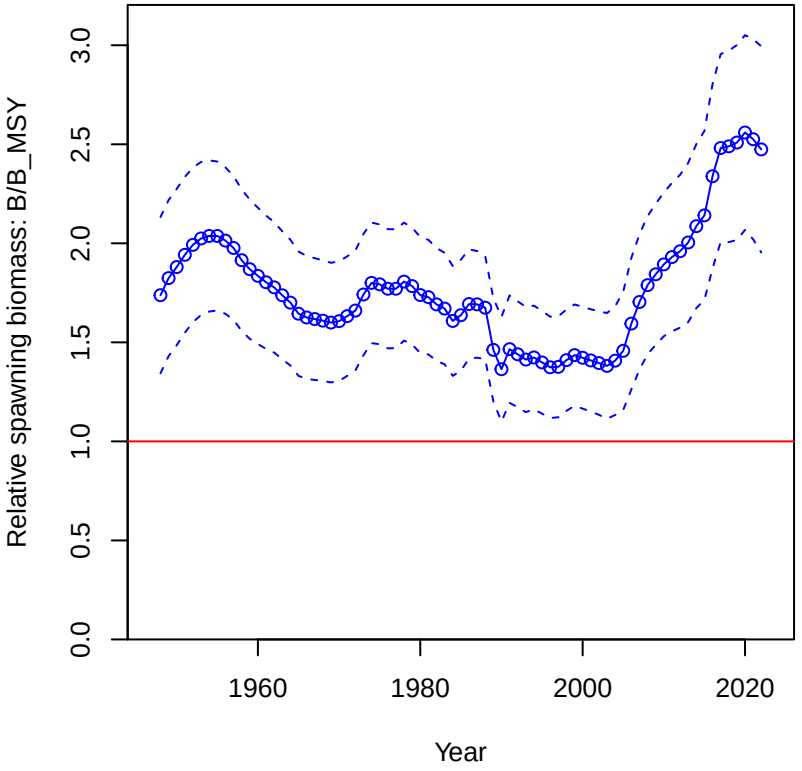

Length (cm)
0
20
40
60
80
100
1
0.8
0.6
0.4
0
0
5
10
15
20
25
30
Age (yr)

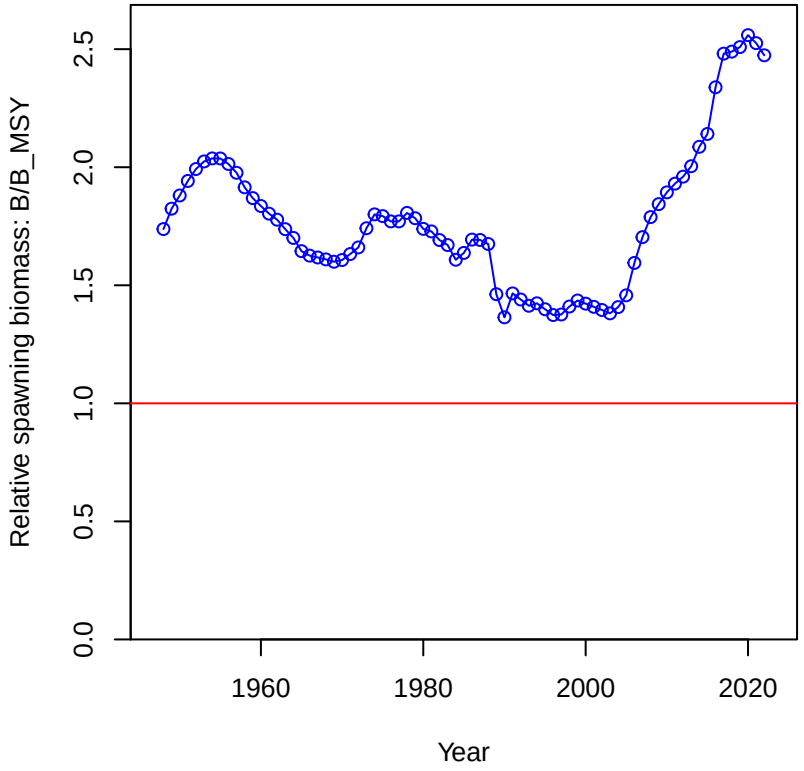

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0
0
5
10
15
20
25
30
Age (yr)

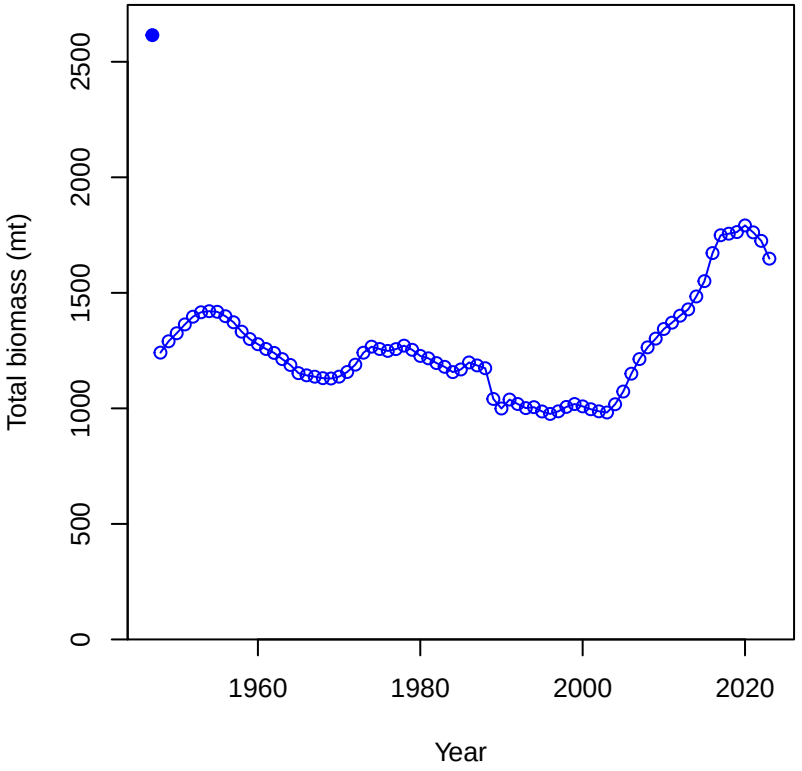

Length (cm)
0
20
40
60
80
100
0.8
0.6
0.4
0
0
5
10
15
20
25
30
Age (yr)

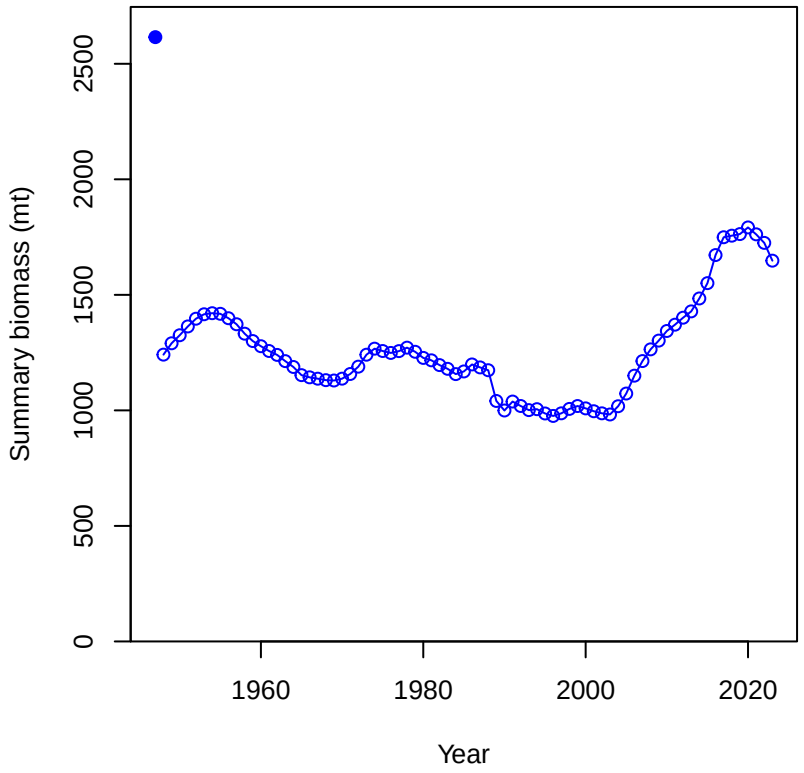

Spawning biomass (mt)
0
200
400
600
800
1000
1200
1960
1980
2000
2020
Year

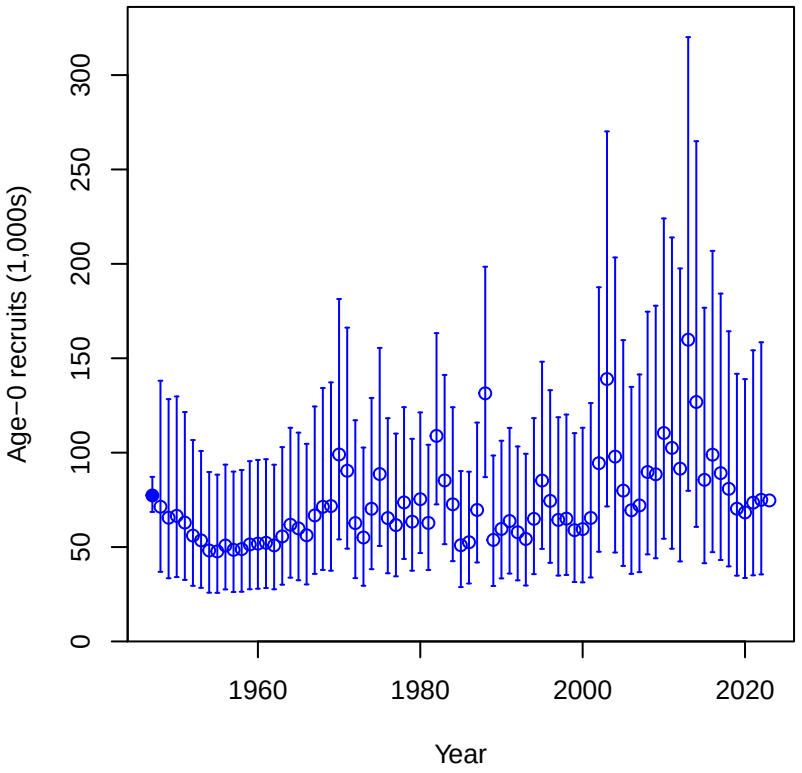

Spawning biomass (mt)
0
200
400
600
800
1000
1200
1400
1960
1980
2000
2020
Year

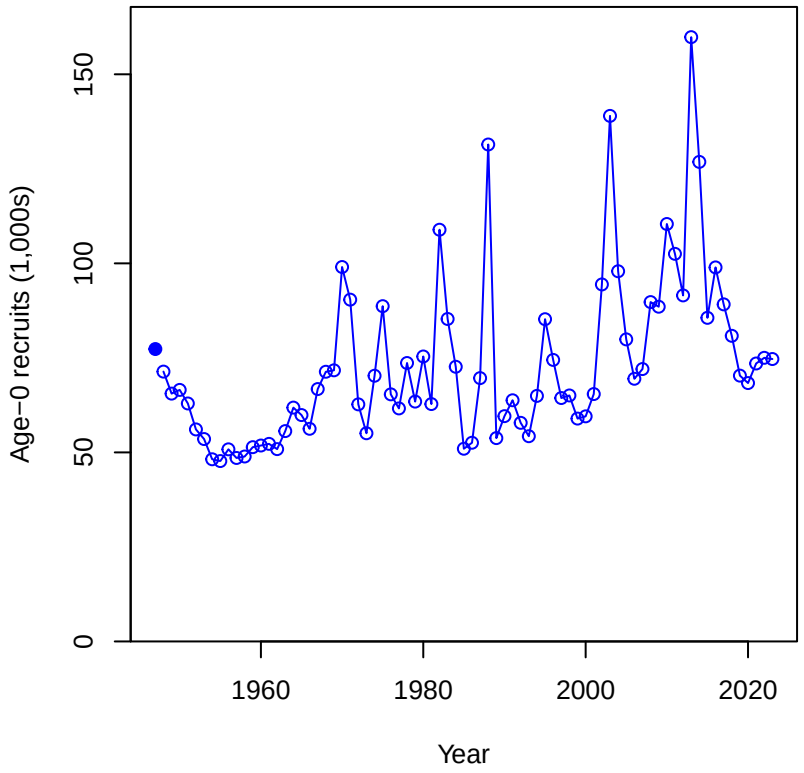

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1960
1980
2000
2020
Year

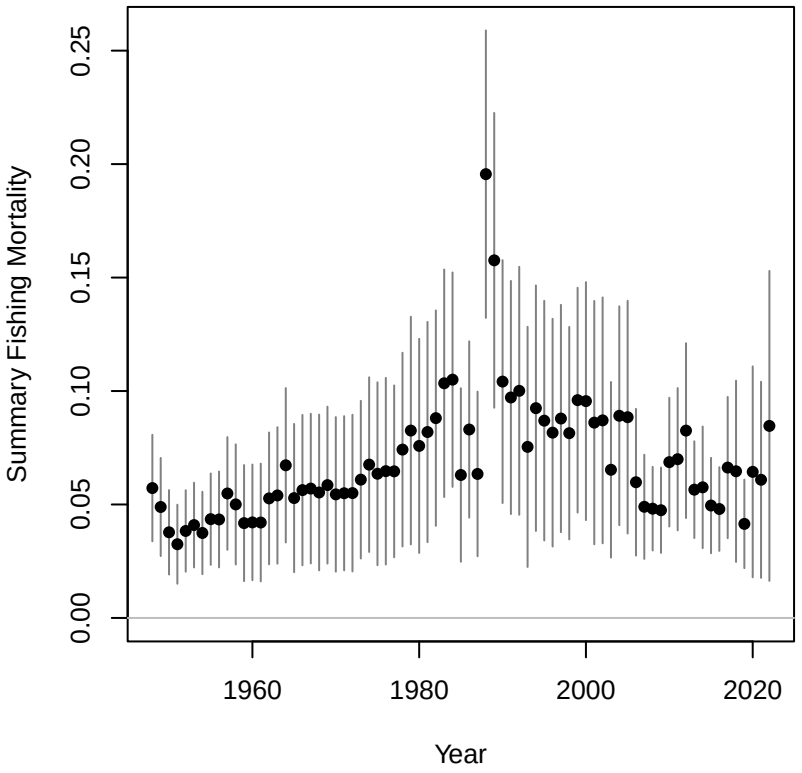

Relative spawning biomass: B/B_MSY
0.0
0.5
1.0
1.5
2.0
2.5
1960
1980
2000
2020
Year

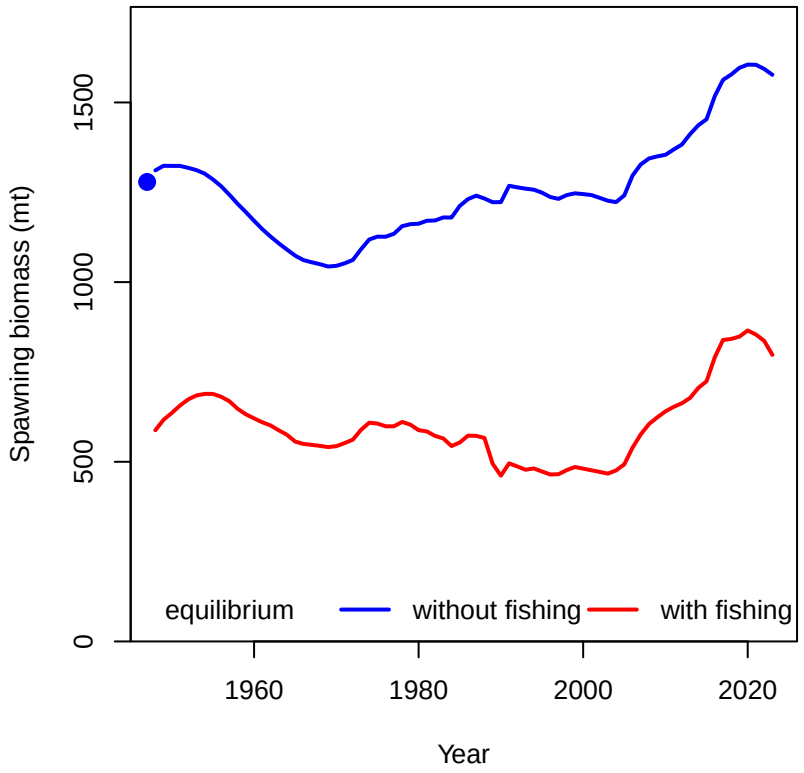

Total biomass (mt)
0
500
1000
1500
2000
2500
1960
1980
2000
2020
Year

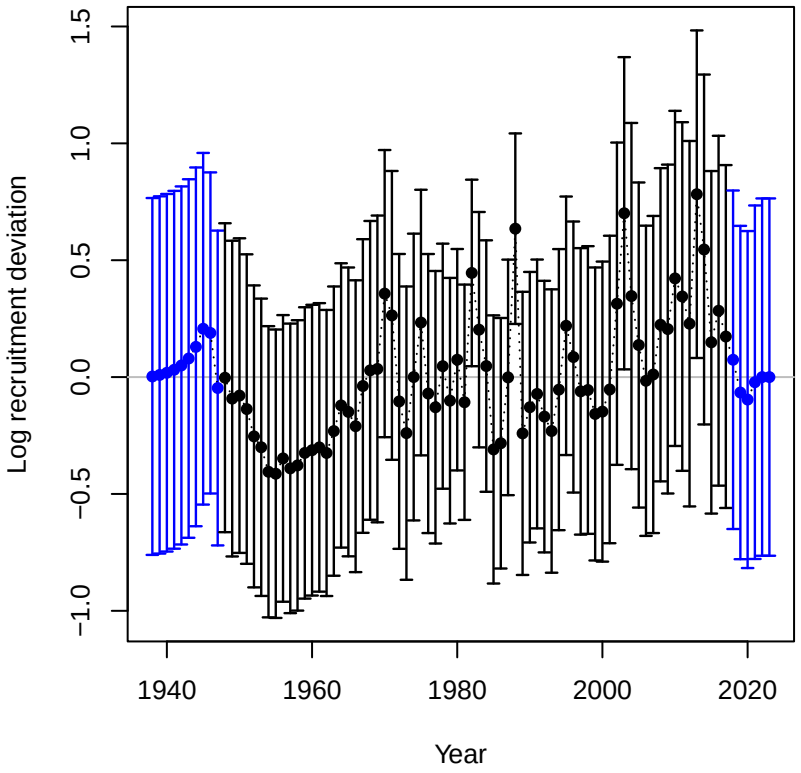

Summary biomass (mt)
0
500
1000
1500
2000
2500
1960
1980
2000
2020
Year

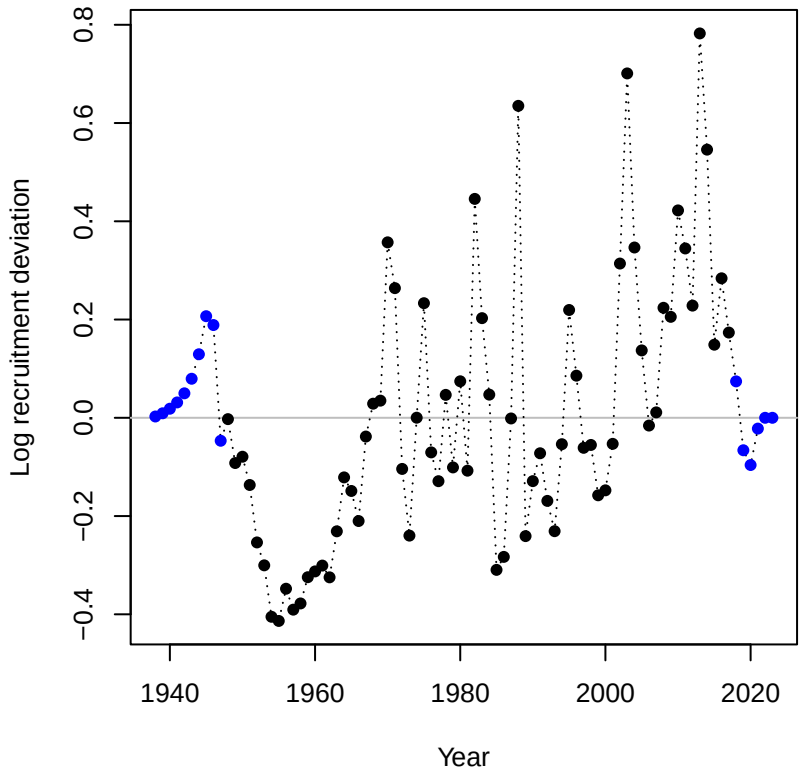

Age−0 recruits (1,000s)
0
50
100
150
200
250
300
1960
1980
2000
2020
Year

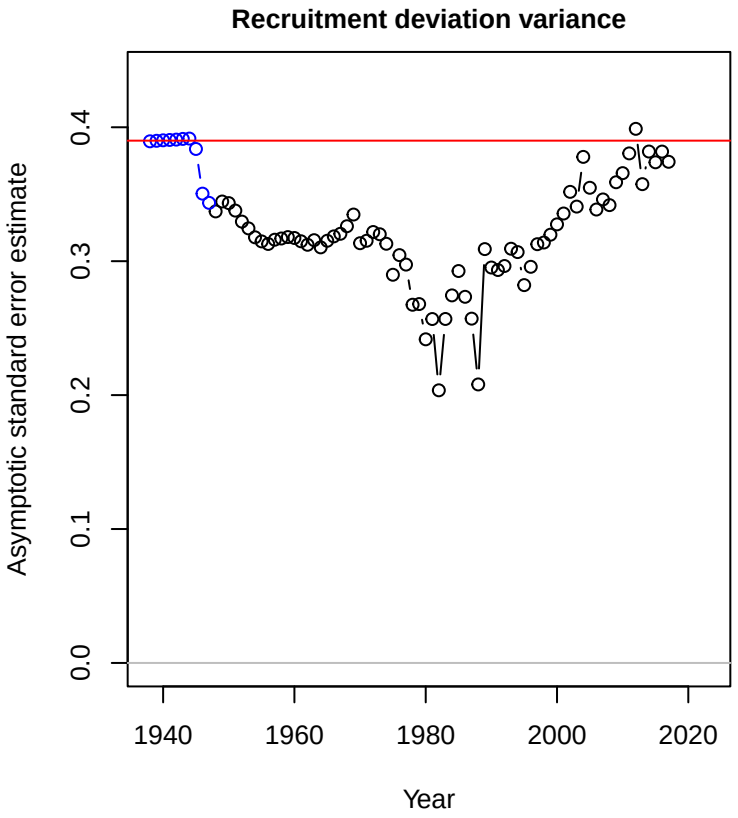

Age−0 recruits (1,000s)
0
50
100
150
1960
1980
2000
2020
Year

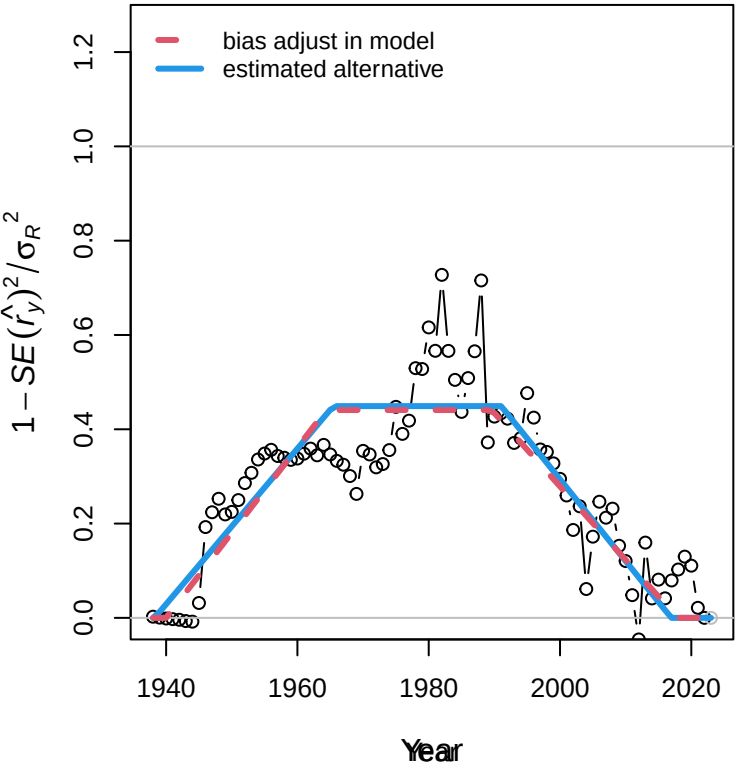

Summary Fishing Mortality
0.00
0.05
0.10
0.15
0.20
0.25
1960
1980
2000
2020
Year

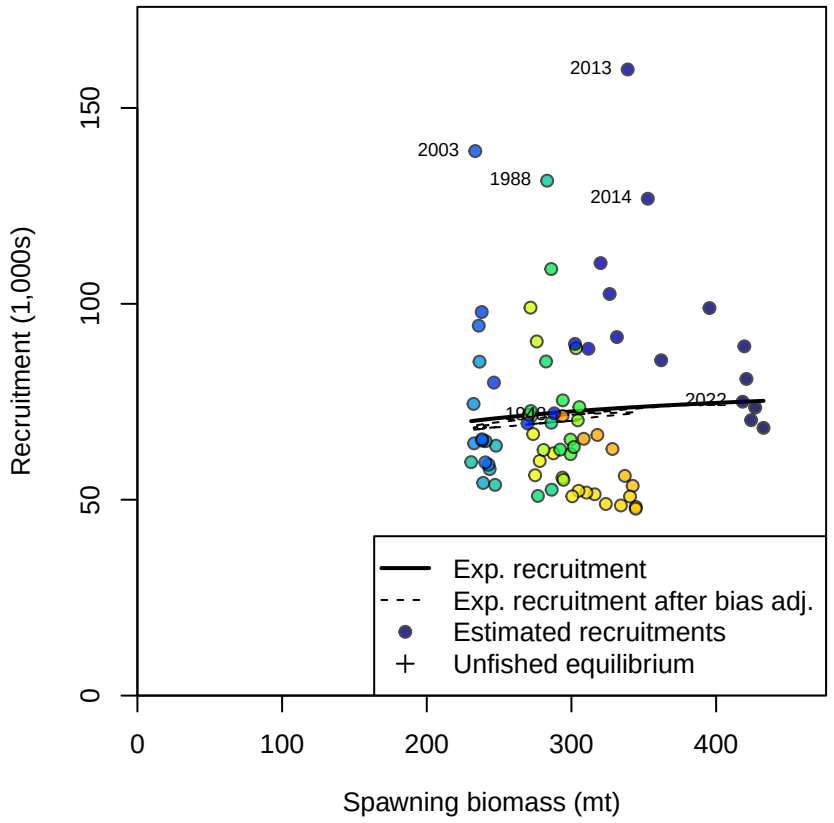

Spawning biomass (mt)
0
500
1000
1500
equilibrium
without fishing
with fishing
1960
1980
2000
2020
Year

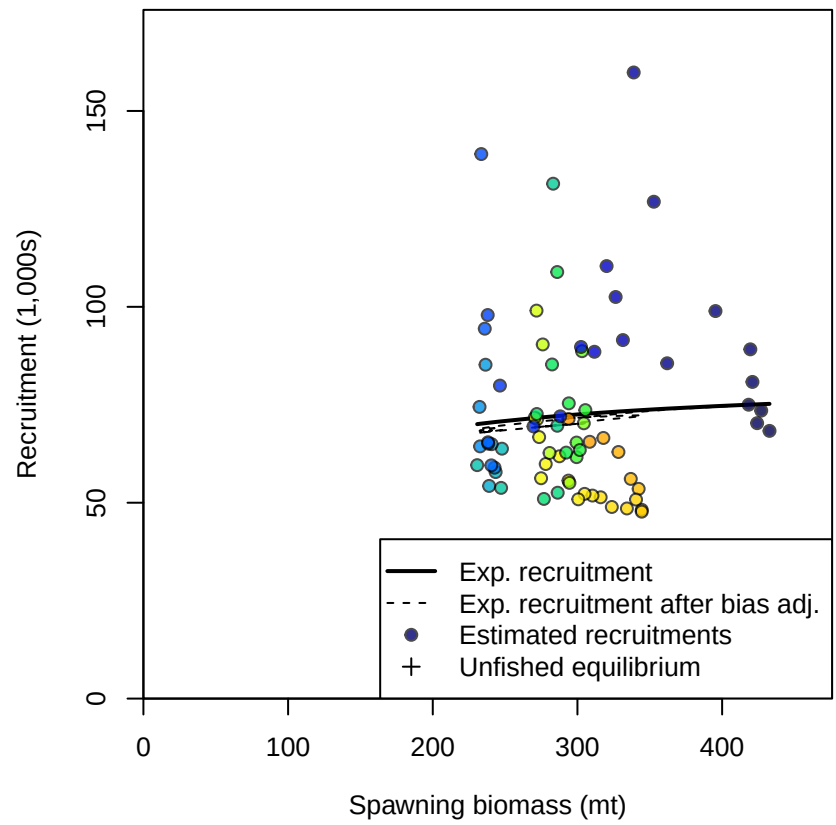

Log recruitment deviation
−1.0
−0.5
0.0
0.5
1.0
1.5
1940
1960
1980
2000
2020
Year

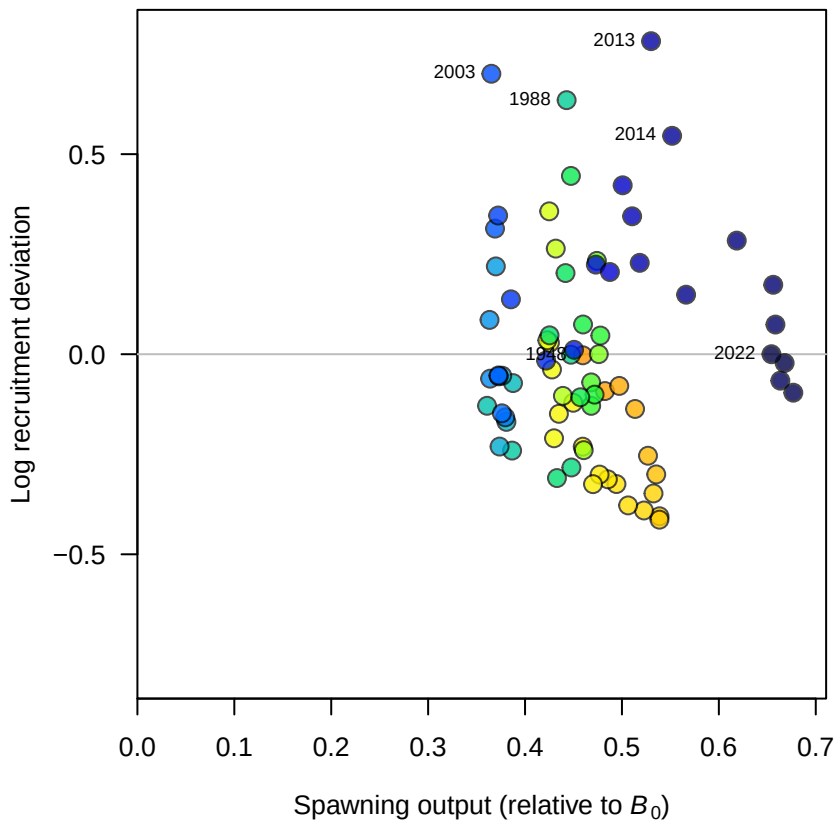

Log recruitment deviation
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
1940
1960
1980
2000
2020
Year

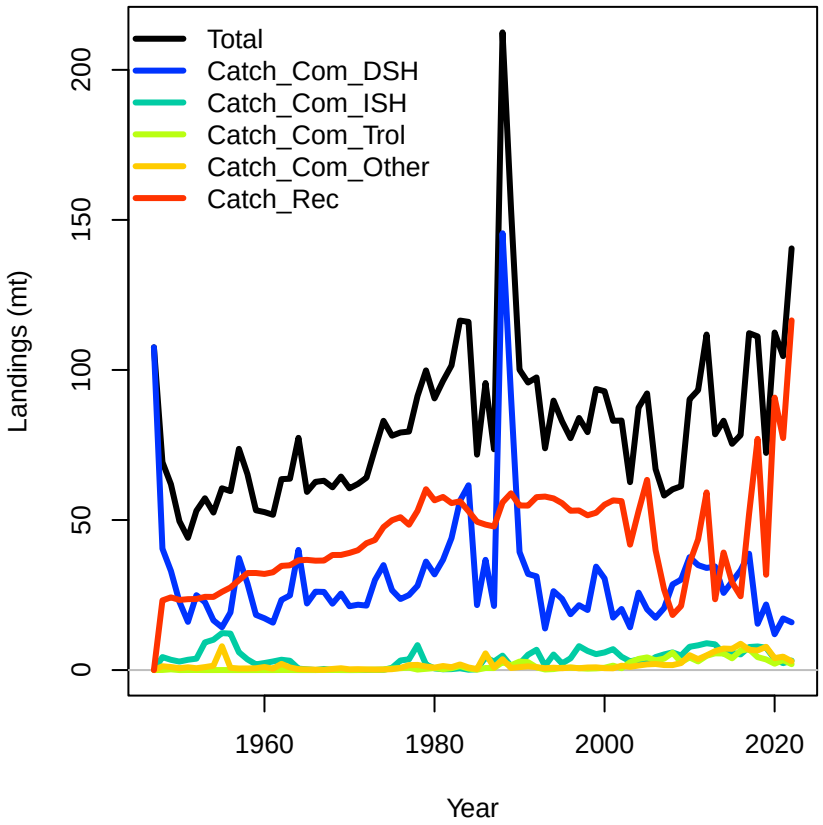

Recruitment deviation variance
Asymptotic standard error estimate
0.0
0.1
0.2
0.3
0.4
1940
1960
1980
2000
2020
Year

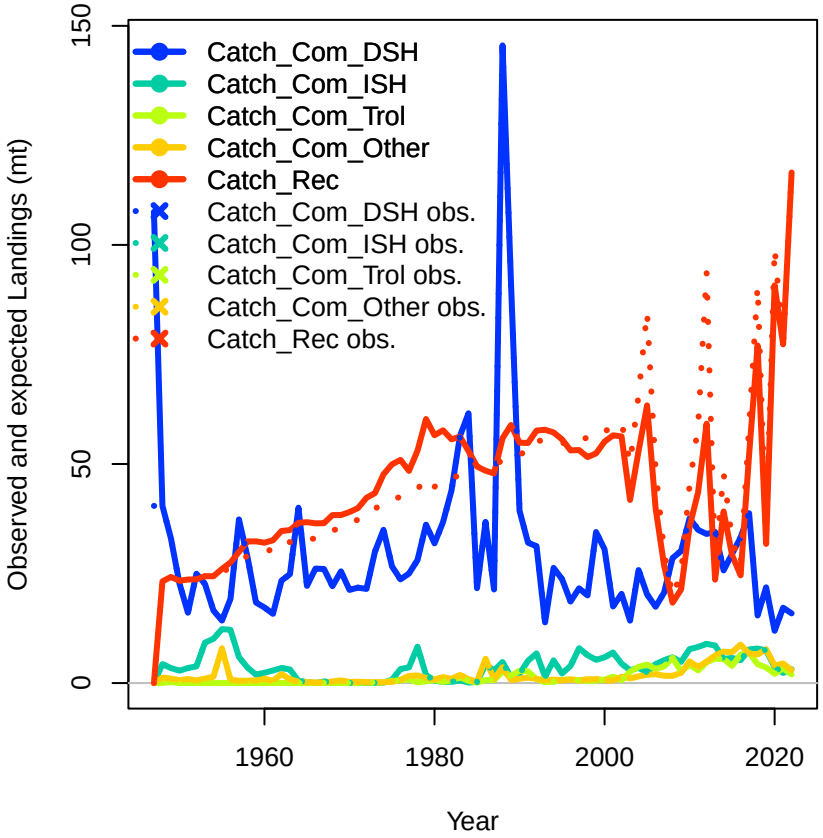

bias adjust in model
estimated alternative
$1 - SE(\hat{r}_y)^2/\sigma_R^2$
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1940
1960
1980
2000
2020
Year

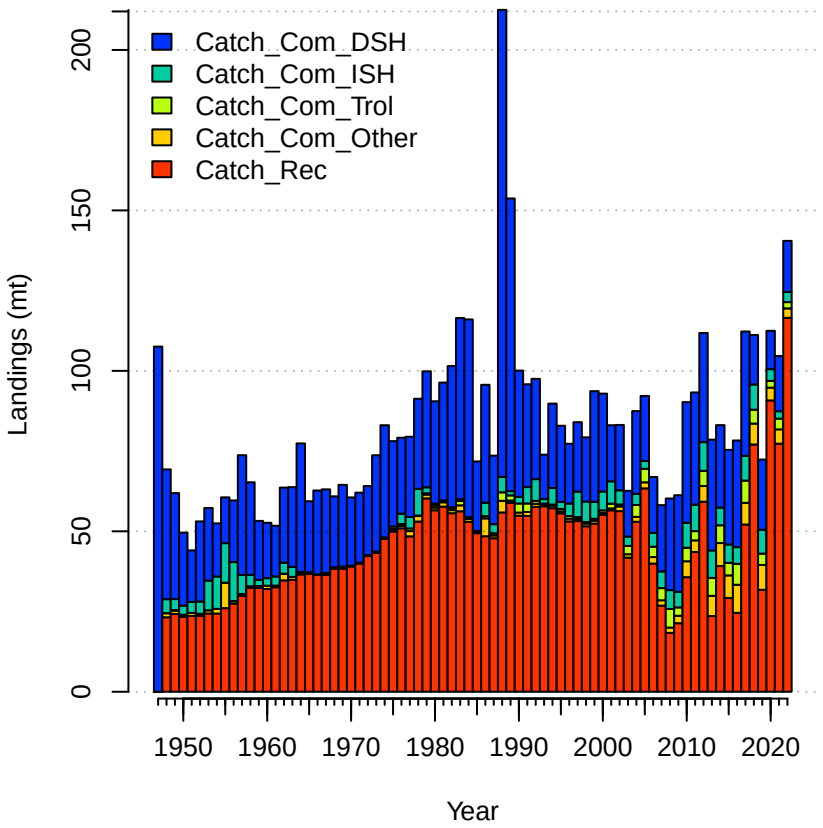

2013
2003
1988
2014
2022
1948
Recruitment (1,000s)
0
50
100
150
0
100
200
300
400
Spawning biomass (mt)
Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium

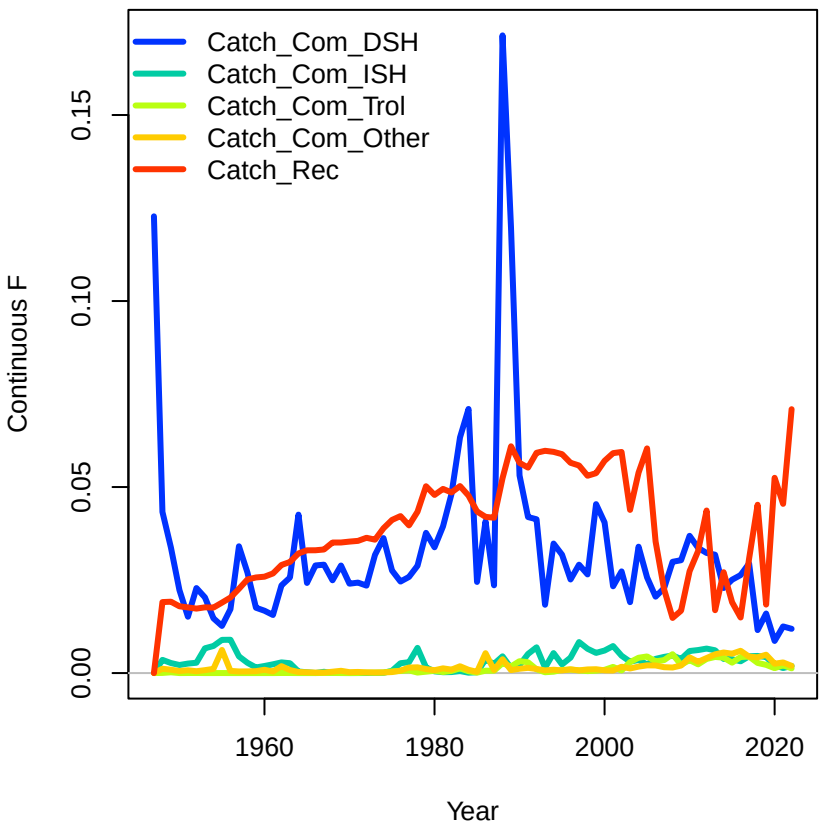

Recruitment (1,000s)
0
50
100
150
0
100
200
300
400
Spawning biomass (mt)
Exp. recruitment
Exp. recruitment after bias adj.
Estimated recruitments
Unfished equilibrium

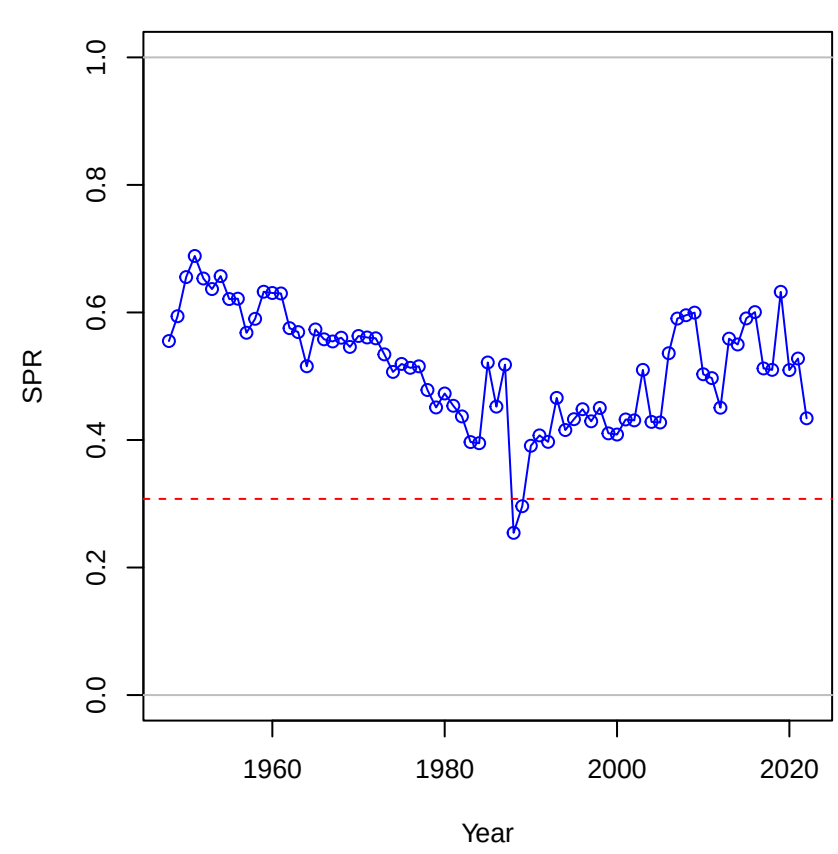

2013
2003
1988
2014
2022
1948
Log recruitment deviation
−0.5
0.0
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Spawning output (relative to B_0)

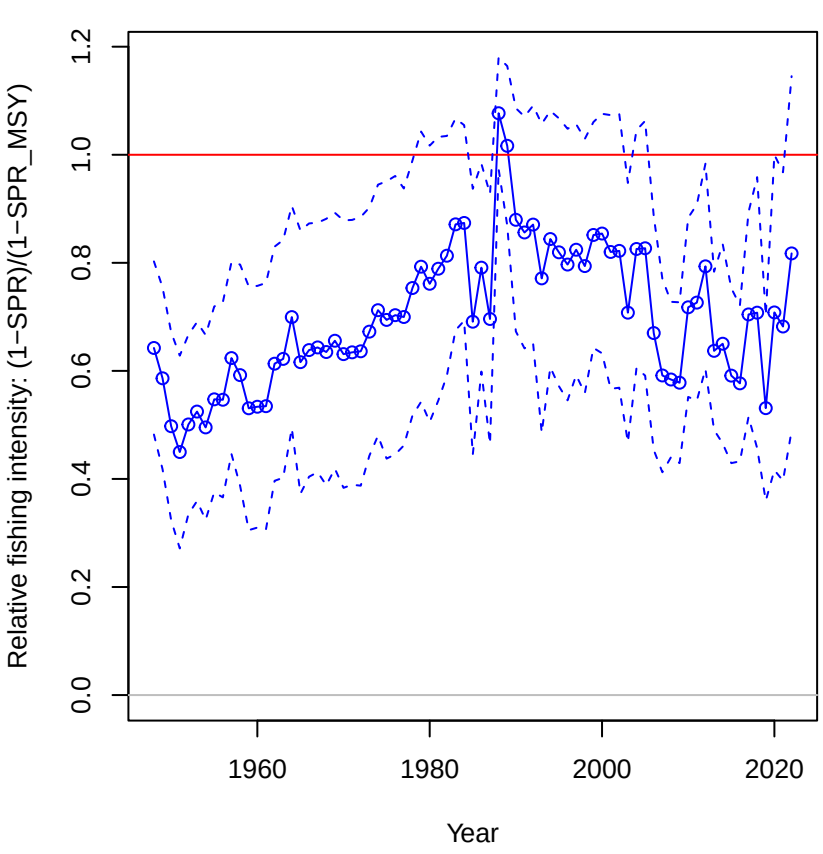

Total
Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Landings (mt)
0
50
100
150
200
1960
1980
2000
2020
Year

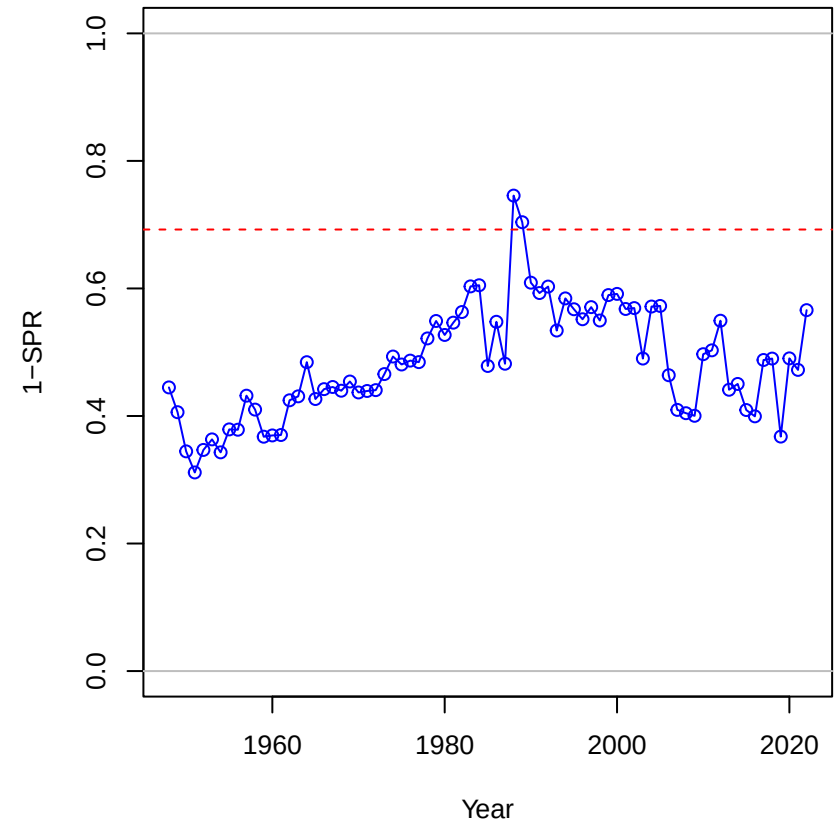

Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Catch_Com_DSH obs.
Catch_Com_ISH obs.
Catch_Com_Trol obs.
Catch_Com_Other obs.
Catch_Rec obs.
Observed and expected Landings (mt)
0
50
100
150
1960
1980
2000
2020
Year

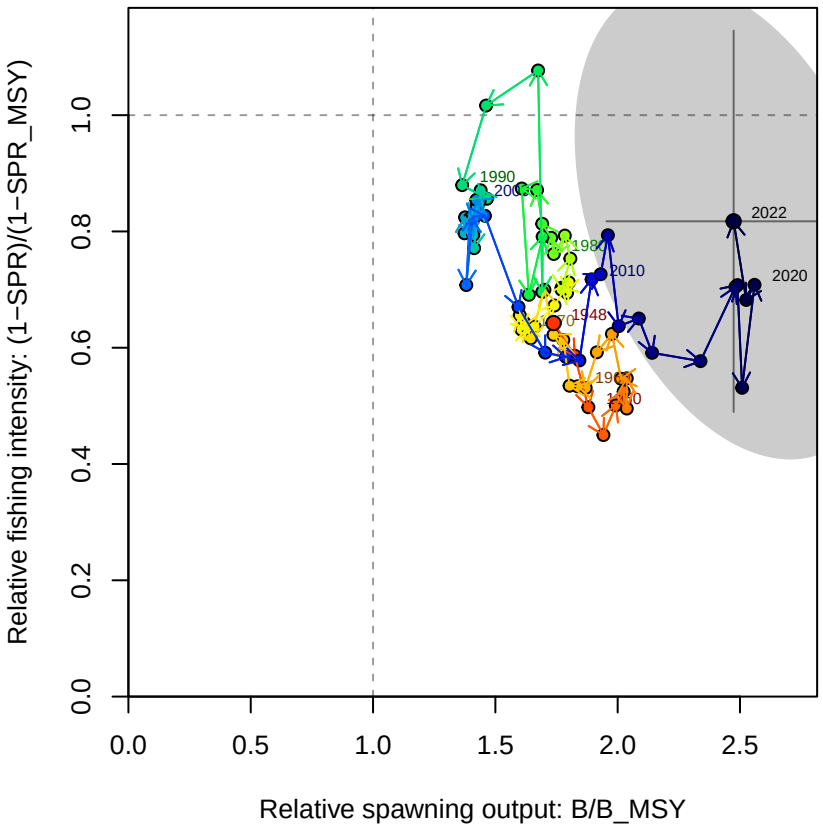

Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Landings (mt)
0
50
100
150
200
1950
1960
1970
1980
1990
2000
2010
2020
Year

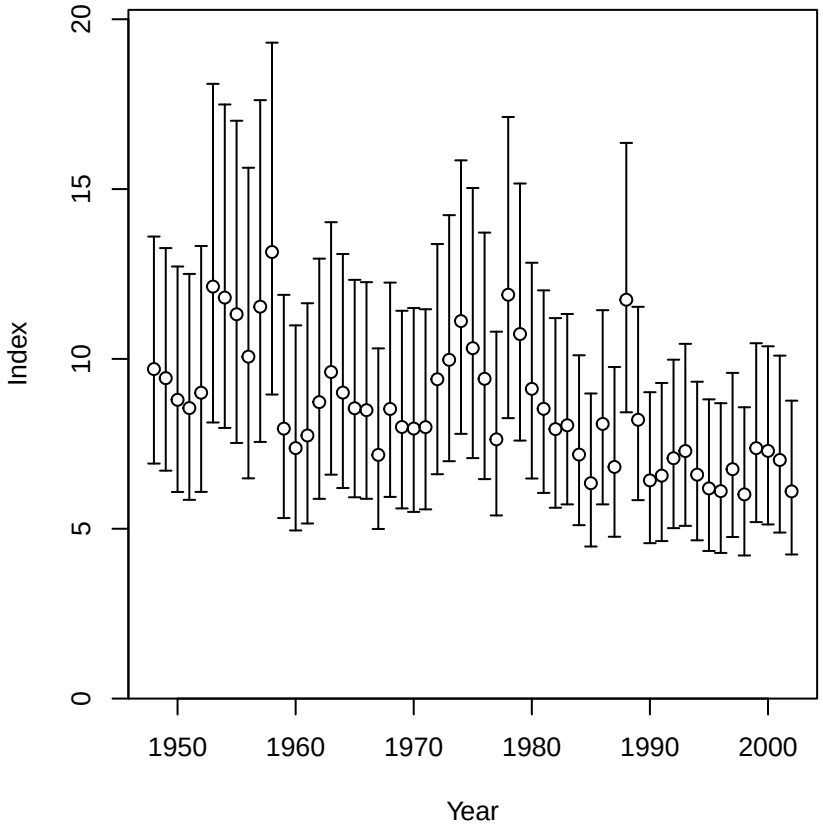

Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Continuous F
0.00
0.05
0.10
0.15
1960
1980
2000
2020
Year

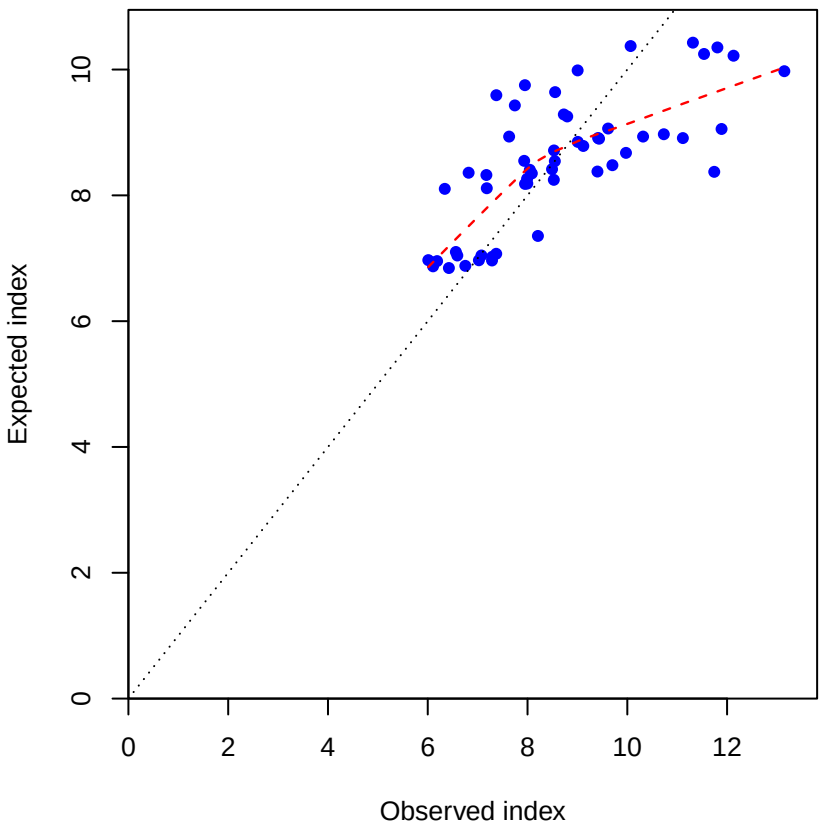

SPR
0.0
0.2
0.4
0.6
0.8
1.0
1960
1980
2000
2020
Year

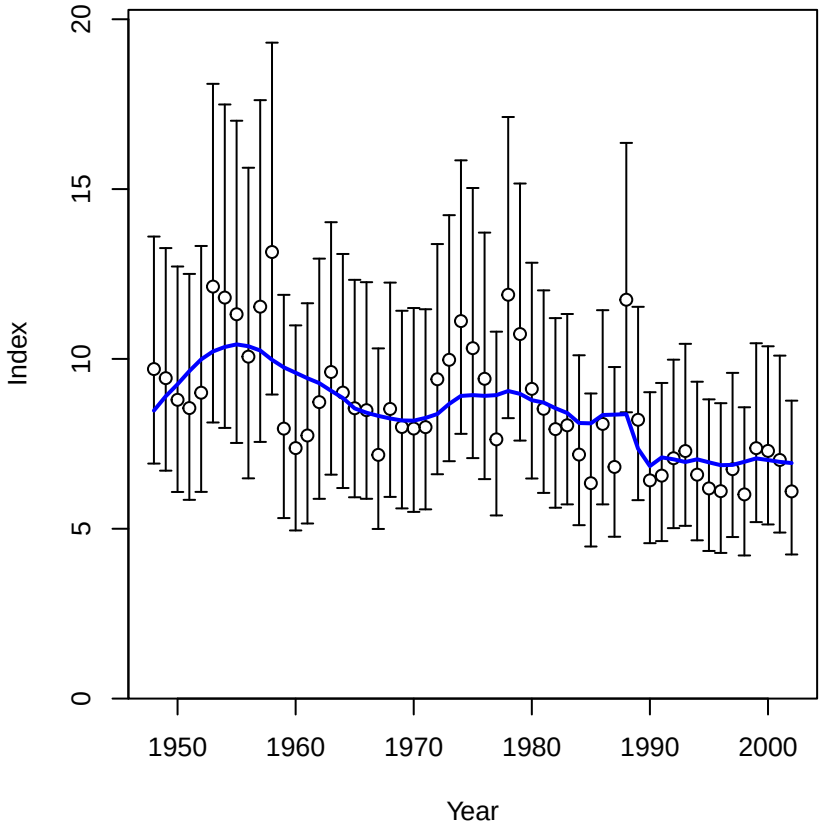

Relative fishing intensity: (1−SPR)/(1−SPR_MSY)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1960
1980
2000
2020
Year

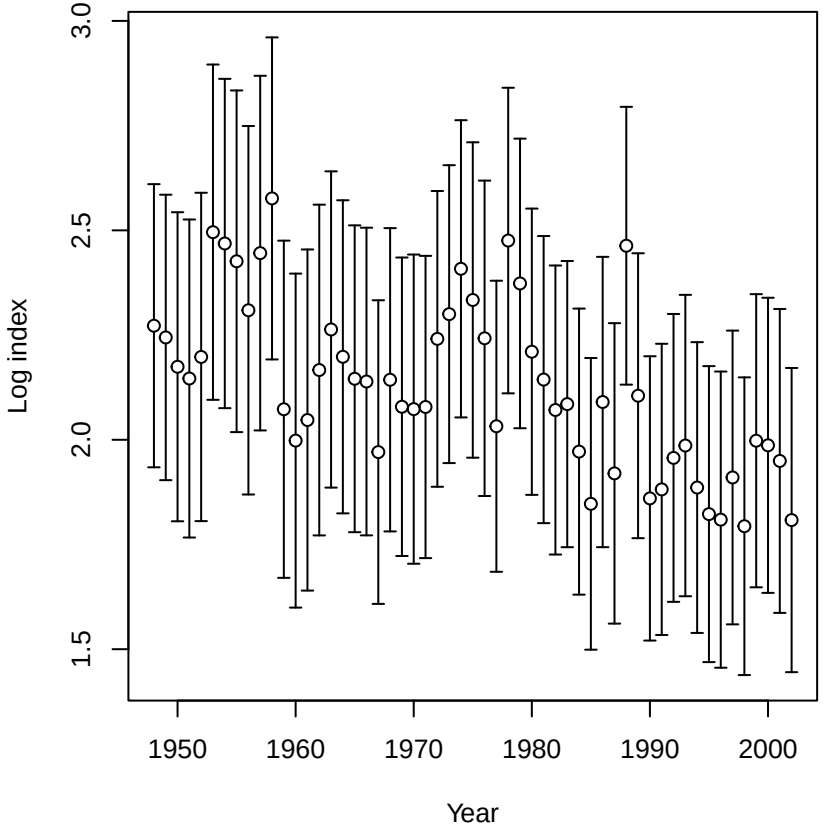

1−SPR
0.0
0.2
0.4
0.6
0.8
1.0
1960
1980
2000
2020
Year

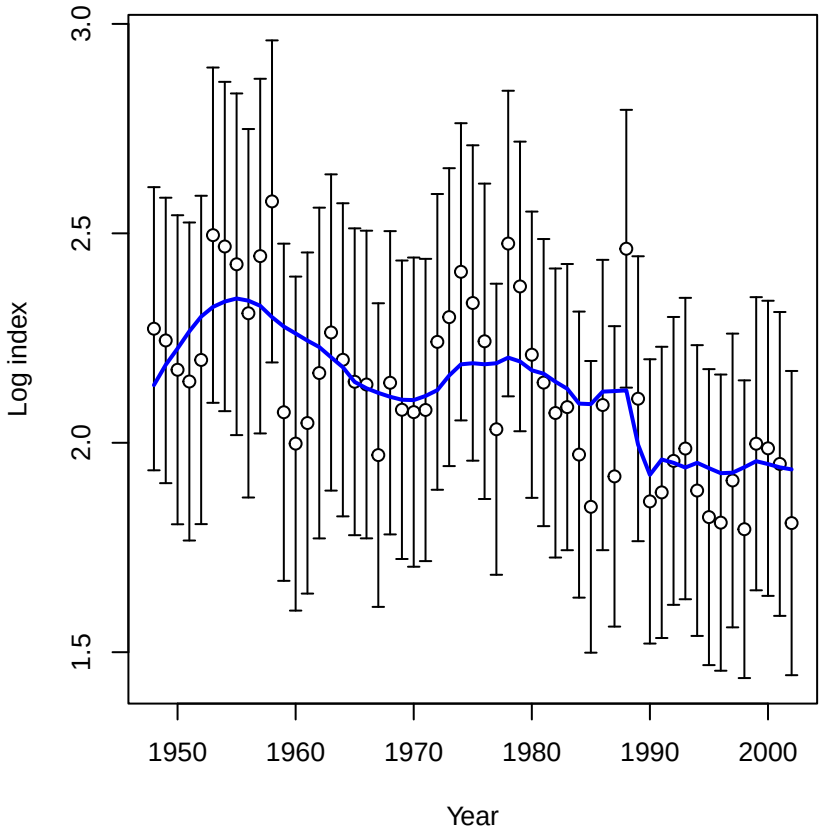

Relative fishing intensity: (1−SPR)/(1−SPR_MSY)
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
Relative spawning output: B/B_MSY
1990
1980
2010
1948
2022
2020

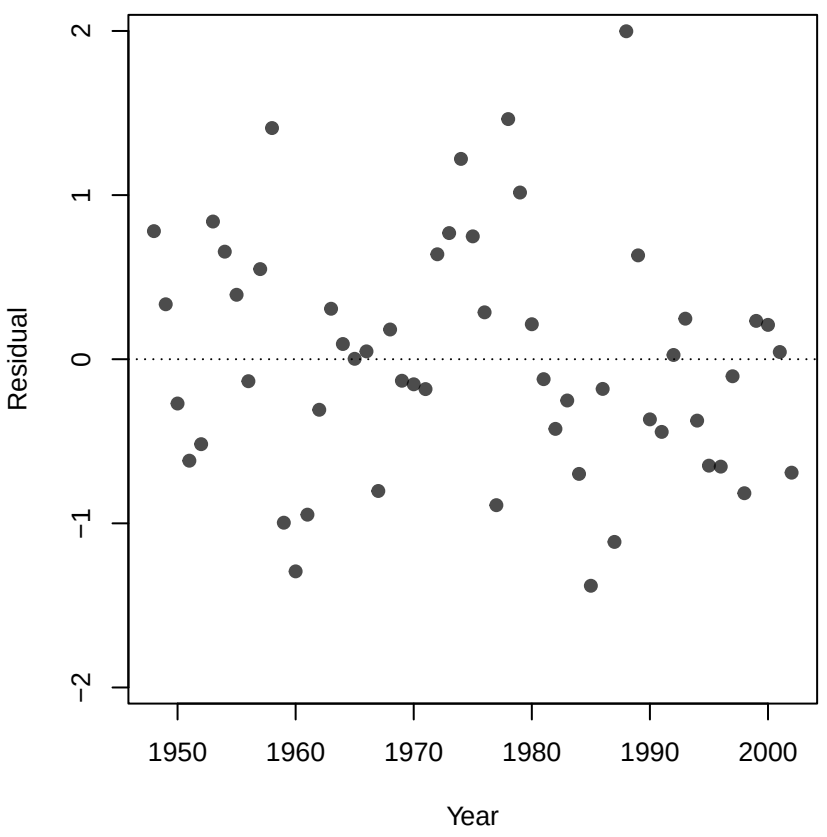

Index
Year
0
5
10
15
20
1950
1960
1970
1980
1990
2000

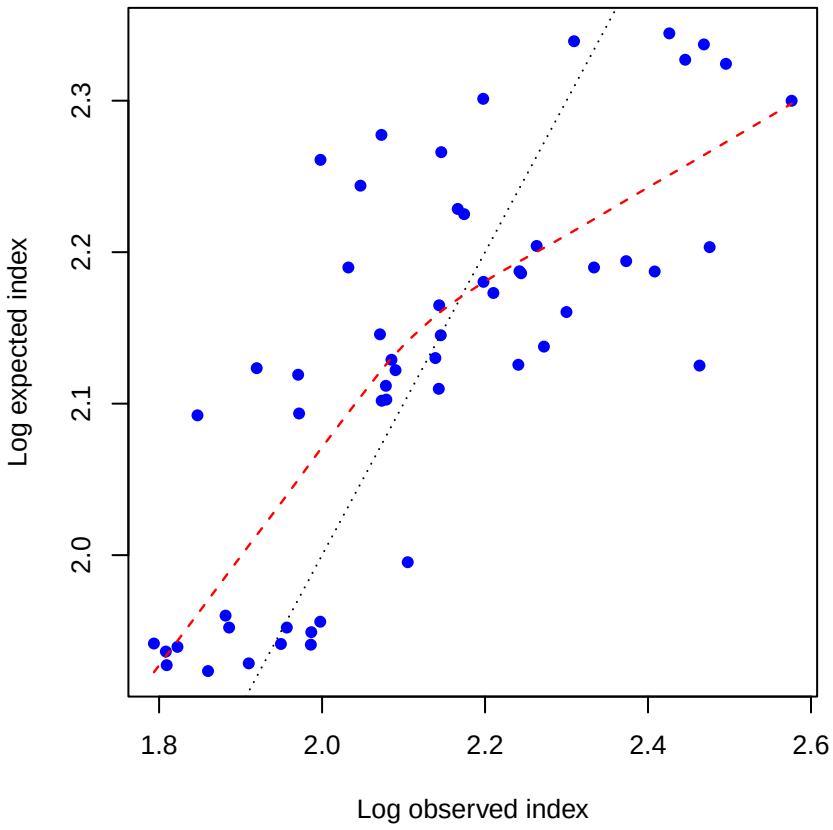

Expected index
Observed index
0
2
4
6
8
10
12

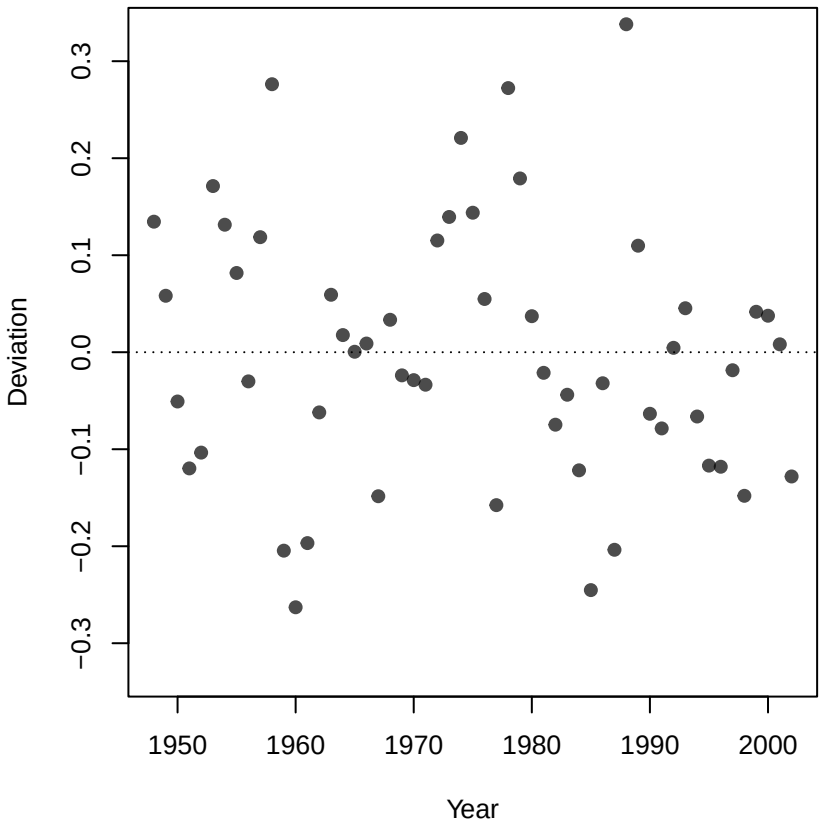

Index
Year
0
5
10
15
20
1950
1960
1970
1980
1990
2000

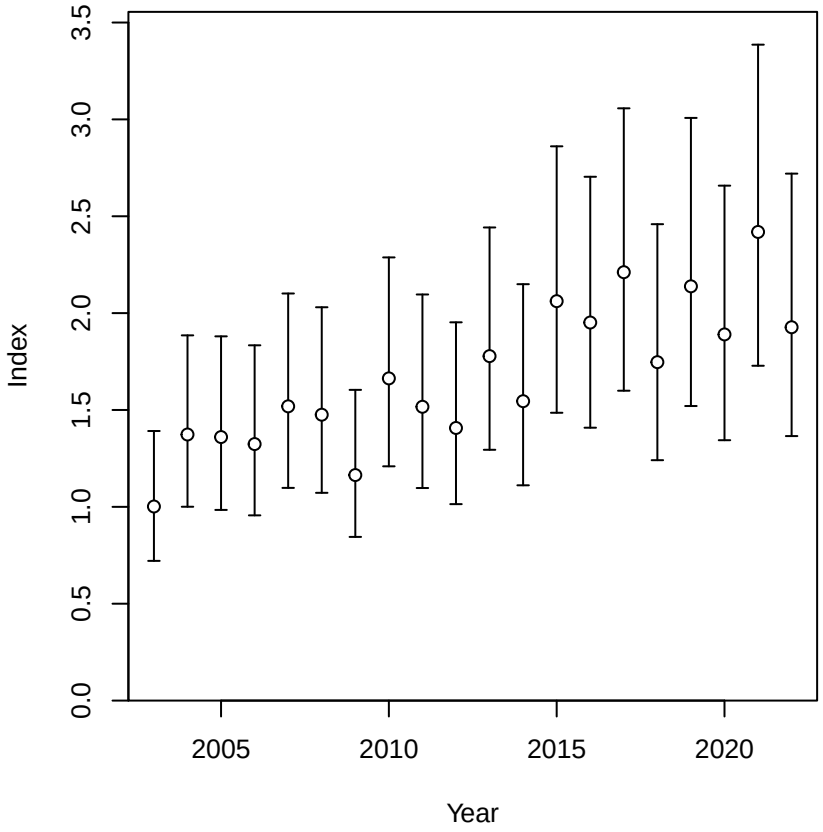

Log index
Year
1.5
2.0
2.5
3.0
1950
1960
1970
1980
1990
2000

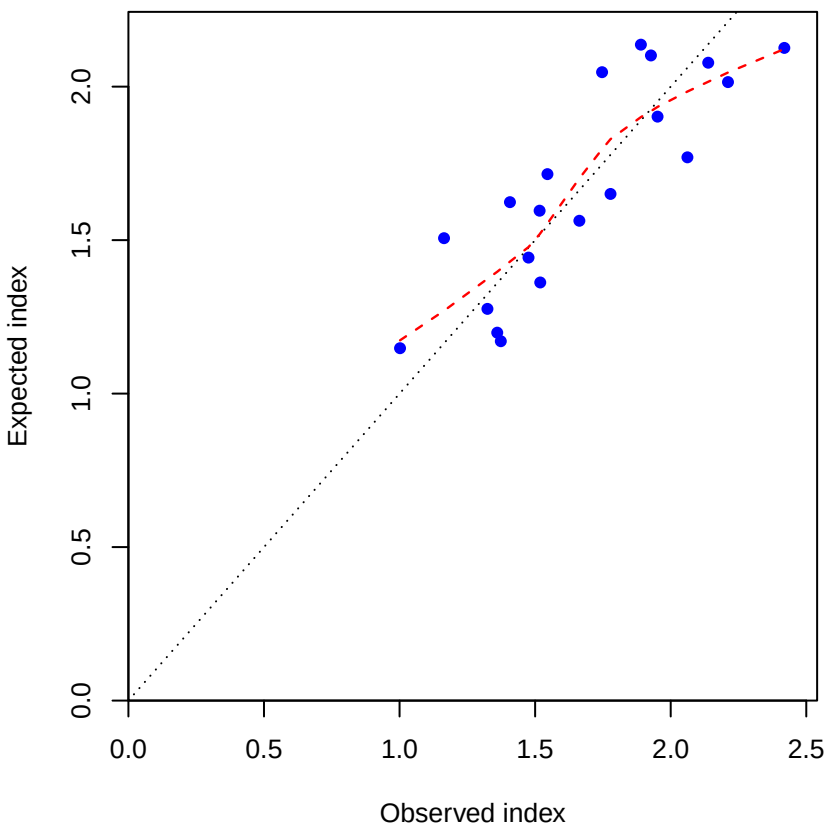

Log index
3.0
2.5
2.0
1.5
1950
1960
1970
1980
1990
2000
Year

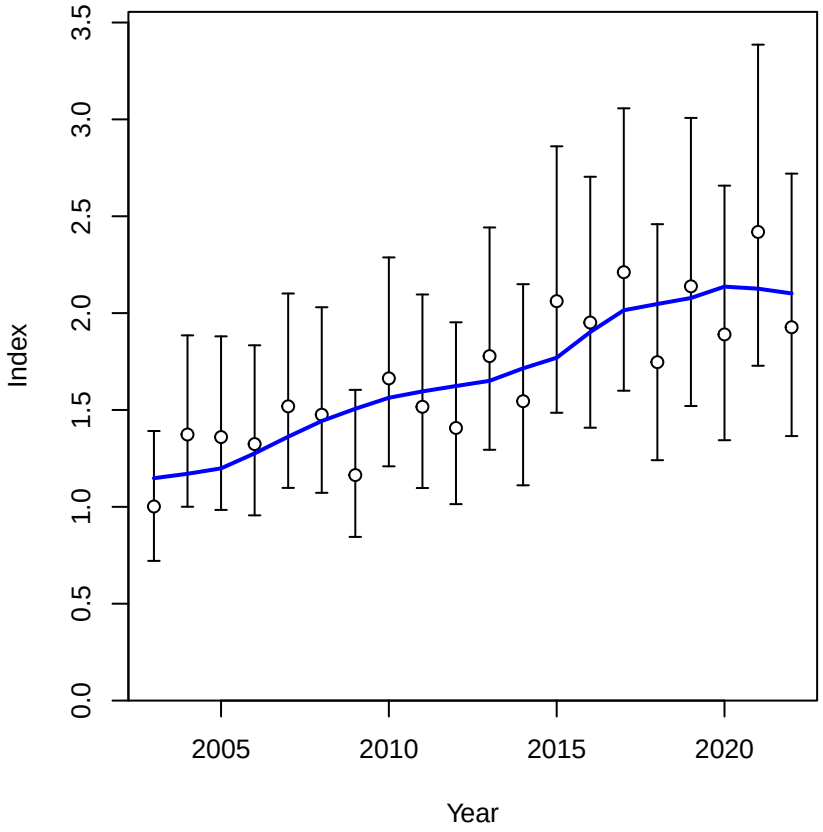

Residual
2
1
0
−1
−2
1950
1960
1970
1980
1990
2000
Year

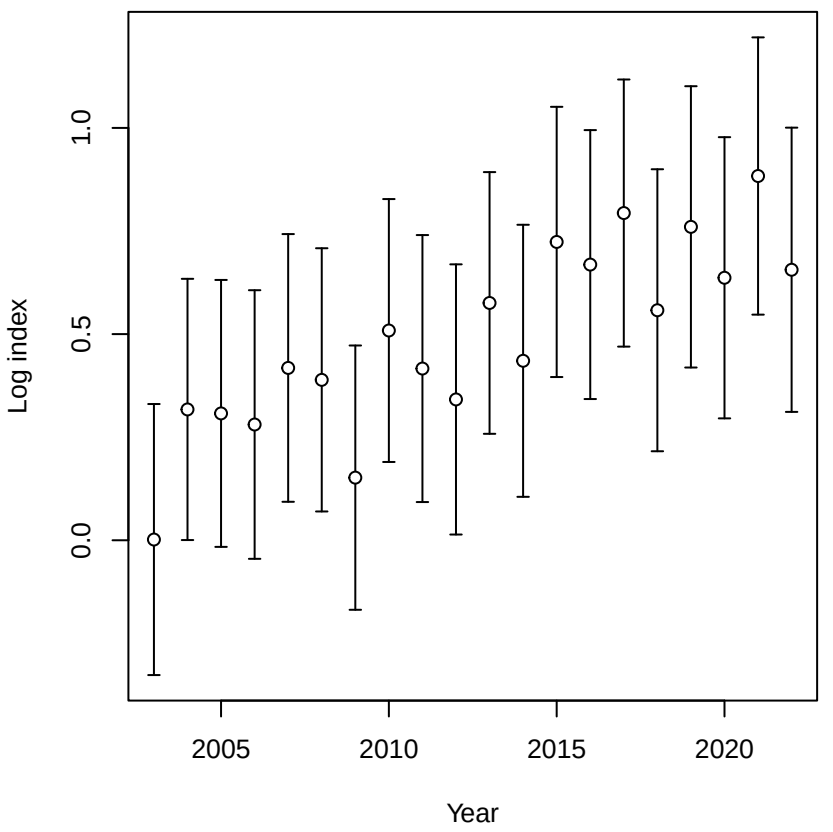

Log expected index
2.3
2.2
2.1
2.0
1.8
2.0
2.2
2.4
2.6
Log observed index

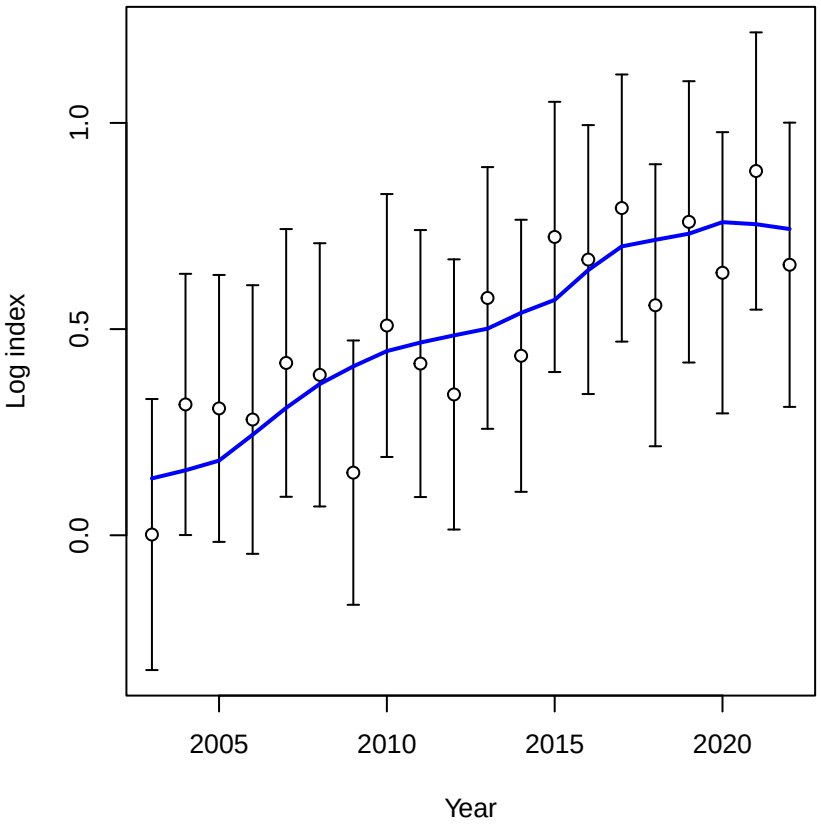

Deviation
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
1950
1960
1970
1980
1990
2000
Year

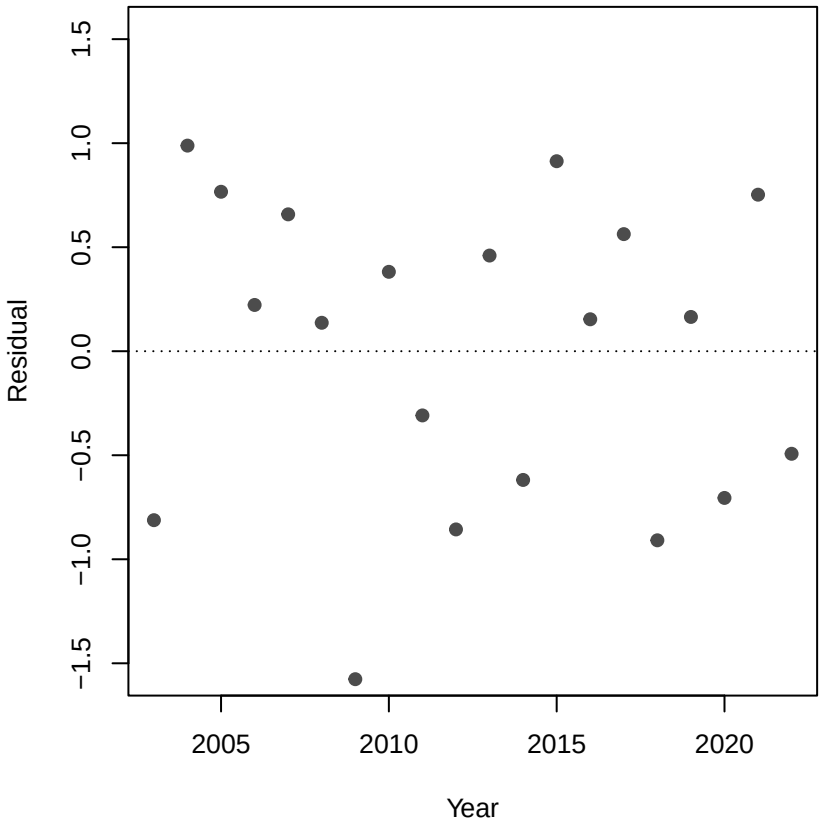

Index
Year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2005
2010
2015
2020

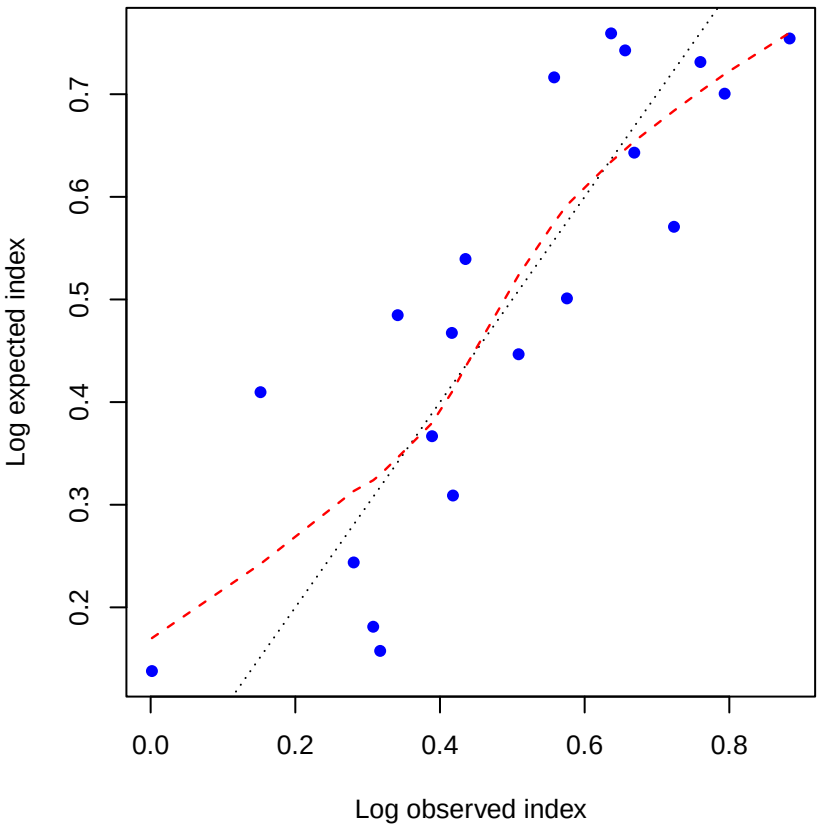

Expected index
Observed index
0.0
0.5
1.0
1.5
2.0
2.5

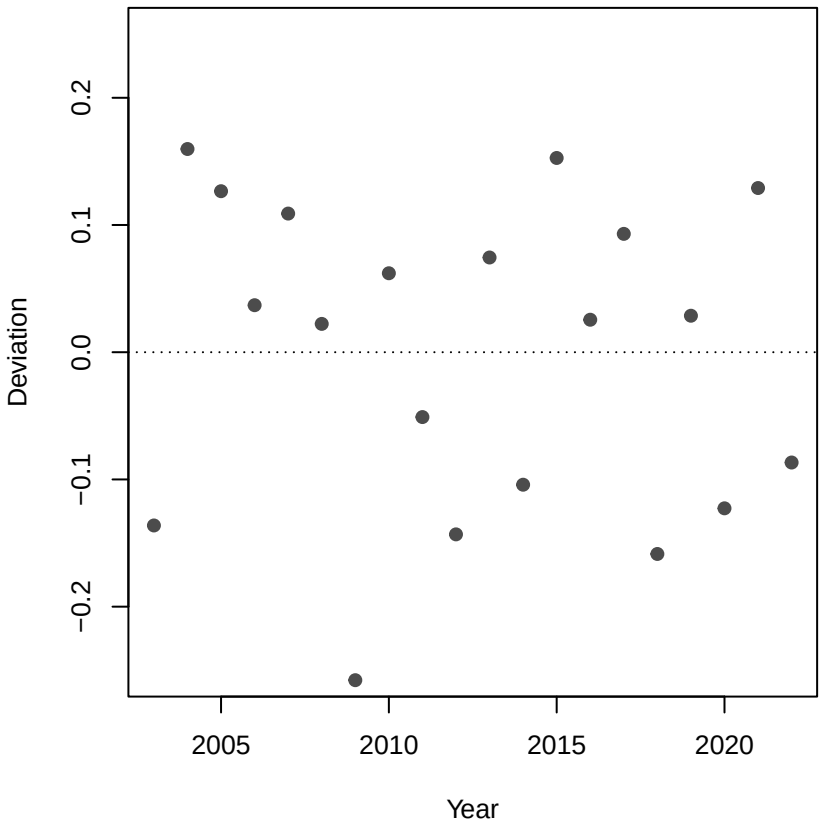

Index
Year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2005
2010
2015
2020

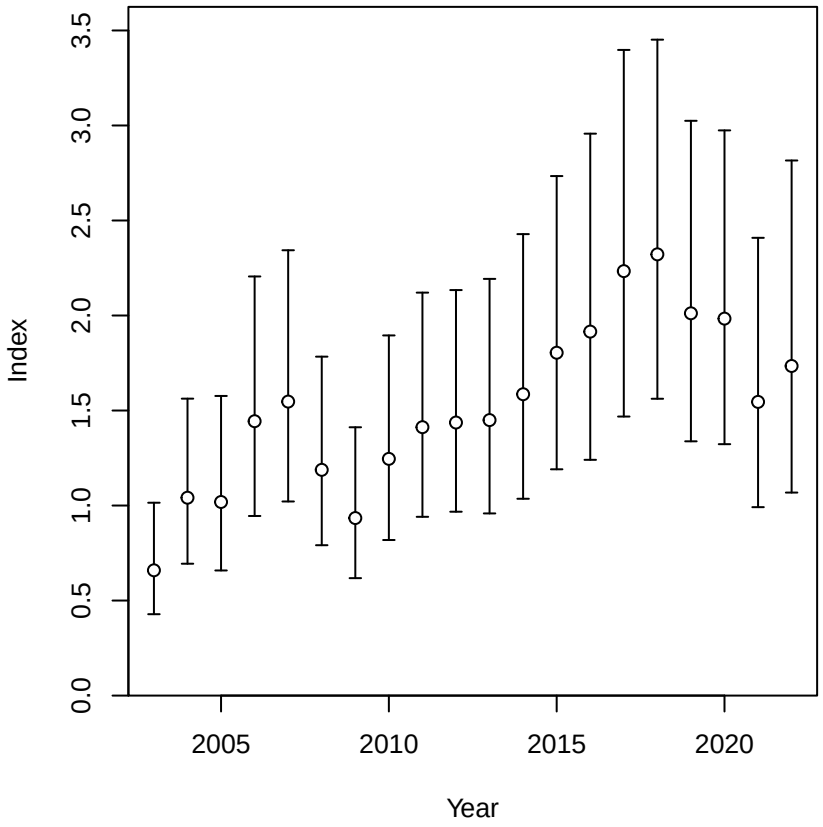

Log index
Year
0.0
0.5
1.0
2005
2010
2015
2020

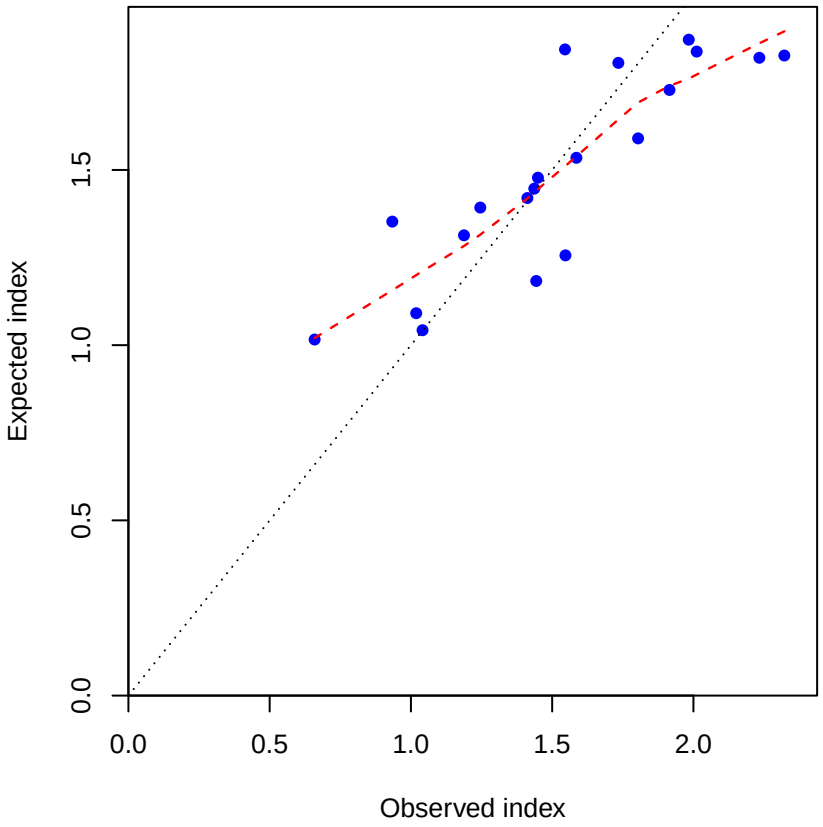

Log index
1.0
0.5
0.0
2005
2010
2015
2020
Year

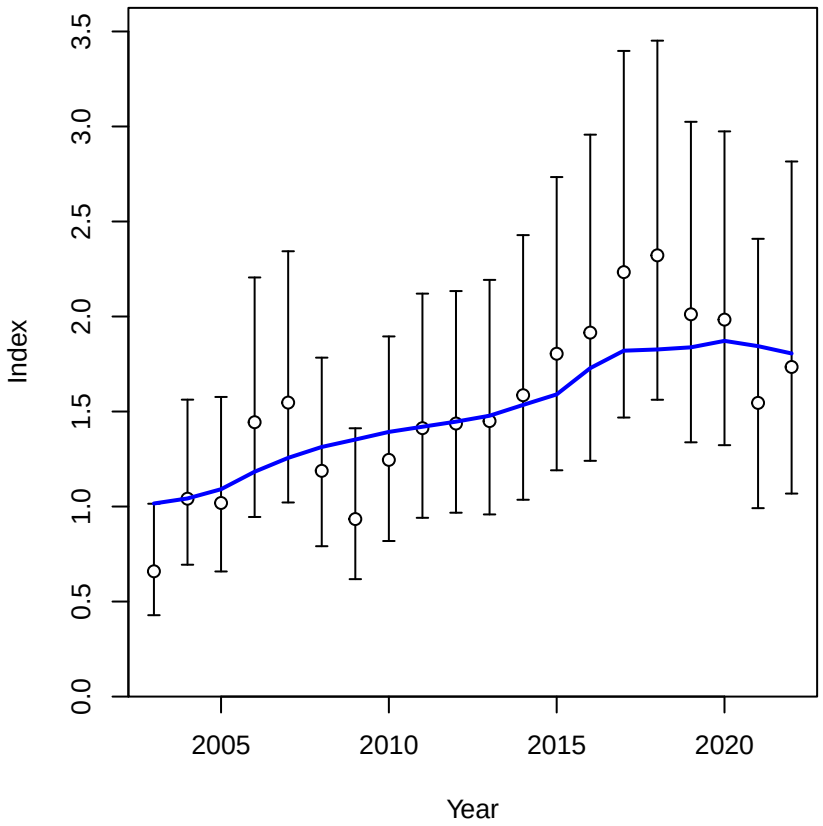

Residual
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
2005
2010
2015
2020
Year

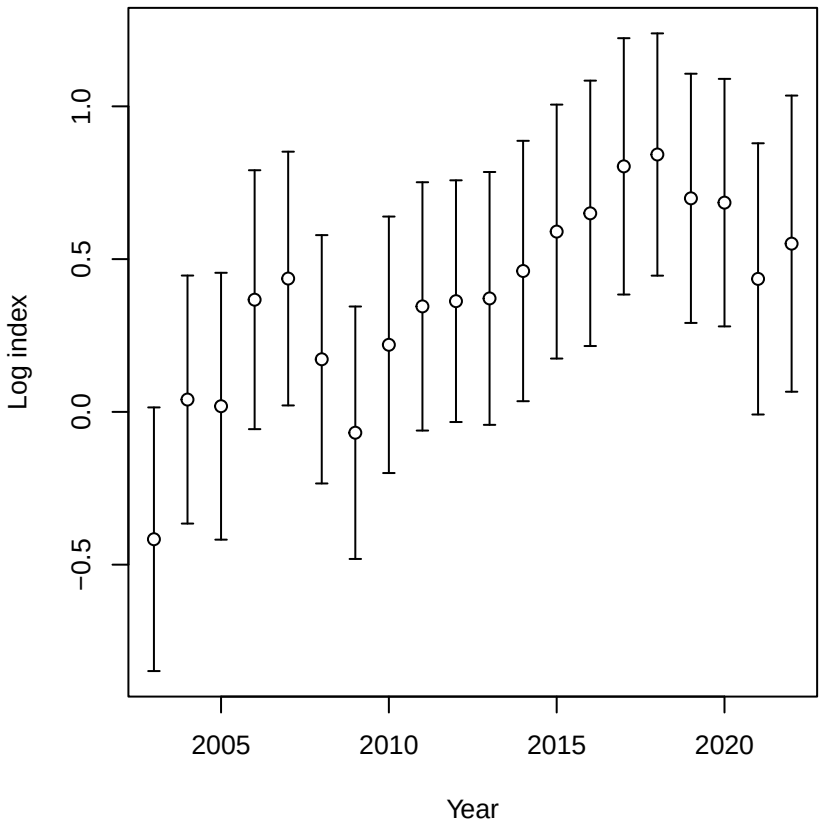

Log expected index
0.7
0.6
0.5
0.4
0.3
0.2
0.0
0.2
0.4
0.6
0.8
Log observed index

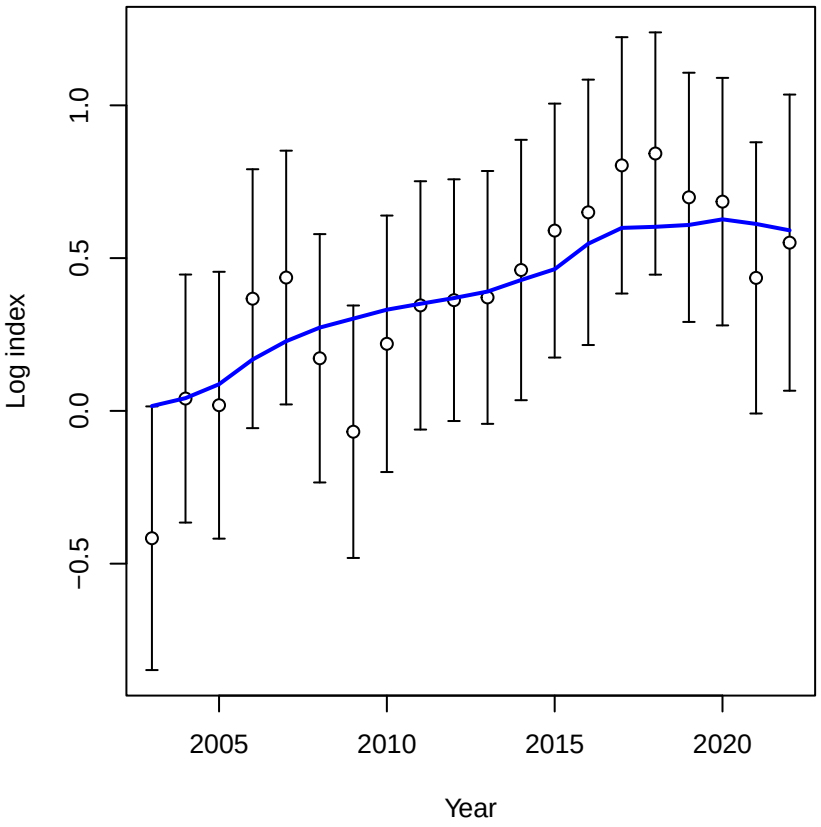

Deviation
0.2
0.1
0.0
−0.1
−0.2
2005
2010
2015
2020
Year

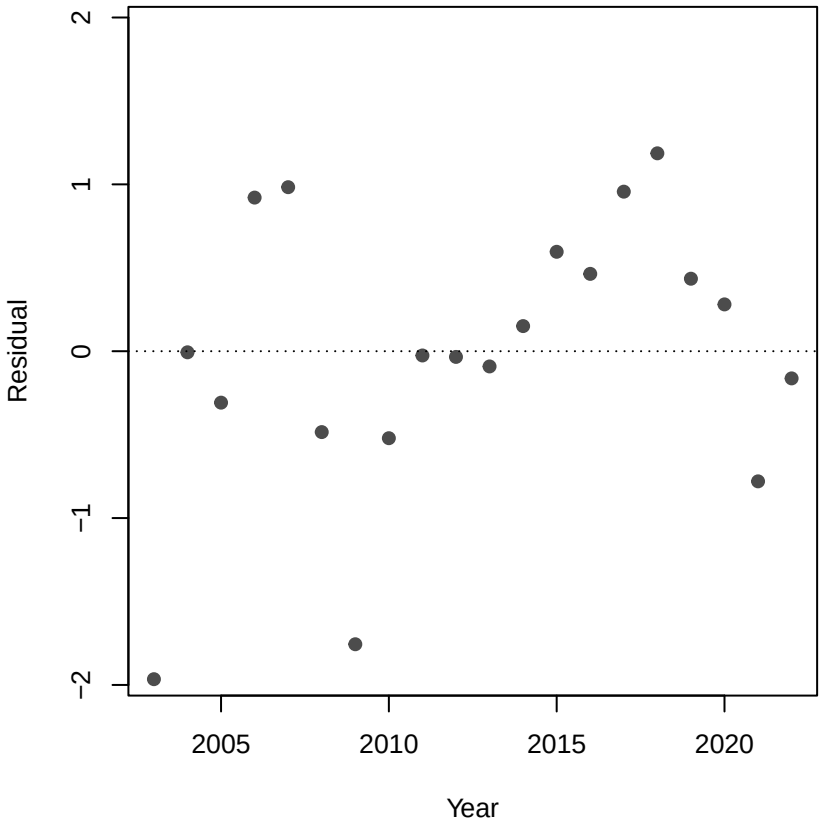

Index
Year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2005
2010
2015
2020

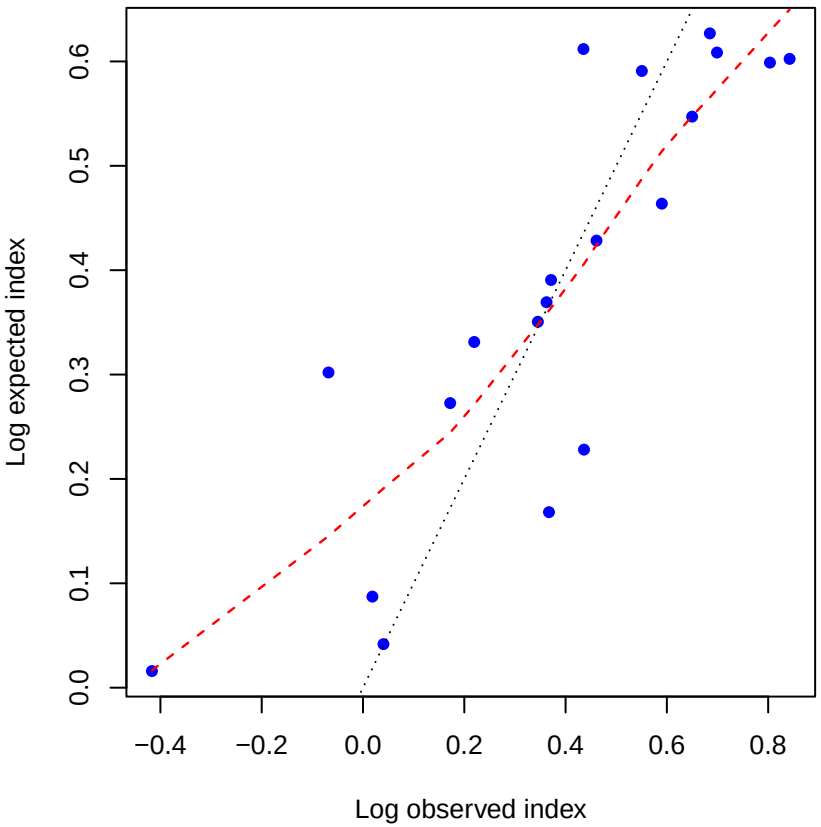

Expected index
Observed index
0.0
0.5
1.0
1.5
2.0

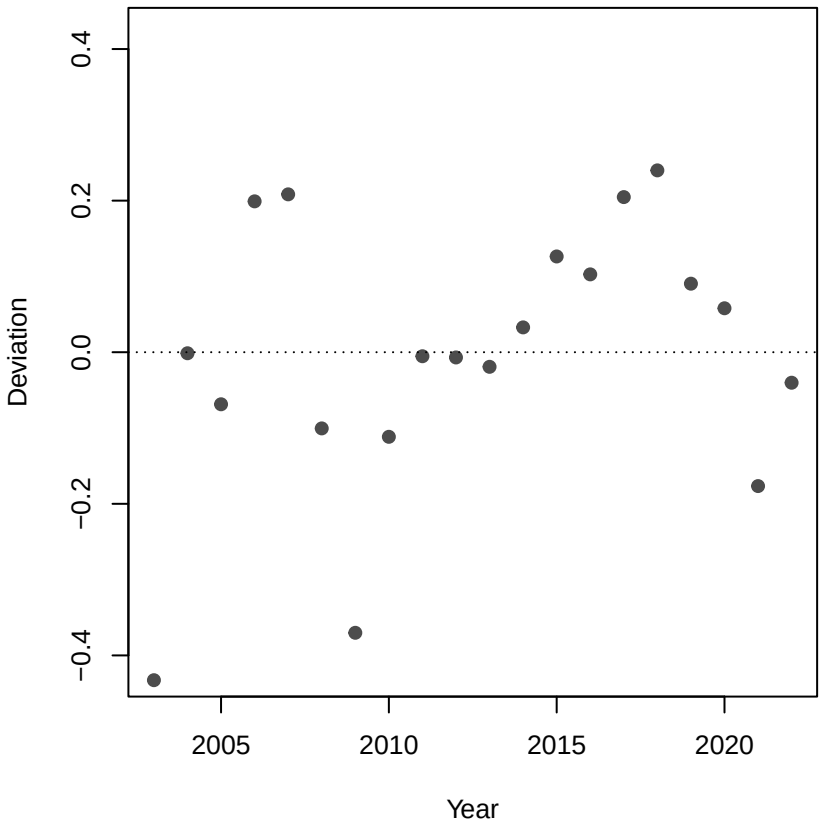

Index
Year
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2005
2010
2015
2020

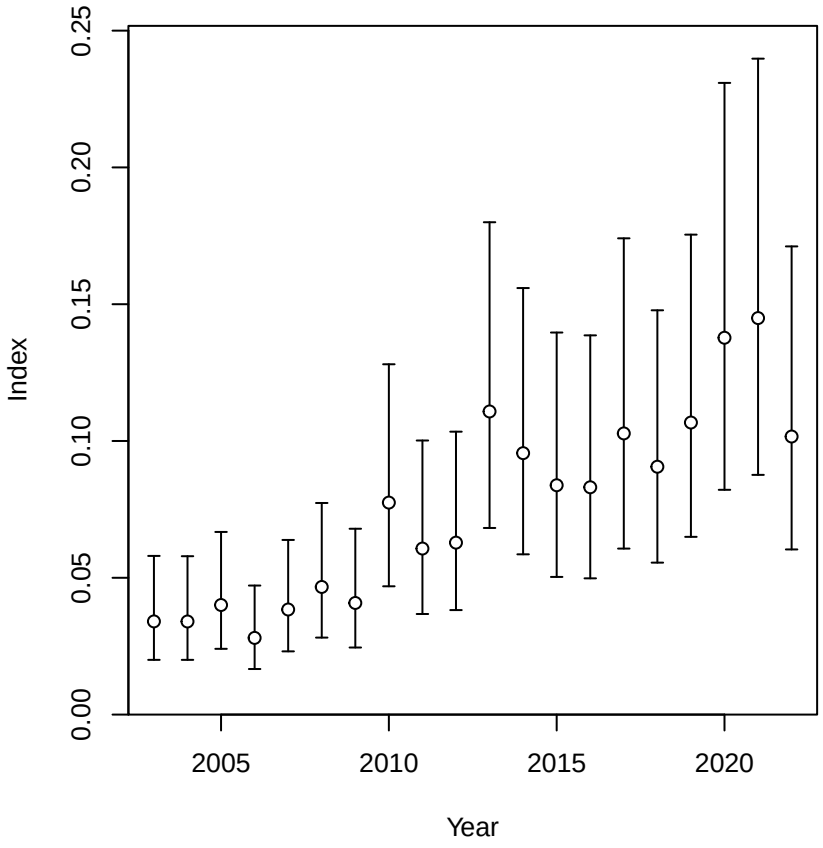

Log index
Year
−0.5
0.0
0.5
1.0
2005
2010
2015
2020

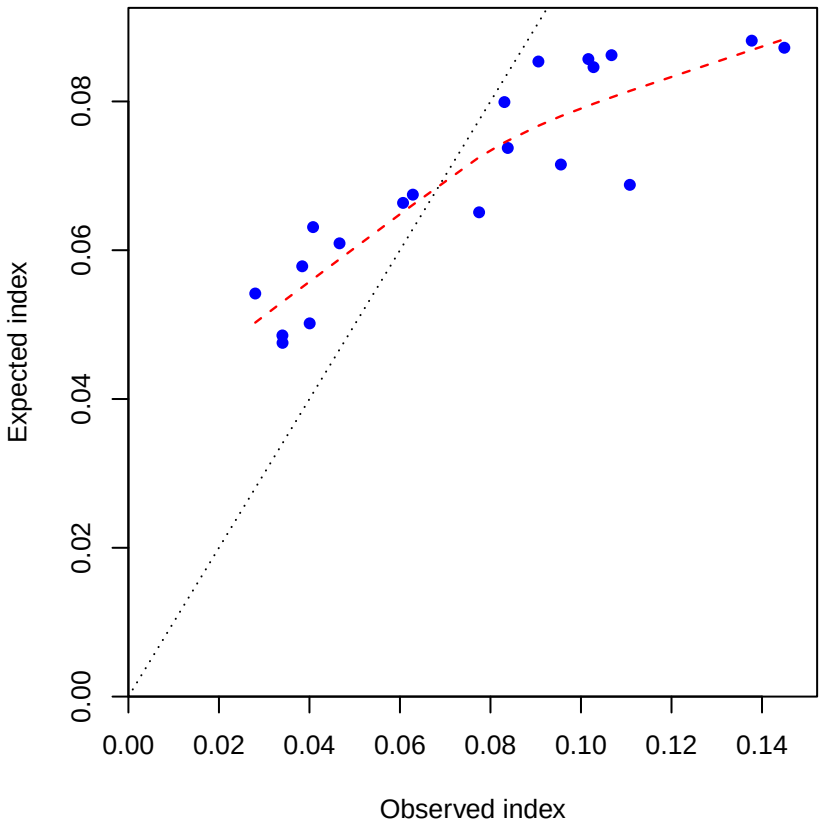

Log index
1.0
0.5
0.0
−0.5
2005
2010
2015
2020
Year

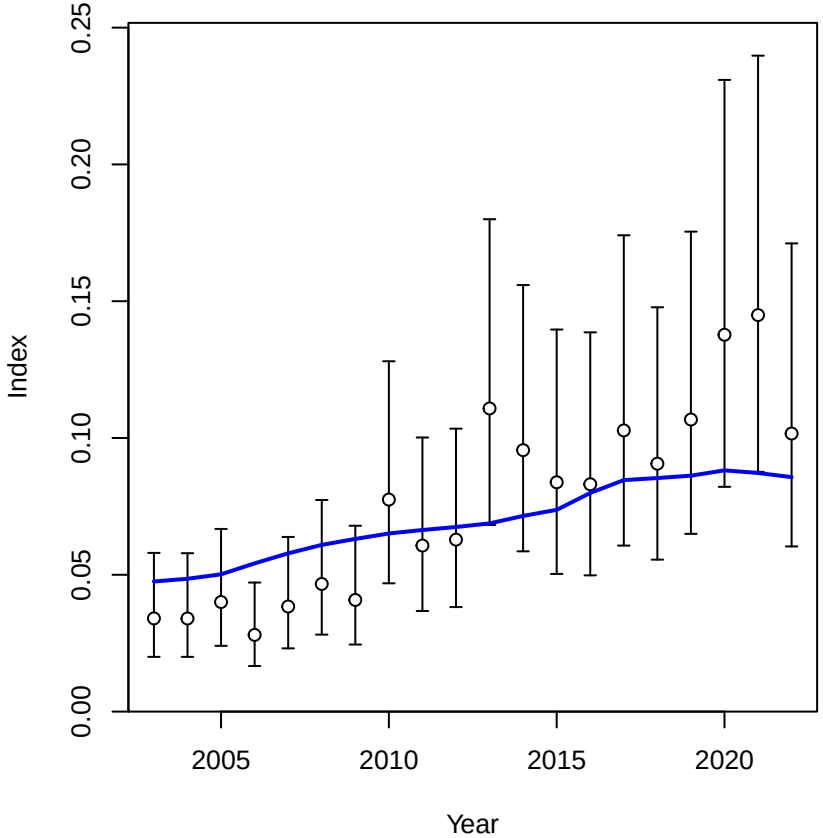

Residual
2
1
0
−1
−2
2005
2010
2015
2020
Year

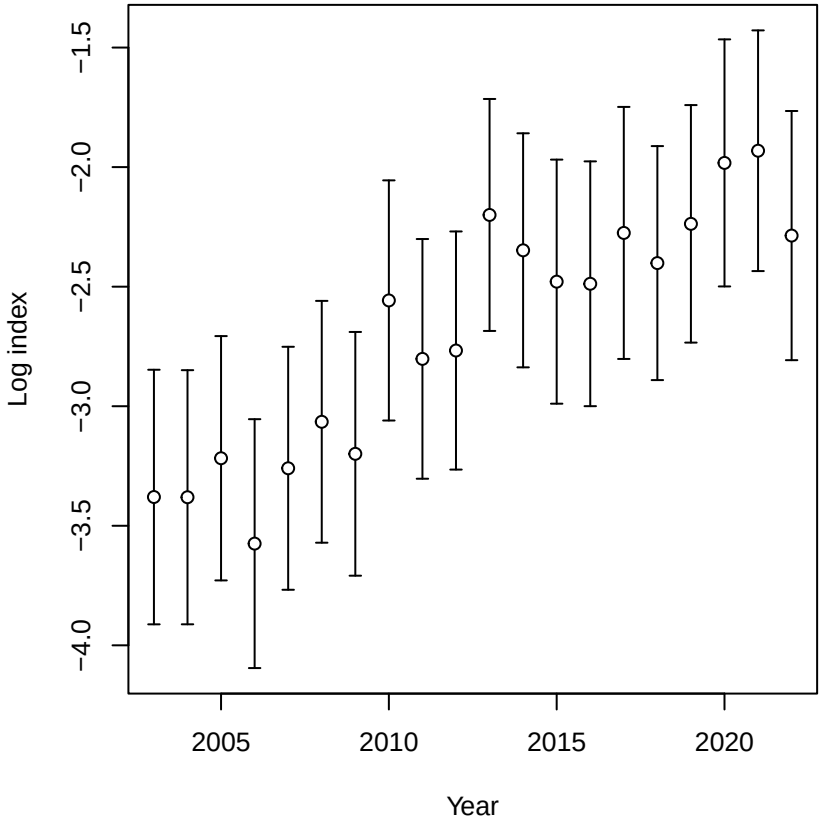

Log expected index
0.6
0.5
0.4
0.3
0.2
0.1
0.0
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
Log observed index

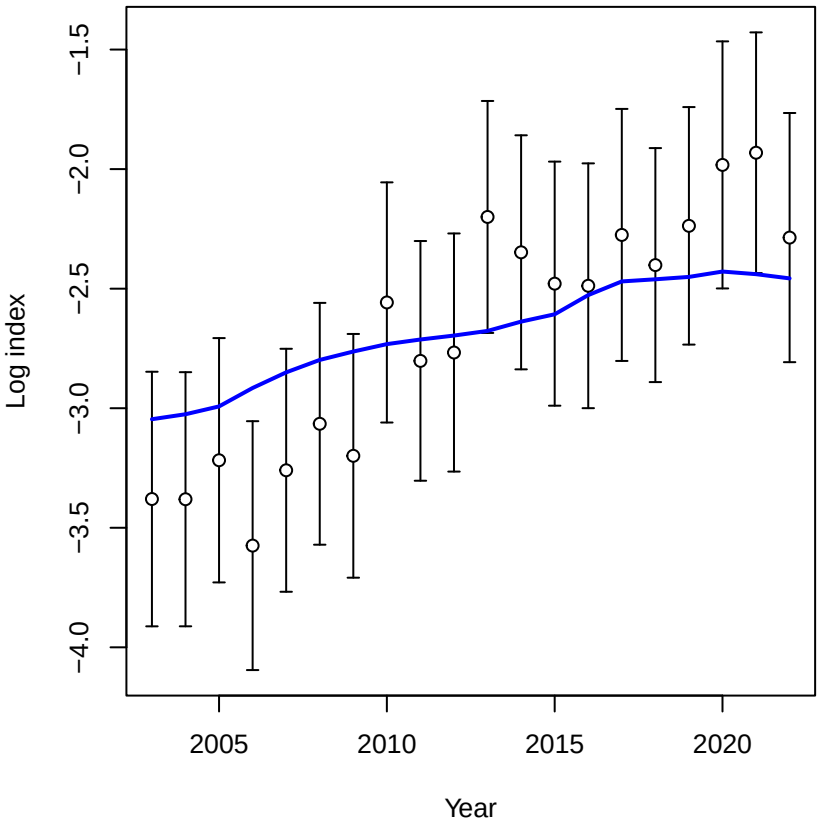

Deviation
0.4
0.2
0.0
−0.2
−0.4
2005
2010
2015
2020
Year

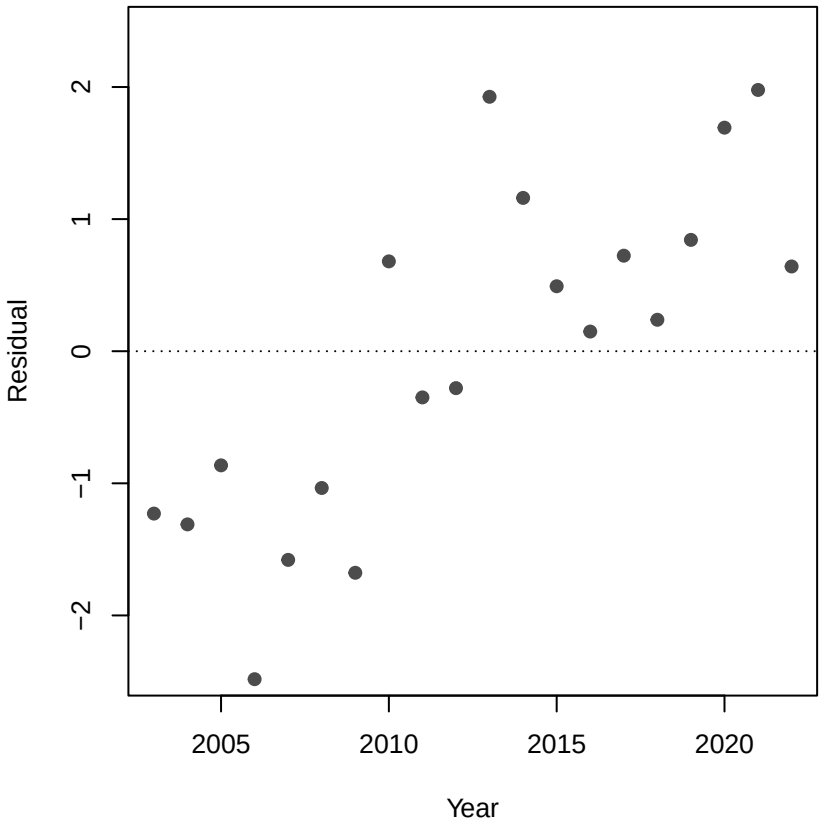

Index
0.00
0.05
0.10
0.15
0.20
0.25
2005
2010
2015
2020
Year

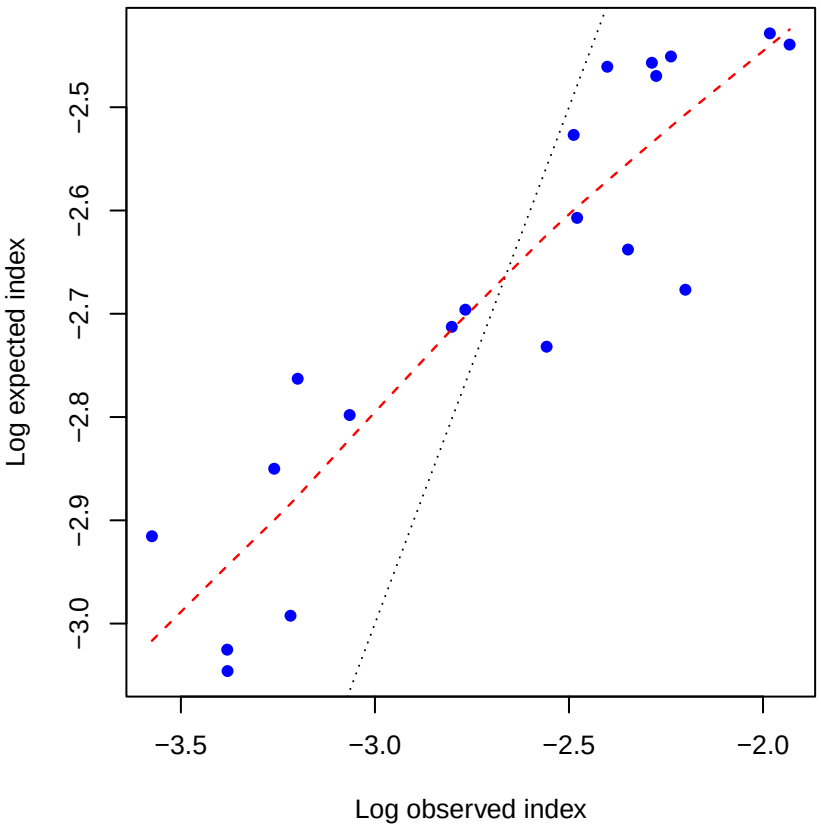

Expected index
0.00
0.02
0.04
0.06
0.08
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Observed index

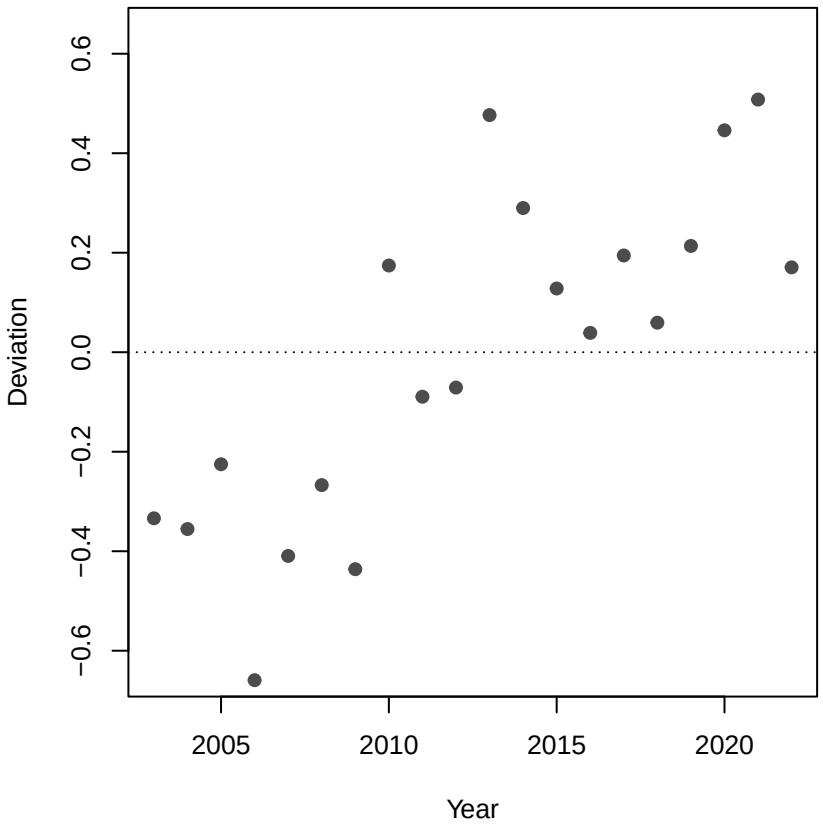

Index
0.00
0.05
0.10
0.15
0.20
0.25
2005
2010
2015
2020
Year

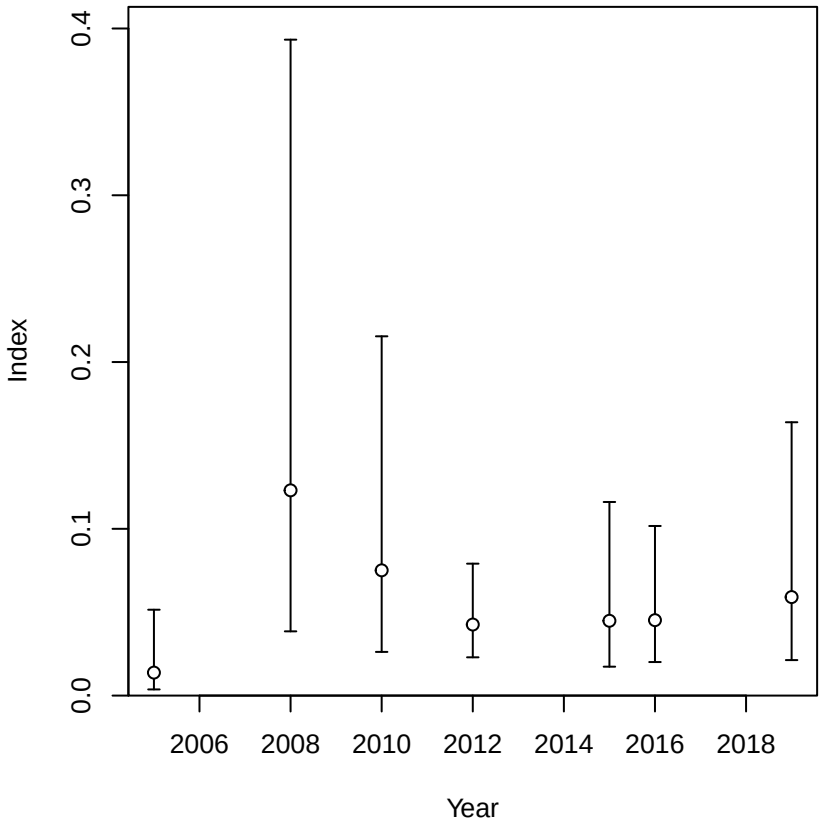

Log index
−4.0
−3.5
−3.0
−2.5
−2.0
−1.5
2005
2010
2015
2020
Year

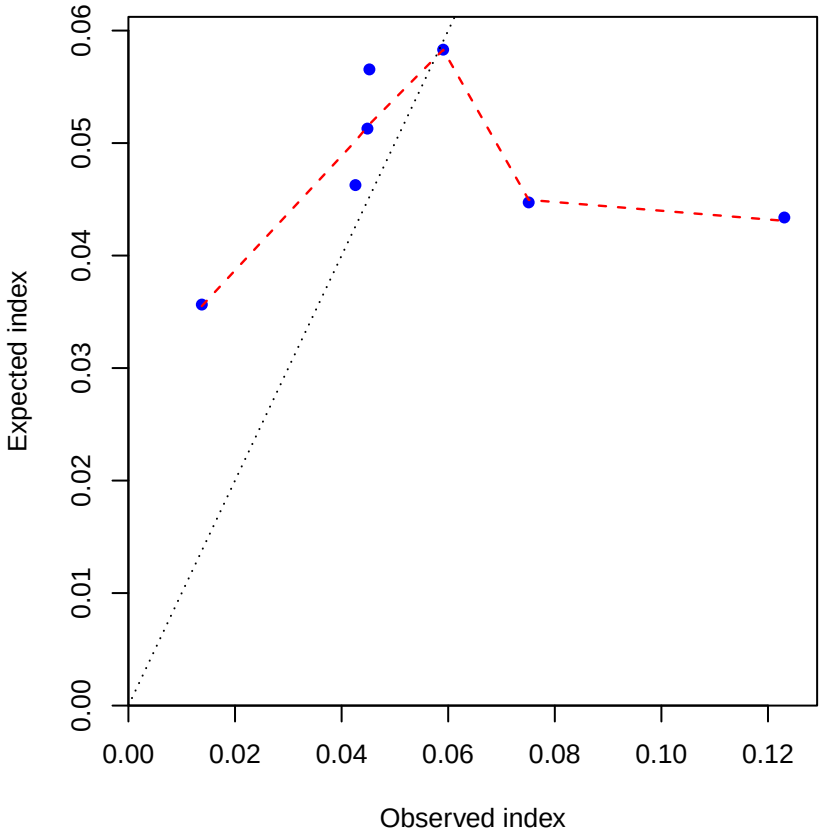

Log index
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
2005
2010
2015
2020
Year

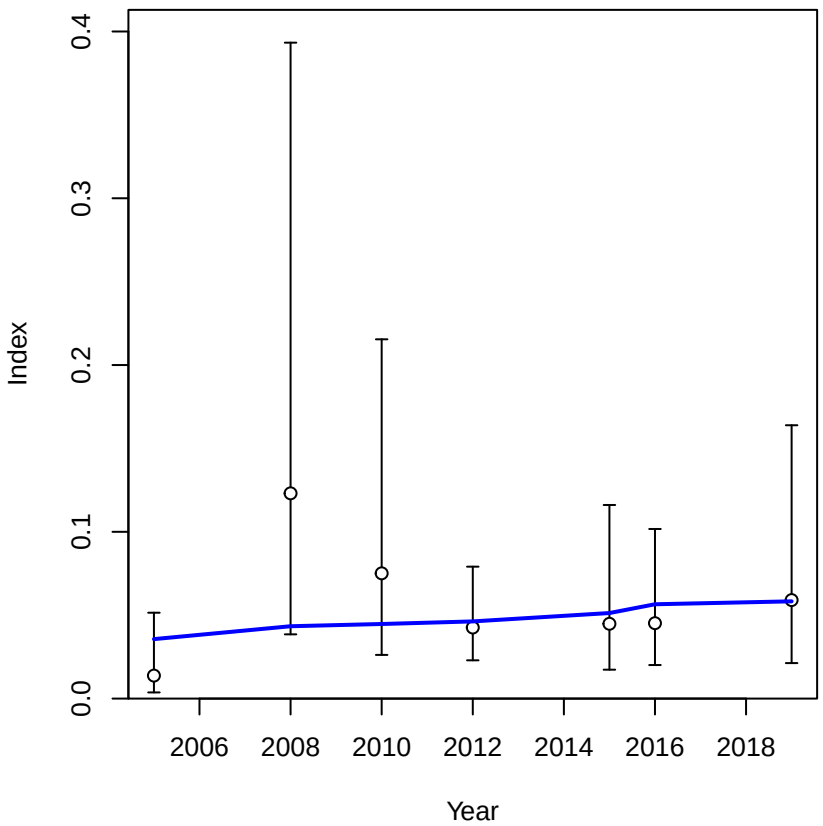

Residual
2
1
0
−1
−2
2005
2010
2015
2020
Year

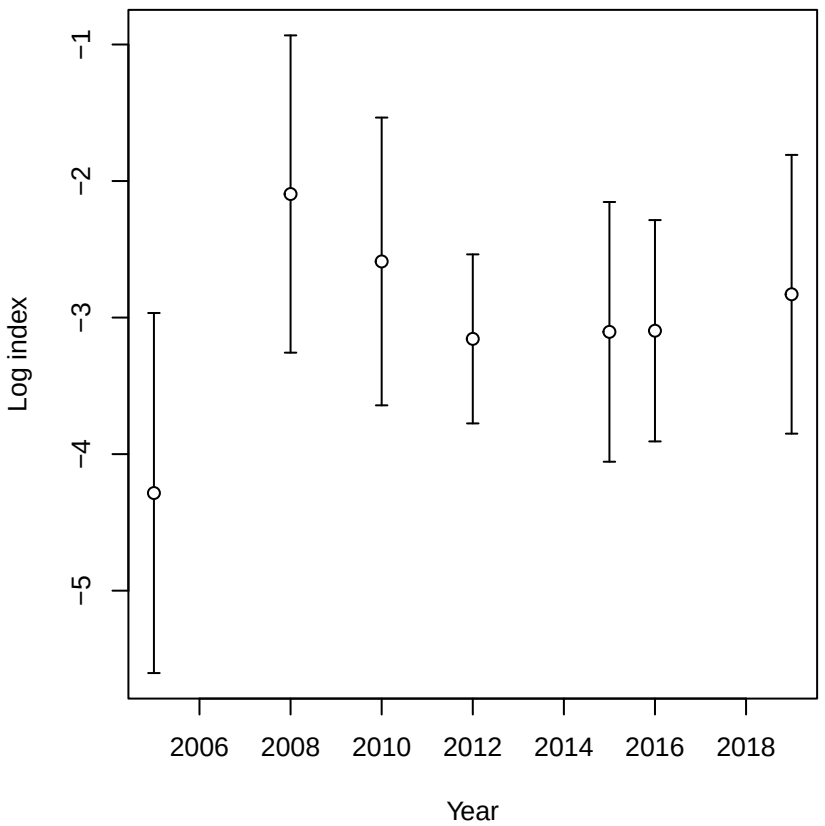

Log expected index
−2.5
−2.6
−2.7
−2.8
−2.9
−3.0
−3.5
−3.0
−2.5
−2.0
Log observed index

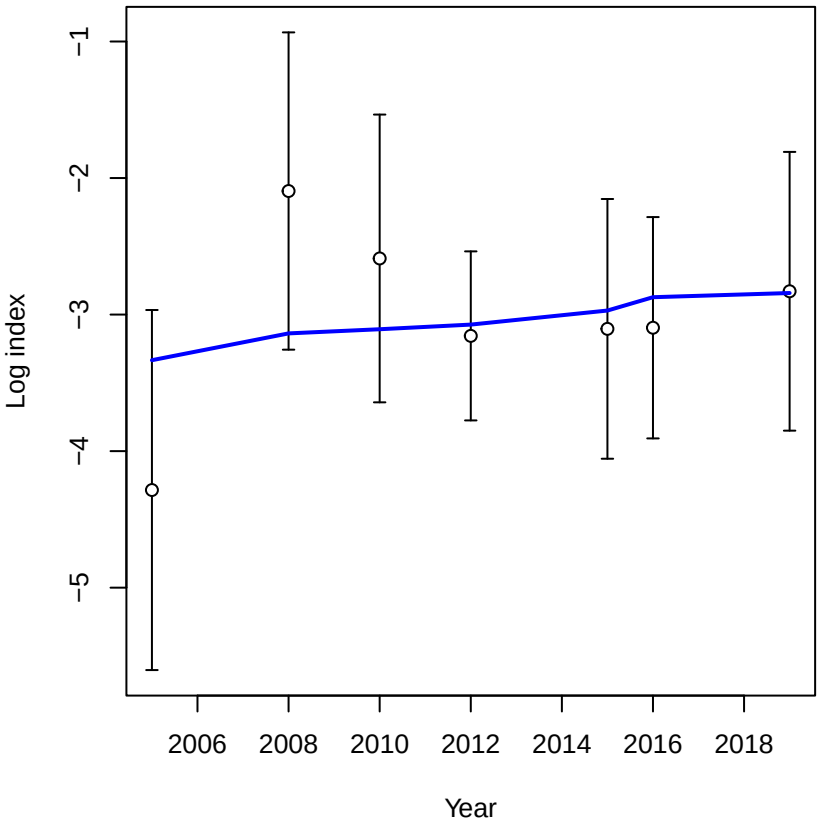

Deviation
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
2005
2010
2015
2020
Year

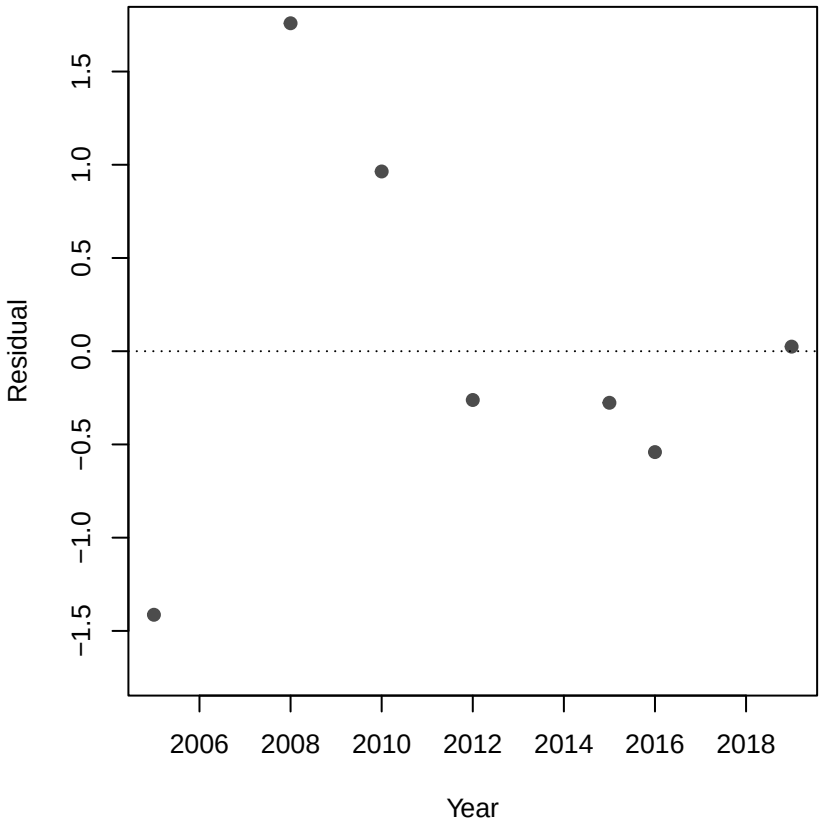

Index
0.0
0.1
0.2
0.3
0.4
2006
2008
2010
2012
2014
2016
2018
Year

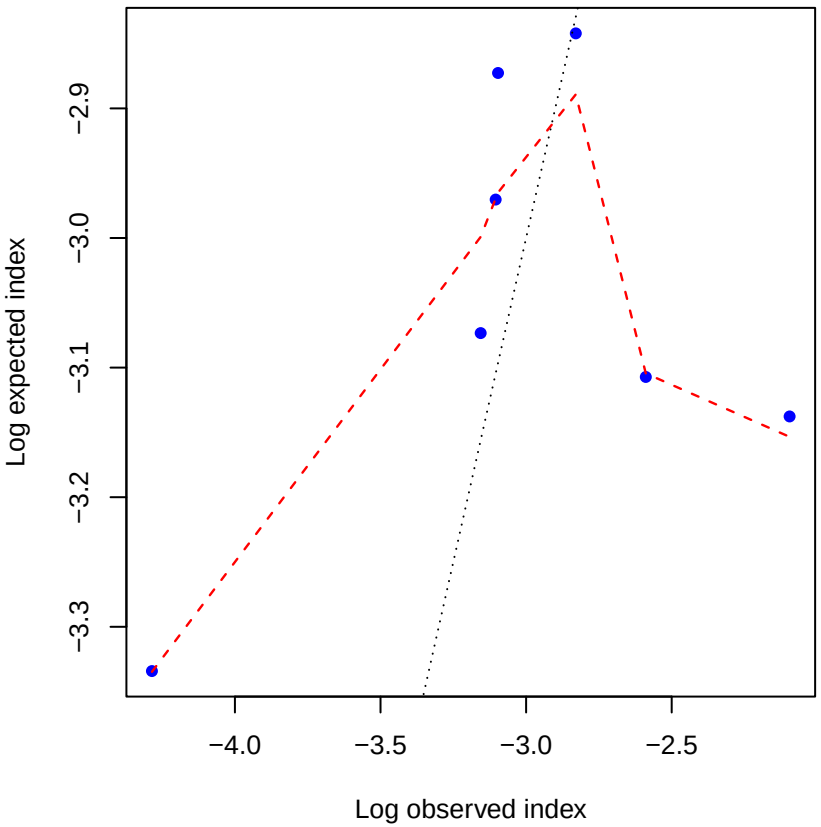

Expected index
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.00
0.02
0.04
0.06
0.08
0.10
0.12
Observed index

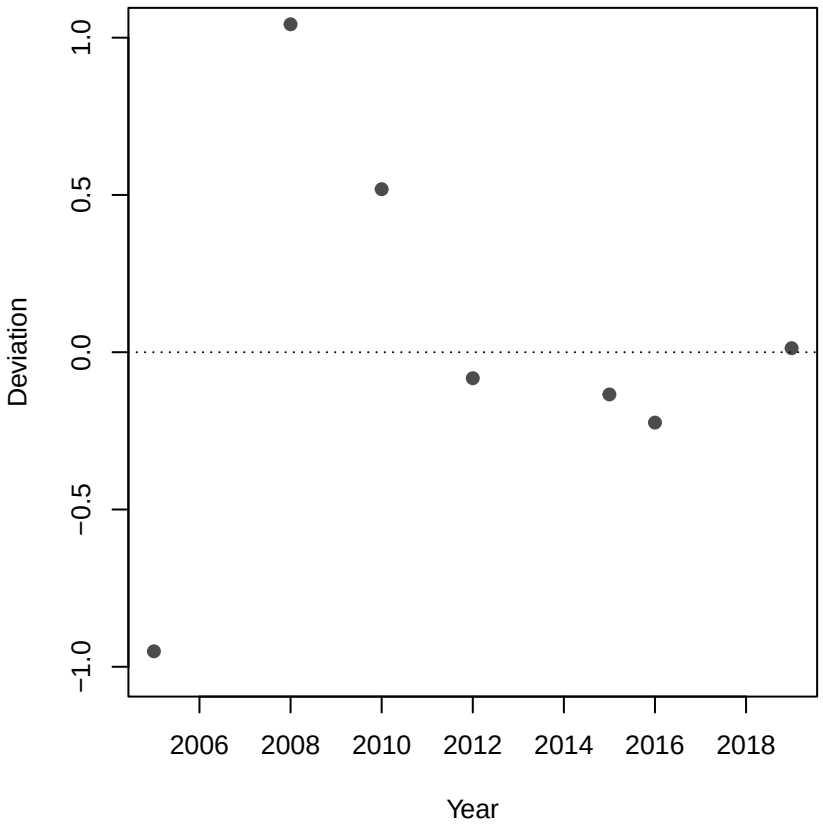

Index
0.0
0.1
0.2
0.3
0.4
2006
2008
2010
2012
2014
2016
2018
Year

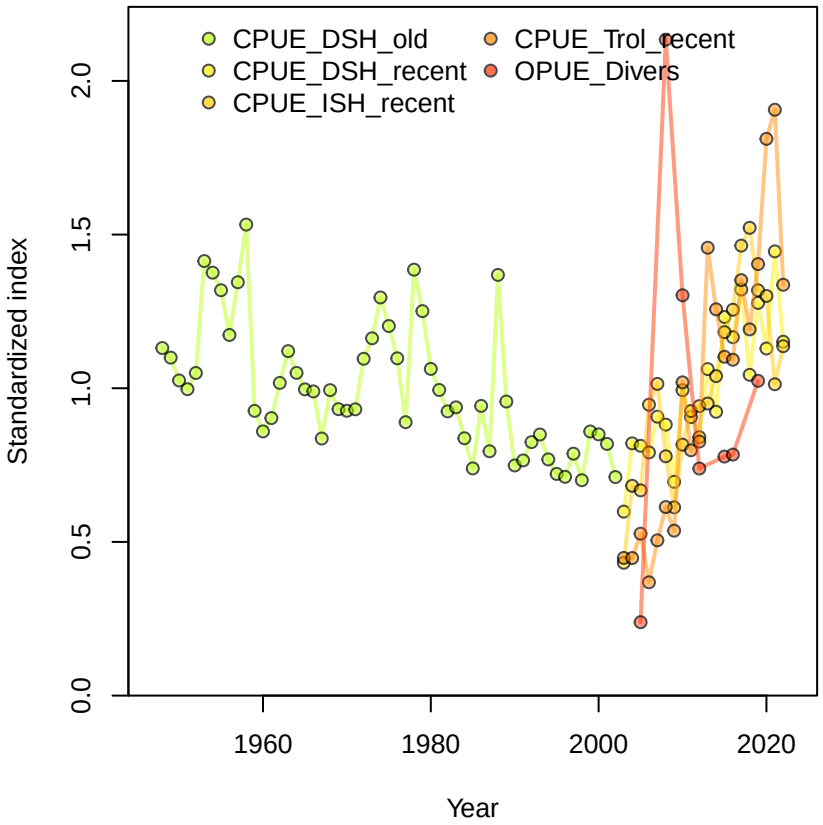

Log index
−1
−2
−3
−4
−5
2006
2008
2010
2012
2014
2016
2018
Year

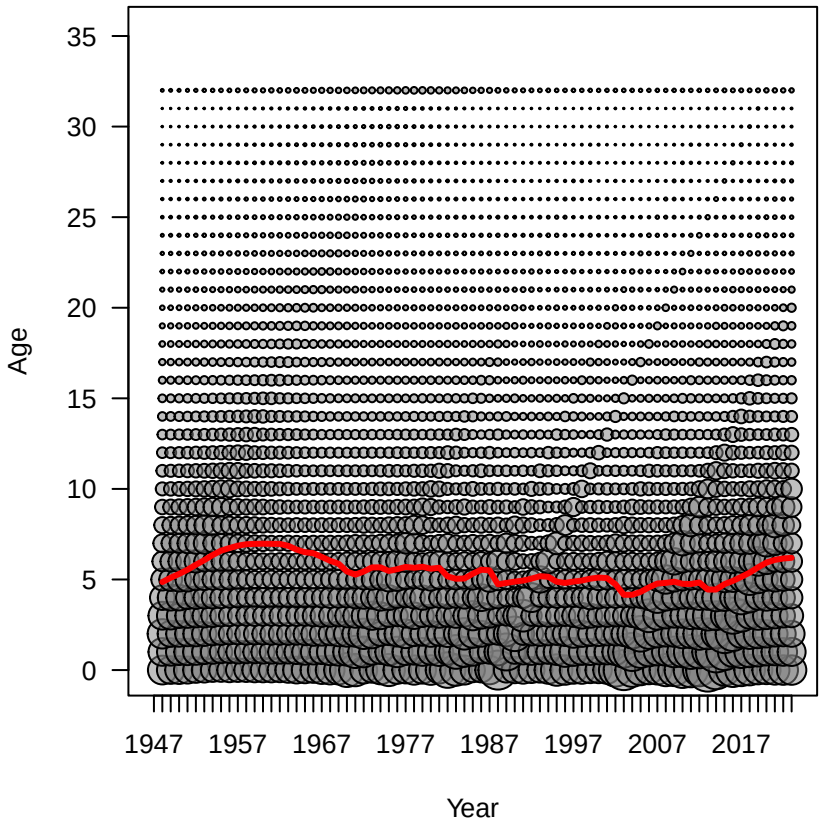

Log index
−1
−2
−3
−4
−5
2006
2008
2010
2012
2014
2016
2018
Year

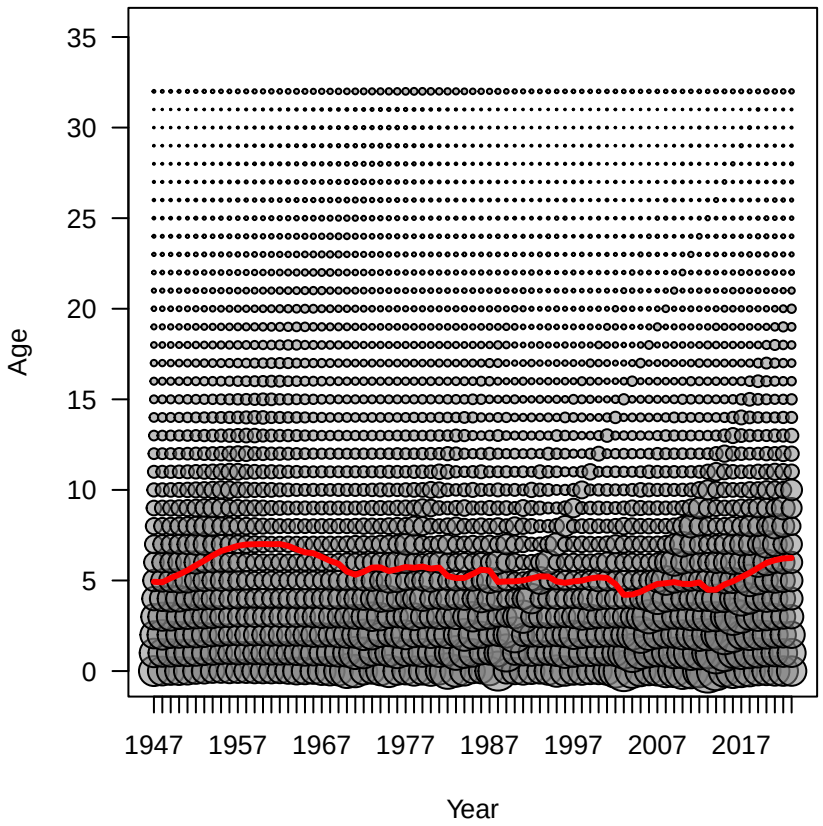

Residual
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
2006
2008
2010
2012
2014
2016
2018
Year

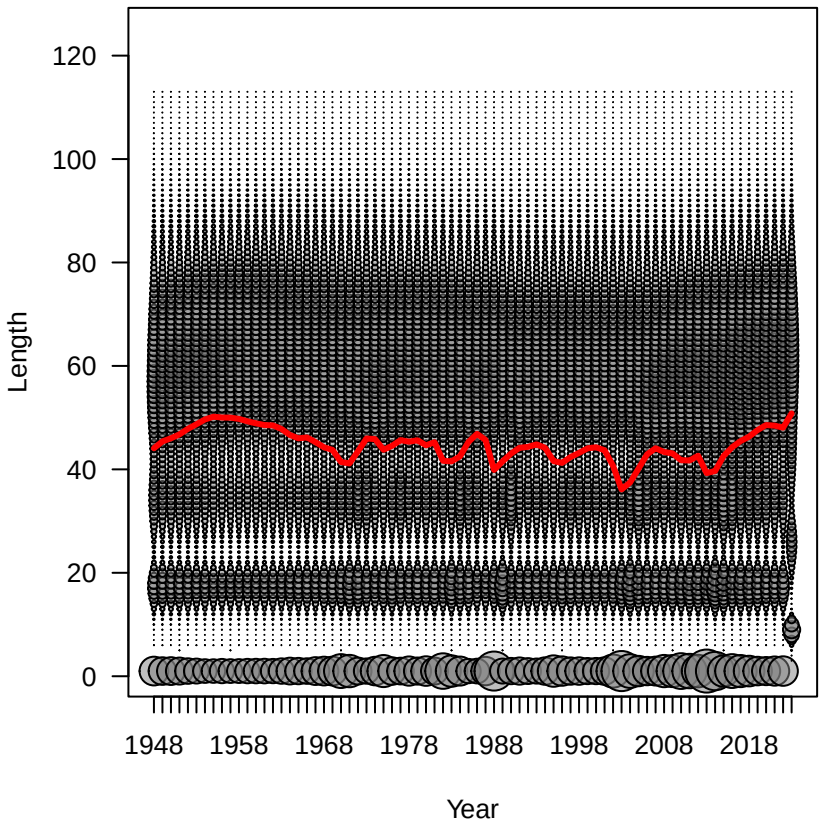

Log expected index
−2.9
−3.0
−3.1
−3.2
−3.3
−4.0
−3.5
−3.0
−2.5
Log observed index

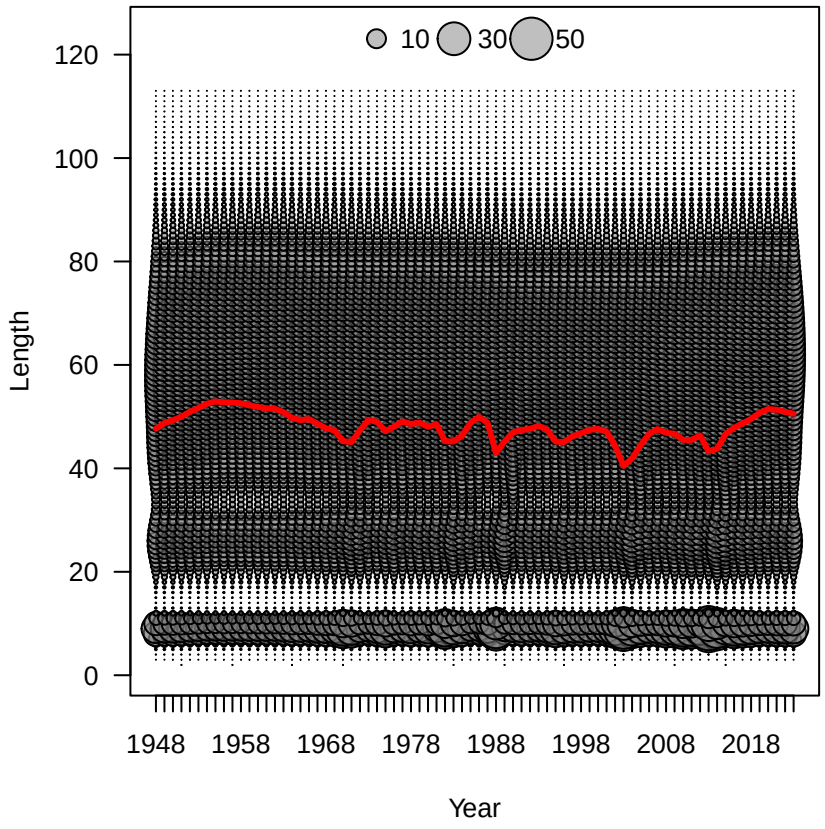

Deviation
1.0
0.5
0.0
−0.5
−1.0
2006
2008
2010
2012
2014
2016
2018
Year

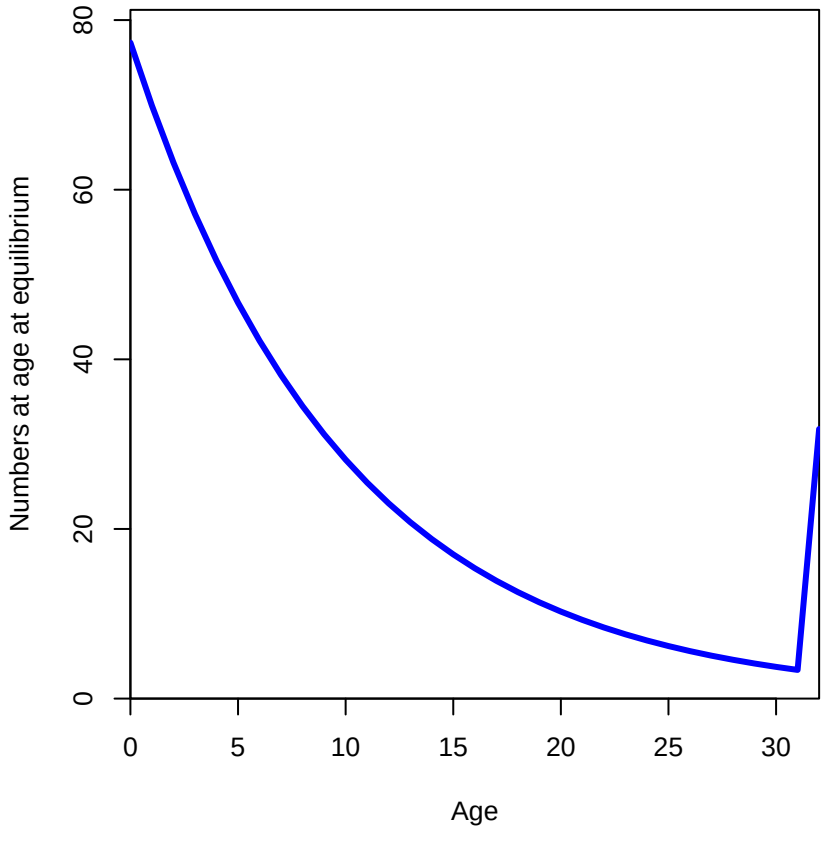

CPUE_DSH_old
CPUE_DSH_recent
CPUE_ISH_recent
CPUE_Trol_recent
OPUE_Divers
Standardized index
0.0
0.5
1.0
1.5
2.0
1960
1980
2000
2020
Year

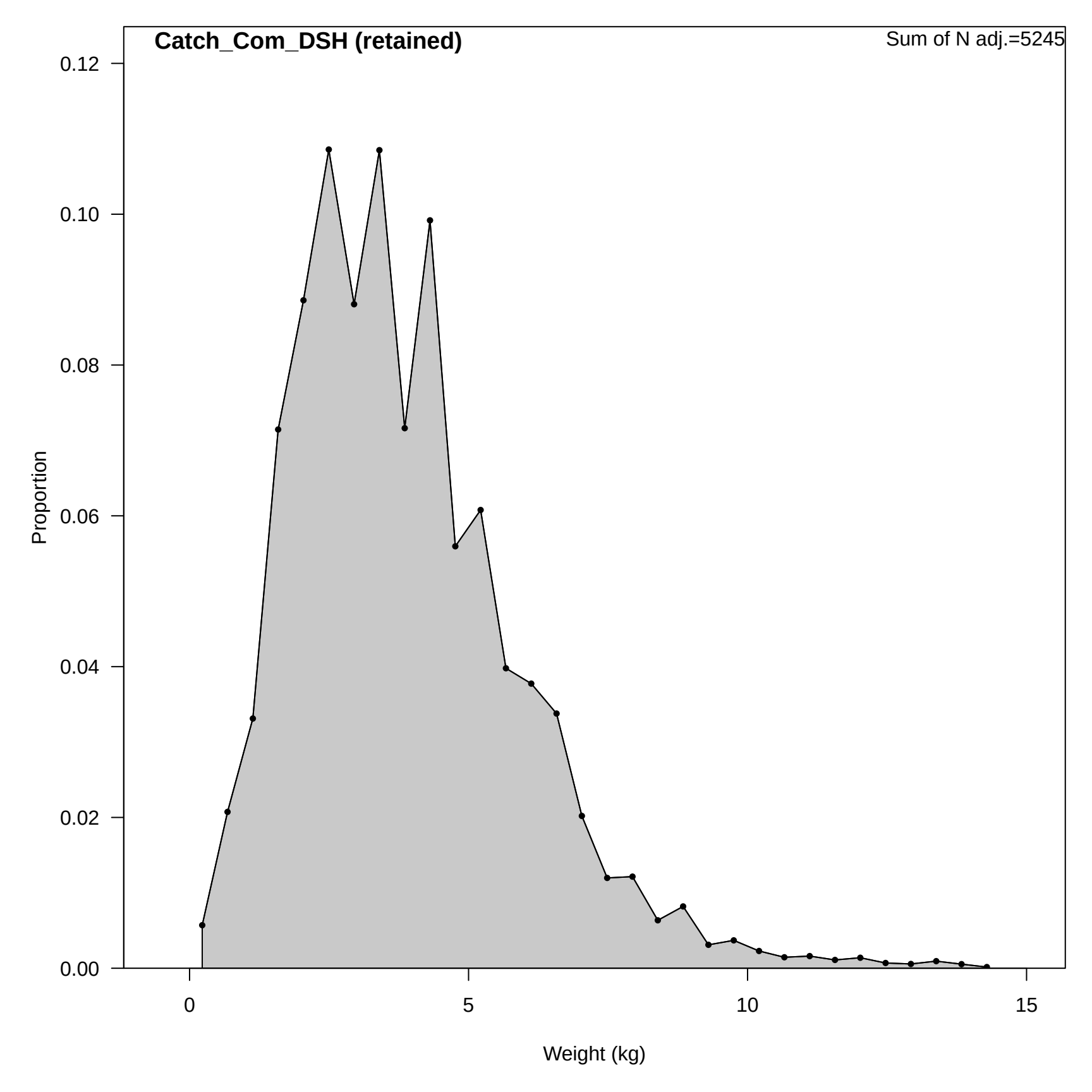

Age
0
5
10
15
20
25
30
35
1947
1957
1967
1977
1987
1997
2007
2017
Year

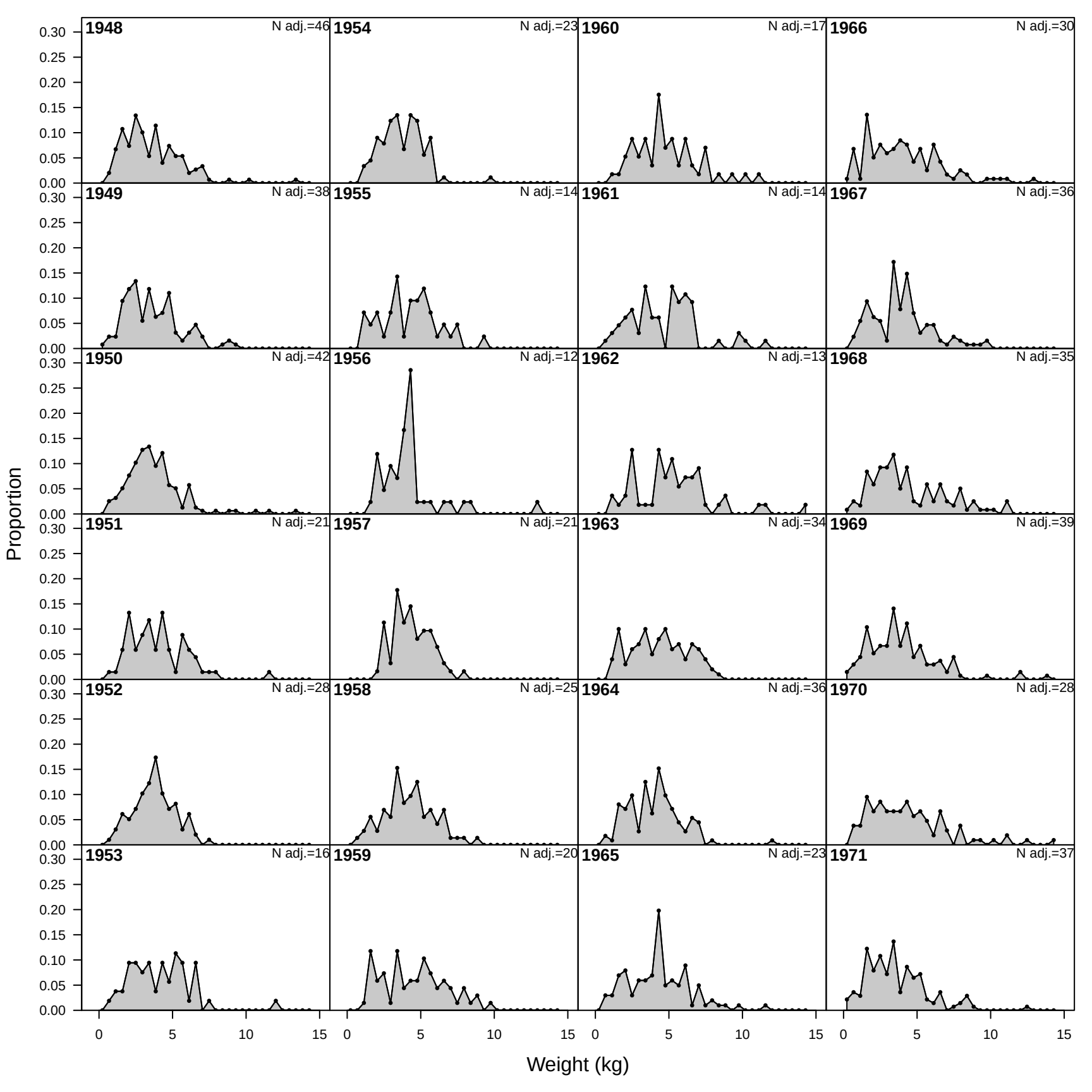

Age
0
5
10
15
20
25
30
35
1947
1957
1967
1977
1987
1997
2007
2017
Year

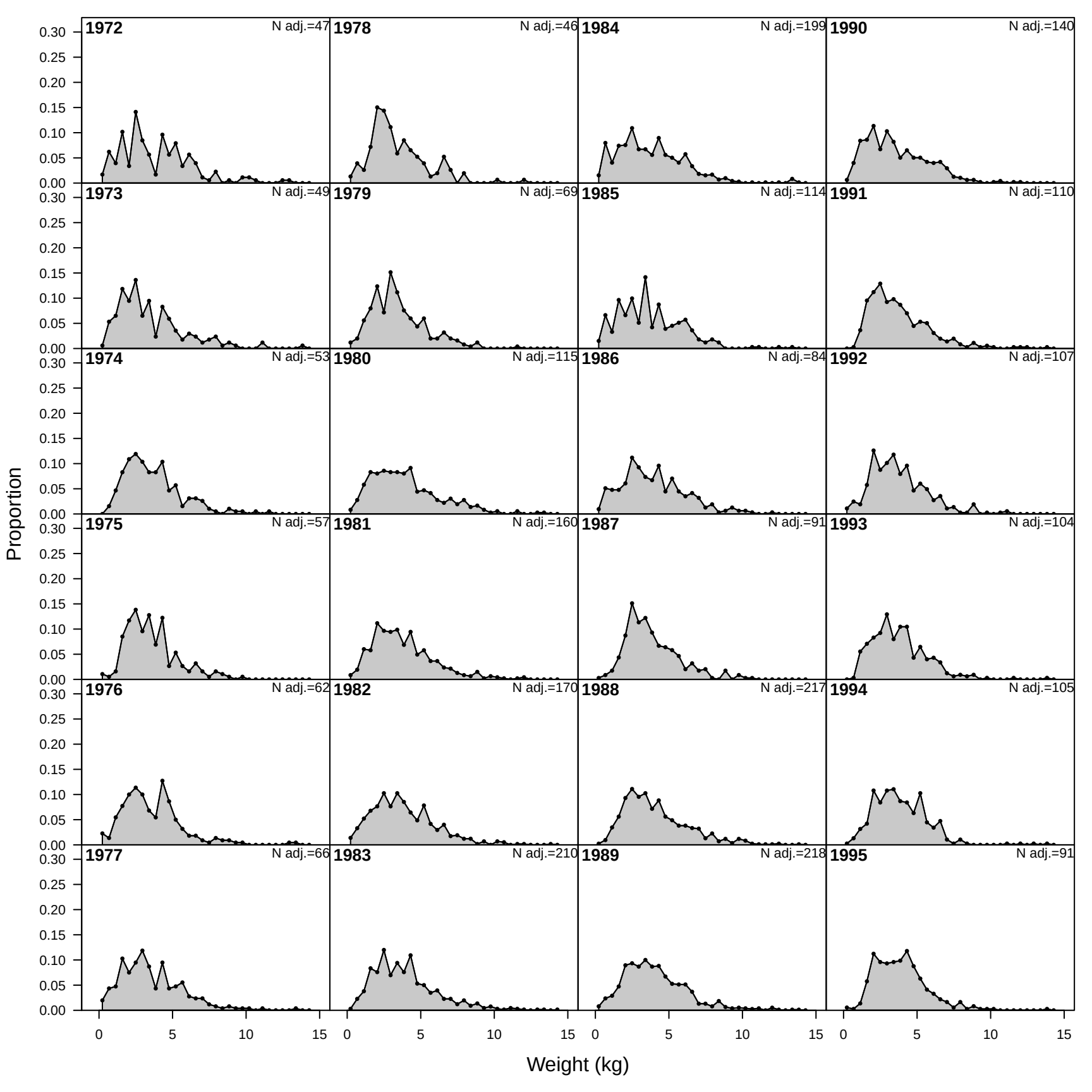

Length
0
20
40
60
80
100
120
1948
1958
1968
1978
1988
1998
2008
2018
Year

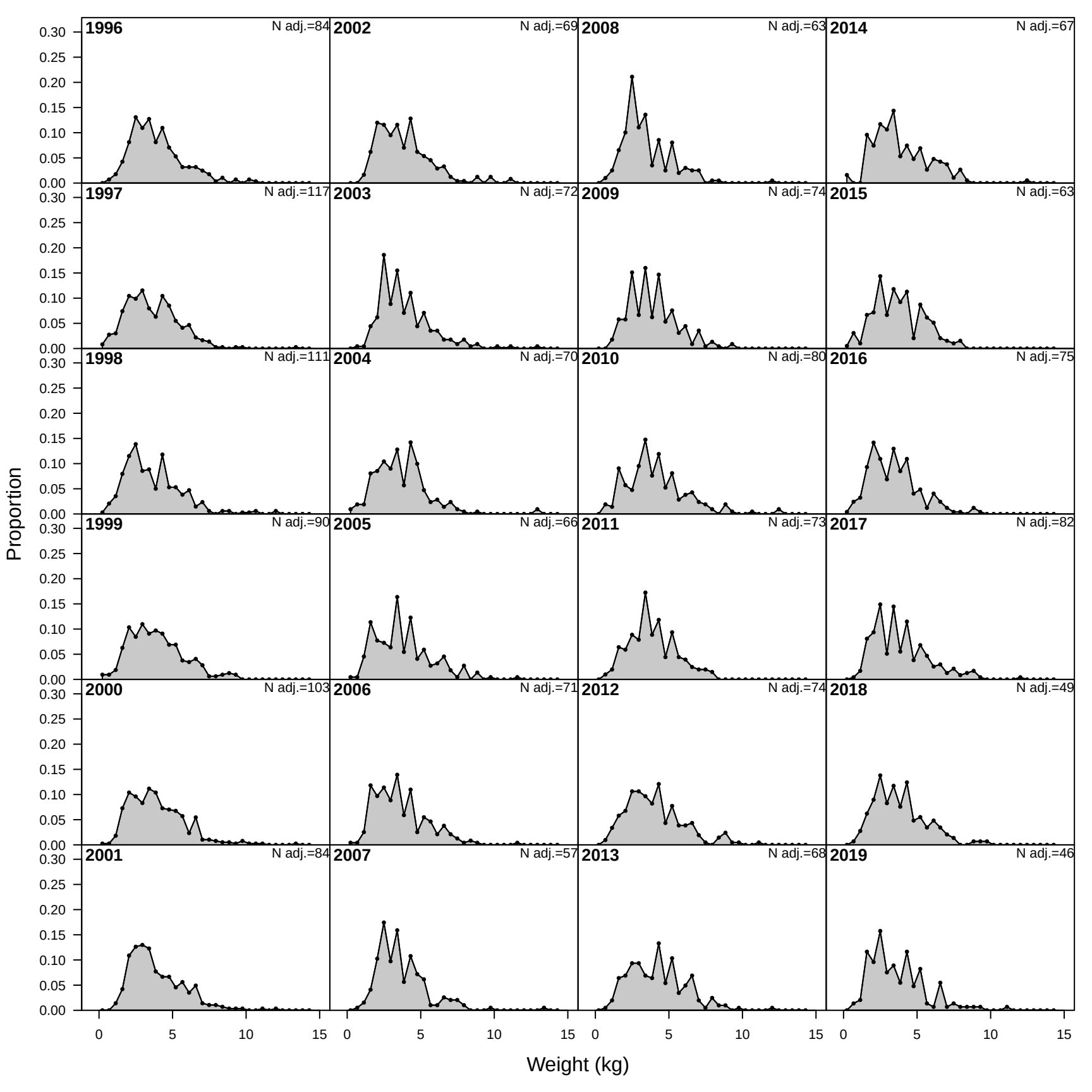

10
30
50
120
100
80
60
40
20
0
Length
1948
1958
1968
1978
1988
1998
2008
2018
Year

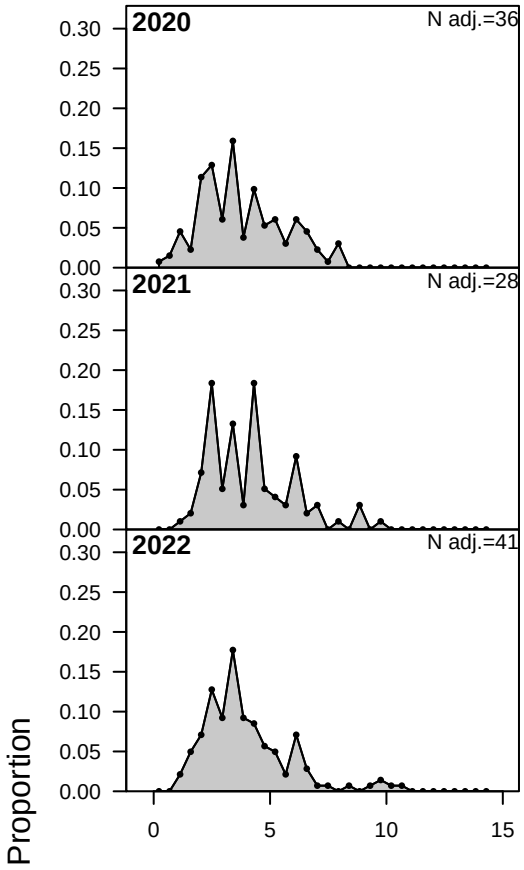

80
60
40
20
0
Numbers at age at equilibrium
0
5
10
15
20
25
30
Age

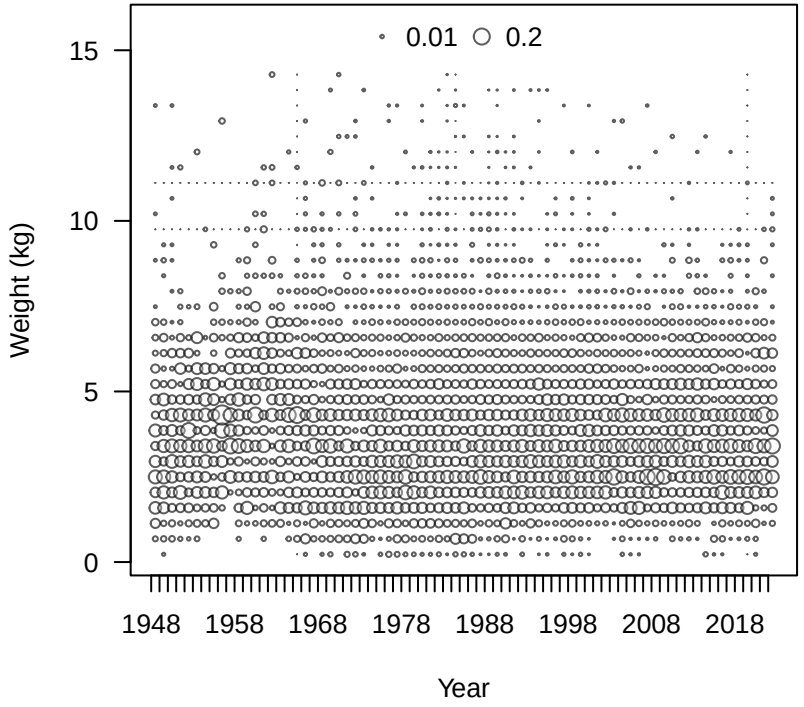

Catch_Com_DSH (retained)
Sum of N adj.=5245
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Proportion
0
5
10
15
Weight (kg)

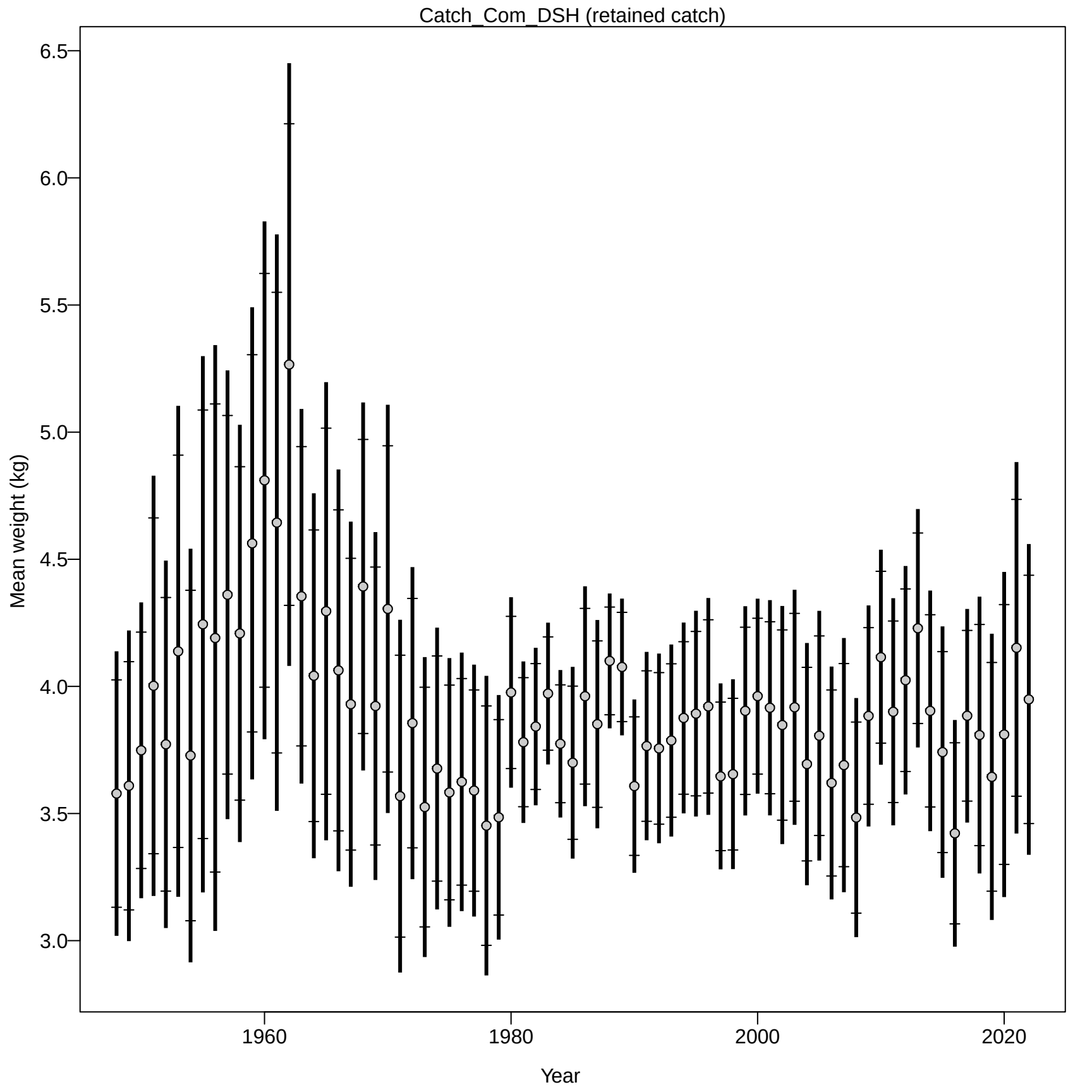

1948 N adj.=46
1954 N adj.=23
1960 N adj.=17
1966 N adj.=30
1949 N adj.=38
1955 N adj.=14
1961 N adj.=14
1967 N adj.=36
1950 N adj.=42
1956 N adj.=12
1962 N adj.=13
1968 N adj.=35
1951 N adj.=21
1957 N adj.=21
1963 N adj.=34
1969 N adj.=39
1952 N adj.=28
1958 N adj.=25
1964 N adj.=36
1970 N adj.=28
1953 N adj.=16
1959 N adj.=20
1965 N adj.=23
1971 N adj.=37
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

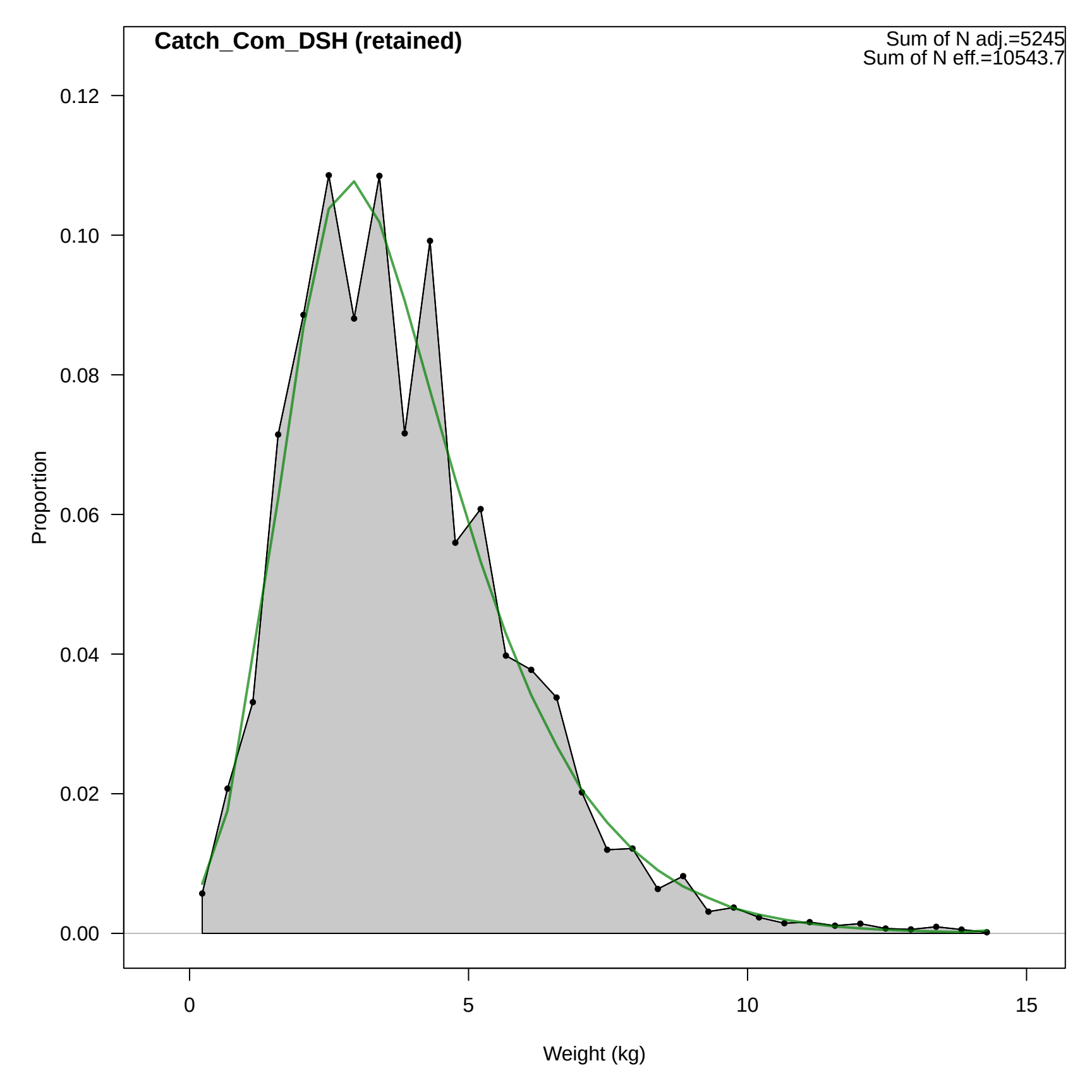

1972 N adj.=47
1978 N adj.=46
1984 N adj.=199
1990 N adj.=140
1973 N adj.=49
1979 N adj.=69
1985 N adj.=114
1991 N adj.=110
1974 N adj.=53
1980 N adj.=115
1986 N adj.=84
1992 N adj.=107
1975 N adj.=57
1981 N adj.=160
1987 N adj.=91
1993 N adj.=104
1976 N adj.=62
1982 N adj.=170
1988 N adj.=217
1994 N adj.=105
1977 N adj.=66
1983 N adj.=210
1989 N adj.=218
1995 N adj.=91
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

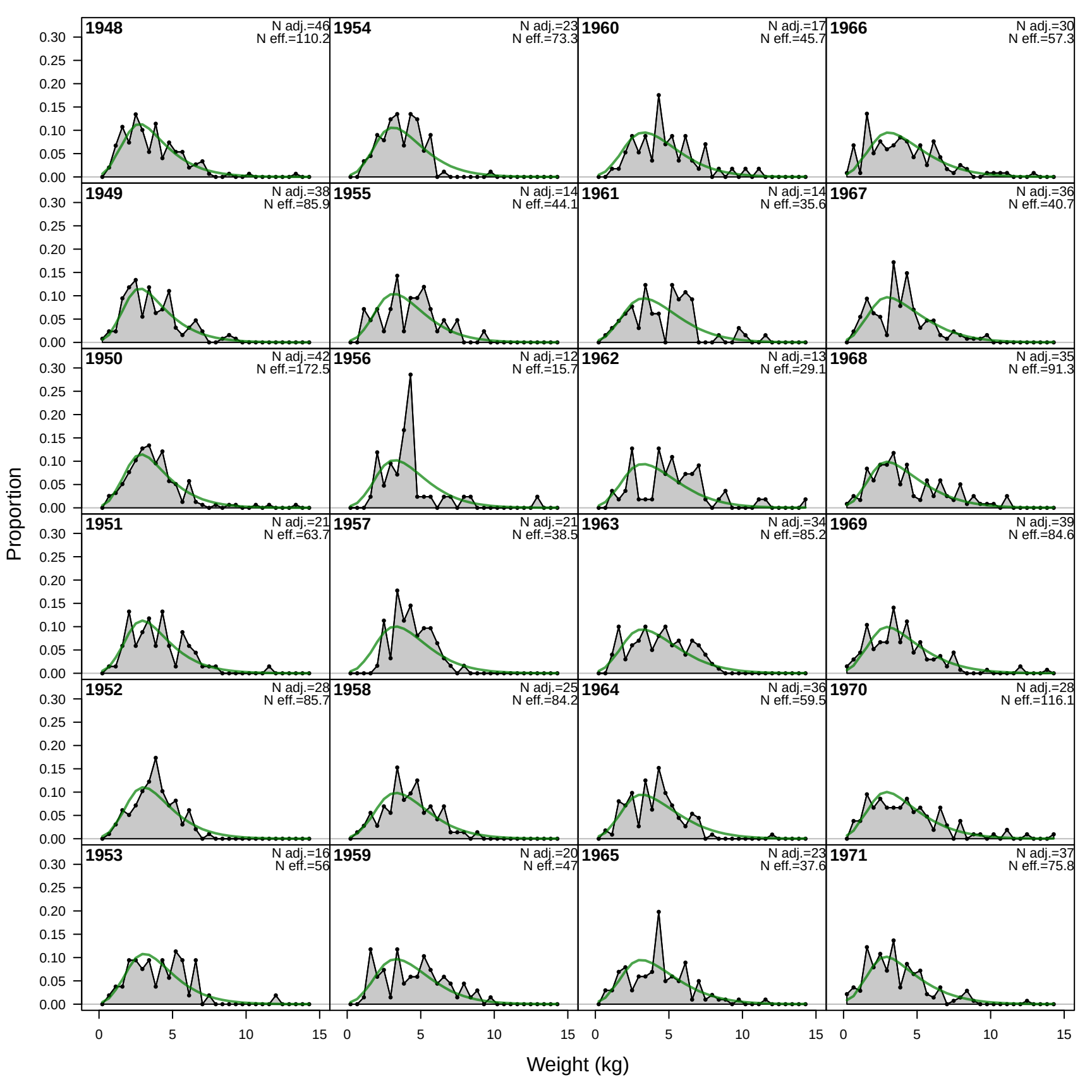

1996 N adj.=84
2002 N adj.=69
2008 N adj.=63
2014 N adj.=67
1997 N adj.=117
2003 N adj.=72
2009 N adj.=74
2015 N adj.=63
1998 N adj.=111
2004 N adj.=70
2010 N adj.=80
2016 N adj.=75
1999 N adj.=90
2005 N adj.=66
2011 N adj.=73
2017 N adj.=82
2000 N adj.=103
2006 N adj.=71
2012 N adj.=74
2018 N adj.=49
2001 N adj.=84
2007 N adj.=57
2013 N adj.=68
2019 N adj.=46
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

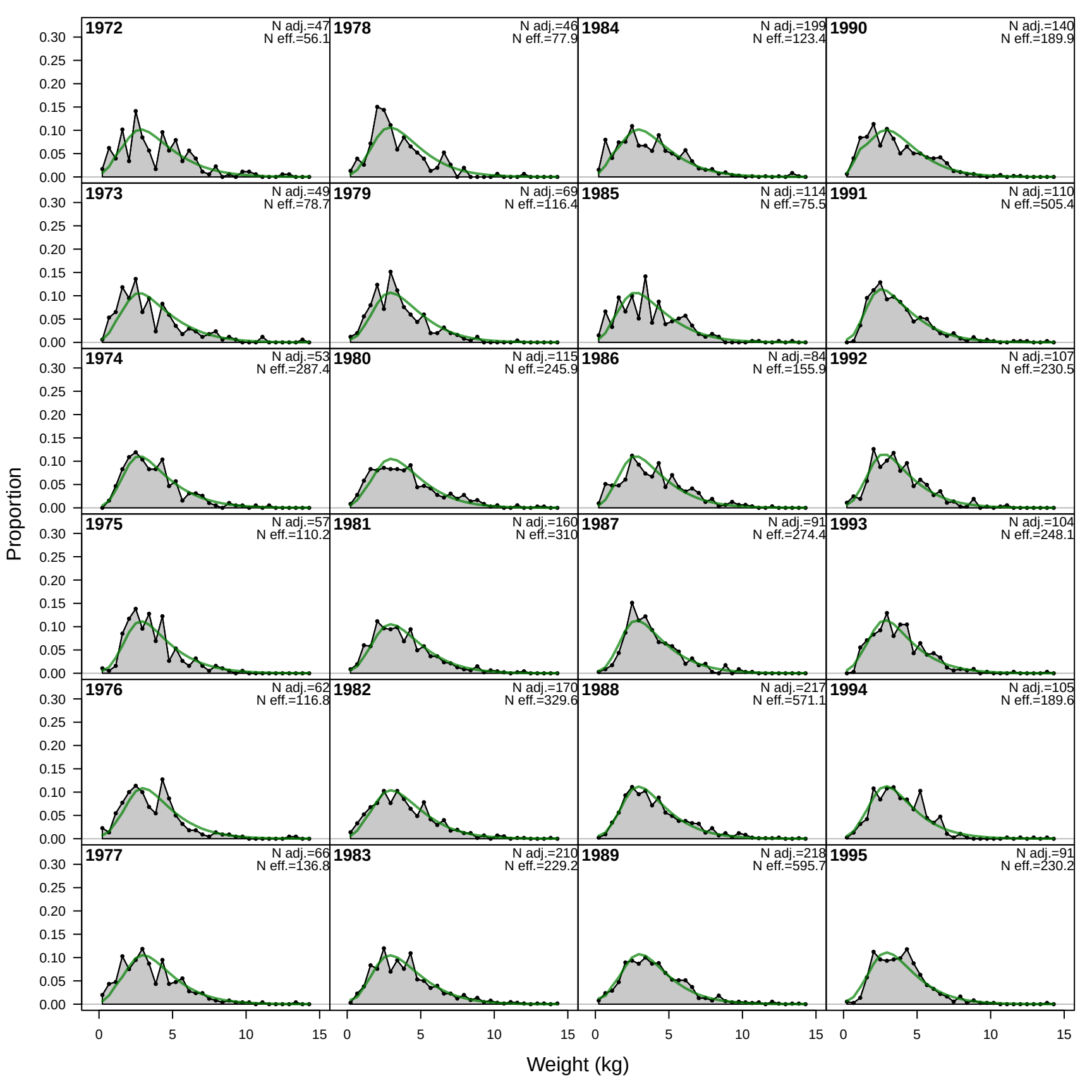

2020
N adj.=36
2021
N adj.=28
2022
N adj.=41
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
Proportion
Weight (kg)

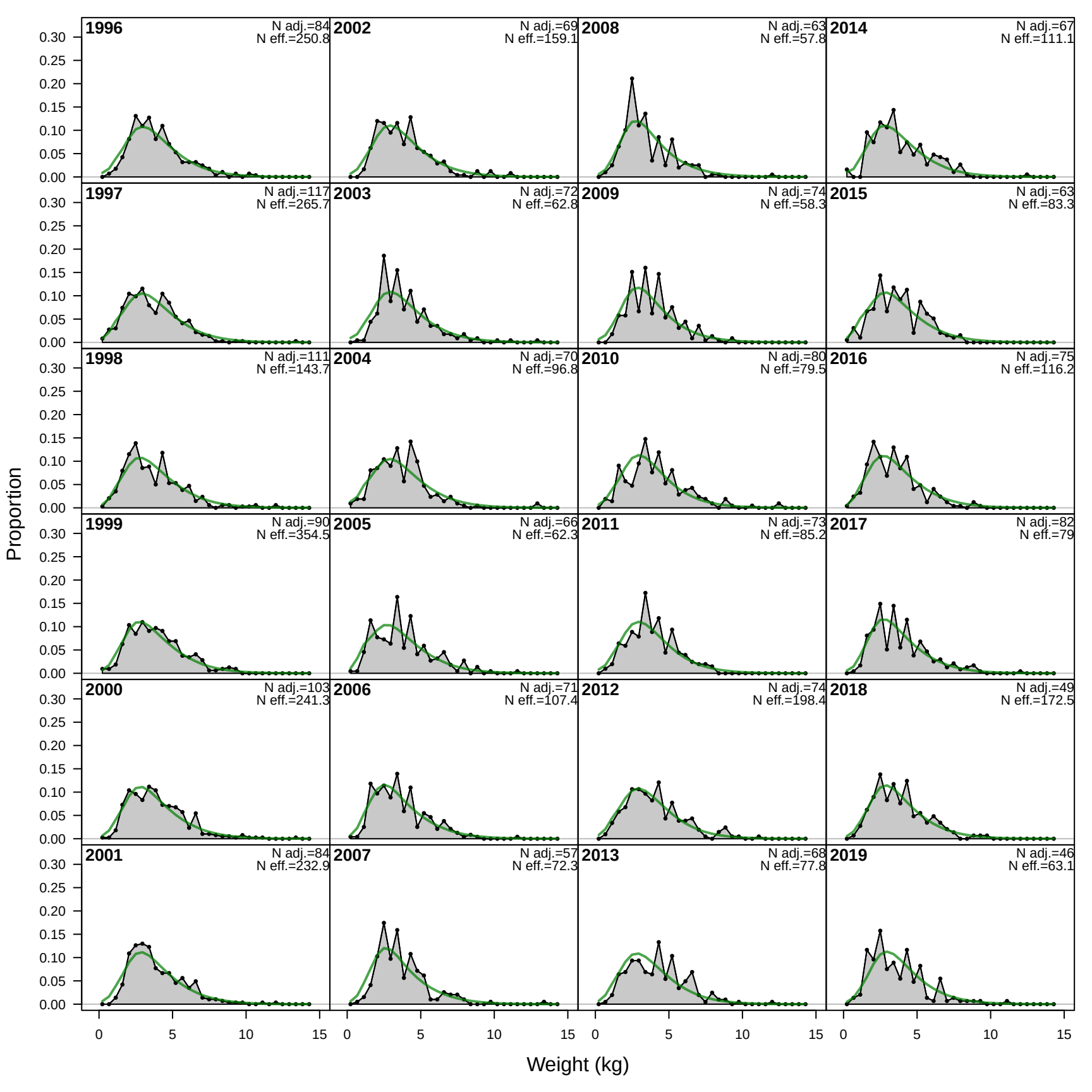

0.01
0.2
15
10
5
0
Weight (kg)
1948
1958
1968
1978
1988
1998
2008
2018
Year

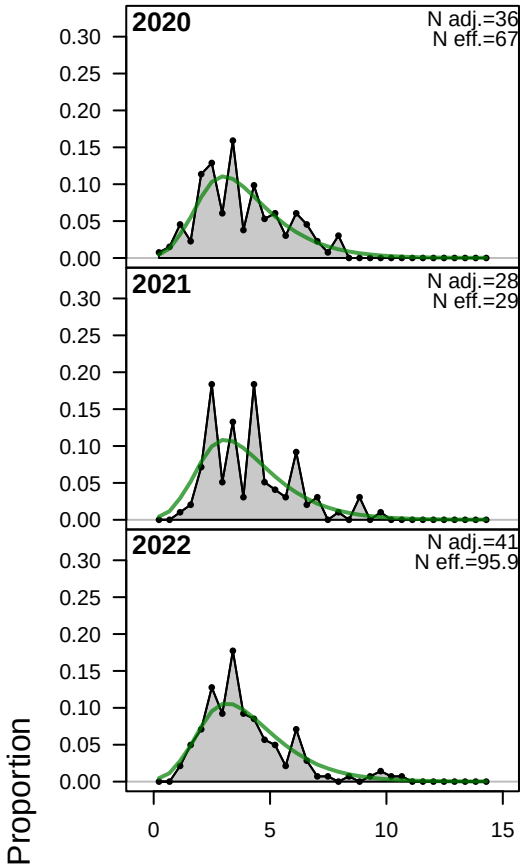

Catch_Com_DSH (retained catch)
Mean weight (kg)
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1960
1980
2000
2020
Year

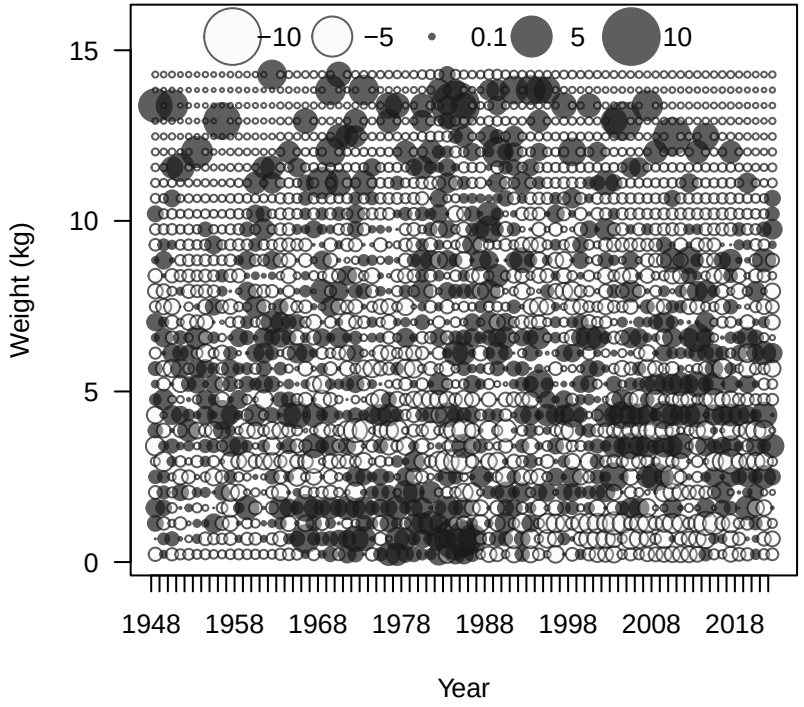

Catch_Com_DSH (retained)
Sum of N adj.=5245
Sum of N eff.=10543.7
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Proportion
0
5
10
15
Weight (kg)

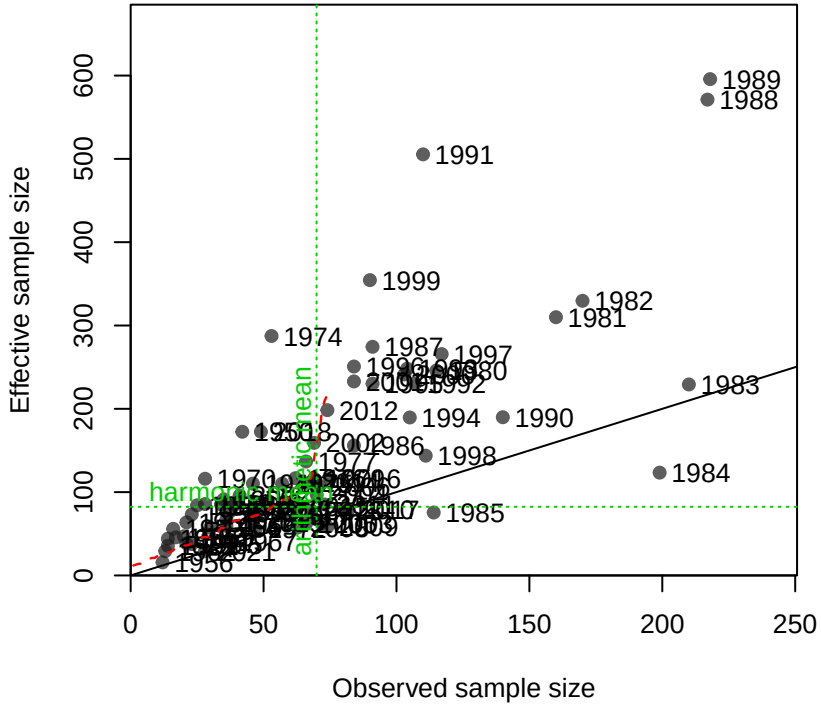

1948
N adj.=46
N eff.=110.2
1954
N adj.=23
N eff.=73.3
1960
N adj.=17
N eff.=45.7
1966
N adj.=30
N eff.=57.3
1949
N adj.=38
N eff.=85.9
1955
N adj.=14
N eff.=44.1
1961
N adj.=14
N eff.=35.6
1967
N adj.=36
N eff.=40.7
1950
N adj.=42
N eff.=172.5
1956
N adj.=12
N eff.=15.7
1962
N adj.=13
N eff.=29.1
1968
N adj.=35
N eff.=91.3
1951
N adj.=21
N eff.=63.7
1957
N adj.=21
N eff.=38.5
1963
N adj.=34
N eff.=85.2
1969
N adj.=39
N eff.=84.6
1952
N adj.=28
N eff.=85.7
1958
N adj.=25
N eff.=84.2
1964
N adj.=36
N eff.=59.5
1970
N adj.=28
N eff.=116.1
1953
N adj.=16
N eff.=56
1959
N adj.=20
N eff.=47
1965
N adj.=23
N eff.=37.6
1971
N adj.=37
N eff.=75.8
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

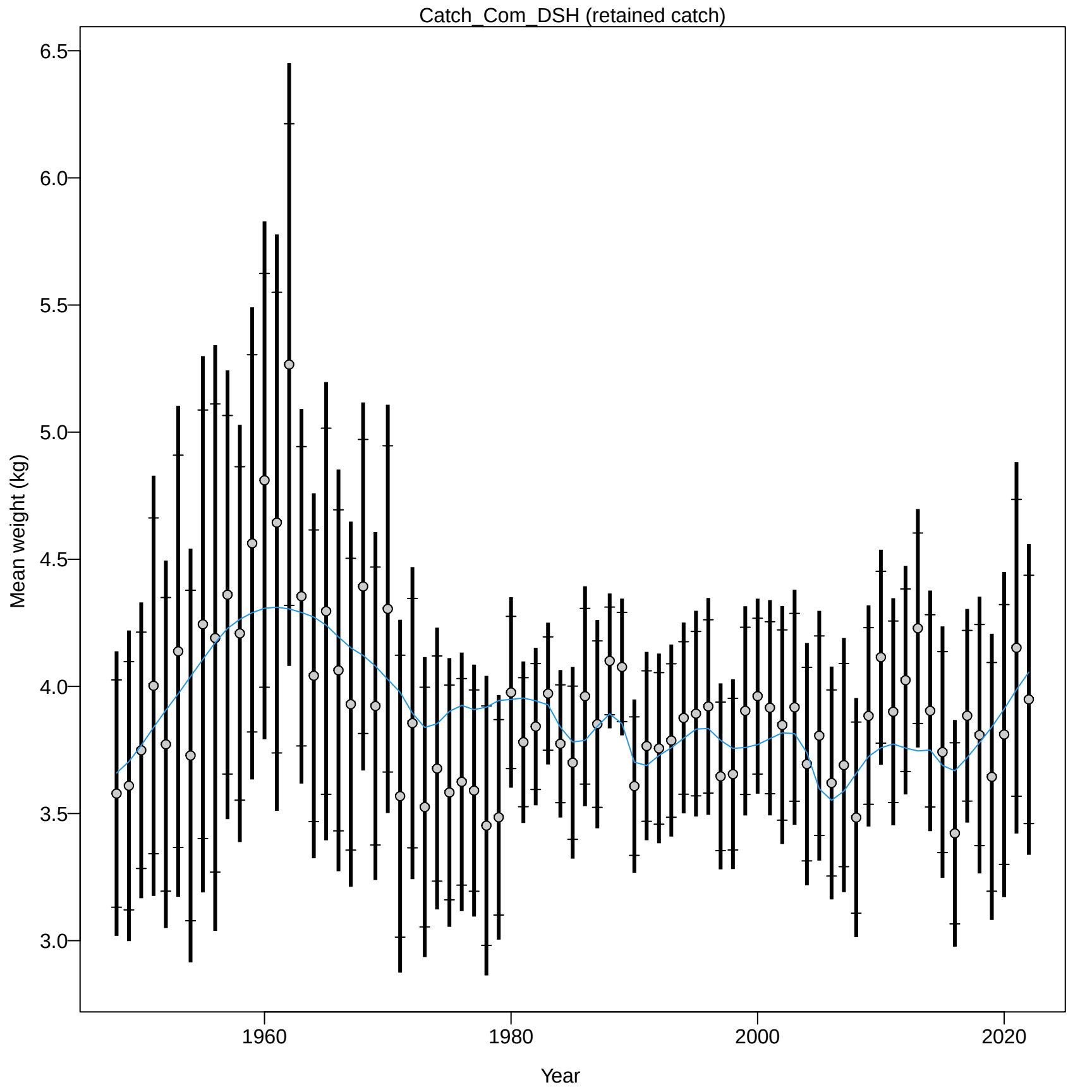

1972
N adj.=47
N eff.=56.1
1978
N adj.=46
N eff.=77.9
1984
N adj.=199
N eff.=123.4
1990
N adj.=140
N eff.=189.9
1973
N adj.=49
N eff.=78.7
1979
N adj.=69
N eff.=116.4
1985
N adj.=114
N eff.=75.5
1991
N adj.=110
N eff.=505.4
1974
N adj.=53
N eff.=287.4
1980
N adj.=115
N eff.=245.9
1986
N adj.=84
N eff.=155.9
1992
N adj.=107
N eff.=230.5
1975
N adj.=57
N eff.=110.2
1981
N adj.=160
N eff.=310
1987
N adj.=91
N eff.=274.4
1993
N adj.=104
N eff.=248.1
1976
N adj.=62
N eff.=116.8
1982
N adj.=170
N eff.=329.6
1988
N adj.=217
N eff.=571.1
1994
N adj.=105
N eff.=189.6
1977
N adj.=66
N eff.=136.8
1983
N adj.=210
N eff.=229.2
1989
N adj.=218
N eff.=595.7
1995
N adj.=91
N eff.=230.2
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

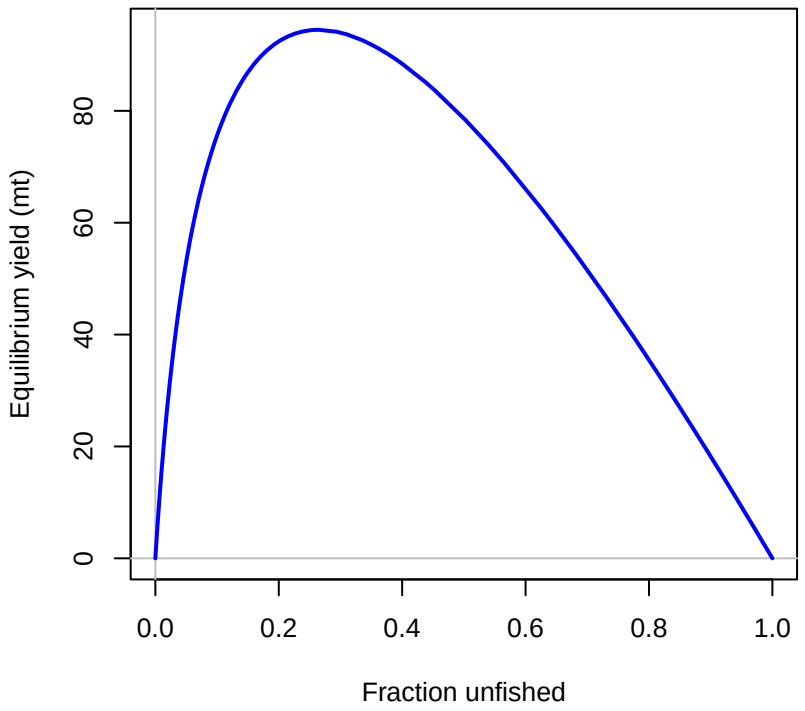

1996
N adj.=84
N eff.=250.8
2002
N adj.=69
N eff.=159.1
2008
N adj.=63
N eff.=57.8
2014
N adj.=67
N eff.=111.1
1997
N adj.=117
N eff.=265.7
2003
N adj.=72
N eff.=62.8
2009
N adj.=74
N eff.=58.3
2015
N adj.=63
N eff.=83.3
1998
N adj.=111
N eff.=143.7
2004
N adj.=70
N eff.=96.8
2010
N adj.=80
N eff.=79.5
2016
N adj.=75
N eff.=116.2
1999
N adj.=90
N eff.=354.5
2005
N adj.=66
N eff.=62.3
2011
N adj.=73
N eff.=85.2
2017
N adj.=82
N eff.=79
2000
N adj.=103
N eff.=241.3
2006
N adj.=71
N eff.=107.4
2012
N adj.=74
N eff.=198.4
2018
N adj.=49
N eff.=172.5
2001
N adj.=84
N eff.=232.9
2007
N adj.=57
N eff.=72.3
2013
N adj.=68
N eff.=77.8
2019
N adj.=46
N eff.=63.1
Proportion
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
5
10
15
Weight (kg)

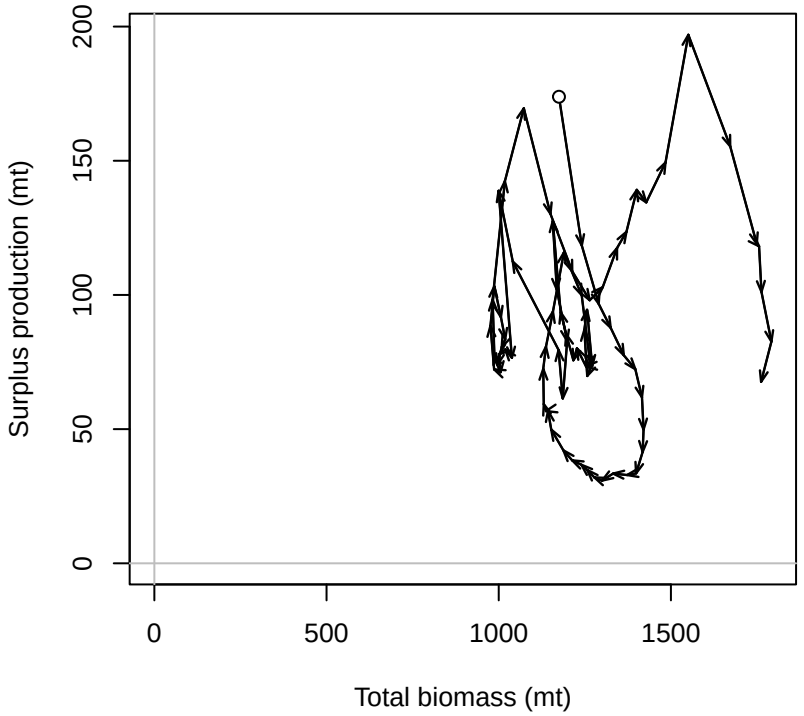

2020
N adj.=36
N eff.=67
2021
N adj.=28
N eff.=29
2022
N adj.=41
N eff.=95.9
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
Proportion
Weight (kg)

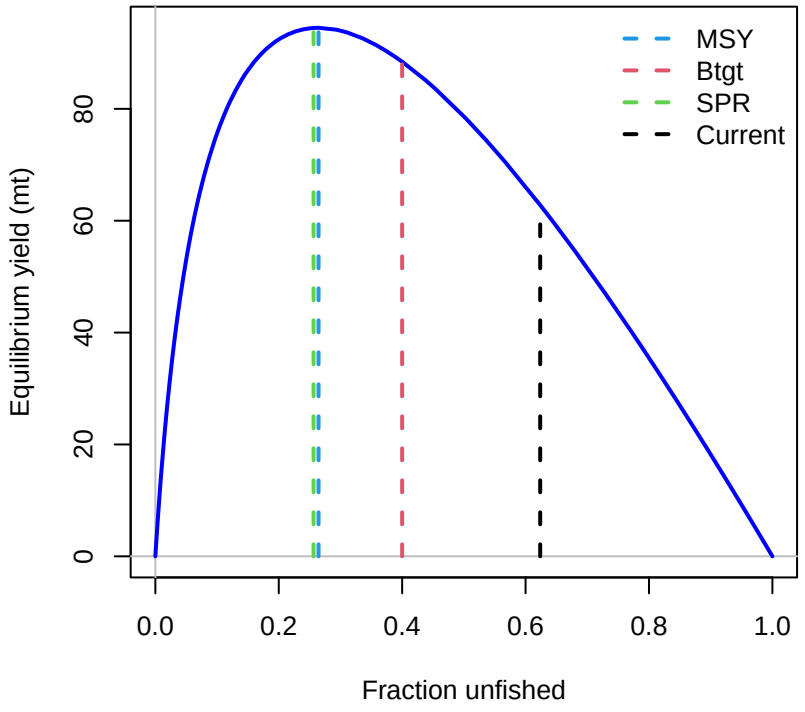

−10
−5
0.1
5
10
Weight (kg)
0
5
10
15
1948
1958
1968
1978
1988
1998
2008
2018
Year

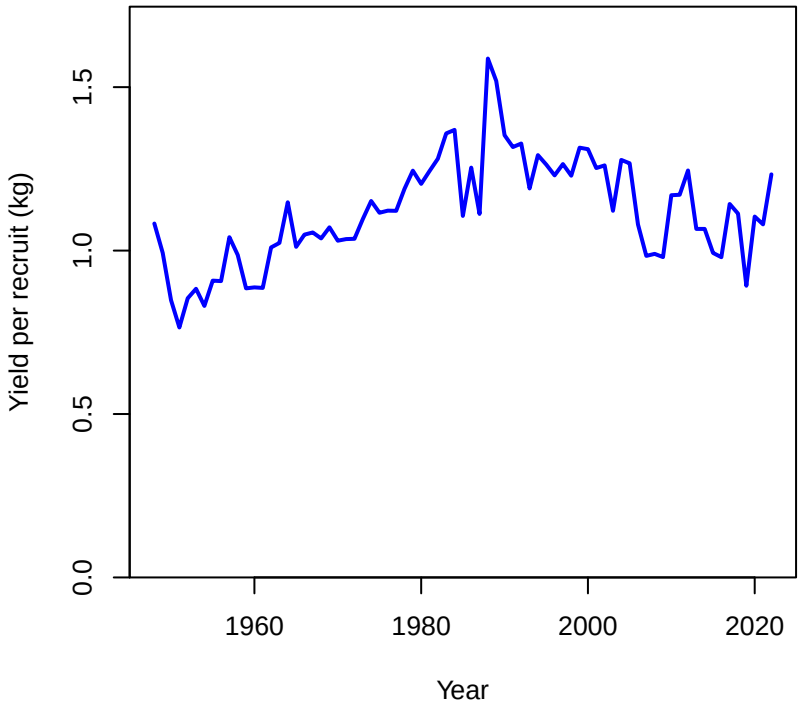

Effective sample size
0
100
200
300
400
500
600
0
50
100
150
200
250
Observed sample size
1989
1988
1991
1999
1982
1981
1974
1987
1997
1983
2012
1994
1990
1998
1984
1985
1956
harmonic mean
arithmetic mean

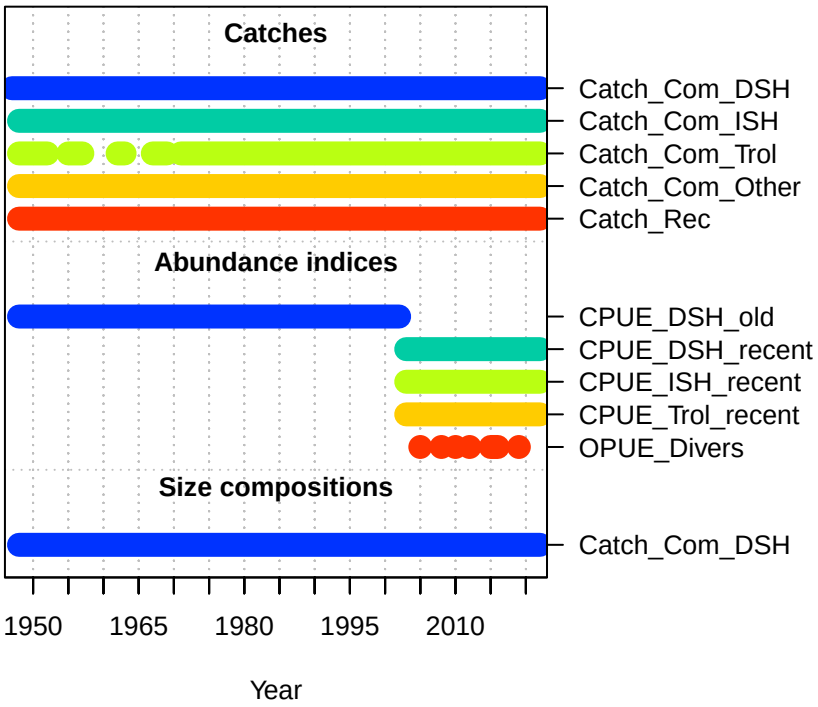

Catch_Com_DSH (retained catch)
Mean weight (kg)
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1960
1980
2000
2020
Year

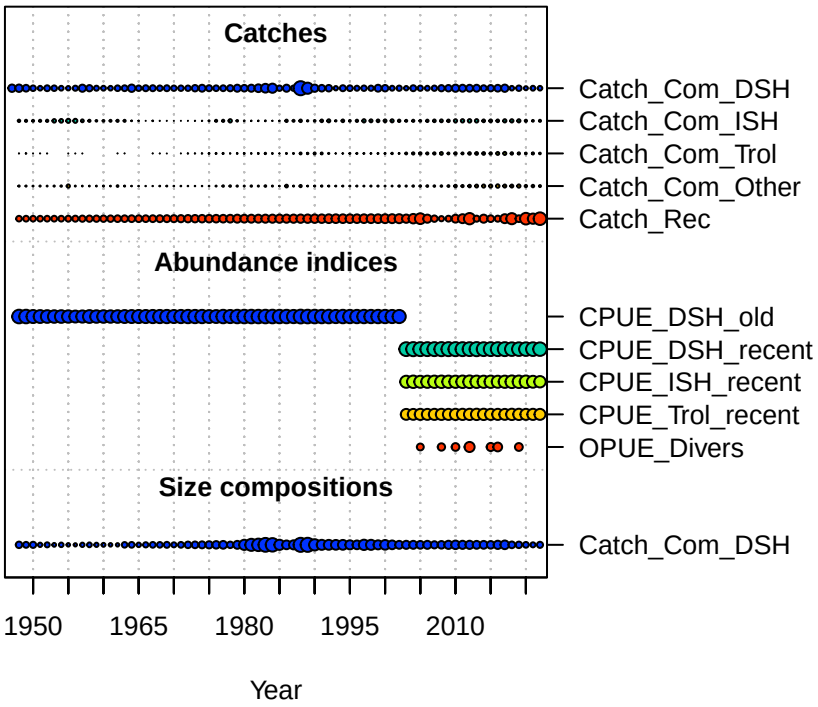

Equilibrium yield (mt)
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished

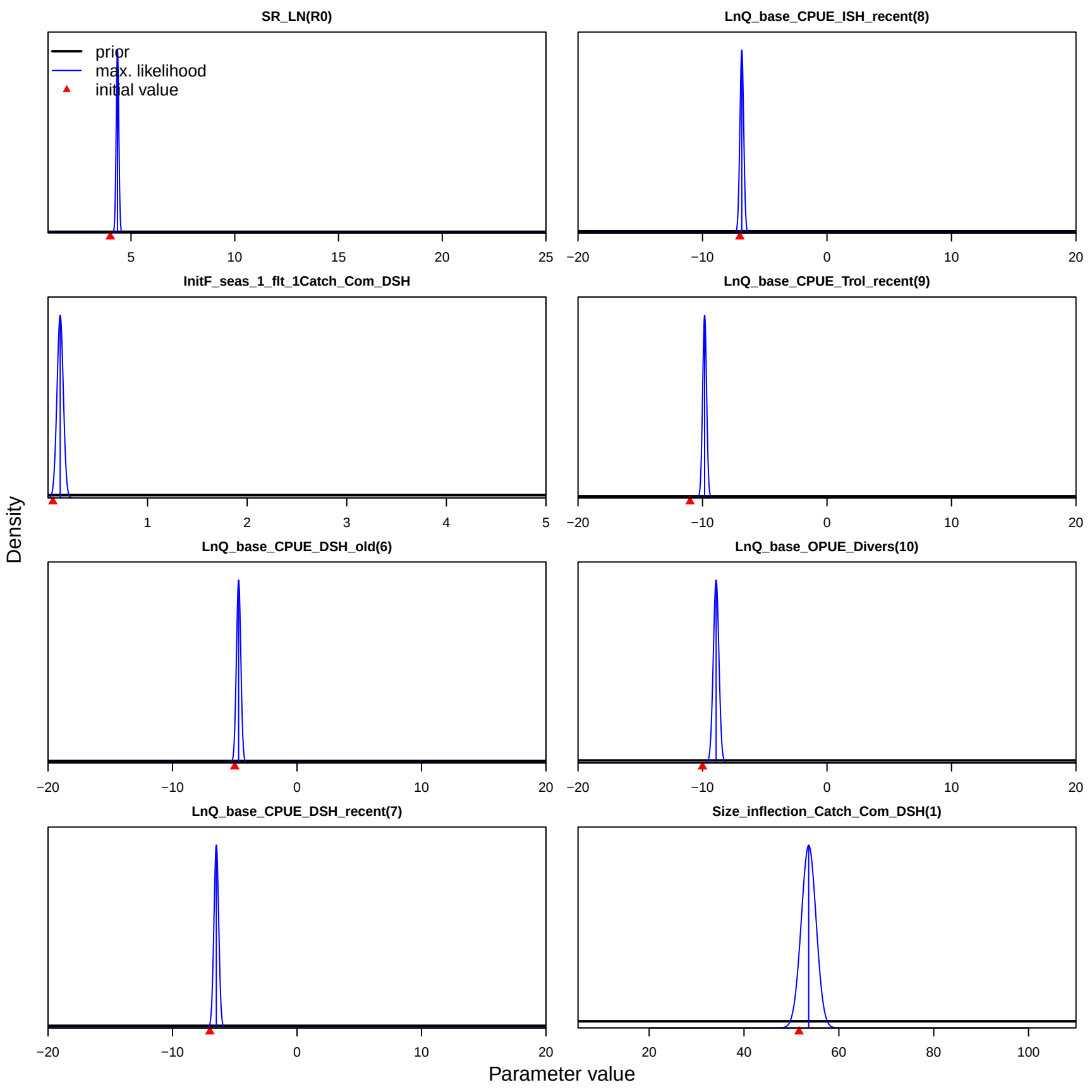

Surplus production (mt)
0
50
100
150
200
0
500
1000
1500
Total biomass (mt)

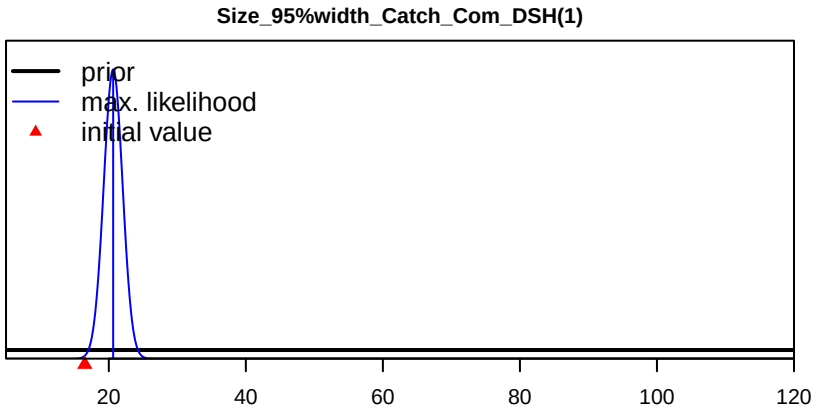

Equilibrium yield (mt)
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
1.0
Fraction unfished
MSY
Btgt
SPR
Current


Yield per recruit (kg)
0.0
0.5
1.0
1.5
1960
1980
2000
2020
Year


Catches
Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Abundance indices
CPUE_DSH_old
CPUE_DSH_recent
CPUE_ISH_recent
CPUE_Trol_recent
OPUE_Divers
Size compositions
Catch_Com_DSH
1950
1965
1980
1995
2010
Year


Catches
Catch_Com_DSH
Catch_Com_ISH
Catch_Com_Trol
Catch_Com_Other
Catch_Rec
Abundance indices
CPUE_DSH_old
CPUE_DSH_recent
CPUE_ISH_recent
CPUE_Trol_recent
OPUE_Divers
Size compositions
Catch_Com_DSH
1950
1965
1980
1995
2010
Year


SR_LN(R0)
prior
max. likelihood
initial value
LnQ_base_CPUE_ISH_recent(8)
InitF_seas_1_flt_1Catch_Com_DSH
LnQ_base_CPUE_Trol_recent(9)
LnQ_base_CPUE_DSH_old(6)
LnQ_base_OPUE_Divers(10)
LnQ_base_CPUE_DSH_recent(7)
Size_inflection_Catch_Com_DSH(1)
Density
Parameter value



Density

Parameter value