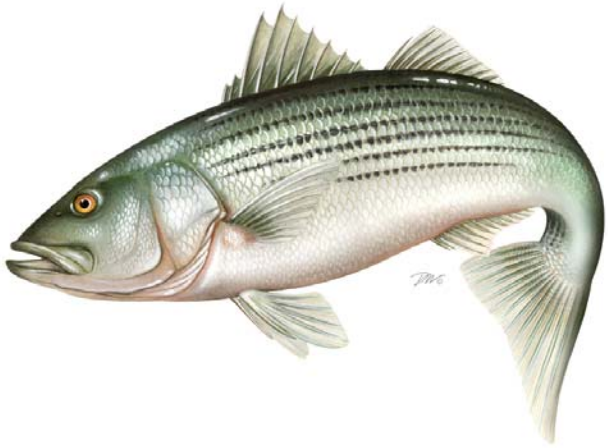
Atlantic States Marine Fisheries Commission
Update of the Striped Bass Stock Assessment using Final 2012 Data
October 2013



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Healthy, self-sustaining populations of all Atlantic coast fish species or successful restoration well in progress by the year 2015

Model Description

The striped bass statistical catch-at-age (SCA) model used since 2007 has been generalized to allow, among other things, specification of multiple fleets, different stock-recruitment relationships, and year- and age-specific natural mortality rates. The changes in model structure and additions are based on recommendations of the 2007 benchmark review committee (NEFSC 2008). The 2013 SCA model is used to estimate fishing mortality, abundance, and spawning stock biomass of striped bass during 1982-2012 from total removals-at-age and fisheries-dependent and fisheries-independent survey indices. See the 2013 SARC Document for complete description of model. A summary of the model structure used in this assessment is listed in Table 1.

Data Inputs

Plus Group

As in the 2007 benchmark, an age 13+ plus-group was used for catch and indices data as an attempt to address the increase in scale-ageing bias after ages 12 or so.

Updated Catch Data

Commercial harvest data for some states changed in the final version of datasets and these were updated (Tables 2 and 3). Commercial discard data for 2004-2012 (Table 4) were also updated with the changes in MRIP and commercial harvest data for 2012 and a correction in the hook-and-line discard mortality (from 0.08 to 0.09 following the use of the Diodati and Richards (1997) release mortality estimate). The recreational harvest (Tables 5 and 6) and release (Tables 7 and 8) data were updated with the final 2012 MRIP estimates. Average catch weights-at-age (Table 9) were also updated with the new total weights-at-age and total numbers-at-age from state spreadsheets.

Comparison of the preliminary numbers from the benchmark assessment and the final numbers used in this update, expressed as percent differences (final-prelim)/prelim*100), are shown in Figure 1 for each data type, state and year (where applicable). Changes in estimates ranged from -1.6% (NY) to 18.5% (MD) for MRIP harvest, -1.4% (NY) to 2.8% (MD) for MRIP releases, and 0% (MA, RI, DE, PRFC, NC) to 0.40% (NY) for commercial harvest. Commercial discards rose between 0.6% (2005) and 2.9% (2012) (Figure 1). For 2012, the resulting changes increased total removals by only 2% (3,597,528 versus 3,670,791).

Total removals (recreational and commercial harvest numbers plus number of discards that die due to handling and release and incidental removals) and the proportions of catch-at-age of striped bass fisheries are the primary data used in the model. The removals data were partitioned into three "fleets" in an attempt to account for more realistic patterns in fishing selectivity known to have occurred as management measures changed over time. All selectivity time blocks corresponded to Amendment changes. Removals data were split into *Chesapeake Bay*, *Coast* and the *Commercial Dead Discards*. The latter was a separate fleet because commercial discards were from a multitude of gears that do not necessarily target striped bass and the mixed gear types may have a unique selectivity over time. In addition, the data prior to 1996 could not be separated into regions. The Chesapeake Bay fleet includes commercial and recreational harvest and recreational dead discards

taken in the Bay by MD, VA, and the PRFC. The Coast fleet includes commercial and recreational harvest and recreational dead discards taken in the coastal regions, Delaware Bay and Hudson River by ME, NH, MA, NY, NJ, DE, MD, VA and NC. The observed total removals and catch age compositions were generated from all state reported landings-at-age, recreational dead discards-at-age and incidental removals-at-age. The total removals and age composition by region are given year (Table 10).

Indices of Relative Abundance

States provided age-specific and aggregate indices from fisheries-dependent and fisheries-independent sources that were assumed to reflect trends in striped bass relative abundance. A formal review of age-2+ abundance indices was conducted by ASMFC at a workshop in July of 2004. The 2004 workshop developed a set of evaluation criteria and tasked states with a review of indices. Both the Striped Bass Technical Committee and the Management Board approved of the criteria and of the review. The resulting review led to revisions and elimination of some indices used in previous stock assessments. The following sources were used as tuning indices in the current stock assessment:

MRFSS/MRIP Total Catch Rate Index
Maryland Gillnet Survey
New York Ocean Haul Seine Survey
Northeast Fisheries Science Center Bottom Trawl Survey
Young-of-the-Year Indices from the Delaware River, Hudson River,
and MD and VA portions of the Chesapeake Bay
Age 1 Indices from the Hudson trawl survey and MD seine survey
Connecticut Bottom Trawl Survey
New Jersey Bottom Trawl Survey
Delaware Electrofishing Spawning Stock Survey
Virginia Pound Net Survey

All indices used in the benchmark assessment were used in the update.

Starting Values

Initial starting values for all parameters are given in Table B11 of the SARC document and were selected based on trial-and-error and used in the benchmark assessment. Based on the coast-wide age samples, the starting effective sample sizes for the age proportions in each fleet were set at 50.

Used as starting values, the average effective sample size for each survey with age composition data was calculated in the 2007 benchmark (http://www.nefsc.noaa.gov/publications/crd/crd0803/) by using methods in Pennington and Volstad (1994) and Pennington and others (2002). In essence, effective sample size was estimated by first calculating the length sample variance using the simple random sampling equation and dividing into it the cluster sampling variance of mean length derived through bootstrapping, assuming each seine/trawl haul, gillnet set, or electrofishing run was the sampling unit. The average of the annual effective sample sizes was used as starting values in each survey multinomial error distribution (NJ Trawl = 23; NYOHS = 56; DESSN = 68; MDSSN=68; VAPNET = 68).

Sex Proportions-at-age

Female sex proportions-at-age are used to apportion the numbers-at-age to female numbers-at-age for calculation of female spawning stock biomass. The sex proportions were derived from available state catch datasets. The proportions used were:

Age	1	2	3	4	5	6	7	8	9	10	11	12	13+
Prop	0.53	0.56	0.56	0.52	0.57	0.65	0.73	0.81	0.88	0.92	0.95	0.97	1.00

Female Maturity

The proportions mature-at-age for females were derived from literature values and field samples.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13+
Prop	0.0	0.0	0.0	0.04	0.13	0.45	0.89	0.94	1.00	1.00	1.00	1.00	1.00

Natural Mortality

The age-specific M estimates used in the updated base model are:

Age	1	2	3	4	5	6	$\geq$7
M	1.13	0.68	0.45	0.33	0.25	0.19	0.15

Model Specification

Phases

Model parameters were solved in phases. The parameters solved in each phase were:

1 Yr 1, Age 1 N or Avg N (log)
2 recruitment deviations and fishing mortality
3 stock-recruitment parameters
4 catch selectivity parameters
5 survey selectivity parameters
6 catchability coefficients of survey indices

Catch Selectivity Functions

The same four time blocks for catch selectivity estimations used in the 2013 benchmark were used in the update.

Stock-Recruitment Curve

Based on literature reviews and committee opinion, the Beverton-Holt equation was selected as the appropriate stock recruitment relationship for striped bass.

Data Weighting

Data weighting was accomplished by first running the model with all initial starting values, lambda weights = 1, and index CV weights = 1. The lambda weights for the total removal data were increased to 2 for the Bay, Coast, and Commercial Discards to force the model to better fit the data in these early years (1982-1984). Based on recommendations by the SARC panel, the initial effective sample sizes were first adjusted once by using the Francis multipliers and the model was re-run. After the model was re-run, the index CV weights were adjusted to obtain index RMSE values close 1.0. The estimated RMSE values were used as the CV weights and this allowed the resulting RMSE values to be near 1.0. The model was re-run to make small adjustments in the RMSE values. Since the MRFSS and MDSSN indices have considerable influence on the model results, the CV weights for these indices were then adjusted until the RMSE values were nearly identical to balance the influence of each index.

Results

Resulting contributions to total likelihood are listed in Table 11. The converged total likelihood was 9,746.1 (Table 11). Estimates of fully-recruited fishing mortality for each fleet, total fishing mortality, recruitment, parameters of the selectivity functions for the selectivity periods, catchability coefficients for all surveys, and parameters of the survey selectivity functions are given in Table 12 and are shown graphically in Figures 2-4. Graphs depicting the observed and predicted values and residuals for the catch age composition, survey indices, and survey compositions are given in Appendix A. The model fit the observed total catches (Figure 2) and catch age compositions of all fleets well, except for ages 1 and 13+ for the Coast and Commercial Discard fleets (Appendix A), and the YOY, age 1, CTTrawl, and NEFSC indices reasonably well (Appendix A). The predicted trends matched the observed trends in age composition survey indices (except MDSSN and NYOHS), and predicted the survey age composition reasonably well (MDSSN) to poorly (NJ Trawl) (Appendix A).
Estimates of the catch selectivity patterns for each fleet showed that, although the patterns varied over time with changes in regulation, selectivity was dome-shaped for Chesapeake Bay and Commercial Discard fleets and primarily flat-topped for the Coast over time (Figure 3).

Fishing Mortality

Partial fully-recruited fishing mortality in 2012 for the Bay, Coast and Commercial Discard fleets was 0.058, 0.141, and 0.041, respectively (total fully-recruited F_{2012} =0.200) (Table 12; Figure 4). An average F weighted by N was calculated for comparison to tagging results since the tag releases and recaptures are weighted by abundance as part of the experimental design. The 2012 F weighted by N for ages 7-11 (age 7 to compare with tagged fish $\geq$28") was 0.192 (Table 13; Figure 5). An F weighted by N for ages 3-8, comparable to the direct enumeration estimate for Chesapeake Bay, was equal to 0.099 (Table 13; Figure 5). The maximum total F-at-age in 2012 was 0.200 for ages 10-11 (Table 14). Average fishing mortality on ages 3-8, which are generally targeted in producer areas, was 0.14 (Table 13; Figure 5).

Fishing mortality-at-age in 2011 and 2012 for the three fleets is shown in Figure 5. Fishing mortality-at-age peaked at age 5 in the Chesapeake Bay and Commercial Discards fleets and age 13+ in the

Coast fleet. The highest fishing mortality was attributed to the Coast fleet at ages ≥6 (Table 14; Figure 6).

Population Abundance (January 1)

Striped bass abundance (1+) increased steadily from 1982 through 1997 when it peaked around 246 million fish (Table 15; Figure 7). Total abundance fluctuated without trend through 2004. From 2005-2010, age 1+ abundance declined to about 134 million fish. Total abundance increased to 211 million fish by 2012 (Figure 7). The increase in 2012 was due primarily to the abundant 2011 year class from Chesapeake Bay (Table 15). Total abundance is expected to drop in 2013 as the very small 2012 year-class from Chesapeake Bay recruits to the population (Figure 7). Abundance of striped bass age 8+ increased steadily through 2004 to 11.3 million, but declined to 7.2 million fish through 2010 (Table 15; Figure 7). A small increase in 8+ abundance occurred in 2011 as the 2003 year class became age 8 (Figure 7).

Spawning Stock Biomass and Total Biomass

Weights-at-age used to calculate female spawning stock biomass (SSB) were generated from catch weights-at-age and the Rivard algorithm described in the NEFSC's VPA/ADAPT program. Female SSB grew steadily from 1982 through 2003 when it peaked at about 78 thousand metric tons (Table 16, Figure 8A). Female SSB has declined since then and was estimated at 58.2 thousand metric tons (95% CI: 43,262-73,212) in 2012 (Table 16; Figure 8A). The SSB point estimate in 2012 remained just above the threshold level of 57.6 thousand metric tons (1995 SSB value) and indicates that the striped bass are not overfished. However, given the error associated with the 1995 and 2012 values, there is a probability of 0.46 that the female spawning stock biomass in 2012 is below the threshold. The spawning stock numbers (Figure 8B) declined more rapidly than the spawning stock biomass.

Total biomass (January 1) increased from 18,782 metric tons in 1982 to its peak at 218,221 metric tons in 1999 (Figure 8C) Total biomass declined through 2011, but increased in 2012 due to the strong 2011 year-class (Figure 8C).

Retrospective Analysis

Retrospective analysis plots and percent difference plots between the 2012 and peels of the retrospective analysis are shown in Figure 9. Moderate retrospective bias was evident in the more recent estimates of fully-recruited total F, SSB, and age 8+ abundance of SCA (Figure 9). The retrospective pattern suggests that fishing mortality is likely slightly over-estimated (between 9 and 13% since 2007) and could decrease with the addition of future years of data, while female spawning biomass appears under-estimated and could increase with the addition of future years of data. Similar retrospective trends have been observed in the previous assessment of striped bass using the ADAPT VPA (ASMFC 2005), the 2007 benchmark, and supporting ASAP model presented in the 2013 benchmark assessment document.

Biological Reference Points

Biological reference points for striped bass calculated in the last assessment and currently used as thresholds in management are F_{MSY} (0.34) and an SSB proxy which is equivalent to the 1995 spawning stock biomass. The SSB target was calculated as 125% of the 1995 SSB, and the F target was defined as an exploitation rate of 24% or F=0.3. The estimate for FMSY was derived using the results of the 2008 SCA assessment in which four stock-recruitment models were considered; a Ricker, a log-normal Ricker model, a Shepherd and a log-normal Shepherd model. The TC used a model averaging approach among the four results, producing an estimate of FMSY = 0.34 (range of 0.28-0.40).

For this assessment, the SSB_{Target} and $SSB_{Threshold}$ definitions remained the same, but F reference points were chosen to link the target and threshold F with the target and threshold SSB. Using a stochastic projection drawing recruitment from empirical estimates and a distribution of starting population abundance at age, fishing mortality associated with the SSB target and threshold were determined.

Empirical estimates of recruitment, selectivity, and the starting population came from the SCA model results. Selectivity was calculated as the geometric mean of the 2008-2012 of total F at age, scaled to the highest F at age. Estimates of recruitment were restricted to 1990 and later, when the stock was considered restored but not fully rebuilt. Similarly, spawning stock weights-at-age were calculated as the geometric mean of the 2008-2012 of adjusted Rivard weights-at-age. The median 50-year SSB of 1000 projections was compared to the 1995 SSB value.

This resulted in an SSB_{Target} of 72,032 metric tons metric tons with an associated F_{Target} = 0.180, and an $SSB_{Threshold}$ of 57,626 metric tons with an associated $F_{Threshold}$ = 0.219.

One SARC reviewer suggested using only the 1995-2012 recruitment values since the 1995 SSB value reflects the year when the stock was declared. To explore the impact, the above analyses were repeated using only 1995-2012 recruitment estimates. An F threshold of 0.222 was required to achieve a median SSB of 57,626 metric tons in the 50^{th} year (compared to 0.219), and an F target of 0.182 was required to achieve a median SSB of 72,032 metric tons (compared to 0.180).

The time series of fully-recruited F from the SCA model is compared to the $F_{Threshold}$ and F_{Target} values in Figure 10. The F estimate for 2012 is below the threshold but above the target indicated overfishing is not occurring. However, if error in both the 2012 F and $F_{Threshold}$ estimates is accounted for, the probability of the 2012 F values being above or equal to the $F_{Threshold}$ is 0.31.

Spawning Stock Biomass Projections

Five-year projections of female spawning stock biomass were made by using a population simulation model written in R. The model projection began in year 2012 and abundance-at-age data with associated standard errors, total fishing-at age, Rivard weights, natural mortality, female sex proportions-at-age, and female maturity-at-age from the model input/output for 2012 were used to parameterize the model and calculate SSB using the abundance and spawning stock biomass equation given in the model structure portion of this document. For the years greater than 2012, total fully-

recruited fishing mortality was first specified and multiplied by the average selectivity derived from the average F-at-age values from 2008-2012. This F-at-age vector is used to project the population in the remaining years. For each iteration of the simulation, the abundance-at-age in 2012 is first randomly drawn from a normal distribution parameterized with the 2012 estimates of January-1 abundance–at-age and associated standard errors from the stock assessment model, and spawning stock biomass is calculated. For the remaining years, abundance of age 1 recruits is randomly generated using the using 1990-2012 recruitment estimates. An age 13 plus-group was assumed. Female spawning stock biomass is calculated by using average Rivard weight estimates from 2008-2012, sex proportions-at-age, and female maturity-at-age. Each year's SSB estimate is stored in a file and the whole procedure is repeated for the specified number of iterations.

For each year of the projection, the probability of SSB going below the SSB reference point was calculated using SSBs from all iterations of the simulation and an algorithm used to approximate equation 2 in Shertzer et al. (2008). This equation was used to incorporate the associated error of the projected SSB and the associated error of the SSB reference point (1995 value in SCA model). Several F scenarios were investigated. For years >2012, simulations were performed using the current fully-recruited F, $F_{threshold}$ reference point (=0.219), F_{target} (=0.180), the old $F_{threshold}$ (=0.34), F=0.15, F=0.10.

If the current fully-recruited F (0.200) is maintained during 2013-2017, the probability of being below the SSB reference point increases to 0.86 by 2015 (Figure 11). After 2016, the probability is expected to decline slightly. If the current fully-recruited F increases to $F_{threshold}$ (0.219) and is maintained during 2013-2017, the probability of being below the SSB reference point reaches 0.93 by 2015 and declines thereafter (Figure 11). If the fully-recruited F decreases to the current F_{target} (0.180) and is maintained during 2013-2017, the probability of being below the SSB reference point reaches 0.77 by 2015 and declines thereafter (Figure 11). If the fully-recruited F increases to the old $F_{threshold}$ (0.34) and is maintained during 2013-2017, the probability of being below the SSB reference point reaches 0.98 by 2014 and 1.0 thereafter (Figure 11). If the fully-recruited F decreases to 0.15 and is maintained during 2013-2017, the probability of being below the SSB reference point reaches a maximum of 0.60 by 2013 and declines thereafter (Figure 11). If the fully-recruited F decreases to 0.10 and is maintained during 2013-2017, the probability of being below the SSB reference point reaches is maximum (0.54) in 2013 and declines thereafter (Figure 11).

Comparison of Results from the Updated Assessment with 2012 Final Data and the 2013 Benchmark Assessment

Fully-recruited fishing mortality and female spawning stock biomass estimates from the update and benchmarks assessments are shown in Figure 12. The updated assessment produced higher fully-recruited fishing mortality and lower female spawning stock biomass estimates than the benchmark assessment (Figure 12).

Status of the Stock

In 2012, the Atlantic striped bass stock was not overfished or experiencing overfishing based on the points estimates of fully-recruited fishing mortality and female spawning stock biomass relative to the reference points defined in this assessment. Female spawning stock biomass was estimated at 58.2

thousand metric tons (128 million pounds), above the SSB threshold of 57,626 metric tons, but below the SSB target of 72,023 metric tons. Total fishing mortality was estimated at 0.200, below the F threshold of 0.219 but above the F target of 0.180.

However, because of error associated with these estimates, there is a probability of 0.46 that the 2012 female SSB estimates is below or equal to the SSB threshold, and a probability of 0.31 that the 2012 fully-recruited fishing mortality is above or equal the fishing mortality threshold. If the estimates are adjusted for the average retrospective bias in the last five years (fishing mortality = 12% over-estimate; SSB = 14% under-estimate), the probability of the 2012 female SSB estimates being below or equal to the SSB threshold declines to 0.12, while the probability of the 2012 fully-recruited fishing mortality being above or equal the fishing mortality threshold declines to 0.13.

Literature Cited

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Pennington M, Volstad JH. 1994. Assessing the effect of intra-haul correlation and variable density on estimates of population characteristics from marine surveys. Biometrics 50:725-732.

Pennington M, Burmeister L, Hjellvik V. 2002. Assessing the precision of frequency distributions estimated from trawl-survey samples. Fishery Bulletin 100: 74-80.

Table 1. Model structure, equation, and data inputs used in this assessment.

Input Data	Symbol	Description/Definition
Catch Weight-at-age (kg)	$w_{y,a}$	Overall average of mean weights-at-age reported for fishery components of states
Rivard Weight-at-age (kg)	$rw_{y,a}$	January-1 weights calculated from catch weights.
SSB Weight-at-age (kg)	$sw_{y,a}$	Adjustment of $rw_{y,a}$ (average of $rw_{y,a}$ and $w_{y,a}$) made to match time of spawning.
Natural Mortality	$M_{y,a}$	Age 1 2 3 4 5 6 ≥7 M 1.13 0.68 0.45 0.33 0.25 0.19 0.15 From regression fit to tag estimates of Z for ages 1-3 from Western Long Island Sound, and tag-based estimates of M (Jiang et al., 2007) for ages 3-6 prior to 1997. M for ages ≥ 7 from longevity method. M assumed constant across years
Female sex proportions-at-age	sr_a	Calculated from scientific and fishery samples
Maturity-at-age	m_a	Calculated from literature and field samples

Table 1 cont.

Population Model	Symbol	Equation
Age-1 numbers	$\hat{N}_{y,1}$	$\hat{N}_{y,1} = \exp\left(\log_e(\hat{\alpha}) + \log_e(SSB_{y-1}) - \log_e\left(1+\frac{SSB_{y-1}}{\hat{\beta}}\right) + \hat{e}_y - 0.5\hat{\sigma}_R^2\right)$ $\hat{\sigma}_R = \sqrt{\frac{\sum_y (\hat{e}_y - \bar{\hat{e}})^2}{n-1}}$ where e_y are independent and identically distributed normal random variables with zero mean and constant variance and are constrained to sum to zero over all years
Abundance-at-Age	$\hat{N}_{y,a}$	First year (ages 2-A in 1970): $\hat{N}_{y,a} = \hat{N}_{y,a-1} \exp^{-\hat{F}_{1982,a-1} - M_{1982,a-1}}$ Rest of years (ages 2-12): $\hat{N}_{y,a} = \hat{N}_{y-1,a-1} \exp^{-\hat{F}_{y-1,a-1} - M_{y-1,a-1}}$
Plus-group abundance-at-age	$\hat{N}_{y,A}$	$\hat{N}_{y,A} = \hat{N}_{y-1,A-1} \exp^{-\hat{F}_{y-1,A-1} - M_{y-1,A-1}} + \hat{N}_{y-1,A} \exp^{-\hat{F}_{y-1,A} - M_{y-1,A}}$
Fishing Mortality	$\hat{F}_{f,y,a}$	$\hat{F}_{f,y,a} = \hat{F}_{f,y} \cdot \hat{s}_{f,a}$ where $F_{f,y}$ and $s_{f,a}$ are estimated parameters
Total Mortality	$\hat{Z}_{y,a}$	$Z_{y,a} = F_{y,a} + M_{y,a}$
Fleet Selectivity	$\hat{s}_{f,a}$	Fleet 1 (Chespeake Bay): 1982-1984, 1985-1989, 1990-1995, 1996-2012 Fleet 2 (Coast): 1982-1984 Fleet 3 (Commercial Dead Discards): 1985-1989,1990-1995,1996-2002,2003-2012 $\hat{s}_a = \frac{1}{1-\hat{\gamma}} \cdot \left(\frac{1-\hat{\gamma}}{\hat{\gamma}}\right)^{\hat{\gamma}} \frac{\exp^{\hat{\alpha}\hat{\gamma}(\hat{\beta}-a)}}{1+\exp^{\hat{\alpha}(\hat{\beta}-a)}}$ Fleet 2 (Coast): 1985-1989, 1990-1996, 1997-2012 $\hat{s}_a = \exp^{(-\exp^{-\hat{\beta}(a-\hat{\alpha})})}$ Fleet 3 (Commercial Dead Discards): 1982-1984 $\hat{s}_a = \alpha \exp^{\beta a}$
Predicted Catch-At-Age	$\hat{C}_{f,y,a}$	$\hat{C}_{f,y,a} = \frac{\hat{F}_{f,y,a}}{\hat{F}_{f,y,a} + M_{y,a}} \cdot (1 - \exp^{-\hat{F}_{y,a} - M_{y,a}}) \cdot \hat{N}_{y,a}$

Table 1 cont.

Population Model	Symbol	Equation
Predicted Total Catch	$\hat{C}_{y,a}$	$\hat{C}_{f,y} = \sum_a \hat{C}_{f,y,a}$
Predicted Proportions of Catch-At-Age	$\hat{P}_{f,y,a}$	$\hat{P}_{f,y,a} = \frac{\hat{C}_{f,y,a}}{\sum_a \hat{C}_{f,y,a}}$
Predicted Aggregated Indices of Relative Abundance	$\hat{I}_{t,y,\sum a}$	$\hat{I}_{t,y,\Sigma a} = \hat{q}_t \cdot \sum_a \hat{N}_{y,a} \cdot \exp^{-p_t \cdot Z_{y,a}}$
Predicted Age-Specific Indices of Relative Abundance	$\hat{I}_{t,y,a}$	$\hat{I}_{t,y,a} = \hat{q}_t \cdot \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot \exp^{-p_t \cdot \hat{Z}_{y,a}}$
Predicted Total Indices of Relative Abundance with Age Composition Data	$\hat{I}_{t,y}$	$\hat{I}_{t,y} = \hat{q}_t \sum_a \hat{s}_{t,a} \cdot \hat{N}_{y,a} \cdot \exp^{-p_t \cdot \hat{Z}_{y,a}}$
Predicted Age Composition of Survey	$\hat{U}_{t,y,a}$	$\hat{U}_{t,y,a} = \frac{\hat{I}_{t,y,a}}{\sum_a \hat{I}_{t,y,a}}$
Female Spawning Stock Biomass (metric tons)	SSB_y	$SSB_y = \sum_{a=1}^{A} N_{y,a} \cdot sr_a \cdot m_a \cdot sw_{y,a} / 1000$
January-1 Biomass (metric tons)	B_y	$B_y = \sum_{a=1}^{A} N_{y,a} \cdot rw_{y,a} / 1000$

Table 1 cont.

Likelihood	Symbol	Equation
Concentrated Lognormal Likelihood for Fleet Catch and Indices of Relative Abundance	$-L_l$	$-L_l = 0.5 * \sum_i n_i * \ln\left(\frac{\sum_i RSS_i}{\sum_i n_i}\right)$ where $RSS_f = \lambda_f \sum_y \left(\frac{\ln\left(C_{f,y}+1e^{-5}\right)-\ln\left(\hat{C}_{f,y}+1e^{-5}\right)}{CV_{f,y}}\right)^2$ $RSS_t = \lambda_t \sum_y \left(\frac{\ln\left(I_{t,y}+1e^{-5}\right)-\ln\left(\hat{I}_{t,y}+1e^{-5}\right)}{\delta_t \cdot CV_{t,y}}\right)^2$ CV_{fy} and $CV_{t,y}$ are the annual coefficient of variation for the observed total catch and index in year y, δ_t is the CV weight for index t, and λ_t and λ_f are relative weights
Multinomial fleet catch (f) and index (t) age compositions	$-L_f$ or $-L_t$	$-L_f = \lambda_f \sum_y -n_{f,y} \sum_a P_{f,y,a} \cdot \ln\left(\hat{P}_{f,y,a}+1e^{-7}\right)$ $-L_t = \lambda_t \sum_y -n_{t,y} \sum_a U_{t,y,a} \cdot \ln\left(\hat{U}_{t,y,a}+1e^{-7}\right)$ where λ_f and λ_t are a user-defined weighting factors and n_y are the effective sample sizes
Effective sample size	$\hat{\bar{n}}$	The multiplier from equation 1.8 of Francis (2011) was used to adjust the starting values
Constraints Added To Total Likelihood	P_{n1}, P_{rdev}, P_{fadd}	$P_{n1} = \lambda_{n1}(\hat{N}_{y,1} - N^e_{y,1})^2$ - forces $N_{l,1}$ to follow S-R curve $P_{rdev} = \lambda_R \sum_y \log_e(\hat{\sigma}_R) + \frac{\hat{e}_y^2}{2\hat{\sigma}_R^2}$ - for bias correction to constrain deviations $P_{f_{add}} = \begin{cases} \text{phase} < 3, & 10 \cdot \sum_y (F_{f,y} - 0.15)^2 \\ \text{phase} \geq 3, & 0.000001 \cdot \sum_y (F_{f,y} - 0.15)^2 \end{cases}$ - avoid small F values at start

Table 1 cont.

Diagnostics	Symbol	Equation
Standardized residuals (lognormal – catch and surveys)	$r_{f,y,a}$ or $r_{t,y,a}$	$r_{t,y} = \frac{\log I_{t,y} - \log \hat{I}_{t,y}}{\sqrt{\log_e((\delta_t CV_{t,y})^2 + 1)}}$ $r_{f,y} = \frac{\log C_{f,y} - \log \hat{C}_{f,y}}{\sqrt{\log_e(CV_{f,y}^2 + 1)}}$
Standardized residuals (age compositions – catch and surveys)	$ra_{f,y,a}$ or $ra_{t,y,a}$	$ra_{f,y,a} = \frac{P_{f,y,a} - \hat{P}_{f,y,a}}{\sqrt{\frac{\hat{P}_{f,y,a}(1-\hat{P}_{f,y,a})}{\hat{\tilde{n}}_f}}}$ $ra_{t,y,a} = \frac{P_{t,y,a} - \hat{P}_{t,y,a}}{\sqrt{\frac{\hat{P}_{t,y,a}(1-\hat{P}_{t,y,a})}{\hat{\tilde{n}}_t}}}$
Root mean square error	*RMSE*	Total catch $RMSE_f = \sqrt{\frac{\sum_y r_{f,y}^2}{n_f}}$ Index $RMSE_t = \sqrt{\frac{\sum_y r_{t,y}^2}{n_t}}$

Table 2. Commercial harvest (numbers) by state and year.

Year	ME	NH	MA*	RI	CT	NY	NJ	DE	MD	PRFC	VA	NC	Total
1982			26,183	52,896	207	74,935		12,794	189,089	54,421	14,905	3,200	428,630
1983			9,528	48,173	83	66,334		5,806	147,079	63,171	15,962	1,405	357,541
1984			5,838	8,878	192	70,472		12,832	392,696	372,924	6,507	532	870,871
1985	90		7,601	7,173	350	52,048		1,359		82,550	23,450		174,621
1986			3,797	2,668						10,965	251		17,681
1987			3,284	23						9,884	361		13,552
1988			3,388							19,334	10,588		33,310
1989			7,402										7,402
1990			5,927	784		11,784		698	534	38,884	56,222	803	115,636
1991			9,901	3,596		15,426		3,091	31,880	44,521	44,970	413	153,798
1992			11,532	9,095		20,150		2,703	119,286	23,291	42,912	1,745	230,714
1993			13,099	6,294		11,181		4,273	211,089	24,451	39,059	3,414	312,860
1994			11,066	4,512		15,212		4,886	208,914	25,196	32,382	5,275	307,443
1995			44,965	19,722		43,704		5,565	280,051	29,308	88,274	23,325	534,914
1996			38,354	18,570		39,707		20,660	415,272	46,309	184,495	3,151	766,518
1997			44,841	7,061		37,852		33,223	706,847	87,643	165,583	25,562	1,108,612
1998			43,315	8,835		45,149		31,386	790,154	93,299	204,911	16,040	1,233,089
1999			40,838	11,559		49,795		34,841	650,022	90,575	205,143	21,040	1,103,812
2000			40,256	9,418		54,894		25,188	627,777	91,471	202,227	6,480	1,057,712
2001			40,248	10,917		58,296		34,373	549,896	87,809	148,346	22,936	952,820
2002			48,926	11,653		47,142		30,440	296,635	80,300	127,211	15,784	658,091
2003			61,262	15,497		68,354		31,531	439,482	83,091	161,777	13,823	874,817
2004			66,556	15,867		70,367		28,406	461,064	91,888	147,998	31,014	913,160
2005			65,332	14,949		70,560		26,336	569,964	80,615	119,244	26,573	973,572
2006			75,062	15,429		73,528		30,212	655,951	92,288	109,396	2,799	1,054,664
2007			57,634	13,934		78,287		31,090	598,495	86,695	140,602	16,621	1,023,358
2008			65,330	16,616		73,263		31,866	594,655	81,720	134,603	12,903	1,010,955
2009			63,875	20,725		82,574		21,590	618,076	89,693	138,303	8,675	1,043,512
2010			65,277	17,256		81,896		19,830	584,554	90,258	159,197	12,670	1,030,938
2011			63,309	14,344		87,349		20,517	490,969	96,126	148,063	10,814	931,490
2012			66,394	14,953		66,897		15,738	472,517	90,616	111,891	323	839,329

* Includes fish taken for personal consumption

Table 3. Total commercial harvest (numbers) by age and year.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
1982	0	45,129	200,221	117,158	22,927	5,035	3,328	2,861	1,871	4,407	5,837	7,639	2,509	2,810	6,898	428,630
1983	0	54,348	120,639	120,999	38,278	7,416	1,954	677	607	1,690	1,314	2,375	2,656	1,856	2,733	357,541
1984	0	478,268	270,140	55,598	30,580	21,688	6,441	1,744	1,020	771	146	279	1,096	1,042	2,058	870,871
1985	0	53,699	45,492	7,545	9,448	19,248	21,569	6,581	3,692	1,514	466	607	493	894	3,373	174,621
1986	0	639	6,020	3,207	180	703	1,425	1,199	546	182	105	220	288	963	2,004	17,681
1987	0	0	3,087	4,265	1,618	252	1,104	1,075	448	233	95	273	302	235	565	13,552
1988	0	0	2,086	3,961	15,491	6,469	2,803	539	541	218	266	108	250	41	537	33,310
1989	0	0	0	0	0	139	1,111	959	1,007	631	475	164	343	444	2,129	7,402
1990	0	650	12,551	48,024	29,596	15,122	3,111	2,357	1,147	519	272	130	428	322	1,407	115,636
1991	0	2,082	22,430	44,723	41,048	21,614	8,546	4,412	4,816	1,163	269	125	80	553	1,937	153,798
1992	0	640	32,277	58,009	46,661	41,581	22,186	11,514	8,746	6,314	1,062	464	169	346	745	230,714
1993	0	1,848	21,073	93,868	87,447	42,112	32,485	13,829	8,396	6,420	3,955	763	184	76	404	312,860
1994	0	1,179	22,873	71,614	101,512	48,269	28,530	14,886	8,902	5,323	2,513	1,250	198	68	326	307,443
1995	0	6,726	35,190	114,519	134,709	98,471	38,918	34,191	37,324	21,827	8,364	3,166	997	363	149	534,914
1996	0	557	50,102	127,825	179,031	161,361	120,693	51,995	29,907	18,864	11,663	9,674	2,264	1,134	1,449	766,518
1997	0	1,843	37,754	342,867	213,454	206,836	102,034	76,149	54,989	30,373	17,813	13,813	4,873	3,125	2,688	1,108,612
1998	0	6,124	54,375	267,791	411,067	184,209	94,726	75,915	63,592	31,809	19,948	12,110	5,149	2,574	3,700	1,233,089
1999	0	7,591	94,342	211,645	264,460	221,773	92,992	66,837	63,357	35,916	20,939	14,180	4,611	2,549	2,621	1,103,812
2000	0	244	51,876	203,457	284,772	194,336	121,949	72,841	51,768	37,496	19,263	11,391	4,041	1,850	2,430	1,057,712
2001	0	165	86,190	189,602	241,867	140,555	89,963	95,580	34,026	31,547	22,172	12,853	5,027	2,582	692	952,820
2002	0	184	39,914	133,965	130,689	107,219	68,875	45,032	56,146	28,715	20,386	12,252	7,430	3,341	3,942	658,091
2003	0	3,932	59,027	156,836	171,626	132,005	96,662	76,612	70,049	59,722	20,916	15,944	6,647	2,366	2,472	874,817
2004	1,221	18,069	83,780	173,546	123,717	102,815	94,480	97,849	73,246	57,207	43,534	22,876	13,844	3,906	3,068	913,160
2005	0	145	43,488	239,748	252,020	102,076	57,072	56,939	75,306	50,440	41,629	25,937	19,435	4,598	4,738	973,572
2006	0	81	90,820	192,639	335,889	150,133	48,304	43,705	46,313	61,550	39,664	23,017	13,656	5,447	3,448	1,054,664
2007	0	0	4,711	305,597	207,826	190,053	78,099	51,494	64,579	51,397	32,964	20,498	9,282	3,006	3,853	1,023,358
2008	0	0	12,506	233,419	311,903	125,702	92,605	60,928	42,177	41,351	35,246	29,726	15,626	5,848	3,920	1,010,955
2009	0	69	19,745	190,560	356,448	191,280	68,995	69,342	41,636	31,813	27,531	18,630	16,438	6,490	4,534	1,043,512
2010	0	7,178	46,448	219,450	247,340	177,935	133,809	58,962	45,183	30,091	21,540	17,394	14,386	5,165	6,055	1,030,938
2011	0	788	49,592	127,860	199,887	198,523	118,074	93,069	45,488	42,628	15,586	12,507	10,349	9,153	7,987	931,490
2012	0	8,532	58,497	87,861	250,673	139,183	99,949	53,740	59,019	22,634	25,562	13,779	7,732	6,480	5,688	839,329

Table 4. Commercial discards (numbers) by age and year.

	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Total
1982	0	31,645	3,644	11,456	5,623	1,291	2,397	1,014	369	92	85	0	0	7	0	57,624
1983	0	24,067	1,453	2,878	7,761	2,311	610	610	262	174	0	0	0	0	0	40,127
1984	0	33,575	1,611	5,812	9,734	11,272	2,815	117	586	66	0	52	0	0	0	65,639
1985	0	7,728	30,472	5,939	10,891	3,395	2,742	1,045	261	131	131	0	0	0	0	62,734
1986	0	5,841	20,758	100,067	27,989	13,315	4,295	1,415	346	0	0	0	0	0	0	174,024
1987	0	4,206	14,382	28,597	51,389	16,940	6,520	1,319	1,011	395	111	86	111	0	0	125,066
1988	0	6,142	22,593	36,616	70,959	71,694	23,232	9,116	3,110	1,653	218	195	24	0	0	245,552
1989	0	13,854	50,240	49,029	83,396	82,757	33,479	15,502	6,342	705	1,409	1,409	663	41	0	338,827
1990	0	14,526	68,713	80,935	111,888	115,702	71,600	36,256	5,948	1,539	1,401	1,503	0	0	0	510,011
1991	79	12,632	37,009	64,210	77,335	56,894	36,912	24,857	6,610	4,071	6,542	16	0	0	0	327,167
1992	117	3,698	34,218	36,746	44,412	34,688	14,798	11,179	3,398	2,356	991	0	0	0	0	186,601
1993	0	7,449	50,160	79,011	95,116	63,487	20,941	15,351	9,270	4,606	1,651	536	260	0	0	347,839
1994	0	31,770	47,169	45,081	88,122	84,570	39,229	12,524	6,223	3,674	712	415	30	0	0	359,518
1995	0	72,822	75,520	53,551	94,158	121,592	61,447	19,083	7,569	4,269	2,290	2,346	807	0	0	515,454
1996	0	27,133	114,085	76,336	61,884	58,787	30,835	14,916	6,148	3,989	159	502	50	0	0	394,824
1997	476	7,108	64,352	61,871	30,602	20,951	14,002	6,592	1,963	4,309	2,658	801	1,060	0	0	216,745
1998	0	13,233	53,899	98,510	83,288	29,197	12,970	12,591	7,860	4,372	3,891	2,419	3,311	124	367	326,032
1999	984	58,076	49,894	43,744	55,740	14,477	5,213	3,704	1,980	1,304	648	612	240	3	0	236,619
2000	196	178,457	189,933	157,291	62,699	33,918	26,938	7,831	4,111	3,876	801	863	41	17	25	666,997
2001	0	2,638	58,079	77,958	88,808	29,410	18,877	11,613	9,664	6,371	4,778	1,957	737	10	0	310,900
2002	1,700	20,888	42,641	21,409	28,791	23,720	12,381	6,854	5,645	2,255	1,522	149	173	33	43	168,201
2003	1,512	6,227	28,061	54,464	56,728	19,866	30,850	18,633	16,410	13,572	8,164	3,207	2,894	165	1,222	261,974
2004	2,943	52,811	80,744	76,790	62,580	48,683	52,231	41,378	23,549	9,829	10,381	2,365	446	899	14	465,642
2005	432	11,513	103,930	245,644	169,860	68,808	54,397	43,911	43,609	23,102	16,147	8,477	5,238	2,009	1,466	798,544
2006	0	555	25,769	28,836	36,995	27,669	15,055	16,698	12,693	13,187	7,392	4,430	5,245	0	0	194,524
2007	288	6,384	18,385	89,872	98,205	140,521	78,873	48,659	42,564	30,519	22,267	19,933	11,810	0	0	608,279
2008	0	109	2,928	45,076	71,474	58,005	44,675	21,699	13,857	13,043	12,619	14,253	10,978	0	0	308,715
2009	0	1,661	80,748	166,818	123,878	91,220	30,653	38,426	20,517	16,384	15,706	7,675	18,258	0	0	611,944
2010	0	1,379	16,212	76,208	64,148	46,221	19,637	9,510	6,534	4,079	3,116	1,792	6,007	0	0	254,841
2011	0	3,760	59,534	107,156	127,696	82,263	58,450	57,352	41,289	34,924	16,356	12,334	9,925	9,513	13,869	634,421
2012	0	8,790	48,850	118,242	201,781	142,385	118,204	52,233	43,181	18,375	22,095	17,022	2,871	10,337	14,211	818,579

Table 5. Recreational harvest (numbers) by state and year (includes wave 1 estimated harvest for Virginia).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Total
1982	929		83,933	1,757	50,081	21,278	58,294	0	984	0	0	217,256
1983	7,212	4,576	39,316	1,990	42,826	43,731	127,912	135	31,746	0	0	299,444
1984	0	0	3,481	1,230	5,678	57,089	13,625	16,571	16,789	0	0	114,463
1985	11,862	0	66,019	670	15,350	23,107	13,145	0	2,965	404	0	133,522
1986	0	0	29,434	3,291	1,760	27,477	36,999	0	14,077	1,585	0	114,623
1987	0	90	10,807	2,399	522	14,191	9,279	0	4,025	2,442	0	43,755
1988	0	647	21,050	5,226	2,672	20,230	12,141	0	133	24,259	367	86,725
1989	738	0	13,044	4,303	5,777	12,388	1,312	0	0	0	0	37,562
1990	2,912	617	20,515	4,677	6,082	24,799	44,878	2,009	736	56,017	0	163,242
1991	3,265	274	20,799	17,193	4,907	54,502	38,300	2,741	77,873	42,224	391	262,469
1992	6,357	2,213	57,084	14,945	9,154	45,162	41,426	2,400	99,354	21,118	967	300,180
1993	612	1,540	58,511	17,826	19,253	78,560	64,935	4,055	104,682	78,481	264	428,719
1994	3,771	3,023	74,538	5,915	16,929	87,225	34,877	4,140	199,378	127,945	7,426	565,167
1995	2,189	3,902	73,806	29,997	38,261	155,821	254,055	15,361	355,237	149,103	11,450	1,089,182
1996	1,893	6,461	68,300	60,074	62,840	225,428	127,952	22,867	337,415	244,746	17,136	1,175,112
1997	35,259	13,546	199,373	62,162	64,639	236,902	67,800	19,706	334,068	518,483	96,189	1,648,127
1998	38,094	5,929	207,952	44,890	64,215	166,868	88,973	18,758	391,824	383,786	45,773	1,457,062
1999	21,102	4,641	126,755	56,320	55,805	195,261	237,010	8,772	263,191	411,873	65,658	1,446,388
2000	62,186	4,262	181,295	95,496	53,191	270,798	402,302	39,543	506,462	389,126	20,452	2,025,113
2001	59,947	15,291	288,032	80,125	54,165	189,714	560,208	41,195	382,557	355,020	58,873	2,085,127
2002	71,907	12,857	308,749	78,190	51,060	202,075	416,455	29,149	282,429	411,248	109,052	1,973,171
2003	57,765	24,878	407,100	115,471	95,983	313,761	391,842	29,522	525,191	455,812	127,727	2,545,052
2004	48,816	8,386	445,745	83,990	102,844	263,096	424,208	25,429	368,682	548,768	230,783	2,550,747
2005	83,617	24,940	340,743	110,490	141,290	376,894	411,532	20,438	533,929	293,161	104,904	2,441,938
2006	75,347	13,521	314,987	75,811	115,214	367,835	509,606	20,159	669,140	547,482	79,023	2,788,125
2007	53,694	6,348	315,409	101,400	118,549	474,062	289,656	8,465	765,169	353,372	37,376	2,523,500
2008	59,152	5,308	377,959	51,191	108,166	685,589	309,411	26,934	415,403	401,155	25,750	2,466,018
2009	62,153	8,587	344,401	71,427	60,876	356,311	283,024	19,539	501,845	326,867	5,650	2,040,680
2010	17,396	5,948	341,045	70,108	92,806	538,374	320,413	16,244	457,898	102,405	23,778	1,986,415
2011	18,105	32,704	255,507	88,635	63,288	674,844	393,194	18,023	445,171	146,603	94,182	2,230,256
2012	11,624	14,498	377,931	61,537	64,573	424,522	168,629	25,399	262,143	134,758	0	1,545,614

Table 6. Recreational harvest (numbers) by age and year.

st-a-tage	Age															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1982	0	5,721	36,125	81,725	24,916	10,963	16,943	11,960	8,970	5,980	4,983	5,980	997	997	997	217,257
1983	4,617	25,001	50,976	62,840	95,870	27,371	15,035	3,338	1,799	1,799	2,699	2,699	1,799	1,799	1,799	299,443
1984	2,021	22,316	24,474	15,610	16,528	15,288	8,034	2,548	0	849	849	0	849	2,548	2,548	114,463
1985	225	3,305	13,315	22,732	36,208	19,572	18,593	9,786	1,957	1,957	0	0	0	0	5,872	133,522
1986	11,002	5,426	9,354	12,136	12,339	13,473	12,285	18,427	7,020	4,387	2,632	877	877	877	3,510	114,623
1987	1,083	1,370	3,822	2,596	4,838	3,756	3,756	2,817	3,756	1,878	939	1,878	2,817	1,878	6,573	43,756
1988	1,023	8,195	5,116	5,120	6,135	11,214	10,191	12,225	9,169	3,056	3,056	3,056	2,037	3,056	4,075	86,725
1989	0	0	3,130	2,087	4,174	6,260	7,304	4,174	2,087	2,087	1,043	0	1,043	1,043	3,130	37,562
1990	627	7,933	17,317	39,534	22,708	22,980	16,657	15,810	7,680	3,009	1,797	899	1,797	1,797	2,696	163,242
1991	1,368	21,382	38,339	61,798	27,957	13,322	24,432	26,848	23,268	9,293	4,159	937	937	1,405	7,025	262,470
1992	1,881	15,923	61,295	52,925	54,507	20,325	13,805	23,488	23,613	18,849	3,854	1,943	971	2,428	4,371	300,179
1993	2,209	18,044	53,461	93,539	68,083	49,704	18,614	20,458	36,054	35,685	19,855	4,461	2,012	503	6,037	428,719
1994	2,112	43,976	138,180	95,461	91,957	47,419	29,827	23,833	34,809	29,999	13,650	8,815	855	427	3,846	565,167
1995	562	134,922	222,570	183,276	105,211	164,461	64,387	81,839	59,042	34,224	24,276	6,888	4,634	1,144	1,745	1,089,181
1996	531	129,149	257,038	214,669	109,367	116,156	137,033	80,275	58,041	27,210	18,534	19,437	5,627	1,535	512	1,175,113
1997	1,837	2,837	74,549	240,321	185,350	213,594	217,940	290,961	183,150	120,586	58,005	32,037	14,960	7,718	4,280	1,648,125
1998	0	20,368	133,541	229,441	168,884	164,613	134,977	153,529	163,905	96,099	87,690	41,837	31,341	14,855	15,983	1,457,063
1999	0	2,307	39,471	141,735	166,527	282,809	200,750	168,942	155,988	108,584	87,820	42,054	29,505	13,081	6,813	1,446,388
2000	0	503	37,950	255,084	402,268	367,123	423,409	201,142	120,257	97,670	53,095	28,375	17,434	10,132	10,671	2,025,112
2001	1,036	559	60,048	169,642	340,240	403,155	379,607	314,763	150,791	92,207	80,417	44,978	26,295	13,149	8,239	2,085,127
2002	0	1,530	33,823	141,000	266,095	405,275	334,964	249,670	237,566	107,817	86,338	46,611	33,558	12,795	16,128	1,973,171
2003	0	36,600	76,642	198,625	295,548	362,028	463,663	336,910	275,724	218,321	123,058	72,670	46,796	25,286	13,182	2,545,052
2004	427	214	94,601	207,895	211,670	268,011	301,427	435,274	331,997	265,634	210,003	103,959	54,859	39,501	25,272	2,550,745
2005	0	322	40,333	245,135	337,585	282,138	285,659	240,402	308,962	233,801	232,352	100,482	67,791	32,149	34,826	2,441,938
2006	0	8,326	112,441	209,402	372,824	335,684	245,484	289,948	249,576	341,499	248,790	158,204	107,653	41,432	66,863	2,788,125
2007	0	73	25,068	333,424	269,399	403,913	267,964	239,743	269,469	267,806	182,806	133,849	62,176	35,214	32,598	2,523,500
2008	0	246	7,036	74,691	340,359	211,584	473,211	359,388	200,562	243,217	197,085	156,271	103,591	36,841	61,936	2,466,018
2009	0	970	15,868	103,386	228,968	429,381	221,964	309,080	169,576	122,503	132,590	111,295	104,868	38,709	51,521	2,040,680
2010	0	8,973	25,576	141,402	156,928	288,769	487,688	201,524	215,001	155,490	81,649	79,440	58,948	37,431	47,595	1,986,415
2011	0	8,101	33,913	89,551	176,608	330,321	360,990	542,248	186,305	174,692	84,284	63,411	60,207	63,773	55,850	2,230,256
2012	880	5,750	37,455	51,034	138,448	166,043	230,082	267,495	275,475	91,442	91,694	60,174	36,369	35,751	57,521	1,545,614

Table 7. Recreational dead releases (numbers) by state and year (using 0.09 release mortality).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Total
1982	62	0	580	230	57,887	1,107	7,888	0	2,734	0	0	70,487
1983	0	0	3,062	490	0	132	10,603	0	19,214	1,080	0	34,580
1984	170	0	8,856	7,662	2,806	3,642	4,764	0	9,369	790	0	38,058
1985	7,304	8	1,112	3,651	2,425	5,179	497	63	13,239	234	0	33,713
1986	394	0	39,807	181	944	11,146	0	0	35,106	678	0	88,256
1987	1,630	39	8,429	5,746	7,059	22,859	5,103	1,529	10,656	685	0	63,734
1988	408	603	18,867	2,101	2,298	8,335	43,768	221	11,903	507	0	89,009
1989	1,443	434	17,376	3,421	11,283	32,914	23,936	433	10,284	6,549	0	108,073
1990	1,129	1,397	30,556	6,076	8,054	23,859	22,895	1,297	37,808	15,754	0	148,823
1991	6,074	590	40,386	2,788	27,133	68,100	14,958	3,450	93,241	18,752	23	275,494
1992	2,806	2,485	70,183	10,837	26,303	71,923	37,216	3,324	67,496	10,431	61	303,066
1993	33,576	1,348	75,021	9,089	24,419	62,470	27,743	8,059	140,116	9,034	137	391,011
1994	32,733	3,915	189,226	12,509	44,097	101,944	51,124	9,359	250,685	17,732	450	713,776
1995	45,518	25,694	295,279	32,069	45,641	108,863	62,540	10,383	216,115	33,385	1,460	876,948
1996	146,403	26,354	294,277	28,290	94,645	129,248	69,855	8,943	229,071	68,392	10,500	1,105,980
1997	127,618	25,137	487,598	54,607	65,044	91,700	66,306	11,707	361,799	110,909	12,227	1,414,651
1998	62,224	21,897	646,592	55,208	92,357	79,616	43,949	16,651	237,751	71,673	15,633	1,343,553
1999	58,483	13,116	411,859	32,411	63,362	110,577	103,741	9,513	214,885	84,668	23,710	1,126,325
2000	84,833	18,865	664,383	48,736	83,373	123,576	79,676	13,665	292,026	91,984	11,676	1,512,793
2001	78,347	14,790	486,981	33,973	99,694	74,185	86,909	14,641	260,105	55,885	4,496	1,210,005
2002	125,298	21,420	514,709	47,736	62,728	52,934	64,359	10,319	263,573	63,606	5,694	1,232,375
2003	76,204	23,415	392,554	40,384	75,873	97,543	83,330	15,211	418,752	87,350	4,405	1,315,020
2004	62,406	20,320	448,117	47,334	74,405	243,832	135,242	14,009	313,167	155,960	20,007	1,534,800
2005	268,668	51,537	358,981	57,048	158,547	127,097	109,700	22,594	347,000	116,619	9,309	1,627,101
2006	360,028	41,455	702,880	75,146	88,803	155,015	170,126	22,289	334,021	148,951	2,184	2,100,897
2007	100,356	23,163	479,832	61,007	88,617	150,995	161,036	22,382	275,844	85,424	1,245	1,449,902
2008	41,850	6,951	328,447	37,474	279,430	121,175	117,851	23,461	120,486	47,894	970	1,125,989
2009	23,716	5,170	205,434	35,882	104,515	96,612	72,046	13,103	128,100	32,309	487	717,373
2010	17,437	4,665	150,429	16,480	60,348	96,180	62,131	5,854	135,778	12,092	1,833	563,227
2011	12,825	8,882	87,587	19,287	55,113	135,547	79,561	9,908	101,476	13,822	9,913	533,923
2012	19,277	5,780	89,056	22,237	23,843	52,744	36,549	9,896	198,587	9,156	145	467,270

Table 8. Recreational dead releases (numbers) by age and year.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1982	2,203	26,433	18,723	12,115	5,507	2,203	2,203	1,101	0	0	0	0	0	0	0
1983	1,153	18,443	11,527	2,305	1,153	0	0	0	0	0	0	0	0	0	0
1984	4,613	14,993	11,533	4,613	1,153	1,153	0	0	0	0	0	0	0	0	0
1985	1,204	10,836	16,856	3,612	1,204	0	0	0	0	0	0	0	0	0	0
1986	2,234	13,406	35,749	21,226	8,937	3,351	1,117	2,234	0	0	0	0	0	0	0
1987	1,138	5,691	19,348	18,210	10,243	4,552	2,276	1,138	1,138	0	0	0	0	0	0
1988	1,156	18,495	17,339	18,495	16,183	9,248	4,624	2,312	1,156	0	0	0	0	0	0
1989	1,114	25,625	30,082	17,826	20,055	7,799	3,342	1,114	1,114	0	0	0	0	0	0
1990	3,382	40,588	39,461	25,931	10,147	11,275	9,020	5,637	2,255	1,127	0	0	0	0	0
1991	0	56,686	71,424	56,686	21,541	11,337	20,407	19,273	11,337	4,535	2,267	0	0	0	0
1992	1,127	36,052	104,777	61,965	45,066	14,646	10,140	13,520	9,013	5,633	1,127	0	0	0	0
1993	2,015	64,083	92,190	92,190	57,338	39,349	14,615	8,994	8,994	6,746	3,373	1,124	0	0	0
1994	5,629	95,695	206,027	120,464	123,841	65,298	37,152	20,265	19,139	12,384	4,503	3,377	0	0	0
1995	4,550	280,942	187,674	141,040	73,932	92,131	30,710	34,122	17,061	6,824	6,824	1,137	0	0	0
1996	523	74,207	397,331	237,531	184,811	117,545	67,642	18,029	5,979	654	1,652	77	0	0	0
1997	41,946	241,354	248,485	378,306	180,913	112,747	73,915	69,136	33,748	21,040	7,060	4,225	1,364	306	106
1998	15,640	168,148	313,615	292,810	260,185	130,762	70,364	45,509	22,978	10,590	7,780	2,385	1,642	785	359
1999	2,830	34,857	280,195	252,317	179,524	210,450	77,416	37,074	22,135	14,195	9,208	3,415	1,244	676	790
2000	36,627	161,331	160,505	424,773	256,963	211,257	157,541	58,495	17,816	12,115	7,178	3,966	2,298	1,098	830
2001	48,231	140,656	156,770	170,708	236,480	156,842	129,616	108,404	31,428	9,872	10,156	5,552	3,203	850	1,236
2002	22,723	225,755	192,562	179,559	136,437	213,849	110,951	72,533	42,377	12,326	10,814	5,600	3,851	2,209	830
2003	950	295,633	335,248	168,906	146,578	85,458	108,307	72,217	40,777	34,257	12,480	6,617	5,954	913	727
2004	71,171	119,239	600,408	306,543	125,022	104,379	67,587	65,250	30,875	16,012	14,024	7,379	3,427	2,658	733
2005	21,321	484,439	253,499	406,041	221,051	75,313	48,982	37,607	34,575	18,354	13,451	6,402	3,203	1,743	1,050
2006	34,400	212,388	953,539	235,964	313,891	173,093	48,895	37,392	27,426	30,541	16,625	9,338	4,058	1,881	1,452
2007	9,182	122,212	218,914	309,915	126,062	161,052	100,212	90,585	95,908	77,293	52,531	37,942	24,048	15,272	8,713
2008	18,323	78,987	187,667	204,472	355,236	95,227	77,349	39,419	20,916	16,653	14,205	10,456	4,286	1,435	1,359
2009	15,986	82,905	96,331	122,987	109,557	161,686	34,648	39,057	17,297	10,042	9,272	7,094	6,198	2,060	2,150
2010	1,653	57,745	125,938	79,677	83,941	68,881	69,651	18,731	18,196	10,842	6,122	7,592	5,411	4,815	4,012
2011	36,803	63,312	103,487	109,801	38,884	76,011	39,600	34,050	9,666	8,356	4,214	3,264	2,735	1,977	1,761
2012	61,548	106,620	100,952	44,062	41,962	27,394	29,141	22,132	16,123	4,874	4,501	2,702	1,343	2,173	1,743

Table 9. Average catch weight (kilograms)-at-age by year.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.13	0.64	1.09	1.54	2.42	3.75	4.83	5.79	6.2	8.68	10.8	11.2	14.05
1983	0.2	0.55	0.94	1.37	2.37	3.29	3.77	5.36	6.01	8.1	9.57	10.39	11.11
1984	0.24	0.6	1.69	1.62	2.67	3.39	5.07	5.65	6.76	7.76	8.41	12.65	12.38
1985	0.06	0.61	1.07	1.66	2.19	3.59	4.91	5.46	6.77	7.45	9	10.69	13.91
1986	0.14	0.57	1.27	2.4	2.44	3.12	3.95	5.05	5.44	6.09	7.75	9.16	12.78
1987	0.2	0.77	1.41	2.11	2.5	2.91	3.61	4.74	5.52	6.49	7.77	9.78	13.15
1988	0.31	0.91	1.1	1.98	3.12	4.02	4.38	4.7	5.24	5.62	8.58	10.4	13.27
1989	0.16	0.83	1.22	2.23	3.06	4.53	5.37	6.23	6.04	8.68	8.94	9.74	13.36
1990	0.08	0.89	1.14	2.05	2.35	3.83	4.91	5.96	5.7	5.97	7.44	9.08	12.6
1991	0.21	0.92	1.29	2.17	2.62	3.17	4.81	5.64	6.46	6.24	9.46	8.3	14.22
1992	0.1	0.69	1.31	1.93	2.81	3.67	4.9	5.79	6.96	8.15	9.77	12.44	13.97
1993	0.07	0.76	1.31	1.99	2.77	3.58	4.8	6.11	7.03	8.01	9.53	10.76	14.55
1994	0.24	1.05	1.69	2.21	2.85	3.5	4.94	6.2	6.8	7.53	9.73	10.69	12.73
1995	0.28	0.7	1.35	2.18	2.77	3.65	5.38	6.16	7.27	8.86	7.57	9.73	16.66
1996	0.14	1.05	1.47	2.32	3.23	4.52	6.39	7.11	7.81	9.2	9.31	10.1	13.7
1997	0.13	0.62	1.18	2.46	2.81	3.64	4.51	5.07	6.73	9.17	9.94	10.24	14.78
1998	0.39	0.77	1.2	1.62	2.25	2.95	4.69	5.66	6.82	7.03	7.76	9.87	11.87
1999	0.62	0.9	1.11	1.44	1.91	2.51	3.36	5.03	6.56	7.85	8.69	9.76	11.98
2000	0.37	0.55	1.1	1.45	1.96	2.79	3.89	5.09	7.11	7.37	9.7	10.7	13.55
2001	0.16	0.38	1.12	1.75	2.21	3.25	4.12	5.02	6.36	7.79	8.65	8.29	10.87
2002	0.12	0.31	1.06	1.51	2.18	3.17	4.19	5.48	6.03	7.56	9.09	9.75	11.52
2003	0.1	0.6	1	1.4	2.2	3.2	4.1	5.2	6.1	7.2	8.5	9.4	11
2004	0.23	0.33	0.84	1.40	2.43	3.11	4.14	5.17	6.07	7.12	8.18	9.03	10.71
2005	0.13	0.50	1.14	1.64	2.22	3.23	4.18	5.64	6.38	7.21	8.51	10.00	12.19
2006	0.18	0.38	0.81	1.35	1.96	2.80	3.84	5.35	6.70	7.41	8.58	9.40	12.05
2007	0.10	0.46	0.94	1.30	2.10	3.07	4.31	5.32	6.89	7.84	9.39	10.12	12.77
2008	0.21	0.45	1.04	1.43	2.14	3.47	5.05	5.51	6.69	8.26	9.19	9.82	12.00
2009	0.26	0.62	1.03	1.41	1.92	3.29	4.49	5.74	6.87	7.73	8.81	9.47	12.24
2010	0.16	0.70	1.11	1.41	1.99	3.34	4.27	5.21	6.27	7.65	8.97	9.15	11.59
2011	0.20	0.52	1.04	1.55	2.00	3.08	4.10	5.13	6.41	7.54	8.20	9.98	13.08
2012	0.27	0.7	1.31	2.27	3.11	3.61	4.34	5.37	6.22	7.74	8.8	9.66	12.51

Table 10. Total removals and associated coefficients of variation and age proportions of total removals of striped bass split into Chesapeake Bay, Coast, and Commercial Discard fleet, 1982-2012.

	Chesapeake Bay		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	262,133	0.857	0.00507	0.12678	0.59014	0.23839	0.03160	0.00498	0.00099	0.00089	0.00012	0.00000	0.00029	0.00047	0.00029
1983	277,824	0.224	0.01104	0.28325	0.36483	0.28873	0.03398	0.00918	0.00351	0.00307	0.00086	0.00028	0.00016	0.00032	0.00078
1984	798,853	0.444	0.00557	0.61276	0.33834	0.03751	0.00495	0.00013	0.00068	0.00005	0.00001	0.00000	0.00000	0.00000	0.00000
1985	122,842	0.447	0.01132	0.52144	0.40241	0.04234	0.01142	0.00471	0.00483	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000
1986	56,504	0.516	0.09360	0.28059	0.46742	0.10997	0.01729	0.00595	0.01951	0.00567	0.00000	0.00000	0.00000	0.00000	0.00000
1987	23,170	0.489	0.05059	0.17128	0.40184	0.24355	0.07494	0.00375	0.02876	0.02530	0.00000	0.00000	0.00000	0.00000	0.00000
1988	42,211	0.887	0.02643	0.20139	0.10296	0.10244	0.36728	0.14152	0.05660	0.00138	0.00000	0.00000	0.00000	0.00000	0.00000
1989	16,791	0.285	0.06463	0.56728	0.15406	0.10122	0.07011	0.02801	0.01070	0.00400	0.00000	0.00000	0.00000	0.00000	0.00000
1990	205,740	0.333	0.01873	0.14393	0.18579	0.32698	0.17722	0.10363	0.02839	0.00924	0.00457	0.00152	0.00000	0.00000	0.00000
1991	352,428	0.171	0.00255	0.15667	0.24267	0.25941	0.15361	0.07895	0.05201	0.02952	0.01372	0.00641	0.00448	0.00000	0.00000
1992	383,546	0.156	0.00530	0.09234	0.22350	0.24898	0.18261	0.12646	0.06779	0.03110	0.01392	0.00612	0.00188	0.00000	0.00000
1993	597,071	0.152	0.00278	0.11137	0.16410	0.27782	0.20806	0.11027	0.06903	0.02844	0.01566	0.00797	0.00363	0.00087	0.00000
1994	859,681	0.158	0.00841	0.08882	0.17138	0.19982	0.23514	0.13061	0.08229	0.04048	0.02364	0.01201	0.00506	0.00235	0.00000
1995	1,133,791	0.132	0.00447	0.14701	0.20492	0.22479	0.16855	0.14799	0.04925	0.03082	0.01229	0.00383	0.00414	0.00097	0.00099
1996	1,465,451	0.137	0.00036	0.09842	0.26089	0.18188	0.16817	0.14229	0.08644	0.03241	0.01535	0.00720	0.00462	0.00121	0.00076
1997	1,998,211	0.117	0.02075	0.04500	0.07404	0.32221	0.18116	0.15894	0.08528	0.05664	0.02819	0.01457	0.00648	0.00427	0.00247
1998	1,934,786	0.099	0.00169	0.03597	0.14993	0.25242	0.27003	0.12710	0.06030	0.03604	0.02901	0.01880	0.00978	0.00517	0.00377
1999	1,726,756	0.107	0.00123	0.01763	0.15538	0.22930	0.22668	0.19522	0.07263	0.03593	0.02879	0.01361	0.01137	0.00630	0.00593
2000	2,019,358	0.092	0.01360	0.05297	0.06707	0.24036	0.27401	0.16615	0.09269	0.04241	0.01809	0.01515	0.00751	0.00515	0.00486
2001	1,695,685	0.089	0.02650	0.05998	0.11749	0.19551	0.23594	0.13129	0.08764	0.06882	0.02137	0.01887	0.01455	0.01317	0.00888
2002	1,311,055	0.096	0.01116	0.10412	0.10416	0.19271	0.18460	0.15229	0.10087	0.04483	0.05433	0.01364	0.01389	0.00794	0.01547
2003	2,052,319	0.075	0.00000	0.10428	0.13637	0.17148	0.14837	0.12365	0.09679	0.06315	0.05577	0.05495	0.01998	0.01202	0.01319
2004	1,825,612	0.076	0.03768	0.04394	0.20312	0.20733	0.11058	0.09403	0.08510	0.06536	0.04986	0.03511	0.03521	0.01488	0.01780
2005	1,963,065	0.088	0.00404	0.11522	0.07071	0.24342	0.21513	0.08748	0.05656	0.03891	0.05310	0.03768	0.03703	0.02214	0.01857
2006	2,329,278	0.072	0.01351	0.05082	0.17163	0.17673	0.24904	0.11652	0.04082	0.03479	0.03336	0.04266	0.02650	0.01715	0.02646
2007	2,134,342	0.100	0.00347	0.03161	0.03894	0.34255	0.18042	0.15994	0.05946	0.03628	0.03861	0.03262	0.03410	0.01809	0.02391
2008	1,548,345	0.081	0.00549	0.02349	0.02065	0.20074	0.33928	0.09984	0.08117	0.05211	0.03130	0.03331	0.03126	0.04252	0.03883
2009	1,702,422	0.082	0.00831	0.01123	0.04313	0.18089	0.31257	0.16230	0.06459	0.05332	0.03420	0.02459	0.02821	0.02540	0.05127
2010	1,482,203	0.111	0.00081	0.03521	0.06430	0.25782	0.24658	0.17408	0.09437	0.04192	0.03002	0.01570	0.00713	0.01028	0.02178
2011	1,378,058	0.088	0.02015	0.02148	0.08227	0.15313	0.23472	0.20793	0.11087	0.06843	0.02710	0.02681	0.01204	0.00919	0.02588
2012	1,198,075	0.108	0.05011	0.05624	0.11305	0.10887	0.25845	0.14595	0.09375	0.03454	0.04980	0.01686	0.02784	0.00949	0.03504

Table 10 cont.

	Coast		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	454,241	0.366	0.00192	0.09698	0.22097	0.32694	0.09921	0.03720	0.04890	0.03454	0.02380	0.02287	0.02365	0.02971	0.03331
1983	413,741	0.699	0.00653	0.04616	0.19767	0.25603	0.30420	0.07791	0.03870	0.00765	0.00524	0.00825	0.00959	0.01205	0.03003
1984	224,539	0.450	0.00973	0.11611	0.15973	0.20421	0.19731	0.16935	0.06206	0.01893	0.00451	0.00722	0.00443	0.00124	0.04517
1985	219,014	0.679	0.00017	0.01728	0.11977	0.13099	0.20756	0.17460	0.18067	0.07387	0.02579	0.01585	0.00213	0.00277	0.04854
1986	164,055	0.324	0.04844	0.02205	0.15063	0.18503	0.12483	0.10479	0.08366	0.13130	0.04612	0.02785	0.01669	0.00669	0.05193
1987	97,873	0.265	0.01071	0.03159	0.17315	0.19850	0.15288	0.08658	0.06610	0.04540	0.05458	0.02157	0.01056	0.02198	0.12638
1988	166,833	0.326	0.00637	0.10903	0.12105	0.13938	0.13371	0.12561	0.09128	0.09001	0.06513	0.01963	0.01991	0.01897	0.05992
1989	136,245	0.276	0.00021	0.11817	0.22478	0.13368	0.16919	0.10076	0.08498	0.04536	0.03088	0.01995	0.01114	0.00120	0.05969
1990	221,962	0.126	0.00071	0.08812	0.14014	0.20822	0.11709	0.12640	0.10339	0.09868	0.04569	0.01956	0.00932	0.00463	0.03806
1991	339,335	0.144	0.00138	0.07349	0.13753	0.21154	0.10729	0.05437	0.10331	0.11826	0.10193	0.03752	0.01508	0.00313	0.03518
1992	450,413	0.106	0.00216	0.03819	0.25005	0.17186	0.16916	0.06228	0.04469	0.08125	0.08000	0.06316	0.01181	0.00534	0.02005
1993	535,519	0.119	0.00479	0.03264	0.12837	0.21235	0.16552	0.12198	0.04575	0.04911	0.08234	0.08233	0.04671	0.01088	0.01721
1994	726,704	0.074	0.00071	0.08875	0.30239	0.15930	0.15848	0.06702	0.03408	0.03328	0.05852	0.05144	0.02245	0.01571	0.00787
1995	1,367,251	0.099	0.00003	0.18718	0.15586	0.13456	0.08978	0.13697	0.05718	0.08427	0.07277	0.04281	0.02543	0.00738	0.00578
1996	1,582,160	0.067	0.00033	0.03773	0.20362	0.19814	0.14332	0.11791	0.12558	0.06498	0.04515	0.02287	0.01586	0.01732	0.00721
1997	2,173,177	0.055	0.00106	0.07183	0.09794	0.14617	0.10018	0.09920	0.10283	0.14866	0.09919	0.06575	0.03218	0.01912	0.01587
1998	2,098,919	0.064	0.00589	0.05958	0.10075	0.14372	0.15136	0.11133	0.08738	0.09777	0.09259	0.04866	0.04597	0.02207	0.03292
1999	1,953,346	0.062	0.00039	0.00743	0.07537	0.10786	0.11237	0.19360	0.12586	0.10795	0.09818	0.06923	0.05035	0.02498	0.02644
2000	2,584,015	0.064	0.00356	0.02137	0.04529	0.15533	0.15168	0.16933	0.19966	0.09557	0.05935	0.04518	0.02493	0.01290	0.01586
2001	2,554,609	0.045	0.00170	0.01553	0.04076	0.07805	0.16409	0.18713	0.17640	0.15741	0.07048	0.03981	0.03448	0.01607	0.01810
2002	2,553,899	0.052	0.00317	0.03562	0.05083	0.07920	0.11422	0.20629	0.14982	0.12079	0.10372	0.05129	0.03890	0.02117	0.02498
2003	2,682,570	0.047	0.00035	0.04553	0.07122	0.06428	0.11528	0.12142	0.17520	0.13276	0.10143	0.07438	0.04304	0.02630	0.02881
2004	3,173,119	0.063	0.00127	0.01806	0.12858	0.09754	0.08148	0.09566	0.09711	0.15098	0.10876	0.08659	0.06406	0.03374	0.03617
2005	3,079,601	0.055	0.00434	0.08402	0.06446	0.13414	0.12610	0.09345	0.09115	0.08397	0.10216	0.07424	0.06973	0.02901	0.04321
2006	3,614,394	0.051	0.00081	0.02834	0.20945	0.06263	0.12243	0.10721	0.06851	0.08024	0.06795	0.09247	0.06733	0.04167	0.05098
2007	2,862,392	0.052	0.00062	0.01915	0.05785	0.07610	0.07623	0.14451	0.11158	0.10634	0.12142	0.11419	0.06831	0.05369	0.05001
2008	3,054,618	0.059	0.00321	0.01403	0.05737	0.06605	0.15785	0.09098	0.16941	0.12409	0.07045	0.08173	0.06487	0.04276	0.05720
2009	2,099,071	0.055	0.00088	0.03088	0.02788	0.05193	0.07758	0.24108	0.10273	0.15564	0.08113	0.05836	0.05782	0.04468	0.06941
2010	2,098,391	0.058	0.00022	0.01035	0.04893	0.02783	0.05848	0.13228	0.26271	0.10345	0.11146	0.08251	0.04706	0.04250	0.07222
2011	2,317,609	0.054	0.00390	0.01838	0.03177	0.05013	0.03966	0.13735	0.15787	0.24813	0.08807	0.08143	0.03775	0.02870	0.07686
2012	1,654,138	0.074	0.00144	0.03236	0.03716	0.03175	0.07341	0.09537	0.14923	0.18257	0.17589	0.05970	0.05345	0.03947	0.06821

Table 10 cont.

	Commercial Discards		Age Proportions												
Year	Total	CV	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	57,624	0.350	0.00000	0.54917	0.06325	0.19881	0.09759	0.02240	0.04160	0.01760	0.00640	0.00160	0.00148	0.00000	0.00012
1983	40,127	0.350	0.00000	0.59977	0.03620	0.07172	0.19342	0.05759	0.01521	0.01521	0.00652	0.00435	0.00000	0.00000	0.00000
1984	65,639	0.350	0.00000	0.51151	0.02455	0.08854	0.14829	0.17173	0.04288	0.00179	0.00893	0.00100	0.00000	0.00079	0.00000
1985	62,734	0.350	0.00000	0.12319	0.48574	0.09467	0.17361	0.05411	0.04371	0.01665	0.00416	0.00208	0.00208	0.00000	0.00000
1986	174,024	0.350	0.00000	0.03356	0.11928	0.57502	0.16084	0.07651	0.02468	0.00813	0.00199	0.00000	0.00000	0.00000	0.00000
1987	125,066	0.350	0.00000	0.03363	0.11499	0.22866	0.41089	0.13545	0.05213	0.01055	0.00808	0.00315	0.00089	0.00069	0.00089
1988	245,552	0.350	0.00000	0.02501	0.09201	0.14912	0.28898	0.29197	0.09461	0.03713	0.01267	0.00673	0.00089	0.00079	0.00010
1989	338,827	0.350	0.00000	0.04089	0.14828	0.14470	0.24613	0.24425	0.09881	0.04575	0.01872	0.00208	0.00416	0.00416	0.00208
1990	510,011	0.350	0.00000	0.02848	0.13473	0.15869	0.21938	0.22686	0.14039	0.07109	0.01166	0.00302	0.00275	0.00295	0.00000
1991	327,167	0.350	0.00024	0.03861	0.11312	0.19626	0.23638	0.17390	0.11282	0.07598	0.02020	0.01244	0.02000	0.00005	0.00000
1992	186,601	0.350	0.00063	0.01982	0.18337	0.19692	0.23801	0.18589	0.07930	0.05991	0.01821	0.01263	0.00531	0.00000	0.00000
1993	347,839	0.350	0.00000	0.02142	0.14421	0.22715	0.27345	0.18252	0.06020	0.04413	0.02665	0.01324	0.00475	0.00154	0.00075
1994	359,518	0.350	0.00000	0.08837	0.13120	0.12539	0.24511	0.23523	0.10911	0.03484	0.01731	0.01022	0.00198	0.00115	0.00008
1995	515,454	0.350	0.00000	0.14128	0.14651	0.10389	0.18267	0.23589	0.11921	0.03702	0.01468	0.00828	0.00444	0.00455	0.00156
1996	394,824	0.350	0.00000	0.06872	0.28895	0.19334	0.15674	0.14889	0.07810	0.03778	0.01557	0.01010	0.00040	0.00127	0.00013
1997	216,745	0.350	0.00220	0.03279	0.29690	0.28546	0.14119	0.09666	0.06460	0.03041	0.00906	0.01988	0.01226	0.00370	0.00489
1998	326,032	0.350	0.00000	0.04059	0.16532	0.30215	0.25546	0.08955	0.03978	0.03862	0.02411	0.01341	0.01193	0.00742	0.01166
1999	236,619	0.350	0.00416	0.24544	0.21086	0.18487	0.23557	0.06118	0.02203	0.01565	0.00837	0.00551	0.00274	0.00259	0.00103
2000	666,997	0.350	0.00029	0.26755	0.28476	0.23582	0.09400	0.05085	0.04039	0.01174	0.00616	0.00581	0.00120	0.00129	0.00012
2001	310,900	0.350	0.00000	0.00849	0.18681	0.25075	0.28565	0.09460	0.06072	0.03735	0.03108	0.02049	0.01537	0.00629	0.00240
2002	168,201	0.350	0.01011	0.12418	0.25351	0.12728	0.17117	0.14102	0.07361	0.04075	0.03356	0.01340	0.00905	0.00089	0.00148
2003	261,974	0.350	0.00577	0.02377	0.10711	0.20790	0.21654	0.07583	0.11776	0.07112	0.06264	0.05181	0.03116	0.01224	0.01634
2004	465,642	0.350	0.00632	0.11341	0.17340	0.16491	0.13439	0.10455	0.11217	0.08886	0.05057	0.02111	0.02229	0.00508	0.00292
2005	798,544	0.350	0.00054	0.01442	0.13015	0.30761	0.21271	0.08617	0.06812	0.05499	0.05461	0.02893	0.02022	0.01062	0.01091
2006	194,524	0.350	0.00000	0.00285	0.13247	0.14824	0.19018	0.14224	0.07739	0.08584	0.06525	0.06779	0.03800	0.02277	0.02696
2007	608,279	0.350	0.00047	0.01050	0.03022	0.14775	0.16145	0.23101	0.12967	0.08000	0.06997	0.05017	0.03661	0.03277	0.01941
2008	308,715	0.350	0.00000	0.00035	0.00948	0.14601	0.23152	0.18789	0.14471	0.07029	0.04489	0.04225	0.04088	0.04617	0.03556
2009	611,944	0.350	0.00000	0.00271	0.13195	0.27260	0.20243	0.14907	0.05009	0.06279	0.03353	0.02677	0.02567	0.01254	0.02984
2010	254,841	0.350	0.00000	0.00541	0.06361	0.29904	0.25172	0.18137	0.07706	0.03732	0.02564	0.01601	0.01223	0.00703	0.02357
2011	634,421	0.350	0.00000	0.00593	0.09384	0.16890	0.20128	0.12967	0.09213	0.09040	0.06508	0.05505	0.02578	0.01944	0.05250
2012	818,579	0.350	0.00000	0.01074	0.05968	0.14445	0.24650	0.17394	0.14440	0.06381	0.05275	0.02245	0.02699	0.02079	0.03350

Table 11. Likelihood components with respective contributions from base model run.

Likelihood Components

Concentrated Log-likelihood	Weight	RSS
Fleet 1 Total Catch:	2	19.72
Fleet 2 Total Catch:	2	0.54
Fleet 3 Total Catch:	2	0.09
Aggregate Abundance Indices		
NYYOY	1	37.37
NJYOY	1	25.39
MD YOY	1	39.06
VA YOY	1	27.89
NY Age 1	1	24.89
MD Age 1	1	31.72
MRFSS	1	23.94
CTTRL	1	26.20
NEFSC	1	17.04
Age Comp Abundance Indices		
NYOHS	1	25.57
NJ Trawl	1	22.32
MDSSN	1	23.57
DESSN	1	17.20
VAPNET	1	21.69
Total RSS		384.19
No. of Obs		481
Conc. Likel.		-54.05
Age Composition Data Likelihood		
Fleet 1 Age Comp:	1	1769.45
Fleet 2 Age Comp:	1	3129.18
Fleet 3 Age Comp:	1	1523.00
NYOHS	1	540.41
NJ Trawl	1	226.29
MDSSN	1	1096.18
DESSN	1	1101.92
VAPNET	1	449.36
log_R constraint	1	0.26
Recr Devs	1	12.87
Total Likelihood		9746.11
AIC		19888.20

Table 12. Parameter estimates and associated standard deviations of base model configuration.

	Bay			Coast			Commercial Discards			Total			Recruitment		
Year	Full F	SD	CV	Full F	SD	CV	Full F	SD	CV	Full F	SD	CV			
1982	0.831	0.128	0.15	0.164	0.003	0.02	0.011	0.001	0.11	0.888	0.126	0.14	18,727,000	2,246,190	0.120
1983	0.071	0.048	0.68	0.123	0.004	0.03	0.007	0.006	0.82	0.159	0.052	0.33	45,215,100	4,268,940	0.094
1984	0.145	0.003	0.02	0.063	0.004	0.06	0.009	0.015	1.74	0.170	0.050	0.30	39,555,500	3,885,090	0.098
1985	0.009	0.015	1.67	0.104	0.003	0.03	0.017	0.002	0.12	0.108	0.052	0.48	39,172,100	3,756,450	0.096
1986	0.004	0.052	14.33	0.061	0.007	0.11	0.032	0.005	0.16	0.067	0.021	0.31	32,081,700	3,277,090	0.102
1987	0.001	0.002	1.40	0.028	0.005	0.19	0.017	0.019	1.13	0.032	0.008	0.26	42,415,300	3,937,520	0.093
1988	0.002	0.050	20.65	0.039	0.004	0.09	0.030	0.004	0.12	0.047	0.009	0.19	55,745,800	4,746,850	0.085
1989	0.001	0.021	25.71	0.026	0.006	0.22	0.039	0.006	0.15	0.048	0.010	0.22	63,712,900	5,222,560	0.082
1990	0.015	0.003	0.17	0.017	0.006	0.34	0.057	0.020	0.35	0.086	0.015	0.18	83,514,400	6,320,380	0.076
1991	0.022	0.003	0.12	0.023	0.006	0.29	0.032	0.006	0.19	0.073	0.010	0.13	69,257,200	5,679,860	0.082
1992	0.021	0.051	2.46	0.026	0.008	0.30	0.016	0.007	0.44	0.057	0.006	0.11	69,427,100	5,825,090	0.084
1993	0.029	0.005	0.18	0.027	0.006	0.23	0.025	0.026	1.02	0.076	0.008	0.11	91,525,900	7,037,110	0.077
1994	0.039	0.001	0.03	0.034	0.006	0.18	0.023	0.002	0.07	0.089	0.009	0.10	180,532,000	10,755,400	0.060
1995	0.047	0.021	0.45	0.057	0.003	0.05	0.031	0.007	0.24	0.123	0.012	0.09	115,494,000	8,239,010	0.071
1996	0.056	0.009	0.17	0.056	0.007	0.12	0.010	0.022	2.22	0.114	0.009	0.08	124,097,000	8,635,660	0.070
1997	0.065	0.000	0.01	0.152	0.016	0.11	0.005	0.005	0.97	0.186	0.019	0.10	150,834,000	9,577,810	0.063
1998	0.059	0.009	0.15	0.137	0.001	0.01	0.008	0.005	0.69	0.169	0.017	0.10	99,090,300	7,372,100	0.074
1999	0.051	0.005	0.09	0.119	0.005	0.04	0.005	0.026	4.88	0.145	0.015	0.10	99,259,400	7,245,520	0.073
2000	0.059	0.001	0.02	0.150	0.015	0.10	0.016	0.003	0.17	0.184	0.018	0.10	78,733,800	6,357,190	0.081
2001	0.051	0.012	0.24	0.146	0.002	0.01	0.008	0.007	0.85	0.173	0.017	0.10	113,744,000	7,987,150	0.070
2002	0.042	0.008	0.19	0.145	0.005	0.03	0.004	0.019	4.16	0.166	0.016	0.10	133,633,000	8,990,880	0.067
2003	0.068	0.000	0.00	0.154	0.013	0.08	0.009	0.006	0.66	0.193	0.018	0.09	75,862,200	6,494,110	0.086
2004	0.061	0.007	0.12	0.188	0.001	0.01	0.016	0.007	0.48	0.228	0.022	0.10	157,460,000	10,622,100	0.067
2005	0.066	0.010	0.15	0.190	0.005	0.03	0.027	0.020	0.75	0.240	0.024	0.10	85,542,800	7,358,240	0.086
2006	0.080	0.004	0.04	0.233	0.016	0.07	0.007	0.003	0.40	0.275	0.029	0.10	81,113,200	7,342,620	0.091
2007	0.074	0.002	0.03	0.193	0.004	0.02	0.021	0.007	0.35	0.243	0.027	0.11	58,453,200	6,212,400	0.106
2008	0.057	0.015	0.27	0.214	0.004	0.02	0.011	0.024	2.13	0.249	0.029	0.12	80,225,900	8,274,700	0.103
2009	0.069	0.003	0.05	0.154	0.015	0.10	0.024	0.007	0.30	0.205	0.023	0.11	56,047,700	7,134,000	0.127
2010	0.066	0.003	0.05	0.161	0.002	0.01	0.011	0.007	0.64	0.200	0.024	0.12	76,222,600	10,190,400	0.134
2011	0.065	0.009	0.13	0.188	0.004	0.02	0.030	0.020	0.65	0.241	0.030	0.13	106,913,000	13,238,500	0.124
2012	0.059	0.003	0.05	0.141	0.015	0.10	0.041	0.010	0.25	0.200	0.027	0.13	140,382,000	23,899,800	0.170

Table 12 cont.

Catch Selectivtiy Parameters

Bay				Coast				Commercial Discards			
	Estimate	SD	CV		Estimate	SD	CV		Estimate	SD	CV
1982-1984				1982-1984				1982-1984			
α	-5.649	0.457	0.08	α	-2.4840	0.3488	0.14	α	0.0164	0.0078	0.48
β	2.2655	0.0659	0.03	β	3.3610	0.2593	0.08	β	1.2446	0.1901	0.15
□	0.9196	0.0221	0.02	□	0.9936	0.0230	0.02				
1985-1989				1985-1989				1985-1989			
α	-3.8292	0.4960	0.13	α	5.26E+00	6.53E-01	0.12	α	-2.1327	0.2379	0.11
β	2.0072	0.1294	0.06	β	4.22E-01	6.48E-02	0.15	β	4.0912	0.3809	0.09
□	0.9533	0.0232	0.02					□	0.8831	0.0649	0.07
1990-1995				1990-1995				1990-1995			
α	-2.2902	0.2378	0.10	α	3.12E+00	1.85E-01	0.06	α	-1.9033	0.1544	0.08
β	3.4543	0.2537	0.07	β	9.05E-01	1.13E-01	0.13	β	4.6668	0.3601	0.08
□	0.8928	0.0386	0.04					□	0.8180	0.0614	0.08
1996-2012				1996-2012				1996-2002			
α	-1.9169	0.1279	0.07	α	5.27E+00	2.70E-01	0.05	α	-2.7415	0.4946	0.18
β	3.7534	0.1554	0.04	β	4.36E-01	3.25E-02	0.07	β	2.8138	0.2741	0.10
□	0.9447	0.0179	0.02					□	0.9564	0.0277	0.03
								2003-2012			
								α	-2.4583	0.3314	0.13
								β	3.6391	0.2015	0.06
								□	0.9800	0.0168	0.02

Survey Selectivity Parameters			
NYOHS	Estimate	SD	CV
α	-5.69	0.09	0.02
β	2.29	0.04	0.02
□	0.96	0.01	0.01
NJ Trawl			
α	3.12	0.67	0.22
β	0.52	0.14	0.28
DE SSN			
α	3.25	0.17	0.05
β	0.83	0.11	0.14
MDSSN			
s_2	0.14	0.02	0.15
VAPNET			
α	-3.16	0.41	0.13
β	3.15	0.13	0.04
□	0.99	0.01	0.01

Catchability Coefficients			
Survey	Estimate	SD	CV
NY YOY	1.42E-07	1.64E-08	0.12
NJ YOY	1.27E-08	9.87E-10	0.08
MD YOY	4.52E-08	3.79E-09	0.08
VA YOY	1.10E-07	8.90E-09	0.08
NY Age 1	4.52E-08	4.19E-09	0.09
MD Age 1	9.93E-09	9.81E-10	0.10
MRFSS	2.58E-08	1.61E-09	0.06
CTTRL	3.60E-08	2.73E-09	0.08
NEFSC	1.03E-08	1.08E-09	0.11
NYOHS	1.61E-07	1.43E-08	0.09
NJTRL	1.00E-07	1.27E-08	0.13
MDSSN	1.28E-07	1.65E-08	0.12
DESSN	8.06E-08	9.72E-09	0.12
VAPNET	5.51E-07	6.42E-08	0.12

Table 13. Average total fishing mortality for various age ranges and weighting schemes.

Year	Maximum F-at-Age	Unweighted Avg. 3-8	Unweighted Avg. 8-11	N-weighted Avg. 3-8	N-weighted Avg. 7-11
1982	0.888	0.508	0.216	0.763	0.248
1983	0.159	0.142	0.128	0.135	0.132
1984	0.170	0.125	0.077	0.153	0.086
1985	0.108	0.061	0.099	0.031	0.089
1986	0.067	0.049	0.067	0.029	0.065
1987	0.032	0.024	0.032	0.016	0.031
1988	0.047	0.038	0.046	0.030	0.047
1989	0.048	0.037	0.038	0.029	0.042
1990	0.086	0.061	0.042	0.047	0.058
1991	0.073	0.054	0.041	0.043	0.050
1992	0.057	0.045	0.038	0.035	0.042
1993	0.076	0.058	0.046	0.050	0.052
1994	0.089	0.069	0.055	0.061	0.063
1995	0.123	0.098	0.083	0.081	0.094
1996	0.114	0.095	0.099	0.066	0.105
1997	0.186	0.118	0.180	0.079	0.172
1998	0.169	0.109	0.164	0.077	0.158
1999	0.145	0.093	0.141	0.064	0.134
2000	0.184	0.120	0.179	0.095	0.168
2001	0.173	0.107	0.166	0.086	0.156
2002	0.166	0.096	0.157	0.077	0.147
2003	0.193	0.124	0.188	0.092	0.180
2004	0.228	0.138	0.218	0.093	0.208
2005	0.240	0.151	0.232	0.114	0.223
2006	0.275	0.165	0.263	0.104	0.252
2007	0.243	0.154	0.236	0.113	0.225
2008	0.249	0.143	0.235	0.108	0.217
2009	0.205	0.137	0.201	0.115	0.195
2010	0.200	0.127	0.194	0.096	0.183
2011	0.241	0.153	0.233	0.123	0.223
2012	0.200	0.137	0.197	0.099	0.192

Table 14. Total fishing mortality-at-age and fishing mortality-at-age by fleet.

Total Fishing Mortality

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.003	0.250	0.888	0.687	0.515	0.391	0.309	0.257	0.223	0.200	0.185	0.174	0.170
1983	0.001	0.026	0.113	0.158	0.159	0.148	0.140	0.134	0.129	0.125	0.123	0.120	0.118
1984	0.001	0.046	0.170	0.156	0.131	0.110	0.095	0.085	0.079	0.074	0.071	0.069	0.067
1985	0.001	0.008	0.020	0.039	0.059	0.072	0.083	0.092	0.098	0.102	0.105	0.107	0.108
1986	0.000	0.004	0.014	0.036	0.055	0.061	0.063	0.065	0.067	0.067	0.067	0.067	0.067
1987	0.000	0.002	0.007	0.018	0.028	0.030	0.031	0.031	0.032	0.032	0.032	0.031	0.031
1988	0.000	0.003	0.010	0.029	0.045	0.047	0.047	0.047	0.047	0.046	0.045	0.045	0.044
1989	0.000	0.002	0.009	0.031	0.048	0.047	0.044	0.041	0.039	0.037	0.035	0.034	0.032
1990	0.000	0.004	0.019	0.053	0.086	0.085	0.069	0.055	0.045	0.037	0.032	0.028	0.025
1991	0.000	0.004	0.021	0.052	0.073	0.071	0.060	0.050	0.043	0.038	0.034	0.031	0.029
1992	0.000	0.004	0.019	0.044	0.057	0.056	0.049	0.044	0.039	0.036	0.033	0.032	0.030
1993	0.000	0.005	0.024	0.058	0.076	0.073	0.063	0.055	0.048	0.043	0.039	0.036	0.034
1994	0.001	0.006	0.031	0.072	0.089	0.085	0.074	0.065	0.057	0.052	0.048	0.044	0.042
1995	0.001	0.008	0.042	0.097	0.123	0.120	0.107	0.095	0.086	0.079	0.073	0.069	0.066
1996	0.001	0.008	0.040	0.087	0.112	0.114	0.111	0.106	0.101	0.097	0.093	0.089	0.086
1997	0.001	0.006	0.031	0.082	0.121	0.144	0.160	0.172	0.179	0.183	0.185	0.186	0.185
1998	0.001	0.006	0.030	0.077	0.112	0.132	0.147	0.157	0.164	0.167	0.169	0.169	0.168
1999	0.001	0.005	0.025	0.065	0.096	0.113	0.125	0.134	0.140	0.144	0.145	0.145	0.144
2000	0.001	0.007	0.037	0.087	0.123	0.144	0.160	0.171	0.178	0.182	0.184	0.184	0.183
2001	0.001	0.006	0.029	0.073	0.108	0.129	0.145	0.157	0.165	0.170	0.172	0.173	0.173
2002	0.001	0.005	0.024	0.062	0.095	0.117	0.134	0.147	0.156	0.161	0.164	0.166	0.166
2003	0.001	0.006	0.030	0.086	0.129	0.152	0.168	0.180	0.187	0.192	0.193	0.193	0.192
2004	0.001	0.006	0.032	0.091	0.139	0.168	0.190	0.206	0.217	0.223	0.226	0.228	0.227
2005	0.001	0.007	0.035	0.104	0.156	0.184	0.205	0.221	0.231	0.237	0.239	0.240	0.239
2006	0.001	0.008	0.038	0.108	0.165	0.201	0.228	0.248	0.261	0.269	0.274	0.275	0.275
2007	0.001	0.007	0.037	0.107	0.160	0.189	0.210	0.225	0.235	0.240	0.243	0.243	0.242
2008	0.001	0.007	0.032	0.090	0.141	0.174	0.200	0.219	0.233	0.241	0.246	0.248	0.249
2009	0.001	0.006	0.033	0.099	0.145	0.168	0.183	0.194	0.201	0.204	0.205	0.205	0.203
2010	0.001	0.006	0.030	0.087	0.131	0.155	0.173	0.185	0.193	0.198	0.200	0.200	0.199
2011	0.001	0.007	0.036	0.106	0.158	0.187	0.207	0.222	0.232	0.238	0.240	0.241	0.240
2012	0.001	0.006	0.033	0.101	0.147	0.168	0.182	0.191	0.197	0.200	0.200	0.199	0.197

Chesapeake Bay

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0016	0.2426	0.8307	0.5356	0.3400	0.2158	0.1370	0.0870	0.0552	0.0350	0.0222	0.0141	0.0122
1983	0.0001	0.0206	0.0706	0.0455	0.0289	0.0183	0.0116	0.0074	0.0047	0.0030	0.0019	0.0012	0.0010
1984	0.0003	0.0423	0.1448	0.0933	0.0593	0.0376	0.0239	0.0152	0.0096	0.0061	0.0039	0.0025	0.0021
1985	0.0003	0.0053	0.0088	0.0075	0.0063	0.0053	0.0044	0.0037	0.0031	0.0026	0.0022	0.0018	0.0015
1986	0.0001	0.0022	0.0036	0.0031	0.0026	0.0022	0.0018	0.0015	0.0013	0.0011	0.0009	0.0007	0.0006
1987	0.0000	0.0009	0.0014	0.0012	0.0010	0.0009	0.0007	0.0006	0.0005	0.0004	0.0004	0.0003	0.0003
1988	0.0001	0.0015	0.0024	0.0021	0.0017	0.0014	0.0012	0.0010	0.0008	0.0007	0.0006	0.0005	0.0004
1989	0.0000	0.0005	0.0008	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002	0.0001
1990	0.0002	0.0011	0.0066	0.0153	0.0150	0.0120	0.0094	0.0074	0.0058	0.0045	0.0035	0.0028	0.0022
1991	0.0002	0.0016	0.0096	0.0223	0.0218	0.0175	0.0138	0.0108	0.0084	0.0066	0.0052	0.0040	0.0032
1992	0.0002	0.0015	0.0089	0.0208	0.0203	0.0163	0.0128	0.0100	0.0078	0.0061	0.0048	0.0038	0.0029
1993	0.0003	0.0021	0.0124	0.0290	0.0284	0.0228	0.0179	0.0140	0.0109	0.0086	0.0067	0.0052	0.0041
1994	0.0004	0.0028	0.0167	0.0390	0.0382	0.0306	0.0240	0.0188	0.0147	0.0115	0.0090	0.0070	0.0055
1995	0.0005	0.0034	0.0201	0.0467	0.0457	0.0367	0.0288	0.0225	0.0176	0.0138	0.0108	0.0084	0.0066
1996	0.0005	0.0028	0.0144	0.0417	0.0558	0.0540	0.0492	0.0443	0.0398	0.0358	0.0322	0.0290	0.0261
1997	0.0006	0.0033	0.0168	0.0487	0.0652	0.0631	0.0574	0.0517	0.0465	0.0419	0.0377	0.0339	0.0305
1998	0.0005	0.0030	0.0153	0.0444	0.0594	0.0575	0.0523	0.0471	0.0424	0.0381	0.0343	0.0309	0.0277
1999	0.0004	0.0026	0.0131	0.0380	0.0508	0.0492	0.0448	0.0403	0.0363	0.0326	0.0293	0.0264	0.0237
2000	0.0005	0.0030	0.0151	0.0438	0.0585	0.0567	0.0516	0.0465	0.0418	0.0376	0.0338	0.0304	0.0274
2001	0.0004	0.0026	0.0133	0.0384	0.0514	0.0498	0.0453	0.0408	0.0367	0.0330	0.0297	0.0267	0.0240
2002	0.0004	0.0021	0.0107	0.0312	0.0417	0.0404	0.0368	0.0331	0.0298	0.0268	0.0241	0.0217	0.0195
2003	0.0006	0.0034	0.0176	0.0511	0.0684	0.0662	0.0602	0.0543	0.0488	0.0439	0.0395	0.0355	0.0319
2004	0.0005	0.0031	0.0156	0.0454	0.0606	0.0588	0.0534	0.0482	0.0433	0.0390	0.0350	0.0315	0.0283
2005	0.0006	0.0033	0.0169	0.0490	0.0655	0.0635	0.0577	0.0520	0.0468	0.0421	0.0378	0.0340	0.0306
2006	0.0007	0.0040	0.0207	0.0600	0.0802	0.0777	0.0707	0.0637	0.0573	0.0515	0.0463	0.0417	0.0375
2007	0.0006	0.0037	0.0191	0.0554	0.0741	0.0718	0.0653	0.0588	0.0529	0.0476	0.0428	0.0385	0.0346
2008	0.0005	0.0029	0.0147	0.0428	0.0572	0.0554	0.0504	0.0454	0.0409	0.0368	0.0331	0.0297	0.0267
2009	0.0006	0.0035	0.0179	0.0519	0.0694	0.0672	0.0612	0.0551	0.0496	0.0446	0.0401	0.0361	0.0324
2010	0.0006	0.0033	0.0170	0.0493	0.0660	0.0639	0.0581	0.0524	0.0471	0.0424	0.0381	0.0343	0.0308
2011	0.0006	0.0033	0.0168	0.0489	0.0654	0.0633	0.0576	0.0519	0.0467	0.0420	0.0378	0.0340	0.0305
2012	0.0005	0.0030	0.0151	0.0438	0.0586	0.0567	0.0516	0.0465	0.0418	0.0376	0.0338	0.0304	0.0274

Table 14 cont.

Coast

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0005	0.0058	0.0500	0.1411	0.1644	0.1644	0.1620	0.1594	0.1569	0.1545	0.1520	0.1496	0.1473
1983	0.0004	0.0043	0.0374	0.1056	0.1231	0.1231	0.1213	0.1194	0.1175	0.1156	0.1138	0.1120	0.1103
1984	0.0002	0.0022	0.0192	0.0542	0.0632	0.0632	0.0623	0.0613	0.0603	0.0594	0.0585	0.0575	0.0566
1985	0.0003	0.0020	0.0080	0.0196	0.0353	0.0518	0.0667	0.0787	0.0877	0.0942	0.0987	0.1017	0.1038
1986	0.0002	0.0012	0.0047	0.0116	0.0209	0.0307	0.0395	0.0466	0.0519	0.0557	0.0584	0.0602	0.0614
1987	0.0001	0.0006	0.0022	0.0053	0.0096	0.0141	0.0182	0.0214	0.0239	0.0257	0.0269	0.0277	0.0283
1988	0.0001	0.0008	0.0030	0.0074	0.0133	0.0195	0.0252	0.0297	0.0331	0.0355	0.0372	0.0384	0.0391
1989	0.0001	0.0005	0.0020	0.0050	0.0089	0.0131	0.0168	0.0199	0.0221	0.0238	0.0249	0.0257	0.0262
1990	0.0000	0.0011	0.0056	0.0110	0.0144	0.0160	0.0167	0.0170	0.0172	0.0172	0.0172	0.0172	0.0173
1991	0.0000	0.0014	0.0074	0.0144	0.0188	0.0210	0.0219	0.0223	0.0225	0.0226	0.0226	0.0226	0.0226
1992	0.0000	0.0016	0.0084	0.0163	0.0214	0.0239	0.0249	0.0254	0.0256	0.0257	0.0257	0.0257	0.0257
1993	0.0000	0.0017	0.0090	0.0174	0.0228	0.0255	0.0266	0.0271	0.0273	0.0274	0.0274	0.0274	0.0274
1994	0.0000	0.0022	0.0112	0.0217	0.0285	0.0317	0.0332	0.0338	0.0340	0.0341	0.0342	0.0342	0.0342
1995	0.0001	0.0036	0.0186	0.0361	0.0473	0.0527	0.0551	0.0561	0.0565	0.0567	0.0567	0.0568	0.0568
1996	0.0001	0.0035	0.0183	0.0356	0.0467	0.0520	0.0544	0.0554	0.0558	0.0559	0.0560	0.0560	0.0560
1997	0.0003	0.0025	0.0107	0.0277	0.0512	0.0763	0.0986	0.1164	0.1296	0.1390	0.1454	0.1496	0.1525
1998	0.0002	0.0022	0.0096	0.0250	0.0462	0.0687	0.0889	0.1049	0.1168	0.1252	0.1310	0.1348	0.1374
1999	0.0002	0.0019	0.0083	0.0216	0.0399	0.0594	0.0768	0.0907	0.1010	0.1082	0.1132	0.1165	0.1187
2000	0.0003	0.0024	0.0105	0.0272	0.0504	0.0750	0.0970	0.1145	0.1275	0.1367	0.1429	0.1472	0.1499
2001	0.0002	0.0024	0.0103	0.0265	0.0491	0.0731	0.0945	0.1116	0.1242	0.1331	0.1393	0.1434	0.1461
2002	0.0002	0.0023	0.0102	0.0263	0.0487	0.0725	0.0938	0.1107	0.1233	0.1322	0.1383	0.1423	0.1450
2003	0.0003	0.0025	0.0108	0.0280	0.0518	0.0771	0.0997	0.1177	0.1311	0.1405	0.1470	0.1513	0.1542
2004	0.0003	0.0030	0.0132	0.0342	0.0632	0.0941	0.1217	0.1437	0.1600	0.1715	0.1794	0.1847	0.1882
2005	0.0003	0.0031	0.0133	0.0345	0.0638	0.0949	0.1228	0.1450	0.1614	0.1730	0.1810	0.1863	0.1899
2006	0.0004	0.0038	0.0164	0.0423	0.0783	0.1166	0.1507	0.1780	0.1982	0.2124	0.2222	0.2288	0.2331
2007	0.0003	0.0031	0.0135	0.0350	0.0648	0.0964	0.1247	0.1473	0.1640	0.1758	0.1838	0.1893	0.1928
2008	0.0004	0.0035	0.0150	0.0389	0.0719	0.1071	0.1385	0.1635	0.1821	0.1951	0.2041	0.2101	0.2141
2009	0.0003	0.0025	0.0108	0.0279	0.0517	0.0769	0.0994	0.1174	0.1307	0.1401	0.1465	0.1509	0.1537
2010	0.0003	0.0026	0.0113	0.0292	0.0540	0.0803	0.1039	0.1226	0.1366	0.1464	0.1531	0.1576	0.1606
2011	0.0003	0.0030	0.0132	0.0342	0.0633	0.0942	0.1218	0.1438	0.1601	0.1716	0.1795	0.1848	0.1883
2012	0.0002	0.0023	0.0099	0.0257	0.0474	0.0706	0.0913	0.1078	0.1201	0.1287	0.1346	0.1386	0.1412

Commercial Discards

Age

Year	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.0006	0.0021	0.0072	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
1983	0.0004	0.0014	0.0047	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
1984	0.0005	0.0017	0.0060	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087	0.0087
1985	0.0001	0.0005	0.0029	0.0115	0.0174	0.0152	0.0121	0.0094	0.0073	0.0057	0.0045	0.0035	0.0027
1986	0.0001	0.0009	0.0054	0.0213	0.0321	0.0281	0.0222	0.0174	0.0135	0.0105	0.0082	0.0064	0.0050
1987	0.0001	0.0005	0.0029	0.0114	0.0172	0.0151	0.0119	0.0093	0.0073	0.0057	0.0044	0.0034	0.0027
1988	0.0001	0.0008	0.0050	0.0199	0.0300	0.0263	0.0208	0.0162	0.0127	0.0099	0.0077	0.0060	0.0047
1989	0.0002	0.0011	0.0065	0.0255	0.0385	0.0338	0.0267	0.0209	0.0163	0.0127	0.0099	0.0077	0.0060
1990	0.0003	0.0015	0.0070	0.0269	0.0567	0.0569	0.0429	0.0307	0.0217	0.0154	0.0109	0.0077	0.0054
1991	0.0002	0.0009	0.0040	0.0152	0.0321	0.0322	0.0243	0.0173	0.0123	0.0087	0.0061	0.0043	0.0031
1992	0.0001	0.0004	0.0019	0.0074	0.0155	0.0156	0.0117	0.0084	0.0059	0.0042	0.0030	0.0021	0.0015
1993	0.0001	0.0007	0.0031	0.0118	0.0249	0.0250	0.0188	0.0135	0.0095	0.0067	0.0048	0.0034	0.0024
1994	0.0001	0.0006	0.0028	0.0108	0.0227	0.0228	0.0172	0.0123	0.0087	0.0062	0.0044	0.0031	0.0022
1995	0.0002	0.0008	0.0038	0.0145	0.0305	0.0306	0.0230	0.0165	0.0117	0.0082	0.0058	0.0041	0.0029
1996	0.0001	0.0013	0.0073	0.0100	0.0092	0.0082	0.0073	0.0064	0.0057	0.0051	0.0045	0.0040	0.0035
1997	0.0001	0.0007	0.0038	0.0052	0.0048	0.0042	0.0038	0.0033	0.0030	0.0026	0.0023	0.0021	0.0018
1998	0.0001	0.0010	0.0055	0.0076	0.0070	0.0062	0.0055	0.0049	0.0043	0.0038	0.0034	0.0030	0.0027
1999	0.0001	0.0007	0.0038	0.0053	0.0048	0.0043	0.0038	0.0034	0.0030	0.0027	0.0024	0.0021	0.0019
2000	0.0002	0.0020	0.0113	0.0155	0.0143	0.0127	0.0113	0.0100	0.0089	0.0079	0.0070	0.0062	0.0055
2001	0.0001	0.0010	0.0057	0.0078	0.0072	0.0064	0.0057	0.0051	0.0045	0.0040	0.0035	0.0031	0.0028
2002	0.0001	0.0006	0.0033	0.0045	0.0041	0.0037	0.0033	0.0029	0.0026	0.0023	0.0020	0.0018	0.0016
2003	0.0000	0.0002	0.0017	0.0068	0.0088	0.0086	0.0082	0.0078	0.0075	0.0071	0.0068	0.0064	0.0061
2004	0.0000	0.0003	0.0031	0.0120	0.0155	0.0153	0.0146	0.0139	0.0132	0.0126	0.0120	0.0114	0.0109
2005	0.0001	0.0006	0.0052	0.0204	0.0265	0.0261	0.0249	0.0237	0.0226	0.0215	0.0204	0.0195	0.0185
2006	0.0000	0.0001	0.0013	0.0053	0.0068	0.0067	0.0064	0.0061	0.0058	0.0055	0.0053	0.0050	0.0048
2007	0.0000	0.0004	0.0041	0.0162	0.0210	0.0206	0.0197	0.0187	0.0178	0.0170	0.0162	0.0154	0.0147
2008	0.0000	0.0002	0.0022	0.0087	0.0114	0.0112	0.0107	0.0101	0.0097	0.0092	0.0088	0.0083	0.0079
2009	0.0001	0.0005	0.0048	0.0188	0.0244	0.0240	0.0229	0.0218	0.0208	0.0198	0.0188	0.0179	0.0171
2010	0.0000	0.0002	0.0022	0.0087	0.0113	0.0111	0.0106	0.0101	0.0096	0.0091	0.0087	0.0083	0.0079
2011	0.0001	0.0006	0.0059	0.0230	0.0299	0.0294	0.0280	0.0267	0.0254	0.0242	0.0230	0.0219	0.0209
2012	0.0001	0.0009	0.0081	0.0317	0.0411	0.0404	0.0386	0.0368	0.0350	0.0333	0.0317	0.0302	0.0287

Table 15. Estimates of population abundance by age.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	8+
1982	18,727,000	5,687,350	4,130,530	2,369,680	572,248	188,329	161,441	106,960	80,605	89,500	70,204	135,764	67,896	32,387,507	550,929
1983	45,215,100	6,032,860	2,243,010	1,083,820	856,932	266,310	105,374	101,969	71,204	55,530	63,070	50,232	147,468	56,292,879	489,473
1984	39,555,500	14,592,800	2,977,090	1,277,790	665,350	569,384	189,892	78,869	76,791	53,869	42,160	48,024	151,128	60,278,647	450,841
1985	39,172,100	12,765,300	7,059,080	1,601,570	785,724	454,470	422,014	148,649	62,341	61,094	43,049	33,799	160,179	62,769,368	509,110
1986	32,081,700	12,646,400	6,416,790	4,413,310	1,107,780	576,904	349,611	334,252	116,724	48,643	47,463	33,351	149,896	58,322,824	730,329
1987	42,415,300	10,359,300	6,379,640	4,035,860	3,060,900	816,170	448,884	282,402	269,475	93,985	39,142	38,187	147,492	68,386,736	870,682
1988	55,745,800	13,699,000	5,238,270	4,041,480	2,849,780	2,318,350	654,948	374,631	235,562	224,712	78,367	32,641	154,899	85,648,440	1,100,812
1989	63,712,900	18,002,400	6,919,060	3,305,400	2,821,600	2,121,770	1,828,690	537,762	307,671	193,526	184,703	64,452	154,419	100,154,353	1,442,533
1990	83,514,400	20,576,200	9,101,570	4,371,080	2,303,400	2,094,450	1,673,490	1,506,290	444,237	254,768	160,571	153,511	182,327	126,336,294	2,701,704
1991	69,257,200	26,964,700	10,385,500	5,693,130	2,979,640	1,645,950	1,590,990	1,344,240	1,227,000	365,663	211,297	133,902	281,601	122,080,813	3,563,703
1992	69,427,100	22,362,900	13,607,500	6,485,030	3,885,820	2,157,770	1,268,240	1,289,700	1,100,100	1,011,450	303,045	175,806	347,223	123,421,684	4,227,324
1993	91,525,900	22,420,100	11,289,400	8,511,380	4,459,460	2,857,990	1,687,680	1,038,910	1,062,510	910,344	839,804	252,255	436,612	147,292,345	4,540,435
1994	180,532,000	29,552,500	11,307,400	7,024,470	5,772,880	3,218,630	2,196,650	1,363,510	846,768	871,880	750,828	695,287	572,714	244,705,517	5,100,987
1995	115,494,000	58,286,000	14,888,300	6,991,890	4,701,460	4,111,730	2,444,420	1,755,150	1,099,900	688,151	712,571	616,259	1,045,240	212,835,071	5,917,271
1996	124,097,000	37,282,800	29,299,600	9,099,480	4,560,640	3,236,340	3,015,880	1,890,600	1,373,680	868,881	547,476	569,942	1,336,840	217,179,159	6,587,419
1997	150,834,000	40,062,100	18,744,800	17,950,100	5,994,820	3,176,740	2,387,420	2,323,580	1,463,480	1,068,420	678,839	429,493	1,504,980	246,618,772	7,468,792
1998	99,090,300	48,682,500	20,166,700	11,584,200	11,893,500	4,136,050	2,275,600	1,751,420	1,684,730	1,053,040	765,463	485,437	1,383,880	204,952,820	7,123,970
1999	99,259,400	31,983,600	24,511,700	12,473,000	7,711,660	8,277,250	2,996,180	1,691,450	1,288,540	1,231,300	766,810	556,576	1,360,060	194,107,526	6,894,736
2000	78,733,800	32,042,300	16,120,400	15,239,500	8,404,530	5,458,770	6,114,350	2,275,010	1,272,790	963,939	918,104	570,969	1,427,660	169,542,122	7,428,472
2001	113,744,000	25,410,700	16,114,400	9,905,980	10,048,000	5,786,850	3,907,300	4,485,400	1,650,400	916,721	691,522	657,580	1,432,450	194,751,303	9,834,073
2002	133,633,000	36,715,400	12,797,200	9,978,960	6,621,460	7,026,360	4,205,190	2,907,750	3,298,310	1,203,960	665,580	500,899	1,513,150	221,067,219	10,089,649
2003	75,862,200	43,140,300	18,507,700	7,964,720	6,742,710	4,691,530	5,171,060	3,166,190	2,161,150	2,429,670	881,944	486,044	1,468,330	172,673,548	10,593,328
2004	157,460,000	24,485,200	21,722,500	11,450,500	5,254,830	4,616,020	3,332,830	3,761,840	2,276,620	1,542,290	1,726,720	625,716	1,387,590	239,642,656	11,320,776
2005	85,542,800	50,821,400	12,325,400	13,416,300	7,512,310	3,559,960	3,226,600	2,372,940	2,635,850	1,578,050	1,062,100	1,185,120	1,380,390	186,619,220	10,214,450
2006	81,113,200	27,607,700	25,569,600	7,585,610	8,693,590	5,006,520	2,448,080	2,261,570	1,637,990	1,801,200	1,072,090	719,628	1,738,090	167,254,868	9,230,568
2007	58,453,200	26,174,000	13,876,000	15,690,400	4,897,360	5,738,830	3,386,480	1,677,830	1,519,400	1,085,690	1,184,090	701,748	1,606,210	135,991,238	7,774,968
2008	80,225,900	18,863,700	13,164,100	8,528,620	10,139,900	3,250,660	3,929,290	2,363,480	1,153,390	1,034,180	734,833	799,458	1,558,840	145,746,351	7,644,181
2009	56,047,700	25,893,300	9,494,120	8,129,490	5,601,350	6,861,820	2,259,640	2,770,220	1,634,070	786,738	699,436	494,588	1,583,060	122,255,532	7,968,112
2010	76,222,600	18,089,200	13,033,300	5,854,510	5,295,650	3,771,810	4,796,530	1,618,900	1,963,340	1,150,330	551,946	490,205	1,458,840	134,297,161	7,233,561
2011	106,913,000	24,601,600	9,108,160	8,060,930	3,857,590	3,617,210	2,670,530	3,474,120	1,157,990	1,392,930	812,359	388,992	1,374,150	167,429,561	8,600,541
2012	140,382,000	34,504,700	12,377,300	5,602,720	5,211,940	2,563,970	2,481,550	1,868,070	2,394,080	790,189	945,197	549,864	1,193,860	210,865,440	7,741,260

Table 16. Estimate of female spawning stock biomass-at-age by year.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total	SD
1982	0	0	0	57	83	186	455	433	383	651	680	1,367	893	5,188	1,208
1983	0	0	0	26	122	220	242	381	351	364	526	481	1,541	4,252	1,020
1984	0	0	0	33	101	480	529	289	407	341	315	519	1,769	4,784	1,089
1985	0	0	0	50	108	413	1,158	572	335	385	334	311	2,098	5,763	1,201
1986	0	0	0	161	167	450	828	1,207	529	265	327	279	1,811	6,023	1,138
1987	0	0	0	140	515	623	963	924	1,215	509	258	324	1,840	7,311	1,223
1988	0	0	0	137	548	2,263	1,594	1,189	1,003	1,096	564	290	1,948	10,631	1,421
1989	0	0	0	115	526	2,394	5,623	2,214	1,456	1,292	1,325	560	1,957	17,461	1,939
1990	0	0	0	146	361	2,066	4,945	6,303	2,159	1,331	1,119	1,278	2,181	21,889	2,190
1991	0	0	0	195	497	1,321	4,443	5,280	6,478	1,946	1,605	995	3,800	26,561	2,554
1992	0	0	0	210	694	1,989	3,429	5,143	6,060	6,786	2,385	1,879	4,603	33,179	3,027
1993	0	0	0	283	764	2,626	4,654	4,329	5,931	6,138	6,931	2,437	6,025	40,120	3,438
1994	0	0	0	252	1,017	2,894	6,145	5,709	4,668	5,621	6,262	6,638	6,910	46,116	3,699
1995	0	0	0	264	830	3,829	7,225	7,344	6,381	4,957	4,835	5,497	16,463	57,626	4,501
1996	0	0	0	341	901	3,515	10,245	8,989	8,382	6,535	4,510	4,901	17,282	65,601	4,857
1997	0	0	0	718	1,082	3,039	6,556	8,891	8,214	8,091	5,874	3,892	20,782	67,140	5,061
1998	0	0	0	321	1,846	3,268	6,104	6,681	8,790	6,305	5,506	4,357	15,373	58,551	4,473
1999	0	0	0	318	955	5,491	5,950	5,977	6,728	8,054	5,632	4,667	15,284	59,058	4,606
2000	0	0	0	382	1,028	3,751	12,972	7,435	6,828	5,933	7,498	5,257	18,077	69,161	5,329
2001	0	0	0	286	1,349	4,495	8,899	15,069	8,178	6,008	5,107	5,144	14,565	69,101	5,166
2002	0	0	0	259	924	5,527	10,088	10,595	15,665	7,510	5,177	4,304	16,316	76,365	5,744
2003	0	0	0	192	909	3,691	12,088	11,102	10,549	14,375	6,456	4,102	15,079	78,544	5,910
2004	0	0	0	272	749	3,557	7,849	13,029	10,896	9,046	12,092	5,022	13,825	76,338	5,992
2005	0	0	0	344	998	2,888	7,588	8,781	13,058	9,319	7,631	10,158	15,636	76,401	6,520
2006	0	0	0	181	1,094	3,562	5,441	8,041	8,577	10,958	7,748	5,926	19,391	70,918	6,587
2007	0	0	0	334	618	4,246	7,934	5,829	8,039	6,995	9,247	6,140	19,054	68,438	6,896
2008	0	0	0	203	1,289	2,686	10,620	8,682	5,962	6,978	5,725	6,991	17,365	66,502	6,907
2009	0	0	0	196	672	5,477	5,775	10,945	8,720	5,032	5,371	4,204	18,070	64,462	7,059
2010	0	0	0	141	651	2,967	11,662	5,781	9,892	7,354	4,227	4,020	15,774	62,469	7,032
2011	0	0	0	212	475	2,693	6,300	12,064	5,767	8,575	5,779	3,407	16,701	61,972	7,530
2012	0	0	0	193	916	2,157	6,002	6,666	11,653	5,008	7,092	4,614	13,936	58,238	7,640

Figure 1. Comparison of removal estimates used in the benchmark assessment and updated assessment, expressed as percent differences ((final-prelim)/prelim*100), by state and year (where applicable).

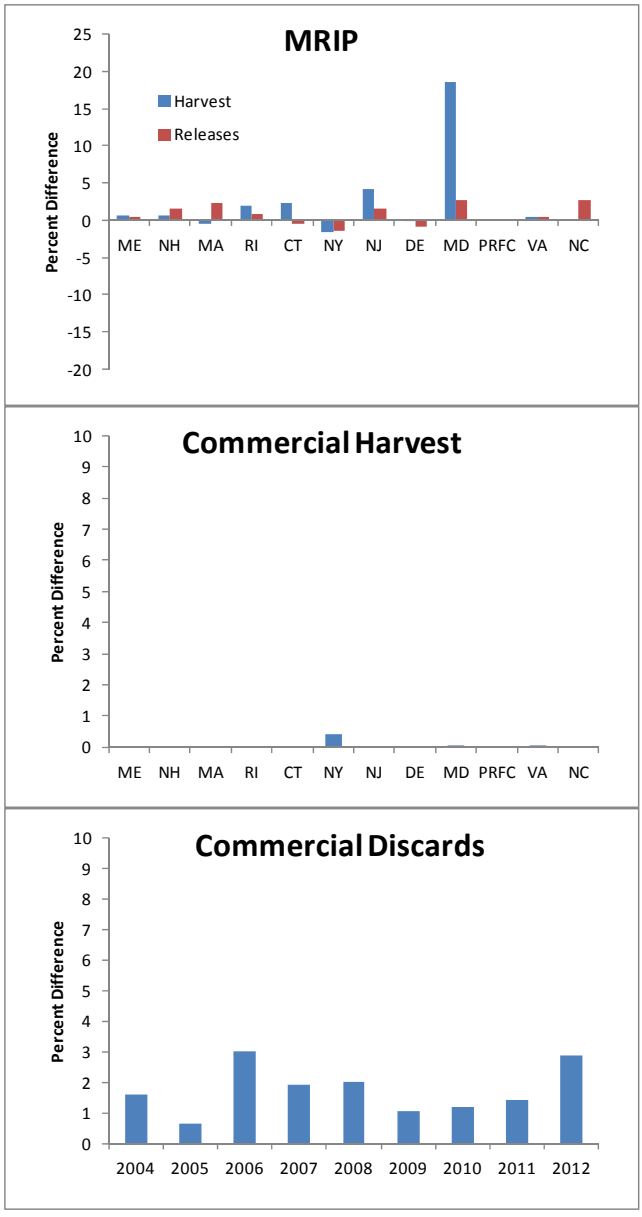


Figure 2. Observed and predicted total catch and standardized residuals by fleet.

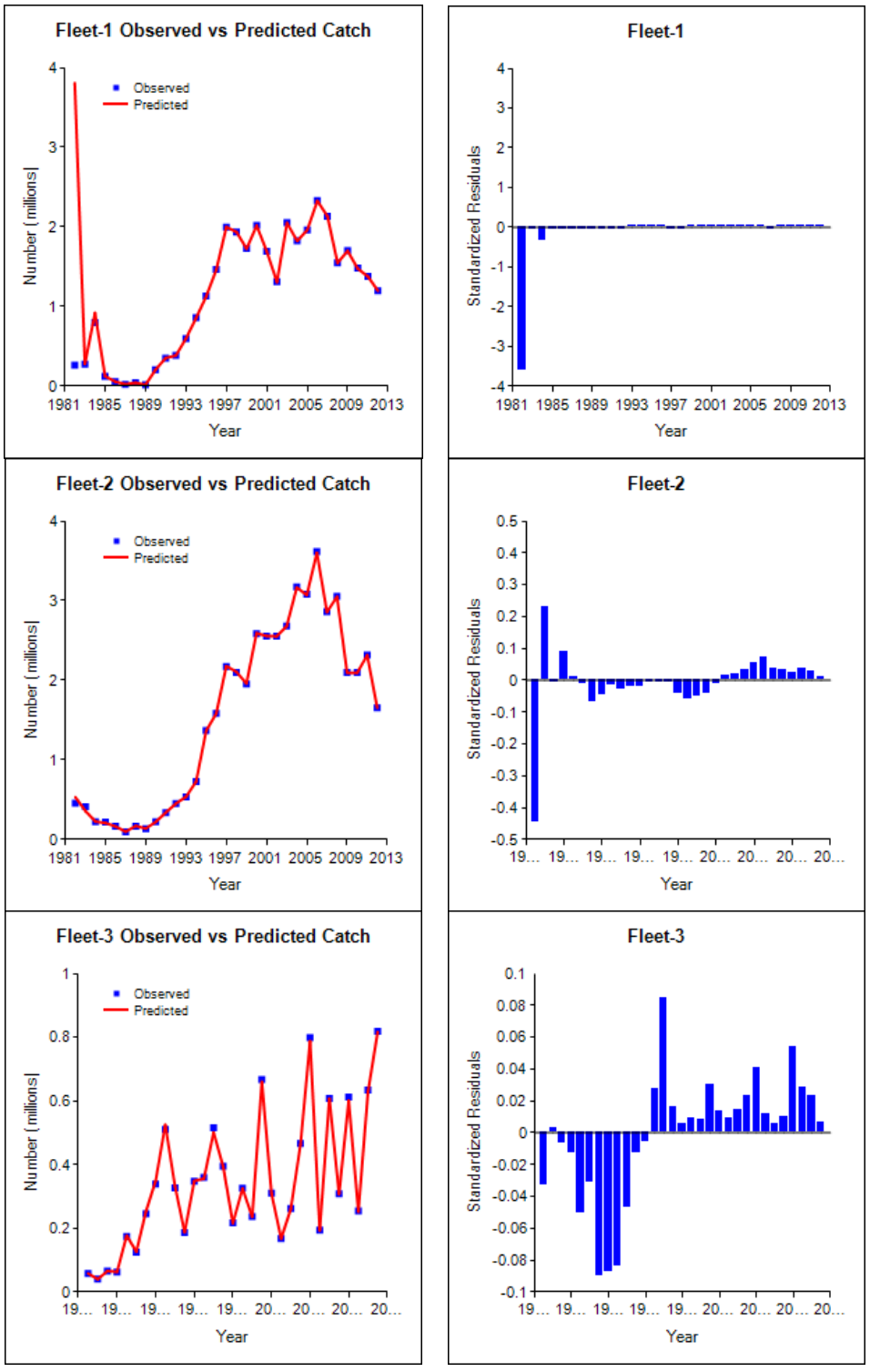


Figure 3. Catch selectivity patterns by fleet (Fleet 1 = Bay, Fleet 2 = Coast, Fleet 3 = Commercial Discards).

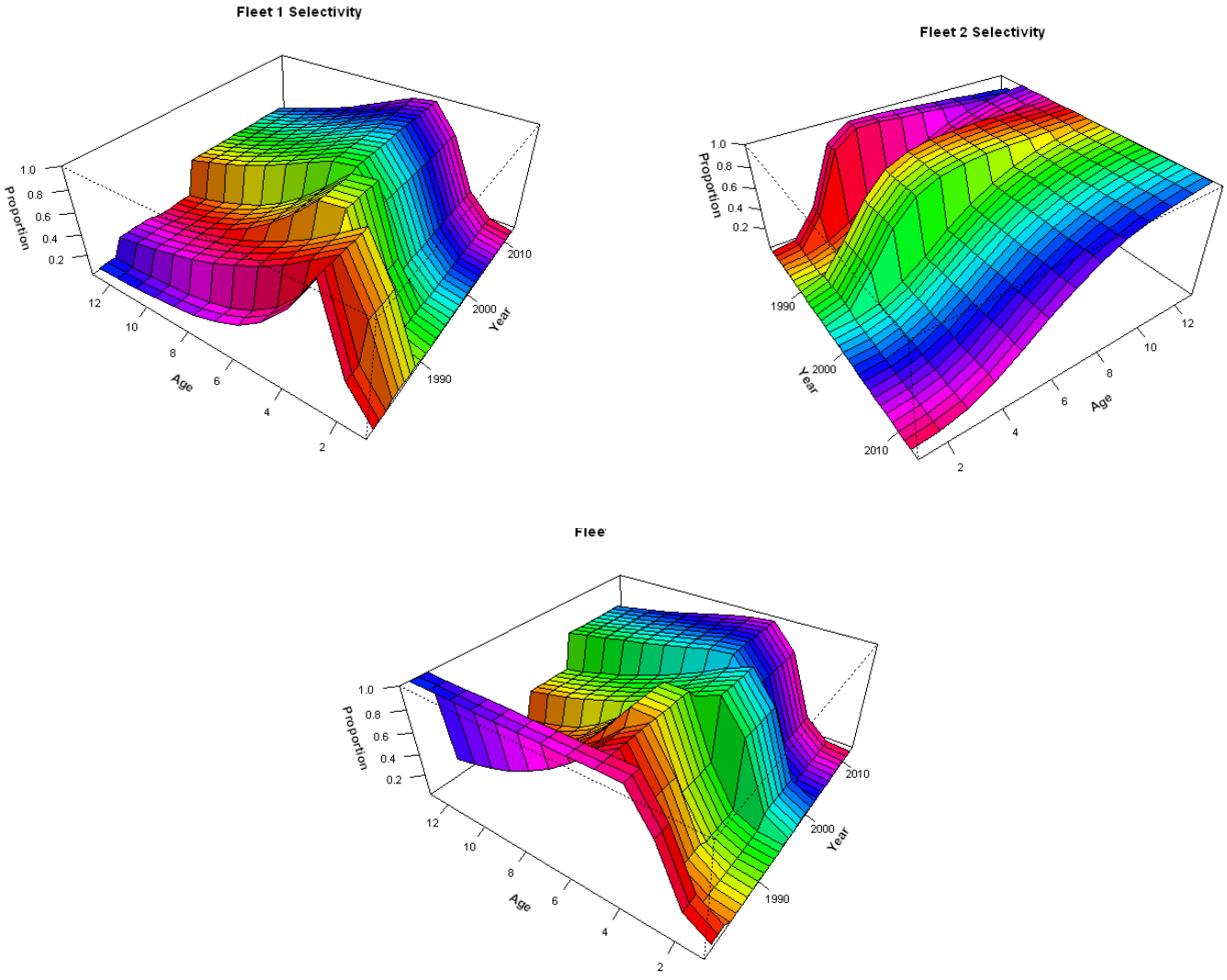


Figure 4. Estimates of total and fleet-specific fully-recruited fishing mortality (±1 SD) and recruitment (±1 SD) from the SCA base model run.

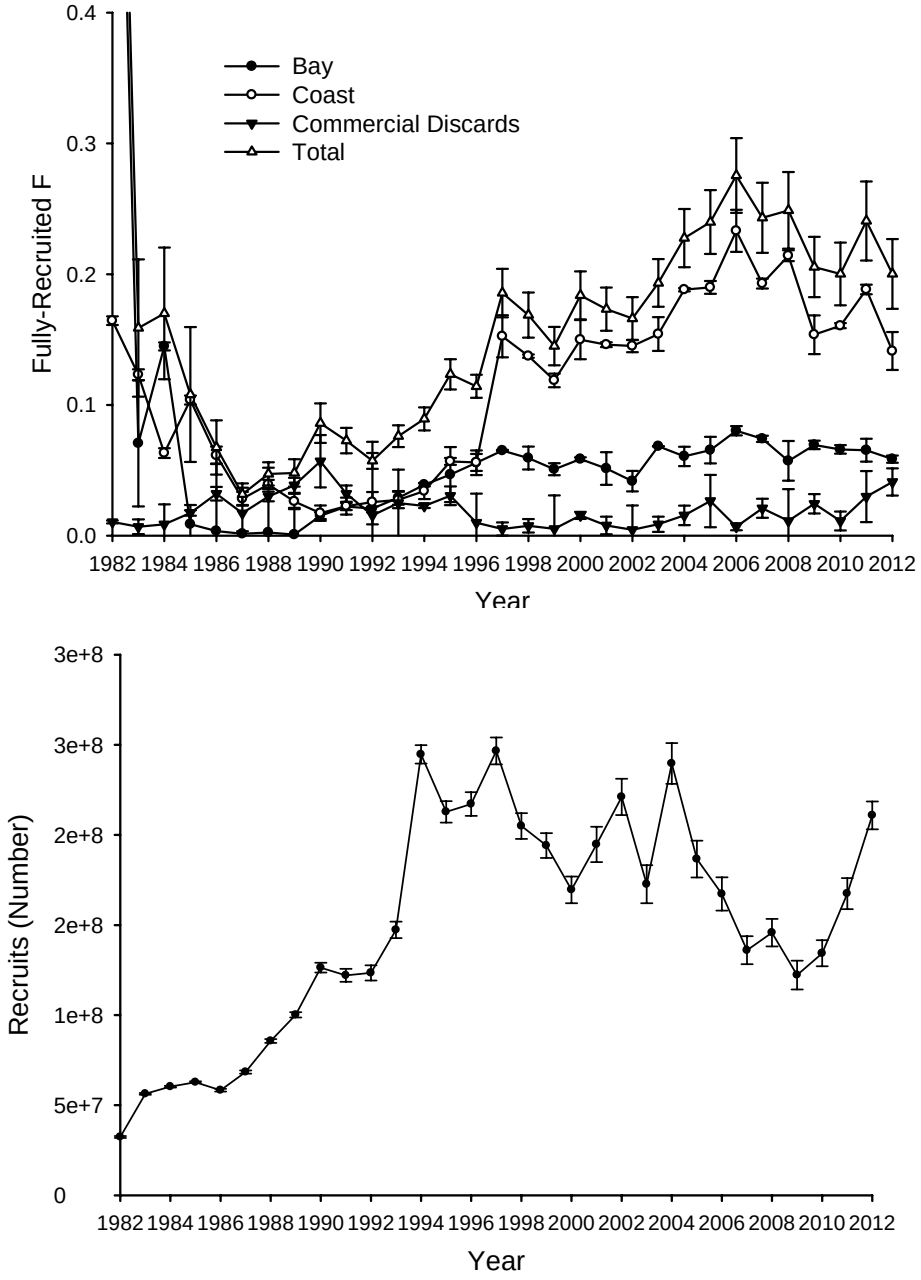


Figure 5. Comparison of average fishing mortality estimates from the SCA model.

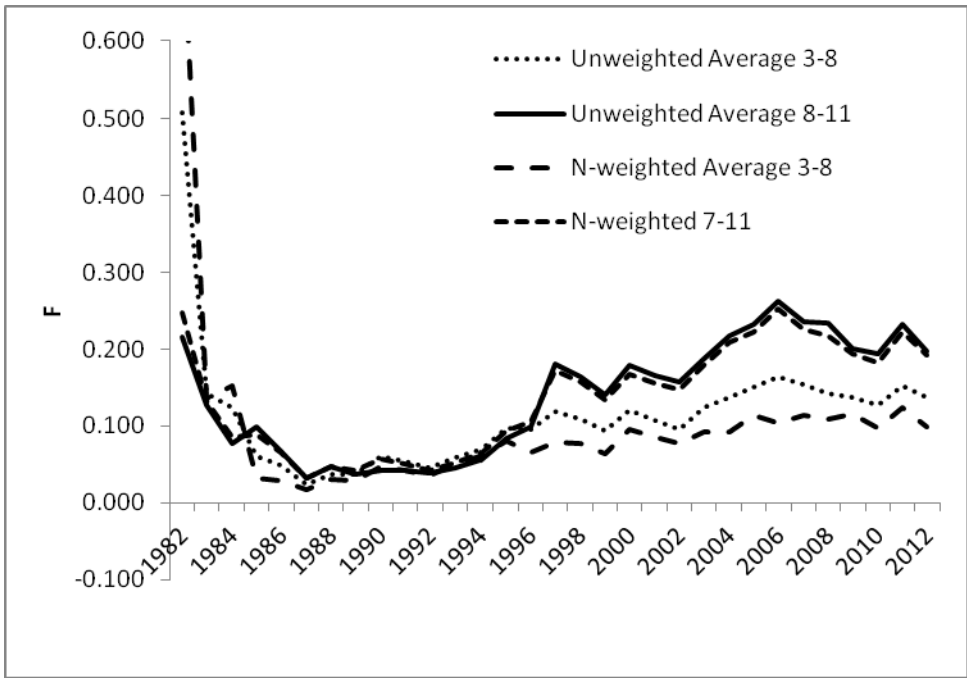


Figure 6. Comparison of fishing mortality-at-age in 2011 and 2012 from the SCA model partitioned into fleets.

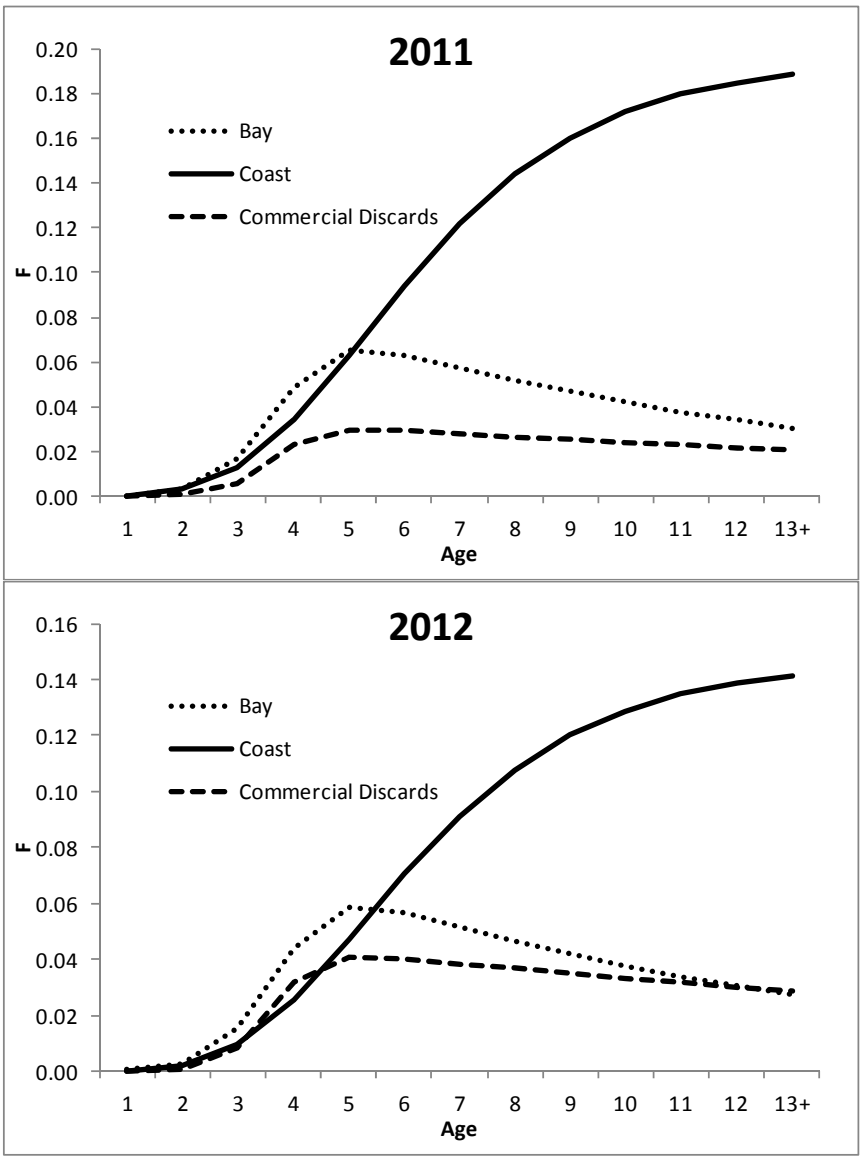


Figure 7. Estimates of January-1 total (age 1+) and 8+ abundance for 1982-2013. January-1 abundance for age 1 in 2013 was estimated from the 2012 observed values of the YOY indices and SCA model catchability coefficients, while older ages were projected from January-1 abundances and fishing and natural mortalities-at-age for 2012.

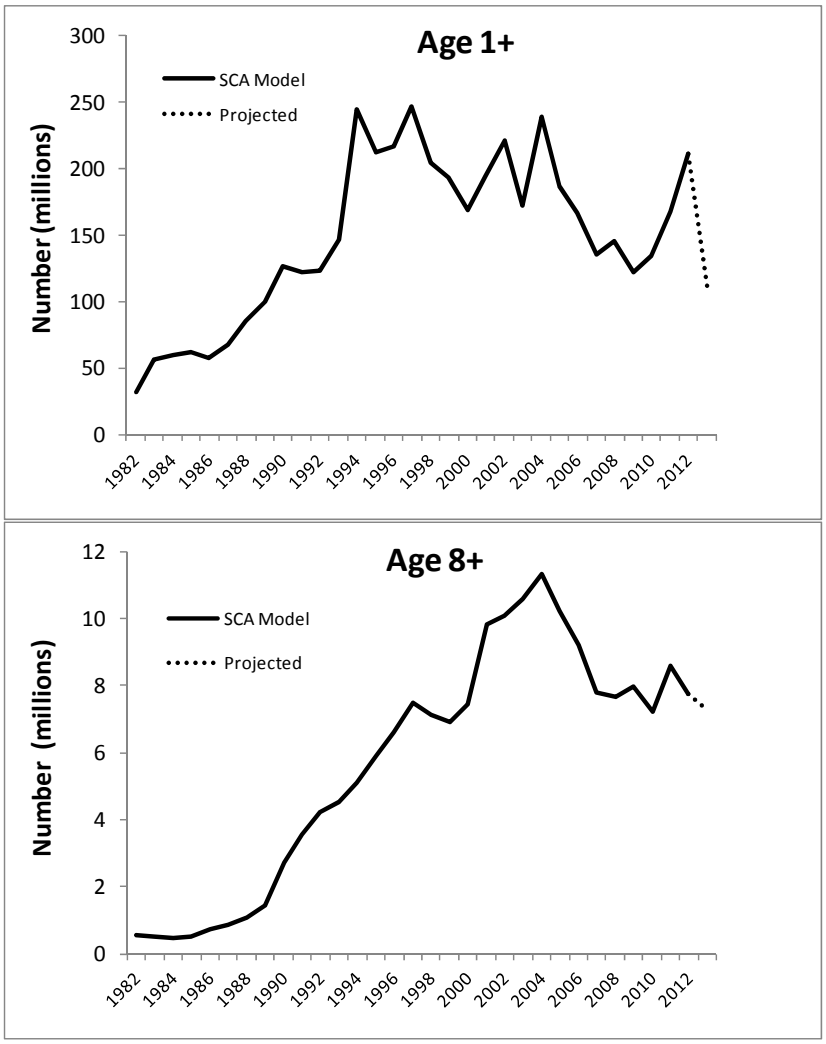


Figure 8. Estimates of A) female spawning stock biomass by year (solid line), B) female spawning stock numbers, and C) total January-1 biomass. Dotted lines equal 95% confidence intervals. Dashed line is the female SSB threshold (1995 value). Solid grey line is the SSB target (125% of threshold).

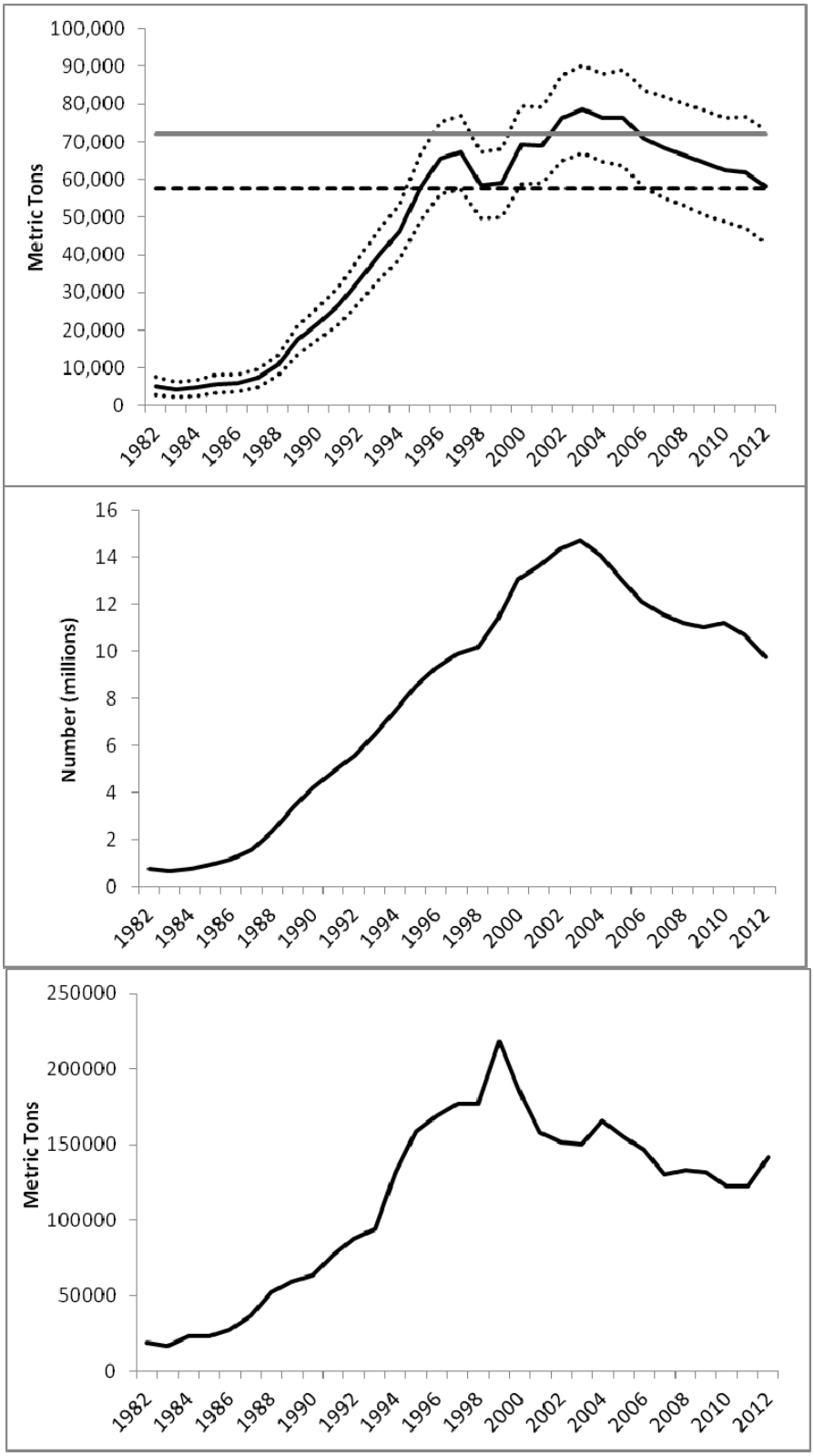


Figure 9. Retrospective analysis of fully-recruited F, female spawning stock biomass , 8+ abundance and Age 1 recruits.

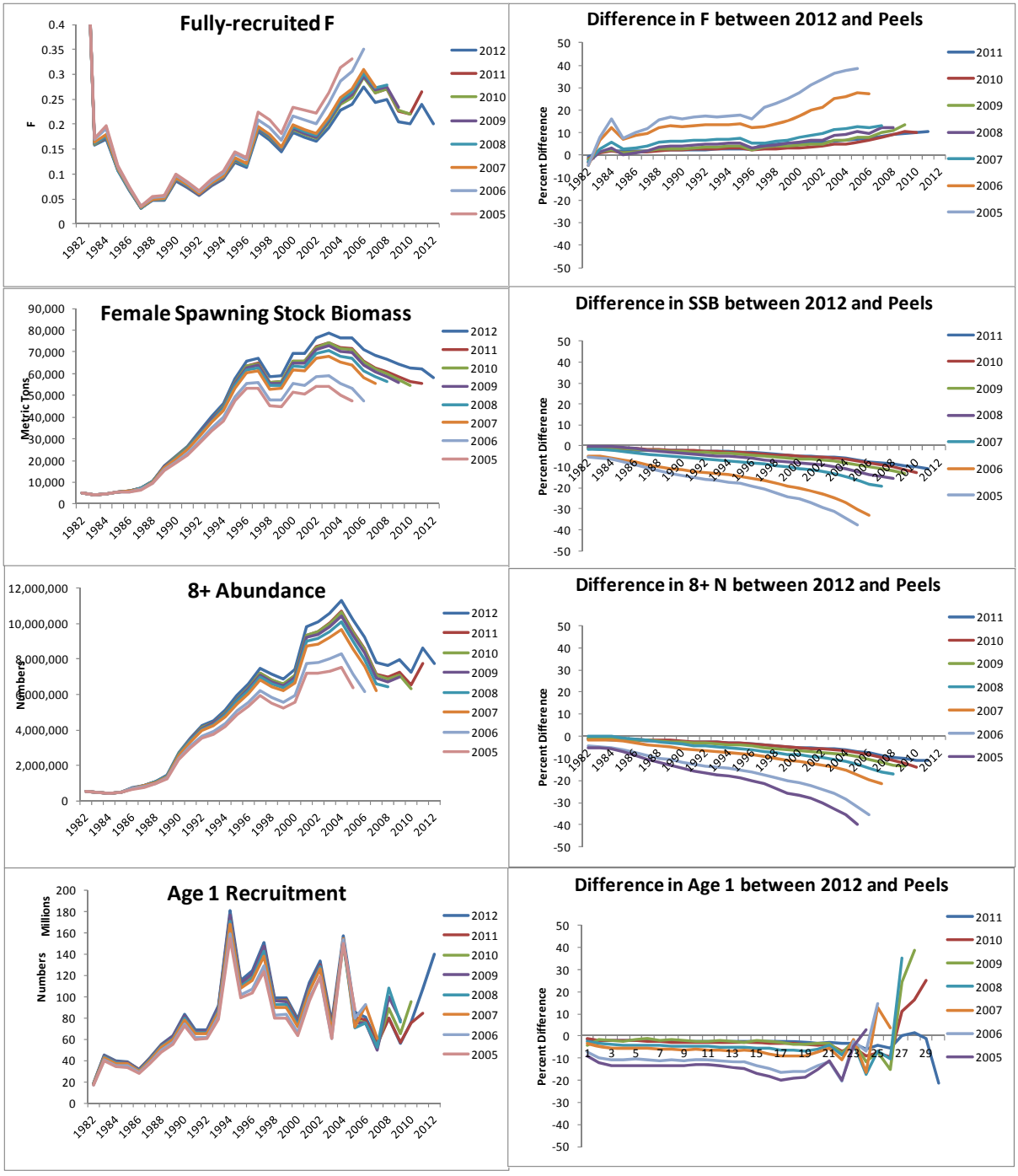


Figure 10. Comparison of fully-recruited F time series and the $F_{threshold}$ and F_{target} reference points.

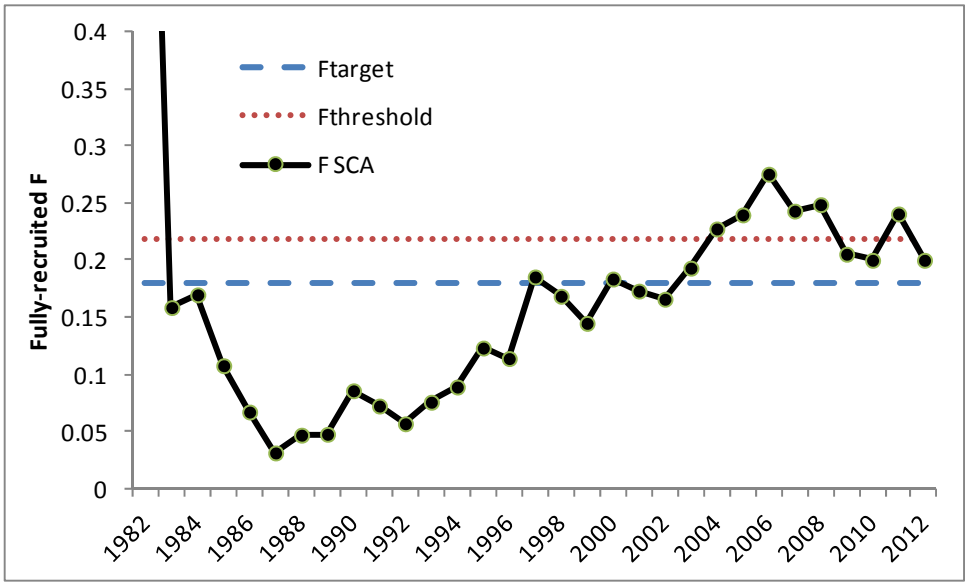


Figure 11. Results of the female spawning stock biomass projections using parameter estimates from the 2012 base SCA model and randomly drawing recruitment values from the 1990-2012 time series of recruitment estimates. Gray lines are the 1000 SSB projections and red line is the median of the 1000 SSB projections.

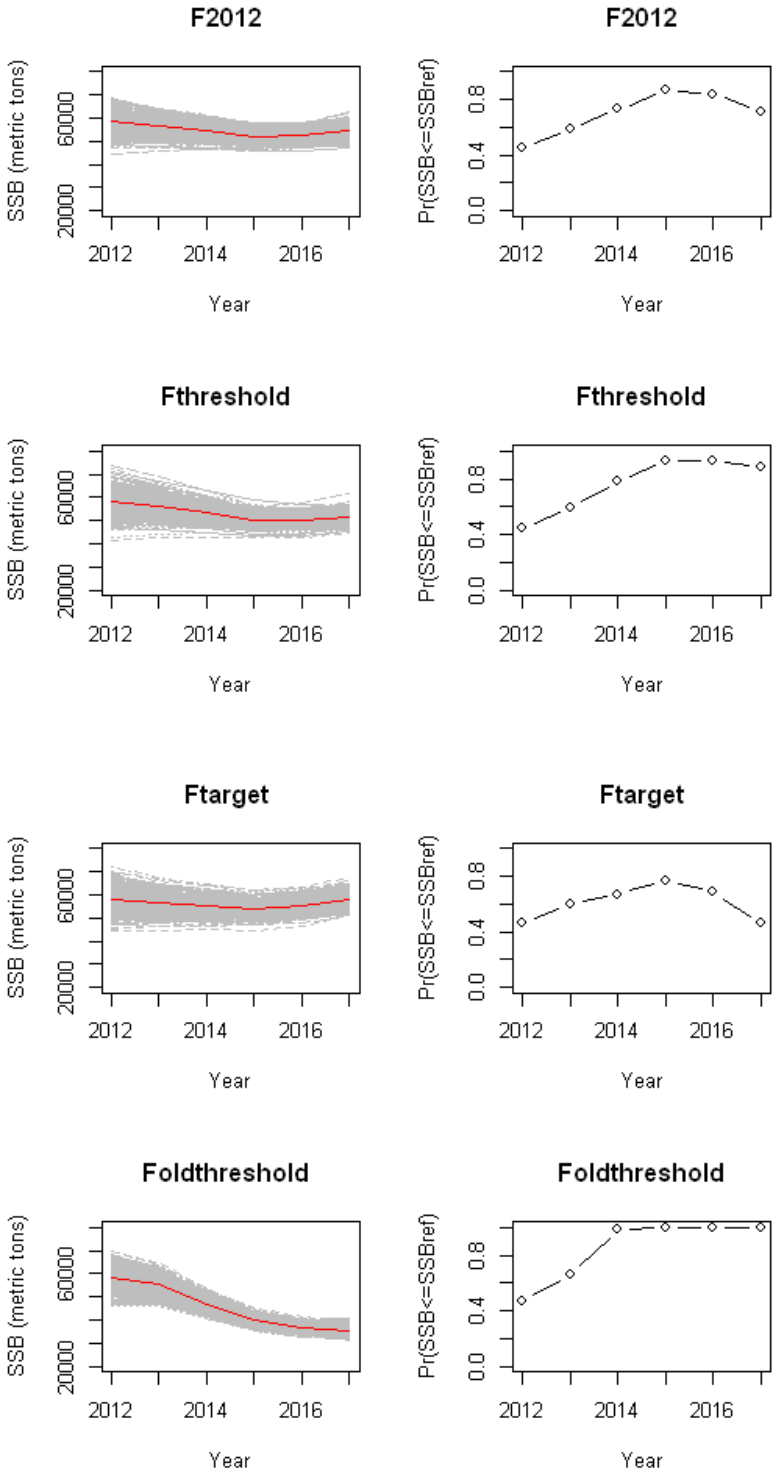


Table 11 cont.

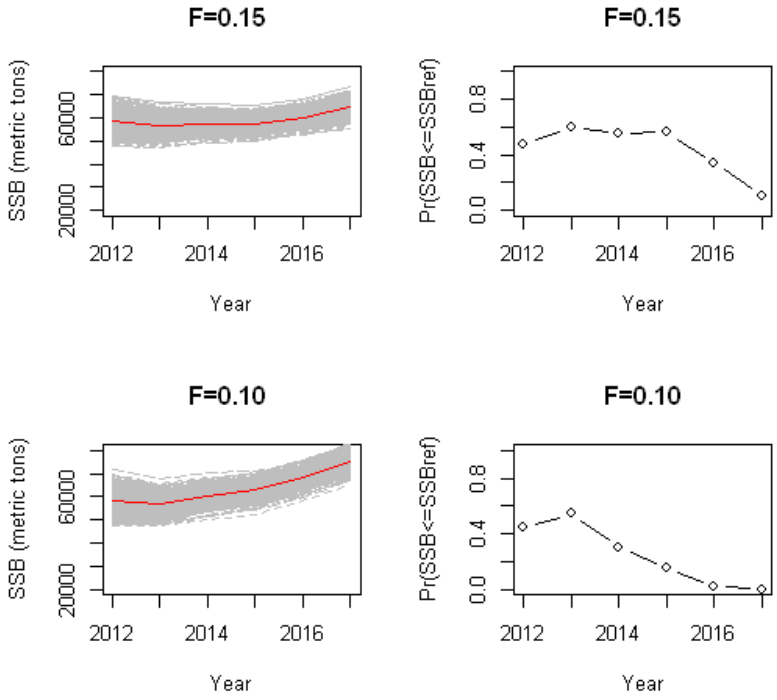
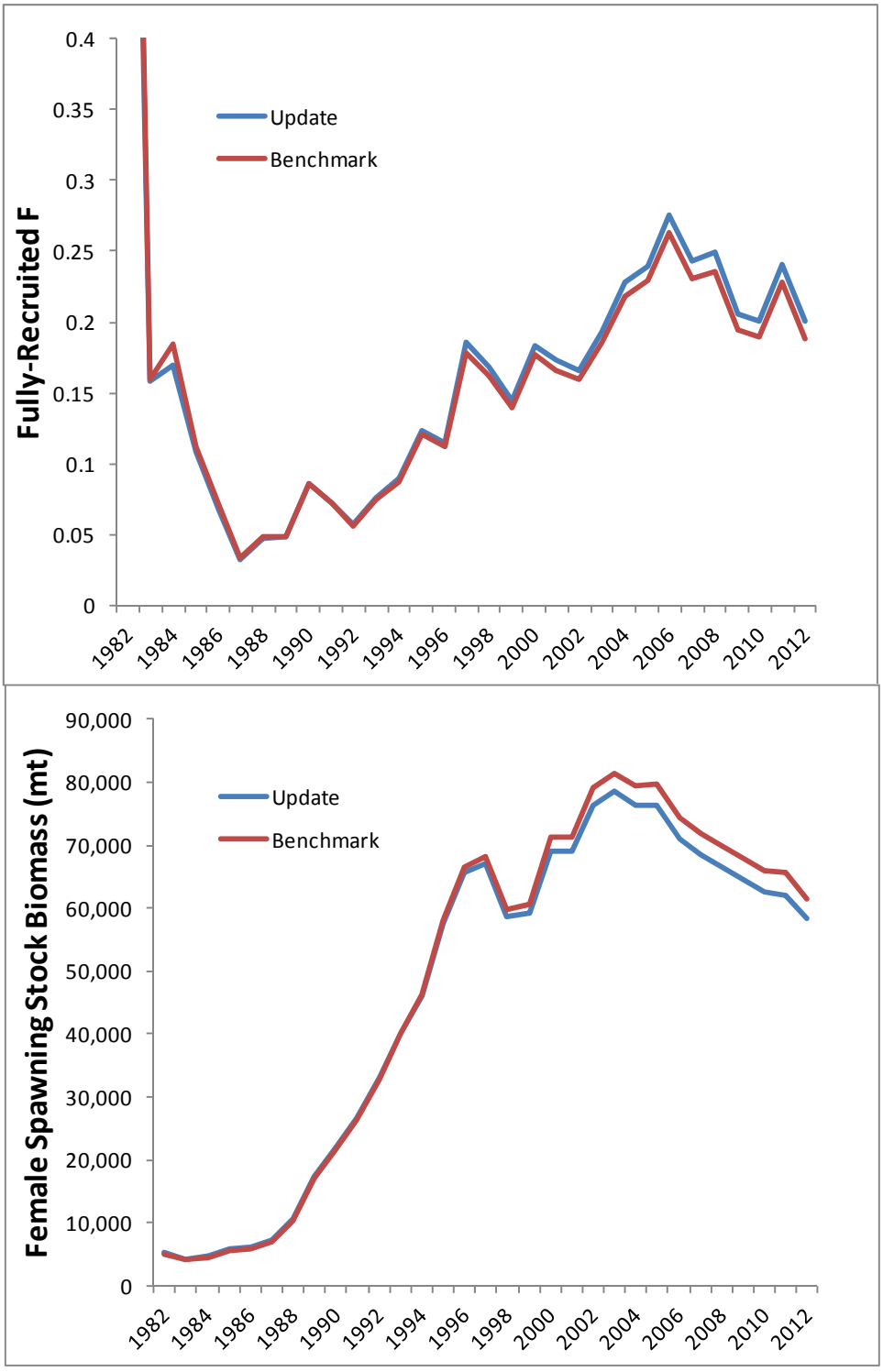


Table 12. Comparison of fully-recruited fishing mortality and female spawning stock biomass estimates between the updated and benchmark assessments.



Appendix A. Plots of SCA model output.

Figure 1. Plots of observed and predicted catch proportions-at-age by year for each fleet.

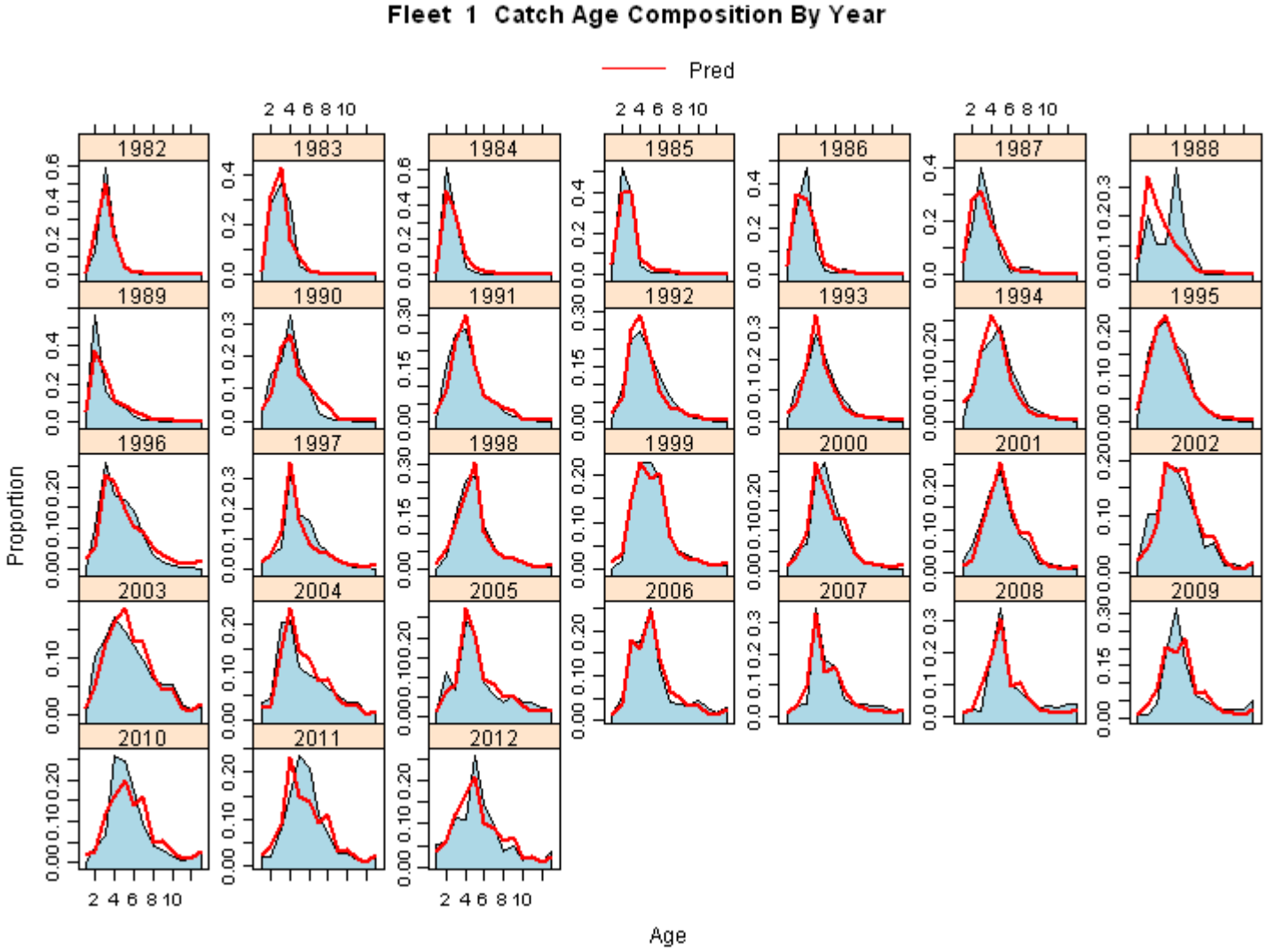


Figure 1 cont.

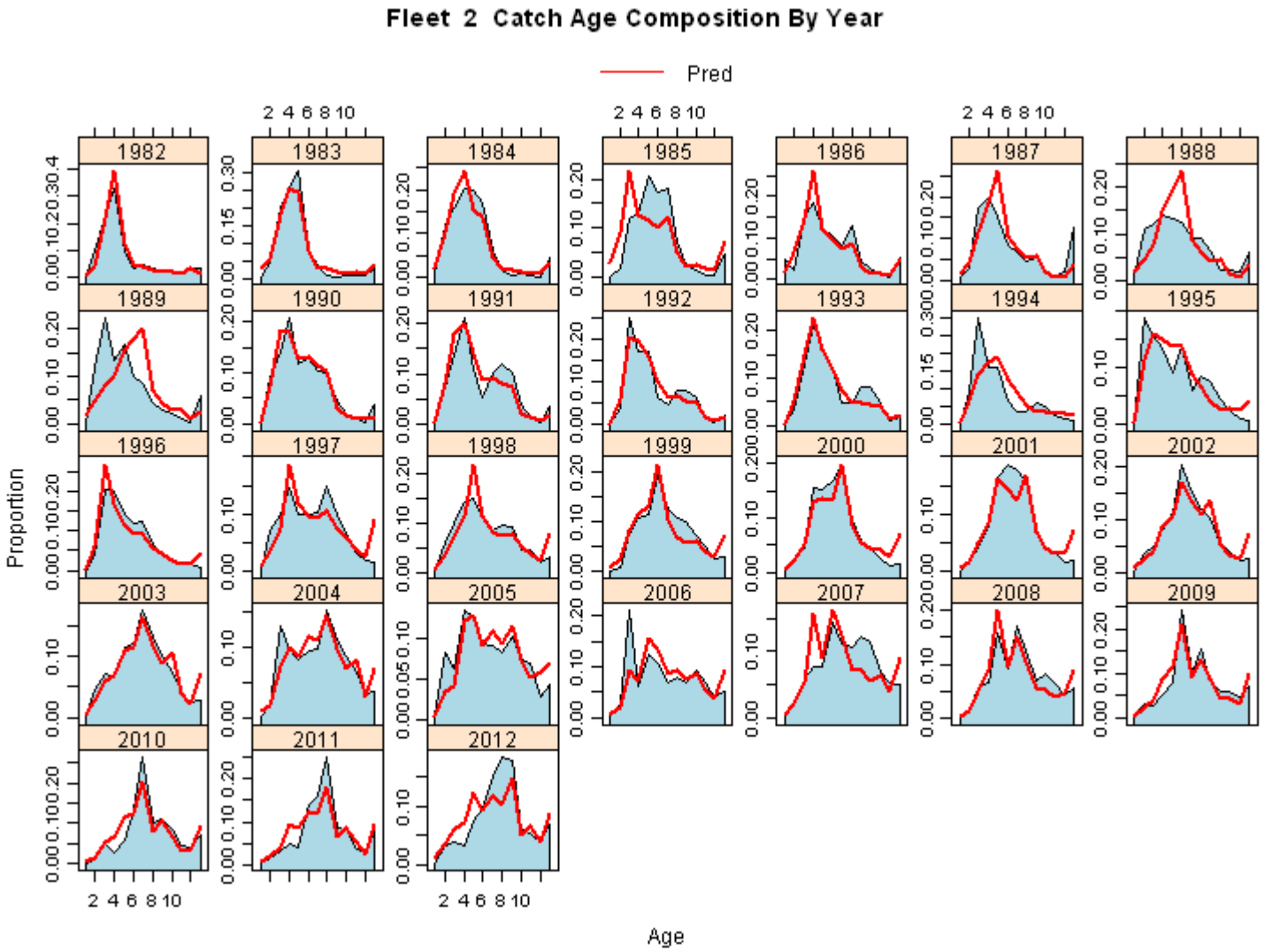


Figure 1 cont.

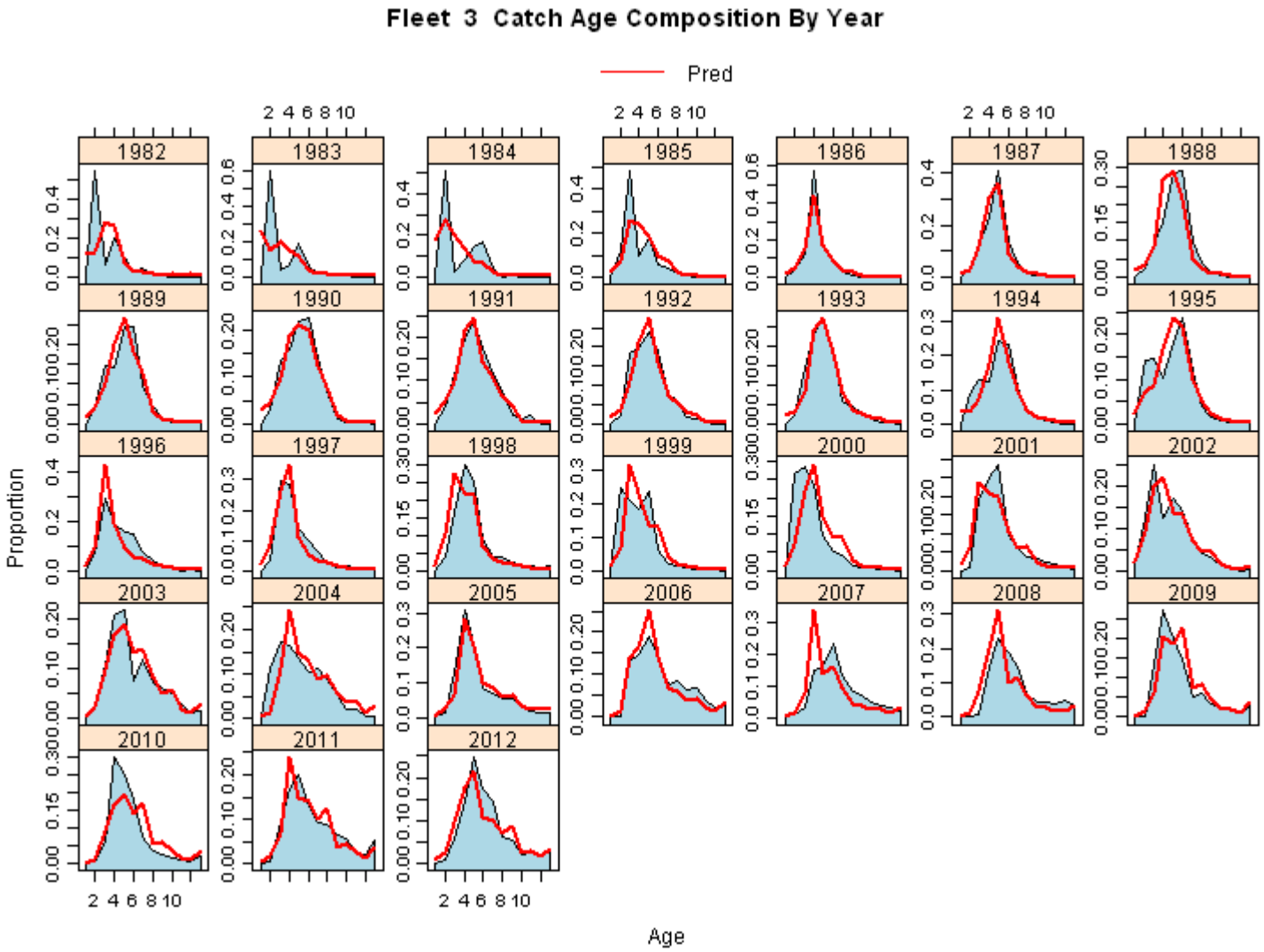


Figure 2. Standardized residuals of catch proportions-at-age by year for each fleet.

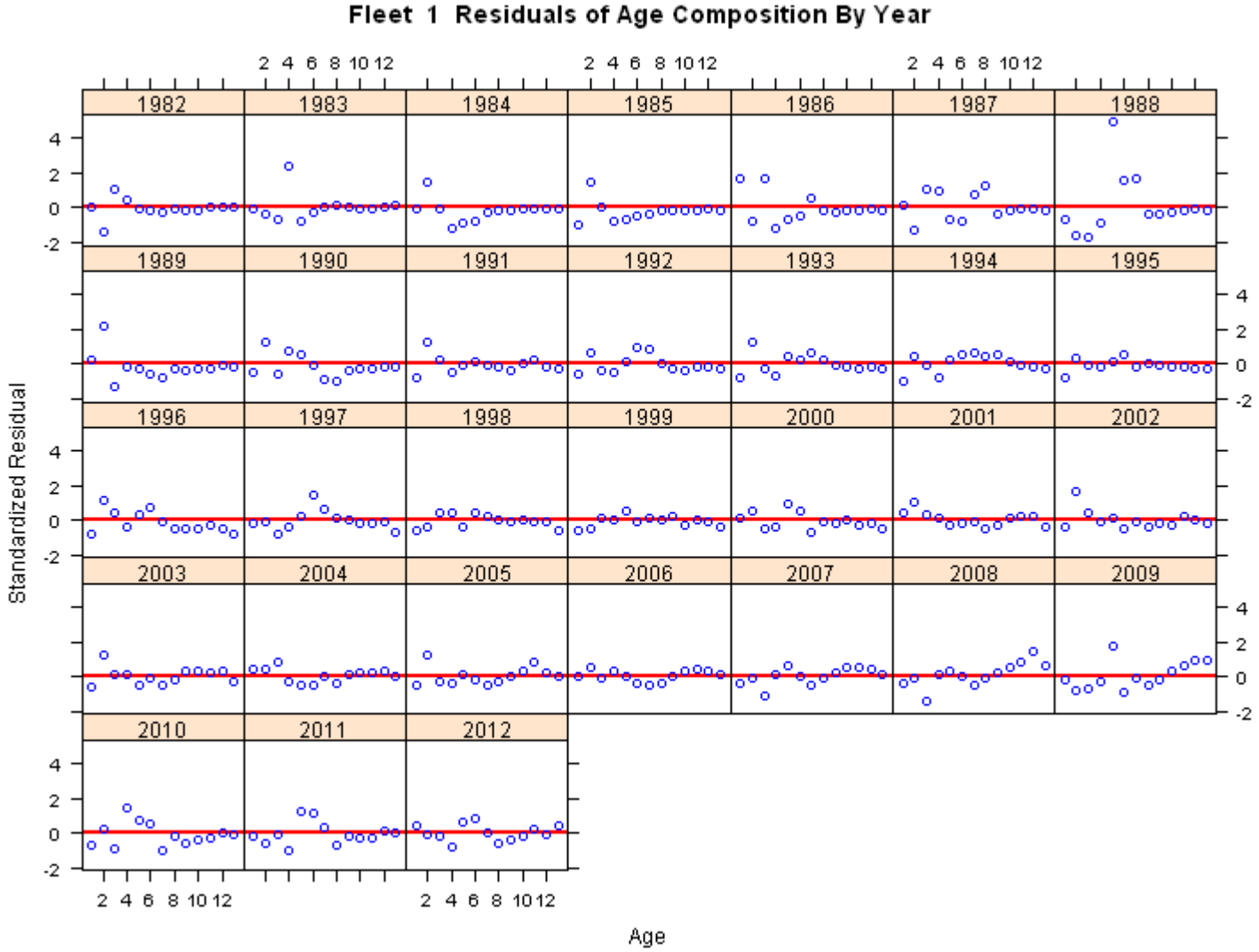


Figure 2 cont.

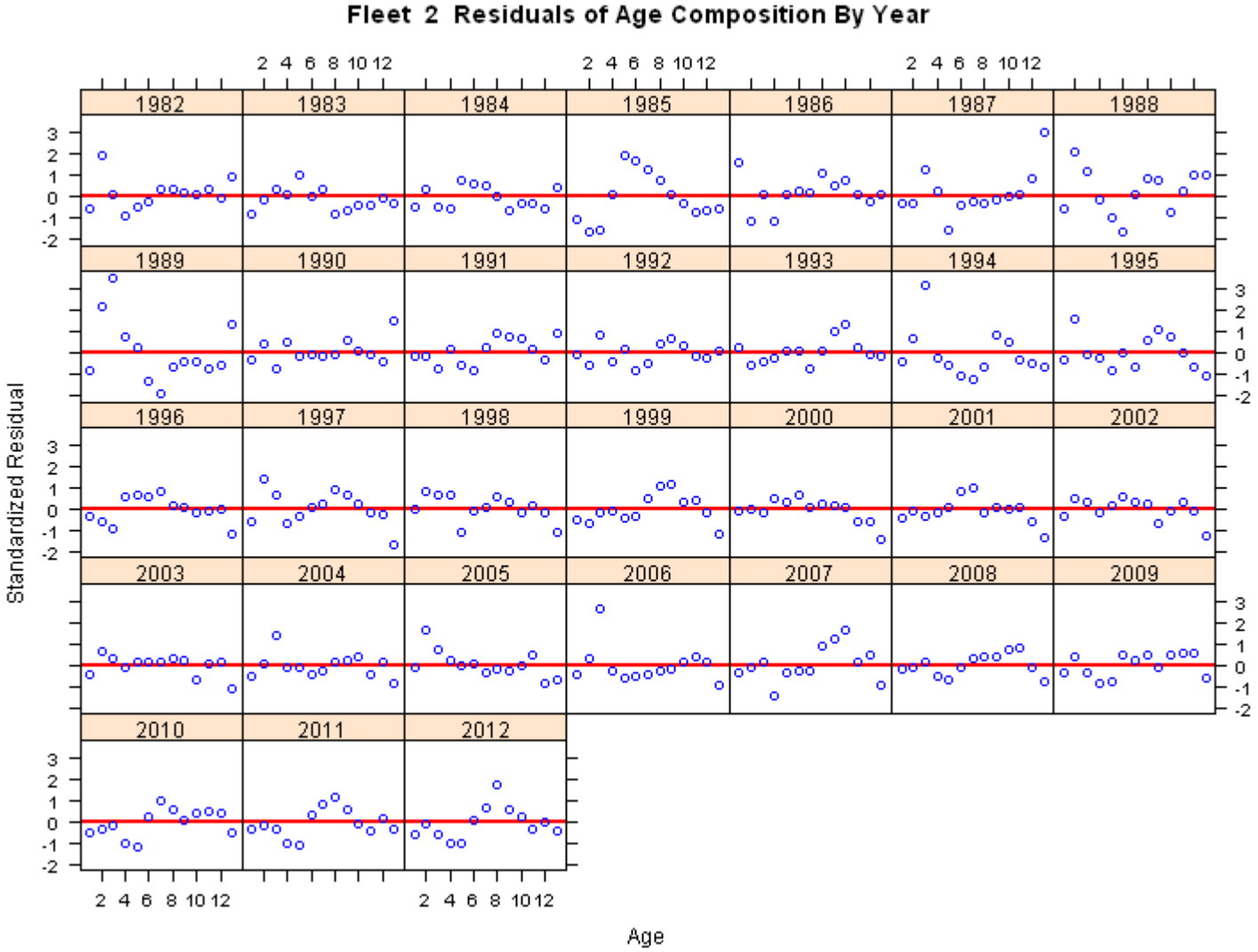


Figure 2 cont.

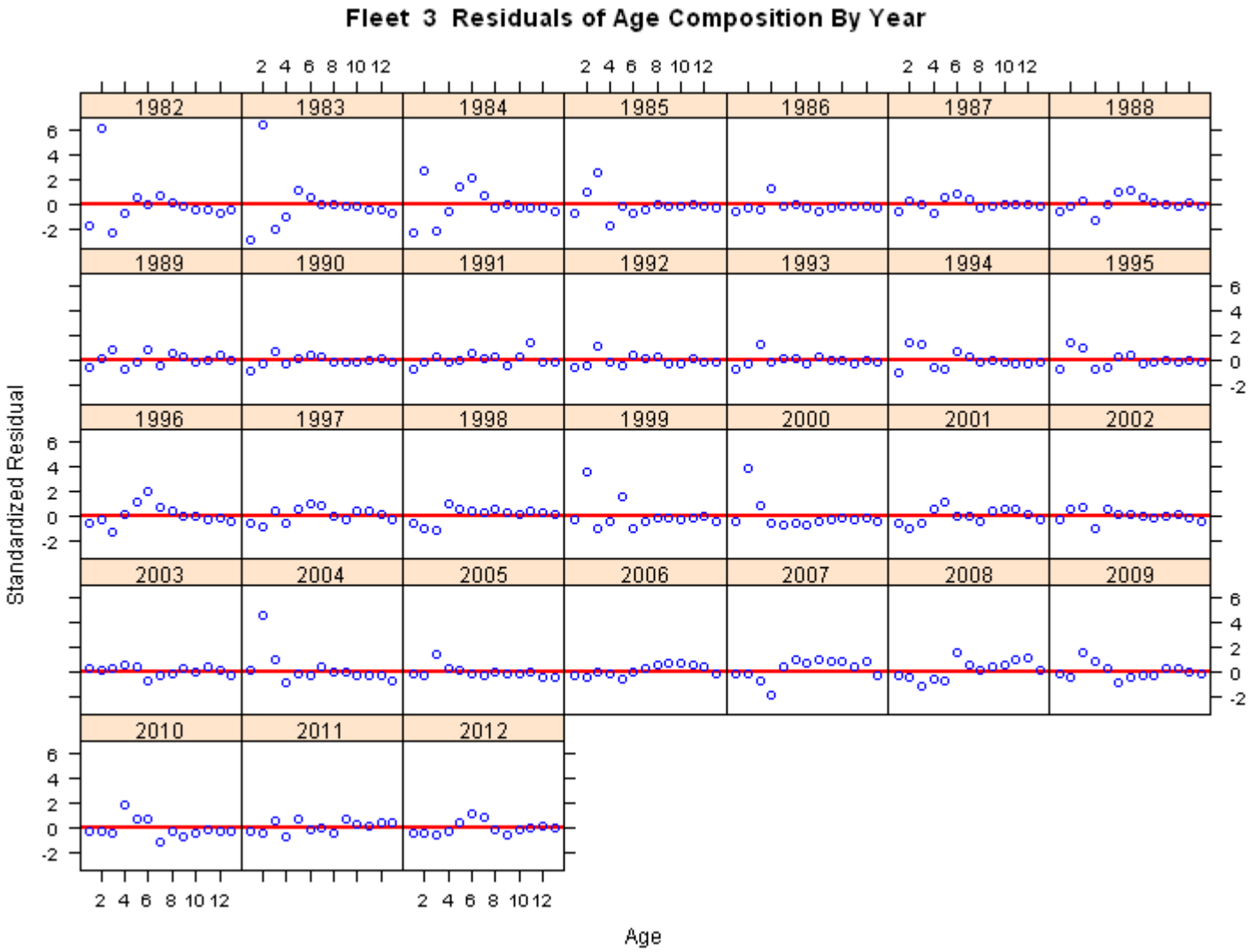


Figure 3 .Observed and predicted catch proportions-at-age by age for each fleet

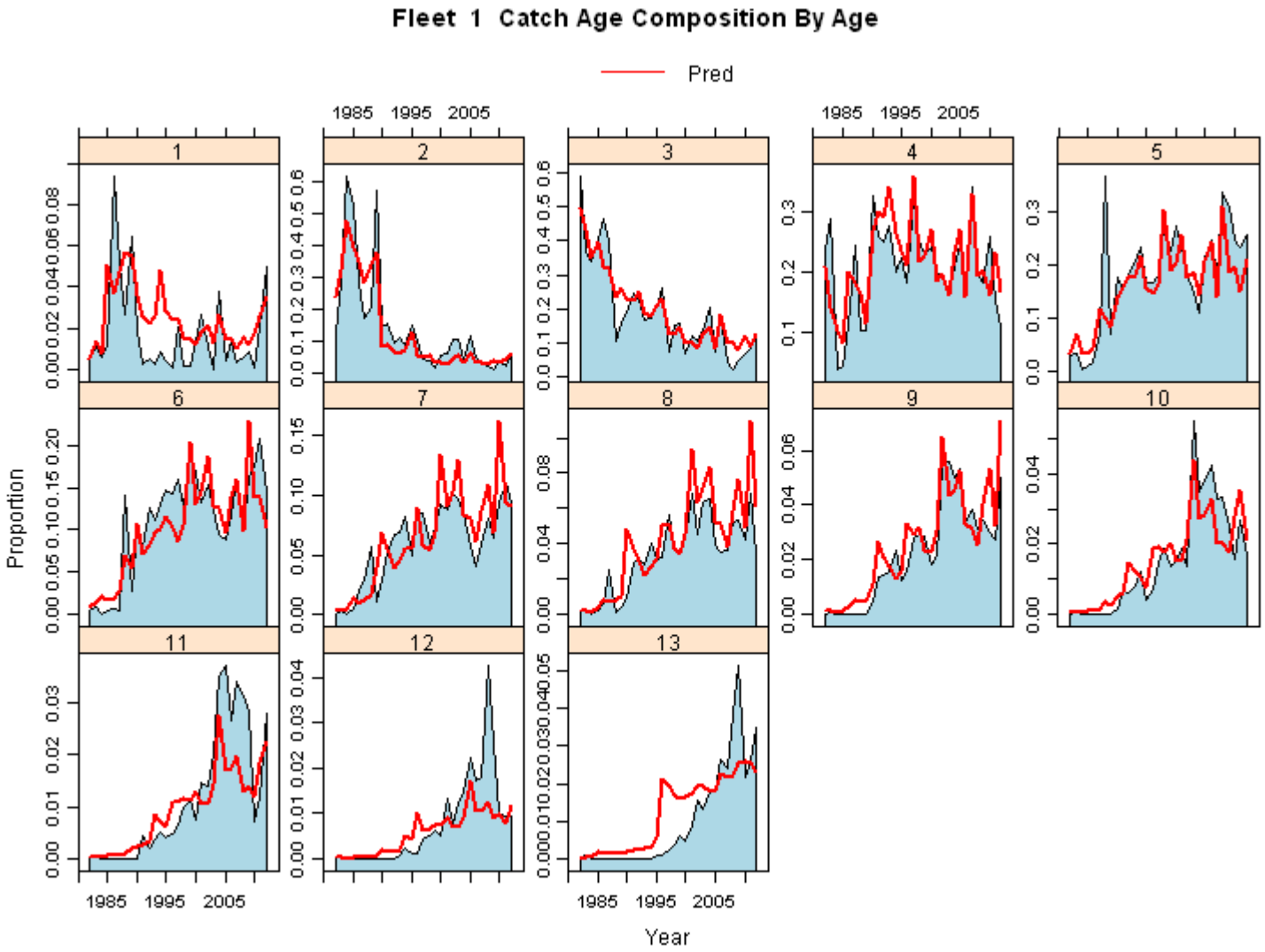


Figure 3 cont.

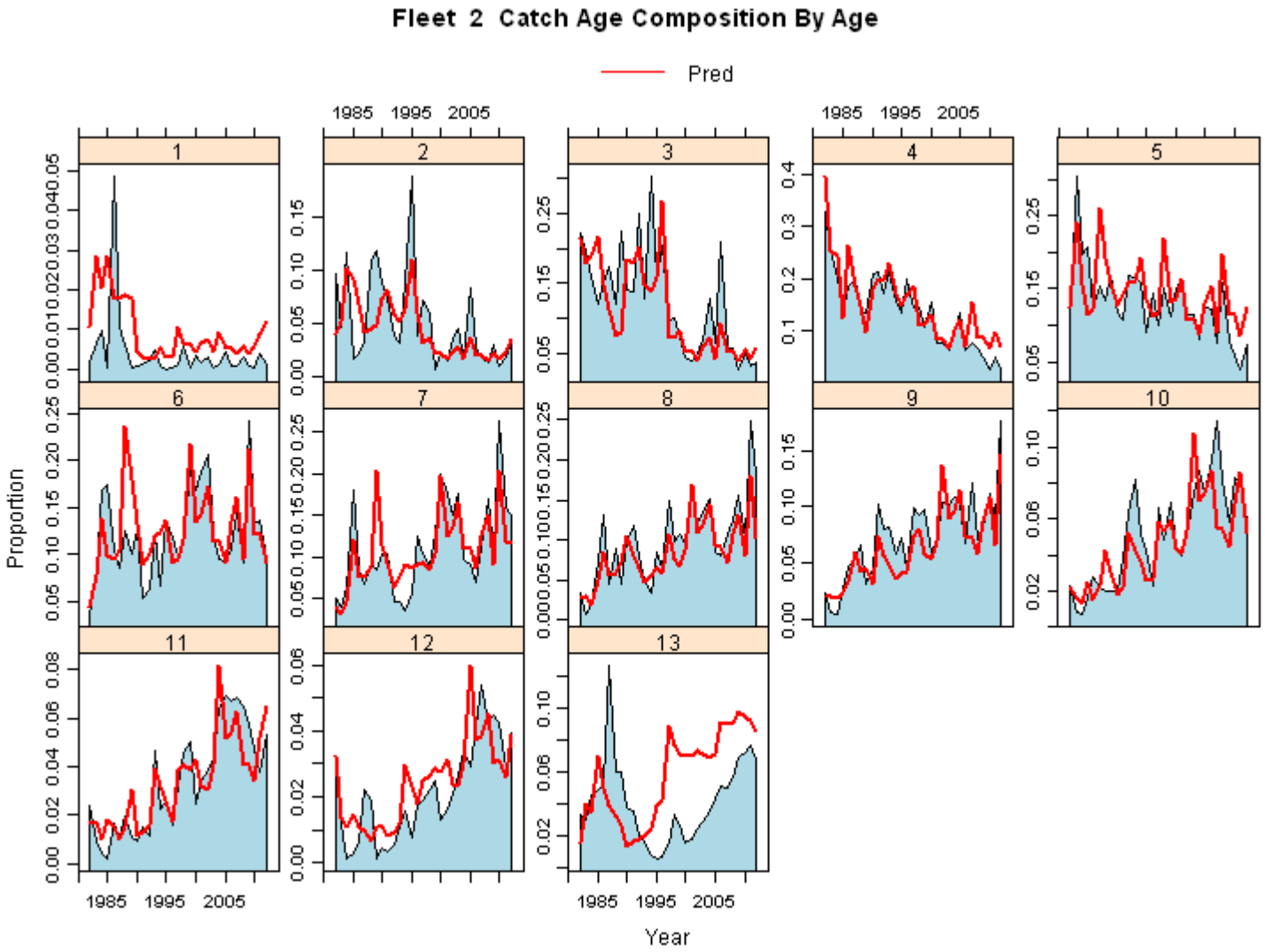


Figure 3 cont.

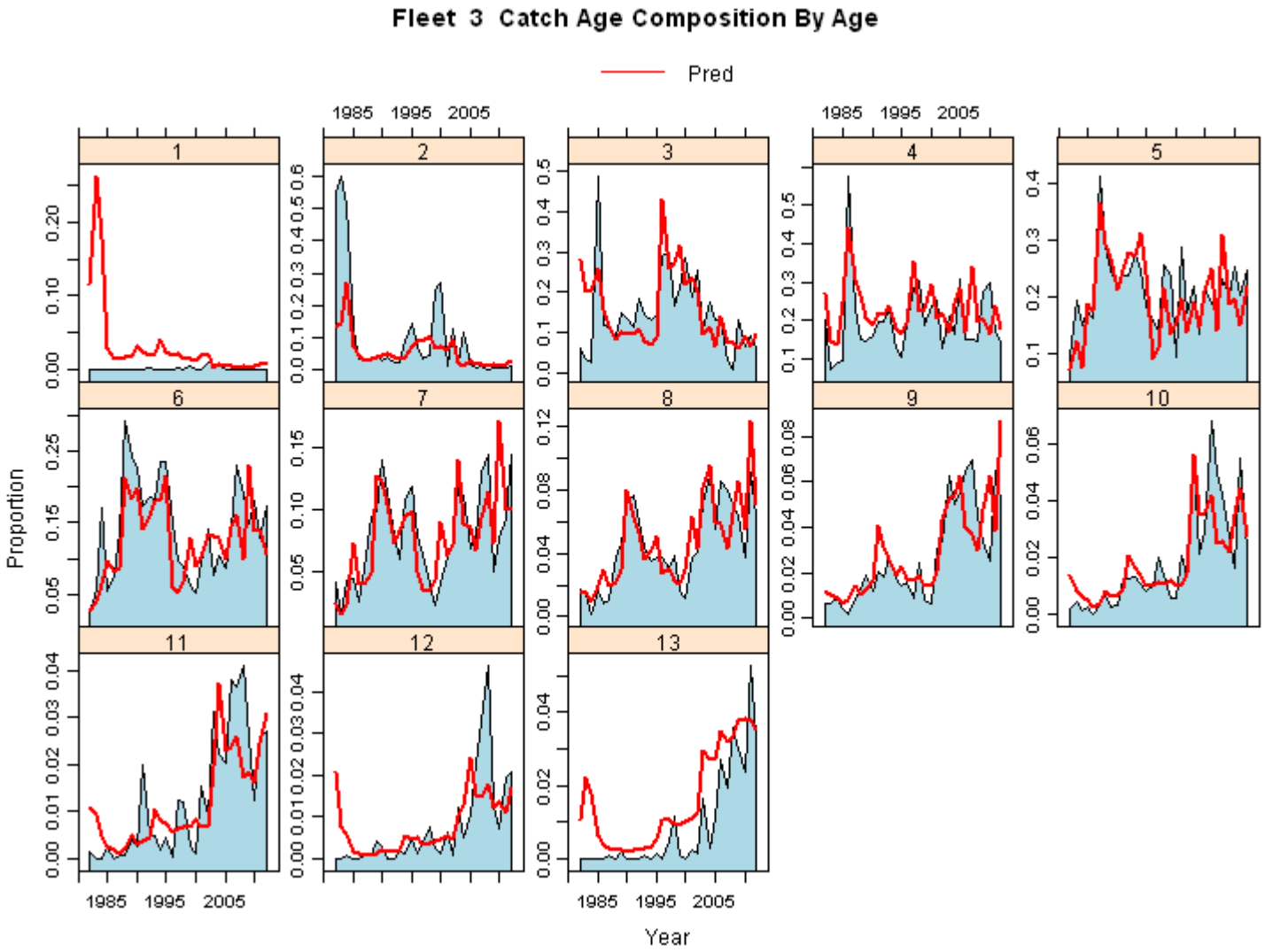


Figure 4. Standardized residuals of catch proportions-at-age by age.

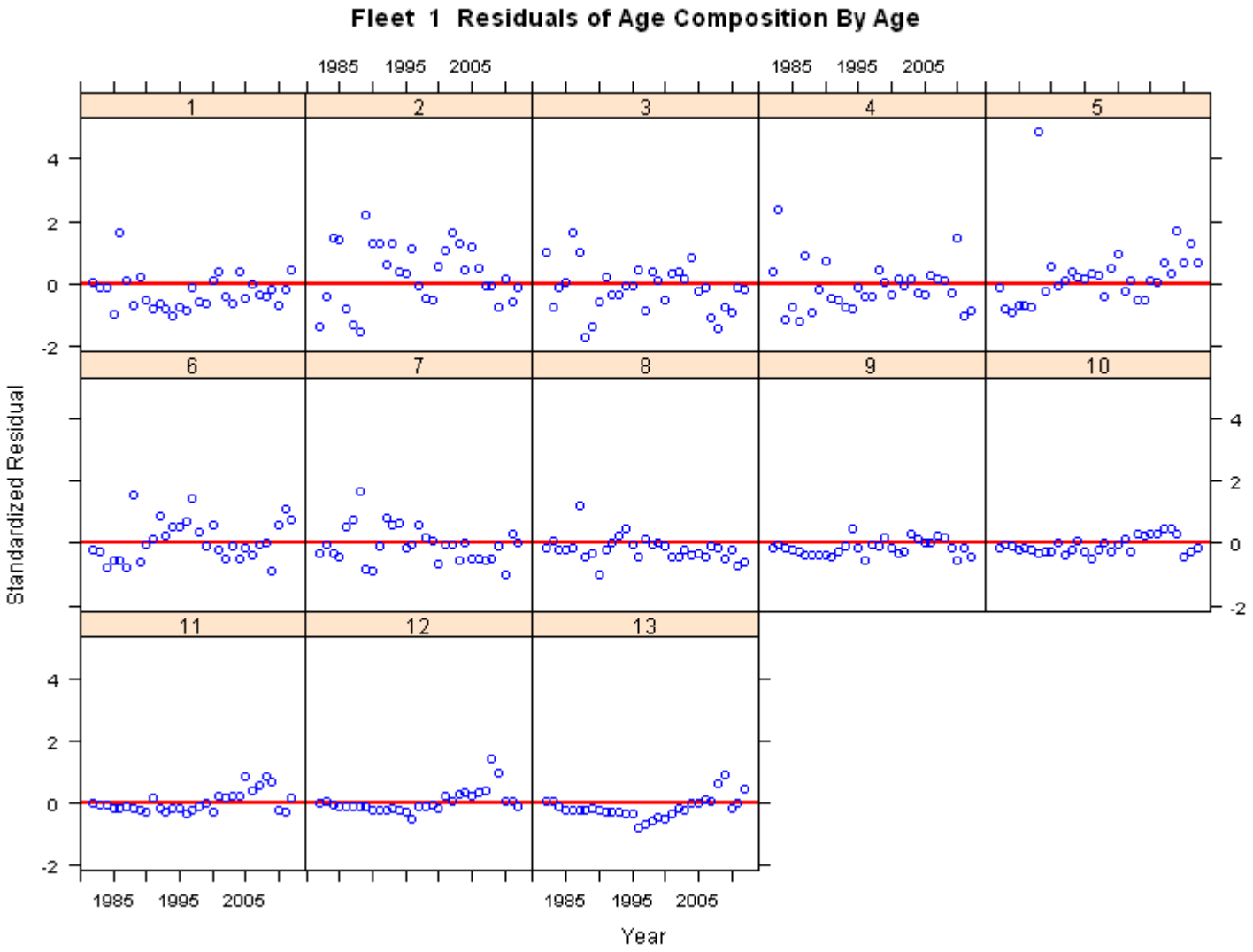


Figure 4 cont.

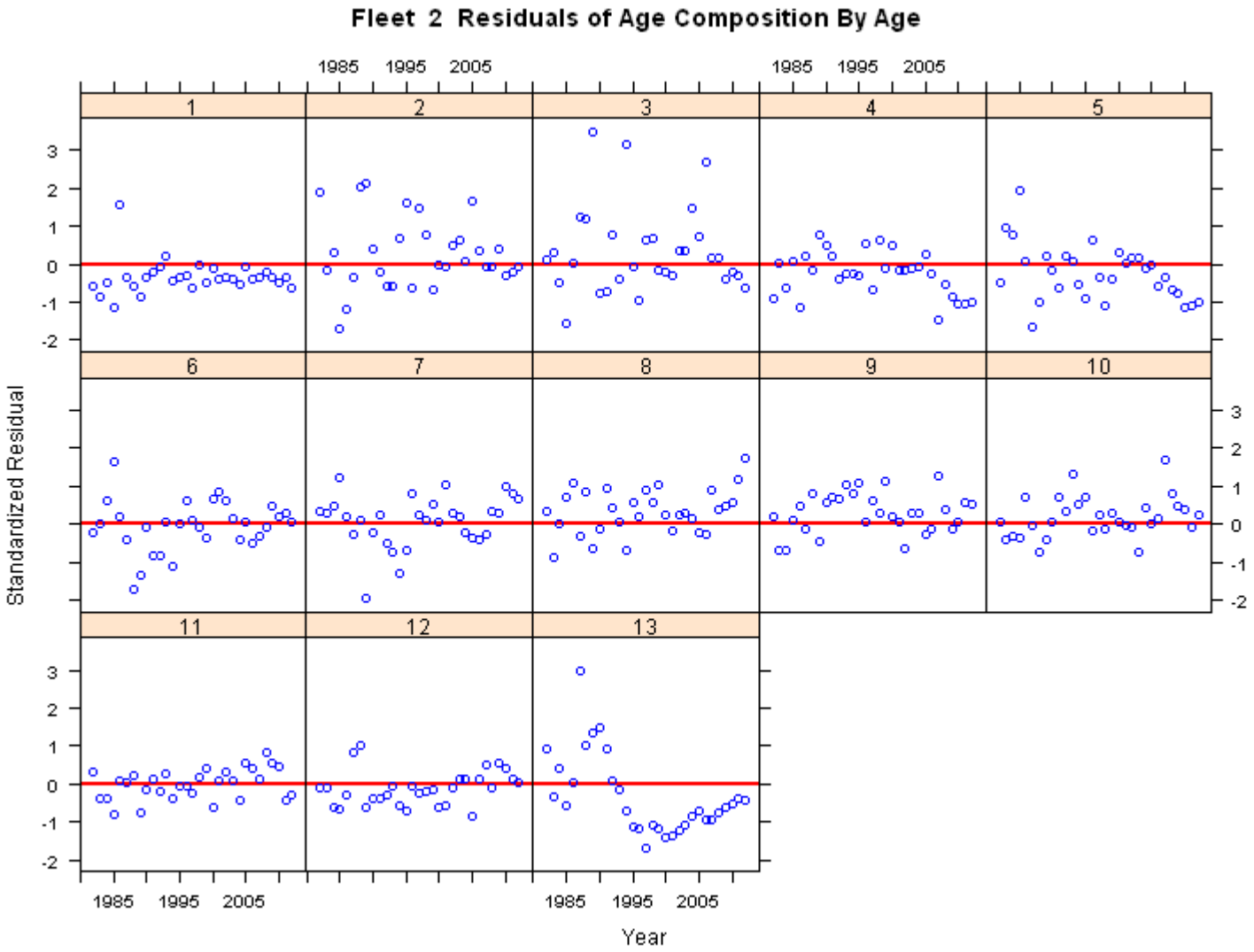


Figure 4 cont.

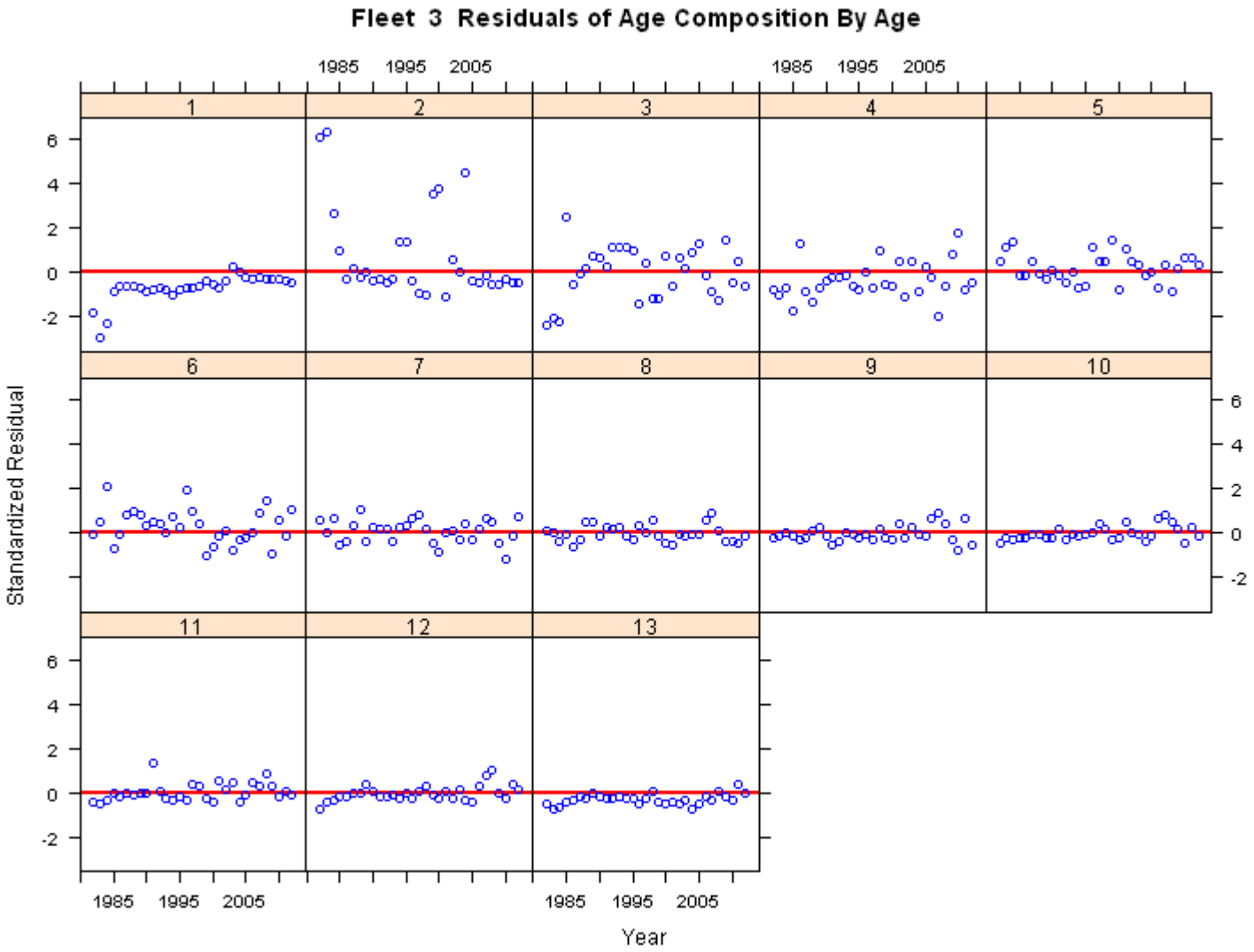


Figure 5. Observed and predicted values and standardized residuals for young-of-the-year and yearling surveys tuned to Age 1 and 2, respectively.

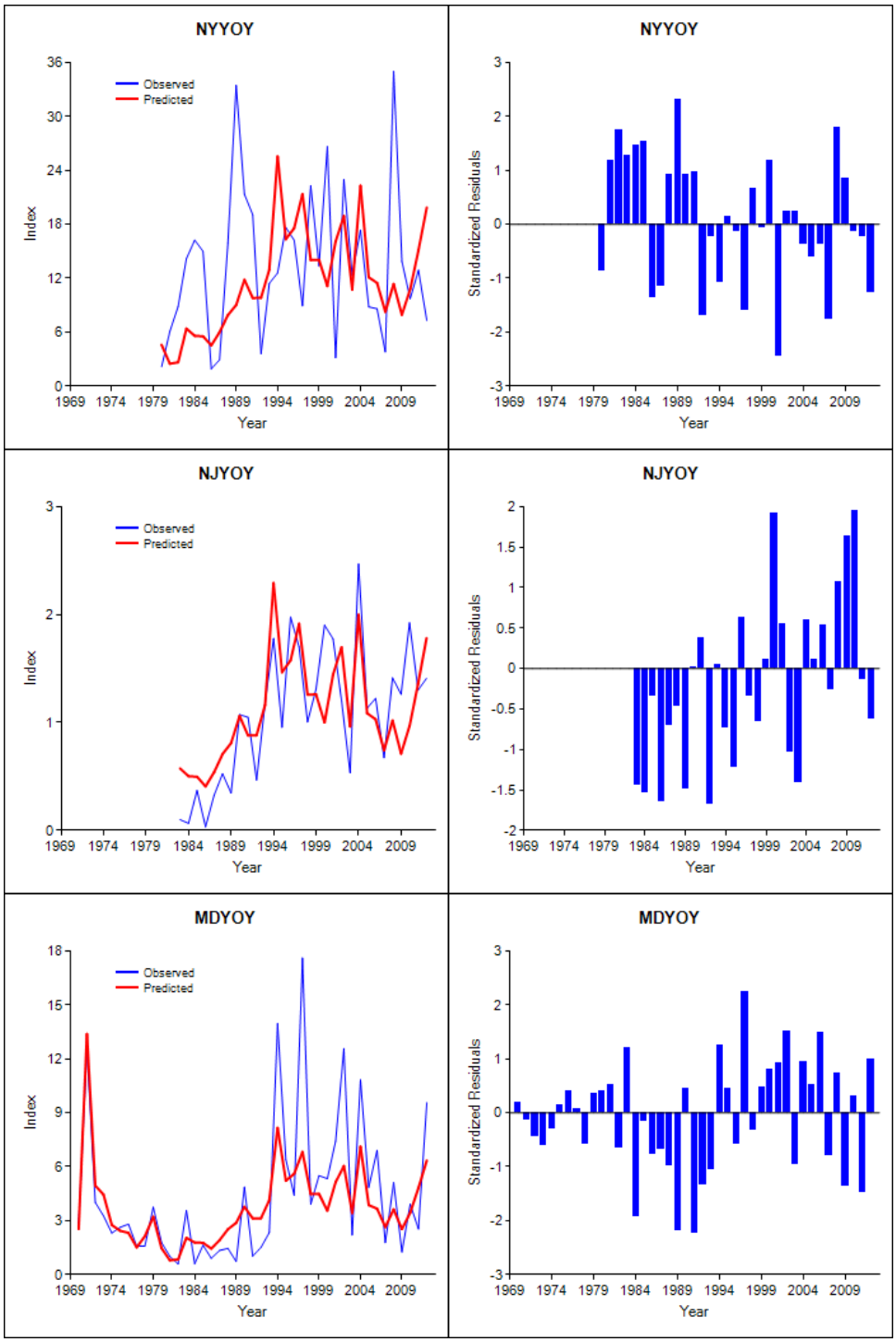


Figure 5 cont.

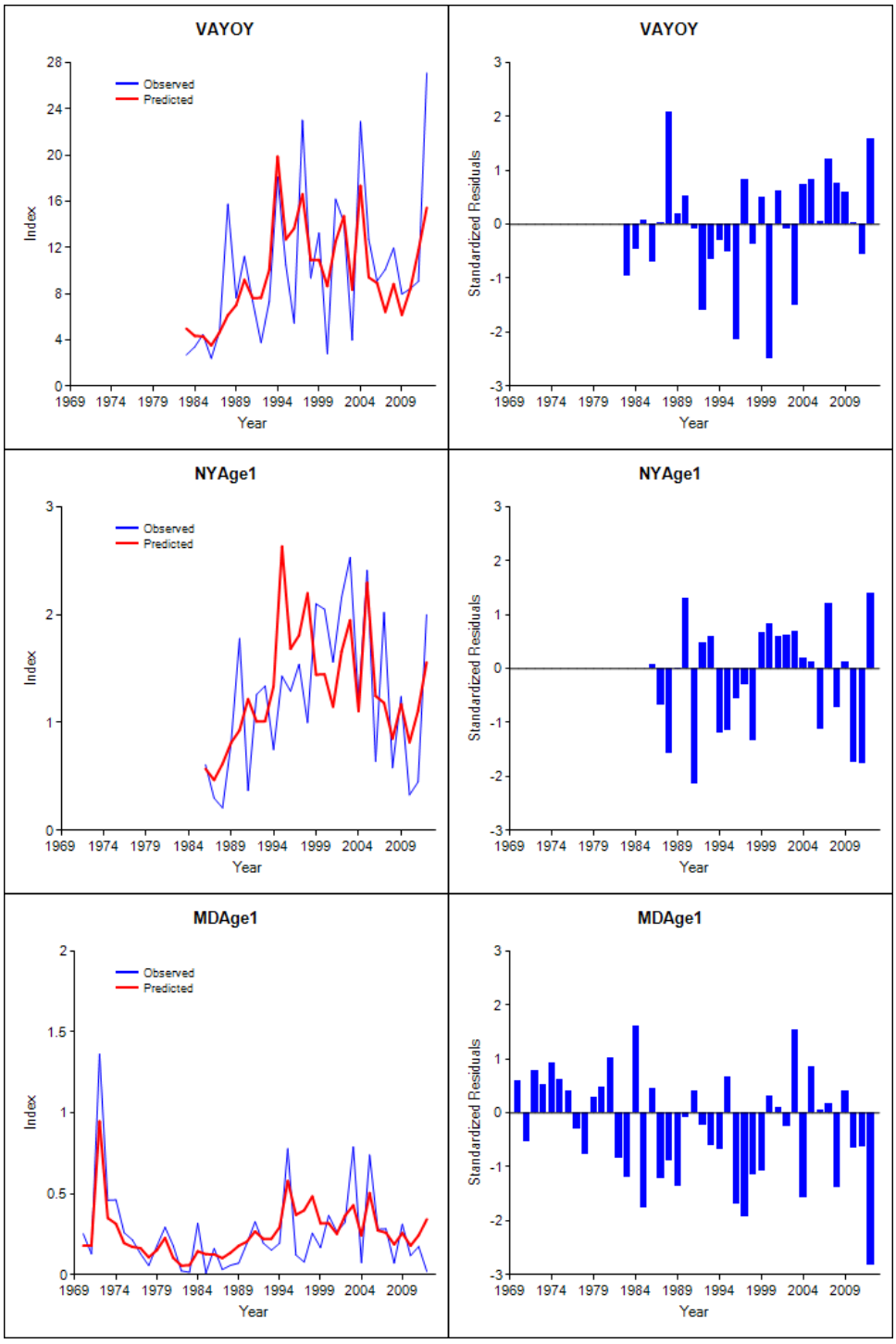


Figure 6. Observed and predicted values and standardized residuals for age-aggregated surveys.

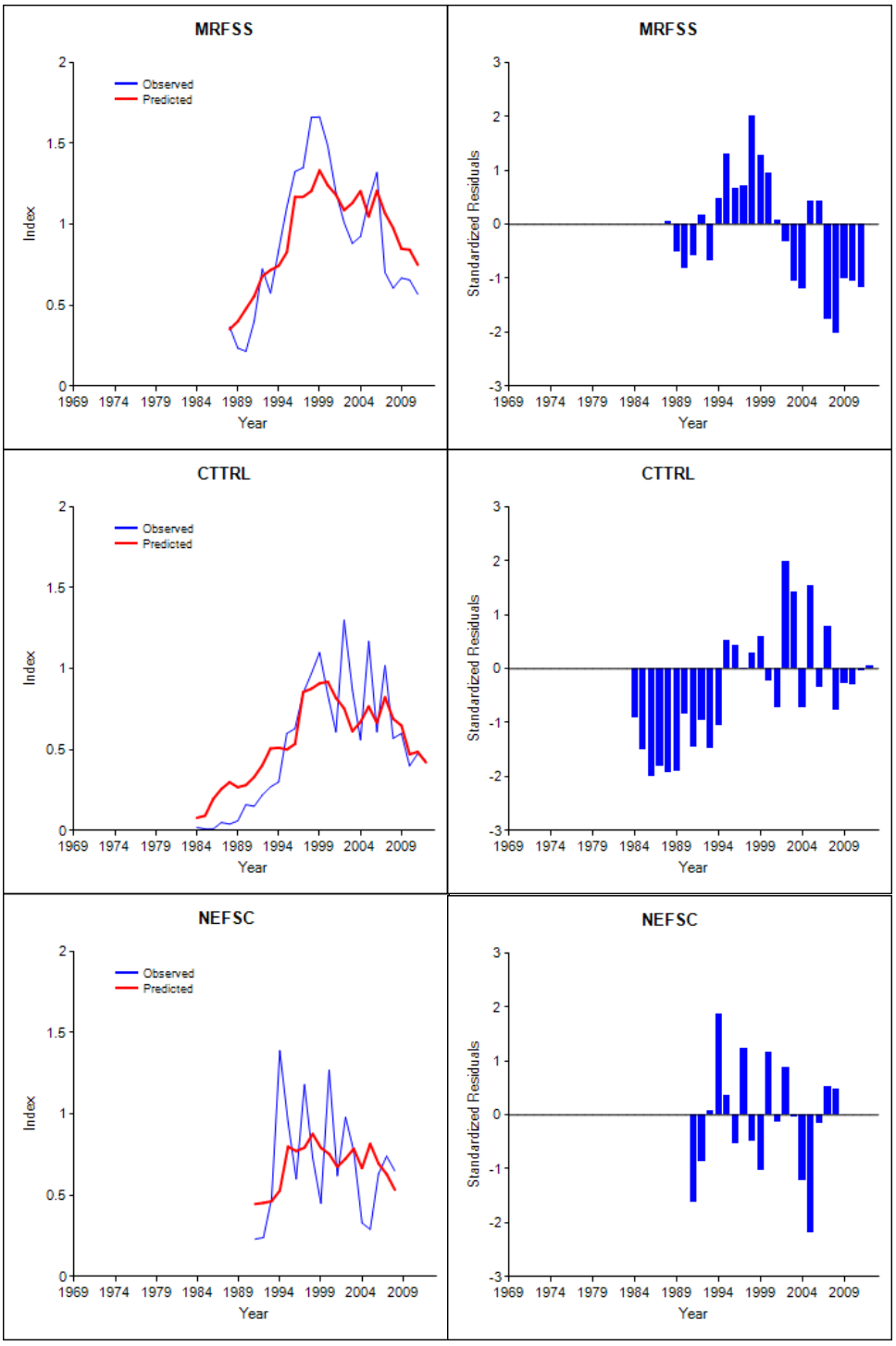


Figure 7. Observed and predicted values of the total index and standardized residuals for surveys with age composition data.

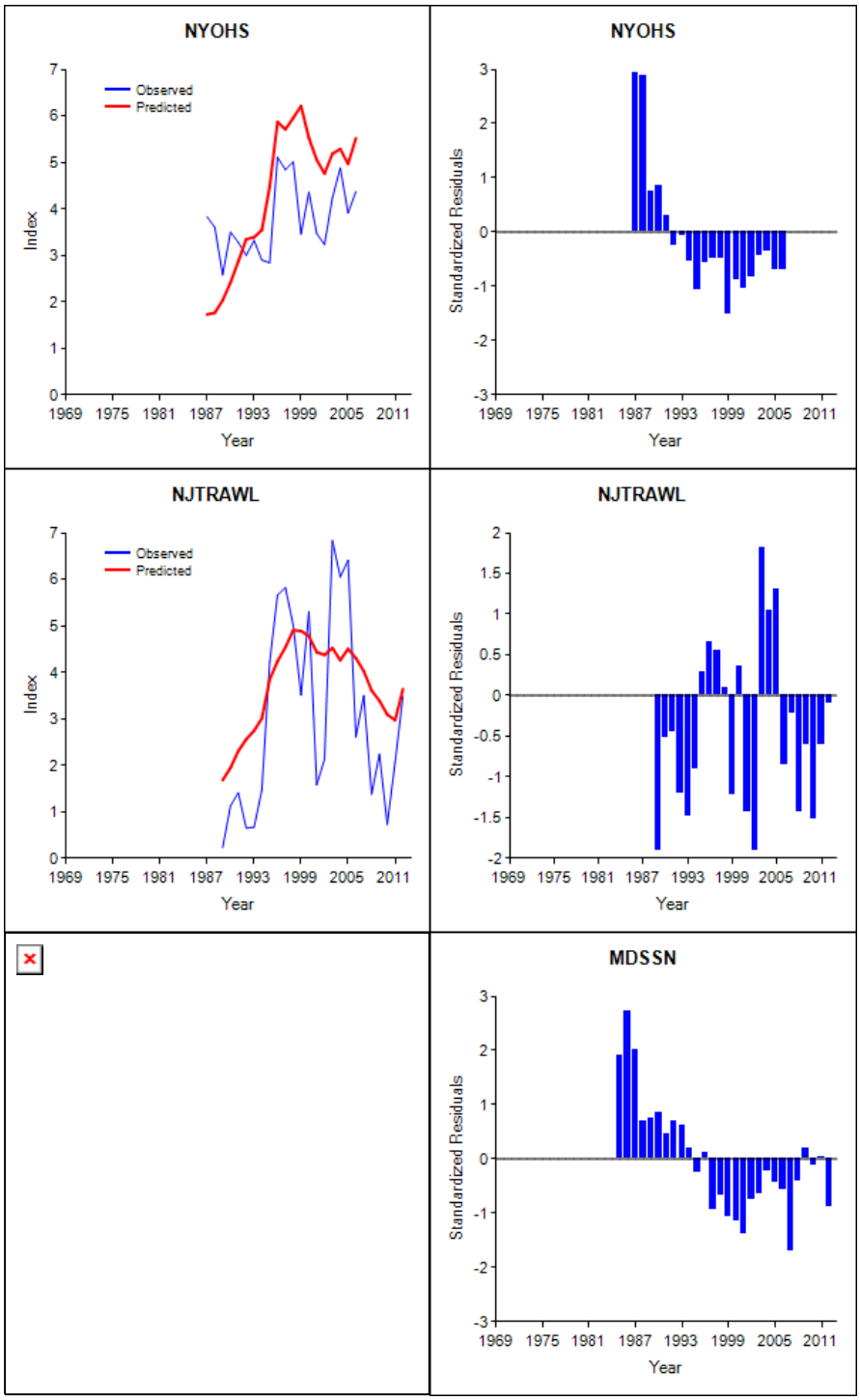


Figure 7 cont.

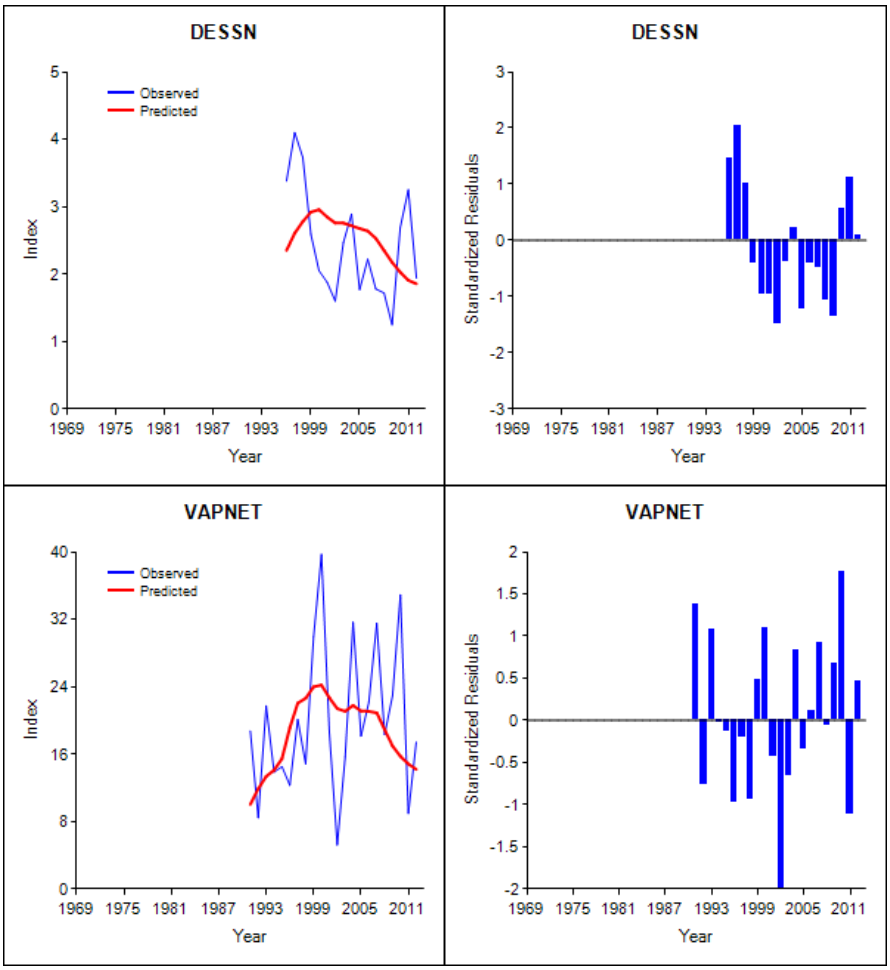


Figure 8. Selectivity patterns estimated for the NYOHS, NJ Trawl, MD SSN, DE SSN surveys and VAPNET.

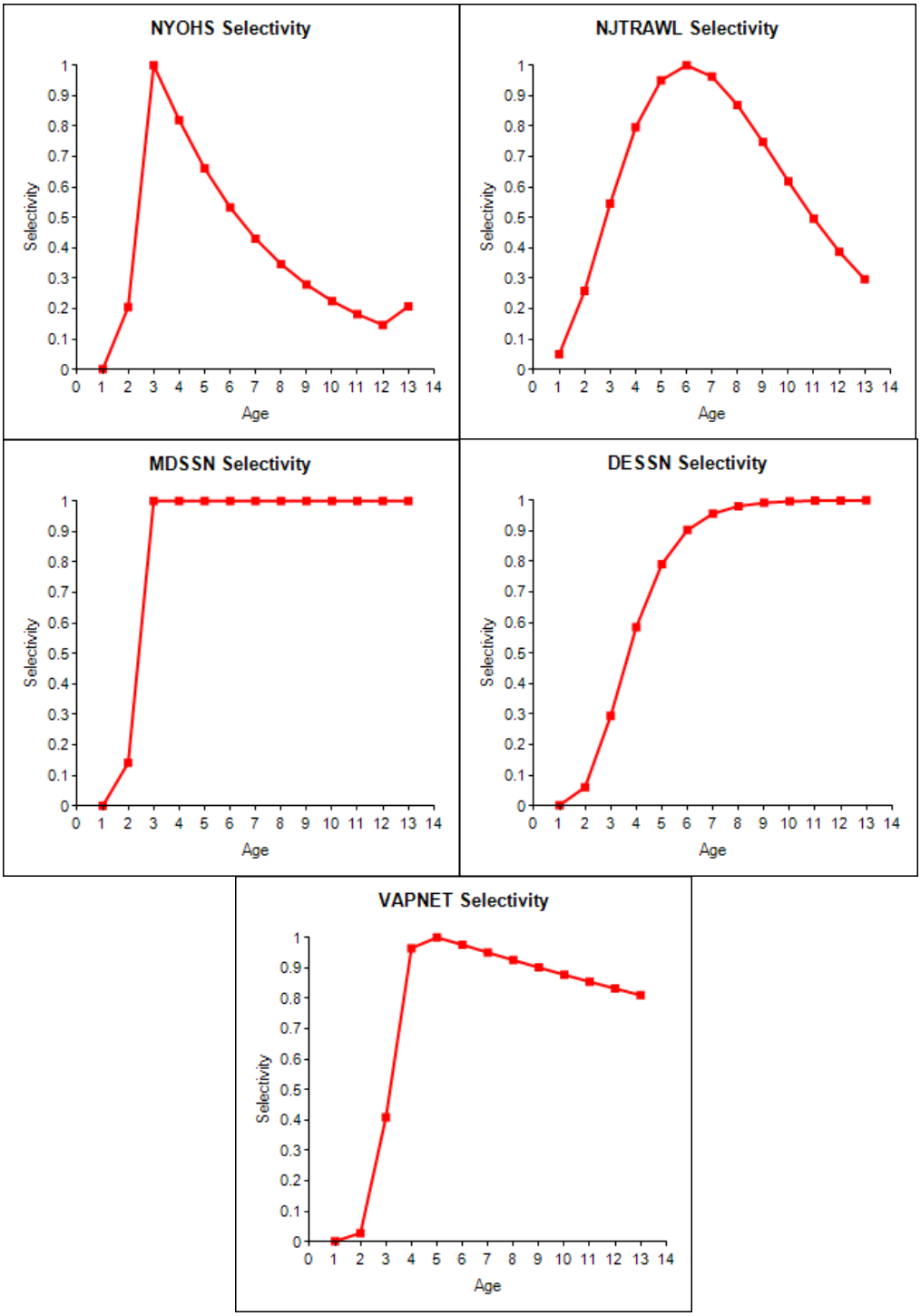


Figure 9. Observed and predicted proportions-at-age and standardized residual for each age by year for the NYOHS survey.

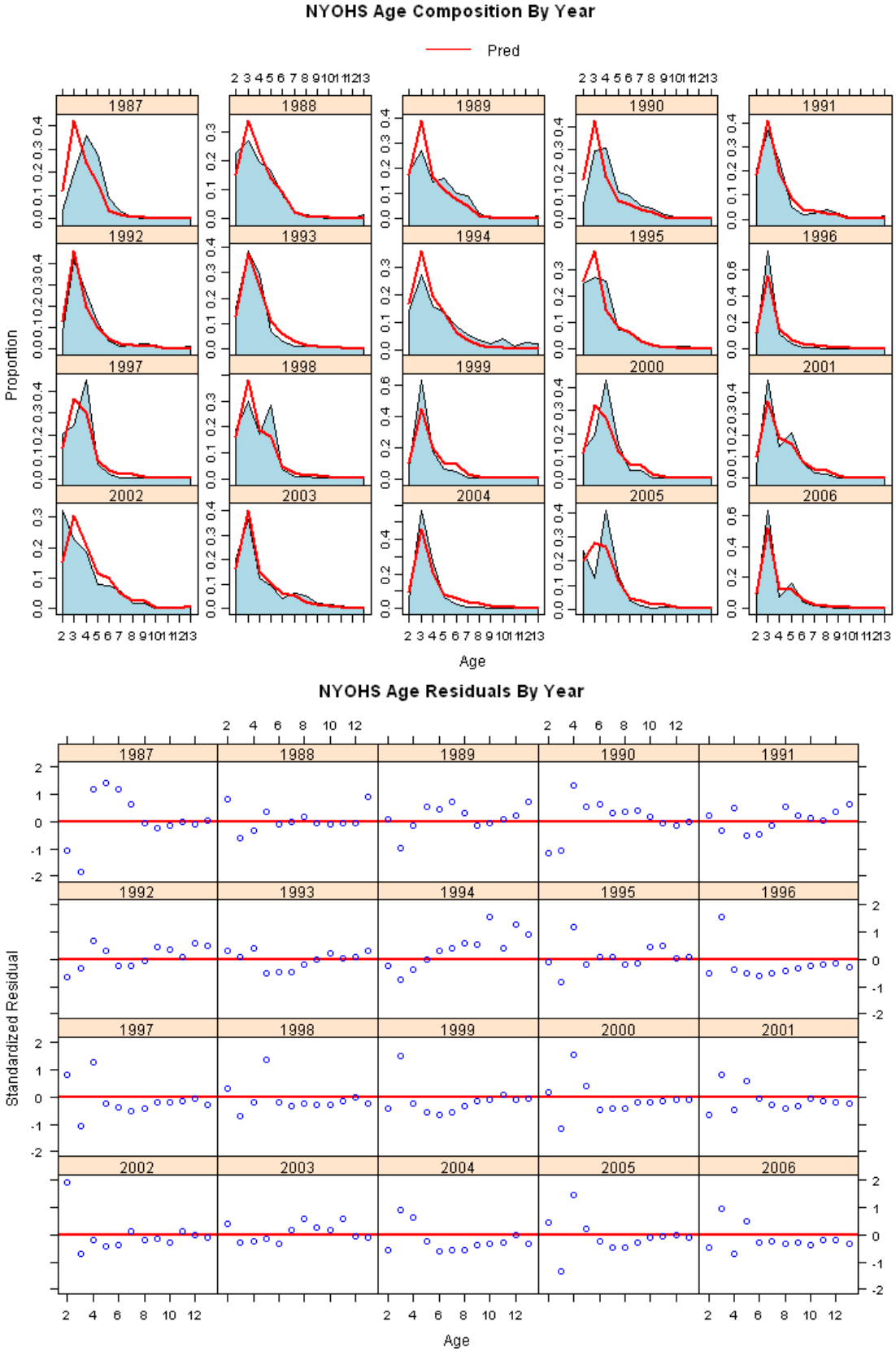


Figure 10. Observed and predicted proportions-at-age and standardized residual for each year by age for the NYOHS survey.

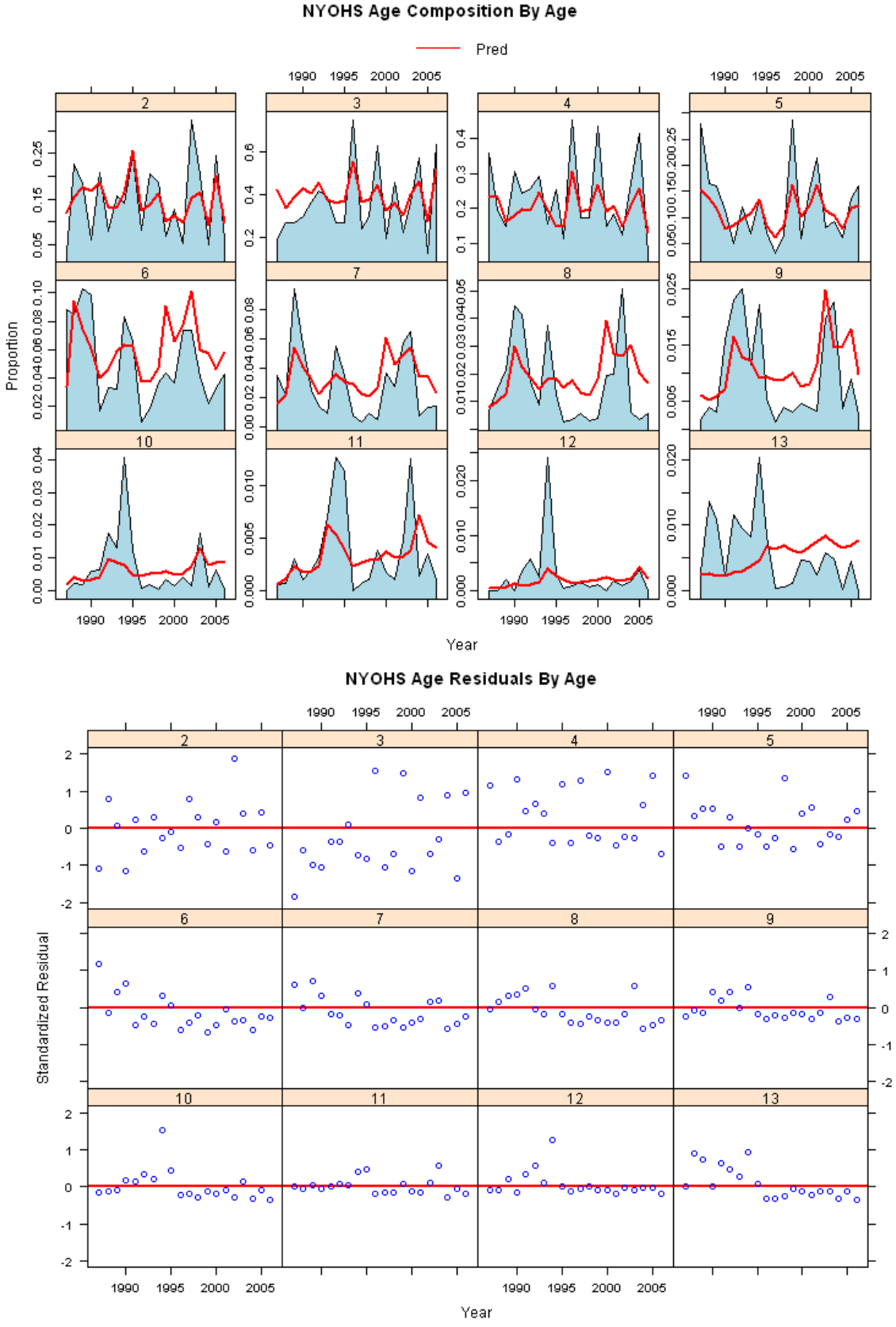


Figure 11. Observed and predicted proportions-at-age and standardized residuals for each age by year for the NJ Trawl survey.

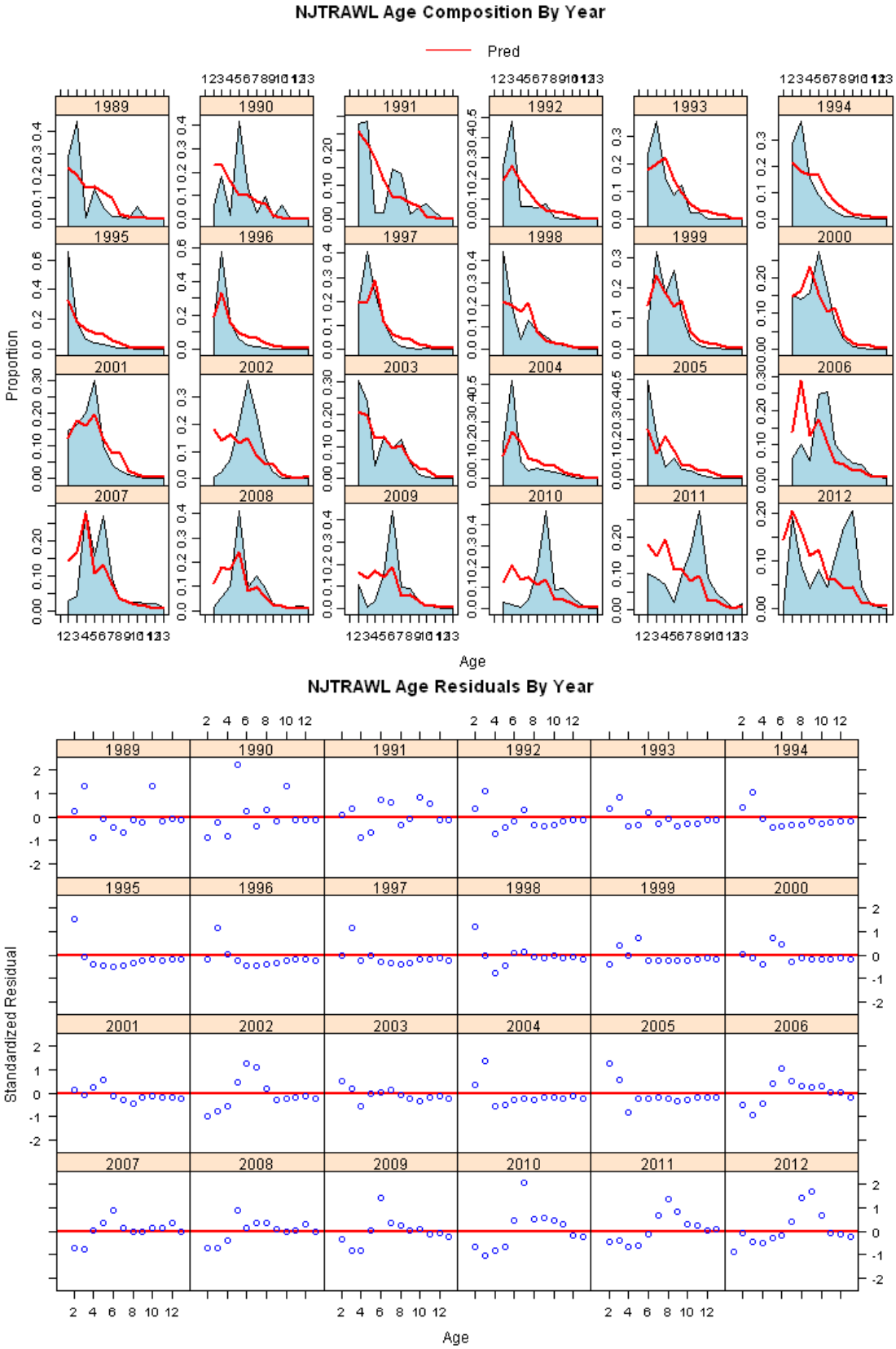
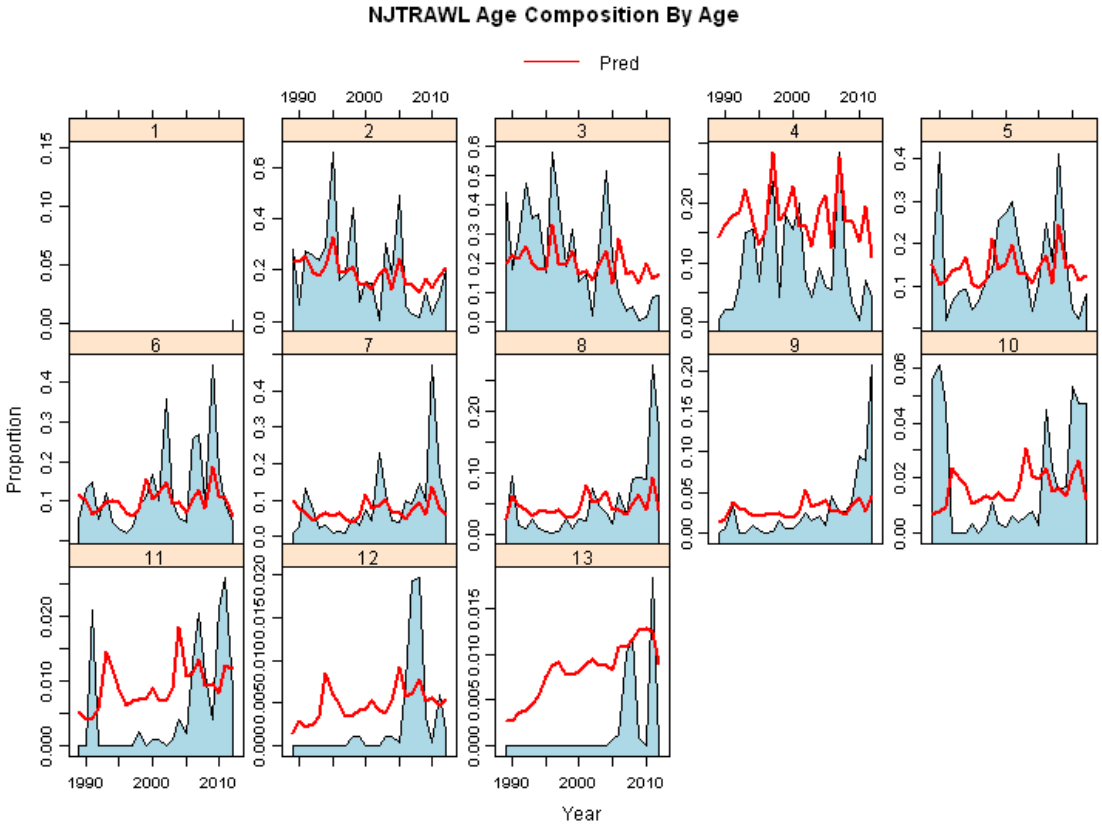


Figure 12. Observed and predicted proportions-at-age and residuals for each year by age for the NJ Trawl survey.



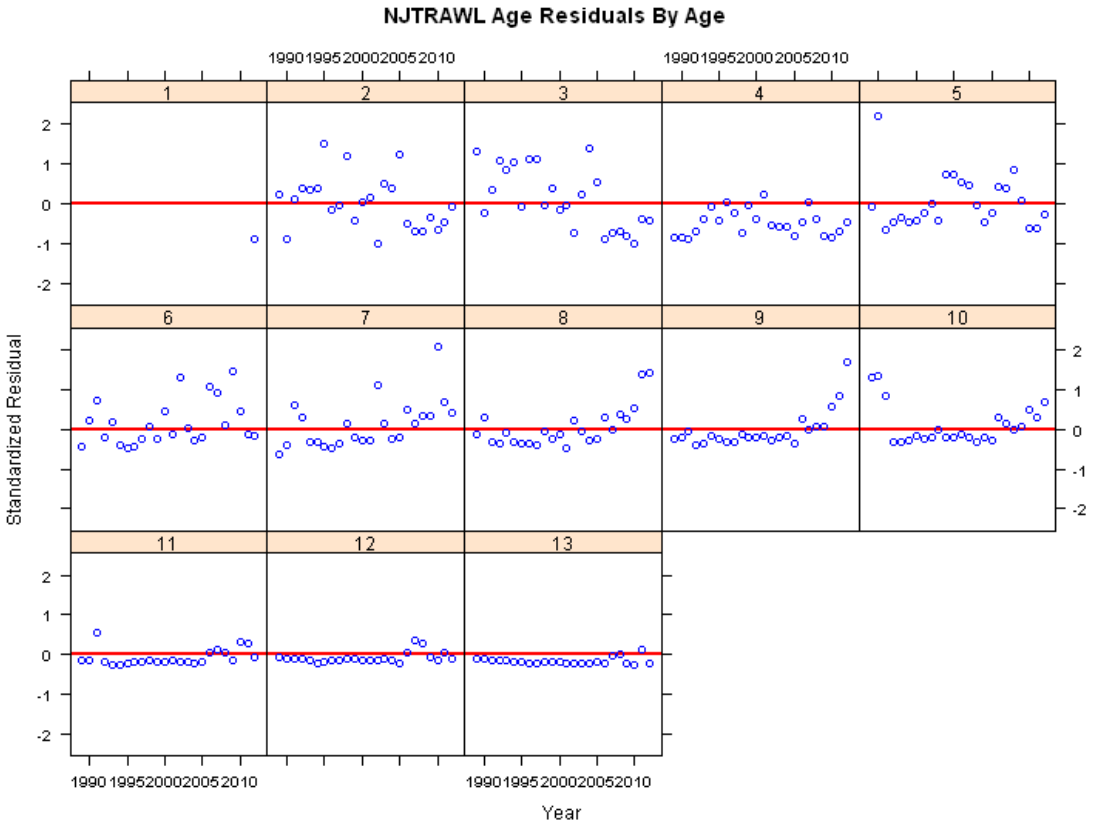
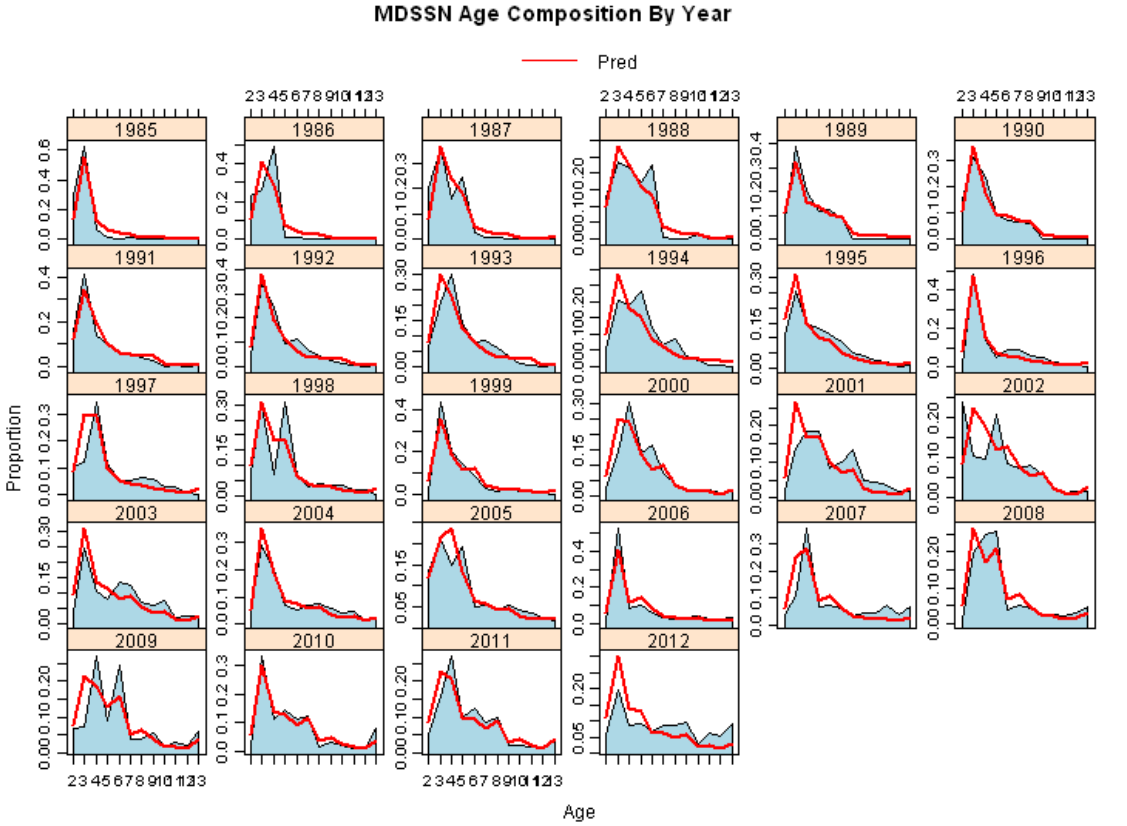


Figure 13. Observed and predicted proportions-at-age for each age by year for the MD SSN gillnet survey.



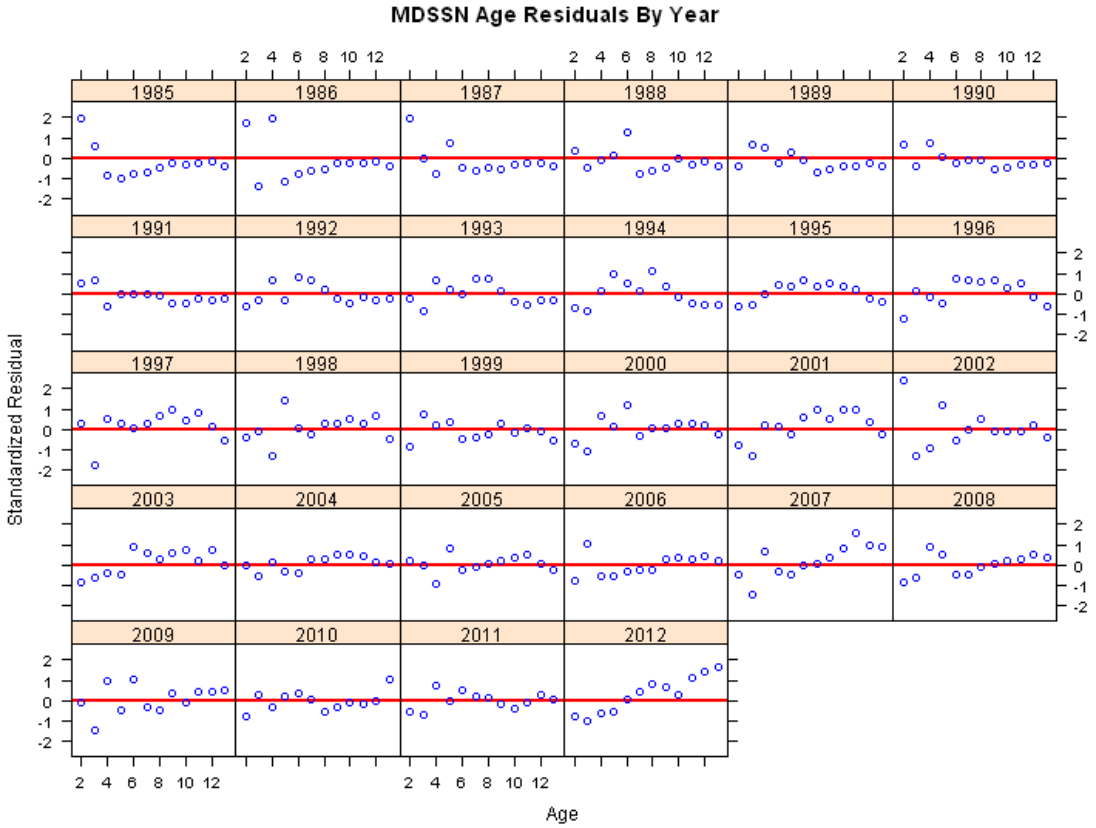


Figure 14. Observed and predicted proportions-at-age and standardized residuals for each year by age for the MD SSN gillnet survey.

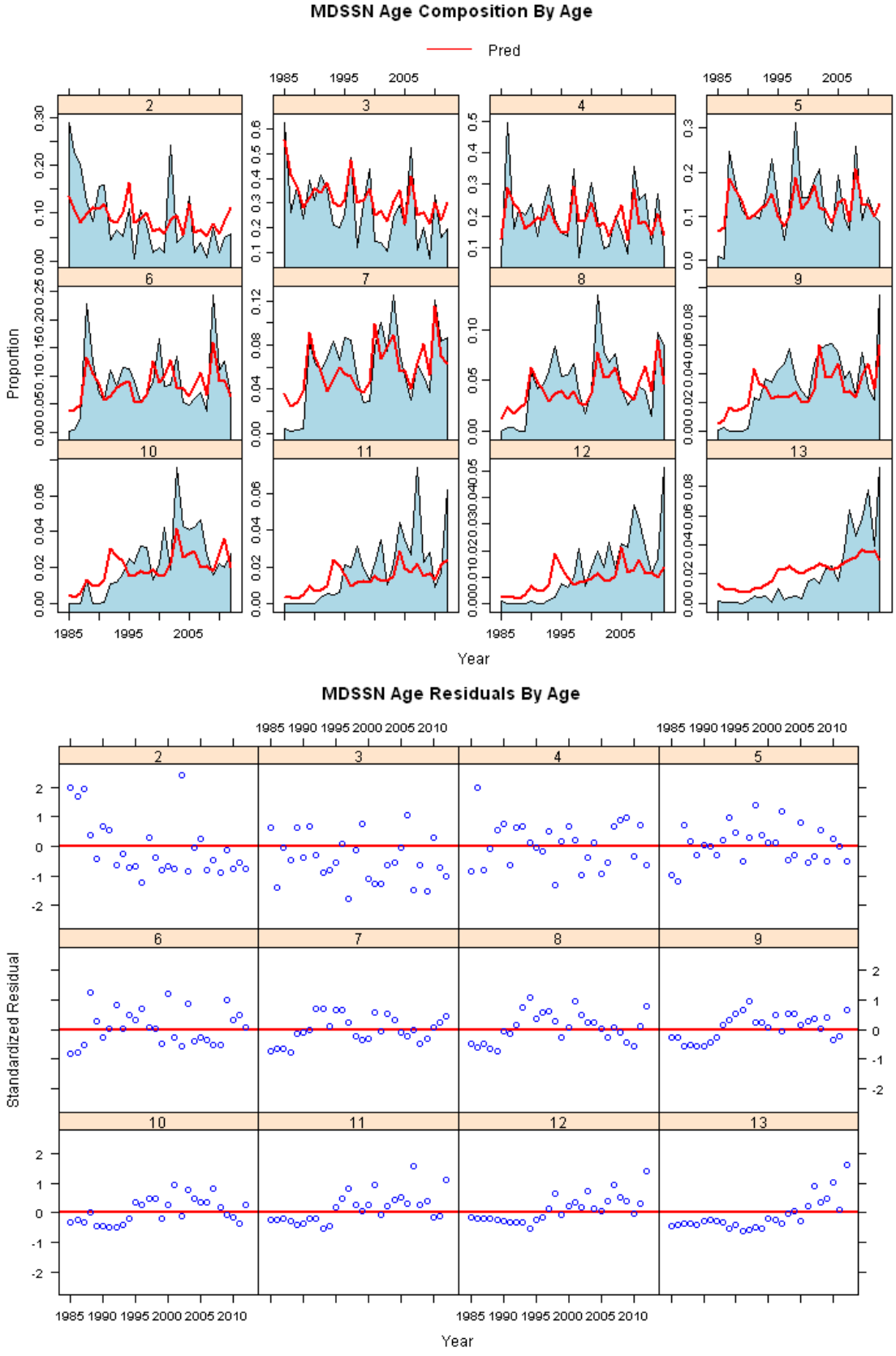


Figure 15. Observed and predicted proportions-at-age and standardized residuals for each age by year for the DE SSN electrofishing survey.

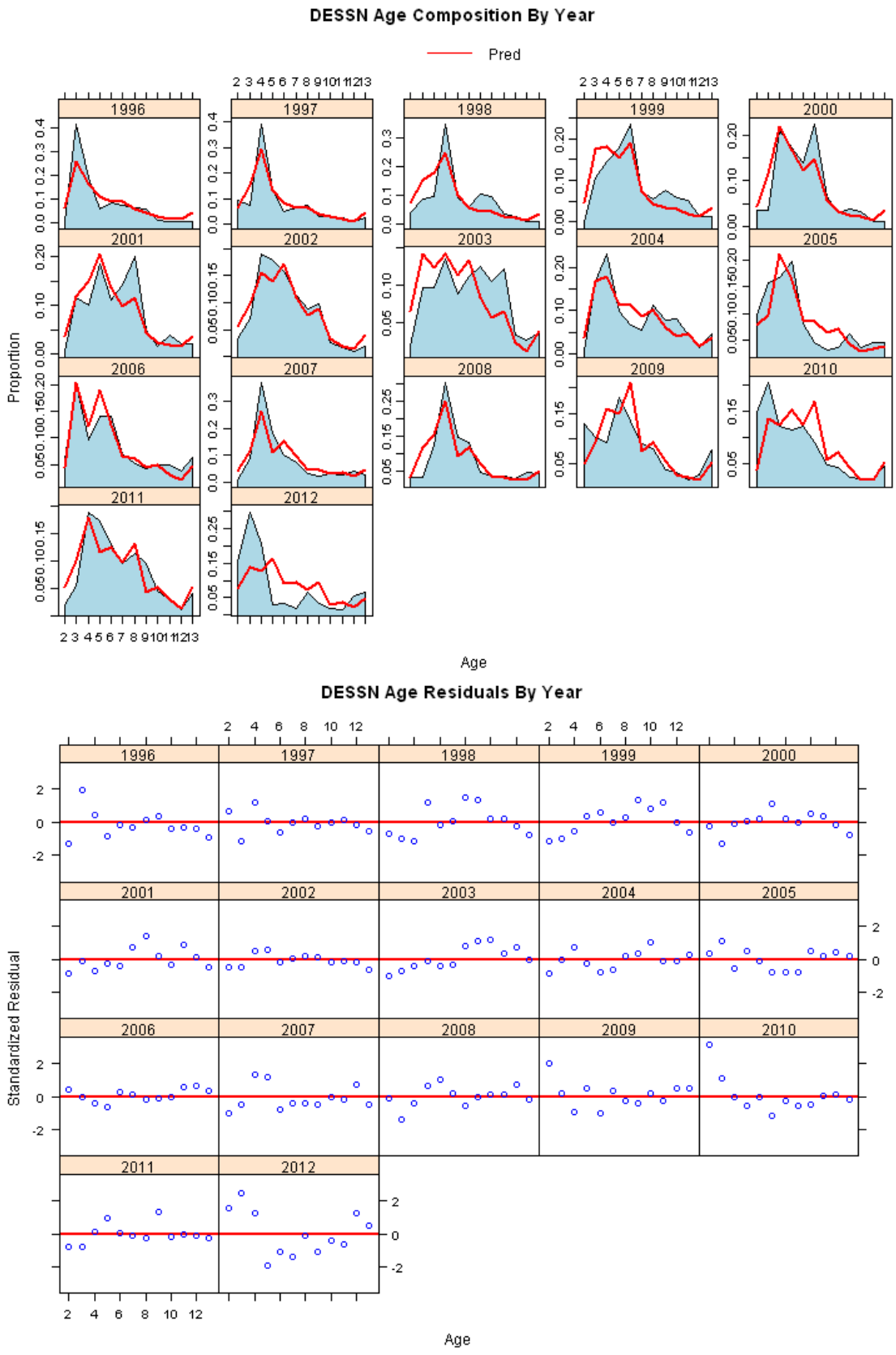


Figure 16. Observed and predicted proportions-at-age and standardized residuals for each year by age for the DE SSN electrofishing survey.

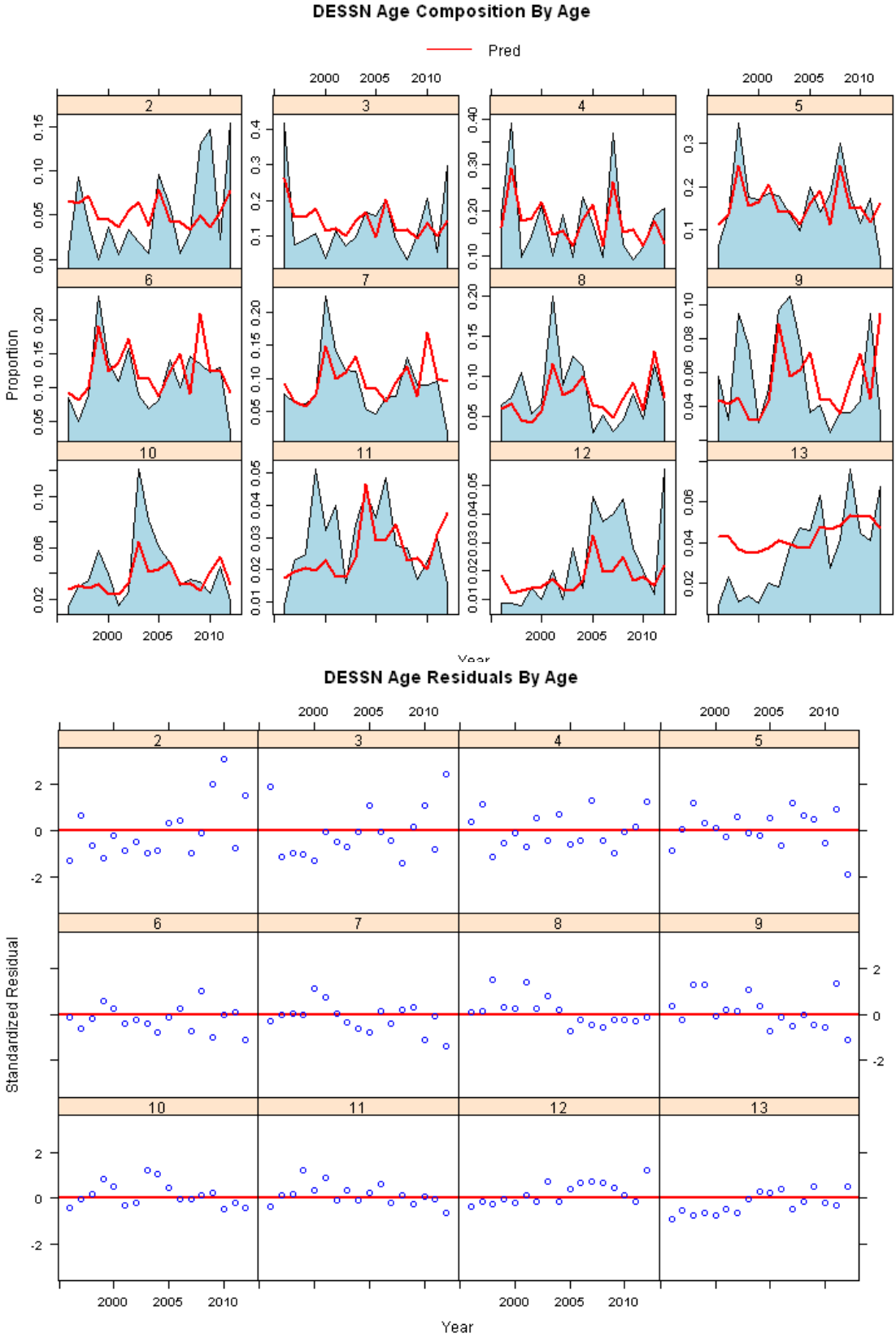


Figure 17. Observed and predicted proportions-at-age and standardized residuals for each age by year for the VAPNET survey.

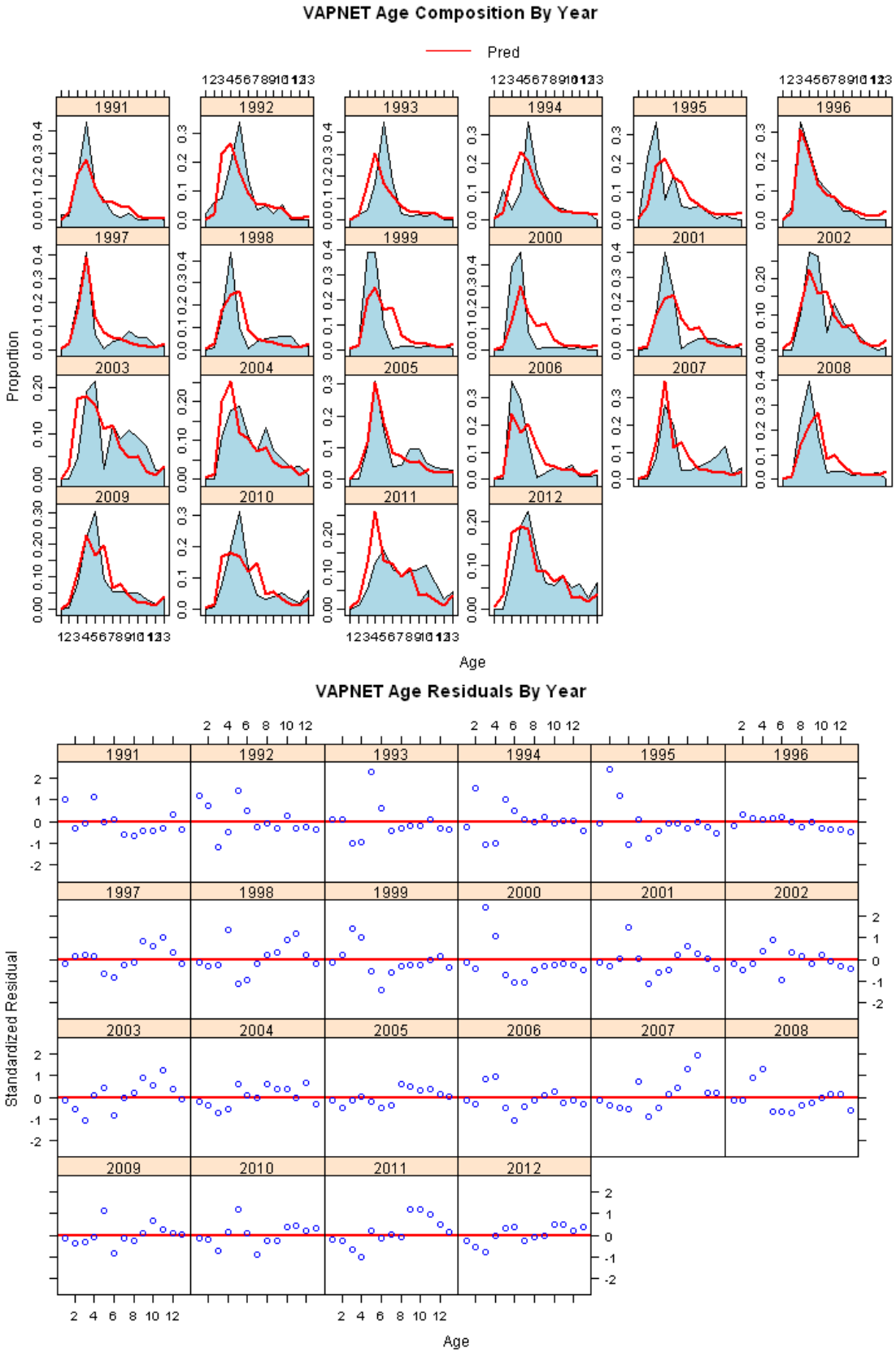


Figure 18. Observed and predicted proportions-at-age and standardized residuals for each year by age for the VAPNET survey.