5. Assessment Summary Report

The Summary Report provides a broad but concise view of the salient aspects of the 2012 South Atlantic cobia 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 cobia stock assessment presented by the SEDAR 28 Assessment Workshop (AW) provided the Review Panel (RP) with outputs and results from two assessments models. The primary model was the Beaufort Assessment Model (BAM), while a secondary surplus production model (ASPIC) provided a comparison of model results. The RP 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 was estimated to be SSB_{2011}/MSST=1.75. The current level of fishing (exploitation status) was $F_{2009\text{-}2011}/F_{MSY} = 0.599$, with $F_{2011}/F_{MSY} = 0.423$. Therefore, the RP 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 were in general agreement with those of the Monte Carlo Bootstrap (MCB) analysis (an additional way to examine uncertainty) in BAM. The RP concluded that the ASPIC model results were not informative for stock status determination and fisheries management.

Stock Status and Determination Criteria

Point estimates from the base model indicated that the U.S. southeast stock of cobia (*Rachycentron canadum*) is currently not overfished and overfishing is not occurring.

Estimated time series of stock status (SSB/MSST, SSB/SSB_{MSY}) showed a general decline through the 1980s, an increase in the late 1980s and early 1990s, followed by a decline in more recent years (Figure 5.7). The increase in stock status in the 1990s may have been driven by several strong year classes and perhaps reinforced by the 2-fish per person bag limit implemented in 1990. Base run estimates of spawning biomass have remained above MSST throughout the time series. Current stock status in the base run was estimated to be SSB_{2011}/MSST = 1.75 (Table 5.1), indicating that the stock is not overfished. Uncertainty from the MCB analysis suggested that the estimate of a stock that is not overfished (i.e., SSB > MSST) is relatively robust. Age structure estimated from the base run shows more older fish than the (equilibrium) age structure expected at MSY. However, in the most recent year, ages 1-7 approached the MSY age structure.

The estimated time series of F/F_{MSY} from the base run suggested that overfishing has not been occurring over the course of the assessment period but with considerable uncertainty, particularly since the mid 2000s, as demonstrated by the MCB analysis (Figure 5.7). Current fishery status, with current F represented by the geometric mean from 2009-2011, is estimated by the base run to be $F_{2009\text{-}2011}/F_{MSY}$ = 0.599 (Table 5.1), but with much uncertainty in that estimate.

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 weight of mature females.

Criteria	Recommended Values from SEDAR 28	
	Definition	Value
M (Instantaneous natural mortality; per year)	Average of Lorenzen M (if used)	0.26
Fcurrent (per year)	Geometric mean of apical fishing mortality rates for 2009-2011 ($F_{2009\text{-}2011}$)	0.276
F_{MSY} (per year)	F_{MSY}	0.461
B_{MSY} (metric tons)	Biomasss at MSY	1991.6
SSB_{2011} (metric tons)	Spawning stock biomass in 2011	693
SSB_{MSY} (metric tons)	Spawning stock biomass at MSY	536.8
MSST (metric tons)	MSST = [(1-M) or 0.5 whichever is greater]*B_{MSY}	397.2
MFMT (per year)	F_{MSY}	0.461
MSY (1000 lb)	Yield at F_{MSY}	808
OY	Yield at F_{OY}	
F_{OY}	F_{OY} = 65%,75%, 85% F_{MSY}	65% F_{MSY} = 0.299 75% F_{MSY}=0.345 85% F_{MSY}=0.391
Biomass Status	SSB_{2011}/MSST	1.75
	SSB_{2011}/SSB_{MSY}	1.29
Exploitation Status	$F_{2009\text{-}2011}/F_{MSY}$	0.599
	F_{2011}/F_{MSY}	0.423

Stock Identification and Management Unit

Microsatellite-based analyses demonstrated that tissue samples collected from NC, SC, east coast Florida (near St. Lucie), MS and TX showed disparate allele frequency distributions and subsequent analysis of molecular variance showed population structuring occurring between the states. Results showed that the Gulf of Mexico stock appeared to be genetically homogeneous and that segment of the population continued around the Florida peninsula to St. Lucie Florida, with a genetic break somewhere between St. Lucie Florida and Port Royal Sound in South Carolina. Tag recapture data suggested two stocks of fish that overlap at Brevard County Florida and corroborated the genetic findings.

The South Atlantic and Gulf stocks were separated at the FL/GA line because genetic data suggested that the split is north of the Brevard/Indian River County line and there was no tagging data to dispute this split. The FL/GA line was selected as the stock boundary based on recommendations from the commercial and recreational work groups and comments that for ease of management the FL/GA line would be the preferable stock boundary and did not conflict with the life history information available. However, there was not enough resolution in the genetic or tagging data to suggest that a biological stock boundary exists specifically at the FL/GA line, only that a mixing zone occurs around Brevard County, FL and potentially to the north. The Atlantic stock extended northward to New York.

Assessment Methods

Following the Terms of Reference, two models of cobia 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 the Beaufort assessment model (BAM), which applies a statistical catch-age formulation. The model was 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 population match available data on the real population. Statistical catch-age models share many attributes with ADAPT-style tuned and untuned VPAs.

A logistic age-aggregated surplus production model, implemented in ASPIC, was considered for cobia by the AW panel. The production model failed to converge under a variety of configurations. The primary difficulty was a lack of contrast in the data, so that very little information was available on the production function for cobia. The production model did converge under a very restricted set of conditions, and gave qualitatively similar results to the catch-age model. The AW panel considered the age structured model to be more appropriate for cobia.

Assessment Data

The catch-age model included data from two fishery dependent surveys, and from both recreational and commercial fisheries that caught southeastern U.S. cobia. The model was fitted to data on annual combined recreational landings and discards, annual combined commercial landings and discards, annual length compositions of recreational landings, annual age compositions of recreational landings, a combined length composition of commercial landings (1982-2011), a combined age composition of commercial landings (1986-2011), and two indices of abundance (the South Atlantic Regional Headboat Survey (SRHS) and the South Carolina logbook program). Discards were a small proportion of landings and no information on size or age of discards was available to estimate discard selectivity; therefore, discards were combined with landings. Not all of the above data sources were available for all fleets that caught cobia in all years.

The recreational landings estimates included headboat landings, developed by the headboat survey, and the general recreational landings for private recreational, charterboat, and shore modes of the Marine Recreational Fishing Statistical Survey (MRFSS). MRFSS began in 1981 and is undergoing modifications, including a change of name to Marine Recreational Information Program (MRIP). The sampling and estimation methodology for this assessment is that of MRFSS from 1981-2003 and MRIP from 2004-2011 as recommended by the DW.

Release Mortality

Discards were a small proportion of landings (mean: 0.048 for recreational discards and 0.013 for commercial discards) and no information was available to estimate discard selectivity. Therefore, dead discards were combined with landings as total recreational removals (landings plus discards) and total commercial removals (landings plus discards). The data workshop provided discard mortality rates for vertical lines (0.05) and for gillnets (0.51) that were used to calculate dead discards prior to combining with landings. Data on commercial discards was available from 1993-2011. Commercial discards were hindcast to 1983 using the mean ratio of discards:landings for 1993-1997. Data on recreational discards were available from 1983-2011. Commercial and recreational discards were assumed negligible prior to 1983 (the first year of regulation).

Catch Trends

The cobia fishery was dominated by the recreational fleet. Observed recreational landings began in 1981 and were variable over the entire time series. Recreational landings peaked in 1986 and again in the early to mid 2000s. Recreational dead discards began in 1983 (the first year of regulation) and were variable with an overall increasing trend over the time series.

Commercial landings peaked in the mid 1990s, followed by a small decline. Commercial landings have remained relatively stable since the early 2000s. Commercial dead discards increased throughout the late 1990s and 2000s, peaking in 2008. See Figures 5.1 and 5.2 for detail on landings and discard trends.

Fishing Mortality Trends

The estimated time series of fishing mortality rates (F) from BAM was highly variable, with F for fully selected ages varying greater than four-fold since the 1980s (Figure 5.3). There was a drop in F in the 1990s following the implementation of the 2-fish per person bag limit, but there has been a notable increase since the early 2000s. In recent years (since 2003), estimates of F have averaged about 0.30. The general recreational fleet has been the largest contributor to total F throughout the time series (Figure 5.3).

Stock Abundance and Biomass Trends

Estimated abundance at age since the 1990s showed a slight truncation of the oldest ages compared to the 1980s, but in general there was little obvious change in age structure over time. Total estimated abundance has varied about two-fold since the 1980s with a general decline since 2005. A strong year class was predicted to have occurred in 2005 comparable to those predicted periodically in the late 1980s and throughout the 1990s. However, predicted recruitment in recent years (2007-2009) has been below average.

Estimated biomass at age followed the same general pattern as estimated abundance at age. Total biomass and spawning biomass showed similar trends - generally higher biomass in the 1990s and early 2000s compared to the 1980s and a decline in more recent years (Figure 5.4). The stock was estimated to be at its lowest point in the late 1980s and was estimated to be at a comparable level now.

Scientific Uncertainty

Sensitivity analysis can be useful for evaluating the consequences of assumptions made in the base assessment model, and for interpreting MCB results in terms of expected effects from input parameters. Time series of F/F_{MSY} and SSB/SSB_{MSY} are plotted in Section III, part 3 of the Stock Assessment Report to demonstrate sensitivity to natural mortality, steepness, model component weights, catchability, the South Carolina cobia stocking program, discard mortality, inclusion or exclusion of indices of abundance, and the measure of reproductive potential. Status indicators were most sensitive to natural mortality, model components weights, and steepness. The qualitative results on terminal stock status were similar across most sensitivity runs, and generally indicated that the stock is not overfished ($SSB/SSB_{MSY} > 1$) and overfishing is not occurring ($F/FMSY < 1$) (Figure 5.8). Sensitivity analyses were in general agreement with the results of the MCB analysis.

Retrospective analyses did not suggest any patterns in F, B, SSB, recruits, SSB/SSB_{MSY}, or F/F_{MSY} and seemed to indicate no retrospective error. The departures in the terminal year for the early retrospectives (terminal year: 2004 - 2007) should be interpreted with caution because they were associated with a large change in sample sizes for recreational age compositions beginning in 2007.

Significant Assessment Modifications

The review panel accepted the base run as developed by the assessment panel. Additional sensitivity runs were conducted during the Review Workshop, including evaluation of dome shaped selectivity, time varying selectivity, a change in model start date (1950 vs. 1981), an alternate stock recruitment model (Ricker), and exploration of growth model assumptions.

Sources of Information

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

Figures

Figure 5.1: South Atlantic cobia commercial and recreational landings. Commercial landings are in units of pounds whole weight. Recreational landings are in units of pounds whole weight (1981 – 2011) and numbers of fish (1955 – 2011). *(Generated from data in Table 2.6 and Table 2.10 of the Assessment Report.)*

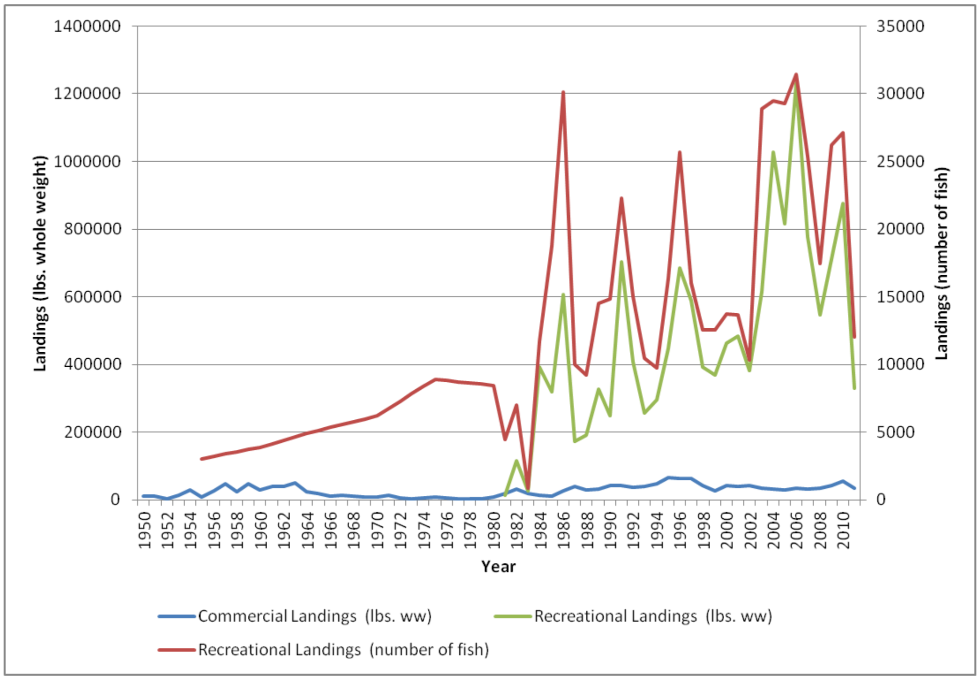

Figure 5.2: South Atlantic cobia commercial and recreational dead discards. Commercial discards are in units of pounds whole weight. Recreational discards are in units of numbers of fish *(Generated from data in Table 2.7 and Table 2.11 of the Assessment Report.)*

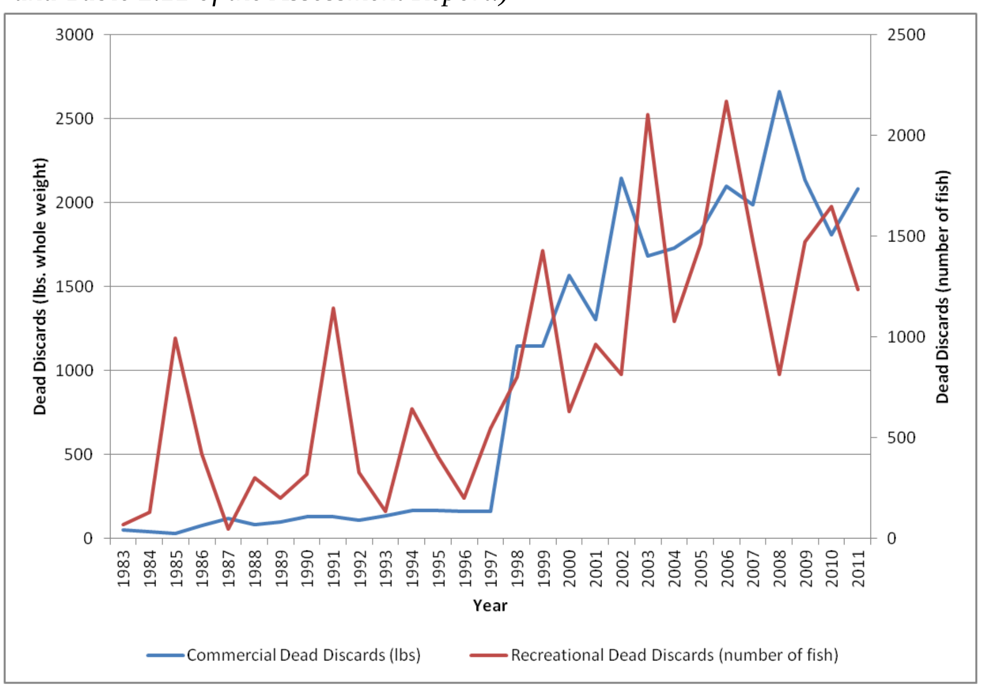

Figure 5.3: Estimated fully selected fishing mortality rate (per year) by fishery. cA refers to commercial, mrip to recreational, both include discards. *(Extracted from Figure 3.17 of the Assessment Report.)*

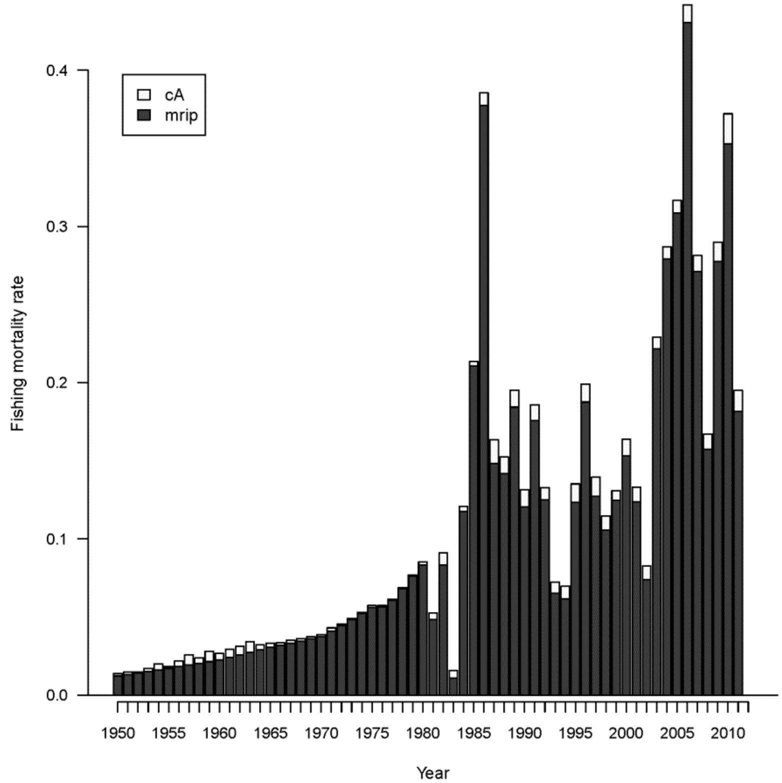

Figure 5.4a: Estimated total biomass (metric tons) at start of year. Horizontal dashed line indicates B_{MSY}. *(Extracted from Figure 3.14 of the Assessment Report.)*

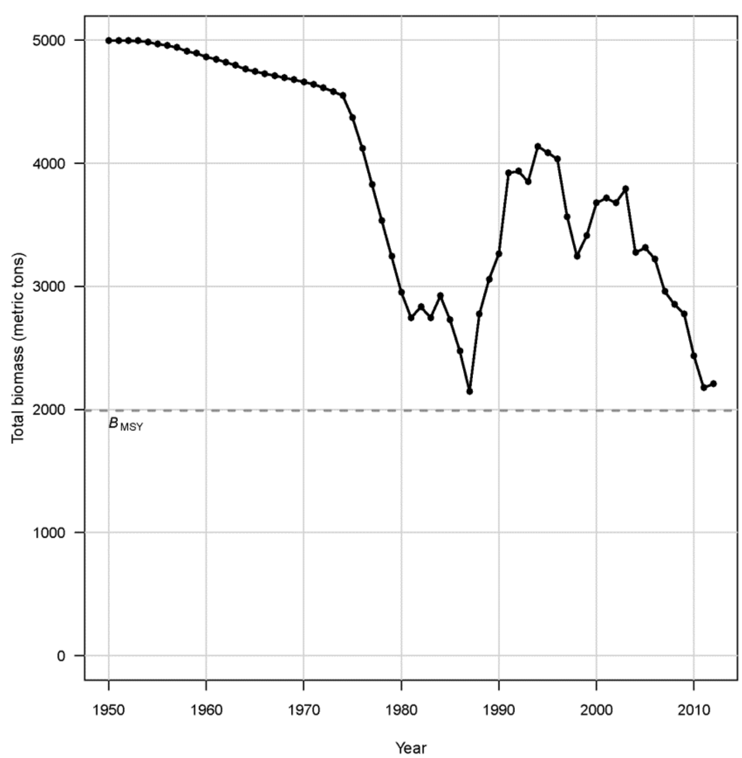

Figure 5.4b: Estimated spawning stock (mature female biomass) at time of peak spawning. *(Extracted from Figure 3.14 of the Assessment Report.)*

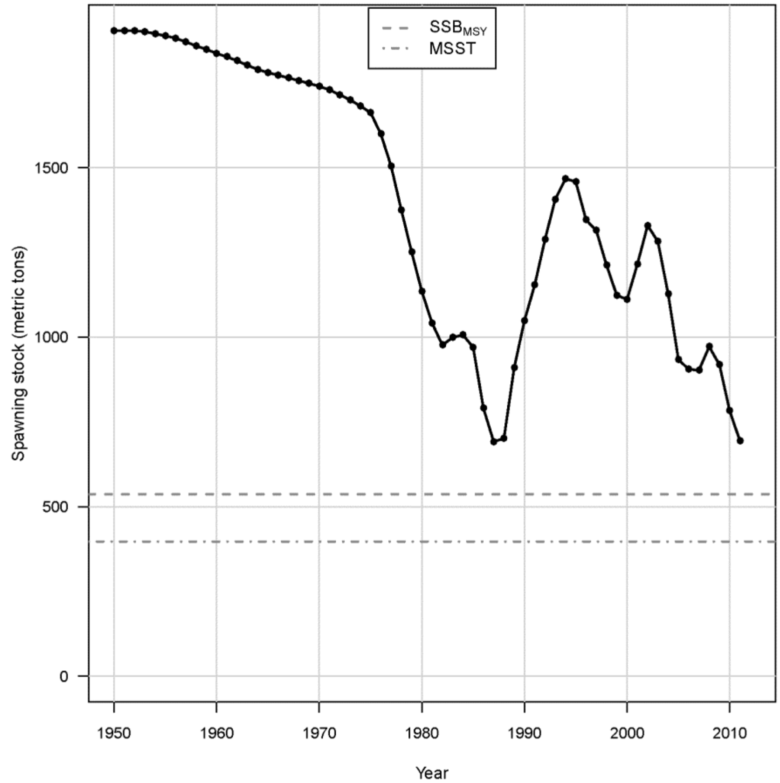

Figure 5.5: South Atlantic cobia indices of abundance from headboat and SC logbook. Each index is scaled to its mean value. *(Generated from data in Table 2.14 of the Assessment Report.)*

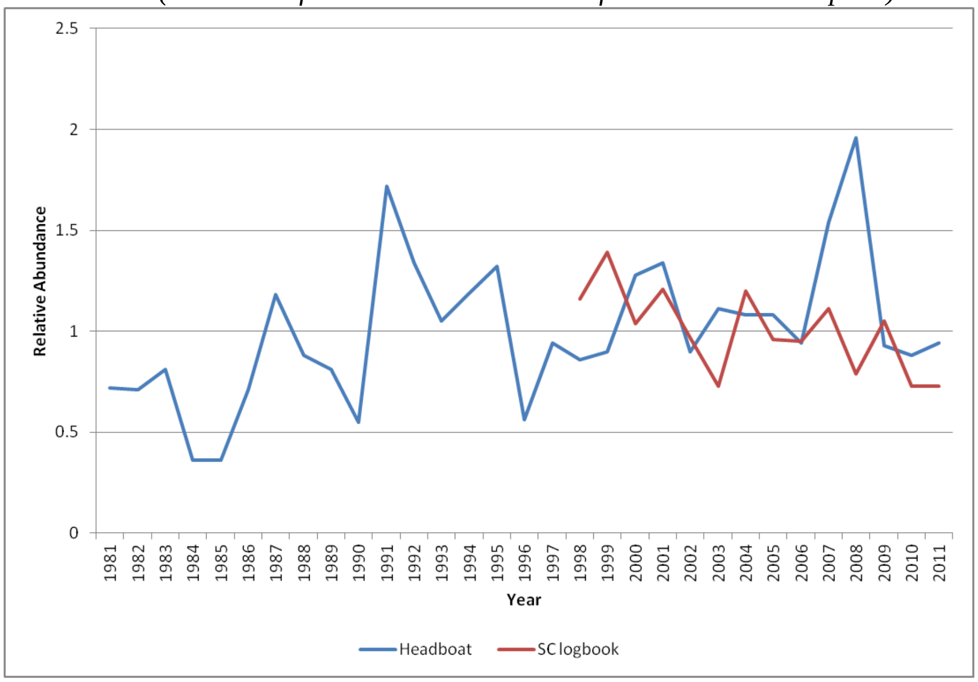

Figure 5.6: Beverton-Holt spawner-recruit curves, with and without lognormal bias correction. The expected (upper) curve was used for computing management benchmarks. Years within panel indicate year of recruitment generated from spawning biomass one year prior. *(Extracted from Figure 3.20 of the Assessment Report.)*

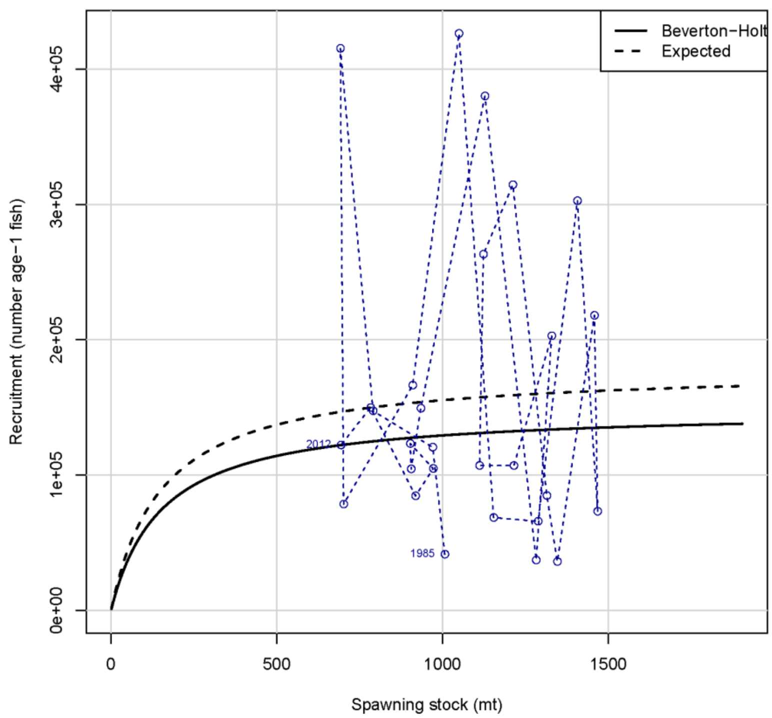

Figure 5.7a: Estimated time series relative to benchmarks. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the MCB trials. Spawning biomass relative to the minimum stock size threshold (MSST). *(Extracted from Figure 3.27 of the Assessment Report.)*

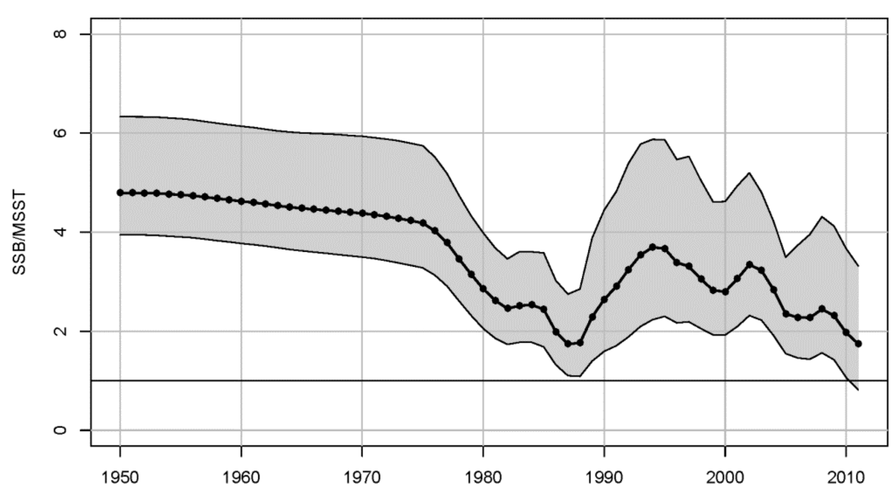

Figure 5.7b: Estimated time series relative to benchmarks. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the MCB trials. Spawning biomass relative to SSB_{MSY}. *(Extracted from Figure 3.27 of the Assessment Report.)*

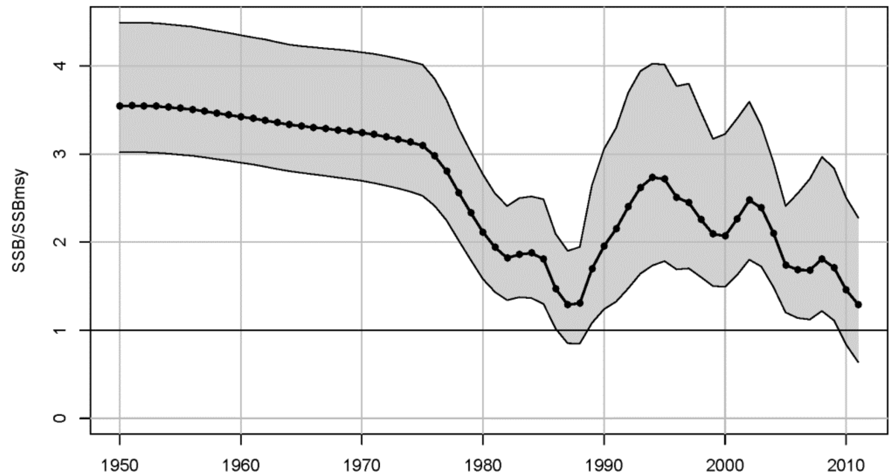

Figure 5.7c: Estimated time series relative to benchmarks. Solid line indicates estimates from base run of the Beaufort Assessment Model; gray error bands indicate 5th and 95th percentiles of the MCB trials. F relative to F_{MSY}. *(Extracted from Figure 3.27 of the Assessment Report.)*

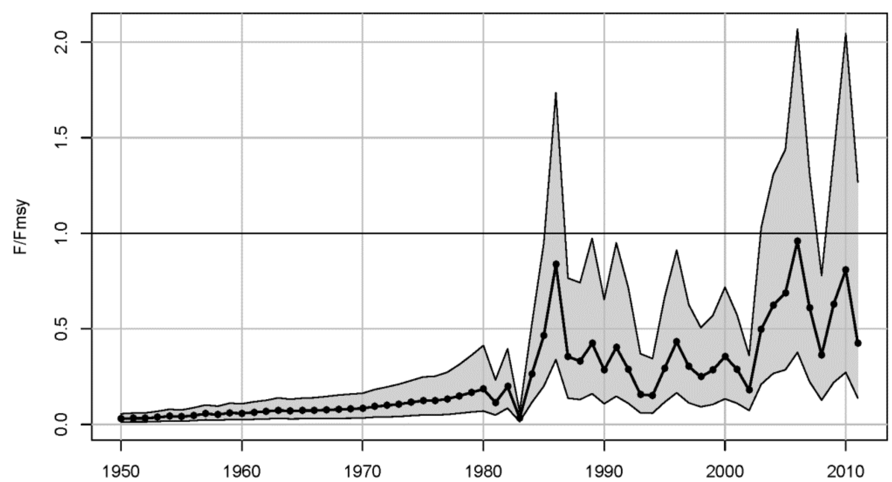

Figure 5.8: Phase plot of terminal status estimates from sensitivity runs of the Beaufort Assessment Model. *(Figure 3.39 of the Assessment Report was updated to include sensitivity runs conducted during the Review Workshop. Gray points (legend in upper left corner) identify the additional sensitivity runs conducted at the Review Workshop.)*