Appendix A1

New England Fishery Management Council
Whiting Advisory Panel Meeting
SMAST – Fairhaven, MA

DRAFT Meeting Summary
August 6, 2010

Purpose of meeting: The advisory panel meeting served as an initial hake assessment meeting for stakeholders and fishermen to provide input on fishery and survey data.

Attendance: Advisors: Dan Farnham and Bill Phoel. Also in attendance were David Goethel (Oversight Committee chair), Andrew Applegate (staff) Steve Cadrin (SSC and WG chair, SMAST), Pingguo He, Klondike Jonas, Yuying Zhang, Tony Wood, and Daniel Goethel (SMAST), Loretta O'Brien, Michele Traver, Katherine Sosebee and Larry Alade (NEFSC), and Dick Allen (advisor at large).

Motions: No motions were made.

Summary

Steve Cadrin gave a presentation outlining the benchmark assessment Terms of Reference and known issues from previous assessments for the three hake species: silver, offshore, and red. He emphasized that besides simply assessing the status of the stocks with new data and models, it was important that the stock assessment produced sufficient projections for 2011-2013 to set ACLs and specifications within the planned FMP amendment for small mesh multispecies.

All five stocks (northern and southern silver hake, offshore hake, and northern and southern red hake) have existing proxy MSY reference points developed in 2002 during the last amendment, but these may be inconsistent with new estimates of MSY. Dr. Cadrin stressed the importance of making a status determination against the existing reference points as well as against any reference point recommendations that would be estimated and developed. Meeting participants also noted that another benchmark assessment may be a long way off, so that this benchmark assessment needed to identify how future update assessments should be conducted, either by the PDT or another group.

Dr. Cadrin also reviewed the calendar of related meetings, including a data meeting in early September, followed by a models/analysis meeting in late October, and the SAW review in early December.

Larry Alade, Michele Travers, and Kathy Sosebee gave an overview of the assessment data for silver, offshore, and red hakes, respectively. Data for all three species exhibited problems with mis-identification and reporting, uncertain stock structure (north and south stocks for silver and red hake), and difficult to estimate stock dynamics. Particularly for silver hake, it was noted that

landings have been at relatively low levels since 1980, yet the survey biomass indices have not increased very much. The low landings may have been a result of the 5% groundfish catch limit for small mesh fisheries.

During the presentations, several issues were raised and there was some discussion of possible approaches and analyses to address these issues.

Silver hake

For silver hake, these issues included mis-reporting of species (silver and offshore hake mixed), stock structure (separate north/south stocks or combined), potential aging errors (mis-interpretation of annuli), difficulty in following strong and weak cohorts beyond age 2, and the effects of cannibalism on biological reference points and productivity. The work group was given a term of reference and had plans to develop model-based estimates of the species composition in landings and discard.

Species composition may be resolved through a variety of means. Although the dealer data is considered to be the more accurate estimate of landings volume, in this case, the vessel trip reports may be the more accurate estimate of species composition. Although sampling frequency in the observer data may be too low to estimate species composition, the VMS data may be useful because silver and offshore hake stratify by depth.

Some suggested that the dealer reports may also be subject to some underreporting, either via sales as bait or via sales to dealers in other states via truck. Some states, particularly CT, obtain these landings and make an aggregate report at the end of the year. Nonetheless, one of the advisors suggested that silver hake reported landings may be as much as 2 million pounds too low. Some discussion also occurred about industrial, or 'trash' fish, landings in the 1960s and 1970s, particularly at the Point Judith fish meal plant. Someone would investigate whether there was more information about those landings. Some fishermen thought that there might have been an increase in CPUE around 1975, when larger vessels began to fish offshore, which also may have lead to an increase in landings of offshore hake. Advisors reported that the hake fishery was market driven, controlled by what can be landed for a price, rather than what can be caught.

Some discussion also occurred about the apparent absence of larger 3+ fish in the survey data, without high landings. It was decided that the working group would inquire about growth ring validation. Fishermen reported that the larger silver hake move more seasonally than the smaller silver hake and can be found in deeper water (> 40 fathoms). Periodic or ad hoc offshore surveys, like the cooperative monkfish survey, should be investigated for presence of silver hake in deep water, the working group decided. Some wondered whether the larger fish in the southern portion of the range end up in the northern portion, but there is no tagging data suggesting that this is the case. Hake are difficult to tag due to their delicate nature and high discard mortality.

Red hake

It has been 20 years since the last red hake assessment and aging data is only available up to

1985. It was noted that there is significant over the side bait sales (supposedly reported on vessel trip reports), but that there were few red hake in the groundfish catch, suggesting low discards by vessels using large groundfish mesh. There were also industrial fish landings that included red hake, potentially recoverable data in the ICNAF data.

Although previous assessments analyzed a northern and southern stock separately, there was little evidence for such a separation. The group decided that a combined assessment would be appropriate, but that separate north/south assessments would also be needed for status determinations using the existing reference points and overfishing definitions.

Offshore hake

Besides the species composition of the commercial catch discussed in the context of silver hake, the offshore range and what proportion of the stock was sampled by the NMFS trawl survey was an issue. And like silver hake, periodic offshore surveys like the cooperative monkfish survey might be informative. The length of the derived catch series was questioned and it might be difficult to complete an analytical assessment. A catch/biomass exploitation rate might be possible, but its utility as a measure of population trend and mortality would be questionable due to noise caused by availability to the survey and to the fishery. It was suggested that the relationship between the survey index (or number of positive tows) might be related to the NAO and Gulf Stream positioning. The working group thought that this could be a productive avenue for analysis.

Depending on the amount of catch and the range of the stock relative to the commercial fishery, it seemed that offshore hake might be re-classified as an ecosystem fishery component by a new amendment. This would mean that there would be monitoring, but no overfishing definition.

Other issues; Management and amendment schedule

For both red and silver hake, discards would be estimated and hindcasted, using sea sampling data, most recently collected using standard bycatch reporting methodology (SBRM). Dr. He indicated that there were some experiments planned to estimate discard mortality, but not enough data would be available for this assessment. In the absence of more data, the group thought that 100% discard mortality was the most reasonable assumption for trawls and especially dredges. Non-catch mortality was discussed, but not having any data, it would be assumed that there was no non-catch mortality of hakes, although some is likely, particularly in scallop dredges and might occur in large mesh trawls.

Andy Applegate gave a brief summary of the amendment timeline and process going forward. He indicated that except for the structure of accountability measures, it was difficult to make much progress on the amendment until the stock assessment was completed because the assessment might change the biological reference points and stock status. He said that the January Council meeting would be the earliest that the Council could approve draft amendment alternatives, which then would be analyzed and taken to public hearing. The Council could consider final alternatives in April, but he thought that June would be much more likely. In this case, the Council would submit the final amendment in June or July, and the final rule could be

published in late 2011, with an ACL that applied to the 2011 fishing year beginning in May 2011. He thought that unless the assessment changed the status, the specification cycle would be for three years, or 2011-2013.

Appendix A2-A6 Silver Hake ASAP Model Results

[SAW51 Editor's Note: The SARC-51 peer review panel concluded that no single silver hake ASAP model run provided a suitable basis for providing management advice. The silver hake ASAP model results, which are described in Appendices A2-A6, are included in this report mainly to document the ASAP modeling runs that the Hake Working Group provided to the SARC for peer review.]

A. **Appendix 2:** Combined Area Consumption ASAP model results (Also summarizes as Run 6 in Table A52). Two block selectivity in the directed fleet and assumes Flat-top selectivity in the survey.

B. **Appendix A3:** North Model ASAP results M=0.4 Base run

C. **Appendix A4:** North Model ASAP results M=0.4 assuming Flat-top selectivity in the survey

D. **Appendix A5:** North Model Consumption ASAP model results M=0.15 _Base run

E. **Appendix A6:** North Model ASAP results M=0.15. Assuming Flat-top selectivity in survey

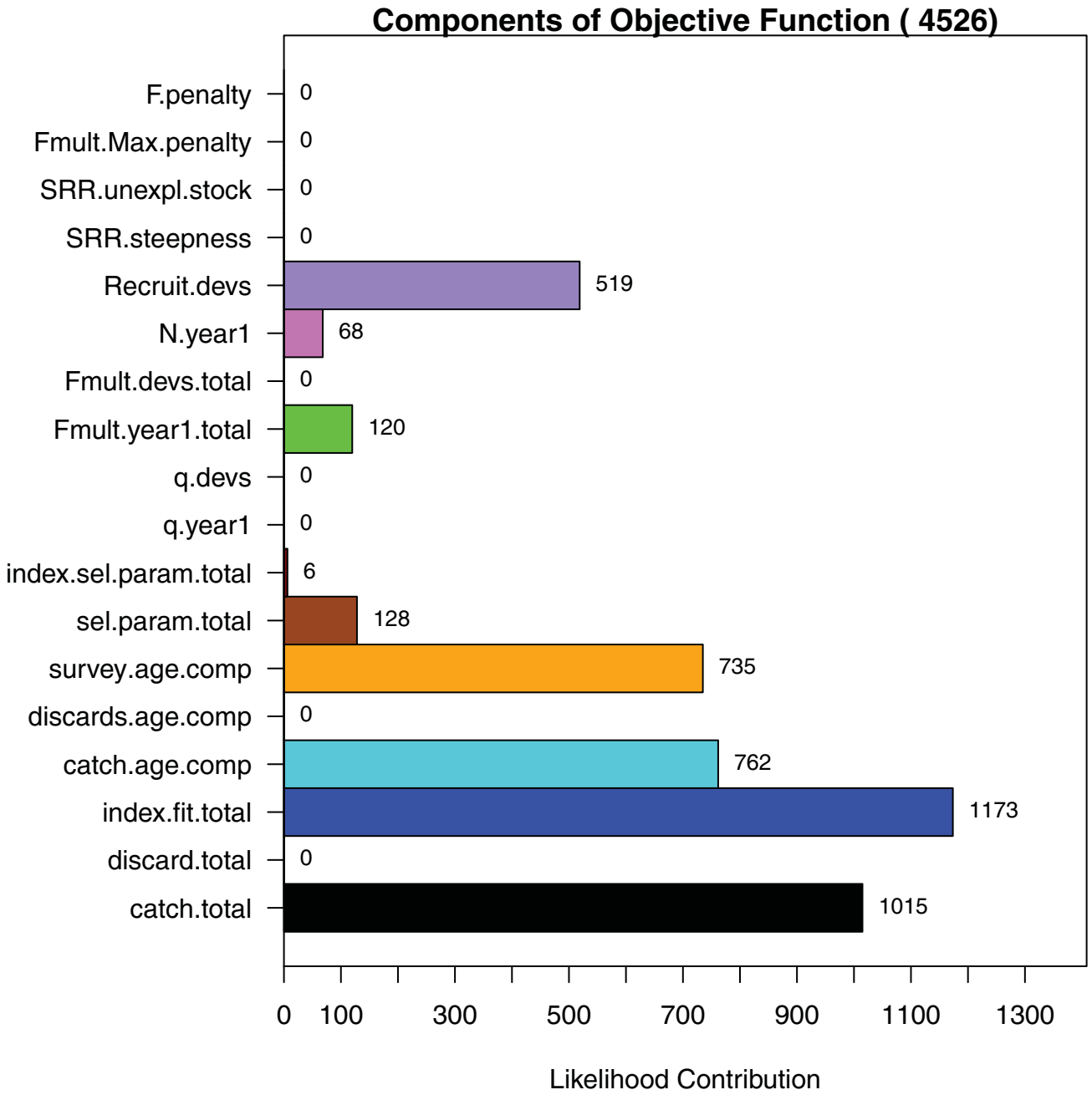
Appendix A2: Combined Area Consumption ASAP Model Results (Also summarized as Run 6 in Table A52)

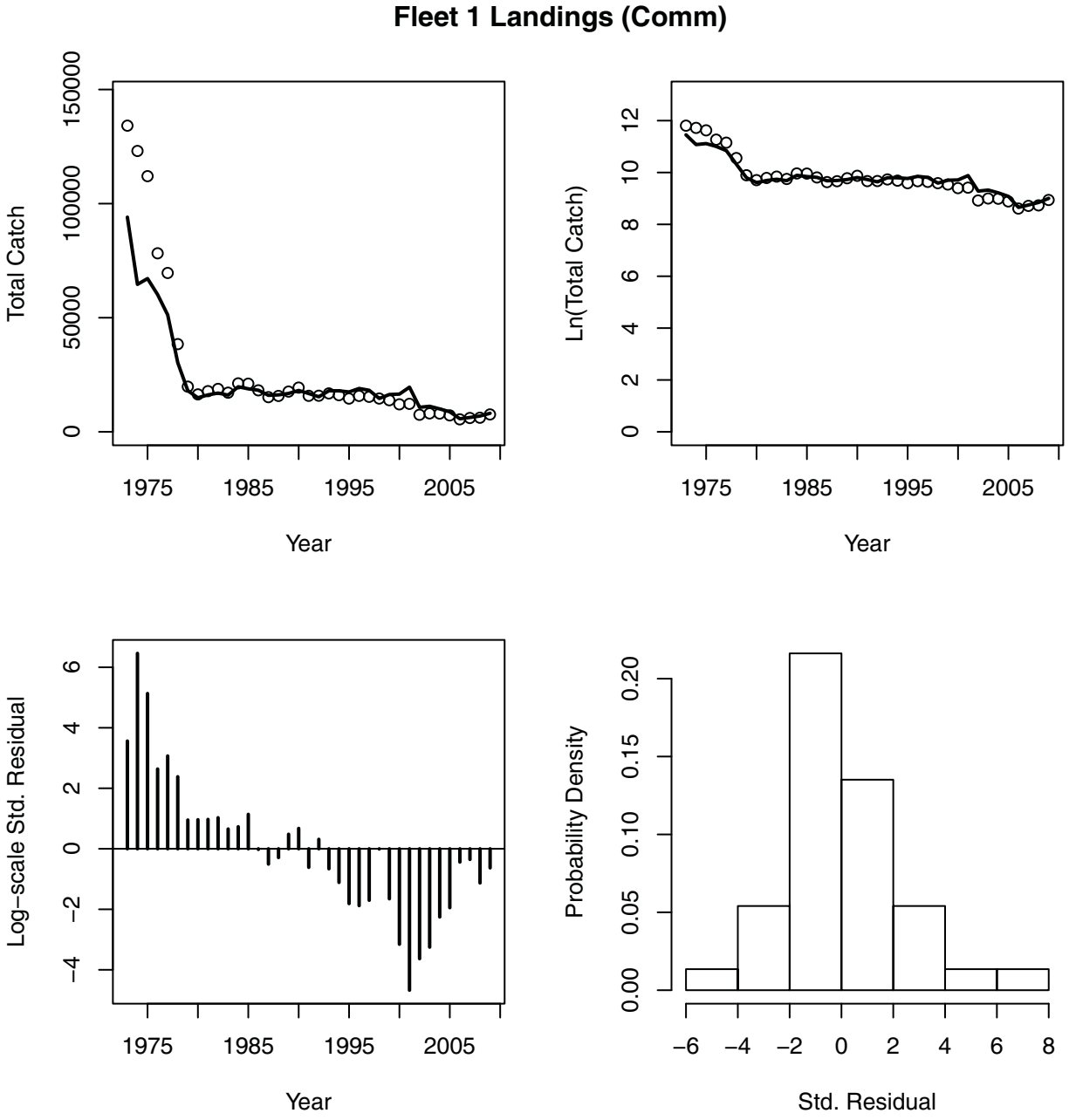
Model Attributes:

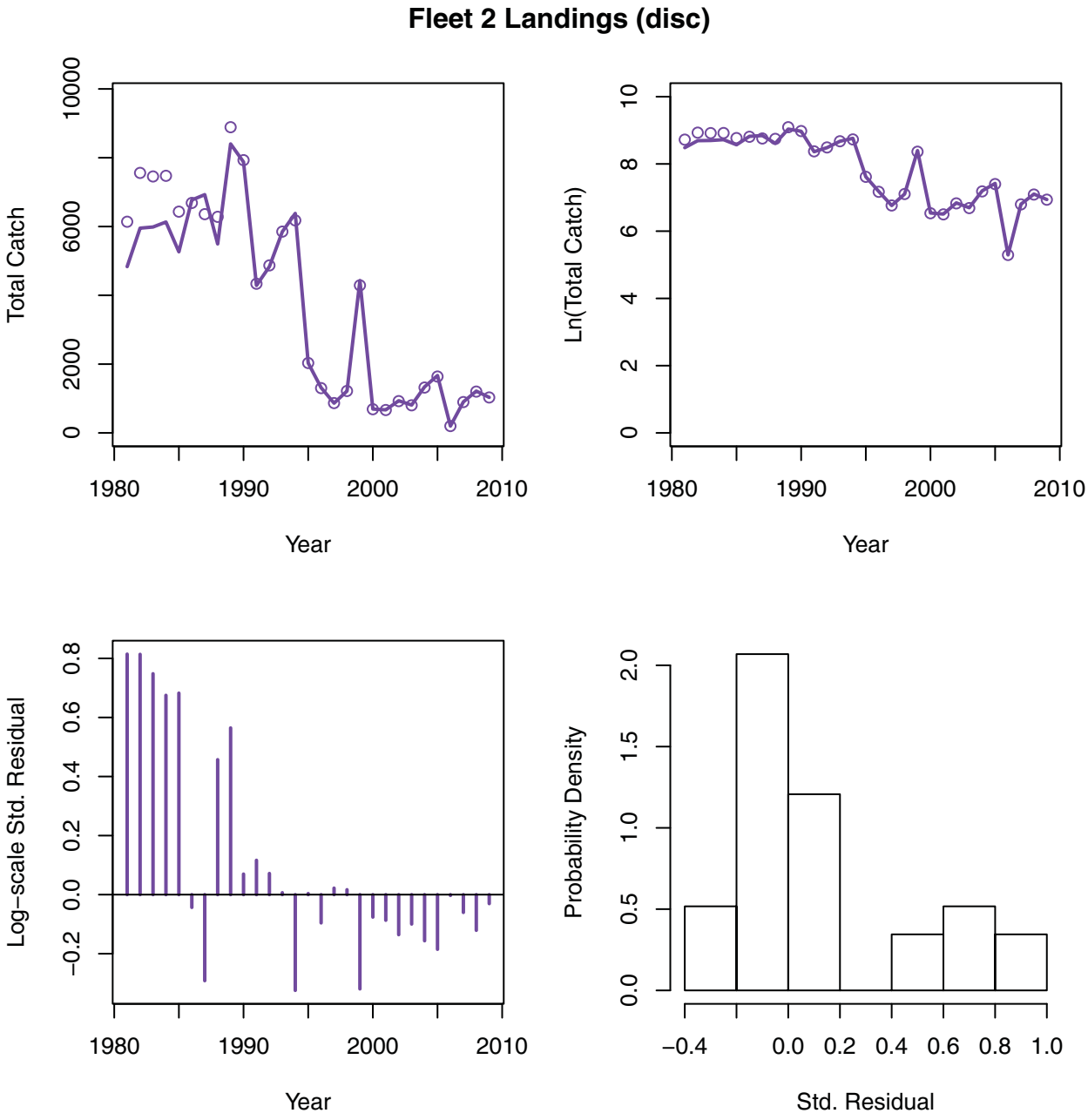
1. 3 Fleet Model
    a. Catch : 1973-2009
    b. Discards: 1981 – 2009
    c. Consumption – 1973-2009

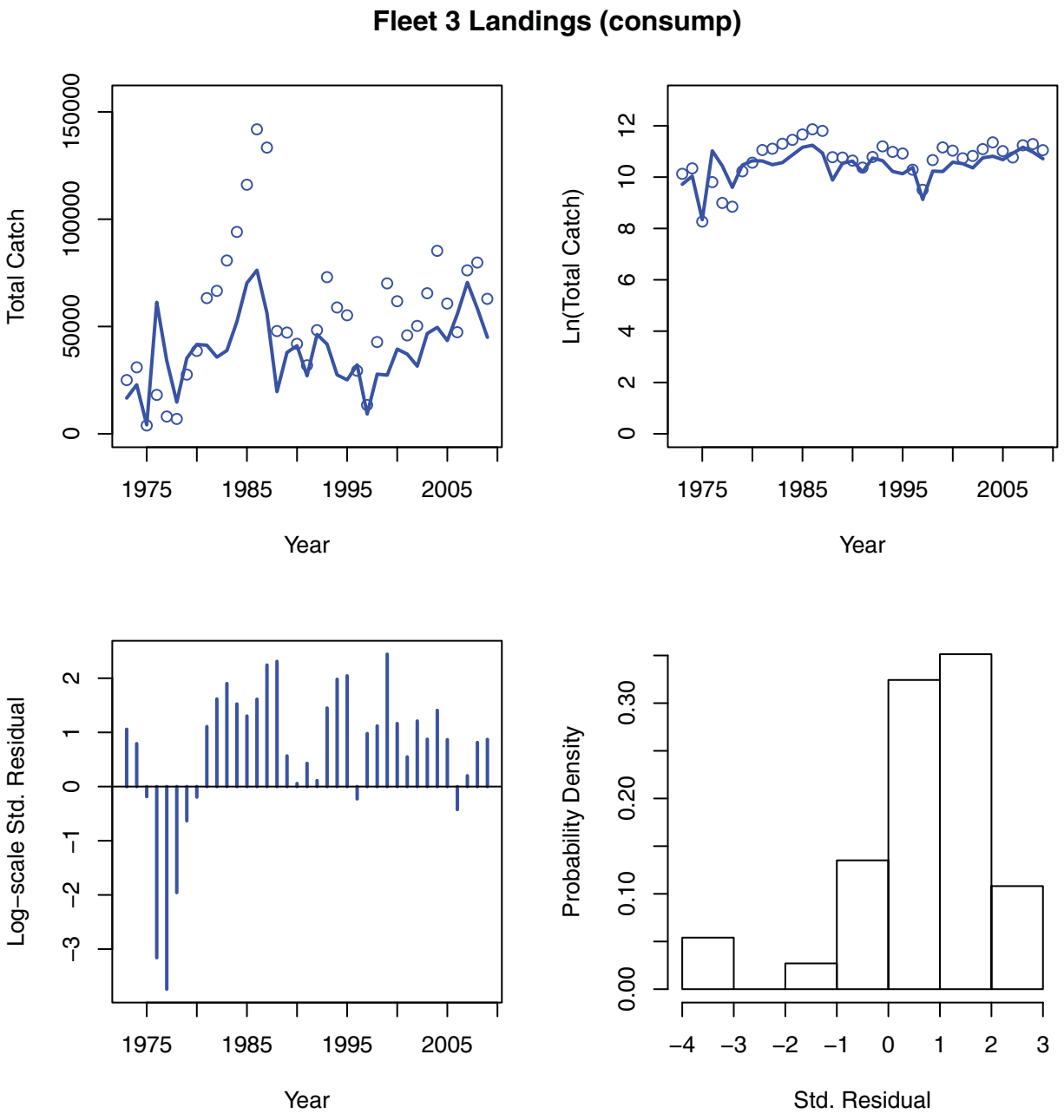
2. Fishery Selectivity (3 Block Selectivity)
    a. Landings (2 Blocks: 1973-1988; 1989-2009)
    b. Discards (1 Block: 1981-2009)
    c. Consumption (Double Logistic Functional Form)

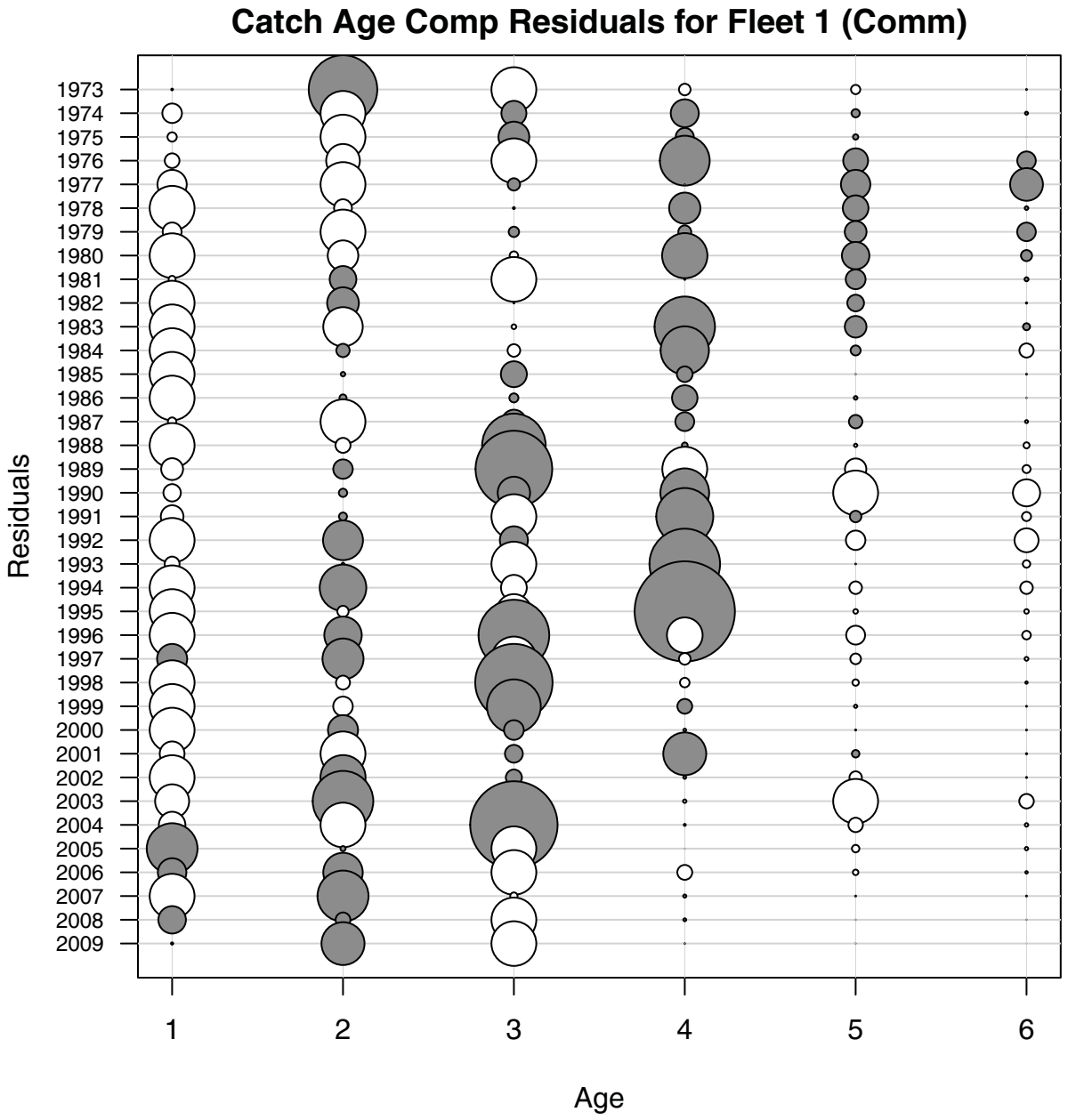
3. Survey Selectivity (Fixed 100% at age 2 – 6+) i.e. Flat-top

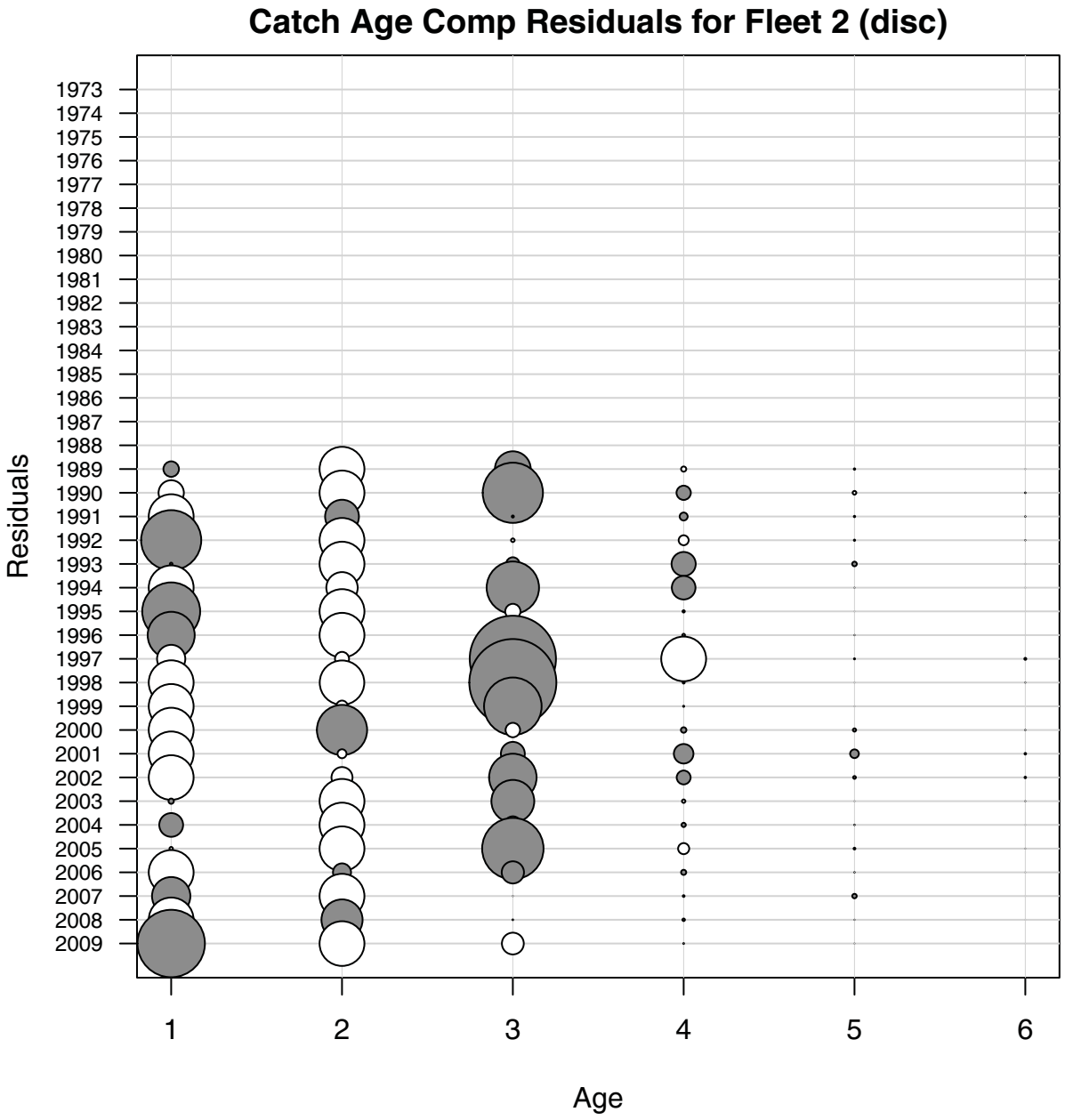

Components of Objective Function (4526)
F.penalty
Fmult.Max.penalty
SRR.unexpl.stock
SRR.steepness
Recruit.devs
N.year1
Fmult.devs.total
Fmult.year1.total
q.devs
q.year1
index.sel.param.total
sel.param.total
survey.age.comp
discards.age.comp
catch.age.comp
index.fit.total
discard.total
catch.total
0
0
0
0
519
68
0
120
0
0
6
128
735
0
762
1173
0
1015
0
100
300
500
700
900
1100
1300
Likelihood Contribution

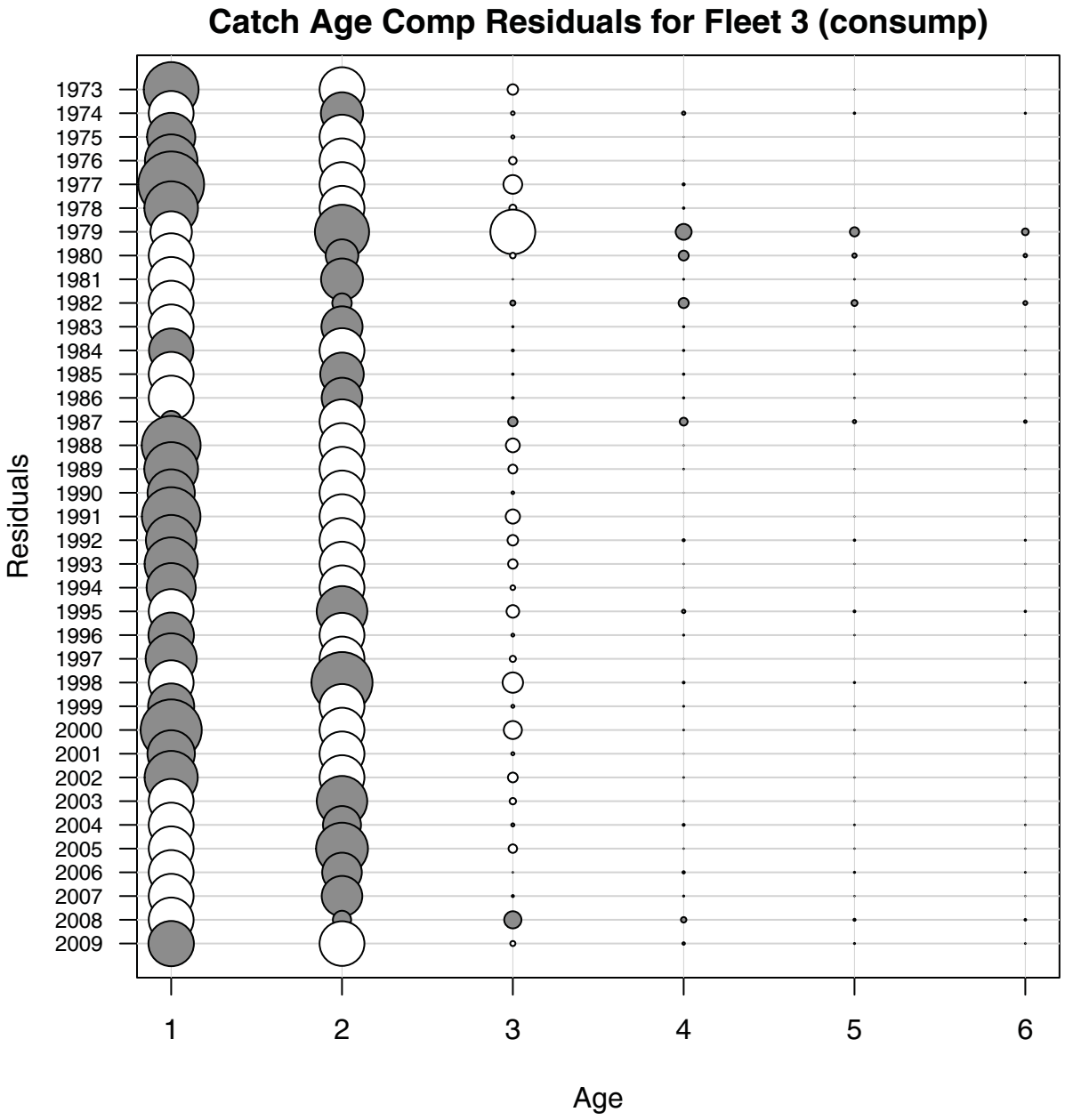

Fleet 1 Landings (Comm)
Total Catch
0
50000
100000
150000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
−4
−2
0
2
4
6
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
0.20
−6
−4
−2
0
2
4
6
8
Std. Residual

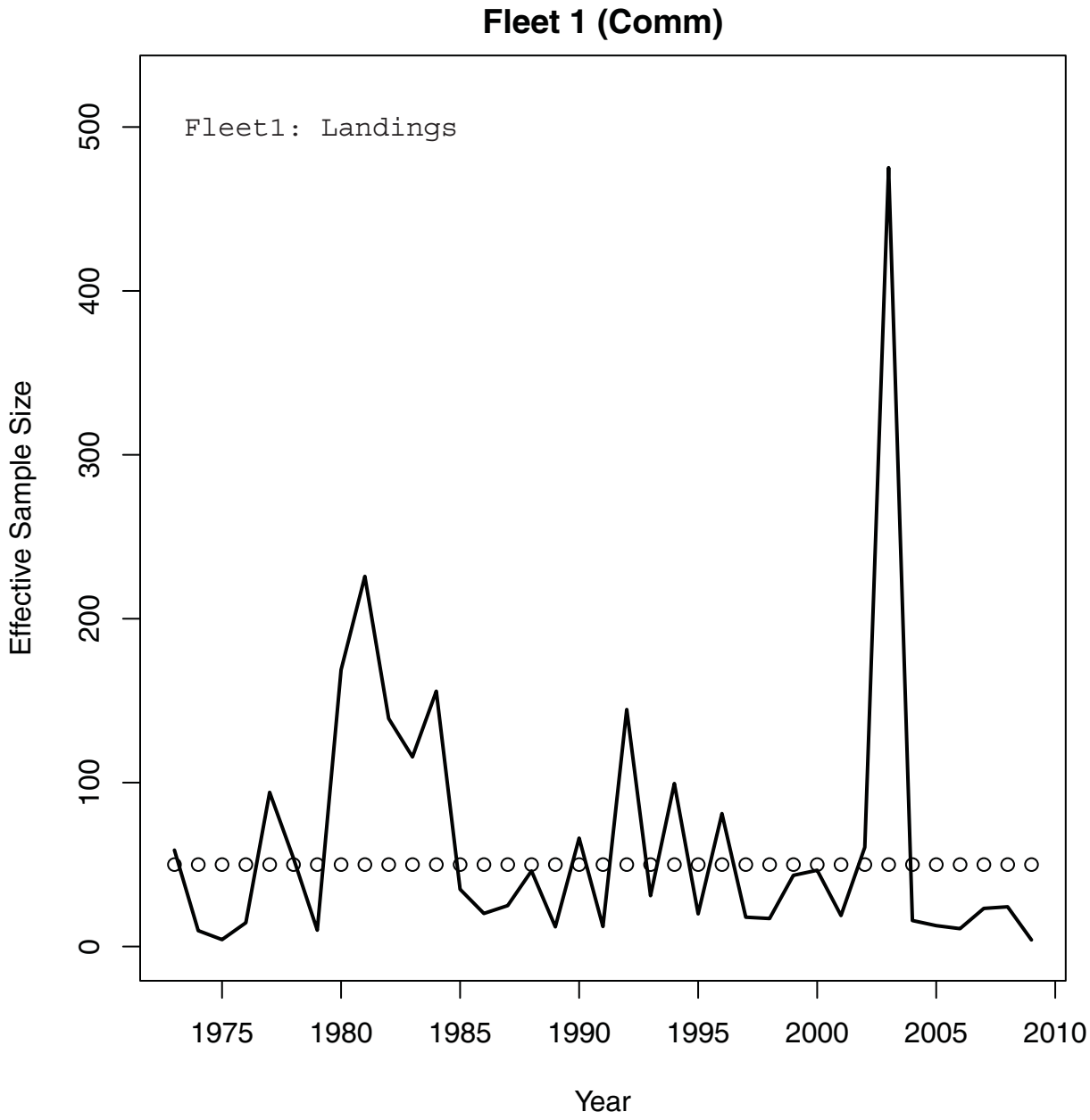

Fleet 2 Landings (disc)
Total Catch
0
2000
6000
10000
1980
1990
2000
2010
Year
Ln(Total Catch)
0
2
4
6
8
10
1980
1990
2000
2010
Year
Log−scale Std. Residual
−0.2
0.0
0.2
0.4
0.6
0.8
1980
1990
2000
2010
Year
Probability Density
0.0
0.5
1.0
1.5
2.0
−0.4
0.0
0.2
0.4
0.6
0.8
1.0
Std. Residual

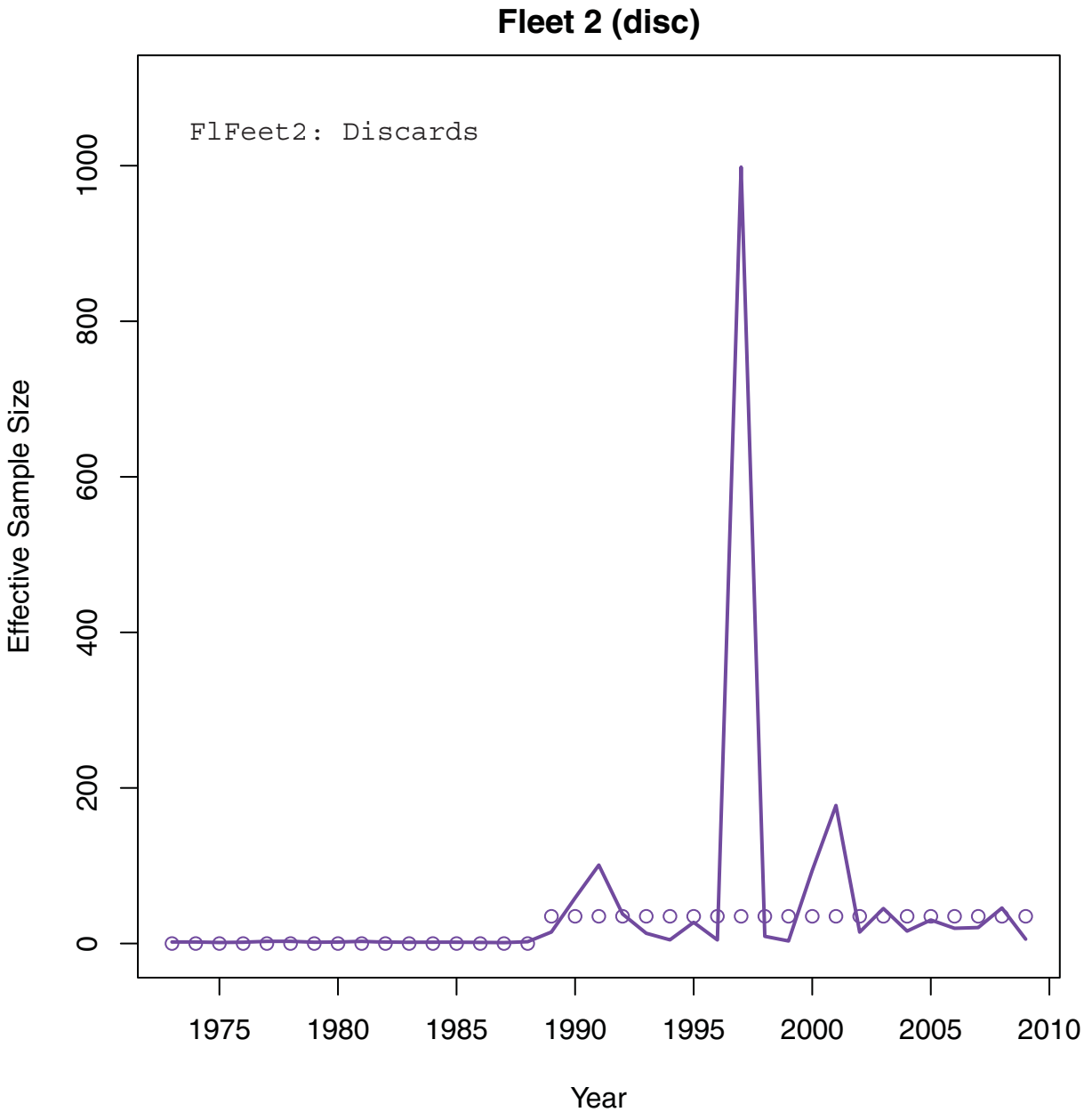

Fleet 3 Landings (consump)
Total Catch
0
50000
100000
150000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
−3
−2
−1
0
1
2
1975
1985
1995
2005
Year
Probability Density
0.00
0.10
0.20
0.30
−4
−3
−2
−1
0
1
2
3
Std. Residual

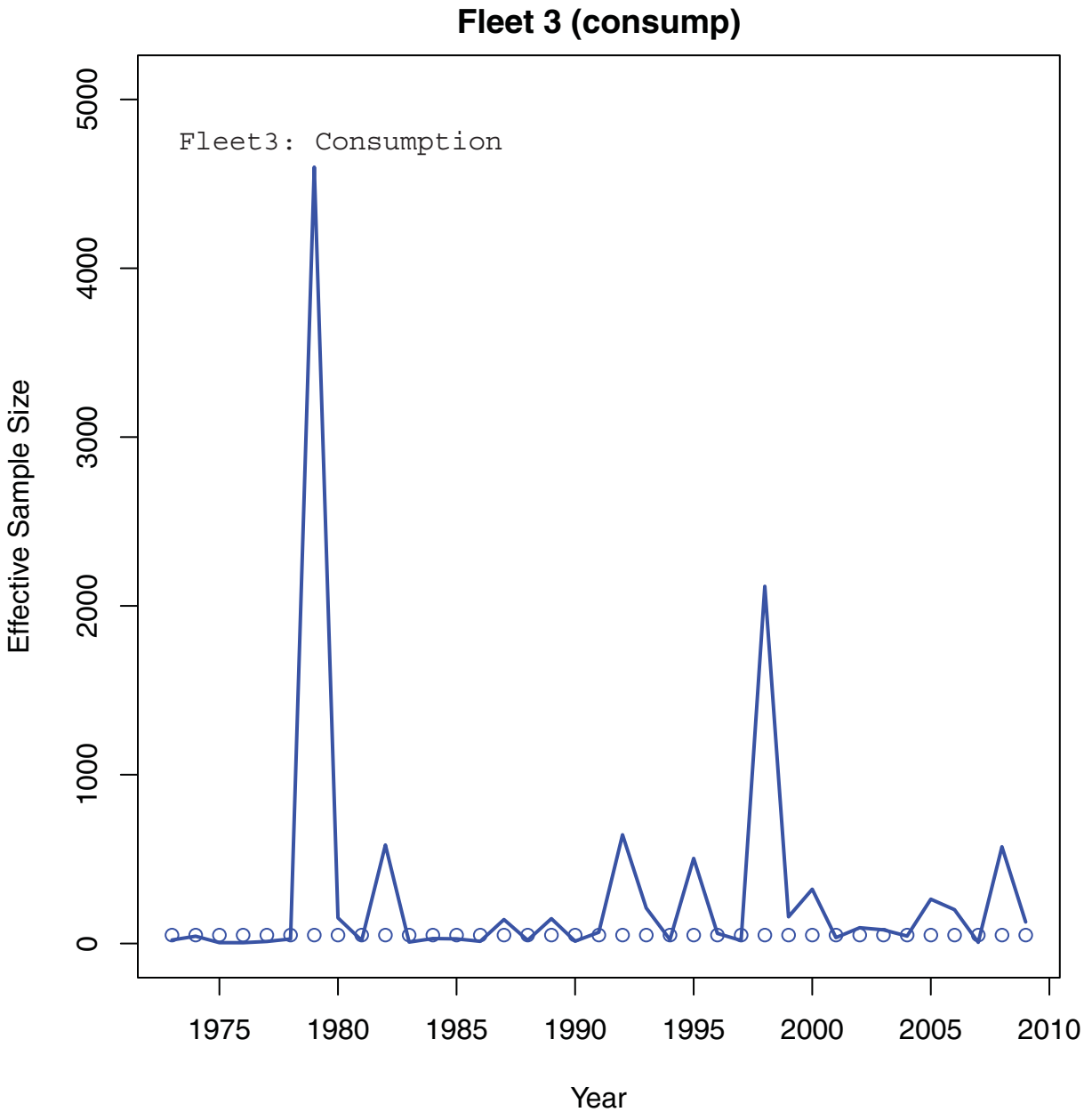

Catch Age Comp Residuals for Fleet 1 (Comm)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

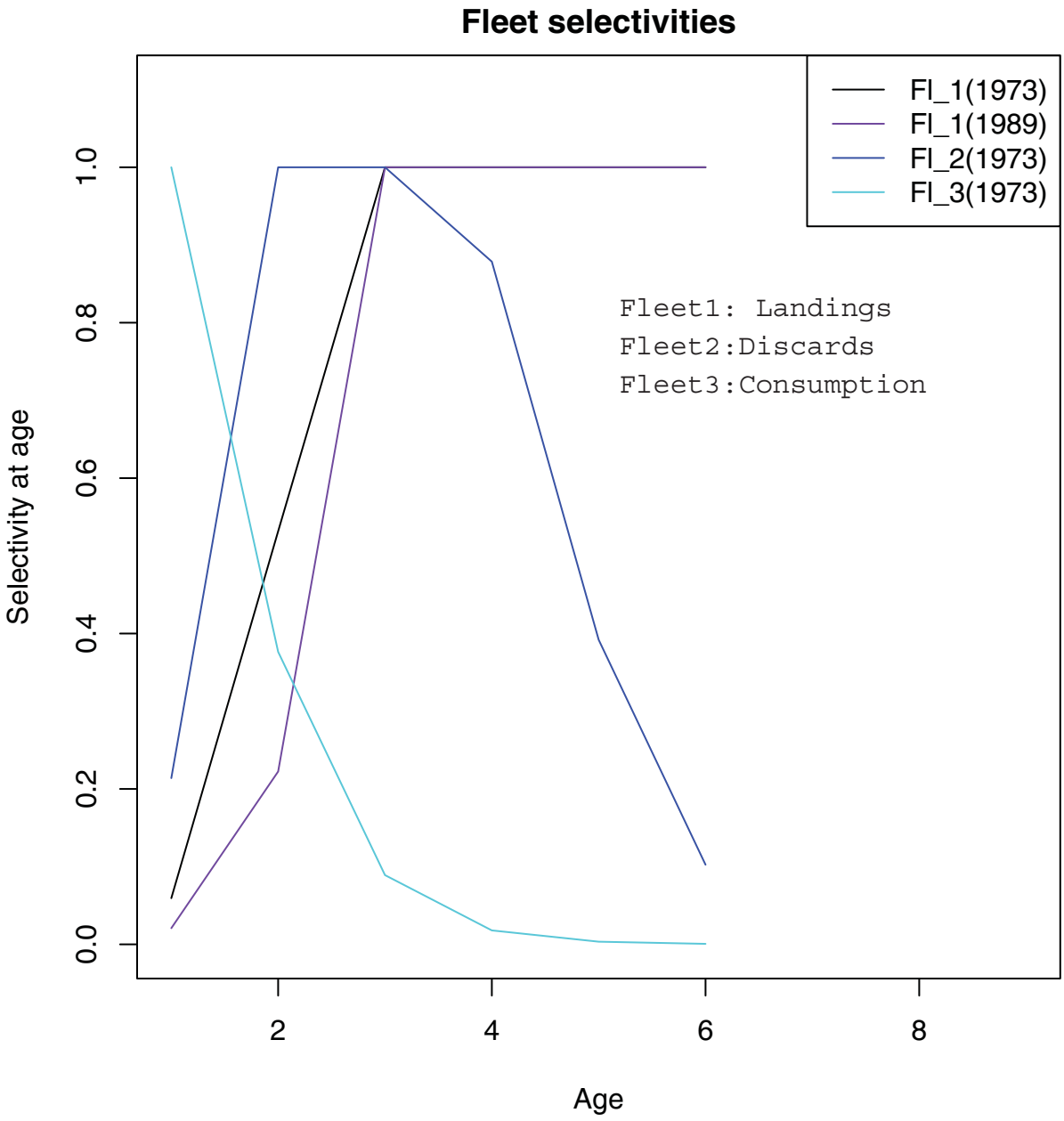

Catch Age Comp Residuals for Fleet 2 (disc)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Catch Age Comp Residuals for Fleet 3 (consump)
Residuals
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
1
2
3
4
5
6
Age


Fleet 1 (Comm)
Fleet1: Landings
Effective Sample Size
0
100
200
300
400
500
1975
1980
1985
1990
1995
2000
2005
2010
Year

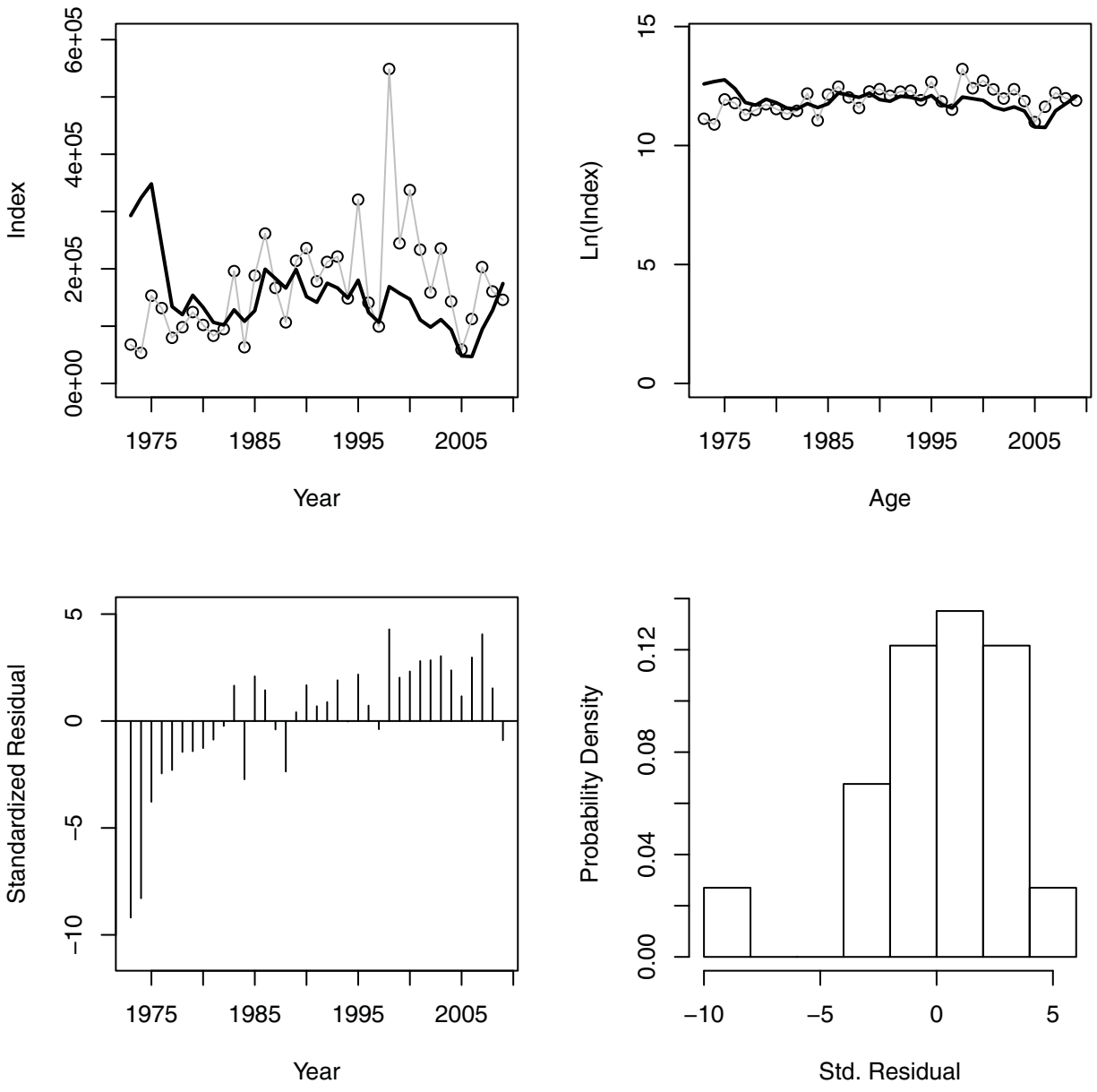

Fleet 2 (disc)
FlFeet2: Discards
Effective Sample Size
0
200
400
600
800
1000
1975
1980
1985
1990
1995
2000
2005
2010
Year


Fleet 3 (consump)
Fleet3: Consumption
Effective Sample Size
0
1000
2000
3000
4000
5000
1975
1980
1985
1990
1995
2000
2005
2010
Year


Fleet selectivities
Fl_1(1973)
Fl_1(1989)
Fl_2(1973)
Fl_3(1973)
Fleet1: Landings
Fleet2:Discards
Fleet3:Consumption
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

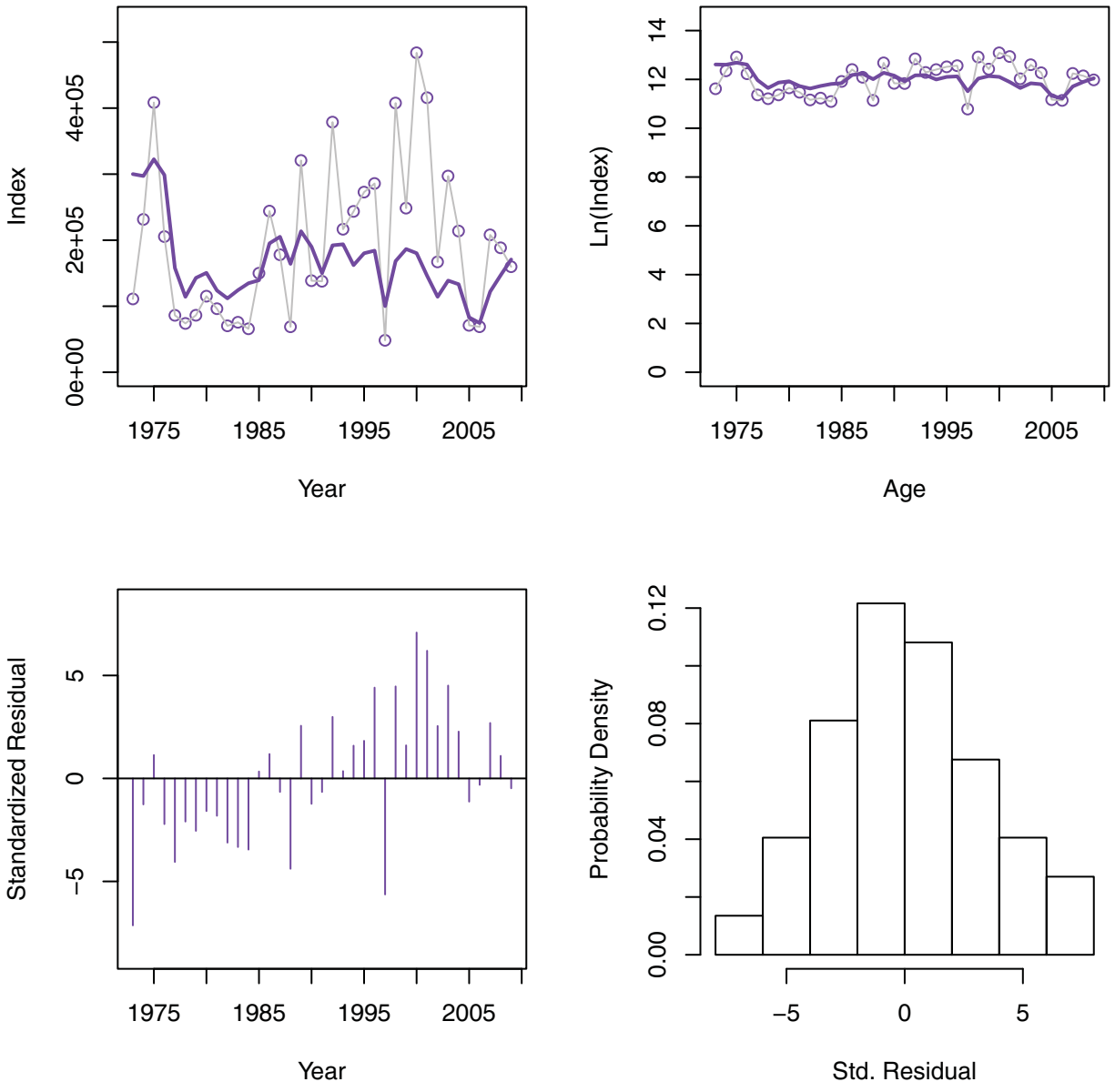
Index 1

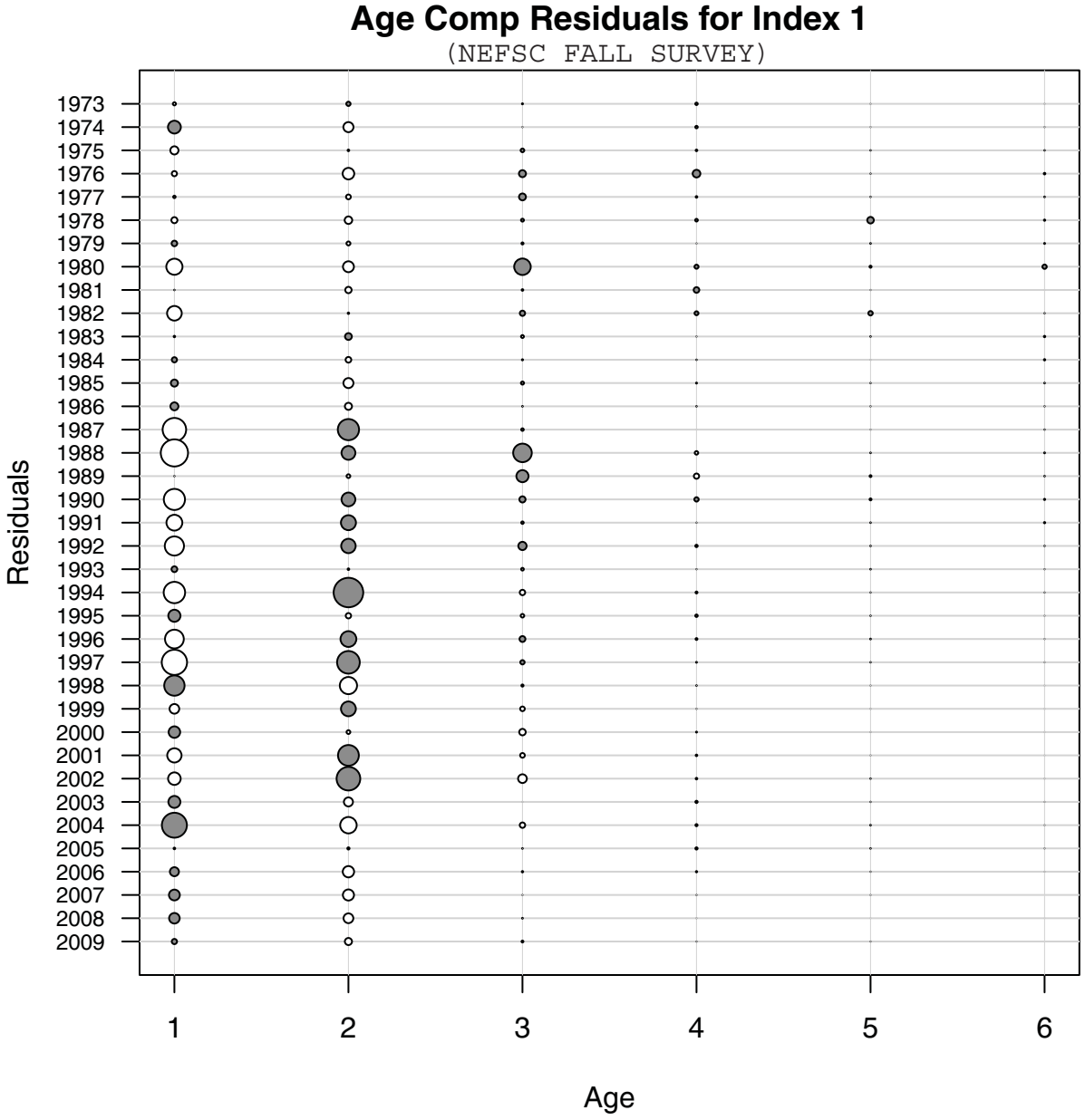
NEFSC FALL SURVEY



Index 2

NEFSC Spring Survey




Age Comp Residuals for Index 1
(NEFSC FALL SURVEY)
Residuals
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
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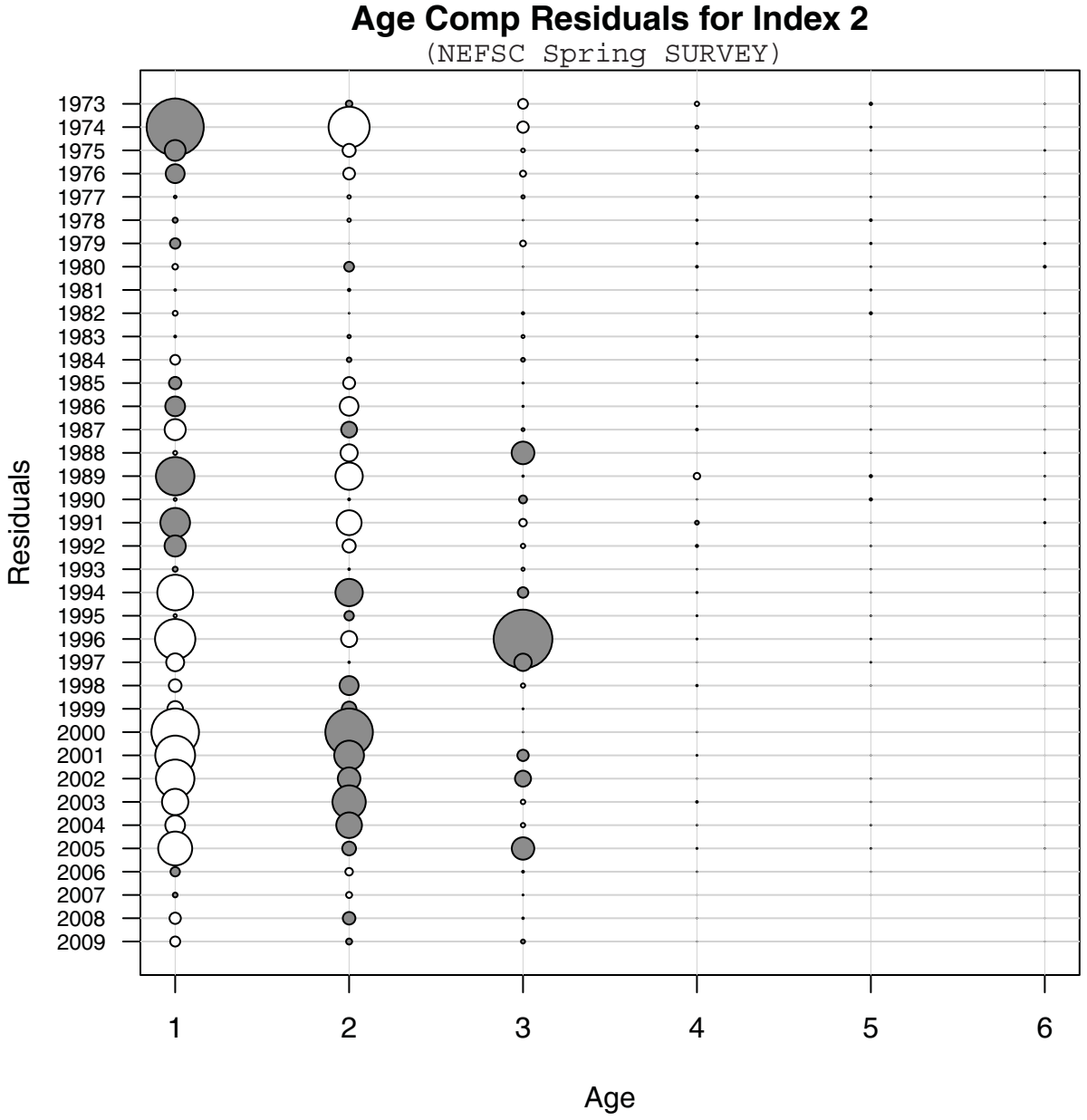
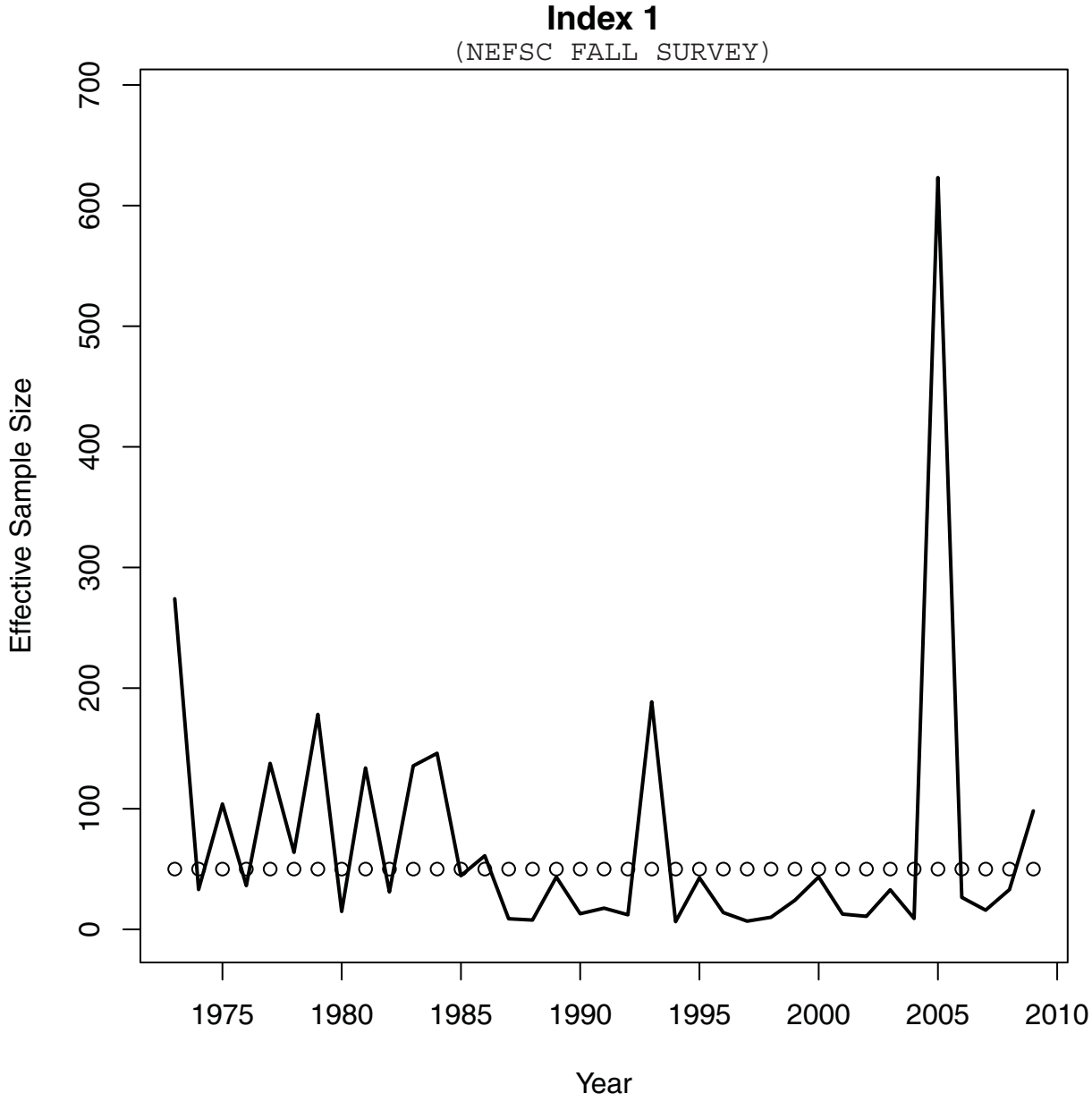
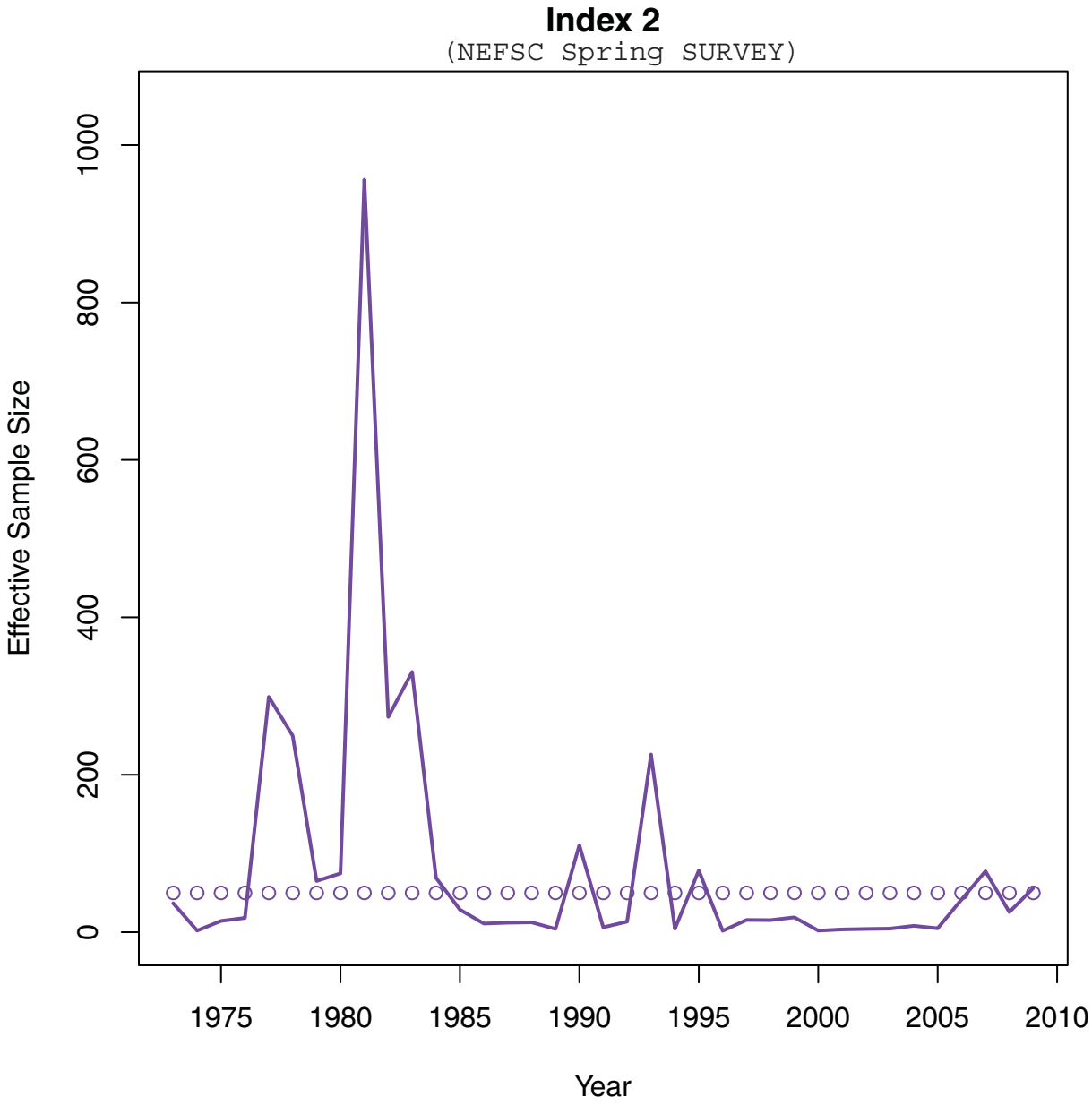
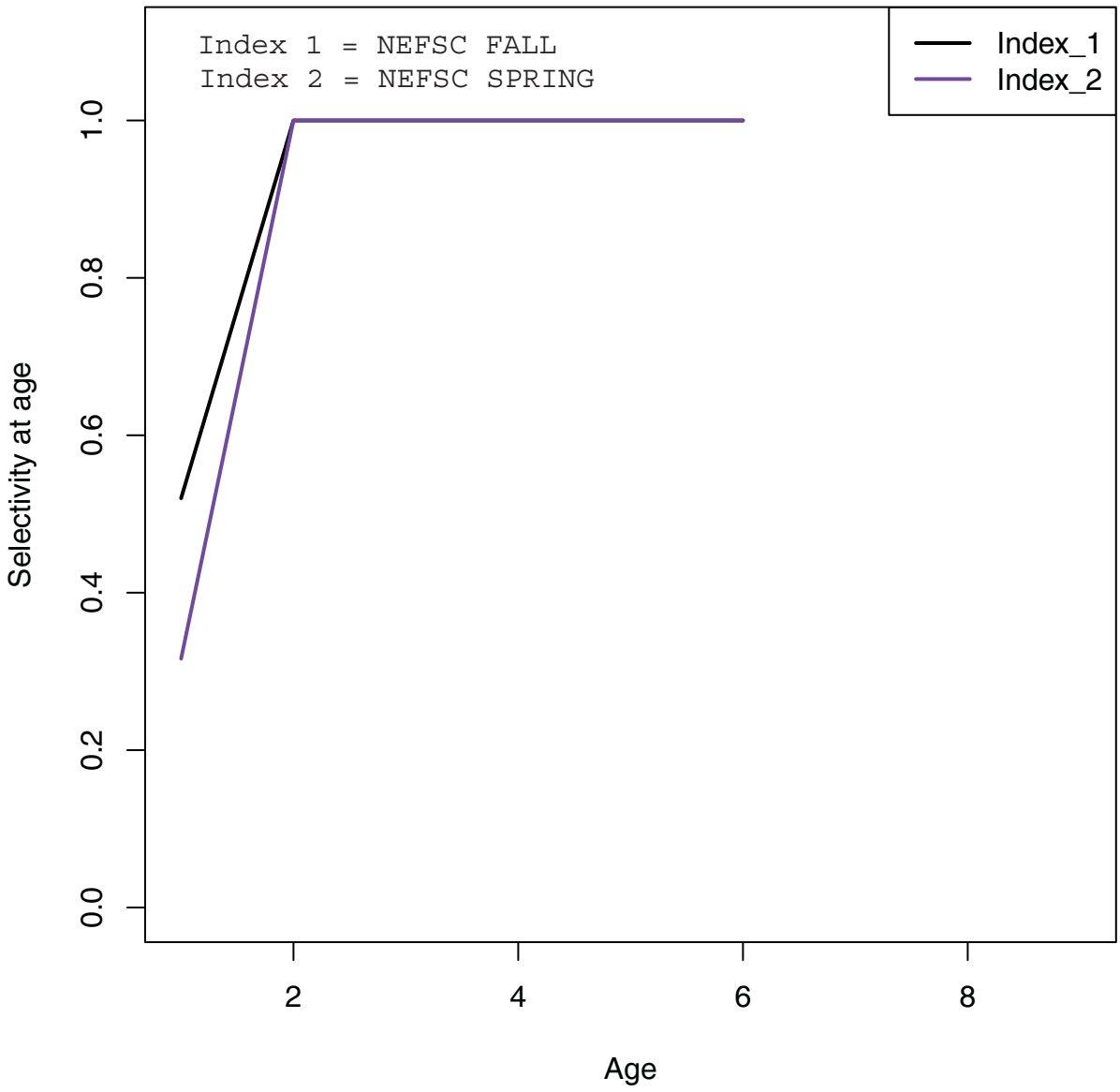
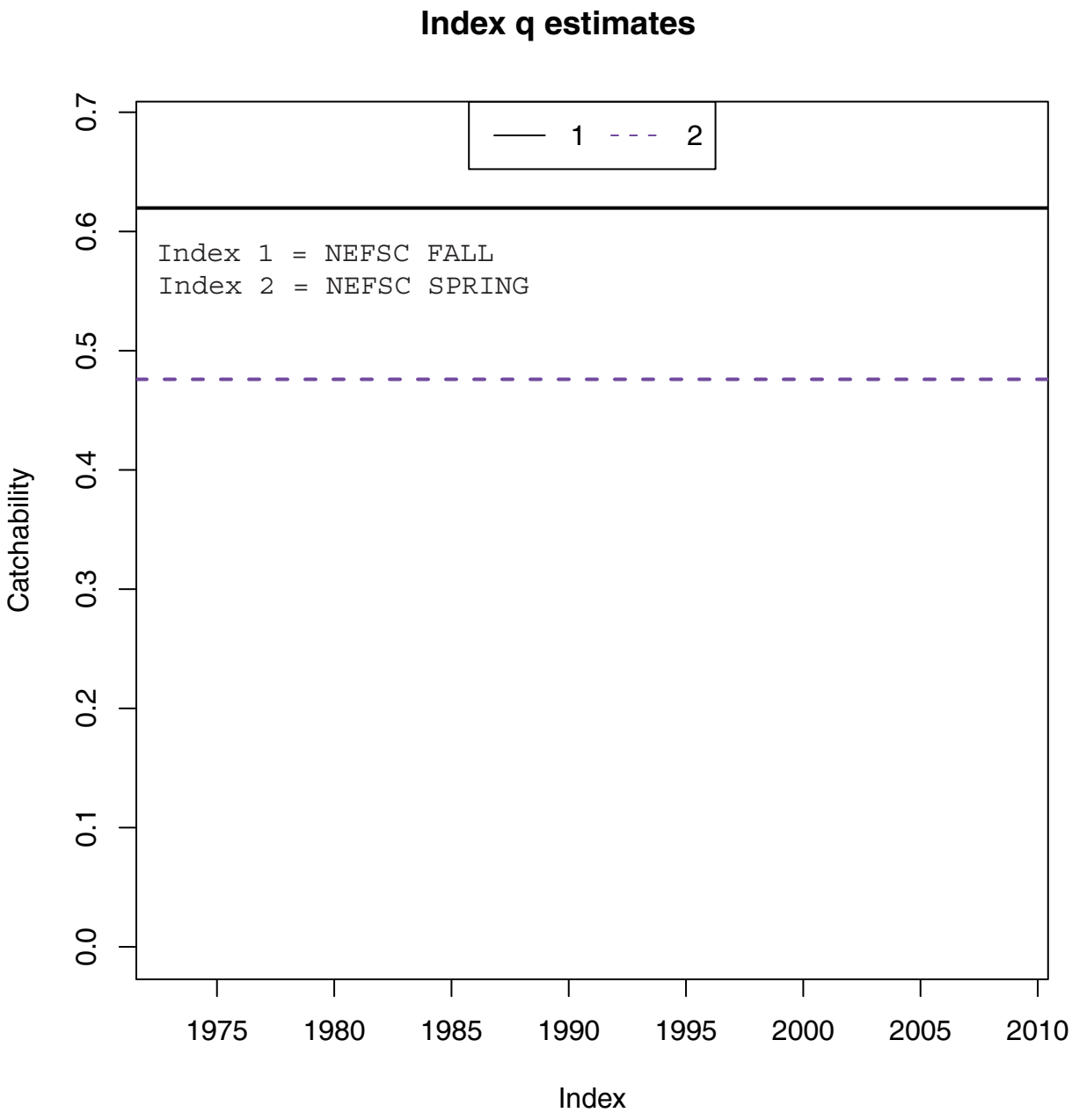
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

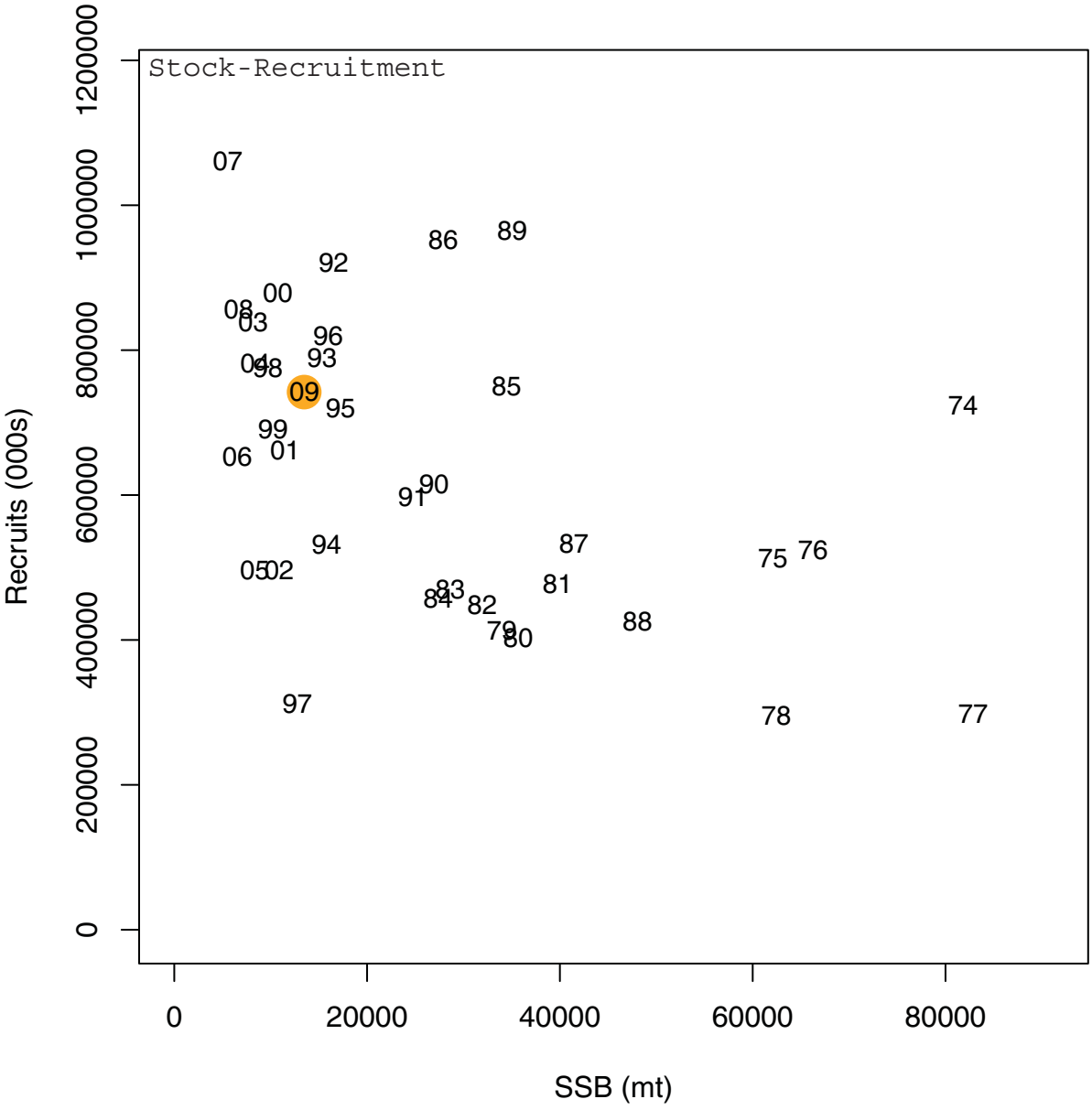

Age Comp Residuals for Index 2
(NEFSC Spring SURVEY)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Index 1
(NEFSC FALL SURVEY)
Effective Sample Size
0
100
200
300
400
500
600
700
1975
1980
1985
1990
1995
2000
2005
2010
Year


Index 2
(NEFSC Spring SURVEY)
Effective Sample Size
0
200
400
600
800
1000
1975
1980
1985
1990
1995
2000
2005
2010
Year


Index 1 = NEFSC FALL
Index 2 = NEFSC SPRING
Index_1
Index_2
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age


Index q estimates
1
2
Index 1 = NEFSC FALL
Index 2 = NEFSC SPRING
Catchability
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1975
1980
1985
1990
1995
2000
2005
2010
Index


Stock-Recruitment
Recruits (000s)
SSB (mt)
0
200000
400000
600000
800000
1000000
1200000
0
20000
40000
60000
80000
07
86
89
92
00
08
03
96
04
98
93
09
85
95
74
99
06
01
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91
94
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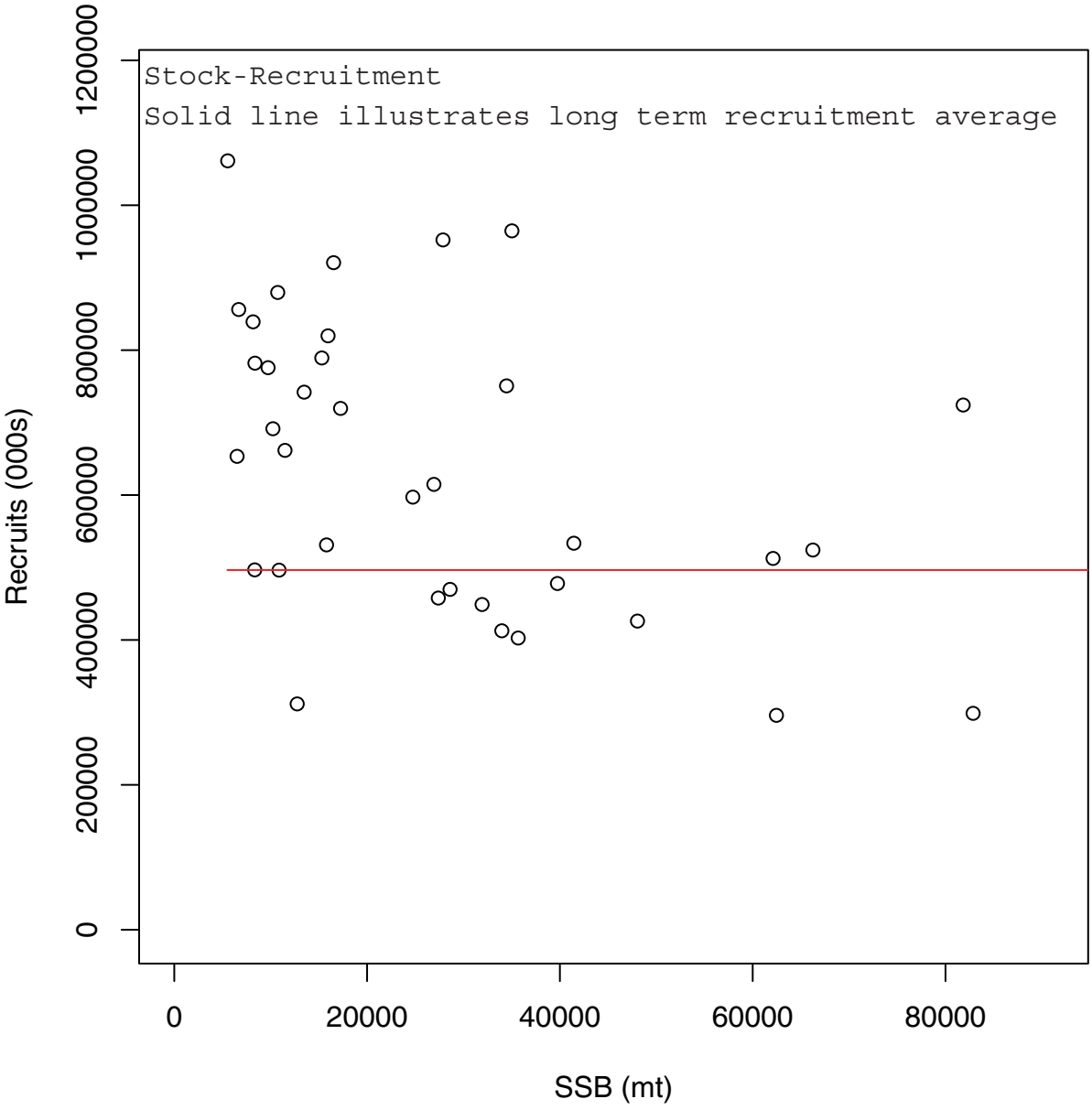
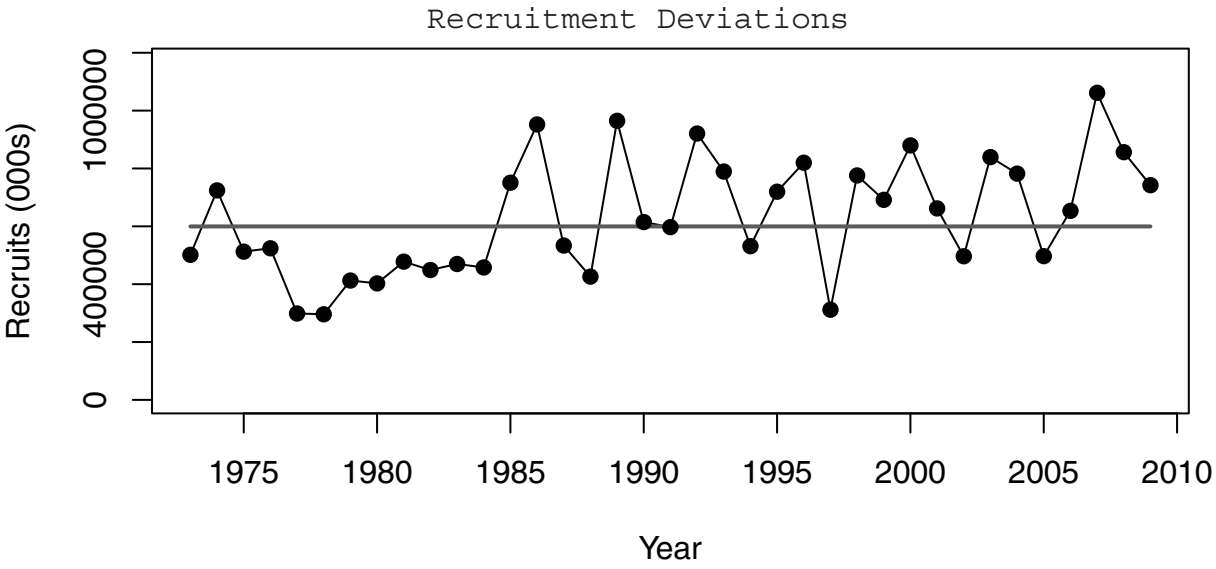
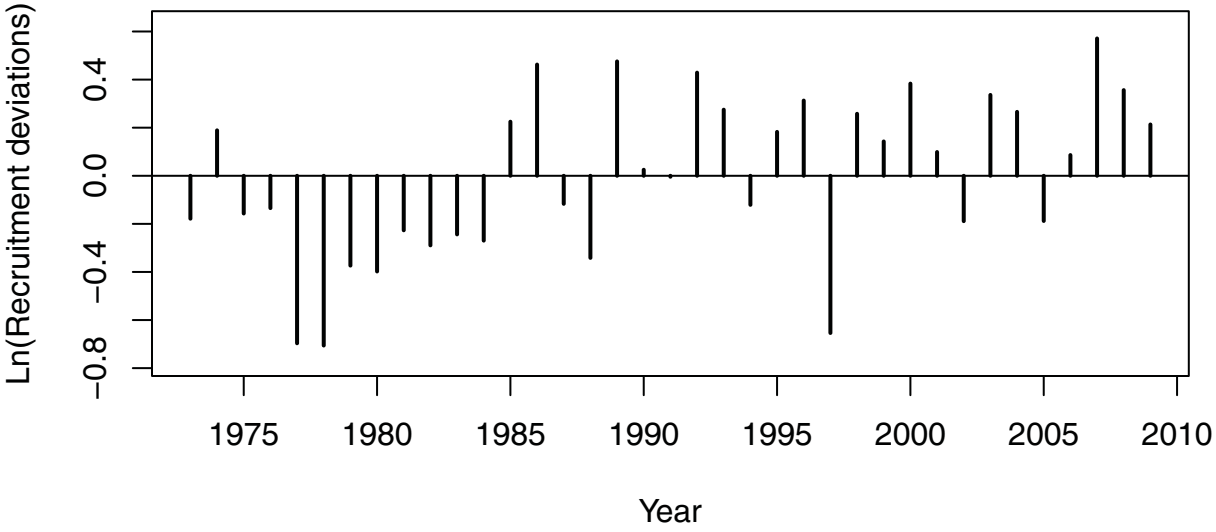
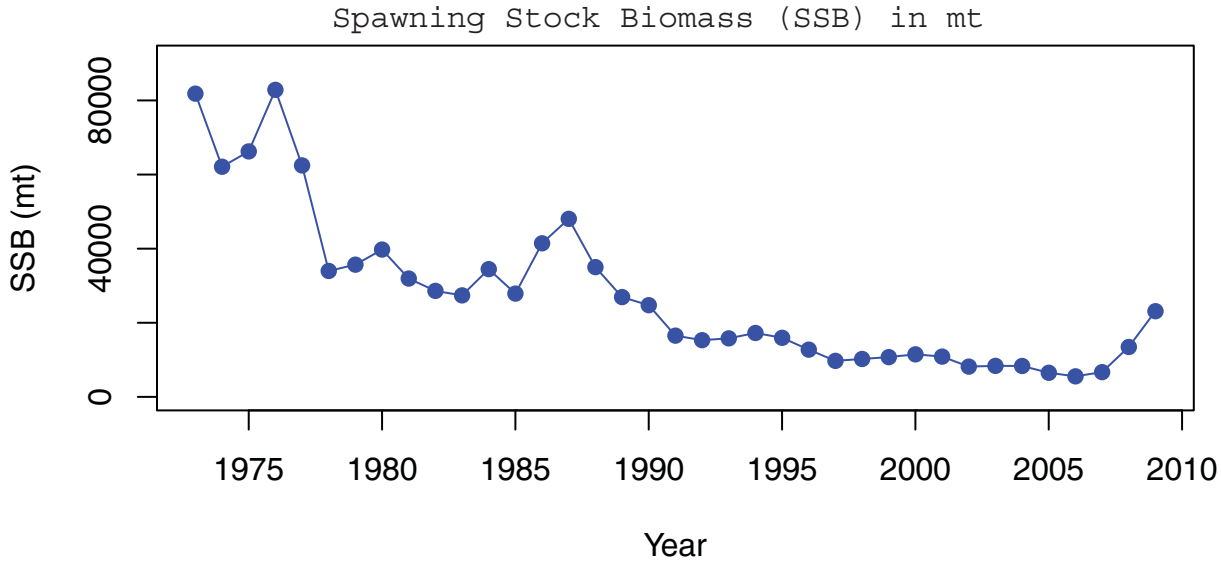
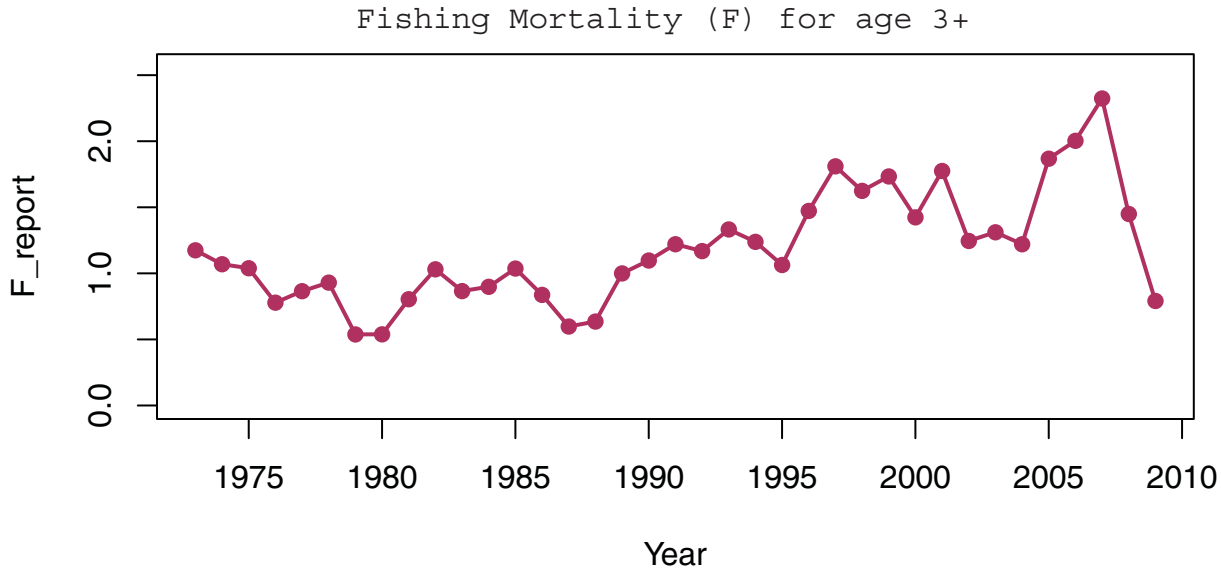
76
05
02
83
84
82
81
88
79
80
97
78
77

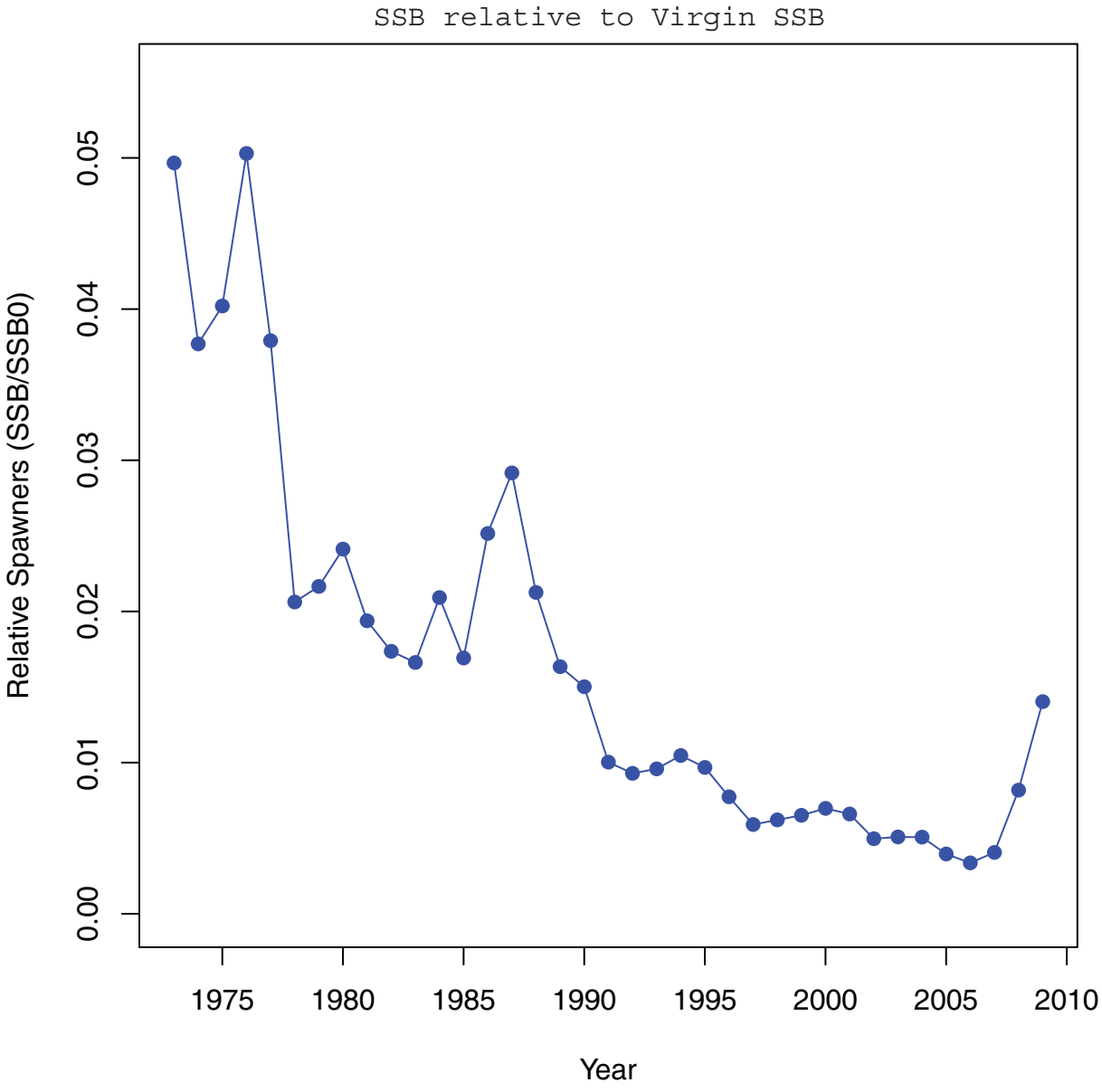

Stock-Recruitment
Solid line illustrates long term recruitment average
Recruits (000s)
0
200000
400000
600000
800000
1000000
1200000
0
20000
40000
60000
80000
SSB (mt)

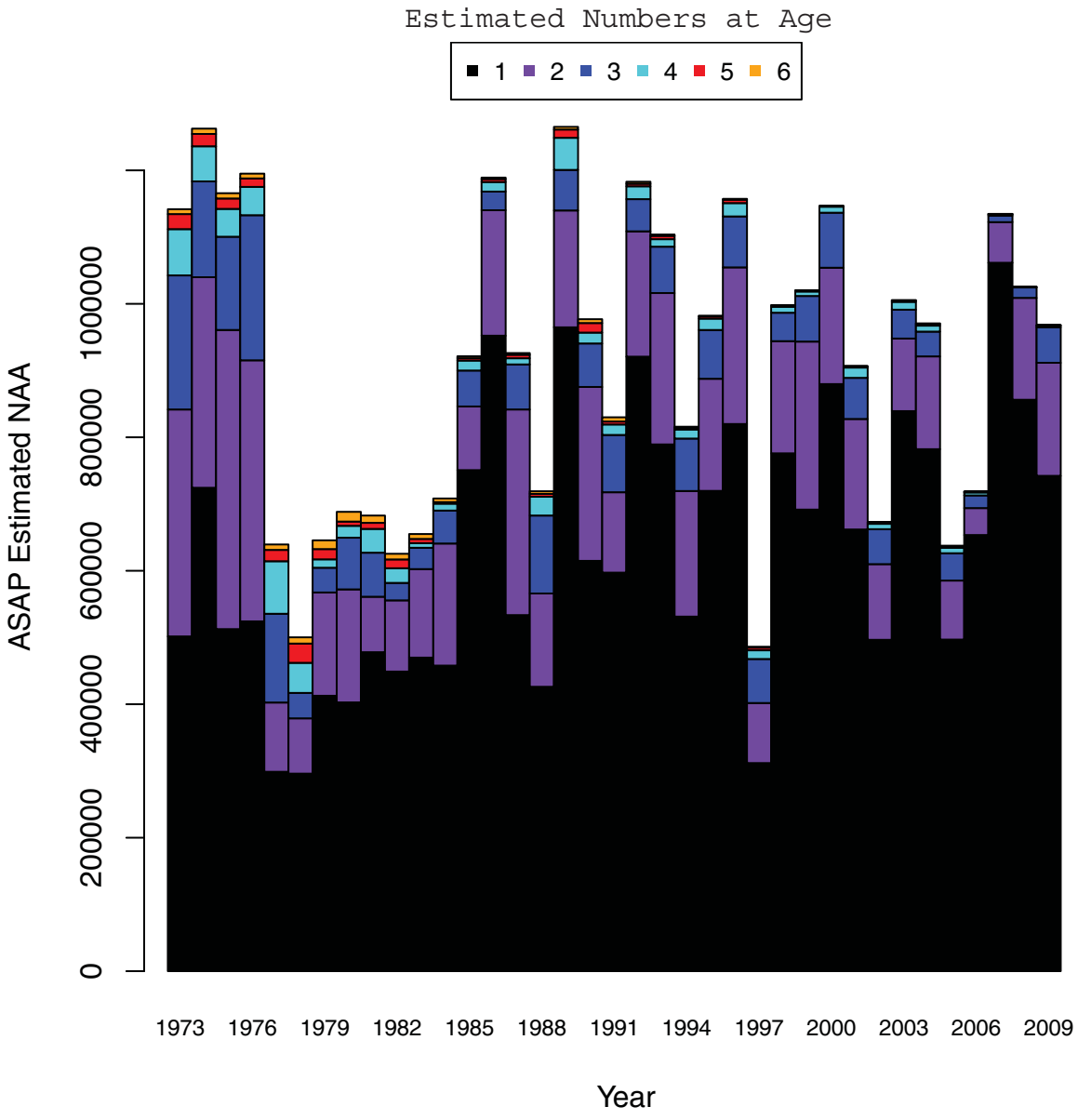

Recruitment Deviations
Recruits (000s)
0
400000
1000000
1975
1980
1985
1990
1995
2000
2005
2010
Year

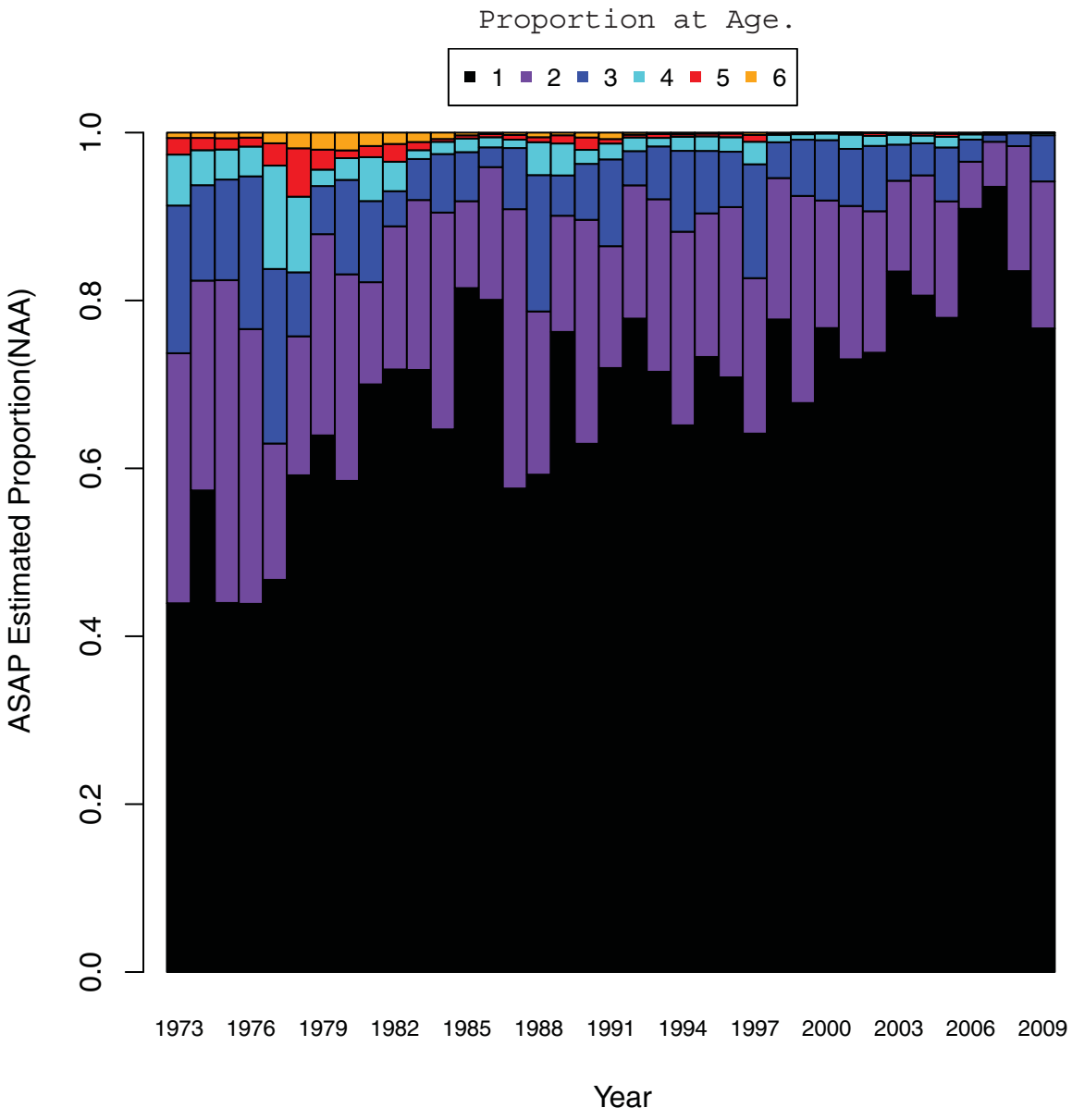

Ln(Recruitment deviations)
−0.8
−0.4
0.0
0.4
1975
1980
1985
1990
1995
2000
2005
2010
Year

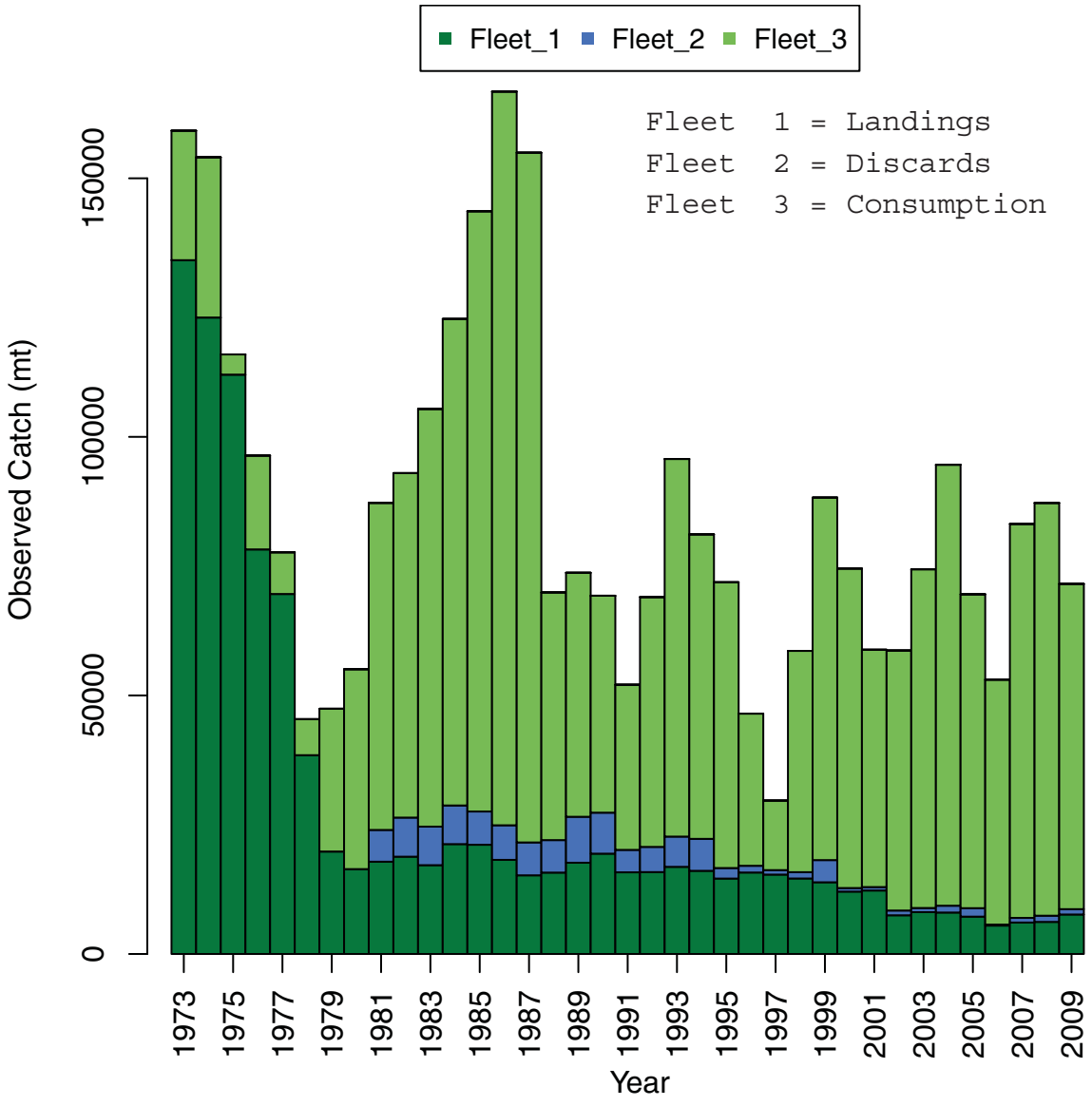

Spawning Stock Biomass (SSB) in mt
SSB (mt)
0
40000
80000
1975
1980
1985
1990
1995
2000
2005
2010
Year

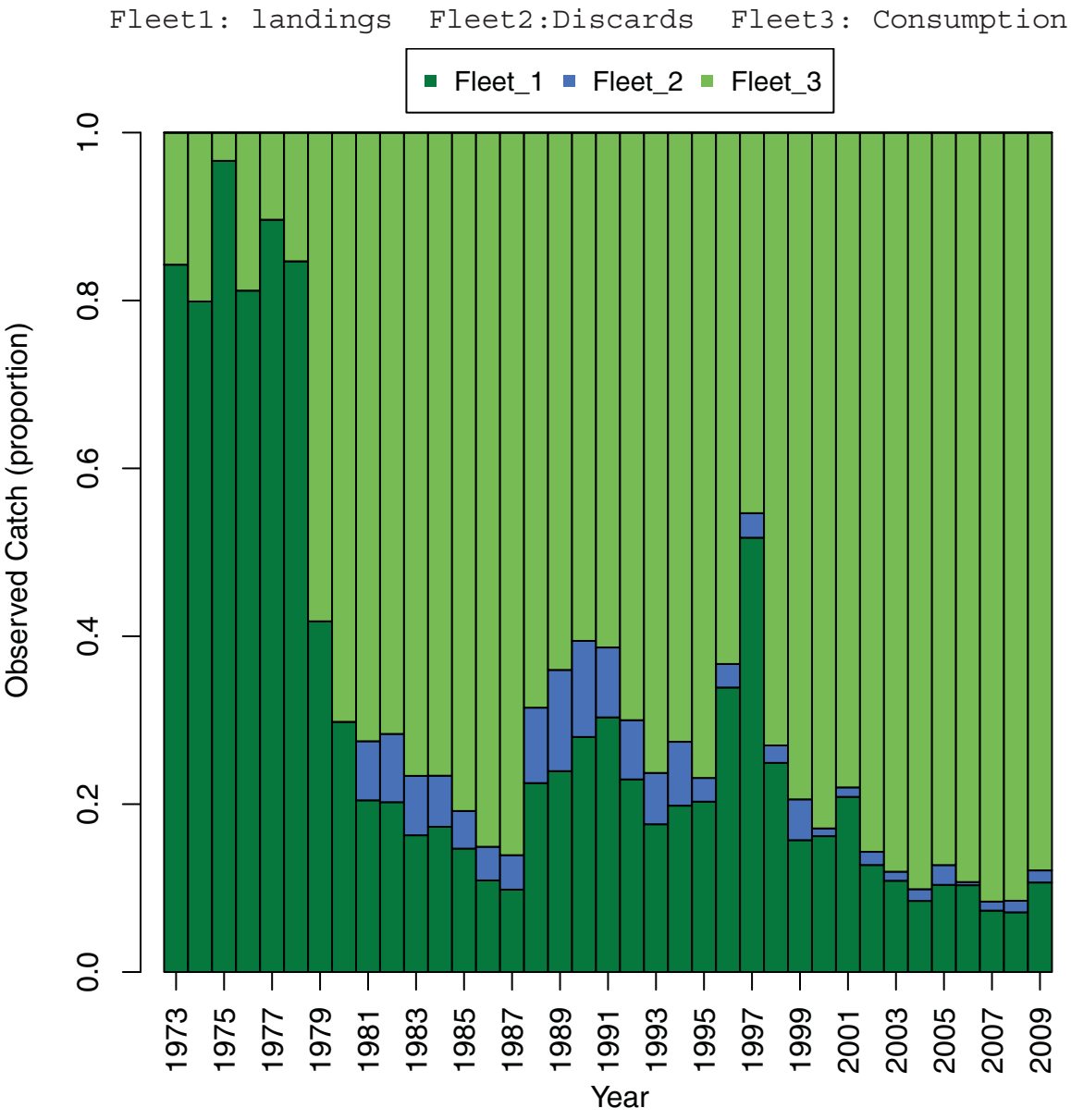

Fishing Mortality (F) for age 3+
F_report
0.0
1.0
2.0
1975
1980
1985
1990
1995
2000
2005
2010
Year

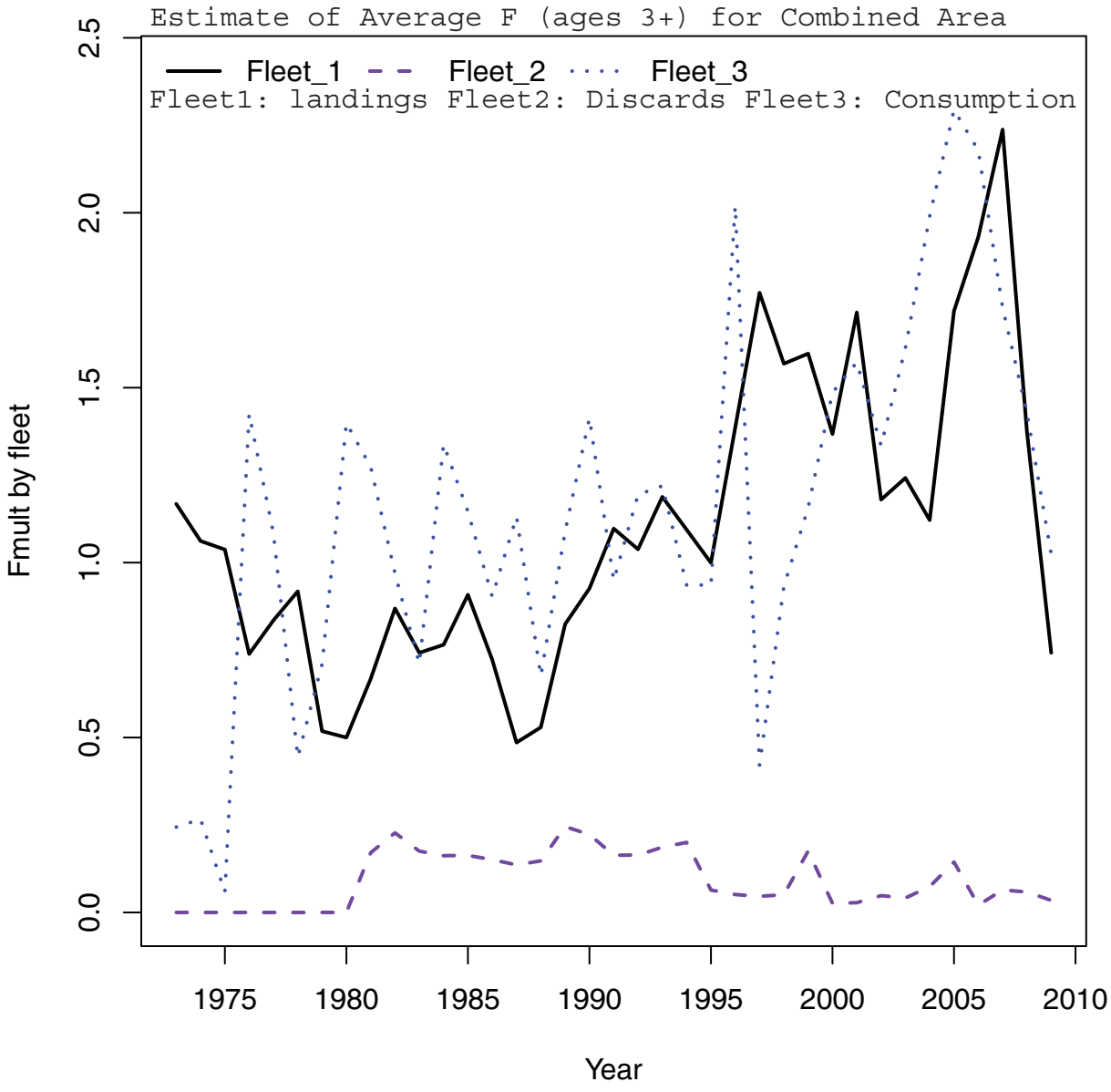

SSB relative to Virgin SSB
Relative Spawners (SSB/SSB0)
0.00
0.01
0.02
0.03
0.04
0.05
1975
1980
1985
1990
1995
2000
2005
2010
Year

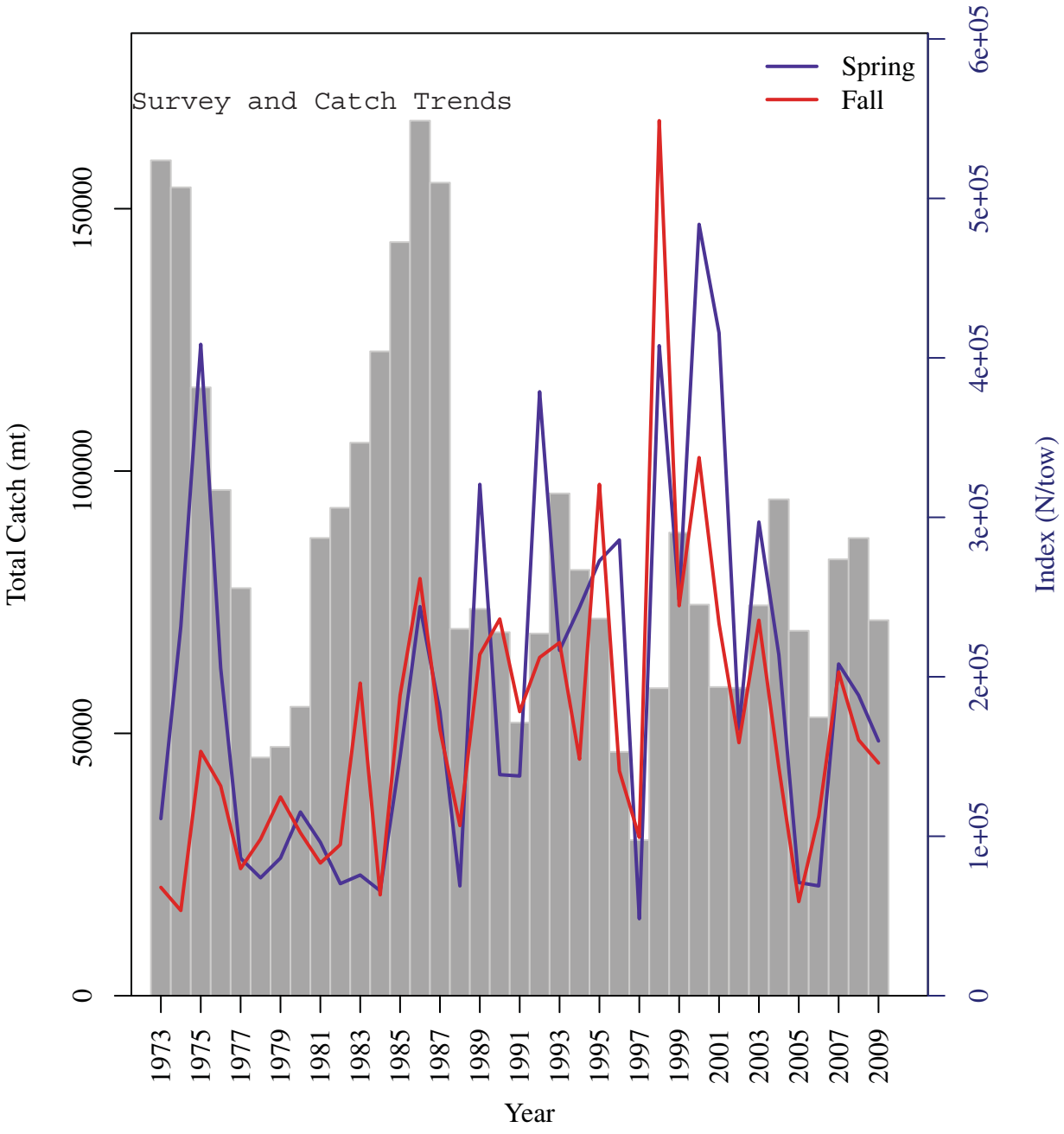

Estimated Numbers at Age
1
2
3
4
5
6
ASAP Estimated NAA
0
200000
400000
600000
800000
1000000
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

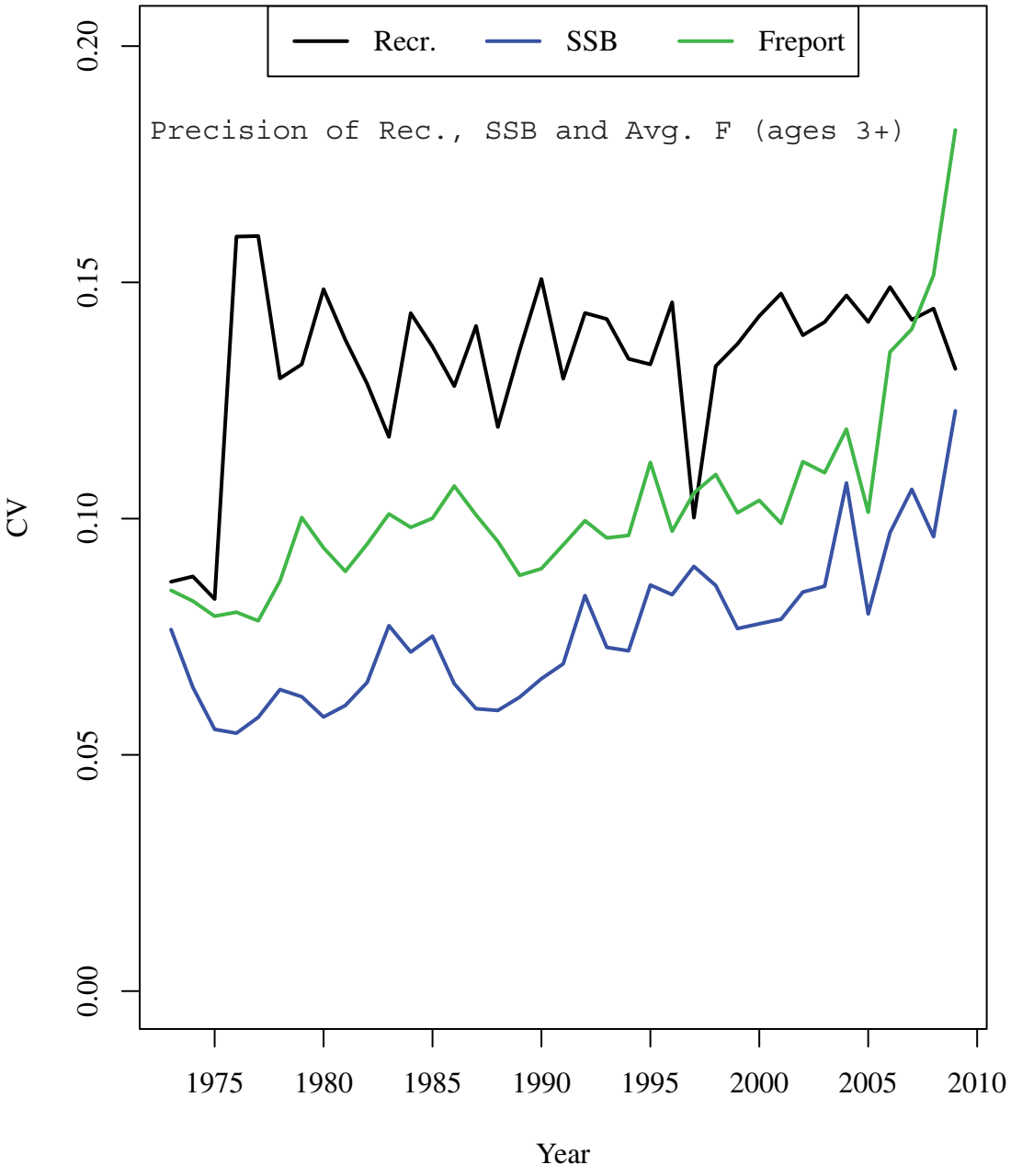

Proportion at Age.
1
2
3
4
5
6
ASAP Estimated Proportion(NAA)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

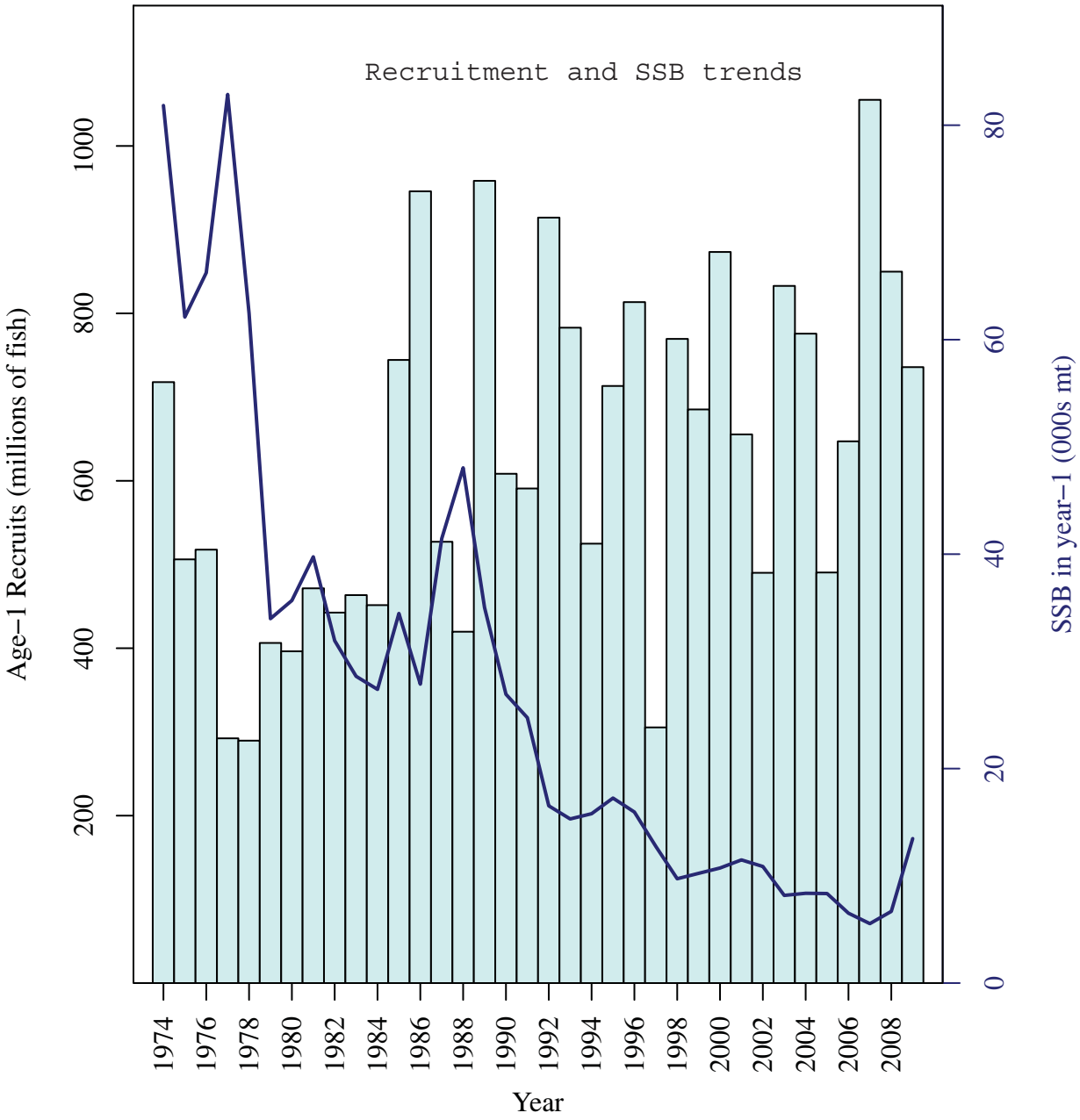

Fleet_1
Fleet_2
Fleet_3
Fleet 1 = Landings
Fleet 2 = Discards
Fleet 3 = Consumption
Observed Catch (mt)
0
50000
100000
150000
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet1: landings Fleet2:Discards Fleet3: Consumption
Fleet_1
Fleet_2
Fleet_3
Observed Catch (proportion)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Estimate of Average F (ages 3+) for Combined Area
Fleet_1
Fleet_2
Fleet_3
Fleet1: landings Fleet2: Discards Fleet3: Consumption
Fmult by fleet
0.0
0.5
1.0
1.5
2.0
2.5
1975
1980
1985
1990
1995
2000
2005
2010
Year


Survey and Catch Trends
Spring
Fall
Total Catch (mt)
Index (N/tow)
Year
0
50000
100000
150000
0
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Recr.
SSB
Freport
Precision of Rec., SSB and Avg. F (ages 3+)
CV
0.00
0.05
0.10
0.15
0.20
1975
1980
1985
1990
1995
2000
2005
2010
Year


Recruitment and SSB trends
Age−1 Recruits (millions of fish)
200
400
600
800
1000
SSB in year−1 (000s mt)
0
20
40
60
80
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year

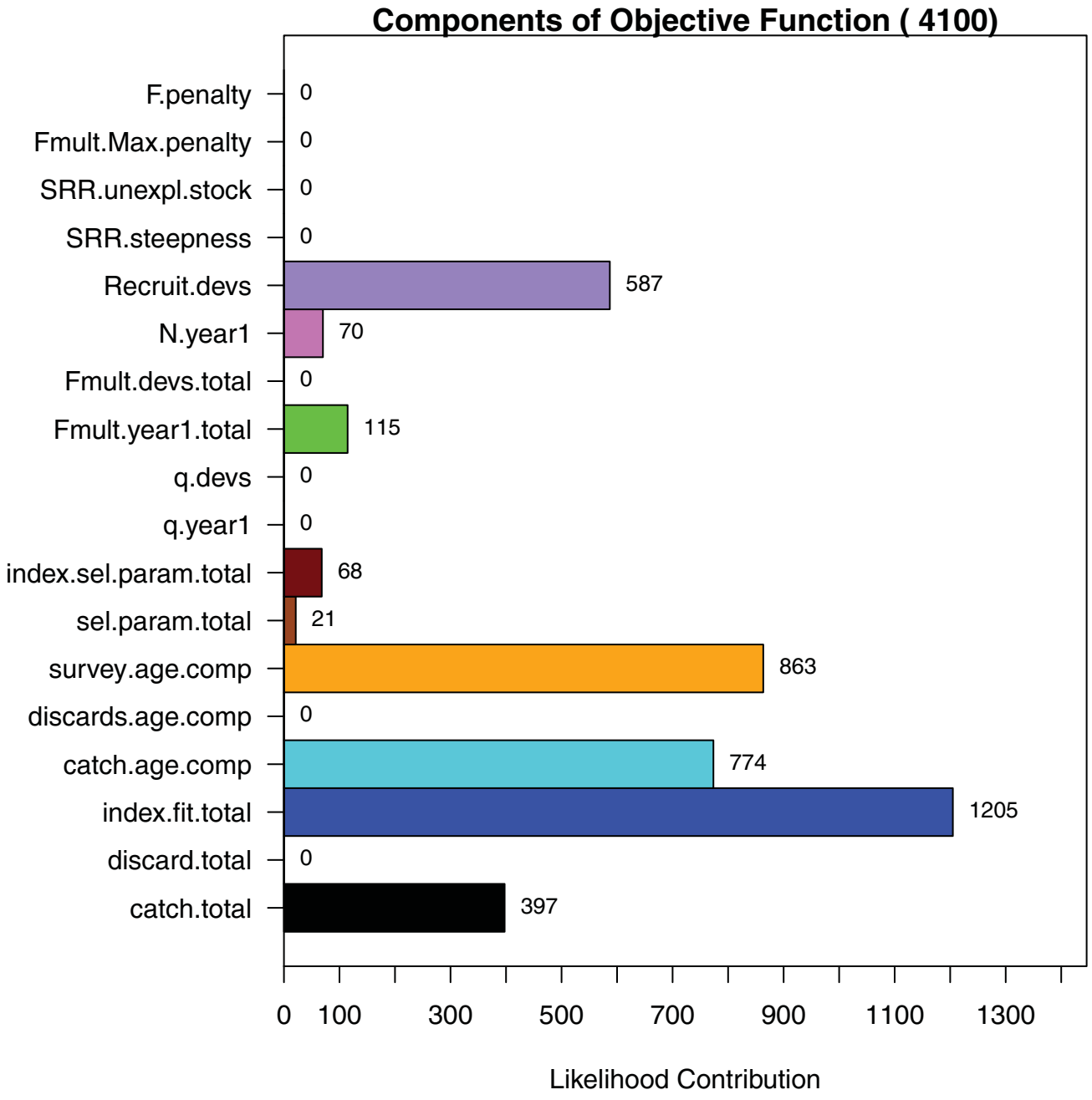
Appendix A3: North Model ASAP results M = 0.4 Base run

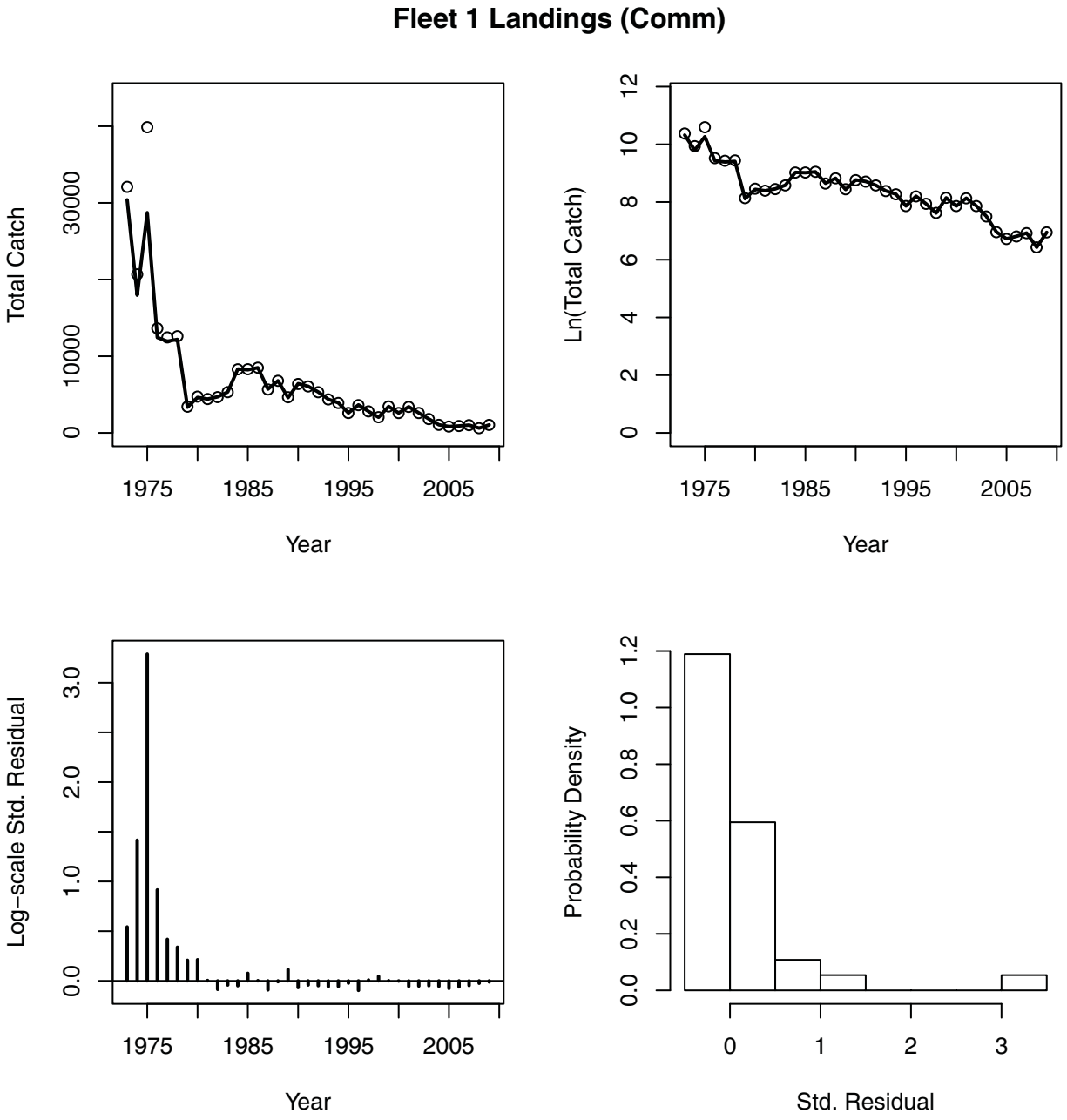
Model Attributes:

1. 3 Fleet Model
    a. Catch : 1973-2009
    b. Discards: 1981 – 2009
    c. Consumption – 1973-2009

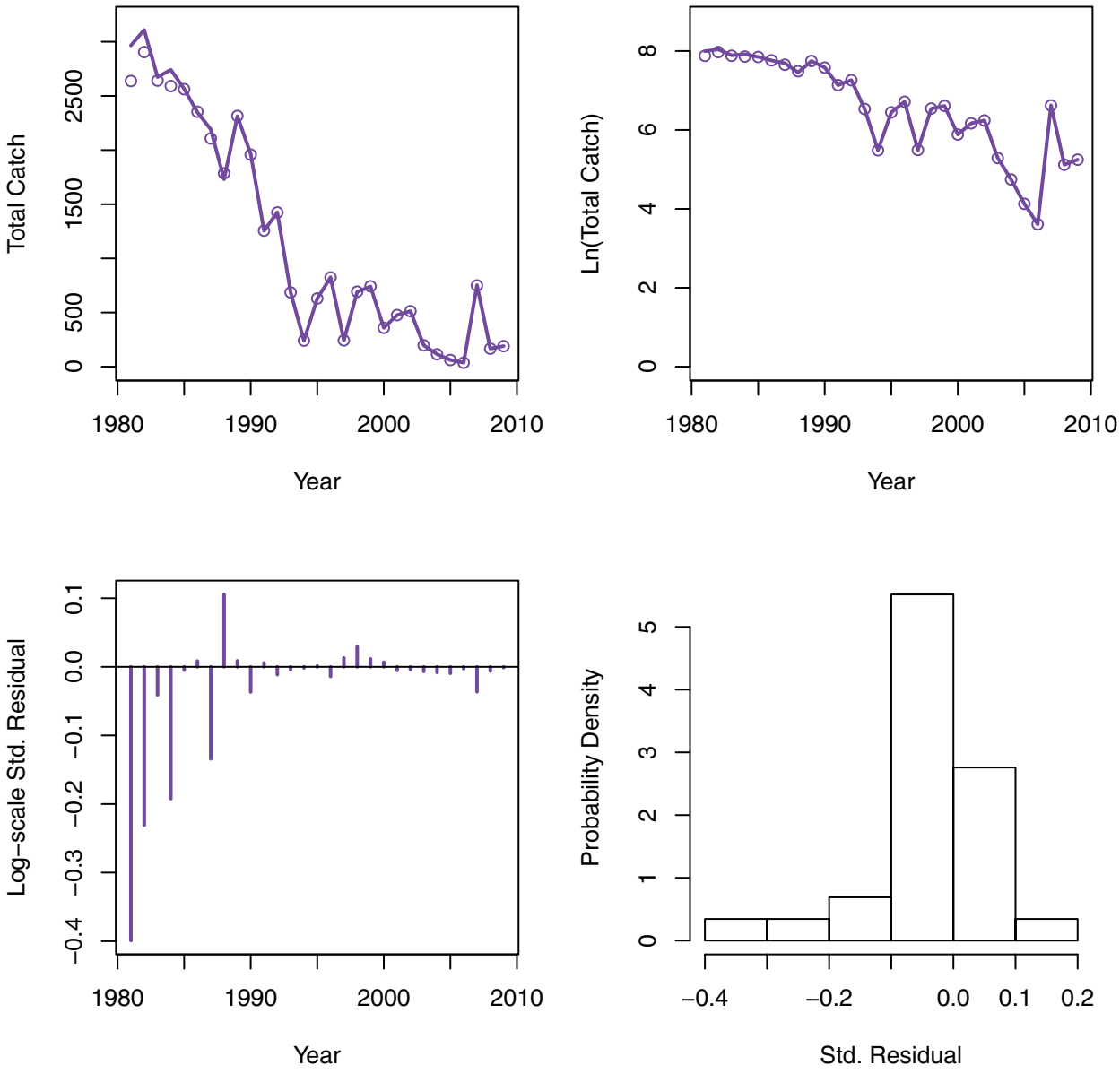
2. Fishery Selectivity (3 Block Selectivity)
    a. Landings (1 Blocks: 1973-2009)
    b. Discards (1 Block: 1981-2009)
    c. Consumption (Double Logistic Functional Form)

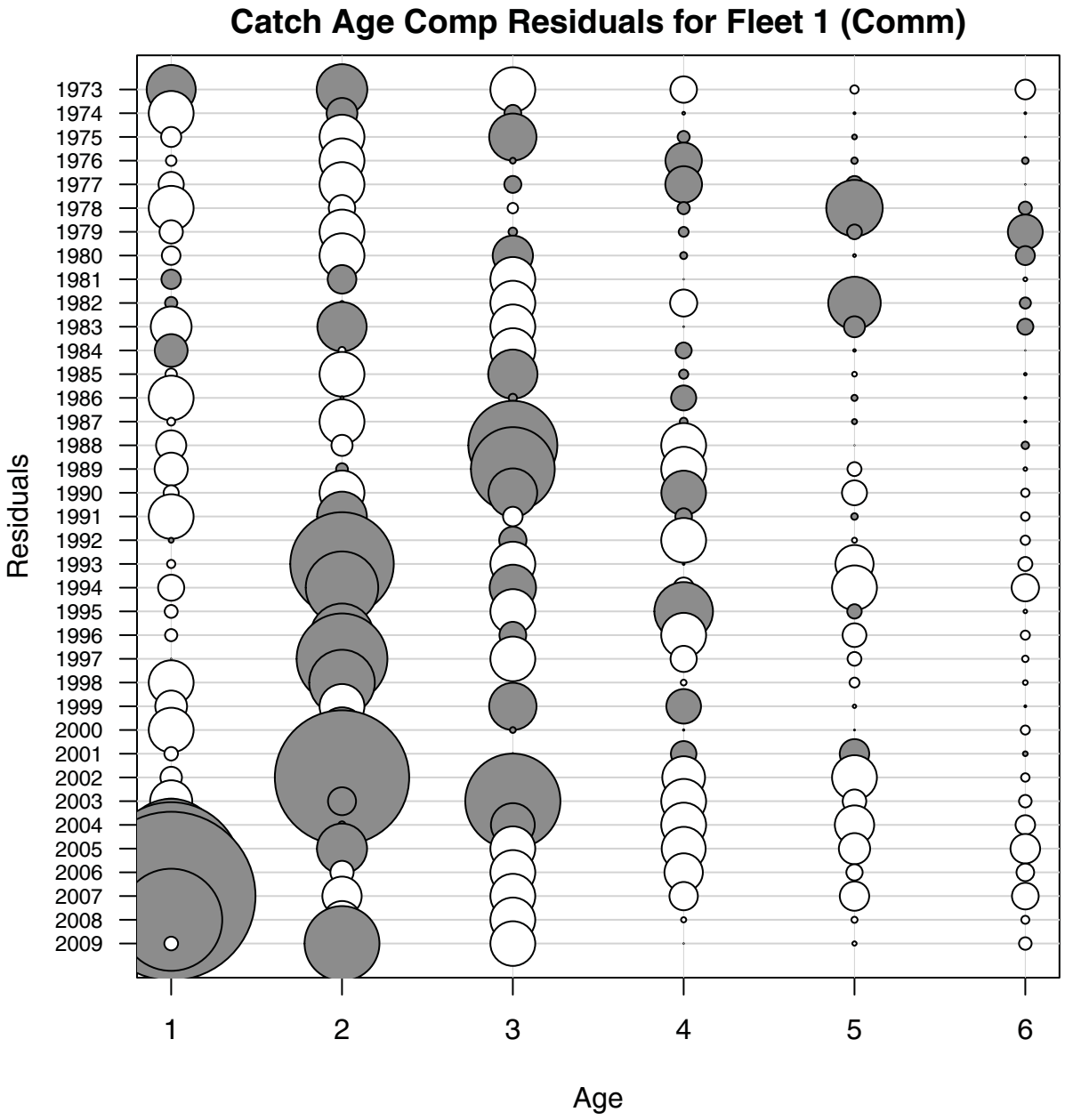
3. Survey Selectivity (Fixed 100% at age 2 and freely estimated older aged (3+)

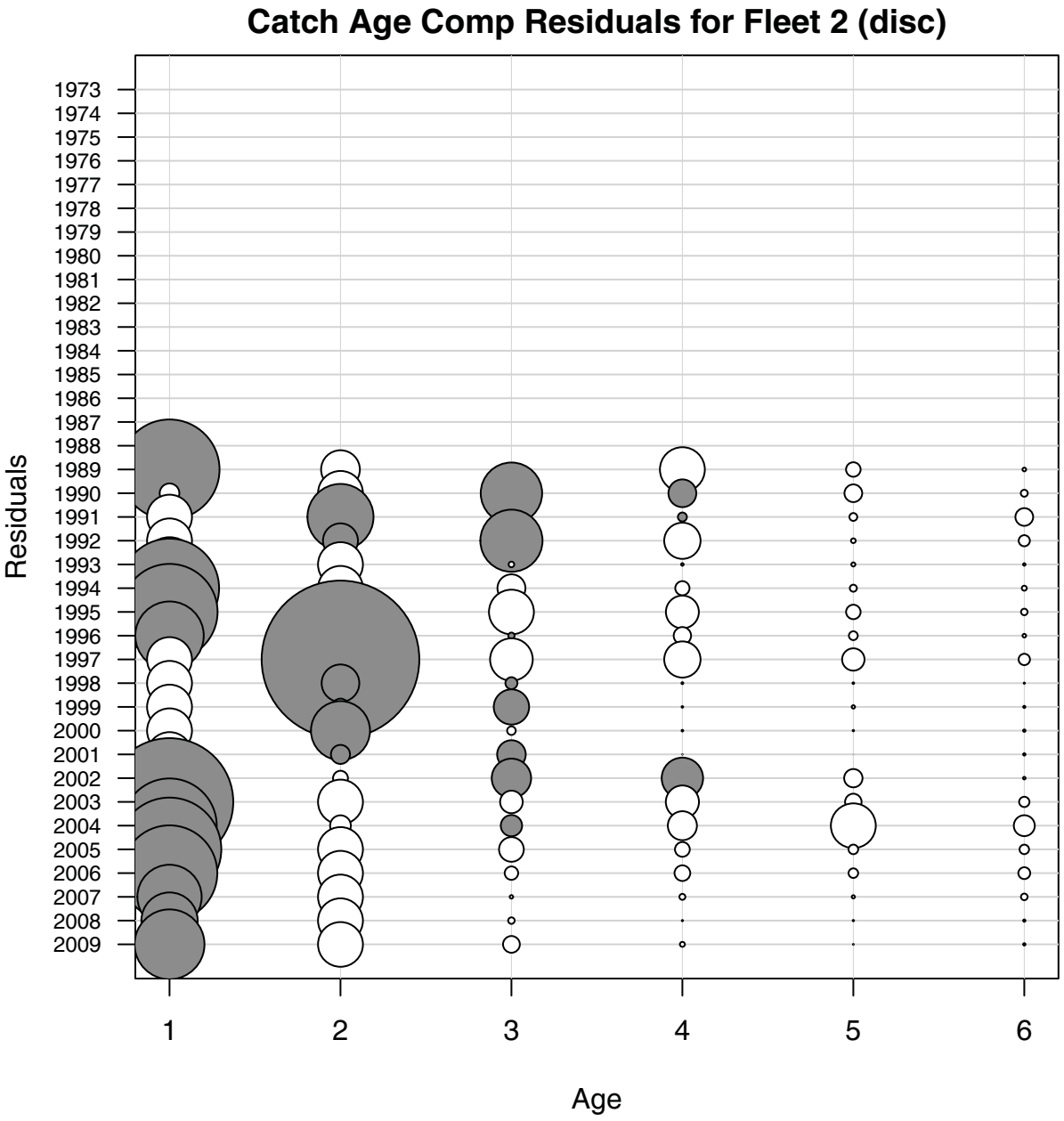

Components of Objective Function (4100)
F.penalty
Fmult.Max.penalty
SRR.unexpl.stock
SRR.steepness
Recruit.devs
N.year1
Fmult.devs.total
Fmult.year1.total
q.devs
q.year1
index.sel.param.total
sel.param.total
survey.age.comp
discards.age.comp
catch.age.comp
index.fit.total
discard.total
catch.total
0
0
0
0
587
70
0
115
0
0
68
21
863
0
774
1205
0
397
0
100
300
500
700
900
1100
1300
Likelihood Contribution

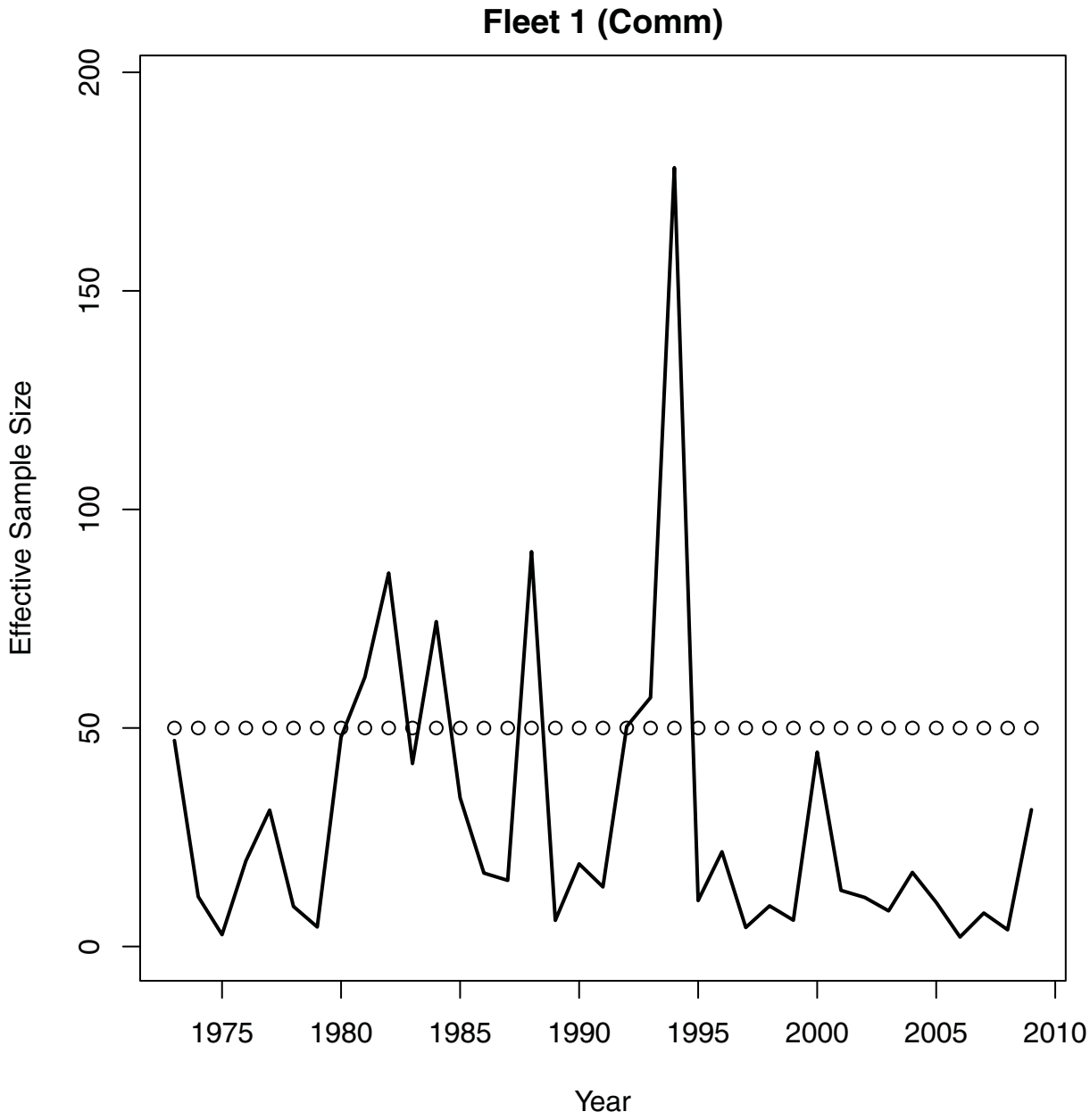

Fleet 1 Landings (Comm)
Total Catch
0
10000
30000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
0.0
1.0
2.0
3.0
1975
1985
1995
2005
Year
Probability Density
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
1
2
3
Std. Residual

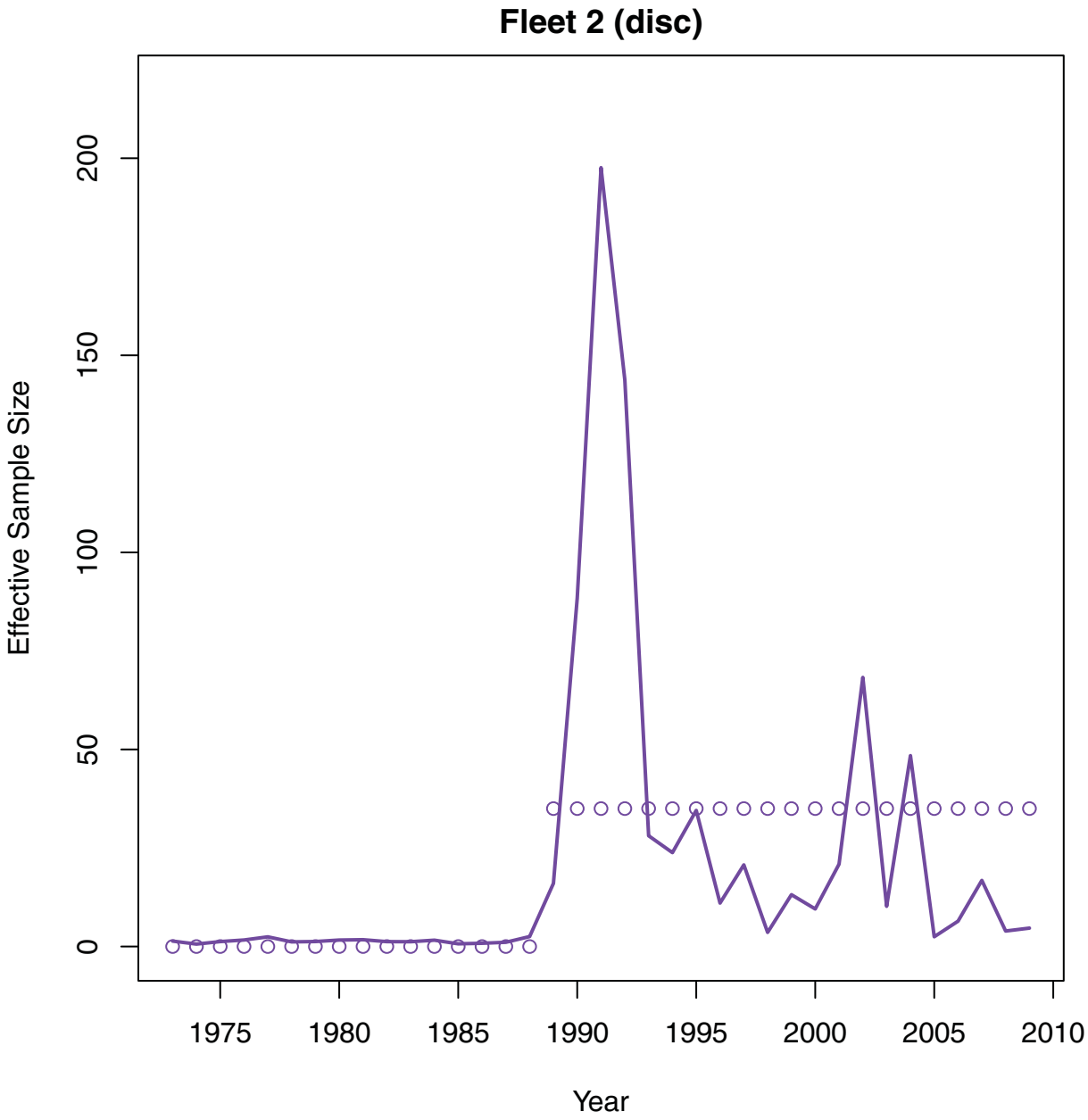
Fleet 2 Landings (disc)

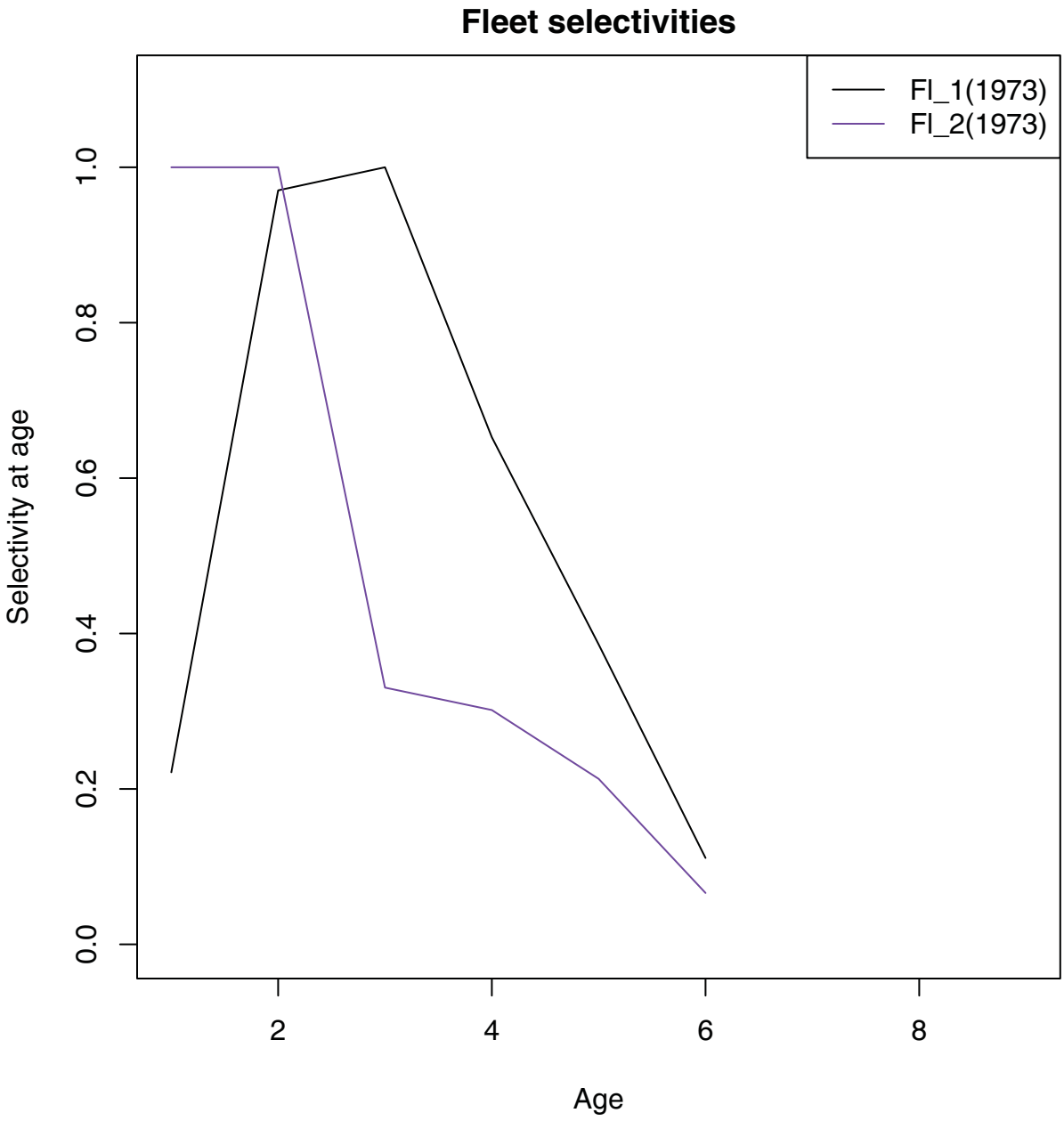



Catch Age Comp Residuals for Fleet 1 (Comm)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

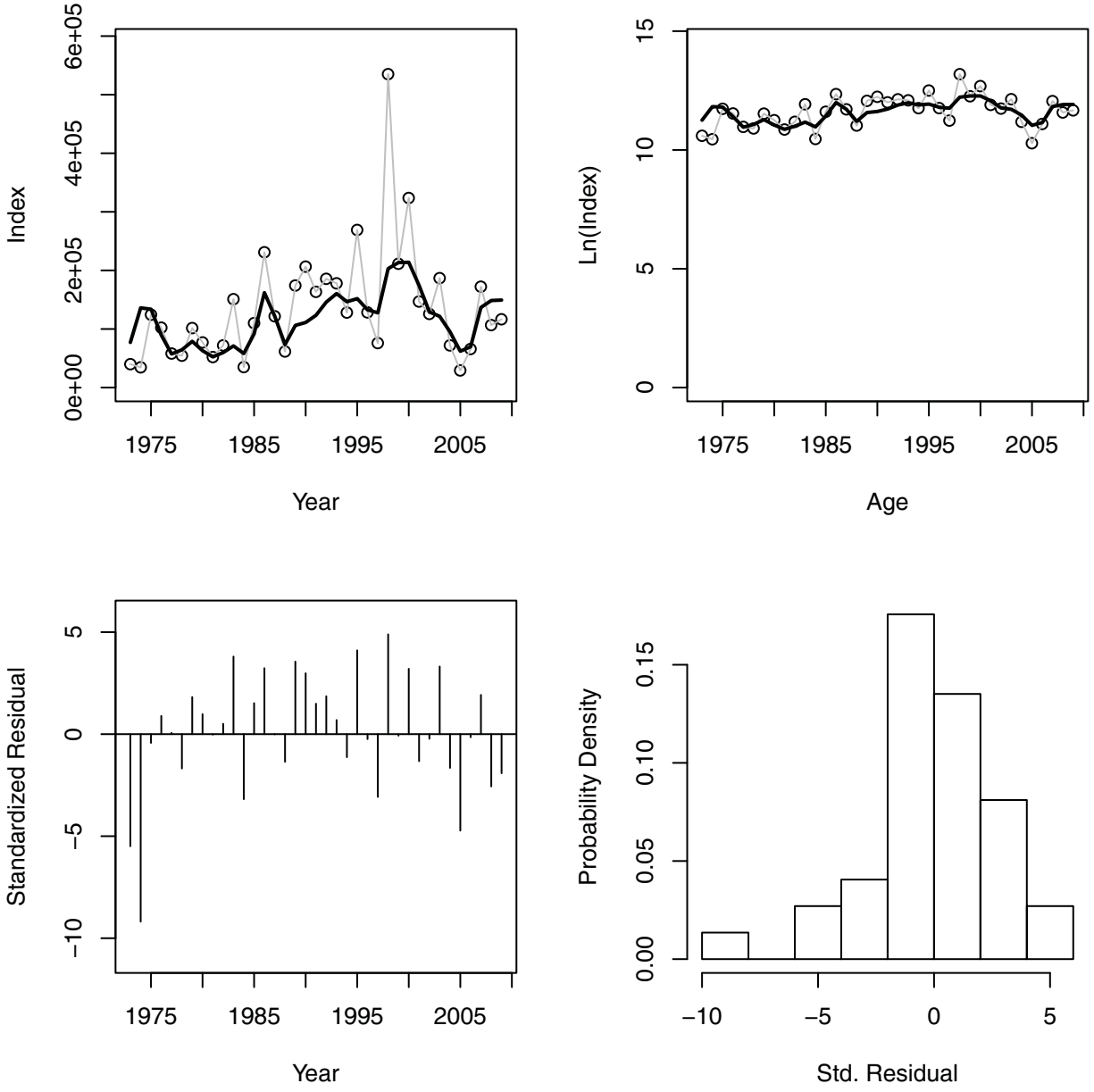

Catch Age Comp Residuals for Fleet 2 (disc)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Fleet 1 (Comm)
Effective Sample Size
0
50
100
150
200
1975
1980
1985
1990
1995
2000
2005
2010
Year

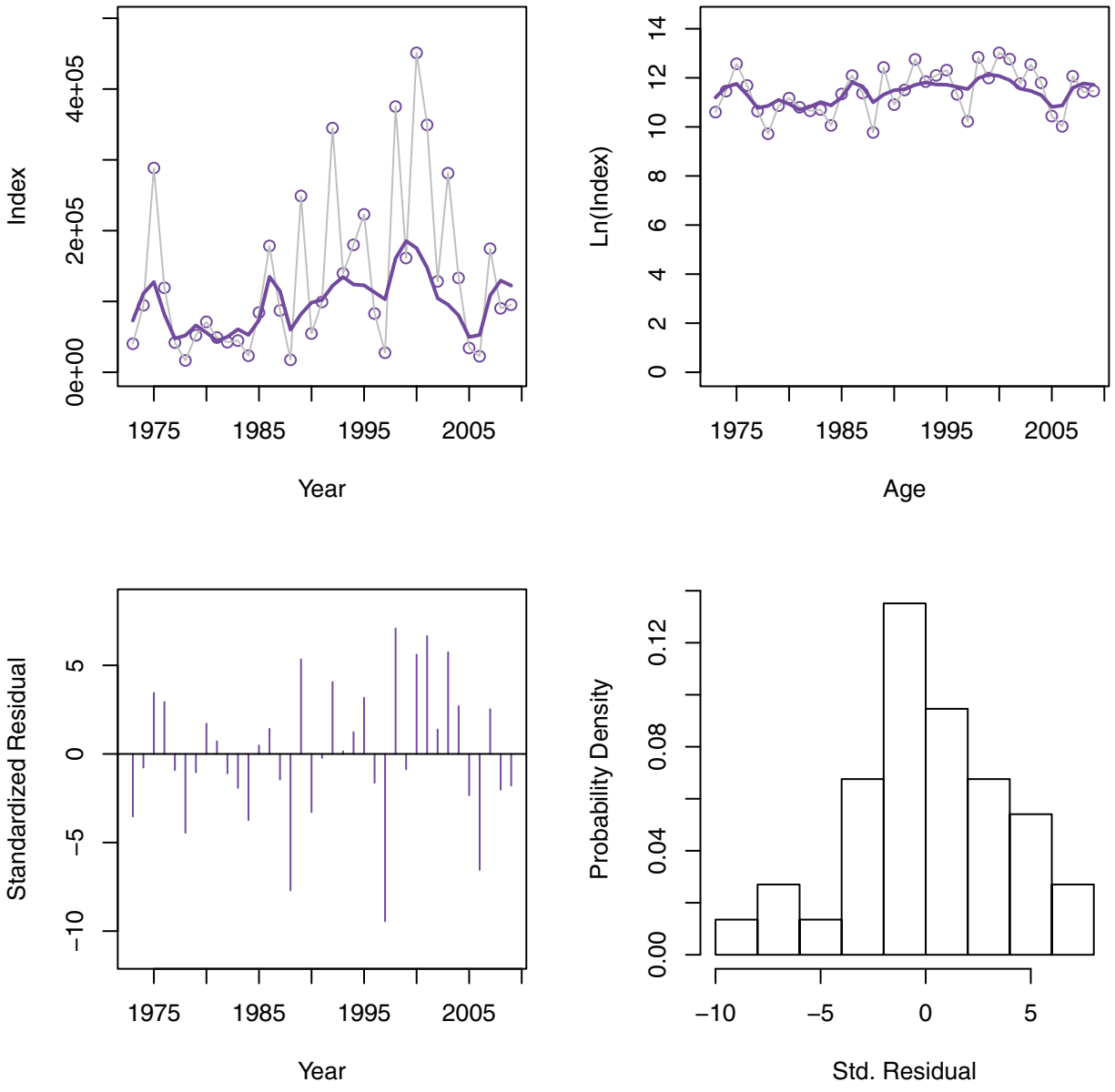

Fleet 2 (disc)
Effective Sample Size
0
50
100
150
200
1975
1980
1985
1990
1995
2000
2005
2010
Year

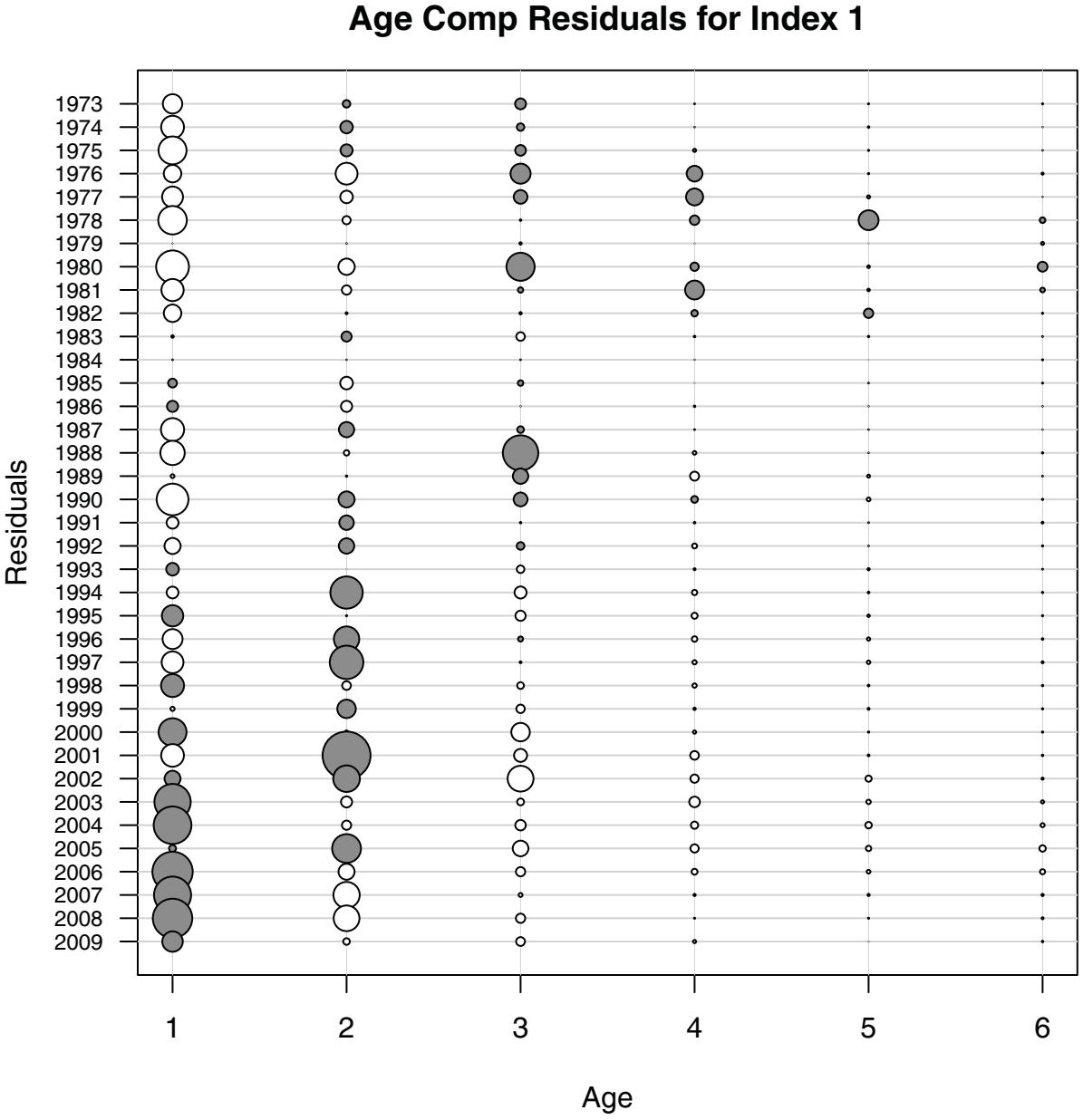

Fleet selectivities
Fl_1(1973)
Fl_2(1973)
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

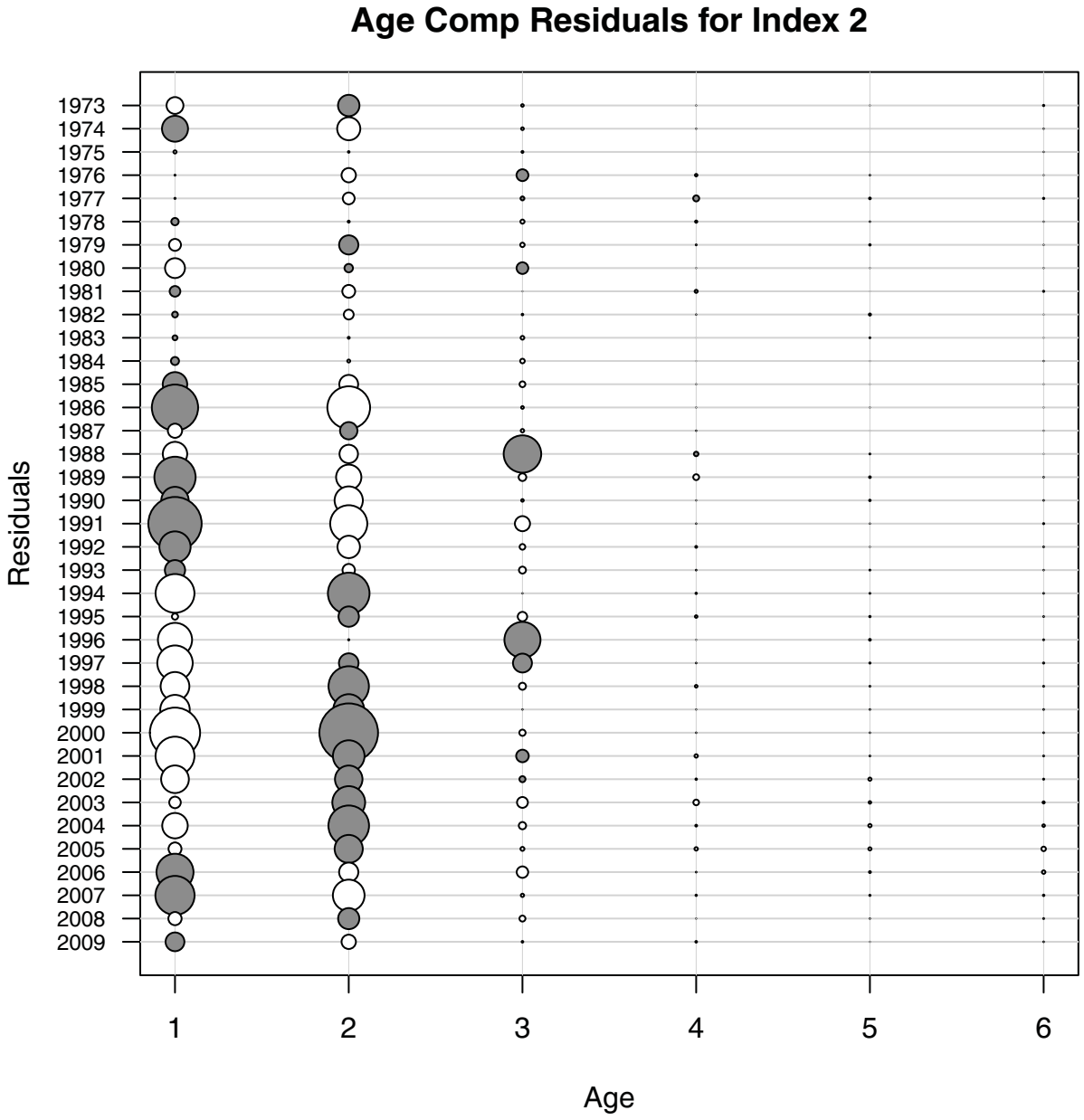
Index 1

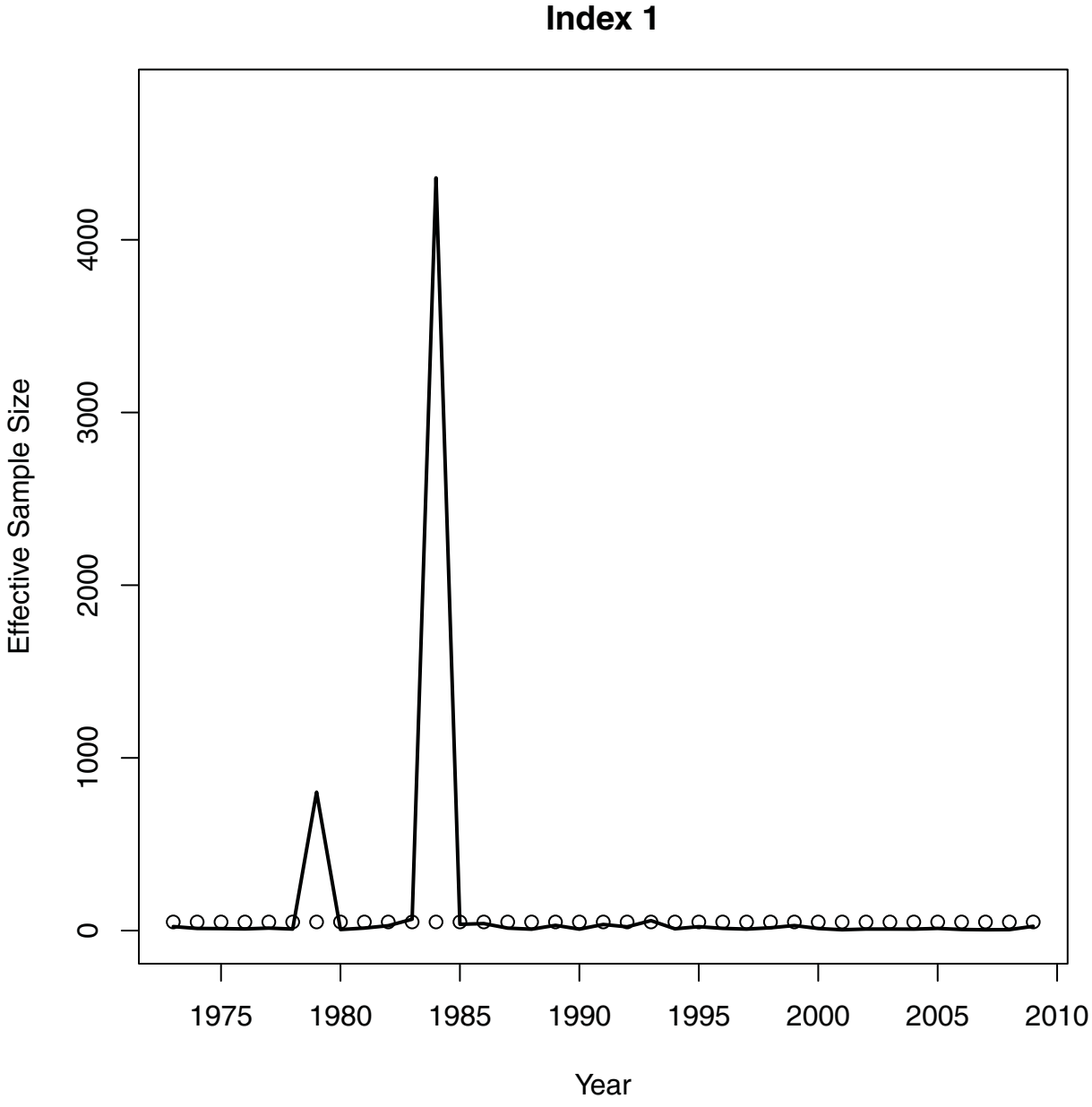

Index
0e+00
2e+05
4e+05
6e+05
1975
1985
1995
2005
Year
Ln(Index)
0
5
10
15
1975
1985
1995
2005
Age
Standardized Residual
−10
−5
0
5
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
−10
−5
0
5
Std. Residual

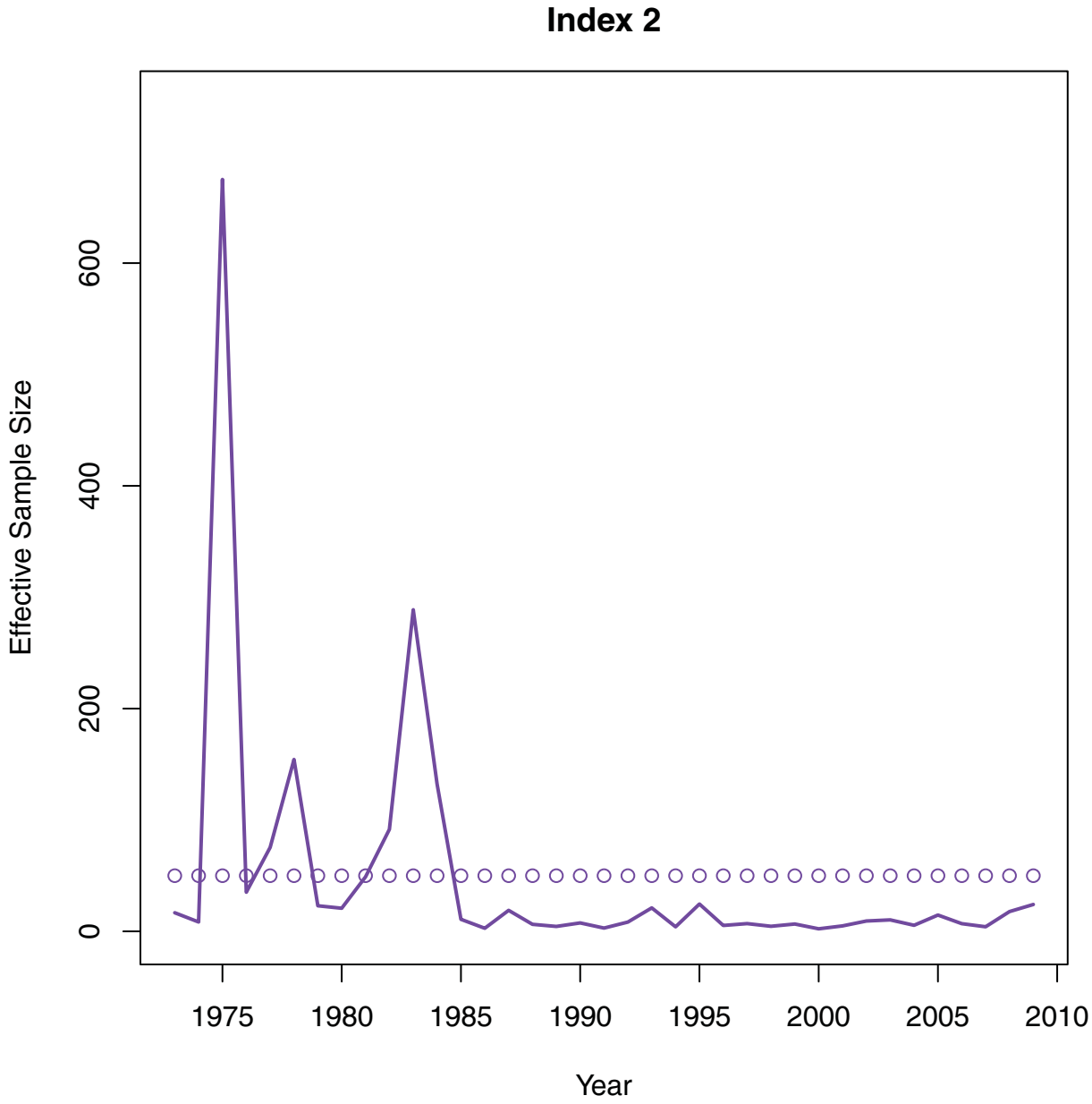
Index 2

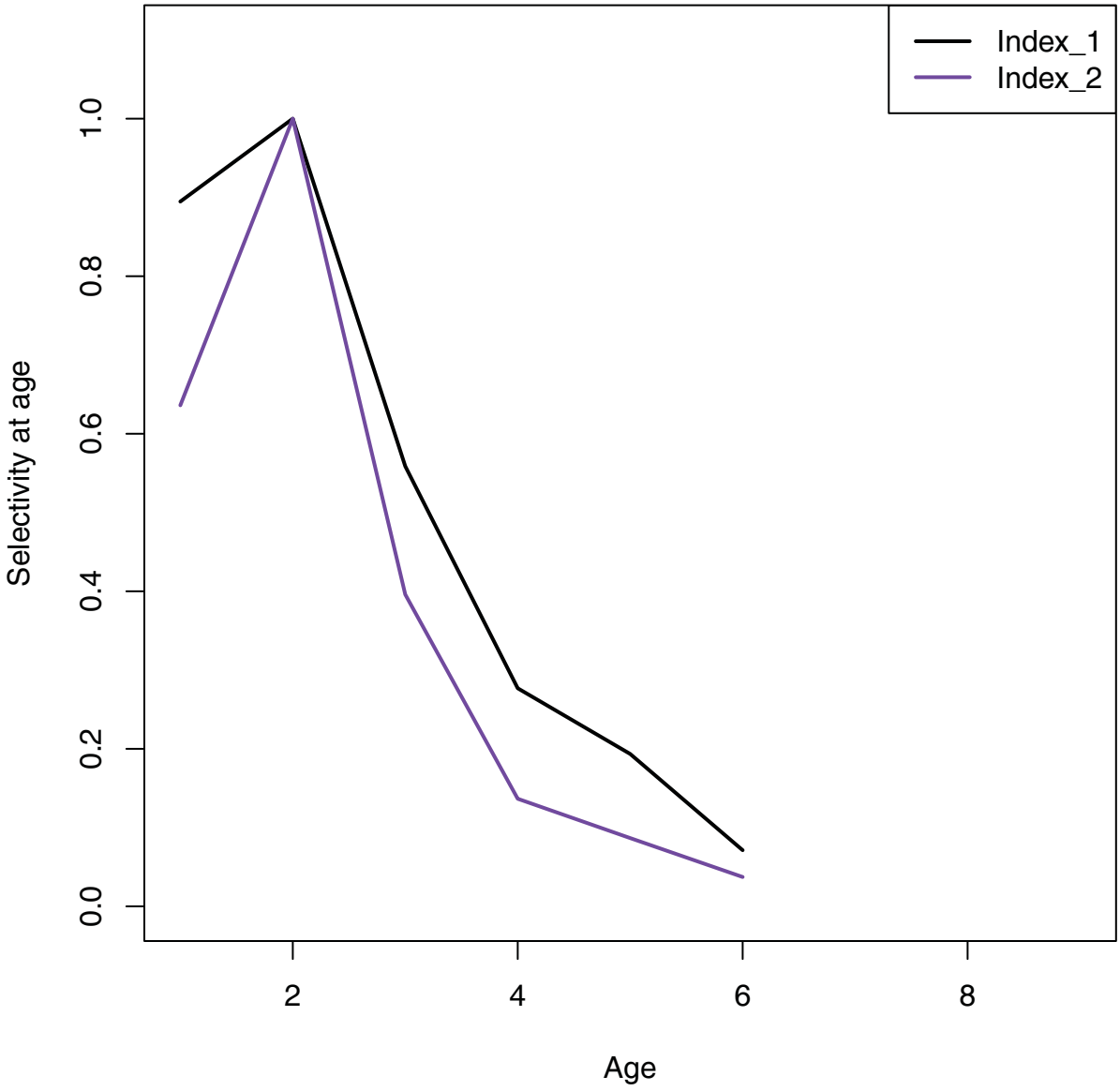

Index
0e+00
2e+05
4e+05
1975
1985
1995
2005
Year
Ln(Index)
0
2
4
6
8
10
12
14
1975
1985
1995
2005
Age
Standardized Residual
−10
−5
0
5
1975
1985
1995
2005
Year
Probability Density
0.00
0.04
0.08
0.12
−10
−5
0
5
Std. Residual

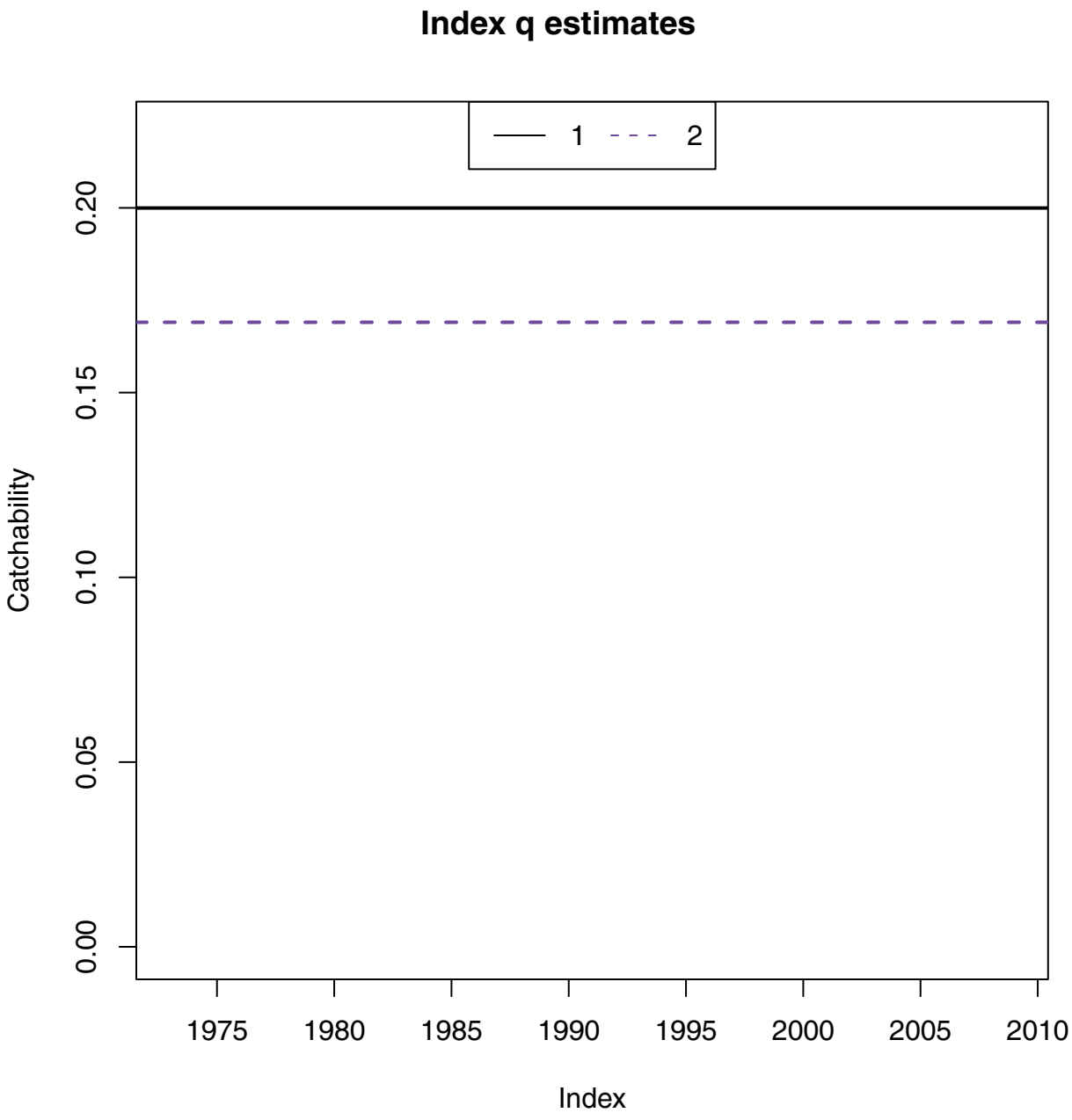

Age Comp Residuals for Index 1
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

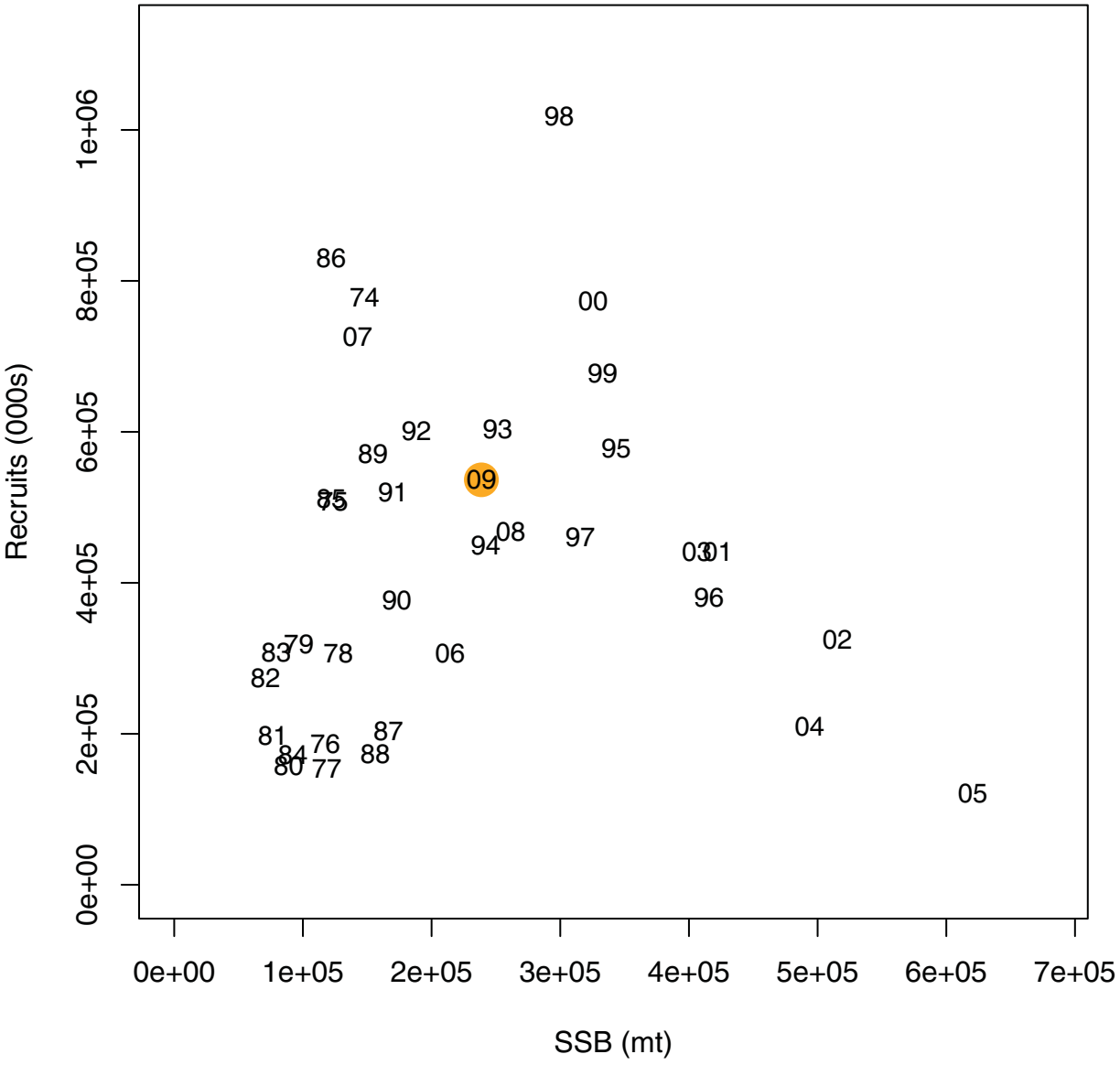

Age Comp Residuals for Index 2
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

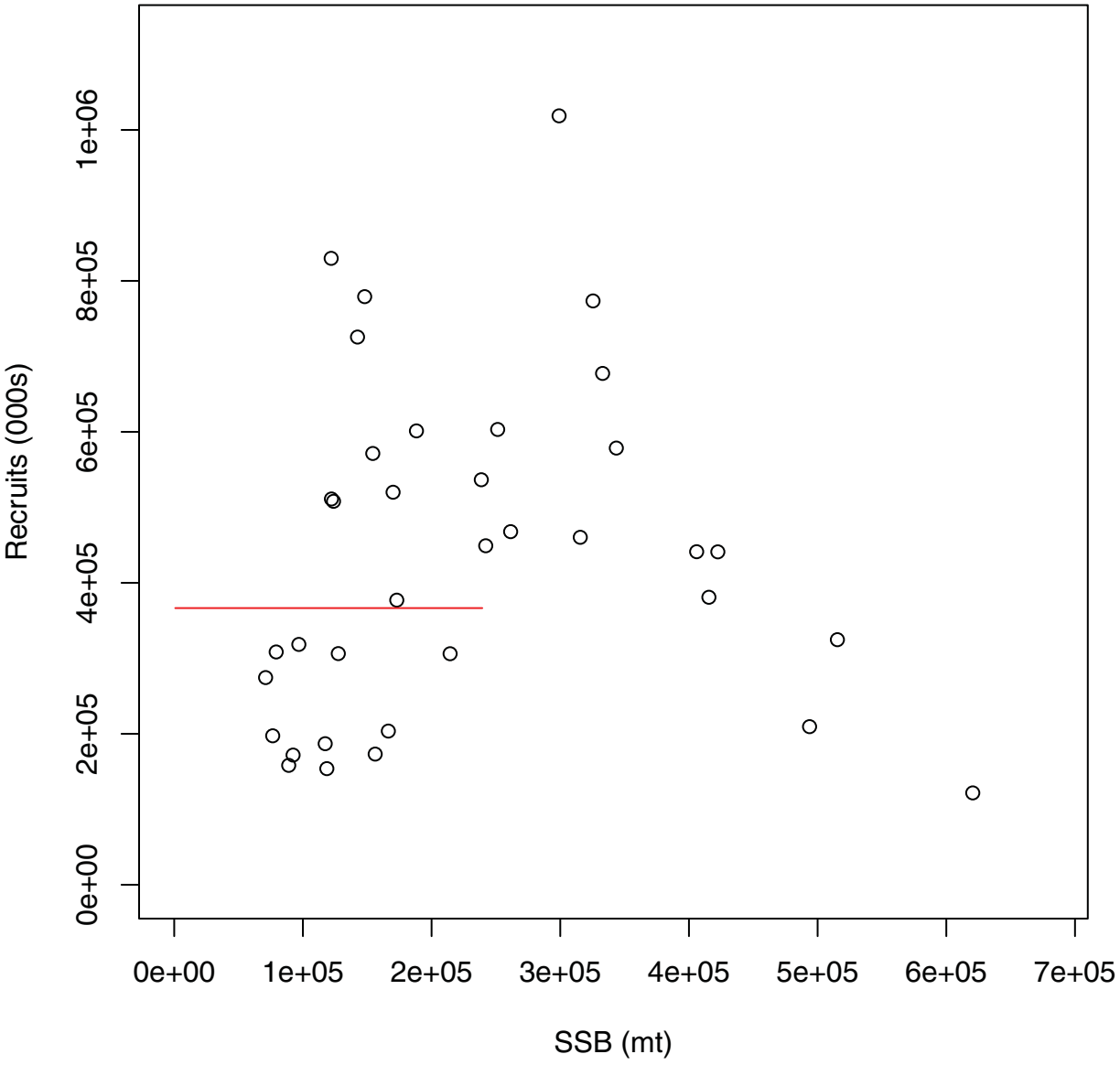

Index 1
Effective Sample Size
0
1000
2000
3000
4000
1975
1980
1985
1990
1995
2000
2005
2010
Year

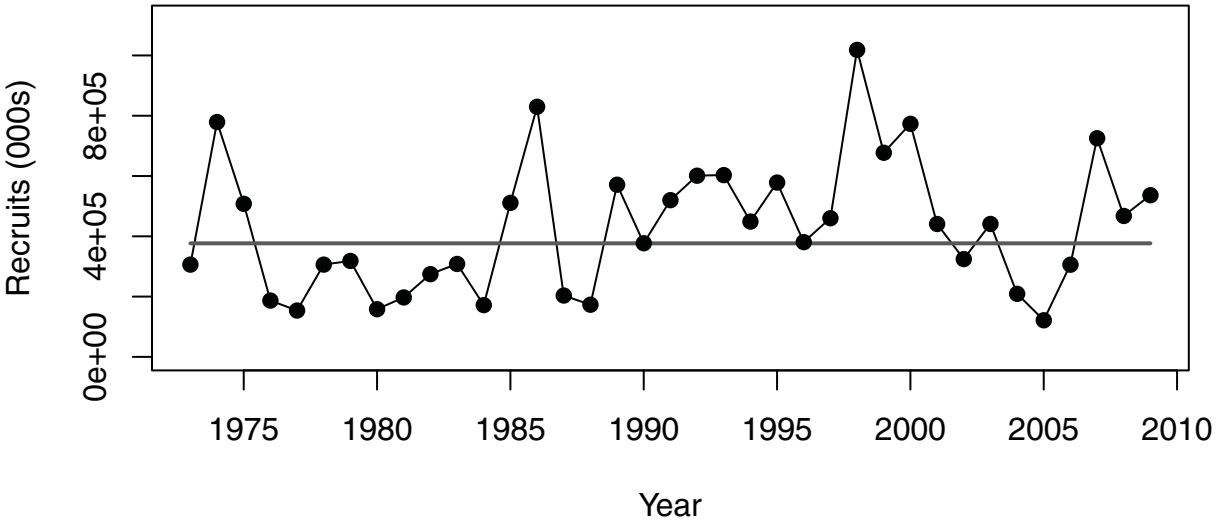

Index 2
Effective Sample Size
0
200
400
600
1975
1980
1985
1990
1995
2000
2005
2010
Year

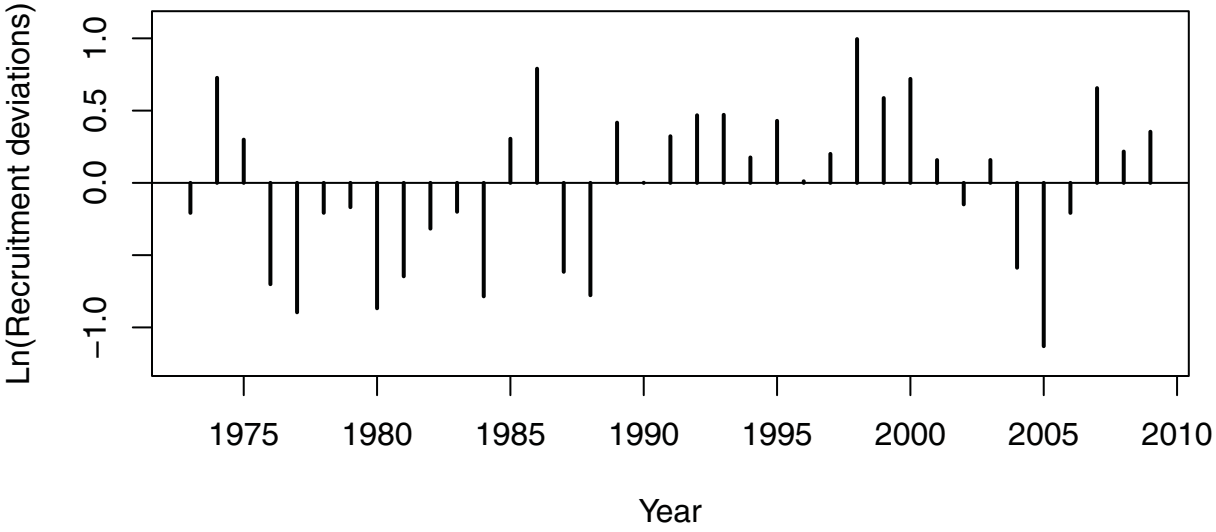

Index_1
Index_2
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

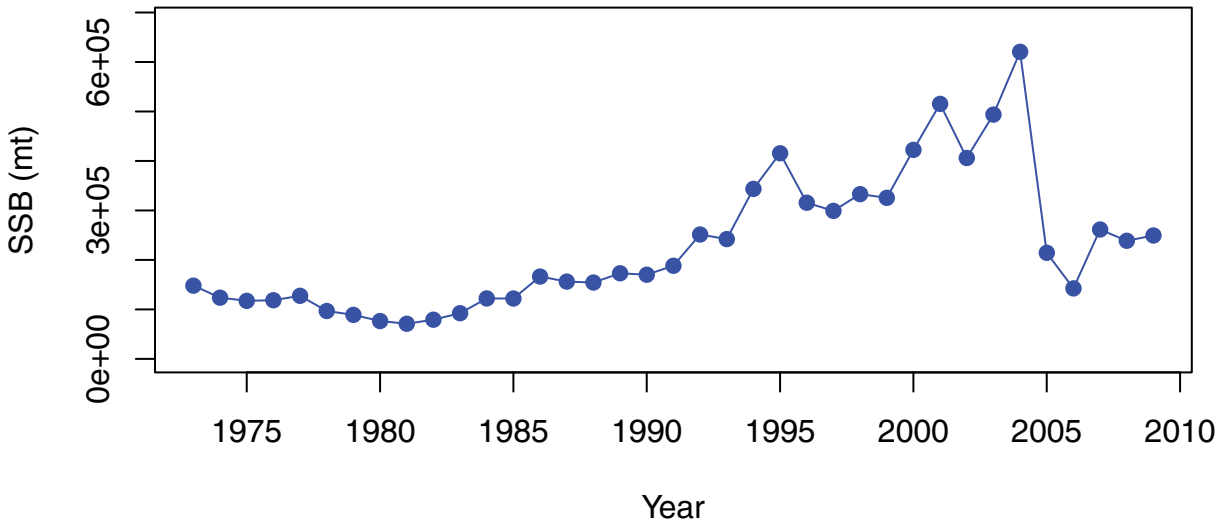

Index q estimates
1
2
0.20
0.15
0.10
0.05
0.00
Catchability
1975
1980
1985
1990
1995
2000
2005
2010
Index

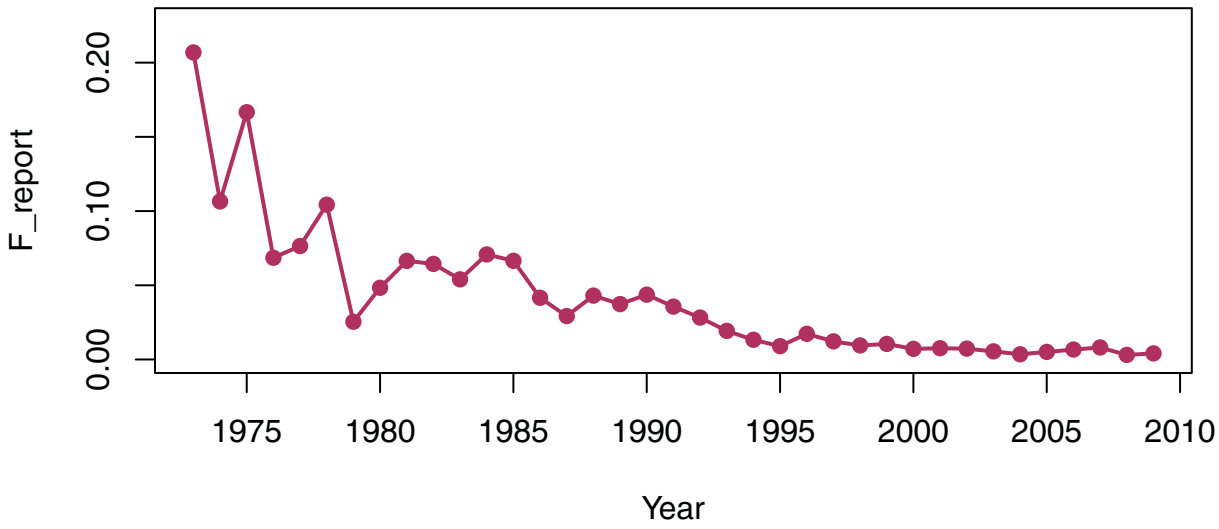

Recruits (000s)
0e+00
2e+05
4e+05
6e+05
8e+05
1e+06
SSB (mt)
0e+00
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
7e+05
98
86
74
00
07
99
92
93
89
95
09
91
08
97
94
90
96
02
79
83
78
06
82
04
81
87
76
88
84
77
05

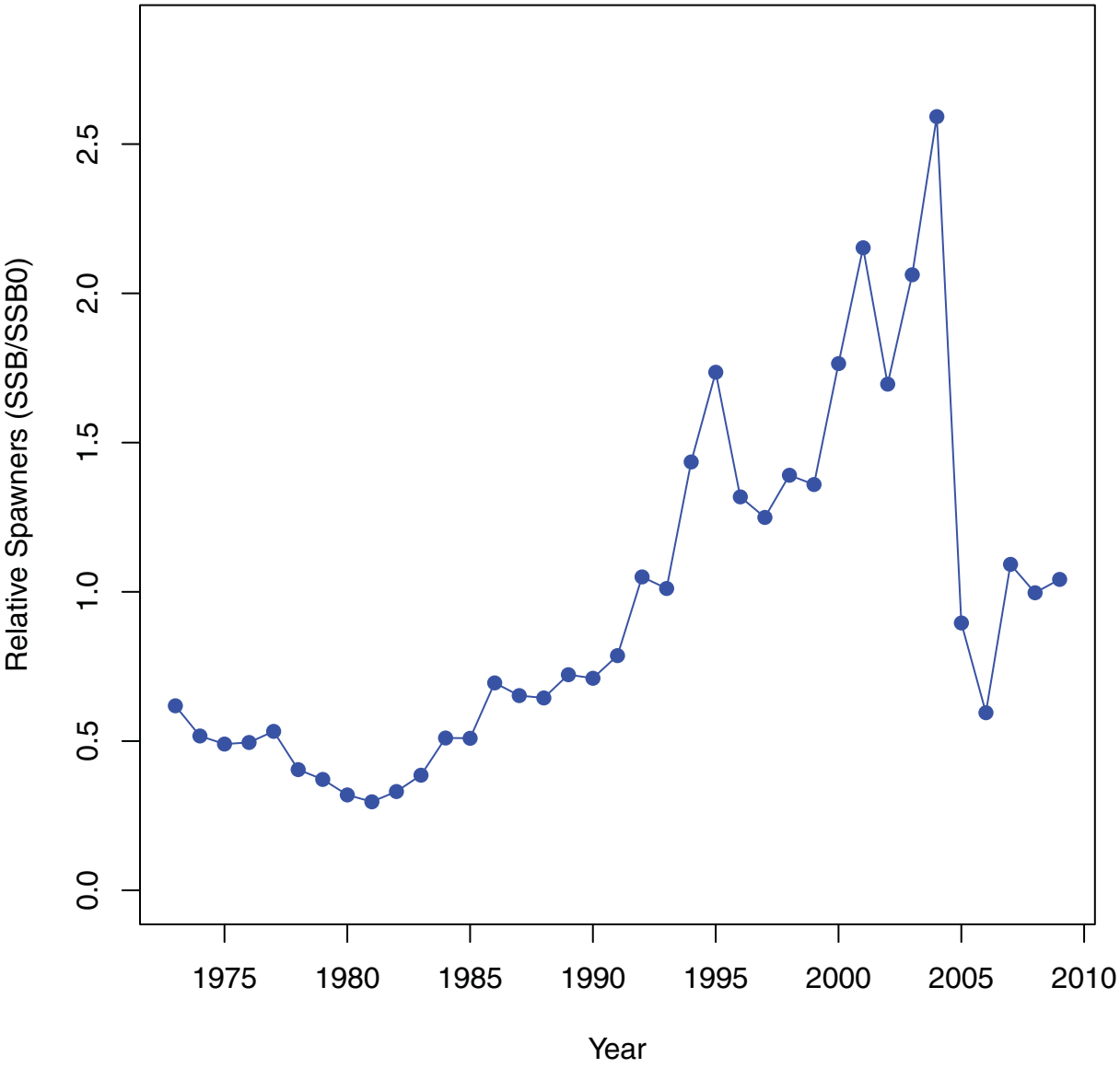

Recruits (000s)
0e+00
2e+05
4e+05
6e+05
8e+05
1e+06
0e+00
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
7e+05
SSB (mt)

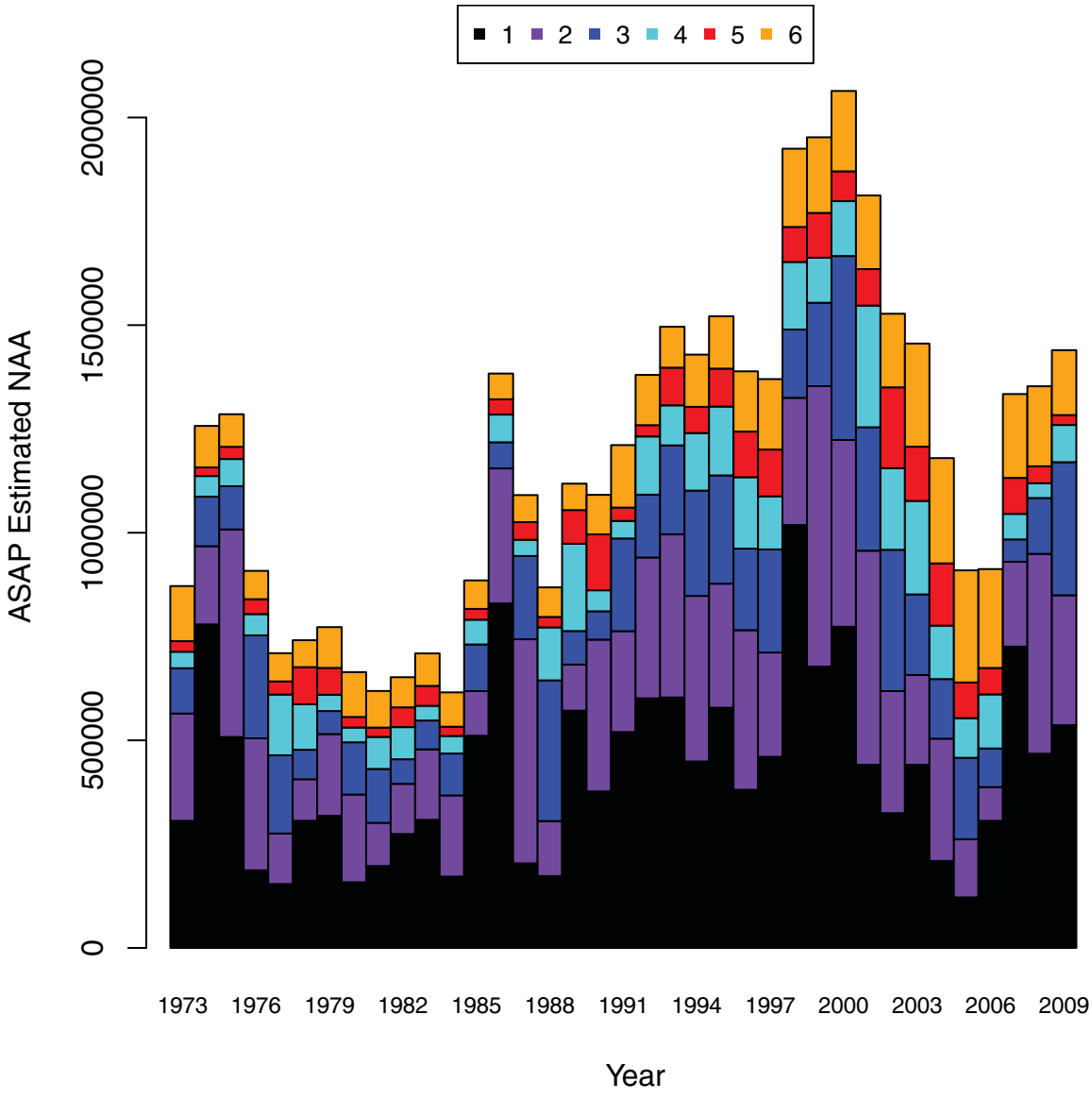

Recruits (000s)
0e+00
4e+05
8e+05
1975
1980
1985
1990
1995
2000
2005
2010
Year

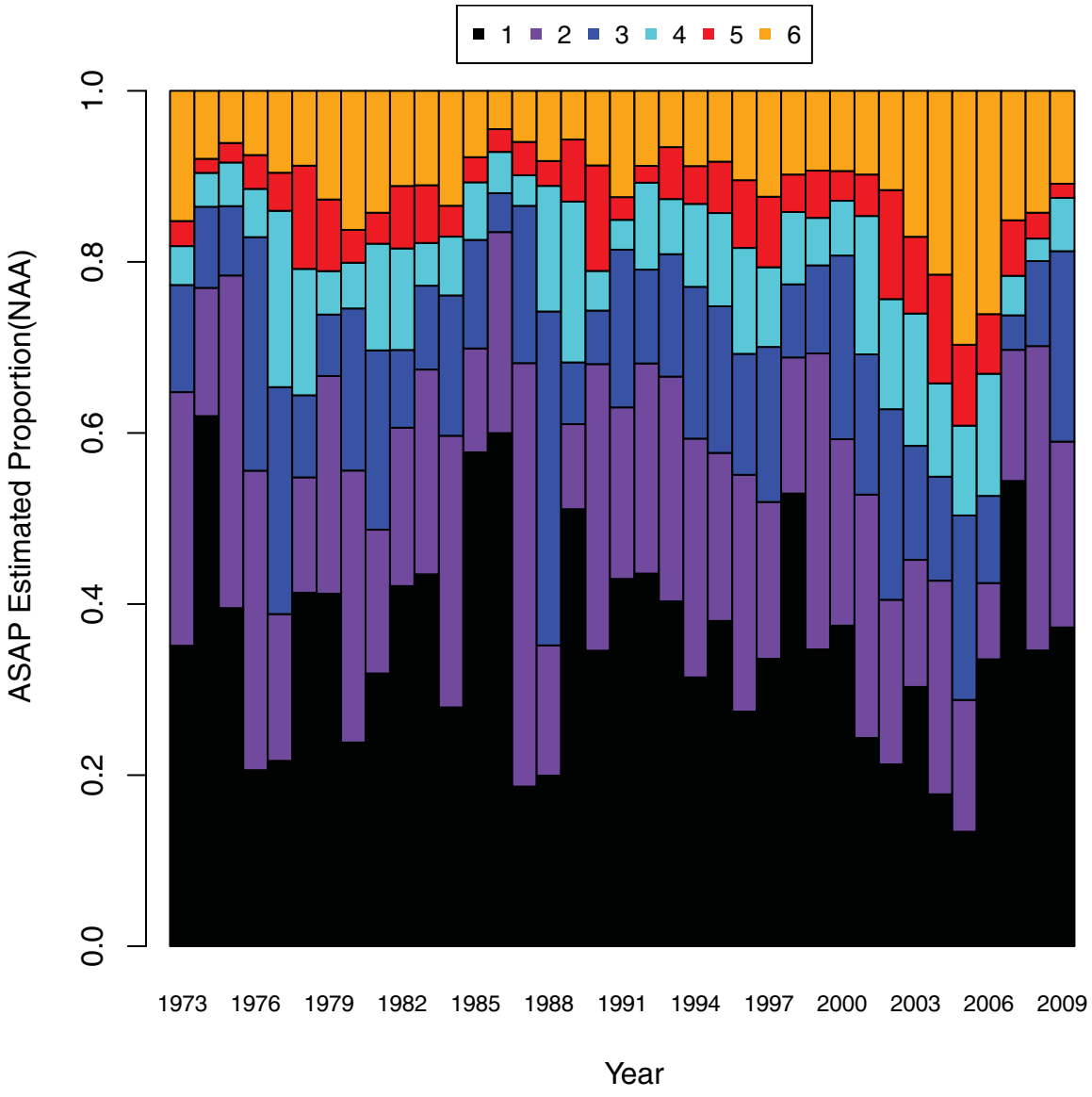

Ln(Recruitment deviations)
−1.0
0.0
0.5
1.0
1975
1980
1985
1990
1995
2000
2005
2010
Year

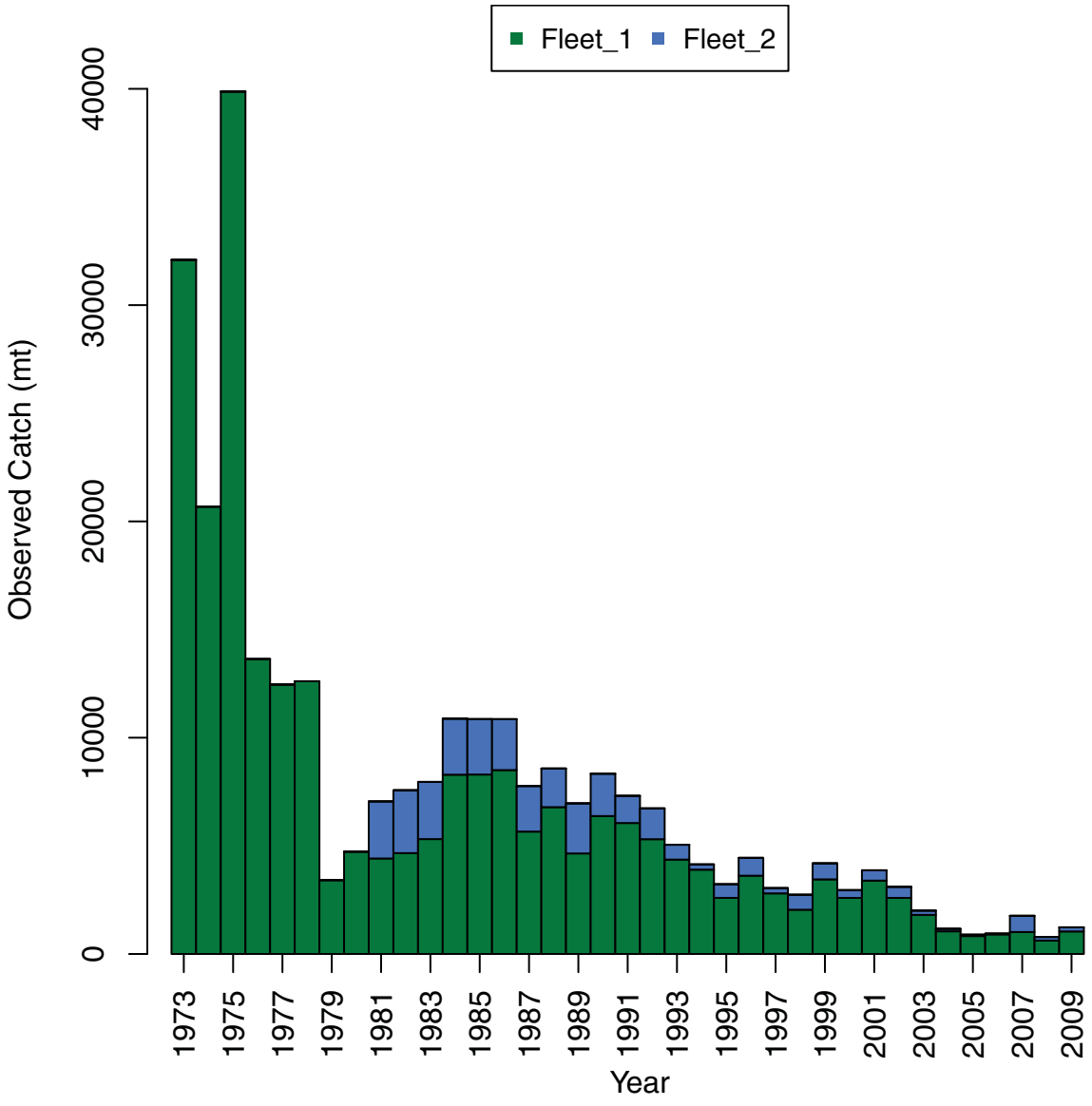

SSB (mt)
0e+00
3e+05
6e+05
1975
1980
1985
1990
1995
2000
2005
2010
Year

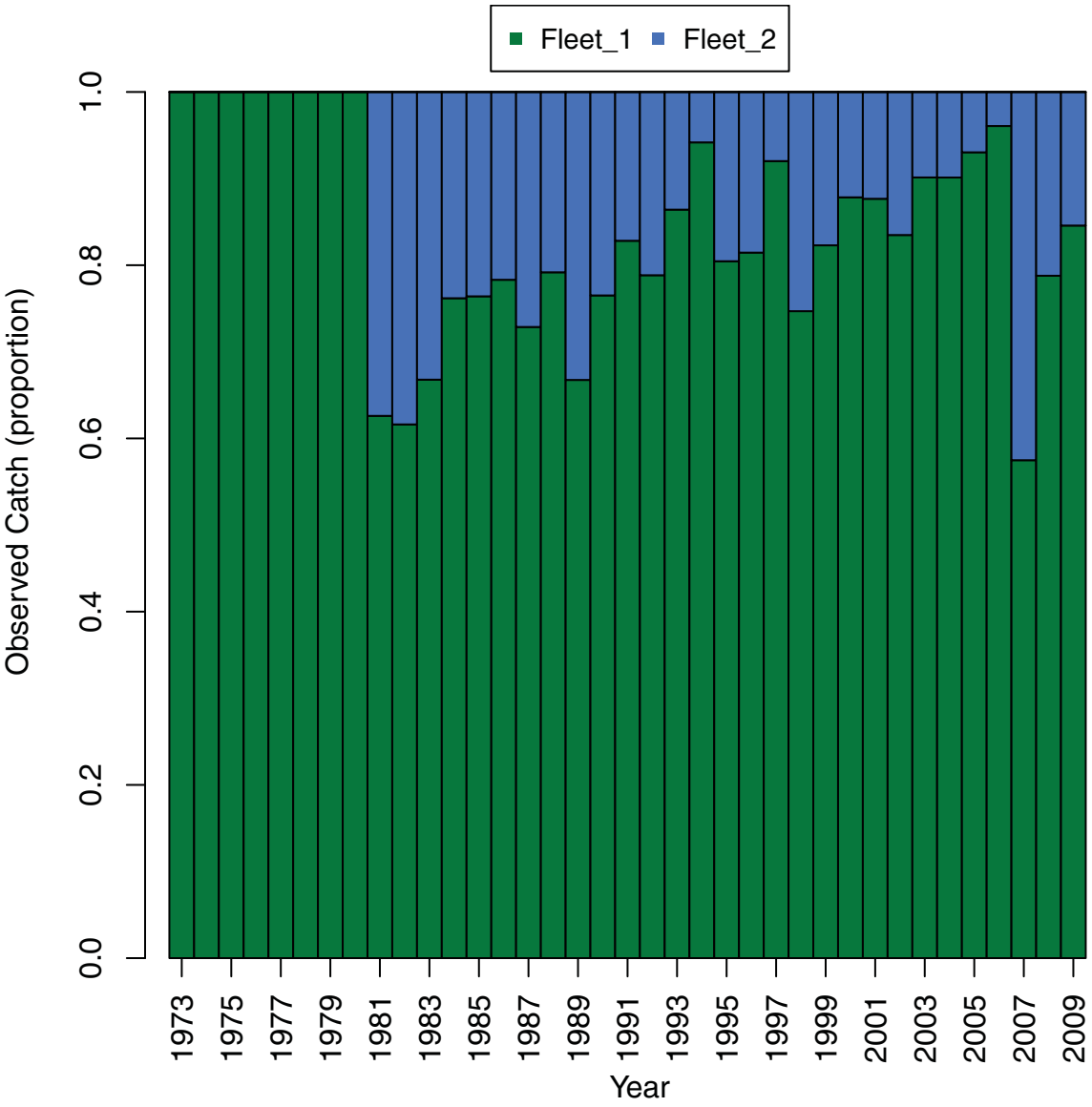

F_report
0.00
0.10
0.20
1975
1980
1985
1990
1995
2000
2005
2010
Year

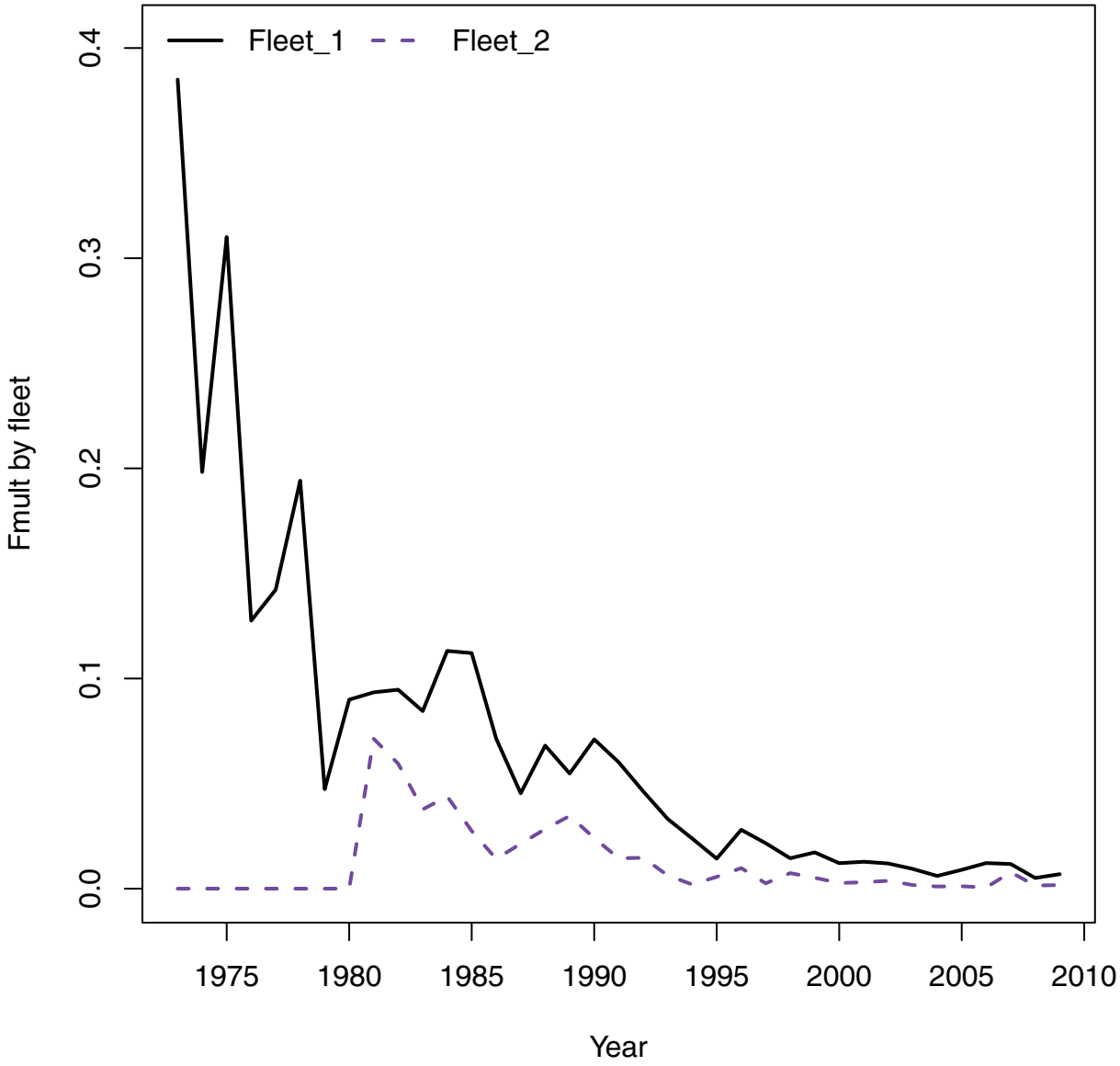

Relative Spawners (SSB/SSB0)
0.0
0.5
1.0
1.5
2.0
2.5
1975
1980
1985
1990
1995
2000
2005
2010
Year

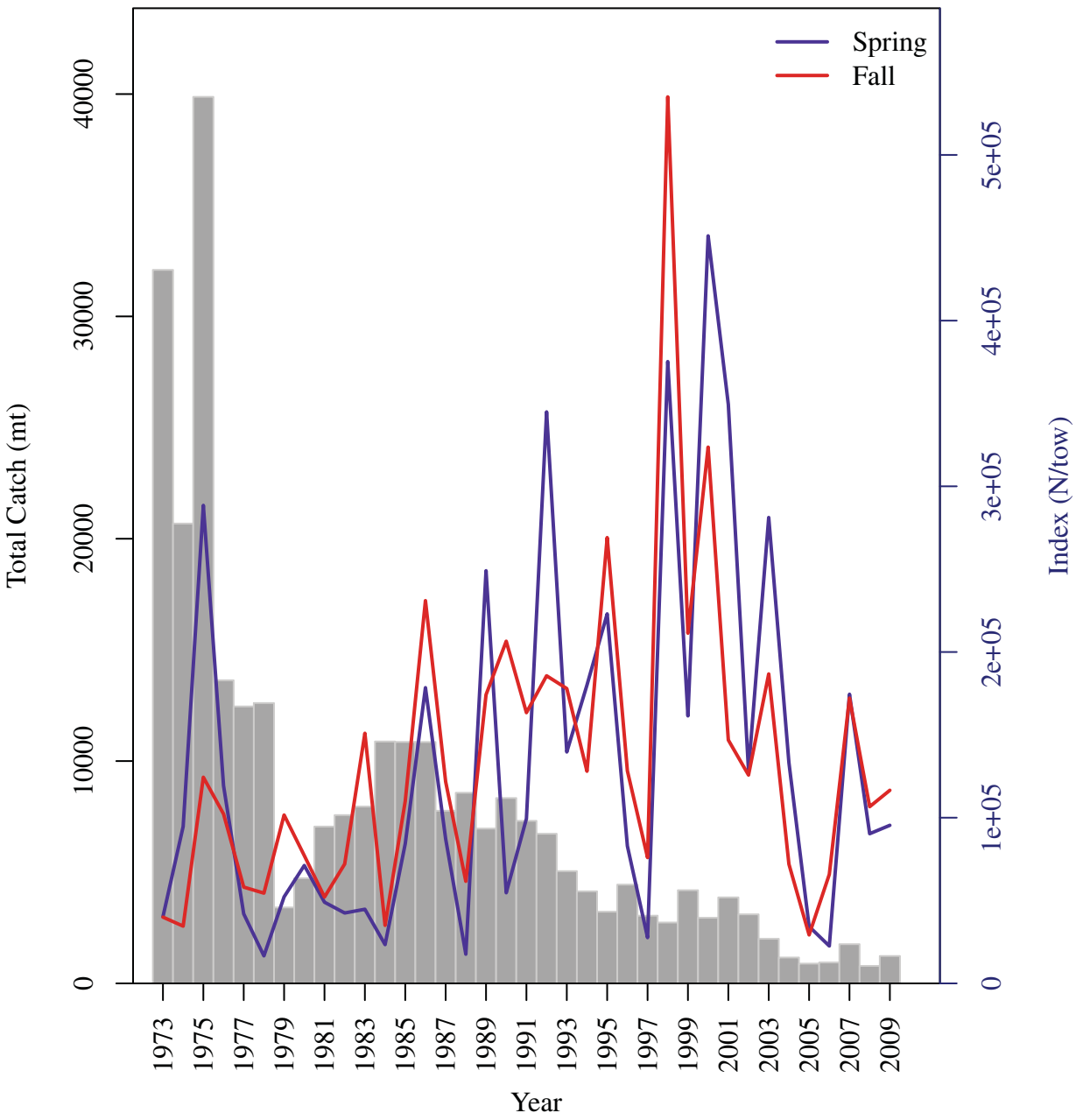

1
2
3
4
5
6
ASAP Estimated NAA
0
500000
1000000
1500000
2000000
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

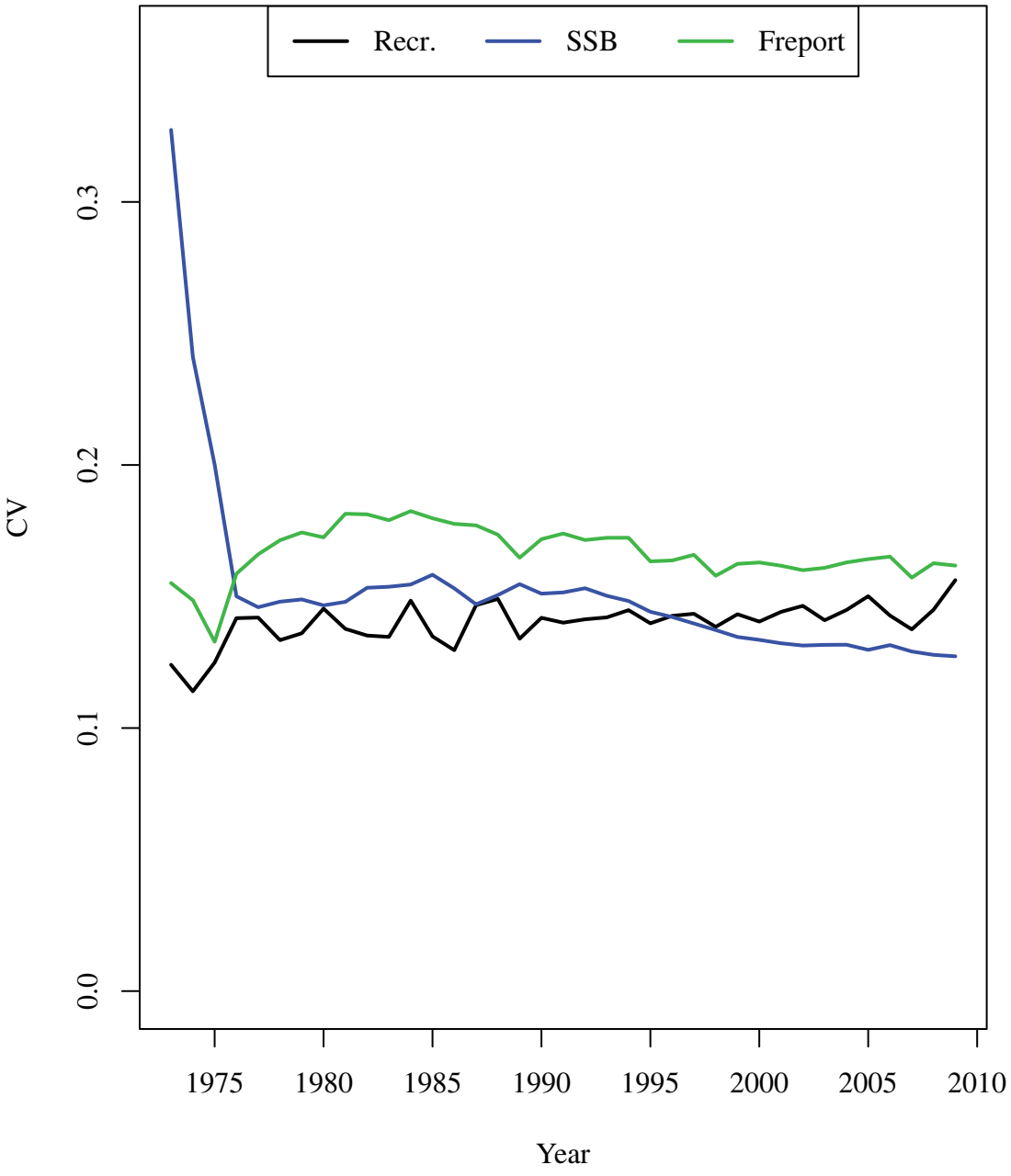

1
2
3
4
5
6
ASAP Estimated Proportion(NAA)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

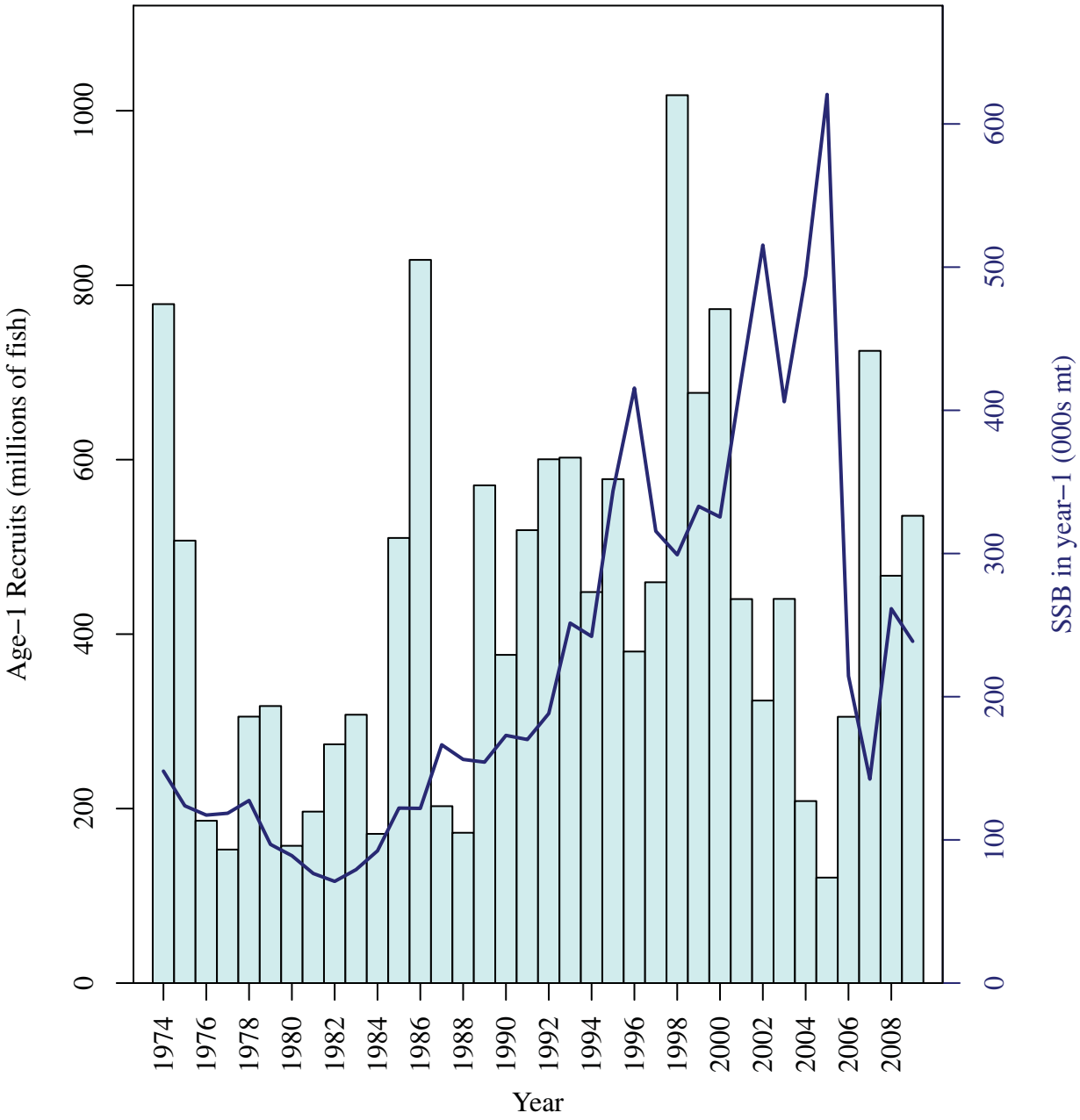

Fleet_1
Fleet_2
Observed Catch (mt)
0
10000
20000
30000
40000
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Observed Catch (proportion)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fmult by fleet
0.0
0.1
0.2
0.3
0.4
1975
1980
1985
1990
1995
2000
2005
2010
Year


Spring
Fall
Total Catch (mt)
Index (N/tow)
Year
0
10000
20000
30000
40000
1e+05
2e+05
3e+05
4e+05
5e+05
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Recr.
SSB
Freport
CV
0.0
0.1
0.2
0.3
1975
1980
1985
1990
1995
2000
2005
2010
Year


Age−1 Recruits (millions of fish)
0
200
400
600
800
1000
SSB in year−1 (000s mt)
0
100
200
300
400
500
600
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year

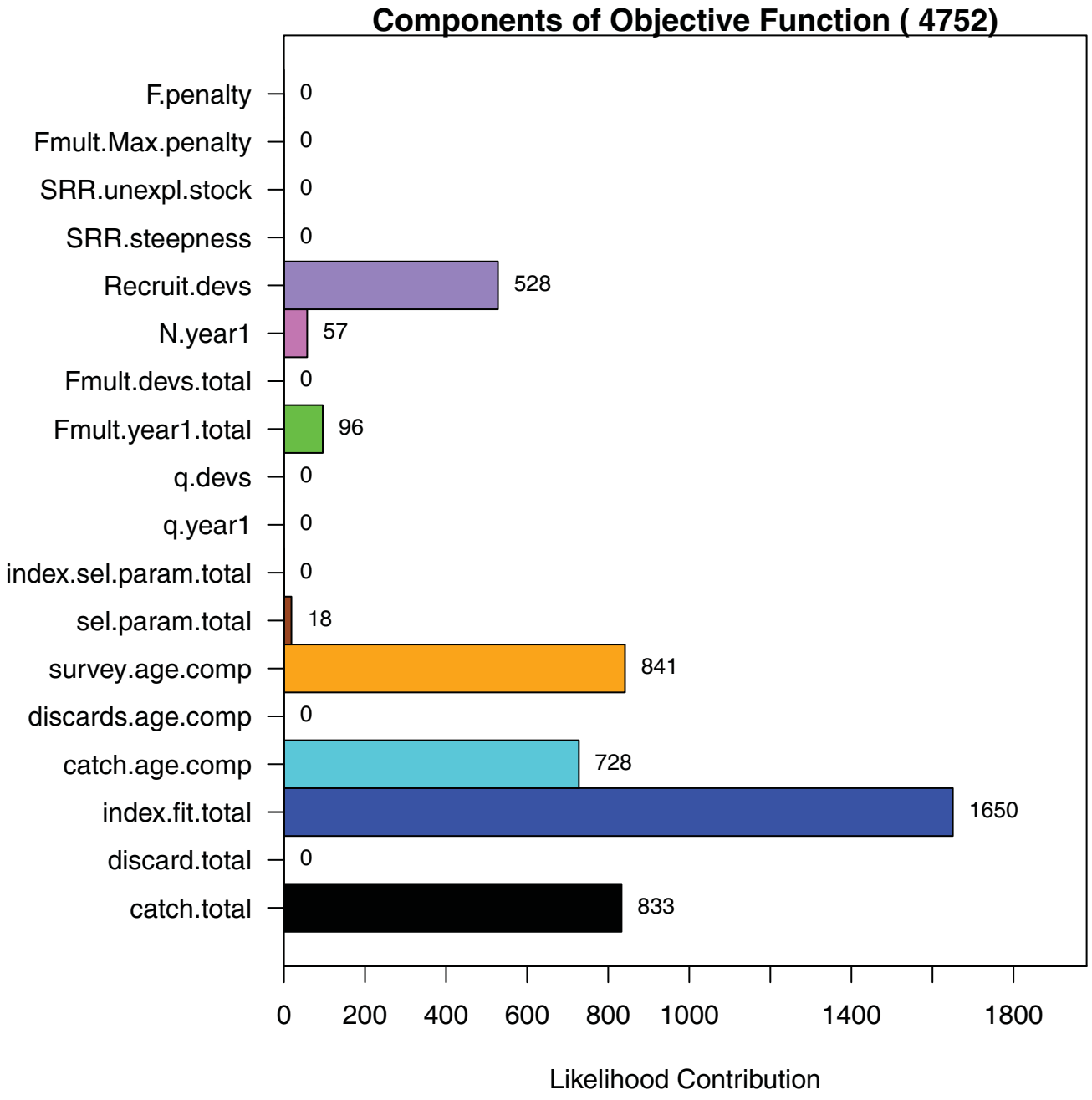
Appendix A4: North Model ASAP results M = 0.4 assuming Flat-top Selectivity in the Survey

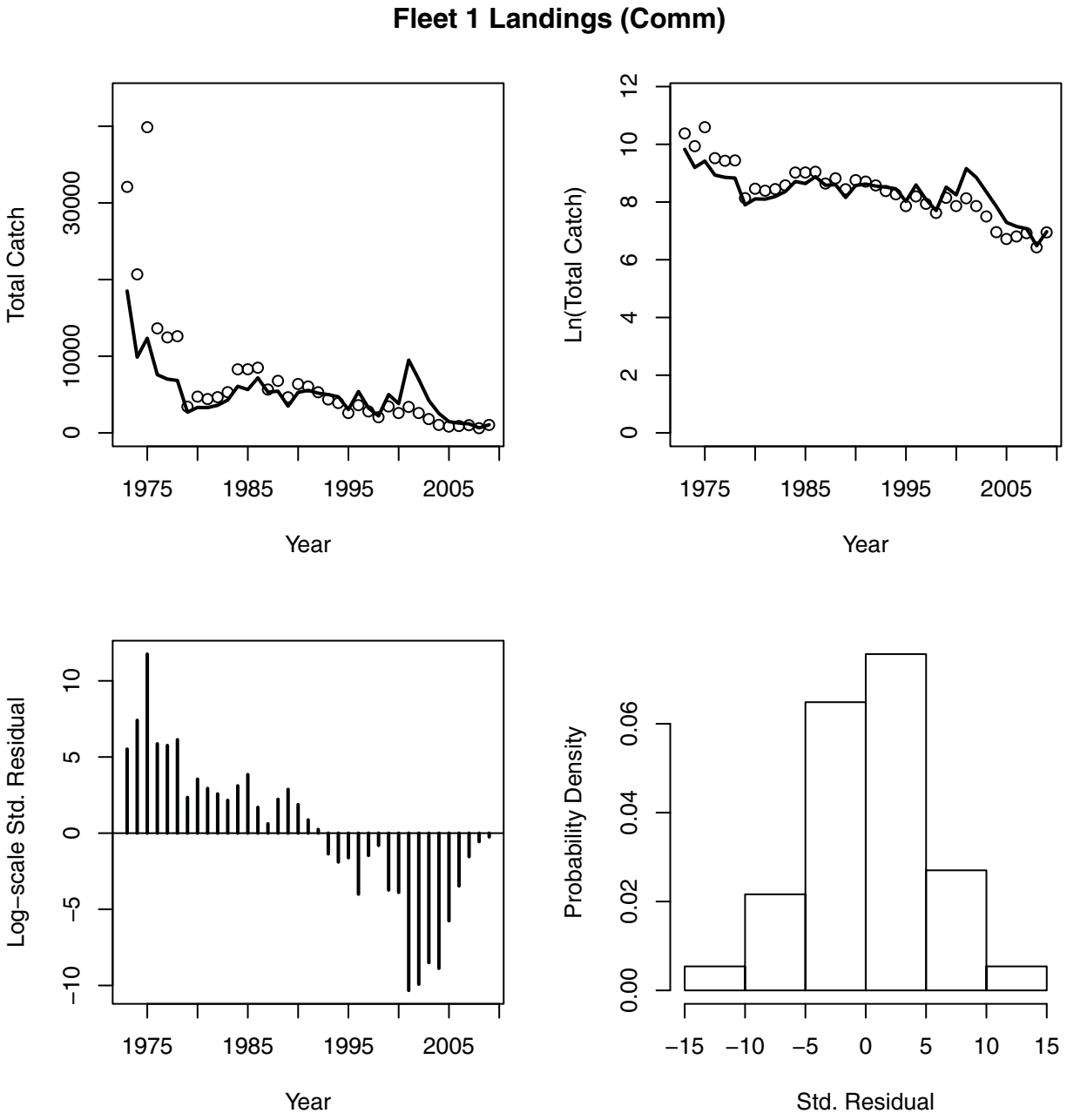
Model Attributes:

1. 3 Fleet Model
    a. Catch : 1973-2009
    b. Discards: 1981 – 2009
    c. Consumption – 1973-2009

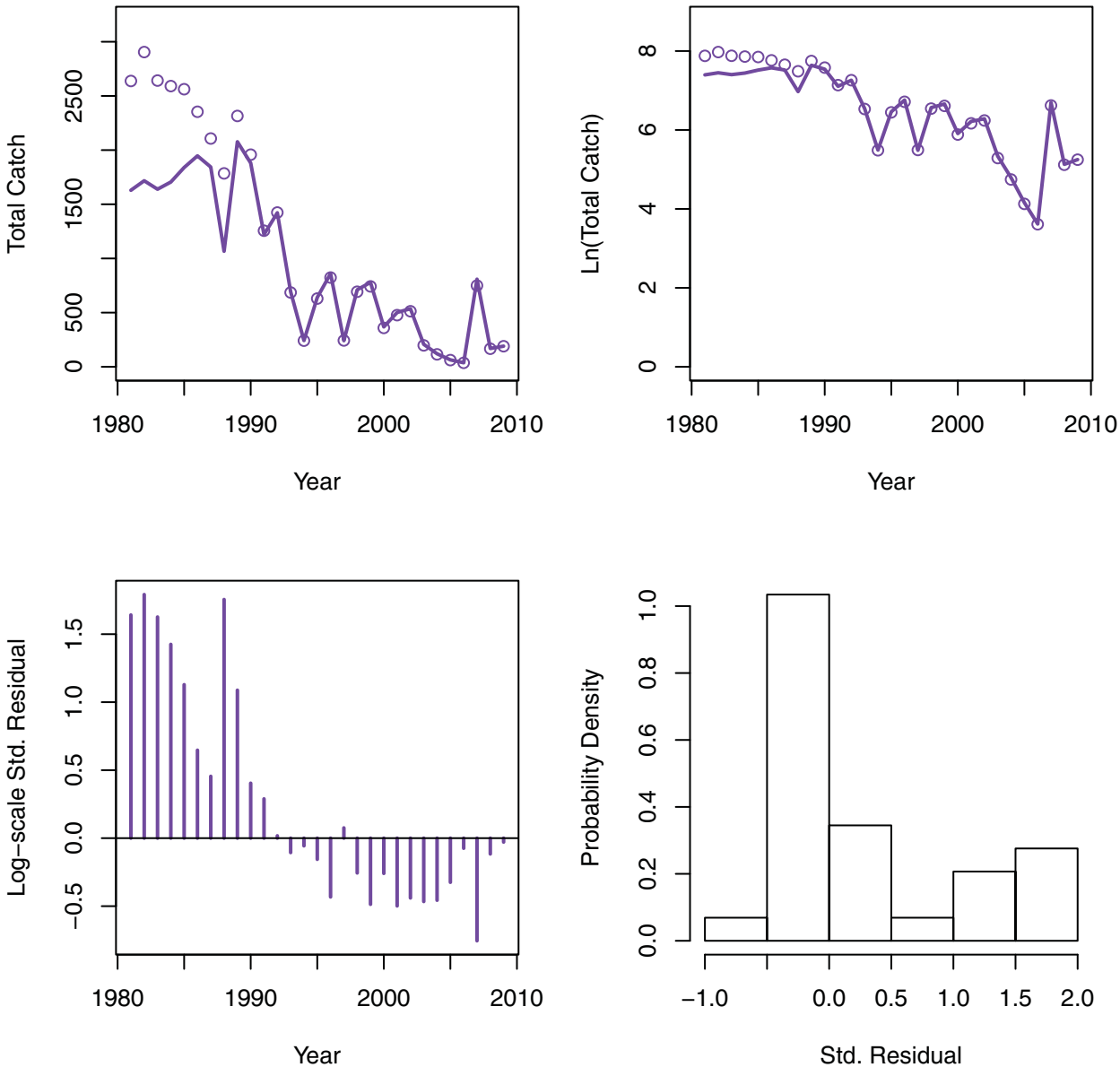
2. Fishery Selectivity (3 Block Selectivity)
    a. Landings (1 Blocks: 1973-2009)
    b. Discards (1 Block: 1981-2009)
    c. Consumption (Double Logistic Functional Form)

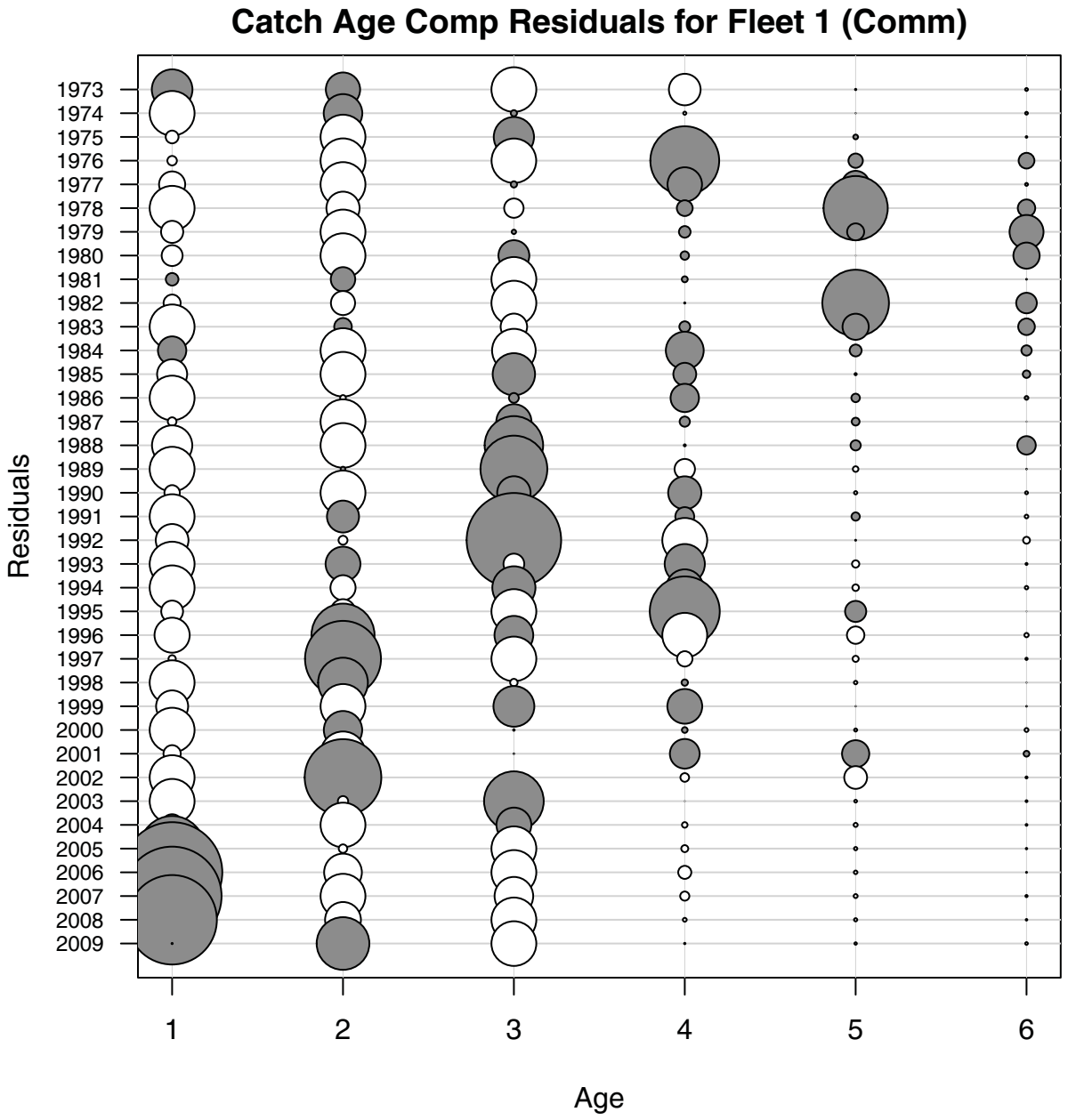
3. Survey Selectivity (Fixed 100% at age 2-6+)

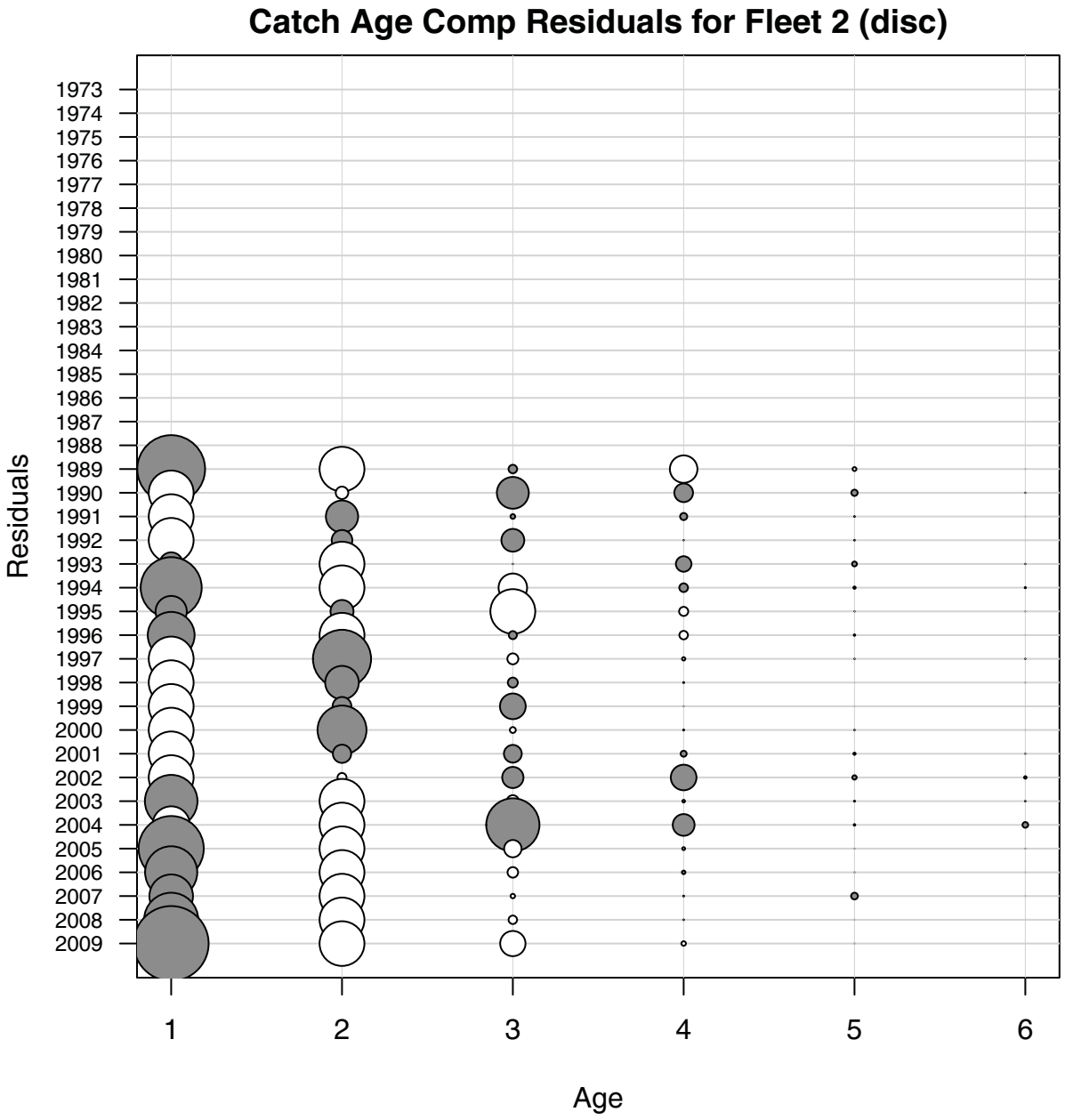

Components of Objective Function (4752)
F.penalty
Fmult.Max.penalty
SRR.unexpl.stock
SRR.steepness
Recruit.devs
N.year1
Fmult.devs.total
Fmult.year1.total
q.devs
q.year1
index.sel.param.total
sel.param.total
survey.age.comp
discards.age.comp
catch.age.comp
index.fit.total
discard.total
catch.total
0
0
0
0
528
57
0
96
0
0
0
18
841
0
728
1650
0
833
0
200
400
600
800
1000
1400
1800
Likelihood Contribution

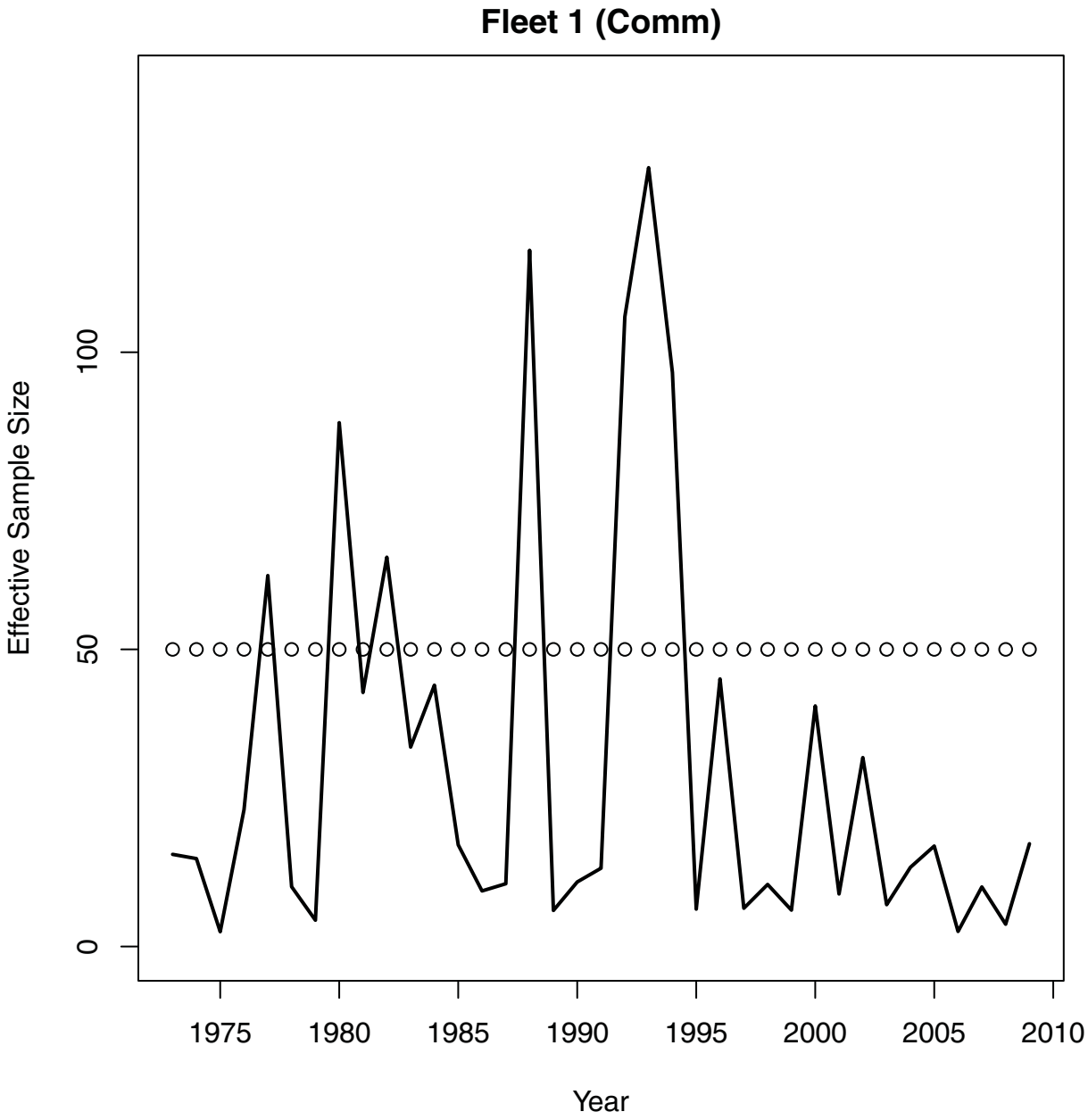

Fleet 1 Landings (Comm)
Total Catch
0
10000
30000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
−10
−5
0
5
10
1975
1985
1995
2005
Year
Probability Density
0.00
0.02
0.04
0.06
−15
−10
−5
0
5
10
15
Std. Residual

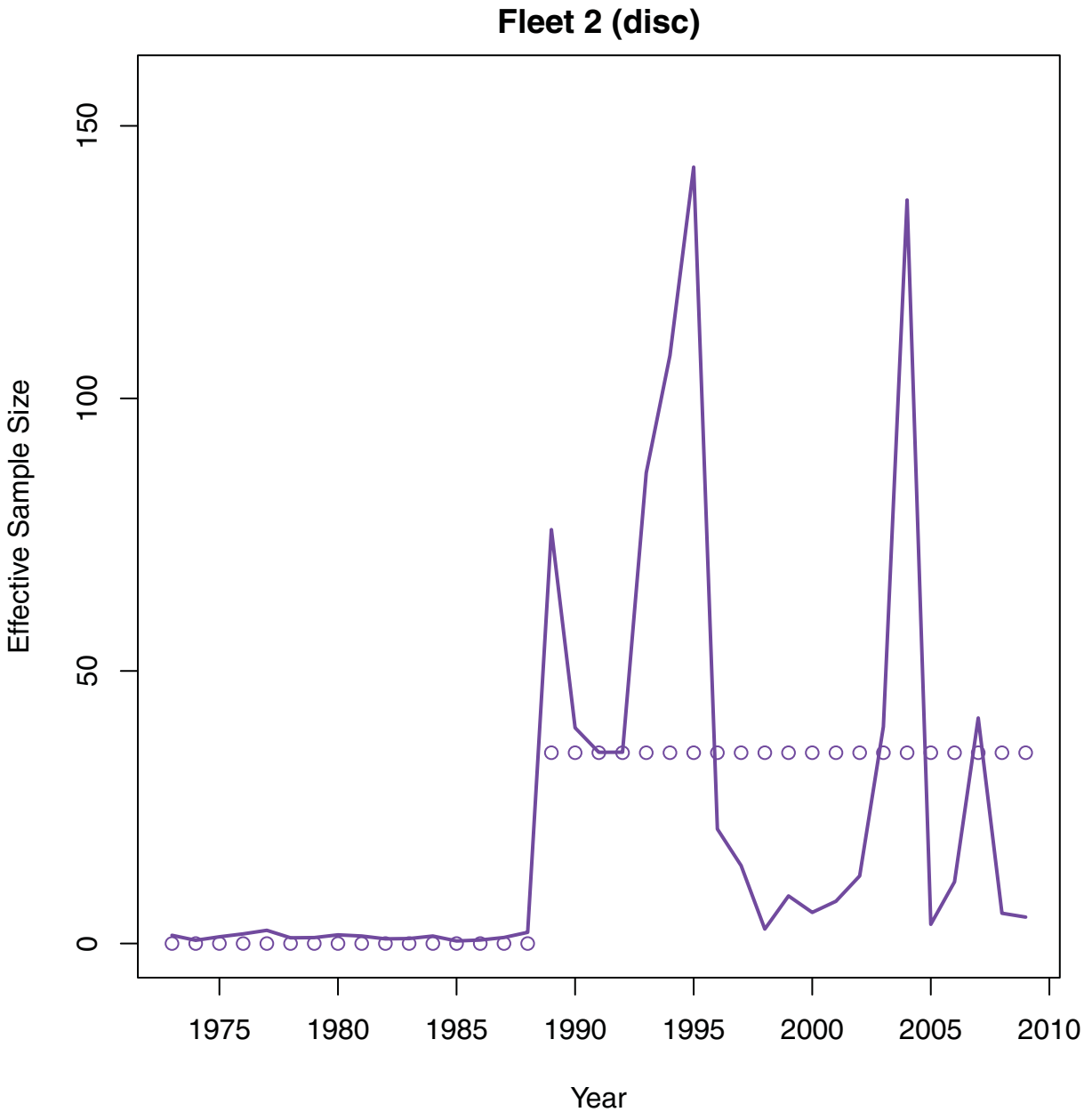
Fleet 2 Landings (disc)

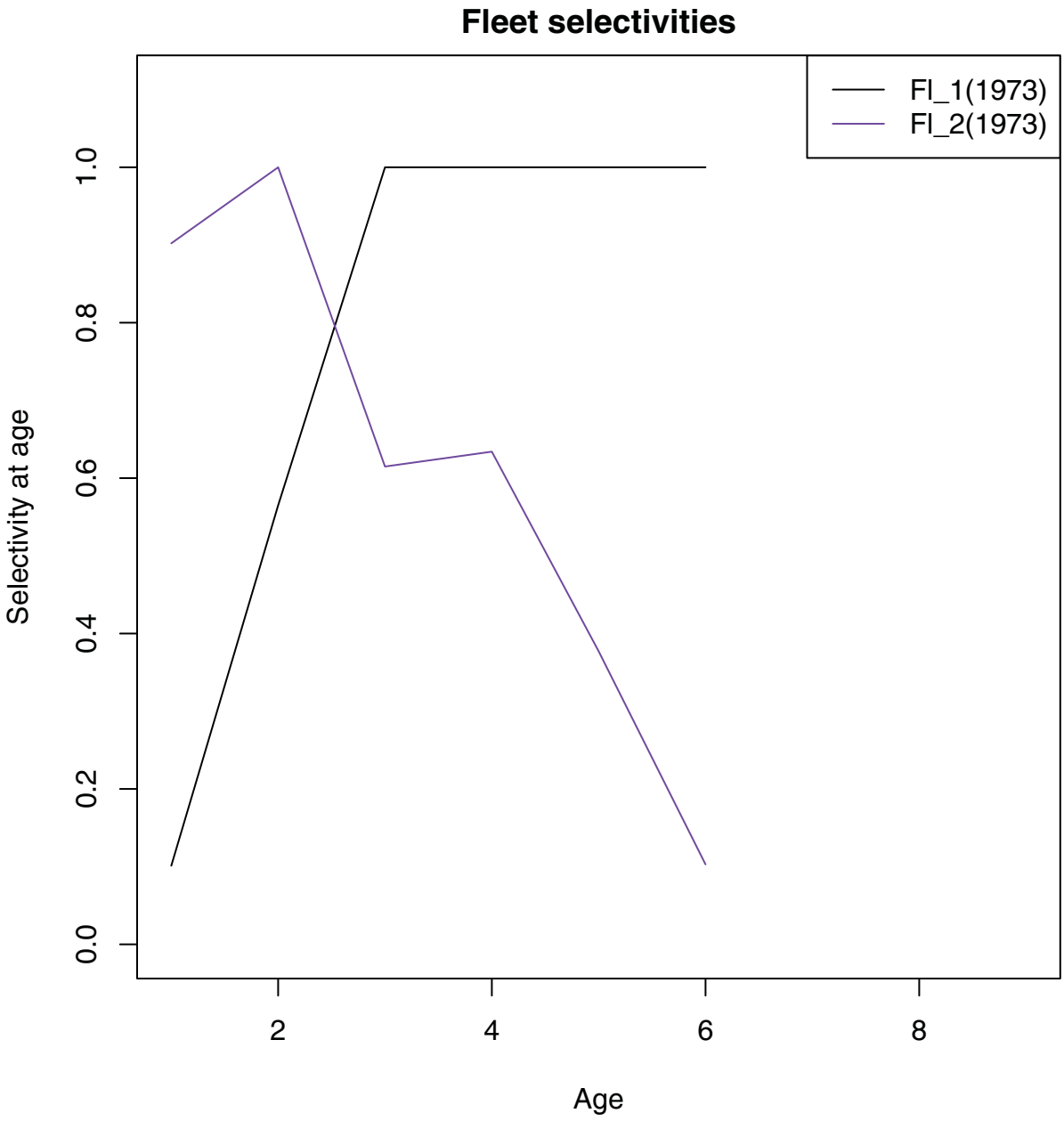



Catch Age Comp Residuals for Fleet 1 (Comm)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

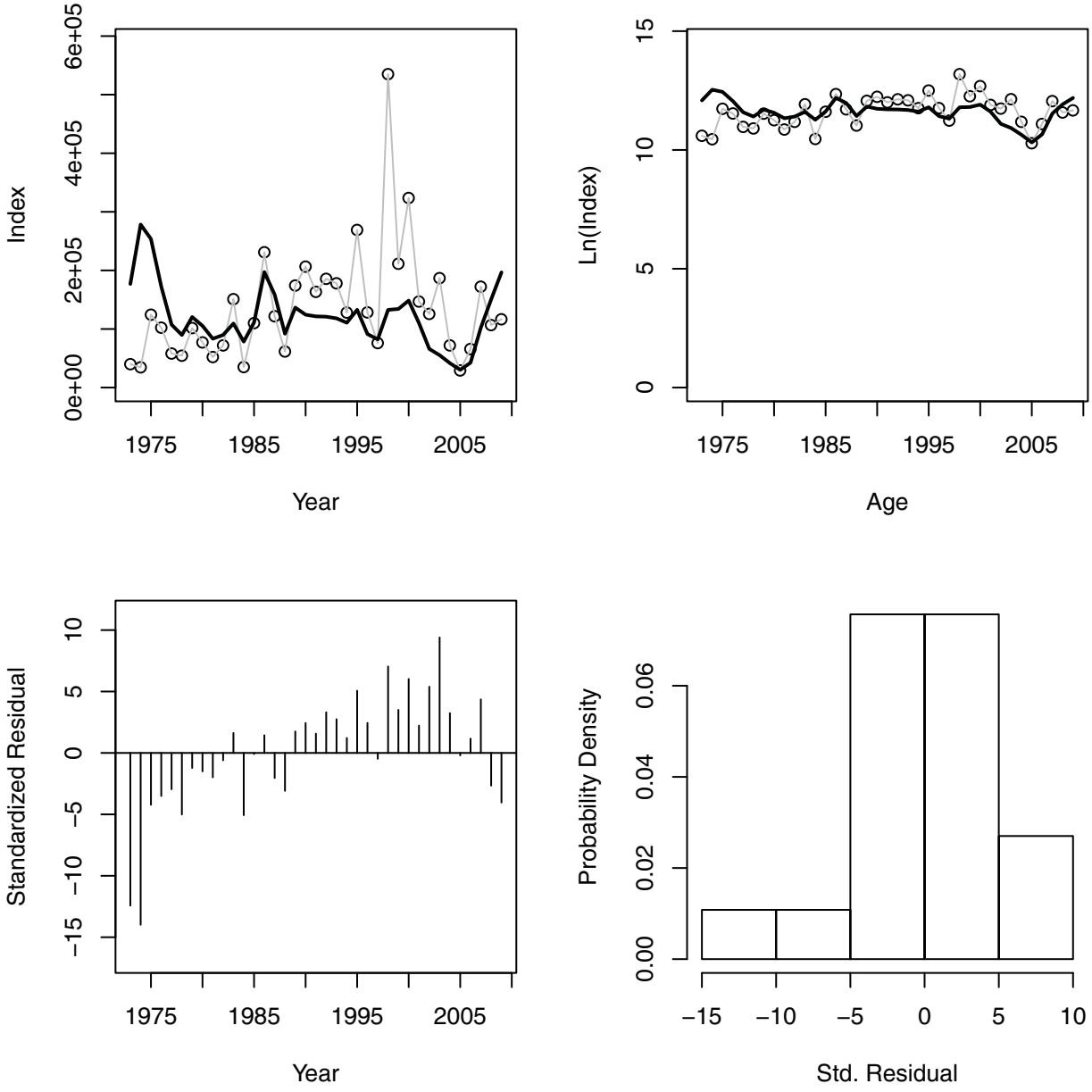

Catch Age Comp Residuals for Fleet 2 (disc)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Fleet 1 (Comm)
Effective Sample Size
0
50
100
1975
1980
1985
1990
1995
2000
2005
2010
Year

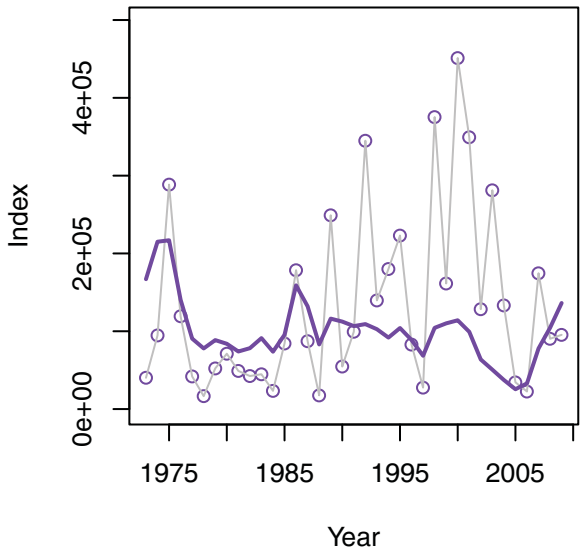

Fleet 2 (disc)
Effective Sample Size
0
50
100
150
1975
1980
1985
1990
1995
2000
2005
2010
Year

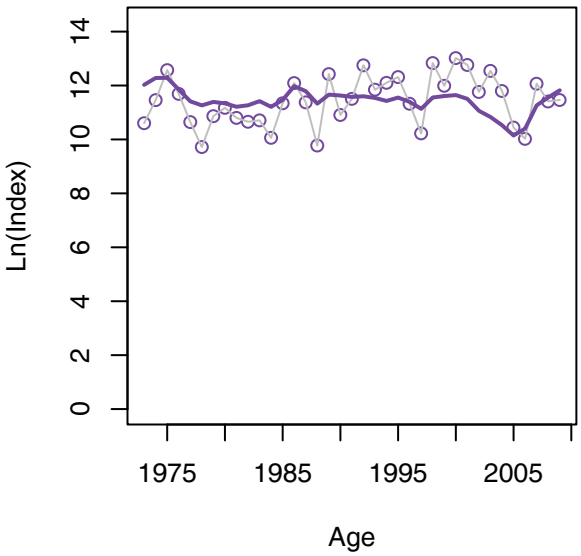

Fleet selectivities
Fl_1(1973)
Fl_2(1973)
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

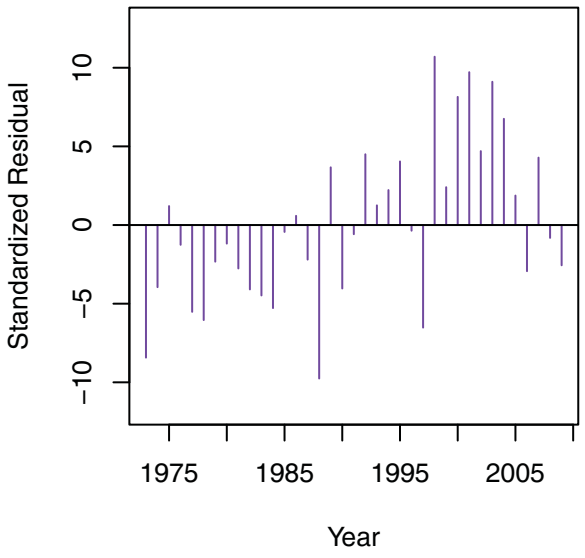
Index 1

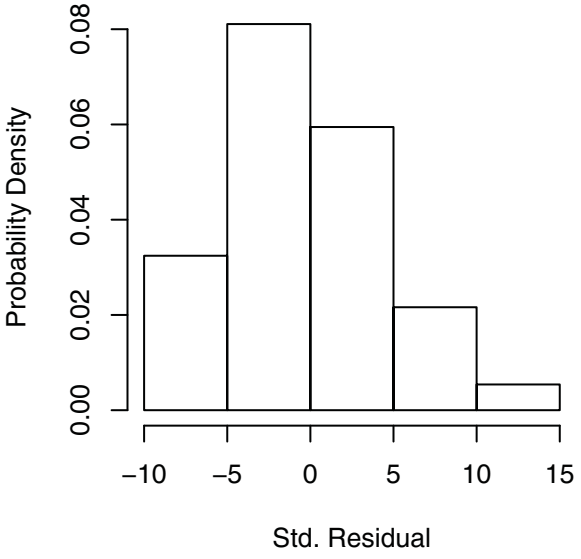

Index
0e+00
2e+05
4e+05
6e+05
1975
1985
1995
2005
Year
Ln(Index)
0
5
10
15
1975
1985
1995
2005
Age
Standardized Residual
−15
−10
−5
0
5
10
1975
1985
1995
2005
Year
Probability Density
0.00
0.02
0.04
0.06
−15
−10
−5
0
5
10
Std. Residual

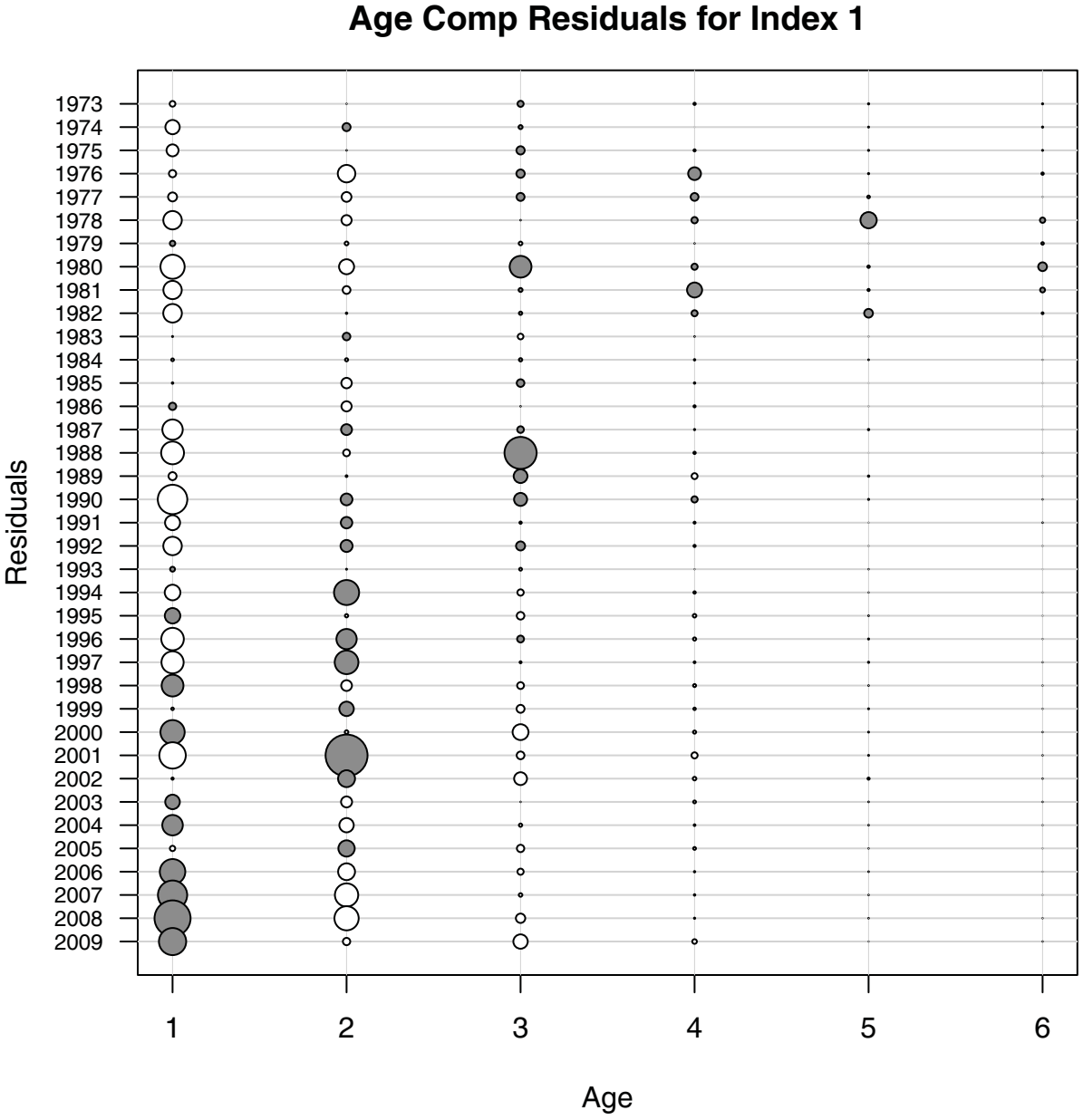
Index 2

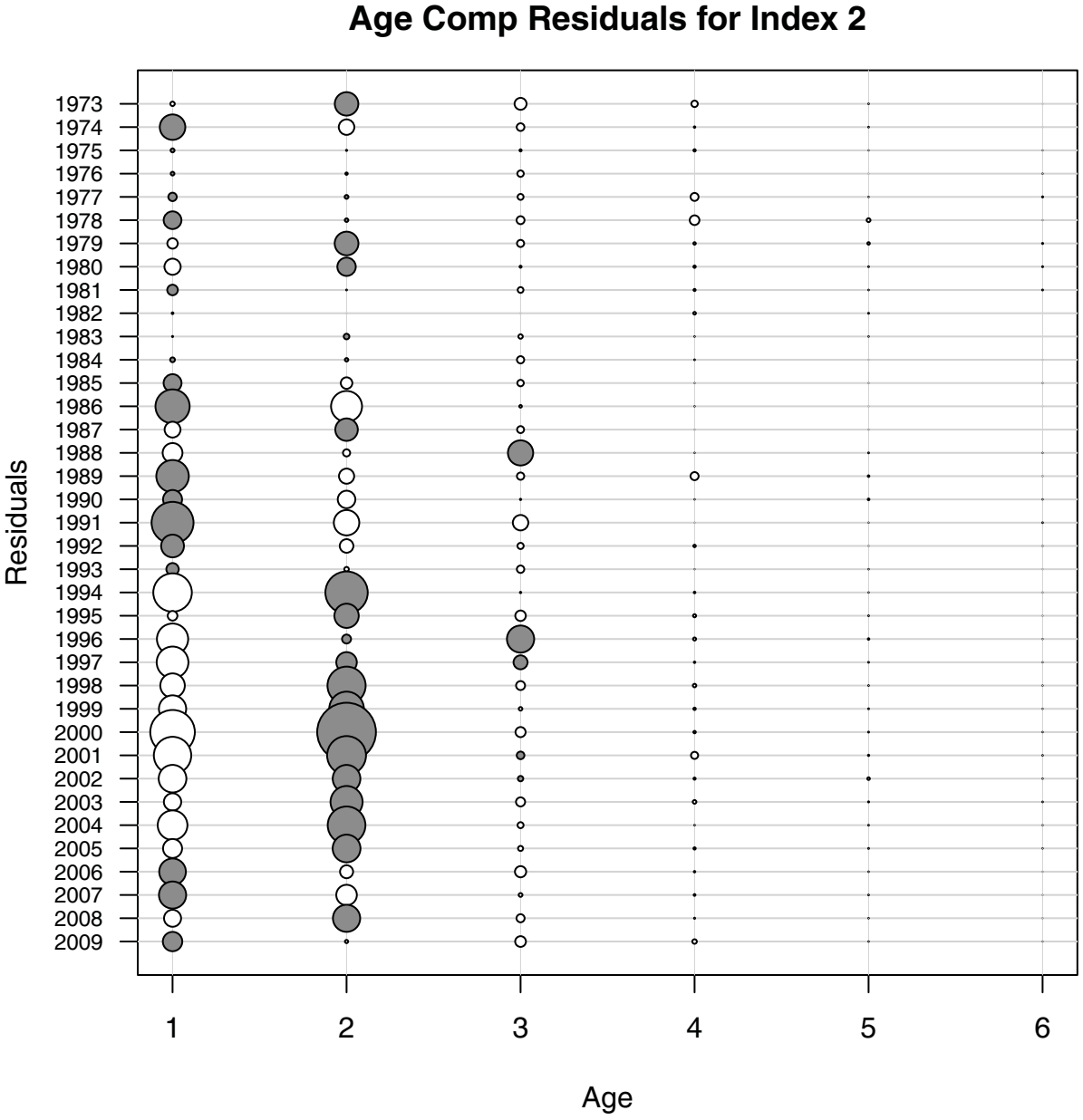

Index
0e+00
2e+05
4e+05
1975
1985
1995
2005
Year

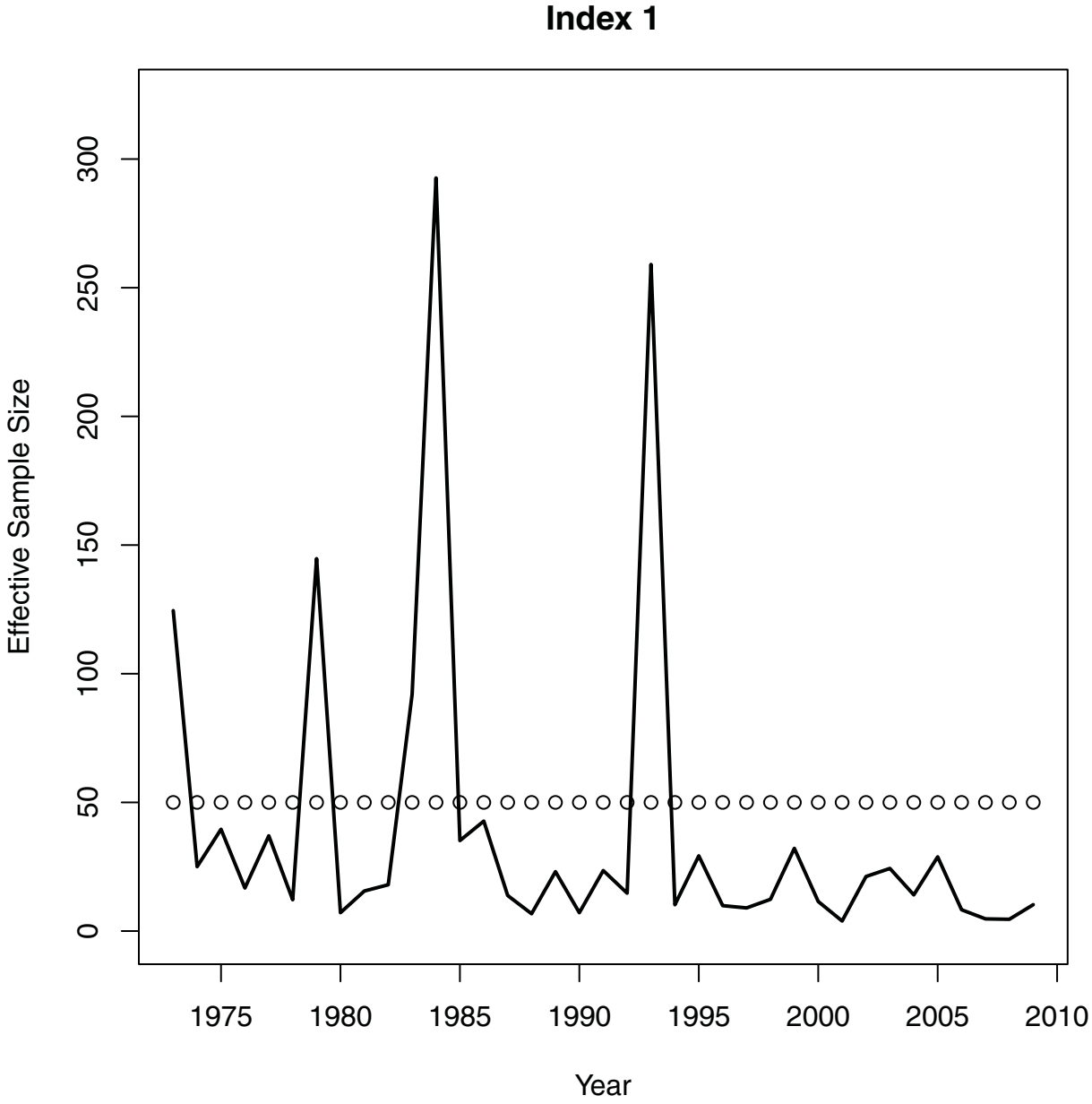

Ln(Index)
0
2
4
6
8
10
12
14
1975
1985
1995
2005
Age

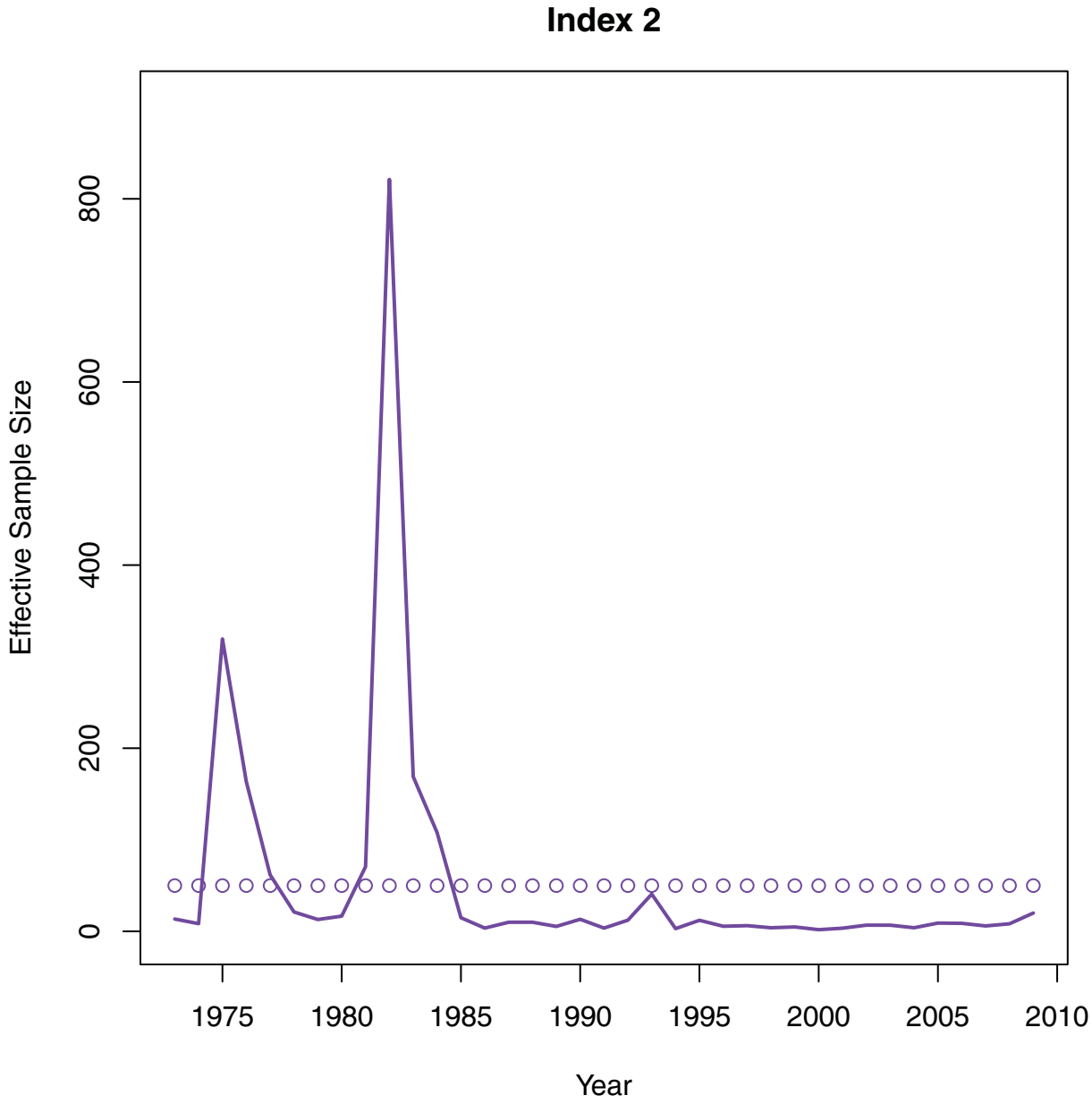

Standardized Residual
−10
−5
0
5
10
1975
1985
1995
2005
Year

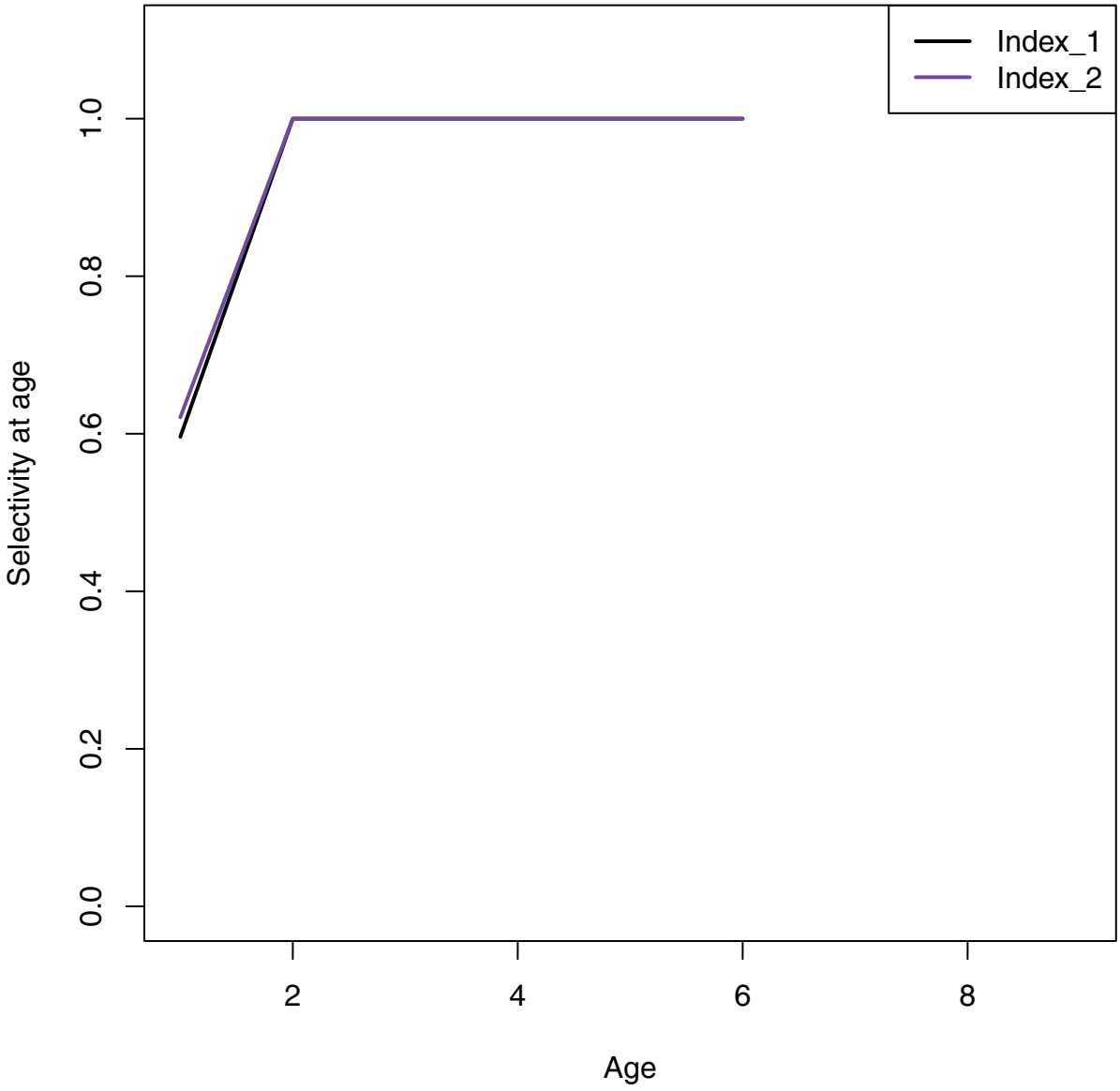

Probability Density
0.00
0.02
0.04
0.06
0.08
−10
−5
0
5
10
15
Std. Residual

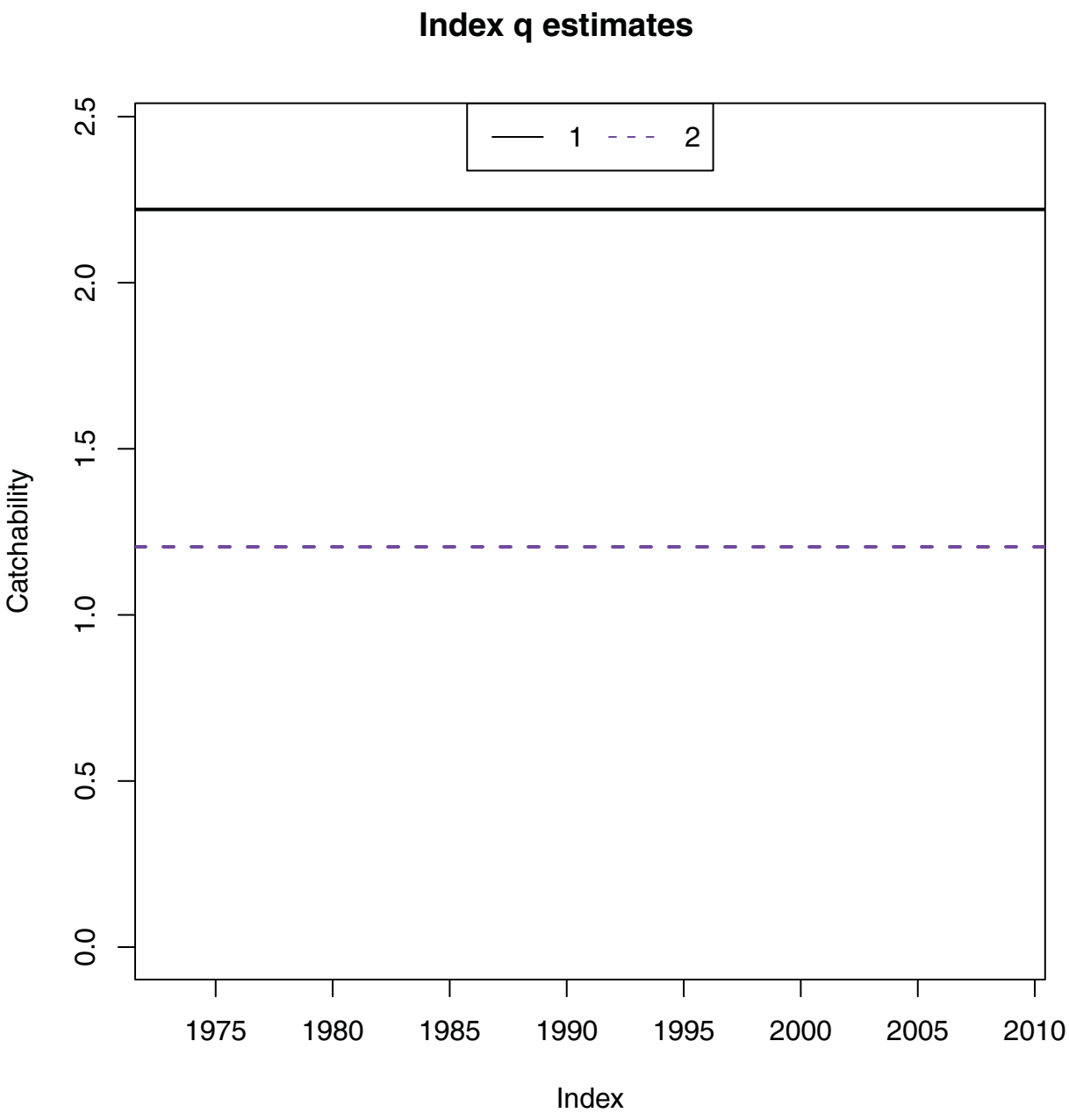

Age Comp Residuals for Index 1
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

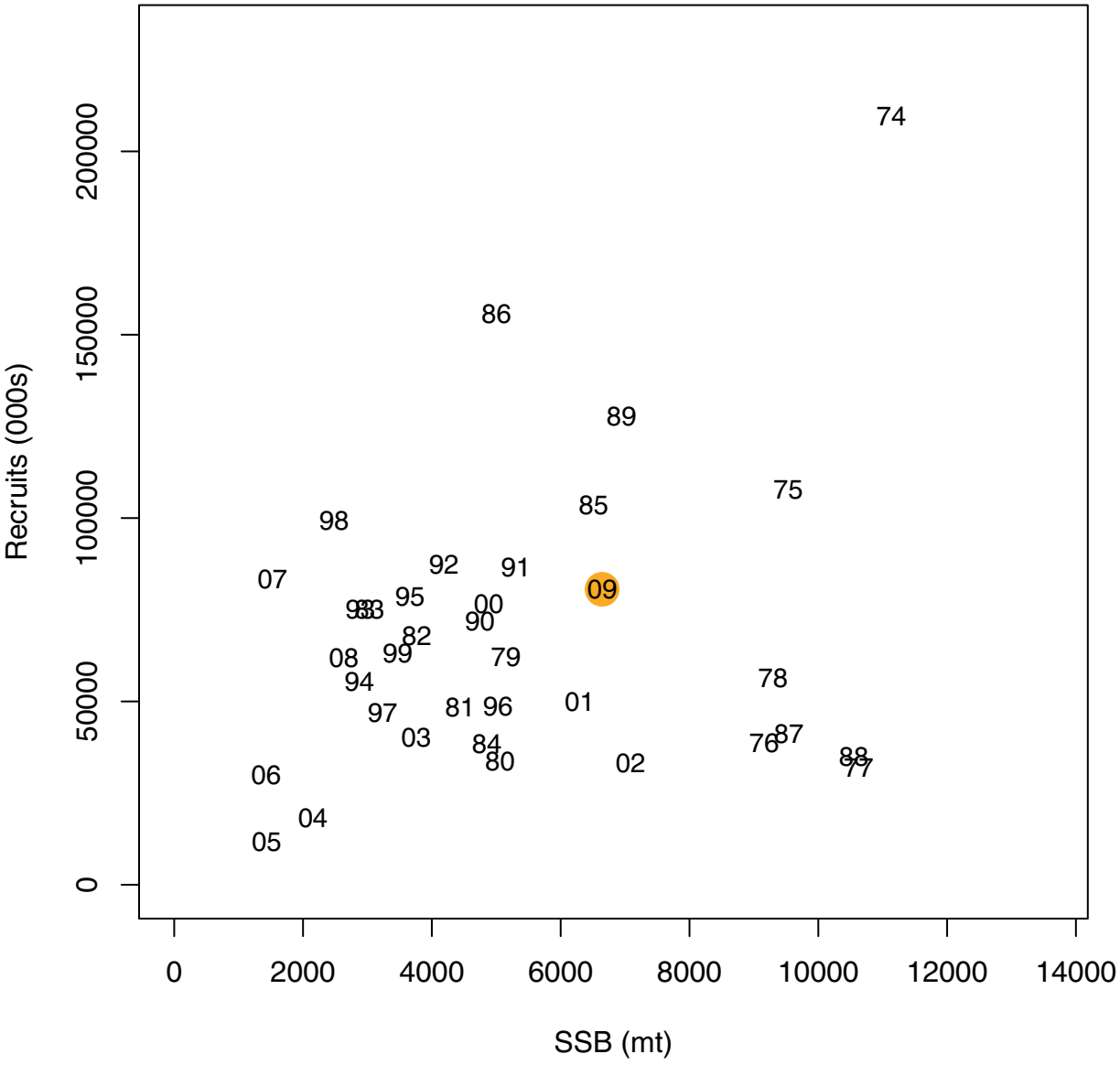

Age Comp Residuals for Index 2
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

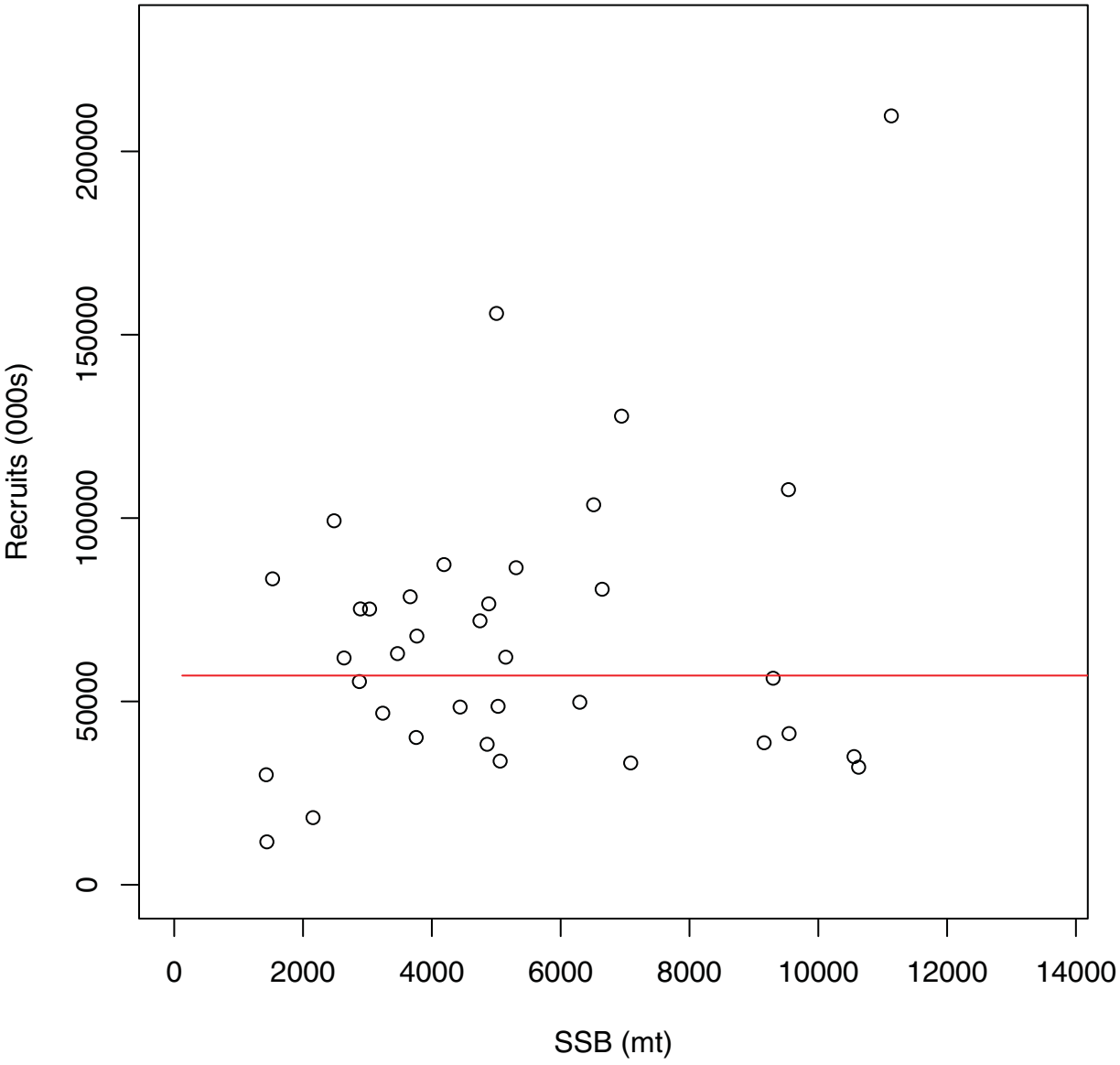

Index 1
Effective Sample Size
0
50
100
150
200
250
300
1975
1980
1985
1990
1995
2000
2005
2010
Year

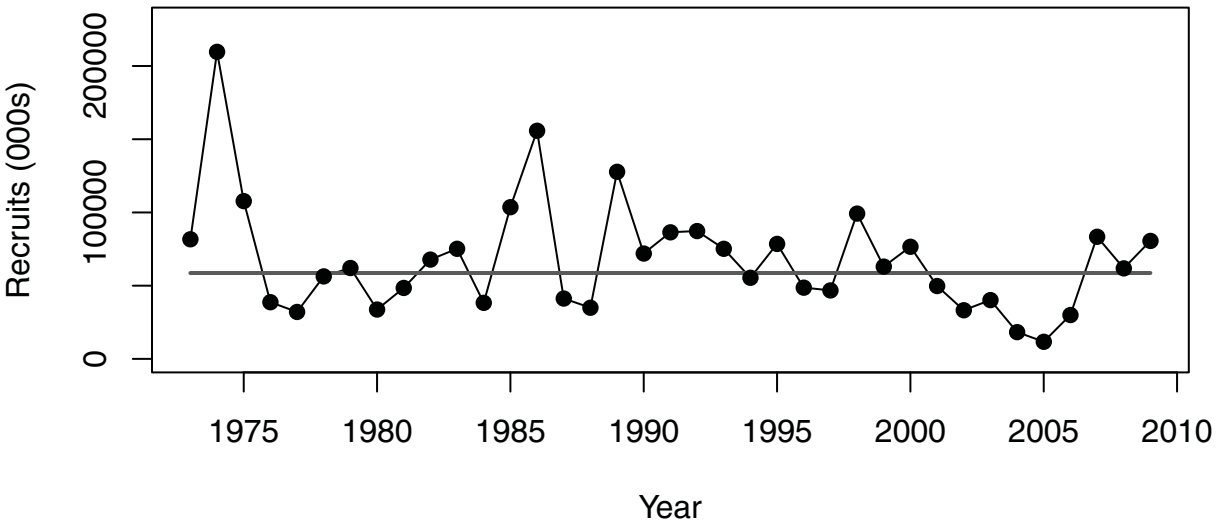

Index 2
Effective Sample Size
0
200
400
600
800
1975
1980
1985
1990
1995
2000
2005
2010
Year

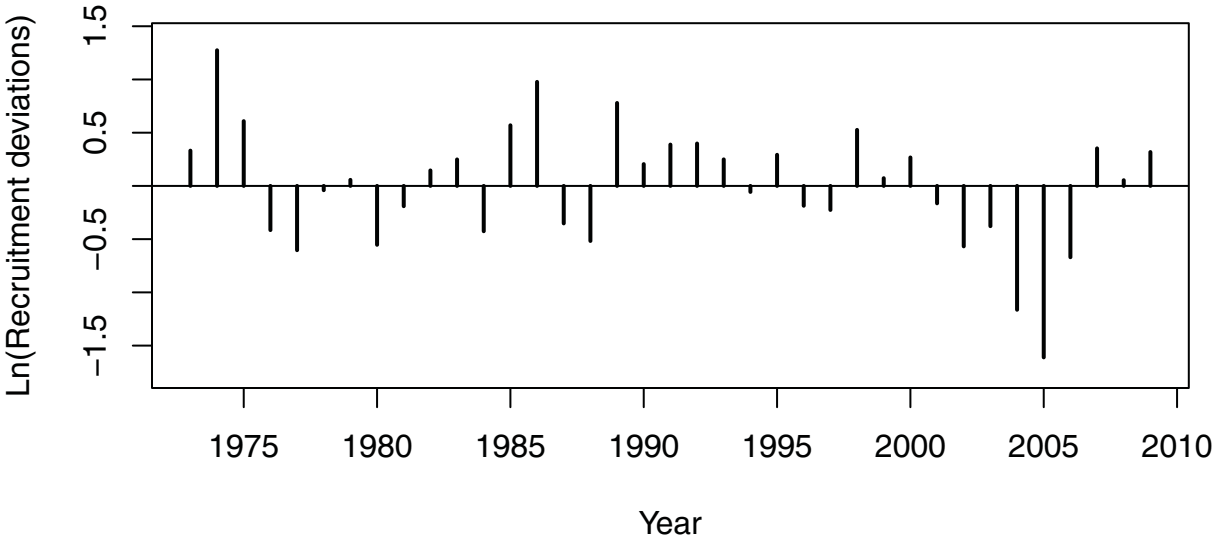

Index_1
Index_2
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

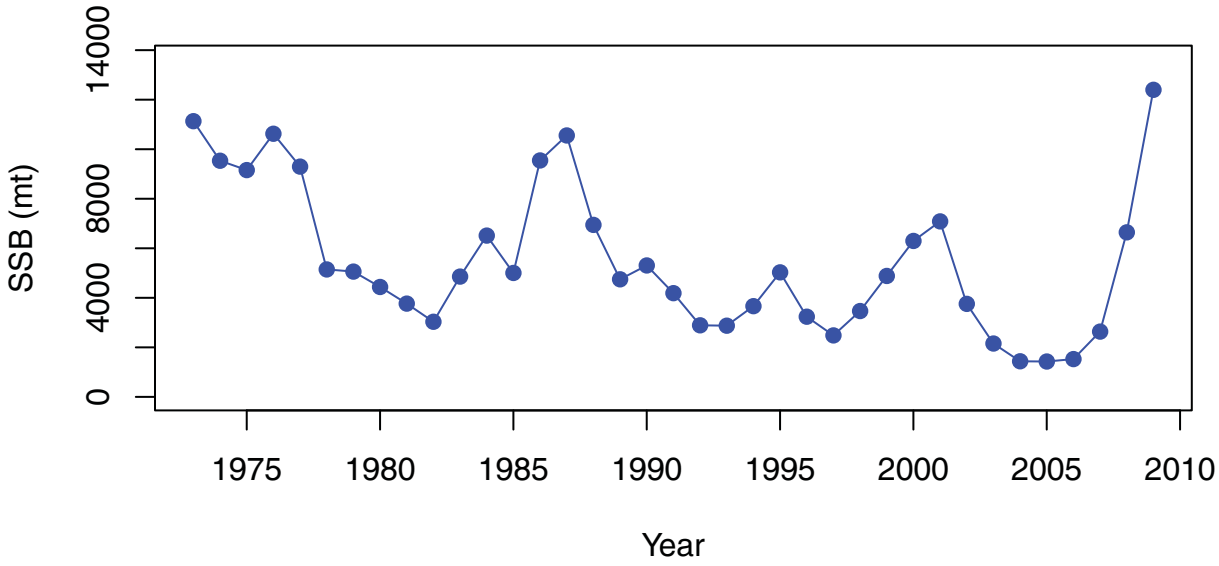

Index q estimates
1
2
Catchability
0.0
0.5
1.0
1.5
2.0
2.5
1975
1980
1985
1990
1995
2000
2005
2010
Index

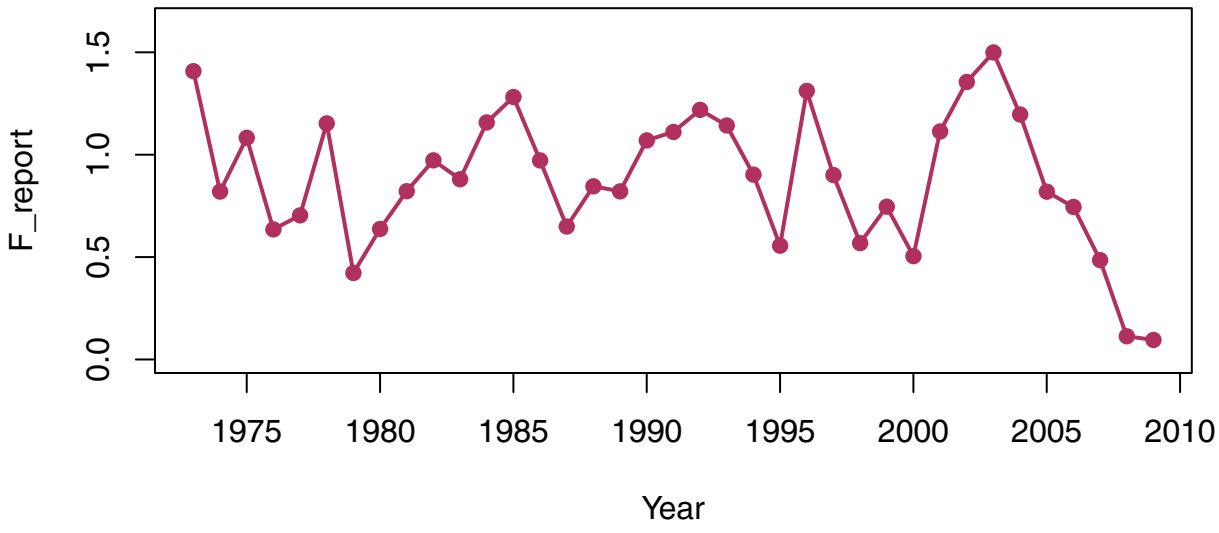

Recruits (000s)
0
50000
100000
150000
200000
SSB (mt)
0
2000
4000
6000
8000
10000
12000
14000
74
86
89
75
85
98
92
91
07
09
95
00
90
82
08
99
79
94
78
97
81
96
01
03
84
87
76
80
02
06
04
05

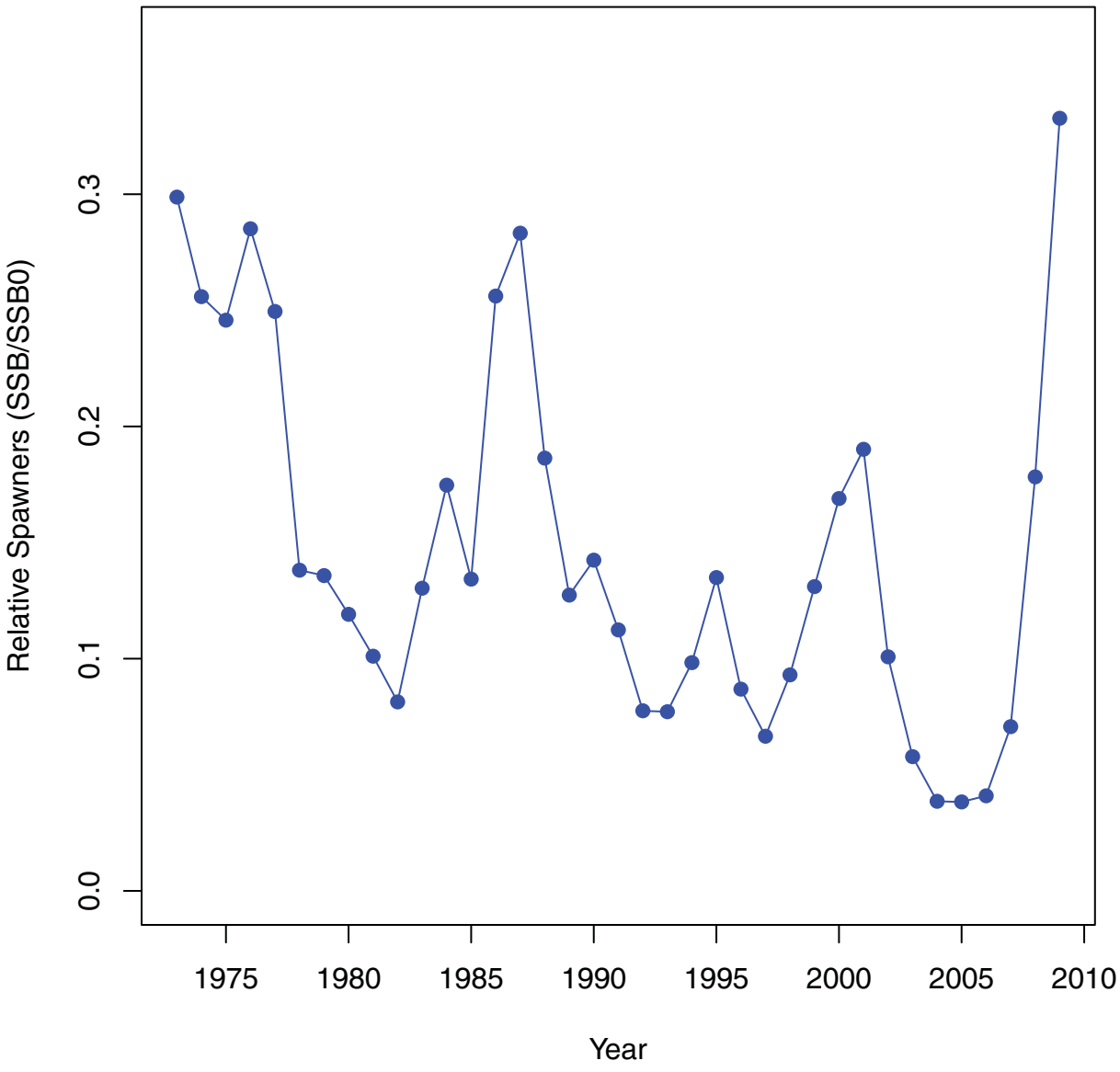

Recruits (000s)
0
50000
100000
150000
200000
0
2000
4000
6000
8000
10000
12000
14000
SSB (mt)

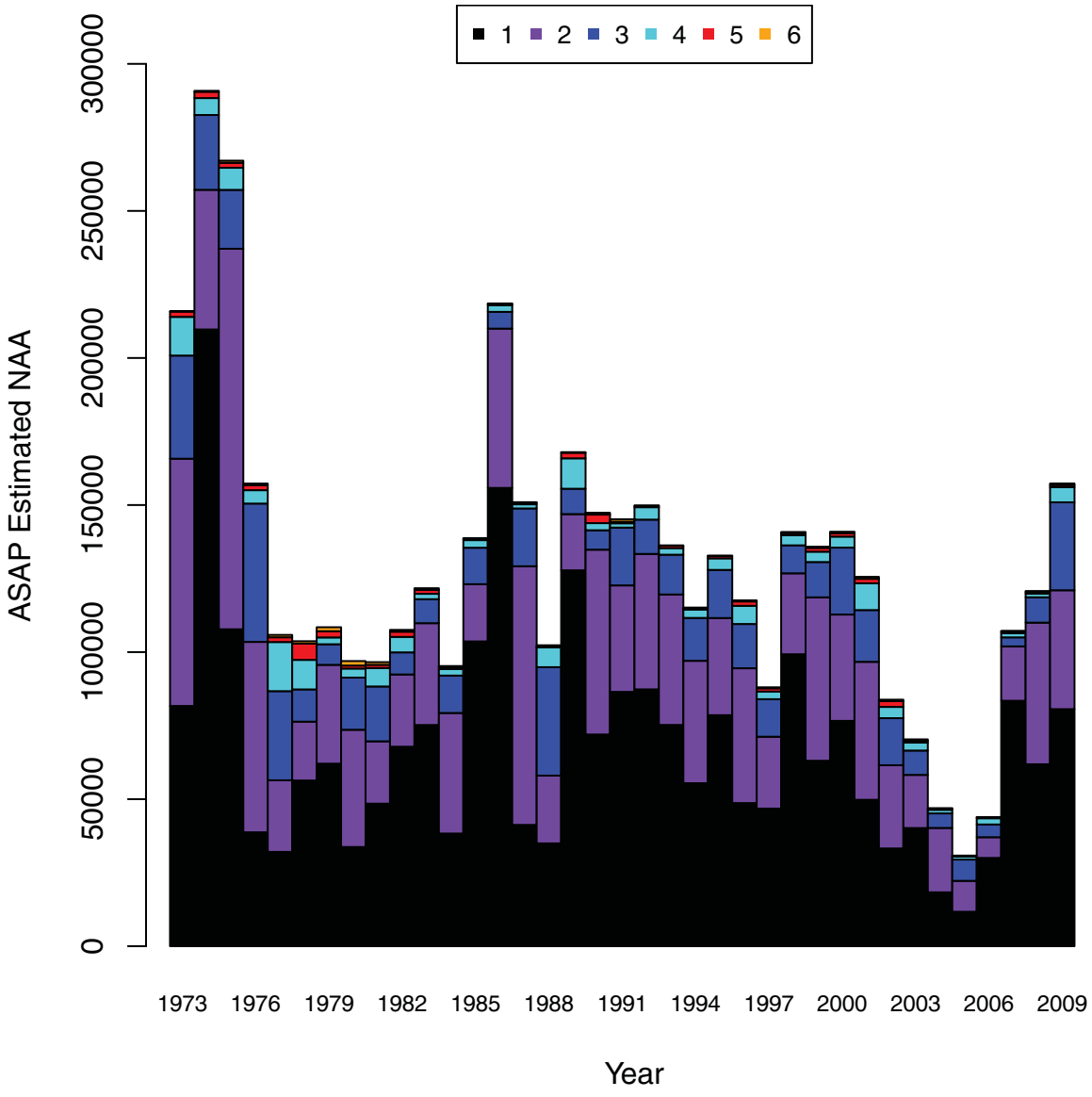

Recruits (000s)
0
100000
200000
1975
1980
1985
1990
1995
2000
2005
2010
Year

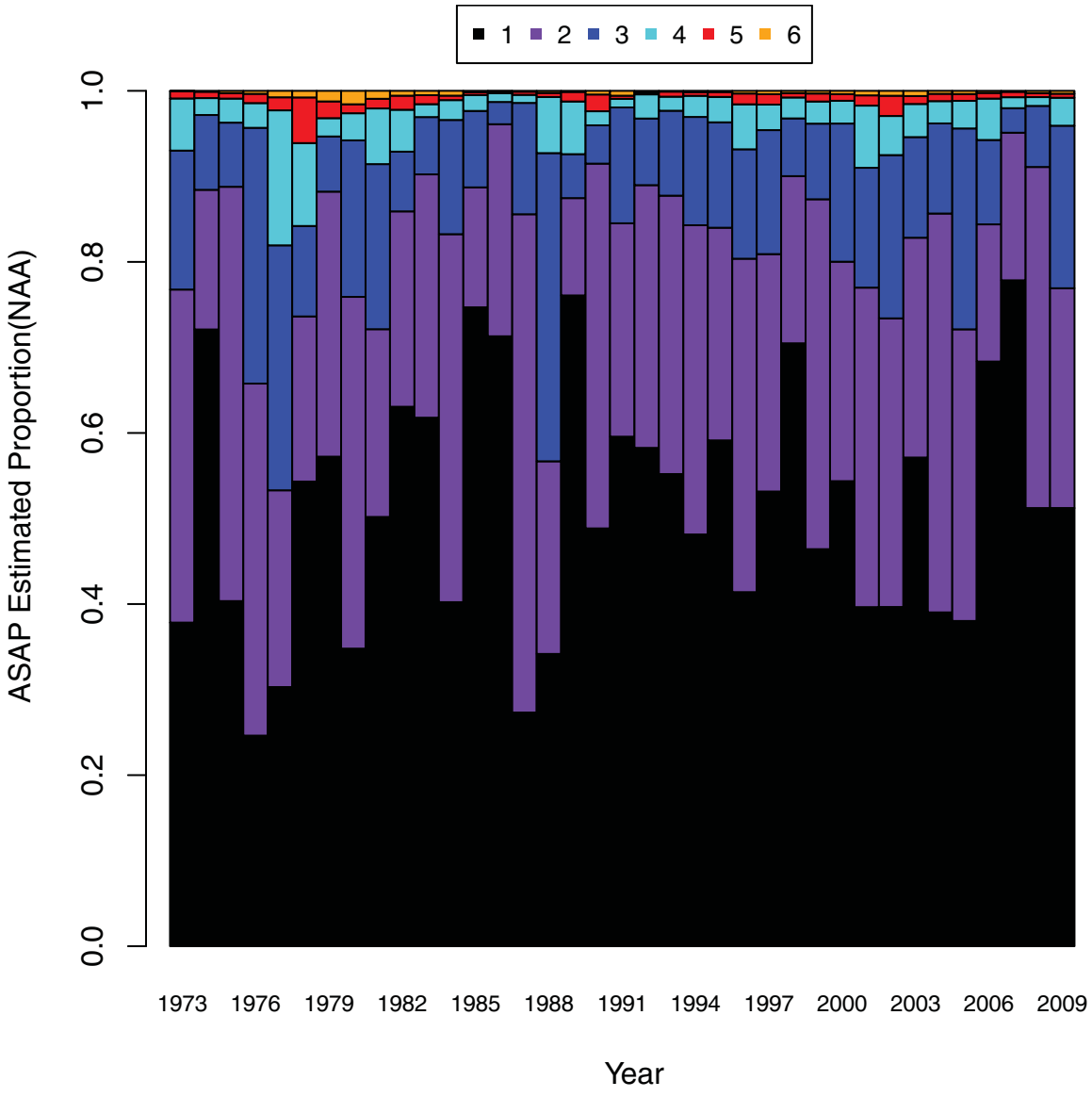

Ln(Recruitment deviations)
−1.5
−0.5
0.5
1.5
1975
1980
1985
1990
1995
2000
2005
2010
Year

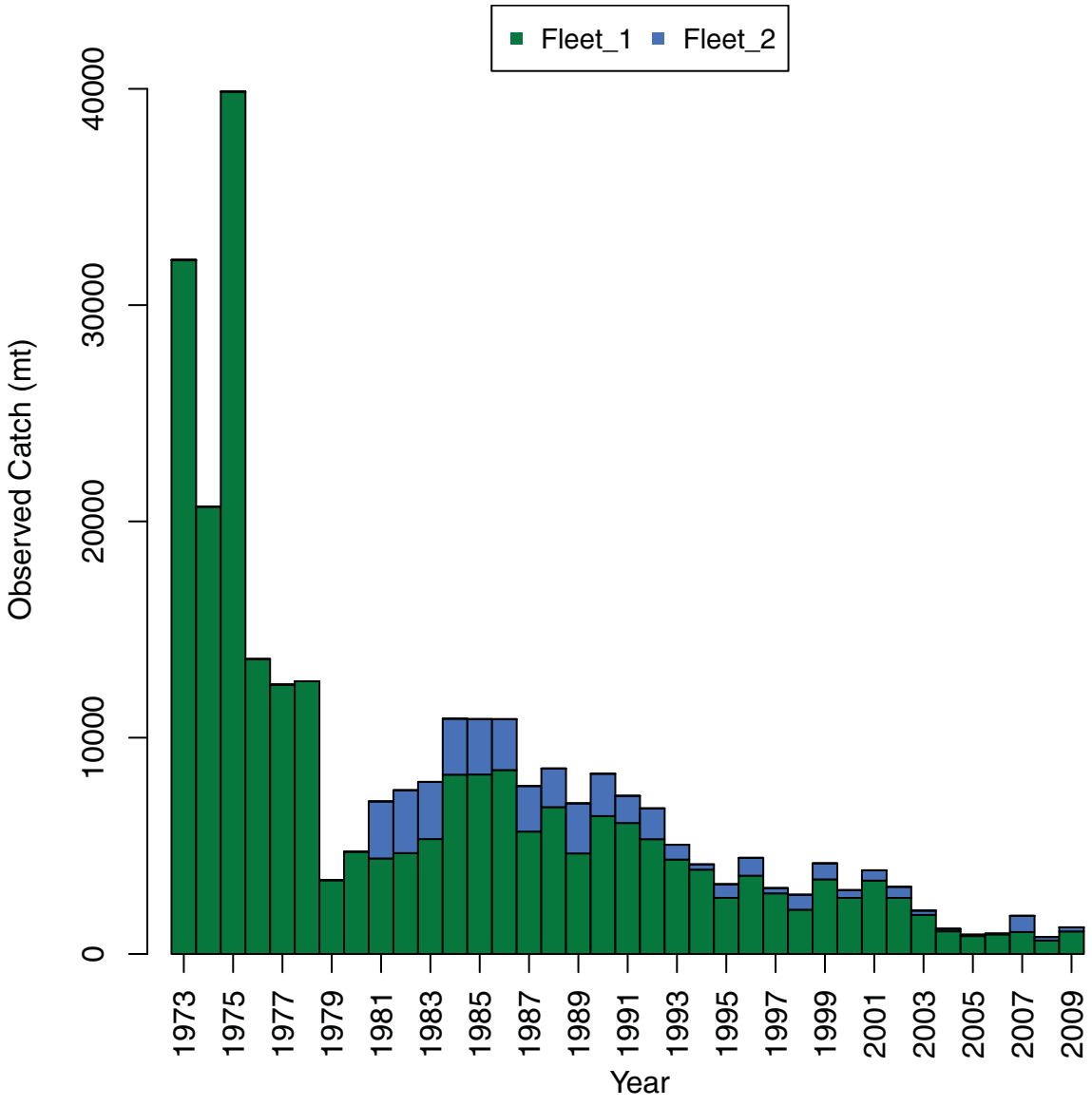

SSB (mt)
0
4000
8000
14000
1975
1980
1985
1990
1995
2000
2005
2010
Year

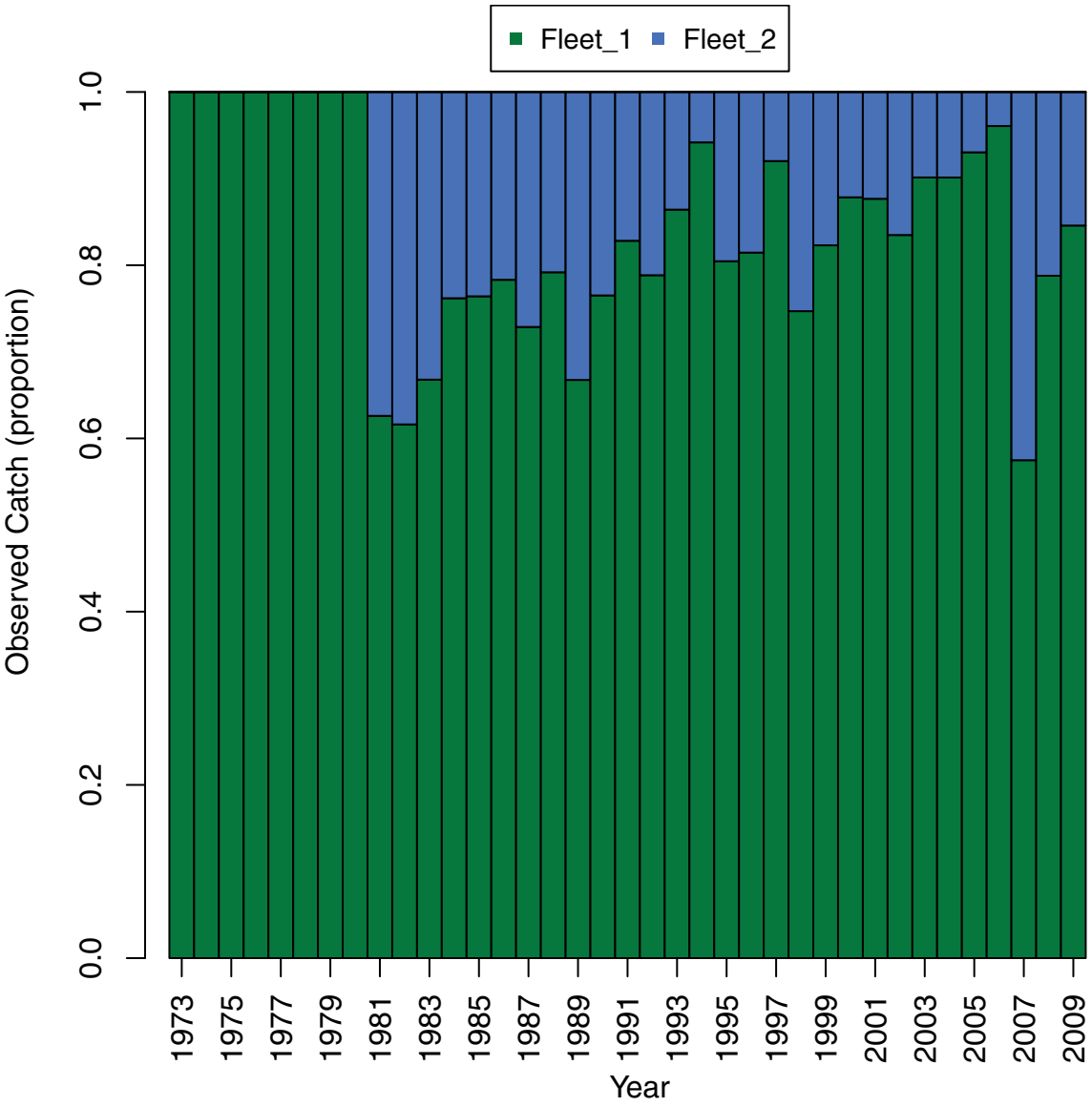

F_report
0.0
0.5
1.0
1.5
1975
1980
1985
1990
1995
2000
2005
2010
Year

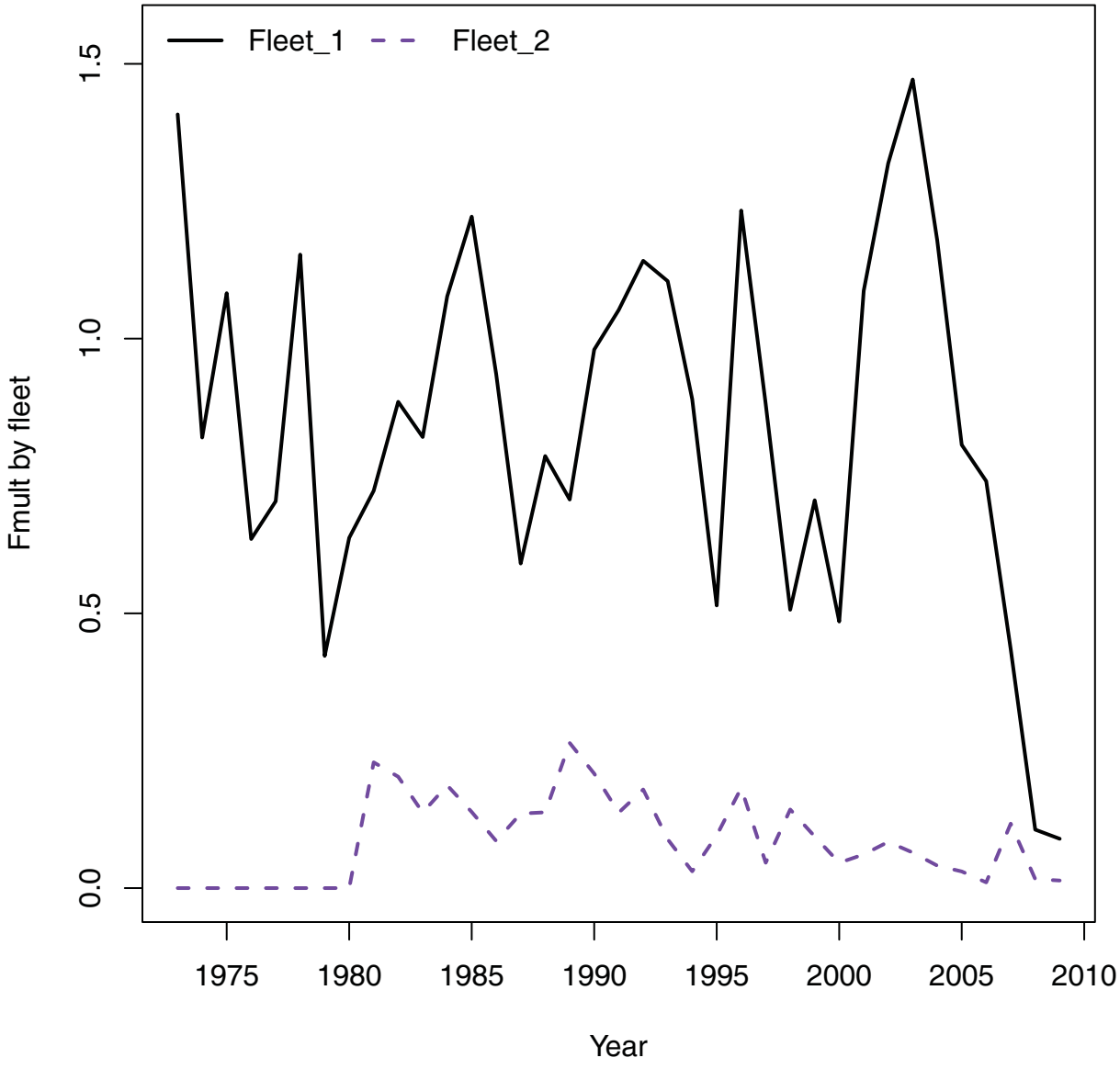

Relative Spawners (SSB/SSB0)
0.0
0.1
0.2
0.3
1975
1980
1985
1990
1995
2000
2005
2010
Year

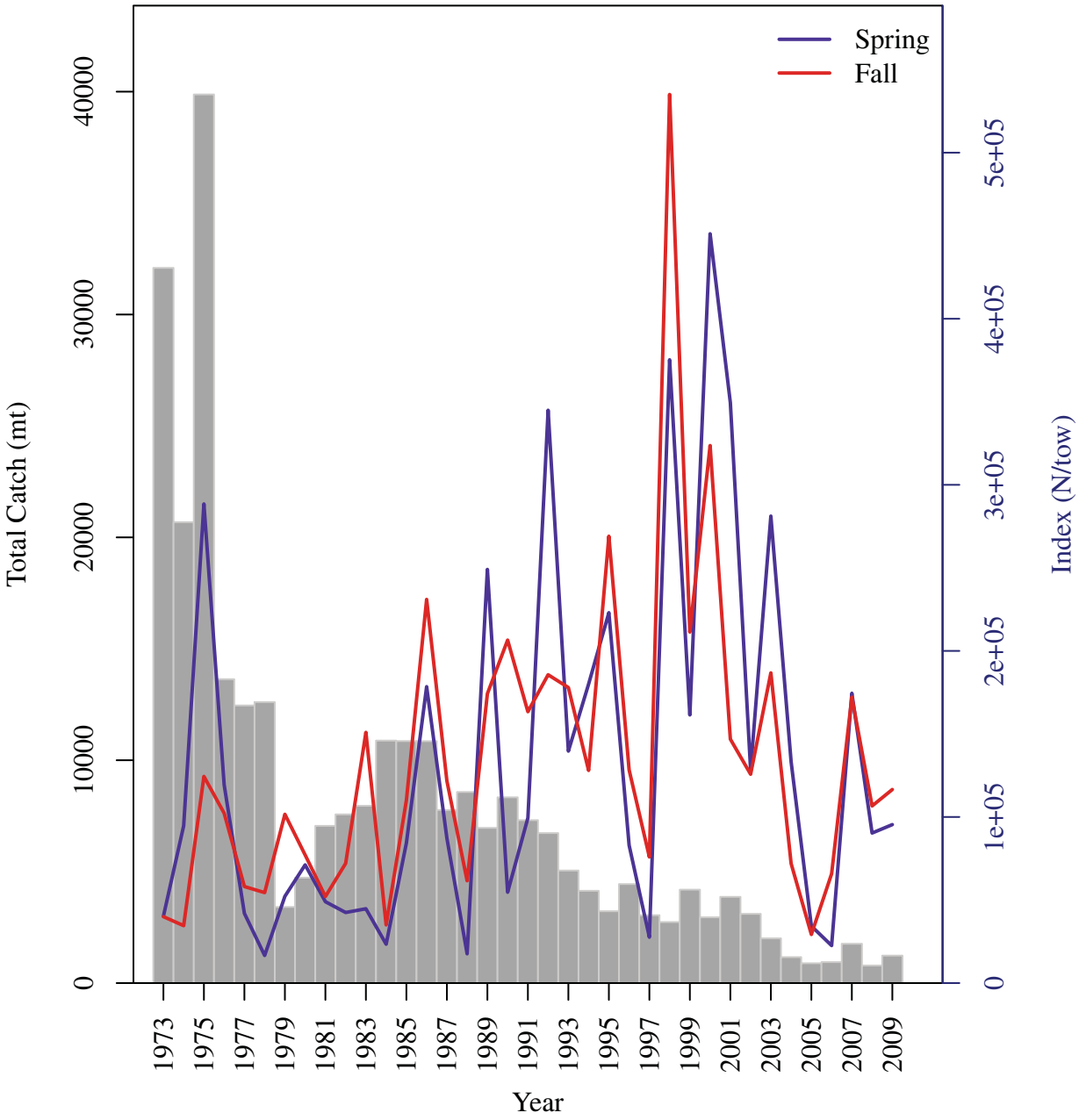

1
2
3
4
5
6
ASAP Estimated NAA
0
50000
100000
150000
200000
250000
300000
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

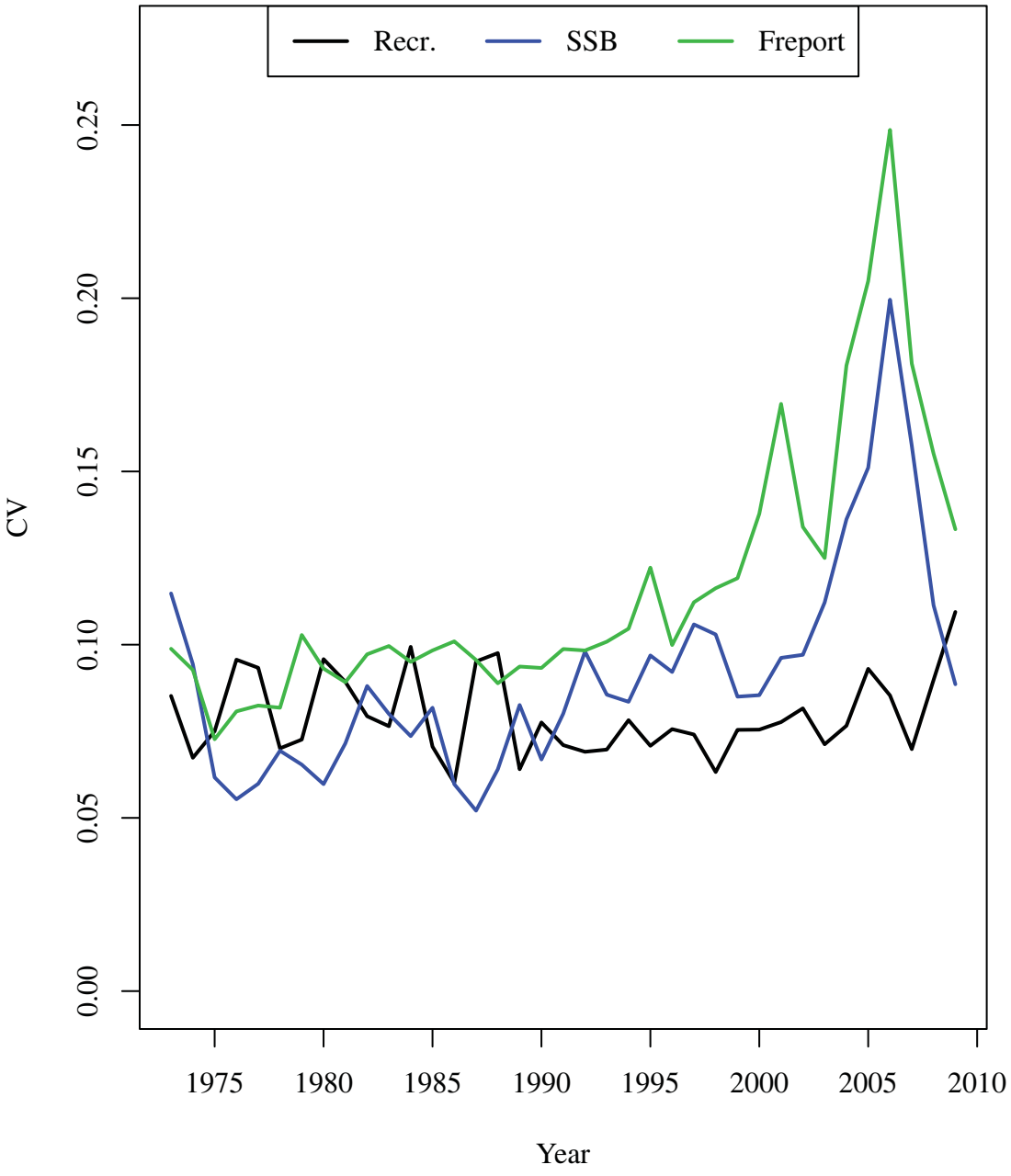

1
2
3
4
5
6
ASAP Estimated Proportion(NAA)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

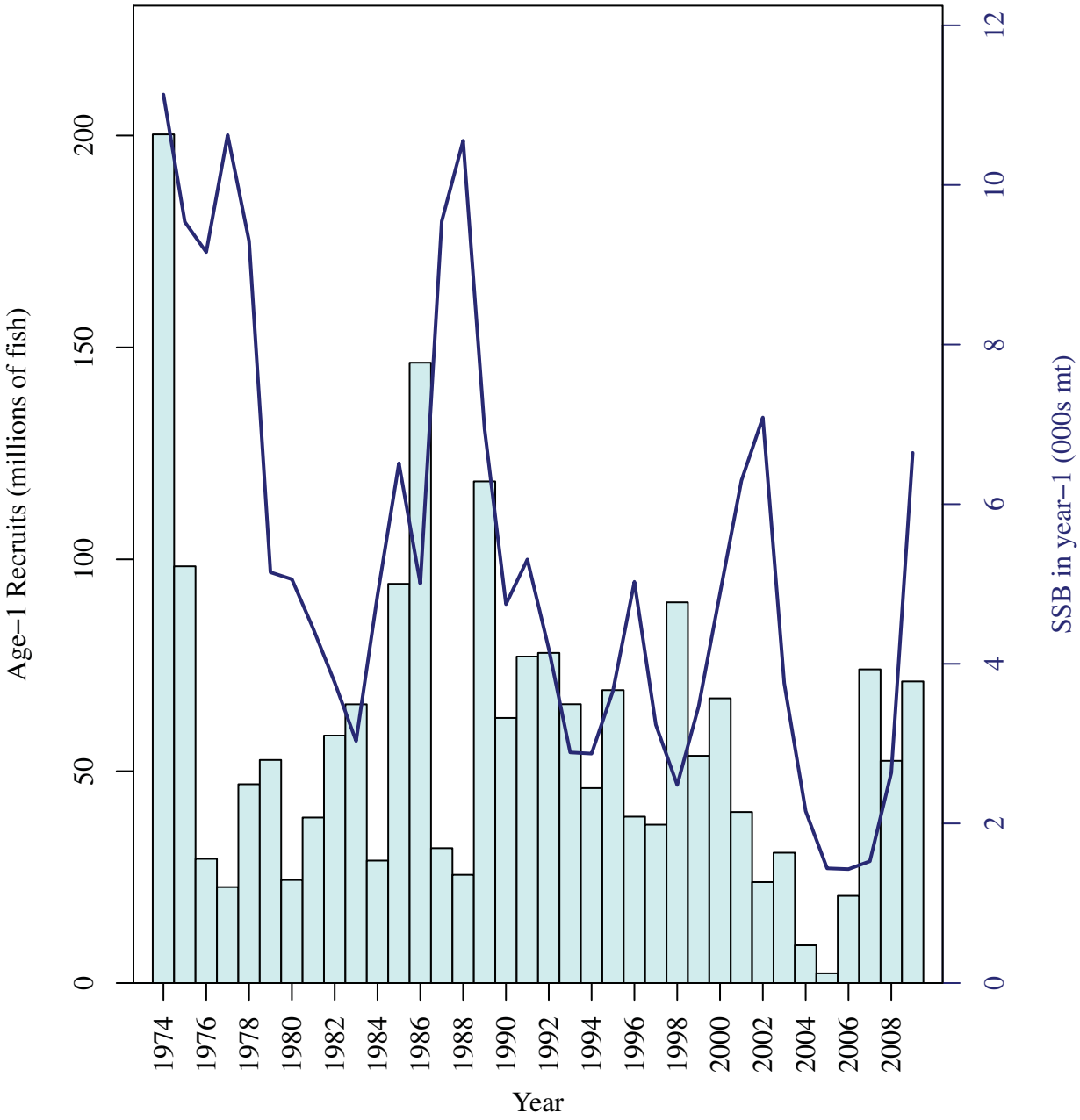

Fleet_1
Fleet_2
Observed Catch (mt)
0
10000
20000
30000
40000
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Observed Catch (proportion)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fmult by fleet
0.0
0.5
1.0
1.5
1975
1980
1985
1990
1995
2000
2005
2010
Year


Spring
Fall
Total Catch (mt)
Index (N/tow)
Year
0
10000
20000
30000
40000
1e+05
2e+05
3e+05
4e+05
5e+05
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Recr.
SSB
Freport
CV
0.00
0.05
0.10
0.15
0.20
0.25
1975
1980
1985
1990
1995
2000
2005
2010
Year


Age−1 Recruits (millions of fish)
0
50
100
150
200
SSB in year−1 (000s mt)
0
2
4
6
8
10
12
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year

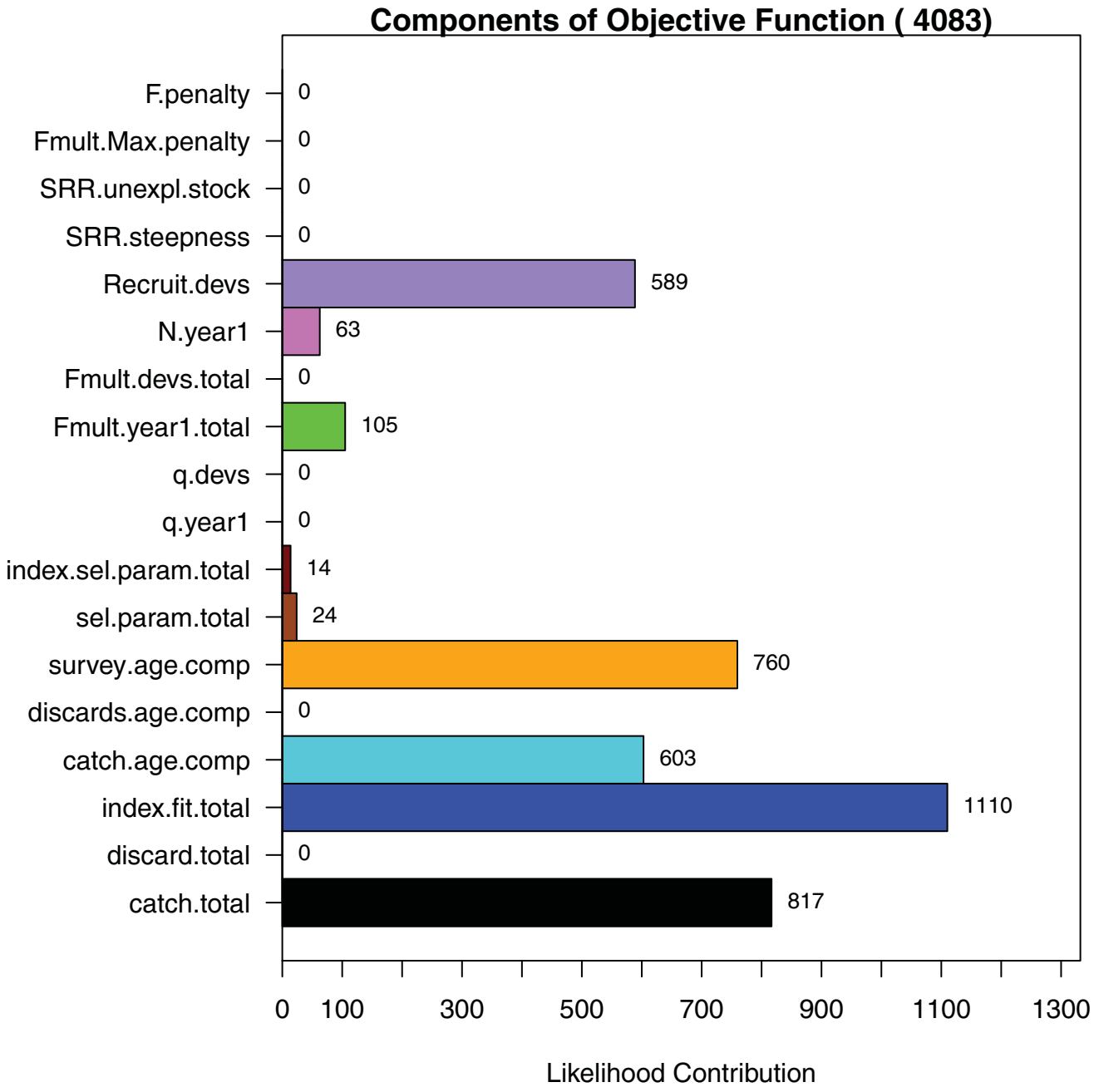
Appendix A5: North Model Consumption ASAP results M = 0.15_Base run

Model Attributes:

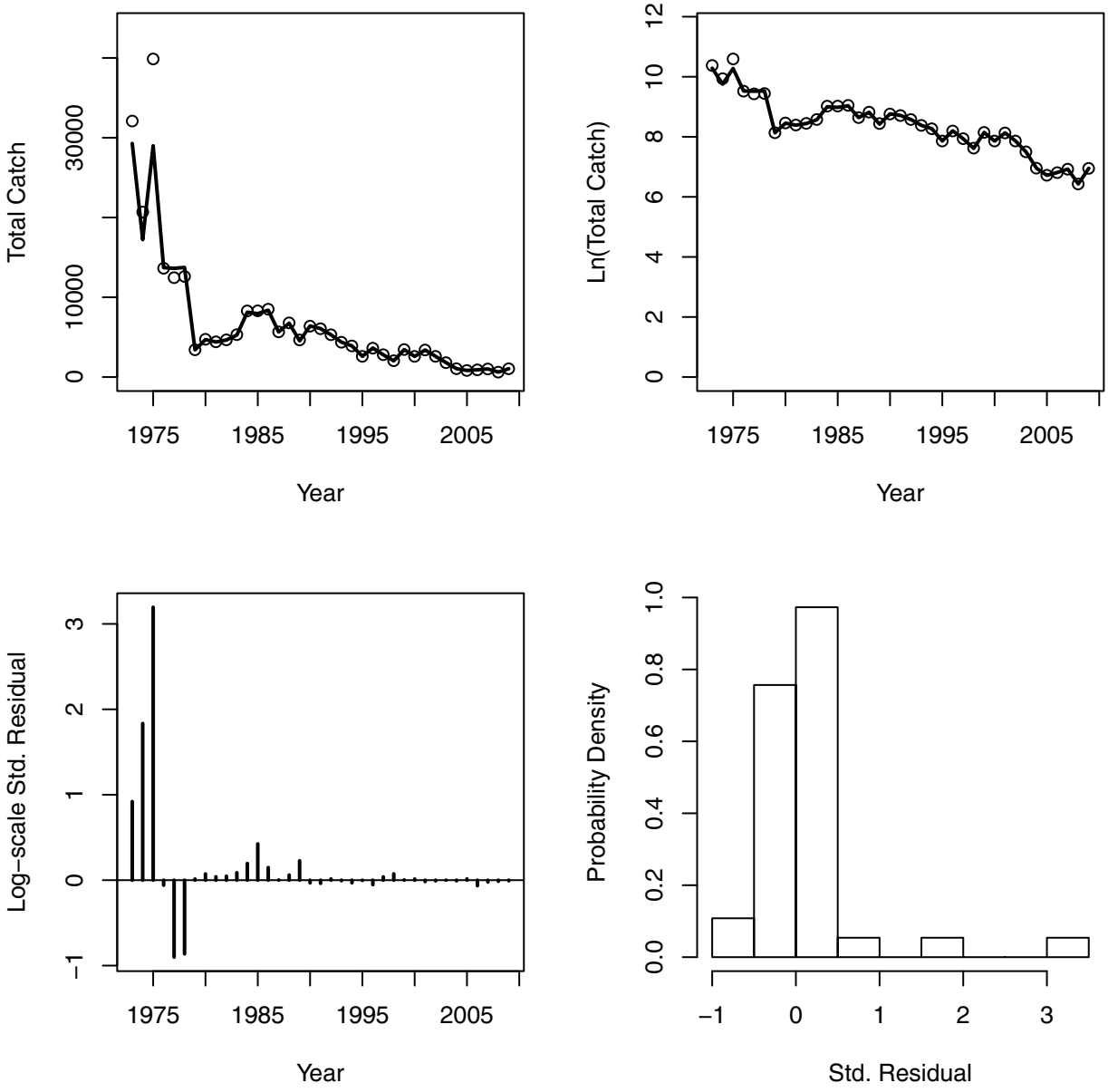
1. 3 Fleet Model
    a. Catch : 1973-2009
    b. Discards: 1981 – 2009
    c. Consumption – 1973-2009

2. Fishery Selectivity (3 Block Selectivity)
    a. Landings (1 Blocks: 1973-2009)
    b. Discards (1 Block: 1981-2009)
    c. Consumption (Double Logistic Functional Form)

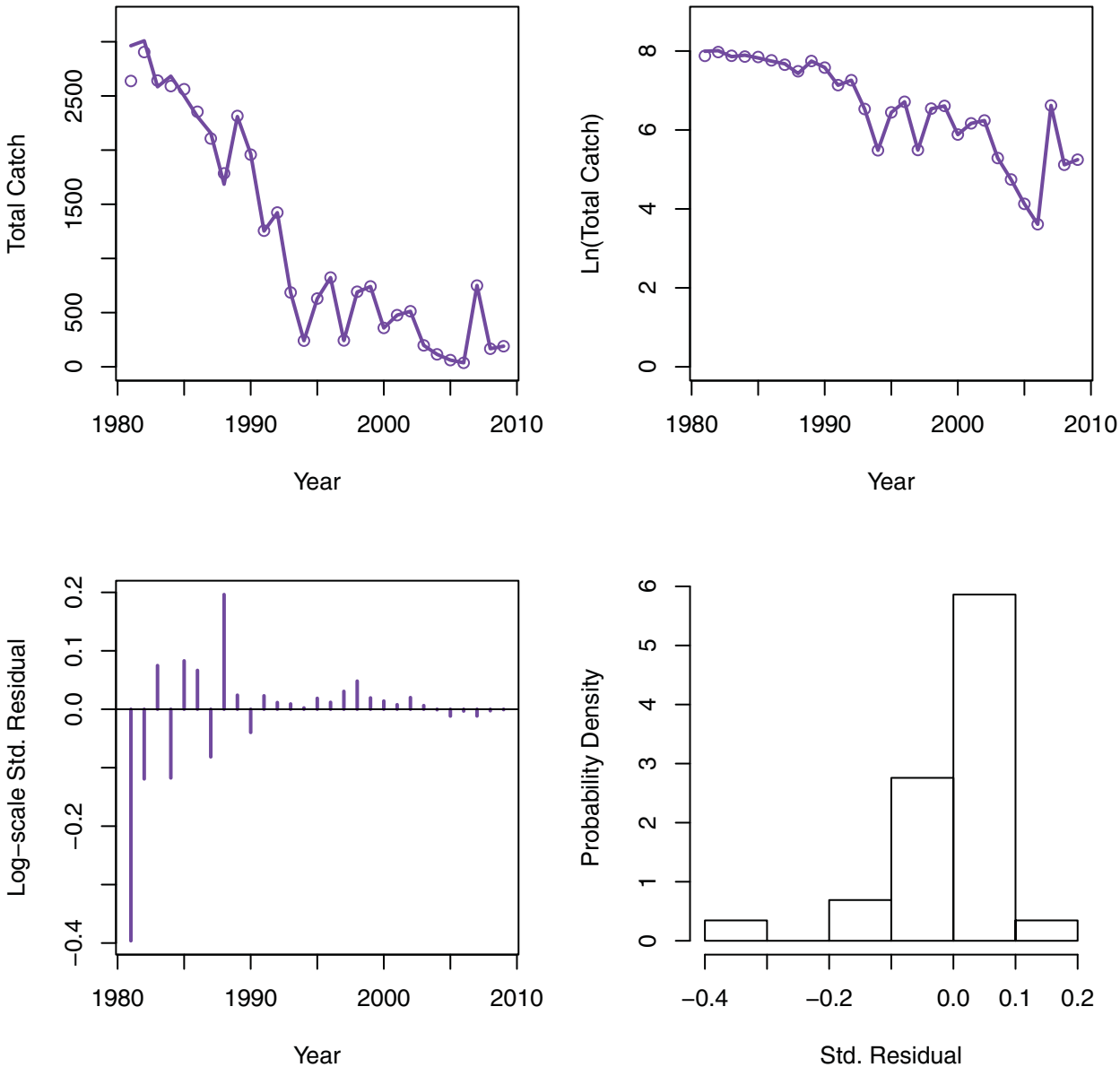
3. Survey Selectivity (Fixed 100% at age 2 and freely estimating older ages (3+)

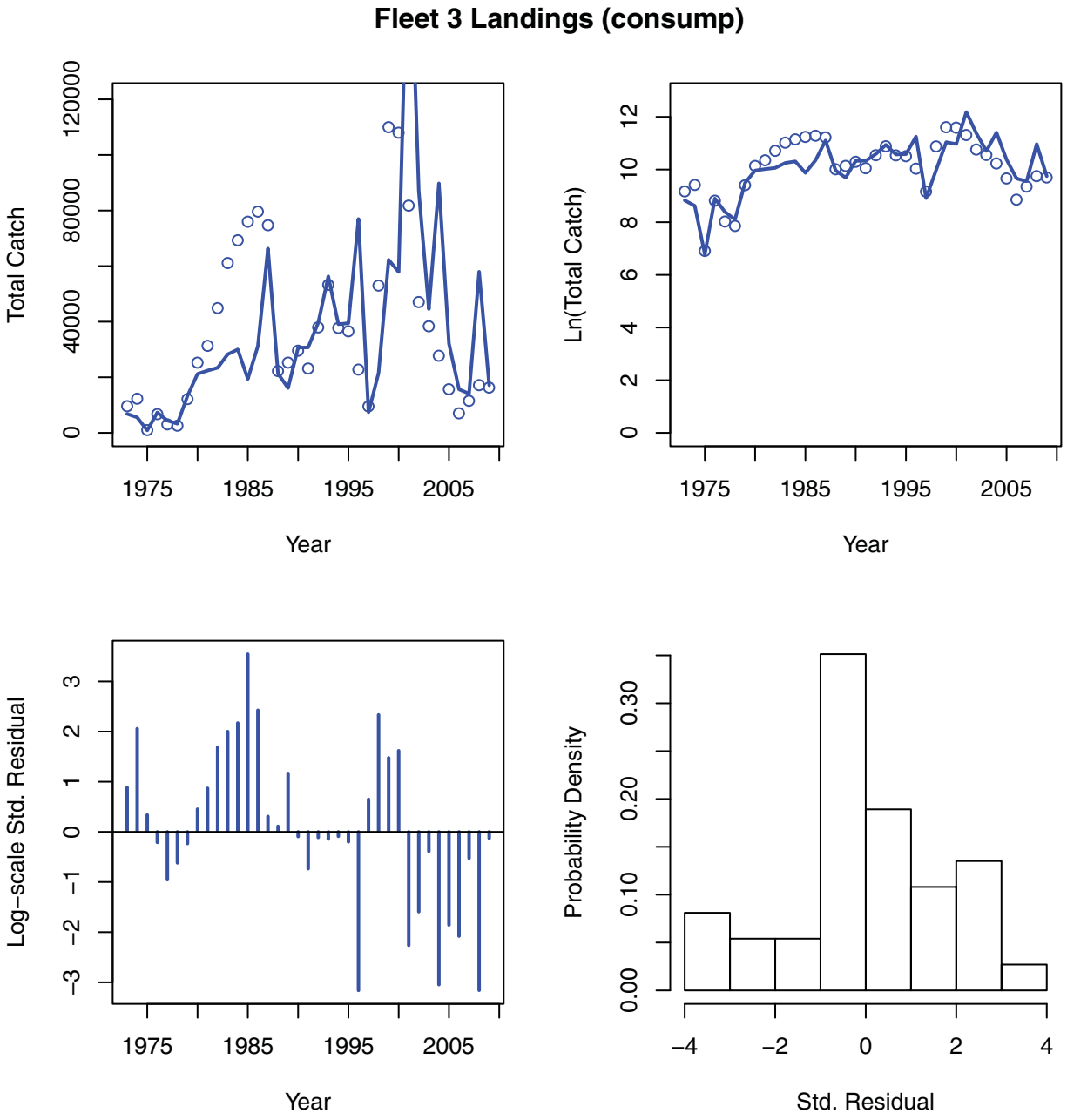

Components of Objective Function (4083)
F.penalty
Fmult.Max.penalty
SRR.unexpl.stock
SRR.steepness
Recruit.devs
N.year1
Fmult.devs.total
Fmult.year1.total
q.devs
q.year1
index.sel.param.total
sel.param.total
survey.age.comp
discards.age.comp
catch.age.comp
index.fit.total
discard.total
catch.total
0
0
0
0
589
63
0
105
0
0
14
24
760
0
603
1110
0
817
0
100
300
500
700
900
1100
1300
Likelihood Contribution

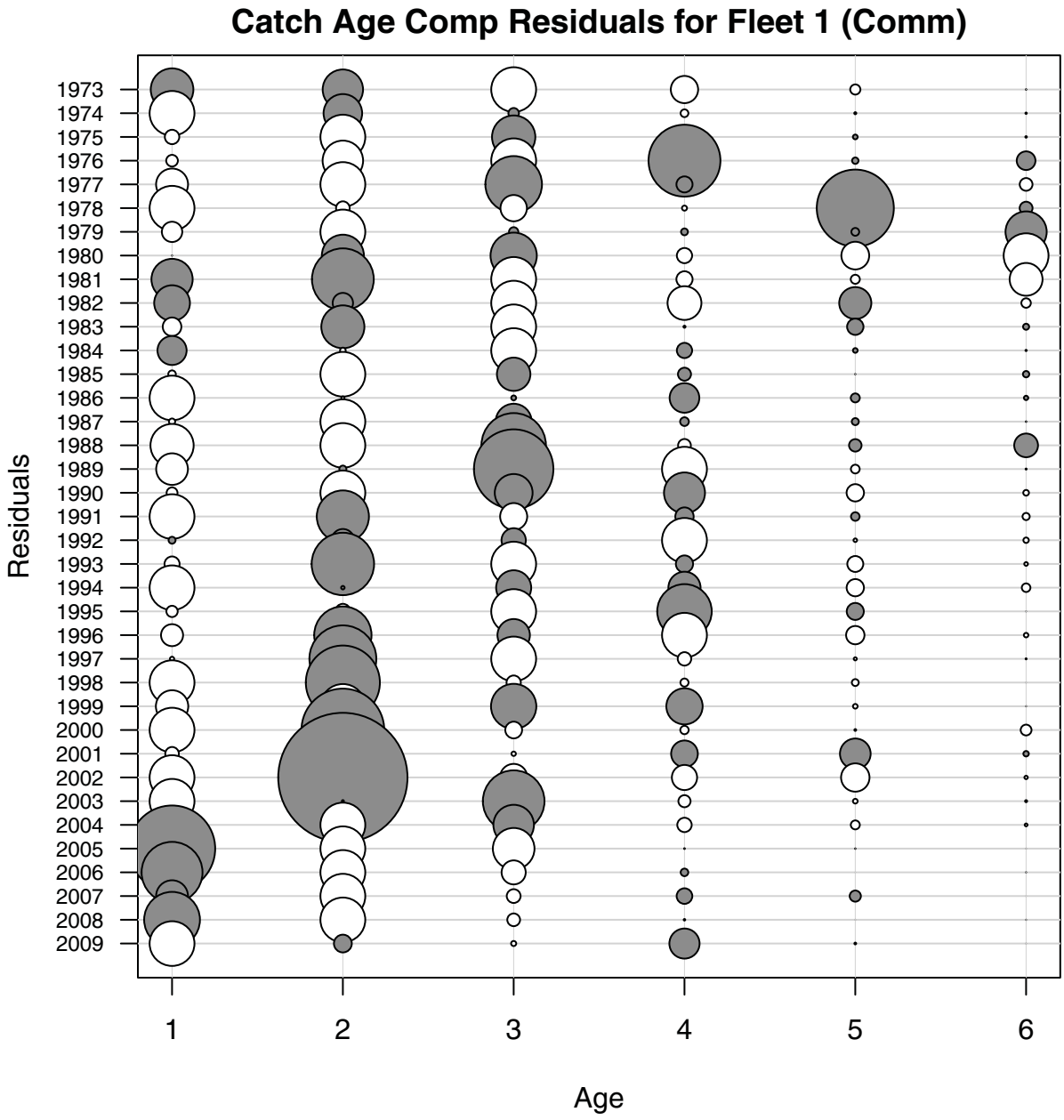
Fleet 1 Landings (Comm)

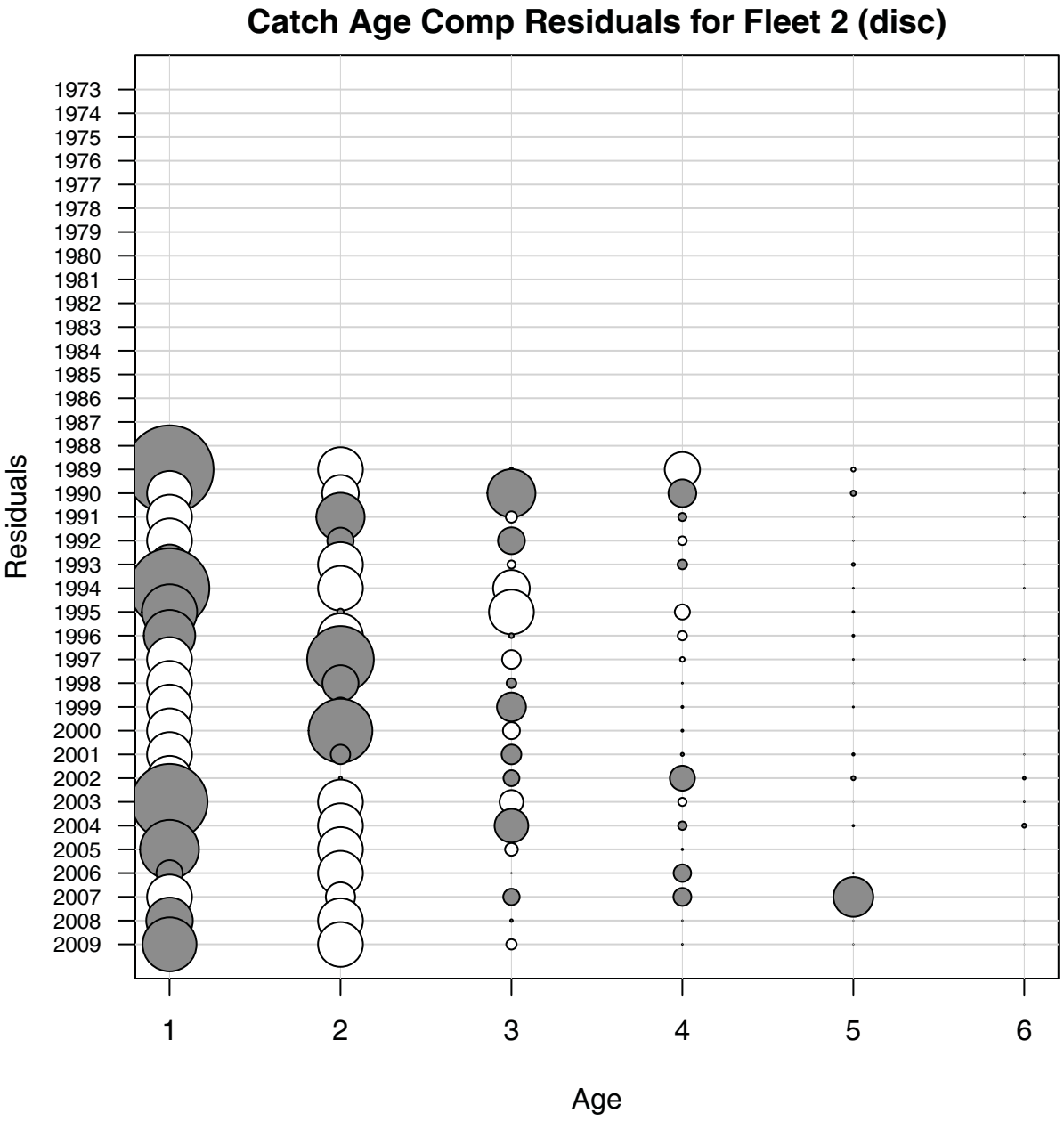


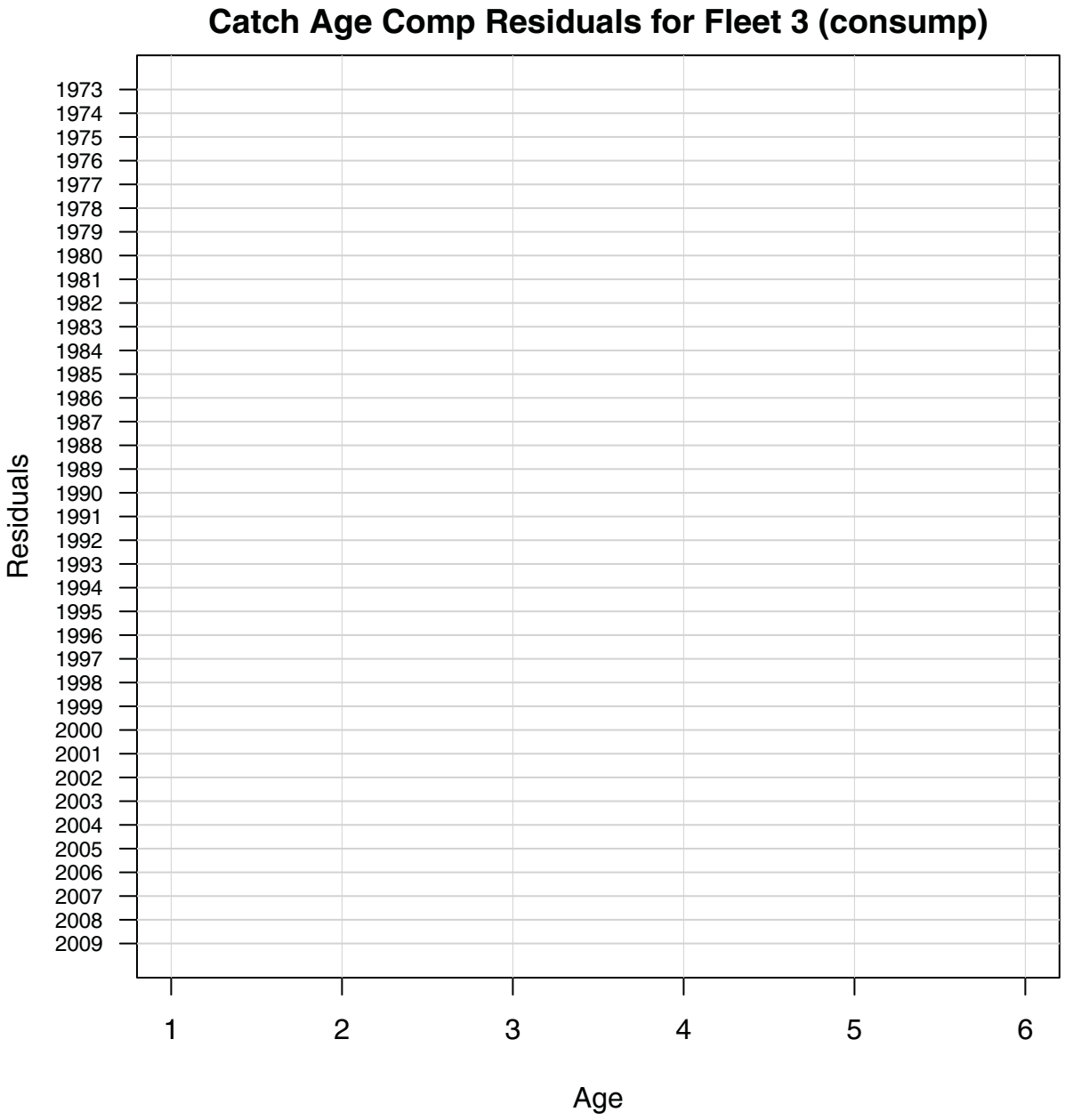
Fleet 2 Landings (disc)

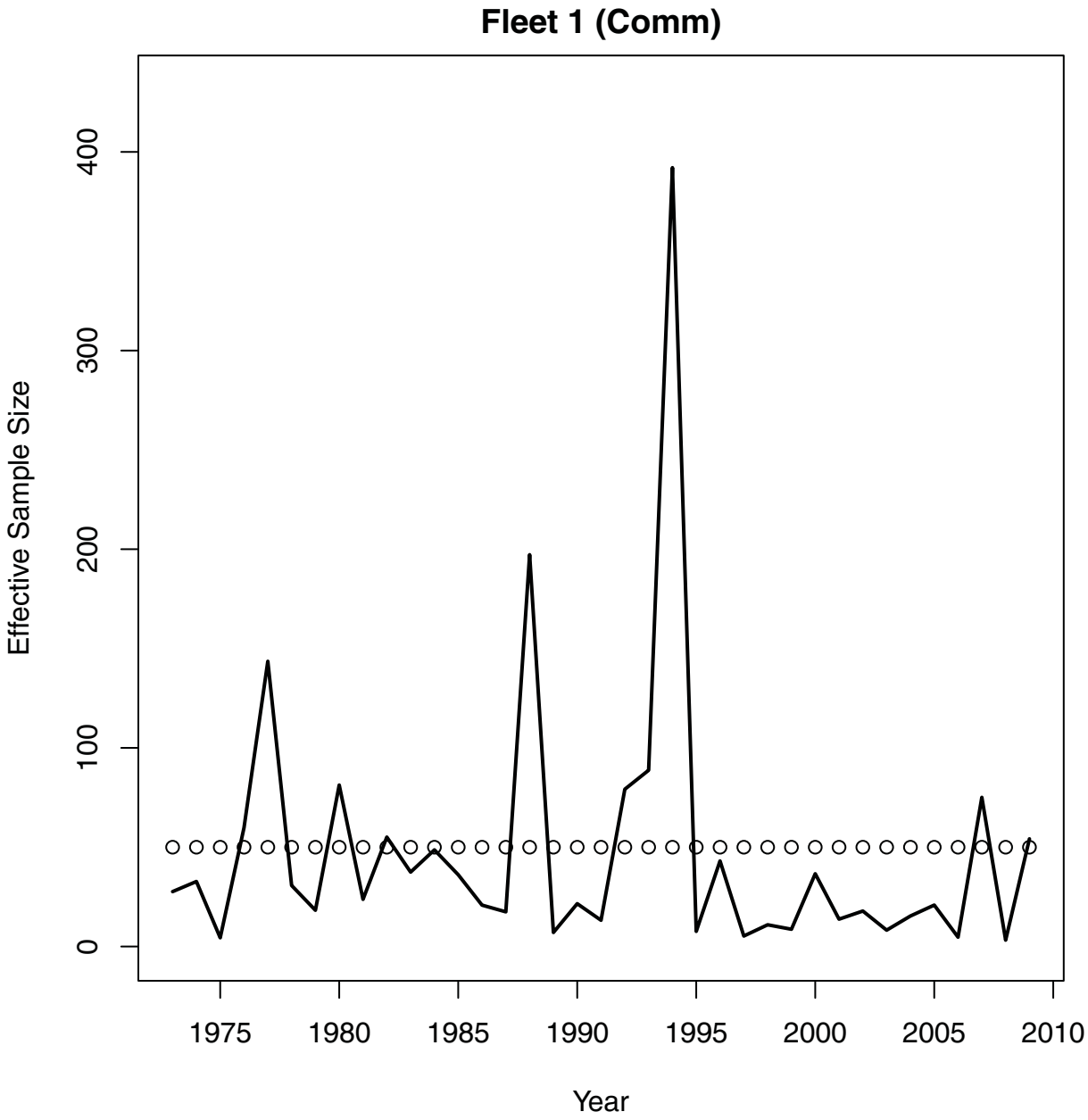


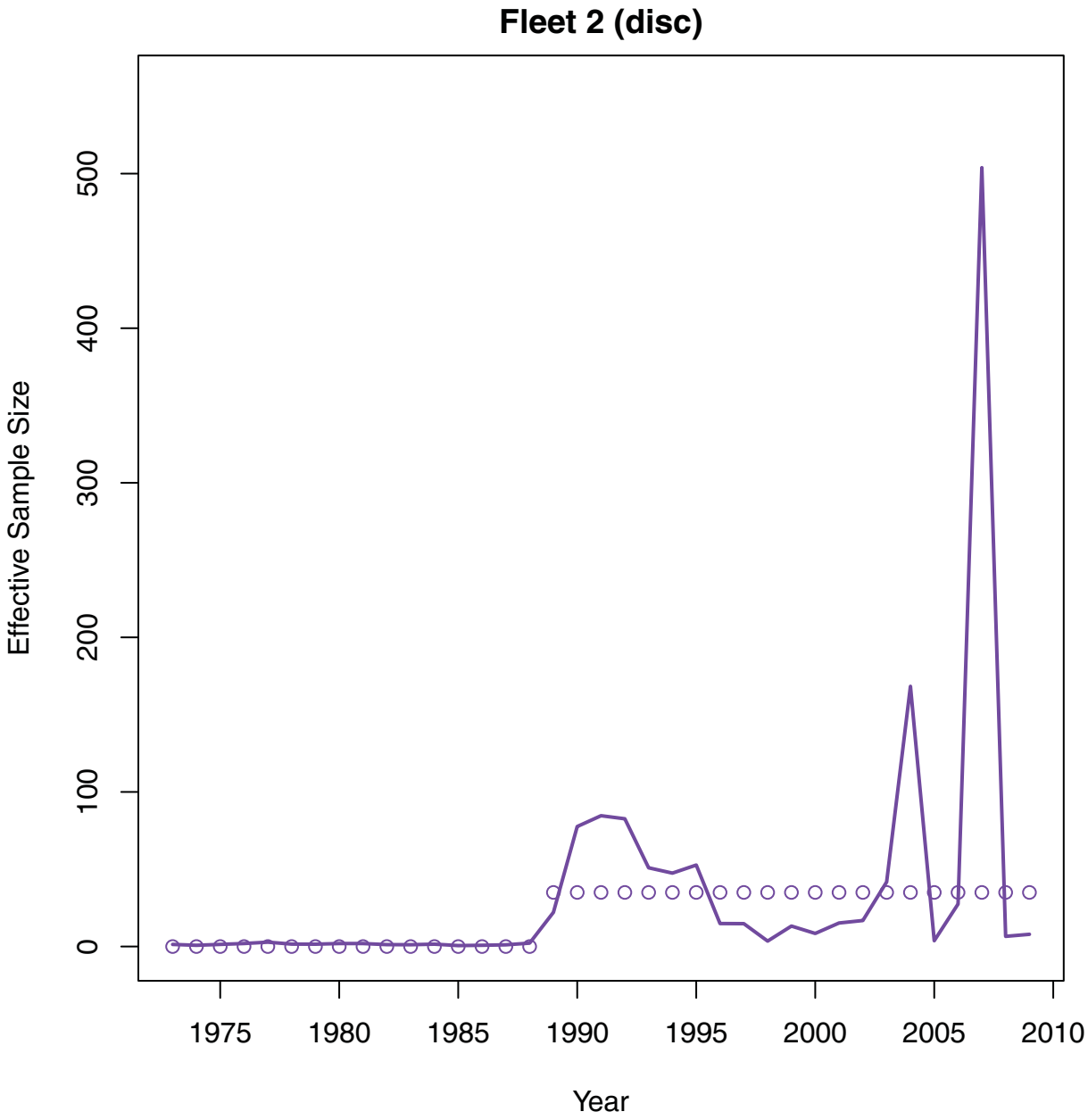

Fleet 3 Landings (consump)
Total Catch
0
40000
80000
120000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
−3
−2
−1
0
1
2
3
1975
1985
1995
2005
Year
Probability Density
0.00
0.10
0.20
0.30
−4
−2
0
2
4
Std. Residual

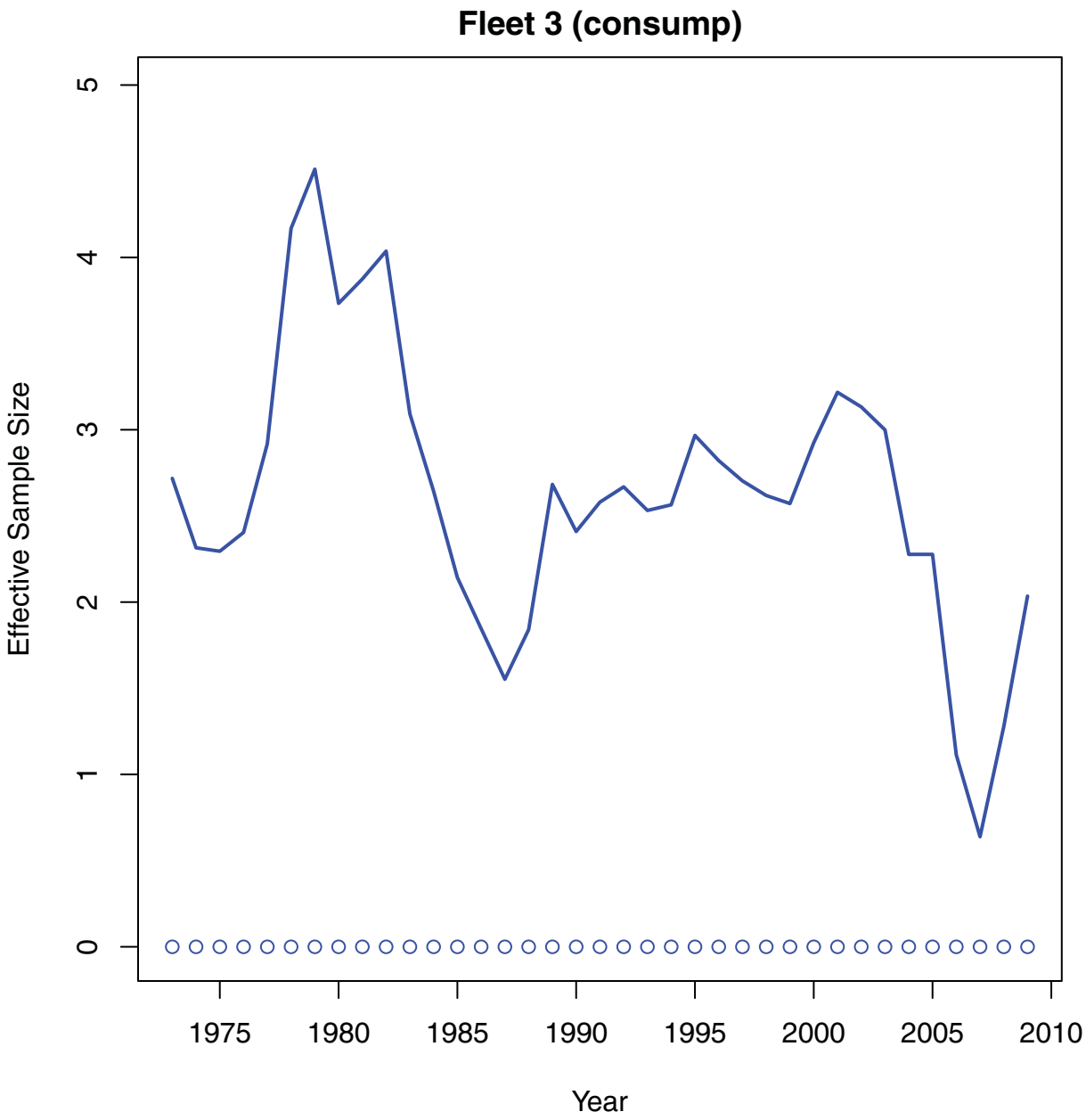

Catch Age Comp Residuals for Fleet 1 (Comm)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

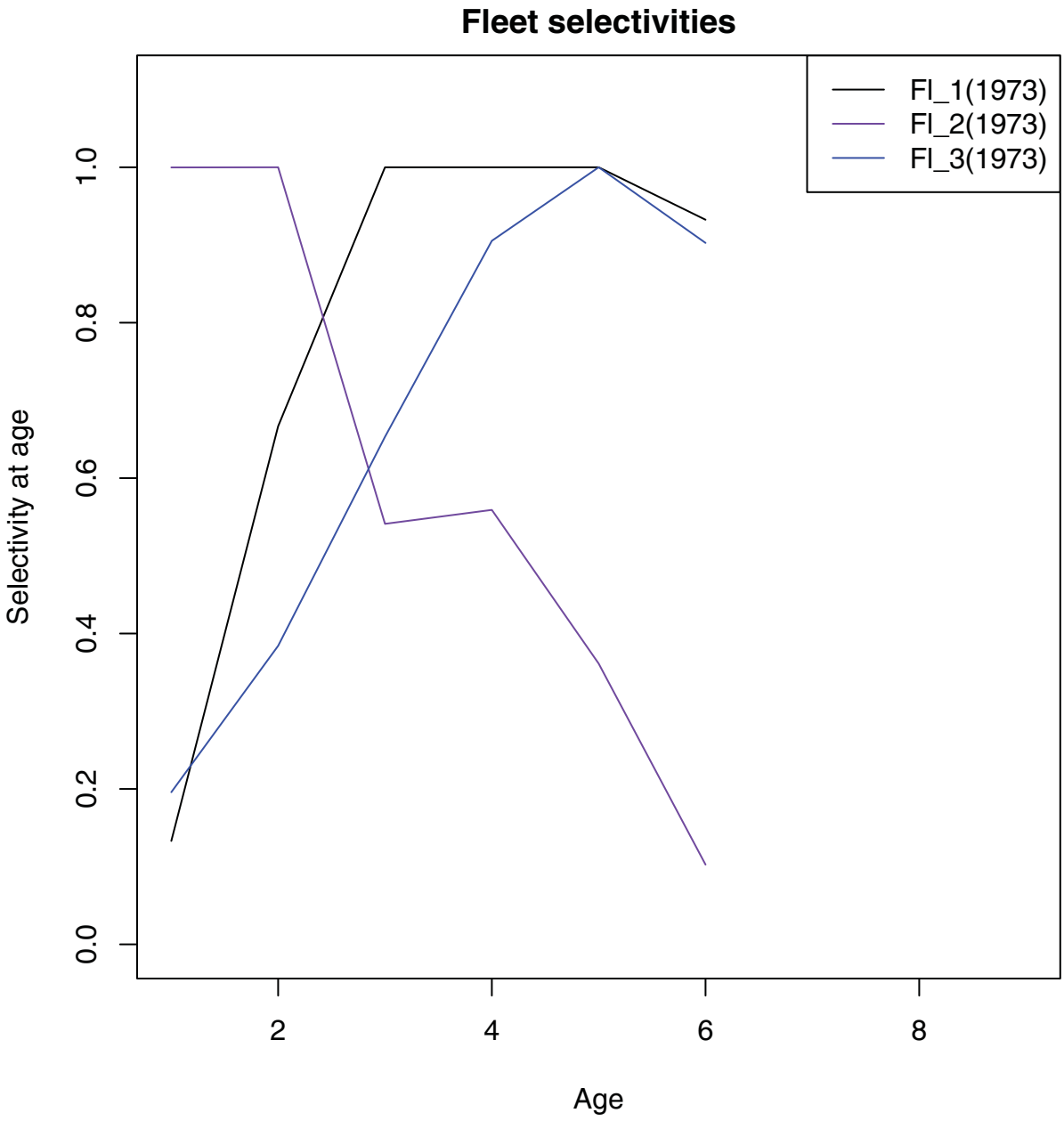

Catch Age Comp Residuals for Fleet 2 (disc)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Catch Age Comp Residuals for Fleet 3 (consump)
Residuals
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
1
2
3
4
5
6
Age

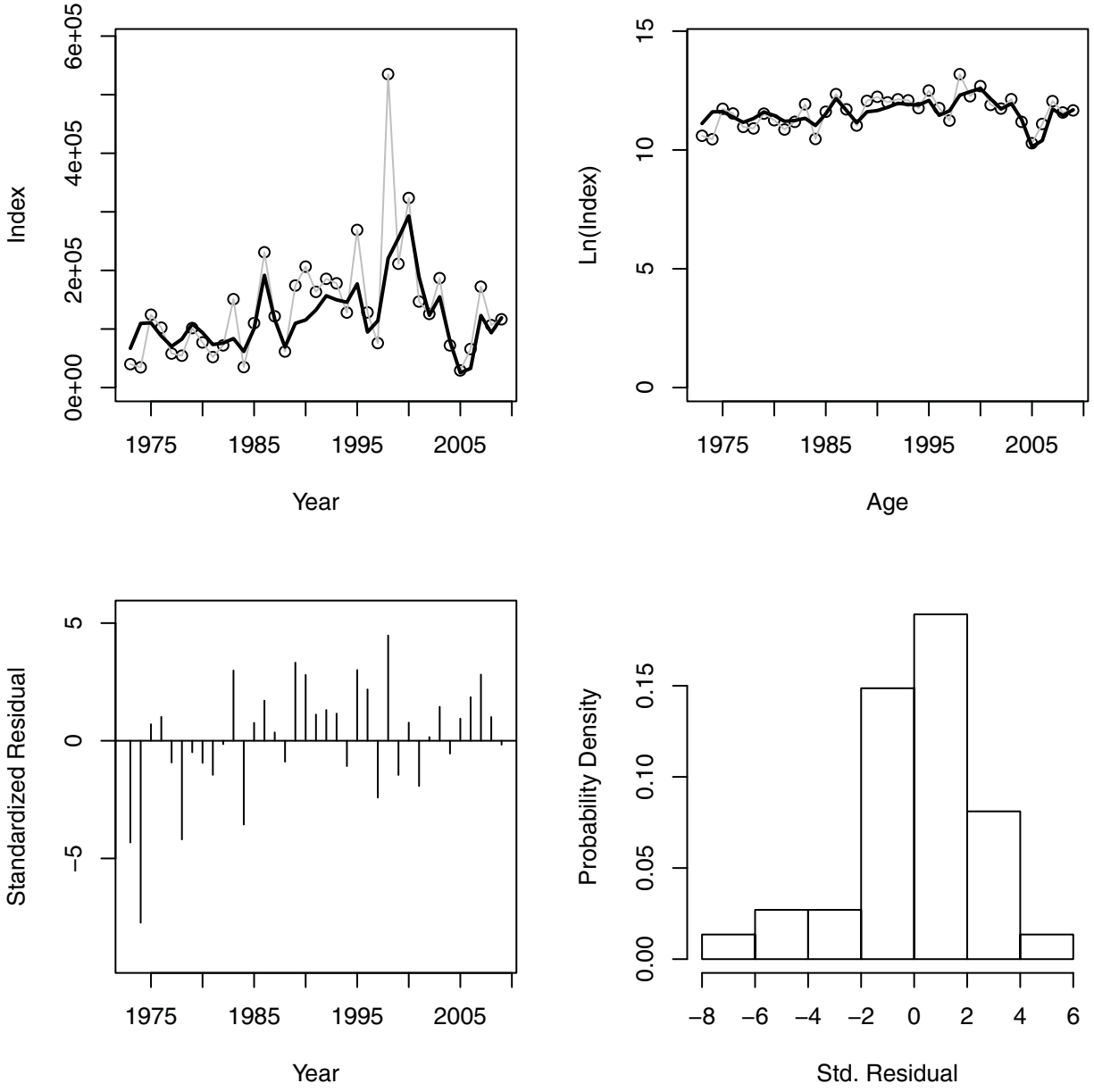

Fleet 1 (Comm)
Effective Sample Size
0
100
200
300
400
1975
1980
1985
1990
1995
2000
2005
2010
Year


Fleet 2 (disc)
Effective Sample Size
0
100
200
300
400
500
1975
1980
1985
1990
1995
2000
2005
2010
Year

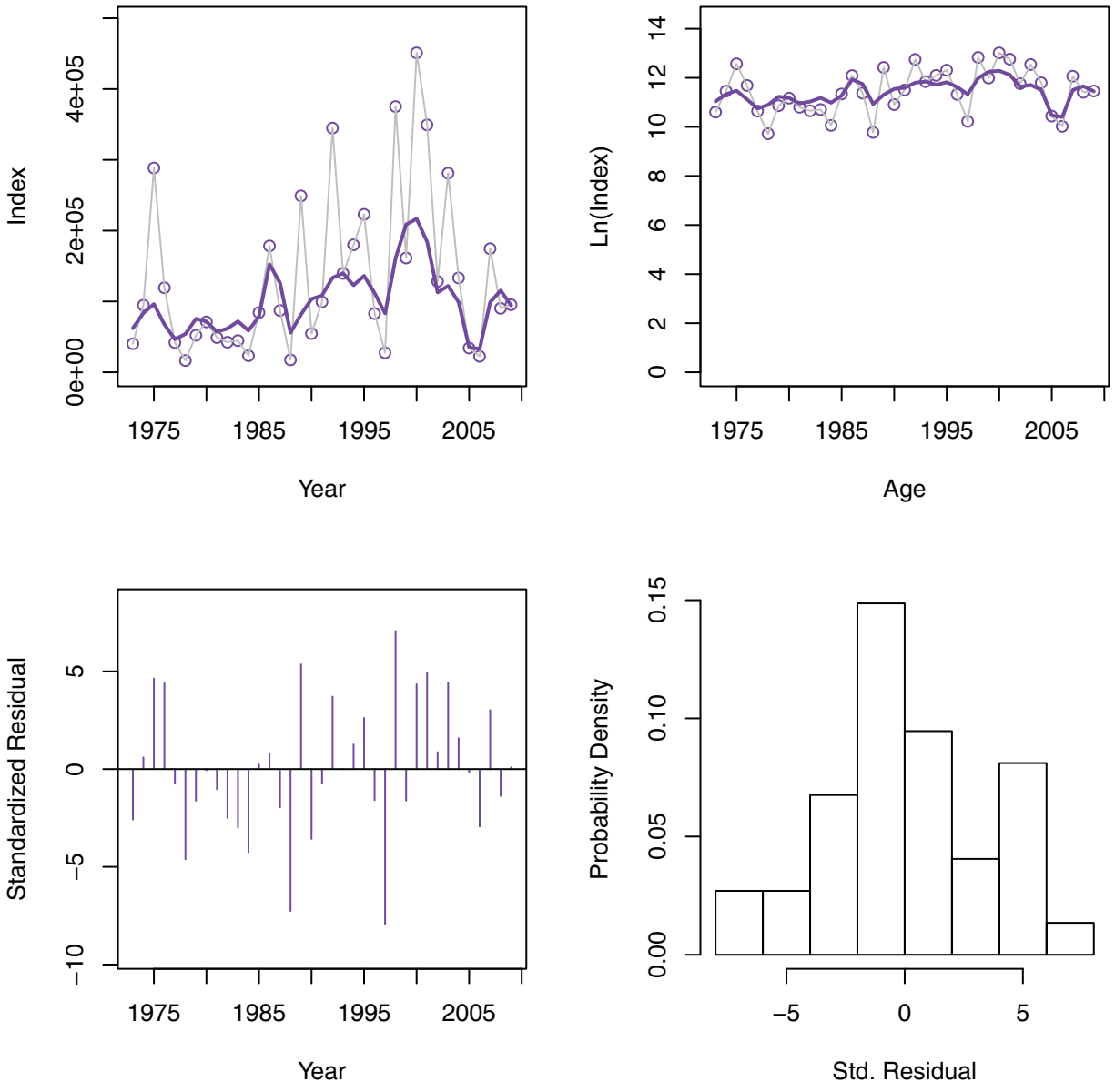

Fleet 3 (consump)
Effective Sample Size
0
1
2
3
4
5
1975
1980
1985
1990
1995
2000
2005
2010
Year

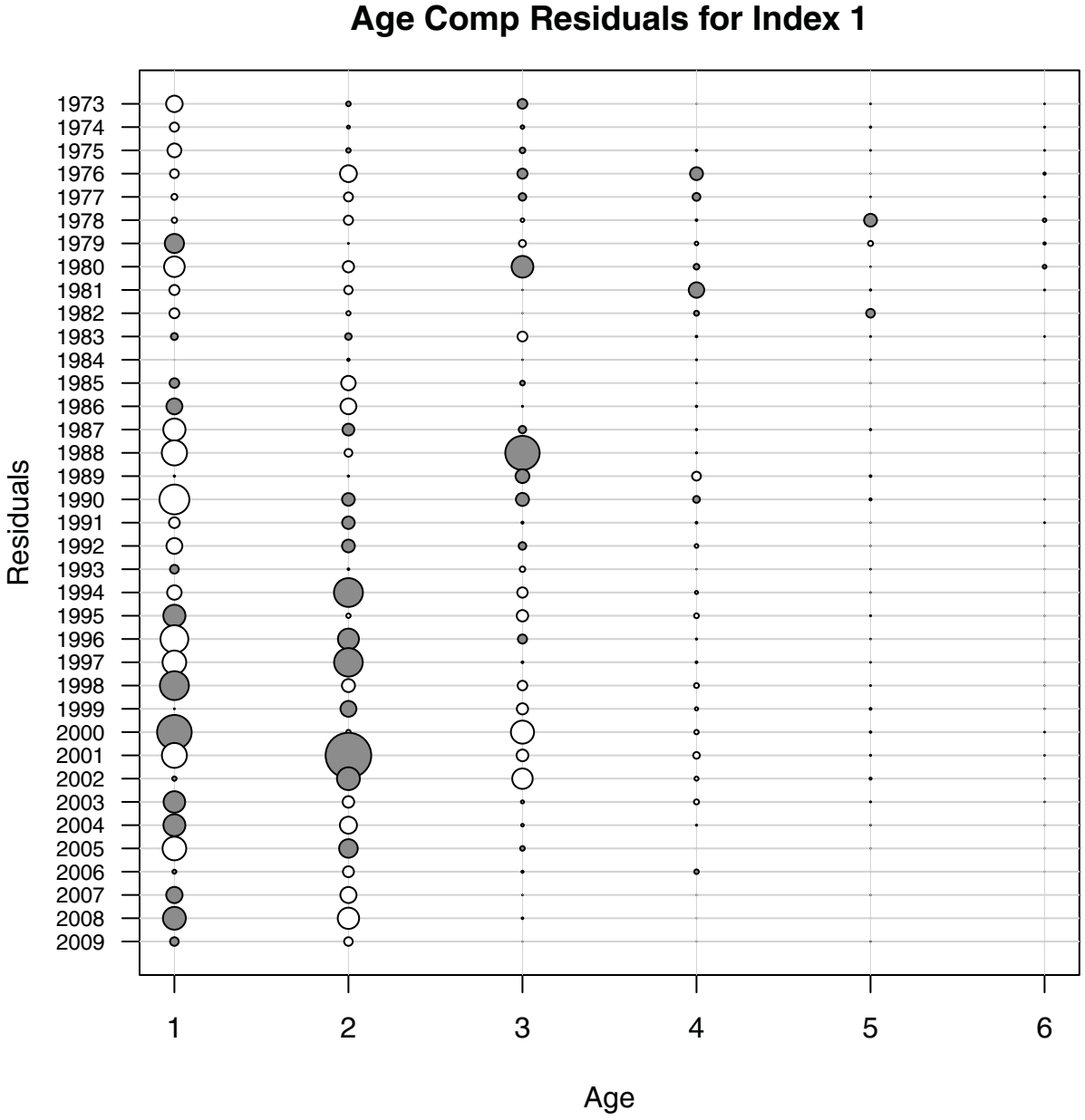

Fleet selectivities
Fl_1(1973)
Fl_2(1973)
Fl_3(1973)
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

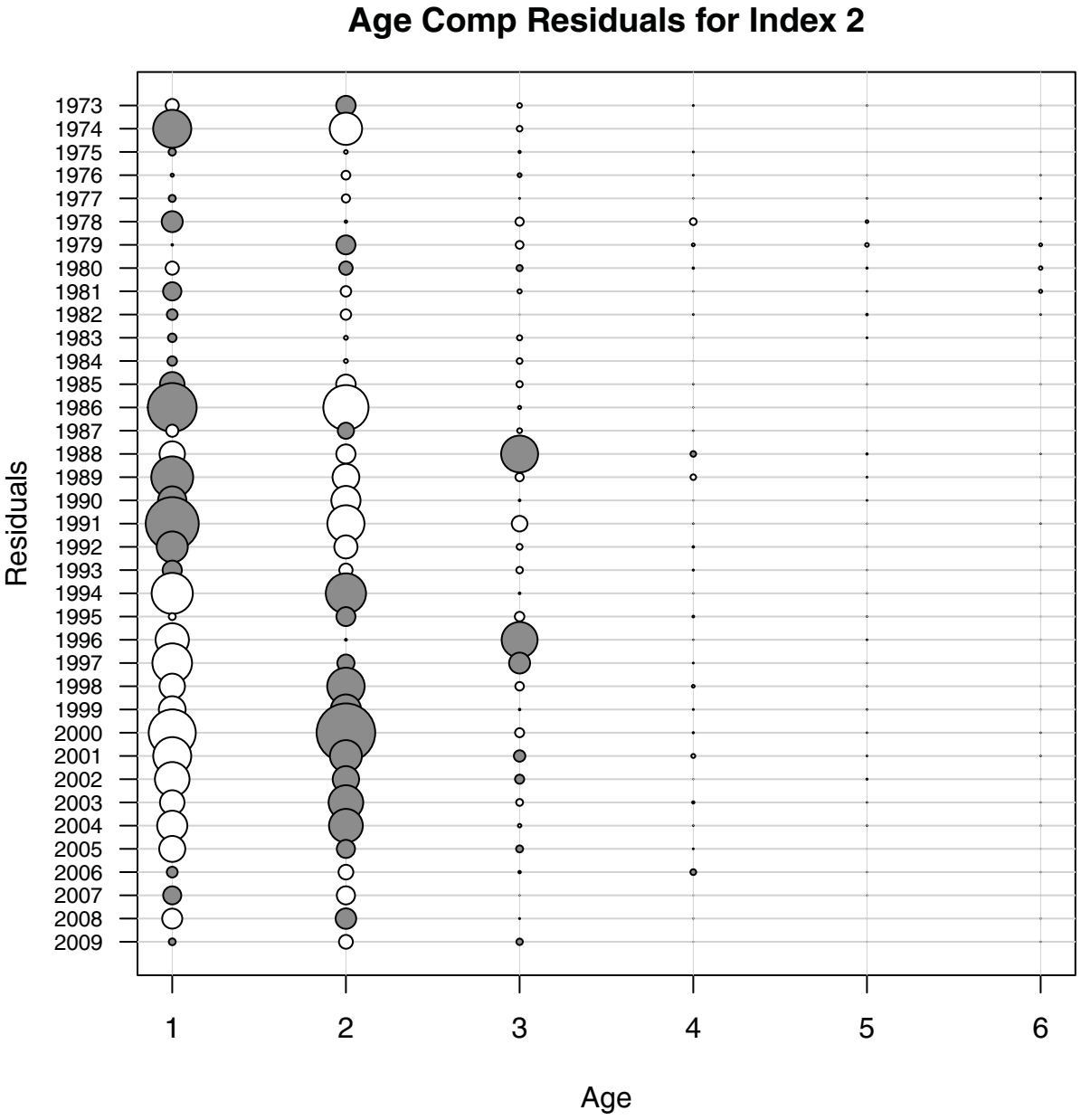
Index 1

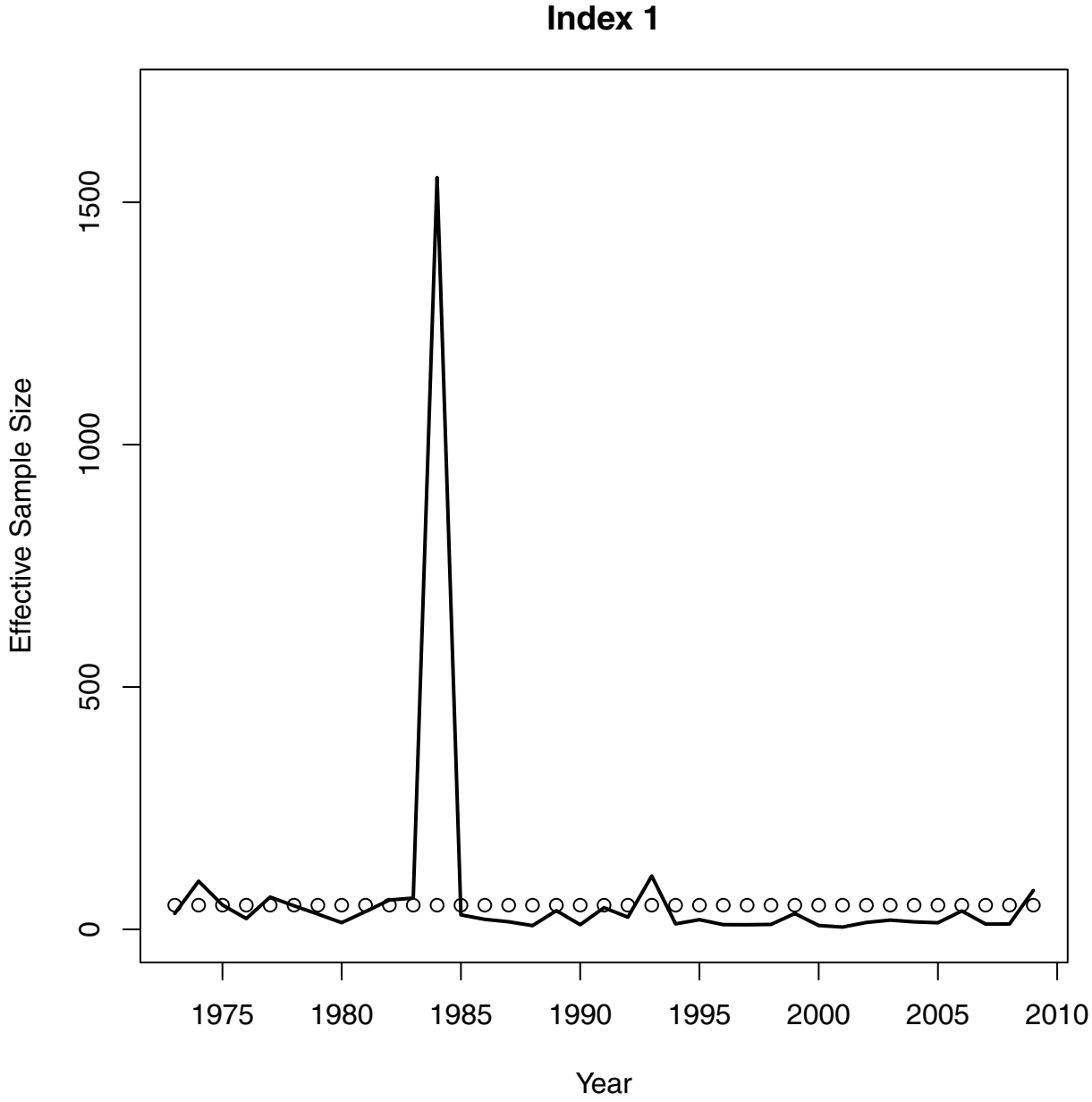

Index
0e+00
2e+05
4e+05
6e+05
1975
1985
1995
2005
Year
Ln(Index)
0
5
10
15
1975
1985
1995
2005
Age
Standardized Residual
−5
0
5
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
−8
−6
−4
−2
0
2
4
6
Std. Residual

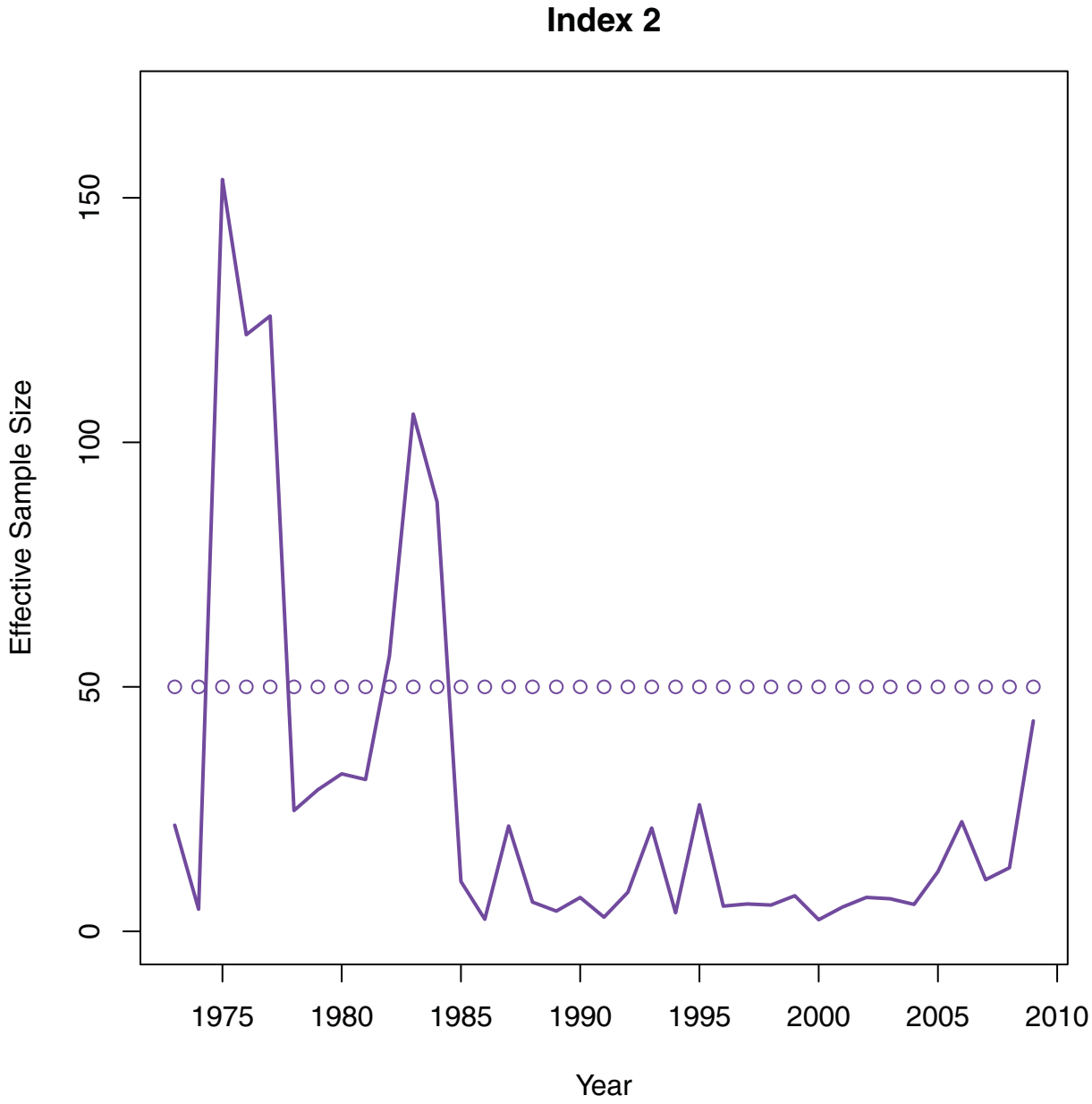
Index 2

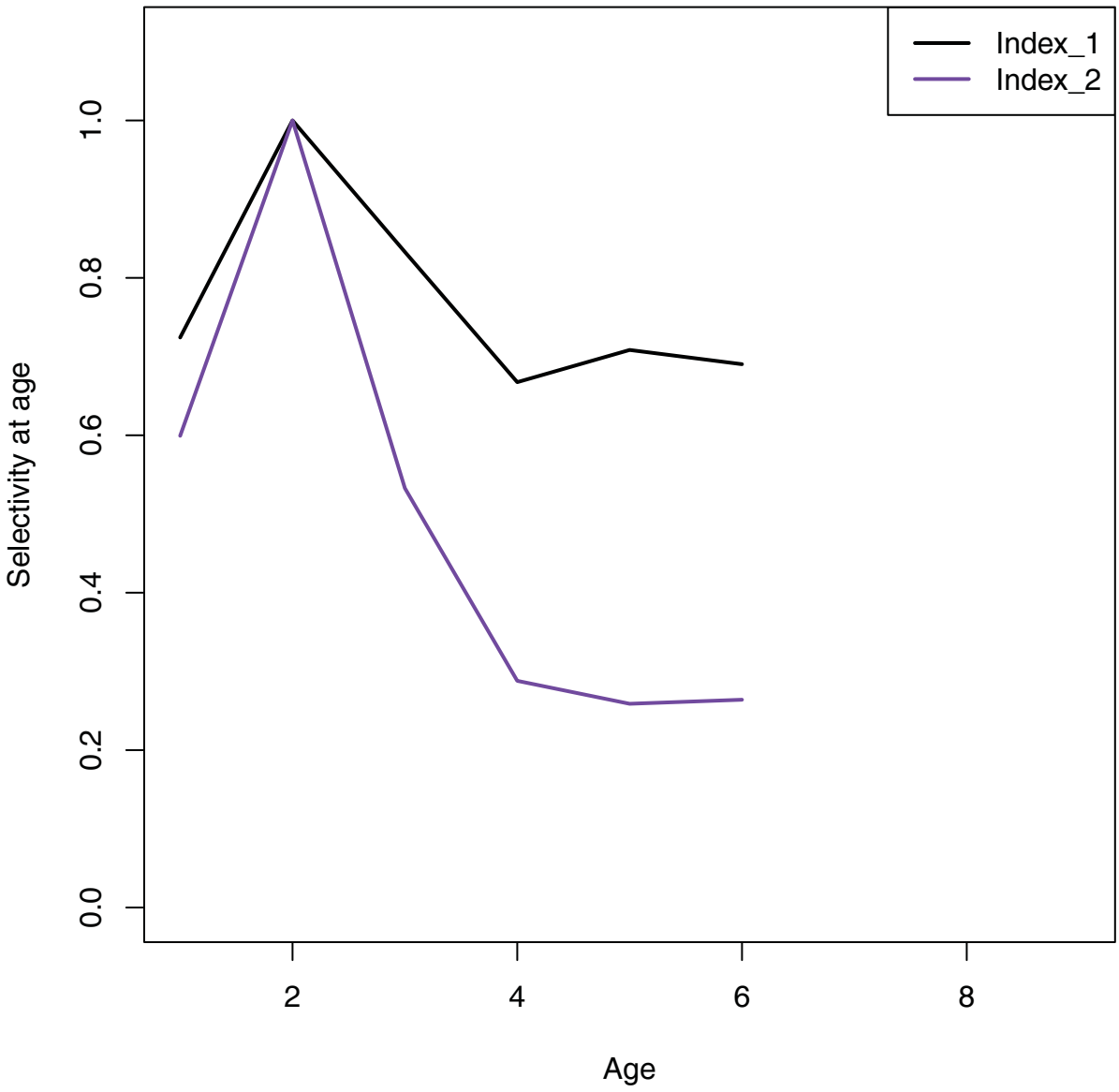

Index
0e+00
2e+05
4e+05
1975
1985
1995
2005
Year
Ln(Index)
0
2
4
6
8
10
12
14
1975
1985
1995
2005
Age
Standardized Residual
−10
−5
0
5
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
−5
0
5
Std. Residual

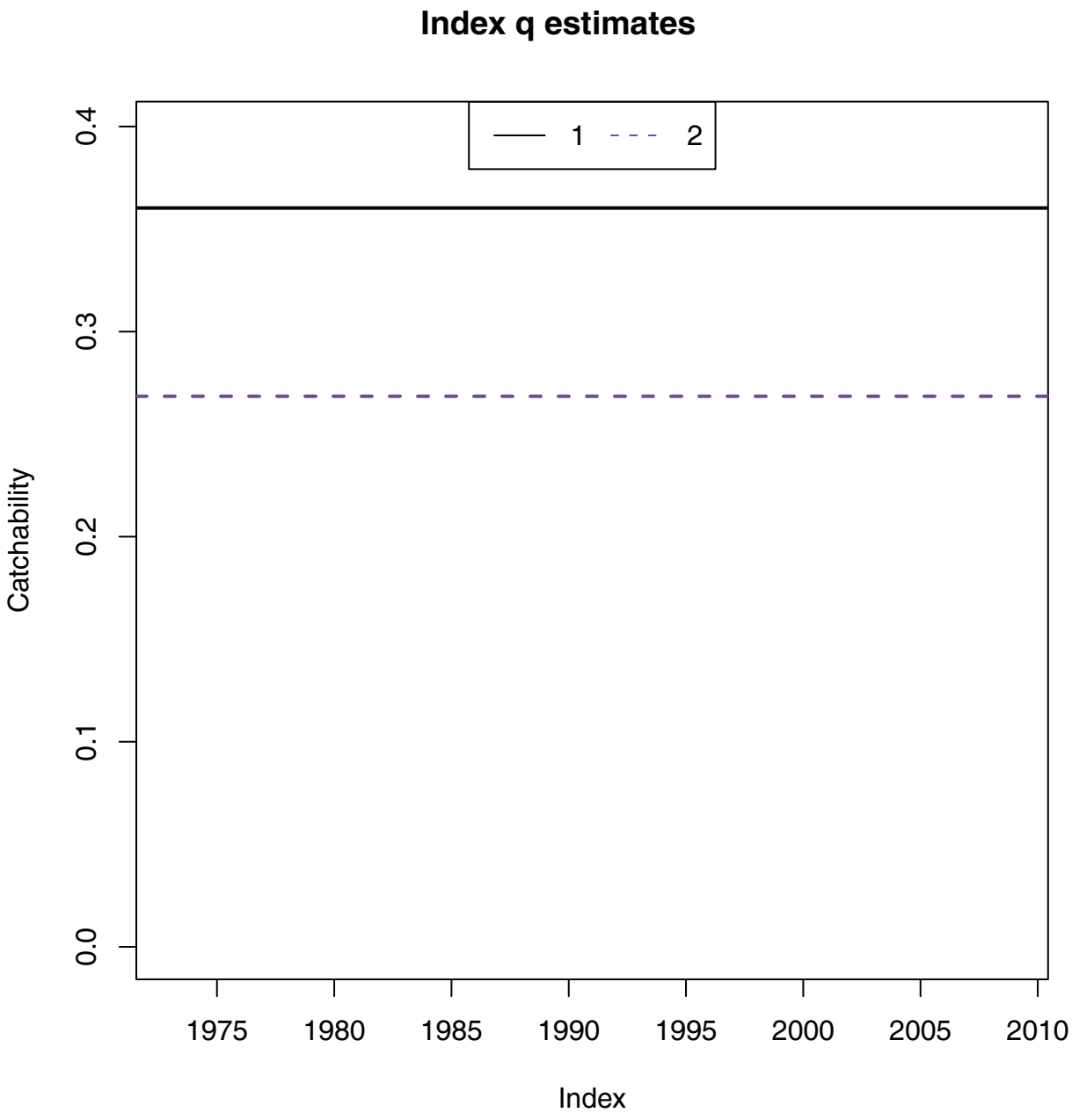

Age Comp Residuals for Index 1
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

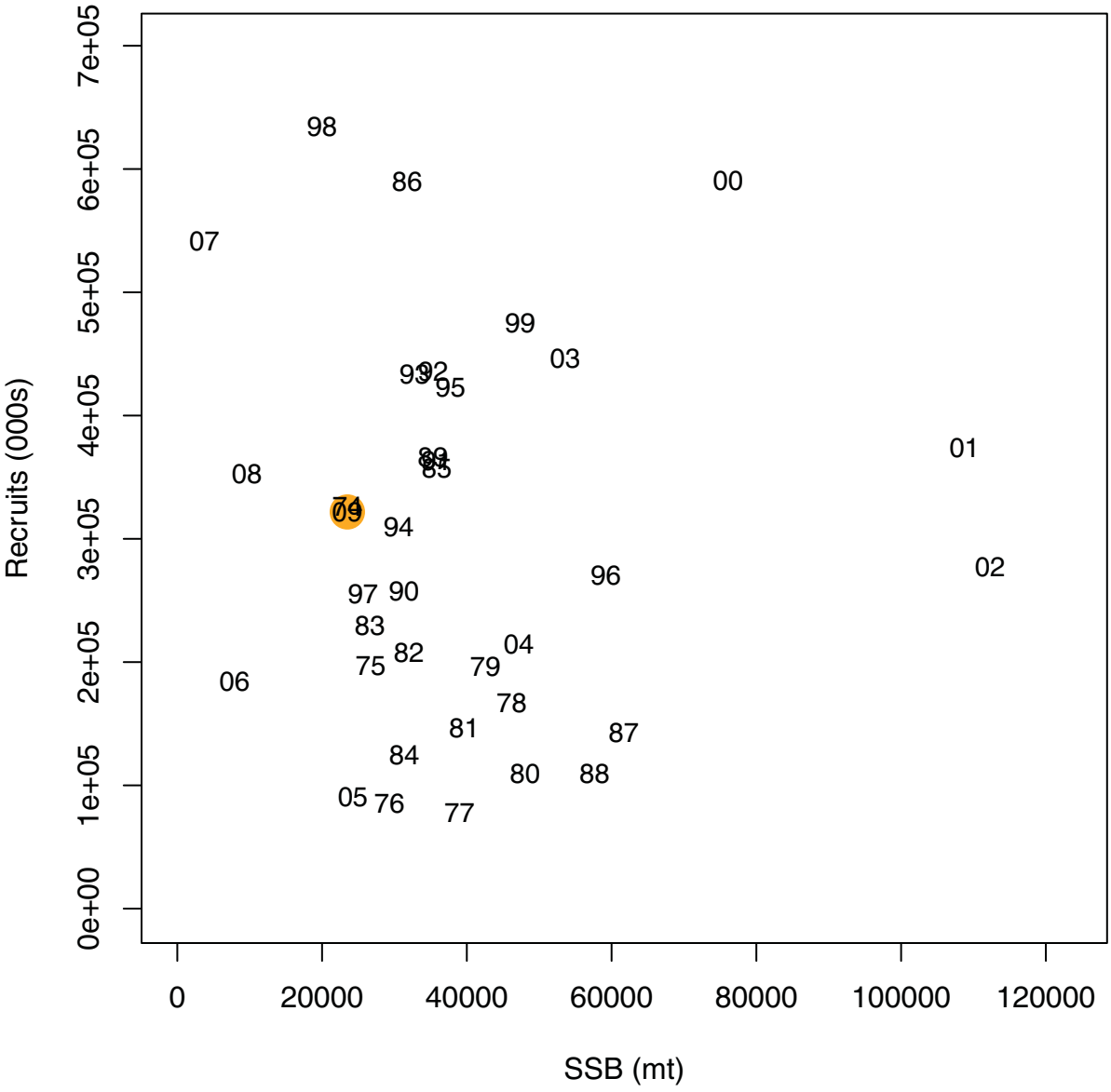

Age Comp Residuals for Index 2
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

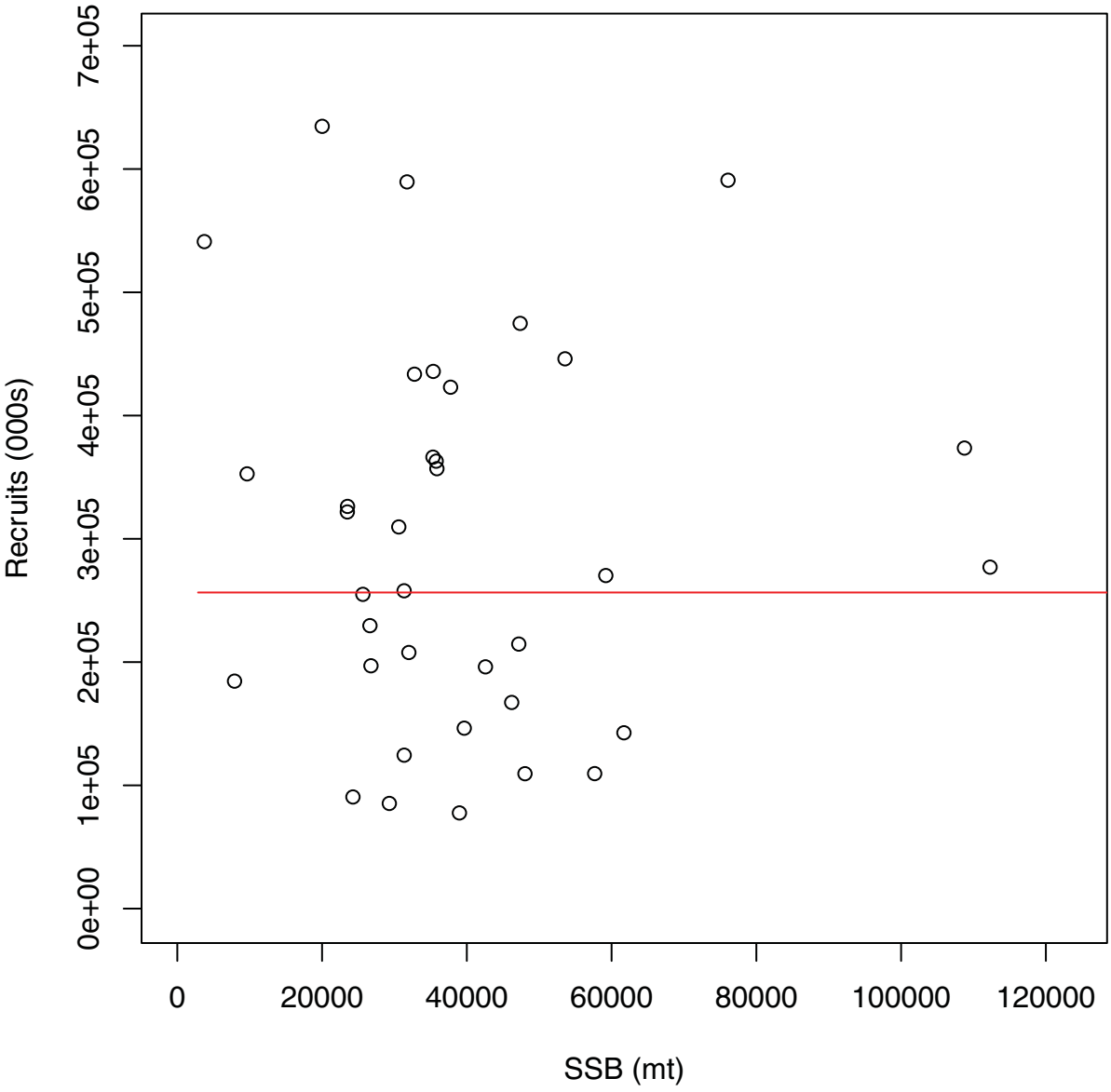

Index 1
Effective Sample Size
0
500
1000
1500
1975
1980
1985
1990
1995
2000
2005
2010
Year

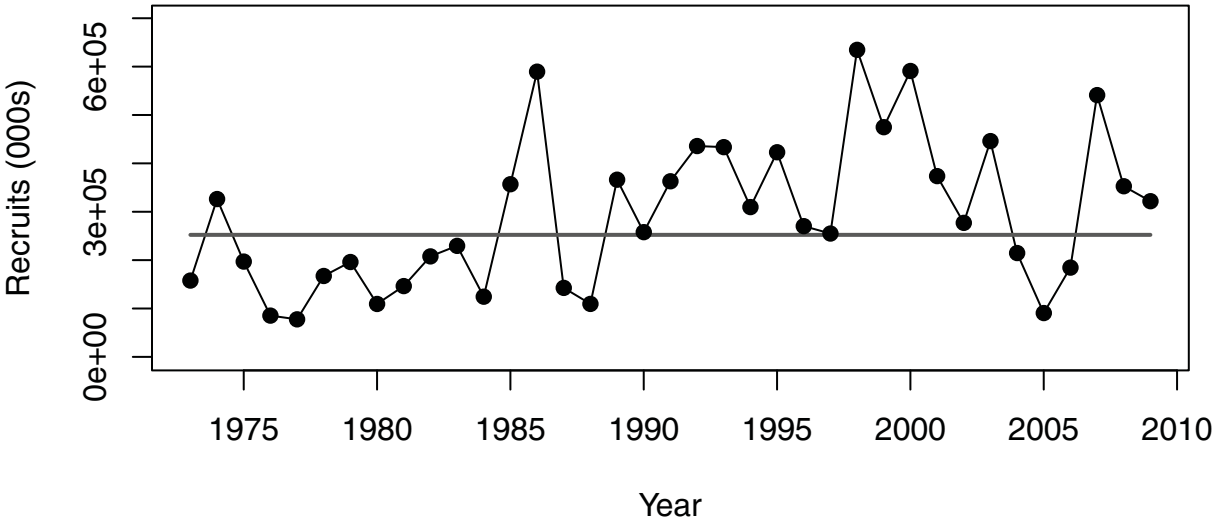

Index 2
Effective Sample Size
0
50
100
150
1975
1980
1985
1990
1995
2000
2005
2010
Year

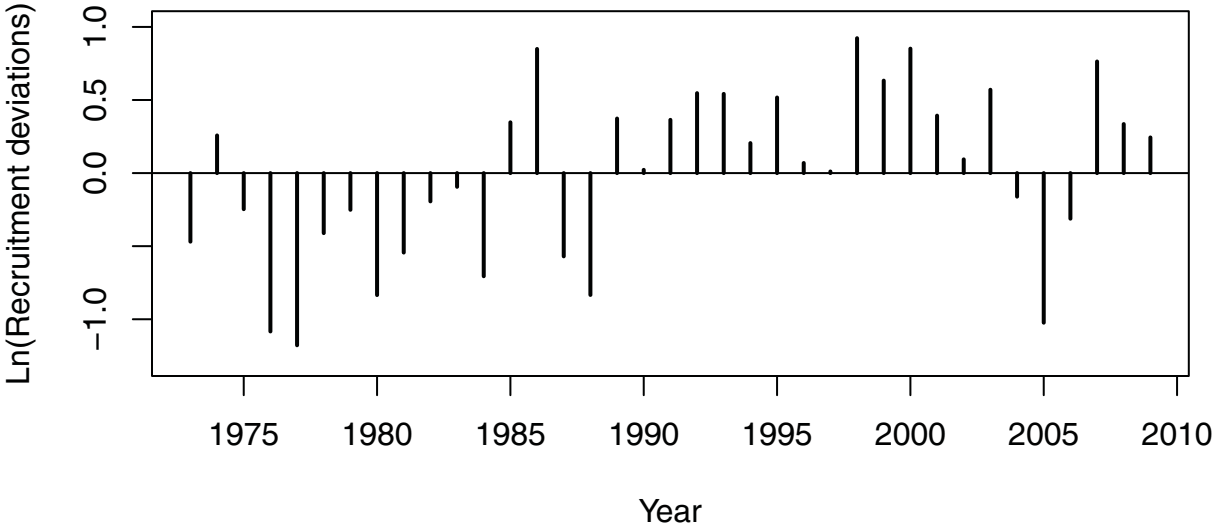

Index_1
Index_2
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

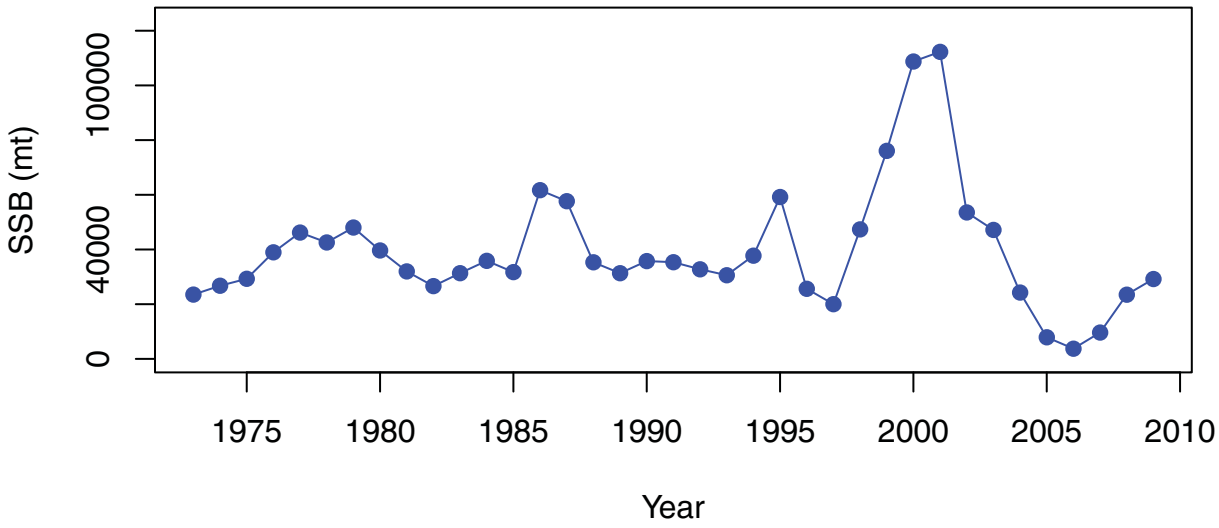

Index q estimates
1
2
0.4
0.3
0.2
0.1
0.0
Catchability
1975
1980
1985
1990
1995
2000
2005
2010
Index

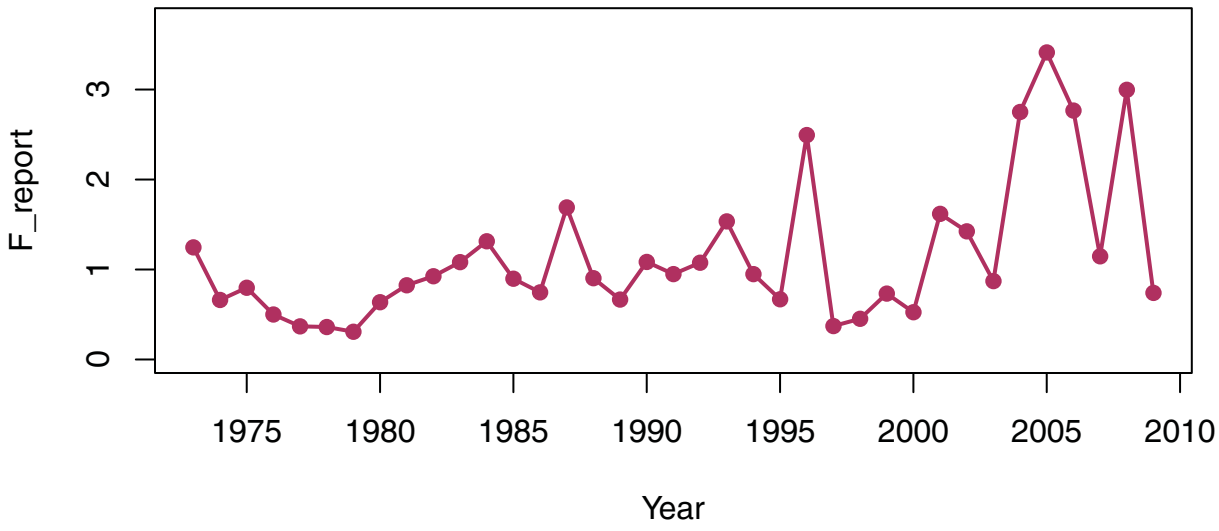

Recruits (000s)
0e+00
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
7e+05
0
20000
40000
60000
80000
100000
120000
SSB (mt)
98
86
00
07
99
03
95
01
08
94
96
02
97
90
83
04
82
75
79
06
78
81
87
84
80
88
05
76
77

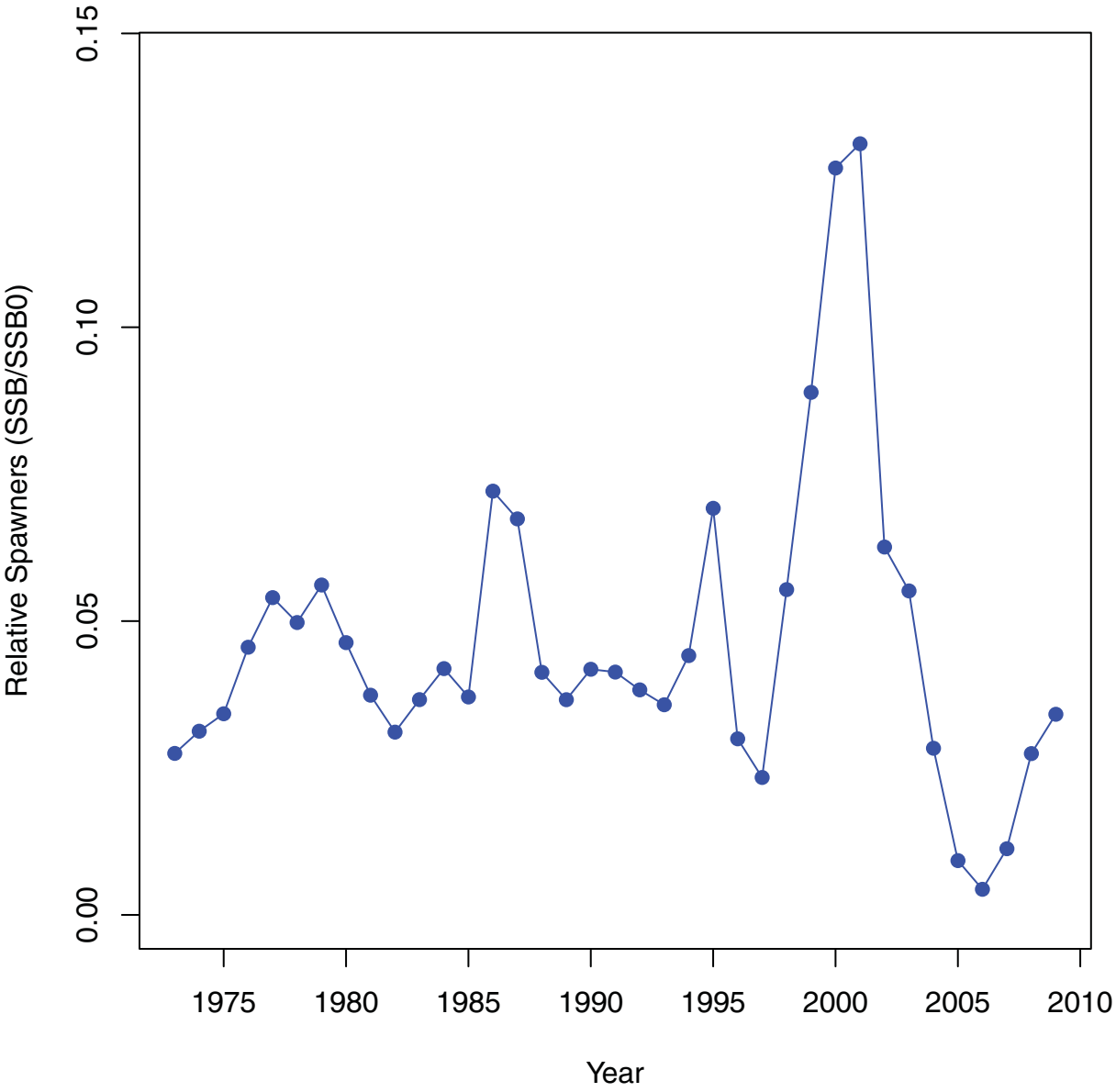

Recruits (000s)
0e+00
1e+05
2e+05
3e+05
4e+05
5e+05
6e+05
7e+05
0
20000
40000
60000
80000
100000
120000
SSB (mt)

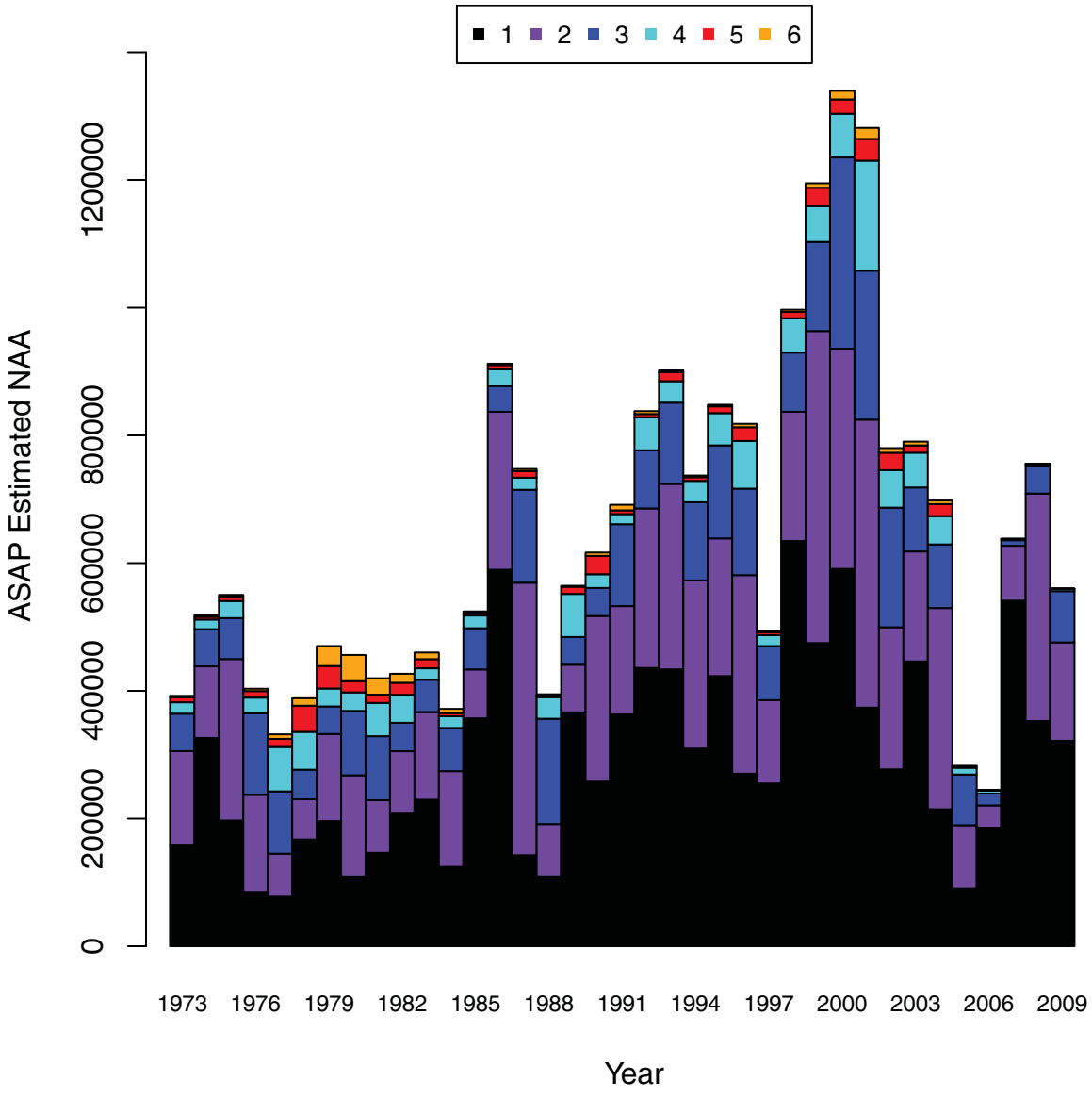

Recruits (000s)
0e+00
3e+05
6e+05
1975
1980
1985
1990
1995
2000
2005
2010
Year

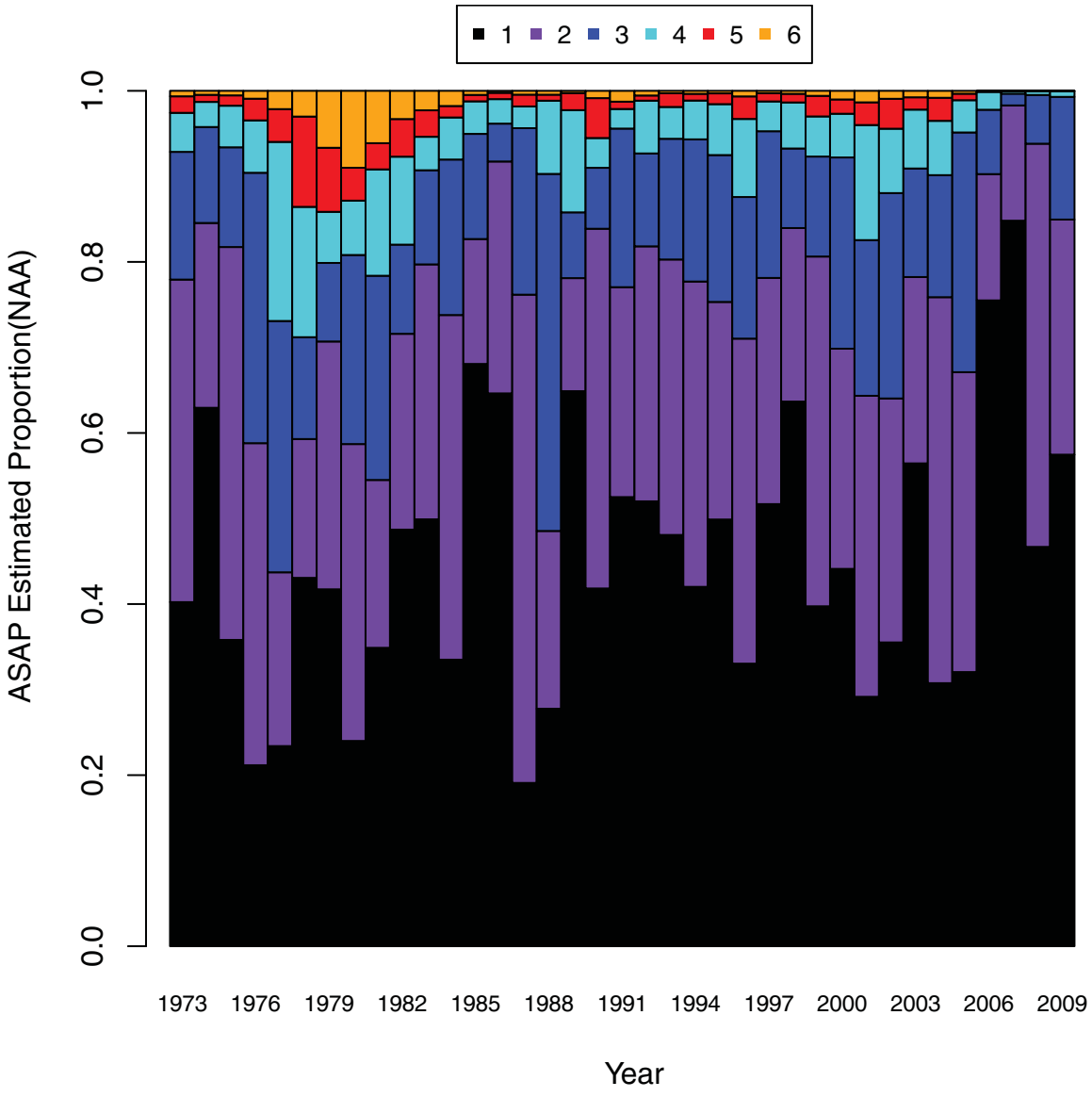

Ln(Recruitment deviations)
−1.0
0.0
0.5
1.0
1975
1980
1985
1990
1995
2000
2005
2010
Year

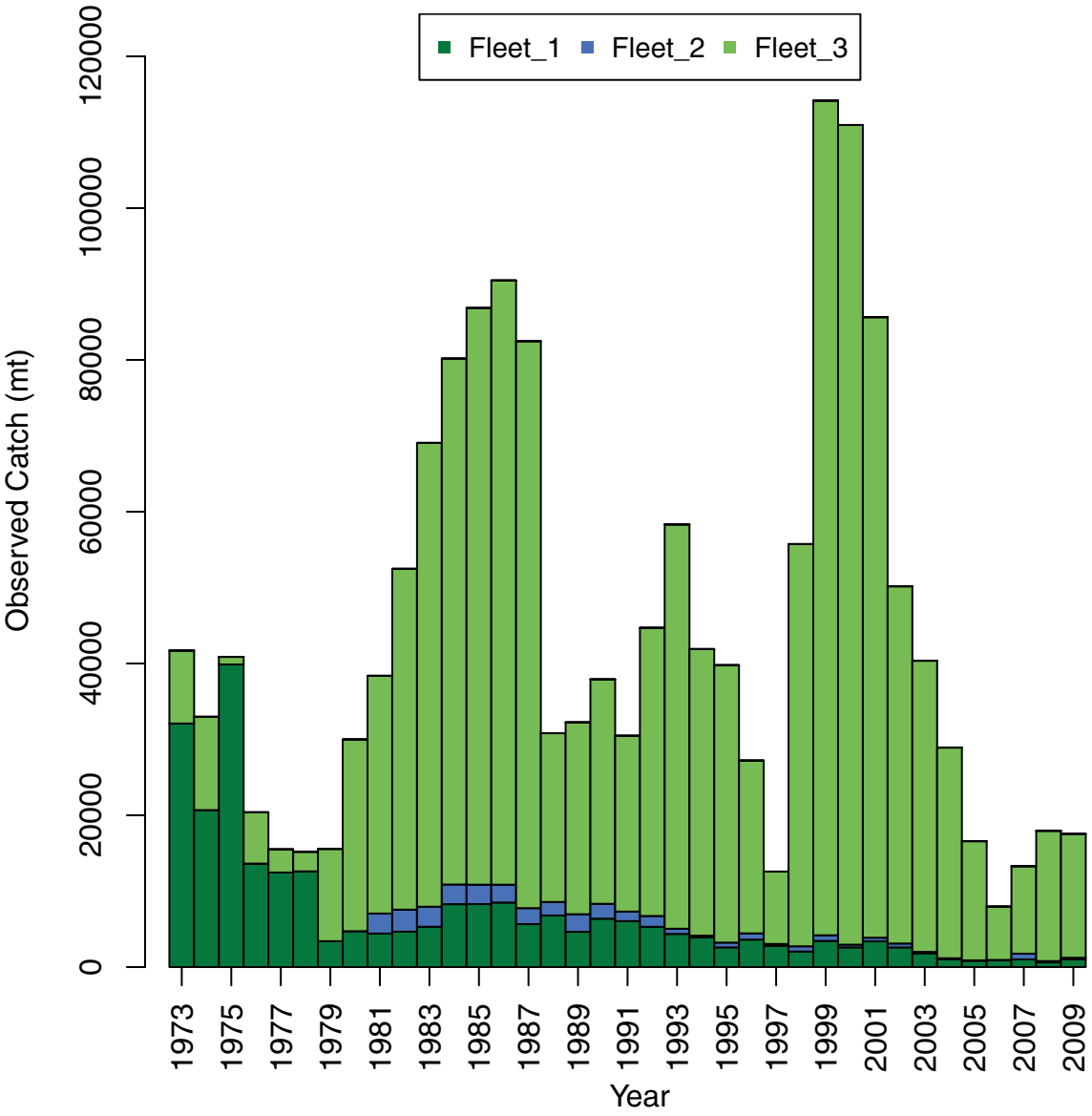

SSB (mt)
0
40000
100000
1975
1980
1985
1990
1995
2000
2005
2010
Year

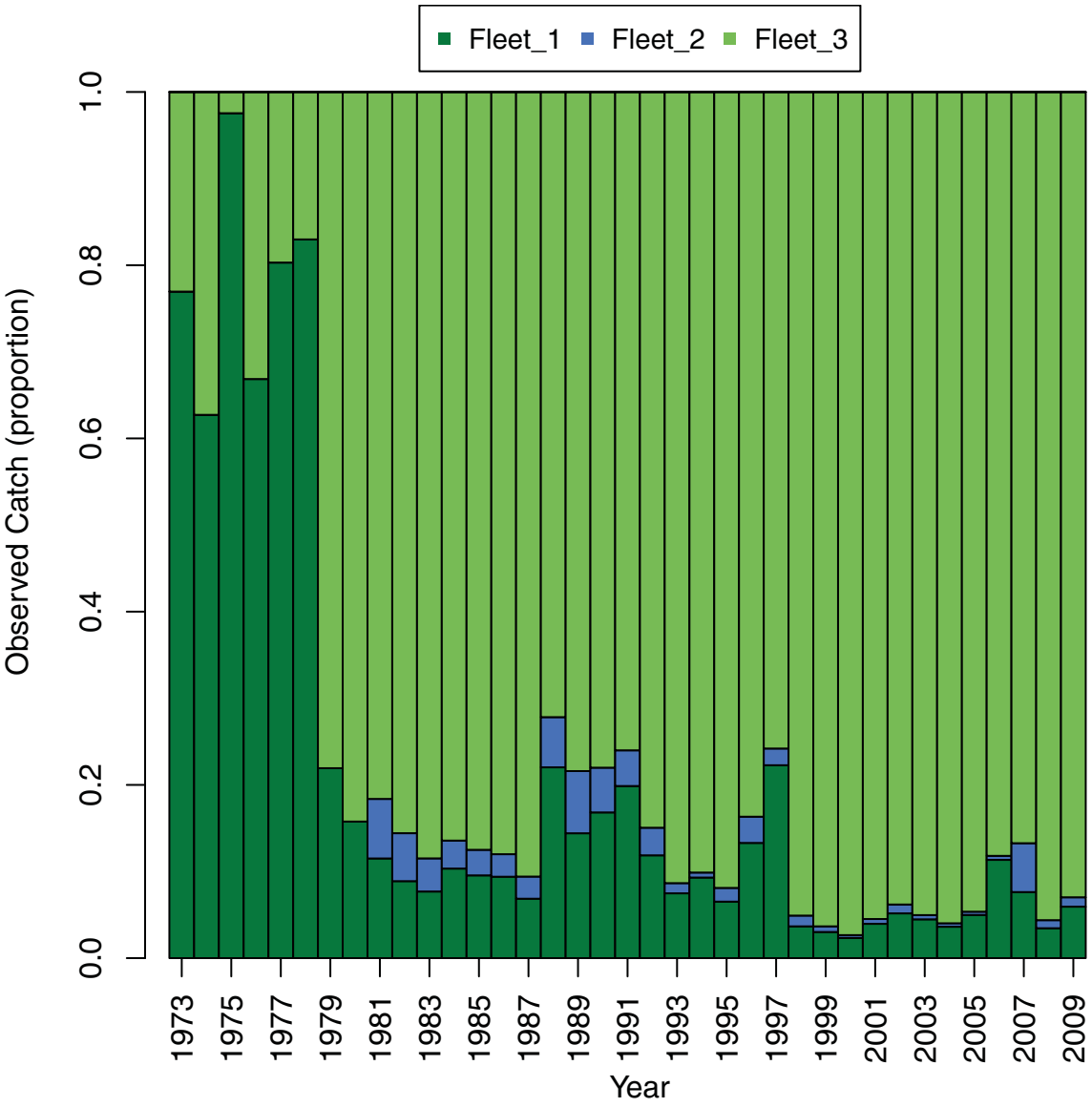

F_report
0
1
2
3
1975
1980
1985
1990
1995
2000
2005
2010
Year

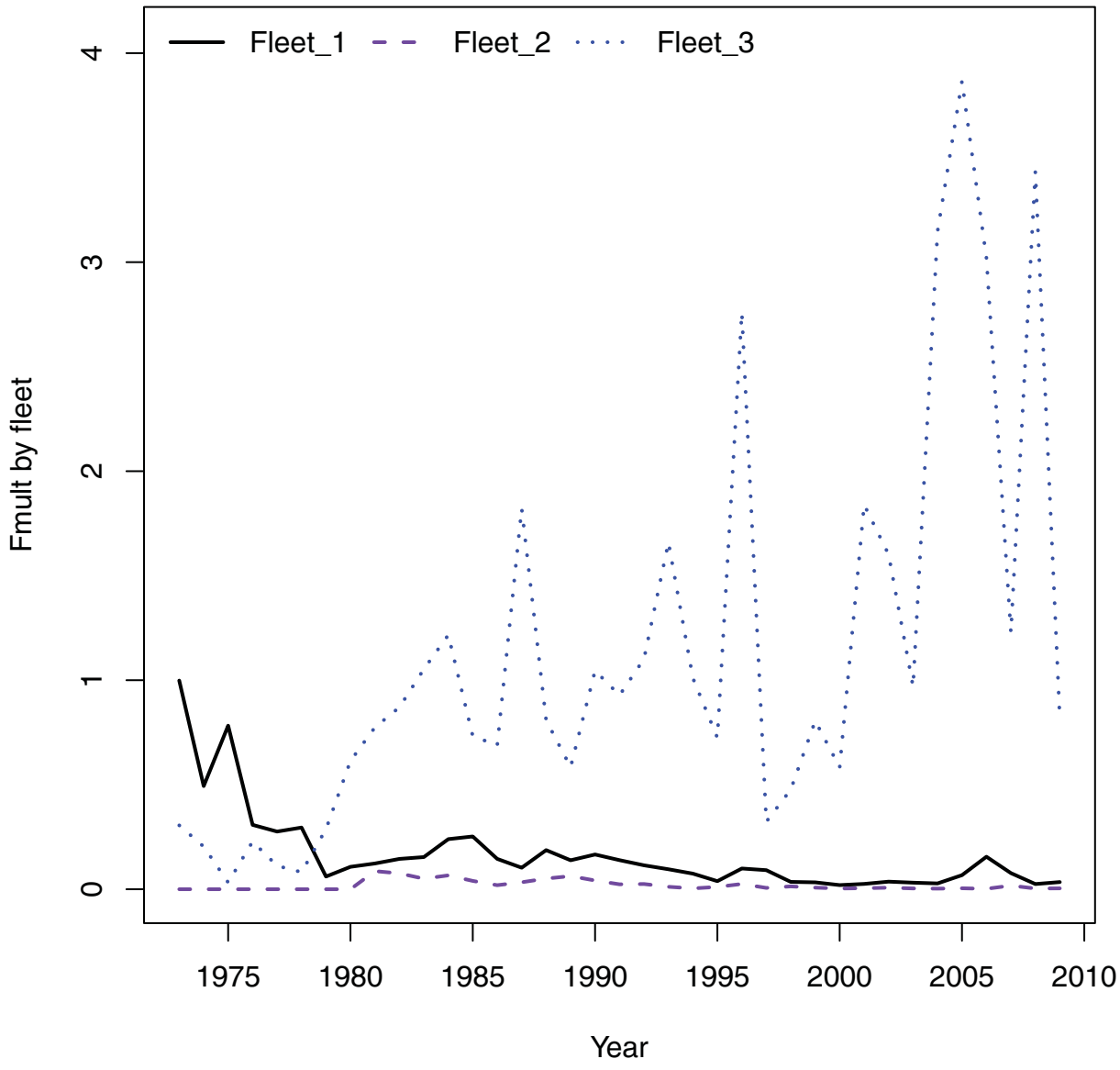

Relative Spawners (SSB/SSB0)
0.00
0.05
0.10
0.15
1975
1980
1985
1990
1995
2000
2005
2010
Year

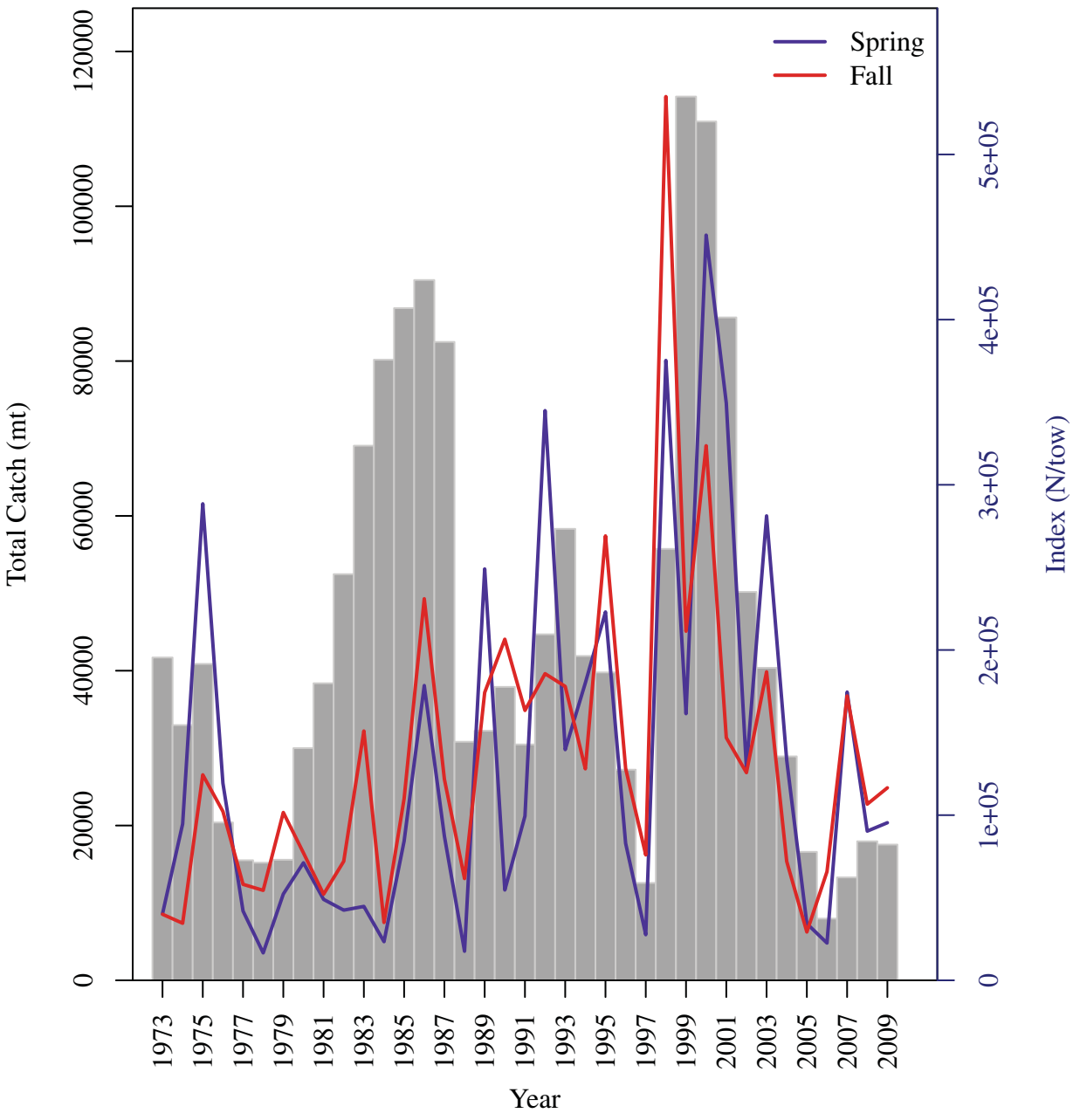

1
2
3
4
5
6
ASAP Estimated NAA
0
200000
400000
600000
800000
1200000
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

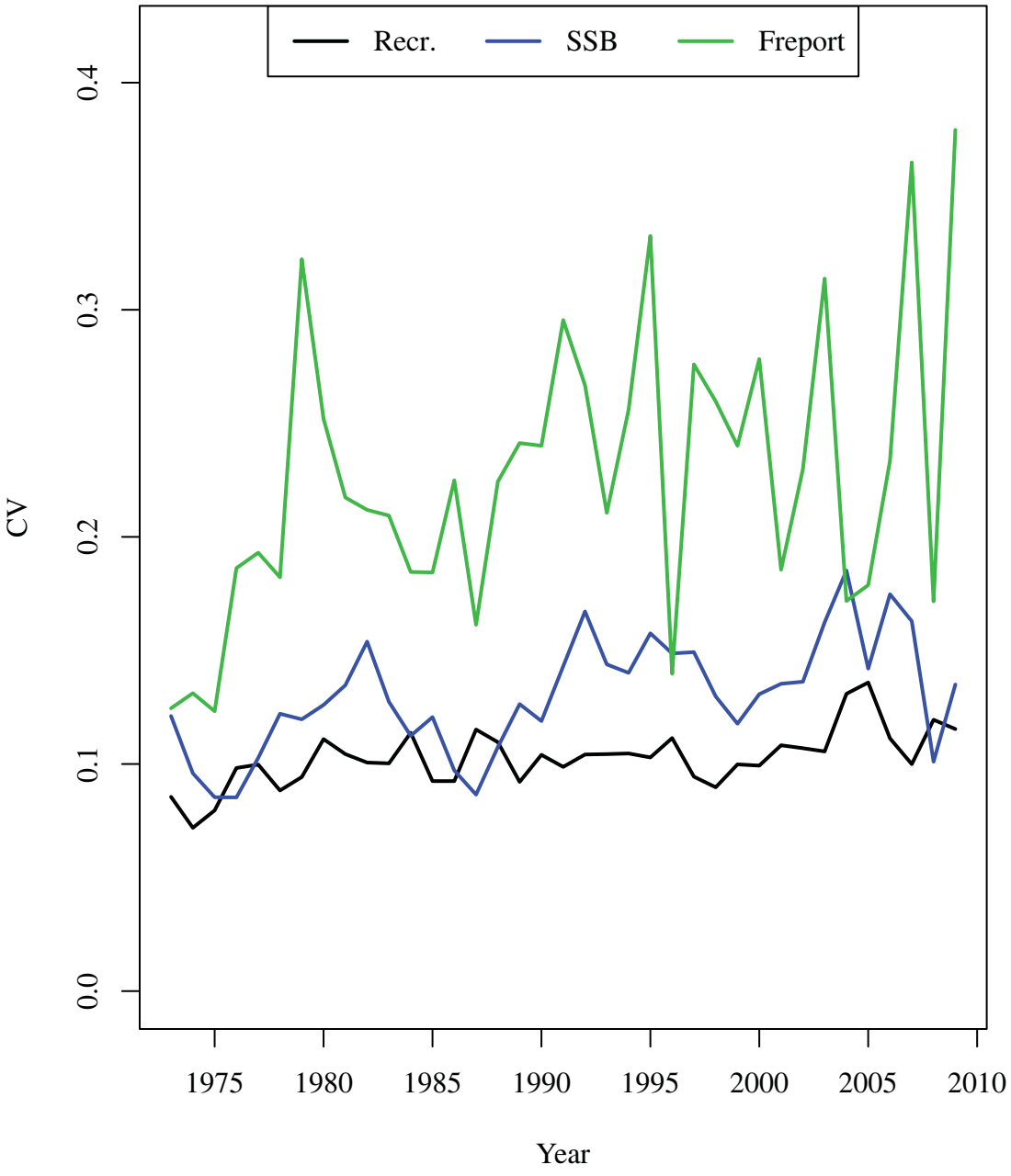

1
2
3
4
5
6
ASAP Estimated Proportion(NAA)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

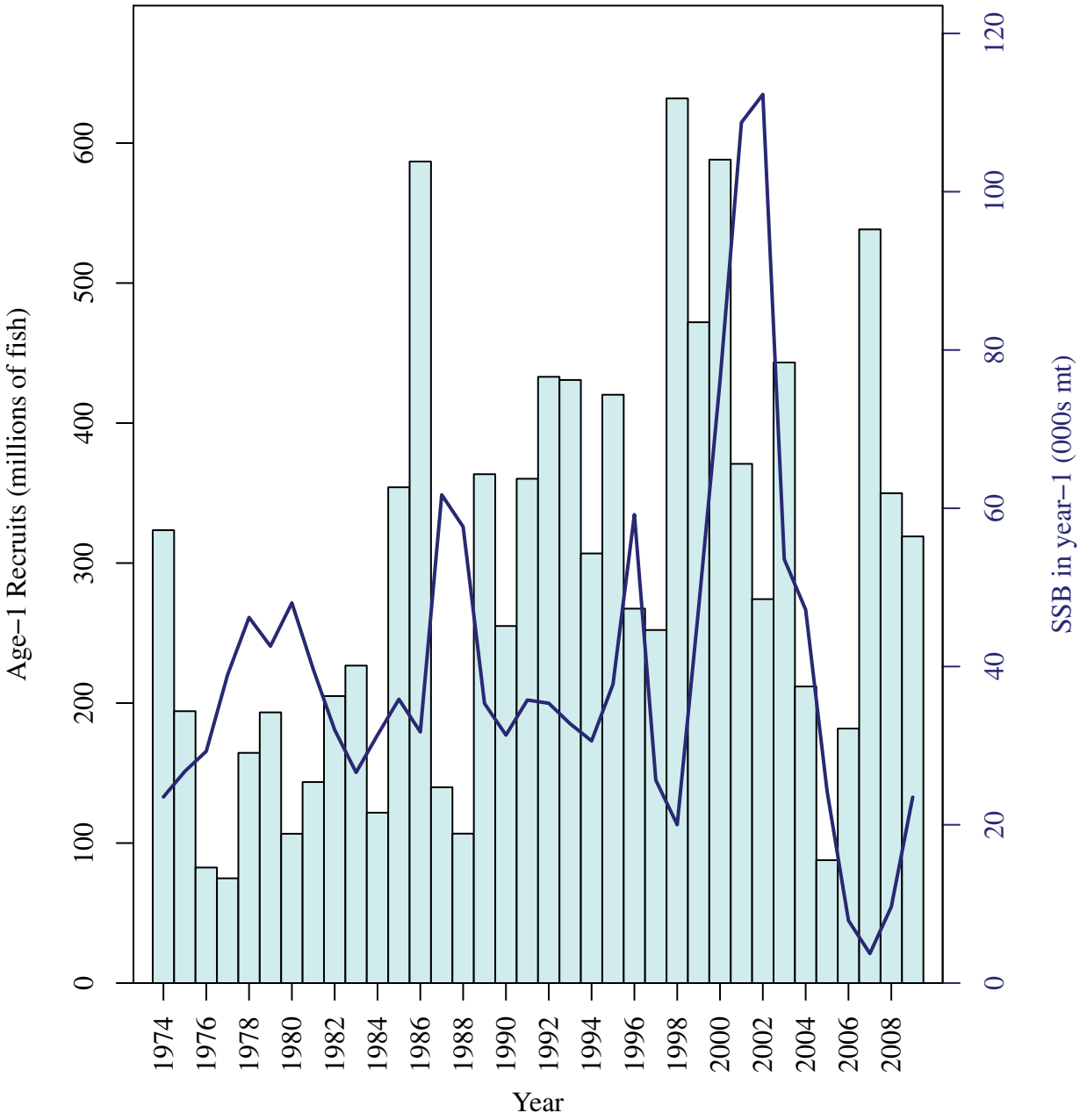

Fleet_1
Fleet_2
Fleet_3
Observed Catch (mt)
0
20000
40000
60000
80000
100000
120000
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fleet_3
Observed Catch (proportion)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fleet_3
Fmult by fleet
0
1
2
3
4
1975
1980
1985
1990
1995
2000
2005
2010
Year


Spring
Fall
Total Catch (mt)
Index (N/tow)
Year
0
20000
40000
60000
80000
100000
120000
1e+05
2e+05
3e+05
4e+05
5e+05
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Recr.
SSB
Freport
CV
0.0
0.1
0.2
0.3
0.4
1975
1980
1985
1990
1995
2000
2005
2010
Year


Age−1 Recruits (millions of fish)
0
100
200
300
400
500
600
SSB in year−1 (000s mt)
0
20
40
60
80
100
120
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year

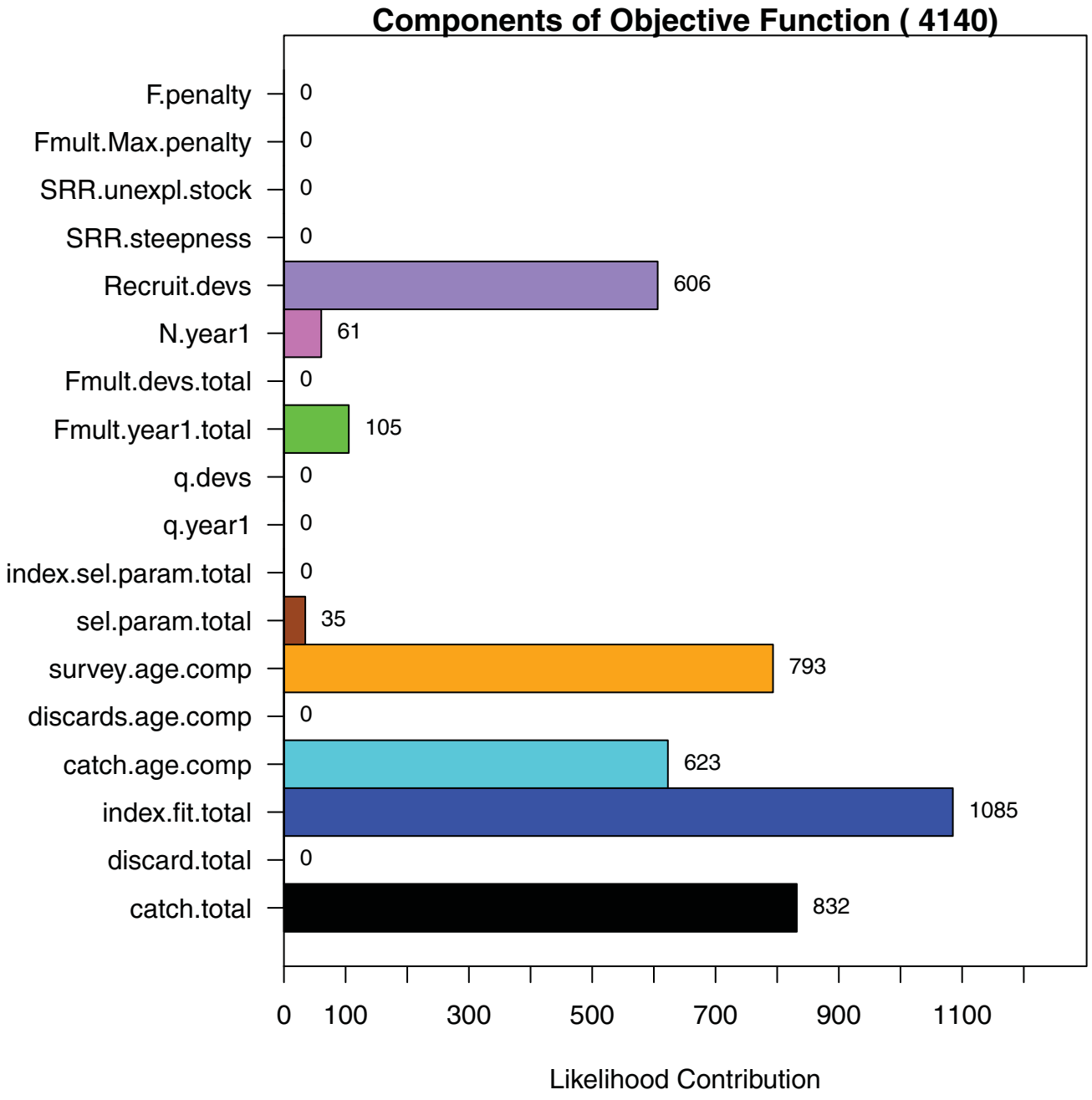
Appendix A6: North Model Consumption ASAP results M = 0.15_Assuming Flat-top Selectivity in the Survey

Model Attributes:

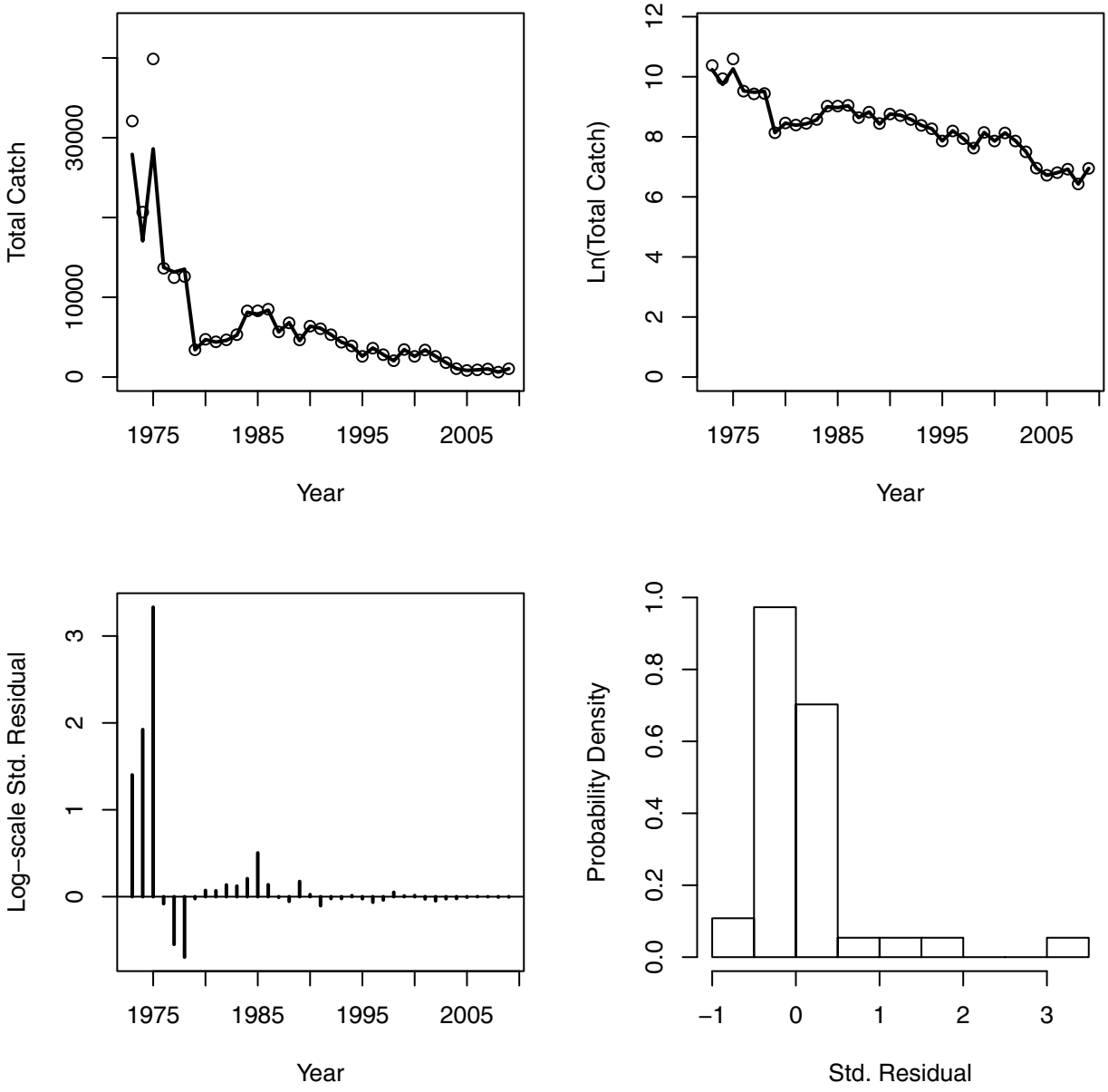
1. 3 Fleet Model
    a. Catch : 1973-2009
    b. Discards: 1981 – 2009
    c. Consumption – 1973-2009

2. Fishery Selectivity (3 Block Selectivity)
    a. Landings (1 Blocks: 1973-2009)
    b. Discards (1 Block: 1981-2009)
    c. Consumption (Double Logistic Functional Form)

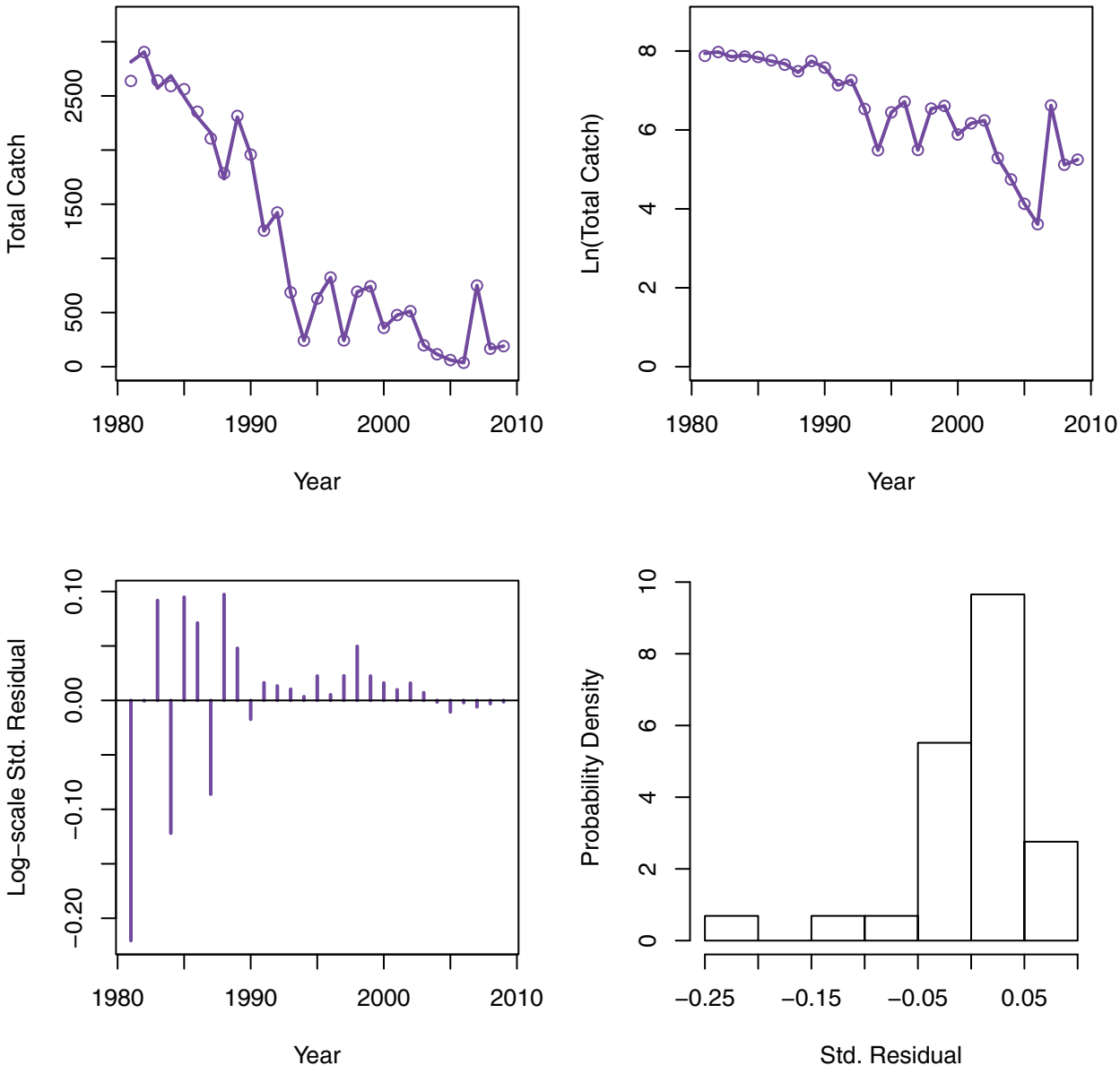
3. Survey Selectivity (Fixed 100% at age 2-6)

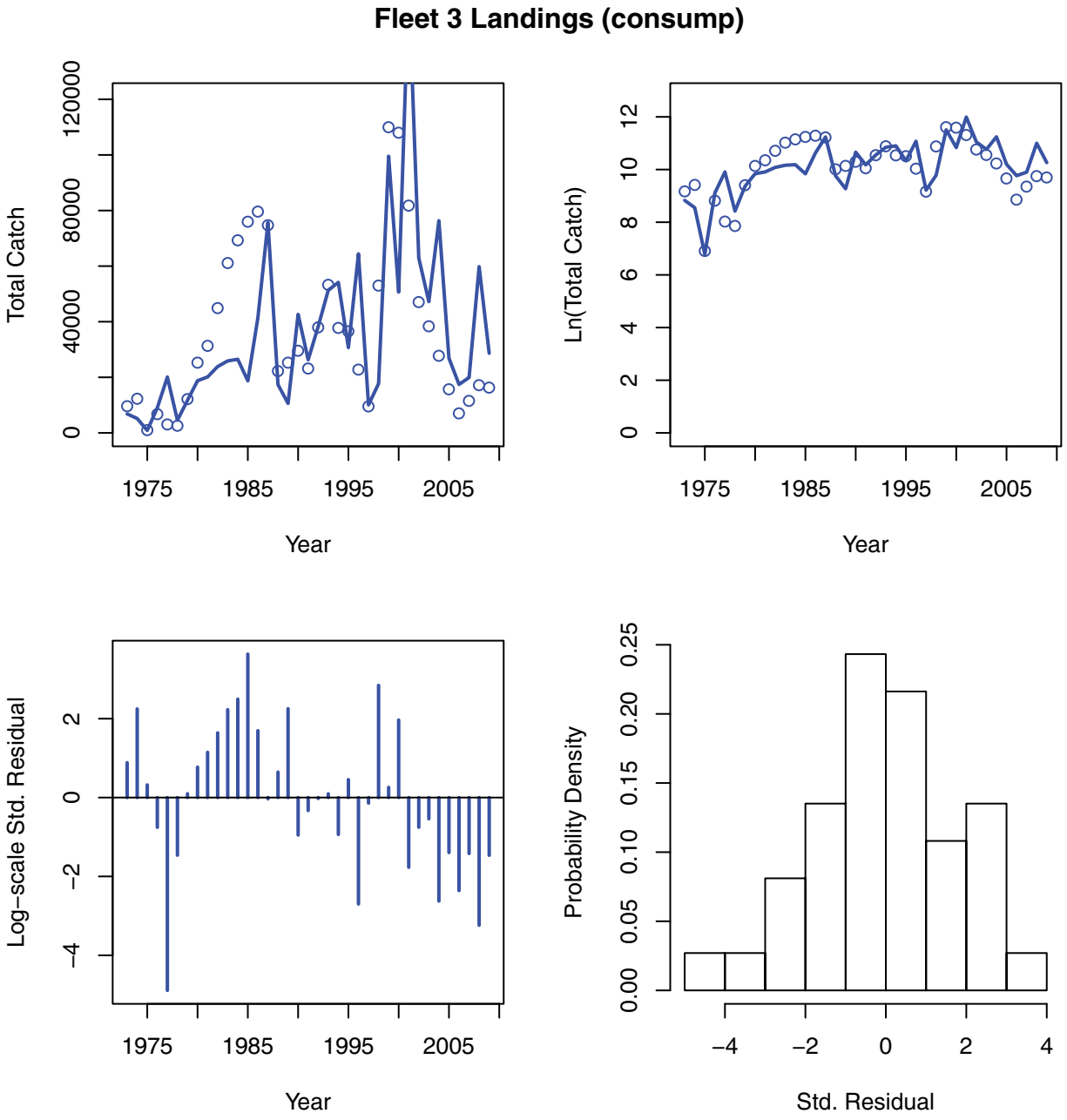

Components of Objective Function (4140)
F.penalty
Fmult.Max.penalty
SRR.unexpl.stock
SRR.steepness
Recruit.devs
N.year1
Fmult.devs.total
Fmult.year1.total
q.devs
q.year1
index.sel.param.total
sel.param.total
survey.age.comp
discards.age.comp
catch.age.comp
index.fit.total
discard.total
catch.total
0
0
0
0
606
61
0
105
0
0
0
35
793
0
623
1085
0
832
0
100
300
500
700
900
1100
Likelihood Contribution

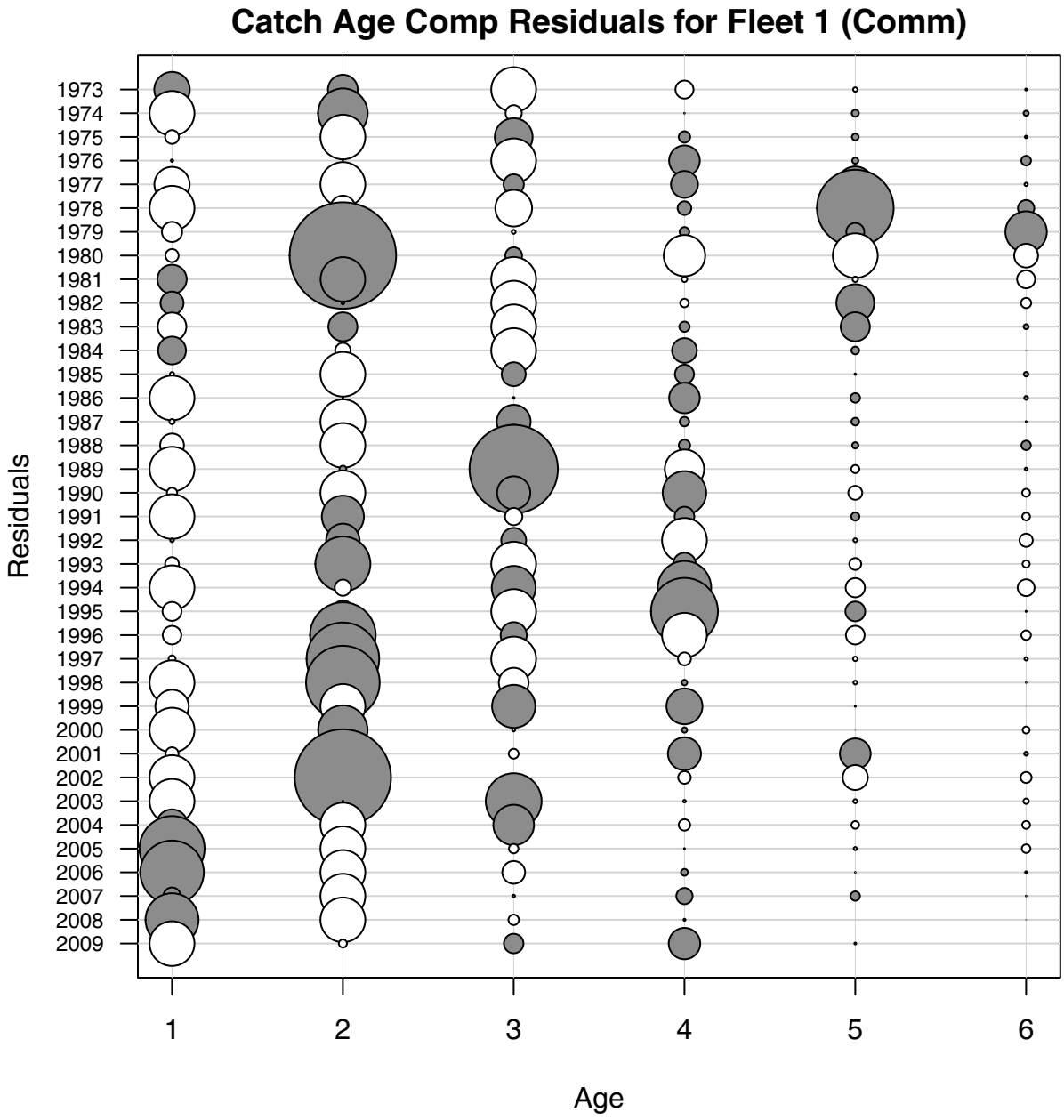
Fleet 1 Landings (Comm)

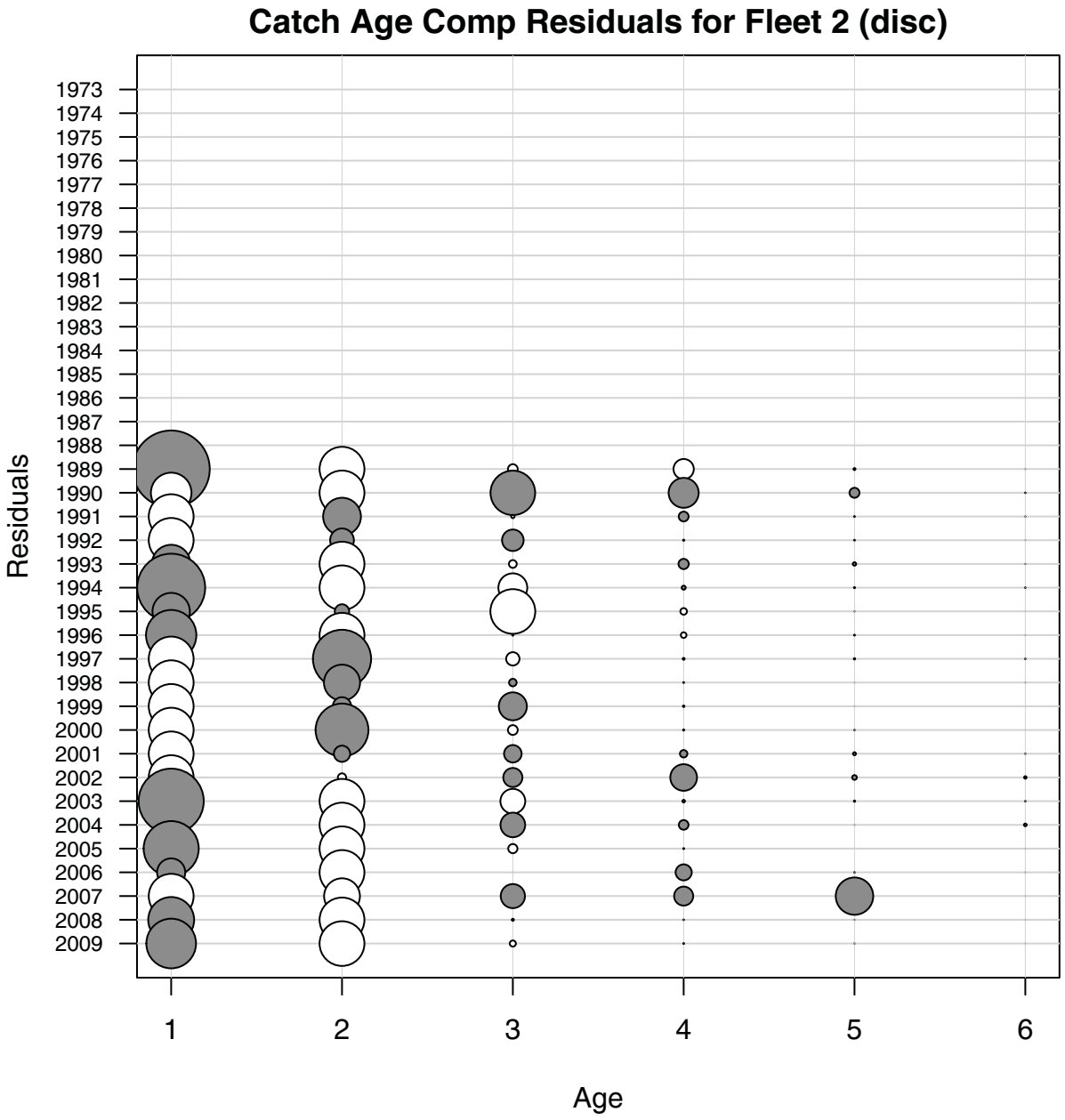


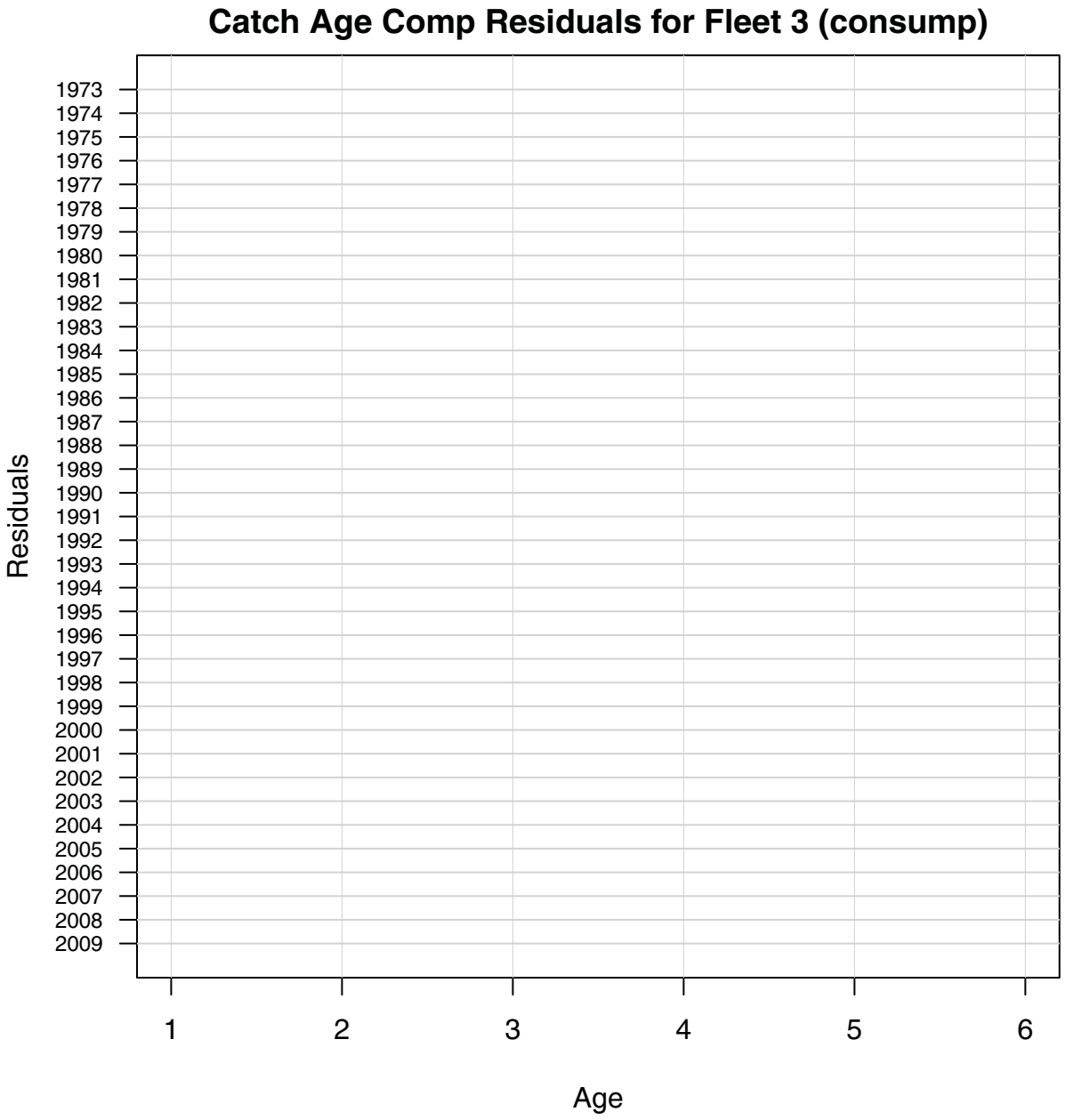
Fleet 2 Landings (disc)

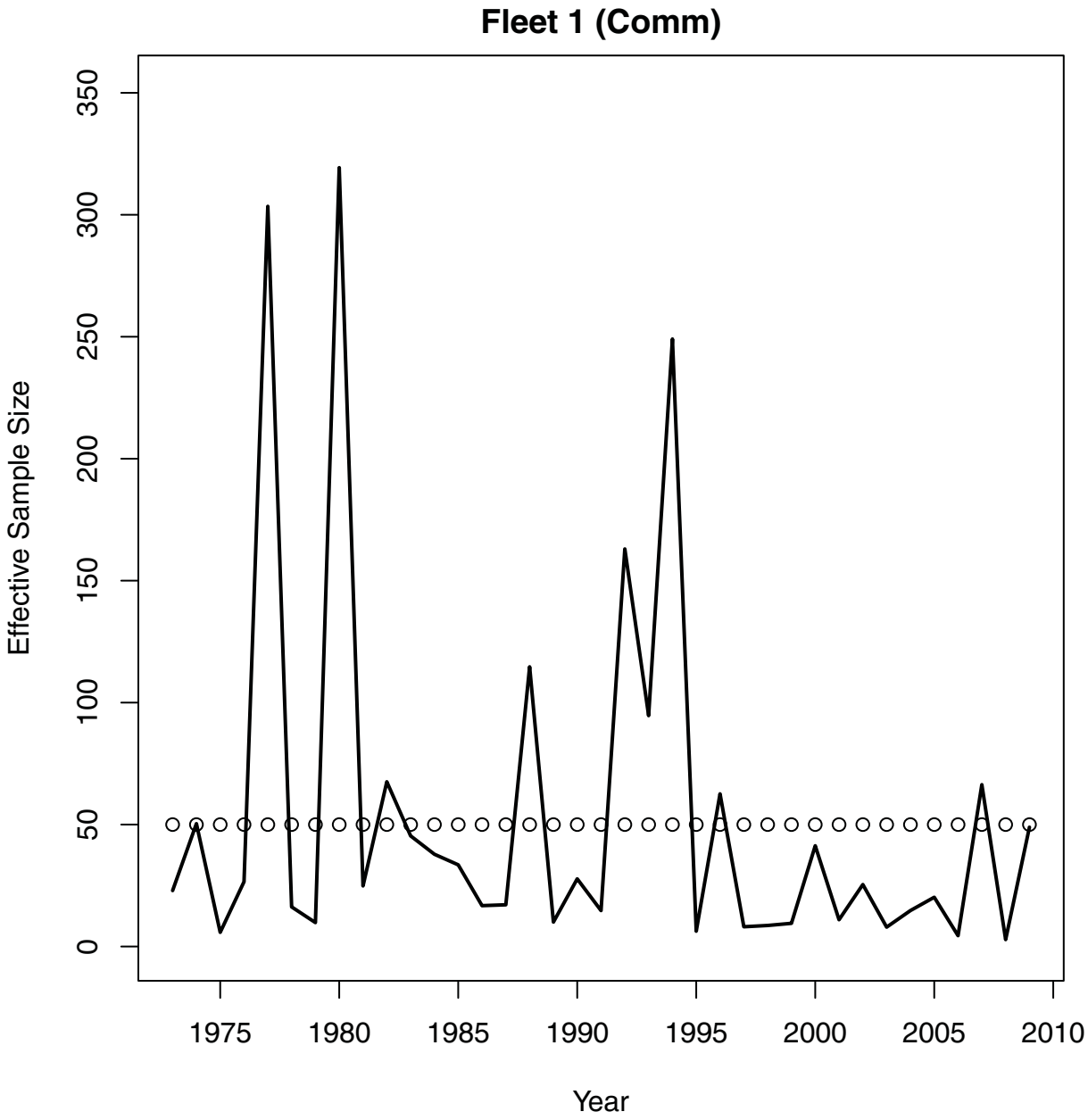


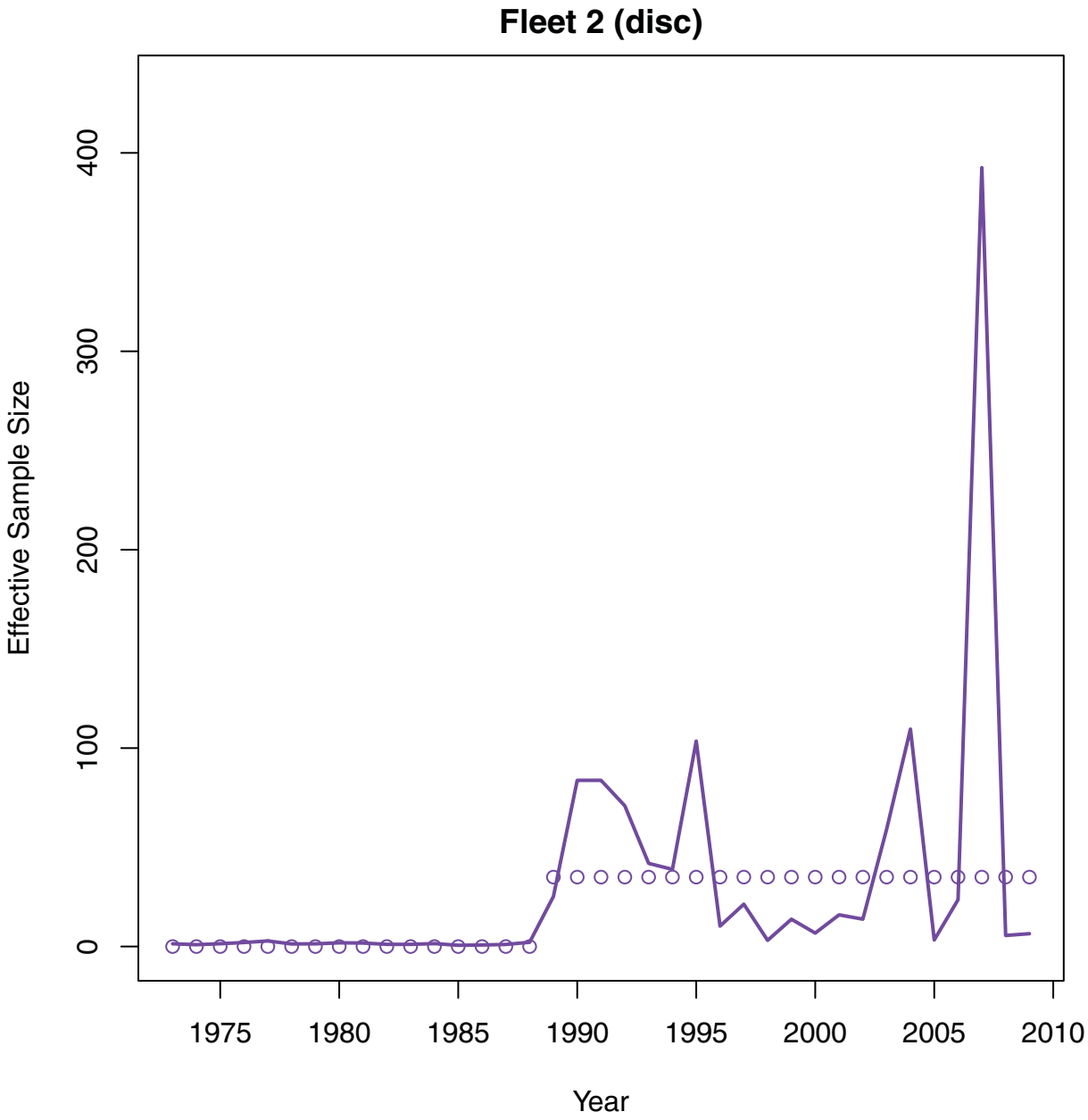

Fleet 3 Landings (consump)
Total Catch
0
40000
80000
120000
1975
1985
1995
2005
Year
Ln(Total Catch)
0
2
4
6
8
10
12
1975
1985
1995
2005
Year
Log−scale Std. Residual
−4
−2
0
2
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
0.20
0.25
−4
−2
0
2
4
Std. Residual

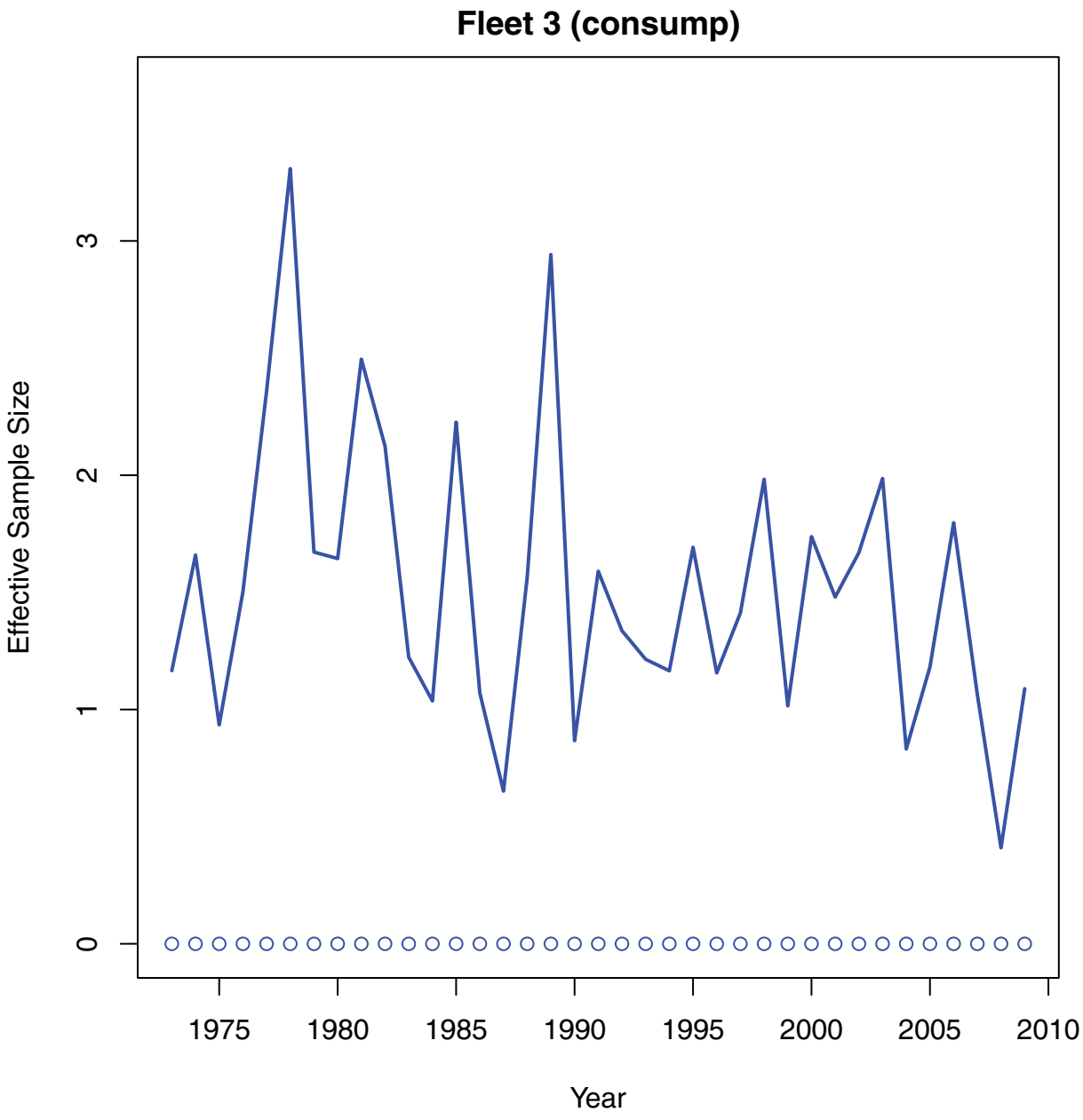

Catch Age Comp Residuals for Fleet 1 (Comm)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

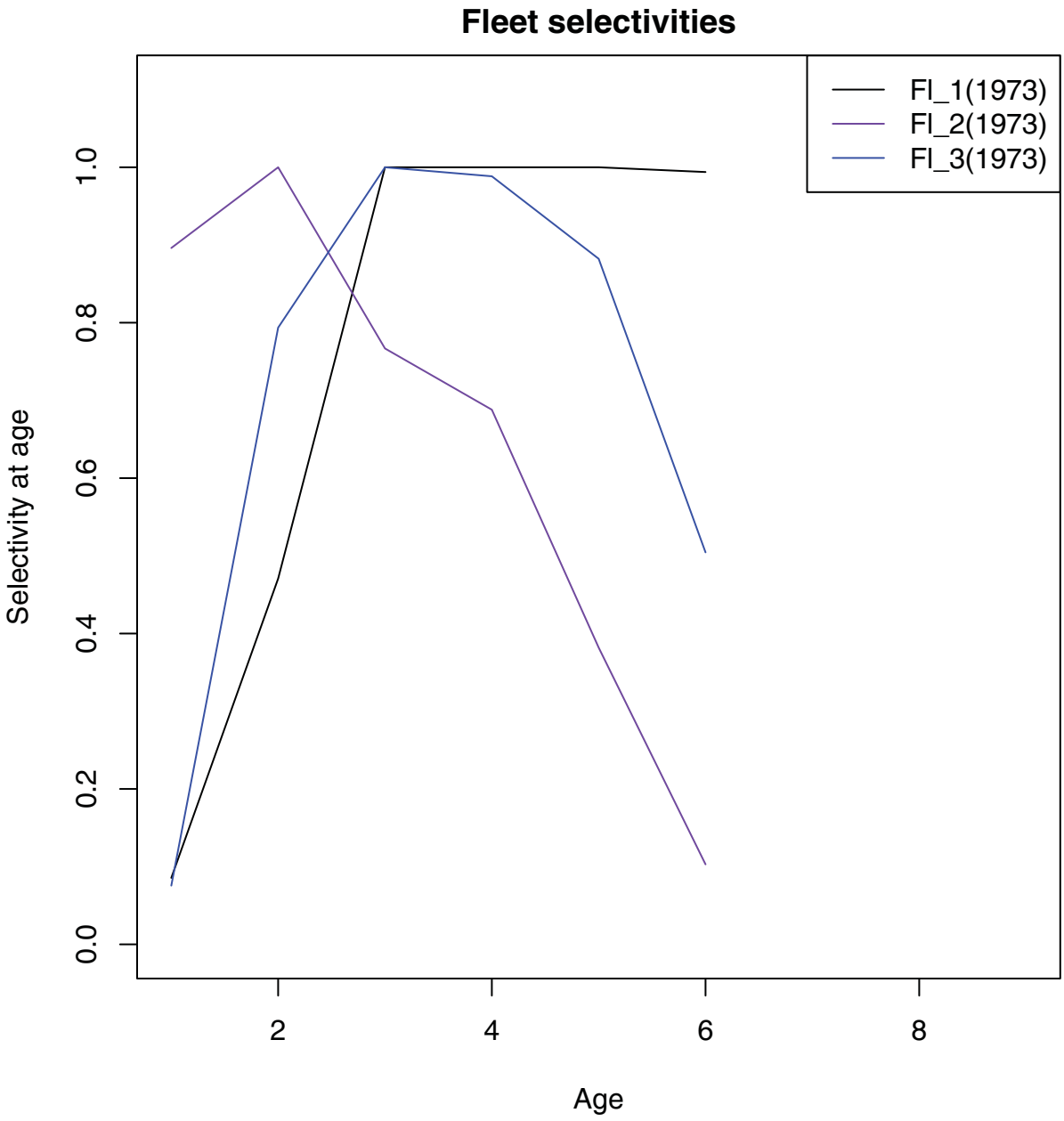

Catch Age Comp Residuals for Fleet 2 (disc)
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age


Catch Age Comp Residuals for Fleet 3 (consump)
Residuals
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
1
2
3
4
5
6
Age

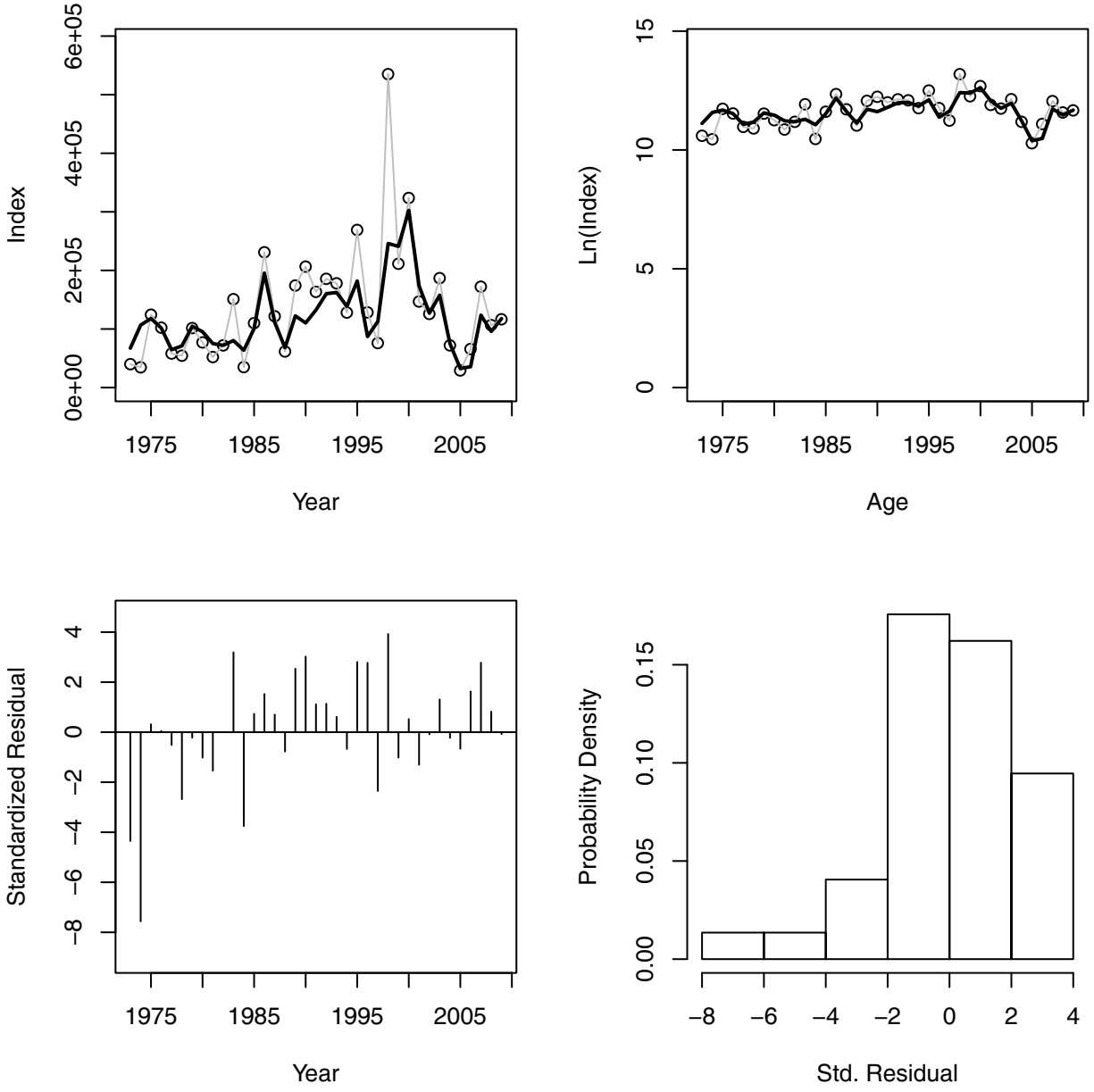

Fleet 1 (Comm)
Effective Sample Size
0
50
100
150
200
250
300
350
1975
1980
1985
1990
1995
2000
2005
2010
Year


Fleet 2 (disc)
Effective Sample Size
0
100
200
300
400
1975
1980
1985
1990
1995
2000
2005
2010
Year

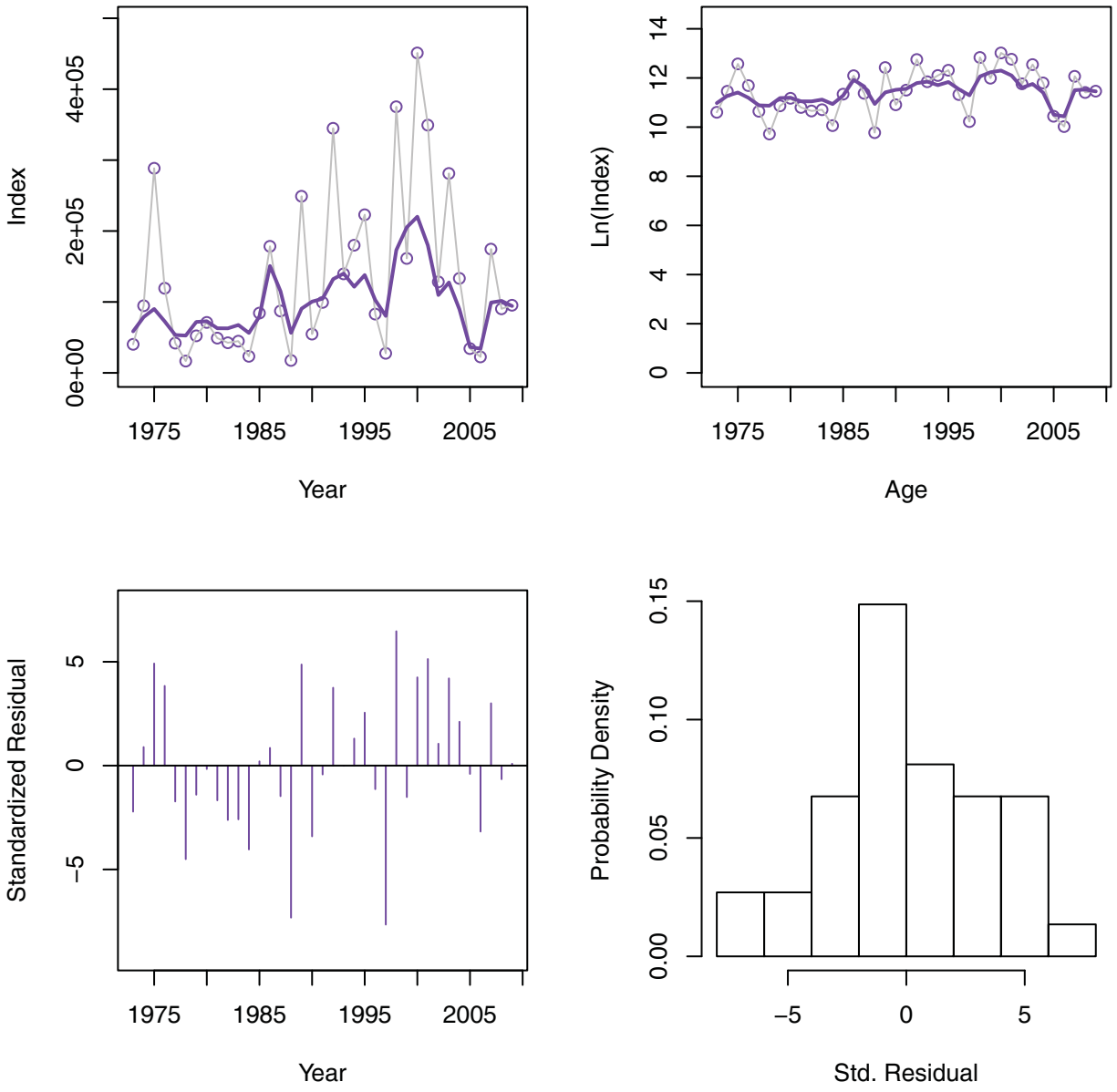

Fleet 3 (consump)
Effective Sample Size
0
1
2
3
1975
1980
1985
1990
1995
2000
2005
2010
Year

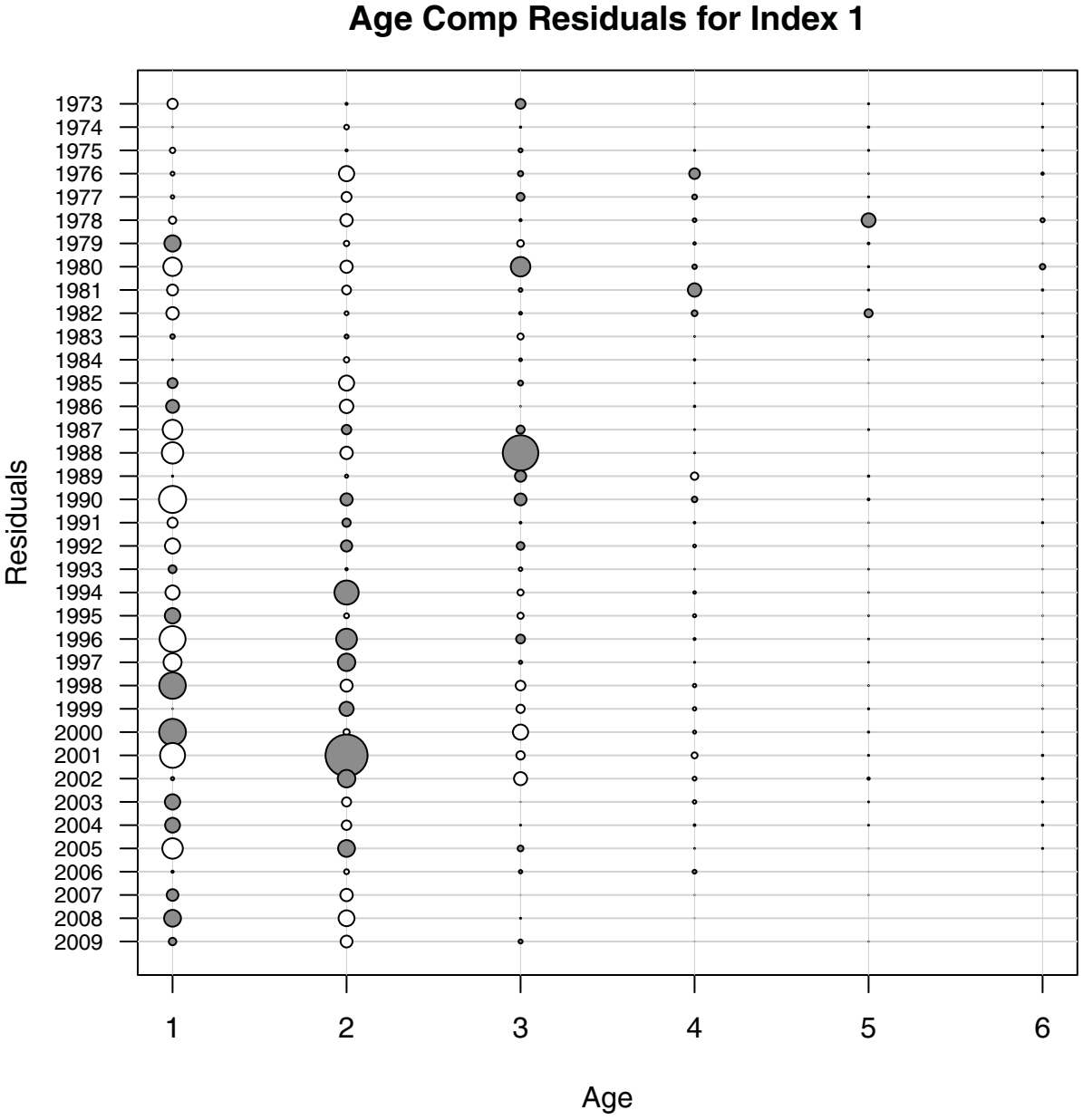

Fleet selectivities
Fl_1(1973)
Fl_2(1973)
Fl_3(1973)
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

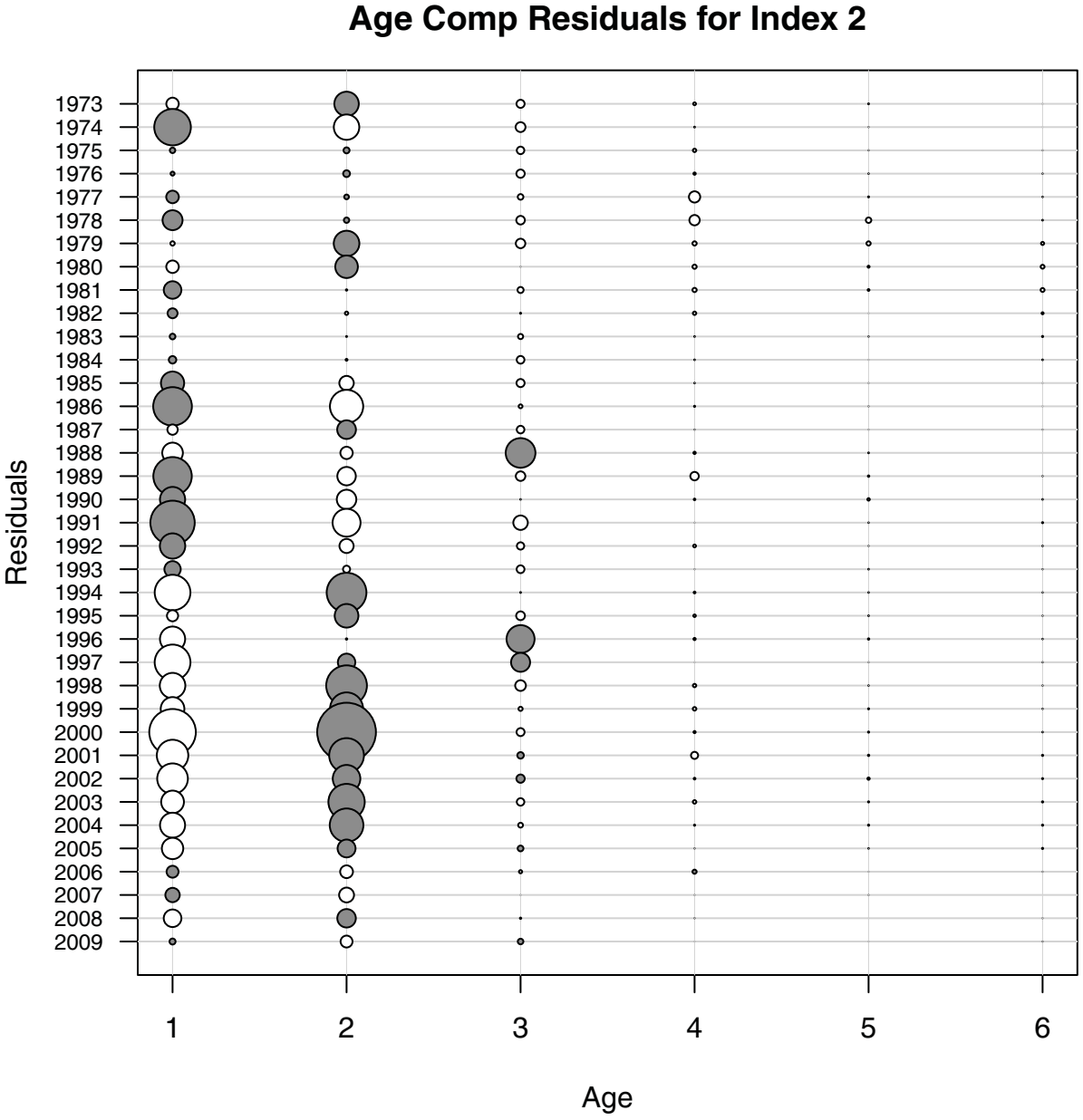
Index 1

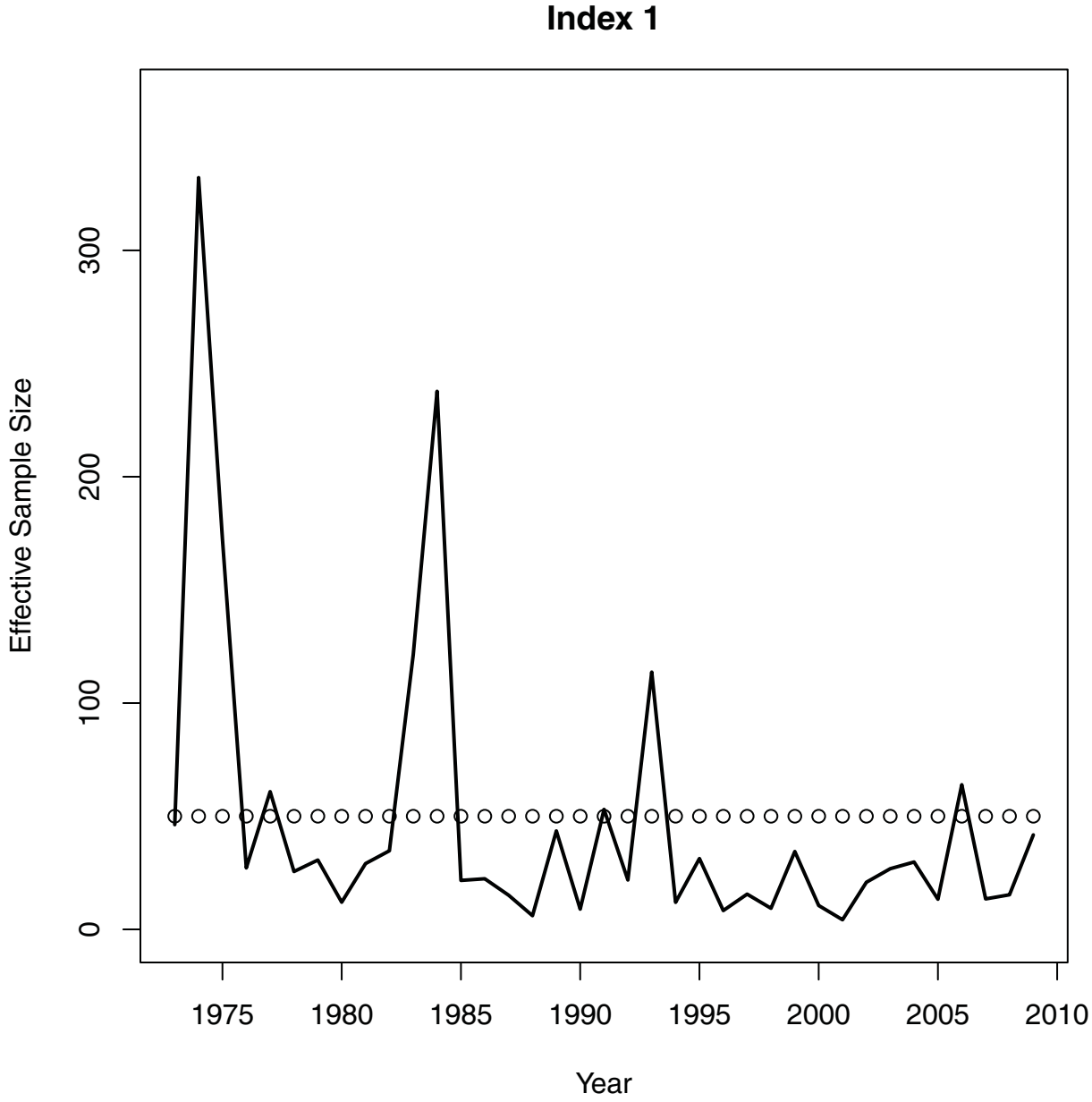

Index
0e+00
2e+05
4e+05
6e+05
1975
1985
1995
2005
Year
Ln(Index)
0
5
10
15
Age
Standardized Residual
−8
−6
−4
−2
0
2
4
Probability Density
0.00
0.05
0.10
0.15
Std. Residual

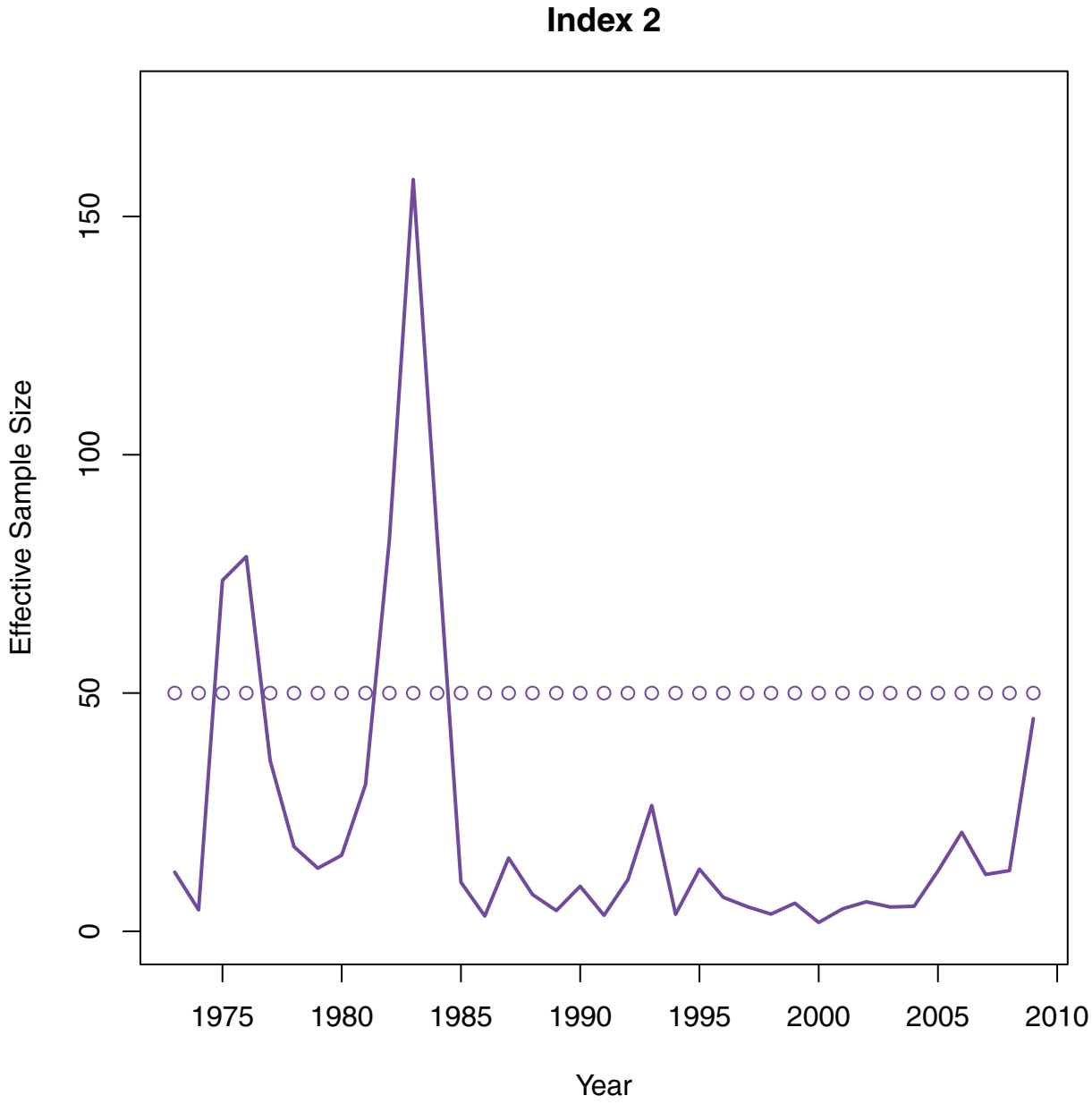
Index 2

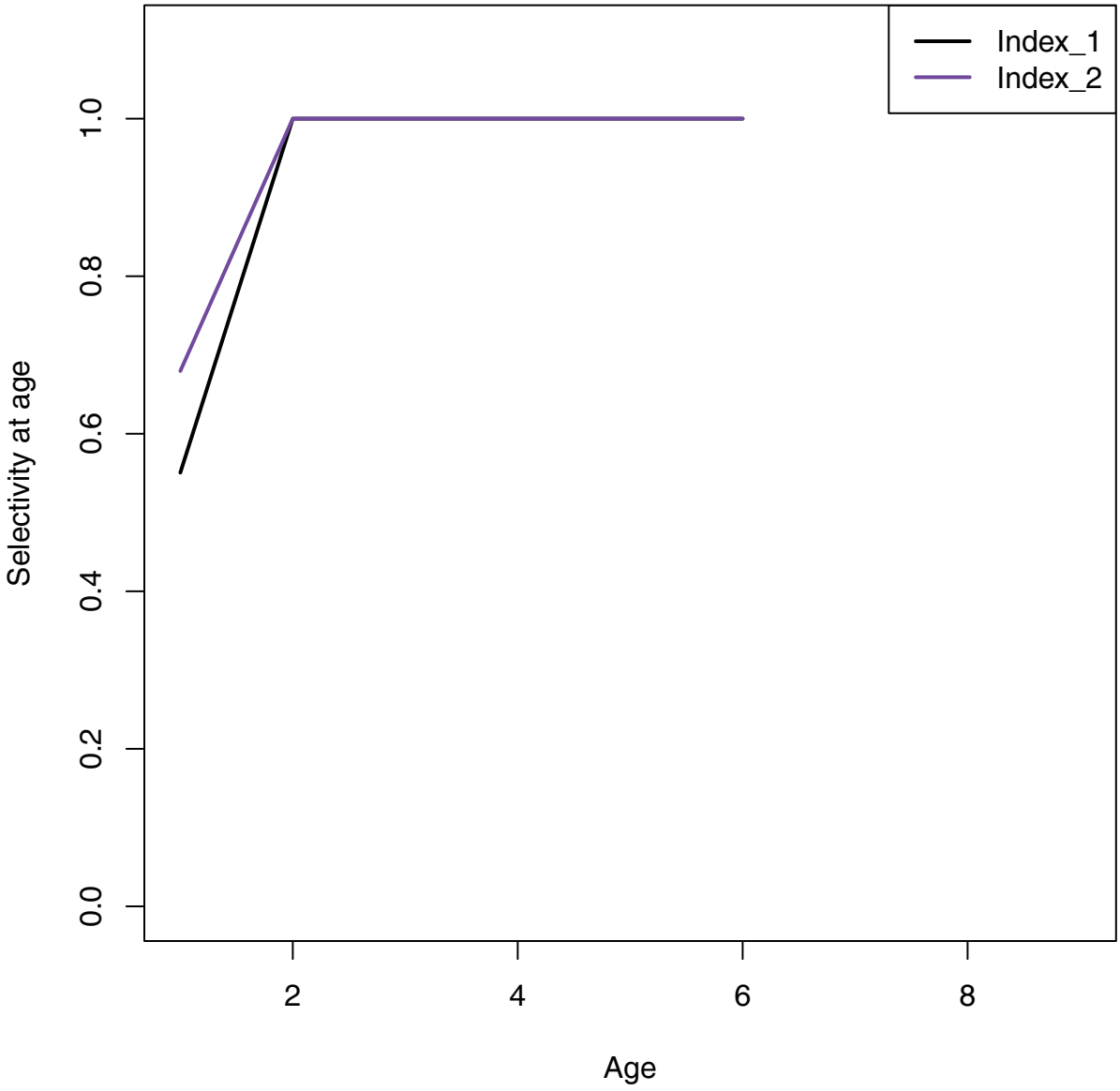

Index
0e+00
2e+05
4e+05
1975
1985
1995
2005
Year
Ln(Index)
0
2
4
6
8
10
12
14
1975
1985
1995
2005
Age
Standardized Residual
−5
0
5
1975
1985
1995
2005
Year
Probability Density
0.00
0.05
0.10
0.15
−5
0
5
Std. Residual

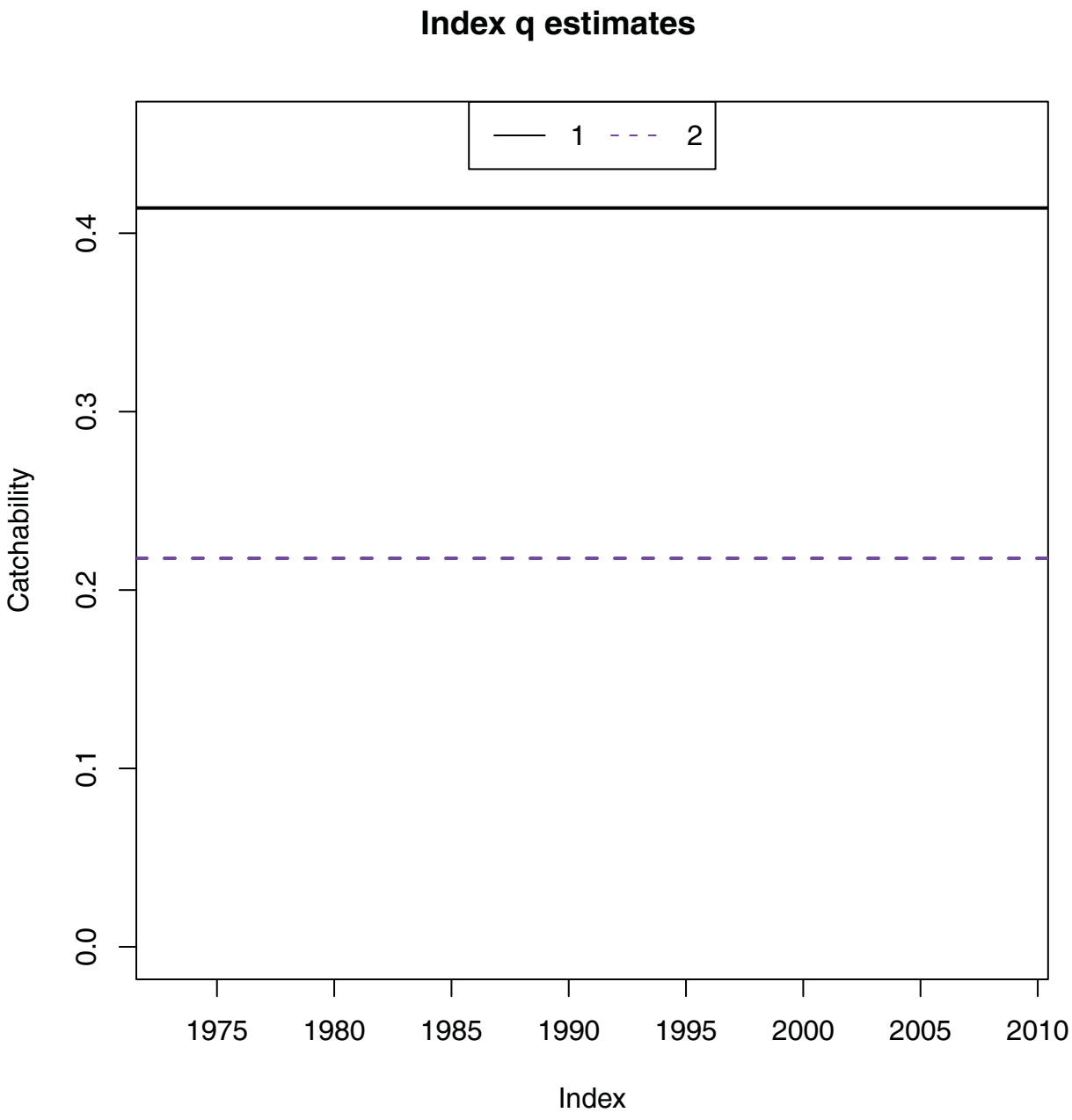

Age Comp Residuals for Index 1
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

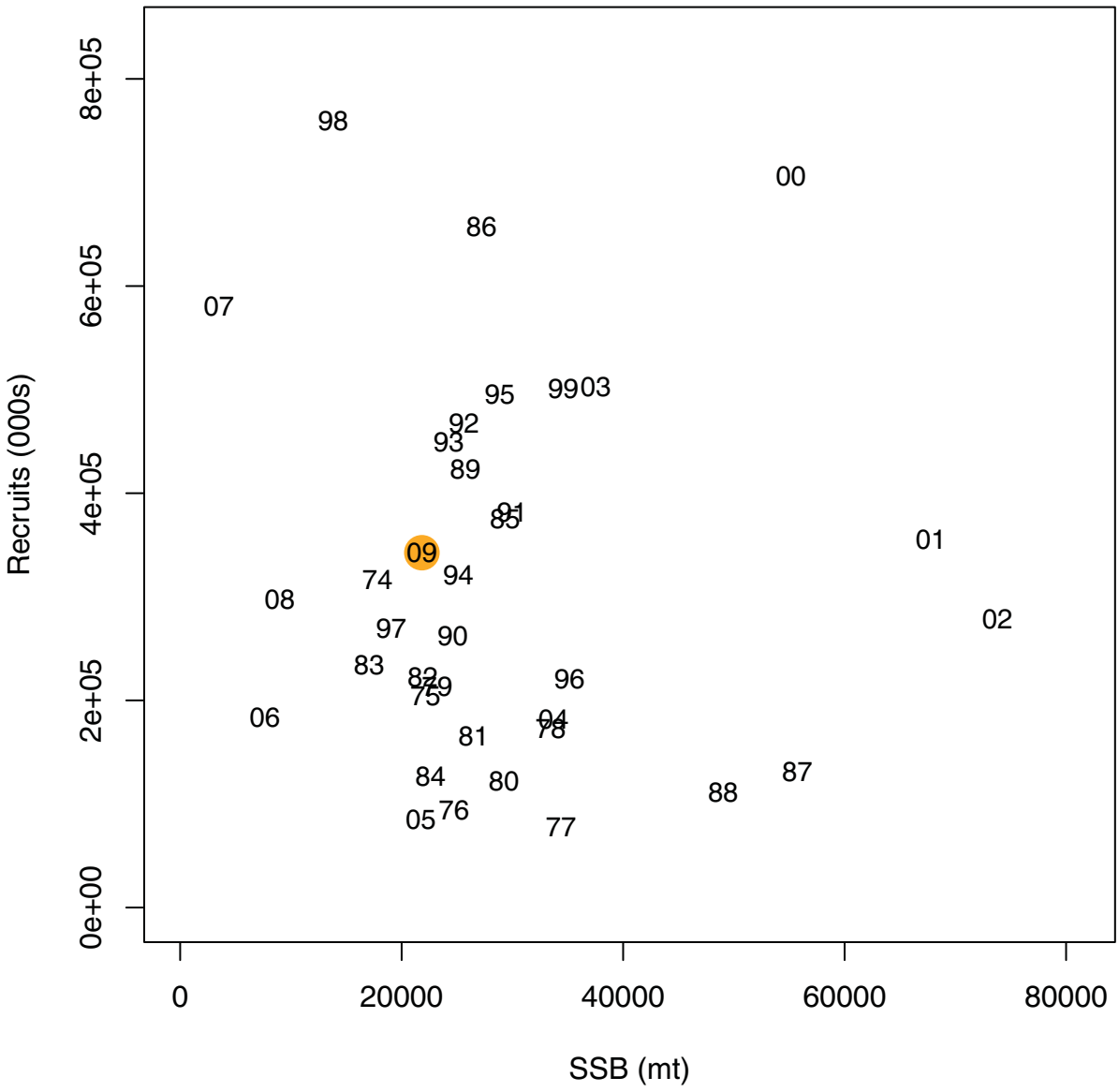

Age Comp Residuals for Index 2
Residuals
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
1
2
3
4
5
6
Age

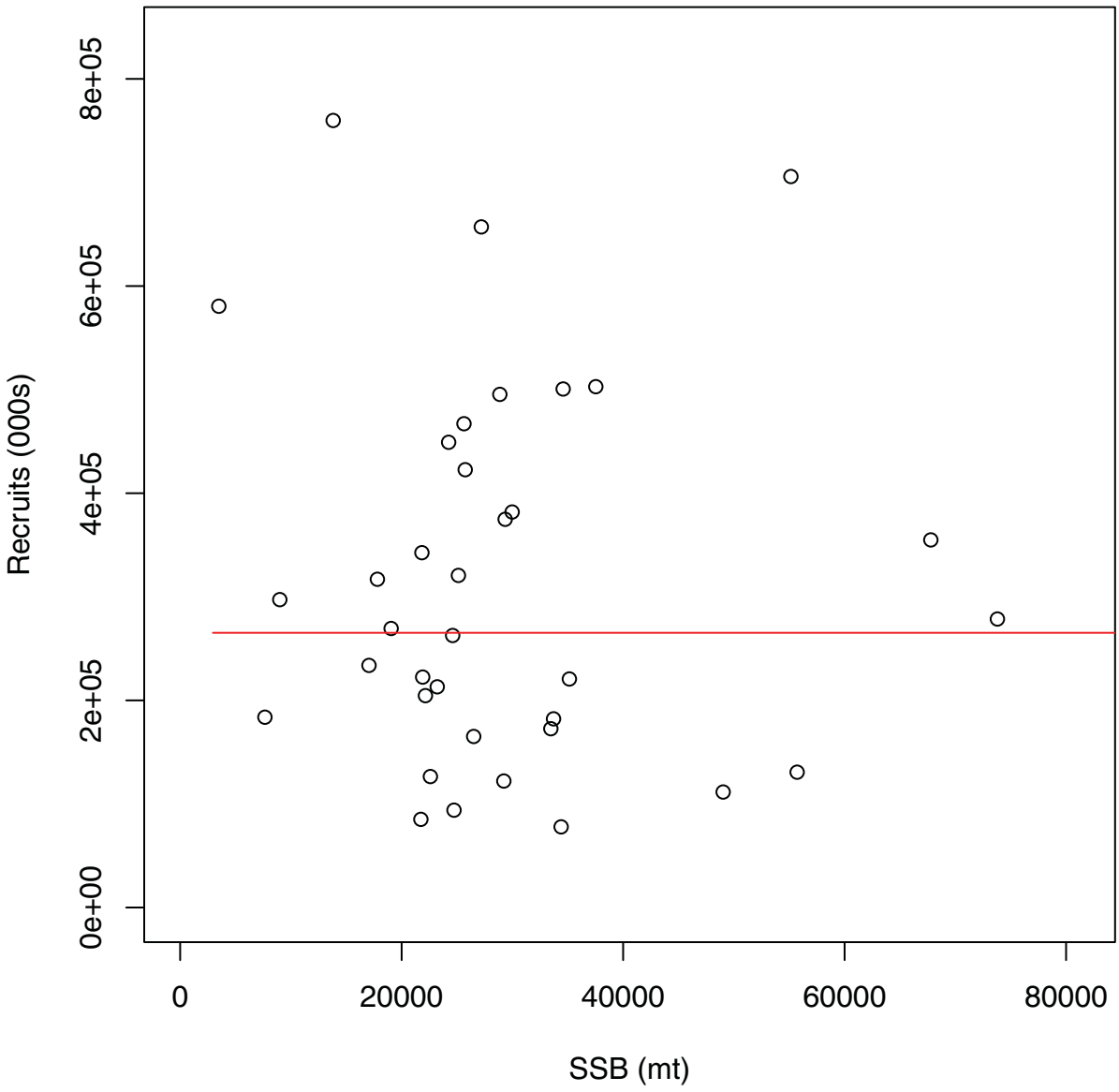

Index 1
Effective Sample Size
0
100
200
300
1975
1980
1985
1990
1995
2000
2005
2010
Year

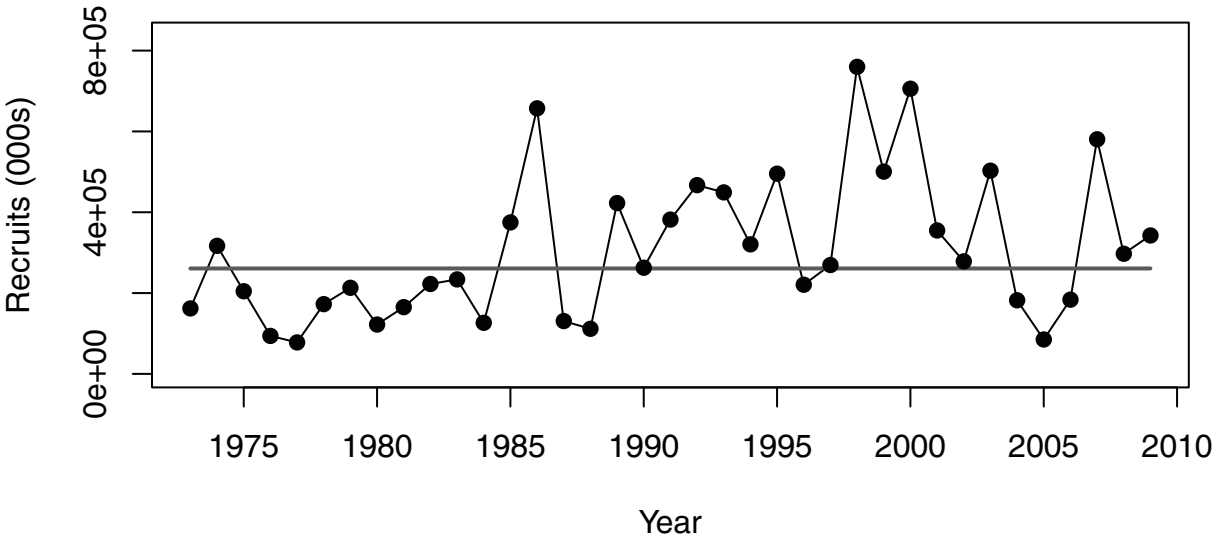

Index 2
Effective Sample Size
0
50
100
150
1975
1980
1985
1990
1995
2000
2005
2010
Year

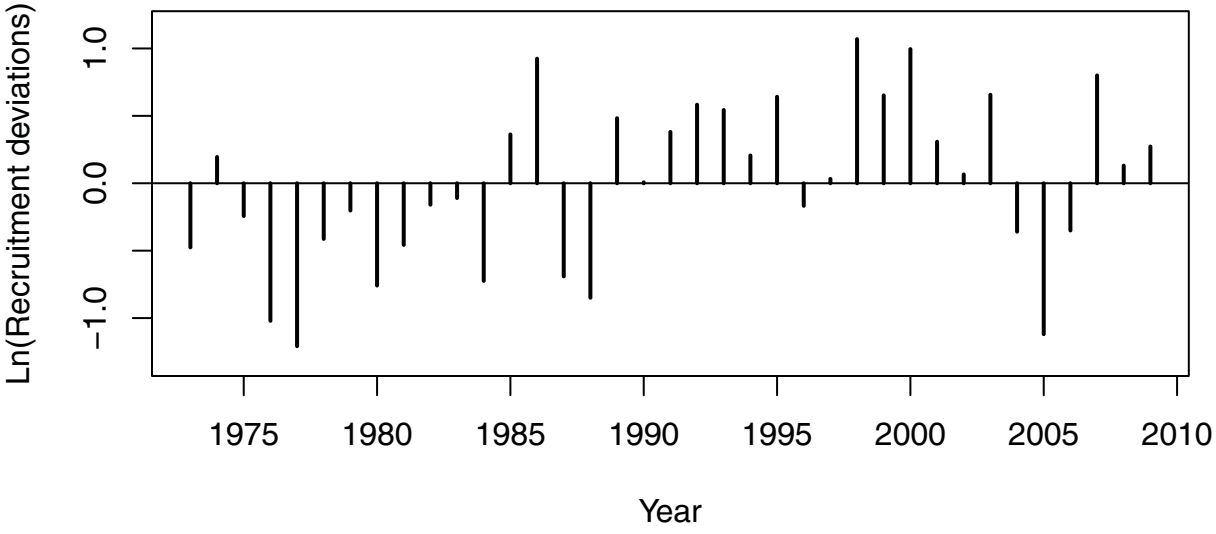

Index_1
Index_2
Selectivity at age
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
Age

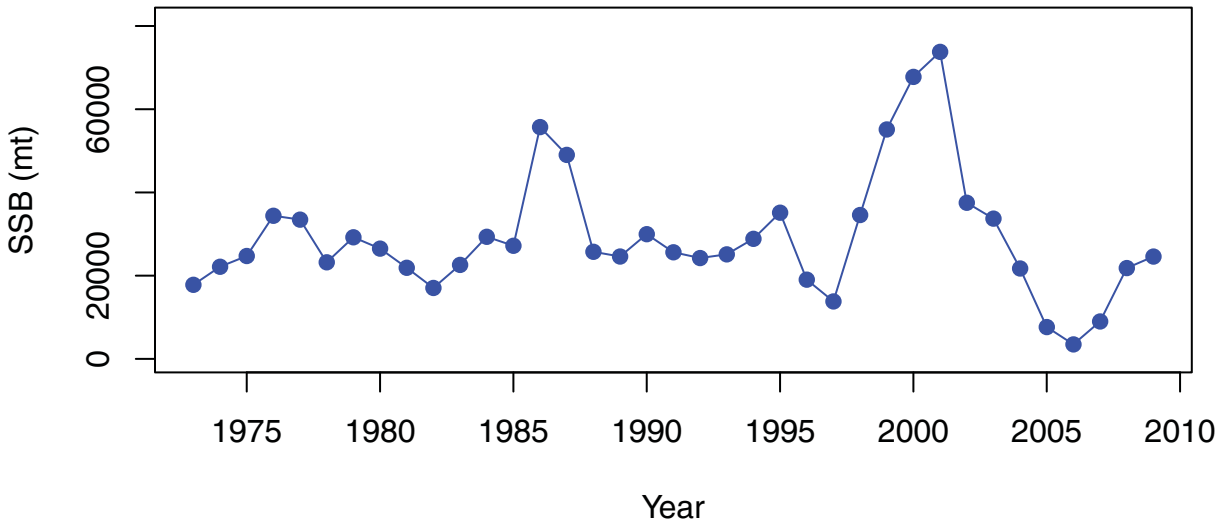

Index q estimates
1
2
Catchability
0.0
0.1
0.2
0.3
0.4
1975
1980
1985
1990
1995
2000
2005
2010
Index

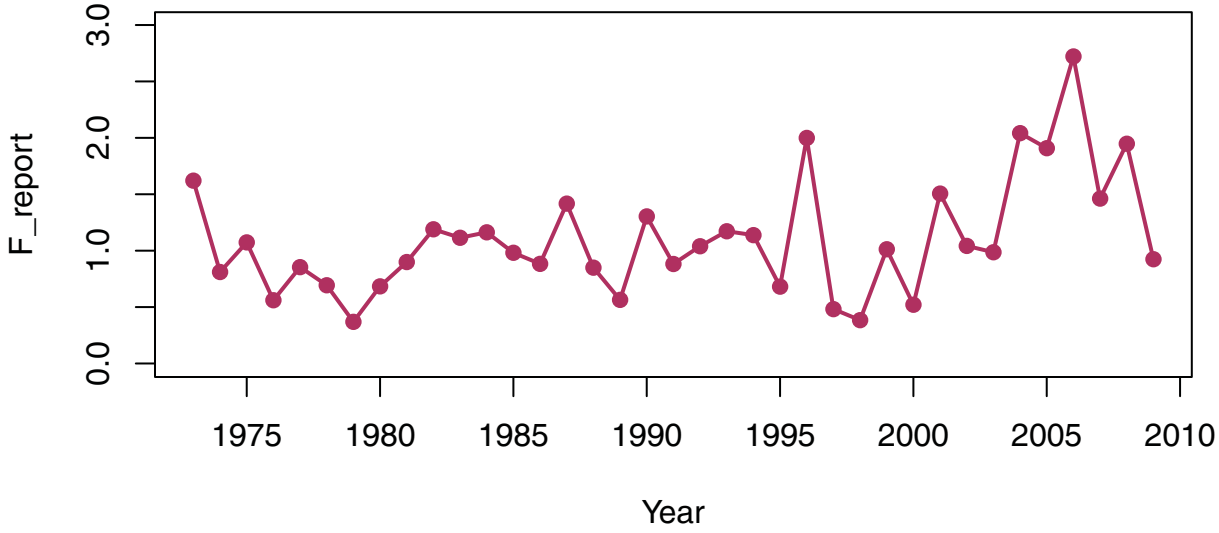

Recruits (000s)
0e+00
2e+05
4e+05
6e+05
8e+05
0
20000
40000
60000
80000
SSB (mt)
98
00
86
07
95
99
03
92
93
89
91
85
01
09
74
94
08
02
97
90
83
82
75
79
96
06
04
78
81
84
80
87
88
05
76
77

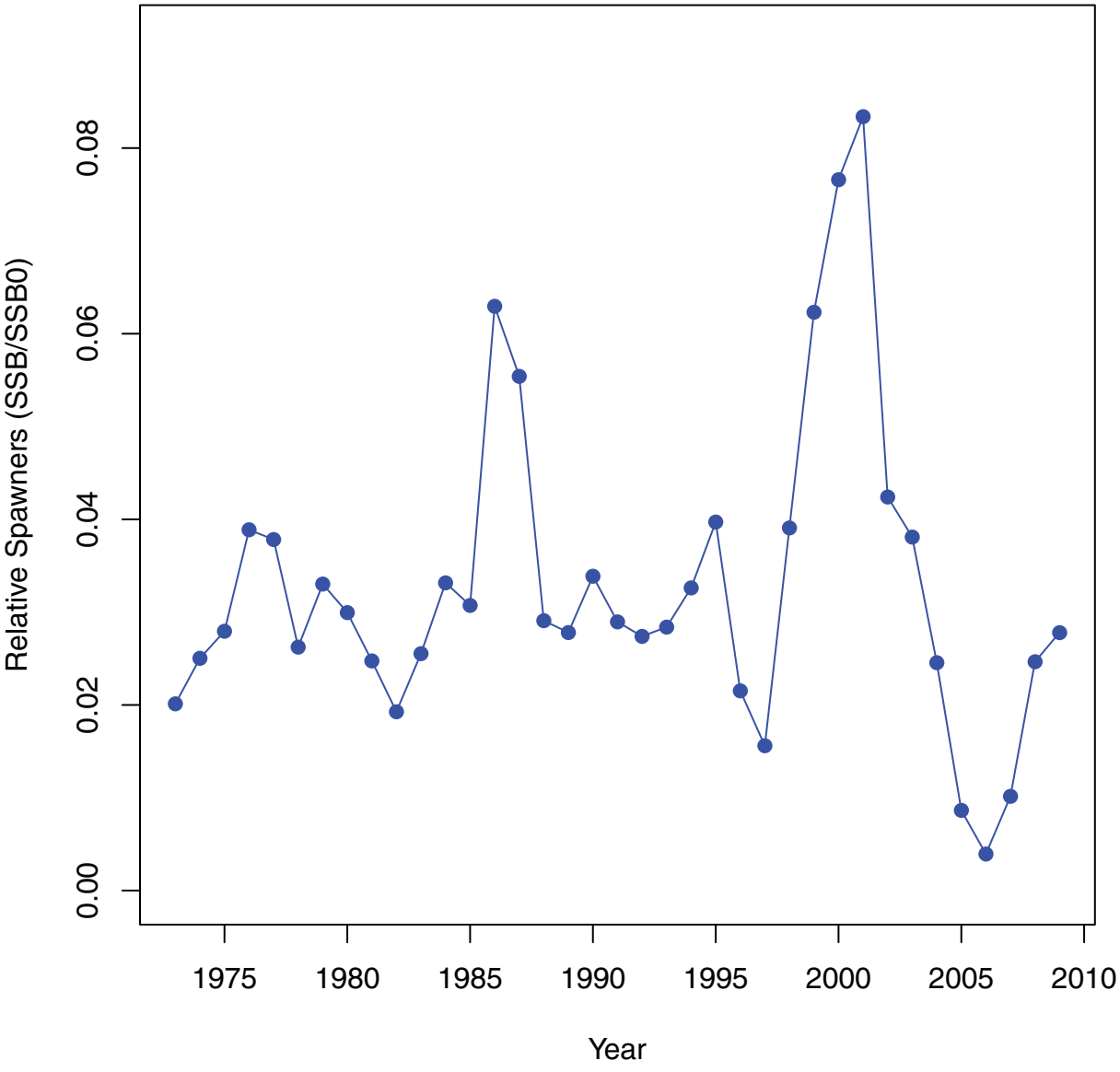

Recruits (000s)
0e+00
2e+05
4e+05
6e+05
8e+05
0
20000
40000
60000
80000
SSB (mt)

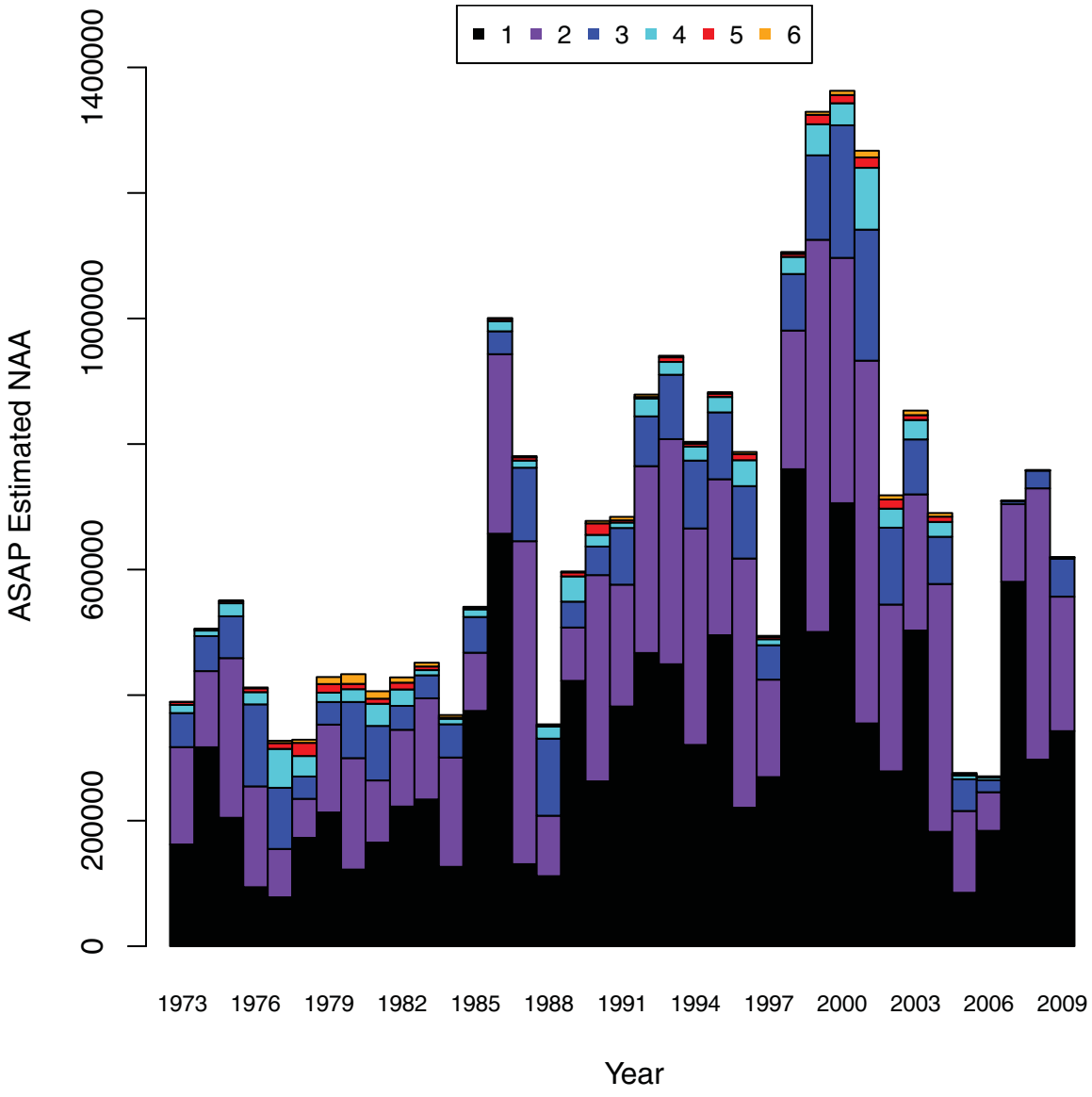

Recruits (000s)
0e+00
4e+05
8e+05
1975
1980
1985
1990
1995
2000
2005
2010
Year

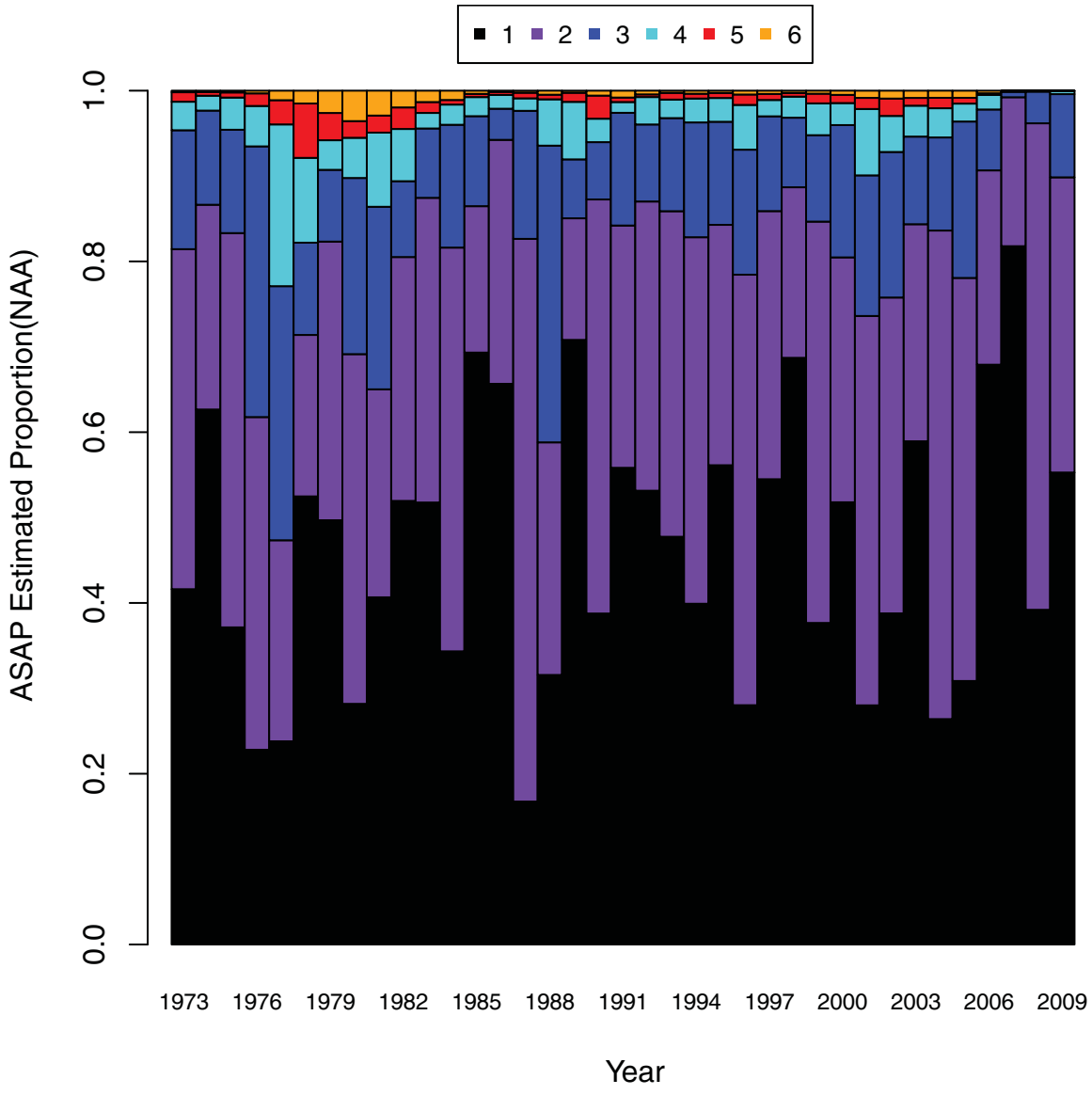

Ln(Recruitment deviations)
−1.0
0.0
1.0
1975
1980
1985
1990
1995
2000
2005
2010
Year

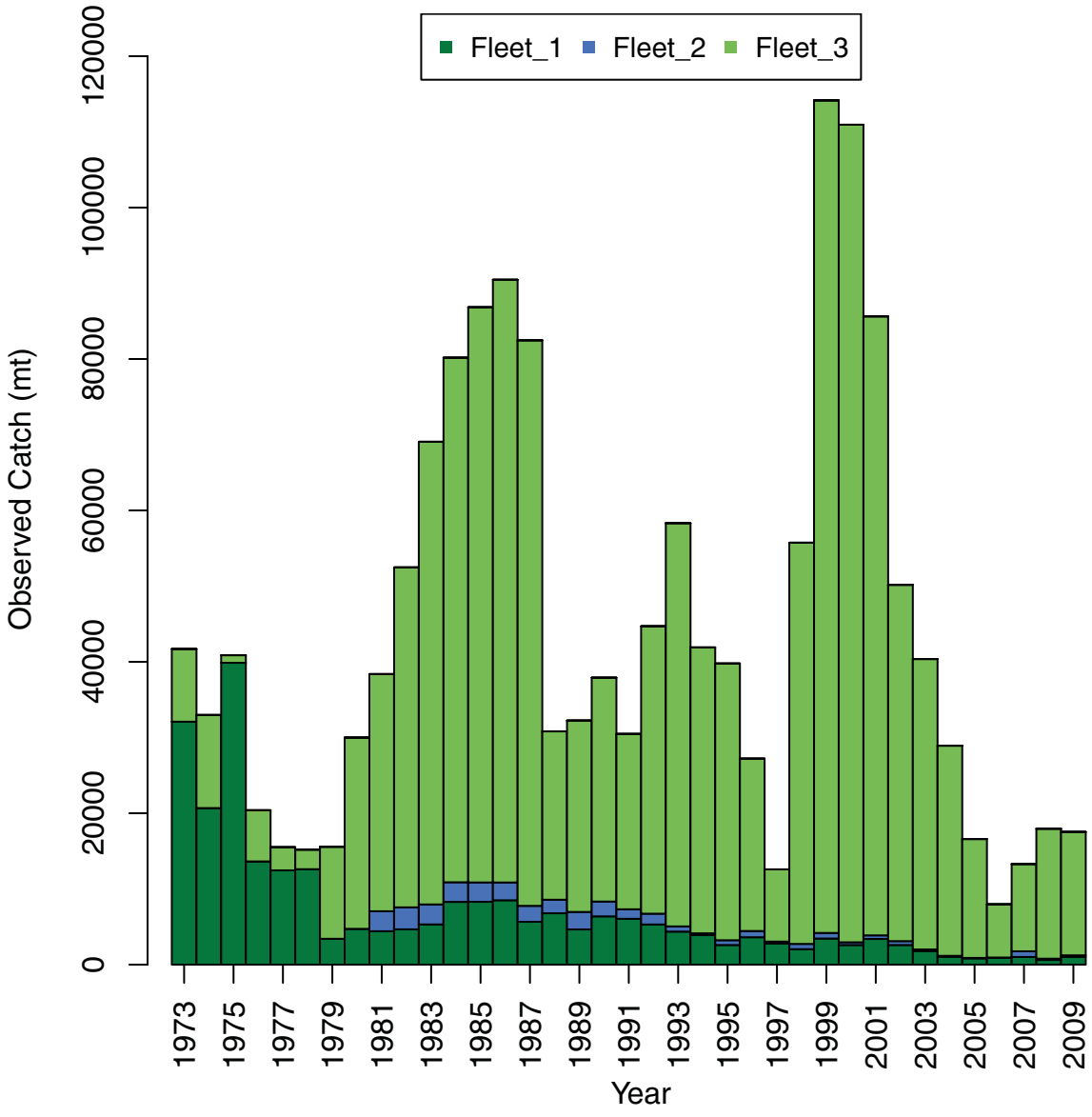

SSB (mt)
0
20000
60000
1975
1980
1985
1990
1995
2000
2005
2010
Year

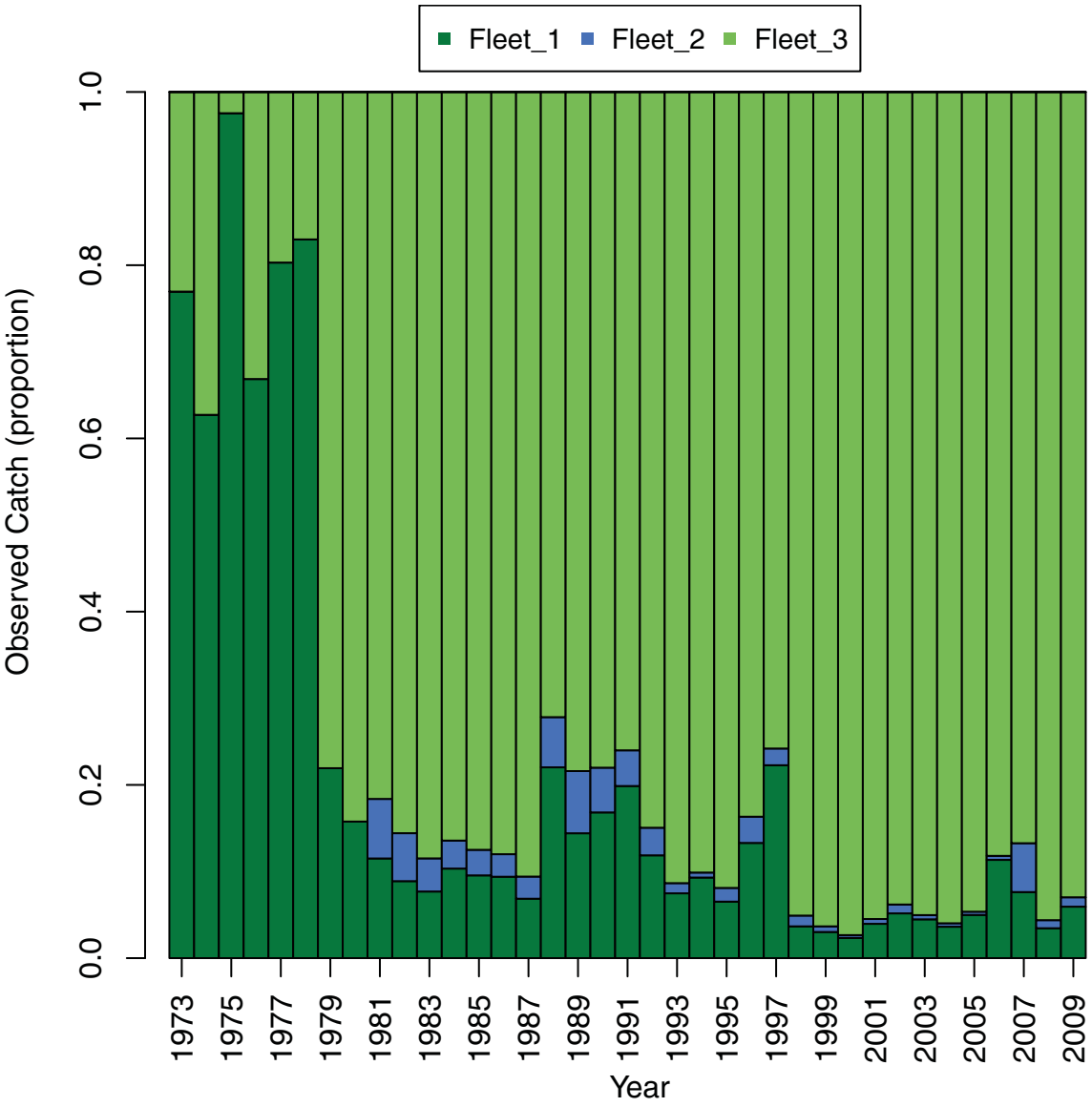

F_report
0.0
1.0
2.0
3.0
1975
1980
1985
1990
1995
2000
2005
2010
Year

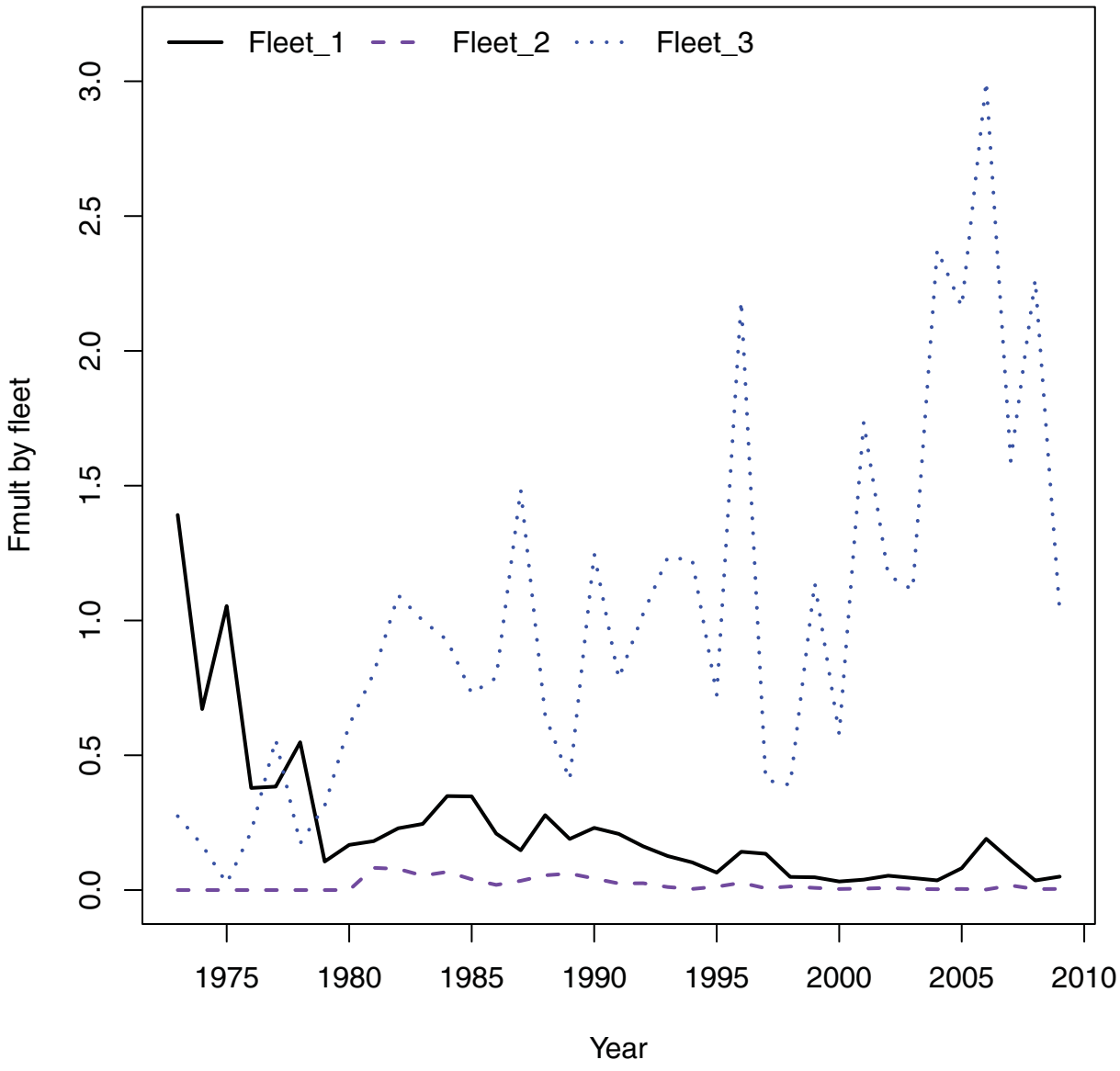

Relative Spawners (SSB/SSB0)
0.00
0.02
0.04
0.06
0.08
1975
1980
1985
1990
1995
2000
2005
2010
Year

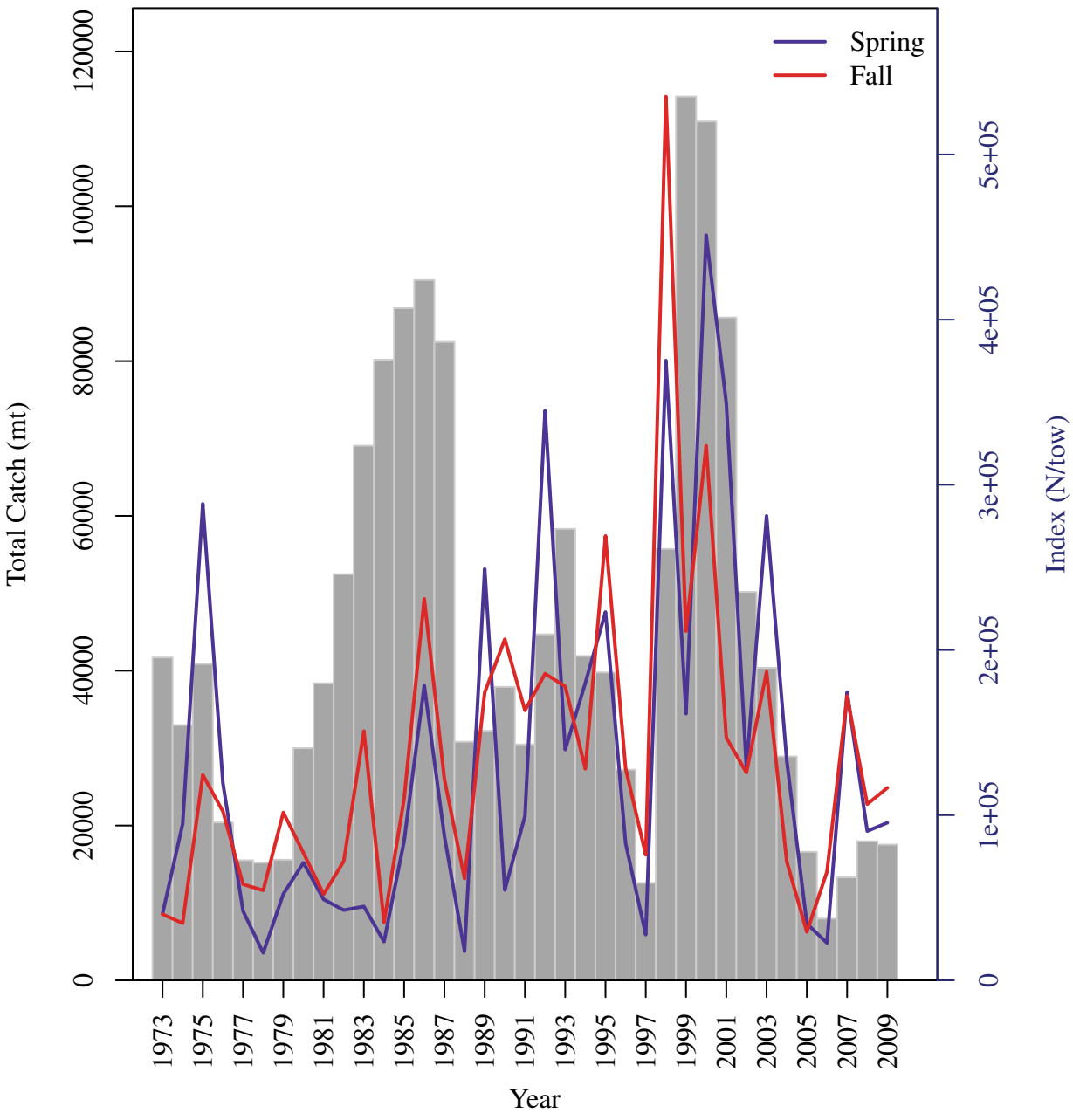

1 2 3 4 5 6
ASAP Estimated NAA
0
200000
600000
1000000
1400000
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009
Year

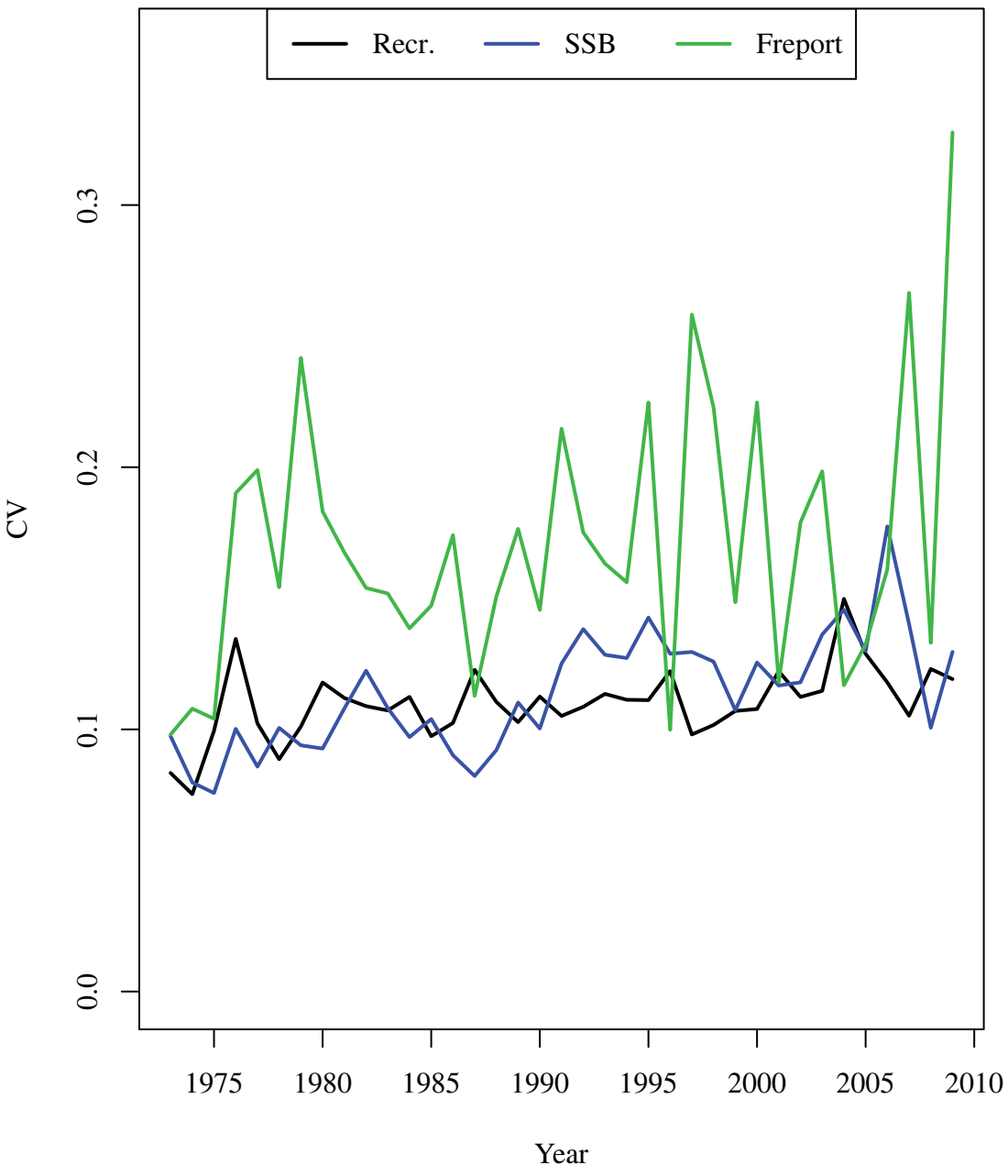

1
2
3
4
5
6
ASAP Estimated Proportion(NAA)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Year

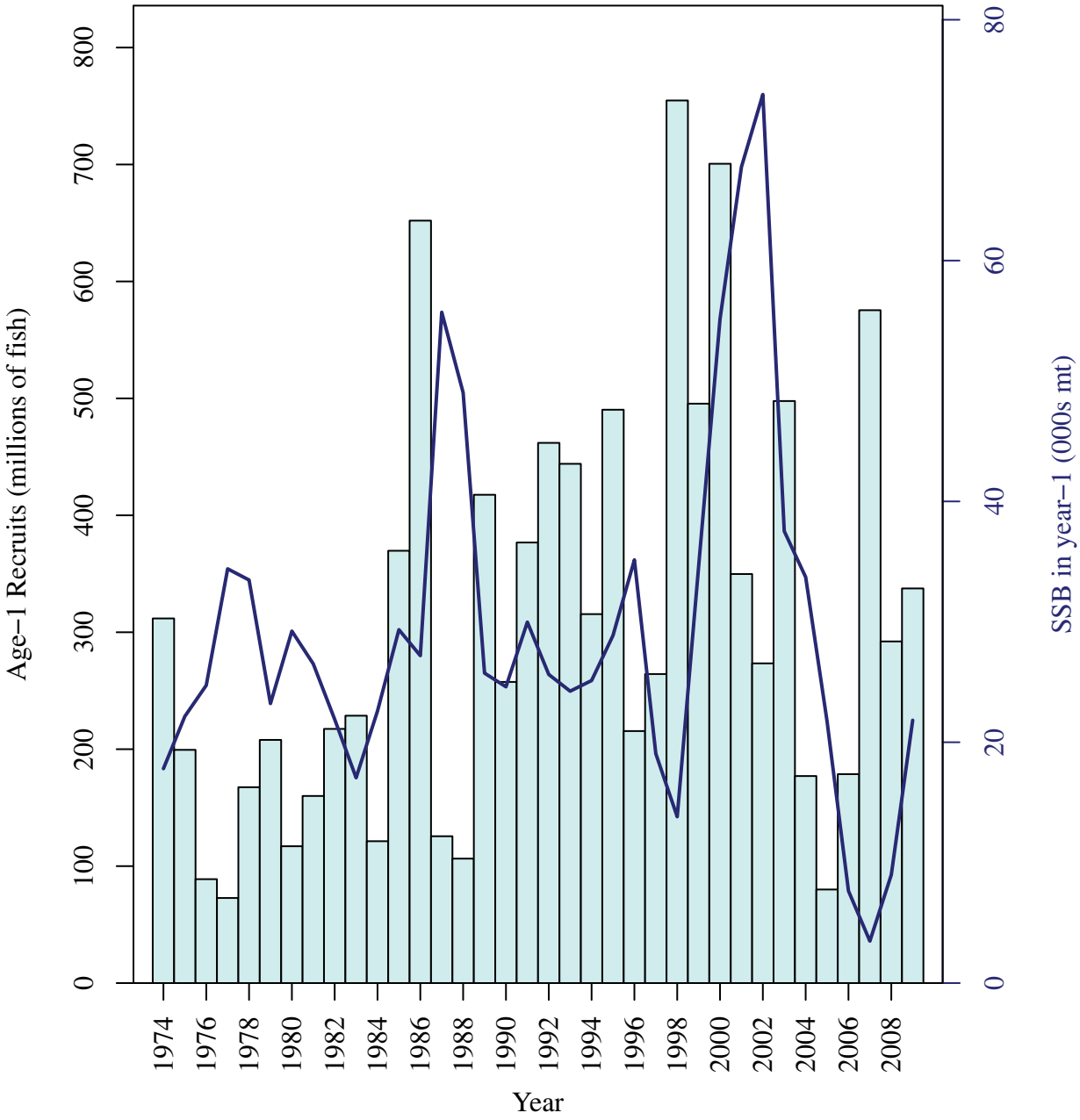

Fleet_1
Fleet_2
Fleet_3
Observed Catch (mt)
0
20000
40000
60000
80000
100000
120000
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fleet_3
Observed Catch (proportion)
0.0
0.2
0.4
0.6
0.8
1.0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Fleet_1
Fleet_2
Fleet_3
Fmult by fleet
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1975
1980
1985
1990
1995
2000
2005
2010
Year


Spring
Fall
Total Catch (mt)
Index (N/tow)
Year
0
20000
40000
60000
80000
100000
120000
1e+05
2e+05
3e+05
4e+05
5e+05
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Recr.
SSB
Freport
CV
0.0
0.1
0.2
0.3
1975
1980
1985
1990
1995
2000
2005
2010
Year


Age−1 Recruits (millions of fish)
0
100
200
300
400
500
600
700
800
SSB in year−1 (000s mt)
0
20
40
60
80
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year