5. Assessment Summary Report

The Summary Report provides a broad but concise view of the salient aspects of the 2012 South Atlantic Spanish mackerel stock assessment (SEDAR 28). It recapitulates: (a) the information available to and prepared by the Data Workshop (DW); (b) the application of those data, development and execution of one or more assessment models, and identification of the base-run model configuration by the Assessment Workshop (AW); and (c) the findings and advice determined during the Review Workshop.

Executive Summary

The South Atlantic Spanish mackerel stock assessment presented by the SEDAR 28 Assessment Workshop (AW) provided the Review Panel (RP) with outputs and results from two assessment models. The primary model was a statistical catch-age model, the Beaufort Assessment Model (BAM); while a secondary, surplus-production model (ASPIC) provided a comparison of model results. The Review Panel concluded that the BAM was the most appropriate model to characterize the stock status for management purposes.

The current stock biomass status in the base run from the BAM was estimated to be $SSB_{2011}/MSST=2.29$. The current level of fishing (exploitation rate) was $F_{2009\text{-}2011}/F_{MSY} = 0.526$, with $F_{2011}/F_{MSY} = 0.521$. Therefore, the Review Panel concluded that the stock is not overfished and is not undergoing overfishing. The qualitative results on terminal stock status were similar across presented sensitivity runs, indicating that the stock status results were robust given the provided data and can be used for management. The outcomes of sensitivity analyses done with BAM were in general agreement with those of the Monte Carlo Bootstrap analysis (an additional way to examine uncertainty) in BAM. In general, stock status results from ASPIC were qualitatively similar to those from BAM.

Stock Status and Determination Criteria

Point estimates from the base model indicated that the U.S. southeast stock of Spanish mackerel (*Scomberomorus maculatus*) is currently not overfished and overfishing is not occurring.

Estimated time series of B/B_{MSY} and SSB/SSB_{MSY} show similar patterns: the stock was at a steady size until the mid 1970s when the stock quickly declined to the lowest biomass in the mid-1980s. The stock size stayed at a low level for about 10 years and has been steadily increasing since 1995 (Figures 5.4 and 5.7). Current stock status was estimated to be $SSB_{2011}/SSB_{MSY} = 1.49$ and $SSB_{2011}/MSST = 2.29$, indicating that the stock is not overfished (Table 5.1).

The estimated time series of F/F_{MSY} showed a generally steady value until the mid 1970s when increased fishing pressure changed the magnitude of the overall fishing mortality. The general trend was decreasing since the early 1990s (Figure 5.7), and the most recent estimate ($F_{current}$ = 0.36) indicated that the stock is not experiencing overfishing (Table 5.1).

Table 5.1 Summary of stock status determination criteria. Estimated status indicators, benchmarks, and related quantities from the Beaufort catch-age model, conditional on estimated current selectivities averaged across fisheries. Rate estimates (F) are in units of y^{-1}; status indicators are dimensionless; and biomass estimates are in units of metric tons or pounds, as indicated. Spawning stock biomass (SSB) and minimum stock size threshold (MSST) are measured by total biomass of mature females.

Criteria	Recommended Values from SEDAR 28	
	Definition	Value
M (Instantaneous natural mortality; per year)	Average of Lorenzen M (if used)	0. 35
Fcurrent (per year)	Geometric mean of full fishing mortality rates for 2009-2011 ($F_{2009-2011}$)	0.36
F_{MSY} (per year)	F_{MSY}	0.69
B_{MSY} (metric tons)	Biomasss at MSY	9548
SSB_{2011} (metric tons)	Spawning stock biomass in 2011	4862
SSB_{MSY} (metric tons)	Spawning stock biomass at MSY	3266
MSST (metric tons)	MSST = [(1-M) or 0.7 whichever is greater]*B_{MSY}	2127
MFMT (per year)	F_{MSY}	0.69
MSY (metric tons)	Yield at F_{MSY}	2750
OY	Yield at F_{OY}	
F_{OY}	F_{OY} = 65%,75%, 85% F_{MSY}	65% F_{MSY} = 0.449 75% F_{MSY}=0.518 85% F_{MSY}=0.587
Biomass Status	SSB_{2011}/MSST	2.29
	SSB_{2011}/SSB_{MSY}	1.49
Exploitation Status	$F_{2009-2011}/F_{MSY}$	0.526
	F_{2011}/F_{MSY}	0.521

Stock Identification and Management Unit

The Atlantic stock and Gulf of Mexico stock were split along SAFMC/GMFMC jurisdictions. Atlantic stock consists of all fish caught south of highway US 1 through the Florida Keys, northward along the east coast of Florida to Maine. Based on electrophoresis studies, spawning locations, stock distribution patterns, and catch history, amendment 2 to the Coastal Pelagics FMP designated two groups of Spanish mackerel. For SEDAR 28 it was agreed that fish landed north of US Highway 1 in Monroe County Florida were Gulf of Mexico stock and fish landed south of US Highway 1 were Atlantic stock. This reflects a change from SEDAR

17 where data were split at the Dade-Monroe County line. This change was recommended as the oceanographic split and most efficient for splitting commercial data, and it was acknowledged there was little biological evidence for either the Council Boundary or Dade-Monroe County line as the stock division.

Assessment Methods

Following the Terms of Reference, two models of Spanish mackerel were discussed during the Assessment Workshop (AW): a statistical catch-age model and a surplus-production model (ASPIC). The statistical catch-age was selected at the AW to be the primary assessment model.

The primary model in this assessment was a statistical catch-age model, implemented with the AD Model Builder software. In essence, a statistical catch-age model simulates a population forward in time while including fishing processes. Quantities to be estimated are systematically varied until characteristics of the simulated populations match available data on the real population. Statistical catch-age models share many attributes with ADAPT-style tuned and untuned VPAs.

A logistic surplus production model, implemented in ASPIC, was used to estimate stock status of Spanish mackerel off the southeastern U.S. While primary assessment of the stock was performed via the age-structured model, the surplus production approach was intended as a complement, and for additional verification that the age-structured approach was providing reasonable results.

Assessment Data

The catch-age model was fit to data from one fishery-independent index, two fishery-dependent indices, estimates of bycatch in the shrimp fishery, and to data from each of the five primary fisheries on southeastern U.S. Spanish mackerel: commercial gill net, commercial pound net, commercial cast net, commercial handlines (including hook & line, trolling, and electric reels), and general recreational (including headboat). These data included annual landings by fishery (in total weight for commercial and in numbers for general recreational and shrimp bycatch), annual discards from the recreational sector, and annual age composition of landings by fishery. Discards from the commercial fisheries were added to landings as they were not a large enough proportion of total catch to model separately. Data on annual discard mortalities were not available, but an overall discard mortality rate for the recreational sector was applied to total discards as per the recommendation of the DW. All shrimp bycatch was assumed dead.

Release Mortality

Starting in 1986 with the implementation of size-limit regulations, time series of discard mortalities (in units of 1000 fish) were available for commercial handline and gill net fisheries. The magnitude of the commercial discards was trivial in comparison to the landings. As a result, the AW decided to include the commercial discards with the landings rather than model the discards separately. Recreational angler survey data indicated non-negligible discards prior to establishment of the size limit. Data from these years were used to calculate a ratio of discards to landings, which was used to extrapolate recreational discards back to year six of the assessment model. As with landings, discard mortalities were modeled via the Baranov catch equation, which required estimates of discard selectivities and release mortality rates.

Selectivities of discards were assumed to be dome-shaped. They were partially estimated, assuming that discards consisted primarily of undersized fish, as implied by observed length compositions of discards. The general approach taken was that age-specific values for ages 0–2 were estimated, age 3 was assumed to have full selection, and selectivity for each age 4+ was set equal to the age-specific probability of being below the size limit, given the estimated normal distribution of size at age. In this way, the descending limb of discard selectivities would change with modification in the size limit. The exception to the above approach was for commercial discards in years 2009–2010, when a commercial quota was in place. For those years, commercial discard selectivity included fish larger than the 10-inch size limit that would have been released during the closed season. The commercial discard selectivity for these years was computed as the combined selectivities of sublegal-sized fish and landed fish from commercial lines and pots, weighted by the geometric mean (2009-2010) of fleet-specific observed discards or landings.

Catch Trends

The commercial gillnet fishery peaked in the late 1970s then generally declined. Commercial cast net landings began in 1995. In the early 2000s cast net landings increased and have recently become one of the dominant gears in the fishery. Commercial pound net and handline landings were relatively low compared to the other gears. Commercial pound net landings increased in the late 1980s with a peak in 1990, followed by a decline through the mid-2000s. Commercial handline landings remained low from 1960 – 2000 with the exception of 1976, and have been increasing since the early 2000s. Commercial discards from the shrimp bycatch fishery increased from 1950 through the early 1980s and then generally declined.

The observed recreational landings began in 1981 and were variable over the entire time series. An increasing trend was seen in the late 1980s with a peak in 1988. The recreational landings remained relatively stable from the late 1990s - 2011. Recreational discards began in 1981 and have generally been increasing over the time series. See Figures 5.1 and 5.2 for detail on landings and discard trends.

Fishing Mortality Trends

The estimated time series of fishing mortality rate (F) showed a peak in the late 1970s followed by about ten years of similarly high rates. The rates dropped substantially in the mid-1990s, likely due to the Florida net ban (Figure 5.3). Since 2000, the model suggests that fishing mortality rates have been between 0.35 and 0.5. Historically, the majority of the full F was dominated by gill net and recreational fisheries, with a shift in the most recent years to include a larger percentage of mortality attributable to the commercial cast net and handline fisheries (Figure 5.3).

Stock Abundance and Biomass Trends

Estimated abundance at age showed truncation of the oldest ages during the late 1970s through the mid 1980s; however, the stock appears to have rebounded to numbers last seen in the mid 1970s. Recruitment in recent years was estimated to be below average overall.

Estimated biomass at age followed a similar pattern of truncation as did abundance. Total biomass and spawning biomass showed nearly identical trends - sharp decline in the 1970s and early 1980's ostensibly due to a high volume of landings in the commercial gill net fishery. The stock was estimated to be at its lowest point in the early-mid 1980s, and since has added substantial biomass (Figure 5.4).

Scientific Uncertainty

Uncertainty in results of the base assessment model was evaluated through sensitivity and retrospective analyses. In Section III, part 3.7 of the assessment report, time series are plotted of F/F_{MSY} and SSB/SSB_{MSY} for variation in natural mortality, the influence of early recreational angling records, different assumptions of the proportion female, and differences in steepness. Retrospective analyses did not show any trends, and in general, results of sensitivity analyses were similar to those in the base model run. In particular, the runs indicated that the stock was not overfished and that the stock is not experiencing overfishing.

The Monte Carlo bootstrap (MCB) results indicated that there is some uncertainty around the estimates of stock status. In general, there appeared to be a small probability of overfishing and/or overfished status under certain combinations of input data. Although all possible combinations of data used by the MCB analysis are not equally likely, the uncertainty is demonstrated in the plots of F/F_{MSY} and SSB/SSB_{MSY}. Conclusions about stock status during the MCB analysis were most sensitive to different combinations of input data and variance around fixed parameters (steepness, recreational discard mortality, historical recreational landings and natural mortality).

Significant Assessment Modifications

The review panel accepted the base run as developed by the assessment panel.

SEDAR 28 differed from SEDAR 17 in a number of ways. The changes to the data included the following: shrimp bycatch was calculated using a simplified method; the method for back-calculating the historical recreational catch was changed; the discard mortality was assumed to be substantially lower; and discards were not modeled separately for all fleets. The assessment model was changed as follows: the steepness was fixed; a separate fishery-specific von Bertalanffy growth curve was used to scale landings, robust multinomial likelihoods were used to model the age composition data, and a Monte Carlo bootstrap method was used to illustrate the uncertainty in the assessment.

Sources of Information

The contents of this summary report were taken from the SEDAR 28 South Atlantic Spanish mackerel data, assessment, and review reports.

Figures

Figure 5.1a: Time series of commercial landings for handline (HL), pound net (PN), gillnet (GN), and cast net. Landings are in units of 1000 lb whole weight. *(Generated from data in Table 2.2 of the Assessment Report.)*

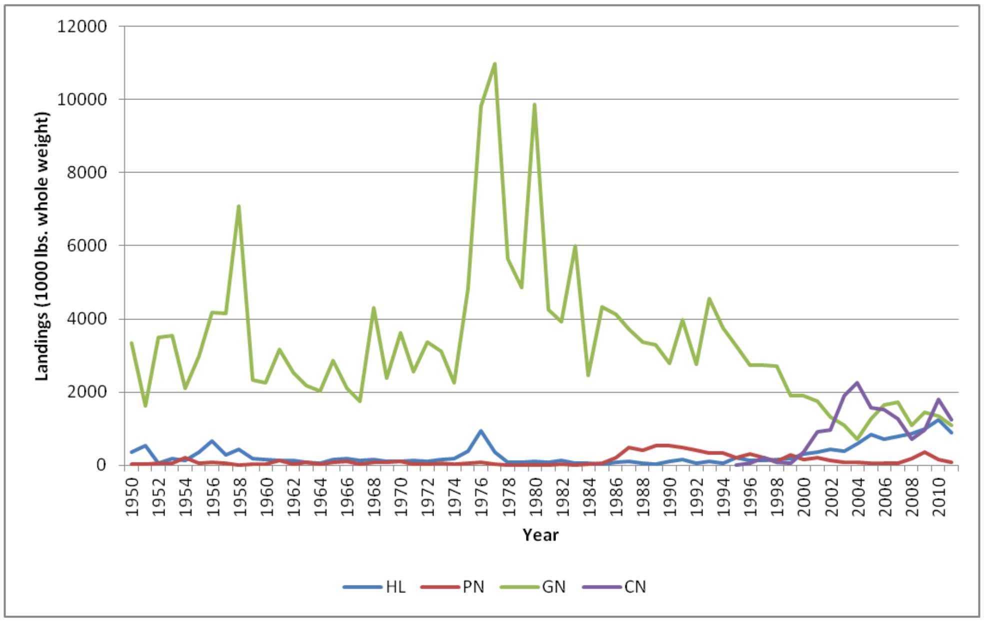

Figure 5.1b: Time series of general recreational landings. Landings are in units of 1000 fish. *(Generated from data in Table 2.2 of the Assessment Report.)*

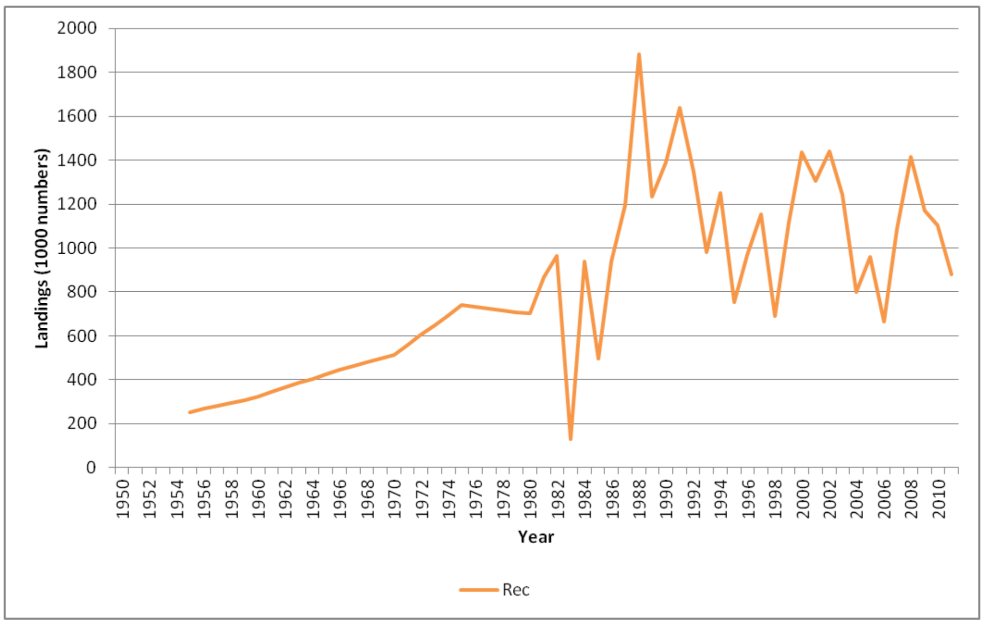

Figure 5.2: Observed time series of discards for the general recreational fleet (Rec) and from bycatch from the shrimp fishery (Shrimp). Discards are in units of 1000 fish. Discards include all released fish, live or dead. *(Generated from data in Table 2.2 of the Assessment Report.)*

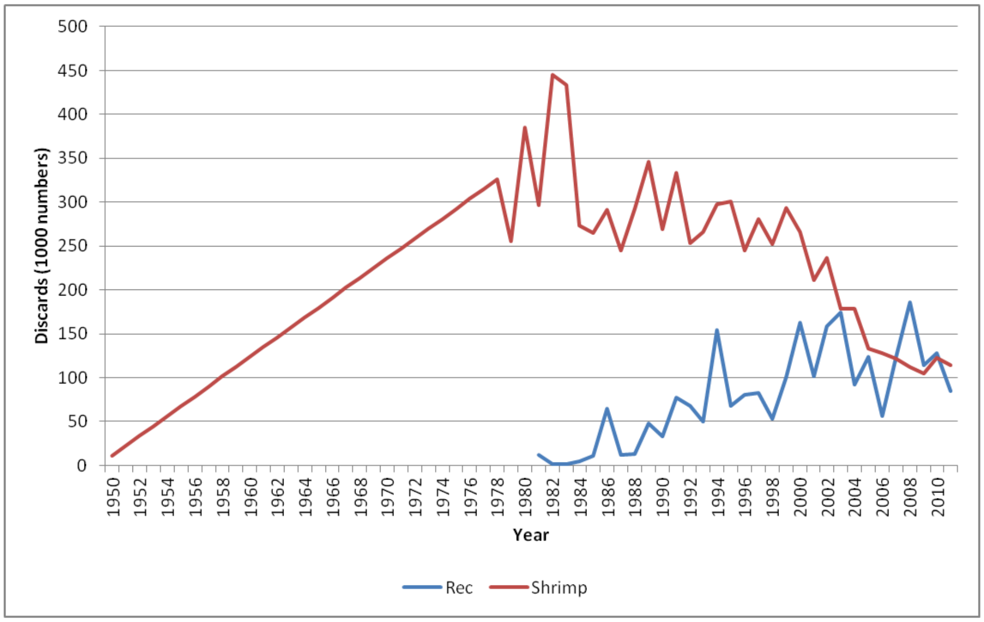

Figure 5.3: Estimated fully selected fishing mortality rate (per year) by fishery. HL refers to commercial handline, PN to commercial pound net, GN to commercial gill net, CN to commercial cast net, Rec for recreational, Rec.D for recreational discards, and shrimp.B for shrimp bycatch. *(Extracted from Figure 3.28 of the Assessment Report.)*

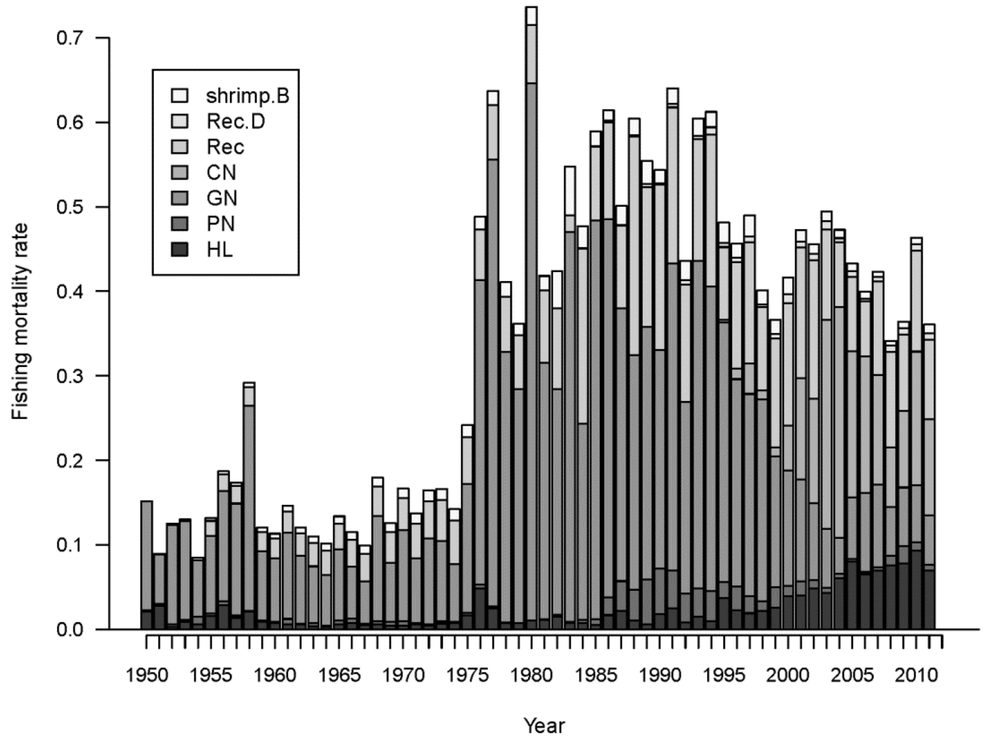

Figure 5.4a: Estimated total biomass (metric tons) at start of year. Horizontal dashed line indicates B_{MSY}. *(Extracted from Figure 3.38 of the Assessment Report.)*

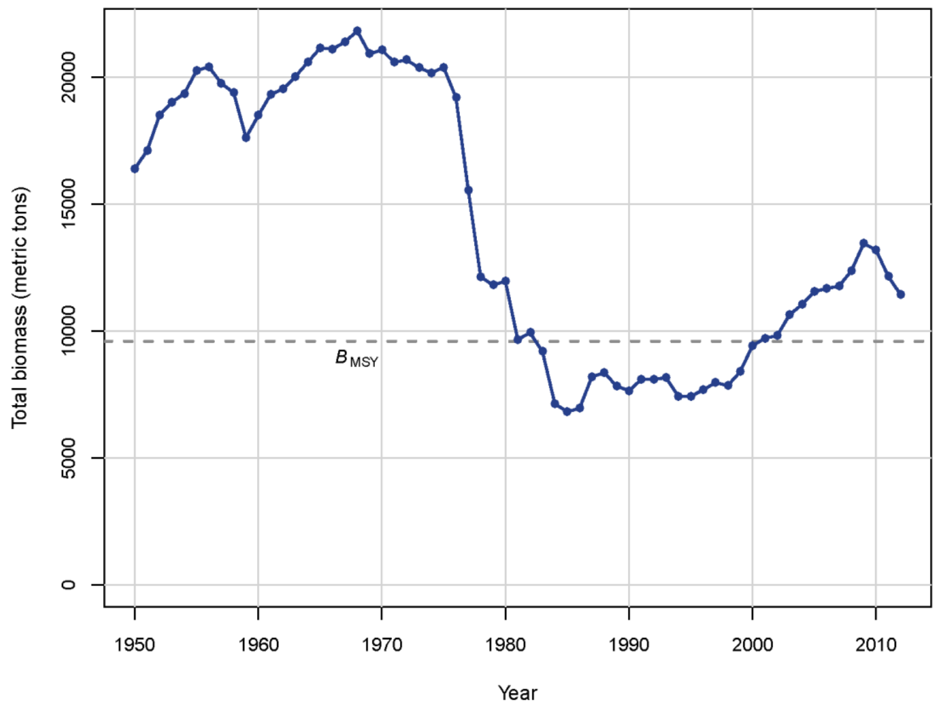

Figure 5.4b: Estimated spawning stock (gonad biomass of mature females) at time of peak spawning. *(Extracted from Figure 3.38 of the Assessment Report.)*

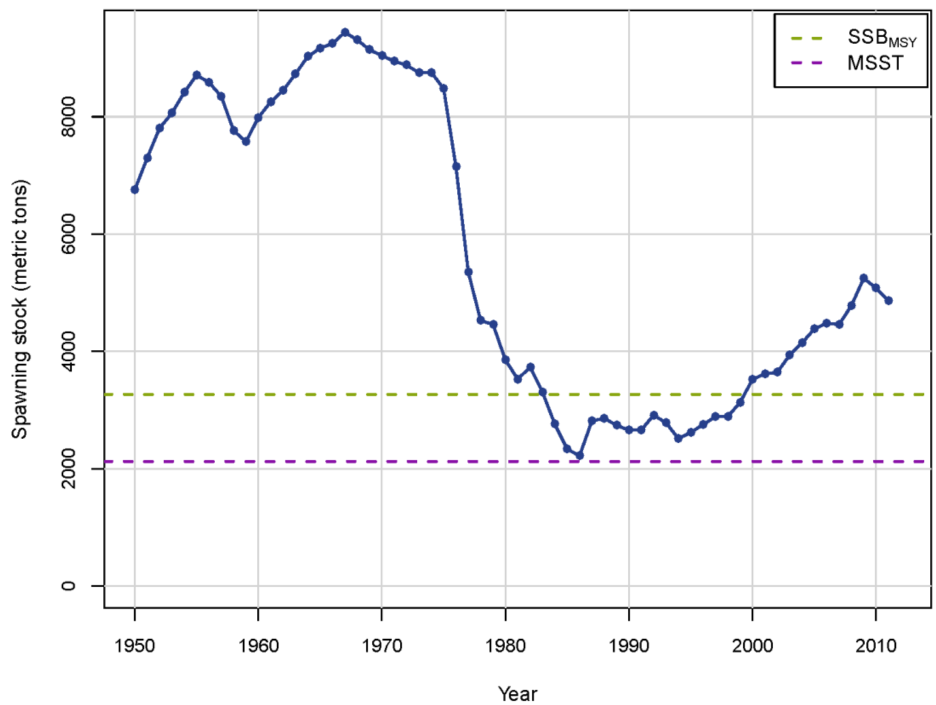

Figure 5.5: Observed indices of abundance from Florida handline trip ticket (FL.HL), MRFSS (MRFSS), and the SEAMAP YOY survey (SEAMAP). *(Generated from data in Table 2.8 of the Assessment Report.)*

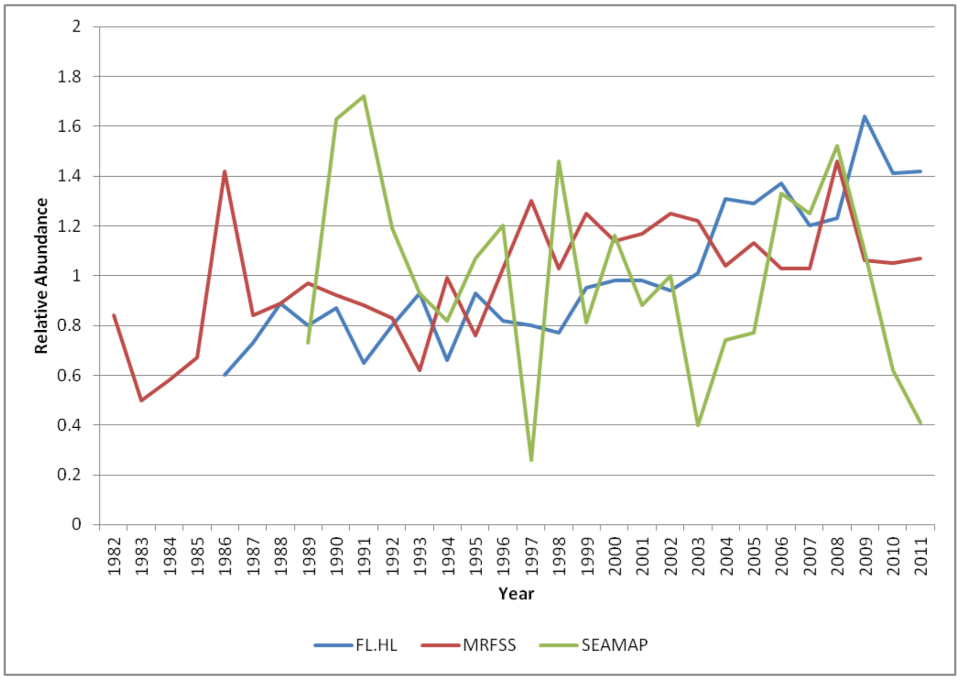

Figure 5.6: Beverton-Holt spawner-recruit curves, with and without lognormal bias correction. The expected (upper) curve was used for computing management benchmarks. Years within panel indicate year of recruitment generated from spawning biomass one year prior. *(Extracted from Figure 3.31 of the Assessment Report.)*

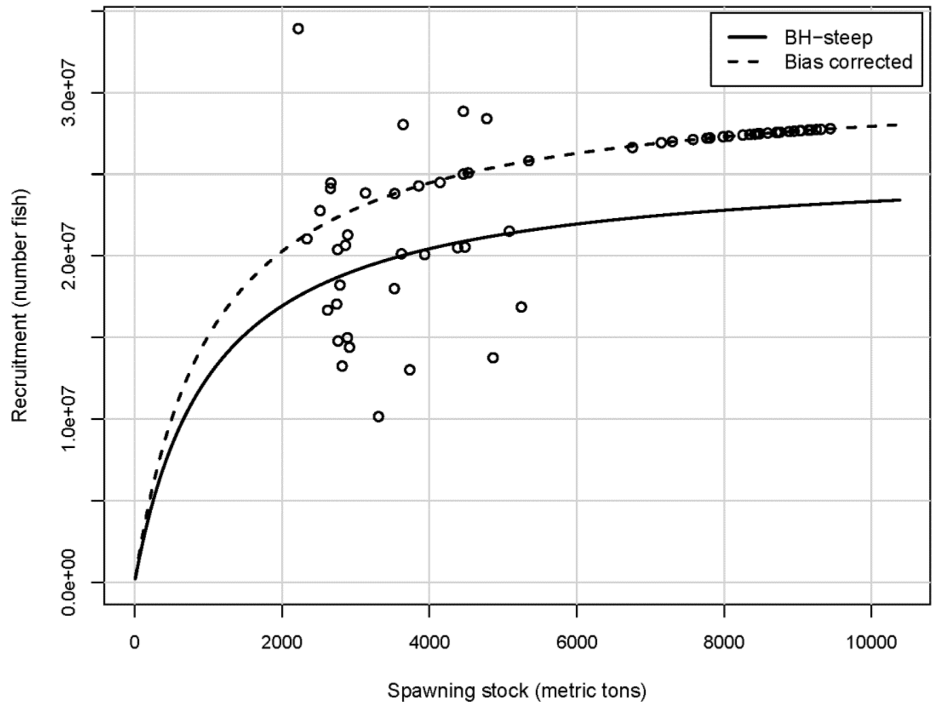

Figure 5.7a: Estimated time series relative to benchmarks. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the MCB trials. Spawning biomass relative to the spawning stock biomass at MSY. *(Extracted from Figure 3.37 of the Assessment Report.)*

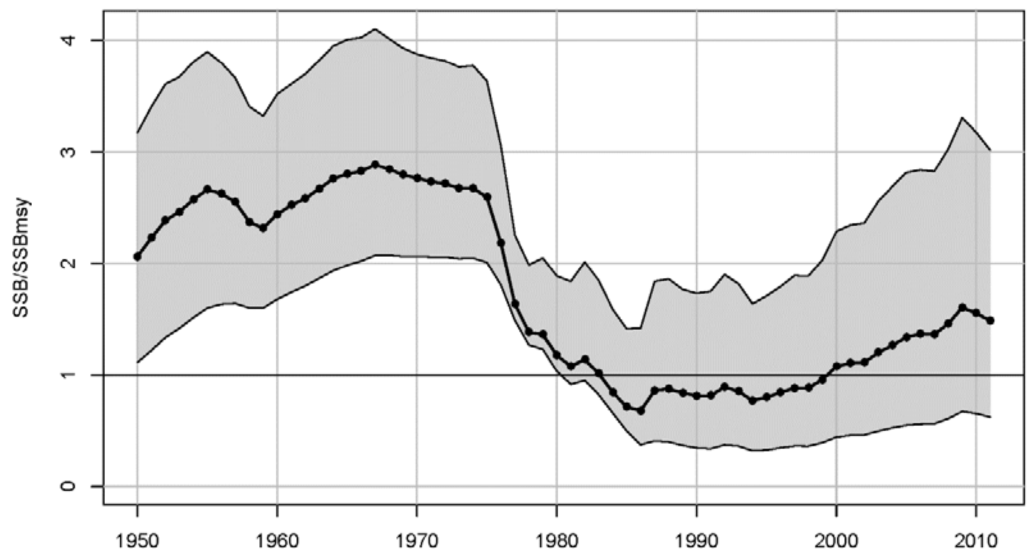

Figure 5.7b: Estimated time series relative to benchmarks. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the MCB trials. F relative to F_{MSY}. *(Extracted from Figure 3.37of the Assessment Report.)*

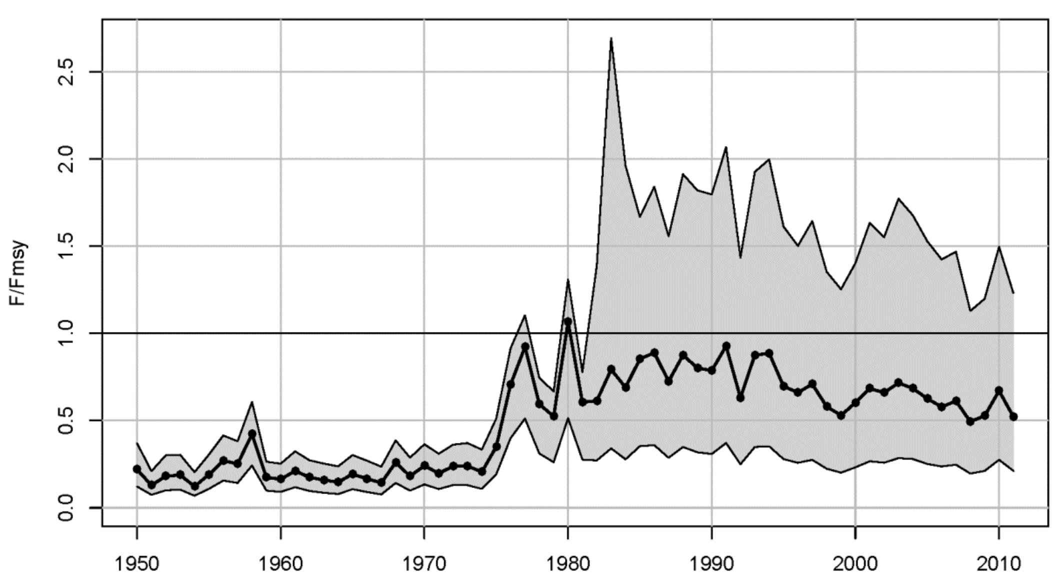

Figure 5.8: Phase plot of terminal status estimates from base and sensitivity runs of the Beaufort Assessment Model. *(Extracted from Figure 3.42 of the Assessment Report.)*