SEDAR

Southeast Data, Assessment, and Review

SEDAR 28

Gulf of Mexico Cobia

SECTION III: Assessment Process Report

December 2012

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

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1. WORKSHOP PROCEEDINGS

1.1. Introduction

1.1.1 Workshop time and Place

1.1.2 Terms of Reference

1. Review and provide justifications for any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model.
2. Recommend a model configuration which is deemed most reliable for providing management advice using available compatible data. Document all input data, assumptions, and equations.
3. Incorporate known applicable environmental covariates into the selected model, and provide justification for why any of those covariates cannot be included at the time of the assessment.
4. Provide estimates of stock population parameters
   - Include fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, and other parameters as appropriate given data availability and modeling approaches
   - Include appropriate and representative measures of precision for parameter estimates.
5. Characterize uncertainty in the assessment and estimated values
   - Consider components such as input data, modeling approach, and model configuration.
   - Provide appropriate measures of model performance, reliability, and 'goodness of fit'.
6. Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations.
7. Provide estimates of stock status relative to management criteria consistent with applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards for each model run presented for review.
8. Project future stock conditions and develop rebuilding schedules if warranted; include estimated generation time. Develop stock projections in accordance with the following:

   A) If stock is overfished:

   F=0, F=current, F=Fmsy, Ftarget (OY),

   F=Frebuild (max that rebuild in allowed time)

   B) If stock is undergoing overfishing

   F=Fcurrent, F=Fmsy, F= Ftarget (OY)

   C) If stock is neither overfished nor overfishing

   F=Fcurrent, F=Fmsy, F=Ftarget (OY)

   D) If data limitations preclude classic projections (i.e. A, B, C above), explore alternate models to provide management advice
9. Provide a probability distribution function for the base model, or a combination of models that represent alternate states of nature, presented for review.
   - Determine the yield associated with a probability of exceeding OFL at P* values of 30% to 50% in single percentage increments for use with the Tier 1 ABC control rule

- Provide justification for the weightings used in producing combinations of models

10. Provide recommendations for future research and data collection. Be as specific as possible in describing sampling design and intensity, and emphasize items which will improve assessment capabilities and reliability. Recommend the interval and type for the next assessment.
11. Prepare a spreadsheet containing all model parameter estimates and all relevant population information resulting from model estimates and projection and simulation exercises. Include all data included in assessment report tables and all data that support assessment workshop figures.
12. Complete the Assessment Workshop Report (Section III: SEDAR Stock Assessment Report).

1.2. Panel recommendations and comments

1.2.1. Term of Reference 1

Review and provide justifications for any changes in data following the data workshop and any analyses suggested by the data workshop. Summarize data as used in each assessment model.

All changes to the data following the data workshop are reviewed in Section 2. The primary changes include 1) aggregating landings, discard, and length composition data into three fishing fleets; commercial, recreational and shrimping bycatch, 2) making the age composition data conditional on length, 3) removing a number of samples from the length composition data that were either mis-specified units or not representative of the fishery, and 4) adding the reef fish observer length composition data.

1.2.2. Term of Reference 2

Recommend a model configuration which is deemed most reliable for providing management advice using available compatible data. Document all input data, assumptions, and equations.

A fully integrated length based statistical-catch-at-age model configured using Stock Synthesis was used for the assessment. The model configuration and data inputs are described in Section 3.1.1. See Section 2 for a complete description of all data inputs. Appendices A-D include all input files necessary to run the Stock Synthesis model.

1.2.3. Term of Reference 3

Incorporate known applicable environmental covariates into the selected model, and provide justification for why any of those covariates cannot be included at the time of the assessment.

No applicable environmental covariates were recommended by the data or assessment workshop panels.

1.2.4. Term of Reference 4

Provide estimates of stock population parameters

- *Include fishing mortality, abundance, biomass, selectivity, stock-recruitment relationship, and other parameters as appropriate given data availability and modeling approaches*
- *Include appropriate and representative measures of precision for parameter estimates.*

Estimates of assessment model parameters and their associated standard errors are reported in Section 3.1.4 and Table 3.1. Estimates of assessment model parameters and standard deviations from the bootstrap analysis are presented in Table 3.2. Estimates of stock biomass, spawning stock biomass, recruitment, and fishing mortality are presented in Tables 3.4-3.6.

1.2.5. Term of Reference 5

Characterize uncertainty in the assessment and estimated values

- *Consider components such as input data, modeling approach, and model configuration.*
- *Provide appropriate measures of model performance, reliability, and 'goodness of fit'.*

Model performance and reliability are characterized in Section 3.2. Uncertainty in the assessment and estimated values was characterized using sensitivity analyses and a parametric bootstrap approach. Results of the sensitivity analyses are characterized in Section 3.2.7 and Tables 3.7-3.8. Uncertainty in the assessment parameters and estimated values is characterized in Section 3.2 and Table 3.1-3.2.

1.2.6. Term of Reference 6

Provide yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations.

Yield-per-recruit, spawner-per-recruit, and stock-recruitment evaluations are provided in Section 3.2.8.

1.2.7. Term of Reference 7

Provide estimates of stock status relative to management criteria consistent with applicable FMPs, proposed FMPs and Amendments, other ongoing or proposed management programs, and National Standards for each model run presented for review.

Stock status relative to a management criteria of $F_{SPR30\%}$ are presented in Tables 3.2.8.

1.2.8. Term of Reference 8

Project future stock conditions and develop rebuilding schedules if warranted; include estimated generation time.

Stock biomass and yield projections for 2013-2019 are presented in Section 3.2.9 and Table 3.9. Projections were run at three levels of fishing mortality: 1) $F_{SPR30\%}$ (F_{MSY} proxy), 2) F_{OY}, and $F_{CURRENT}$ (geometric mean of *F* 2009-2011) (Tables 3.10-3.12).

1.2.9. Term of Reference 9

Provide a probability distribution function for the base model, or a combination of models that represent alternate states of nature, presented for review.

Ten sensitivity runs were presented to characterize uncertainty in model specification. Of the ten runs presented, three were used for projections and represent alternate states of nature. These runs include uncertainty in the natural mortality rate. Probability distribution functions were developed for the subset of three runs and will be made available to the Scientific and Statistical Committee (SSC) for the development of management advice, including OFL and ABC.

1.2.10. Term of Reference 10

Provide recommendations for future research and data collection. Be as specific as possible in describing sampling design and intensity, and emphasize items which will improve assessment capabilities and reliability. Recommend the interval and type for the next assessment.

Recommendations for future research and data collection were made in the SEDAR 22 Data Workshop report. Additional recommendations are made in Section 3.3.

1.2.11. Term of Reference 11

Prepare a spreadsheet containing all model parameter estimates and all relevant population information resulting from model estimates and projection and simulation exercises. Include all data included in assessment report tables and all data that support assessment workshop figures.

All assessment model inputs are presented in Appendix A-D. All model parameter estimates and their associated standard errors are reported in Table 3.1.

2 DATA REVIEW AND UPDATE

Processing of data for this assessment is described in the SEDAR 28 Gulf of Mexico Cobia Data Workshop Report (SEDAR 2011). This section summarizes the data input for the Stock Synthesis (SS) base run and describes additional processing prior to and during the Assessment Workshop (AW). In particular, data for 2011, which were not available at the DW, were added. In some cases the addition of the final year of data changed estimates for earlier years.

2.1 Life history

Life history data used in the assessment included natural mortality, growth, maturity, and fecundity. Some of the life history data were input in the Stock Synthesis model as fixed values, while others were treated as estimable parameters. For the estimable parameters, the initial parameter values were taken from the data workshop.

A single von Bertalanffy equation was used in the assessment model to model growth of cobia for both sexes. The von Bertalanffy parameters L_{inf} and K were estimated within the SS model. The recommended values from the DW were used as initial starting guesses for L_{inf} and K. Stock synthesis does not use t_0 as an input parameter; rather SS uses a parameterization that includes the parameters L_{min}, and A_{min} to describe the growth of fish from age 0.0 to A_{min}.

The relationship between weight and length ($W=aFL^b$) for sexes combined was developed at the DW and used as a fixed model input. The length-weight coefficient, a, had to be adjusted due to differences in units used in the DW (mm) and assessment model (cm) (Table 2.1).

An age-specific maturity vector was developed at the DW and used as a fixed model input. The DW recognized that maturity was more strongly correlated with size than age but lack of samples of young fish precluded the determination of a size at 50% maturity. The assessment model used age-2 for age at 50% maturity and assumed that all age-3+ fish were fully mature. The relationship between female weight and batch fecundity was developed at the DW. Fecundity was assumed to be directly proportion to female weight in the SS model.

The DW recommended that a skewed sex ratio be incorporated into the assessment model. Two recommendations for the skewed sex ratio were proposed by the DW: 1) by age, use 60% females for all ages, and 2) by length, consider using 50% females up to 80 cm FL, derive a function to describe the increasing proportion of females between 80 and 120 cm, and use 100% females above 120 cm. Since there was little information to accomplish (2), the first recommendation, 60% females for all ages, was incorporated into the assessment model.

A scaled Lorenzen age-specific natural mortality vector was developed at the DW but was updated after the DW due to an error in the ages used for scaling the estimates. The cumulative survival of ages 3-11 based on a point estimate of natural mortality (M=0.38 y^{-1}) was used to scale the age-based estimates of natural mortality (Table 2.2).

2.2 Landings

2.2.1 Commercial landings

Commercial landings data (1927-2011) used in the assessment are presented in Table 2.3 and Figures 2.1-2.2. Final commercial landings were computed following the data workshop (DW), but a full description of the landings and how they were calculated is given in the SEDAR 22 Data Workshop Report. Commercial landings were originally stratified by gear and included handline, longline and miscellaneous (other) gears. For the assessment, commercial landings were aggregated across gears. Handline landings represented approximately 67% of total commercial landings since 1981. Commercial landings were reported in 1000s lbs whole weight and converted to metric tons for input into the assessment model.

2.2.2 Recreational landings

Recreational landings data (1950-2011) used in the assessment are presented in Table 2.4 and Figures 2.1-2.2. Final recreational landings were computed following the data workshop (DW), but a full description of the landings and how they were calculated is given in the SEDAR 22 Data Workshop Report. Recreational landings were originally reported by mode and included charterboat, headboat, private/rental boat, and shore modes. In addition, recreational landings from Texas were calculated separately from the rest of the Gulf of Mexico. For the assessment, recreational landings were aggregated across modes and regions. Private/rental boat landings represented approximately 75% of the total recreational landings by numbers since 1981. Recreational landings were reported in numbers of fish and input into the assessment model as 1000s of fish.

2.3 Discards

2.3.1 Commercial discards

Commercial discard data (1993-2011) used in the assessment are presented in Table 2.5. Final commercial discards were computed following the data workshop (DW), but a full description of the discards and how they were calculated is given in the SEDAR 22 Data Workshop Report. Commercial discards were reported as numbers of fish and converted to metric tons for the assessment. The weight of a commercially discarded fish was determined from length composition data from the reef fish observer program. The mean length of a discarded cobia from the reef fish observer program was estimated at 70 cm; the average weight of a 70 cm cobia is 3.76 kg (8.28 lbs).

The DW recommended a discard mortality rate of 5% for all hook and line fisheries and 51% for the gillnet fishery. Estimates of discard mortality came from data collected by observers as part of the commercial logbook programs for commercial vessels operating in the South Atlantic and Gulf of Mexico. However, of the 586 reported gill net trips that occurred in the Gulf of Mexico between 2002 and 2010 none reported cobia discards. Thus, a discard mortality rate of 5% was used for the commercial fishery.

2.3.2 Recreational discards

Recreational discard data used in the assessment is presented in Table 2.6. Final recreational discards were computed following the data workshop (DW), but a full description of the discards and how they were calculated is given in the SEDAR 22 Data Workshop Report. Recreational discards were reported as numbers of fish and input into the assessment as 1000s of fish. A discard mortality rate of 5%, as recommended by the DW, was used for the recreational fishery.

2.3.3 Shrimp discards

Final shrimp fishery discards were computed following the data workshop (DW), but a full description of the discards and how they were calculated is given in the SEDAR 22 Data Workshop Report (Table 2.7). Due to concerns about the accuracy and precision of the annual estimates of cobia bycatch from the shrimp fishery the AP agreed to not use annual point estimates of bycatch in the assessment model. The AP recommended that shrimp fishery effort be used as a proxy for cobia bycatch trends since shrimp fishery effort is known with more certainty (Table 2.8). The median estimate of shrimp bycatch over the time series, 1972-2011, was used to represent the magnitude of cobia removals from the shrimp fleet and input into Stock Synthesis using the super-year approach of Methot (2011). See section 3.1.3 for a complete description on how shrimp discards were estimated in the assessment model.

2.4 Length composition

2.4.1 Commercial length composition

Commercial length composition data were updated to include 2011 following the DW. Commercial length composition data used in the assessment are presented in Table 2.9. Annual length compositions were combined into 3-cm bins with a minimum size of 6 cm and maximum size of 165 cm (Figure 2.3). Following the DW a number of errors were identified in the commercial length composition data. Samples with mis-specified units were identified by plotting observed length-weight data and eliminating any samples with length-weight observations that fell outside the 95% confidence intervals for the length-weight relationship. Annual sample sizes for length composition data were set equal to the number of fish measured if less than 100 fish were measured. If more than 100 fish were measured, sample size was fixed at 100 to avoid over-weighting the length composition data.

Length composition data collected independently from the reef fish observer program were also included to characterize the composition of the commercial catch. Data were collected from 2006-2011 and included all fish captured (Table 2.10). This data set provided the only information available on the size of cobia that were captured and released for any of the fisheries (Figure 2.4).

2.4.2 Recreational length composition

Recreational length composition data were updated to include 2011 following the DW. Recreational length composition data used in the assessment are presented in Table 2.11. Annual length compositions were combined into 3-cm bins with a minimum size of 6 cm and maximum size of 165 cm (Figure 2.5). Following the DW a number of errors were identified in the recreational length composition data. Samples with mis-specified units were identified by plotting observed length-weight data and eliminating any samples with length-weight observations that fell outside the 95% confidence intervals for the length-weight relationship.

Annual sample sizes for length composition data were set equal to the number of fish measured if less than 100 fish were measured. If more than 100 fish were measured, sample size was fixed at 100 to avoid over-weighting the length composition data.

2.4.3 SEAMAP trawl survey length composition

SEAMAP trawl survey length composition data used in the assessment are presented in Table 2.12. Due to small annual sample sizes, the length composition data from the SEAMAP trawl survey was aggregated over years into a single length distribution and assumed to be representative of the shrimp fishery (Figure 2.6). This was handled in SS using the super-year approach (Methot 2011).

2.5 Age composition

2.5.1 Commercial age composition

Commercial age composition data was not used in the assessment. Small samples precluded the use of the commercial age composition data. Between 1987 and 2011 only 64 age samples were collected. The maximum number of samples collected in any single year was 19 (1989) and no age samples have been collected since 1999 (Figure 2.7).

2.5.2 Recreational age composition

Recreational age composition data used in the assessment is presented in Figure 2.8 and Appendix A. The age compositions were made conditional on length. In other words, a separate age composition was specified for each 3 cm length bin containing fish whose ages had been estimated (Figures 2.8a-2.8c). Using these conditional age compositions has the advantage of linking age data directly to length data (essentially creating an age-length key). As a result, the data contain more detailed information about the relationship between size and age and so provides a stronger ability to estimate growth parameters, especially the variance of size-at-age.

In SS, all cohorts of fish graduate to the age of 1 when they first reach January 1, regardless of when they are born. This means that SS operates under the assumption that all age data have been adjusted so that fish graduate to the next age on January 1.

Cobia spawning occurs between the months of April and September in the Gulf of Mexico. The DW used a birthday of May 1 for converting calendar ages to fractional ages. Determination of calendar age from increment counts of sagittal otoliths was based on the timing of annulus formation and an estimate of the amount of translucent edge present. For any fish caught July-December, calendar age = increment count regardless of edge code. For any fish caught January-June with an edge code of 3 or 4, calendar age = annulus count + 1. No fish with an edge code of 1 or 2 were caught during January-March, but for those caught April-June, calendar age = annulus count (i.e., ages were not advanced). In the original Mote data set, only raw annulus counts were available (i.e., there were no marginal increment codes and they did not calculate calendar age). Based on examination of monthly distribution of annulus edge types in the GCRL study, the decision was made to estimate calendar age of Mote fish using the following protocol: advance the ages of all Mote fish collected Jan-Apr by one year, i.e., final or calendar age = ring count + 1. For fish collected during May-December, ages were not advanced, i.e., the final or calendar age = ring count. The protocol followed by the DW conformed to the required age input into SS; see Tables 2.13-2.16 for the increment count, calendar age, fractional age, and model age of fish within each age cohort in the model.

2.5.3 SEAMAP trawl survey age composition

SEAMAP age composition data was not used in the assessment.

2.6 Indices

Five indices of abundance were presented to the DW Index working group. Three of the five indices were rejected due to inadequacies. The DW Index working group rejected the fishery dependent commercial logbook index due to concerns that the index did not provide a true reflection of population abundance. The Texas Park and Wildlife Department fishery dependent index of abundance was rejected due to concerns over the lack of spatial coverage of the index. The fishery-independent SEAMAP Groundfish survey was rejected due to low frequency of occurrence of cobia in the samples.

The DW recommended the use of two indices for the assessment: the Marine Recreational Fishery Statistics Survey (MRFSS) and the Headboat Survey (see SEDAR 28 Data Workshop Report). Both indices are fishery-dependent and both provide indices of abundance for the recreational fishery for cobia in the Gulf of Mexico. The MRFSS survey tracks total catches of cobia (landed plus discards), whereas the Headboat survey tracks only landed fish (Figures 2.9 and 2.10).

Both indices and their associated CVs were updated following the DW, but a full description of the indices and how they were calculated is given in the SEDAR 22 Data Workshop Report. The standardized indices of relative abundance and associated CVs used in the assessment are presented in Table 2.17. The coefficients of variation (CV) associated with the standardized indices were converted to log-scale standard errors by:

$$\log(SE) = \sqrt{\log_e\left(1 + CV^2\right)},$$

for input into the Stock Synthesis assessment model.

2.7 Tables

Table 2.1. Length-weight function used to convert fork length of Gulf stock cobia to weight in kilograms.

Sex	Model	FL units	n	a	b
Combined	Wt=a*FL^b	mm	6463	9.00E-09	3.03
Combined	Wt=a*FL^b	cm	6463	9.64E-06	3.03

Table 2.2. Age-specific natural mortality of Gulf of Mexico cobia based on the Lorenzen (1996) method for all data combined.

Age	Scaled Lorenzen base (y^{-1})
0	0.942
1	0.599
2	0.485
3	0.432
4	0.404
5	0.387
6	0.376
7	0.370
8	0.366
9	0.363
10	0.361
11	0.360

Table 2.3. Gulf of Mexico cobia commercial landings in pounds whole weight and metric tons.

Year	Handline	Longline	Other	Total (lbs)	Total (mt)
1927	5,511	0	3,939	9,450	4.29
1928	13,312	0	9,515	22,827	10.35
1929	8,588	0	6,139	14,727	6.68
1930	8,365	0	5,979	14,344	6.51
1931	6,093	0	4,355	10,448	4.74
1932	3,385	0	2,420	5,805	2.63
1933	0	0	0	0	0.00
1934	4,315	0	3,085	7,400	3.36
1935	0	0	0	0	0.00
1936	3,441	0	2,459	5,900	2.68
1937	1,166	0	834	2,000	0.91
1938	4,315	0	3,085	7,400	3.36
1939	3,732	0	2,668	6,400	2.90
1940	816	0	584	1,400	0.64
1941	0	0	0	0	0.00
1942	0	0	0	0	0.00
1943	0	0	0	0	0.00
1944	0	0	0	0	0.00
1945	175	0	125	300	0.14
1946	0	0	0	0	0.00
1947	0	0	0	0	0.00
1948	2,508	0	1,792	4,300	1.95
1949	15,978	0	11,422	27,400	12.43
1950	25,717	0	18,383	44,100	20.00
1951	29,041	0	20,759	49,800	22.59
1952	21,926	0	15,674	37,600	17.06
1953	16,853	0	12,047	28,900	13.11
1954	15,337	0	10,963	26,300	11.93
1955	17,844	0	12,756	30,600	13.88
1956	8,747	0	6,253	15,000	6.80
1957	15,045	0	10,755	25,800	11.70
1958	14,229	0	10,171	24,400	11.07
1959	24,084	0	17,216	41,300	18.73
1960	33,123	0	23,677	56,800	25.76
1961	20,352	0	14,548	34,900	15.83
1962	33,700	0	5,800	39,500	17.92
1963	42,000	0	2,800	44,800	20.32
1964	27,400	0	600	28,000	12.70
1965	22,700	0	2,800	25,500	11.57
1966	31,400	0	11,200	42,600	19.32
1967	24,300	0	23,800	48,100	21.82
1968	51,000	0	38,300	89,300	40.51
1969	42,900	0	32,600	75,500	34.25

Table 2.3. Gulf of Mexico cobia commercial landings in pounds whole weight and metric tons (continued).

Year	Handline	Longline	Other	Total (lbs)	Total (mt)
1970	59,900	0	59,700	119,600	54.25
1972	51,200	0	36,300	87,500	39.69
1973	35,400	0	52,200	87,600	39.73
1974	45,600	0	55,300	100,900	45.77
1975	47,800	0	49,900	97,700	44.32
1976	69,100	127	47,900	117,127	53.13
1977	64,500	0	47,810	112,310	50.94
1978	62,356	0	51,106	113,462	51.47
1979	58,144	0	42,842	100,986	45.81
1980	71,258	0	47,845	119,103	54.02
1981	86,138	0	56,922	143,060	64.89
1982	79,806	0	47,328	127,134	57.67
1983	98,561	0	51,986	150,547	68.29
1984	124,268	0	33,979	158,247	71.78
1985	135,223	0	37,615	172,838	78.40
1986	159,649	4,238	30,013	193,900	87.95
1987	174,586	8,646	49,772	233,004	105.69
1988	163,172	13,395	56,628	233,195	105.78
1989	225,910	11,793	66,115	303,818	137.81
1990	169,632	6,619	64,171	240,422	109.05
1991	161,148	19,210	93,502	273,860	124.22
1992	191,904	22,664	132,256	346,824	157.32
1993	184,195	24,864	144,023	353,082	160.16
1994	174,849	19,345	157,620	351,814	159.58
1995	183,322	13,722	133,997	331,041	150.16
1996	222,452	27,020	116,387	365,859	165.95
1997	174,026	20,195	107,602	301,823	136.90
1998	177,084	16,957	94,333	288,374	130.80
1999	155,769	24,159	104,689	284,617	129.10
2000	142,489	26,150	43,370	212,009	96.17
2001	117,670	19,320	40,876	177,866	80.68
2002	130,631	24,148	28,752	183,531	83.25
2003	141,183	29,757	23,892	194,832	88.37
2004	124,077	27,601	27,612	179,290	81.32
2005	91,243	19,531	26,077	136,851	62.07
2006	90,134	24,910	36,001	151,045	68.51
2007	108,604	15,073	23,511	147,188	66.76
2008	99,241	19,084	21,089	139,414	63.24
2009	102,707	9,462	25,135	137,304	62.28
2010	173,107	5,920	15,906	194,933	88.42
2011	205,240	10,241	23,319	238,799	108.32

Table 2.4. Gulf of Mexico cobia recreational landings (numbers).

Year	CH	CH/HB	Private	Shore	Headboat	TPWD	Total (N)
1950	-	-	-	-	-	-	1,000
1951	-	-	-	-	-	-	5,000
1952	-	-	-	-	-	-	10,000
1953	-	-	-	-	-	-	20,000
1954	-	-	-	-	-	-	30,000
1955	-	-	-	-	-	-	36,996
1956	-	-	-	-	-	-	41,040
1957	-	-	-	-	-	-	45,084
1958	-	-	-	-	-	-	49,128
1959	-	-	-	-	-	-	53,172
1960	-	-	-	-	-	-	57,217
1961	-	-	-	-	-	-	58,244
1962	-	-	-	-	-	-	59,271
1963	-	-	-	-	-	-	60,299
1964	-	-	-	-	-	-	61,326
1965	-	-	-	-	-	-	62,354
1966	-	-	-	-	-	-	64,819
1967	-	-	-	-	-	-	67,284
1968	-	-	-	-	-	-	69,749
1969	-	-	-	-	-	-	72,215
1970	-	-	-	-	-	-	74,680
1971	-	-	-	-	-	-	81,468
1972	-	-	-	-	-	-	88,257
1973	-	-	-	-	-	-	95,045
1974	-	-	-	-	-	-	101,833
1975	-	-	-	-	-	-	108,622
1976	-	-	-	-	-	-	108,813
1977	-	-	-	-	-	-	109,003
1978	-	-	-	-	-	-	109,194
1979	-	-	-	-	-	-	109,385
1980	-	-	-	-	-	-	109,576
1981	0	18,049	69,670	1,723	1,373	850	91,665
1982	0	15,299	123,718	11,502	2,174	850	153,543
1983	310	19,773	75,493	3,397	1,644	1,273	101,890
1984	839	14,511	55,385	6,740	1,782	533	79,790
1985	629	11,381	46,865	11,420	1,669	786	72,750
1986	7,925	0	69,609	0	2,162	326	80,022
1987	10,543	0	57,313	2,101	2,337	821	73,115
1988	13,942	0	68,545	2,503	2,402	521	87,913
1989	7,337	0	64,027	3,181	2,454	312	77,311

Table 2.4. Gulf of Mexico cobia recreational landings (numbers) (continued).

Year	CH	CH/HB	Private	Shore	Headboat	TPWD	Total (N)
1990	8,272	0	46,764	0	2,658	440	58,134
1992	9,505	0	62,656	13,859	3,485	2,735	92,240
1993	23,632	0	46,757	6,316	4,385	514	81,604
1994	16,089	0	54,875	6,618	4,089	1,166	82,837
1995	11,949	0	40,194	4,665	4,018	817	61,643
1996	27,739	0	46,414	14,964	3,243	3,182	95,542
1997	20,934	0	91,550	7,345	3,322	2,479	125,630
1998	8,710	0	48,914	1,926	1,852	2,230	63,632
1999	7,819	0	56,590	4,097	2,346	1,740	72,592
2000	6,505	0	49,153	7,213	1,581	1,091	65,543
2001	12,470	0	46,935	5,690	1,847	1,365	68,307
2002	8,937	0	37,225	5,910	1,881	1,000	54,953
2003	12,439	0	67,106	2,435	1,799	1,318	85,097
2004	15,218	0	51,775	538	747	1,428	69,706
2005	12,456	0	43,317	0	1,735	1,081	58,589
2006	10,287	0	48,883	2,874	1,001	1,665	64,710
2007	11,216	0	58,441	0	2,013	1,404	73,074
2008	12,357	0	37,419	4,723	1,517	2,181	58,197
2009	7,455	0	34,184	0	1,641	1,984	45,264
2010	4,946	0	46,228	3,329	1,691	1,020	57,214
2011	10,285	0	47,816	4,429	1,455	850	64,835

Table 2.5. Gulf of Mexico cobia commercial discards (mt).

Year	Gillnet	Vertical Line	Trolling	Total (N)	Avg. Weight (lbs)	Total (mt)
1993	0	9,131	42	9,173	8.28	34.45
1994	0	10,877	43	10,919	8.28	41.01
1995	0	10,246	48	10,293	8.28	38.66
1996	0	11,080	71	11,151	8.28	41.88
1997	0	12,350	64	12,415	8.28	46.63
1998	0	11,854	273	12,127	8.28	45.55
1999	0	13,569	276	13,845	8.28	52.00
2000	0	12,743	265	13,008	8.28	48.85
2001	0	11,847	236	12,083	8.28	45.38
2002	0	12,522	198	12,720	8.28	47.77
2003	0	13,385	189	13,574	8.28	50.98
2004	0	11,715	142	11,858	8.28	44.54
2005	0	11,421	111	11,532	8.28	43.31
2006	0	11,327	143	11,471	8.28	43.08
2007	0	10,728	158	10,886	8.28	40.89
2008	0	9,482	159	9,641	8.28	36.21
2009	0	11,769	163	11,932	8.28	44.81
2010	0	9,557	141	9,698	8.28	36.42
2011	0	11241	123	11,364	8.28	42.68

Table 2.6. Gulf of Mexico cobia recreational discards (numbers).

Year	MRFSS	Headboat	TPWD	Total (N)
1981	11,229	439	58	11,726
1982	18,419	439	58	18,916
1983	354	439	27	820
1984	42,684	577	47	43,308
1985	1,125	439	101	1,665
1986	42,493	189	168	42,850
1987	24,201	196	148	24,545
1988	72,822	494	163	73,479
1989	72,558	169	106	72,833
1990	90,705	1,357	282	92,344
1991	241,006	1,315	421	242,742
1992	118,092	1,114	1,160	120,366
1993	87,514	621	287	88,422
1994	119,505	1,071	690	121,266
1995	87,115	1,398	548	89,061
1996	111,194	1,410	1,584	114,188
1997	130,966	2,662	943	134,571
1998	112,206	1,822	1,236	115,264
1999	112,775	575	917	114,267
2000	124,162	535	1,138	125,835
2001	143,835	432	859	145,126
2002	138,199	432	787	139,418
2003	86,974	288	1,132	88,394
2004	92,635	91	1,485	94,211
2005	57,092	609	980	58,681
2006	73,511	467	1,847	75,825
2007	80,298	493	1,011	81,802
2008	130,946	1,022	1,569	133,537
2009	83,347	1,373	1,544	86,264
2010	68,785	968	847	70,600
2011	92,800	817	0	93,617

Table 2.7. Annual shrimp bycatch estimates for Gulf of Mexico cobia.

Year	Estimated Shrimp Bycatch (N)
1972	225,600
1973	41,650
1974	282,100
1975	128,900
1976	105,800
1977	442,00
1978	42,450
1979	445,300
1980	285,200
1981	56,630
1982	165,400
1983	203,000
1984	143,100
1985	161,800
1986	149,600
1987	221,200
1988	100,800
1989	195,500
1990	173,500
1991	189,100
1992	586,100
1993	166,900
1994	164,700
1995	119,800
1996	411,800
1997	494,900
1998	376,000
1999	491,100
2000	151,100
2001	455,600
2002	209,400
2003	98,590
2004	44,570
2005	87,340
2006	176,800
2007	47,030
2008	13,340
2009	18,980
2010	5,759
2011	41,260

Table 2.8. Annual standardized estimates of Gulf of Mexico cobia shrimp fishery effort.

Year	Standardized Shrimp Effort
1945	0.000
1946	0.004
1947	0.023
1948	0.060
1949	0.097
1950	0.173
1951	0.220
1952	0.260
1953	0.268
1954	0.349
1955	0.345
1956	0.443
1957	0.518
1958	0.670
1959	0.721
1960	0.720
1961	0.445
1962	0.767
1963	0.868
1964	1.023
1965	0.662
1966	0.559
1967	0.671
1968	0.786
1969	0.861
1970	0.605
1971	0.685
1972	0.958
1973	0.975
1974	1.006
1975	0.772
1976	1.073
1977	1.333
1978	1.855
1979	1.953
1980	1.436
1981	1.483
1982	1.418

Table 2.8. Annual standardized estimates of Gulf of Mexico cobia shrimp fishery effort (continued).

Year	Standardized Shrimp Effort
1983	1.536
1985	1.696
1986	1.786
1987	2.076
1988	1.568
1989	1.874
1990	1.825
1991	1.745
1992	1.515
1993	1.418
1994	1.553
1995	1.333
1996	1.430
1997	1.461
1998	1.587
1999	1.653
2000	1.478
2001	1.435
2002	1.272
2003	1.036
2004	0.799
2005	0.480
2006	0.638
2007	0.625
2008	0.540
2009	0.629
2010	0.446
2011	0.417

Table 2.9. Gulf of Mexico cobia commercial length composition data by 3cm length bins.

Year	Samples	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102	105	108	111
1983	7	0	0	0	1	0	2	1	0	0	0	1	0	1	0	0	0	0	0
1984	42	0	0	1	3	3	1	2	4	4	2	3	2	4	4	1	2	2	0
1985	36	0	0	0	2	0	0	2	0	1	0	1	1	1	2	5	4	3	0
1986	32	0	0	1	0	2	3	2	1	0	5	4	2	1	3	4	1	0	0
1987	9	0	0	0	0	0	1	1	1	0	0	2	0	0	1	0	1	1	0
1988	7	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2	0	0
1989	3	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
1990	47	0	0	0	0	0	0	2	4	9	3	7	9	4	4	2	0	0	0
1991	96	0	0	0	0	0	1	2	6	12	16	9	8	8	5	4	7	9	3
1992	99	0	0	0	0	1	1	2	2	11	6	15	14	7	8	7	4	4	8
1993	83	0	0	0	0	0	0	2	6	6	10	13	17	9	6	1	3	0	3
1994	100	0	0	0	0	0	0	0	3	11	8	10	11	7	11	7	8	9	7
1995	60	0	0	0	0	0	0	0	3	7	3	4	5	5	5	5	4	5	4
1996	47	0	0	0	0	0	0	0	3	5	3	1	7	3	2	4	2	2	3
1997	40	0	0	0	0	0	0	0	1	5	2	2	4	3	2	3	3	1	4
1998	29	0	0	0	0	0	0	0	1	0	0	1	1	2	3	0	1	2	2
1999	30	0	0	0	0	0	0	0	1	0	1	0	1	2	3	0	6	2	2
2000	37	0	0	0	1	0	0	0	2	1	1	2	2	3	3	5	4	2	3
2001	65	0	0	0	0	0	1	1	3	2	0	0	6	3	4	2	7	4	9
2002	33	0	0	0	0	0	1	1	2	0	3	2	3	3	4	1	1	0	2
2003	50	0	0	0	0	0	0	0	1	0	1	2	4	4	4	4	5	9	5
2004	129	0	0	0	0	0	0	2	4	5	8	5	9	6	12	13	11	11	6
2005	86	0	0	0	0	0	1	3	3	6	6	6	1	6	9	8	10	5	8
2006	49	0	0	0	0	0	0	0	0	1	4	7	6	8	7	2	1	3	3
2007	66	0	0	0	0	0	1	1	5	4	10	7	10	5	9	4	1	1	2
2008	38	0	0	0	0	0	0	1	0	1	6	3	2	3	3	2	2	2	3
2009	48	0	0	0	0	0	0	2	4	4	7	7	4	1	3	6	2	1	2
2010	73	0	0	0	0	0	2	1	7	5	7	7	7	6	5	8	2	2	2
2011	80	0	0	0	0	0	0	2	4	20	6	9	12	7	4	6	5	1	1

Table 2.9. Gulf of Mexico cobia commercial length composition data by 3cm length bins (continued).

Year	Samples	114	117	120	123	126	129	132	135	138	141	144	147	150	153	156	159	162	165
1983	7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1984	42	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	36	1	0	4	0	0	2	3	0	0	1	1	0	1	1	0	0	0	0
1986	32	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	7	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	47	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1991	96	0	2	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1992	99	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	83	1	1	2	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0
1994	100	2	1	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
1995	60	2	0	2	3	0	2	0	0	1	0	0	0	0	0	0	0	0	0
1996	47	5	0	0	3	0	0	2	2	0	0	0	0	0	0	0	0	0	0
1997	40	2	2	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1998	29	2	2	1	4	2	2	2	0	1	0	0	0	0	0	0	0	0	0
1999	30	2	1	2	1	1	3	1	0	1	0	0	0	0	0	0	0	0	0
2000	37	1	0	1	0	0	0	2	1	1	0	1	1	0	0	0	0	0	0
2001	65	4	2	4	4	2	6	1	0	0	0	0	0	0	0	0	0	0	0
2002	33	1	4	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0
2003	50	2	3	3	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0
2004	129	8	8	3	8	4	3	1	0	1	1	0	0	0	0	0	0	0	0
2005	86	1	2	5	1	0	1	0	2	1	0	0	1	0	0	0	0	0	0
2006	49	1	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2007	66	3	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2008	38	2	3	1	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0
2009	48	2	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
2010	73	3	3	3	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
2011	80	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.10. Gulf of Mexico cobia length composition data from the reef fish observer program by 3cm length bins.

Year	Samples	42	45	48	51	54	57	60	63	66	69	72	75	78	81	84	87	90	93	96	99	102
2006	5	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	2	0	0
2007	9	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	1	0	4	0
2008	15	0	2	0	0	0	1	1	0	0	1	0	0	1	1	1	1	3	0	1	1	0
2009	25	0	0	0	0	0	0	0	0	2	3	0	2	1	0	3	2	2	3	0	2	1
2010	24	0	0	0	0	0	0	0	1	1	1	0	0	2	1	2	2	2	1	2	2	2
2011	14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	1	1	1	1

Year	Samples	105	108	111	114	117	120	123	126	129	132	135	138	141	144	147	150	153	156	159	162	165
2006	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	25	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2010	24	2	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2011	14	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0

Table 2.11. Gulf of Mexico cobia recreational length composition data by 3cm length bins.

Year	Samples	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75	78	81	84	87	90	93	96
1979	16	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	2	1	0	1	1	0	2	0
1980	11	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	3	2	1	1	0	0	0
1981	36	0	0	0	0	0	0	0	0	0	1	1	0	0	2	5	2	4	2	4	1	7	1	2
1982	65	1	0	0	0	1	1	3	1	1	2	6	4	4	5	3	8	5	2	2	4	2	2	3
1983	63	0	0	0	0	0	0	1	1	0	0	1	1	4	4	4	3	3	3	2	5	4	3	8
1984	105	0	0	1	4	1	2	3	1	1	5	1	2	3	4	5	5	6	2	5	7	5	10	8
1985	69	0	0	0	0	0	0	0	2	1	1	2	2	0	3	2	6	3	7	6	10	5	3	3
1986	145	0	0	0	0	0	0	0	0	0	2	2	2	4	2	5	6	15	10	14	17	16	9	8
1987	143	0	0	0	0	0	0	0	2	1	4	6	4	9	1	1	5	6	5	9	17	11	10	16
1988	101	0	0	0	0	0	0	0	0	0	0	1	1	0	1	5	5	12	9	13	11	6	12	3
1989	95	0	0	0	0	0	0	0	0	2	2	1	0	0	1	2	3	2	9	9	10	6	10	7
1990	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	5	10	7	7	3	3
1991	104	0	0	0	0	0	0	0	0	0	0	3	1	0	3	1	1	5	9	14	17	14	10	6
1992	188	0	0	0	0	0	0	0	0	1	2	0	0	1	1	1	3	11	21	19	29	19	16	14
1993	188	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	12	18	28	27	23	21	18
1994	231	0	0	0	0	0	0	0	1	2	1	2	0	0	2	3	1	4	26	23	43	30	26	21
1995	227	0	0	0	0	0	0	0	0	0	1	0	1	0	1	2	4	9	22	27	38	26	14	28
1996	272	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	7	31	34	35	29	40	23
1997	283	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	3	6	33	36	39	30	30	25
1998	394	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	4	10	23	57	40	37	36	28
1999	403	0	0	0	0	0	0	0	0	0	1	0	1	1	1	5	8	9	23	21	47	23	37	51
2000	225	0	0	0	0	0	0	0	1	0	0	1	0	0	2	2	6	8	16	27	25	22	9	19
2001	289	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	5	27	35	31	28	41	25
2002	235	0	0	0	0	0	0	0	0	0	1	1	0	3	2	1	3	3	15	25	32	32	22	25
2003	340	0	0	0	0	0	0	0	0	0	0	0	1	0	2	6	6	16	31	32	49	35	23	38
2004	261	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	11	22	26	18	29	30	23
2005	188	0	0	0	0	0	0	0	0	0	2	1	0	2	1	2	5	5	17	21	20	20	22	16
2006	248	0	0	0	0	0	0	0	0	0	0	2	0	0	2	4	7	8	17	33	27	28	24	19
2007	261	0	0	0	0	0	0	0	0	0	0	1	0	2	0	3	6	12	33	30	34	32	13	18
2008	209	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	4	18	34	17	27	24	21
2009	199	0	0	0	0	0	0	0	1	0	1	4	1	1	0	1	4	9	17	29	25	19	12	12
2010	224	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	5	18	21	36	25	29	16
2011	154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	7	15	12	27	20	19

Table 2.11. Gulf of Mexico cobia recreational length composition data by 3cm length bins (continued).

Year	Samples	99	102	105	108	111	114	117	120	123	126	129	132	135	138	141	144	147	150	153	156	159	162	165
1979	16	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	11	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	36	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	65	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	63	2	0	0	4	2	3	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1984	105	6	5	1	1	3	5	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1985	69	2	6	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	145	10	7	4	3	2	1	3	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1987	143	14	7	6	1	2	4	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1988	101	6	4	3	2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	95	15	3	4	4	0	2	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
1990	73	5	6	2	9	3	1	3	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0
1991	104	2	3	8	2	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	188	10	6	4	5	7	3	1	7	4	1	0	1	0	1	0	0	0	0	0	0	0	0	0
1993	188	13	7	2	8	1	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	231	12	10	11	5	3	2	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
1995	227	12	14	6	7	4	4	2	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0
1996	272	17	6	7	8	10	8	3	4	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0
1997	283	11	9	9	12	9	7	7	6	1	0	3	2	0	0	0	0	0	0	0	0	0	0	0
1998	394	29	38	22	21	14	4	10	8	2	1	3	1	0	0	0	0	1	0	0	0	0	0	0
1999	403	40	43	17	27	16	10	8	5	2	2	1	3	0	0	0	1	0	0	0	0	0	0	0
2000	225	17	14	14	12	5	10	3	6	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2001	289	25	13	17	8	10	6	1	1	4	2	1	1	0	0	0	0	1	0	0	0	0	0	0
2002	235	20	7	9	10	8	5	4	3	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0
2003	340	32	13	14	9	10	10	5	4	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2004	261	25	18	14	8	15	8	5	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	188	10	11	5	7	10	5	2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2006	248	20	16	15	6	8	6	4	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2007	261	29	12	7	4	5	6	6	2	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	209	17	12	7	10	4	2	4	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2009	199	14	6	10	7	7	8	4	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2010	224	21	16	5	6	7	6	4	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	154	10	7	9	8	6	4	2	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.12. Gulf of Mexico cobia shrimp fishery length composition data by 3cm length bins.

Year	Samples	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75	78	81	84	87	90	93	96
1989	5	0	0	0	0	0	0	1	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	9	0	0	0	0	1	0	2	0	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	5	0	0	0	0	0	1	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	9	0	0	0	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
1993	28	1	0	0	1	0	2	5	11	5	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1994	17	0	0	0	1	0	0	1	3	4	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	13	0	1	0	2	1	0	0	0	1	2	0	0	0	0	0	0	1	2	1	0	0	0	1	0	0	0	1	0
1996	16	0	0	1	1	0	3	6	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	28	0	0	0	1	0	6	6	6	5	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1998	8	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	2	1	1	0	0	0	0	0
1999	15	1	0	0	0	0	2	1	1	3	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	2	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	16	0	0	0	1	0	3	7	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	6	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
2003	9	0	1	1	1	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	16	0	0	1	0	0	2	3	4	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	22	4	2	1	1	1	3	1	1	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	13	0	0	1	0	0	1	1	2	2	0	4	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2007	9	0	0	2	2	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	19	0	0	0	0	1	0	2	3	1	4	1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0
2009	12	1	0	0	1	1	0	0	1	0	2	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	17	0	2	2	3	1	1	3	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.12. Gulf of Mexico cobia shrimp fishery length composition data by 3cm length bins (continued).

Year	Samples	99	102	105	108	111	114	117	120	123	126	129	132	135	138	141	144	147	150	153	156	159	162	165
1989	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	22	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	19	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.13. Otolith increment counts of fish for each SS age cohort based on month of collection.

	Month collected											
Cohort	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Age 0					0	0	0	0	0	0	0	0
Age 1	0	0	0	0	1	1	1	1	1	1	1	1
Age 2	1	1	1	1	2	2	2	2	2	2	2	2
Age 3	2	2	2	2	3	3	3	3	3	3	3	3
Age 4	3	3	3	3	4	4	4	4	4	4	4	4
Age 5	4	4	4	4	5	5	5	5	5	5	5	5
Age 6	5	5	5	5	6	6	6	6	6	6	6	6
Age 7	6	6	6	6	7	7	7	7	7	7	7	7
Age 8	7	7	7	7	8	8	8	8	8	8	8	8
Age 9	8	8	8	8	9	9	9	9	9	9	9	9
Age 10	9	9	9	9	10	10	10	10	10	10	10	10

Table 2.14. Calendar age of fish for each SS age cohort based on month of collection.

	Month collected											
Cohort	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Age 0					0	0	0	0	0	0	0	0
Age 1	1	1	1	1	1	1	1	1	1	1	1	1
Age 2	2	2	2	2	2	2	2	2	2	2	2	2
Age 3	3	3	3	3	3	3	3	3	3	3	3	3
Age 4	4	4	4	4	4	4	4	4	4	4	4	4
Age 5	5	5	5	5	5	5	5	5	5	5	5	5
Age 6	6	6	6	6	6	6	6	6	6	6	6	6
Age 7	7	7	7	7	7	7	7	7	7	7	7	7
Age 8	8	8	8	8	8	8	8	8	8	8	8	8
Age 9	9	9	9	9	9	9	9	9	9	9	9	9
Age 10	10	10	10	10	10	10	10	10	10	10	10	10

Table 2.15. Fractional age of fish for each SS age cohort.

Cohort	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Age 0					0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.58
Age 1	0.67	0.75	0.83	0.92	1.00	1.08	1.17	1.25	1.33	1.42	1.50	1.58
Age 2	1.67	1.75	1.83	1.92	2.00	2.08	2.17	2.25	2.33	2.42	2.50	2.58
Age 3	2.67	2.75	2.83	2.92	3.00	3.08	3.17	3.25	3.33	3.42	3.50	3.58
Age 4	3.67	3.75	3.83	3.92	4.00	4.08	4.17	4.25	4.33	4.42	4.50	4.58
Age 5	4.67	4.75	4.83	4.92	5.00	5.08	5.17	5.25	5.33	5.42	5.50	5.58
Age 6	5.67	5.75	5.83	5.92	6.00	6.08	6.17	6.25	6.33	6.42	6.50	6.58
Age 7	6.67	6.75	6.83	6.92	7.00	7.08	7.17	7.25	7.33	7.42	7.50	7.58
Age 8	7.67	7.75	7.83	7.92	8.00	8.08	8.17	8.25	8.33	8.42	8.50	8.58
Age 9	8.67	8.75	8.83	8.92	9.00	9.08	9.17	9.25	9.33	9.42	9.50	9.58
Age 10	9.67	9.75	9.83	9.92	10.00	10.08	10.17	10.25	10.33	10.42	10.50	10.58

Table 2.16. Model age of fish for each SS age cohort

Cohort	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Age 0	0.00	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.83	0.92
Age 1	1.00	1.08	1.17	1.25	1.33	1.42	1.50	1.58	1.67	1.75	1.83	1.92
Age 2	2.00	2.08	2.17	2.25	2.33	2.42	2.50	2.58	2.67	2.75	2.83	2.92
Age 3	3.00	3.08	3.17	3.25	3.33	3.42	3.50	3.58	3.67	3.75	3.83	3.92
Age 4	4.00	4.08	4.17	4.25	4.33	4.42	4.50	4.58	4.67	4.75	4.83	4.92
Age 5	5.00	5.08	5.17	5.25	5.33	5.42	5.50	5.58	5.67	5.75	5.83	5.92
Age 6	6.00	6.08	6.17	6.25	6.33	6.42	6.50	6.58	6.67	6.75	6.83	6.92
Age 7	7.00	7.08	7.17	7.25	7.33	7.42	7.50	7.58	7.67	7.75	7.83	7.92
Age 8	8.00	8.08	8.17	8.25	8.33	8.42	8.50	8.58	8.67	8.75	8.83	8.92
Age 9	9.00	9.08	9.17	9.25	9.33	9.42	9.50	9.58	9.67	9.75	9.83	9.92
Age 10	10.00	10.08	10.17	10.25	10.33	10.42	10.50	10.58	10.67	10.75	10.83	10.92

Table 2.17. Standardized indices of relative abundance and associated log-scale standard errors for Gulf of Mexico cobia.

	MRFSS		Headboat	
Year	Std CPUE	log SE	Std CPUE	log SE
1981	0.8473	0.33	-	-
1982	1.1959	0.21	-	-
1983	0.8716	0.29	-	-
1984	0.7475	0.27	-	-
1985	0.6671	0.30	-	-
1986	0.5511	0.19	0.4691	0.27
1987	0.7546	0.18	0.4015	0.28
1988	0.9446	0.19	0.3755	0.29
1989	1.0279	0.20	0.5335	0.26
1990	1.5867	0.18	0.7100	0.25
1991	1.6207	0.15	0.8692	0.23
1992	1.0814	0.12	0.8649	0.23
1993	1.0354	0.15	1.1310	0.21
1994	1.3619	0.13	1.1147	0.21
1995	0.6666	0.17	0.9744	0.23
1996	1.3853	0.13	1.0415	0.23
1997	1.9183	0.11	1.2572	0.22
1998	1.1846	0.11	1.0947	0.22
1999	1.0917	0.09	1.6814	0.20
2000	0.7838	0.10	0.9681	0.22
2001	0.9087	0.10	1.2529	0.22
2002	0.9308	0.09	1.0083	0.24
2003	1.0102	0.10	1.2268	0.21
2004	0.8415	0.10	0.9729	0.24
2005	0.7870	0.11	1.0257	0.23
2006	0.7349	0.11	0.9857	0.24
2007	0.8082	0.11	1.2373	0.21
2008	0.9602	0.11	1.1913	0.21
2009	0.7509	0.12	1.2268	0.21
2010	0.9009	0.12	1.0998	0.22
2011	1.0428	0.11	1.2856	0.21

2.8 Figures

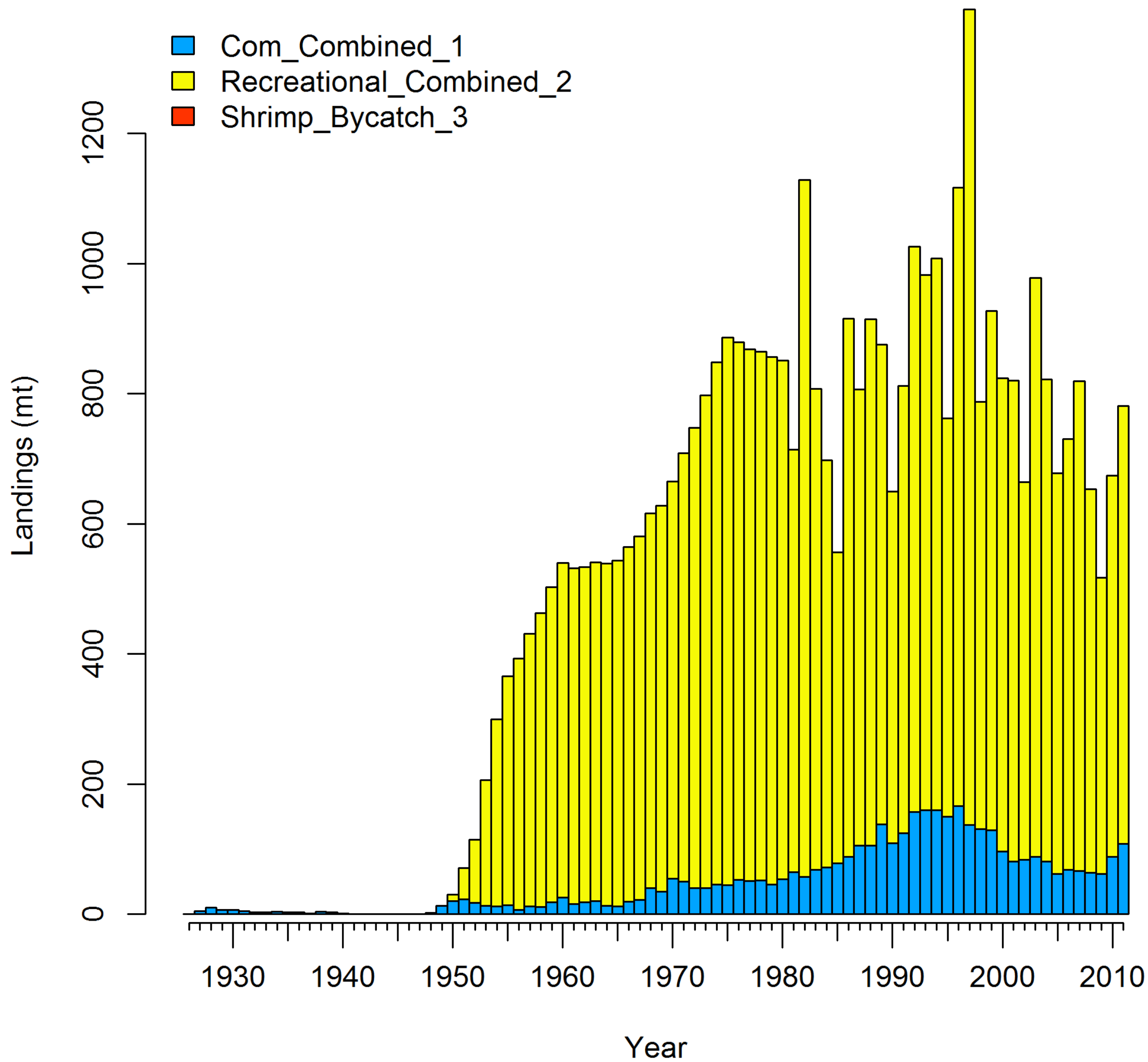

Figure 2.1. Gulf of Mexico Cobia estimated landings history, 1926-2011.

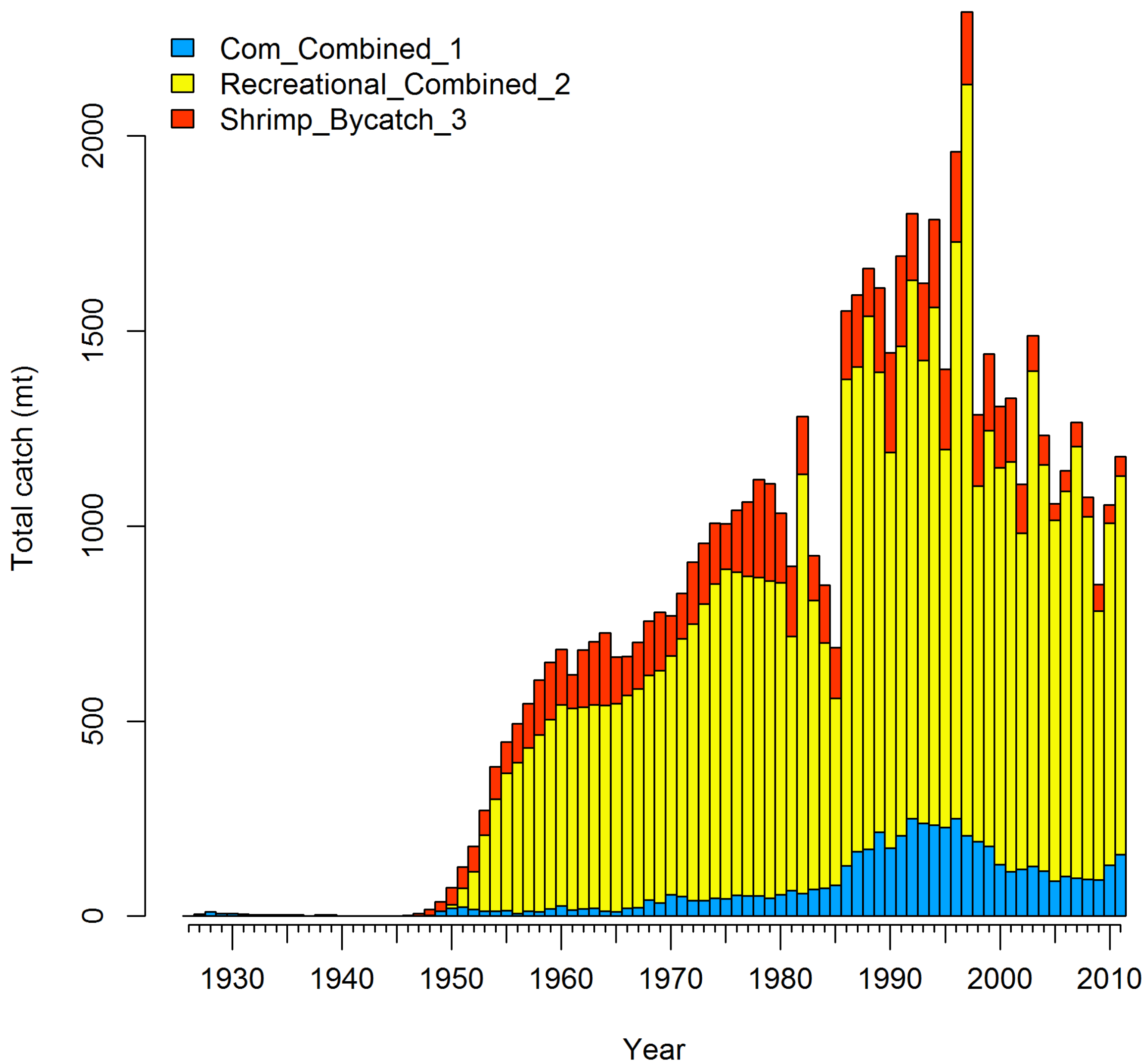

Figure 2.2. Gulf of Mexico Cobia estimated catch history, 1926-2011. Estimated catch includes both landings and discards.

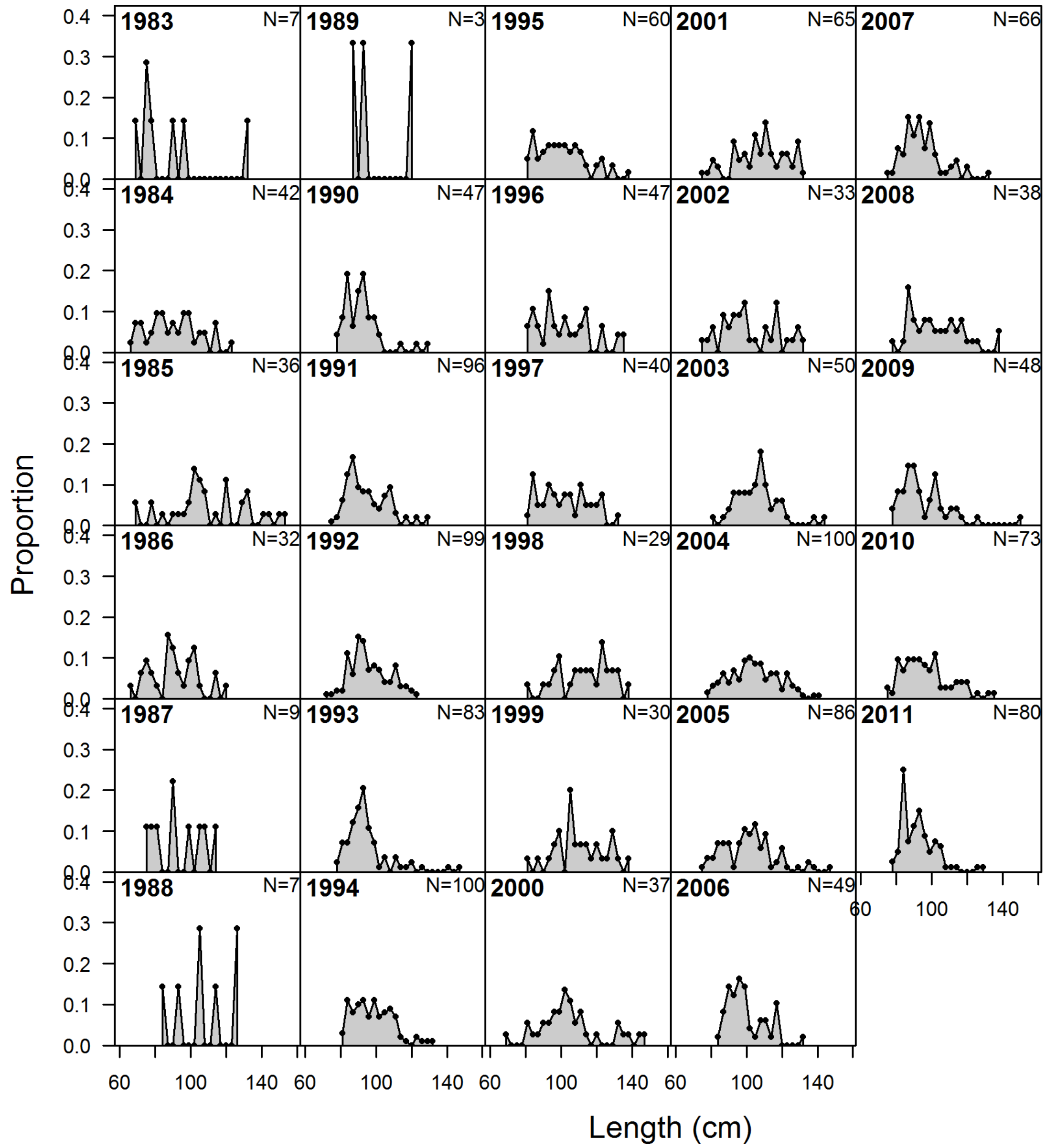

Figure 2.3. Observed length composition data of Gulf of Mexico Cobia from the commercial fishing fleet, 1983-2011.

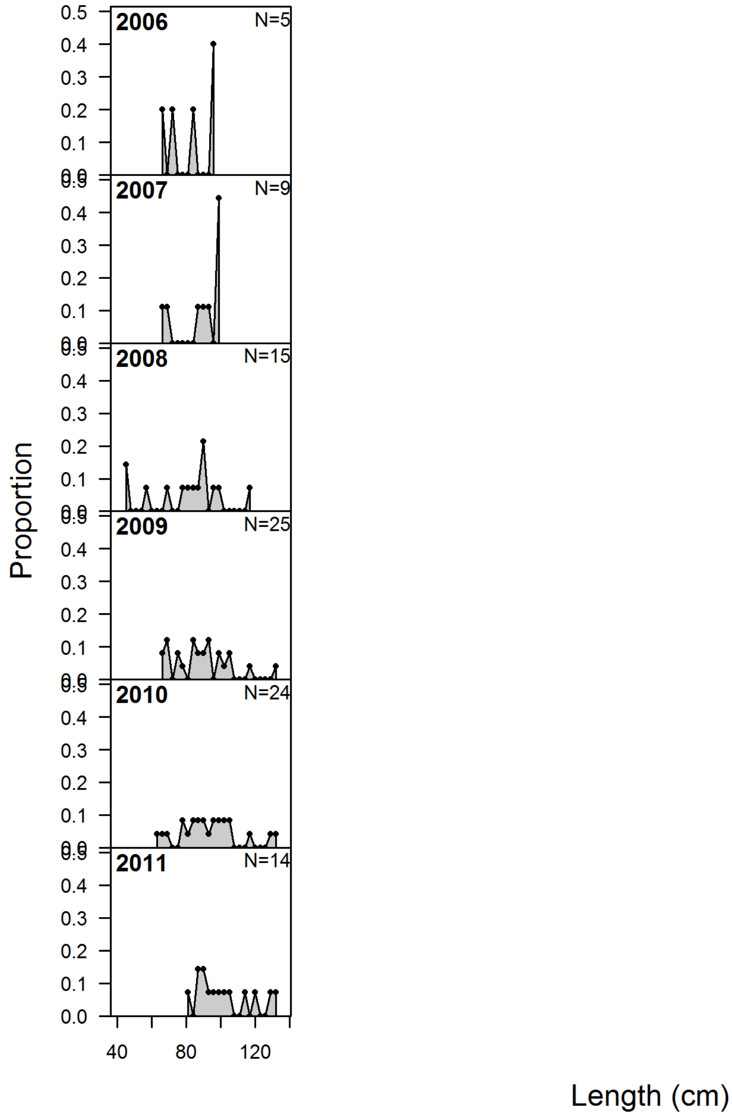

Figure 2.4. Length composition data from the reef fish observer program, 2006-2011.

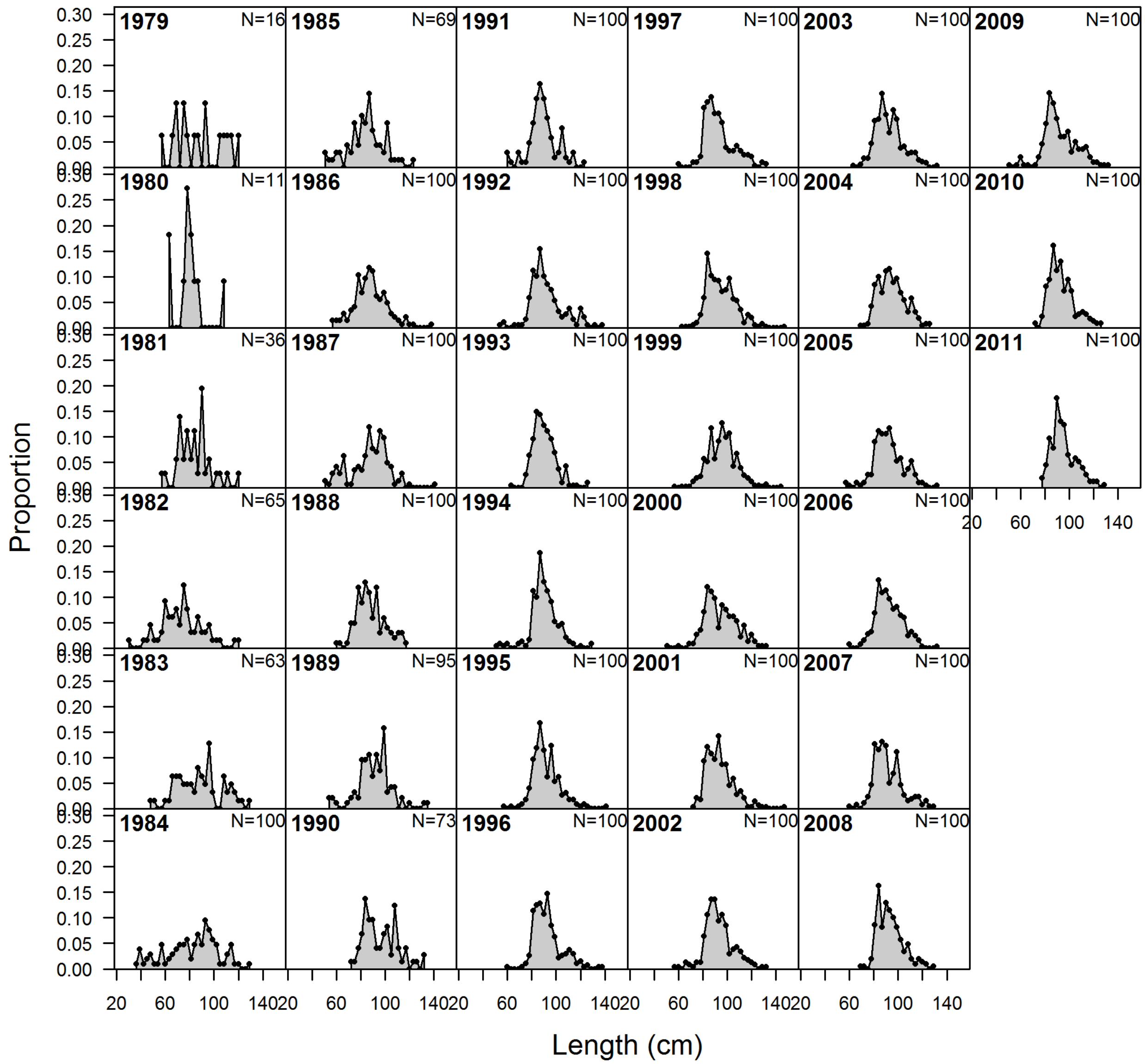

Figure 2.5. Observed length composition data of Gulf of Mexico Cobia from the recreational fishing fleet, 1979-2011.

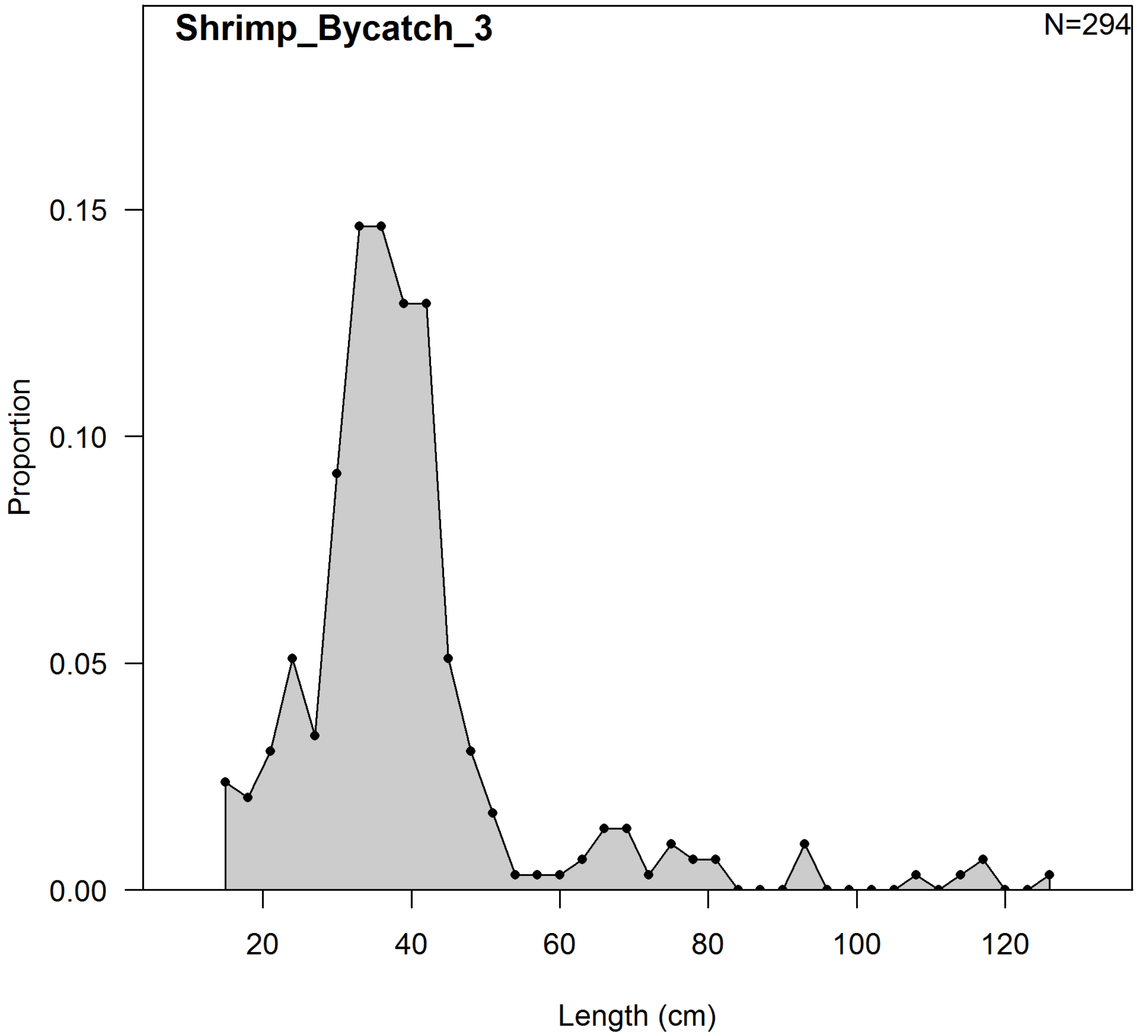

Figure 2.6. Observed length composition data of Gulf of Mexico Cobia from the shrimp fishing fleet, 1979-2011.

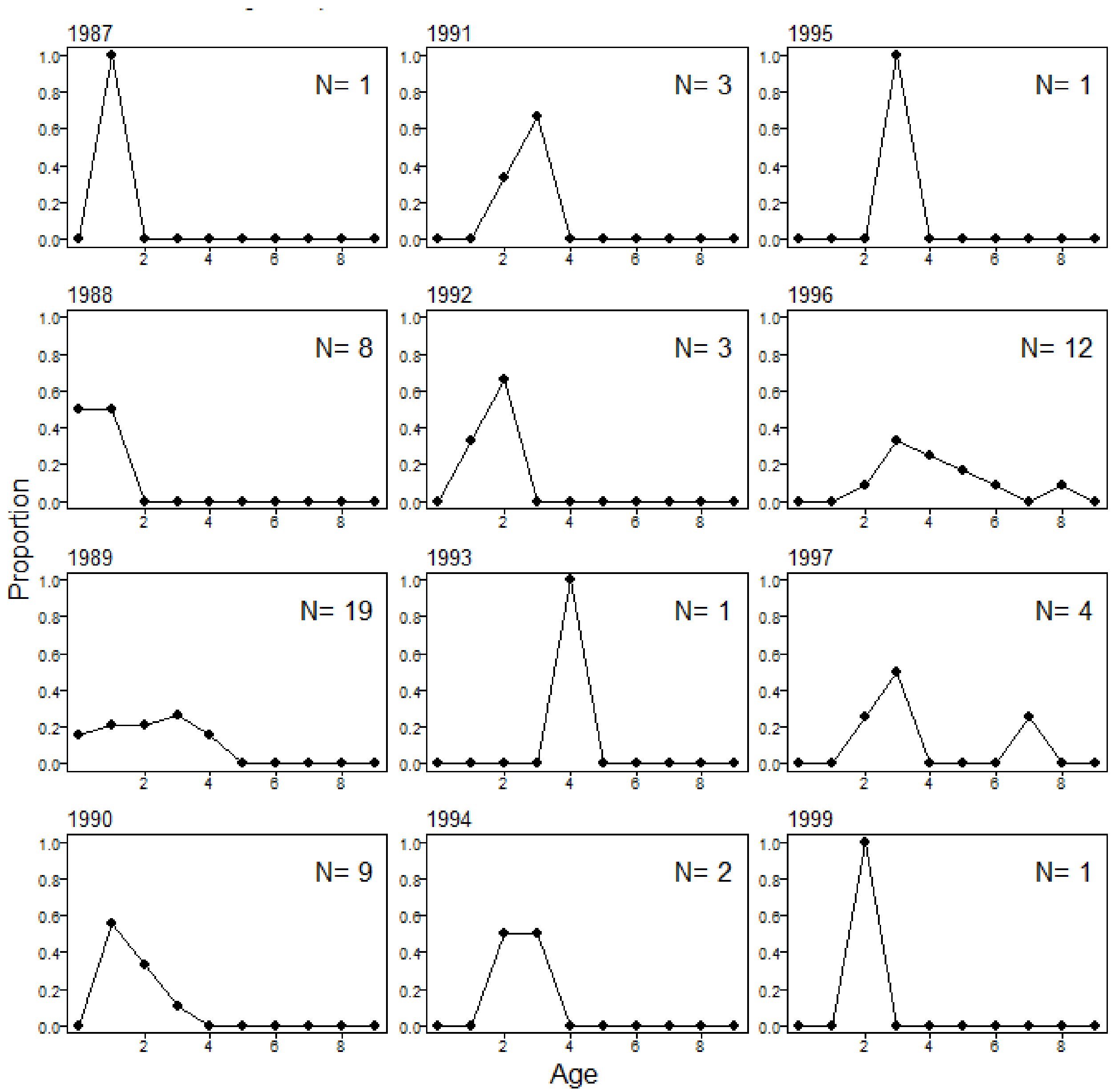

Figure 2.7. Observed age composition data of Gulf of Mexico Cobia from the commercial fishing fleet, 1987-1999.

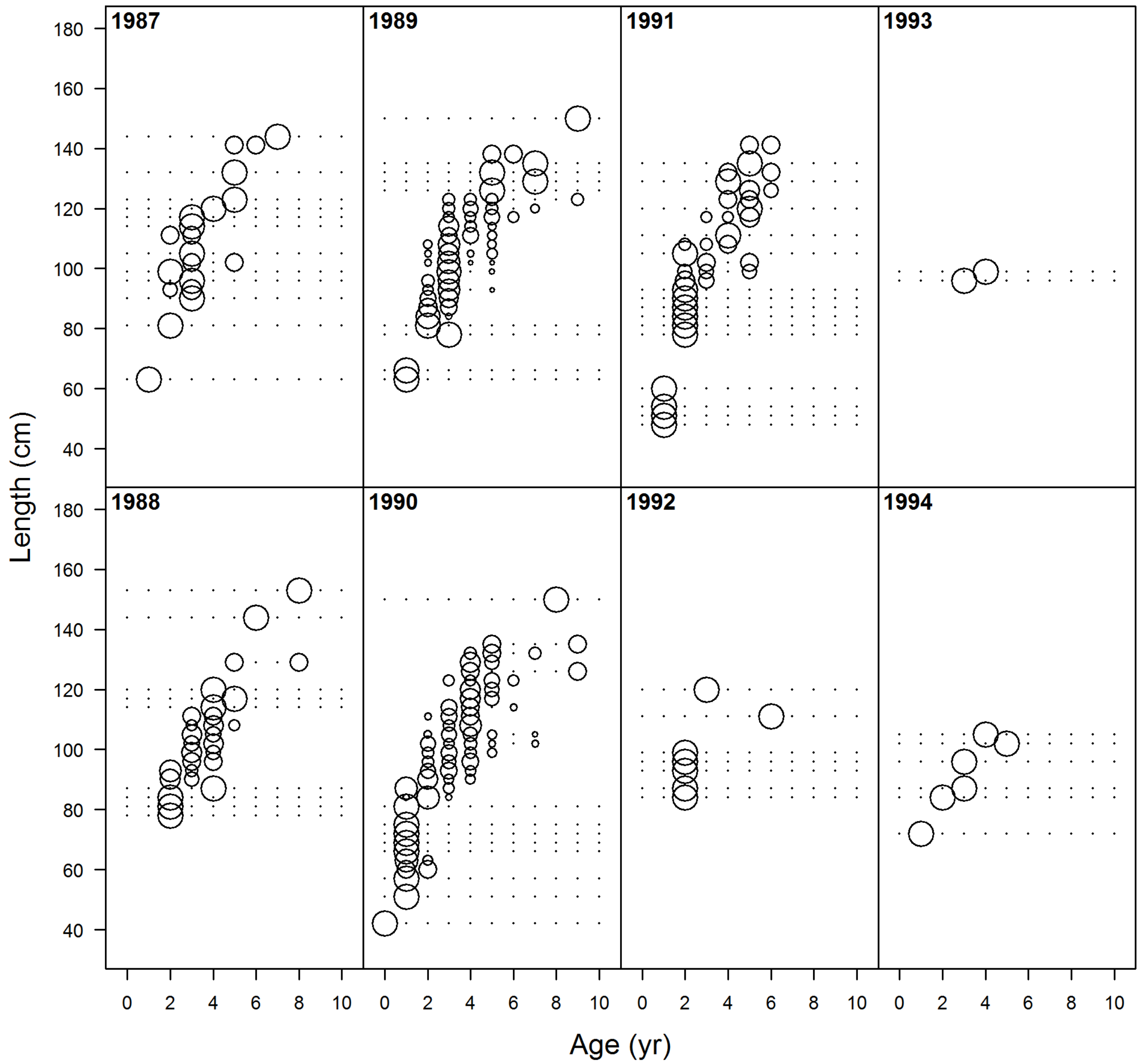

Figure 2.8a. Observed conditional age-at-length data of Gulf of Mexico Cobia from the recreational fishing fleet, 1987-2011.

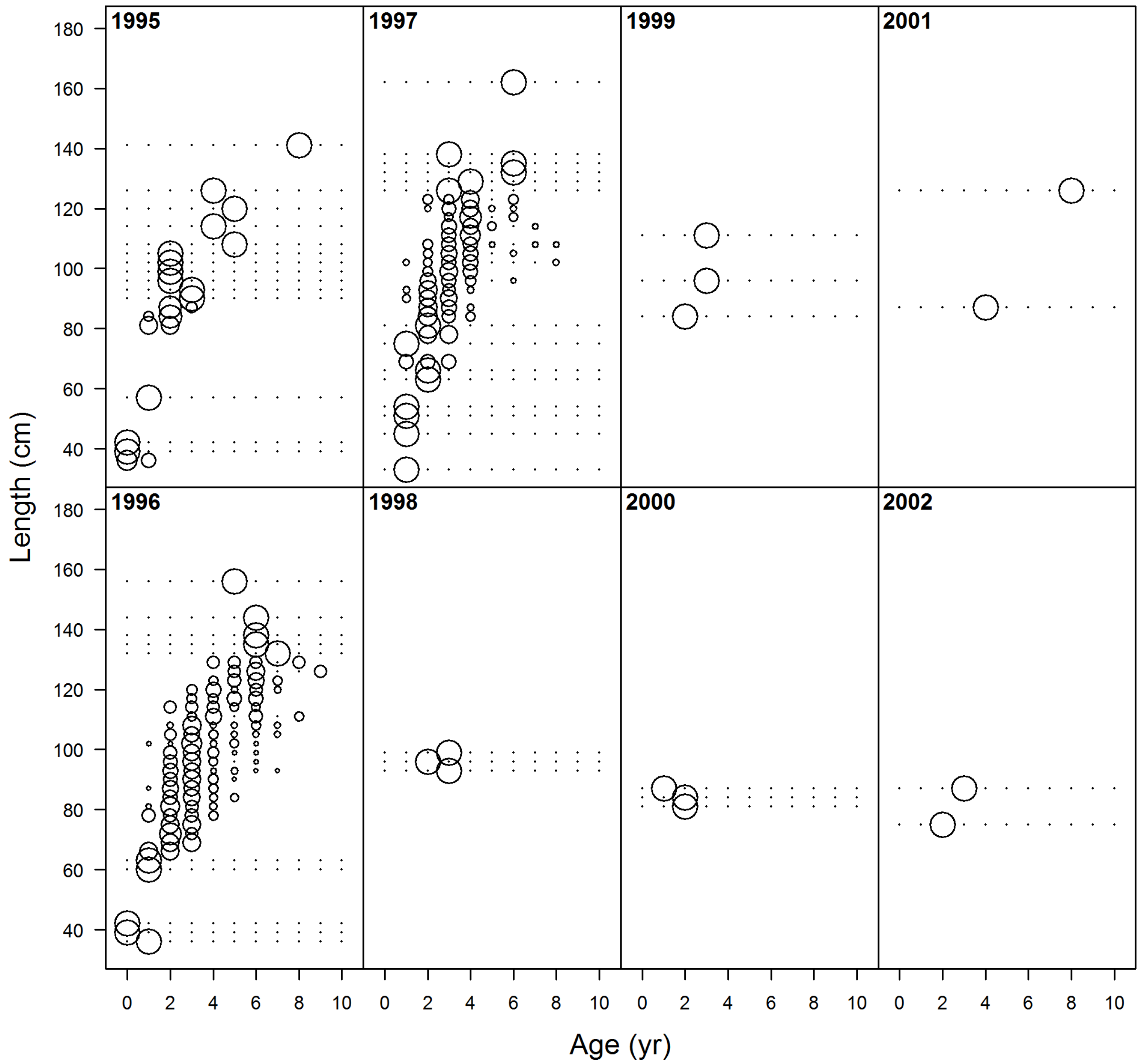

Figure 2.8b. Observed conditional age-at-length data of Gulf of Mexico Cobia from the recreational fishing fleet, 1987-2011.

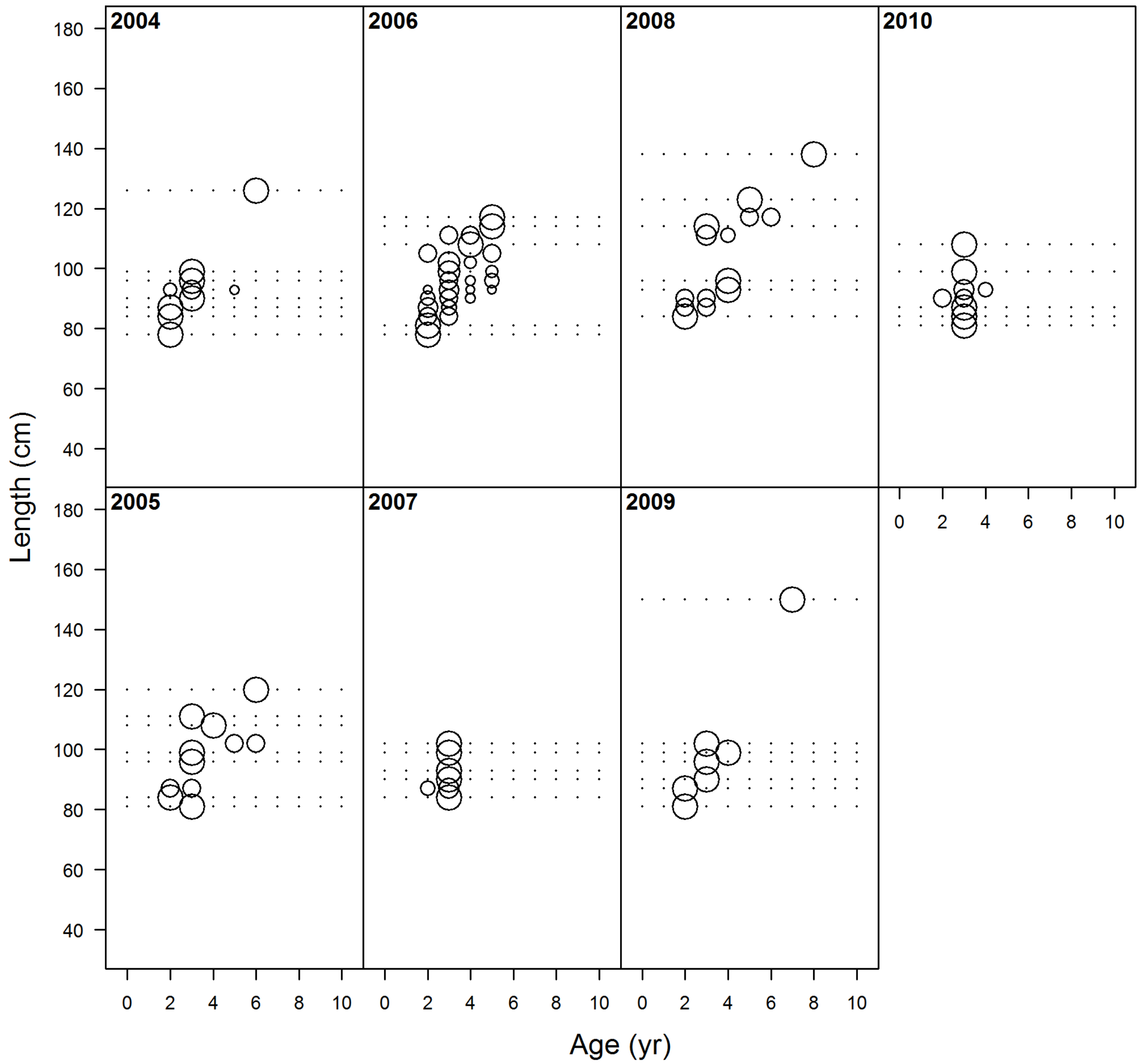

Figure 2.8c. Observed conditional age-at-length data of Gulf of Mexico Cobia from the recreational fishing fleet, 1987-2011.

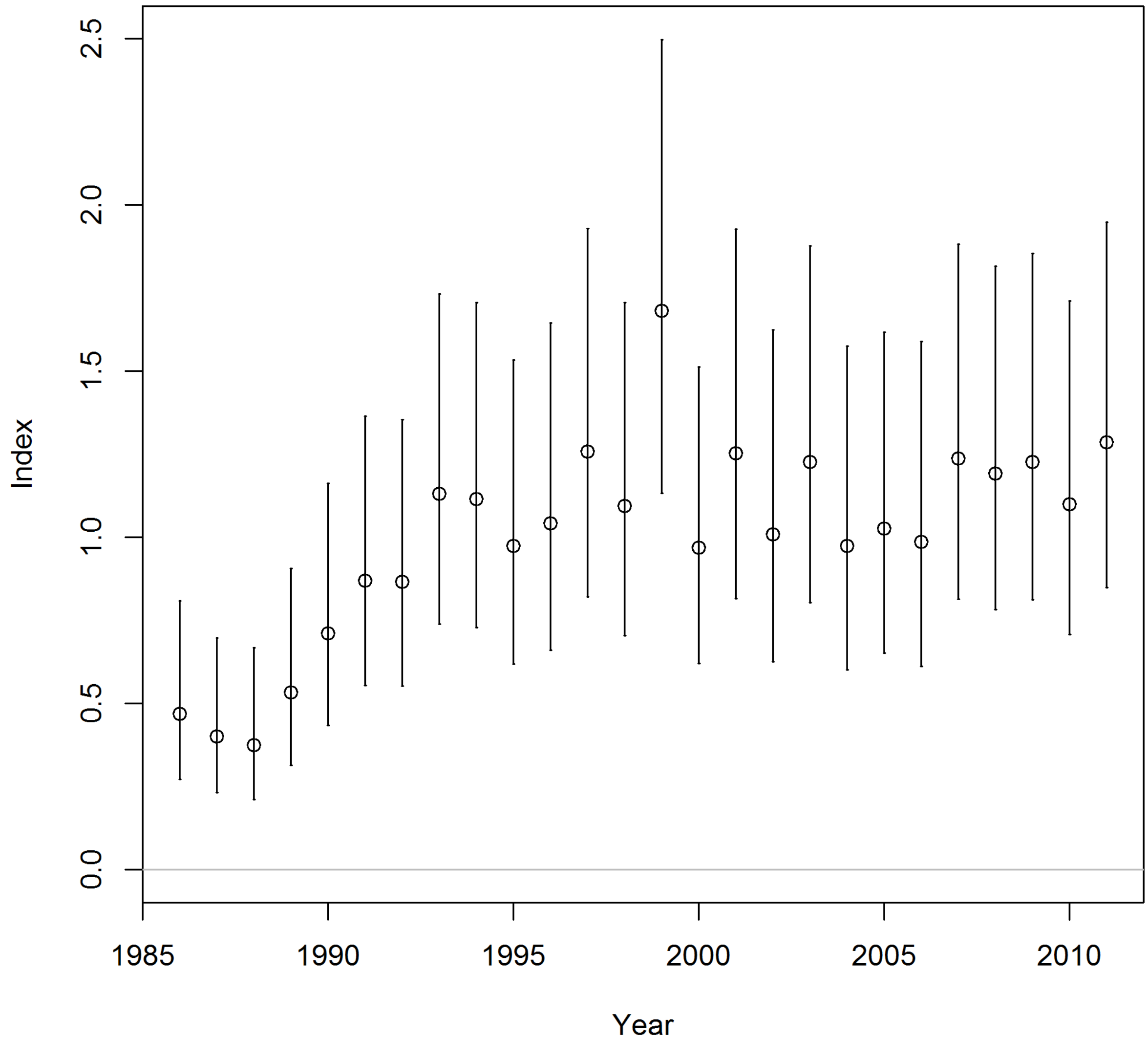

Figure 2.9. Standardized index of relative abundance and associated standard errors from the Gulf of Mexico recreational headboat fishery, 1985-2011.

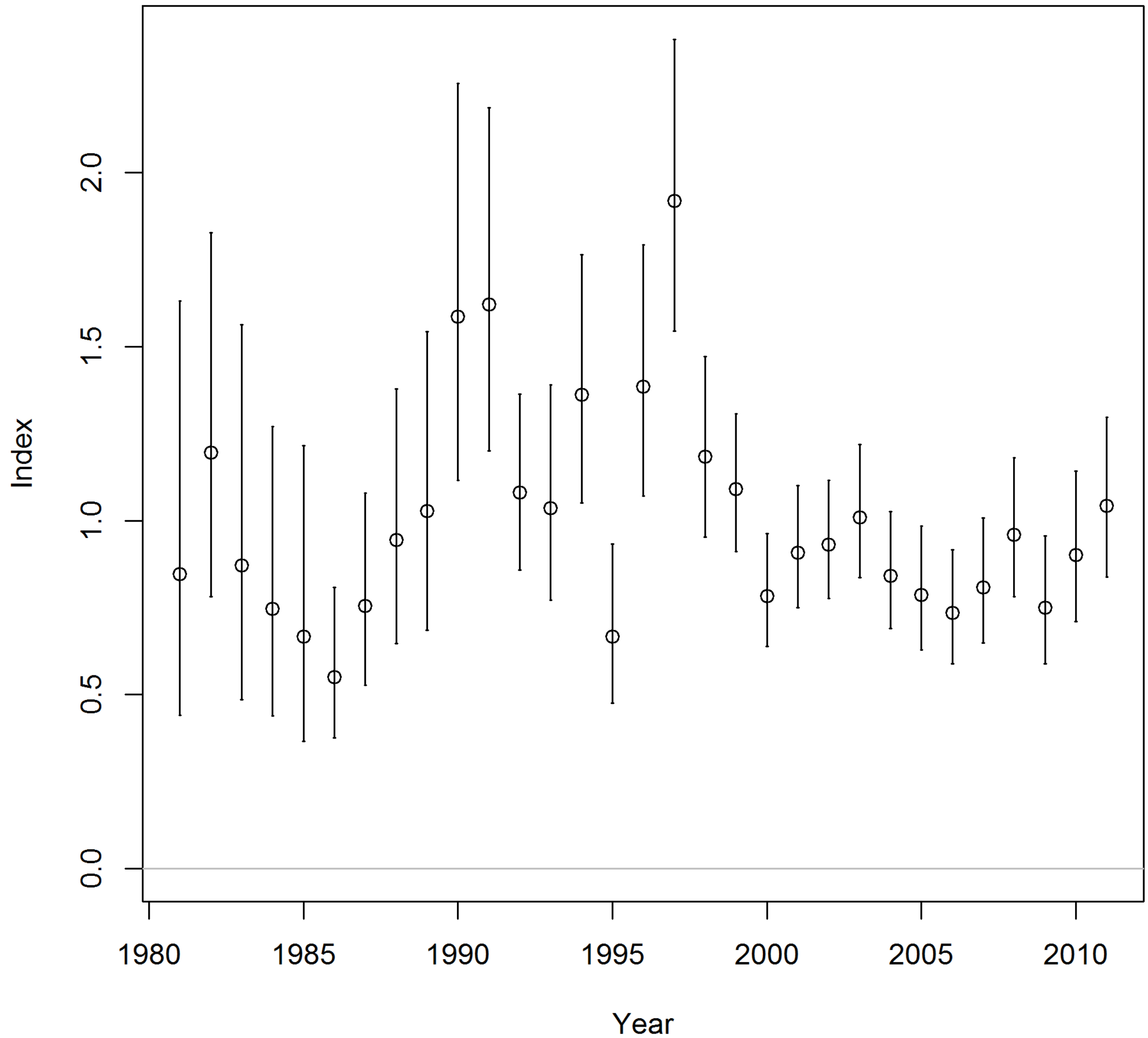

Figure 2.10. Standardized index of relative abundance and associated standard errors from the Gulf of Mexico recreational fishery (MRFSS), 1981-2011.

3 STOCK ASSESSMENT MODELS AND RESULTS

3.1 Stock Synthesis

3.1.1 Overview

The primary assessment model selected for the Gulf of Mexico cobia assessment was Stock Synthesis (Methot 2011) version 3.4d. Stock Synthesis (SS) has been widely used and tested for assessment evaluations, particularly in the US west coast NMFS centers (Methot 2011). Descriptions of SS algorithms and options are available in the SS user's manual (Methot 2011) and at the NOAA Fisheries Toolbox website (http://nft.nefsc.noaa.gov/).

Stock Synthesis is an integrated statistical catch-at-age model which is widely used for stock assessments in the United States and throughout the world. SS takes relatively unprocessed input data and incorporates many of the important processes (mortality, selectivity, growth, etc) that operate in conjunction to produce observed catch, size and age composition and CPUE indices. Because many of these inputs are correlated, the concept behind SS is that they should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment. SS has the ability to incorporate an early, data poor time period for which only catch data are available and a more recent, data-rich time period for which indices and length and age observations are available. SS also offers a lot of flexibility for constructing models of varying complexity. Data inputs and model parameters can be easily turned on or off to create alternative models of varying degrees of complexity. For this assessment SS was first constructed as a simple production model with minimal parameters. The model was then extended to an age-structured production model. Finally, length and age composition data was added to construct a length-structured catch-at-age model. General trends in estimated stock biomass over time remained similar as model complexity was increased. The model presented is the fully parameterized length based statistical-catch-at-age model. This model was selected because it incorporates all available data sources and is best suited for providing management advice.

3.1.2 Data sources

The landings, discards, length composition, age composition, and indices of abundance used in SS are described in Section 2 (Figure 3.1). Appendix A contains the data file for Stock Synthesis.

3.1.3 Model configuration and equations

The primary assessment model selected for the Gulf of Mexico cobia assessment was Stock Synthesis (Methot 2011) version 3.4d. Stock Synthesis version 3.4d was amended to deal with particular issues raised during the SEDAR 28 stock assessments for Gulf of Mexico Cobia and Gulf of Mexico Spanish mackerel. The major addition in Stock Synthesis 3.4d was the ability to explicitly model fisheries for which the only source of mortality is discarding of bycatch. Changes in Stock Synthesis 3.4d allowed for the approach explained in Section 2.3.3 for modeling shrimp bycatch of cobia explicitly as a bycatch fishery.

The Gulf of Mexico cobia population was modeled as a single stock that occurred from the Georgia-Florida border in the South Atlantic through the Northern Gulf of Mexico to the Mexico-Texas border. The assessment uses data through 2011 and the time period of the assessment is 1926-2011. Model projections were run for 2013-2019. A general description of the assessment model follows.

The assessment was set up to include three fishing fleets and two indices of abundance. The three fishing fleets were commercial, recreational, and the shrimp bycatch fishery. The two indices of abundance used in the assessment were the marine recreational fishing statistical survey (MRFSS) and headboat survey.

The stock is assumed to be in equilibrium at the beginning of the modeled period in 1926. Commercial landings of cobia were first reported in 1927. Recreational landings were hindcast to 1950 and estimates of shrimp effort were available back to 1945. Recreational landings data were collected from 1981-2011 through the Marine Recreational Fishing Statistical Survey (MRFSS). The data workshop report provides details on how recreational landings were estimated for 1950-1980. Substantial removals of cobia did not occur until after WWII for any of the fisheries. An initial equilibrium fishing mortality rate of zero was assumed for all fleets. The model estimated annual fishing mortality rates for each fishery. Annual fishing mortality rates are adjusted within the model so that the calculated retained catches will nearly exactly match the observed retained catches. No seasons are used to structure removals or biological predictions, so data collection is assumed to be relatively continuous throughout the year.

The natural mortality rate (*M*) was assumed constant over time, but decreasing with age. The form of *M* as a function of age was based on Lorenzen (1996). The DW life history working group recommended using a base $M = 0.38\ y^{-1}$ and a reference age of 3. The base *M* of 0.38 y^{-1} was developed using the relationship between maximum age (11) and *M* (Hoenig 1983). The age-specific natural mortality vector developed at the DW was input into SS as a fixed vector. Sensitivity runs using a range of Lorenzen age-variable *M* values that represented a CV of 0.54 were recommended by the DW life history working group. However, this range of *M* values was considered too high by the AW. Sensitivity runs with *M* scaled at 0.50 y^{-1} for a high estimate and 0.26 y^{-1} for a low estimate were used (Figure 3.2).

In SS, all cohorts of fish graduate to the age of 1 when they first reach January 1, regardless of when they are born. This means that SS operates under the assumption that all age data have been adjusted so that fish graduate to the next age on January 1. The DW used a birthday of May 1 for converting calendar ages to fractional ages. Thus, age-0 fish are graduated to age-1 in the model after only 7 months of biological life (May 1 – January 1). To resolve this accounting discrepancy we had to adjust the natural mortality rate for age-0 fish. Instead of undergoing a full year of instantaneous natural mortality, we reduced the estimated *M* for age-0 fish so that age-0 fish underwent 7 months of instantaneous natural mortality.

Growth rates were estimated in the assessment model using a single growth curve for both sexes. Growth was modeled with a three parameter von Bertalanffy equation (L_{min}, L_{max}, and *K*). In SS, when fish recruit at the real age of 0.0 they have a body size equal to the lower edge of the first population bin (L_{bin}; fixed at 6 cm FL). Fish then grow linearly until they reach a real age equal to the input value of A_{min} (growth age for L_{min}) and have a size equal to the L_{min}. As they age further, they grow according to the von Bertalanffy growth equation. The value of A_{min} was fixed at 0.75 which is representative of a fractional age of 0.42 (lifespan: May 1 – October 1). This value was chosen for A_{min} because there were 10 observations of length-at-age data for age-0 fish collected in the months of October and November to inform the model estimate of L_{min}. L_{max} was specified as equivalent to L_{∞}. Variation in the size-at-age was estimated in the model for ages 0.5 and 10. For intermediate ages a linear interpolation of the CV on mean size-at-age is used.

A fixed length-weight relationship was used to convert body length (cm) to body weight (kg). Fecundity was assumed to be proportional to female biomass. Maturity was input as a fixed function of age, with age-2 fish being 50% mature and age-3+ fish being full mature.

A single Beverton-Holt stock-recruitment function was estimated in SS. Spawning stock was assumed to be total mature female biomass. Two parameters of the stock recruitment relationship were estimated; the log of unexploited equilibrium recruitment (R_0) and steepness (*h*). A third parameter representing the standard deviation in recruitment (*sigmaR*) was input as a fixed value of 0.6. Rarely is *sigmaR* directly estimable from the given data and hence it is often necessary to input as a fixed parameter. There were no applicable environmental covariates to link to recruitment.

Annual deviations from the stock-recruit function from 1982-2010 were estimated in SS as a vector of deviations forced to sum to zero. Prior to 1982, recruitment is estimated as a function of spawning stock biomass based on the stock-recruit parameters. Stock synthesis assumes a lognormal error structure for recruitment. Therefore, expected recruitments were bias adjusted. Methot and Taylor (2011) recommend that the full bias adjustment only be applied to data-rich years in the assessment and few years into the data-rich period. This is done so SS will apply the full bias-correction only to those recruitment deviations that have enough data to inform the model about the full range of recruitment variability (Method 2011). Full bias adjustment was used from 1984 to 2009 when length and age composition data are available. Bias adjustment was phased in from no bias adjustment prior to 1982 to full bias adjustment in 1984 linearly. Bias adjustment was phased out over the last two years (2010-2011), decreasing from full bias adjustment to no bias adjustment. The years selected for full bias adjustment were estimated following the methods of Methot and Taylor (2011). The proportion of female recruits was set at 0.60.

SS provides the option to model the age composition as a set of conditional ages at length. This modeling framework operates similarly to an age-length key where a distribution of ages is input for a given length bin. This modeling approach is recommended (Methot 2011) and avoids double use of fish for both age and size information because the age information is considered conditional on the length information, contains more detailed information on the variance of size-at-age and provides better ability to estimate growth parameters and the age composition need not be selected completely at random. Thus, data collected in a length-stratified program can be incorporated, provided there is no bias for a particular age within a length bin. The age composition data was input in this manner with ages assigned to 3 cm length bins with the length bins ranging from 6 to 165 cm and ages from 0-11 where 11 represents a plus group age.

Size based selectivity patterns were specified for each fishery and survey in SS. Four selectivity patterns were defined in SS: 1) commercial fishery, 2) recreational fishery, 3) shrimp trawl fishery, and 4) MRFSS survey. The AP decided to constrain the selectivity patterns for the commercial and recreational fisheries to be asymptotic. A two parameter logistic function was used to model selectivity for the commercial and recreational fisheries. The selectivity for the shrimp trawl fishery was modeled using a six parameter double-normal function. The double normal can model dome-shaped selectivity, but it also can model asymptotic selectivity by holding several of the function's parameters at fixed values. The selectivity for the shrimp trawl fishery was modeled with all six parameters of the double-normal allowed to vary which resulted in a dome-shaped selectivity pattern. The selectivity pattern of the MRFSS index was assumed to mirror the selectivity pattern of the recreational fishery. Selectivity patterns were assumed to be constant over time for each fishery and survey.

Retention curves were used to account for discards and incorporate the impact of a minimum size limit for the commercial and recreational fisheries. A minimum size limit of 33 inches (83.8 cm FL) was enacted in 1984 in both federal and state waters for all fisheries. Time blocks on the retention curves were specified to create separate retention curves for the time period of 1927-1984 and 1985-2011. Prior to the minimum size limit, it was assumed that some discarding occurred in both the commercial and recreational fishery. The MRFSS data set estimated low levels of discards prior to the size limit; no information was available on commercial discards prior to 1993. To account for discarding prior to the size limit, a retention curve with an inflection point of 40 cm FL and slope of 2 (almost knife-edge) was used for both fisheries. The retention curves were fixed because there was no length composition data of discarded fish available to inform the model on their shape. Length composition data collected before 1984 shows that approximately 50% of retained fish were less than 33 inches. The smallest observed fish in the recreational length composition data prior to 1984 was 32 cm FL. The smallest observed fish in the headboat length composition data prior to 1984 was 57 cm FL. Less than 2% of fish in the recreational length composition data were less than 50 cm prior to the size limit. Only one year of commercial length composition data was available prior to the size limit; the smallest fish in the length composition data was 55 cm FL. Retention parameters for the time period 1984-2011 were estimated by the model for both the commercial and recreational fisheries.

An update in SS 3.4d allowed for the shrimp fishery to be modeled explicitly as a bycatch fishery. Due to concerns about the accuracy and precision of the annual estimates of cobia bycatch from the shrimp fishery the AP agreed to not use annual point estimates of bycatch in the assessment model. The AP recommended that shrimp fishery effort be used as a proxy for cobia bycatch trends since shrimp fishery effort is known with more certainty. In SS, an annual estimate of shrimp fishery effort (1945-2011) was input as an index of fishing mortality. SS interprets effort data as being proportional to the level of the fishery *F* values. A catchability coefficient (*Q*) was required to scale the shrimp effort time series, the resultant proportionality constant has units of 1/*Q*. Shrimp fishing effort was scaled to an estimate of cobia bycatch by assuming that the median estimate of cobia bycatch from 1972-2011 was representative of the level of bycatch from the fishery. This median estimate of cobia bycatch was input in SS as a discard time series using a super-year approach and represents the observed level of shrimp bycatch (Method 2011). The magnitude of the bycatch was estimated in SS by minimizing the difference between the observed and model predicted mean bycatch for the time period of 1972-2011. Stock synthesis used the model predicted mean bycatch for 1972-2011 and input levels of shrimp fishing effort to predict the annual number of removals from the shrimp bycatch fishery.

The SS input files are presented in Appendices A-D.

3.1.4 Parameters estimated

A total of 268 parameters were estimated for the base case model (Table 3.1). Table 3.1 includes predicted parameter values and their associated standard errors from SS, initial parameter values, and minimum and maximum values a parameter could take. Parameters designated as fixed were held at their initial values. Uniform, non-informative priors were applied to all estimated parameters in the base model. Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation. The soft bounds option in SS was utilized when fitting the assessment model. This option creates a weak symmetric beta penalty on selectivity parameters to move parameters away from the bounds (Methot 2011).

Of the 268 parameters estimated, 5 were used to model growth, 16 were used to estimate selectivity and retention curves, 2 were used to model the stock-recruit relationship, 1 catchability coefficient for shrimp fishing effort was used, 30 annual recruitment deviations were estimated, and 214 fishing mortality rate parameters were estimated.

3.1.5 Model convergence

To test for convergence, 50 trials were performed using a 'jitter' value (Methot 2011) of 0.1 for the base case model. In large statistical models the solution surface tends to be very complex. To ensure that the model converged to a "global" solution, rather than a local minimum, it is important to start the model using alternative starting values for the model parameters. This test perturbs the initial values used for minimization with the intention of causing the search to traverse a broader region of the likelihood surface.

3.1.6 Uncertainty and Measures of Precision

Uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter (Table 3.2). Asymptotic standard errors are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives of the likelihood with respect to the parameters) after the model fitting process. Asymptotic standard errors are based upon the model's analytical estimate of the variance near the converged solution.

Uncertainty in parameter estimates was further investigated using a parametric bootstrap approach. Bootstrapping is a standard technique used to estimate confidence intervals for model parameters or other quantities of interest. There is a built-in option to create bootstrapped data-sets using SS. This feature performs a parametric bootstrap using the error assumptions and sample sizes from the input data to generate new observations about the fitted model expectations. The model was refit to 1000 bootstrapped data-sets and the distribution of the parameter estimates was used to represent the uncertainty in the parameters and derived quantities of interest.

Likelihood profiles were completed for two key model parameters: steepness of the stock-recruit relationship (*h*) and unexploited equilibrium recruitment (R_0). Likelihood profiles are commonly used to elucidate conflicting information among various data sources, to determine how asymmetric the likelihood surfaces surrounding point estimates may be, and to provide an additional evaluation of how precisely parameters are being estimated.

3.1.7 Sensitivity analysis

Uncertainty in data inputs and model configuration was examined through sensitivity analyses. The models reported in this section are by no means meant to be a comprehensive comparison of all possible aspects of model uncertainty, nor do they reflect even the full range of models considered in developing the base case. These scenarios are intended to provide more information about sensitivity to key model parameters and potential conflict in signal among data sources. The order in which they are presented is not intended to reflect their importance; each run included here provided important information for developing or evaluating the base case model and alternate states of nature. Ten alternative runs are included in this report.

Run 1: The central run off which the sensitivity runs were based. This run used the model configuration and initial parameter values described in Section 3.1.3 and Table 3.1.

Run 2: Low *M* run. The Lorenzen natural mortality rate at age was rescaled to provide the same cumulative survival through the oldest observed age as would a constant $M = 0.26\ y^{-1}$ (Figure 3.1). This *M* is equal to the base *M* used in the South Atlantic cobia stock assessment. The maximum age reported for Atlantic cobia was 16 yr which was 5 years older than the maximum age for the Gulf of Mexico – hence the *M* estimate for the South Atlantic was much lower than the Gulf of Mexico.

Run 3: High *M* run. The Lorenzen natural mortality rate at age was rescaled to provide the same cumulative survival through the oldest observed age as would a constant $M = 0.50\ y^{-1}$ (Figure 3.1).

Run 4: High discard mortality run. For this run discard mortality rates for both commercial and recreational fisheries were doubled from 0.05 to 0.10.

Run 5: Steepness fixed at 0.70. The base run estimated steepness at 0.92 and the likelihood profile of steepness was relatively flat between values of 0.80 and 1.0. However, a steepness of 0.70 is biologically feasible and this run represents a scenario given a lower bound on stock productivity.

Run 6: Steepness fixed at 0.80. The base run estimated steepness at 0.92 and the likelihood profile of steepness was relatively flat between values of 0.80 and 1.0. Given the relatively flat profile for steepness, fixing steepness at 0.80 represents an alternative state where the stock is slightly less productive.

Run 7-8: MRFSS index only or Headboat index only. Only two indices of abundance were used in the assessment model. Both indices of abundance were linked to the recreational fishery. The two indices have structural differences as the MRFSS index is an index of all fish captured whereas the Headboat index is an index of only legal fish. There were slight differences in their annual signals and their overall trend. The MRFSS index tended to have greater inter-annual deviations but annual point estimates had lower CVs, especially in the most recent years. In addition, the MRFSS index displayed more patterns in stock size fluctuation over time whereas the Headboat index displayed a general trend of increasing stock size over time.

Run 9: Data component weights iteratively re-weighted using SS approach. The goal of data weighting is to achieve consistency between the degree of uncertainty in each data set and the model's ability to fit those data. Variances and samples sizes for data components are first derived from the raw data sources. Variances and samples can then be iteratively re-weighted to ensure consistency between the input sample sizes (or standard errors) and the effective sample sizes based on model fit. SS allows for iterative reweighting of data components using variance adjustment factors. For data components, these weights are applied by either adjusting CVs of the abundance indices or adjusting effective sample sizes of composition data. SS calculates a root mean squared error (RMSE) for the fit to abundance indices and an effective sample size for fits to composition data. Weights are applied to data components so that the CVs of the abundance indices match the RMSE and sample sizes for composition data match effective sample sizes estimated by SS. This approach attempts to reduce the potential for particular data sources to have a disproportionate effect of total model fit, while creating estimates of uncertainty that are commensurate with the uncertainty inherent in the input data.

Run 10: Data components iteratively re-weighted following Francis (2011). The implementation of the Francis (2011) approach is similar to approach described above for SS: weights are applied by either adjusting CVs of the abundance indices or adjusting effective sample sizes of composition data using variance adjustment factors to ensure consistency between the degree of uncertainty in each data set and the model's ability to fit those data. However, the calculation of data weights differs between the approaches. Most notably, the Francis (2011) approach tends to down-weight age- and length-composition data relative to the SS approach.

Run 11-16: In addition, a retrospective analysis of Run 1 was conducted, in which the model was refit while sequentially dropping the last six years of data. Retrospective analysis is used to look for systematic bias in key model output quantities over time.

3.1.8 Benchmark/Reference points methods

Benchmark and reference points for fishing mortality and stock biomass were estimated relative to SPR 30% levels. Benchmarks and reference points are calculated in SS. The user can select reference points based on MSY, SPR, and spawning biomass. Stock Synthesis calculates SPR as the equilibrium spawning biomass per recruit that would result from a given year's pattern and intensity of *F*s. For SPR-based reference points, SS searches for an *F* that will produce the specified level of spawning biomass per recruit relative to the unfished value. For spawning biomass-based reference points, SS searches for an *F* that produces the specified level of spawning biomass relative to the unfished value. Both MSY and spawning biomass-based reference points are dependent on the stock-recruit relationship.

3.1.9 Projection methods

Projections were run from 2013 to 2019 for the three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}. $F_{CURRENT}$ was defined as the geometric mean *F* of the three most recent years (2009-2011). F_{SPR30} was used as the F_{MSY} proxy. F_{OY} was defined as 75% of F_{SPR30}.

Projections were run assuming that selectivity, discarding, and retention were the same as the five most recent years. Recruitment deviations for the projection period were derived from the stock-recruitment relationship and did not include inter-annual variation. Catch allocation used for the projections reflects the average distribution of fishing intensity among fleets during 2009-2011. A fixed level of fishing mortality rate equal to the geometric mean *F* of the three most recent years (2009-2011) was used to predict removals for each of the fisheries for 2012 since 2012 data was not available. A fixed level of fishing mortality equal to the geometric mean *F* of the three most recent years (2009-2011) was input for the shrimp fishery for the entire projection period (2013-2019) as recommended by the AP. Thus, it is assumed that recent levels of shrimp fishing effort (2009-2011) are representative of future fishing effort levels. This approach was used since cobia bycatch from the shrimp fishery is assumed to be a function shrimp fishing effort and is independent of cobia management regulations.

3.2 Model Results

3.2.1 Measures of overall model fit

Stock Synthesis effectively treats the landings data as being known without error. Therefore, the landings are fit precisely.

Predicted discards for the commercial fleet were within the observed confidence intervals across all years but did not fit observed estimates well, especially in the early time period (1993-1998) (Figure 3.3). Predicted discards are higher than the observed estimates from 1993-1998 and slightly lower than observed estimates from 1999-2009. The model predicted that the discard proportion (discards/(landings+discards)) would remain relatively stable over time given that selectivity and retention were assumed to be constant over the time period. Thus, model predicted discards generally tracked observed changes in the landings data. However, the observed discards are relatively stable over time despite a corresponding reduction in landings, which peaked in the mid-1990’s, suggesting an increase in the discard rate over time from 1993-2011. One potential reason for this mismatch is that the observed discard data contains high uncertainty while the observed landings are treated as being known without error. Given that selectivity and retention are assumed to be constant, the model would require a strong signal in the length composition data to predict an increase in the discard proportion over time. However, the length composition data of the landings are relatively stable over time and the observed mean length of cobia landed in the commercial fishery has not changed over time. Thus, there is nothing in the data or model parameterization to corroborate the observed increase in discard rate over time.

The fit to the recreational discards was better than the commercial discards but showed a similar pattern. Following the implementation of the size limit, predicted discards for the recreational fleet are higher than the observed estimates from 1986-1997 (except 1991), then lower than observed estimates from 1998-2002 and then fit well in the most recent years (2003-2011) (Figure 3.4). The model predicted discard rates were very similar to the observed discard rates from 1990-2011 (Figure 3.5). The model predicted discards and discard rate was higher than the observed estimates from 1986-1990 as the model estimated a large increase in the discard rate from the implementation of the minimum size limit in 1985. However, the observed recreational discard data does not show a rapid change in discards following 1984; in fact, the data shows almost no discards in 1985 (0.02). The recreational length composition data shows some evidence that the size limit was not effective for a few years after implementation as a number of sub-legal fish are observed in the sampled landings from 1984-1987. Following 1990, the observed and predicted discard rates are very similar. In 1990, a two-fish bag limit was instituted for cobia for U.S. federal waters. There is evidence of a large increase in discards between 1989 and 1991 suggesting the bag limit had an effect on discard rate. However, the bag limit was not implemented in the assessment model. The models ability to fit the recreational discard data well despite not accounting for the two-fish bag limit suggests that the bag limit is rarely filled by recreational fisheries. Of the trips with positive catches of cobia in the MRFSS data set, only 2% filled the bag limit.

Predicted cobia bycatch from the shrimp fishery was appropriately scaled and followed the patterns of shrimp fishing effort input into the model (Figure 3.6). The model predicted mean bycatch level was very similar to the input estimate used for the super-year approach (Figure 3.6). The model predicted annual cobia bycatch estimates were not fit to the annual estimates of cobia bycatch from the data workshop. Instead, the model predicted annual cobia bycatch using the model predicted mean bycatch level and the input estimate of shrimp fishing effort.

The indices of abundance were fit well by the model (Figures 3.7 and 3.8). The model fit to the MRFSS index was somewhat better than the model fit to the Headboat index. The root mean squared error (RMSE) for the MRFSS and Headboat index was 0.222 and 0.236, respectively. These values were very similar to the input average annual variance estimates, 0.156 and 0.234, for the MRFSS and Headboat indices. The MRFSS index started earlier (1981) relative to the Headboat index (1985) and has lower CVs in the most recent years. The MRFSS index is characterized by two periods of stock decline (1981-1986, 1996-2006) and two periods of subsequent stock recovery (1986-1996, 2006-2011). The model was unable to fit some the drastic inter-annual changes in abundance but fit the overall pattern of the index well. The Headboat index is characterized by an initial increase from the late 1980's through the early 1990's followed by a relatively stable trend from 1995-2011. The model fit the overall trend in the index well but predicted greater fluctuations in abundance than the Headboat index suggested. The shrimp fishery effort which was input as an index of fishing mortality was fit almost precisely by the model (Figure 3.9). The model configuration did not require an exact match to the shrimp fishing effort; a CV of 0.10 was used for the index.

The length compositions were fit well by the model, especially given the low sample sizes in some years (Figures 3.10-3.14). The fit to the recreational length composition data was generally superior to the fit of the commercial length compositions owing to the relatively greater sample sizes. Length compositions were fit better later in the time series for both the commercial and recreational length compositions. Sample sizes for the commercial length compositions were low from 1983-1990 (Figure 3.10). Only one year of commercial data had greater than 100 length samples. The model underestimated small fish (<70 cm FL) early in the time series (1983-1987) and underestimated large fish (> 110 mm FL) in the middle of the time series (1996-2004) (Figure 3.11). There does appear to be a slight pattern in the residuals with a shift towards larger catches in the middle of the time series when the model predicts stock biomass was highest.

The recreational length compositions were fit very well by the model, especially from 1991-2011. There were high sample sizes (>100) every year from 1985-2011 (Figure 3.12). The predicted distribution is slightly wider than the observed distribution leading to some positive residuals in the middle of the distribution and negative residuals at the tails. The model underestimated the number of fish less than 60 cm FL throughout the time series (Figure 3.13). The model estimated the asymptote of the retention curve used for 1985-2011 to be right at the size limit of 83 cm FL, however, the model did allow for some retention under the size limit by widening the slope of the curve relative to a knife-edge slope. The higher slope improved the fit to the length composition data given the number of samples under the size limit. It is unclear why so many sublegal fish were in the observed length composition data.

The model fit the SEAMAP trawl survey length composition data well (Figure 3.14). The SEAMAP trawl survey length composition data consisted of 295 cobia measured from 1987-2011 which were combined into a single length composition using the super-year approach and assumed to representative of the shrimp fishery. The predicted length composition effectively fit the mode of fish observed in the SEAMAP trawl survey between 30-50 cm FL.

The conditional age compositions were fit well by the model given the small sample sizes (Figure 3.15a-3.15c). The largest residuals tended to occur for older fish with the model under-estimating the mean length-at-age of older fish. This occurred because the model predicted very strong size selection effects from the recreational and commercial fisheries (Figure 3.16). The input conditional-length-at-age data were exclusively fishery-dependent samples from the recreational fishery which has a minimum size limit of 83.8cm FL. Of the 1229 length-at-age samples, 1114 were fish greater than the minimum size limit. SS accounts for the size-selection of the fishery when estimating the population growth curve. The estimated population growth curve from SS was lower than the growth curve estimated at the DW (Figure 3.17). The DW growth curve was supposed to account for the effects of size-selection using the Diaz et al. (2004) approach. However, SS predicted greater size-selection bias than the DW model.

3.2.2 Parameter estimates & associated measures of uncertainty

A list of all model parameters is presented in Table 3.1. The table includes predicted parameter values and their associated standard errors from SS, initial parameter values, minimum and maximum values a parameter could take, and whether the parameter was fixed or estimated. Parameters designated as fixed were held at their initial values.

The standard errors are low for the majority of parameters with a few exceptions. The standard errors are high for a number of the recruitment deviations, indicating that the recruit deviations are poorly estimated (Figure 3.18). Standard errors for recruitment deviations increased over time with standard errors generally less than 0.2 prior to 1996 and increasing to around 0.3 from 1996-2010. The two most recent years of recruitment deviations had the greatest uncertainty with recruitment for 2011 being the most uncertain parameter estimated. There was not a lot of data available to inform the recruitment deviations; the age composition data was too sparse to track cohorts through time and the length composition data are not particularly informative about historical recruitment patterns because cobia have very fast and variable growth and a minimum size limit has existed over the entire data-rich period.

Two of the parameters used to model the double-normal selectivity pattern for the shrimp fishery had high standard errors. These two parameters controlled the initial selectivity at the minimum size and the ascending width of the selectivity curve (see Section 3.2.3). All other parameters had relative standard errors less than 20%.

In general, estimates of uncertainty from the bootstrap procedure were very similar to estimates of asymptotic standard errors calculated by inverting the Hessian matrix. A list of the mean and standard deviation from the distribution of parameter estimates for the 1000 bootstrap samples is presented in Table 3.2.

To test for convergence, 50 trials were performed using a ‘jitter’ value (Method 2011) of 0.1 for the base case model. Forty-eight of these trials returned converged on a solution that was within 2 likelihood units of the base case, inverting the Hessian and producing small gradients (Table 3.3). Only one trial failed to converge. Results of trials that converged on a solution show almost identical levels of ending depletion and spawning biomass. This test cannot prove convergence of the model, but it did not provide any evidence to the contrary.

3.2.3 Fishery Selectivity

Fishery size selectivity patterns for the commercial and recreational fisheries were modeled using logistic functions (Figures 3.19-3.21). As expected, the recreational fishery selects for smaller fish than the commercial fishery. The estimated selectivity curve for the commercial fishery was much steeper than the recreational fishery. Both abundance indices were assumed to have the same selectivity patterns as the recreational fishery.

Two retention functions were modeled for both the commercial and recreational fisheries to account for the implementation of a minimum size limit in 1984 (Figures 3.22-3.23). Retention was modeled to change starting in 1985. Prior to the size limit, the retention curve was fixed so that fish less than 40 cm FL were discarded. The two parameters used to model retention curve for both the commercial and recreational fisheries following the size limit were estimated by the model. The estimated asymptote for the retention curve was 92 cm FL for the commercial fishery and 82 cm FL for the recreational fishery. The model predicted the commercial fishery would release some legal size fish, while the model estimated the recreational retention less right at the size limit.

Size selectivity for the shrimp fishery was modeled using a 6 parameter double-normal function (Figure 3.24). The double-normal allows for a large range of potential shapes to the selectivity curve. All sizes of fish were predicted to be vulnerable to the shrimp fishery. The selectivity of fish less than 30cm FL was predicted to be 45%. Length composition data from the SEAMAP trawl survey show that fish begin to be captured at 16cm FL. There was some evidence of differences in composition in length composition from samples collected in the summer verse samples collected in the fall (Figure 3.25). Sample sizes of cobia collected in the summer were small but the distribution shows a mode around 20cm FL. These fish are likely fast growing or early spawned age-0 fish. Beyond 30cm FL selectivity increases rapidly with a peak between 35 and 40cm FL and then quickly descends. This peak corresponds with the majority of the samples collected during the fall SEAMAP surveys. Selectivity for the shrimp fishery was predicted to be constant at a low level for fish greater 50 cm FL. Observations of large cobia in the SEAMAP trawl survey support this pattern. The standard errors for two of the selectivity parameters were high and indicate that this selectivity pattern was not well estimated. The correlation matrix shows that the parameters describing the initial pattern of the selectivity curve were highly correlated. A number of model configurations were attempted to alleviate this issue. Reducing the bin size for the length composition data from 5cm bins to 3cm bins had the biggest impact on reducing the uncertainty in these parameters. The distribution of parameter estimates from the bootstrapping procedure show high uncertainty in the models ability to estimate these parameters (Figure 3.26).

3.2.4 Recruitment

Steepness is estimated to be 0.925 and virgin recruitment is 1,033,130 age 0 recruits for the base model. The asymptotic standard errors for steepness and unexploited equilibrium recruitment (ln(R_0)) are 0.13 and 0.10, respectively. The standard deviation from the bootstrap samples for steepness and ln(R_0) are 0.08 and 0.07, respectively (Table 3.2). The distribution of estimates from the 1000 bootstrap samples support that equilibrium recruitment was well estimated by the model (Figure 3.27). The bootstrap analysis revealed that steepness was not well estimated and that the model tended to approach the upper bound of steepness for a large proportion of model runs (Figure 3.27). The distribution of estimates from the bootstrap analysis suggests that steepness is likely to greater than 0.8 but estimates between 0.85 and 1.0 were equally likely.

The plot of the stock-recruitment relationship shows little contrast over time in terms of spawning biomass (Figure 3.28). Spawning biomass is predicted to have been relatively stable over the past 30 years (relative to virgin biomass) leading to little variation in stock size. Two of the highest recruitment years were predicted to occur directly following the year with the lowest spawning stock biomass. In addition, the landings data and MRFSS index both show patterns of rapid stock increase following decreases suggesting a relatively productive stock.

Predicted age-0 recruits are presented in Figure 3.29 and Table 3.4. The model predicts a number of poor recruitment years starting in 1982, the first year the model can estimate recruitment deviations. The model predicts higher than average or average recruitment from 1989-1996. The landings data and abundance indices all show a similar pattern of increasing abundance over this time period. The model predicts a number of lower than average recruitment years from 1996-2007. This coincides with a decrease in the landings data and decrease in the MRFSS index. Predicted recruitment over the past several years is average but highly uncertain. An uptick in landings for both the commercial and recreational fishery as well as the MRFSS index supports the higher than average recruitments during the most recent years.

The likelihood profile of steepness shows that steepness is relatively flat between 0.80 and 1.0 (Figure 3.30). However, there is a minimum between 0.85 and 0.95 and the profile increases rapidly for steepness values less than 0.70. There is some discrepancy in the estimate of steepness from the alternative likelihood components. The recruitment component of the likelihood shows a strong preference towards a value of steepness that approaches the limit of 1.0. The length data and discard data both have minima around 0.8. The age composition data favors a steepness value around 0.65. There appears to be little information in any of the abundance indices for steepness. When the likelihood profile of steepness was rerun at a finer scale it was revealed that the point estimate of steepness may not be well defined in the model. This is illustrated by the bouncing up and down of the length- and age-composition likelihood components when the profile is run at a finer scale (Figure 3.31). The bouncing of the likelihood components occurs because the model is settling on two alternative model solutions with slightly different point estimates of growth and selectivity parameters. This occurs due to confounding between the growth parameters and selectivity parameters. In particular, the model has trouble estimating the growth of young fish and selectivity of the shrimp fishery. Despite this ‘chatter’ in the likelihood, the alternative solutions are very similar and point estimates of growth and selectivity parameters are only slightly different. In addition, the patterns of stock dynamics are not different between the alternative solutions.

The likelihood profile of equilibrium recruitment shows that this parameter is well estimated (Figure 3.32). All likelihood components show a similar signal favoring a value near 7 for equilibrium recruitment (base model = 6.94).

3.2.5 Stock Biomass

Predicted total biomass and spawning biomass are presented in Table 3.4 and Figures 3.33 and 3.34, respectively. The bootstrap distributions of estimates of biomass show these values were well estimated by the model (Figure 3.35). The general biomass trend is a steady decline starting in 1950 as the recreational and shrimp fisheries begin to build up. Biomass is predicted to have reached a minimum from 1984-1989 and then increased rapidly from 1989 to 1997. The predicted biomass declines from 1997 to 2007 and then is followed by a steady increase over the past four years. Total stock biomass in the most recent year is predicted to be 34% of the unfished total biomass. Spawning stock biomass is predicted to be 30.5% of the unfished spawning stock biomass (Table 3.5). Spawning stock biomass is predicted to have exceeded the target spawning biomass ($SSB_{SPR30\%}$) in the two most recent years. Spawning stock biomass was less than $SSB_{SPR30\%}$ from 1983-1991 with a minimum of 0.57 in 1986. Spawning stock biomass exceeded $SSB_{SPR30\%}$ from 1992-2003 but then decreased to levels less than $SSB_{SPR30\%}$ again from 2004-2009.

Predicted abundance at age is presented in Figure 3.36. Mean age was predicted to be 1.76 years at unfished conditions. Mean age steadily declines from 1950 to 1980 to just over 1 years as the fisheries developed. The minimum predicted mean age over the time series was 0.48 in 1989. Predicted mean at age has been increasing since 1989 with some oscillation; mean age in 2010 is predicted to be 1.22.

3.2.6 Fishing Mortality

Predicted fishing mortality rates are presented in Table 3.6. Fishing mortality shows a steady increase for all fleets following 1950 (Figure 3.37). The commercial fishery *F* increases at a slower rate than the other fisheries but shows a rapid increase in the 1980's with a peak instantaneous fishing mortality rate of 0.50 y^{-1} occurring in 1989. The fishing mortality rate for commercial fishery declines rapidly following 1989 and has been steady around 0.075 y^{-1} since 2000. The recreational fishery shows an exponential pattern of increase from 1950 to 1986. Recreational *F* peaks at 1.44 y^{-1} in 1986. Recreational fishing mortality has oscillated around 0.40 y^{-1} since the late 1990's with lower rates over the past few years. Fishing mortality from the recreational fishery in 2009 was at its lowest level since the late 1970's. The patterns of fishing mortality in the shrimp fishery follow the patterns in shrimp effort input into the model. Shrimp fishery *F* peaks in the late 1980's similar to the other fisheries. A large decrease in shrimp effort since 2000 leads to predictions of low *F*s over the most recent years.

Fishing mortality rate was predicted to exceed the target fishing mortality rate of $F_{SPR30\%}$ from 1984-1989 (Table 3.6; Figure 3.38). Fishing mortality rates have been less than $F_{SPR30\%}$ since 1989. The average fishing mortality relative to $F_{SPR30\%}$ over the past three years is 0.63. Results of the bootstrap analysis show that overfishing was likely occurring in the mid to late 1980's and overfishing is no longer occurring (Figure 3.39).

3.2.7 Evaluation of Uncertainty

Estimates of asymptotic standard errors for all model parameters are presented in Table 3.1. A list of the mean and standard deviation from the distribution of parameter estimates for the 1000 bootstrap samples is presented in Table 3.2. In general, estimates of uncertainty were very similar between the two methods.

Results of the sensitivity analysis are summarized in Table 3.7.

Run 2: Low *M* run. Decreasing the natural mortality rate led to a stock that was experiencing greater fishing mortality and more depressed relative to stock reference points. This was the only scenario in which the stock was predicted to be overfished or undergoing overfishing. Given this level of natural mortality, the model predicted a higher virgin spawning stock biomass and lower current spawning stock biomass relative to the base model (Figure 3.40). In addition, the stock is predicted to have been overfished since 1980 and to have been undergoing overfishing every year from 1978-2011 except 2010 (Figure 3.41).

Run 3: High *M* run. Increasing the natural mortality rate led to a stock that was experiencing less fishing mortality and was in improved shape relative to reference points. This scenario resulted in the best stock status of all sensitivity runs. Given this level of natural mortality, the model predicted a lower virgin spawning stock biomass and higher current spawning stock biomass relative to the base model (Figure 3.40). In addition, the stock is predicted to have been fished at levels less than F_{SPR30} over the entire time series (Figure 3.41).

Run 4: High discard mortality run. Increasing the discard mortality rate from 0.05 to 0.10 had little impact on the stock dynamics or stock status (Table 3.7). The model predicted slightly greater productivity and slightly higher fishing mortality rates under this scenario.

Run 5: Steepness fixed at 0.70. Fixing the steepness at a lower level of 0.70 resulted in a predicted stock biomass that was more depressed relative to unfished levels compared to the base model (Figure 3.42). In addition, the model predicted the stock to be experiencing slightly lower fishing mortality. Under this scenario, the stock status relative to reference levels was similar to the base run with the stock neither overfished nor undergoing overfishing (Figure 3.43).

Run 6: Steepness fixed at 0.80. Fixing the steepness at a lower level of 0.80 resulted in a predicted stock biomass that was more depressed relative to unfished levels compared to the base model (Figure 3.42). In addition, the model predicted the stock to be experiencing slightly lower fishing mortality. Under this scenario, the stock status relative to reference levels was similar to the base run with the stock neither overfished nor undergoing overfishing (Figure 3.43).

Run 7: MRFSS index only. Removing the Headboat index from the assessment led to a stock that was less productive and experiencing greater fishing mortality. Removing the Headboat index had the greatest influence on predicted spawning biomass and fishing mortality rates over the past 11 years; historical patterns prior to 2000 were very similar to the base model (Figure 3.44). The MRFSS index suggests that the relative abundance of cobia throughout the 2000's is depressed relative to the relative abundance throughout the 1990's. Under this scenario the model predicted lower current spawning biomass and higher fishing mortality rate compared to the base model (Figure 3.44). In addition, the model predicted F exceeded F_{SPR30} in 2003 and 2007 and that the spawning biomass has been less than SSB_{SPR30} since 2001 (Figure 3.45).

Run 8: Headboat index only. Removing the MRFSS index from the assessment led to a stock that was more productive and experiencing lower fishing mortality. The model estimated steepness to be at the upper bound of 1.0 when the MRFSS index was removed. The Headboat index shows an increasing trend in stock size over the survey period of 1985-2011 with no signal of stock decline. Under this scenario the model predicted higher current spawning biomass and lower fishing mortality rates compared to the base model (Figures 3.44).

Run 9: Data component weights iteratively re-weighted using SS approach. The model fit the abundance indices very well. A small additional variance component was added to the MRFSS and Headboat index, 0.0644 and 0.0028, respectively. The model fit to the recreational length composition data was better than expected and was up-weighted slightly (1.138). The commercial and shrimp fishery length composition data were down-weighted by a factor of 0.846 and 0.688, respectively. Reweighting of the model components led to a stock that was slightly more productive and experiencing lower fishing mortality rates. However, patterns of stock dynamics over time (Figure 3.46) and current status relative to benchmark levels are very similar to the base model (Figure 3.47).

Run 10: Data components iteratively re-weighted following Francis (2011). The Francis (2011) approach up-weighted the Headboat index (-0.02) and down-weighted the MRFSS index slightly (0.067). The model fits to the index data and weights were very similar between the two methods. In contrast to the SS weighting approach, the Francis (2011) approach down-weighted all length composition data. The recreational and commercial length composition data were down-weighted by a factor of 0.41 and 0.53, respectively. This approach did not estimate a weighting factor for the shrimp length composition data because only one year of data was available. Reweighting of the model components led to a stock that was slightly more productive and experiencing lower fishing mortality rates. The stock status and dynamics were very similar between the two weighting approaches (SS and Francis (2011)) and the base case model (Figures 3.46-3.47). The reweighting of data components did not reveal any conflicting information among alternative data sources.

Results of the retrospective analysis are also presented in Table 3.7. In general, there were no major patterns or systematic bias revealed from the retrospective analysis. Removing the past two years of data led to predictions of higher steepness. Predicted spawning stock biomass over time was relatively consistent for each of the data sets analyzed (Figure 3.48). Predicted age-0 recruits showed divergence between the models starting in 2002 (Figure 3.49). The data set ending in 2008 predicted a spike in recruitment in the final year that was not predicted for the 2009-2011 data sets. The final two years of recruitment had high uncertainty in the base model and thus divergence in predicted recruitments was expected since there is no data to inform the most recent years in any of the models. Fishing mortality rate patterns were consistent between the data sets and no bias was revealed (Figure 3.50).

3.2.8 Benchmarks/Reference points

Stock status and benchmarks relative to the SPR 30% reference point are presented in Table 3.8 for each of the sensitivity runs. The maximum fishing mortality threshold (MFMT) was the fishing mortality rate that produced a SPR of 30%, $F_{SPR30\%}$. The minimum stock size threshold (MSST) was calculated as $(1-M)*SSB_{SPR30\%}$, where $M = 0.38\ y^{-1}$ for the base model. For the base case model the stock is not considered overfished nor undergoing overfishing. For the base model the current fishing mortality rate (2009-2011) relative to MFMT was 0.63 and the current spawning biomass (2011) relative to MSST was 1.73. All 1000 estimates from bootstrap analysis predicted that current fishing mortality was less than $F_{SPR30\%}$ (Figure 3.51) and current stock size was greater than MSST (Figure 3.52). The status of the stock relative to $F_{SPR30\%}$ and $SSB_{SPR30\%}$ over the time series for the base model is presented in Figure 3.53. The status of the stock relative to MFMT and MSST over the time series for the base model is presented in Figure 3.54. For all sensitivity runs except the low natural mortality rate scenario (Run 2) the stock was is not considered overfished or undergoing overfishing (Figure 3.55). For the low natural mortality rate scenario the stock was considered both overfished and undergoing overfishing.

Yield per recruit and spawning potential ratio were computed as functions of F (Figure 3.56). The yield per recruit curve peaked at F_{max} = 0.63. The *F* that provides 30% SPR is 0.38 and F_{msy} is 0.51. SPR at F_{msy} is estimated at 21%. Equilibrium catch was also computed as function of *F* (Figure 3.56). By definition, the *F* that maximizes equilibrium catch is F_{msy}, and the corresponding level of catch is MSY. Equilibrium catch was estimated in terms of total removals (landings plus dead discards) for this analysis. Equilibrium catch as a function of stock depletion is presented in Figure 3.57. MSY, in terms of total removals from all fleets, was estimated at 1335 (mt) and occurs when the stock is at 19% of virgin biomass.

3.2.9 Projection

Benchmarks for the SPR 30% reference point and projections are presented in Tables 3.9. Only a subset of the sensitivity runs was selected for use in projections. The AP felt that the entire set of sensitivity runs was not necessary for projections and only a subset designed to represent possible alternative states of nature were used. The AP decided to use three values of natural mortality rate (base, low and high) to evaluate alternative states of nature. For the base model, current exploitation rate is less than the target exploitation rate for achieving an SPR of 30% (Figure 3.59). Fishing at either F_{SPR30} or F_{OY} levels would require an increase in the fishing mortality rate. The current spawning biomass is greater than the minimum stock size threshold but close to a target biomass of $SSB_{SPR30\%}$ (Figure 3.60). Fishing at a F_{SPR30} would lead to a decrease in stock biomass relative to current levels. Fishing at either F_{OY} or $F_{CURRENT}$ levels would lead to an increase in the spawning stock biomass. The projected yield stream for the base model suggests that the stock can sustain a greater yield relative to yield at current exploitation rates (Figure 3.61). Under all three fishing mortality scenarios, the model projects an increase in the level of yield compared to recent levels. One reason for the projected increase in yield even under the $F_{CURRENT}$ scenario, is that the model predicts sustained levels of recruitment that are greater than the average recruitment from 2001-2011 (Figure 3.62). The model uses the stock-recruitment relationship to predict recruitments during the projection period. Uncertainty in projected yield from the bootstrap analysis for the base model at F_{SPR30} is presented in Figure 3.63.

The sensitivity run with a lower natural mortality rate (Run 2) predicted that the stock was both overfished and undergoing overfishing. However, stock biomass was predicted to be increasing in recent years and fishing mortality rate was very close to F_{SPR30} (Figure 3.64). Both the F_{SPR30} and F_{OY} scenarios led to the stock that was neither undergoing overfishing nor overfished by 2014 (Figures 3.64-3.65). The $F_{CURRENT}$ scenario resulted in stock that was no longer overfished by 2014 but was still undergoing overfishing over the entire projection period. Under all three fishing mortality scenarios, the model projects an increase in the level of yield compared to recent levels (Figure 3.66). One reason for the projected increase in spawning biomass and yield is that the model predicts sustained levels of recruitment that are greater than the average recruitment from 2001-2011 (Figure 3.67).

The sensitivity run with a higher natural mortality rate (Run 3) predicted that the current spawning stock biomass exceeded $SSB_{SPR30\%}$ and that current fishing mortality was less than $F_{SPR30\%}$. Fishing at either F_{SPR30} or F_{OY} levels would require over the fishing mortality rate to be over twice as high relative to current levels (Figure 3.68). Both the F_{SPR30} and F_{OY} fishing mortality scenarios led to a decrease in spawning biomass closer to $SSB_{SPR30\%}$ levels (Figure 3.69). Fishing at either F_{SPR30} or F_{OY} levels would also lead to substantially greater yields relative to current yields (Figure 3.70).

Tables 3.10-3.12 show projected yield, fishing mortality rate, fishing mortality rate relative to $F_{SPR30\%}$, spawning biomass, and spawning biomass relative to $SSB_{SPR30\%}$ for 2013 to 2019 for three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

3.3 Discussion and Recommendations

Gulf of Mexico cobia suffers some of the same problems that make assessments of data poor species so difficult. There is not a large targeted fishery for cobia and they tend to occur mostly as an opportunistic catch. For this reason, many sources of data lacked sufficient sample sizes to be included in the assessment. Given the low frequency of positive catches pre trip, both of the fishery dependent indices of abundance and the annual estimates of recreational discards were sensitive to individual positive catches.

The majority of the length composition data, all of the age-composition data, and both indices of abundance came from the recreational fishery which is the primary fishery. The landings data are dominated by the recreational fishery; however, catches prior to 1981 are likely highly uncertain. Uncertainty in the hindcast estimates of recreational landings was not incorporated into the model and should be evaluated in future assessments.

Data on the size of discarded fish was lacking for the recreational fishery. The reef fish observer program provided some information on the size composition of released fish for the commercial fishery in recent years. This information helped in estimating the selectivity and retention parameters of the commercial fishery. Length composition data of discarded fish for the recreational fishery would have improved the assessment model.

Lack of age composition data restricted the assessment from being able to track cohorts through time or identify strong year classes. A systematic age sampling program for the recreational fishing sector would improve future assessments.

The parameters describing early growth of cobia and the selectivity pattern of the shrimp fishery had the greatest uncertainty and required extensive model diagnostics to reconcile. Additional information on the size selectivity patterns for the shrimp fishery would have improved the assessment model.

3.4 Acknowledgements

Many people at various state and federal agencies assisted with assembling the data sources included in this stock assessment. The assessment panel was instrumental in guiding the assessment configuration and dealing with the nuances of the data. Jeff Isely was the original lead analyst for this assessment and completed the majority of the ground work for the assessment. Nancie Cummings was part of the SEDAR 28 analyst team and provided significant input along the way. The assessment was greatly improved with help of Clay Porch, Shannon Cass-Calay, Michael Schirripa, Brian Linton, and John F. Walter. Richard Methot provided an updated version of Stock Synthesis 3 exclusively to deal with issues which arose during the assessment and helped answer a number of questions along the way. Ian Taylor has greatly improved the R code for plotting and diagnostics of Stock Synthesis models (http://code.google.com/p/r4ss/) with which many of the figures in this document were created.

3.5 References

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3.6 Tables

Table 3.1. List of SS parameters for Gulf of Mexico cobia. The list includes predicted parameter values and their associated standard errors from SS Run 1, initial parameter values, minimum and maximum values a parameter could take, and prior densities assigned to parameters. Parameters designated as fixed were held at their initial values.

Label	Value	SD	Initial	Min	Max	Status	Description
L_at_Amin_Fem_GP_1	46.599	1.666	41	15	60	Estimated	Length at age 0.5
L_at_Amax_Fem_GP_1	133.304	9.161	128.1	100	150	Estimated	Linf
VonBert_K_Fem_GP_1	0.209	0.037	0.3	0.08	0.8	Estimated	K
CV_young_Fem_GP_1	0.223	0.010	0.1	0.001	0.5	Estimated	Young growth CV
CV_old_Fem_GP_1	0.115	0.021	0.1	0.001	0.5	Estimated	Old growth CV
Wtlen_1_Fem	0.000	_	9.64E-06	_	_	Fixed	Weight-length scalar
Wtlen_2_Fem	3.030	_	3.03	_	_	Fixed	Weight-length exponent
Eggs/kg_inter_Fem	1.000	_	1	_	_	Fixed	Fecundity scalar
Eggs/kg_slope_wt_Fem	1.000	_	0	_	_	Fixed	Fecundity exponent
SR_LN(R0)	6.940	0.108	7	1	20	Estimated	Virgin recruit
SR_BH_steep	0.925	0.130	0.8	0.2	1	Estimated	Steepness
SR_sigmaR	0.600	_	0.6	_	_	Fixed	Stock -recruit standard deviation
SR_envlink	0.100	_	0.1	_	_	Fixed	Stock-recruit environmental link
SR_R1_offset	0.000	_	0	_	_	Fixed	Stock-recruit offset
SR_autocorr	0.000	_	0	_	_	Fixed	Stock-recruit autocorrelation
Main_RecrDev_1982	-0.253	0.194	_	_	_	Estimated	1982 recruit deviation
Main_RecrDev_1983	-1.163	0.291	_	_	_	Estimated	1983 recruit deviation
Main_RecrDev_1984	0.489	0.098	_	_	_	Estimated	1984 recruit deviation
Main_RecrDev_1985	-0.690	0.185	_	_	_	Estimated	1985 recruit deviation
Main_RecrDev_1986	0.510	0.116	_	_	_	Estimated	1986 recruit deviation
Main_RecrDev_1987	-0.143	0.142	_	_	_	Estimated	1987 recruit deviation
Main_RecrDev_1988	-0.259	0.166	_	_	_	Estimated	1988 recruit deviation
Main_RecrDev_1989	0.740	0.129	_	_	_	Estimated	1989 recruit deviation
Main_RecrDev_1990	0.707	0.166	_	_	_	Estimated	1990 recruit deviation
Main_RecrDev_1991	0.226	0.175	_	_	_	Estimated	1991 recruit deviation
Main_RecrDev_1992	-0.180	0.146	_	_	_	Estimated	1992 recruit deviation
Main_RecrDev_1993	0.675	0.088	_	_	_	Estimated	1993 recruit deviation
Main_RecrDev_1994	0.456	0.102	_	_	_	Estimated	1994 recruit deviation
Main_RecrDev_1995	0.537	0.137	_	_	_	Estimated	1995 recruit deviation
Main_RecrDev_1996	0.545	0.176	_	_	_	Estimated	1996 recruit deviation
Main_RecrDev_1997	-0.580	0.367	_	_	_	Estimated	1997 recruit deviation
Main_RecrDev_1998	-0.054	0.278	_	_	_	Estimated	1998 recruit deviation
Main_RecrDev_1999	0.211	0.240	_	_	_	Estimated	1999 recruit deviation
Main_RecrDev_2000	-0.202	0.317	_	_	_	Estimated	2000 recruit deviation

Main_RecrDev_2001	0.317	0.160	_	_	_	Estimated	2001 recruit deviation
Main_RecrDev_2002	-0.365	0.206	_	_	_	Estimated	2002 recruit deviation
Main_RecrDev_2003	-0.283	0.188	_	_	_	Estimated	2003 recruit deviation
Main_RecrDev_2004	0.107	0.155	_	_	_	Estimated	2004 recruit deviation
Main_RecrDev_2005	-0.465	0.251	_	_	_	Estimated	2005 recruit deviation
Main_RecrDev_2006	-0.292	0.225	_	_	_	Estimated	2006 recruit deviation
Main_RecrDev_2007	0.236	0.171	_	_	_	Estimated	2007 recruit deviation
Main_RecrDev_2008	-0.091	0.276	_	_	_	Estimated	2008 recruit deviation
Main_RecrDev_2009	-0.181	0.314	_	_	_	Estimated	2009 recruit deviation
Main_RecrDev_2010	-0.556	0.402	_	_	_	Estimated	2010 recruit deviation
Late_RecrDev_2011	0.311	0.602	_	_	_	Estimated	2011 recruit deviation
InitF_1Commercial	0.000	_	0	0	1	Fixed	Commercial initial F
InitF_2Recreational	0.000	_	0	0	1	Fixed	Recreational initial F
InitF_3Shrimp_Bycatch	0.000	_	0	0	1	Fixed	Shrimp initial F
Q_base_3_Shrimp_Bycatch	1.709	0.148	1	-10	20	Estimated	Catchability coefficient for shrimp effort
SizeSel_P1_Commercial	88.006	1.209	80	40	150	Estimated	Commercial size select peak
SizeSel_P2_Commercial	16.123	1.138	10	1	50	Estimated	Commercial size select slope
DiscMort_P1_Commercial	-5.000	_	-5	-10	10	Fixed	Commercial discard inflection
DiscMort_P2_Commercial	1.000	_	1	-1	2	Fixed	Commercial discard slope
DiscMort_P3_Commerical	0.050	_	0.05	-1	2	Fixed	Commercial discard asymptotic mortality
DiscMort_P4_Commerical	0.000	_	0	-1	2	Fixed	Commercial male offset
SizeSel_P1_Recreational	71.624	2.375	70	40	150	Estimated	Recreational size select peak
SizeSel_P2_Recreational	33.411	2.160	10	1	60	Estimated	Recreational size select slope
DiscMort_P1_Recreational	-5.000	_	-5	-10	10	Fixed	Recreational discard inflection
DiscMort_P2_Recreational	1.000	_	1	-1	1	Fixed	Recreational discard slope
DiscMort_P3_Recreational	0.050	_	0.05	-1	2	Fixed	Recreational discard asymptotic mortality
DiscMort_P4_Recreational	0.000	_	0	-1	2	Fixed	Recreational male offset
SizeSel_P1_Shrimp_Bycatch	34.485	0.345	35	20	50	Estimated	Shrimp size select peak
SizeSel_P2_Shrimp_Bycatch	-3.041	0.253	-3	-15	15	Estimated	Shrimp size select top
SizeSel_P3_Shrimp_Bycatch	-9.738	6.904	-2	-15	15	Estimated	Shrimp size select ascending width
SizeSel_P4_Shrimp_Bycatch	3.646	0.445	5	-15	15	Estimated	Shrimp size select descending width
SizeSel_P5_Shrimp_Bycatch	-0.286	0.470	-10	-15	15	Estimated	Shrimp size select initial
SizeSel_P6_Shrimp_Bycatch	-2.050	0.258	10	-15	15	Estimated	Shrimp size select final
SizeSel_P1_MRFSS_4	1.000	_	1	1	32	Fixed	MRFSS size select initial bin
SizeSel_P2_MRFSS_4	57.000	_	32	1	32	Fixed	MRFSS size select final bin
AgeSel_P1_Commercial	0.000	_	0	0	15	Fixed	Commercial age select min
AgeSel_P2_Commercial	15.000	_	15	0	15	Fixed	Commercial age select max
AgeSel_P1_Shrimp_Bycatch	0.000	_	0	0	15	Fixed	Shrimp age select min
AgeSel_P2_Shrimp_Bycatch	15.000	_	15	0	15	Fixed	Shrimp age select max
Retain_Commerical_TB1	40.000	_	40	_	_	Fixed	Commercial retention peak pre size limit
Retain_Commercial_TB2	92.337	1.476	83.8	70	100	Estimated	Commercial retention peak post size limit
Retain_Commercial_TB1	2.000	_	2	_	_	Fixed	Commercial retention slope pre size limit

Retain_Commercial_TB2	12.122	1.439	2	0.1	20	Estimated	Commercial retention slope post size limit
Retain_Recreational_TB1	40.000	_	40	_	_	Fixed	Recreational retention peak pre size limit
Retain_Recreational_TB2	82.444	0.493	83.8	70	100	Estimated	Recreational retention peak post size limit
Retain_Recreational_TB1	3.900	2.332	2	0.1	20	Estimated	Recreational retention slope pre size limit
Retain_Recreational_TB2	4.856	0.218	2	0.1	20	Estimated	Recreational retention slope post size limit

Table 3.2. Mean and standard deviation of parameter estimates from 1000 bootstrap samples for Gulf of Mexico cobia.

Label	Value	SD	Status	Description
L_at_Amin_Fem_GP_1	47.77	1.58	Estimated	Length at age 0.5
L_at_Amax_Fem_GP_1	129.54	9.38	Estimated	Linf
VonBert_K_Fem_GP_1	0.21	0.04	Estimated	K
CV_young_Fem_GP_1	0.22	0.01	Estimated	Young growth CV
CV_old_Fem_GP_1	0.15	0.03	Estimated	Old growth CV
Wtlen_1_Fem	9.64E-09	_	Fixed	Weight-length scalar
Wtlen_2_Fem	3.03	_	Fixed	Weight-length exponent
Eggs/kg_inter_Fem	1.00	_	Fixed	Fecundity scalar
Eggs/kg_slope_wt_Fem	1.00	_	Fixed	Fecundity exponent
SR_LN(R0)	6.98	0.07	Estimated	Virgin recruit
SR_BH_steep	0.93	0.08	Estimated	Steepness
SR_sigmaR	0.60	_	Fixed	Stock -recruit standard deviation
SR_envlink	0.10	_	Fixed	Stock-recruit environmental link
SR_R1_offset	0.00	_	Fixed	Stock-recruit offset
SR_autocorr	0.00	_	Fixed	Stock-recruit autocorrelation
Main_RecrDev_1982	-0.38	0.19	Estimated	1982 recruit deviation
Main_RecrDev_1983	-0.93	0.21	Estimated	1983 recruit deviation
Main_RecrDev_1984	0.41	0.10	Estimated	1984 recruit deviation
Main_RecrDev_1985	-0.65	0.17	Estimated	1985 recruit deviation
Main_RecrDev_1986	0.49	0.09	Estimated	1986 recruit deviation
Main_RecrDev_1987	-0.17	0.13	Estimated	1987 recruit deviation
Main_RecrDev_1988	-0.28	0.15	Estimated	1988 recruit deviation
Main_RecrDev_1989	0.72	0.13	Estimated	1989 recruit deviation
Main_RecrDev_1990	0.71	0.15	Estimated	1990 recruit deviation
Main_RecrDev_1991	0.14	0.17	Estimated	1991 recruit deviation
Main_RecrDev_1992	-0.21	0.14	Estimated	1992 recruit deviation
Main_RecrDev_1993	0.68	0.09	Estimated	1993 recruit deviation
Main_RecrDev_1994	0.49	0.10	Estimated	1994 recruit deviation
Main_RecrDev_1995	0.45	0.15	Estimated	1995 recruit deviation
Main_RecrDev_1996	0.49	0.18	Estimated	1996 recruit deviation
Main_RecrDev_1997	-0.37	0.24	Estimated	1997 recruit deviation
Main_RecrDev_1998	-0.14	0.22	Estimated	1998 recruit deviation
Main_RecrDev_1999	0.11	0.21	Estimated	1999 recruit deviation
Main_RecrDev_2000	-0.04	0.21	Estimated	2000 recruit deviation
Main_RecrDev_2001	0.18	0.17	Estimated	2001 recruit deviation
Main_RecrDev_2002	-0.33	0.20	Estimated	2002 recruit deviation
Main_RecrDev_2003	-0.27	0.19	Estimated	2003 recruit deviation
Main_RecrDev_2004	0.04	0.16	Estimated	2004 recruit deviation
Main_RecrDev_2005	-0.38	0.21	Estimated	2005 recruit deviation

Main_RecrDev_2006	-0.34	0.22	Estimated	2006 recruit deviation
Main_RecrDev_2007	0.22	0.17	Estimated	2007 recruit deviation
Main_RecrDev_2008	-0.11	0.24	Estimated	2008 recruit deviation
Main_RecrDev_2009	-0.20	0.22	Estimated	2009 recruit deviation
Main_RecrDev_2010	-0.34	0.22	Estimated	2010 recruit deviation
Late_RecrDev_2011	-0.02	0.19	Estimated	2011 recruit deviation
InitF_1Commercial	0.00	_	Fixed	Commercial initial F
InitF_2Recreational	0.00	_	Fixed	Recreational initial F
InitF_3Shrimp_Bycatch	0.00	_	Fixed	Shrimp initial F
Q_base_3_Shrimp_Bycatch	1.82	0.14	Estimated	Catchability coefficient for shrimp effort
SizeSel_P1_Commercial	88.88	1.33	Estimated	Commercial size select peak
SizeSel_P2_Commercial	16.51	0.98	Estimated	Commercial size select slope
DiscMort_P1_Commercial	-5.00	_	Fixed	Commercial discard inflection
DiscMort_P2_Commercial	1.00	_	Fixed	Commercial discard slope
DiscMort_P3_Commerical	0.05	_	Fixed	Commercial discard asymptotic mortality
DiscMort_P4_Commerical	0.00	_	Fixed	Commercial male offset
SizeSel_P1_Recreational	73.05	3.68	Estimated	Recreational size select peak
SizeSel_P2_Recreational	33.35	3.19	Estimated	Recreational size select slope
DiscMort_P1_Recreational	-5.00	_	Fixed	Recreational discard inflection
DiscMort_P2_Recreational	1.00	_	Fixed	Recreational discard slope
DiscMort_P3_Recreational	0.05	_	Fixed	Recreational discard asymptotic mortality
DiscMort_P4_Recreational	0.00	_	Fixed	Recreational male offset
SizeSel_P1_Shrimp_Bycatch	34.55	2.64	Estimated	Shrimp size select peak
SizeSel_P2_Shrimp_Bycatch	-3.81	2.36	Estimated	Shrimp size select top
SizeSel_P3_Shrimp_Bycatch	-4.59	5.20	Estimated	Shrimp size select ascending width
SizeSel_P4_Shrimp_Bycatch	2.17	2.96	Estimated	Shrimp size select descending width
SizeSel_P5_Shrimp_Bycatch	0.16	1.51	Estimated	Shrimp size select initial
SizeSel_P6_Shrimp_Bycatch	-1.99	0.27	Estimated	Shrimp size select final
SizeSel_P1_MRFSS_4	1.00	_	Fixed	MRFSS size select initial bin
SizeSel_P2_MRFSS_4	57.00	_	Fixed	MRFSS size select final bin
AgeSel_P1_Commercial	0.00	_	Fixed	Commercial age select min
AgeSel_P2_Commercial	15.00	_	Fixed	Commercial age select max
AgeSel_P1_Shrimp_Bycatch	0.00	_	Fixed	Shrimp age select min
AgeSel_P2_Shrimp_Bycatch	15.00	_	Fixed	Shrimp age select max
Retain_Commerical_TB1	40.00	_	Fixed	Commercial retention peak pre size limit
Retain_Commercial_TB2	92.02	1.46	Estimated	Commercial retention peak post size limit
Retain_Commercial_TB1	2.00	0.00	Fixed	Commercial retention slope pre size limit
Retain_Commercial_TB2	12.93	1.98	Estimated	Commercial retention slope post size limit
Retain_Recreational_TB1	40.00	0.00	Fixed	Recreational retention peak pre size limit
Retain_Recreational_TB2	82.87	0.74	Estimated	Recreational retention peak post size limit
Retain_Recreational_TB1	5.03	2.05	Estimated	Recreational retention slope pre size limit
Retain_Recreational_TB2	5.07	0.29	Estimated	Recreational retention slope post size limit

Table 3.3. Model total likelihood, predicted unfished spawning biomass (mt) and predicted 2011 spawning biomass from 50 model runs from the jitter analysis.

Run	Likelihood	SSB unfished	SSB 2011	Depletion
Base model	1127.22	7235	2213	0.31
1	1127.85	7277	2180	0.30
2	1127.85	7277	2180	0.30
3	1126.94	7253	2212	0.30
4	1127.85	7277	2180	0.30
5	1127.85	7277	2180	0.30
6	1126.68	7260	2240	0.31
7	1126.68	7260	2240	0.31
8	1126.94	7253	2212	0.30
9	1127.85	7277	2180	0.30
10	1126.94	7253	2212	0.30
11	1126.68	7260	2240	0.31
12	1127.22	7235	2213	0.31
13	1127.85	7277	2180	0.30
14	1126.94	7253	2212	0.30
15	1126.94	7253	2212	0.30
16	1127.85	7277	2180	0.30
17	1126.94	7253	2212	0.30
18	1127.85	7277	2180	0.30
19	1126.68	7260	2240	0.31
20	1127.22	7235	2213	0.31
21	1127.22	7235	2213	0.31
22	1127.85	7277	2180	0.30
23	1126.94	7253	2212	0.30
24	1127.22	7235	2213	0.31
25	1126.68	7260	2240	0.31
26	1126.94	7253	2212	0.30
27	1126.94	7253	2212	0.30
28	1127.85	7277	2180	0.30
29	1127.22	7235	2213	0.31
30	1126.68	7260	2240	0.31
31	1127.22	7235	2213	0.31
32	1127.22	7235	2213	0.31
33	1126.94	7253	2212	0.30
34	1127.22	7235	2213	0.31
35	1127.22	7235	2213	0.31
36	1126.68	7260	2240	0.31
37	1127.85	7277	2180	0.30
38	1127.85	7277	2180	0.30
39	1126.68	7260	2240	0.31
40	1131.13	7257	2195	0.30
41	1126.94	7253	2212	0.30
42	1127.85	7277	2180	0.30
43	1126.68	7260	2240	0.31
44	1127.22	7235	2213	0.31
45	1126.68	7260	2240	0.31
46	1126.94	7253	2212	0.30
47	1127.85	7277	2180	0.30
48	1127.85	7277	2180	0.30
49	1132.46	7295	2168	0.30
50	1127.22	7235	2213	0.31

Table 3.4. Predicted total biomass (mt), spawning biomass (mt), and age-0 recruits (thousand fish), for Gulf of Mexico cobia from the base model run (Run 1).

Year	Total Biomass	Spawning Biomass	Recruits
1927	8821	7235	1033
1928	8818	7232	1033
1929	8810	7225	1033
1930	8808	7222	1033
1931	8805	7220	1033
1932	8805	7220	1033
1933	8807	7221	1033
1934	8808	7223	1033
1935	8808	7223	1033
1936	8809	7224	1033
1937	8810	7225	1033
1938	8812	7227	1033
1939	8812	7226	1033
1940	8812	7226	1033
1941	8813	7228	1033
1942	8815	7230	1033
1943	8816	7231	1033
1944	8817	7232	1033
1945	8818	7233	1033
1946	8819	7233	1033
1947	8817	7233	1033
1948	8810	7228	1033
1949	8789	7214	1033
1950	8748	7182	1033
1951	8672	7120	1033
1952	8554	7016	1032
1953	8403	6876	1032
1954	8197	6677	1031
1955	7925	6422	1030
1956	7649	6154	1029
1957	7376	5898	1028
1958	7102	5644	1027
1959	6810	5382	1026
1960	6523	5116	1024
1961	6260	4860	1023
1962	6131	4695	1022
1963	5958	4552	1021
1964	5783	4413	1020
1965	5598	4257	1019
1966	5526	4148	1018
1967	5492	4080	1017

1968	5438	4037	1017
1969	5342	3965	1016
1970	5232	3874	1015
1971	5171	3786	1014
1972	5077	3691	1013
1973	4905	3565	1012
1974	4711	3394	1010
1975	4498	3193	1007
1976	4344	3017	1004
1977	4167	2872	1002
1978	3970	2728	999
1979	3695	2534	995
1980	3436	2317	990
1981	3309	2145	985
1982	3316	2132	650
1983	2754	1865	255
1984	2134	1677	1318
1985	2413	1288	396
1986	2033	1186	1302
1987	2353	1196	678
1988	2263	1251	607
1989	2070	1325	1658
1990	2632	1127	1576
1991	3373	1513	1005
1992	3572	2167	688
1993	3311	2349	1625
1994	3736	2134	1298
1995	3922	2195	1410
1996	4421	2710	1440
1997	4629	2851	468
1998	3836	2839	793
1999	3593	2764	1032
2000	3393	2254	675
2001	3089	2113	1129
2002	3178	1980	568
2003	3022	2059	618
2004	2681	1903	909
2005	2747	1670	507
2006	2675	1768	606
2007	2588	1792	1029
2008	2804	1592	735
2009	2978	1803	678
2010	3150	2175	517
2011	3030	2213	1347

Table 3.5. Predicted spawning biomass (mt), spawning biomass relative to unfished spawning biomass (mt), and spawning biomass relative to the reference spawning biomass ($SSB_{SPR30\%}$).

Year	Spawning Biomass	$SSB/SSB_{unfished}$	$SSB/ SSB_{SPR30\%}$
1927	7235	1.00	3.50
1928	7232	1.00	3.50
1929	7225	1.00	3.50
1930	7222	1.00	3.50
1931	7220	1.00	3.50
1932	7220	1.00	3.50
1933	7221	1.00	3.50
1934	7223	1.00	3.50
1935	7223	1.00	3.50
1936	7224	1.00	3.50
1937	7225	1.00	3.50
1938	7227	1.00	3.50
1939	7226	1.00	3.50
1940	7226	1.00	3.50
1941	7228	1.00	3.50
1942	7230	1.00	3.50
1943	7231	1.00	3.50
1944	7232	1.00	3.50
1945	7233	1.00	3.50
1946	7233	1.00	3.50
1947	7233	1.00	3.50
1948	7228	1.00	3.50
1949	7214	1.00	3.49
1950	7182	0.99	3.48
1951	7120	0.98	3.45
1952	7016	0.97	3.40
1953	6876	0.95	3.33
1954	6677	0.92	3.23
1955	6422	0.89	3.11
1956	6154	0.85	2.98
1957	5898	0.82	2.86
1958	5644	0.78	2.73
1959	5382	0.74	2.61
1960	5116	0.71	2.48
1961	4860	0.67	2.35
1962	4695	0.65	2.27
1963	4552	0.63	2.20
1964	4413	0.61	2.14
1965	4257	0.59	2.06
1966	4148	0.57	2.01

1967	4080	0.56	1.98
1968	4037	0.56	1.95
1969	3965	0.55	1.92
1970	3874	0.54	1.88
1971	3786	0.52	1.83
1972	3691	0.51	1.79
1973	3565	0.49	1.73
1974	3394	0.47	1.64
1975	3193	0.44	1.55
1976	3017	0.42	1.46
1977	2872	0.40	1.39
1978	2728	0.38	1.32
1979	2534	0.35	1.23
1980	2317	0.32	1.12
1981	2145	0.30	1.04
1982	2132	0.29	1.03
1983	1865	0.26	0.90
1984	1677	0.23	0.81
1985	1288	0.18	0.62
1986	1186	0.16	0.57
1987	1196	0.17	0.58
1988	1251	0.17	0.61
1989	1325	0.18	0.64
1990	1127	0.16	0.55
1991	1513	0.21	0.73
1992	2167	0.30	1.05
1993	2349	0.32	1.14
1994	2134	0.29	1.03
1995	2195	0.30	1.06
1996	2710	0.37	1.31
1997	2851	0.39	1.38
1998	2839	0.39	1.37
1999	2764	0.38	1.34
2000	2254	0.31	1.09
2001	2113	0.29	1.02
2002	1980	0.27	0.96
2003	2059	0.28	1.00
2004	1903	0.26	0.92
2005	1670	0.23	0.81
2006	1768	0.24	0.86
2007	1792	0.25	0.87
2008	1592	0.22	0.77
2009	1803	0.25	0.87
2010	2175	0.30	1.05
2011	2213	0.31	1.07

Table 3.6. Predicted fishing mortality rate, fishing mortality rate relative to the reference fishing mortality rate ($F_{SPR30\%}$), and spawning potential ratio.

Year	F	F/ $F_{SPR30\%}$	SPR
1927	0	0	1
1928	0	0	1
1929	0	0	1
1930	0	0	1
1931	0	0	1
1932	0	0	1
1933	0	0	1
1934	0	0	1
1935	0	0	1
1936	0	0	1
1937	0	0	1
1938	0	0	1
1939	0	0	1
1940	0	0	1
1941	0	0	1
1942	0	0	1
1943	0	0	1
1944	0	0	1
1945	0	0	1
1946	0	0	1
1947	0	0	0.99
1948	0	0.01	0.98
1949	0	0.01	0.97
1950	0.01	0.02	0.94
1951	0.01	0.04	0.91
1952	0.02	0.05	0.88
1953	0.03	0.09	0.84
1954	0.05	0.12	0.78
1955	0.06	0.15	0.75
1956	0.06	0.17	0.72
1957	0.07	0.2	0.69
1958	0.08	0.22	0.64
1959	0.1	0.25	0.62
1960	0.1	0.28	0.6
1961	0.1	0.26	0.63
1962	0.11	0.29	0.58
1963	0.12	0.31	0.56
1964	0.12	0.33	0.53
1965	0.12	0.31	0.57
1966	0.12	0.32	0.58

1967	0.13	0.34	0.55
1968	0.14	0.36	0.53
1969	0.14	0.38	0.51
1970	0.15	0.39	0.52
1971	0.16	0.42	0.5
1972	0.18	0.47	0.45
1973	0.19	0.51	0.43
1974	0.21	0.56	0.4
1975	0.22	0.58	0.4
1976	0.24	0.62	0.37
1977	0.25	0.66	0.34
1978	0.28	0.73	0.29
1979	0.29	0.78	0.27
1980	0.3	0.78	0.29
1981	0.27	0.71	0.32
1982	0.38	1.01	0.23
1983	0.33	0.87	0.25
1984	0.39	1.04	0.25
1985	0.41	1.09	0.22
1986	0.52	1.37	0.21
1987	0.42	1.12	0.2
1988	0.47	1.24	0.21
1989	0.54	1.44	0.2
1990	0.35	0.93	0.25
1991	0.32	0.84	0.26
1992	0.34	0.9	0.28
1993	0.36	0.96	0.3
1994	0.34	0.89	0.28
1995	0.25	0.67	0.36
1996	0.31	0.82	0.31
1997	0.35	0.92	0.28
1998	0.26	0.68	0.36
1999	0.32	0.84	0.32
2000	0.29	0.77	0.33
2001	0.32	0.86	0.32
2002	0.25	0.67	0.36
2003	0.36	0.95	0.31
2004	0.34	0.9	0.34
2005	0.26	0.7	0.39
2006	0.3	0.79	0.37
2007	0.35	0.93	0.34
2008	0.26	0.69	0.39
2009	0.2	0.53	0.45
2010	0.23	0.62	0.44
2011	0.29	0.76	0.41

Table 3.7. Summary of SS results from sensitivity runs for Gulf of Mexico cobia. Results include virgin recruitment (thousand fish; R0), steepness, virgin total biomass (mt; B0), total biomass in final year (mt; Bcurrent), virgin spawning biomass (mt; SSB0), spawning biomass in final year (mt; SSBcurrent), and SPR in final year (SPRcurrent). For model runs 1-10, current refers to 2011. For the retrospective analyses (R), current relates to the final year of data used.

Run	Model	R0	Steepness	B0	Bcurrent	SSB0	SSB	SSBcurrent/SSB0	SPRcurrent
1	Base model	1033	0.92	8821	3030	7235	2213	0.31	0.41
2	M_Low	604	0.96	12536	2454	11259	1872	0.17	0.26
3	M_High	1857	0.92	7776	3845	5634	2587	0.46	0.55
4	D_High	1007	0.98	8659	3048	7089	2197	0.31	0.40
5	Steepness=0.7	1303	0.70	10774	2797	8749	2121	0.24	0.41
6	Steepness=0.8	1157	0.80	9765	2911	8000	2167	0.27	0.40
7	MRFSS only	1047	0.88	9139	2720	7479	1921	0.26	0.38
8	HB only	1008	1.00	8496	3722	6994	2940	0.42	0.47
9	Stock synthesis weighted	1003	0.94	8886	3189	7112	2340	0.33	0.41
10	Francis (2011) weighting	1024	0.95	8790	3346	7244	2415	0.33	0.43
11	Retrospective 2010	1011	0.92	9074	3172	7277	2093	0.29	0.41
12	Retrospective 2009	1001	0.96	8670	2862	7061	1779	0.25	0.44
13	Retrospective 2008	996	1.00	8642	2619	7021	1720	0.24	0.39
14	Retrospective 2007	976	0.99	8514	2642	6934	1803	0.26	0.34
15	Retrospective 2006	952	0.99	8581	2588	6856	1829	0.27	0.36
16	Retrospective 2005	1025	0.94	8185	2622	6562	1716	0.26	0.43

Table 3.8. Reference points and benchmarks from sensitivity runs for Gulf of Mexico cobia from SS. Benchmarks are reported for SPR 30%. *Current* refers to the geometric mean of 2009-2011 for *F*. MSST = (1-*M*)*$SSB_{SPR30\%}$ with *M* = 0.38 y^{-1} for all models except runs 2 (*M* = 0.26 y^{-1}) and 3 (*M* = 0.50 y^{-1}).

Run	Model	Fcurrent	SSB2011	$F_{SPR30\%}$	$SSB_{SPR30\%}$	MFMT	MSST	F/MFMT	$SSB/SSB_{SPR30\%}$	SSB/MSST
1	Base model	0.24	2213	0.38	2065	0.38	1280	0.63	1.07	1.73
2	M_Low	0.30	1872	0.29	3302	0.29	2443	1.05	0.57	0.77
3	M_High	0.18	2587	0.45	1608	0.45	804	0.40	1.61	3.22
4	D_High	0.24	2197	0.37	2099	0.37	1302	0.65	1.05	1.69
5	Steepness=0.7	0.24	2121	0.39	1894	0.39	1174	0.63	1.12	1.81
6	Steepness=0.8	0.24	2168	0.38	2027	0.38	1257	0.64	1.04	1.73
7	MRFSS only	0.26	1921	0.37	2060	0.37	1277	0.70	0.93	1.50
8	HB only	0.19	2940	0.37	2098	0.37	1301	0.52	1.40	2.26
9	Stock synthesis weighted	0.22	2340	0.35	2053	0.35	1273	0.58	1.15	1.85
10	Francis (2011) weighting	0.22	2415	0.38	2105	0.38	1305	0.61	1.14	1.84

Table 3.9. Required SFA and MSRA evaluations using SPR 30% reference point for Gulf of Mexico cobia SS runs 1-3. Biomass units are in mt.

Criteria	Definition	Run 1	Run 2	Run 3
Base M		0.38	0.26	0.50
Steepness		0.92	0.96	0.92
Virgin Recruitment		1033	604	1857
SSB unfished		7235	11259	5634
	Mortality Rate Criteria			
$F_{MSY\ or\ proxy}$	$F_{SPR30\%}$	0.378	0.287	0.452
MFMT	$F_{SPR30\%}$	0.378	0.287	0.452
F_{OY}	75% of $F_{SPR30\%}$	0.284	0.215	0.339
$F_{CURRENT}$	$F_{2009-F2011}$	0.236	0.302	0.180
$F_{CURRENT}$/MFMT	$F_{2009-F2011}$	0.624	1.053	0.398
	Biomass Criteria			
$SSB_{MSY\ or\ proxy}$	Equilibrium SSB @ $F_{SPR30\%}$	2065	3302	1608
MSST	(1-M)*$SSB_{SPR30\%}$	1280	2443	804
$SSB_{CURRENT}$	SSB_{2011}	2213	1872	2587
$SS_{CURRENT}$/MSST	SSB_{2011}/MSST	1.729	0.766	3.218
Equilibrium MSY	Equilibrium Yield @ $F_{SPR30\%}$	1208	1111	1500
Equilibrium OY	Equilibrium Yield @ F_{OY}	1108	1021	1362
OFL	Annual Yield @ MFMT			
	OFL 2013	1292	709	2184
	OFL 2014	1289	840	1828
	OFL 2015	1271	946	1648
	OFL 2016	1243	1014	1557
	OFL 2017	1226	1055	1523
	OFL 2018	1217	1079	1510
	OFL 2019	1213	1092	1504
Annual OY (ACT)	Annual Yield @ F_{OY}			
	OY 2013	1017	548	1754
	OY 2014	1085	680	1594
	OY 2015	1116	793	1488
	OY 2016	1118	874	1417
	OY 2017	1114	928	1385
	OY 2018	1111	963	1372
	OY 2019	1109	985	1367
Annual Yield	Annual Yield @ $F_{CURRENT}$			
	Y 2013	765	801	736
	Y 2014	869	925	816
	Y 2015	931	1021	857
	Y 2016	959	1078	868
	Y 2017	971	1110	868
	Y 2018	977	1128	867
	Y 2019	979	1138	865

Table 3.10. Projected yield (mt), fishing mortality rate, and spawning stock biomass at F_{SPR30} (F_{MSY} proxy) for the base model and two sensitivity runs. *Ref* refers to the reference point of SPR 30%.

	Run 1					Run 2					Run 3				
Year	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref
2013	1292	0.36	0.95	2292	1.11	709	0.26	0.89	1967	0.60	2184	0.47	1.04	2675	1.66
2014	1289	0.37	0.97	2412	1.17	840	0.26	0.92	2466	0.75	1828	0.45	1.01	2316	1.44
2015	1271	0.37	0.97	2340	1.13	946	0.27	0.95	2756	0.83	1648	0.44	0.98	2028	1.26
2016	1243	0.37	0.97	2282	1.10	1014	0.28	0.97	2942	0.89	1557	0.43	0.96	1905	1.18
2017	1226	0.36	0.96	2249	1.09	1055	0.28	0.97	3055	0.93	1523	0.43	0.95	1860	1.16
2018	1217	0.36	0.96	2232	1.08	1079	0.28	0.98	3122	0.95	1510	0.43	0.95	1843	1.15
2019	1213	0.36	0.96	2224	1.08	1092	0.28	0.98	3161	0.96	1504	0.43	0.95	1835	1.14

Table 3.11. Projected yield (mt), fishing mortality rate, and spawning stock biomass at F_{OY} for the base model and two sensitivity runs. *Ref* refers to the reference point of SPR 30%.

	Run 1					Run 2					Run 3				
Year	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref
2013	1017	0.29	0.76	2292	1.11	548	0.20	0.71	1967	0.60	1754	0.38	0.84	2675	1.66
2014	1085	0.30	0.79	2592	1.26	680	0.21	0.74	2585	0.78	1594	0.38	0.83	2549	1.59
2015	1116	0.30	0.80	2624	1.27	793	0.22	0.76	2988	0.90	1488	0.37	0.82	2323	1.44
2016	1118	0.30	0.80	2618	1.27	874	0.22	0.78	3272	0.99	1417	0.36	0.81	2204	1.37
2017	1114	0.30	0.80	2608	1.26	928	0.23	0.79	3463	1.05	1385	0.36	0.80	2153	1.34
2018	1111	0.30	0.80	2602	1.26	963	0.23	0.80	3587	1.09	1372	0.36	0.80	2133	1.33
2019	1109	0.30	0.80	2599	1.26	985	0.23	0.80	3666	1.11	1367	0.36	0.80	2124	1.32

Table 3.12. Projected yield (mt), fishing mortality rate, and spawning stock biomass at $F_{CURRENT}$ for the base model and two sensitivity runs. *Ref* refers to the reference point of SPR 30%.

	Run 1					Run 2					Run 3				
Year	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref	Yield	F	F/Fref	SSB	SSB/SSBref
2013	765	0.22	0.58	2292	1.09	801	0.29	0.99	1967	0.60	736	0.17	0.37	2675	1.66
2014	869	0.23	0.61	2759	1.33	925	0.29	1.03	2399	0.73	816	0.18	0.39	3136	1.95
2015	931	0.24	0.63	2909	1.41	1021	0.30	1.05	2630	0.80	857	0.18	0.40	3208	2.00
2016	959	0.24	0.63	2979	1.44	1078	0.31	1.07	2769	0.84	868	0.18	0.40	3223	2.00
2017	971	0.24	0.64	3012	1.46	1110	0.31	1.08	2849	0.86	868	0.18	0.40	3220	2.00
2018	977	0.24	0.64	3029	1.46	1128	0.31	1.08	2893	0.88	867	0.18	0.40	3215	2.00
2019	979	0.24	0.64	3037	1.47	1138	0.31	1.08	2917	0.88	865	0.18	0.40	3210	2.00

3.7 Figures

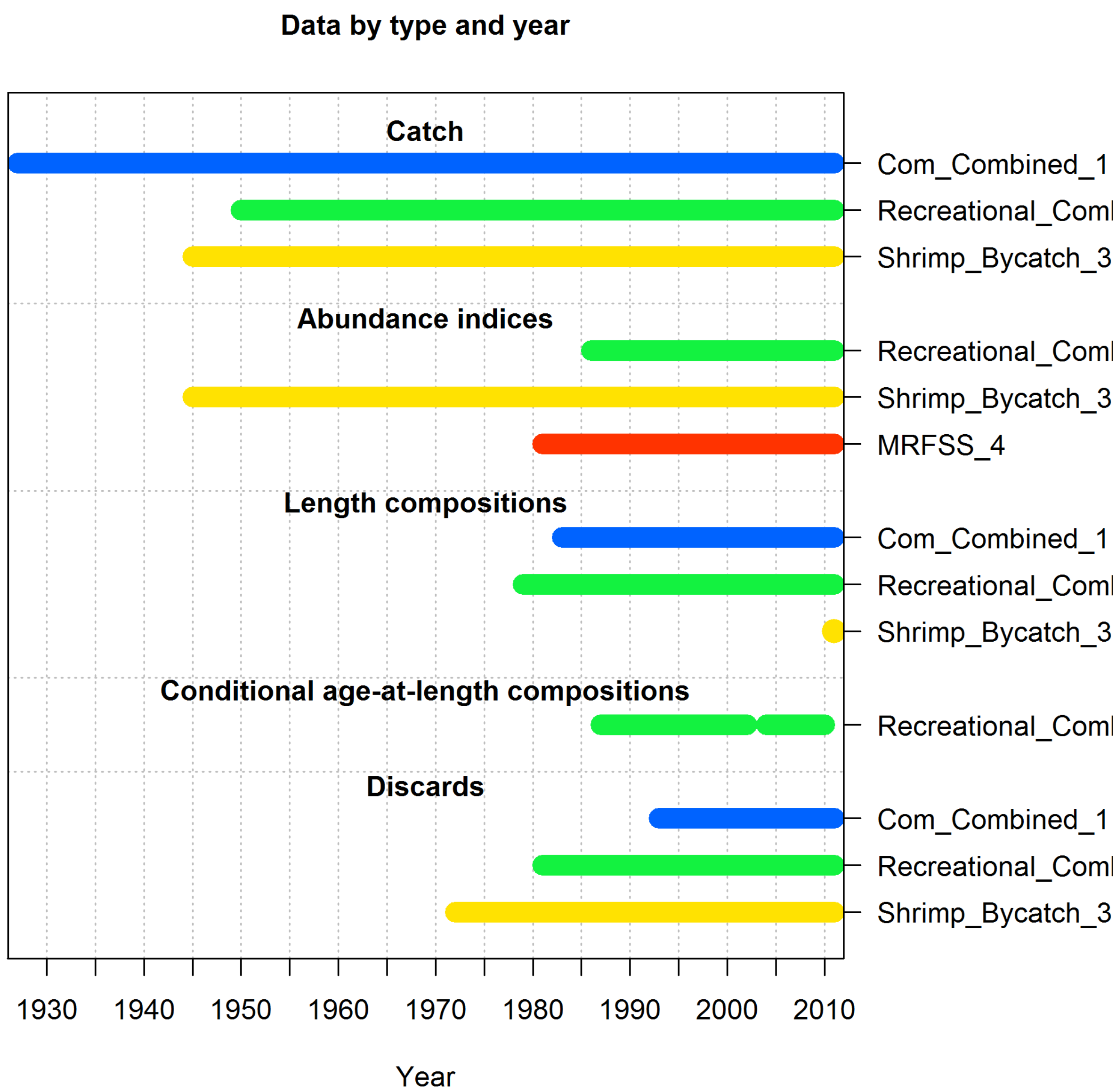

Figure 3.1. Data sources used in the assessment model.

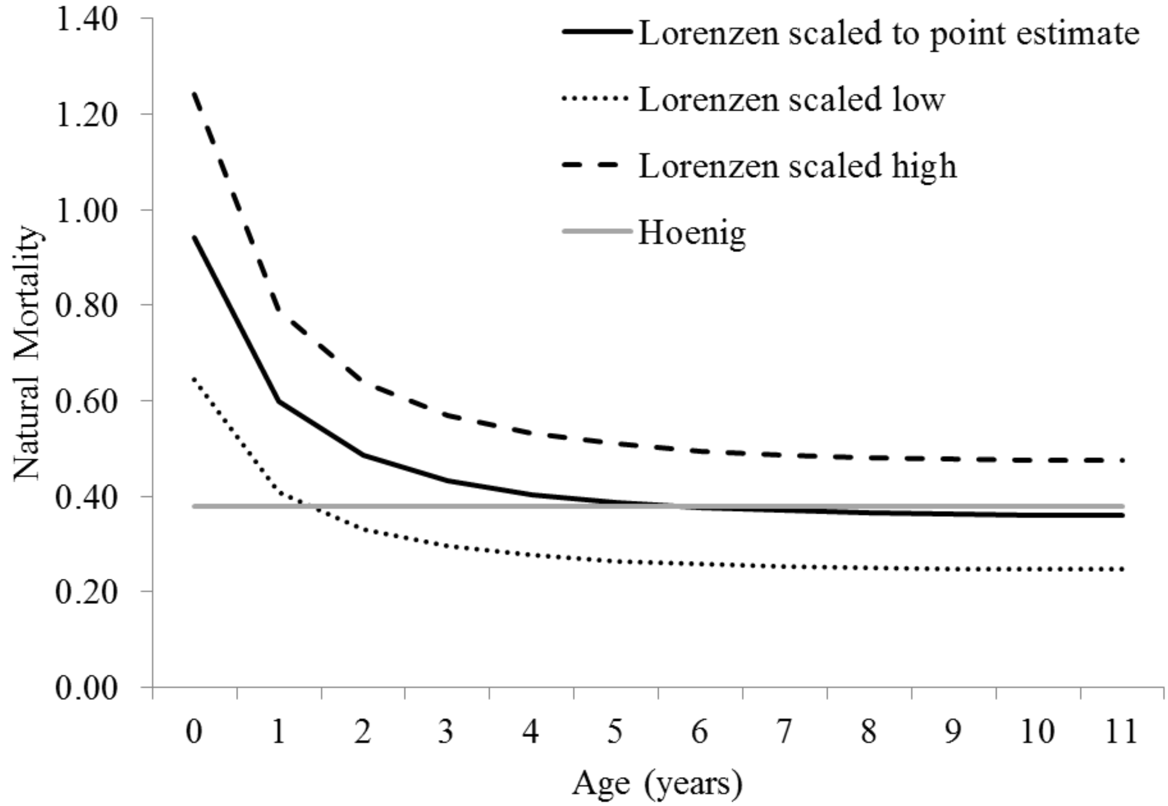

Figure 3.2. Age-specific natural mortality of Gulf of Mexico cobia based on the Lorenzen (1996) method. The three lines represent estimates of natural mortality for the base case model (Run 1; solid line), a low estimate (Run 2; dotted line), and high estimate (Run 3; dashed line).

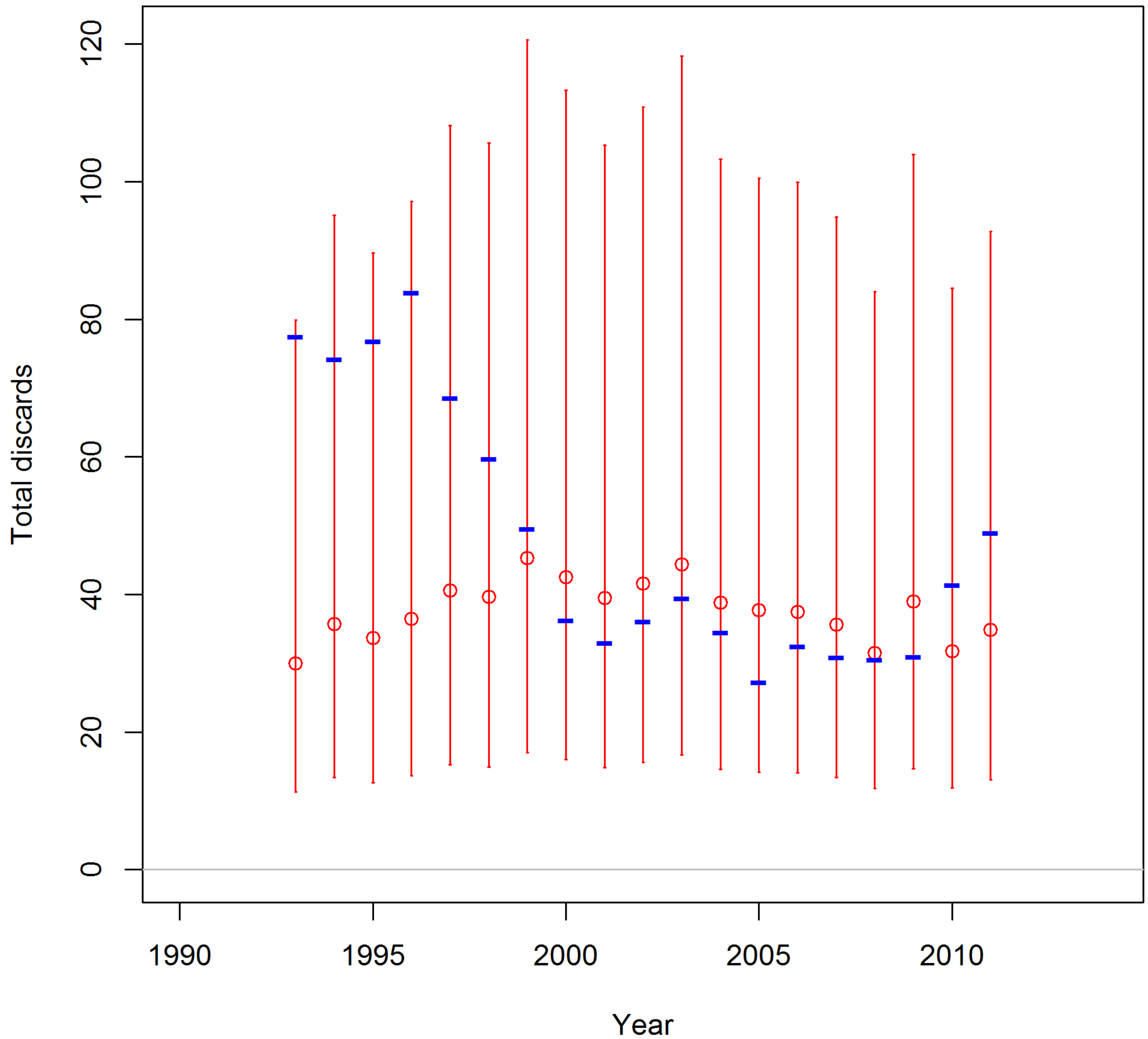

Figure 3.3. Observed (red dots) and predicted discards (blue dashes) (mt) of Gulf of Mexico Cobia from the commercial fishing fleet, 1993-2011.

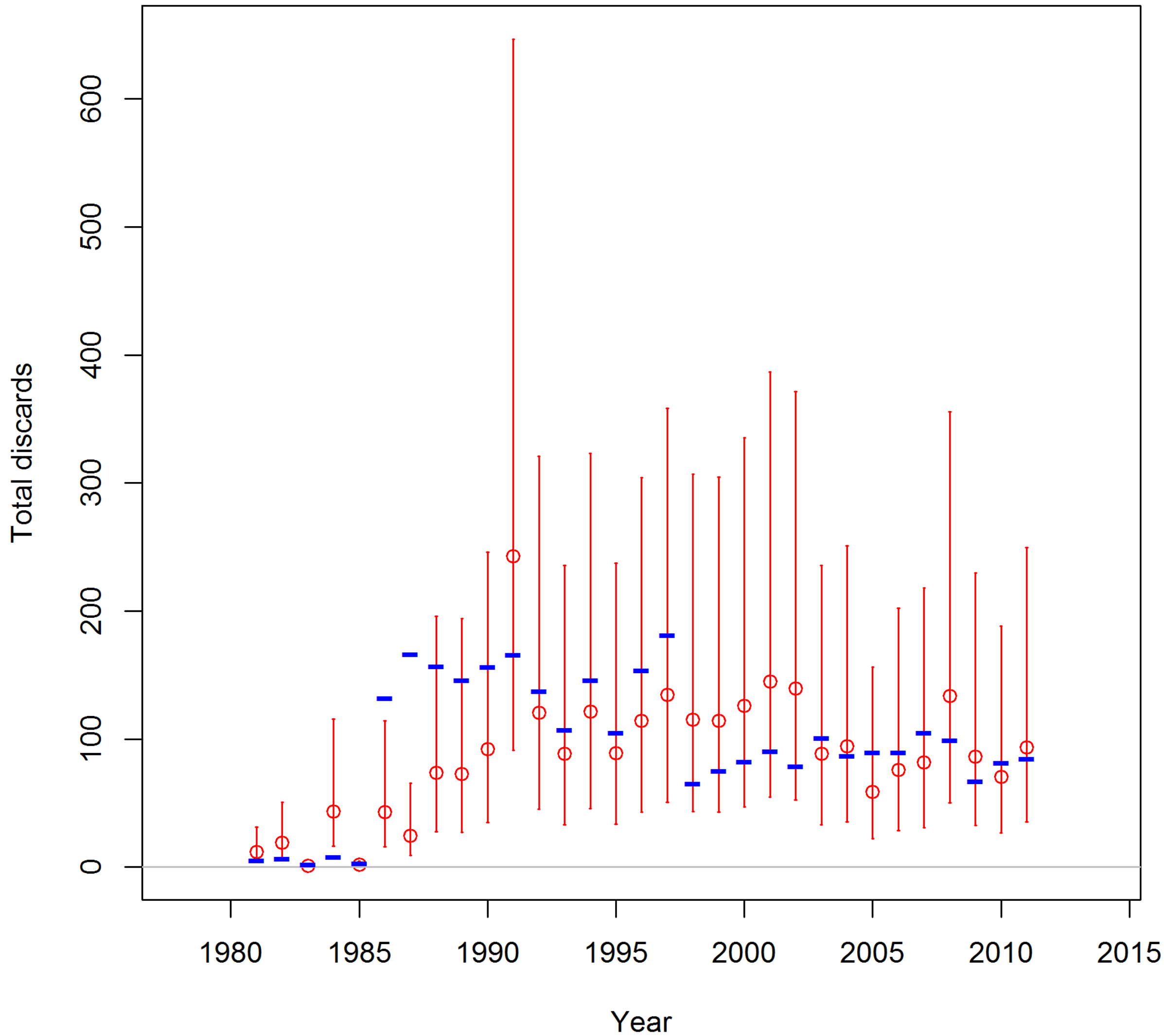

Figure 3.4. Observed (red dots) and predicted discards (blue dashes) (1000's of fish) of Gulf of Mexico cobia from the recreational fishing fleet, 1981-2011.

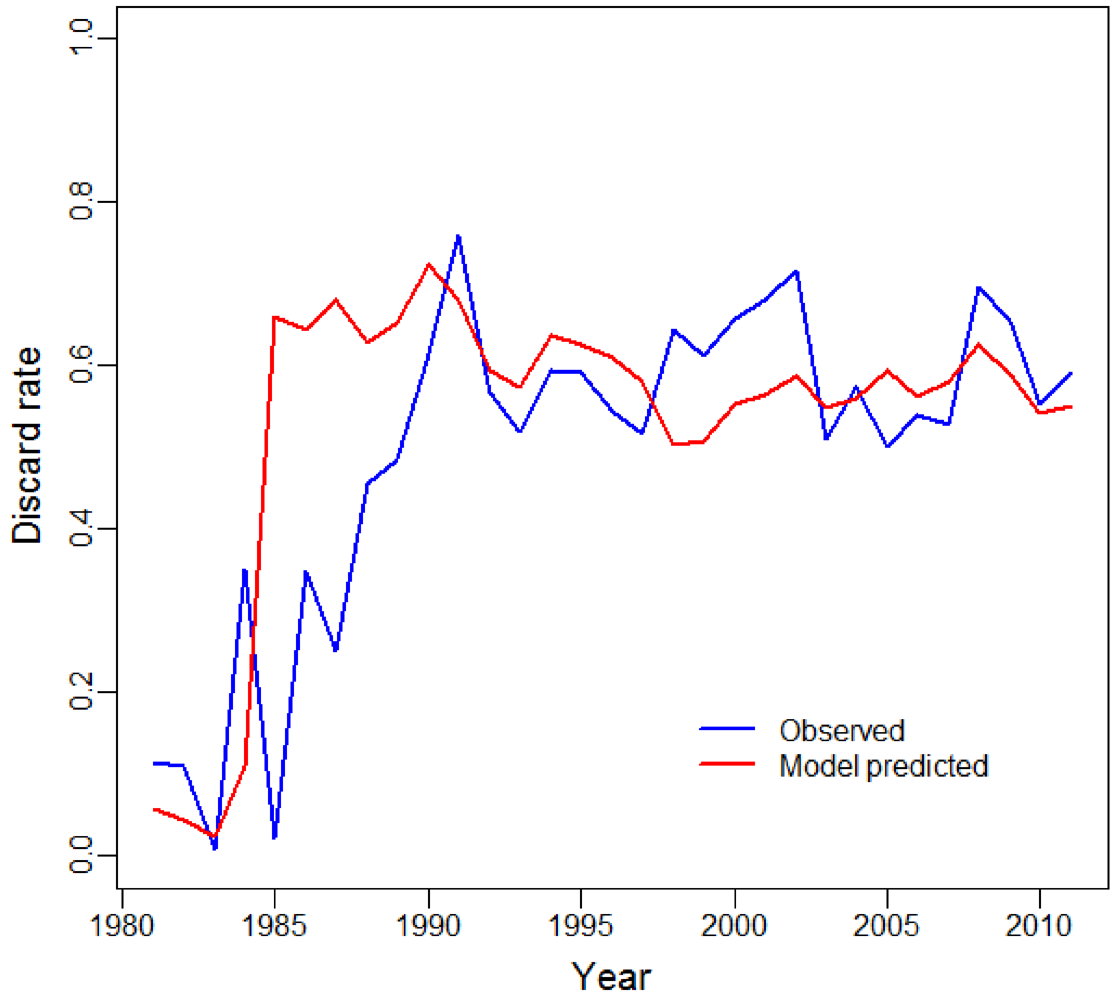

Figure 3.5. Observed and model predicted discard proportion of Gulf of Mexico cobia from the recreational fishing fleet, 1981-2011.

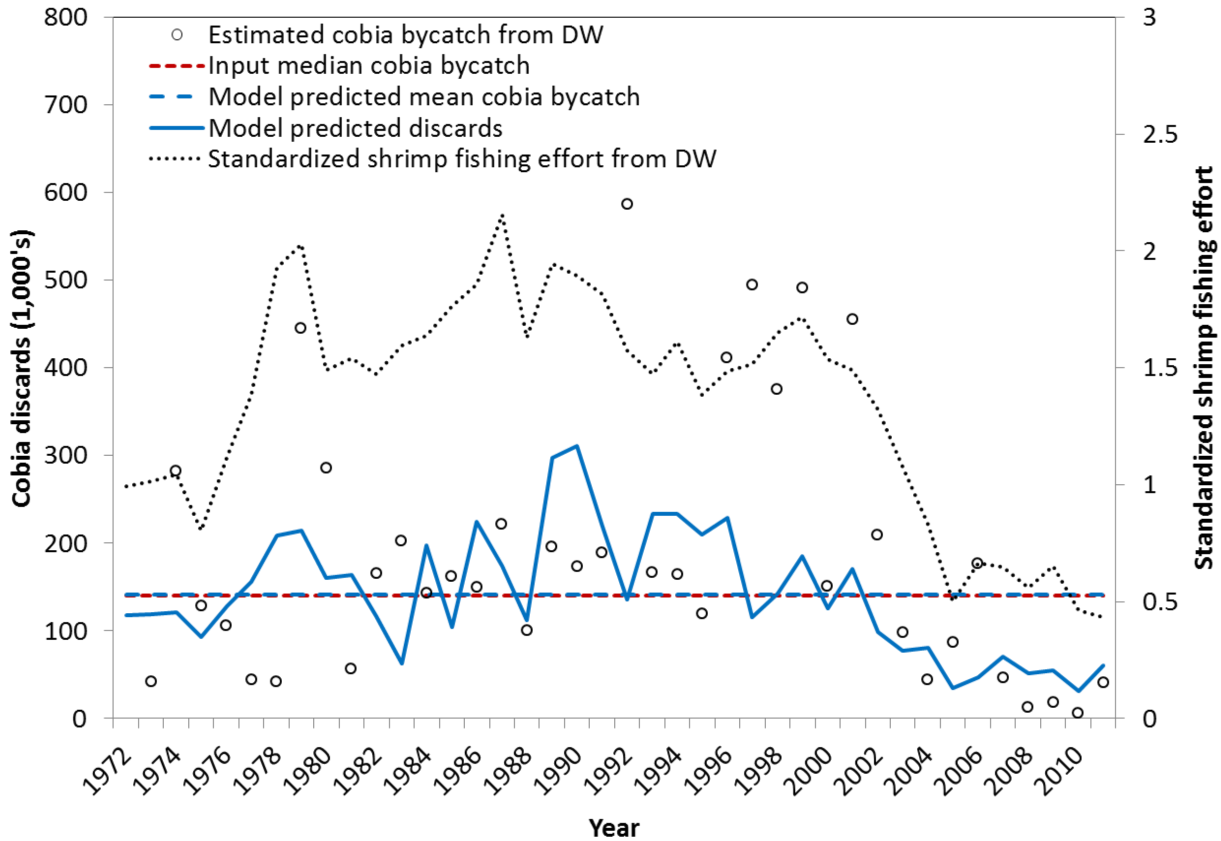

Figure 3.6. Observed and predicted discards (1000's of fish) of Gulf of Mexico cobia from the shrimp fishery, 1972-2011. Open circles represent annual estimates of cobia bycatch from the data workshop. The red dashed line represents the input estimate of shrimp bycatch used for the super-year approach. The blue dashed line represents the model predicted mean shrimp bycatch for 1972-2011. The solid blue line represents model predicted annual cobia bycatch. The black dotted line represents the standardized estimate of shrimp fishing effort from the data workshop. It is important to note that the model predicted annual cobia bycatch (blue line) was not fit to the annual estimates of cobia bycatch (open circles).

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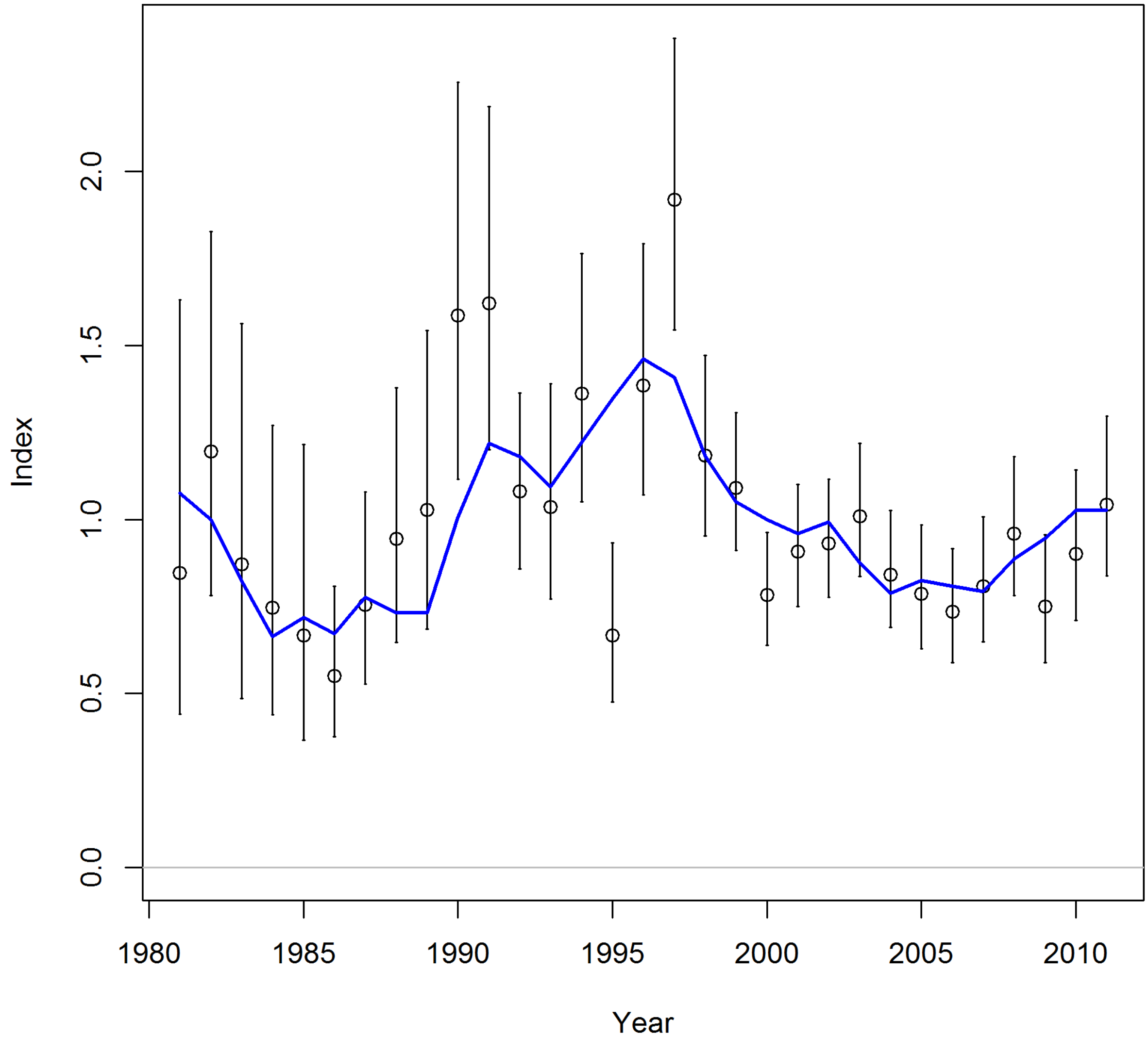

Figure 3.7. Observed and predicted index of CPUE for Gulf of Mexico cobia from SS Run 1.

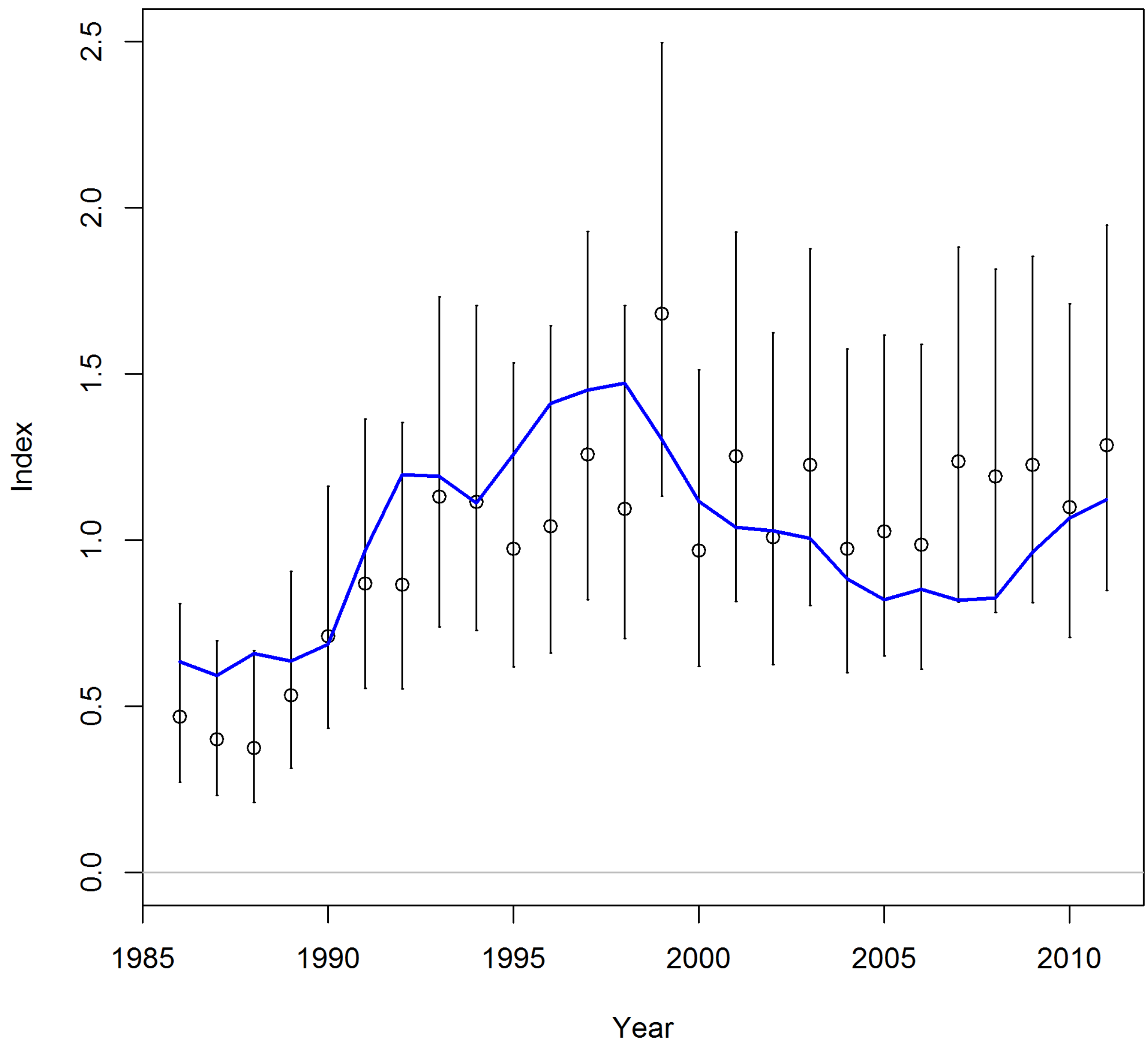

Figure 3.8. Observed and predicted index of CPUE for Gulf of Mexico cobia from SS Run 1.

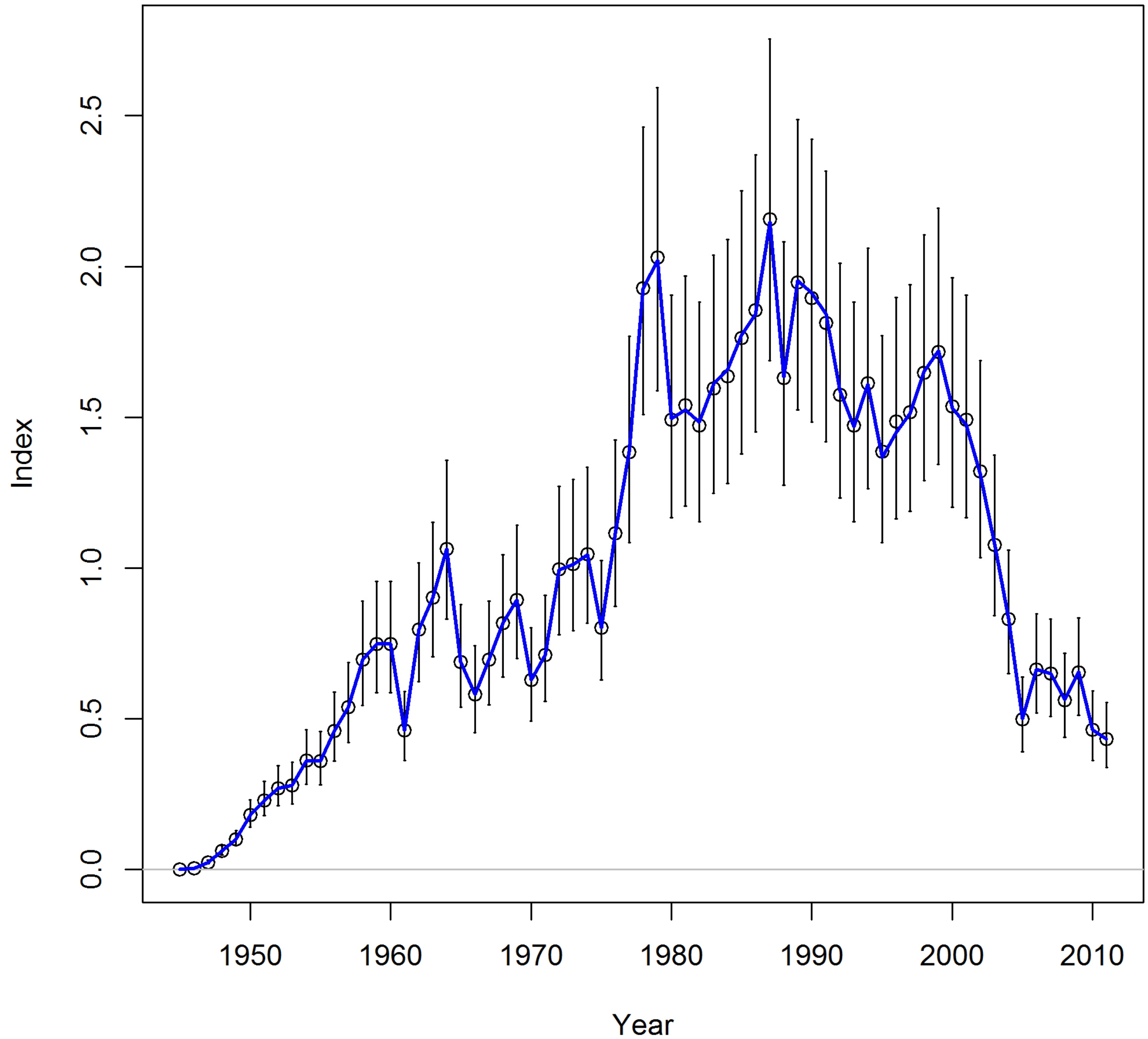

Figure 3.9. Observed and predicted index of shrimp fishing effort from SS Run 1.

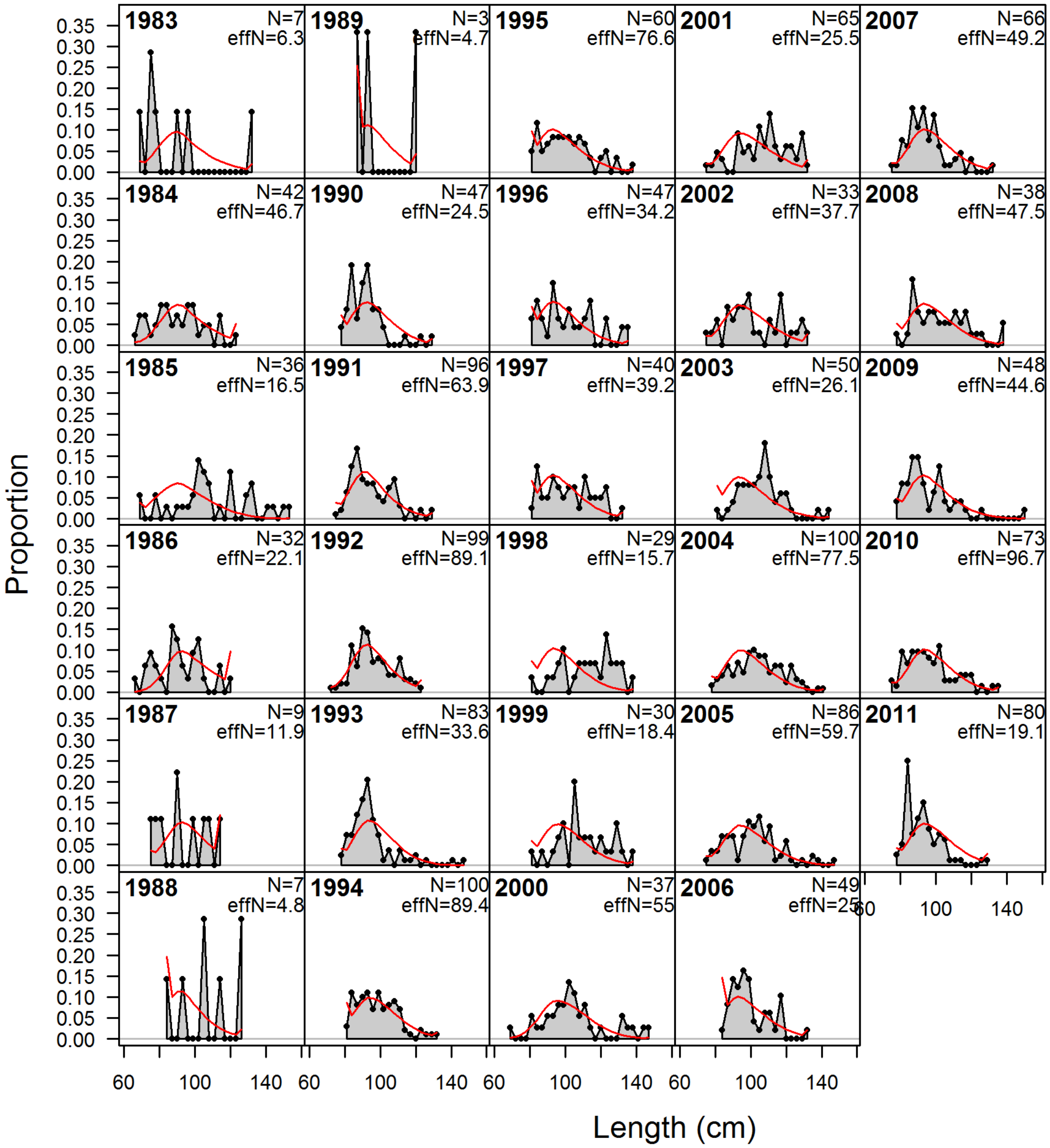

Figure 3.10. Observed and predicted length compositions for Gulf of Mexico cobia in the commercial fishery from SS Run 1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 100 fish.

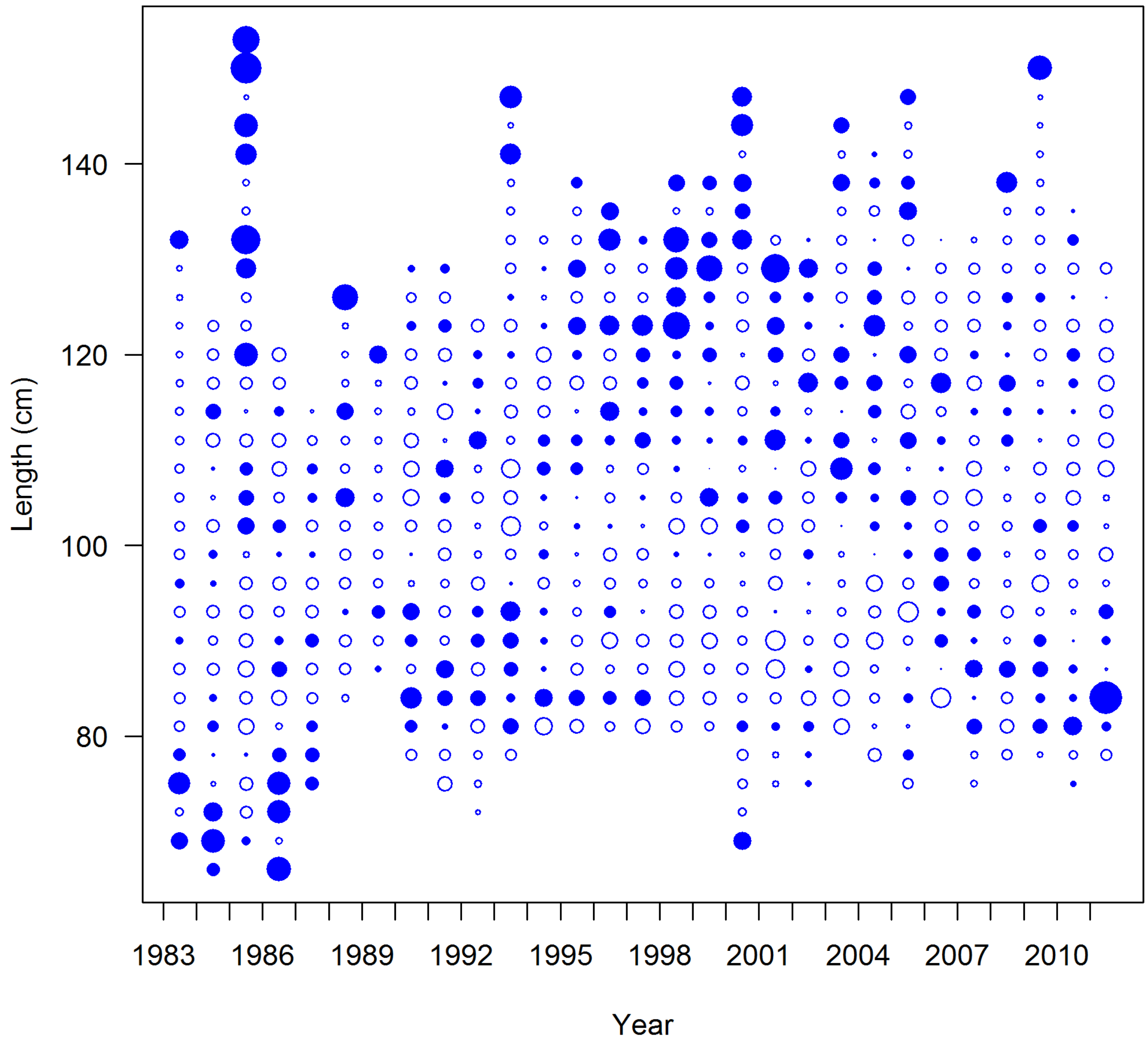

Figure 3.11. Pearson residuals of length composition fits for Gulf of Mexico cobia in the commercial fishery from SS Run 1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed) (max=7.5).

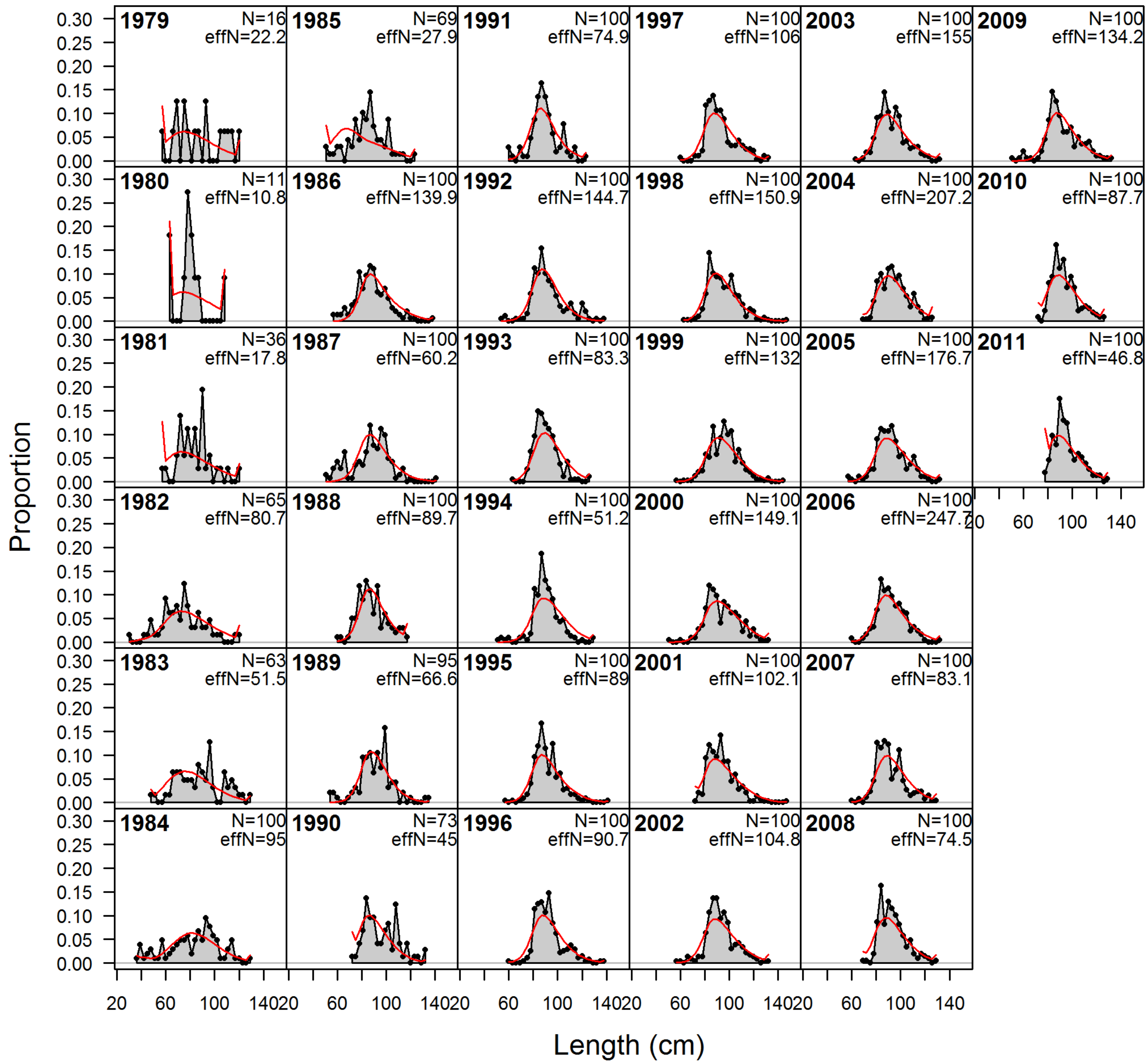

Figure 3.12. Observed and predicted length compositions for Gulf of Mexico cobia in the recreational fishery from SS Run 1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Observed sample sizes were capped at a maximum of 100 fish.

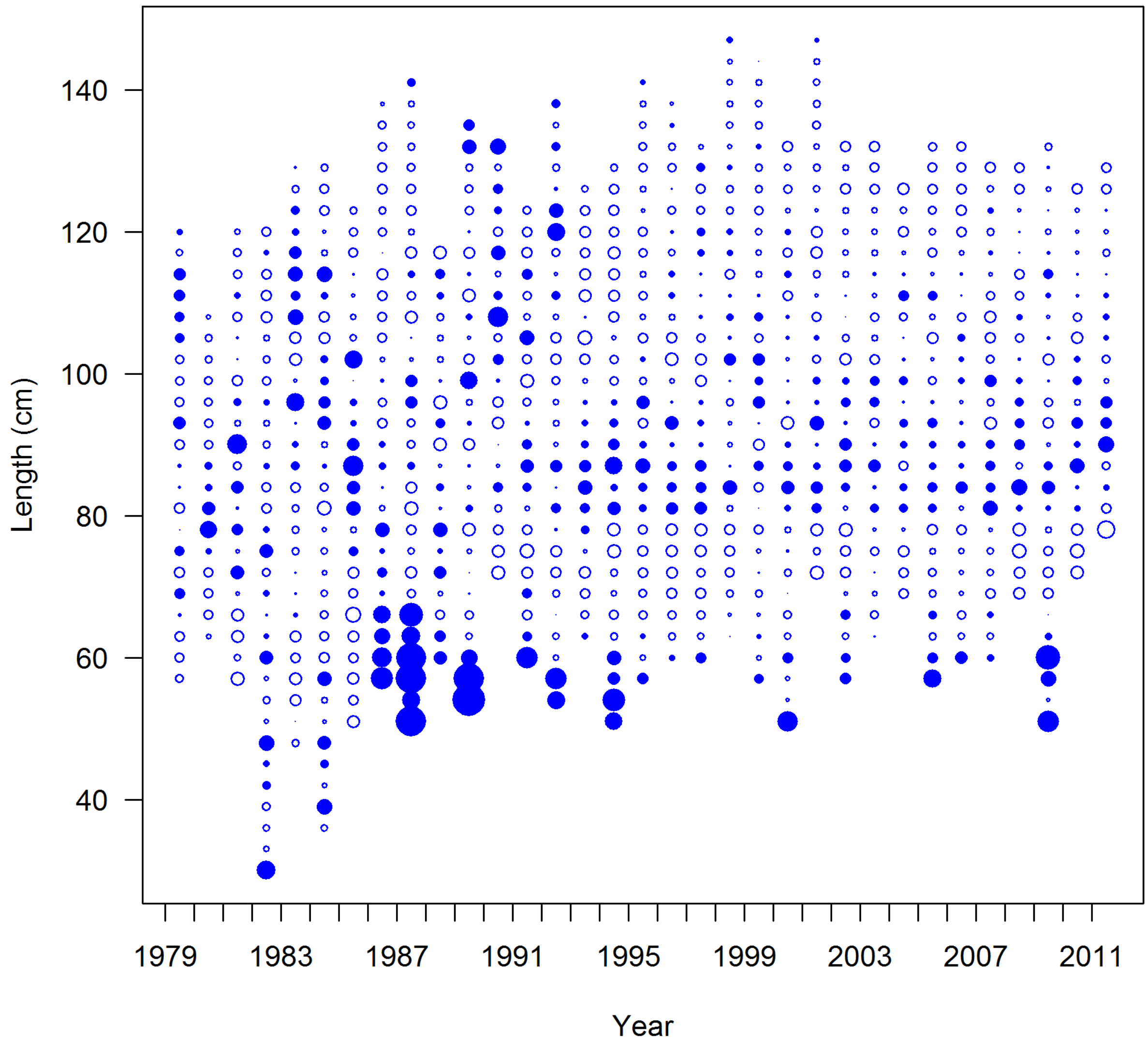

Figure 3.13. Pearson residuals of length composition fits for Gulf of Mexico cobia in the recreational fishery from SS Run 1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed) (max=11).

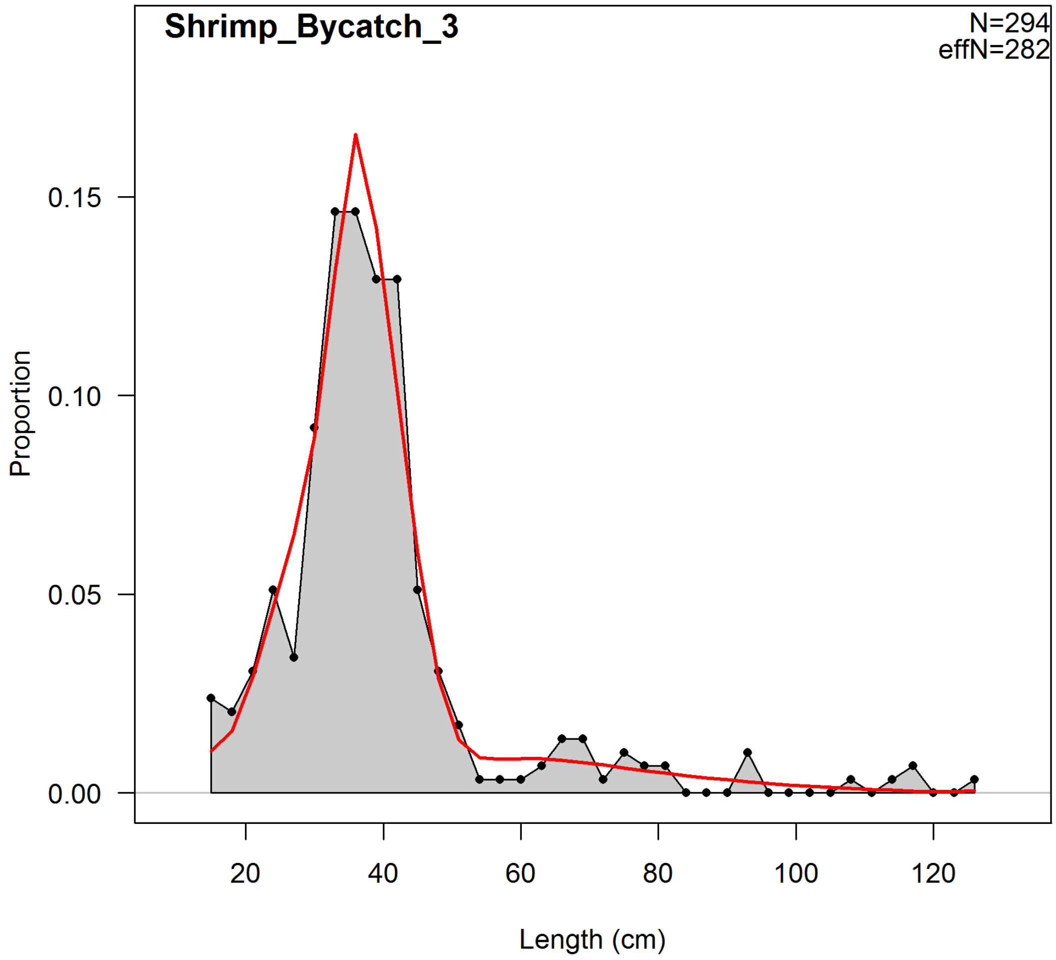

Figure 3.14. Observed and predicted length compositions for Gulf of Mexico cobia in the SEAMAP trawl survey from SS Run 1. Observed (N) sample sizes and effective sample sizes (effN) estimated by SS are also reported. Length composition data was aggregated over years into a single distribution.

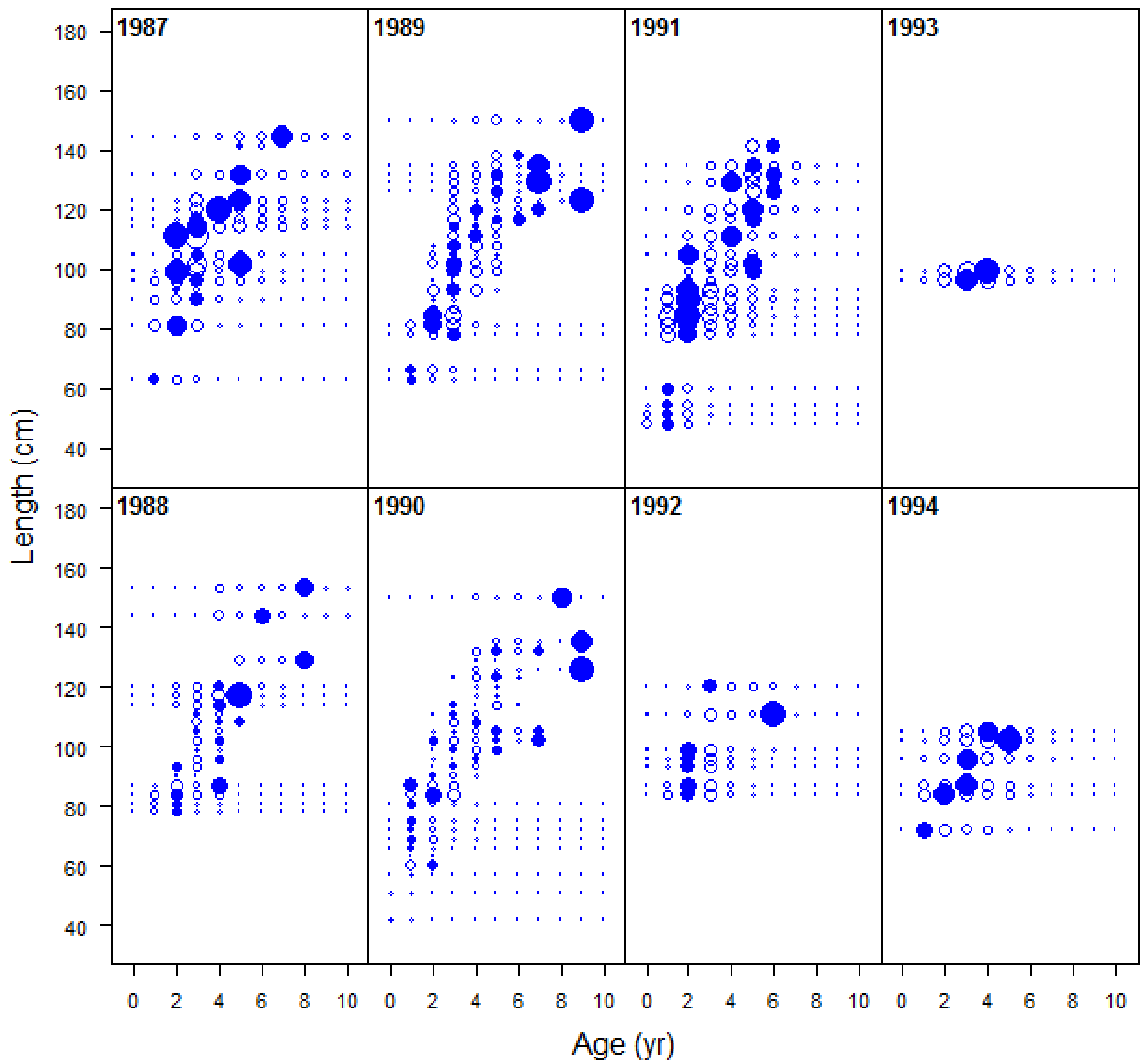

Figure 3.15a. Pearson residuals of conditional age composition fits for Gulf of Mexico cobia in the recreational fishery from SS Run 1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed) (max=10).

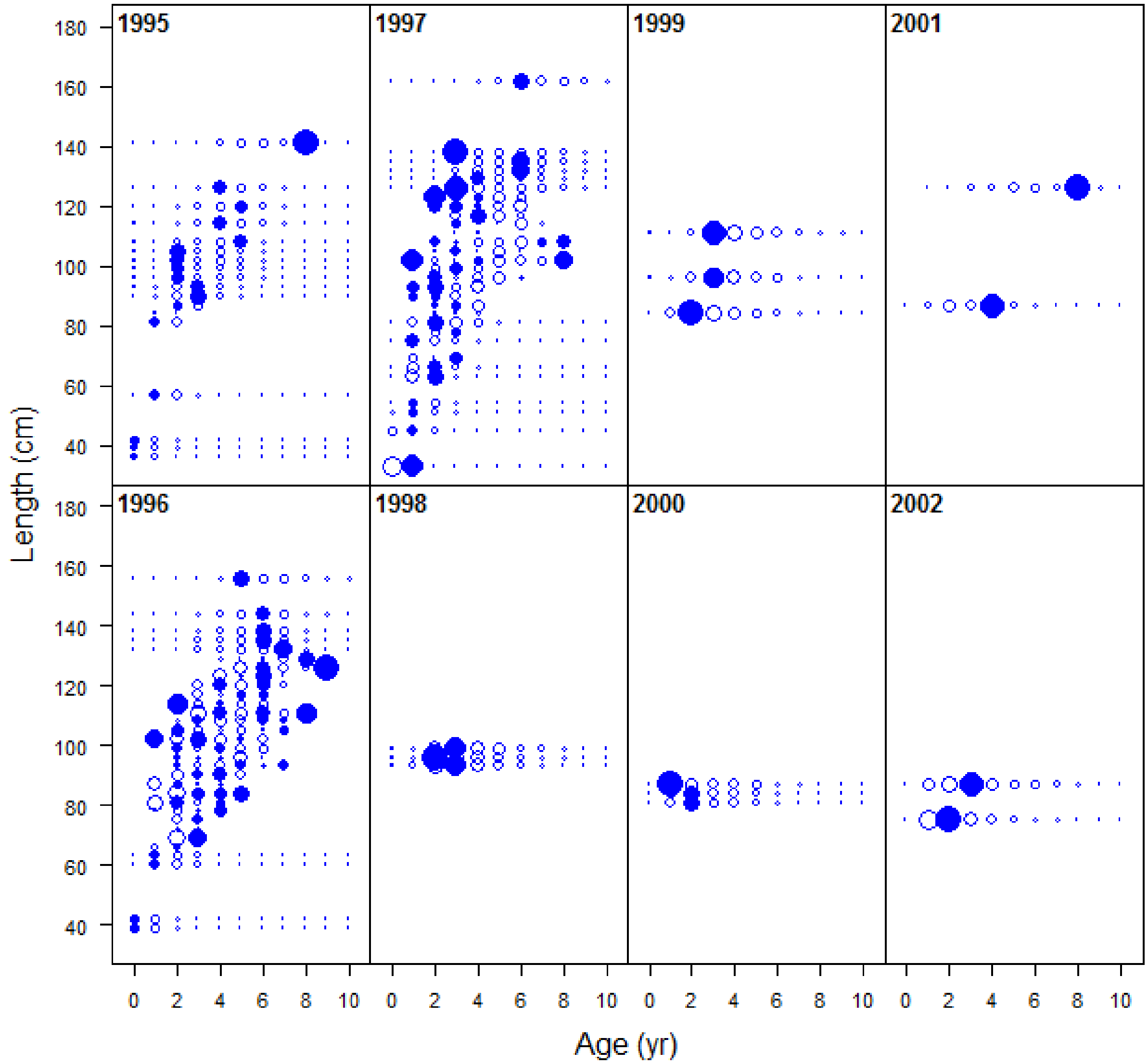

Figure 3.15b. Pearson residuals of conditional age composition fits for Gulf of Mexico cobia in the recreational fishery from SS Run 1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed) (max=10).

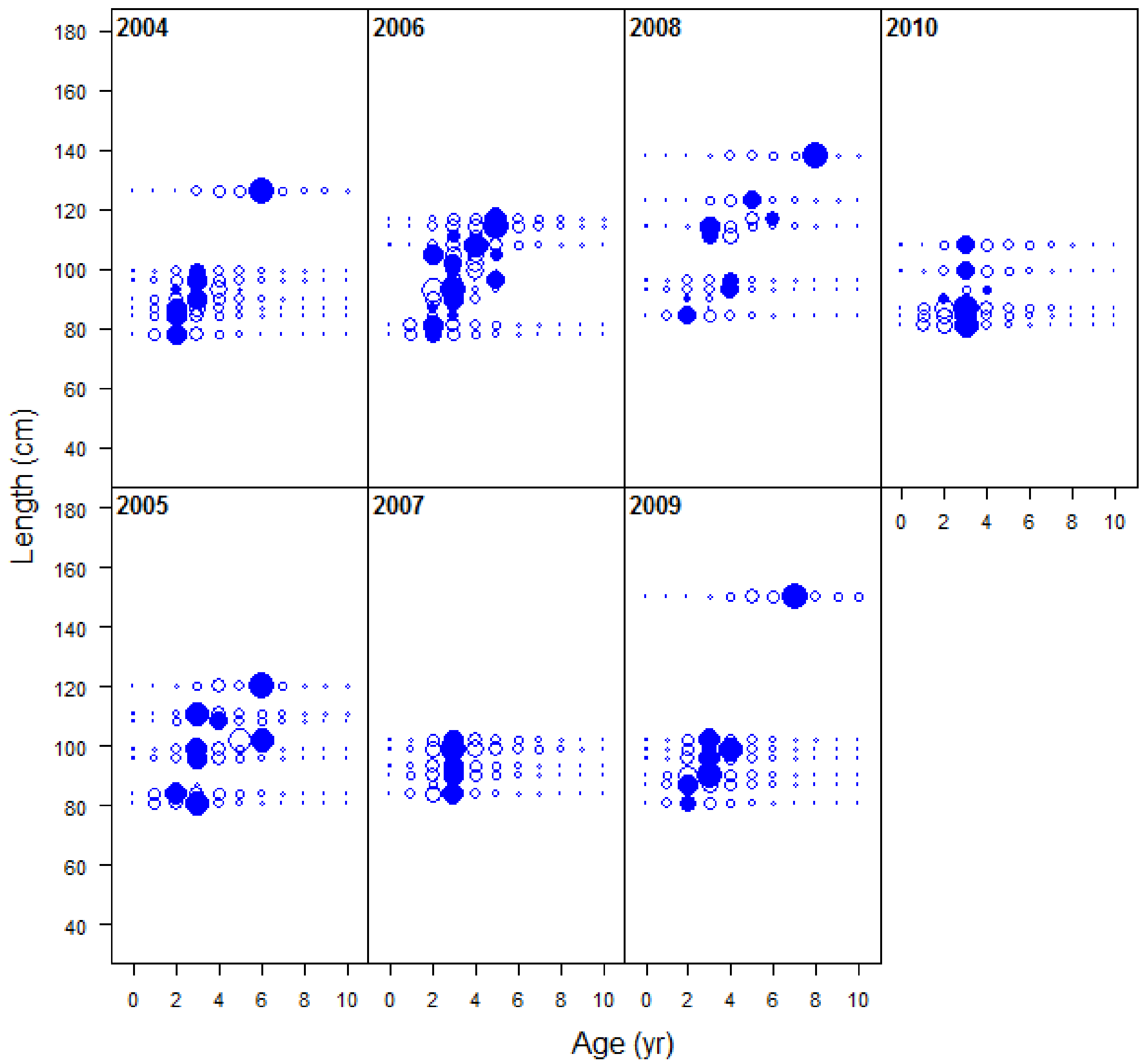

Figure 3.15c. Pearson residuals of conditional age composition fits for Gulf of Mexico cobia in the recreational fishery from SS Run 1. Solid circles are positive residuals (i.e., observed greater than predicted) and open circles are negative residuals (i.e., predicted greater than observed) (max=10).

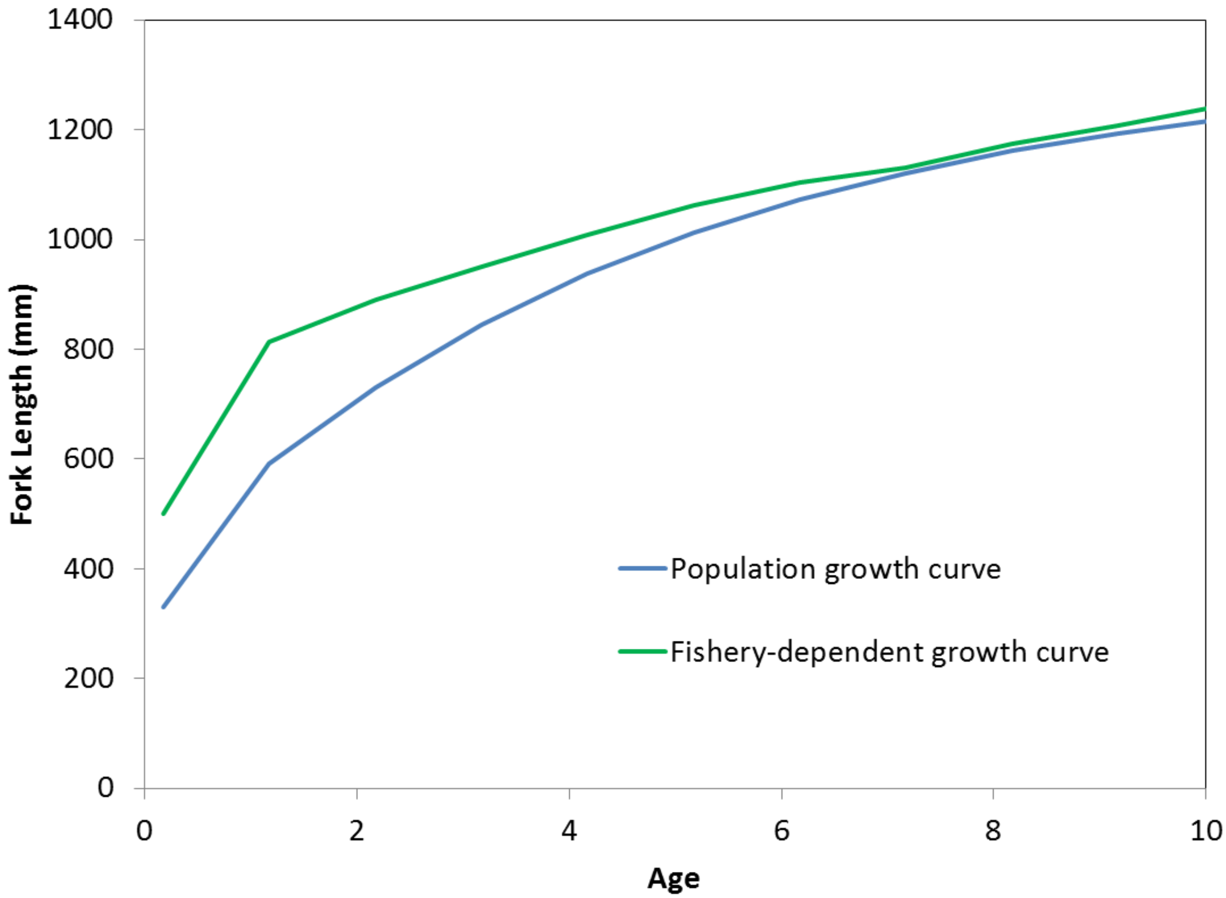

Figure 3.16. Predicted population growth curve and predicted growth curve from fishery-dependent samples from the recreational fishery.

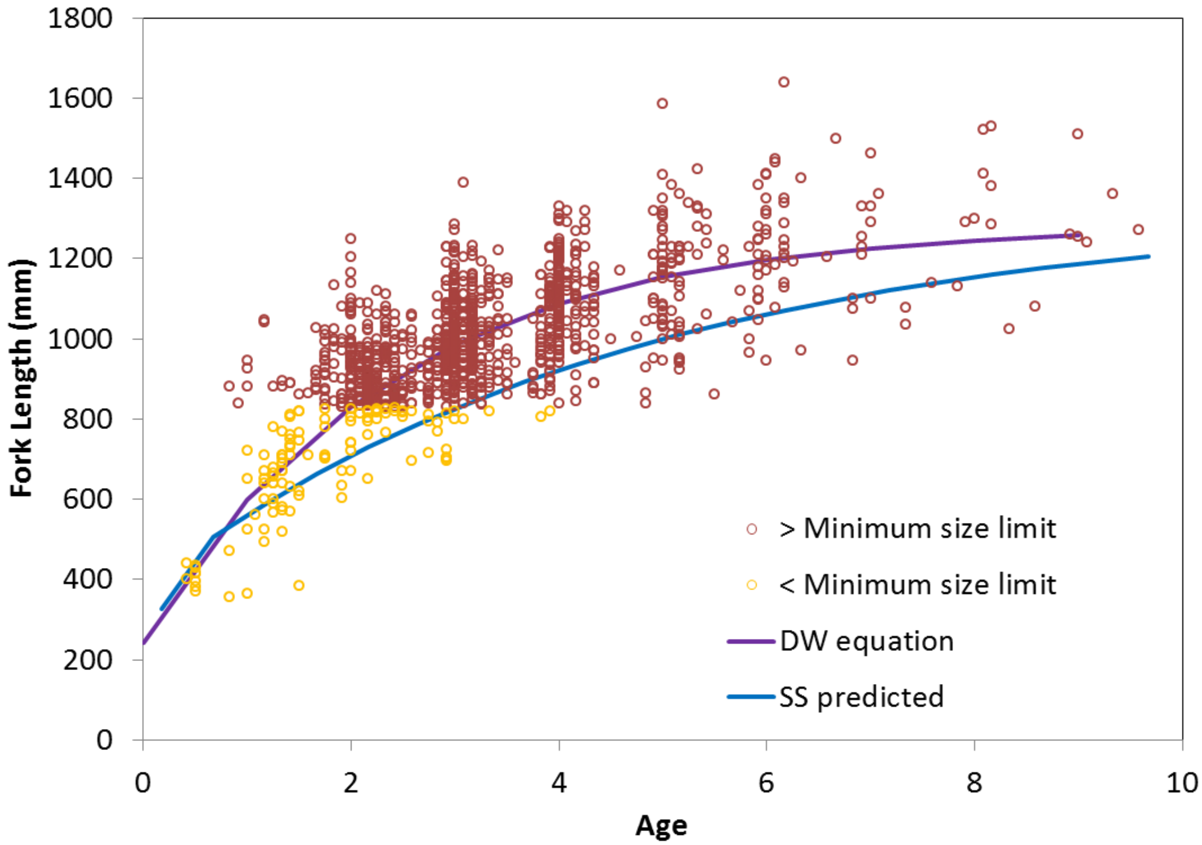

Figure 3.17. Observed length-at-age data (points), predicted growth curve from the data workshop (purple line), and predicted population growth curve from Stock Synthesis (blue line).

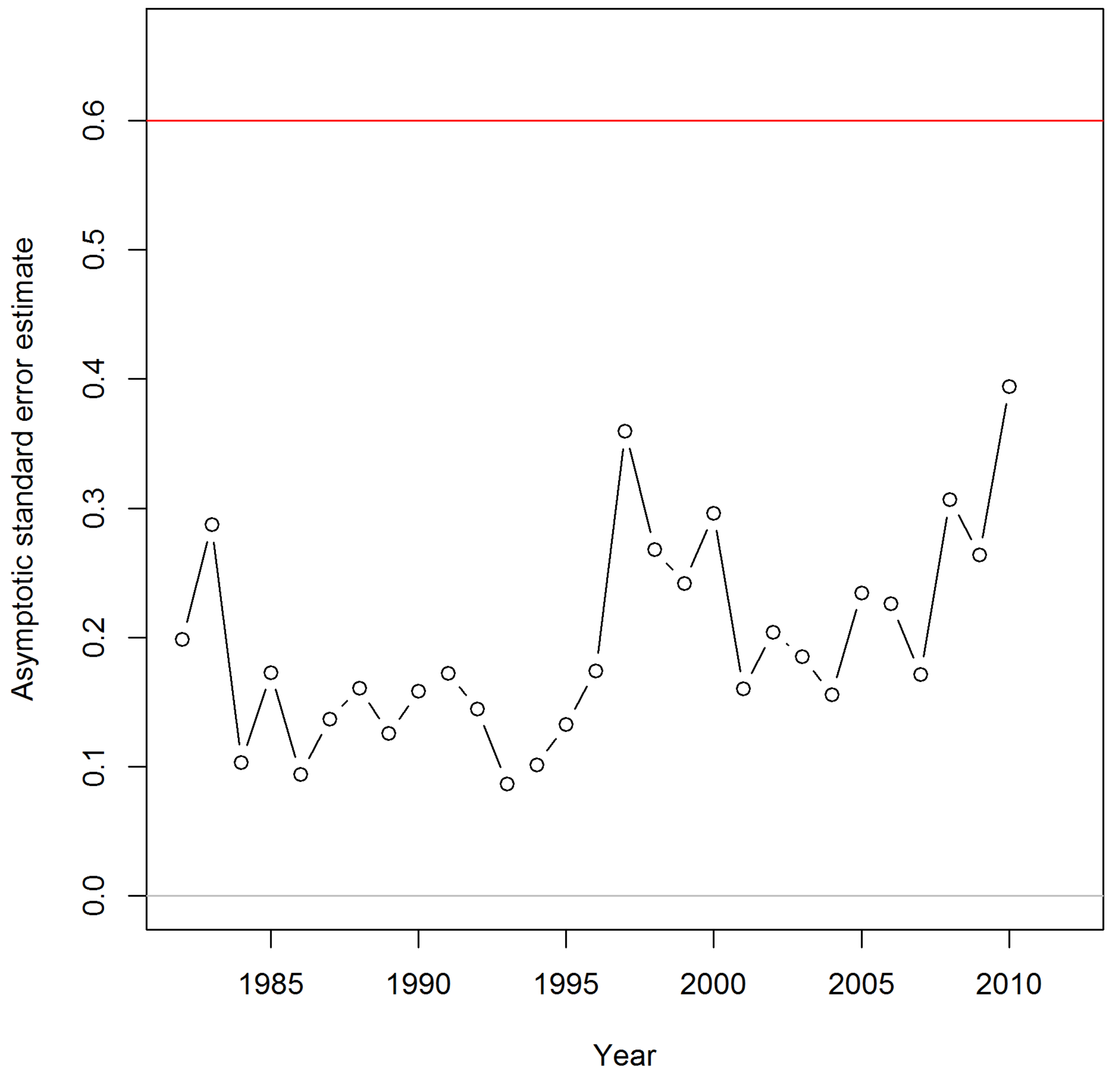

Figure 3.18. Asymptotic standard errors for recruitment deviations, 1982-2010. The red line represents the fixed value for sigma R used in the model.

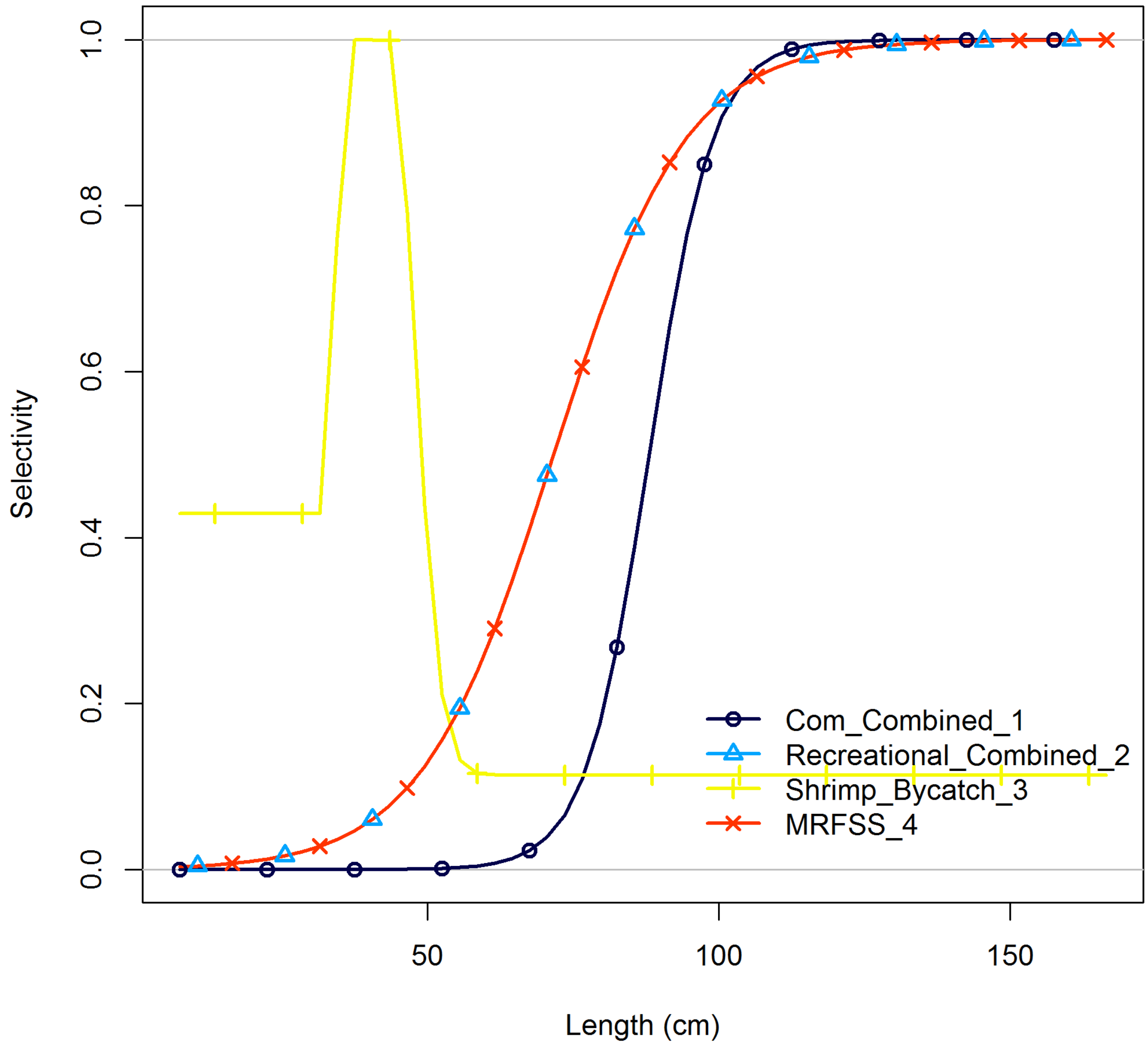

Figure 3.19. Length-based selectivity for each fleet. Selectivity is assumed to be constant over the entire assessment time period, 1927-2011.

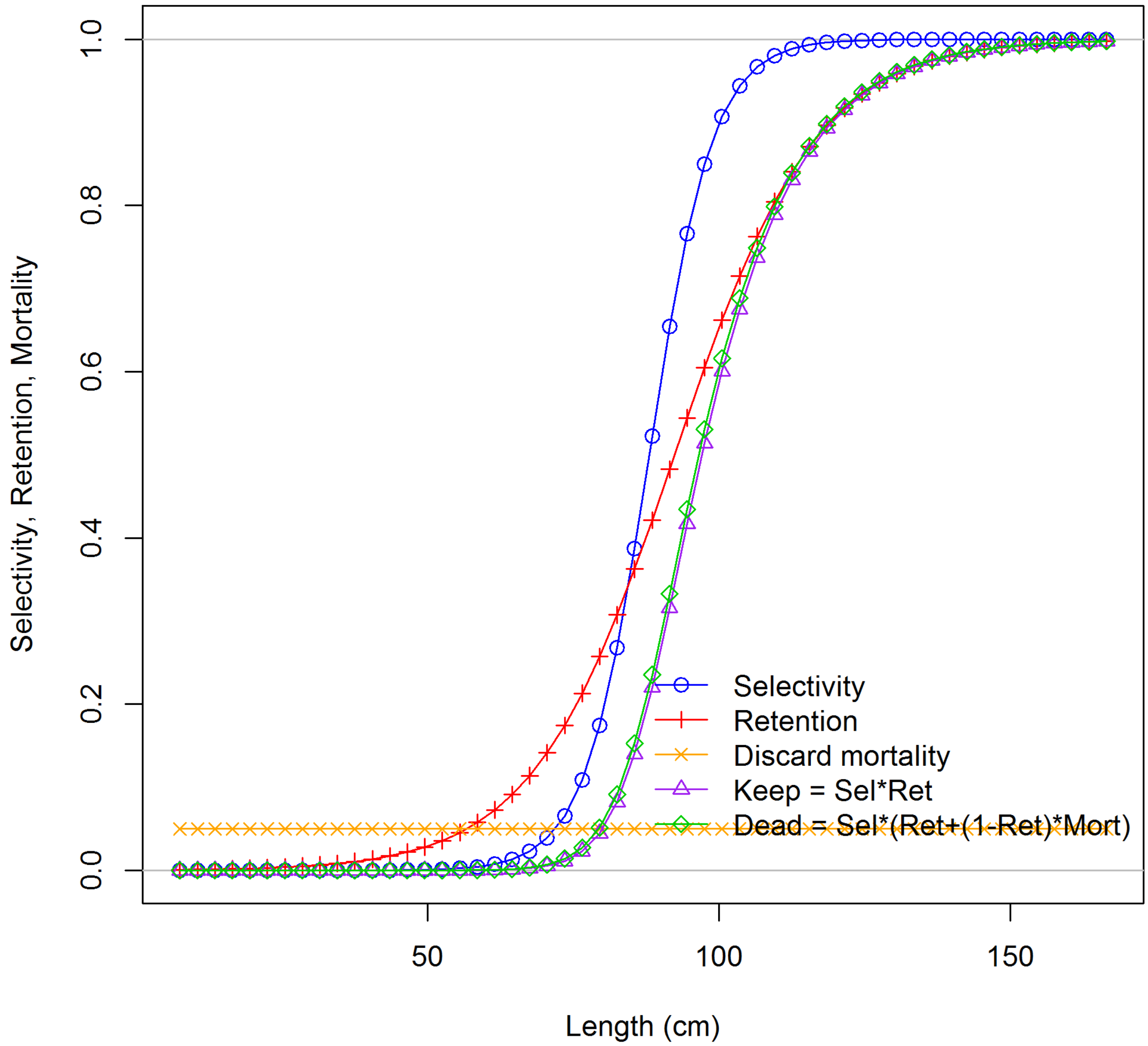

Figure 3.20. Length-based selectivity for the commercial fishery. Selectivity (blue line) is constant over the entire assessment time period (1927-2011). Retention (red line) is shown for time period 1985-2011. Discard mortality (orange line) is constant at 0.05.

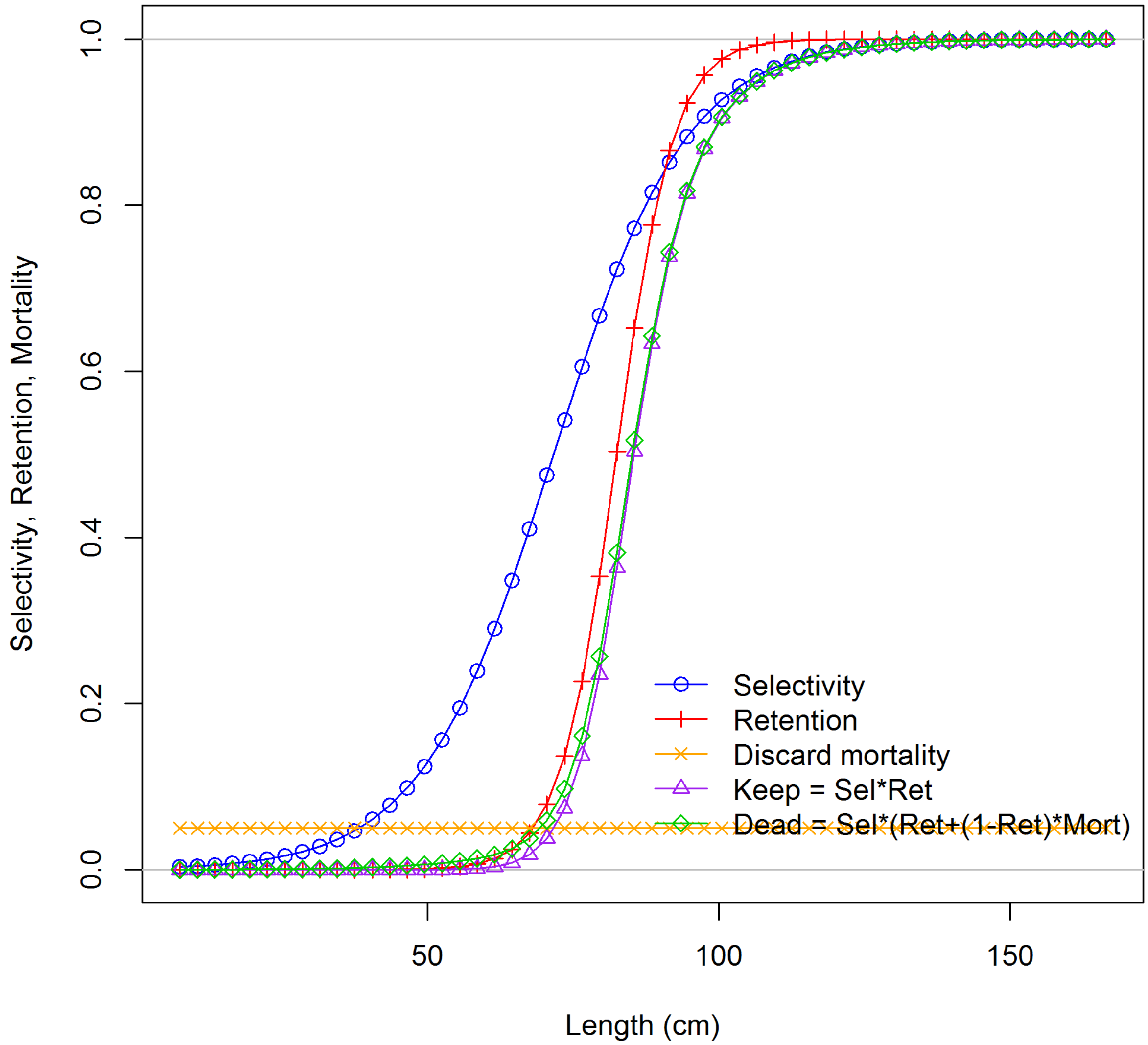

Figure 3.21. Length-based selectivity for the recreational fishery. Selectivity (blue line) is constant over the entire assessment time period (1927-2011). Retention (red line) is shown for time period 1985-2011. Discard mortality (orange line) is constant at 0.05.

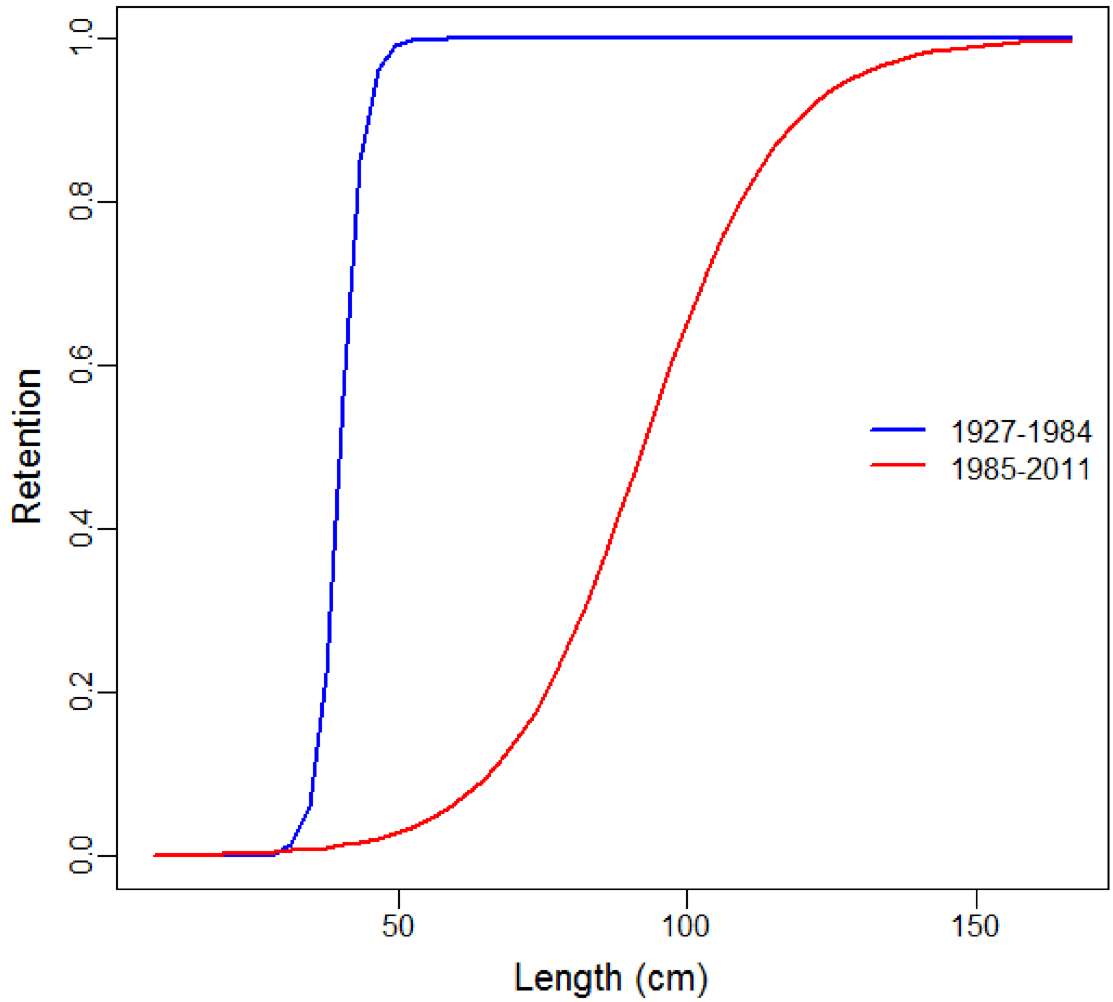

Figure 3.22. Retention patterns for the commercial fishery before and after the implementation of a minimum size limit of 33in FL in 1984.

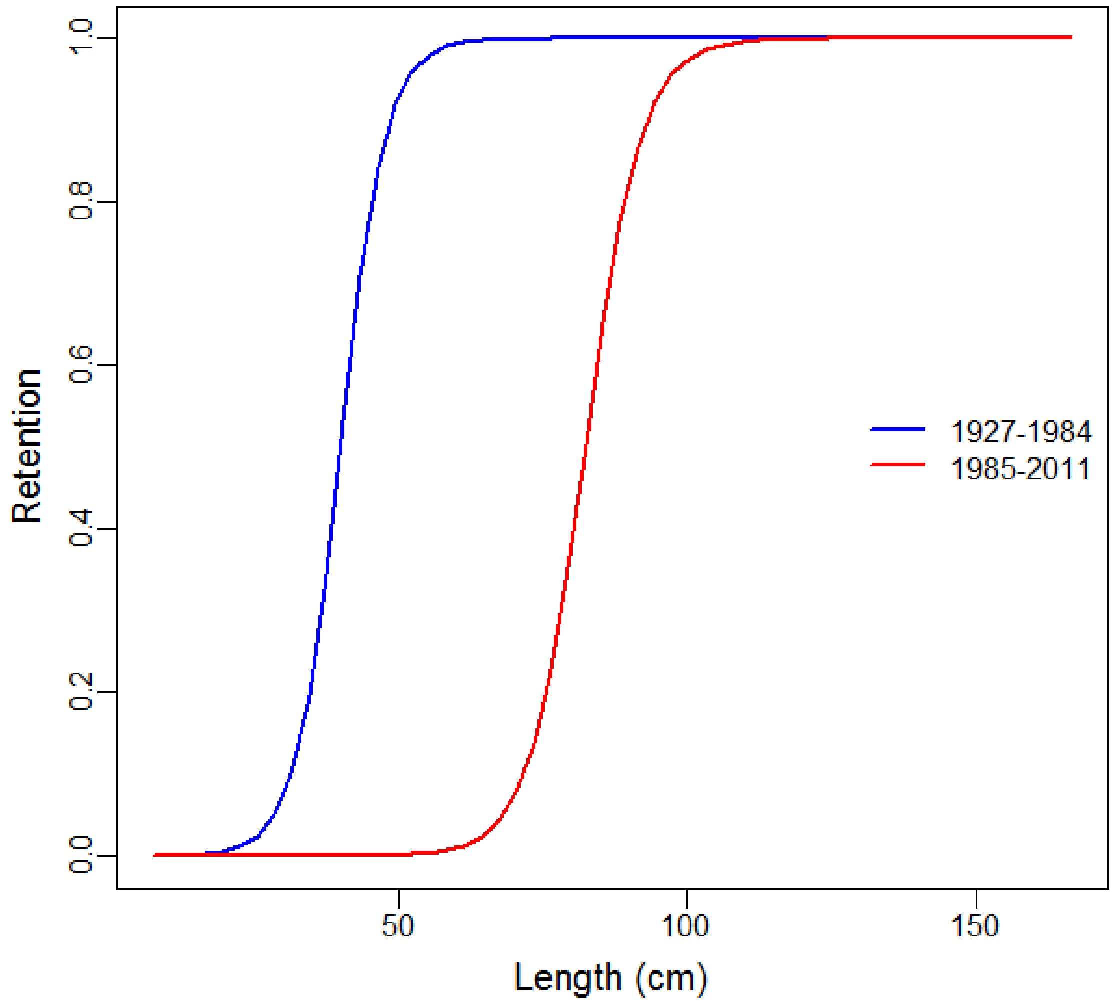

Figure 3.23. Retention patterns for the recreational fishery before and after the implementation of a minimum size limit of 33in FL in 1984.

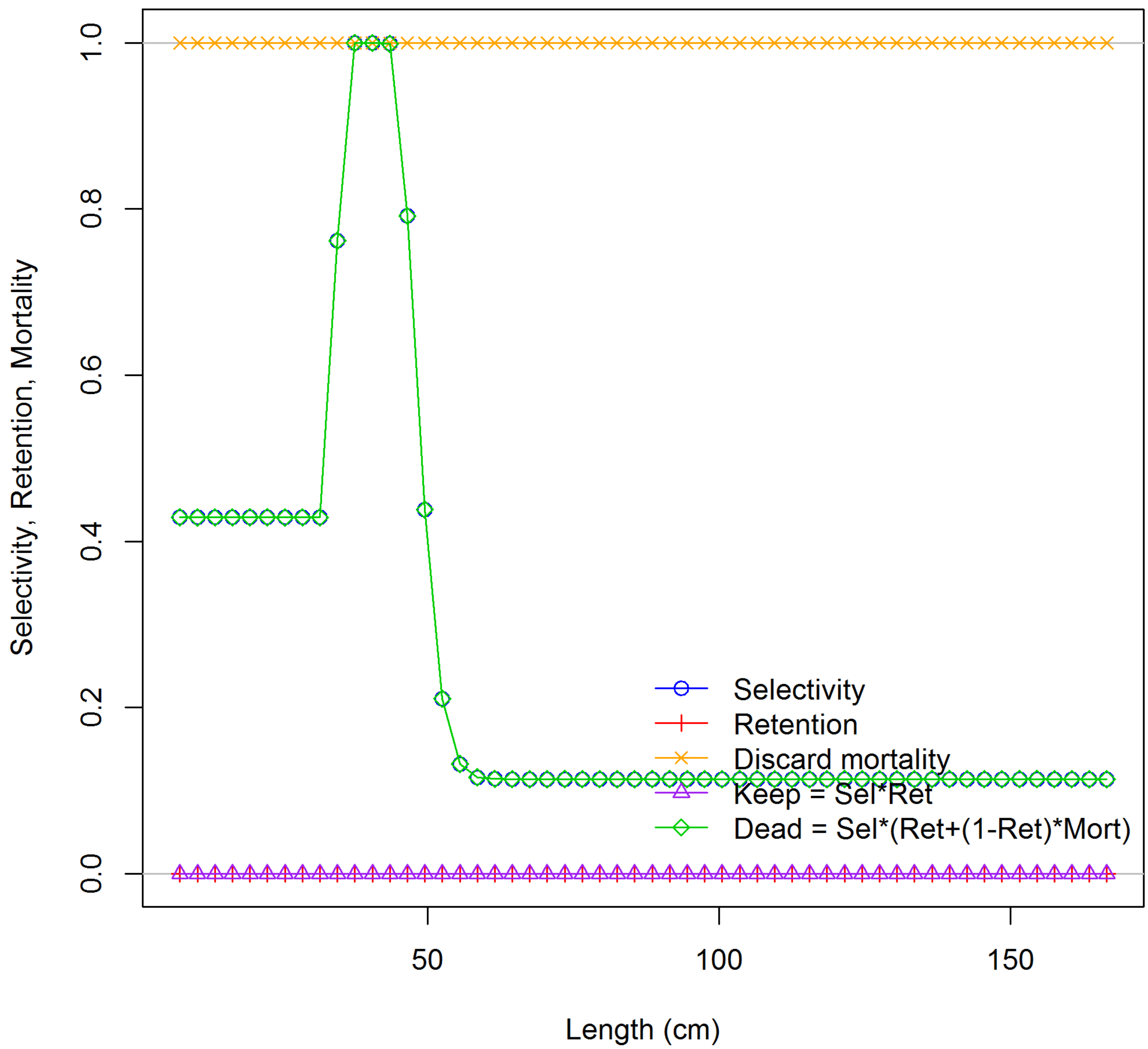

Figure 3.24. Length-based selectivity for the shrimp fishery. Selectivity (blue line) is constant over the entire assessment time period (1927-2011). All selected fish are assumed to be discarded dead.

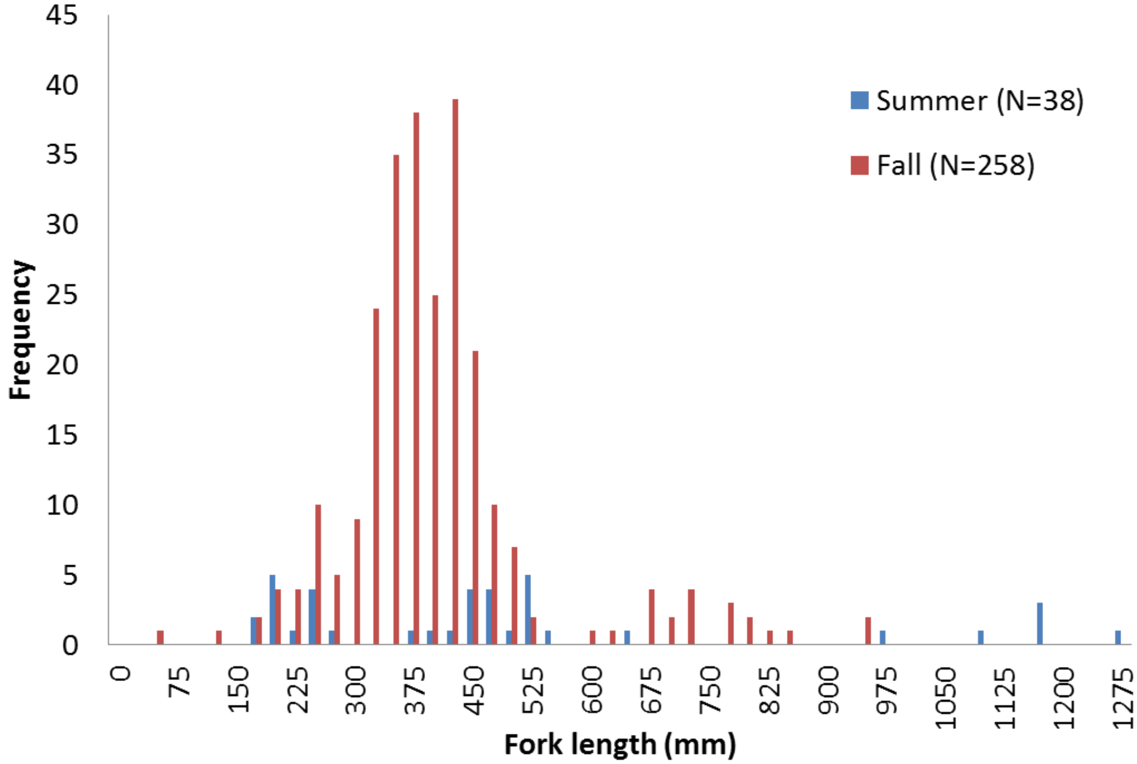

Figure 3.25. Length composition of Gulf of Mexico Cobia from the SEAMAP trawl survey by season.

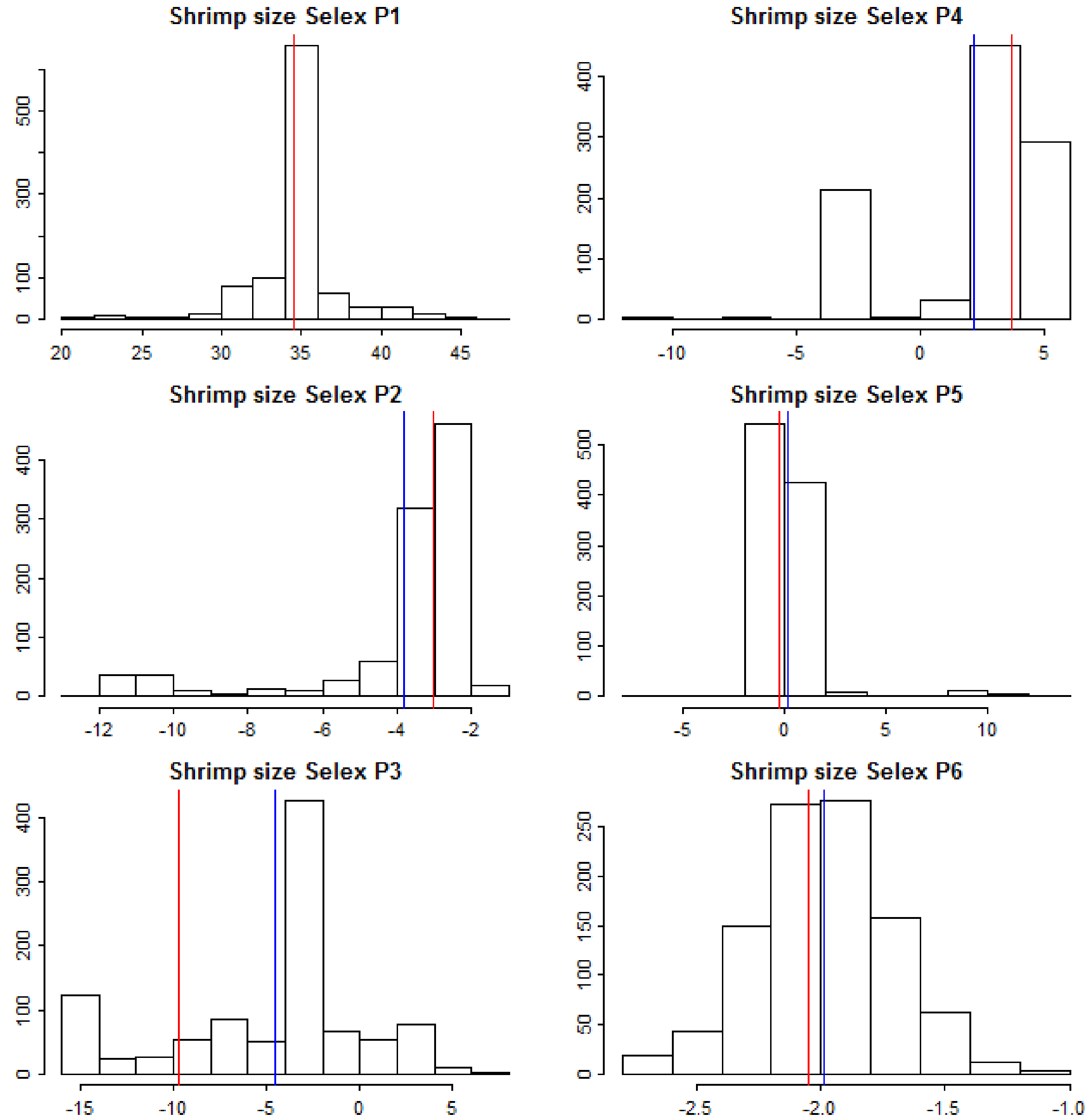

Figure 3.26. Distribution of estimated shrimp selectivity parameters from 1000 bootstrap samples. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

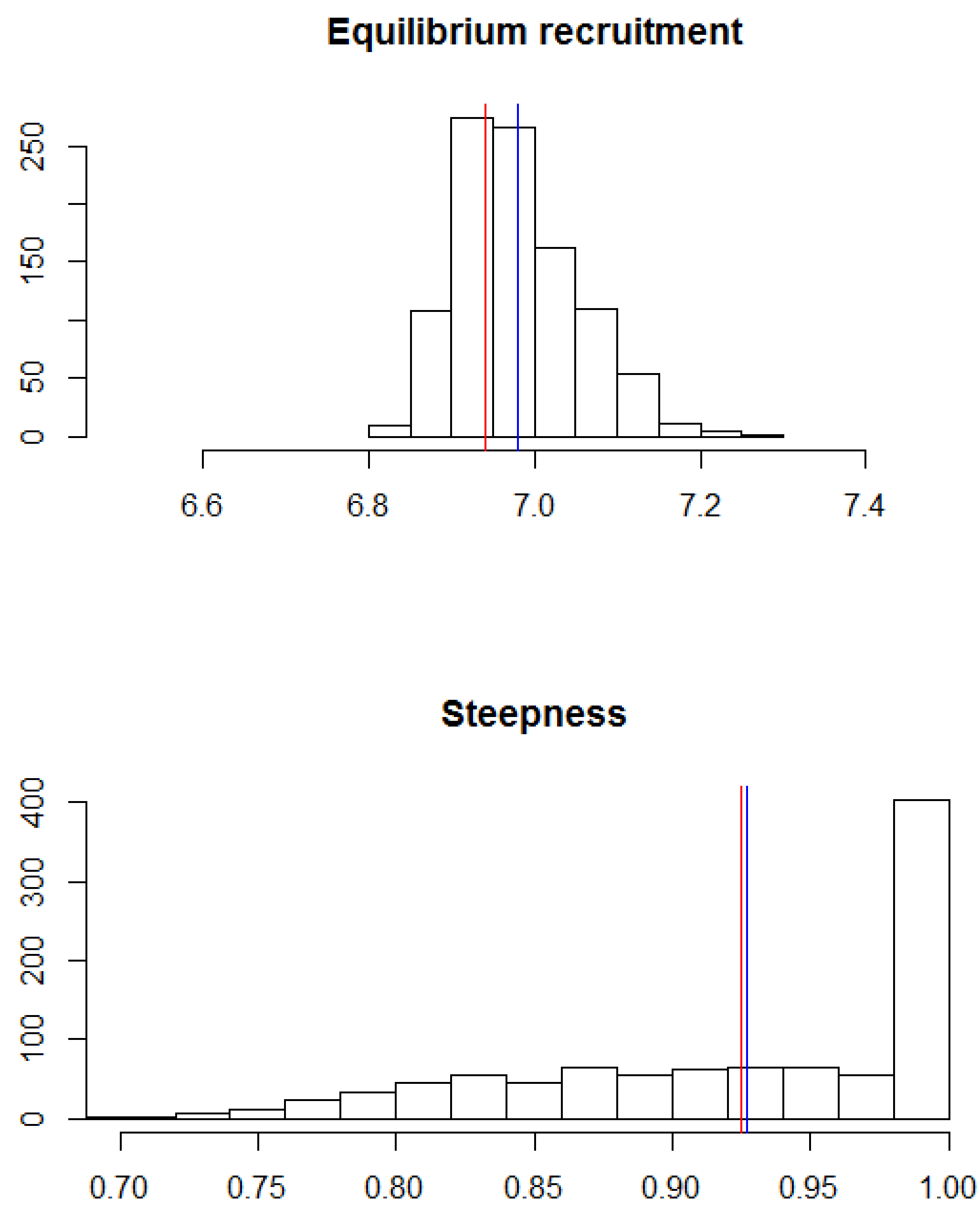

Figure 3.27. Distribution of estimated equilibrium recruitment and steepness from 1000 bootstrap samples. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

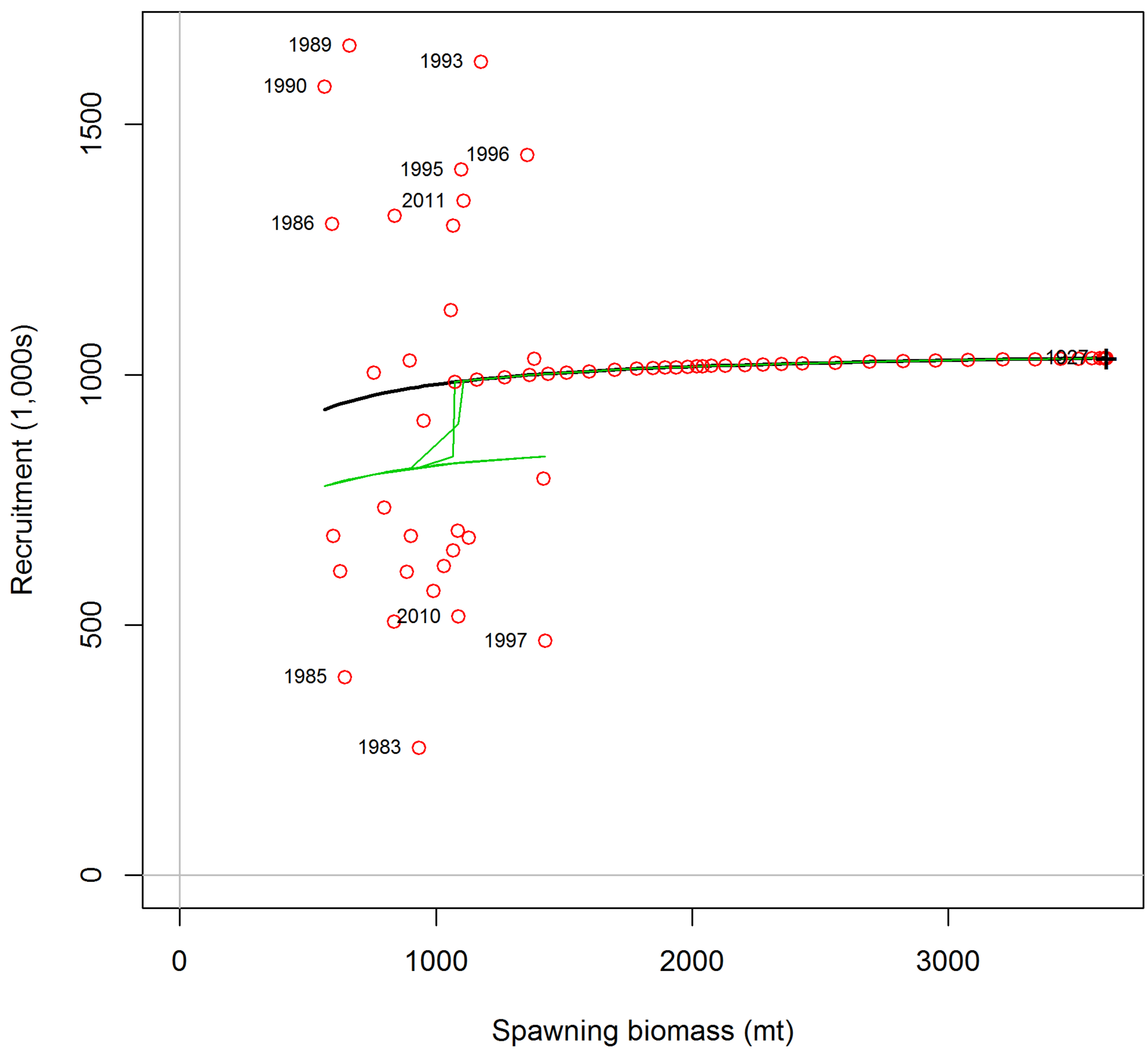

Figure 3.28. Predicted stock-recruitment relationship for Gulf of Mexico cobia for the base model. Plotted are predicted annual recruitments from SS (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (green line).

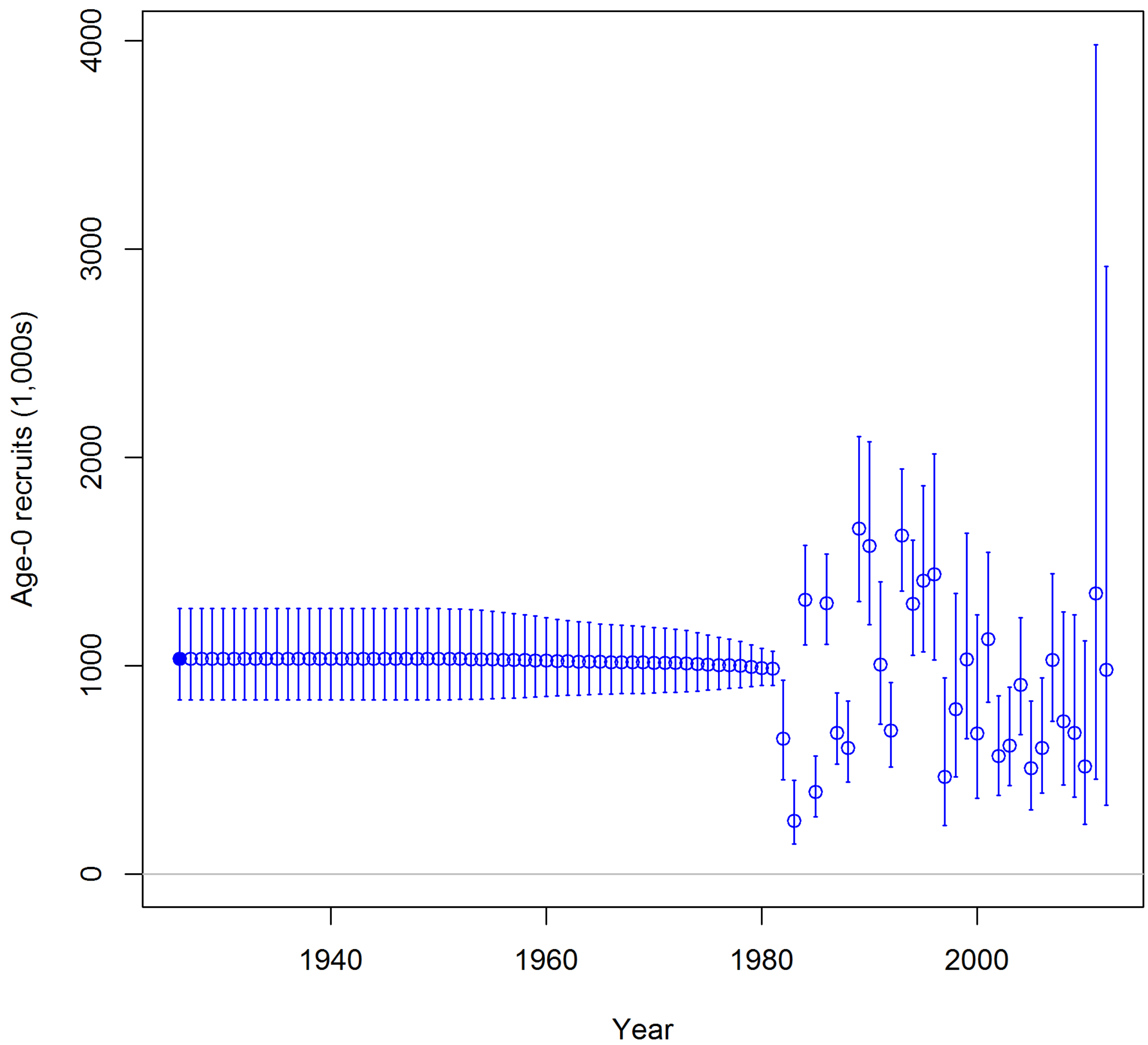

Figure 3.29. Predicted age-0 recruits with associated 95% asymptotic intervals.

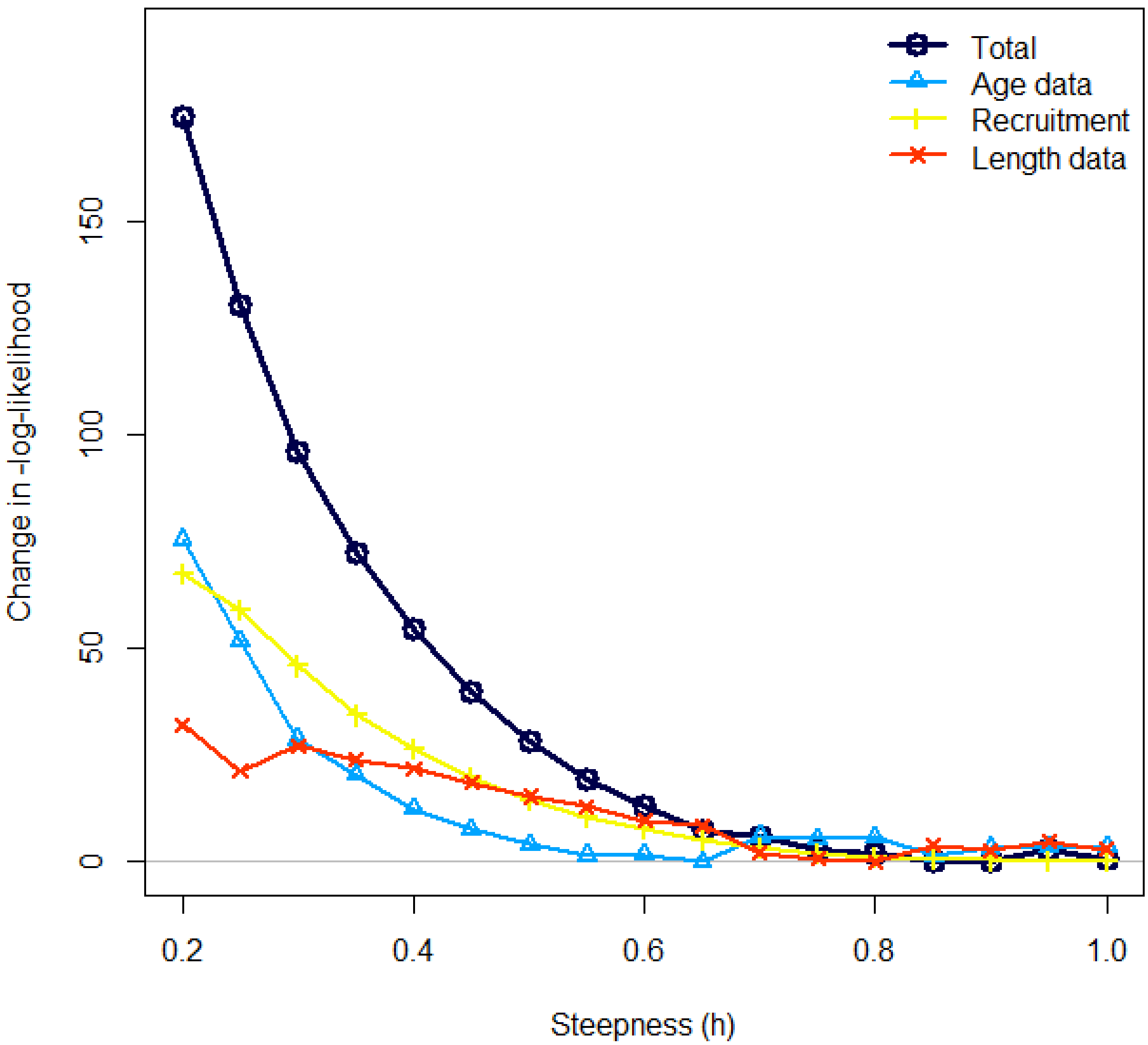

Figure 3.30. Likelihood profile for steepness at intervals of 0.05.

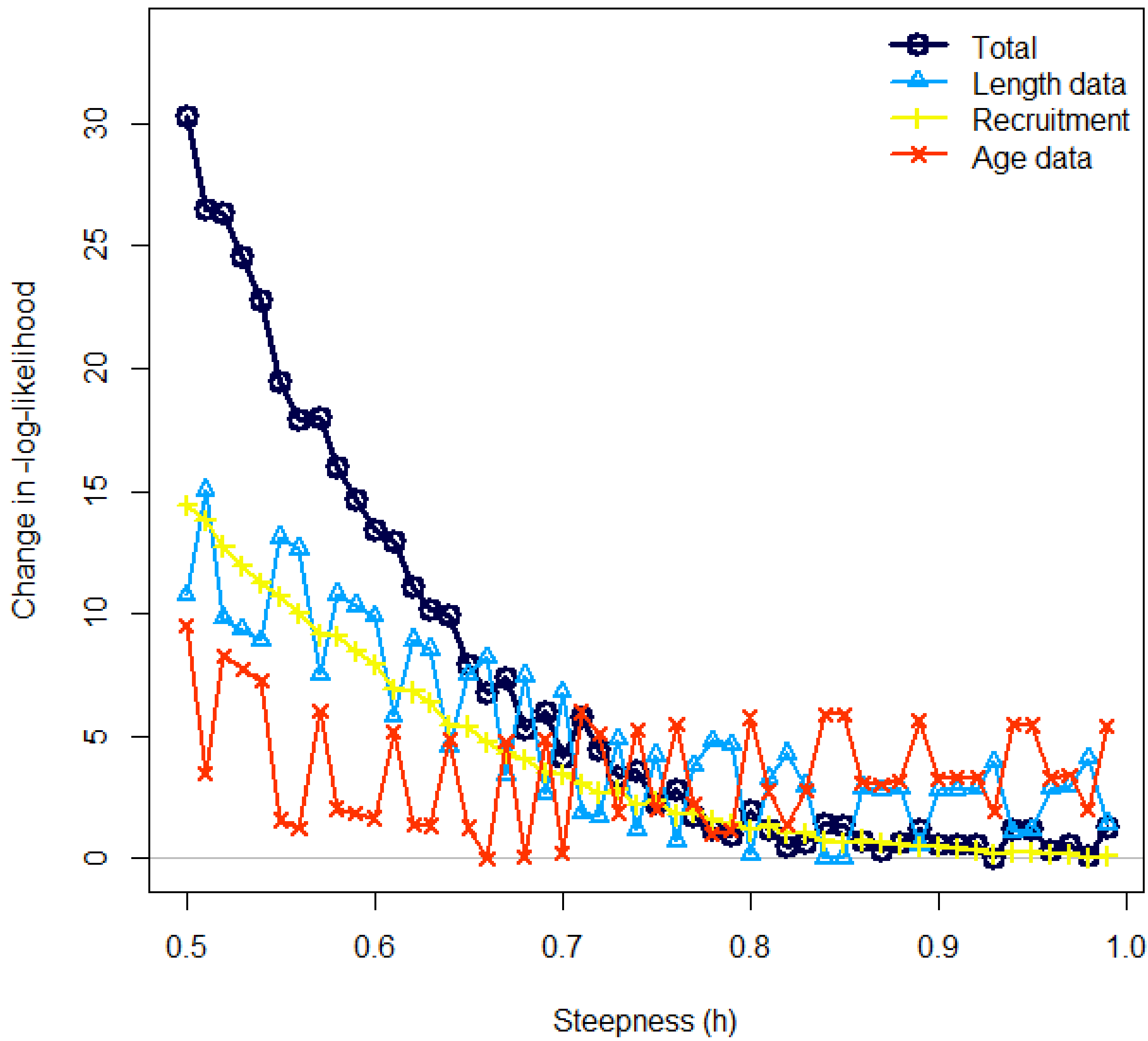

Figure 3.31. Likelihood profile for steepness at intervals of 0.01.

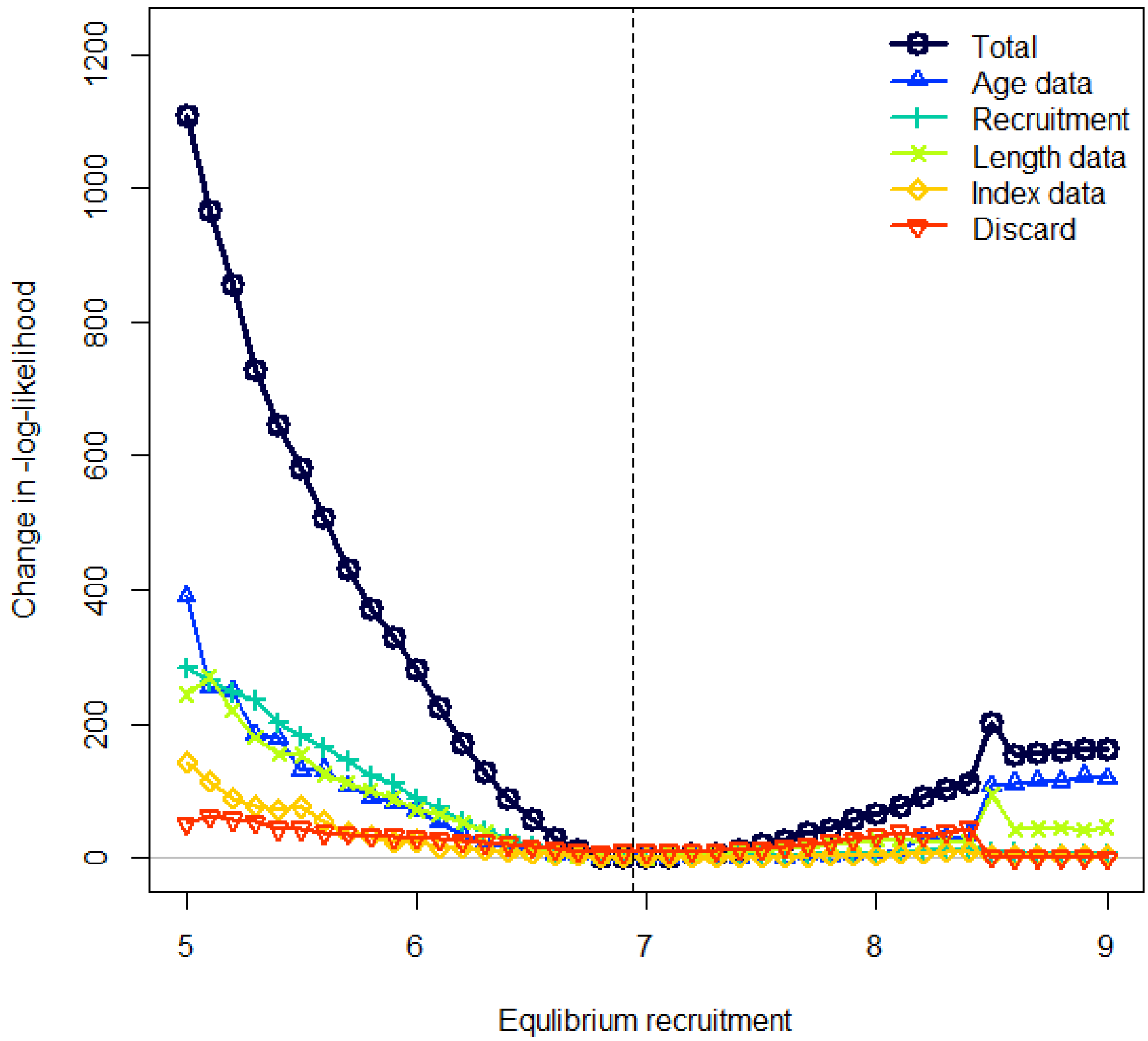

Figure 3.32. Likelihood profile for equilibrium recruitment. The dotted line represents the point estimate from the base model.

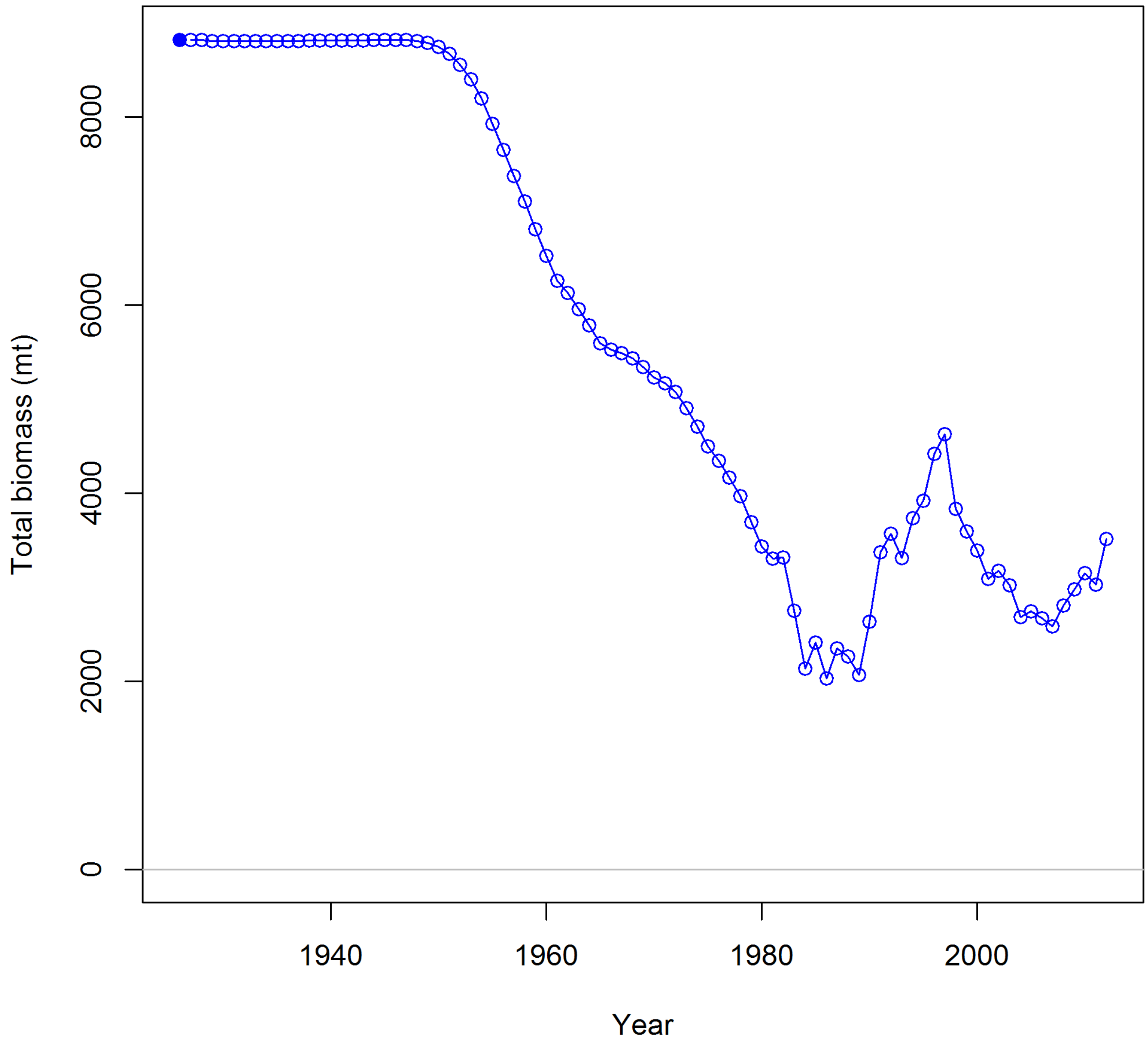

Figure 3.33. Predicted total biomass (mt) of Gulf of Mexico cobia from 1927-2011.

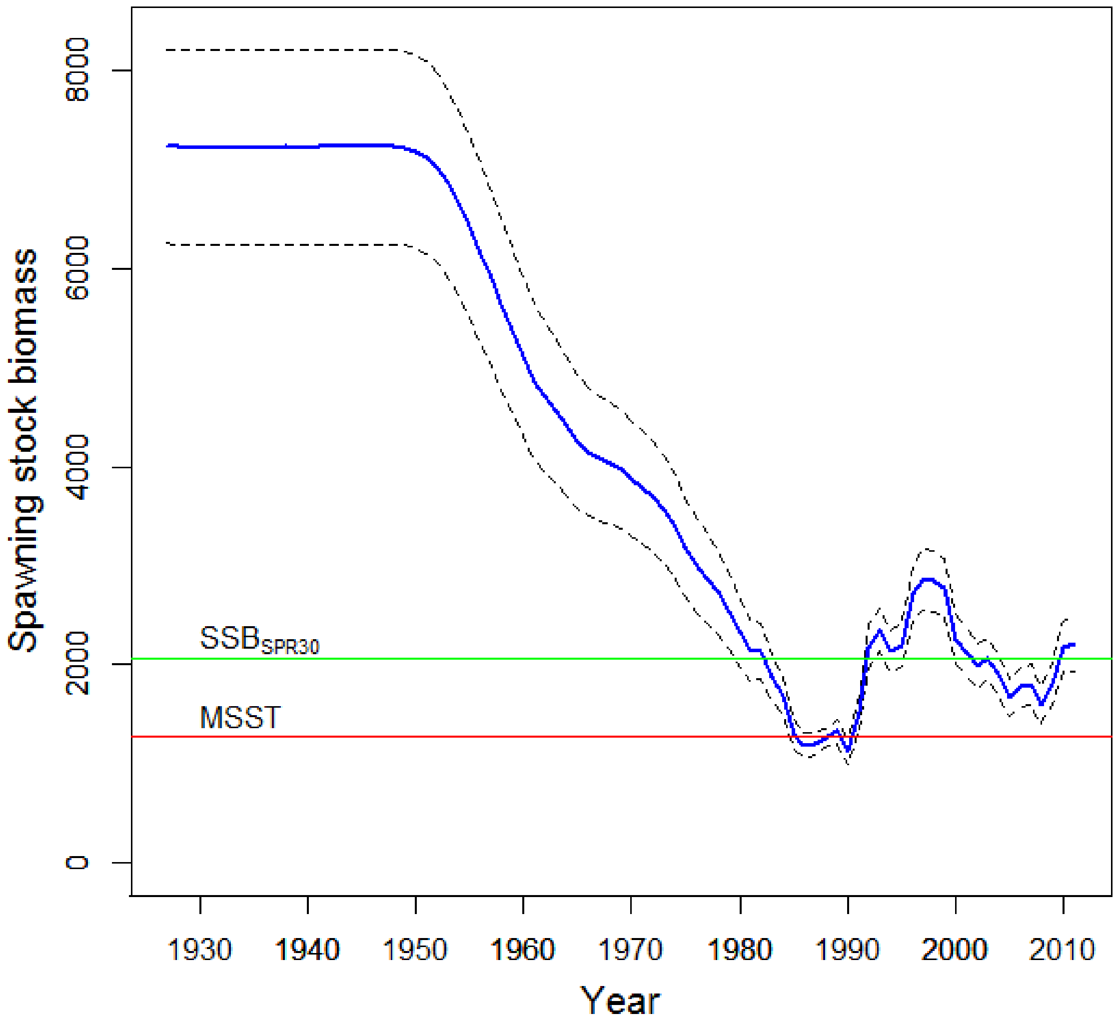

Figure 3.34. Predicted spawning biomass (mt) of Gulf of Mexico cobia (blue line) with associated 80% asymptotic intervals (dashed lines). The green line represents spawning stock biomass at $F_{SPR30\%}$ and the red line represents the minimum stock size threshold.

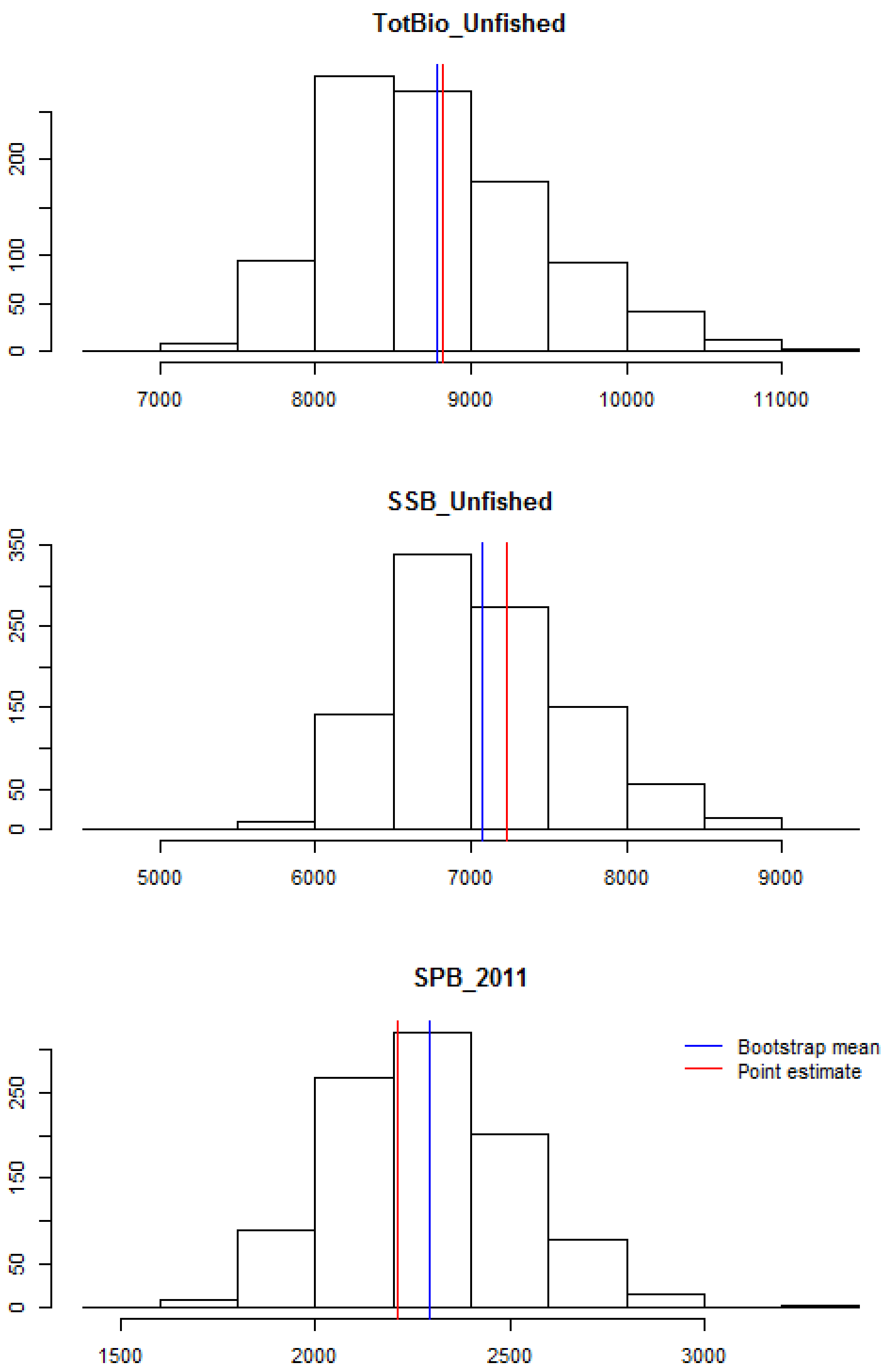
TotBio_Unfished
0
50
100
200
7000
8000
9000
10000
11000
SSB_Unfished
0
50
150
250
350
5000
6000
7000
8000
9000
SPB_2011
Bootstrap mean
Point estimate
0
50
150
250
1500
2000
2500
3000

Figure 3.35. Distribution of estimated unfished total biomass, unfished spawning biomass and current spawning biomass (2011) from 1000 bootstrap samples of the base model. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

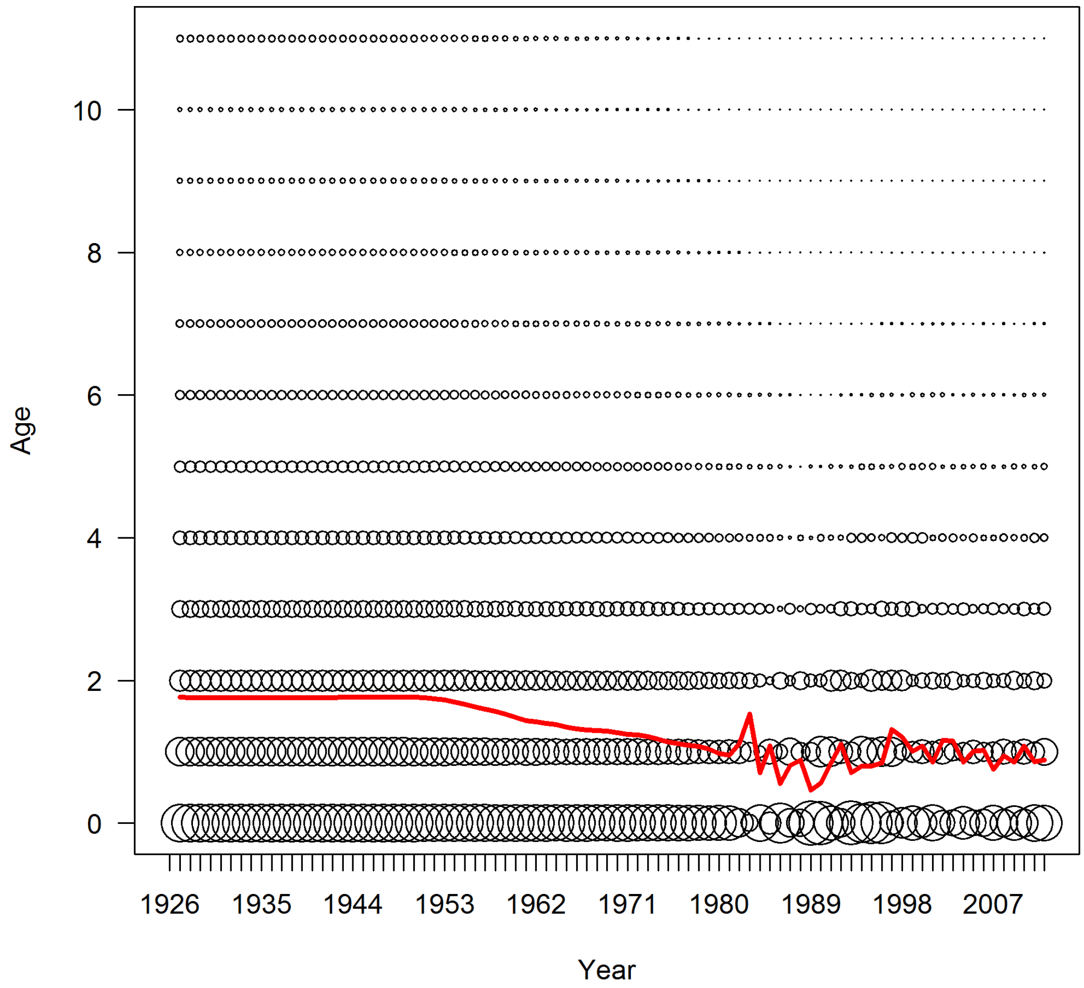

Figure 3.36. Predicted numbers at age (bubbles) and mean age of Gulf of Mexico cobia (red line).

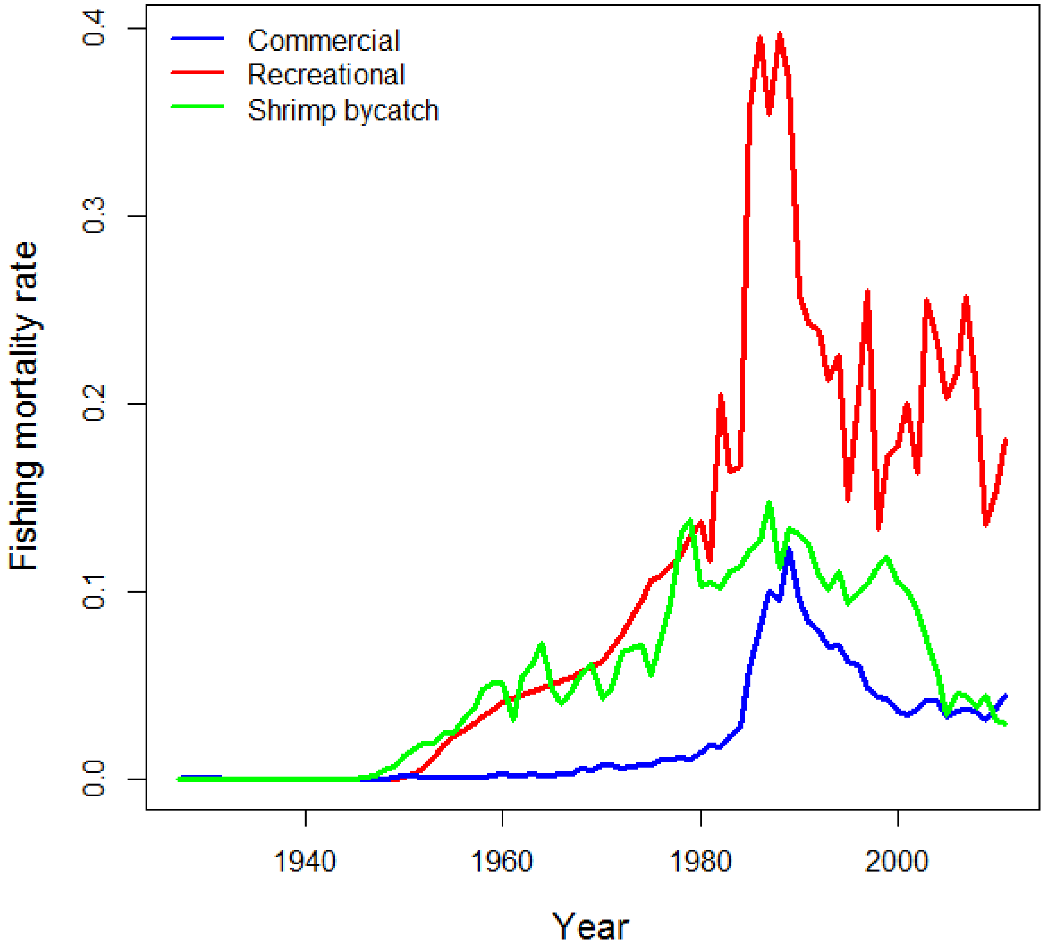

Figure 3.37. Fleet-specific estimates of instantaneous fishing mortality rate in terms of exploitable biomass.

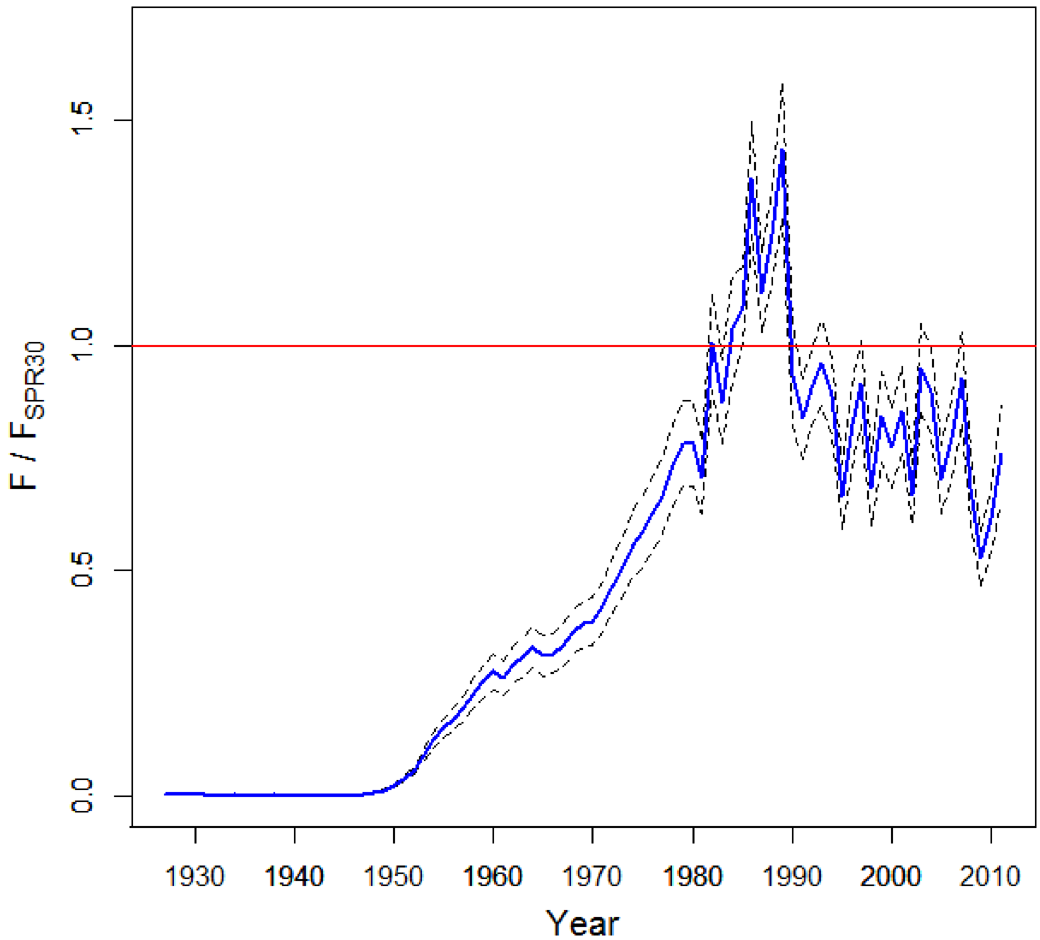

Figure 3.38. Total fishing mortality rate relative to F_{SPR30} for Gulf of Mexico cobia with associated 80% asymptotic confidence limits.

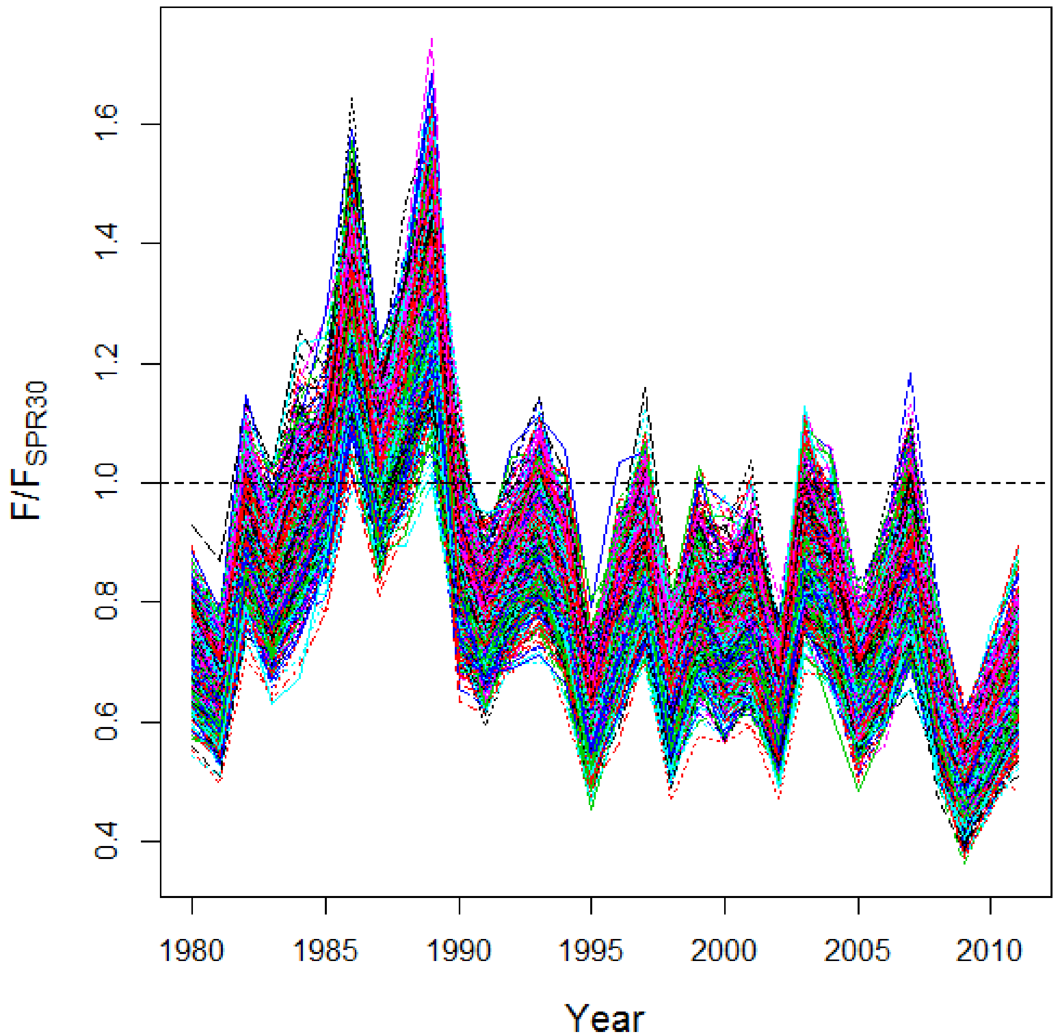

Figure 3.39. 1000 bootstrap estimates of the current fishing mortality (F2009-F2011) relative to F_{SPR30} for Gulf of Mexico cobia from 1980-2011.

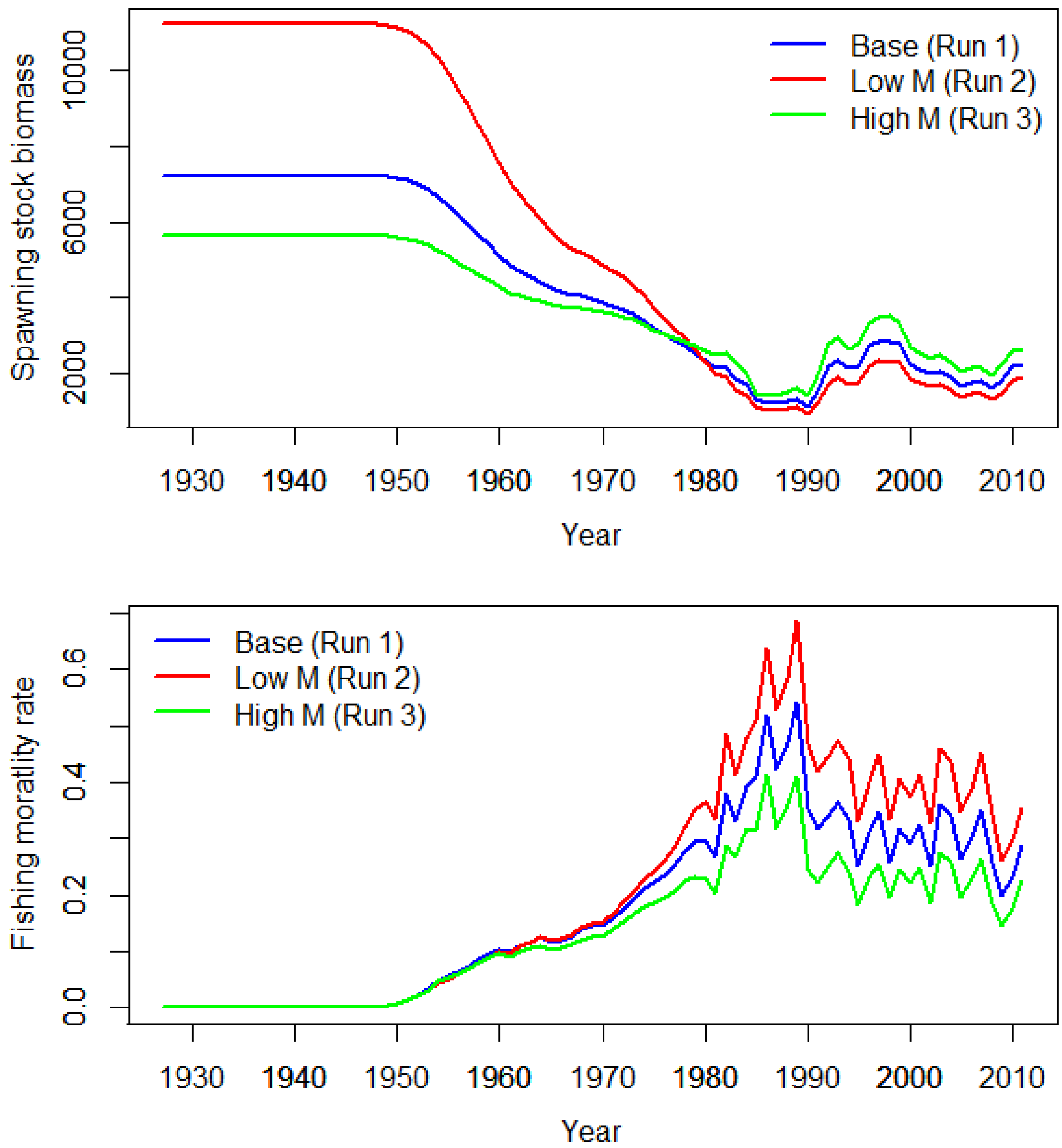

Figure 3.40. Predicted spawning stock biomass (top panel) and fishing mortality rate (bottom panel) over time for Gulf of Mexico cobia for three alternative levels of natural mortality rate (Runs 1-3).

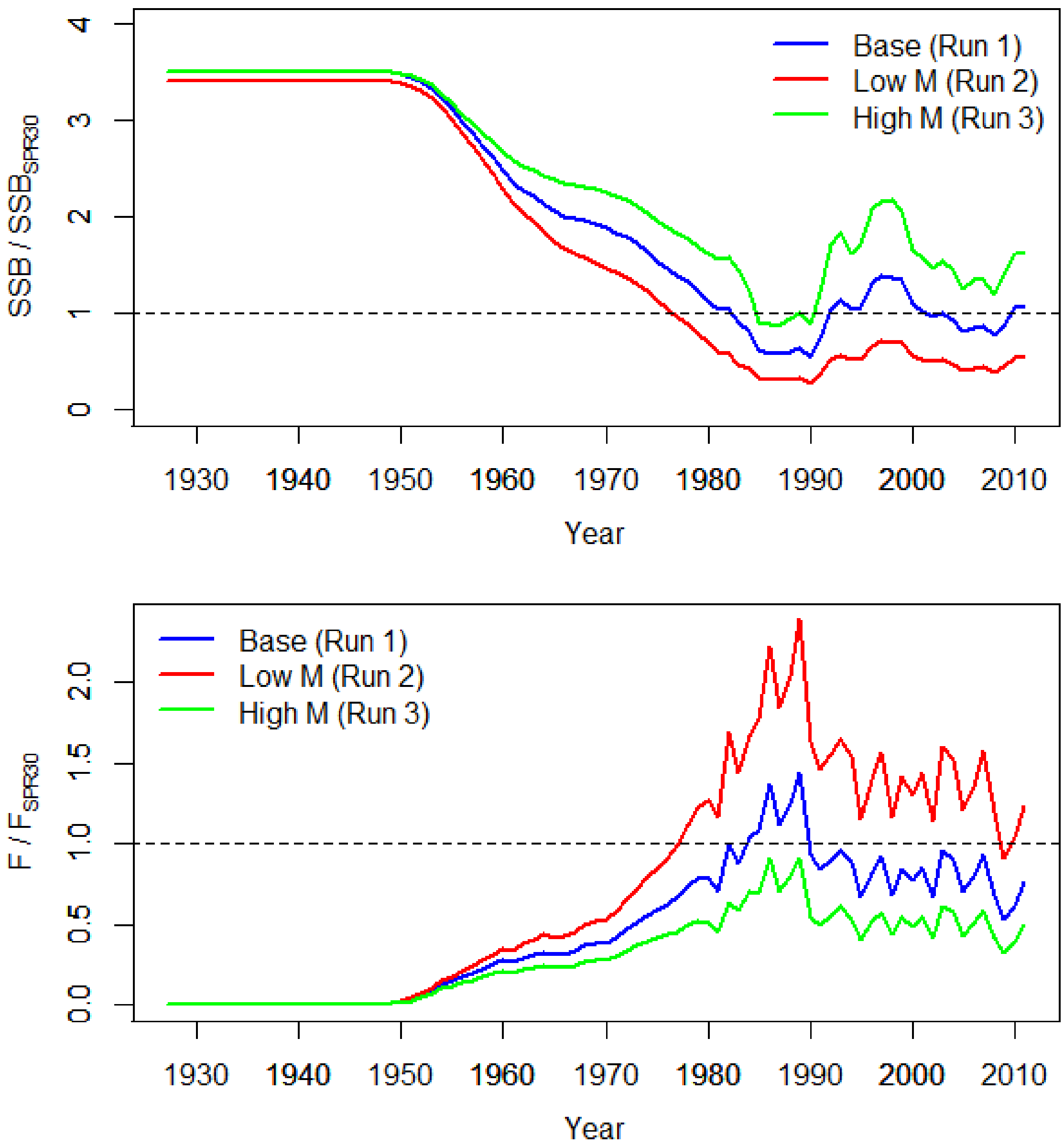

Figure 3.41. Predicted spawning stock biomass relative to $SSB_{SPR30\%}$ (top panel) and fishing mortality rate relative to $F_{SPR30\%}$ (bottom panel) over time for Gulf of Mexico cobia for three alternative levels of natural mortality rate (Runs 1-3).

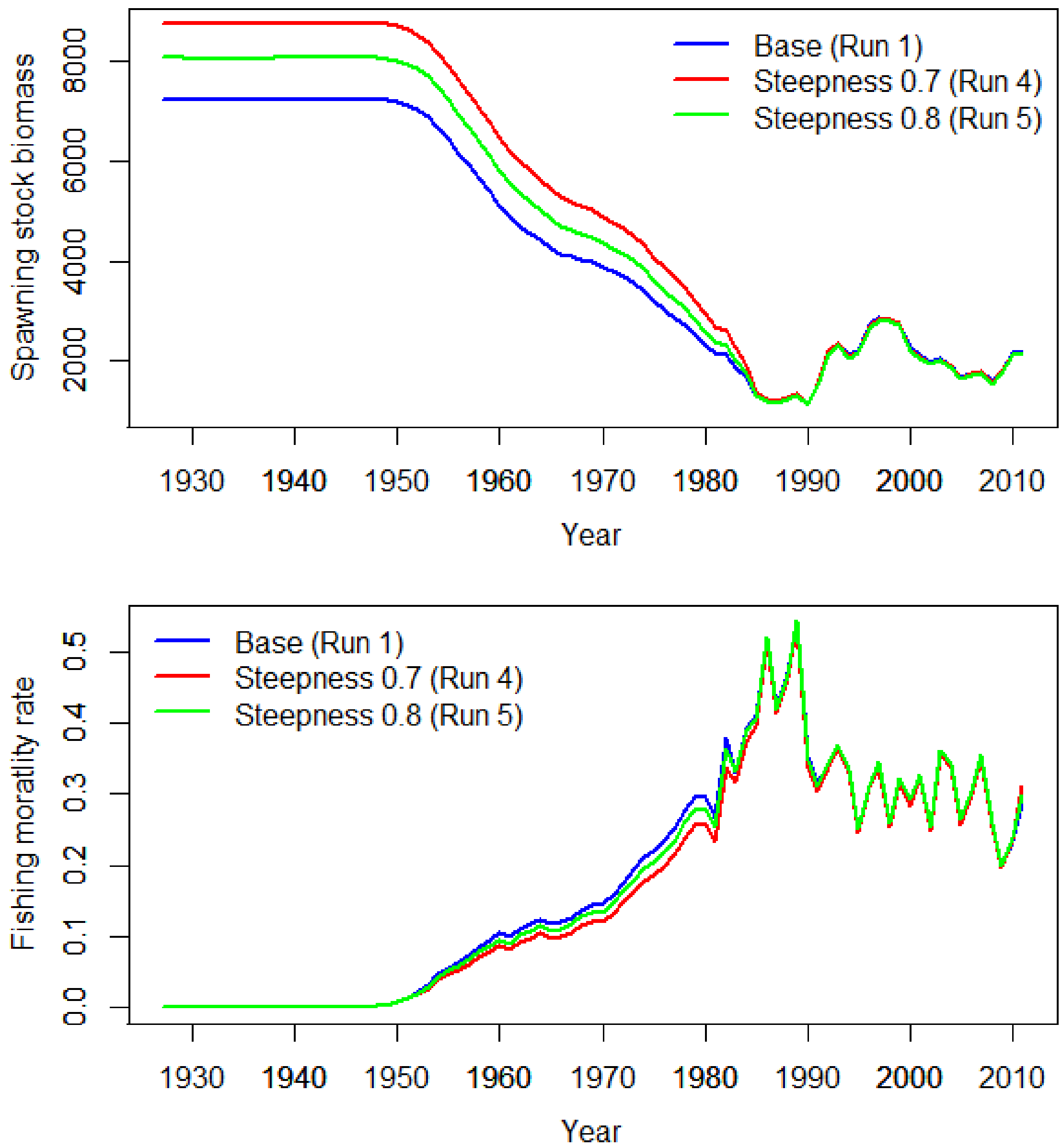

Figure 3.42. Predicted spawning stock biomass (top panel) and fishing mortality rate (bottom panel) over time for Gulf of Mexico cobia for three alternative levels of steepness (Runs 1, 5, 6; Base model steepness is 0.92).

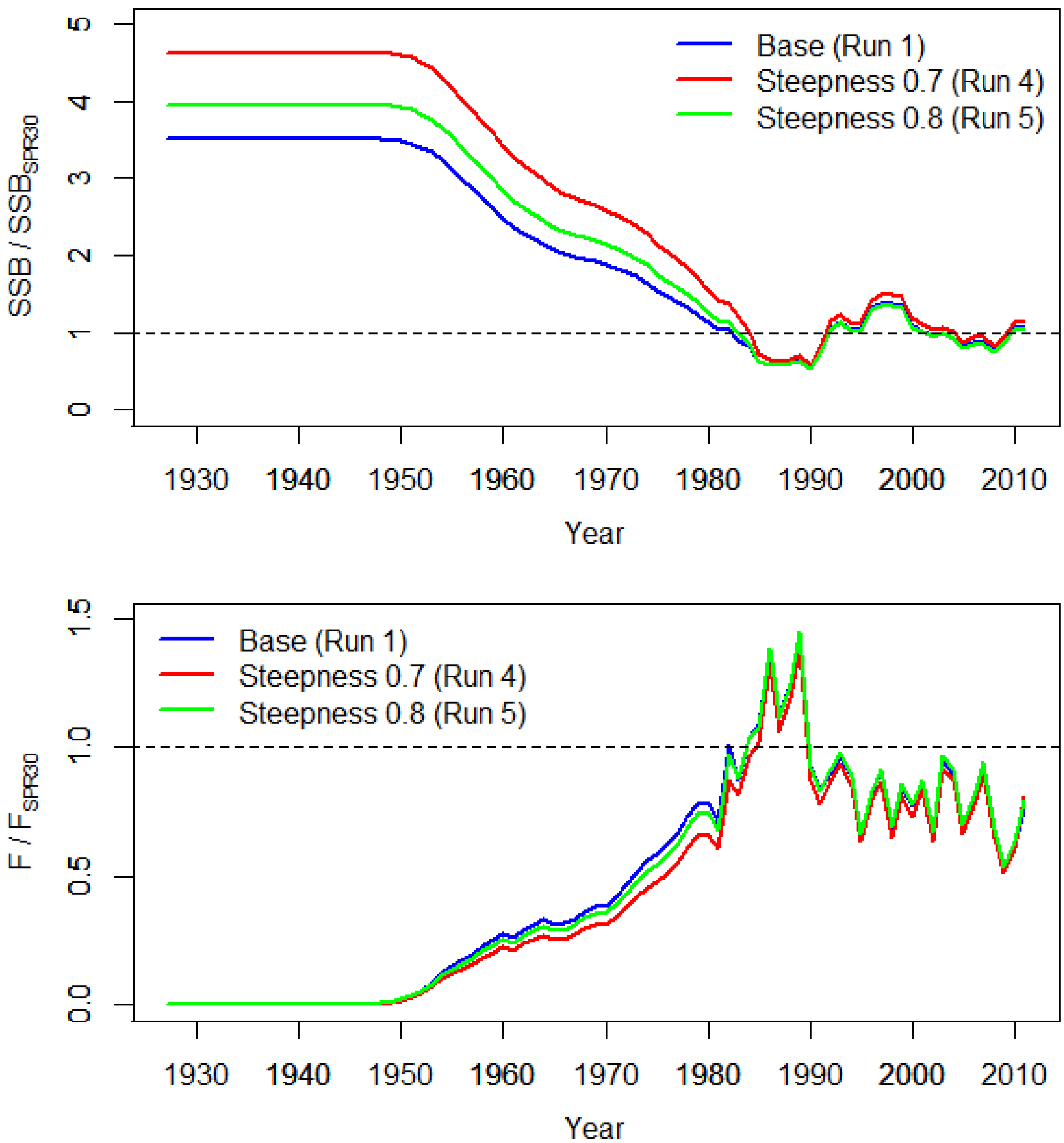

Figure 3.43. Predicted spawning stock biomass relative to $SSB_{SPR30\%}$ (top panel) and fishing mortality rate relative to $F_{SPR30\%}$ (bottom panel) over time for Gulf of Mexico cobia for three alternative levels of steepness (Runs 1, 5, 6; Base model steepness is 0.92).

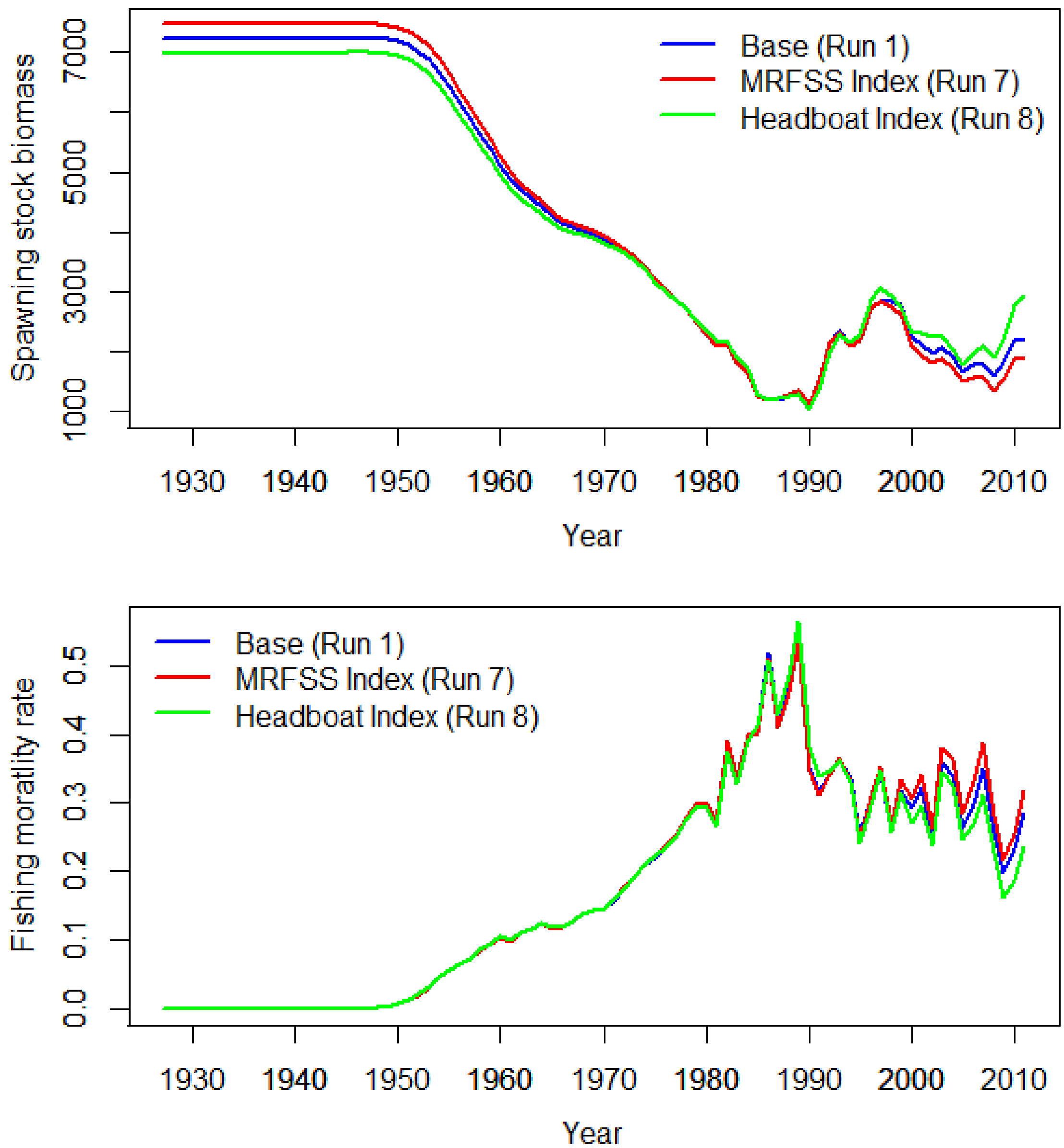

Figure 3.44. Predicted spawning stock biomass (top panel) and fishing mortality rate (bottom panel) over time for Gulf of Mexico cobia under three scenarios; using both indices of abundance, removing the Headboat index, and removing the MRFSS index (Runs 1, 7, 8).

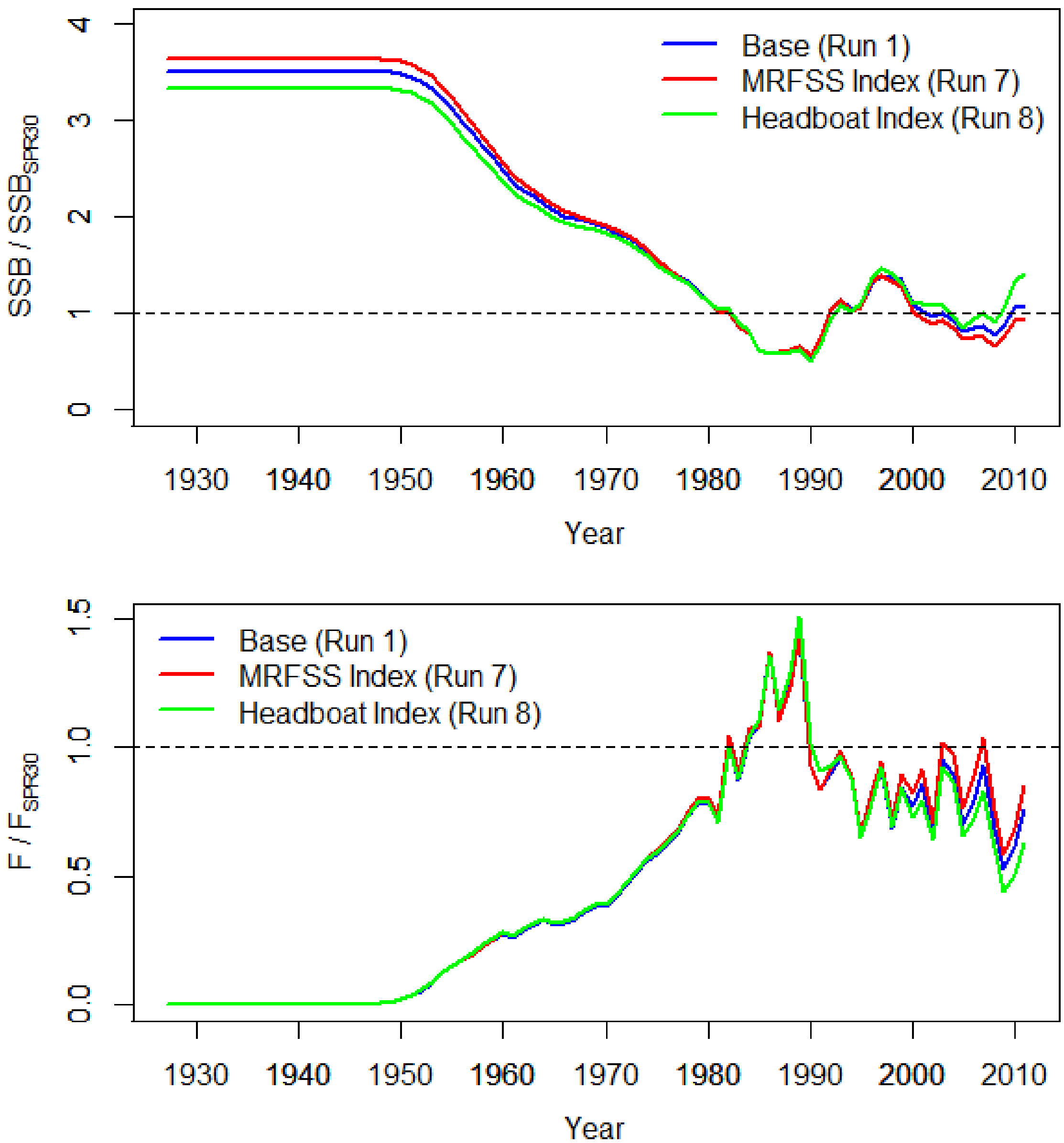

Figure 3.45. Predicted spawning stock biomass relative to $SSB_{SPR30\%}$ (top panel) and fishing mortality rate relative to $F_{SPR30\%}$ (bottom panel) over time for Gulf of Mexico cobia under three scenarios; using both indices of abundance, removing the Headboat index, and removing the MRFSS index (Runs 1, 7, 8).

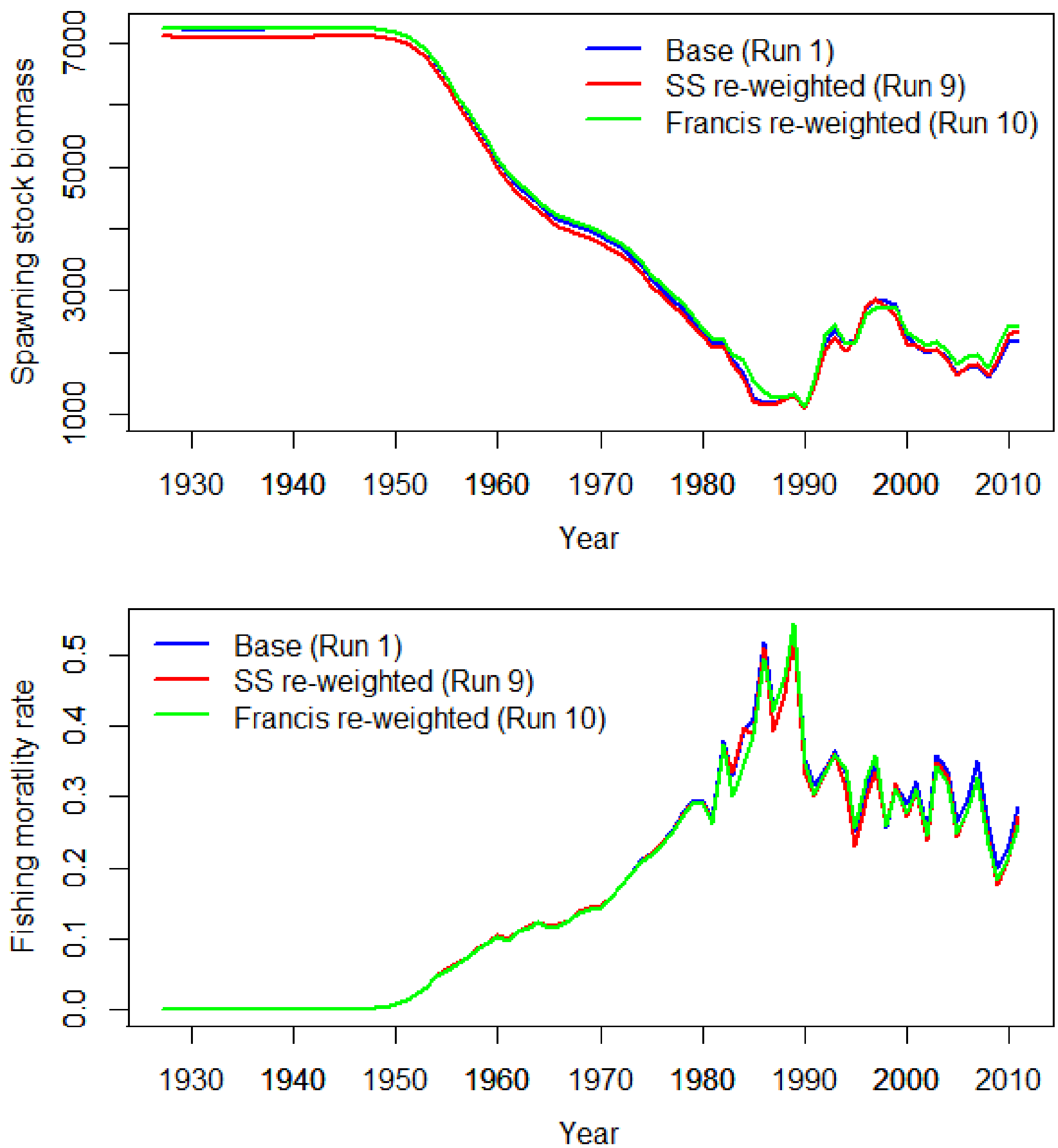

Figure 3.46. Predicted spawning stock biomass (top panel) and fishing mortality rate (bottom panel) over time for Gulf of Mexico cobia using alternative data weighting approaches; the base model does not reweight model components (Run 1), the SS reweighted (Run 9) and Francis (Run 10) scenarios reweight model components relative to the models ability to fit the data.

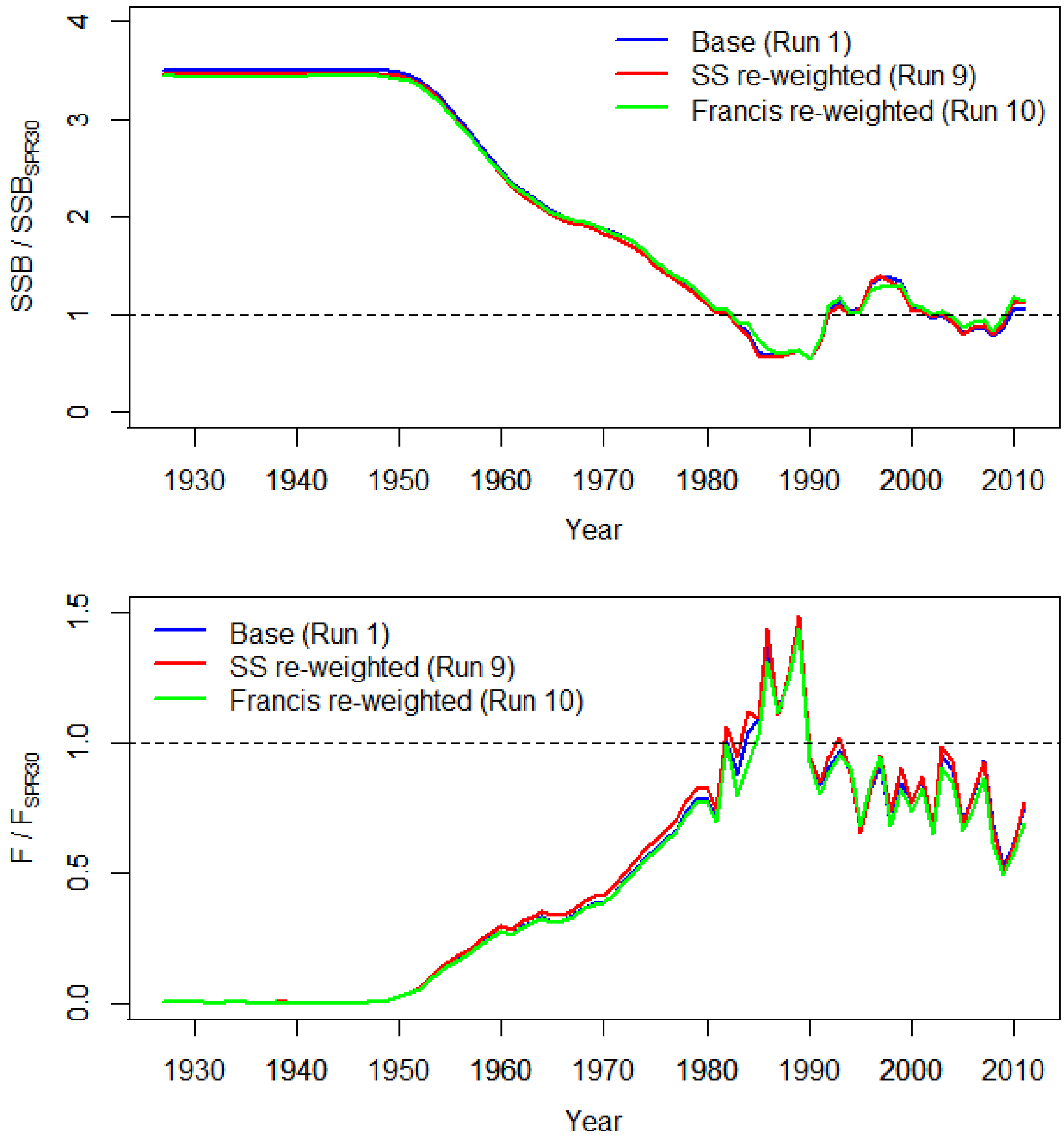

Figure 3.47. Predicted spawning stock biomass relative to $SSB_{SPR30\%}$ (top panel) and fishing mortality rate relative to $F_{SPR30\%}$ (bottom panel) over time for Gulf of Mexico cobia using alternative data weighting approaches; the base model does not reweight model components (Run 1), the SS reweighted (Run 9) and Francis (Run 10) scenarios reweight model components relative to the models ability to fit the data.

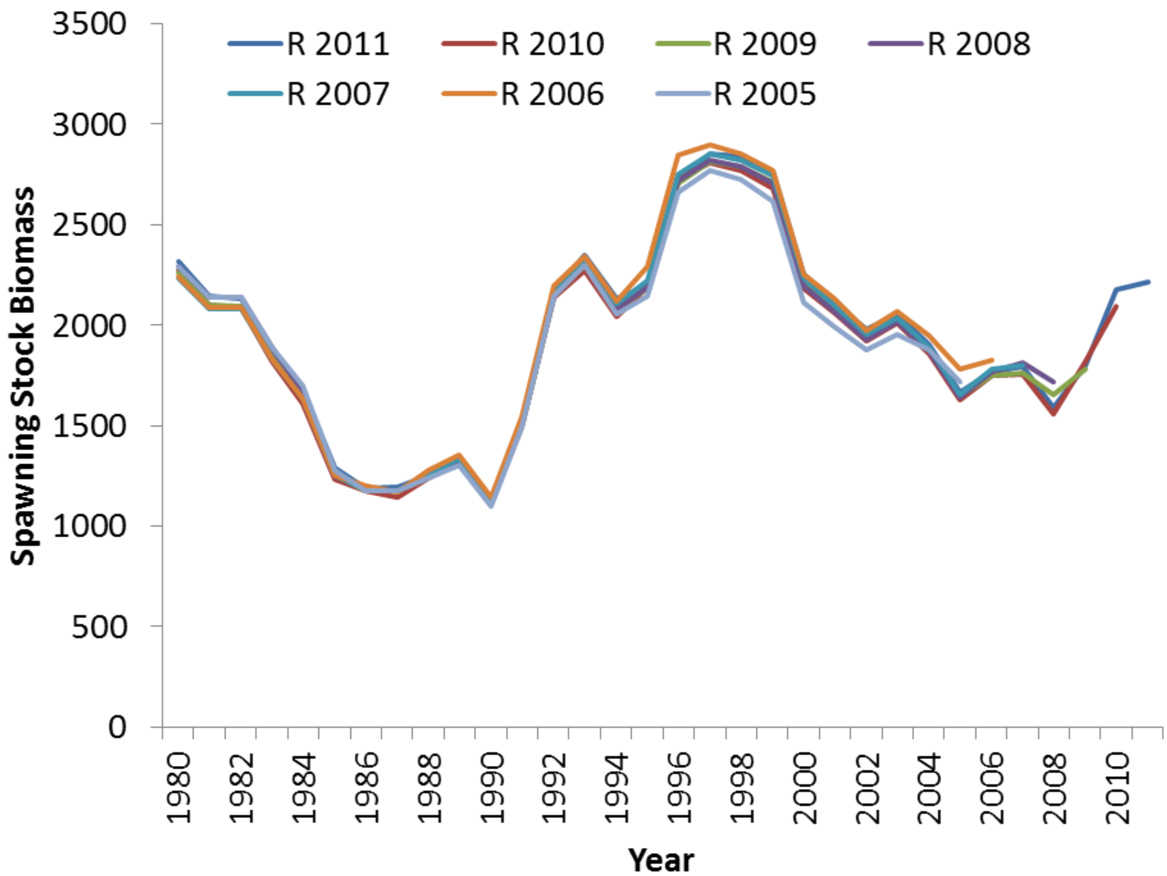

Figure 3.48. Predicted spawning stock biomass over time for Gulf of Mexico cobia from the retrospective analysis.

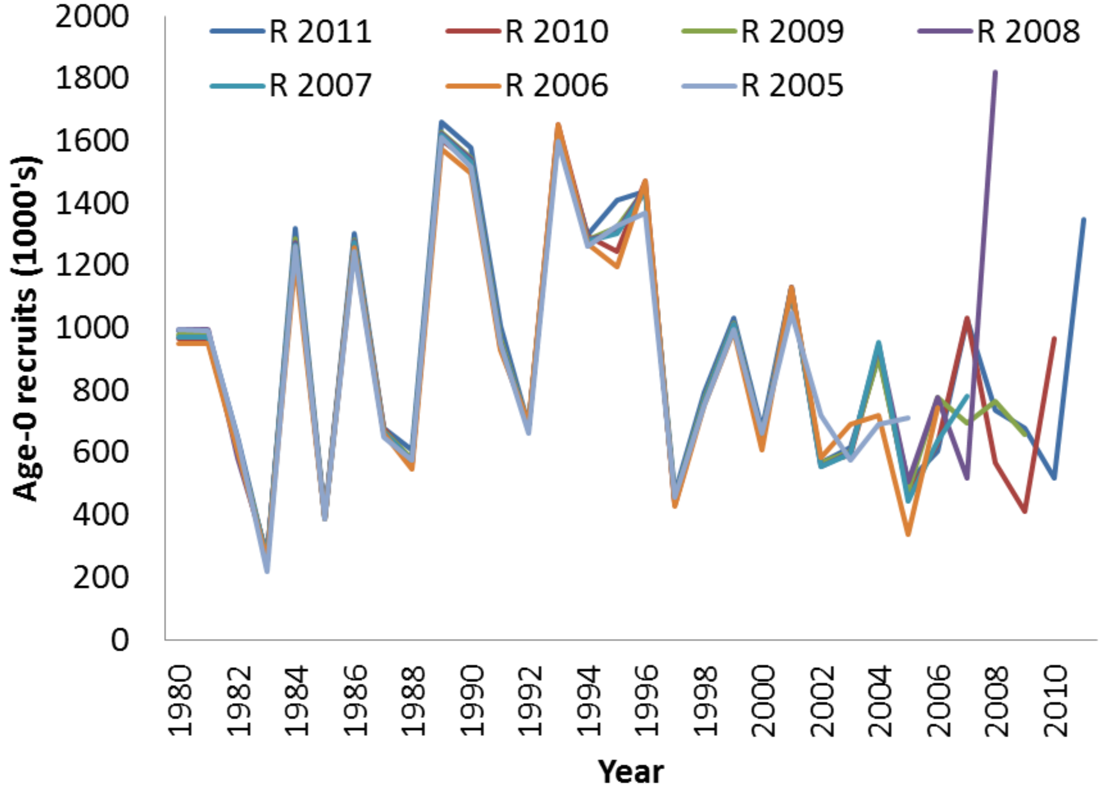

Figure 3.49. Predicted age-0 recruits (1000’s) over time for Gulf of Mexico cobia from the retrospective analysis.

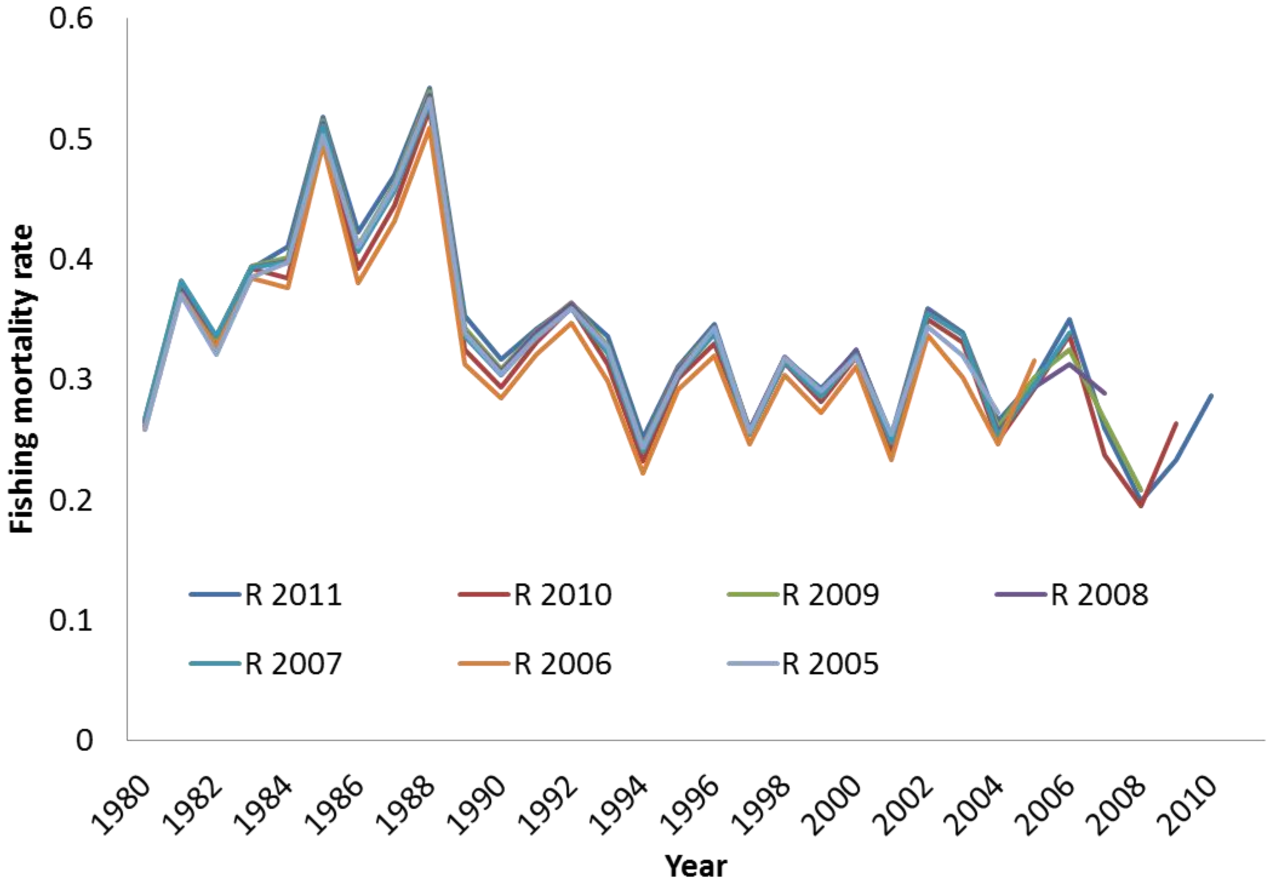

Figure 3.50. Predicted fishing mortality rate for Gulf of Mexico cobia from the retrospective analysis.

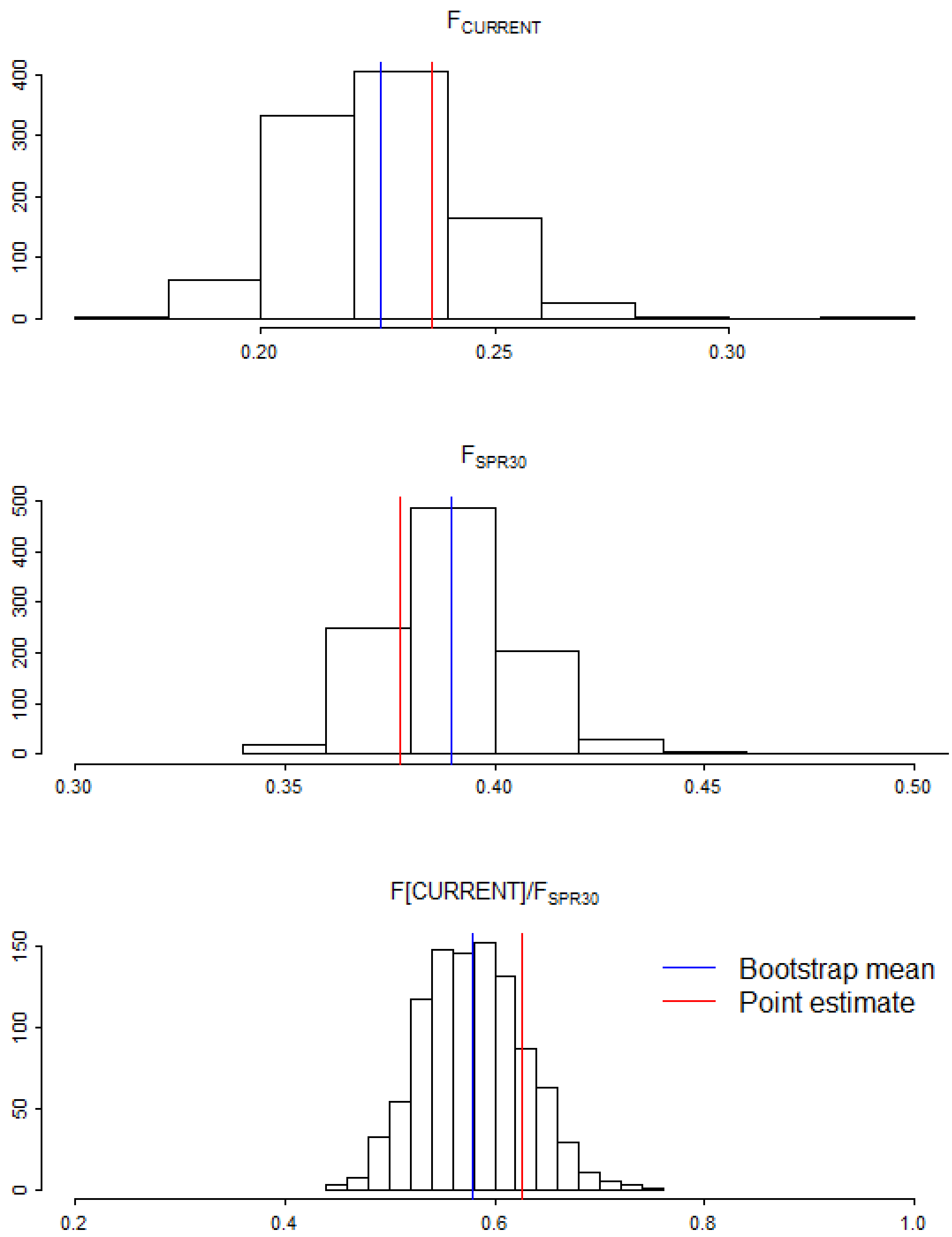

Figure 3.51. Estimates of F(2011) and F(2011)/ $F_{SPR30\%}$ from 1000 bootstrap samples of the base model. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

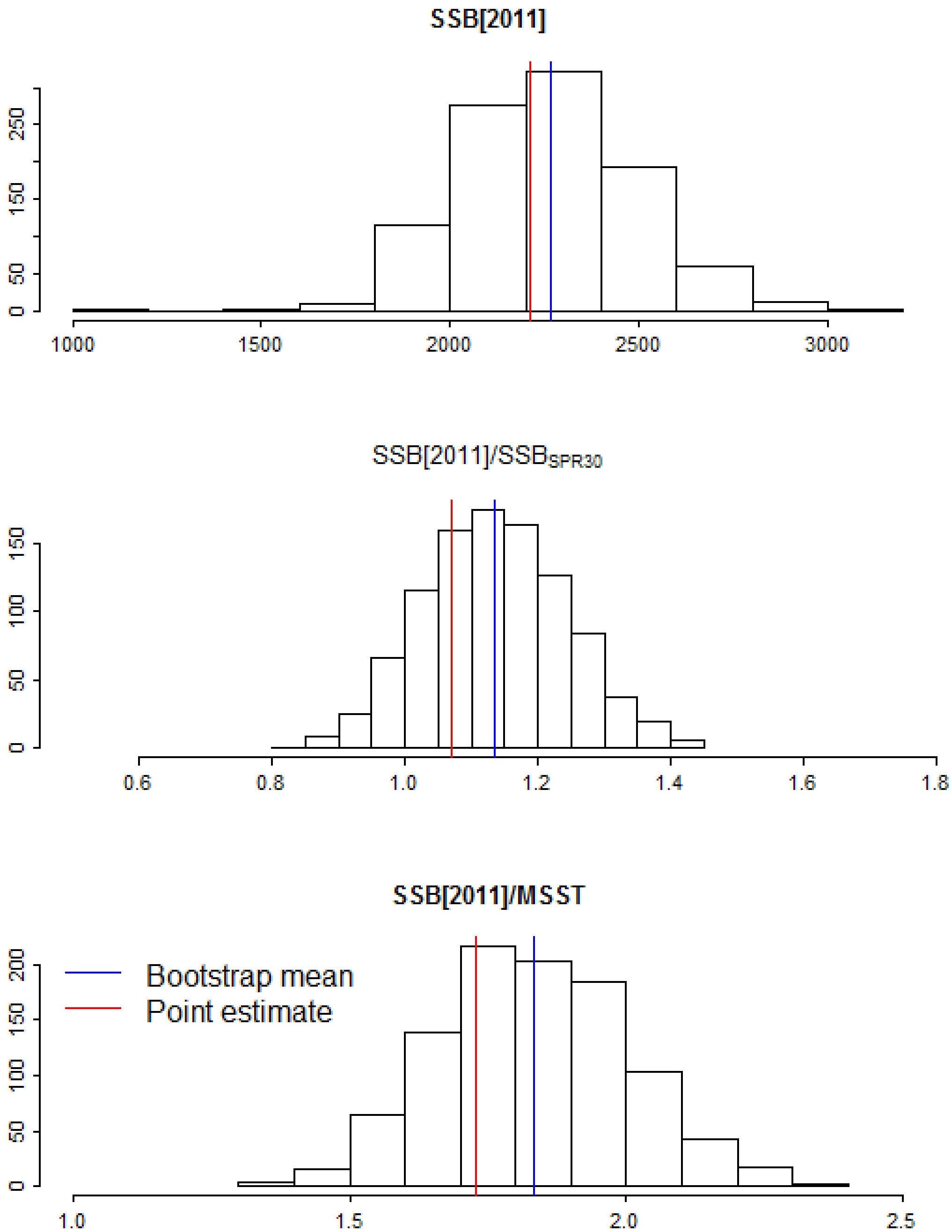

Figure 3.52. Estimates of spawning biomass in 2011, spawning biomass relative to SSB and spawning biomass relative to MSST from 1000 bootstrap samples of the base model. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

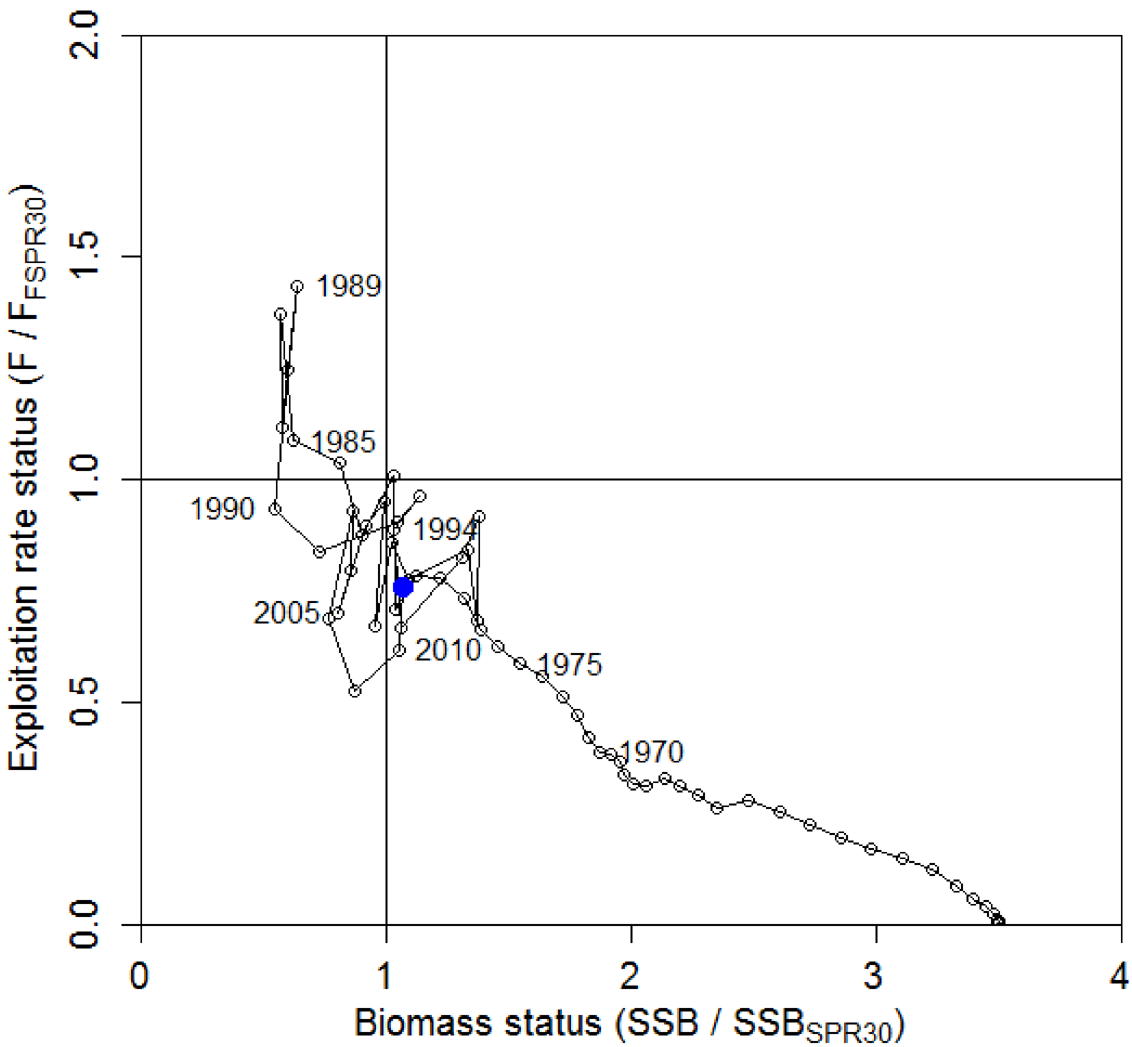

Figure 3.53. Stock status relative to reference targets for fishing mortality rate ($F_{SPR30\%}$) and spawning stock biomass ($SSB_{SPR30\%}$) over time for the base model. The large blue dot represents predicted stock status in 2011.

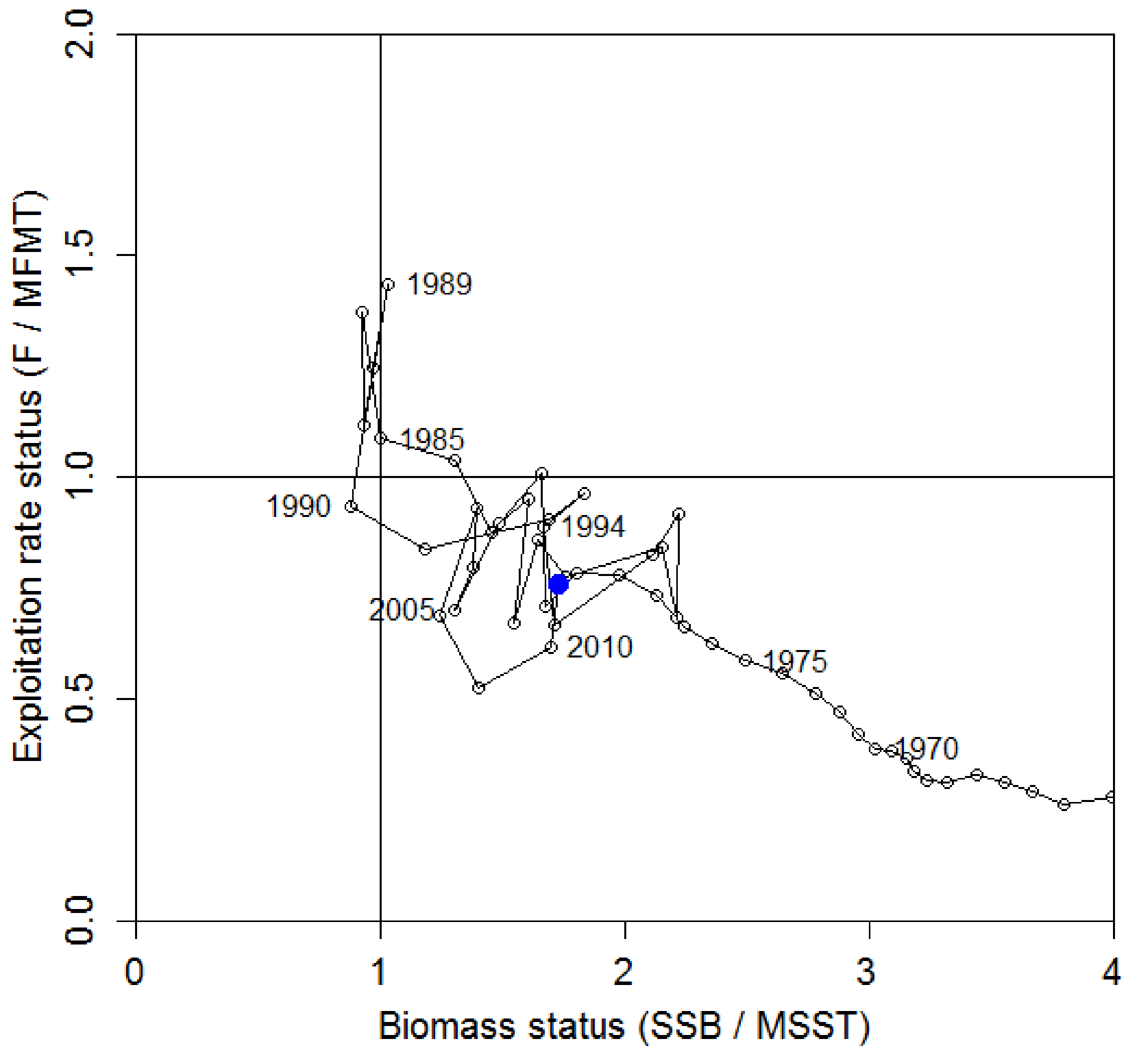

Figure 3.54. Stock status relative to reference targets for fishing mortality rate (MFMT) and spawning stock biomass (MSST) over time for the base model. The large blue dot represents predicted stock status in 2011.

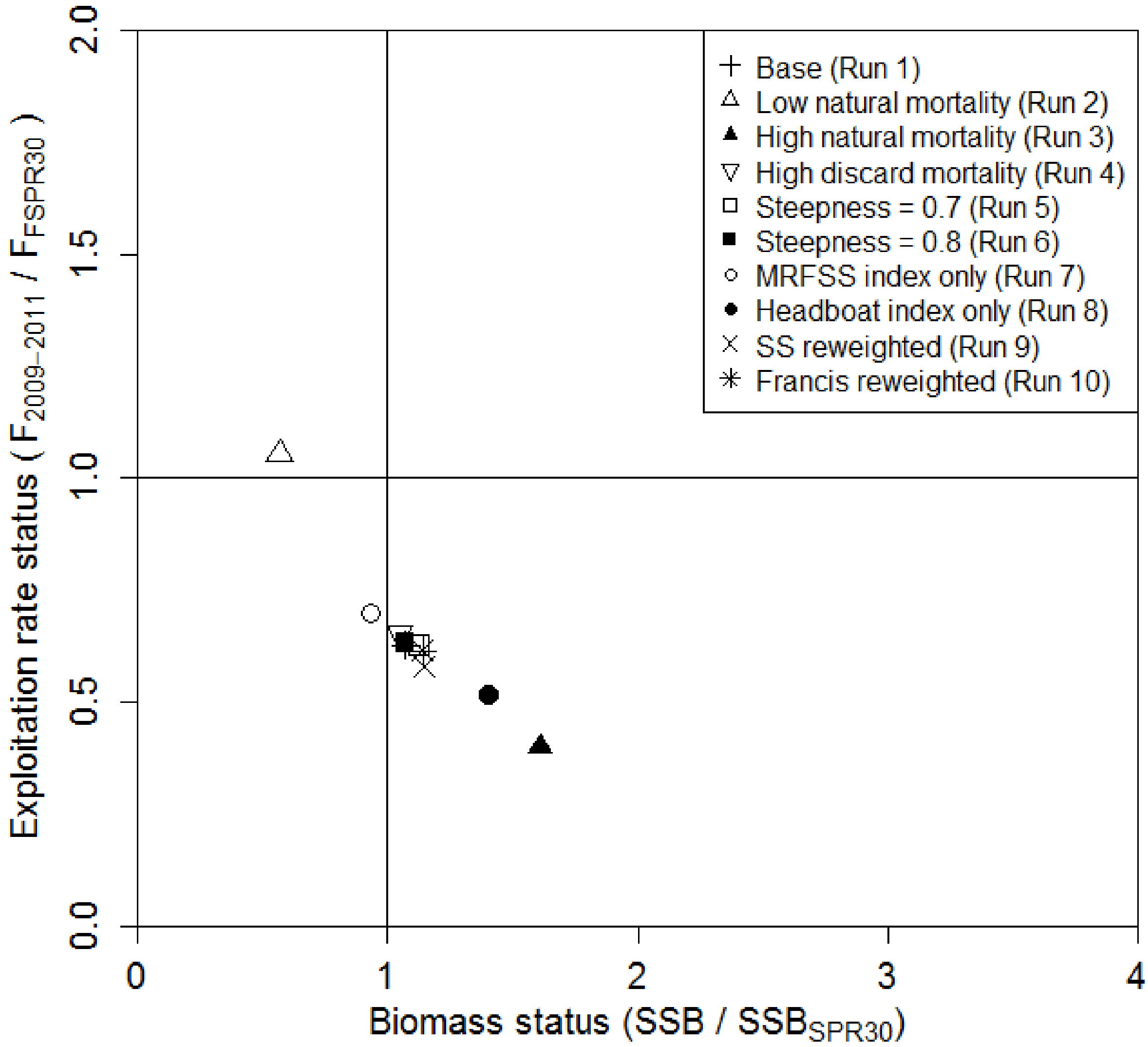

Figure 3.55. Phase plot of terminal status estimates relative to SPR 30% levels for all sensitivity runs.

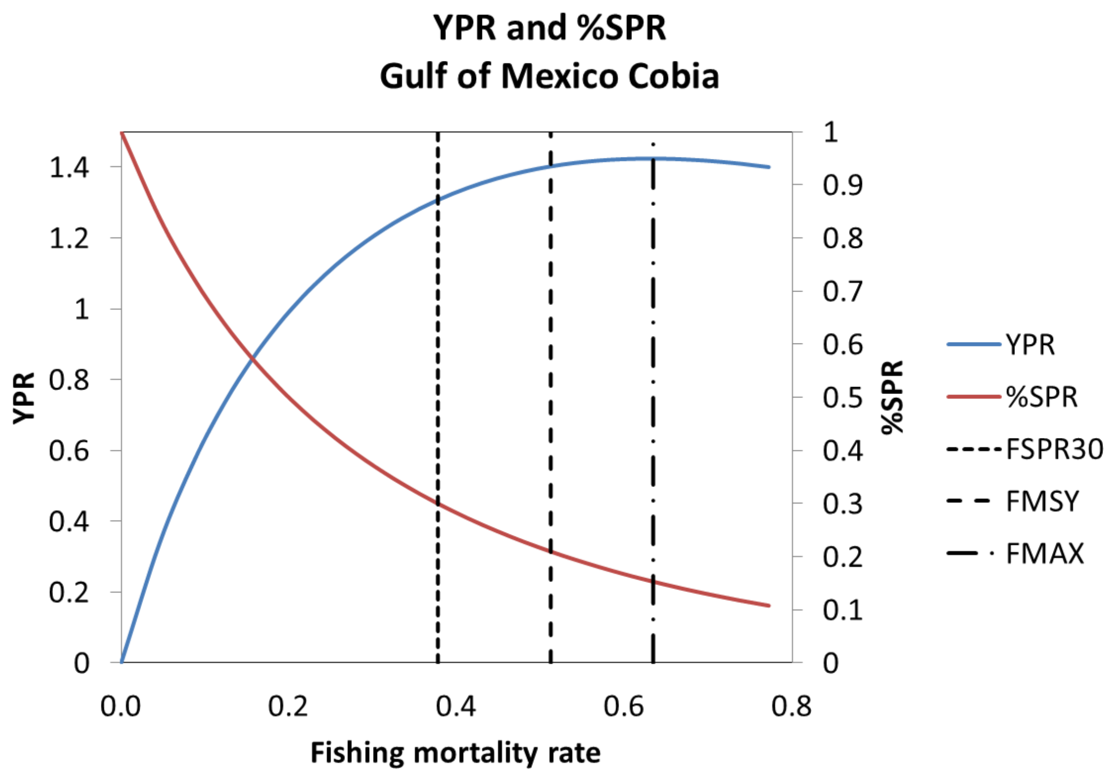

Figure 3.56. Yield per recruit (blue line) and spawning potential ratio (red line) as a function of fishing mortality rate. Vertical lines represent $F_{SPR30\%}$ (F = 0.378), F_{MSY} (F = 0.512), and F_{MAX} (F = 0.634).

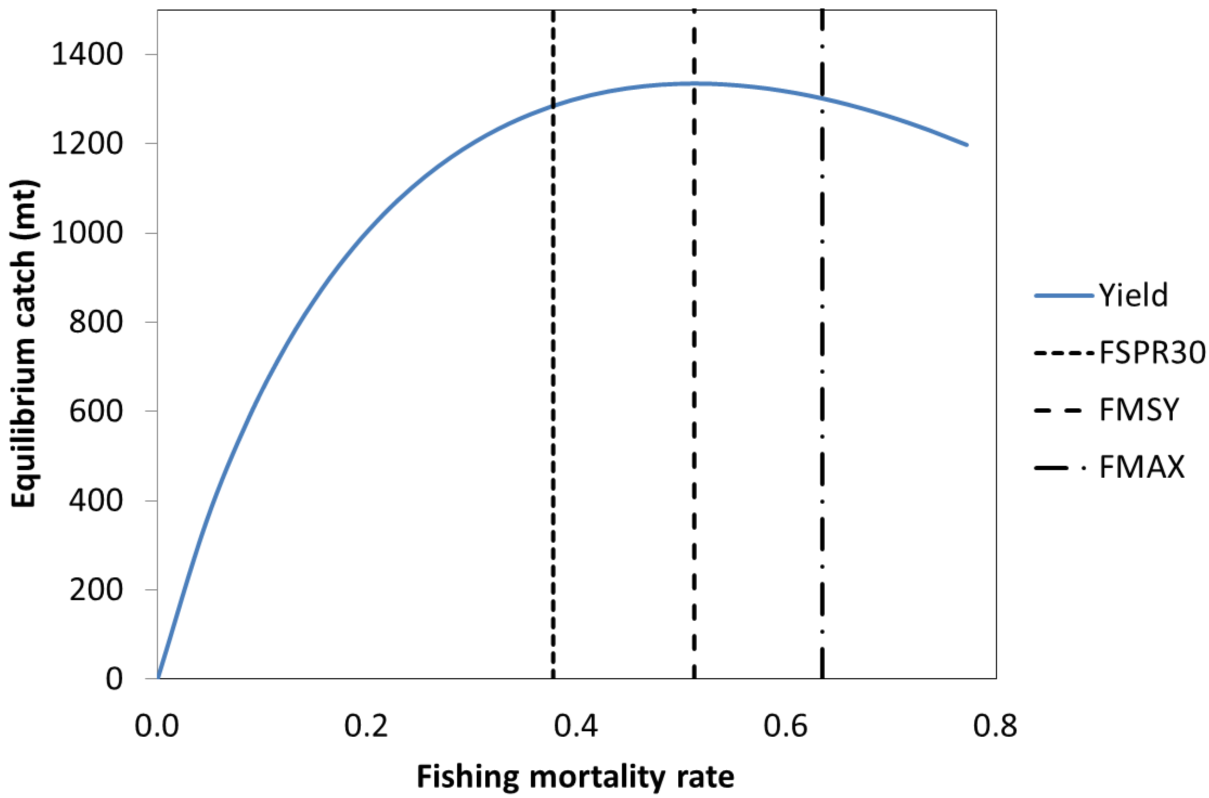

Figure 3.57. Equilibrium catch (retained catch plus dead discards; mt) as a function of fishing mortality rate. The peak occurs where fishing mortality rate is F_{MSY} = 0.512 and equilibrium catch is MSY = 1335 (mt) and equilibrium landings (retained catch) are MSY = 1176 (mt).

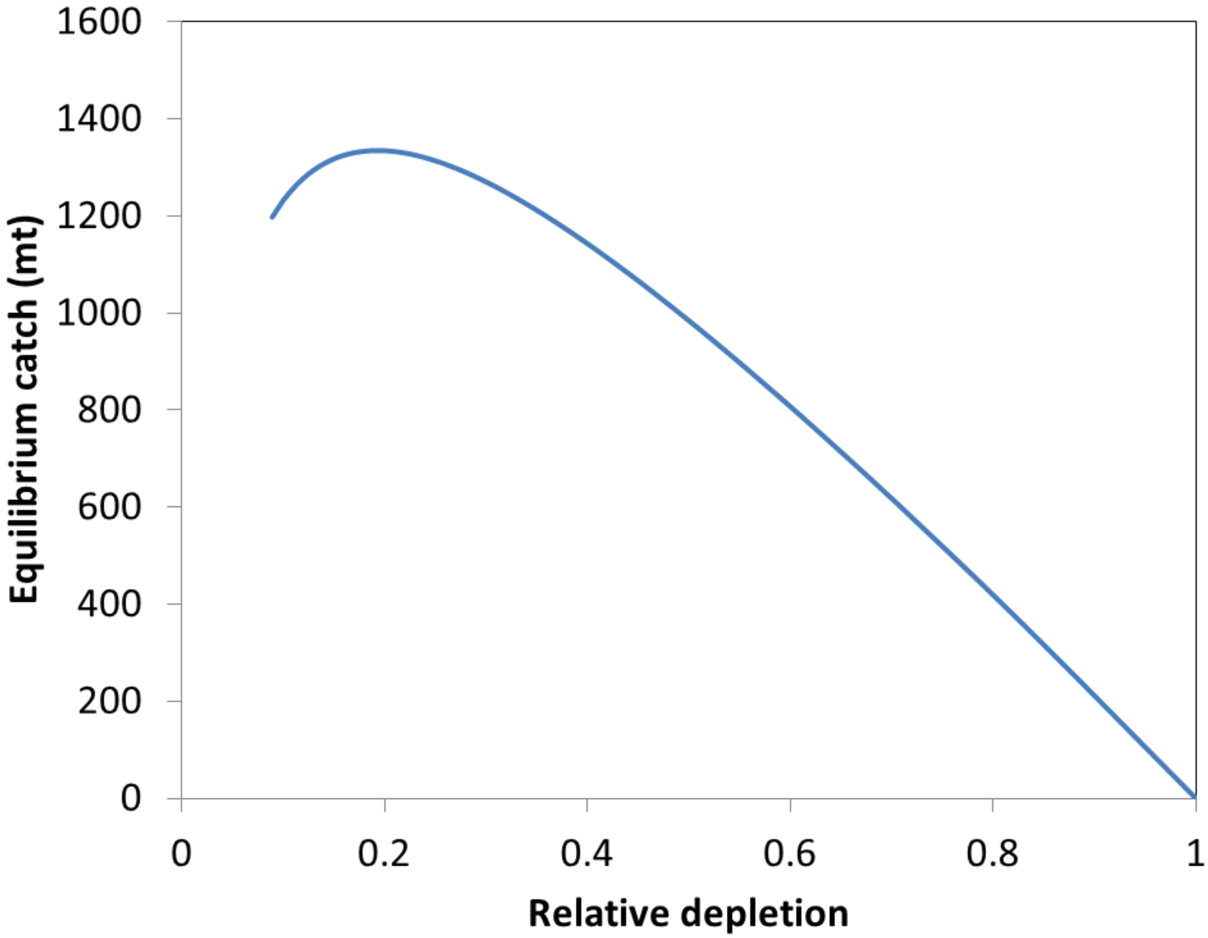

Figure 3.58. Equilibrium catch (retained catch plus dead discards; mt) as a function of relative depletion of the stock, which itself is a function of fishing mortality rate. The peak occurs equilibrium catch is MSY = 1335 (mt) and relative depletion is 0.19.

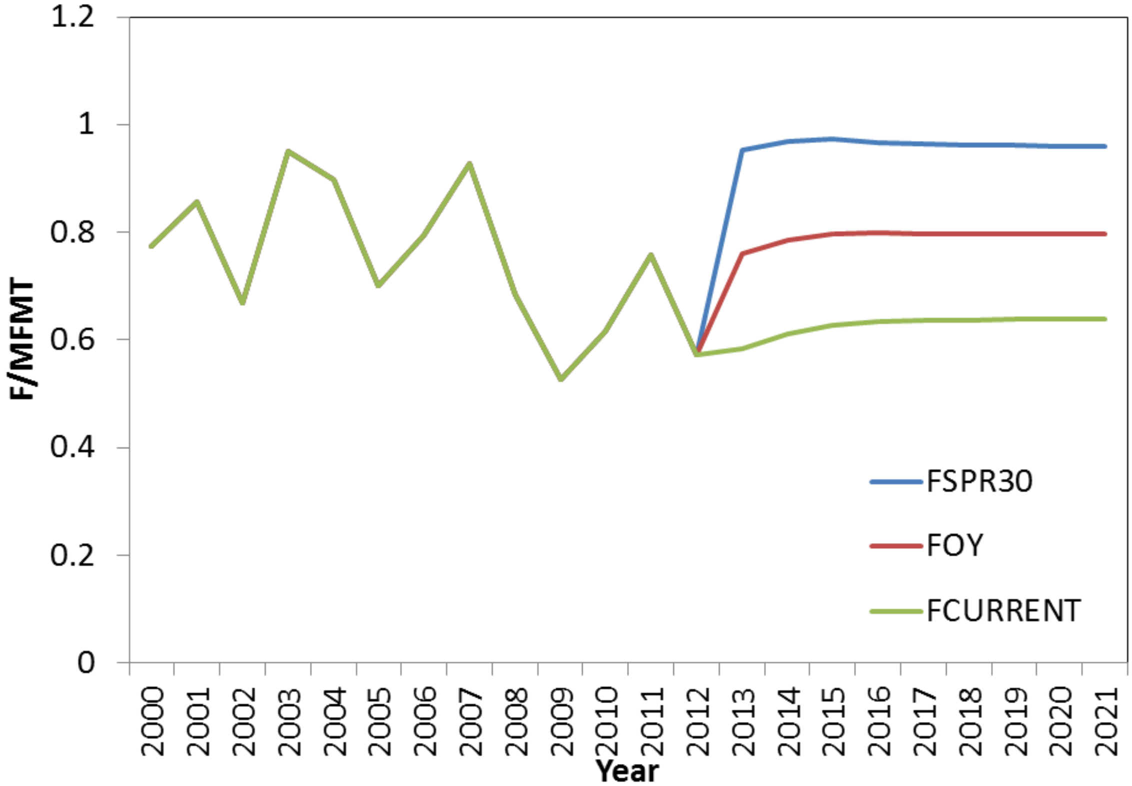

Figure 3.59. Projected fishing mortality rate relative to $F_{SPR30\%}$ for the base model under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

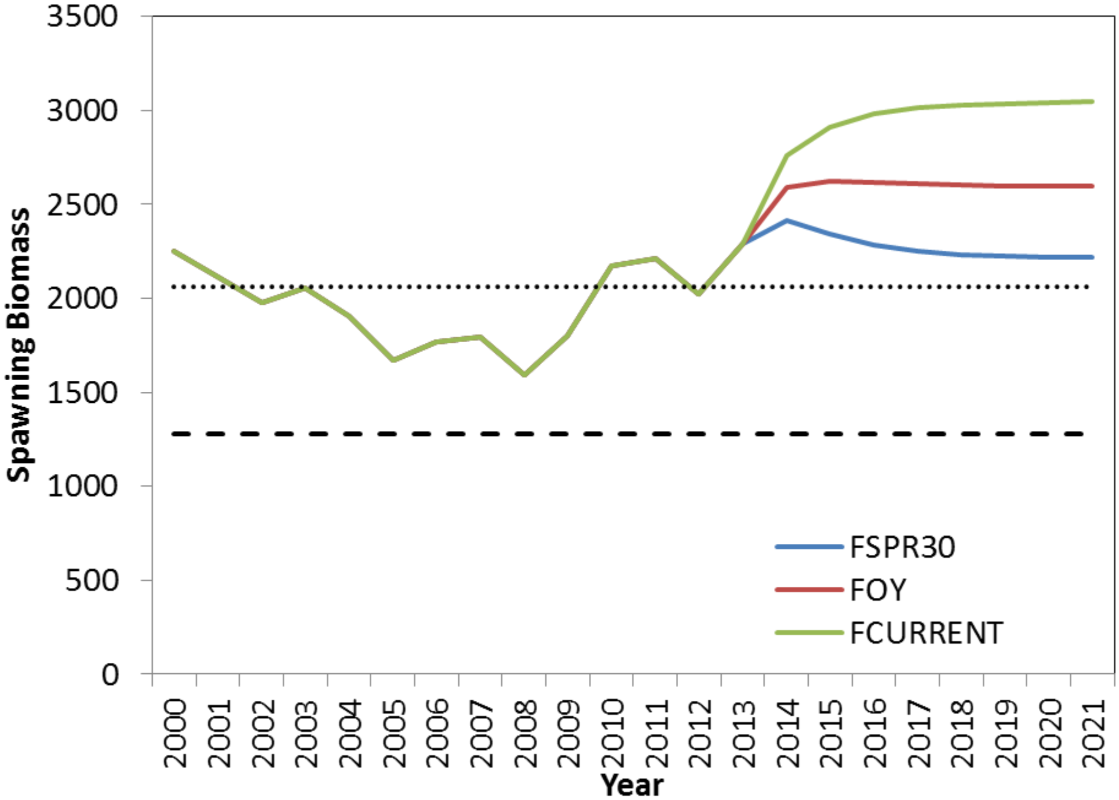

Figure 3.60. Projected spawning biomass for the base model under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}. The black dotted line represents SSB at $F_{SPR30\%}$. The black dashed line represents the minimum stock size threshold (MSST).

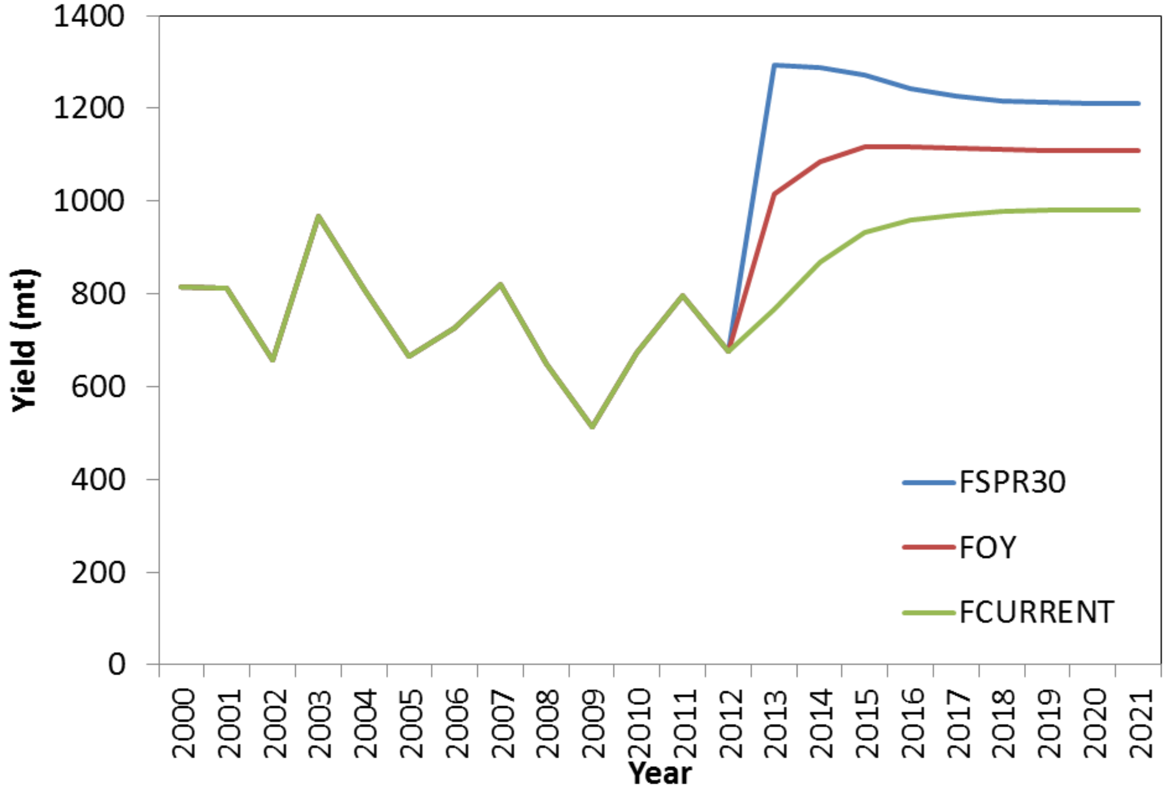

Figure 3.61. Projected yield (mt) for the base model under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

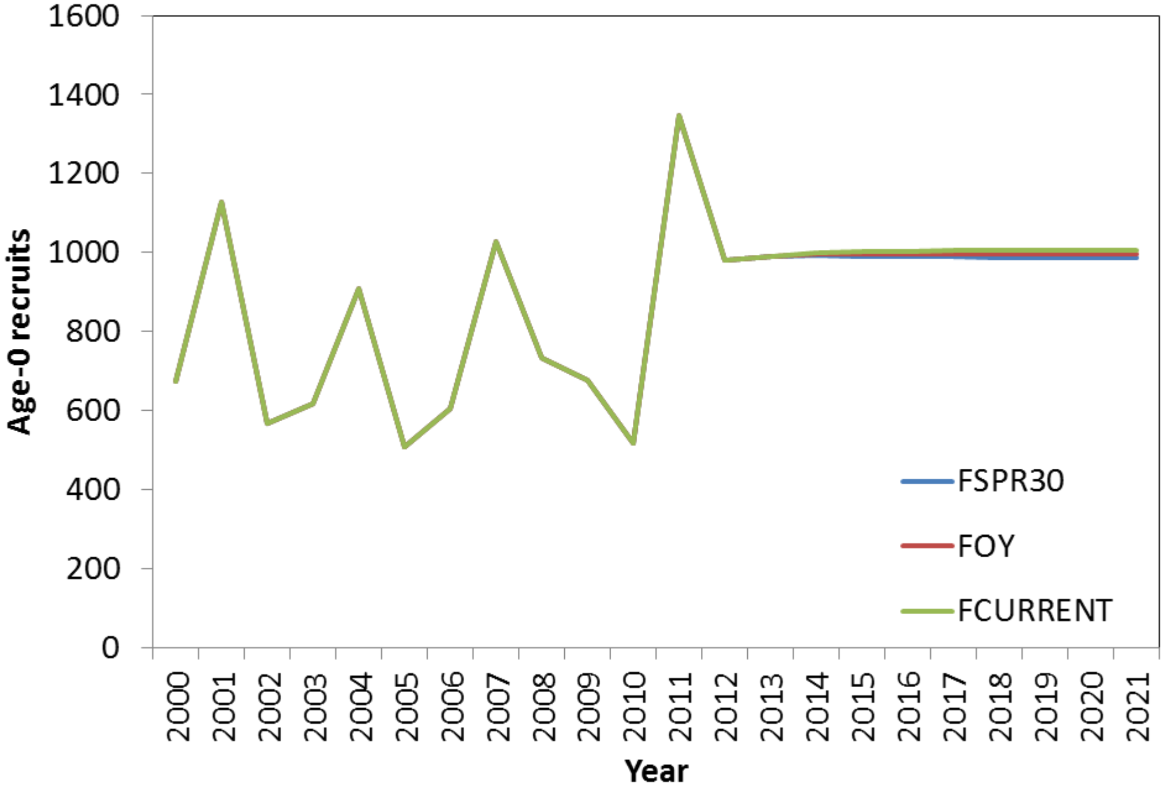

Figure 3.62. Projected age-0 recruits for the base model under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

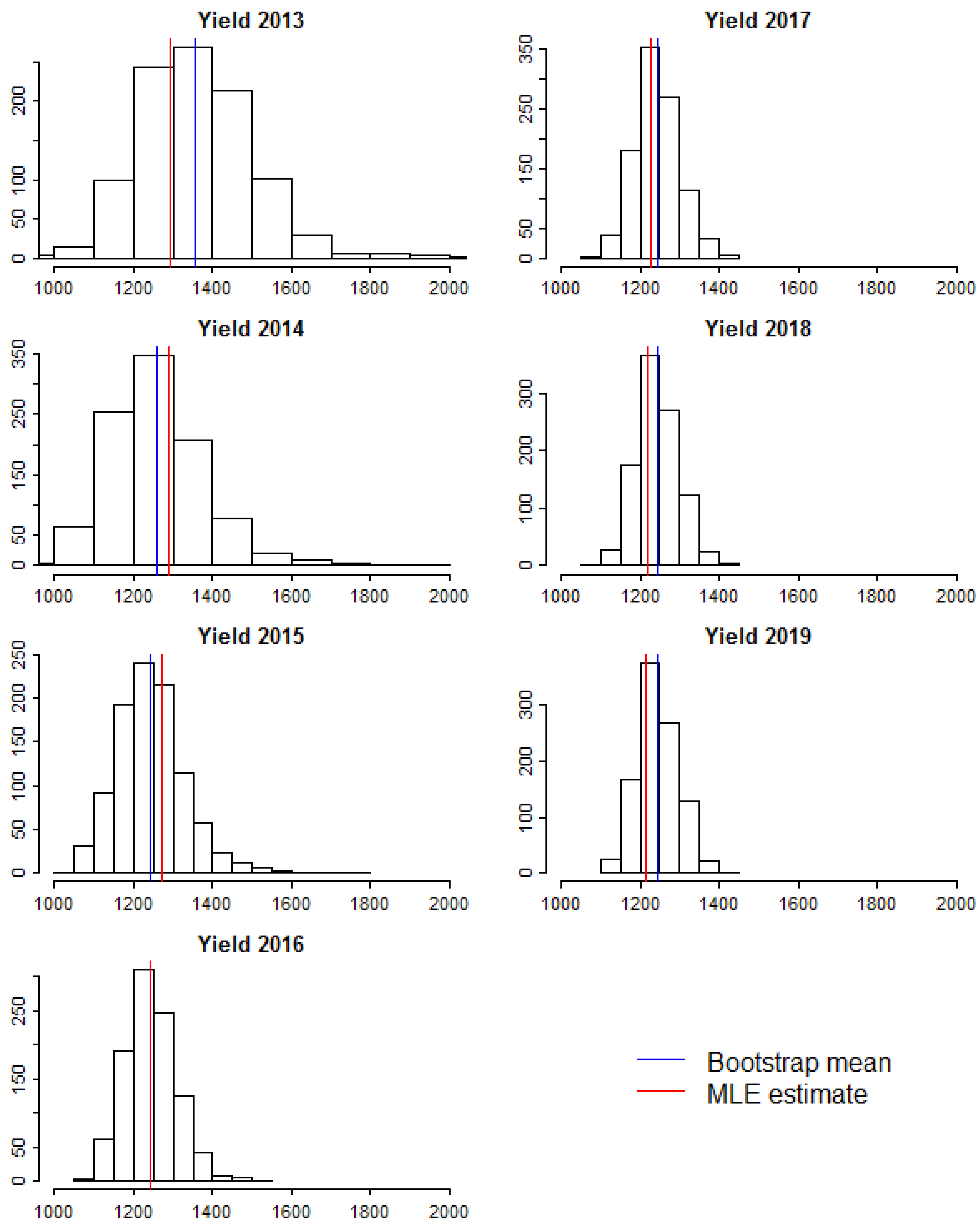

Figure 3.63. Estimates of projected yield (mt) for the base model at $F_{SPR30\%}$ from 1000 bootstrap samples of the base model. Blue lines represent mean estimates from the bootstrap samples, red lines represent the point estimate of the parameters from the base model.

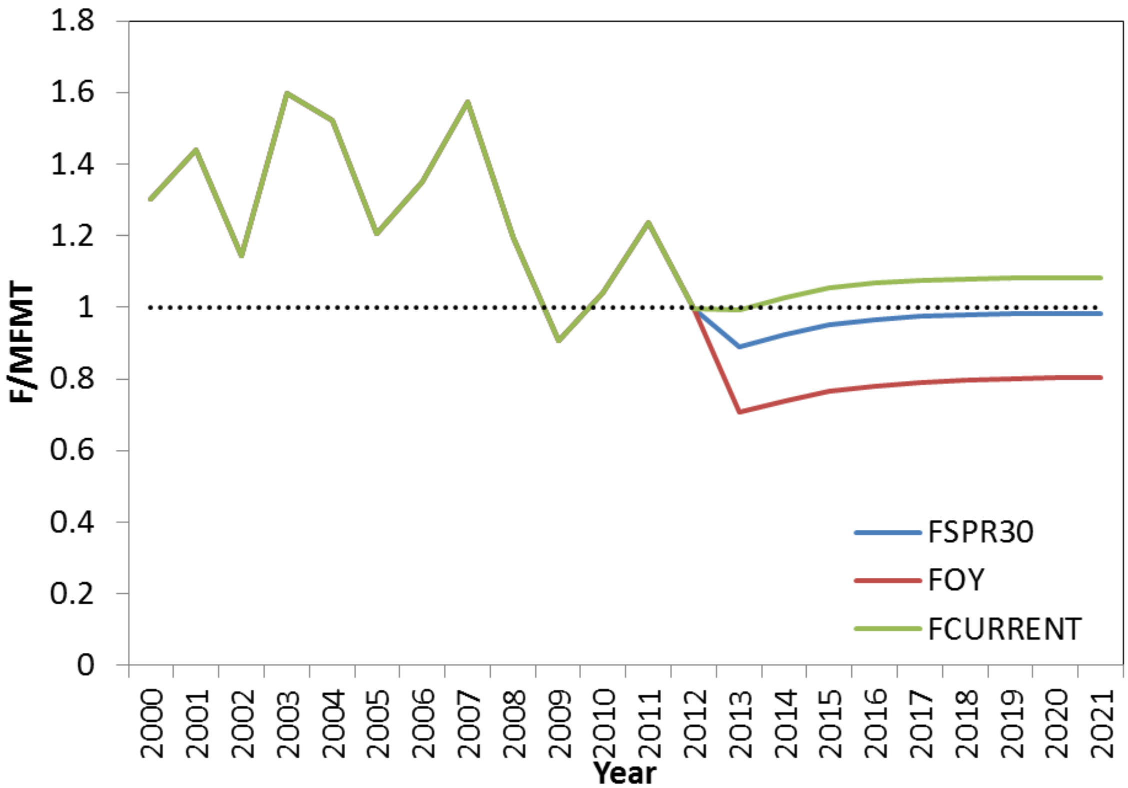

Figure 3.64. Projected fishing mortality rate relative to $F_{SPR30\%}$ for the low natural mortality model (Run 2) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

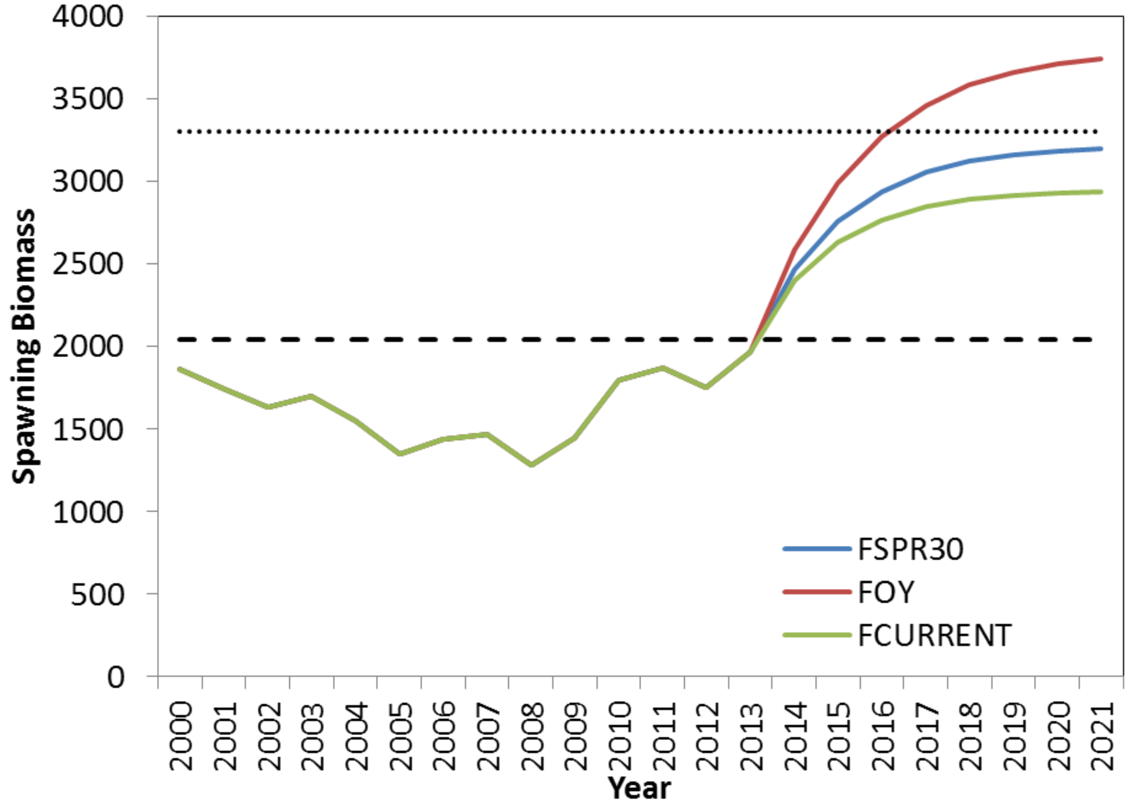

Figure 3.65. Projected spawning biomass for the low natural mortality model (Run 2) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}. The black dotted line represents SSB at $F_{SPR30\%}$. The black dashed line represents the minimum stock size threshold (MSST).

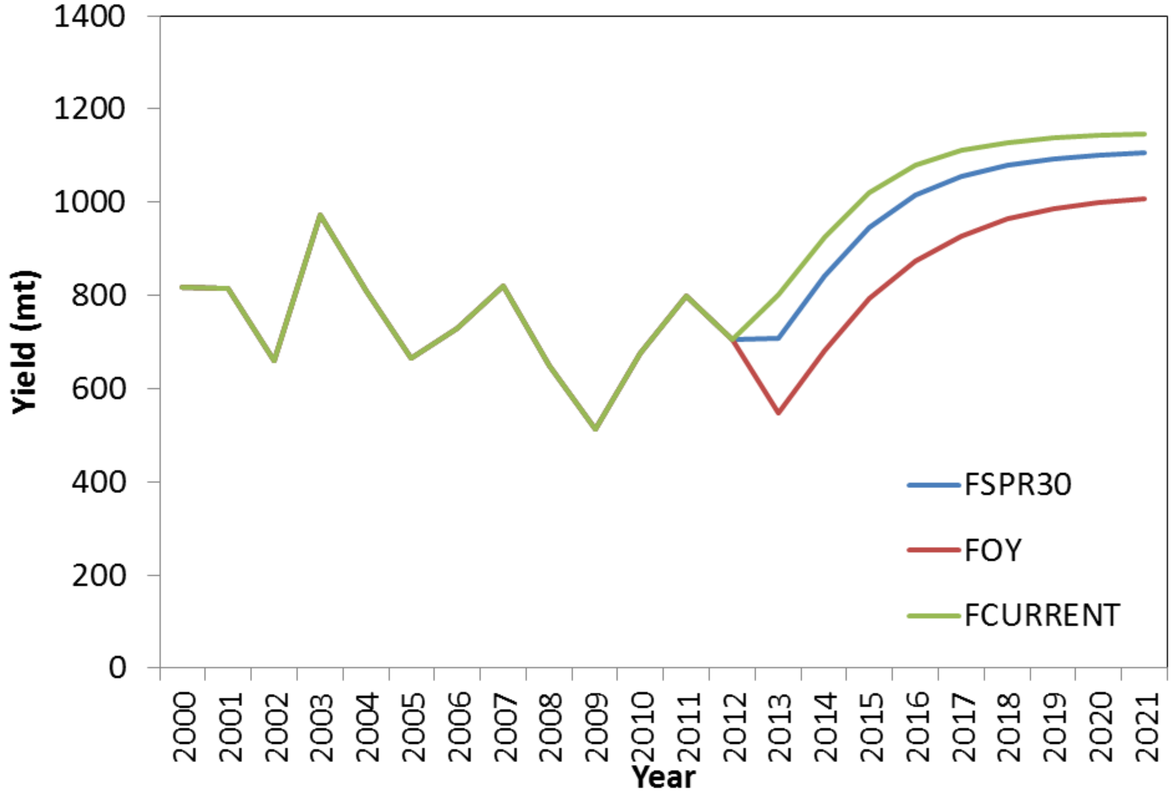

Figure 3.66. Projected yield (mt) for the low natural mortality model (Run 2) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

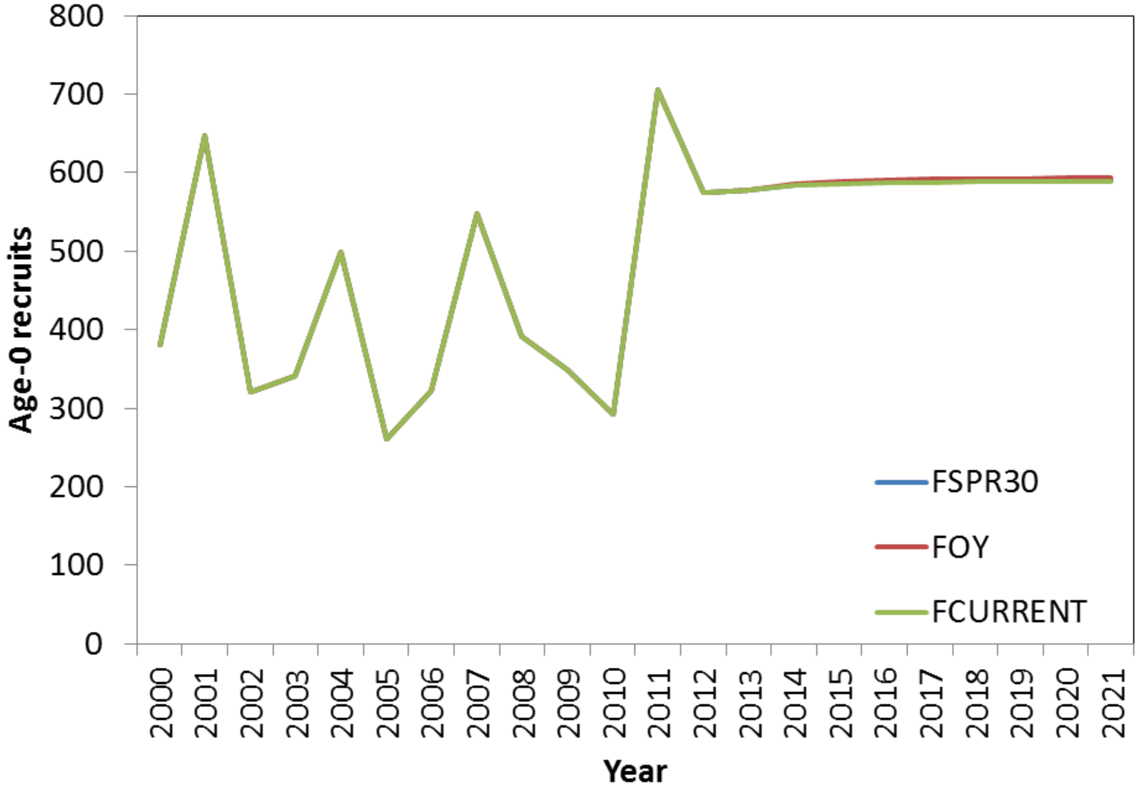

Figure 3.67. Projected age-0 recruits for the low natural mortality model (Run 2) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

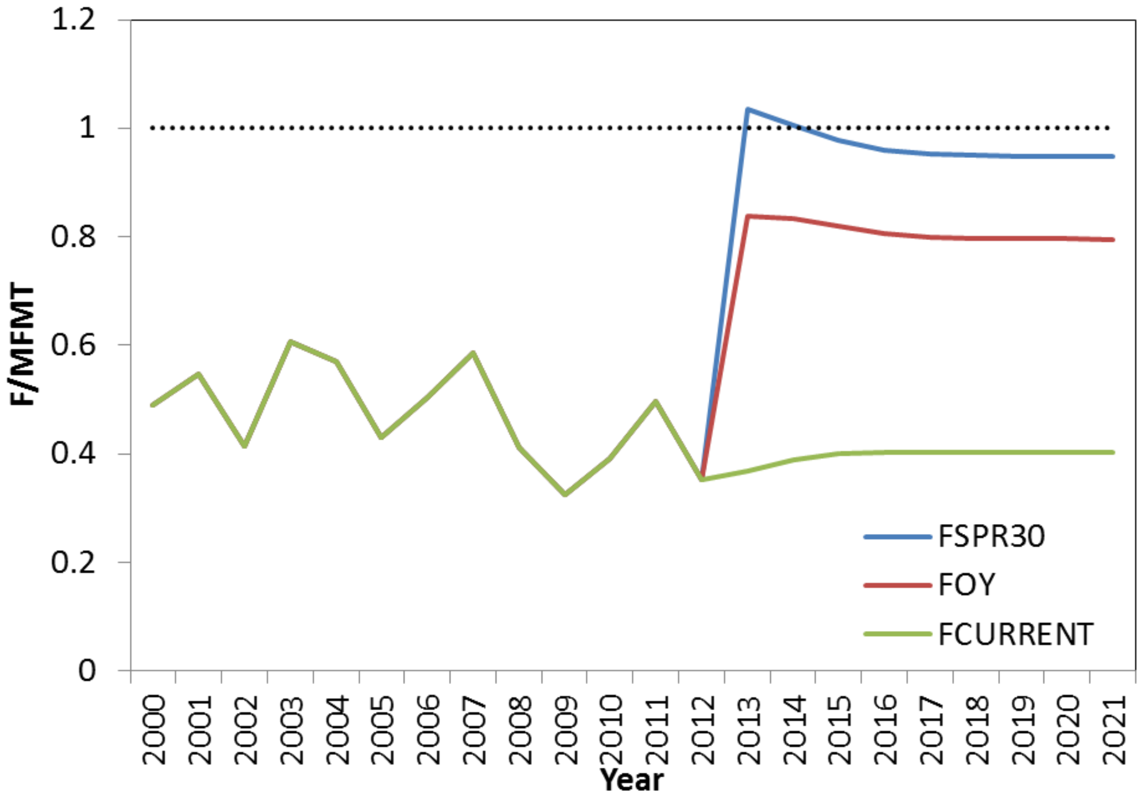

Figure 3.68. Projected fishing mortality rate relative to $F_{SPR30\%}$ for the high natural mortality model (Run 3) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

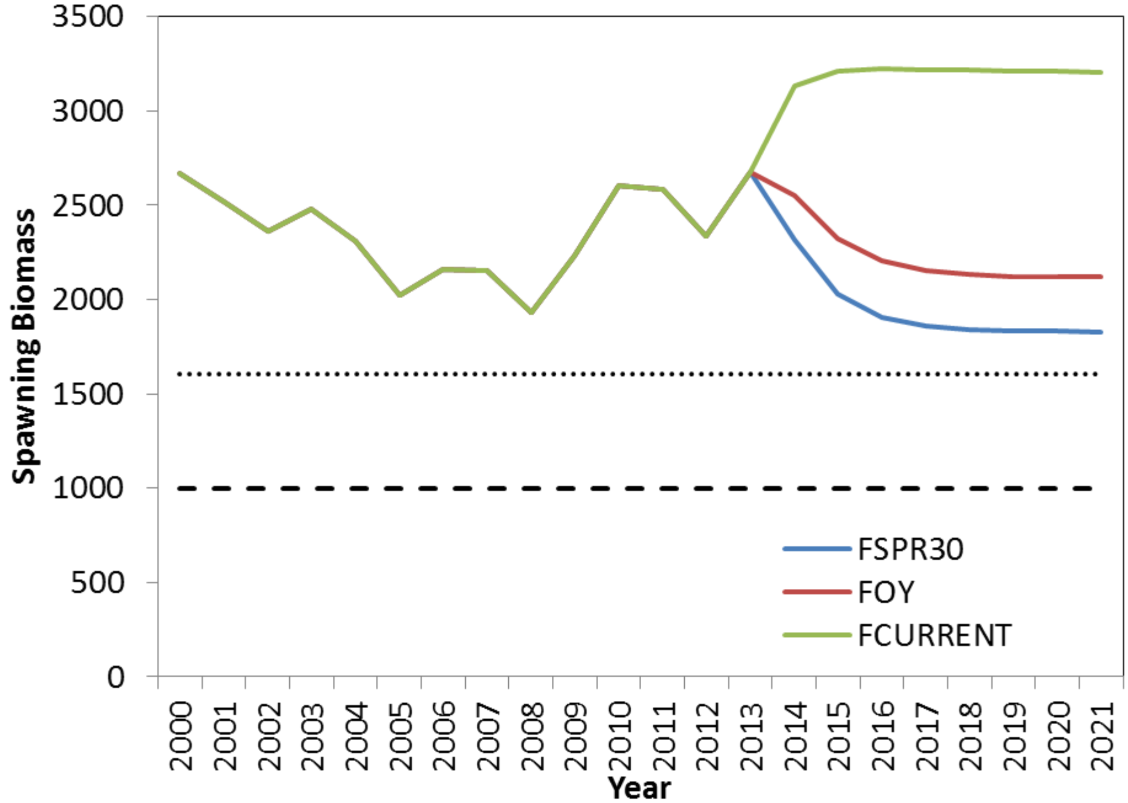

Figure 3.69. Projected spawning biomass for the high natural mortality model (Run 3) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}. The black dotted line represents SSB at $F_{SPR30\%}$. The black dashed line represents the minimum stock size threshold (MSST).

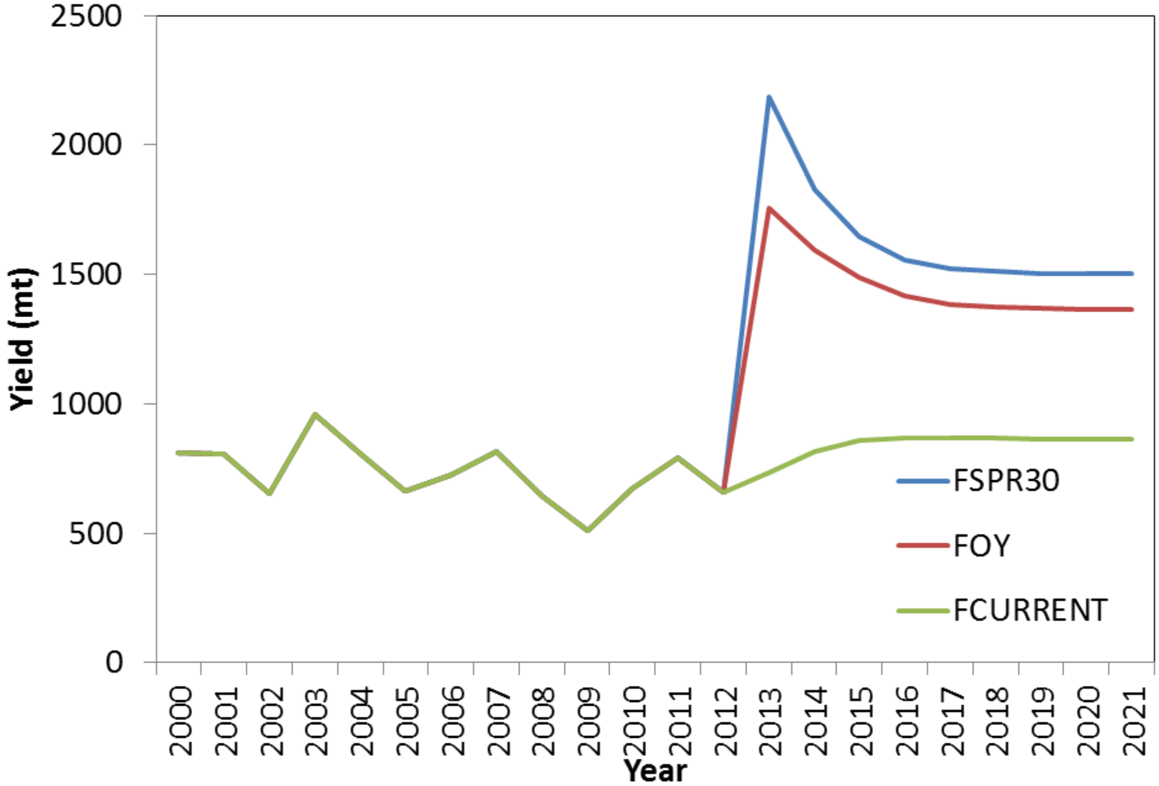

Figure 3.70. Projected yield (mt) for the high natural mortality model (Run 3) under three fishing mortality scenarios: $F_{CURRENT}$, F_{SPR30}, and F_{OY}.

3.8 Appendix A. Cobia.DAT File

#V3.24f
#_SSV3.24fsafe;_08/03/2012;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB_10.1
#C Cobia 2011
#_observed data:
1927 #_styr
2011 #_endyr
1 #_nseas
12 #_months/season
1 #_spawn_seas
3 #_Nfleet
1 #_Nsurveys
1 #_N_areas
Com_Combined_1%Recreational_Combined_2%Shrimp_Bycatch_3%MRFSS_4
0.5 0.5 0.5 0.5 #_surveytiming_in_season
1 1 1 1 #_area_assignments_for_each_fishery_and_survey
1 2 2 #_units of catch: 1=bio; 2=num
0.01 0.01 -1 #_se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3; use -1 for discard only fleets
1 #_Ngenders
11 #_Nages
0 0 0 #_init_equil_catch_for_each_fishery
85 #_N_lines_of_catch_to_read
#_catch_biomass(mtons):_columns_are_fisheries,year,season
4.28634 0 0 1927 1
10.3539 0 0 1928 1
6.67988 0 0 1929 1
6.50616 0 0 1930 1
4.73901 0 0 1931 1
2.63304 0 0 1932 1
2.99454 0 0 1933 1
3.3565 0 0 1934 1
3.01631 0 0 1935 1
2.67613 0 0 1936 1
0.907161 0 0 1937 1
3.3565 0 0 1938 1
2.90292 0 0 1939 1
0.635013 0 0 1940 1

0.181432 0 0 1941 1
0.181432 0 0 1942 1
0.181432 0 0 1943 1
0.181432 0 0 1944 1
0.136074 0 0.01 1945 1
0.181432 0 0.01 1946 1
0.181432 0 0.01 1947 1
1.9504 0 0.01 1948 1
12.4281 0 0.01 1949 1
20.0029 1 0.01 1950 1
22.5883 5 0.01 1951 1
17.0546 10 0.01 1952 1
13.1085 20 0.01 1953 1
11.9292 30 0.01 1954 1
13.8796 36.996 0.01 1955 1
6.80371 41.04 0.01 1956 1
11.7024 45.084 0.01 1957 1
11.0674 49.128 0.01 1958 1
18.7329 53.172 0.01 1959 1
25.7634 57.217 0.01 1960 1
15.83 58.244 0.01 1961 1
17.9164 59.271 0.01 1962 1
20.3204 60.299 0.01 1963 1
12.7003 61.326 0.01 1964 1
11.5663 62.354 0.01 1965 1
19.3225 64.819 0.01 1966 1
21.8172 67.284 0.01 1967 1
40.5047 69.749 0.01 1968 1
34.2453 72.215 0.01 1969 1
54.2482 74.68 0.01 1970 1
50.0753 81.468 0.01 1971 1
39.6883 88.257 0.01 1972 1
39.7337 95.045 0.01 1973 1
45.7663 101.833 0.01 1974 1
44.3148 108.622 0.01 1975 1
53.1265 108.813 0.01 1976 1
50.9416 109.003 0.01 1977 1
51.4642 109.194 0.01 1978 1
45.8053 109.385 0.01 1979 1
54.0228 109.576 0.01 1980 1

64.8892 91.665 0.01 1981 1
57.6655 153.543 0.01 1982 1
68.2852 101.89 0.01 1983 1
71.7778 79.79 0.01 1984 1
78.4531 72.75 0.01 1985 1
87.9493 80.022 0.01 1986 1
105.686 73.115 0.01 1987 1
105.773 87.913 0.01 1988 1
137.806 77.311 0.01 1989 1
109.051 58.134 0.01 1990 1
124.218 76.281 0.01 1991 1
157.313 92.24 0.01 1992 1
160.151 81.604 0.01 1993 1
159.576 82.837 0.01 1994 1
150.154 61.643 0.01 1995 1
165.947 95.542 0.01 1996 1
136.901 125.63 0.01 1997 1
130.801 63.632 0.01 1998 1
129.097 72.592 0.01 1999 1
96.1632 65.543 0.01 2000 1
80.6766 68.307 0.01 2001 1
83.2461 54.953 0.01 2002 1
88.372 85.097 0.01 2003 1
81.3225 69.706 0.01 2004 1
62.073 58.589 0.01 2005 1
68.5111 64.71 0.01 2006 1
66.7616 73.074 0.01 2007 1
63.2355 58.197 0.01 2008 1
62.2784 45.264 0.01 2009 1
88.4178 57.214 0.01 2010 1
108.315 64.835 0.01 2011 1
#
124 #_N_cpue_and_surveyabundance_observations
#_Units: 0=numbers; 1=biomass; 2=F
#_Errtype: -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0 # Com_Combined_1
2 0 0 # Recreational_Combined_2
3 2 0 # Shrimp_Bycatch_3
4 0 0 # MRFSS_4

#_year seas index obs err
1945 1 3 0.001 0.125 # Shrimp_Bycatch_3
1946 1 3 0.00466902 0.125 # Shrimp_Bycatch_3
1947 1 3 0.023812 0.125 # Shrimp_Bycatch_3
1948 1 3 0.0625648 0.125 # Shrimp_Bycatch_3
1949 1 3 0.101084 0.125 # Shrimp_Bycatch_3
1950 1 3 0.180224 0.125 # Shrimp_Bycatch_3
1951 1 3 0.228548 0.125 # Shrimp_Bycatch_3
1952 1 3 0.269869 0.125 # Shrimp_Bycatch_3
1953 1 3 0.278507 0.125 # Shrimp_Bycatch_3
1954 1 3 0.362549 0.125 # Shrimp_Bycatch_3
1955 1 3 0.358814 0.125 # Shrimp_Bycatch_3
1956 1 3 0.460599 0.125 # Shrimp_Bycatch_3
1957 1 3 0.537637 0.125 # Shrimp_Bycatch_3
1958 1 3 0.696151 0.125 # Shrimp_Bycatch_3
1959 1 3 0.748677 0.125 # Shrimp_Bycatch_3
1960 1 3 0.748249 0.125 # Shrimp_Bycatch_3
1961 1 3 0.461965 0.125 # Shrimp_Bycatch_3
1962 1 3 0.796689 0.125 # Shrimp_Bycatch_3
1963 1 3 0.901471 0.125 # Shrimp_Bycatch_3
1964 1 3 1.06238 0.125 # Shrimp_Bycatch_3
1965 1 3 0.688011 0.125 # Shrimp_Bycatch_3
1966 1 3 0.5806 0.125 # Shrimp_Bycatch_3
1967 1 3 0.696735 0.125 # Shrimp_Bycatch_3
1968 1 3 0.816885 0.125 # Shrimp_Bycatch_3
1969 1 3 0.894284 0.125 # Shrimp_Bycatch_3
1970 1 3 0.628212 0.125 # Shrimp_Bycatch_3
1971 1 3 0.711676 0.125 # Shrimp_Bycatch_3
1972 1 3 0.99505 0.125 # Shrimp_Bycatch_3
1973 1 3 1.01257 0.125 # Shrimp_Bycatch_3
1974 1 3 1.04504 0.125 # Shrimp_Bycatch_3
1975 1 3 0.802247 0.125 # Shrimp_Bycatch_3
1976 1 3 1.11513 0.125 # Shrimp_Bycatch_3
1977 1 3 1.38455 0.125 # Shrimp_Bycatch_3
1978 1 3 1.92755 0.125 # Shrimp_Bycatch_3
1979 1 3 2.02914 0.125 # Shrimp_Bycatch_3
1980 1 3 1.49187 0.125 # Shrimp_Bycatch_3
1981 1 3 1.54041 0.125 # Shrimp_Bycatch_3
1982 1 3 1.47356 0.125 # Shrimp_Bycatch_3
1983 1 3 1.59532 0.125 # Shrimp_Bycatch_3

1984 1 3 1.63608 0.125 # Shrimp_Bycatch_3
1985 1 3 1.76228 0.125 # Shrimp_Bycatch_3
1986 1 3 1.85552 0.125 # Shrimp_Bycatch_3
1987 1 3 2.15635 0.125 # Shrimp_Bycatch_3
1988 1 3 1.62936 0.125 # Shrimp_Bycatch_3
1989 1 3 1.94697 0.125 # Shrimp_Bycatch_3
1990 1 3 1.8955 0.125 # Shrimp_Bycatch_3
1991 1 3 1.81257 0.125 # Shrimp_Bycatch_3
1992 1 3 1.57443 0.125 # Shrimp_Bycatch_3
1993 1 3 1.47332 0.125 # Shrimp_Bycatch_3
1994 1 3 1.61289 0.125 # Shrimp_Bycatch_3
1995 1 3 1.38522 0.125 # Shrimp_Bycatch_3
1996 1 3 1.48535 0.125 # Shrimp_Bycatch_3
1997 1 3 1.51771 0.125 # Shrimp_Bycatch_3
1998 1 3 1.64828 0.125 # Shrimp_Bycatch_3
1999 1 3 1.71744 0.125 # Shrimp_Bycatch_3
2000 1 3 1.53573 0.125 # Shrimp_Bycatch_3
2001 1 3 1.49119 0.125 # Shrimp_Bycatch_3
2002 1 3 1.32141 0.125 # Shrimp_Bycatch_3
2003 1 3 1.07636 0.125 # Shrimp_Bycatch_3
2004 1 3 0.829801 0.125 # Shrimp_Bycatch_3
2005 1 3 0.499034 0.125 # Shrimp_Bycatch_3
2006 1 3 0.663099 0.125 # Shrimp_Bycatch_3
2007 1 3 0.649566 0.125 # Shrimp_Bycatch_3
2008 1 3 0.560997 0.125 # Shrimp_Bycatch_3
2009 1 3 0.653462 0.125 # Shrimp_Bycatch_3
2010 1 3 0.46317 0.125 # Shrimp_Bycatch_3
2011 1 3 0.433603 0.125 # Shrimp_Bycatch_3
1981 1 4 0.847337 0.334146 # MRFSS_4
1982 1 4 1.19585 0.216502 # MRFSS_4
1983 1 4 0.871614 0.29782 # MRFSS_4
1984 1 4 0.747462 0.270699 # MRFSS_4
1985 1 4 0.667115 0.306129 # MRFSS_4
1986 1 4 0.551108 0.194988 # MRFSS_4
1987 1 4 0.754596 0.182761 # MRFSS_4
1988 1 4 0.94461 0.192593 # MRFSS_4
1989 1 4 1.02793 0.207095 # MRFSS_4
1990 1 4 1.58666 0.179624 # MRFSS_4
1991 1 4 1.6207 0.152961 # MRFSS_4
1992 1 4 1.08135 0.118142 # MRFSS_4

1993 1 4 1.03541 0.150494 # MRFSS_4
1994 1 4 1.36186 0.131972 # MRFSS_4
1995 1 4 0.666587 0.17157 # MRFSS_4
1996 1 4 1.38528 0.131297 # MRFSS_4
1997 1 4 1.91831 0.110693 # MRFSS_4
1998 1 4 1.18463 0.110908 # MRFSS_4
1999 1 4 1.0917 0.0921619 # MRFSS_4
2000 1 4 0.78377 0.104784 # MRFSS_4
2001 1 4 0.908711 0.097775 # MRFSS_4
2002 1 4 0.930825 0.0924892 # MRFSS_4
2003 1 4 1.0102 0.0957156 # MRFSS_4
2004 1 4 0.841514 0.100863 # MRFSS_4
2005 1 4 0.787023 0.114288 # MRFSS_4
2006 1 4 0.734919 0.112987 # MRFSS_4
2007 1 4 0.808154 0.112244 # MRFSS_4
2008 1 4 0.96015 0.105312 # MRFSS_4
2009 1 4 0.750867 0.123361 # MRFSS_4
2010 1 4 0.900918 0.121558 # MRFSS_4
2011 1 4 1.04283 0.111139 # MRFSS_4
1986 1 2 0.469071 0.277703 # Recreational_Combined_2
1987 1 2 0.401495 0.281573 # Recreational_Combined_2
1988 1 2 0.375526 0.293591 # Recreational_Combined_2
1989 1 2 0.533509 0.269635 # Recreational_Combined_2
1990 1 2 0.709967 0.251059 # Recreational_Combined_2
1991 1 2 0.869174 0.229837 # Recreational_Combined_2
1992 1 2 0.864945 0.228333 # Recreational_Combined_2
1993 1 2 1.13102 0.216958 # Recreational_Combined_2
1994 1 2 1.11466 0.216819 # Recreational_Combined_2
1995 1 2 0.974367 0.231314 # Recreational_Combined_2
1996 1 2 1.04151 0.233091 # Recreational_Combined_2
1997 1 2 1.25721 0.218121 # Recreational_Combined_2
1998 1 2 1.09467 0.225903 # Recreational_Combined_2
1999 1 2 1.68145 0.201552 # Recreational_Combined_2
2000 1 2 0.968132 0.227321 # Recreational_Combined_2
2001 1 2 1.25294 0.219522 # Recreational_Combined_2
2002 1 2 1.00828 0.243063 # Recreational_Combined_2
2003 1 2 1.22685 0.216429 # Recreational_Combined_2
2004 1 2 0.972875 0.245796 # Recreational_Combined_2
2005 1 2 1.02572 0.231821 # Recreational_Combined_2
2006 1 2 0.985744 0.243344 # Recreational_Combined_2

```
 2007 1 2 1.2373 0.213905 # Recreational_Combined_2
 2008 1 2 1.19134 0.21467 # Recreational_Combined_2
 2009 1 2 1.22684 0.210574 # Recreational_Combined_2
 2010 1 2 1.09983 0.225074 # Recreational_Combined_2
 2011 1 2 1.28559 0.212042 # Recreational_Combined_2
#
3 #_N_fleets_with_discard
#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)
#_discard_errtype:  >0 for DF of T-dist(read CV below); 0 for normal with CV; -1 for normal with se; -2 for lognormal
#_Fleet units errtype
1 1 -2 # Com_Combined_1
2 1 -2 # Recreational_Combined_2
3 3 -2 # Shrimp_Bycatch_3
90 #_N_discard_obs
#_year seas fleet obs err
1993	1	1	34.45	0.5	#	Com_Combined_1
1994	1	1	41.01	0.5	#	Com_Combined_1
1995	1	1	38.66	0.5	#	Com_Combined_1
1996	1	1	41.88	0.5	#	Com_Combined_1
1997	1	1	46.63	0.5	#	Com_Combined_1
1998	1	1	45.54	0.5	#	Com_Combined_1
1999	1	1	52.00	0.5	#	Com_Combined_1
2000	1	1	48.85	0.5	#	Com_Combined_1
2001	1	1	45.38	0.5	#	Com_Combined_1
2002	1	1	47.77	0.5	#	Com_Combined_1
2003	1	1	50.98	0.5	#	Com_Combined_1
2004	1	1	44.53	0.5	#	Com_Combined_1
2005	1	1	43.31	0.5	#	Com_Combined_1
2006	1	1	43.08	0.5	#	Com_Combined_1
2007	1	1	40.88	0.5	#	Com_Combined_1
2008	1	1	36.21	0.5	#	Com_Combined_1
2009	1	1	44.81	0.5	#	Com_Combined_1
2010	1	1	36.42	0.5	#	Com_Combined_1
2011	1	1	39.99	0.5	#	Com_Combined_1
 1981 1 2 11.7264 0.5 # Recreational_Combined_2
 1982 1 2 18.9164 0.5 # Recreational_Combined_2
 1983 1 2 0.820407 0.5 # Recreational_Combined_2
 1984 1 2 43.3077 0.5 # Recreational_Combined_2
 1985 1 2 1.66541 0.5 # Recreational_Combined_2
```

1986 1 2 42.8504 0.5 # Recreational_Combined_2
1987 1 2 24.5445 0.5 # Recreational_Combined_2
1988 1 2 73.4787 0.5 # Recreational_Combined_2
1989 1 2 72.8329 0.5 # Recreational_Combined_2
1990 1 2 92.3444 0.5 # Recreational_Combined_2
1991 1 2 242.742 0.5 # Recreational_Combined_2
1992 1 2 120.366 0.5 # Recreational_Combined_2
1993 1 2 88.4223 0.5 # Recreational_Combined_2
1994 1 2 121.266 0.5 # Recreational_Combined_2
1995 1 2 89.0609 0.5 # Recreational_Combined_2
1996 1 2 114.188 0.5 # Recreational_Combined_2
1997 1 2 134.571 0.5 # Recreational_Combined_2
1998 1 2 115.264 0.5 # Recreational_Combined_2
1999 1 2 114.267 0.5 # Recreational_Combined_2
2000 1 2 125.835 0.5 # Recreational_Combined_2
2001 1 2 145.126 0.5 # Recreational_Combined_2
2002 1 2 139.418 0.5 # Recreational_Combined_2
2003 1 2 88.3938 0.5 # Recreational_Combined_2
2004 1 2 94.211 0.5 # Recreational_Combined_2
2005 1 2 58.681 0.5 # Recreational_Combined_2
2006 1 2 75.825 0.5 # Recreational_Combined_2
2007 1 2 81.802 0.5 # Recreational_Combined_2
2008 1 2 133.537 0.5 # Recreational_Combined_2
2009 1 2 86.264 0.5 # Recreational_Combined_2
2010 1 2 70.6 0.5 # Recreational_Combined_2
2011 1 2 93.617 0.5 # Recreational_Combined_2
1972 -1 3 139.9 0.1 # Shrimp_Bycatch_3
1973 1 -3 41.65 0.5 # Shrimp_Bycatch_3
1974 1 -3 282.1 0.5 # Shrimp_Bycatch_3
1975 1 -3 128.9 0.5 # Shrimp_Bycatch_3
1976 1 -3 105.8 0.5 # Shrimp_Bycatch_3
1977 1 -3 44.2 0.5 # Shrimp_Bycatch_3
1978 1 -3 42.45 0.5 # Shrimp_Bycatch_3
1979 1 -3 445.3 0.5 # Shrimp_Bycatch_3
1980 1 -3 285.2 0.5 # Shrimp_Bycatch_3
1981 1 -3 56.63 0.5 # Shrimp_Bycatch_3
1982 1 -3 165.4 0.5 # Shrimp_Bycatch_3
1983 1 -3 203 0.5 # Shrimp_Bycatch_3
1984 1 -3 143.1 0.5 # Shrimp_Bycatch_3
1985 1 -3 161.8 0.5 # Shrimp_Bycatch_3

1986 1 -3 149.6 0.5 # Shrimp_Bycatch_3
1987 1 -3 221.2 0.5 # Shrimp_Bycatch_3
1988 1 -3 100.8 0.5 # Shrimp_Bycatch_3
1989 1 -3 195.5 0.5 # Shrimp_Bycatch_3
1990 1 -3 173.5 0.5 # Shrimp_Bycatch_3
1991 1 -3 189.1 0.5 # Shrimp_Bycatch_3
1992 1 -3 586.1 0.5 # Shrimp_Bycatch_3
1993 1 -3 166.9 0.5 # Shrimp_Bycatch_3
1994 1 -3 164.7 0.5 # Shrimp_Bycatch_3
1995 1 -3 119.8 0.5 # Shrimp_Bycatch_3
1996 1 -3 411.8 0.5 # Shrimp_Bycatch_3
1997 1 -3 494.9 0.5 # Shrimp_Bycatch_3
1998 1 -3 376 0.5 # Shrimp_Bycatch_3
1999 1 -3 491.1 0.5 # Shrimp_Bycatch_3
2000 1 -3 151.1 0.5 # Shrimp_Bycatch_3
2001 1 -3 455.6 0.5 # Shrimp_Bycatch_3
2002 1 -3 209.4 0.5 # Shrimp_Bycatch_3
2003 1 -3 98.59 0.5 # Shrimp_Bycatch_3
2004 1 -3 44.57 0.5 # Shrimp_Bycatch_3
2005 1 -3 87.34 0.5 # Shrimp_Bycatch_3
2006 1 -3 176.8 0.5 # Shrimp_Bycatch_3
2007 1 -3 47.03 0.5 # Shrimp_Bycatch_3
2008 1 -3 13.34 0.5 # Shrimp_Bycatch_3
2009 1 -3 18.98 0.5 # Shrimp_Bycatch_3
2010 1 -3 5.759 0.5 # Shrimp_Bycatch_3
2011 -1 -3 41.26 0.5 # Shrimp_Bycatch_3
#
0 #_N_meanbodywt_obs
30 #_DF_for_meanbodywt_T-distribution_like
2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
3 # binwidth for population size comp
6 # minimum size in the population (lower edge of first bin and size at age 0.00)
165 # maximum size in the population (lower edge of last bin)
0 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
54 #_N_LengthBins
6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
51 54 57 60 63 66 69 72 75 78 81 84
87 90 93 96 99 102 105 108 111 114 117 120

	123	126	129	132	135	138	141	144	147	150	153	156
	159	162	165									

85 #_N_Length_obs

#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)

1983	1	1	0	2	7	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	2	1	0	0	0	1	0	1
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
1984	1	1	0	2	42	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	3	3	1	2	4	4	2	3	2	4
	4	1	2	2	0	3	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1985	1	1	0	2	36	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	0	0	2	0	1	0	1	1	1
	2	5	4	3	0	1	0	4	0	0	2	3
	0	0	1	1	0	1	1	0	0	0	0	
1986	1	1	0	2	32	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	2	3	2	1	0	5	4	2	1
	3	4	1	0	0	2	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1987	1	1	0	2	9	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	1	0	0	2	0	0
	1	0	1	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1988	1	1	0	2	7	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	1	0
	0	0	2	0	0	1	0	0	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1989	1	1	0	2	3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	1	0
	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

1990	1	1	0	2	47	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	4	9	3	7	9	4
	4	2	0	0	0	1	0	0	1	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	
1991	1	1	0	2	96	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	2	6	12	16	9	8	8
	5	4	7	9	3	0	2	0	2	0	2	0
	0	0	0	0	0	0	0	0	0	0	0	
1992	1	1	0	2	99	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	1	2	2	11	6	15	14	7
	8	7	4	4	8	3	3	2	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1993	1	1	0	2	83	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	6	6	10	13	17	9
	6	1	3	0	3	1	1	2	0	1	0	0
	0	0	1	0	1	0	0	0	0	0	0	
1994	1	1	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	3	11	8	10	11	7
	11	7	8	9	7	2	1	0	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	
1995	1	1	0	2	60	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	3	7	3	4	5	5
	5	5	4	5	4	2	0	2	3	0	2	0
	0	1	0	0	0	0	0	0	0	0	0	
1996	1	1	0	2	47	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	3	5	3	1	7	3
	2	4	2	2	3	5	0	0	3	0	0	2
	2	0	0	0	0	0	0	0	0	0	0	
1997	1	1	0	2	40	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	5	2	2	4	3
	2	3	3	1	4	2	2	2	3	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	

1998	1	1	0	2	29	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	1	1	2
	3	0	1	2	2	2	2	1	4	2	2	2
	0	1	0	0	0	0	0	0	0	0	0	
1999	1	1	0	2	30	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	1	0	1	2
	3	0	6	2	2	2	1	2	1	1	3	1
	0	1	0	0	0	0	0	0	0	0	0	
2000	1	1	0	2	37	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	2	1	1	2	2	3
	3	5	4	2	3	1	0	1	0	0	0	2
	1	1	0	1	1	0	0	0	0	0	0	
2001	1	1	0	2	65	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	3	2	0	0	6	3
	4	2	7	4	9	4	2	4	4	2	6	1
	0	0	0	0	0	0	0	0	0	0	0	
2002	1	1	0	2	33	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	2	0	3	2	3	3
	4	1	1	0	2	1	4	0	1	1	2	1
	0	0	0	0	0	0	0	0	0	0	0	
2003	1	1	0	2	50	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	1	2	4	4
	4	4	5	9	5	2	3	3	1	0	0	0
	0	1	0	1	0	0	0	0	0	0	0	
2004	1	1	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	4	5	8	5	9	6
	12	13	11	11	6	8	8	3	8	4	3	1
	0	1	1	0	0	0	0	0	0	0	0	
2005	1	1	0	2	86	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	3	3	6	6	6	1	6
	9	8	10	5	8	1	2	5	1	0	1	0
	2	1	0	0	1	0	0	0	0	0	0	

2006	1	1	0	2	49	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	4	7	6	8
	7	2	1	3	3	1	5	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
2007	1	1	0	2	66	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	5	4	10	7	10	5
	9	4	1	1	2	3	0	2	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
2008	1	1	0	2	38	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	1	0	1	6	3	2	3
	3	2	2	2	3	2	3	1	1	1	0	0
	0	2	0	0	0	0	0	0	0	0	0	
2009	1	1	0	2	48	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	4	4	7	7	4	1
	3	6	2	1	2	2	1	0	0	1	0	0
	0	0	0	0	0	1	0	0	0	0	0	
2010	1	1	0	2	73	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	2	1	7	5	7	7	7	6
	5	8	2	2	2	3	3	3	0	1	0	1
	1	0	0	0	0	0	0	0	0	0	0	
2011	1	1	0	2	80	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	2	4	20	6	9	12	7
	4	6	5	1	1	1	0	0	0	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	
2006	1	1	0	0	10	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	2	1	1	0	0	0	1	0	0	0	2
	1	1	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	0	0	0	0	0	
2007	1	1	0	0	15	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	2	0	1	0	0	1	3	1	1	0
	4	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

2008	1	1	0	0	22	0	0	0	0	0	0	0
	0	0	0	0	0	0	2	0	0	0	1	1
	0	0	2	1	1	2	2	2	1	3	0	1
	1	1	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2009	1	1	0	0	33	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	1	2	4	0	3	1	0	3	2	3	3	0
	4	2	2	0	0	0	1	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
2010	1	1	0	0	25	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0
	1	1	2	0	1	2	1	2	1	2	1	2
	1	2	2	0	0	0	1	0	0	0	1	1
	0	0	0	0	0	0	0	0	0	0	0	
2011	1	1	0	0	57	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	3	1
	2	0	2	3	1	2	3	1	10	5	2	3
	3	2	4	3	0	2	0	2	0	0	1	1
	0	0	0	0	0	0	0	0	0	0	0	
1979	1	2	0	2	16	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	1	2	0	2	1	0	1	1	0	2	0
	0	0	1	1	1	1	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1980	1	2	0	2	11	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	1	3	2	1	1	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1981	1	2	0	2	36	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	0	0	2	5	2	4	2	4	1	7	1	2
	0	1	1	0	1	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1982	1	2	0	2	65	0	0	0	0	0	0	0
	0	1	0	0	0	1	1	3	1	1	2	6
	4	4	5	3	8	5	2	2	4	2	2	3
	1	1	1	0	0	0	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

1983	1	2	0	2	63	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	0	0	1
	1	4	4	4	3	3	3	2	5	4	3	8
	2	0	0	4	2	3	2	1	1	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	
1984	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	1	4	1	2	3	1	1	5	1
	2	3	4	5	5	6	2	5	7	5	10	8
	6	5	1	1	3	5	1	1	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	
1985	1	2	0	2	69	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	2	1	1	2
	2	0	3	2	6	3	7	6	10	5	3	3
	2	6	1	1	1	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1986	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	2	2
	2	4	2	5	6	15	10	14	17	16	9	8
	10	7	4	3	2	1	3	1	1	0	0	0
	0	1	0	0	0	0	0	0	0	0	0	
1987	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	2	1	4	6
	4	9	1	1	5	6	5	9	17	11	10	16
	14	7	6	1	2	4	0	1	0	0	0	0
	0	0	1	0	0	0	0	0	0	0	0	
1988	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	1	0	1	5	5	12	9	13	11	6	12	3
	6	4	3	2	3	3	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1989	1	2	0	2	95	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	2	2	1
	0	0	1	2	3	2	9	9	10	6	10	7
	15	3	4	4	0	2	0	1	0	0	0	1
	1	0	0	0	0	0	0	0	0	0	0	
1990	1	2	0	2	73	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	1	3	5	10	7	7	3	3
	5	6	2	9	3	1	3	0	1	1	0	2
	0	0	0	0	0	0	0	0	0	0	0	

1991	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	3
	1	0	3	1	1	5	9	14	17	14	10	6
	2	3	8	2	1	3	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1992	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	2	0
	0	1	1	1	3	11	21	19	29	19	16	14
	10	6	4	5	7	3	1	7	4	1	0	1
	0	1	0	0	0	0	0	0	0	0	0	
1993	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	5	12	18	28	27	23	21	18
	13	7	2	8	1	1	1	0	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1994	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	2	1	2
	0	0	2	3	1	4	26	23	43	30	26	21
	12	10	11	5	3	2	0	1	0	0	2	0
	0	0	0	0	0	0	0	0	0	0	0	
1995	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	1	0	1	2	4	9	22	27	38	26	14	28
	12	14	6	7	4	4	2	1	2	1	0	0
	0	0	1	0	0	0	0	0	0	0	0	
1996	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	1	3	7	31	34	35	29	40	23
	17	6	7	8	10	8	3	4	1	2	0	0
	1	1	0	0	0	0	0	0	0	0	0	
1997	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	2
	0	0	0	3	3	6	33	36	39	30	30	25
	11	9	9	12	9	7	7	6	1	0	3	2
	0	0	0	0	0	0	0	0	0	0	0	
1998	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	2	4	10	23	57	40	37	36	28
	29	38	22	21	14	4	10	8	2	1	3	1
	0	0	0	0	1	0	0	0	0	0	0	

1999	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	1	1	1	5	8	9	23	21	47	23	37	51
	40	43	17	27	16	10	8	5	2	2	1	3
	0	0	0	1	0	0	0	0	0	0	0	
2000	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0	1
	0	0	2	2	6	8	16	27	25	22	9	19
	17	14	14	12	5	10	3	6	3	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	
2001	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	6	5	27	35	31	28	41	25
	25	13	17	8	10	6	1	1	4	2	1	1
	0	0	0	0	1	0	0	0	0	0	0	
2002	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	0	3	2	1	3	3	15	25	32	32	22	25
	20	7	9	10	8	5	4	3	2	0	1	1
	0	0	0	0	0	0	0	0	0	0	0	
2003	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	2	6	6	16	31	32	49	35	23	38
	32	13	14	9	10	10	5	4	3	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
2004	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	2	11	22	26	18	29	30	23
	25	18	14	8	15	8	5	1	2	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2005	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	2	1
	0	2	1	2	5	5	17	21	20	20	22	16
	10	11	5	7	10	5	2	2	1	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	
2006	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	2
	0	0	2	4	7	8	17	33	27	28	24	19
	20	16	15	6	8	6	4	1	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	

2007	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	2	0	3	6	12	33	30	34	32	13	18
	29	12	7	4	5	6	6	2	4	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	
2008	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	0	4	18	34	17	27	24	21
	17	12	7	10	4	2	4	3	2	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	
2009	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	1	4
	1	1	0	1	4	9	17	29	25	19	12	12
	14	6	10	7	7	8	4	2	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	
2010	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	2	0	5	18	21	36	25	29	16
	21	16	5	6	7	6	4	3	2	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2011	1	2	0	2	100	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	3	7	15	12	27	20	19
	10	7	9	8	6	4	2	2	2	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	
2011	-1	3	0	0	294	0	0	0	7	6	9	15
	10	27	43	43	38	38	15	9	5	1	1	1
	2	4	4	1	3	2	2	0	0	0	3	0
	0	0	0	1	0	1	2	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1989	1	-3	0	0	5	0	0	0	0	0	0	0
	0	0	1	0	2	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1990	1	-3	0	0	9	0	0	0	0	0	0	0
	1	0	2	0	2	3	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

1991	1	-3	0	0	5	0	0	0	0	0	0	0
	0	1	0	1	1	2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1992	1	-3	0	0	9	0	0	0	0	0	0	0
	3	1	0	2	1	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1993	1	-3	0	0	28	0	0	0	1	0	0	1
	0	2	5	11	5	0	0	2	0	0	0	0
	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1994	1	-3	0	0	17	0	0	0	0	0	0	1
	0	0	1	3	4	5	1	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1995	1	-3	0	0	13	0	0	0	0	1	0	2
	1	0	0	0	1	2	0	0	0	0	0	0
	1	2	1	0	0	0	1	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1996	1	-3	0	0	16	0	0	0	0	0	1	1
	0	3	6	2	1	1	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1997	1	-3	0	0	28	0	0	0	0	0	0	1
	0	6	6	6	5	2	1	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
1998	1	-3	0	0	8	0	0	0	0	0	0	0
	0	1	0	0	1	0	0	0	0	0	0	1
	0	0	1	0	2	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

1999	1	-3	0	0	15	0	0	0	1	0	0	0
	0	2	1	1	3	5	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2000	1	-3	0	0	2	0	0	0	0	0	0	0
	0	0	0	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2001	1	-3	0	0	16	0	0	0	0	0	0	1
	0	3	7	2	1	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2002	1	-3	0	0	6	0	0	0	0	0	0	0
	0	1	1	0	0	1	1	0	0	0	0	0
	0	1	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2003	1	-3	0	0	9	0	0	0	0	1	1	1
	0	0	2	0	3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2004	1	-3	0	0	16	0	0	0	0	0	1	0
	0	2	3	4	2	2	1	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2005	1	-3	0	0	22	0	0	0	4	2	1	1
	1	3	1	1	2	3	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2006	1	-3	0	0	13	0	0	0	0	0	1	0
	0	1	1	2	2	0	4	0	1	0	0	0
	0	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

2007	1	-3	0	0	9	0	0	0	0	0	2	2
	1	0	1	1	0	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2008	1	-3	0	0	19	0	0	0	0	0	0	0
	1	0	2	3	1	4	1	1	0	0	1	0
	0	1	0	1	0	0	0	0	0	0	1	0
	0	0	0	0	0	1	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2009	1	-3	0	0	12	0	0	0	1	0	0	1
	1	0	0	1	0	2	2	1	2	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	
2010	-1	-3	0	0	17	0	0	0	0	2	2	3
	1	1	3	2	1	2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	

11 #_N_age_bins
0 1 2 3 4 5 6 7 8 9 10
2 #_N_ageerror_definitions
0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5
0.01 0.05 0.15 0.15 0.2 0.3 0.5 0.5 0.75 0.75 1 1
279 #_N_Agecomp_obs
2 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1 #_combine males into females at or below this bin number
#Yr Seas Flt/Svy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

1987	1	2	0	2	2	20	20	1	0	1	0	0
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	26	26	1	0	0	1	0
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	29	29	1	0	0	0	1
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	30	30	3	0	0	1	2
	0	0	0	0	0	0	0					

1987	1	2	0	2	2	31	31	2	0	0	0	2
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	32	32	1	0	0	1	0
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	33	33	4	0	0	0	2
	0	2	0	0	0	0	0					
1987	1	2	0	2	2	34	34	1	0	0	0	1
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	36	36	2	0	0	1	1
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	37	37	4	0	0	0	4
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	38	38	1	0	0	0	1
	0	0	0	0	0	0	0					
1987	1	2	0	2	2	39	39	1	0	0	0	0
	1	0	0	0	0	0	0					
1987	1	2	0	2	2	40	40	1	0	0	0	0
	0	1	0	0	0	0	0					
1987	1	2	0	2	2	43	43	1	0	0	0	0
	0	1	0	0	0	0	0					
1987	1	2	0	2	2	46	46	2	0	0	0	0
	0	1	1	0	0	0	0					
1987	1	2	0	2	2	47	47	1	0	0	0	0
	0	0	0	1	0	0	0					
1988	1	2	0	2	2	25	25	1	0	0	1	0
	0	0	0	0	0	0	0					
1988	1	2	0	2	2	26	26	1	0	0	1	0
	0	0	0	0	0	0	0					
1988	1	2	0	2	2	27	27	3	0	0	3	0
	0	0	0	0	0	0	0					
1988	1	2	0	2	2	28	28	1	0	0	0	0
	1	0	0	0	0	0	0					
1988	1	2	0	2	2	29	29	3	0	0	2	1
	0	0	0	0	0	0	0					
1988	1	2	0	2	2	30	30	4	0	0	3	1
	0	0	0	0	0	0	0					
1988	1	2	0	2	2	31	31	2	0	0	0	1
	1	0	0	0	0	0	0					
1988	1	2	0	2	2	32	32	6	0	0	0	4
	2	0	0	0	0	0	0					

1988	1	2	0	2	2	33	33	5	0	0	0	2
	3	0	0	0	0	0	0					
1988	1	2	0	2	2	34	34	5	0	0	0	3
	2	0	0	0	0	0	0					
1988	1	2	0	2	2	35	35	5	0	0	0	1
	3	1	0	0	0	0	0					
1988	1	2	0	2	2	36	36	2	0	0	0	1
	1	0	0	0	0	0	0					
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	2	0	0	0	0	0	0					
1988	1	2	0	2	2	38	38	2	0	0	0	0
	0	2	0	0	0	0	0					
1988	1	2	0	2	2	39	39	2	0	0	0	0
	2	0	0	0	0	0	0					
1988	1	2	0	2	2	42	42	2	0	0	0	0
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1988	1	2	0	2	2	47	47	1	0	0	0	0
	0	0	1	0	0	0	0					
1988	1	2	0	2	2	50	50	1	0	0	0	0
	0	0	0	0	1	0	0					
1989	1	2	0	2	2	20	20	1	0	1	0	0
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	21	21	2	0	2	0	0
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	25	25	1	0	0	0	1
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	26	26	5	0	0	5	0
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	27	27	14	0	0	13	1
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	28	28	9	0	0	5	4
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	29	29	7	0	0	3	4
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	30	30	22	0	0	4	17
	0	1	0	0	0	0	0					
1989	1	2	0	2	2	31	31	26	0	0	7	19
	0	0	0	0	0	0	0					
1989	1	2	0	2	2	32	32	20	0	0	0	19
	0	1	0	0	0	0	0					

1989	1	2	0	2	2	33	33	23	0	0	2	19
	1	1	0	0	0	0	0					
1989	1	2	0	2	2	34	34	11	0	0	1	7
	1	2	0	0	0	0	0					
1989	1	2	0	2	2	35	35	16	0	0	2	12
	0	2	0	0	0	0	0					
1989	1	2	0	2	2	36	36	7	0	0	0	3
	3	1	0	0	0	0	0					
1989	1	2	0	2	2	37	37	9	0	0	0	6
	2	1	0	0	0	0	0					
1989	1	2	0	2	2	38	38	5	0	0	0	1
	1	2	1	0	0	0	0					
1989	1	2	0	2	2	39	39	8	0	0	0	2
	3	2	0	1	0	0	0					
1989	1	2	0	2	2	40	40	4	0	0	0	1
	1	1	0	0	0	1	0					
1989	1	2	0	2	2	41	41	1	0	0	0	0
	0	1	0	0	0	0	0					
1989	1	2	0	2	2	42	42	1	0	0	0	0
	0	0	0	1	0	0	0					
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	0	2	0	0	0	0	0					
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1989	1	2	0	2	2	45	45	2	0	0	0	0
	0	1	1	0	0	0	0					
1989	1	2	0	2	2	49	49	1	0	0	0	0
	0	0	0	0	0	1	0					
1990	1	2	0	2	2	13	13	1	1	0	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	16	16	1	0	1	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	18	18	1	0	1	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	19	19	2	0	1	1	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	20	20	6	0	5	1	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	21	21	2	0	2	0	0
	0	0	0	0	0	0	0					

1990	1	2	0	2	2	22	22	6	0	6	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	23	23	2	0	2	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	24	24	3	0	3	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	26	26	1	0	1	0	0
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	27	27	14	0	1	12	1
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	28	28	5	0	4	0	1
	0	0	0	0	0	0	0					
1990	1	2	0	2	2	29	29	6	0	0	4	1
	1	0	0	0	0	0	0					
1990	1	2	0	2	2	30	30	11	0	0	4	5
	2	0	0	0	0	0	0					
1990	1	2	0	2	2	31	31	13	0	0	3	4
	6	0	0	0	0	0	0					
1990	1	2	0	2	2	32	32	14	0	0	3	6
	3	2	0	0	0	0	0					
1990	1	2	0	2	2	33	33	11	0	0	4	2
	3	1	0	1	0	0	0					
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	7	3	0	1	0	0	0					
1990	1	2	0	2	2	35	35	13	0	0	0	3
	10	0	0	0	0	0	0					
1990	1	2	0	2	2	36	36	12	0	0	1	5
	6	0	0	0	0	0	0					
1990	1	2	0	2	2	37	37	12	0	0	0	5
	6	0	1	0	0	0	0					
1990	1	2	0	2	2	38	38	3	0	0	0	0
	2	1	0	0	0	0	0					
1990	1	2	0	2	2	39	39	3	0	0	0	0
	2	1	0	0	0	0	0					
1990	1	2	0	2	2	40	40	5	0	0	0	1
	1	2	1	0	0	0	0					
1990	1	2	0	2	2	41	41	2	0	0	0	0
	1	0	0	0	0	1	0					
1990	1	2	0	2	2	42	42	3	0	0	0	0
	2	1	0	0	0	0	0					

1990	1	2	0	2	2	43	43	4	0	0	0	0
	1	2	0	1	0	0	0					
1990	1	2	0	2	2	44	44	2	0	0	0	0
	0	1	0	0	0	1	0					
1990	1	2	0	2	2	49	49	1	0	0	0	0
	0	0	0	0	1	0	0					
1991	1	2	0	2	2	15	15	1	0	1	0	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	16	16	1	0	1	0	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	17	17	1	0	1	0	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	19	19	1	0	1	0	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	25	25	2	0	0	2	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	26	26	3	0	0	3	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	27	27	11	0	0	11	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	28	28	2	0	0	2	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	29	29	7	0	0	7	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	30	30	4	0	0	4	0
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	31	31	5	0	0	3	2
	0	0	0	0	0	0	0					
1991	1	2	0	2	2	32	32	3	0	0	1	1
	0	1	0	0	0	0	0					
1991	1	2	0	2	2	33	33	2	0	0	0	1
	0	1	0	0	0	0	0					
1991	1	2	0	2	2	34	34	1	0	0	1	0
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1991	1	2	0	2	2	35	35	4	0	0	1	1
	2	0	0	0	0	0	0					
1991	1	2	0	2	2	36	36	1	0	0	0	0
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1991	1	2	0	2	2	38	38	5	0	0	0	1
	1	3	0	0	0	0	0					

1991	1	2	0	2	2	39	39	2	0	0	0	0
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1991	1	2	0	2	2	40	40	2	0	0	0	0
	1	1	0	0	0	0	0					
1991	1	2	0	2	2	41	41	3	0	0	0	0
	0	2	1	0	0	0	0					
1991	1	2	0	2	2	42	42	1	0	0	0	0
	1	0	0	0	0	0	0					
1991	1	2	0	2	2	43	43	2	0	0	0	0
	1	0	1	0	0	0	0					
1991	1	2	0	2	2	44	44	1	0	0	0	0
	0	1	0	0	0	0	0					
1991	1	2	0	2	2	46	46	2	0	0	0	0
	0	1	1	0	0	0	0					
1992	1	2	0	2	2	27	27	2	0	0	2	0
	0	0	0	0	0	0	0					
1992	1	2	0	2	2	28	28	2	0	0	2	0
	0	0	0	0	0	0	0					
1992	1	2	0	2	2	30	30	1	0	0	1	0
	0	0	0	0	0	0	0					
1992	1	2	0	2	2	31	31	1	0	0	1	0
	0	0	0	0	0	0	0					
1992	1	2	0	2	2	32	32	1	0	0	1	0
	0	0	0	0	0	0	0					
1992	1	2	0	2	2	36	36	1	0	0	0	0
	0	0	1	0	0	0	0					
1992	1	2	0	2	2	39	39	1	0	0	0	1
	0	0	0	0	0	0	0					
1993	1	2	0	2	2	31	31	1	0	0	0	1
	0	0	0	0	0	0	0					
1993	1	2	0	2	2	32	32	1	0	0	0	0
	1	0	0	0	0	0	0					
1994	1	2	0	2	2	23	23	1	0	1	0	0
	0	0	0	0	0	0	0					
1994	1	2	0	2	2	27	27	1	0	0	1	0
	0	0	0	0	0	0	0					
1994	1	2	0	2	2	28	28	1	0	0	0	1
	0	0	0	0	0	0	0					
1994	1	2	0	2	2	31	31	1	0	0	0	1
	0	0	0	0	0	0	0					

1994	1	2	0	2	2	33	33	1	0	0	0	0
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1994	1	2	0	2	2	34	34	1	0	0	0	0
	1	0	0	0	0	0	0					
1995	1	2	0	2	2	11	11	3	3	0	0	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	12	12	2	2	0	0	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	13	13	1	1	0	0	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	18	18	3	0	3	0	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	26	26	2	0	1	1	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	27	27	6	0	1	5	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	28	28	5	0	0	4	1
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	29	29	1	0	0	0	1
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	30	30	1	0	0	0	1
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	31	31	1	0	0	1	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	32	32	1	0	0	1	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	33	33	1	0	0	1	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	34	34	1	0	0	1	0
	0	0	0	0	0	0	0					
1995	1	2	0	2	2	35	35	1	0	0	0	0
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1995	1	2	0	2	2	37	37	1	0	0	0	0
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1995	1	2	0	2	2	39	39	1	0	0	0	0
	0	1	0	0	0	0	0					
1995	1	2	0	2	2	41	41	1	0	0	0	0
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1995	1	2	0	2	2	46	46	1	0	0	0	0
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1996	1	2	0	2	2	12	12	2	2	0	0	0
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	13	13	1	1	0	0	0
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	19	19	2	0	2	0	0
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	20	20	1	0	1	0	0
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	21	21	2	0	1	1	0
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	22	22	6	0	0	3	3
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	23	23	4	0	0	3	1
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	24	24	2	0	0	1	1
	0	0	0	0	0	0	0					
1996	1	2	0	2	2	25	25	7	0	2	2	2
	1	0	0	0	0	0	0					
1996	1	2	0	2	2	26	26	19	0	1	11	5
	2	0	0	0	0	0	0					
1996	1	2	0	2	2	27	27	27	0	0	9	12
	3	3	0	0	0	0	0					
1996	1	2	0	2	2	28	28	35	0	1	15	14
	5	0	0	0	0	0	0					
1996	1	2	0	2	2	29	29	32	0	0	10	16
	5	1	0	0	0	0	0					
1996	1	2	0	2	2	30	30	33	0	0	12	14
	2	3	1	1	0	0	0					
1996	1	2	0	2	2	31	31	22	0	0	7	11
	3	0	1	0	0	0	0					
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1996	1	2	0	2	2	33	33	23	0	1	1	15
	2	3	1	0	0	0	0					
1996	1	2	0	2	2	34	34	13	0	0	3	5
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1996	1	2	0	2	2	35	35	13	0	0	1	7
	1	1	2	1	0	0	0					
1996	1	2	0	2	2	36	36	7	0	0	0	1
	3	0	2	0	1	0	0					

1996	1	2	0	2	2	37	37	8	0	0	2	2
	2	1	1	0	0	0	0					
1996	1	2	0	2	2	38	38	6	0	0	0	1
	1	2	2	0	0	0	0					
1996	1	2	0	2	2	39	39	11	0	0	0	2
	4	1	3	1	0	0	0					
1996	1	2	0	2	2	40	40	7	0	0	0	0
	1	2	3	1	0	0	0					
1996	1	2	0	2	2	41	41	4	0	0	0	0
	0	1	2	0	0	1	0					
1996	1	2	0	2	2	42	42	4	0	0	0	0
	1	1	1	0	1	0	0					
1996	1	2	0	2	2	43	43	1	0	0	0	0
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1996	1	2	0	2	2	44	44	1	0	0	0	0
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1996	1	2	0	2	2	45	45	1	0	0	0	0
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1996	1	2	0	2	2	47	47	1	0	0	0	0
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1996	1	2	0	2	2	51	51	1	0	0	0	0
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1997	1	2	0	2	2	10	10	1	0	1	0	0
	0	0	0	0	0	0	0					
1997	1	2	0	2	2	14	14	1	0	1	0	0
	0	0	0	0	0	0	0					
1997	1	2	0	2	2	16	16	1	0	1	0	0
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1997	1	2	0	2	2	17	17	1	0	1	0	0
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1997	1	2	0	2	2	20	20	1	0	0	1	0
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1997	1	2	0	2	2	21	21	1	0	0	1	0
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1997	1	2	0	2	2	22	22	3	0	1	1	1
	0	0	0	0	0	0	0					
1997	1	2	0	2	2	24	24	1	0	1	0	0
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1997	1	2	0	2	2	25	25	2	0	0	1	1
	0	0	0	0	0	0	0					

1997	1	2	0	2	2	26	26	3	0	0	3	0
	0	0	0	0	0	0	0					
1997	1	2	0	2	2	27	27	7	0	0	4	2
	1	0	0	0	0	0	0					
1997	1	2	0	2	2	28	28	11	0	0	6	4
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1997	1	2	0	2	2	29	29	9	0	1	4	4
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1997	1	2	0	2	2	30	30	11	0	1	6	3
	1	0	0	0	0	0	0					
1997	1	2	0	2	2	31	31	21	0	0	9	7
	4	0	1	0	0	0	0					
1997	1	2	0	2	2	32	32	12	0	0	2	6
	4	0	0	0	0	0	0					
1997	1	2	0	2	2	33	33	15	0	1	2	5
	6	0	0	0	1	0	0					
1997	1	2	0	2	2	34	34	14	0	0	2	6
	5	0	1	0	0	0	0					
1997	1	2	0	2	2	35	35	18	0	0	3	6
	6	1	0	1	1	0	0					
1997	1	2	0	2	2	36	36	9	0	0	0	3
	6	0	0	0	0	0	0					
1997	1	2	0	2	2	37	37	16	0	0	0	6
	7	2	0	1	0	0	0					
1997	1	2	0	2	2	38	38	8	0	0	0	1
	6	0	1	0	0	0	0					
1997	1	2	0	2	2	39	39	13	0	0	1	4
	6	1	1	0	0	0	0					
1997	1	2	0	2	2	40	40	6	0	0	1	1
	3	0	1	0	0	0	0					
1997	1	2	0	2	2	41	41	2	0	0	0	2
	0	0	0	0	0	0	0					
1997	1	2	0	2	2	42	42	1	0	0	0	0
	1	0	0	0	0	0	0					
1997	1	2	0	2	2	43	43	1	0	0	0	0
	0	0	1	0	0	0	0					
1997	1	2	0	2	2	44	44	1	0	0	0	0
	0	0	1	0	0	0	0					
1997	1	2	0	2	2	45	45	1	0	0	0	1
	0	0	0	0	0	0	0					

1997	1	2	0	2	2	53	53	1	0	0	0	0
	0	0	1	0	0	0	0					
1998	1	2	0	2	2	30	30	1	0	0	0	1
	0	0	0	0	0	0	0					
1998	1	2	0	2	2	31	31	1	0	0	1	0
	0	0	0	0	0	0	0					
1998	1	2	0	2	2	32	32	1	0	0	0	1
	0	0	0	0	0	0	0					
1999	1	2	0	2	2	27	27	1	0	0	1	0
	0	0	0	0	0	0	0					
1999	1	2	0	2	2	31	31	1	0	0	0	1
	0	0	0	0	0	0	0					
1999	1	2	0	2	2	36	36	1	0	0	0	1
	0	0	0	0	0	0	0					
2000	1	2	0	2	2	26	26	1	0	0	1	0
	0	0	0	0	0	0	0					
2000	1	2	0	2	2	27	27	1	0	0	1	0
	0	0	0	0	0	0	0					
2000	1	2	0	2	2	28	28	1	0	1	0	0
	0	0	0	0	0	0	0					
2001	1	2	0	2	2	28	28	1	0	0	0	0
	1	0	0	0	0	0	0					
2001	1	2	0	2	2	41	41	1	0	0	0	0
	0	0	0	0	1	0	0					
2002	1	2	0	2	2	24	24	1	0	0	1	0
	0	0	0	0	0	0	0					
2002	1	2	0	2	2	28	28	1	0	0	0	1
	0	0	0	0	0	0	0					
2004	1	2	0	2	2	25	25	1	0	0	1	0
	0	0	0	0	0	0	0					
2004	1	2	0	2	2	27	27	1	0	0	1	0
	0	0	0	0	0	0	0					
2004	1	2	0	2	2	28	28	1	0	0	1	0
	0	0	0	0	0	0	0					
2004	1	2	0	2	2	29	29	2	0	0	0	2
	0	0	0	0	0	0	0					
2004	1	2	0	2	2	30	30	7	0	0	2	4
	0	1	0	0	0	0	0					
2004	1	2	0	2	2	31	31	2	0	0	0	2
	0	0	0	0	0	0	0					

2004	1	2	0	2	2	32	32	1	0	0	0	1	0	0	0	0	0	0	0
2004	1	2	0	2	2	41	41	1	0	0	0	0	0	0	1	0	0	0	0
2005	1	2	0	2	2	26	26	1	0	0	0	1	0	0	0	0	0	0	0
2005	1	2	0	2	2	27	27	2	0	0	2	0	0	0	0	0	0	0	0
2005	1	2	0	2	2	28	28	2	0	0	1	1	0	0	0	0	0	0	0
2005	1	2	0	2	2	31	31	1	0	0	0	1	0	0	0	0	0	0	0
2005	1	2	0	2	2	32	32	1	0	0	0	1	0	0	0	0	0	0	0
2005	1	2	0	2	2	33	33	2	0	0	0	0	0	1	1	0	0	0	0
2005	1	2	0	2	2	35	35	1	0	0	0	0	1	0	0	0	0	0	0
2005	1	2	0	2	2	36	36	1	0	0	0	1	0	0	0	0	0	0	0
2005	1	2	0	2	2	39	39	1	0	0	0	0	0	0	1	0	0	0	0
2006	1	2	0	2	2	25	25	1	0	0	1	0	0	0	0	0	0	0	0
2006	1	2	0	2	2	26	26	2	0	0	2	0	0	0	0	0	0	0	0
2006	1	2	0	2	2	27	27	2	0	0	1	1	0	0	0	0	0	0	0
2006	1	2	0	2	2	28	28	8	0	0	5	3	0	0	0	0	0	0	0
2006	1	2	0	2	2	29	29	6	0	0	2	3	1	0	0	0	0	0	0
2006	1	2	0	2	2	30	30	8	0	0	1	5	1	1	0	0	0	0	0
2006	1	2	0	2	2	31	31	6	0	0	0	3	1	2	0	0	0	0	0
2006	1	2	0	2	2	32	32	4	0	0	0	3	0	1	0	0	0	0	0
2006	1	2	0	2	2	33	33	4	0	0	0	3	1	0	0	0	0	0	0

2006	1	2	0	2	2	34	34	2	0	0	1	0
	0	1	0	0	0	0	0					
2006	1	2	0	2	2	35	35	1	0	0	0	0
	1	0	0	0	0	0	0					
2006	1	2	0	2	2	36	36	2	0	0	0	1
	1	0	0	0	0	0	0					
2006	1	2	0	2	2	37	37	2	0	0	0	0
	0	2	0	0	0	0	0					
2006	1	2	0	2	2	38	38	1	0	0	0	0
	0	1	0	0	0	0	0					
2007	1	2	0	2	2	27	27	1	0	0	0	1
	0	0	0	0	0	0	0					
2007	1	2	0	2	2	28	28	3	0	0	1	2
	0	0	0	0	0	0	0					
2007	1	2	0	2	2	29	29	1	0	0	0	1
	0	0	0	0	0	0	0					
2007	1	2	0	2	2	30	30	1	0	0	0	1
	0	0	0	0	0	0	0					
2007	1	2	0	2	2	32	32	3	0	0	0	3
	0	0	0	0	0	0	0					
2007	1	2	0	2	2	33	33	1	0	0	0	1
	0	0	0	0	0	0	0					
2008	1	2	0	2	2	27	27	2	0	0	2	0
	0	0	0	0	0	0	0					
2008	1	2	0	2	2	28	28	2	0	0	1	1
	0	0	0	0	0	0	0					
2008	1	2	0	2	2	29	29	2	0	0	1	1
	0	0	0	0	0	0	0					
2008	1	2	0	2	2	30	30	1	0	0	0	0
	1	0	0	0	0	0	0					
2008	1	2	0	2	2	31	31	1	0	0	0	0
	1	0	0	0	0	0	0					
2008	1	2	0	2	2	36	36	3	0	0	0	2
	1	0	0	0	0	0	0					
2008	1	2	0	2	2	37	37	1	0	0	0	1
	0	0	0	0	0	0	0					
2008	1	2	0	2	2	38	38	2	0	0	0	0
	0	1	1	0	0	0	0					
2008	1	2	0	2	2	40	40	1	0	0	0	0
	0	1	0	0	0	0	0					

2008	1	2	0	2	2	45	45	1	0	0	0	0
	0	0	0	0	1	0	0					
2009	1	2	0	2	2	26	26	1	0	0	1	0
	0	0	0	0	0	0	0					
2009	1	2	0	2	2	28	28	2	0	0	2	0
	0	0	0	0	0	0	0					
2009	1	2	0	2	2	29	29	2	0	0	0	2
	0	0	0	0	0	0	0					
2009	1	2	0	2	2	31	31	1	0	0	0	1
	0	0	0	0	0	0	0					
2009	1	2	0	2	2	32	32	1	0	0	0	0
	1	0	0	0	0	0	0					
2009	1	2	0	2	2	33	33	1	0	0	0	1
	0	0	0	0	0	0	0					
2009	1	2	0	2	2	49	49	1	0	0	0	0
	0	0	0	1	0	0	0					
2010	1	2	0	2	2	26	26	2	0	0	0	2
	0	0	0	0	0	0	0					
2010	1	2	0	2	2	27	27	2	0	0	0	2
	0	0	0	0	0	0	0					
2010	1	2	0	2	2	28	28	4	0	0	0	4
	0	0	0	0	0	0	0					
2010	1	2	0	2	2	29	29	2	0	0	1	1
	0	0	0	0	0	0	0					
2010	1	2	0	2	2	30	30	3	0	0	0	2
	1	0	0	0	0	0	0					
2010	1	2	0	2	2	32	32	1	0	0	0	1
	0	0	0	0	0	0	0					
2010	1	2	0	2	2	35	35	1	0	0	0	1
	0	0	0	0	0	0	0					

0 #_N_MeanSize-at-Age_obs
#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)
samplesize(female-male)
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data
999
ENDDATA

3.9 Appendix B. Cobia.CTL File

#V3.24f
#_data_and_control_files: cobia_dat.ss // cobia_ctl.ss
#_SS-V3.24f-
safe;_08/03/2012;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB_10.1
1 #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond 1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)
#_Cond 0 # N recruitment designs goes here if N_GP*nseas*area>1
#_Cond 0 # placeholder for recruitment interaction request
#_Cond 1 1 1 # example recruitment design element for GP=1, seas=1, area=1
#_Cond 0 # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10
1 #_Nblock_Patterns
2 #_blocks_per_pattern
begin and end years of blocks
1927 1984 1985 2011
0.6 #_fracfemale
3 #_natM_type:_0=1Parm;
1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#3 #_reference age for Lorenzen function
#_Age_natmort_by gender x growthpattern
0.54636 0.599 0.485 0.432 0.404 0.387 0.376 0.370 0.366 0.363 0.361 0.360
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=age_speciific_K; 4=not implemented
0.75 #_Growth_Age_for_L1
999 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A); 4 logSD=F(A)
3 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=read fec and wt from wtatage.ss
0.0 0.0 0.5 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 #_placeholder for empirical age-maturity by growth pattern
2 #_First_Mature_Age

3 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b; (4)eggs=a+b*L; (5)eggs=a+b*W
0 #_hermaphroditism option: 0=none; 1=age-specific fxn
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound check)
Prior types (-1 = none, 0=normal, 1=symmetric beta, 2=full beta, 3=lognormal)
#_growth_parms
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
0.2 0.5 0.38 0.4 0 1 -3 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
30 60 41 41 -1 10 3 0 0 0 0 0.5 0 0 # L_at_Amin_Fem_GP_1
100 150 128.1 128.1 -1 10 3 0 0 0 0 0.5 0 0 # L_at_Amax_Fem_GP_1
0.05 0.8 0.3 0.42 -1 0.8 3 0 0 0 0 0.5 0 0 # VonBert_K_Fem_GP_1
0.01 0.5 0.1 0.1 0 -1 5 0 0 0 0 0.5 0 0 # CV_young_Fem_GP_1
0.01 0.5 0.1 0.1 0 -1 5 0 0 0 0 0.5 0 0 # CV_old_Fem_GP_1
0 1 0.00000964367 0.00000964367 0 0.1 -3 0 0 0 0 0.5 0 0 # Wtlen_1_Fem
0 4 3.03 3.03 0 0.8 -3 0 0 0 0 0.5 0 0 # Wtlen_2_Fem
50 100 70 70 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-1 0 -0.065 -0.065 -1 0.8 -3 0 0 0 0 0 0 0 # Mat_slope_Fem
0 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eggs/kg_inter_Fem
0 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eggs/kg_slope_wt_Fem
0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_GP_1
0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_Area_1
0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_Seas_1
0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # CohortGrowDev
#_Cond 0 #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters
#_Cond 0 #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters
#_Cond No MG parm trends
#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters
#_Cond -4 #_MGparm_Dev_Phase
#
#_Spawner-Recruitment
3 #_SR_function: 2=Ricker; 3=std_B-H; 4=SCAA; 5=Hockey; 6=B-H_flattop; 7=survival_3Parm

#_LO HI INIT PRIOR PR_type SD PHASE
 1 20 7.05864 7.05 -1 10 1 # SR_LN(R0)
 0.2 1 0.8 0.8 -1 0.05 4 # SR_BH_steep
 0 2 0.6 0.6 -1 0.8 -4 # SR_sigmaR
 -5 5 0.1 0 -1 1 -3 # SR_envlink
 -5 5 0 0 -1 1 -4 # SR_R1_offset
 0 0 0 0 -1 0 -99 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
1 #do_recdev: 0=none; 1=devvector; 2=simple deviations
1982 # first year of main recr_devs; early devs can preceed this era
2010 # last year of main recr_devs; forecast devs start in following year
2 #_recdev phase
1 # (0/1) to read 13 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for Fcast_recr_like occurring before endyr+1
1972 #_last_early_yr_nobias_adj_in_MPD
1983 #_first_yr_fullbias_adj_in_MPD
2009 #_last_yr_fullbias_adj_in_MPD
2011 #_first_recent_yr_nobias_adj_in_MPD
1 #_max_bias_adj_in_MPD (-1 to override ramp and set biasadj=1.0 for all estimated recdevs)
0 #_period of cycles in recruitment (N parms read below)
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#_end of advanced SR options
#
#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2010 # F ballpark year (neg value to disable)
2 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9 # max F or harvest rate, depends on F_Method
no additional F input needed for Fmethod 1
if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read
if Fmethod=3; read N iterations for tuning for Fmethod 3
0.05 1 3 # overall start F value; overall phase; N detailed inputs to read
#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)
1 1927 1 0.01 0.05 1

2 1950 1 0.01 0.05 1
3 1945 1 0.01 0.05 1
#
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.01 0 99 -1 # InitF_1Com_Combined_1
 0 1 0 0.01 0 99 -1 # InitF_2Recreational_Combined_2
 0 1 0 0.01 0 99 -1 # InitF_3Shrimp_Bycatch_3
#
#_Q_setup
 # Q_type options: <0=mirror, 0=float_nobiasadj, 1=float_biasadj, 2=parm_nobiasadj, 3=parm_w_random_dev, 4=parm_w_randwalk, 5=mean_unbiased_float_assign_to_parm
#_for_env-var:_enter_index_of_the_env-var_to_be_linked
#_Den-dep env-var extra_se Q_type
 0 0 0 0 # 1 Com_Combined_1
 0 0 0 0 # 2 Recreational_Combined_2
 0 0 0 2 # 3 Shrimp_Bycatch_3
 0 0 0 0 # 4 MRFSS_4
#
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
LO HI INIT PRIOR PR_type SD PHASE
 -10 20 1 1 -1 1 1 # Q_base_3_Shrimp_Bycatch_3
#
#_size_selex_types
#discard_options:_0=none;_1=define_retention;_2=retention&mortality;_3=all_discarded_dead
#_Pattern Discard Male Special
 1 2 0 0 # 1 Com_Combined_1
 1 2 0 0 # 2 Recreational_Combined_2
 24 3 0 0 # 3 Shrimp_Bycatch_3
 5 0 0 2 # 4 MRFSS_4
#
#_age_selex_types
#_Pattern ___ Male Special
 11 0 0 0 # 1 Com_Combined_1
 15 0 0 1 # 2 Recreational_Combined_2
 11 0 0 0 # 3 Shrimp_Bycatch_3
 15 0 0 1 # 4 MRFSS_4

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
Commercial selectivity (2), retention (4), discard mortality (4)
40 150 80 80 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_2P_1_Com_Combined_2
1 60 15 20 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_2P_2_Com_Combined_2
30 100 83 83 -1 99 -3 0 0 0 0 0.5 1 2 # Retain_1P_1_Com_Combined_1
-1 20 1 1 -1 99 -3 0 0 0 0 0.5 1 2 # Retain_1P_2_Com_Combined_1
0 1 1 1 -1 99 -2 0 0 0 0 0.5 0 0 # Retain_1P_3_Com_Combined_1
-1 2 0 0 -1 99 -4 0 0 0 0 0.5 0 0 # Retain_1P_4_Com_Combined_1
-10 10 -5 -5 -1 99 -2 0 0 0 0 0.5 0 0 # DiscMort_1P_1_Com_Combined_1
-1 2 1 1 -1 99 -4 0 0 0 0 0.5 0 0 # DiscMort_1P_2_Com_Combined_1
-1 2 0.05 0.05 -1 99 -2 0 0 0 0 0.5 0 0 # DiscMort_1P_3_Com_Combined_1
-1 2 0 0 -1 99 -4 0 0 0 0 0.5 0 0 # DiscMort_1P_4_Com_Combined_1
Recreational selectivity (2), retention (4), discard mortality (4)
40 150 70 70 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_2P_1_Recreational_Combined_2
1 60 10 10 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_2P_2_Recreational_Combined_2
30 100 83 83 -1 99 -3 0 0 0 0 0.5 1 2 # Retain_2P_1_Recreational_Combined_2
-1 20 1 1 -1 99 -3 0 0 0 0 0.5 1 2 # Retain_2P_2_Recreational_Combined_2
0 1 1 1 -1 99 -2 0 0 0 0 0.5 0 0 # Retain_2P_3_Recreational_Combined_2
-1 2 0 0 -1 99 -4 0 0 0 0 0.5 0 0 # Retain_2P_4_Recreational_Combined_2
-10 10 -5 -5 -1 99 -2 0 0 0 0 0.5 0 0 # DiscMort_2P_1_Recreational_Combined_2
-1 1 1 1 -1 99 -4 0 0 0 0 0.5 0 0 # DiscMort_2P_2_Recreational_Combined_2
-1 2 0.05 0.05 -1 99 -2 0 0 0 0 0.5 0 0 # DiscMort_2P_3_Recreational_Combined_2
-1 2 0 0 -1 99 -4 0 0 0 0 0.5 0 0 # DiscMort_2P_4_Recreational_Combined_2
Shrimp fishery selectivity (6)
20 60 35 35 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_1_Shrimp_Bycatch_3
-15 5 -3 -3.4 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_2_Shrimp_Bycatch_3
-15 10 -2 -5 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_3_Shrimp_Bycatch_3
-12 6 5 5 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_4_Shrimp_Bycatch_3
-15 15 -10 -2 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_5_Shrimp_Bycatch_3
-15 15 -10 -2 -1 99 5 0 0 0 0 0.5 0 0 # SizeSel_3P_6_Shrimp_Bycatch_3
MRFSS selectivity bins (2)
1 57 1 1 -1 99 -1 0 0 0 0 0 0 0 # SizeSel_4P_1_MRFSS_4
1 57 57 53 -1 99 -1 0 0 0 0 0 0 0 # SizeSel_4P_2_MRFSS_4
Age selectivity
0 15 0 0 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_Com_Combined_1
0 15 15 15 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_Com_Combined_1
0 15 0 0 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_3P_1_Shrimp_Bycatch_3
0 15 15 15 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_3P_2_Shrimp_Bycatch_3
#_Cond 0 #_custom_sel-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns
1 #_custom_sel-blk_setup (0/1)
Retention time block setup
30 85 40 52.4316 -1 1 -6 # Retain_1P_1_Com_Combined_1_BLK1repl_1927
70 100 83.8 83 -1 1 6 # Retain_1P_1_Com_Combined_1_BLK1repl_1988
0 20 2 10 -1 1 -4 # Retain_1P_2_Com_Combined_1_BLK1repl_1927
0 20 2 5 -1 1 6 # Retain_1P_2_Com_Combined_1_BLK1repl_1988
30 85 40 60 -1 1 -6 # Retain_2P_1_Recreational_Combined_2_BLK1repl_1927
70 100 83.8 83 -1 1 6 # Retain_2P_1_Recreational_Combined_2_BLK1repl_1988
0 20 2 10 -1 99 6 # Retain_2P_2_Recreational_Combined_2_BLK1repl_1927
0 20 2 5 -1 99 6 # Retain_2P_2_Recreational_Combined_2_BLK1repl_1988
#_Cond No selex parm trends
#_Cond -4 # placeholder for selparm_Dev_Phase
1 #_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)
#
Tag loss and Tag reporting parameters go next
0 # TG_custom: 0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters
#
1 #_Variance_adjustments_to_input_values
#_fleet: 1 2 3 4
0 0 0 0 #_add_to_survey_CV
0 0 0 0 #_add_to_discard_stddev
0 0 0 0 #_add_to_bodywt_CV
1 1 1 1 #_mult_by_lencomp_N
1 1 1 1 #_mult_by_agecomp_N
1 1 1 1 #_mult_by_size-at-age_N
#
7 #_maxlambdaphase
1 #_sd_offset
#
0 # number of changes to make to default Lambdas (default value is 1.0)
Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey phase value sizefreq_method
#
lambdas (for info only; columns are phases)

0 #_CPUE/survey:_1
1 #_CPUE/survey:_2
1 #_CPUE/survey:_3
1 #_CPUE/survey:_4
1 #_discard:_1
1 #_discard:_2
1 #_discard:_3
0 #_discard:_4
1 #_lencomp:_1
1 #_lencomp:_2
1 #_lencomp:_3
0 #_lencomp:_4
0 #_agecomp:_1
1 #_agecomp:_2
0 #_agecomp:_3
0 #_agecomp:_4
1 #_init_equ_catch
1 #_recruitments
1 #_parameter-priors
1 #_parameter-dev-vectors
1 #_crashPenLambda
0 # (0/1) read specs for more stddev reporting
 # 0 1 -1 5 1 5 1 -1 5 # placeholder for selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages
 # placeholder for vector of selex bins to be reported
 # placeholder for vector of growth ages to be reported
 # placeholder for vector of NatAges ages to be reported
999

3.10 Appendix C. Starter.SS File

#Starter file for cobia full SS3 model
#Stock Synthesis Version 3.24
cobia_dat.ss
cobia_ctl.ss
0 # 0=use init values in control file; 1=use ss3.par
1 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
4 # write parm values to ParmTrace.sso
2 # report level in CUMREPORT.SSO (0,1,2)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence
0 # Number of bootstrap datafiles to produce
7 # Turn off estimation for parameters entering after this phase
1000 # MCMC burn interval
100 # MCMC thin interval
0.2 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
0.0001 # final convergence criteria
0 # retrospective year relative to end year
1 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator
4 # (1-SPR)_reporting: 0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-SPR_Btarget); 4=notrel
1 # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num); 3=sum(frates)
1 # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt
999

3.11 Appendix D. Forecast.SS File

```
#C generic forecast file
#V3.20b
# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg
number for rel.endyr
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
1 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.3 # Biomass target (e.g. 0.40)
0 0 -5 0 0 0 #_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter
actual year, or values of 0 or -integer to be rel. endyr)
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs);
5=input annual F scalar
10 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
-5 0 -2 0 #_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of
0 or -integer to be rel.endyr)
2 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.01 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.001 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1.0 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1-3) (fixed at 3 for now)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active
impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2014 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
# Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio;
5=deadnum;6=retainnum)
# Conditional input if relative F choice = 2
# Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY1
# 1
# max totalcatch by fleet (-1 to have no max)
-1 -1 -1
# max totalcatch by area (-1 to have no max)
-1
```

fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
0 0 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
12 # Number of forecast catch levels to input (else calc catch from forecast F)
99 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values

#Year	Seas	Fleet	Catch(or_F)
2012	1	1	0.0993
2012	1	2	0.4123
2012	1	3	0.0919
2013	1	3	0.0919
2014	1	3	0.0919
2015	1	3	0.0919
2016	1	3	0.0919
2017	1	3	0.0919
2018	1	3	0.0919
2019	1	3	0.0919
2020	1	3	0.0919
2021	1	3	0.0919

999 # verify end of input