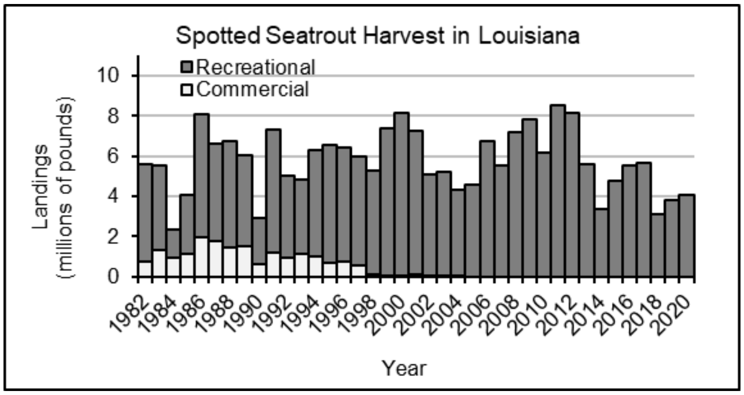
Update Assessment of Spotted Seatrout (*Cynoscion nebulosus)* in Louisiana Waters
2021 Report

Executive Summary

Landings of spotted seatrout (SST) in Louisiana have remained below 5 million pounds per year in the most recent decade with the exceptions of 2011-2013 and 2016-2017. The 2014 and 2018-2020 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 age samples of the fishery and a growth model.

In earlier assessments of the LA SST stock (West et al. 2011, West et al. 2014, West et al. 2019), 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 update, estimates of stock status relative to the proposed limits indicates the stock is currently overfished and undergoing overfishing. Management actions will be needed in order to prevent future overfishing and recover the stock from its current overfished condition.

Summary of Changes from 2019 Assessment

Assessment model inputs have been updated through 2020. No changes have been made to the assessment model itself. Trends in basin-specific fishery landings, fishery-independent gill-net catch rates, and corresponding age compositions (2014-2020) have also been included this report (see *Appendix 4*).

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2021 Report

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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 1982-2020. 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 age samples of the fishery (2002-2020) 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 below 5 million pounds per year in the most recent decade with the exceptions of 2011-2013 and 2016-2017. The 2014 and 2018-2020 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 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 (Figure 2).

2.2 Fishery Dependent

Commercial

Commercial SST landings are taken from NMFS commercial statistical records (1982-1998; NMFS 2021a) and the LDWF Trip Ticket Program (1999-2020).

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 2014-2020) 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; 2014-2020) 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 earlier LA SST stock assessments (West *et al.* 2011,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 (2014-2020) 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 (~2% of LA angler trips per year, 2018-2020; 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.

Bycatch

Menhaden Reduction Fishery

Time series of incidental catch of SST from the LA menhaden reduction fishery have been developed from observations of retained and released SST CPUE (numbers per purse seine set) and annual effort estimates of the menhaden reduction fishery (LDWF 2020, see *Appendix 2*). The mean estimates of spotted seatrout bycatch in the most recent decade indicate very low levels of SST bycatch relative to the landings of the directed LA fisheries (0.07% in units of weight). Due to the negligible level of estimated SST bycatch relative to the landings of the LA directed fisheries, incidental SST catches of the LA menhaden reduction fishery are not considered further in this assessment.

Shrimp Fishery

Bycatch has been characterized for the 2019-2020 inshore LA shrimp fishery (Cagle and West 2020; see *Appendix 3*). Incidental catches of SST were observed in this study. A time-series of annual LA inshore bycatch of SST in units of weight can be estimated as the product of the mean bycatch to shrimp sample ratio from the bycatch study, the annual inshore LA shrimp landings, and the proportion of SST observed in the catches of the bycatch study, under the assumption that estimates from the study are characteristic of the inshore fishery through time. While this assumption allows calculation of a time-series of bycatch, the fishery has transformed and developed over time making this assumption unlikely. Nevertheless, a time-series of SST bycatch estimates are calculated, following the method outlined, for comparison to the SST landings of the directed LA fisheries (Figure 3). The estimates of annual SST bycatch from the LA inshore shrimp fishery in the most recent decade indicate relatively low levels of bycatch when compared to the landings of the directed LA fisheries (6.6% in units of weight).

The age and sex composition of the annual estimates of SST bycatch can be calculated from the size composition of SST bycatch observed in the study, the annual SST bycatch estimates in units of numbers (converted from weight using the mean weight of SST observed in the study), the estimated sex ratio at size (see *3. Life History Information*), and an age-length-key. Since the majority of samples in the bycatch study occurred in the fall months, the ALK developed in this assessment to assign ages to landings based on size in the second half of the calendar year (July-December) is used for this purpose (Table 8; see *5. Catch at Age Estimation*). All SST bycatch from the inshore LA shrimp fishery are assumed to not survive.

The time-series of estimated SST bycatch from the LA inshore shrimp fishery, as numbers of females greater than age-0, along with the corresponding annual yield and age-specific mean weights are included in a sensitivity run of the assessment model (Table 4; see *6. Assessment Model*).

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) as:

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

where FL is in mm.

3.3 Growth

Spotted seatrout exhibit differences in growth between males and females, with larger SST being predominantly female (Wieting 1989). The growth model developed for female SST in the previous assessment (West *et al.* 2018) that accounts for decreasing growth rates with age (*i.e.*, damped growth model; Porch *et al.* 2002) is used in this assessment. 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:

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

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 (total egg production), the number of eggs spawned per batch and the number of batches spawned per season must be known. Estimates from a recent LDWF fecundity study (LDWF unpublished data) suggests female fecundity-at-size and female weight-at-size are roughly equivalent. However, estimates from the recent study were hindered by low sample sizes due to the inherent difficulty obtaining samples of spawning fish in the proper condition which led to large estimates of error around the fecundity estimates precluding their use for assessment purposes. 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 sexually 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 average 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 average value of M is rescaled where the mean mortality rate over ages vulnerable to the fishery is equivalent to the average M rate as:

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

where M is the average 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:

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

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 Winter Mortality

Spotted seatrout are subject to winter mortality events that vary with winter severity (Ellis *et al*. 2017). An index of winter severity was developed by compiling water temperature data from continuous water temperature monitoring stations across the LA coast and was calculated as the product of the number of days with water temperatures ≤ 7 degrees Celsius (*i.e.,* approximate water temperature SST cold-stun deaths begin to occur; Ellis *et al*. 2017) and the inverse of the mean water temperature during that duration (Table 5, Figure 4). Water temperature data from the months of November and December are grouped with the following year's January-March water temperatures for index development (e.g., winter of 1989-90 denoted as 1990).

3.9 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 6). 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 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$(c, p)\approx \rho_{c,p}[SE(c_y)SE(p_y)]$ 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 indices, and coefficients of variation of the standardized indices are presented (Table 7). Standardized IOAs and nominal CPUEs, normalized to 1 for comparison, are also presented (Figure 5).

5. Catch at Age Estimation

Age-length-keys (ALKs) are developed to estimate the age composition 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 age samples collected from the fishery. For earlier years, ALKs are developed from the damped growth model.

1982-2001 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 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 8) and also for instances discussed below.

2002-2020 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 10). 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 12-14).

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 9). 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 11, Figure 5).

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 (1982-2020) 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 $\sum_a \hat{C}_{ayf} \overline{W}_{ayf}$, where $\overline{W}_{ayf}$ 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 abundance indices modeled. Parameters are estimated in log-space and then back transformed. The base model of this assessment was defined with an age-6 plus group, steepness fixed at 1.0, five fishery selectivity blocks, and three survey selectivity blocks. For the base model, 158 parameters are estimated:

1. 32 selectivity parameters (5 blocks for the commercial and recreational fisheries; 3 blocks for the surveys)
2. 78 apical fishing mortality rates (F_{mult} in the initial year and 38 deviations in subsequent years for 2 fisheries)
3. 39 recruitment deviations (1982-2020)
4. 5 initial population abundance deviations (age-2 through 6-plus)
5. 3 catchability coefficients (3 survey IOAs)
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:

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

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 (2014-2020) 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 (1999-2020; Table 13). Input levels of error for survey catch-rates were specified with CV's estimated from each IOA standardization (Table 7). Annual recruitment deviations were specified with CV's of 0.5 for all years of the modeled 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 15.

Model Fit

The base model provides an overall reasonable fit to the data. Model estimated catches match the observations well (Figure 6); however, in the recreational landings time-series, catches are generally over-estimated in earlier years of the time-series and under-estimated in the more recent years prior to 2014. Model estimated survey catch-rates provide acceptable fits to the data, but fail to fit all extremes with a noticeable lack of fit to the catch rates of the 1.0-inch mesh panel in the most recent years of the time-series (Figure 7). Patterning of the residuals is also apparent, where catch-rates are generally under-estimated in the beginning of each time-series and then over-estimated in later years of each 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 selectivity 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. After the 12-inch recreational MLL regulation was implemented in 1987, the age-1 recreational selectivity estimate was reduced by approximately 50%

Abundance, Age Composition, Recruitment, and Spawning Stock

Total stock size and abundance-at-age estimates from the ASAP base model are presented in Table 16. Total stock size has varied considerably over the time-series. Stock size generally increased over the first half of the time-series from 8.8 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 5.0 million females estimated in 2018. The 2020 estimate of female stock size is 8.7 million females.

The age composition of the stock in the most recent years of the time-series (2015-2020) indicates further age truncation where the proportion of the stock ≥ age-3+ remains less than 10%. (Figure 13). The 2019 and 2020 estimates of the proportion of the stock ≥ age-3+ are the lowest on record (5% and 4% respectively). The age composition of the stock ≥ age-3+ varied in earlier years of the time-series prior to 2015, with a maximum of 22% estimated in 1982, a minimum of 7% estimated in 1990, and an average of 13% from 1982-2014. The age-composition ≥ age-3+ observed in the landings time-series 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 16). The average recruitment (geometric mean) over the entire time-series is 6.5 million fish. The average recruitment (geometric mean) in the most recent decade is 5.7 million fish. The 2018 recruitment estimate is the second lowest of the time-series (3.7 million female fish). The 2020 age-1 recruitment estimate is 6.6 million female 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 to a low of 4.3 million pounds estimated in 1989, female SSB generally increased to a maximum of 9.1 million pounds observed in 2008. After 2008, female SSB began to decrease. The most recent SSB estimates of the time-series (2016-2020) are the lowest on record (4.27, 3.0, 2.4, 2.7, and 3.3 million pounds respectively).

Fishing Mortality

Estimated fishing mortality rates are presented in Table 17 (annual apical, average, and age-specific) and Figure 16 (average only). Fishing mortality rates have varied over the time-series with a clear upward trend apparent in the most recent decade. Before 2012, the time-series of average F estimates was relatively flat and generally lacked a trend with a mean of 0.62 per year from 1982-2011. Beginning in 2012, average fishing mortality rates increased to over 0.9 per year and have remained high with a mean of 0.91 per year from 2012-2020. The 2017 estimate of average F is the highest on record (1.7 per year). The 2020 estimate of average F is 0.72 per year.

Stock-Recruitment

No discernable relationship is observed between female SSB and subsequent age-1 recruitment (Figure 17). However, the most recent female SSB estimates are the lowest on record and the 2018 estimate of age-1 female recruits is the second lowest on record. The ASAP base model was run with steepness fixed at 1.0. The estimated unexploited female SSB was 43.5 million pounds. 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, 158 parameters were estimated. Asymptotic standard errors ($\pm$2) for the time-series of age-1 female 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 LDWF SST assessments (West *et al.* 2011, West *et al.* 2014, West *et al.* 2019) 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 the 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 2018-2020) 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 2018-2020). 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 2018-2020 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 9.8%, a SPR_{target} of 14.1%, and a maximum SPR of 20.8% (Figure 19). Limit and target reference points are also presented in Table 18.

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 the winter severity index presented in Table 5 (Model 7). Baseline M-at-age (M_a) was allowed to vary with time ($M_{a,y}$) by adjusting to the winter severity index (WS_y) assuming winter mortality events are additive as:

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

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 assumption 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.

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

A final sensitivity run was conducted that included estimates of SST bycatch (females only > age-0) from the LA inshore shrimp fishery (Table 4) as an additional fishery fleet (Model 12).

Results of each sensitivity run relative to the proposed limit reference points are presented in Table 19. Current estimates of female SSB and average F are taken as the geometric mean of the 2018-2020 estimates. Estimates from all sensitivity runs indicate the stock is currently below SSB_{limit}. Estimates from all sensitivity runs indicate the fishery is currently operating above F_{limit} with the exception of Models 5, 7, and 10. Model 7 (winter-severity index used to time-vary M) resulted in the lowest estimate of current F due to a high M estimated from the severe winter 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 20). 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 2016-2020). Retrospective estimates of age-1 female recruits, SSB and average fishing mortality differed from the base run (Figure 20). 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 21. 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 currently undergoing overfishing. 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 a few years earlier in 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 2016. The current SPR estimate is 6.3% (SPR_{limit}=9.8%).

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. Continuing the collection of age samples 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.

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, 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. Recent estimates of a LDWF fecundity study suggest fecundity at size and female biomass at size are roughly equivalent; however, error estimates around the fecundity estimates were large due to low sample sizes precluding their use in this assessment update. 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 (in millions of pounds) derived from NMFS statistical records, LDWF Trip Ticket Program, MRIP, and LA Creel. Recreational landings represent harvest only. Confidential commercial landings records (****) are not presented.

	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	5.31	21.2	78.8
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	4.05	19.4	80.6
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	0.1	99.9
2009	0.00	7.82	0.0	100.0
2010	****	6.18	0.0	100.0
2011	****	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	4.74	0.1	99.9
2016	0.00	5.51	0.0	100.0
2017	0.00	5.68	0.1	99.9
2018	0.00	3.09	0.1	99.9
2019	****	3.84	0.0	100.0
2020	****	4.06	0.0	100.0

Table 2: Louisiana commercial size frequencies 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) taken from MRIP (1982-2013) and the LDWF Biological Sampling Program (2014-2020).

Recreational, January-June 1982-2001																				
TL_in	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
6	0.008																			
7	0.003	0.001	0.010			0.006													0.001	
8	0.047	0.001		0.026	0.016	0.005								0.000			0.001	0.001		0.001
9	0.045	0.041	0.010	0.020	0.043	0.023											0.001			
10	0.067	0.071	0.035	0.164	0.097	0.096	0.002			0.009	0.003	0.003	0.004	0.001	0.005	0.006		0.009	0.001	0.001
11	0.123	0.127	0.241	0.186	0.126	0.178	0.035	0.006	0.076	0.057	0.063	0.053	0.094	0.092	0.066	0.059	0.046	0.051	0.039	0.019
12	0.129	0.137	0.364	0.240	0.243	0.175	0.212	0.068	0.180	0.234	0.224	0.278	0.259	0.281	0.176	0.175	0.183	0.211	0.194	0.179
13	0.097	0.187	0.065	0.127	0.094	0.136	0.305	0.273	0.191	0.212	0.273	0.258	0.217	0.209	0.226	0.244	0.219	0.218	0.196	0.182
14	0.082	0.178	0.124	0.051	0.151	0.174	0.156	0.257	0.211	0.128	0.209	0.143	0.158	0.129	0.193	0.206	0.263	0.174	0.182	0.176
15	0.057	0.098	0.061	0.023	0.062	0.122	0.101	0.147	0.133	0.144	0.111	0.085	0.093	0.102	0.082	0.112	0.089	0.110	0.109	0.107
16	0.033	0.016	0.060	0.046	0.060	0.050	0.043	0.083	0.088	0.103	0.051	0.034	0.068	0.062	0.122	0.076	0.063	0.093	0.116	0.084
17	0.038	0.022		0.046	0.062	0.009	0.057	0.063	0.043	0.061	0.032	0.048	0.048	0.043	0.034	0.051	0.055	0.040	0.053	0.072
18	0.093	0.024	0.019	0.026	0.017	0.008	0.025	0.030	0.046	0.025	0.014	0.035	0.017	0.022	0.040	0.039	0.042	0.018	0.037	0.076
19	0.033	0.015	0.013	0.005	0.011	0.006	0.030	0.032	0.009	0.011	0.008	0.033	0.016	0.030	0.042	0.015	0.018	0.033	0.032	0.040
20	0.028	0.051		0.013	0.009	0.008	0.020	0.023	0.022	0.008	0.008	0.011	0.012	0.011	0.006	0.006	0.008	0.018	0.026	0.027
21	0.019	0.015		0.020	0.005	0.002	0.015	0.009	0.001	0.004	0.002	0.013	0.009	0.012	0.002	0.003	0.011	0.015	0.007	0.015
22	0.028	0.008		0.004		0.001		0.003		0.002	0.001	0.003	0.004	0.002	0.005	0.002	0.001	0.007	0.005	0.011
23	0.015	0.008			0.002	0.000		0.002		0.002	0.001	0.002	0.003	0.000		0.006		0.001	0.002	0.003
24	0.016				0.002			0.002			0.001			0.002				0.001	0.000	0.005
25	0.026			0.003							0.000	0.002		0.001		0.001		0.000		0.003
26	0.003																			
27	0.003							0.002										0.000		
28	0.003																			
29	0.001																			

Recreational, January-June 2000-2020																			
TL_in	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
6																		0.003	
7																		0.005	
8											0.000								
9				0.001									0.002						
10	0.001	0.003	0.001		0.002		0.003	0.001				0.001				0.002			
11	0.049	0.050	0.058	0.046	0.054	0.045	0.054	0.037	0.042	0.031	0.050	0.092	0.002	0.000	0.005	0.002	0.002	0.004	0.002
12	0.160	0.161	0.244	0.198	0.144	0.163	0.200	0.191	0.130	0.148	0.164	0.154	0.089	0.092	0.100	0.060	0.064	0.059	0.121
13	0.144	0.175	0.190	0.228	0.155	0.227	0.222	0.276	0.136	0.260	0.162	0.180	0.239	0.204	0.222	0.186	0.143	0.149	0.223
14	0.155	0.208	0.153	0.216	0.219	0.160	0.201	0.222	0.185	0.195	0.139	0.215	0.266	0.243	0.211	0.249	0.181	0.202	0.274
15	0.157	0.133	0.128	0.133	0.159	0.112	0.112	0.102	0.159	0.145	0.159	0.153	0.167	0.225	0.212	0.228	0.224	0.223	0.186
16	0.109	0.071	0.070	0.082	0.118	0.092	0.074	0.063	0.108	0.084	0.131	0.072	0.107	0.128	0.138	0.126	0.142	0.185	0.104
17	0.067	0.052	0.060	0.043	0.065	0.070	0.055	0.055	0.093	0.056	0.078	0.051	0.051	0.060	0.042	0.075	0.098	0.078	0.037
18	0.050	0.049	0.045	0.023	0.045	0.054	0.042	0.028	0.039	0.038	0.035	0.030	0.036	0.019	0.034	0.035	0.055	0.049	0.028
19	0.042	0.054	0.021	0.014	0.025	0.039	0.016	0.009	0.036	0.013	0.020	0.028	0.017	0.016	0.017	0.016	0.042	0.016	0.010
20	0.024	0.019	0.008	0.009	0.009	0.021	0.012	0.009	0.054	0.018	0.029	0.015	0.006	0.008	0.010	0.010	0.024	0.018	0.012
21	0.020	0.009	0.009	0.001	0.004	0.006	0.004	0.002	0.004	0.008	0.023	0.009	0.004	0.003	0.006	0.006	0.013	0.005	0.001
22	0.010	0.006	0.008	0.006		0.008	0.003	0.001	0.008	0.000	0.004		0.010	0.000	0.002	0.003	0.003	0.002	0.002
23	0.010	0.006	0.002		0.002	0.001	0.002	0.003	0.001	0.003	0.005		0.000	0.000	0.000	0.002	0.008		
24	0.001	0.002	0.002			0.001	0.000	0.001	0.001	0.000		0.001	0.001		0.000	0.001	0.000	0.001	
25		0.002	0.000						0.004	0.002			0.000		0.000	0.000		0.001	0.000
26			0.001			0.000					0.000								
27							0.000						0.001						
28									0.000										
29																			

Table 3 (continued.): Annual size frequency distributions of Louisiana recreational spotted seatrout harvest (July-December) taken from MRIP (1982-2013) and the LDWF Biological Sampling Program (2014-2020).

Recreational, July-December 1982-2001																				
TL_in	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4	0.001			0.001																
5	0.001			0.001					0.002											
6	0.002			0.001			0.000													
7	0.013	0.000		0.003	0.000							0.006								
8	0.017	0.004	0.004	0.017	0.011	0.002					0.002	0.004	0.002	0.002	0.002		0.006			
9	0.036	0.015	0.032	0.044	0.095	0.012	0.001	0.011	0.003	0.001	0.003	0.003	0.004	0.003	0.003	0.006	0.003		0.002	0.000
10	0.044	0.038	0.031	0.135	0.195	0.077	0.004	0.013	0.008	0.002	0.008	0.007	0.005	0.007	0.007	0.013	0.007	0.004	0.002	0.000
11	0.122	0.143	0.079	0.122	0.184	0.144	0.018	0.016	0.052	0.073	0.050	0.094	0.072	0.075	0.056	0.065	0.080	0.069	0.046	0.053
12	0.185	0.114	0.119	0.198	0.177	0.201	0.117	0.114	0.232	0.287	0.307	0.274	0.257	0.272	0.169	0.299	0.270	0.286	0.244	0.239
13	0.235	0.177	0.109	0.205	0.115	0.180	0.275	0.245	0.216	0.298	0.221	0.242	0.258	0.242	0.245	0.241	0.208	0.205	0.205	0.199
14	0.164	0.228	0.152	0.136	0.087	0.176	0.193	0.234	0.163	0.133	0.167	0.147	0.149	0.155	0.176	0.150	0.165	0.157	0.139	0.146
15	0.055	0.108	0.066	0.080	0.050	0.114	0.126	0.141	0.110	0.097	0.095	0.089	0.098	0.107	0.102	0.068	0.086	0.083	0.105	0.122
16	0.036	0.091	0.069	0.032	0.041	0.049	0.108	0.088	0.101	0.046	0.063	0.063	0.055	0.042	0.100	0.052	0.069	0.066	0.091	0.090
17	0.025	0.018	0.005	0.005	0.018	0.027	0.070	0.065	0.056	0.039	0.037	0.036	0.041	0.045	0.060	0.048	0.042	0.055	0.054	0.055
18	0.029	0.055	0.177	0.013	0.013	0.012	0.033	0.037	0.022	0.010	0.023	0.011	0.023	0.011	0.042	0.021	0.032	0.031	0.045	0.037
19	0.016	0.003	0.025	0.003	0.005	0.002	0.021	0.020	0.022	0.009	0.014	0.010	0.012	0.015	0.021	0.021	0.018	0.021	0.034	0.019
20	0.015	0.002	0.005	0.004	0.003	0.002	0.015	0.005	0.009	0.002	0.005	0.007	0.012	0.011	0.004	0.008	0.007	0.014	0.013	0.014
21	0.001		0.051		0.002	0.001	0.008	0.004		0.000	0.003	0.002	0.005	0.004	0.005	0.002	0.006	0.003	0.011	0.012
22	0.001	0.002	0.052		0.002		0.006	0.003	0.002	0.002	0.001	0.003	0.004	0.004	0.007	0.001	0.001	0.003	0.005	0.006
23	0.001	0.002	0.025		0.001		0.003	0.002	0.002		0.001	0.001	0.003	0.002	0.001	0.001	0.000	0.001	0.003	0.004
24	0.002				0.000		0.002	0.001				0.001		0.002	0.001	0.002		0.001	0.001	0.004
25			0.000							0.001			0.001	0.000				0.001		
26			0.000									0.000	0.001	0.001					0.001	
27					0.000						0.000									
28																				

Recreational, July-December 2000-2018																			
TL_in	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
5																			
6																			
7																			
8					0.000					0.001				0.001					
9				0.002	0.000	0.001	0.000				0.000	0.002		0.002	0.001				0.001
10	0.000	0.001	0.001	0.002	0.002	0.002	0.003		0.003	0.001	0.005	0.001		0.001		0.002			
11	0.044	0.079	0.094	0.077	0.067	0.067	0.062	0.068	0.045	0.033	0.057	0.046	0.009	0.007	0.005	0.006	0.004	0.004	0.006
12	0.265	0.310	0.284	0.311	0.294	0.273	0.226	0.271	0.292	0.166	0.253	0.260	0.191	0.167	0.186	0.142	0.151	0.200	0.186
13	0.231	0.211	0.232	0.210	0.219	0.269	0.235	0.227	0.298	0.205	0.227	0.279	0.236	0.243	0.303	0.228	0.271	0.336	0.274
14	0.166	0.142	0.188	0.157	0.170	0.155	0.197	0.154	0.159	0.194	0.164	0.175	0.196	0.213	0.238	0.234	0.236	0.221	0.211
15	0.112	0.099	0.086	0.101	0.091	0.088	0.123	0.111	0.103	0.151	0.101	0.090	0.160	0.155	0.134	0.160	0.164	0.106	0.149
16	0.076	0.054	0.041	0.048	0.062	0.056	0.073	0.081	0.048	0.091	0.065	0.067	0.111	0.094	0.062	0.087	0.086	0.059	0.083
17	0.042	0.029	0.029	0.044	0.043	0.036	0.044	0.036	0.019	0.049	0.056	0.037	0.059	0.059	0.034	0.089	0.043	0.037	0.041
18	0.033	0.023	0.018	0.020	0.026	0.023	0.016	0.025	0.019	0.044	0.033	0.020	0.021	0.029	0.017	0.032	0.023	0.022	0.022
19	0.011	0.018	0.016	0.016	0.020	0.009	0.010	0.010	0.009	0.036	0.018	0.008	0.009	0.014	0.011	0.010	0.014	0.007	0.010
20	0.012	0.019	0.006	0.010	0.003	0.008	0.007	0.007	0.002	0.010	0.010	0.009	0.005	0.012	0.004	0.007	0.006	0.002	0.008
21	0.002	0.007	0.001	0.002	0.002	0.006	0.002	0.004	0.001	0.006	0.006		0.001	0.002	0.004	0.002	0.000	0.003	0.004
22	0.002	0.002	0.002	0.000	0.000	0.002	0.001	0.002		0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001
23	0.001	0.002	0.001		0.000	0.003	0.000	0.000	0.001	0.007	0.002	0.002	0.002	0.000		0.000	0.000	0.000	
24	0.002	0.001			0.000	0.000	0.001	0.002		0.002	0.001	0.001		0.000		0.000		0.002	0.001
25	0.001	0.001	0.001			0.000	0.000	0.001		0.003	0.001				0.001				0.001
26	0.001	0.000								0.000	0.001								
27		0.001																	0.000
28																			

Table 4: Louisiana inshore shrimp fishery spotted seatrout bycatch-at-age and yield estimates (females only), and corresponding mean weights-at-age in pounds.

Inshore Shrimp Bycatch-at-age							
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Yield (lbs)
1982	113,351	2	0	0	0	0	72,979
1983	95,320	1	0	0	0	0	61,370
1984	127,988	2	0	0	0	0	82,403
1985	123,987	2	0	0	0	0	79,827
1986	173,777	3	0	0	0	0	111,884
1987	139,207	2	0	0	0	0	89,627
1988	131,638	2	0	0	0	0	84,753
1989	114,592	2	0	0	0	0	73,779
1990	157,056	2	0	0	0	0	101,118
1991	100,306	1	0	0	0	0	64,581
1992	105,573	2	0	0	0	0	67,971
1993	100,703	1	0	0	0	0	64,836
1994	104,194	2	0	0	0	0	67,084
1995	130,037	2	0	0	0	0	83,722
1996	104,613	2	0	0	0	0	67,353
1997	108,911	2	0	0	0	0	70,121
1998	148,478	2	0	0	0	0	95,596
1999	168,799	3	0	0	0	0	108,679
2000	207,433	3	0	0	0	0	133,553
2001	186,163	3	0	0	0	0	119,859
2002	134,305	2	0	0	0	0	86,471
2003	169,642	3	0	0	0	0	109,222
2004	185,231	3	0	0	0	0	119,259
2005	142,146	2	0	0	0	0	91,519
2006	196,326	3	0	0	0	0	126,402
2007	172,493	3	0	0	0	0	111,057
2008	145,850	2	0	0	0	0	93,904
2009	162,803	2	0	0	0	0	104,819
2010	128,538	2	0	0	0	0	82,757
2011	151,321	2	0	0	0	0	97,426
2012	156,912	2	0	0	0	0	101,026
2013	158,658	2	0	0	0	0	102,150
2014	198,237	3	0	0	0	0	127,632
2015	162,402	2	0	0	0	0	104,560
2016	167,092	2	0	0	0	0	107,580
2017	146,970	2	0	0	0	0	94,625
2018	161,260	2	0	0	0	0	103,825
2019	144,044	2	0	0	0	0	92,741
2020	117,896	2	0	0	0	0	75,906

Inshore Shrimp Bycatch Mean Weight-at-age						
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1982	0.64	1.06	--	--	--	--
1983	0.64	1.06	--	--	--	--
1984	0.64	1.06	--	--	--	--
1985	0.64	1.06	--	--	--	--
1986	0.64	1.06	--	--	--	--
1987	0.64	1.06	--	--	--	--
1988	0.64	1.06	--	--	--	--
1989	0.64	1.06	--	--	--	--
1990	0.64	1.06	--	--	--	--
1991	0.64	1.06	--	--	--	--
1992	0.64	1.06	--	--	--	--
1993	0.64	1.06	--	--	--	--
1994	0.64	1.06	--	--	--	--
1995	0.64	1.06	--	--	--	--
1996	0.64	1.06	--	--	--	--
1997	0.64	1.06	--	--	--	--
1998	0.64	1.06	--	--	--	--
1999	0.64	1.06	--	--	--	--
2000	0.64	1.06	--	--	--	--
2001	0.64	1.06	--	--	--	--
2002	0.64	1.06	--	--	--	--
2003	0.64	1.06	--	--	--	--
2004	0.64	1.06	--	--	--	--
2005	0.64	1.06	--	--	--	--
2006	0.64	1.06	--	--	--	--
2007	0.64	1.06	--	--	--	--
2008	0.64	1.06	--	--	--	--
2009	0.64	1.06	--	--	--	--
2010	0.64	1.06	--	--	--	--
2011	0.64	1.06	--	--	--	--
2012	0.64	1.06	--	--	--	--
2013	0.64	1.06	--	--	--	--
2014	0.64	1.06	--	--	--	--
2015	0.64	1.06	--	--	--	--
2016	0.64	1.06	--	--	--	--
2017	0.64	1.06	--	--	--	--
2018	0.64	1.06	--	--	--	--
2019	0.64	1.06	--	--	--	--
2020	0.64	1.06	--	--	--	--

Table 5: Annual winter severity index values (1982-2021) derived as the product of the number of days with water temperatures <= 7 degrees Celsius in each winter and the inverse of the mean water temperature during that period.

Year	days<=7C	Wtemp_mean	WS Index
1982	8	5.95	1.34
1983	0	--	0.00
1984	15	4.58	3.27
1985	4	4.25	0.94
1986	0	--	0.00
1987	0	--	0.00
1988	1	6.65	0.15
1989	0	--	0.00
1990	9	3.12	2.89
1991	0	--	0.00
1992	0	--	0.00
1993	0	--	0.00
1994	0	--	0.00
1995	0	--	0.00
1996	6	5.55	1.08
1997	1	7.00	0.14
1998	0	--	0.00
1999	1	6.82	0.15
2000	0	--	0.00
2001	6	5.51	1.09
2002	4	5.93	0.67
2003	0	--	0.00
2004	0	--	0.00
2005	3	5.90	0.51
2006	0	--	0.00
2007	0	--	0.00
2008	1	6.58	0.15
2009	0	--	0.00
2010	6	4.58	1.31
2011	4	6.52	0.61
2012	0	--	0.00
2013	0	--	0.00
2014	6	5.51	1.09
2015	0	--	0.00
2016	0	--	0.00
2017	0	--	0.00
2018	9	5.31	1.70
2019	0	--	0.00
2020	0	--	0.00
2021	5	6.41	0.78

Table 6: 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 7: Annual sample sizes, nominal proportion of positive samples and nominal CPUEs of positive samples, 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	%Pos	CPUE	IOA	CV	n	%Pos	CPUE	IOA	CV	n	%Pos	CPUE	IOA	CV
1986	487	41%	0.88	1.15	0.31	--	--	--	--	--	487	22%	0.83	0.70	0.27
1987	475	33%	1.09	0.86	0.33	--	--	--	--	--	475	31%	1.03	1.16	0.24
1988	417	39%	1.19	1.33	0.31	417	50%	1.35	1.82	0.27	417	42%	1.36	2.12	0.22
1989	474	36%	1.04	1.14	0.32	472	46%	1.03	1.43	0.28	473	31%	1.29	1.50	0.24
1990	489	31%	1.00	0.81	0.34	489	37%	1.02	0.94	0.31	489	24%	1.13	0.84	0.26
1991	471	36%	1.48	1.31	0.32	470	40%	1.58	1.39	0.30	470	26%	1.38	1.16	0.25
1992	472	33%	1.38	1.10	0.33	472	41%	1.47	1.36	0.30	472	34%	1.45	1.76	0.23
1993	459	36%	1.09	1.04	0.32	458	41%	1.48	1.43	0.30	457	29%	1.52	1.43	0.25
1994	487	36%	1.11	1.04	0.32	487	38%	1.22	1.07	0.30	486	27%	1.06	1.13	0.25
1995	520	35%	1.61	1.12	0.32	520	38%	1.20	1.03	0.30	520	26%	1.24	1.10	0.25
1996	520	32%	0.94	0.84	0.33	520	42%	0.94	1.14	0.29	520	27%	1.13	1.16	0.24
1997	520	33%	0.95	0.84	0.33	520	33%	1.05	0.86	0.32	519	29%	1.07	1.18	0.24
1998	509	34%	1.00	0.89	0.32	509	34%	1.22	0.93	0.31	509	25%	1.16	1.02	0.25
1999	520	38%	1.19	1.13	0.31	520	38%	1.30	1.15	0.30	520	30%	1.59	1.39	0.24
2000	528	38%	0.82	0.94	0.31	528	44%	1.08	1.36	0.28	528	35%	1.22	1.70	0.22
2001	528	26%	0.74	0.55	0.35	528	31%	0.96	0.70	0.32	528	27%	1.12	1.11	0.25
2002	520	33%	0.73	0.72	0.33	520	35%	0.76	0.76	0.31	520	22%	0.75	0.72	0.26
2003	525	30%	0.90	0.69	0.34	525	27%	0.96	0.59	0.34	525	20%	0.87	0.63	0.27
2004	527	32%	0.85	0.78	0.33	527	30%	0.86	0.67	0.33	527	23%	0.90	0.75	0.26
2005	478	38%	1.25	1.17	0.31	478	37%	1.08	0.99	0.31	478	23%	0.80	0.75	0.26
2006	519	38%	0.98	1.11	0.31	518	37%	1.09	1.06	0.30	519	30%	1.05	1.24	0.24
2007	528	35%	1.02	1.12	0.32	528	37%	0.94	0.97	0.30	528	25%	0.92	0.98	0.25
2008	514	36%	1.23	1.20	0.32	514	37%	1.15	1.04	0.30	514	25%	0.87	0.87	0.25
2009	528	34%	1.01	0.92	0.32	528	32%	1.13	0.84	0.32	528	27%	1.13	1.07	0.25
2010	463	28%	0.99	0.79	0.34	463	27%	0.87	0.66	0.34	463	19%	0.73	0.60	0.28
2011	1202	28%	0.90	0.79	0.32	1202	30%	0.75	0.81	0.30	1202	19%	0.75	0.80	0.23
2012	1269	27%	0.68	0.72	0.32	1269	30%	0.78	0.89	0.29	1269	17%	0.70	0.74	0.23
2013	624	34%	1.21	1.56	0.29	624	33%	0.84	1.27	0.28	624	19%	0.88	1.14	0.25
2014	625	33%	0.74	1.29	0.29	625	32%	0.63	1.03	0.29	624	15%	0.81	0.81	0.26
2015	626	23%	0.78	0.81	0.33	626	22%	0.63	0.68	0.33	626	12%	0.60	0.52	0.29
2016	626	32%	0.79	1.24	0.30	626	25%	0.68	0.84	0.32	625	13%	0.72	0.68	0.28
2017	620	27%	0.95	1.06	0.31	620	27%	0.78	0.97	0.31	620	16%	0.78	0.87	0.26
2018	624	22%	0.64	0.73	0.34	624	24%	0.64	0.81	0.32	624	11%	0.73	0.49	0.29
2019	648	26%	0.93	0.98	0.32	648	21%	0.65	0.60	0.33	648	6%	0.75	0.27	0.35
2020	612	30%	0.90	1.23	0.30	612	27%	0.87	0.91	0.31	612	13%	0.65	0.61	0.28

Table 8: 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_0	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	1.00	0.00	0.00	0.00	0.00	0.00
6	0.00	1.00	0.00	0.00	0.00	0.00	0.00
7	0.00	1.00	0.00	0.00	0.00	0.00	0.00
8	0.00	1.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.00	0.00	0.00	0.00	0.00	0.00
10	0.00	1.00	0.00	0.00	0.00	0.00	0.00
11	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12	0.00	1.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.97	0.03	0.00	0.00	0.00	0.00
14	0.00	0.00	1.00	0.00	0.00	0.00	0.00
15	0.00	0.00	1.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.99	0.01	0.00	0.00	0.00
17	0.00	0.00	0.83	0.17	0.00	0.00	0.00
18	0.00	0.00	0.12	0.84	0.04	0.00	0.00
19	0.00	0.00	0.00	0.79	0.18	0.02	0.00
20	0.00	0.00	0.00	0.37	0.48	0.12	0.03
21	0.00	0.00	0.00	0.06	0.47	0.30	0.17
22	0.00	0.00	0.00	0.00	0.18	0.34	0.47
23	0.00	0.00	0.00	0.00	0.03	0.18	0.79
24	0.00	0.00	0.00	0.00	0.00	0.05	0.94
25	0.00	0.00	0.00	0.00	0.00	0.01	0.99
26	0.00	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Fishery Landings 1981-2001 (July-December)							
TL_in	Age_0	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.00	0.00	0.00	0.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.00	0.00	0.00	0.00	0.00	0.00	0.00
9	1.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.24	0.76	0.00	0.00	0.00	0.00	0.00
11	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12	0.00	1.00	0.00	0.00	0.00	0.00	0.00
13	0.00	1.00	0.00	0.00	0.00	0.00	0.00
14	0.00	1.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.98	0.02	0.00	0.00	0.00	0.00
16	0.00	0.16	0.83	0.00	0.00	0.00	0.00
17	0.00	0.00	0.98	0.02	0.00	0.00	0.00
18	0.00	0.00	0.86	0.13	0.01	0.00	0.00
19	0.00	0.00	0.35	0.57	0.07	0.01	0.00
20	0.00	0.00	0.03	0.65	0.25	0.05	0.02
21	0.00	0.00	0.00	0.29	0.42	0.18	0.10
22	0.00	0.00	0.00	0.05	0.31	0.30	0.34
23	0.00	0.00	0.00	0.00	0.10	0.23	0.67
24	0.00	0.00	0.00	0.00	0.02	0.10	0.89
25	0.00	0.00	0.00	0.00	0.00	0.03	0.97
26	0.00	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Table 9: 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_0	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.00	0.00	0.00	0.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	1.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.00	0.00	0.00	0.00	0.00	0.00
10	0.00	1.00	0.00	0.00	0.00	0.00	0.00
11	0.00	1.00	0.00	0.00	0.00	0.00	0.00
12	0.00	1.00	0.00	0.00	0.00	0.00	0.00
13	0.00	1.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.99	0.01	0.00	0.00	0.00	0.00
15	0.00	0.06	0.94	0.00	0.00	0.00	0.00
16	0.00	0.00	1.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.96	0.04	0.00	0.00	0.00
18	0.00	0.00	0.61	0.38	0.02	0.00	0.00
19	0.00	0.00	0.06	0.80	0.12	0.01	0.00
20	0.00	0.00	0.00	0.55	0.35	0.08	0.02
21	0.00	0.00	0.00	0.16	0.47	0.24	0.13
22	0.00	0.00	0.00	0.02	0.25	0.33	0.40
23	0.00	0.00	0.00	0.00	0.06	0.21	0.73
24	0.00	0.00	0.00	0.00	0.01	0.08	0.92
25	0.00	0.00	0.00	0.00	0.00	0.02	0.98
26	0.00	0.00	0.00	0.00	0.00	0.00	1.00
27	0.00	0.00	0.00	0.00	0.00	0.00	1.00
28	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Table 10: 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 10 (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 10 (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 10 (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 10 (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 10 (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

2019 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	3						3
12	87	12					99
13	99	45	1				145
14	38	111	2				151
15	10	182	5	1	1		199
16	5	175	11	1	1		193
17	1	89	8	1			99
18		31	19	2	1		53
19		4	12				16
20		3	11	2			16
21	1	1	4				6
22			2	1			3
23							0
24			2		1		3
25				1			1
26							0
27							0
28							0
Total	244	653	77	9	4	0	987

2019 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	5						5
12	269	3	1				273
13	584	4	1				589
14	396	9	1				406
15	192	13	2	1			208
16	59	26	1				86
17	18	44	2				64
18	6	32	5				43
19	3	5	3				11
20	1	1	3				5
21		2	1				3
22	1		1				2
23				1			1
24			1				1
25							0
26							0
27							0
28							0
Total	1534	139	22	2	0	0	1697

Table 10 (continued):

2020 (January-June)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	2	1					3
12	64	39		1			104
13	44	153	5	1			203
14	6	263	6				275
15	1	204	3		1		209
16		105					105
17		36	4				40
18		23	5				28
19		5	6				11
20		3	5	2			10
21			2				2
22				1			1
23							0
24							0
25				1			1
26							0
27							0
28							0
Total	117	832	36	6	1	0	992

2020 (July-December)							
TL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Total
10							0
11	3	2					5
12	170	13					183
13	282	25	1				308
14	232	69	1				302
15	136	90	1				227
16	44	77	2	1			124
17	13	60					73
18	4	50	1				55
19	1	20	1				22
20	2	6	2				10
21		2	3				5
22		2	1				3
23							0
24				1			1
25		1					1
26							0
27						1	1
28							0
Total	887	417	13	2	0	1	1320

Table 11: Annual survey age composition and sample sizes of female spotted seatrout catches from the LDWF experimental marine gillnet survey.

	1.0" Mesh							1.25" Mesh							1.5" 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+	n	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+
1986	561	0.980	0.020	0.000	0.000	0.000	0.000	--	--	--	--	--	--	--	277	0.394	0.576	0.030	0.000	0.000	0.000
1987	546	0.969	0.031	0.000	0.000	0.000	0.000	--	--	--	--	--	--	--	464	0.540	0.440	0.020	0.000	0.000	0.000
1988	627	0.950	0.040	0.010	0.000	0.000	0.000	1075	0.910	0.080	0.010	0.000	0.000	0.000	733	0.778	0.212	0.010	0.000	0.000	0.000
1989	571	0.910	0.080	0.010	0.000	0.000	0.000	862	0.840	0.150	0.010	0.000	0.000	0.000	589	0.590	0.390	0.020	0.000	0.000	0.000
1990	486	0.940	0.050	0.010	0.000	0.000	0.000	713	0.859	0.141	0.000	0.000	0.000	0.000	406	0.570	0.420	0.010	0.000	0.000	0.000
1991	803	0.930	0.070	0.000	0.000	0.000	0.000	1132	0.879	0.121	0.000	0.000	0.000	0.000	529	0.400	0.590	0.010	0.000	0.000	0.000
1992	685	0.920	0.070	0.010	0.000	0.000	0.000	1081	0.830	0.160	0.010	0.000	0.000	0.000	714	0.505	0.485	0.010	0.000	0.000	0.000
1993	573	0.930	0.060	0.010	0.000	0.000	0.000	1072	0.881	0.109	0.010	0.000	0.000	0.000	630	0.540	0.440	0.020	0.000	0.000	0.000
1994	620	0.919	0.071	0.010	0.000	0.000	0.000	868	0.889	0.111	0.000	0.000	0.000	0.000	436	0.560	0.410	0.030	0.000	0.000	0.000
1995	942	0.930	0.060	0.010	0.000	0.000	0.000	903	0.870	0.120	0.010	0.000	0.000	0.000	524	0.455	0.515	0.030	0.000	0.000	0.000
1996	508	0.870	0.090	0.020	0.010	0.000	0.010	776	0.848	0.141	0.010	0.000	0.000	0.000	497	0.475	0.495	0.030	0.000	0.000	0.000
1997	529	0.880	0.090	0.020	0.010	0.000	0.000	684	0.838	0.152	0.010	0.000	0.000	0.000	496	0.485	0.465	0.040	0.010	0.000	0.000
1998	555	0.909	0.061	0.020	0.010	0.000	0.000	821	0.870	0.130	0.000	0.000	0.000	0.000	449	0.556	0.414	0.030	0.000	0.000	0.000
1999	749	0.880	0.090	0.020	0.010	0.000	0.000	984	0.818	0.172	0.010	0.000	0.000	0.000	770	0.545	0.434	0.020	0.000	0.000	0.000
2000	517	0.850	0.090	0.030	0.010	0.010	0.010	958	0.879	0.111	0.010	0.000	0.000	0.000	703	0.570	0.370	0.050	0.010	0.000	0.000
2001	321	0.828	0.121	0.030	0.010	0.000	0.010	614	0.778	0.212	0.010	0.000	0.000	0.000	495	0.525	0.434	0.030	0.010	0.000	0.000
2002	396	0.850	0.110	0.020	0.010	0.000	0.010	527	0.840	0.140	0.010	0.000	0.000	0.010	271	0.540	0.430	0.020	0.000	0.000	0.010
2003	457	0.939	0.040	0.010	0.010	0.000	0.000	522	0.881	0.099	0.010	0.000	0.000	0.010	286	0.580	0.400	0.020	0.000	0.000	0.000
2004	466	0.900	0.050	0.020	0.010	0.000	0.020	516	0.890	0.080	0.010	0.000	0.000	0.020	334	0.610	0.340	0.020	0.010	0.000	0.020
2005	730	0.939	0.061	0.000	0.000	0.000	0.000	736	0.909	0.081	0.000	0.000	0.000	0.010	272	0.550	0.380	0.030	0.010	0.010	0.020
2006	621	0.891	0.079	0.020	0.010	0.000	0.000	811	0.778	0.212	0.010	0.000	0.000	0.000	513	0.400	0.540	0.050	0.010	0.000	0.000
2007	596	0.920	0.050	0.010	0.010	0.000	0.010	709	0.878	0.112	0.010	0.000	0.000	0.000	380	0.580	0.370	0.030	0.010	0.000	0.010
2008	723	0.920	0.060	0.010	0.000	0.000	0.010	834	0.830	0.150	0.010	0.000	0.000	0.010	352	0.510	0.420	0.040	0.010	0.010	0.010
2009	590	0.910	0.050	0.010	0.010	0.010	0.010	739	0.848	0.141	0.010	0.000	0.000	0.000	493	0.535	0.444	0.020	0.000	0.000	0.000
2010	405	0.900	0.060	0.010	0.010	0.000	0.020	414	0.879	0.111	0.010	0.000	0.000	0.000	198	0.396	0.505	0.059	0.020	0.010	0.010
2011	957	0.909	0.081	0.010	0.000	0.000	0.000	1045	0.859	0.131	0.010	0.000	0.000	0.000	538	0.480	0.480	0.030	0.010	0.000	0.000
2012	746	0.920	0.060	0.010	0.000	0.000	0.010	1152	0.879	0.111	0.010	0.000	0.000	0.000	474	0.400	0.550	0.040	0.010	0.000	0.000
2013	815	0.737	0.091	0.040	0.051	0.040	0.040	666	0.812	0.149	0.020	0.010	0.000	0.010	332	0.414	0.515	0.061	0.010	0.000	0.000
2014	488	0.980	0.020	0.000	0.000	0.000	0.000	479	0.889	0.101	0.010	0.000	0.000	0.000	240	0.545	0.406	0.040	0.010	0.000	0.000
2015	351	0.919	0.030	0.020	0.010	0.010	0.010	337	0.860	0.130	0.010	0.000	0.000	0.000	136	0.574	0.356	0.040	0.010	0.000	0.020
2016	500	0.970	0.030	0.000	0.000	0.000	0.000	404	0.870	0.120	0.010	0.000	0.000	0.000	186	0.495	0.434	0.061	0.010	0.000	0.000
2017	506	0.930	0.040	0.010	0.010	0.000	0.010	504	0.840	0.150	0.010	0.000	0.000	0.000	241	0.485	0.475	0.030	0.010	0.000	0.000
2018	277	0.940	0.050	0.010	0.000	0.000	0.000	365	0.880	0.110	0.010	0.000	0.000	0.000	149	0.500	0.470	0.020	0.010	0.000	0.000
2019	503	0.980	0.020	0.000	0.000	0.000	0.000	339	0.960	0.040	0.000	0.000	0.000	0.000	89	0.650	0.340	0.000	0.010	0.000	0.000
2020	525	0.949	0.051	0.000	0.000	0.000	0.000	549	0.910	0.090	0.000	0.000	0.000	0.000	166	0.640	0.350	0.010	0.000	0.000	0.000

Table 12: 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	0.24
1984	391,755	199,957	49,228	34,885	24,723	31,707	1,228,965	0.30
1985	1,501,525	208,313	46,230	18,466	8,293	7,598	1,749,025	0.21
1986	2,633,193	842,301	104,620	28,925	11,178	15,474	3,610,915	0.16
1987	2,548,528	897,532	50,771	17,580	5,494	3,273	3,507,535	0.17
1988	1,487,973	812,106	150,429	55,867	19,677	13,883	3,122,697	0.20
1989	1,476,612	979,986	137,268	43,066	15,603	20,631	3,437,101	0.17
1990	1,085,067	414,345	58,012	12,634	3,495	3,092	1,832,308	0.18
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	0.16
1993	1,852,853	537,393	110,829	32,450	12,661	14,908	2,815,927	0.17
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	0.20
1996	2,242,323	1,047,477	172,192	40,556	16,166	16,686	4,301,554	0.16
1997	2,401,381	1,051,553	160,089	29,997	11,778	22,891	4,139,145	0.16
1998	2,384,739	1,204,289	186,819	45,615	15,448	8,721	4,400,806	0.16
1999	3,092,437	1,463,862	238,406	89,735	36,088	36,470	5,927,097	0.14
2000	3,110,291	1,602,485	318,164	100,733	36,713	37,420	6,654,898	0.14
2001	2,603,830	1,450,127	372,252	116,122	49,827	70,476	6,297,577	0.13
2002	1,776,126	1,075,727	365,693	74,240	29,492	41,091	4,308,986	0.16
2003	1,723,601	1,564,798	296,999	52,115	23,102	33,744	4,509,671	0.15
2004	1,555,848	1,558,269	213,562	30,339	14,781	25,995	3,822,010	0.15
2005	1,682,168	1,799,367	198,589	17,063	8,621	6,817	4,096,272	0.14
2006	2,110,375	2,694,800	332,830	23,581	6,578	9,002	6,100,329	0.15
2007	1,784,603	1,851,821	343,331	50,101	20,639	26,709	4,865,481	0.14
2008	2,256,965	2,632,435	579,080	35,033	8,777	15,439	6,297,865	0.15
2009	2,268,888	3,088,448	502,249	79,771	5,249	22,516	6,719,497	0.14
2010	2,545,061	1,585,205	360,711	56,527	8,890	19,356	5,294,537	0.19
2011	2,793,285	2,334,920	436,470	79,623	28,377	57,790	7,374,019	0.16
2012	2,973,166	2,369,144	446,859	58,825	25,957	41,457	7,488,382	0.17
2013	2,392,436	1,818,372	180,867	29,375	12,483	13,459	5,000,219	0.15
2014	1,677,404	1,028,212	73,847	10,282	3,614	5,117	3,279,951	0.06
2015	2,332,459	1,252,861	132,163	15,619	3,886	4,040	4,481,251	0.05
2016	2,909,711	1,457,978	165,538	19,654	7,874	7,912	5,184,852	0.05
2017	2,266,899	2,074,552	105,611	19,126	6,942	8,135	5,560,356	0.04
2018	1,601,410	529,906	63,608	3,202	3,713	2,060	2,653,599	0.06
2019	2,474,821	488,025	60,879	12,404	5,953	8,398	3,400,851	0.05
2020	1,991,344	1,295,553	46,767	12,612	5,484	10,423	3,886,182	0.05

Table 13: 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	70,448	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	3,629	21,537	9,126	1,872	846	1,061	66,732	0.05
2003	128	7,390	2,223	450	143	211	18,003	0.05
2004	13	8,572	1,870	208	161	253	18,390	0.05
2005	142	8,826	1,300	72	63	58	15,370	0.05
2006	13	1,019	175	9	3	5	1,867	0.05
2007	0	4,258	1,404	172	68	88	10,288	0.05
2008	82	4,097	1,692	100	25	47	9,365	0.05
2009	8	462	123	15	2	4	906	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	894	99	32	10	17	3,366	0.05
2014	1,876	2,239	138	25	9	13	6,237	0.05
2015	854	1,460	163	18	4	4	3,663	0.05
2016	473	934	119	9	5	5	2,226	0.05
2017	793	1,314	69	14	5	6	3,244	0.05
2018	1,154	1,061	190	10	9	4	3,655	0.05
2019	0	0	0	0	0	0	1	0.05
2020	0	0	0	0	0	0	1	0.05

Table 14: 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	2.88	3.61	4.38
2003	0.82	1.31	2.19	2.81	3.20	4.86
2004	0.82	1.19	2.08	2.62	3.74	4.14
2005	0.81	1.23	2.12	2.71	3.16	3.89
2006	0.80	1.34	2.02	2.96	3.69	4.21
2007	0.82	1.27	2.06	2.91	3.73	4.31
2008	0.85	1.18	1.87	2.63	3.75	4.57
2009	0.84	1.17	1.83	1.88	4.09	4.96
2010	0.86	1.30	2.14	2.51	3.83	4.76
2011	0.95	1.38	2.02	2.98	3.79	4.77
2012	0.88	1.46	2.16	2.84	3.26	4.76
2013	0.87	1.27	2.25	2.92	3.42	4.32
2014	0.96	1.43	1.97	2.28	3.61	4.55
2015	0.97	1.49	2.17	2.60	3.81	4.00
2016	0.94	1.37	2.11	2.65	3.40	4.63
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
2019	0.97	1.59	2.18	2.95	3.36	4.62
2020	0.95	1.39	2.08	2.90	3.52	4.95

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	4.20
2003	1.09	1.40	2.18	2.58	3.33	4.70
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	4.24
2007	.	1.44	2.16	2.77	3.68	4.32
2008	1.19	1.31	1.96	2.81	3.76	4.52
2009	1.22	1.30	1.92	2.19	3.83	4.58
2010	1.20	1.45	2.24	2.60	3.82	4.76
2011	1.25	1.73	2.37	3.04	4.17	4.89
2012	1.17	1.48	2.42	2.68	3.74	4.35
2013	1.26	1.55	2.49	2.85	3.74	4.51
2014	1.26	1.54	2.12	2.21	3.71	4.42
2015	1.24	1.48	2.20	2.66	3.75	3.97
2016	1.20	1.43	2.23	3.10	3.29	4.55
2017	1.25	1.54	2.21	2.45	3.46	4.42
2018	1.26	1.58	2.35	3.26	2.99	4.15
2019	1.24	1.54	2.23	2.80	2.98	4.59
2020	1.19	1.36	2.14	3.20	2.71	4.05

Table 15: Summary of objective function components and negative log-likelihood values of the ASAP base model.

Objective function=	25665.8		
Component	Lambda	ESS	negLL
Catch_Recreational	1	--	-48
Catch_Commercial	1	--	-105
Index_1.0" mesh	1	--	-21
Index_1.25" mesh	1	--	-20
Index_1.5" mesh	1	--	-12
Catch_agecomps	--	15600	14242
Index_agecomps	--	20600	11643
Selectivity_parms_catch	20	--	1
Selectivity_parms_indices	12	--	12
Recruitment_devs	1	--	-25

Table 16: Annual female spotted seatrout abundance-at-age and total stock size estimates from the ASAP base model.

Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6+	Totals
1982	5,499,580	1,420,180	514,160	238,077	186,129	969,726	8,827,852
1983	4,768,340	1,720,030	402,969	204,816	124,118	794,079	8,014,352
1984	3,060,540	1,154,880	296,664	116,802	89,186	599,374	5,317,446
1985	6,043,130	1,182,430	347,012	127,584	64,983	488,382	8,253,521
1986	7,567,090	2,369,650	370,760	153,118	71,961	394,395	10,926,974
1987	6,895,680	2,249,230	487,326	123,312	73,062	313,872	10,142,482
1988	8,116,710	2,059,330	492,356	167,661	59,783	260,185	11,156,025
1989	6,392,620	3,048,030	382,064	162,246	86,688	228,755	10,300,403
1990	6,441,640	1,752,240	277,585	86,701	71,186	215,228	8,844,580
1991	7,401,140	2,718,060	491,744	119,942	51,078	209,711	10,991,675
1992	6,861,790	2,458,710	417,872	151,613	60,628	185,567	10,136,180
1993	7,299,870	2,415,570	448,445	142,945	80,464	176,139	10,563,433
1994	7,832,730	2,620,080	440,390	150,952	75,078	181,775	11,301,005
1995	8,019,600	2,696,860	455,910	147,140	79,305	182,474	11,581,289
1996	7,561,810	2,867,600	560,630	172,857	82,294	188,708	11,433,899
1997	7,135,470	2,867,070	670,258	224,800	98,976	196,391	11,192,965
1998	8,280,490	2,811,360	743,314	291,526	135,085	216,495	12,478,270
1999	8,311,700	3,333,410	844,386	355,702	182,387	259,301	13,286,886
2000	9,079,460	3,140,150	882,504	379,969	216,694	322,925	14,021,702
2001	6,266,740	3,276,420	759,008	379,902	227,079	392,889	11,302,038
2002	5,523,270	2,068,430	644,251	293,513	216,805	447,468	9,193,737
2003	5,646,650	2,054,680	526,635	283,905	177,210	487,540	9,176,620
2004	6,290,900	1,974,770	465,101	219,407	167,288	487,274	9,604,740
2005	7,955,890	2,406,900	541,533	213,403	134,779	484,649	11,737,154
2006	6,863,780	3,383,350	828,636	278,710	137,747	464,657	11,956,880
2007	7,577,340	2,674,900	970,422	389,357	172,965	447,801	12,232,785
2008	7,967,560	3,160,200	884,997	489,741	249,197	463,211	13,214,906
2009	6,577,740	2,961,030	817,676	394,693	297,168	522,598	11,570,905
2010	6,646,640	2,159,920	589,297	319,685	226,268	592,466	10,534,276
2011	7,118,700	2,492,580	570,915	265,768	194,913	604,328	11,247,204
2012	5,785,430	2,562,140	603,519	246,363	158,985	588,799	9,945,236
2013	5,141,980	1,595,430	351,342	195,643	130,268	538,001	7,952,664
2014	5,508,890	1,292,580	179,260	102,999	99,059	477,385	7,660,173
2015	6,280,180	1,761,180	242,193	67,945	58,264	422,122	8,831,884
2016	7,355,850	1,828,400	270,698	83,121	36,823	350,444	9,925,335
2017	4,789,000	1,980,970	238,109	85,483	43,458	281,360	7,418,380
2018	3,716,610	865,821	110,097	48,982	37,149	226,897	5,005,557
2019	5,807,810	998,522	111,925	34,622	25,564	190,875	7,169,317
2020	6,591,440	1,698,460	155,217	38,646	18,812	158,016	8,660,591

Table 17: 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	0.63	0.90	0.61	0.37	0.20	0.11	0.90	0.60
1983	0.89	1.39	0.93	0.55	0.30	0.16	1.39	0.91
1984	0.42	0.84	0.53	0.30	0.16	0.08	0.84	0.47
1985	0.41	0.80	0.51	0.29	0.15	0.08	0.80	0.44
1986	0.69	1.22	0.79	0.45	0.24	0.13	1.22	0.78
1987	0.68	1.16	0.76	0.44	0.24	0.12	1.16	0.77
1988	0.45	1.32	0.80	0.37	0.16	0.06	1.32	0.62
1989	0.77	2.03	1.17	0.54	0.23	0.09	2.03	1.13
1990	0.33	0.91	0.53	0.24	0.10	0.04	0.91	0.44
1991	0.57	1.51	0.87	0.40	0.17	0.07	1.51	0.80
1992	0.52	1.34	0.76	0.35	0.15	0.06	1.34	0.71
1993	0.50	1.34	0.78	0.36	0.15	0.06	1.34	0.69
1994	0.54	1.38	0.79	0.36	0.15	0.06	1.38	0.73
1995	0.50	1.21	0.66	0.30	0.12	0.05	1.21	0.66
1996	0.44	1.09	0.60	0.27	0.11	0.05	1.09	0.60
1997	0.40	0.99	0.52	0.22	0.09	0.04	0.99	0.55
1998	0.38	0.84	0.43	0.18	0.07	0.03	0.84	0.47
1999	0.45	0.96	0.49	0.21	0.09	0.03	0.96	0.56
2000	0.49	1.06	0.53	0.23	0.09	0.04	1.06	0.60
2001	0.58	1.26	0.64	0.28	0.11	0.04	1.26	0.74
2002	0.46	1.00	0.51	0.22	0.09	0.04	1.00	0.55
2003	0.52	1.12	0.57	0.24	0.10	0.04	1.12	0.62
2004	0.43	0.93	0.47	0.20	0.08	0.03	0.93	0.51
2005	0.33	0.70	0.35	0.15	0.06	0.02	0.70	0.39
2006	0.41	0.88	0.45	0.19	0.08	0.03	0.88	0.53
2007	0.35	0.74	0.37	0.16	0.07	0.03	0.74	0.41
2008	0.46	0.99	0.50	0.21	0.09	0.03	0.99	0.56
2009	0.59	1.25	0.63	0.27	0.11	0.04	1.25	0.71
2010	0.45	0.97	0.49	0.21	0.09	0.03	0.97	0.52
2011	0.49	1.05	0.53	0.23	0.09	0.04	1.05	0.58
2012	0.76	1.62	0.82	0.35	0.14	0.06	1.62	0.92
2013	0.85	1.82	0.92	0.40	0.16	0.06	1.82	0.97
2014	0.61	1.31	0.66	0.28	0.12	0.05	1.31	0.69
2015	0.71	1.51	0.76	0.33	0.13	0.05	1.51	0.83
2016	0.78	1.67	0.84	0.36	0.15	0.06	1.67	0.92
2017	1.18	2.53	1.27	0.55	0.22	0.09	2.53	1.49
2018	0.79	1.68	0.85	0.37	0.15	0.06	1.68	0.90
2019	0.70	1.50	0.75	0.32	0.13	0.05	1.50	0.79
2020	0.59	1.27	0.64	0.28	0.11	0.04	1.27	0.72

Table 18: Limit and target reference point estimates for the Louisiana spotted seatrout stock. Spawning stock biomass units are millions of pounds. Fishing mortality units are per year.

Management Benchmarks		
Parameters	Derivation	Value
SSB_{limit}	Lowest SSB (1982-2009)	4.30
SPR_{limit}	Equation [29] and SSB_{limit}	9.8%
F_{limit}	Equation [29] and SPR_{limit}	0.77
SSB_{target}	Median SSB (1982-2009)	6.19
SPR_{target}	Equation [29] and SSB_{target}	14.1%
F_{target}	Equation [29] and SPR_{target}	0.62

Table 19: Sensitivity analysis table of proposed limit reference points. Current estimates are taken as the geometric mean of the 2018-2020 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are per year.

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)	25665.8	9.8%	4.87	0.77	4.30	6.3%	1.03	0.64
Model 1 (h=0.95)	25665.7	10.0%	4.72	0.76	4.28	6.9%	1.05	0.64
Model 2 (h=0.90)	25665.8	10.3%	4.56	0.75	4.27	7.6%	1.07	0.64
Model 3 (h=0.85)	25666.2	10.7%	4.38	0.73	4.28	8.4%	1.10	0.64
Model 4 (h=0.80)	25666.9	11.2%	4.19	0.72	4.31	9.4%	1.13	0.64
Model 5 (Yield lambda*10)	24056.0	8.0%	5.11	0.86	3.61	6.2%	0.87	0.77
Model 6 (IOA lambdas*10)	24846.6	10.0%	4.46	0.75	4.02	5.8%	1.24	0.58
Model 7 (Winterkill index)	25695.7	8.1%	5.74	0.85	4.11	4.8%	0.86	0.59
Model 8 (Discard M=0.25)	25502.8	9.3%	4.98	0.81	4.27	6.0%	1.04	0.65
Model 9 (Growth model ALK's 1982-2020)	25265.6	10.1%	4.73	0.81	4.27	5.7%	1.09	0.57
Model 10 (ACAL MRIP hindcast)	25440.7	8.6%	5.15	0.84	3.97	5.9%	0.95	0.69
Model 11 (MRIP Size with FES and APAIS)	25663.6	9.7%	4.86	0.78	4.27	6.2%	1.04	0.63
Model 12 (Inshore shrimp bycatch fleet)	25605.6	9.5%	4.95	0.80	4.27	6.1%	1.04	0.64

Table 20: Sensitivity analysis table of MSY related reference points. Current estimates are taken as the geometric mean of 2018-2020 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are per year.

Model run	negLL	SPR_{MSY}	MSY	F_{MSY}	SSB_{MSY}	$SPR_{current}$	$F_{current}/F_{MSY}$	$SSB_{current}/SSB_{MSY}$
Base Model (h=1)	25665.8	--	--	--	--	6.3%	--	--
Model 1 (h=0.95)	25665.7	12.3%	4.75	0.67	5.40	6.9%	1.19	0.51
Model 2 (h=0.90)	25665.8	17.6%	4.88	0.53	8.36	7.6%	1.52	0.33
Model 3 (h=0.85)	25666.2	21.9%	5.28	0.45	11.82	8.4%	1.80	0.23
Model 4 (h=0.80)	25666.9	25.8%	6.08	0.39	16.82	9.4%	2.08	0.16

11. Figures

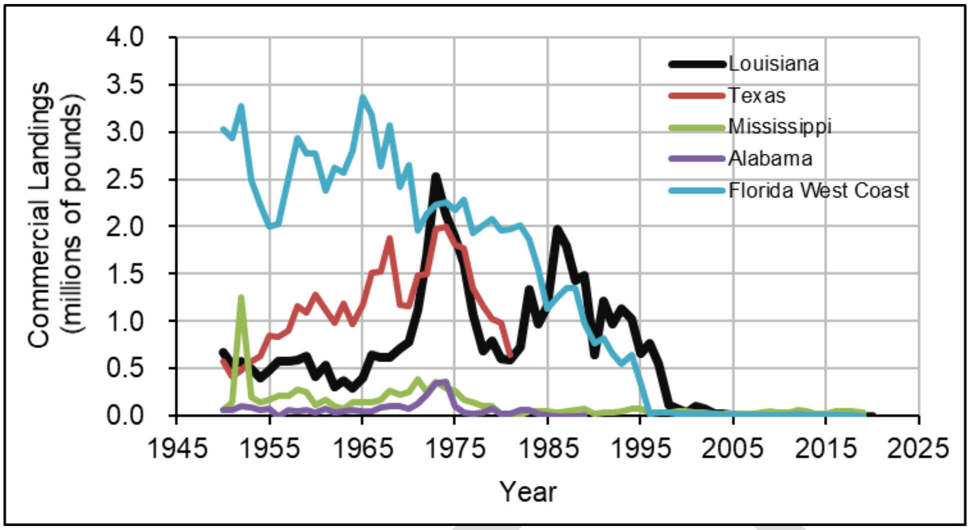


Figure 1: Reported commercial spotted seatrout landings of the Gulf of Mexico derived from NMFS statistical records and the LDWF Trip Ticket Program.

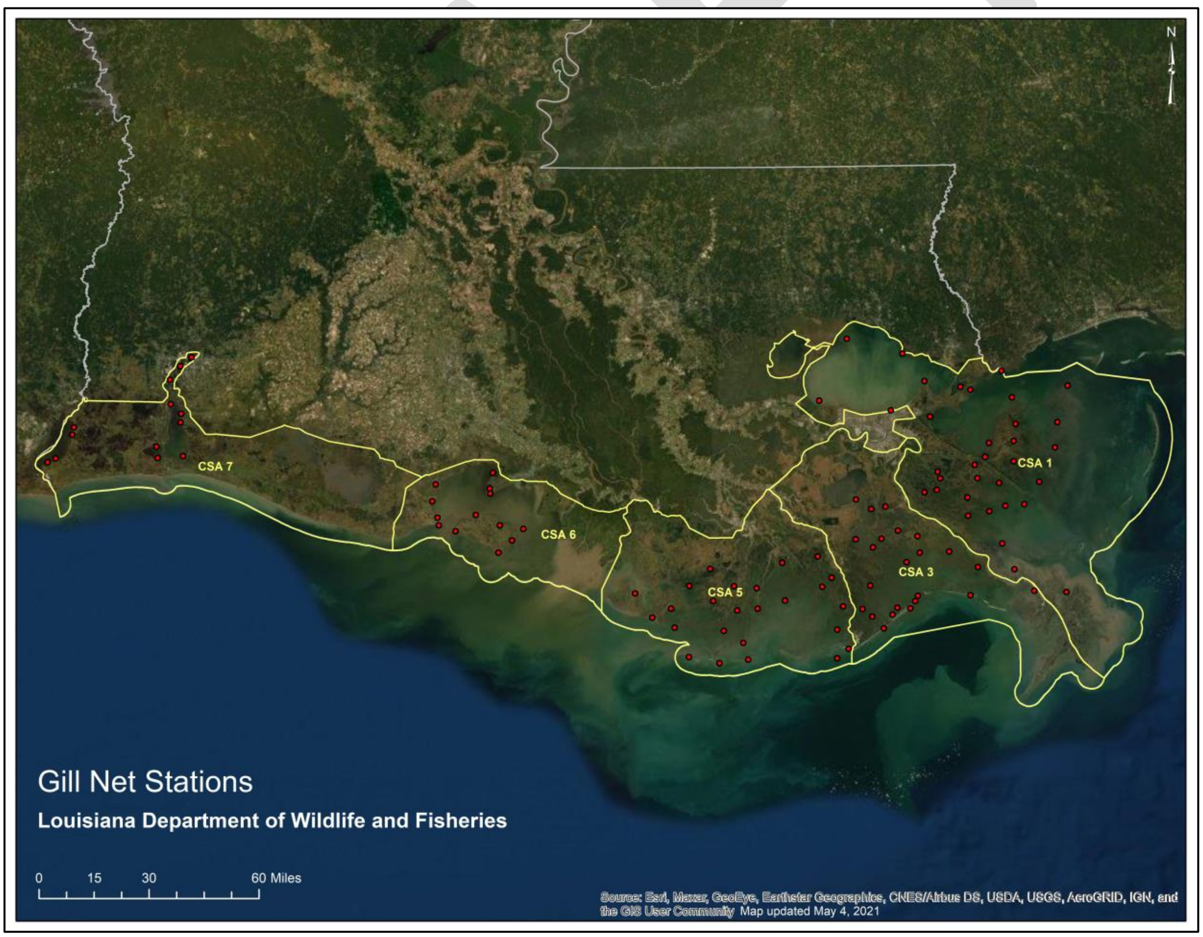


Figure 2: Station locations of the LDWF marine experimental gillnet survey. Yellow lines delineate LDWF Coastal Study Areas and state/federal waters.

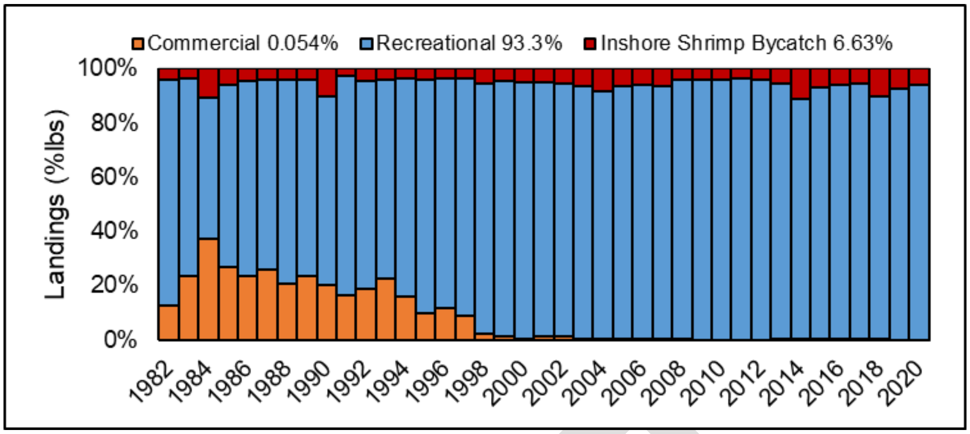


Figure 3: Comparison of LA spotted seatrout commercial and recreational landings, and LA inshore shrimp fishery spotted seatrout bycatch estimates from 1982-2020. Values in legends represent the mean landings percentages from each fishery in the most recent decade (2011-2020).

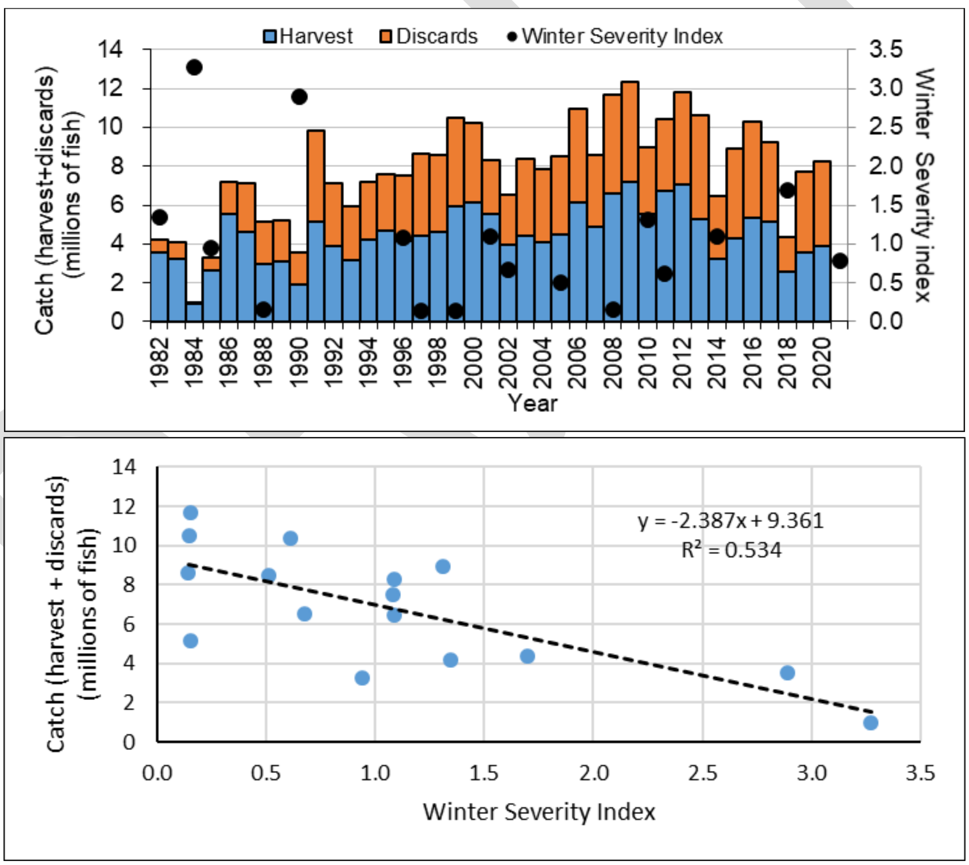


Figure 4: Louisiana recreational spotted seatrout total catch (harvest + discards, 1982-2020) and winter severity index values (1982-2021; top graphic) and the relationship between total recreational catch and winter severity index values in the years with winter severity index values >0 (bottom graphic). The linear regression of total catch on winter severity index values in the bottom graphic explains 53% of the annual variability in total recreational catch.

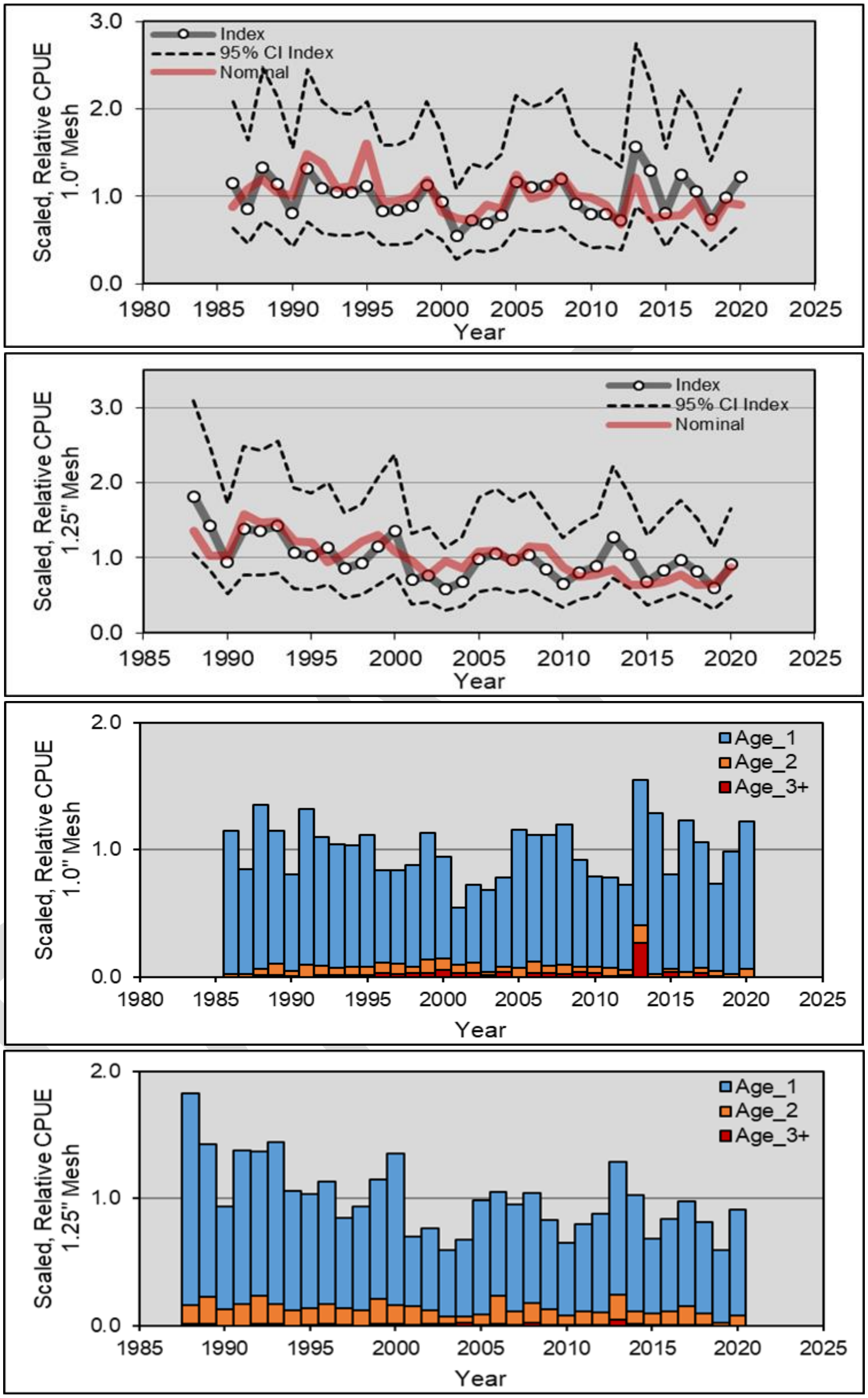


Figure 5: Standardized indices of abundance, nominal catch-per-unit-effort, and 95% confidence intervals of the standardized indices derived from the 1.0-inch and 1.25-inch meshes of the LDWF experimental marine gillnet survey (top graphics). Bottom graphics depicts the standardized indices of abundance by age-class. Each time-series has been normalized to its individual long-term mean.

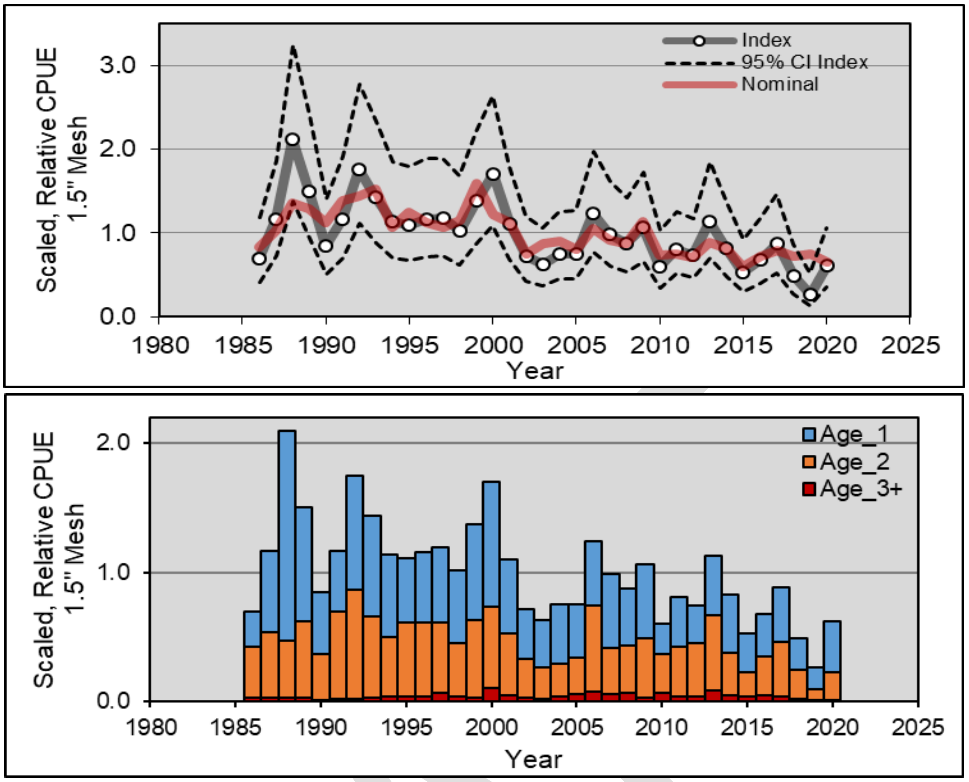


Figure 5 (continued): Standardized index of abundance, nominal catch-per-unit-effort, and 95% confidence intervals of the standardized index derived from the 1.5-inch mesh of the LDWF experimental marine gillnet survey (top graphics). Bottom graphic depicts the standardized index of abundance by age-class. Each time-series has been normalized to its individual long-term mean.

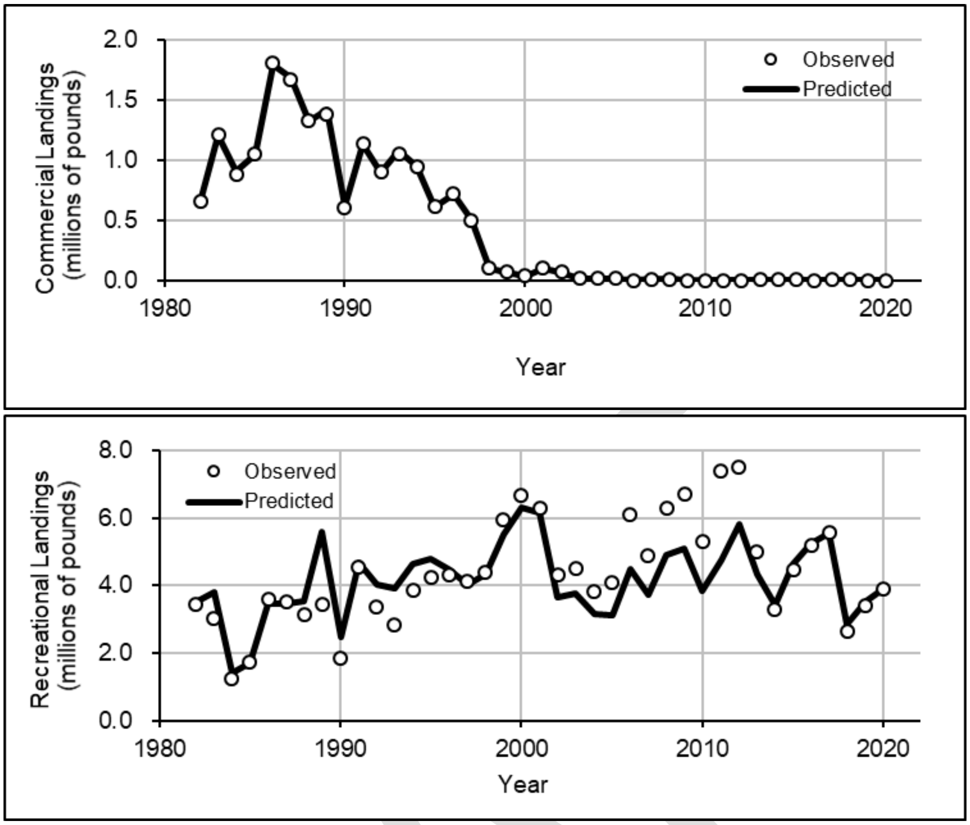


Figure 6: Observed and ASAP base model estimated commercial and recreational yield (females only).

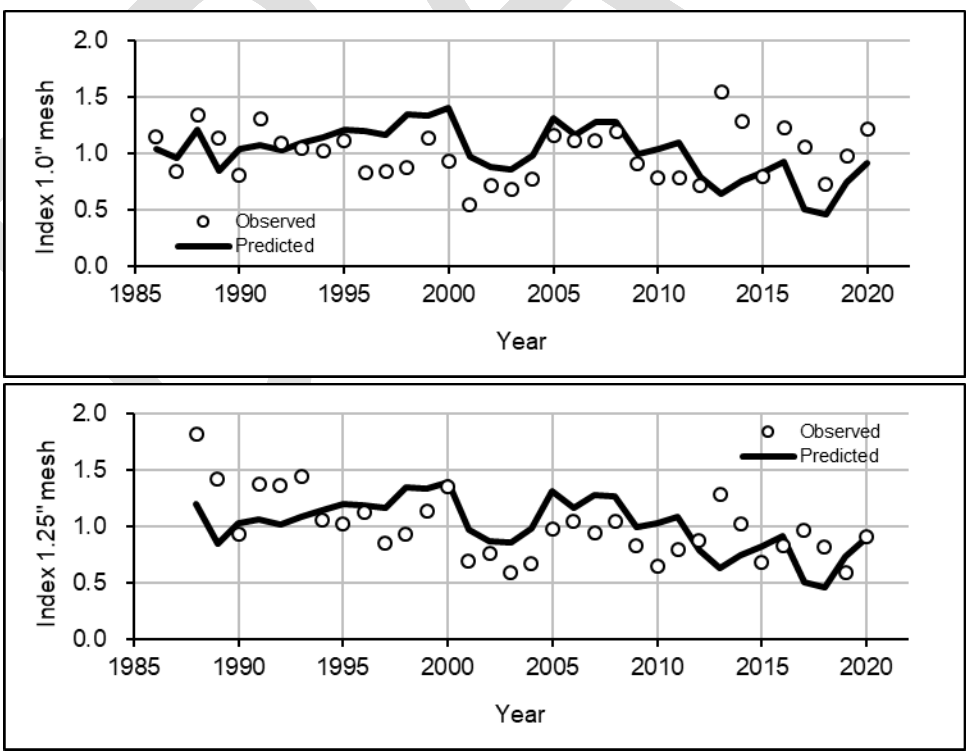


Figure 7: Observed and ASAP base model estimated survey indices of abundance (females only).

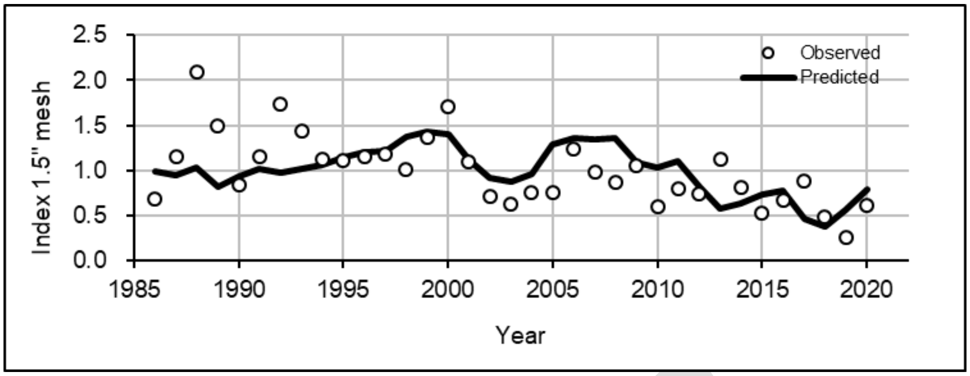


Table 7 (continued):

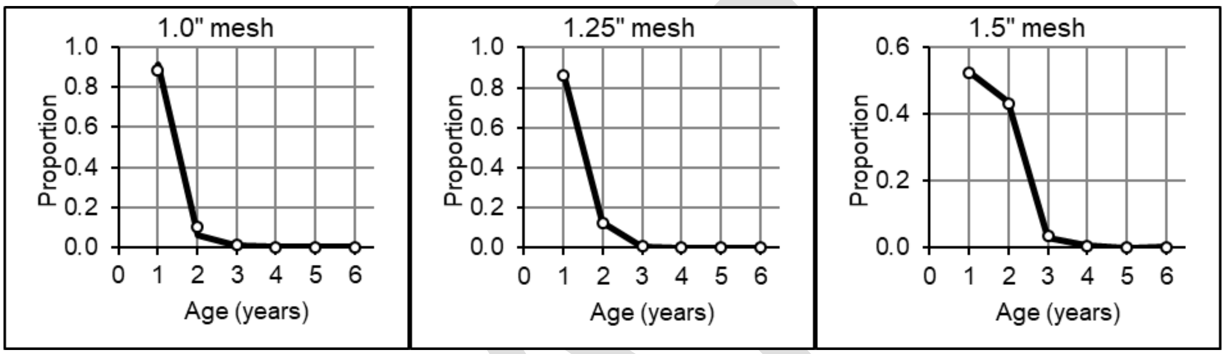


Figure 8: Overall (average) input (open circles) and ASAP estimated (bold lines) age compositions of experimental gillnet survey catches.

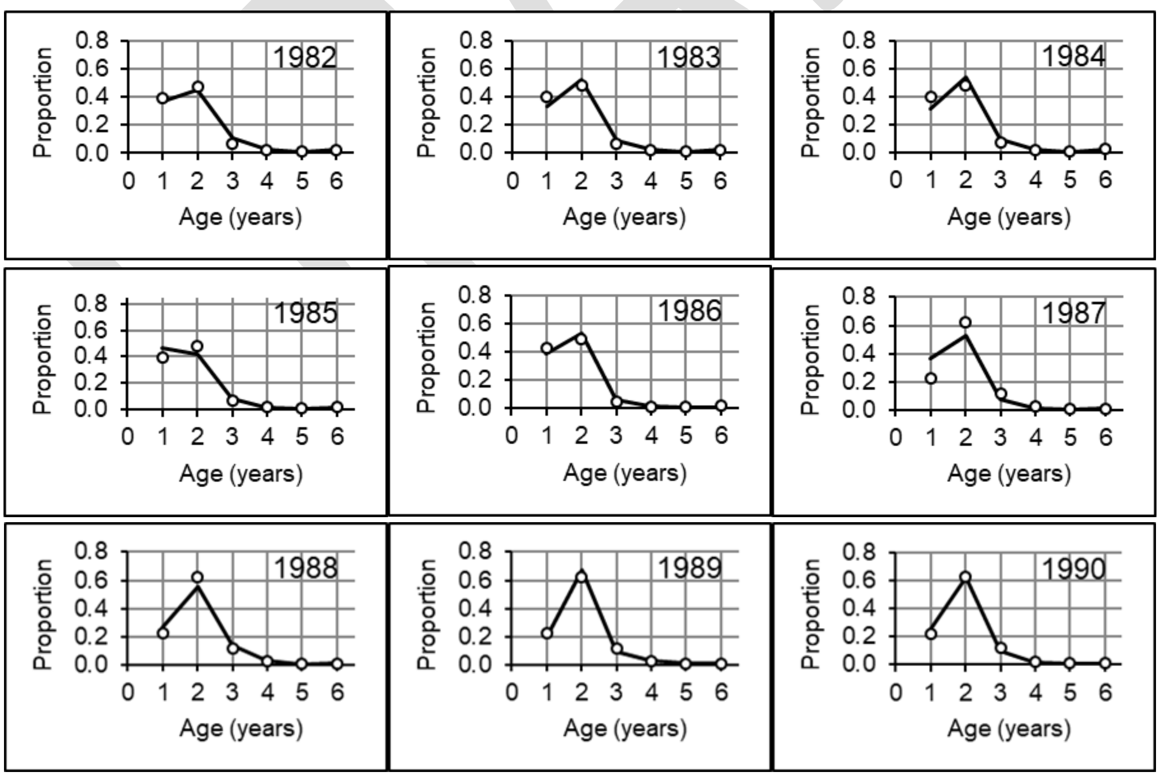


Figure 9: Annual input (open circles) and ASAP estimated (bold lines) commercial harvest age compositions.

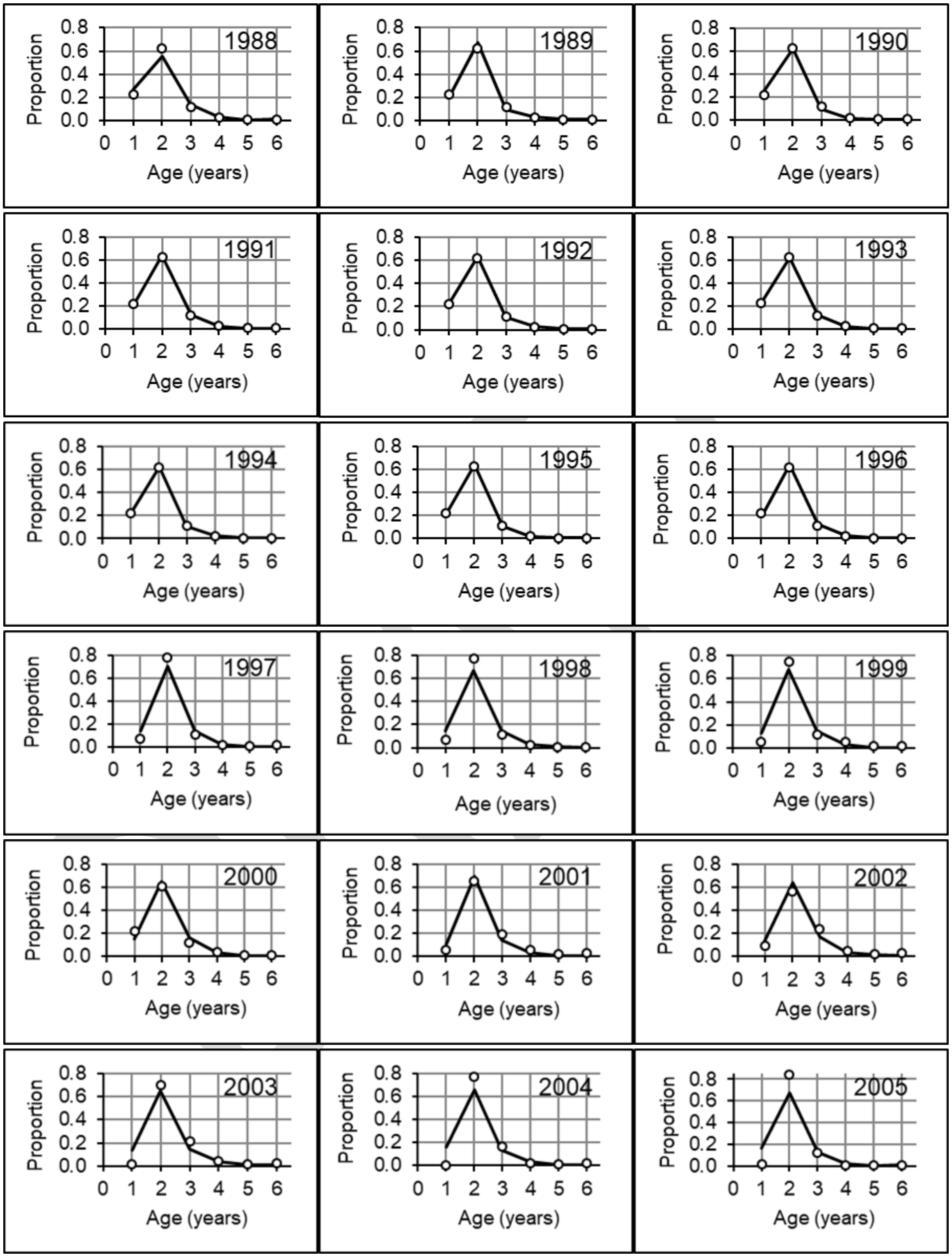


Figure 9 (continued):

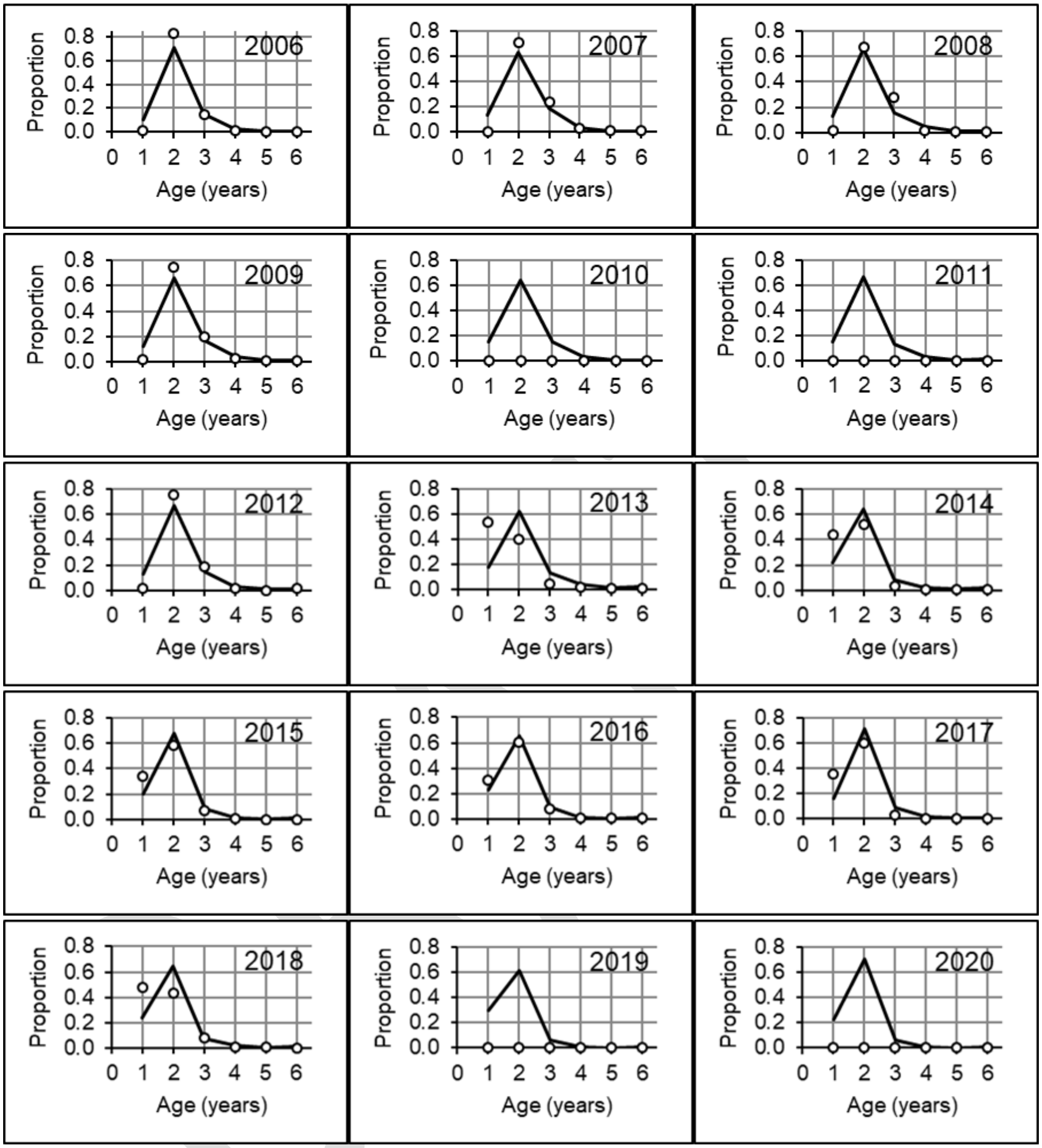


Figure 9 (continued):

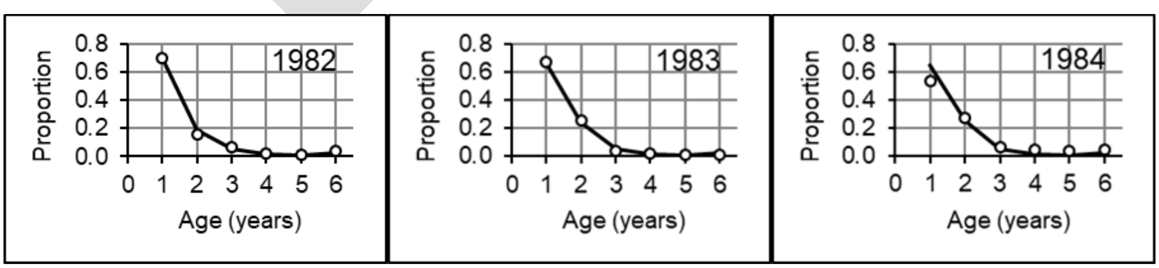


Figure 10: Annual input (open circles) and ASAP estimated (bold lines) recreational harvest age compositions.

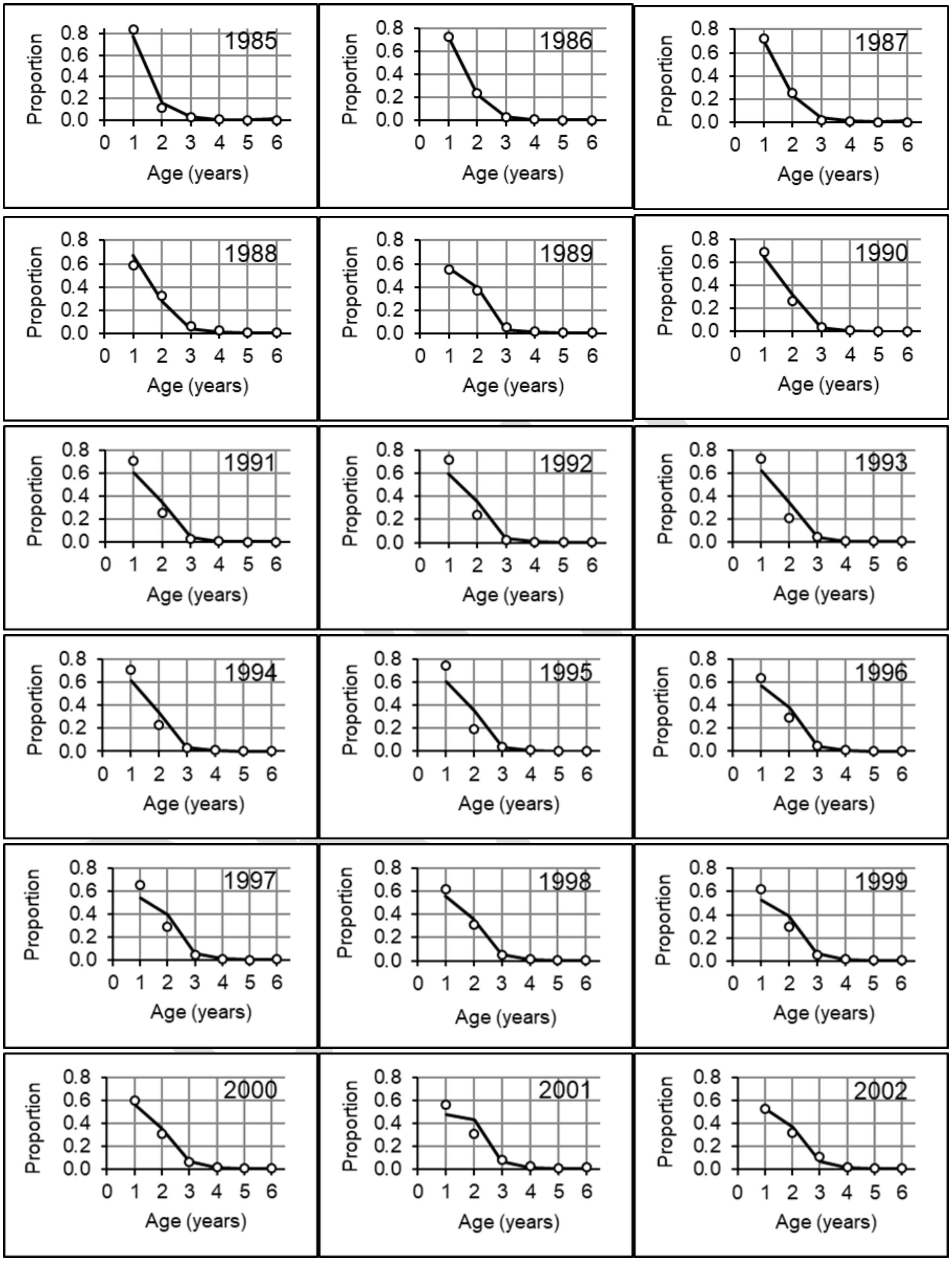


Figure 10 (continued):

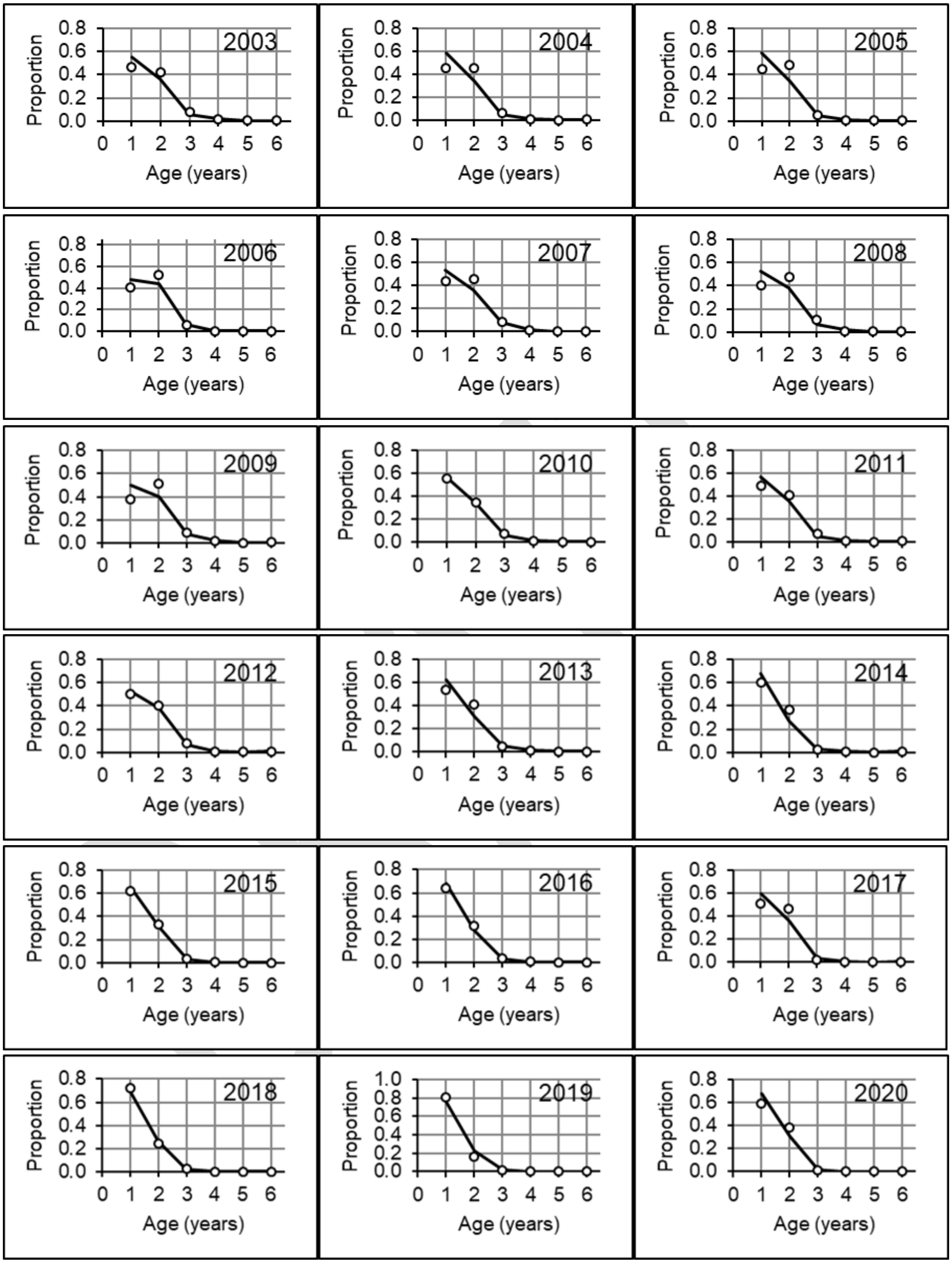


Figure 10 (continued):

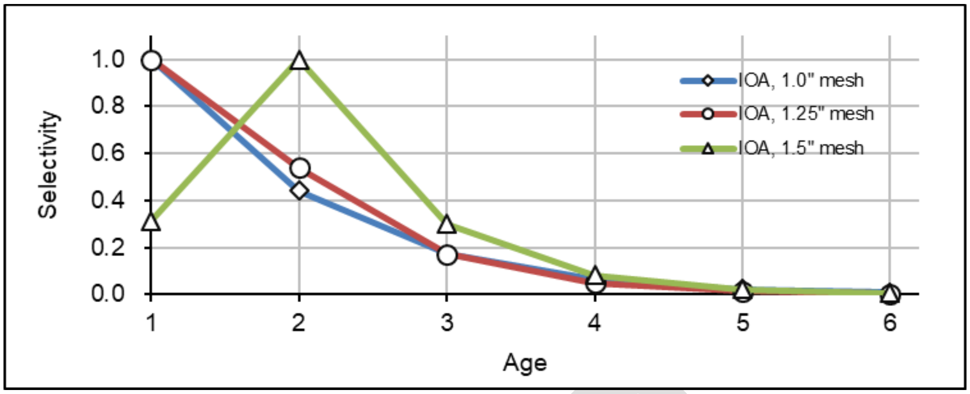


Figure 11: ASAP base model estimated survey selectivities (females only).

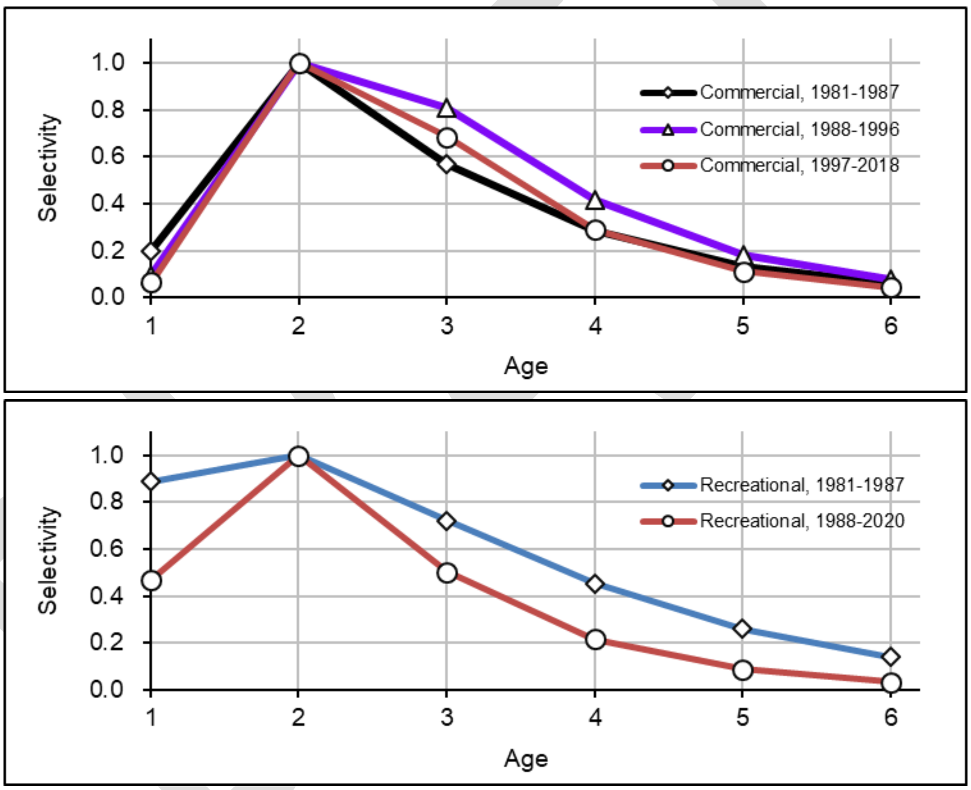
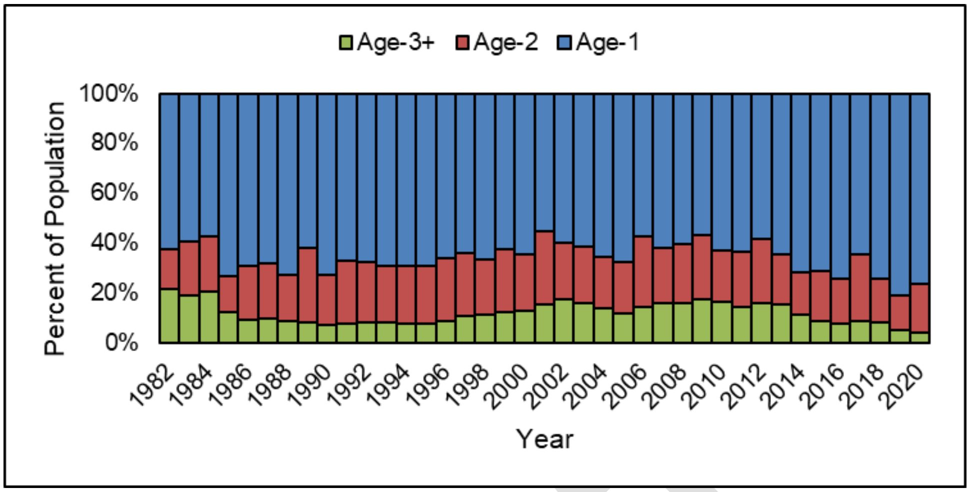


Figure 12: ASAP base model estimated fishery selectivities (females only).



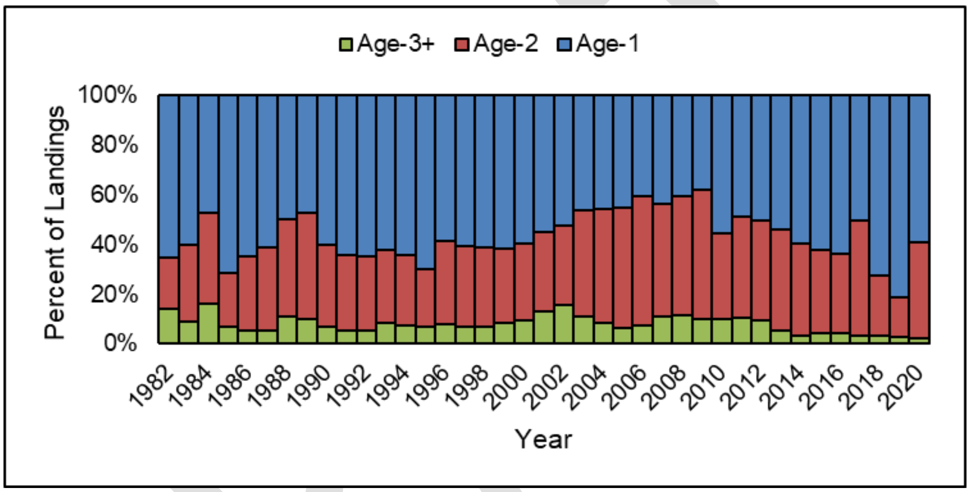


Figure 13: Age composition of the ASAP base model estimated female stock (top graphic) and the age composition of observed female landings (bottom graphic).

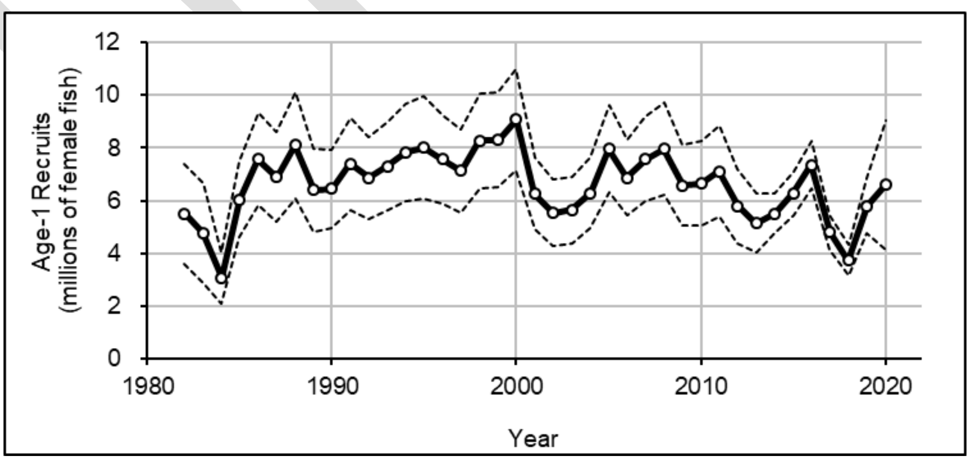


Figure 14: ASAP base model estimated recruitment (age-1 females). Dashed lines represent ±2 asymptotic standard errors.

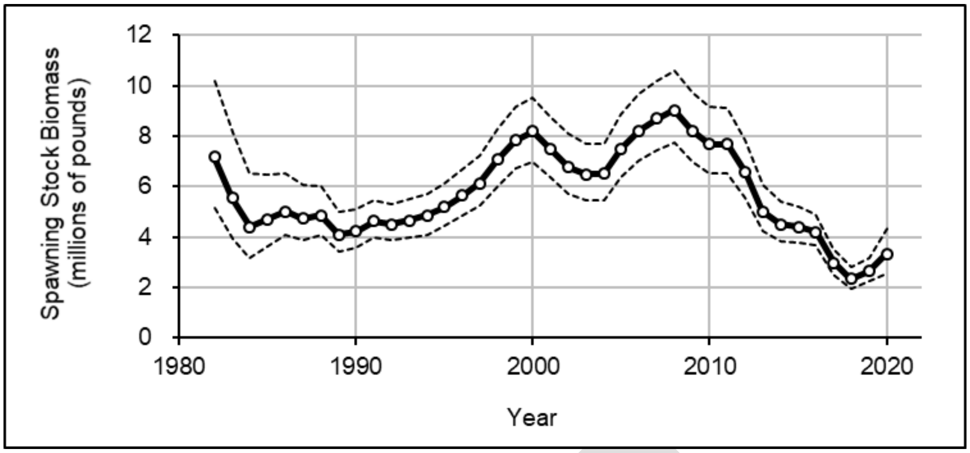


Figure 15: ASAP base model estimated female spawning stock biomass (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

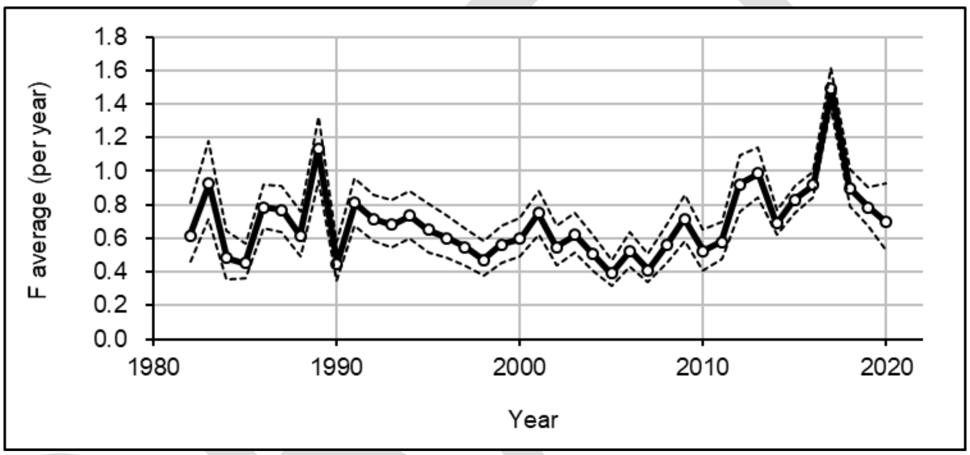


Figure 16: ASAP base model estimated average fishing mortality (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

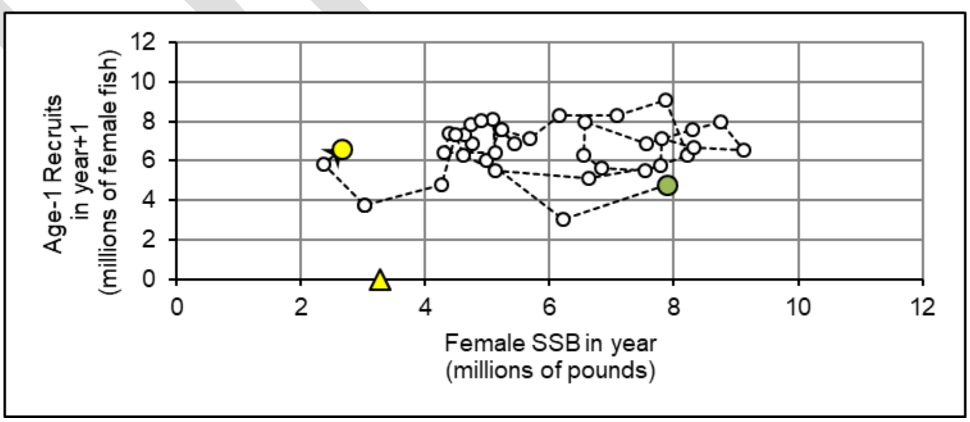


Figure 17: ASAP base model estimated age-1 recruits and female spawning stock biomass. Arrow represents direction of the time-series. The yellow circle represents the most current data pair (2020 age-1 recruits / 2019 female SSB) and the yellow triangle represents the 2020 SSB estimate. The green circle represents the first data pair (1983 age-1 recruits / 1982 female SSB).

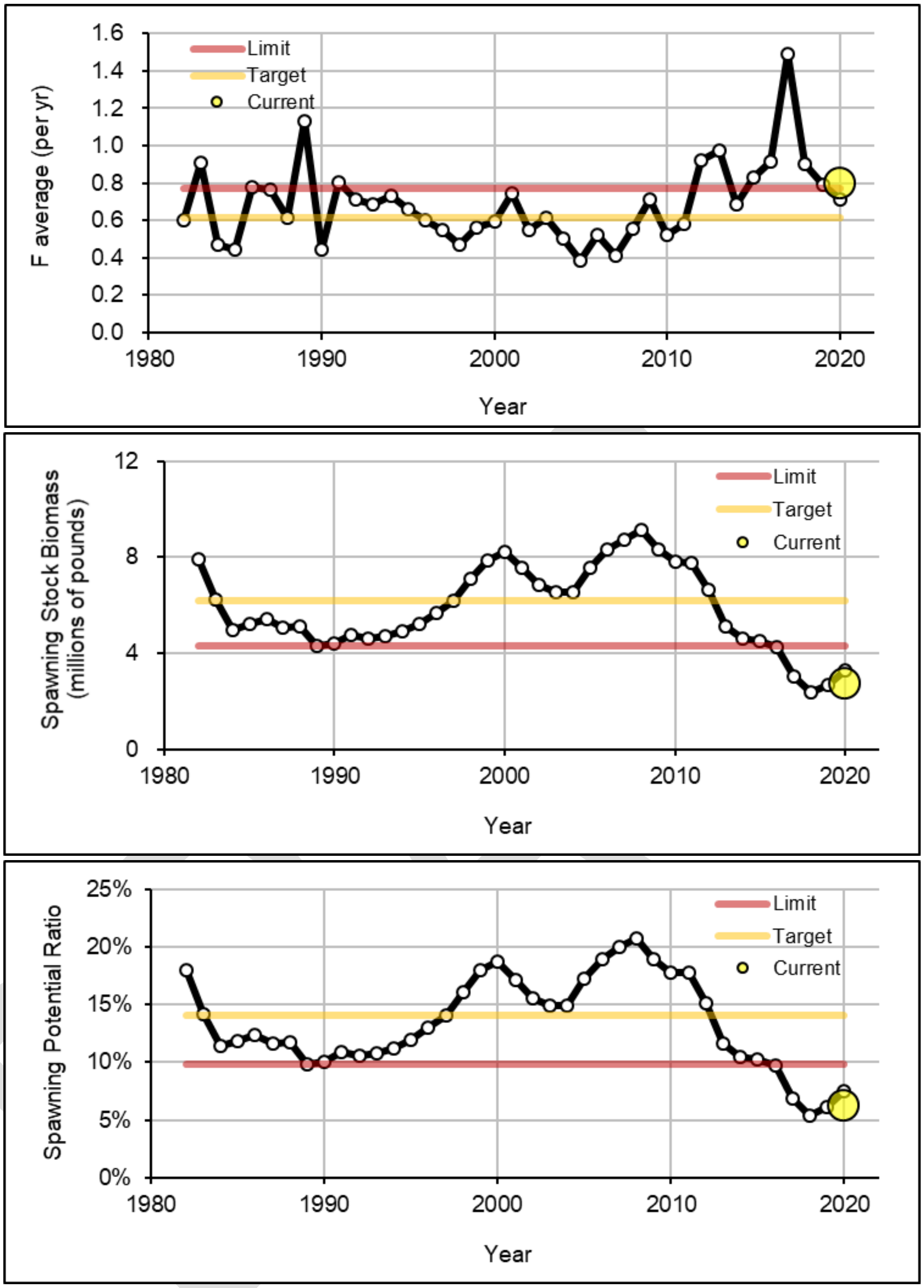


Figure 18: Time-series of ASAP base model estimated average fishing mortality rates, female spawning stock biomass, and spawning potential ratios relative to proposed limit and target reference points. Current values represent the geometric mean of the 2018-2020 estimates.

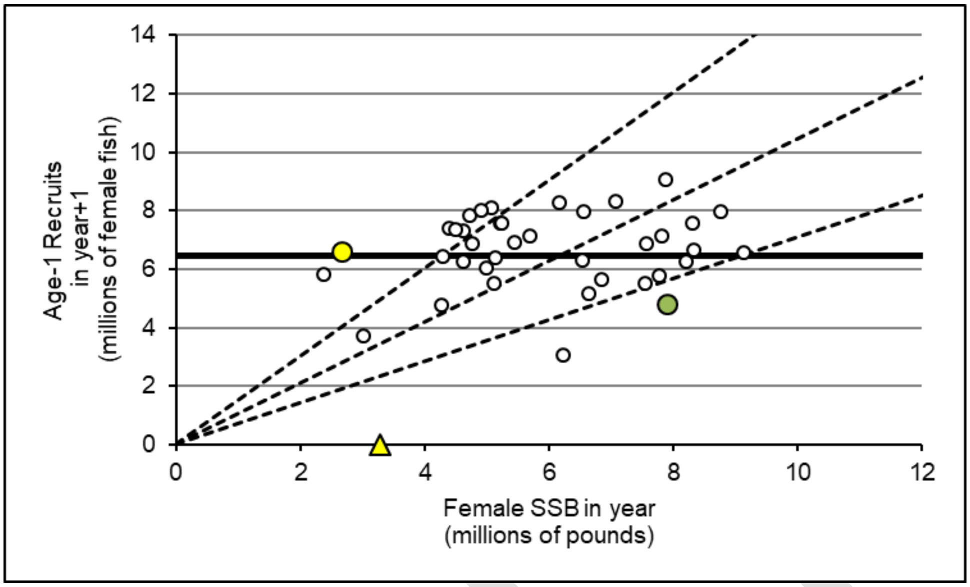


Figure 19: ASAP base model estimated age-1 recruits and female spawning stock biomass (open circles). Equilibrium recruitment is represented by the bold horizontal. The yellow circle represents the most current data pair (2020 age-1 recruits / 2019 female SSB) and the yellow triangle represents the 2020 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}=9.8%SPR; SSB_{target}=14.1%; max. SSB=20.8%SPR).

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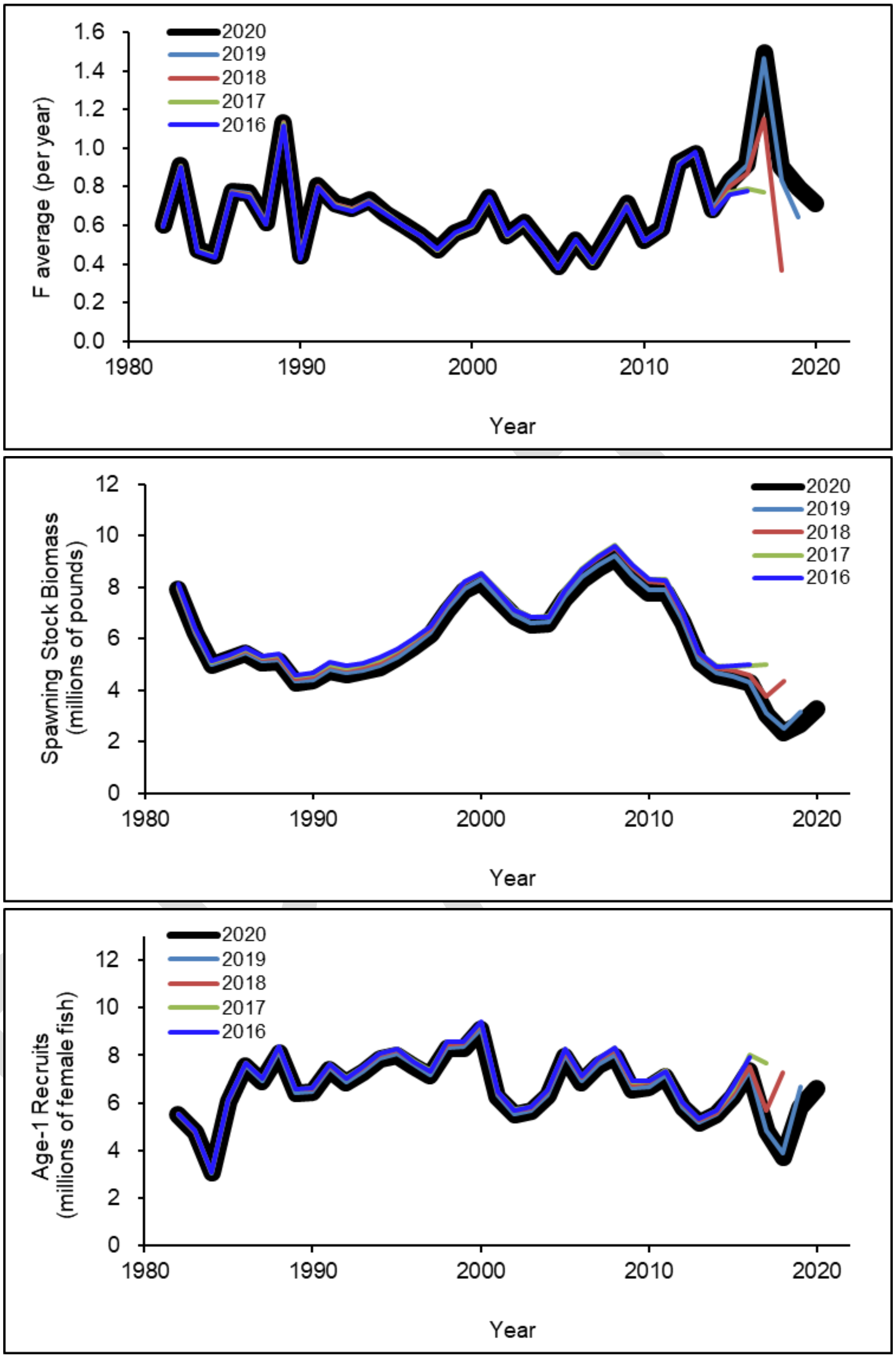

Figure 20: Retrospective analysis of ASAP base model. Top graphics depict annual average fishing mortality and female spawning stock biomass estimates. Bottom graphic depicts estimated age-1 female recruits.

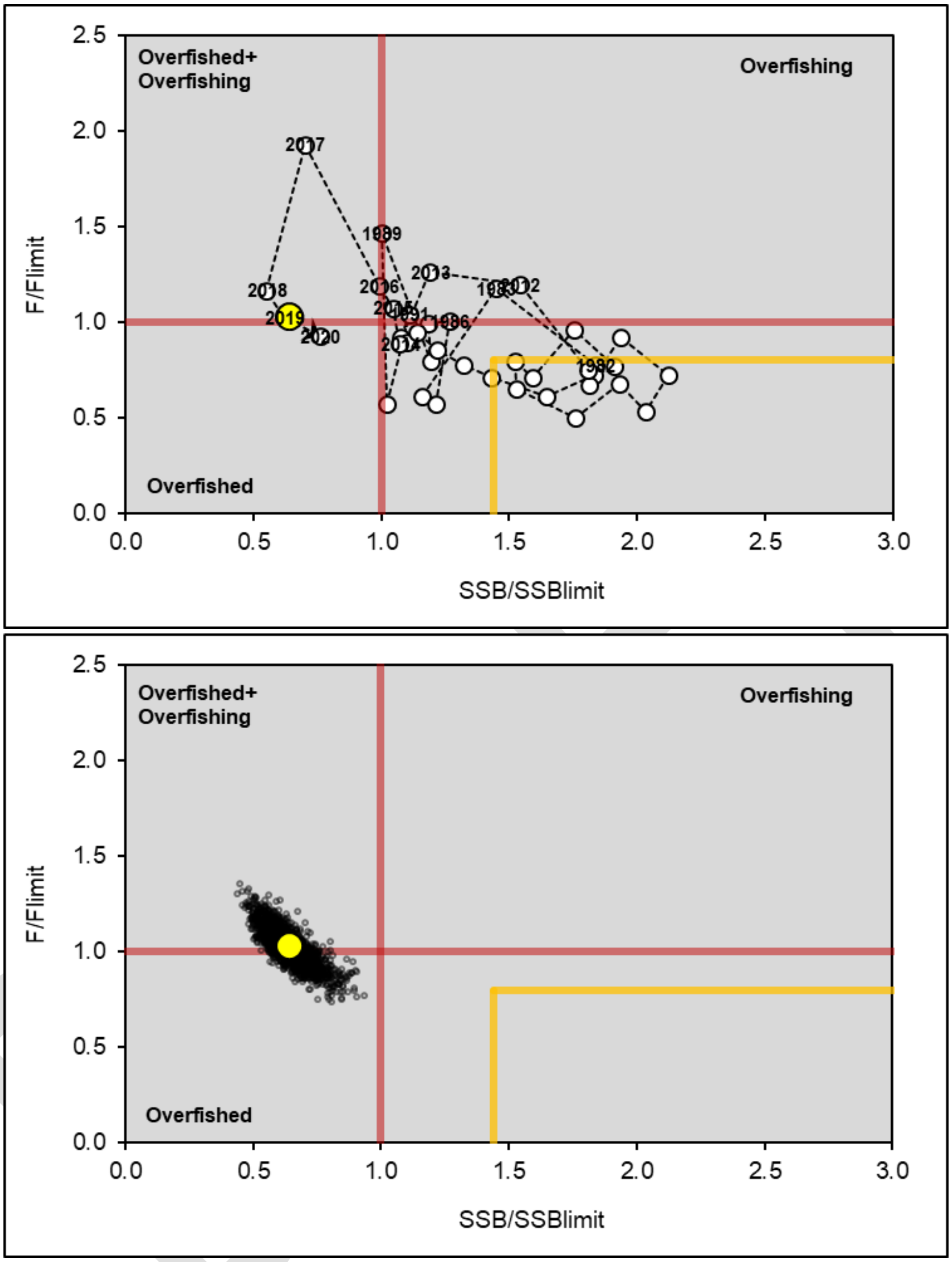

Figure 21: ASAP base model estimated ratios of annual average fishing mortality rates and female spawning stock biomass to the proposed limit reference points (F_{limit} and SSB_{limit}). Also presented are the proposed target reference points (yellow lines). Arrow represents direction of time-series. 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 2018-2020). 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

Joe West and Xinan Zhang
Office of Fisheries
Louisiana Department of Wildlife and Fisheries
Updated 10/29/2020

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

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

optimal, it does allow comparison of effort over additional years.

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	760,757	0.187
P	2	229,436	608,036	0.377
P	3	425,433	908,285	0.468
P	4	349,345	1,075,253	0.325
P	5	284,077	935,917	0.304
P	6	277,228	806,998	0.344
SH	1	50,377	753,943	0.067
SH	2	80,580	642,766	0.125
SH	3	151,142	897,938	0.168
SH	4	73,203	1,095,251	0.067
SH	5	105,286	1,228,032	0.086
SH	6	64,342	950,532	0.068

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

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

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	422,174	33.0	3,046,664	12.0	921,357	20.0	511,387	34.3	188,413	39.4	497,263	19.5	190,627	25.9	9,160,786	16.2	3,146,198	22.6
1983	1,659,509	34.3	610,662	39.0	4,758,470	32.7	1,605,600	40.4	1,064,824	38.1	346,803	43.1	1,929,817	51.4	594,965	59.9	7,402,179	20.0	2,710,035	27.4
1984	362,104	26.0	137,134	32.9	2,976,458	38.9	983,477	41.9	548,364	47.5	174,784	39.8	213,064	23.0	72,613	29.7	2,503,426	29.8	807,030	34.7
1985	356,406	30.0	111,625	33.3	2,563,074	14.5	859,464	20.3	340,142	32.1	117,102	34.8	431,284	24.5	153,297	29.0	5,947,072	15.2	2,157,908	23.9
1986	918,541	24.1	310,194	28.1	2,635,843	10.0	855,348	17.9	252,644	15.5	85,391	21.7	1,464,132	48.5	500,797	49.1	14,077,720	7.8	5,037,007	16.1
1987	683,049	25.6	227,818	31.7	2,602,974	23.0	885,506	29.4	270,702	33.7	86,011	33.5	147,601	25.2	51,262	28.5	11,023,715	10.1	4,044,859	17.9
1988	344,681	15.4	117,966	20.7	1,160,955	20.2	351,623	22.6	277,793	21.3	92,972	25.8	358,099	13.2	123,938	18.5	6,890,452	14.3	2,445,984	20.4
1989	227,336	20.4	76,687	24.4	2,015,801	12.6	687,964	21.3	789,892	49.3	250,017	49.1	341,489	25.9	109,591	28.7	8,082,318	11.9	2,714,014	17.3
1990	231,168	22.9	80,781	26.4	1,469,547	16.8	477,778	22.0	270,726	27.1	102,078	30.5	805,964	23.6	271,576	27.4	4,881,711	13.7	1,677,370	19.8
1991	183,005	19.4	62,124	24.1	1,824,768	20.0	597,343	28.0	402,935	32.6	141,868	35.1	694,466	16.1	242,476	20.3	13,468,560	9.9	4,784,368	16.8
1992	333,217	23.9	116,216	27.5	2,807,145	8.7	926,924	15.4	563,816	25.3	178,285	27.1	615,928	14.6	218,119	18.7	10,680,755	9.3	3,608,794	16.9
1993	246,588	17.6	89,348	23.4	2,581,130	9.9	868,002	16.6	885,380	26.7	306,149	33.0	500,023	14.8	172,917	19.0	7,757,436	12.1	2,638,017	18.0
1994	234,272	16.9	80,413	23.5	2,311,786	9.5	770,586	15.8	508,883	17.8	172,554	23.1	578,264	21.0	211,204	25.3	10,418,883	10.5	3,491,233	17.0
1995	335,507	18.4	109,171	21.7	3,842,177	8.7	1,281,488	17.2	920,809	20.4	272,993	23.5	398,528	14.0	144,829	21.1	12,135,672	13.2	4,042,945	22.9
1996	414,798	12.9	136,121	18.6	3,197,497	9.0	1,088,408	15.6	760,607	21.7	248,066	27.2	416,737	11.4	147,144	16.9	10,306,475	11.3	3,538,044	17.9
1997	477,705	16.1	156,723	19.9	2,861,918	9.6	982,355	16.2	1,005,406	18.2	308,997	20.7	445,579	11.7	157,583	17.8	10,415,118	11.9	3,628,093	17.9
1998	920,933	14.6	306,943	20.2	2,762,600	8.0	943,728	15.0	1,138,280	15.6	360,910	21.7	393,018	13.8	147,920	19.9	10,005,379	8.7	3,642,009	17.6
1999	681,905	11.9	233,143	17.5	3,459,681	6.9	1,193,797	14.2	793,093	16.2	245,601	22.1	758,946	10.4	266,165	16.0	14,037,235	8.5	4,711,633	15.7
2000	1,017,717	12.8	346,026	17.7	4,249,272	6.9	1,462,416	14.3	769,653	28.0	250,138	32.0	670,295	13.3	239,347	18.6	15,977,551	7.7	5,316,672	16.1
2001	765,815	13.7	255,378	18.9	4,322,843	7.7	1,429,691	14.1	567,945	15.8	193,752	20.5	427,914	12.2	156,040	18.3	12,618,114	8.0	4,299,637	14.9
2002	908,616	12.6	311,241	18.7	3,445,574	8.2	1,156,118	14.6	1,249,437	18.7	412,469	26.6	443,758	18.8	172,816	26.5	9,816,916	10.3	3,471,004	16.7
2003	659,209	14.7	223,268	20.0	2,977,090	7.4	1,006,043	14.9	1,257,175	23.2	386,996	26.1	647,034	15.7	247,872	22.9	10,528,223	9.6	3,722,763	17.5
2004	546,776	12.0	180,874	17.0	2,605,118	8.1	887,098	14.8	1,722,589	24.9	554,019	30.5	408,006	12.6	149,051	18.1	9,728,915	10.5	3,369,942	17.4
2005	461,775	13.0	155,544	18.9	2,236,920	9.4	769,288	15.5	962,130	23.6	301,610	26.7	286,521	12.9	107,932	19.5	10,699,116	8.5	3,636,945	15.9
2006	354,910	14.3	114,788	18.6	2,385,907	10.7	805,677	15.9	430,504	25.3	121,203	28.8	285,429	11.9	96,047	16.6	13,779,620	8.7	5,041,323	16.9
2007	415,104	15.7	140,658	18.9	3,049,990	8.3	1,033,903	14.7	320,952	21.9	94,883	22.0	355,606	19.0	125,321	23.1	11,790,003	8.3	3,996,827	15.8
2008	668,820	12.8	223,760	19.0	3,336,041	7.9	1,138,176	14.5	623,988	17.6	205,956	24.0	239,893	10.9	85,657	16.7	15,551,638	9.5	5,406,002	17.2
2009	908,297	13.6	306,083	18.4	3,414,547	8.2	1,181,030	15.3	1,055,358	22.6	294,230	26.8	398,573	14.6	138,485	19.0	15,667,348	8.8	5,486,627	16.4
2010	697,188	14.5	231,978	18.5	5,128,842	8.0	1,770,689	14.5	753,414	22.4	253,947	26.8	571,870	14.4	214,835	20.6	14,465,717	10.7	5,109,130	20.0
2011	679,614	15.1	229,698	19.5	4,548,266	8.3	1,572,134	15.1	1,425,042	35.5	484,582	42.3	544,173	14.7	199,173	19.5	17,697,003	9.6	6,056,375	16.8
2012	694,257	12.8	239,881	19.1	3,458,029	8.8	1,205,064	16.3	577,843	16.7	173,799	20.6	524,259	14.8	186,030	19.6	17,938,248	8.9	6,291,503	18.2
2013	528,084	14.3	170,664	20.1	4,523,043	8.7	1,495,702	15.3	311,155	16.9	93,968	20.4	930,394	13.1	323,565	21.0	12,928,606	9.4	4,379,022	16.6

FM = Shore

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	880,444	22.8	105,131	42.4	2,388,907	23.1	274,159	38.6	676,628	29.0	62,101	32.8	834,940	21.4	95,797	40.1	2,787,818	23.5	281,415	36.0
1983	500,922	29.9	58,639	38.2	1,351,640	25.0	115,437	35.1	2,326,172	25.9	262,151	40.7	327,205	34.7	28,920	38.1	2,927,094	47.2	245,487	47.3
1984	536,866	34.1	47,392	47.4	660,866	35.0	54,017	35.4	987,229	41.9	80,659	41.6	112,657	45.9	9,158	48.8	331,308	40.5	29,935	42.2
1985	181,986	27.0	15,182	33.5	618,693	30.8	44,043	36.4	656,976	30.2	48,274	39.6	284,046	29.1	21,773	35.3	500,629	27.9	40,577	34.6
1986	469,638	52.0	36,857	49.3	243,647	45.9	17,936	49.4	782,112	81.2	54,471	79.8	189,325	42.5	16,675	48.5	1,815,727	55.4	135,153	52.9
1987	260,971	52.0	24,154	52.0	665,407	54.3	47,110	56.1	65,880	46.2	4,511	55.2	185,090	37.3	13,993	39.7	965,130	44.3	107,313	59.3
1988	429,974	36.6	44,760	47.2	237,418	45.6	16,866	48.4	662,260	57.5	53,517	54.6	90,283	40.5	7,779	40.9	398,803	39.6	39,377	48.7
1989	484,955	58.2	43,202	67.8	472,062	35.4	42,270	44.0	179,471	40.2	15,201	44.3	127,388	33.6	11,241	39.5	402,794	68.4	28,735	67.9
1990	122,352	47.4	15,053	64.0	627,617	29.6	51,503	40.2	80,673	46.7	7,133	53.2	238,834	24.9	20,903	33.4	1,178,966	28.6	114,639	44.3
1991	80,287	38.8	7,218	45.5	497,827	35.7	36,833	41.6	109,726	43.1	7,730	46.2	617,776	26.6	64,608	38.5	1,611,329	29.8	181,444	48.6
1992	266,722	39.0	22,670	43.9	535,731	21.7	54,124	31.7	1,470,811	61.9	102,204	66.6	197,948	31.2	16,495	33.6	1,622,752	18.8	151,030	26.5
1993	332,409	38.4	30,470	47.2	1,058,829	26.2	95,426	32.6	438,233	37.3	32,297	40.7	152,286	34.8	14,130	36.6	1,262,891	19.3	133,129	31.7
1994	111,090	26.4	11,042	37.0	973,065	30.5	79,607	36.6	339,821	55.8	25,980	51.8	245,182	26.2	24,551	30.8	2,585,733	32.7	212,925	35.3
1995	122,762	40.4	10,232	37.8	747,219	23.9	57,820	33.9	338,135	43.2	31,308	40.9	56,558	30.7	5,633	40.1	1,432,447	21.4	134,570	30.5
1996	529,054	58.3	39,338	55.7	864,227	22.6	79,139	28.0	682,583	41.1	50,882	43.8	134,402	31.1	13,588	42.7	2,327,551	27.4	260,453	42.7
1997	123,564	39.8	13,754	56.7	347,632	21.5	31,628	29.5	283,171	25.4	26,246	33.0	307,330	23.1	29,895	35.4	1,905,584	21.5	186,083	32.5
1998	86,575	34.3	11,317	53.9	397,083	31.2	36,709	34.9	450,254	36.2	32,677	41.5	128,645	26.4	14,741	40.5	2,415,887	30.1	303,726	52.7
1999	385,329	39.6	31,947	45.0	492,350	25.7	54,909	38.8	202,445	35.8	16,600	36.7	641,276	32.9	54,674	38.0	3,530,688	27.9	288,942	35.4
2000	625,217	26.3	51,753	31.9	822,698	21.3	69,669	26.6	202,744	52.7	17,790	51.6	136,953	43.0	12,753	44.5	2,697,901	36.0	222,046	40.3
2001	675,474	30.1	69,123	38.6	621,324	23.2	53,291	31.1	399,908	49.4	43,424	54.5	305,296	67.4	37,260	72.2	2,657,545	28.5	269,017	35.7
2002	399,178	23.6	36,575	30.2	945,520	31.8	80,339	37.4	872,663	35.4	72,526	43.6	323,826	31.2	33,693	40.6	923,988	31.5	99,269	39.8
2003	288,546	23.4	27,192	30.4	280,366	33.2	24,715	34.7	983,844	36.8	102,183	38.4	199,400	38.3	16,524	38.0	945,730	42.3	67,249	45.2
2004	137,240	36.0	12,726	38.9	559,991	19.0	50,246	28.0	603,693	36.9	46,089	43.2	395,552	36.1	38,056	47.6	1,303,971	45.1	178,356	62.5
2005	138,758	28.0	12,505	38.3	704,981	30.9	53,900	41.0	563,322	29.6	48,230	38.5	450,207	38.7	33,234	52.7	632,798	30.7	51,805	37.7
2006	261,544	30.8	23,555	40.8	389,280	25.4	32,980	36.4	593,305	31.2	42,006	38.8	335,766	29.1	32,038	32.6	788,193	22.7	71,014	31.4
2007	286,213	35.5	26,082	38.6	187,726	25.1	16,635	36.1	257,091	36.2	25,721	43.8	348,752	28.0	36,807	37.0	771,812	27.5	79,384	35.9
2008	247,234	25.5	20,967	34.3	374,463	27.9	28,401	32.9	1,396,084	30.3	106,247	36.9	260,865	36.4	22,101	34.7	1,140,758	33.3	125,464	47.3
2009	100,842	26.9	9,449	34.4	123,122	28.0	11,253	34.3	523,105	46.9	57,138	57.2	470,681	44.6	37,214	45.7	611,298	25.2	58,398	33.3
2010	184,668	41.2	15,662	42.7	531,708	32.4	47,942	35.0	561,648	40.1	42,755	40.8	94,348	29.4	8,368	33.9	584,064	43.3	42,629	45.1
2011	380,669	21.7	34,092	28.5	983,461	22.1	91,170	28.1	1,318,064	44.8	114,952	55.5	430,717	40.0	37,441	40.4	651,281	27.8	64,311	37.5
2012	283,508	22.6	24,574	32.7	279,299	36.1	21,571	40.0	695,553	42.6	50,298	45.6	155,170	30.6	14,154	34.0	727,577	29.5	76,733	39.3
2013	471,823	13.0	34,758	29.7	849,762	9.3	74,732	28.1	659,450	12.4	45,522	36.7	573,922	18.3	47,486	33.0	2,682,372	11.4	228,143	24.3

Appendix

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:

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

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:

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

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

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

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:

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

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

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

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

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

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	342,393	62.2	274,870	40.0	98,227	42.3	515,459	44.8	204,110	48.5	1,083,668	45.5	421,148	51.2	1,654,868	35.7	594,062	39.0
1983	671,251	47.1	221,158	50.2	793,805	34.3	276,867	39.3	833,079	71.7	283,429	76.2	145,644	54.4	50,016	55.2	2,092,864	42.4	785,069	46.9
1984	284,254	68.2	95,815	67.1	346,317	56.3	115,622	57.6	309,986	35.6	95,232	44.2	65,411	64.9	20,866	65.9	197,040	21.8	65,344	29.3
1985	291,106	38.5	96,316	41.4	243,413	40.1	94,362	47.4	317,951	28.8	111,945	33.6	61,785	68.0	21,053	66.7	1,709,137	23.1	602,297	28.0
1986	448,236	20.4	147,784	25.7	451,777	15.3	165,090	21.0	393,569	19.8	127,576	25.2	367,830	40.1	163,383	47.5	4,745,760	10.2	1,657,453	17.8
1987	300,153	41.9	93,818	46.4	2,360,122	24.5	767,630	32.3	210,127	21.2	72,374	25.9	10,809	42.4	4,030	45.8	6,980,249	12.7	2,392,248	20.4
1988	350,541	21.1	121,213	26.8	3,062,822	16.2	1,010,477	21.1	398,058	25.6	130,073	30.3	375,399	58.9	118,042	59.6	5,610,284	10.4	2,046,380	17.6
1989	228,012	35.0	73,311	38.8	2,998,273	20.9	1,009,167	28.0	483,464	37.6	167,906	42.3	260,401	93.8	81,599	91.0	5,656,036	14.2	1,867,058	19.1
1990	653,511	28.7	222,412	33.7	1,880,922	19.7	577,599	22.7	408,363	25.1	142,262	28.8	334,821	40.3	110,310	41.6	4,750,794	18.0	1,592,531	22.9
1991	389,398	26.0	131,179	29.7	7,412,013	11.2	2,496,220	22.1	272,267	26.1	102,330	29.6	114,636	37.5	33,497	32.0	12,341,402	9.3	4,362,600	16.5
1992	559,417	33.2	180,394	37.5	5,753,237	9.1	1,822,782	15.9	440,289	16.8	139,865	21.4	42,988	21.4	14,639	24.4	8,795,484	8.4	2,990,434	15.1
1993	710,873	18.2	238,220	22.8	4,143,002	11.2	1,376,592	17.8	758,778	20.8	258,952	26.3	45,686	33.2	16,433	36.2	6,905,906	11.3	2,273,152	17.2
1994	440,825	29.8	142,921	32.2	4,086,816	12.5	1,285,719	18.2	608,190	19.3	203,610	24.0	34,050	29.6	11,784	31.8	7,780,829	9.7	2,535,516	16.2
1995	816,070	17.5	287,267	22.7	4,248,542	15.4	1,351,245	19.8	558,424	25.6	182,168	30.3	59,357	34.4	21,519	34.0	7,603,172	11.0	2,500,637	19.7
1996	525,560	20.4	179,994	25.3	3,312,106	11.9	1,042,253	16.2	878,282	23.1	281,778	28.4	80,897	23.0	27,331	27.1	8,055,743	10.2	2,831,212	16.9
1997	1,057,203	18.5	362,214	24.4	5,150,476	11.3	1,635,185	17.7	1,138,193	23.4	399,291	30.0	98,494	29.1	34,023	32.0	10,917,063	19.7	3,786,705	24.2
1998	1,439,547	24.7	481,648	27.7	5,753,271	10.8	1,828,452	16.4	1,056,926	17.9	345,562	24.6	99,007	29.1	32,671	32.2	9,977,400	9.3	3,575,231	16.7
1999	820,371	13.6	271,531	18.2	5,477,613	9.4	1,861,757	16.1	699,825	18.9	220,631	25.4	84,447	20.8	28,690	25.4	11,688,515	8.8	3,908,262	15.9
2000	1,833,450	16.2	626,732	20.2	6,018,948	8.2	2,025,284	15.8	586,993	21.9	201,858	26.3	121,790	28.3	35,906	27.9	11,091,619	7.9	3,712,515	15.0
2001	1,781,293	17.4	641,567	22.3	6,184,966	9.5	1,849,989	14.6	816,650	16.4	290,637	21.3	88,936	21.8	33,982	27.9	7,365,829	11.2	2,409,330	16.7
2002	1,670,431	17.1	545,567	22.6	6,266,166	10.8	2,053,397	18.0	854,311	17.0	273,201	20.2	90,982	26.1	33,016	29.7	6,778,238	11.5	2,352,328	17.5
2003	1,172,837	17.8	404,338	21.7	5,286,909	10.2	1,718,114	18.6	930,576	20.8	289,313	26.9	172,327	23.4	66,101	29.7	10,682,302	9.5	3,736,073	17.8
2004	1,155,649	17.0	386,806	22.6	3,841,642	10.1	1,223,227	15.4	701,938	19.9	252,030	25.3	149,844	27.6	52,254	29.8	9,847,326	11.5	3,369,107	17.0
2005	954,552	24.2	329,037	28.2	3,505,968	11.8	1,131,872	17.0	770,173	15.0	255,092	21.8	87,557	25.3	30,737	27.2	10,903,988	9.7	3,744,965	16.4
2006	699,933	16.3	227,405	20.2	4,124,647	11.7	1,361,914	18.2	616,668	30.1	178,526	30.8	41,784	27.7	13,966	30.2	11,930,250	9.1	4,301,096	16.2
2007	818,643	15.4	279,147	19.4	4,630,404	11.5	1,539,046	18.3	308,039	21.2	100,962	24.9	78,231	25.8	27,959	31.2	9,924,934	8.4	3,372,169	15.8
2008	1,320,182	14.8	443,174	20.6	5,074,358	8.1	1,689,068	14.6	609,401	23.6	195,937	28.0	50,063	26.0	17,563	28.6	13,158,192	9.4	4,636,757	16.2
2009	1,788,575	14.5	600,705	21.0	6,242,208	9.6	2,054,138	17.3	744,464	19.5	222,282	23.8	89,961	28.4	31,515	31.9	13,919,234	10.0	4,676,052	16.5
2010	1,813,254	14.9	631,758	20.5	7,335,948	10.2	2,550,321	16.2	711,836	21.9	247,398	26.3	111,912	23.5	40,390	25.4	9,190,616	12.6	3,268,802	20.1
2011	1,390,360	14.9	469,280	19.0	4,744,947	9.7	1,522,357	15.5	259,735	17.7	86,003	21.4	85,027	24.1	31,292	27.7	10,091,732	9.5	3,470,918	16.1
2012	1,136,427	13.3	367,841	18.5	5,374,152	8.9	1,783,819	16.5	422,968	13.4	135,356	18.5	152,363	24.3	53,816	27.4	13,175,745	8.7	4,589,246	17.3
2013	1,709,164	12.2	581,107	17.5	6,088,863	9.9	1,998,284	15.9	398,767	14.8	132,773	20.6	197,844	21.3	73,027	25.1	13,404,945	10.3	4,614,319	17.0
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	19,100	81.1	364,343	26.2	48,582	45.4	89,674	57.7	10,792	71.0	128,975	30.5	14,650	50.4	386,524	48.1	47,837	62.3
1983	69,276	40.0	5,936	60.9	15,283	79.9	1,417	73.4	25,959	61.6	2,774	59.0					7,794	83.8	1,312	88.6
1984	285,887	32.0	19,441	48.5	83,103	84.6	5,554	90.6	12,248	103.2	2,062	105.1	3,384	99.3	290	100.4	59,529	52.1	4,649	51.5
1985	138,851	42.9	11,318	55.3	32,336	53.0	2,763	51.6	155,985	38.0	10,990	48.3	12,292	79.8	830	80.6	603,943	44.5	44,912	47.2
1986	107,212	49.6	7,372	54.2	19,379	65.3	1,624	60.4	473,615	72.5	33,039	74.9	11,853	75.8	921	77.8	267,044	41.3	21,357	38.9
1987	102,949	71.9	7,886	73.2	352,180	47.9	25,506	49.6	36,133	89.7	3,098	95.1	13,517	87.5	1,091	89.2	642,898	37.9	60,579	42.2
1988	185,774	51.5	14,729	61.3	329,574	30.8	26,758	37.1	116,937	36.7	10,189	42.4	7,726	52.0	576	57.0	205,385	41.4	22,996	51.5
1989	61,484	38.9	5,308	46.9	1,080,247	72.5	118,259	82.8	115,300	39.3	10,975	45.9	49,549	66.9	3,412	67.5	311,869	36.9	26,408	40.8
1990	96,587	44.0	12,814	60.3	327,612	37.7	26,362	47.2	18,485	89.3	1,251	93.7	783,955	82.6	66,386	86.0	736,838	34.5	62,271	40.6
1991	237,878	30.6	23,323	37.8	1,544,560	43.0	117,501	46.9	207,958	30.7	14,069	48.3	91,471	44.6	9,555	47.5	1,902,261	22.7	209,051	37.4
1992	860,902	31.0	70,997	33.3	1,833,394	25.8	156,676	29.2	514,453	32.0	39,314	41.6	49,674	57.6	4,294	56.5	1,468,815	20.7	134,383	28.7
1993	1,345,395	39.9	104,766	45.9	1,630,396	23.1	162,446	32.3	1,109,224	51.0	81,363	54.2	51,220	62.5	3,660	68.3	2,544,151	26.7	310,186	44.4
1994	947,564	31.5	92,207	35.4	2,220,435	25.8	177,992	32.1	690,548	35.8	51,181	37.4	27,765	64.3	1,973	67.3	2,280,973	19.3	200,469	28.0
1995	602,888	40.5	45,117	41.0	942,643	25.9	80,564	29.3	72,571	30.1	8,291	38.9	18,216	63.3	1,249	63.7	1,617,673	19.6	152,401	30.0
1996	493,436	28.1	49,281	33.9	1,516,179	39.1	113,893	40.7	295,818	49.5	22,680	48.2	123,621	57.8	15,883	74.4	2,271,614	31.3	295,972	53.1
1997	1,032,761	51.8	83,634	50.5	1,179,933	27.3	95,188	34.5	199,864	33.2	16,220	37.9	71,388	41.3	7,967	48.9	2,076,029	22.6	197,373	33.0
1998	1,033,214	43.8	78,806	45.8	2,262,074	26.0	189,917	33.0	207,500	34.3	18,802	41.7	39,280	40.3	3,078	43.3	1,721,873	25.1	211,949	48.4
1999	532,125	37.2	41,454	46.1	1,281,413	23.5	123,086	32.0	51,091	32.2	4,175	42.3	68,459	49.6	6,737	57.2	4,103,241	23.1	353,553	30.9
2000	955,854	28.8	67,785	40.4	1,948,980	22.8	174,209	30.3	265,642	61.1	20,300	56.9	24,518	50.4	1,952	53.5	2,552,559	34.6	197,526	37.5
2001	1,404,055	37.8	132,125	44.9	1,702,671	23.4	149,553	28.9	627,865	66.9	46,605	65.6	267,359	75.6	34,971	75.6	2,252,160	31.5	175,034	33.5
2002	559,039	30.6	42,687	35.5	1,187,635	24.6	93,346	28.8	192,094	28.9	15,190	36.7	132,712	47.7	10,853	49.7	1,035,758	30.9	89,243	35.9
2003	1,024,308	33.3	97,787	39.2	744,196	31.1	68,597	37.0	114,932	46.8	10,857	48.3	299,436	63.4	28,993	64.7	1,546,106	34.1	113,669	37.9
2004	477,328	44.0	35,200	46.7	944,587	31.1	78,277	32.1	83,683	37.1	8,907	46.5	24,033	55.8	1,613	59.6	1,547,223	44.2	171,926	58.2
2005	793,236	24.4	72,502	32.7	1,986,884	22.7	184,683	38.9	322,768	29.1	25,309	36.5	127,575	57.7	10,118	61.3	895,780	34.2	84,088	37.7
2006	1,085,517	44.4	88,671	42.9	2,355,407	21.3	234,798	36.0	670,528	47.6	47,895	50.2	109,904	38.3	14,008	53.5	1,144,271	28.0	108,628	34.3
2007	464,018	30.3	50,691	42.4	1,109,367	20.9	102,287	30.2	256,654	49.1	21,786	44.7	96,680	53.7	15,629	66.9	929,550	25.0	96,819	36.3
2008	901,587	24.4	74,919	30.1	1,912,635	19.8	149,123	25.8	248,799	29.8	17,155	39.8	12,748	60.9	1,198	65.4	1,377,270	27.7	114,490	31.4
2009	417,567	31.0	37,138	32.2	1,414,008	28.6	120,295	33.9	384,706	30.4	34,876	34.0	87,082	93.5	5,992	93.7	927,737	30.0	103,308	44.0
2010	572,004	29.7	53,063	30.8	1,506,818	23.6	146,558	36.2	583,189	30.2	43,420	36.4	74,678	40.5	7,322	49.4	828,375	54.9	59,780	56.2
2011	1,434,105	21.3	125,761	28.7	1,860,121	22.2	152,108	27.7	249,435	48.1	20,780	45.8	103,717	65.2	6,984	66.3	719,286	25.7	60,778	32.8
2012	1,263,476	24.4	124,775	32.1	977,186	35.2	84,370	34.7	175,964	43.2	12,527	46.9	52,159	45.4	5,726	57.4	674,174	31.1	71,681	37.4
2013	2,271,755	9.7	183,679	24.0	3,675,890	9.3	307,193	20.5	939,354	18.9	71,453	33.6	41,427	37.2	2,945	43.0	5,525,367	8.1	482,847	23.7
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:

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Estimates of Spotted Seatrout and Red Drum Bycatch in the Louisiana Menhaden Reduction Fishery

Louisiana Department of Wildlife and Fisheries

Office of Fisheries

Overview

The Gulf menhaden reduction fishery is the largest commercial fishery operating in the Gulf of Mexico with the majority of landings occurring in Louisiana (LA) waters. Estimates of spotted seatrout (SST) and red drum (RD) incidental bycatch from the menhaden fishery have been requested to allow comparisons of menhaden fishery bycatch in LA waters relative to the directed LA fisheries.

Incidental bycatch has been characterized in the Gulf menhaden fishery from both at-sea and processing plant studies that were reviewed in SEDAR49-DW-04 (Sagarese et al. 2016). The earlier bycatch studies reviewed did not characterize released catches, only the retained portion, limiting their utility for total bycatch estimation. The more recent studies conducted characterized both released and retained catches (Condrey 1994, de Silva and Condrey 1997, Pulver and Scott Denton 2012* as reviewed in Sagarese et al. 2016). Bycatch observations categorized as kept in Pulver and Scott Denton 2012* are considered retained catches.

Methods

The bycatch information from the Gulf menhaden fishery used in this analysis was limited to the studies where both retained and released catches were reported along with the number of purse-seine sets observed allowing calculation of per set catch rates for SST and RD (Tables 1 and 2). Catch per set observations are summarized across studies (mean, minimum, and maximum) to provide a range of catch rates that are assumed constant through time and representative of catches in LA waters. The most recent study (Pulver and Scott-Denton 2012*) accounted only for bycatch >50 cm (19.7 inches) and is excluded from the SST analysis for that reason.

Annual bycatch can be estimated by expanding the catch per set observations from the annual menhaden fishery effort (number of purse-seine sets per year). Annual menhaden fishery effort observations in LA waters are confidential. To avoid issues reporting bycatch estimates developed from confidential observations, fishery effort is estimated for all years included in this analysis (1982-2019, Figure 1) from a linear regression between the currently available annual effort observations (2000-2018) and the corresponding landings in pounds (sets=1.114E-05*landings + 8.247E+03, $p=0.01$, $r^2=0.37$).

Time-series of LA spotted seatrout and red drum incidental bycatch from the menhaden fishery (1982-2019, Table 3) are estimated by summing the product of the retained and released catches per set (mean, minimum, and maximum), the estimated annual LA menhaden fishery effort, and assumed mortality rates of the catches. All retained catches are assumed to die and released SST and RD catches are assumed to have 100% and 75% mortality rates respectively. No information is available on the mortality of released SST in the menhaden fishery, and observations of RD dead releases averaged across studies included in this analysis indicates a 45% mortality rate. That estimate is increased to account for delayed mortality of the live releases that are disoriented or injured.

Bycatch in units of numbers are converted into weight with assumptions of mean weight of the catches. Mean weight of red drum catches are assumed to be 12.6 pounds based on observations of the LDWF nearshore bottom longline survey and 1.44 pounds for SST assuming a 16-inch mean total length of the catches and applying the conversions in West et al. (2019).

Recreational landings estimates are taken from the LA Creel survey (2014-2019) and estimates hindcast to the historic MRIP time-series (1982-2013, West et al. 2019). Commercial landings are taken from the LDWF Trip Ticket program (1999-2019) and NOAA Fisheries commercial statistical records (1982-1998, NOAA Fisheries 2020).

Results

Louisiana bycatch estimates (mean, minimum, and maximum) in units of weight are compared to the SST and RD landings from the recreational and commercial LA fisheries (Table 4).

Bycatch estimates of SST relative to the landings of the directed LA fisheries are minimal. Estimates of SST bycatch from the menhaden fishery in units of weight in the most recent decade are all less than one tenth of one percent (maximum=0.09%, mean=0.07%, minimum=0.06%) when compared to the landings of the commercial and recreational LA fisheries (Figure 2).

Bycatch estimates of red drum relative to the directed LA fisheries are also minimal but of greater magnitude than SST estimates. Estimates of RD bycatch from the menhaden fishery in units of weight in the most recent decade range from 4.4% (maximum) to 0.3% (minimum) with a mean of 2.1% when compared to the landings of the directed LA fisheries (Figure 3).

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Tables

Table 1: Spotted seatrout released and retained catches, number of sets observed, and the mean, minimum, and maximum catches per set across studies.

			released catch			retained catch		
Study	Year	Species	fish	sets	fish/set	fish	sets	fish/set
Condrey 1994	1992	SST	19	127	0.15	0	49	0.00
de Silva and Condrey 1997	1994	SST	26	235	0.11	3	220	0.01
de Silva and Condrey 1997	1995	SST	41	257	0.16	1	199	0.01
Pulver and Scott-Denton 2012*	2011	SST	0	223	0.00	0	223	0.00
		Min			**0.11**			**0.000**
		Mean			**0.14**			**0.006**
		Max			**0.16**			**0.014**

Table 2: Red drum released and retained catches, number of sets observed, and the mean, minimum, and maximum catches per set across studies.

			released catch			retained catch		
Study	Year	Species	fish	sets	fish/set	fish	sets	fish/set
Condrey 1994	1992	Rdrum	15	127	0.12	0	49	0.00
de Silva and Condrey 1997	1994	Rdrum	116	235	0.49	3	220	0.01
de Silva and Condrey 1997	1995	Rdrum	245	257	0.95	0	199	0.00
Pulver and Scott-Denton 2012*	2011	Rdrum	368	223	1.65	32	223	0.14
		Min			**0.12**			**0.00**
		Mean			**0.80**			**0.04**
		Max			**1.65**			**0.14**

Table 3: Time-series of LA spotted seatrout and red drum total bycatch estimates (numbers of fish) from 1982-2019 for the maximum, mean, and minimum catch per set observations.

	SST Bycatch			RD Bycatch		
Year	max	mean	min	max	mean	min
1982	4,478	3,779	2,861	35,684	16,597	2,291
1983	4,813	4,062	3,075	38,355	17,839	2,462
1984	4,818	4,066	3,078	38,393	17,857	2,464
1985	4,377	3,694	2,797	34,884	16,225	2,239
1986	4,244	3,582	2,712	33,823	15,731	2,171
1987	4,535	3,827	2,897	36,139	16,808	2,320
1988	3,583	3,024	2,289	28,555	13,281	1,833
1989	3,395	2,865	2,169	27,056	12,584	1,737
1990	3,184	2,687	2,034	25,371	11,800	1,629
1991	3,377	2,850	2,157	26,910	12,516	1,727
1992	2,947	2,487	1,883	23,484	10,923	1,507
1993	3,471	2,929	2,218	27,659	12,865	1,775
1994	4,331	3,655	2,767	34,513	16,052	2,215
1995	3,206	2,706	2,048	25,548	11,883	1,640
1996	3,253	2,746	2,079	25,926	12,059	1,664
1997	3,776	3,186	2,412	30,089	13,995	1,931
1998	3,181	2,684	2,032	25,347	11,789	1,627
1999	4,134	3,488	2,641	32,941	15,321	2,114
2000	3,509	2,961	2,242	27,962	13,005	1,795
2001	3,088	2,606	1,973	24,607	11,445	1,580
2002	3,540	2,988	2,262	28,211	13,121	1,811
2003	3,269	2,759	2,088	26,049	12,116	1,672
2004	3,094	2,611	1,977	24,653	11,466	1,582
2005	2,697	2,277	1,723	21,497	9,998	1,380
2006	2,869	2,421	1,833	22,862	10,633	1,468
2007	2,952	2,491	1,886	23,526	10,942	1,510
2008	2,859	2,413	1,826	22,781	10,595	1,462
2009	2,944	2,485	1,881	23,463	10,913	1,506
2010	2,680	2,262	1,712	21,356	9,933	1,371
2011	3,615	3,051	2,310	28,811	13,400	1,849
2012	3,078	2,598	1,967	24,533	11,410	1,575
2013	3,072	2,593	1,963	24,485	11,388	1,572
2014	2,775	2,342	1,773	22,118	10,287	1,420
2015	3,165	2,671	2,022	25,219	11,730	1,619
2016	2,992	2,525	1,912	23,843	11,089	1,530
2017	2,767	2,335	1,768	22,047	10,254	1,415
2018	3,087	2,606	1,973	24,604	11,444	1,579
2019	2,862	2,416	1,829	22,810	10,609	1,464

Table 4: Comparisons of LA spotted seatrout and red drum recreational and commercial landings (in pounds), and bycatch estimates (in pounds) from 1982-2019 for the maximum, mean, and minimum catch per set observations. Confidential commercial landings records (***) are not presented.

	SST Landings		SST Bycatch			RD Landings		RD Bycatch		
Year	rec	com	max	mean	min	rec	com	max	mean	min
1982	4,869,061	727,606	6,429	5,426	4,107	2,855,725	1,454,503	450,138	209,363	28,894
1983	4,173,565	1,340,625	6,910	5,832	4,415	2,952,651	1,938,615	483,829	225,033	31,057
1984	1,362,509	973,250	6,917	5,837	4,419	2,367,474	2,608,383	484,310	225,257	31,088
1985	2,903,358	1,161,598	6,285	5,304	4,015	2,174,399	2,933,573	440,046	204,669	28,246
1986	6,140,234	1,978,038	6,094	5,143	3,893	1,993,626	7,817,694	426,663	198,445	27,387
1987	4,854,132	1,801,874	6,511	5,495	4,160	2,306,832	4,571,177	455,876	212,032	29,263
1988	5,313,332	1,433,408	5,145	4,342	3,287	2,424,843	245,365	360,214	167,539	23,122
1989	4,553,228	1,488,878	4,874	4,114	3,114	3,251,530	24,811	341,302	158,742	21,908
1990	2,246,316	648,645	4,571	3,858	2,920	2,977,243	0	320,042	148,854	20,543
1991	6,131,699	1,220,231	4,848	4,092	3,098	2,804,216	0	339,464	157,888	21,790
1992	4,047,596	971,481	4,231	3,571	2,703	4,072,597	0	296,240	137,784	19,016
1993	3,680,464	1,138,070	4,983	4,205	3,184	5,087,621	1,884	348,913	162,282	22,397
1994	5,287,571	1,023,687	6,218	5,248	3,973	4,610,560	2,957	435,373	202,496	27,946
1995	5,897,013	658,084	4,603	3,884	2,941	7,502,450	0	322,280	149,895	20,687
1996	5,633,898	774,474	4,671	3,942	2,984	7,157,264	1,925	327,053	152,115	20,993
1997	5,429,323	549,505	5,421	4,575	3,463	7,128,952	0	379,562	176,537	24,364
1998	5,177,850	111,979	4,567	3,854	2,918	5,442,578	4,769	319,748	148,717	20,524
1999	7,323,715	***	5,935	5,009	3,792	6,642,380	0	415,536	193,269	26,673
2000	8,118,153	***	5,038	4,251	3,219	8,288,060	0	352,729	164,057	22,642
2001	7,185,774	***	4,433	3,741	2,832	7,417,608	0	310,406	144,373	19,925
2002	5,012,133	***	5,082	4,289	3,247	7,196,064	0	355,868	165,517	22,843
2003	5,186,776	***	4,693	3,961	2,998	6,592,330	0	328,603	152,836	21,093
2004	4,332,901	***	4,442	3,748	2,838	5,778,575	0	310,993	144,646	19,963
2005	4,564,983	***	3,873	3,268	2,474	4,733,062	0	271,174	126,125	17,407
2006	6,745,371	***	4,119	3,476	2,632	5,098,331	0	288,400	134,137	18,512
2007	5,530,280	***	4,238	3,577	2,708	6,061,853	0	296,768	138,029	19,049
2008	7,164,674	***	4,104	3,464	2,622	6,672,823	0	287,370	133,658	18,446
2009	7,817,443	***	4,227	3,568	2,701	7,355,418	0	295,983	137,664	18,999
2010	6,184,412	***	3,848	3,247	2,458	8,346,255	0	269,401	125,301	17,293
2011	8,525,814	***	5,191	4,381	3,316	8,304,959	0	363,442	169,040	23,329
2012	8,163,839	***	4,420	3,730	2,824	6,044,853	0	309,474	143,939	19,865
2013	5,622,064	***	4,411	3,723	2,818	7,928,973	0	308,867	143,657	19,826
2014	3,251,893	***	3,985	3,363	2,546	6,367,723	0	279,007	129,769	17,909
2015	4,686,909	***	4,543	3,834	2,903	6,072,877	0	318,130	147,965	20,421
2016	5,367,655	***	4,295	3,625	2,744	4,711,394	0	300,766	139,889	19,306
2017	5,721,125	***	3,972	3,352	2,538	6,422,647	0	278,114	129,353	17,852
2018	2,982,455	***	4,433	3,741	2,832	7,633,391	0	310,375	144,358	19,923
2019	3,811,437	***	4,109	3,468	2,626	5,171,537	0	287,740	133,830	18,470

<u>Figures</u>

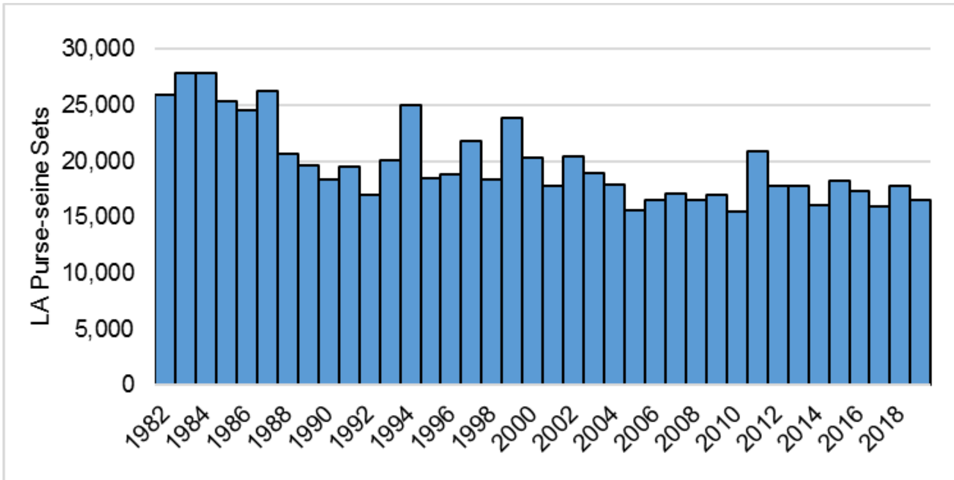

Figure 1: Time-series of estimated LA menhaden fishery effort (number of purse-seine sets per year).

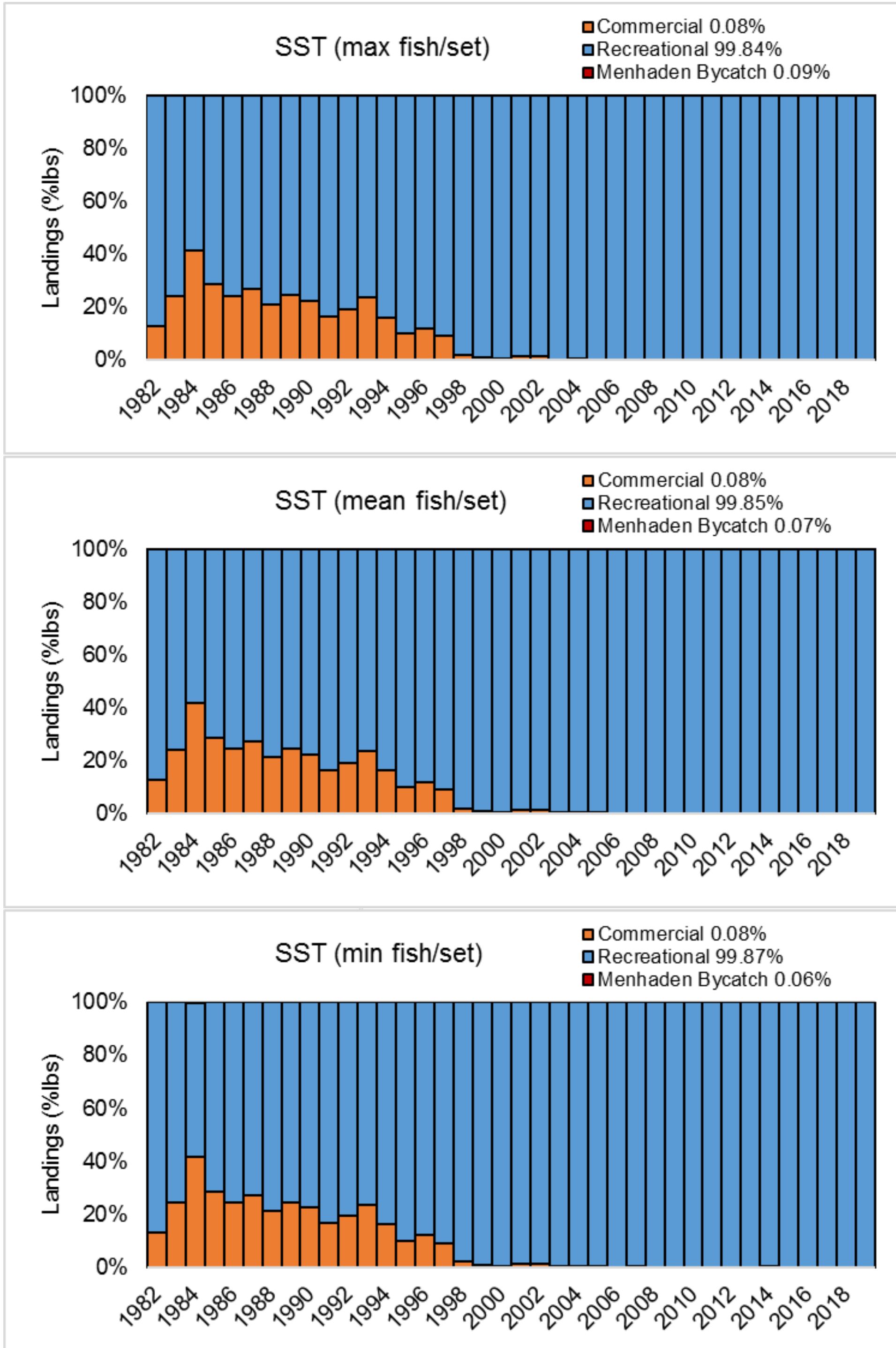

Figure 2: Comparison of LA spotted seatrout commercial and recreational landings, and LA menhaden bycatch estimates for the maximum (top), mean (center), and minimum (bottom) catch per set observations. Values in legends represent the mean landings percentages from 2010-2019.

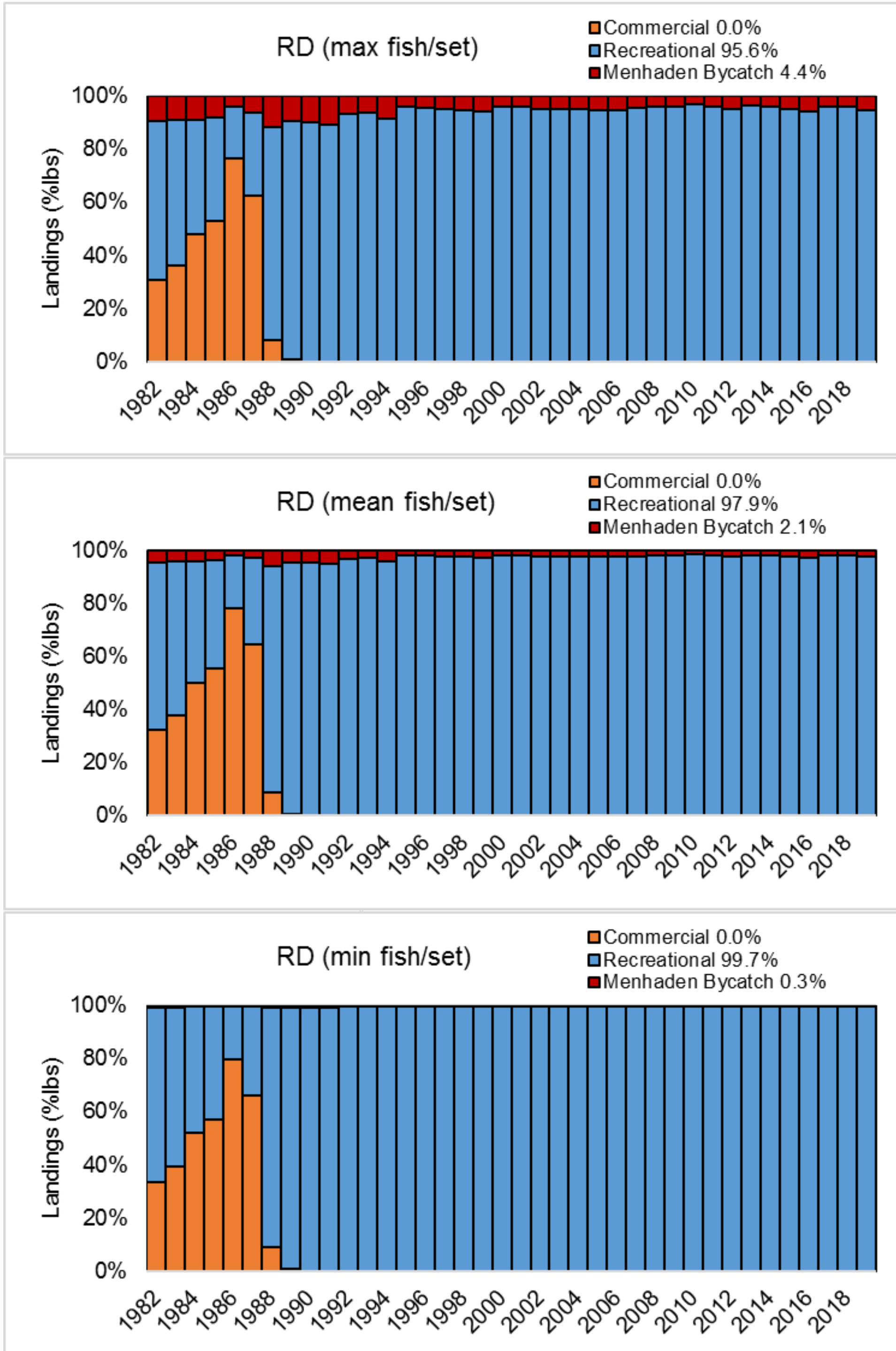

Figure 3: Comparison of LA red drum commercial and recreational landings, and LA menhaden bycatch estimates for the maximum (top), mean (center), and minimum (bottom) catch per set observations. Values in legends represent the mean landings percentages from 2010-2019.

Appendix 3:

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Evaluation of Commercial Shrimp Fishery Bycatch in Louisiana Waters

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Office of Fisheries
Louisiana Department of Wildlife and Fisheries
November 2020

Overview

Project Need

In 2010, a Fisheries Improvement Project (FIP) was initiated for the commercial shrimp fishery operating in Louisiana (LA) waters as a first step in the process of achieving a sustainability certification for the fishery. This was followed by an official improvement plan for the fishery in 2012. By 2015, the LA shrimp fishery met the goals outlined in the initial plan which allowed the fishery to progress into a comprehensive FIP that addresses all issues within the fishery to ensure the fishery is in compliance with the sustainability standards outlined by the certifying body.

Several action items were outlined in the comprehensive FIP, including the need for current bycatch data from the fishery to assess the main bycatch species per standards of the certifying body. The Louisiana Shrimp Task Force (LSTF) and involved members of the industry approached the Louisiana Department of Wildlife and Fisheries (LDWF) in 2016 and initiated discussions to conduct a study to characterize the current bycatch of the fishery in LA waters. In 2018, LDWF partnered with the LSTF and the American Shrimp Processors Association (ASPA) to fund a one-year observer study designed by the LDWF to focus exclusively on the bycatch of the shrimp fishery operating in LA waters, as the bycatch of the fishery operating in federal waters is monitored and reported by NOAA Fisheries.

Project Objectives

Objectives of this study were:

1. Characterize the current bycatch of the commercial shrimp fishery operating in LA waters.
2. Identify the main bycatch species of the fishery per standards of the Audubon Nature Institute (ANI) Gulf United for Lasting Fisheries (GULF) Responsible Fisheries Management (RFM) program (ANI 2020).
3. Assess the population resilience of the main bycatch species to fisheries exploitation.

Fishery Description

The commercial harvest of shrimp in LA dates back to the 1800s (LDWF 2016). As the popularity of shrimp as a food source grew in the early 1900s, the LA commercial shrimp industry expanded and commercial landings began to increase above 20 million pounds annually. Continued expansion of the industry into current times has led to the most valuable commercial fishery operating in LA waters with landings averaging over 70 million pounds annually in the most recent decade.

In the early 1900s, the otter trawl was developed and became the primary fishing gear used by LA shrimp fishers. This was followed by introduction of the butterfly net in the 1950s that allowed stationary fishing in tidal passes. The introduction of skimmer nets in the 1980s, which allowed fishers to focus efforts in shallower water and fish the entire water column, was widely accepted by the LA shrimp fishery.

A shift in gear preference of the LA commercial shrimp fishery has occurred over time as well as an overall decrease in license sales (Table 1). Based on commercial gear license sales, the use of otter trawl and butterfly net gear has decreased since 2000 while the use of skimmer nets has increased. The overall number of commercial licenses sold has decreased by over 70% since 2000.

Commercial shrimp landings in LA waters and the corresponding number of fishery trips have also decreased since 2000 (Figure 1). Commercial landings have decreased over 30% since 2000 while the number of fishery trips has declined by over 65%. This disproportionate decrease is primarily due to the characteristics of the shrimp fishery operating in LA waters changing over time, where a noticeable decline occurred in the mid-2000’s in the number of trips less than 1-day at sea.

Regulatory Authority

Regulatory authorities for the LA shrimp fishery are the Governor of Louisiana, the Louisiana Legislature, the Louisiana Wildlife and Fisheries Commission (LWFC), and the Secretary of LDWF. The Governor has the authority to issue executive orders, in limited instances, which are enforced in the same manner as statutes passed by the legislature. The LA Legislature has the authority to enact laws to protect, conserve, and replenish the natural resources of the state, such as gear regulations, licensing requirements, and entry limitations. Some of the authority of the legislature has been delegated to the LWFC, allowing regulatory authority of seasons, quotas, size limits, and possession limits.

Specific to commercial shrimping, the LWFC has the authority to open and close state outside waters, set the inshore shrimp season dates, and modify gear mesh sizes during the special shrimp seasons. The LWFC also has the authority to promulgate regulations regarding the use and configuration of excluder devices. Some authority of the LWFC is delegated to the Secretary of LDWF, including the ability to open or close special and regular shrimp seasons as well as open or close state outside waters.

Methods

Bycatch Characterization

In 2019, LDWF, along with the LSTF and ASPA, initiated an observer study of the commercial shrimp fishery operating in Louisiana waters to characterize bycatch of the fishery from July 2019 through June

2020. LGL Ecological Research Associates, Inc. (LGL) was contracted for this study to provide biological staff to act as observers onboard commercial shrimp fishing vessels operating in LA waters.

Fishery participants were solicited though the LSTF, social media, and LDWF news releases, and an online portal was developed for interested commercial fishers to enroll. All commercial fishers operating out of LA ports were eligible to participate in this study. Commercial vessels in which observers were placed were selected randomly from the pool of participating commercial fishers. Commercial fishers randomly drawn from this group were compensated $350 per day for each fishing trip where bycatch was observed by an LGL biologist. Fishing trips conducted with observers onboard were not to exceed 48 hours. Trips in which observers were placed were randomly assigned proportional to the recent fishery effort (number of trips) by fishing gear, LDWF Coastal Study Area (CSA), and fishing season (spring, fall, inshore closed).

Bycatch information was collected over the duration of each observed trip by sampling each tow. On vessels containing multiple nets, samples were collected by alternating which net the samples were collected from after each tow. Any observed interactions with sea turtles were to be documented, regardless of which net was sampled.

For each net sampled, the total weight of the tow was estimated through a volumetric approach as described in the NOAA Observer Training Manual (NOAA Fisheries 2010). Multiple fish baskets were equally filled with the entire catch of the sampled tow and then one fish basket was randomly chosen, weighed and used to extrapolate the weight of the entire tow's catch from the number of baskets filled. Catch of the randomly chosen basket was also characterized by sorting, enumerating, and weighing each species to the nearest gram with the exception of white and brown shrimp and jellyfish species where only weight measurements were recorded. The species weight composition of the subsample was then used to extrapolate the total catch weight of each tow.

Size measurements of up to thirty individuals per sampled tow were recorded for penaeid shrimp species and other selected species that are managed or commonly harvested. Large specimens that weren't included in the volumetric sampling method were identified by species, counted, released condition documented, and size or weight measurements recorded when possible. Tow times and locations were also recorded along with the position of the sampled net for each tow.

Main Bycatch Identification

The ANI GULF RFM program identifies relevant bycatch (non-target catches), whether discarded or retained, as managed non-target species (species regulated for commercial, bait, or recreational use) greater than 1% of total catch and non-managed non-target species greater than 10% of total catch (ANI 2020).

Resilience to Exploitation

Population resilience is a population's ability to withstand perturbation. Populations with higher resilience are at less risk of extinction due to fishery exploitation than populations with lower resilience. Productivity, which is a function of growth rates, fecundity, natural mortality, age at maturity, and longevity, can be a reasonable proxy for population resilience. Productivity classification indices were developed for each species identified as main bycatch from their life history characteristics based on a classification scheme developed at the Food and Agricultural Organization of the United Nations (FAO) second technical consultation on the suitability of the Convention on International Trade in Endangered Species (CITES) criteria for listing commercially-exploited aquatic species (FAO 2001).

Results

Bycatch Characterization

Thirty-three shrimp fishing trips with 363 tows and 501 hours of tow time were observed from July 2019 through June 2020 from 12 individual commercial fishing vessels. Of the twelve participating vessels, 9 fished with skimmer nets, 2 with otter trawls, and 1 with butterfly net gear. The otter trawls were all equipped with bycatch reduction devices (BRDs) and turtle excluder devices, and two-thirds of the skimmer nets were equipped with BRDs.

Observer coverage of the fishery over the course of this study was approximately 0.1% (33 observed trips/37,203 fishery trips) and nearly proportional to the number of fishery trips by gear, CSA, and fishing season with the exception of CSA 6 and 7 due to the lack of fishery participation in those areas (Table 2, Figure 2).

From the 363 observed tows, 14,266 kg of total catch was observed consisting of 105 unique species or grouped species (Table 3). Four species of penaeid shrimp, 82 finfish species, 12 crustacean species (excluding penaeid shrimp), and 7 non-crustacean invertebrate species were observed. Penaeid shrimp species were the highest group caught by weight (48.1%), followed by finfish (40.2%), crustaceans other than penaeid shrimp (5.0%), and invertebrates (3.0%). Debris made up 3.7% of the total catch by weight.

The most abundant species caught consisting of >1% by weight of the total catch were white shrimp (44.3%), Gulf menhaden, (14.1%), Atlantic croaker (5.4%), blue crab (4.9%), brown shrimp (3.7%), spot (3.2%), jellyfish sp. (2.9%), sand seatrout (2.8%), hardhead catfish (2.2%), gafftopsail catfish (2.1%), and Atlantic cutlassfish (2.1%).

The bycatch to shrimp sample ratio error distribution was assumed lognormal and the corresponding sample ratio geometric mean in units of weight was 1.01 (Table 4). Size compositions and mean sizes of penaeid shrimp and the managed and commonly harvested species catches are presented in Table 5. Catch composition of large specimens not represented in the volumetric samples are presented in Table 6 along with released condition and corresponding size and weight measurements if available. Interactions with diamondback terrapins were observed in which all were released alive (Table 6). No interactions with sea turtles were observed.

Main Bycatch Identification

Gulf menhaden and blue crab were identified as the main bycatch species of the current LA commercial shrimp fishery per ANI standards. Both are managed species that are greater than 1% of the total catch by weight. The other non-target species consisting of greater than 1% of the total catch are non-managed species not regulated for recreational, bait, or commercial use. No non-managed non-target species was greater than 10% of the total catch by weight.

Resilience to Exploitation

Blue crab and Gulf menhaden were assigned productivity/resilience levels (high, medium, or low) based on each species life history characteristics (Table 7). Life history parameter values were taken from the most recent stock assessments if available (SEDAR 2018, West et al. 2019). Parameter values not available in the stock assessment reports were taken from FishBase (Froese and Pauly 2011) and SeaLifeBase (Palomares and Pauly 2020). Parameter values for each of the main bycatch species indicate overall high productivity/resilience.

<u>Discussion</u>

Historic Bycatch Ratios

The bycatch to penaeid shrimp sample ratio mean from this study (1.01) is less than an earlier LDWF shrimp bycatch study conducted in LA waters (Adkins 1993). The bycatch to penaeid shrimp sample ratio mean in that study, recalculated as a geometric mean, was 1.24, suggesting bycatch in the LA shrimp fishery has decreased through time. This decrease is likely due to the changing characteristics of the fishery where skimmer nets have become the preferred gear of the fishery, along with the use of BRDs. An earlier NOAA Fisheries bycatch study conducted in LA waters (Scott-Denton et al. 2006), which only characterized bycatch from the skimmer net fishery operating primarily in Vermilion Bay (CSA 6), reported an overall ratio of bycatch to penaeid shrimp of 0.63.

Management Implications

For managed species identified as main bycatch, the ANI standards require the effects of the fishery to be considered. Consideration of managed non-target species aims primarily at establishing whether the overall effects of fishing on the stock under consideration and all significant removals are accounted for; and that the management strategy and relative measures are effective in maintaining other managed species from experiencing overfishing and other impacts that are likely to be irreversible or very slowly reversible (ANI 2020).

The main bycatch species of the LA commercial shrimp fishery per ANI standards (Gulf menhaden and blue crab) are regulated species which undergo periodic stock assessments that output estimates used as metrics of stock status (SEDAR 2018, West et al. 2019) with fisheries that currently hold Global Sustainable Seafood Initiative (GSSI) accredited sustainability certifications. Removals of Gulf menhaden and blue crab as bycatch from the LA shrimp fishery have not been considered in the respective stock assessments. Bycatch from the offshore Gulf of Mexico shrimp fishery was considered in the most recent Gulf menhaden stock assessment (SEDAR 2018), but was ultimately not used as a model input by the assessment panelists due to the high uncertainty in the estimated time-series and the relatively insignificant level of bycatch when compared to the landings of the fishery.

Future LDWF blue crab and SEDAR Gulf menhaden stock assessments would be required to consider removals from the LA shrimp fishery per ANI standards. Time-series of bycatch removals could be estimated directly from annual LA shrimp landings from the mean bycatch to shrimp ratio from this study and the earlier LDWF study (Adkins 1993) along with the percent composition of blue crab and Gulf menhaden in the catches and assumptions of discard mortality. These time-series would unfortunately be considered highly uncertain due to the few bycatch to shrimp ratio estimates available in LA waters over time coupled with the changing characteristics of the fishery, but would allow accurate estimation of the current bycatch removals of the LA shrimp fishery to determine their significance relative to the directed landings of each fishery.

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Tables

Table 1. Louisiana annual commercial shrimp gear license sales (percent by gear and total sales), 2000-2019.

Year	Trawl	Skimmer	Butterfly	Total
2000	54%	34%	12%	22,218
2001	52%	37%	10%	22,865
2002	51%	40%	9%	21,627
2003	48%	44%	8%	20,586
2004	48%	43%	8%	17,347
2005	46%	45%	9%	15,420
2006	44%	48%	9%	13,646
2007	43%	48%	9%	12,590
2008	42%	49%	10%	11,476
2009	40%	50%	10%	12,082
2010	38%	52%	10%	12,806
2011	37%	54%	9%	13,234
2012	38%	53%	8%	12,728
2013	29%	64%	7%	10,123
2014	42%	49%	9%	7,319
2015	41%	50%	9%	7,551
2016	41%	51%	9%	7,340
2017	41%	51%	8%	6,867
2018	41%	51%	8%	6,236
2019	40%	51%	8%	5,791

Table 2: Louisiana shrimp fishery trips and observer coverage (July 2019 – June 2020) by gear, CSA, and fishing season.

Fishery trips	37,203
Observed trips	33

	Fishery trips		Observed trips	
Gear	Frequency	Percent	Frequency	Percent
Butterfly net	2276	6.1%	3	9.1%
Otter trawl	6452	17.3%	6	18.2%
Skimmer net	28475	76.5%	24	72.7%

	Fishery trips		Observed trips	
CSA	Frequency	Percent	Frequency	Percent
1	6564	17.6%	7	21.2%
3	11136	29.9%	12	36.4%
5	14607	39.3%	14	42.4%
6	1108	3.0%	0	0.0%
7	3788	10.2%	0	0.0%

	Fishery trips		Observed trips	
Season	Frequency	Percent	Frequency	Percent
Spring	7823	21.0%	7	21.2%
Fall	24457	65.7%	24	72.7%
Inshore closed	4923	13.2%	2	6.1%

Table 3: Species total catch composition and corresponding mean weights. Species mean weights are calculated from the subsampled weights and counts.

Species	total kg	% kg	mean kg
WHITE SHRIMP	6321.765	44.313	--
GULF MENHADEN	2013.137	14.111	0.014
ATLANTIC CROAKER	768.736	5.389	0.011
BLUE CRAB	700.646	4.911	0.054
BROWN SHRIMP	527.423	3.697	--
DEBRIS	521.480	3.655	--
SPOT	449.081	3.148	0.030
JELLYFISH SP.	415.590	2.913	--
SAND SEATROUT	402.123	2.819	0.012
HARDHEAD CATFISH	314.820	2.207	0.018
GAFFTOPSAIL CATFISH	302.624	2.121	0.015
ATLANTIC CUTLASSFISH	299.163	2.097	0.021
ATLANTIC THREAD HERRING	117.899	0.826	0.015
BAY ANCHOVY	102.212	0.716	0.001
GIZZARD SHAD	94.846	0.665	0.019
THREADFIN SHAD	68.982	0.484	0.014
COWNOSE RAY	68.401	0.479	0.772
SPANISH MACKEREL	67.702	0.475	0.023
SPOTTED SEATROUT	66.077	0.463	0.080
ATLANTIC MOONFISH	62.295	0.437	0.008
CATFISH SP.	54.260	0.380	0.022
STRIPED MULLET	43.462	0.305	0.039
ATLANTIC STINGRAY	41.300	0.289	0.215
HARVESTFISH	36.490	0.256	0.025
PINFISH	31.478	0.221	0.039
STRIPED ANCHOVY	31.222	0.219	0.012
HOGCHOKER	25.958	0.182	0.016
SHEEPSHEAD	23.683	0.166	1.203
SOUTHERN FLOUNDER	23.201	0.163	0.337
SOUTHERN KINGFISH	20.237	0.142	0.032
SILVER PERCH	17.558	0.123	0.026
SEABOB	17.386	0.122	0.005
BLUE CATFISH	16.445	0.115	0.007
LEAST PUFFER	16.150	0.113	0.007
WHITE MULLET	16.042	0.112	0.023
ATLANTIC BRIEF SQUID	15.726	0.110	0.009
BAY WHIFF	15.136	0.106	0.009
SCALED SARDINE	14.126	0.099	0.007
LADYFISH	10.005	0.070	0.102
CREVALLE JACK	9.887	0.069	0.028
STAR DRUM	8.882	0.062	0.014
INSHORE LIZARDFISH	8.292	0.058	0.034
ATLANTIC SPADEFISH	7.770	0.054	0.013
HIGHFIN GOBY	7.558	0.053	0.027
ATLANTIC BUMPER	6.027	0.042	0.003
VIOLET GOBY	5.584	0.039	0.030
LOOKDOWN	4.889	0.034	0.015
FLORIDA POMPANO	4.535	0.032	0.092
BLUE RUNNER	4.382	0.031	0.045
BLACK DRUM	3.471	0.024	0.088
GRAY SNAPPER	3.053	0.021	0.044
HERMIT CRAB SP.	2.905	0.020	0.018

Table 3 (continued):

Species	total kg	% kg	mean kg
BANDED DRUM	2.866	0.020	0.006
ATLANTIC MIDSHIPMAN	2.304	0.016	0.022
GULF STONE CRAB	2.166	0.015	0.440
ATLANTIC NEEDLEFISH	2.048	0.014	0.026
BLACKTIP SHARK	1.970	0.014	0.200
ATLANTIC SILVERSTRIPE HALFBEAK	1.871	0.013	0.035
SPINY SEAROBIN	1.723	0.012	0.004
LEATHERJACKET	1.615	0.011	0.008
INLAND SILVERSIDE	1.600	0.011	0.004
BIGHEAD SEAROBIN	1.590	0.011	0.005
ROUGH SILVERSIDE	1.492	0.010	0.002
BLACKCHEEK TONGUEFISH	0.985	0.007	0.033
GULF TOADFISH	0.886	0.006	0.036
PIGFISH	0.886	0.006	0.060
STRIPED BURRFISH	0.886	0.006	0.180
GULF BUTTERFISH	0.768	0.005	0.005
NEEDLEFISH SP.	0.704	0.005	0.029
SNAIL SP.	0.689	0.005	0.016
NAKED SOLE	0.596	0.004	0.020
NORTHERN KINGFISH	0.596	0.004	0.040
SHARKSUCKER	0.566	0.004	0.038
ISOPODA SP.	0.502	0.004	0.034
BAYOU KILLIFISH	0.478	0.003	0.019
GIANT TIGER PRAWN	0.359	0.003	0.073
FALSE SILVERSTRIPE HALFBEAK	0.355	0.002	0.024
ATLANTIC MENHADEN	0.345	0.002	0.070
MOJARRA SP.	0.295	0.002	0.015
BLUNTNOSE JACK	0.251	0.002	0.009
FALSE SHARK EYE	0.246	0.002	0.013
CRESTED CUSK EEL	0.197	0.001	0.040
THINSTRIPE HERMIT CRAB	0.197	0.001	0.013
FAT SLEEPER	0.177	0.001	0.018
FRINGED FLOUNDER	0.158	0.001	0.004
FLORIDA ROCKSNAIL	0.148	0.001	0.015
OYSTER TOADFISH	0.148	0.001	0.030
RIVER SHRIMP	0.148	0.001	0.030
SPOTFIN MOJARRA	0.148	0.001	0.015
YELLOWFIN MOJARRA	0.148	0.001	0.008
PYGMY SEA BASS	0.108	0.001	0.022
SMOOTH PUFFER	0.103	0.001	0.011
AMERICAN PADDLEFISH	0.098	0.001	0.020
BIVALVE CLAM SP.	0.098	0.001	0.020
MANTIS SHRIMP	0.098	0.001	0.010
PINK PURSE CRAB	0.098	0.001	0.010
WHITE RIVER CRAWFISH	0.098	0.001	0.010
SILVER ANCHOVY	0.079	0.001	0.008
BIGCLAW SNAPPING SHRIMP	0.049	0.000	0.010
REDEAR SUNFISH	0.049	0.000	0.010
FLORIDA LADY CRAB	0.044	0.000	0.009
TIDEWATER MOJARRA	0.044	0.000	0.009
ESTUARINE MUD CRAB	0.015	0.000	0.001
BIGEYE ROBIN	0.005	0.000	0.001
GULF PIPEFISH	0.005	0.000	0.001
SPECKLED SWIMMING CRAB	0.005	0.000	0.001

Table 4: Bycatch to penaeid shrimp (brown, white, seabob) sample ratio summary statistics in units of weight. The sample ratio mean and error estimates are geometric.

Ratio (bycatch /shrimp)		
Bin	Frequency	Percent
0.0	163	50.309
1.0	55	16.975
2.0	39	12.037
3.0	18	5.556
4.0	16	4.938
5.0	12	3.704
6.0	5	1.543
7.0	4	1.235
8.0	2	0.617
9.0	--	--
10.0	2	0.617
11.0	--	--
12.0	--	--
13.0	1	0.309
14.0	--	--
15.0	1	0.309
16.0	2	0.617
17.0	--	--
18.0	--	--
19.0	2	0.617
--	--	--
51.0	1	0.309
--	--	--
111.0	1	0.309

Ratio (bycatch/shrimp)	
Mean	1.013
L95%CI	0.882
U95%CI	1.163
CV	1.986
Tows	324

Table 5: Bycatch size compositions of managed and commonly harvested species. Size measurements are fork length (finfish), total length (shrimp), and carapace width (crab).

Size bin (cm)	ATLANTIC CROAKER	BLACK DRUM	BLUE CRAB	BROWN SHRIMP	GRAY SNAPPER	GULF MENHADEN	SEABOB	SHEEPSHEAD	SOUTHERN FLOUNDER	SPOTTED SEATROUT	STRIPED MULLET	WHITE SHRIMP
0	2	--	--	--	--	--	--	--	--	--	--	--
1	1	--	30	1	--	--	--	--	--	--	--	--
2	--	--	96	1	2	1	--	--	--	--	--	1
3	3	--	291	--	1	6	--	--	--	--	--	6
4	1	--	358	15	--	64	--	--	--	--	--	14
5	39	--	285	91	--	302	--	--	--	--	--	74
6	284	--	177	419	--	627	1	--	--	--	1	263
7	485	--	139	1,087	--	1,074	6	--	--	--	2	700
8	748	1	111	1,246	--	970	28	--	--	--	4	1,039
9	632	--	91	635	--	579	34	--	--	5	9	1,043
10	618	--	94	260	1	742	15	--	--	9	24	788
11	988	--	123	112	1	830	1	--	--	12	39	1,035
12	822	--	116	20	--	330	--	--	--	18	25	1,395
13	513	--	89	4	1	156	--	--	--	11	30	1,562
14	261	--	82	1	--	172	--	--	--	6	27	1,021
15	120	--	99	--	--	126	--	--	--	6	16	336
16	55	--	124	--	--	53	--	--	--	6	12	78
17	24	2	71	--	--	11	--	--	--	8	6	9
18	10	--	24	1	--	5	--	--	--	1	8	2
19	3	3	6	--	--	1	--	--	--	4	6	2
20	1	1	--	--	--	1	--	--	1	8	3	--
21	3	1	--	--	--	--	--	--	1	12	2	--
22	--	--	--	--	--	1	--	--	--	13	1	--
23	--	--	--	--	--	--	--	--	1	5	2	--
24	--	--	--	--	--	--	--	--	1	6	--	--
25	--	--	--	--	--	--	--	--	--	8	--	--
26	--	--	--	--	--	--	--	--	1	3	--	--
27	--	--	--	--	--	--	--	--	--	5	--	--
28	--	--	--	--	--	--	--	--	1	4	--	--
29	--	--	--	--	--	--	--	--	1	2	--	--
30	--	--	--	--	--	--	--	1	1	2	--	--
31	--	--	--	--	--	--	--	--	--	--	--	--
32	--	--	--	--	--	--	--	1	--	--	--	--
33	--	--	--	--	--	--	--	--	--	2	--	--
34	--	--	--	--	--	--	--	1	--	3	--	--
35	--	--	--	--	--	--	--	--	2	--	--	--
36	--	--	--	--	--	--	--	--	1	1	--	--
37	--	--	--	--	--	--	--	--	1	--	--	--
38	--	--	--	--	--	--	--	--	--	--	--	--
39	--	--	--	--	--	--	--	--	--	--	--	--
40	--	--	--	--	--	--	--	--	--	--	--	--
41	--	--	--	--	--	--	--	--	--	--	--	--
42	--	--	--	--	--	--	--	--	--	--	--	--
43	--	--	--	--	--	--	--	1	--	--	--	--
Mean size (mm)	107	176	83	82	73	94	91	354	290	187	135	113
n	5613	8	2406	3893	6	6051	85	4	12	160	217	9368

Table 6: Large specimen catch composition. Size measurements are fork length.

Species	numbers	released condition: alive	dead	unknown	weight (kg): mean	n	min	max	size (mm): mean	n	min	max
Black Drum	33	20	2	11	7.67	2	6.98	8.35	905	1	905	905
Cownose Ray	27	5	--	22	0.81	5	0.60	0.96	323	4	136	410
Atlantic Stingray	25	10	11	4	0.86	3	0.41	1.16	146	1	146	146
Sheepshead	15	10	1	4	2.59	3	2.48	2.78	494	3	460	528
Longnose Gar	12	12	--	--	--	--	--	--	--	--	--	--
Diamondback Terrapin	5	5	--	--	--	--	--	--	--	--	--	--
Red Drum	5	5	--	--	--	--	--	--	--	--	--	--
Hardhead Catfish	5	5	--	--	--	--	--	--	--	--	--	--
Alligator Gar	4	4	--	--	--	--	--	--	1140	2	450	1829
Atlantic Tripletail	3	2	--	1	--	--	--	--	--	--	--	--
Bull shark	2	2	--	--	4.92	2	4.83	5.01	--	--	--	--
Spotted Seatrout	2	2	--	--	--	--	--	--	--	--	--	--
Bonnethead	1	1	--	--	--	--	--		--	--	--	--
Blacktip Shark	1	1	--	--	3.62	1	3.62	3.62	566	1	566	566

Table 7: FAO proposed guideline for indices of productivity/resilience for exploited aquatic species (top table) and corresponding productivity/resilience levels for blue crab and Gulf menhaden (bottom table). Parameter values are taken from the latest stock assessment reports (West et al. 2019, SEDAR 63) unless noted by an * where values are taken from FishBase (Froese and Pauly 2011) for Gulf menhaden and SeaLifeBase (Palomares and Pauly 2020) for blue crab.

Parameter	Productivity/Resilience: Low	Medium	High
Intrinsic rate of population growth (r per yr)	<0.14	0.14 - 0.35	>0.35
Natural mortality rate (M per yr)	<0.2	0.2 - 0.5	>0.5
Individual growth rate (K per yr)	<0.15	0.15 - 0.33	>0.33
Age at maturity (yrs)	>8	8 - 3.3	<3.3
Maximum age (yrs)	>25	14 - 25	<14
Generation time (yrs)	>10	10.0 - 5.0	<5

Parameter	Blue Crab: Value	Index	Gulf Menhaden: Value	Index
Intrinsic rate of population growth (r per yr)	0.6*	High	3.0*	High
Natural mortality rate (M per yr)	1.0	High	1.1	High
Individual growth rate (K per yr)	1.9	High	0.3	High
Age at maturity (yrs)	1.0	High	2.0	High
Maximum age (yrs)	3.0	High	6.0	High
Generation time (yrs)	<3.0	High	2.4*	High
Overall productivity /resilience level	High		High	

Figures

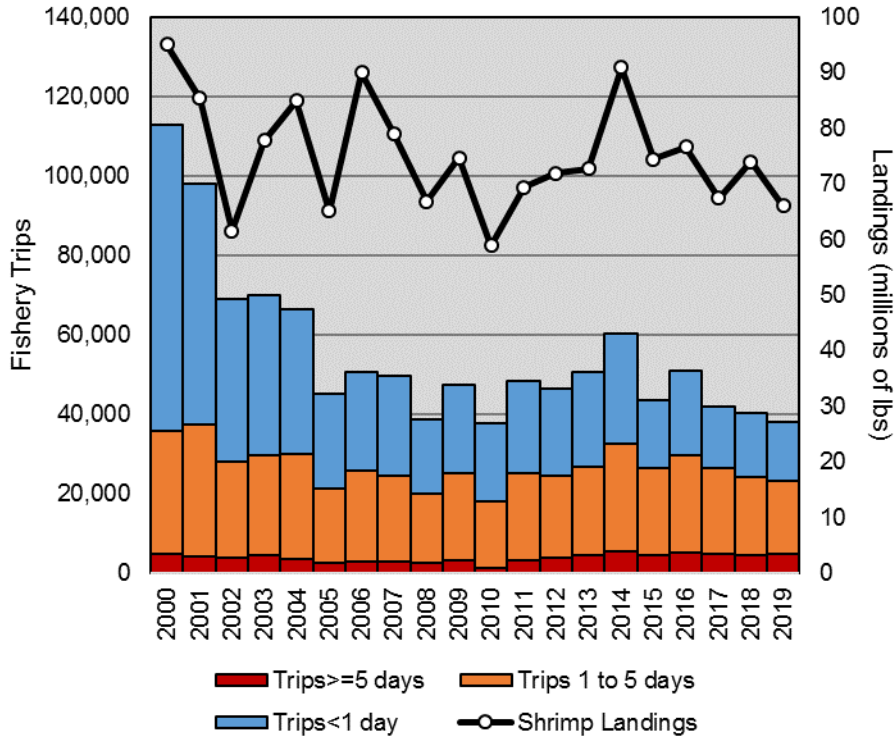


Figure 1: Shrimp fishery trips in LA waters by number of days at sea and corresponding total penaeid shrimp landings taken from the LDWF Trip Ticket program, 2000-2019. Note: Landings and fishery trips do not include records from out of state or federal waters.

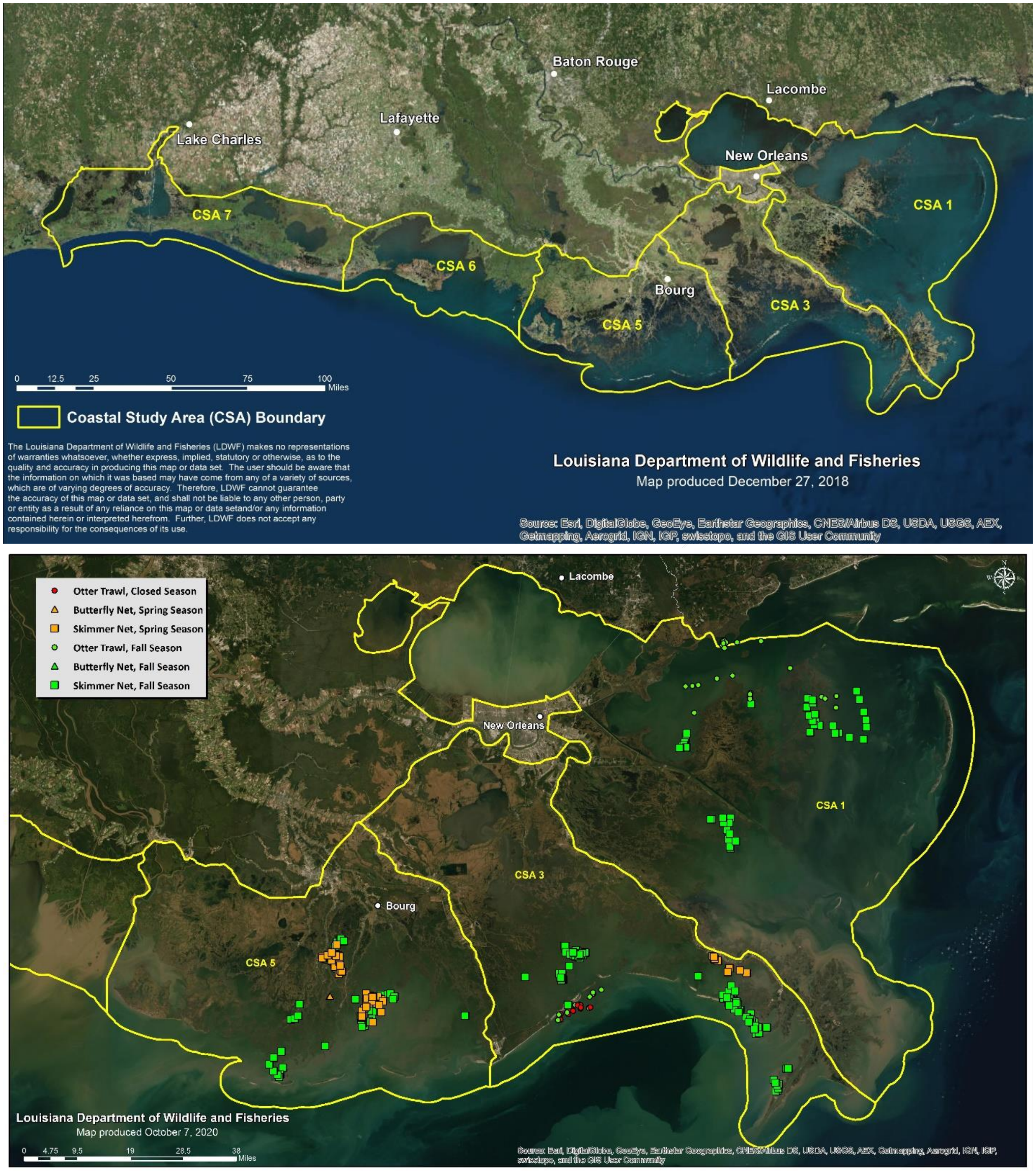


Figure 2: Louisiana state waters and LDWF Coastal Study Areas delineated by the yellow lines (top graphic) and locations of observed fishery tows (bottom graphic) by gear fished (otter trawl, skimmer net, butterfly net) and fishing season (spring, fall, inshore closed).

Appendix 4:

Louisiana Basin-specific Spotted Seatrout Information (2014-2020)

Office of Fisheries
Louisiana Department of Wildlife and Fisheries

Overview

The Louisiana spotted seatrout (SST) fishery is one of the largest fisheries operating in Louisiana (LA) waters. Basin-specific SST information has been requested as part of this stock assessment update to allow comparisons of fishery landings and survey catch rates among LA drainage basins.

The Louisiana Department of Wildlife and Fisheries (LDWF) recreational creel survey (LA Creel) estimates fishery effort and fishery catches (harvest + discards) for each LA drainage basin as well as the offshore waters of LA. The LDWF Biological Sampling Program collects size, sex, and age composition information from LA recreational and commercial fishery landings. The LDWF fishery-independent experimental marine gillnet survey collects relative abundance information along with size, sex, and age composition information from important marine species within the LA drainage basins.

Time-series of annual SST basin-specific recreational fishery landings, catch rates of the LDWF fishery-independent experimental marine gill net survey, and corresponding age compositions are presented in this report from 2014-2020. The basin-specific information presented in this report is derived in the same manner using the same methodology as the statewide metrics presented in the main assessment report. Due to confidentially issues, basin-specific commercial landings are not presented.

Fishery Information

Angler Effort, Harvest, and Discards

Annual basin-specific estimates of recreational fishery effort (as angler trips), SST harvest, and SST discards (as numbers of male and female fish) from the LA Creel survey (2014-2020) are presented (Table 1, Figure 1).

Recreational fishery effort varies by LA drainage basin with the majority of angler trips from 2014-2020 occurring in the Pontchartrain, Barataria, and Terrebonne basins (24%, 29%, and 21% respectively). Fishing effort in the Vermilion/Teche and Calcasieu/Sabine drainage basins, and the offshore waters of LA accounts for a much smaller fraction of the total LA recreational marine fishing effort (6%, 15%, and 5% respectively).

Recreational harvest and discards (2014-2020) also vary with LA drainage basins and follow similar trends with fishery effort with the majority of harvest and discards occurring in the Pontchartrain, Barataria, and Terrebonne basins (harvest: 30%, 30%, and 30% respectively, and discards: 28%, 32%, and 34% respectively). Catches from the Vermilion/Teche and Calcasieu/Sabine drainage basins, and the offshore waters of LA account for a much smaller percentage of the total LA recreational SST catch (harvest: 2%, 8%, and 1% respectively, and discards: 0.4%, 6%, and 0.1% respectively).

Female Harvest, Discards, and Age Composition

Annual basin-specific female SST harvest, discards, and corresponding age compositions of female removals (harvest + dead discards) derived from the LA Creel Survey and the LDWF Biological Sampling Program are presented (Table 2, Figure 2) along with the percentage of SST harvest taken by fishing mode (private versus charter). Due to the low SST catches that occur in the offshore waters of LA, offshore female SST landings and age compositions are not presented.

Pontchartrain Basin (CSA 1)

Female SST recreational harvest estimates in the Pontchartrain basin increased from 1.1 million females harvested in 2014 to 1.5 million females harvested in 2016. After 2016, female harvest decreased to a low of 0.58 million females estimated in 2018. The 2019 and 2020 harvest estimates are 0.69 and 0.84 million females respectively.

Female SST recreational discard estimates in the Pontchartrain basin follow a similar trend as the harvest estimates. Female discard estimates increased from 0.52 million females discarded in 2014 to 0.93 million females discarded in 2016. After 2016, female discards decreased to a low of 0.34 million females estimated in 2018. The 2019 and 2020 discard estimates are 0.35 and 0.59 million females respectively.

The age composition of the Pontchartrain basin female SST removals (harvest + dead discards) from 2014-2020 for age-0 through age-3+ fish are 1.2%, 57%, 37%, and 4.6% respectively.

The majority of the Pontchartrain basin female SST harvest (2014-2020) is taken by private anglers (92%).

Barataria Basin (CSA 3)

Female SST recreational harvest estimates in the Barataria basin increased from 0.55 million females harvested in 2014 to 1.4 million females harvested in 2016. After 2016, female harvest decreased to 0.62 million females estimated in 2018. The 2019 and 2020 harvest estimates are 1.1 and 0.88 million females respectively.

Female SST recreational discard estimates in the Barataria basin follow a similar trend as the harvest estimates. Female discard estimates increased from 0.61 million females discarded in 2014 to 0.82 million females discarded in 2016. After 2016, female discards decreased to a low of 0.23 million females estimated in 2018. The 2019 and 2020 discard estimates are 0.77 and 0.68 million females respectively.

The age composition of the Barataria basin female SST removals (harvest + dead discards) from 2014-2020 for age-0 through age-3+ fish are 1.5%, 65%, 29%, and 4.1% respectively.

The majority of the Barataria basin female SST harvest (2014-2020) is taken by private anglers (83%).

Terrebonne Basin (CSA 5)

Female SST recreational harvest estimates in the Terrebonne basin increased from 0.68 million females harvested in 2014 to 1.4 million females harvested in 2017. After 2017, female harvest decreased to 0.89 million females estimated in 2018. The 2019 and 2020 harvest estimates are 0.97 and 1.3 million females respectively.

Female SST recreational discard estimates in the Terrebonne basin follow a similar trend as the harvest estimates. Female discard estimates increased from 0.50 million females discarded in 2014 to 0.81 million females discarded in 2016. After 2016, female discards decreased to a low of 0.32 million females estimated in 2018. The 2019 and 2020 discard estimates are 0.95 and 0.97 million females respectively.

The age composition of the Terrebonne basin female SST removals (harvest + dead discards) from 2014-2020 for age-0 through age-3+ fish are 1.5%, 69%, 27%, and 2.6% respectively.

The majority of the Terrebonne basin female SST harvest (2014-2020) is taken by private anglers (85%).

Vermilion/Teche Basins (CSA 6)

Female SST recreational harvest estimates in the Vermilion/Teche basins decreased from 126 thousand females harvested in 2014 to 41 thousand females harvested in 2015. After 2015, female harvest increased to 87 thousand females estimated in 2017. The 2018-2020 harvest estimates are 29, 15, and 65 thousand females respectively.

Female SST recreational discard estimates in the Vermilion/Teche basins follow a similar trend as the harvest estimates. Female discard estimates increased from 6.8 thousand females discarded in 2014 to 11 thousand females discarded in 2015. After 2015, female discards decreased to a low of 5.4 thousand females estimated in 2018. The 2019 and 2020 discard estimates are 8.1 and 8.4 thousand females respectively.

The age composition of the female SST removals (harvest + dead discards) in the Vermilion/Teche basins from 2014-2020 for age-0 through age-3+ fish are 0.41%, 73%, 22%, and 4.5% respectively.

The female SST harvest (2014-2020) in the Vermilion/Teche basins is taken almost entirely by private anglers (99.5%).

Calcasieu/Sabine Basins (CSA 7)

Female SST recreational harvest estimates in the Calcasieu/Sabine basins increased from 243 thousand females harvested in 2014 to 329 thousand females harvested in 2017. After 2017, female harvest decreased to a low of 127 thousand females estimated in 2018. The 2019 and 2020 harvest estimates are 209 and 260 thousand females respectively.

Female SST recreational discard estimates in the Calcasieu/Sabine basins follow a similar trend as the harvest estimates. Female discard estimates increased from 122 thousand females discarded in 2014 to

153 thousand females discarded in 2015. After 2015, female discards decreased to a low of 64 thousand females estimated in 2018. The 2019 and 2020 discard estimates are 189 and 141 thousand females respectively.

The age composition of the female SST removals (harvest + dead discards) in the Calcasieu/Sabine basins from 2014-2020 for age-0 through age-3+ are 1.2%, 64%, 29%, and 6.2% respectively.

The female SST harvest (2014-2020) in the Calcasieu/Sabine basins is taken primarily by private anglers (66%).

Fishery-independent Information

Basin-specific female SST indices of abundance and corresponding age compositions of female SST catches from each mesh panel of the LDWF marine experimental gill net survey (1.0-inch, 1.25-inch, and 1.5-inch panels only) are presented (Tables 3-5 and Figures 3-5). Each abundance index time-series has been normalized to 1 to facilitate comparisons.

Pontchartrain Basin (CSA 1)

1.0-inch mesh panel
Annual female SST abundance index values estimated from of the 1.0-inch mesh panel of the Pontchartrain basin gillnet survey increased from 1.0 in 2014 to 1.1 in 2016. After 2016, abundance index values decreased to 0.82 estimated in 2017 and then increased to 1.2 estimated in 2018. The 2019 and 2020 abundance index values are 0.94 and 0.88.

The age composition of the female SST catches of the 1.0-inch mesh panel of the Pontchartrain basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.75%, 97%, 1.6%, and 0.67% respectively.

1.25-inch mesh panel
Annual female SST abundance index values estimated from of the 1.25-inch mesh panel of the Pontchartrain basin gillnet survey decreased from 0.98 in 2014 to 0.85 in 2015. After 2015, abundance index values increased to 0.97 estimated in 2016 and 1.4 estimated in 2017 and then decreased to 1.1 estimated in 2018. The 2019 and 2020 abundance index values are 0.62 and 1.2.

The age composition of the female SST catches of the 1.25-inch mesh panel of the Pontchartrain basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.25%, 97%, 11%, and 1.7% respectively.

1.5-inch mesh panel
Annual female SST abundance index values estimated from of the 1.5-inch mesh panel of the Pontchartrain basin gillnet survey decreased from 0.92 in 2014 to 0.91 in 2015. After 2015, abundance index values increased to 1.3 estimated in 2016 and 1.8 estimated in 2017 and then decreased to 0.62 estimated in 2018. The 2019 and 2020 abundance index values are 0.19 and 1.3.

The age composition of the female SST catches of the 1.5-inch mesh panel of the Pontchartrain basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 67%, 29%, and 4.4% respectively.

<u>*Barataria Basin (CSA 3)*</u>

1.0-inch mesh

Annual female SST abundance index values estimated from of the 1.0-inch mesh panel of the Barataria basin gillnet survey decreased from 0.96 in 2014 to 0.90 in 2015. After 2015, abundance index values increased to 1.2 estimated in 2016 and 2017 and then decreased to 0.71 estimated in 2018. The 2019 and 2020 abundance index values are 1.0 and 1.1.

The age composition of the female SST catches of the 1.0-inch mesh panel of the Barataria basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.23%, 96%, 3.0%, and 0.25% respectively.

1.25-inch mesh

Annual female SST abundance index values estimated from of the 1.25-inch mesh panel of the Barataria basin gillnet survey increased from 0.96 in 2014 to 1.1 in 2015. After 2015, abundance index values decreased to 0.93 estimated in 2016 and then increased to 1.2 estimated in 2017. The 2018- 2020 abundance index values are 1.0, 0.84, and 1.0 respectively.

The age composition of the female SST catches of the 1.25-inch mesh panel of the Barataria basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 94%, 5.9%, and 0.02% respectively.

1.5-inch mesh

Annual female SST abundance index values estimated from of the 1.5-inch mesh panel of the Barataria basin gillnet survey decreased from 1.4 in 2014 to 0.88 in 2015. After 2015, abundance index values increased to 0.96 estimated in 2016 and 1.6 estimated in 2017 and then decreased to 0.76 estimated in 2018 and 0.50 estimated in 2019. The 2020 abundance index value is 0.92.

The age composition of the female SST catches of the 1.5-inch mesh panel of the Barataria basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 68%, 32%, and 0.85% respectively.

<u>*Terrebonne Basin (CSA 5)*</u>

1.0-inch mesh

Annual female SST abundance index values estimated from of the 1.0-inch mesh panel of the Terrebonne basin gillnet survey decreased from 1.2 in 2014 to 0.53 in 2015. After 2015, abundance index values increased to 1.0 estimated in 2016 and 1.1 estimated in 2017 and then decreased to 0.44 estimated in 2018. The 2019 and 2020 abundance index values are 1.1 and 1.6.

The age composition of the female SST catches of the 1.0-inch mesh panel of the Terrebonne basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.22%, 97%, 3.1%, and 0.14% respectively.

1.25-inch mesh
Annual female SST abundance index values estimated from of the 1.25-inch mesh panel of the Terrebonne basin gillnet survey decreased from 1.2 in 2014 to 0.59 in 2015. After 2015, abundance index values increased to 0.72 estimated in 2016 and 1.0 estimated in 2017 and then decreased to 0.88 estimated in 2018 and 2019. The 2020 abundance index value is 1.7.
The age composition of the female SST catches of the 1.25-inch mesh panel of the Terrebonne basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.11%, 91%, 8.1%, and 0.59% respectively.

1.5-inch mesh
Annual female SST abundance index values estimated from of the 1.5-inch mesh panel of the Terrebonne basin gillnet survey decreased from 1.5 in 2014 to 0.86 in 2015 and 0.52 in 2016. After 2016, abundance index values increased to 1.1 estimated in 2017 and then decreased to 0.90 estimated in 2018 and 0.61 estimated in 2019. The 2020 abundance index value is 1.6.

The age composition of the female SST catches of the 1.5-inch mesh panel of the Terrebonne basin gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.68%, 62%, 35%, and 1.8% respectively.

Vermilion/Teche Basins (CSA 6)

1.0-inch mesh
Annual female SST abundance index values estimated from of the 1.0-inch mesh panel of the Vermilion/Teche basins gillnet survey decreased from 1.6 in 2014 to 0.51 in 2015. After 2015, abundance index values increased to 1.4 estimated in 2016 and then decreased to 1.0 estimated in 2017. The 2018-2020 abundance index values are 0.54, 0.70, and 1.2 respectively.

The age composition of the female SST catches of the 1.0-inch mesh panel of the Vermilion/Teche basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0.58%, 89%, 9.1%, and 1.2% respectively.

1.25-inch mesh
Annual female SST abundance index values estimated from of the 1.25-inch mesh panel of the Vermilion/Teche basins gillnet survey decreased from 1.2 in 2014 to 0.80 in 2015. After 2015, abundance index values increased to 1.5 estimated in 2016 and then decreased to 1.0 estimated in 2017 and 0.85 estimated in 2018. The 2019 and 2020 abundance index values are 0.73 and 0.91.

The age composition of the female SST catches of the 1.25-inch mesh panel of the Vermilion/Teche basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 84%, 15%, and 0.90% respectively.

1.5-inch mesh
Annual female SST abundance index values estimated from of the 1.5-inch mesh panel of the Vermilion/Teche basins gillnet survey decreased from 1.3 in 2014 to 0.93 in 2015 and 0.75 in 2016. After

2016, abundance index values increased to 1.4 estimated in 2017 and then decreased to 1.2 estimated in 2018 and 0.55 estimated in 2019. The 2020 abundance index value is 0.91.

The age composition of the female SST catches of the 1.5-inch mesh panel of the Vermilion/Teche basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 35%, 61%, and 3.8% respectively.

Calcasieu/Sabine Basins (CSA 7)

1.0-inch mesh

Annual female SST abundance index values estimated from of the 1.0-inch mesh panel of the Calcasieu/Sabine basins gillnet survey decreased from 1.7 in 2014 to 0.88 in 2015. After 2015, abundance index values increased to 1.0 estimated in 2016 and then decreased to 0.75 estimated in 2017 and 0.46 estimated in 2018. The 2019 and 2020 abundance index values are 0.92 and 1.3.

The age composition of the female SST catches of the 1.0-inch mesh panel of the Calcasieu/Sabine basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 80%, 8.0%, and 12% respectively.

1.25-inch mesh

Annual female SST abundance index values estimated from of the 1.25-inch mesh panel of the Calcasieu/Sabine basins gillnet survey decreased from 1.9 in 2014 to 0.84 in 2015. After 2015, abundance index values increased to 1.3 estimated in 2016 and then decreased to 0.75 estimated in 2017. The 2018-2020 abundance index values are 0.78, 0.67, and 0.79 respectively.

The age composition of the female SST catches of the 1.25-inch mesh panel of the Calcasieu/Sabine basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 77%, 20%, and 3.5% respectively.

1.5-inch mesh

Annual female SST abundance index values estimated from of the 1.5-inch mesh panel of the Calcasieu/Sabine basins gillnet survey decreased from 1.5 in 2014 to 0.77 in 2015. After 2015, abundance index values increased to 1.9 estimated in 2016 and then decreased to 0.80 estimated in 2017 and 0.67 estimated in 2018. The 2019 and 2020 abundance index values are 0.53 and 0.83.

The age composition of the female SST catches of the 1.5-inch mesh panel of the Calcasieu/Sabine basins gillnet survey from 2014-2020 for age-0 through age-3+ fish are 0%, 49%, 44%, and 8.1% respectively.

Tables:

Table 1: Annual basin-specific recreational fishing effort estimates (angler trips; top table), spotted seatrout harvest estimates (numbers of male and female fish; center table), and spotted seatrout discard estimates (numbers of male and female fish; bottom table). CSA 1 represents Pontchartrain basin, CSA 3 represents Barataria basin, CSA 5 represents Terrebonne basin, CSA 6 represents Vermilion/Teche basins, and CSA 7 represents Calcasieu/Sabine basins.

Marine Recreational Fishery Effort (number of angler trips):

Year	CSA 1	CSA 3	CSA 5	CSA 6	CSA 7	Offshore	Totals
2014	552,802	516,139	456,942	167,240	362,330	171,407	2,226,861
2015	584,987	716,714	452,291	138,546	393,296	140,459	2,426,292
2016	582,157	645,427	466,906	114,261	303,086	130,749	2,242,586
2017	532,832	697,968	446,958	179,957	347,370	100,985	2,306,069
2018	479,491	690,331	556,088	125,831	315,884	108,316	2,275,941
2019	490,411	638,076	480,277	93,897	293,421	112,381	2,108,462
2020	576,822	707,046	566,406	183,171	367,414	104,266	2,505,125

Spotted Seatrout Harvest (numbers of male and female fish):

Year	CSA 1	CSA 3	CSA 5	CSA 6	CSA 7	Offshore	Totals
2014	1,334,233	660,583	751,236	154,195	320,131	10,637	3,231,015
2015	1,397,377	1,304,600	1,079,507	51,255	421,625	39,052	4,293,416
2016	1,758,185	1,667,308	1,402,414	52,352	390,206	56,029	5,326,494
2017	1,393,041	1,660,878	1,519,482	121,868	417,754	22,706	5,135,729
2018	652,915	758,369	954,472	41,270	162,052	8,028	2,577,106
2019	800,492	1,254,731	1,202,587	15,586	251,016	17,231	3,541,643
2020	938,028	994,275	1,497,039	78,854	346,500	7,002	3,861,698

Spotted Seatrout Discards (numbers of male and female fish):

Year	CSA 1	CSA 3	CSA 5	CSA 6	CSA 7	Offshore	Totals
2014	954,375	1,123,645	911,426	12,171	223,156	2,603	3,227,377
2015	1,574,940	1,508,250	1,193,974	19,055	278,783	6,345	4,581,347
2016	1,704,350	1,522,343	1,467,565	16,834	261,015	3,822	4,975,929
2017	1,102,658	1,356,197	1,410,746	13,857	205,884	1,715	4,091,057
2018	625,451	423,021	592,700	9,919	113,511	822	1,765,424
2019	636,829	1,398,159	1,751,932	13,044	342,414	12,589	4,154,967
2020	1,079,790	1,247,013	1,790,960	15,133	249,169	1,885	4,383,950

Table 2: Annual basin-specific female spotted seatrout recreational harvest and discard estimates as numbers of fish, the percent of female harvest taken by fishing mode (private or charter), and the age composition of female removals (harvest + dead discards) with the corresponding female spotted seatrout sample sizes.

Pontchartrain (CSA 1)

Year	Harvest	Discards	% Harvest PR	% Harvest CH
2014	1,106,101	516,550	83.6%	16.4%
2015	1,200,555	852,803	93.5%	6.5%
2016	1,529,669	925,065	90.5%	9.5%
2017	1,168,229	600,380	91.7%	8.3%
2018	580,145	340,044	94.6%	5.4%
2019	691,112	347,602	91.2%	8.8%
2020	844,058	585,307	96.8%	3.2%

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	869	0.9%	51.0%	45.6%	2.5%
2015	1153	1.6%	57.8%	34.9%	5.7%
2016	1171	1.2%	49.4%	44.8%	4.6%
2017	814	0.8%	32.2%	61.6%	5.4%
2018	678	1.0%	76.6%	18.3%	4.1%
2019	456	1.6%	64.7%	27.4%	6.3%
2020	503	1.3%	68.1%	26.8%	3.7%

Barataria (CSA 3)

Year	Harvest	Discards	% Harvest PR	% Harvest CH
2014	554,137	606,601	82.5%	17.5%
2015	1,167,169	814,781	83.0%	17.0%
2016	1,436,878	822,952	82.2%	17.8%
2017	1,405,987	735,549	78.0%	22.0%
2018	615,336	232,184	83.6%	16.4%
2019	1,120,177	766,631	82.8%	17.2%
2020	879,460	678,597	87.7%	12.3%

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	850	2.0%	49.3%	43.7%	5.0%
2015	597	1.6%	77.1%	16.2%	5.0%
2016	922	1.0%	66.6%	28.8%	3.7%
2017	850	2.0%	60.5%	34.0%	3.6%
2018	576	1.3%	68.1%	24.5%	6.0%
2019	753	1.3%	87.5%	10.0%	1.2%
2020	633	1.1%	48.3%	46.8%	3.9%

Terrebonne (CSA 5)

Year	Harvest	Discards	% Harvest PR	% Harvest CH
2014	684,040	503,372	88.9%	11.1%
2015	903,841	655,534	82.1%	17.9%
2016	1,191,978	806,262	82.7%	17.3%
2017	1,351,941	762,623	84.0%	16.0%
2018	885,960	322,075	86.8%	13.2%
2019	965,125	945,610	83.9%	16.1%
2020	1,345,089	970,029	85.1%	14.9%

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	668	1.5%	68.2%	26.9%	3.3%
2015	778	2.3%	67.9%	27.6%	2.2%
2016	826	1.2%	81.4%	15.1%	2.3%
2017	497	0.9%	54.5%	42.4%	2.2%
2018	595	1.5%	68.6%	27.0%	2.9%
2019	490	1.7%	82.2%	14.4%	1.7%
2020	531	1.1%	61.2%	34.3%	3.3%

Vermilion/Teche (CSA 6)

Year	Harvest	Discards	% Harvest PR	% Harvest CH
2014	125,978	6,796	100.0%	0.0%
2015	41,170	10,555	100.0%	0.0%
2016	42,771	9,413	100.0%	0.0%
2017	86,586	7,580	100.0%	0.0%
2018	28,633	5,439	100.0%	0.0%
2019	14,756	8,065	100.0%	0.0%
2020	64,757	8,410	96.4%	3.6%

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	67	0.1%	68.5%	25.8%	5.7%
2015	309	0.5%	67.3%	25.1%	7.1%
2016	169	0.4%	78.5%	19.3%	1.8%
2017	209	0.1%	57.9%	29.9%	12.1%
2018	348	0.4%	73.3%	23.4%	2.9%
2019	486	0.8%	93.7%	4.9%	0.6%
2020	270	0.6%	69.7%	28.1%	1.5%

Calcasieu/Sabine (CSA 7)

Year	Harvest	Discards	% Harvest PR	% Harvest CH
2014	242,928	122,238	70.4%	29.6%
2015	322,252	153,007	63.2%	36.8%
2016	291,478	143,164	62.8%	37.2%
2017	328,567	113,401	63.3%	36.7%
2018	127,091	64,325	52.0%	48.0%
2019	208,997	188,926	75.5%	24.5%
2020	259,872	140,712	71.9%	28.1%

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	640	0.9%	74.8%	17.3%	7.0%
2015	740	0.9%	50.6%	40.9%	7.6%
2016	802	0.9%	63.3%	26.9%	9.0%
2017	463	0.6%	57.2%	34.6%	7.6%
2018	488	2.4%	68.5%	23.7%	5.4%
2019	482	1.9%	84.3%	9.7%	4.1%
2020	371	0.7%	46.1%	50.2%	3.1%

Table 3: Annual basin-specific sample sizes, nominal proportion of positive samples and nominal CPUEs of positive samples, indices of abundance and corresponding coefficients of variation, and the age composition of the female catches with the corresponding female spotted seatrout sample sizes from the 1.0-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Nominal CPUE and abundance indices have been normalized to their individual long-term means for comparison.

Pontchartrain (CSA 1) 1.0-inch mesh:

Year	n	%Pos	CPUE	IOA	CV	Year	n	Age-0	Age-1	Age-2	Age-3+
2014	179	25.7%	0.92	1.01	0.12	2014	80	0.0%	98.8%	1.2%	0.0%
2015	180	18.3%	1.10	1.01	0.15	2015	68	0.7%	96.3%	1.6%	1.4%
2016	182	24.2%	1.00	1.12	0.12	2016	83	1.2%	98.8%	0.0%	0.0%
2017	177	19.8%	0.88	0.82	0.14	2017	58	0.0%	94.9%	5.0%	0.0%
2018	180	23.3%	1.24	1.23	0.13	2018	98	0.0%	100.0%	0.0%	0.0%
2019	179	20.1%	0.89	0.94	0.14	2019	60	0.0%	98.3%	0.0%	1.7%
2020	180	18.3%	0.97	0.88	0.15	2020	61	3.3%	91.9%	3.2%	1.7%

Barataria (CSA 3) 1.0-inch mesh:

Year	n	%Pos	CPUE	IOA	CV	Year	n	Age-0	Age-1	Age-2	Age-3+
2014	170	33.5%	0.84	0.96	0.17	2014	129	0.0%	96.9%	3.1%	0.0%
2015	169	33.1%	0.99	0.90	0.18	2015	149	0.3%	97.0%	2.0%	0.6%
2016	167	43.1%	0.99	1.18	0.15	2016	191	0.3%	96.7%	3.0%	0.0%
2017	168	37.5%	1.31	1.17	0.16	2017	221	0.0%	95.5%	3.5%	1.1%
2018	168	29.8%	0.69	0.71	0.19	2018	93	0.5%	93.2%	6.2%	0.0%
2019	168	33.3%	1.31	1.00	0.18	2019	197	0.5%	98.0%	1.4%	0.0%
2020	152	38.8%	0.87	1.08	0.17	2020	138	0.0%	98.0%	2.0%	0.0%

Terrebonne (CSA 5) 1.0-inch mesh:

Year	n	%Pos	CPUE	IOA	CV	Year	n	Age-0	Age-1	Age-2	Age-3+
2014	60	56.7%	1.09	1.19	0.26	2014	156	0.0%	98.7%	1.3%	0.0%
2015	61	34.4%	0.79	0.53	0.36	2015	70	0.0%	92.6%	7.4%	0.0%
2016	61	63.9%	0.73	1.03	0.23	2016	120	0.0%	99.2%	0.8%	0.0%
2017	59	52.5%	1.29	1.08	0.28	2017	168	0.0%	97.8%	2.2%	0.0%
2018	60	33.3%	0.59	0.44	0.37	2018	50	1.5%	92.5%	5.2%	0.9%
2019	60	58.3%	1.10	1.14	0.25	2019	162	0.0%	99.4%	0.6%	0.0%
2020	60	65.0%	1.41	1.59	0.23	2020	232	0.0%	95.6%	4.4%	0.0%

Vermilion/Teche (CSA 6) 1.0-inch mesh:

Year	n	%Pos	CPUE	IOA	CV	Year	n	Age-0	Age-1	Age-2	Age-3+
2014	108	22.2%	1.15	1.63	0.28	2014	50	2.0%	96.0%	2.0%	0.0%
2015	108	10.2%	0.62	0.51	0.44	2015	12	0.0%	83.6%	13.2%	3.2%
2016	108	18.5%	1.35	1.43	0.31	2016	49	2.1%	93.9%	4.0%	0.0%
2017	108	15.7%	0.88	1.00	0.34	2017	27	0.0%	96.2%	2.3%	1.5%
2018	108	8.3%	1.08	0.54	0.49	2018	18	0.0%	77.8%	21.7%	0.5%
2019	120	11.7%	1.09	0.70	0.38	2019	28	0.0%	92.8%	7.1%	0.1%
2020	120	20.0%	0.83	1.18	0.29	2020	36	0.0%	83.7%	13.5%	2.8%

Calcasieu/Sabine (CSA 7) 1.0-inch mesh:

Year	n	%Pos	CPUE	IOA	CV	Year	n	Age-0	Age-1	Age-2	Age-3+
2014	108	40.7%	0.86	1.67	0.16	2014	74	0.0%	91.9%	4.1%	4.0%
2015	108	18.5%	1.31	0.88	0.26	2015	51	0.0%	66.6%	2.3%	31.1%
2016	108	21.3%	1.28	1.04	0.24	2016	58	0.0%	86.4%	10.1%	3.5%
2017	108	19.4%	0.78	0.75	0.26	2017	32	0.0%	50.9%	21.4%	27.8%
2018	108	13.0%	0.66	0.46	0.32	2018	18	0.0%	78.0%	5.7%	16.3%
2019	121	23.1%	1.03	0.92	0.22	2019	57	0.0%	96.6%	3.4%	0.0%
2020	100	28.0%	1.08	1.28	0.21	2020	59	0.0%	90.2%	9.1%	0.7%

Table 4: Annual basin-specific sample sizes, nominal proportion of positive samples and nominal CPUEs of positive samples, indices of abundance and corresponding coefficients of variation, and the age composition of the female catches with the corresponding female spotted seatrout sample sizes from the 1.25-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Nominal CPUE and abundance indices have been normalized to their individual long-term means for comparison.

Pontchartrain (CSA 1) 1.25-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	179	20.7%	0.88	0.98	0.20
2015	180	18.9%	0.81	0.85	0.21
2016	182	18.1%	1.16	0.97	0.21
2017	177	23.2%	1.08	1.36	0.19
2018	180	20.0%	0.98	1.06	0.20
2019	179	11.7%	1.00	0.62	0.27
2020	180	20.0%	1.10	1.16	0.20

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	67	0.0%	86.8%	11.7%	1.5%
2015	56	1.8%	73.8%	19.5%	5.0%
2016	78	0.0%	91.2%	8.7%	0.0%
2017	91	0.0%	84.1%	14.8%	1.1%
2018	72	0.0%	89.1%	6.8%	4.1%
2019	43	0.0%	97.6%	2.4%	0.0%
2020	81	0.0%	85.8%	14.2%	0.0%

Barataria (CSA 3) 1.25-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	170	27.6%	1.02	0.96	0.19
2015	169	32.5%	0.88	1.06	0.17
2016	167	30.5%	0.81	0.93	0.18
2017	168	34.5%	1.46	1.22	0.17
2018	168	32.1%	0.82	1.00	0.18
2019	168	28.0%	1.08	0.84	0.19
2020	152	30.9%	0.93	1.00	0.19

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	137	0.0%	95.0%	5.0%	0.0%
2015	138	0.0%	90.3%	9.7%	0.0%
2016	118	0.0%	95.0%	5.0%	0.0%
2017	242	0.0%	82.8%	17.2%	0.1%
2018	126	0.0%	96.9%	3.1%	0.0%
2019	145	0.0%	100.0%	0.0%	0.0%
2020	124	0.0%	98.3%	1.7%	0.0%

Terrebonne (CSA 5) 1.25-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	60	68.3%	0.75	1.21	0.17
2015	61	27.9%	1.03	0.59	0.31
2016	61	42.6%	0.66	0.72	0.24
2017	59	49.2%	0.81	1.03	0.22
2018	60	38.3%	1.01	0.88	0.26
2019	60	43.3%	0.84	0.88	0.24
2020	60	60.0%	1.90	1.70	0.19

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	116	0.0%	95.6%	2.4%	2.0%
2015	66	0.0%	83.9%	16.0%	0.1%
2016	65	0.8%	93.3%	5.9%	0.0%
2017	89	0.0%	90.2%	9.3%	0.5%
2018	87	0.0%	90.6%	8.3%	1.1%
2019	82	0.0%	94.1%	5.9%	0.0%
2020	258	0.0%	90.8%	8.9%	0.4%

Vermilion/Teche (CSA 6) 1.25-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	108	28.7%	0.82	1.24	0.14
2015	108	13.0%	1.10	0.80	0.23
2016	108	16.7%	1.58	1.46	0.20
2017	108	21.3%	0.84	1.00	0.17
2018	108	17.6%	0.94	0.85	0.19
2019	120	16.7%	0.76	0.73	0.19
2020	120	20.0%	0.97	0.91	0.17

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	60	0.0%	83.7%	16.3%	0.0%
2015	37	0.0%	89.3%	10.6%	0.1%
2016	67	0.0%	83.9%	13.8%	2.3%
2017	46	0.0%	76.1%	22.7%	1.2%
2018	42	0.0%	72.1%	25.5%	2.5%
2019	36	0.0%	97.4%	2.6%	0.0%
2020	55	0.0%	84.3%	15.6%	0.2%

Calcasieu/Sabine (CSA 7) 1.25-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	108	38.0%	1.14	1.85	0.17
2015	108	17.6%	0.99	0.84	0.27
2016	108	25.0%	1.33	1.31	0.22
2017	108	15.7%	1.02	0.75	0.29
2018	108	14.8%	1.12	0.78	0.30
2019	121	17.4%	0.74	0.67	0.26
2020	100	22.0%	0.66	0.79	0.25

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	100	0.0%	73.3%	21.2%	5.5%
2015	40	0.0%	87.9%	9.5%	2.6%
2016	76	0.0%	66.5%	29.6%	3.9%
2017	37	0.0%	83.8%	7.4%	8.8%
2018	38	0.0%	64.2%	35.6%	0.2%
2019	33	0.0%	73.2%	23.6%	3.2%
2020	31	0.0%	87.5%	12.4%	0.1%

Table 5: Annual basin-specific sample sizes, nominal proportion of positive samples and nominal CPUEs of positive samples, indices of abundance and corresponding coefficients of variation, and the age composition of the female catches with the corresponding female spotted seatrout sample sizes from the 1.5-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Nominal CPUE and abundance indices have been normalized to their individual long-term means for comparison.

Pontchartrain (CSA 1) 1.5-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	179	10.6%	0.82	0.92	0.21
2015	180	9.4%	0.88	0.91	0.23
2016	182	11.0%	1.20	1.29	0.21
2017	177	18.1%	0.96	1.82	0.16
2018	180	5.6%	1.00	0.62	0.30
2019	179	1.7%	0.93	0.19	0.56
2020	180	9.4%	1.21	1.25	0.23

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	28	0.0%	85.9%	14.0%	0.0%
2015	27	0.0%	66.7%	24.4%	8.8%
2016	43	0.0%	58.8%	33.9%	7.3%
2017	55	0.0%	71.5%	24.7%	3.8%
2018	18	0.0%	56.5%	32.7%	10.8%
2019	5	0.0%	60.7%	39.2%	0.1%
2020	37	0.0%	68.4%	31.6%	0.1%

Barataria (CSA 3) 1.5-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	170	14.1%	1.22	1.40	0.26
2015	169	12.4%	0.78	0.88	0.28
2016	167	13.8%	0.88	0.96	0.27
2017	168	15.5%	1.62	1.58	0.25
2018	168	9.5%	0.93	0.76	0.33
2019	168	6.5%	0.88	0.50	0.40
2020	152	14.5%	0.70	0.92	0.28

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	67	0.0%	78.0%	21.9%	0.1%
2015	38	0.0%	71.4%	28.4%	0.3%
2016	46	0.0%	74.5%	24.6%	0.9%
2017	96	0.0%	40.4%	58.3%	1.3%
2018	34	0.0%	62.5%	34.5%	3.0%
2019	22	0.0%	68.9%	30.9%	0.2%
2020	35	0.0%	77.5%	22.4%	0.2%

Terrebonne (CSA 5) 1.5-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	59	22.0%	1.13	1.47	0.33
2015	61	13.1%	1.15	0.86	0.44
2016	61	14.8%	0.43	0.52	0.41
2017	59	25.4%	0.56	1.08	0.31
2018	60	15.0%	1.39	0.90	0.41
2019	60	11.7%	1.05	0.61	0.47
2020	60	20.0%	1.29	1.55	0.35

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	40	0.0%	51.3%	47.5%	1.2%
2015	25	0.0%	76.3%	20.0%	3.8%
2016	11	4.8%	56.5%	37.2%	1.5%
2017	23	0.0%	65.5%	29.1%	5.3%
2018	34	0.0%	57.1%	42.8%	0.1%
2019	20	0.0%	55.2%	44.3%	0.5%
2020	42	0.0%	74.3%	25.4%	0.3%

Vermilion/Teche (CSA 6) 1.5-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	108	17.6%	1.08	1.28	0.23
2015	108	13.9%	0.73	0.93	0.27
2016	107	10.3%	0.88	0.75	0.32
2017	108	12.0%	1.55	1.38	0.29
2018	108	17.6%	1.06	1.20	0.23
2019	120	7.5%	0.88	0.55	0.35
2020	120	14.2%	0.83	0.91	0.25

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	47	0.0%	32.5%	62.8%	4.7%
2015	25	0.0%	29.8%	69.5%	0.8%
2016	22	0.0%	28.5%	65.7%	5.8%
2017	46	0.0%	32.9%	59.5%	7.6%
2018	46	0.0%	34.2%	64.3%	1.6%
2019	18	0.0%	67.1%	32.4%	0.5%
2020	32	0.0%	20.5%	73.9%	5.6%

Calcasieu/Sabine (CSA 7) 1.5-inch mesh:

Year	n	%Pos	CPUE	IOA	CV
2014	108	18.5%	1.34	1.49	0.30
2015	108	11.1%	0.80	0.77	0.40
2016	108	18.5%	1.47	1.90	0.30
2017	108	12.0%	0.74	0.80	0.38
2018	108	11.1%	0.65	0.67	0.40
2019	121	6.6%	1.37	0.53	0.50
2020	100	14.0%	0.65	0.83	0.36

Year	n	Age-0	Age-1	Age-2	Age-3+
2014	59	0.0%	33.7%	51.9%	14.4%
2015	21	0.0%	34.4%	41.8%	23.8%
2016	64	0.0%	30.6%	55.9%	13.4%
2017	21	0.0%	44.6%	55.3%	0.1%
2018	17	0.0%	48.1%	51.6%	0.3%
2019	24	0.0%	67.4%	28.4%	4.2%
2020	20	0.0%	80.4%	19.5%	0.0%

Figures:

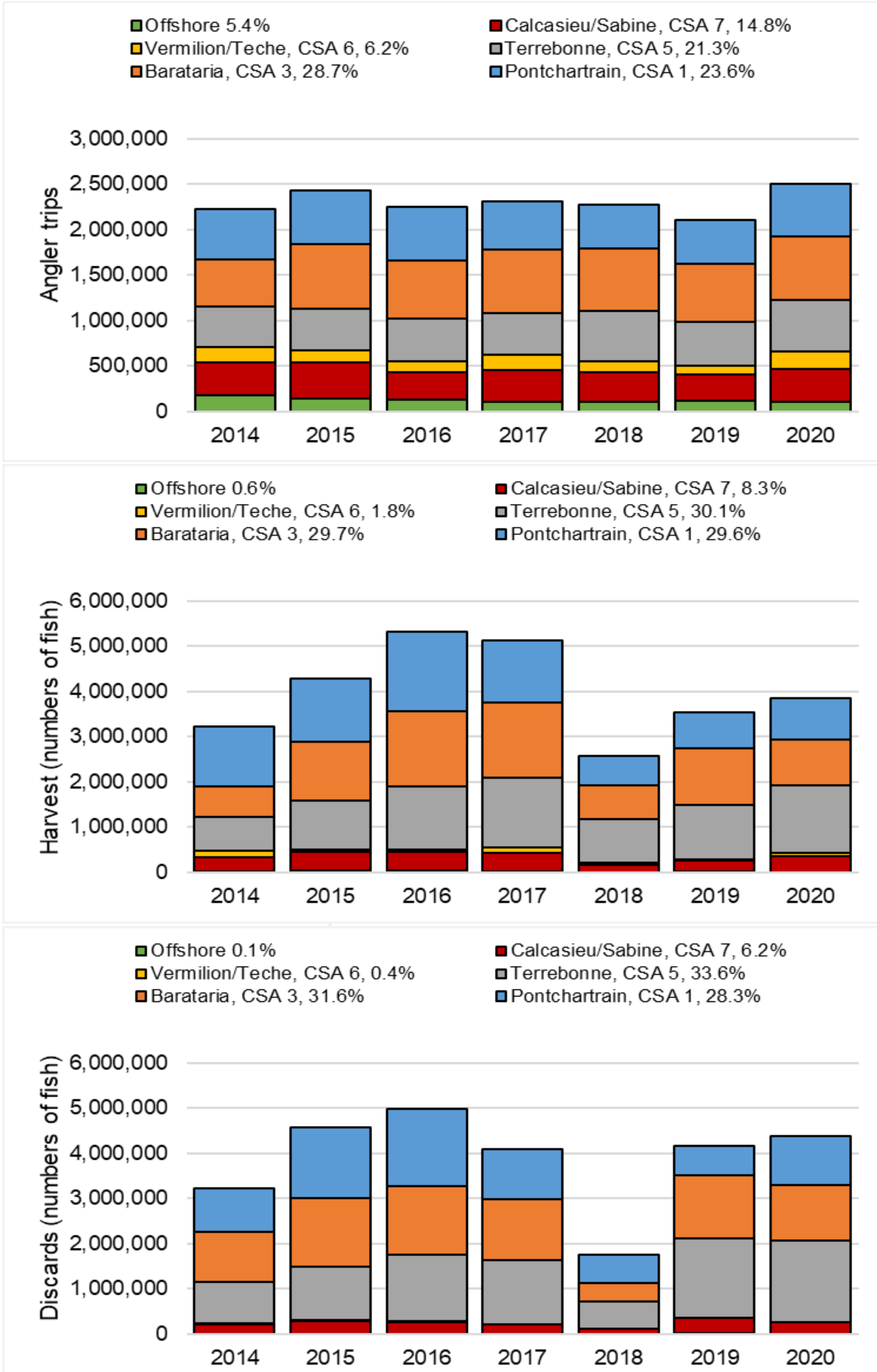
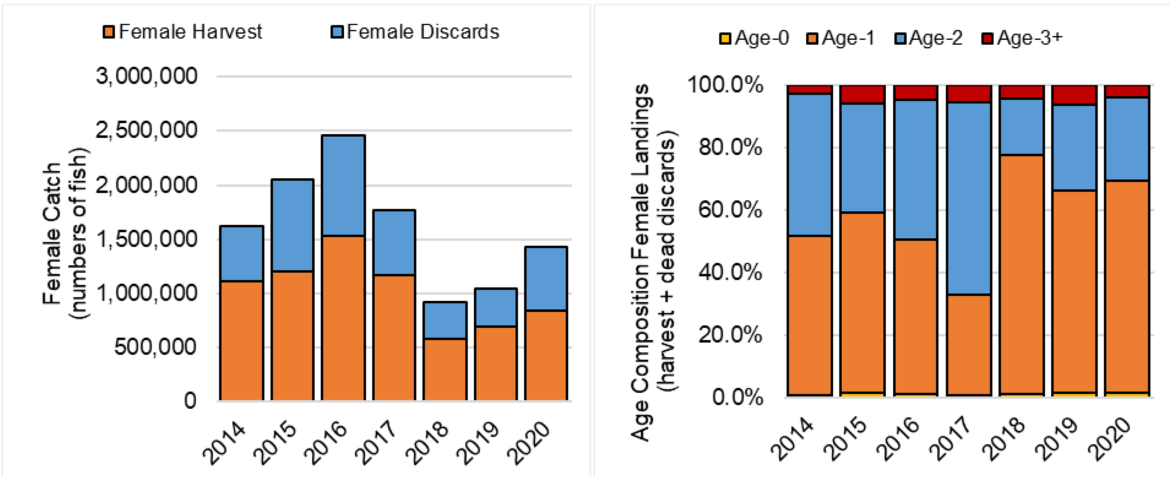
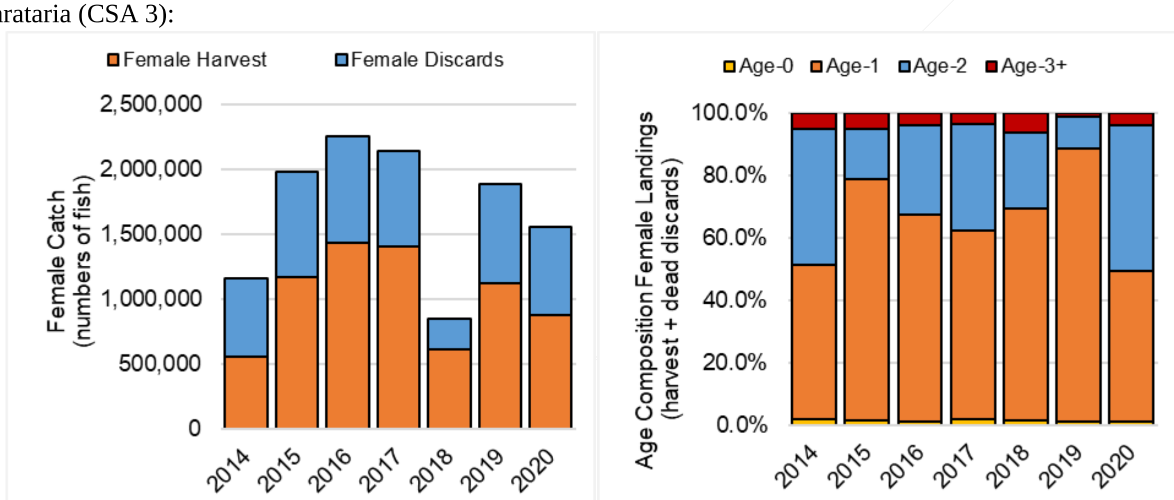


Figure 1: Annual basin-specific recreational fishing effort estimates (angler trips; top graphic), spotted seatrout harvest estimates (numbers of male and female fish; center graphic), and spotted seatrout discard estimates (numbers of male and female fish; bottom graphic). Values in legends represent the mean percentages of the time series (2014-2020).

Pontchartrain (CSA 1):



Barataria (CSA 3):



Terrebonne (CSA 5):

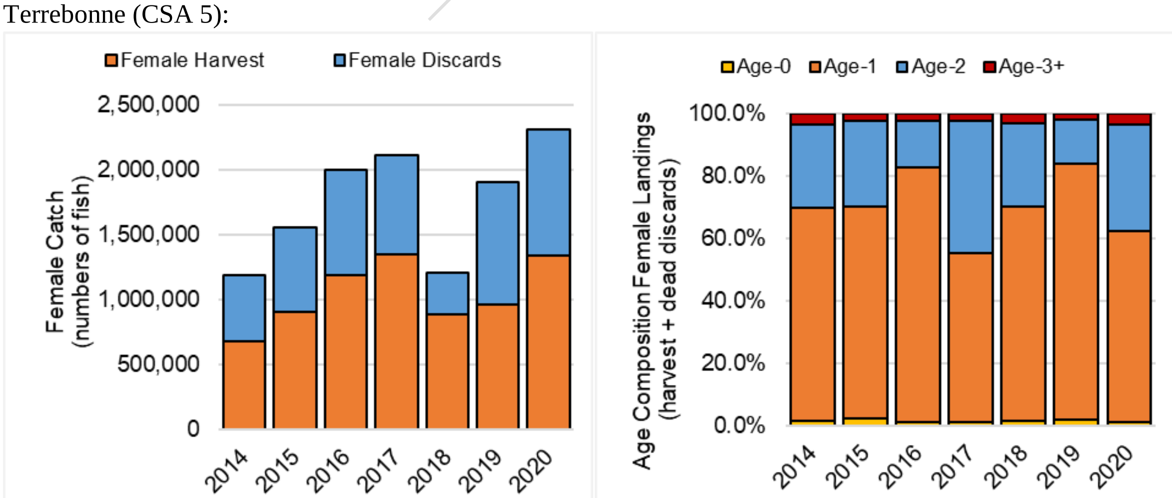
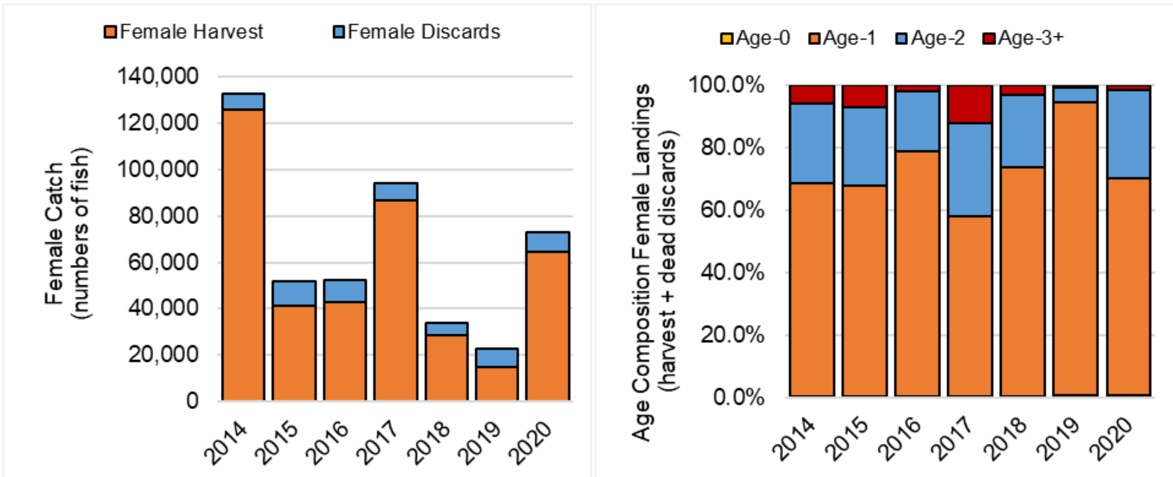


Figure 2: Annual basin-specific female spotted seatrout recreational catch estimates (harvest and discards) as numbers of fish, and the age composition of female landings (harvest + dead discards).

Vermilion/Teche (CSA 6):



Calcasieu/Sabine (CSA 7):

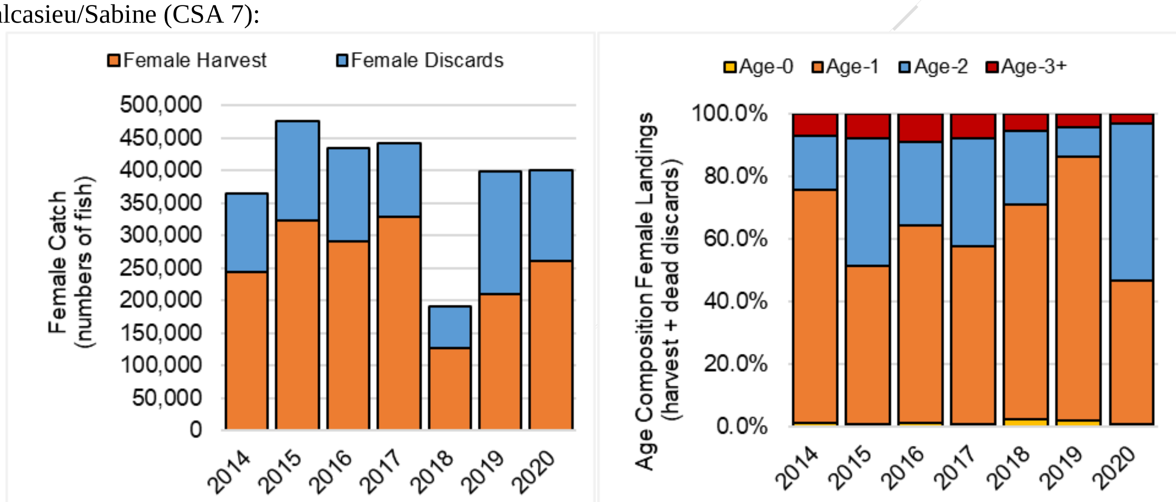
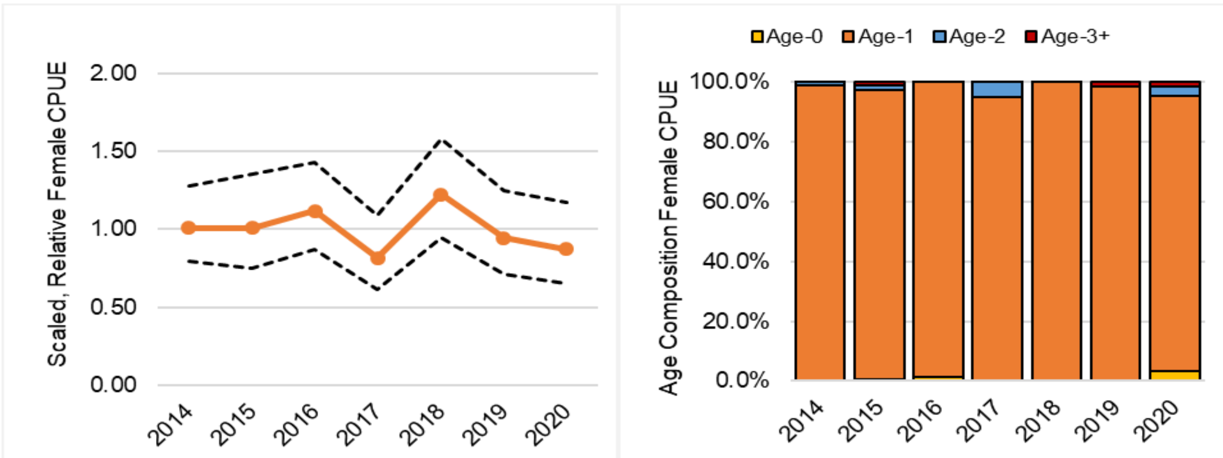
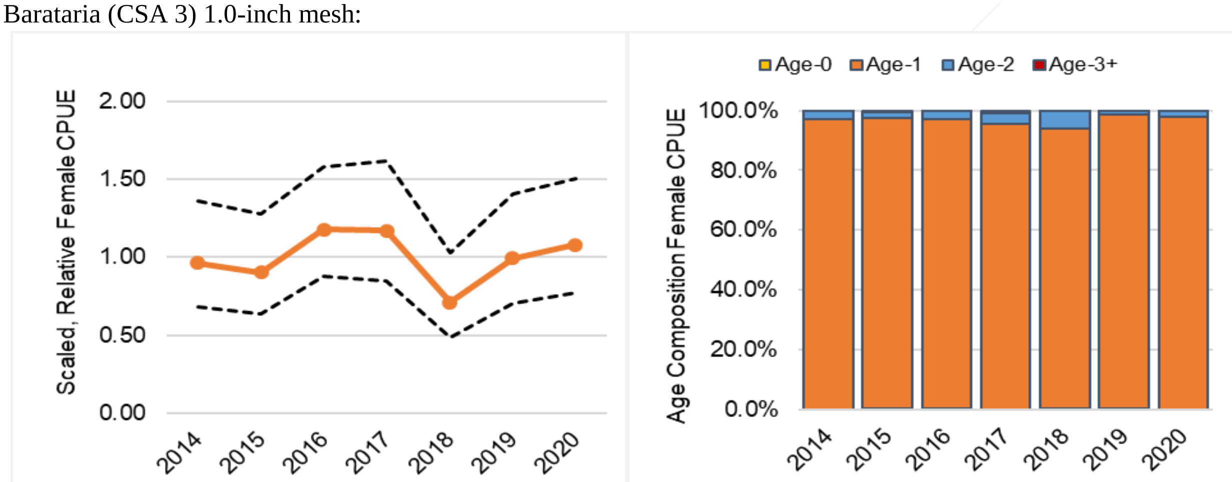


Figure 2: (continued)

Pontchartrain (CSA 1) 1.0-inch mesh:



Barataria (CSA 3) 1.0-inch mesh:



Terrebonne (CSA 5) 1.0-inch mesh:

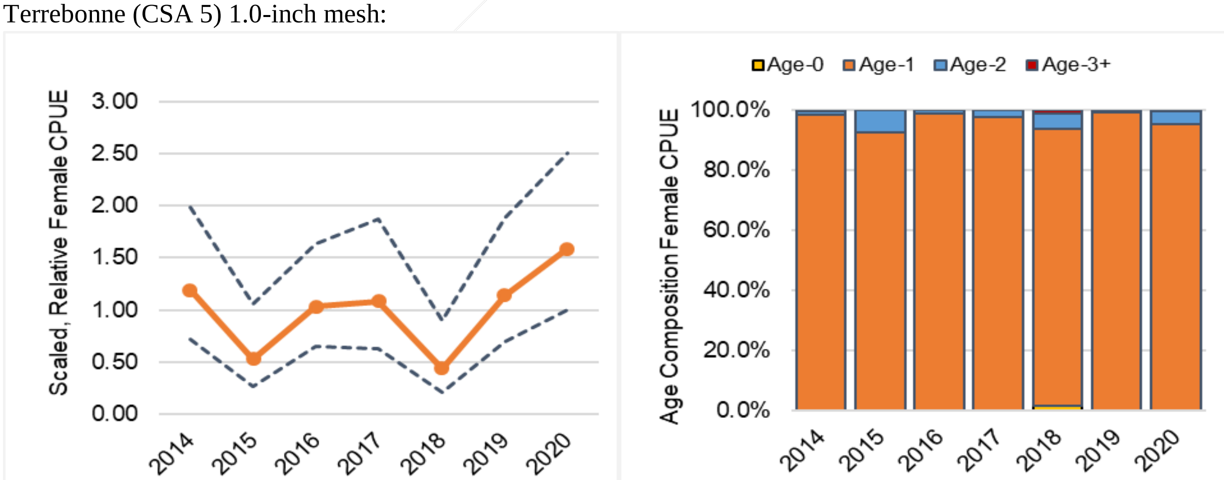
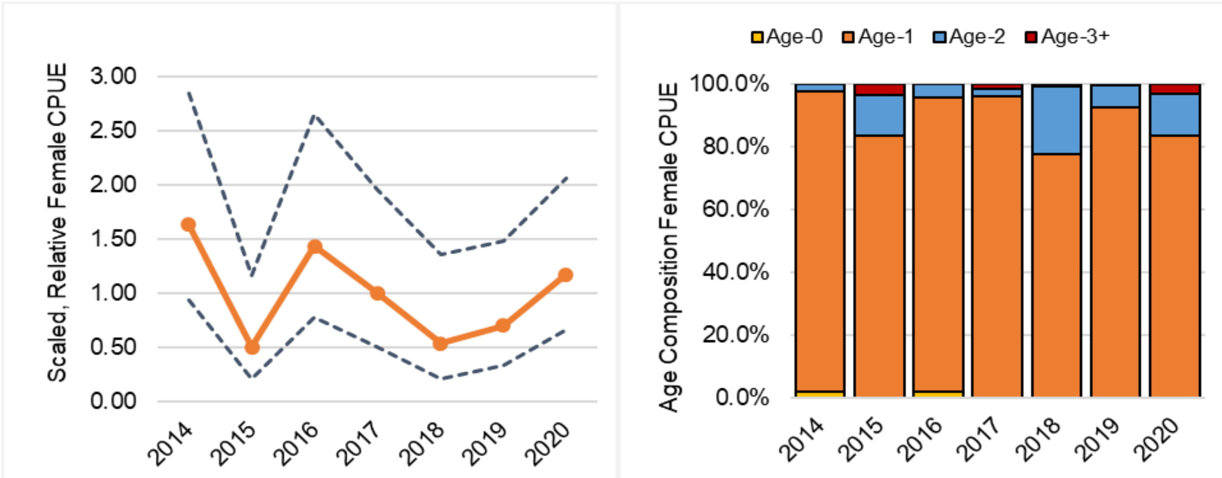


Figure 3: Annual basin-specific indices of abundance and 95% confidence intervals, and the age composition of the female catches derived from the 1.0-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Abundance indices have been normalized to their individual long-term means

Vermilion/Teche (CSA 6) 1.0-inch mesh:



Calcasieu/Sabine (CSA 7) 1.0-inch mesh:

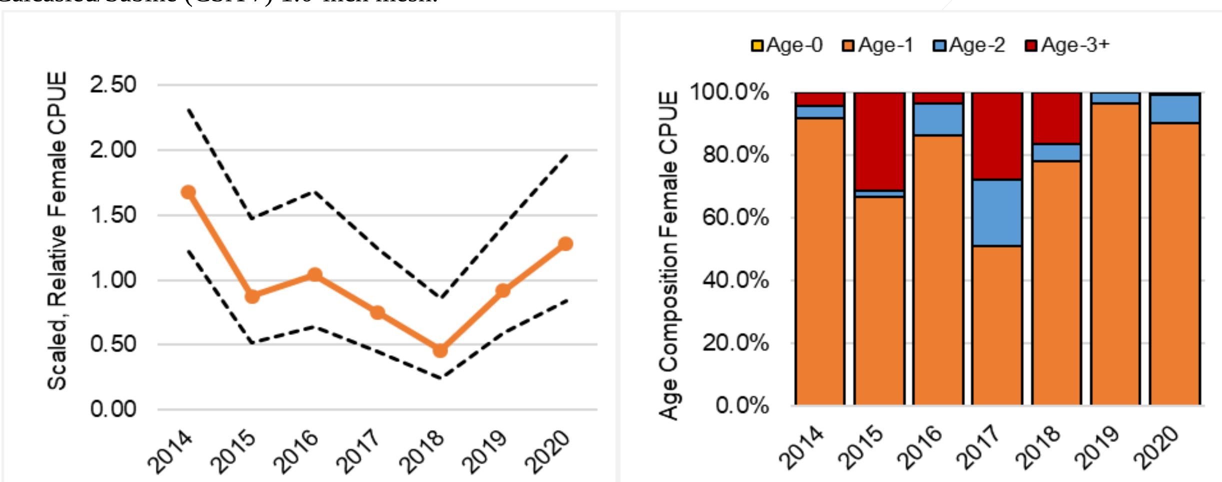
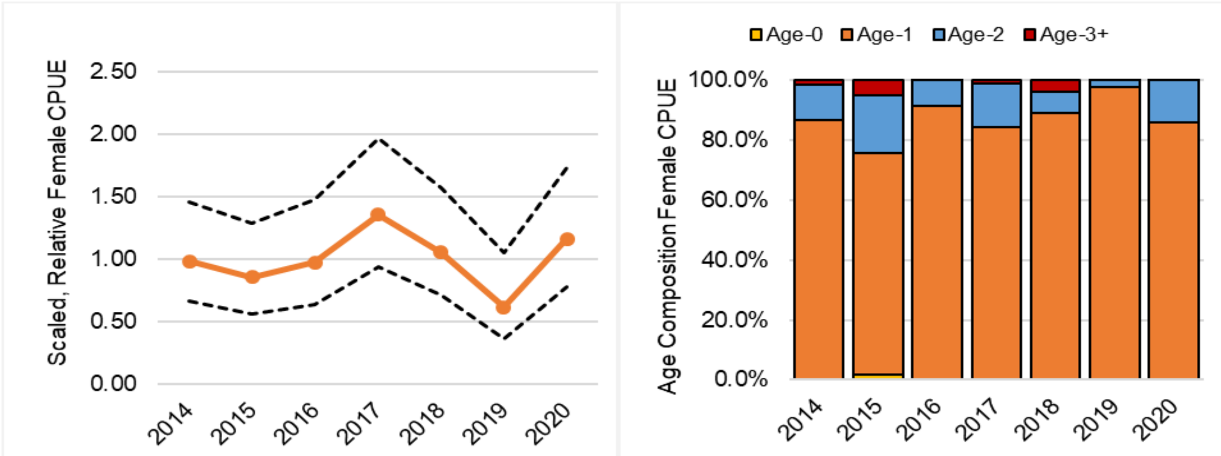
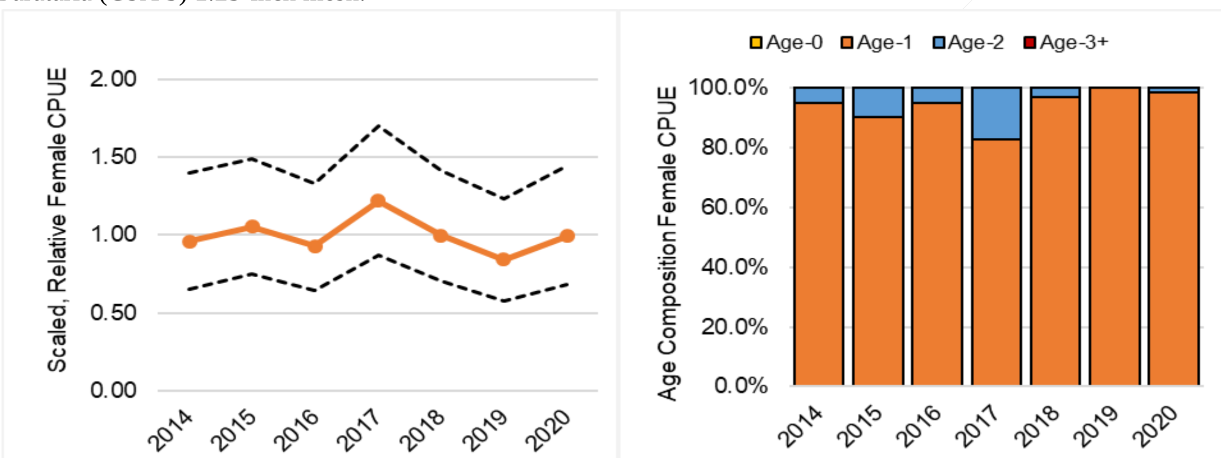


Figure 3: (continued)

Pontchartrain (CSA 1) 1.25-inch mesh:



Barataria (CSA 3) 1.25-inch mesh:



Terrebonne (CSA 5) 1.25-inch mesh:

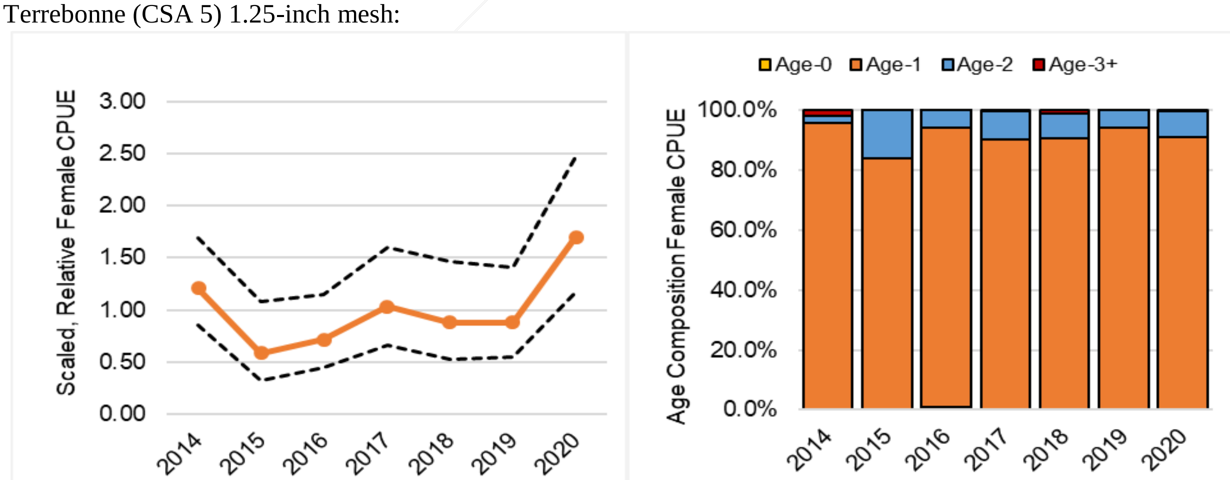
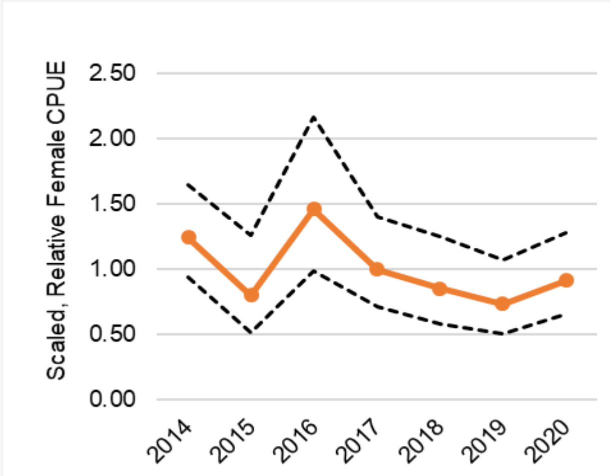
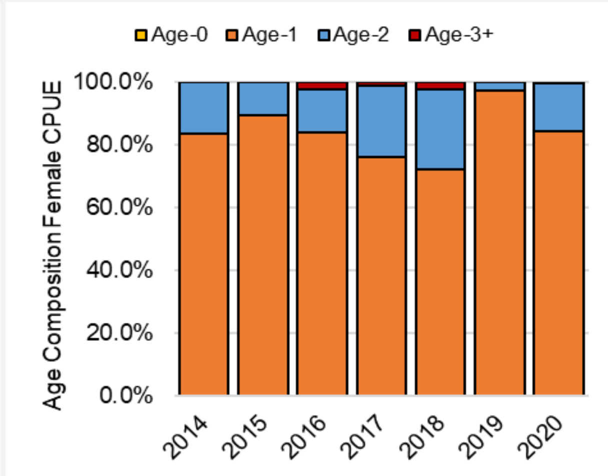


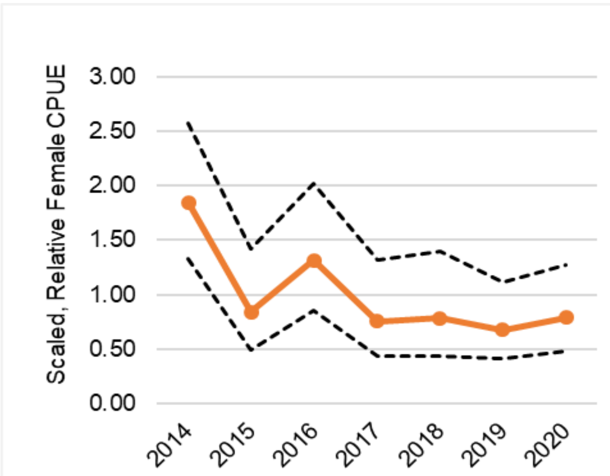
Figure 4: Annual basin-specific indices of abundance and 95% confidence intervals, and the age composition of the female catches derived from the 1.25-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Abundance indices have been normalized to their individual long-term means

Vermilion/Teche (CSA 6) 1.25-inch mesh:





Calcasieu/Sabine (CSA 7) 1.25-inch mesh:



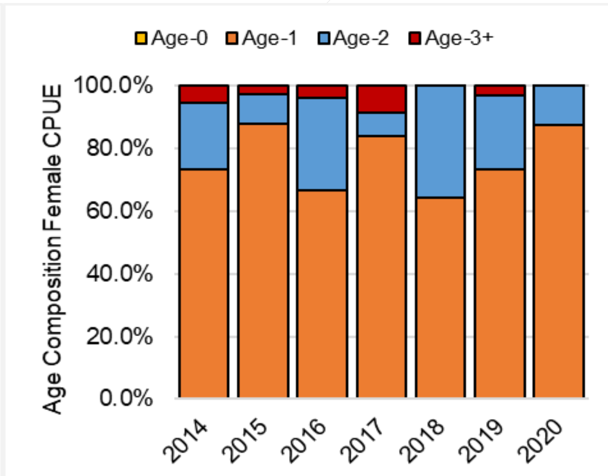
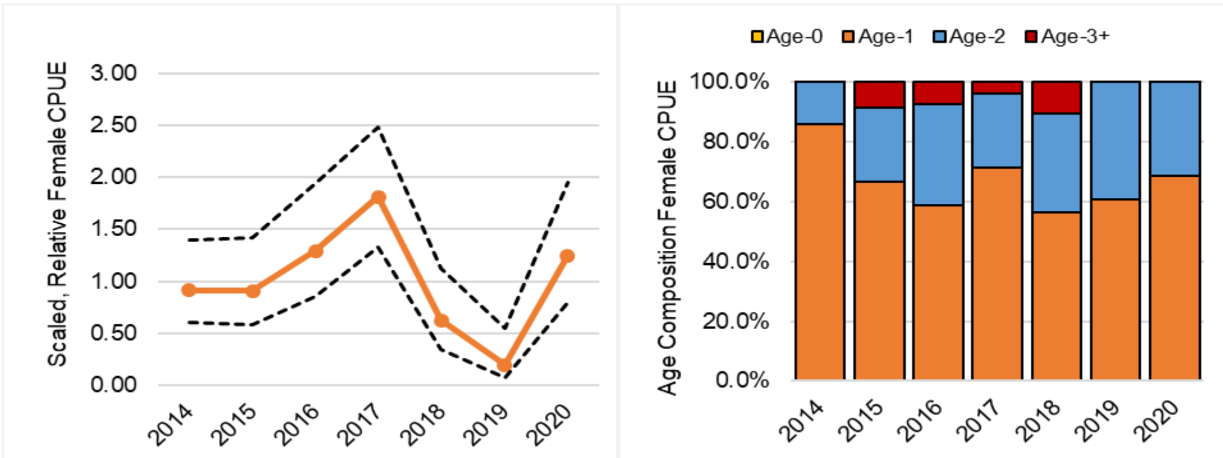
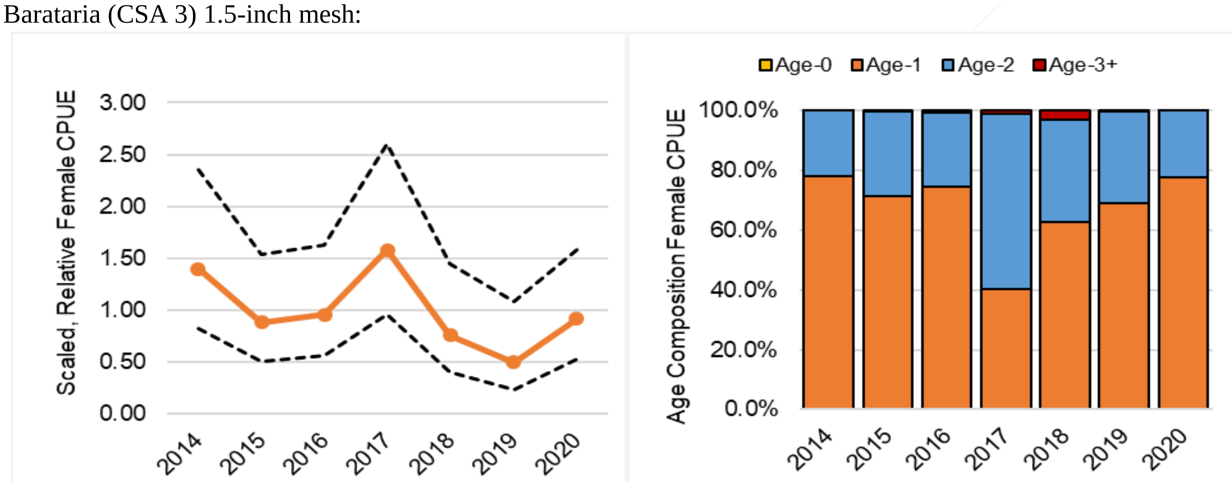


Figure 4: (continued)

Pontchartrain (CSA 1) 1.5-inch mesh:



Barataria (CSA 3) 1.5-inch mesh:



Terrebonne (CSA 5) 1.5-inch mesh:

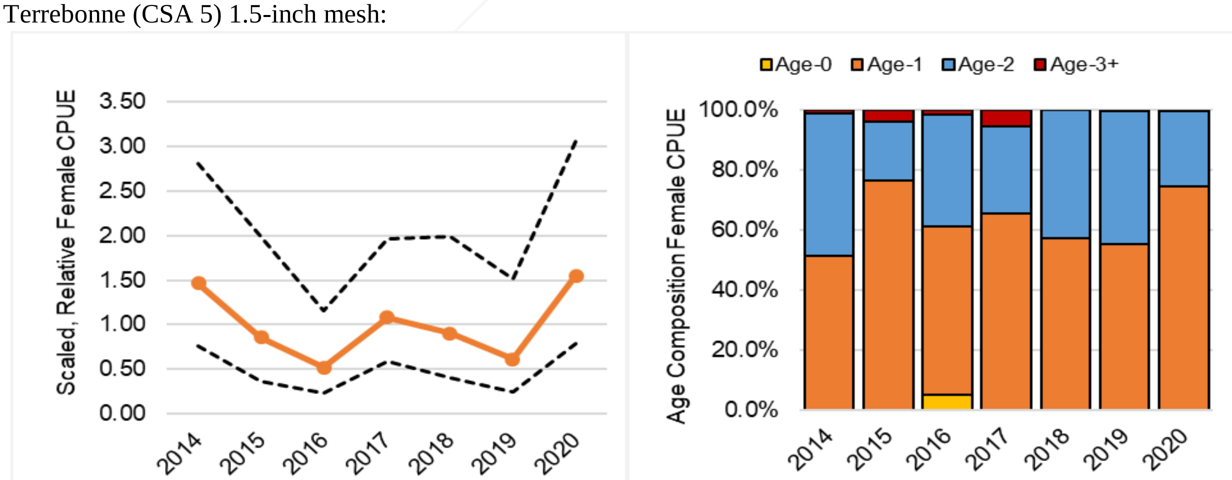
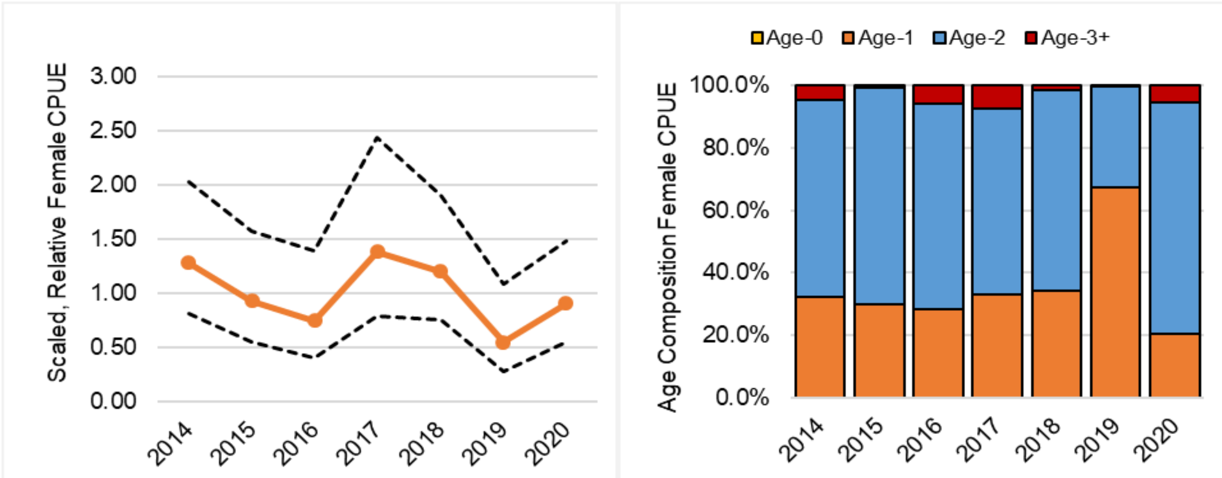


Figure 5: Annual basin-specific indices of abundance and 95% confidence intervals, and the age composition of the female catches derived from the 1.5-inch mesh panel of the LDWF fishery-independent marine gillnet survey. Abundance indices have been normalized to their individual long-term means

Vermilion/Teche (CSA 6) 1.5-inch mesh:



Calcasieu/Sabine (CSA 7) 1.5-inch mesh:

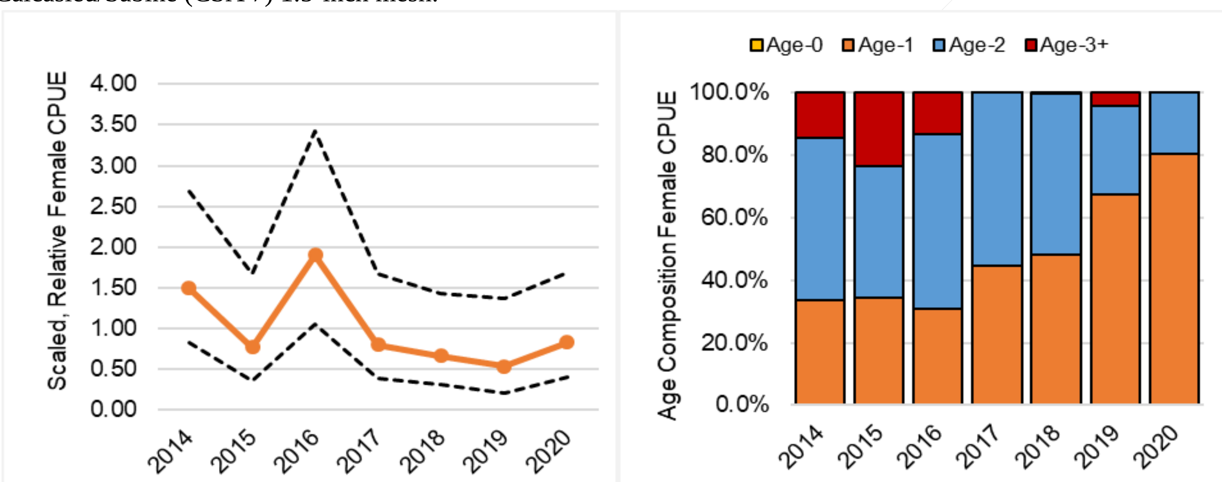


Figure 5: (continued)