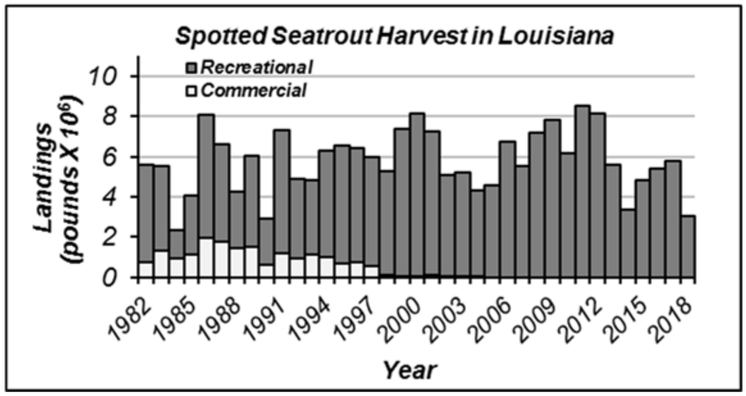
Assessment of Spotted Seatrout (*Cynoscion nebulosus)* in Louisiana Waters
2019 Report
Post-review Final Version

<u>*Executive Summary*</u>

Landings of spotted seatrout (SST) in Louisiana have remained above 5 million pounds per year in the most recent decade with the exceptions of 2014, 2015 and 2018. The 2014 and 2018 recreational harvests were the lowest observed since 1990. The highest recreational harvest on record (over 8 million pounds) was observed in 2011. After the commercial net ban in 1997, when rod and reel gear became the only allowed method of spotted seatrout harvest, commercial landings declined significantly and account for less than 0.1% of annual landings in the most recent decade.



A statistical catch-at-age model is used in this stock assessment to describe the dynamics of the female portion of the Louisiana spotted seatrout stock. The assessment model forward projects annual abundance at age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. Minimum data requirements are fishery catch-at-age and an index of abundance. Landings are taken from the Louisiana Department of Wildlife and Fisheries (LDWF) Recreational Creel Survey and Commercial Trip Ticket Programs, the National Marine Fisheries Service (NMFS) commercial statistical records, and the NMFS Marine Recreational Information Program (MRIP). Abundance indices are developed from the LDWF experimental marine gillnet survey. Age composition of fishery catches are estimated with age-length-keys derived from direct samples of the fishery and a growth model.

In earlier assessments of the LA SST stock (West *et al*. 2011, West *et al.* 2014), targets and explicit limits of fishing were proposed to ensure future sustainability of the stock. The proposed limits of fishing were based on the history of the stock by requiring female spawning stock biomass not fall below the lowest level observed earlier in the fishery in which the stock demonstrated sustainability. Based on results of this assessment, estimates of stock status relative to the proposed limits indicates the stock is currently overfished and has been undergoing overfishing. Management actions will be needed in order to prevent future overfishing and recover the stock from its current overfished condition.

<u>*Summary of Changes from 2014 Assessment*</u>

Assessment model inputs have been updated through 2018. No changes have been made to the assessment model itself. A number of changes have been made to the data inputs of the assessment model that are described below. Because of these changes, this stock assessment is considered a benchmark assessment rather than an update of the previous assessment.

The time-series of recreational landings estimates used in this assessment has changed. In the previous assessment, recreational landing estimates were taken from the NMFS MRIP survey (1981-2013). In this assessment, recreational landings estimates are taken from the LDWF Recreational Creel Survey (LA Creel; 2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; details in *Appendix 1*).

A new sampling program was established in 2014, when LDWF transitioned from MRIP to LA Creel, to provide biological information characterizing the size and age composition of LA fishery landings. In earlier assessments, size composition information of recreational landings was taken entirely from the MRIP survey. In this assessment, beginning in 2014, size composition of recreational landings was obtained from the LDWF Biological Sampling Program and from MRIP for years prior (details in *2. Data Sources*).

The LDWF experimental marine gill net survey is used to develop indices of abundance as data inputs of the assessment model. This survey was conducted from 1986 to April 2013 at fixed sampling stations within each LDWF Coastal Study Area (CSA). In October 2010, additional fixed stations were added to allowing more spatial coverage within each CSA. In April 2013, the survey design was modified where sampling locations are now selected randomly from the established stations within each CSA (details in *2. Data Sources*).

The standard von Bertalanffy growth model that was used in previous LDWF assessments to describe female spotted seatrout growth and develop age-length-keys for age assignments of fishery and survey catches has been replaced in this assessment with a growth model that accounts for decreasing growth rates (k) with age (details in *Appendix 2*).

A change was also made to better represent the uncertainty of recreational and commercial landings in the assessment model. In the previous assessment, variability of landings was assumed constant across each time-series. In this assessment, annual values of variability are used to control model fits of fishery yield (details in *6. Assessment Model*).

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<u>*Table of Contents*</u>

1. Introduction

A statistical catch-at-age model is used in this stock assessment to describe the dynamics of the female portion of the Louisiana (LA) spotted seatrout *Cynoscion nebulosus* (SST) stock from 1982-2018. The assessment model forward projects annual abundance at age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. Minimum data requirements are fishery catch-at-age and an index of abundance (IOA). Commercial landings values are taken from the Louisiana Department of Wildlife and Fisheries (LDWF) Trip Ticket Program and the National Marine Fisheries Service (NMFS) commercial statistical records. Recreational harvest estimates are obtained from the LDWF Recreational Creel Program (LA Creel) and the NMFS Marine Recreational Information Program (MRIP). Abundance indices are developed from the LDWF experimental marine gillnet survey. Age composition of fishery catches are estimated with age-length keys derived from direct samples of the fishery (2002-2018) and a growth model (1982-2001).

1.1 Fishery Regulations

The LA SST fishery is governed by the LA State Legislature, the Wildlife and Fisheries Commission, and the Department of Wildlife and Fisheries. Current recreational regulations are a 12-inch minimum length limit (MLL) and a 25-fish per day creel limit, with the exception of south-west Louisiana (from the Texas border to the Mermentau River) that is currently managed with a 15-fish daily creel limit with a 12-inch MLL and no more than two fish allowed over 25-inches. Commercial harvest is limited to rod and reel gear only, with a 14-inch MLL. Historic commercial and recreational SST fishery regulations were reviewed in an earlier assessment report (West *et al.* 2011).

1.2 Trends in Harvest

Time-series of recreational and commercial landings are presented (Table 1, Figure 1). Louisiana spotted seatrout landings have remained above 5 million pounds per year in the most recent decade with the exceptions of 2014, 2015 and 2018. The 2014 and 2018 recreational harvests were the lowest observed since 1990. The highest recreational harvest on record (>8 million pounds) was observed in 2011. After the commercial net ban in 1997, when rod and reel gear became the only allowed method of spotted seatrout harvest, commercial landings declined significantly and account for less than 0.1% of annual landings in the most recent decade.

2. Data Sources

2.1 Fishery Independent

The LDWF fishery-independent experimental marine gillnet survey is used in this assessment to develop abundance indices for use in the assessment model. Below is a brief description of this surveys methodology. Complete details can be found in LDWF (2018).

For sampling purposes, coastal Louisiana is currently divided into five LDWF coastal study areas (CSAs). Current CSA definitions are as follows: CSA 1 – Mississippi State line to South Pass of the Mississippi River (Pontchartrain Basin); CSA 3 – South Pass of the Mississippi River to Bayou Lafourche (Barataria Basin); CSA 5 – Bayou Lafourche to eastern shore of Atchafalaya Bay (Terrebonne Basin); CSA 6 – Eastern shore of Atchafalaya Bay to western shore of Freshwater Bayou Canal (Vermillion/Teche/Atchafalaya Basins); CSA 7 – western shore of Freshwater Bayou Canal to Texas State line (Mermentau/Calcasieu/Sabine Basins).

The LDWF Marine Fisheries Section conducts routine standardized sampling within each CSA as part of a long-term comprehensive monitoring program to collect life-history information and measure relative abundance/size distributions of recreationally and commercially important species. These include the experimental marine gillnet, trammel net, and bag seine surveys.

In this assessment, only the experimental marine gillnet survey is used. This survey has the highest spotted seatrout catch rates, frequency of occurrence, and precision when compared to the other LDWF FI surveys. The survey is conducted with standardized design. Hydrological and climatological measurements are taken with each biological sample, including water temperature, turbidity, conductivity and salinity. Survey gear is a 750-foot monofilament gillnet comprised of five 150-foot panels of 1.0, 1.25, 1.5, 1.75, and 2.0-inch bar meshes.

Samples are taken by ‘striking’ the net. All captured SST are enumerated and a maximum of 30 randomly selected SST per mesh panel are collected for length measurements, gender determination, and maturity information. When more than 30 SST are captured per mesh panel, catch-at-size is derived as the product of total catch and proportional subsample-at-size.

The survey was conducted from 1986 to April 2013 at fixed sampling locations within each CSA. The 1.25 and 1.75-inch bar mesh sizes, however, were not included in the survey until 1988. In October of 2010, additional fixed stations were added to this survey allowing more spatial coverage within each CSA. Beginning in April 2013, the survey design was modified where sampling locations are now selected randomly from the established stations within each CSA.

2.2 Fishery Dependent

Commercial

Commercial SST landings are taken from NMFS commercial statistical records (1982-1998; NMFS 2018a) and the LDWF Trip Ticket Program (1999-2017). The 2017 commercial SST landings values are used as a proxy for 2018 commercial landings that were not available at the time of this assessment.

For aging purposes, annual landings are allocated into six-month seasons (*i.e.,* January-June and July-December). Because only limited seasonal landings data are available from earlier in the fishery, the monthly landings records that are available are pooled into time-periods of consistent regulation (1981-1996 and 1997-1998) to develop seasonal catch compositions. Starting in 1999, seasonal catches are taken directly from the LDWF Trip Ticket Program.

Size composition of commercial catches in each year and season are derived from LDWF sampling effort (pre-1997 and 2014-2018) and MRIP records (1997-2013). Pre-1997 size distributions are only available for a limited number of years (1986 and 1990-1992) during which time the commercial sector operated under different MLLs and used a wider variety of harvest methods. Therefore, the 1990-1992 data are combined to describe the size composition of commercial catches from 1987- 1996 (*i.e.,* primarily a net fishery with a 14-inch MLL) and the 1986 data are used to describe the 1981-1986 commercial size compositions (*i.e.*, primarily a net fishery with 10 and 12-inch MLLs; Table 2). Seasonal size distributions of commercial catches are not available pre-1997; therefore, equivalent size composition is assumed for each six-month period. For years following the commercial net ban (*i.e*., 1997-present; only rod and reel harvest allowed with a 14 inch MLL), size composition of commercial catches are taken from MRIP records and the LDWF Biological Sampling Program (*i.e*., assuming equivalent vulnerability to rod and reel gear for both fisheries, but selecting only sizes ≥14 inches total length; Table 3).

Recreational

Recreational SST landings estimates are taken from the LDWF recreational creel survey (LA Creel; 2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; details in *Appendix 1*). Consequently, the pre-2014 recreational harvest estimates used in this assessment differ from the LA estimates currently published by MRIP (https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index). Furthermore, due to changes made to the MRIP Access Point Angler Intercept Survey (APAIS) in 2013 (see https://www.fisheries.noaa.gov/topic/recreational-fishing-data#making-improvements) and the recent transition from the MRIP Coastal Household Telephone Survey to the new Fishing Effort Survey (FES; see https://www.fisheries.noaa.gov/recreational-fishing-data/types-recreational-fishing-surveys#fishing-effort-survey), harvest estimates currently available from MRIP also differ from those used in the prior LA SST stock assessment (West *et al.* 2014).

For aging purposes, SST harvest and live release estimates are derived in six-month periods described in the previous section. Live releases are further delineated as legal or illegal with LA Creel and MRIP catch disposition codes.

Size composition of SST harvest estimates are derived from the LDWF Biological Sampling Program (2014-2018) and MRIP (1982-2013; prior to the APAIS and FES calibration changes) for each year and six-month season (Table 3); size composition of legal live releases is assumed equivalent. Statewide size compositions obtained from the LDWF Biological Sampling Program are derived by statistically weighting the CSA-specific size compositions by the corresponding recreational landings estimates.

Size composition of under-sized releases in each year and season is estimated by first assuming all illegal discards as < 12 inches total length. Some catch, however, is in fact legal-sized, but coded as illegal due to catches greater than the creel limit. These catches (~3% of LA angler trips per year, 2016-2018; LA Creel unpublished data) occur infrequently and are thus considered negligible for purposes of this assessment. Size composition of SST catches < 12 inches are pooled from the years prior to recreational MLL implementation and used as proxies of sublegal size composition after the 12 inch MLL was implemented in 1987.

3. Life History Information

3.1 Unit Stock Definition

Spotted seatrout occur in estuaries and nearshore coastal habitat along the Atlantic and Gulf coasts from Cape Cod, Massachusetts, to the Bay of Campeche, Mexico (GSMFC 2001). Most of the harvest, however, is taken in the Gulf of Mexico (GOM) with the largest recreational harvest occurring in LA waters.

Studies using mitochondrial DNA markers (Gold and Richardson 1998; Gold *et al.* 1999) have confirmed significant population substructuring across GOM SST populations. For the purpose of this assessment, the unit stock is defined as those female SST occurring in LA waters. This approach is consistent with the current statewide management strategy; although SST in south-west LA (from the Texas border to the Mermentau River) are managed with slightly different regulations (see *1.1 Fishery Regulations*).

3.2 Morphometrics

Weight-length regressions for LA SST were developed by Wieting (1989). For the purpose of this assessment, only the female-specific relationship is used with weight calculated from size as:

$$W = 1.17 \times 10^{-5} (FL)^{2.97} \quad [1]$$

where W is whole weight in grams and FL is fork length in mm. Fish with only FL measurements available are converted to TL (and conversely) using a relationship provided by the Florida Fish and Wildlife Institute (personal communication from Joe O'Hop, July 2010) where:

$$TL = 1.0008 \times FL + 0.6306 \quad [2]$$

3.3 Growth

Spotted seatrout exhibit differences in growth between males and females, with larger SST being predominantly female (Wieting 1989). The von Bertalanffy growth function developed in an earlier assessment for female SST (West *et al.* 2011) is replaced in this assessment with a growth model that accounts for decreasing growth rates with age (*i.e.,* damped growth model; Porch *et al.* 2002; see *Appendix 2*). Total length-at-age is calculated with the damped growth model as:

$$TL_a = 28.1 \times (1 - e^{\beta - 0.113(a - 0.0373)}) \quad [3]$$

$$\beta = \frac{0.414}{0.329}(e^{-0.329a} - e^{-0.329 \times 0.0373})$$

where TL_a is female TL-at-age in inches and years.

3.4 Sex Ratio

The probability of being female at a specific size is calculated with a logistic function developed in West *et al.* (2011) as:

$$P_{fem,l} = \frac{1}{[1 + e^{[-0.464(TL - 10.9)]}]} \quad [4]$$

where $P_{fem,l}$ is the estimated proportion of females in 1 inch TL intervals. The minimum sex ratio-at-size is assumed as 50:50.

3.5 Fecundity/Maturity

Spotted seatrout are serial spawners where annual fecundity is seasonally indeterminate. To realistically estimate annual fecundity, the number of eggs spawned per batch and the number of batches spawned per season must be known. Consistent estimates of batch fecundity and spawning frequency are currently not available for the LA SST stock (Wieting 1989; Nieland *et al.* 2002); therefore, female spawning stock biomass (SSB) is used as a proxy for total egg production in this assessment. This may introduce bias if fecundity does not scale linearly with body weight (Rothschild and Fogarty 1989).

Female maturity at size is calculated with a logistic function developed in West *et al.* (2011) as:

$$P_{mat,TL} = \frac{1}{[1 + e^{[-0.765(TL - 7.70)]}]} \quad [5]$$

where $P_{mat,TL}$ is the estimated proportion of sexualyl mature female spotted seatrout in 1 inch TL intervals. Female maturity at age is then calculated by substituting equation [5] into equation [3].

3.6 Natural Mortality

Spotted seatrout can live to at least ten years of age (GSMFC 2001, Herdter *et al.* 2019). For purposes of this assessment, a value of constant M is assumed (0.3) based on longevity of the species, but is allowed to vary with weight-at-age to calculate a declining natural mortality rate with age. This value of M is consistent with a stock where approximately 5% of the stock remains alive to 10 years of age (Quinn and Deriso 1999). Following SEDAR 12 (SEDAR 2006), the estimate is rescaled where the average mortality rate over ages vulnerable to the fishery is equivalent to the constant rate over ages as:

$$M_a = M \frac{nL(a)}{\sum_{a_c}^{a_{max}} L(a)} \qquad [6]$$

where M is a constant natural mortality rate over exploitable ages a, a_{max} is the oldest age-class, a_c is the first fully-exploited age-class, and n is the number of exploitable ages. The Lorenzen curve as a function of age is calculated from:

$$L(a) = W_a^{-0.288} \qquad [7]$$

where -0.288 is the allometric exponent estimated for natural ecosystems (Lorenzen 1996) and W_a is weight-at-age.

3.7 Discard Mortality

Reported SST discard mortality estimates are highly variable (~5-95%; Murphy *et al.* 1995; Stunz and McKee 2006; James *et al.* 2007; personal communication from Glenn Thomas, LDWF, July 2011). Results of these studies suggest the magnitude of post-release mortality as dependent on a number of factors including water quality, bait/hook type, anatomical hooking location, and angler skill-level. Spotted seatrout landings, however, are not directly separable into such components. Therefore, discard mortality is assumed constant in this assessment (10%). This rate is consistent with the overall rod-and-reel release mortality rates from the previously mentioned studies, *i.e.* 5, 11, 10 and 14%, respectively. For modeling purposes, stock losses due to discard mortalities are incorporated directly into recreational landings estimates (see *5. Catch at Age Estimation*).

3.8 Relative Productivity / Resilience

The key parameter in age-structured population dynamics models is the steepness parameter (*h*) of the stock-recruitment relationship. Steepness is defined as the ratio of recruitment levels when the spawning stock is reduced to 20% of its unexploited level relative to the unexploited level and determines the degree of compensation in the population (Mace and Doonan 1988). Populations with higher steepness values are more resilient to perturbation and if the spawning stock is reduced to levels where recruitment is impaired are more likely to recover sooner once overfishing has ended. Generally, this parameter is difficult to estimate due to a lack of contrast in spawning stock size (*i.e.,* data not available at both high and low levels of stock size) and is typically fixed or constrained during the model fitting process. Estimates of steepness are not available for spotted seatrout.

Productivity is a function of fecundity, growth rates, natural mortality, age of maturity, and longevity and can be a reasonable proxy for resilience. We characterize the relative productivity of LA SST based on life-history characteristics, following Southeast Data Assessment and Review (SEDAR) 9, with a classification scheme developed at the Food and Agriculture Organization of the United Nations (FAO) second technical consultation on the suitability of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) criteria for listing commercially-exploited aquatic species (FAO 2001; Table 4). Each life history characteristic (von Bertalanffy growth rate*, age at maturity, longevity, and natural mortality rate) is assigned a rank (low=1, medium=2, and high=3) and then averaged to compute an overall productivity score. In this case, the overall productivity score is 2.75 for LA spotted seatrout indicating high productivity and resilience. The von Bertalanffy growth rate referenced above is replaced in this assessment with the mean growth rate across ages from the damped growth model (see *Appendix 2*) weighted by expected relative abundance-at-age (k = 0.357).

4. Abundance Index Development

Abundance indices are developed separately for each mesh panel of the LDWF experimental marine gillnet survey with the exception of the 1.75 and 2.0-inch bar meshes that are excluded due to low catch rates. Stations not sampled regularly through time (prior to October 2010) and the less frequent 'cold-month' samples (*i.e.*, October –March) are also excluded. Catch per unit effort is defined as the number of female SST caught in each mesh panel per net sample. To reduce unexplained variability in catch rates unrelated to changes in abundance, each IOA time-series was standardized using methods described below.

A delta lognormal approach (Lo *et al.* 1992; Ingram *et al.* 2010) is used to standardize female SST catch-rates in each year as:

$$I_y = c_y p_y \quad [8]$$

where c_y are estimated annual mean CPUEs of non-zero female SST catches assumed as lognormal distributions and p_y are estimated annual mean probabilities of female SST capture assumed as binomial distributions. The lognormal and binomial means and their standard errors are estimated with generalized linear models as least square means and back transformed. The lognormal model considers only samples in which SST were captured; the binomial model considers all samples. Each IOA is then computed from equation [8] using the estimated least-squares means with variances calculated from:

$$V(I_y) \approx V(c_y)p_y^2 + c_y^2 V(p_y) + 2c_y p_y \mathrm{Cov}(c,p) \quad [9]$$

where Cov(c, p)≈ $\rho_{c,p}[SE(c_y)SE(p_y)]$ and $\rho_{c,p}$ represents the correlation of c and p among years.

Because of the designed nature of the experimental marine gillnet survey, model development was rather straightforward. Variables considered in model inclusion were year, CSA, and sampling location. Because only 'warm' month samples (*i.e.*, April-September) are included, time of year was not considered in model inclusion. To determine the most appropriate models, we began the model selection process with a fully-reduced model that included only year as a fixed effect. More complex models were then developed including interactions and random effects and compared using AIC and log-likelihood values. All sub-models were estimated with the SAS generalized linear mixed modeling procedure (PROC GLIMMIX; SAS 2008). In the final sub-models, year was considered a fixed effect, CSA was considered a random block effect, and sampling locations within CSAs were considered random subsampling block effects.

Sample sizes, proportion positive samples, nominal CPUE, standardized index, and coefficients of variation of the standardized indices are presented (Table 5). Standardized and nominal CPUEs, normalized to 1 for comparison, are also presented (Figure 2).

5. Catch at Age Estimation

Age-length-keys (ALKs) are developed to estimate age composition/catch-at-age of fishery and survey catches as described below.

Spotted seatrout in LA exhibit a protracted spawning season, with spawning primarily occurring across a six-month period from April through September (Hein and Shepard 1980). The mid-point of the spawning season (July 1st) is typically assumed as a biological birthday. However, for purposes of this assessment, ages were assigned based on the calendar year by assuming a January 1st birthday, where SST spawned the previous year become age-1 on January 1st and remain age-1 until the beginning of the following year.

5.1 Fishery

Beginning in 2002, ALKs are developed from samples directly of the fishery; for earlier years, from the damped growth model.

1981-2001 Probabilities of age a given length l in each six-month season (s; January-June and July-December) are computed as:

$$P(a|l)_s = \frac{P(l|a)_s}{\sum_a P(l|a)_s} \quad [10a]$$

where the probability of length given age in each season is estimated from a normal probability density as:

$$P(l|a)_s = \frac{1}{\sigma_{as}\sqrt{2\pi}} \int_{l-d}^{l+d} e\left[-\frac{(l-l_{as})^2}{2\sigma_{as}^2}\right] dl \quad [10b]$$

where length bins are 1 inch TL intervals with midpoint l, maximum $l + d$, and minimum $l - d$ lengths. Mean length-at-age in each season l_{as} is estimated from equation [3]. Variance in length-at-age is approximated as $\sigma_{as} = l_{as}CV_l$, where the coefficient of variation in length-at-age CV_l is assumed constant (in this case approximated as 0.05). To approximate changes in growth during each season, mean length-at-age is calculated at the midpoint of each six-month period. Thus, two seasonal $P(a|l)_s$ matrices are developed to assign ages to female SST fishery landings from 1982-2001 (Table 6) and also for instances discussed below.

_2002-2018_ Probabilities of age given length for each year and six-month season are computed as:

$$P(a|l)_{yfs} = \frac{n_{lays}}{\sum_a n_{lays}} \quad [11]$$

where n_{lays} is female sample-size in each length/age bin in each year and six-month season (Table 8). When $\sum_a n_{lays} < 10$, the $P(a|l)$ for that 1 inch TL interval is estimated with Equation [10].

Annual fishery-specific (f, recreational or commercial) catch-at-age (females only) is then calculated as:

$$C_{afy} = \sum_l \sum_s P_{fem,l} C_{lfys} P(a|l)_{ys} \quad [12]$$

where $P_{fem,l}$ is taken from equation [4], C_{lfy} is fishery-specific catch-at-size in each year and six-month season, and $P(a|l)_y$ are taken from Equations [10 or 11]. Recreational discard mortalities are incorporated directly into the recreational harvest-at-age by applying a 10% discard mortality rate to the estimated recreational releases-at-size and combining them with the recreational harvest-at-size estimates. Resulting fleet-specific annual catch-at-age (including discard mortalities) and associated mean weights-at-age are presented (Tables 10-12).

5.2 Survey

Probabilities of age given length for female SST catches of the LDWF marine gillnet survey are computed from equation [10]. Mean length-at-age is estimated from equation [3]. Variance in length-at-age is approximated as $\sigma_{as} = l_{as}CV_l$, where the coefficient of variation in length-at-age CV_l is assumed constant (in this case 0.05). To approximate changes in growth during the survey period (April-

September), mean length-at-age is calculated at the midpoint of the six-month survey period. Resulting survey $P(a|l)$ is presented (Table 7). Annual survey female catch-at-age is then taken from equation [12] with annual gear-specific survey catch-at-size substituted. Resulting annual survey age compositions (females only) are presented (Table 9).

6. Assessment Model

The Age-Structured Assessment Program (ASAP3 Version 3.0.12; NOAA Fisheries Toolbox) is used in this assessment to describe the dynamics of the female proportion of the LA SST stock. ASAP is a statistical catch-at-age model that allows internal estimation of a Beverton-Holt stock recruitment relationship and MSY-related reference points. Minimum data requirements are fishery catch-at-age, corresponding mean weights-at-age, and an index of abundance. ASAP projects abundance at age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. An overview of the basic model configuration, equations, and their estimation, as applied in this assessment, are provided below. Specific details and full capabilities of ASAP can be found in the technical documentation (ASAP3; NOAA Fisheries Toolbox).

6.1 Model Configuration

For purposes of this assessment, the model is configured with annual time-steps (1982-2018) and a calendar year time-frame.

Mortality

Fishing mortality is assumed separable by age a, year y, and fishery f as:

$$F_{ayf} = v_{af} Fmult_{yf} \quad [13]$$

where v_{af} are age and fishery-specific selectivities and $Fmult_{yf}$ are annual fishery-specific apical fishing mortality rates. Apical fishing mortalities are estimated in the initial year and as deviations from the initial estimates in subsequent years.

Fishery-specific selectivities are modeled with double logistic functions as:

$$v_{af} = \left(\frac{1}{1+e^{-(a-\alpha_f)/\beta_f}}\right)\left(1-\frac{1}{1+e^{-(a-\alpha 2_f)/\beta 2_f}}\right) \quad [14]$$

Total mortality for each age and year is estimated from the age-specific natural mortality rate M_a and the estimated fishing mortalities as:

$$Z_{ay} = M_a + \sum_f F_{ayf} \quad [15]$$

For reporting purposes, annual fishing mortalities are averaged by weighting by population numbers at age as:

$$F_y = \frac{\sum_a F_{ay} N_{ay}}{\sum_a N_{ay}} \quad [16]$$

Abundance

Abundance in the initial year of the time series and recruitment in subsequent years are estimated and used to forward calculate the remaining numbers at age from the age and year-specific total mortality rates as:

$$N_{ay} = N_{a-1,y-1} e^{-Z_{a-1,y-1}} \quad [17]$$

Numbers in the plus group A are calculated from:

$$N_{Ay} = N_{A-1,y-1} e^{-Z_{A-1,y-1}} + N_{A,y-1} e^{-Z_{A,t-1}} \quad [18]$$

Stock Recruitment

Expected recruitment is calculated from the Beverton-Holt stock recruitment relationship, reparameterized by Mace and Doonan (1988), with annual lognormal deviations as:

$$\hat{R}_{y+1} = \frac{\alpha SSB_y}{\beta + SSB_y} + e^{\delta_{y+1}} \quad [19]$$

$$\alpha = \frac{4\tau(SSB_0/SPR_0)}{5\tau - 1} \text{ and } \beta = \frac{SSB_0(1-\tau)}{5\tau - 1}$$

where SSB_0 is unexploited female spawning stock biomass, SPR_0 is unexploited spawning stock biomass per recruit, τ is steepness, and $e^{\delta_{y+1}}$ are annual lognormal recruitment deviations..

Spawning Stock

Female spawning stock biomass in each year is calculated from:

$$SSB_y = \sum_{i=1}^{A} N_{ay} W_{SSB,a}\, p_{mat,a} e^{-Z_{ay}(0.5)} \quad [20]$$

where $W_{SSB,a}$ are female spawning stock biomass weights-at-age, $p_{mat,a}$ is the proportion of mature females-at-age, and $-Z_{ay}(0.5)$ is the proportion of total mortality occurring prior to spawning on July 1st.

Catch

Expected fishery catches are estimated from the Baranov catch equation as:

$$\hat{C}_{ayf} = N_{ay}F_{ayf}\frac{(1-e^{-Z_{ay}})}{Z_{ay}} \quad [21]$$

Expected age composition of fishery catches are then calculated from $\frac{\hat{C}_{ayf}}{\sum_a \hat{C}_{ayf}}$. Expected fishery yields are computed as $\sum_a \hat{C}_{ayf}\bar{W}_{ayf}$, where $\bar{W}_{ayf}$ are observed mean catch weights.

Catch-rates

Expected survey catch-rates are computed from:

$$\hat{I}_{ay} = q\sum_a N_{ay}(1-e^{-Z_{ay}(0.5)})v_a \quad [22]$$

where v_a are survey selectivities, q are the estimated catchability coefficients, and $-Z_{ay}(0.5)$ is the proportion of the total mortality occurring prior to the time of the survey (July 1st midpoint). Survey selectivities are modeled with double logistic functions (equation [14]). Expected survey age composition is then calculated as $\frac{\hat{I}_{ay}}{\sum_a \hat{I}_{ay}}$.

Parameter Estimation

The number of parameters estimated is dependent on the length of the time-series, number of fisheries/selectivity blocks modeled, and the number of tuning indices modeled. Parameters are estimated in log-space and then back transformed. In this assessment, 152 parameters are estimated:

1. 32 selectivity parameters (5 blocks for the fisheries; 3 blocks for the surveys)
2. 74 apical fishing mortality rates (F_{mult} in the initial year and 36 deviations in subsequent years for 2 fisheries)
3. 37 recruitment deviations (1982-2018)
4. 5 initial population abundance deviations (age-2 through 6-plus)
5. 3 catchability coefficients (3 surveys)
6. 1 stock-recruitment parameter (SSB_0; the steepness parameter is fixed at 1.0 for the base run).

The model is fit to the data by minimizing the objective function:

$$-ln(L) = \sum_i \lambda_i(-ln\, L_i) + \sum_j(-ln\, L_j) \quad [23]$$

where $-ln(L)$ is the entire negative log-likelihood , lnL_i are log-likelihoods of lognormal estimations, λ_i are user-defined weights applied to lognormal estimations, and lnL_j are log-likelihoods of multinomial estimations.

Negative log-likelihoods with assumed lognormal error are derived (ignoring constants) as:

$$-ln(L_i) = 0.5 \sum_i \frac{[ln(obs_i) - ln(pred_i)]^2}{\sigma^2} \quad [24]$$

where obs_i and $pred_i$ are observed and predicted values; standard deviations σ are user-defined CVs as $\sqrt{ln(CV^2 + 1)}$.

Negative log-likelihoods with assumed multinomial error are derived (ignoring constants) as:

$$-ln(L_j) = -ESS \sum_{i=1}^{A} p_i \, ln(\hat{p}_i) \quad [25]$$

where p_i and $\hat{p}_i$ are observed and predicted age composition. Effective sample-sizes ESS are used to create the expected numbers $\hat{n}_a$ in each age bin and act as multinomial weighting factors.

6.2 Model Assumptions/Inputs

Model assumptions include: 1) the unit stock is adequately defined and closed to migration, 2) observations are unbiased, 3) errors are independent and their structures are adequately specified, 4) fishery and survey vulnerabilities are dome-shaped, 5) abundance indices are proportional to absolute abundance, and 6) natural mortality and growth do not vary significantly with time. Lognormal error is assumed for catches, abundance indices, the stock-recruitment relationship, apical fishing mortalities, selectivity parameters, initial abundance deviations, and catchabilities. Multinomial error is assumed for fishery and survey age compositions.

The base model was defined with an age-6 plus group, steepness fixed at 1.0, five fishery selectivity blocks, three survey selectivity blocks, and input levels of error and weighting factors as described below.

Input levels of error for recreational fishery landings estimates were specified with the corresponding CV's estimated from the LDWF LA Creel survey (2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; Table 12). Input levels of error for commercial fishery landings were specified with CV's of 0.1 for years where landings were obtained from NMFS commercial records (1982-1998) and CV's of 0.05 for years where landings were obtained from the LDWF Trip Ticket Program (1999-2018; Table 13). Input levels of error for survey catch-rates were specified with CV's estimated from each IOA standardization (Table 5). Annual recruitment deviations were specified with CV's of 0.5 for all years of the time-series.

Lognormal components included in the objective function were equally weighted (all lambdas=1). Input effective sample sizes (ESS) for estimation of fishery and survey age compositions were specified equally for all years of the time-series (all ESS=200).

6.3 Model Results

Objective function components, weighting factors, and likelihood values of the base model are summarized in Table 13.

Model Fit

The base model provides an overall reasonable fit to the data. Model estimated catches match the observations well (Figures 3 and 4); however, patterning of the residuals is apparent in the recreational landings time-series where catches are generally over-estimated in earlier years and under-estimated in more recent years. Model estimated survey catch-rates provide acceptable fits to the data, but fail to fit all extremes (Figures 5-7). Patterning of the residuals is also apparent, where catch-rates are generally under-estimated in the beginning of the time-series and then over-estimated later in the time-series until the beginning of the most recent decade, suggesting a contradiction between data sources (*i.e.*, fishery landings vs. survey catch-rates). Model estimated fishery and survey age compositions provide reasonable fits to the input age proportions (Figures 8-10).

Selectivities

Estimated fishery and survey selectivities are presented in Figures 11 and 12. Survey estimates indicate full-vulnerability to the 1.0 and 1.25-inch bar mesh sizes at age-1 and full-vulnerability to the 1.5-inch bar mesh size at age-2. Commercial estimates indicate full-vulnerability at age-2 for each period of consistent regulation. Recreational estimates also indicate full-vulnerability at age-2 for each period of consistent regulation; the age-1 recreational selectivity estimate was reduced by approximately 50% after the 12-inch recreational MLL regulation was implemented in 1987.

Abundance, Age Composition, Recruitment, and Spawning Stock

Total stock size and abundance-at-age estimates from the ASAP base model are presented in Table 14. Total stock size has varied considerably over the time-series. Stock size generally increased over the first half of the time-series from 9.1 million females estimated in 1982 to a maximum of 14.0 million females estimated in 2000. After 2000, stock size generally decreased to a minimum of 7.7 million females estimated in 2014. The 2018 estimate of female stock size is 9.1 million females.

The age composition of the stock in the most recent years of the time-series (2015-2018) indicates further truncation where the proportion of the stock ≥ age-3+ is now less than 10%. (Figure 13). The 2016 and 2018 estimates of the proportion of the stock ≥ age-3+ are the lowest on record (7% and 5% respectively). The age composition of the stock ≥ age-3+ varied in earlier years of the time-series (1982-2014) with a maximum of 24% estimated in 1982, a minimum of 8% estimated from 1990-1995, and an average of 13%. The age-composition observed in the landings time-series ≥ age-3+ depicts a similar trend where the lowest estimates on record are the most recent (Figure 13).

Estimates of age-1 recruitment (Figure 14) follow comparable trends with total stock size (Table 14). The average recruitment (geometric mean) over the entire time-series is 6.7 million fish. The average recruitment (geometric mean) in the most recent decade is 6.4 million fish. The 2018 age-1 recruitment estimate is 7.4 million fish.

Female SSB estimates are presented in Figure 15. Female SSB has also varied considerably over the time-series. After an initial decline in earlier years of the time-series, female SSB generally increased to a maximum of 9.1 million pounds observed in 2008. After 2008, female SSB generally decreased. The 2017 and 2018 female SSB estimates are the lowest on record (3.4 and 4.0 million pounds respectively).

Fishing Mortality

Estimated fishing mortality rates are presented in Table 15 (annual apical, average, and age-specific) and Figure 16 (average only). Fishing mortality rates have varied over the time-series with an upward trend apparent in the most recent decade. Before 2012, the time-series of average F was relatively flat and generally lacked a trend. Beginning in 2012, fishing mortality increased (>0.9 yr^{-1}) and has remained high with the exception of the terminal year estimate. The 2017 estimate of average F is the highest on record (1.2 yr^{-1}).

Stock-Recruitment

No discernable relationship is observed between female SSB and subsequent age-1 recruitment (Figure 17). The most recent female SSB estimates, however, are the lowest on record. The ASAP base model was run with steepness fixed at 1.0. The estimated unexploited female SSB was 45.3 million pounds. When allowed to directly solve for steepness, the parameter was estimated as 1.0. Alternate runs with steepness values fixed at 0.95, 0.90, 0.85, and 0.80 are discussed in the *Model Diagnostics* Section below.

Parameter Uncertainty

In the ASAP base model, 152 parameters were estimated. Asymptotic standard errors (±2) for the time-series of age-1 recruits are presented in Figure 14. Markov Chain Monte Carlo (MCMC) derived confidence intervals (95%) for the average fishing mortality rate and female SSB time-series are presented in Figures 15 and 16.

6.4 Management Benchmarks

Overfishing and overfished limits should be defined for exploitable stocks. The implication is that when biomass falls below a specified limit, there is an unacceptable risk that recruitment will be reduced to undesirable levels. Management actions are needed to avoid approaching this limit and to recover the stock if biomass falls below the limit.

Precautionary limits were proposed in earlier assessments (West *et al.* 2011, West *et al.* 2014) based on the history of the stock by requiring that female SSB not fall below the lowest level observed in the fishery prior to 2010 in which the stock demonstrated sustainability (*i.e.,* no observed decline in recruitment over a wide range of female SSB; Figure 17). This would be similar to maintaining the stock above a limit spawning potential ratio (SPR; Goodyear, 1993) where SPR is estimated from mature female biomass rather than total egg production. The method for calculating SPR_{limit} and the corresponding limit reference points is presented below.

When the stock is in equilibrium, equation [20] can be solved, excluding the year index, for any given exploitation rate as:

$$\frac{SSB}{R}(F) = \sum_{i=1}^{A} N_a p_{mat,a} W_{SSB,a} e^{-Z_a(0.5)} \quad [29]$$

where total mortality at age Z_a is computed as $M_a + v_a \times Fmult$; vulnerability at age v_a is taken by rescaling the current F-at-age estimate (geometric mean 2016-2018) to the maximum. Per recruit abundance-at-age is estimated as $N_a = S_a$, where survivorship at age is calculated recursively from $S_a = S_{a-1}e^{-Z_a}$, $S_1 = 1$. Per recruit catch-at-age is then calculated with the Baranov catch equation [21], excluding the year index. Yield per recruit (Y/R) is then taken as $\sum_a C_a \overline{W}_a$ where $\overline{W}_a$ are current mean fishery weights at age (arithmetic mean 2016-2018). Fishing mortality is averaged by weighting by relative abundance-at-age.

Equilibrium spawning stock biomass SSB_{eq} is calculated by substituting SSB/R estimated from equation [29] into the Beverton-Holt stock recruitment relationship as $\alpha \times SSB/R - \beta$. Equilibrium recruitment R_{eq} and yield Y_{eq} are then taken as $SSB_{eq} \div SSB/R$ and $Y/R \times R_{eq}$. Equilibrium SPR (e.g., SPR_{limit}) is computed as the ratio of SSB/R when F>0 to SSB/R when F=0.

As reference points to guide management, we estimate the spawning potential ratio and average fishing mortality rate that lead to the lowest SSB observed prior to 2010 (SSB_{limit}, SPR_{limit}, and F_{limit}). The targets of fishing should not be so close to the limits that the limits are exceeded by random variability of the environment. Therefore, we propose a SSB target (SSB_{target}) as the median SSB prior to 2010 in which the stock demonstrated sustainability and estimate the SPR and average F that lead to this target (SPR_{target} and F_{target}).

The proposed limits and targets of fishing are presented in Figure 18 relative to each respective time-series. Current estimates are taken as the geometric mean of the 2016-2018 estimates.

Also presented are a plot of the stock-recruitment data, equilibrium recruitment, and diagonals from the origin intersecting R_{eq} at the SSB_{limit}, SSB_{target}, and maximum SSB estimates of the time-series, corresponding with a SPR_{limit} of 10.2%, a SPR_{target} of 13.6%, and a maximum SPR of 19.8% (Figure 19). Limit and target reference points are also presented in Table 16.

6.5 Model Diagnostics

Sensitivity Analysis

In addition to the base model run, a series of sensitivity runs were used to explore uncertainty in the base model's configuration.

The ASAP base model was run with steepness fixed at 1.0. Alternate runs were conducted examining reference point estimates with steepness fixed at 0.95, 0.90, 0.85 and 0.80 (Models 1-4).

Additional sensitivity runs were conducted by separately up-weighting the contributions of fishery yield and the IOA components within the base models objective function (lambdas increased from 1 to 10; Models 5 and 6).

An additional sensitivity run was conducted by time-varying the baseline M-at-age used in the ASAP base model by adjusting it to a winter-kill index (Model 7). The winter-kill index was developed by compiling water temperature data from continuous water temperature monitoring stations across the LA coast and is calculated as the product of the number of days ≤ 7 degrees Celsius (*i.e.*, approximate water temperature where spotted seatrout cold-stun deaths begin to occur; Ellis *et al*. 2017) and the inverse of the mean water temperature during that duration (Figure 20). Baseline M-at-age (M_a) was allowed to vary with time ($M_{a,y}$) by adjusting to the winter kill index (WK_y) assuming winterkill events are additive as:

$$M_{a,y} = M_a + (WK_y \times c) \quad [30]$$

The value of the scaling parameter (c) above was chosen arbitrarily (in this case c=0.25).

Another sensitivity run was conducted by increasing the discard mortality rate from 10% to 25% (Model 8).

An additional sensitivity run was conducted where the ALK's developed from the damped growth model (Table 6) were used to assign ages to the entire time-series of fishery landings (Model 9).

Another sensitivity run was conducted using the MRIP ACAL time-series (see https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-glossary#calibrated-data), rather than the FCAL time-series, to hindcast LA Creel estimates to the historic MRIP time-series (Model 10). This time-series was developed using the same approach described in *Appendix 1* with the ACAL estimates substituted for the FCAL estimates.

A final sensitivity run was conducted using the MRIP size distributions with the FES and APAIS calibrations applied (Model 11).

Results of each sensitivity run relative to the proposed limit reference points are presented in Table 17. Current estimates of female SSB and average F are taken as the geometric mean of the 2016-2018 estimates. Estimates from all sensitivity runs indicate the stock is currently below SSB_{limit} with the exception of Model 5. Estimates from all sensitivity runs indicate the fishery is currently operating above F_{limit} with the exception of Models 5, 7, 8 and 10. Model 7 (winter-kill index used to time-vary M) resulted in the lowest estimate of current F due to a high M estimated from the severe cold spell in 2018, but also led to one of the lowest estimates of current SSB of all model runs.

Also presented are estimates of maximum sustainable yield (MSY) and associated reference points for those sensitivity runs with the steepness parameter not fixed at 1 (Table 18). Results of each run indicate that the fishery is currently operating past MSY, where ratios of current F and SSB to F_{MSY} and SSB_{MSY} are above and below 1 respectively. It's important to note, however, that the selection of specific values for the steepness parameter results in specified values of $SSB_{MSY,}$ $F_{MSY,}$ and other MSY statistics. Therefore, MSY values are not estimated per se, but are the results of the value selected for steepness.

Retrospective Analysis

A retrospective analysis was conducted by sequentially truncating the base model by a year (terminal years 2014-2018). Retrospective estimates of age-1 recruits, SSB and average fishing mortality differed from the base run (Figure 21). Terminal year estimates of age-1 recruits and female SSB indicate a marginal positive bias, where estimates tend to decrease as more years are added to the model. Terminal year estimates of average fishing mortality rates indicate a larger negative bias, where estimates tend to increase as more years are added to the model.

7. Stock Status

The history of the LA SST stock relative to F/F_{limit} and SSB/SSB_{limit} is presented in Figure 22. Fishing mortality rates exceeding F_{limit} (F/F_{limit}>1.0) are defined as overfishing; spawning stock sizes below SSB_{limit} (SSB/SSB_{limit}< 1.0) are defined as the overfished condition.

Overfishing Status

The current estimate of F/F_{limit} is <1.0, suggesting the stock is not currently undergoing overfishing. However, the current estimate is extremely close to the overfishing limit (F/F_{limit}=0.99). The current assessment model also indicates that the stock has been undergoing overfishing since 2012 with the exception of 2014 and the terminal year and also experienced overfishing in earlier years of the time-series.

Overfished Status

The current estimate of SSB/SSB_{limit} is <1.0, suggesting the stock is currently in an overfished state. The current assessment model also indicates that the stock has been overfished since 2014. The current SPR estimate is 8.5% (SPR_{limit}=10.2%).

Control Rules

There is currently no harvest control rule established for the LA SST stock.

8. Research and Data Needs

As with any analysis, the accuracy of this assessment is dependent on the accuracy of the information of which it is based. Below we list additional recommendations to improve future assessments of SST in Louisiana.

Assessment of regional or estuarine-specific spotted seatrout populations could differentiate exploitation rates and stock status within the state. If time-series of fine-scale spatial distribution data become available that allow for spatially-explicit assessment, results could be used to determine if regional management is an effective alternative to a statewide management strategy. Current LDWF surveys and commercial landings reported through the LDWF Trip Ticket Program could form the basis for this approach, but the time-series of basin-level recreational harvest and corresponding biological sampling are still not long enough for reliable assessment of regional populations.

Spotted seatrout in south-west LA from the Texas border to the Mermentau River are currently managed with slightly different regulations than the remainder of the state. Again, if data become available that allow for spatially-explicit assessment, results could be used to determine if current management has altered exploitation/stock status in the south-west region and, if so, used as a framework for future management. Current LDWF surveys (LA Creel, fishery-independent, and biological sampling) and commercial landings reporting through trip tickets could form the basis of this approach, but the recreational harvest and biological sampling time-series are still not long enough for reliable assessment of regional populations.

Information describing the connectivity of nearshore and inshore spotted seatrout populations along the Louisiana coast is currently not available. As data becomes available for spatially-explicit assessments, understanding the link between nearshore and inshore populations will become necessary.

The relationship between wetlands losses and the continuation of fishery production within Louisiana has been discussed by numerous authors. Understanding this relationship as it applies to the LA SST stock should be an ongoing priority.

This assessment highlights differing trends between fishery-independent catch-rates and fishery-dependent data sources. These differences should be evaluated further to determine which trends are truly reflective of population abundance, or whether other factors (e.g., increasing harvest efficiencies, changing vulnerabilities of the stock, etc.) are involved.

Only limited age data are available from the LDWF marine gillnet survey. Ages of survey catches in this assessment were assigned from ALK's developed from a growth model. Age samples collected directly from the survey would allow a more accurate representation of survey age composition in future assessments.

Winterkill events were included as a sensitivity run in this assessment by time-varying M-at-age proportionally to a winter-severity index. If age-classes are affected disproportionally to cold-stun deaths this approach will introduce bias into model estimates. Investigation of the relationship between spotted seatrout cold-stun deaths and age-class is needed.

Winterkill events were included as a sensitivity run in this assessment by time-varying M-at-age to a winter-severity index where the scaling parameter was chosen arbitrarily. Future modeling efforts should investigate integration of Equation [30], or a similar approach, into the assessment model itself to allow estimation of the scaling parameter during model fitting or investigate alternative models that allow integration of environmental time-series.

Factors that influence year-class strength of spotted seatrout are poorly understood. Investigation of these factors, including inter-annual variation in seasonal factors and the influence of environmental perturbations such as the Deepwater Horizon oil spill, could elucidate causes of inter-annual variation in abundance, as well as the species stock-recruitment relationship.

Spawning potential ratio estimates may be biased if egg production does not scale linearly with female body weight and existing estimates of batch fecundity and spawning frequency are conflicting. Current management benchmarks are based on the history of the stock by requiring the stock biomass to not fall below the lowest level observed earlier in the fishery. If management strategy were to change so that benchmarks are based on the reproductive potential of the stock, unbiased estimates of SPR would be needed.

Fishery-dependent data alone is not a reliable source of information to assess status of a fish stock. Consistent fishery-dependent and fishery-independent data sources, in a comprehensive monitoring plan, are essential to understanding the status of fishery. Present monitoring programs should be assessed for adequacy with respect to their ability to evaluate stock status, and modified if deemed necessary.

With the recent trend toward ecosystem-based assessment models (NMFS 2001), more data is needed linking spotted seatrout population dynamics to environmental conditions. The addition of meteorological and physical oceanographic data coupled with food web data may lead to a better understanding of the spotted seatrout stock and its habitat.

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10. Tables

Table 1: Louisiana annual commercial and recreational spotted seatrout landings (pounds x 10^6) derived from NMFS statistical records, LDWF Trip Ticket Program, MRIP, and LA Creel. Recreational landings represent harvest only.

	Harvest			
Year	Commercial	Recreational	%Commercial	%Recreational
1982	0.73	4.87	13.0	87.0
1983	1.34	4.17	24.3	75.7
1984	0.97	1.36	41.7	58.3
1985	1.16	2.90	28.6	71.4
1986	1.98	6.14	24.4	75.6
1987	1.80	4.85	27.1	72.9
1988	1.43	2.82	33.7	66.3
1989	1.49	4.55	24.6	75.4
1990	0.65	2.25	22.4	77.6
1991	1.22	6.13	16.6	83.4
1992	0.97	3.94	19.8	80.2
1993	1.14	3.68	23.6	76.4
1994	1.02	5.29	16.2	83.8
1995	0.66	5.90	10.0	90.0
1996	0.77	5.63	12.1	87.9
1997	0.55	5.43	9.2	90.8
1998	0.11	5.18	2.1	97.9
1999	0.08	7.32	1.0	99.0
2000	0.04	8.12	0.5	99.5
2001	0.11	7.19	1.5	98.5
2002	0.07	5.01	1.4	98.6
2003	0.02	5.19	0.4	99.6
2004	0.02	4.33	0.5	99.5
2005	0.02	4.56	0.4	99.6
2006	0.00	6.75	0.0	100.0
2007	0.01	5.53	0.2	99.8
2008	0.01	7.16	0.2	99.8
2009	0.00	7.82	0.0	100.0
2010	0.00	6.18	0.0	100.0
2011	0.00	8.53	0.0	100.0
2012	0.00	8.16	0.0	100.0
2013	0.00	5.62	0.1	99.9
2014	0.01	3.36	0.2	99.8
2015	0.00	4.81	0.1	99.9
2016	0.00	5.42	0.0	100.0
2017	0.00	5.80	0.1	99.9
2018	0.00	3.06	0.1	99.9

Table 2: Louisiana commercial size compositions of spotted seatrout landings derived from LDWF commercial landings records.

Commercial, 1981-1996		
TL_in	1981-1986	1987-1996
10	1	
11	12	
12	80	3
13	166	61
14	276	347
15	304	441
16	146	384
17	89	316
18	47	172
19	39	81
20	23	42
21	10	16
22	11	7
23	7	5
24	11	1
25	3	1
26	1	1
27		

Table 3: Annual size frequency distributions of Louisiana recreational spotted seatrout harvest (January-June; A+B1 catches only) taken from MRIP (1982-2013) and the LDWF Biological Sampling Program (2014-2018).

Recreational, January-June 1982-1999																		
TL_in	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
6	0.01																	
7	0.00	0.00	0.01			0.01												
8	0.05	0.00		0.03	0.02	0.01								0.00			0.00	0.00
9	0.05	0.04	0.01	0.02	0.04	0.02											0.00	
10	0.07	0.07	0.04	0.16	0.10	0.10	0.00			0.01	0.00	0.00	0.00	0.00	0.00	0.01		0.01
11	0.12	0.13	0.24	0.19	0.13	0.18	0.03	0.01	0.08	0.06	0.06	0.05	0.09	0.09	0.07	0.06	0.05	0.05
12	0.13	0.14	0.36	0.24	0.24	0.17	0.21	0.07	0.18	0.23	0.22	0.28	0.26	0.28	0.18	0.17	0.18	0.21
13	0.10	0.19	0.07	0.13	0.09	0.14	0.31	0.27	0.19	0.21	0.27	0.26	0.22	0.21	0.23	0.24	0.22	0.22
14	0.08	0.18	0.12	0.05	0.15	0.17	0.16	0.26	0.21	0.13	0.21	0.14	0.16	0.13	0.19	0.21	0.26	0.17
15	0.06	0.10	0.06	0.02	0.06	0.12	0.10	0.15	0.13	0.14	0.11	0.08	0.09	0.10	0.08	0.11	0.09	0.11
16	0.03	0.02	0.06	0.05	0.06	0.05	0.04	0.08	0.09	0.10	0.05	0.03	0.07	0.06	0.12	0.08	0.06	0.09
17	0.04	0.02		0.05	0.06	0.01	0.06	0.06	0.04	0.06	0.03	0.05	0.05	0.04	0.03	0.05	0.05	0.04
18	0.09	0.02	0.02	0.03	0.02	0.01	0.02	0.03	0.05	0.02	0.01	0.04	0.02	0.02	0.04	0.04	0.04	0.02
19	0.03	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.01	0.01	0.01	0.03	0.02	0.03	0.04	0.01	0.02	0.03
20	0.03	0.05		0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
21	0.02	0.02		0.02	0.01	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.02
22	0.03	0.01		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
23	0.02	0.01			0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00		0.01		0.00
24	0.02				0.00			0.00			0.00			0.00				0.00
25	0.03			0.00							0.00	0.00		0.00		0.00		0.00
26	0.00																	
27	0.00							0.00										0.00
28	0.00																	
29	0.00																	
30																		

Recreational, January-June 2000-2018																			
TL_in	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
6																			
7	0.00																		
8		0.00											0.00						
9						0.00										0.00			
10	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00				0.00				0.00	
11	0.04	0.02	0.05	0.05	0.06	0.05	0.05	0.04	0.05	0.04	0.04	0.03	0.05	0.09	0.00	0.00	0.01	0.00	0.00
12	0.19	0.18	0.16	0.16	0.24	0.20	0.14	0.16	0.20	0.19	0.13	0.15	0.16	0.15	0.09	0.09	0.10	0.06	0.06
13	0.20	0.18	0.14	0.18	0.19	0.23	0.16	0.23	0.22	0.28	0.14	0.26	0.16	0.18	0.20	0.24	0.22	0.19	0.14
14	0.18	0.18	0.16	0.21	0.15	0.22	0.22	0.16	0.20	0.22	0.19	0.19	0.14	0.21	0.24	0.27	0.21	0.25	0.18
15	0.11	0.11	0.16	0.13	0.13	0.13	0.16	0.11	0.11	0.10	0.16	0.14	0.16	0.15	0.22	0.17	0.21	0.23	0.22
16	0.12	0.08	0.11	0.07	0.07	0.08	0.12	0.09	0.07	0.06	0.11	0.08	0.13	0.07	0.13	0.11	0.14	0.13	0.14
17	0.05	0.07	0.07	0.05	0.06	0.04	0.06	0.07	0.05	0.06	0.09	0.06	0.08	0.05	0.06	0.05	0.04	0.08	0.10
18	0.04	0.08	0.05	0.05	0.05	0.02	0.04	0.05	0.04	0.03	0.04	0.04	0.04	0.03	0.02	0.04	0.03	0.03	0.05
19	0.03	0.04	0.04	0.05	0.02	0.01	0.02	0.04	0.02	0.01	0.04	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.04
20	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.05	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.02
21	0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.01
22	0.00	0.01	0.01	0.01	0.01	0.01		0.01	0.00	0.00	0.01	0.00	0.00		0.00	0.01	0.00	0.00	0.00
23	0.00	0.00	0.01	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01		0.00	0.00	0.00	0.00	0.01
24	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00
25		0.00		0.00	0.00						0.00	0.00				0.00	0.00	0.00	
26					0.00			0.00					0.00						
27									0.00							0.00			
28											0.00								
29																			
30																			

Table 3 (cont.): Annual size frequency distributions of Louisiana recreational spotted seatrout harvest (July-December; A+B1 catches only) taken from MRIP (1982-2013) and the LDWF Biological Sampling Program (2014-2018).

Recreational, July-December 1982-1999																		
TL_in	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*
4	0.00			0.00														
5	0.00			0.00					0.00									
6	0.00			0.00			0.00											
7	0.01	0.00		0.00	0.00							0.01						
8	0.02	0.00	0.00	0.02	0.01	0.00					0.00	0.00	0.00	0.00	0.00		0.01	
9	0.04	0.01	0.03	0.04	0.10	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
10	0.04	0.04	0.03	0.13	0.19	0.08	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
11	0.12	0.14	0.08	0.12	0.18	0.14	0.02	0.02	0.05	0.07	0.05	0.09	0.07	0.07	0.06	0.07	0.08	0.07
12	0.18	0.11	0.12	0.20	0.18	0.20	0.12	0.11	0.23	0.29	0.31	0.27	0.26	0.27	0.17	0.30	0.27	0.29
13	0.24	0.18	0.11	0.20	0.12	0.18	0.27	0.25	0.22	0.30	0.22	0.24	0.26	0.24	0.24	0.24	0.21	0.21
14	0.16	0.23	0.15	0.14	0.09	0.18	0.19	0.23	0.16	0.13	0.17	0.15	0.15	0.16	0.18	0.15	0.17	0.16
15	0.05	0.11	0.07	0.08	0.05	0.11	0.13	0.14	0.11	0.10	0.09	0.09	0.10	0.11	0.10	0.07	0.09	0.08
16	0.04	0.09	0.07	0.03	0.04	0.05	0.11	0.09	0.10	0.05	0.06	0.06	0.05	0.04	0.10	0.05	0.07	0.07
17	0.02	0.02	0.00	0.00	0.02	0.03	0.07	0.06	0.06	0.04	0.04	0.04	0.04	0.05	0.06	0.05	0.04	0.06
18	0.03	0.06	0.18	0.01	0.01	0.01	0.03	0.04	0.02	0.01	0.02	0.01	0.02	0.01	0.04	0.02	0.03	0.03
19	0.02	0.00	0.03	0.00	0.00	0.00	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
20	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
21	0.00		0.05		0.00	0.00	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
22	0.00	0.00	0.05		0.00		0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
23	0.00	0.00	0.03		0.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00				0.00		0.00	0.00				0.00		0.00	0.00	0.00		0.00
25			0.00							0.00			0.00	0.00				0.00
26			0.00									0.00	0.00	0.00				
27					0.00						0.00							
28																		
29																		
30																		

Recreational, July-December 2000-2018																			
TL_in	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
4																			
5																			
6																			
7																			
8							0.00					0.00			0.00				
9	0.00	0.00				0.00	0.00	0.00	0.00				0.00	0.00	0.00		0.00		
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			0.00	
11	0.05	0.05	0.04	0.08	0.09	0.08	0.07	0.07	0.06	0.07	0.05	0.03	0.06	0.05	0.01	0.01	0.00	0.01	0.00
12	0.24	0.24	0.26	0.31	0.28	0.31	0.29	0.27	0.23	0.27	0.29	0.17	0.25	0.26	0.17	0.19	0.19	0.14	0.15
13	0.21	0.20	0.23	0.21	0.23	0.21	0.22	0.27	0.24	0.23	0.30	0.20	0.23	0.28	0.24	0.24	0.30	0.23	0.27
14	0.14	0.15	0.17	0.14	0.19	0.16	0.17	0.16	0.20	0.15	0.16	0.19	0.16	0.17	0.21	0.20	0.24	0.23	0.24
15	0.10	0.12	0.11	0.10	0.09	0.10	0.09	0.09	0.12	0.11	0.10	0.15	0.10	0.09	0.16	0.16	0.13	0.16	0.16
16	0.09	0.09	0.08	0.05	0.04	0.05	0.06	0.06	0.07	0.08	0.05	0.09	0.07	0.07	0.09	0.11	0.06	0.09	0.09
17	0.05	0.06	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.02	0.05	0.06	0.04	0.06	0.06	0.03	0.09	0.04
18	0.04	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.04	0.03	0.02	0.03	0.02	0.02	0.03	0.02
19	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.01
20	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
21	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01		0.00	0.00	0.00	0.00	0.00
22	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00		0.00	0.00
24	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00			0.00	
25			0.00	0.00	0.00			0.00	0.00	0.00		0.00	0.00				0.00		
26	0.00		0.00	0.00								0.00	0.00						
27				0.00															
28																			
29																			
30																			

Table 4: FAO proposed guidelines for indices of productivity for exploited fish species.

Parameter	Productivity			Species	Score
	Low	Medium	High	Spotted Seatrout	
M	<0.2	0.2 - 0.5	>0.5	**0.3**	2
K	<0.15	0.15 - 0.33	>0.33	**0.36**	3
tmat	>8	3.3 - 8	<3.3	**2**	3
tmax	>25	14 - 25	<14	**10**	3
Examples	orange roughy, many sharks	cod, hake	sardine, anchovy	**Spotted Seatrout Productivity Score = 2.75 (high)**	

Table 5: Annual sample sizes, proportion positive samples, nominal CPUEs, indices of abundance, and corresponding coefficients of variation derived from the LDWF fishery-independent marine gillnet survey. Nominal cpue and abundance indices have been normalized to their individual long-term means for comparison.

	1.0" mesh					1.25" mesh					1.5" mesh				
Year	n	% Positive	CPUE	Index	CV	n	% Positive	CPUE	Index	CV	n	% Positive	CPUE	Index	CV
1986	487	40.9%	0.88	1.15	0.29	--	--	--	--	--	487	22.0%	0.82	0.68	0.27
1987	475	33.1%	1.08	0.87	0.32	--	--	--	--	--	475	30.5%	1.01	1.12	0.24
1988	417	39.3%	1.19	1.34	0.30	417	49.6%	1.33	1.79	0.26	417	41.7%	1.33	2.05	0.22
1989	474	36.1%	1.04	1.15	0.31	472	46.4%	1.01	1.40	0.27	473	31.1%	1.27	1.45	0.24
1990	489	30.9%	1.00	0.81	0.32	489	37.2%	1.00	0.93	0.30	489	23.7%	1.11	0.82	0.26
1991	471	35.9%	1.48	1.32	0.31	470	39.8%	1.55	1.37	0.29	470	26.2%	1.36	1.12	0.26
1992	472	32.8%	1.37	1.10	0.32	472	40.7%	1.44	1.35	0.28	472	33.7%	1.42	1.70	0.23
1993	459	35.7%	1.09	1.05	0.31	458	41.3%	1.46	1.41	0.29	457	29.1%	1.50	1.39	0.25
1994	487	35.7%	1.11	1.05	0.31	487	38.0%	1.20	1.06	0.29	486	27.2%	1.04	1.10	0.25
1995	520	35.2%	1.60	1.13	0.31	520	37.7%	1.18	1.02	0.29	520	26.2%	1.22	1.06	0.25
1996	520	32.3%	0.94	0.84	0.32	520	41.5%	0.92	1.12	0.28	520	27.3%	1.11	1.13	0.25
1997	520	33.5%	0.94	0.85	0.31	520	32.5%	1.04	0.85	0.31	519	28.7%	1.05	1.14	0.24
1998	509	34.2%	0.99	0.89	0.31	509	34.4%	1.20	0.92	0.30	509	24.6%	1.14	0.99	0.26
1999	520	37.9%	1.18	1.14	0.30	520	37.9%	1.28	1.14	0.29	520	30.0%	1.56	1.34	0.24
2000	528	37.5%	0.81	0.94	0.30	528	43.8%	1.06	1.34	0.27	528	35.0%	1.20	1.65	0.23
2001	528	25.6%	0.74	0.55	0.34	528	31.4%	0.95	0.70	0.31	528	26.9%	1.10	1.07	0.25
2002	520	32.7%	0.72	0.73	0.31	520	34.6%	0.75	0.76	0.30	520	22.3%	0.74	0.69	0.26
2003	525	30.1%	0.90	0.70	0.32	525	27.0%	0.94	0.58	0.33	525	20.2%	0.85	0.61	0.27
2004	527	32.4%	0.85	0.78	0.32	527	29.8%	0.84	0.67	0.32	527	22.6%	0.89	0.73	0.26
2005	478	38.3%	1.24	1.18	0.30	478	37.2%	1.06	0.98	0.30	478	22.8%	0.79	0.73	0.27
2006	519	38.3%	0.97	1.11	0.30	518	37.3%	1.08	1.05	0.29	519	30.3%	1.03	1.20	0.24
2007	528	34.7%	1.01	1.12	0.31	528	37.1%	0.93	0.95	0.29	528	25.2%	0.90	0.95	0.25
2008	514	35.6%	1.23	1.20	0.30	514	36.8%	1.13	1.03	0.29	514	25.3%	0.86	0.84	0.25
2009	528	34.5%	1.01	0.92	0.31	528	32.2%	1.11	0.83	0.31	528	26.5%	1.11	1.03	0.25
2010	463	27.6%	0.98	0.80	0.33	463	26.8%	0.86	0.65	0.33	463	18.8%	0.72	0.58	0.28
2011	1202	27.5%	0.90	0.80	0.30	1202	30.0%	0.74	0.78	0.29	1202	19.1%	0.74	0.78	0.23
2012	1269	27.1%	0.67	0.73	0.30	1269	30.4%	0.77	0.86	0.28	1269	17.2%	0.69	0.71	0.23
2013	624	33.7%	1.21	1.57	0.28	624	33.0%	0.83	1.23	0.27	624	19.4%	0.87	1.10	0.25
2014	625	32.8%	0.74	1.30	0.28	625	31.5%	0.62	1.00	0.28	625	15.2%	0.80	0.78	0.27
2015	626	22.5%	0.77	0.82	0.32	626	22.2%	0.62	0.66	0.32	626	11.7%	0.59	0.50	0.29
2016	626	31.6%	0.78	1.25	0.28	626	24.8%	0.67	0.81	0.31	626	13.3%	0.71	0.66	0.28
2017	620	26.9%	0.94	1.07	0.30	620	27.1%	0.77	0.94	0.30	620	16.0%	0.77	0.84	0.26
2018	624	21.6%	0.64	0.74	0.32	624	23.7%	0.63	0.79	0.31	624	10.6%	0.71	0.47	0.30

Table 6: Probabilities of age given length used in age assignments of spotted seatrout landings 1982-2001 (females only).

Fishery Landings 1981-2001 (January-June)						
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
10	1.00	0.00	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.00	0.00
13	0.97	0.03	0.00	0.00	0.00	0.00
14	0.00	1.00	0.00	0.00	0.00	0.00
15	0.00	1.00	0.00	0.00	0.00	0.00
16	0.00	0.99	0.01	0.00	0.00	0.00
17	0.00	0.83	0.17	0.00	0.00	0.00
18	0.00	0.12	0.84	0.04	0.00	0.00
19	0.00	0.00	0.79	0.18	0.02	0.00
20	0.00	0.00	0.37	0.48	0.12	0.03
21	0.00	0.00	0.06	0.47	0.30	0.17
22	0.00	0.00	0.00	0.18	0.34	0.47
23	0.00	0.00	0.00	0.03	0.18	0.79
24	0.00	0.00	0.00	0.00	0.05	0.94
25	0.00	0.00	0.00	0.00	0.01	0.99
26	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	1.00

Fishery Landings 1981-2001 (July-December)						
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
10	0.76	0.00	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.00	0.00
13	1.00	0.00	0.00	0.00	0.00	0.00
14	1.00	0.00	0.00	0.00	0.00	0.00
15	0.98	0.02	0.00	0.00	0.00	0.00
16	0.16	0.83	0.00	0.00	0.00	0.00
17	0.00	0.98	0.02	0.00	0.00	0.00
18	0.00	0.86	0.13	0.01	0.00	0.00
19	0.00	0.35	0.57	0.07	0.01	0.00
20	0.00	0.03	0.65	0.25	0.05	0.02
21	0.00	0.00	0.29	0.42	0.18	0.10
22	0.00	0.00	0.05	0.31	0.30	0.34
23	0.00	0.00	0.00	0.10	0.23	0.67
24	0.00	0.00	0.00	0.02	0.10	0.89
25	0.00	0.00	0.00	0.00	0.03	0.97
26	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	1.00

Table 7: Probabilities of age given length used in age assignments of spotted seatrout catches of the LDWF marine experimental gillnet survey (females only).

Survey Catches (April-September)						
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
10	1.00	0.00	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.00	0.00
13	1.00	0.00	0.00	0.00	0.00	0.00
14	0.99	0.01	0.00	0.00	0.00	0.00
15	0.06	0.94	0.00	0.00	0.00	0.00
16	0.00	1.00	0.00	0.00	0.00	0.00
17	0.00	0.96	0.04	0.00	0.00	0.00
18	0.00	0.61	0.38	0.02	0.00	0.00
19	0.00	0.06	0.80	0.12	0.01	0.00
20	0.00	0.00	0.55	0.35	0.08	0.02
21	0.00	0.00	0.16	0.47	0.24	0.13
22	0.00	0.00	0.02	0.25	0.33	0.40
23	0.00	0.00	0.00	0.06	0.21	0.73
24	0.00	0.00	0.00	0.01	0.08	0.92
25	0.00	0.00	0.00	0.00	0.02	0.98
26	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	1.00

Table 8: Length at age samples used in age assignments of spotted seatrout landings 2002-2018 (females only).

2002 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	5	1					6
13	6	6					12
14	1	16					17
15		22	1				23
16	1	14	6				21
17		8	10				18
18		4	5				9
19			6	1			7
20		1	4	2			7
21			4				4
22							0
23							0
24							0
25							0
26							0
27							0
28							0
Total	13	72	36	3	0	0	124

2002 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	25	5	1				31
13	54	5		1			60
14	64	8	2				74
15	41	10	2				53
16	18	19	1				38
17	7	18	4				29
18	2	15	8				25
19	1	4	6	1			12
20		3	3				6
21		1	1				2
22		1	2				3
23					1		1
24							0
25							0
26							0
27							0
28							0
Total	212	89	30	2	1	0	334

2003 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	2						2
12	10	11	1				22
13	5	45	2				52
14	2	48	5	1			56
15		48	4				52
16		51	6				57
17		32	10				42
18		11	9	2	1		23
19		2	11	2			15
20		1	9	5	2		17
21			7	3			10
22			2	3	1		6
23				4	1		5
24			1	1			2
25				1			1
26							0
27							0
28							0
Total	19	249	67	22	5	0	362

2003 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	2						2
12	57	10					67
13	119	15	2				136
14	75	25					100
15	41	31	1		1		74
16	15	41	1				57
17	3	41					44
18		22	5				27
19		8	2				10
20		4	9				13
21		1	6				7
22		1	3	1			5
23			1				1
24				3			3
25						1	1
26				1		2	3
27							0
28					1		1
Total	312	199	30	5	2	3	551

2004 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	4	32	1				37
13	6	62	2	2			72
14		77					77
15		79					79
16		39	8				47
17		18	8				26
18		7	12	1			20
19		3	13				16
20			8	1	1	1	11
21			1	4	1		6
22				1	1		2
23		1		2			3
24						1	1
25							0
26							0
27							0
28							0
Total	10	318	53	11	3	2	397

2004 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	2						2
12	59	6	1				66
13	110	25					135
14	91	30	1				122
15	44	33	1			1	79
16	19	34	3				56
17	4	29	3				36
18		18	5	1			24
19		7	7				14
20		1	4	1			6
21		2	2				4
22					2		2
23				2			2
24			2			1	3
25					1		1
26							0
27							0
28							0
Total	329	185	29	4	3	2	552

Table 8 (continued):

2005 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	10	15					25
13	12	55	2				69
14	4	105	4	1			114
15		129	6		1		136
16		57	4				61
17		31	11				42
18		9	9				18
19		5	16	1			22
20		1	14				15
21			13		1		14
22			7				7
23			1				1
24				4			4
25						1	1
26							0
27				1		1	2
28							0
Total	26	407	87	7	2	2	531

2005 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	1						1
12	37	2					39
13	69	9	1				79
14	48	20					68
15	37	31					68
16	12	33	3				48
17	5	34	3				42
18	1	15	2				18
19		5	2				7
20		2	3				5
21			5	2	1		8
22			1	1			2
23			1				1
24			1				1
25							0
26							0
27							0
28							0
Total	210	151	22	3	1	0	387

2006 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	3						3
12	17	11	1				29
13	17	77	2				96
14	3	140	2				145
15	1	141	5				147
16	1	79	9				89
17		28	12				40
18		15	15	1			31
19		4	11				15
20		1	11	2			14
21			8				8
22			8				8
23			1	1			2
24				1			1
25							0
26							0
27							0
28							0
Total	42	496	85	5	0	0	628

2006 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	40	2					42
13	103	8	3				114
14	75	33					108
15	39	70					109
16	9	40	1				50
17	5	43	2				50
18	1	25	4				30
19		11	1	1			13
20		6	1				7
21			4				4
22		1		1			2
23		2	1				3
24							0
25							0
26							0
27							0
28							0
Total	272	241	17	2	0	0	532

2007 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	1						1
12	9	11	1				21
13	4	49	2				55
14		89	1				90
15		101	7				108
16		80	18	2			100
17		29	29				58
18		16	21	3			40
19		8	13	1			22
20		3	14	3	1		21
21			4	1			5
22			4	3	1		8
23			3	1			4
24					1		1
25							0
26							0
27							0
28							0
Total	14	386	117	14	3	0	534

2007 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	2						2
12	71	8					79
13	110	23	1				134
14	91	39	3				133
15	47	70	4	1			122
16	13	57	1				71
17	3	57	4	1			65
18	2	29	9				40
19	1	14	7				22
20		4	2	2			8
21			5	1			6
22			5				5
23			1	1			2
24							0
25			1				1
26							0
27							0
28							0
Total	340	301	43	6	0	0	690

Table 8 (continued):

2008 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10	1						1
11		1					1
12	19	40	2				61
13	5	104	2				111
14	1	106	4				111
15		87	19	1			107
16		56	24				80
17		15	34				49
18		10	31	1			42
19		3	26	1	1		31
20		1	7	4			12
21			9	3			12
22			4	1			5
23			2				2
24					1		1
25					1		1
26							0
27							0
28							0
Total	26	423	164	11	3	0	627

2008 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	1						1
12	78	12	3				93
13	145	41	5				191
14	109	71	6	1			187
15	69	68	3	1			141
16	28	64	7				99
17	4	38	9				51
18	1	28	13				42
19		8	14				22
20		3	15	3	1		22
21		4	8	2			14
22			2	3			5
23							0
24			1				1
25			1		1		2
26							0
27							0
28							0
Total	435	337	87	10	2	0	871

2009 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11		1					1
12	21	39	1	2			63
13	4	109	6	2			121
14	1	138	4	1			144
15	2	92	16				110
16		42	18	1			61
17		30	20	2			52
18		7	29	4			40
19		4	17	3	1		25
20		1	16	6			23
21			10	3			13
22			4	2			6
23			1	4			5
24				7			7
25				2	1		3
26							0
27							0
28							0
Total	28	463	142	39	2	0	674

2009 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	2						2
12	56	9	2				67
13	121	30	3				154
14	104	52	4				160
15	55	71	4				130
16	28	66	5				99
17	6	52	2				60
18	4	28	13	2			47
19		12	7	1			20
20		5	7	2			14
21			9	1			10
22			6	4			10
23			4	3			7
24				1	2		3
25			1	3			4
26							0
27			1				1
28							0
Total	376	325	68	17	2	0	788

2010 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	12	18	1				31
13	6	57	4	1			68
14	1	89	3	1			94
15		88	1				89
16		55	12	1			68
17		28	18	2			48
18		9	23	2			34
19			18	2			20
20			12	3			15
21			4	1			5
22				1			1
23			2	1			3
24				1			1
25							0
26							0
27							0
28							0
Total	19	344	98	16	0	0	477

2010 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	1	1					2
12	69	5					74
13	152	18	2				172
14	127	26	4				157
15	55	41	3	1			100
16	13	32	4				49
17	3	33	1				37
18	1	21	2				24
19		6	3				9
20			1	2			3
21		1	1				2
22			2		1		3
23				3			3
24							0
25							0
26							0
27							0
28							0
Total	421	184	23	6	1	0	635

Table 8 (continued):

2011 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10		1					1
11		1					1
12	12	8					20
13	28	38	2				68
14	13	66	10	1			90
15	3	109	8				120
16		80	10				90
17		52	16				68
18		10	19				29
19		2	20				22
20		1	3				4
21			4	1			5
22				1			1
23							0
24						1	1
25				1			1
26					1		1
27							0
28							0
Total	56	368	92	4	1	1	522

2011 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	3						3
12	70	9					79
13	119	12	2				133
14	123	15	2				140
15	66	42	1				109
16	36	51	1				88
17	6	53	7				66
18	3	30	12	1			46
19		8	6	2			16
20	1	5	6	1			13
21	1	1	2	4			8
22			1	1			2
23							0
24							0
25							0
26							0
27							0
28							0
Total	428	226	40	9	0	0	703

2012 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11	1						1
12	41	17	2				60
13	41	65	10				116
14	10	114	14	2			140
15	2	209	9	1			221
16	1	173	9	1			184
17		111	20	1			132
18		46	43	4			93
19		16	37	2	1	1	57
20		2	23	7	1		33
21			13	1			14
22		1	4	4			9
23			1	1			2
24					1		1
25				2			2
26							0
27							0
28							0
Total	96	754	185	26	3	1	1065

2012 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	35	3					38
13	66	8	1				75
14	75	11	2				88
15	31	7	2				40
16	14	15					29
17	4	21	2		1		28
18		17	1				18
19		8	2				10
20		8	1	1			10
21			1	1			2
22							0
23							0
24							0
25							0
26							0
27							0
28							0
Total	225	98	12	2	1	0	338

2013 (January-June)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10							0
11							0
12	18	39	2				59
13	14	119	5				138
14	4	168	7				179
15		158	2				160
16		101	1	1			103
17		57	4				61
18		22	12				34
19		5	16	1			22
20		2	18				20
21			7	2			9
22		1	2	2	1		6
23							0
24							0
25							0
26							0
27							0
28							0
Total	36	672	76	6	1	0	791

2013 (July-December)							
TL_in	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Total*
10	1						1
11	3	1					4
12	159	12					171
13	222	19					241
14	151	31	1				183
15	84	42	1				127
16	30	43		1			74
17	8	30					38
18	8	16	2	1			27
19	1	5	1				7
20			1				1
21			2				2
22		1					1
23							0
24							0
25							0
26							0
27							0
28							0
Total	667	200	8	2	0	0	877

Table 8 (continued):

2014 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	2		1				3
12	60	71	2				133
13	77	215	7				299
14	20	229	14	2			265
15		196	9	2	1		208
16		153	19				172
17		83	16				99
18		26	25				51
19		5	25				30
20			11	1			12
21		1	3	3	1		8
22		1	7	2			10
23			1	1			2
24						1	1
25					2		2
26							0
27						2	2
28							0
Total	159	980	140	11	4	3	1297

2014 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	19						19
12	301	19	2				322
13	359	54	4				417
14	284	130	2				416
15	161	144	1	2			308
16	59	153	5	1			218
17	14	100	8	1			123
18	3	49	10				62
19	2	15	11	1	1		30
20	2	10	4				16
21			3	1			4
22		1	2	1			4
23			1	2			3
24							0
25							0
26							0
27							0
28							0
Total	1204	675	53	9	1	0	1942

2015 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	2	1					3
12	93	32	1				126
13	85	172	5	2			264
14	14	353	7				374
15		361	11	1			373
16	1	272	14	2			289
17		113	44	1			158
18		25	38	1			64
19		3	34	1			38
20		1	17	5			23
21			4	3			7
22				4			4
23			3				3
24							0
25							0
26							0
27							0
28							0
Total	195	1333	178	20	0	0	1726

2015 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10	2						2
11	11	2					13
12	247	15					262
13	372	24	4				400
14	335	58					393
15	184	132	3				319
16	66	128	7	1			202
17	18	119	13	2			152
18	6	53	12	1			72
19	2	32	6	1			41
20	2	10	21				33
21		1	6	2			9
22			2	2	2		6
23			1				1
24		1					1
25							0
26							0
27							0
28							0
Total	1245	575	75	9	2	0	1906

2016 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	1	4					5
12	96	71	3	1			171
13	115	212	8	5			340
14	23	358	5				386
15	4	404	12		1		421
16	2	282	18	2			304
17		104	32				136
18		37	37	1			75
19		8	29				37
20			21		1		22
21			11	4			15
22			4	3	1		8
23				1		1	2
24				3			3
25					1		1
26							0
27							0
28							0
Total	241	1480	180	20	4	1	1926

2016 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	9						9
12	340	19	1	1			361
13	537	40	3				580
14	359	75	6				440
15	160	94	3				257
16	40	96	2				138
17	10	78	7	1			96
18	2	29	13				44
19	2	11	10				23
20		5	5	1	1		12
21		1	7	1			9
22			2				2
23							0
24							0
25		1					1
26							0
27							0
28							0
Total	1459	449	59	4	1	0	1972

Table 8 (continued):

2017 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10		2					2
11	4	1					5
12	77	29	4				110
13	64	163	3	1			231
14	14	281	1	2			298
15	1	314	4	1			320
16		209	9	1			219
17	1	140	19		1		161
18		44	20	1			65
19		15	18	2			35
20		3	10	1			14
21			9	1	1		11
22			3	1	1		5
23			1	2			3
24			1	2			3
25				1			1
26							0
27							0
28							0
Total	161	1201	102	16	3	0	1483

2017 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10	2						2
11	6						6
12	133	11					144
13	213	49	3				265
14	240	90	1				331
15	134	109	2				245
16	43	90		1			134
17	21	91	7	1			120
18	3	56	3	1			63
19		24	3		1		28
20	1	10	1				12
21		3	1				4
22			2	2			4
23				1			1
24				1			1
25							0
26							0
27							0
28							0
Total	796	533	23	7	1	0	1360

2018 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	3						3
12	52	21	3				76
13	56	93	4				153
14	30	155	8	1			194
15	1	269	10				280
16		201	20		1		222
17	2	107	43	1	2		155
18		39	37	1			77
19		22	37				59
20		2	28	2	1		33
21		1	12	1			14
22			5	1			6
23			7	2	1		10
24				1	2		3
25							0
26							0
27							0
28							0
Total	144	910	214	10	7	0	1285

2018 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	9						9
12	165	7	1				173
13	314	18	1				333
14	296	22	3				321
15	190	58					248
16	91	53					144
17	26	46	2		1		75
18	3	41	5				49
19	3	20	2				25
20		9	3				12
21			1	1			2
22			1				1
23			1	1			2
24							0
25							0
26							0
27							0
28							0
Total	1097	274	20	2	1	0	1394

Table 9: Annual survey age composition and sample sizes (female SST) derived from the LDWF experimental marine gillnet survey.

	1.0" mesh							1.25" mesh						
Year	n	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	n	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1986	561	0.98	0.02	0.00	0.00	0.00	0.00	--	--	--	--	--	--	--
1987	546	0.96	0.04	0.00	0.00	0.00	0.00	--	--	--	--	--	--	--
1988	627	0.96	0.04	0.01	0.00	0.00	0.00	1075	0.91	0.08	0.01	0.00	0.00	0.00
1989	571	0.91	0.08	0.01	0.00	0.00	0.00	862	0.84	0.15	0.01	0.00	0.00	0.00
1990	486	0.94	0.05	0.01	0.00	0.00	0.00	713	0.85	0.14	0.00	0.00	0.00	0.00
1991	803	0.93	0.07	0.00	0.00	0.00	0.00	1132	0.87	0.12	0.00	0.00	0.00	0.00
1992	685	0.92	0.07	0.01	0.00	0.00	0.00	1081	0.83	0.16	0.01	0.00	0.00	0.00
1993	573	0.93	0.06	0.01	0.00	0.00	0.00	1072	0.89	0.11	0.01	0.00	0.00	0.00
1994	620	0.91	0.07	0.01	0.00	0.00	0.00	869	0.88	0.11	0.00	0.00	0.00	0.00
1995	942	0.93	0.06	0.01	0.00	0.00	0.00	903	0.87	0.12	0.01	0.00	0.00	0.00
1996	508	0.87	0.09	0.02	0.01	0.00	0.01	776	0.84	0.14	0.01	0.00	0.00	0.00
1997	529	0.88	0.09	0.02	0.01	0.00	0.00	684	0.83	0.15	0.01	0.00	0.00	0.00
1998	555	0.90	0.06	0.02	0.01	0.00	0.00	821	0.87	0.13	0.00	0.00	0.00	0.00
1999	749	0.88	0.09	0.02	0.01	0.00	0.00	984	0.81	0.17	0.01	0.00	0.00	0.00
2000	517	0.85	0.09	0.03	0.01	0.01	0.01	958	0.87	0.11	0.01	0.00	0.00	0.00
2001	321	0.83	0.12	0.03	0.01	0.00	0.01	614	0.77	0.21	0.01	0.00	0.00	0.00
2002	396	0.85	0.11	0.02	0.01	0.00	0.01	527	0.84	0.14	0.01	0.00	0.00	0.01
2003	457	0.93	0.04	0.01	0.01	0.00	0.00	522	0.89	0.10	0.01	0.00	0.00	0.01
2004	466	0.90	0.05	0.02	0.01	0.00	0.02	516	0.89	0.08	0.01	0.00	0.00	0.02
2005	730	0.93	0.06	0.00	0.00	0.00	0.00	736	0.90	0.08	0.00	0.00	0.00	0.01
2006	621	0.90	0.08	0.02	0.01	0.00	0.00	811	0.77	0.21	0.01	0.00	0.00	0.00
2007	596	0.92	0.05	0.01	0.01	0.00	0.01	709	0.86	0.11	0.01	0.00	0.00	0.00
2008	723	0.92	0.06	0.01	0.00	0.00	0.01	834	0.83	0.15	0.01	0.00	0.00	0.01
2009	590	0.91	0.05	0.01	0.01	0.01	0.01	739	0.84	0.14	0.01	0.00	0.00	0.00
2010	405	0.90	0.06	0.01	0.01	0.00	0.02	414	0.87	0.11	0.01	0.00	0.00	0.00
2011	957	0.90	0.08	0.01	0.00	0.00	0.00	1045	0.85	0.13	0.01	0.00	0.00	0.00
2012	746	0.92	0.06	0.01	0.00	0.00	0.01	1152	0.87	0.11	0.01	0.00	0.00	0.00
2013	815	0.73	0.09	0.04	0.05	0.04	0.04	666	0.82	0.15	0.02	0.01	0.00	0.01
2014	488	0.97	0.02	0.00	0.00	0.00	0.00	479	0.88	0.10	0.01	0.00	0.00	0.00
2015	351	0.91	0.03	0.02	0.01	0.01	0.01	337	0.86	0.13	0.01	0.00	0.00	0.00
2016	500	0.97	0.03	0.00	0.00	0.00	0.00	404	0.87	0.12	0.01	0.00	0.00	0.00
2017	506	0.93	0.04	0.01	0.01	0.00	0.01	504	0.84	0.15	0.01	0.00	0.00	0.00
2018	277	0.94	0.05	0.01	0.00	0.00	0.00	365	0.88	0.11	0.01	0.00	0.00	0.00

	1.5" mesh						
Year	n	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1986	277	0.39	0.57	0.03	0.00	0.00	0.00
1987	464	0.54	0.44	0.02	0.00	0.00	0.00
1988	733	0.77	0.21	0.01	0.00	0.00	0.00
1989	589	0.59	0.39	0.02	0.00	0.00	0.00
1990	406	0.57	0.42	0.01	0.00	0.00	0.00
1991	529	0.40	0.59	0.01	0.00	0.00	0.00
1992	714	0.50	0.48	0.01	0.00	0.00	0.00
1993	630	0.54	0.44	0.02	0.00	0.00	0.00
1994	436	0.56	0.41	0.03	0.00	0.00	0.00
1995	524	0.46	0.52	0.03	0.00	0.00	0.00
1996	497	0.47	0.49	0.03	0.00	0.00	0.00
1997	496	0.49	0.47	0.04	0.01	0.00	0.00
1998	449	0.55	0.41	0.03	0.00	0.00	0.00
1999	770	0.54	0.43	0.02	0.00	0.00	0.00
2000	703	0.57	0.37	0.05	0.01	0.00	0.00
2001	495	0.52	0.43	0.03	0.01	0.00	0.00
2002	271	0.54	0.43	0.02	0.00	0.00	0.01
2003	286	0.58	0.40	0.02	0.00	0.00	0.00
2004	334	0.61	0.34	0.02	0.01	0.00	0.02
2005	272	0.55	0.38	0.03	0.01	0.01	0.02
2006	513	0.40	0.54	0.05	0.01	0.00	0.00
2007	380	0.58	0.37	0.03	0.01	0.00	0.01
2008	352	0.51	0.42	0.04	0.01	0.01	0.01
2009	493	0.53	0.44	0.02	0.00	0.00	0.00
2010	198	0.40	0.51	0.06	0.02	0.01	0.01
2011	538	0.48	0.48	0.03	0.01	0.00	0.00
2012	474	0.40	0.55	0.04	0.01	0.00	0.00
2013	332	0.41	0.51	0.06	0.01	0.00	0.00
2014	240	0.55	0.41	0.04	0.01	0.00	0.00
2015	136	0.58	0.36	0.04	0.01	0.00	0.02
2016	186	0.49	0.43	0.06	0.01	0.00	0.00
2017	241	0.49	0.48	0.03	0.01	0.00	0.00
2018	149	0.50	0.47	0.02	0.01	0.00	0.00

Table 10: Recreational spotted seatrout catch-at-age and yield (females only), and ASAP base model input coefficients of variation.

Recreational Catch-at-age								
Year	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Yield (lbs)*	*CV*
1982	*1,818,279*	*415,740*	*186,480*	*54,681*	*29,288*	*96,729*	*3,437,031*	*0.21*
1983	*1,694,837*	*641,628*	*94,457*	*52,208*	*22,089*	*22,855*	*3,008,300*	*0.21*
1984	*391,755*	*199,957*	*49,228*	*34,885*	*24,723*	*31,707*	*1,228,965*	*0.29*
1985	*1,501,525*	*208,313*	*46,230*	*18,466*	*8,293*	*7,598*	*1,749,025*	*0.19*
1986	*2,633,193*	*842,301*	*104,620*	*28,925*	*11,178*	*15,474*	*3,610,915*	*0.15*
1987	*2,548,528*	*897,532*	*50,771*	*17,580*	*5,494*	*3,273*	*3,507,535*	*0.14*
1988	*1,487,973*	*812,106*	*150,429*	*55,867*	*19,677*	*13,883*	*3,122,697*	*0.19*
1989	*1,476,612*	*979,986*	*137,268*	*43,066*	*15,603*	*20,631*	*3,437,101*	*0.16*
1990	*1,085,067*	*414,345*	*58,012*	*12,634*	*3,495*	*3,092*	*1,832,308*	*0.19*
1991	*3,002,943*	*1,070,330*	*114,805*	*24,111*	*9,176*	*11,572*	*4,524,888*	*0.17*
1992	*2,285,253*	*773,982*	*76,493*	*19,045*	*6,565*	*7,722*	*3,382,887*	*0.19*
1993	*1,852,853*	*537,393*	*110,829*	*32,450*	*12,661*	*14,908*	*2,815,927*	*0.16*
1994	*2,434,226*	*784,676*	*113,803*	*42,265*	*19,089*	*22,932*	*3,843,690*	*0.15*
1995	*2,797,444*	*718,486*	*137,437*	*47,669*	*20,249*	*30,429*	*4,227,036*	*0.23*
1996	*2,242,323*	*1,047,477*	*172,192*	*40,556*	*16,166*	*16,686*	*4,301,554*	*0.17*
1997	*2,401,381*	*1,051,553*	*160,089*	*29,997*	*11,778*	*22,891*	*4,139,145*	*0.15*
1998	*2,384,739*	*1,204,289*	*186,819*	*45,615*	*15,448*	*8,721*	*4,400,806*	*0.15*
1999	*3,092,437*	*1,463,862*	*238,406*	*89,735*	*36,088*	*36,470*	*5,927,097*	*0.15*
2000	*3,110,291*	*1,602,485*	*318,164*	*100,733*	*36,713*	*37,420*	*6,654,898*	*0.17*
2001	*2,603,830*	*1,450,127*	*372,252*	*116,122*	*49,827*	*70,476*	*6,297,577*	*0.13*
2002	*1,775,080*	*1,075,457*	*367,275*	*74,956*	*29,352*	*40,645*	*4,308,044*	*0.15*
2003	*1,725,470*	*1,565,595*	*297,082*	*52,494*	*21,932*	*33,554*	*4,507,858*	*0.17*
2004	*1,553,813*	*1,560,464*	*217,122*	*30,719*	*14,666*	*25,415*	*3,825,069*	*0.16*
2005	*1,682,655*	*1,797,790*	*198,893*	*17,619*	*9,322*	*6,658*	*4,097,190*	*0.15*
2006	*2,112,540*	*2,700,688*	*327,731*	*23,284*	*6,488*	*8,895*	*6,100,106*	*0.13*
2007	*1,783,613*	*1,848,157*	*344,064*	*51,527*	*20,527*	*26,392*	*4,863,160*	*0.15*
2008	*2,257,775*	*2,632,454*	*581,327*	*38,715*	*8,771*	*15,450*	*6,305,014*	*0.16*
2009	*2,271,765*	*3,091,355*	*510,436*	*84,305*	*5,234*	*22,585*	*6,743,622*	*0.13*
2010	*2,543,488*	*1,585,918*	*360,525*	*54,581*	*8,920*	*19,231*	*5,290,488*	*0.21*
2011	*2,793,364*	*2,331,671*	*439,934*	*79,663*	*28,326*	*57,416*	*7,375,588*	*0.16*
2012	*2,971,186*	*2,373,766*	*440,792*	*57,164*	*26,821*	*41,494*	*7,486,447*	*0.17*
2013	*2,395,533*	*1,818,577*	*181,464*	*28,578*	*12,817*	*13,176*	*5,001,386*	*0.14*
2014	*1,678,052*	*1,027,768*	*73,704*	*10,281*	*3,613*	*5,116*	*3,280,650*	*0.06*
2015	*2,332,965*	*1,252,876*	*132,080*	*15,736*	*3,967*	*4,087*	*4,482,312*	*0.05*
2016	*2,910,578*	*1,456,746*	*166,030*	*19,640*	*7,770*	*7,761*	*5,184,650*	*0.05*
2017	*2,266,905*	*2,074,560*	*105,611*	*19,126*	*6,942*	*8,135*	*5,560,378*	*0.04*
2018	*1,601,847*	*530,028*	*63,466*	*3,203*	*3,713*	*2,059*	*2,653,937*	*0.05*

Table 11: Commercial spotted seatrout catch-at-age and yield (females only), and ASAP base model input coefficients of variation.

Commercial Catch-at-age								
Year	*Age_1*	*Age_2*	*Age_3*	*Age_4*	*Age_5*	*Age_6+*	*Yield (lbs)*	*CV*
1982	173,155	209,659	30,100	9,249	4,466	10,569	656,097	0.10
1983	319,041	386,299	55,459	17,041	8,229	19,473	1,208,869	0.10
1984	231,613	280,441	40,262	12,371	5,974	14,137	877,600	0.10
1985	276,436	334,713	48,053	14,765	7,130	16,873	1,047,437	0.10
1986	556,589	633,781	61,952	17,790	8,463	19,977	1,810,058	0.10
1987	223,577	629,982	117,329	23,523	7,220	7,587	1,671,991	0.10
1988	177,858	501,157	93,337	18,712	5,744	6,035	1,330,085	0.10
1989	184,740	520,551	96,949	19,437	5,966	6,269	1,381,556	0.10
1990	80,484	226,783	42,237	8,468	2,599	2,731	601,889	0.10
1991	151,407	426,625	79,456	15,930	4,889	5,138	1,132,274	0.10
1992	120,542	339,655	63,258	12,682	3,893	4,090	901,454	0.10
1993	141,212	397,899	74,106	14,857	4,560	4,792	1,056,035	0.10
1994	127,019	357,908	66,658	13,364	4,102	4,310	949,897	0.10
1995	81,655	230,083	42,851	8,591	2,637	2,771	610,648	0.10
1996	96,097	270,776	50,430	10,110	3,103	3,261	718,648	0.10
1997	22,222	252,693	36,322	6,238	2,553	4,992	502,434	0.10
1998	4,703	52,118	7,941	1,837	632	340	101,930	0.10
1999	2,315	31,805	4,866	2,064	851	742	70,447	0.05
2000	4,856	13,429	2,618	827	290	273	37,358	0.05
2001	3,208	36,762	10,813	3,048	1,226	1,683	102,485	0.05
2002	3,635	21,568	9,145	1,856	844	1,053	66,750	0.05
2003	143	7,383	2,235	455	140	212	18,009	0.05
2004	13	8,570	1,872	207	160	253	18,387	0.05
2005	162	8,821	1,314	78	70	59	15,422	0.05
2006	13	1,021	172	9	3	5	1,865	0.05
2007	0	4,263	1,400	176	69	88	10,300	0.05
2008	84	4,087	1,702	98	24	47	9,360	0.05
2009	9	463	125	16	2	4	912	0.05
2010	0	0	0	0	0	0	1	0.05
2011	0	0	0	0	0	0	1	0.05
2012	1	40	10	1	0	1	92	0.05
2013	1,216	892	102	31	10	17	3,363	0.05
2014	1,878	2,237	137	25	9	13	6,237	0.05
2015	854	1,459	163	18	4	4	3,663	0.05
2016	473	934	120	9	4	4	2,226	0.05
2017	793	1,314	69	14	5	6	3,244	0.05
2018	1,235	828	122	6	7	3	3,243	0.05

Table 12: Mean weight-at-age (pounds) of recreational and commercial spotted seatrout landings (females only).

Recreational Mean Weight-at-age						
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1982	0.82	1.67	2.47	3.11	3.78	5.24
1983	0.87	1.50	2.53	3.12	3.53	4.07
1984	0.89	1.96	2.73	3.63	3.91	4.16
1985	0.79	1.59	2.41	3.17	3.44	4.30
1986	0.73	1.48	2.38	3.08	3.56	4.52
1987	0.81	1.37	2.47	3.02	3.31	3.68
1988	0.86	1.45	2.49	3.08	3.40	3.91
1989	0.94	1.46	2.46	3.04	3.51	4.71
1990	0.89	1.59	2.49	2.95	3.43	4.08
1991	0.84	1.49	2.33	3.00	3.56	4.42
1992	0.85	1.47	2.48	3.04	3.54	4.33
1993	0.83	1.48	2.46	3.06	3.53	4.39
1994	0.85	1.52	2.55	3.19	3.64	4.32
1995	0.86	1.55	2.57	3.15	3.64	4.61
1996	0.88	1.57	2.46	3.07	3.66	4.06
1997	0.82	1.47	2.40	2.96	3.72	4.55
1998	0.84	1.44	2.41	3.05	3.37	3.57
1999	0.83	1.49	2.55	3.09	3.51	4.22
2000	0.87	1.58	2.54	3.09	3.53	4.23
2001	0.88	1.54	2.46	3.12	3.62	4.45
2002	0.91	1.33	2.09	2.85	3.61	4.40
2003	0.82	1.31	2.19	2.78	3.28	4.86
2004	0.83	1.19	2.06	2.58	3.74	4.20
2005	0.81	1.23	2.11	2.66	3.02	3.92
2006	0.80	1.34	2.04	2.97	3.69	4.23
2007	0.82	1.28	2.06	2.88	3.73	4.33
2008	0.85	1.18	1.86	2.47	3.75	4.56
2009	0.84	1.17	1.81	1.84	4.09	4.95
2010	0.86	1.30	2.14	2.55	3.82	4.77
2011	0.95	1.38	2.01	2.99	3.78	4.78
2012	0.88	1.46	2.18	2.89	3.20	4.76
2013	0.87	1.28	2.25	2.96	3.37	4.35
2014	0.96	1.43	1.97	2.28	3.61	4.55
2015	0.97	1.49	2.17	2.61	3.80	3.99
2016	0.94	1.37	2.11	2.65	3.39	4.64
2017	0.99	1.44	2.06	2.39	3.46	4.42
2018	1.03	1.56	2.21	3.42	2.95	4.15

Commercial Mean Weight-at-age						
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1982	1.04	1.46	2.47	3.12	3.78	4.79
1983	1.04	1.46	2.47	3.12	3.78	4.79
1984	1.04	1.46	2.47	3.12	3.78	4.79
1985	1.04	1.46	2.47	3.12	3.78	4.79
1986	1.04	1.41	2.44	3.11	3.78	4.79
1987	1.20	1.59	2.37	2.95	3.44	4.36
1988	1.20	1.59	2.37	2.95	3.44	4.36
1989	1.20	1.59	2.37	2.95	3.44	4.36
1990	1.20	1.59	2.37	2.95	3.44	4.36
1991	1.20	1.59	2.37	2.95	3.44	4.36
1992	1.20	1.59	2.37	2.95	3.44	4.36
1993	1.20	1.59	2.37	2.95	3.44	4.36
1994	1.20	1.59	2.37	2.95	3.44	4.36
1995	1.20	1.59	2.37	2.95	3.44	4.36
1996	1.20	1.59	2.37	2.95	3.44	4.36
1997	1.17	1.36	2.30	2.91	3.72	4.50
1998	1.18	1.33	2.33	3.00	3.35	3.51
1999	1.18	1.36	2.48	3.08	3.47	4.03
2000	1.21	1.51	2.50	3.05	3.48	4.14
2001	1.21	1.41	2.38	3.02	3.53	4.46
2002	1.27	1.37	2.13	3.07	3.59	4.22
2003	1.09	1.40	2.18	2.58	3.33	4.69
2004	1.19	1.39	2.20	3.21	3.73	4.32
2005	1.08	1.35	2.10	2.20	2.96	3.98
2006	1.22	1.39	2.14	2.98	3.75	4.25
2007	.	1.44	2.16	2.77	3.68	4.32
2008	1.19	1.31	1.96	2.81	3.76	4.51
2009	1.22	1.30	1.92	2.19	3.83	4.58
2010	1.20	1.45	2.24	2.60	3.82	4.77
2011	1.25	1.73	2.37	3.04	4.17	4.90
2012	1.17	1.48	2.42	2.68	3.74	4.34
2013	1.26	1.55	2.49	2.85	3.74	4.55
2014	1.26	1.54	2.12	2.21	3.71	4.42
2015	1.24	1.48	2.20	2.67	3.74	3.96
2016	1.20	1.43	2.23	3.09	3.27	4.58
2017	1.25	1.54	2.21	2.45	3.46	4.42
2018	1.26	1.62	2.33	3.34	2.97	4.15

Table 13: Summary of objective function components and negative log-likelihood values of the ASAP base model.

Objective function=	25271		
Component	**Lambda**	**ESS**	**negLL**
Catch_Recreational	1	--	-44
Catch_Commercial	1	--	-99
Index_1.0" mesh	1	--	-22
Index_1.25" mesh	1	--	-22
Index_1.5" mesh	1	--	-13
Catch_agecomps	--	7400	13960
Index_agecomps	--	19400	11522
Selectivity_parms_catch	20	--	1
Selectivity_parms_indices	12	--	13
Recruitment_devs	1	--	-24

Table 14: Annual female spotted seatrout abundance-at-age and stock size estimates from the ASAP base model.

Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Totals
1982	5,508,960	1,439,010	539,603	262,145	216,190	1,182,930	9,148,838
1983	4,723,040	1,719,400	411,903	221,756	141,801	983,600	8,201,500
1984	3,110,230	1,186,480	314,555	129,194	103,936	763,823	5,608,218
1985	6,063,720	1,213,770	367,208	140,966	74,647	627,590	8,487,901
1986	7,659,270	2,382,550	386,928	167,257	82,087	509,340	11,187,432
1987	6,976,850	2,262,960	493,560	133,684	83,430	409,132	10,359,616
1988	8,218,400	2,063,440	495,179	175,302	67,482	340,263	11,360,066
1989	6,490,300	3,077,300	372,005	162,141	91,465	294,293	10,487,504
1990	6,673,470	1,833,160	289,248	87,053	73,282	268,239	9,224,452
1991	7,699,190	2,807,350	505,975	125,011	51,703	251,991	11,441,220
1992	7,133,150	2,584,730	432,919	158,356	64,406	218,672	10,592,233
1993	7,436,910	2,432,230	430,321	143,083	83,746	203,710	10,730,000
1994	8,126,190	2,726,530	453,898	147,909	76,662	206,033	11,737,222
1995	8,323,200	2,820,650	473,352	153,335	78,960	202,939	12,052,436
1996	7,682,410	2,923,700	551,434	175,822	85,787	204,383	11,623,536
1997	7,199,940	2,858,780	640,244	215,591	100,407	211,022	11,225,984
1998	8,266,030	2,819,020	715,346	274,610	129,369	228,766	12,433,141
1999	8,296,080	3,296,540	813,163	337,568	171,612	264,888	13,179,851
2000	9,110,890	3,125,400	847,492	363,310	206,183	320,408	13,973,683
2001	6,318,970	3,271,730	728,634	361,379	217,612	384,745	11,283,070
2002	5,580,080	2,072,420	615,562	278,310	206,669	436,270	9,189,311
2003	5,668,570	2,038,880	495,274	264,861	167,319	472,540	9,107,444
2004	6,330,560	1,977,410	446,706	204,861	156,633	470,639	9,586,809
2005	8,136,290	2,419,200	528,885	203,950	126,275	465,830	11,880,430
2006	7,038,000	3,466,810	822,428	272,029	132,158	445,239	12,176,664
2007	7,650,960	2,673,810	920,570	374,670	167,527	429,295	12,216,832
2008	8,245,720	3,210,030	880,355	466,254	241,221	446,543	13,490,123
2009	6,796,660	3,087,960	824,712	394,405	285,129	506,450	11,895,316
2010	6,695,150	2,172,400	562,091	311,677	224,580	572,790	10,538,688
2011	7,277,630	2,520,540	565,722	253,635	191,176	590,288	11,398,991
2012	5,960,020	2,609,220	589,895	242,131	152,163	577,252	10,130,681
2013	5,279,940	1,642,360	343,461	189,901	128,903	527,428	8,111,993
2014	5,550,860	1,323,580	175,515	99,694	96,800	471,113	7,717,562
2015	6,359,680	1,779,270	241,676	66,382	56,784	417,557	8,921,350
2016	7,472,050	1,865,860	268,164	83,158	36,341	347,742	10,073,315
2017	5,509,870	2,050,860	243,244	85,895	44,177	280,750	8,214,796
2018	7,396,120	1,205,630	162,795	60,941	41,162	232,131	9,098,779

Table 15: Annual female spotted seatrout age-specific, apical, and average fishing mortality rates estimated from the ASAP base model.

Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Apical F	Avg. F
1982	0.64	0.89	0.58	0.33	0.17	0.09	0.89	0.58
1983	0.85	1.33	0.85	0.47	0.24	0.12	1.33	0.85
1984	0.41	0.81	0.49	0.26	0.13	0.06	0.81	0.44
1985	0.41	0.78	0.48	0.26	0.13	0.06	0.78	0.43
1986	0.69	1.21	0.75	0.41	0.21	0.10	1.21	0.77
1987	0.69	1.16	0.73	0.40	0.20	0.10	1.16	0.76
1988	0.45	1.35	0.81	0.37	0.15	0.06	1.35	0.62
1989	0.74	2.00	1.14	0.51	0.21	0.08	2.00	1.10
1990	0.34	0.92	0.53	0.24	0.10	0.04	0.92	0.45
1991	0.56	1.51	0.85	0.38	0.15	0.06	1.51	0.79
1992	0.55	1.43	0.80	0.35	0.14	0.06	1.43	0.76
1993	0.48	1.31	0.76	0.34	0.14	0.05	1.31	0.66
1994	0.53	1.39	0.78	0.34	0.14	0.05	1.39	0.73
1995	0.52	1.27	0.68	0.30	0.12	0.05	1.27	0.69
1996	0.46	1.15	0.63	0.28	0.11	0.04	1.15	0.63
1997	0.41	1.02	0.54	0.23	0.09	0.03	1.02	0.56
1998	0.39	0.88	0.44	0.19	0.07	0.03	0.88	0.49
1999	0.45	0.99	0.50	0.21	0.08	0.03	0.99	0.57
2000	0.50	1.09	0.54	0.23	0.09	0.03	1.09	0.61
2001	0.59	1.31	0.65	0.27	0.11	0.04	1.31	0.76
2002	0.48	1.07	0.53	0.22	0.09	0.03	1.07	0.58
2003	0.53	1.15	0.57	0.24	0.10	0.04	1.15	0.63
2004	0.43	0.95	0.47	0.20	0.08	0.03	0.95	0.51
2005	0.33	0.71	0.35	0.15	0.06	0.02	0.71	0.39
2006	0.44	0.96	0.48	0.20	0.08	0.03	0.96	0.57
2007	0.34	0.75	0.37	0.16	0.06	0.02	0.75	0.41
2008	0.45	1.00	0.49	0.21	0.08	0.03	1.00	0.56
2009	0.61	1.34	0.66	0.28	0.11	0.04	1.34	0.76
2010	0.45	0.98	0.49	0.20	0.08	0.03	0.98	0.52
2011	0.50	1.09	0.54	0.23	0.09	0.03	1.09	0.59
2012	0.76	1.66	0.82	0.35	0.14	0.05	1.66	0.94
2013	0.86	1.87	0.93	0.39	0.15	0.06	1.87	0.99
2014	0.61	1.34	0.66	0.28	0.11	0.04	1.34	0.69
2015	0.70	1.53	0.76	0.32	0.13	0.05	1.53	0.83
2016	0.76	1.67	0.83	0.35	0.14	0.05	1.67	0.90
2017	0.99	2.17	1.07	0.45	0.18	0.07	2.17	1.25
2018	0.33	0.73	0.36	0.15	0.06	0.02	0.73	0.38

Table 16: Limit and target reference point estimates for the Louisiana spotted seatrout stock. Spawning stock biomass units are pounds x 10^6. Fishing mortality units are $years^{-1}$.

Management Benchmarks		
Parameters	Derivation	Value
SSB_{limit}	Lowest SSB (1982-2009)	4.66
SPR_{limit}	Equation [29] and SSB_{limit}	10.2%
F_{limit}	Equation [29] and SPR_{limit}	0.76
SSB_{target}	Median SSB (1982-2009)	6.22
SPR_{target}	Equation [29] and SSB_{target}	13.6%
F_{target}	Equation [29] and SPR_{target}	0.63

Table 17: Sensitivity analysis table of proposed limit reference points. Current estimates are taken as the geometric mean of the 2016-2018 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are years^{-1}.

Model run	negLL	SPR_{limit}	$Yield_{limit}$	F_{limit}	SSB_{limit}	$SPR_{current}$	$F_{current}/F_{limit}$	$SSB_{current}/SSB_{limit}$
Base Model (h=1)	25271.2	10.2%	4.96	0.76	4.66	8.5%	0.99	0.84
Model 1 (h=0.95)	25271.3	10.4%	4.81	0.75	4.64	9.0%	1.01	0.84
Model 2 (h=0.90)	25271.7	10.7%	4.64	0.73	4.61	9.5%	1.03	0.84
Model 3 (h=0.85)	25272.1	11.1%	4.46	0.72	4.60	10.1%	1.05	0.85
Model 4 (h=0.80)	25272.8	11.5%	4.26	0.70	4.59	10.8%	1.07	0.85
Model 5 (Yield lambda*10)	23766.2	8.3%	5.18	0.85	3.87	8.5%	0.86	1.03
Model 6 (IOA lambdas*10)	24457.0	10.8%	4.52	0.72	4.52	7.7%	1.21	0.71
Model 7 (Winterkill index)	25309.0	8.1%	5.88	0.84	4.31	6.5%	0.85	0.80
Model 8 (Discard M=0.25)	25119.9	9.7%	5.08	0.79	4.61	8.2%	0.99	0.84
Model 9 (Growth model ALK's 1982-2018)	24878.7	10.2%	4.90	0.80	4.45	7.1%	1.11	0.69
Model 10 (ACAL MRIP hindcast)	25036.0	9.3%	5.19	0.81	4.43	8.0%	0.95	0.86
Model 11 (MRIP Size with FES/APAIS)	25268.3	10.3%	4.96	0.75	4.70	8.4%	1.00	0.82

Table 18: Sensitivity analysis table of MSY related reference points. Current estimates are taken as the geometric mean of 2016-2018 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are years^{-1}.

Model run	negLL	SPR_{MSY}	MSY	F_{MSY}	SSB_{MSY}	$SPR_{current}$	$F_{current}/F_{MSY}$	$SSB_{current}/SSB_{MSY}$
Base Model (h=1)	25271.2	--	--	--	--	8.5%	--	--
Model 1 (h=0.95)	25271.3	12.0%	4.82	0.69	5.43	9.0%	1.10	0.72
Model 2 (h=0.90)	25271.7	17.3%	4.90	0.54	8.42	9.5%	1.40	0.46
Model 3 (h=0.85)	25272.1	21.7%	5.24	0.45	11.85	10.1%	1.67	0.33
Model 4 (h=0.80)	25272.8	25.7%	5.97	0.39	16.74	10.8%	1.93	0.23

11. Figures

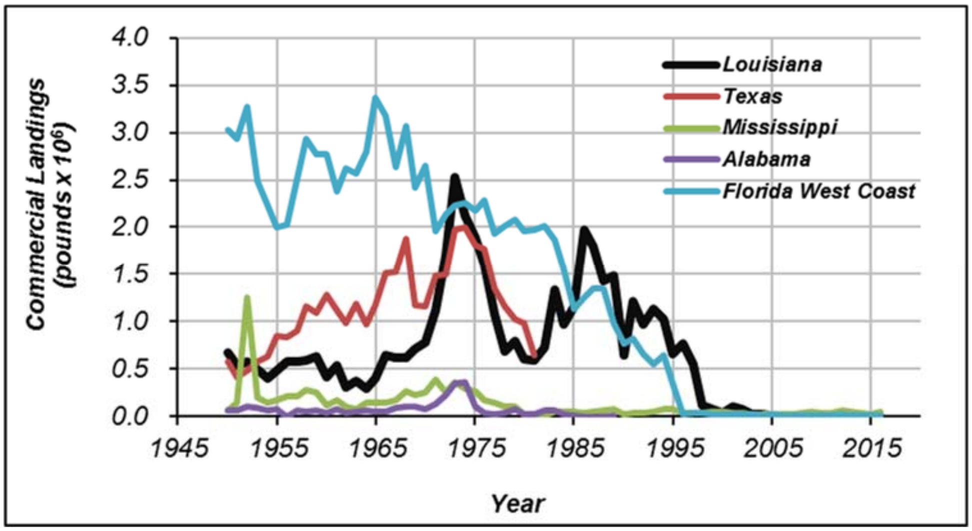

Figure 1: Reported commercial spotted seatrout landings (pounds x 10^6) of the Gulf of Mexico derived from NMFS statistical records and the LDWF Trip Ticket Program.

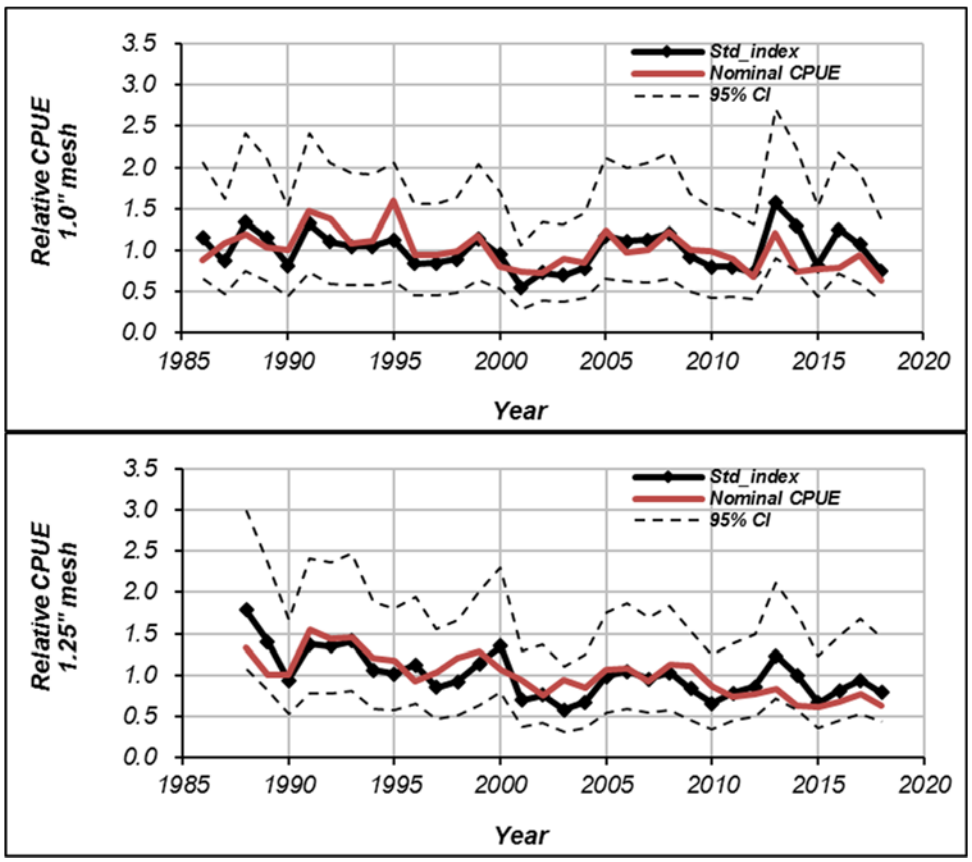

Figure 2: Standardized indices of abundance, nominal catch-per-unit-effort, and 95% confidence intervals of the standardized indices derived from the LDWF experimental marine gillnet survey. Each time-series has been normalized to its individual long-term mean for comparison.

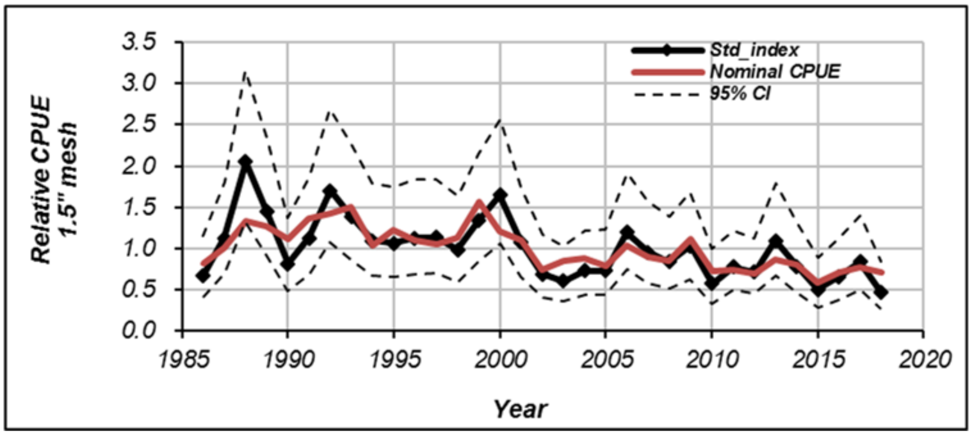

Figure 2 (continued):

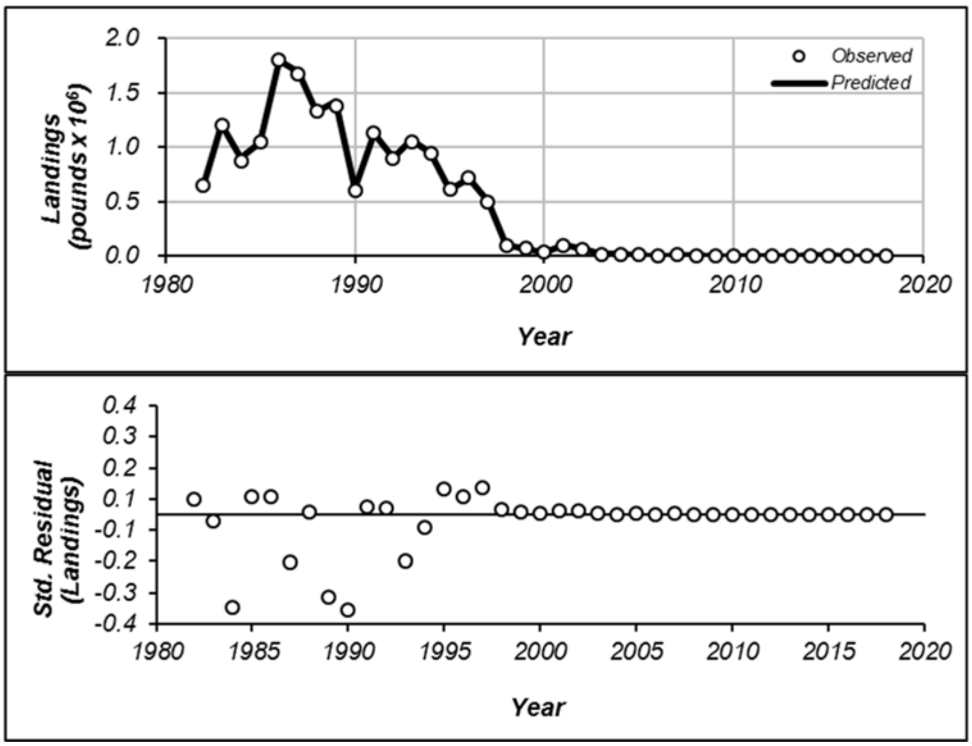

Figure 3: Observed and ASAP base model estimated commercial yield (females only; top) and standardized residuals (bottom).

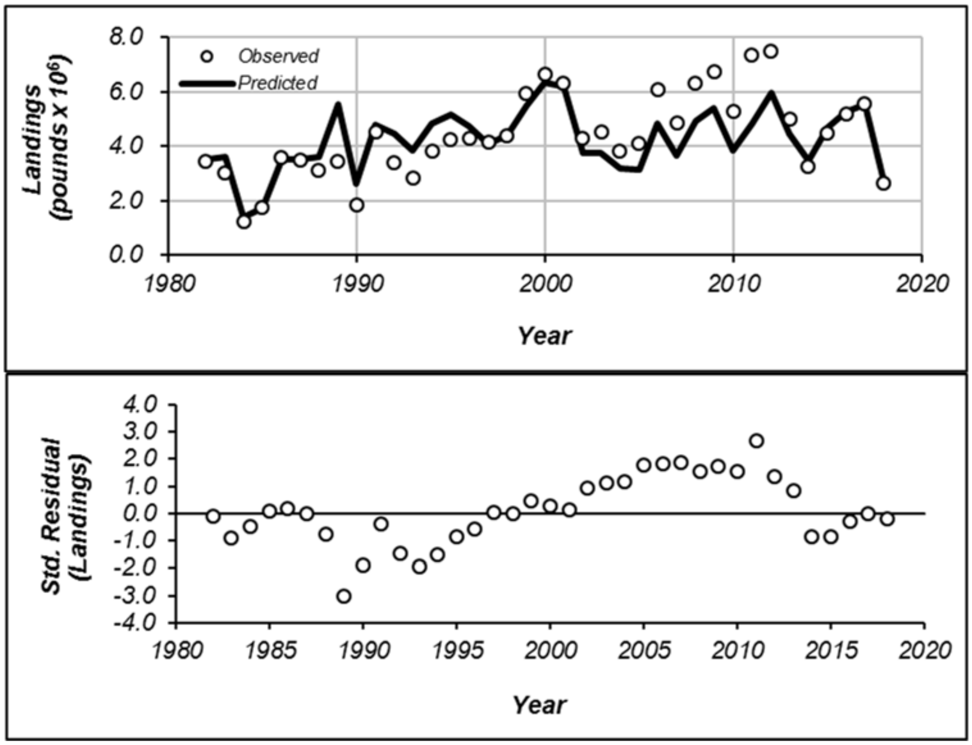

Figure 4: Observed and ASAP base model estimated recreational yield (females only; top) and standardized residuals (bottom).

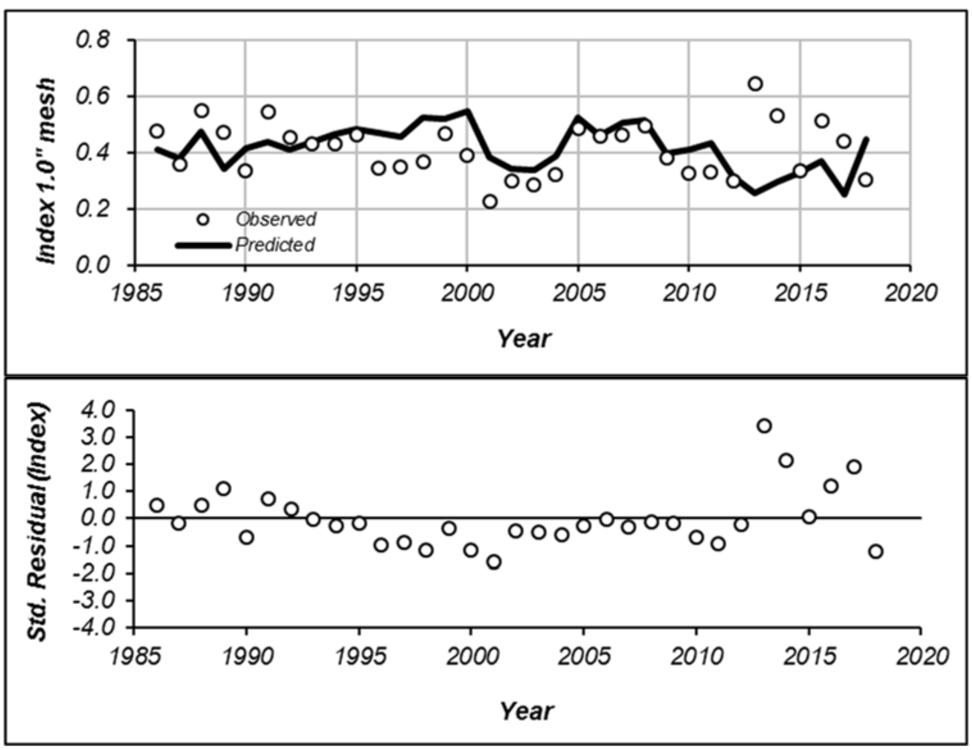

Figure 5: Observed and ASAP base model estimated survey CPUE (1.0" mesh; females only, top) and standardized residuals (bottom).

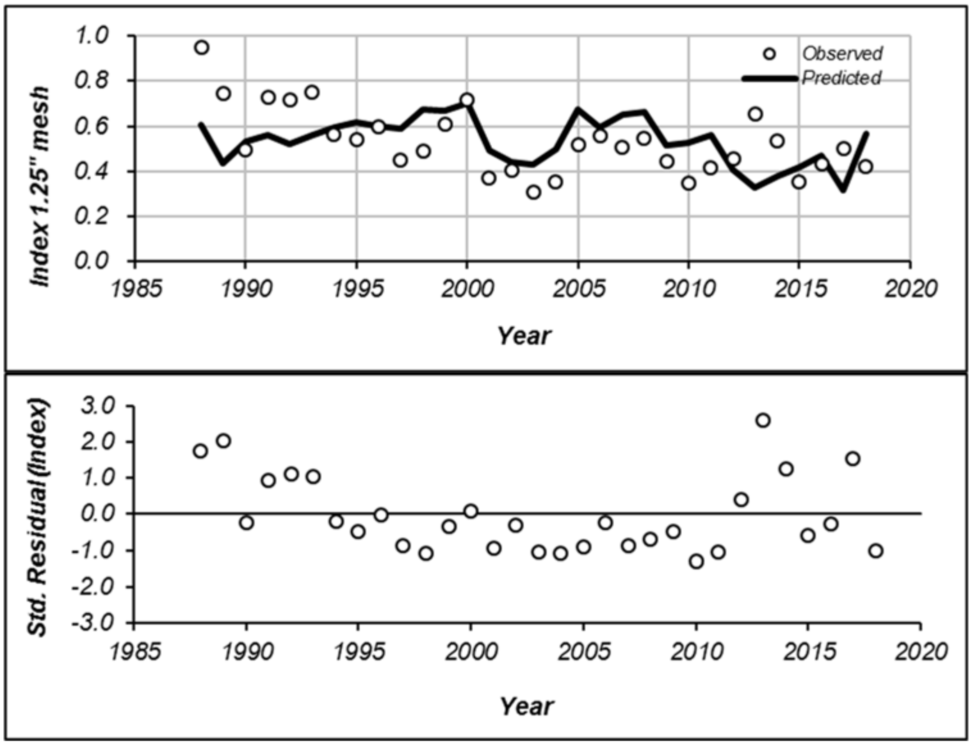

Figure 6: Observed and ASAP base model estimated survey CPUE (1.25" mesh; females only, top) and standardized residuals (bottom).

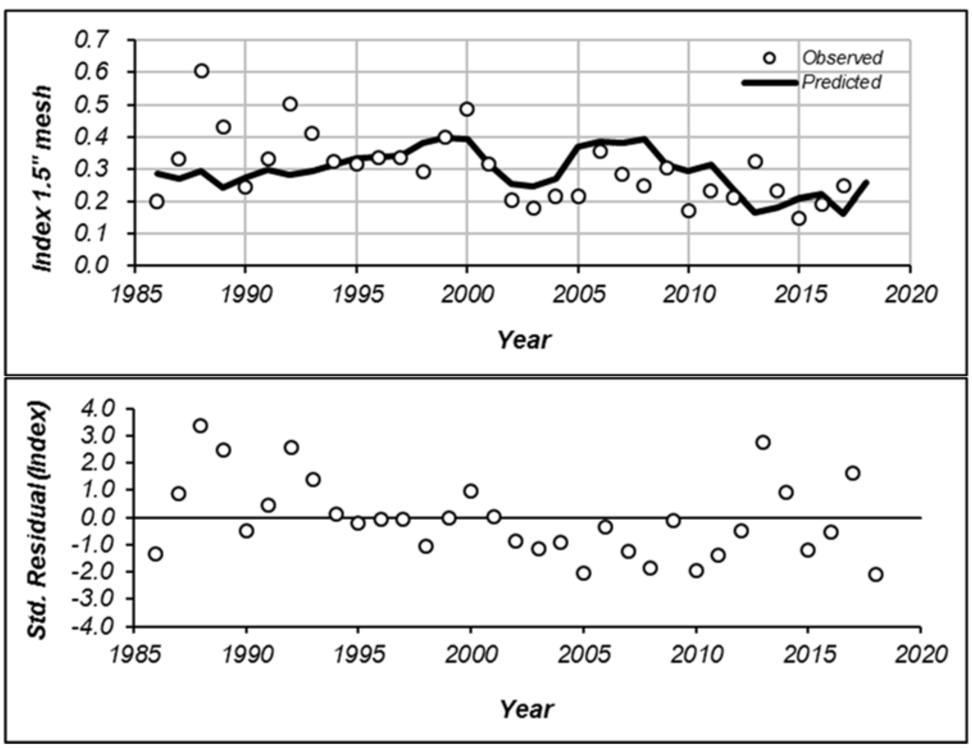

Figure 7: Observed and ASAP base model estimated survey CPUE (1.5" mesh; females only, top) and standardized residuals (bottom).

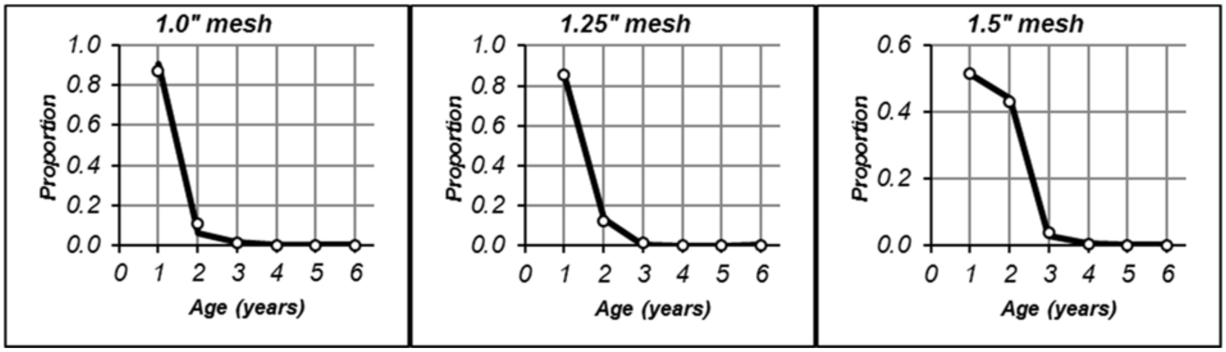

Figure 8: Overall (average) input (open circles) and ASAP estimated (bold lines) age compositions of experimental gillnet survey catches.

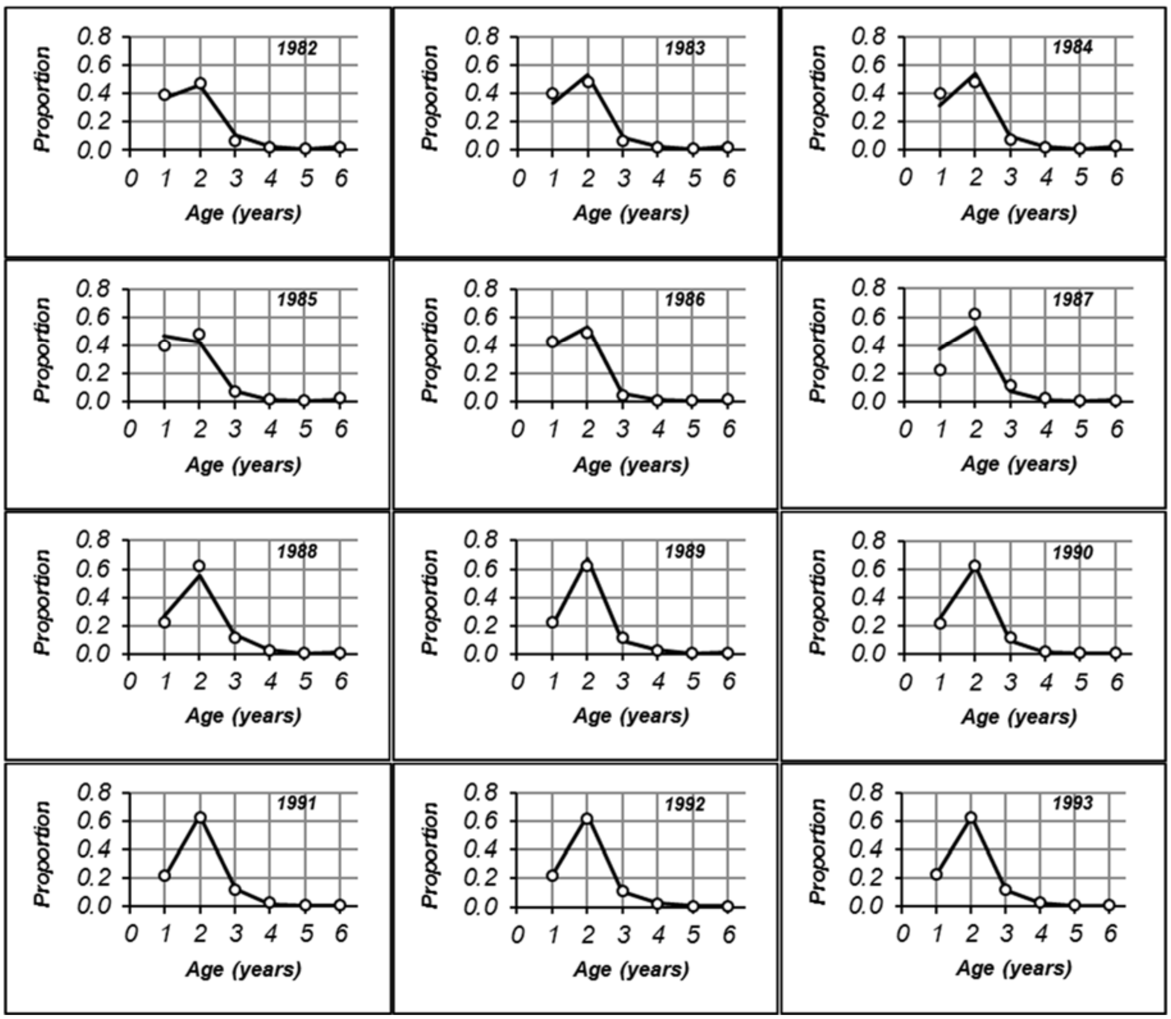

Figure 9: Annual input (open circles) and ASAP estimated (bold lines) commercial harvest age compositions.

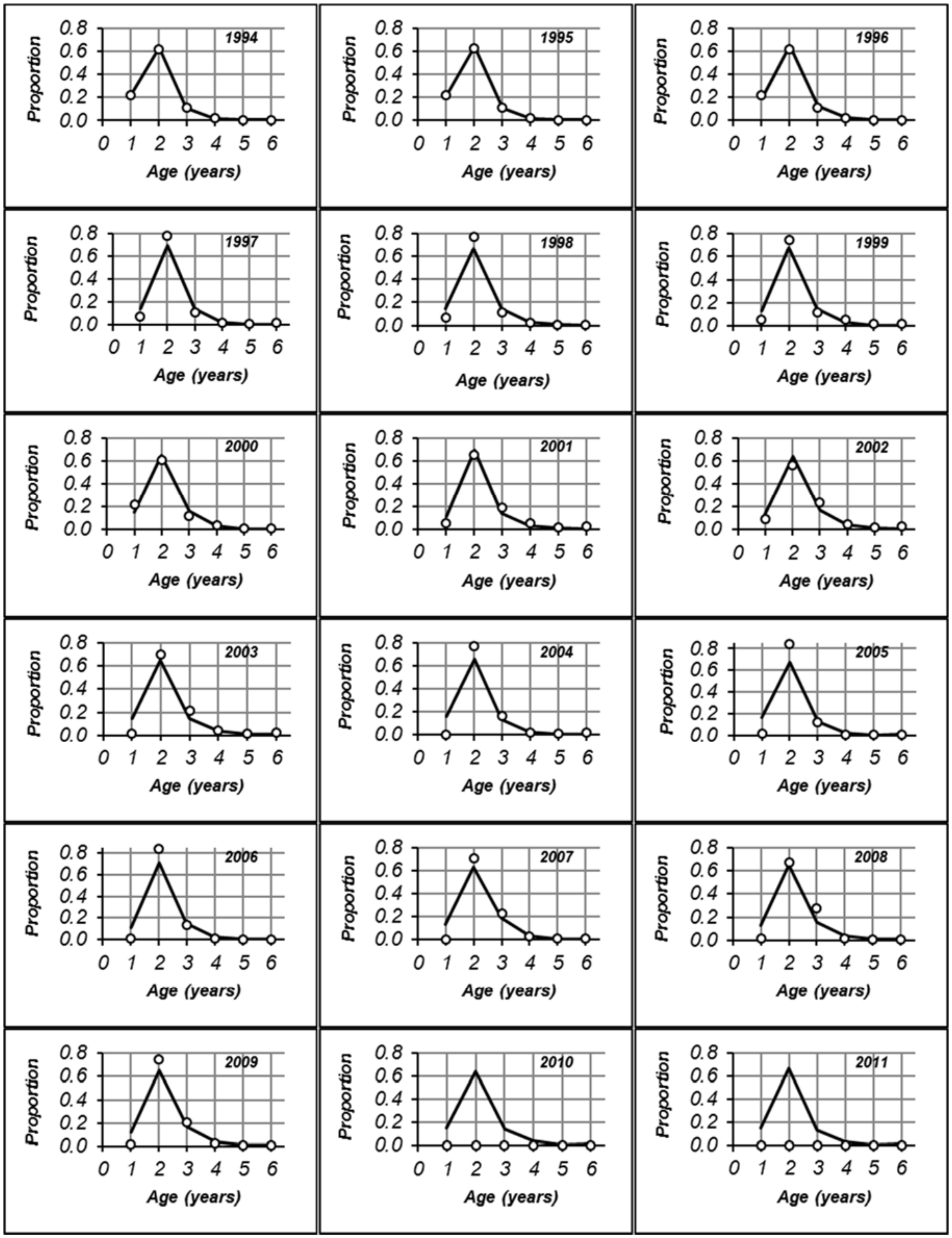

Figure 9 (continued):

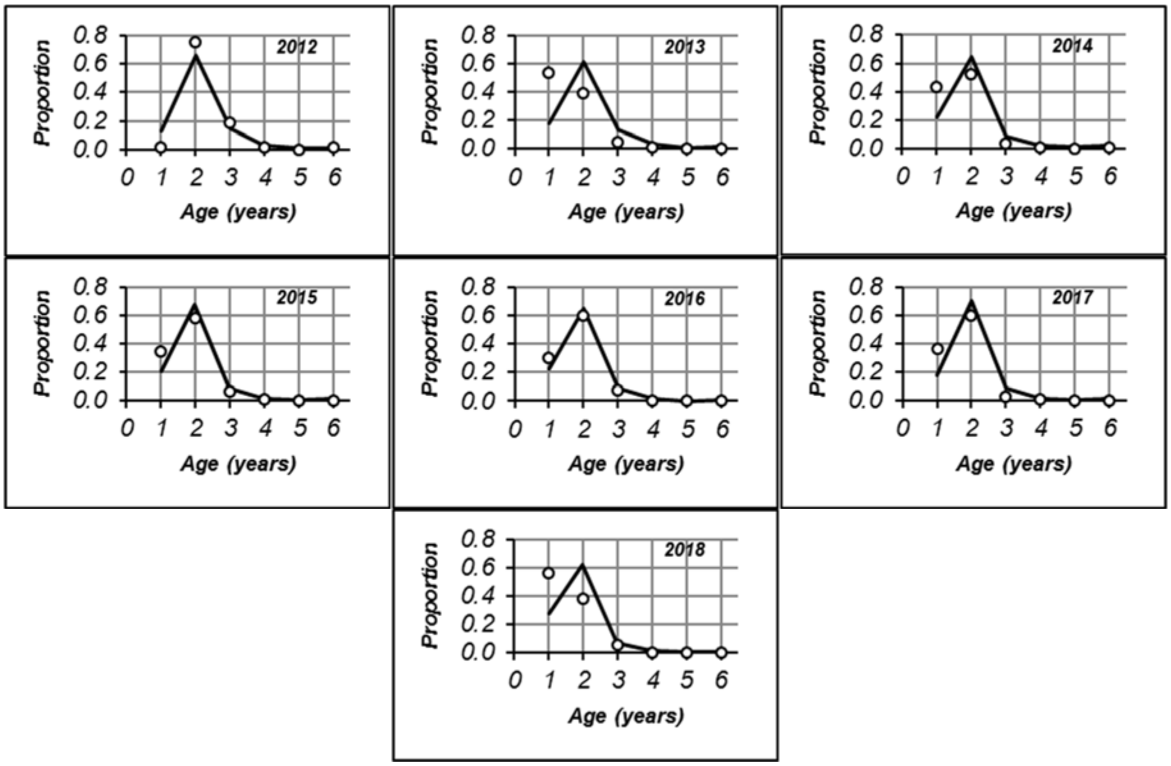

Figure 9 (continued):

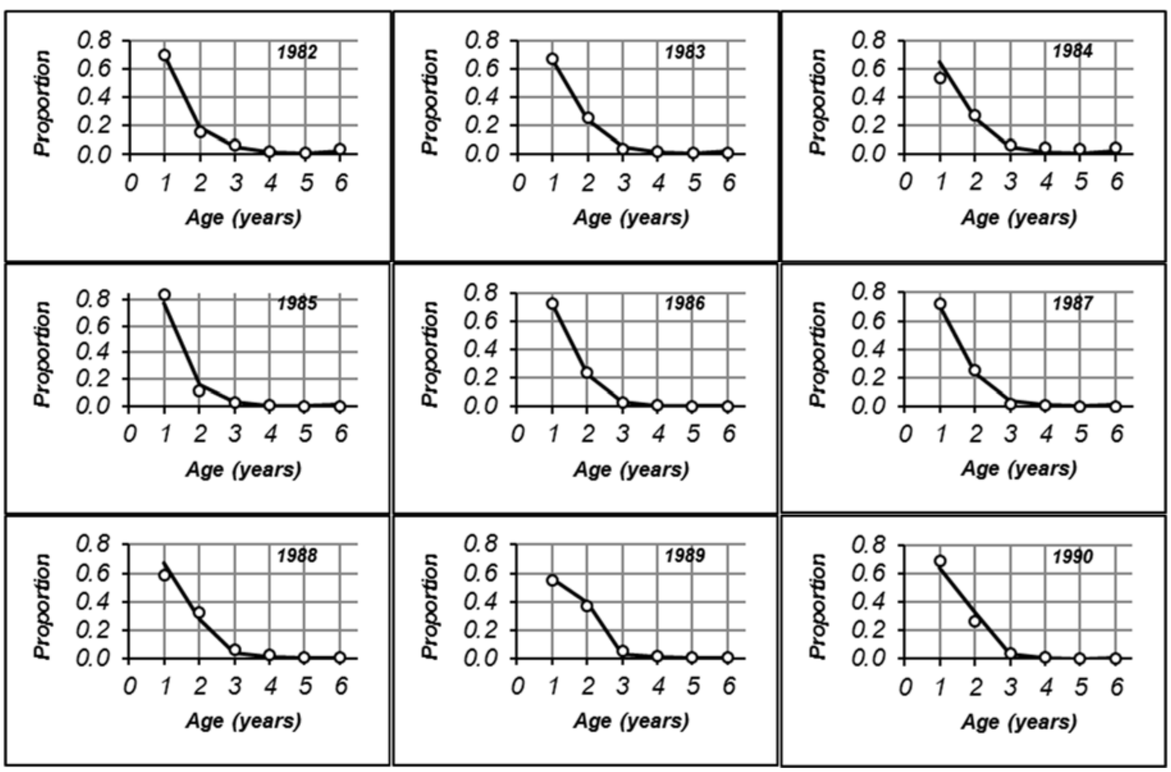

Figure 10: Annual input (open circles) and ASAP estimated (bold lines) recreational harvest age compositions.

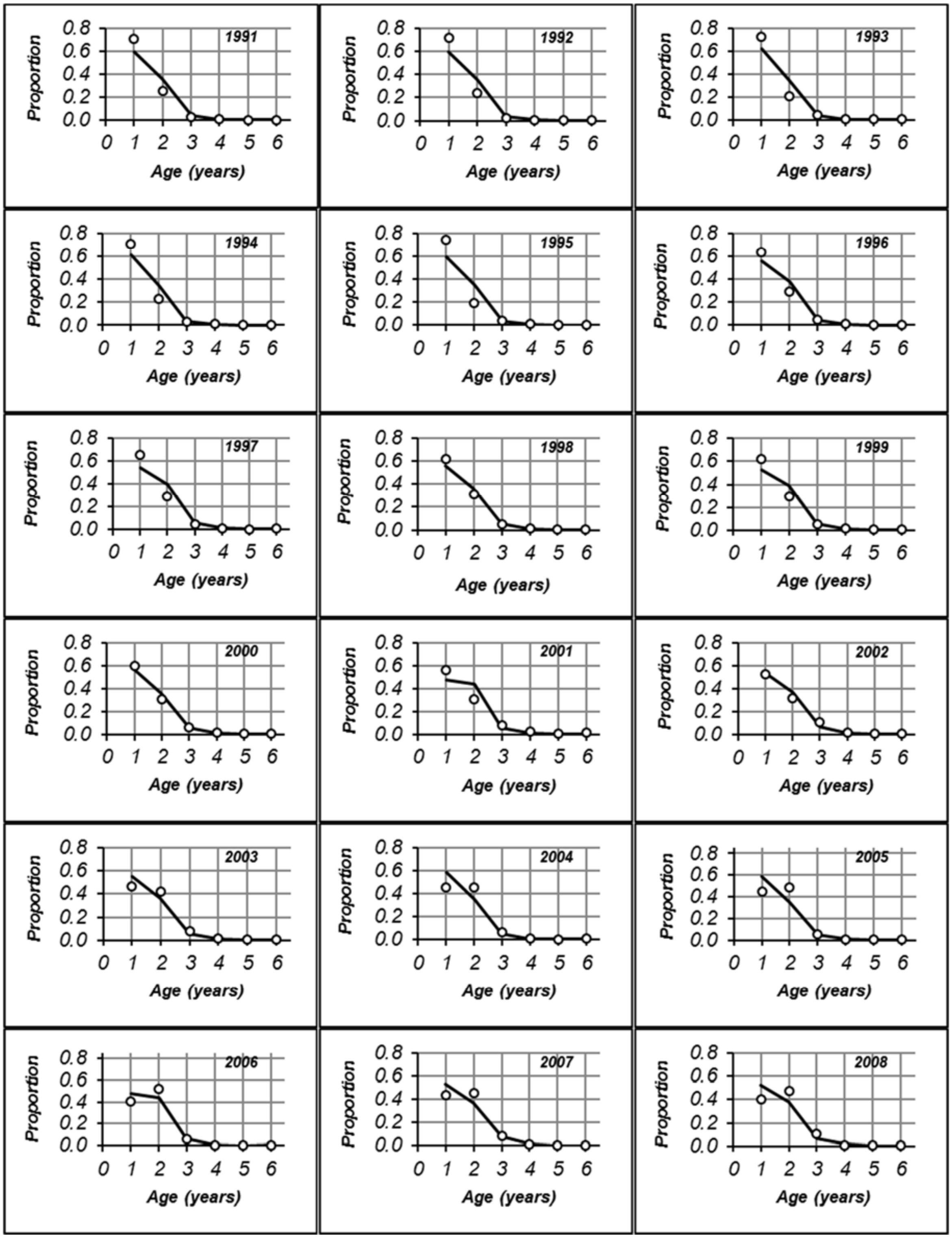

Figure 10 (continued):

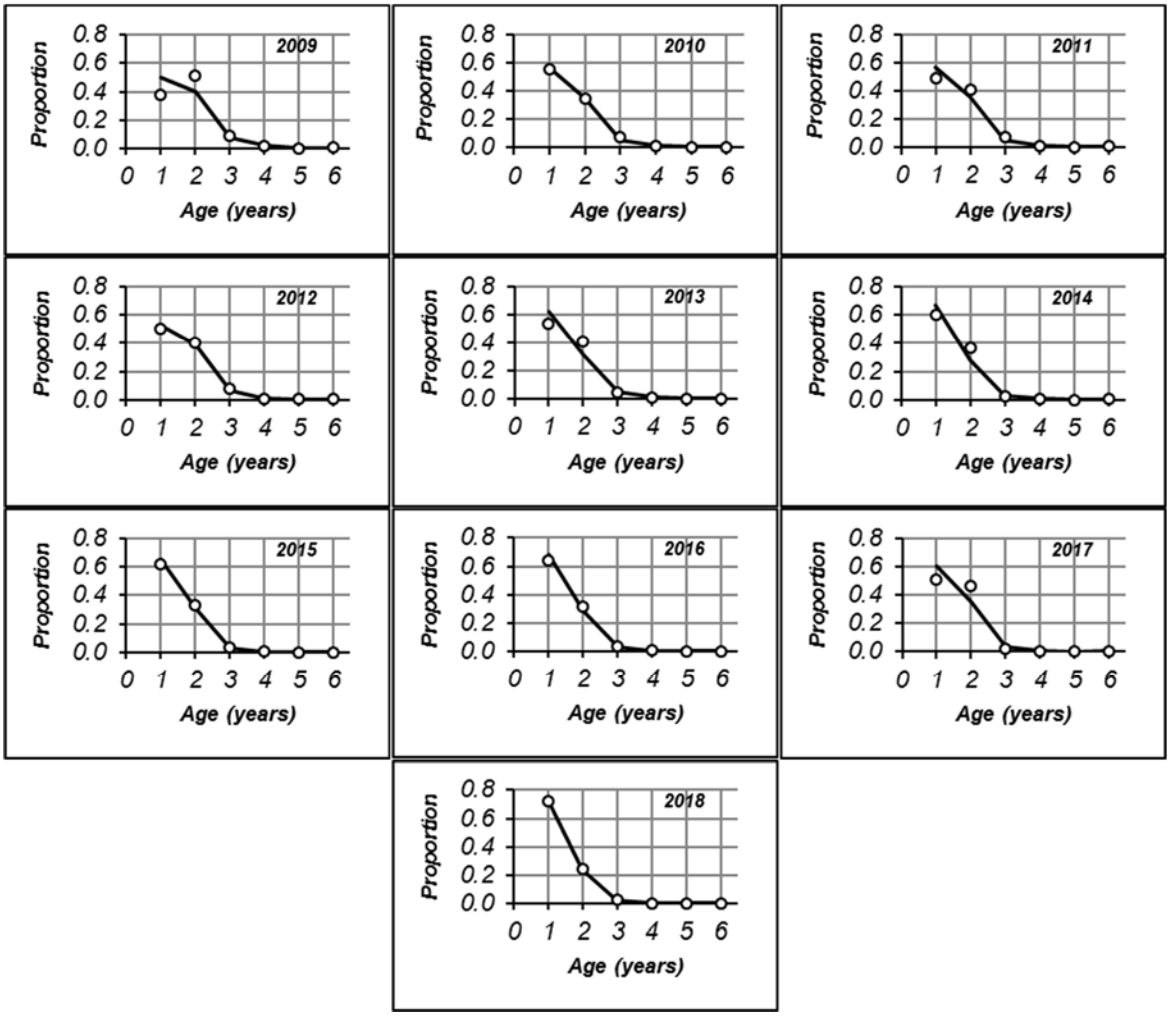

Figure 10 (continued):

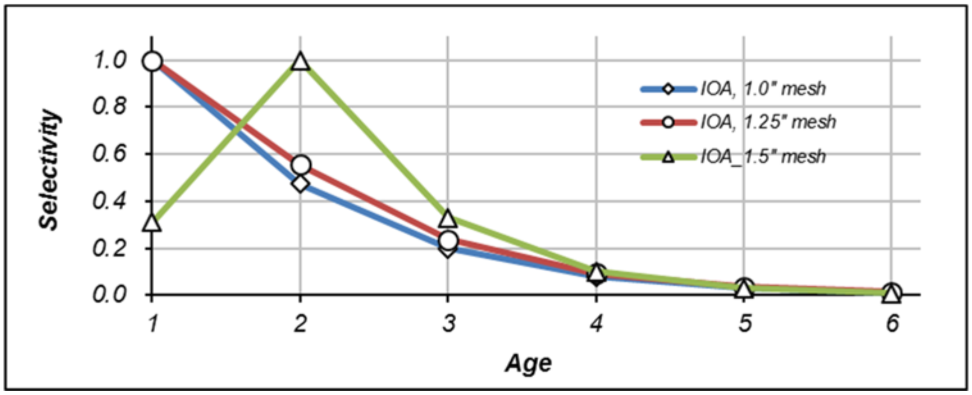

Figure 11: ASAP base model estimated survey selectivities (females only).

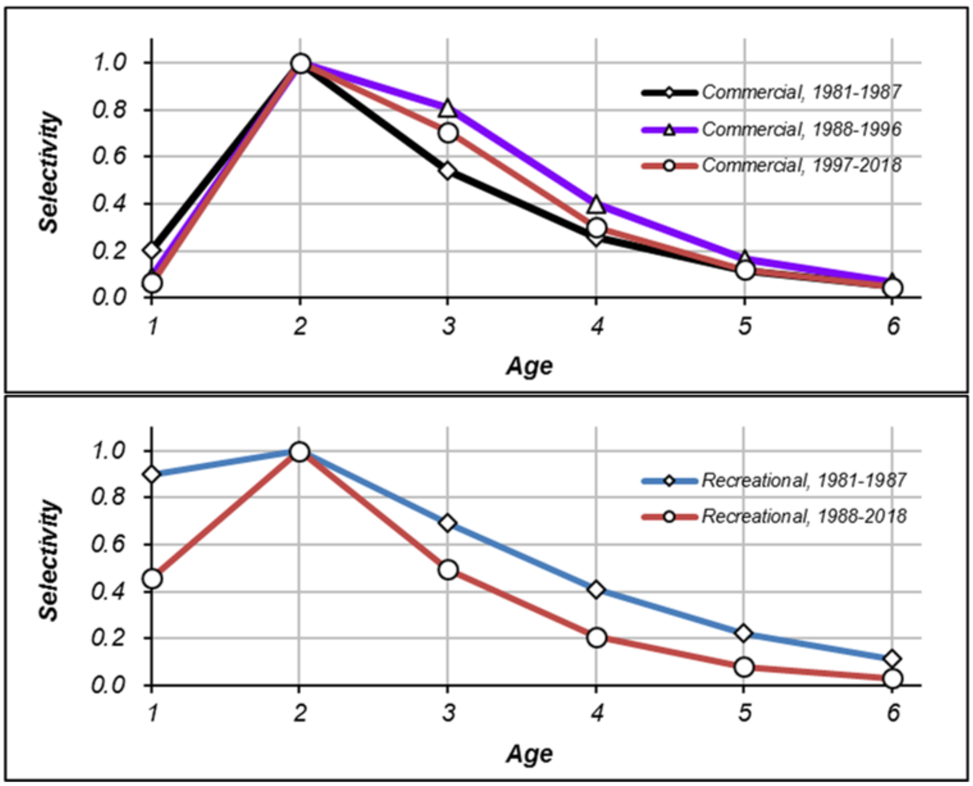

Figure 12: ASAP base model estimated fishery selectivities (females only).

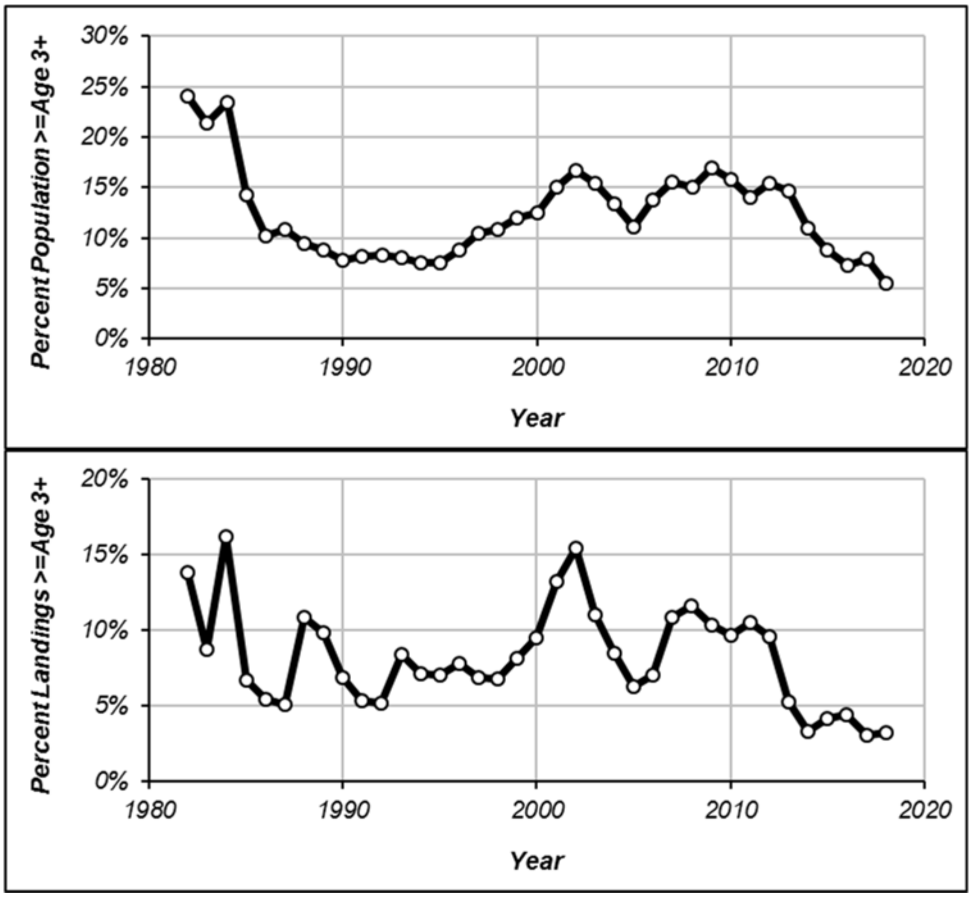

Figure 13: Proportion of the ASAP base model estimated stock ≥ age-3+ (top graphic) and the proportion of observed landings (females only) ≥ age-3+ (bottom graphic).

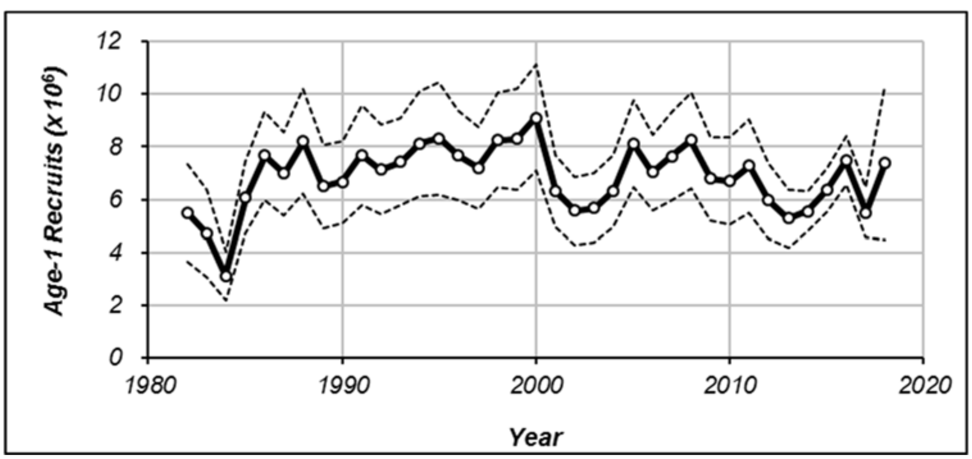

Figure 14: ASAP base model estimated recruitment (age-1 females). Dashed lines represent ±2 asymptotic standard errors.

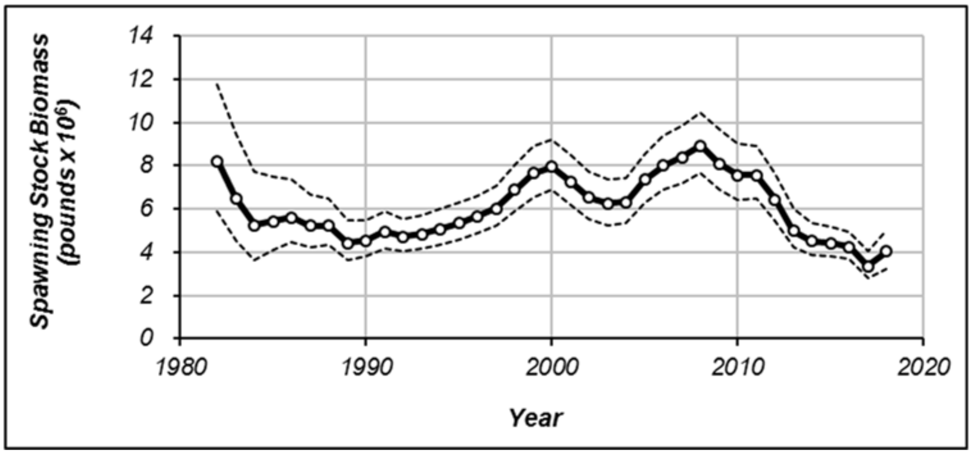

Figure 15: ASAP base model estimated female spawning stock biomass (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

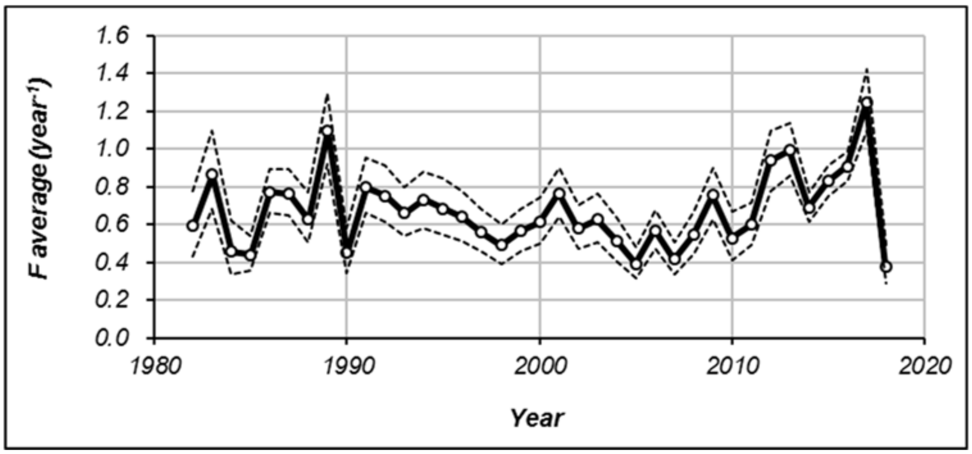

Figure 16: ASAP base model estimated average fishing mortality (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

Figure 17: ASAP base model estimated age-1 recruits and female spawning stock biomass. Arrow represents direction of the time-series. The yellow circle represents the most current data pair (2018 age-1 recruits / 2017 female SSB) and the yellow triangle represents the 2018 SSB estimate. The green circle represents the first data pair (1983 age-1 recruits / 1982 female SSB).

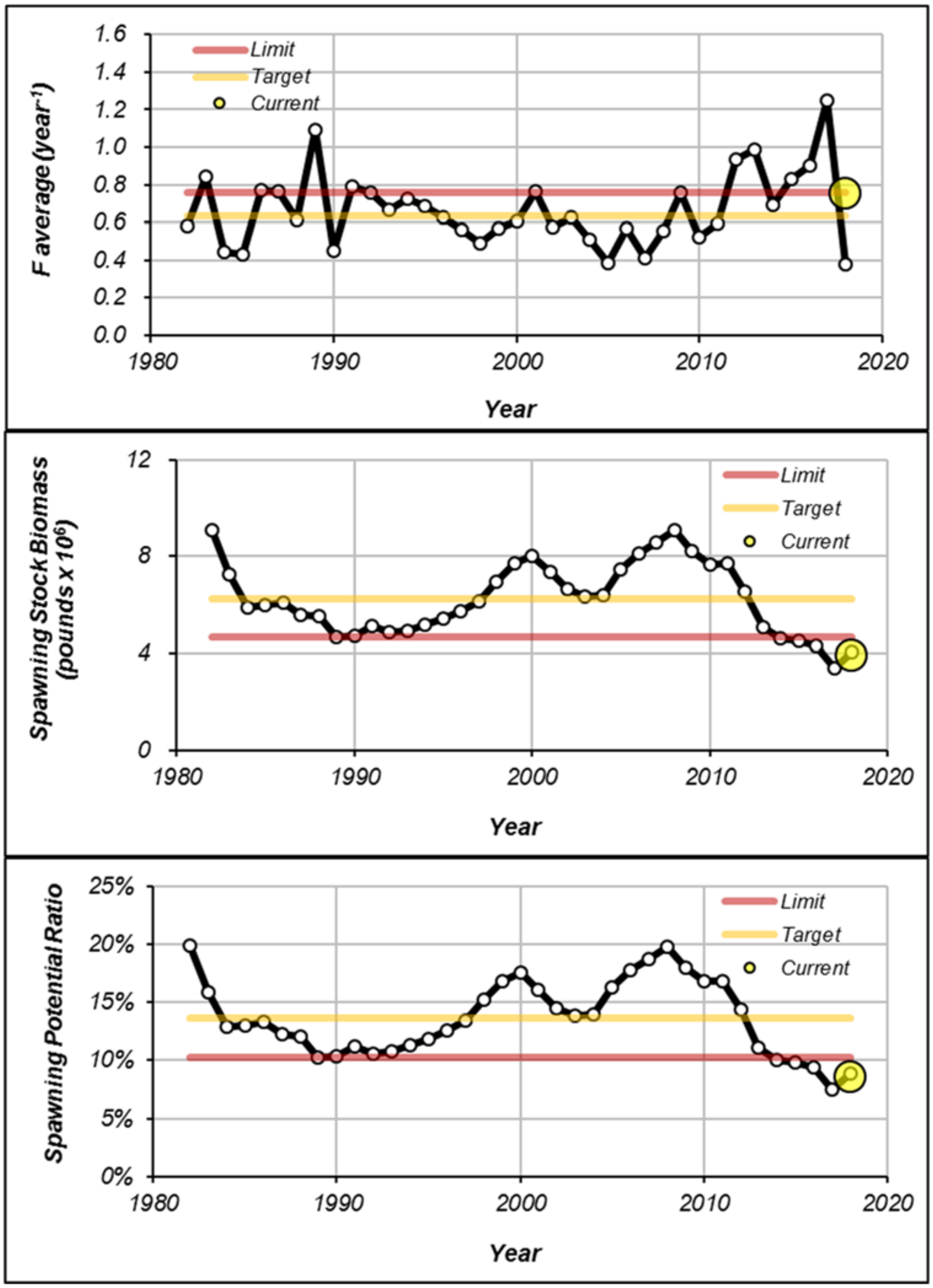

Figure 18: Time-series of ASAP base model estimated average fishing mortality rates, female spawning stock biomass, and spawning potential ratio relative to proposed limit and target reference points. Current values represent the geometric mean of the 2016-2018 estimates.

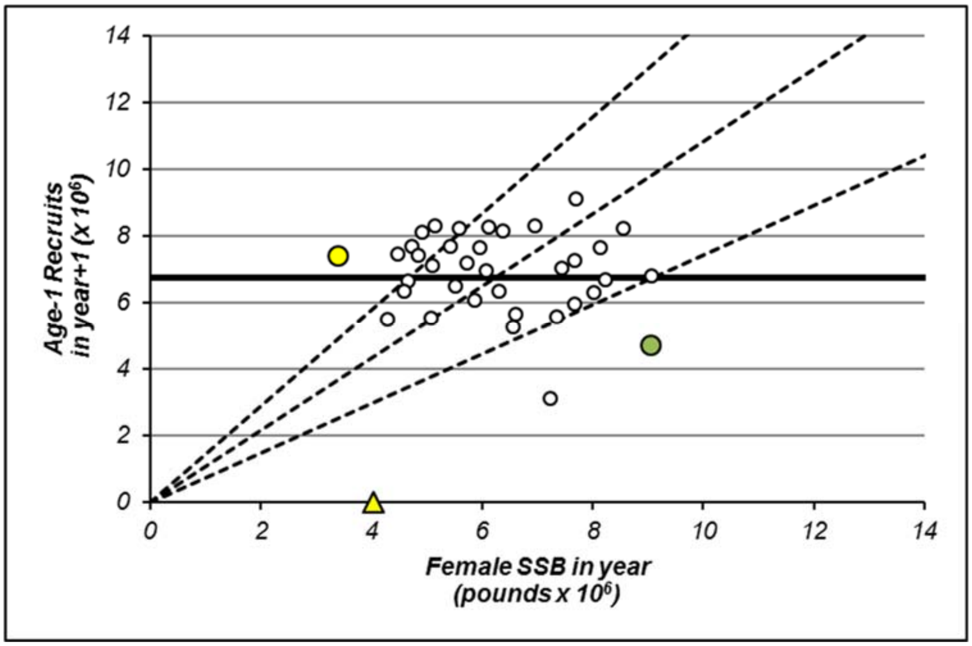

Figure 19: ASAP base model estimated age-1 recruits and female spawning stock biomass (open circles). Equilibrium recruitment is represented by the bold horizontal. The yellow circle represents the most current data pair (2018 age-1 recruits / 2017 female SSB) and the yellow triangle represents the 2018 SSB estimate. The green circle represents the first data pair (1983 age-1 recruits / 1982 female SSB). Equilibrium recruitment per spawning stock biomass corresponding with the limit and target spawning stock biomass reference point estimates and the maximum spawning stock biomass are represented by the slopes of the dashed diagonals (SSB_{limit}=10.2%SPR; SSB_{target}=13.6%; max. SSB=19.8%SPR).

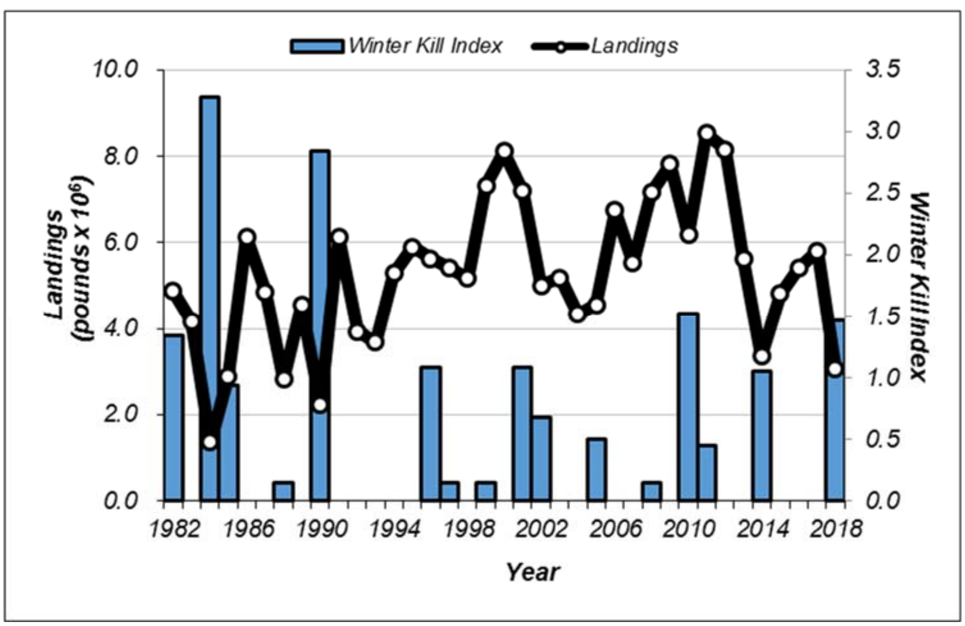

Figure 20: Spotted seatrout landings (total) relative to winterkill index values.

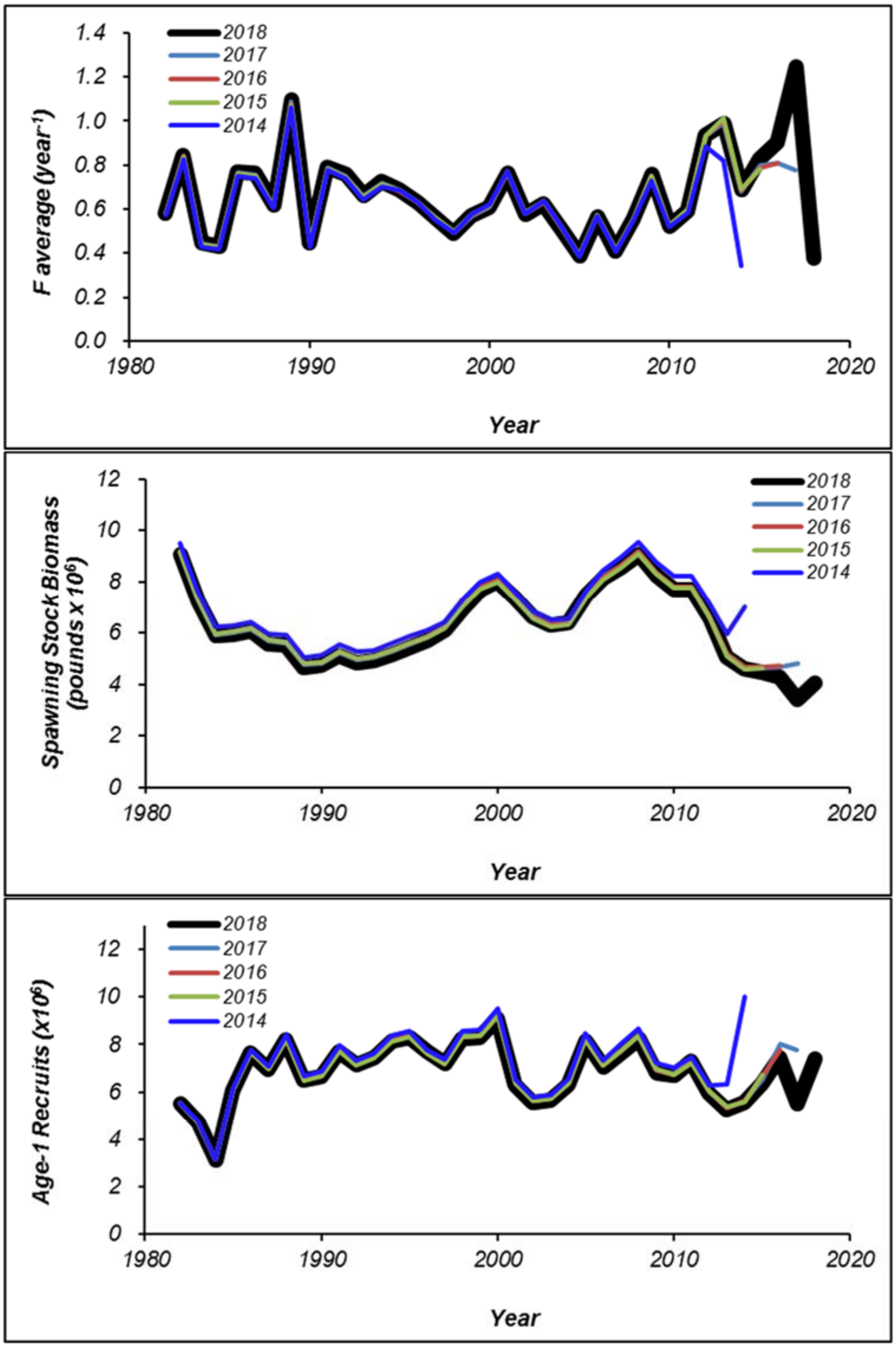

Figure 21: Retrospective analysis of ASAP base model. Top graphics depict annual average fishing mortality and female spawning stock biomass estimates. Bottom graphic depicts estimated age-1 recruits.

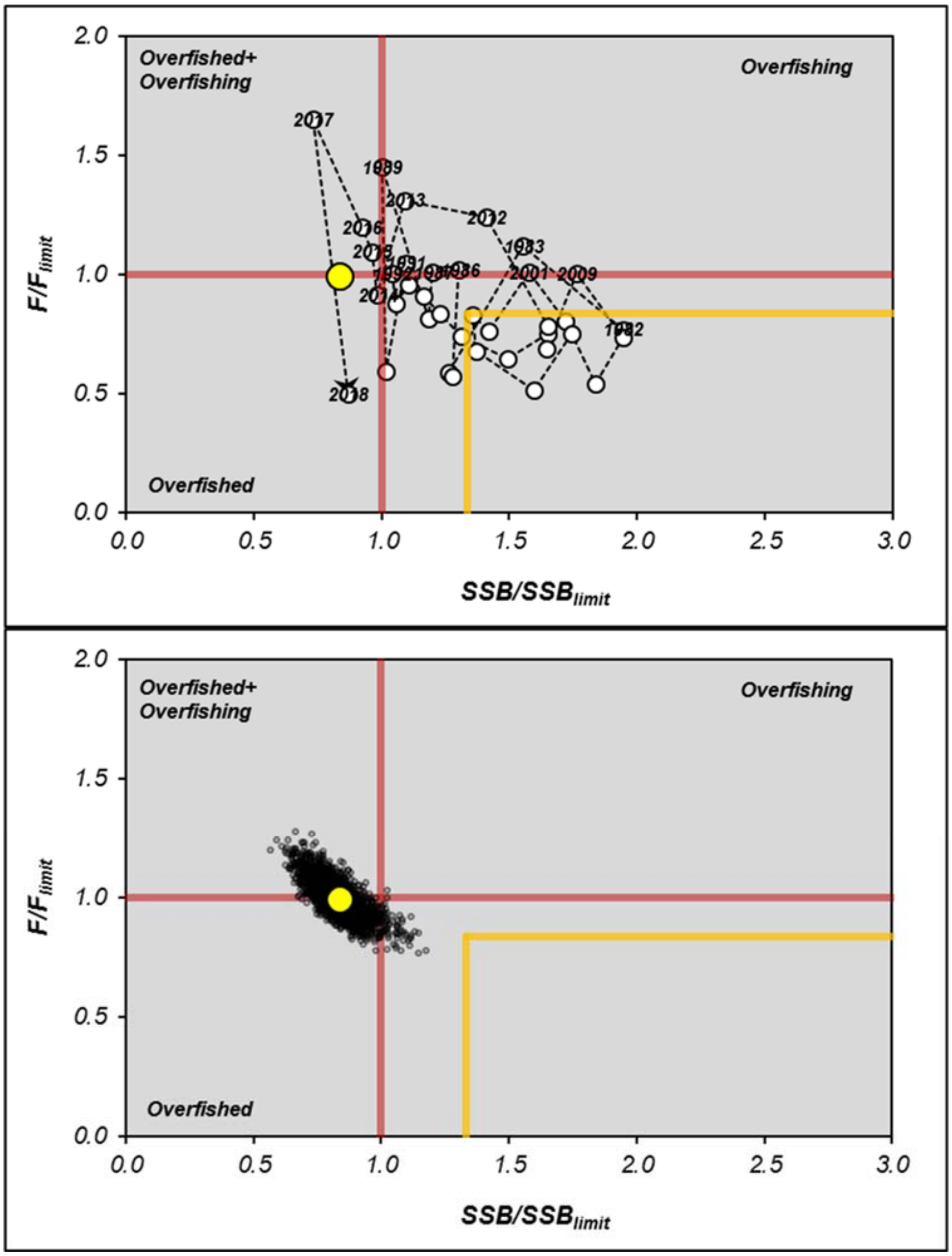

Figure 22: ASAP base model estimated ratios of annual average fishing mortality rates and female spawning stock biomass to the proposed limit reference points (F_{limit} and SSB_{limit}). Also presented are the proposed target reference points (yellow lines). Arrow represents direction of time-series. The first and last year of the time-series are identified along with the years overfishing occurred and/or the stock was considered overfished. The yellow circle represents current status (geometric mean 2016-2018). Bottom graphic depicts current status and results of 2000 MCMC simulations relative to proposed limit and target reference points.

Appendix 1:

LA Creel/MRIP Calibration Procedure

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10/8/2018

Overview

The Louisiana Department of Wildlife and Fisheries (LDWF) conducts stock assessments on important recreationally and commercially landed species. Time-series of fishery removals are critical components of these stock assessments as they provide the level of depletion of the resource through time. Beginning in 2014, LDWF started its own creel survey (LA Creel) to provide recreational landings estimates for Louisiana-specific fishery management and stock assessment purposes. Prior to 2014 recreational landings estimates were taken from the National Marine Fisheries Service's Marine Recreational Intercept Program and the earlier Marine Recreational Fisheries Statistical Survey (MRIP/MRFSS). The MRIP and LA Creel surveys were conducted simultaneously in 2015 for benchmarking purposes. Methods are now needed to calibrate MRIP landings estimates to LA Creel landings estimates for species with upcoming LDWF stock assessments.

Calibration Methodology

A ratio estimator approach is described below allowing hind-casting of LA Creel recreational harvest estimates to 1982. The calibration procedure to hind-cast LA Creel discard estimates is presented in the Appendix of this document.

Concurrent harvest rate estimates of LA Creel and MRIP are only available for the single year (2015) both surveys were conducted simultaneously. Effort estimates, however, are available from both surveys for multiple years (2015-2017). The reliability of this calibration procedure could be greatly improved with more comparison years of the surveys.

Note: MRIP private fishing effort is distributed across the various fishing modes (shore, inshore, and offshore) by applying the observed distribution of those modes from the dockside survey. In 2016 and 2017, the MRIP effort estimation process required additional estimations, as the dockside portion of that survey was not conducted in Louisiana. NOAA Fisheries applied the proportions of trips by fishing mode observed in 2015 to the effort data collected in 2016 and 2017 to obtain estimates of angler trips by fishing mode. While this method is clearly not optimal, it does allow comparison of effort over additional years.

Abbreviations used in this document:

E - Fishing effort
FM - Fishing mode
- C - charter
- CI - charter inshore
- CO - charter offshore
- P - private
- PI - private inshore (LA Creel)
- PO - private offshore
- PR - private boat (MRIP)
- SH - shore (MRIP)

H - Harvest
HR - Harvest rate
D - Discards
DR – Discard rate
PSE - Percent standard error
R - Ratio
V - Variance
y – Year
w – Bimonthly period
wk – Week of year

The LA Creel survey provides estimates for four fishing modes (FM): private inshore (PI), private offshore (PO), charter inshore (CI), and charter offshore (CO). The MRIP survey provides estimates for five fishing modes: private boat (PR), shore (SH), PO, CI, and CO. For calibration purposes, LA Creel estimates are transformed into a fifth fishing mode equivalent to the MRIP surveys SH mode by separating the PI mode into PR and SH modes. Additionally, the inshore/offshore fishing modes of each survey are collapsed into overall private (P) and charter (C) fishing modes for the species included in this report that support predominantly inshore fisheries.

Fishing effort (E) estimates of the two surveys are calibrated separately by collapsed fishing mode (P and SH only) and bimonthly period (w). Because the charter fishing effort frame used by the LA Creel and MRIP surveys are functionally equivalent, charter fishing effort and corresponding variance estimates of the two surveys are assumed equivalent and not adjusted. Harvest rates and corresponding variance estimates of the MRIP and LA Creel surveys for the species included in this report are also assumed equivalent and not adjusted. Calibrated effort estimates of the shore and private fishing modes are then combined with unadjusted MRIP harvest rate estimates to provide time-series of recreational harvest estimates for species with upcoming LDWF stock assessments as described below.

Fishing Effort

To allow hind-casting of LA Creel effort estimates to the historic MRIP effort time-series, fishing effort calibration factors are calculated as the ratio of mean fishing effort (2015-2017) from each survey by fishing mode (P and SH only) and bimonthly period as:

$$\hat{R}_{E,FM,w} = \frac{\bar{E}_{LAcreel,FM,w}}{\bar{E}_{MRIP,FM,w}} \qquad [1]$$

Note: MRIP effort estimates in Equation [1] are based on the FES and APAIS methodologies.

Survey-specific mean fishing effort (angler trips) and calibration factors for the P and SH fishing modes by bimonthly period are presented below.

FM	w	$\bar{E}_{LAcreel}$	$\bar{E}_{MRIP}$	$\hat{R}_E$
P	1	141,988	683,741	0.208
P	2	229,436	539,929	0.425
P	3	425,433	913,075	0.466
P	4	349,345	1,131,685	0.309
P	5	284,077	898,045	0.316
P	6	277,228	865,312	0.320
SH	1	50,377	692,050	0.073
SH	2	80,580	588,099	0.137
SH	3	151,142	865,279	0.175
SH	4	73,203	1,056,573	0.069
SH	5	105,286	1,115,605	0.094
SH	6	64,342	902,530	0.071

The hind-cast LA Creel fishing effort estimates (1982-2013) are then calculated by fishing mode and bimonthly period as:

$$\hat{E}_{y,w,FM,\hat{R}} = \hat{R}_{E,FM,w}\hat{E}_{y,w,FM,MRIP} \quad [2]$$

Note: MRIP effort estimates in Equation [2] have been calibrated to the FES and APAIS design changes (FCAL).

Variances of the hind-cast LA Creel fishing effort estimates from Equation [2] are approximated by fishing mode and bimonthly period as:

$$\hat{V}\left(\hat{E}_{y,w,FM,\hat{R}}\right) = \hat{E}^2_{y,w,FM,MRIP}\hat{V}\left(\hat{R}_{E,FM,w}\right) + \hat{R}^2_{E,FM,w}\hat{V}\left(\hat{E}_{y,w,FM,MRIP}\right) - \hat{V}\left(\hat{R}_{E,FM,w}\right)\hat{V}\left(\hat{E}_{y,w,FM,MRIP}\right) \quad [3]$$

where

$$\hat{V}\left(\hat{R}_{E,FM,w}\right) = \hat{R}_{E,FM,w}{}^2\left[\frac{\hat{V}(\bar{E}_{LAcreel,FM,w})}{\bar{E}_{LAcreel,FM,w}{}^2} + \frac{\hat{V}(\bar{E}_{MRIP,FM,w})}{\bar{E}_{MRIP,FM,w}{}^2} - 2\frac{Cov(\bar{E}_{LAcreel,FM,w},\bar{E}_{MRIP,FM,w})}{\bar{E}_{LAcreel,FM,w}\bar{E}_{MRIP,FM,w}}\right]$$

Effort variances $\hat{V}\left(\hat{E}_{y,w,FM,MRIP}\right)$ in Equation [3] are post-calibration (i.e. after applying a mean fishing effort variance ratio estimator $\frac{\hat{V}(\bar{E}_{LAcreel,FM,w})}{\hat{V}(\bar{E}_{MRIP,FM,w})}$ to the MRIP variance estimates).

Harvest

The hind-cast LA Creel harvest estimates (1982-2013) by fishing mode (P and SH only) for the species included in this report are then calculated as:

$$\hat{H}_{y,FM,\hat{R}} = \sum_w \hat{E}_{y,w,FM,\hat{R}}\,\widehat{HR}_{y,w,FM,MRIP} \quad [4]$$

Note: MRIP harvest rate estimates in Equation [4] are FCAL estimates and represent A+ B1 landings only.

Variances of the calibrated harvest estimates are then calculated as:

$$\hat{V}\left(\hat{H}_{y,FM,\hat{R}}\right) = \sum_w\left[\hat{E}_{y,FM,w,\hat{R}}{}^2\hat{V}(\widehat{HR}_{y,FM,w,MRIP}) + \widehat{HR}_{y,FM,w,MRIP}{}^2\hat{V}\left(\hat{E}_{y,FM,w,\hat{R}}\right) - \hat{V}\left(\hat{E}_{y,FM,w,\hat{R}}\right)\hat{V}(\widehat{HR}_{y,FM,w,MRIP})\right] \quad [5]$$

Percent standard errors of the calibrated harvest estimates are then calculated as:

$$PSE\left(\hat{H}_{y,FM,\hat{R}}\right) = 100 \times \frac{\sqrt{\hat{V}\left(\hat{H}_{y,FM,\hat{R}}\right)}}{\hat{H}_{y,FM,\hat{R}}} \quad [6]$$

The MRIP (FCAL) and hind-cast LA Creel harvest estimate time-series and corresponding PSEs by fishing mode for species with upcoming LDWF stock assessments are presented below.

FM = Private

Year	Black Drum				Red Drum				Sheepshead				Southern Flounder				Spotted Seatrout			
	MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel	
	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE
1982	1,106,821	27.1	426,166	31.2	3,046,664	12.0	925,323	21.4	511,387	34.3	184,011	40.4	497,263	19.5	190,801	23.4	9,160,786	16.2	3,111,188	23.8
1983	1,659,509	34.3	595,673	38.8	4,758,470	32.7	1,542,955	41.7	1,064,824	38.1	334,974	43.8	1,929,817	51.4	610,002	58.6	7,402,179	20.0	2,660,990	25.0
1984	362,104	26.0	138,699	29.8	2,976,458	38.9	960,611	40.8	548,364	47.5	176,510	39.5	213,064	23.0	73,394	28.5	2,503,426	29.8	790,913	33.0
1985	356,406	30.0	115,179	34.5	2,563,074	14.5	865,588	21.9	340,142	32.1	114,127	35.8	431,284	24.5	150,115	27.3	5,947,072	15.2	2,109,649	22.2
1986	918,541	24.1	317,533	28.9	2,635,843	10.0	843,830	21.1	252,644	15.5	84,282	23.6	1,464,132	48.5	483,555	47.8	14,077,720	7.8	4,947,892	16.4
1987	683,049	25.6	237,415	30.7	2,602,974	23.0	876,900	30.6	270,702	33.7	87,926	33.0	147,601	25.2	52,016	27.6	11,023,715	10.1	4,035,139	15.6
1988	344,681	15.4	115,234	22.3	1,160,955	20.2	349,965	26.3	277,793	21.3	90,608	28.5	358,099	13.2	123,628	18.1	6,890,452	14.3	2,511,864	21.3
1989	227,336	20.4	76,002	25.3	2,015,801	12.6	676,453	24.5	789,892	49.3	254,087	50.2	341,489	25.9	111,900	29.0	8,082,318	11.9	2,753,203	18.0
1990	231,168	22.9	79,940	26.9	1,469,547	16.8	481,003	25.0	270,726	27.1	104,809	31.1	805,964	23.6	264,106	26.8	4,881,711	13.7	1,640,863	21.0
1991	183,005	19.4	62,265	26.3	1,824,768	20.0	582,125	33.1	402,935	32.6	138,862	35.4	694,466	16.1	248,442	20.6	13,468,560	9.9	4,744,596	18.2
1992	333,217	23.9	119,606	28.4	2,807,145	8.7	936,586	15.5	563,816	25.3	182,360	27.9	615,928	14.6	217,218	17.6	10,680,755	9.3	3,584,240	20.0
1993	246,588	17.6	88,970	24.2	2,581,130	9.9	880,530	16.3	885,380	26.7	320,661	35.5	500,023	14.8	175,907	18.0	7,757,436	12.1	2,655,102	18.2
1994	234,272	16.9	79,717	24.5	2,311,786	9.5	778,462	16.4	508,883	17.8	170,439	24.2	578,264	21.0	216,551	26.3	10,418,883	10.5	3,481,640	17.6
1995	335,507	18.4	109,385	22.1	3,842,177	8.7	1,269,660	19.6	920,809	20.4	274,232	26.3	398,528	14.0	146,807	19.4	12,135,672	13.2	3,937,329	27.0
1996	414,798	12.9	137,386	20.9	3,197,497	9.0	1,120,688	16.0	760,607	21.7	243,914	29.8	416,737	11.4	148,322	15.5	10,306,475	11.3	3,488,899	20.1
1997	477,705	16.1	161,196	20.3	2,861,918	9.6	987,223	16.3	1,005,406	18.2	318,972	22.9	445,579	11.7	155,574	18.2	10,415,118	11.9	3,599,696	17.9
1998	920,933	14.6	311,906	20.5	2,762,600	8.0	955,164	15.1	1,138,280	15.6	358,340	25.5	393,018	13.8	148,318	18.2	10,005,379	8.7	3,578,852	18.8
1999	681,905	11.9	236,111	18.6	3,459,681	6.9	1,208,361	14.4	793,093	16.2	246,697	26.4	758,946	10.4	272,110	16.0	14,037,235	8.5	4,731,081	18.3
2000	1,017,717	12.8	352,152	18.8	4,249,272	6.9	1,474,223	16.0	769,653	28.0	246,219	34.0	670,295	13.3	246,882	18.4	15,977,551	7.7	5,264,946	19.6
2001	765,815	13.7	259,288	20.5	4,322,843	7.7	1,456,752	14.4	567,945	15.8	193,751	22.4	427,914	12.2	155,260	16.0	12,618,114	8.0	4,269,752	15.9
2002	908,616	12.6	315,701	19.5	3,445,574	8.2	1,168,322	15.9	1,249,437	18.7	408,449	30.9	443,758	18.8	173,052	23.0	9,816,916	10.3	3,441,381	16.8
2003	659,209	14.7	229,521	22.3	2,977,090	7.4	1,014,320	17.2	1,257,175	23.2	396,409	28.7	647,034	15.7	250,097	18.7	10,528,223	9.6	3,662,095	20.0
2004	546,776	12.0	183,643	18.3	2,605,118	8.1	898,352	15.2	1,722,589	24.9	586,483	33.7	408,006	12.6	148,846	17.3	9,728,915	10.5	3,334,545	18.8
2005	461,775	13.0	156,509	21.3	2,236,920	9.4	772,472	15.8	962,130	23.6	302,340	30.7	286,521	12.9	108,654	15.8	10,699,116	8.5	3,616,229	17.8
2006	354,910	14.3	117,386	19.2	2,385,907	10.7	812,152	16.3	430,504	25.3	125,365	32.5	285,429	11.9	98,401	15.3	13,779,620	8.7	5,016,008	16.0
2007	415,104	15.7	142,698	18.7	3,049,990	8.3	1,045,909	15.6	320,952	21.9	95,855	25.9	355,606	19.0	123,052	23.8	11,790,003	8.3	3,967,935	18.2
2008	668,820	12.8	224,335	20.6	3,336,041	7.9	1,155,421	14.9	623,988	17.6	205,809	26.8	239,893	10.9	88,186	16.8	15,551,638	9.5	5,347,885	19.1
2009	908,297	13.6	308,638	19.6	3,414,547	8.2	1,187,696	16.4	1,055,358	22.6	315,386	32.0	398,573	14.6	140,011	19.7	15,667,348	8.8	5,452,613	16.8
2010	697,188	14.5	231,949	19.1	5,128,842	8.0	1,797,454	14.5	753,414	22.4	261,214	29.3	571,870	14.4	214,026	18.3	14,465,717	10.7	4,974,270	23.5
2011	679,614	15.1	232,721	20.6	4,548,266	8.3	1,584,573	14.9	1,425,042	35.5	525,042	44.9	544,173	14.7	198,755	17.6	17,697,003	9.6	5,977,076	18.1
2012	694,257	12.8	241,481	18.1	3,458,029	8.8	1,210,182	15.5	577,843	16.7	175,722	24.4	524,259	14.8	184,915	17.5	17,938,248	8.9	6,201,433	19.0
2013	528,084	14.3	172,534	20.4	4,523,043	8.7	1,512,033	15.4	311,155	16.9	95,381	24.0	930,394	13.1	317,618	25.0	12,928,606	9.4	4,374,563	17.4

FM = Shore

	Black Drum				Red Drum				Sheepshead				Southern Flounder				Spotted Seatrout			
	MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel	
Year	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE	Harvest	PSE
1982	880,444	22.8	113,540	38.2	2,388,907	23.1	293,698	36.1	676,628	29.0	66,012	30.5	834,940	21.4	103,180	36.3	2,787,818	23.5	296,866	35.0
1983	500,922	29.9	62,566	38.0	1,351,640	25.0	123,385	34.4	2,326,172	25.9	276,981	40.7	327,205	34.7	31,100	37.4	2,927,094	47.2	258,452	45.3
1984	536,866	34.1	51,163	46.2	660,866	35.0	57,459	34.8	987,229	41.9	85,083	40.5	112,657	45.9	9,755	45.9	331,308	40.5	32,117	42.3
1985	181,986	27.0	16,397	32.7	618,693	30.8	46,417	33.4	656,976	30.2	51,856	35.9	284,046	29.1	23,081	33.1	500,629	27.9	43,400	33.5
1986	469,638	52.0	39,289	48.9	243,647	45.9	18,934	47.8	782,112	81.2	57,566	79.5	189,325	42.5	18,019	48.7	1,815,727	55.4	142,905	52.4
1987	260,971	52.0	26,358	51.9	665,407	54.3	49,467	55.0	65,880	46.2	4,878	52.4	185,090	37.3	14,954	38.7	965,130	44.3	112,992	58.7
1988	429,974	36.6	48,607	46.1	237,418	45.6	18,170	48.4	662,260	57.5	57,664	53.5	90,283	40.5	8,305	40.6	398,803	39.6	41,221	48.1
1989	484,955	58.2	47,183	67.1	472,062	35.4	45,444	43.7	179,471	40.2	16,156	43.5	127,388	33.6	12,077	38.8	402,794	68.4	30,056	67.0
1990	122,352	47.4	15,821	63.4	627,617	29.6	54,607	36.3	80,673	46.7	7,631	52.3	238,834	24.9	22,144	31.2	1,178,966	28.6	120,340	42.6
1991	80,287	38.8	7,830	45.0	497,827	35.7	39,572	39.7	109,726	43.1	8,166	45.0	617,776	26.6	69,562	37.3	1,611,329	29.8	190,451	48.5
1992	266,722	39.0	24,559	43.7	535,731	21.7	57,486	31.8	1,470,811	61.9	111,109	64.6	197,948	31.2	17,703	32.4	1,622,752	18.8	160,534	25.9
1993	332,409	38.4	32,083	46.0	1,058,829	26.2	102,231	30.1	438,233	37.3	34,539	38.3	152,286	34.8	14,994	35.2	1,262,891	19.3	139,848	32.3
1994	111,090	26.4	12,000	35.3	973,065	30.5	86,198	33.8	339,821	55.8	27,751	51.7	245,182	26.2	26,246	30.4	2,585,733	32.7	225,016	34.0
1995	122,762	40.4	10,791	37.0	747,219	23.9	61,587	28.3	338,135	43.2	33,177	41.4	56,558	30.7	5,970	40.2	1,432,447	21.4	141,769	30.2
1996	529,054	58.3	42,278	55.7	864,227	22.6	85,059	27.2	682,583	41.1	54,497	42.0	134,402	31.1	14,417	42.1	2,327,551	27.4	272,968	42.0
1997	123,564	39.8	14,500	55.8	347,632	21.5	33,897	27.2	283,171	25.4	28,012	31.1	307,330	23.1	31,614	33.0	1,905,584	21.5	196,046	32.0
1998	86,575	34.3	11,850	53.2	397,083	31.2	39,546	33.4	450,254	36.2	34,658	37.6	128,645	26.4	15,533	39.9	2,415,887	30.1	316,704	52.1
1999	385,329	39.6	34,484	42.0	492,350	25.7	58,215	38.6	202,445	35.8	17,647	34.4	641,276	32.9	57,671	36.5	3,530,688	27.9	302,816	33.9
2000	625,217	26.3	55,444	30.4	822,698	21.3	74,515	25.1	202,744	52.7	18,710	49.9	136,953	43.0	13,647	44.9	2,697,901	36.0	235,416	36.6
2001	675,474	30.1	74,021	37.8	621,324	23.2	56,647	29.7	399,908	49.4	46,027	53.6	305,296	67.4	40,328	72.5	2,657,545	28.5	284,780	35.3
2002	399,178	23.6	39,488	28.7	945,520	31.8	86,759	37.0	872,663	35.4	77,666	40.1	323,826	31.2	35,596	40.3	923,988	31.5	104,622	40.0
2003	288,546	23.4	29,030	28.5	280,366	33.2	26,439	34.2	983,844	36.8	108,655	37.5	199,400	38.3	17,629	37.0	945,730	42.3	70,559	43.3
2004	137,240	36.0	13,664	36.9	559,991	19.0	53,877	26.8	603,693	36.9	49,237	39.0	395,552	36.1	39,848	47.2	1,303,971	45.1	186,126	62.8
2005	138,758	28.0	13,443	36.2	704,981	30.9	57,698	36.6	563,322	29.6	52,206	36.7	450,207	38.7	35,117	45.5	632,798	30.7	54,561	34.2
2006	261,544	30.8	25,308	39.5	389,280	25.4	35,566	35.1	593,305	31.2	44,987	35.3	335,766	29.1	34,011	31.9	788,193	22.7	75,533	29.7
2007	286,213	35.5	28,210	37.6	187,726	25.1	17,832	35.4	257,091	36.2	27,901	42.7	348,752	28.0	38,995	36.9	771,812	27.5	84,196	35.4
2008	247,234	25.5	22,539	32.8	374,463	27.9	30,507	30.4	1,396,084	30.3	113,710	33.3	260,865	36.4	23,363	33.9	1,140,758	33.3	131,023	47.6
2009	100,842	26.9	10,221	33.5	123,122	28.0	12,120	33.8	523,105	46.9	62,220	56.4	470,681	44.6	39,588	45.3	611,298	25.2	62,519	33.2
2010	184,668	41.2	16,865	42.9	531,708	32.4	50,704	34.5	561,648	40.1	46,001	39.1	94,348	29.4	8,854	31.9	584,064	43.3	45,383	43.2
2011	380,669	21.7	36,537	27.0	983,461	22.1	96,717	27.3	1,318,064	44.8	124,632	55.1	430,717	40.0	39,973	40.9	651,281	27.8	67,792	37.1
2012	283,508	22.6	26,638	30.9	279,299	36.1	23,109	38.3	695,553	42.6	54,144	43.8	155,170	30.6	15,176	33.3	727,577	29.5	80,824	39.4
2013	471,823	13.0	36,871	21.6	849,762	9.3	80,731	27.2	659,450	12.4	48,095	25.1	573,922	18.3	51,029	30.3	2,682,372	11.4	241,359	21.8

<u>Appendix (Discard Hindcast):</u>

A ratio estimator approach is described below allowing hind-casting of LA Creel recreational discard estimates to 1982. Concurrent discard estimates of the LA Creel and MRIP surveys are not available.

Analogous to the procedure to hind-cast LA Creel harvest estimates, the hind-cast LA Creel effort estimates of the shore and private fishing modes are combined with unadjusted MRIP discard rate estimates to provide time-series of recreational discard estimates for species with upcoming LDWF stock assessments as described below. Discard estimates of the charter fishing mode for the LA Creel and MRIP surveys are assumed equivalent and not adjusted.

Discards (1982-2013)

The hind-cast LA Creel discard estimates (1982-2013) are calculated by collapsed fishing mode (P and SH only) and bimonthly period as:

$$\widehat{D}_{y,FM,\hat{R}} = \sum_{w} \widehat{E}_{y,w,FM,\hat{R}} \, \widehat{DR}_{y,w,FM,MRIP} \quad [1a]$$

Note: MRIP discard rate estimates in Equation [1a] are FCAL estimates and represent B2 landings only. The calibrated effort estimates are taken from Equation [2].

Variances of the calibrated discard estimates from Equation [1a] are then calculated as:

$$\widehat{V}\left(\widehat{D}_{y,FM,\hat{R}}\right) = \sum_{w} \left[\widehat{E}_{y,FM,w,\hat{R}}^{\;2} \widehat{V}(\widehat{DR}_{y,FM,w,MRIP}) + \widehat{DR}_{y,FM,w,MRIP}^{\;2} \widehat{V}\left(\widehat{E}_{y,FM,w,\hat{R}}\right) - \widehat{V}\left(\widehat{E}_{y,FM,w,\hat{R}}\right)\widehat{V}(\widehat{DR}_{y,FM,w,MRIP})\right] \quad [2a]$$

Percent standard errors of the calibrated discard estimates are then calculated as:

$$PSE\left(\widehat{D}_{y,FM,\hat{R}}\right) = 100 \times \frac{\sqrt{\widehat{V}\left(\widehat{D}_{y,FM,\hat{R}}\right)}}{\widehat{D}_{y,FM,\hat{R}}} \quad [3a]$$

Discards (2014-2016)

Discard estimates of the LA Creel survey are only available from week 19 of 2016 to present. Discard estimates prior to week 19 of 2016 are imputed by fishing mode (P, SH, and C) and week of year (wk) by calculating discard to harvest ratios from the LA Creel estimates from week 19 of 2016 to week 18 of 2017 as:

$$\widehat{R}_{D/H,FM,wk} = \frac{\widehat{D}_{LAcreel,FM,wk}}{\widehat{H}_{LAcreel,FM,wk}} \quad [4a]$$

The imputed LA Creel discard estimates are then calculated by fishing mode from week 1 of 2014 to week 18 of 2016 as:

$$\widehat{D}_{y,wk,FM,\hat{R}_{D/H}} = \widehat{R}_{D/H,FM,wk} \widehat{H}_{y,wk,FM,LAcreel} \quad [5a]$$

Variances of the imputed LA Creel discard estimates from Equation [5a] are approximated by fishing mode and week of year as:

$$\hat{V}\left(\hat{D}_{y,wk,FM,\hat{R}_{D/H}}\right) = \hat{H}^2_{y,wk,FM,LAcreel}\hat{V}\left(\hat{R}_{D/H,FM,wk}\right) + \hat{R}^2_{D/H,FM,wk}\hat{V}\left(\hat{H}_{y,wk,FM,LAcreel}\right) - \hat{V}\left(\hat{R}_{D/H,FM,wk}\right)\hat{V}\left(\hat{H}_{y,wk,FM,LAcreel}\right) \qquad [6a]$$

where

$$\hat{V}\left(\hat{R}_{D/H,FM,wk}\right) = \hat{R}_{D/H,FM,wk}{}^2\left[\frac{\hat{V}(\hat{D}_{LAcreel,FM,wk})}{\hat{D}_{LAcreel,FM,wk}{}^2} + \frac{\hat{V}(\hat{H}_{LAcreel,FM,wk})}{\hat{H}_{LAcreel,FM,wk}{}^2}\right]$$

Harvest variances $\hat{V}\left(\hat{H}_{y,wk,FM,LAcreel}\right)$ in Equation [6a] are post-calibration (i.e. after applying a discard to harvest variance ratio estimator $\frac{\hat{V}(\hat{D}_{LAcreel,FM,wk})}{\hat{V}(\hat{H}_{LAcreel,FM,wk})}$ to the LA Creel harvest variance estimates).

The MRIP (FCAL) and hind-cast/imputed LA Creel discard estimate annual time-series and corresponding PSEs by fishing mode for species with upcoming LDWF stock assessments are presented below.

FM = Private

	Black Drum				Red Drum				Sheepshead				Southern Flounder				Spotted Seatrout			
	MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel	
Year	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE
1982	818,734	54.5	345,860	60.5	274,870	40.0	94,664	41.5	515,459	44.8	200,681	47.1	1,083,668	45.5	415,439	50.2	1,654,868	35.7	609,681	39.2
1983	671,251	47.1	224,549	50.1	793,805	34.3	265,412	40.0	833,079	71.7	268,324	76.4	145,644	54.4	50,553	55.2	2,092,864	42.4	754,795	47.4
1984	284,254	68.2	93,240	65.6	346,317	56.3	111,489	56.2	309,986	35.6	93,467	45.2	65,411	64.9	21,520	65.9	197,040	21.8	64,439	30.9
1985	291,106	38.5	95,314	41.4	243,413	40.1	91,863	46.5	317,951	28.8	109,302	37.0	61,785	68.0	19,987	66.6	1,709,137	23.1	579,765	29.5
1986	448,236	20.4	152,135	27.7	451,777	15.3	162,385	19.5	393,569	19.8	127,427	29.5	367,830	40.1	162,331	43.1	4,745,760	10.2	1,630,190	19.8
1987	300,153	41.9	93,694	44.6	2,360,122	24.5	759,753	32.9	210,127	21.2	74,868	25.8	10,809	42.4	4,341	46.5	6,980,249	12.7	2,367,280	21.1
1988	350,541	21.1	118,251	29.1	3,062,822	16.2	1,010,542	22.4	398,058	25.6	135,054	32.6	375,399	58.9	119,109	60.9	5,610,284	10.4	2,077,053	16.1
1989	228,012	35.0	75,276	40.5	2,998,273	20.9	986,135	30.8	483,464	37.6	174,497	44.9	260,401	93.8	84,574	91.5	5,656,036	14.2	1,879,166	20.3
1990	653,511	28.7	214,860	36.2	1,880,922	19.7	575,989	24.4	408,363	25.1	146,133	30.3	334,821	40.3	107,726	42.4	4,750,794	18.0	1,566,570	24.0
1991	389,398	26.0	130,884	32.2	7,412,013	11.2	2,413,187	27.7	272,267	26.1	100,654	28.7	114,636	37.5	35,343	33.6	12,341,402	9.3	4,316,171	17.6
1992	559,417	33.2	179,758	38.0	5,753,237	9.1	1,845,345	17.5	440,289	16.8	142,247	23.5	42,988	21.4	14,876	24.2	8,795,484	8.4	2,994,762	16.4
1993	710,873	18.2	235,327	23.6	4,143,002	11.2	1,394,760	19.0	758,778	20.8	261,093	28.4	45,686	33.2	16,234	35.7	6,905,906	11.3	2,294,599	17.5
1994	440,825	29.8	144,491	33.2	4,086,816	12.5	1,292,596	19.6	608,190	19.3	200,928	25.0	34,050	29.6	11,832	31.0	7,780,829	9.7	2,545,253	17.4
1995	816,070	17.5	288,067	20.8	4,248,542	15.4	1,356,682	22.3	558,424	25.6	180,589	31.0	59,357	34.4	21,731	33.3	7,603,172	11.0	2,469,940	22.8
1996	525,560	20.4	180,919	27.4	3,312,106	11.9	1,066,067	18.3	878,282	23.1	280,982	30.9	80,897	23.0	28,339	27.1	8,055,743	10.2	2,790,011	17.6
1997	1,057,203	18.5	357,381	27.0	5,150,476	11.3	1,623,792	20.9	1,138,193	23.4	388,364	33.4	98,494	29.1	33,249	32.9	10,917,063	19.7	3,714,497	25.0
1998	1,439,547	24.7	488,061	28.2	5,753,271	10.8	1,852,465	18.5	1,056,926	17.9	341,063	28.4	99,007	29.1	32,096	32.3	9,977,400	9.3	3,525,435	17.2
1999	820,371	13.6	272,222	19.4	5,477,613	9.4	1,855,481	17.3	699,825	18.9	218,048	29.4	84,447	20.8	29,392	26.0	11,688,515	8.8	3,900,534	18.2
2000	1,833,450	16.2	636,903	21.0	6,018,948	8.2	2,015,680	18.4	586,993	21.9	204,594	28.9	121,790	28.3	37,513	29.7	11,091,619	7.9	3,696,143	17.1
2001	1,781,293	17.4	641,432	22.0	6,184,966	9.5	1,893,106	18.7	816,650	16.4	289,672	22.4	88,936	21.8	33,827	26.2	7,365,829	11.2	2,385,033	19.6
2002	1,670,431	17.1	549,754	23.8	6,266,166	10.8	2,051,328	21.1	854,311	17.0	278,770	22.5	90,982	26.1	32,596	28.9	6,778,238	11.5	2,325,982	18.2
2003	1,172,837	17.8	408,312	22.5	5,286,909	10.2	1,707,282	22.5	930,576	20.8	286,148	31.2	172,327	23.4	67,664	27.1	10,682,302	9.5	3,656,768	20.8
2004	1,155,649	17.0	384,622	24.5	3,841,642	10.1	1,251,295	17.5	701,938	19.9	253,961	27.9	149,844	27.6	53,175	29.8	9,847,326	11.5	3,329,014	17.7
2005	954,552	24.2	324,774	29.3	3,505,968	11.8	1,125,035	19.3	770,173	15.0	252,100	25.9	87,557	25.3	31,613	26.7	10,903,988	9.7	3,699,324	17.6
2006	699,933	16.3	227,542	20.8	4,124,647	11.7	1,352,670	19.7	616,668	30.1	179,470	34.3	41,784	27.7	14,147	30.4	11,930,250	9.1	4,253,200	16.1
2007	818,643	15.4	279,976	19.3	4,630,404	11.5	1,534,744	20.7	308,039	21.2	101,638	25.6	78,231	25.8	28,165	30.1	9,924,934	8.4	3,345,776	18.0
2008	1,320,182	14.8	447,658	22.4	5,074,358	8.1	1,704,655	15.5	609,401	23.6	193,005	30.6	50,063	26.0	17,325	28.4	13,158,192	9.4	4,628,268	17.0
2009	1,788,575	14.5	598,396	22.8	6,242,208	9.6	2,046,201	20.1	744,464	19.5	224,182	27.5	89,961	28.4	32,910	34.0	13,919,234	10.0	4,655,798	17.8
2010	1,813,254	14.9	636,963	18.6	7,335,948	10.2	2,585,291	15.8	711,836	21.9	248,894	26.2	111,912	23.5	40,129	23.3	9,190,616	12.6	3,180,901	22.2
2011	1,390,360	14.9	475,469	19.2	4,744,947	9.7	1,532,673	16.4	259,735	17.7	86,064	22.2	85,027	24.1	31,745	26.9	10,091,732	9.5	3,443,856	16.2
2012	1,136,427	13.3	373,501	18.6	5,374,152	8.9	1,776,461	17.9	422,968	13.4	136,234	19.8	152,363	24.3	53,417	25.2	13,175,745	8.7	4,524,702	18.2
2013	1,709,164	12.2	586,398	18.1	6,088,863	9.9	2,013,792	17.0	398,767	14.8	130,785	21.7	197,844	21.3	72,578	23.8	13,404,945	10.3	4,608,071	16.5
2014			330,955	24.0			1,609,006	11.8			148,454	38.3			44,345	56.6			2,316,191	11.3
2015			295,893	21.4			1,486,227	10.3			98,800	30.3			30,296	41.4			3,440,509	12.3
2016			161,733	21.0			1,096,370	6.4			47,135	25.6			29,612	24.3			3,643,636	8.6

FM = Shore

	Black Drum				Red Drum				Sheepshead				Southern Flounder				Spotted Seatrout			
	MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel	
Year	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE
1982	149,995	64.4	19,897	80.7	364,343	26.2	52,316	41.6	89,674	57.7	11,246	70.6	128,975	30.5	15,915	45.2	386,524	48.1	49,802	62.2
1983	69,276	40.0	6,493	59.5	15,283	79.9	1,470	73.4	25,959	61.6	2,914	58.8					7,794	83.8	1,361	89.1
1984	285,887	32.0	20,494	39.5	83,103	84.6	5,758	89.8	12,248	103.2	2,139	105.1	3,384	99.3	319	100.5	59,529	52.1	4,864	50.1
1985	138,851	42.9	12,304	55.2	32,336	53.0	2,919	51.6	155,985	38.0	11,628	41.9	12,292	79.8	881	80.3	603,943	44.5	47,922	44.9
1986	107,212	49.6	7,822	51.3	19,379	65.3	1,723	60.3	473,615	72.5	34,777	72.6	11,853	75.8	1,010	78.1	267,044	41.3	22,713	38.7
1987	102,949	71.9	8,596	74.4	352,180	47.9	26,897	48.2	36,133	89.7	3,410	94.8	13,517	87.5	1,198	89.8	642,898	37.9	64,120	42.0
1988	185,774	51.5	16,072	60.9	329,574	30.8	28,447	35.6	116,937	36.7	10,973	40.9	7,726	52.0	616	56.8	205,385	41.4	24,387	50.9
1989	61,484	38.9	5,723	46.1	1,080,247	72.5	128,194	83.5	115,300	39.3	11,720	45.4	49,549	66.9	3,586	66.6	311,869	36.9	27,571	40.1
1990	96,587	44.0	13,477	59.9	327,612	37.7	28,235	45.2	18,485	89.3	1,318	92.6	783,955	82.6	72,564	86.6	736,838	34.5	65,803	38.9
1991	237,878	30.6	24,906	36.8	1,544,560	43.0	124,239	43.5	207,958	30.7	14,829	39.1	91,471	44.6	10,241	47.2	1,902,261	22.7	219,559	37.7
1992	860,902	31.0	76,139	32.3	1,833,394	25.8	167,249	28.7	514,453	32.0	41,930	37.4	49,674	57.6	4,587	56.0	1,468,815	20.7	142,809	28.3
1993	1,345,395	39.9	110,604	41.5	1,630,396	23.1	171,511	31.8	1,109,224	51.0	86,564	51.4	51,220	62.5	3,860	64.5	2,544,151	26.7	323,743	45.9
1994	947,564	31.5	99,539	33.8	2,220,435	25.8	190,194	29.9	690,548	35.8	54,745	36.3	27,765	64.3	2,143	65.9	2,280,973	19.3	214,069	27.3
1995	602,888	40.5	48,383	40.0	942,643	25.9	86,408	28.5	72,571	30.1	8,839	38.7	18,216	63.3	1,309	62.8	1,617,673	19.6	162,345	29.9
1996	493,436	28.1	52,883	32.7	1,516,179	39.1	120,897	39.3	295,818	49.5	24,464	47.5	123,621	57.8	16,558	74.1	2,271,614	31.3	308,086	52.8
1997	1,032,761	51.8	90,230	49.3	1,179,933	27.3	100,418	31.4	199,864	33.2	17,257	35.4	71,388	41.3	8,442	48.4	2,076,029	22.6	207,557	32.1
1998	1,033,214	43.8	84,752	44.3	2,262,074	26.0	204,593	31.1	207,500	34.3	20,284	40.9	39,280	40.3	3,276	42.0	1,721,873	25.1	220,941	47.8
1999	532,125	37.2	45,165	42.1	1,281,413	23.5	130,179	31.6	51,091	32.2	4,474	39.5	68,459	49.6	7,292	57.3	4,103,241	23.1	371,893	29.8
2000	955,854	28.8	73,538	36.4	1,948,980	22.8	182,824	29.6	265,642	61.1	21,463	56.0	24,518	50.4	2,069	53.3	2,552,559	34.6	207,540	35.3
2001	1,404,055	37.8	143,215	44.1	1,702,671	23.4	159,705	28.0	627,865	66.9	49,516	64.4	267,359	75.6	37,792	76.1	2,252,160	31.5	187,174	32.3
2002	559,039	30.6	45,914	33.0	1,187,635	24.6	99,572	27.3	192,094	28.9	16,154	33.4	132,712	47.7	11,419	48.6	1,035,758	30.9	94,081	34.7
2003	1,024,308	33.3	104,601	38.7	744,196	31.1	73,392	36.7	114,932	46.8	11,660	47.4	299,436	63.4	31,155	65.2	1,546,106	34.1	119,188	35.8
2004	477,328	44.0	37,608	44.0	944,587	31.1	83,721	31.6	83,683	37.1	9,645	45.2	24,033	55.8	1,683	59.3	1,547,223	44.2	179,206	58.2
2005	793,236	24.4	78,009	30.6	1,986,884	22.7	197,746	37.7	322,768	29.1	27,129	33.4	127,575	57.7	10,772	59.1	895,780	34.2	88,581	36.9
2006	1,085,517	44.4	94,206	40.6	2,355,407	21.3	246,212	35.5	670,528	47.6	51,507	48.7	109,904	38.3	14,722	53.3	1,144,271	28.0	114,481	33.4
2007	464,018	30.3	53,814	41.9	1,109,367	20.9	108,758	29.6	256,654	49.1	23,186	43.8	96,680	53.7	16,221	68.5	929,550	25.0	101,536	36.6
2008	901,587	24.4	79,859	28.4	1,912,635	19.8	158,866	23.6	248,799	29.8	18,285	34.4	12,748	60.9	1,302	65.4	1,377,270	27.7	120,320	31.0
2009	417,567	31.0	39,805	30.9	1,414,008	28.6	126,475	32.2	384,706	30.4	37,443	32.7	87,082	93.5	6,332	93.7	927,737	30.0	109,736	43.9
2010	572,004	29.7	56,545	30.2	1,506,818	23.6	154,439	35.8	583,189	30.2	46,495	32.6	74,678	40.5	7,726	48.6	828,375	54.9	63,464	53.8
2011	1,434,105	21.3	134,468	28.0	1,860,121	22.2	162,394	25.3	249,435	48.1	22,119	43.9	103,717	65.2	7,384	66.2	719,286	25.7	64,218	31.8
2012	1,263,476	24.4	132,282	31.2	977,186	35.2	90,057	34.4	175,964	43.2	13,443	45.1	52,159	45.4	6,074	56.4	674,174	31.1	75,140	37.8
2013	2,271,755	9.7	195,413	19.6	3,675,890	9.3	327,093	18.3	939,354	18.9	77,379	32.1	41,427	37.2	3,162	40.7	5,525,367	8.1	504,444	24.1
2014			79,920	38.8			375,249	12.4			51,901	55.7			9,346	53.3			594,294	15.1
2015			76,780	21.4			378,245	11.5			23,835	34.1			9,300	45.9			727,719	12.3
2016			50,106	21.9			275,986	8.7			24,951	66.9			9,495	37.5			892,875	11.4

FM = Charter

	Black Drum				Red Drum				Sheepshead				Southern Flounder				Spotted Seatrout			
	MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel		MRIP		LA Creel	
Year	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE	Discards	PSE
1982																	7,252	32.4		
1983													352	57.8			121,816	54.1		
1984	182	112.8							1,166	78.8							116	101.5		
1985									587	107.7							42,739	26.9		
1986					25	55.4			266	97.1							16,514	42.5		
1987	2,752	45.9			2,597	42.5			2,484	64.6							64,522	30.1		
1988	5	106.1			1,561	59.4											59,254	37.7		
1989	298	63.1			26,854	45.6			1,199	62.5			1,401	106.9			190,285	38.2		
1990	6,449	56.2			30,305	40.5			16,177	94.7			445	57.1			39,578	32.1		
1991	3,258	52.2			46,366	44.7			1,641	52.5			280	82.8			144,689	30.9		
1992	7,421	46.7			63,966	35.7			3,664	55.2			225	61.5			91,373	31.5		
1993	410	71.7			58,230	19.2											155,919	30.0		
1994	329	100.1			70,705	32.6			1,123	61.4							243,186	36.3		
1995	2,606	72.8			198,687	34.0			1,654	110.7							300,673	31.6		
1996	4,776	74.9			113,101	28.6			406	56.1			843	103.1			223,999	36.0		
1997	20,581	37.1			157,816	23.0			19,422	46.2			490	68.4			260,983	23.5		
1998	18,161	43.4			138,650	25.5			8,030	44.8			647	48.0			199,955	31.8		
1999	12,980	33.2			105,462	22.3			5,944	40.9			520	57.8			277,771	21.3		
2000	10,335	28.4			108,340	13.2			1,739	48.3			259	59.4			175,694	15.8		
2001	13,566	28.8			203,577	19.3			12,615	31.6			1,224	72.4			211,516	15.0		
2002	9,657	30.9			138,601	17.2			4,954	29.6			1,248	50.0			104,977	25.3		
2003	25,831	34.0			129,125	18.5			16,306	53.2			982	53.9			170,658	26.6		
2004	13,050	32.7			105,936	14.2			10,370	38.8			503	55.6			221,275	16.5		
2005	5,692	45.0			53,333	25.0			3,190	61.4							263,044	26.2		
2006	30,916	38.8			144,300	48.0			10,206	71.3							464,015	26.8		
2007	13,350	37.3			178,892	21.5			23,101	34.4			486	60.6			238,335	19.0		
2008	31,830	33.1			198,411	16.5			30,031	55.1			1,197	59.3			323,315	17.3		
2009	62,094	27.2			332,961	19.7			16,588	52.9			98	71.3			356,216	17.4		
2010	38,261	33.5			151,250	23.0			10,938	36.4			69	107.9			167,473	21.6		
2011	29,517	38.0			203,917	17.0			5,021	34.4			640	62.2			149,933	27.4		
2012	21,344	30.0			153,584	17.6			5,844	46.6			2,353	48.7			205,441	22.7		
2013	83,501	7.5			281,131	7.2			48,342	11.3			12,017	15.1			222,879	7.6		
2014			14,093	31.5			353,243	19.2			2,706	40.6			442	53.7			316,892	29.4
2015			14,464	32.7			403,525	14.1			16,575	50.0			553	46.7			413,119	18.4
2016			16,975	33.3			338,910	7.4			10,778	23.1			497	31.4			439,247	9.6

Appendix 2:

Louisiana Spotted Seatrout Growth

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Overview

In an earlier assessment of the Louisiana spotted seatrout stock (West *et al.* 2011), a standard three-parameter von Bertalanffy growth model was used to describe female spotted seatrout growth and construct age-length-keys for age assignments of fishery and survey catches. Due to the rapid growth exhibited in younger spotted seatrout and the relatively slower growth of older fish, the standard von Bertalanffy growth model overestimated the predicted length-at-age of younger ages and underestimated the predicted length-at-age of older ages. To overcome this lack of fit, the influence of younger ages was down-weighted during model fitting.

New Model

A different growth model has been developed that accounts for decreasing growth rates with age (Porch et al. 2002), rather than the constant growth rate across ages inherent to the standard von Bertalanffy growth model. The new model also allows age-specific growth rates to vary seasonally. Length-at-age is calculated with the new model, excluding the seasonal component, as:

$$l_t = l_\infty (1 - e^{\beta - k_0 (t - t_0)})$$

$$\beta = \frac{k_1}{\lambda}(e^{-\lambda t} - e^{-\lambda t_0})$$

where $k = k_0 + k_1 e^{-\lambda t} \geq 0$ (i.e., assuming fish will not shrink with age). The λ parameter is a damping coefficient allowing growth rates to decline with age.

Results

The damped growth model was fit to the same dataset of female spotted seatrout length-at-age observations from the earlier assessment (West *et al.* 2011) with the SAS nonlinear regression fitting procedure (PROC NLIN; SAS 2008) using the Newton iterative method (Figure 1). With the seasonal component included, the model failed to adequately fit the dataset. Parameter estimates and corresponding approximate standard errors of the damped growth model are reported in Table 1.

Literature Cited

Porch C.E., C.A. Wilson C.A., D.L. Nieland. 2002. A new growth model for red drum (Sciaenops ocellatus) that accommodates seasonal and ontogenic changes in growth rates. Fish Bull 100:149–152.

SAS Institute Inc. 2008. SAS/STAT® 9.2 User's Guide. Cary, NC: SAS Institute Inc.

Table 1: Parameter estimates and corresponding approximate standard errors of the damped growth model.

Parameter	Estimate	SE
l_∞	28.1	1.86
k_0	0.113	0.0397
t_0	0.0373	0.00303
k_1	0.414	0.0239
λ	0.329	0.0609

Figure 1: Female spotted seatrout total length-at-age observations and predicted total length-at-age from the damped growth model.