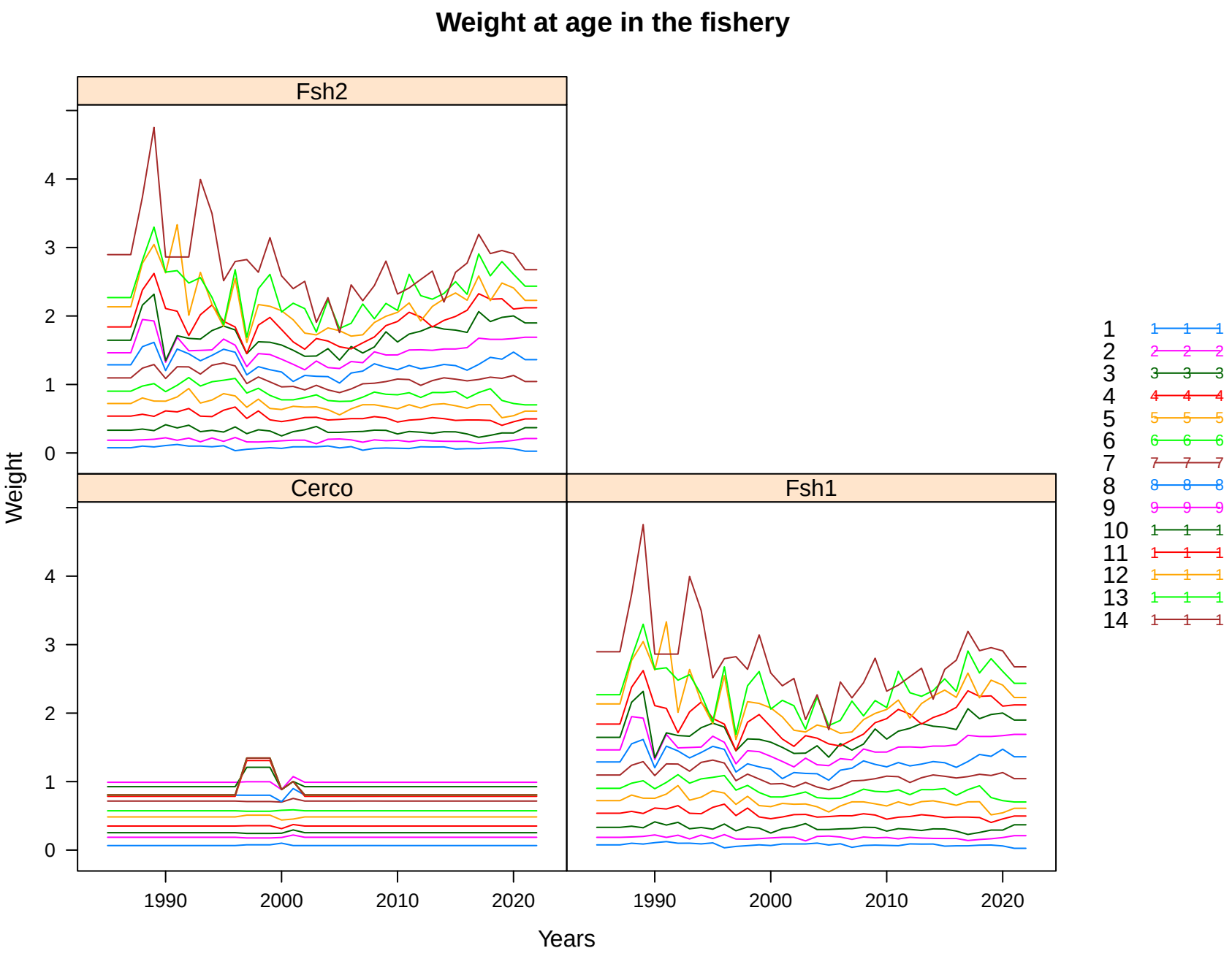
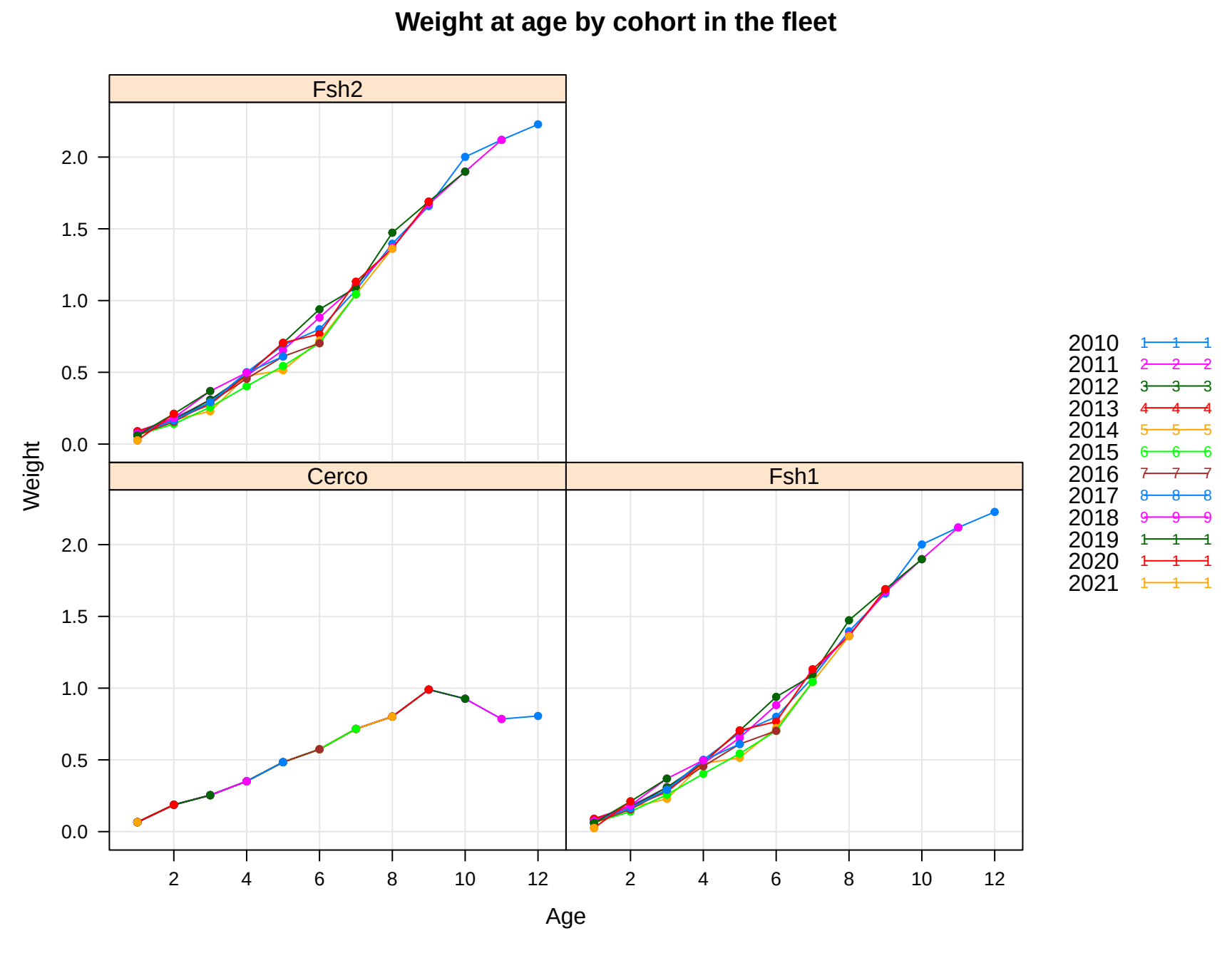
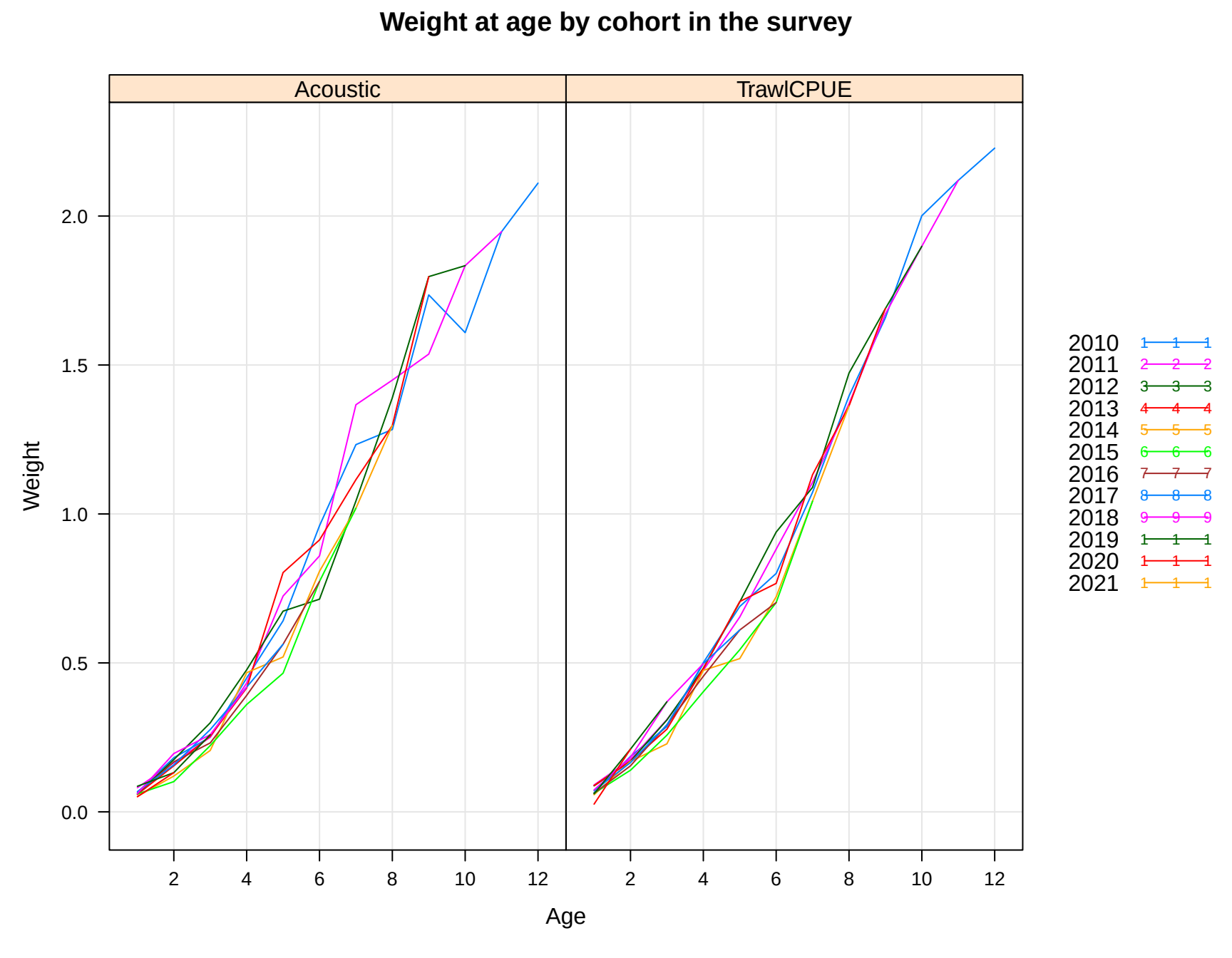
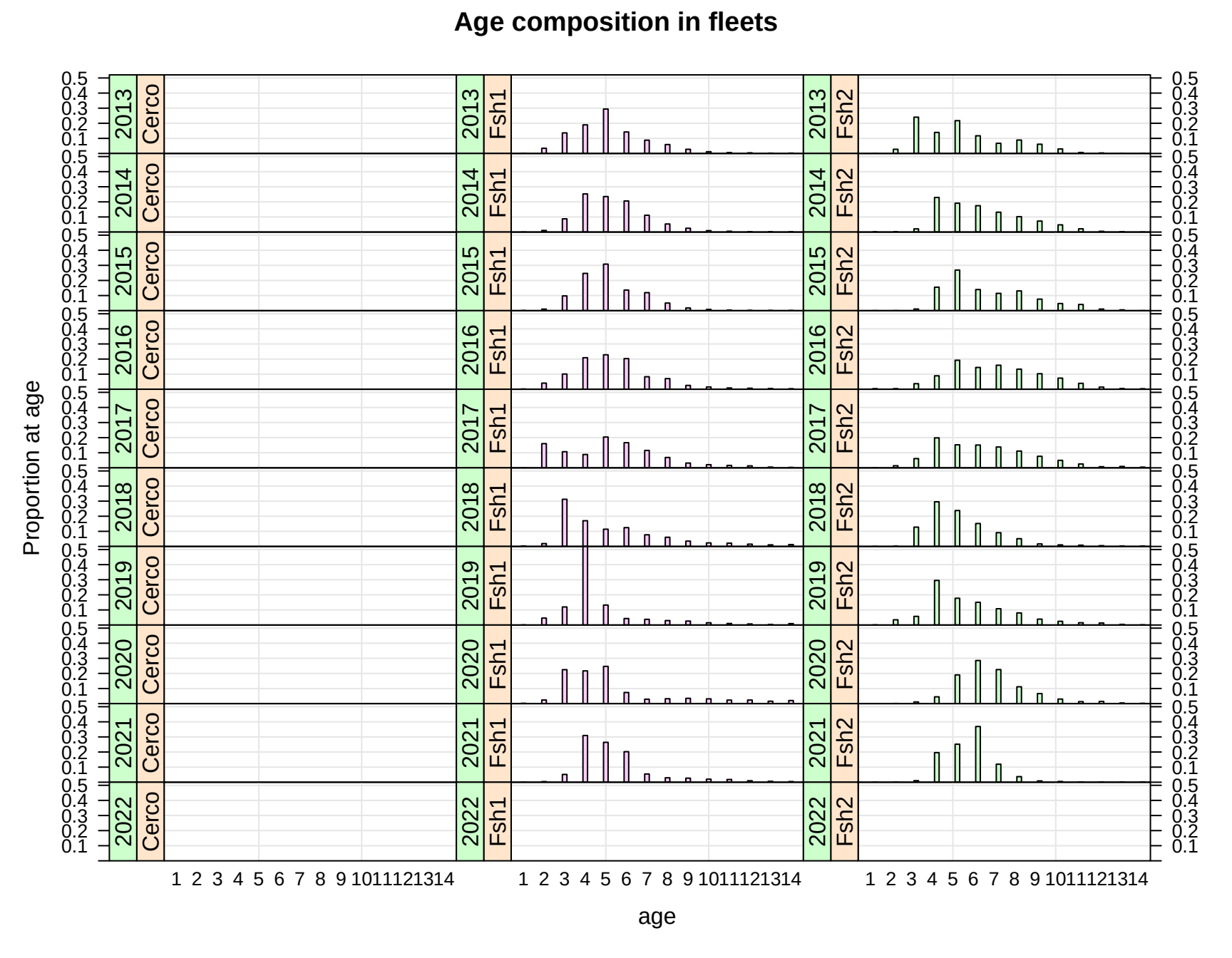
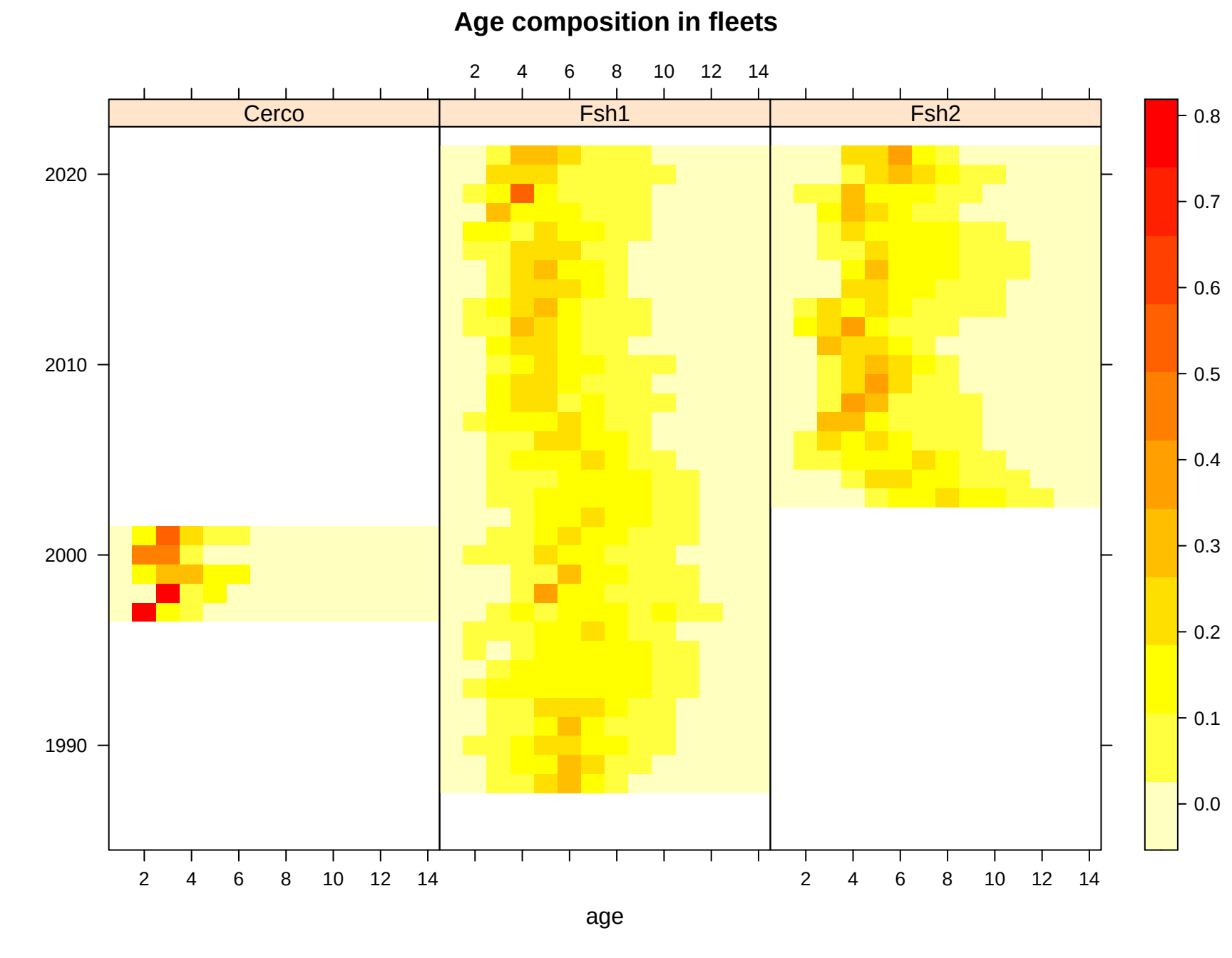

Weight at age in the fishery
Fsh2
Cerco
Fsh1
Weight
Years
0
1
2
3
4
1990
2000
2010
2020
1
2
3
4
5
6
7
8
9
10
11
12
13
14

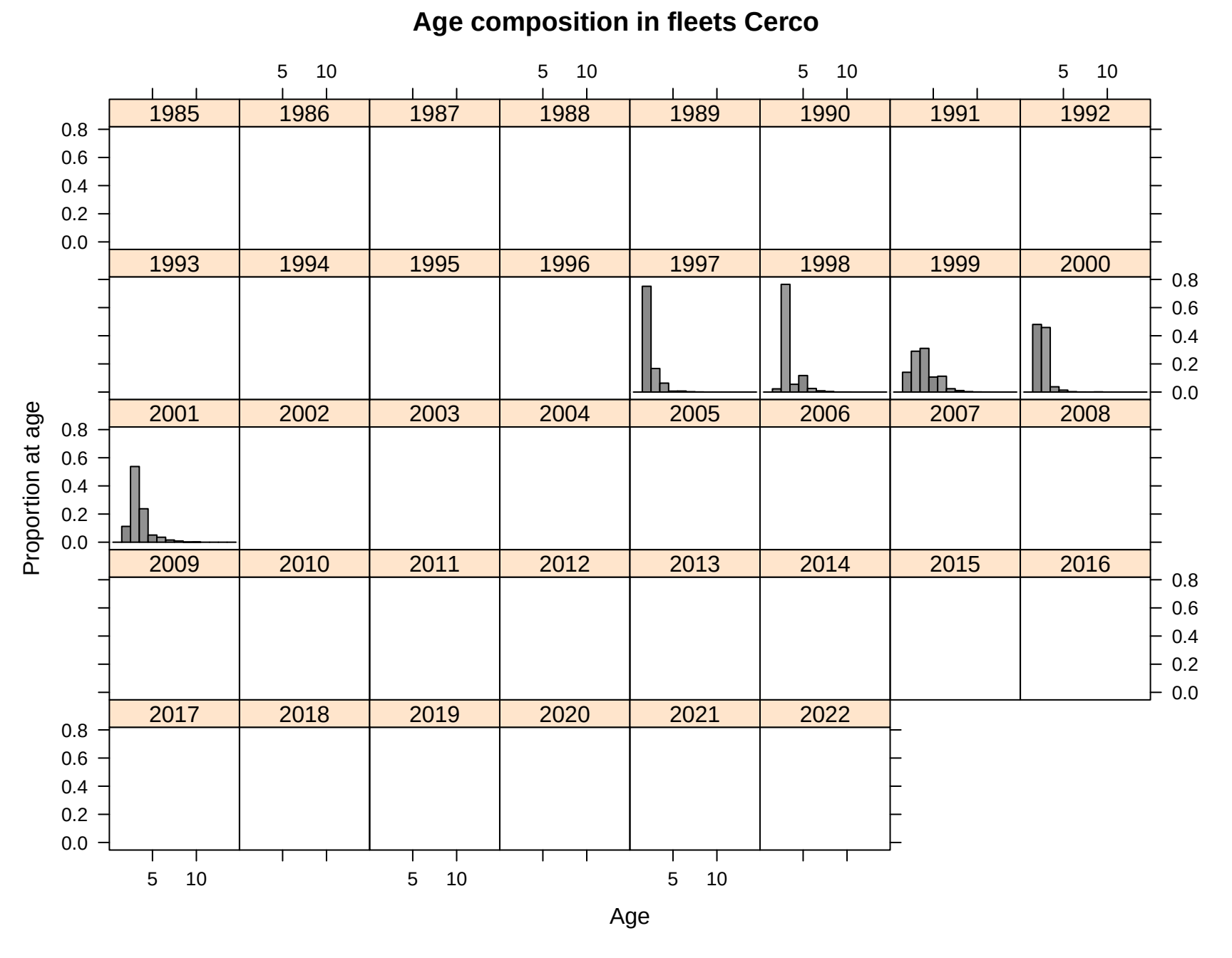
Weight at age in the survey
Acoustic
TrawlCPUE
Weight
0
1
2
3
4
1990
2000
2010
2020
Years
1
2
3
4
5
6
7
8
9
10
11
12
13
14

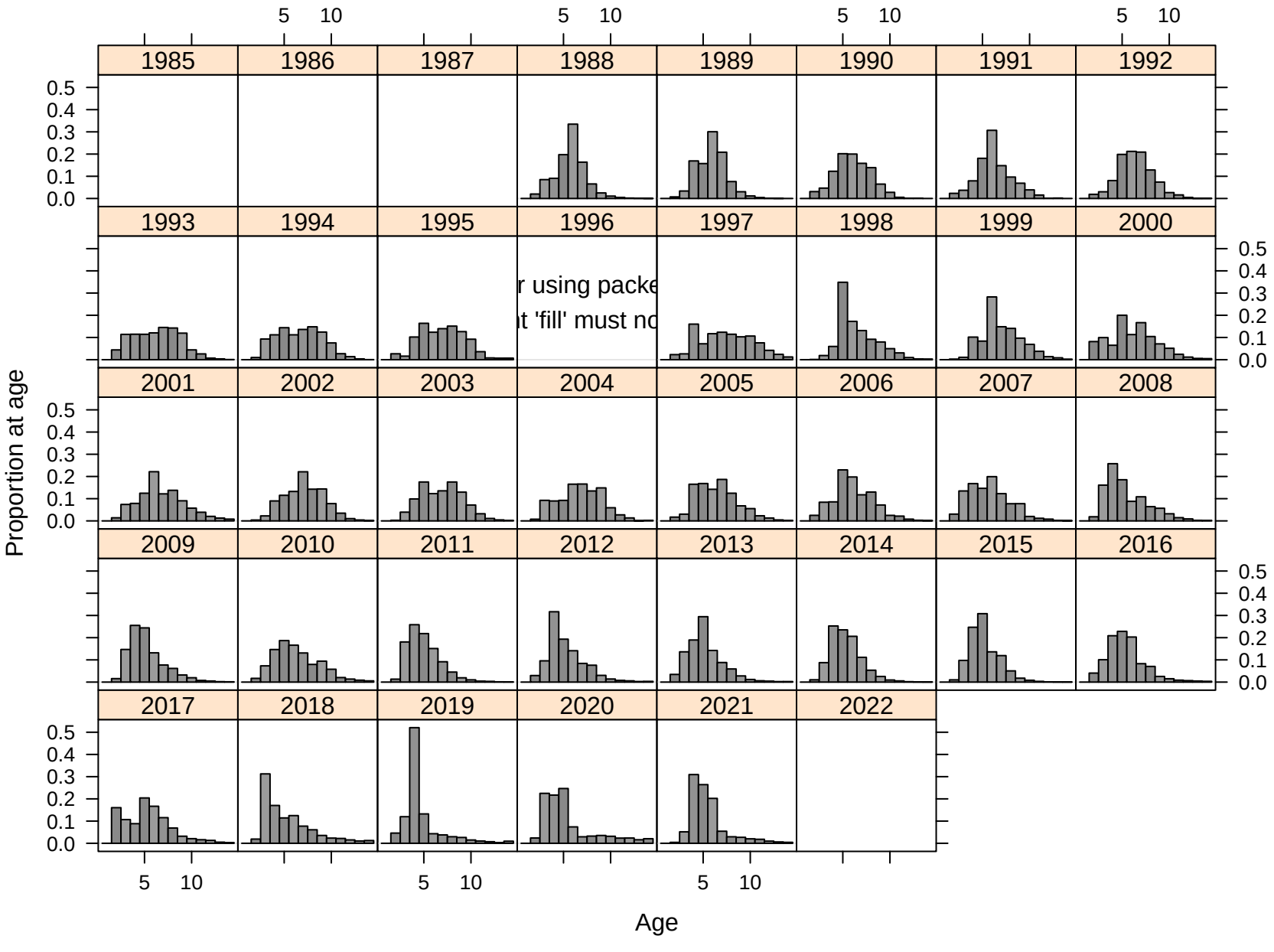

Weight at age by cohort in the fleet
Fsh2
Cerco
Fsh1
Weight
Age
0.0
0.5
1.0
1.5
2.0
2
4
6
8
10
12
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

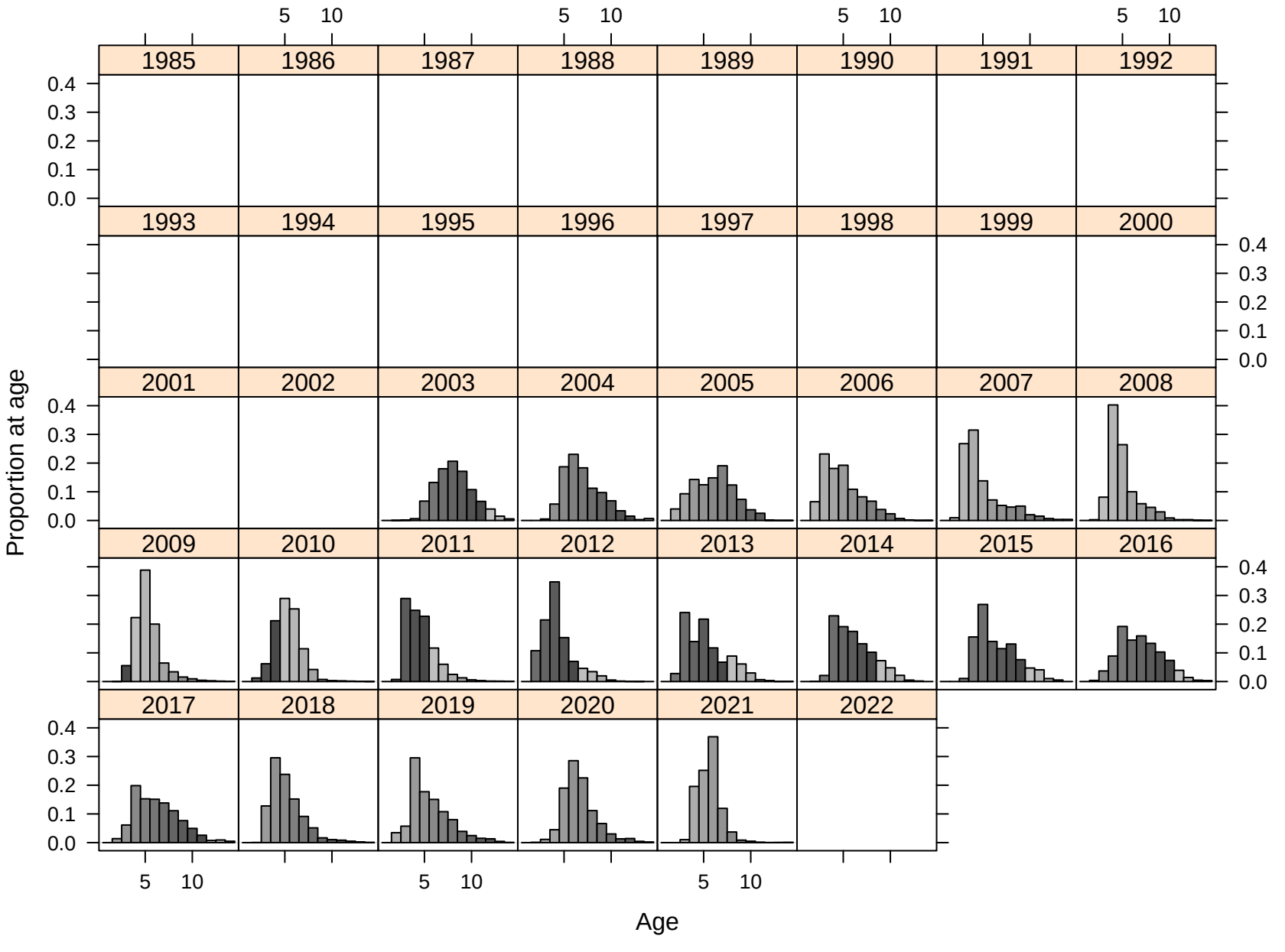

Weight at age by cohort in the survey
Acoustic
TrawlCPUE
Weight
Age
0.0
0.5
1.0
1.5
2.0
2
4
6
8
10
12
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

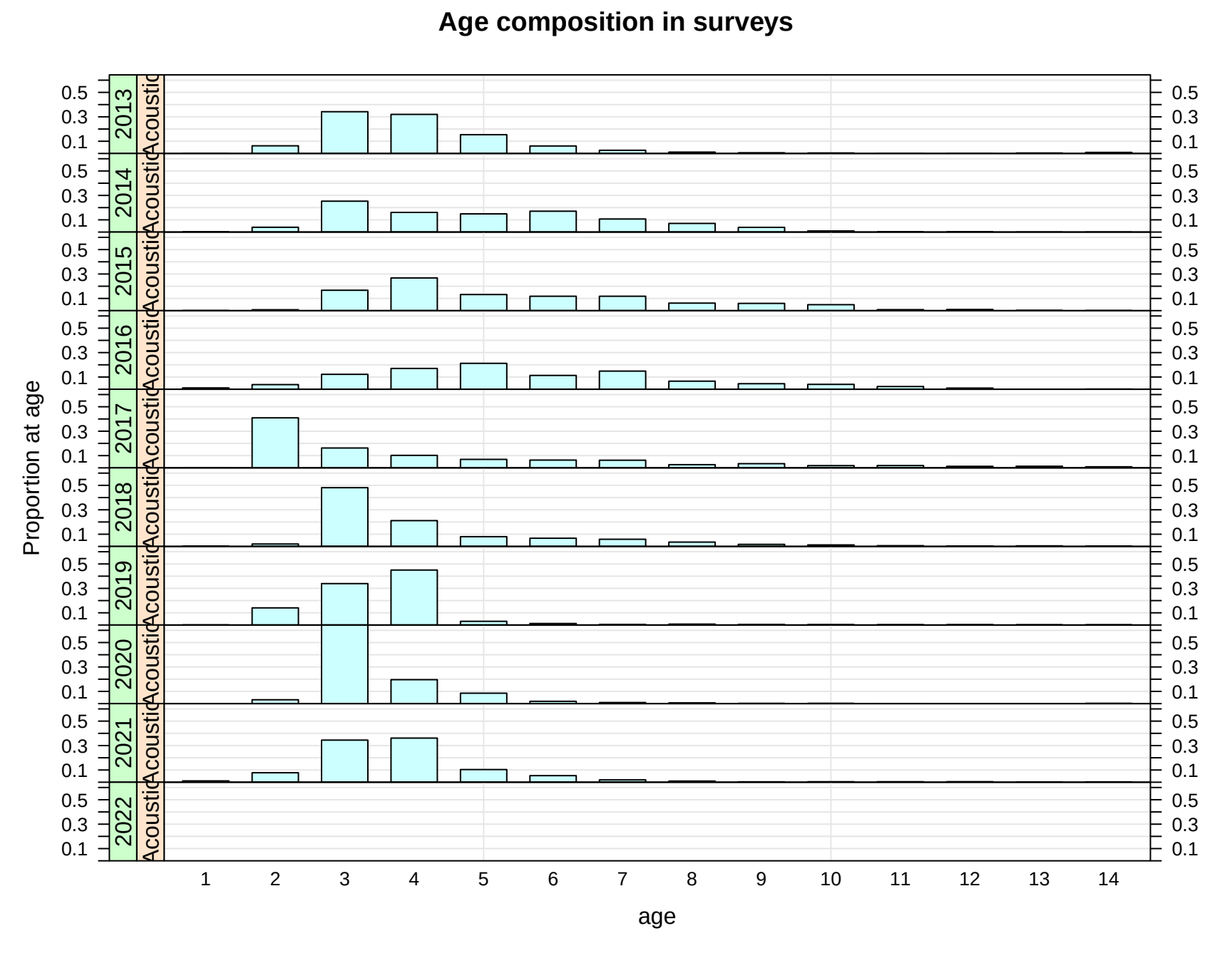

Age composition in fleets
Proportion at age
age
Cerco
Fsh1
Fsh2
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

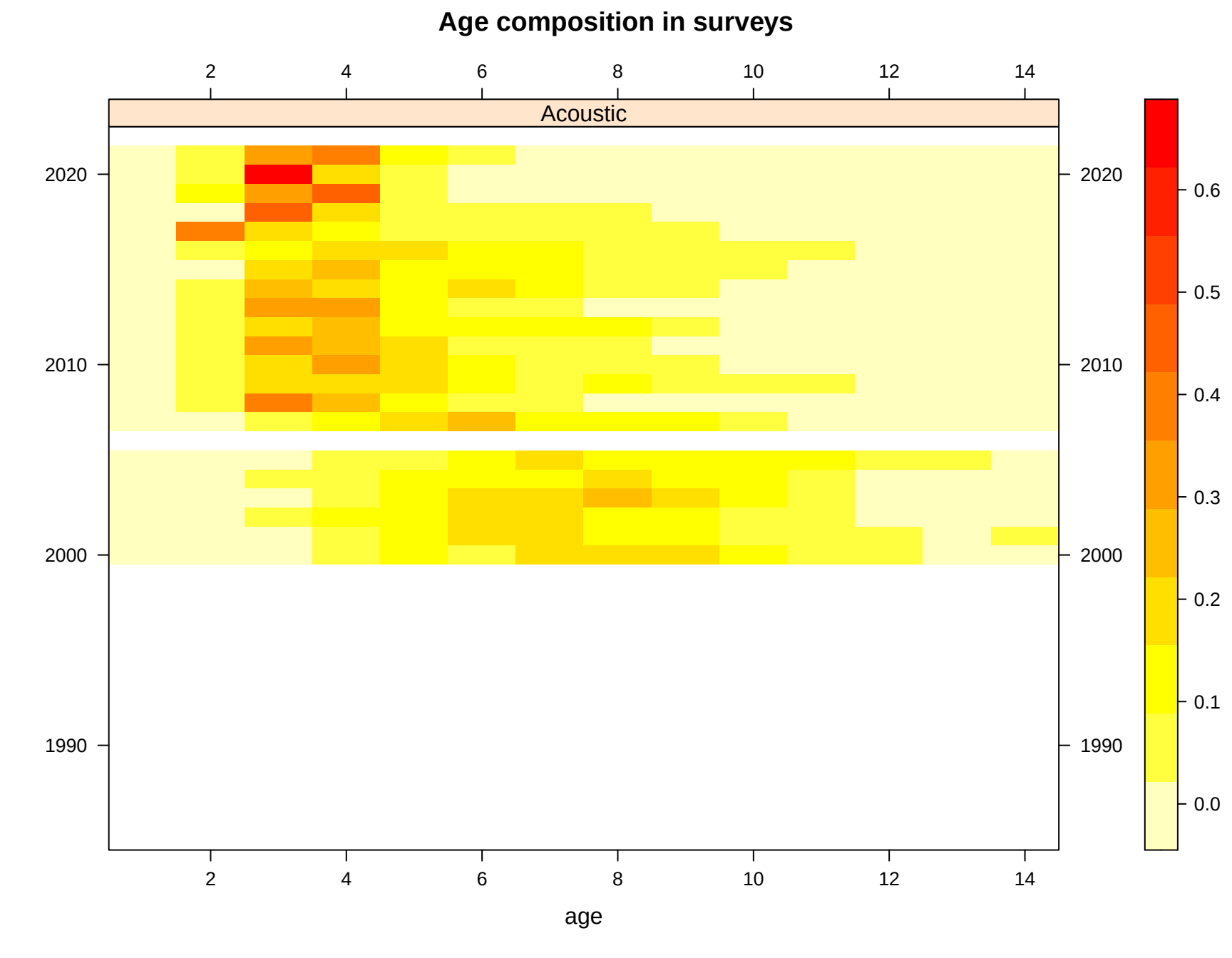

Age composition in fleets
Cerco
Fsh1
Fsh2
2020
2010
2000
1990
2
4
6
8
10
12
14
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
age

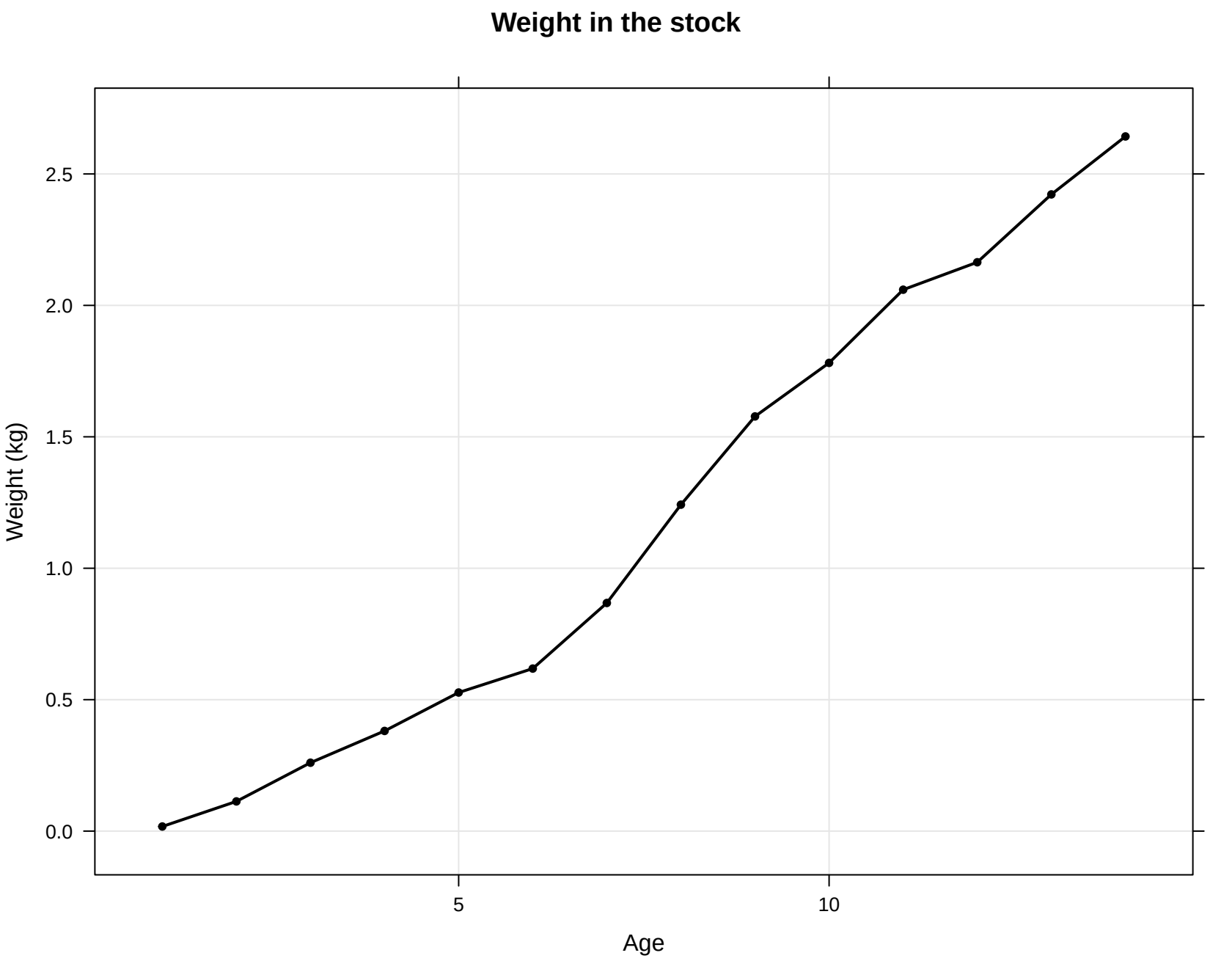

Age composition in fleets Cerco
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Proportion at age
Age
0.0
0.2
0.4
0.6
0.8
5
10

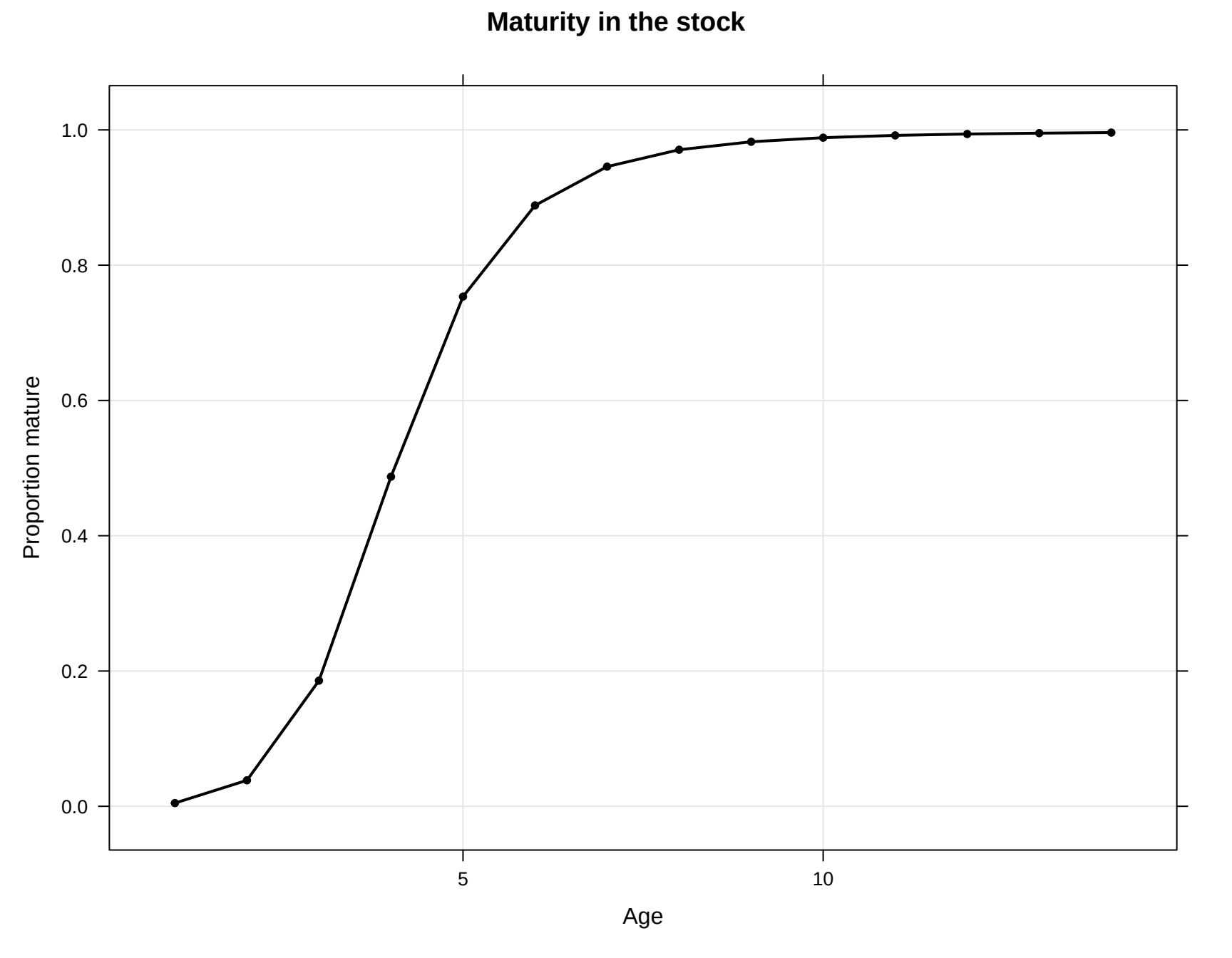

Age composition in fleets Fsh1
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
r using packe
t 'fill' must nc
Proportion at age
Age
0.0
0.1
0.2
0.3
0.4
0.5
5
10

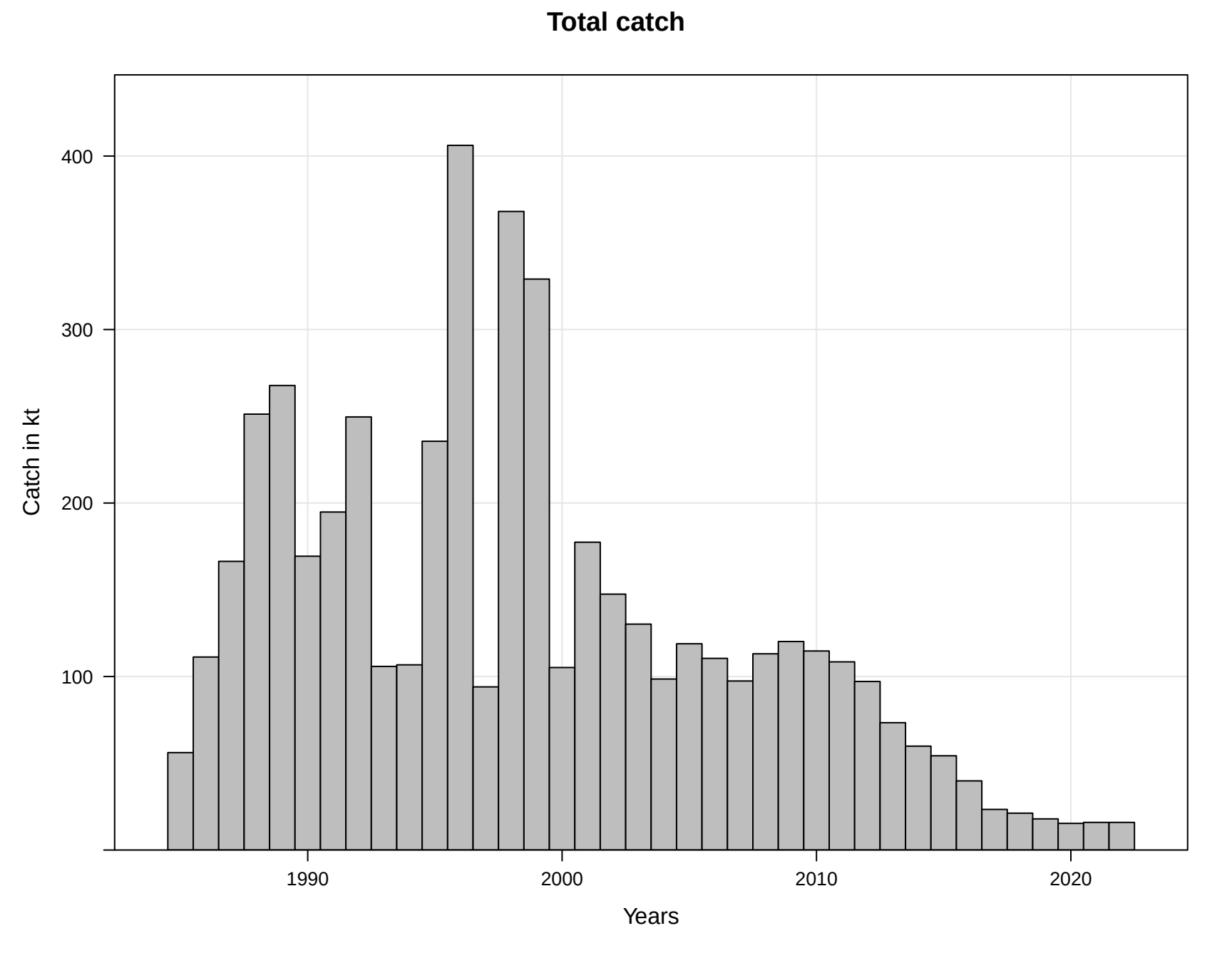

Age composition in fleets Fsh2
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Proportion at age
Age
0.0
0.1
0.2
0.3
0.4
5
10

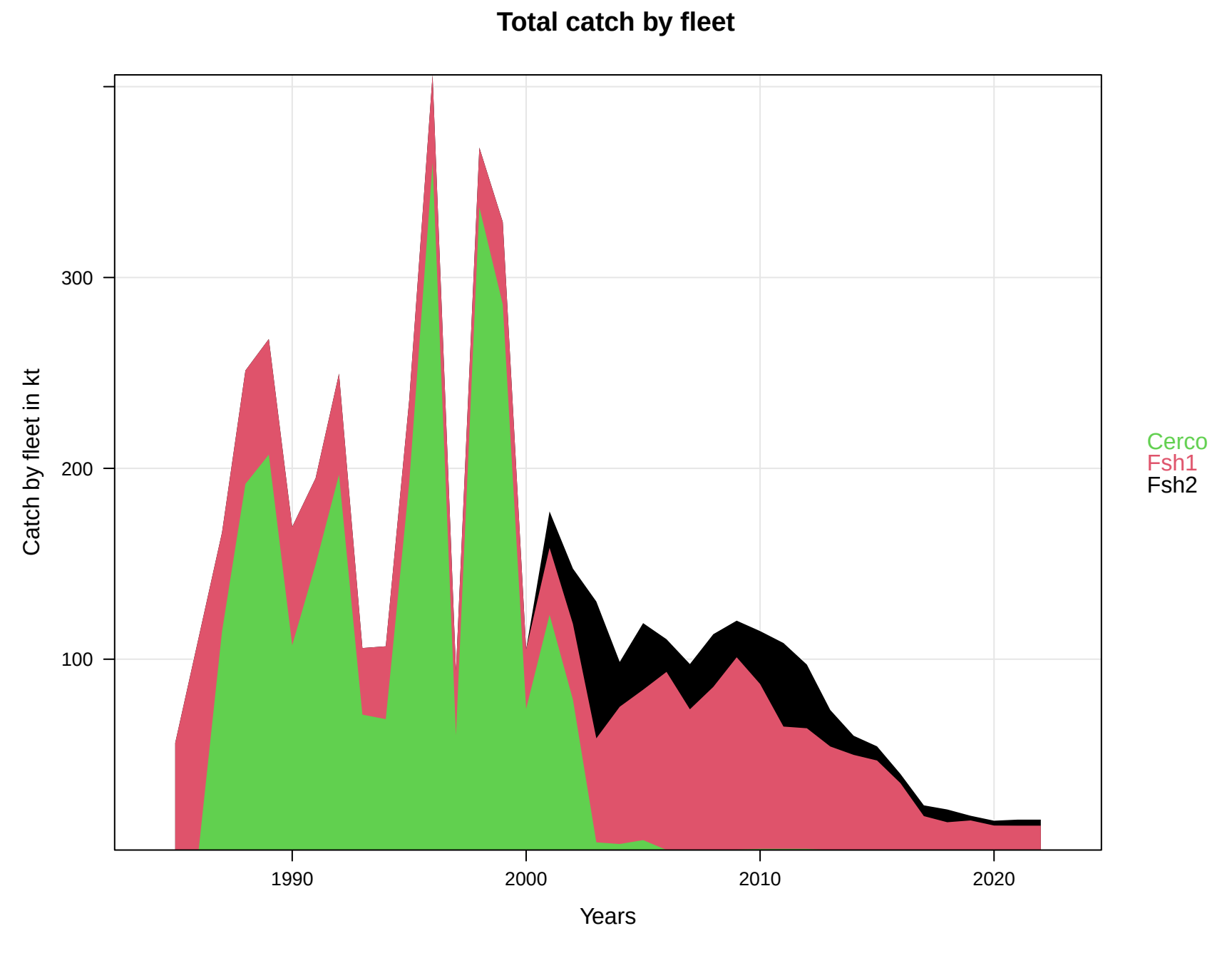

Age composition in surveys
Proportion at age
age
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Acoustic
0.5
0.3
0.1
1
2
3
4
5
6
7
8
9
10
11
12
13
14

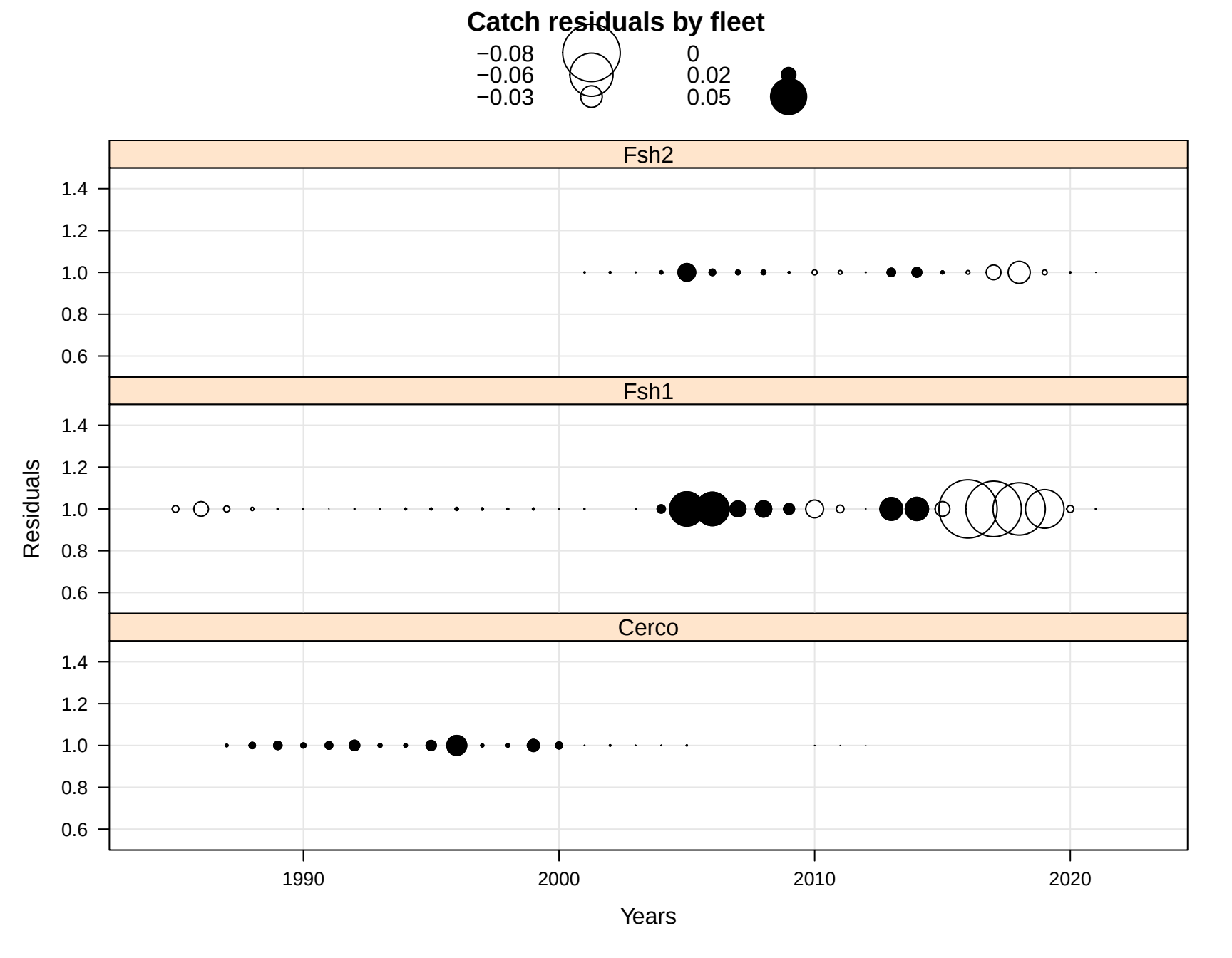

Age composition in surveys
Acoustic
2
4
6
8
10
12
14
2020
2010
2000
1990
0.6
0.5
0.4
0.3
0.2
0.1
0.0
age

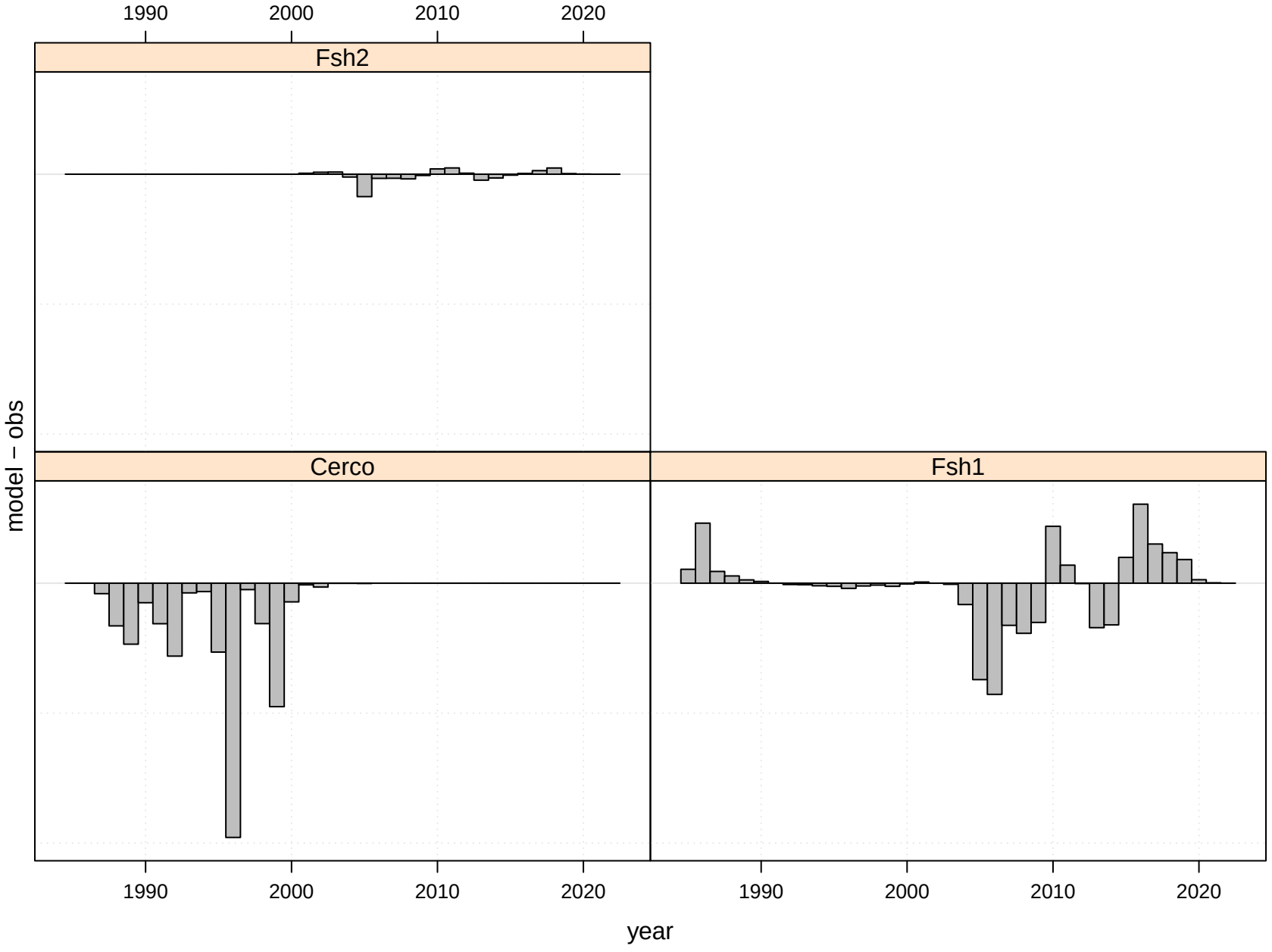

Weight in the stock
Weight (kg)
0.0
0.5
1.0
1.5
2.0
2.5
5
10
Age

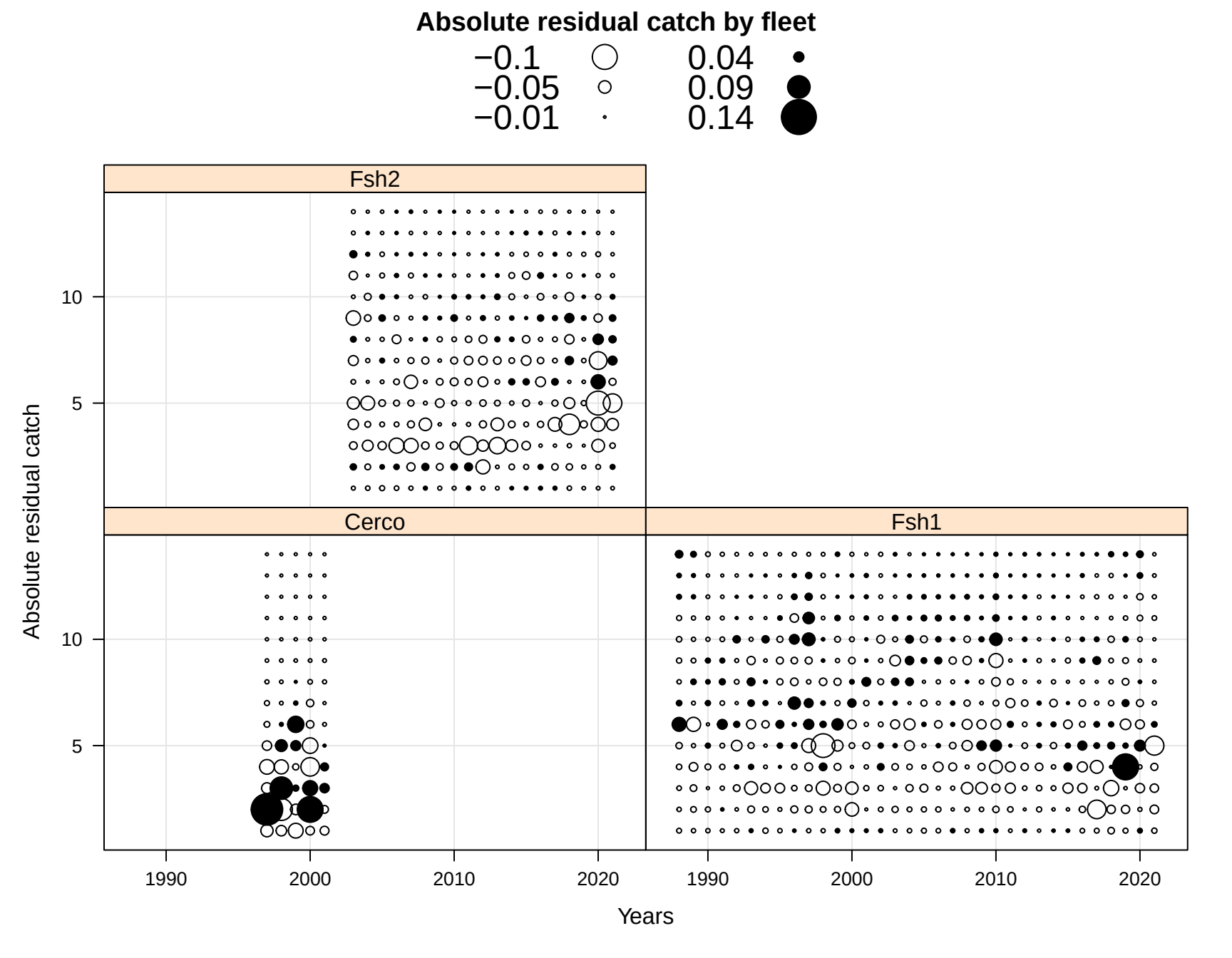

Maturity in the stock
Proportion mature
1.0
0.8
0.6
0.4
0.2
0.0
5
10
Age

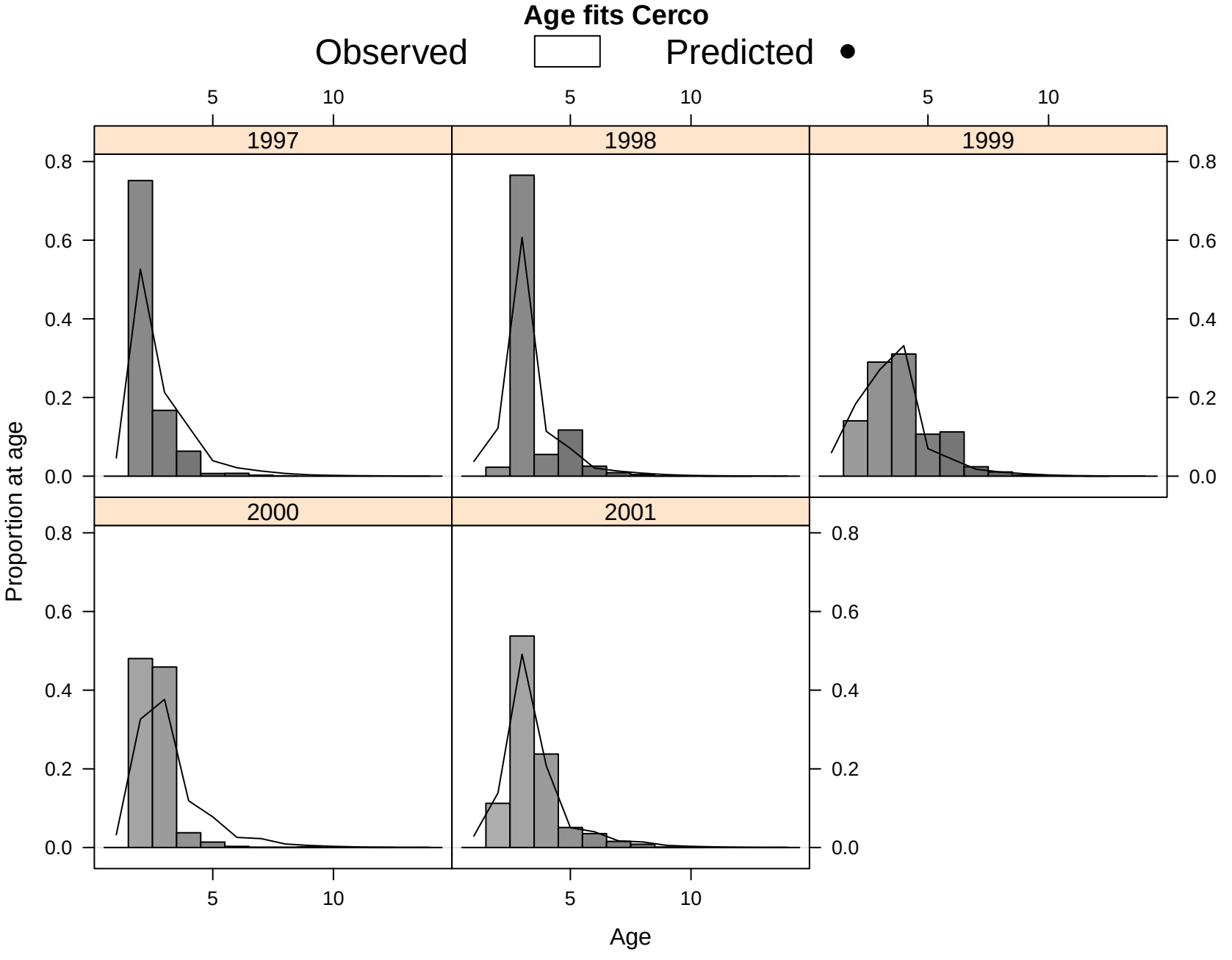

Total catch
Catch in kt
400
300
200
100
1990
2000
2010
2020
Years

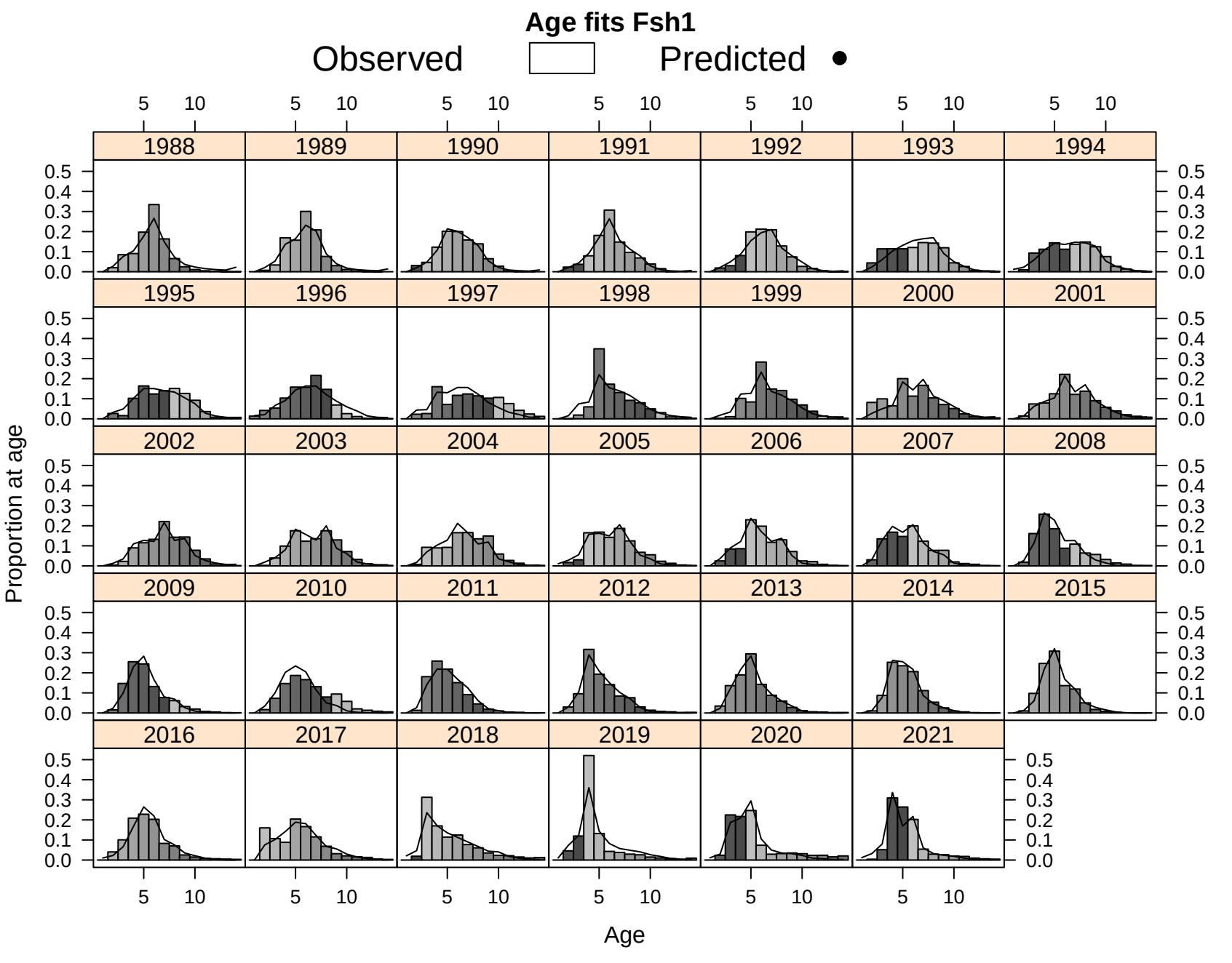

Total catch by fleet
Catch by fleet in kt
300
200
100
1990
2000
2010
2020
Years
Cerco
Fsh1
Fsh2

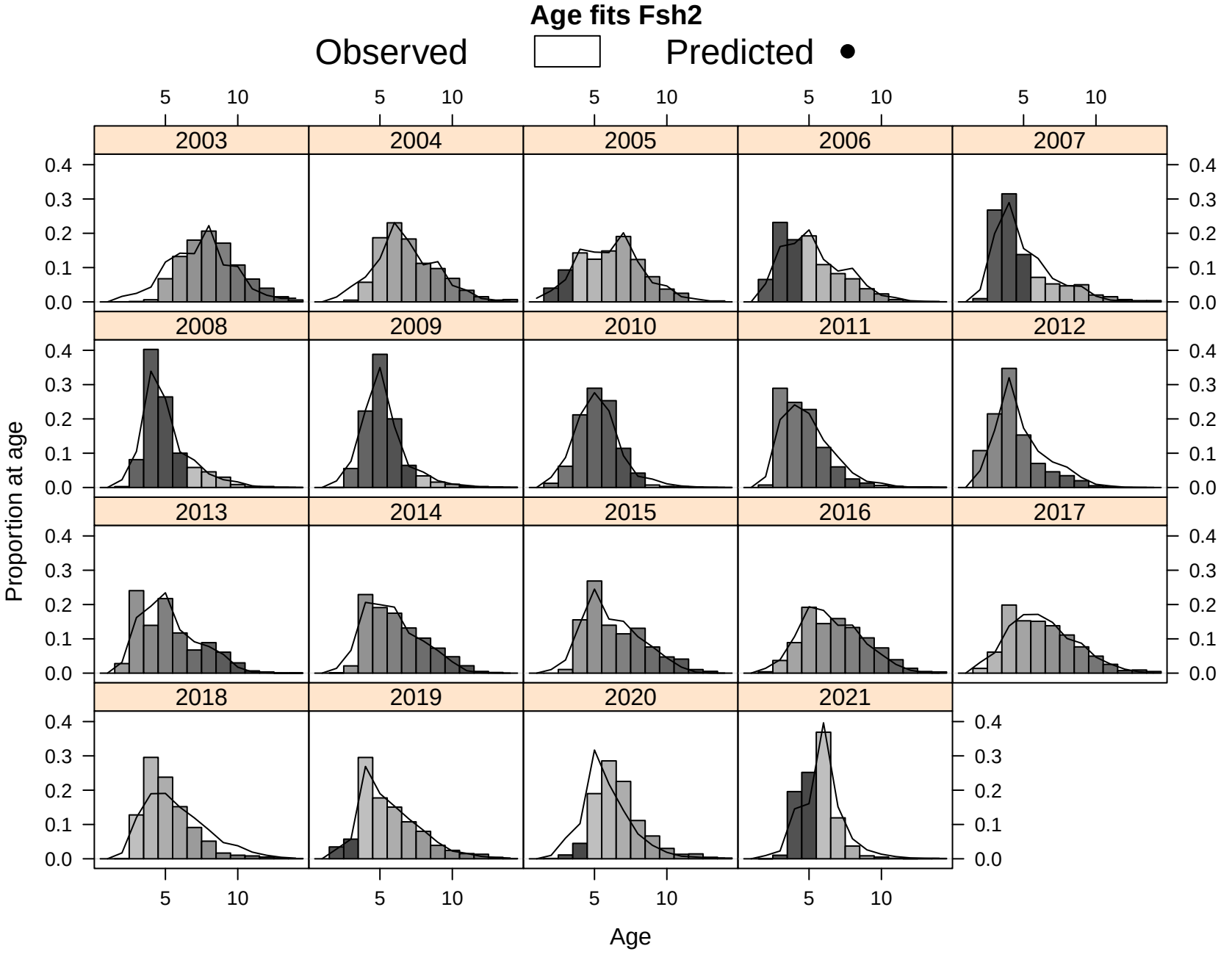

Catch residuals by fleet
−0.08
−0.06
−0.03
0
0.02
0.05
Fsh2
Fsh1
Cerco
Residuals
1.4
1.2
1.0
0.8
0.6
1990
2000
2010
2020
Years

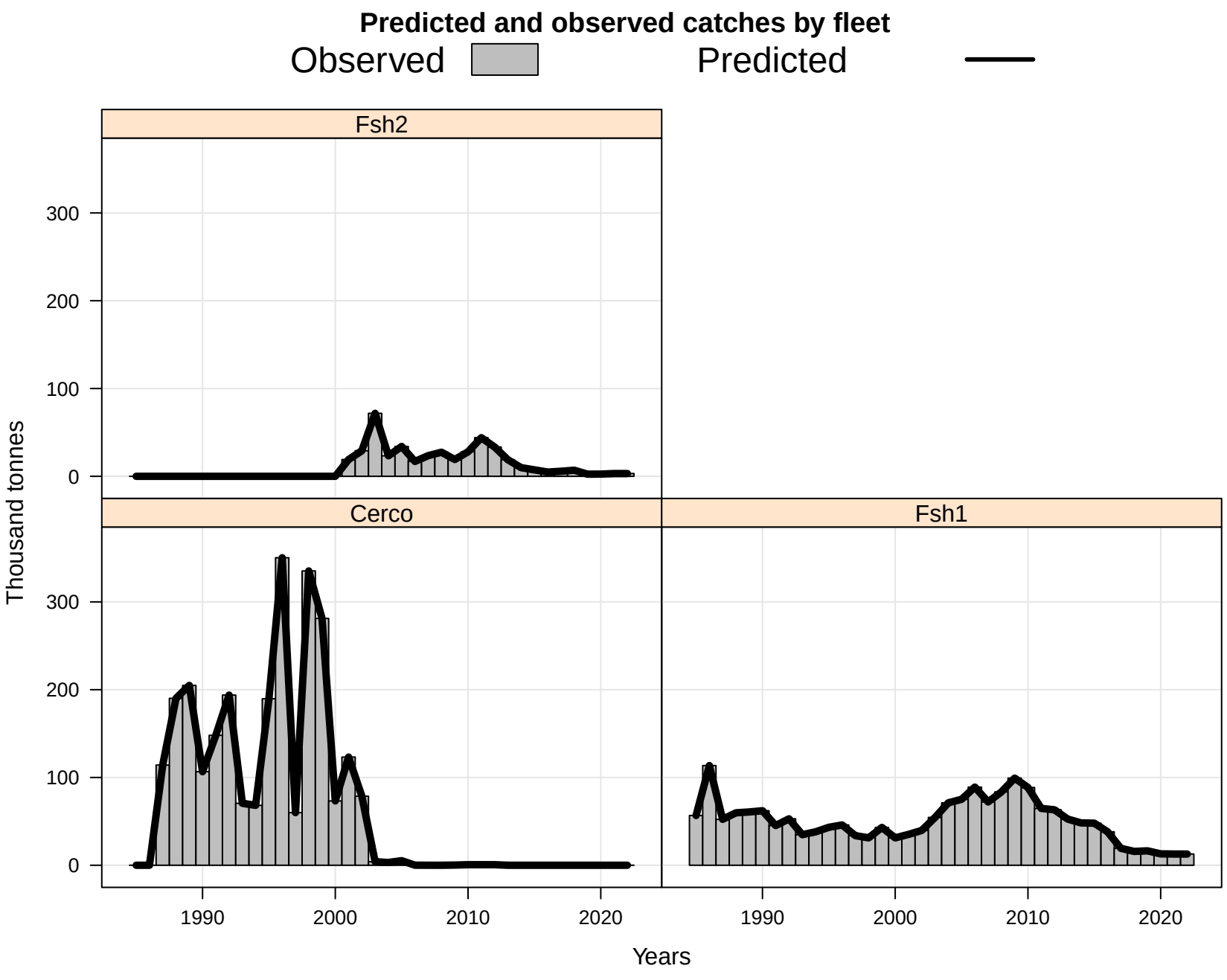

Fsh2
Cerco
Fsh1
model – obs
year
1990
2000
2010
2020

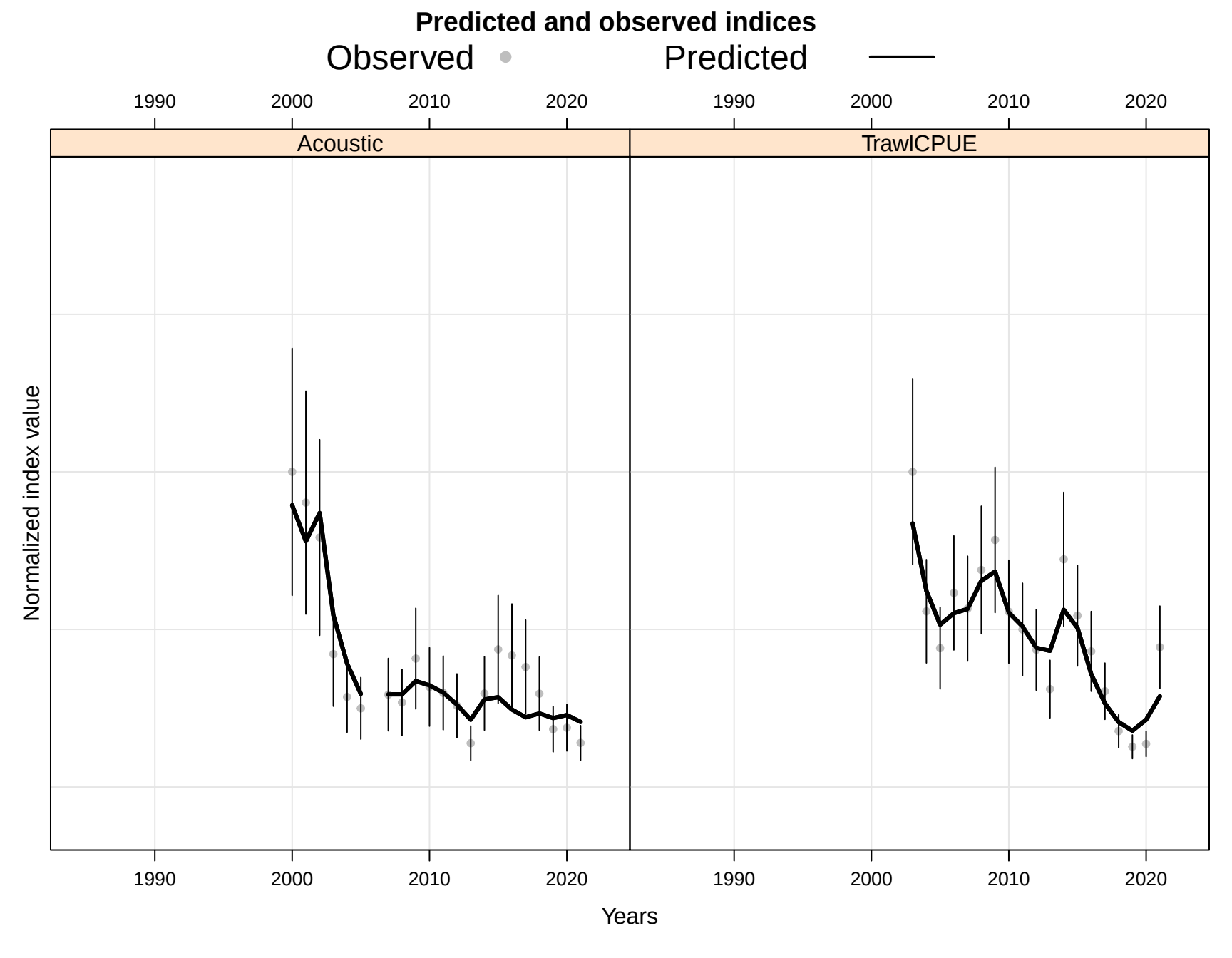

Absolute residual catch by fleet
−0.1
−0.05
−0.01
0.04
0.09
0.14
Fsh2
Cerco
Fsh1
Absolute residual catch
10
5
10
5
1990
2000
2010
2020
1990
2000
2010
2020
Years

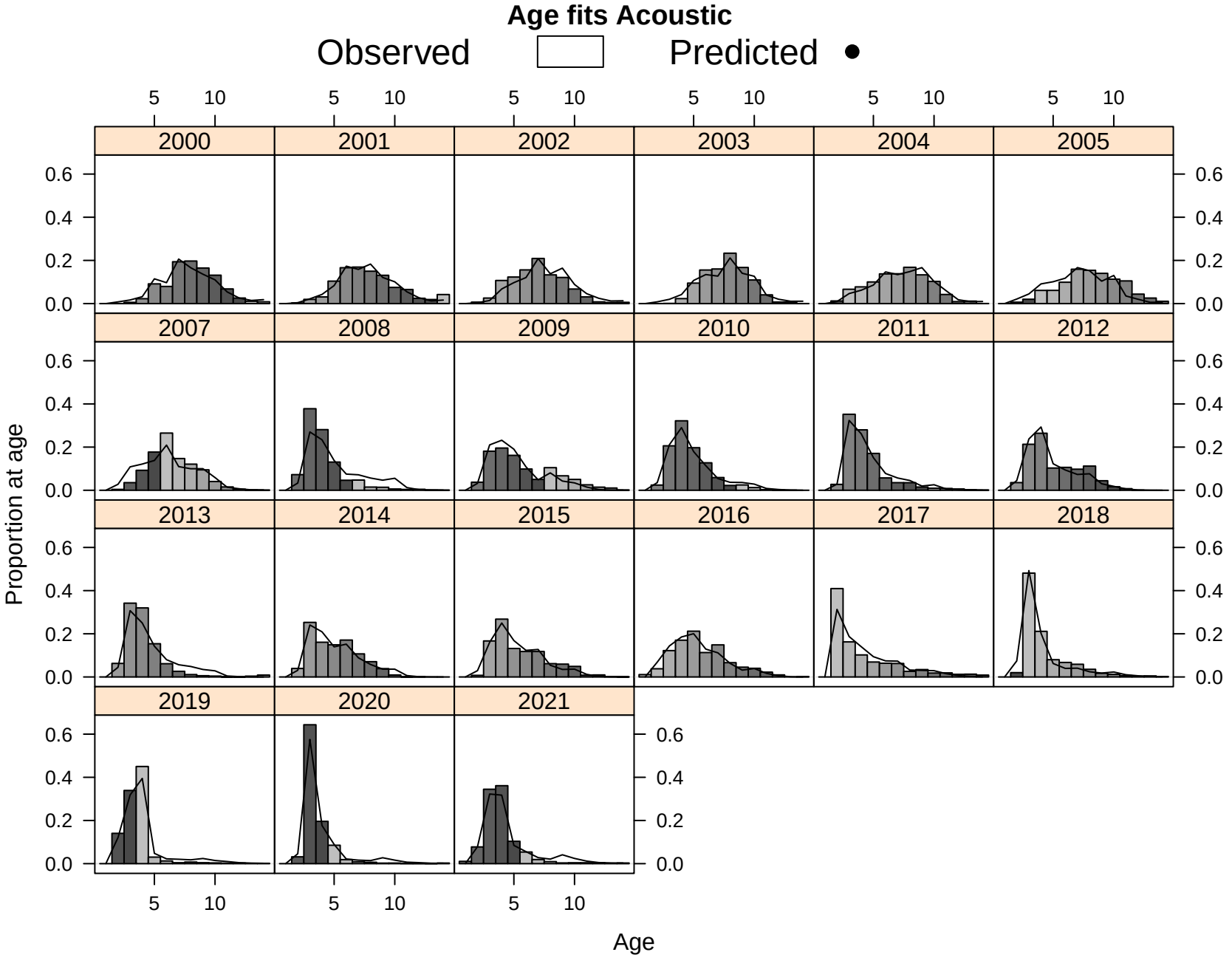

Age fits Cerco
Observed
Predicted
1997
1998
1999
2000
2001
Proportion at age
Age
0.0
0.2
0.4
0.6
0.8
5
10

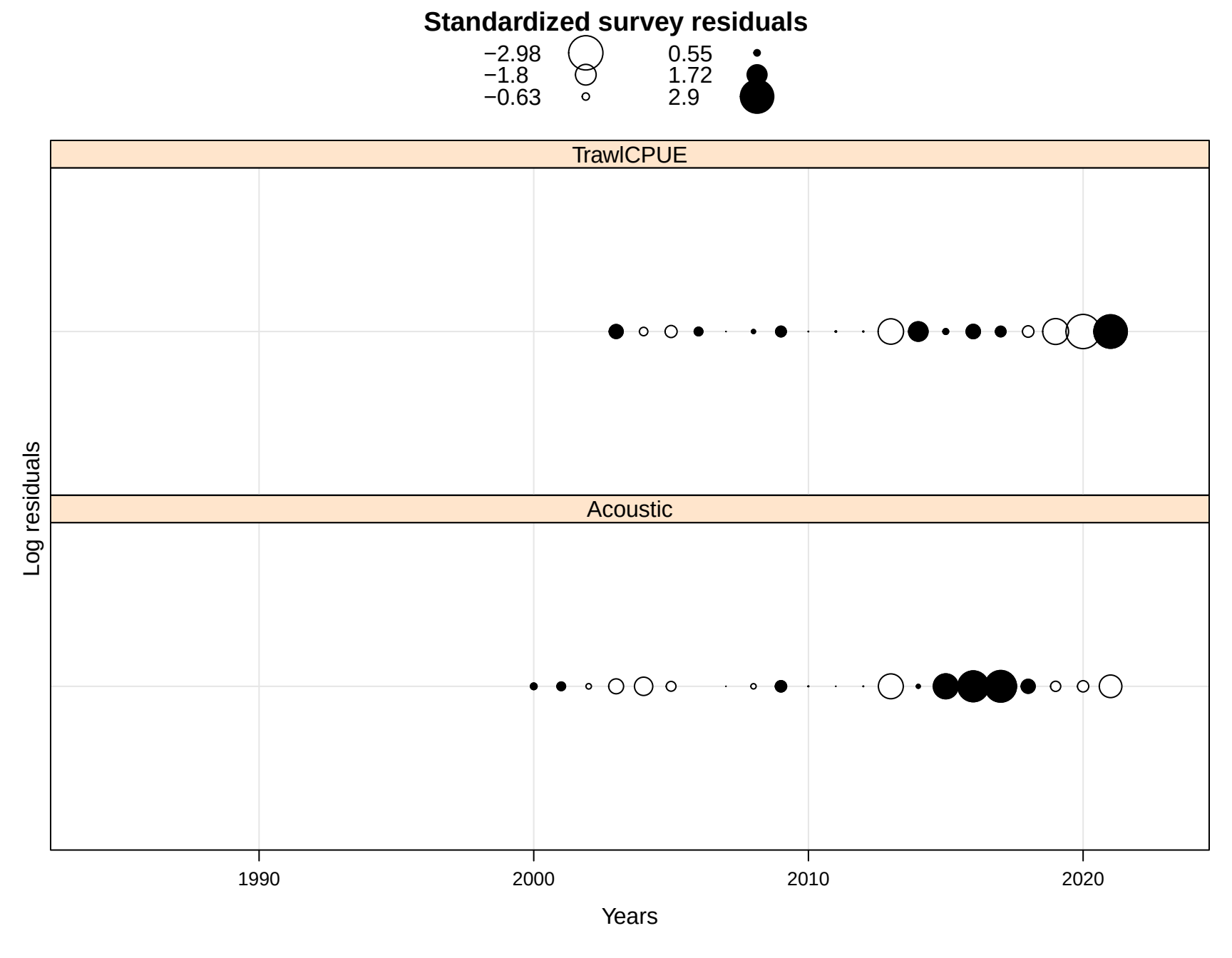

Age fits Fsh1
Observed
Predicted
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion at age
Age

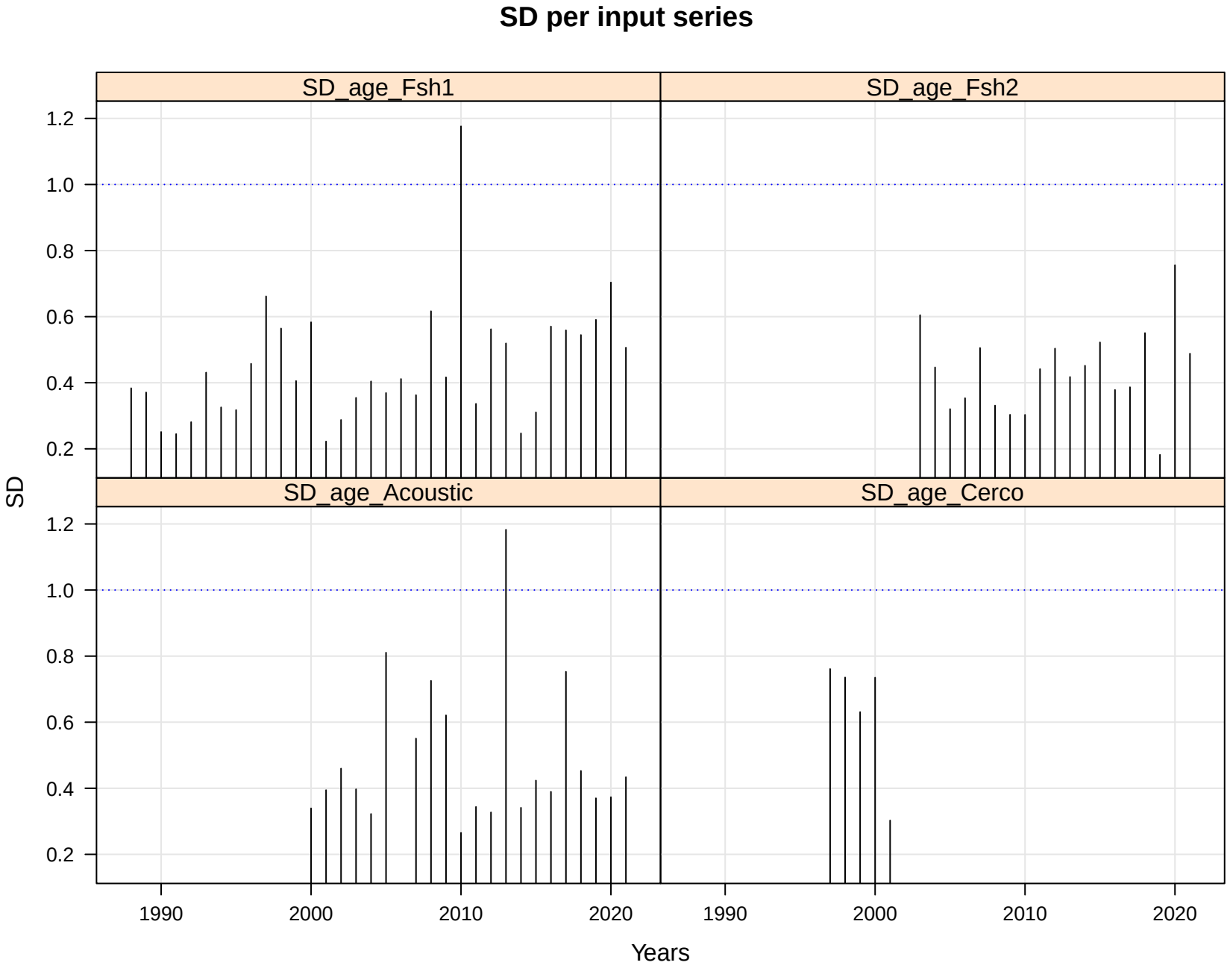

Age fits Fsh2
Observed
Predicted
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion at age
Age
0.0
0.1
0.2
0.3
0.4
5
10

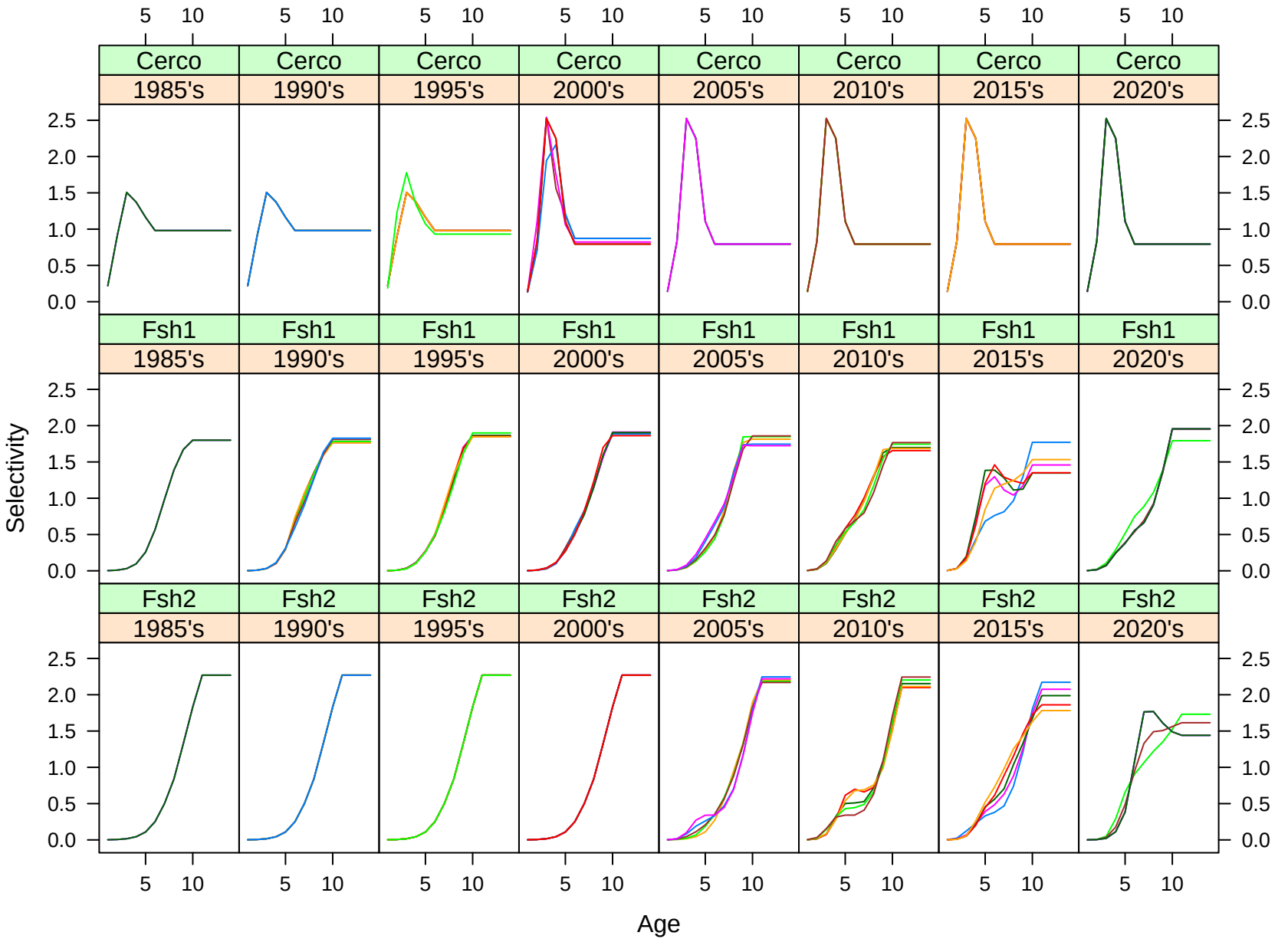

Predicted and observed catches by fleet
Observed
Predicted
Fsh2
Cerco
Fsh1
Thousand tonnes
0
100
200
300
1990
2000
2010
2020
Years

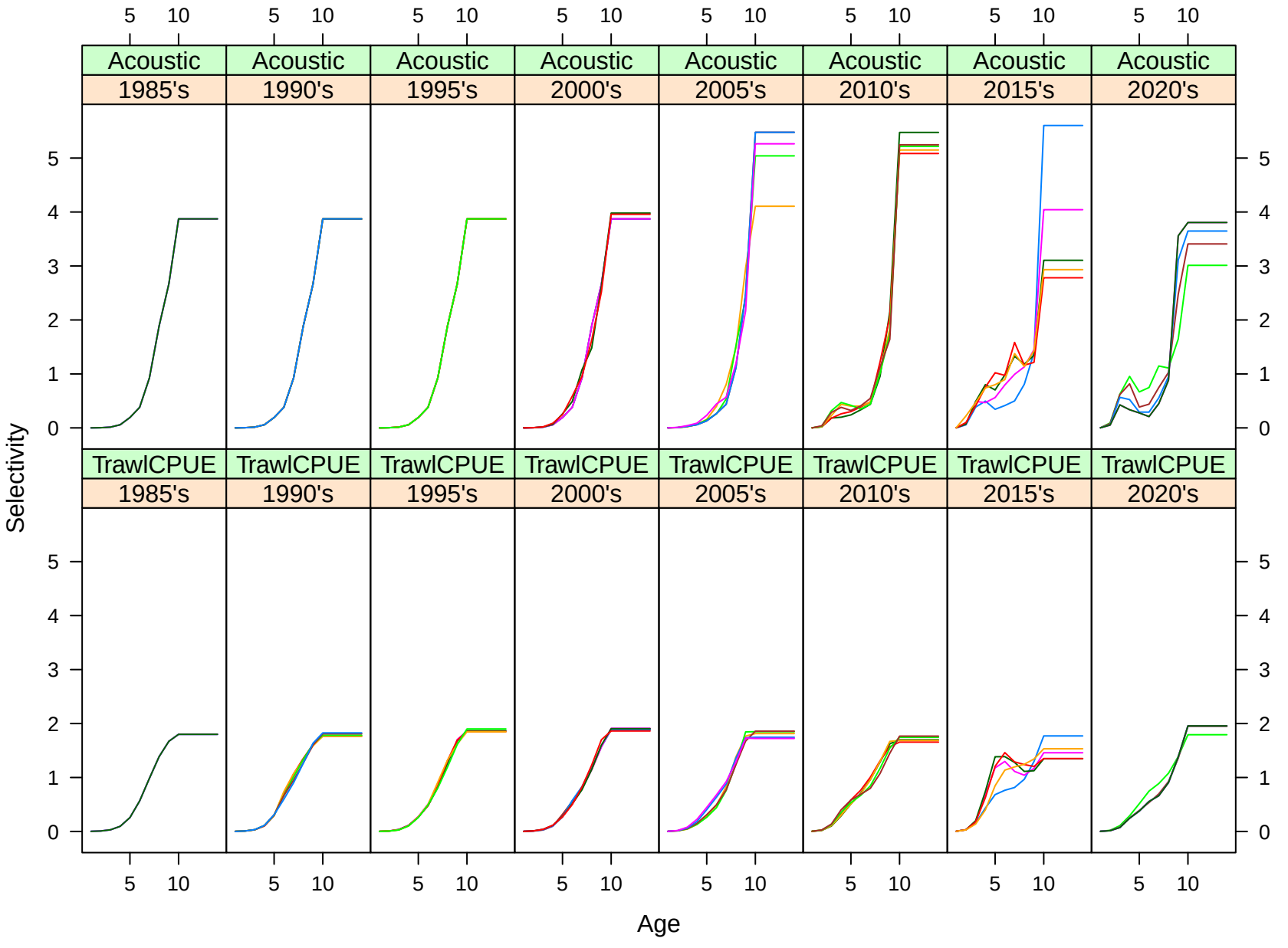

Predicted and observed indices
Observed
Predicted
1990
2000
2010
2020
Acoustic
TrawlCPUE
Normalized index value
Years

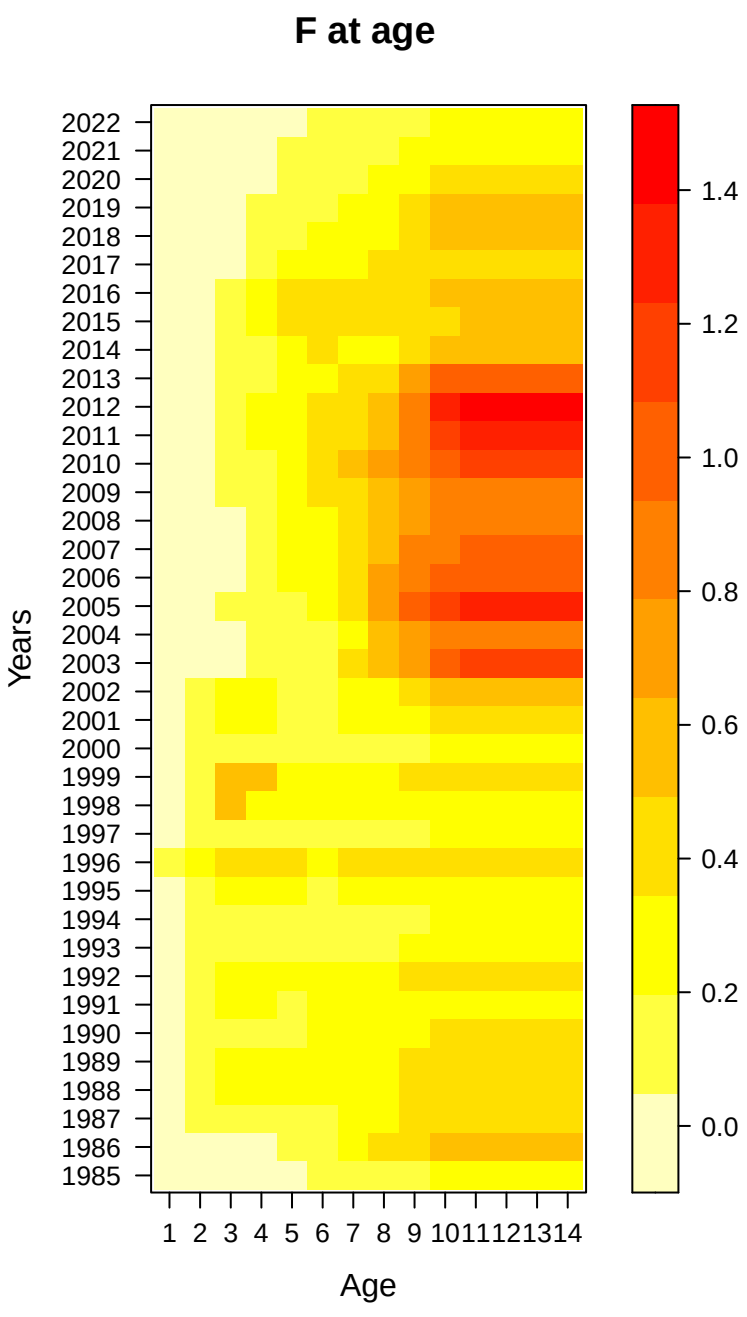

Age fits Acoustic
Observed
Predicted
2000
2001
2002
2003
2004
2005
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Proportion at age
Age
0.0
0.2
0.4
0.6
5
10

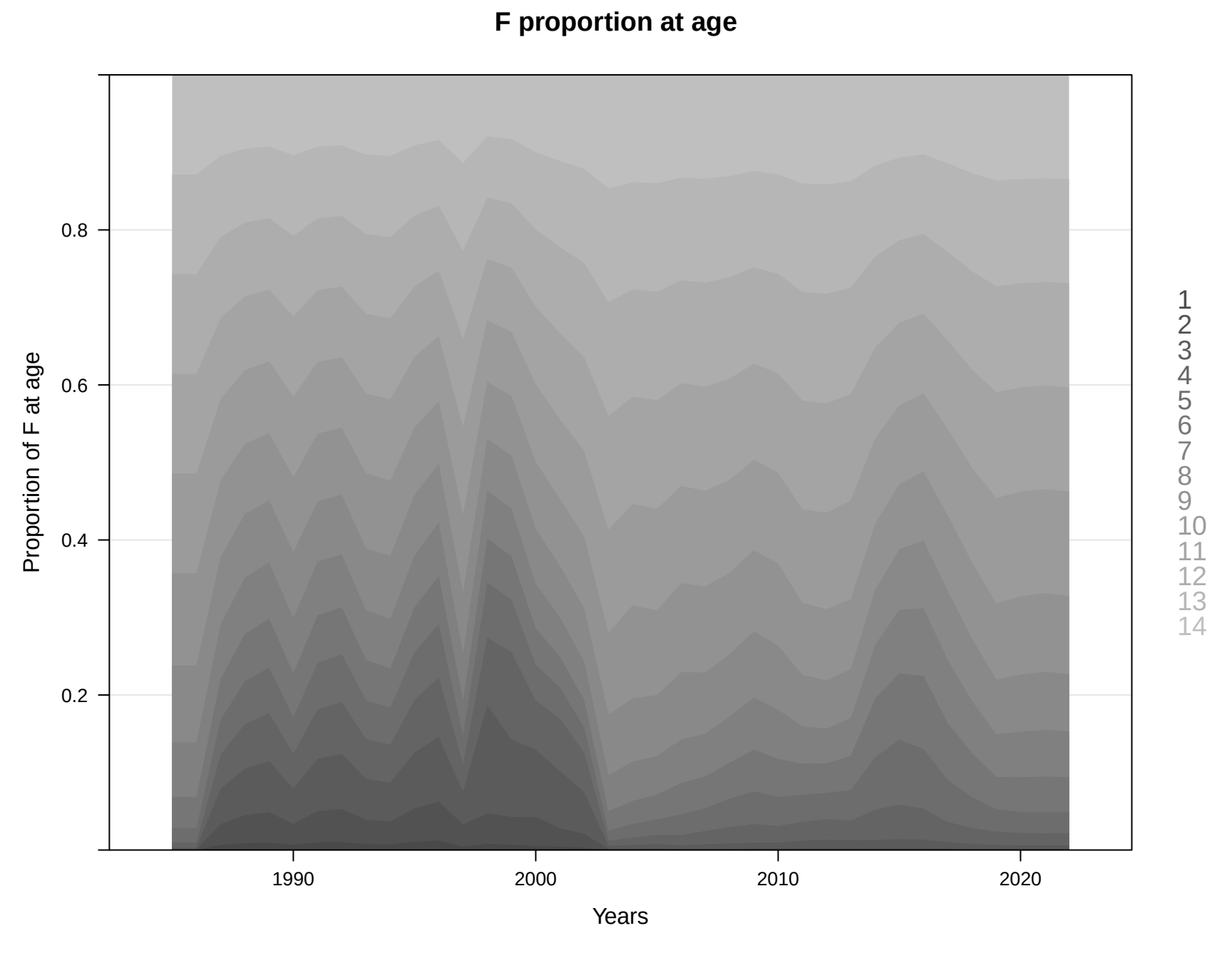

Standardized survey residuals
−2.98
−1.8
−0.63
0.55
1.72
2.9
TrawlCPUE
Acoustic
Log residuals
1990
2000
2010
2020
Years

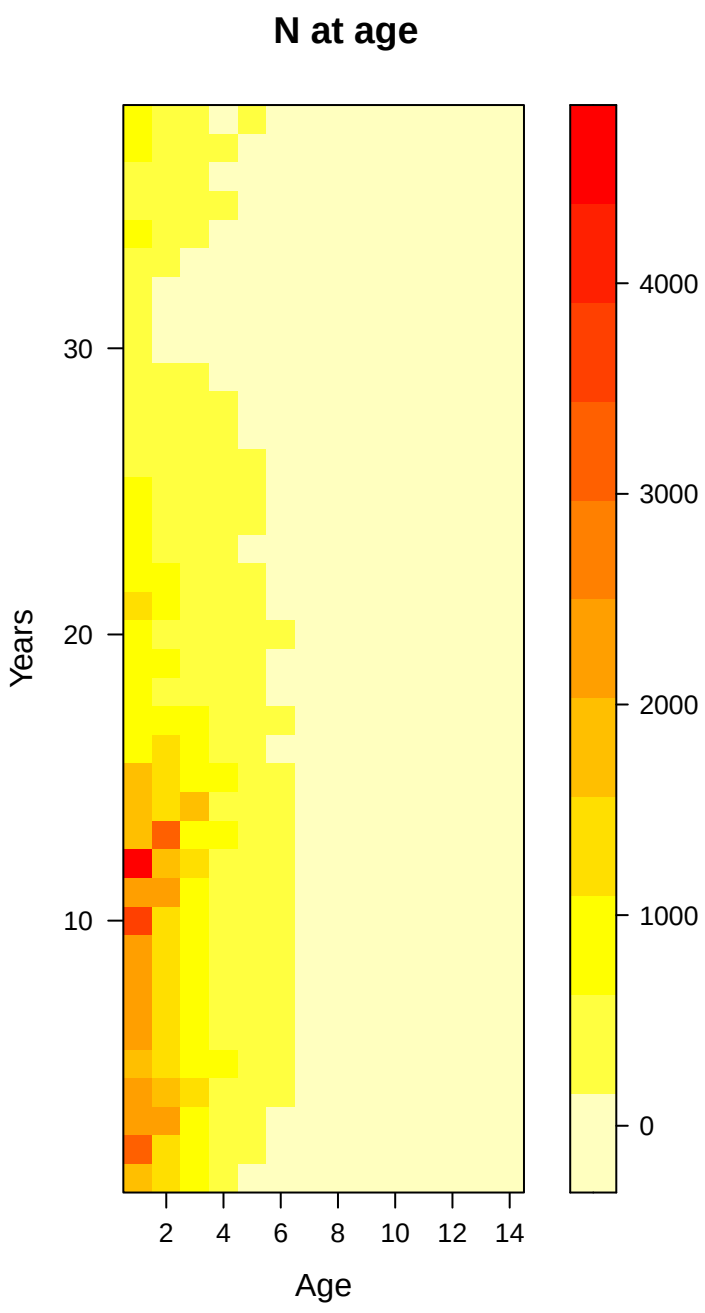

SD per input series
SD_age_Fsh1
SD_age_Fsh2
SD_age_Acoustic
SD_age_Cerco
SD
Years
1.2
1.0
0.8
0.6
0.4
0.2
1990
2000
2010
2020

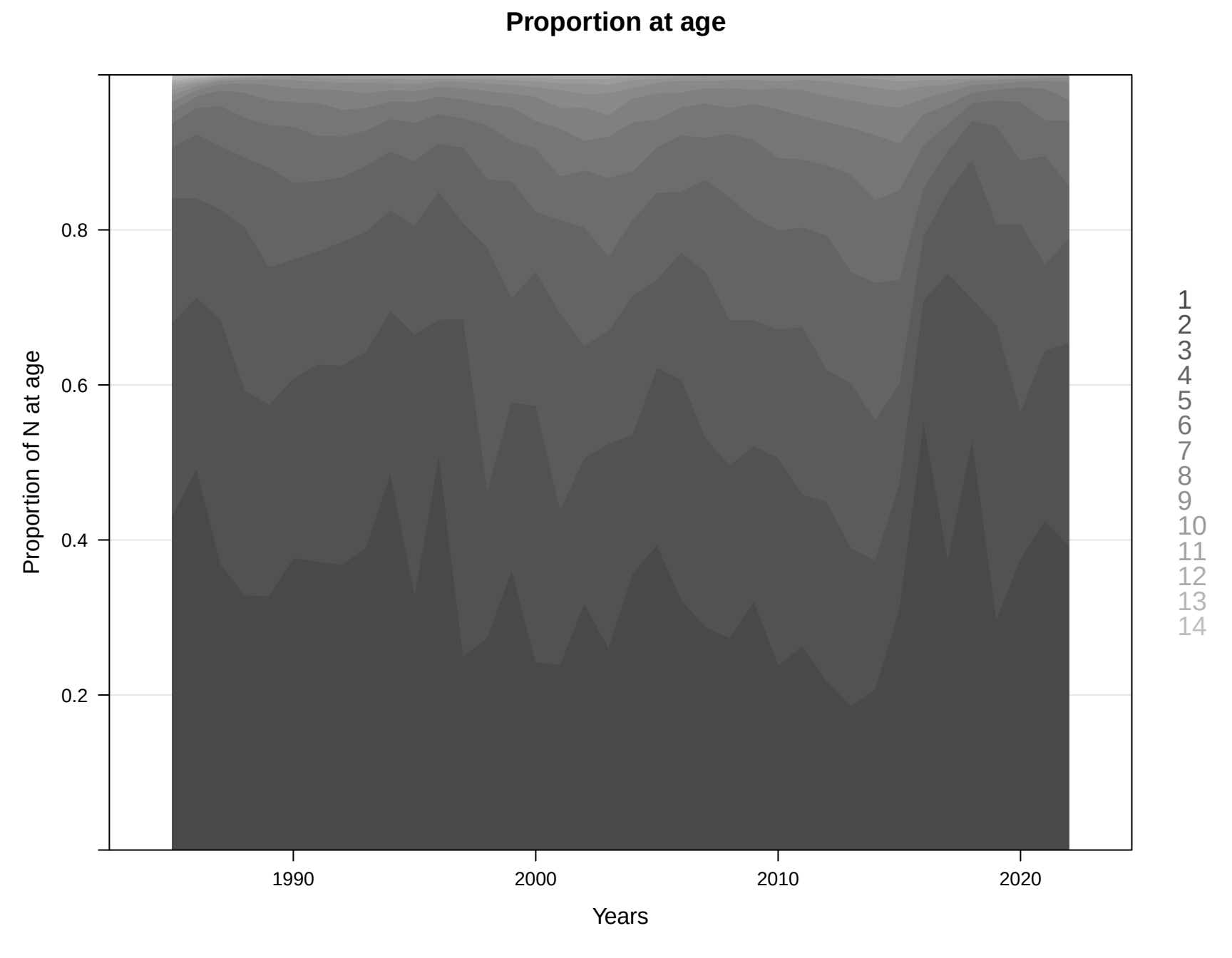

Selectivity of the Fishery by Pentad
Cerco
Fsh1
Fsh2
1985's
1990's
1995's
2000's
2005's
2010's
2015's
2020's
Selectivity
Age
0.0
0.5
1.0
1.5
2.0
2.5
5
10

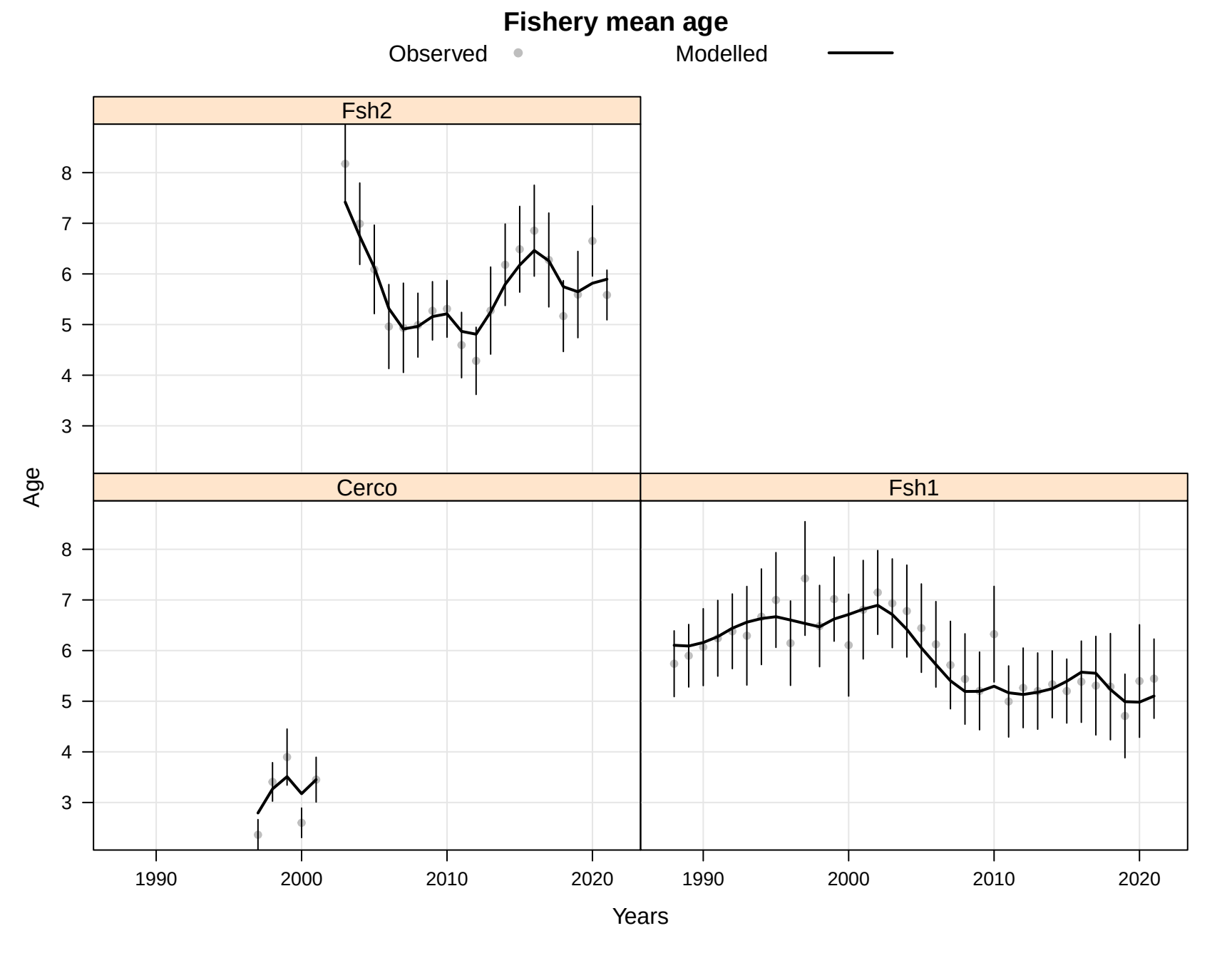

Selectivity of the survey by Pentad
Acoustic
1985's
1990's
1995's
2000's
2005's
2010's
2015's
2020's
TrawlCPUE
Selectivity
Age
0
1
2
3
4
5
5
10

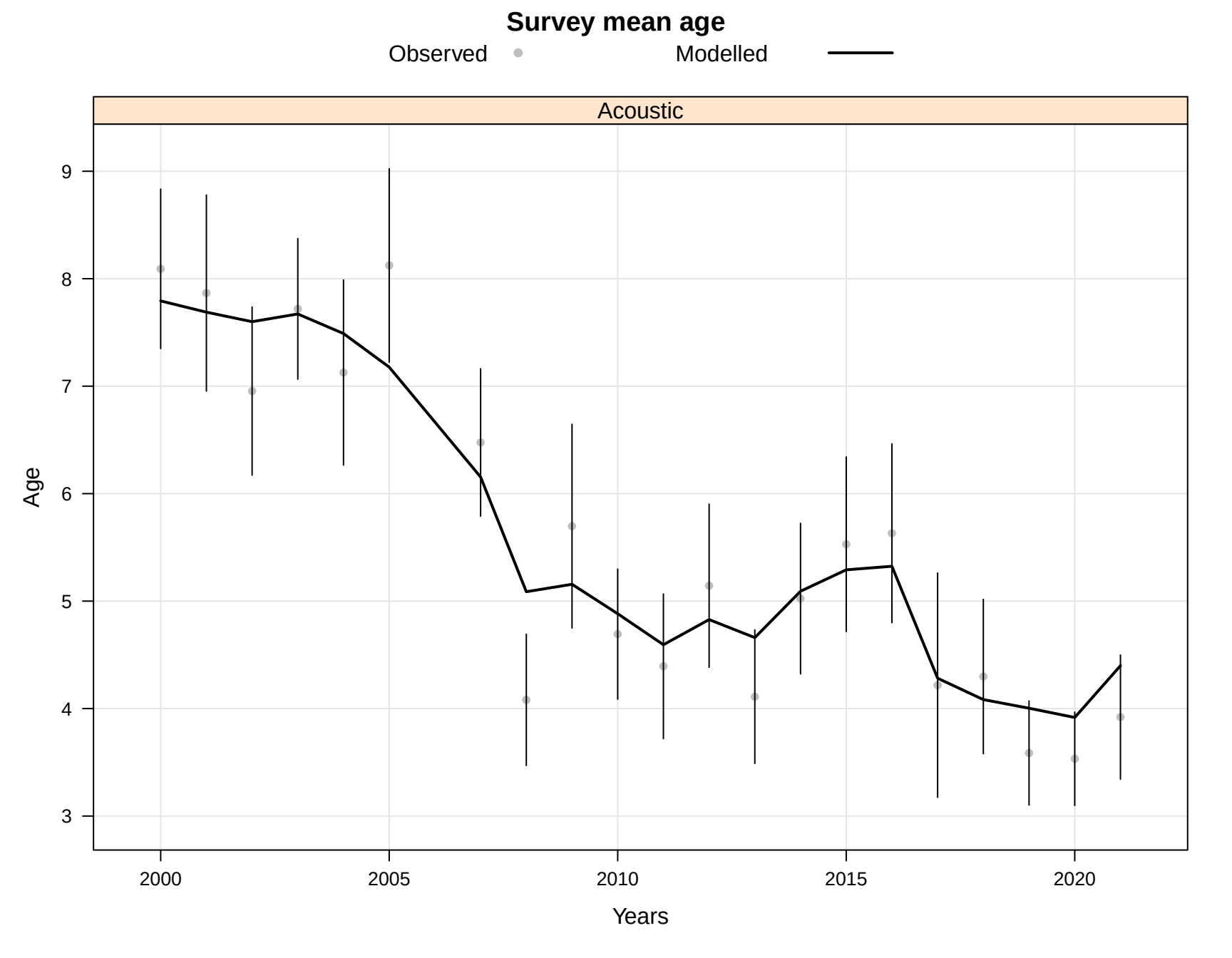

F at age
Years
2022
2021
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
1991
1990
1989
1988
1987
1986
1985
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Age
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

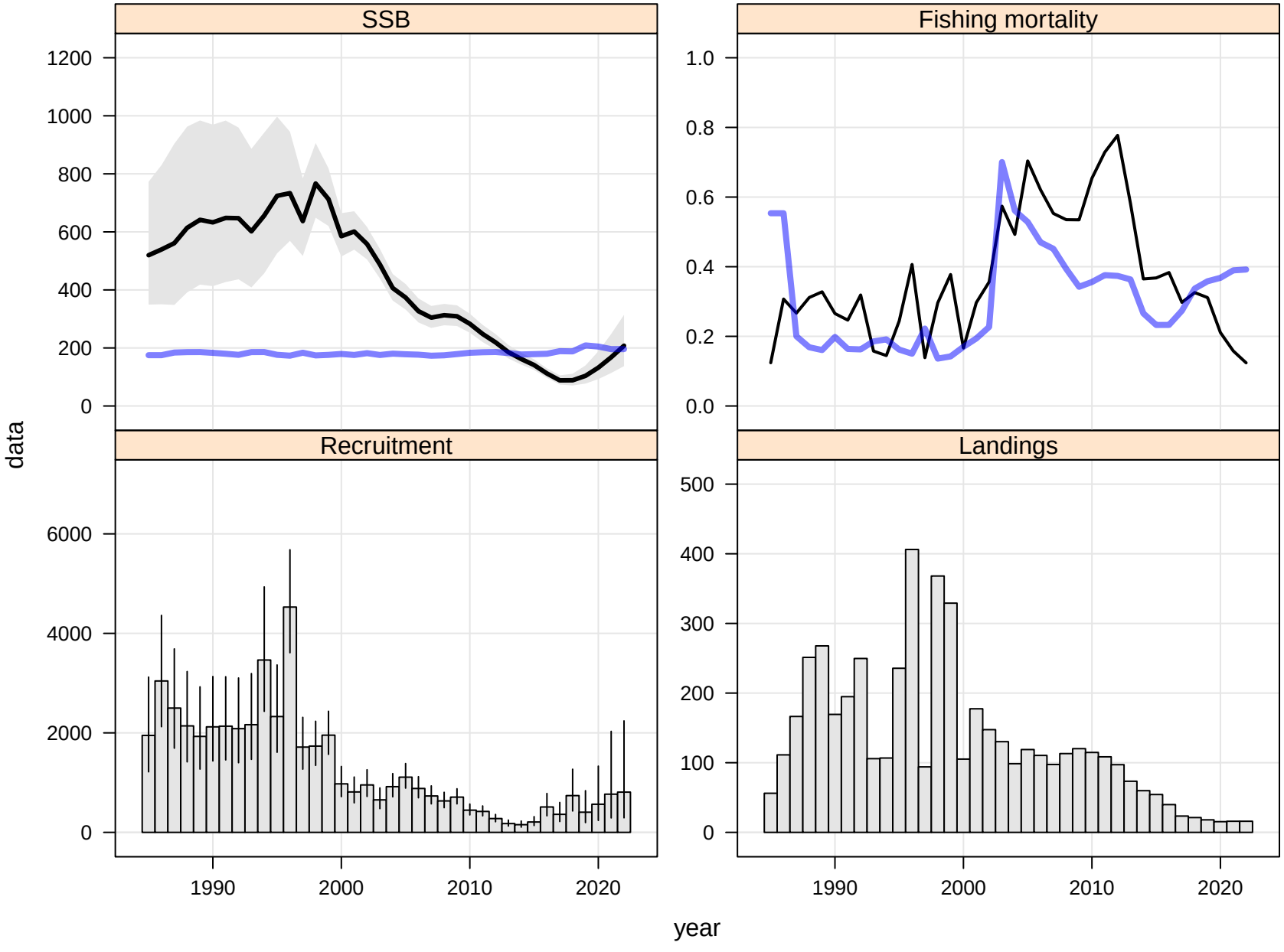

F proportion at age
Proportion of F at age
0.8
0.6
0.4
0.2
1990
2000
2010
2020
Years
1
2
3
4
5
6
7
8
9
10
11
12
13
14


N at age
Years
30
20
10
2
4
6
8
10
12
14
Age
4000
3000
2000
1000
0

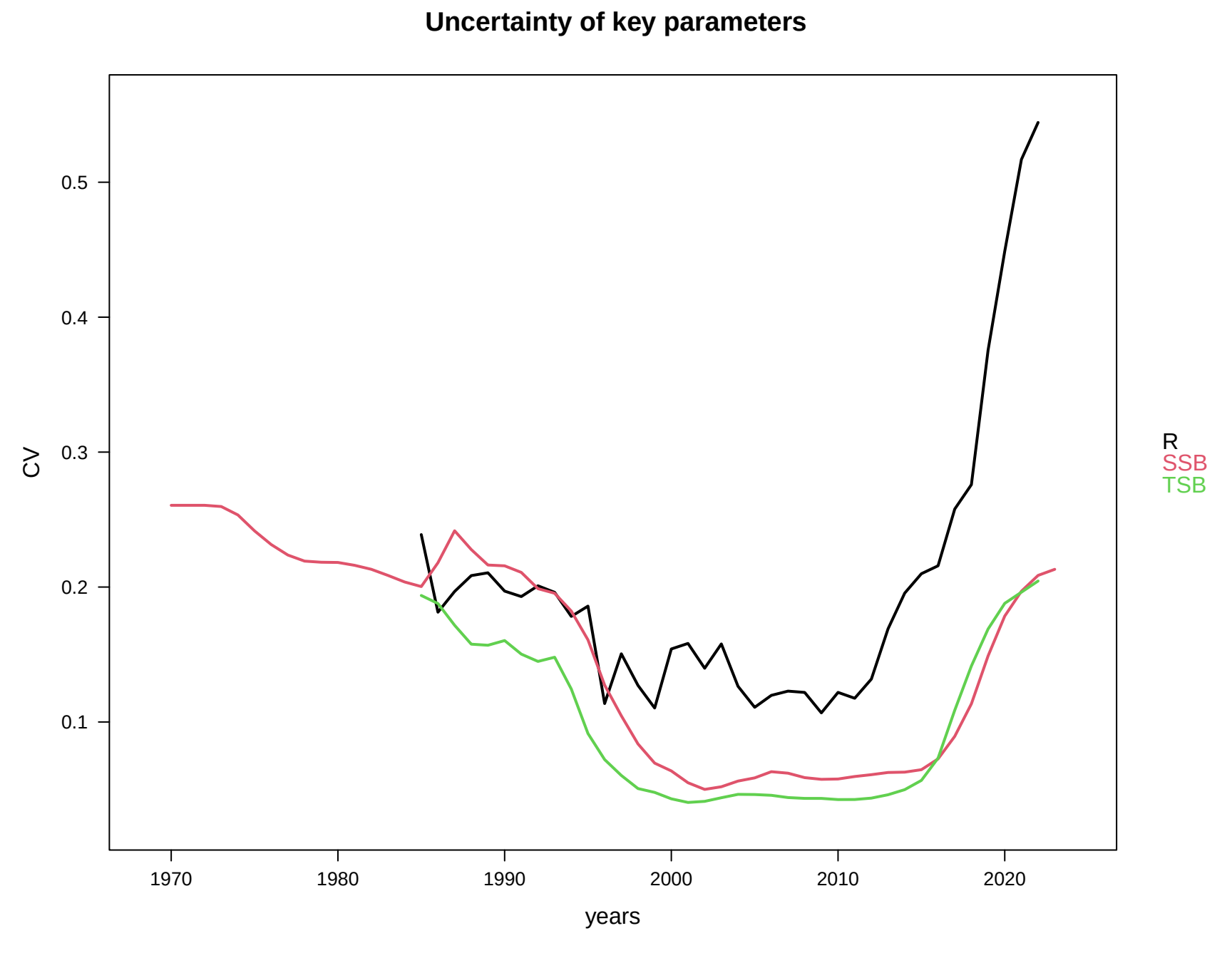

Proportion at age
Proportion of N at age
0.8
0.6
0.4
0.2
1990
2000
2010
2020
Years
1
2
3
4
5
6
7
8
9
10
11
12
13
14

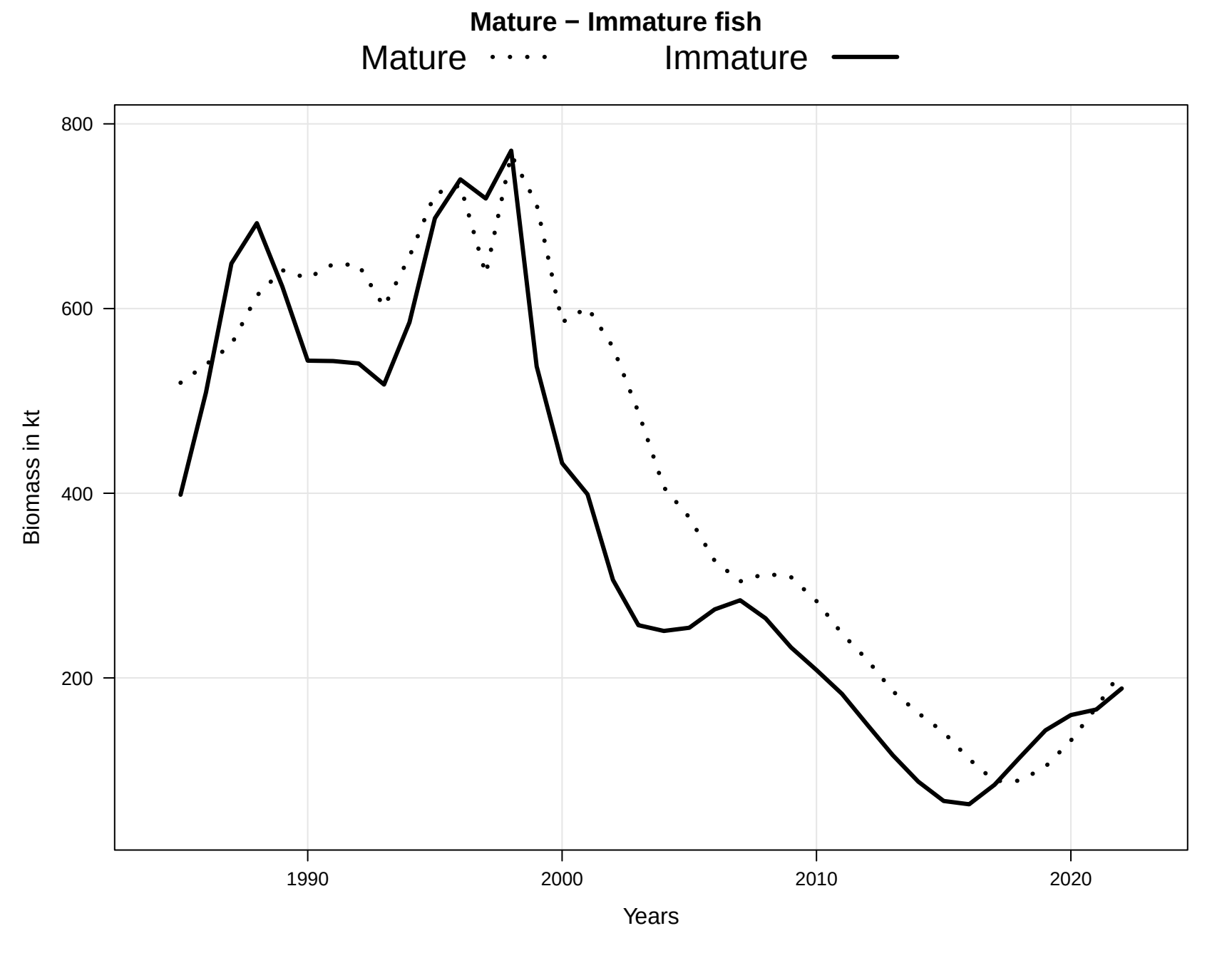

Fishery mean age
Observed
Modelled
Fsh2
Cerco
Fsh1
Age
Years
3
4
5
6
7
8
1990
2000
2010
2020

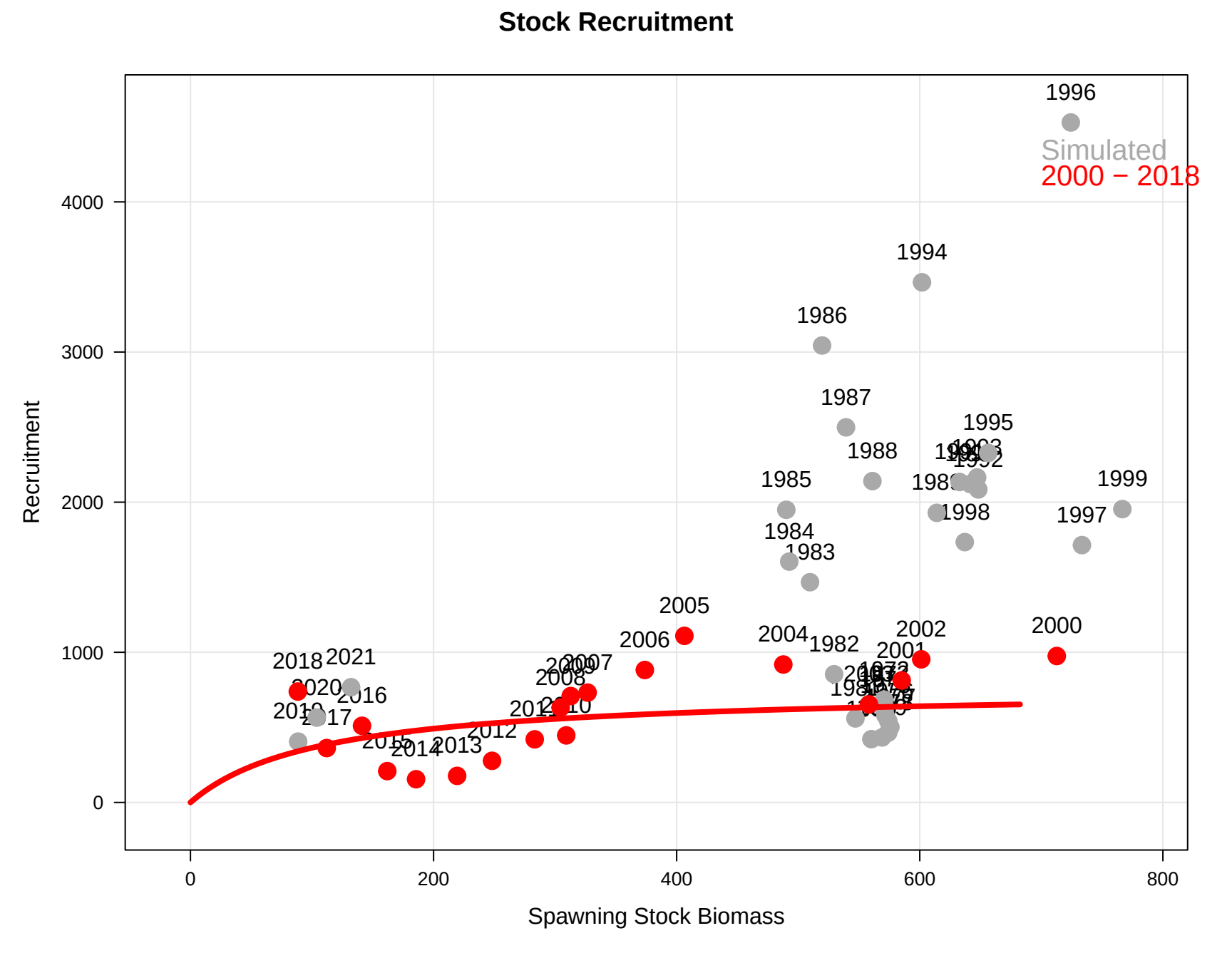

Survey mean age
Observed
Modelled
Acoustic
Age
Years
9
8
7
6
5
4
3
2000
2005
2010
2015
2020

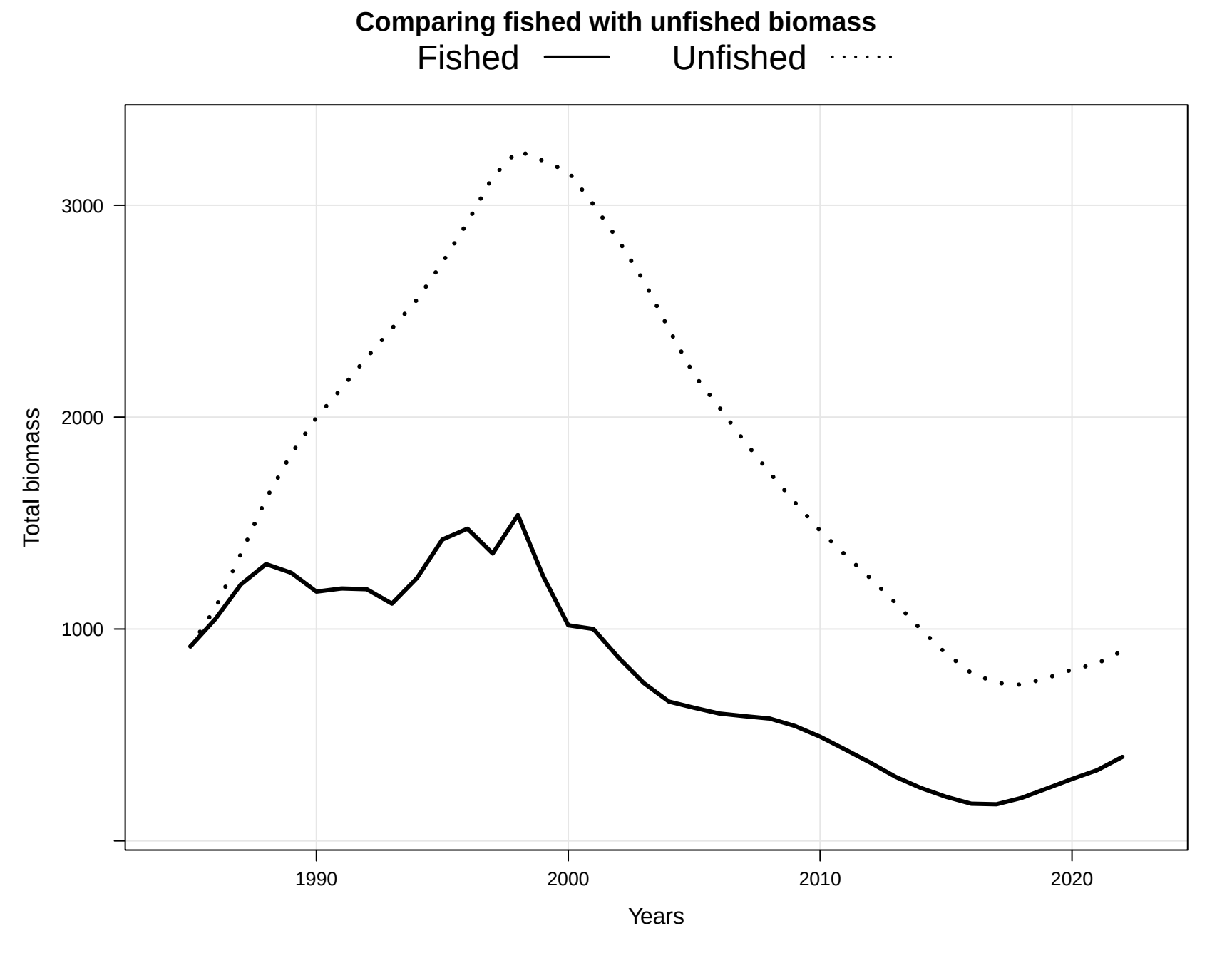

SSB
Fishing mortality
Recruitment
Landings
data
year
1200
1000
800
600
400
200
0
1.0
0.8
0.6
0.4
0.2
0.0
6000
4000
2000
500
300
100
1990
2000
2010
2020

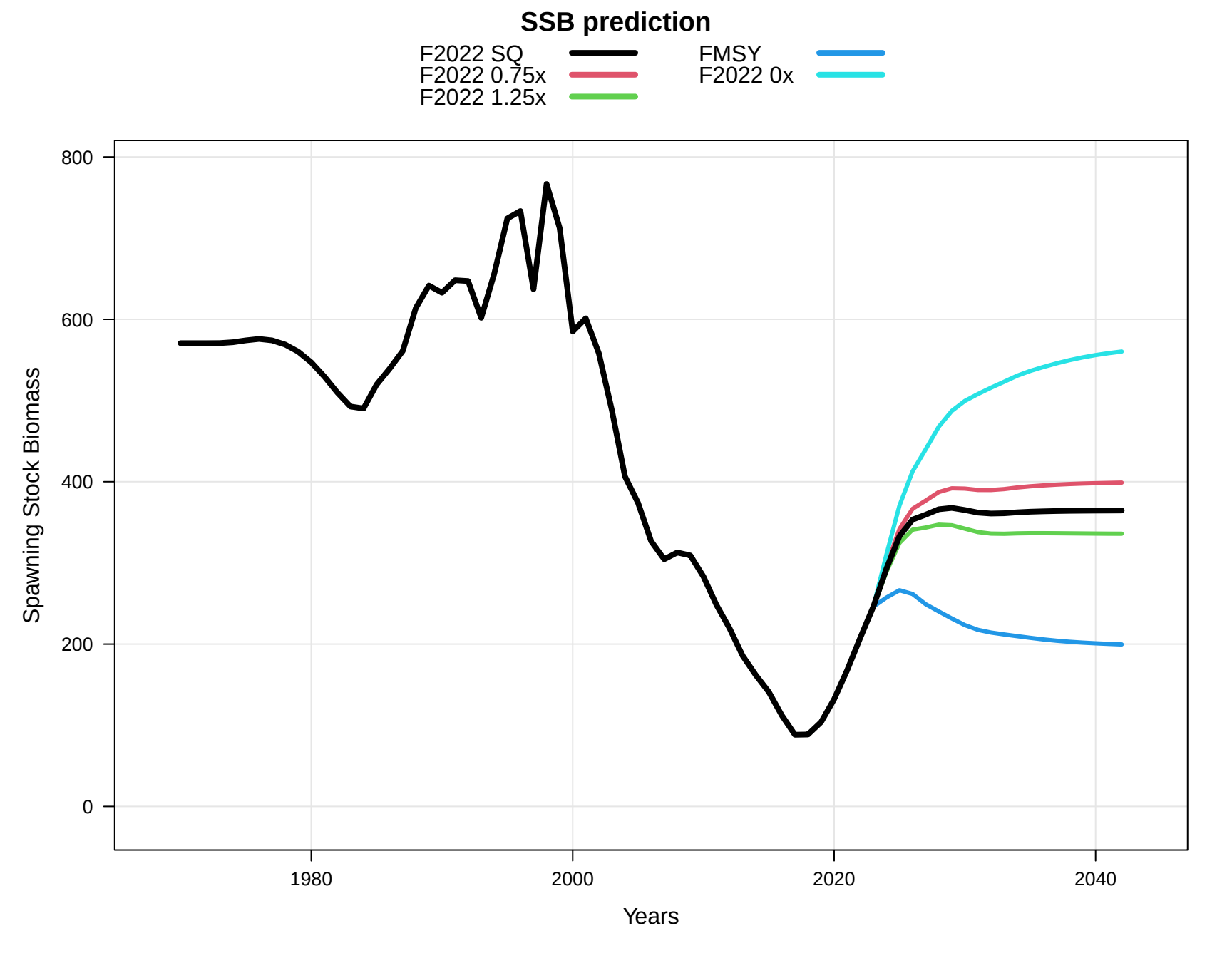
Total biomass
1500
1000
500
Fishing mortality
0.8
0.6
0.4
0.2
Recruitment
6000
5000
4000
3000
2000
1000
Unfished biomass
4000
3000
2000
1000
data
1990
2000
2010
2020
year

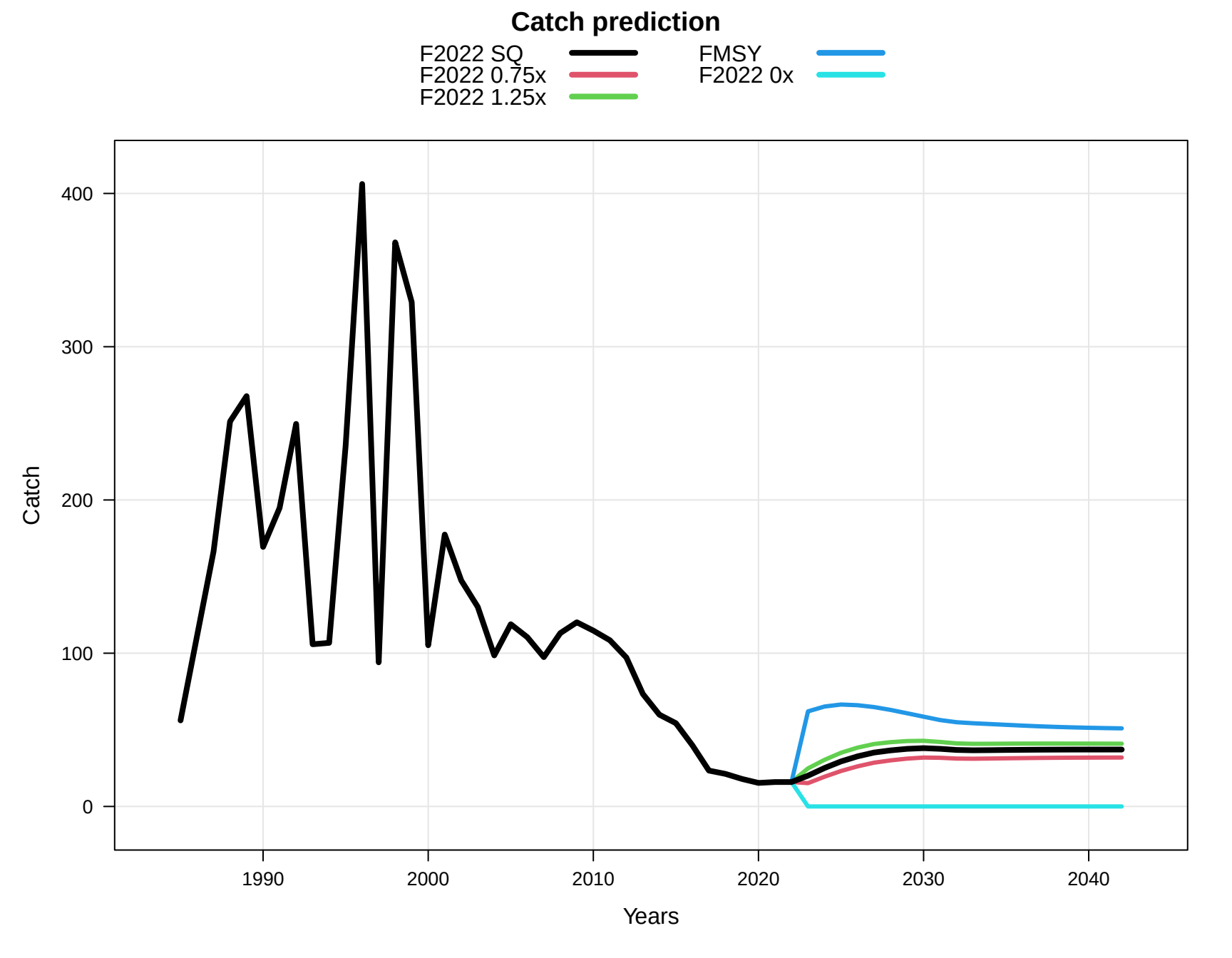

Uncertainty of key parameters
CV
0.1
0.2
0.3
0.4
0.5
1970
1980
1990
2000
2010
2020
years
R
SSB
TSB

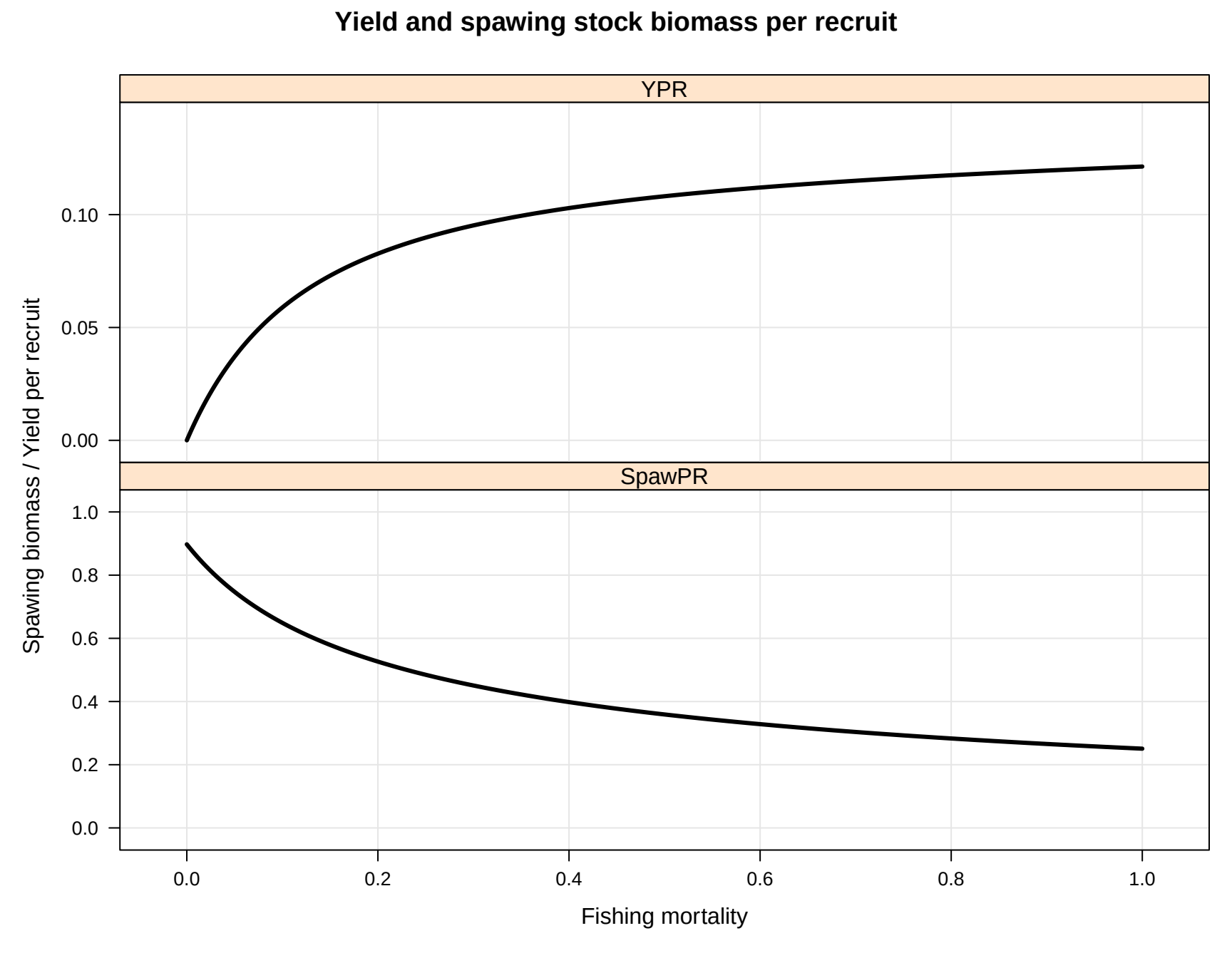

Mature − Immature fish
Mature
Immature
800
600
400
200
Biomass in kt
1990
2000
2010
2020
Years

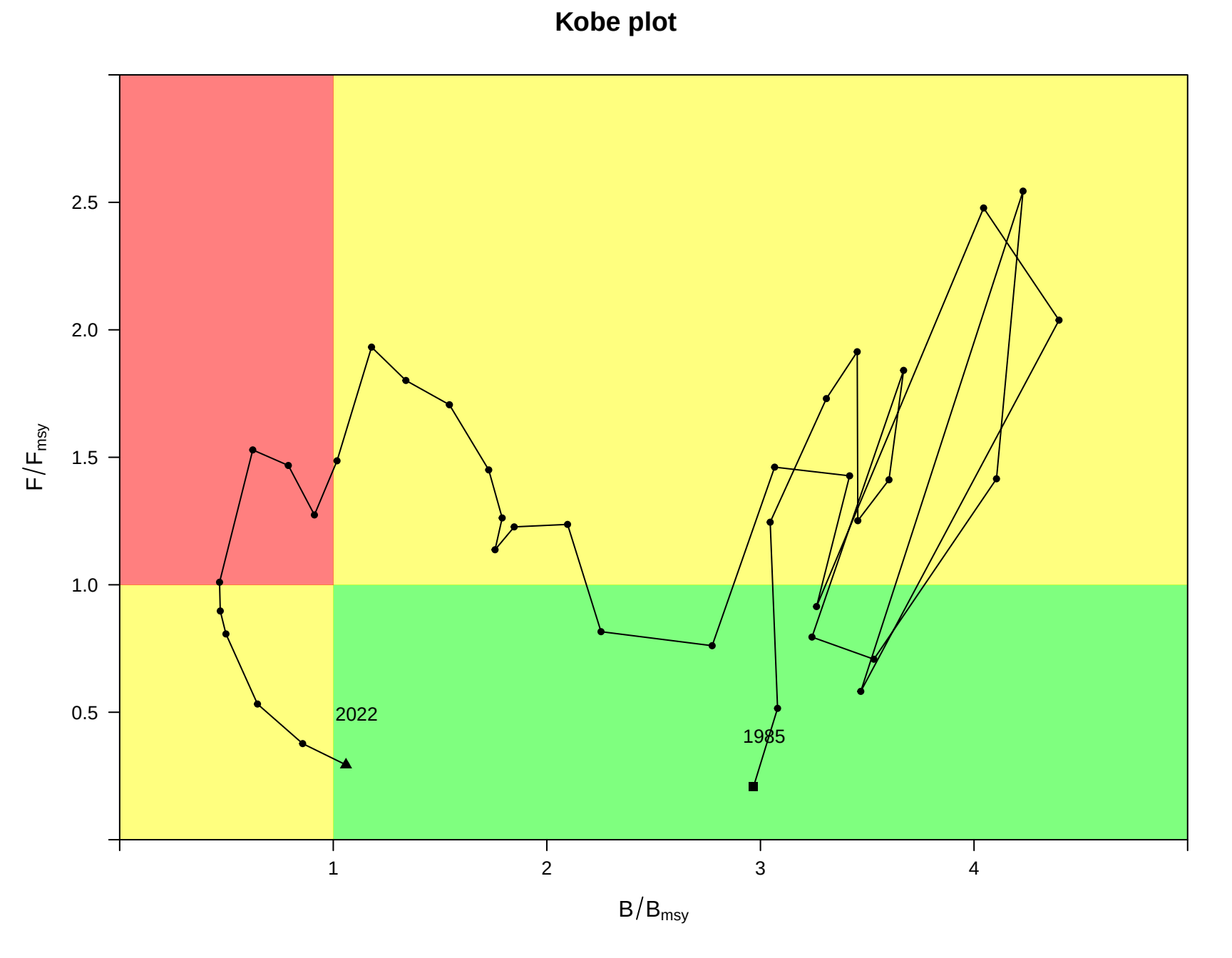

Stock Recruitment
Simulated
2000 − 2018
Recruitment
Spawning Stock Biomass
0
1000
2000
3000
4000
0
200
400
600
800
1996
1994
1986
1987
1995
1988
1985
1999
1998
1997
1984
1983
2005
2006
2004
2002
2000
1982
2001
2018
2021
2020
2016
2017
2007
2008
2012
2014
2013

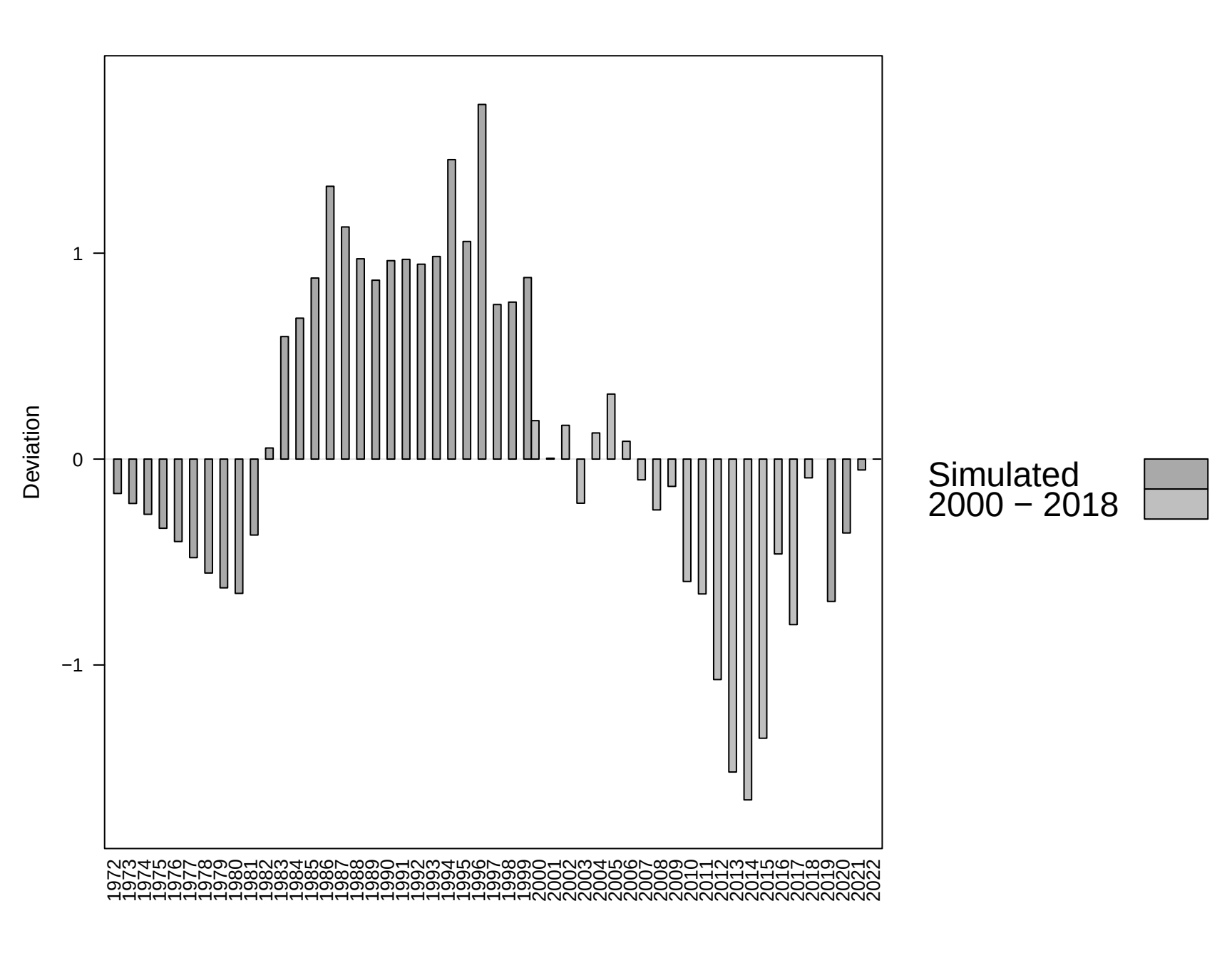

Comparing fished with unfished biomass
Fished
Unfished
3000
2000
1000
Total biomass
1990
2000
2010
2020
Years

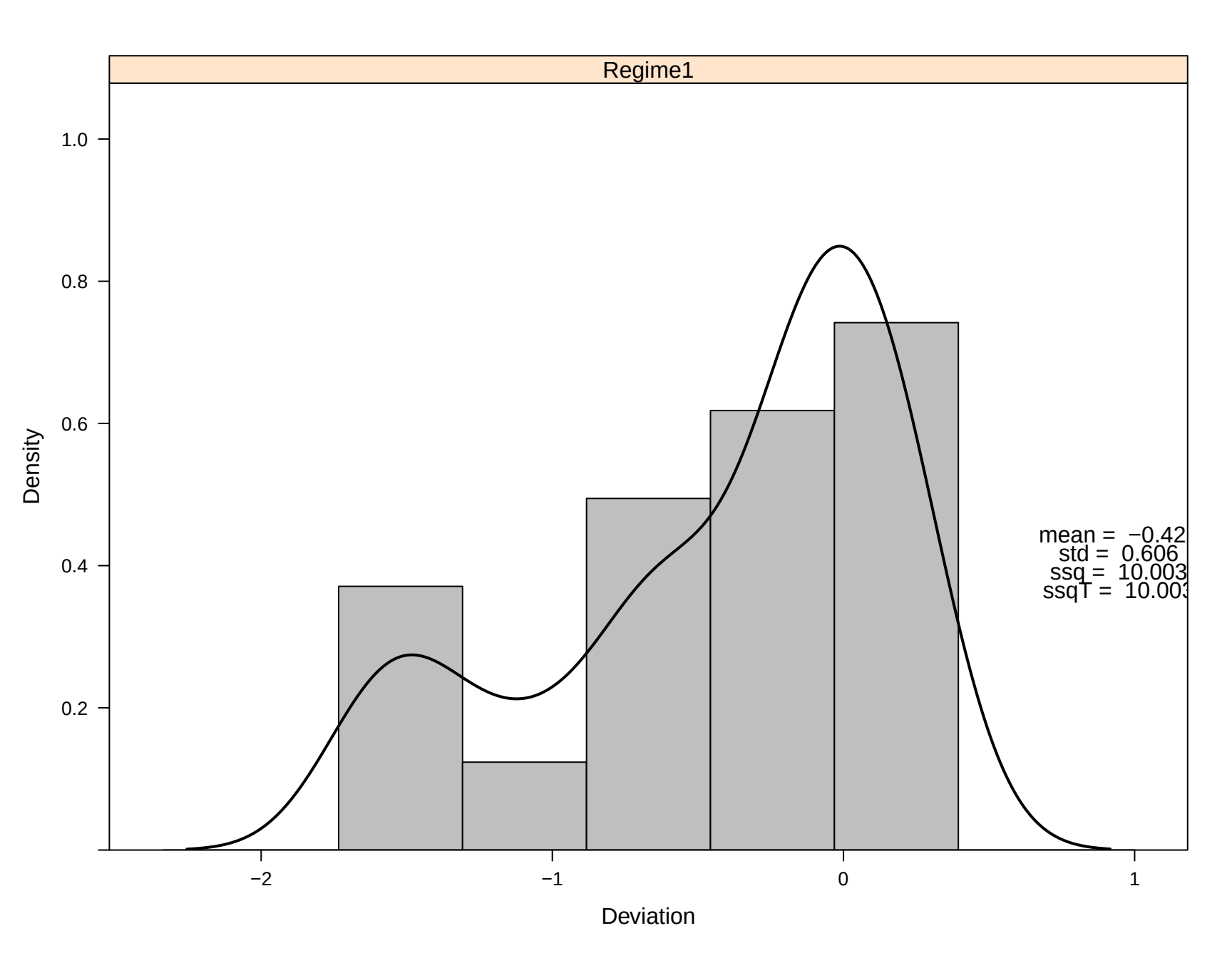

SSB prediction
F2022 SQ
F2022 0.75x
F2022 1.25x
FMSY
F2022 0x
Spawning Stock Biomass
800
600
400
200
0
1980
2000
2020
2040
Years


Catch prediction
F2022 SQ
F2022 0.75x
F2022 1.25x
FMSY
F2022 0x
Catch
400
300
200
100
0
1990
2000
2010
2020
2030
2040
Years


Yield and spawing stock biomass per recruit
YPR
SpawPR
Spawing biomass / Yield per recruit
Fishing mortality
0.00
0.05
0.10
0.0
0.2
0.4
0.6
0.8
1.0


Kobe plot
2.5
2.0
1.5
1.0
0.5
F/F_msy
1
2
3
4
B/B_msy
2022
1985


Deviation
1
0
−1
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Simulated
2000 − 2018


Regime1
1.0
0.8
0.6
0.4
0.2
Density
−2
−1
0
1
Deviation
mean = −0.42
std = 0.606
ssq = 10.003
ssqT = 10.003