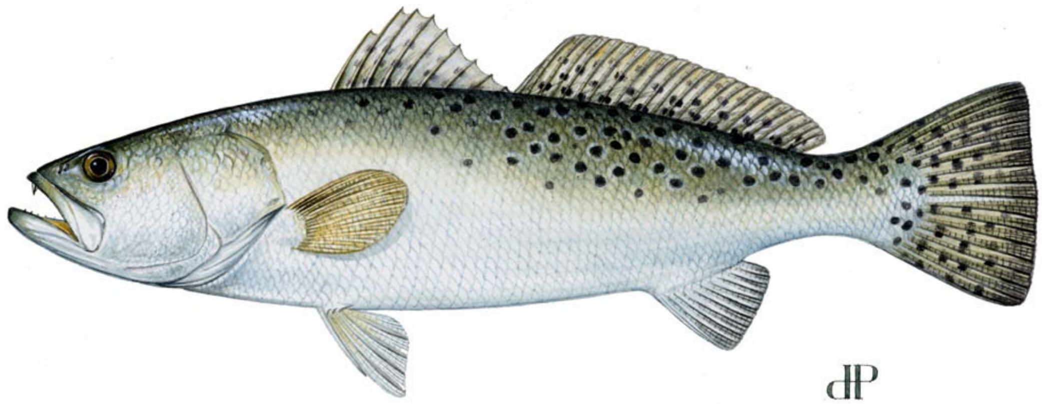
The 2024 stock assessment of Spotted Seatrout, *Cynoscion nebulosus*, in Florida



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Executive Summary

This report assesses the status of Spotted Seatrout populations found in Florida. Spotted Seatrout population dynamics are described for both the Florida Gulf and Florida Atlantic coasts utilizing available information on catch, effort, relative abundance, biology/life history, and length/age composition. It provides results from Stock Synthesis (SS) models for the period 1986-2023.

Historically, Spotted Seatrout in Florida have been assessed using regional management units, however based on recent genetic evidence using SNPS (single nucleotide polymorphisms) (Wallace et al., in prep) indicating no hard genetic breaks within Florida waters, the current assessment is conducted separately for each coast: Florida Gulf (Escambia through Monroe County) and Florida Atlantic (Miami-Dade through Nassau County).

For the present stock assessment, input data included updated life-history information, commercial landings, recreational landings and releases, as well as indices of abundance and length/age compositions from fishery-dependent and fishery-independent sources. The indices of abundance were the Marine Recreational Information Program (MRIP) total catch rates, and the catch rates from the FWC Fishery Independent Monitoring (FIM) young-of-the-year (21.3-m center bag seine) and 183-m haul seine surveys.

The condition of the Florida Spotted Seatrout stocks was determined using SS models and results were compared to management reference points. The FWC Commission's management objective for Spotted Seatrout is to maintain the SPR at or above 35% and transitional SPR (tSPR) is used to determine whether the stock meets the Commission's objective. The current condition of the stock is represented by the geometric mean of tSPR ($tSPR_{current}$) from the last three years (2021–2023). According to the Florida Gulf base model, $tSPR_{current}$ = 0.61. According to the Florida Atlantic base model, $tSPR_{current}$ = 0.58. Therefore, $tSPR_{current}$ estimates from both Florida coastal base models exceed the management objective.

Other population benchmarks that were calculated are the ratio of the current fishing mortality to $F_{35\%SPR}$, as well as the current spawning biomass to the $SSB_{35\%SPR}$. The objective is to maintain the fishing mortality ratio ($F_{current}/F_{SPR35\%}$) below 1.0 and the

spawning biomass ratio ($SSB_{current}/SSB_{SPR35\%}$) above 1.0. Defining current to be the geometric mean of the years 2021-2023, the fishing mortality ratio by coast is 0.33 for the Gulf, 0.31 for the Atlantic, and the spawning biomass ratio by coast is 1.54 for the Gulf, 1.29 for the Atlantic indicating that Florida Spotted Seatrout are not overfished nor undergoing overfishing on either coast.

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1. Introduction

1.1 Objectives

The primary objective of this assessment is to update the biology and catch statistics of Spotted Seatrout through 2023 and then to apply these updated data to stock assessment models to evaluate the condition of the stock on a coastwide basis for the Gulf coast and Atlantic coast of Florida. The last benchmark assessment for Florida Spotted Seatrout had a data terminal year of 2015 (Addis, et al. 2018) and since then improvements in the data, methods, and in the assessment model configuration have been made (see section 5.0).

1.2 Regulations

Spotted Seatrout have been managed in Florida waters using a variety of measures that include size limits, commercial seasons, trip limits, recreational daily bag limits, and season closures:

November 1989 - There were few restrictions on the harvest of Spotted Seatrout in Florida besides a 12-inch fork length (30.5 cm TL) minimum size limit for all areas of the state except Franklin County. In November 1989, the first significant “modern” changes in restrictions to harvest were enacted, including a statewide 14-inch total length (35.6 cm TL) minimum size limit, the addition of a recreational 24-inch (61.0 cm TL) maximum size limit with allowance for the take of one fish over this size per day, and a 10-fish recreational bag limit. Commercial fishing was restricted with a minimum mesh size, regional harvest quotas and daily vessel limits.

January 1996 - Seasonal closures, more restrictive bag and size limits, and more restrictive commercial vessel limits were added. The commercial fishery was also significantly impacted by the ban on the use of entangling nets in Florida waters beginning July 1, 1996 (Florida Constitution, Amendment X, Section 16).

July 2000 - The northern and southern recreational management units were created with unit-specific bag limits and season closures and a statewide 15-inch total length (38.1 cm TL) minimum size limit and a 20-inch (50.8 cm TL) maximum size limit with allowance for the take of one larger fish.

July 2006 - "total length" was defined as the straight-line distance from the most forward point of the head with the mouth closed, to the farthest tip of the tail with the tail compressed or squeezed, while the fish is lying on its side.

February 2012 - All recreational season closures were removed, the recreational bag limit in the northeast was increased to six fish, the commercial seasons were revised (northwest and southwest: June 1 – Oct. 31; northeast: June 1 – Nov 30; and southeast: May -1 Sept 30), and a commercial vessel limit of 150 fish was established when two or more licensed fishermen are aboard. [1]

February 2019 – A temporary modification of regulations for Spotted Seatrout in Southwest Florida was put in place from Feb 22, 2019 through May 10, 2019 due to a wide scale prolonged red tide event, and prohibited harvest of Spotted Seatrout greater than 20 inches total length within state waters and adjacent federal waters for Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee counties in addition to Collier county north of a line extending due east and due west from the south bank at the mouth of Gorden Pass.

May 2019 – A temporary modification of regulations for Red Drum, Snook and Spotted Seatrout in Southwest Florida was continued through May 31, 2020 and put in place catch and release only within state waters and adjacent federal waters for Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee counties in addition to Collier county north of a line extending due east and due west from the south bank at the mouth of Gorden Pass.

February 2020 – Management zones were modified by splitting the Northwest zone into the Western Panhandle and Big Bend zones and moved the border between the Southwest and Southeast zones to the Broward Palm Beach County line. Bag limits were established to three fish in the Western Panhandle and South zones, two fish in the Central East zone, and five fish in the NE zone, and the recreational slot size limit to 15-19 inches. This rule also allowed the harvest of one Spotted Seatrout over the slot limit per vessel and prohibits guides

1 The evolution and more specific aspects of these rules can be found at the FWC website at https://www.flrules.org/gateway/ChapterHome.asp?Chapter=68B-37

(captain and crew) from keeping a personal bag limit when on a for-hire trip. The rule re-establishes a February winter closure in the Western Panhandle and a November – December winter closure in the Central East zone. The rule reduces the daily commercial trip and vessel limits to 50 seatrout per person with a maximum of 100 seatrout per vessel statewide.

1.3 Management Units

The current Florida Spotted Seatrout management regions established in 2020 (Figure 1) are described as follows:

Western Panhandle: Escambia County through the portions of Gulf County west of longitude 85 degrees, 13.76 minutes but NOT including Indian Pass/Indian Lagoon.

Big Bend: Remaining portion of Gulf County plus Indian Lagoon, and Franklin County to Fred Howard Park Causeway in Pinellas County near the Pasco County line.

South: Fred Howard Park Causeway in Pinellas County near the Pasco County line through Broward County.

Central East: Palm Beach through Volusia counties.

Northeast: Flagler through Nassau counties.

1.4 Stock Assessment History

Fishery analyses and quantitative stock assessments for Spotted Seatrout in Florida have been conducted periodically since 1992. Most of these have relied on age-specific analyses designed to estimate past spawning potential ratios (SPR), with the more recent assessments using integrated statistical catch-at-age approaches. Historically, the geographic boundaries that frame the FWC periodic stock assessments and other demographic evaluations of Spotted Seatrout were defined as Northwest (Escambia through Pasco counties); Southwest (Pinellas through Monroe counties); Northeast (Nassau through Flagler counties); and Southeast (Volusia through Miami-Dade counties).

The 2006 assessment (Murphy *et al.* 2006) found that the transitional spawning potential ratios (tSPR) in all four regions likely exceeded the Commission's target of

35% tSPR. The average tSPRs during 2003-2005 were 38% in the Northwest, 46% in the Southwest, 62% in the Northeast, and 51% in the Southeast region.

The 2010 assessment (Murphy *et al*. 2011) estimated current (average for 2007-2009) transitional spawning potential ratios (tSPR) in all four regions to be exceeding the Commission's objective of 35%. The average tSPR was 37% in the Northwest, 49% in the Southwest, 67% in the Northeast, and 45% in the Southeast region.

The 2016 assessment (Addis et al. 2018) explored multiple modeling platforms (AD Model Builder statistical catch-at-age, Stock Synthesis, and Age Structured Assessment Program [ASAP]) with SS base model estimates of current tSPR (geometric mean of last 3 years) ratios of 27% in the Northwest, 51% in the Southwest, 29% in the Northeast, and 45% in the Southeast region. The Northwest and Northeast regions, at 27% and 29% respectively, did not achieve the Commission's management objective of maintaining the current tSPR at or above 35%.

A subsequent update to the 2016 assessment in 2019 using with data through 2017 resulted in estimates of current tSPR ratios of 24% in the Northwest, 46% in the Southwest, 31% in the Northeast, and 34% in the Southeast region.

2 Data Review

2.1 Life History

2.1.1 Stock Distribution

Spotted Seatrout occur along the U.S. Atlantic and Gulf coasts from Cape Cod, Massachusetts to Carmen Island in the lower Gulf of Campeche, Mexico (Mercer 1984). Historically, genetic evidence of isolation by distance has led to acceptance of fine-scale (e.g., at the state level) assessment and management of spotted seatrout in the United States (McBride 2014, Seyoum et al. 2014).

In Florida, most tagging studies indicated the presence of Spotted Seatrout stock subdivisions along each coast. Using early tagging and growth studies in Florida, Iverson and Tabb (1962) postulated that separate stocks of Spotted Seatrout occurred in each of Florida's major estuaries. Seyoum *et al*. (2014) identified three genetic stocks of Spotted Seatrout in Florida waters with two genetic markers: a 335-base pair segment of the mitochondrial DNA and 38 microsatellite loci. Each of the identified stocks had a unique range: 1) from the western border of Florida to Apalachicola Bay, 2) east of Apalachicola Bay through Biscayne Bay, and 3) from Sebastian Inlet to the northeast border of the state (Fig. 1B). No samples were collected from Biscayne Bay to Sebastian Inlet. However, a more contemporary genetics study on Spotted Seatrout in Florida using single nucleotide polymorphisms (SNPs) technology has indicated that there are no hard genetic breaks along Florida's Gulf and Atlantic coasts (Wallace et al. 2024, in prep). While the spawning dynamics of Spotted Seatrout appear to be largely localized (within-estuary) phenomena, the potential for occasional longshore larval transport between adjacent estuaries exists, along with occasional adult straying. Therefore, in light of recent genetic findings it was determined that this Spotted Seatrout assessment will be conducted on a coastwide basis, Florida Gulf (Escambia through Monroe county) and Florida Atlantic (Miami-Dade through Nassau county). The two coastal unit stocks as delineated will retain a meaningful degree of demographic independence in population dynamic analyses.

2.1.2 Age and Growth

Annual ages of adult Spotted Seatrout have been determined mostly from recognizable markings on scales or on sectioned otoliths (Murphy and Taylor 1994; DeVries *et al.* 1997). The maximum reported ages for adult Spotted Seatrout, in a given area, generally range from 4 to 12 years for males and females (Welsh and Breder 1923; Moody 1950; Klima and Tabb 1959; Moffett 1961; Stewart 1961; Tabb 1961; Brown 1981; Rutherford 1982; Arnoldi 1985; Maceina *et al.* 1987; Cottrell 1990; Wenner *et al.* 1990; Woodward *et al.* 1990; Murphy and Taylor 1994). Although females always appear to be more abundant than males at older ages, the oldest individual Spotted Seatrout observed in many studies was a male (Moffett 1961; Maceina *et al.* 1987; Colura *et al.* 1993; Murphy and Taylor 1994; DeVries *et al*. 1997). Bourgeois *et al.* (1996) concluded that Spotted Seatrout in the northern parts of their range, either along the U.S. Gulf or Atlantic coasts, live longer than the southern populations do. In Chesapeake Bay, Virginia (Brown 1981), and Galveston Bay, Texas (Maceina *et al.*

1987), observed maximum ages of 12 years which were higher than those seen elsewhere.

Differences in growth rates between sexes have been reported for adult Spotted Seatrout. Females were generally found to grow more quickly than males (Mercer 1984). Spotted Seatrout of both sexes generally grow at their fastest rate during their first year. Fish reach about 200 to 250 mm TL by the end of their first winter; grow less than 100 mm in the second year and then grow less than 75 mm per year thereafter. Sex-specific and regional differences in growth were quite apparent for Spotted Seatrout occurring in different areas of Florida (Murphy and Taylor 1994).

Spotted Seatrout growth was modeled external to the assessment model by sex and coast. Spotted Seatrout age data were filtered for samples obtained from fishery independent sources (Fishery Independent Monitoring, Life History studies) and were fit using von Bertalanffy growth curves. The age data were supplemented by the daily ages of unsexed, age-0 fish (10-170 mm SL, 5d-225d aged, n=98) from the McMichael and Peters (1989) life history study within Tampa Bay. These daily ages were also used as proxies within the growth curves for age-0 fish on the FL Atlantic coast. Because these daily ages are inherently more precise than estimated biological ages for age-0 Spotted Seatrout, ages in the dataset that were estimated to be less than 6 months old were removed due to high variability. This improved model fit and resulted in a growth curve better fit to the origin (i.e. t0). Additionally, due to higher sample sizes within ages 2-4 and to reduce oversampling of younger ages which could bias the model curve, the number of otoliths per decimal age (tenths of a year) were reduced by randomly selecting a maximum of 30 per decimal age.

Growth was modeled using the von Bertalanffy growth function,

$$L_t = L_{inf}(1 - e^{-K(t-t_0)}),$$

where L_t is the expected or average length at time t, L_{inf} is the asymptotic average length, K is the Brody growth rate coefficient, and t_0 represents the time or age when the average length was zero. Resulting von Bertalanffy growth models and parameters (L_{inf}, K, t_0) by Florida coast and sex are presented in Table 1 and Figure 2.

2.1.3 Morphometrics

Length-length and length-weight conversions were developed using available fishery-independent and fishery-dependent data.

Length-weight conversions were described using the power function,

$$W = a*L^b,$$

where W is the whole weight in kilograms, *a* and *b* are the power function parameters, and L is total length in centimeters. Length-weight conversions were developed by sex and coast.

Length-length conversions were described with the linear regression equation,

$$Y = a + X*b,$$

where Y is $TL_{natural}$ = total length with relaxed tail in millimeters, TL_{max} = total length with pinched tail in millimeters, or SL = standard length in millimeters, *a* and *b* are the regression parameters, and X is FL = fork length in millimeters. Length-length conversions were not found to differ among region or coast or by sex. Therefore, statewide and combined sex equations were developed.

Resulting morphometric parameters by Florida coast and sex are presented in Table 1.

2.1.4 Sex-ratios

Due to the sex specific differences in growth rates and maximum lengths in Spotted Seatrout, this assessment will model both male and female portions of the Spotted Seatrout population. Therefore, a sex-ratio-at-length key was developed by year and coast to track sex-ratio trends through time. The sex ratios were applied to unsexed fishery-independent and fishery-dependent length composition data. Length bins that had less than 20 samples in a year were removed. For both the Gulf and the Atlantic there were no length bins with more than 20 samples in 1988, so the data from 1987 was replicated. For the Gulf, 1997 also had low sample sizes and the average of

1996 and 1998 was used. Due to low data availability data from the Atlantic was grouped into 5-year bins starting in 1999-2023 before performing the analysis.
The sex-ratio-at-length relationship was described using the logistic function:

$$p_{fem,l} = 1/1 + e(-r(\mathrm{TL} - L_{50})),$$

where $p_{fem,l}$ is the proportion of females-at-length (cm), r is the rate of change and L_{50} is the length (cm) where the proportion of females is equal to 50% (i.e. the inflection point) (Leaf et al. 2017). The proportion of female was predicted yearly for 2 cm length bins ranging from 8 cm to 80 cm. The resulting mean parameter estimates of the logistic sex-ratio-at-length relationships are shown in Table 2. Values were set to 0.5 for all lengths ≤ 20 cm.

2.1.5 Maturity and Reproduction

Spotted Seatrout have a protracted spring through fall spawning season with a peak in April-July along the Florida Gulf coast. Spawning in southwest and east-central Florida occurs year-round with a peak in April and May (Murphy and Taylor, FWC-FMRI unpublished data). Crabtree and Adams (1998) found that the most intense period of spawning in the Indian River Lagoon was May through August. In Apalachicola Bay, the spawning season is more limited, occurring March through September with peak activity in May. In Tampa Bay, McMichael and Peters (1989) found that Spotted Seatrout spawned from early April through late October with major seasonal peaks in spring and summer. Lesser peaks in spawning apparently coincided with full moon phases. Males generally mature earlier in the season than females (Hein and Shepard 1979).

Spotted Seatrout are multiple (indeterminate) spawners, as evidenced by the persistent recruitment of vitellogenic and fully yolked oocytes in ovaries throughout the spawning season (Brown-Peterson *et al.* 1988). The average interval between spawning events, as determined from the inverse of the fraction of fish in imminent spawning condition (i.e., with hydrated oocytes), was once every 3.2 days in the Indian River Lagoon, Florida (Crabtree and Adams 1998) and once every 4.9 days in Tampa Bay (Barbieri 2004). Using the presence of postovulatory follicles as evidence of spawning, Barbieri (2004) estimated a longer average period between spawns of 8.9 days. Lowerre-Barbieri *et al.* (2013) tracked individual fish over time with acoustic tags and determined that the average spawning interval for female Spotted Seatrout at a Tampa Bay pass was 9.3 d. Given a 6-month spawning season, Spotted Seatrout females may spawn between 9 and 60 times during a spawning season. In Florida, there is evidence that older Spotted Seatrout contribute more to the total egg production each year than younger fish because they may spawn more frequently. Age-specific annual fecundities were estimated assuming a 184-day spawning season and conservative age-specific spawning frequencies based on observed postovulatory follicles and acoustic tagging. Annual fecundities were age-0, 0 eggs; age-1, 1,919,700 eggs; age-2, 5,854,464 eggs; age-3, 9,224,781 eggs; age-4, 15,701,400 eggs, and ages 5 and older, 18,048,054 eggs.

Most Florida Spotted Seatrout become sexually mature by the end of their first year at a length of 250-350 mm TL; males generally mature at smaller sizes and younger ages than females (Murphy and Taylor, FWC-FMRI, unpublished data). Since the assessment methodology uses a calendar-year time frame, the age groups referred to in this report represent a single year-class of fish that is present during each calendar year. For instance, model age-1 Spotted Seatrout are those fish in a year-class that in January are about 3-9 months old and by December are 15-21 months old. In this scheme, model age-0 fish are represented by fish that typically are less than 9 months old by the end of their initial calendar year. All biological schedules based on the biological age including maturity schedules were adjusted for this difference. For this assessment, a single maturity schedule was used for Spotted Seatrout for both coasts. Of course, no model age-0 Spotted Seatrout are likely to be mature, but recent work on Spotted Seatrout reproduction indicated that 83% of female Spotted Seatrout reach maturity during their first spawning season after hatching, and all fish age-2 and older were mature (S. Barbieri, FWC-FWRI, pers. comm.).

2.1.6 Natural Mortality

The natural (non-fishing-related) mortality for Spotted Seatrout has not been measured for Florida (i.e. mark-recapture studies). Consequently, empirical estimates were based on their maximum observed age (Hamel and Cope 2022). For Spotted Seatrout, the maximum age observed for fished populations is 12 years (see *Age and Growth* above). Given that these maxima were observed in the northern Gulf and Virginia and that archeological digs have unearthed otoliths that show a maximum age of only 9 years, the maximum age in an unexploited population off Florida was assumed also to be about 12 years.

In this assessment, the empirical, maximum-age-based estimate of natural mortality (0.45 y^{-1}, Hamel and Cope 2022) was distributed across ages using the Lorenzen approach, which assumes that natural mortality is inversely related to fish length (Lorenzen 2005). Coast specific female and male age vectors of instantaneous natural mortality were derived using this approach then rescaled so that they provided the same cumulative mortalities over ages 2-12 as did a constant mortality rate of 0.45 y^{-1} (Table 3).

2.2 Fishery-Dependent Data

2.2.1 Commercial Fishery

2.2.1.1 Commercial Landings

Commercial harvest information was obtained from the FWC’s Marine Fisheries Information System (“trip tickets”) and from the Fisheries Statistics Division of the National Marine Fisheries Service (NMFS) for the years 1950-2023. The NMFS data include annual landings from monthly dealer reports collected by NMFS’s port agents during the period 1950-1985 and trip tickets reported to the FWC during the period 1986-2023 (Table 4).

Overall, the annual commercial landings of Spotted Seatrout in Florida declined quite slowly during the 1950s and 1960s, and then the decline accelerated during the 1970s (Figure 3). Statewide commercial landings never exceeded much more than 500 mt during the early 1990s and dropped drastically to fewer than 50 mt after implementation of the constitutional amendment banning the use of entangling gear and the establishment of a 3-month open season in 1996 (Table 4).

The dominant commercial fishing gear used to capture Spotted Seatrout prior to 1996 was entanglement gear (i.e. gillnets, trammel nets). Dominant gears used by the commercial fishers to capture Spotted Seatrout in post net limitation amendment years include hook and line and cast net, with minor gears used: haul seines, traps, and other. However, since 1996, the Commission has designated only hook and line and cast nets as allowable commercial gear for the harvest of Spotted Seatrout. Currently the commercial fishery makes up less than 0.01% of the total landings of Spotted Seatrout in Florida and the average statewide commercial landings from the last five years (2019-2023) is around 13,500 pounds.

2.2.1.2 Commercial Length Composition

Most of the length data from the commercial Spotted Seatrout fishery were collected from 1986-1995, prior to the net limitation amendment (Table 5 and 6). The fish lengths ranged from 10-30 in (25-76 cm) total length, although few fish were larger than 25 in (63.5 cm) TL (Figure 4 and 5).

2.2.1.3 Commercial Discards and Bycatch

There are no monitoring programs that determine the number of Spotted Seatrout discarded from commercial fishing gear. Commercial fishers often modified their gears or fishing operations to avoid undersized fish. Limited observations of the gillnet fishery during the early 1990s in Tampa Bay supported this contention with discard rates of less than 2% of the landed numbers (Motta *et al.* 1993). Therefore, we assume that commercial discards were negligible and insignificant relative to total landings and, therefore, did not include them in the assessment.

2.2.1.4 Commercial Catch Rates

Prior to 1986, there was no program in place to measure the numbers of participants in the Spotted Seatrout fisheries in Florida or monitor their fishing effort. The number of commercial trips reporting landings of Spotted Seatrout were available for 1986-2023 from FWC trip tickets. During the 1980s and early 1990s, the number of commercial trips reporting landings of Spotted Seatrout declined slowly on the Atlantic coast and more rapidly on the Gulf coast. After the net limitation amendment was implemented in 1996, the number of commercial trips plummeted on both coasts and remained very low. Declines in the number of commercial trips from the mid-1980s to recent years were over 90% on the Atlantic coast and nearly 99% on the Gulf coast. Due to the reduced catch and effort within the commercial fishery in recent years, we deemed the data insufficient to generate informative time series of the commercial catch rates for Spotted Seatrout in Florida.

2.2.1.5 Commercial Age Composition

Age compositions of fish collected from commercially caught Spotted Seatrout were developed using the Fishery Dependent Monitoring subsection biostatistical and NMFS's Trip Interview Program (TIP) databases. The commercial ages of Spotted Seatrout consistently ranged from 1 to 9 y during 1992-2023, with the largest proportion of ages being from ages 1 to 6 y.

2.2.2 Recreational Fishery

Information on the recreational fishery in Florida came from the Marine Recreational Information Program (MRIP, 1981-2023). In 2008, the MRIP officially replaced MRFSS (Marine Recreational Fisheries Statistics Survey) as a more precise and accurate method for estimating recreational catch and effort. Due to changes made to the MRIP Access Point Angler Intercept Survey (APAIS) in 2013 and the more recent transition from the MRIP Coastal Household Telephone survey to the Fishing Effort Survey (FES), landings and discard estimates currently available from MRIP will differ from those used in earlier FL Spotted Seatrout assessments (Addis et al. 2018).

The MRIP recalibration from the updated APAIS and transition to FES did not consider the change in charterboat effort estimates from the CHTS to the For-Hire Survey effort estimates. Because of the difficulty in encountering anglers with random digit dialing who had taken charterboat trips, the For-Hire Survey called a random, stratified sample 10% of the charterboat operators in each For-Hire region every week and then expanded that information to obtain the number of charterboat trips by region. The MRIP recalibrated process assumed that effort for all modes was calculated from the CHTS. Therefore, for comparability, it was necessary to adjust the charterboat effort in the years prior to the implementation of the For-Hire Survey and we used the conversion factors by stratum developed by Dettloff and Matter (2019).

NOAA Fisheries continues to reevaluate and improve recreational data collection and the MRIP program. The Fishing Effort Survey (FES) is in the process of being revised, and the revised design is currently being tested throughout 2024 and is in alignment with prior pilot studies. The timeline for FES revisions is currently on track, with data collection efforts for the FES study concluding by the end of 2024; a public report will be produced in 2025 outlining key findings, and a new design will be implemented in 2026, pending favorable study results and peer review. Calibrated historical effort estimates updated to reflect outputs from the revised design will be available in spring 2026 for incorporation into stock assessments and fisheries management. NOAA Fisheries' guidance to fisheries managers and stock assessors who currently use FES data is to continue using existing FES data until the follow-up study has been completed, the new design peer reviewed, and the historical estimates have been calibrated.

2.2.2.1 Recreational Landings and Releases

Landings and releases from 1981-2023 were estimated for the Atlantic and Gulf coasts of Florida separately for each stratum: six two-month waves of the year; three fishing modes (shore, charter boats/guide boats, and private/rental boats), and three areas along each coast (inshore waters, state territorial waters, and federal offshore waters). For this purpose, MRIP developed a SAS program to estimate all catch components (e.g., landings, Type A + B1; released fish, Type B2, and weight landed, Type A + B1) for a custom domain herein defined by the previous strata. This program also provides the variances of the catch components. It should be noted that these MRIP estimates for charterboats/guides were then adjusted using the For-Hire Survey adjustment method described above. For each coast of Florida, a single recreational fleet was considered by aggregating the annual estimates of total catch, landings, and releases across strata.

The total harvest was the number of Spotted Seatrout retained plus the number of Spotted Seatrout that died after being released alive. The number of released seatrout that died subsequently was the number of seatrout released alive multiplied by the release mortality rate of 8% that was based on a compilation of literature-reported estimates and was agreed to by a scientific panel convened to review an earlier Spotted Seatrout assessment (Muller *et al*. 1997). Thus, the share of Spotted Seatrout kept and dead releases in total harvest can be calculated.

The recreational landings, live releases, total catch of Spotted Seatrout as well as the associated CV are in Table 7 and Figure 6. Table 8 shows the percentage of Spotted Seatrout released alive, the number of Spotted Seatrout that died after being released, the mean estimates of Spotted Seatrout total harvest, and the percentage of dead releases in Spotted Seatrout total harvest.

Recreational total catches dominate on the Gulf coast of Florida with a recent 5-year average of 81% of landings occurring on the Gulf coast and 19% occurring on the Atlantic coast. The total catches of Spotted Seatrout were highest during 2005-2006, ranging between 11.7 and 12.4 million fish on the Atlantic coast and during 2011-2012, ranging between 32.6 and 34.4 million fish on the Gulf coast. While the total numbers of Spotted Seatrout released alive were more precise (lower CV) than the number of Spotted Seatrout kept, both were imprecise before 1992 particularly on the Atlantic coast (Table 7). Note that, due to the changes in MRIP effort described above, the recalibrated MRIP data for Spotted Seatrout differ considerably from the MRIP adjusted data used in the 2016 stock assessment (Addis et al. 2018; Figure 7). On average, the MRIP recalibrated landings and releases of Spotted Seatrout on the Atlantic and Gulf coasts were 3 and 2 times higher than the MRIP adjusted values of the 2016 stock assessment, respectively.

As Table 7 and Figure 6 indicate, anglers released more Spotted Seatrout than they kept, and the number of Spotted Seatrout released alive increased significantly over time. Thus, although the release mortality rate of Spotted Seatrout is relatively low (8%), the proportion of harvest attributed to release mortality and increased significantly since the 1980s, ranging from around 30-58% on both coasts (Table 8, Figure 6)

2.2.2.2 Recreational Length Composition

The length composition of the recreational harvest (Type A+B1 fish) was compiled by Florida coast from the MRIP angler intercept data and weighted by the adjusted harvest estimates. The lengths were converted from fork length to total length and aggregated into 2-cm length bins (Figure 8).

The lengths of released Spotted Seatrout (Type B2 fish) were obtained from volunteer angler logbooks (2002-2009); logbook cards (2011-2023); and the Snook and Gamefish Foundation's Angler Action data set (2011-2019). Release lengths were combined from all sources, compiled by Florida coast, then aggregated into 2-cm length bins (Figure 9).

2.2.2.3 Recreational Age Composition

Age compositions were constructed from lengths and aged otoliths collected from recreationally caught fish from various fishery dependent sources (MRIP, State Reef Fish Survey [SRFS], Gulf Reef Fish Survey [GRFS], Marine Fisheries Initiative [MARFIN], At-sea sampling, dockside sampling, tournaments, etc.). Although the sample size (number of fish in each 2-cm) ranged from 0 to 1,105 fish/year on Florida Gulf and 0 to 96 fish/year on Florida Atlantic, the number of otoliths collected from the recreational fishery has remained very low, especially from the Atlantic coast averaging around 25 otoliths per year from 2021-2023.

2.2.2.4 Recreational Catch Rates

Recreational interviewers collect information on the number of fish released and the number of fish landed. Thus, a fishery dependent index (MRIP catch-per-unit-effort, CPUE) for both of Florida's coasts was developed using MRIP's total catch (landed + discarded fish) per trip. If more than one interview was conducted on the same recreational trip, beginning in 1991, MRIP has a data field that allows linking these ancillary trips to the primary interview; therefore, catch rates were determined from the 1981 to 2023 MRIP data and the measure for the catch rate was the total number of Spotted Seatrout caught by all of the anglers on the recreational trip identified by the primary interview.

2.2.2.4.1 Development of MRIP CPUE

Cluster analysis was used to identify which MRIP interviews had the potential to catch Spotted Seatrout (Krebs 1989; Shertzer and Williams 2008). Rare species (occurring in <1% of all trips) and those not identified to species were excluded from the cluster analyses. Based on the most recent 20 years of data, the Spotted Seatrout clusters on both the Atlantic and Gulf coasts included Red Drum, Ladyfish, Crevalle Jack, and Common Snook. The selection criterion was to include any trip that caught any species in the cluster as a possible Spotted Seatrout trip for MRIP index standardization.

The standardization of MRIP used generalized linear models (GLM). One GLM estimated the probability that a trip would catch a Spotted Seatrout, assuming a binomial distribution (logit link) for the proportion of positive trips. The other GLM assumed a gamma distribution (log link) for the number of Spotted Seatrout caught on successful trips in the Atlantic, and assumed a Poisson distribution (log link) for the number of Spotted Seatrout caught on successful trips in the Gulf. Comparisons among multiple distributions (Nominal, Poisson, Gamma, Log-normal, etc) while modeling the number of Spotted Seatrout caught per positive trip showed that the above assumed distributions produced the greatest reductions in deviance. Thus, on the Atlantic coast, the GLM model with the gamma distribution for MRIP catch data reduced the deviance by 8.4%. On the Gulf coast, the GLM model with the Poisson distribution for MRIP catch data reduced the deviance by 10.7%.

The abundance indices were obtained by multiplying the annual proportion of positive trips by the annual mean number of fish caught on positive trips, after they had both been back-calculated from their linear forms. Potential variables for the analyses of MRIP CPUE included year, the two-month wave during which the trip was conducted, the number of anglers on a fishing trip, the number of hours that the anglers spent fishing, area fished (bay or nearshore), region (current Spotted Seatrout management region), bay system, weekend or weekday trip, the mode of fishing (shore or private/rental boat), avidity (the average number of fishing trips that the anglers made in the previous two-months).

Analyses were based on main effects and the final model included only variables that were statistically significant and that explained at least 0.5% of the residual mean deviance [(a measure of variability)/degrees-of-freedom]. A Monte Carlo simulation approach (10,000 iterations) was used to calculate the index and its variability. Each iteration involved the least-squares mean estimates and their standard errors from the GLM models and added uncertainty by multiplying the standard errors by a random normal deviate (μ = 0, σ = 1). As indicated above, these values were converted back from their linear scale prior to being multiplied together.

2.2.2.4.2 Estimated MRIP CPUE

The binomial sub-model on proportion positive trips (PPT) and the gamma sub-model on the total number of fish caught per trip on the Atlantic coast were: PPT = Area fished + fishing mode + year; number of fish per trip = Hours fished + bay + year + fishing mode + wave. The binomial sub-model on proportion positive trips (PPT) and the Poisson sub-model on the total number of fish caught per trip on the Gulf coast were: PPT = fishing mode + bay + year + wave; number of fish per trip = hours fished + fishing mode + year + bay + wave. With the retained factors, the GLM with the binomial distribution reduced the mean deviance of the proportion positive trips by 20.9% on the Atlantic coast and by 11.4% on the Gulf coast. The GLM with the gamma distribution reduced the mean deviance of the number of Spotted Seatrout caught on positive trips by 8.5% on the Atlantic coast the GLM with the Poisson distribution reduced the mean deviance of the number of Spotted Seatrout caught on positive trips by 9.5% on the Gulf coast.

On the Atlantic coast, the MRIP CPUE of Spotted Seatrout declined between 1981 and 1988, then showed an increasing trend to a peak in 2012; and has generally declined throughout the rest of the time series, with 9 of the last 10 years being below the mean of the time series (Table 9 and Figure 10). On the Gulf coast, the MRIP CPUE of Spotted Seatrout showed a peak in 1984, and has shown a variable and general decline through 2023, with the past six years being lower than the mean of the time series (Table 9 and Figure 10).

2.2.3 Other Fishery Dependent Data Sources

Other fishery dependent data sources were considered for this assessment: the Everglades National Park (ENP) creel survey and the Biscayne National Park (BNP) creel survey. Both creel surveys occur at fishing access locations within their respective park boundaries. It was concluded that the ENP creel survey operates in a spatially restricted area of Florida's Gulf coast, and likely wouldn't be representative of coastwide recreational catch rates. Furthermore, to reduce redundancy and/or potential conflicts in indices of abundance trends, this assessment already uses a fishery dependent MRIP CPUE that is spatially oriented to the entire Gulf coast to monitor recreational angler catch rates. The BNP also suffers from spatial restriction and more importantly, despite the high amount of recreational effort the park experiences, the creel survey had very few positive recreational angler trips for Spotted Seatrout (highest number caught in a single year being 6 fish).

2.3 Fishery-Independent Data

2.3.1 Fishery Independent Monitoring Program (FIM)

Fishery-independent data for Spotted Seatrout came from the FWC-FWRI Fishery Independent Monitoring (FIM) program. The FIM program used monthly stratified random surveys to collect data, monitor abundance, and collect biological information on animals inhabiting bays and estuaries of Florida. The types of sampling gear FIM samplers commonly used to catch Spotted Seatrout were a 21.3-m center-bag seine and a 183-m haul seine, designed to collect, respectively, juvenile and subadult fishes in shallow areas (<1.8 m), and subadult and adult fishes in shallow waters (< 2.5 m). Strata are defined for each gear by year, month, depth, shore type (overhanging or not), and bottom vegetation (vegetated or not). This program also collects data on lengths, weight, sex, maturity, age, and diet of the captured fish.

2.3.1.1 FIM Length Composition

Each year during 1986–2023, the FIM program measured between 205–1,028 Spotted Seatrout on the Gulf coast and between 93–863 Spotted Seatrout on the Atlantic coast (Table 11). The lengths of Spotted Seatrout in FIM samples ranged between 4-86 cm TL. The FIM length data were among many other length data sources used to develop size compositions.

2.3.1.2 FIM Age Composition

The number of Spotted Seatrout ages sampled during the 183-m haul seine survey from 1986–2023 varied between 49 and 496 fish per year on the Gulf coast and between 16 and 204 fish per year on the Atlantic coast. Spotted Seatrout individuals collected by FIM were 0 to 9 years old.

2.3.1.3 FIM Indices of Abundance

2.3.1.3.1 FIM 183-m Haul Seine

The 183-m haul seine deployed by FIM is suited for sampling Spotted Seatrout because it catches a wide range of sizes and ages. Relative abundance indices of Spotted Seatrout were derived from the FIM program's seine surveys conducted in Apalachicola Bay, Cedar Key, Tampa Bay, Charlotte Harbor, the Indian River Lagoon, and in the St. Johns River/Nassau Sound areas. The Florida Gulf coast included data from Apalachicola Bay, Cedar Key, Tampa Bay and Charlotte Harbor data, the Florida Atlantic coast included data from the St. John River and coastal tributaries, and northern and southern Indian River Lagoon.

To account for various sources of uncertainty in the numbers of Spotted Seatrout caught per haul seine set that were not related to the abundance, the number of fish per haul seine set was standardized using GLM models similar to GLM models applied to MRIP catch rates: a binomial distribution (logit link) for dealing with the probability that a haul seine set would catch a Spotted Seatrout and a lognormal distribution (log link) for estimating the number of the Spotted Seatrout caught in successful hauls. The annual index was the annual proportion of positive haul seine sets multiplied by the annual mean number of fish caught on positive haul seine sets after they had been back-calculated from their linear forms.

Potential variables included in the GLM models for indices were year, month, zone, bottom type (e.g., structure, sand), shore type (e.g., mangrove, emergent, terrestrial, structure), water temperature, depth, and salinity. Temperature, salinity, and depth were divided into categories to handle any non-linearity in the catch-rate response. Analyses were based on the main effects and only statistically significant factors that explained more than 0.5% of the residual deviance were retained in the models. The variability in the annual estimates of each index was calculated using Monte Carlo simulations (10,000 iterations).

The GLM for proportion positive sets (PPS) and GLM for the catch per successful haul seine set were PPS = year + month + zone + bottom vegetation, and the number of fish caught per positive set = year + temperature + zone on the Gulf coast. PPS = year + zone + temperature + bottom type, and the number of fish caught per positive set = year + temperature + salinity + bottom vegetation on the Atlantic coast. On the Gulf coast, the GLM reduced the mean deviance of the proportion of positive haul seine sets by 3.6% and the mean deviance of the positive hauls model by 8.1%. On the Atlantic coast, the GLM reduced the mean deviance of the proportion of positive haul seine sets by 10.0% and the mean deviance of the positive hauls model by 8.0%.

The numbers of Spotted Seatrout per haul seine set on the Gulf coast showed notable highs in 2008 and 2010, decreased through 2015, and have since been above the long-term average with the exception of 2022. On the Atlantic coast, the numbers of Spotted Seatrout per haul seine set showed an increasing trend from 2001-2011 followed by a dramatic decline through 2013, and have since shown a general decline through 2023, with 9 of the last 10 years being below the long-term average (Table 10 and Figure 11)

2.3.1.3.2 FIM 21.3-m center-bag seine

Annual coast-specific young-of-the-year indices, defined as Spotted Seatrout smaller than or equal to 100 mm standard length (SL) during a ‘recruitment window’, were based on collections of Spotted Seatrout made using 21.3-m center-bag seines. Sets used to develop the coastal indices were made during Spotted Seatrout’s peak recruitment season of March-September. All fish were counted and up to 20 fish within a size class (e.g. small or large) of a species were measured for standard length.

To account for various sources of uncertainty in the numbers of Spotted Seatrout caught per seine set that were not related to the abundance, the number of fish per seine set was standardized using GLM models similar to GLM models applied to MRIP catch rates: a binomial distribution (logit link) for dealing with the probability that a seine set would catch a Spotted Seatrout and a lognormal distribution (log link) for estimating the number of the Spotted Seatrout caught in successful sets. The annual index was the annual proportion of positive seine sets multiplied by the annual mean number of fish caught on positive seine sets after they had been back-calculated from their linear forms.

The GLM for proportion positive sets (PPS) and GLM for the catch per successful seine set were PPS = year + zone + month +bottom vegetation + salinity + shore type + temperature, and the number of fish caught per positive set = year + bottom vegetation + temperature on the Gulf coast. PPS = year + bottom vegetation + month + zone + salinity + temperature, and the number of fish caught per positive set = year + bottom vegetation + zone + month + temperature on the Atlantic coast. On the Gulf coast, the GLM reduced the mean deviance of the proportion of positive seine sets by 16.9% and the mean deviance of the positive sets model by 12.0%. On the Atlantic coast, the GLM reduced the mean deviance of the proportion of positive seine sets by 7.8% and the mean deviance of the positive sets model by 6.6%.

The numbers of young-of-the-year Spotted Seatrout per seine set on the Gulf coast were generally higher in early years (1998-2004), with most of the recent years being at or below the long-term average. On the Atlantic coast, the numbers of young-of-the-year Spotted Seatrout per seine set show much stronger variation on a general decreasing trend from 2006 through current (Table 12 and Figure 12).

2.3.2 Other Fishery Independent Data Sources

Additional age determinations were developed from FWC's Fish Biology subsection and Fish Health subsection databases. Over 12,000 Spotted Seatrout were collected and aged from various independent research projects (collected with multiple gears) within Florida's bay systems from 1986-2015. These ages (labeled "BIOAGES") in form of conditional age-at-length data were considered within assessment models to potentially aid in estimating growth, however were ultimately not used in this assessment due to unknown gear (i.e. selectivity) in many cases, as well as the ages not being representative of a fleet’s catch or a survey monitoring abundance in the model.

3.0 Stock Assessment Modeling

3.1 Stock Synthesis Models (SS)

3.1.1 Overview

The base model for the Florida Spotted Seatrout stock assessment was developed in Stock Synthesis (SS) version 3.30.22.1. Stock Synthesis is an integrated statistical catch-at-age model that can accommodate age-structured, size-structured, and age-aggregated data (Methot and Wetzel 2013). It has 1) a population sub-model that simulates growth, maturity, fecundity, recruitment, movement, and mortality processes, 2) an observation sub-model which predicts values for the input data, 3) a statistical sub-model which characterizes goodness of fit and obtains best-fitting parameters and their associated variance via maximum likelihood, and 4) a forecast sub-model which projects various user-determined management quantities (Methot et al. 2024). Further descriptions of SS options, equations, and algorithms can be found in the SS user’s manual (Methot et al. 2024), the NOAA Fisheries Toolbox website (http://nft.nefsc.noaa.gov/), and Methot and Wetzel (2013).

3.1.2 Stock Synthesis Configuration and Methods

The Florida Gulf and Atlantic base models were of moderate complexity – informed by catch data from two commercial fleets and one recreational fleet (including landings, discards, length composition, and conditional age-at-length), a fishery dependent index of abundance (including length compositions), two fishery-independent abundance indices (including length composition and conditional age-at-length), and fishery-independent conditional age-at-length composition data that were not associated with any fleet or survey.

The Florida Gulf and Atlantic models estimated 126 out of the 157, and 125 out of the 156 parameters respectively. These parameters included, but were not limited to, growth parameters (asymptotic length [L_{inf}], von Bertalanffy growth coefficient [k], and the reference length for the start of von Bertalanffy growth [L_{min}]), virgin recruitment ($\ln(R_0)$), steepness (h), variability in recruitment (sigmaR), time-varying stock-recruit deviations, fishing mortality rates for each fleet and year that it was operational, length-based selectivity parameters for fleets, landings, discards, retention and indices with length composition data. Model-derived estimates include maximum sustainable yield (MSY) and MSY-proxy reference points (e.g., $F_{35\%SPR}$), and a full time series of population abundance-at-age (units: 1,000s of fish) and biomass (female spawning stock biomass, total, and exploitable in metric tons). The r4ss (Taylor et al. 2021) and ss3diags (Carvalho et al. 2021) software packages were utilized extensively to summarize and plot model outputs and perform diagnostic runs.

3.1.2.1 Temporal Structure

Based on previous life history studies throughout Florida, Spotted Seatrout generally show a prolonged spawning season from March through October, with a core spawning season varying depending on region, bay, or estuary.

Therefore, Florida Gulf and Atlantic Spotted Seatrout populations were modeled with a single season timestep, starting with spawning on January 1st as age 0 and aging one year each January 1st through age 8+, which represents a plus group. Catch, length, conditional-age-at-length, and index data were fit from 1986 – 2023.

3.1.2.2 Spatial Structure

Sufficient data informing age-based movement of Spotted Seatrout were unavailable to configure a multi-area model, therefore a single area model was implemented such that fish were assumed to homogeneously settle as recruits and spawn as adults across Florida coasts.

3.1.2.3 Life History

3.1.2.3.1 Growth

A single growth pattern was assumed for each coastal model. Growth was estimated within SS according to the von Bertalanffy growth function where initial values for the asymptotic length (L_∞), the von Bertalanffy growth coefficient (k), and the CV as a linear function of length-at-age were initially based on the external model results (Table 1, Figure 2).

The maximum length (L_{MAX}) was specified as equivalent to L_∞. The CV parameters were used in SS to describe the variability in length-at-age for the minimum (CV_{young}) and the maximum (CV_{old}) observed ages. The CV of mean length-at-age for intermediate ages was linearly interpolated. In the base models, growth was configured such that fish grew according to the von Bertalanffy growth model immediately upon 'settlement' at age-0 on January 1 (A_{min} = 0), beginning at a length 12-18 cm (L_{min}), but L_{min} was freely estimated.

3.1.2.3.2 Natural Mortality

The instantaneous natural mortality estimate was 0.45 yr^{-1} using the Hamel and Cope (2022) longevity equation with tmax = 12 yr (Table 3). Age and sex specific natural mortality was specified in the Florida Gulf and Atlantic base models using the Lorenzen option in Stock Synthesis scaled between ages 2-12. Estimated age and sex specific natural mortality rates by coast were found to range from 0.403 yr^{-1} to 1.065 yr^{-1} for ages 1 to 12 years.

3.1.2.3.3 Maturity, Fecundity, and Spawning Stock Biomass

Base models were configured as two-sex models, where female spawning biomass is estimated, and does not need to be multiplied by a fraction female. Maturity-at-age was specified with a user-defined vector. Fecundity was configured as eggs/kg to body weight ($eggs=a*Wt^b$) and parameterized such that a=1 and b=1, therefore making fecundity equivalent to spawning biomass.

3.1.2.4 Initial Conditions

Stock Synthesis requires equilibrium catch values as fixed inputs and the estimation of initial fishing mortality rates for each fleet. Initial equilibrium catches represent catches from a stock exhibiting a balance of removals and natural mortality by stable recruitment and growth. However, the Spotted Seatrout population was not assumed to be in equilibrium prior to the assessment's start year (1986) given the reported fishing history. Initial equilibrium catches for each fleet were therefore estimated within the base model. Specified initial equilibrium catches for the commercial fleets and recreational fleet were equal to 25-50% of the reported landings in the first year (1986). Initial fishing mortality rates for each fleet were freely estimated but diffuse symmetric beta priors were applied when required to keep model estimates in a plausible space.

3.1.2.5 Recruitment Dynamics

The Stock Synthesis base model used the Beverton-Holt stock-recruitment model (Beverton and Holt 1957). In SS, this stock-recruitment function uses three parameters which can be simultaneously estimated: 1) steepness (h/BH_steep; the recruitment obtained at 20% of the virgin biomass), 2) the virgin recruitment estimated in log-space ($\ln(R_0)$), and 3) the standard deviation of the natural log of recruitment (sigmaR). SigmaR penalizes deviations from the spawner-recruitment curve (calculated from $\ln(R_0)$ and steepness) and defines the difference between the arithmetic mean spawner-recruitment curve and the expected geometric mean (Methot et al 2024). All three stock-recruitment parameters were estimated within the base model.

Simple annual deviations from the stock-recruitment function, which were not constrained to sum to zero, were estimated assuming a lognormal error structure. The main recruitment deviations were estimated for the time period of greatest data-richness (1984 – 2023), which corresponds to when age data for the fleets largely became available. Additionally, early recruitment deviations were estimated for 1978 – 1983 and were informed by removals from natural mortality and commercial catch.

Expected recruitments need to be bias adjusted in SS because of its assumed lognormal error structure. The adjustment is accomplished by applying a full-bias correction to the recruitment deviations ($\sigma^2/2$) which have enough data to inform the model about the range of recruitment variability (Methot et al. 2024). Following the recommendation from Methot and Taylor (2011) to use the full bias adjustment on data-rich years, the Gulf base model used full bias adjustment between 1995 – 2022 after which it decreased the full bias adjustment to no bias adjustment by 2027. The Atlantic base model used full bias adjustment between 1991 – 2022 after which it decreased the full bias adjustment to no bias adjustment by 2034.

3.1.2.6 Fleet and Survey Configuration

Three fleets were included in the Florida Gulf and Florida Atlantic base models: Commercial Gillnet (which includes other minor gears), Commercial Hook and Line, and Recreational. All fleets in the Florida Gulf and Florida Atlantic base models had associated length compositions and conditional age-at-length data.

A fishery-independent young-of-the-year from the FIM Inshore 21.3-m Center Bag Seine data and one fishery-independent post YOY index that used the FIM Inshore 183-m Haul Seine data were modeled, along with a single fishery-dependent recreational CPUE index (MRIP total catch per trip). The associated length and age composition from the FIM 183-m haul seine was used. MRIP retained length composition (A+B1) was combined with live release length composition (B2) to inform the MRIP Total Catch (A+B1+B2) index length compositions.

3.1.2.7 Selectivity

Selectivity patterns describe the probability of capture-at-length or -age by a given fishery or gear. Selectivity can be used to model different gear types, targeting, and fish availability according to the spatial utilization of fish and/or fishery. Stock Synthesis allows selectivity to differ by length, age, or both. The Florida Gulf and Florida Atlantic base models were configured using length-based selectivity for all fleets, including the FIM 183-m haul seine index and the MRIP total catch CPUE index. The FIM YOY index was specified as a recruitment index. All selectivity parameters were freely estimated, except where noted.

Selectivity patterns across fleets and indices were configured to be constant over time, thereby assuming that major changes in the availability of Spotted Seatrout and/or changes to management regulations have not occurred so as to alter these patterns since the model’s start year.

Length- or age-based selectivity can be specified in various ways in Stock Synthesis (Methot et al. 2024), however for the Florida Gulf and Florida Atlantic base models only one of the following three selectivity forms were applied to each fleet/index: a two-parameter single logistic function (i.e., flat-topped), a six-parameter double normal function (i.e., dome-shaped), and a 3+2*N parameter cubic spline with N nodes. Two parameters describe logistic selectivity: (1) the length at 50% selectivity, and (2) the difference between the length at 95% selectivity and the length at 50% selectivity. Six parameters describing the double normal function: 1) peak selectivity: beginning size (or age) for the plateau (in cm or age), 2) top: width of plateau, as logistic between peak and maximum length (or age), 3) ascending width: parameter value is ln(width), 4) descending width: parameter value is ln(width), 5) initial: selectivity at first bin, as logistic between 0 and 1, and 6) final: selectivity at last bin, as logistic between 0 and 1. For a 5 node setup using the cubic spline: 1) Code for initial set up which controls whether or not auto-generation is applied, 2) Gradient at the first node, 3) Gradient at the last node, 4-8) The nodes in units of cm, held constant, 9-13) The values at the nodes, units are ln(selectivity) before rescaling.

Length-based selectivity was configured for the Florida Gulf and Florida Atlantic base models: Commercial Gillnet (double normal), Commercial Hook and Line (simple logistic), Recreational (simple logistic), FIM 183-m haul seine index (Cubic Spline with 5 nodes). The cubic spline was modeled for the FIM Haul Seine index because a bi-modal pattern was evident in the length composition which persisted at the year and month resolution for both coasts.

Time-varying selectivity functions were used to allow selectivity to change according to increases in the minimum size limits. To capture discernable shifts in recreational fleet selectivity and to reduce the number of time blocks, one time block was used for an early period for the recreational fleet (1986-1989) when there were few restrictions on harvest besides a 12-inch FL minimum size limit for all areas of the state except Franklin County. A second time block was 1990-2023 when statewide bag limits and slot limits were implemented for Spotted Seatrout in Florida in late 1989 (14-20 inch TL slot, allowance for the take of one fish over this size per day, and a 10 fish bag limit).

3.1.2.8 Length-based Retention

The recreational fleet was assumed to release fish in accordance with the size regulations. In Stock Synthesis, retention is defined as a logistic function of size or age (Methot et al 2024). Since size regulations for Florida Spotted Seatrout are in the form of a slot limit, with allowance of one fish per vessel or one fish per shore angler above the slot limit included in the bag limit, retention was modeled as an asymptotic function with length and consisted of four parameters: (1) the inflection point, (2) the slope, (3) the asymptote, and (4) the male offset inflection (not applicable to this model and assumed to be zero). The inflection point, slope, and asymptote were freely estimated for all retention functions, except where noted.

As with selectivity, two time-varying retention functions were also used to allow the lengths of releases to change according to increases in the minimum size limits.

3.1.2.9 Landings

The uncertainty associated with landings and releases for the recreational fleets was greater than that for the commercial fleets leading to a different treatment in the estimation of fishing mortality rates between these two sectors. For the commercial fleets, the fishing mortality rates were specified using the ‘hybrid F’ option, wherein the estimated landings were practically an exact fit to the observed landings. For the recreational fleets, the fishing mortality rates were specified as parameters, allowing a reduced fit to observed landings in order to better fit other data sources (e.g., discards, indices). Treating fishing mortality rates as parameters is preferred when catch is known imprecisely and when it is acceptable to have a solution in which the estimated fishing mortality rates do not reproduce the input catch levels exactly.

3.1.2.10 Releases

Live and dead releases for each fleet were calculated and fit within the base model. Live releases were estimated by applying the complement of the retention function to the total catch, while dead releases were the result of assumed release mortality rates (Methot and Wetzel 2013). Fleet-specific release mortality rates were treated as fixed model inputs and were assumed constant through time. Spotted Seatrout release mortality was input at 8%. This was an average rate calculated from several hook-and-line catch and release studies in the 1990’s for Spotted Seatrout in Florida and Texas (Murphy et al. 1995, Matlock et al. 1993, Gibson and Vaughan 2002), and has been used in previous Florida Spotted Seatrout stock assessments (Murphy et al. 2006, Murphy et al. 2011, Addis et al. 2018).

3.1.2.11 Catchability

Constant catchability was assumed for all surveys, and was configured as Q "float", with no prior, not time varying, and not estimated as an active parameter within SS. With Q "float" the units of the survey or fishery CPUE are treated as dimensionless so the Q is adjusted within each model iteration to maintain a mean difference of 0.0 between observed and expected.

3.1.3 Goodness of Fit and Assumed Error Structure

A maximum likelihood approach is used in Stock Synthesis to evaluate the overall goodness of fit to each data source (i.e., landings, discards, indices, length compositions, and conditional-age-at-length). Datasets contained an assumed error distribution (e.g. lognormal) and an associated likelihood determined by the difference between observed and predicted values and the variance of the error distribution. The total likelihood is the sum of the individual components' likelihoods. The global best fit to all the data was determined using a nonlinear iterative search algorithm to minimize the total negative loglikelihood across the multidimensional parameter space.

Some model components were not given any weight in the loglikelihood function (i.e., the likelihood component multiplied by the weight (lambda) value was set to zero). These zero weight components included fishery independent biological samples, termed "BIOAGES" and input as conditional age-at-length data that were obtained during life history studies that are not linked to any fleet or survey within the models. Setting the weight in the loglikelihood function to zero (or near zero) reflects a lack of confidence in values for components or the component was not used in fitting the model to the data and parameters.

The error structure for landings, indices, and discards was assumed to be lognormal, except where noted. For most data sources, the variance of the observations was available only as a coefficient of variation (CV). In SS, if lognormal error structures were required, CVs were converted to a standard error (SE) in log-space using the following formula:

$$SE = \sqrt{ln(1 + CV^2)}$$

Multinomial distributions were assumed for the length composition data of the landings, discards, and indices as well as the conditional age-at-length composition data of the landings and fishery-independent dataset, which have variances estimated by the input effective sample sizes. The variance of the multinomial distribution is a function of true probability and sample size; thus, an increase in sample size represents lower variance and vice versa. The effective sample size is meant to represent the number of independent and random samples each year to determine the length or age composition. The assumption of independent and random sampling is typically violated because fish caught in the same tow or set tend to be more similar to each other in length or age than are fish from different catches, and this can extend to fish caught by the same vessel. In addition, the assumption of random sampling can be violated (e.g. by sampling vessels non-randomly or by under-sampling nighttime trips or fishing areas).

The variance associated with each data source can be highly influential, especially when there are conflicts among data sources. Because true effective sample sizes are unknown, effective sample sizes for length compositions were initially set to the square root of the sample size to avoid over-weighting observations of lengths in the likelihoods. The effective sample sizes for conditional age-at-length were set to the number of Spotted Seatrout sampled because there are fewer fish aged at a given length.

Francis (2011) and Punt et al. (2017) have developed re-weighting procedures to adjust the effective sample sizes of length and conditional age-at-length data iteratively until the multipliers reached a stable value. Multipliers are calculated so that variability of model inputs is consistent with the model fits to mean length or mean age (Francis 2011).

A feature available in Stock Synthesis is to apply Francis weights separately to length or age data from each fleet/survey and partition (released or landed). This allows for different weighting factors between released lengths and retained lengths, which comparatively have a much greater input effective sample size. An alternative weighting method for composition data is to use the Dirichlet-Multinomial distribution which estimates a parameter (theta) that internally scales the input sample size (Thorson et al. 2017; Methot et al. 2024).

3.1.4 Estimated Parameters and Derived Quantities

Stock Synthesis estimated a total of 126 out of 157 parameters within the Florida Gulf base model and a total of 125 out of 156 parameters within the Florida Atlantic base model for Florida Spotted Seatrout. Included in Table 13 are estimated parameter values from Stock Synthesis, the range of values a parameter could take, their initial starting values, their associated standard deviations and CVs, the prior type and its standard deviation (where applicable), the phase, and if the parameter was either estimated (positive phase) or fixed (negative phase). Most parameter bounds were set wide and may include unrealistic values, however this was intentional as it reduced the gradient and allowed the search algorithm to adequately explore the solution space and avoid finding a local minimum. The base models also used the soft bounds option which moves parameters away from the bounds with a weak penalty (Methot et al. 2024).

Derived quantities include annual numbers- and biomass-at-age, spawning stock biomass, fishing mortality rates-at-age, and internally calculated reference points (e.g., $F_{MSYproxy}$, $SSB_{MSYproxy}$, MSY_{proxy}). Also, recent fishing mortality rates ($F_{Current}$) and recent spawning stock biomass ($SSB_{Current}$) as the geometric mean of the most recent three years. Stock Synthesis does not calculate transitional SPR (tSPR), the management reference point for which Spotted Seatrout is managed in Florida, so this was calculated external to the model.

3.1.4.1 Uncertainty of Parameters and Derived Quantities

Approximate uncertainty estimates for estimated and derived quantities were calculated after model fitting based on the asymptotic standard errors from the covariance matrix determined by inverting the Hessian matrix (i.e., the matrix of second derivatives was used to determine the level of curvature in the parameter phase space and to calculate parameter correlations; Methot and Wetzel 2013). Asymptotic standard errors provided a minimum estimate of uncertainty in parameter values.

In addition, Monte Carlo Markov Chain (MCMC) analyses provided posterior distributions of model parameters and selected derived quantities. MCMC allows probabilistic reporting of the uncertainty associated with the estimated values. Estimates of population values in the terminal year of the stock assessment are often the most uncertain. Assuming the MCMC posterior distributions provide reliable estimates of model uncertainty, the probability that the estimated terminal year value is above or below the overfished/overfishing reference points can be calculated. In this way, a level of risk associated with failing to reach the reference points can be quantitatively specified.

Two MCMC chains were initially produced for both the Florida Gulf and Florida Atlantic base models. For each chain, a total of 10,000,000 iterations were performed but only one out of every 2,000 iterations was saved, resulting in 5,000 potential iterations used to generate estimates of uncertainty in fishing mortality and spawning stock biomass. Visual inspection of trace plots was used to adjust appropriate levels of burn-in and thinning as well as to address any autocorrelation in the iterations. Convergence of a single chain was assessed by Geweke's diagnostic to determine whether the mean of the first 10% of the chain is not significantly different from the last 50% of the chain, while convergence of two chains was assessed using Gelman and Rubin's (1992) potential reduction scale factor implemented in the 'coda' package (Plummer et al. 2006) in R.

Parametric bootstrap resampling methods were used to analyze the uncertainty associated with the data and to detect possible model misspecification. Five hundred bootstrapped datasets were produced by randomly drawing datasets according to assumed error distributions centered on fitted values. By fitting the model to each of the bootstrapped datasets, base model parameter estimates and derived quantities were compared to the distribution of parameter estimates and derived quantities from the bootstraps. Discrepancies between base model estimates and the median of the distribution produced by bootstrap analysis may indicate model misspecification of error distributions, data conflicts, or considerable autocorrelation within datasets (Methot and Wetzel 2013).

3.1.5 Model Diagnostics

Model diagnostics of the Florida Gulf and Florida Atlantic base models were performed in R using the ‘r4ss’ and ‘ss3diags’ (github.com/JABBAmodel/ss3diags) packages and largely follow the recommendations put forth in the Carvalho et al. (2021) ‘cookbook’ for integrated stock assessment models. While we briefly summarize each diagnostic here, further descriptions can be found in Carvalho et al. (2021) and references therein.

3.1.5.1 Model Convergence

Several approaches were used to assess convergence of the base model. First, the Hessian matrix must be invertible (i.e., there are valid solutions for all the parameters in the model). Next, the maximum gradient component (a measure of the degree to which the model converged to a local or global minimum) was compared to the final convergence criteria (0.0001, common default value). Ideally, the maximum gradient component will be less than the criterion.

Once these two criteria were met, a jitter analysis was performed on the parameter’s starting values to suggest whether the base model had converged on a global solution instead of a local minimum. For this analysis, initial values were jittered by 15% and 200 iterations were performed.

3.1.5.2 Correlation Analysis

High correlation among parameters was also assessed as it can lead to poor model stability along with flat likelihood response surfaces. While some parameters will always be correlated due to their structural nature (e.g., growth and stock-recruitment parameters), many highly correlated parameters may warrant reconsideration of modeling assumptions and parameterization. Therefore, correlation among parameters was examined and any correlations with an absolute value greater than 0.7 were reported.

3.1.5.3 Likelihood Profiles

Parameter profiling was used to elucidate model support for a range of parameter values, particularly for parameters that are often unknown or ill-informed by data (e.g., steepness, unfished recruitment, variation of recruitment deviations, natural mortality). This type of analysis can identify data conflicts and broad, not well-informed likelihood surfaces. Parameter profiling entails holding a parameter value constant at a chosen value while estimating the remaining parameters, and then evaluating the associated marginal log-likelihood (either in totality or for each data source).

Ideally, the plotted relationship between negative marginal likelihood values and the range of parameter values yields a well-defined minimum that aligns with that estimated by the base model. If a given parameter is not well estimated, the profile plot may show conflicting signals across data sources and/or a flat marginal likelihood surface. This indicates that multiple parameter values are equally likely given the data. In such instances, the parameter may not be influential in the model, or the model shows instability and model assumptions may need to be reconsidered. Likelihood profiles were done for two stock-recruitment parameters estimated in the base model steepness and virgin recruitment (R_0).

3.1.5.4 Model Consistency

To measure model consistency, the base model was first subject to a retrospective analysis that removed successive years of data from the model for seven years (i.e. seven peels). Iteratively removing data from the final model year reveals the effect of a single or successive years of data on model results. If the results of this analysis show a retrospective bias (consistent patterns of increasing or decreasing model estimates and related derived quantities with each retrospective peel), it can be an indication of model misspecification of temporal dynamics. It is preferable for estimates associated with each retrospective peel to be randomly distributed around base model results. Model performance was evaluated by visual inspection of retrospective patterns and the Mohn's Rho (ρ) metric (Mohn 1999, Hurtado-Ferro et al. 2015). Based on simulation studies, a Mohn's Rho value between -0.22 to 0.3 is generally considered acceptable for shorter-lived species (Hurtado-Ferro et al. 2015; Carvalho et al. 2021). This work also suggested that positive values of Mohn's Rho for biomass and negative values for fishing mortality imply consistent overestimation of biomass and the highest risk for overfishing.

Additionally, an age-structured production model (ASPM) and an ASPM with estimated recruitment deviations (ASPMdev) were also developed in Stock Synthesis to investigate which processes were influencing the shape of the production function and whether composition data was influencing the variability in recruitment. For the ASPM, this was completed first by fixing all parameters to those values estimated by the base model except for the R_0 parameter and the initial fishing mortality parameters. Next, the likelihood components (i.e., lambdas) for the length and age composition data were set to zero along with the recruitment deviations for both the early and main periods such that only the catch and indices of abundance were fit by the model. For the ASPMdev, recruitment deviations were also estimated and the bias-correction factor was re-adjusted following Methot and Taylor (2011). Trends in both spawning stock biomass and fishing mortality were compared between the base model, the ASPM, and the ASPMdev.

3.1.5.5 Sensitivity Runs

Sensitivity runs were conducted to investigate the impact of alternative assumptions or data sets on model fits and results. Key sensitivity runs are described below, but many additional exploratory runs were also implemented.

3.1.5.5.1 1950 Start year

There were no accepted estimates of recreational landings of marine fishes in Florida before implementation of the Marine Recreational Fisheries Statistics Survey in 1981. Historic recreational landings and releases can be approximated back to 1950, to match the time series of available commercial landings. Previous Florida stock assessments of inshore species (Addis 2020, Addis et al. 2018, Chagaris et al. 2015, Murphy et al. 2006, Murphy et al. 2011) have utilized information from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) and/or historical fishing license data to estimate historical recreational harvest and releases from 1950-1980. This method involves generating FHWAR estimates of the proportion of anglers that are saltwater anglers and applying that proportion to the annual certified number of fishing licenses to estimate the annual number of saltwater anglers in Florida. The average total catch per angler from MRFSS 1981-1985 was used together with the annual estimates of saltwater anglers to approximate the historical, recreational landings, in numbers and weight, back to 1950. The average standard errors from 1981-1985 landings and releases are also applied to estimated historical landings and releases.

The models were then run with a start year of 1950, with the use of steepness in the initial equilibrium recruitment calculation, and initial equilibrium catch using 1950 fleet values in 1000's of numbers or metric tons.

3.1.5.5.2 Release Mortality

Sensitivity runs examining the effect of alternative release mortality rates were performed. This was completed by configuring the fixed parameter inputs in the release mortality equation to produce the respective release mortality rates for each fleet. For the recreational fleet, the two higher release mortality sensitivities were set at 15% and at 25%, so that the release mortality assumption in the base model of 8% is a low estimate.

3.1.5.5.3 Remove S-R curve

The stock-recruitment relationship is frequently poorly estimated or can be biased due to patterns in recruitment caused by other factors. Thus, Maunder and Thorson (2019) recommend that assessments using a stock-recruitment relationship compare the performance with a model without such a relationship (i.e., steepness = 0.99).

3.2 Florida Gulf Coast Stock Assessment Model Results

3.2.1 Estimated Parameters and Derived Quantities

The Florida Gulf coast base model estimated most parameters reasonably well (i.e., |CV| < 1; Table 13). Of the 126 active parameters, 28 exhibited poor estimation (i.e., |CV| > 1); including 8 initial age composition adjustments, 14 recruitment deviations, and 6 parameters describing selectivity (the top width, descending width, and start of the Commercial Gillnet, and inflection and width of retention for the recreational fleet). No parameters were estimated near the bounds.

3.2.2 Model Fit

3.2.2.1 Landings

The landings data for the commercial fleets (in metric tons) were fit exactly due to the minimal associated uncertainty in the observed values, while the predicted landings for the recreational fleets (in 1000s) were allowed to differ from the observed values (Figure 13). Predicted recreational landings tended to underestimate the observed values prior to 1995 and slightly overestimate the observed landings starting in the 2000s.

3.2.2.2 Releases

Releases from the recreational fleet were characterized by uncertainty and have generally increased throughout the time series (Figure 14). The model largely followed the trends of the observed, apart from overestimating a few years in the late 1980s. Model estimated discard rates correspond to increases in the minimum size limit for Spotted Seatrout in 1989 (Figure 15).

3.2.2.3 Indices

Indices were fit adequately by the Florida Gulf base model (Figure 16). The MRIP index exhibited a general declining trend over the entire timeseries. Model fits to the MRIP total catch CPUE index (longest index in the timeseries) were good, but modestly overestimated the data in some years (1988, 2001, 2019, and 2022). The two fishery-independent indices began in the late 1990s, with the FIM YOY index exhibiting a variable but general declining trend over the timeseries and the FIM Haul Seine index exhibiting a variable but general increasing trend over the timeseries. Model fit to the FIM YOY index was adequate, but under or overestimated exceptionally high and low years. Model fit to the FIM Haul Seine index was less favorable, with the model fit showing a flat trajectory amidst the subtle trends in the index (Figure 16).

3.2.2.4 Length and Age Composition

3.2.2.4.1 Data Weighting

Iterative reweighting of length and conditional length-at-age composition data was performed according to Francis composition weighting method TA1.8 (Francis 2011). Francis weights were calculated iteratively until they stabilized to the values presented in Table 14, which occurred on the 5th iteration. As shown, length compositions from Recreational fleet, the MRIP CPUE, and the FIM Haul Seine index were up-weighted the most, while length compositions for Commercial Gillnet and Commercial Hook-and-line were slightly downweighted. Age compositions from all fleets/surveys were downweighted.

3.2.2.4.2 Length Composition

Overall, the Florida Gulf base model fit the observed length compositions with 2-cm bins reasonably well and when aggregated across years, the expected length compositions were similar to the observed compositions for most fleets and surveys and among sexes (Figure 17). The overall observed length compositions for the Commercial Gillnet and Commercial Hook-and-Line were slightly bimodal, but the assumed selectivity patterns for these fleets (double normal and simple logistic, respectively) cannot accommodate bimodality. Therefore, the smaller lengths between 20-30 cm are underestimated in some years, and some larger lengths in the 60-70 cm bins were underestimated as well. The overall observed length compositions for the FIM 183-m haul seine showed very apparent bimodality. The assumed selectivity pattern for this fleet (cubic spline) allowed the model to produce a good fit to the length composition.

Overall, model fits to the recreational discard length composition are acceptable. However, as is often the case, fits to retained recreational length compositions were better than fits to recreational discarded length compositions, and sample sizes were notably smaller for discard length compositions. The model slightly overestimated smaller discards (28-34 cm) while slightly underestimated larger discard lengths (36-70 cm) (Figure 17).

3.2.2.4.3 Conditional Age-at-Length

The base model fits to mean age by year for each data source are presented in Figure 18. Model fits were reasonably good and largely fell within the confidence intervals for most years within fleets/surveys after reweighting input sample sizes according to Francis (2011). Mean age within commercial gillnet, commercial hook-and-line, and the recreational fleets remained relatively stable for their respective timeseries of age data at around age 3. A declining trend of mean age is displayed for the FIM haul seine index, where in the late 1990’s the mean age was around 3 yrs, and by the end of the timeseries the mean age decreased significantly by ~50% to a mean age of 1.5 yrs.

The fits to annual age-at-length by fleet/survey for the Florida Gulf base model for Commercial Gillnet, Commercial Hook and Line, Recreational, and FIM Haul Seine are in Figures 19-22, respectively.

3.2.3 Selectivity and Retention

Estimated length-based selectivity functions and derived age-based selectivity by fleet for the Florida Gulf base model are plotted in Figure 23. Spotted Seatrout were selected at larger sizes for the commercial fleets relative to the recreational fleets.

The derived age-based selectivity for each fleet (via model estimated growth and population dynamics), show that all fleets select females at younger ages than males. Additionally, commercial fleets generally encounter older fish compared to other fleets. The recreational fleet selects all ages more frequently than the commercial fleets (Figure 24).

Parameters related to recreational retention are estimated. These retention functions are time-varying; generally coinciding with changes to the minimum size limit. The changes to retention over time for the recreational fleet, as well as terminal year (2023) selectivity, retention, discard mortality (constant at 0.08), along with the fraction of fish kept, dead, and discarded are illustrated in Figure 24. Estimated retention on both coasts is similar with more fish being discarded than kept.

3.2.4 Fishing Mortality

The Florida Gulf coast base model estimates of annual instantaneous fishing mortality rates (for all combined fleets) on age 2-4 Spotted Seatrout are presented in

Table 15 and Figure 25. The estimated annual Spotted Seatrout fishing mortality rates were variable but showed a modest increase from 1990 - 2023. The current fishing mortality rate ($F_{current}$) for the Florida Gulf base model, calculated as the geometric mean of 2021-2023 estimates, is 0.27 yr^{-1}.

3.2.5 Recruitment

Steepness was estimated in the Florida Gulf coast base model at 0.871 and the corresponding Beverton-Holt stock recruit relationship is shown in Figure 26. The estimate of sigmaR was 0.226 and $ln(R_0)$ at 11.03 (Table 13), which equates to 61.7 million age-0 Spotted Seatrout.

The number of age-0 recruits shifted lower in 1992 and remained stable throughout the time series at values around 40-70 million, showing more variability after 2010 (Figure 27). Recruitment deviations showed above average recruitment up until 1992, where deviations then hovered around average recruitment until 2012 through 2023, where the majority of years were below average recruitment (Figure 28).

3.2.6 Biomass and Abundance Trajectories

Predicted total biomass (metric tons), spawning stock biomass (SSB; metric tons), abundance (1000s of fish), age-1 recruits (1000s of fish), and depletion (SSB/SSB_0) for Spotted Seatrout from the Florida Gulf coast base model from 1986 to 2023 are provided in Table 16. Total biomass averaged 10,909 metric tons, ranging from 9,136 metric tons in 2014 to 13,616 metric tons in 1991 (Figure 29). Estimates of SSB averaged 4,855 metric tons and ranged from 3,948 metric tons in 2022 to 6,135 metric tons in 1992. The geometric mean from 2021-2023 was 4,204 metric tons ($SSB_{current}$) (Figure 30). Both total biomass and spawning biomass showed a general declining trend over the timeseries.

Depletion (SSB/virgin SSB) ratio averaged 0.58 and ranged from 0.47 in 2015 to 0.73 in 1992 (Table 16). The mean age of Florida Gulf Spotted Seatrout has hovered just under or at 1 throughout the time series for both sexes (Figure 31).

3.2.7 Uncertainty Analyses

3.2.7.1 MCMC Analysis

Uncertainty estimates based on the asymptotic standard errors from the covariance matrix only provide a minimum estimate of uncertainty in parameter values and derived quantities. Therefore, Monte Carlo Markov Chain (MCMC) analyses were applied to produce posterior distributions of model parameters and selected derived quantities.

Two converged chains of MCMC draws were produced. Out of the original 5,000 iterations for each chain (10,000 total), an added burn-in of 500 iterations and additional thinning (i.e., saving every 1 out of 2 iterations) resulted in 4500 total iterations. For most parameters and derived quantities of interest, Geweke's diagnostic did not suggest that the mean of the first 10% of the chain was significantly different from the mean of the last 50% of the chain (Table 17). Figure 32 displays trace plots for several parameters and derived quantities for individual chains and Figure 33 displays trace plots for combined chains. Posterior distributions were produced for steepness, ln(R_0), unfished SSB, as well as the geometric mean of SSB from 2021-2023 ($SSB_{current}$) and geometric mean of age 2-4 fishing mortality rates from 2021-2023 ($F_{current}$) (Figure 34). Florida Gulf base model results all fall inside the interquartile range of posterior distributions, especially for $SSB_{current}$ and $F_{current}$ (Figure 34).

3.2.7.2 Parametric Bootstrap Analysis

A parametric bootstrap analysis produced 500 bootstrapped datasets. Fits to these datasets were fair, as some base run estimated parameters and derived quantities were outside of the inter-quartiles of the estimates produced by the bootstrap analysis but were all within the main distribution and not outlying (Figure 35).

An important caveat to this analysis is that the base model itself and nearly all bootstrapped runs had gradients higher than 0.0001. Additionally, 460 of the original runs had parameters estimated to be on or near bounds. The parameter most commonly estimated near the bounds was the CV at old age for males.

3.2.8 Model Diagnostics

3.2.8.1 Model Convergence

The Florida Gulf coast base had a total objective function of 2147.52, with length compositions and conditional age-at-length from the catch and indices contributing the most to the magnitude of the likelihood function (Figure 36). The model contained no parameters on the bounds, had a small final gradient (0.0006), and had a positive definite Hessian matrix.

The results of the jitter analysis suggested that the Florida Gulf coast base model had converged on a global solution but was sensitive to the initial parameter values. Of the 200 jittered runs, only 3 runs had maximum gradient < 0.0001 and 161 runs (81%) had a maximum gradient < 0.5. No jittered runs had a total likelihood lower than the base model. The range of log-likelihood values associated with only runs that had a maximum gradient < 0.5 is presented in Figure 37.

3.2.8.2 Correlation Analysis

Correlation among parameters is common in highly parametrized models but should be investigated as it can lead to poor model stability along with flat likelihood response surfaces. Commercial Gillnet fleet selectivity parameters were highly correlated (> 90%, Table 18). These parameters defined the peak and the width of the ascending limb of the double normal selectivity pattern. However, all correlated parameters were found to be structurally correlated and did not suggest model instability.

3.2.8.3 Likelihood Profiles

Likelihood profiles were used to examine the change in log-likelihood for selected model across a range of values in order to gauge the model’s support of a given parameter estimate and to identify conflicts among log-likelihood values of different data components. Likelihood profiles were done for two stock-recruitment parameters (steepness and virgin recruitment [R_0]) (Figure 38 and 39).

For this analysis, each profiled parameter was held constant at a chosen value and the remaining parameters were estimated. All runs were considered, even those that had high gradients or non-positive definite hessians.

3.2.8.3.1 Steepness

Profiled values of steepness varied from 0.5 to 0.99 in increments of 0.01. The effect of varying fixed steepness values on the total log-likelihood (LL) value is presented in Figure 38. Changes in steepness over the profile caused an inverse relationship of equilibrium catch and length data with index, catch, and recruitment data in terms of LL change, although the change in LL was very minimal (<1). The base run estimated steepness (=0.871) resulted in the lowest LL value; however the LL value is similar for a wide range of steepness values from approximately 0.75 to 0.99 (Figure 38).

3.2.8.3.2 Unfished Recruitment

Profiled values of unfished recruitment ($\ln(R_0)$) ranged from 7 to 14 in increments of 0.1. The total LL value is the lowest for the base run estimated unfished recruitment $\ln(R_0)$ (11.03; Figure 39), however this analysis suggests there is equal model support for unfished recruitment values between a modest range of 10.9 and 11.5. As with steepness, recruitment is the most informative of $\ln(R_0)$ (Figure 39). Except for particularly low and high values of $\ln(R_0)$ (i.e., less than 9 or more than 12), changes in $\ln(R_0)$ do not appear to affect the log-likelihood of other model components.

3.2.8.4 Model Consistency

To measure model consistency, the Florida Gulf coast base model was first subject to a retrospective analysis that removed successive years of data from the model for seven years (i.e., removing data for 2023, 2022-2023…, and lastly 2017 - 2023) to determine the effect of recent years on model results. This analysis was also paired with one-year-ahead projections (see Carvalho et al. (2021) for additional details). Mohn's Rho is a measure of the severity of bias in the retrospective patterns and the forecast bias is an estimate of bias in the forecasted quantities when years of data were removed. The rule of thumb proposed by Hurtado-Ferro et al. (2015) is that for short-lived (max age 0-15 yrs) species such as Spotted Seatrout (max age = 12), Mohn's Rho values should fall between -0.22 and 0.30. A retrospective plot of spawning stock biomass and age 2-4 fishing mortality rates indicated little retrospective pattern (Figure 40). According to the rule of thumb, the results of the retrospectives illustrated acceptable levels of retrospective bias and forecasting bias in spawning stock biomass (Mohn's Rho of 0.04 and Forecasting Bias of 0.03) and age 2-4 fishing mortality rates (Mohn's Rho of -0.06 and Forecasting Bias of -0.14; Table 19 and Figure 40). The forecasting bias in fishing mortality rates was elevated (-0.14), which suggests that forecasts of fishing mortality rates were consistently less than realized values.

The results from the Florida Gulf ASPM indicate that, for at least for most of the timeseries, there is enough information in both the catch and index data for the production function to largely drive the stock dynamics as the general trends and scale of the ASPM and the Florida Gulf base model align after 1990 (Figure 41). Starting in 1986, the ASPM estimates a higher magnitude of spawning stock biomass that decreases until it scales with the base model around 1990. For most of the timeseries the ASPM estimates higher spawning biomass and lower F for ages 2-4 than the base model. When recruitment deviations were included in an ASPM, the trends in the estimated spawning biomass and fishing mortality rates closely resembled those estimated by the base model (Figure 41). This may suggest the early length and age information informs the scale of the base model and without it, initial apical fishing mortalities rates are lower in the age-structured production models.

3.2.8.5 Sensitivity Runs

Sensitivity runs were conducted to investigate the impact of alternative assumptions or data sets on model fits and results. Results for key sensitivity runs are presented below, but many additional exploratory runs were also implemented.

3.2.8.5.1 1950 start year

A sensitivity run was conducted to investigate the effect of extending estimated recreational fleet landings and releases back to 1950 with a model start year of 1950. This was an attempt to add historical years of recreational catch data to better estimate stock depletion and to place the model in different initial equilibrium fishing conditions.

These changes to data and model configuration led to an 84.09 point increase in the overall log-likelihood (2231.61). The sensitivity run estimated a timeseries of spawning biomass and age-0 recruitment that scaled lower than that of the base model, however F rates are very similar (Figure 42).

3.2.8.5.2 Release mortality

Sensitivity runs examining the effect of alternative release mortality rates were performed. This was completed by configuring the fixed parameter inputs in the release mortality equation to produce the respective release mortality rates for the recreational fleet. Two higher levels of release mortality were investigated: 25% and 15%, so that the release mortality assumption in the base model of 8% is a low estimate. Assuming the fixed release mortalities of 15% and 25%, sensitivity run results showed scale differences from the base model, displaying higher F and lower SPR starting around 1990 along with the implementation of the 14-inch minimum size limit and increased spawning biomass and recruitment from the beginning of the time series (Figure 42).

3.2.8.5.3 Remove S-R curve (Steepness ≈ 1)

Due to the inherent uncertainties surrounding the stock-recruitment relationship, Maunder and Thorson (2019) recommend that assessments using a stock-recruitment relationship compare the performance with a model that avoids specifying such a relationship and instead assumes a relationship functioning as average recruitment across time (i.e., fixing steepness at 0.99). Assuming constant mean recruitment throughout the time series led to a 0.02-point increase in the overall log-likelihood (2147.54), suggesting essentially equal model support as when estimating steepness. Figure 43 shows the steepness sensitivity model derived quantities (i.e., recruitment, spawning stock biomass, fishing mortality rates, SPR) as compared to the Florida Gulf base model. The results appear to be exact or very similar.

3.3 Florida Atlantic Coast Stock Assessment Model Results

3.3.1 Estimated Parameters and Derived Quantities

The Florida Atlantic base model estimated most parameters reasonably well (i.e., |CV| < 1; Table 13). Of the 125 active parameters, 23 exhibited poor estimation (i.e., |CV| > 1); including 4 initial age composition adjustments, 14 recruitment deviations, and 5 parameters describing selectivity (the top width, descending width, start, and end of the Commercial Gillnet, and inflection and width of retention for the recreational fleet). No parameters were estimated near the bounds.

3.3.2 Model Fit

3.3.2.1 Landings

The landings data for the commercial fleets (in metric tons) were fit exactly due to the minimal associated uncertainty in the observed values, while the predicted landings for the recreational fleets (in 1000s) were allowed to differ from the observed values (Figure 13). Predicted recreational landings tended to underestimate the observed values prior to 1995 and slightly overestimate the observed landings starting in the 2000s.

3.3.2.2 Releases

Releases from the recreational fleet have generally increased through 2010, and then with a general declining trend through the end of the time series (Figure 14). The model largely overestimated releases in the late 1980s, early 1990s and underestimated releases in 2004-2006 and 2022 (Figure 14). Model estimated discard rates correspond to increases in the minimum size limit for Spotted Seatrout in 1989 (Figure 15).

3.3.2.3 Indices

Indices were fit reasonably well by the Florida Atlantic base model (Figure 16). The MRIP index exhibited a general increasing trend from 1986-1991, remained stable to around 2001, when it increased and remained high until 2012, then showed a steady decline through the end of the timeseries. Model fits to the MRIP total catch CPUE index (longest index in the timeseries) were good and captured the major trends of the timeseries, however the model missed the exceptionally high and low years giving preference to the trendline.

The two fishery-independent indices began in the early 2000s, with the FIM YOY index exhibiting a variable trend with most of the early years showing higher than average rates and later years showing lower than average rates and the FIM Haul Seine index exhibiting a steady increasing trend through 2010, then showing a starker decline through the end of the timeseries. Model fit to the FIM YOY index was adequate, capturing the major trends with some overestimation (2009-2010, 2014) and underestimation (2006-2007, 2011-2012) in certain years. Model fit to the FIM Haul Seine index was adequate, capturing the major trends with some overestimation in later years and underestimation in the late 2000s, early 2010s (Figure 16).

3.3.2.4 Length and Age Composition

3.3.2.4.1 Data weighting

Iterative reweighting of length and conditional length-at-age composition data was performed according to Francis composition weighting method TA1.8 (Francis 2011). Francis weights were calculated iteratively until they stabilized to the values presented in Table 14, which occurred on the 4th iteration. As shown, length compositions from Commercial Hook and Line fleet, Recreational fleet, MRIP CPUE, and the FIM Haul Seine index were up weighted, while length compositions for Commercial Gillnet were down weighted. Age compositions from all fleets/surveys were down weighted.

3.3.2.4.2 Length Composition

Overall, the Florida Atlantic base model fit the observed length compositions with 2-cm bins reasonably well and when aggregated across years, the expected length compositions were similar to the observed compositions for most fleets and surveys and among sexes (Figure 17). The overall observed length compositions for the Commercial Gillnet were slightly bimodal, but the assumed selectivity patterns for this fleet (double normal) cannot accommodate bimodality. Therefore, the smaller lengths between 32-38 cm are underestimated and 40-44 cm are overestimated in some years. The overall observed length compositions for the FIM 183-m haul seine showed bimodality. The assumed selectivity pattern for this fleet (cubic spline) allowed the model to produce a good fit to the length composition, with slight underestimation in some length bins. The model estimated acceptable fits to the recreational (retained catch) and MRIP CPUE (total catch) length compositions with slightly overestimating smaller lengths (32-36 cm) and the peak.

Overall, model fits to the recreational discard length composition are acceptable. However, as is often the case, fits to retained recreational length compositions were better than fits to recreational discarded length compositions, and sample sizes were notably smaller for discard length compositions. The model slightly overestimated smaller discards (24-32 cm) while slightly underestimated larger discard lengths (38-80 cm), especially for female fish (Figure 17).

3.3.2.4.3 Conditional Age-at-Length

The base model fits to mean age by year for each data source are presented in Figure 18. Model fits were reasonably good and largely fell within the confidence intervals for most years within fleets/surveys after reweighting input sample sizes according to Francis (2011). Mean age within commercial gillnet, commercial hook-and-line, and the recreational fleets remained relatively stable for their respective timeseries of age data. Commercial Gillnet mean age was observed to exploit the older ages, with a mean age just under 5 yrs. Commercial Hook and Line fleet and the Recreational fleet mean ages are similar at around 3 yrs. A declining trend of mean age is apparent for the FIM haul seine index, where in the late 1990's the mean age was around 2.5 yrs, and by the end of the timeseries the mean age decreased significantly to a mean age of below 1.5 yrs.

The fits to annual age-at-length by fleet/survey for the Florida Atlantic base model for Commercial Gillnet, Commercial Hook and Line, Recreational, and FIM Haul Seine are in Figures 19-22, respectively.

3.3.3 Selectivity and Retention

Estimated length-based selectivity functions and derived age-based selectivity by fleet for the Florida Atlantic base model are plotted in Figure 23. Spotted Seatrout were selected at larger sizes for the commercial fleets relative to the recreational fleets.

The derived age-based selectivity for each fleet (via model estimated growth and population dynamics), show that all fleets select females at younger ages than males. Additionally, commercial fleets generally encounter older fish compared to other fleets. The recreational fleet selects all ages more frequently than the commercial fleets. (Figure 23)

Parameters related to recreational retention are estimated. These retention functions are time-varying; generally coinciding with changes to the minimum size limit. The changes to retention over time for the recreational fleet, as well as terminal year (2023) selectivity, retention, discard mortality (constant at 0.08), along with the fraction of fish kept, dead, and discarded are illustrated in Figure 24. Estimated retention on both coasts is similar with more fish being discarded than kept.

3.3.4 Fishing Mortality

The Florida Atlantic coast base model estimates of annual instantaneous fishing mortality rates (for all combined fleets) on age 2-4 Spotted Seatrout are presented in Table 15 and Figure 25. The estimated annual Spotted Seatrout fishing mortality rates were variable but showed a modest increase from 1990 - 2021. The current fishing mortality rate ($F_{current}$) for the Florida Atlantic base model, calculated as the geometric mean of 2021-2023 estimates, is 0.20 yr-1.

3.3.5 Recruitment

Steepness was estimated in the Florida Atlantic coast base model at 0.833 and the corresponding Beverton-Holt stock recruit relationship is shown in Figure 26. The estimate of sigmaR was 0.358 and ln(R_0) at 9.68 (Table 13), which equates to 15.99 million age-0 Spotted Seatrout.

The number of age-0 recruits were stable through the early years of the time series at values around 10-18 million, then increasing to around 29 million in 2004, showing more variability thereafter along with a declining trend occurring from 2009 through 2021 to recruitment levels similar to the early years in the 1980's and 1990's (Figure 27). Recruitment deviations showed below average recruitment up until 1989, where it then hovered around average recruitment until a period of above average recruitment between 2001 and 2011, followed by variable recruitment until 2023 (Figure 28).

3.3.6 Biomass and Abundance Trajectories

Predicted total biomass (metric tons, pounds), spawning stock biomass (SSB; metric tons, pounds), abundance (1000s of fish), age-1 recruits (1000s of fish), and depletion (SSB/SSB_0) for Spotted Seatrout from the Florida Atlantic coast base model from 1986 to 2023 are provided in Table 16. Total biomass averaged 2,588 metric tons, ranging from 1,639 metric tons in 1988 to 3,625 metric tons in 2010 (Figure 29). Estimates of SSB averaged 1,232 metric tons and ranged from 711 metric tons in 1989 to 1,804 metric tons in 2005. The geometric mean from 2021-2023 was 868 metric tons ($SSB_{current}$) (Figure 30). Total biomass and spawning biomass both show an increasing trend from a notable low in 1988 until 2004 when levels became stable but high until around 2010, when levels then declined steadily to recent years.

Depletion (SSB/virgin SSB) ratio averaged 0.58 and ranged from 0.33 in 1989 to 0.85 in 2005 (Table 16). The mean age of Florida Gulf Spotted Seatrout has hovered just under or at 1 y throughout the time series for both sexes (Figure 31).

3.3.7 Uncertainty Analyses

3.3.7.1 MCMC Analysis

Uncertainty estimates based on the asymptotic standard errors from the covariance matrix only provide a minimum estimate of uncertainty in parameter values and derived quantities. Therefore, Monte Carlo Markov Chain (MCMC) analyses were applied to produce posterior distributions of model parameters and selected derived quantities.

Two converged chains of MCMC draws were produced. Out of the original 5,000 iterations for each chain (10,000 total), an added burn-in of 500 iterations and additional thinning (i.e., saving every 1 out of 2 iterations) resulted in 4500 total iterations. For most parameters and derived quantities of interest, Geweke's diagnostic did not suggest that the mean of the first 10% of the chain was significantly different from the mean of the last 50% of the chain (Table 17). Figure 32 displays trace plots for several parameters and derived quantities for individual chains and Figure 33 displays trace plots for combined chains. Posterior distributions were produced for steepness, $\ln(R_0)$, unfished SSB, as well as the geometric mean of SSB from 2021-2023 ($SSB_{current}$) and geometric mean of age 2-4 fishing mortality rates from 2021-2023 ($F_{current}$) (Figure 34). Florida Atlantic base model results all fall inside the interquartile range of posterior distributions, especially for $SSB_{current}$ and $F_{current}$ (Figure 34).

3.3.7.2 Parametric Bootstrap Analysis

A parametric bootstrap analysis produced 500 bootstrapped datasets. Fits to these datasets were fair, as some base run estimated parameters and derived quantities were outside of the inter-quartiles of the estimates produced by the bootstrap analysis but were all within the main distribution and not outlying (Figure 35).

An important caveat to this analysis is that the base model itself and nearly all bootstrapped runs had gradients higher than 0.0001. Additionally, all the original runs had parameters estimated to be on or near bounds. The parameter most commonly estimated near the bounds was the CV at old age for males.

3.3.8 Model Diagnostics

3.3.8.1 Model Convergence

The Florida Atlantic coast base model technically did not achieve the target gradient of (0.0001) but was close with a final gradient of 0.0006 and a total objective function of 2084.81, with length compositions and conditional age-at-length from the catch and indices contributing the most to the magnitude of the likelihood function (Figure 36).

The results of the jitter analysis suggested that the Florida Atlantic coast base model had converged on a global solution but was sensitive to the initial parameter values. Of the 200 jittered runs, only 3 runs had maximum gradient < 0.0001 and 164 runs (82%) had a maximum gradient < 1. No jittered runs were found to contain a total likelihood lower than the base model. The range of log-likelihood values associated with only runs that had a maximum gradient < 0.5 is presented in Figure 37.

3.3.8.2 Correlation Analysis

Correlation among parameters is common in highly parametrized models but should be investigated as it can lead to poor model stability along with flat likelihood response surfaces. Commercial Gillnet fleet selectivity parameters were highly correlated (> 90%, Table 18). These were parameters defining the peak and the width of the ascending limb, as well as the parameters defining the width of the top and the width of the descending limb of the double normal selectivity pattern. However, all correlated parameters were found to be structurally correlated and did not suggest model instability.

3.3.8.3 Likelihood Profiles

Likelihood profiles were used to examine the change in log-likelihood for selected model across a range of values in order to gauge the model's support of a given parameter estimate and to identify conflicts among log-likelihood values of different data components. Likelihood profiles were done for two stock-recruitment parameters (steepness and virgin recruitment [R_0]) (Figure 38 and 39).

For this analysis, each profiled parameter was held constant at a chosen value and the remaining parameters were estimated. All runs were considered, even those that had high gradients or non-positive definite hessians.

3.3.8.3.1 Steepness

Profiled values of steepness varied from 0.5 to 0.99 in increments of 0.01. The effect of varying fixed steepness values on the total log-likelihood (LL) value is presented in Figure 38. The base run estimated steepness (=0.833) resulted in the lowest LL value; however the LL value is similar for a wide range of steepness values from approximately 0.75 to 0.9 (Figure 38).

3.3.8.3.2 Unfished Recruitment

Profiled values of unfished recruitment ($\ln(R_0)$) ranged from 7 to 14 in increments of 0.1. The total LL value is the lowest for the base run estimated unfished recruitment $\ln(R_0)$ (9.69; Figure 40) with good model support for this estimation according to the shape of the likelihood curve. As with steepness, recruitment is the most informative of $\ln(R_0)$. Except for particularly high values of $\ln(R_0)$ (i.e., more than 11.3), changes in $\ln(R_0)$ do not appear to affect the log-likelihood of other model components (Figure 39).

3.3.8.4 Model Consistency

To measure model consistency, the Florida Atlantic coast base model was first subject to a retrospective analysis that removed successive years of data from the model for seven years (i.e., removing data for 2023, 2022-2023…, and lastly 2017 - 2023) to determine the effect of recent years on model results. This analysis was also paired with one-year-ahead projections (see Carvalho et al. (2021) for additional details). Mohn's Rho is a measure of the severity of bias in the retrospective patterns and the forecast bias is an estimate of bias in the forecasted quantities when years of data were removed. The rule of thumb proposed by Hurtado-Ferro et al. (2015) is that for short-lived (max age 0-15 yrs) species such as Spotted Seatrout (max age = 12), Mohn's Rho values should fall between -0.22 and 0.30. A retrospective plot of spawning stock biomass and age 2-4 fishing mortality rates indicated little retrospective pattern (Figure 40). According to the rule of thumb, the results of the retrospectives illustrated acceptable levels of retrospective bias and forecasting bias in spawning stock biomass (Mohn's Rho of 0.09 and Forecasting Bias of 0.07) and an acceptable level of retrospective bias and a high level of forecasting bias in age 2-4 fishing mortality rates (Mohn's Rho of -0.09 and Forecasting Bias of -0.28; Table 19 and Figure 40). The forecasting bias in fishing mortality rates was high and beyond acceptable values (-0.28) and forecasts of fishing mortality rates were consistently less than realized values, especially after the 2019 peel. This would indicate that this model would likely forecast consistently lower than realized F values if it were used to produce projections.

The results from the Florida Atlantic ASPM indicate that, for at least for most of the timeseries, there is enough information in both the catch and index data for the production function to largely drive the stock dynamics as the general trends and scale of the ASPM and the Florida Atlantic base model align (Figure 41). For most of the timeseries the ASPM estimates higher spawning biomass and lower F for ages 2-4 than the base model. When recruitment deviations were included in an ASPM, the trends in the estimated spawning biomass and fishing mortality rates closely resembled those estimated by the base model (Figure 41). This may suggest the early length and age information informs the scale of the base model and without it, initial apical fishing mortalities rates are lower in the age-structured production models.

3.3.8.5 Sensitivity Runs

Sensitivity runs were conducted to investigate the impact of alternative assumptions or data sets on model fits and results. Results for key sensitivity runs are presented below, but many additional exploratory runs were also implemented.

3.3.8.5.1 1950 start year

A sensitivity run was conducted to investigate the effect of extending estimated recreational fleet landings and releases back to 1950 with a model start year of 1950. This was an attempt to add historical years of recreational catch data to better estimate stock depletion and to place the model in different initial equilibrium fishing conditions. These changes to data and model configuration led to a 113.57 point increase in the overall log-likelihood (2198.38), The sensitivity run estimated a timeseries of spawning biomass and age-0 recruitment that scaled lower than that of the base model, however the F rates scale higher (Figure 42).

3.3.8.5.2 Release mortality

Sensitivity runs examining the effect of alternative release mortality rates were performed. This was completed by configuring the fixed parameter inputs in the release mortality equation to produce the respective release mortality rates for the recreational fleet. Two higher levels of release mortality were investigated: 25% and 15%, so that the release mortality assumption in the base model of 8% is a low estimate. Assuming the fixed release mortalities of 15% and 25%, sensitivity run results showed scale differences from the base model, displaying higher F and lower SPR starting around

1990 along with the implementation of the 14-inch minimum size limit and increased spawning biomass and recruitment from the beginning of the time series (Figure 42).

3.3.8.5.3 Remove S-R curve (Steepness ≈ 1)

Due to the inherent uncertainties surrounding the stock-recruitment relationship, Maunder and Thorson (2019) recommend that assessments using a stock-recruitment relationship compare the performance with a model that avoids specifying such a relationship and instead assumes a relationship functioning as average recruitment across time (i.e., fixing steepness at 0.99). Assuming constant mean recruitment throughout the time series led to a 6.69-point increase in the overall log-likelihood (2091.5), suggesting slightly less model support as compared to estimating steepness. However, Figure 42 shows the steepness sensitivity model derived quantities (i.e., recruitment, spawning stock biomass, fishing mortality rates, SPR) as compared to the Florida Atlantic base model. The results appear to be exact or very similar.

4 Evaluation of Current Stock Status

The FWC Commission's management objective for Spotted Seatrout is to maintain the SPR at or above 35% and transitional SPR (tSPR) is used to determine whether the stock meets the Commission's objective. The current condition of the stock is represented by the geometric mean of tSPR ($tSPR_{current}$) from the last three years (2021–2023). According to the Florida Gulf base model, $tSPR_{current}$ = 0.61. According to the Florida Atlantic base model, $tSPR_{current}$ = 0.58 (Table 20, Figure 43). Therefore, $tSPR_{current}$ estimates from both Florida coastal base models exceed the management objective.

The reference spawning biomass ($SSB_{SPR35\%}$) and equilibrium fishing mortality rates that achieve 35% SPR ($F_{SPR35\%}$) were estimated by base models (Table 21). The current condition of the stock is represented by the geometric mean of SSB ($SSB_{current}$) from the last three years (2021–2023), and the current condition of the fishery is represented by the geometric mean of F ($F_{current}$) from the last three years (2021–2023). According to the Florida Gulf base model, $SSB_{current}/SSB_{SPR35\%}$ = 1.54 and $F_{current}/F_{SPR35\%}$ = 0.33, suggesting that the Spotted Seatrout stock on Florida's Gulf Coast is not overfished ($SSB_{current} > SSB_{SPR35\%}$), nor undergoing overfishing ($F_{Current}$ <

$F_{SPR35\%}$). According to the Florida Atlantic base model, $SSB_{current}/SSB_{SPR35\%}$ = 1.29 and $F_{current}/F_{SPR35\%}$ = 0.31, suggesting that the Spotted Seatrout stock on Florida's Atlantic Coast is not overfished ($SSB_{current} > SSB_{SPR35\%}$), nor undergoing overfishing ($F_{Current} < F_{SPR35\%}$) (Table 21).

5 Discussion

Comparison of Florida Spotted Seatrout stock assessment results here with previous assessments isn't feasible due to many reasons. Most importantly, the previous Spotted Seatrout assessment (Addis et al. 2018), as well as earlier assessments (Murphy et al. 2011, Murphy et al. 2006) had different stock/regional management unit definitions than the coastwide basis defined here, and therefore are evaluating different portions of the stock. Other key differences include significant changes in MRIP estimation due to the implementation of the new FES (which fully replaced the CHTS in 2018), differing methods of estimating natural mortality, inclusion of reweighting procedures, differing fishery dependent index development (MRIP effort based F index vs MRIP total catch CPUE), significant model configuration differences due to Stock Synthesis version changes (addition of new and improved model options; v3.24 vs v3.30.22.1), and other minor but significant data and model configuration differences (model start year, differing selectivity patterns, catchability parameterization, differing data source inclusion).

Although the results of the Atlantic coast base model indicate that management objectives are being met, there are concerns that arise from the data pertaining to reductions of adult abundance, mean age, and recruitment in recent years. Between 2011 and 2019, ~19,000 ha or ~58% of seagrasses were lost within the Indian River Lagoon, primarily due to shading by intense and extensive blooms of phytoplankton (Morris et al. 2022). This habitat loss is presumed to be reflected within fishery independent indices of abundance for Florida Atlantic Spotted Seatrout. The Atlantic FIM 183-m haul seine index shows a dramatic decrease of adult abundance from 2010 to 2013 and has continued to steadily decline though 2023 to a level of half the long-term average (Figure 11). This also parallels to declines in mean age of seatrout caught in the haul seine over the same time (Figure 18). The Atlantic FIM 21.3-m center bag seine recruitment index has also shown 10 out of the last 11 years being below the long-term average (Figure 12).

The impact of environmental effects on Florida Spotted Seatrout populations is not explicitly accounted for and configured within these assessment models. Dead seatrout have been observed in cold kills and during severe red tide events and FWC does not have reliable quantitative data to incorporate removals from these events into stock assessment models. However, these effects are accounted for indirectly by inclusion of fishery independent indices of abundance from inshore monitoring surveys. If the stock's abundance has been reduced by a mortality event or an acute or prolonged environmental effect, it is assumed that the index would track this decline via decreased catch rates within the monitoring survey. Qualitatively, we know that these environmental impacts reduce the number of available fish which, in turn, increases the fishing mortality. If such effects are causing declines in the fish stock, and the objective is to increase the tSPR, a reasonable plan would be to allow more fish to survive (i.e. fishing mortality should be less than the target rate) by means of regulatory changes (e.g. bag limits, size limits, seasonal closures) or emergency orders (e.g. EO 19-06 and EO 19-14 Temporary Modification of Regulations for Spotted Seatrout in Southwest Florida, 2019).

Historically, fisheries management has received concerns from stakeholders regarding depletions of Spotted Seatrout in specific localities of Florida. However, current and historic Florida Spotted Seatrout assessments are conducted over large geographic areas (frequently containing multiple bay systems) and do not address local population or fishery dynamics at such resolutions. For example, Spotted Seatrout growth, reproduction, and recruitment has been found to be variable among Florida estuaries (Bedee et al. 2003; DeVries et al. 2003; Kupschus 2004; Murphy et al. 2011; Murphy and McMichael 2003), and fisheries are well known to operate in a spatially heterogenous manner and local populations could be subjected to overfishing or depletion while the broader, assessed stock could be evaluated as healthy. Tradeoffs occur with age-structured stock assessments conducted on smaller geographic scales (e.g. single bay systems, county level). These assessments could inform conditions at that resolution with the caveat of amplifying data limitations in abundance, biology, and catch which can often result in greater uncertainty in model outputs and stock status.

6 Research Recommendations

The potential impact of a recalibration of MRIP-FES (planned for 2026) on this assessment and its stock status is currently unknown but would likely be minimal if trends remain similar. Due to the Spotted Seatrout fishery in Florida being predominantly recreational based and management reference points being relative measures (e.g. tSPR), changes in MRIP-FES often act as a rescaling factor within an assessment model for biomass and fishing mortality without necessarily altering stock status or the underlying health of the stock. However, if MRIP-FES revisions reveal substantial new trends, this could influence stock status and even reveal past over- or underestimations.

There is a need to investigate Spotted Seatrout release mortality with emphasis on seasonal or temporal effects to obtain a more precise estimate of average release mortality. Average release mortality (8%) in this assessment is applied to recreational live release estimates to obtain total harvest estimates. The percentage of fish released hovers around 90% for both coasts and the percent dead releases in total harvest in recent years show values between 27-58%, which is significant (Table 8). A more contemporary estimate of average release mortality would result in more precise estimates of dead removals from the fishery.

Future stock assessments for Florida Spotted Seatrout could explore alternative structural model configurations which may include: multiple seasons as a means to explore spawning and settlement timing; spatial models that would assume very little movement from region to region but could accommodate differences in life history (growth, natural mortality, etc.) and differing trends in indices and composition among defined regions; and potentially implementing a single, general commercial fleet.

Seagrass is a major structural habitat for Spotted Seatrout within Florida estuary and bay systems, and the significant reduction in seagrass habitat along the Atlantic coast in recent years could have impacted the carrying capacity and/or the relationship between spawners and recruits, with decreased recruitment for a given number of spawners due to lower habitat quality. Therefore, there was some exploration regime shifts within the Florida Atlantic coast model to account for the extensive habitat loss in the Indian River Lagoon since the early 2010's. The spawner-recruit regime parameter within Stock Synthesis is a modifier on R_0 (virgin recruitment). The regime shift parameter line (can be time varying by blocks, trends, environmental linkages, or random deviations) allows for multi-year or environmentally driven deviations from R_0. Due to time constraints of exploring this configuration, it was ultimately not implemented in this assessment. Future Spotted Seatrout assessments may consider Florida Atlantic model configurations using the regime shift parameterization.

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Table 1. Coastal morphometric parameter estimates for Spotted Seatrout from fishery-dependent and fishery-independent samples collect during 1981-2023. Growth: Lt (cm) = L_{inf}*(1-exp(-K(t-t0))); Length-Weight: W(kg) = a*L(cm)^b; Length-Length equation: Y(mm) = a + X(mm)*b. $TL_{natural}$ = total length with relaxed tail, TL_{max} = total length with pinched tail, SL = standard length, and FL = fork length.

Female

	Growth				Length-Weight			
FL Coast	L_{inf}	K	t0	n	a	b	n	r^2
Gulf	57.84	0.4959	-0.282	1,777	0.000014	2.8743	14,700	0.982
Atlantic	67.31	0.4151	-0.213	1,522	6.85E-06	3.075	5,084	0.991

Male

	Growth				Length-Weight			
FL Coast	L_{inf}	K	t0	n	a	b	n	r^2
Gulf	41.98	0.8328	-0.14	1,635	0.000013	2.8951	6,370	0.973
Atlantic	47.87	0.5849	-0.226	1,336	8.09E-06	3.0341	2,399	0.989

Statewide - Combined Sexes

	Length-Length				
Y (mm)	a	b	X (mm)	n	Adj r^2
SL	-13.531	0.882	FL	1,031	0.99
$TL_{natural}$	0.17221	1.001	FL	6,252	0.999
TL_{max}	-2.87808	1.021	FL	9,265	0.997

Table 2. Mean parameter estimates of the logistic sex-ratio-at-length relationship by year and Florida coast, where *r* is the rate of change and L_{50} is the length (cm) where the proportion of females is equal to 50% (i.e. the inflection point).

	FL Atlantic		FL Gulf	
Year	*r*	L_{50}	*r*	L_{50}
1986	-0.028	18.0466	-0.029	19.5899
1987	-0.0288	19.2881	-0.0471	22.4126
1988				
1992	-0.038	14.6333	-0.0375	14.2369
1993	-0.0498	14.572	-0.0384	12.9589
1994	-0.0369	17.2601	-0.0502	20.1574
1995	-0.0666	13.6696	-0.0505	20.5551
1996	-0.0512	13.3468	-0.0285	23.6495
1997	-0.0566	10.5159		
1998			-0.0335	19.5411
1999			-0.0307	15.8593
2000			-0.0581	17.5295
2001			-0.048	19.2879
2002	-0.0336	18.4487	-0.0401	21.5054
2003			-0.0447	16.0543
2004			-0.0453	16.0142
2005			-0.049	13.9117
2006			-0.0534	13.3543
2007	-0.0302	14.1491	-0.0546	14.0176
2008			-0.0551	15.0605
2009			-0.0458	17.0674
2010			-0.0528	14.3339
2011			-0.0395	17.0625
2012	-0.0312	14.0609	-0.0297	16.7068
2013			-0.0344	15.2642
2014			-0.0438	16.8919
2015			-0.0407	14.5338
2016			-0.0425	14.5527
2017	-0.0388	16.9842	-0.0418	13.8029
2018			-0.0356	14.2433
2019			-0.0544	13.4425
2020			-0.0545	15.0566
2021			-0.0524	14.2444
2022			-0.054	13.7682
2023	-0.0348	17.2425	-0.0497	14.2946

Table 3. Age-specific instantaneous natural mortality rates (M, yr^{-1}) for Spotted Seatrout by Florida coast and sex based on the Lorenzen method (2005). The M estimates were calculated using total lengths (cm) at midyear age predicted by an estimated von Bertalanffy growth curve with a longevity based natural mortality estimate (Target M = 0.45 yr^{-1}, max age of 12, Hamel and Cope 2022).

	Florida Gulf				Florida Atlantic			
	Female		Male		Female		Male	
Age	Length	M	Length	M	Length	M	Length	M
0	18.6	0.924	17.3	0.752	17.2	1.065	16.6	0.871
1	27.2	0.724	25.7	0.601	26.6	0.806	24.5	0.684
2	39.2	0.561	34.9	0.497	40.4	0.598	34.9	0.539
3	46.5	0.494	38.9	0.463	49.6	0.512	40.6	0.482
4	50.9	0.461	40.6	0.450	55.6	0.468	43.9	0.456
5	53.6	0.443	41.4	0.444	59.6	0.443	45.6	0.443
6	55.3	0.433	41.7	0.442	62.2	0.428	46.6	0.436
7	56.3	0.427	41.9	0.441	63.9	0.419	47.2	0.432
8	56.9	0.423	41.9	0.441	65.1	0.413	47.5	0.430
9	57.3	0.421	42.0	0.440	65.8	0.409	47.7	0.428
10	57.5	0.419	42.0	0.440	66.3	0.406	47.8	0.428
11	57.6	0.419	42.0	0.440	66.7	0.404	47.8	0.427
12	57.7	0.418	42.0	0.440	66.9	0.403	47.9	0.427

Table 4. Commercial gillnet and Commercial hook and line landings (pounds) of Spotted Seatrout by Florida coast. Gillnet landings also include landings from other gears which include cast nets, seines, trammel nets, trawls, and traps. Hook and line landings also includes landings from longline gear.

	Florida Gulf		Florida Atlantic	
Year	Commercial Gillnet	Commercial Hook&Line	Commercial Gillnet	Commercial Hook&Line
1950	557,200	2,475,700	1,185,300	272,700
1951	1,577,900	1,356,600	1,029,100	207,700
1952	1,713,600	1,552,700	502,500	985,100
1953	1,721,100	764,600	556,300	676,200
1954	1,937,900	286,300	803,100	423,400
1955	1,817,300	188,500	701,900	218,900
1956	1,816,600	206,700	837,800	231,000
1957	2,312,400	204,900	753,300	133,000
1958	2,644,400	283,300	683,600	79,300
1959	2,492,800	278,400	704,100	64,100
1960	2,526,800	237,800	784,600	105,200
1961	2,117,600	263,200	686,500	63,000
1962	2,353,700	273,900	694,400	61,300
1963	2,279,000	292,400	672,800	128,500
1964	2,410,400	388,900	647,100	117,400
1965	2,928,000	441,700	614,800	67,300
1966	2,752,500	421,300	650,600	73,400
1967	2,299,900	336,800	524,100	75,100
1968	2,724,900	340,300	538,900	99,300
1969	2,129,100	289,600	590,100	89,500
1970	2,338,900	304,000	616,800	94,400
1971	1,745,000	216,100	436,100	58,800
1972	1,903,700	236,500	548,000	86,100
1973	1,940,600	285,600	593,900	71,900
1974	1,981,700	278,200	577,800	80,700
1975	1,952,100	217,300	479,100	56,000
1976	1,993,500	288,800	483,000	48,700
1977	1,750,500	181,400	445,500	48,400
1978	1,800,161	215,398	363,432	39,522
1979	1,862,823	222,895	429,141	46,668
1980	1,746,731	209,004	504,008	54,809
1981	1,761,839	210,812	663,836	72,190
1982	1,794,629	214,735	660,456	71,822
1983	1,670,438	199,875	434,306	47,229

	Florida Gulf		Florida Atlantic	
Year	Commercial Gillnet	Commercial Hook&Line	Commercial Gillnet	Commercial Hook&Line
1984	1,385,158	165,740	331,492	36,049
1985	1,010,173	120,872	333,490	36,266
1986	1,116,929	146,740	220,822	83,701
1987	1,191,096	156,484	230,136	87,231
1988	1,204,658	158,266	229,136	86,853
1989	885,873	116,384	262,569	99,525
1990	679,168	89,228	171,471	64,995
1991	729,893	95,892	163,743	62,065
1992	590,381	74,823	182,637	79,455
1993	474,083	74,440	164,217	61,773
1994	580,775	64,656	188,461	59,988
1995	283,979	69,360	132,773	51,280
1996	4,995	17,818	2,053	46,184
1997	6,896	25,397	3,298	54,018
1998	10,460	30,244	1,709	39,814
1999	3,487	18,375	1,837	59,965
2000	4,608	16,289	1,702	43,645
2001	4,173	13,646	1,565	28,669
2002	3,520	14,193	1,487	43,153
2003	4,971	21,522	506	26,569
2004	2,901	7,438	933	28,668
2005	10,447	9,383	751	36,011
2006	1,482	5,342	1,063	35,624
2007	1,278	3,878	850	45,988
2008	2,079	5,190	126	20,761
2009	4,298	11,782	1,025	45,271
2010	1,252	12,271	335	39,038
2011	1,924	10,736	1,378	62,215
2012	3,739	13,859	2,552	59,107
2013	4,681	11,256	1,475	56,746
2014	2,929	9,054	1,040	36,663
2015	1,870	6,586	421	38,811
2016	2,800	6,947	619	22,486
2017	1,710	4,022	283	15,912
2018	1,661	2,862	286	21,600
2019	613	2,120	152	16,548
2020	624	515	435	12,156
2021	1,378	599	194	12,299
2022	862	706	106	5,590
2023	856	1,154	54	10,674

Table 5. Observed length frequencies (TL cm) of Spotted Seatrout caught in the commercial gillnet fishery and landed during 1986-2023 by Florida coast.

Gulf Coast

Gillnet Lengths

TL (cm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																																						
4																																						
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24		3																																				
26		8																																				
28	3	9						1						1																								
30	6	9						4																														
32	24	12						18	7	1																												
34	23	16						80	45	7																												
36	15	19				1	1	87	99	10				1																							1	
38	25	10	3			2	2	85	110	19				4														1										
40	15	12	5			2		104	87	31			1	3														1										
42	11	8	8			1	3	80	86	18				9														1										
44	4	9	2				1	87	86	27				2																								
46	7	2	9					55	60	10				1																							1	
48	4	6	3			1		36	55	19				2																								
50	5	4	1				1	20	35	9				1		1																						
52	1	3	11					14	9	5				1																								
54	2	1	2					10	12	6			2																									
56	1		3			1		7	5	3																												
58			1					3	8	6																												
60			1					2	1	7																												
62								4	1	1																												
64								1		2																												
66								1		3																												
68			1																																			
70			1																																			
72																																						
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Table 5 continued. Observed length frequencies (TL cm) of Spotted Seatrout caught in the commercial gillnet fishery and landed during 1986-2023 by Florida coast.

Atlantic Coast

Gillnet Lengths

TL (cm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																																						
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20							4																															
22							3																															
24							1																															
26										1																												
28		12						2		9				1																								
30	25	18	7					4	2	13																												
32	54	73	3				32	3	21	22																												
34	92	123	11				124	45	20	23			1																									
36	88	90	6			1	162	70	39	28																												
38	71	84	2				128	69	25	21					1																							
40	71	76	3			3	70	77	21	31																			1									
42	53	63	5			3	101	103	25	44		1																										
44	68	54	1			6	119	115	38	70		1	6	1																								
46	44	51	9			6	124	104	42	66		1	2																1									
48	47	40	3			5	147	94	46	60																												
50	26	38	4			17	168	84	32	44		3	1																1									
52	24	30				11	196	65	18	30		2																										
54	25	25	1			15	166	37	16	21																										1		
56	21	22	2			13	151	40	12	11			1																									
58	14	18				10	106	29	6	9		1																							1	1		
60	8	13				9	64	29	7	7		1																								1		
62	15	15				10	45	16	2																													
64	6	13	2			2	34	10	3																													
66	6	8	1				20	4	1																													
68	5	6	2			1	8	2																														
70	8	6	1				3	1	2																													
72	4	5				1	6	1	1																													
74	5	3																																				
76	2	3																																				
78		1																																				
80	1	1																																				
82																																						

Table 6. Observed length frequencies (TL cm) of Spotted Seatrout caught in the commercial hook and line fishery and landed during 1986-2023 by Florida coast.

Gulf Coast

Hook and Line Lengths

TL (cm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																																						
4																																						
6																																						
8																																						
10																																						
12																																						
14																																						
16																																						
18																																						
20	2																																					
22	2	7																																				
24	17	16																																				
26	42	36																																				
28	78	65																																				
30	92	99	1					1																														
32	109	109		1	1	1	1				1											1																
34	114	87	2	2	10	46	27	2	2		3																											
36	95	95		3	14	57	33		6		1	6			4	4	3			1		1			1													
38	96	47	3	6	14	41	24	1	5	3	19	25	9	12	22	18	14	8		9		15			2								4					
40	82	64	2	3	7	31	28	2	2	2	10	20	14	27	17	18	12	15		12		11			3								1					
42	47	37	2	5	8	12	21	7	10	1	15	28	11	19	13	22	12	17		9		4			2							1	2					
44	35	35	2	2	10	4	13	6	5	1	14	26	6	7	13	11	4	9		2		2											5					
46	41	29		2	12	8	5	10	8		13	26	4	4	5	13	1	5		2		3			1								2					
48	21	24	4	4	7	2	7	4	6	2	8	19	4	1	5	15	1	10		1		3											3					
50	14	21		2	7		3	5	4		10	14	2	2	5	5	3	6								1												
52	16	19			5	1	4	1	6		1	12		1	4	1	2	2									3						1					
54	8	7		2	7		3	1	5	1	2	5		2				1									1											
56	8	1					6	2	2		2	1			1	1											2											
58	3	5		1		2	3	2	1			3															2											
60	3	1					1		1			1						1																				
62	2	1					2	1			2	2																										
64									1																													
66									1																													
68																																						
70																																						
72																																						
74																																						
76																																						
78																																						
80																																						
82																																						

Table 6 continued. Observed length frequencies (TL cm) of Spotted Seatrout caught in the commercial hook and line fishery and landed during 1986-2023 by Florida coast.

Atlantic Coast

Hook and Line Lengths

TL (cm)	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																																						
4																																						
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18																																						
20																																						
22																																						
24																																						
26																																						
28	1																																					
30	6	9						1	7	7																												
32	34	17					12	2	36	37	3	6	1			3			1		1																	
34	32	8					76	19	62	33	12	57	4	2		5	3								1													
36	36	4					102	54	93	27	52	97	37	35	25	25	26	6	2		4	6		1	4			9						2				
38	20	3					92	59	69	31	57	113	61	124	121	43	96	43	45		20	6		10	29			13	4					9				
40	18	9					74	51	49	18	34	69	67	99	84	34	116	41	54		30	8	1	9	21		4	8	4					20				1
42	20	7					45	31	54	16	44	67	45	93	81	40	99	43	49		13	9		21	26		2	4	2					9				
44	16	4					37	34	44	22	32	51	35	79	66	38	95	37	34		6	5		19	22		1	7	8					7				1
46	12	5					23	20	30	15	26	43	26	67	39	23	80	22	36		6	10		13	14			12	5					9				2
48	12	10					22	11	20	8	22	33	15	49	43	22	59	27	19		2	4		10	16			12	3					2				
50	12	8					16	9	11	2	15	19	12	29	29	17	29	15	9		4	5	3	6	12			9	2					2				1
52	8	4					18	14	8	2	11	13	12	18	24	15	27	13	13		1	7		6	8			14	3									
54	2	4					11	5	6	1	5	7	6	25	12	11	20	9	5		2	7	1	1	17			9	6									1
56	4	1					4	8	2	1	1	7	3	8	15	11	16	13	4			3	1		8		1	7	4					1				
58	3	1					7	5			5	10	5	6	9	3	9	8	3			2	2	1	3		1	3	2									
60	2						10	8	3	1	4	4	3	9	5	3	6	2	3			4	1	2	1			3	1									
62	2						2	1	1		1	1		1		1	2	4	1				1					1						1				
64	1						1	2			3	2	2					1				1																
66	1						1				1				1			1											1									
68	1						5	1				1																										
70	2						1						1																									
72							2					1											1															
74	1											1																										
76		1					1					3																										
78																																						
80																																						
82									1																													

Table 7. Estimated MRIP catch statistics (in numbers of fish) for Spotted Seatrout by Florida coast, 1986-2023.

Florida Gulf						
Year	Landings	CV	Releases	CV	Total catch	CV
1986	6,780,797	0.15	4,725,979	0.13	11,506,776	0.13
1987	7,141,547	0.26	5,674,674	0.14	12,816,221	0.17
1988	8,604,466	0.12	7,126,542	0.11	15,731,008	0.10
1989	7,190,021	0.12	13,533,240	0.13	20,723,261	0.11
1990	3,773,427	0.13	15,969,487	0.12	19,742,914	0.11
1991	6,861,155	0.19	19,872,294	0.12	26,733,449	0.12
1992	4,482,735	0.12	13,456,930	0.08	17,939,665	0.08
1993	3,538,589	0.10	14,035,133	0.10	17,573,725	0.09
1994	3,287,699	0.09	12,397,608	0.08	15,685,306	0.08
1995	3,740,865	0.09	13,228,477	0.08	16,969,342	0.07
1996	2,222,630	0.10	11,591,726	0.08	13,814,356	0.07
1997	2,898,405	0.15	17,334,758	0.07	20,233,163	0.08
1998	3,815,408	0.11	20,239,178	0.08	24,054,586	0.08
1999	4,202,572	0.07	25,766,867	0.08	29,969,439	0.08
2000	3,420,102	0.16	19,100,056	0.12	22,520,158	0.12
2001	2,041,063	0.10	12,575,892	0.07	14,616,955	0.07
2002	3,143,741	0.11	21,535,649	0.08	24,679,390	0.09
2003	3,035,615	0.08	19,648,664	0.06	22,684,280	0.06
2004	4,983,724	0.15	21,521,226	0.08	26,504,950	0.08
2005	4,277,347	0.11	25,468,599	0.09	29,745,947	0.09
2006	3,379,275	0.15	19,825,725	0.15	23,204,999	0.15
2007	3,074,253	0.12	19,502,126	0.09	22,576,378	0.09
2008	3,095,105	0.09	19,732,213	0.08	22,827,318	0.08
2009	3,116,303	0.10	17,443,607	0.08	20,559,911	0.07
2010	2,523,328	0.09	19,931,920	0.07	22,455,247	0.06
2011	3,825,573	0.18	28,727,797	0.09	32,553,368	0.10
2012	4,520,415	0.10	29,884,464	0.07	34,404,878	0.08
2013	3,711,974	0.10	20,353,127	0.08	24,065,101	0.07
2014	2,759,260	0.08	16,189,648	0.09	18,948,907	0.09
2015	2,734,034	0.15	15,823,619	0.08	18,557,654	0.08
2016	3,299,107	0.08	23,005,001	0.08	26,304,108	0.07
2017	3,693,681	0.09	24,991,224	0.08	28,684,906	0.08
2018	3,488,903	0.10	16,411,487	0.09	19,900,389	0.09
2019	2,797,196	0.13	15,297,195	0.10	18,094,392	0.10
2020	2,328,190	0.14	19,287,177	0.09	21,615,366	0.09
2021	3,625,272	0.16	19,723,142	0.10	23,348,416	0.10
2022	3,220,919	0.13	18,084,779	0.11	21,305,699	0.11
2023	2,995,347	0.13	21,354,255	0.08	24,349,603	0.08

Table 7 continued. Estimated MRIP catch statistics (in numbers of fish) for Spotted Seatrout by Florida coast, 1986-2023.

Florida Atlantic						
Year	Landings	CV	Releases	CV	Total catch	CV
1986	2,530,921	0.26	83,466	0.57	2,614,387	0.25
1987	2,115,806	0.27	159,533	0.66	2,275,339	0.27
1988	930,848	0.32	1,197,474	0.54	2,128,322	0.41
1989	657,517	0.25	896,320	0.44	1,553,836	0.33
1990	966,696	0.29	1,084,410	0.33	2,051,106	0.28
1991	960,448	0.21	2,444,990	0.25	3,405,439	0.21
1992	1,241,541	0.18	2,986,235	0.30	4,227,776	0.23
1993	1,125,702	0.19	2,723,364	0.18	3,849,066	0.16
1994	713,398	0.17	1,308,441	0.13	2,021,837	0.11
1995	933,492	0.18	2,558,037	0.18	3,491,530	0.16
1996	542,018	0.33	2,934,435	0.14	3,476,453	0.14
1997	508,256	0.22	3,688,028	0.18	4,196,285	0.18
1998	493,822	0.22	2,968,327	0.14	3,462,149	0.13
1999	698,889	0.16	3,847,550	0.11	4,546,439	0.11
2000	769,641	0.15	5,602,246	0.12	6,371,887	0.11
2001	634,022	0.18	3,564,802	0.11	4,198,826	0.10
2002	708,525	0.16	6,003,012	0.11	6,711,538	0.11
2003	565,584	0.19	4,555,366	0.11	5,120,951	0.11
2004	608,197	0.16	6,602,479	0.13	7,210,676	0.13
2005	1,080,998	0.17	10,657,861	0.16	11,738,859	0.15
2006	1,231,055	0.20	11,200,753	0.13	12,431,809	0.13
2007	813,094	0.20	8,007,269	0.11	8,820,363	0.11
2008	614,485	0.27	6,336,960	0.15	6,951,445	0.15
2009	593,948	0.15	4,967,758	0.13	5,561,706	0.12
2010	1,182,958	0.25	9,710,007	0.15	10,892,964	0.15
2011	926,512	0.15	7,796,032	0.12	8,722,544	0.11
2012	1,655,089	0.24	9,511,116	0.16	11,166,204	0.16
2013	1,066,910	0.23	5,503,785	0.11	6,570,695	0.12
2014	1,065,732	0.20	7,214,394	0.15	8,280,125	0.15
2015	500,118	0.14	5,998,667	0.15	6,498,784	0.14
2016	962,361	0.17	4,774,871	0.14	5,737,232	0.13
2017	963,670	0.33	5,803,537	0.09	6,767,207	0.09
2018	907,022	0.25	5,195,054	0.15	6,102,076	0.15
2019	613,386	0.19	4,013,804	0.13	4,627,189	0.12
2020	667,395	0.23	5,201,448	0.16	5,868,843	0.15
2021	620,820	0.40	4,464,291	0.14	5,085,112	0.14
2022	323,293	0.21	5,630,841	0.23	5,954,133	0.22
2023	222214	0.21	2,825,335	0.11	3,047,548	0.11

Table 8. Percent released and harvest (in numbers of fish) of Spotted Seatrout by Florida coast, 1986-2023.

Florida Gulf				
Year	Percent released	Dead released	Total harvest	Percent dead releases in total harvest
1986	41.1%	378,078	7,158,875	5%
1987	44.3%	453,974	7,595,521	6%
1988	45.3%	570,123	9,174,589	6%
1989	65.3%	1,082,659	8,272,680	13%
1990	80.9%	1,277,559	5,050,986	25%
1991	74.3%	1,589,784	8,450,939	19%
1992	75.0%	1,076,554	5,559,289	19%
1993	79.9%	1,122,811	4,661,400	24%
1994	79.0%	991,809	4,279,508	23%
1995	78.0%	1,058,278	4,799,143	22%
1996	83.9%	927,338	3,149,968	29%
1997	85.7%	1,386,781	4,285,186	32%
1998	84.1%	1,619,134	5,434,542	30%
1999	86.0%	2,061,349	6,263,921	33%
2000	84.8%	1,528,004	4,948,106	31%
2001	86.0%	1,006,071	3,047,134	33%
2002	87.3%	1,722,852	4,866,593	35%
2003	86.6%	1,571,893	4,607,508	34%
2004	81.2%	1,721,698	6,705,422	26%
2005	85.6%	2,037,488	6,314,835	32%
2006	85.4%	1,586,058	4,965,333	32%
2007	86.4%	1,560,170	4,634,423	34%
2008	86.4%	1,578,577	4,673,682	34%
2009	84.8%	1,395,489	4,511,792	31%
2010	88.8%	1,594,554	4,117,882	39%
2011	88.2%	2,298,224	6,123,797	38%
2012	86.9%	2,390,757	6,911,172	35%
2013	84.6%	1,628,250	5,340,224	30%
2014	85.4%	1,295,172	4,054,432	32%
2015	85.3%	1,265,890	3,999,924	32%
2016	87.5%	1,840,400	5,139,507	36%
2017	87.1%	1,999,298	5,692,979	35%
2018	82.5%	1,312,919	4,801,822	27%
2019	84.5%	1,223,776	4,020,972	30%
2020	89.2%	1,542,974	3,871,164	40%
2021	84.5%	1,577,851	5,203,123	30%
2022	84.9%	1,446,782	4,667,701	31%
2023	87.7%	1,708,340	4,703,687	36%

Table 8 continued. Percent released and harvest (in numbers of fish) of Spotted Seatrout by Florida coast, 1986-2023.

Florida Atlantic				
Year	Percent released	Dead released	Total harvest	Percent dead releases in total harvest
1986	3.2%	6,677	2,537,598	0%
1987	7.0%	12,763	2,128,569	1%
1988	56.3%	95,798	1,026,646	9%
1989	57.7%	71,706	729,223	10%
1990	52.9%	86,753	1,053,449	8%
1991	71.8%	195,599	1,156,047	17%
1992	70.6%	238,899	1,480,440	16%
1993	70.8%	217,869	1,343,571	16%
1994	64.7%	104,675	818,073	13%
1995	73.3%	204,643	1,138,135	18%
1996	84.4%	234,755	776,773	30%
1997	87.9%	295,042	803,298	37%
1998	85.7%	237,466	731,288	32%
1999	84.6%	307,804	1,006,693	31%
2000	87.9%	448,180	1,217,821	37%
2001	84.9%	285,184	919,206	31%
2002	89.4%	480,241	1,188,766	40%
2003	89.0%	364,429	930,013	39%
2004	91.6%	528,198	1,136,395	46%
2005	90.8%	852,629	1,933,627	44%
2006	90.1%	896,060	2,127,115	42%
2007	90.8%	640,582	1,453,676	44%
2008	91.2%	506,957	1,121,442	45%
2009	89.3%	397,421	991,369	40%
2010	89.1%	776,801	1,959,759	40%
2011	89.4%	623,683	1,550,195	40%
2012	85.2%	760,889	2,415,978	31%
2013	83.8%	440,303	1,507,213	29%
2014	87.1%	577,152	1,642,884	35%
2015	92.3%	479,893	980,011	49%
2016	83.2%	381,990	1,344,351	28%
2017	85.8%	464,283	1,427,953	33%
2018	85.1%	415,604	1,322,626	31%
2019	86.7%	321,104	934,490	34%
2020	88.6%	416,116	1,083,511	38%
2021	87.8%	357,143	977,963	37%
2022	94.6%	450,467	773,760	58%
2023	92.7%	226,027	448,241	50%

Table 9. MRIP standardized total catch rates of Spotted Seatrout by Florida coast during 1981-2023. The statistics shown for the estimated catch rates are the mean, coefficient of variation (CV), the nth percentile where n is 2.5, 25, 50 (median), 75, and 97.5, as well as the total number of trips (n_trips) and the number of positive trips (n_positive).

Florida Gulf									
Year	Mean	CV	2.5^{th}	25^{th}	Median	75^{th}	97.5^{th}	n_trips	n_positive
1981	2.267	0.061	2.004	2.172	2.265	2.361	2.540	387	181
1982	3.126	0.041	2.877	3.039	3.126	3.214	3.376	587	365
1983	3.523	0.054	3.155	3.394	3.521	3.653	3.894	394	206
1984	4.431	0.039	4.097	4.313	4.430	4.550	4.770	431	290
1985	3.623	0.046	3.299	3.511	3.622	3.737	3.946	374	239
1986	3.566	0.034	3.329	3.484	3.567	3.650	3.798	874	608
1987	3.068	0.035	2.859	2.994	3.068	3.142	3.280	1002	649
1988	2.334	0.051	2.101	2.251	2.334	2.416	2.570	504	348
1989	3.603	0.029	3.396	3.529	3.603	3.677	3.804	1117	799
1990	3.280	0.031	3.080	3.209	3.280	3.350	3.482	1036	676
1991	4.190	0.032	3.928	4.101	4.189	4.279	4.451	999	642
1992	2.986	0.026	2.836	2.931	2.985	3.041	3.139	2016	1128
1993	3.593	0.026	3.414	3.528	3.592	3.656	3.773	1895	1054
1994	3.198	0.026	3.035	3.140	3.197	3.256	3.362	2034	1179
1995	3.130	0.028	2.961	3.071	3.130	3.189	3.301	1990	1059
1996	2.692	0.027	2.551	2.640	2.691	2.742	2.836	2209	1215
1997	3.366	0.024	3.212	3.311	3.366	3.420	3.521	2556	1457
1998	3.433	0.021	3.294	3.384	3.433	3.482	3.573	3075	1809
1999	3.711	0.018	3.583	3.665	3.712	3.756	3.843	4159	2603
2000	2.681	0.022	2.567	2.641	2.681	2.722	2.797	3239	1877
2001	2.087	0.024	1.992	2.053	2.087	2.121	2.185	3309	1749
2002	3.180	0.020	3.060	3.135	3.179	3.222	3.304	3942	2333
2003	3.142	0.020	3.016	3.099	3.143	3.186	3.265	3794	2145
2004	2.937	0.022	2.811	2.893	2.938	2.980	3.062	3200	1763
2005	3.190	0.024	3.047	3.139	3.189	3.242	3.338	3078	1658
2006	2.429	0.025	2.312	2.386	2.427	2.471	2.549	2989	1501
2007	2.721	0.024	2.598	2.677	2.720	2.766	2.848	3129	1685
2008	2.529	0.023	2.417	2.489	2.528	2.568	2.641	3225	1794
2009	2.586	0.022	2.478	2.547	2.586	2.625	2.695	3513	1987
2010	3.142	0.019	3.028	3.100	3.142	3.183	3.258	3554	2162
2011	3.748	0.017	3.619	3.703	3.748	3.792	3.875	3880	2541
2012	3.360	0.017	3.251	3.321	3.359	3.399	3.472	4410	2762
2013	2.464	0.022	2.359	2.427	2.464	2.501	2.568	3237	1768
2014	2.212	0.021	2.121	2.179	2.212	2.244	2.304	3976	2143
2015	2.255	0.021	2.163	2.221	2.254	2.288	2.350	4141	2255
2016	2.742	0.021	2.630	2.702	2.742	2.782	2.853	4017	2226

Florida Gulf									
Year	Mean	CV	2.5^{th}	25^{th}	Median	75^{th}	97.5^{th}	n_trips	n_positive
2017	3.015	0.021	2.887	2.971	3.015	3.059	3.141	3260	1952
2018	2.302	0.026	2.188	2.261	2.302	2.343	2.417	2640	1472
2019	1.806	0.030	1.702	1.768	1.805	1.843	1.910	2537	1180
2020	2.294	0.025	2.182	2.254	2.293	2.333	2.406	3026	1620
2021	2.157	0.028	2.039	2.114	2.157	2.198	2.278	2536	1222
2022	1.769	0.032	1.661	1.729	1.769	1.807	1.880	2115	995
2023	2.197	0.025	2.092	2.159	2.197	2.236	2.305	2737	1439

Table 9 continued. MRIP standardized total catch rates of Spotted Seatrout by Florida coast during 1981-2023. The statistics shown for the estimated catch rates are the mean, coefficient of variation (CV), the nth percentile where n is 2.5, 25, 50 (median), 75, and 97.5, as well as the total number of trips (n_trips) and the number of positive trips (n_positive).

Florida Atlantic									
Year	Mean	CV	2.5th	25th	Median	75th	97.5th	n_trips	n_positive
1981	1.516	0.271	0.860	1.216	1.468	1.765	2.446	82	28
1982	0.920	0.135	0.696	0.832	0.911	1.001	1.182	215	110
1983	0.959	0.161	0.696	0.848	0.947	1.058	1.300	246	74
1984	0.585	0.138	0.442	0.527	0.580	0.639	0.755	356	102
1985	0.867	0.156	0.625	0.772	0.858	0.952	1.162	253	78
1986	0.311	0.126	0.241	0.283	0.309	0.336	0.393	343	134
1987	0.411	0.135	0.312	0.371	0.407	0.446	0.528	317	115
1988	0.244	0.355	0.117	0.182	0.230	0.291	0.452	103	17
1989	0.246	0.148	0.182	0.220	0.243	0.269	0.322	321	93
1990	0.287	0.148	0.214	0.256	0.283	0.315	0.375	311	95
1991	0.614	0.126	0.476	0.558	0.609	0.663	0.776	413	128
1992	0.503	0.111	0.403	0.464	0.501	0.539	0.620	602	168
1993	0.619	0.090	0.518	0.580	0.617	0.656	0.734	825	246
1994	0.369	0.087	0.312	0.346	0.368	0.391	0.437	1205	263
1995	0.530	0.080	0.452	0.500	0.529	0.559	0.618	1289	321
1996	0.573	0.082	0.488	0.540	0.571	0.604	0.670	1148	313
1997	0.598	0.081	0.509	0.563	0.596	0.629	0.698	1091	326
1998	0.455	0.077	0.390	0.431	0.454	0.479	0.527	1376	364
1999	0.483	0.056	0.432	0.464	0.482	0.501	0.539	2302	778
2000	0.585	0.055	0.525	0.562	0.584	0.606	0.649	2131	824
2001	0.504	0.057	0.450	0.485	0.504	0.524	0.562	2118	747
2002	0.686	0.055	0.615	0.660	0.685	0.710	0.762	2074	830
2003	0.453	0.060	0.403	0.434	0.452	0.472	0.509	1894	642
2004	0.612	0.061	0.543	0.586	0.610	0.637	0.687	1636	638
2005	0.916	0.055	0.822	0.880	0.915	0.950	1.019	1711	786
2006	0.837	0.053	0.754	0.806	0.836	0.868	0.926	1948	939
2007	0.795	0.056	0.712	0.764	0.794	0.826	0.885	1672	809
2008	0.611	0.063	0.540	0.584	0.610	0.636	0.689	1426	599
2009	0.568	0.066	0.497	0.541	0.567	0.593	0.643	1349	534
2010	0.759	0.064	0.668	0.725	0.758	0.792	0.861	1573	591
2011	0.665	0.062	0.588	0.636	0.663	0.692	0.749	1421	605
2012	0.961	0.055	0.861	0.925	0.960	0.997	1.067	1623	807
2013	0.562	0.076	0.481	0.531	0.561	0.590	0.650	1096	375
2014	0.535	0.072	0.464	0.508	0.534	0.561	0.613	1265	423
2015	0.672	0.065	0.590	0.642	0.671	0.701	0.762	1334	545

Florida Atlantic									
Year	Mean	CV	2.5th	25th	Median	75th	97.5th	n_trips	n_positive
2016	0.528	0.077	0.454	0.500	0.526	0.556	0.613	995	377
2017	0.556	0.074	0.479	0.527	0.555	0.583	0.642	1060	414
2018	0.523	0.084	0.442	0.492	0.521	0.552	0.614	843	313
2019	0.582	0.084	0.490	0.548	0.581	0.615	0.684	785	316
2020	0.494	0.075	0.425	0.468	0.493	0.518	0.571	998	397
2021	0.408	0.074	0.352	0.387	0.407	0.428	0.470	1281	395
2022	0.477	0.080	0.406	0.450	0.475	0.502	0.556	1039	349
2023	0.352	0.075	0.303	0.333	0.351	0.370	0.406	1232	398

Table 10. Fisheries Independent Monitoring (FIM) 183-m haul seine observed mean number caught per set and standardized indices by Florida coast. The index is scaled to the mean.

	Florida Gulf					Florida Atlantic				
Year	N	N pos	Obs Mean	Index	Index SE (log)	N	N pos	Obs Mean	Index	Index SE (log)
1997	484	76	0.157	0.840	0.178					
1998	611	98	0.160	0.873	0.157					
1999	684	117	0.171	0.868	0.145					
2000	750	113	0.151	0.735	0.148					
2001	748	92	0.123	0.604	0.165	181	45	0.249	1.162	0.250
2002	685	109	0.159	0.853	0.148	268	78	0.291	0.925	0.197
2003	740	110	0.149	0.862	0.150	280	79	0.282	1.062	0.194
2004	713	120	0.168	1.085	0.142	281	80	0.285	1.314	0.186
2005	698	91	0.130	0.576	0.165	256	67	0.262	1.271	0.207
2006	675	105	0.156	0.837	0.154	274	72	0.263	1.063	0.198
2007	667	108	0.162	0.799	0.149	288	76	0.264	1.301	0.194
2008	724	164	0.227	1.377	0.121	281	92	0.327	1.339	0.172
2009	707	143	0.202	1.063	0.128	286	81	0.283	1.525	0.187
2010	719	176	0.245	1.632	0.116	353	104	0.295	1.739	0.166
2011	709	153	0.216	1.192	0.125	352	106	0.301	1.647	0.161
2012	709	129	0.182	0.980	0.136	261	71	0.272	1.159	0.202
2013	722	123	0.170	0.883	0.141	249	41	0.165	0.625	0.262
2014	641	107	0.167	0.929	0.152	266	52	0.195	0.788	0.237
2015	713	121	0.170	0.883	0.142	259	63	0.243	1.063	0.213
2016	738	129	0.175	1.020	0.139	281	52	0.185	0.801	0.235
2017	697	122	0.175	1.046	0.140	270	42	0.156	0.592	0.263
2018	674	129	0.191	1.147	0.136	286	44	0.154	0.518	0.262
2019	674	146	0.217	1.261	0.130	290	48	0.166	0.661	0.245
2020	592	149	0.252	1.359	0.128	229	37	0.162	0.566	0.282
2021	661	112	0.169	1.116	0.149	252	25	0.099	0.405	0.340
2022	672	123	0.183	0.940	0.140	277	40	0.144	0.525	0.270
2023	687	129	0.188	1.249	0.136	251	27	0.108	0.412	0.333

Table 11. Fisheries Independent Monitoring (FIM) 183-m haul seine observed lengths (TL in cm) by Florida coast.

Gulf Coast
183-m Haul Seine Lengths

TL (cm)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																												
4	4			2									1	2	1		2		1		1	1		10		4	1	2
6	6	2	1		2		3	7	3	1	2	2	4	3	4	3	3	2	2	1	4	2	2	26	4	6	2	1
8	3	1	2		3	4	4	6	6	5	3	5	8	7	6	3	3	1	6	9	1	5	14	21	3	9	3	2
10	2	1	5	2	1	7	4	4	10	7	5	2	11	9	10	3		3	4	3	16	12	31	57	11	13	4	1
12	4	1	6	5	3	4	8	12	27	6	13	10	17	12	17	4	7	5	1	11	29	24	30	73	10	20	6	9
14	9	1	33	8	21	24	14	39	43	18	27	19	28	60	45	10	5	6	11	40	43	42	46	81	23	25	16	19
16	13	18	74	82	39	47	50	58	78	63	47	58	85	76	91	56	42	27	22	76	48	63	60	105	50	53	43	76
18	24	34	78	153	64	49	58	67	77	55	45	58	96	85	90	100	90	42	29	77	58	67	51	91	57	68	87	97
20	19	33	60	126	55	32	52	56	55	46	49	44	94	55	72	63	70	42	31	47	39	55	27	52	48	48	52	64
22	3	13	43	70	27	36	31	45	31	20	44	28	54	35	32	58	43	35	34	31	25	31	24	43	29	26	53	49
24	6	18	36	44	22	22	34	25	36	10	37	20	32	31	29	40	40	35	12	30	35	19	18	38	25	31	27	38
26		9	20	38	22	27	24	19	26	15	22	28	27	26	29	35	18	24	18	11	18	10	18	26	26	26	15	40
28	4	12	22	15	21	25	31	19	32	10	20	16	47	32	38	42	32	11	13	12	22	14	19	38	21	33	20	42
30	2	6	28	25	15	16	43	17	22	11	17	13	40	17	28	35	37	22	17	7	24	9	14	32	18	29	16	37
32	4	11	27	26	9	30	30	20	26	17	24	18	45	24	21	42	55	19	13	16	27	17	23	28	30	21	12	46
34	2	16	17	41	24	26	21	22	27	19	17	18	34	22	21	29	27	30	15	7	24	17	22	21	30	21	8	35
36	9	17	25	43	21	17	21	25	18	18	7	21	55	22	34	29	38	19	33	15	33	15	25	26	42	27	7	32
38	7	14	41	39	28	28	29	24	22	18	12	21	49	33	44	35	25	25	34	13	27	12	31	23	54	41	11	27
40	12	18	37	47	31	32	28	36	36	17	15	31	65	22	56	32	37	31	49	17	30	24	54	28	45	36	19	22
42	11	14	58	26	24	17	25	29	29	23	22	24	42	33	29	45	28	32	33	8	24	18	34	20	45	24	9	20
44	13	10	38	39	29	13	17	17	41	17	15	21	41	17	39	21	13	24	37	14	29	19	40	24	26	32	22	14
46	9	11	26	29	19	20	17	30	28	12	26	13	32	12	28	20	19	15	36	13	22	17	29	14	35	23	16	23
48	16	10	19	31	16	16	7	27	24	18	17	9	27	31	23	14	13	18	26	11	18	16	24	21	20	22	18	17
50	7	3	8	25	15	11	8	23	15	11	16	6	22	13	18	19	7	14	19	10	8	10	24	12	15	9	10	6
52	4	7	13	12	18	5	9	11	10	9	7	5	19	22	11	8	6	5	13	9	13	16	15	7	13	14	14	8
54	5	4	14	17	7	3	8	13	11	7	13	3	10	4	10	8	8	4	10	7	7	6	19	10	13	9	7	10
56	2	3	4	13	13	4	7	3	8	12	8	5	9	5	9	10	3	6	7	3	5	5	12	7	8	8	1	7
58	2	3	7	9	7	2	2	5	5	8	8	3	8	1	4	4	4	4	4	3	1	5	8	3	7	7	4	3
60	3	4	4	8	9	3		1	7	11	4	2	10	3	5	3	1	3	4		1	9	9	4	6	3	4	2
62		1	2	6	2	1		3	4	9	4	1	5	4	4	1		4	3		2	2	7		2	2	4	1
64		6		13	7		3	3	5	6	2		7		5	2	2	1	2	2		2	5		3	1	2	3
66			2	5	3	2		3	2	2	2	3	1	3	7	2		2	6			1	8		1	1	2	1
68			1	1		3	1	1	6	5		1	1	1	1	3	1	3	6		1	2	2	1	1		3	
70			1	2	3	2	1	1	9				1	2	3		1	2	2				2	2			1	2
72			3	2			1		1	1			1				1		2	1				2				1
74				3	1		1		4							1			1	1								1
76								1	1						2	1	1			1		1				1	1	
78							1		1					1		1			1					1				
80												1																
82					1																							
84								1																1				
86																												

Table 11 continued. Fisheries Independent Monitoring (FIM) 183-m haul seine observed lengths (TL in cm) by Florida coast.

Atlantic Coast
183-m Haul Seine Lengths

TL (cm)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2																											
4												3					1										1
6			1	2		2	2	1	3		2		6					2	4								
8		5	3	3		2	7	5	2	3	7	4	4	1			2	3	4	4	3	1			1		
10		1		3		2	1	4	3	2	6	2	6	1		2		1	2	6	1	4	1	1	2	2	1
12	2			3	3	3	4	4	6	3	5	13	12	7	10		2	14	9	3	13	14	6	7	3	2	3
14	2	2	1	6	7	6	10	12	12	15	14	23	24	20	15	3	4	18	11	11	26	10	7	4		6	6
16	1	2	4	12	11	22	19	28	11	27	23	45	48	81	55	17	1	32	36	21	32	7	20	8	8	10	9
18	9	11	7	7	22	26	27	45	17	25	31	42	43	82	56	52	4	25	26	17	19	7	18	12	15	36	11
20	8	10	17	10	14	17	29	30	8	15	11	12	29	80	42	32	5	26	24	31	11	6	11	9	11	15	8
22	3	10	24	11	8	15	19	25	8	17	22	15	28	63	42	20	3	38	27	21	23	4	12	7	4	6	5
24	10	7	11	6	13	20	24	23	15	19	18	18	28	64	68	31	10	30	29	32	23	9	5	9	13	7	11
26	8	10	21	8	9	15	26	28	29	27	26	21	19	50	57	29	3	26	27	43	18	13	17	12	17	4	4
28	8	12	14	5	21	21	27	30	52	56	39	43	35	60	61	37	4	28	23	52	16	28	14	14	19	11	4
30	4	6	3	6	11	30	35	27	45	55	26	20	24	54	39	29	16	31	28	45	17	23	23	7	10	8	2
32	8	6	10	5	11	38	57	25	45	31	36	28	36	60	48	31	17	28	28	29	14	37	19	10	11	6	3
34	5	2	4	3	16	23	38	26	28	16	31	29	36	57	28	16	23	18	16	23	12	32	11	15	14	3	3
36		2	2	5	15	34	26	19	21	19	19	21	33	51	38	20	18	17	15	16	14	18	20	13	10	5	3
38	4	7	4	9	11	29	30	17	26	11	18	31	19	40	25	11	8	24	13	16	7	11	15	12	5	5	6
40		6	3	4	10	29	14	11	25	8	9	19	21	26	25	17	9	12	11	15	9	18	20	10	10	8	4
42		1	2	3	11	20	5	13	20	12	6	9	13	21	17	6	9	10	8	14	7	20	10	6	5	5	3
44	2	2	1	4	6	12	6	6	12	7	4	2	6	14	10	6	5	8	6	8	7	13	11	7	3	4	4
46		1	6	1	4	9	5	9	5	5	5	4	10	9	9	4	5	5	6	8	4	4	9	4	5	5	2
48	1	4		2	2	10	1	9	6	3	5	5	8	7	13	3	3	3	7	7	3	10	3	5	3	1	2
50	1	1	1		2	3	2	4	5	2	5	2	8	2	7	6	4	2			2	3	5	6	2	4	
52	2	1	4	1	4	3	4	1	6	1	1	1	2	2	11	4	6	3	1	8	1		9	3	1	2	
54	1	1			3	4	3	3		2	3	3	1	3	8	5	4	4	3	11	2	3	4	5	1	1	1
56	4	2	1	1		2	2	2	6	1	2	1		2	4	6	3	2	1	4	1	5	1	3	1	2	2
58		3	2	1	2	2	3	3	2		2	2		1	2	8	3		1	5	2	4	1	3	4		4
60		4		1		1	2		2	2	3		4	2	2	6	2		2	1	1	2	2	4	2	1	1
62	2	4	3				1	2	1		2		2	2		2	2	2	1	2	2		4	4	1		
64		1	1		1		1		2	2	2	1	3		1	3	4	5	3	2			2	1		1	
66	1	1		1	2		2	1	4	1	1							2		3			3		1	1	1
68	1	1				1		2	1		2	1				2	3	1		1				3			
70	2	2		1				1	2	2		1	1		1	1	1	1			1				2		
72	1		1	1	1			1	2	1							2	6		1							1
74			1			2				1				1		2	1	3									
76	3	1		2				1	1								1				1						
78			2			2										1					1						
80				1					1	2					1												
82				1					2																		
84							1			1															1		
86							1																				

Table 12. Fisheries Independent Monitoring (FIM) 21.3-m center bag seine observed mean number caught per set and standardized indices by Florida coast. The index is scaled to the mean.

	Florida Gulf					Florida Atlantic				
Year	N	N pos	Obs Mean	Index	Index SE (log)	N	N pos	Obs Mean	Index	Index SE (log)
1998	763	212	0.278	1.453	0.122					
1999	790	188	0.238	1.231	0.127					
2000	834	185	0.222	1.116	0.130					
2001	856	183	0.214	1.225	0.129	355	47	0.132	0.698	0.246
2002	832	190	0.228	1.037	0.128	371	80	0.216	1.130	0.187
2003	776	206	0.265	1.643	0.118	372	62	0.167	0.997	0.214
2004	863	228	0.264	1.432	0.116	358	77	0.215	1.248	0.191
2005	917	172	0.188	1.008	0.134	345	60	0.174	1.372	0.216
2006	943	169	0.179	0.802	0.135	362	98	0.271	1.543	0.166
2007	860	174	0.202	0.734	0.136	327	61	0.187	1.239	0.218
2008	966	217	0.225	1.081	0.120	347	73	0.210	1.374	0.193
2009	941	211	0.224	0.885	0.123	340	51	0.150	0.983	0.236
2010	939	195	0.208	0.879	0.125	374	64	0.171	0.767	0.215
2011	947	244	0.258	1.207	0.114	363	90	0.248	1.621	0.173
2012	973	220	0.226	0.961	0.119	315	59	0.187	1.191	0.217
2013	971	187	0.193	0.814	0.129	324	39	0.120	0.558	0.267
2014	957	247	0.258	1.071	0.113	345	61	0.177	0.920	0.216
2015	961	231	0.240	1.115	0.117	346	57	0.165	0.984	0.224
2016	1223	267	0.218	1.030	0.107	332	66	0.199	1.202	0.206
2017	1244	234	0.188	0.916	0.117	343	42	0.122	0.643	0.263
2018	1224	179	0.146	0.641	0.131	339	40	0.118	0.722	0.271
2019	1213	217	0.179	0.682	0.119	369	49	0.133	0.715	0.243
2020	1091	244	0.224	0.811	0.115	283	32	0.113	0.476	0.303
2021	1217	212	0.174	0.798	0.123	344	38	0.110	0.598	0.276
2022	1043	219	0.210	1.042	0.121	325	56	0.172	0.942	0.226
2023	1062	224	0.211	0.978	0.118	321	59	0.184	0.946	0.222

Table 13. List of Stock Synthesis parameters for the Florida coast base models. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviation (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and the phase of estimation. Parameters designated as fixed were held at their initial values and have no associated range or SD.

FLORIDA GULF COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
1	NatM_Lorenzen_averageFem_GP_1	0.447	(0.1,0.6)				fixed
2	L_at_Amin_Fem_GP_1	16.470	(1,40)	0.61	0.04		1
3	L_at_Amax_Fem_GP_1	40.493	(30,85)	1.74	0.04		2
4	VonBert_K_Fem_GP_1	0.246	(0.1,0.9)	0.02	0.09		2
5	CV_young_Fem_GP_1	0.260	(0.1,0.9)	0.02	0.06		3
6	CV_old_Fem_GP_1	0.428	(0.005,0.9)	0.03	0.08		3
7	Wtlen_1_Fem_GP_1	0.000	(0,3)				fixed
8	Wtlen_2_Fem_GP_1	2.874	(1,4)				fixed
9	Mat50%_Fem_GP_1	30.000	(20,60)				fixed
10	Mat_slope_Fem_GP_1	-0.250	(-3,0)				fixed
11	Eggs_scalar_Fem_GP_1	1.000	(-3,3)				fixed
12	Eggs_exp_wt_Fem_GP_1	1.000	(-3,3)				fixed
13	NatM_Lorenzen_averageMal_GP_1	0.449	(0.1,0.6)				fixed
14	L_at_Amin_Mal_GP_1	14.274	(1,40)	0.45	0.03		1
15	L_at_Amax_Mal_GP_1	68.868	(30,70)	1.11	0.02	41.98	2
16	VonBert_K_Mal_GP_1	0.083	(0.01,0.99)	0.00	0.05		2
17	CV_young_Mal_GP_1	0.320	(0.1,0.9)	0.02	0.06		3
18	CV_old_Mal_GP_1	0.170	(0.005,0.4)	0.04	0.21		3
19	Wtlen_1_Mal_GP_1	0.000	(-3,3)				fixed
20	Wtlen_2_Mal_GP_1	2.895	(-3,4)				fixed
21	CohortGrowDev	1.000	(0.1,10)				fixed
22	FracFemale_GP_1	0.500	(1E-06,0.99)				fixed
23	SR_LN(R0)	11.034	(7,15)	0.13	0.01		2
24	SR_BH_steep	0.871	(0.2,0.99)	0.48	0.55		3
25	SR_sigmaR	0.226	(0.2,1)	0.02	0.10	0.6	4
26	SR_regime	0.000	(-5,5)				fixed
27	SR_autocorr	0.000	(-1,1)				fixed
28	Early_InitAge_8	-0.001	(-4,4)	0.23	-209.88		7
29	Early_InitAge_7	-0.001	(-4,4)	0.23	-161.59		7
30	Early_InitAge_6	-0.003	(-4,4)	0.23	-65.59		7
31	Early_InitAge_5	-0.008	(-4,4)	0.23	-28.48		7

FLORIDA GULF COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
32	Early_InitAge_4	-0.016	(-4,4)	0.22	-14.11		7
33	Early_InitAge_3	-0.017	(-4,4)	0.22	-12.80		7
34	Main_InitAge_2	0.032	(-4,4)	0.22	6.78		3
35	Main_InitAge_1	0.187	(-4,4)	0.21	1.10		3
36	Main_RecrDev_1986	0.167	(-4,4)	0.20	1.22		3
37	Main_RecrDev_1987	0.084	(-4,4)	0.20	2.37		3
38	Main_RecrDev_1988	0.122	(-4,4)	0.19	1.57		3
39	Main_RecrDev_1989	0.267	(-4,4)	0.17	0.64		3
40	Main_RecrDev_1990	0.315	(-4,4)	0.15	0.49		3
41	Main_RecrDev_1991	0.313	(-4,4)	0.15	0.47		3
42	Main_RecrDev_1992	-0.147	(-4,4)	0.17	-1.15		3
43	Main_RecrDev_1993	-0.036	(-4,4)	0.15	-4.13		3
44	Main_RecrDev_1994	-0.223	(-4,4)	0.14	-0.61		3
45	Main_RecrDev_1995	0.056	(-4,4)	0.10	1.75		3
46	Main_RecrDev_1996	0.113	(-4,4)	0.08	0.73		3
47	Main_RecrDev_1997	-0.099	(-4,4)	0.09	-0.88		3
48	Main_RecrDev_1998	0.030	(-4,4)	0.07	2.41		3
49	Main_RecrDev_1999	-0.139	(-4,4)	0.07	-0.53		3
50	Main_RecrDev_2000	-0.135	(-4,4)	0.08	-0.58		3
51	Main_RecrDev_2001	0.058	(-4,4)	0.08	1.41		3
52	Main_RecrDev_2002	-0.039	(-4,4)	0.08	-1.95		3
53	Main_RecrDev_2003	0.032	(-4,4)	0.07	2.32		3
54	Main_RecrDev_2004	0.040	(-4,4)	0.07	1.82		3
55	Main_RecrDev_2005	-0.107	(-4,4)	0.08	-0.72		3
56	Main_RecrDev_2006	0.169	(-4,4)	0.08	0.45		3
57	Main_RecrDev_2007	-0.091	(-4,4)	0.08	-0.85		3
58	Main_RecrDev_2008	0.145	(-4,4)	0.07	0.49		3
59	Main_RecrDev_2009	0.075	(-4,4)	0.07	1.00		3
60	Main_RecrDev_2010	0.223	(-4,4)	0.07	0.33		3
61	Main_RecrDev_2011	0.085	(-4,4)	0.08	0.92		3
62	Main_RecrDev_2012	-0.136	(-4,4)	0.08	-0.56		3
63	Main_RecrDev_2013	-0.400	(-4,4)	0.08	-0.20		3
64	Main_RecrDev_2014	-0.207	(-4,4)	0.09	-0.43		3
65	Main_RecrDev_2015	0.221	(-4,4)	0.09	0.41		3
66	Main_RecrDev_2016	-0.057	(-4,4)	0.08	-1.31		3
67	Main_RecrDev_2017	-0.161	(-4,4)	0.08	-0.48		3
68	Main_RecrDev_2018	-0.185	(-4,4)	0.08	-0.46		3
69	Main_RecrDev_2019	0.147	(-4,4)	0.08	0.56		3
70	Main_RecrDev_2020	-0.328	(-4,4)	0.08	-0.25		3
71	Main_RecrDev_2021	-0.213	(-4,4)	0.09	-0.42		3
72	Main_RecrDev_2022	0.206	(-4,4)	0.10	0.49		3

FLORIDA GULF COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
73	Main_RecrDev_2023	-0.040	(-4,4)	0.10	-2.44		3
74	InitF_seas_1_flt_1COMMGN	0.186	(0.0001,1)	0.08	0.45		1
75	InitF_seas_1_flt_2COMMHL	0.025	(0.0001,0.5)	0.01	0.44		1
76	InitF_seas_1_flt_3REC	2.839	(0.0001,3)	1.01	0.36		1
77	F_fleet_3_YR_1986_s_1	1.470	(0,4.9)	0.29	0.20		2
78	F_fleet_3_YR_1987_s_1	1.287	(0,4.9)	0.25	0.19		2
79	F_fleet_3_YR_1988_s_1	1.858	(0,4.9)	0.29	0.16		2
80	F_fleet_3_YR_1989_s_1	2.637	(0,4.9)	0.41	0.15		2
81	F_fleet_3_YR_1990_s_1	3.061	(0,4.9)	0.40	0.13		2
82	F_fleet_3_YR_1991_s_1	3.661	(0,4.9)	0.48	0.13		2
83	F_fleet_3_YR_1992_s_1	2.289	(0,4.9)	0.23	0.10		2
84	F_fleet_3_YR_1993_s_1	2.323	(0,4.9)	0.24	0.10		2
85	F_fleet_3_YR_1994_s_1	2.185	(0,4.9)	0.20	0.09		2
86	F_fleet_3_YR_1995_s_1	2.561	(0,4.9)	0.23	0.09		2
87	F_fleet_3_YR_1996_s_1	1.980	(0,4.9)	0.17	0.09		2
88	F_fleet_3_YR_1997_s_1	2.849	(0,4.9)	0.25	0.09		2
89	F_fleet_3_YR_1998_s_1	3.448	(0,4.9)	0.29	0.09		2
90	F_fleet_3_YR_1999_s_1	4.401	(0,4.9)	0.35	0.08		2
91	F_fleet_3_YR_2000_s_1	3.851	(0,4.9)	0.42	0.11		2
92	F_fleet_3_YR_2001_s_1	2.461	(0,4.9)	0.20	0.08		2
93	F_fleet_3_YR_2002_s_1	3.927	(0,4.9)	0.34	0.09		2
94	F_fleet_3_YR_2003_s_1	3.582	(0,4.9)	0.27	0.07		2
95	F_fleet_3_YR_2004_s_1	4.318	(0,4.9)	0.37	0.09		2
96	F_fleet_3_YR_2005_s_1	4.900	(0,4.9)	0.00	0.00		2
97	F_fleet_3_YR_2006_s_1	4.748	(0,4.9)	0.59	0.12		2
98	F_fleet_3_YR_2007_s_1	3.997	(0,4.9)	0.38	0.09		2
99	F_fleet_3_YR_2008_s_1	3.733	(0,4.9)	0.31	0.08		2
100	F_fleet_3_YR_2009_s_1	3.244	(0,4.9)	0.27	0.08		2
101	F_fleet_3_YR_2010_s_1	3.055	(0,4.9)	0.23	0.08		2
102	F_fleet_3_YR_2011_s_1	4.570	(0,4.9)	0.42	0.09		2
103	F_fleet_3_YR_2012_s_1	4.900	(0,4.9)	0.00	0.00		2
104	F_fleet_3_YR_2013_s_1	3.903	(0,4.9)	0.31	0.08		2
105	F_fleet_3_YR_2014_s_1	3.306	(0,4.9)	0.28	0.08		2
106	F_fleet_3_YR_2015_s_1	3.566	(0,4.9)	0.33	0.09		2
107	F_fleet_3_YR_2016_s_1	4.387	(0,4.9)	0.35	0.08		2
108	F_fleet_3_YR_2017_s_1	4.739	(0,4.9)	0.40	0.08		2
109	F_fleet_3_YR_2018_s_1	3.826	(0,4.9)	0.35	0.09		2
110	F_fleet_3_YR_2019_s_1	3.373	(0,4.9)	0.34	0.10		2
111	F_fleet_3_YR_2020_s_1	3.513	(0,4.9)	0.34	0.10		2
112	F_fleet_3_YR_2021_s_1	4.370	(0,4.9)	0.46	0.11		2
113	F_fleet_3_YR_2022_s_1	4.203	(0,4.9)	0.47	0.11		2

FLORIDA GULF COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
114	F_fleet_3_YR_2023_s_1	4.314	(0,4.9)	0.46	0.11		2
115	LnQ_base_FIMYOY(4)	- 10.945	(-15,15)				fixed
116	LnQ_base_FIMHS(5)	-7.422	(-15,15)				fixed
117	LnQ_base_MRIP_CPUE(7)	-8.383	(-15,15)				fixed
118	Q_extraSD_MRIP_CPUE(7)	0.134	(0,0.2)	0.02	0.16		1
119	Size_DblN_peak_COMMGN(1)	46.781	(13,70)	2.26	0.05		2
120	Size_DblN_top_logit_COMMGN(1)	1.439	(-5,3)	30.46	21.17		3
121	Size_DblN_ascend_se_COMMGN(1)	4.219	(0,10)	0.31	0.07		3
122	Size_DblN_descend_se_COMMGN(1)	3.377	(0,6)	60.51	17.92		3
123	Size_DblN_start_logit_COMMGN(1)	-9.900	(-15,5)	8.26	-0.83		2
124	Size_DblN_end_logit_COMMGN(1)	3.448	(-5,5)	35.98	10.43		2
125	Size_inflection_COMMHL(2)	39.974	(1,60)	0.82	0.02		1
126	Size_95%width_COMMHL(2)	7.446	(1,30)	0.61	0.08		2
127	Size_inflection_REC(3)	32.678	(18,54)	0.65	0.02		3
128	Size_95%width_REC(3)	5.287	(1,30)	0.60	0.11		3
129	Retain_L_infl_REC(3)	7.021	(1,40)	119.44	17.01		2
130	Retain_L_width_REC(3)	1.216	(0.01,10)	24.55	20.18		2
131	Retain_L_asymptote_logit_REC(3)	-0.629	(-10,10)	0.06	-0.09		2
132	Retain_L_maleoffset_REC(3)	0.000	(-10,10)				fixed
133	DiscMort_L_infl_REC(3)	-8.000	(-10,10)				fixed
134	DiscMort_L_width_REC(3)	1.000	(-1,2)				fixed
135	DiscMort_L_level_old_REC(3)	0.080	(-1,2)				fixed
136	DiscMort_L_male_offset_REC(3)	0.500	(-1,2)				fixed
137	SizeSpline_Code_FIMHS(5)	0.000	(0,2)				fixed
138	SizeSpline_GradLo_FIMHS(5)	0.479	(-0.001,1)	0.07	0.14		3
139	SizeSpline_GradHi_FIMHS(5)	0.158	(-1,1)	0.02	0.12		3
140	SizeSpline_Knot_1_FIMHS(5)	11.262	(10,80)				fixed
141	SizeSpline_Knot_2_FIMHS(5)	17.867	(10,80)				fixed
142	SizeSpline_Knot_3_FIMHS(5)	26.807	(10,80)				fixed
143	SizeSpline_Knot_4_FIMHS(5)	39.259	(10,80)				fixed
144	SizeSpline_Knot_5_FIMHS(5)	58.648	(10,80)				fixed
145	SizeSpline_Val_1_FIMHS(5)	-2.415	(-9,7)	0.19	-0.08		3
146	SizeSpline_Val_2_FIMHS(5)	-0.656	(-9,7)	0.06	-0.09		3
147	SizeSpline_Val_3_FIMHS(5)	-1.000	(-9,7)				fixed
148	SizeSpline_Val_4_FIMHS(5)	1.095	(-9,7)	0.06	0.06		3
149	SizeSpline_Val_5_FIMHS(5)	3.216	(-9,7)	0.11	0.03		3
150	Size_inflection_MRIP_CPUE(7)	36.570	(1,54)	0.32	0.01		1
151	Size_95%width_MRIP_CPUE(7)	7.458	(1,30)	0.23	0.03		2
152	minage@sel=1_BIOAGES(6)	0.000	(0,1)				fixed
153	maxage@sel=1_BIOAGES(6)	8.000	(7,9)				fixed

FLORIDA GULF COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
154	Size_inflection_REC(3)_BLK1repl_1990	34.469	(1,50)	0.31	0.01		4
155	Size_95%width_REC(3)_BLK1repl_1990	7.713	(1,30)	0.32	0.04		4
156	Retain_L_infl_REC(3)_BLK1repl_1990	37.432	(18,54)	0.14	0.00		4
157	Retain_L_width_REC(3)_BLK1repl_1990	1.188	(0.01,8)	0.07	0.06		4

Table 13 continued. List of Stock Synthesis parameters for the Florida coast base models. The list includes expected parameter values, lower and upper bounds of the parameters, associated standard deviation (SD) and coefficients of variation (CV), prior type and densities (value, SD) if applicable, and the phase of estimation. Parameters designated as fixed were held at their initial values and have no associated range or SD.

FLORIDA ATLANTIC COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
1	NatM_Lorenzen_averageFem_GP_1	0.446	(0.1,0.6)				fixed
2	L_at_Amin_Fem_GP_1	14.669	(2,40)	1.04	0.07		1
3	L_at_Amax_Fem_GP_1	41.921	(20,105)	2.94	0.07		2
4	VonBert_K_Fem_GP_1	0.232	(0.1,0.6)	0.03	0.11		2
5	CV_young_Fem_GP_1	0.298	(0.01,0.5)	0.03	0.11		3
6	CV_old_Fem_GP_1	0.530	(0.005,0.9)	0.05	0.10		3
7	Wtlen_1_Fem_GP_1	0.000	(0,3)				fixed
8	Wtlen_2_Fem_GP_1	3.075	(1,4)				fixed
9	Mat50%_Fem_GP_1	30.000	(20,60)				fixed
10	Mat_slope_Fem_GP_1	-0.250	(-3,0)				fixed
11	Eggs_scalar_Fem_GP_1	1.000	(-3,3)				fixed
12	Eggs_exp_wt_Fem_GP_1	1.000	(-3,3)				fixed
13	NatM_Lorenzen_averageMal_GP_1	0.448	(0.1,0.6)				fixed
14	L_at_Amin_Mal_GP_1	13.353	(2,40)	0.76	0.06		1
15	L_at_Amax_Mal_GP_1	75.498	(40,80)	4.14	0.05	47.87	2
16	VonBert_K_Mal_GP_1	0.072	(0.05,0.8)	0.01	0.10		2
17	CV_young_Mal_GP_1	0.366	(0.05,1)	0.04	0.10		3
18	CV_old_Mal_GP_1	0.302	(0.001,0.5)	0.07	0.24		3
19	Wtlen_1_Mal_GP_1	0.000	(-3,3)				fixed
20	Wtlen_2_Mal_GP_1	3.034	(-3,4)				fixed
21	CohortGrowDev	1.000	(0.1,10)				fixed
22	FracFemale_GP_1	0.500	(1E-06, 0.99)				fixed
23	SR_LN(R0)	9.688	(7,14)	0.10	0.01		3
24	SR_BH_steep	0.834	(0.59,0.99)	0.11	0.14	0.8	3
25	SR_sigmaR	0.358	(0,1)	0.05	0.15		6
26	SR_regime	0.000	(-5,5)				fixed
27	SR_autocorr	0.000	(-1,1)				fixed
28	Early_InitAge_8	-0.216	(-4,4)	0.33	-1.51		7
29	Early_InitAge_7	-0.185	(-4,4)	0.33	-1.79		7
30	Early_InitAge_6	-0.285	(-4,4)	0.32	-1.12		7
31	Early_InitAge_5	-0.405	(-4,4)	0.31	-0.76		7

FLORIDA ATLANTIC COAST BASE MODEL

	Parameter Label	Value	Range	SD	CV	Prior	Phase
32	Early_InitAge_4	-0.523	(-4,4)	0.30	-0.57		7
33	Early_InitAge_3	-0.589	(-4,4)	0.29	-0.49		7
34	Main_InitAge_2	-0.500	(-4,4)	0.28	-0.56		3
35	Main_InitAge_1	-0.045	(-4,4)	0.25	-5.51		3
36	Main_RecrDev_1986	-0.122	(-4,4)	0.26	-2.13		3
37	Main_RecrDev_1987	-0.417	(-4,4)	0.27	-0.64		3
38	Main_RecrDev_1988	-0.140	(-4,4)	0.24	-1.73		3
39	Main_RecrDev_1989	0.141	(-4,4)	0.20	1.40		3
40	Main_RecrDev_1990	0.247	(-4,4)	0.15	0.60		3
41	Main_RecrDev_1991	0.237	(-4,4)	0.12	0.51		3
42	Main_RecrDev_1992	-0.177	(-4,4)	0.14	-0.78		3
43	Main_RecrDev_1993	-0.503	(-4,4)	0.18	-0.36		3
44	Main_RecrDev_1994	0.244	(-4,4)	0.14	0.56		3
45	Main_RecrDev_1995	-0.207	(-4,4)	0.20	-0.96		3
46	Main_RecrDev_1996	-0.013	(-4,4)	0.19	-14.55		3
47	Main_RecrDev_1997	-0.169	(-4,4)	0.18	-1.08		3
48	Main_RecrDev_1998	0.075	(-4,4)	0.15	2.04		3
49	Main_RecrDev_1999	0.073	(-4,4)	0.15	2.04		3
50	Main_RecrDev_2000	0.329	(-4,4)	0.12	0.35		3
51	Main_RecrDev_2001	0.034	(-4,4)	0.12	3.52		3
52	Main_RecrDev_2002	0.265	(-4,4)	0.11	0.41		3
53	Main_RecrDev_2003	0.528	(-4,4)	0.11	0.21		3
54	Main_RecrDev_2004	0.670	(-4,4)	0.10	0.16		3
55	Main_RecrDev_2005	0.197	(-4,4)	0.12	0.60		3
56	Main_RecrDev_2006	0.295	(-4,4)	0.10	0.36		3
57	Main_RecrDev_2007	0.053	(-4,4)	0.12	2.23		3
58	Main_RecrDev_2008	0.518	(-4,4)	0.10	0.19		3
59	Main_RecrDev_2009	0.710	(-4,4)	0.10	0.14		3
60	Main_RecrDev_2010	0.292	(-4,4)	0.12	0.41		3
61	Main_RecrDev_2011	0.435	(-4,4)	0.10	0.23		3
62	Main_RecrDev_2012	-0.091	(-4,4)	0.11	-1.26		3
63	Main_RecrDev_2013	-0.308	(-4,4)	0.13	-0.44		3
64	Main_RecrDev_2014	0.489	(-4,4)	0.10	0.20		3
65	Main_RecrDev_2015	0.059	(-4,4)	0.11	1.90		3
66	Main_RecrDev_2016	0.091	(-4,4)	0.11	1.21		3
67	Main_RecrDev_2017	0.159	(-4,4)	0.11	0.67		3
68	Main_RecrDev_2018	-0.271	(-4,4)	0.12	-0.44		3
69	Main_RecrDev_2019	-0.164	(-4,4)	0.11	-0.69		3
70	Main_RecrDev_2020	-0.478	(-4,4)	0.14	-0.29		3
71	Main_RecrDev_2021	-0.239	(-4,4)	0.13	-0.55		3

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	Parameter Label	Value	Range	SD	CV	Prior	Phase
72	Main_RecrDev_2022	0.105	(-4,4)	0.13	1.27		3
73	Main_RecrDev_2023	0.076	(-4,4)	0.16	2.15		3
74	InitF_seas_1_flt_1COMMGN	0.044	(0.001,0.5)	0.02	0.39		1
75	InitF_seas_1_flt_2COMMHL	0.010	(0.001,0.5)	0.00	0.35		1
76	InitF_seas_1_flt_3REC	0.903	(0.001,1)	0.09	0.10	0.8	1
77	F_fleet_3_YR_1986_s_1	3.392	(0,4)	1.08	0.32		2
78	F_fleet_3_YR_1987_s_1	2.908	(0,4)	0.88	0.30		2
79	F_fleet_3_YR_1988_s_1	2.798	(0,4)	0.88	0.31		2
80	F_fleet_3_YR_1989_s_1	1.611	(0,4)	0.40	0.25		2
81	F_fleet_3_YR_1990_s_1	1.873	(0,4)	0.48	0.25		2
82	F_fleet_3_YR_1991_s_1	2.532	(0,4)	0.46	0.18		2
83	F_fleet_3_YR_1992_s_1	3.627	(0,4)	0.60	0.17		2
84	F_fleet_3_YR_1993_s_1	2.733	(0,4)	0.41	0.15		2
85	F_fleet_3_YR_1994_s_1	1.297	(0,4)	0.16	0.13		2
86	F_fleet_3_YR_1995_s_1	2.262	(0,4)	0.32	0.14		2
87	F_fleet_3_YR_1996_s_1	1.961	(0,4)	0.27	0.14		2
88	F_fleet_3_YR_1997_s_1	2.355	(0,4)	0.35	0.15		2
89	F_fleet_3_YR_1998_s_1	2.079	(0,4)	0.27	0.13		2
90	F_fleet_3_YR_1999_s_1	2.573	(0,4)	0.28	0.11		2
91	F_fleet_3_YR_2000_s_1	3.296	(0,4)	0.36	0.11		2
92	F_fleet_3_YR_2001_s_1	2.195	(0,4)	0.24	0.11		2
93	F_fleet_3_YR_2002_s_1	3.290	(0,4)	0.35	0.11		2
94	F_fleet_3_YR_2003_s_1	2.467	(0,4)	0.28	0.11		2
95	F_fleet_3_YR_2004_s_1	2.315	(0,4)	0.26	0.11		2
96	F_fleet_3_YR_2005_s_1	3.058	(0,4)	0.37	0.12		2
97	F_fleet_3_YR_2006_s_1	4.000	(0,4)	0.00	0.00		2
98	F_fleet_3_YR_2007_s_1	3.829	(0,4)	0.43	0.11		2
99	F_fleet_3_YR_2008_s_1	3.882	(0,4)	0.57	0.15		2
100	F_fleet_3_YR_2009_s_1	2.333	(0,4)	0.29	0.12		2
101	F_fleet_3_YR_2010_s_1	4.000	(0,4)	0.00	0.00		2
102	F_fleet_3_YR_2011_s_1	2.928	(0,4)	0.32	0.11		2
103	F_fleet_3_YR_2012_s_1	3.932	(0,4)	0.51	0.13		2
104	F_fleet_3_YR_2013_s_1	3.315	(0,4)	0.39	0.12		2
105	F_fleet_3_YR_2014_s_1	4.000	(0,4)	0.00	0.00		2
106	F_fleet_3_YR_2015_s_1	2.720	(0,4)	0.33	0.12		2
107	F_fleet_3_YR_2016_s_1	3.372	(0,4)	0.43	0.13		2
108	F_fleet_3_YR_2017_s_1	3.684	(0,4)	0.39	0.10		2
109	F_fleet_3_YR_2018_s_1	3.329	(0,4)	0.46	0.14		2
110	F_fleet_3_YR_2019_s_1	2.639	(0,4)	0.33	0.12		2
111	F_fleet_3_YR_2020_s_1	3.844	(0,4)	0.54	0.14		2
112	F_fleet_3_YR_2021_s_1	4.000	(0,4)	0.00	0.00		2

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	Parameter Label	Value	Range	SD	CV	Prior	Phase
113	F_fleet_3_YR_2022_s_1	3.263	(0,4)	0.55	0.17		2
114	F_fleet_3_YR_2023_s_1	2.046	(0,4)	0.26	0.13		2
115	LnQ_base_FIMYOY(4)	-9.782	(-15,15)				fixed
116	LnQ_base_FIMHS(5)	-6.768	(-15,15)				fixed
117	LnQ_base_MRIP_CPUE(7)	-6.792	(-15,15)				fixed
118	Size_DblN_peak_COMMGN(1)	57.156	(20,70)	3.30	0.06		3
119	Size_DblN_top_logit_COMMGN(1)	0.942	(-5,3)	6.44	6.84		3
120	Size_DblN_ascend_se_COMMGN(1)	5.062	(-4,12)	0.24	0.05		3
121	Size_DblN_descend_se_COMMGN(1)	2.626	(2,6)	18.22	6.94		3
122	Size_DblN_start_logit_COMMGN(1)	-14.272	(-15,5)	17.61	-1.23		3
123	Size_DblN_end_logit_COMMGN(1)	-1.844	(-5,5)	7.53	-4.08		3
124	Size_inflection_COMMHL(2)	38.346	(1,50)	0.32	0.01		1
125	Size_95%width_COMMHL(2)	4.815	(1,20)	0.32	0.07		2
126	Size_inflection_REC(3)	31.369	(25,45)	0.22	0.01		1
127	Size_95%width_REC(3)	1.399	(1,20)	0.35	0.25		2
128	Retain_L_infl_REC(3)	25.953	(25,40)	22.01	0.85		2
129	Retain_L_width_REC(3)	0.267	(0.01,20)	6.54	24.49		2
130	Retain_L_asymptote_logit_REC(3)	-0.842	(-1,10)	0.09	-0.11		2
131	Retain_L_maleoffset_REC(3)	0.000	(-10,10)				fixed
132	DiscMort_L_infl_REC(3)	-8.000	(-10,10)				fixed
133	DiscMort_L_width_REC(3)	1.000	(-1,2)				fixed
134	DiscMort_L_level_old_REC(3)	0.080	(-1,2)				fixed
135	DiscMort_L_male_offset_REC(3)	0.500	(-1,2)				fixed
136	SizeSpline_Code_FIMHS(5)	0.000	(0,2)				fixed
137	SizeSpline_GradLo_FIMHS(5)	0.583	(-0.001,1)	0.06	0.11		3
138	SizeSpline_GradHi_FIMHS(5)	0.194	(-1,1)	0.02	0.10		3
139	SizeSpline_Knot_1_FIMHS(5)	12.029	(10,80)				fixed
140	SizeSpline_Knot_2_FIMHS(5)	20.398	(10,80)				fixed
141	SizeSpline_Knot_3_FIMHS(5)	27.802	(10,80)				fixed
142	SizeSpline_Knot_4_FIMHS(5)	35.552	(10,80)				fixed
143	SizeSpline_Knot_5_FIMHS(5)	61.478	(10,80)				fixed
144	SizeSpline_Val_1_FIMHS(5)	-3.460	(-9,7)	0.20	-0.06		2
145	SizeSpline_Val_2_FIMHS(5)	-1.929	(-9,7)	0.06	-0.03		2
146	SizeSpline_Val_3_FIMHS(5)	-1.000	(-9,7)				fixed
147	SizeSpline_Val_4_FIMHS(5)	-0.115	(-9,7)	0.06	-0.50		2
148	SizeSpline_Val_5_FIMHS(5)	1.440	(-9,7)	0.13	0.09		2
149	Size_inflection_MRIP_CPUE(7)	38.402	(1,40)	0.21	0.01		1
150	Size_95%width_MRIP_CPUE(7)	5.542	(1,20)	0.21	0.04		2
151	minage@sel=1_BIOAGES(6)	0.000	(0,1)				fixed
152	maxage@sel=1_BIOAGES(6)	8.000	(7,9)				fixed

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	Parameter Label	Value	Range	SD	CV	Prior	Phase
153	Size_inflection_REC(3)_BLK1repl_1990	33.580	(1,50)	0.55	0.02		3
154	Size_95%width_REC(3)_BLK1repl_1990	8.133	(1,30)	0.56	0.07		3
155	Retain_L_infl_REC(3)_BLK1repl_1990	37.166	(18,54)	0.30	0.01		3
156	Retain_L_width_REC(3)_BLK1repl_1990	1.805	(0.01,20)	0.14	0.08		3

Table 14. Francis weights applied to length and conditional age-at-length data for Florida coast base models.

Florida Gulf		
Data Type	**Fleet/Index**	**Francis Weight**
Length Composition	Commercial Gillnet	0.465448
	Commercial Hook and Line	2.13025
	Recreational	2.50267
	FIM Haul Seine Index	10.2319
	MRIP CPUE	7.15509
Age Composition	Commercial Gillnet	0.178022
	Commercial Hook and Line	0.326198
	Recreational	0.544321
	FIM Haul Seine Index	0.442097

Florida Atlantic		
Data Type	**Fleet/Index**	**Francis Weight**
Length Composition	Commercial Gillnet	0.927371
	Commercial Hook and Line	0.977681
	Recreational	2.02342
	FIM Haul Seine Index	13.1857
	MRIP CPUE	1.97489
Age Composition	Commercial Gillnet	0.54412
	Commercial Hook and Line	0.600245
	Recreational	0.101338
	FIM Haul Seine Index	0.367858

Table 15. Annual estimates and standard deviation of instantaneous fishing mortality rates on ages 2-4 Spotted Seatrout combined across all fleets for the Florida coast base models.

Year	**Florida Gulf Coast**		**Florida Atlantic Coast**	
	Total F	SD	Total F	SD
1986	0.21	0.03	0.44	0.13
1987	0.19	0.03	0.36	0.10
1988	0.26	0.03	0.36	0.10
1989	0.35	0.04	0.25	0.05
1990	0.21	0.03	0.15	0.03
1991	0.24	0.03	0.18	0.03
1992	0.16	0.02	0.26	0.04
1993	0.16	0.02	0.20	0.03
1994	0.17	0.02	0.12	0.01
1995	0.18	0.02	0.19	0.03
1996	0.13	0.01	0.13	0.02
1997	0.18	0.02	0.17	0.03
1998	0.22	0.02	0.15	0.02
1999	0.29	0.02	0.18	0.02
2000	0.24	0.02	0.22	0.03
2001	0.16	0.01	0.15	0.02
2002	0.26	0.02	0.22	0.02
2003	0.22	0.02	0.17	0.02
2004	0.27	0.02	0.16	0.02
2005	0.30	0.02	0.20	0.02
2006	0.29	0.03	0.26	0.02
2007	0.25	0.02	0.27	0.03
2008	0.23	0.02	0.27	0.04
2009	0.21	0.02	0.16	0.02
2010	0.19	0.01	0.26	0.02
2011	0.29	0.02	0.19	0.02
2012	0.30	0.02	0.28	0.03
2013	0.24	0.02	0.23	0.03
2014	0.22	0.02	0.29	0.02
2015	0.25	0.02	0.20	0.03
2016	0.28	0.02	0.20	0.03
2017	0.27	0.02	0.25	0.03
2018	0.24	0.02	0.23	0.03
2019	0.22	0.02	0.18	0.02
2020	0.23	0.02	0.28	0.04
2021	0.26	0.03	0.27	0.02
2022	0.28	0.03	0.23	0.04
2023	0.28	0.03	0.14	0.02

Table 16. Predicted total biomass (metric tons), spawning stock biomass (SSB; metric tons), abundance (1000s of fish), age-0 recruits (1000s of fish), and depletion (SSB/SSB_0) for Florida Spotted Seatrout from the Florida coast base models. Virgin is the estimated unfished condition while Initial is the estimated initial conditions of the stock before the model start year.

Florida Gulf Coast

Year	Total Biomass (mt)	Total Biomass (1000 lbs)	SSB (mt)	SSB (1000 lbs)	Abundance (1000 num)	Age-0 Recruits (1000 num)	SSB/SSB_0
Virgin	16,048	35,379	8,414	18,550	61,765	61,911	1.00
Initial	10,098	22,263	4,243	9,354	47,364	61,911	0.50
1986	11,058	24,378	4,552	10,036	52,971	70,464	0.54
1987	11,649	25,681	5,139	11,329	55,829	65,223	0.61
1988	12,149	26,784	5,434	11,979	55,255	67,859	0.65
1989	12,534	27,633	5,353	11,801	54,882	78,188	0.64
1990	12,685	27,965	5,264	11,605	57,803	81,835	0.63
1991	13,616	30,017	5,847	12,891	63,482	82,002	0.69
1992	12,712	28,024	6,135	13,526	65,641	51,819	0.73
1993	12,444	27,434	5,967	13,154	54,971	57,689	0.71
1994	11,584	25,538	5,668	12,496	52,231	47,647	0.67
1995	11,494	25,340	5,228	11,527	46,479	62,602	0.62
1996	11,602	25,577	5,127	11,304	49,921	66,133	0.61
1997	11,567	25,501	5,490	12,104	53,970	53,710	0.65
1998	11,429	25,197	5,260	11,596	49,588	60,939	0.63
1999	10,750	23,699	5,039	11,108	50,044	51,364	0.60
2000	9,953	21,943	4,542	10,013	45,258	51,211	0.54
2001	10,101	22,269	4,318	9,520	43,488	61,885	0.51
2002	10,509	23,168	4,713	10,391	48,542	56,503	0.56
2003	10,510	23,170	4,619	10,184	47,329	60,590	0.55
2004	10,710	23,611	4,711	10,386	48,881	61,132	0.56
2005	10,296	22,698	4,670	10,295	49,247	52,752	0.55
2006	10,541	23,238	4,365	9,622	45,309	69,213	0.52
2007	10,252	22,602	4,545	10,019	50,838	53,538	0.54
2008	10,792	23,792	4,572	10,079	47,240	67,815	0.54
2009	11,109	24,490	4,838	10,666	51,936	63,412	0.58
2010	11,913	26,263	5,093	11,228	52,664	73,807	0.61
2011	12,193	26,880	5,505	12,136	57,741	64,536	0.65
2012	11,219	24,733	5,270	11,618	54,598	51,662	0.63
2013	9,730	21,452	4,700	10,362	47,186	39,364	0.56
2014	9,136	20,142	4,142	9,132	39,138	47,376	0.49

Florida Gulf Coast

Year	Total Biomass (mt)	Total Biomass (1000 lbs)	SSB (mt)	SSB (1000 lbs)	Abundance (1000 num)	Age-0 Recruits (1000 num)	SSB/SSB_0
2015	10,028	22,107	3,961	8,731	39,258	72,377	0.47
2016	10,173	22,427	4,459	9,829	50,158	55,282	0.53
2017	9,828	21,667	4,501	9,922	47,390	49,891	0.53
2018	9,334	20,577	4,225	9,315	43,402	48,469	0.50
2019	9,996	22,038	4,098	9,034	41,527	67,409	0.49
2020	9,629	21,227	4,516	9,956	49,283	42,229	0.54
2021	9,335	20,581	4,327	9,539	41,860	47,194	0.51
2022	9,924	21,878	3,948	8,703	39,725	71,420	0.47
2023	10,060	22,177	4,350	9,589	49,558	56,504	0.52

Table 16 continued. Predicted total biomass (metric tons), spawning stock biomass (SSB; metric tons), abundance (1000s of fish), age-0 recruits (1000s of fish), and depletion (SSB/SSB_0) for Florida Spotted Seatrout from the Florida coast base models. Virgin is the estimated unfished condition while Initial is the estimated initial conditions of the stock before the model start year.

Florida Atlantic Coast

Year	Total Biomass (mt)	Total Biomass (1000 lbs)	SSB (mt)	SSB (1000 lbs)	Abundance (1000 num)	Age-0 Recruits (1000 num)	SSB/SSB_0
Virgin	3,834	8,453	2,129	4,693	15,047	16,130	1.00
Initial	2,937	6,476	1,505	3,317	14,434	16,130	0.71
1986	2,094	4,616	1,021	2,252	10,223	13,038	0.48
1987	1,733	3,822	854	1,883	9,585	9,482	0.40
1988	1,639	3,614	743	1,638	7,980	12,249	0.35
1989	1,738	3,832	711	1,568	8,455	16,052	0.33
1990	2,040	4,498	848	1,871	10,587	18,181	0.40
1991	2,390	5,270	1,069	2,356	12,747	18,373	0.50
1992	2,426	5,348	1,219	2,687	13,744	12,293	0.57
1993	2,160	4,761	1,138	2,508	11,381	8,820	0.53
1994	2,252	4,965	1,012	2,231	9,018	18,414	0.48
1995	2,307	5,085	1,142	2,519	12,245	11,869	0.54
1996	2,309	5,091	1,126	2,483	10,815	14,386	0.53
1997	2,300	5,071	1,156	2,549	11,322	12,339	0.54
1998	2,337	5,152	1,121	2,471	10,593	15,706	0.53
1999	2,426	5,348	1,163	2,565	11,735	15,729	0.55
2000	2,608	5,750	1,184	2,611	12,162	20,351	0.56
2001	2,588	5,706	1,252	2,760	14,148	15,218	0.59
2002	2,783	6,134	1,323	2,917	13,224	19,245	0.62
2003	3,013	6,644	1,327	2,925	14,175	25,043	0.62
2004	3,489	7,691	1,523	3,359	17,293	29,154	0.72
2005	3,598	7,933	1,804	3,976	20,568	18,370	0.85
2006	3,536	7,796	1,771	3,905	17,336	20,234	0.83
2007	3,173	6,996	1,601	3,531	16,238	15,785	0.75
2008	3,170	6,989	1,422	3,136	13,924	24,941	0.67
2009	3,444	7,593	1,446	3,188	16,704	30,250	0.68
2010	3,625	7,991	1,760	3,881	20,727	20,173	0.83
2011	3,579	7,890	1,713	3,776	17,851	23,226	0.80
2012	3,343	7,370	1,742	3,841	18,127	13,749	0.82
2013	2,818	6,212	1,494	3,293	13,899	10,957	0.70
2014	2,841	6,264	1,251	2,758	10,954	23,986	0.59

Florida Atlantic Coast

Year	Total Biomass (mt)	Total Biomass (1000 lbs)	SSB (mt)	SSB (1000 lbs)	Abundance (1000 num)	Age-0 Recruits (1000 num)	SSB/SSB_0
2015	2,668	5,882	1,252	2,760	14,878	15,602	0.59
2016	2,696	5,944	1,310	2,889	13,577	16,160	0.62
2017	2,670	5,886	1,271	2,803	13,039	17,266	0.60
2018	2,435	5,368	1,237	2,726	13,163	11,201	0.58
2019	2,269	5,003	1,134	2,500	10,769	12,377	0.53
2020	2,079	4,584	1,078	2,378	10,299	8,998	0.51
2021	1,861	4,103	904	1,993	8,381	11,228	0.42
2022	1,873	4,129	810	1,786	8,425	15,665	0.38
2023	2,018	4,448	892	1,966	10,467	15,463	0.42

Table 17. Geweke's diagnostic used to determine convergence of MCMC chains of selected parameters and derived quantities for the Florida coast base models.

Florida Gulf Chain 1

Parameter/Derived Quantity	Z-Score	p-value
Recr_Virgin	0.5076	0.6117
SSB_Virgin	0.2768	0.7819
SR_BH_steep	-0.4245	0.6712
SR_sigmaR	-0.4667	0.6407
F_2021	1.5730	0.1157
F_2022	0.9453	0.3445
F_2023	1.0417	0.2976
annF_MSY	0.0093	0.9926
SSB_MSY	-0.7121	0.4764
Ret_Catch_MSY	-0.6400	0.5222
SSB_2021	-1.0458	0.2956
SSB_2022	-1.8509	0.0642
SSB_2023	-1.9224	0.0546
SPRratio_2023	0.8062	0.4201
F_current	1.6533	0.0983
SSB_current	-1.7423	0.0815

Florida Gulf Chain 2

Parameter/Derived Quantity	Z-Score	p-value
Recr_Virgin	-0.2708	0.7865
SSB_Virgin	-0.5379	0.5906
SR_BH_steep	-0.3227	0.7469
SR_sigmaR	-0.0590	0.9529
F_2021	0.5685	0.5697
F_2022	0.2025	0.8395
F_2023	-1.9585	0.0502
annF_MSY	0.4385	0.6610
SSB_MSY	-0.1246	0.9009
Ret_Catch_MSY	-0.2693	0.7877
SSB_2021	1.6894	0.0911
SSB_2022	1.6693	0.0951
SSB_2023	1.4138	0.1574
SPRratio_2023	-1.6435	0.1003
F_current	-0.4908	0.6236
SSB_current	1.6943	0.0902
Recr_Virgin	-0.2708	0.7865
SSB_Virgin	-0.5379	0.5906

Table 17 continued. Geweke's diagnostic used to determine convergence of MCMC chains of selected parameters and derived quantities for the Florida coast base models.

Florida Atlantic Chain 1

Parameter/Derived Quantity	Z-Score	p-value
Recr_Virgin	-0.1567	0.8755
SSB_Virgin	0.0975	0.9223
SR_BH_steep	-0.9445	0.3449
SR_sigmaR	-0.5731	0.5666
F_2021	-0.5092	0.6106
F_2022	-0.4542	0.6497
F_2023	0.1943	0.8459
annF_MSY	0.7409	0.4588
SSB_MSY	-0.7618	0.4462
Ret_Catch_MSY	-1.8872	0.0591
SSB_2021	0.9397	0.3474
SSB_2022	0.7719	0.4402
SSB_2023	0.4788	0.6321
SPRratio_2023	-0.5726	0.5669
F_current	-0.2419	0.8089
SSB_current	0.7523	0.4519

Florida Atlantic Chain 2

Parameter/Derived Quantity	Z-Score	p-value
Recr_Virgin	1.1800	0.2380
SSB_Virgin	0.0613	0.9511
SR_BH_steep	-0.0948	0.9245
SR_sigmaR	0.2040	0.8384
F_2021	-2.5609	0.0104
F_2022	-0.6775	0.4981
F_2023	-1.6868	0.0916
annF_MSY	-1.0593	0.2895
SSB_MSY	-0.0193	0.9846
Ret_Catch_MSY	0.3732	0.7090
SSB_2021	0.3619	0.7174
SSB_2022	1.3555	0.1753
SSB_2023	1.0320	0.3021
SPRratio_2023	-1.1168	0.2641
F_current	-2.1267	0.0334
SSB_current	1.0004	0.3171
Recr_Virgin	1.1800	0.2380
SSB_Virgin	0.0613	0.9511

Table 18. Summary of correlated parameters with correlation coefficients exceeding 0.7 for the Florida coast base models.

Florida Gulf

Parameter1	Parameter 2	Correlation
Size_DblN_ascend_se_COMMGN(1)	Size_DblN_peak_COMMGN(1)	0.95
SR_BH_steep	SR_LN(R_0)	-0.89
CV_young_Mal_GP_1	L_at_Amin_Mal_GP_1	-0.81
SizeSpline_Val_1_FIMHS(5)	L_at_Amin_Mal_GP_1	0.80
L_at_Amin_Mal_GP_1	CV_young_Fem_GP_1	-0.79
SizeSpline_Val_1_FIMHS(5)	CV_young_Mal_GP_1	-0.79
SizeSpline_Val_1_FIMHS(5)	SizeSpline_GradLo_FIMHS(5)	-0.78
SizeSpline_Val_1_FIMHS(5)	CV_young_Fem_GP_1	-0.77
L_at_Amin_Mal_GP_1	L_at_Amin_Fem_GP_1	0.77
Size_95%width_COMMHL(2)	Size_inflection_COMMHL(2)	0.75
CV_young_Mal_GP_1	CV_young_Fem_GP_1	0.75
Size_95%width_REC(3)	Size_inflection_REC(3)	0.74
CV_young_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.71
CV_old_Fem_GP_1	L_at_Amin_Fem_GP_1	0.70

Florida Atlantic

Parameter1	Parameter 2	Correlation
Size_DblN_ascend_se_COMMGN(1)	Size_DblN_peak_COMMGN(1)	0.95
Size_DblN_descend_se_COMMGN(1)	Size_DblN_top_logit_COMMGN(1)	-0.92
L_at_Amin_Mal_GP_1	L_at_Amin_Fem_GP_1	0.87
CV_young_Mal_GP_1	L_at_Amin_Mal_GP_1	-0.83
L_at_Amin_Mal_GP_1	CV_young_Fem_GP_1	-0.81
CV_young_Fem_GP_1	L_at_Amin_Fem_GP_1	-0.79
SizeSpline_Val_1_FIMHS(5)	L_at_Amin_Mal_GP_1	0.78
SizeSpline_Val_1_FIMHS(5)	L_at_Amin_Fem_GP_1	0.77
Retain_L_width_REC(3)	Retain_L_infl_REC(3)	-0.73
CV_young_Mal_GP_1	CV_young_Fem_GP_1	0.73
Size_95%width_COMMHL(2)	Size_inflection_COMMHL(2)	0.71
SizeSpline_Val_1_FIMHS(5)	CV_young_Fem_GP_1	-0.71

Table 19. Retrospective analysis and retrospective forecast spawning stock biomass (SSB) and age 2-4 fishing mortality (F) for the last seven terminal years and combined (shaded rows) for Florida coast base models. The rule of thumb of the acceptable range of Mohn's Rho values is -0.22 to 0.30 for shorter-lived species (Hurtado-Ferro et al. 2015).

Florida Gulf Model

Type	Peel	Mohn's Rho	Forecast Mohn's Rho
SSB	2022	0.02	-0.03
SSB	2021	0.07	0.07
SSB	2020	0.05	0.05
SSB	2019	-0.04	-0.04
SSB	2018	0.13	0.07
SSB	2017	0.03	0.08
SSB	2016	-0.01	0.00
SSB	Combined	0.04	0.03
F	2022	-0.04	-0.14
F	2021	-0.11	-0.13
F	2020	-0.07	-0.13
F	2019	0.03	-0.23
F	2018	-0.18	-0.18
F	2017	-0.06	-0.03
F	2016	-0.02	-0.13
F	Combined	-0.06	-0.14

Florida Atlantic Model

Type	Peel	Mohn's Rho	Forecast Mohn's Rho
SSB	2022	0.12	0.19
SSB	2021	0.02	0.01
SSB	2020	0.04	0.03
SSB	2019	0.09	0.04
SSB	2018	0.07	0.02
SSB	2017	0.07	0.04
SSB	2016	0.18	0.17
SSB	Combined	0.09	0.07
F	2022	-0.19	-0.54
F	2021	0.01	-0.46
F	2020	-0.10	-0.25
F	2019	-0.07	-0.33
F	2018	0.02	-0.13
F	2017	-0.05	-0.02
F	2016	-0.17	-0.19
F	Combined	-0.08	-0.28

Table 20. Calculated static and transitional spawning potential ratios for the Florida coast base models. Current = geometric mean of the last 3 years.

	Florida Gulf		Florida Atlantic	
Year	sSPR	tSPR	sSPR	tSPR
1986	0.63	0.69	0.47	0.84
1987	0.65	0.65	0.49	0.60
1988	0.60	0.65	0.50	0.53
1989	0.55	0.62	0.58	0.51
1990	0.63	0.58	0.65	0.54
1991	0.61	0.60	0.62	0.59
1992	0.68	0.60	0.56	0.61
1993	0.68	0.64	0.61	0.58
1994	0.69	0.66	0.72	0.60
1995	0.67	0.68	0.65	0.65
1996	0.72	0.68	0.68	0.65
1997	0.66	0.70	0.65	0.67
1998	0.63	0.68	0.68	0.66
1999	0.59	0.65	0.64	0.67
2000	0.61	0.62	0.59	0.65
2001	0.69	0.61	0.67	0.62
2002	0.61	0.65	0.60	0.64
2003	0.63	0.63	0.65	0.62
2004	0.59	0.63	0.66	0.63
2005	0.57	0.61	0.61	0.64
2006	0.58	0.59	0.56	0.63
2007	0.61	0.58	0.57	0.59
2008	0.62	0.60	0.57	0.58
2009	0.64	0.61	0.66	0.57
2010	0.65	0.63	0.56	0.61
2011	0.59	0.64	0.62	0.58
2012	0.57	0.61	0.56	0.60
2013	0.61	0.59	0.59	0.58
2014	0.64	0.60	0.56	0.59
2015	0.63	0.62	0.63	0.57
2016	0.59	0.62	0.59	0.60
2017	0.58	0.61	0.58	0.60
2018	0.61	0.59	0.59	0.59
2019	0.64	0.60	0.64	0.59
2020	0.63	0.62	0.57	0.61
2021	0.59	0.63	0.56	0.59
2022	0.60	0.61	0.60	0.57
2023	0.59	0.60	0.68	0.59
Current	**0.60**	**0.61**	**0.61**	**0.58**

Table 21. Derived reference points from Florida coast models. SSB is mature female biomass, sSPR is static spawning potential ratio; tSPR is transitional spawning potential ratio; $SSB_{SPR35\%}$ is the value of spawning stock biomass that represents 35% SPR; $F_{SPR35\%}$ is the value of F that produces 35% *SPR*; *current* = geometric mean of last 3 years (2021-2023).

SPOTTED SEATROUT STOCK STATUS DETERMINATION TABLE		
Reference Point	Florida Gulf Base Model	Florida Atlantic Base Model
SSB unfished (mt)	8,413.95	2,128.56
Total B unfished (mt)	16,047.80	3,834.18
$SSB_{SPR35\%}$ (mt)	2,735.23	672.36
$F_{SPR35\%}$ (y^{-1})	0.81	0.64
Dead Catch at $SPR_{35\%}$ (mt)	5,459.50	1,262.45
Retained Yield at $SPR_{35\%}$ (mt)	3,929.64	919.03
$SSB_{current}$ (mt)	4,203.90	867.65
$F_{current}$ (ages 2-4, y^{-1})	0.27	0.20
$SSB_{current}/SSB_{SPR35\%}$	1.54	1.29
$F_{current}/F_{SPR35\%}$	0.33	0.31
$sSPR_{current}$	0.60	0.61
$tSPR_{current}$	0.61	0.58

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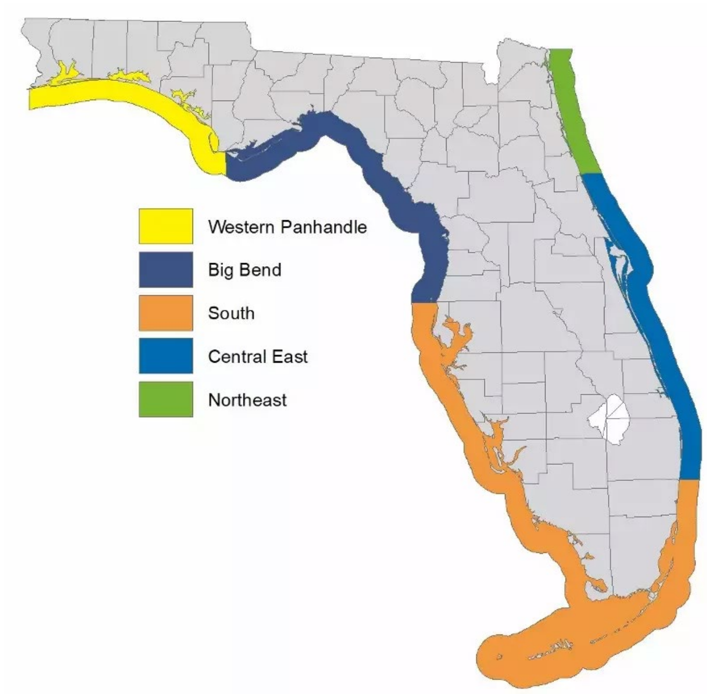
43	Calculated static and transitional spawning potential ratios for the Florida coast base models.

(a)



(b)

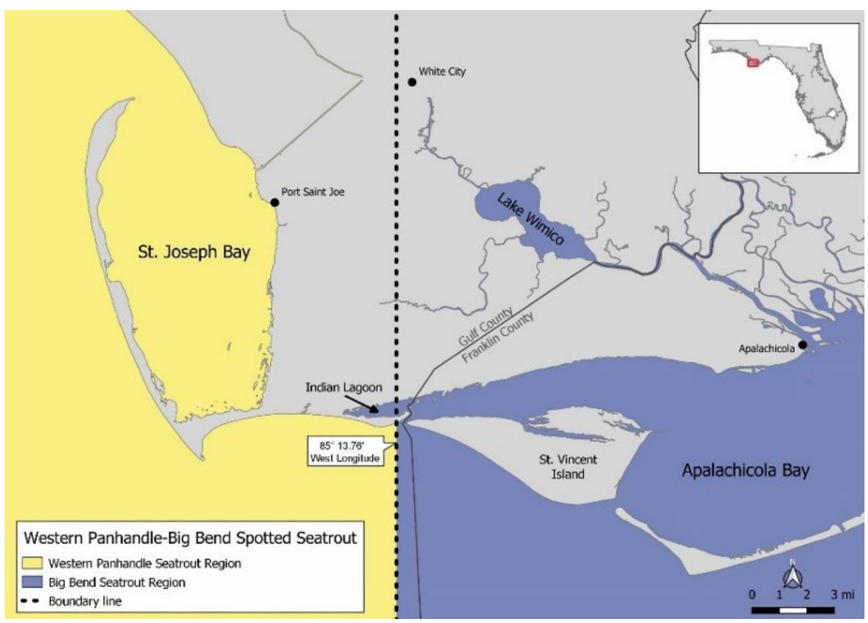
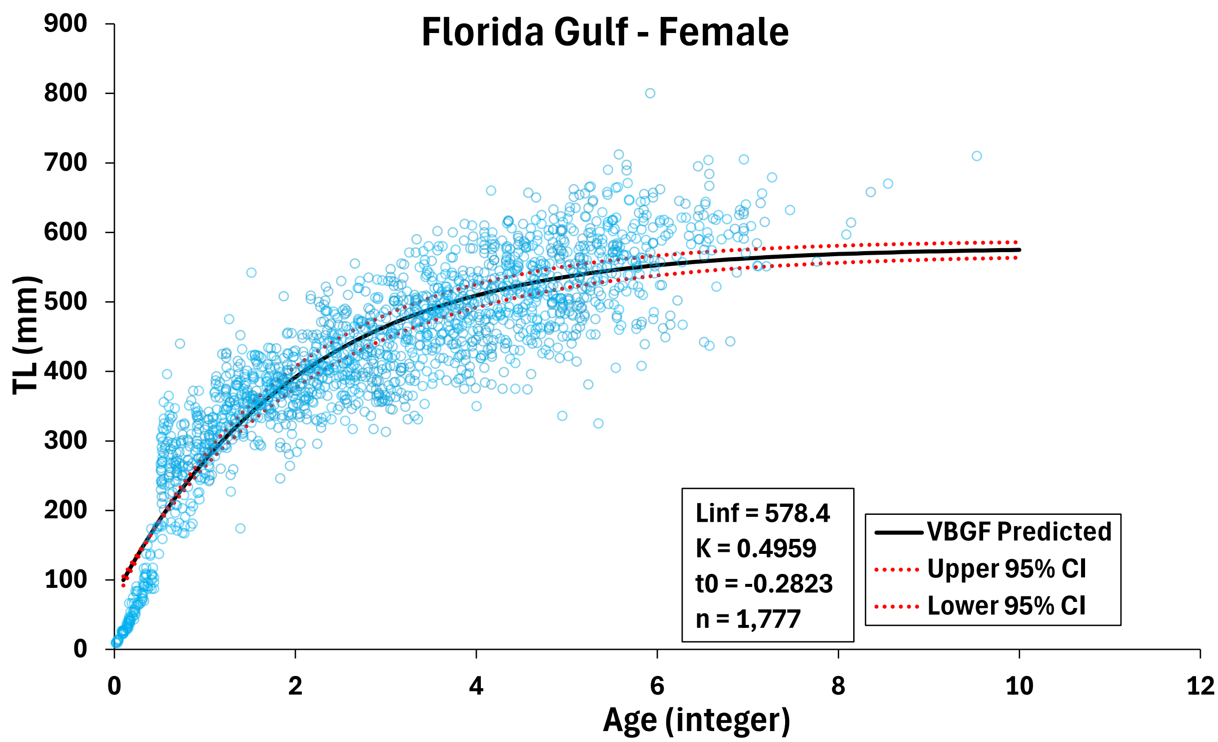


Figure 1. Current Florida Spotted Seatrout management regions as established in 2020 (a), with location details of the boundary line between the Western Panhandle and Big Bend management regions (b).



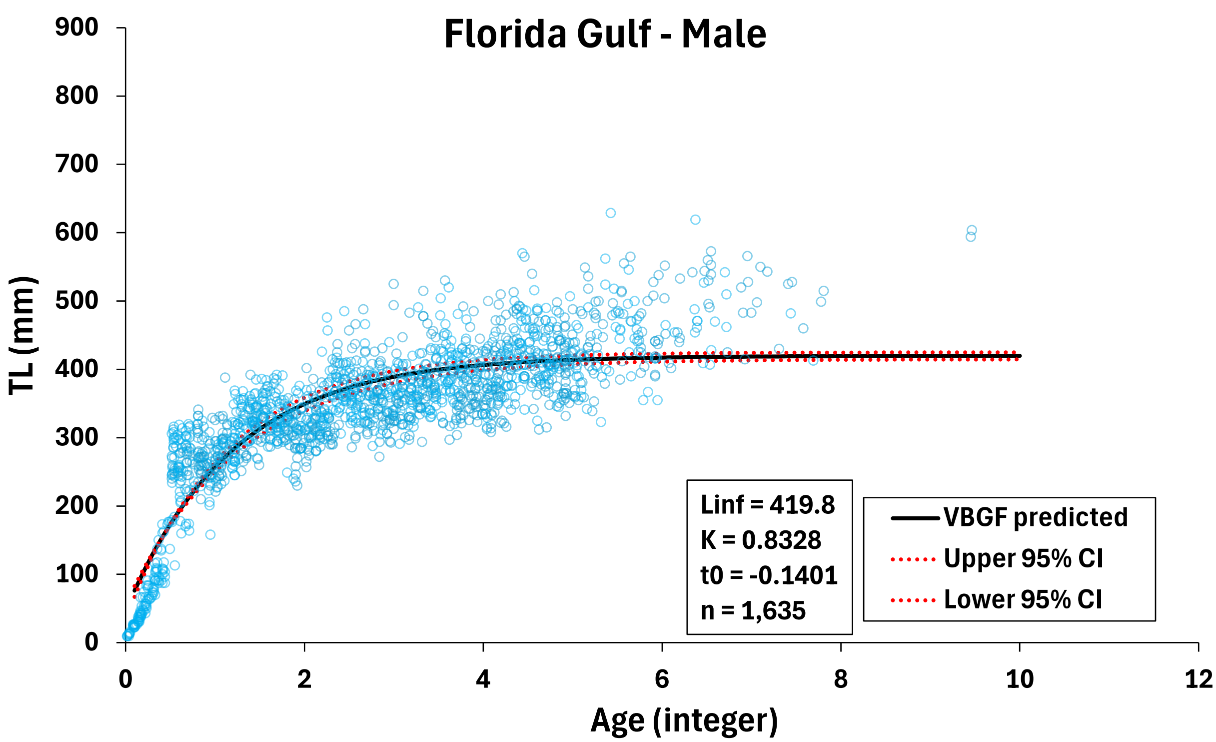
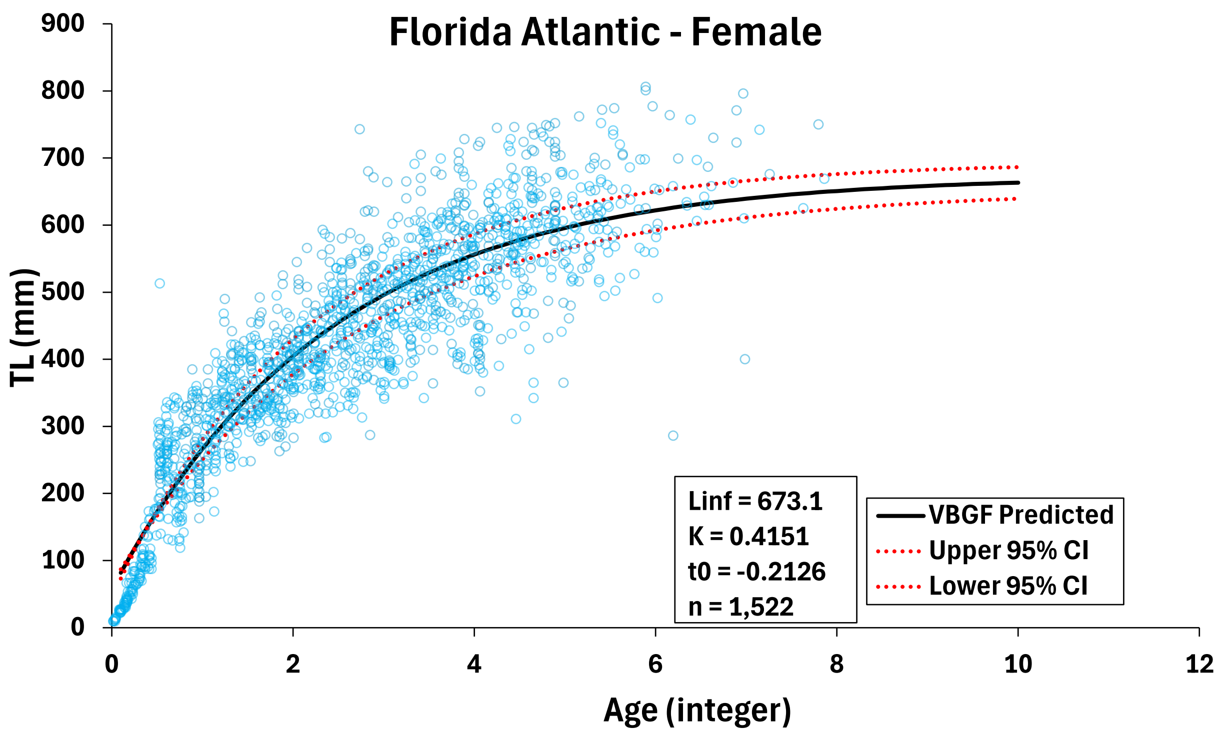


Figure 2. Florida coast and sex specific von Bertalanffy growth models.



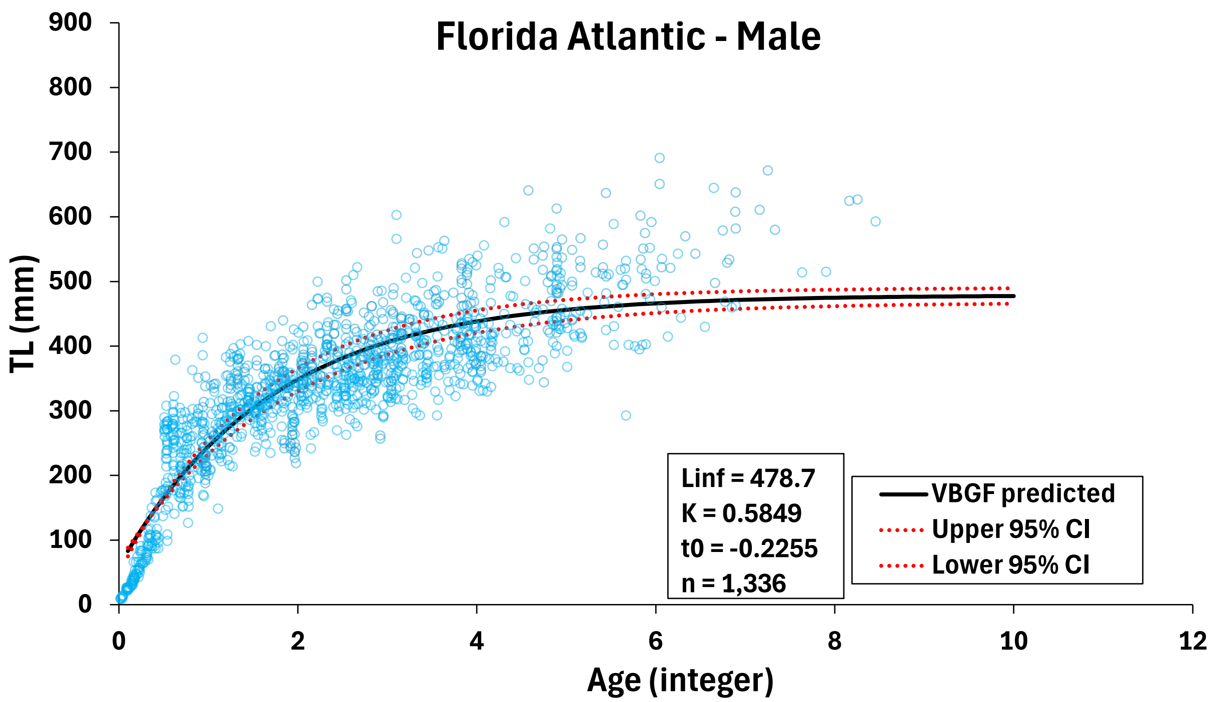
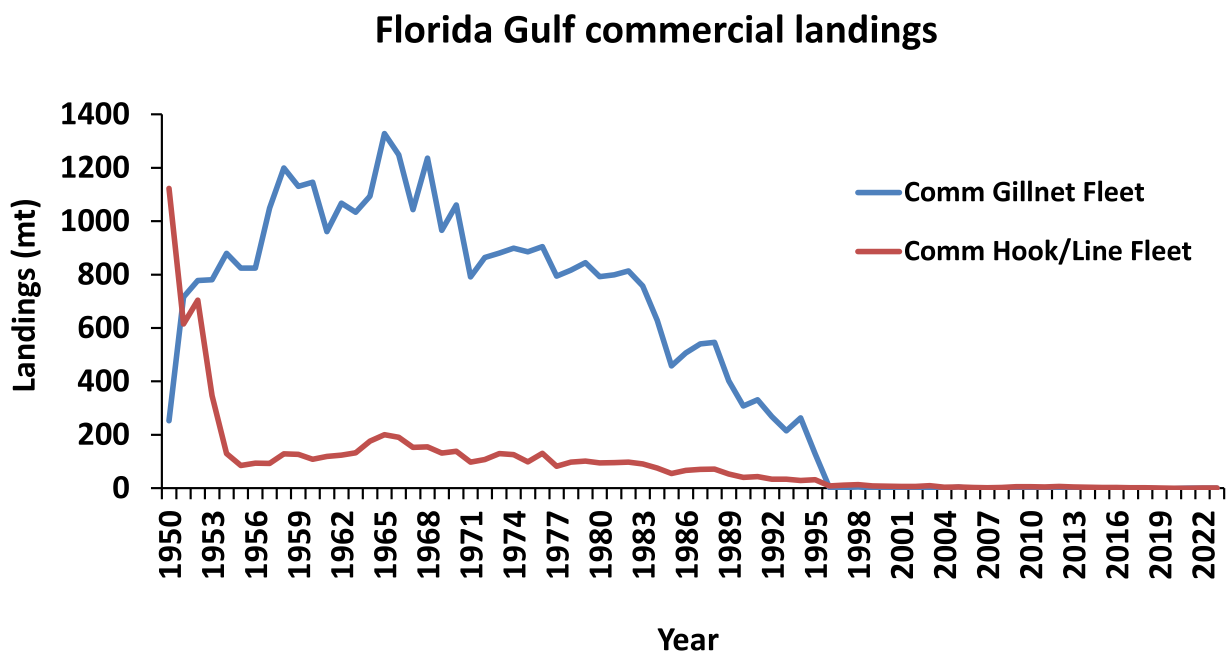


Figure 2 continued. Florida coast and sex specific von Bertalanffy growth models.



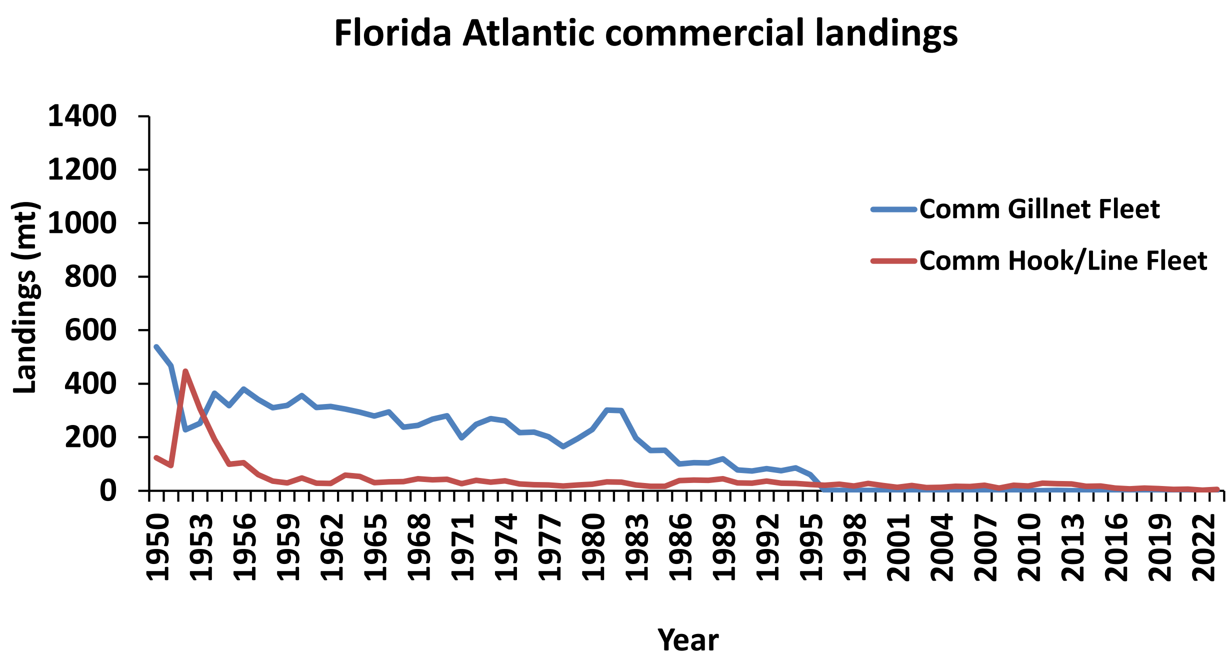


Figure 3. Commercial gillnet fleet and hook and line fleet landings (metric tons) of Spotted Seatrout by Florida coast. Gillnet fleet landings also include landings from other gears which include cast nets, seines, trammel nets, trawls, and traps. Hook and line fleet landings also includes landings from longline gear.

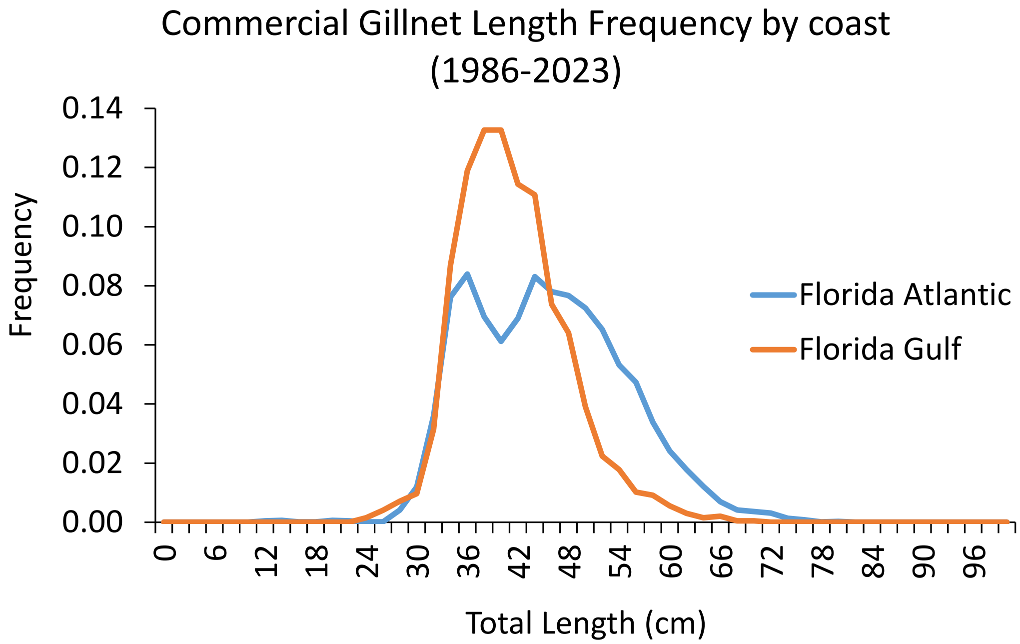


Figure 4. Estimated length frequencies (TL cm) of Spotted Seatrout caught in the commercial gillnet fishery and landed during 1986-2023 by Florida coast

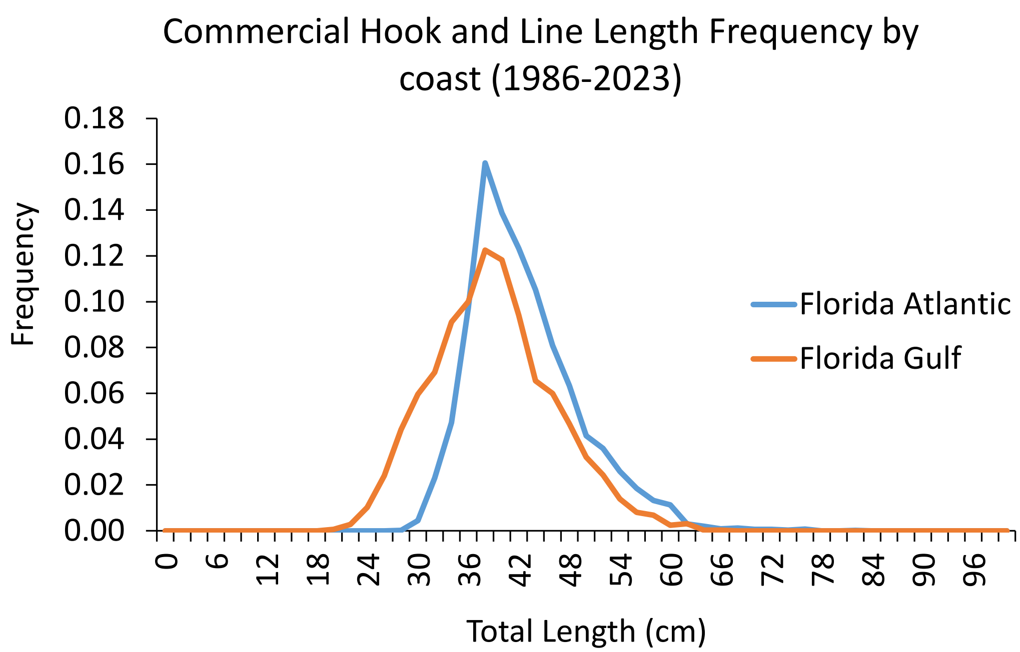


Figure 5. Estimated length frequencies (TL cm) of Spotted Seatrout caught in the commercial hook and line fishery and landed during 1986-2023 by Florida coast

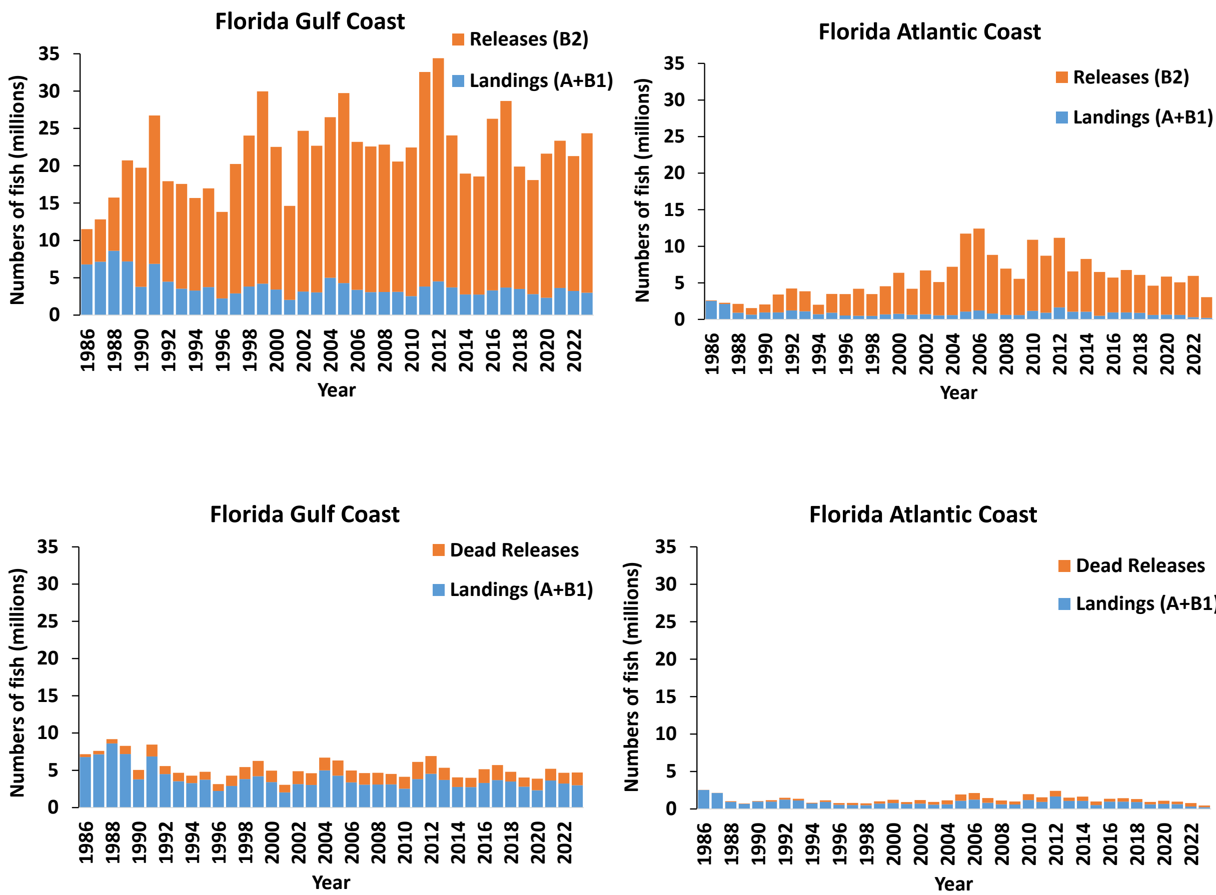


Figure 6. Total recreational catch (live releases plus fish kept, top panels), and total recreational harvest of Spotted Seatrout (fish landed and kept plus fish that died after being released alive, bottom panels) by Florida coast during 1986–2023.

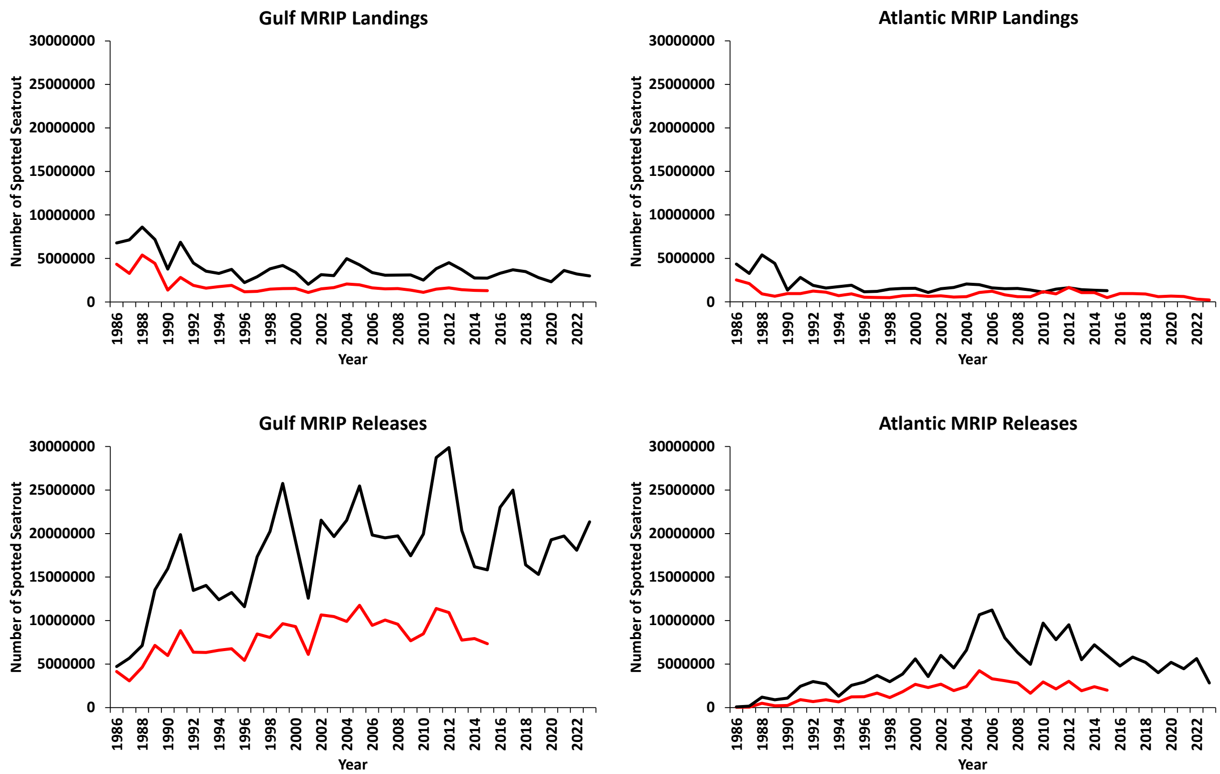
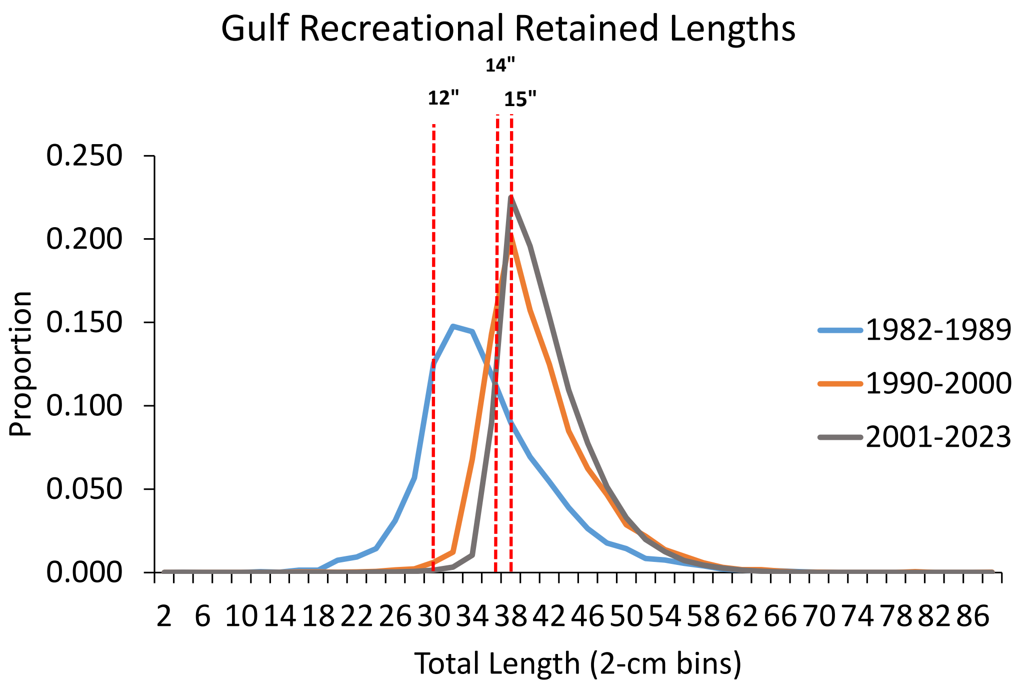


Figure 7. Comparison of MRIP landings (top panels) and live releases (bottom panels) of Spotted Seatrout used in the 2016 stock assessment (solid red line) and MRIP catch statistics used for this stock assessment (solid black line).



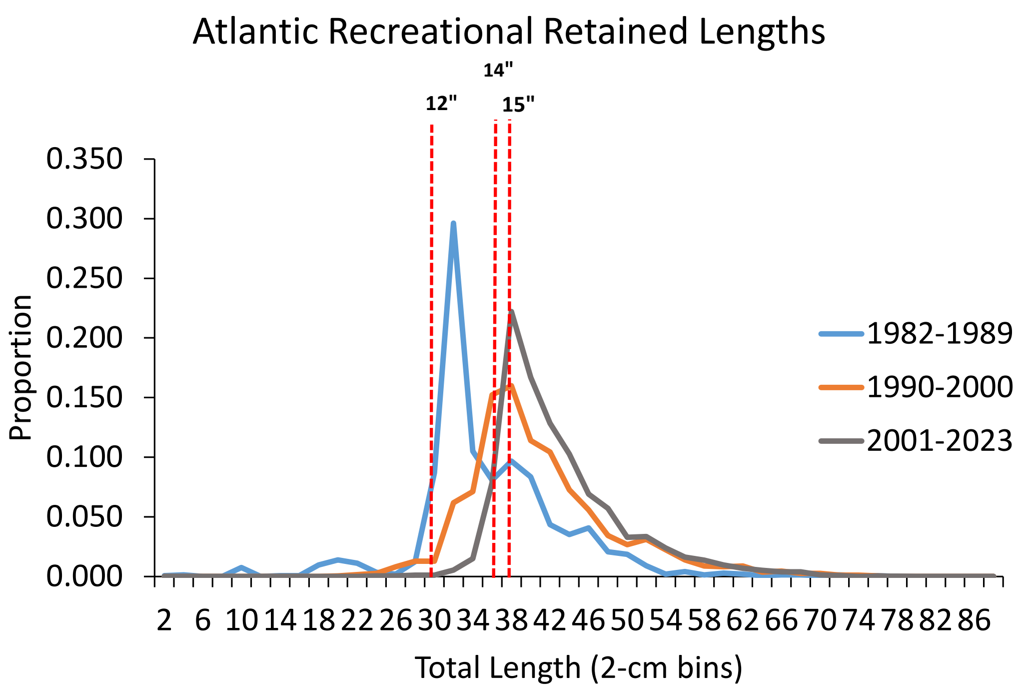
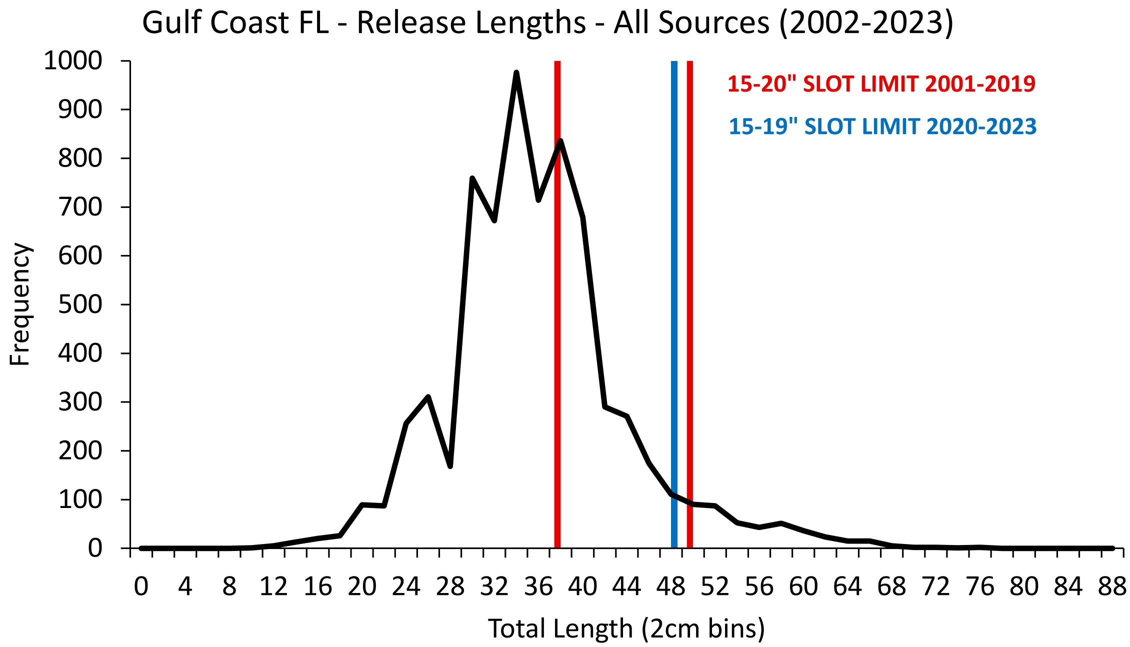


Figure 8. Length frequencies (cm TL) of Spotted Seatrout landings (A+B1) by recreational anglers during 1982-1989 (12” inch TL minimum size limit), 1990-2000 (14” inch TL minimum size limit), 2001-2023 (15” inch TL minimum size limit) by Florida coast.



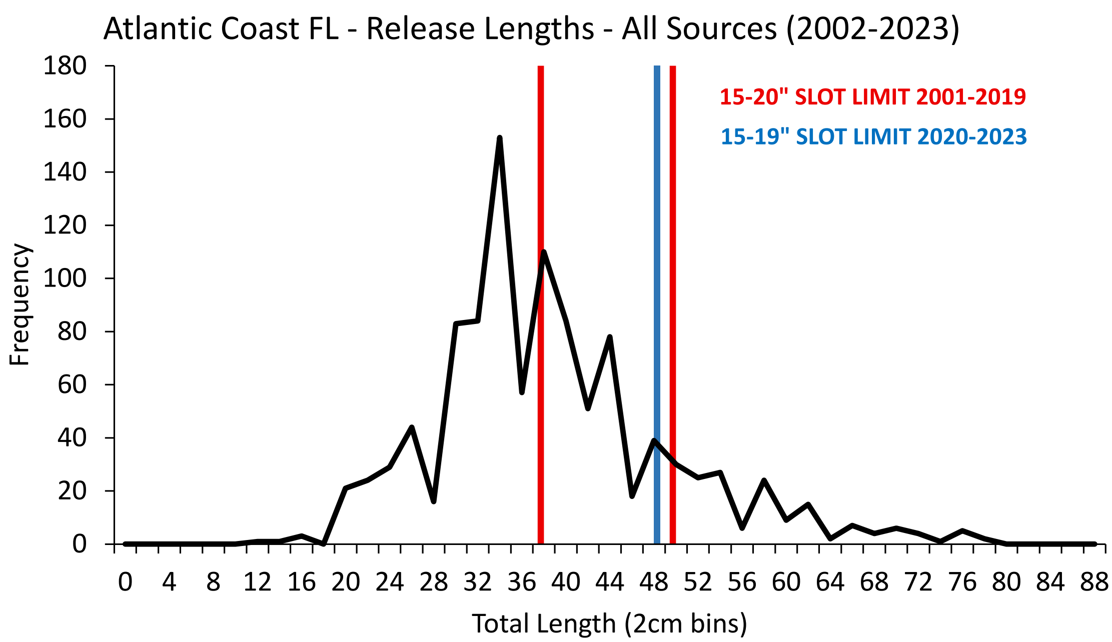
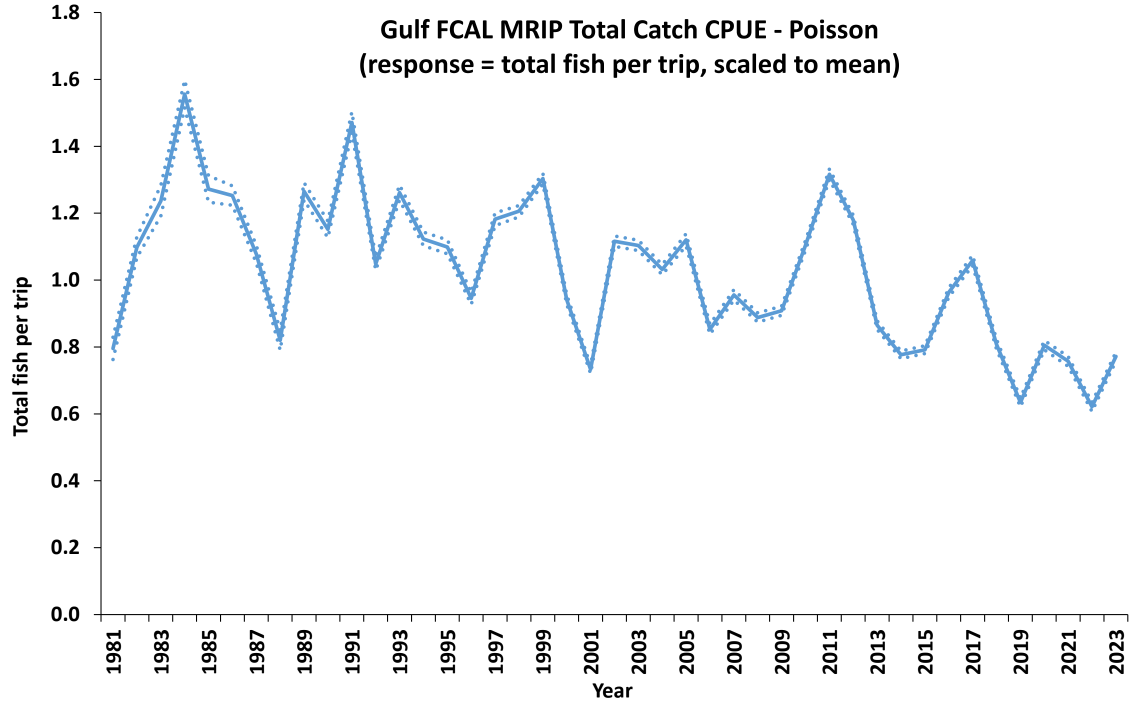


Figure 9. Length frequencies (cm TL) of Spotted Seatrout releases (B2) by recreational anglers during 2002-2023 by Florida coast. Release lengths were obtained from volunteer angler logbooks (2002-2009); logbook cards (2011-2023); and the Snook and Gamefish Foundation's Angler Action data set (2011-2019). Note: Anglers may possess one Spotted Seatrout over the slot limit per vessel or, if fishing from shore, one over the slot limit per person, included in the bag limit.



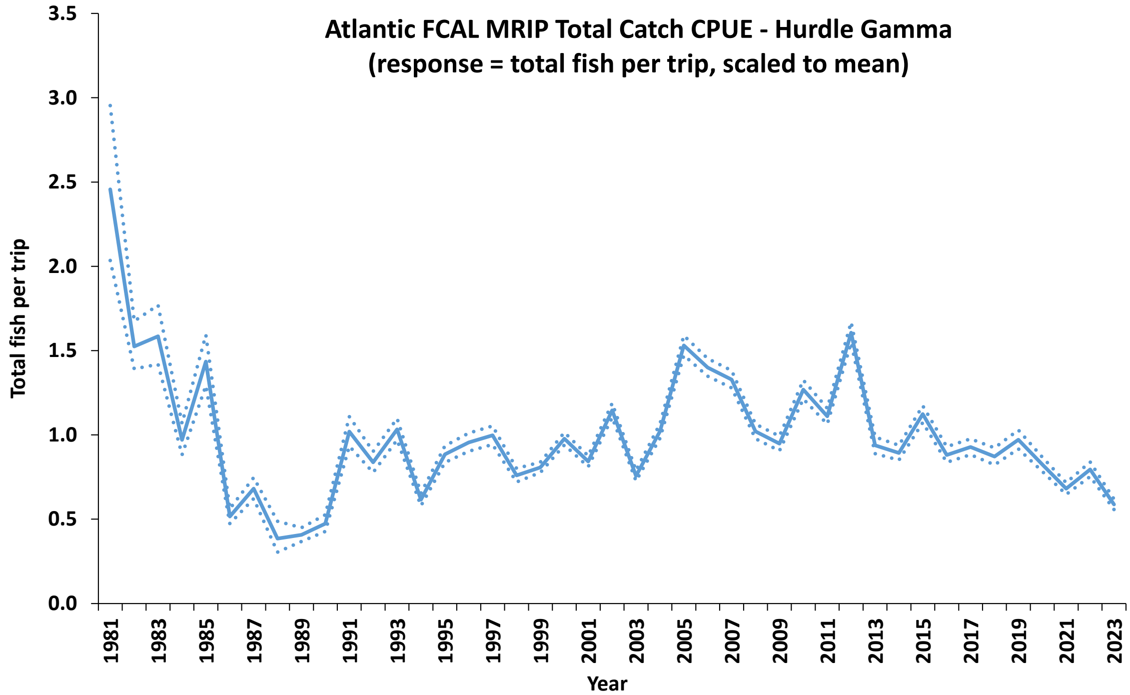
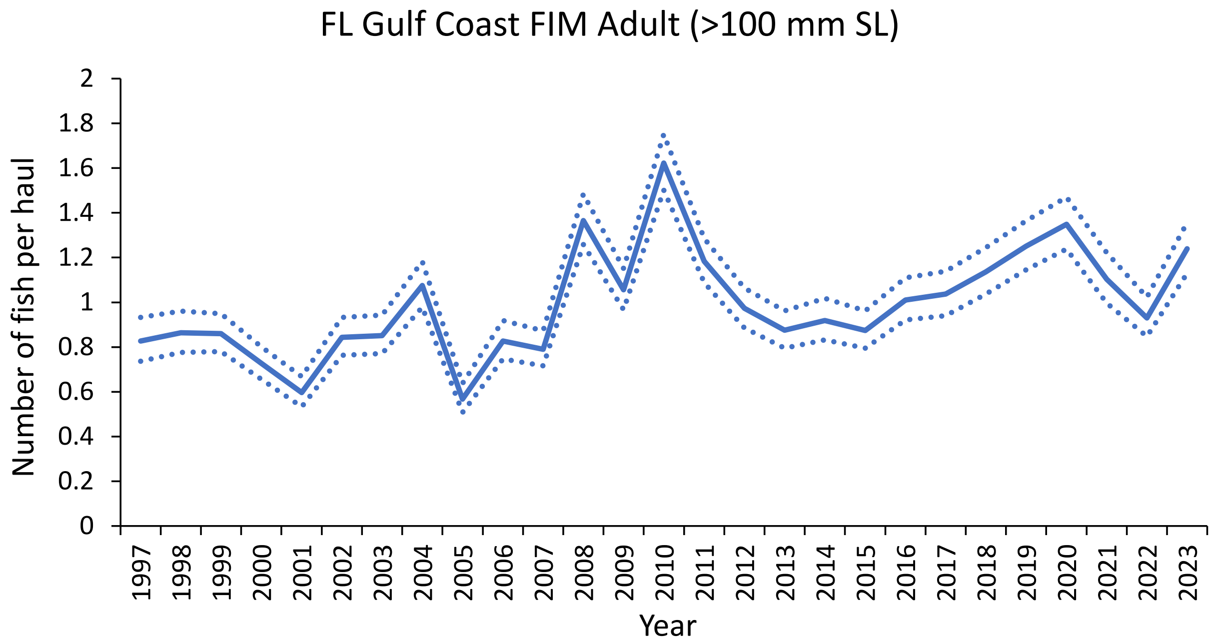


Figure 10. MRIP standardized total catch rate of Spotted Seatrout by Florida coast during 1981-2023. The solid blue line represents the median, the dashed lines represent the 25th-75th percentiles. Annual index values are scaled to the mean.



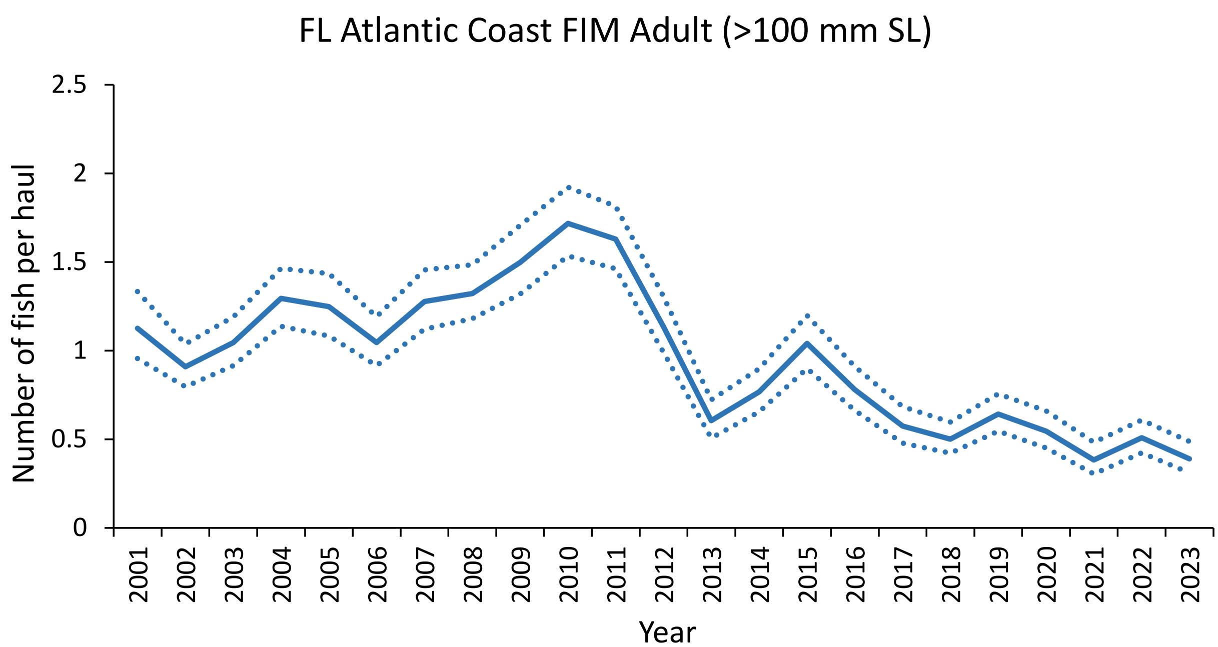
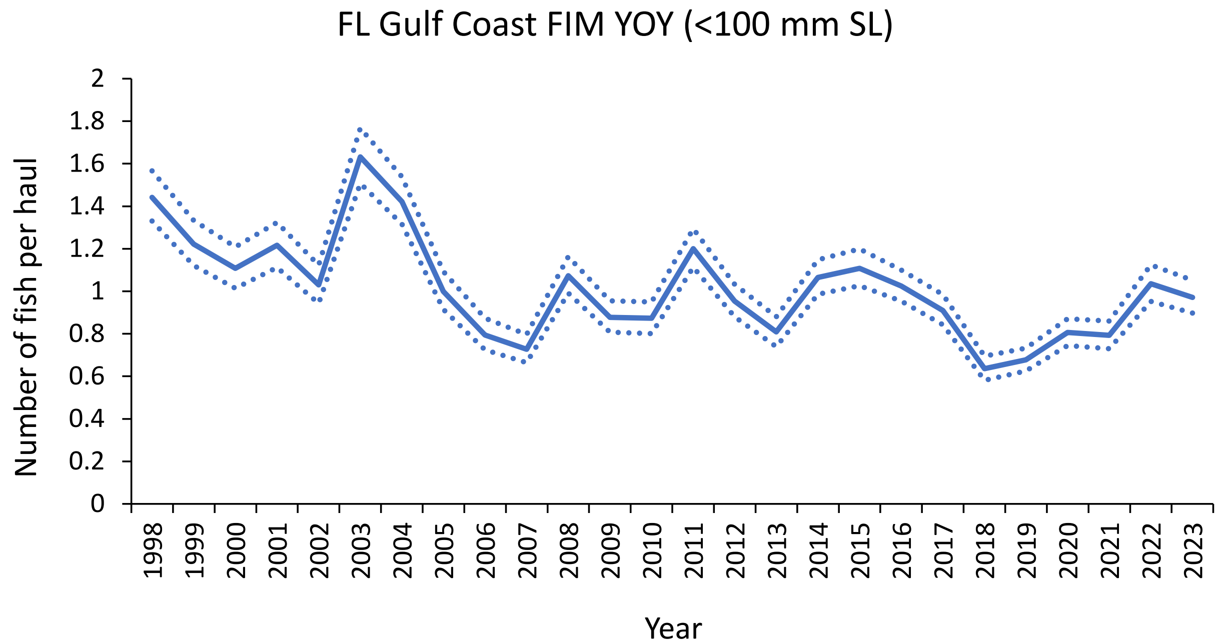


Figure 11. The standardized adult index of abundance for the FIM 183-m haul seine number of Spotted Seatrout per haul, by Florida coast



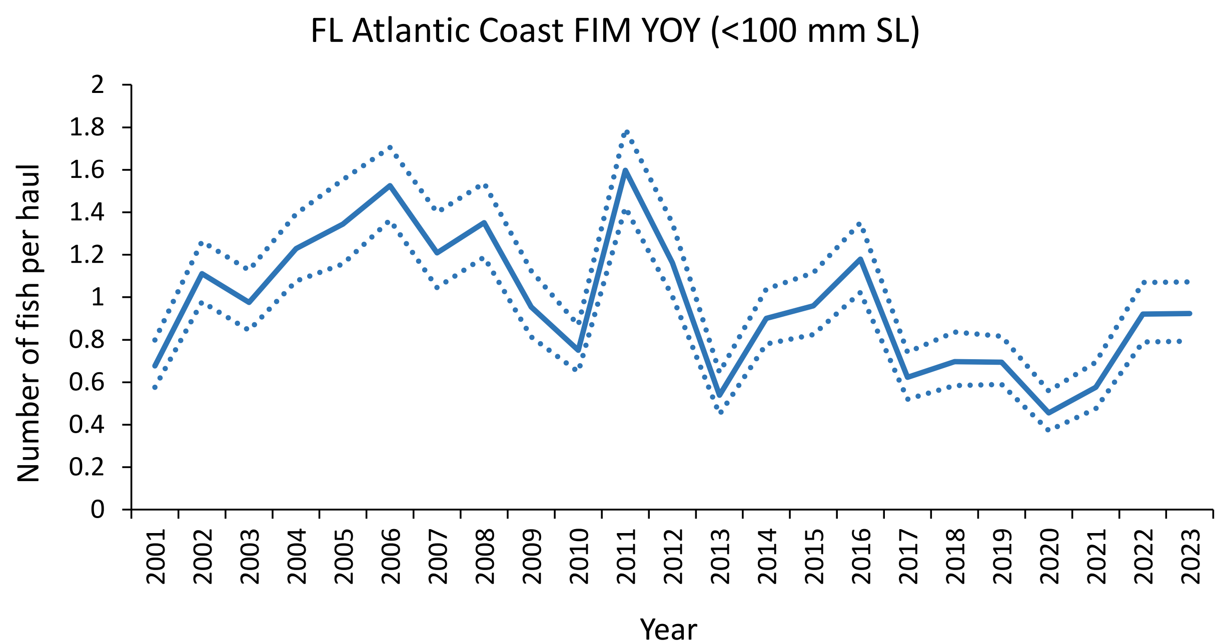


Figure 12. The standardized young-of-the-year index of abundance for the FIM 21.3-m center bag seine number of Spotted Seatrout per haul, by Florida coast.

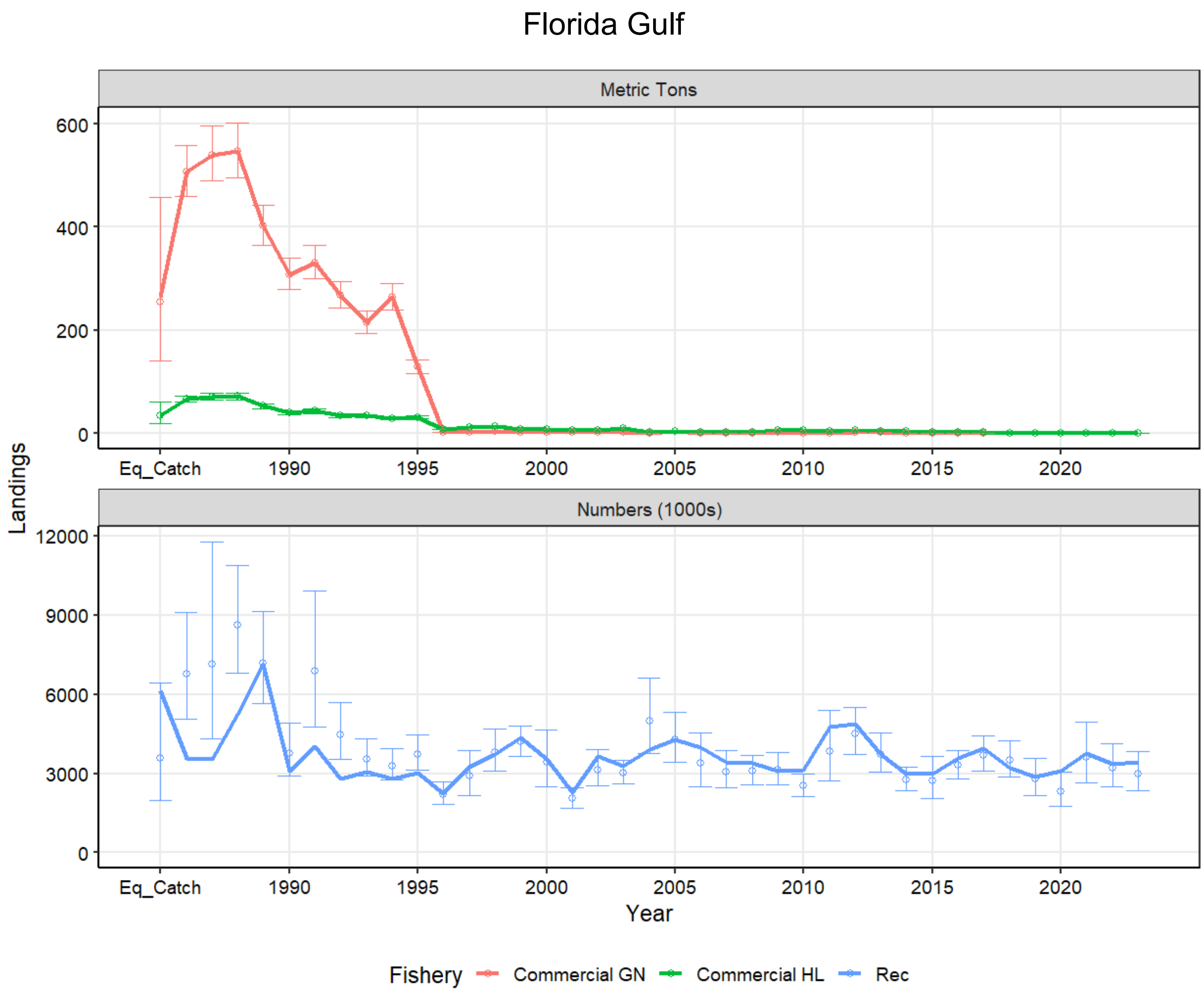


Figure 13. Observed (open circles and error bars) and predicted (solid lines) landings for the commercial fleets (in metric tons) and the recreational fleets (in 1000s) for the Florida coast base models. Input and predicted equilibrium catch values are shown in the first year.

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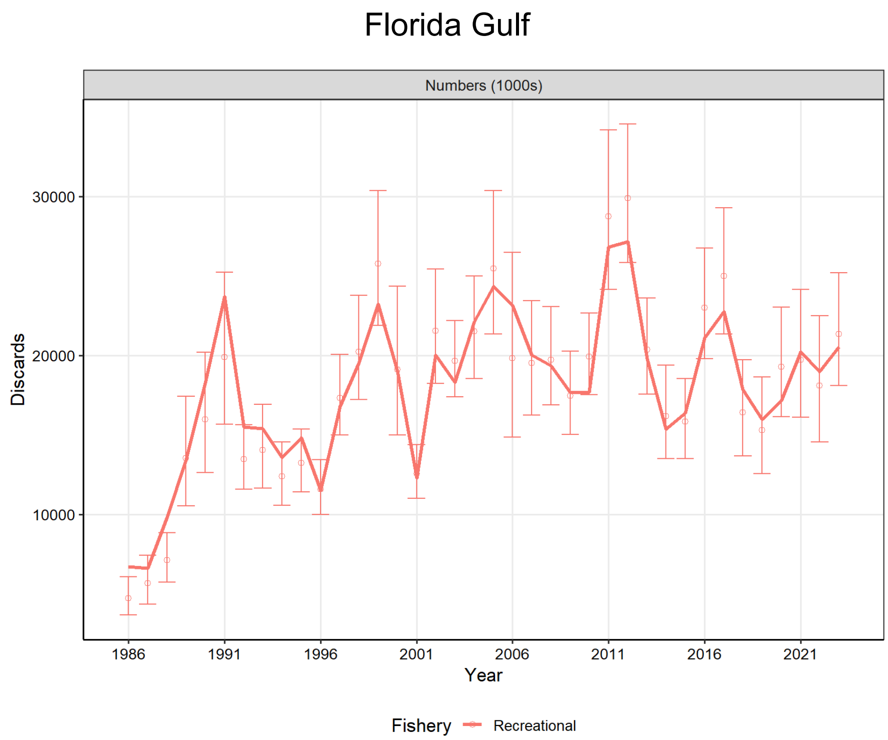
Figure 13 continued. Observed (open circles and error bars) and predicted (solid lines) landings for the commercial fleets (in metric tons) and the recreational fleets (in 1000s) for the Florida coast base models. Input and predicted equilibrium catch values are shown in the first year.



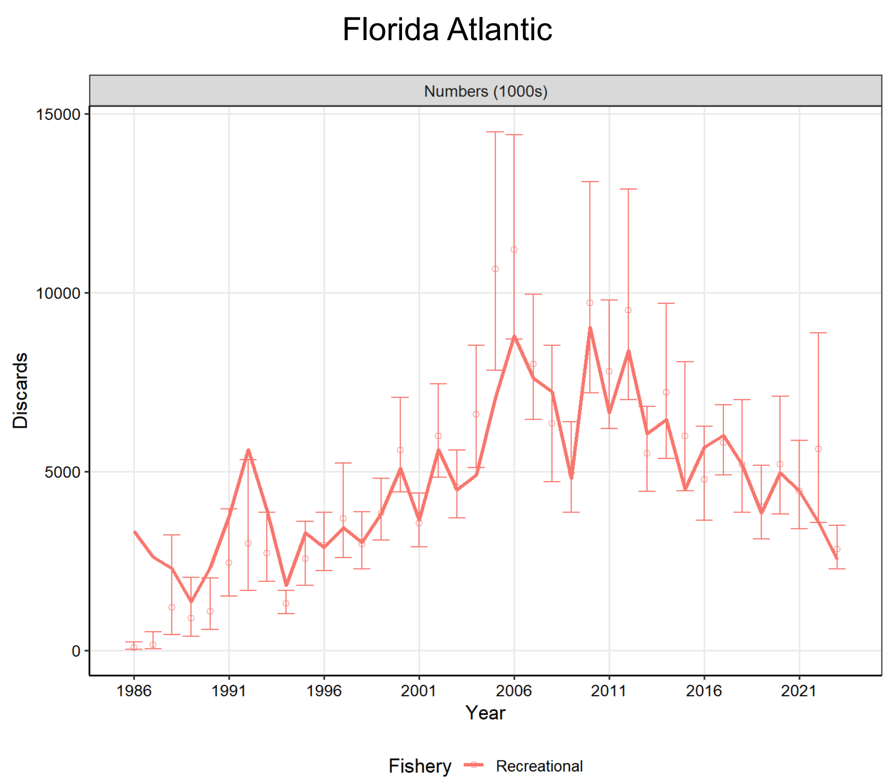
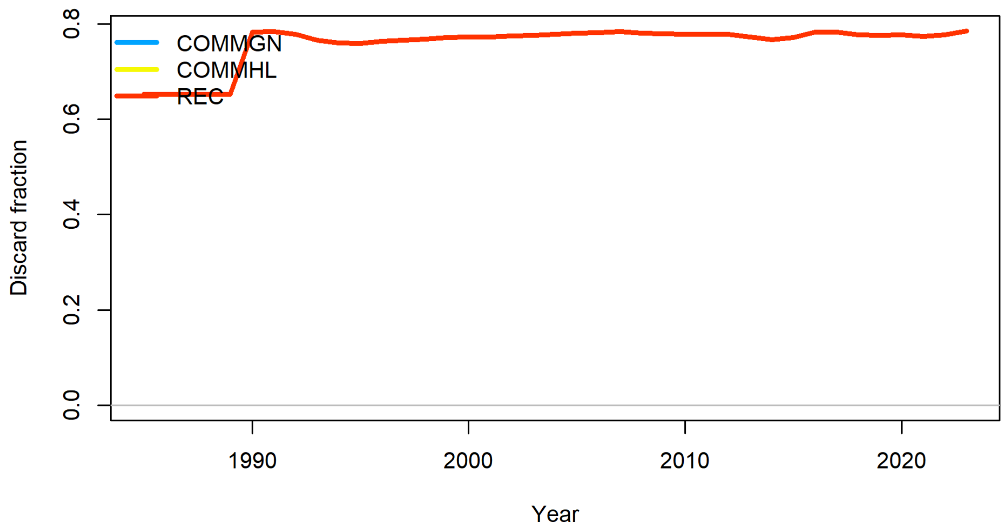


Figure 14. Observed (open circles and error bars) and predicted (solid lines) releases (in 1000s) for the recreational fleet for the Florida coast base models.

Florida Gulf



Florida Atlantic

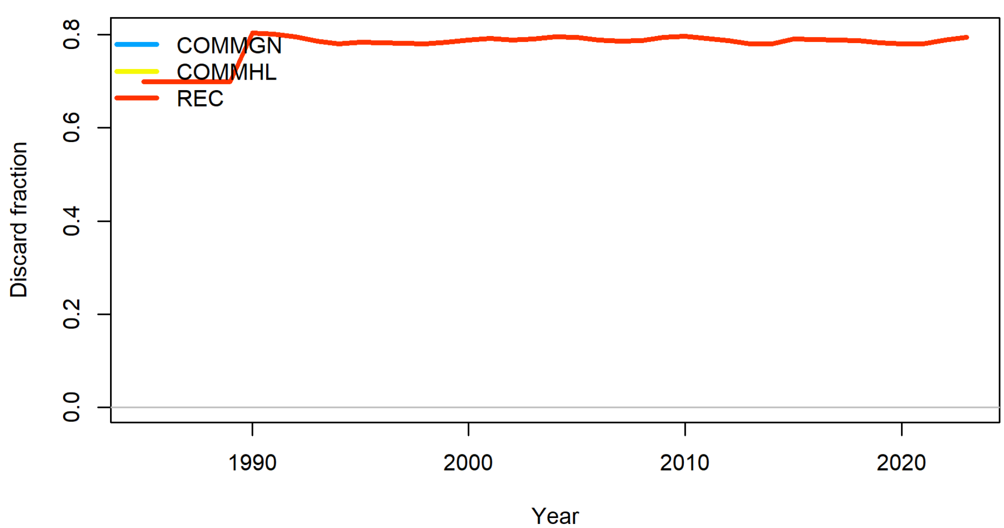


Figure 15. Estimated discard fractions for the recreational fleet for the Florida coast base models.

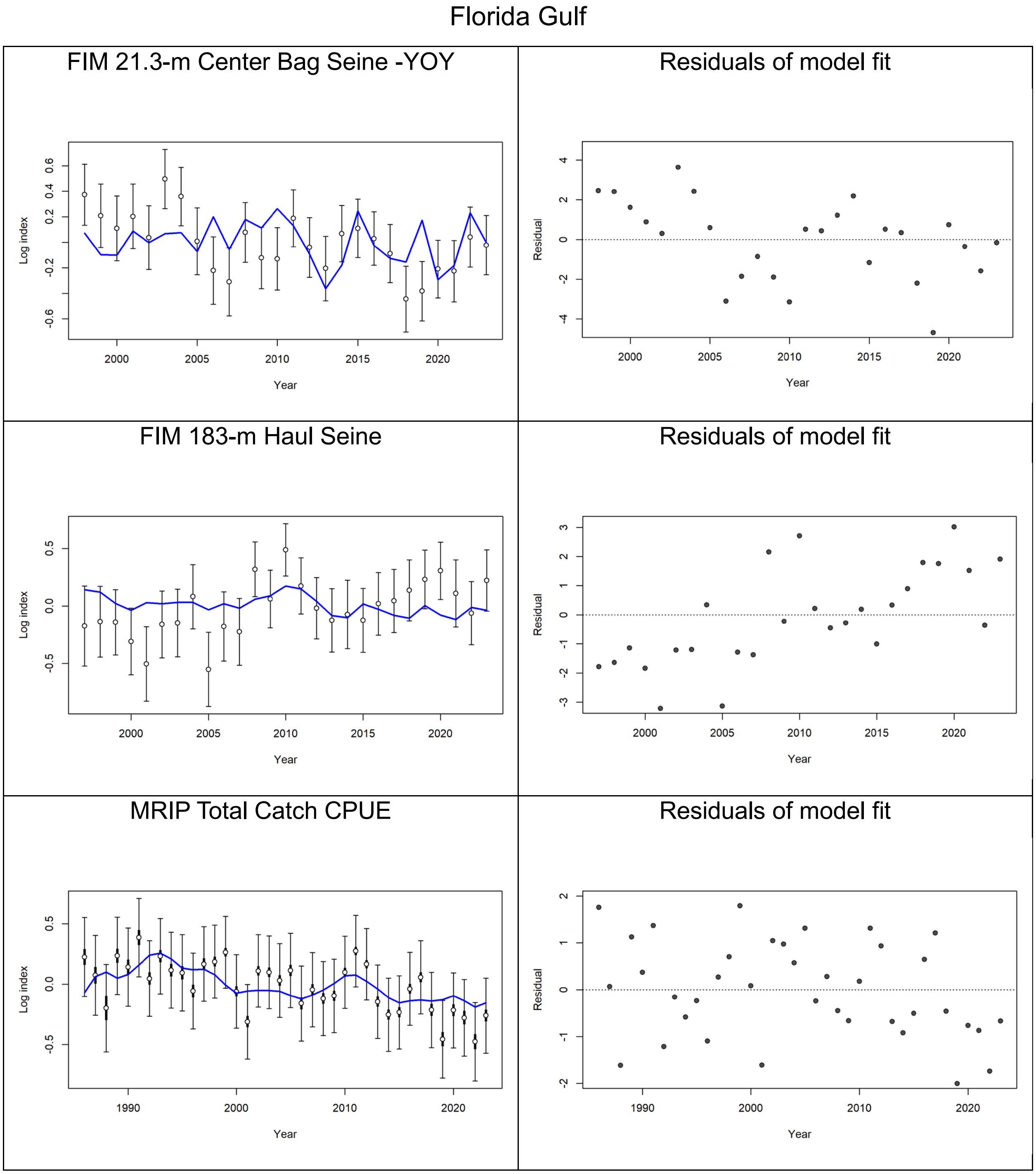


Figure 16. Observed (open circles and error bars) and predicted (solid lines) indices of abundance for the Florida coast base models (left column) and residuals of model fits (right column). Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines (if present) indicate input uncertainty before addition of estimated additional uncertainty parameter.

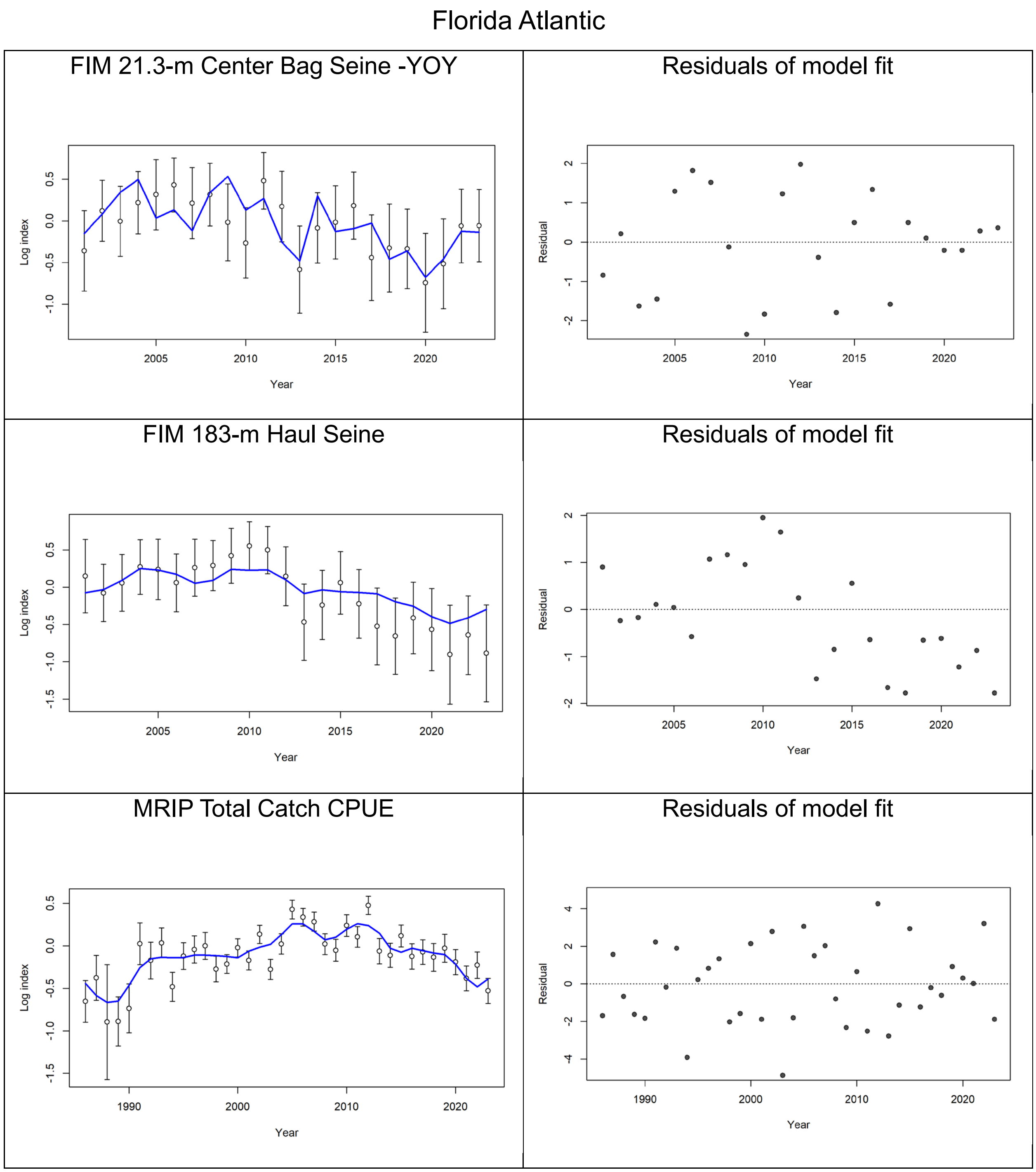


Figure 16 continued. Observed (open circles and error bars) and predicted (solid lines) indices of abundance for the Florida coast base models (left column) and residuals of model fits (right column). Lines indicate 95% uncertainty interval around index values based on the model assumption of lognormal error. Thicker lines (if present) indicate input uncertainty before addition of estimated additional uncertainty parameter.

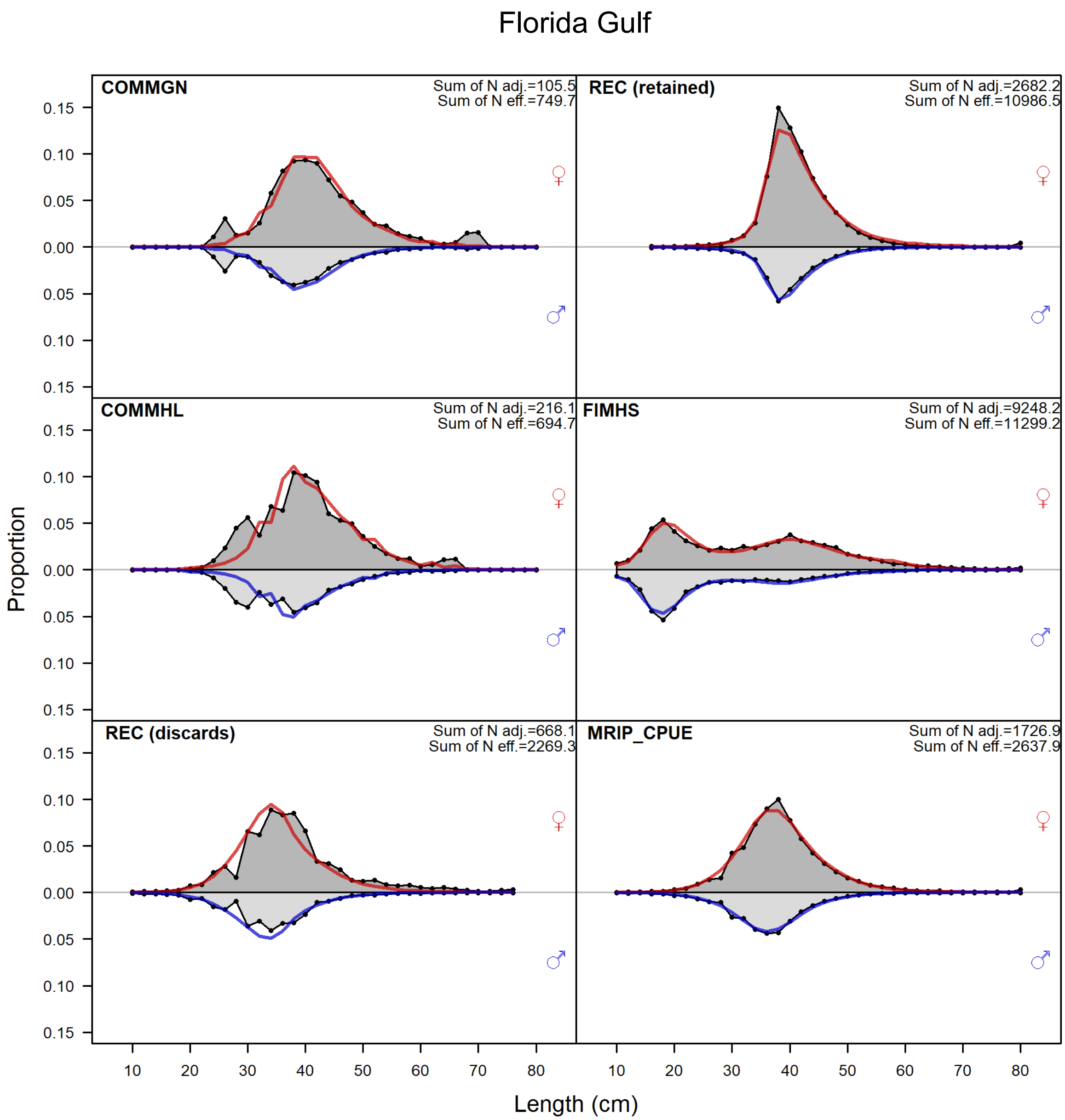


Figure 17. Model fits to the length composition (2 cm Max TL bin-width) of discarded (i.e., released) or retained catch aggregated across years within a given fleet or survey for Spotted Seatrout by Florida coast and sex. Lines represent expected length compositions by sex (red – females, blue – males), while grey shaded regions represent observed length compositions. 'N adj.' is the input sample size after data-weighting adjustment. ‘N eff.’ is the calculated effective sample size used in the McAllister-Ianelli tuning method. Abbreviations include: Commercial Gillnet (COMMGN), Commercial Hook and Line (COMMHL), Recreational (REC), FIM 183-m Haul Seine (FIMHS), and MRIP Total Catch CPUE (MRIP_CPUE).

Florida Atlantic

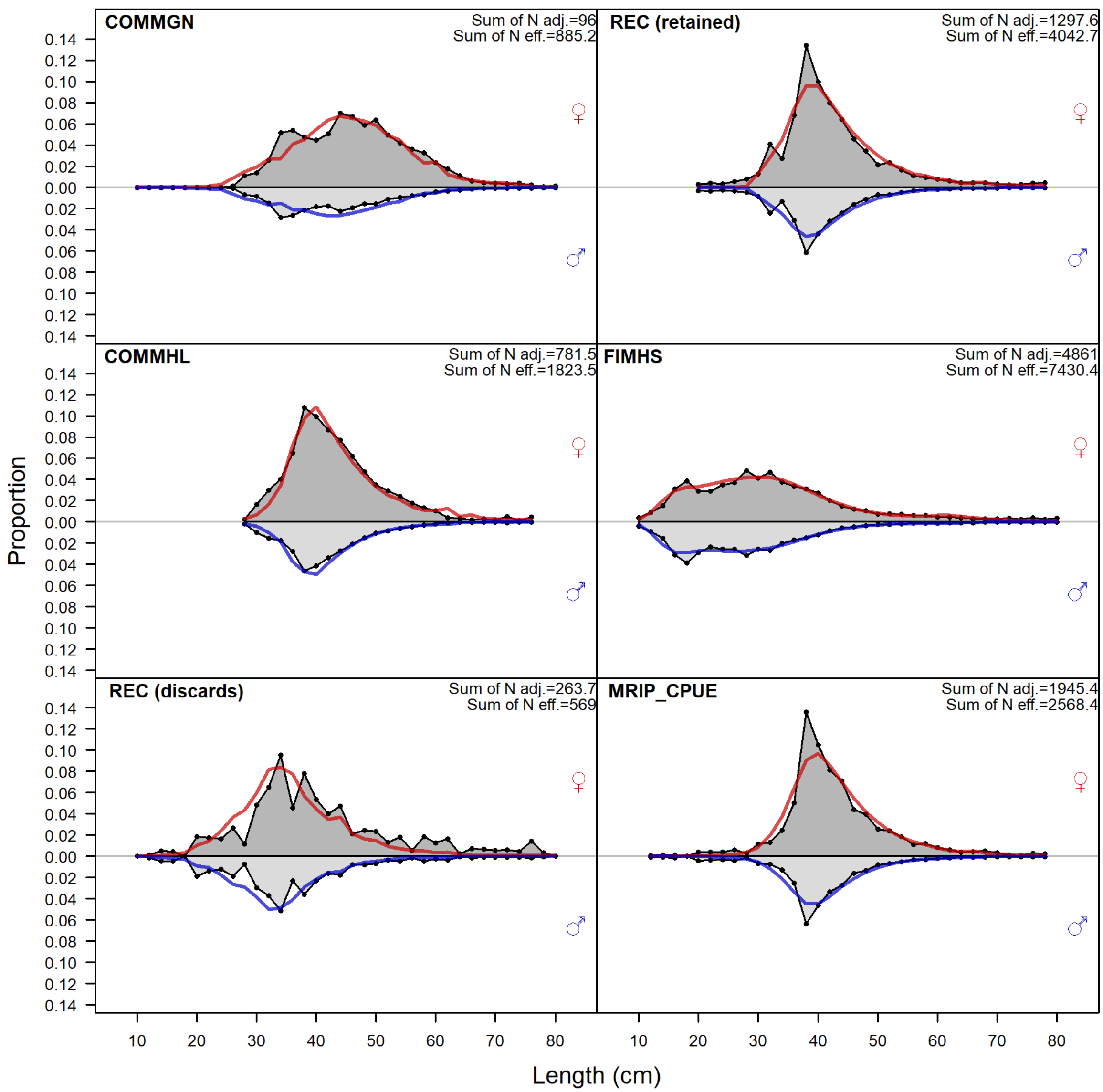


Figure 17 continued. Model fits to the length composition (2 cm Max TL bin-width) of discarded (i.e., released) or retained catch aggregated across years within a given fleet or survey for Spotted Seatrout by Florida coast and sex. Lines represent expected length compositions by sex (red – females, blue – males), while grey shaded regions represent observed length compositions. 'N adj.' is the input sample size after data-weighting adjustment. ‘N eff.’ is the calculated effective sample size used in the McAllister-Ianelli tuning method. Abbreviations include: Commercial Gillnet (COMMGN), Commercial Hook and Line (COMMHL), Recreational (REC), FIM 183-m Haul Seine (FIMHS), and MRIP Total Catch CPUE (MRIP_CPUE).

Florida Gulf

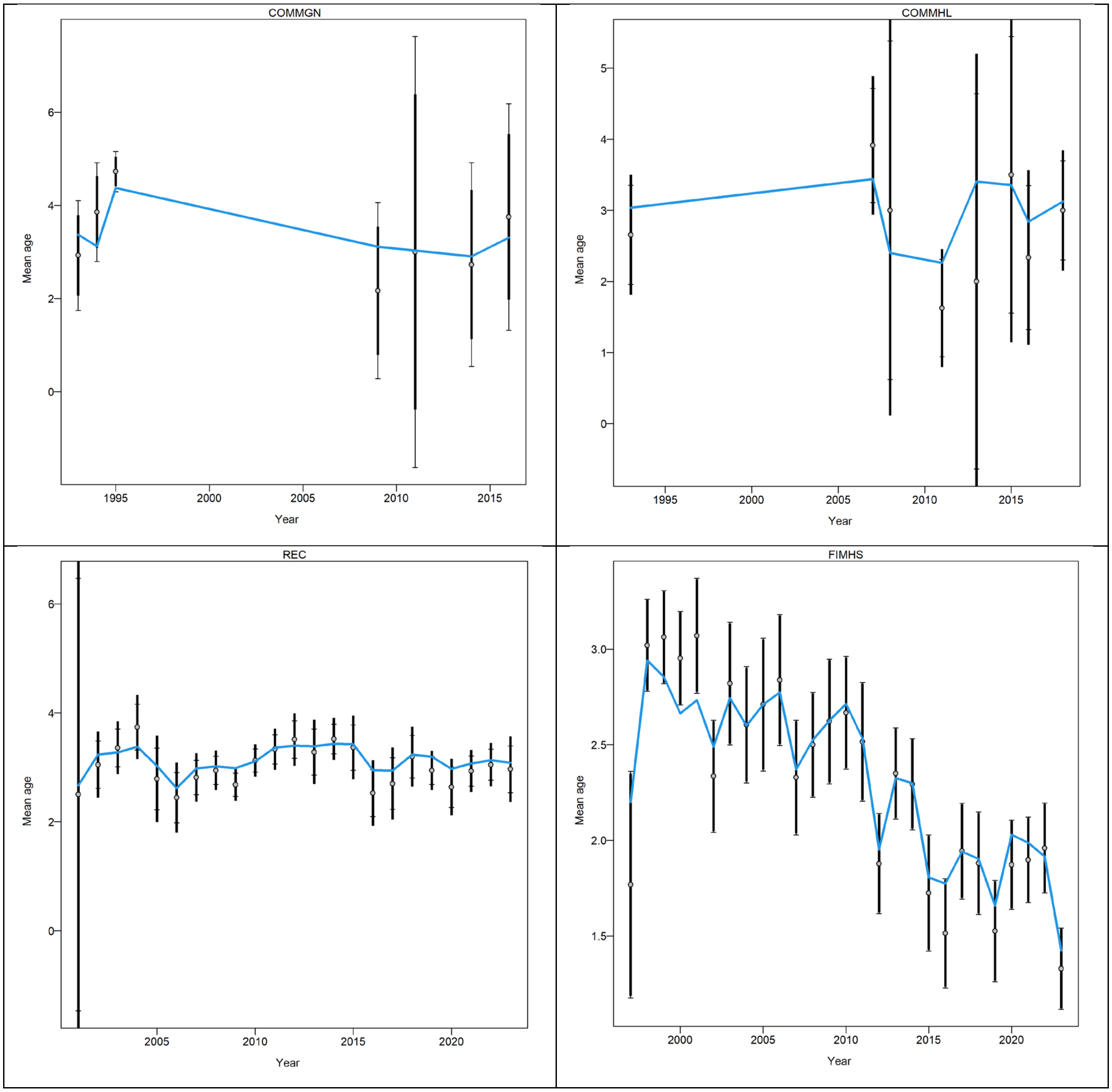


Figure 18. Mean ages of Spotted Seatrout from the Florida coast base models of conditional age-at-length data aggregated across length bins for each fleet and the fishery-independent data source (observed -- dots with 95% confidence intervals and predicted --black line). Abbreviations include: Commercial Gillnet (COMMGN), Commercial Hook and Line (COMMHL), Recreational (REC), FIM 183-m Haul Seine (FIMHS).

Florida Atlantic

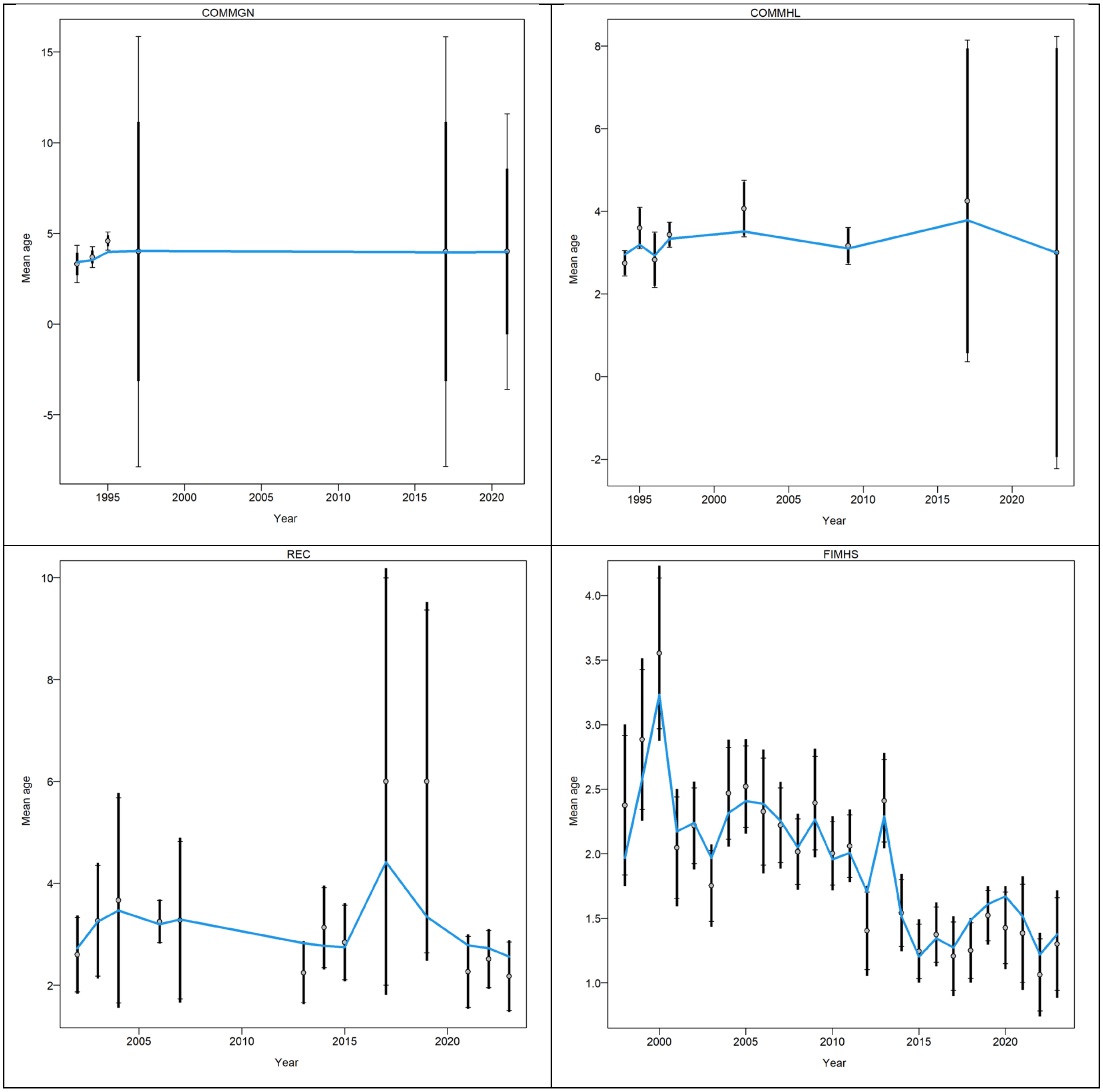
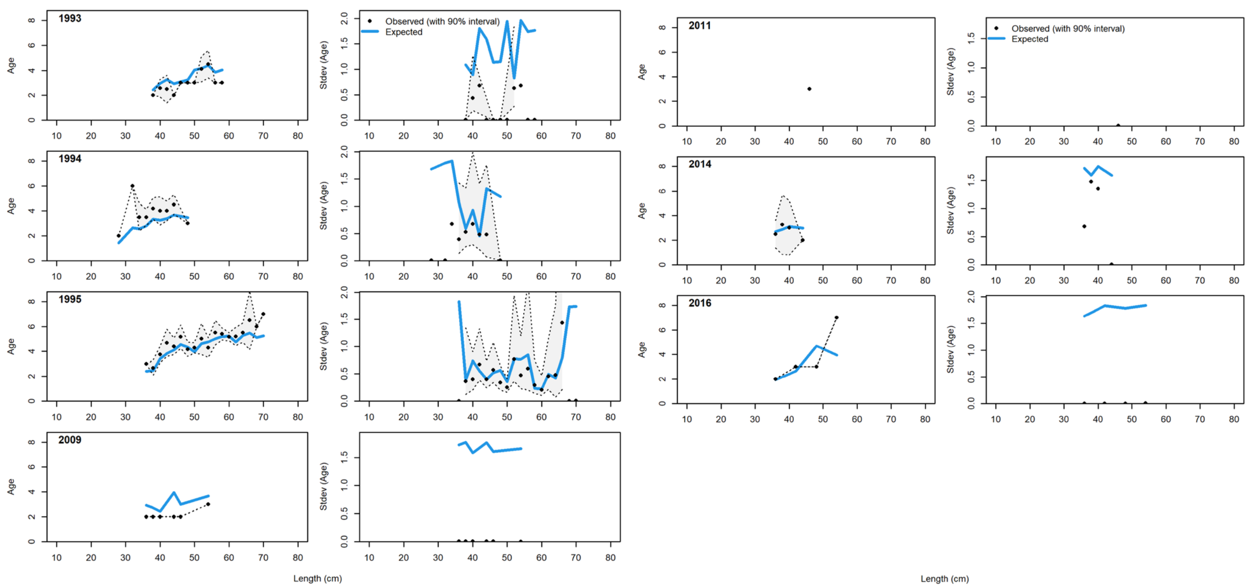


Figure 18 continued. Mean ages of Spotted Seatrout from the Florida coast base models of conditional age-at-length data aggregated across length bins for each fleet and the fishery-independent data source (observed -- dots with 95% confidence intervals and predicted --black line). Abbreviations include: Commercial Gillnet (COMMGN), Commercial Hook and Line (COMMHL), Recreational (REC), FIM 183-m Haul Seine (FIMHS).

Florida Gulf



Florida Atlantic

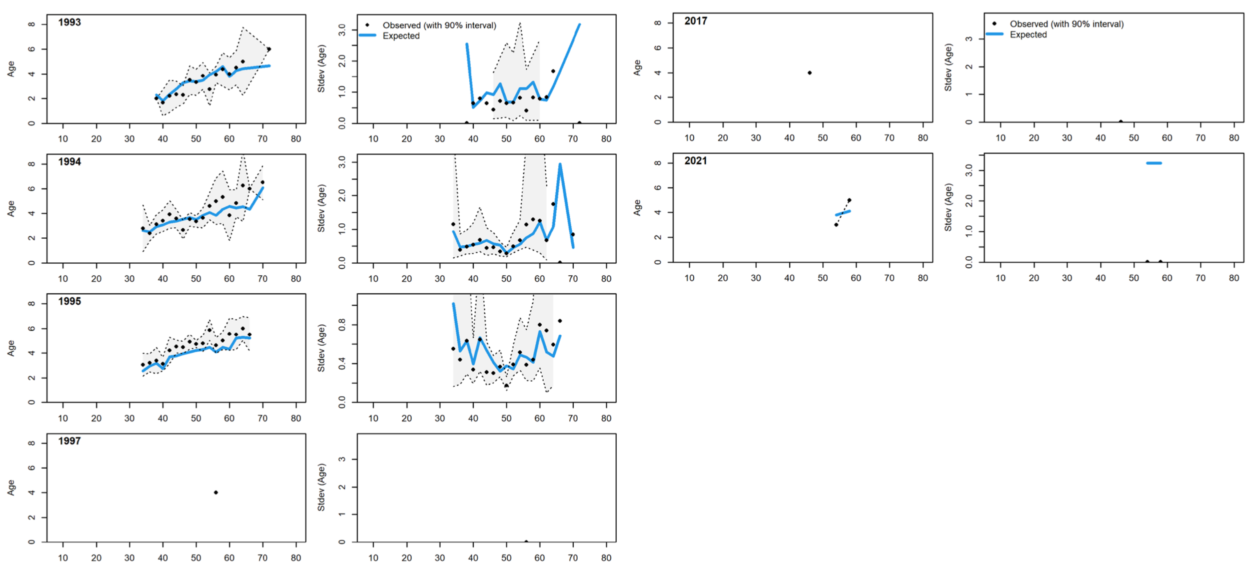
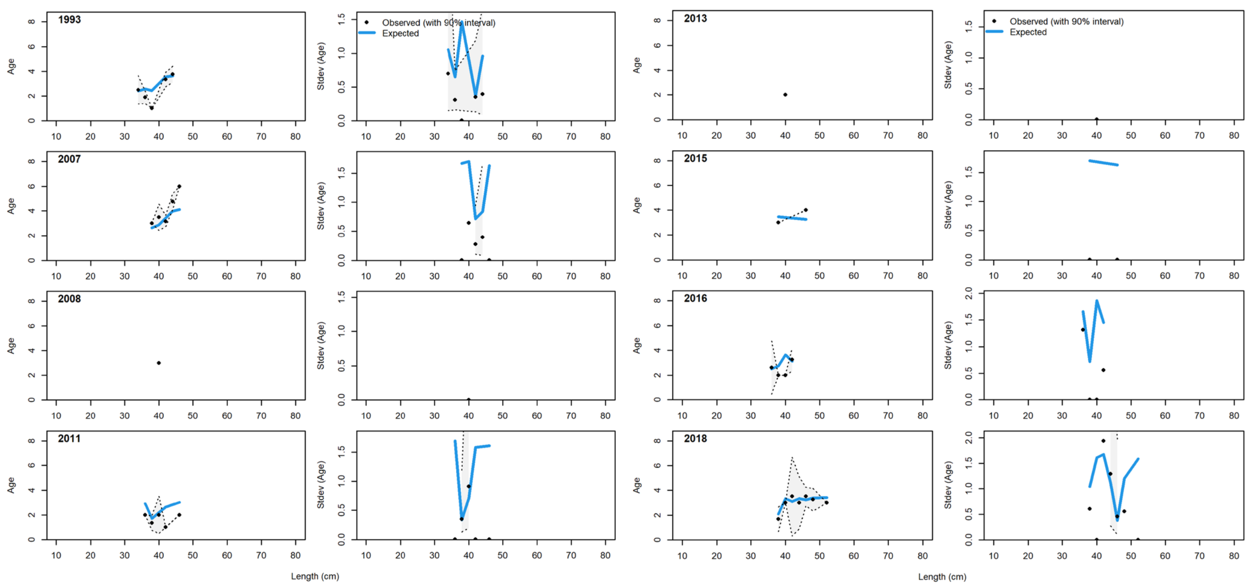


Figure 19. Florida coast base model fits to the annual conditional age-at-length data from retained catch by the Commercial Gillnet fleet for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf



Florida Atlantic

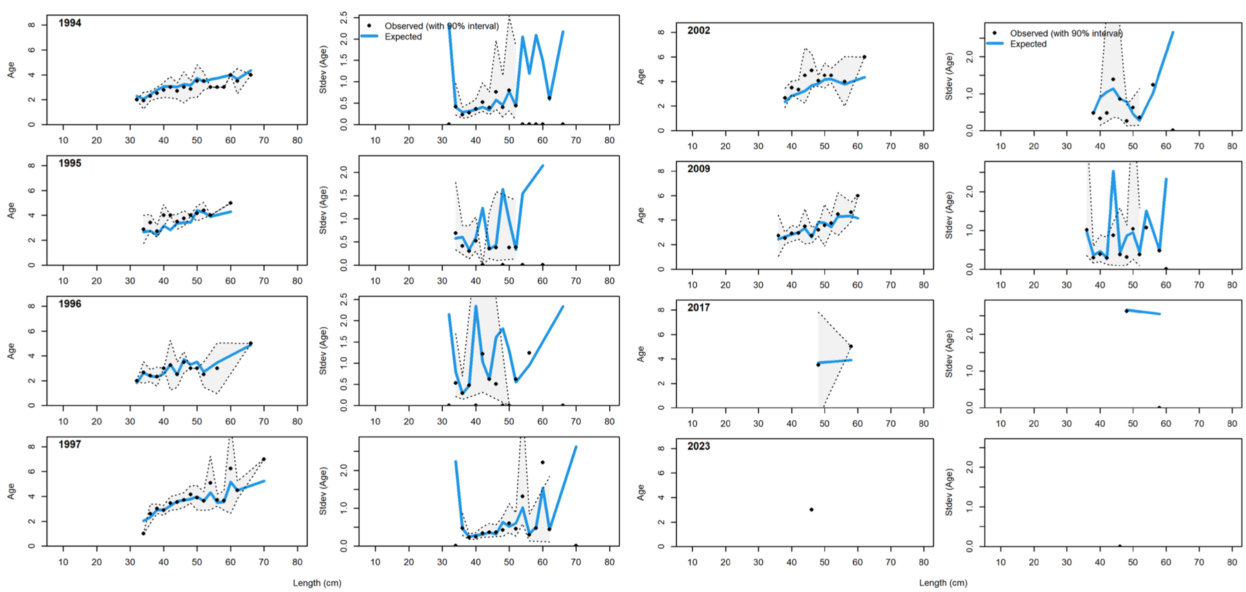


Figure 20. Florida coast base model fits to the annual conditional age-at-length data from retained catch by the Commercial Hook and Line fleet for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf

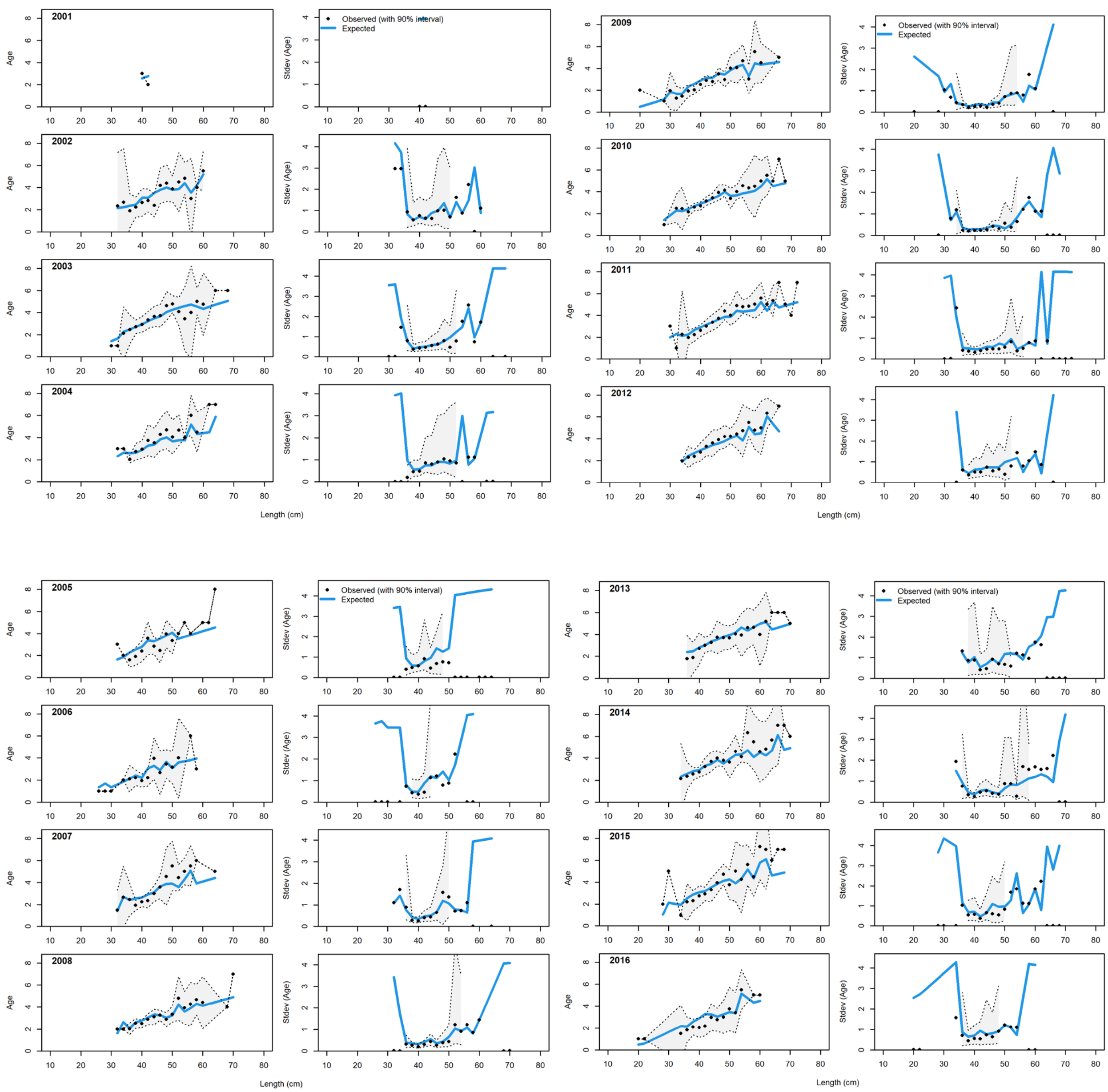
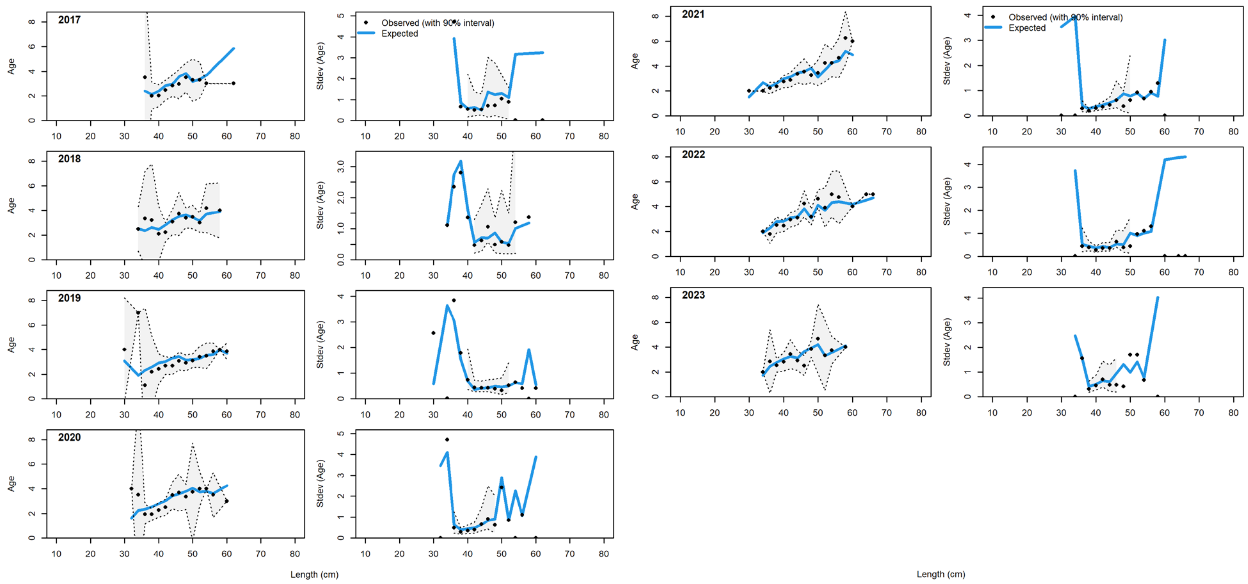


Figure 21. Florida coast base model fits to the annual conditional age-at-length data from retained catch by the Recreational fleet for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf (continued)



Florida Atlantic

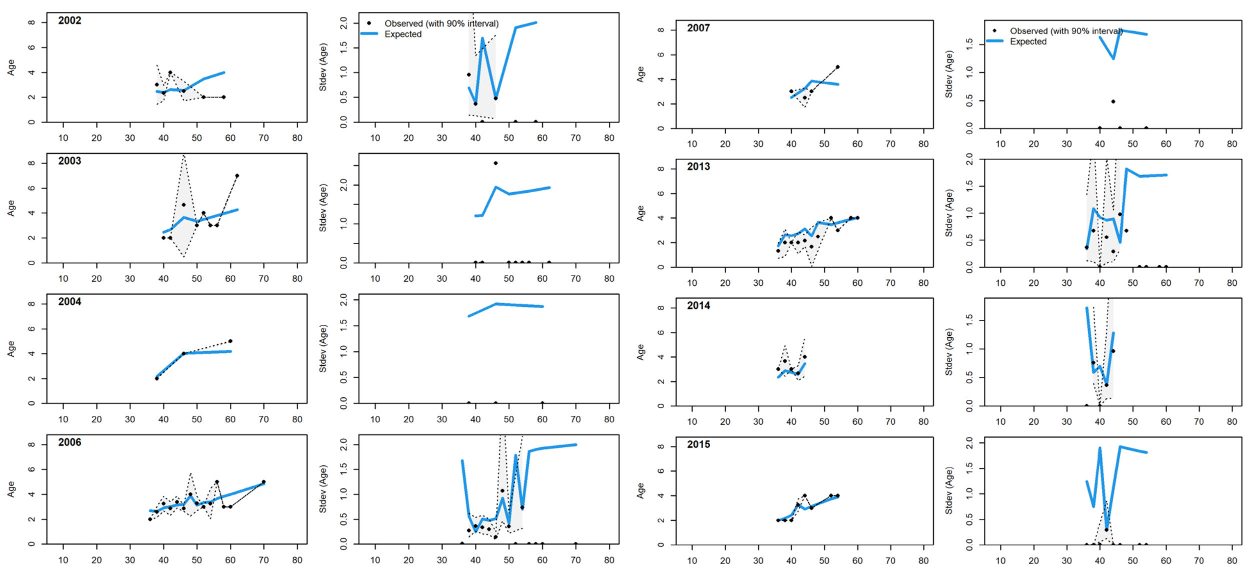


Figure 21 continued. Florida coast base model fits to the annual conditional age-at-length data from retained catch by the Recreational fleet for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Atlantic (continued)

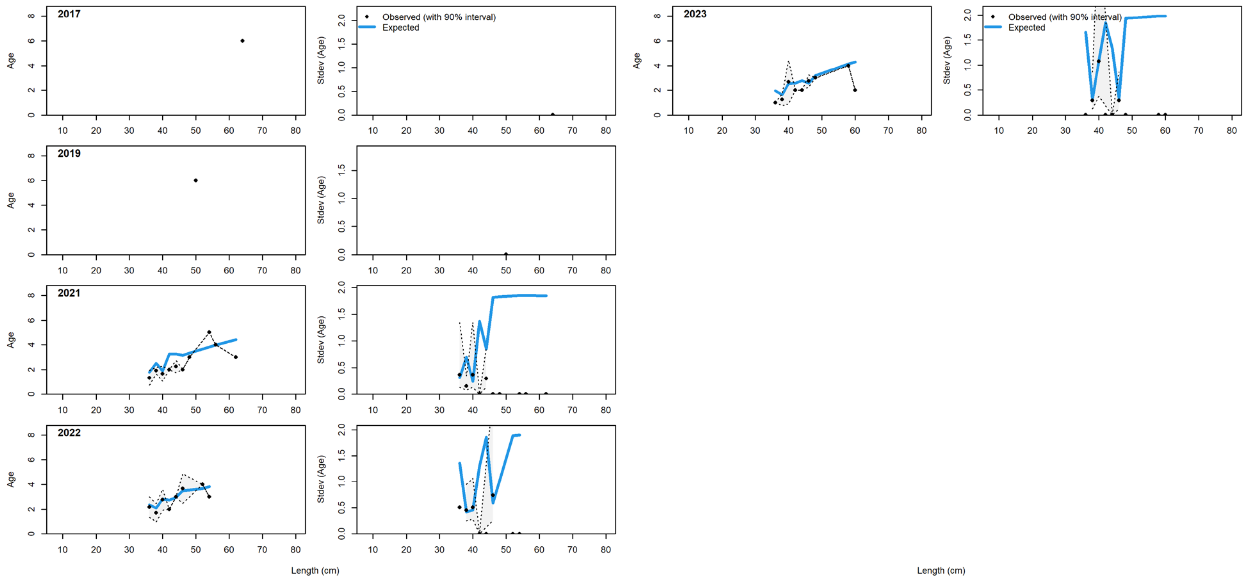


Figure 21 continued. Florida coast base model fits to the annual conditional age-at-length data from retained catch by the Recreational fleet for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf

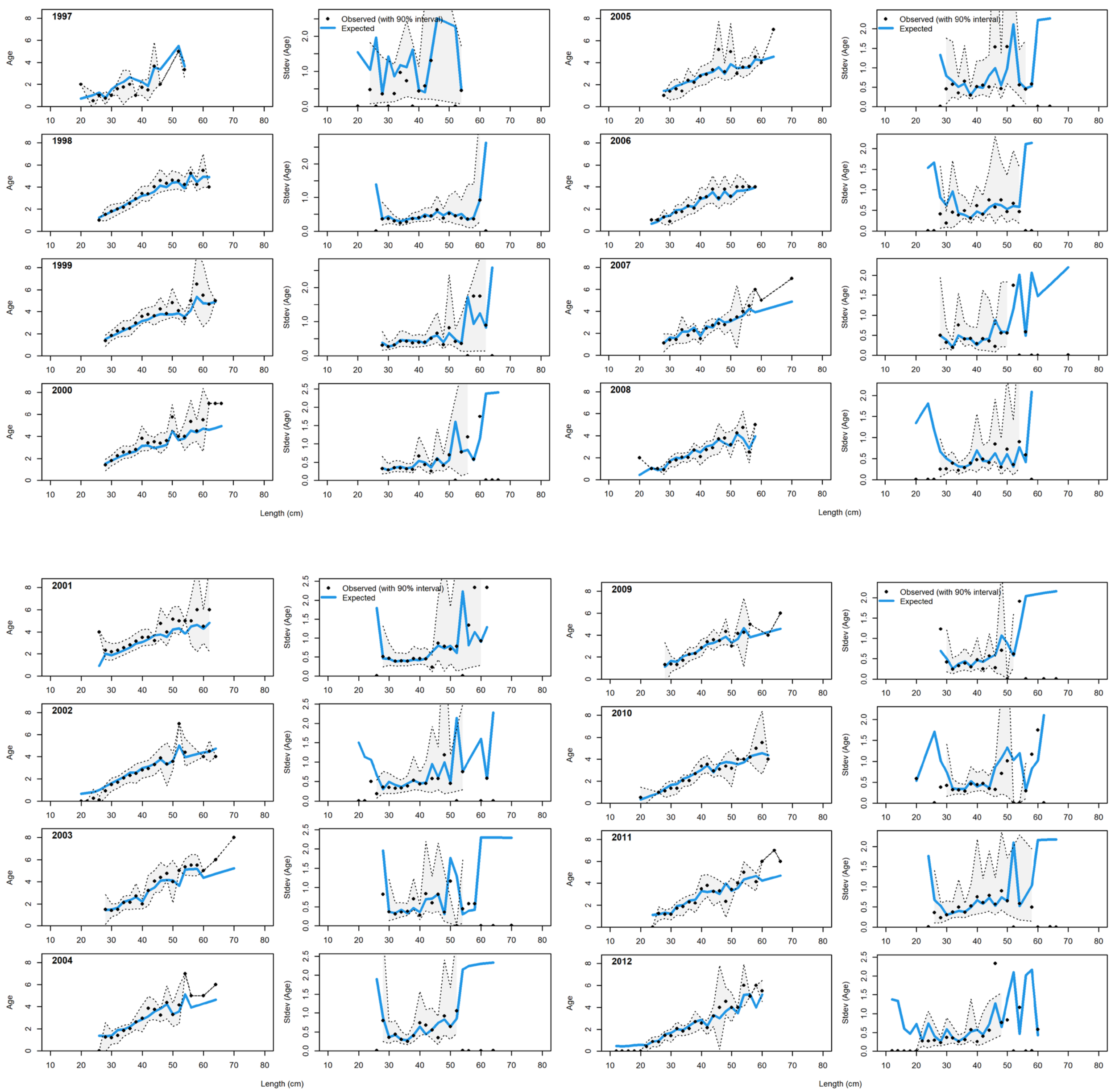


Figure 22. Florida coast base model fits to the annual conditional age-at-length data from the FIM Haul Seine index for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf (continued)

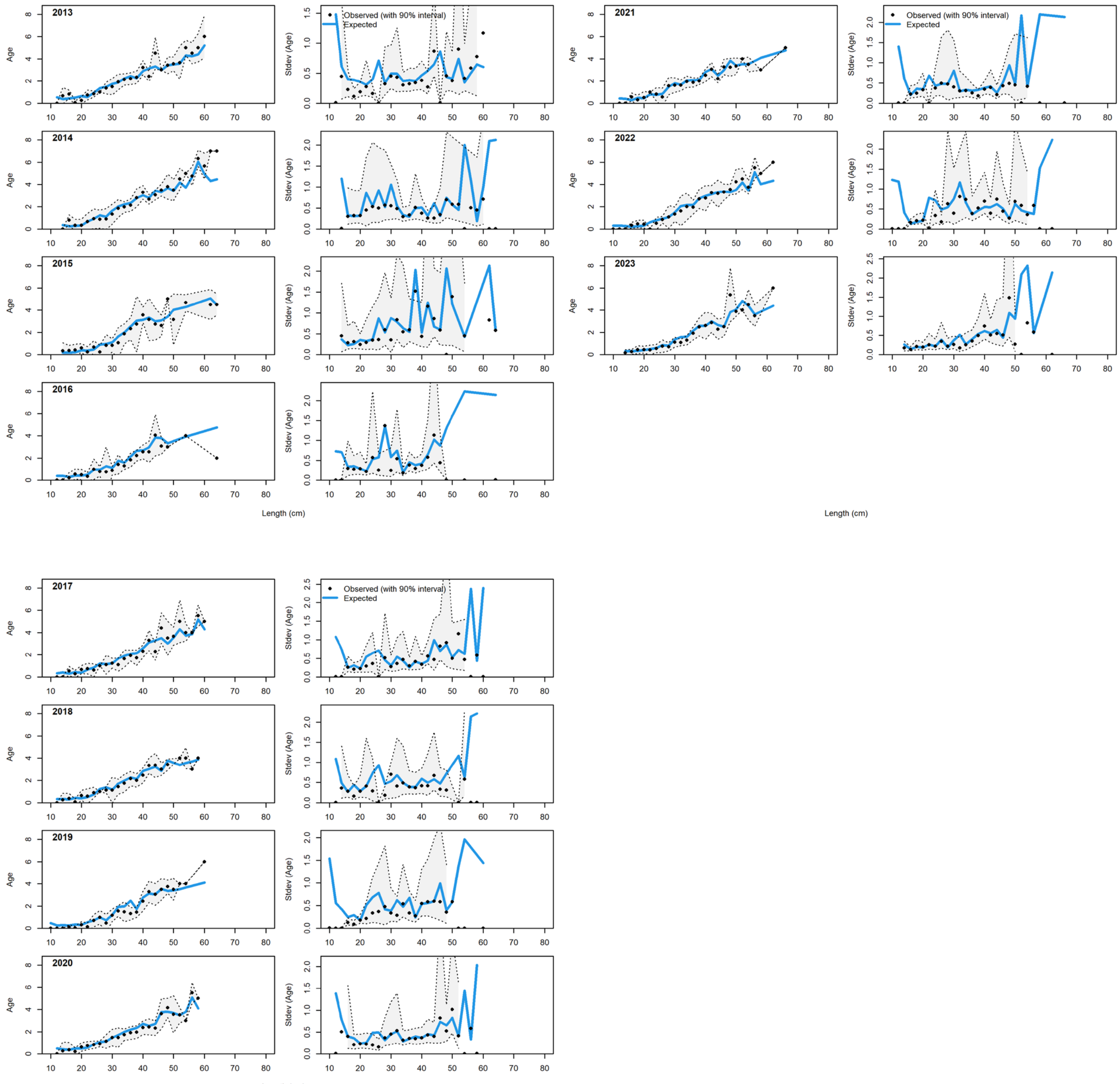


Figure 22 continued. Florida coast base model fits to the annual conditional age-at-length data from the FIM Haul Seine index for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Atlantic

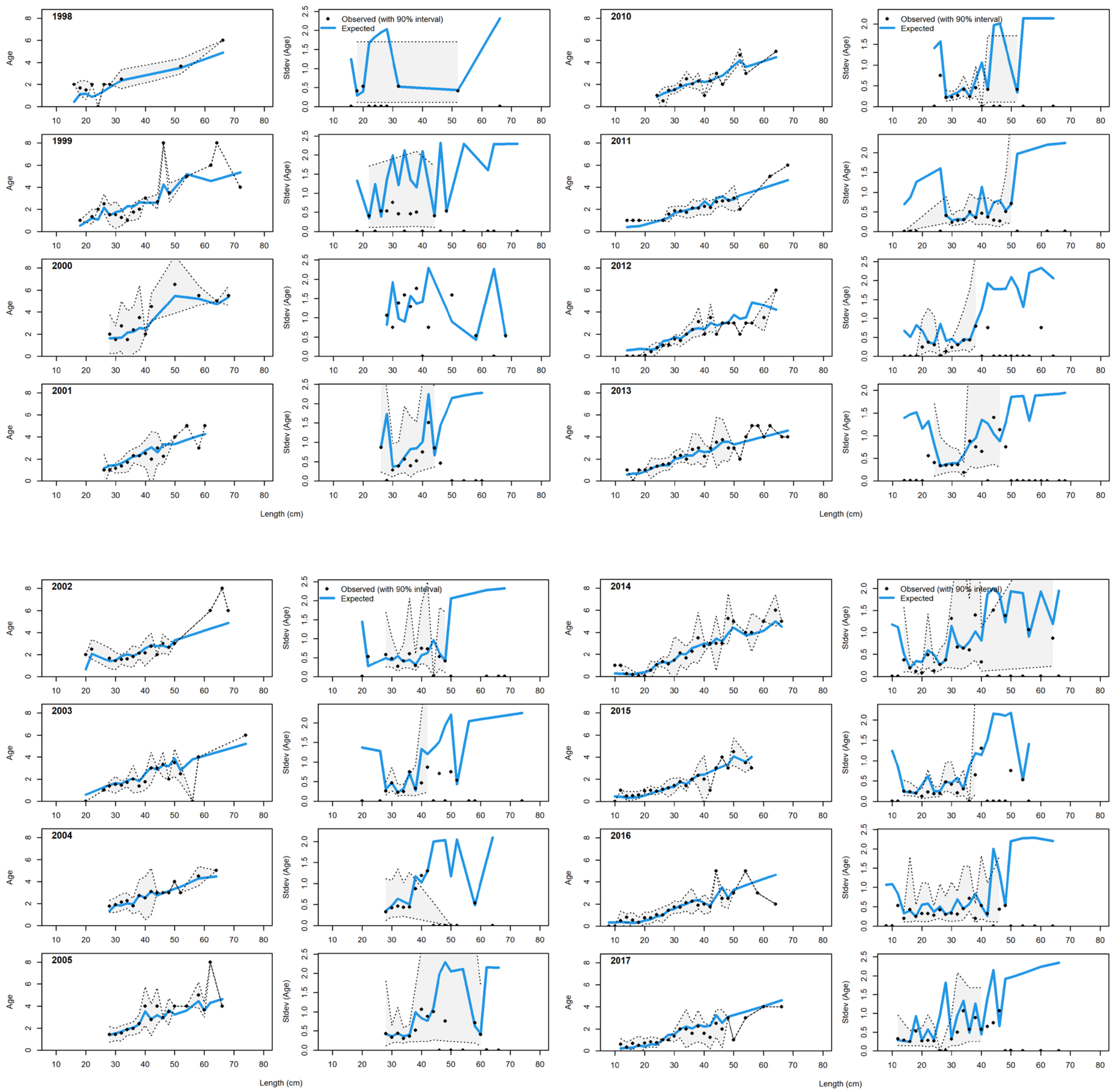


Figure 22 continued. Florida coast base model fits to the annual conditional age-at-length data from the FIM Haul Seine index for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Atlantic (continued)

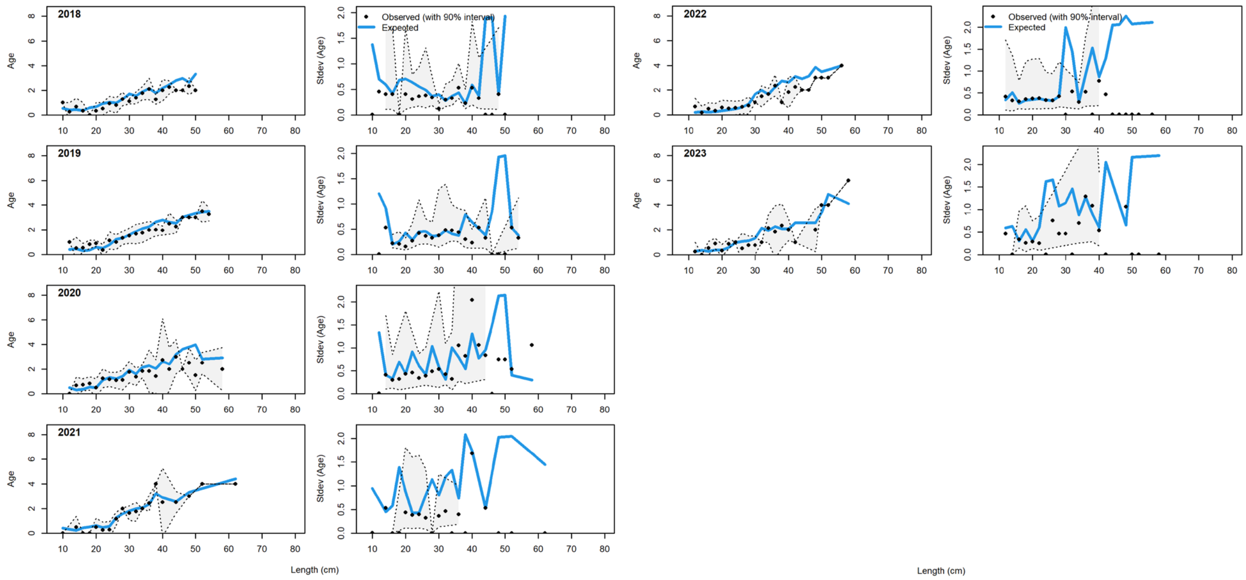
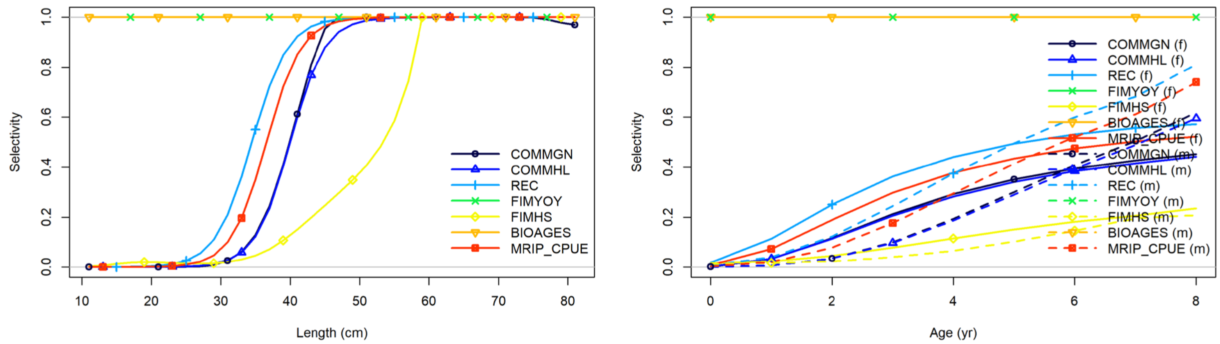


Figure 22 continued. Florida coast base model fits to the annual conditional age-at-length data from the FIM Haul Seine index for Spotted Seatrout. Blue lines represent predicted mean age-at-length by size class while the black dots and grey shaded regions represent the observed mean age-at-length by size class with 90% confidence intervals.

Florida Gulf



Florida Atlantic

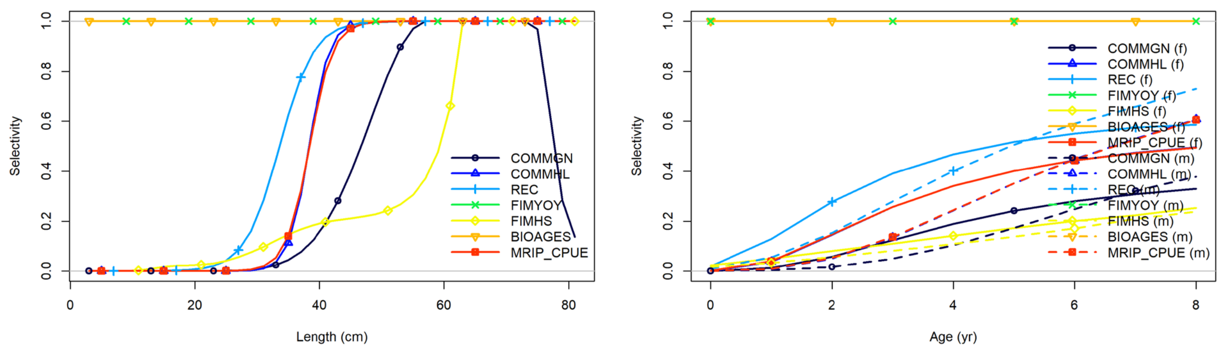


Figure 23. Length-based selectivity and related age-derived selectivity (by sex) for each fleet in the Florida coast base models

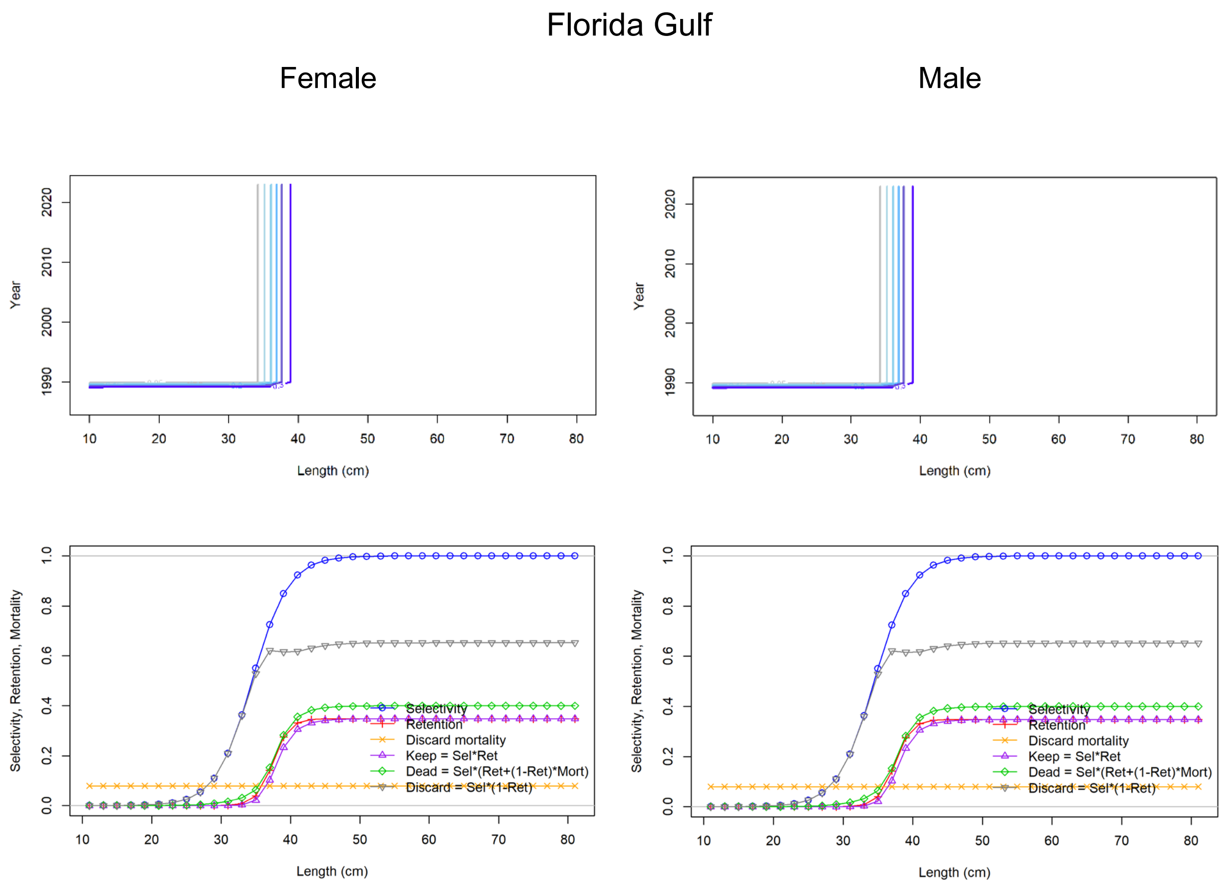


Figure 24. Time-varying retention (top) for the Recreational fleet in the Florida coast base models by sex and the related interplay between terminal year (2023) selectivity, retention, discard mortality (constant at 0.08), along with the fraction of fish kept, dead, and discarded (bottom).

Florida Atlantic

Female | Male

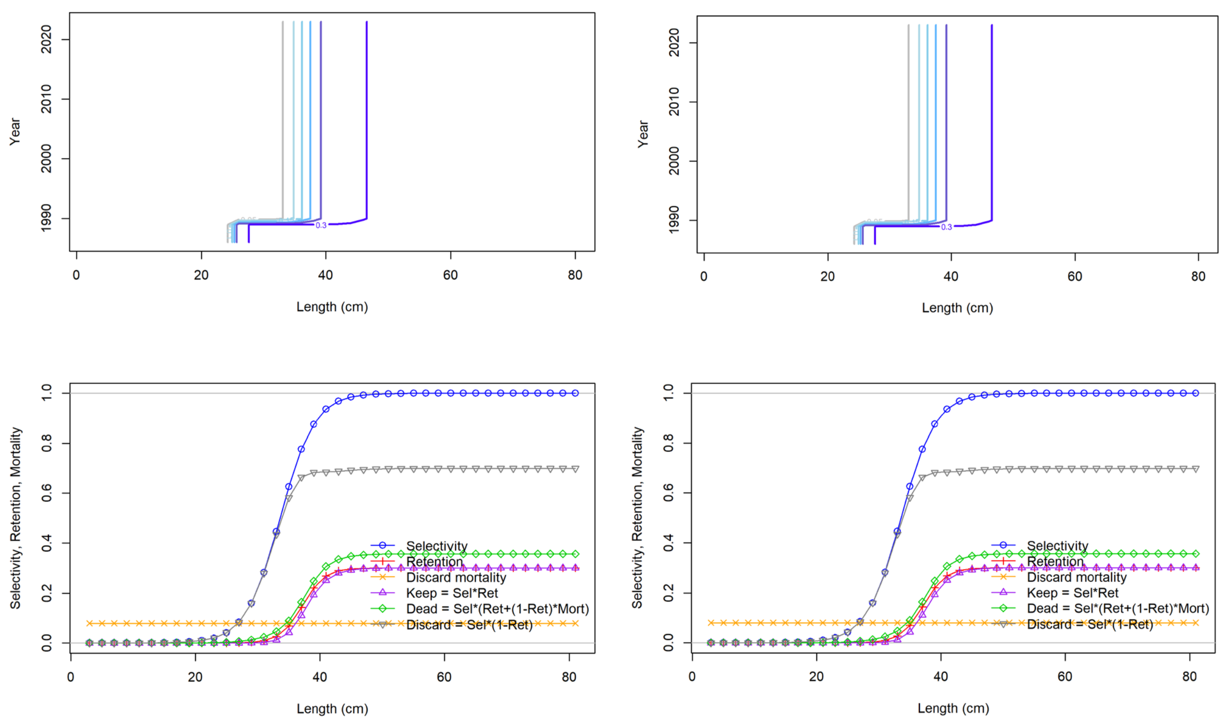
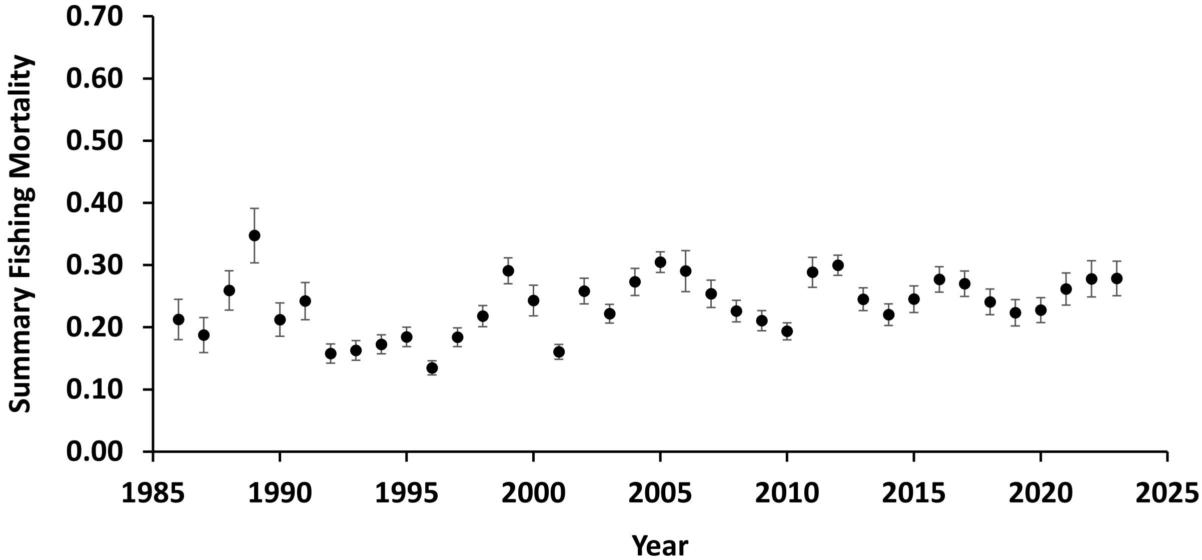


Figure 24 continued. Time-varying retention (top) for the Recreational fleet in the Florida coast base models by sex and the related interplay between terminal year (2023) selectivity, retention, discard mortality (constant at 0.08), along with the fraction of fish kept, dead, and discarded (bottom).

Florida Gulf



Florida Atlantic

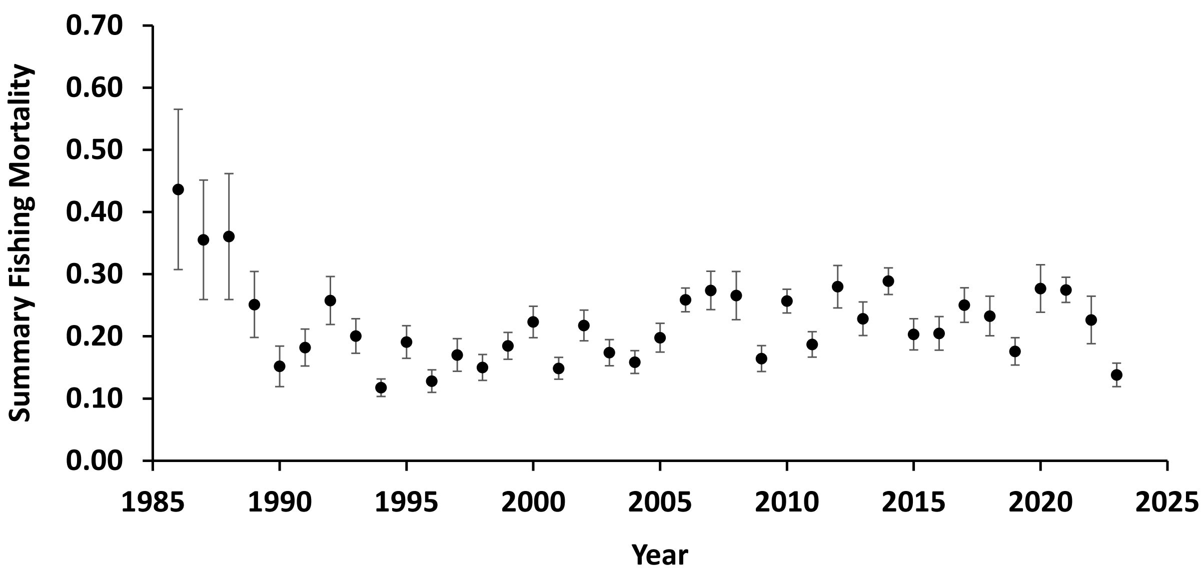


Figure 25. Annual instantaneous fishing mortality rates for age 2-4 Florida coast Spotted Seatrout (dots) with standard deviation (vertical lines).

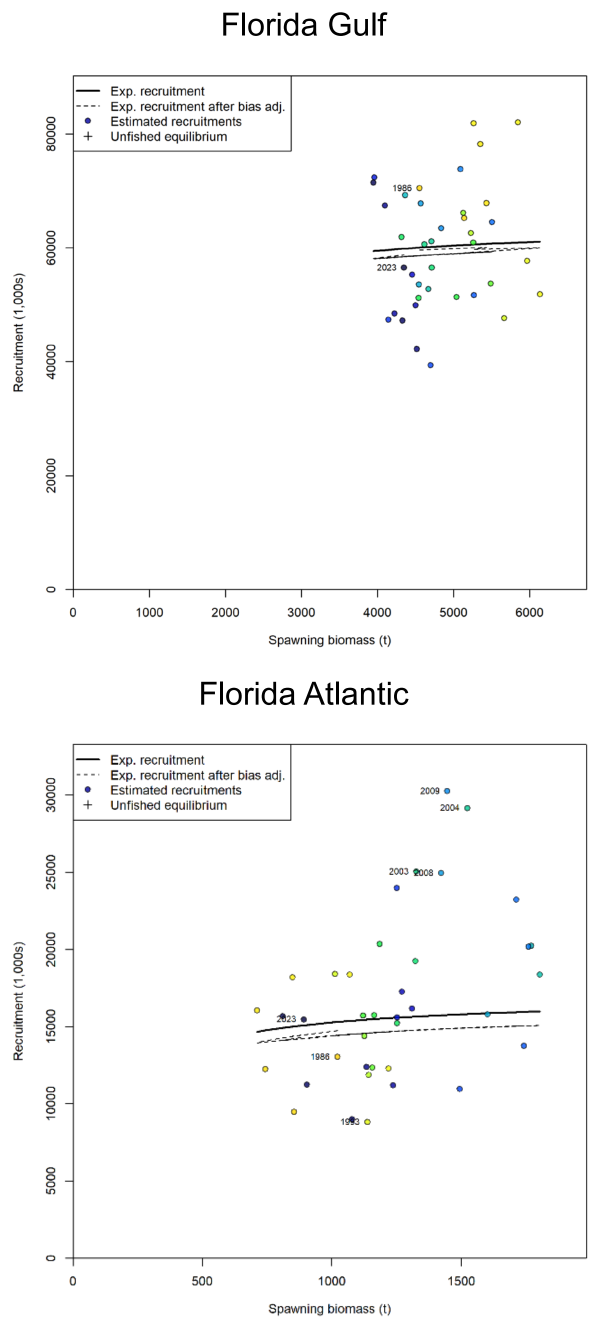


Figure 26. Expected stock-recruitment relationship for Florida coasts' Spotted Seatrout. Steepness was estimated at 0.871 and 0.833, respectively and sigmaR was estimated at 0.226 and 0.358, respectively. Plotted are expected annual recruitments from the base models (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line). Point colors indicate year, with warmer colors indicating earlier years and cooler colors showing later years.

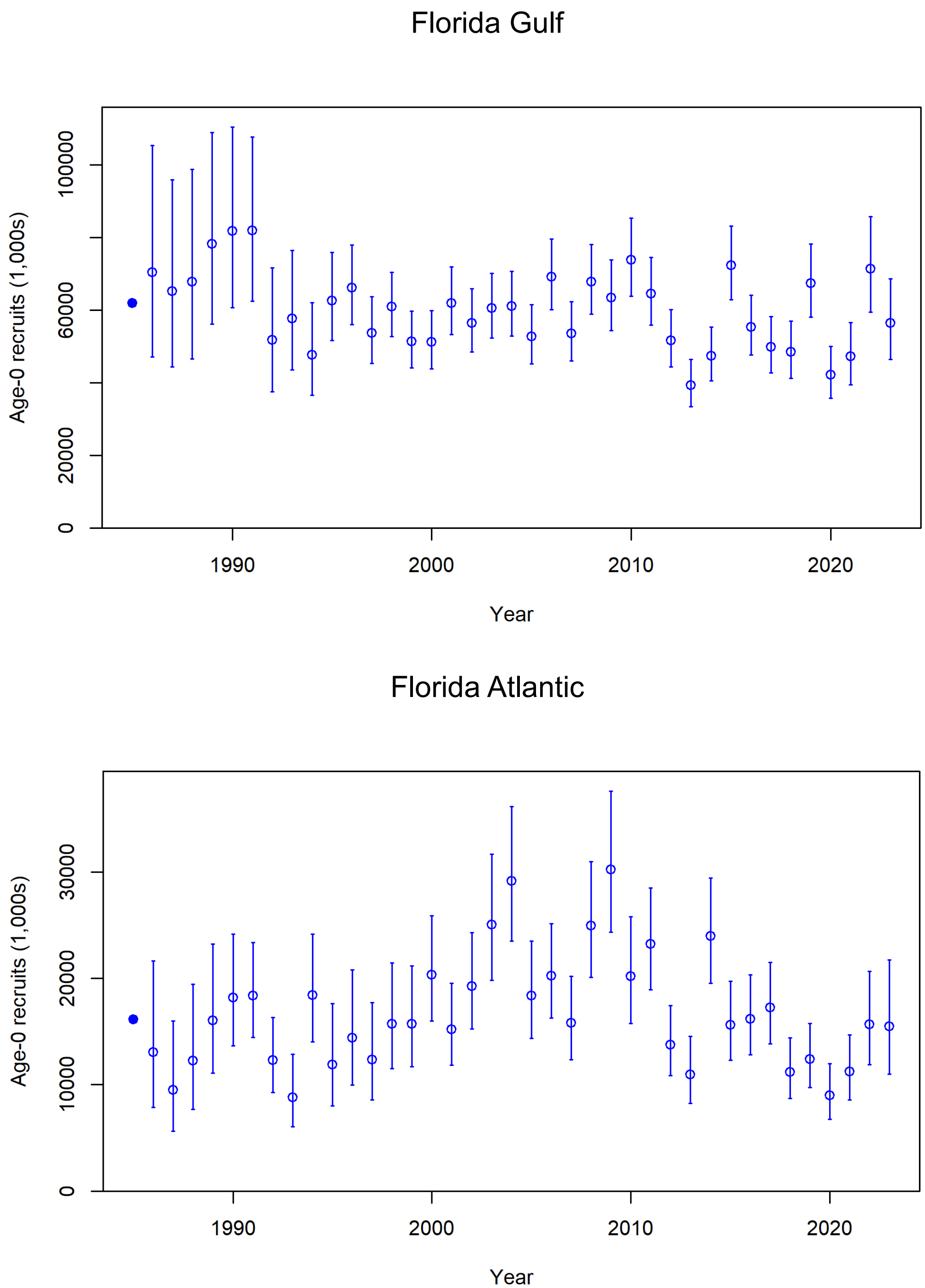
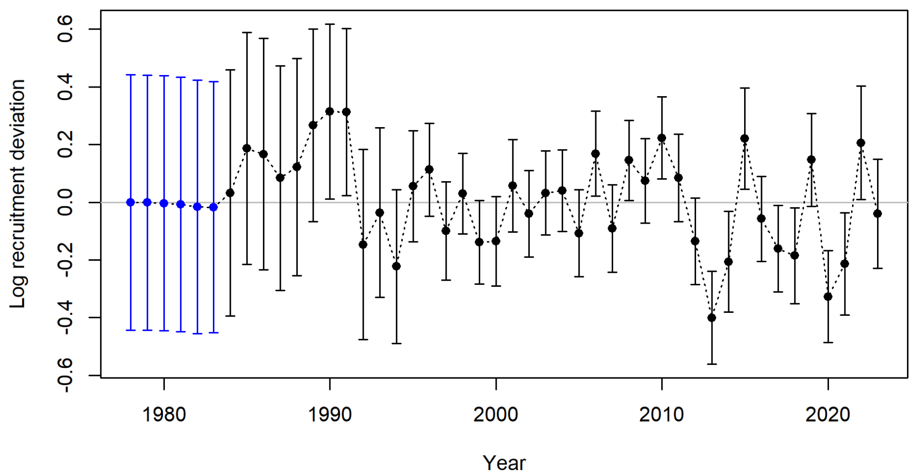


Figure 27. Estimated Age-0 recruitment (in 1,000s, circles) with approximate 95% confidence intervals (vertical lines) for Florida coasts' Spotted Seatrout. Virgin recruitment is shown in solid blue.

Florida Gulf



Florida Atlantic

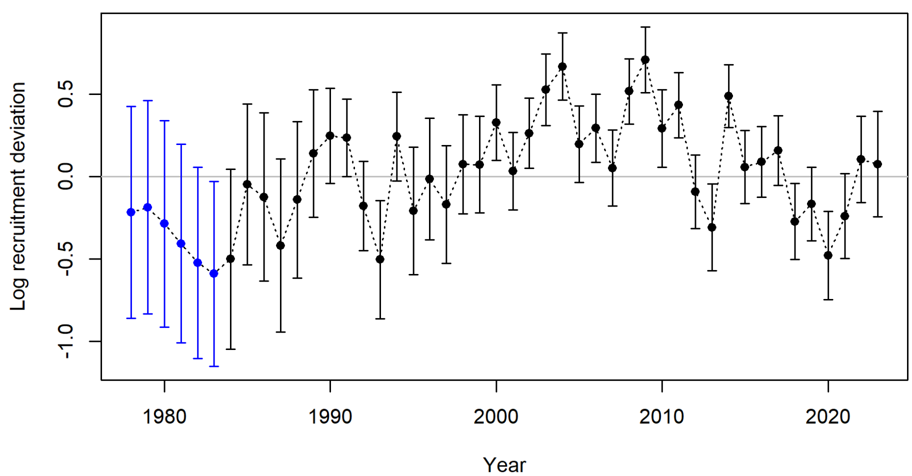
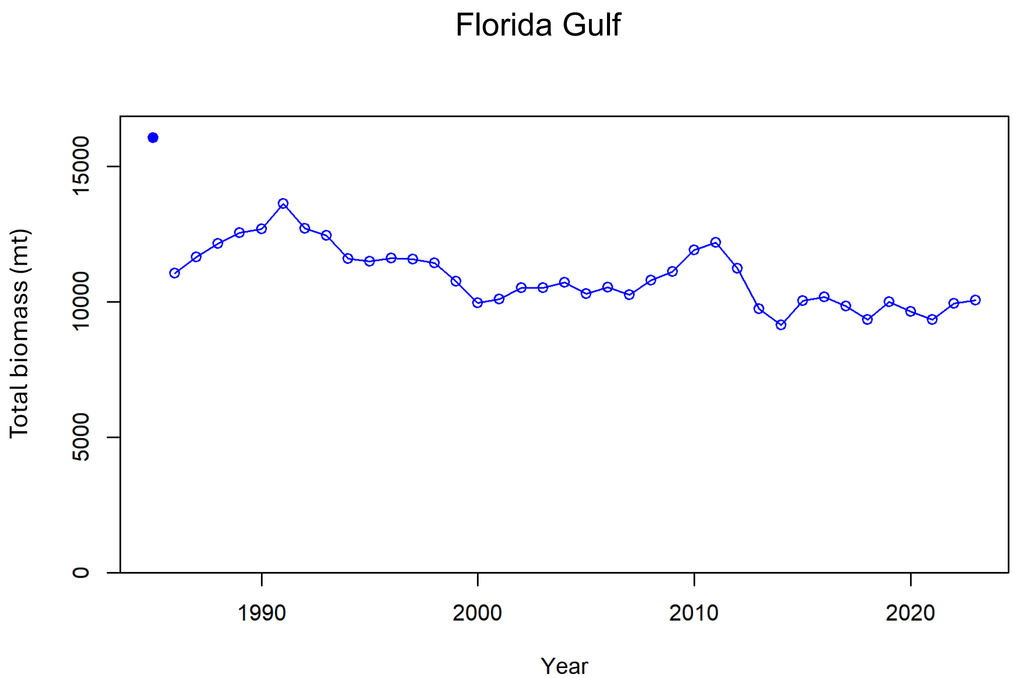


Figure 28. Estimated log-scale recruitment deviations (dots) with 95% confidence intervals (vertical lines) for Florida coasts' Spotted Seatrout, Steepness for Florida Gulf and Atlantic was estimated at 0.871 and 0.833, respectively and SigmaR for Florida Gulf and Atlantic was estimated at 0.226 and 0.358, respectively. Blue dots identify early and late recruitment deviations.



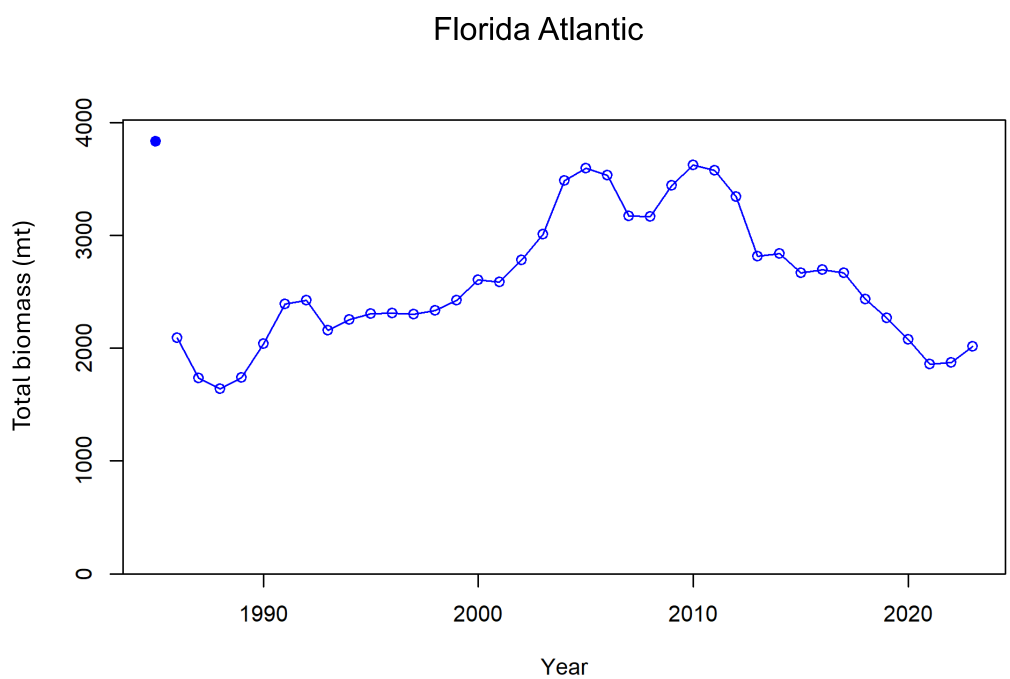
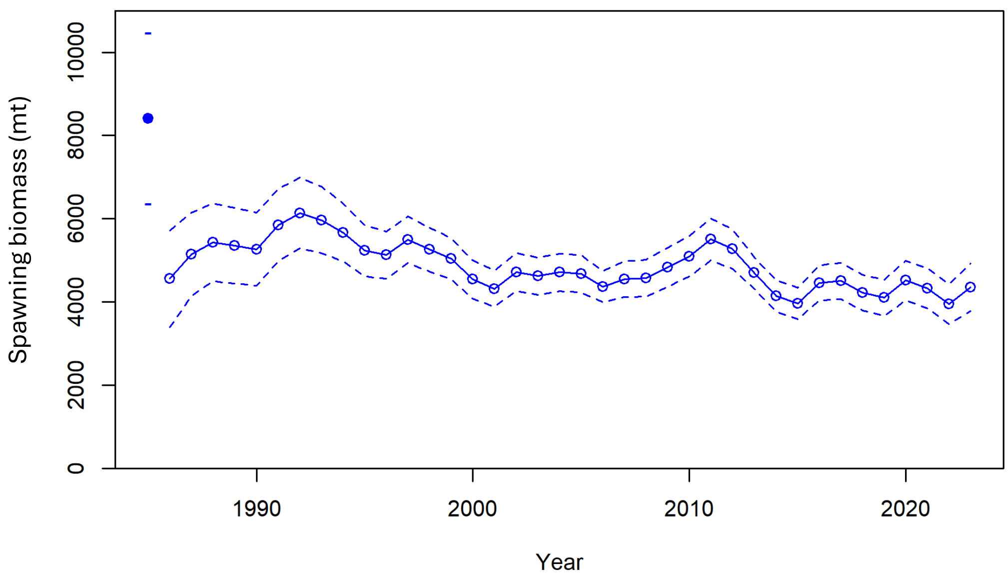


Figure 29. Estimates of total biomass (metric tons) for Florida coasts' Spotted Seatrout. Unfished total biomass is shown by the solid blue point in 1985.

Florida Gulf



Florida Atlantic

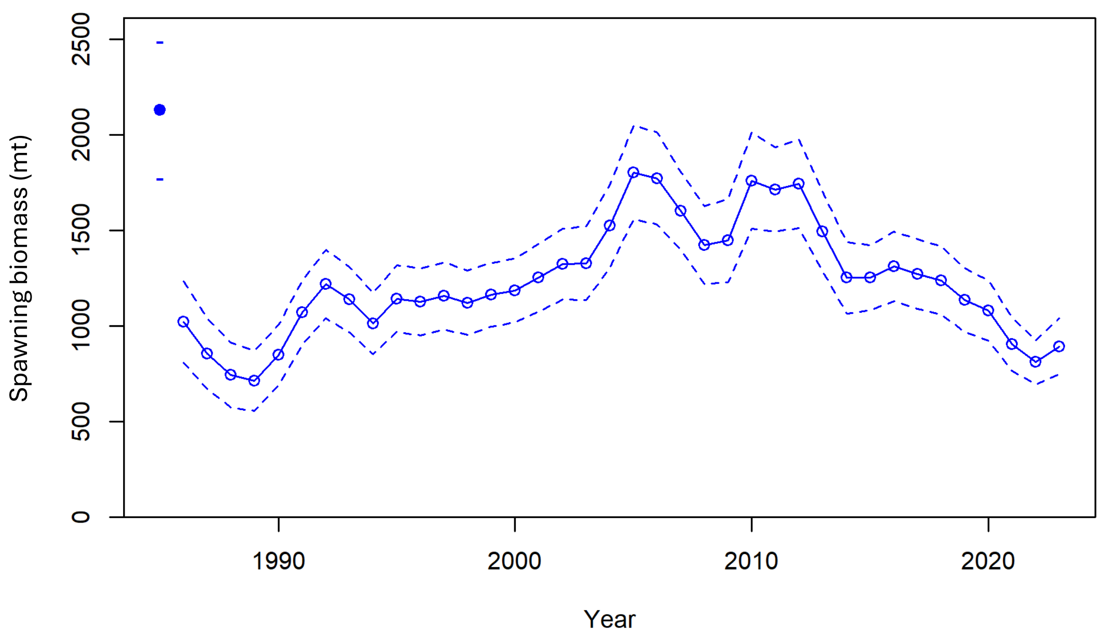


Figure 30. Estimates of female spawning stock biomass (metric tons, circles) with approximate 95% confidence intervals (dashed lines) for Florida coasts' Spotted Seatrout. Unfished spawning stock biomass is shown by the solid blue point in 1985.

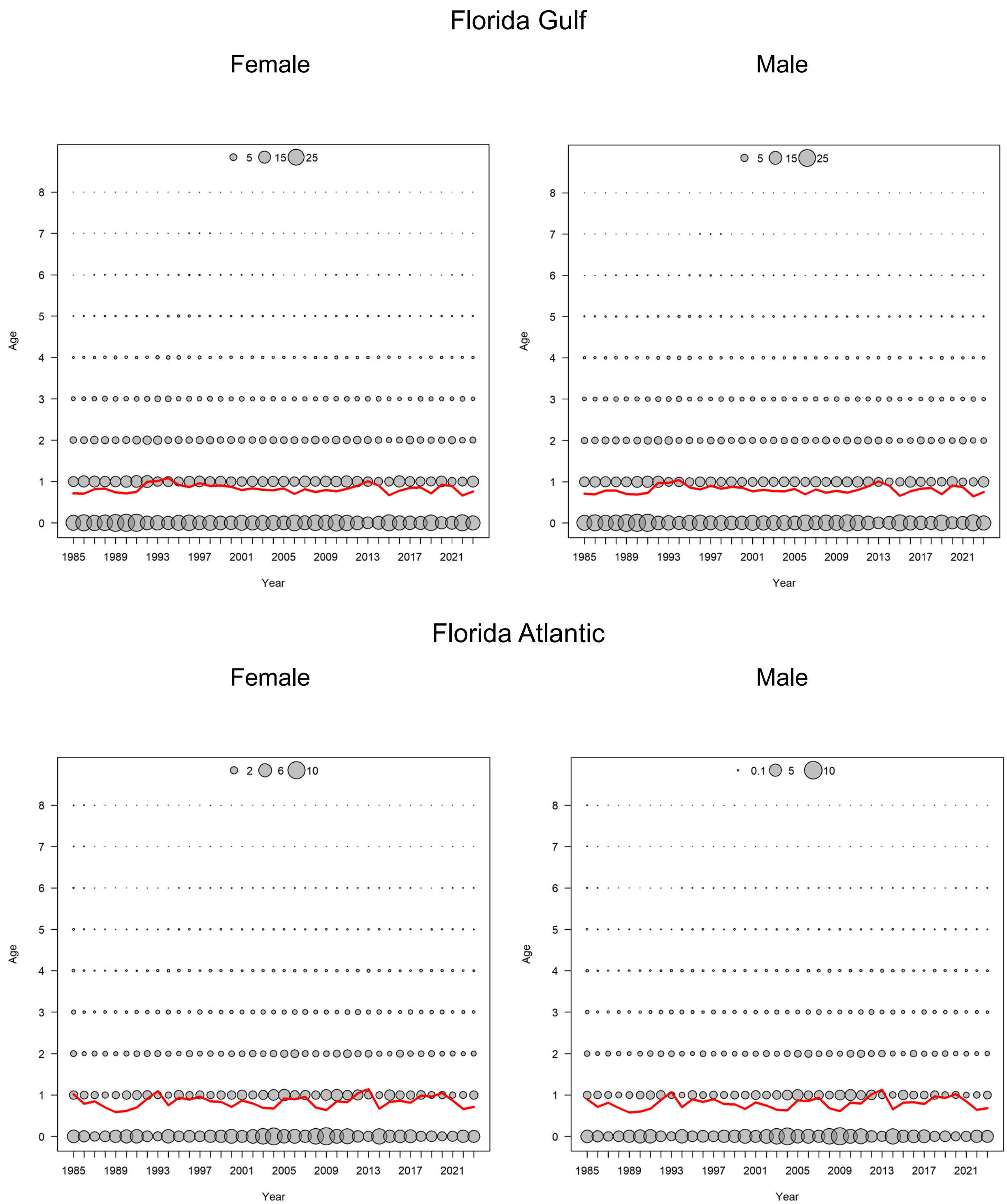
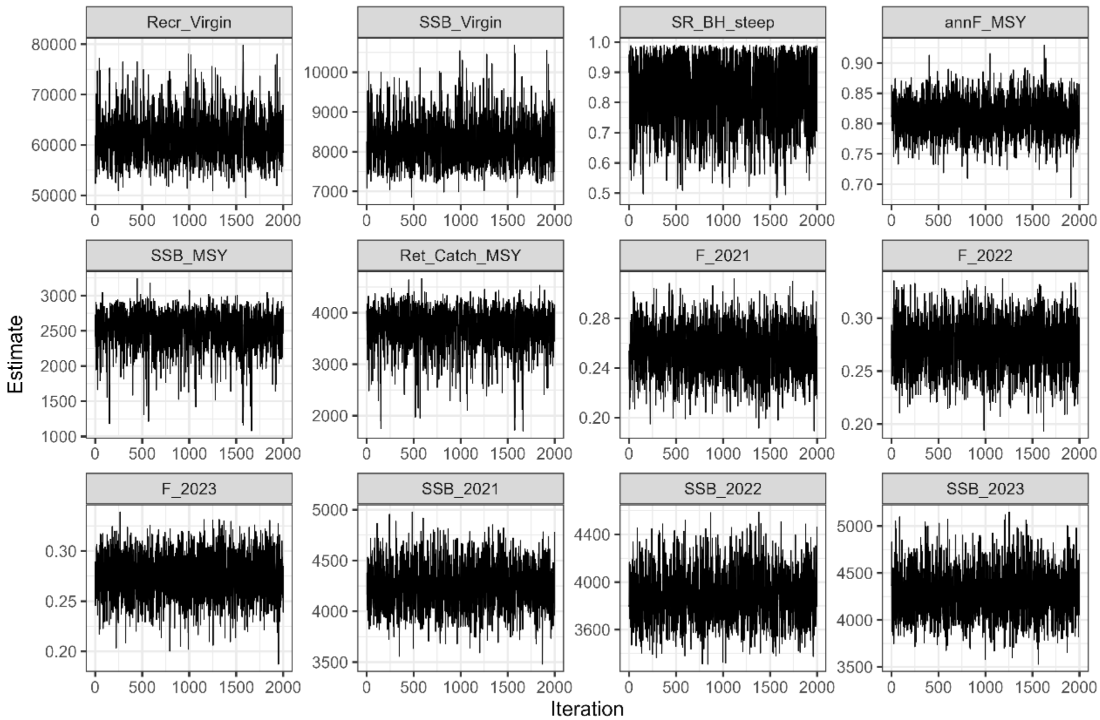


Figure 31. Expected numbers-at-age (bubbles) and mean age (red line) at the middle of the year for Florida Gulf (female max ~ 28.3 million, male max ~ 26.0 million) and Florida Atlantic (female max ~ 10.2 million, male max ~ 9.4 million) Spotted Seatrout by sex.

Florida Gulf – Chain 1



Florida Gulf – Chain 2

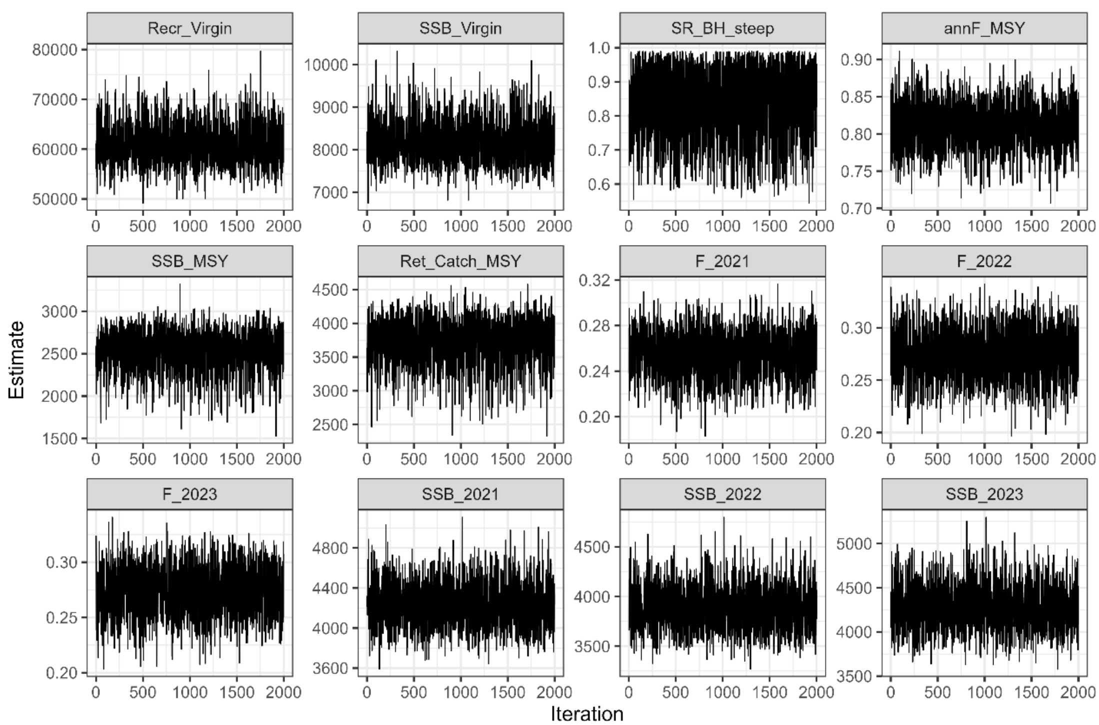
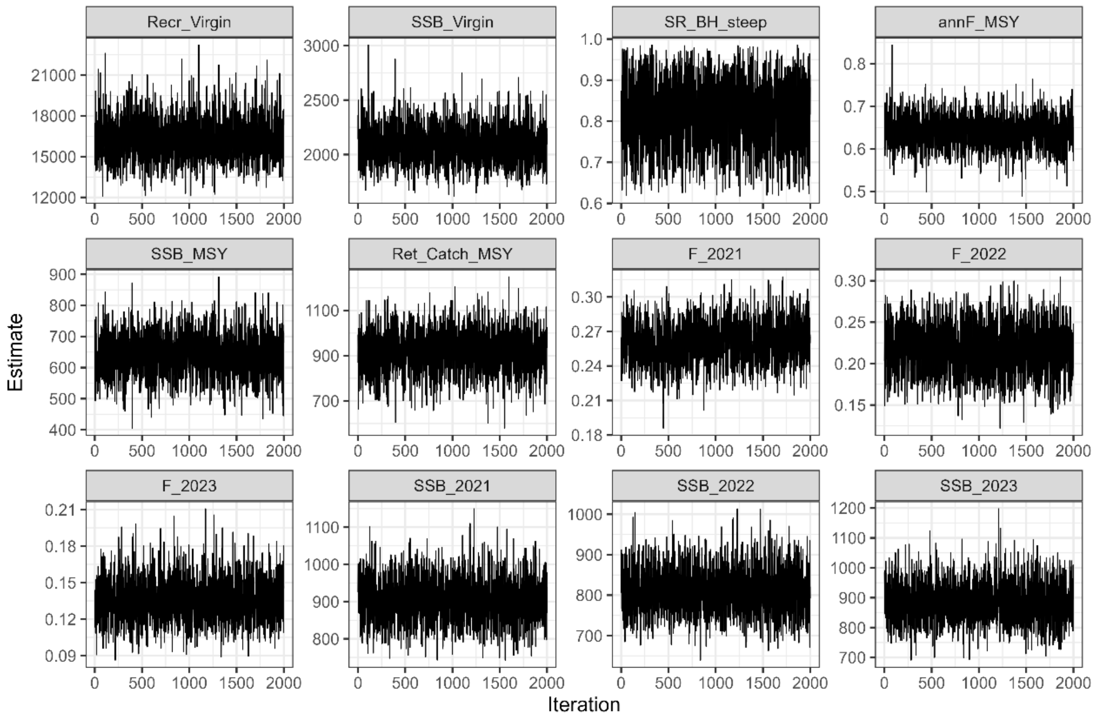


Figure 32. Traceplots of MCMC chains for selected parameters and derived quantities for Florida coast base models.

Florida Atlantic – Chain 1



Florida Atlantic – Chain 2

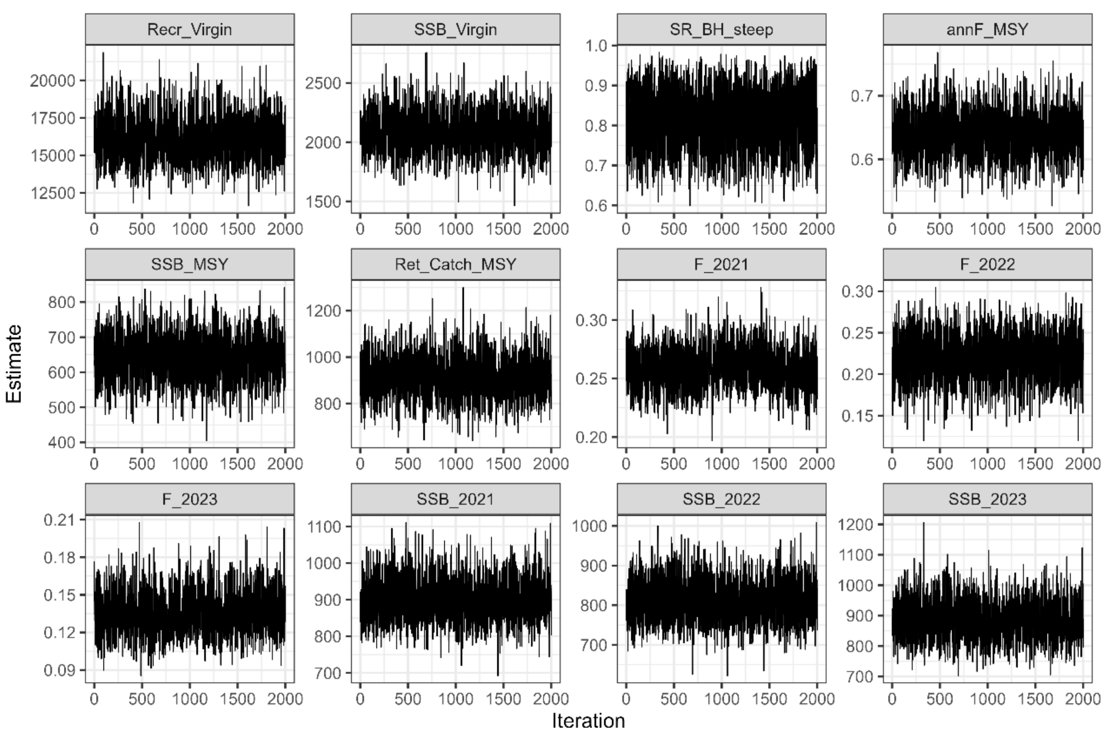


Figure 32 continued. Traceplots of MCMC chains for selected parameters and derived quantities for Florida coast base models.

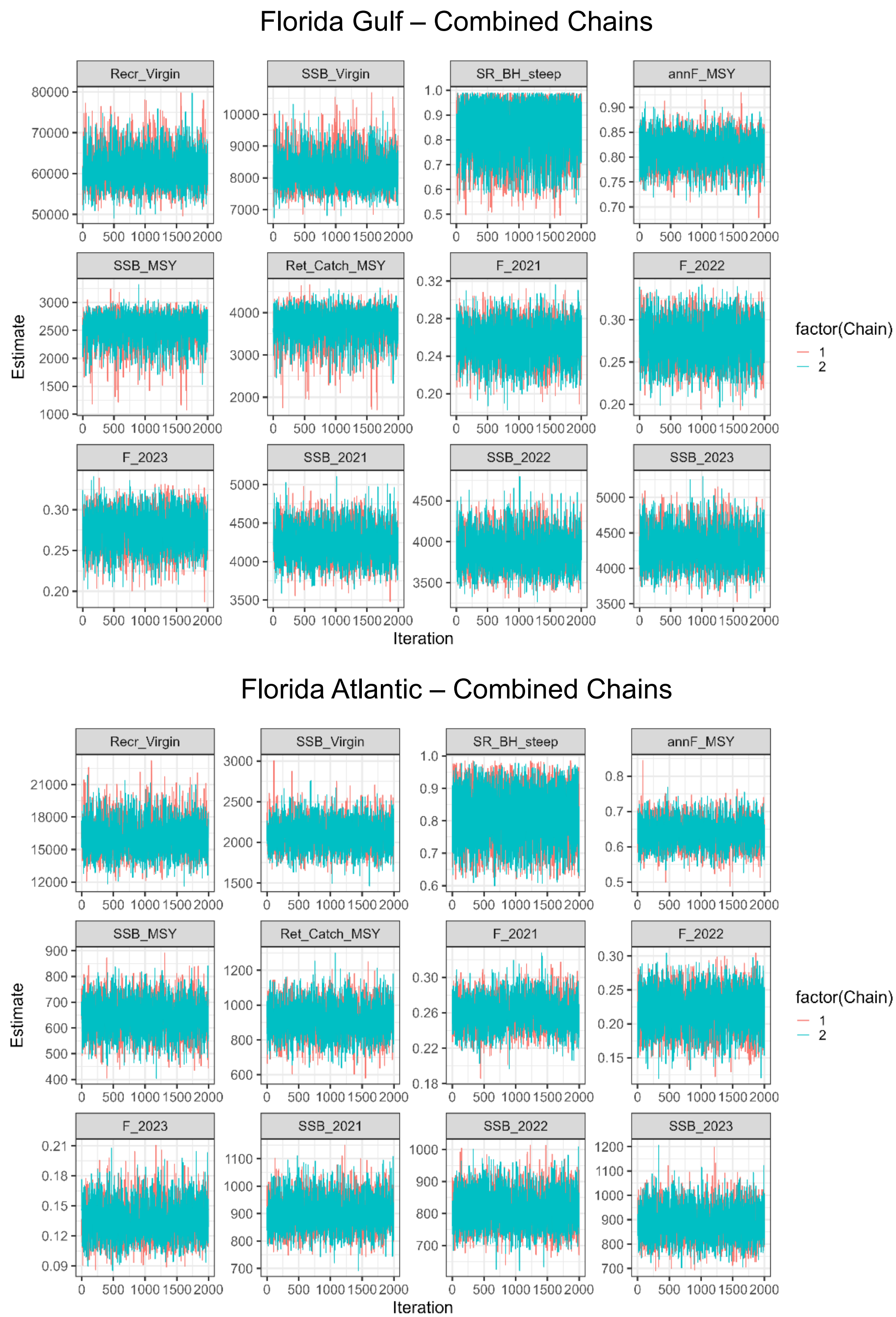


Figure 33. Traceplots of combined MCMC chains for selected parameters and derived quantities for Florida coast base models.

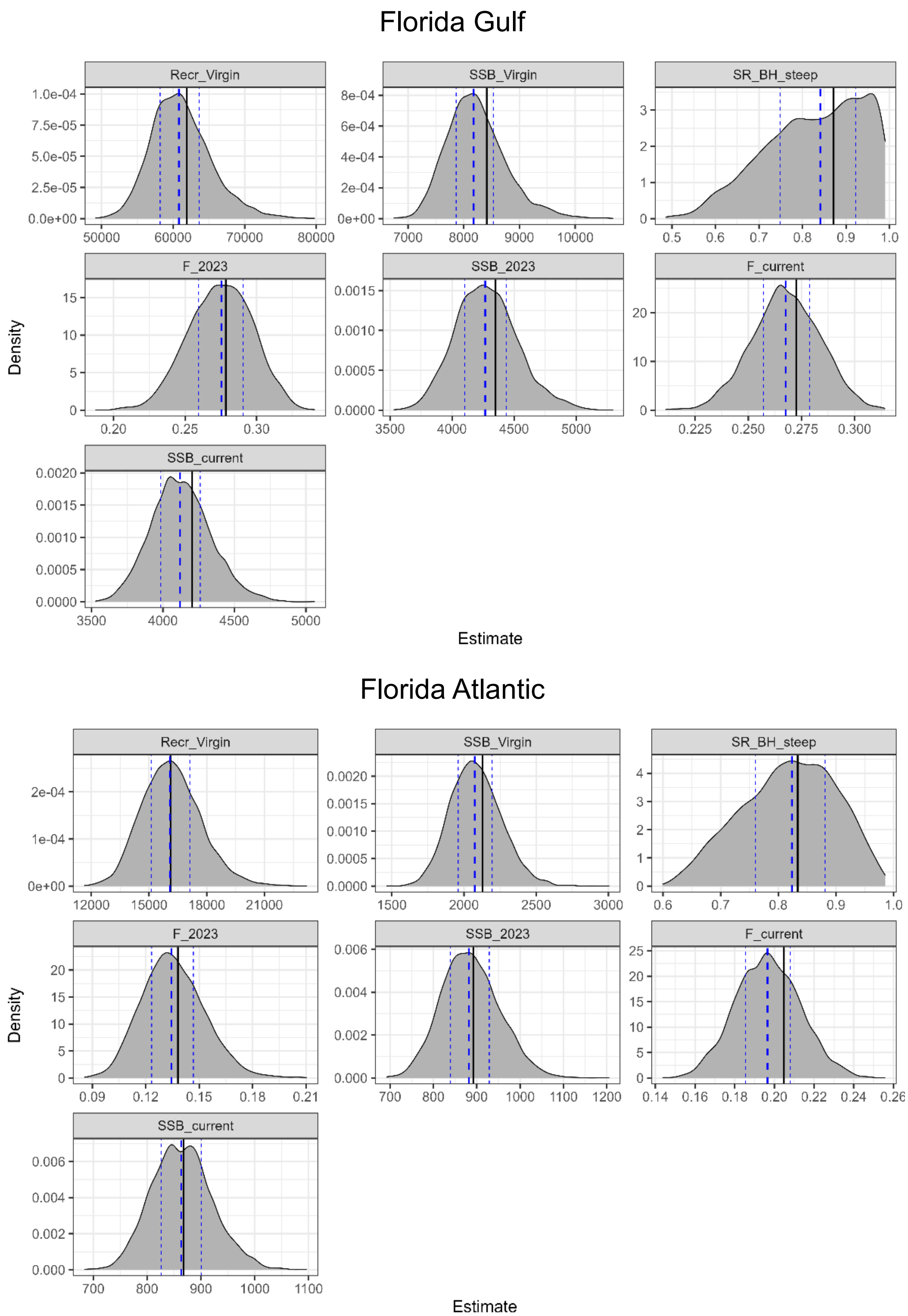


Figure 34. Two chain MCMC posterior distributions of selected parameters and derived quantities (n = 4500 iterations per coast). Blue dotted lines indicate the mean and interquartile range. Florida coasts' base model run estimates are shown in black.

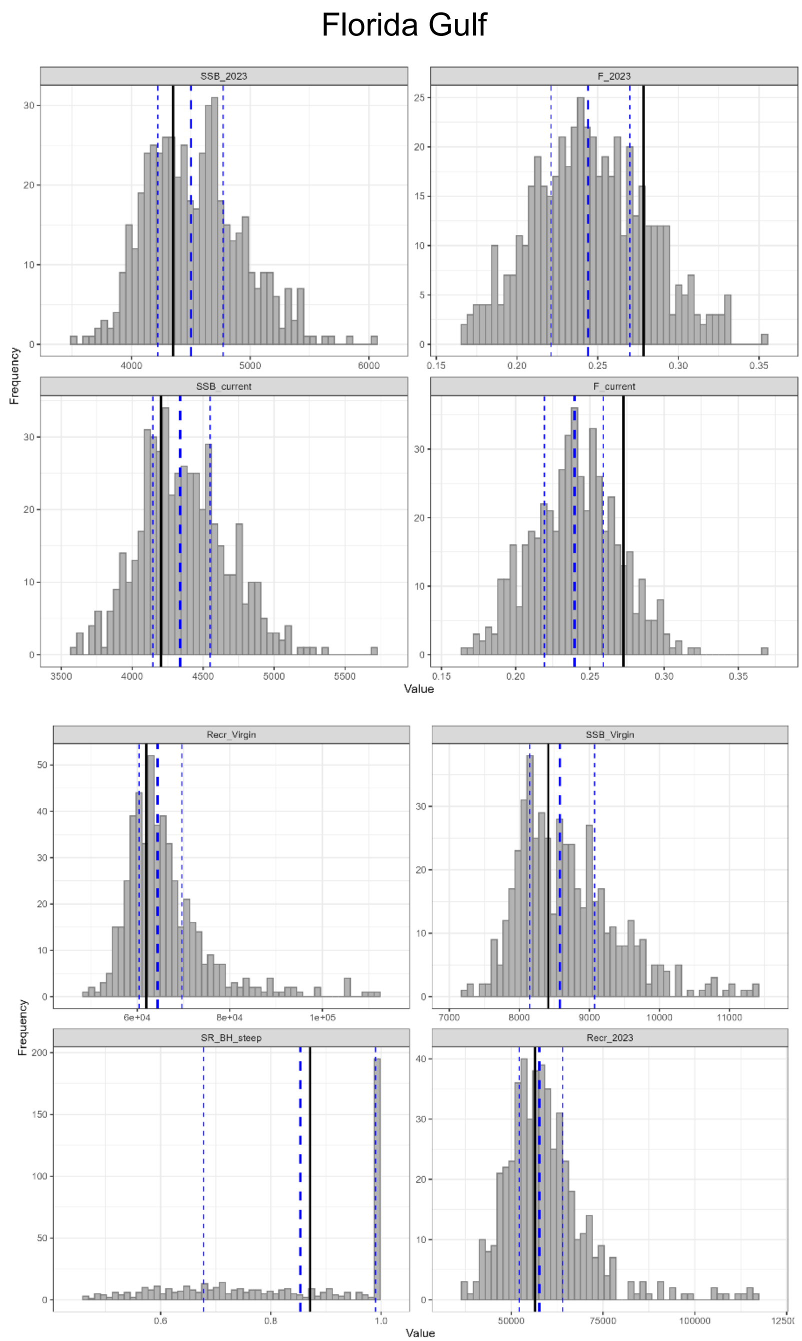


Figure 35. Histograms of parameter estimates associated with 500 bootstrap runs (grey bars) and Florida coast base model estimates are shown in black. The dashed lines represent the 25th and 75th percentiles and the thick dashed lines represent the median of parameter distributions.

Florida Atlantic

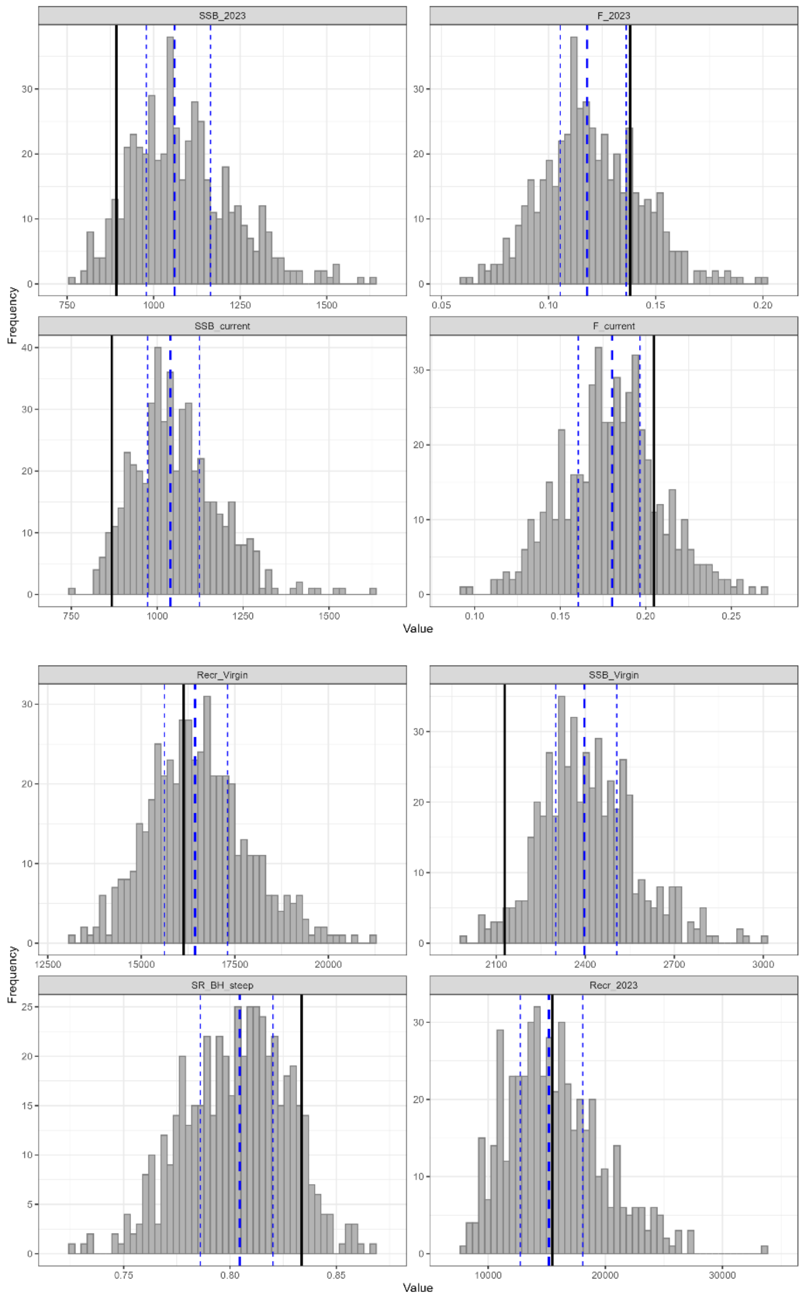


Figure 35 continued. Histograms of parameter estimates associated with 500 bootstrap runs (grey bars) and Florida coast base model estimates are shown in black. The dashed lines represent the 25th and 75th percentiles and the thick dashed lines represent the median of parameter distributions.

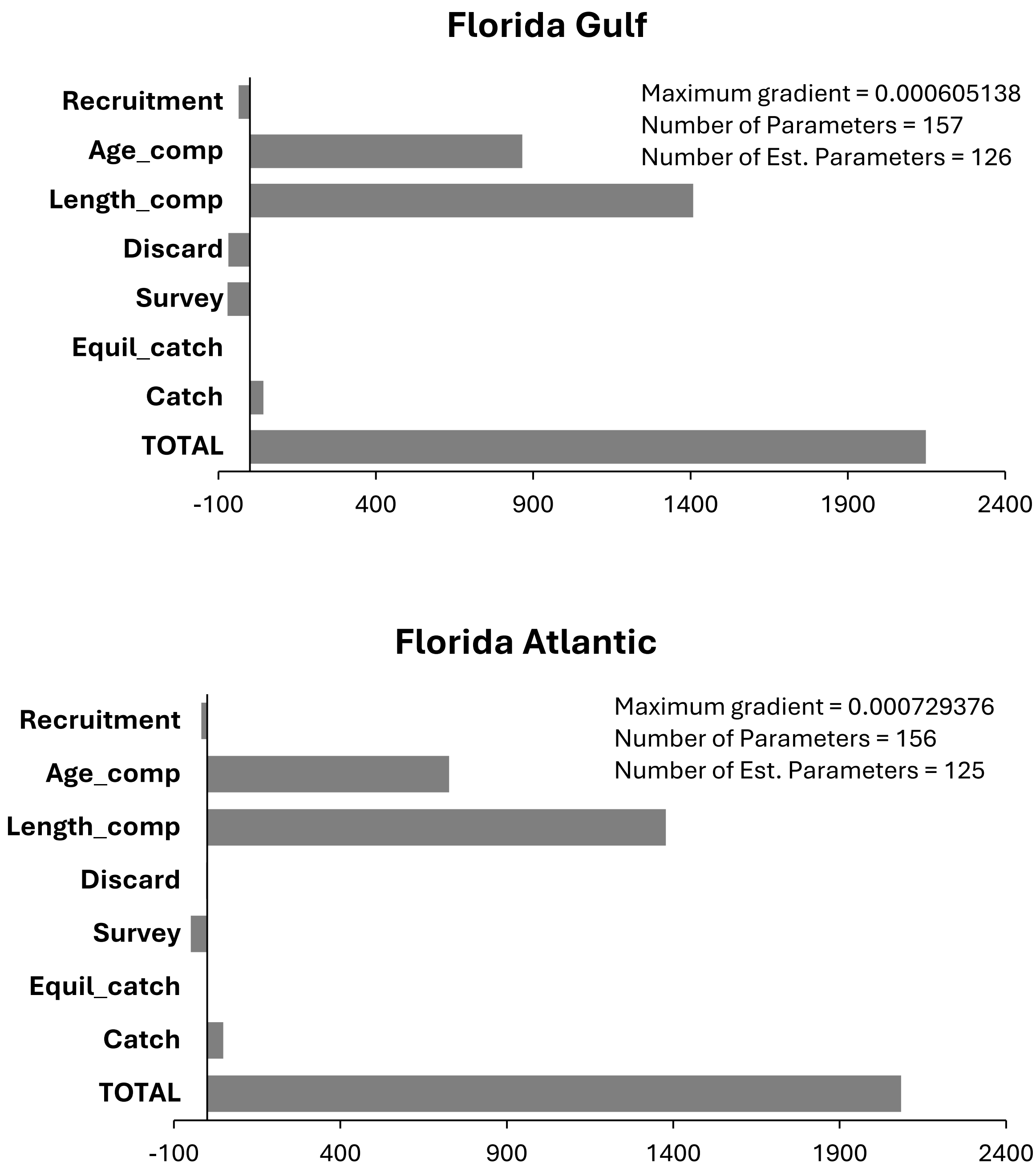
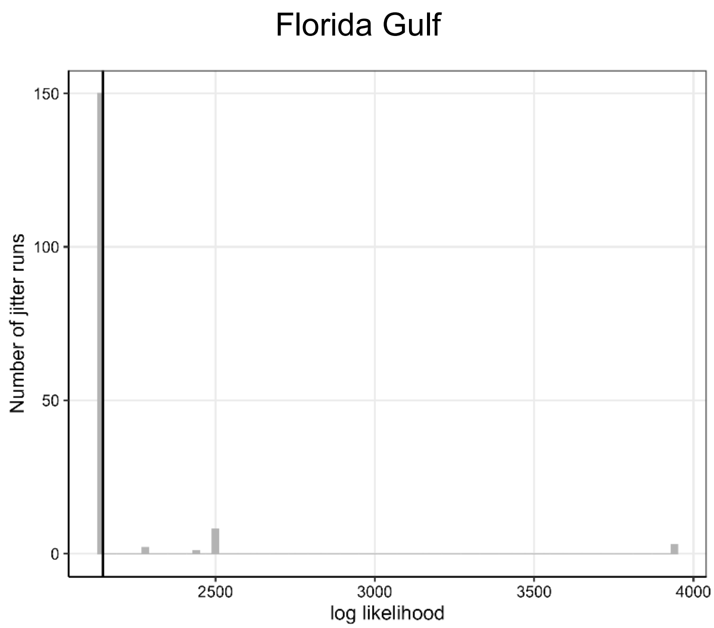


Figure 36. Magnitude of the components of the negative log-likelihood for the Florida Gulf (Total nLL = 2147.52) and Florida Atlantic (Total nLL = 2084.81) base models.



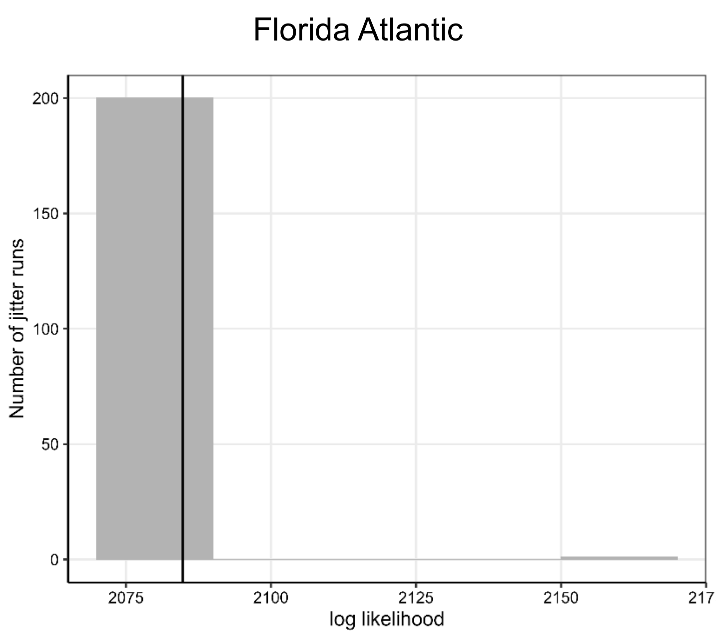


Figure 37. Histograms of log-likelihood values associated with jittered runs (n = 200, 15% jitter) that had maximum gradients < 0.5 for the Florida coast base models. The log-likelihood value associated with the base model is shown by the black line. No jitter run, regardless of maximum gradient, found a lower log-likelihood value than the base model's log-likelihood.

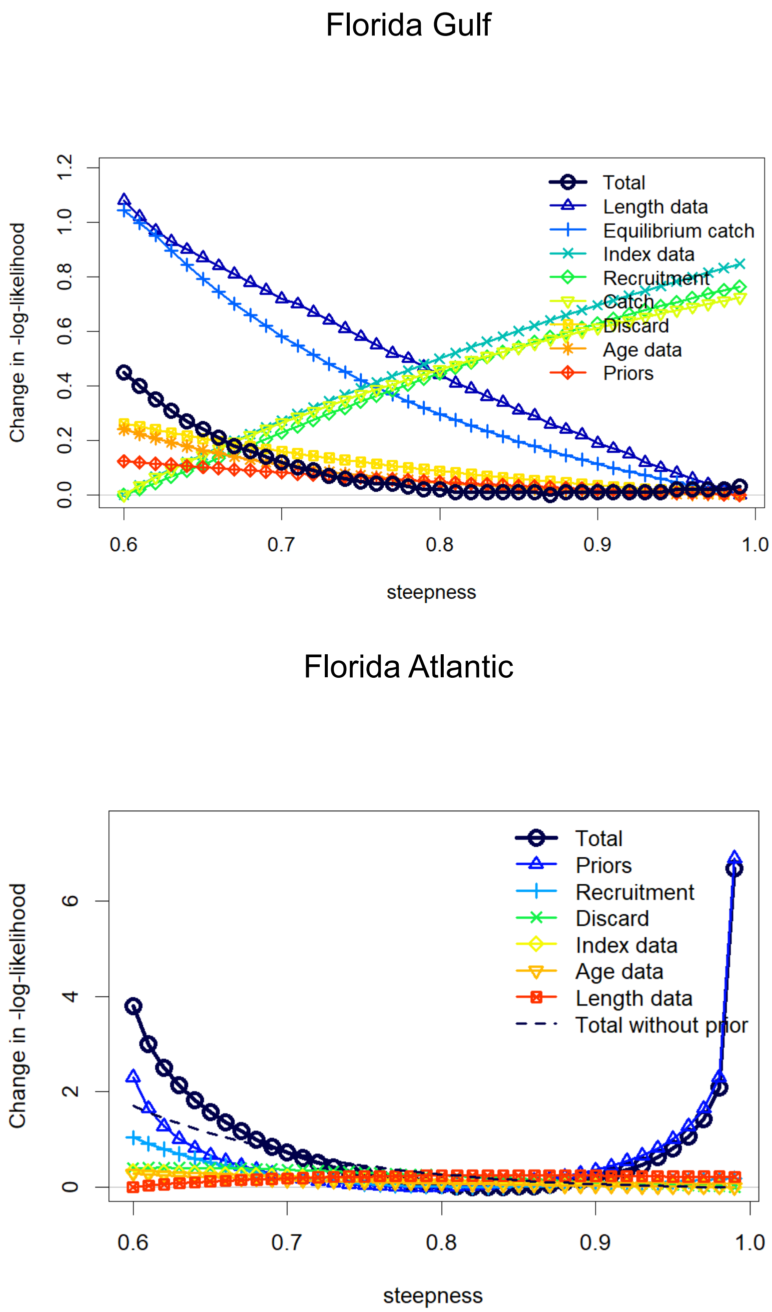


Figure 38. The likelihood profile for steepness (*h*) of the Beverton – Holt stock-recruit function for Florida coast Spotted Seatrout base models. The black line indicates the negative log-likelihood values across the range of fixed values tested. The estimates of steepness from the Florida Gulf and Florida Atlantic base models was 0.871 and 0.834, respectively. The dashed horizontal lines are the Florida Gulf and Florida Atlantic base model log-likelihood value of 2147.52 and 2084.81, respectively.

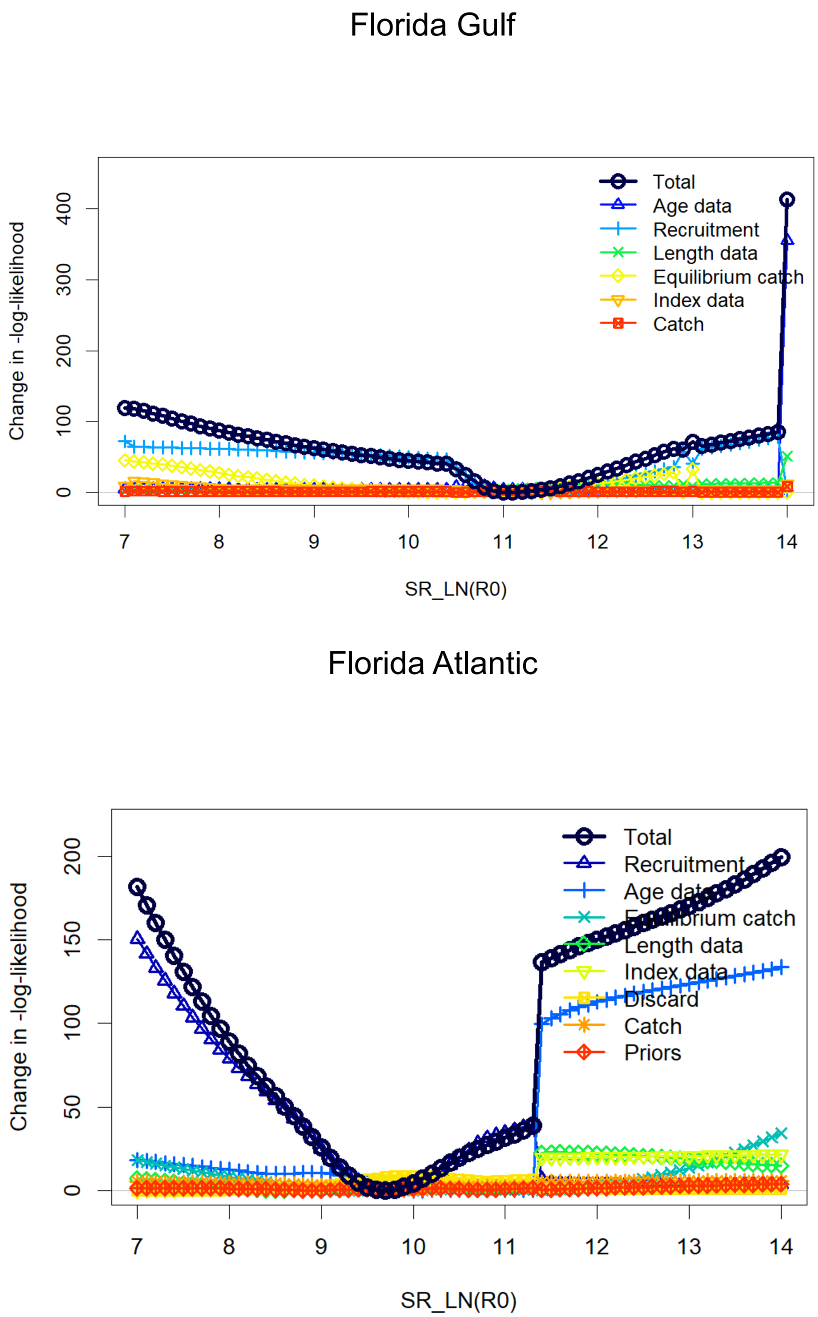


Figure 39. The likelihood profile for the natural log of the virgin recruitment parameter ($\ln(R_0)$) of the Beverton – Holt stock-recruit function for Florida coast Spotted Seatrout base models. The black line indicates the negative log-likelihood values across the range of fixed values tested. The estimate of $\ln(R_0)$ from the Florida Gulf and Florida Atlantic base models was 11.03 and 9.69, respectively.

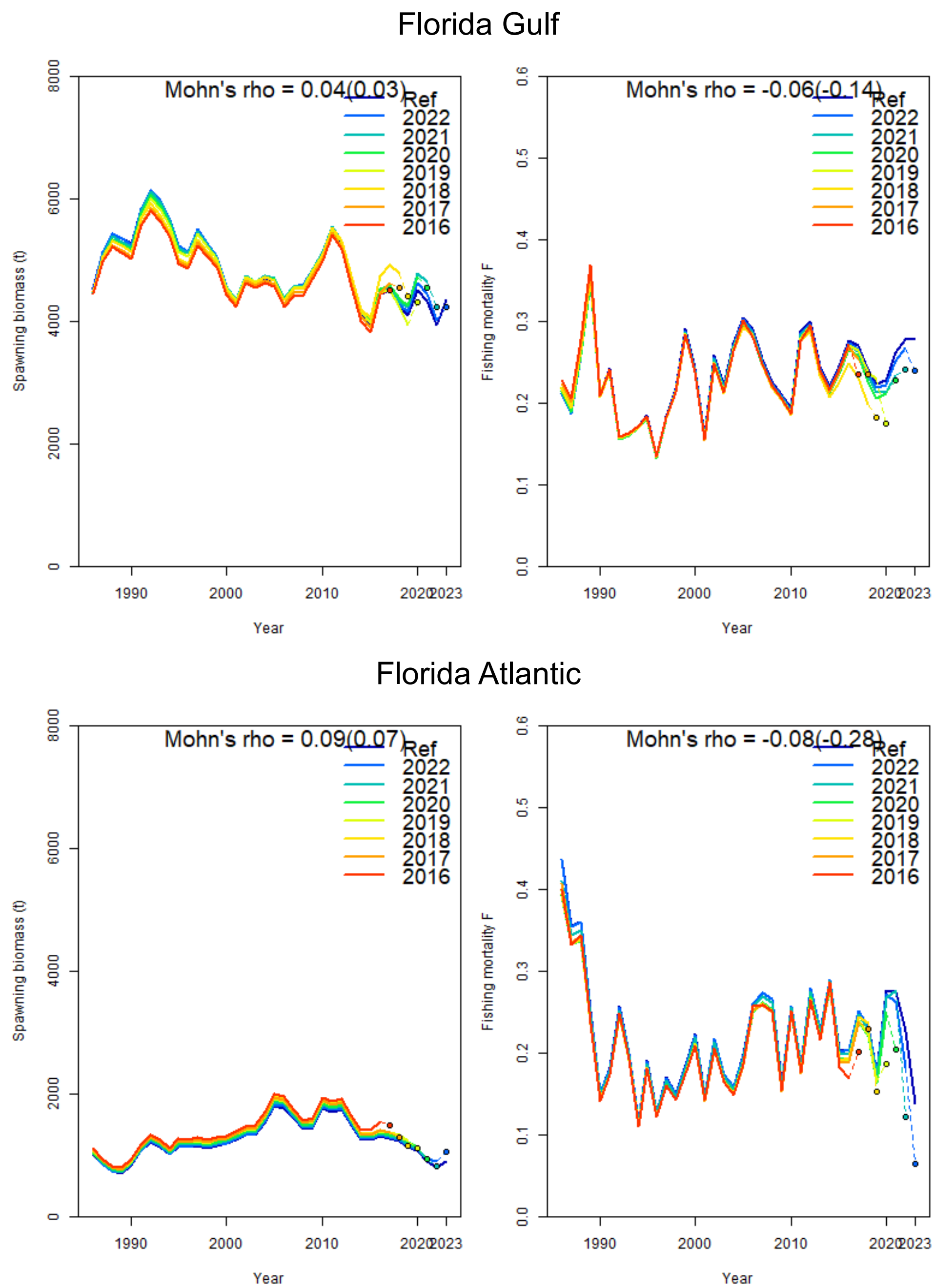
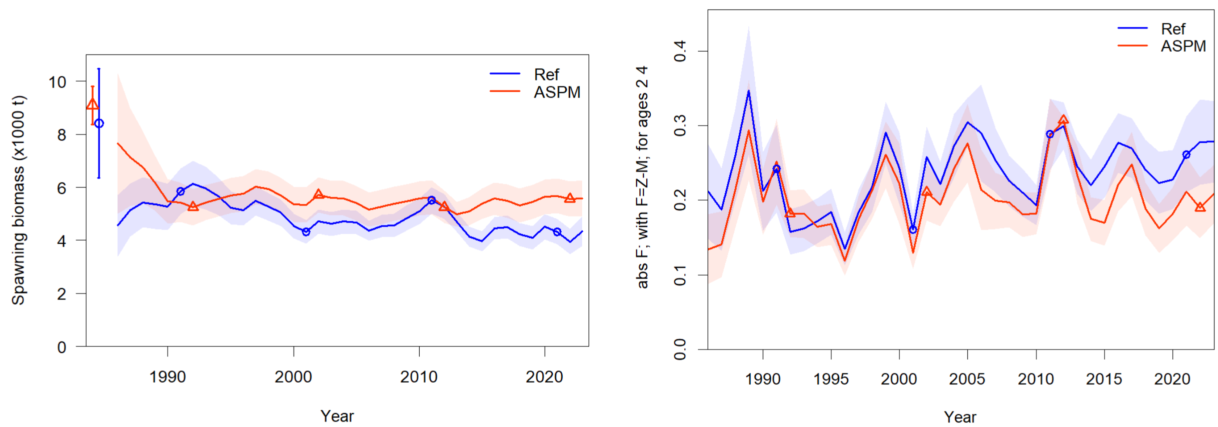


Figure 40. Retrospective analysis of spawning stock biomass and age 2-4 fishing mortality estimates for Florida coasts' Spotted Seatrout conducted by removing seven years of observations, one year at a time sequentially. The retrospective results are shown for the entire time series and for the most recent years only. Mohn's rho statistic and the corresponding 'forecast rho' values (in parentheses) are printed at the top of each panel. One-year-ahead projections denoted by color-coded dashed lines with terminal points shown for each model.

Florida Gulf – Base and ASPM



Florida Gulf – Base and ASPM (with recruitment deviations)

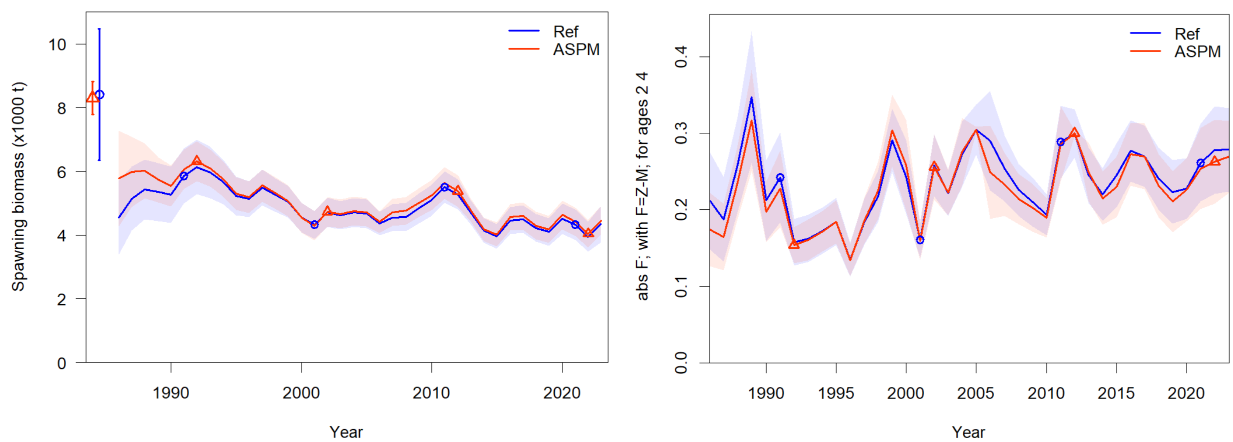
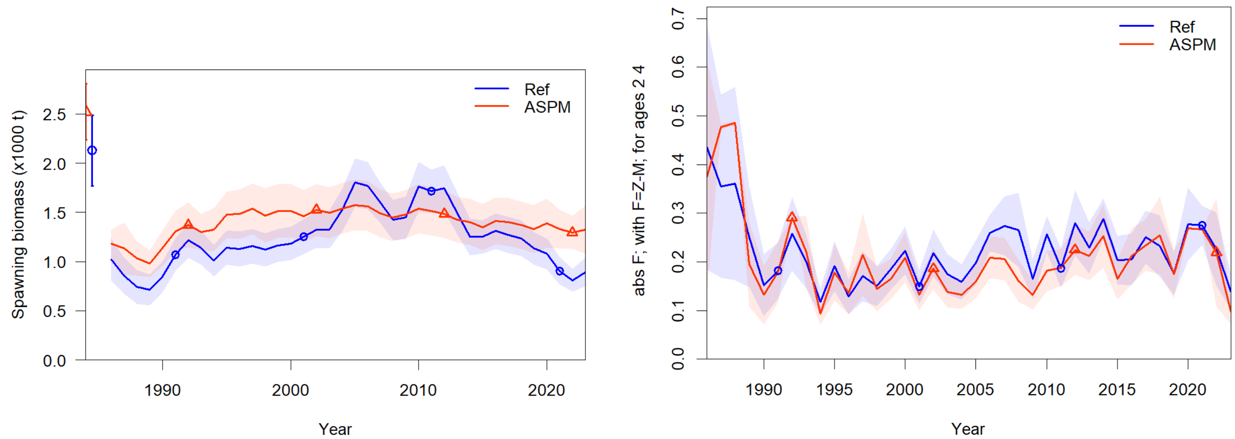


Figure 41. Comparison between the Florida coast base models, the deterministic Age Structured-Production Models (ASPM), and the ASPM with recruitment deviations showing spawning stock biomass and age 2-4 fishing mortality rates.

Florida Atlantic – Base and ASPM



Florida Atlantic – Base and ASPM (with recruitment deviations)

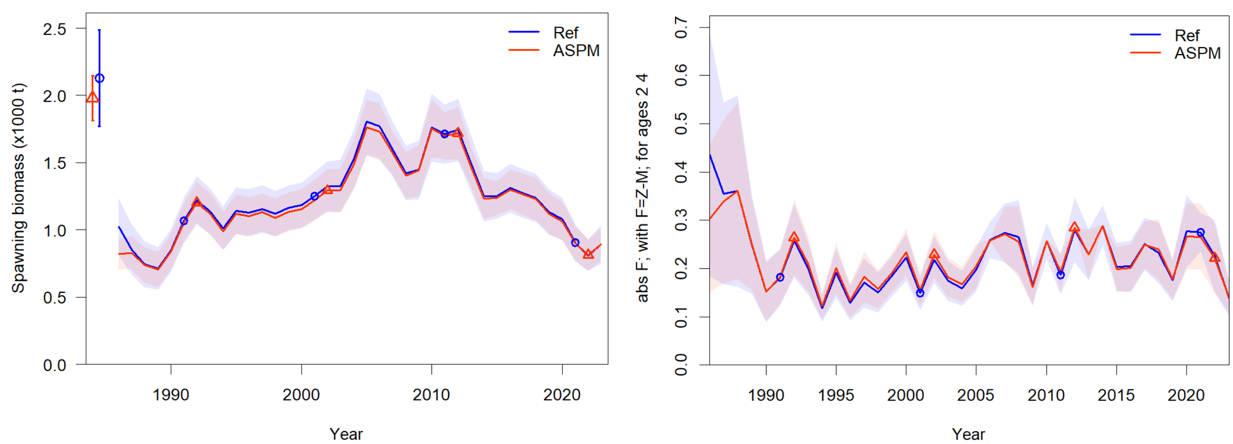


Figure 41 continued. Comparison between the Florida coast base models, the deterministic Age Structured-Production Models (ASPM), and the ASPM with recruitment deviations showing spawning stock biomass and age 2-4 fishing mortality rates.

Figure 42. Comparison of fishing mortality rates, spawning stock biomass, recruitment, virgin recruitment (R_0) and static SPR estimated by Florida coast ('Base') and sensitivity runs: model start year of 1950, 15% release mortality, 25% release mortality, and a fixed steepness of ~1 (0.99).

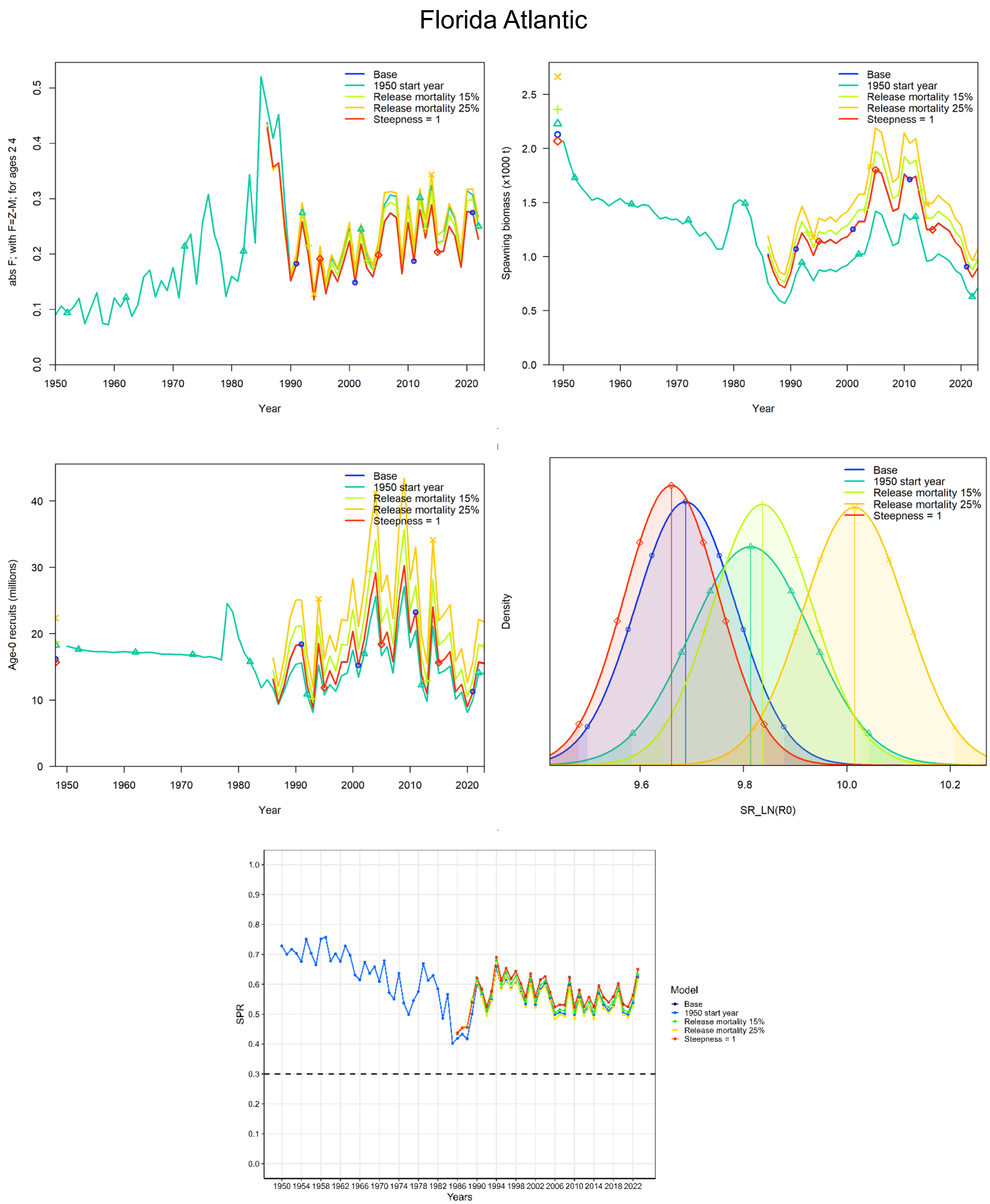


Figure 42 continued. Comparison of fishing mortality rates, spawning stock biomass, recruitment, virgin recruitment (R_0), and static SPR estimated by Florida coast ('Base') and sensitivity runs: model start year of 1950, 15% release mortality, 25% release mortality, and a fixed steepness of ~1 (0.99).

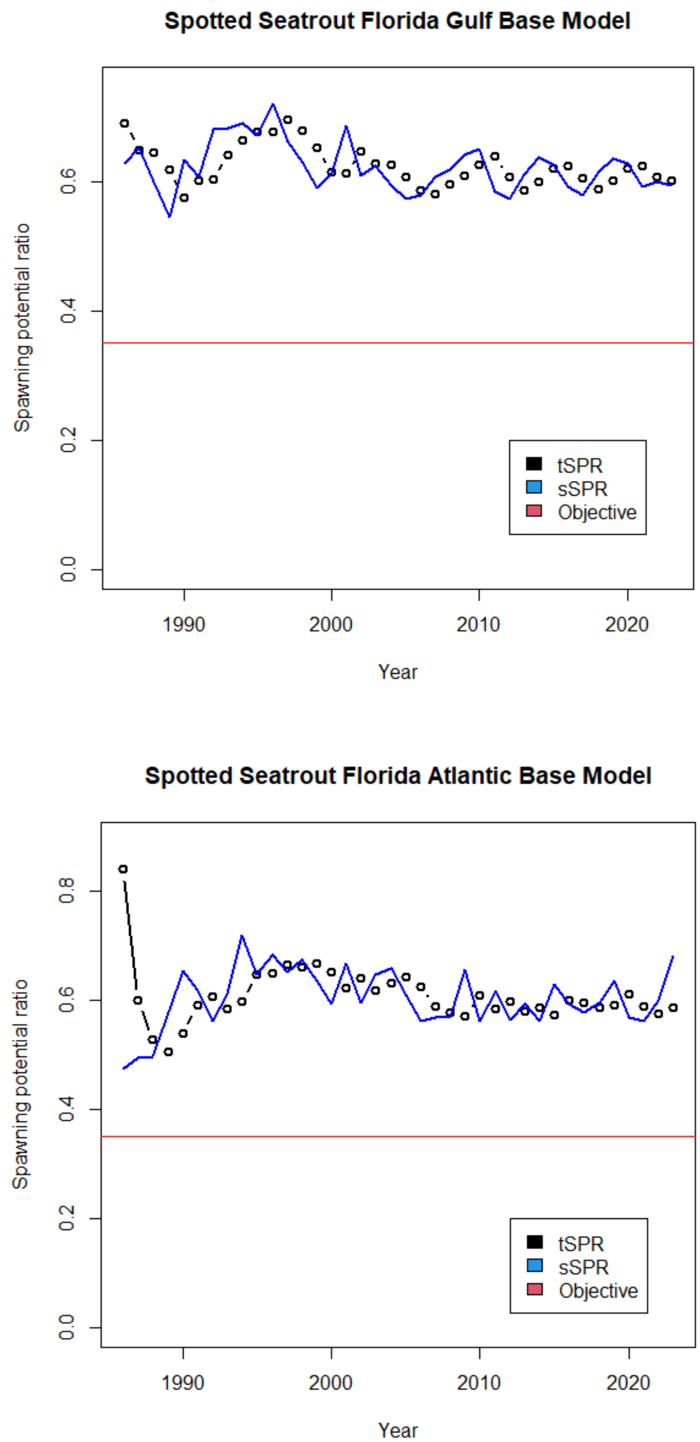


Figure 43. Calculated static and transitional spawning potential ratios for the Florida coast base models. The red line indicates the current tSPR target of 35% for Spotted Seatrout management in Florida.