Preliminary Report King Mackerel stock assessment results 2008

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Introduction

1.1 Preface

This is a full assessment of the Atlantic and Gulf of Mexico king mackerel migratory stock units, following the recommendations and TOR provided by the SEDAR5, Mackerel Stock Assessment Panel 2003 (MSAP), and the SEDAR16 steering committee (Ref). This assessment updates new biological data, catch and effort, and other auxiliary data up to the 2006 calendar year. This assessment provides an update of the last Gulf king assessment (SEDAR5) and Atlantic king assessment (MSAP 2003), maintaining continuity in the modeling approach, fixed parameter values, major assumptions, and treatment of the input data. It also explores an alternative approach where both stocks are modeled simultaneously, including a spatio-temporal movement of the stocks such that they co-exist in a 'mixing' area. This approach addresses a major concern regarding the origin of catches from the South Atlantic Florida coast, and its implication for the long term productivity of the stocks.

1.2 Species biology and history

King mackerel (*Scomberomorus cavalla*) typically occur in tropical, subtropical and temperate waters from 20 to 150 feet (Collete and Russo 1984). They are distributed throughout the western Atlantic from New England south to Brazil. They are schooling, fast-swimming predatory fishes that feed voraciously, grow rapidly, mature early, and spawn over an extended period of months. They also show sexually dimorphic growth, with females attaining larger sizes than males. Kings are serial spawners, releasing batches of eggs throughout the spawning season which extends from spring to fall, with peak spawning during the summer months. Off the U.S. Atlantic and Gulf of Mexico coast, king mackerels exhibit migratory patterns. They are normally found in the northern Gulf of Mexico and off the Carolinas coast and north during the summer and fall months; however, when water temperatures drop, they migrate southwards, and both groups mix in the South Florida and the Florida Keys area during the winter months (Finucane et al 1986, Ref). In the U.S. EEZ, king mackerels have been managed under the Coastal Pelagics Fishery Management Plan (FMP) since the 1980's (Ref). Two different migratory stock units have been recognized: one in the U.S. Atlantic Ocean (ATL) and a second in the Gulf of Mexico (GOM). For management purposes, the boundary between stocks was set at the line projecting offshore between the Monroe and Collier counties in Florida during the summer months (Apr – Oct), and between the Flagler and Volusia counties in the Florida east coast during the winter months (Nov-Mar). Therefore, all catch in Florida south of Volusia during the winter is allocated to the GOM migratory group. However, tagging data, otolith analysis including shape and microchemistry, and genetic studies have indicated that in fact there is substantial mixing of stocks during the winter in the south Florida region; therefore, the catch from this area likely represents the combined removals from ATL and GOM king mackerel migratory groups or stocks. This has been a major source of uncertainty in past assessments. Following recommendations from previous review panels and the SEDAR 16 steering committee, a main objective of the present assessment is to explore alternative models that better reflect the dynamics of king mackerels migratory groups.

The U.S. commercial fishery for king mackerel began in the 1880s off Chesapeake Bay, moving southwards since then. There are four major production areas: a) off North Carolina, b) the Florida east coast (Cape Canaveral to Palm Beach), c) the Florida Keys, and d) off Grand Isle, Louisiana. Commercial landings peak during the mid 1970s were close to 5,000 metric tons (t), with higher catches in the Gulf and the South Florida regions. King mackerel is also a popular and highly valued recreational gamefish throughout their range; in fact, recreational landings have surpassed the commercial catch for several years. Kings are primarily caught using hook and line gear, such as handlines and troll lines. But historically, commercial fisheries have utilized gillnets, purse-seines, otter trawls and round-gillnets. In 1989, purse seines and drift gillnets were prohibited for coastal pelagic species. In 1996, a ban on gillnets in Florida state waters greatly reduced the catches of king mackerel by gears other than hook and line type. Unrestricted high fishing exploitation on GOM kings from the mid 1970s through early 1980s quickly reduced the overall GOM stock. After the implementation of the Coastal Pelagics FMP (1982), management regulations (including catch quotas (TACs), minimum size limits, creel-limits, gear restrictions, and trip-limits) have allowed the stock to rebuild. In fact, the last assessment of GOM king migratory unit, indicated that the stock was not overfished, and that fishing exploitation was below the maximum fishing mortality threshold (MFMT) (SEDAR 5).

2 Data sources

As part of the SEDAR process, a data workshop took place on March 2008 (SEDAR16-DW-Report), in preparation for the assessment. Please refer to the SEDAR16-DW report for specific details, conclusions and recommendations regarding available data to be used in the assessment. In this assessment, the available data and general treatment are summarized before input into the different assessment models. It is important, however, to mention that since the FMP established the two migratory groups, the assessment models have treated the GOM king and ATL king units independently. Therefore, all inputs of catch, indices/surveys, and biological data were specified for each stock, and models (mainly VPA) were then run independently for each one. Following the FMP definitions, the catch in South Florida and the FL Keys from November through March has been allocated to the GOM unit, and management advice has been based on those assumptions (SEDAR5, MSAP2003). In addition to the continuity scenarios, this assessment explores an alternative model that treats both stock units GOM and ATL jointly. This required defining a spatio-temporal model structure that allows movement between the mixing area and the respective no-mixing regions for each migratory unit. Therefore, the input data required the preparation for two options: 1) the single-independent stock unit case, and 2) according to the alternative model spatio-temporal specifications.

The alternative assessment model selected was Stock Synthesis (Methot 2007) version 3 (SS3), an updated version of SS2. Stock Synthesis has been widely used and tested for assessment evaluations, particularly in the US west coast NMFS centers (Methot 2007); descriptions of Stock Synthesis algorithms, options, and examples are available at http://nft.nefsc.noaa.gov. For the King mackerel application, SS3 was structured to include the following partitions. Two growth patterns: 1) GOM and 2) ATL; Age and sex specific: 1) females, 2) males and Ages 0 -25; three areas: 1) GOM no mixing (GOM), 2) ATL no mixing (ATL), and 3) Mixing; and four seasons: 1) Jul-Oct, 2) Nov-Dec, 3) Jan-

Mar, 4) Apr-Jun. Following this spatio-temporal structure, input data (such catch, indices/surveys, size distributions, age distributions, and discards) were calculated for each area (GOM, ATL, and MIX) and by season. Furthermore, the model included four main fisheries; commercial hand line, recreational MRFSS, recreational Headboat, and the shrimp bycatch fisheries. Each fishery operates in each area/season, with the exception of the shrimp fishery that does not exist in the MIX area.

2.1 Directed Fisheries Catch

Commercial catch data were compiled from the Accumulated Landed System (ALS) database. Landings from 1980 through 2006 were broken down by State, gear, and month. In the case of Florida catches, more spatial information by county was provided, in order to partition catches between mixing and non-mixing areas (Mix area from Volusia to Monroe counties) (SEDAR16-DW-28). SEDAR16-DW-24 presented the reconstruction of commercial catches before 1980. The estimates were provided as annual values since 1880 (please see document for details and estimation procedures) for each of the areas, GOM, ATL and MIX. Table 1 and Figure 1 summarize the commercial catch (1930-2006) estimated by area and season. Figure 2 shows the proportion of catch by season for each area for 1979-1989. In the ATL and MIX areas, seasonal catches were proportional similar between 1979 and 1989; in the GOM area, more variation was observed. The average proportion by season for this period (1979-1989) was used to partition commercial catches prior to 1979. The SEDAR16 DW commercial catch group concluded that discards of king mackerel from commercial fisheries were very low, and recommended ignoring them for assessment purposes.

Overall, the commercial fisheries operating in the MIX (all months) area accounted for about 60% of the total king mackerel landings per year since 1980 (Fig 1). Figure 1 shows the distribution of catch by seasons and area. In the MIX area, most of the catch is during the Jan-Mar season (50%), but there are catches during the other months; in the ATL area, the catches are predominantly in the summer and fall (Jul-Dec), while in the GOM commercial catches have been mainly in the summer since 1990. Some of this seasonality may also be as a result of quota allocations between regions.

Recreational catch of king mackerels was compiled from three main sources: the MRFSS data surveys, the Headboat survey (HBt), and the Texas Parks and Wildlife Department (TXPWD). MRFSS recreational estimates were available since 1981, and HBt since 1986. SEDAR16-DW-21 describes the inputs and estimates for the recreational data of king mackerel, and SEDAR16-DW-28 shows summaries of recreational catch by area and season. The SEDAR16-DW recreational catch group made several recommendations to the catch series provided in SEDAR16-DW-28 document (please refer to the DW report for further details). Similar to the commercial catch, recreational catches of king mackerel were reconstructed prior to 1981; SEDAR16-DW-03 describes the sources and estimation procedures. Tables 2 and 3, and Figure 3 show the historic recreational catch trends of king mackerel by area and season. Recreational catches were split between MRFSS and Head boat fisheries, but overall MRFSS accounted for more than 95% of the recreational landings. By area, recreational catches are more evenly distributed between mixing and non-mixing areas, although recreational catches are primarily in the summer months in the no-mixing areas, while in the mixing area catches occur year around. The highest catches were in the 1980s and 1970s (SEDAR16 DW Report). An important feature of recreational catches in recent years is the increase in the reported B2 catch (non-observed discards MRFSS) (Fig 4). By 2006, the numbers of B2 in the Gulf were similar to the numbers of the retained catch (AB1) in the GOM, and about 35% of the retained catch in the Atlantic. It is expected that of the B2 releases, a given proportion of fish die (discard mortality).

During the DW, the group concluded that increases in the numbers of B2 may reflect a trend towards catch and release practices, but also an effect of bag limits and/or minimum size restrictions. The DW recommended that discards from recreational fisheries be included in the total removals of king mackerel. The DW recreational group concluded that discards from MRFSS were primarily due to bag limits, thus the size distribution of the discards was likely the same as the retained catch. They recommend a 20% discard mortality to be applied to the B2 MRFSS estimates, and included with the retained catch (AB1). In the case of the Headboat, the DW recreational group concluded that discards in this fishery were mainly due to minimum size restrictions, and recommended that minimum size changes be handled directly by the model for this fishery with a 33% expected discard mortality (SEDAR16-DW Report, SEDAR16-DW-25).

2.1.1 Bycatch of king mackerels

King mackerel is not commonly caught as bycatch in other commercial finfish fisheries (SEDAR16-DW-23). However, juvenile kings have been shown as bycatch in the shrimp fisheries, particularly in the Gulf of Mexico (Nichols et al 1987, MSAP 2000, Ortiz et al 2000). Given the magnitude and distribution of the shrimp fisheries, mortality of king juveniles has been included in past assessments; the DW and review panels recommended including this source of mortality in the present evaluation, not only for the GOM stock but also for the ATL stock. SEDAR16-DW-05 presented preliminary estimates of king mackerels caught by the shrimp fishery in the Gulf and South Atlantic fisheries. Revision of bycatch estimation methods and discussion on which Bycatch reduction devices are currently implemented in the GOM shrimp fleet, prompted updated estimates of king mackerel bycatch for the Gulf of Mexico. SEDAR16-AW-## presents the updated bycatch estimates for the GOM shrimp fleet that supersede the GOM estimates presented in SEDAR16-DW-05. Table 4 shows the estimates of king bycatch by year and season for the ATL and GOM areas. Estimates for the GOM were available from 1972 to 2006, with exception of 1983, while for the ATL estimates were available from 1989 to 2006. During SEDAR5 the panel adopted king bycatch estimates derived from the GLM model (SEDAR5 Final Report, Ortiz 2002). Instead, the SEDAR16 DW and AW adopted the delta-model estimates of bycatch as the best scientific information for the current assessment. Figure 6 shows a comparison of the shrimp bycatch estimates for GOM king between SEDAR5 and the current adopted delta-model estimates (SEDAR16-AW-##).Bycatch in the Gulf and Atlantic is mainly from May through December (Fig 5). Prior assessments panels and limited size frequency information suggest that bycatch is mostly age 0 kings.

2.2 Size Composition Data

SEDAR16-DW-07 presented a revision of the size and size-composition data available for king mackerel. Briefly, over 490 thousand fish were measured since 1980. Most samples were from the MIX area (50%) and from commercial fisheries (48%). Of these size samples, 60% were sexed. Discussions at the DW recommended the removal of size samples collected from tournaments and samples labeled as "bias-sampling." However, they agreed to include the tournament-sampling from North Carolina after a scientist familiar with that program described the sampling methodology. He reported that anglers were collecting size information on all fish encountered, not only trophy-retained fish. Size samples were aggregated for each area (GOM, ATL, and MIX), year, season and fishery (Commercial Hand line, recreational MRFSS, and Headboat). A preliminary analysis of size-frequency samples in SEDAR16-DW-07 excluded observations with a relatively low number of fish measured, highly skewed, and/or highly kurtosed size frequency distributions. After filtering those observations, the input size composition data included 468,826 measured fish from 654 different size-frequency observations. Size data were used in different steps according to the assessment model:

1) For the VPA models, where total Catch at Age (CAA) is required, the size samples were used to convert the catch to Catch-at-Size (CAS). This process matches size samples with specific fisheries, regions, months, and catch; and it has been described in detail in prior documents (Ortiz et al 2003). For this assessment, CAS was updated for 2001-06 years; the 1984 to 2000 CAS was the same as used in prior assessments (SEDAR5, MSAP2003).
2) For the SS3, size frequency samples were input directly as size composition observations. In cases were sex was identified, the size composition was split between males and females. Otherwise, size composition was assigned as combined sex. Because size composition observations vary largely in number of fish measured, for SS3 it was decided that a size composition samples must have 75 or more fish to be included, either by sex or combined sex observation.

Size composition samples were aggregated into 5 cm bin sizes (FL), from 20 cm to 160 cm.

2.3 Age data and age composition

Otoliths of king mackerel have been collected and used for ageing the catch since 1985. The Panama City Laboratory aged the otolith samples and provided the updated size and age database; documents SEDAR16-DW-07 and SEDAR16-DW-12 provided a detailed description of the otolith-aged sample distribution. Briefly, over 45 thousand king otolith samples have been aged mainly by scientists at the Panama City laboratory. However in recent years, expansion of biological sampling through the FIN program and scientific projects have provided additional aged otoliths (approximately 2600) to the database (SEDAR16-DW-02). Otoliths were collected from the GOM area (18K), the MIX area (14K), and the ATL area (12K). Because of concerns regarding the stock origin of samples collected within the MIX area, SEDAR16-DW-07 estimated von Bertalanffy growth parameters using only samples outside the MIX area. Almost all age-samples were also sexed, thus growth models were constructed by sex, also taking also into account sampling truncation due to minimum size restrictions (most otoliths were collected from fishery-dependent samples).

As with size samples, age samples were used with different protocols depending upon the assessment model:

a) For the VPA model(s), age samples were primarily used to construct Age Length Keys (ALK), and to update von Bertalanffy growth models by stock. These were used with the alternative stochastic length deconvolution ageing method (Shepherd 1985) when ALK were not available (1981 to 1983).
b) For the SS3 model, age samples were input as age composition observations for a given strata. Age samples were aggregated by year, season, area (GOM, ATL, and MIX), sex, and fishery (Commercial, MRFSS, and HeadBoat). Age samples were allocated to a given fishery using the source/mode and gear information recorded for each sample.

Discussions during the SEDAR16-DW focused on ageing error, particularly of otoliths read outside the Panama City Lab. The inclusion of ageing error information to those age samples (2000-06), particularly in the SS3 model settings, was recommended. Unfortunately, when aged samples were aggregated into a given strata, it usually included samples from multiple sources, mainly PC Lab. Thus it was not possible to isolate single age composition observations to match with the ageing error matrices provided (SEDAR16-DW-02). Otolith samples have been primarily collected by port samplers from commercial or recreational docks, in some years using a-non random size-base quota. Because of this non-random sampling, age compositions for SS3 were disaggregated among three size classes; from 0-70, 70-110, and 100-160 FL cm. In SS3 model, age composition observations were also restricted to those with 50 or more aged fish per observation/strata. During the DW, additional age samples were also provided (SEDAR16-DW-27) and later added to the age database. The life history working group recommended re-calculating the von Bertalanffy growth parameters including those additional observations; Table 5 shows comparisons of the growth parameters when including or not including these samples. However, due to time constraints, it was not possible to update the ageing of the total catch (CAA), nor the age composition samples included in SS3 as they represent scientific collections, not a fishery-dependent age composition.

2.4 Indices of abundance

For king mackerel relative indices of abundance were constructed from fishery independent/dependent sources, and discussed at length during the SEDAR DW (SEDAR16 DW Report). Because of the complex management history regulations of king mackerel stocks, several questions were raised regarding indices derived from fisheries dependent data. Full description and details are provided in the index section of the SEDAR-16 DW Report, and readers should consult it for detailed discussion, conclusions and recommendations. In past assessment, all except one index was derived from fisheries dependent sources. In 2008, four indices of abundance were presented that were derived from scientific surveys (SEDAR-16 DW 01, 08, 09, 20, and 29,). Of these, the Indices group at the DW recommended that three be used as index input in the assessment models: the larval SEAMAP GOM index, the fall Groundfish survey index (GOM), and the south Atlantic SEAMAP survey index (ATL). The fishery independent indices represent primarily larval sampling or young of the year king surveys.

Fisheries dependent indices of abundance were also available from the major fisheries in each area. From commercial fisheries, indices were constructed from the Trip ticket data of North Carolina (SEDAR-16-DW-11), the Florida Trip Ticket data (SEDAR-16-04), and from the logbook database (SEDAR-16-22). All commercial indices were subject to multiple management regulations, including minimum size, trip limits, and closed seasons. Following recommendations from the DW, some of the indices were re-analyzed to determine the impact or limitations of the index associated with these management regulations; SEDAR16-AW-02 presents the conclusions for those analyses. Indices were also constructed from recreational fisheries, MRFSS and Headboat fisheries (SEDAR16-DW-14, 16). Because minimum size and bag limits may have impacted the information provided by those indices,, similar analyses were also performed on recreational derived indices. In addition, an index was constructed from the shrimp bycatch fishery in the GOM.

For the continuity case, it was requested that indices of abundance be constructed using similar approaches as in the last assessments for either GOM or ATL king stocks. Table 6 summarizes the available indices for the continuity VPA cases. For the SS3 spatial model, however, it was requested that indices be constructed for each specific area (i.e. GOM, ATL, and MIX) and by season in each fishery. Table 7 summarizes the indices available for the SS3 model. The AW panel recommended the following indices of abundance as input for the base case models:

- The larval SEAMAP GOM index, applied as indicator of spawning stock biomass for the GOM stock unit.
- The fall Groundfish survey index (GOM), as indicator of age 0 for the GOM no mix stock unit
- The south Atlantic SEAMAP survey index (ATL), as indicator of age 0 for the ATL no mix stock unit
- The MRFSS index for the ATL no mix, GOM no mix, and the Mix area indices
- The Headboat index for the ATL no mix, GOM no mix, and the Mix area indices
- The Logbook index for the GOM no mix and the Logbook Mix area index associated to commercial fisheries in those areas, and
- The North Carolina Trip Ticket index as indicator for the commercial fisheries in the ATL no mix area.

2.5 Additional Biological Data

At the SEDAR DW the life history (LH) group reviewed and made recommendations regarding the new and updated biological data for king mackerel assessment. New information included: revised estimates of natural mortality, preliminary estimates of fecundity and batch fecundity, updated weight and size relationships, information on stock origin, the composition of fish collected within the MIX area, and sex at size ratios.

2.5.1 Natural mortality estimates for king mackerel

Past assessments of king mackerel have assumed a constant rate of natural mortality for all ages by migratory group: 0.20 for GOM kings and 0.15 for ATL kings. The LH group recommended updating the estimates of M based on the oldest age fish for each group (24 year old for the GOM, and 26 year old for the ATL), and assuming a declining natural mortality rate by age model. The group adopted overall estimates of M based on Hoening's natural mortality formulation of 0.1738 for GOM kings and 0. 1603 for ATL kings. These values were then used in the declining M by age of Lorenzen's model, assuming that age 2 represented the fully selected class for both ATL and GOM migratory groups. Table 8 presents the estimated M at age by migratory group and the expected per recruit survival in each case compared to the prior assumed constant M values of 0.20 and 0.15, respectively (Fig 7).

2.5.2 Preliminary estimates of batch fecundity

SEDAR16-DW-06 presented preliminary estimates of batch fecundity for ATL and GOM king mackerels. Discussions at the DW and AW concluded that estimates of spawning frequency were preliminary, but recommended that new estimates of fecundity (eggs per female) be used combining the samples from the Atlantic and Gulf sources. These new estimates of fecundity were based on hydrated oocytes, a more reliable and commonly accepted measurement of fish fecundity (Fitzhugh et al 2008). Table 8A shows the new estimates of fecundity per stock, in units of hydrated eggs per capita female (i.e. assuming one spawning event per season), likely an underestimate of total egg production since is expected that king females spawn more than once each year (Fitzhugh et al 2008, Finucane et al 1986). No new estimates of maturity at age were available, thus the same vectors from last assessments were used.

2.5.3 Updated weight and size relationship

The LH group recommended updating the weight at size relationship for king mackerel by sex and stock using fish collected outside of the MIX area. For this, the Panama City lab provided all size weight observations available for kings (33 thousand observations). Power functions were fitted to whole weight (kg) and size (Fork Length cm) for samples collected outside the mixing zone by sex and stock unit, and for combined sex groups (including unidentified sex observations). Similar functions were estimated for gutted weight and size observations. A preliminary analysis of the data excluded outliers that were outside of the 99% bivariate nonparametric density contour. There were few fish having both gutted and whole weight on the same animal. Thus, a linear function was estimated that related predicted gutted and predicted whole weight by size. Table 9 shows the estimated parameters, and Figure 8 compares compared the fitted functions with the function used in prior assessments (Johnson et al 1982).

2.5.4 Stock origin and composition

One of the main research topics for king mackerel stock in recent years deals with methods to identify stock origin for fish caught in the mixing area, particularly during the winter time, the main fishery season. Early conventional tagging studies and genetic analysis concluded that within the region between Volusia and Monroe counties during the November to March period, catches of king mackerel were not only GOM stock fish, but also fish from the ATL stock unit (SEDAR16-RD01, RD02, RD03, and RD04). However, the data provided no precise proportions of the stock origin for the fish removed, and likely, this proportion was not constant through the years, either because of biomass changes in each stock, changes in migration rates within a stock unit, or a combination of both. Later, analysis of otolith shape offered the opportunity to get better estimates of the stock origin and composition within the mixing area. After the last assessment, research continued using otoliths as stock markers, with a focus on the microchemistry composition of otoliths as more reliable marker than the shape analysis (SEDAR16-DW-30). At the SEDAR16 DW several documents presented the latest results of the stock composition in the mixing area (SEDAR16-DW-30, SEDAR16-DW-17, and SEDAR16-DW-18). Briefly, results corroborated that both GOM and ATL king migratory fish were present during the winter months in the Mixing area. The microchemistry composition analysis was more reliable in discriminating the origin of stock samples, and proportions were variable between years and sexes (SEDAR16-DW-30). This research reported mixing proportion by year, gender and by areas (the Florida south west, the Florida Keys, and Palm Beach) (Figure 3 SEDAR16-DW-30).

Stock composition proportions were used as input into the SS3 model as a vector of observations for the 2001-02 years. However, SS3 does not handle migration by sex groups, so proportions were estimated for combined sex; also the three subareas specified in SEDAR16-DW-30 were at a much lower spatial resolution than the model SS3 structure, thus it was estimated that a single proportion for each year represented an average of the three subareas. The SEDAR LH group recommended using the stock composition derived from the microchemistry analysis, and using a landings weighting factor for averaging the proportions by the subareas. At present, the averaging of proportions was weighted by the number of samples per subarea. Table 10 presents a summary of the stock composition information that is being inputted into the SS3 model.

2.5.5 Sex at size ratios

The SEDAR5 assessment of the king mackerel GOM migratory group recommended updating the sex ratio information. SEDAR16-DW-28 summarized the available king mackerel sex data; briefly, over 328 thousand fish were sexed, following the procedures of the prior sex-at-size ratio estimation (Restrepo 1996a), proportion of males by size was estimated using a non-parametric general additive model (GAM). The analysis was restricted to fish of sizes FL >= 30 cm, and aggregated into 5 cm bin intervals. The estimated sex ratio at size assumed that fish below 30 cm FL had a 50% proportion between males and females. The sex-at-size ratios were used in the conversion of CAS to CAS by sex to generate also CAA by sex groups only. With SS3 model runs it is assumed that when recruits are incorporated into the population, sex proportions are similar, 50% for males and females.

2.5.6 Weight at age

Previous assessments estimated mean weight at age from the predicted von Bertalanffy growth models, usually at mid-year, and converted to weight units using available weight-size relationships (SEDAR5, MSAP 2003). This estimation can't accommodate changes in mean weight at age associated with size selectivity effects, cohort strength and or environmental conditions. For the VPA models estimates of mean weight at age are required. Therefore, for this evaluation alternative estimates of weight at age were calculated based on the biological information collected for king mackerel. Specifically using the ageing data, where for a given sample precise estimates of size were taken, and absolute age estimates were provided, it was possible to estimate the expected weight at age using the updated weight size relationship by stock and gender. Figure 30 shows the estimated mean weight at age for the GOM and ATL stocks by year from the ageing data for combined sex. Because of the variation of sample size among ages and between years, it was decided to estimate averages for groups of years, when changes in minimum size regulations were introduced. Table 10B presents the estimated mean weight at age for the ATL and GOM units by groups of years. Figure 31 shows a comparison of the overall average mean weight at age (all years) versus the corresponding vectors used in the prior assessments. The trend was similar for the GOM stock, however for the ATL there was a change in the overall weight at age. This difference was due to differences in the predicted mean size at age (from the von Bertalanffy growth model of Collins). Figure 32 shows the estimated size at age, the estimated weight at age, and the predicted mean weight at age derived from the Collins growth model or the updated von Bertalanffy model (2008). Differences in size at age between growth functions were greater for the age classes 4 to 15. These differences in mean weight at age have importance in estimating weight or biomass based reference points from the VPA analyses and projections of future yields.

3 Description of model(s) structure

Two main assessment models were evaluated; a) single independently stock evaluation using VPA model (including the continuity case) for ATL and GOM migratory groups, and b) a combined king mackerel stocks using Stock Synthesis 3 model.

NOTE: As of 27 May, the description of the latest VPA model configurations and results is presented in document *AW-06-VpaModels*. The information in that document supersedes the information in Sections 3.1 and 3.2, below. These two documents will be consolidated at a later date.

3.1 Continuity Case

Prior assessments for both ATL and GOM king migratory groups have used age structure virtual population models (VPA), specifically the software package FADAPT (Restrepo 1996). This program required a full Catch at Age (CAA) input, vectors of natural mortality by age, weight at age, relative indices of abundances, and an index associated specification of selectivity patterns or partial catches by age. Normally, the parameters estimated were the last year's fishing mortality rates by age (Terminal F's), and model settings assumed a constant F ratio of 1.0 for the last age in each year.. CAA was assumed without error, and non-parametric bootstrap of index residuals was implemented to determine uncertainty of model results. For the last assessment of the GOM king migratory group, modeled ages were 0 to 11+ (11 as plus group) and for the fishing years (FY) 1981 through 2002 (SEDAR5 Report). The FY for the GOM stock starts in July 1st and ends in June 30th of the following calendar year. For the ATL king migratory group, modeled ages were 1-11+ and for the fishing years (FY) 1981 – 2002 (MSAP 2003). The FY for the ATL stock starts in April 1st and ends in March 30th of the following calendar year. Model minimization in both cases used Maximum Likelihood estimation (ML) and a lognormal objective function parameterization (Restrepo 1996).

For this assessment, continuity runs used a different VPA software program, VPA2BOX ver. 3.0.5 May 2004 (Porch 2003) that is part of the NOAA Fisheries Toolbox package (NFT). A comparison run between FADAPT and VPA2BOX with the same inputs and model run specifications for ATL and GOM king mackerels were performed to check that both programs provided identical solutions and results. Please refer to SEDAR16-AW-## document for settings and results from the VPA runs.

As presented in section 2, since the last assessment, new and updated information has been accumulated for king mackerel, and the SEDAR16-DW panel recommended that this information be used in the present evaluations. Therefore, the "continuity case" was defined as a run updating only the data of catch and indices since last assessment, and following the same protocols as the final model selected by the SEDAR5 (GOM) and the MSAP 2003 (ATL) review panels. Abiding by this definition, the continuity runs for ATL and GOM migratory groups have the following specifications:

- Catches and indices calculated according to the current migratory stock definition:
    - ATL stock = US Atlantic catches north of Volusia FL during the months of November through March, and north of Monroe FL the remaining months (Apr-Oct) of the year.
    - GOM stock = US Gulf of Mexico catch from Texas to Collier FL during the months of April through October and to Volusia FL during the months of November through March.
- For estimation of the CAA: same growth von Bertalanffy parameters as used in SEDAR5 and MSAP-2003, CAS 2001-2006 updated, same sex-at-size ratios (1985-1998, using 1998 sex ratios for all subsequent years), and Age Length Keys constructed using same protocols as in SEDAR5/MSAP2003, by quarter for each stock.
- Same vector of weight at age as used in SEDAR5/MSAP2003.
- Same methods/procedures to construct indices of abundance as used before.
- Constant natural mortality rate M: 0.20 for GOM king, and 0.15 for ATL king.
- Only retained catch (AB1) for recreational fisheries, no commercial discards.
- Shrimp bycatch estimates for Age 0 GOM stock.
- Assume a fixed ratio for the terminal F_{2006} of ages 0 and 1 (GOM) to $F_{2,2006}$ and for $F1_{,2006}$ (ATL) to $F_{2,2006}$, derived from SVPA runs including last 7 years.
- Catch and indices estimated according to the FY definitions; Jul-Jun (GOM), Apr-Mar (ATL).

3.2 VPA runs

A second set of VPA runs were performed for the ATL and GOM migratory groups where both data and parameters were updated as recommended by the SEDAR16 DW. This run used VPA2BOX program with the following settings and inputs:

- Catches and indices calculated according to the current migratory stock definition (see above).
- For estimation of the CAA: updated growth von Bertalanffy parameters (SEDAR16-DW-06) by sex and stock using observations collected outside of the MIX area. CAS 2001-2006 updated, sex at size ratios updated from 1985 through 2006. ALK constructed by semester and used from 1984 to 2006, SAR only for 1981-84 years.
- Updated vector of weight at age estimated from the age samples, and using the updated weight-at-size relationship by sex and stock from samples of non-mixing areas.
- New estimates of M derived from Hoening's formulation of 0.174 for GOM and 0.160 for ATL, and converted to M by age according to Lorenzen's model using age 2 as fully recruited age-class.
- Updated catch commercial/recreational/shrimp bycatch (GOM)
- Updated recreational MRFSS and Headboat fisheries catch (retained catch (AB1) + dead discards (B2*discard mortality), no commercial discards.
- Estimating all Terminal F's for ages 0-11+ (GOM) and 1-11+ (ATL), with fix ratio for last age class all years of 1, and using ML estimation with lognormal error distribution for indices variance.
- Catch and shrimp bycatch estimated according to the FY definitions; Jul-Jun (GOM), Apr-Mar (ATL).

Estimates of uncertainty were generated from non-parametric bootstraps of the index residual fits.

3.3 Combined king mackerel migratory group runs, SS3 model

For the combined king migratory groups runs, the following settings were implemented in the Stock Synthesis 3 model:

- Two growth patterns: 1 GOM migratory group, and 2 ATL migratory group.
- Two genders: 1 Females, 2 Males.
- Three spatial areas: 1 GOM no mixing, Texas through Collier FL; 2 ATL no mixing, Flagler FL through Maine; and 3 MIX area, Monroe county to Volusia County FL.
- Four seasons: 1 July – October, 2 November – December, 3 January- March, and 4 April-June. Year results of SSE runs are from July 1st through June 30th of the next calendar year. For the last SS3 Year 2006 seasons 3 and 4 (Jan-07/Jun-07), it was assumed that all fisheries have the same catch as the calendar year 2006 Jan through Jun.
- 26 Ages, 0 to 25, with age 25 representing a plus group.

- 5 cm size bins, starting in 20 cm through 160 cm for the size composition, and 0 to 160 cm for the population size structure.

3.3.1 Movement of migratory groups within SS3

In SS3, the movement of fish from one area to another occurs at the end of a user specified season. Movement/migration is by migratory group, for all sexes, but can be for groups of ages. Indirect observations from catch and tagging suggest that some portion of the older fish remain offshore instead of migrating towards winter grounds. Therefore, two different age-groups were assumed: group 1) ages 1-10, and group 2) ages 11 and older. The following matrix shows the schedule and direction of migratory patterns.

Stock group	Season	Area from	Area to	Age ranges	Notes
1 GOM	1	1	3	1-10 / 11+	Southwards end Oct
2 ATL	1	2	3	1-10 / 11+	Southwards end Oct
1 GOM	3	3	1	1-10 / 11+	Northbound end Apr
2 ATL	3	3	2	1-10 / 11+	Northbound end Apr

This matrix implies that the stocks have spawning fidelity (i.e. they return to their original stock unit), and that mixing occurs only in area 3. The movement rates for older fish (11+) were fixed to a value of 0.10, while the movement of group 1 fish was set as an estimable parameter by the model. As recommended by the SEDAR16 AW panel, Age 0 fish do not migrate between areas. Although size information data indicates that small size fish are caught in the MIX area fisheries, size ranges are equivalent to the age 0-1 boundary.

3.3.2 Spawning and recruitment in SS3

Spawning was assumed to occur at the beginning of SS3 Year (July 1st) during season 1 for both ATL and GOM migratory groups. The maturity of the female king mackerels used the same maturity at age vector as in the last assessment(s) (SEDAR5, MSAP 2003). Stock Synthesis was designed to estimate a single stock recruitment relationship between sub-populations. In the case of king mackerels, different migratory groups with separate spawning areas and presumed 100% spawning fidelity (i.e. no GOM fish will spawn in the ATL spawning area and vice versa) were assumed. Therefore, in SS3 it was assumed that there was no relationship between spawning biomass and recruitment. This was set by: a) specifying a steepness of 1, b) estimating only the parameters R0 and virgin recruitment and c) the fraction of recruits allocated to each migratory group (ATL or GOM) was also an estimated parameter, with a wide variance that was allowed to vary between years. Available observations for recruitment estimation in king mackerel began in 1984; therefore, the recruitment deviations were split into two groups of years: a) from 1984-2006, and b) 1983 and years before. The annual recruitment deviations 1984-2006 were allowed to vary by year, and should sum to zero; while for the years without data information (1983 and prior), the mean recruitment might vary with respect to the group 1984-05, but cannot vary within years. Effectively, the recruitment estimates for each migratory group were independent among stocks and by years (1984-2006), or only among stocks (1983 and prior). King mackerels were assumed to have a 50% sex ratio at the time of recruitment.

3.3.3 Fisheries and indices/surveys

The assessment model included four main fisheries: a) commercial hand line, b) recreational Headboat, c) recreational all others (MRFSS), and d) shrimp bycatch. Because of the spatial areas, for the SS3 model the fisheries are required to be split into area-specific fleets. Thus, a total of 11 fleets were modeled within SS3: 1- ATL_ComHL, 2- ATL_MRFSS, 3- ATL_HB, 4- ATL_SHBY, 5- GOM_ComHL, 6 GOM_MRFSS, 7 GOM_HB, 8 GOM_SHBY, 9- MIX_ComHL, 10- MIX_MRFSS, and 11- MIX_HB (Tables 1, 2, 3, and 4). The SEDAR DW recommended no shrimp bycatch in the Mixing area. Catch for each fleet was input by year and season. Catch for commercial fleets was input as landings (metric tons), while catch from recreational and shrimp fisheries was input as numbers (thousand fish). Catch matrix extended from 1930 to 2006 calendar year (1929/3 to 2006/4 SS3 Year schedule). Discard data were available for the recreational Headboat fleets (3, 7, and 11), and estimated as numbers of B2 releases. Discard mortality was input as a fixed parameter with a value of 0.33 for the headboat fisheries.

For each of the 11 fleets, at least one fishery dependent index of abundance was available. Indices were initially estimated by season; however, SS3 cannot modify catchability by season/fleet. Therefore, indices were then allocated to a specific season by fleet using the yearly index estimates instead. Table 7 summarizes the index inputs, estimates of variance (CV), and fleet/season allocation.

There were 3 additional surveys: 2 for the GOM stock and 1 for the ATL stock. The Groundfish Fall survey in the GOM was used as an indicator of age 0; the Fall plankton survey in the GOM was used as an indicator of GOM stock spawning biomass; and the SEAMAP Atlantic survey was used as an indicator of age 0 for the ATL_SHBY fleet.

3.3.4 Size and age composition data

The model included males and females as separate sexes in both the underlying dynamics and in all data sources where this was possible. The accumulator age for the internal dynamics of the population model was set to 25 yrs, above the asymptote for growth. The underlying population model was set to 5 cm size bins from 20-160 cm. Size composition data were aggregated into 5 cm by year-season-fleet. Only size composition observations with 75 or more fish were included. The maximum sample size per observation was set at 450, to adjust for the effective sample size of the overall size composition inputs. Age composition was also restricted to observations with 50 or more fish. However, age composition observations were not adjusted for effective sample size.

3.3.5 Stock composition data for mixing area

The estimates of stock composition based on otolith microchemistry for samples collected in the MIX area during 2001 and 2002 were input as observations of stock composition (SEDAR16-DW-30). They were averaged over sex and subareas (weighted by the number of samples), as movement is not sex specific in SS3, and the sub-areas described in the document were within the MIX area specification of SS3 (Table 10).

3.3.6 Estimated and fixed parameters

Selectivity was assumed to be length-based for commercial and recreational fleets, and age-based for the shrimp bycatch and surveys. No restrictions were imposed on the shape of the selectivity curves. In SS3, a double normal selectivity model was used (option # 24) for all length-based fleets. For the Headboat fleets, selectivity was estimated for the captured fish, with a time-block set such that the fraction of retained fish change with time correlated with the changes of minimum size regulations. The 1st time block was from the year's start to 1990 (30.5 cm), 2nd time through 1992 (51 cm), and 3rd time through 2000 (61 cm). Selectivity for the shrimp bycatch fleets and surveys was set at 1 for Age 0 in the GOM and ATL stocks.

Individual growth was modeled via the von Bertalanffy growth equation. Growth up to age 1 was assumed equal for females and males, growing in a linear fashion. After reaching age 1, growth followed the von Bertalanffy models and was estimated by stock and sex. Natural mortality was assumed to be age-dependent, following the Lorenzen's model decline. Overall M for ATL stock was set at 0.160 and 0.174 for GOM stock, with age 2 as fully selected age reference. During initial runs, natural mortality was allowed to be calculated within the SS3 model. However, when both growth parameters and natural mortality are estimated simultaneously, SS3 results tend to decrease natural mortality rates to compensate for increasing catches. Because there is not really information for the model to estimate natural mortality, it was recommended to input as fixed vector the M(age) base on the Lorenzen model for each stock and gender using the von Bertalanffy growth parameters estimated in SEDAR16-DW-12. Table 10A shows the estimated M(age) for each stock sex for ages 1-25, for age 0 the value was set at the natural mortality rate estimated for age 0 at season 1 from SS3 runs when M was initially estimated.

Table 11 shows the estimated parameters, initial guesses, and parameter bounds of initial runs. Emphasis factors (lambdas) for each likelihood component were adjusted accordingly to the preliminary variance estimates; for indices and surveys a variance adjustment of 0.2 was added, while the size and age composition observations were multiplied by 0.2 for all fleets.

4 Results Stock Synthesis 3

Before starting the report of the combined king mackerel assessment runs, it is important to contrast the differences between the continuity runs, single stock/runs and the combined stock runs (SS3). Table 12 summarizes the settings and inputs used in each case.

The main differences between single vs. combined runs can be summarized as:

Setting	Single stock run (VPA)	Combined stock (SS3)
Time frame	All start in 1981 FY to 2006 FY No seasons	Historic 1930 or 1980 SS3 Yr to 2006 SS3 Yr 4 Seasons
Spatial frame	No area specified No movement/migration	3 Areas: 2 no mix, 1 mixing Yes Migration 2 episodes per year/stock
Catch series	FULL CAA all fleets Recreational catch Updated DW Shrimp bycatch GOM/ATL Dead discards MRFSS/Headboat	11 fleets + dead discards Recreational catch Updated DW all Shrimp bycatch GOM/ATL Dead discards MRFFS/ Headboat

Indices of abundance	Yearly associated with PCAA Age selectivity	Yearly estimates assign to a season Size selectivity for 9 fleets
"Tunning"	Only to indices	Indices, size composition, age composition, stock composition
Catch in Mixing zone	Fully allocated to one stock (100% or 50%)	Variable between stocks and years tuned to stock composition observations by model, size and age composition etc.

4.1.1 SS3 selected base run results

Table 13 shows the dimensions and associated codes for any of the SS3 runs of king mackerel. The initial runs in SS3 (run 4-6) estimated the growth parameters, using as initial guesses the SEDAR16-DW-12 von Bertalanffy estimates. The model estimated values were similar to the initial values, in all likelihood because the von Bertalanffy growth parameters of SEDAR16-DW-12 already accounted for the truncation of ageing samples due to minimum size (selectivity of retention), thus in SS3 model this was not an issue (Fig 9). Therefore it was decided to fix the growth parameters at the initial estimates starting with run 7 (Table 13).

Parameter	Estimated	Initial guess
Lmin-Fem_GP_1_GOM	55.92	60.40
Lmax-Fem_GP_1_GOM	139.41	132.83
VBK-Fem_GP_1_GOM	0.14	0.17
Lmin-Fem_GP_2_ATL	50.48	58.00
Lmax-Fem_GP_2_ATL	122.41	121.61
VBK-Fem_GP_2_ATL	0.22	0.23
Lmin-Male_GP_1_GOM	53.09	58.00
Lmax-Male_GP_1_GOM	98.45	100.02
VBK-Male_GP_1_GOM	0.23	0.24
Lmin-Male_GP_2_ATL	47.17	54.70
Lmax-Male_GP_2_ATL	97.59	98.36
VBK-Male_GP_2_ATL	0.32	0.32

Run 7 was presented during the AW meeting as a "preliminary base" run, as judged by the fitting diagnostics, comparison of standard deviations of input and predicted levels by the model, and the overall pattern of residuals as evaluated to date. After review and discussion the AW panel recommended several changes in the inputs and conditions for the base run including:

1. Eliminating the censoring of size-composition observations below minimum size regulations for the commercial and MRFSS fisheries in all areas,
2. Specifying what indices of abundance be used as base case scenario:
   - 2.1. The larval SEAMAP GOM index, applied as indicator of Spawning Stock biomass for the GOM.
   - 2.2. The fall Groundfish survey index (GOM), as indicator of age 0 for the GOM no mix stock unit
   - 2.3. The south Atlantic SEAMAP survey index (ATL), as indicator of age 0 for the ATL no mix stock unit

   2.4. The MRFSS index for the ATL no mix, GOM no mix, and the Mix area indices
   2.5. The Headboat index for the ATL no mix, GOM no mix, and the Mix area indices
   2.6. The Logbook index for the GOM no mix and the Logbook Mix area index associated to commercial fisheries in those areas, and
   2.7. The North Carolina Trip Ticket index as indicator for the commercial fisheries in the ATL no mix area.
3. Revision and updated of shrimp bycatch estimates particularly for the GOM fishery.
4. Update of the fecundity vector based on the hydrate oocyte data.
5. No migration of age 0 fish from the spawning grounds.

Run 24 included all the AW recommendations and modifications requested and it is presented here as the updated base run. Table 14 shows the likelihood and partition of likelihood fit between the components. For this run the age and size composition observations were multiplied by a factor of 0.2 to adjust the effective size of these observations. Also, for the discard observations of headboat fleets, an additional variance of 0.2 CV was added, as well for some of the fisheries dependent indices so that estimated residual mean square error by SS3 for each index was similar to the input variances (Fig 11).

Overall, stock synthesis estimated dome shape selectivity patterns for the fleets in the mixing zone, and more flattened or wide dome shaped patterns for fleets in the non-mixing areas. Fig 10 shows the estimated selectivity curves grouped by the type of fishery. Figures 12, 13 and 14 present the fit to the indices of abundance grouped by area. In general, index trends were followed; indices with larger uncertainty had poorer fit (for example the MRFSS index in the ATL area).

The fits to the size and age composition by fleet and year/season were plotted and evaluated; in general, no trends or residual patterns were encountered. However, some inconsistencies were found upon comparing the size and age composition information provided for the model. For example, for the headboat fishery (fleets 3, 7 and 11), size composition indicated catches of small fish while the age composition information for the same years did not indicate catch of corresponding young age classes. It was also noted that the proportion of "undersized" fish (i.e. fish below the minimum size) became higher as minimum size regulations increased in all fisheries (Fig. 14), although discussions during the DW indicated otherwise. In particular, the Headboat fleets are likely to retain larger fractions of undersize mackerels since the introduction of the 24" MSL. Further evaluation of the size composition data for the Headboat fisheries indicated that the fishery did retain larger fish in the 1980s compared to more recent times (Fig 15), although it is possible that size sampling could be disproportionate to the size composition of the landings during some periods. In fact, only in the mixing zone has the mean size of kings caught by the headboat recreational fisheries increased during the 2000s (Fig 16). Following the recommendations from the AW all size-composition data was included for all fisheries. Because of the large number of plots for size and age composition to evaluate, alternative plots were created that summarize the residual patterns by aggregating the data by fleet. Figure 17 presents a boxplot of the residuals (observed minus expected frequency) for the fit to the age-composition by fleet from the SS3 base model. The box plots show the 50% and 95% percentiles of the residuals for each age class and fleet. The expected pattern is a symmetrical distribution of the residuals centered on the zero line. The histograms to the right show the distribution of the residuals. In this type of plot, information by year/season and gender are aggregated. However, this type of plot is beneficial because it provides condensed information regarding possible residual patterns. For example, in the case of the headboat fleets (fisheries 7 and 11), it appears there are some residual patterns for the ages 1 through 5. Similar plots were created for the length composition (Appendix 1).

The estimated fishing mortality rates by year (SS3 year) and fleet are shown in Figure 18. The shrimp bycatch fisheries, particularly in the GOM had the highest F values. Among the directed fisheries, the recreational fishery MRFSS showed larger F values in the no-mixing areas, while in the MIX area, the commercial and recreational fisheries exploited the stocks more evenly, at least since the 1990s. In all, the headboat fishery had the least fishing impact on the stocks. Figure 19 shows the estimated average fishing mortality by age group for each of the stock units (GOM and ATL). These rates correspond to the overall annual fishing mortality experienced by each age group in all areas.

Figure 20 presents the trends of annual (SS3 year) total biomass, stock size and recruits from the base run 24 for each stock unit/growth pattern. The GOM stock shows a decreasing trend from 1981 to 1990; followed by a slow increasing trend until 2000, thereafter the biomass started to increase at a faster rate. In contrast, the ATL stock shows a decreasing trend from 1981 to the 1990s and a slow increase since then. Recruitment trends were similar for both the stocks from 1980 until 1989; then recruitment increased for the GOM stock, while the ATL remained stable until 2000, then dropped with some recovering in the most recent years. Spawning stock biomass also showed a decrease for both stocks from the 1980s to the 1990s, followed by a recovery which was faster for the GOM stock than the ATL one.

Figure 21 shows the observed and predicted discards of the headboat fleets by season and area. Of note, the catches from the headboat fisheries were less than 5% of the total recreational catch; also most of the catch/discards (by numbers) of the headboat occurred in the MIX area. The stock size by group of ages is shown in Figure 22. In the GOM stock unit, the proportion of ages 1-3 has increased recently. Figure 23 shows the annual trend of catch (in numbers of fish) by the commercial and recreational fisheries in each area from the GOM and ATL stocks (left column plots). To the right are the plots of the estimated proportion of the catch caught in the mixing area that was of GOM stock origin. The trend indicated that about 50% of the catch in the mixing area was of GOM stock origin during the 1980's. Since 1990, that percent has increased, reaching 70% by 2006. The stock composition in the mixing area predicted by the SS3 model is shown in Figure 24. The predicted trends follow the trend of the observed data, albeit with limited sample size. Finally, Figure 25 shows an estimate of the migration fraction for each stock unit. This was calculated as the fraction of the stock (in numbers) that is present in the mixing area at the beginning of Nov (season 2 - immediately after the southbound migration has occurred), and the proportions that returned to the non-mixing areas at the beginning of Apr (season 4- north-bound migration). Only age 0 did not migrate (as specified in the model. Ages 1 to 11+ moved, for the GOM about 60% of each age group migrated south, and 50% to 80% returned for the next season.

The results of the Base run 24 show generally good fits to the indices, stock size composition, and age composition. Some residual patterns were observed, particularly for the headboat fisheries and size composition of these fleets. One source of discrepancy is that the size information suggests that in the mix area there are catches of small kings, fish of sizes corresponding to age 0. Because no migration of age 0 is allowed, then the residual patterns are consistent for the headboat fleet in the mixing zone (fleet 11). An alternative model formulation was explored in which a small fraction of recruits are allowed to be allocated to the mixing zone (instead of moving a reduced fraction of the age 0 class, which is not possible in SS3). Run 25 is this alternative formulation, with allocation of recruits in the mixing area. The results and plots of Run 25 are summarized in appendix 2; they follow the same formats as the run 24 results presented here. Allocating some recruitment in the mixing zone reduces the residual pattern, but it did not eliminate it completely.

4.1.2 Comparison of SS3 and VPA model results

Results from the SS3 model base run 24 indicated that between 50% and 70% of catch in the mixing area are from the GOM stock. A VPA run was done allocating 50% of the catch in the mixing area during the Nov-Mar season to the GOM stock, and 50% to the ATL stock. We selected the results from these two models to compare the trends and magnitudes for different indicators. For details regarding the settings and assumptions of the VPA run please see the VPA results (SEDAR16-AW-06).

Figure 26 shows the annual trends in stock size (ages 1+), spawning biomass and recruits for the ATL and GOM stock units. Stock size is comparable in magnitude between the VPA50% and SS3 models, however the trends differ particularly in the 2000-2004 period, and the early years (1981-1989). For the Atlantic the trend is similar, but the magnitude differs, with higher stock size being estimated by the VPA model. The trends of SSB are different for the ATL stock in particular, with higher estimates by the VPA model, two times those estimated by the SS3 model. The SSB trend also differs for the GOM stock, the VPA indicated a rapid increase in SSB during the 1985-2000 period, while the SS3 trend indicted a more subtle increase, only faster after 2000. The recruitment trends are more similar in magnitude and trend for the ATL: the GOM the trends diverge after 1996 (Fig 27). The scatter plots of the stock-recruitment series indicated that the VPA estimated a more productive stock per unit of spawner for the ATL and GOM kings. This is most noticeable for the ATL stock (Fig 28). Estimated annual fishing mortality rates by age groups are shown in Figure 29. SS3 estimated lower F rates for all ages for the GOM stock. For the ATL stock, VPA estimated higher F rates for Ages 11+, compared to the SS3 estimates.

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Table 1. Compiled and estimated commercial fisheries catch (landings tones) of king mackerel by area, season and year. Split by season for historical (1930-1978) catch used the seasonal averages of years 1979-1989.

Catch MT	GLFnoMix					MixZone					ATLnoMix				
Cal Year	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total
1930	203.34	63.45	197.92	173.04	637.75	510.71	226.18	150.36	147.85	1,035.10	0.79	2.50	5.73	4.14	13.15
1931	108.32	33.80	105.44	92.18	339.74	597.77	264.74	175.99	173.05	1,211.55	0.49	1.55	3.56	2.57	8.16
1932	86.05	26.85	83.76	73.23	269.89	605.60	268.21	178.30	175.32	1,227.42	0.35	1.12	2.57	1.86	5.90
1933	99.79	31.14	97.13	84.92	312.98	522.12	231.24	153.72	151.15	1,058.23	0.62	1.98	4.54	3.28	10.43
1934	102.25	31.90	99.52	87.01	320.69	442.45	195.95	130.26	128.09	896.75	0.87	2.76	6.32	4.57	14.51
1935	137.25	42.83	133.59	116.79	430.46	496.83	220.04	146.27	143.83	1,006.97	1.14	3.62	8.30	6.00	19.05
1936	145.35	45.35	141.47	123.69	455.86	658.41	291.60	193.85	190.61	1,334.47	1.38	4.39	10.08	7.28	23.13
1937	199.00	62.09	193.70	169.34	624.14	443.79	196.55	130.66	128.48	899.47	1.65	5.25	12.05	8.71	27.67
1938	125.39	39.12	122.05	106.70	393.26	627.31	277.82	184.69	181.61	1,271.42	3.80	12.07	27.70	20.02	63.59
1939	227.48	70.98	221.42	193.58	713.46	546.52	242.04	160.90	158.22	1,107.67	-	-	-	-	-
1940	285.46	89.07	277.85	242.92	895.30	337.04	149.27	99.23	97.57	683.11	0.95	3.01	6.92	5.00	15.88
1941	246.30	76.85	239.73	209.59	772.47	477.81	211.61	140.67	138.33	968.42	-	-	-	-	-
1942	236.17	73.69	229.88	200.97	740.72	514.06	227.67	151.35	148.82	1,041.90	-	-	-	-	-
1943	225.90	70.49	219.88	192.24	708.51	550.10	243.62	161.96	159.25	1,114.93	-	-	-	-	-
1944	215.78	67.33	210.03	183.62	676.76	586.35	259.68	172.63	169.75	1,188.41	0.22	0.69	1.58	1.14	3.63
1945	164.58	51.35	160.20	140.05	516.19	622.38	275.64	183.24	180.18	1,261.44	0.43	1.38	3.16	2.28	7.26
1946	156.77	48.92	152.60	133.41	491.69	568.22	251.65	167.29	164.50	1,151.67	0.62	1.98	4.54	3.28	10.43
1947	148.96	46.48	144.99	126.76	467.20	513.84	227.57	151.28	148.76	1,041.45	0.84	2.67	6.13	4.43	14.06
1948	141.15	44.04	137.39	120.12	442.71	459.68	203.58	135.34	133.08	931.68	1.06	3.36	7.71	5.57	17.69
1949	205.64	64.17	200.16	174.99	644.96	405.30	179.50	119.32	117.33	821.46	0.93	2.96	6.80	4.91	15.60
1950	61.05	19.05	59.42	51.95	191.46	259.72	115.02	76.46	75.19	526.39	1.60	5.07	11.64	8.41	26.72
1951	166.48	51.95	162.04	141.67	522.13	442.43	195.94	130.26	128.08	896.71	0.46	1.47	3.38	2.44	7.76
1952	117.75	36.74	114.62	100.20	369.31	342.05	151.49	100.70	99.02	693.27	0.32	1.01	2.31	1.67	5.31
1953	185.38	57.84	180.44	157.75	581.41	291.83	129.25	85.92	84.49	591.48	0.28	0.90	2.07	1.50	4.76
1954	156.63	48.87	152.45	133.28	491.24	206.12	91.29	60.68	59.67	417.76	0.02	0.06	0.14	0.10	0.32
1955	171.81	53.61	167.24	146.21	538.87	311.30	137.87	91.65	90.12	630.95	0.35	1.12	2.57	1.86	5.90
1956	174.13	54.33	169.49	148.18	546.13	543.18	240.56	159.92	157.25	1,100.91	0.20	0.63	1.44	1.04	3.31
1957	128.86	40.21	125.43	109.66	404.15	549.87	243.53	161.89	159.19	1,114.48	1.25	3.99	9.15	6.61	21.00
1958	203.34	63.45	197.92	173.04	637.75	402.84	178.41	118.60	116.62	816.47	1.63	5.19	11.91	8.61	27.35
1959	179.19	55.91	174.42	152.48	562.00	491.46	217.66	144.69	142.28	996.09	0.98	3.10	7.11	5.14	16.33
1960	258.16	80.55	251.28	219.68	809.66	404.52	179.15	119.09	117.11	819.87	1.36	4.31	9.88	7.14	22.68
1961	243.45	75.96	236.96	207.16	763.53	464.63	205.77	136.79	134.51	941.70	1.75	5.55	12.74	9.21	29.26
1962	251.68	78.53	244.97	214.17	789.36	563.09	249.38	165.78	163.02	1,141.27	1.54	4.88	11.19	8.09	25.69
1963	140.03	43.69	136.30	119.16	439.19	942.38	417.36	277.45	272.82	1,910.01	1.85	5.89	13.52	9.77	31.03
1964	44.13	13.77	42.95	37.55	138.41	706.19	312.75	207.91	204.44	1,431.29	2.59	8.24	18.90	13.66	43.39
1965	89.48	27.92	87.09	76.14	280.64	894.11	395.98	263.24	258.85	1,812.17	4.07	12.94	29.68	21.45	68.15
1966	252.66	78.84	245.93	215.00	792.42	636.11	281.72	187.28	184.15	1,289.25	2.72	8.64	19.83	14.33	45.53
1967	188.66	58.87	183.63	160.54	591.70	1,120.90	496.42	330.01	324.50	2,271.83	0.70	2.22	5.09	3.68	11.69
1968	257.52	80.35	250.65	219.14	807.66	1,041.35	461.19	306.59	301.47	2,110.59	0.31	0.99	2.26	1.63	5.19
1969	164.70	51.39	160.31	140.15	516.55	1,184.21	524.46	348.65	342.83	2,400.15	0.53	1.69	3.87	2.80	8.88
1970	171.44	53.49	166.87	145.89	537.68	1,295.98	573.96	381.55	375.19	2,626.67	0.42	1.33	3.06	2.21	7.02
1971	219.09	68.36	213.25	186.43	687.13	971.27	430.15	285.95	281.18	1,968.55	0.84	2.67	6.12	4.42	14.05
1972	168.32	52.52	163.84	143.24	527.92	870.18	385.38	256.19	251.92	1,763.68	0.54	1.72	3.94	2.85	9.04
1973	115.83	36.14	112.74	98.57	363.28	1,187.68	526.00	349.67	343.83	2,407.17	2.56	8.13	18.65	13.48	42.81
1974	336.98	105.15	328.00	286.76	1,056.88	1,895.24	839.36	557.98	548.67	3,841.25	1.87	5.93	13.60	9.83	31.22
1975	204.14	63.70	198.70	173.71	640.24	1,147.53	508.21	337.85	332.21	2,325.80	3.85	12.22	28.05	20.27	64.38
1976	144.75	45.17	140.90	123.18	454.00	1,532.27	678.60	451.12	443.59	3,105.58	6.72	21.36	49.02	35.42	112.52
1977	45.71	14.26	44.49	38.90	143.36	2,026.95	897.69	596.76	586.80	4,108.21	10.30	32.72	75.09	54.27	172.38
1978	32.28	10.07	31.42	27.47	101.23	1,138.59	504.26	335.22	329.62	2,307.69	7.12	22.61	51.88	37.49	119.10
1979	4.49	29.33	48.83	12.15	94.80	1,296.02	392.99	268.75	301.51	2,259.27	1.69	37.12	108.39	91.56	238.76
1980	245.72	78.36	50.27	9.84	384.19	1,255.91	379.81	434.10	381.70	2,451.52	3.66	58.90	220.12	200.22	482.89
1981	5.74	36.37	16.15	1.26	59.52	2,204.94	344.76	317.93	781.24	3,648.87	13.36	67.20	231.56	113.58	425.70
1982	44.39	2.86	11.90	106.38	165.53	1,715.27	659.94	449.49	190.52	3,015.22	9.20	144.83	294.03	228.97	677.03
1983	431.63	50.18	168.45	53.43	703.70	1,313.87	427.83	158.31	137.84	2,037.84	9.18	83.83	212.67	190.51	496.19
1984	29.17	20.95	78.99	242.39	371.50	938.18	164.29	284.08	225.05	1,611.60	33.91	121.09	163.88	125.77	444.64
1985	81.92	50.53	78.73	258.94	470.11	774.72	426.45	196.14	148.76	1,546.07	24.24	120.23	144.07	203.03	491.57
1986	66.34	40.50	55.35	38.70	200.89	1,017.18	349.90	299.82	129.13	1,796.02	41.96	123.12	331.14	125.08	621.30
1987	134.94	7.28	126.90	5.54	274.67	302.97	500.97	310.36	248.96	1,363.26	57.81	115.42	340.26	214.06	727.55
1988	1.49	8.66	121.60	97.80	229.55	2.36	714.65	219.29	398.81	1,335.10	85.05	81.40	211.89	123.92	502.26
1989	1.32	1.71	262.07	64.63	329.73	16.14	438.12	252.46	193.97	900.69	51.18	99.00	156.46	128.22	434.86
1990	2.91	2.14	296.20	20.30	321.55	360.47	361.82	149.06	370.70	1,242.05	121.34	151.77	186.11	181.13	640.36
1991	1.32	1.79	291.74	39.44	334.29	133.46	282.90	180.03	282.85	879.23	184.18	111.30	218.14	188.40	702.02
1992	19.56	2.32	544.59	31.55	598.01	324.32	227.90	153.13	326.95	1,032.29	160.67	138.18	183.63	154.64	637.11
1993	14.23	1.48	440.46	42.79	498.97	713.87	315.01	153.27	423.06	1,605.20	152.64	122.43	104.88	123.16	503.10
1994	0.72	12.63	463.84	132.25	609.44	255.50	323.98	158.30	118.75	856.53	96.53	91.36	123.40	136.69	447.98
1995	4.39	6.55	365.72	44.93	421.60	590.23	300.19	85.56	175.24	1,151.22	154.37	62.94	130.67	179.01	526.99
1996	48.25	10.74	405.71	48.13	512.84	554.87	399.83	178.60	242.29	1,375.58	89.90	72.58	122.85	146.99	432.31
1997	27.78	2.06	505.14	69.33	604.31	573.14	418.55	195.80	279.88	1,467.37	304.81	88.28	171.35	203.01	767.46
1998	108.73	5.30	466.21	80.68	660.91	583.30	326.12	209.67	258.01	1,377.09	140.78	73.28	110.82	260.23	585.11
1999	107.54	4.24	564.76	68.70	745.23	849.33	393.66	132.32	93.58	1,468.89	176.32	46.37	75.29	240.14	538.13
2000	79.42	1.08	541.67	32.09	654.27	538.49	306.97	167.46	136.41	1,149.33	126.51	69.97	156.99	179.09	532.56
2001	51.36	4.65	413.70	120.45	590.16	630.56	284.39	175.63	148.05	1,238.63	74.60	78.88	107.70	158.94	420.11
2002	38.05	5.12	495.75	37.24	576.15	604.82	263.76	140.40	141.16	1,150.14	111.91	26.87	101.72	145.96	386.46
2003	38.36	7.97	533.06	18.50	597.89	743.69	253.32	239.94	168.57	1,405.53	112.87	37.62	56.66	163.72	370.87
2004	78.51	4.18	510.62	28.55	621.86	640.57	498.90	239.08	49.90	1,428.44	33.75	53.64	95.41	277.03	459.82
2005	56.03	12.22	377.94	74.72	520.91	807.62	318.55	149.11	115.30	1,390.57	115.03	58.53	101.64	321.35	596.55
2006	42.47	41.47	513.92	47.87	645.73	719.27	514.04	273.81	117.76	1,624.88	79.13	49.88	133.84	303.33	566.18
2007	149.72	14.63	44.83		209.18	622.87	384.53	169.53		1,176.92	47.11	71.77	94.50	243.09	456.46

Table 2. Compiled and estimated Headboat recreational fisheries catch (numbers of fish) of king mackerel by area, season and year.

Catch_Numb				HeadBoat											
	ATLnoMix					GLFnoMix					MixZone				
Year	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total
1930	1	98	194	15	309	18	38	121	3	179	12,354	9,678	15,512	7,722	45,266
1931	2	101	201	16	319	42	108	305	17	472	12,766	10,001	16,029	7,980	46,775
1932	2	104	207	16	329	66	179	488	32	766	13,177	10,324	16,546	8,237	48,284
1933	2	107	214	17	340	91	250	672	47	1,059	13,589	10,646	17,063	8,495	49,793
1934	2	111	220	17	350	115	320	855	62	1,353	14,001	10,969	17,580	8,752	51,302
1935	2	114	227	18	360	140	391	1,039	77	1,646	14,413	11,291	18,097	9,009	52,811
1936	2	117	233	18	370	164	462	1,222	92	1,940	14,825	11,614	18,614	9,267	54,320
1937	2	120	240	19	381	189	532	1,406	107	2,233	15,236	11,937	19,131	9,524	55,829
1938	2	124	246	19	391	213	603	1,589	122	2,527	15,648	12,259	19,648	9,782	57,337
1939	2	127	252	20	401	80	335	682	113	1,210	16,060	12,582	20,165	10,039	58,846
1940	0	13	26	2	41	26	74	196	15	311	1,647	1,290	2,068	1,030	6,036
1941	0	13	27	2	42	29	82	214	17	341	1,688	1,323	2,120	1,055	6,186
1942	0	14	27	2	43	31	89	232	18	370	1,730	1,355	2,172	1,081	6,337
1943	0	14	28	2	44	34	96	251	20	399	1,771	1,387	2,223	1,107	6,488
1944	0	14	28	2	45	36	103	269	21	429	1,812	1,419	2,275	1,133	6,639
1945	0	15	29	2	46	291	652	2,033	60	3,035	1,853	1,452	2,327	1,158	6,790
1946	2	150	298	24	473	409	1,169	3,057	241	4,875	18,942	14,840	23,785	11,841	69,408
1947	2	153	304	24	484	433	1,239	3,240	256	5,169	19,354	15,163	24,302	12,098	70,917
1948	2	156	311	25	494	458	1,310	3,424	271	5,462	19,766	15,485	24,819	12,356	72,426
1949	2	159	317	25	504	482	1,381	3,607	286	5,756	20,178	15,808	25,336	12,613	73,935
1950	2	163	324	26	514	506	1,451	3,791	300	6,049	20,590	16,131	25,853	12,871	75,444
1951	2	166	330	26	525	531	1,522	3,974	315	6,343	21,001	16,453	26,370	13,128	76,953
1952	3	169	337	27	535	555	1,593	4,158	330	6,636	21,413	16,776	26,887	13,386	78,462
1953	3	173	343	27	545	580	1,663	4,341	345	6,930	21,825	17,098	27,404	13,643	79,971
1954	3	176	350	28	556	604	1,734	4,525	360	7,223	22,237	17,421	27,921	13,900	81,479
1955	3	179	356	28	566	629	1,805	4,708	375	7,517	22,649	17,744	28,438	14,158	82,988
1956	3	179	356	28	566	646	1,843	4,829	378	7,696	22,649	17,744	28,438	14,158	82,988
1957	3	179	356	28	566	664	1,880	4,950	380	7,874	22,649	17,744	28,438	14,158	82,988
1958	3	179	356	28	566	681	1,918	5,072	383	8,053	22,649	17,744	28,438	14,158	82,988
1959	3	179	356	28	566	699	1,955	5,193	385	8,232	22,649	17,744	28,438	14,158	82,988
1960	3	179	356	28	566	716	1,993	5,314	388	8,411	22,649	17,744	28,438	14,158	82,988
1961	3	232	478	27	739	737	2,055	5,480	400	8,672	22,461	17,679	28,273	14,039	82,452
1962	2	286	599	25	913	758	2,116	5,647	412	8,933	22,273	17,615	28,109	13,919	81,916
1963	2	339	721	24	1,086	779	2,177	5,813	424	9,194	22,086	17,550	27,944	13,800	81,380
1964	2	392	843	23	1,260	800	2,239	5,980	436	9,455	21,898	17,485	27,779	13,681	80,844
1965	2	446	964	21	1,434	821	2,300	6,146	448	9,716	21,710	17,421	27,614	13,562	80,308
1966	2	499	1,086	20	1,607	842	2,362	6,313	460	9,977	21,523	17,356	27,450	13,443	79,772
1967	2	553	1,208	19	1,781	863	2,423	6,479	472	10,238	21,335	17,292	27,285	13,324	79,235
1968	2	606	1,329	17	1,954	884	2,485	6,646	484	10,499	21,148	17,227	27,120	13,204	78,699
1969	2	659	1,451	16	2,128	905	2,546	6,812	497	10,760	20,960	17,163	26,955	13,085	78,163
1970	1	713	1,572	15	2,301	926	2,607	6,979	509	11,021	20,772	17,098	26,791	12,966	77,627
1971	1	766	1,694	13	2,475	947	2,669	7,145	521	11,282	20,585	17,033	26,626	12,847	77,091
1972	1	819	1,816	12	2,648	968	2,730	7,312	533	11,543	20,397	16,969	26,461	12,728	76,555
1973	1	873	1,937	11	2,822	989	2,792	7,478	545	11,803	20,209	16,904	26,296	12,609	76,019
1974	1	926	2,059	9	2,995	1,010	2,853	7,645	557	12,064	20,022	16,840	26,132	12,490	75,482
1975	1	979	2,181	8	3,169	1,031	2,915	7,811	569	12,325	19,834	16,775	25,967	12,370	74,946
1976	1	1,033	2,302	7	3,342	1,052	2,976	7,978	581	12,586	19,646	16,711	25,802	12,251	74,410
1977	1	1,086	2,424	5	3,516	1,073	3,038	8,144	593	12,847	19,459	16,646	25,637	12,132	73,874
1978	0	1,083	2,379	4	3,465	1,079	2,980	8,134	556	12,750	18,172	15,900	23,831	11,333	69,235
1979	0	1,074	2,317	2	3,394	1,086	2,919	8,118	516	12,639	16,906	15,159	22,046	10,547	64,657
1980	0	1,060	2,240	1	3,301	198	2,853	8,095	343	11,489	15,662	14,423	20,282	9,774	60,141
1981	-	-	-	-	-	-	1,920	6,181	-	8,101	-	-	-	-	-
1982	-	-	-	-	-	-	1,920	6,181	-	8,101	-	-	-	-	-
1983	-	-	-	-	-	-	1,920	6,181	-	8,101	-	-	-	-	-
1984	-	-	-	-	-	-	1,920	6,181	-	8,101	-	-	-	-	-
1985	-	-	-	-	-	-	1,920	6,181	-	8,101	-	-	-	-	-
1986	-	568	1,224	-	1,792	13	2,780	6,003	38	8,834	3,770	11,587	14,808	4,659	34,824
1987	-	895	2,243	-	3,138	20	2,044	7,533	46	9,643	30,634	15,885	10,405	3,971	60,895
1988	-	1,307	1,792	-	3,099	-	1,384	8,094	5	9,483	480	10,106	8,867	1,703	21,156
1989	-	1,440	877	-	2,317	17	1,316	9,071	52	10,456	2,746	6,820	14,885	7,286	31,737
1990	-	716	1,301	-	2,017	596	1,538	9,091	30	11,255	10,575	13,318	12,530	11,062	47,485
1991	-	1,357	3,797	-	5,154	2	553	12,271	34	12,860	7,425	12,369	23,773	10,390	53,957
1992	-	1,470	3,373	-	4,843	7	3,308	14,601	12	17,928	5,994	6,943	11,389	6,246	30,572
1993	-	1,267	1,495	-	2,762	98	3,154	11,871	130	15,253	11,705	5,819	13,076	7,191	37,791
1994	-	881	1,404	-	2,285	425	5,970	12,868	152	19,415	10,956	9,349	13,456	5,482	39,243
1995	-	825	1,626	-	2,451	13	6,339	15,367	8	21,727	9,717	7,786	8,471	3,636	29,610
1996	-	691	885	-	1,576	4	5,173	14,001	642	19,820	7,274	9,635	20,396	12,282	49,587
1997	20	867	2,951	245	4,083	1,729	5,456	13,624	649	21,458	11,141	8,524	6,101	9,234	35,000
1998	38	2,114	1,664	261	4,077	1,027	4,122	8,826	683	14,658	10,765	5,046	7,232	5,790	28,833
1999	5	956	1,405	313	2,679	611	4,540	13,662	601	19,414	3,485	3,757	13,586	5,705	26,533
2000	111	1,494	3,297	496	5,398	2,049	3,820	9,698	662	16,229	7,062	5,655	8,984	4,084	25,785
2001	99	958	1,492	215	2,764	679	2,431	9,434	701	13,245	5,025	3,676	6,114	2,017	16,832
2002	2	533	899	228	1,662	549	3,397	9,767	940	14,653	2,317	3,693	6,315	2,161	14,486
2003	2	642	607	55	1,306	3,987	7,104	9,644	806	21,541	2,841	1,721	6,072	3,036	13,670
2004	10	639	1,092	972	2,713	1,267	2,366	13,478	387	17,498	3,006	3,762	7,157	3,592	17,517
2005	34	782	1,268	753	2,837	2,029	4,883	11,324	383	18,619	9,555	7,089	11,762	6,460	34,866
2006	22	943	1,515	553	3,033	5,153	6,475	11,026	1,057	23,711	10,812	4,938	9,474	3,127	28,351
2007	22	943	-	-	965	5,153	6,475	-	-	11,628	10,812	4,938	-	-	15,750

Table 3. Compiled and estimated MRFSS recreational fisheries catch (numbers of fish) of king mackerel by area, season and year.

Sum of Catch_Numb — **MRFSS (Include dead discards from B2 values using a 20% discard mortality rate SEDAR16-DW RG)**

	ATLnoMix					GLFnoMix					MixZone				
year	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total	JanMar	AprJun	JulOct	NovDec	Total
1930	3,339	15,099	70,053	345	88,837	1	118	54,025	1	54,143	40,402	35,426	15,649	28,962	120,438
1931	3,451	15,841	72,388	357	92,036	187	868	56,944	249	58,248	41,748	36,607	16,170	29,928	124,454
1932	3,562	16,582	74,723	369	95,236	374	1,619	59,863	498	62,353	43,095	37,789	16,692	30,893	128,469
1933	3,673	17,324	77,058	380	98,435	560	2,370	62,782	747	66,458	44,442	38,971	17,214	31,859	132,485
1934	3,785	18,066	79,393	392	101,635	747	3,120	65,701	995	70,563	45,788	40,152	17,735	32,824	136,500
1935	3,896	18,807	81,728	403	104,835	933	3,871	68,620	1,244	74,668	47,135	41,334	18,257	33,789	140,516
1936	4,007	19,549	84,063	415	108,034	1,120	4,622	71,539	1,493	78,773	48,482	42,516	18,779	34,755	144,531
1937	4,119	20,291	86,398	426	111,234	1,306	5,373	74,458	1,741	82,878	49,829	43,697	19,300	35,720	148,546
1938	4,230	21,032	88,733	438	114,433	1,493	6,123	77,377	1,990	86,983	51,175	44,879	19,822	36,686	152,562
1939	4,341	21,774	91,069	449	117,633	1,673	5,815	73,498	2,234	83,220	52,522	46,061	20,343	37,651	156,577
1940	445	2,305	9,340	46	12,137	187	762	8,445	249	9,642	5,387	4,725	2,087	3,862	16,060
1941	456	2,437	9,574	47	12,514	205	838	8,931	274	10,248	5,522	4,844	2,139	3,958	16,462
1942	468	2,568	9,807	48	12,892	224	913	9,418	298	10,853	5,656	4,963	2,191	4,055	16,865
1943	479	2,700	10,041	50	13,269	243	988	9,905	323	11,459	5,791	5,082	2,243	4,151	17,267
1944	490	2,832	10,274	51	13,647	261	1,063	10,392	348	12,064	5,926	5,201	2,295	4,248	17,669
1945	501	2,964	10,508	52	14,024	290	2,833	21,756	381	25,259	6,060	5,320	2,347	4,344	18,071
1946	5,121	30,954	107,414	530	144,018	2,985	12,129	113,657	3,980	132,751	61,949	54,385	23,995	44,409	184,738
1947	5,232	32,272	109,749	541	147,794	3,171	12,880	118,526	4,228	138,805	63,296	55,574	24,516	45,374	188,760
1948	5,343	33,589	112,084	553	151,569	3,358	13,630	123,395	4,477	144,860	64,642	56,763	25,038	46,340	192,783
1949	5,454	34,907	114,419	564	155,345	3,544	14,381	128,263	4,726	150,914	65,989	57,952	25,560	47,305	196,806
1950	5,566	37,334	116,755	576	160,230	3,731	15,132	136,311	4,975	160,148	67,336	59,157	26,081	48,270	200,844
1951	5,677	38,854	119,090	587	164,208	3,917	15,882	143,118	5,223	168,141	68,683	60,370	26,603	49,236	204,892
1952	5,788	40,375	121,425	599	168,187	4,104	16,633	149,925	5,472	176,133	70,029	61,583	27,125	50,201	208,939
1953	5,900	41,896	123,760	610	172,165	4,290	17,384	156,731	5,721	184,126	71,376	62,797	27,646	51,167	212,986
1954	6,011	43,416	126,095	622	176,144	4,477	18,134	163,538	5,969	192,118	72,723	64,010	28,884	52,132	217,749
1955	6,122	44,937	128,430	1,192	180,681	4,663	18,885	170,344	6,218	200,111	74,069	65,224	32,927	53,098	225,318
1956	6,219	46,404	130,697	1,961	185,281	4,690	19,110	176,431	6,381	206,612	74,819	66,067	36,498	53,729	231,114
1957	6,316	47,871	132,964	2,730	189,881	4,717	19,334	182,518	6,543	213,113	75,569	66,911	40,068	54,361	236,910
1958	6,413	49,338	135,230	3,500	194,481	4,744	19,559	188,605	6,706	219,614	76,319	67,755	43,639	54,993	242,706
1959	6,510	50,805	137,497	4,269	199,082	4,771	19,783	194,692	6,869	226,115	77,069	68,599	47,209	55,625	248,501
1960	6,607	53,585	139,764	5,808	205,763	4,798	20,008	205,896	7,031	237,734	77,818	69,483	54,301	56,257	257,860
1961	7,862	59,700	149,282	6,788	223,632	5,080	21,410	212,998	7,462	246,950	78,751	70,870	59,399	59,040	268,061
1962	9,117	65,815	158,801	7,768	241,501	5,362	22,811	220,100	7,893	256,165	79,684	72,258	64,496	61,824	278,261
1963	10,372	71,930	168,320	8,749	259,370	6,002	24,213	227,201	8,621	266,038	80,618	73,645	69,593	64,607	288,462
1964	11,627	78,045	177,838	9,729	277,239	6,657	25,614	234,303	9,665	276,239	81,551	75,032	74,690	67,390	298,662
1965	12,882	84,161	187,357	10,709	295,108	7,312	27,253	241,405	10,708	286,678	82,484	76,419	79,787	70,173	308,863
1966	14,137	90,276	196,876	11,690	312,977	7,967	30,219	248,507	11,751	298,444	83,417	77,806	84,884	72,956	319,063
1967	15,391	96,391	206,394	12,670	330,846	8,621	33,185	255,608	12,795	310,210	84,350	79,193	89,981	75,739	329,264
1968	16,646	102,506	215,913	13,650	348,715	9,276	36,151	262,710	13,838	321,975	85,283	80,581	95,078	78,523	339,464
1969	17,901	108,621	225,431	14,631	366,585	9,931	39,117	269,812	14,881	333,741	86,216	81,968	100,175	81,306	349,665
1970	19,156	115,299	234,950	15,941	385,346	10,959	43,648	280,165	16,537	351,308	87,149	83,391	108,395	84,089	363,024
1971	20,411	122,260	244,469	17,417	404,556	11,932	47,948	290,040	18,103	368,024	88,082	84,789	114,430	86,872	374,173
1972	21,666	129,221	253,987	18,893	423,767	12,905	52,249	299,916	19,669	384,739	89,015	86,187	120,466	89,655	385,323
1973	22,921	136,182	263,506	20,369	442,977	13,877	56,550	309,792	21,235	401,455	89,948	87,585	126,501	92,438	396,473
1974	24,176	143,143	273,024	21,845	462,188	14,850	60,851	319,667	22,801	418,170	90,881	88,983	132,537	95,222	407,623
1975	25,430	150,104	282,543	23,321	481,398	15,823	65,152	329,543	24,367	434,885	91,815	90,381	138,572	98,005	418,773
1976	26,685	157,065	292,062	24,797	500,609	16,796	69,452	339,419	25,933	451,601	92,748	91,779	144,608	100,788	429,922
1977	27,940	164,026	301,580	26,273	519,819	17,769	73,753	349,295	27,499	468,316	93,681	93,177	150,643	103,571	441,072
1978	27,669	163,345	296,175	25,501	512,690	16,561	69,687	348,763	27,175	462,185	83,333	86,751	149,667	93,495	413,246
1979	27,291	162,227	289,955	24,488	503,962	15,069	64,395	347,616	26,579	453,659	72,744	80,102	148,213	82,841	383,900
1980	26,805	161,876	282,920	23,760	495,362	13,577	60,245	362,735	26,456	463,013	61,912	73,276	150,106	71,609	356,903
1981	-	37,018	323,226	-	360,244	282	53,297	111,961	-	165,540	196,970	119,407	35,105	13,098	364,580
1982	126,575	180,100	111,735	-	418,410	4,640	70,293	689,018	9,000	772,951	85,931	83,767	206,488	64,748	440,934
1983	264	397,819	197,412	-	595,495	2,314	31,437	263,000	-	296,751	28,839	32,459	178,442	8,467	248,207
1984	5,557	108,281	368,659	-	482,497	6,257	10,732	286,319	13,318	316,626	51,676	55,943	113,654	58,796	280,069
1985	9,282	112,709	561,437	5,790	689,219	12,552	33,072	132,968	-	178,592	19,020	101,063	67,354	21,748	209,185
1986	14,527	293,176	326,364	34,786	668,853	1,654	17,599	115,082	9,644	143,980	26,232	46,468	73,387	30,399	176,487
1987	49,666	230,329	248,909	13,347	542,251	2,382	160,659	168,462	17,149	348,652	64,223	47,045	36,130	31,750	179,148
1988	8,785	140,772	336,703	7,032	493,293	1,031	16,309	295,753	-	313,093	9,772	34,126	79,258	84,368	207,524
1989	20,673	75,237	170,389	16,814	283,113	3,098	40,824	182,447	45,332	271,702	43,391	53,276	73,154	27,089	196,910
1990	30,233	69,351	188,348	30,489	318,421	34,166	127,521	191,789	45	353,521	41,181	51,692	102,166	106,148	301,187
1991	3,172	154,350	309,439	67,958	534,919	9,018	76,409	425,459	3,082	513,969	82,272	54,383	137,448	21,087	295,190
1992	50,912	151,045	412,463	12,627	627,047	8,668	97,076	184,903	5,359	296,006	46,722	31,677	119,680	68,291	266,370
1993	6,805	66,432	116,673	19,252	209,162	17,169	94,066	203,342	24,825	339,402	148,366	49,366	99,685	44,637	342,054
1994	26,358	76,034	113,983	28,335	244,711	30,313	108,026	216,040	21,268	375,647	119,000	67,901	97,315	59,393	343,609
1995	8,656	44,584	140,995	50,619	244,854	60,417	152,921	97,809	8,262	319,410	186,697	150,250	148,671	61,225	546,843
1996	10,539	72,660	84,407	12,875	180,482	26,557	195,120	155,161	5,486	382,323	135,774	117,303	118,400	70,820	442,298
1997	36,060	113,218	243,442	15,295	408,016	29,870	116,384	196,631	12,429	355,315	182,853	108,496	100,294	98,960	490,603
1998	27,696	157,806	81,247	22,543	289,292	15,586	65,447	115,683	29,459	226,176	126,390	133,398	88,230	53,532	401,549
1999	7,591	40,347	69,974	23,117	141,028	32,286	107,963	99,639	30,788	270,675	80,996	121,578	98,163	46,710	347,448
2000	7,775	83,230	181,321	23,173	295,499	21,489	101,666	175,858	57,349	356,363	57,238	90,755	170,377	19,265	337,635
2001	8,505	87,302	102,693	11,721	210,221	25,628	78,996	155,558	73,153	333,335	66,008	92,280	74,005	18,540	250,833
2002	2,634	24,970	51,358	34,683	113,645	22,912	147,921	146,937	10,276	328,046	52,914	98,096	83,481	73,188	307,679
2003	3,907	47,472	102,870	21,665	175,914	15,338	96,340	149,155	28,661	289,493	182,075	163,720	127,026	45,935	518,756
2004	6,708	56,928	81,908	20,272	165,815	17,699	117,717	141,969	24,523	301,908	60,610	96,812	125,453	28,547	311,422
2005	1,299	55,569	140,126	14,851	211,845	19,597	135,583	81,814	8,348	245,343	68,734	94,410	103,705	38,847	305,696
2006	5,834	66,978	75,094	7,013	154,919	43,607	247,225	248,486	18,844	558,162	78,146	141,538	154,321	56,113	430,118
2007	895	136,050	-	-	136,945	22,893	161,335	-	-	184,228	88,868	167,726	-	-	256,594

Table 4. Estimates of king mackerel number of fish kill in the shrimp bycatch fisheries.

	Gulf of Mexico					South Atlantic				
Year	Jan-Mar	Apr-Jun	Jul-Oct	Nov-Dec	Total	Jan-Mar	Apr-Jun	Jul-Oct	Nov-Dec	Total
1972	209,532	857,688	1,715,376	857,688	3,640,285					
1973	5,999	70,958	141,915	70,958	289,829					
1974	55,010	218,537	437,074	218,537	929,158					
1975	25,007	164,191	328,381	164,191	681,770					
1976	13,549	125,529	251,057	125,529	515,664					
1977	1,051	16,602	33,205	16,602	67,461					
1978	16,853	207,858	415,717	207,858	848,286					
1979	30,802	350,927	701,853	350,927	1,434,508					
1980	5,003	68,367	136,735	68,367	278,472					
1981	7,989	128,688	257,375	128,688	522,740					
1982	4,543	62,867	125,734	62,867	256,010					
1983	-	-	-	-	-					
1984	27,369	340,766	681,533	340,766	1,390,435					
1985	24,482	161,448	322,896	161,448	670,273					
1986	12,681	102,529	205,059	102,529	422,798					
1987	39,914	310,385	620,769	310,385	1,281,452					
1988	19,545	224,731	449,461	224,731	918,467					
1989	79,388	580,476	1,160,952	580,476	2,401,291	-	689	10,419	12,261	23,369
1990	35,579	364,866	729,731	364,866	1,495,041	-	15,001	24,143	25,003	64,146
1991	56,920	423,035	846,069	423,035	1,749,059	-	7,895	14,972	2,876	25,742
1992	22,979	169,548	339,095	169,548	701,170	-	14	2,477	24,626	27,117
1993	102,251	486,604	973,209	486,604	2,048,668	-	548	9,839	3,109	13,497
1994	82,471	547,475	1,094,950	547,475	2,272,372	-	254	8,377	12,425	21,055
1995	108,047	554,348	1,108,695	554,348	2,325,437	-	2,630	20,873	16,638	40,141
1996	28,896	221,071	442,142	221,071	913,180	-	10,385	49,149	-	59,534
1997	35,487	232,009	464,019	232,009	963,524	-	10,270	5,474	-	15,744
1998	29,580	196,955	393,910	196,955	817,401	-	115	6,418	41,007	47,539
1999	38,986	199,436	398,872	199,436	836,729	-	15,709	13,430	2,864	32,003
2000	29,178	186,377	372,754	186,377	774,685	-	1,717	16,664	-	18,381
2001	22,340	139,670	279,340	139,670	581,021	-	153	2,374	4,672	7,198
2002	9,510	84,512	169,025	84,512	347,559	-	868	3,606	4,005	8,479
2003	11,843	148,207	296,414	148,207	604,672	-	1,154	14,230	-	15,383
2004	65,241	485,493	970,986	485,493	2,007,213	-	5,966	2,219	-	8,185
2005	52,618	354,185	708,369	354,185	1,469,356	-	-	7,202	-	7,202
2006	27,001	142,168	284,335	142,168	595,672	-	1,947	11,173	-	13,120

Table 5. Growth parameter estimates for Atlantic and Gulf king mackarel from samples taken outside the mixing area.

Summary von Bertalanffy Growth parameter estimates

Error distribution
linear increase of deviance at size with age
Constant CV

		Combined Sex		*Females*		*Males*	
		estimate	*st dev*	*estimate*	*st dev*	*estimate*	*st dev*
ATL no Mix	Linf	114.1	0.6759	121.6	0.8199	98.4	0.5518
	K	0.245	0.0077	0.228	0.0072	0.316	0.0104
	t0	-1.689	0.0927	-1.692	0.0899	-1.340	0.0790
	CV	10.6%		9.1%		7.9%	
GLF no Mix	Linf	122.4	1.2932	132.8	1.5275	100.0	1.0529
	K	0.177	0.0067	0.170	0.0063	0.235	0.0126
	t0	-2.651	0.1079	-2.464	0.0967	-2.554	0.1660
	CV	11.5%		9.8%		8.6%	

Table 6. Indices of abundance for the continuity case and VPA models for Atlantic and Gulf king mackerels 2008.

Type of Index	MRFSS-ATL		MRFSS - GULF		HB-Atl. Migratory		HB-Gulf Migratory		Trip Ticket - NC PIDs 8+	
	Fish. Dep. REC		Fish. Dep. REC		Fish. Dep. REC		Fish. Dep. REC		Fish. Dep. COM	
Region	Atl. Migratory		Gulf Migratory		Atl. Migratory		Gulf Migratory		North Carolina	
Standardization	Delta-lognormal (fishing year) - Guild selection		Delta-lognormal (fishing year) - Guild selection		Delta-lognormal (fishing year) - Vessel Selection		Delta-lognormal (fishing year) - Vessel Selection		Delta-Lognormal - Vessel Selection	
Unit	Number		Number		Number		Number		Weight	
Ages	Ages 2-11		Ages 2-8		Ages 2-11		Ages 2-6		?	
Season	Jan-Mar; Apr-Jun; Jul-Oct;		Jan-Mar; Apr-Jun; Jul-Oct;		Jan-Mar; Apr-Jun; Jul-Oct;		Jan-Mar; Apr-Jun; Jul-Oct;		Jan-Mar; Apr-Jun; Jul-Oct;	
Recommended?	Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : NO	
YEAR	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV
1972										
1973										
1974										
1975										
1976										
1977										
1978										
1979										
1980										
1981	1.0100	0.5451	0.6701	0.4054	0.9120	0.3080	1.4620	0.3280		
1982	1.3865	0.4517	0.3601	0.4031	0.7880	0.2970	0.8650	0.3400		
1983	1.3498	0.4694	0.8004	0.3596	0.8450	0.2780	1.9420	0.3040		
1984	1.2746	0.4527	0.4173	0.4014	0.9690	0.2650	0.6200	0.3510		
1985	1.3741	0.4741	0.4266	0.3887	0.5640	0.2860	0.4450	0.2990		
1986	1.9124	0.4105	0.4539	0.3196	0.7610	0.2730	0.4890	0.2520		
1987	1.2688	0.4171	1.0693	0.2858	1.2870	0.2590	0.3240	0.2860		
1988	0.9524	0.4091	0.6765	0.2985	0.8690	0.2810	0.3790	0.2770		
1989	0.7479	0.4111	0.9378	0.3050	0.6240	0.2920	0.6120	0.2540		
1990	1.1712	0.4099	1.2820	0.2862	0.7440	0.2770	0.5040	0.2640		
1991	1.0889	0.4030	1.1803	0.2777	1.5450	0.2500	0.7970	0.2420		
1992	1.1118	0.3986	1.2209	0.2655	1.4070	0.2450	1.0280	0.2340		
1993	0.6404	0.4136	1.1378	0.2725	0.8440	0.2610	1.2300	0.2300		
1994	0.5508	0.4124	1.4390	0.2630	1.0410	0.2570	1.1170	0.2270	0.7000	0.0684
1995	0.6582	0.4064	0.9981	0.2849	0.9350	0.2570	1.0780	0.2370	0.7443	0.0733
1996	0.7676	0.4021	1.3496	0.2708	0.6260	0.2750	1.6730	0.2240	1.1254	0.0694
1997	0.9935	0.4013	1.6397	0.2590	1.1290	0.2610	1.3170	0.2260	1.0329	0.0604
1998	0.8912	0.3995	0.9055	0.2646	0.9110	0.2690	1.0830	0.2310	1.0559	0.0599
1999	0.8238	0.4008	0.8820	0.2630	1.1630	0.2620	1.1270	0.2290	0.9687	0.0610
2000	1.0370	0.3954	1.1231	0.2558	1.8520	0.2500	0.9670	0.2350	0.9864	0.0587
2001	0.5921	0.4010	1.0189	0.2587	1.2150	0.2670	1.1520	0.2340	1.0438	0.0574
2002	0.7217	0.3999	1.3102	0.2531	0.9790	0.2730	1.1640	0.2310	0.9071	0.0690
2003	0.7497	0.4033	0.9135	0.2624	0.8380	0.2800	0.9610	0.2440	0.8793	0.0728
2004	0.9870	0.3981	1.0046	0.2598	0.7150	0.2790	1.0960	0.2400	1.2922	0.0578
2005	0.9991	0.3990	0.9180	0.2642	1.2000	0.2710	1.3780	0.2320	1.2058	0.0627
2006	0.9394	0.4059	1.8647	0.2703	1.2380	0.2690	1.1910	0.3000	1.0581	0.0664
2007										

Type of Index	Trip Ticket Cont-		Trip Ticket Cont-SW FL		Trip Ticket Cont- FL Atl		Shrimp Bycatch		SEAMAP Fall Plankton	
	Fish. Dep. COM		Fish. Dep. COM		Fish. Dep. COM		Fish. Dep. COM Bycatch		Fish. Independent	
Region	Panhandle FL		SW Florida		FL East Coast		Gulf of Mexico		Gulf of Mexico	
Standardization	Lognormal - Trips selected if 50% of catch was king		Lognormal - Trips selected if 50% of catch was king		Lognormal - Trips selected if 50% of catch was king		Delta-Lognormal		Delta-Lognormal	
Unit	Weight		Weight		Weight		Numbers		Numbers	
Ages	Ages 3-6		Ages 3-8		Ages 2-11+		Ages: ?		Ages 1 to 11+, using	
Season	Jul-Oct		Nov-Dec		Apr-Oct		All months		Sept - Oct	
Recommended?	Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : NO		Cont. Case: YES : YES	
YEAR	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV
1972							1.0549	0.4301		
1973										
1974							0.2755	0.5275		
1975							0.2144	0.5500		
1976							0.0700	0.7128		
1977							0.0319	0.6672		
1978							0.2846	0.3936		
1979							0.3081	0.5164		
1980							0.0429	0.5300		
1981							0.1795	0.7878		
1982							0.0894	0.8595		
1983										
1984							0.4553	0.5106		
1985							0.3101	0.5094		
1986	0.7790	0.0520	0.3850	0.0220	1.0240	0.0070	0.1243	0.7533	0.1160	0.5341
1987	0.5430	0.0370	0.5900	0.0170	0.9860	0.0070	0.5681	0.4676	0.3788	0.3219
1988	0.5180	0.0250	0.8170	0.0220	1.1690	0.0070	0.5786	0.4312	0.6130	0.4365
1989	0.3630	0.0480	0.7640	0.0140	1.0300	0.0080	1.5828	0.4062	0.8450	0.3255
1990	0.5410	0.0300	1.0000	0.0120	0.9270	0.0080	1.2579	0.3660	0.6480	0.3211
1991	0.5430	0.0230	1.0180	0.0130	0.8980	0.0070	1.3865	0.4051	0.7212	0.3181
1992	0.7440	0.0190	2.3680	0.0100	0.8330	0.0080	0.5165	0.3282	0.5960	0.2372
1993	0.6470	0.0240	1.0630	0.0120	0.8500	0.0070	1.7224	0.2405	1.2505	0.1987
1994	0.8000	0.0140	0.6630	0.0170	0.8320	0.0080	1.6751	0.3091	1.0500	0.2310
1995	0.7900	0.0180	0.9420	0.0140	0.7800	0.0080	2.2418	0.3122	1.9787	0.1947
1996	1.4350	0.0090	1.1060	0.0110	0.9650	0.0070	0.7715	0.3962	0.7407	0.2647
1997	1.8850	0.0080	0.9300	0.0130	0.9700	0.0070	1.0344	0.3549	1.3597	0.2007
1998	1.2670	0.0120	1.0310	0.0160	0.9810	0.0070	0.9711	0.3766		
1999	1.4600	0.0100	0.6520	0.0180	0.9920	0.0070	0.9071	0.3411	0.9198	0.2249
2000	1.2800	0.0110	1.1700	0.0160	0.8630	0.0070	1.0637	0.3540	0.9219	0.2730
2001	1.5520	0.0100	1.2440	0.0160	0.9050	0.0070	1.9350	0.3483	1.6424	0.2026
2002	1.2190	0.0130	0.8850	0.0190	0.8260	0.0080	0.9723	0.3835	1.4511	0.2143
2003	1.0730	0.0130	1.1300	0.0150	1.0930	0.0070	3.2741	0.3375	1.1027	0.2190
2004	1.0190	0.0180	0.8800	0.0190	1.2940	0.0070	3.7091	0.3379	1.4780	0.2108
2005	1.0620	0.0220	1.4070	0.0150	0.9740	0.0070	1.0116	0.4308		
2006	1.2890	0.0140	0.9550	0.0190	1.4630	0.0070	2.3792	0.3381	1.1865	0.2533
2007	1.1900	0.0250								

Type of Index	SEAMAP South Alt. Trawl		LogBook Com GOM		LogBook Com ATL		LogBook Com MIX	
	Fish. Independent		Fish. Dep. COM		Fish. Dep. COM		Fish. Dep. COM	
Region	South Atl.		GOM no Mix area		ATL no Mix area		Mixing area	
Standardization	Delta-Lognormal		Delta-lognormal vessels selected		Delta-lognormal vessels selected		Delta-lognormal vessels selected	
Unit	Numbers		Weight		Weight		Weight	
Ages	Age 1							
Season	Spring, Summer, Fall							
Recommended?	Updated Models: Yes		Cont. Case: NO YES		Cont. Case: NO YES		Cont. Case: NO YES	
YEAR	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV	STDCPUE	CV
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986								
1987								
1988								
1989	0.8067	0.2121						
1990	2.3766	0.1582						
1991	0.7036	0.2218						
1992	0.8428	0.2413						
1993	0.4464	0.2465	0.720	0.132	1.379	0.076	0.651	0.088
1994	0.7083	0.2317	0.881	0.101	1.213	0.080	0.658	0.075
1995	1.2262	0.1983	0.990	0.093	1.122	0.088	0.680	0.074
1996	2.2610	0.1681	0.974	0.078	0.814	0.112	0.947	0.056
1997	0.5195	0.2405	1.307	0.069	1.115	0.086	0.806	0.058
1998	1.7862	0.1999	1.288	0.068	1.023	0.077	1.039	0.044
1999	1.2129	0.1844	1.118	0.065	1.026	0.079	1.003	0.042
2000	0.8157	0.2211	1.068	0.062	1.052	0.076	0.931	0.042
2001	0.4483	0.2342	1.055	0.064	0.910	0.082	0.974	0.041
2002	0.5061	0.2113	0.994	0.061	0.780	0.102	1.053	0.041
2003	0.9889	0.1956	0.985	0.069	0.740	0.106	1.278	0.040
2004	0.6189	0.3574	0.923	0.073	0.893	0.104	1.278	0.044
2005	0.7264	0.4934	0.732	0.093	0.995	0.091	1.270	0.047
2006	1.0058	0.2213	0.966	0.083	0.937	0.092	1.433	0.047
2007								

Table 7. Indices of abundance for the combined Atlantic and Gulf king model Stock Synthesis 3 (SS3) 2008.

Index	MRFSS-ATL		MRFSS-Mixing		MRFSS-Gulf		HB-ATL		HB-Mixing		HB-Gulf		NC-PID8+		ShrimpBycatch Gulf	
Season	Jul-Oct		Jan-Mar		Jul-Oct		Jul-Oct		Jan-Mar		Jul-Oct		Jul-Oct		Jul-Oct	
Year	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1972															1.055	0.430
1973																
1974															0.276	0.527
1975															0.214	0.550
1976															0.070	0.713
1977															0.032	0.667
1978															0.285	0.394
1979									1.075	0.146					0.308	0.516
1980							0.627	0.406	1.033	0.135					0.043	0.530
1981	1.194	0.723	0.630	0.393	0.722	0.424	1.506	0.475	1.128	0.132					0.180	0.788
1982	1.386	0.650	1.181	0.294	0.467	0.407	0.757	0.497	0.757	0.138					0.089	0.859
1983	1.396	0.671	0.658	0.284	0.883	0.428	1.236	0.387	0.880	0.134						
1984	1.487	0.648	0.730	0.259	0.501	0.390	0.769	0.295	0.947	0.140					0.455	0.511
1985	1.399	0.611	0.748	0.329	0.550	0.417	0.595	0.302	0.739	0.155					0.310	0.509
1986	4.424	0.532	0.541	0.304	0.451	0.338	0.734	0.235	0.660	0.139	0.677	0.184			0.124	0.753
1987	1.700	0.575	0.586	0.323	1.077	0.303	0.858	0.235	0.910	0.134	0.699	0.175			0.568	0.468
1988	1.202	0.576	0.735	0.273	0.710	0.324	0.816	0.238	0.668	0.183	0.809	0.193			0.579	0.431
1989	0.962	0.565	0.617	0.273	0.922	0.332			1.000	0.160	0.799	0.186			1.583	0.406
1990	0.879	0.591	1.241	0.255	1.292	0.318			0.944	0.151	0.558	0.170			1.258	0.366
1991	1.193	0.568	0.993	0.260	1.263	0.301	1.170	0.242	1.135	0.150	1.371	0.156			1.386	0.405
1992	0.946	0.576	0.993	0.228	1.002	0.293	1.517	0.224	0.806	0.140	1.233	0.153			0.516	0.328
1993	0.548	0.645	1.310	0.233	0.998	0.301	0.805	0.238	0.963	0.127	0.838	0.151			1.722	0.240
1994	0.355	0.679	0.839	0.246	1.243	0.290	0.614	0.249	0.824	0.136	1.205	0.133	0.660	0.066	1.675	0.309
1995	0.399	0.681	1.178	0.240	1.115	0.305	0.617	0.232	0.804	0.145	1.295	0.134	0.774	0.067	2.242	0.312
1996	0.342	0.677	1.237	0.236	1.322	0.299	0.464	0.240	1.323	0.146	1.437	0.142	0.910	0.076	0.771	0.396
1997	1.126	0.569	1.280	0.227	1.480	0.285	1.218	0.206	1.486	0.126	1.307	0.140	1.114	0.056	1.034	0.355
1998	0.544	0.617	1.342	0.221	1.083	0.286	1.243	0.209	1.212	0.148	1.083	0.145	1.097	0.058	0.971	0.377
1999	0.937	0.590	1.297	0.215	0.922	0.281	0.976	0.218	0.842	0.182	1.286	0.150	1.029	0.057	0.907	0.341
2000	0.811	0.605	1.104	0.217	1.213	0.276	1.854	0.209	1.117	0.178	0.890	0.152	1.019	0.054	1.064	0.354
2001	0.407	0.660	0.717	0.217	1.114	0.280	1.288	0.213	0.952	0.177	0.686	0.160	1.008	0.057	1.935	0.348
2002	0.188	0.779	0.873	0.210	1.239	0.276	0.885	0.241	0.921	0.215	0.729	0.150	0.847	0.065	0.972	0.384
2003	0.271	0.717	1.631	0.205	0.967	0.281	0.912	0.227	1.015	0.229	1.055	0.153	1.019	0.064	3.274	0.337
2004	0.462	0.649	0.975	0.218	1.019	0.281	0.896	0.223	0.853	0.219	0.654	0.162	1.166	0.061	3.709	0.338
2005	0.843	0.577	1.182	0.216	0.860	0.290	1.496	0.254	1.503	0.188	1.038	0.163	1.250	0.058	1.012	0.431
2006	0.598	0.621	1.383	0.210	1.584	0.276	1.147	0.219	1.501	0.212	1.351	0.148	1.245	0.060	2.379	0.338

Index	FALL_Plankton_GOM		FALL_Groundfish_GOM		SEAMAP_ATL		FL_TT_GLFnoMix		FL_TT_Mixing		LBOOK_ATLnoMix		LBOOK_GLFnoMix		LBOOK_Mix	
Season	Jul-Oct		Nov-Dec		Apr-Jun		Jul-Oct		Nov-Dec		Jul-Oct		Jul-Oct		Nov-Dec	
Year	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV				
1972			2.331	0.534												
1973			0.080	1.482												
1974			0.552	0.900												
1975			0.080	1.482												
1976			0.080	1.482												
1977			0.080	1.482												
1978			0.367	1.093												
1979			0.650	0.901												
1980			0.080	1.482												
1981			0.080	1.482												
1982			0.080	1.482												
1983			0.080	1.482												
1984			0.458	0.911												
1985			0.207	0.823												
1986	0.116	0.534	0.389	1.080			0.779	0.052	0.385	0.022						
1987	0.379	0.322	0.080	1.482			0.543	0.037	0.590	0.017						
1988	0.613	0.437	0.557	0.527			0.518	0.025	0.817	0.022						
1989	0.845	0.326	0.462	0.702	0.807	0.212	0.363	0.048	0.764	0.014						
1990	0.648	0.321	0.738	0.409	2.377	0.158	0.541	0.030	1.000	0.012						
1991	0.721	0.318	0.287	0.565	0.704	0.222	0.543	0.023	1.018	0.013						
1992	0.596	0.237	0.437	0.559	0.843	0.241	0.744	0.019	2.368	0.010						
1993	1.251	0.199	1.934	0.325	0.446	0.247	0.647	0.024	1.063	0.012	1.379	0.076	0.720	0.132	0.651	0.088
1994	1.050	0.231	0.832	0.480	0.708	0.232	0.800	0.014	0.663	0.017	1.213	0.080	0.881	0.101	0.658	0.075
1995	1.979	0.195	0.491	0.641	1.226	0.198	0.790	0.018	0.942	0.014	1.122	0.088	0.990	0.093	0.680	0.074
1996	0.741	0.265	0.398	0.531	2.261	0.168	1.435	0.009	1.106	0.011	0.814	0.112	0.974	0.078	0.947	0.056
1997	1.360	0.201	0.951	0.425	0.519	0.240	1.885	0.008	0.930	0.013	1.115	0.086	1.307	0.069	0.806	0.058
1998			1.019	0.413	1.786	0.200	1.267	0.012	1.031	0.016	1.023	0.077	1.288	0.068	1.039	0.044
1999	0.920	0.225	0.807	0.396	1.213	0.184	1.460	0.010	0.652	0.018	1.026	0.079	1.118	0.065	1.003	0.042
2000	0.922	0.273	0.920	0.480	0.816	0.221	1.280	0.011	1.170	0.016	1.052	0.076	1.068	0.062	0.931	0.042
2001	1.642	0.203	1.150	0.376	0.448	0.234	1.552	0.010	1.244	0.016	0.910	0.082	1.055	0.064	0.974	0.041
2002	1.451	0.214	0.658	0.536	0.506	0.211	1.219	0.013	0.885	0.019	0.780	0.102	0.994	0.061	1.053	0.041
2003	1.103	0.219	2.581	0.289	0.989	0.196	1.073	0.013	1.130	0.015	0.740	0.106	0.985	0.069	1.278	0.040
2004	1.478	0.211	2.050	0.308	0.619	0.357	1.019	0.018	0.880	0.019	0.893	0.104	0.923	0.073	1.278	0.044
2005			2.237	0.292	0.726	0.493	1.062	0.022	1.407	0.015	0.995	0.091	0.732	0.093	1.270	0.047
2006	1.187	0.253	1.735	0.369	1.006	0.221	1.289	0.014	0.955	0.019	0.937	0.092	0.966	0.083	1.433	0.047

Table 8. Estimates of natural mortality by age for ATL and GOM king mackerel from the Lorenzen's model using and overall value of M of 0.160 (GOM) and 0.174 (ATL), respectively. Age 2 was selected as the fully selected age reference for both stocks. And estimates of per recruit survival by age assuming no fishing mortality.

	GOM	Per Rec survival		ATL	Per Rec survival	
Age	M(age)	Cte M 0.20	Lorenzens	M(age)	Cte M 0.15	Lorenzens
0	0.294544	1.000000	1.000000	0.327145	1.000000	1.000000
1	0.250044	0.818731	0.744871	0.267759	0.860708	0.720979
2	0.222637	0.670320	0.580081	0.234819	0.740818	0.551615
3	0.204254	0.548812	0.464300	0.214236	0.637628	0.436170
4	0.191226	0.449329	0.378523	0.200426	0.548812	0.352058
5	0.181633	0.367879	0.312640	0.190723	0.472367	0.288118
6	0.174372	0.301194	0.260712	0.183683	0.406570	0.238090
7	0.168761	0.246597	0.218994	0.178459	0.349938	0.198138
8	0.164356	0.201897	0.184987	0.174515	0.301194	0.165754
9	0.160856	0.165299	0.156950	0.171501	0.259240	0.139211
10	0.158047	0.135335	0.133630	0.169175	0.223130	0.117271
11	0.155776	0.110803	0.114094	0.167366	0.192050	0.099019
12	0.153927	0.090718	0.097636	0.165953	0.165299	0.083759
13	0.152415	0.074274	0.083707	0.164843	0.142274	0.070951
14	0.151173	0.060810	0.071874	0.163968	0.122456	0.060169
15	0.150150	0.049787	0.061790	0.163277	0.105399	0.051069
16	0.149304	0.040762	0.053175	0.162729	0.090718	0.043376
17	0.148604	0.033373	0.045800	0.162295	0.078082	0.036862
18	0.148022	0.027324	0.039475	0.161950	0.067206	0.031340
19	0.147539	0.022371	0.034044	0.161676	0.057844	0.026654
20	0.147137	0.018316	0.029374	0.161458	0.049787	0.022675
21	0.146802	0.014996	0.025355	0.161284	0.042852	0.019294
22	0.146522	0.012277	0.021893	0.161145	0.036883	0.016420
23	0.146289	0.010052	0.018909	0.161035	0.031746	0.013976
24	0.146095	0.008230	0.016336	0.160947	0.027324	0.011898
25	0.145869	0.006738	0.014115	0.160947	0.023518	0.010129

Table 8A. Estimates of fecundity by age for ATL and GOM king mackerel from the updated hydrated oocytes data (ref). Fecundity initially estimates as function of size (FL cm) and then converted to age vector using the von Bertalanffy growth parameter for females by stock unit. Units are million of hydrated eggs per female.

Age	GOM	ATL
0	0	0
1	0.154797	0.129726
2	0.266538	0.250442
3	0.395033	0.388117
4	0.531398	0.528495
5	0.668519	0.662003
6	0.801227	0.783216
7	0.926095	0.889753
8	1.041105	0.981223
9	1.145299	1.058407
10	1.238476	1.122697
11	1.320942	1.175717
12	1.393322	1.219112
13	1.456422	1.254419
14	1.511129	1.283015
15	1.558343	1.306092
16	1.598939	1.324662
17	1.633737	1.339573
18	1.663488	1.351523
19	1.688869	1.361089
20	1.710483	1.368737
21	1.728862	1.374846
22	1.744471	1.379723
23	1.757713	1.383613
24	1.768938	1.386716
25	1.768938	1.38919

Table 9. Estimated weight size relationships for king mackerel by stock unit using observations collected outside of the mixing area.

whole wgt (kg) = alpha * (FL size cm) ^ beta

Stock unit	sex	*parameter*	*Estimate*	*Stderror*
ATLnoMix	Fem	alpha	6.18E-06	3.18E-07
		beta	3.04924112	0.01089133
	Mal	alpha	5.27E-06	6.21E-07
		beta	3.08501672	0.02585292
GOMnoMix	Fem	alpha	7.81E-06	6.62E-07
		beta	2.99880109	0.01789361
	Mal	alpha	6.57E-06	6.29E-07
		beta	3.0288173	0.02093515

whole wgt (kg) = alpha * (FL size cm) ^ beta

Stock unit	sex	*parameter*	*Estimate*	*Stderror*
ATLnoMix	Comb	alpha	6.18E-06	2.63E-07
		beta	3.04948555	0.0090587
GOMnoMix	Comb	alpha	7.07E-06	9.85E-07
		beta	3.01951088	0.0295161

gutted wgt (kg) = alpha * (FL size cm) ^ beta

Stock unit	sex	*parameter*	*Estimate*	*Stderror*
ATLnoMix	Fem	alpha	6.51E-06	3.90E-07
		beta	3.03340742	0.01278212
	Mal	alpha	6.39E-06	7.15E-07
		beta	3.03036916	0.02474112
GOMnoMix	Fem	alpha	4.61E-06	2.61E-07
		beta	3.09945312	0.01218492
	Mal	alpha	6.24E-06	4.72E-07
		beta	3.02758932	0.01682207

Table 10. Stock composition information from Patterson et al (SEDAR16-DW-30) and observed stock composition vector used in SS3 model (Microchemistry derived) for the MIX area in season Jan-Mar.

Table 6 Patterson et al Stock composition mixing zone infered from microchemistry

Year	Sub-area	Sex	ATL%	Low	Upp	CV
2001/02	1	F	21.1	7	35	0.5177
	2	F	38.7	21	59	0.3831
	3	F	85.6	68	99	0.1413
	1	M	39.7	19	62	0.4226
	2	M	73.8	16	99	0.4388
	3	M	83.1	66	99	0.1549
2002/03	1	F	21.3	9	37	0.5129
	2	F	68.1	20	91	0.4068
	3	F	61.1	19	86	0.4278
	1	M	74.8	33	100	0.3495
	2	M	7.3	0	27	1.4430
	3	M	27.2	12	42	0.4303

Microchemestry sample size weighted average combined sex, all 3 subareas

Year	Season	N	GP1(GOM)	GP2(ATL)
2001	Jan-Mar	323	45.0%	55.0%
2002	Jan-Mar	306	53.6%	46.4%

Otolith shape sample size weighted avg combined sex, all 3 subareas

Year	Season	N	GP1(GOM)	GP2(ATL)
2001	Jan-Mar	345	32.0%	68.0%
2002	Jan-Mar	383	56.2%	43.8%

Table 10A. Input vector of M(age) by stock and sex for SS3 king mackerel model. Based on overall values of M of 0.174 for GOM stock, assuming age 2 as fully recruited age class, and von Bertalanffy growth parameters by sex for Ages 1-25. For Age 0, the values were the estimated M by SS3 runs where M was estimated initially. These values represent the annual natural mortality rate at the begining of the year.

	GOM		ATL	
Age	Female	Male	Female	Male
0	1.0955	1.0146	0.9460	0.8849
1	0.2836	0.2492	0.2639	0.2438
2	0.2490	0.2237	0.2264	0.2094
3	0.2262	0.2073	0.2038	0.1902
4	0.2101	0.1959	0.1889	0.1784
5	0.1984	0.1879	0.1786	0.1707
6	0.1895	0.1820	0.1713	0.1655
7	0.1827	0.1777	0.1659	0.1619
8	0.1773	0.1744	0.1618	0.1594
9	0.1730	0.1718	0.1587	0.1577
10	0.1696	0.1699	0.1563	0.1564
11	0.1668	0.1684	0.1545	0.1555
12	0.1645	0.1673	0.1531	0.1548
13	0.1626	0.1664	0.1520	0.1543
14	0.1611	0.1656	0.1511	0.1540
15	0.1598	0.1651	0.1504	0.1538
16	0.1588	0.1647	0.1499	0.1536
17	0.1579	0.1643	0.1494	0.1534
18	0.1572	0.1640	0.1491	0.1533
19	0.1565	0.1638	0.1488	0.1533
20	0.1560	0.1637	0.1486	0.1532
21	0.1556	0.1635	0.1484	0.1532
22	0.1552	0.1634	0.1483	0.1532
23	0.1549	0.1633	0.1482	0.1531
24	0.1547	0.1633	0.1481	0.1531
25	0.1547	0.1633	0.1480	0.1531

Table 10B. Input vectors of weight at age for ATL and GOM stock s derived from the ageing data averaged over the Fyears indicated in the column label.

ATL stock combined sex

Age	1984-86	1987-91	1992-96	1998-01	2002-06	1986-07
0	0.321	0.239	1.489	1.215	0.011	0.240
1	1.195	1.741	1.545	2.043	1.303	1.508
2	2.491	2.842	2.990	3.073	2.505	2.863
3	3.542	3.608	4.159	4.123	3.776	3.872
4	4.215	4.486	5.293	5.056	4.811	4.836
5	5.011	5.199	6.310	6.133	6.076	5.805
6	5.809	6.199	7.448	7.391	9.067	6.908
7	6.788	6.933	7.781	8.482	10.280	7.760
8	7.407	7.540	8.798	9.465	8.445	8.552
9	8.140	8.419	9.067	10.988	9.944	9.318
10	7.860	9.128	10.243	11.776	10.237	9.719
11	10.197	11.029	12.376	12.432	12.849	11.400

GOM stock combined sex

Age	1984-86	1987-91	1992-96	1998-01	2002-06	1986-07
0	0.939	0.932	1.102	1.272	0.135	0.424
1	1.429	1.787	1.989	2.205	1.458	1.857
2	2.630	2.868	3.166	2.700	2.557	2.817
3	3.697	3.901	3.912	3.752	3.659	3.825
4	4.953	5.233	4.842	4.515	4.379	4.825
5	6.605	6.426	5.877	5.644	4.946	6.005
6	7.425	7.759	6.802	6.383	6.633	7.062
7	8.463	8.628	8.342	7.465	7.645	8.125
8	9.388	9.079	10.015	8.311	8.121	8.942
9	10.601	10.085	10.783	8.954	11.246	10.023
10	10.791	11.175	11.792	9.835	11.015	10.786
11	14.727	12.155	13.103	11.276	12.865	12.835

Table 11. List of the parameters estimated in SS3 King mackerel model runs, initial guess estimates, low and upper bounds, and phase of estimation.

Num	Group	Label	Value	Status	Phase	Min	Max	Init	Prior	PR_type	Pr_SD	Prior_Like	Parm_StDev
1	Growth parameters by stock and sex	Lmin-Fem_GP_1_	57.2407	estimate	5	10	70	60.4	60.4	-1	99	0	0
2		Lmax-Fem_GP_1_	132.825	fixed	-5	80	200	132.825	132.4	-1	99	-	-
3		VBK-Fem_GP_1_	0.139523	estimate	5	0.05	0.45	0.170087	0.173	-1	99	0	0
4		CV_yng-Fem_GP_1_	0.0980431	fixed	-3	0.05	0.25	0.0980431	0.099	-1	99	-	-
5		CV_old-Fem_GP_1_	0.0980431	fixed	-3	0.05	0.25	0.0980431	0.099	-1	99	-	-
6		Lmin-Fem_GP_2_	49.2319	estimate	5	10	70	58	58	-1	99	0	0
7		Lmax-Fem_GP_2_	121.605	fixed	-5	80	200	121.605	122.8	-1	99	-	-
8		VBK-Fem_GP_2_	0.169642	estimate	5	0.05	0.45	0.227864	0.211	-1	99	0	0
9		CV_yng-Fem_GP_2_	0.091	fixed	-3	0.05	0.25	0.091	0.091	-1	99	-	-
10		CV_old-Fem_GP_2_	0.091	fixed	-3	0.05	0.25	0.091	0.091	-1	99	-	-
11		Lmin-Male_GP_1_	49.8419	estimate	5	10	70	58	58	-1	99	0	0
12		Lmax-Male_GP_1_	100.017	fixed	-5	80	200	100.017	1000	-1	99	-	-
13		VBK-Male_GP_1_	0.215803	estimate	5	0.05	0.45	0.235366	0.2354	-1	99	0	0
14		CV_yng-Male_GP_1_	0.0861487	fixed	-3	0.05	0.25	0.0861487	0.086	-1	99	-	-
15		CV_old-Male_GP_1_	0.0861487	fixed	-3	0.05	0.25	0.0861487	0.086	-1	99	-	-
16		Lmin-Male_GP_2_	35.4082	estimate	5	10	70	54.7	54.7	-1	99	0	0
17		Lmax-Male_GP_2_	98.3609	fixed	-5	80	200	98.3609	97.5	-1	99	-	-
18		VBK-Male_GP_2_	0.231475	estimate	5	0.05	0.45	0.315868	0.319	-1	99	0	0
19		CV_yng-Male_GP_2_	0.079362	fixed	-3	0.05	0.25	0.079362	0.079	-1	99	-	-
20		CV_old-Male_GP_2_	0.079362	fixed	-3	0.05	0.25	0.079362	0.079	-1	99	-	-
21	Fecundity wgt-size Maturity	Wtlen1-Fem	7.8149E-06	fixed	-3	0	3	7.8149E-06	0.00000781	-1	99	-	-
22		Wtlen2-Fem	2.9988	fixed	-3	2	4	2.9988	3	-1	99	-	-
23		Mat50-Fem	80	fixed	-3	35	120	80	80	-1	99	-	-
24		Matslp-Fem	-0.25	fixed	-3	-1	3	-0.25	-0.25	-1	99	-	-
25		Eggs1-Fem	1.00E+00	fixed	-3	0	3	1.00E+00	1.00E+00	-1	99	-	-
26		Eggs2-Fem	0	fixed	-3	-1	3	0	0	-1	99	-	-
27		Wtlen1-Male	6.5692E-06	fixed	-3	0	3	6.5692E-06	0.00000657	-1	99	-	-
28		Wtlen2-Male	3.02882	fixed	-3	2	4	3.02882	3.0288	-1	99	-	-
29	Allocation Recruits among Stocks	RecrDist-GP-1_	0	fixed	-3	-8	8	0	1	-1	99	-	-
30		RecrDist-GP-2_	-0.373033	estimate	3	-8	8	0	1	-1	99	0	0
31		RecrDist-Area-1_	0.00E+00	fixed	-3	-4	4	0.00E+00	1.00E+00	-1	99	-	-
32		RecrDist-Area-2_	0	fixed	-3	-4	4	0	1	-1	99	-	-
33		RecrDist-Area-3_	0	fixed	-3	-4	4	0	1	-1	99	-	-
34		RecrDist-Seas-1_	0	fixed	-3	-4	4	0	1	-1	99	-	-
35		RecrDist-Seas-2_	0	fixed	-3	-4	4	0	1	-1	99	-	-
36		RecrDist-Seas-3_	0	fixed	-3	-4	4	0	1	-1	99	-	-
37		RecrDist-Seas-4_	0	fixed	-3	-4	4	0	1	-1	99	-	-
38	Migration parameters	CohortGrowDev	1	fixed	-3	-1	2	1	1	-1	99	-	-
39		MoveParm_A_seas_1__morph_1_from_1_to_3_	1.40041	estimate	5	-5	5	2	0	0	99	0.000100048	0
40		MoveParm_B_seas_1__morph_1_from_1_to_3_	0.1	fixed	-5	-5	5	0.1	0	0	99	-	-
41		MoveParm_A_seas_1__morph_2_from_2_to_3_	1.13458	estimate	5	-5	5	2	0	0	99	0.000065671	0
42		MoveParm_B_seas_1__morph_2_from_2_to_3_	0.1	fixed	-5	-5	5	0.1	0	0	99	-	-
43		MoveParm_A_seas_3__morph_1_from_3_to_1_	2	fixed	-5	-5	5	2	0	0	99	-	-
44		MoveParm_B_seas_3__morph_1_from_3_to_1_	0.1	fixed	-5	-5	5	0.1	0	0	99	-	-
45		MoveParm_A_seas_3__morph_2_from_3_to_2_	2	fixed	-5	-5	5	2	0	0	99	-	-
46		MoveParm_B_seas_3__morph_2_from_3_to_2_	0.1	fixed	-5	-5	5	0.1	0	0	99	-	-
47	Annual deviations for allocation of recruits among stocks by year	RecrDist-GP-2__DEV_1980_	-2.0855513	estimate	-	-	-	-	-	-	0	act	0
48		RecrDist-GP-2__DEV_1981_	-0.9910671	estimate	-	-	-	-	-	-	0	act	0
49		RecrDist-GP-2__DEV_1982_	0.62348615	estimate	-	-	-	-	-	-	0	act	0
50		RecrDist-GP-2__DEV_1983_	-1.7369216	estimate	-	-	-	-	-	-	0	act	0
51		RecrDist-GP-2__DEV_1984_	-1.5926317	estimate	-	-	-	-	-	-	0	act	0
52		RecrDist-GP-2__DEV_1985_	-1.5726618	estimate	-	-	-	-	-	-	0	act	0
53		RecrDist-GP-2__DEV_1986_	-0.8222582	estimate	-	-	-	-	-	-	0	act	0
54		RecrDist-GP-2__DEV_1987_	-0.5150052	estimate	-	-	-	-	-	-	0	act	0
55		RecrDist-GP-2__DEV_1988_	-0.1776492	estimate	-	-	-	-	-	-	0	act	0
56		RecrDist-GP-2__DEV_1989_	-1.6212822	estimate	-	-	-	-	-	-	0	act	0
57		RecrDist-GP-2__DEV_1990_	0.67790123	estimate	-	-	-	-	-	-	0	act	0
58		RecrDist-GP-2__DEV_1991_	0.79170524	estimate	-	-	-	-	-	-	0	act	0
59		RecrDist-GP-2__DEV_1992_	0.78928225	estimate	-	-	-	-	-	-	0	act	0
60		RecrDist-GP-2__DEV_1993_	0.99963926	estimate	-	-	-	-	-	-	0	act	0
61		RecrDist-GP-2__DEV_1994_	0.76122327	estimate	-	-	-	-	-	-	0	act	0
62		RecrDist-GP-2__DEV_1995_	0.39775428	estimate	-	-	-	-	-	-	0	act	0
63		RecrDist-GP-2__DEV_1996_	-0.9136023	estimate	-	-	-	-	-	-	0	act	0
64		RecrDist-GP-2__DEV_1997_	-0.2511893	estimate	-	-	-	-	-	-	0	act	0
65		RecrDist-GP-2__DEV_1998_	0.36054831	estimate	-	-	-	-	-	-	0	act	0
66		RecrDist-GP-2__DEV_1999_	0.96743332	estimate	-	-	-	-	-	-	0	act	0
67		RecrDist-GP-2__DEV_2000_	1.12202325	estimate	-	-	-	-	-	-	0	act	0
68		RecrDist-GP-2__DEV_2001_	1.10322335	estimate	-	-	-	-	-	-	0	act	0
69		RecrDist-GP-2__DEV_2002_	0.30909735	estimate	-	-	-	-	-	-	0	act	0
70		RecrDist-GP-2__DEV_2003_	1.06155355	estimate	-	-	-	-	-	-	0	act	0
71		RecrDist-GP-2__DEV_2004_	1.33691365	estimate	-	-	-	-	-	-	0	act	0
72		RecrDist-GP-2__DEV_2005_	0.76408638	estimate	-	-	-	-	-	-	0	act	0
73		RecrDist-GP-2__DEV_2006_	0.21396839	estimate	-	-	-	-	-	-	0	act	0
74	Stock recruitment	SR_R0	9.28588	estimate	2	7	19	9	10	-1	10	0	0
75		SR_steep	0.999	fixed	-3	0.2	1	0.999	0.55	1	0.2	-	-
76		SR_sigmaR	0.5	fixed	-3	0	2	0.5	0.5	-1	0.8	-	-
77		SR_envlink	0	fixed	-3	-5	5	0	0	1	0.2	-	-
78		SR_R1_offset	-0.184469	estimate	3	-5	5	0	0	-1	1	0	0
79		SR_autocorr	0	fixed	-3	-5	5	0	0	-1	1	-	-
80	Initial Age composition	InitAgeComp_6_	-0.0437415	estimate	-	-	-	-	-	-	-	-	0
81		InitAgeComp_5_	-0.140292	estimate	-	-	-	-	-	-	-	-	0
82		InitAgeComp_4_	-0.438879	estimate	-	-	-	-	-	-	-	-	0
83		InitAgeComp_3_	0.190503	estimate	-	-	-	-	-	-	-	-	0
84		InitAgeComp_2_	0.519556	estimate	-	-	-	-	-	-	-	-	0
85		InitAgeComp_1_	0.65999	estimate	-	-	-	-	-	-	-	-	0
86	Annual recruitment deviations by year	RecrDev_1980_	-0.629578	estimate	-	-	-	-	-	-	-	-	0
87		RecrDev_1981_	-0.359899	estimate	-	-	-	-	-	-	-	-	0
88		RecrDev_1982_	-0.160813	estimate	-	-	-	-	-	-	-	-	0
89		RecrDev_1983_	-0.69418	estimate	-	-	-	-	-	-	-	-	0
90		RecrDev_1984_	-0.179938	estimate	-	-	-	-	-	-	-	-	0
91		RecrDev_1985_	-0.0765847	estimate	-	-	-	-	-	-	-	-	0
92		RecrDev_1986_	-0.31196	estimate	-	-	-	-	-	-	-	-	0
93		RecrDev_1987_	-0.44044	estimate	-	-	-	-	-	-	-	-	0
94		RecrDev_1988_	0.0323518	estimate	-	-	-	-	-	-	-	-	0
95		RecrDev_1989_	0.377334	estimate	-	-	-	-	-	-	-	-	0
96		RecrDev_1990_	0.0527305	estimate	-	-	-	-	-	-	-	-	0
97		RecrDev_1991_	-0.110961	estimate	-	-	-	-	-	-	-	-	0
98		RecrDev_1992_	-0.230709	estimate	-	-	-	-	-	-	-	-	0
99		RecrDev_1993_	0.0854286	estimate	-	-	-	-	-	-	-	-	0
100		RecrDev_1994_	0.268557	estimate	-	-	-	-	-	-	-	-	0
101		RecrDev_1995_	0.210239	estimate	-	-	-	-	-	-	-	-	0
102		RecrDev_1996_	-0.0439436	estimate	-	-	-	-	-	-	-	-	0
103		RecrDev_1997_	0.109606	estimate	-	-	-	-	-	-	-	-	0
104		RecrDev_1998_	0.144346	estimate	-	-	-	-	-	-	-	-	0
105		RecrDev_1999_	-0.281781	estimate	-	-	-	-	-	-	-	-	0

106		RecrDev_2000_	-0.0014869	estimate	-	-	-	-	-	-	-	-		0
107		RecrDev_2001_	0.180192	estimate	-	-	-	-	-	-	-	-		0
108		RecrDev_2002_	0.164581	estimate	-	-	-	-	-	-	-	-		0
109		RecrDev_2003_	0.402208	estimate	-	-	-	-	-	-	-	-		0
110		RecrDev_2004_	0.364357	estimate	-	-	-	-	-	-	-	-		0
111		RecrDev_2005_	0.15005	estimate	-	-	-	-	-	-	-	-		0
112		RecrDev_2006_	0.233156	estimate	-	-	-	-	-	-	-	-		0
113	Initial Fishing mortality by fleet	InitF_1_	0.0110862	estimate	1	0.00000001	1	0.00883028	0.01	-1	99		0	0
114		InitF_2_	0.1995	estimate	1	0.00000001	1	0.13315	0.01	-1	99		0	0
115		InitF_3_	0.00089756	estimate	1	0.00000001	1	0.00096555	0.01	-1	99		0	0
116		InitF_4_	0	fixed	-1	0	1	0	0.01	-1	99	-	-	
117		InitF_5_	0.129477	estimate	1	1.00E-08	1	0.00431874	0.01	-1	99		0	0
118		InitF_6_	0.33981	estimate	1	1.00E-08	1	0.0263462	0.01	-1	99		0	0
119		InitF_7_	0.00963845	estimate	1	1.00E-08	1	0.00976714	0.01	-1	99		0	0
120		InitF_8_	0	fixed	-1	0	1	0	0.01	-1	99	-	-	
121		InitF_9_	0.796864	estimate	1	1.00E-08	1.5	0.8	0.01	-1	99		0	0
122		InitF_10_	0.0776157	estimate	1	1.00E-08	1	0.0202789	0.01	-1	99		0	0
123		InitF_11_	0.00502827	estimate	1	1.00E-08	1	0.00627982	0.01	-1	99		0	0
124	Size Selectivity by fleet	SizeSel_1_P_1_	78.9672	estimate	2	40	120	74.21	80	-1	99		0	0
125		SizeSel_1_P_2_	-0.725048	estimate	4	-6.00E+00	4	-2.6	-2.6	1	0.1		0.000298841	0
126		SizeSel_1_P_3_	5.50077	estimate	2	-1.00E+00	30	20	20	-1	99		0	0
127		SizeSel_1_P_4_	3.00723	estimate	2	-1.00E+00	30	20	20	-1	99		0	0
128		SizeSel_1_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
129		SizeSel_1_P_6_	-0.804285	estimate	2	-5	9	1	1	-1	99		0.00E+00	0
130		SizeSel_2_P_1_	86.9719	estimate	2	40	120	80	80	-1	99		0	0
131		SizeSel_2_P_2_	-0.978644	estimate	4	-6	4	-2.6	-2.6	1	0.1		-2.17571E-06	0
132		SizeSel_2_P_3_	6.38429	estimate	2	-1	30	20	20	-1	99		0	0
133		SizeSel_2_P_4_	22.6145	estimate	2	-1.5	35	30	20	-1	99		0	0
134		SizeSel_2_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
135		SizeSel_2_P_6_	8.99828	estimate	2	-5	9	1	1	-1	99		0	0
136		SizeSel_3_P_1_	58.0984	estimate	2	40	90	70	70	-1	99		0	0
137		SizeSel_3_P_2_	-4.04487	estimate	4	-6	4	-2.6	-2.6	1	0.1		0.0463319	0
138		SizeSel_3_P_3_	-0.999977	estimate	2	-1	30	20	20	-1	99		0	0
139		SizeSel_3_P_4_	31.7302	estimate	2	-1	35	30	20	-1	99		0	0
140		SizeSel_3_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
141		SizeSel_3_P_6_	-7.9972	estimate	2	-8	-5	1	1	-1	99		0	0
142	Headboat discard selectivity	Retain_3_P_1_	10	fixed	-3	5	70	10	40	0	99	-	-	
143		Retain_3_P_2_	0.100004	estimate	2	0.1	30	10	10	0	99		0.005	0
144		Retain_3_P_3_	1	fixed	-3	0.001	1	1	1	0	99	-	-	
145		Retain_3_P_4_	0	fixed	-3	-10	10	0	0	0	99	-	-	
146		DiscMort_3_P_1_	1	fixed	-3	1	70	1	10	0	99	-	-	
147		DiscMort_3_P_2_	9	fixed	-3	0.1	10	9	1	0	99	-	-	
148		DiscMort_3_P_3_	0.33	fixed	-3	0.001	1	0.33	1	0	99	-	-	
149		DiscMort_3_P_4_	0	fixed	-3	-10	10	0	0	0	99	-	-	
150	Size Selectivity by fleet	SizeSel_5_P_1_	90.4156	estimate	2	40	120	80	80	-1	99		0	0
151		SizeSel_5_P_2_	0.511886	estimate	4	-6	4	-2.6	-2.6	1	0.1		0.00958415	0
152		SizeSel_5_P_3_	6.26941	estimate	2	-1	30	20	20	-1	99		0	0
153		SizeSel_5_P_4_	17.0815	estimate	2	-1	30	20	20	-1	99		0	0
154		SizeSel_5_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
155		SizeSel_5_P_6_	0.249267	estimate	2	-5	9	1	1	-1	99		0	0
156		SizeSel_6_P_1_	94.5633	estimate	2	40	120	80	80	-1	99		0	0
157		SizeSel_6_P_2_	-0.977317	estimate	4	-6	4	-2.6	-2.6	1	0.1		-1.94199E-06	0
158		SizeSel_6_P_3_	6.70736	estimate	2	-1	30	20	20	-1	99		0	0
159		SizeSel_6_P_4_	18.0972	estimate	2	-1	30	20	20	-1	99		0	0
160		SizeSel_6_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
161		SizeSel_6_P_6_	8.99944	estimate	2	-5	9	1	1	-1	99		0	0
162		SizeSel_7_P_1_	85.0905	estimate	2	40	120	80	80	-1	99		0	0
163		SizeSel_7_P_2_	-4.24522	estimate	4	-6	4	-2.6	-2.6	1	0.1		0.0546829	0
164		SizeSel_7_P_3_	5.92666	estimate	2	-1	30	20	20	-1	99		0	0
165		SizeSel_7_P_4_	-0.999992	estimate	2	-1	30	20	20	-1	99		0	0
166		SizeSel_7_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
167		SizeSel_7_P_6_	1.15662	estimate	2	-5	9	1	1	-1	99		0	0
168		SizeSel_9_P_1_	73.7964	estimate	2	30	100	70	70	-1	99		0	0
169		SizeSel_9_P_2_	-7.59898	estimate	4	-8	4	-2.6	-2.6	1	0.1		0.204608	0
170		SizeSel_9_P_3_	5.72371	estimate	2	-1	30	20	20	-1	99		0	0
171		SizeSel_9_P_4_	5.19128	estimate	2	-1	30	20	20	-1	99		0	0
172		SizeSel_9_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
173		SizeSel_9_P_6_	-1.61064	estimate	2	-5	9	0	0	-1	99		0	0
174		SizeSel_10_P_1_	73.4048	estimate	2	40	120	80	80	-1	99		0	0
175		SizeSel_10_P_2_	-5.64258	estimate	4	-6	4	-2.6	-2.6	1	0.1		0.198125	0
176		SizeSel_10_P_3_	6.04999	estimate	2	-1	30	20	20	-1	99		0	0
177		SizeSel_10_P_4_	4.09389	estimate	2	-1	30	20	20	-1	99		0	0
178		SizeSel_10_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
179		SizeSel_10_P_6_	-0.0526983	estimate	2	-5	9	1	1	-1	99		0	0
180		SizeSel_11_P_1_	72.1612	estimate	2	40	120	80	80	-1	99		0	0
181		SizeSel_11_P_2_	-7.21426	estimate	4	-8	4	-2.6	-2.6	1	0.1		0.140733	0
182		SizeSel_11_P_3_	6.11855	estimate	2	-1	30	20	20	-1	99		0	0
183		SizeSel_11_P_4_	5.14826	estimate	2	-1	30	20	20	-1	99		0	0
184		SizeSel_11_P_5_	-5	fixed	-2	-5	9	-5	-5	-1	99	-	-	
185		SizeSel_11_P_6_	-2.17054	estimate	2	-5	9	1	1	-1	99		0	0
186	Age selectivity	AgeSel_1_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
187		AgeSel_1_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
188		AgeSel_2_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
189		AgeSel_2_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
190		AgeSel_3_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
191		AgeSel_3_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
192		AgeSel_4_P_1_	0	fixed	-2	0	25	0	5	-1	99	-	-	
193		AgeSel_4_P_2_	0	fixed	-2	0	25	0	6	-1	99	-	-	
194		AgeSel_5_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
195		AgeSel_5_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
196		AgeSel_6_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
197		AgeSel_6_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
198		AgeSel_7_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
199		AgeSel_7_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
200		AgeSel_8_P_1_	0	fixed	-2	0	25	0	5	-1	99	-	-	
201		AgeSel_8_P_2_	0	fixed	-2	0	25	0	6	-1	99	-	-	
202		AgeSel_9_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
203		AgeSel_9_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
204		AgeSel_10_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
205		AgeSel_10_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
206		AgeSel_11_P_1_	0	fixed	-2	0	25	0	0	-1	99	-	-	
207		AgeSel_11_P_2_	25	fixed	-2	0	25	25	25	-1	99	-	-	
208		AgeSel_12_P_1_	0	fixed	-2	0	25	0	5	-1	99	-	-	
209		AgeSel_12_P_2_	0	fixed	-2	0	25	0	6	-1	99	-	-	
210		AgeSel_13_P_1_	0	fixed	-2	0	25	0	5	-1	99	-	-	
211		AgeSel_13_P_2_	0	fixed	-2	0	25	0	6	-1	99	-	-	
212		AgeSel_14_P_1_	2	fixed	-2	0	25	2	2	-1	99	-	-	
213		AgeSel_14_P_2_	6	fixed	-2	0	25	6	6	-1	99	-	-	
214	Time block selectivity	Retain_3_P_1__BLK_1990_	30.48	fixed	-2	10	100	30.48	30	-1	99	-	-	
215		Retain_3_P_1__BLK_1992_	50.8	fixed	-2	10	100	50.8	50	-1	99	-	-	
216		Retain_3_P_1__BLK_2000_	60.96	fixed	-2	10	100	60.96	60	-1	99	-	-	

Table 12. General settings for assessment model runs of king mackerels stocks 2008.

Notes	General setting for model runs		
Continuity Run [1]	Same model with Growth parameters von B as (SEDAR5/MSAP03) last assessment to produce CAA		
	Sex ratios as (SEDAR5/MSAP03) 1985-1998, with 1998 apply to subsequent years		
	ALK => same protocol as in SEDAR5/MSAP03, by quearter/ combination ALK & SAR methods		
	wgt_at_age same vector as SEDAR5/MSAP03		
	Updated		
		Catch Commercial Recreational 2001-06	
		CAS 2001-06	
		CAA 1981-06	
		Only retained catch (AB1) MRFSS/HeadBt, no discards Com	
		Shrimp bycatch (GOM) age 0 GLM estimates	
		Indices: same estimation procedure as SEDAR5/MSAP03	
		Constant M at age (0.20 GOM; 0.15 ATL)	
Update VPA Runs	VPA2Box model updating Data and Parameters		
	Updated	Growth von B parameters (SEDAR16-dw-06) to produce CAA	
		Sex ratios 1985-2006 and applied to CAS to produce CAS by sex	
		ALK => 1995-06 by semester/ preferential ALK, SAR only 1981-84	
		wgt-at-age vector estimated from the age-size data using updated wgt~size relationship by stock/sex	
		M(age) Lorenzen's with value of 0.174 GOM, 0.160 ATL and Age Full selected 2 to age max 26 GOM, 24 ATL	
		Catch Commercial Recreational 2001-06 Fishing Year (Jul-Jun GOM / Apr-Mar ATL)	
		CAS 2001-06	
		CAA 1981-06	
		Retained catch (AB1) MRFSS/HeadBt and Dead discards (DeadB2), no discards Com	
		Shrimp bycatch (GOM/ATL) age 0 Fishing year schedule	
Combined stocks Run [4+]	SS3 Application of King mackerel migratory groups in Stock Synthesis Ver 3_B6		
	General sett	Two Growth Patterns (ie Migratory groups); 1 GOM, 2 ATL	
			2: vonB growth models, Natural mortality, Fecundity vector,
		Two sex groups; 1 Fem 2 Mal	
			2x2 vonB growth model, M(age) by sex, wgt_at_size by sex
		3 Areas: 1 GOM, 2 ATL, 3 MIX	
			Areas 1, 2 are the no-mixing definitions for each migratory group
			Mix area: Volusia to Monroe (all year)
		4 season; 1 Jul-Oct, 2 Nov-Dec, 3 Jan-Mar, 4 Apr-Jun	
			Year in SS3 is then set to run as Jul - Jun of next calendar year
		Movement between Areas	

Growth Pattern	Area from	Area to	Season	Note
1 (GOM)	1	3	end of Oct	by groups of ages; 1-10 preferential
1 (GOM)	3	1	end of Apr	as above
2 (ATL)	2	3	end of Oct	by groups of ages; 1-10 preferential
2 (ATL)	3	2	end of Apr	as above

Spawning	Jul (season 1)	
Stock-Recruitm	no relationship, estimate R0 and deviations by year/Growth Pattern	
Recruits	split between GOM (1) and ATL (2) by year	
Observations	Catch by fishery	11 fisheries, Com, MRFSS, Hbt, Shrim Byc by area
	Indices/Surveys	11 Indices and 3 surveys; @ index is the year estimate assigned to a season
	Discards	for Hboat fisheries in each area
		20%*B2 (MRFSS) added to MRFSS catch (AB1)
	Size_composition	by fishery, sex (F, M, C), year, season
		Min sample size 75 size obs per record
		N sample adjusted to 75-450, >450 = 450
	Age_composition	by fishery, sex (F, M), year, season
		Min sample size 50 size obs per record
	Stock_composition	annual proportions base on the otolith microchemistry
		for 2001/02 in mixing area

Table 13. Dimensions and codes associated for the SS3 king mackerel model structure 2008. Year in SS3 starts in Jul 1st and end on Jun 30th of following calendar year.

GP	Name
1	GOM
2	ATL

Gender	Name
1	Fem
2	Mal

Area	Name
1	GOM
2	ATL
3	MIX

Season	Months
1	Jul - Oct
2	Nov - Dec
3	Jan - Mar
4	Apr - Jun

Fleet	Name
1	ATL_Com
2	ATL_MRFSS
3	ATL_HBt
4	ATL_SHB
5	GOM_Com
6	GOM_MRFSS
7	GOM_HBt
8	GOM_SHB
9	MIX_Com
10	MIX_MRFSS
11	MIX_HBt

Index	Name	Fleet associated	AW used
1	NC-PID8+	ATL_ComHL	Yes
2	MRFSS-ATL	ATL_MRFSS	Yes
3	HB-ATL	ATL_HB	Yes
4	SEAMAP_ATL	ATL_Shbyc	Yes
5	FL_TT_GLFnoMix	GOM_ComHL	No
6	MRFSS-Gulf	GOM_MRFSS	Yes
7	HB-Gulf	GOM_HB	Yes
8	ShrimpBycatch Gulf	GOM_Shbyc	No
9	FL_TT_Mixing	MIX_ComHL	No
10	MRFSS-Mixing	MIX_MRFSS	Yes
11	HB-Mixing	MIX_HB	Yes
12	FALL_Plankton_GOM	Survey	Yes
13	FALL_Groundfish_GOM	Survey	Yes
15	LBOOK_ATLnoMix	ATL_ComHL	No
16	LBOOK_GLFnoMix	GOM_ComHL	Yes
17	LBOOK_Mix	MIX_ComHL	Yes

Table 14. Updated base run (run24) king mackerel stocks SS3 likelihood, likelihood components, and variance adjustments to input values.

LIKELIHOOD	**11283.1**		
Component	logL*Lambda	Lambda	% likelihood
TOTAL	11283.100		
catch	0.000		0%
indices	-116.033		-1%
discard	-1706.950		-15%
length_comps	9208.020		82%
age_comps	3878.000		34%
Morphcomp	8.247	1	0%
Equil_catch	0.006	1	0%
Recruitment	-15.044	1	0%
Forecast_Recruitment	0.000	1	0%
Parm_priors	0.668	1	0%
Parm_devs	26.136	1	0%
Crash_Pen	0.000	1	0%

Fleet:	ALL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Catch_lambda:	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Catch_like:	4.2E-05	3.9E-06	2.7E-06	4.9E-07	7.8E-08	4.8E-06	3.1E-06	3.0E-06	2.4E-05	1.9E-07	2.0E-07	1.2E-07	0	0	0
Surv_lambda:	--	1	1	1	1	1	1	1	0	1	1	1	1	1	0
Surv_like:	-86.77	-11.05	4.46	-5.97	11.57	-8.98	-10.67	-9.97	0.00	-16.49	-14.45	-20.56	-6.07	1.42	0
Disc_lambda:	--	0	0	10	0	0	0	10	0	0	0	10	0	0	0
Disc_like:	-1082.86	0.00	0.00	-149.91	0.00	0.00	0.00	18.51	0.00	0.00	0.00	23.11	0	0	0
Length_lambda:	--	1	1	1	0	1	1	1	0	1	1	1	0	0	0
Length_like:	9746.3	970.2	912.0	60.9	0.0	1713.2	1363.8	362.5	0.0	2670.3	597.4	1096.0	0	0	0
Age_lambda:	--	1	1	0	0	1	1	1	0	1	1	1	0	0	0
Age_like:	4158.9	1054.2	195.8	0.0	0.0	665.0	625.6	56.0	0.0	1181.5	357.7	23.1	0	0	0

Variance_adjustments_to_input_values

Fleet	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Index_extra_CV	0.2	0.2	0.2	0	0.2	0	0.2	0.2	0	0	0	0.2	0.2	0
Discard_extra_CV	0	0	0.2	0	0	0	0.2	0	0	0	0.2	0	0	0
MeanBodyWt_extra_CV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
effN_mult_Lencomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Agecomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Len-at-age	1	1	1	1	1	1	1	1	1	1	1	1	1	1

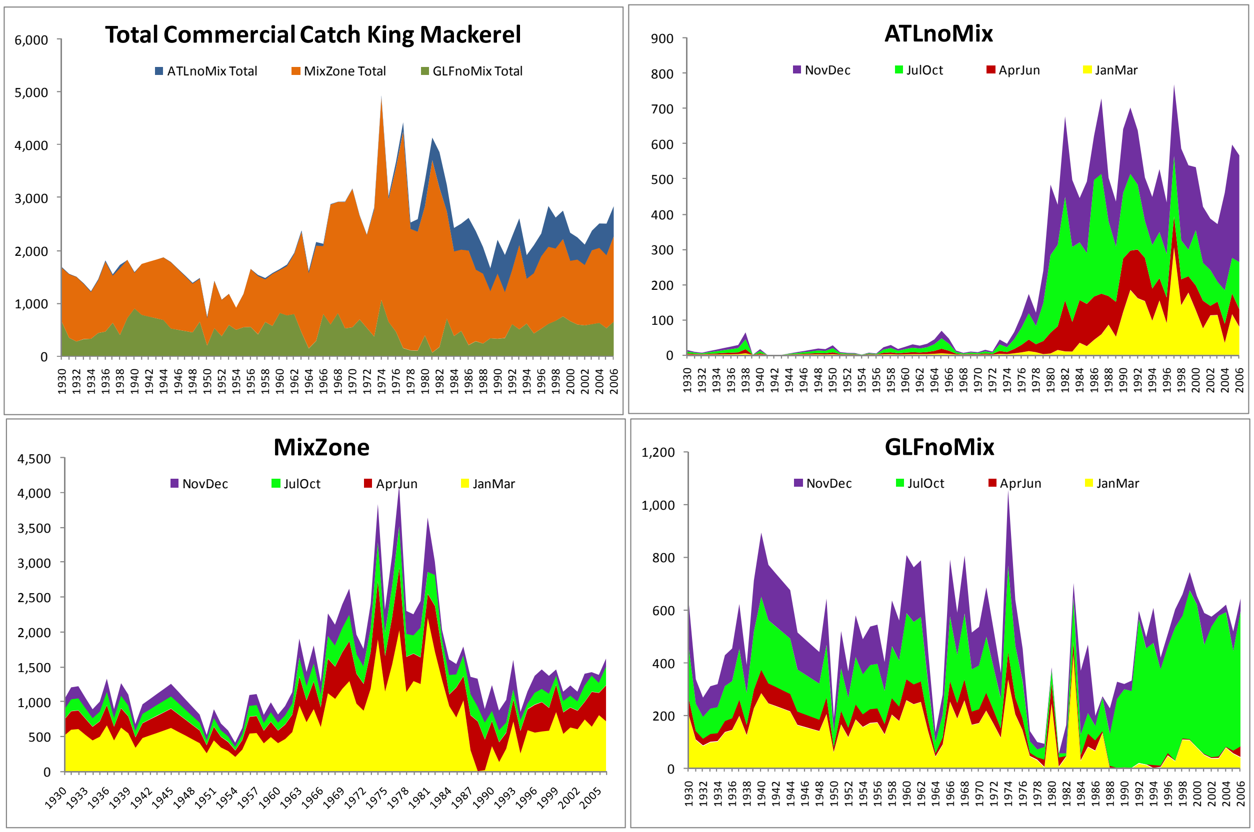


Figure 1. King mackerel commercial catch (t) 1930-2006 by area and season. Top-left panel shows all areas catch together, other panels shows the catch by area and season.

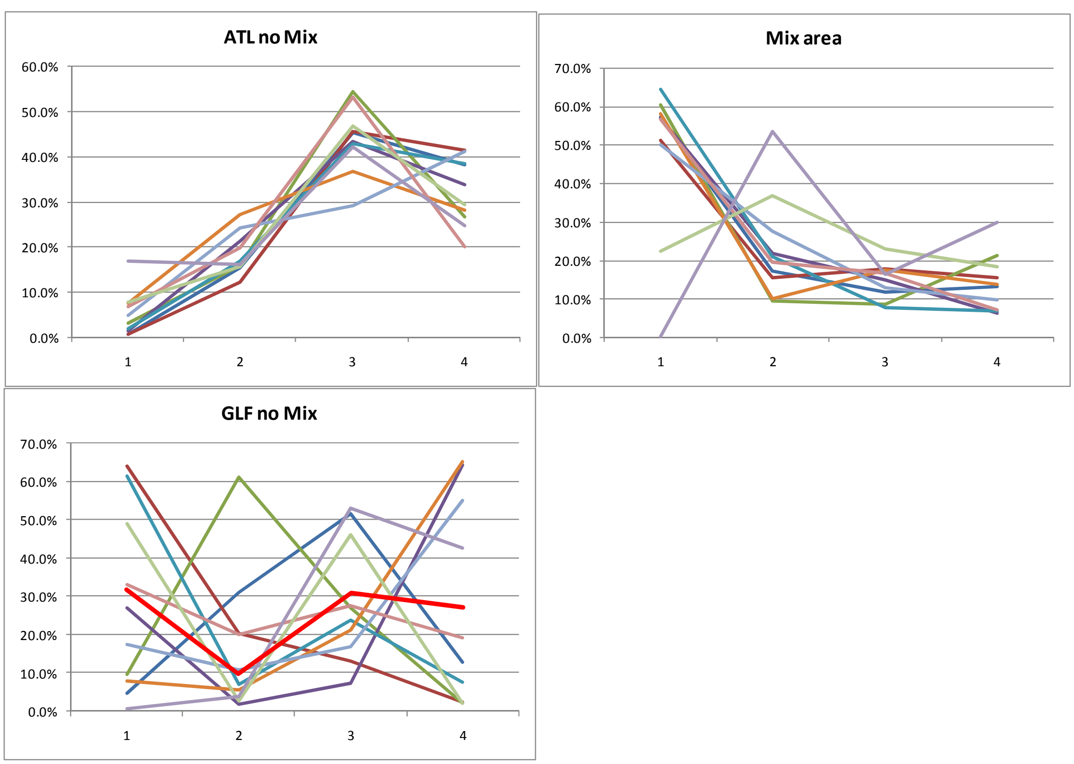


Figure 2. Proportion of seasonal commercial catch king mackerel by area 1979-1989. The average proportion by season was used to split historical commercial catch (1930-1978).

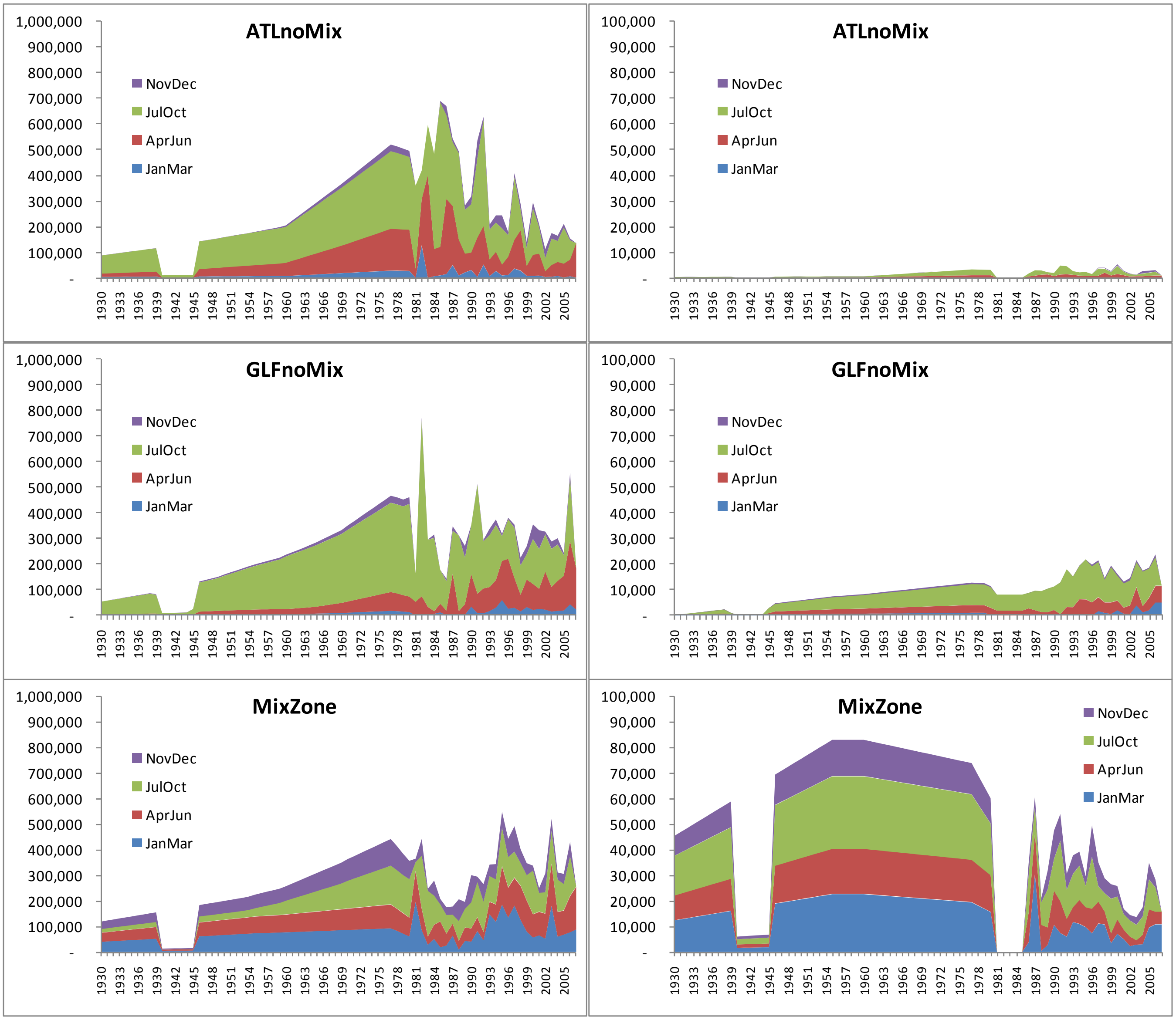


Figure 3. Compiled and estimated recreational catch (numbers of fish) by area, season and fishery. Plots in left column represent the MRFSS estimates which include the dead B2 discard numbers, plots in the right column represent the Headboat recreational estimates. Notice that y-axis scale is different between columns.

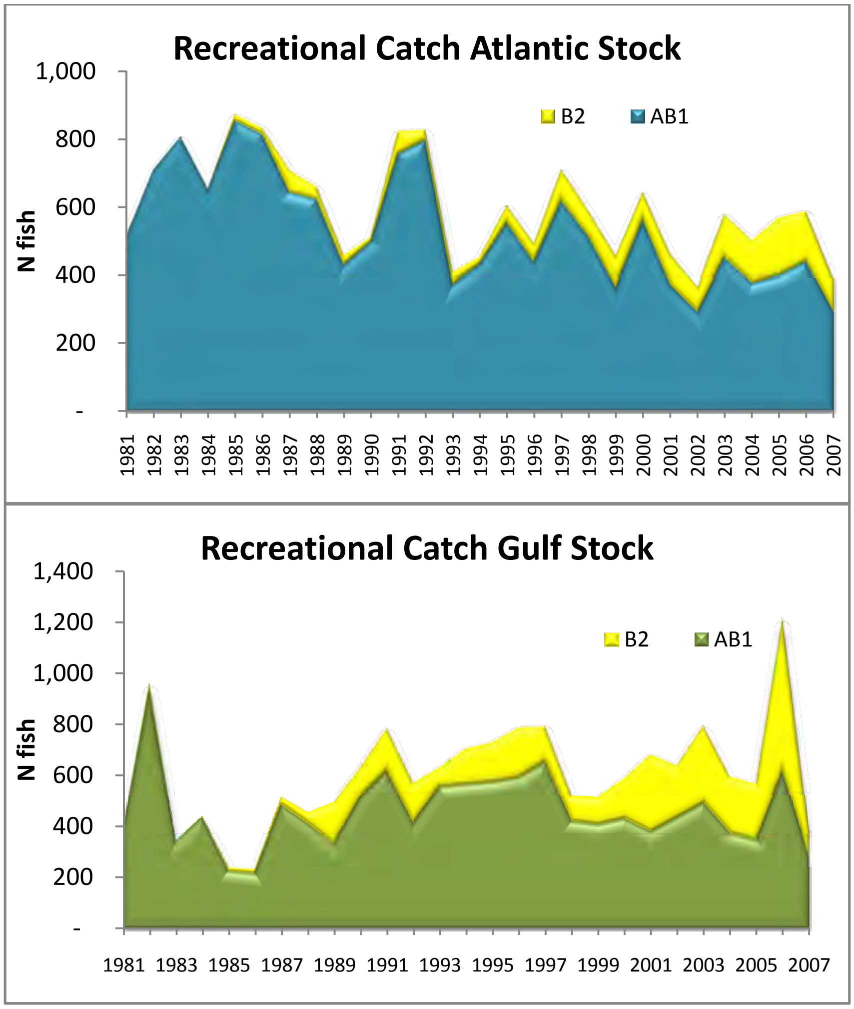


Figure 4. Estimates of recreational catch retained fish AB1 and live releases B2 from MRFSS by stock 1981-2007.

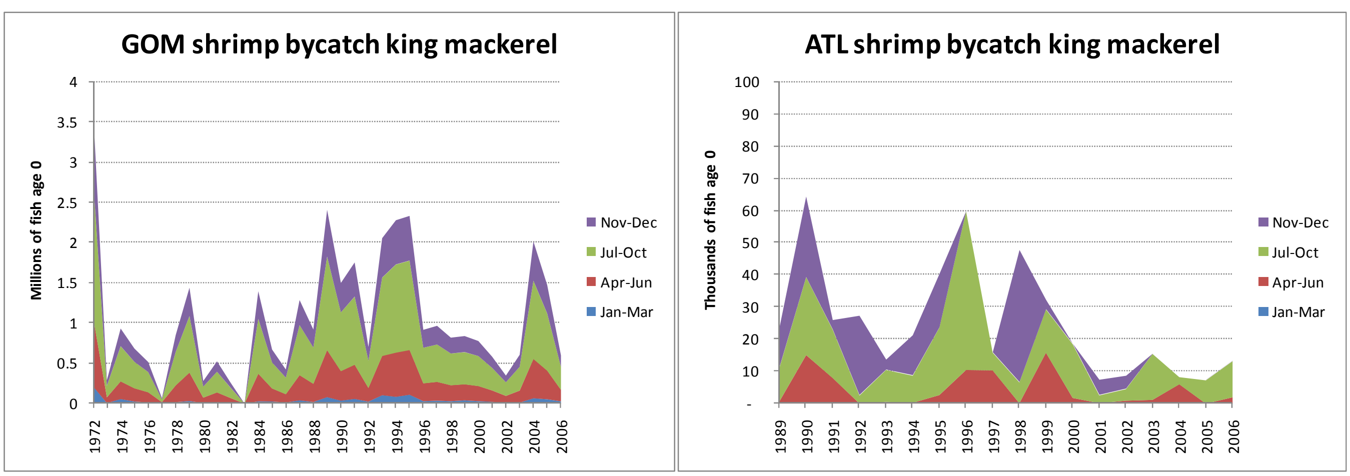


Figure 5. Estimates of shrimp bycatch removals of king mackerel by area and season.

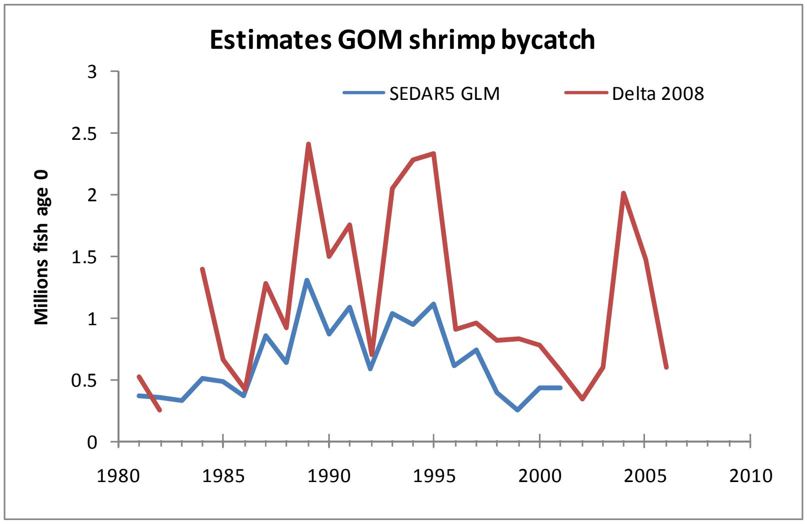


Figure 6. Estimates of shrimp bycatch GOM used in prior assessment SEDAR 5 (GLM model) and current available estimates.

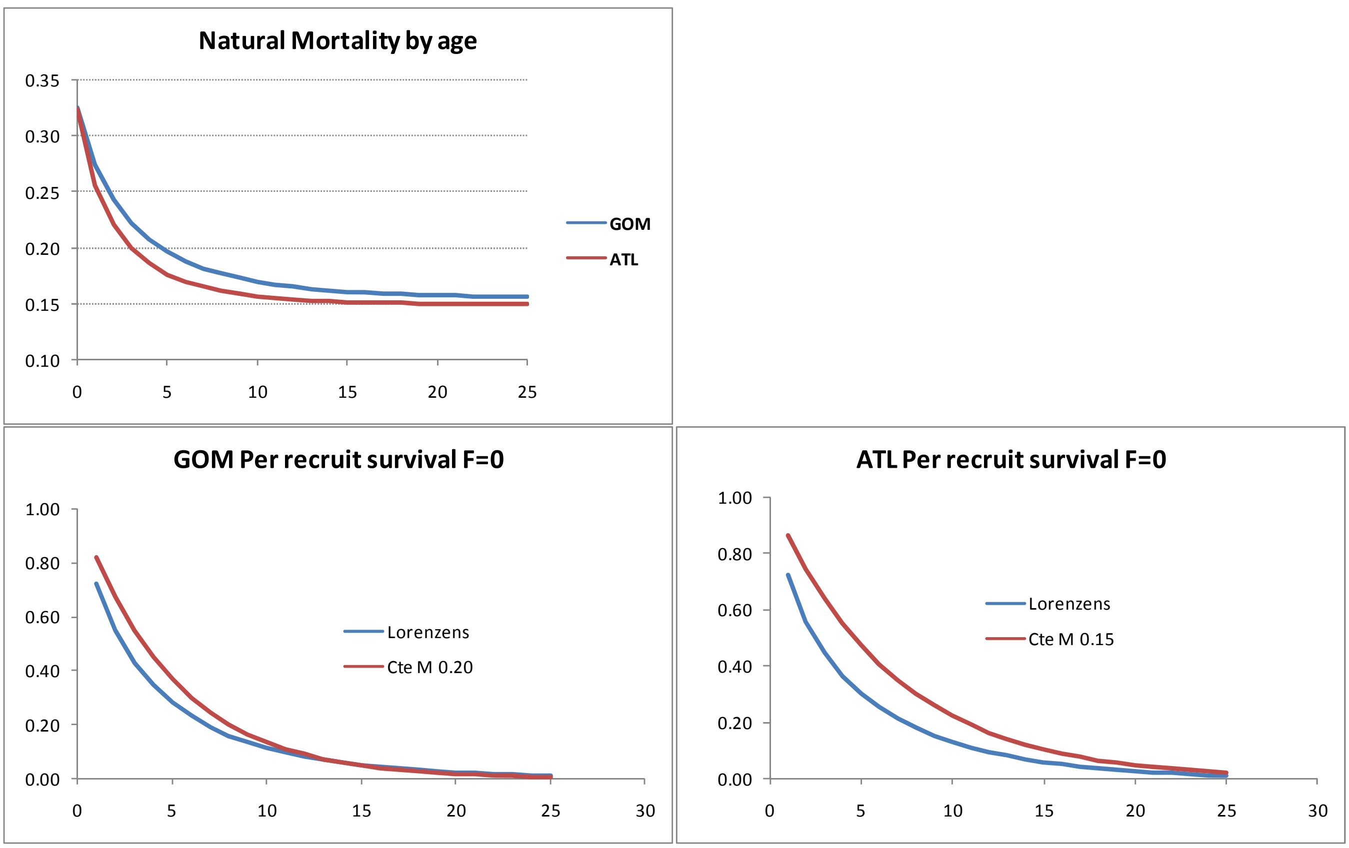


Figure 7. Natural mortality by age (top) for GOM and ATL king mackerel stock estimated by the Lorenzen's model with an overall M of 0.174 (GOM) and 0.160 (ATL) assuming age 2 as fully selective age reference. Bottom plots shows the estimated per recruit survival under the M(age) and constant M assumptions, with no fishing mortality.

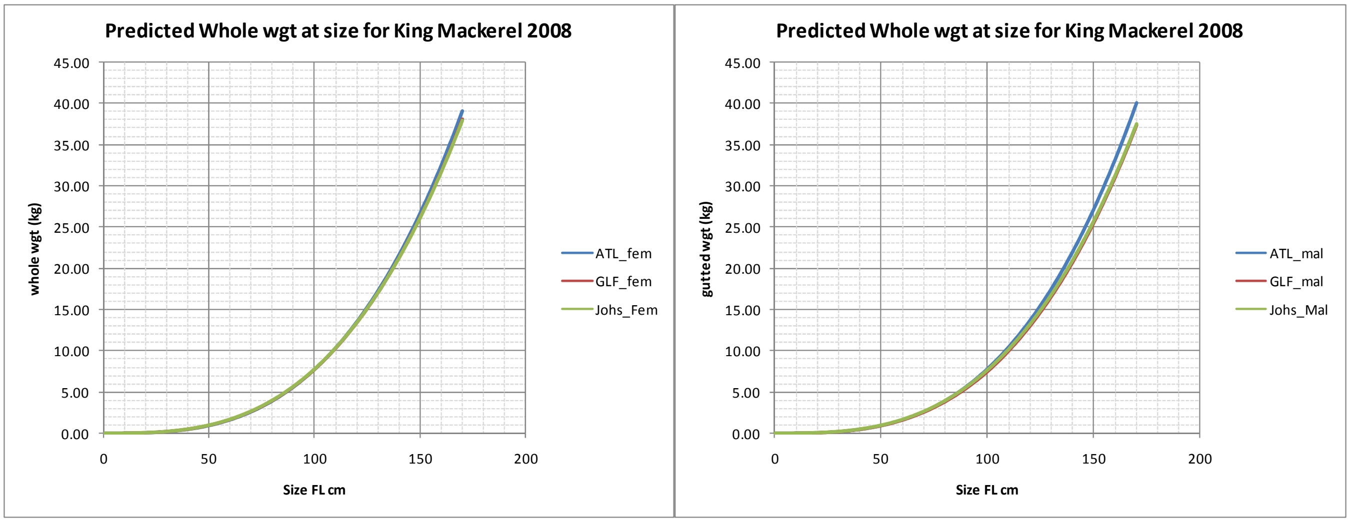


Figure 8. Predicted whole weight (kg) as function of size by sex and stock compared to Johnson's et al (1982) model.

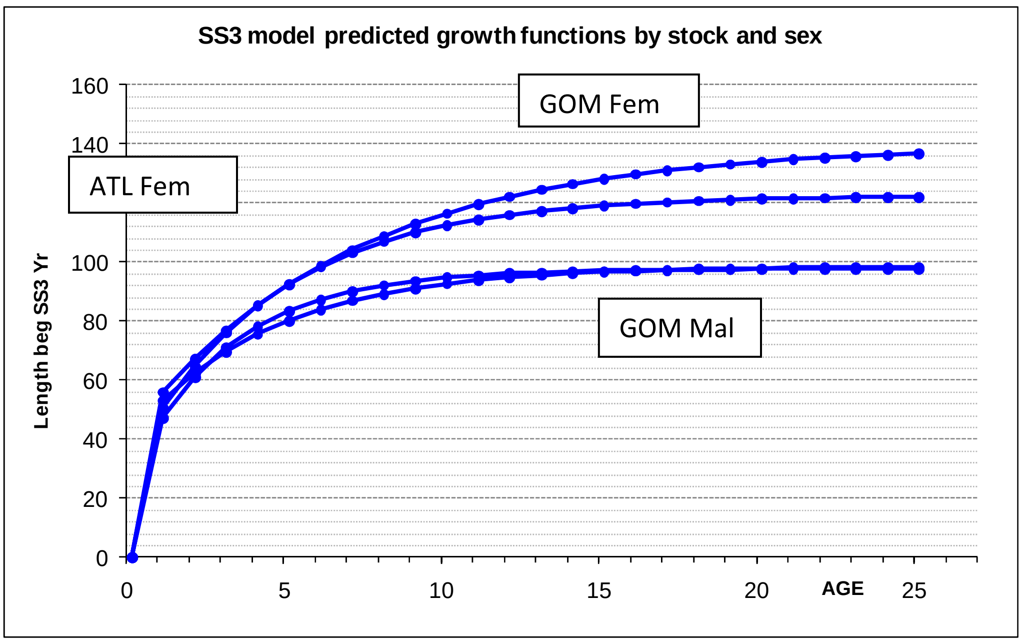


Figure 9. SS3 model predicted growth functions for ATL and GOM stocks by sex. Top line, GOM females, middle line ATL females, and the two lower lines are the GOM and ATL males. Von Bertalanffy growth was assumed to start at age1, from recruitment into the population up to size at age 1, SS3 assumed a linear growth for all growth morphs.

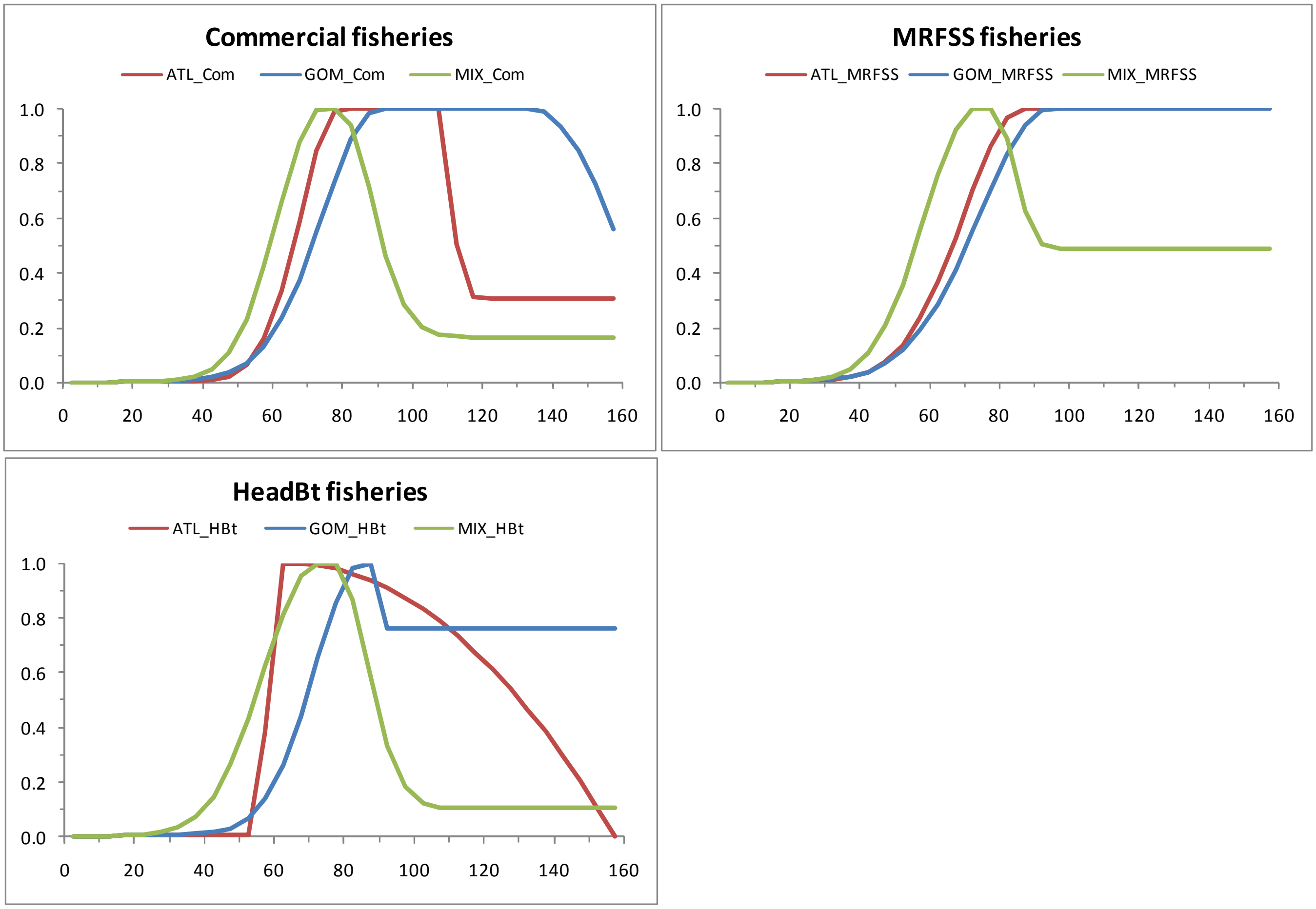


Figure 10. SS3 estimated size based selectivity curves for the fleets catching king mackerel by area and fishery type. For the Headboat fisheries, plots shown are the retained and discarded curve.

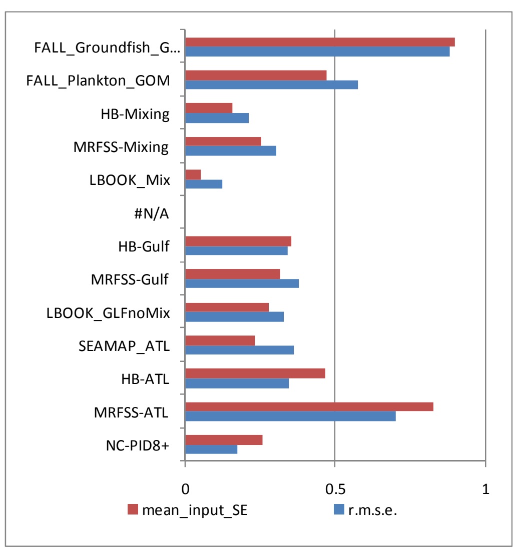


Figure 11. Estimated residual mean square error by SS3 and the input variance for each index.

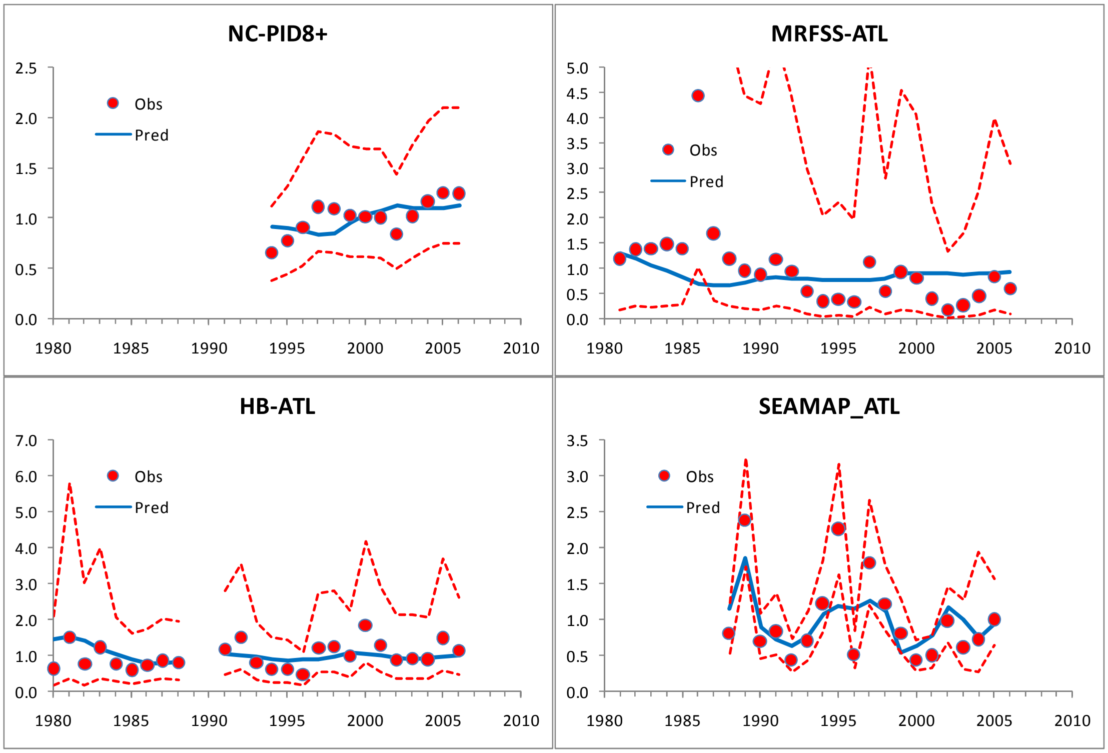


Figure 12. Indices of abundance observed (dots) with +2 stdev margins and predicted trend (solid line) by the SS3 model for the ATL area.

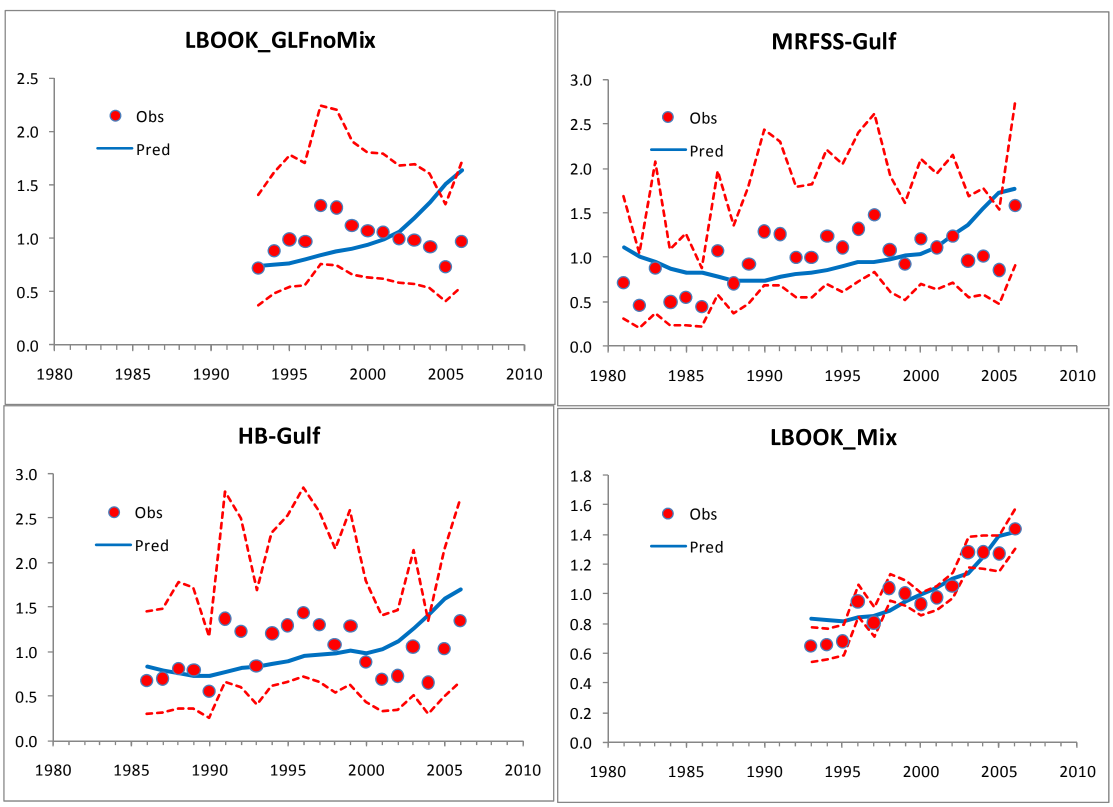


Figure 13. Indices of abundance observed (dots) with +2 stdev margins and predicted trend (solid line) by the SS3 model for the GOM area.

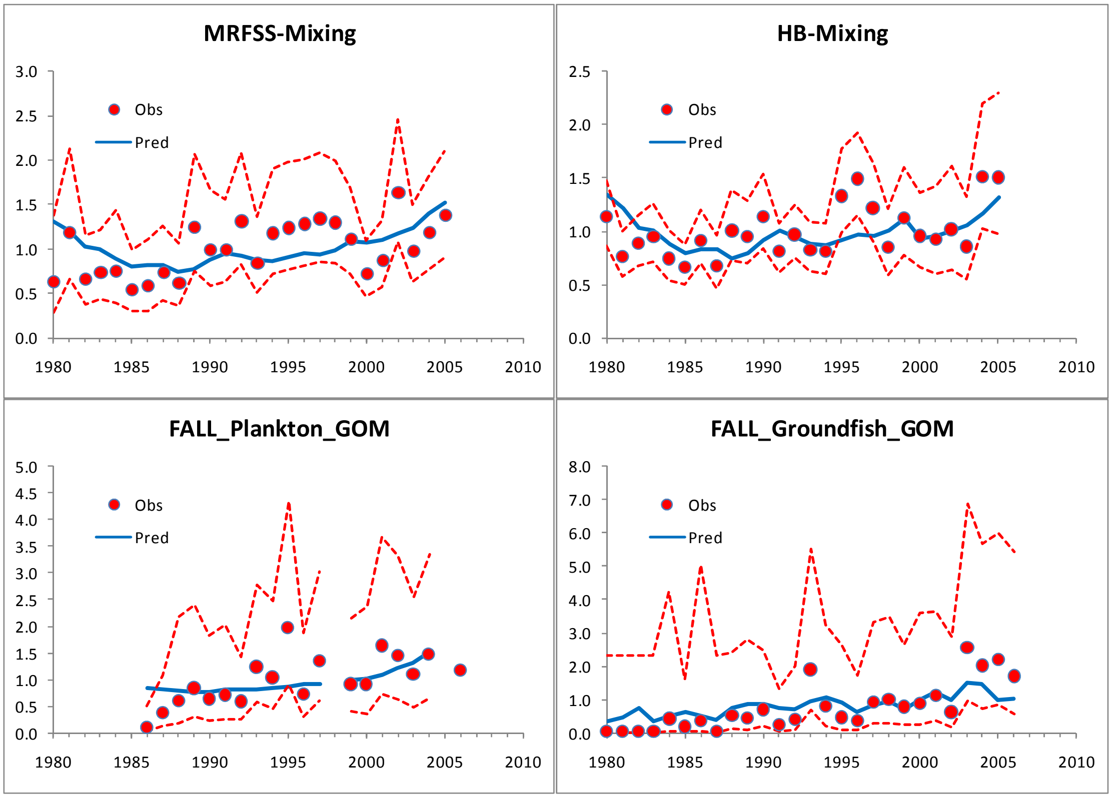


Figure 14. Indices of abundance observed (dots) with +2 stdev margins and predicted trend (solid line) by the SS3 model for the MIX area.

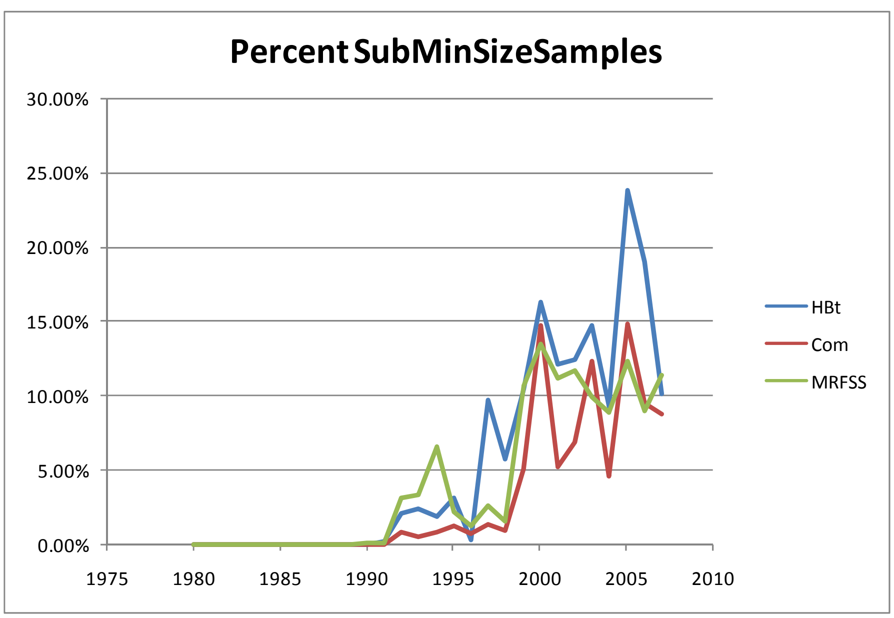


Figure 15. Proportion of sublegal size king mackerel by major fishery estimated from the size composition input data by year. Minimum size regulations started in 1990 with 30.8 cm (12 in), then increased to 51 cm (20 in) in 1992, and again to 61 cm (24 in) in 1999.

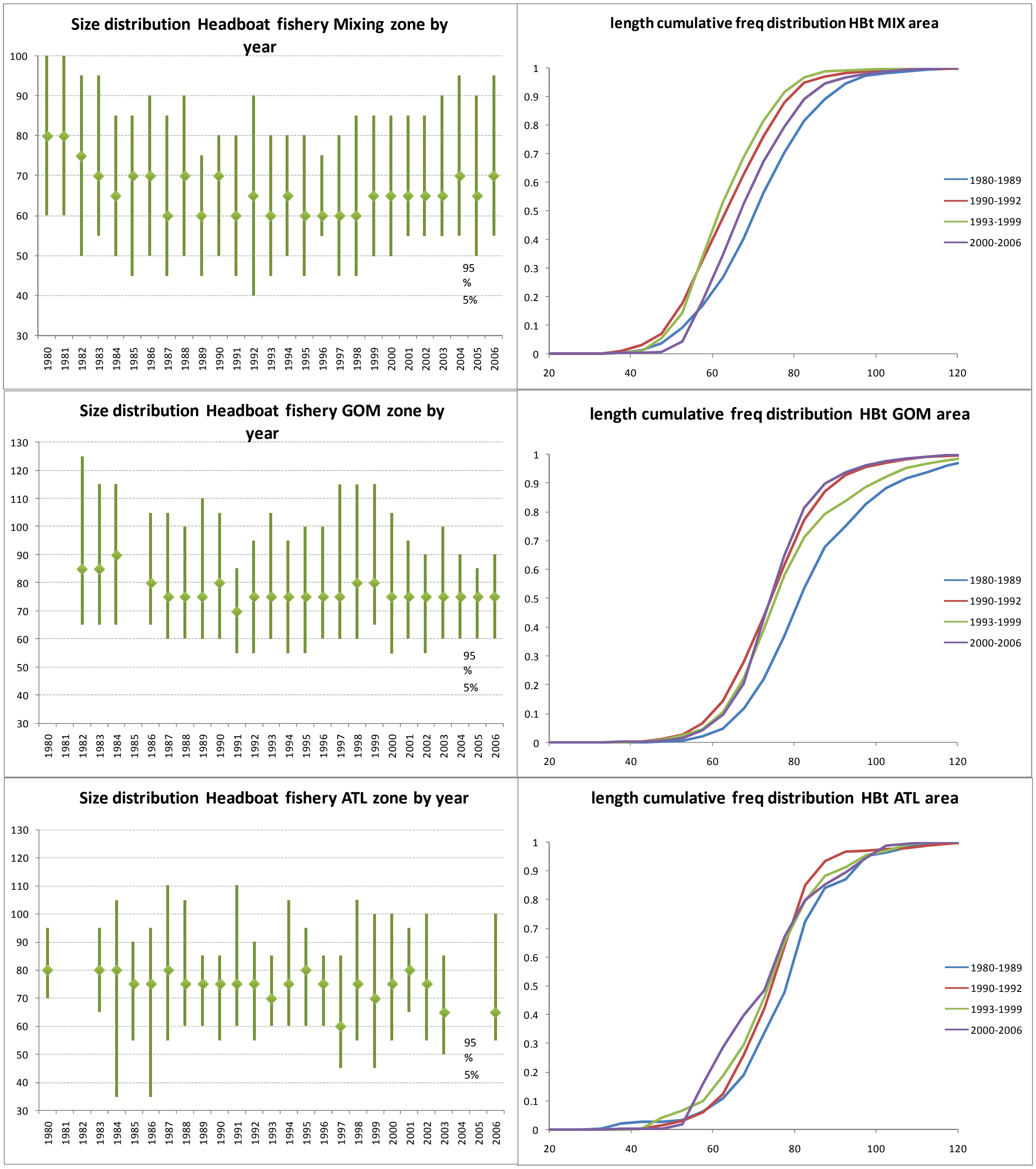
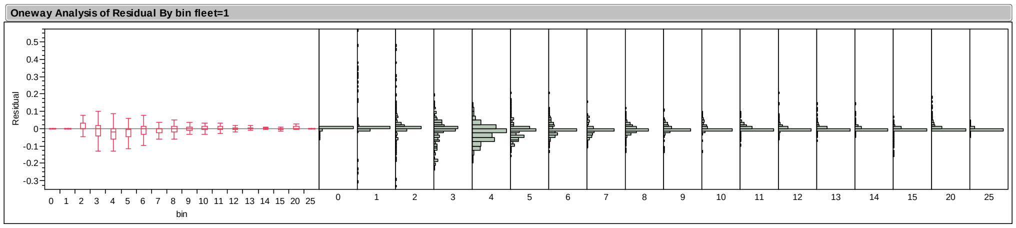
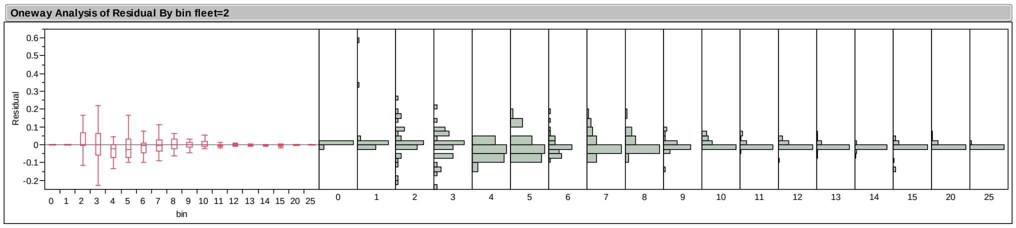


Figure 16. Evaluation of the size composition data for headboat fisheries by area and year. The Left column shows the size distribution by year with the median and 5%-95% percentile of the distribution, the right column shows the size cumulative frequency distributions, grouped by years of constant minimum size regulation: 1980-1989 no minimum size, 1990-92 31 cm (12”), 1993-99 51 cm (20”), and 2000 forwards 61 cm (24”).

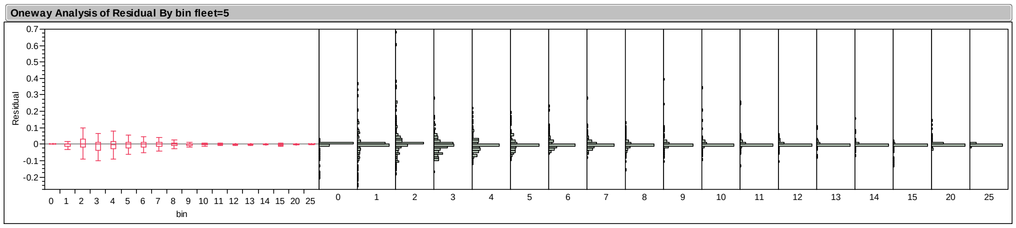
Oneway Analysis of Residual By bin fleet=1



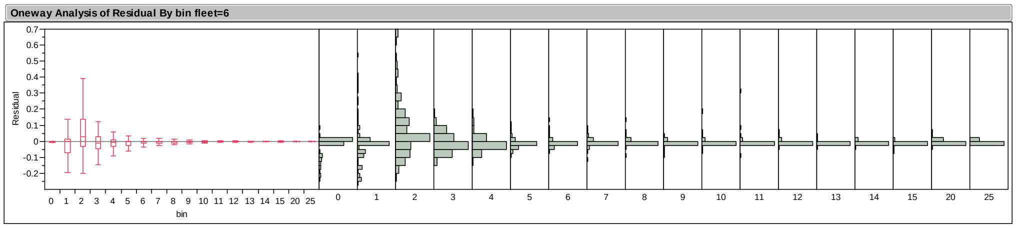
Oneway Analysis of Residual By bin fleet=2



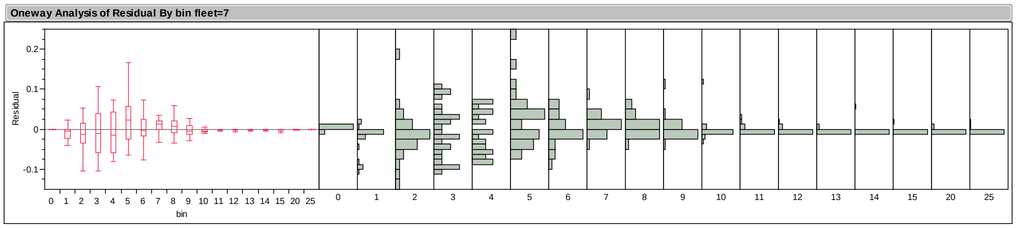
Oneway Analysis of Residual By bin fleet=5



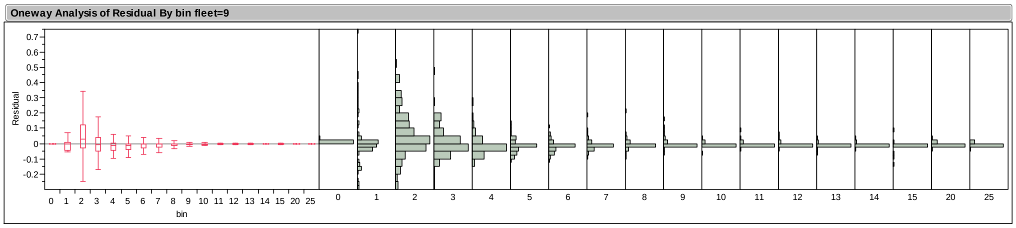
Oneway Analysis of Residual By bin fleet=6



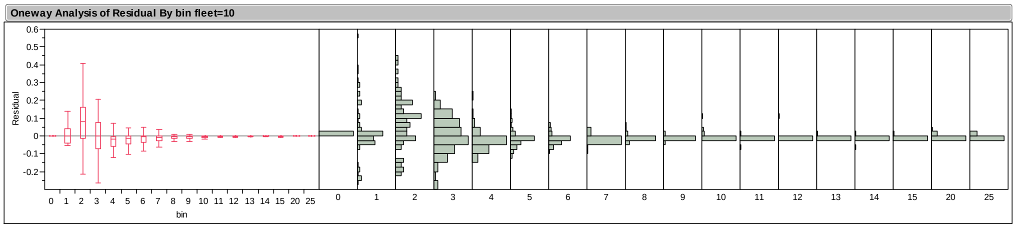
Oneway Analysis of Residual By bin fleet=7



Oneway Analysis of Residual By bin fleet=9



Oneway Analysis of Residual By bin fleet=10



Oneway Analysis of Residual By bin fleet=11

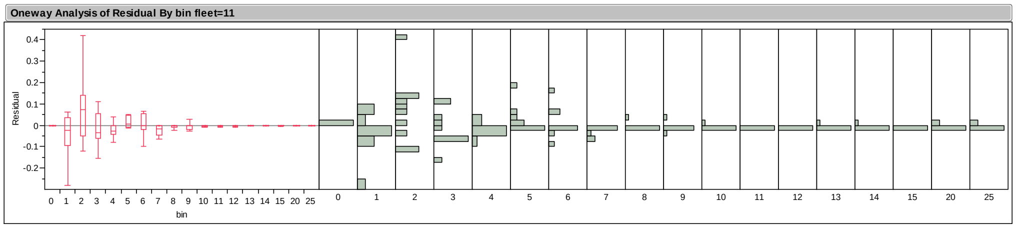


Figure 17. Boxplot of residuals for the age-composition fit of SS3 by fleet. Each panel represents a fleet; box plot is the percentiles of observed minus expected frequency by age distribution of all year-seasons and sex. Histograms to the right are the distribution of the data by age bin.

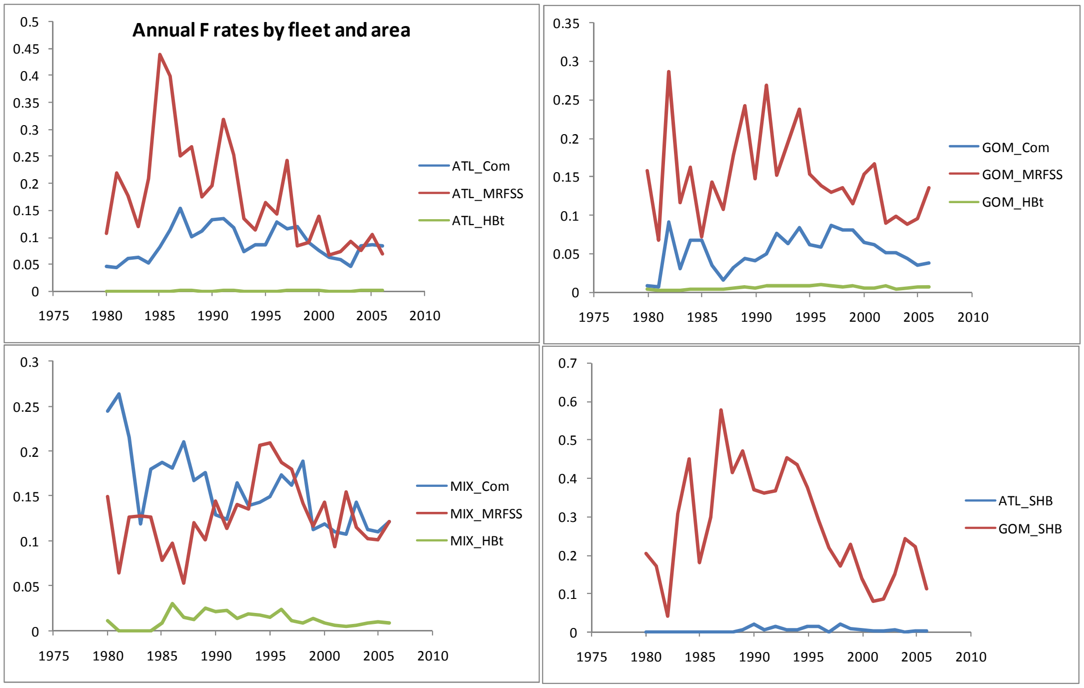


Figure 18. Annual fishing mortality rates (F) by fleet and area from the run 24 SS3.

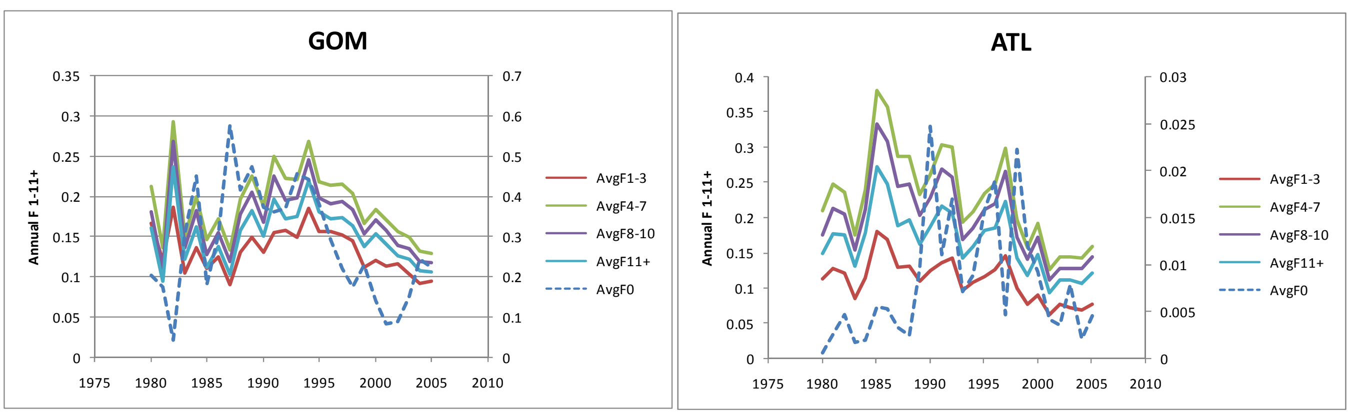


Figure 19. Average annual fishing mortality rates by age groups for each of the stock units, GOM and ATL king mackerel, the right vertical axis correspond to the estimates of F for the age 0 class (broken lines).

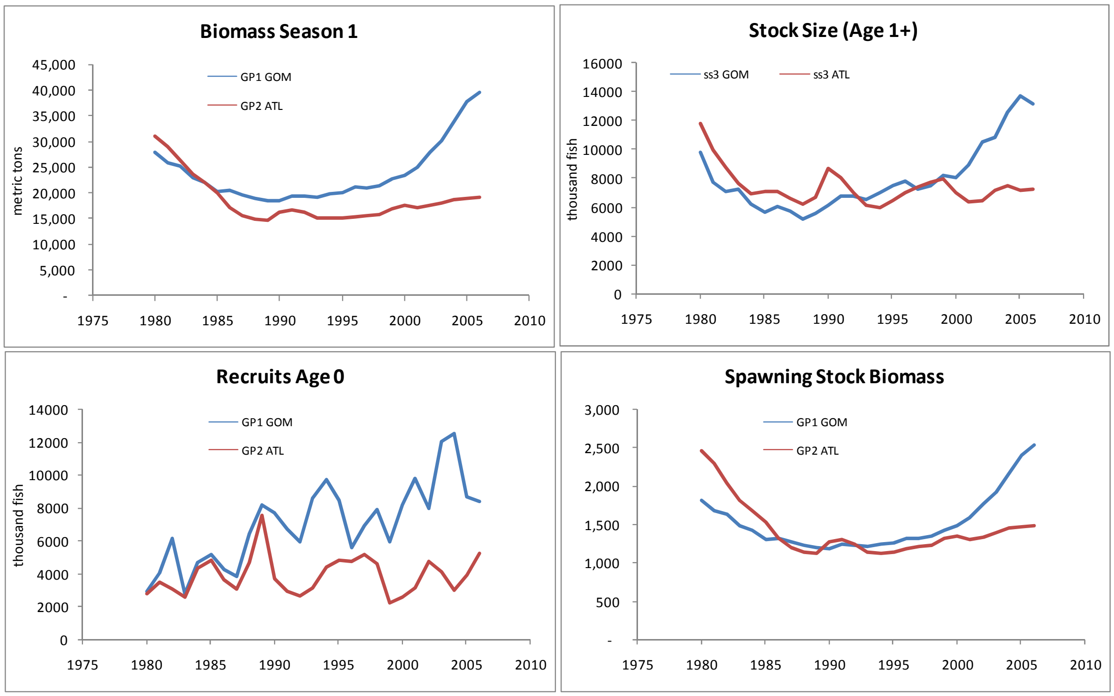


Figure 20. Trends of total biomass (t), stock size ages 1+ (thousands), and recruits (age 0) for each stock king mackerel from the run24 SS3. Year is the SS3 year (Jul-Jun).

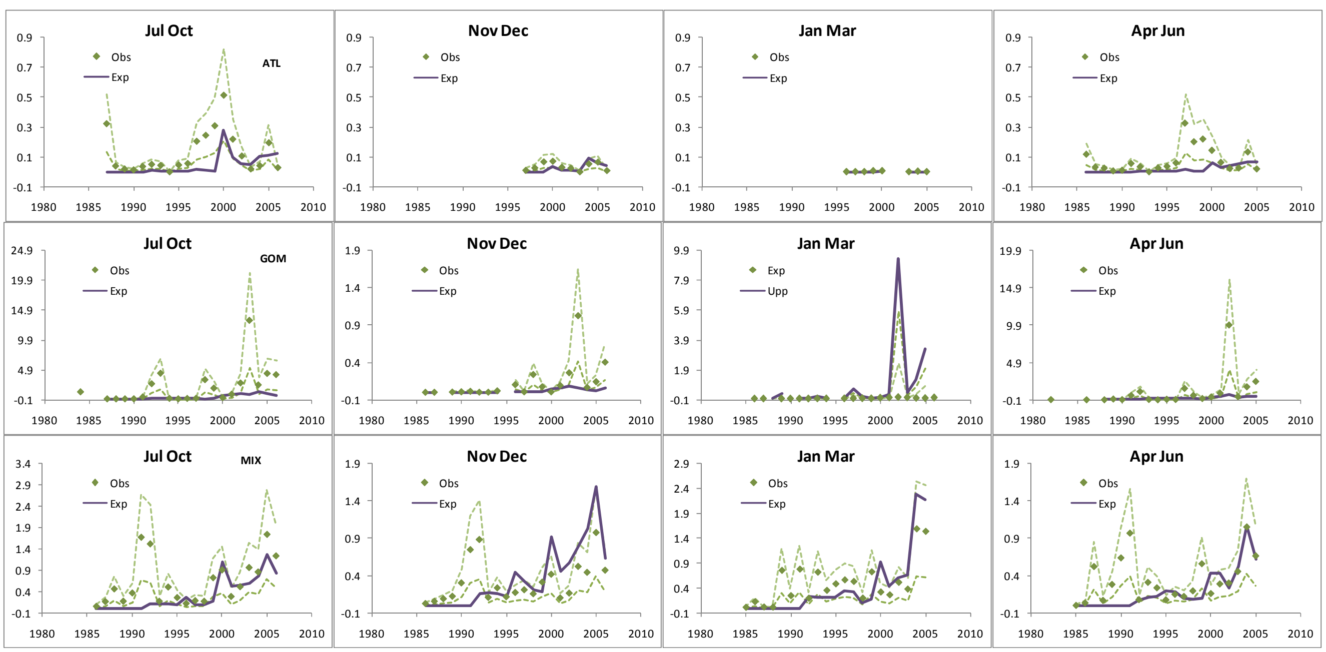


Figure 21. Discards Headboat fleets observed (dots) and predicted (solid line) from the run 24 SS3 by area and season.

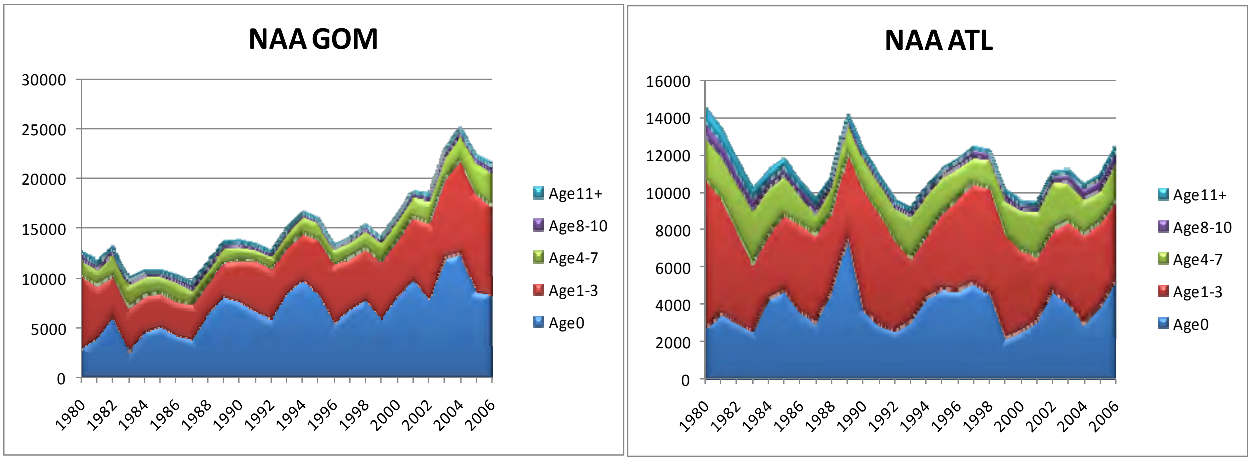


Figure 22. Trends of stock size by groups of ages for each stock unit 1980-2006. Vertical axis is thousands of fish.

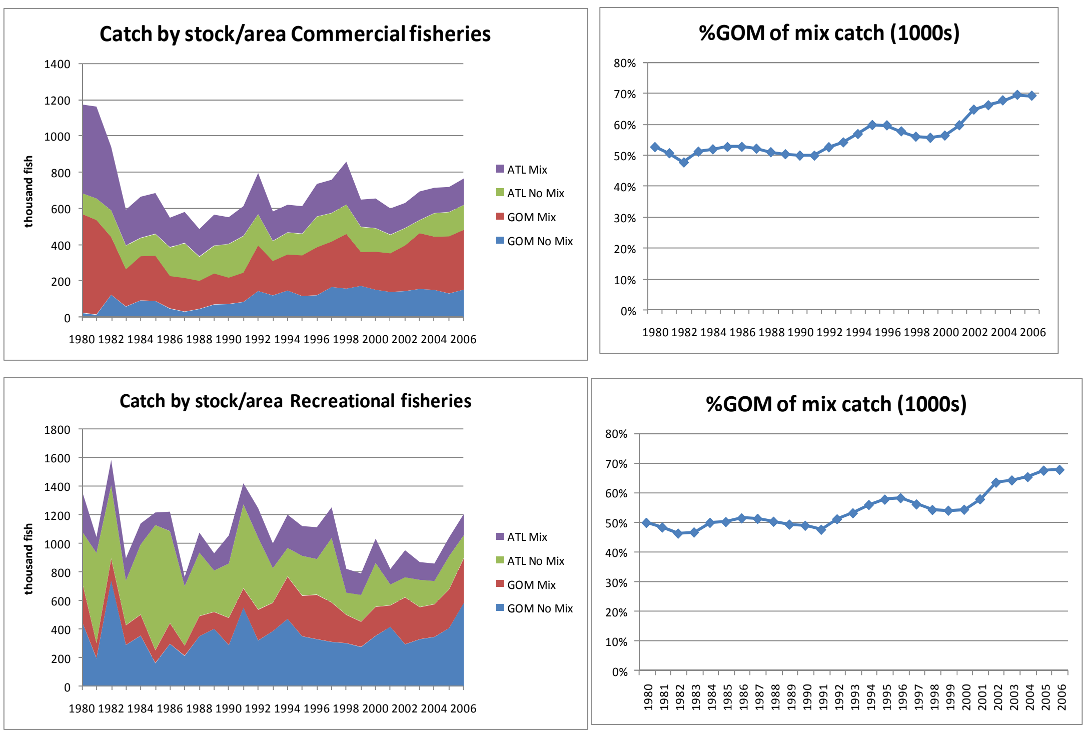


Figure 23. Catch by stock in each area and percent of catch by the GOM stock in the mix area by year for king mackerel. The top row shows the plots for the commercial fisheries, and the bottom row the recreational fisheries component.

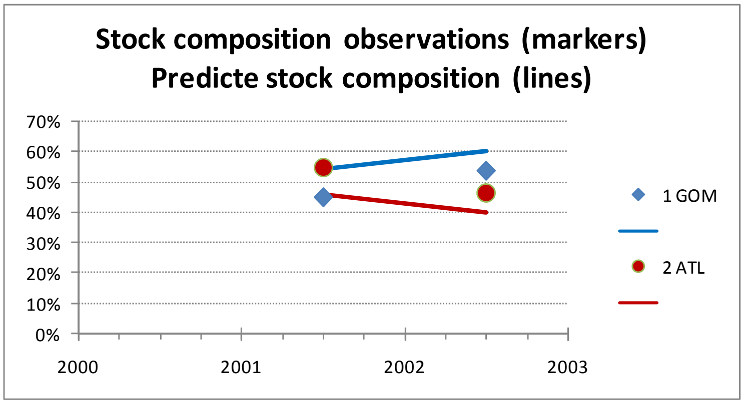


Figure 24. Observed and predicted stock composition by the SS3 model run 24 for the mix area. Observations are from the otolith microchemistry information collected in 2001 and 2002 years allocated to season 3 (Jan-Mar).

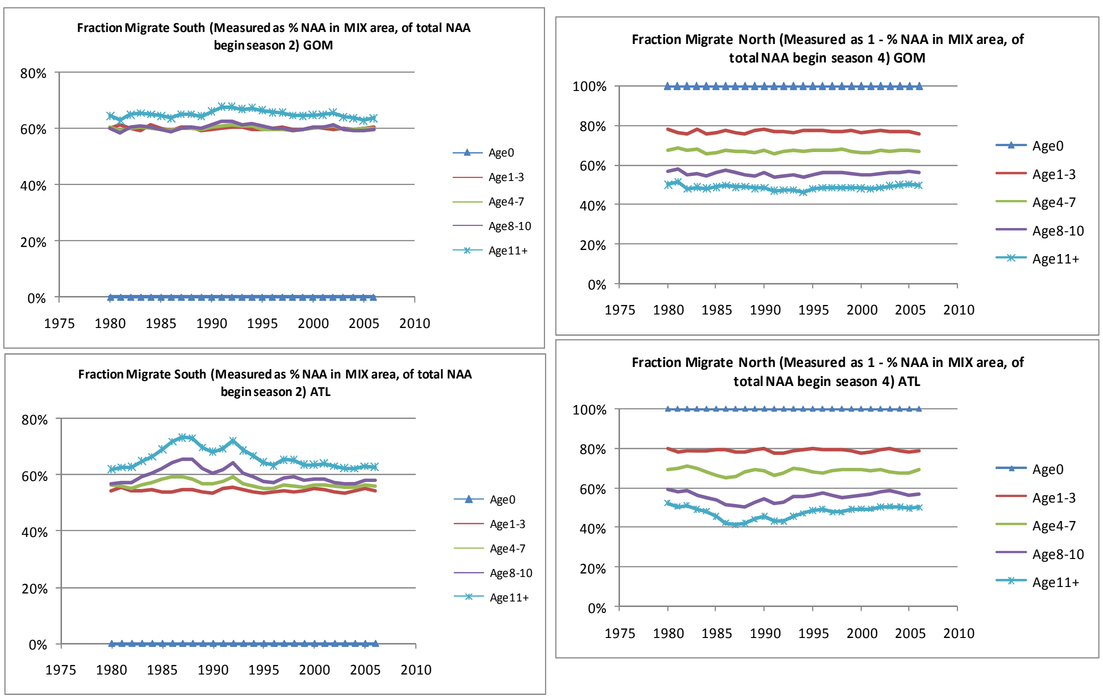


Figure 25. Estimates of movement for ATL and GOM king stocks. The left column plots show the fractions of the stock (as percent of the number of fish) that is present in the mixing area at the beginning of the season 2 (Nov) immediately after migration, by age groups. The top row is for the GOM stock and the bottom row for the ATL stock. In the right, these plots show the north-bound movement, as the fraction of the stock that returned to the non-mixing areas by age groups.

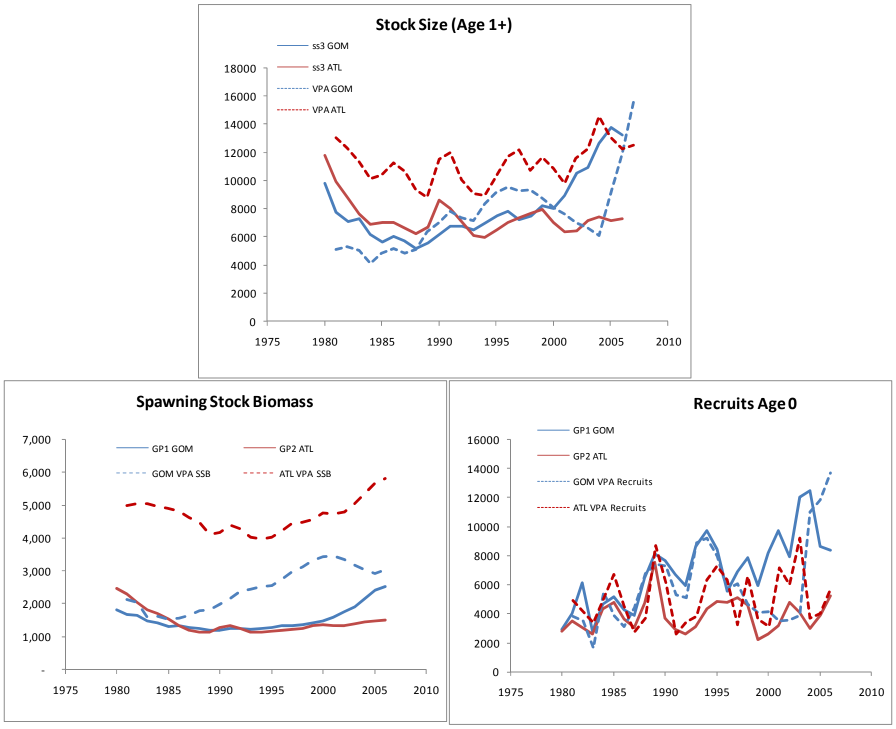


Figure 26. Comparison of stock size (ages 1 plus), spawning stock biomass and recruit trends for ATL (red lines) and GOM (blue lines) from the VPA 50% catch mix allocation (broken lines) and the SS3 base run24 (solid lines). Note, for the GOM fishing year VPA corresponds with the SS3 year schedule (Jul-Jun), but not for the ATL (VPA FYear is Apr-Mar).

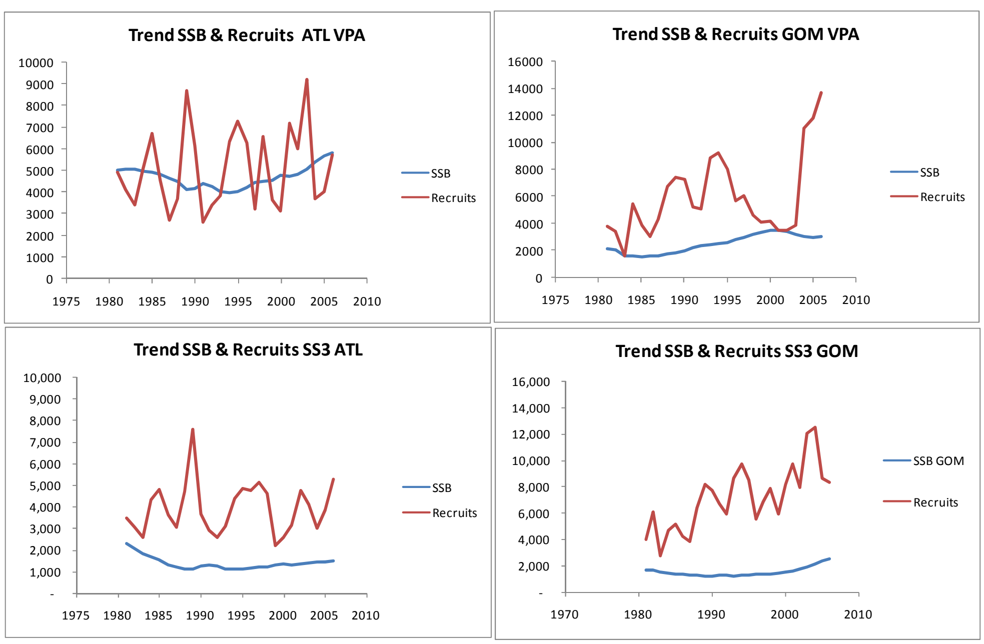


Figure 27. Comparison of spawning stock biomass (blue lines) and recruit trends (red lines) for ATL (left column) and GOM (right column) estimates from the VPA 50% model (top row) and SS3 base run 24 (bottom plots). Units of recruits are thousands of fish, and for SSB metric tons.

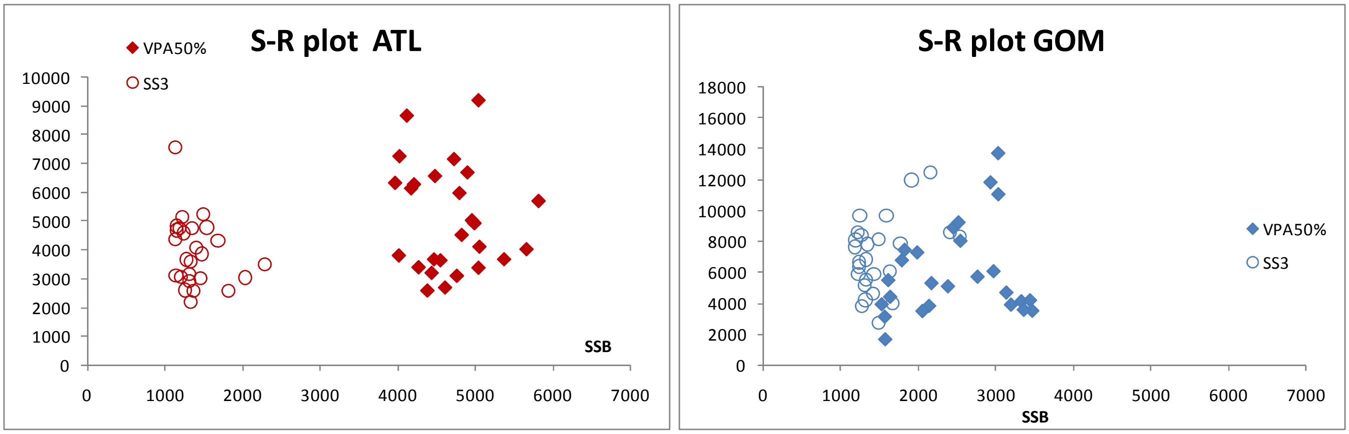


Figure 28. Scatter plots of stock recruitment estimates for the ATL (left) and GOM (right) stock units from the VPA50% and SS3 models.

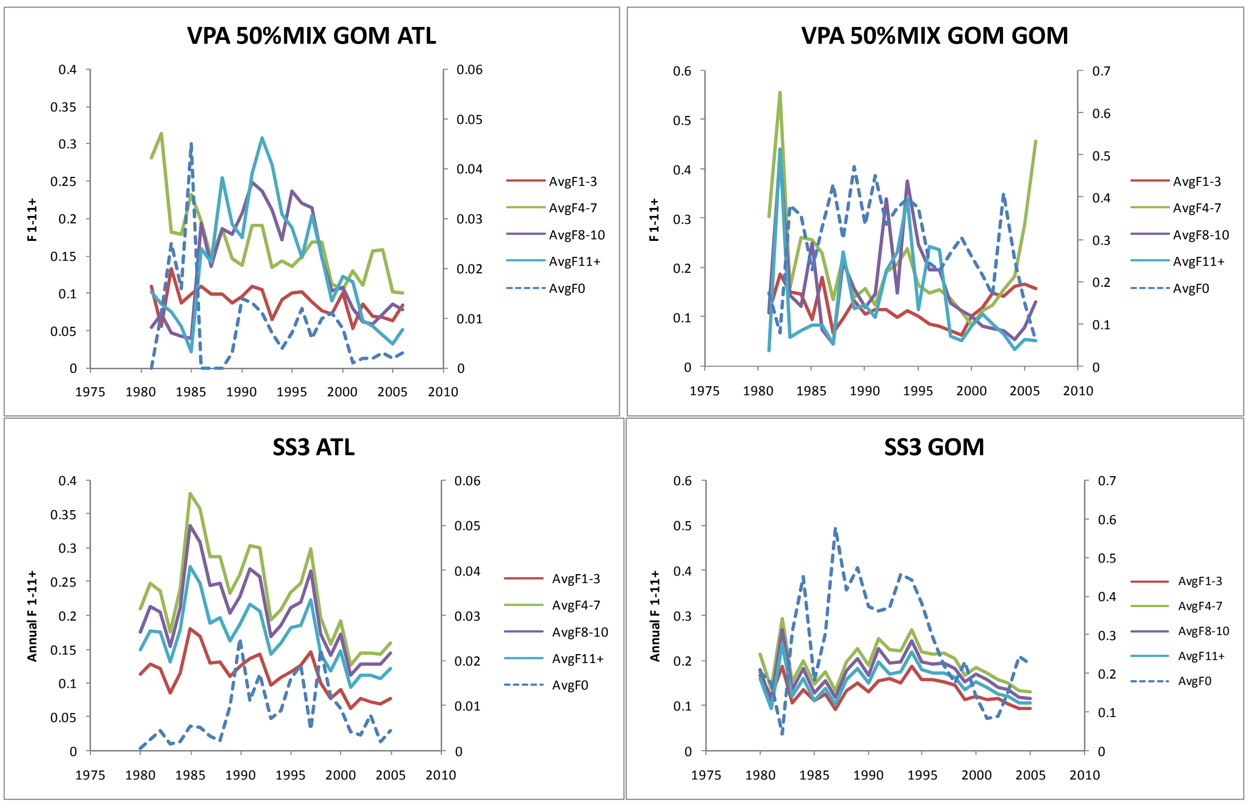
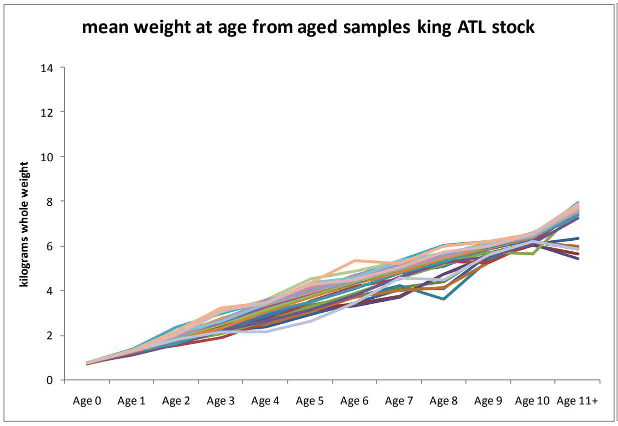


Figure 29. Fishing mortality trends by age group estimated for the ATL (left column) and GOM (right column) stock units from the VPA50% and SS3 models.



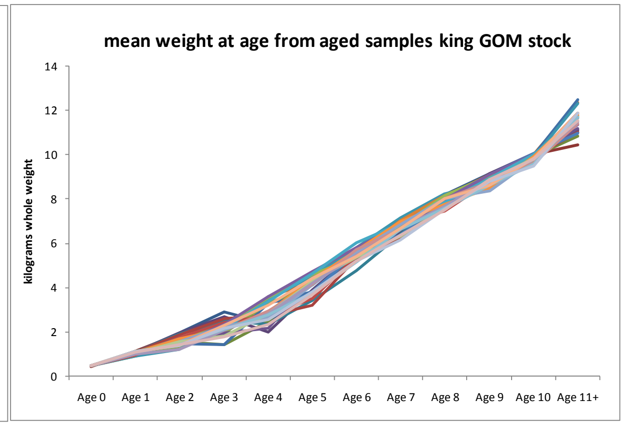
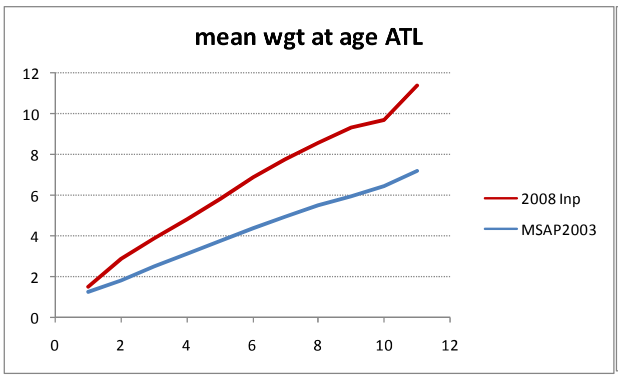


Figure 30. Estimated mean weight at age for ATL and GOM stock derived from the ageing data by year (each line series), units are in kilograms whole weight.



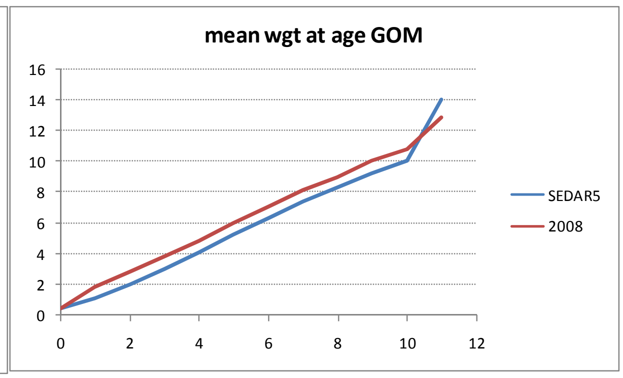


Figure 31. Comparison of the overall average (all years) estimates of mean weight at age in 2008 versus the vector used in the prior assessments for ATL and GOM stocks.

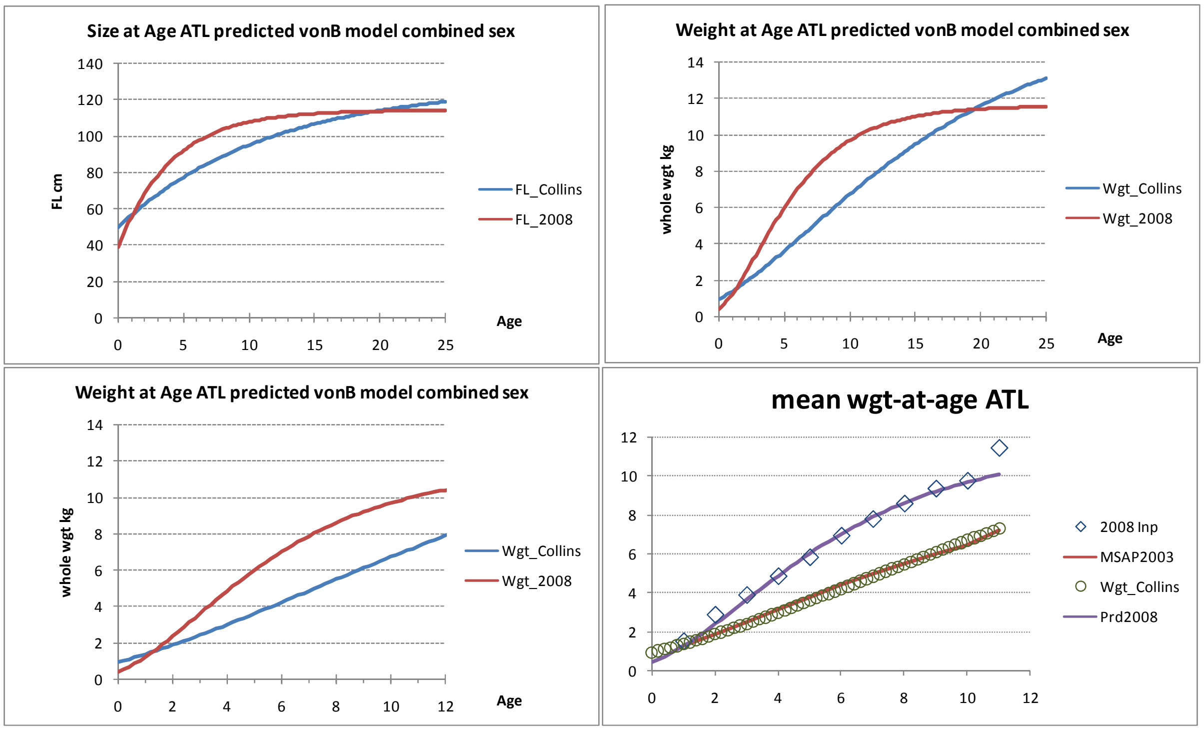
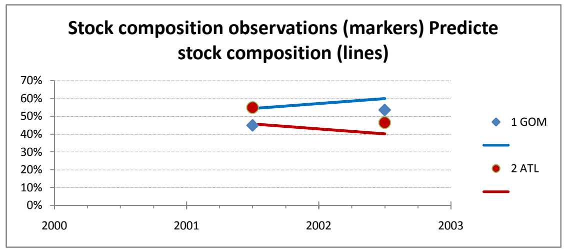


Figure 32. Comparison of the estimated mean weight at age between MSAP 2003 and current estimates (2008) for ATL king. The differences in mean weight are due to differences in the predicted size at age from the von Bertalanffy growth models.

APPENDIX 1 Plots of the SS3 base run 24

Data_File:	KingM-23.dat
Control_File:	KingM-24.CTL

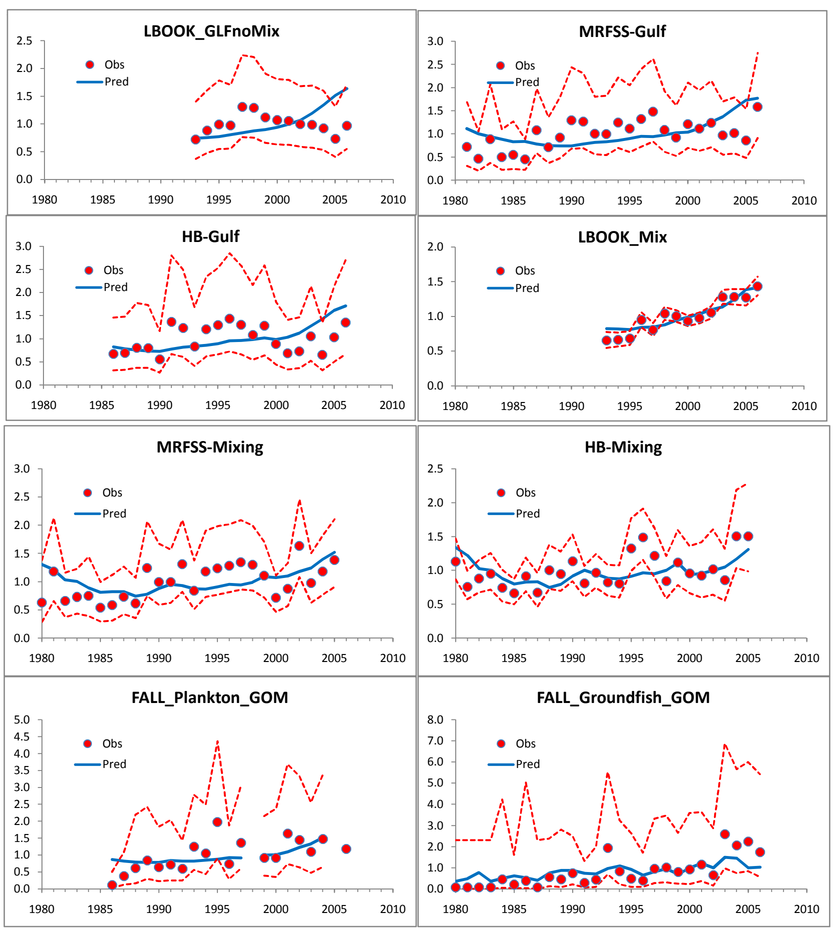


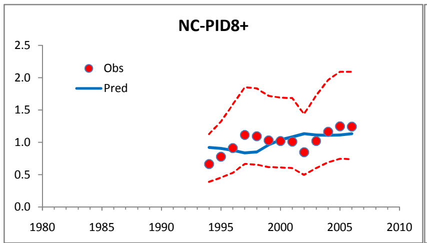
Convergence_Level:	
LIKELIHOOD	**11283.1**
Component	**logL*Lambda**
TOTAL	**11283.1**
catch	0.000134723
indices	-116.033
discard	-1706.95
length_comps	9208.02
age_comps	3878
Morphcomp	8.24661
Equil_catch	0.00585089
Recruitment	-15.0439
Forecast_Recruitment	0
Parm_priors	0.668169
Parm_devs	26.1355
Crash_Pen	0

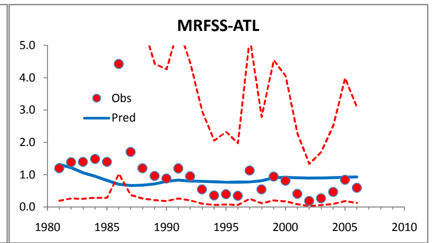
---	ALL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Fleet:	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Catch_lambda:	4.23717E-05	3.91109E-06	2.73713E-06	4.8946E-07	7.80322E-08	4.79679E-06	3.13407E-06	2.98106E-06	2.37404E-05	1.88723E-07	1.98453E-07	1.1657E-07	0	0	0
Catch_like:	--	1	1	1	1	1	1	1	0	1	1	1	1	1	0
Surv_lambda:	-86.7725	-11.0483	4.45513	-5.96669	11.566	-8.98496	-10.6736	-9.97235	0	-16.4873	-14.4503	-20.5566	-6.07371	1.42018	0
Surv_like:	--	0	0	10	0	0	0	10	0	0	0	10	0	0	0
Disc_lambda:	-1082.86	0	0	-149.906	0	0	0	18.5118	0	0	0	23.1085	0	0	0
Disc_like:	--	1	1	1	0	1	1	1	0	1	1	1	0	0	0
Length_lambda:	9746.31	970.212	912.029	60.867	0	1713.2	1363.83	362.503	0	2670.32	597.386	1095.95	0	0	0
Length_like:	--	1	1	0	0	1	1	1	0	1	1	1	0	0	0
Age_lambda:	4158.9	1054.17	195.781	0	0	665.046	625.565	56.035	0	1181.47	357.69	23.1398	0	0	0

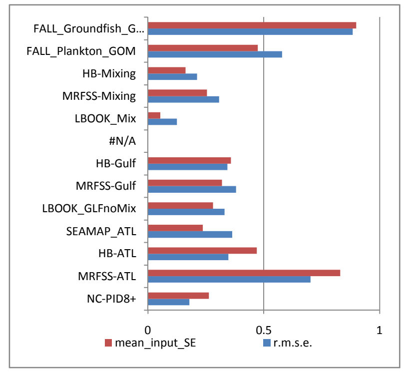
Variance_adjustments_to_input_values														
Fleet	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Index_extra_CV	0.2	0.2	0.2	0	0.2	0	0.2	0.2	0	0	0	0.2	0.2	0
Discard_extra_CV	0	0	0.2	0	0	0	0.2	0	0	0	0.2	0	0	0
MeanBodyWt_extra_CV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
effN_mult_Lencomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Agecomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Len-at-age	1	1	1	1	1	1	1	1	1	1	1	1	1	1

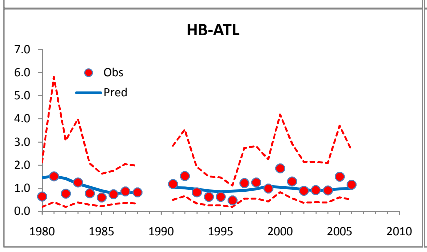
INDICES FIT

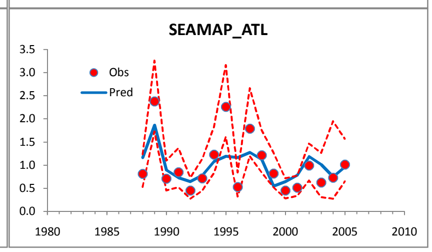


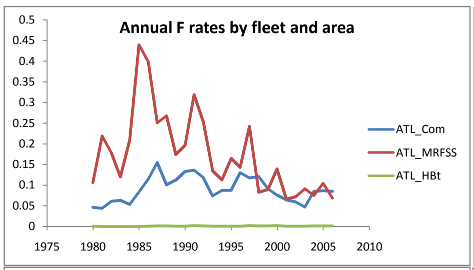

NC-PID8+
Obs
Pred

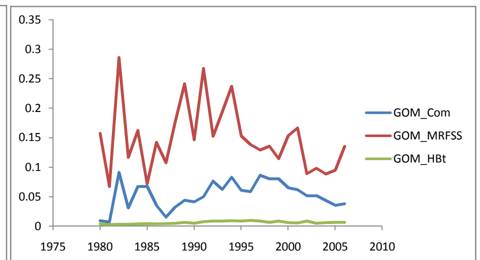

MRFSS-ATL
Obs
Pred

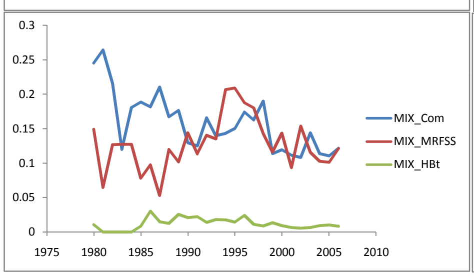

FALL_Groundfish_G...
FALL_Plankton_GOM
HB-Mixing
MRFSS-Mixing
LBOOK_Mix
#N/A
HB-Gulf
MRFSS-Gulf
LBOOK_GLFnoMix
SEAMAP_ATL
HB-ATL
MRFSS-ATL
NC-PID8+
mean_input_SE
r.m.s.e.

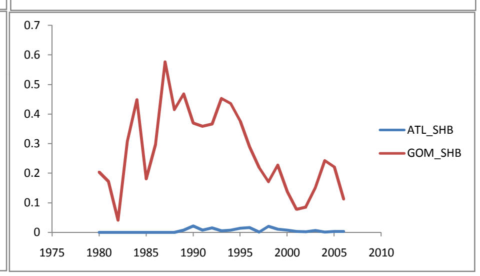

HB-ATL
Obs
Pred

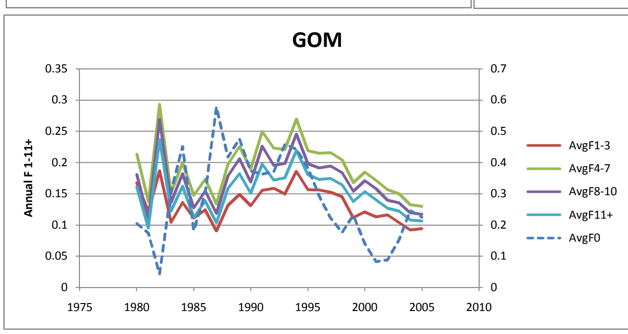

SEAMAP_ATL
Obs
Pred

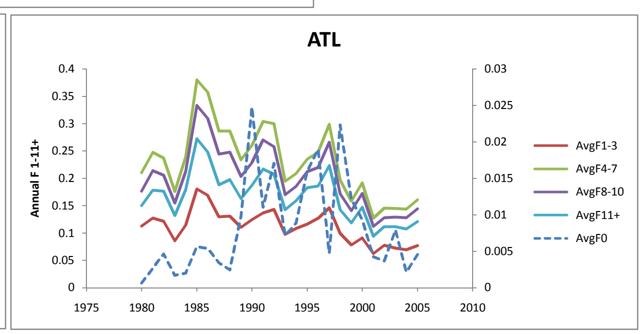

Annual F rates by fleet and area
ATL_Com
ATL_MRFSS
ATL_HBt

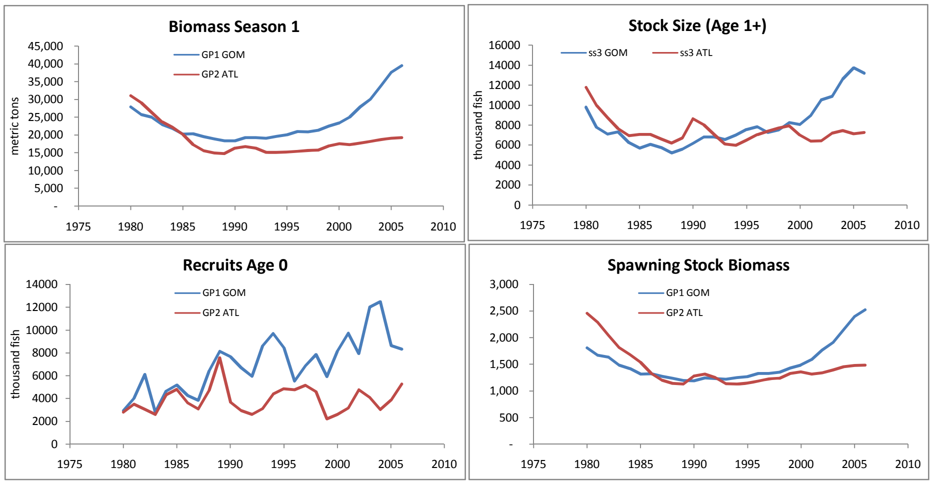

GOM_Com
GOM_MRFSS
GOM_HBt


MIX_Com
MIX_MRFSS
MIX_HBt

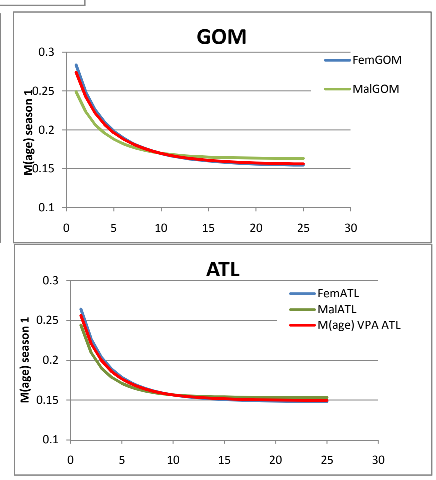

ATL_SHB
GOM_SHB

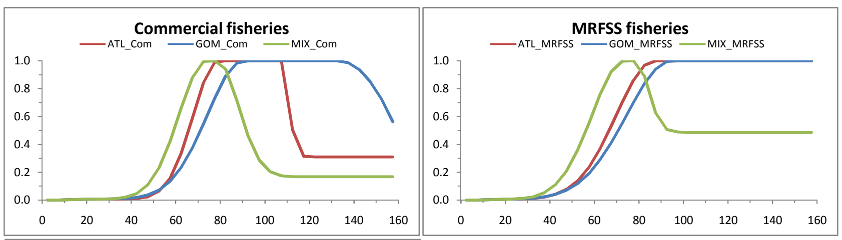

GOM
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

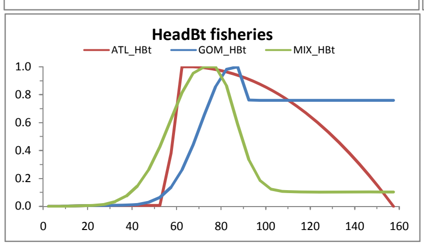

ATL
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0



NATURAL MORTALITY AT AGE

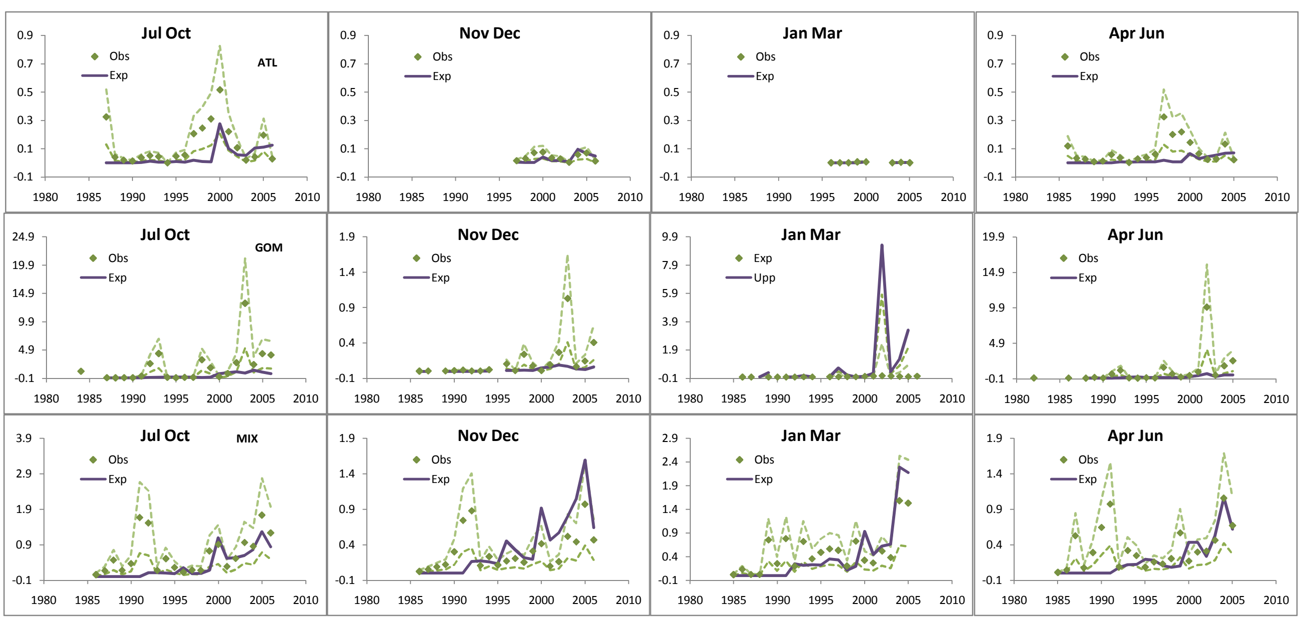


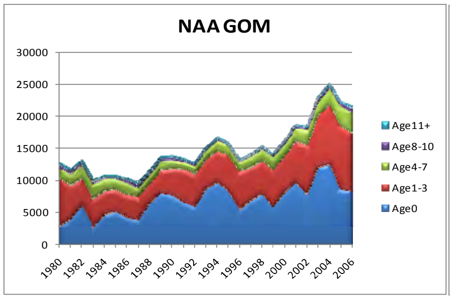


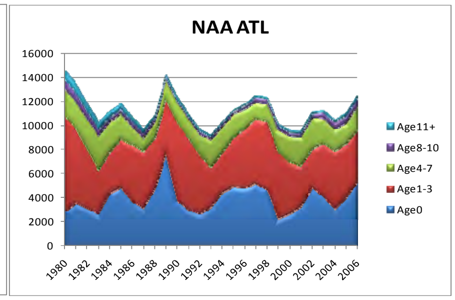


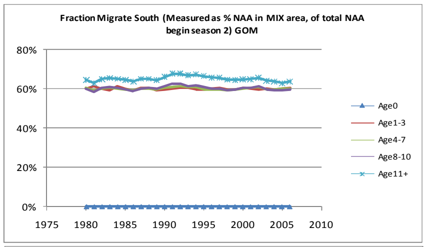
SELECTIVITY AT SIZE

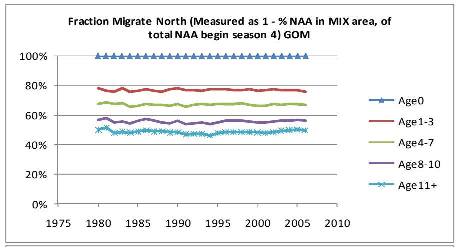
DISCARDS HEADBOAT FISHERIES

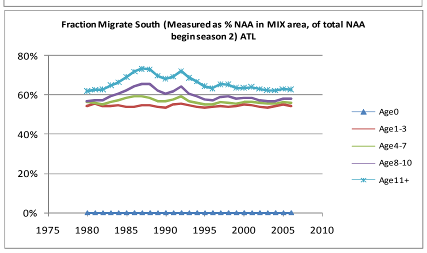


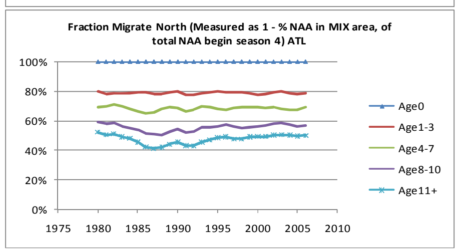

NAA GOM
30000
25000
20000
15000
10000
5000
0
Age11+
Age8-10
Age4-7
Age1-3
Age0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

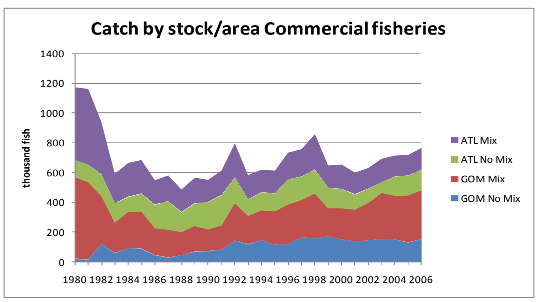

NAA ATL
16000
14000
12000
10000
8000
6000
4000
2000
0
Age11+
Age8-10
Age4-7
Age1-3
Age0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

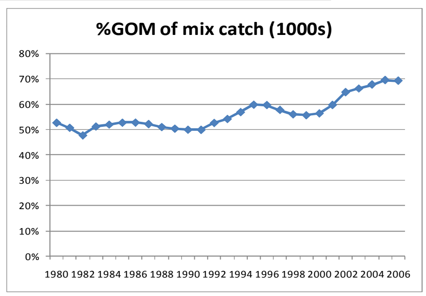

Fraction Migrate South (Measured as % NAA in MIX area, of total NAA begin season 2) GOM
80%
60%
40%
20%
0%
1975
1980
1985
1990
1995
2000
2005
2010
Age0
Age1-3
Age4-7
Age8-10
Age11+

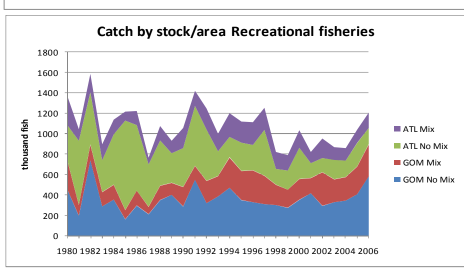

Fraction Migrate North (Measured as 1 - % NAA in MIX area, of total NAA begin season 4) GOM
100%
80%
60%
40%
20%
0%
1975
1980
1985
1990
1995
2000
2005
2010
Age0
Age1-3
Age4-7
Age8-10
Age11+

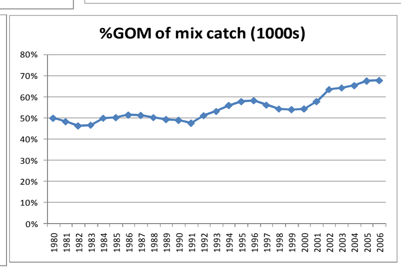

Fraction Migrate South (Measured as % NAA in MIX area, of total NAA begin season 2) ATL
80%
60%
40%
20%
0%
1975
1980
1985
1990
1995
2000
2005
2010
Age0
Age1-3
Age4-7
Age8-10
Age11+


Fraction Migrate North (Measured as 1 - % NAA in MIX area, of total NAA begin season 4) ATL
100%
80%
60%
40%
20%
0%
1975
1980
1985
1990
1995
2000
2005
2010
Age0
Age1-3
Age4-7
Age8-10
Age11+

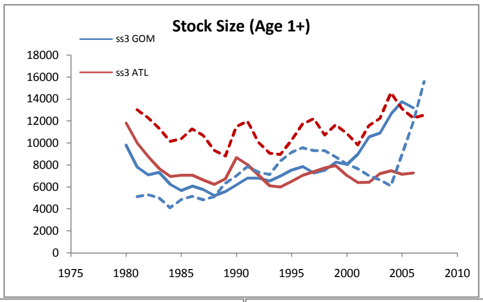

Catch by stock/area Commercial fisheries
thousand fish
1400
1200
1000
800
600
400
200
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
ATL Mix
ATL No Mix
GOM Mix
GOM No Mix

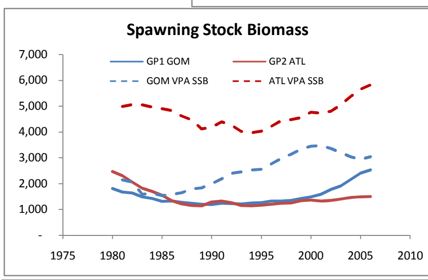

%GOM of mix catch (1000s)
80%
70%
60%
50%
40%
30%
20%
10%
0%
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006

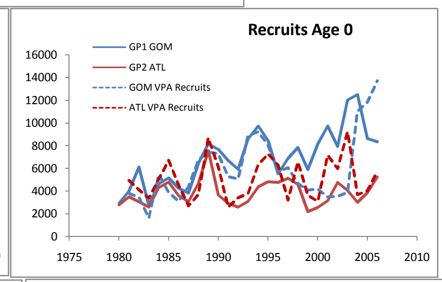

Catch by stock/area Recreational fisheries
thousand fish
1800
1600
1400
1200
1000
800
600
400
200
0
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
ATL Mix
ATL No Mix
GOM Mix
GOM No Mix

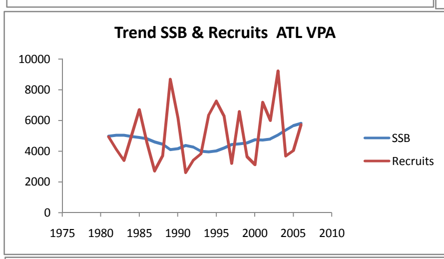

%GOM of mix catch (1000s)
80%
70%
60%
50%
40%
30%
20%
10%
0%

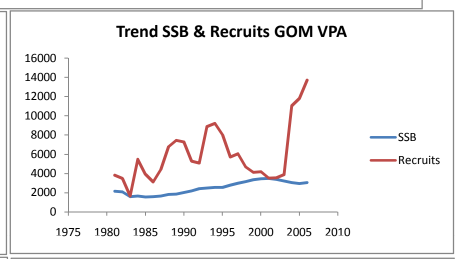
COMPARISON WITH VPA (50% CATCH MIX TO GOM)

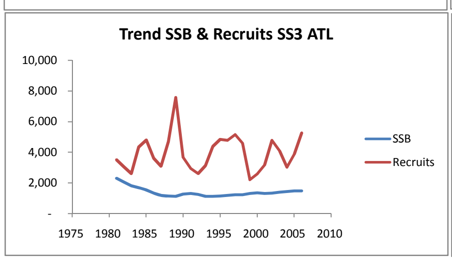


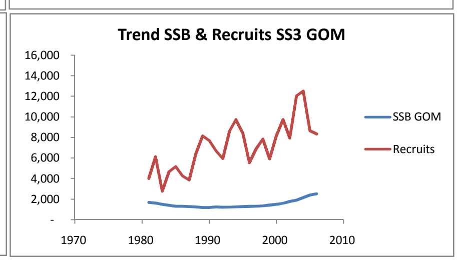


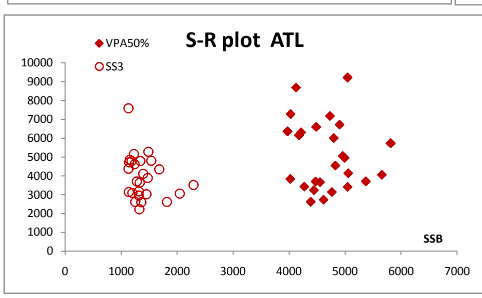


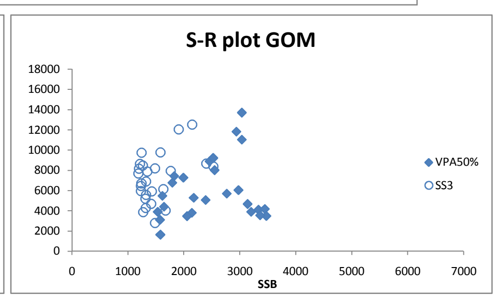


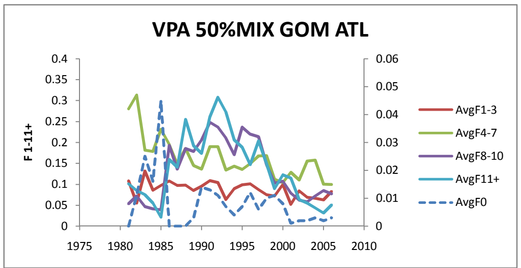


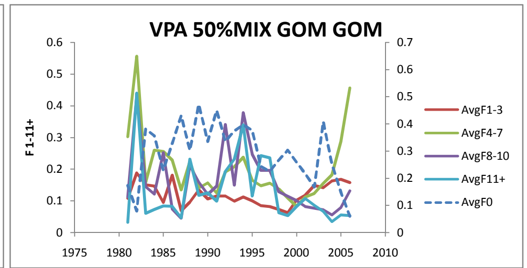


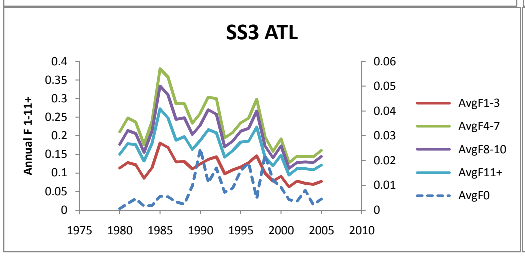


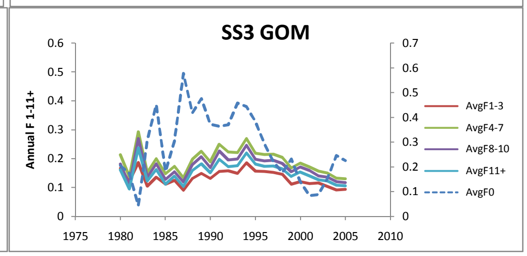


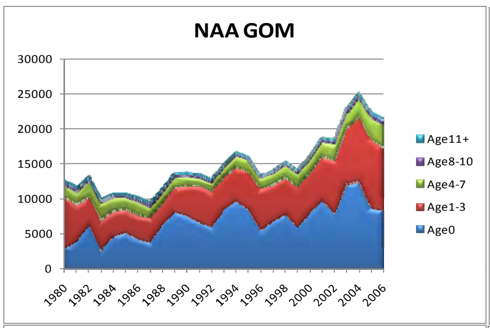


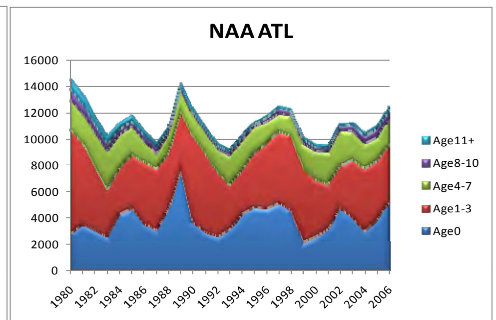

VPA 50%MIX GOM ATL
F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

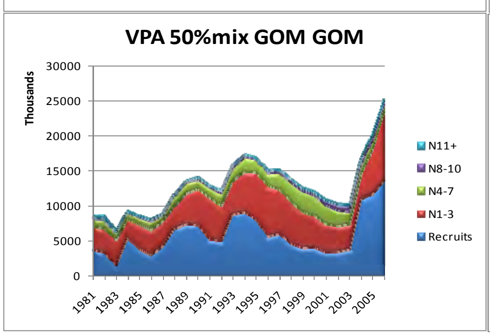

VPA 50%MIX GOM GOM
F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

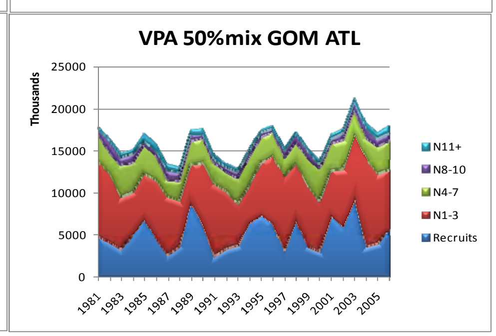

SS3 ATL
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0


SS3 GOM
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

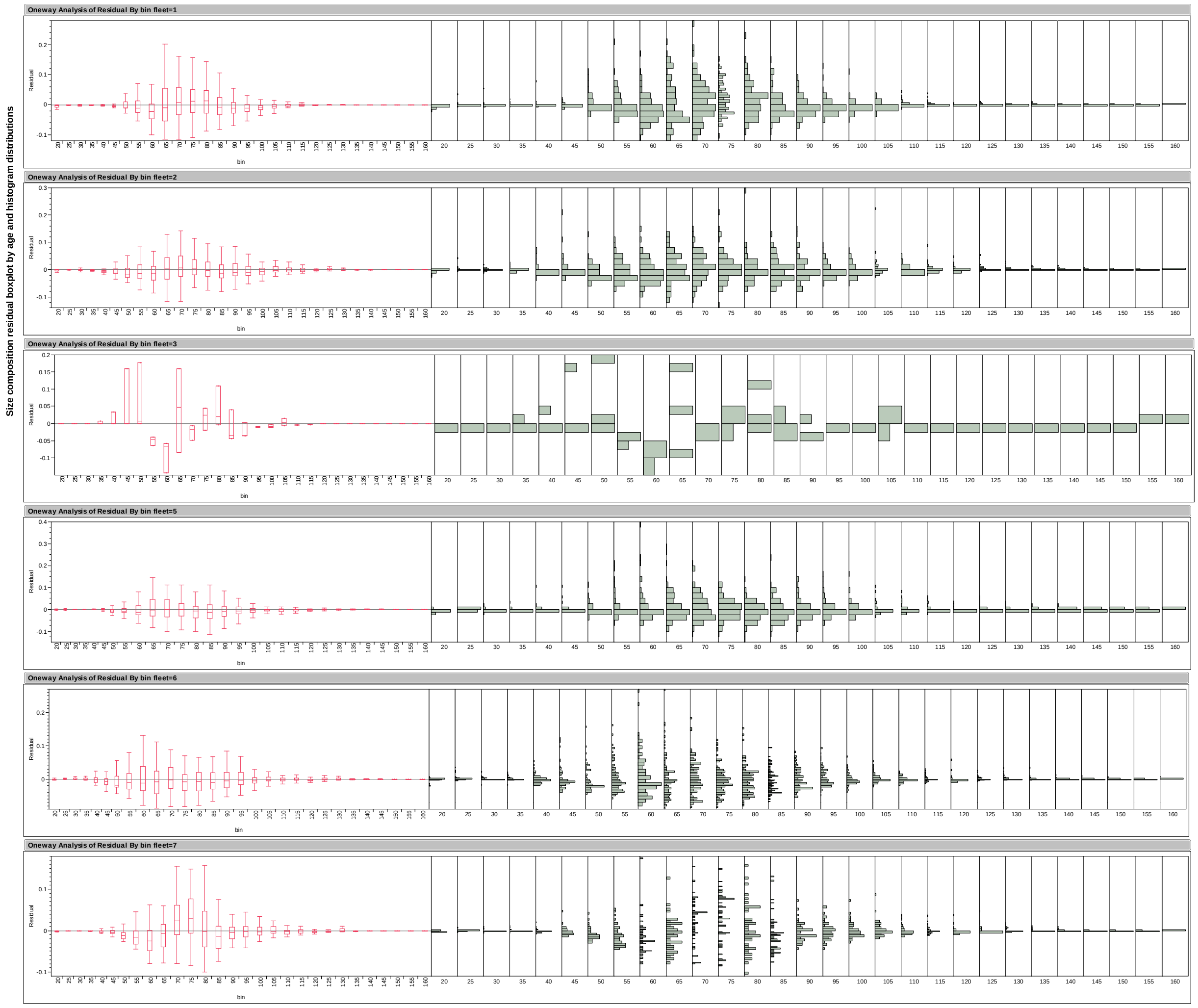

NAA GOM
Age11+
Age8-10
Age4-7
Age1-3
Age0


NAA ATL
Age11+
Age8-10
Age4-7
Age1-3
Age0

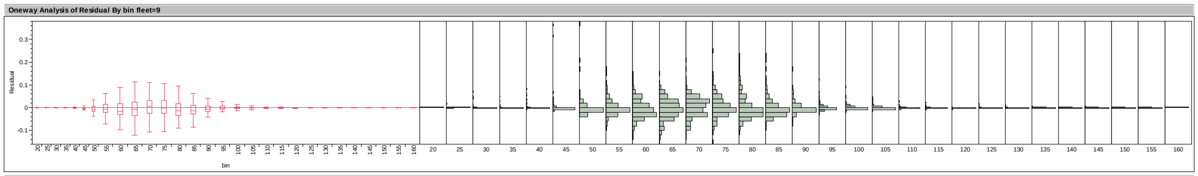

VPA 50%mix GOM GOM
Thousands
N11+
N8-10
N4-7
N1-3
Recruits


VPA 50%mix GOM ATL
Thousands
N11+
N8-10
N4-7
N1-3
Recruits

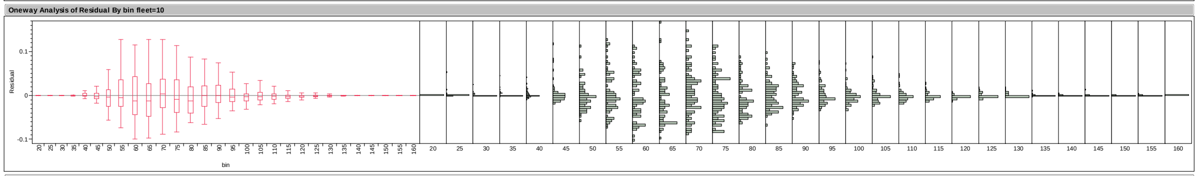
Box plots residuals (obs-exp) for size and age composition by fleet. All year/season gender aggregated



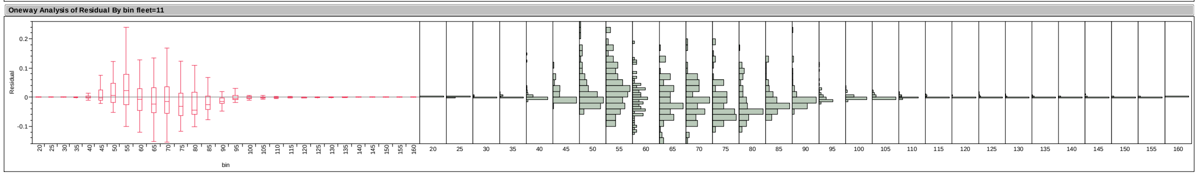
Oneway Analysis of Residual By bin fleet=9



Oneway Analysis of Residual By bin fleet=10

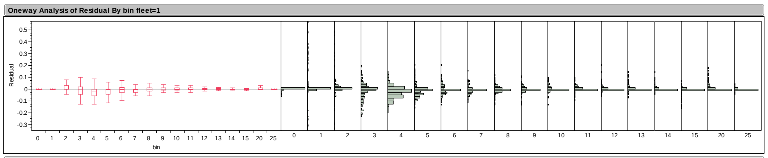


Oneway Analysis of Residual By bin fleet=11

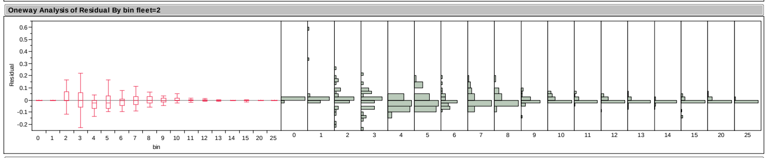


AGE composition Residual (obs-exp) by age class and fleet

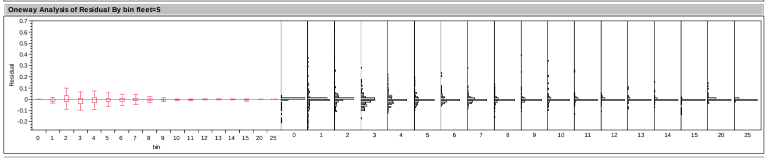
Oneway Analysis of Residual By bin fleet=1



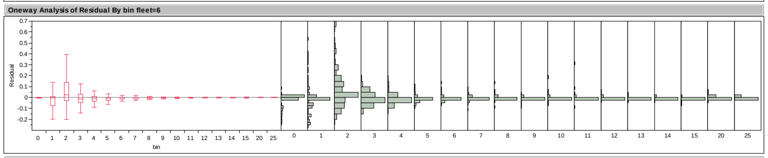
Oneway Analysis of Residual By bin fleet=2



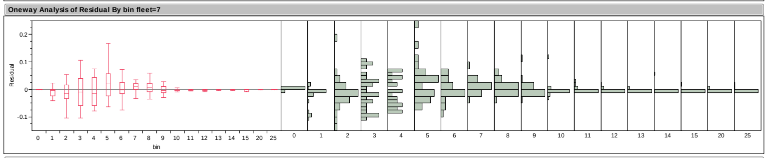
Oneway Analysis of Residual By bin fleet=5



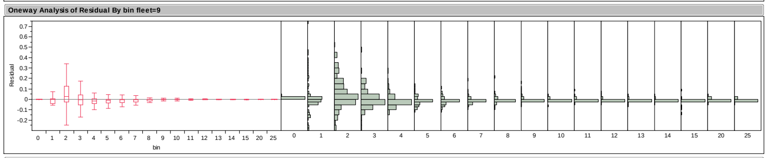
Oneway Analysis of Residual By bin fleet=6



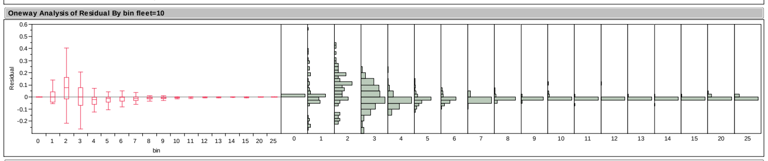
Oneway Analysis of Residual By bin fleet=7



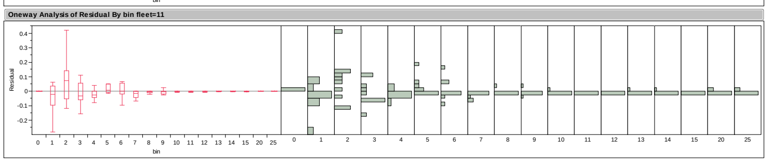
Oneway Analysis of Residual By bin fleet=9



Oneway Analysis of Residual By bin fleet=10

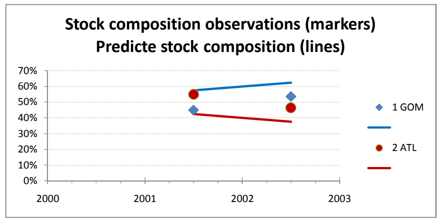


Oneway Analysis of Residual By bin fleet=11



APPENDIX 2 Results SS3 model Run 25 (Allocating recruits in mixing zone)

Data_File:	KingM-23.dat
Control_File:	KingM-25.CTL

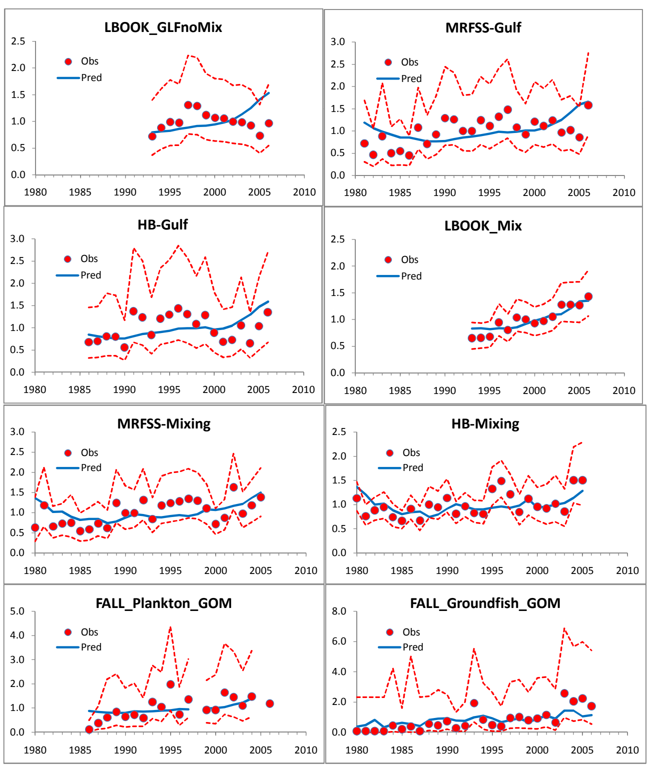


Hessian:	
LIKELIHOOD	**10918.4**
Component	**logL*Lambda**
TOTAL	**10918.4**
catch	0.000137902
indices	-126.544
discard	-1728.12
length_comps	9242.28
age_comps	3520.18
Morphcomp	14.971
Equil_catch	0.00915367
Recruitment	-15.7456
Forecast_Recruitment	0
Parm_priors	0.604017
Parm_devs	10.7407
Crash_Pen	0

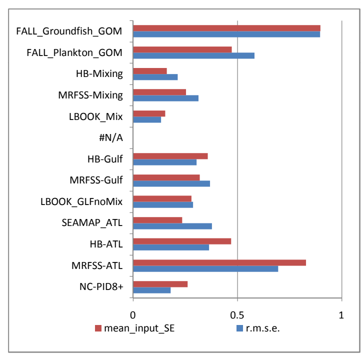
Fleet:	ALL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Catch_lambda:	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Catch_like:	0.000137902	1.7486E-07	1.2477E-07	9.5753E-09	1.7904E-08	4.3042E-05	2.6116E-05	2.7325E-05	3.7301E-05	1.3289E-06	1.3891E-06	1.0733E-06	0	0	0
Surv_lambda:	--	1	1	1	1	1	1	1	0	1	1	1	1	1	0
Surv_like:	-126.544	-14.3305	4.03095	-11.9986	-2.476	-10.6658	-14.4822	-13.892	0	-21.6309	-17.9248	-21.8469	-5.12249	3.79492	0
Disc_lambda:	--	0	0	10	0	0	0	10	0	0	0	10	0	0	0
Disc_like:	-1728.12	0	0	-84.3611	0	0	0	-29.7087	0	0	0	-58.7427	0	0	0
Length_lambda:	--	1	1	1	0	1	1	1	0	1	1	1	0	0	0
Length_like:	9242.28	927.703	916.273	17.1232	0	1640.52	1267.5	287.902	0	2622.77	599.914	962.577	0	0	0
Age_lambda:	--	1	1	0	0	1	1	1	0	1	1	1	0	0	0
Age_like:	3520.18	829.425	160.064	0	0	617.329	565.554	54.4433	0	991.614	279.369	22.3795	0	0	0

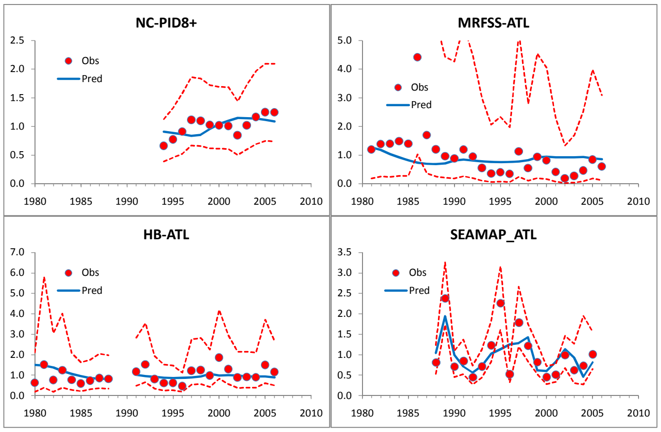
Fleet	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Index_extra_CV	0.2	0.2	0.2	0	0.2	0	0.2	0.2	0.1	0	0	0.2	0.2	0
Discard_extra_CV	0	0	0.2	0	0	0	0.2	0	0	0	0.2	0	0	0
MeanBodyWt_extra_CV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
effN_mult_Lencomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Agecomp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1
effN_mult_Len-at-age	1	1	1	1	1	1	1	1	1	1	1	1	1	1

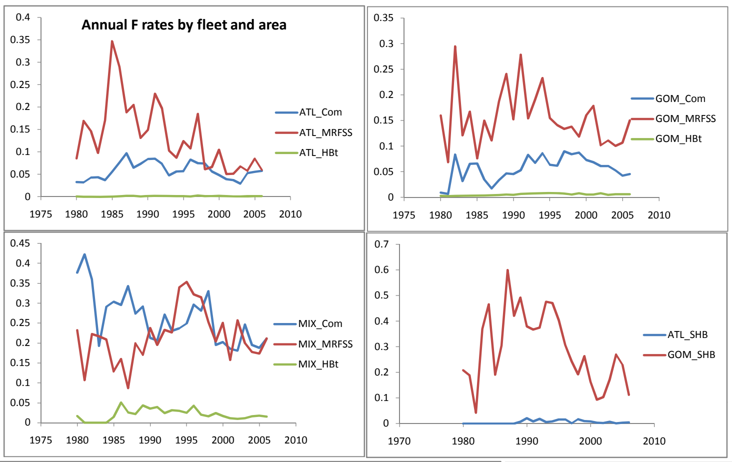
M-G_parmsUsing_offset_approach_#:_1

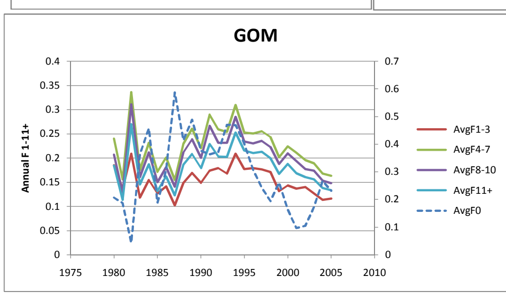


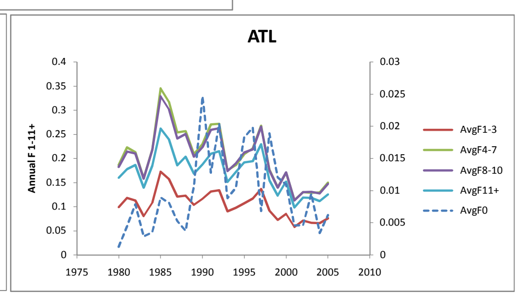
INDICES FIT

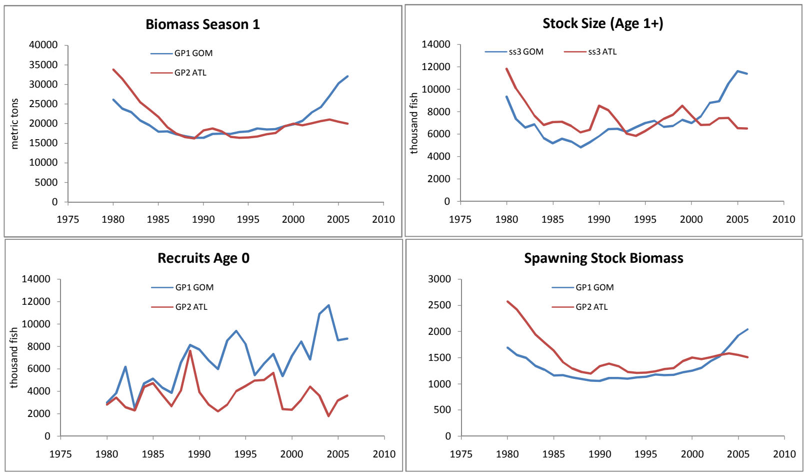



NC-PID8+
Obs
Pred
MRFSS-ATL
Obs
Pred
HB-ATL
Obs
Pred
SEAMAP_ATL
Obs
Pred

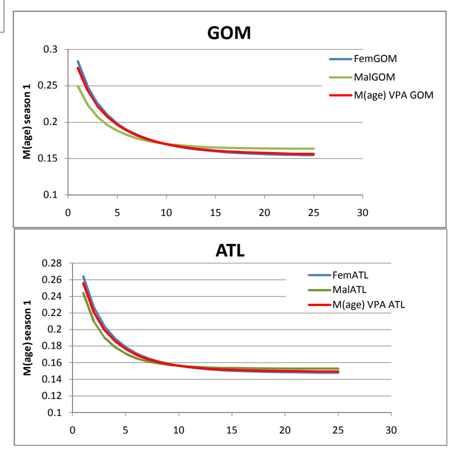

Annual F rates by fleet and area
ATL_Com
ATL_MRFSS
ATL_HBt
GOM_Com
GOM_MRFSS
GOM_HBt
MIX_Com
MIX_MRFSS
MIX_HBt
ATL_SHB
GOM_SHB

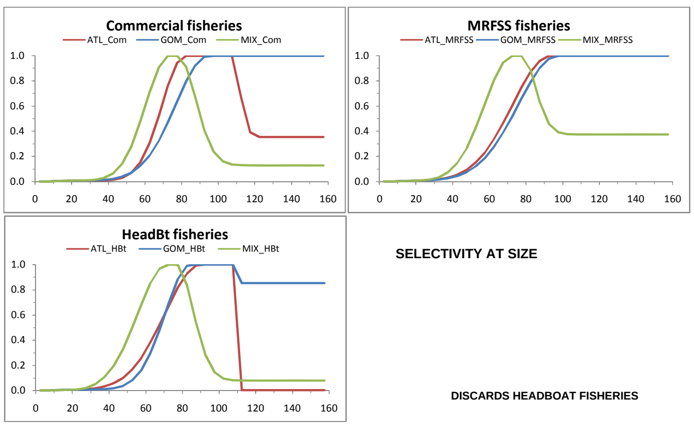

GOM
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0


ATL
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0



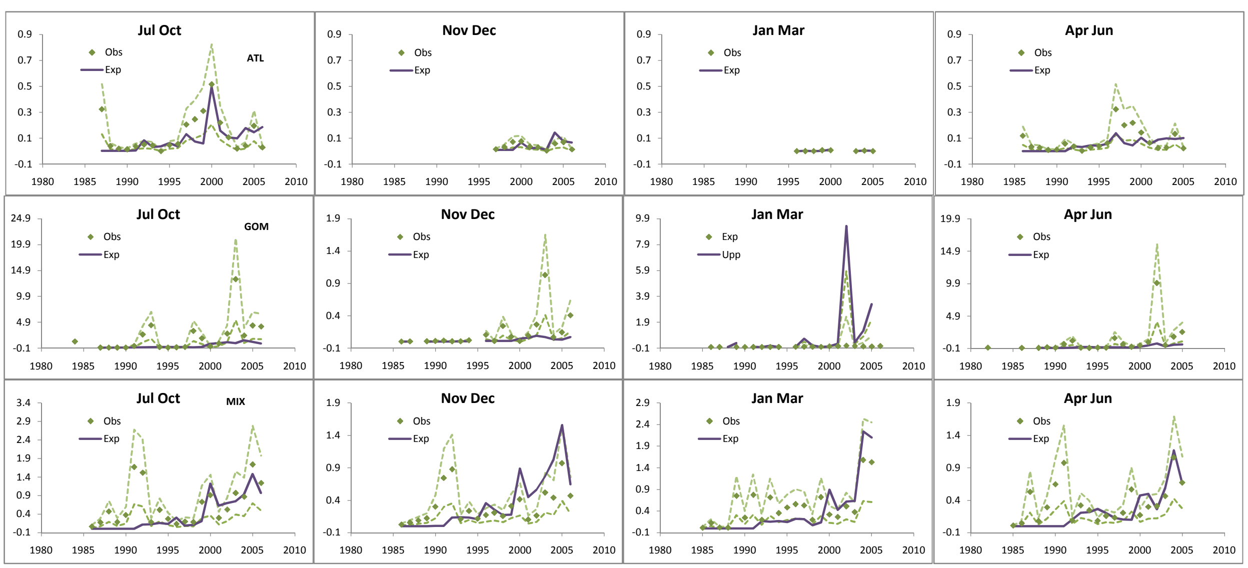
NATURAL MORTALITY AT AGE

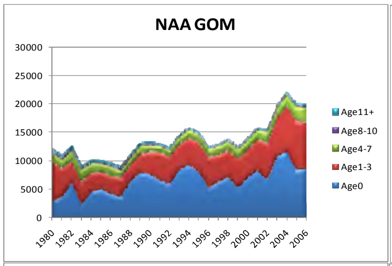


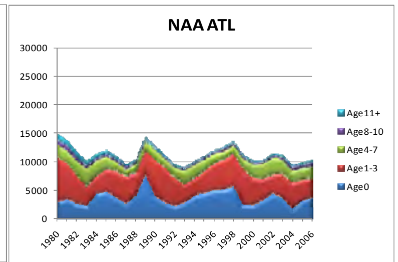


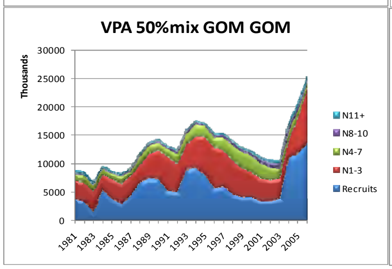
SELECTIVITY AT SIZE

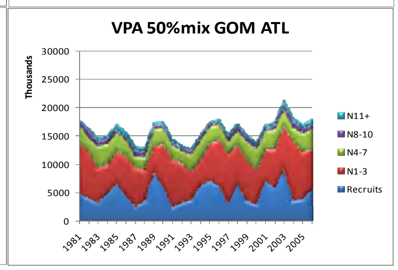
DISCARDS HEADBOAT FISHERIES

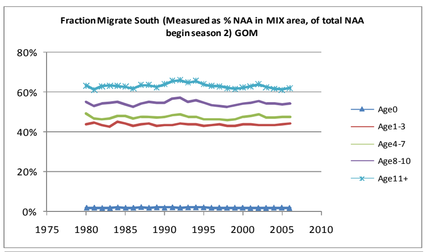


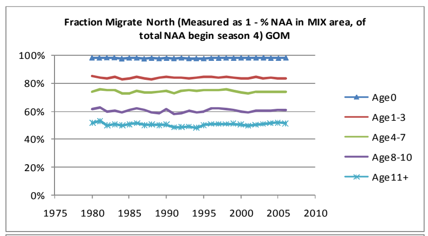

NAA GOM
Age11+
Age8-10
Age4-7
Age1-3
Age0

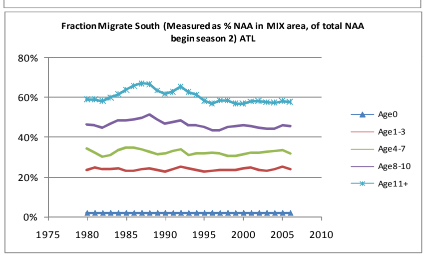

NAA ATL
Age11+
Age8-10
Age4-7
Age1-3
Age0

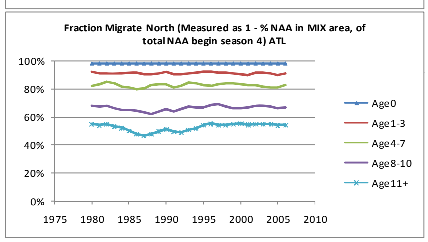

VPA 50%mix GOM GOM
Thousands
N11+
N8-10
N4-7
N1-3
Recruits

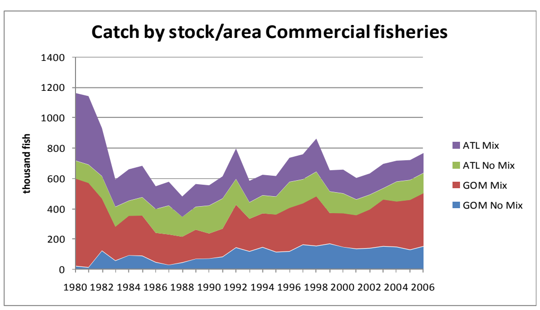

VPA 50%mix GOM ATL
Thousands
N11+
N8-10
N4-7
N1-3
Recruits

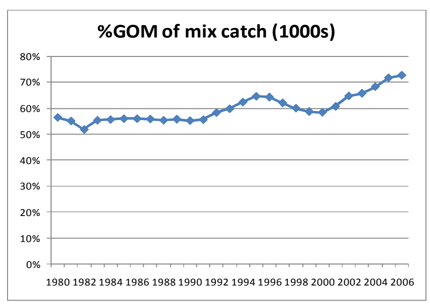

Fraction Migrate South (Measured as % NAA in MIX area, of total NAA begin season 2) GOM
Age0
Age1-3
Age4-7
Age8-10
Age11+

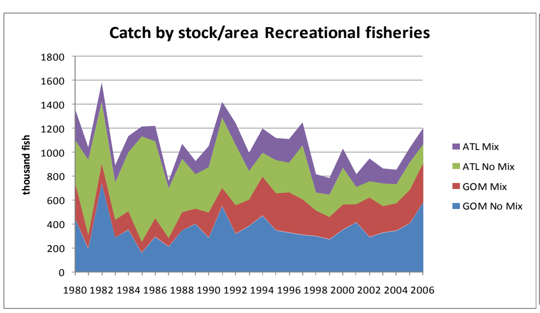

Fraction Migrate North (Measured as 1 - % NAA in MIX area, of total NAA begin season 4) GOM
Age0
Age1-3
Age4-7
Age8-10
Age11+

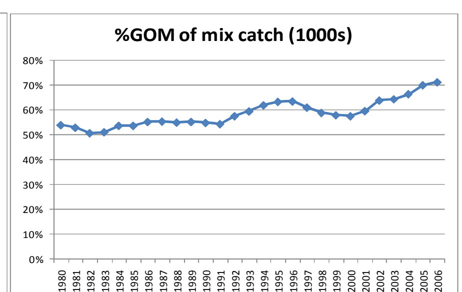

Fraction Migrate South (Measured as % NAA in MIX area, of total NAA begin season 2) ATL
Age0
Age1-3
Age4-7
Age8-10
Age11+


Fraction Migrate North (Measured as 1 - % NAA in MIX area, of total NAA begin season 4) ATL
Age0
Age1-3
Age4-7
Age8-10
Age11+

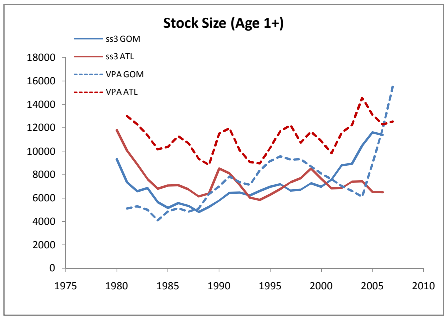

Catch by stock/area Commercial fisheries
thousand fish
ATL Mix
ATL No Mix
GOM Mix
GOM No Mix

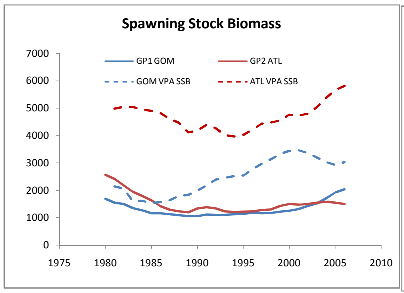

%GOM of mix catch (1000s)

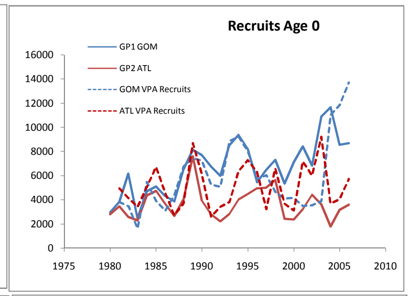

Catch by stock/area Recreational fisheries
thousand fish
ATL Mix
ATL No Mix
GOM Mix
GOM No Mix

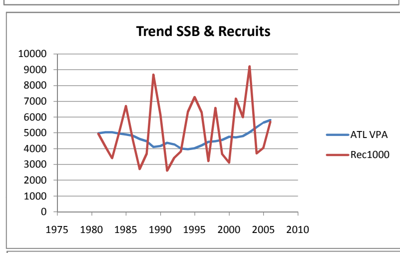

%GOM of mix catch (1000s)

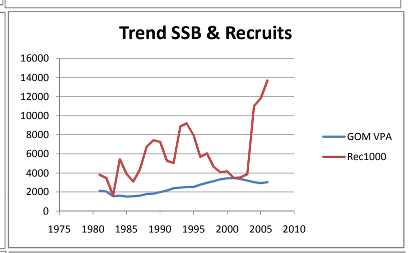
COMPARISON WITH VPA (50% CATCH MIX TO GOM)

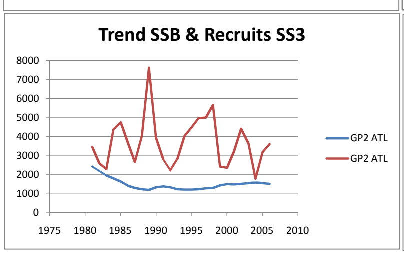


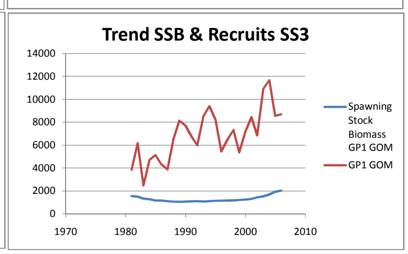


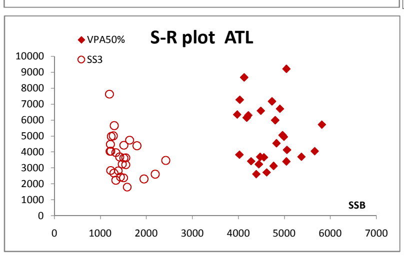


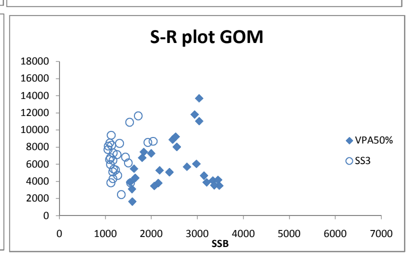


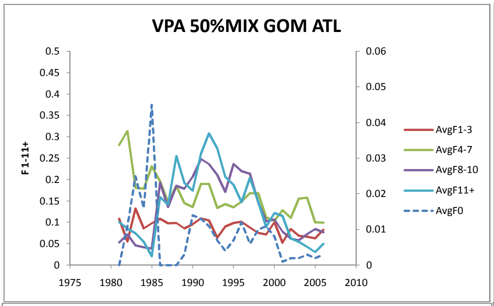


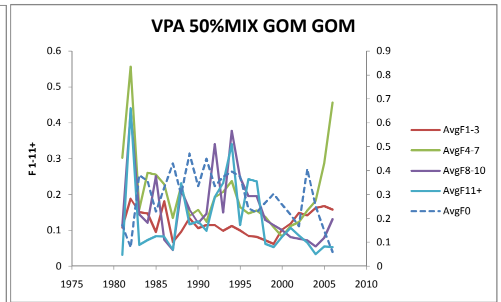


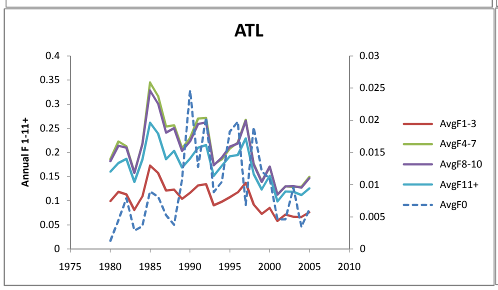


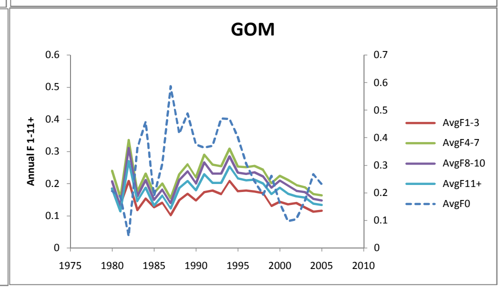


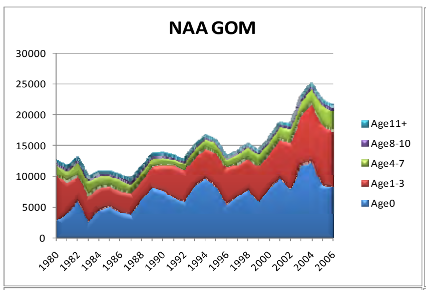


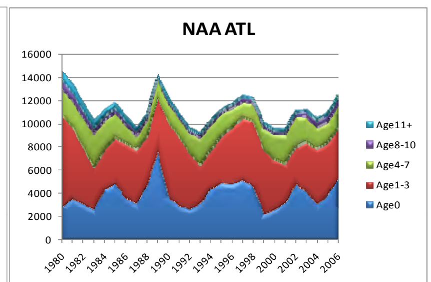

VPA 50%MIX GOM ATL
F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

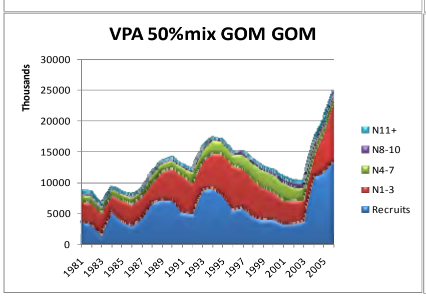

VPA 50%MIX GOM GOM
F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

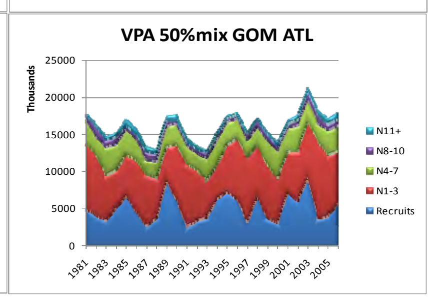

ATL
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0

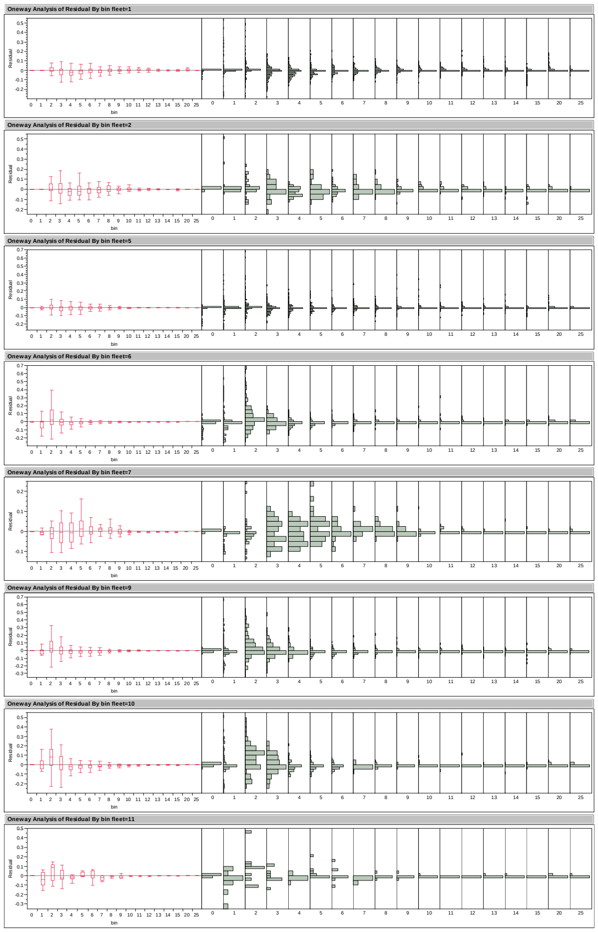

GOM
Annual F 1-11+
AvgF1-3
AvgF4-7
AvgF8-10
AvgF11+
AvgF0


NAA GOM
Age11+
Age8-10
Age4-7
Age1-3
Age0

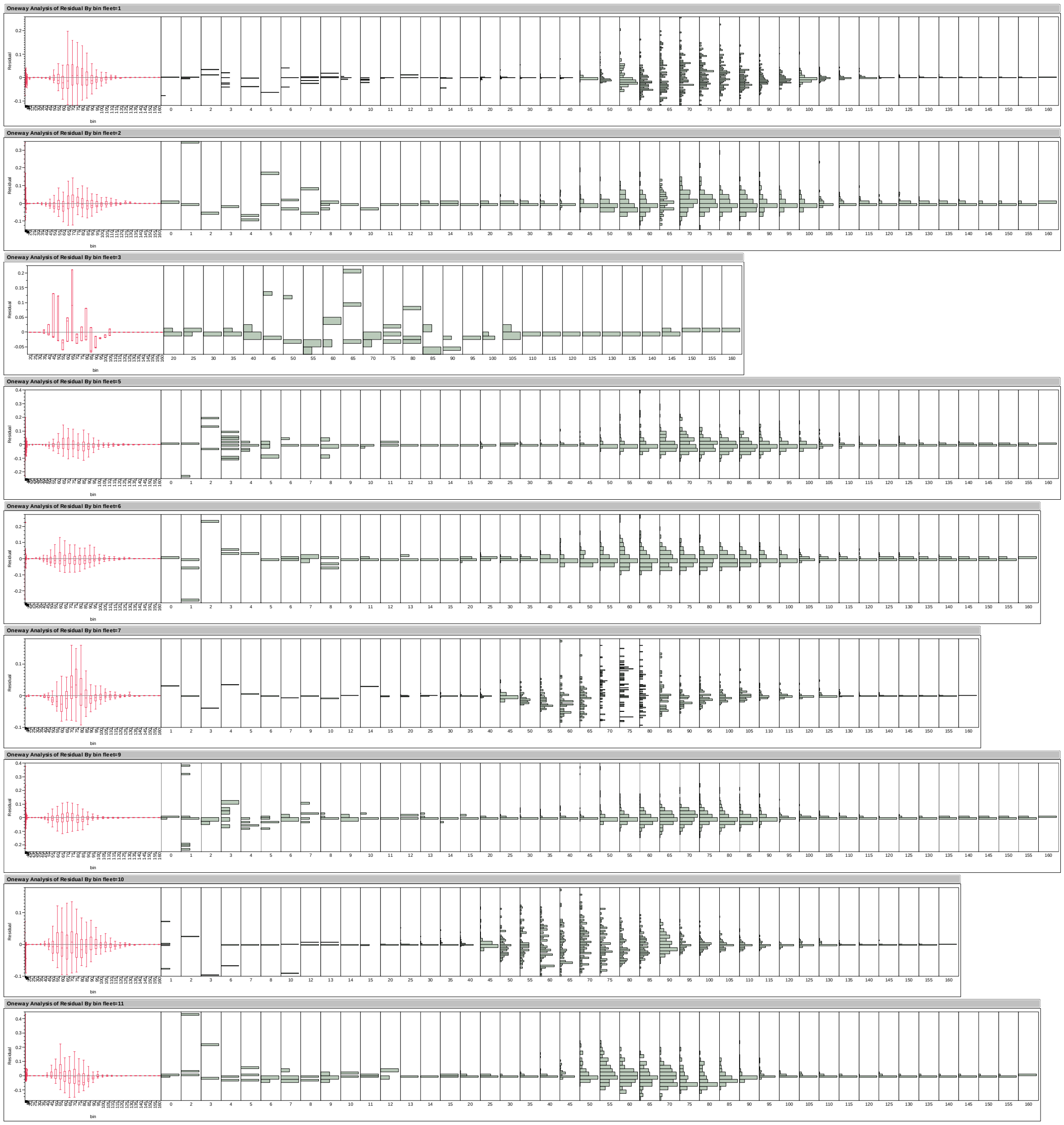

NAA ATL
Age11+
Age8-10
Age4-7
Age1-3
Age0


VPA 50%mix GOM GOM
Thousands
N11+
N8-10
N4-7
N1-3
Recruits


VPA 50%mix GOM ATL
Thousands
N11+
N8-10
N4-7
N1-3
Recruits



Boxplot residuals (obs-exp) age composition fit by fleet and histograms of residual distribution



Boxplot residuals (obs-exp) size composition distribution by fleet and histograms by bin size