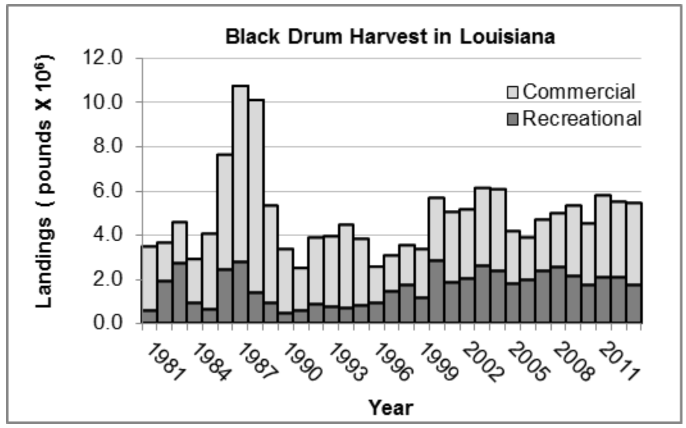
Assessment of Black Drum *Pogonias cromis* in Louisiana Waters
2015 Report

Executive Summary

Landings of black drum in Louisiana have remained above 4 million pounds per year in the most recent decade with the exception of 2006. The highest harvests on record (over 10 million pounds) occurred in 1987 and 1988. After commercial regulations were enacted during the 1980s, black drum landings substantially declined. In the most recent years, recreational landings comprise approximately one third of the total Louisiana black drum harvest.



A statistical catch-at-age model is used in this stock assessment update to describe the dynamics of the of the Louisiana black drum stock from 1985-2013. The assessment model 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. Minimum data requirements are fishery catch-at-age and an index of abundance. Landings are taken from the Louisiana Department of Wildlife and Fisheries Trip Ticket Program, National Marine Fisheries Service commercial statistical records, and the NMFS Marine Recreational Information Program. An index of abundance is developed from the LDWF marine trammel net survey. Age composition of fishery catches are estimated with age-length-keys derived from samples directly of the fishery and a von Bertalanffy growth function.

The conservation threshold established by the Louisiana Legislature for black drum is a 30% spawning potential ratio. Based on results of this assessment, the Louisiana black drum stock is currently neither overfished or experiencing overfishing. The current spawning potential ratio estimate is 36%.

Summary of Changes from 2010 Assessment

In prior assessments (LDWF 1997-2007, 2008, Blanchet 2010), yield and spawner-per-recruit models were used to estimate the impact of fishing pressure on potential yield and spawning potential of black drum in LA waters using fishing mortality rates estimates from an earlier untuned virtual population analysis (LDWF 1990). In this assessment, a statistical catch at age model is used to estimate annual fishing mortality rates and population size from 1985-2013. Direct comparisons between the earlier and current assessments are not included in this report.

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2015 Report

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1. Introduction

A statistical catch-at-age model is used in this assessment to describe the dynamics of the Louisiana (LA) black drum *Pogonias cromis* (BD) stock from 1985-2013. The assessment model 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. 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) Trip Ticket Program, National Marine Fisheries Service (NMFS) commercial statistical records, and the NMFS Marine Recreational Information Program (MRFSS/MRIP). Abundance indices are developed from the LDWF marine trammel net survey. Age composition of fishery catches are estimated with age-length-keys derived from samples directly of the fishery (2002-2013) and a von Bertalanffy growth function (1985-2001).

1.1 Fishery Status

Commercial

Prior to the 1980s, the black drum fishery in LA was underutilized and had virtually no regulations associated with the fishery. From 1961 to 1980, LA BD harvest averaged approximately 0.4 million pounds. The growth of the commercial BD fishery in Louisiana was tied to the commercial fishery for red drum. In the late 1970s and early 1980s, the demand for red drum increased dramatically leading to large commercial red drum landings. In the 1980s, increased concern of overfishing of red drum led to regulations restricting the use of purse seines to the menhaden-type fishery and banning the use of spotter planes in the haul seine fishery. The increased demand and markets for red drum in the 1980s also led to an increase in black drum landings as they were harvested in the same gear and sold in the same markets. Subsequent bans on commercial red drum fishing led BD to become a suitable substitute and it remains so to the present.

The commercial BD fishery operates primarily within state inside waters (from the coastline inland to the saltwater line), outside territorial waters (from the coastline seaward to 3 miles), and some harvest occurs from federal waters of the EEZ.

Recreational

Recreationally harvested BD are typically a secondary target for LA anglers fishing for red drum or spotted seatrout. When BD are targeted or kept, anglers usually prefer smaller sized fish (under 5 lbs.). A variety of tackle are utilized to catch BD and anglers usually fish inshore or very near the coast. Recreational harvest estimates since 1981 show large variability in the amount of BD landed. Landings in recent years have been more consistent, but seem to demonstrate some cyclical variability.

1.2 Fishery Regulations

Commercial

The BD fishery in Louisiana was virtually unregulated until the 1980s. In 1989, regulations were established that set a minimum size limit of 16 inches total length (TL) and a maximum size limit of 27 inches TL for commercial harvesters, however some commercial harvest of BD is allowed over 27 inches. The 1989 regulations also established commercial quotas of 3.25 million pounds for 16-27 inch BD and 300,000 head (i.e., individuals) for BD >27 inches. A commercial bull drum permit was required for commercial harvest of BD>27 inches. That permit requirement was removed in the early 1990s when the LDWF Trip Ticket Program made it possible to monitor the harvest of the two quotas without requiring individual harvest reports. Authority for regulating gear lies with the Louisiana State Legislature. Act 1316 of the 1995 Regular Legislative Session (the Marine Resources Conservation Act of 1995) outlawed the use of "set" gill nets or trammel nets in saltwater areas of Louisiana, and restricted black drum harvest by the use of "strike" nets to the period between the third Monday in October and March 1 of the following year. A "Restricted Species Permit" was required in order to harvest black drum, and several criteria were established in order to qualify for that permit. After March 1, 1997, all harvest by gill or trammel nets was banned, and legal commercial gear to harvest black drum was limited to trawl, set lines and hook and line. Currently, the primary commercial fishing gears include baited trotlines and other set lines, otter trawls, skimmer nets and butterfly nets. The fishing year for commercial BD harvest is September 1 through August 31 in each year. The fishery remains an open access fishery.

Recreational

Regulations were implemented recreational harvesters by the Louisiana Wildlife and Fisheries Commission in 1989 that established a 16 inch minimum TL, a 27 inch maximum TL, and a 5 fish per person bag and possession limit with only one fish allowed over 27 inches. These regulations remain the current recreational limits.

1.3 Trends in Harvest

A comparison of LA commercial and recreational BD harvest (1985-2013) is presented in Table 1.

Commercial

The time-series of LA commercial BD harvest (1950-2013) is presented in Figure 1. Beginning in 1981, the commercial BD fishery in Louisiana experienced dramatic growth with landings reaching 2.89 million pounds in that year. Commercial harvest peaked in 1988 at 8.7 million pounds prior to the implementation of regulations in 1989. From 1981 through 1989 commercial BD landings averaged 4.25

million pounds, a ten-fold increase from the average commercial landings the previous 20 years. With the establishment of state quotas and harvest permits in 1989 coupled with market fluctuations, commercial BD landings dropped to an average of 2.95 million pounds for the years 1990 through 1995. Possible factors influencing harvest after 1989 were less fishing in the EEZ due to the red drum harvest moratorium, redirection of fishing effort to other species such as sheepshead and mullet, and decreasing demand for "bull" BD coinciding with the red drum moratorium (LDWF 1990). After the enactment of regulations on entanglement gears in 1995, BD landings averaged 2.80 million pounds from 1996 through 2013.

Currently both adult ("bull") and juvenile ("puppy") drum are harvested, often with similar gears. The market for adult drum has historically been more limited than the market for the juveniles due to the preference for the flavor and texture of the flesh of younger fish. Larger juvenile and adult fish tend to have high levels of a larval parasite in the flesh, making it less attractive and in some cases affecting the texture of the meat.

A summary of the months and areas where LA BD landings occur, and the primary commercial gears used in the fishery (2000-2013) are presented in Tables 3-5.

Recreational

The MRFSS/MRIP time-series of LA recreational BD harvest (1950-2013) is presented in Figure 2. Since 1981, recreational harvest has ranged from a low of 0.42 million pounds harvested in 1990 to a high of 2.78 million pounds harvested in 2000. Recreational harvest estimates have been less variable during the last decade, with recreational anglers harvesting an average of 2.10 million pounds for the years 2000 through 2013. During the last three years (2011-2013), recreational harvest has averaged 1.90 million pounds per year.

2. Data Sources

2.1 Fishery Independent

The LDWF fishery-independent marine trammel net survey is used in this assessment to develop an index of abundance for use in ASAP. Below is a brief description of this survey's methodology. Complete details can be found in LDWF (2002).

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 – Atchafalaya Bay to western shore of Vermillion Bay (Vermillion/Teche/Atchafalaya Basins);

CSA 7 – western shore of Vermillion Bay 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 beach seine surveys.

In this assessment, only the fishery-independent (FI) marine trammel net survey is used. This survey is conducted with standardized design from October-March. Hydrological and climatological measurements are taken with each biological sample, including water temperature, turbidity, conductivity and salinity. Survey gear is a 750' long and 6' depth net, consisting of 3 walls constructed of nylon. The inner wall has 1 5/8'' bar mesh wall, and the two outer walls have 6'' bar mesh wall. All captured black drum are enumerated and a maximum of 50 randomly selected black drum are collected for length measurements. When more than 50 BD are captured, catch-at-size is derived as the product of total catch and the proportional subsample-at-size.

2.2 Fishery Dependent

Commercial

Commercial black drum landings are taken from the LDWF Trip Ticket Program and NMFS commercial statistical records (NMFS 2013a; Figure 1). Beginning in 2002, black drum landings derived from the LDWF Trip Ticket Program are further delineated into "juvenile" (<27 inches) and "bull" (≥27 inches) size categories (Table 2).

Annual size compositions of commercial harvest (Table 6) are derived from the Trip Interview Program (TIPS; 1994-2001) and the Fishery Information Network (FIN; 2002-2013). Due to the non-random nature BD FIN samples were collected (i.e., separate sampling goals for "juvenile" and "bull" BD), separate annual size compositions are developed to characterize "juvenile" and "bull" BD landings from 2002-2013. Size compositions of 1985-1991 commercial catches are derived from a historical database of length frequencies of commercial BD harvest from the multiple gears used in the fishery during that time (Russell et al. 1986, Russell et al. 1987). Due to the non-random nature these samples were collected, we pooled the information to develop two size compositions representing commercial catches from 1985-1988 (when purse seines were a component of the commercial fishery) and from 1989-1991 (after purse seines were banned). Efforts were not made in this assessment to correct for the historical commercial length composition samples not being collected proportional to the number harvested (see *Research and Data Needs* section). Because no size composition data are available between 1992 and 1993, we used the 1989-91 commercial size composition described above as a proxy.

Ages of commercial black drum landings are derived from a von Bertalanffy growth function (1985-2001) and otoliths collected from LDWF sampling effort (2002-2013; see *Catch at Age Estimation*).

Recreational

Recreational black drum landings (1985-2013, Figure 2) and corresponding size composition information (Table 7) are taken from the NMFS MRFSS/MRIP program (NMFS 2013b). Because recreational size composition samples were not taken proportional to recreational BD landings, size distributions are weighted by the estimated landings within each year/wave/mode. Landings are observed (Type A) and unobserved harvest (Type B1) estimates only. It's important to point out the recent change in estimation methodology for the MRFSS/MRIP survey. Catch estimates, starting in 2004, are now derived with MRIP estimation methods. Earlier estimates are derived with MRFSS estimation methods. In the prior assessment (Blanchet 2010), MRIP catch estimates were not available.

Ages of recreational black drum landings are derived from a von Bertalanffy growth function (1985-2001) and otoliths collected from LDWF sampling effort (2002-2013; see *Catch at Age Estimation*).

3. Life History Information

3.1 Unit Stock Definition

Black drum occur in estuaries and nearshore habitat along the Atlantic and Gulf Coasts from Nova Scotia southward through the GOM and Caribbean Sea to Argentina (GSMFC 1993). Most of the harvest, however, is taken in the GOM with the largest harvest occurring in LA waters (Figures 1 and 2).

Studies using mitochondrial DNA markers (Gold and Richardson 1998) have confirmed spatial homogeneity in black drum haplotype frequencies across the GOM, implying that BD may be considered one stock in the GOM. However, for purposes of this assessment and to remain consistent with the current statewide management strategy, the unit stock is defined as those BD occurring in LA waters.

3.2 Morphometrics

Weight-length regressions and total length (TL)-fork length (FL) conversions for LA BD were reported by Geaghan and Garson in GSMFC (1993). Beckman et al. (1988) found no significant differences between weight-length regression equation slopes comparing male and female BD. For the purpose of this assessment, the non-sex-specific formulation is used with weight calculated from size as:

$$W = 1.274\times10^{-5}(FL)^{3.036} \quad [1]$$

where W is total weight in grams and FL is fork length in mm. Fish with only TL measurements available are converted to FL from the following:

$$FL = 3.80 + \frac{TL}{1.03} \quad [2]$$

3.3 Growth

Beckman et al. (1988) found minor differences between male and female BD growth curves developed from LA-specific data and found the traditional three-parameter von Bertalanffy model inadequate in describing BD growth. For purposes of this assessment, we use a non-sex specific sloped-asymptote ('linear') von Bertalanffy growth function fit to LA BD data (Geaghan and Garson in GSMFC 1993) with size-at-age calculated from:

$$FL_a = (610 + 9.959a)\times(1 - e^{-0.6226(a-0.1229)}) \quad [3]$$

where FL_a is FL-at-age in mm and a is age in years.

3.4 Sex Ratio /Maturity/ Fecundity

Because only minor differences were found between male and female BD growth and sex ratios outside of the spawning season (Fitzhugh and Beckman 1987; Beckman et al. 1988), the sex ratio-at-age/size is assumed to be 50:50 for purposes of this assessment.

An age-specific maturity vector used in an earlier VPA analysis of LA black drum (Geaghan and Garson in GSMFC 1993) is employed in this assessment where no fish age-0 to 3 spawn, 33% of age-4 fish spawn, 66% of age-5 fish spawn, and 100% of fish greater than age-5 spawn.

Black drum are group-synchronous batch spawners. To realistically estimate annual fecundity, the number of eggs spawned per batch and the number of batches spawned per season must be known. Furthermore, batch fecundity and spawning frequency likely vary as a function of fish weight/size/age (Beckman et al. 1990). Estimates of batch fecundity are currently available as a function of fish body weight (Fitzhugh and Beckman 1987); however, spawning frequency estimates are not. Therefore, for purposes of this assessment, female spawning stock biomass is used as a proxy of total egg production. This may introduce bias if fecundity does not scale linearly with body weight (Rothschild and Fogarty 1989).

3.5 Natural Mortality

In the previous assessment (Blanchet 2010), the natural mortality rate was assumed constant across ages; however, an allometric relationship between natural mortality and fish size in natural ecosystems had been demonstrated (Lorenzen 1996). In this assessment, the lowest value of constant M from the previous assessment is assumed (M=0.1), but is allowed to vary with weight-at-age to calculate a declining natural mortality rate with age. Following SEDAR 12 (SEDAR 2006b), the estimate is rescaled where the average mortality rate over ages vulnerable to the fishery is equivalent to the constant rate over ages as:

$$M_a = M \frac{nL(a)}{\sum_{a_c}^{a_{max}} L(a)} \quad [4]$$

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

$$L(a) = W_a^{-0.288} \quad [5]$$

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

3.6 Relative Productivity and 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. Direct estimates of steepness are not available for black drum.

Rose et al. (2001) summarize steepness estimates for periodic, opportunistic, and equilibrium life history strategists for freshwater, pelagic, and anadromous fish stocks from a meta-analysis of Ransom Myers spawner-recruit datasets (http://www.mscs.dal.ca/~myers/welcome.html). In SEDAR 24-AW-06 (SEDAR 2010), the periodic strategist steepness estimates included in the Rose et al. (2001) meta-analysis are refined to include only marine demersal species (mean and median steepness= 0.77 and 0.80, respectively). For purposes of this assessment, we further refine the list of marine demersal species in SEDAR 24-AW-06 to only include species with similar life history characteristics as discussed below.

Productivity is a function of growth rates, natural mortality, age of maturity, and longevity and can be a reasonable proxy for resilience. We characterize the relative productivity of GOM BD based on life-history characteristics, following SEDAR 9 (SEDAR 2006a), with a classification scheme developed at the FAO second technical consultation on the suitability of the CITES criteria for listing commercially-exploited aquatic species (FAO 2001; Table 8). 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 is averaged to compute an overall productivity score. Due to the non-typical von Bertalanffy growth function used in this assessment, the von Bertalanffy growth rate is taken from a traditional three-parameter model (Beckman et al. 1990). In this case, the overall productivity score is 1.25 for GOM black drum indicating low productivity. We further refine the list of marine demersal species in SEDAR 24-AW-06 to only include species with similar overall productivity scores (5 species: productivity score 1.0-1.5; mean and median steepness= 0.71 and 0.80, respectively).

4. Abundance Index Development

An index of abundance (IOA) was developed from the LDWF FI marine trammel net survey for use as a tuning index in ASAP. Stations not sampled regularly through time are excluded from index development. For purposes of this assessment, catch-per-unit effort (CPUE) is defined as the number of black drum caught per trammel net sample. To reduce unexplained variability in catch rates unrelated to changes in abundance, the IOA was standardized using methods described below.

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

$$I_y = c_y p_y \quad [6]$$

where c_y are estimated annual mean CPUEs of non-zero black drum catches assumed as lognormal distributions, and p_y are estimated annual mean probabilities of black drum capture assumed as binomial distributions. The lognormal and binomial means and their standard errors are estimated with generalized linear models as least squares means and back transformed (e^x). The lognormal model considers only samples in which black drum are captured; the binomial model considers all samples. The IOA is then computed from equation [6] with variances approximated from a Monte Carlo resampling routine (2000 iterations) using the estimated least-squares means and standard errors.

Variables considered in model inclusion were:

Factor	Levels	Value
Year	29	1985-2013
Month	6	October-March
Area	5	CSA 1,3,5,6,7
Salinity	Continuous	--
Temperature	Continuous	--

January, February, and March samples are grouped with the previous year's October, November, and December samples for IOA development. This approximates survey timing with the endpoint of the model/calendar year.

To determine the most appropriate models, factors are selected using a forward step-wise approach where each factor is added to each sub-model individually and the resulting reduction in deviance per degree of freedom (Dev/DF) analyzed. The factor causing the greatest reduction in Dev/DF is then added to the base model. Criteria for model inclusion also include a reduction in Dev/DF ≥1% and a Chi-Square significance test ≤0.05. This procedure is then repeated until no factor met criteria for model inclusion. We assume no significant interaction terms with year in this model and consider only the main effects.

The resulting sub-models are as follows:

$$c \sim Year + Area + Salinity \quad [7]$$

$$p \sim Year + Area \quad [8]$$

Sub-models are estimated with the SAS generalized linear modeling procedure (PROC GENMOD; SAS 1994). Sample sizes, proportion positive samples, nominal CPUE, standardized index, and coefficients of variation are presented (Table 9, Figure 3). For assessment modeling purposes, where age-0 BD are not included in the population model, age-0 individuals are removed from the IOA by multiplying the standardized IOA by the proportion of the annual age composition > age-0 (see *Catch at Age Estimation* below).

5. Catch at Age Estimation

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

5.1 Fishery

Black drum in LA exhibit a protracted spawning season, with spawning primarily occurring across a four month window from February through May (Beckman et al. 1988). The midpoint of this season (April 1st) is typically assumed as a biological birthday. However, for purposes of this assessment, BD ages are assigned based on the calendar year by assuming a January 1st birthday, where BD spawned the previous year become age-1 on January 1st and remain age-1 until the beginning of the following year.

1981-2001: Probabilities of age a given length l for recreational and commercial black drum landings are computed from:

$$P(a|l) = \frac{P(l|a)}{\sum_a P(l|a)} \quad [9]$$

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

$$P(l|a) = \frac{1}{\sigma_a\sqrt{2\pi}} \int_{l-d}^{l+d} exp\left[-\frac{(l-l_a)^2}{2\sigma_a^2}\right] dl \quad [10]$$

where length bins are 1 inch FL intervals with midpoint l, maximum $l + d$, and minimum $l - d$ lengths. Mean fork length-at-age l_a is estimated from Equation [3]. The standard deviation in length-at-age is approximated from $\sigma_a = l_a CV_l$, where the coefficient of variation in length-at-age is assumed constant (in this case 0.10). To approximate changes in growth and vulnerability to the fishery through the year, mean l_a is calculated at the mid-point of the calendar/model year. The resulting fishery $P(a|l)$ matrix used in age assignments of 1985-2001 landings is presented in Table 10.

_2002-2013:_ Annual fleet-specific f (i.e., commercial and recreational) probabilities of age given length are computed from:

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

where n_{layf} are annual fleet-specific black drum sample sizes occurring in each length/age bin (Tables 11 and 12). Due to the non-random nature commercial size and age information were collected during FIN BD sampling, probabilities of age given length are calculated separately for "juvenile" (< 27 inches) and "bull" BD (≥27 inches) and coupled with the distinct size frequency distributions and reported landings of "juvenile" and "head" drum described in the *Data Sources* section (Table 2 and Table 6) for catch-at-age estimation (i.e., equation [12] below). For length bins with limited sample sizes, i.e., $\sum_a n_{layf} < 5$ for length bins ≤ 21 inches and $\sum_a n_{layf} < 10$ for length bins >21 inches, the $P(a|l)$ for that length interval is taken from equation [9].

Annual fleet-specific fishery catch-at-age is then taken as:

$$C_{ayf} = \sum_l C_{lyf} \, P(a|l)_{yf} \quad [12]$$

where C_{lyf} are annual fleet-specific fishery catch-at-size in FL, and $P(a|l)_{yf}$ are taken from either equation [9] or [11]. Due to the non-random nature commercial size and age information were collected during FIN BD sampling, catch-at-size is developed separately for "juvenile" (< 27 inches) and "bull" BD (≥27 inches). For modeling purposes, catches > age-10 are summed into a plus group. Resulting annual fleet-specific fishery catch-at-age and corresponding mean weights-at-age are presented (Tables 13-16).

5.2 Survey

Probabilities of age given length for BD catches of the LDWF marine trammel net survey are computed from equation [9]. To approximate survey timing (i.e., a December 31st midpoint), mean l_a is calculated at the end of the calendar/model year relative to January 1st . Resulting survey $P(l|a)$ is presented (Table 17).

Annual survey catch-at-age is then taken from equation [10] with annual survey catch-at-size substituted for fishery catch-at-size. Survey catch-at-size is derived using only those samples included in abundance index development. Annual survey catch-at-size and resulting survey age compositions are presented (Tables 18 and 19).

6. Assessment Model

Previous LDWF black drum stock assessments (LDWF 1997-2007, 2008, Blanchet 2010) estimated the impact of fishing pressure with a yield and spawner-per-recruit model using fishing mortality estimates from an earlier untuned virtual population analysis (LDWF 1990). In this assessment, a statistical catch-at-age model is used to describe the dynamics of black drum occurring in LA waters. Direct comparisons between the earlier and current assessments are not included in this report.

The Age-Structured Assessment Program (ASAP3; NOAA Fisheries Toolbox, http://nft.nefsc.noaa.gov) is used to describe the dynamics of the LA black drum stock from 1985-2013. 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 and a tuning index. ASAP forward calculates 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 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 2012; NOAA Fisheries Toolbox 2013).

6.1 Model Configuration

Mortality

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

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

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

Age and fleet specific fishery 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 estimated annual fleet-specific fishing mortalities as:

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

For reporting purposes, annual fishing mortalities are averaged by weighting by estimated population numbers at age N_{ay} as:

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

Population Abundance

Abundance-at-age 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:

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

Spawning Stock Biomass

Annual spawning stock biomass (of females only) is calculated from:

$$SSB_y = \sum_{i=1}^{A} N_{ay} W_{SSB,a} \left(\frac{p_{mat,a}}{2}\right) e^{-Z_{ay}(0.33)} \quad [19]$$

where $W_{SSB,a}$ are spawning stock biomass weights-at-age, $\frac{p_{mat,a}}{2}$ is the proportion of mature females-at-age assuming a 50:50 sex ratio-at-age, and $-Z_{ay}(0.33)$ is the proportion of total mortality occurring prior to spawning on April 1st.

Stock Recruitment

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

$$\hat{R}_{y+1} = \frac{\alpha SSB_y}{\beta + SSB_y} + e^{\delta_{y+1}} \quad [20]$$

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

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

Expected Catch

Expected fishery catches by age, fleet, and year 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 fishery age compositions are then calculated from $\frac{\hat{\hat{C}}_{ayf}}{\sum_a \hat{C}_{ayf}}$. Expected yields for each age, year, and fleet are computed as $\sum_a \hat{C}_{ayf}\overline{W}_{ayf}$, where $\overline{W}_{ayf}$ are observed mean catch weights.

Survey Catch-rates

Expected survey catch-rates for each age and year are computed from:

$$\hat{I}_{ay} = q\sum_a N_{ay}(1-e^{-Z_{ay}(1.0)})v_a \quad [22]$$

where v_a are estimated age-specific survey selectivities, q is the estimated catchability coefficient, and $-Z_{ay}(1.0)$ is the proportion of the total mortality occurring prior to the time of the survey (December 31st midpoint). Survey selectivities are modeled with a double logistic function as:

$$v_a = \left(\frac{1}{1+e^{-(a-\alpha)/\beta}}\right)\left(1-\frac{1}{1+e^{-(a-\alpha 2)/\beta 2}}\right) \quad [23]$$

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 selectivity blocks modeled, and number of tuning indices used. Parameters are estimated in log-space and then back transformed. In this assessment, 122 parameters are estimated:

1. 24 selectivity parameters (4 parameters per selectivity block: 3 blocks for the commercial fishery, 2 blocks for the recreational fishery, and 1 block for the survey)
2. 58 apical fishing mortality rates (Fmult in the initial year and 28 deviations in subsequent years for 2 fleets)
3. 29 recruitment deviations (1985-2013)
4. 9 initial population abundance deviations (age-2 through 10-plus)
5. 1 survey catchability coefficient
6. 1 stock-recruitment parameter (virgin stock size).

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

$$-ln(L) = \sum_i \lambda_i(-ln\, L_i) + \sum_j(-ln\, L_j) \quad [24]$$

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

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

$$-ln(L_i) = 0.5 \sum_i \frac{[ln(obs_i) - ln(pred_i)]^2}{\sigma^2} \quad [25]$$

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:

$$-ln(L_j) = -ESS \sum_{i=1}^{A} p_i\, ln(\hat{p}_i) \quad [26]$$

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, fecundity, growth and sex ratio at size/age do not vary significantly with time. Lognormal error is assumed for catches, abundance indices, the stock-recruitment relationship, apical fishing mortality, selectivity parameters, initial abundance deviations, and catchability. Multinomial error is assumed for fishery and survey age compositions.

A base model was defined with an age-10 plus group, the steepness parameter fixed at 0.75, three commercial fishery selectivity blocks, two recreational selectivity blocks, and one survey selectivity block. Input levels of error and weighting factors are described below.

For the commercial fleet, three selectivity blocks are modeled that correspond to the following time-periods of consistent regulation: 1) 1985-1988 (no regulations), 2) 1989-1996 (commercial MLL implemented and purse-seines banned), and 3) 1997-2013 (gill and trammel nets banned). Within the recreational fleet, two selectivity blocks are modeled that correspond to the following time-periods of consistent regulation: 1) 1985-1988 (no regulations) and 2) 1989-2013 (recreational MLL and creel limit implemented).

Input levels of error for fishery landings were specified with CV's of 0.2 for each year of the time-series; annual recruitment deviations were specified with CV's of 0.5. Due to model estimation problems (i.e., hessian matrix unable to invert), both fleets' apical fishing mortality rates in the first year were constrained with CVs of 1.0 to allow estimation stability. All lambdas for lognormal components included in the objective function were equally weighted (=1). Input effective sample sizes for estimation of fishery age compositions were specified as ESS=50 for years where annual ALKs were available (2002-2013) and down weighted to ESS=10 for years where the von Bertalanffy growth function was used (1985-2001). Input effective sample size for estimation of survey age compositions, where ages were also assigned from the von Bertalanffy growth function, were specified with ESS=10.

6.3 Model Results

Objective function components, weighting factors, and likelihood values of the base model are summarized in Table 20.

Model Fit

The base model provides an overall reasonable fit to the data. Predicted commercial and recreational catches match the observations well (Figures 4 and 5). However, some patterning of the residuals are apparent, where each fleets landings are overestimated in earlier years of the time-series and underestimated in more recent years. Predicted survey catch-rates match the data well with no strong pattern in residuals (Figure 6). Predicted fishery and survey age compositions provide adequate fits to the input age proportions (Figures 7-9). Survey age compositions, however, are generally underestimated for age-1 fish and overestimated for age-2 individuals.

Selectivities

Estimated fishery and survey selectivities are presented in Figure 10. Fishery estimates indicate full-vulnerability to the commercial fishery at age-2 during the 1985-1988 and 1989-1996 regulation blocks. After the commercial gill/trammel net ban (1997-2013), selectivity estimates indicate full-vulnerability to the commercial fishery at age-3. Recreational estimates indicate full-vulnerability at age-1 for the 1985-1988 regulation block and increased to age-2 after recreational regulations were implemented (1989-2013). Survey estimates indicate full vulnerability to the FI survey gear at age-1.

Abundance, Recruitment, and Spawning Stock

Stock size has varied over the time-series (Table 21). Stock size decreased from 6.8 million fish in 1985 to a minimum of 3.3 million fish in 1991. Since 1991, stock abundance has generally increased to its highest peak of 16.6 million fish in 2012. The 2013 stock size estimate is 16.2 million fish in 2013, which is above the long-term mean of 9.5 million fish.

Recruitment has also varied over the time-series (Figure 11). Recruitment increased from a minimum of 0.9 million age-1 fish in 1990 to a maximum of 5.7 million individuals in 2007. In addition to 2007, recruitment peaks occurred in 2000-2001, 2009, and 2012. The 2013 estimate of recruitment (3.0 million age-1 fish) is above the long-term mean of 2.5 million fish.

Spawning stock biomass (SSB) estimates are presented in Figure 12. Estimates decrease from 38.6 million pounds in 1985 to a minimum of 8.2 pounds in 1996. After 1997, SSB increased to 40.7 million pounds estimated in 2013. The 2013 estimate is greater than the long-term mean of 21.7 million pounds.

Fishing Mortality

Estimated fishing mortality rates are presented in Table 22 (total apical, average, and age-specific) and Figure 13 (average only). Average rates are weighted by estimated population numbers at age. Average fishing mortality rates have varied over the time-series with an overall decreasing trend. The highest estimate of average F was in 1988 (0.43 yr^{-1}) when LA BD landings were at their peak. After 1988, average-F rates decreased to a minimum of 0.07 yr^{-1} in 2007 and have remained low.

Stock-Recruitment

No discernable relationship is observed between female SSB and subsequent age-1 recruitment (Figure 14). The steepness parameter was fixed at 0.75 in the ASAP base model run. The estimated virgin spawning stock biomass was 131.0 million pounds. Alternate runs with steepness values fixed at 1.0, 0.9, 0.8, and 0.7 are discussed in the *Model Diagnostics* Section below.

Parameter Uncertainty

In the ASAP base model, 122 parameters were estimated. Asymptotic standard errors for the recruitment time-series are presented in Figure 11. Markov Chain Monte Carlo (MCMC) derived 95% confidence intervals (CI) for the median female spawning stock biomass and average F rates are presented in Figures 12 and 13. Uncertainty surrounding average F has decreased over time. Uncertainty around SSB has increased over time.

6.4 Management Benchmarks

The conservation standard established by the LA Legislature for black drum (RS 56:325.4: http://www.legis.la.gov/Legis/Law.aspx?d=105210) is a 30% spawning potential ratio (SPR; Goodyear 1993). Methodology used in this assessment to estimate equilibrium yield, female spawning stock biomass, escapement rates, and fishing mortality rates that lead to a 30% SPR are described below.

When the stock is in equilibrium, equation [19] can be solved, excluding the year index, for any given exploitation rate as:

$$\frac{SSB}{R}(F) = \sum_{i=1}^{A} N_a W_{SSB,a} \left(\frac{p_{mat,a}}{2}\right) e^{-Z_a(0.33)} \quad [27]$$

where total mortality at age Z_a is computed as $M_a + v_a Fmult$; vulnerability at age v_a is taken by rescaling the current F-at-age estimate (geometric mean 2011-2013) 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 from 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 mean fishery weights at age from the last three years of the assessment (2011-2013).

Equilibrium spawning stock biomass SSB_{eq} is calculated by substituting SSB/R estimated from equation [27] 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 $Y/R \times R_{eq}$. Fishing mortality is averaged as $\sum_a F_a N_a / \sum_a N_a$. Equilibrium SPR is then computed as the ratio of SSB/R when F>0 to SSB/R when F=0.

Annual escapement rates (i.e., proportion of non-fully mature black drum that survive) are calculated from:

$$E_y = e^{-(F_{1y}+F_{2y}+F_{3y}+F_{4y}+F_{5y})} \quad [28]$$

where F_{1y} – F_{5y} are the total annual age 1-5 fishing mortality rates estimated from the ASAP base model run. Equilibrium escapement rates are calculated from equation [28] excluding the year index and equilibrium F-at-age. The time-series of annual escapement rate estimates is presented (Figure 15). Annual escapement rates varied from 0.35 $year^{-1}$ in 1985 and to a low of 0.03 $year^{-1}$ in 1988. After 1988, escapement increased to an average of 0.55 $year^{-1}$ in the most recent years.

As reference points to guide management, we estimate the equilibrium average fishing mortality rate, female spawning stock biomass, escapement rate, and yield that lead to a 30% SPR ($F_{30\%}$, $SSB_{30\%}$, $E_{30\%}$, and $Y_{30\%}$; Table 23). Also presented are a plot of the stock recruitment data, equilibrium recruitment, and diagonals from the origin intersecting R_{eq} at the minimum and maximum SSB estimates of the time-series, corresponding with a minimum equilibrium SPR of 14% and a maximum of 37% (Figure 16). The current estimate of equilibrium SPR is 36%.

6.5 Model Diagnostics

Sensitivity Analysis

A series of sensitivity runs are used to explore uncertainty in the base model's configuration as follows:

1. steepness parameter h fixed at 1.0, 0.9 ,0.8 and 0.7 (models 1-4)
2. fishery yields up-weighted ($\lambda\times$ 10; model 5)
3. survey catch-rates up-weighted ($\lambda\times$ 20; model 6)

Current conditions are taken as the geometric mean (SSB, F, Yield, and E) of the last three years of the assessment (2011-2013). Reference point estimates from all but one of the sensitivity runs indicate the stock is currently above $SSB_{30\%}$ and the fishery is currently operating below $F_{30\%}$ (Table 24). Model 6 (i.e., survey catch-rates up-weighted), however, suggests that over-fishing is currently occurring. With the exception of model-6, estimates of $F_{30\%}$, $SSB_{30\%}$, $E_{30\%}$, and $Y_{30\%}$, from each sensitivity run were similar in magnitude (0.11 $year^{-1}$, 24.1-32.4 million pounds, 0.45-0.46 $year^{-1}$, and 4.9-6.5 million pounds, respectively).

Retrospective Analysis

A retrospective analysis was conducted by sequentially truncating the base model by a year (terminal years 2009-2013 only). Retrospective estimates of $F/F_{30\%}$, $SSB/SSB_{30\%}$, recruitment, and age-10+ stock numbers are presented in Figure 17, where $SSB_{30\%}$ and $F_{30\%}$ are computed from the full base run. Terminal year estimates from each retrospective differ from the full base run. Terminal year $F/F_{30\%}$ estimates indicate positive bias, where estimates generally decrease as more years are added to the model. Terminal year recruitment estimates indicate minimal negative bias. Terminal year $SSB/SSB_{30\%}$ estimates also indicate negative bias, where estimates generally increase as more years are added to the model. Furthermore, $SSB/SSB_{30\%}$ and $F/F_{30\%}$ estimates in earlier years of the time-series show a large retrospective bias. This bias is likely due to the large retrospective bias observed in age-10+ stock numbers up until the early 2000s (Figure 17; bottom graphic).

7. Stock Status

The history of the LA black drum stock relative to $F/F_{30\%}$ and $SSB/SSB_{30\%}$ is presented in Figure 18. Given the established conservation standard of 30% SPR, fishing mortality rates exceeding $F_{30\%}$ ($F/F_{30\%}$ >1.0) are defined as overfishing; spawning stock sizes below $SSB_{30\%}$ ($SSB/SSB_{30\%}$ < 1.0) are defined as the overfished condition. Given the uncertainty evident in the terminal year of the assessment (see *Model Diagnostics* section), current conditions (i.e., SSB and F rates) are derived as the geometric mean of the last three years of the ASAP base model run (2011-2013).

Overfishing Status

Using results of the ASAP model presented in this assessment, the current estimate of $F/F_{30\%}$ is <1.0 (0.68), suggesting the stock is currently not undergoing overfishing. However, model estimates suggest that overfishing did occur in earlier years of the time-series.

Overfished Status

Using results of the ASAP model presented in this assessment, the current estimate of $SSB/SSB_{30\%}$ is >1.0 (1.30), suggesting the stock is currently not in an overfished state. However, model estimates suggest the stock was considered overfished for the majority of the time-series.

Control Rules

As specified in RS 56:325.4 , if the annual LDWF black drum stock assessment indicates current SPR<30%, the department shall close the season within two weeks for a period of at least one year, or provide management options that provide estimates that the spawning potential ratio will have at least a fifty percent chance of recovery to a thirty percent ratio within ten years or some other appropriate recovery period based on the biology of the stock of the fish, environmental conditions, and the needs of the fishing communities..

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 LA stock assessments of black drum.

Only limited age data are available from the LDWF marine trammel net survey. Ages of survey catches in this assessment were assigned from a von Bertalanffy growth function. Age samples collected directly from the survey in question would allow a more accurate representation of survey age composition in future assessments.

The harvest of adult black drum currently comprises only a small fraction of the overall harvest. However, fishery independent surveys that characterize both the inshore and nearshore adult population would allow additional tuning indices in future modeling efforts that could better characterize adult stock size and provide more certainty in reference point estimates.

Historical commercial black drum size compositions were not sampled proportional to the harvest. Future assessment efforts should explore weighting schemes at the finest scale possible to reduce this sampling bias.

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

Estimates of black drum spawning frequency as a function of age/size are 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. A new LDWF fishery-independent survey methodology was implemented in 2013. This methodology should be assessed for adequacy with respect to its ability to evaluate stock status, and modified if deemed necessary.

With the recent trend toward ecosystem-based assessment models (Mace 2000; NMFS 2001), more data is needed linking black drum 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 black drum stock and its habitat.

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<u>*10. Tables*</u>

Table 1: Annual Louisiana commercial and recreational black drum *Pogonias cromis* landings (pounds x 10^3) derived from NOAA-Fisheries commercial statistical records, LDWF trip ticket program, and MRFSS/MRIP. Recreational landings are A+B1 harvest only.

Year	Harvest		%_Recreational	%_Commercial
	Commercial	Recreational		
1985	3,421	594	14.8	85.2
1986	5,226	2,367	31.2	68.8
1987	8,021	2,726	25.4	74.6
1988	8,757	1,360	13.4	86.6
1989	4,406	898	16.9	83.1
1990	2,876	421	12.8	87.2
1991	1,914	537	21.9	78.1
1992	3,014	824	21.5	78.5
1993	3,178	709	18.2	81.8
1994	3,739	649	14.8	85.2
1995	2,999	779	20.6	79.4
1996	1,619	895	35.6	64.4
1997	1,643	1,389	45.8	54.2
1998	1,782	1,686	48.6	51.4
1999	2,200	1,120	33.7	66.3
2000	2,844	2,782	49.5	50.5
2001	3,195	1,780	35.8	64.2
2002	3,118	1,999	39.1	60.9
2003	3,517	2,571	42.2	57.8
2004	3,761	2,302	38.0	62.0
2005	2,377	1,729	42.1	57.9
2006	1,937	1,909	49.6	50.4
2007	2,365	2,308	49.4	50.6
2008	2,427	2,498	50.7	49.3
2009	3,175	2,124	40.1	59.9
2010	2,794	1,680	37.6	62.4
2011	3,715	2,014	35.2	64.8
2012	3,448	2,016	36.9	63.1
2013	3,712	1,668	31.0	69.0

Table 2: Annual Louisiana commercial black drum *Pogonias cromis* landings showing juvenile, in weight (pounds x 10^3), and head drum, in numbers (x 10^3) from 2002 to 2013 derived from LDWF trip ticket program.

Year	Commercial	
	Juvenile	Head Drum
2002	2,865	16.5
2003	3,396	7.6
2004	3,529	14.9
2005	2,194	11.9
2006	1,845	5.6
2007	2,240	8.2
2008	2,280	11.8
2009	2,955	12.8
2010	2,728	4.3
2011	3,623	6.5
2012	4,108	0.9
2013	3,676	7.6

Table 3. Annual percent contribution by gear of Louisiana commercial black drum landings from the LDWF Trip Ticket Program, 2000-2013.

	% Commercial Landings by Gear					
YEAR	TROT LINES	HAND LINES	OTTER TRAWL, FISH	OTTER TRAWL, SHRIMP	SKIMMER NETS	OTHER
2000	59.2	8.6	4.5	19.5	2.6	3.0
2001	52.3	2.7	7.1	30.6	4.9	0.9
2002	55.6	5.6	5.0	24.4	7.5	1.3
2003	62.9	6.4	8.6	17.2	3.6	0.9
2004	72.1	8.8	2.7	11.8	3.8	0.5
2005	81.9	4.2	3.3	8.2	2.0	0.3
2006	84.4	1.4	4.8	4.9	3.9	0.5
2007	78.6	4.2	2.4	10.7	3.3	0.7
2008	79.4	9.2	1.1	6.5	3.1	0.6
2009	80.9	5.0	3.6	4.2	5.5	0.8
2010	81.4	2.9	4.6	3.0	6.4	1.7
2011	78.7	9.4	4.6	1.7	1.7	3.8
2012	80.8	8.8	3.5	4.3	1.4	1.1
2013	74.8	9.9	6.3	1.3	2.2	5.4

Table 4: Annual percent contribution by month of Louisiana commercial black drum landings from the LDWF Trip Ticket Program, 2000-2013.

	% Commercial Landings by Month											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	8.4	9.8	19.6	7.3	3.9	5.2	6.7	6.1	7.0	8.4	9.1	8.4
2001	16.6	14.0	13.9	7.7	4.4	4.1	4.9	5.9	6.1	8.8	5.0	8.7
2002	12.6	15.9	13.7	9.2	5.3	4.5	5.7	5.7	5.4	6.7	7.0	8.5
2003	9.3	10.6	15.5	9.3	5.1	6.2	6.6	6.9	6.3	8.0	7.1	9.2
2004	11.7	13.1	13.0	7.3	6.3	4.9	6.8	6.6	5.9	6.5	7.5	10.5
2005	14.3	9.9	17.0	8.7	11.4	7.5	6.5	7.9	1.9	2.2	3.8	8.9
2006	7.1	6.1	12.6	6.6	7.2	8.8	8.1	9.4	7.7	7.3	11.0	8.1
2007	14.0	12.0	14.3	5.6	6.1	6.5	6.2	7.0	5.7	5.3	8.0	9.3
2008	14.6	10.7	9.1	9.0	7.9	7.4	5.1	5.5	3.0	8.0	5.6	14.0
2009	11.6	6.7	9.9	6.7	6.8	8.0	6.2	8.3	5.9	7.1	11.5	11.3
2010	10.4	12.4	11.8	10.0	7.9	6.4	2.5	5.9	5.8	6.4	9.7	10.7
2011	13.2	6.1	5.8	6.6	6.9	8.2	7.9	8.3	7.6	10.3	8.2	10.9
2012	8.3	8.7	8.1	7.6	11.0	8.7	9.8	6.2	6.8	8.8	9.1	6.9
2013	14.4	8.3	11.6	8.2	6.9	6.4	6.6	6.1	7.8	8.2	7.3	8.3

Table 5: Annual percent contribution by area of Louisiana commercial black drum landings from the LDWF Trip Ticket Program, 2000-2013.

	% Commercial Landings by Area													
Basin/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
ATCHAFALAYA/VERMILION-TECH	9.5	12.0	19.3	31.4	37.9	47.5	44.6	32.1	42.6	33.9	42.0	34.8	35.2	33.9
BARATARIA	31.5	38.3	35.7	31.5	22.2	17.4	27.0	36.5	22.4	11.8	7.5	7.7	8.6	10.6
CALCASIEU RIVER	24.4	16.7	9.3	7.6	14.6	14.4	15.9	16.3	13.7	20.4	12.4	23.2	23.7	18.1
LAKE PONTCHARTRAIN	4.8	5.2	6.9	5.4	2.7	4.1	1.1	2.2	8.8	19.4	24.7	22.5	20.7	20.7
LOUISIANA GRID 13	8.8	3.5	8.1	0.9	2.5	3.7	1.9	0.4	0.0	0.1	0.3	0.1	0.1	0.4
LOUISIANA GRID 14	1.3	0.6	0.0	0.0	0.0	0.5	1.8	1.6	0.3					
LOUISIANA GRID 15	0.2	3.0	0.2	0.0	0.1	0.3	0.1		0.2			0.4		
LOUISIANA GRID 16		0.1												
LOUISIANA GRID 17	0.1	0.1												
MERMENTAU RIVER	0.0	0.1												
MISSISSIPPI COAST	0.1													
MISSISSIPPI RIVER	7.8	9.7	10.9	16.9	11.5	4.4	2.4	5.4	10.2	9.6	5.4	4.7	4.7	6.1
TERREBONNE	11.4	10.8	9.5	6.1	8.5	7.8	5.3	5.5	1.8	4.8	7.7	6.5	7.1	10.2
UNKNOWN AREA FISHED	0.1													

Table 6: Annual size frequency samples of Louisiana commercial black drum *Pogonias cromis* landings derived from historical data collections (Russell et al.1986 and 1987; 1985-1991), the Trip Interview Program (TIPS; 1994-2001), and the Fishery Information Network (FIN; 2002-2013). Shaded area represents "juvenile" (<27 inches) and "bull" (≥27 inches) black drum samples from the FIN sampling program, where annual size distributions are developed separately to characterize landings of BD <27 inches and those ≥ 27 inches.

Commercial, 1985-2013																						
FL_in	1985-1988	1989-1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5																						
6	3																					
7	6	3																				
8	4	20																				
9	1	54																				
10	6	128																				
11	33	203																				
12	24	188																				
13	36	183	1											1		1		4			1	1
14	117	550	1	2		1				4	2	1	1	3	1	6	2	18		1	2	3
15	196	633	21	106	4	26			5	21	5	8	2	16	10	26	32	41	6	17	14	9
16	679	1,164	49	242	29	27	6	13	17	63	23	28	14	48	31	57	48	119	22	34	42	17
17	582	676	50	247	17	36	17	30	31	83	21	36	32	72	37	82	80	227	36	62	61	37
18	823	1,127	34	201	24	37	18	8	57	93	20	32	35	90	44	129	96	186	49	113	88	39
19	487	313	42	132	24	40	27	8	77	67	14	28	33	73	73	163	125	161	62	141	92	51
20	552	271	29	123	19	39	12	6	42	60	23	29	31	80	71	120	134	106	54	127	94	27
21	267	184	21	74	15	21	2	1	28	37	21	36	23	39	55	106	79	74	45	109	127	50
22	270	344	12	42	12	24	4	1	10	15	14	42	16	49	26	85	83	41	53	94	113	68
23	198	131	8	27	12	20	3		7	6	11	30	19	39	29	75	58	19	38	121	90	64
24	534	127	6	19	19	16	9		11	2	8	17	24	40	25	58	54	23	24	105	67	21
25	1,106	63	3	4	15	14	6		9		6	11	18	25	24	87	60	35	33	88	53	26
26	909	55	3	4	15	13	1		1		2	15	14	12	11	80	49	43	27	76	38	9
27	1,290	138			17	9	1				3	10	2	21	5	79	55	47	6	31	34	8
28	984	111	1	4	14	3	4				2	3	1	15	9	34	33	29	5	14	12	10
29	1,255	205		2	10	2	2					2	1	8	5	31	24	16		7	7	4
30	652	156	3	1	15	3	4					2		5	2	25	6	7		8	4	6
31	596	178	3	7	20	6	2				1			12		6	4	8		5		6
32	231	86	6	3	22	1					1	1		8	3	3	5	5		5		5
33	207	79	6	7	18	6	5				2			3	2	2	4	1		4		3
34	92	35		3	9	3	1				2	1		4	1	3	1	2		1		
35	85	32	4	2	6									4		1	7	4		4		
36	37	12	5	1	3	1								2		2				5	2	
37	47	6	6		3	2								3							1	
38	12		6	2	3	1	1									1				2	1	
39	8	2	4	1	3															1		
40			1																	1		
41					1																	
42			2																			
43				1																		
Totals	12,329	7,457	327	1,257	349	351	125	67	295	451	181	332	266	672	464	1,262	1,039	1,216	460	1,176	943	464

Table 7: Annual size distributions of Louisiana recreational black drum *Pogonias cromis* harvest taken from MRFSS/MRIP (NOAA; 1985-2013).

	Recreational, 1985-2013																												
FL_in	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4	0.00		0.01	0.00																									
5			0.01																				0.00						
6	0.01													0.01		0.00													
7	0.01	0.08	0.00			0.02		0.01		0.01		0.02				0.01													
8	0.15	0.12	0.07	0.02	0.03	0.03		0.04	0.01			0.01	0.02		0.00	0.00							0.00						
9	0.14	0.04	0.11	0.03	0.14	0.07		0.03	0.03		0.00	0.02	0.05		0.03		0.01			0.00			0.00	0.01					
10	0.13	0.09	0.14	0.09	0.03	0.06	0.01	0.01	0.06	0.03	0.01	0.02	0.04	0.01	0.00	0.01	0.01	0.00		0.00			0.00	0.00		0.00			
11	0.05	0.09	0.04	0.13	0.08	0.04	0.06	0.03	0.03	0.02	0.03	0.08	0.01	0.00	0.01	0.00	0.01	0.01		0.00		0.01	0.01	0.02				0.02	0.00
12	0.18	0.10	0.07	0.09	0.09	0.01	0.06	0.03	0.04	0.01	0.03	0.06	0.00	0.01	0.01		0.01	0.01	0.01	0.00		0.00	0.00	0.00	0.03		0.00	0.01	0.01
13	0.04	0.10	0.05	0.07	0.06	0.01	0.16	0.06	0.07	0.03	0.01	0.05	0.03	0.04	0.04	0.01	0.03	0.01	0.01			0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01
14	0.07	0.08	0.08	0.07	0.06	0.04	0.08	0.13	0.05	0.08	0.03	0.04	0.06	0.03	0.02	0.01	0.04	0.04	0.01	0.00	0.02	0.01	0.01	0.02	0.01	0.03	0.02	0.01	0.03
15	0.03	0.05	0.08	0.12	0.07	0.05	0.14	0.12	0.14	0.13	0.12	0.07	0.12	0.07	0.08	0.05	0.06	0.16	0.08	0.09	0.10	0.06	0.05	0.09	0.06	0.17	0.10	0.05	0.12
16	0.04	0.04	0.06	0.05	0.05	0.09	0.10	0.14	0.10	0.15	0.17	0.12	0.13	0.18	0.21	0.12	0.18	0.19	0.13	0.19	0.15	0.17	0.13	0.20	0.25	0.20	0.18	0.19	0.24
17	0.01	0.03	0.02	0.05	0.04	0.06	0.03	0.08	0.09	0.11	0.25	0.15	0.14	0.15	0.18	0.17	0.11	0.16	0.13	0.22	0.19	0.12	0.15	0.17	0.18	0.16	0.14	0.18	0.25
18	0.02	0.01	0.01	0.03	0.07	0.13	0.03	0.06	0.11	0.14	0.11	0.11	0.11	0.12	0.14	0.15	0.12	0.11	0.10	0.13	0.11	0.08	0.14	0.14	0.20	0.14	0.20	0.11	0.14
19	0.00	0.03	0.01	0.04	0.01	0.14	0.04	0.03	0.09	0.08	0.13	0.05	0.09	0.10	0.12	0.13	0.13	0.06	0.09	0.14	0.14	0.12	0.09	0.09	0.07	0.05	0.10	0.05	0.06
20	0.04	0.00	0.07	0.02	0.05	0.06	0.07	0.03	0.07	0.09	0.03	0.09	0.07	0.09	0.08	0.12	0.10	0.07	0.09	0.04	0.06	0.05	0.08	0.06	0.04	0.09	0.06	0.09	0.04
21	0.00	0.01		0.03		0.06	0.03	0.02	0.04	0.01	0.01	0.06	0.05	0.06	0.02	0.09	0.06	0.06	0.07	0.06	0.05	0.06	0.05	0.05	0.02	0.03	0.06	0.08	0.02
22	0.02	0.01	0.03	0.01	0.04		0.03	0.02	0.04	0.04	0.02	0.01	0.04	0.04	0.03	0.05	0.06	0.04	0.05	0.02	0.04	0.07	0.05	0.02	0.03	0.01	0.02	0.06	0.02
23	0.01	0.02	0.02	0.02	0.02	0.04	0.01	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.05	0.03	0.03	0.03	0.03	0.01	0.01	0.03	0.02	0.03	
24	0.01	0.00	0.01	0.02	0.00	0.04	0.00	0.02	0.01	0.04	0.01			0.00	0.00	0.01	0.02	0.02	0.03	0.01	0.02	0.05	0.01	0.01	0.01	0.01	0.03	0.04	0.02
25	0.01	0.01	0.01	0.02	0.01		0.04		0.00					0.01	0.00		0.00	0.00	0.03	0.01	0.01	0.03	0.03	0.01	0.00	0.01	0.01	0.00	0.00
26		0.00		0.00	0.04	0.02	0.02	0.00	0.01	0.01			0.00		0.00	0.01	0.00	0.01	0.03	0.00	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.01	
27	0.01	0.00			0.00		0.02	0.01	0.01			0.00		0.00		0.00	0.00	0.00	0.01	0.01	0.01	0.06	0.02	0.01	0.01	0.01	0.00	0.00	0.02
28	0.00	0.01		0.00	0.00			0.00							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.01	0.00	0.00	0.01	0.01
29	0.00	0.00			0.01		0.02	0.01		0.00				0.01	0.00		0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00
30	0.01	0.00	0.00	0.01				0.00	0.01				0.00			0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.02	0.01	0.02	
31	0.00	0.02	0.02	0.00	0.01			0.01	0.00		0.00	0.01	0.00	0.00			0.00	0.00	0.00	0.00		0.00	0.01		0.01	0.00	0.01	0.01	0.01
32	0.01	0.01				0.01	0.02	0.01	0.00	0.00		0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.02	0.00			0.01	
33		0.01	0.00		0.04	0.00	0.02	0.00	0.01	0.00	0.00		0.00	0.01		0.00	0.00	0.00	0.01	0.00	0.01		0.00	0.00	0.00	0.01	0.00		
34	0.00	0.00	0.01	0.00				0.00					0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01		0.00	0.00	0.01		0.00	0.01	0.01	0.00
35		0.00		0.05		0.01	0.02	0.01		0.00	0.00		0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00		0.00			0.00
36		0.01	0.03	0.00				0.00	0.01		0.00	0.00		0.01	0.00		0.00	0.00	0.01		0.00	0.00	0.01	0.00		0.00		0.00	0.00
37	0.01		0.02		0.03			0.00	0.00			0.00	0.00	0.01				0.00	0.00	0.00	0.01	0.00	0.01		0.00	0.00			
38		0.00	0.02	0.01		0.00		0.00	0.00			0.00		0.00				0.00		0.00	0.00	0.00	0.00				0.00		0.00
39	0.01			0.01	0.02			0.01		0.02	0.01			0.00				0.00			0.01			0.00					0.00
40								0.00						0.00			0.00	0.00		0.00	0.00							0.00	
41								0.00																					
42																				0.00	0.01				0.01				
43								0.01												0.00				0.00	0.00				
44																			0.01										
45								0.00										0.00											

Table 8: FAO proposed guideline for indices of productivity for exploited fish species.

Parameter	***Productivity***			***Species***	
	Low	*Medium*	*High*	*Black drum*	***Score***
M	*<0.2*	*0.2 - 0.5*	*>0.5*	***0.1***	*1*
K	*<0.15*	*0.15 - 0.33*	*>0.33*	***0.05***	*1*
tmat	*>8*	*3.3 - 8*	*<3.3*	***5***	*2*
tmax	*>25*	*14 - 25*	*<14*	***50***	*1*
Examples	*orange roughy, many sharks*	*cod, hake*	*sardine, anchovy*	***Black Drum Productivity Score = 1.25 (low)***	

Table 9: Annual sample sizes, observed percent positive samples, nominal CPUE, index of abundance, and corresponding coefficients of variation derived from the LDWF fishery-independent marine trammel net survey. Nominal CPUE and the index of abundance have been normalized to their individual long-term means for comparison.

Year	*n*	*% Positive*	*Nominal CPUE*	*Index*	*CV*
1985	85	16	0.25	0.41	0.47
1986	95	23	0.27	0.46	0.40
1987	186	20	1.71	0.73	0.29
1988	171	13	0.46	0.25	0.37
1989	207	17	0.16	0.25	0.29
1990	196	21	0.53	0.60	0.26
1991	218	22	2.64	0.75	0.26
1992	229	22	2.18	0.64	0.24
1993	236	17	0.73	0.41	0.28
1994	220	20	0.86	0.62	0.27
1995	220	26	1.78	0.98	0.23
1996	222	30	2.17	1.29	0.22
1997	225	25	1.14	0.87	0.24
1998	228	34	1.50	1.48	0.22
1999	221	29	2.97	1.74	0.23
2000	215	33	1.48	2.01	0.22
2001	225	36	1.15	1.20	0.21
2002	223	29	0.59	0.95	0.23
2003	228	27	1.46	0.87	0.23
2004	228	32	0.55	0.87	0.22
2005	221	38	0.51	1.52	0.21
2006	223	39	0.66	1.24	0.21
2007	232	31	0.29	0.92	0.22
2008	225	39	0.81	1.73	0.20
2009	228	36	0.48	1.10	0.22
2010	225	28	0.46	1.04	0.23
2011	229	34	0.48	1.45	0.21
2012	223	41	0.37	1.64	0.20
2013	263	34	0.38	0.97	0.20

Table 10: Probabilities of age given length used in age assignments of 1985-2001 Louisiana black drum *Pogonias cromis* fishery landings.

FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+
10	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.85	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.47	0.47	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
17	0.10	0.76	0.10	0.02	0.01	0.00	0.00	0.00	0.00	0.00
18	0.01	0.74	0.16	0.04	0.02	0.01	0.01	0.00	0.00	0.01
19	0.00	0.59	0.24	0.08	0.03	0.02	0.01	0.01	0.01	0.01
20	0.00	0.39	0.30	0.13	0.06	0.04	0.02	0.02	0.01	0.03
21	0.00	0.20	0.31	0.17	0.10	0.06	0.04	0.03	0.02	0.07
22	0.00	0.08	0.25	0.19	0.12	0.09	0.06	0.05	0.04	0.12
23	0.00	0.02	0.17	0.18	0.14	0.10	0.08	0.06	0.05	0.20
24	0.00	0.00	0.09	0.14	0.13	0.11	0.09	0.08	0.06	0.29
25	0.00	0.00	0.04	0.10	0.11	0.10	0.09	0.08	0.07	0.40
26	0.00	0.00	0.02	0.06	0.08	0.09	0.09	0.08	0.08	0.51
27	0.00	0.00	0.01	0.03	0.05	0.07	0.07	0.07	0.07	0.62
28	0.00	0.00	0.00	0.01	0.03	0.05	0.05	0.06	0.06	0.73
29	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.04	0.05	0.82
30	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.89
31	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.94
32	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.97
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.99
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Table 11: Annual length-at-age samples used in age assignments of commercial black drum *Pogonias cromis* landings 2002-2013. Probabilities of age given length are calculated separately for those individuals <27 inches ("juvenile") and those ≥ 27 inches ("bull). Shaded areas represent size bins where probabilities of age given length used in commercial age assignments are taken from Table 10.

Commercial - 2002											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14			2								2
15		5									5
16		16	7								23
17		11	7	2							20
18		3	13	2		1	1				20
19		1	10	1	2						14
20			13	5	3	2					23
21			12	4	2	1	1				20
22			4	4	5	1					14
23			2	5	3	1					11
24			1	1	3	2					7
25			2	1	1	2					6
26					1	1					2
27						2	1				3
28					1		1				2
29											
30											
31										1	1
32										1	1
33										2	2
34										2	2
35											
Total		36	73	25	21	13	4			6	178

Commercial - 2003											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14			1								1
15		3	5								8
16	4	1	20	2							27
17		2	27	7							36
18		2	19	8	2		1				32
19		1	11	13	3						28
20		1	12	11	3		1				28
21		1	8	18	6	1					34
22		1	3	23	10		4	1			42
23			1	16	5	6	2				30
24				6	4	2	4	1			17
25			1	1	3	2	4				11
26			1	1	2	1	7	2	1		15
27						1	7	1	1		10
28							2		1		3
29		1								1	2
30		1								1	2
31											
32										1	1
33											
34										1	1
35											
Total	4	14	109	106	38	13	32	5	3	4	328

Commercial - 2004											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14		1									1
15		1	1								2
16		6		8							14
17		5	7	16	3	1					32
18		5	6	18	5						34
19		2	4	22	3		1	1			33
20			5	21	3	1					30
21		1	1	14	5		1	1			23
22			3	7	5	1					16
23				3	12	2	2				19
24			1	3	11	3	4	2			24
25					3	5	3	6	1		18
26					3	2	3	4	1	1	14
27								1	1		2
28										1	1
29										1	1
30											
31											
32											
33											
34											
35											
Total		21	28	112	53	15	14	15	3	3	264

Table 11 (continued):

Commercial - 2005											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13	1										1
14	2	1									3
15		7	4								11
16	6	13	19	2	1						41
17		18	27	3	9	1					58
18	1	18	26	4	18	3	1				71
19		14	13	12	14	3	1				57
20		21	19	3	16	8	1	1	1		70
21		4	7	5	10	3	1				30
22		1	2	7	15	12	1			1	39
23			5	6	14	5	2				32
24			2	4	9	12	3		2		32
25					3	9	6	5	1		24
26					1	4	1	1	4		11
27				1		3	1	2	6	6	19
28						2	1			12	15
29									2	6	8
30							1			4	5
31								1	1	1	3
32										8	8
33										3	3
34										4	4
35										4	4
36										2	2
37										3	3
38											
Total	10	97	124	47	110	65	20	10	17	54	554

Commercial - 2006											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14		1									1
15	1	9									10
16		14	11	3		1					29
17	4	13	16	4							37
18	1	10	24	8		1					44
19		22	20	24	4	3					73
20		16	25	18	6	4	1		1		71
21		4	13	22	4	9	2	1			55
22		1	3	11		8			2	1	26
23			2	14	2	6	4	1			29
24				8	1	11	1	2		2	25
25				5	1	11	4	2	1		24
26						3	4	1	1	1	10
27								2		3	5
28						1	2		1	5	9
29								1		4	5
30										2	2
31											
32										3	3
33										2	2
34										1	1
35											
36											
37											
38											
Total	6	90	114	117	18	58	18	10	6	24	461

Commercial - 2007											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14			2								2
15	2	9	3	1							15
16		25	7	3	1	1					37
17	1	35	7	4	2		1				50
18		58	8	5	4		2	1			78
19		50	16	15	1	1	1				84
20		29	25	11	5		1	1			72
21		3	28	13	4	2	1				51
22		6	22	11	6	1	3		1		50
23			11	9	17	4	8		1		50
24			3	17	7		7	2	1	1	38
25					20	2	20	8	1	2	53
26				3	7	5	16	16	5	6	58
27					1	1	11	16	6	18	53
28					1		2	3	1	16	23
29									2	1	3
30										12	12
31										1	1
32										3	3
33										1	1
34										2	2
35										1	1
36										1	1
37											
38										1	1
Total	3	215	132	92	76	17	73	47	18	66	739

Table 11 (continued):

Commercial - 2008											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14			1								1
15		19		1							20
16		16	6	6	1	1					30
17		13	24	5							42
18		10	37	4	3						54
19		7	67	9							83
20		3	77	6		3	1				90
21			37	13	1	2					53
22			19	31	7	3		1			61
23			5	19	5	3	3	2			37
24			1	9	15	15		6	3		49
25			1	5	13	12	5	12	8	1	57
26				2	2	6	2	16	9	6	43
27					2	1	7	11	16	16	53
28						1	1	3	7	2	14
29								1	4	15	20
30										5	5
31										3	3
32										3	3
33										3	3
34										1	1
35										7	7
36											
37											
38											
Total		68	275	110	49	47	19	52	47	62	729

Commercial - 2009											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13		1	1								2
14		2	3								5
15		4	15								19
16		15	43								58
17		7	99	4	1						111
18		2	90	7			1				100
19		1	70	19	1						91
20			29	24			1				54
21			13	25	1						39
22			3	13	4						20
23			2	9	2	1					14
24				4	6	3				1	14
25				1	2	4	6	1	3	2	19
26					2	1	4	1	5	5	18
27					2		4	1	3	18	28
28							1		2	12	15
29										11	11
30										4	4
31										2	2
32										2	2
33										1	1
34											
35										2	2
36											
37											
38											
Total		32	368	106	21	9	17	3	13	60	629

Commercial - 2010											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14											
15		1	1	1							3
16	1	1	9	4							15
17			13	8	1						22
18		1	8	23	2						34
19			4	27	3						34
20			1	29	2						32
21			2	21	4					1	28
22			2	15	12						29
23			1	14	7	5	1				28
24				1	1	2	1	1			6
25				2	6	3	4	3	1	1	20
26					1	4	1	6		2	14
27							1			3	4
28										2	2
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
Total	1	3	41	145	39	14	8	10	1	9	271

Table 11 (continued):

Commercial - 2011											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14											
15		4	5	2							11
16		7	10	3	2						22
17		2	28	3	5						38
18		17	45	9	15						86
19		3	66	13	28						110
20		1	53	14	28	1					97
21			23	20	28	2					73
22		1	11	17	34	2					65
23		1	7	28	48	3					87
24			1	24	49	6	3				83
25			2	11	26	6	5	1	3	2	56
26				3	25	7	8	5		1	49
27				2	5	3	1	1	6	5	23
28					1			1		9	11
29							1	1		4	6
30								1		7	8
31										4	4
32										4	4
33										4	4
34											
35										4	4
36										4	4
37											
38										2	2
39										1	1
40										1	1
Total		36	251	149	294	30	18	10	9	52	849

Commercial - 2012											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13			1								1
14				1		1					2
15	1	5		4	1						11
16		15	6	4							25
17		18	13	8	1	1					41
18		16	26	19	2	1					64
19		1	18	40	5	4					68
20		1	15	41	4	4	1				66
21		1	13	58	9	8					89
22			8	41	17	19	1				86
23				32	20	19	1				72
24				14	12	25	6	1			58
25				2	7	25	5	5		3	47
26					1	10	6	4	4	5	30
27				1		4	5	3	1	8	22
28						2	1			4	7
29										3	3
30										3	3
31											
32											
33											
34											
35											
36										2	2
37										1	1
38										1	1
39											
40											
Total	1	57	100	265	79	123	26	13	5	30	699

Commercial - 2013											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13	1										1
14		2									2
15	1	6									7
16	1	11	1	1							14
17		24	2		2						28
18		16	12	1							29
19		31	4	1							36
20		16	1		1						18
21		13	7	5	16	2	3				46
22		3	8	3	26	8	7	1			56
23		2	5	4	29	6	11				57
24			5	2	8	1	3	1			20
25			1	1	9	2	10	3			26
26					4	.	1	3			8
27				1		2	3	1	1	1	9
28						3	1	3	1	3	11
29							1	1		2	4
30									1	6	7
31										6	6
32										5	5
33										3	3
34											
Total	3	124	46	19	95	24	40	13	3	26	393

Table 12: Annual length-at-age samples for age assignments of recreational black drum *Pogonias cromis* landings 2002-2013. Shaded areas represent size bins where probabilities of age given length used in recreational age assignments are taken from Table 10.

Recreational - 2002											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13											
14											
15	1	2	1	1							5
16	1	8	10	4							23
17		7	10	1	2						20
18		7	3	1		5					16
19			3	1	2	3					9
20		1	1	6		1					9
21				1	1	1					3
22		1	1	1		1					4
23			1		1						2
24			1		1	2					4
25				1							1
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
Total	2	26	31	17	7	13					96

Recreational - 2003											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
10				1							1
11											
12	1										1
13	1										1
14	1		3								4
15	3	1	7								11
16	1	5	10	3	2						21
17	1	1	9	5	1						17
18			9	4	1		3				17
19		3	10	6	4		1				24
20			8	4	2						14
21		1	3	4			2				10
22			1	4			1				6
23			1	1							2
24			1	1			1				3
25				1		1					2
26											
27							1				1
28				1							1
29											
30											
31											
32										1	1
33										1	1
34											
35										2	2
Total	8	11	62	35	10	1	9			4	140

Recreational - 2004											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
13		1									1
14	2	1									3
15	4	12	1	1							18
16	4	11		5							20
17	2	5	8	12	5						32
18		5	3	11	2						21
19		3	2	8	5						18
20			3	5	3			1			12
21		2		3	3	1					9
22			1		1	1					3
23					2	1					3
24					1	1					2
25					1	1		2			4
26				1				2			3
27						1					1
28											
29											
30											
31											
32											
33											
34										1	1
35											
Total	12	40	18	46	23	6		5		2	152

Table 12 (continued):

Recreational - 2005											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
12											
13											
14	1		1								2
15	1	7	3		1						12
16	1	8	12	2	2						25
17		9	10	1	1						21
18		6	14		3		1				24
19		2	11	2	4						19
20		1	1	2	5				1		10
21			2	4	4						10
22			2	1	1						4
23				1	1	1					3
24						2					2
25					1	1					2
26					1	2					3
27						1					1
28								1			1
29											
30											
31						1				1	2
32											
33											
34										1	1
35										1	1
36										2	2
37											
Total	3	33	56	13	24	8	1	1	1	5	145

Recreational - 2006											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
12											
13	2										2
14	1										1
15	3	1	2								6
16	3	4	5	1							13
17	4	4	6								14
18		3	5	5							13
19	1	6	5	3							15
20		4	6	8		1					19
21		1	2	4	1						8
22		1	2			3					6
23				1				1			2
24				1		1					2
25			1	1		3	1				6
26											
27								1		2	3
28											
29											
30											
31										1	1
32										1	1
33											
34										1	1
35											
36											
37											
Total	14	24	34	24	1	8	1	2		5	113

Recreational - 2007											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
12	1	1									2
13	1										1
14	2		1								3
15	7	24	1	1							33
16	5	41	15								61
17		29	5	5	2	1					42
18	2	26	17	8	5	1					59
19	1	7	8	6	2						24
20		6	8	9	2		2				27
21		1	3	5	3		1				13
22			7	4	2		1				14
23			3	3	2			1			9
24							3				3
25					1				1		2
26								1		1	2
27										2	2
28									1	2	3
29										4	4
30											
31											
32										2	2
33										1	1
34										2	2
35										1	1
36										1	1
37										1	1
Total	19	135	68	41	19	2	7	2	2	17	312

Table 12 (continued):

Recreational - 2008											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
10	2										2
11	2										2
12											
13											
14	2	2									4
15		54	7								61
16	1	73	12	1							87
17		57	28	2							87
18	1	26	25	3	2	2					59
19		13	20	7							40
20		7	16	5	2	2					32
21		2	9	4	1	2					18
22		2	4		2						8
23			1	1	2		1				5
24				2	1	2			1		6
25						2		2			4
26					1	1	1	1	1		5
27									3	2	5
28								4	2		6
29										1	1
30									1	5	6
31										1	1
32											
33										3	3
34										4	4
35										4	4
36										2	2
37										2	2
38										1	1
39											
40											
41											
42										1	1
43											
Total	8	236	122	25	11	11	2	7	8	26	456

Recreational - 2009											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
10											
11			1								1
12											
13	2				1						3
14	2		1								3
15	5	16	25								46
16	13	24	60	1		1					99
17	2	11	71	2							86
18		8	76	7							91
19		5	43	5							53
20		1	35	10							46
21		1	16	11	1						29
22			3	8	4						15
23			3	7			1				11
24			3	6	1		1				11
25					2	1			1		4
26			1		1				1	1	4
27									1	2	3
28										3	3
29										4	4
30										5	5
31										1	1
32										1	1
33										7	7
34										1	1
35										2	2
36										2	2
37										2	2
38										1	1
39											
40											
41											
42											
43										1	1
Total	24	66	338	57	10	2	2		3	33	535

Table 12 (continued):

Recreational - 2010											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
11											
12		1									1
13		3									3
14		2	1	1							4
15		35	3	4							42
16	1	34	15	12							62
17		17	12	21				1			51
18		11	11	25	1			1			49
19		4	10	33							47
20		3	4	19	2						28
21			2	12	1						15
22		1		11	1						13
23				6	1						7
24				1	3		1	1			6
25						1	1	1			3
26					1					2	3
27					1			1			2
28										2	2
29										7	7
30										6	6
31										0	
32										1	1
33										2	2
34										2	2
35											
36										1	1
37										1	1
Total	1	111	58	145	11	1	2	5	0	24	358

Recreational - 2011											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
11	1										1
12	1	1									2
13	4	1									5
14	1	1									2
15	4	18	15								37
16	5	29	26	1	1						62
17	4	40	54	2							100
18		19	28	3	1						51
19		9	21	4	1						35
20		1	16	3	4						24
21			8	1	6						15
22		1	5	2	6						14
23			3	1	1						5
24					4	3					7
25					1	1	2	1	1	1	7
26					4		1	1	1	1	8
27					1			1		2	4
28							1			4	5
29							1			3	4
30											
31										3	3
32											
33										3	3
34										1	1
35											
36											
37											
Total	20	120	176	17	30	4	5	3	2	18	395

Table 12 (continued):

Recreational - 2012											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
11		1									1
12											
13		2									2
14		4									4
15	2	29	8								39
16	1	37	22	2							62
17		32	23	8							63
18		22	21	19							62
19		6	10	15							31
20		1	11	10	1						23
21			5	10	2						17
22			1	16	1	1					19
23				3	1	3					7
24				1		2	1				4
25						2	1		1		4
26					1		3		1	2	7
27						1	2		1	3	7
28										2	3
29									1	5	6
30										1	1
31										4	4
32											
33										3	3
34											
35											
36										1	1
37											
38											
39										1	1
40										1	1
Total	3	134	101	84	6	9	7		4	24	372

Recreational - 2013											
FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Total
11											
12											
13	1	1	1								3
14	2	4									6
15	1	9	3								13
16	5	34	4	1							44
17	2	23	6	4							35
18		17	10	6	1						34
19		8	5	2	1						16
20		3	8	8	2						21
21		3	5	9	6						23
22				2	1						3
23		1	3	1	2	2					9
24			1	1	1	1	2			1	7
25					2	2	2	3		4	13
26							6	2		3	11
27						1	2	3		6	12
28							1	1		7	9
29										6	6
30		1								7	8
31										4	4
32										7	7
33										1	1
34											
35										1	1
36											
37										1	1
38											
39											
40											
Total	11	104	46	34	16	6	13	9		48	287

Table 13: Annual commercial black drum catch-at-age and yield (pounds).

Commercial Catch-at-age											
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Yield (lbs)
1985	20,653	52,894	21,624	15,702	14,601	14,128	13,712	13,273	12,799	148,496	3,417,824
1986	31,545	80,789	33,027	23,983	22,302	21,579	20,943	20,273	19,548	226,809	5,220,309
1987	48,419	124,004	50,694	36,812	34,231	33,122	32,146	31,118	30,005	348,131	8,012,694
1988	52,862	135,383	55,346	40,190	37,372	36,162	35,095	33,973	32,758	380,077	8,747,953
1989	276,435	263,538	72,057	32,036	19,865	14,849	12,284	10,742	9,701	120,934	4,401,945
1990	180,423	172,006	47,030	20,910	12,966	9,692	8,017	7,011	6,332	78,931	2,873,057
1991	120,094	114,491	31,304	13,918	8,630	6,451	5,336	4,667	4,215	52,539	1,912,380
1992	189,113	180,291	49,295	21,917	13,590	10,159	8,403	7,349	6,637	82,733	3,011,441
1993	199,407	190,104	51,979	23,110	14,330	10,712	8,861	7,749	6,998	87,236	3,175,355
1994	74,378	200,571	66,106	28,427	15,930	10,572	7,761	6,054	4,913	87,188	3,708,755
1995	129,822	337,089	97,809	39,108	20,842	13,279	9,388	7,047	5,482	35,592	2,995,848
1996	8,640	28,944	12,586	7,632	5,814	4,929	4,406	4,053	3,790	62,697	1,613,279
1997	29,588	84,326	36,570	19,558	12,897	9,613	7,671	6,359	5,386	42,680	1,641,234
1998	9,591	102,036	36,695	17,062	10,847	8,108	6,588	5,602	4,892	50,863	1,779,538
1999	88,031	400,528	86,749	27,126	12,151	6,809	4,339	2,970	2,114	5,942	2,199,659
2000	33,388	297,423	120,295	51,921	28,874	18,927	13,619	10,311	8,021	30,552	2,843,677
2001	110,130	427,110	138,620	53,661	27,036	16,305	10,941	7,795	5,738	17,801	3,195,361
2002	6,669	126,617	241,803	86,923	58,887	27,123	12,673	4,984	4,425	33,607	3,157,145
2003	10,171	24,197	218,093	213,907	76,560	24,477	48,741	8,492	2,539	3,035	3,504,430
2004	6,374	46,524	65,469	271,033	127,892	36,712	34,351	34,411	5,745	12,836	3,725,842
2005	8,964	87,633	112,700	42,516	99,945	53,667	14,916	6,010	7,828	9,801	2,398,000
2006	5,553	71,753	91,505	93,511	14,487	45,929	13,303	5,914	4,336	7,725	1,932,412
2007	4,316	134,100	83,521	57,327	43,287	9,330	34,721	16,331	5,503	9,933	2,358,379
2008	879	51,751	194,787	72,482	26,727	24,707	6,977	20,474	12,470	10,461	2,453,351
2009	2,407	40,360	434,633	119,443	21,596	9,763	15,799	2,792	11,622	20,699	3,142,291
2010	6,877	4,039	68,608	248,367	69,464	23,363	12,929	19,518	3,638	17,636	2,782,714
2011	522	27,395	187,438	111,205	218,605	21,555	13,157	5,289	3,205	6,831	3,733,042
2012	3,335	67,294	111,294	284,250	80,464	114,489	19,341	9,518	4,071	8,242	4,120,563
2013	9,679	246,026	85,646	32,132	157,398	34,722	58,000	9,836	1,440	12,187	3,796,170

Table 14: Annual mean weights at age (pounds) of commercial black drum landings.

Commercial Mean Weight-at-age										
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+
1985	2.20	3.66	5.46	7.81	9.35	10.28	10.92	11.41	11.82	14.87
1986	2.20	3.66	5.46	7.81	9.35	10.28	10.92	11.41	11.82	14.87
1987	2.20	3.66	5.46	7.81	9.35	10.28	10.92	11.41	11.82	14.87
1988	2.20	3.66	5.46	7.81	9.35	10.28	10.92	11.41	11.82	14.87
1989	1.82	3.38	4.60	5.77	6.85	7.89	8.86	9.74	10.57	15.94
1990	1.82	3.38	4.60	5.77	6.85	7.89	8.86	9.74	10.57	15.94
1991	1.82	3.38	4.60	5.77	6.85	7.89	8.86	9.74	10.57	15.94
1992	1.82	3.38	4.60	5.77	6.85	7.89	8.86	9.74	10.57	15.94
1993	1.82	3.38	4.60	5.77	6.85	7.89	8.86	9.74	10.57	15.94
1994	2.43	3.59	4.68	5.43	5.98	6.46	6.94	7.48	8.11	23.77
1995	2.45	3.49	4.50	5.18	5.64	6.00	6.32	6.65	7.01	14.60
1996	2.37	3.74	5.31	6.86	8.09	9.06	9.87	10.60	11.29	18.35
1997	2.33	3.79	5.15	6.24	7.04	7.63	8.12	8.55	8.96	14.42
1998	2.80	3.81	4.74	5.92	6.95	7.77	8.47	9.11	9.73	15.71
1999	2.75	3.35	3.94	4.29	4.48	4.60	4.68	4.74	4.79	4.92
2000	2.60	3.94	4.74	5.41	5.91	6.27	6.54	6.75	6.93	7.48
2001	2.48	3.66	4.51	4.96	5.21	5.36	5.46	5.55	5.62	5.82
2002	1.74	2.81	4.56	5.89	6.42	6.48	6.88	9.74	9.89	13.20
2003	2.42	3.67	3.85	5.79	6.79	8.26	8.86	9.44	11.29	16.84
2004	1.99	3.32	4.43	4.55	6.86	8.45	8.74	9.28	10.72	12.89
2005	2.39	3.76	3.97	5.45	5.56	7.24	7.93	9.58	9.92	17.40
2006	2.84	3.75	4.24	5.67	5.81	7.43	8.72	8.90	8.18	12.94
2007	2.01	3.84	5.25	5.88	7.66	7.84	8.85	9.98	9.99	13.02
2008	1.74	2.99	4.62	6.04	7.79	8.28	9.02	9.94	10.64	14.22
2009	1.40	2.64	3.58	5.42	7.84	9.33	9.49	10.56	10.70	12.72
2010	2.23	3.05	3.87	5.10	6.85	9.33	9.48	10.34	9.41	9.62
2011	1.74	3.47	4.44	6.56	7.10	8.93	10.13	10.79	10.25	15.85
2012	1.78	3.10	4.30	5.53	6.85	7.84	9.19	10.08	10.88	10.76
2013	1.92	4.04	5.46	6.46	7.10	7.44	7.92	9.35	11.76	13.47

Table 15: Annual recreational black drum catch-at-age and yield (pounds).

Recreational Catch-at-age											
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Yield (lbs)
1985	212,214	17,111	7,110	3,789	2,422	1,764	1,393	1,156	989	12,811	621,337
1986	573,503	74,404	20,873	10,176	6,644	5,083	4,251	3,744	3,405	59,200	2,315,747
1987	273,530	42,389	17,265	9,123	5,684	3,998	3,045	2,440	2,024	46,649	1,836,973
1988	284,279	66,137	20,876	10,445	6,710	4,904	3,853	3,157	2,654	45,185	1,900,529
1989	115,108	28,370	9,859	5,200	3,509	2,687	2,199	1,868	1,622	25,465	951,043
1990	47,721	40,705	14,751	6,582	3,837	2,618	1,947	1,520	1,218	8,292	510,823
1991	58,990	19,479	7,229	3,786	2,520	1,921	1,571	1,336	1,162	12,609	498,634
1992	107,612	47,278	12,415	5,791	3,579	2,578	2,030	1,686	1,448	22,930	1,016,249
1993	107,033	71,886	22,581	9,295	5,058	3,294	2,381	1,828	1,453	11,991	861,765
1994	49,764	51,661	14,720	6,054	3,366	2,220	1,608	1,225	959	7,651	593,351
1995	76,236	106,543	23,757	8,109	3,991	2,423	1,651	1,198	901	5,670	794,771
1996	127,514	102,842	30,495	11,857	6,052	3,716	2,554	1,878	1,441	10,000	985,694
1997	138,510	128,137	38,104	15,129	7,815	4,807	3,290	2,400	1,824	17,093	1,336,506
1998	102,482	166,447	50,151	19,892	10,363	6,467	4,497	3,333	2,569	29,210	1,882,932
1999	104,014	158,219	41,764	15,698	8,080	5,037	3,504	2,594	1,989	10,180	1,246,489
2000	106,346	311,047	109,896	46,718	25,257	16,093	11,317	8,425	6,484	33,366	2,934,209
2001	112,124	177,882	60,894	26,451	14,682	9,577	6,882	5,233	4,117	28,491	1,977,460
2002	109,748	141,315	130,318	43,653	20,125	25,787	5,960	4,641	3,716	25,993	2,081,893
2003	34,867	34,653	179,666	90,043	37,009	8,961	25,292	6,596	5,767	62,250	3,006,032
2004	41,227	136,355	67,838	153,238	56,090	5,459	4,285	5,356	2,912	32,274	2,398,062
2005	9,832	74,359	112,351	25,710	41,487	3,679	4,537	2,650	4,098	30,073	1,746,551
2006	59,796	71,979	95,212	49,593	12,371	11,245	8,681	7,506	6,546	45,401	2,018,327
2007	24,996	131,189	72,484	50,160	24,200	7,214	9,640	4,443	4,192	56,922	2,401,730
2008	33,281	251,918	141,075	33,003	11,429	12,411	4,312	3,927	3,606	48,392	2,675,993
2009	50,226	67,601	316,310	40,082	6,941	3,084	2,904	1,995	2,005	27,842	2,272,807
2010	12,017	139,989	64,908	130,171	7,863	2,935	2,713	4,862	2,355	30,648	1,816,268
2011	26,706	136,359	208,067	24,734	28,914	4,042	3,647	3,295	2,985	28,765	2,106,622
2012	20,521	124,367	116,750	99,530	11,411	5,360	3,630	3,278	2,993	36,318	2,151,855
2013	42,477	245,042	80,788	43,996	10,466	2,817	3,351	4,007	1,212	20,272	1,803,276

Table 16: Annual mean weights at age (pounds) of recreational black drum landings.

Recreational Mean Weight-at-age										
Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+
1985	0.91	3.53	5.21	6.12	6.82	7.44	8.05	8.66	9.30	19.60
1986	1.04	3.28	4.78	6.08	7.12	8.08	9.00	9.89	10.75	18.89
1987	1.08	3.48	5.20	6.05	6.57	7.01	7.46	7.99	8.61	24.36
1988	1.28	3.39	4.90	6.09	6.87	7.42	7.89	8.35	8.84	22.03
1989	1.12	3.50	5.02	6.30	7.24	7.94	8.52	9.04	9.57	21.57
1990	1.20	3.75	4.74	5.61	6.25	6.70	7.06	7.37	7.67	14.35
1991	1.62	3.46	5.07	6.23	7.18	7.92	8.52	9.07	9.59	16.33
1992	1.59	3.22	4.70	5.86	6.67	7.36	8.02	8.71	9.42	22.77
1993	1.55	3.55	4.59	5.27	5.80	6.26	6.69	7.11	7.55	16.67
1994	1.90	3.46	4.51	5.35	5.94	6.34	6.64	6.88	7.09	21.53
1995	1.99	3.33	4.07	4.71	5.16	5.48	5.73	5.94	6.16	17.40
1996	1.49	3.50	4.49	5.00	5.32	5.61	5.92	6.29	6.75	15.07
1997	1.63	3.49	4.53	5.08	5.37	5.59	5.81	6.11	6.52	17.61
1998	2.08	3.51	4.52	5.09	5.46	5.77	6.08	6.42	6.84	20.65
1999	1.93	3.43	4.34	4.98	5.43	5.77	6.07	6.36	6.65	11.73
2000	2.21	3.68	4.71	5.31	5.68	5.96	6.21	6.46	6.73	11.45
2001	1.98	3.61	4.73	5.42	5.87	6.23	6.56	6.90	7.29	15.03
2002	1.93	3.49	3.61	4.21	4.99	4.60	7.03	7.34	7.67	15.47
2003	1.91	3.49	3.78	4.60	5.08	8.62	5.90	9.30	9.65	19.48
2004	2.39	2.98	4.12	3.72	4.28	7.48	7.85	7.09	8.64	21.00
2005	2.00	2.98	3.58	5.06	4.61	8.45	7.15	9.13	7.50	22.45
2006	2.43	3.63	4.01	5.06	8.08	8.24	8.95	9.27	9.55	12.74
2007	1.87	3.16	4.38	5.04	5.73	7.97	8.06	10.97	11.34	17.66
2008	1.31	2.99	3.97	5.14	6.57	6.58	9.83	10.31	10.80	18.14
2009	1.87	2.85	3.41	5.55	7.77	8.04	10.81	12.44	12.62	19.20
2010	1.79	2.67	3.44	3.98	6.60	9.70	10.20	7.16	11.16	16.70
2011	2.07	3.06	3.71	5.13	5.90	9.44	9.77	10.09	10.43	14.86
2012	1.37	2.93	3.80	5.11	6.95	8.58	9.67	10.17	10.70	16.04
2013	2.14	2.95	3.52	4.14	5.55	9.58	10.52	11.09	9.78	17.28

Table 17: Probabilities of age given length for age assignments of black drum catches from the LDWF fishery-independent marine trammel net survey.

FL_in	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.95	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.91	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.79	0.17	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
18	0.56	0.32	0.07	0.02	0.01	0.01	0.00	0.00	0.00	0.00
19	0.27	0.46	0.14	0.05	0.03	0.02	0.01	0.01	0.00	0.01
20	0.08	0.46	0.21	0.09	0.05	0.03	0.02	0.01	0.01	0.03
21	0.02	0.35	0.24	0.13	0.08	0.05	0.04	0.03	0.02	0.06
22	0.00	0.21	0.23	0.15	0.10	0.07	0.05	0.04	0.03	0.11
23	0.00	0.10	0.19	0.16	0.12	0.09	0.07	0.06	0.05	0.18
24	0.00	0.04	0.13	0.14	0.12	0.10	0.08	0.07	0.06	0.26
25	0.00	0.01	0.08	0.11	0.11	0.10	0.09	0.08	0.07	0.36
26	0.00	0.00	0.04	0.07	0.09	0.09	0.08	0.08	0.07	0.47
27	0.00	0.00	0.02	0.04	0.06	0.07	0.07	0.07	0.07	0.59
28	0.00	0.00	0.01	0.02	0.04	0.05	0.06	0.06	0.06	0.70
29	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.05	0.79
30	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.87
31	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.93
32	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.96
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.98
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Table 18: Annual black drum catch-at-size from the LDWF fishery-independent marine trammel net survey.

FL_in	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4				1						1																			
5			1																		1								
6			1			1											1												
7		2	1			1	4	3	1			2	1	3	1						1	3	1	13	5				2
8	3	5	215	3	10	20	183	257	45	100	107	521	60	304	153	21	17	38	51	8	43	107	10	238	44	19	32	35	31
9	9	5	317	13	24	44	714	715	118	164	586	839	86	636	804	137	24	70	139	42	69	309	23	202	47	8	100	22	34
10	1	3	248	6	6	109	483	213	47	59	133	193	96	146	522	47	60	19	133	102	22	76	27	31	59	8	24	27	10
11	2	1	16	2		56	122	22	27	29	54	20	167	30	127	53	207	5	94	30	18	16	20	15	36	15	10	19	27
12	1	2	12	3	3	20	10	4	32	27	38	8	161	23	58	81	172	13	183	22	20	6	25	37	40	9	4	17	19
13	3	7	5	5	7	13	21	37	39	25	57	15	68	43	90	141	112	31	242	24	22	12	14	36	22	12	2	10	28
14	3	15	7	10	2	5	10	44	19	17	123	82	19	47	102	102	60	33	91	16	31	14	4	31	23	14	5	11	27
15	9	14	2	4	2	4	4	33	13	8	53	17	15	34	101	87	64	27	25	9	64	9	6	26	18	20	15	6	30
16	4	7	1	5	1	3	13	20	11	18	31	11	26	33	103	99	140	41	28	14	55	6	5	21	25	14	6	7	24
17	1	6	1	9	1	1	15	24	6	13	63	27	26	36	106	107	73	26	32	20	28	9	8	20	17	12	9	5	25
18	1	2		9		3	4	6	9	6	35	13	22	26	72	121	43	33	17	21	46	4	8	9	11	18	13	4	18
19			2	15	1		1	4	5	3	17	20	21	25	83	126	58	18	12	15	27	15	2	6	26	22	12	5	12
20				20	1	1		1	2	1	12	36	20	27	48	110	52	24	29	22	5	14	8	11	24	40	40	11	10
21				7	4			1			5	15	10	18	23	68	37	24	23	19	9	21	8	8	21	41	63	20	8
22				9	1			1			4	6	10	17	18	25	30	25	21	14	16	8	14	10	20	52	31	16	5
23			1	5							1	4	8	20	11	18	10	12	7	10	14	11	16	9	12	11	17	26	13
24	1		1	1	1	1						1		10	1	5	3	11	5	10	9	7	15	14	10	10	27	35	14
25	1												2	5	1	3		9	6	26	9	13	6	11	8	6	21	20	10
26													2	1	5	1		4	2	44	9	17	7	8	5	11	9	32	14
27	1	2													1		2	2	2	21	9	12	9	21	2	6	8	16	16
28	2	1			1			1					1	1		1	2	1	3	9	7	5	5	11	3	8	5	10	7
29	1				1								1	3		1	1	2	2	4	3	7	9	15	2	6	4	16	12
30					1									1			1	1		4	4	7	4	12	6	6	7	5	8
31					2											1	2	1	2	10	2	1	3	13	3	2	4	20	9
32								2				1				3	1	2	2	5	4	2	4	12	6	3	3	16	5
33			1		2	1				1			1	1	2	1		1	2	1	2	7	5	13	2	1	3	7	3
34	1							2				1	4	1		1		1	4		3	5		12	2	1	8	8	2
35		1		1			1	2								.	2	.	2			4	3	14	2		1	5	7
36											2					1	2	2			1	1	2	12		2		6	1
37																		1		1		2		5	1				1
38		1										1					1							2	1			2	2
39		1												1			1							1		1	1		
40																		1											1
41																					1								
Totals	44	75	831	129	71	283	1585	1392	374	471	1322	1833	827	1494	2431	1362	1176	479	1157	524	552	729	273	899	504	379	485	439	435

Table 19: Annual black drum survey age composition and sample sizes derived from the LDWF fishery-independent marine trammel net survey.

Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	n
1985	0.694	0.047	0.015	0.014	0.015	0.015	0.015	0.014	0.014	0.158	28
1986	0.826	0.055	0.009	0.004	0.004	0.004	0.004	0.004	0.004	0.086	57
1987	0.763	0.074	0.031	0.019	0.014	0.011	0.008	0.007	0.006	0.068	21
1988	0.408	0.261	0.121	0.062	0.037	0.025	0.018	0.014	0.010	0.045	101
1989	0.456	0.108	0.062	0.036	0.025	0.020	0.017	0.015	0.015	0.246	28
1990	0.847	0.067	0.019	0.010	0.006	0.005	0.004	0.003	0.002	0.038	34
1991	0.877	0.084	0.014	0.004	0.002	0.001	0.001	0.001	0.000	0.015	69
1992	0.855	0.074	0.016	0.006	0.003	0.002	0.002	0.001	0.001	0.040	175
1993	0.874	0.089	0.020	0.007	0.004	0.002	0.001	0.001	0.001	0.002	105
1994	0.868	0.089	0.018	0.006	0.003	0.002	0.001	0.001	0.001	0.012	94
1995	0.820	0.112	0.030	0.012	0.007	0.004	0.003	0.002	0.001	0.009	405
1996	0.633	0.179	0.072	0.035	0.020	0.013	0.009	0.007	0.005	0.028	250
1997	0.661	0.147	0.058	0.030	0.018	0.013	0.010	0.008	0.006	0.049	276
1998	0.580	0.160	0.075	0.043	0.028	0.021	0.016	0.013	0.010	0.056	350
1999	0.690	0.168	0.056	0.026	0.015	0.010	0.007	0.005	0.004	0.018	767
2000	0.594	0.206	0.078	0.037	0.021	0.014	0.010	0.008	0.006	0.026	1022
2001	0.667	0.158	0.061	0.030	0.018	0.012	0.009	0.007	0.005	0.034	711
2002	0.516	0.165	0.082	0.048	0.033	0.024	0.019	0.015	0.013	0.086	332
2003	0.749	0.091	0.042	0.023	0.015	0.011	0.009	0.007	0.006	0.048	562
2004	0.298	0.127	0.075	0.057	0.048	0.043	0.038	0.035	0.031	0.249	321
2005	0.575	0.132	0.054	0.033	0.025	0.020	0.017	0.015	0.013	0.116	379
2006	0.253	0.132	0.082	0.058	0.046	0.039	0.034	0.031	0.028	0.298	212
2007	0.251	0.103	0.082	0.064	0.051	0.043	0.038	0.034	0.030	0.304	169
2008	0.370	0.067	0.038	0.030	0.026	0.024	0.022	0.021	0.020	0.383	365
2009	0.424	0.167	0.088	0.053	0.036	0.028	0.022	0.019	0.016	0.149	277
2010	0.272	0.204	0.123	0.074	0.051	0.039	0.031	0.026	0.022	0.159	320
2011	0.156	0.198	0.134	0.087	0.063	0.048	0.039	0.033	0.028	0.214	316
2012	0.134	0.079	0.076	0.065	0.056	0.049	0.044	0.040	0.036	0.420	321
2013	0.444	0.096	0.048	0.036	0.030	0.027	0.024	0.023	0.021	0.252	312

Table 20: Summary of objective function components and likelihood values of the ASAP base model.

Objective function = 2215			
Component	Lambda	ESS	Obj_fun
Catch_Fleet_Total	2		807.93
Index_Fit_Total	1		22.92
Catch_Age_Comps		2978	685.84
Index_Age_Comps		524	247.88
Fmult_Year1_Total	2		1.63
Recruit_devs	1		448.65

Table 21: Annual black drum 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	Age_7	Age_8	Age_9	Age_10	Totals
1985	1,302,550	321,783	208,598	187,548	190,339	202,255	211,360	237,692	268,283	3,660,420	6,790,828
1986	1,800,650	860,455	204,325	144,296	137,816	146,120	160,503	171,847	197,020	3,379,310	7,202,342
1987	1,223,960	776,731	371,769	107,637	87,595	92,441	105,229	121,508	135,001	2,978,750	6,000,621
1988	1,349,300	524,744	262,569	157,361	53,914	49,739	57,723	70,594	86,239	2,417,070	5,029,254
1989	1,029,290	565,976	170,526	107,681	76,847	29,995	30,548	38,205	49,554	1,929,630	4,028,251
1990	870,933	568,542	180,662	67,723	51,847	43,196	19,038	21,253	28,483	1,628,160	3,479,837
1991	948,979	524,549	225,937	85,431	37,273	32,221	29,531	13,985	16,481	1,391,610	3,305,996
1992	1,464,060	632,115	267,946	130,036	54,602	25,897	23,910	23,022	11,320	1,209,280	3,842,188
1993	1,856,790	924,461	279,881	136,688	75,636	35,299	18,200	17,898	18,082	1,031,330	4,394,265
1994	1,955,610	1,213,400	446,958	153,276	83,966	50,952	25,578	13,933	14,290	894,125	4,852,087
1995	1,949,660	1,338,690	665,170	272,484	102,416	60,336	38,770	20,313	11,432	785,686	5,244,956
1996	1,853,210	1,380,750	795,789	430,629	190,413	76,044	47,003	31,307	16,862	693,327	5,515,333
1997	3,210,850	1,397,150	957,227	579,946	329,124	151,096	62,185	39,306	26,645	625,410	7,378,938
1998	2,944,350	2,534,370	1,042,990	677,713	423,837	251,057	119,980	51,024	33,099	572,956	8,651,376
1999	3,306,430	2,324,080	1,900,780	749,033	502,081	326,827	200,942	98,978	43,114	533,034	9,985,299
2000	4,529,970	2,636,490	1,787,690	1,379,240	557,968	388,846	262,697	166,499	84,004	508,385	12,301,789
2001	4,441,370	3,561,030	1,944,830	1,253,540	1,000,500	423,109	307,306	214,724	139,774	518,228	13,804,411
2002	1,536,600	3,533,310	2,714,780	1,394,080	923,870	768,309	337,903	253,431	181,626	577,754	12,221,663
2003	2,592,800	1,221,300	2,709,590	1,994,230	1,052,220	723,032	622,081	281,238	215,596	667,802	12,079,889
2004	2,097,960	2,038,410	903,736	1,917,350	1,459,190	803,416	574,303	510,229	236,618	771,592	11,312,804
2005	1,980,190	1,653,390	1,508,180	628,922	1,379,280	1,099,180	632,033	468,142	427,756	879,939	10,657,012
2006	3,128,670	1,574,950	1,273,620	1,118,180	478,770	1,086,810	894,482	527,902	399,191	1,149,110	11,631,685
2007	5,720,950	2,484,340	1,211,990	951,697	858,225	379,716	888,486	749,263	450,859	1,363,000	15,058,526
2008	2,037,440	4,535,220	1,897,590	894,851	722,638	674,873	308,438	740,819	637,869	1,594,470	14,044,208
2009	4,164,160	1,618,330	3,492,840	1,418,590	687,021	573,266	551,834	258,411	632,806	1,964,290	15,361,548
2010	2,358,170	3,318,930	1,255,160	2,608,020	1,086,260	543,867	468,200	462,198	220,814	2,289,130	14,610,749
2011	2,373,650	1,885,890	2,610,980	957,390	2,035,180	872,946	449,260	395,383	397,237	2,225,860	14,203,776
2012	5,171,340	1,894,210	1,469,500	1,961,390	736,959	1,617,850	715,227	377,169	338,430	2,318,620	16,600,695
2013	2,978,380	4,119,010	1,453,030	1,065,050	1,460,140	570,463	1,299,760	592,337	319,954	2,340,800	16,198,924

Table 22: Annual age-specific, apical, and average black drum fishing mortality rates estimated from the ASAP base model.

Year	Age_1	Age_2	Age_3	Age_4	Age_5	Age_6	Age_7	Age_8	Age_9	Age_10+	Fmult_total	Avg. F
1985	0.21	0.30	0.23	0.18	0.14	0.11	0.09	0.07	0.06	0.05	0.36	0.11
1986	0.64	0.68	0.50	0.37	0.28	0.21	0.16	0.13	0.10	0.08	0.87	0.32
1987	0.64	0.93	0.72	0.56	0.44	0.35	0.28	0.23	0.18	0.15	1.11	0.41
1988	0.66	0.97	0.75	0.59	0.46	0.37	0.29	0.24	0.19	0.16	1.15	0.43
1989	0.39	0.98	0.79	0.60	0.45	0.33	0.24	0.18	0.13	0.09	0.98	0.35
1990	0.30	0.77	0.61	0.47	0.35	0.26	0.19	0.14	0.10	0.07	0.77	0.29
1991	0.20	0.51	0.41	0.32	0.24	0.18	0.13	0.10	0.07	0.05	0.51	0.20
1992	0.25	0.66	0.54	0.41	0.31	0.23	0.17	0.13	0.09	0.07	0.66	0.29
1993	0.22	0.57	0.46	0.36	0.27	0.20	0.15	0.11	0.08	0.06	0.57	0.27
1994	0.17	0.44	0.36	0.27	0.21	0.15	0.11	0.08	0.06	0.04	0.44	0.24
1995	0.14	0.36	0.30	0.23	0.17	0.13	0.10	0.07	0.05	0.04	0.36	0.21
1996	0.08	0.21	0.18	0.14	0.11	0.08	0.06	0.05	0.03	0.02	0.21	0.12
1997	0.03	0.14	0.21	0.18	0.15	0.11	0.08	0.06	0.04	0.03	0.21	0.09
1998	0.03	0.13	0.19	0.17	0.14	0.10	0.07	0.05	0.04	0.03	0.20	0.10
1999	0.02	0.11	0.18	0.17	0.13	0.10	0.07	0.05	0.03	0.02	0.18	0.09
2000	0.04	0.15	0.22	0.19	0.15	0.12	0.08	0.06	0.04	0.03	0.22	0.11
2001	0.02	0.11	0.19	0.18	0.14	0.10	0.07	0.05	0.03	0.02	0.20	0.10
2002	0.02	0.11	0.17	0.15	0.12	0.09	0.07	0.05	0.03	0.02	0.17	0.11
2003	0.04	0.14	0.21	0.18	0.15	0.11	0.08	0.06	0.04	0.03	0.21	0.13
2004	0.03	0.14	0.22	0.20	0.16	0.12	0.09	0.06	0.04	0.03	0.23	0.12
2005	0.02	0.10	0.16	0.14	0.11	0.09	0.06	0.04	0.03	0.02	0.16	0.08
2006	0.03	0.10	0.15	0.14	0.11	0.08	0.06	0.04	0.03	0.02	0.16	0.07
2007	0.03	0.11	0.17	0.15	0.12	0.09	0.06	0.04	0.03	0.02	0.17	0.07
2008	0.03	0.10	0.15	0.14	0.11	0.08	0.06	0.04	0.03	0.02	0.15	0.08
2009	0.02	0.10	0.15	0.14	0.11	0.08	0.06	0.04	0.03	0.02	0.16	0.08
2010	0.02	0.08	0.13	0.12	0.09	0.07	0.05	0.04	0.02	0.02	0.13	0.07
2011	0.02	0.09	0.15	0.13	0.11	0.08	0.06	0.04	0.03	0.02	0.15	0.08
2012	0.02	0.11	0.18	0.17	0.13	0.10	0.07	0.05	0.03	0.02	0.19	0.08
2013	0.02	0.09	0.15	0.14	0.11	0.08	0.06	0.04	0.03	0.02	0.15	0.07

Table 23: Limit reference point estimates from the base model for the Louisiana black drum stock. Spawning stock biomass and yield units are pounds x 10^6. Fishing mortality and escapement (E) units are year^{-1}.

Reference Points		
Parameter	Derivation	Value/Estimate
SPR_{limit}	RS 56:325.4	30%
$F_{30\%}$	Equation 27 And SPR_{limit}	0.11
$SSB_{30\%}$	Equation 27 And SPR_{limit}	31.33
$E_{30\%}$	Equation 27 And SPR_{limit}	0.45
$Yield_{30\%}$	Equation 27 And SPR_{limit}	6.28

Table 24: Sensitivity analysis table. Current estimates are taken as the geometric mean of the last three years of the assessment (2011-2013).

Model run	negLL	$Yield_{30\%}$	$F_{30\%}$	$SSB_{30\%}$	$Esc_{30\%}$	$F_{current}/F_{30\%}$	$SSB_{current}/SSB_{30\%}$
Base Model (h=0.75)	2,215	6.28	0.11	31.33	0.45	0.68	1.30
1 (h=1.0)	2,208	4.86	0.11	24.06	0.46	0.78	1.43
2 (h=0.9)	2,209	5.46	0.11	27.04	0.45	0.74	1.36
3 (h=0.8)	2,211	6.04	0.11	30.05	0.45	0.70	1.32
4 (h=0.7)	2,215	6.49	0.11	32.43	0.45	0.61	1.30
5 (Yield lambda X 10)	9,463	6.33	0.11	31.62	0.45	0.65	1.37
6 (Survey lambda X 20)	1,669	3.73	0.11	18.75	0.45	1.02	1.12

11. Figures

Figure 1: Reported commercial black drum *Pogonias cromis* landings (pounds x 10^3) of the Gulf of Mexico derived from NOAA-Fisheries statistical records and the LDWF trip ticket program.

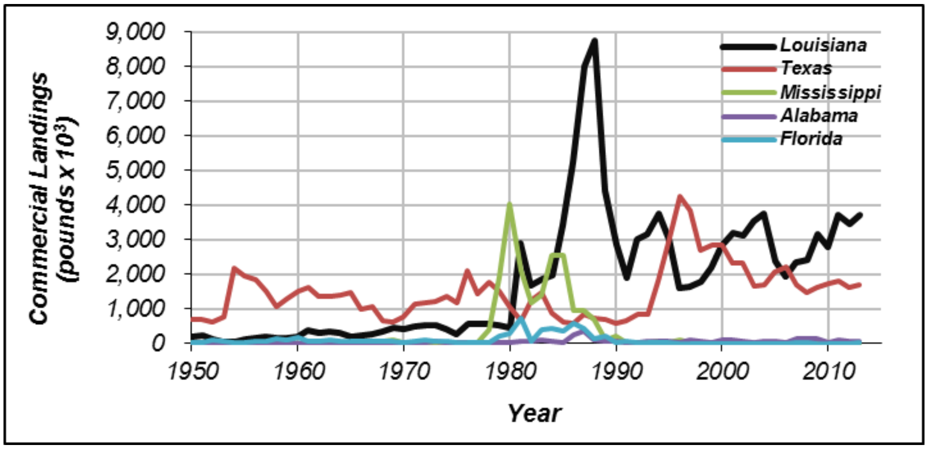

Figure 2: Estimated recreational black drum *Pogonias cromis* landings (pounds x 10^6) of the Gulf of Mexico derived from MRFSS/MRIP. Landings are A+B1 harvest only.

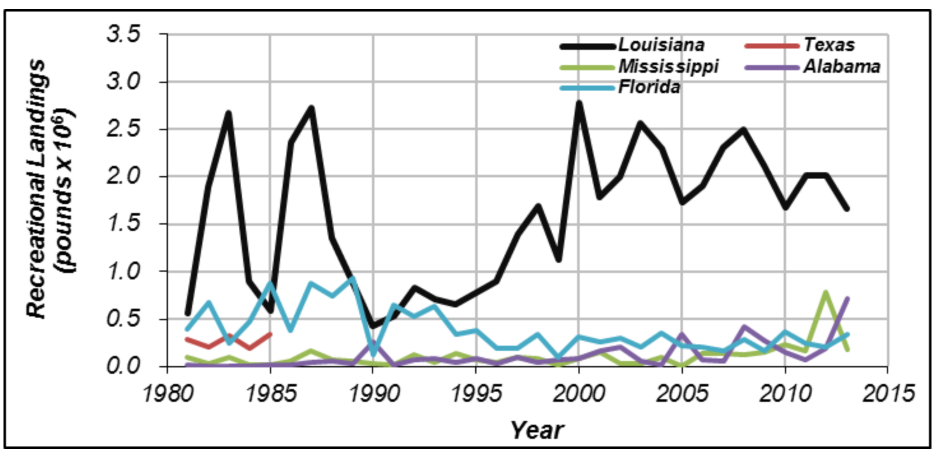

Figure 3: Standardized index of abundance, nominal catch-per-unit-effort, and 95% confidence intervals of the standardized index derived from the LDWF marine trammel net survey (top). Each time-series has been normalized to its individual long-term mean for comparison. Bottom graphic depicts annual observed proportion positive samples of black drum catches from the LDWF marine trammel net survey.

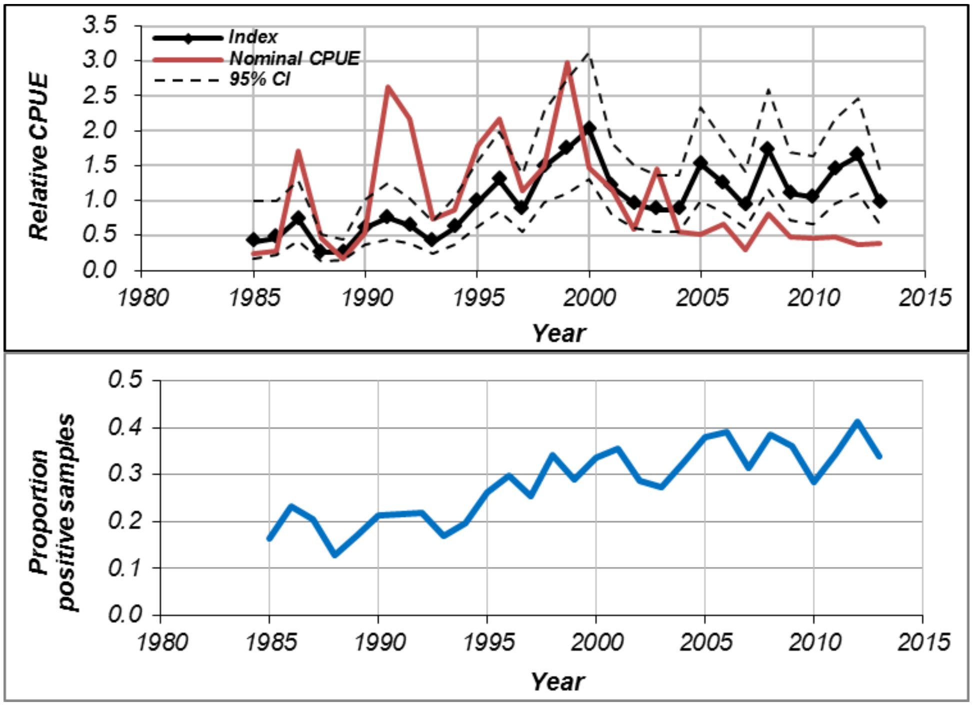

Figure 4: Observed and ASAP base model estimated commercial yield (top) and standardized residuals (bottom).

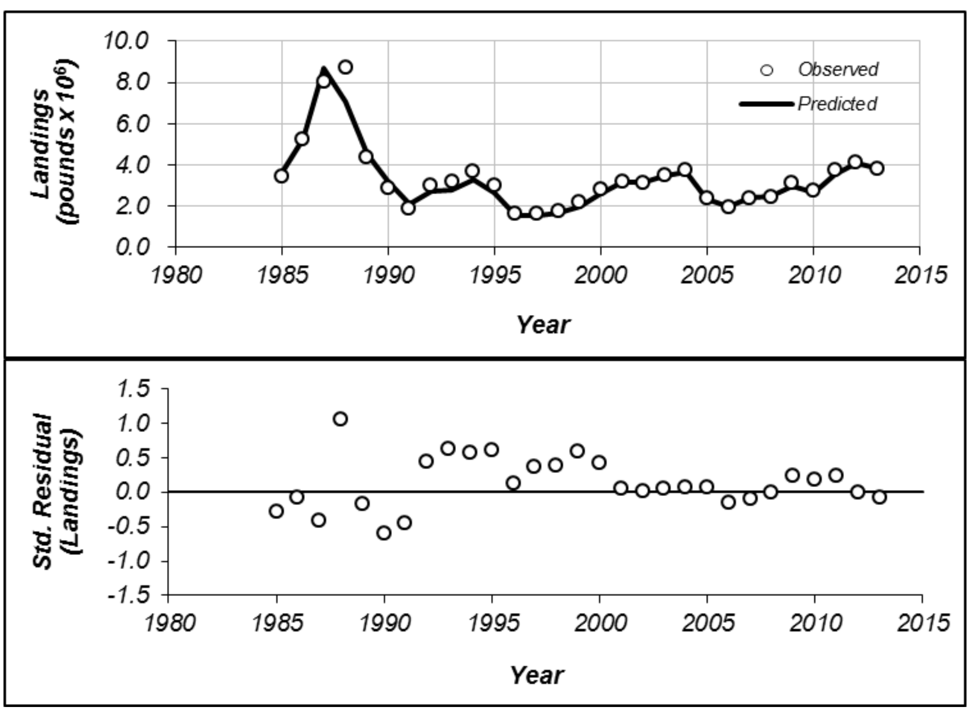

Figure 5: Observed and ASAP base model estimated recreational yield (top) and standardized residuals (bottom).

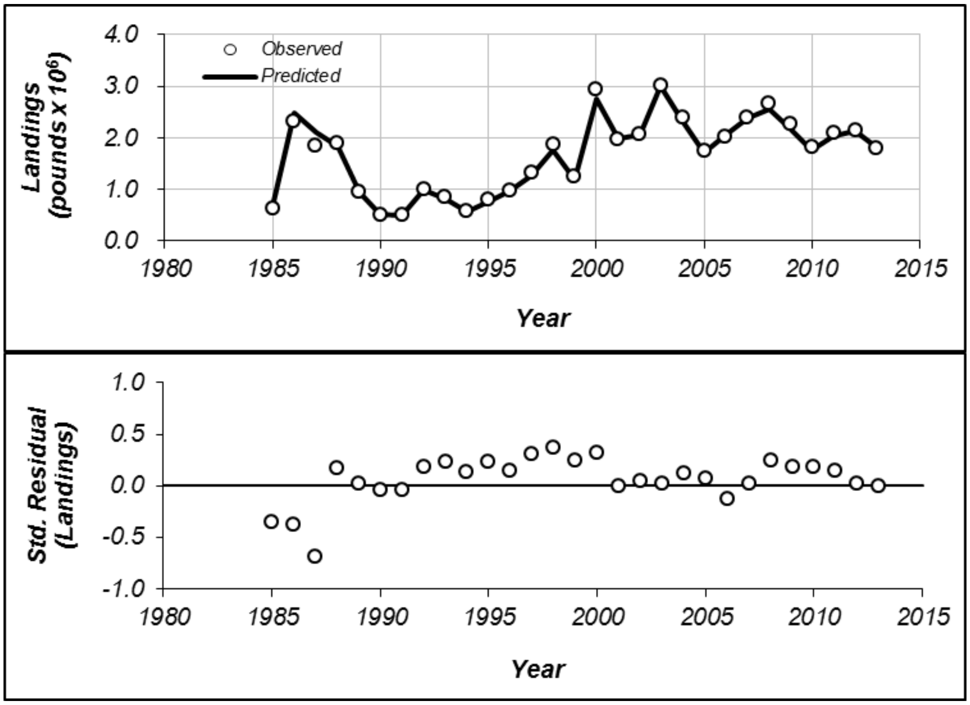

Figure 6: Observed and ASAP base model estimated survey CPUE (top) and standardized residuals (bottom).

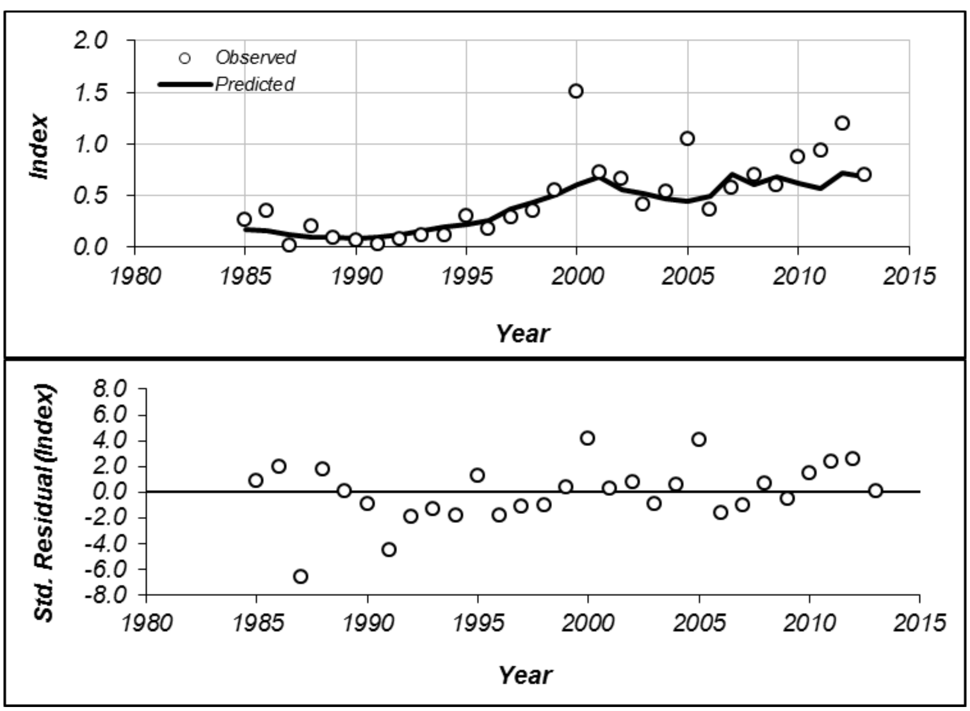

Figure 7: Annual observed (open circles) and ASAP estimated (bold lines) commercial black drum harvest age compositions.

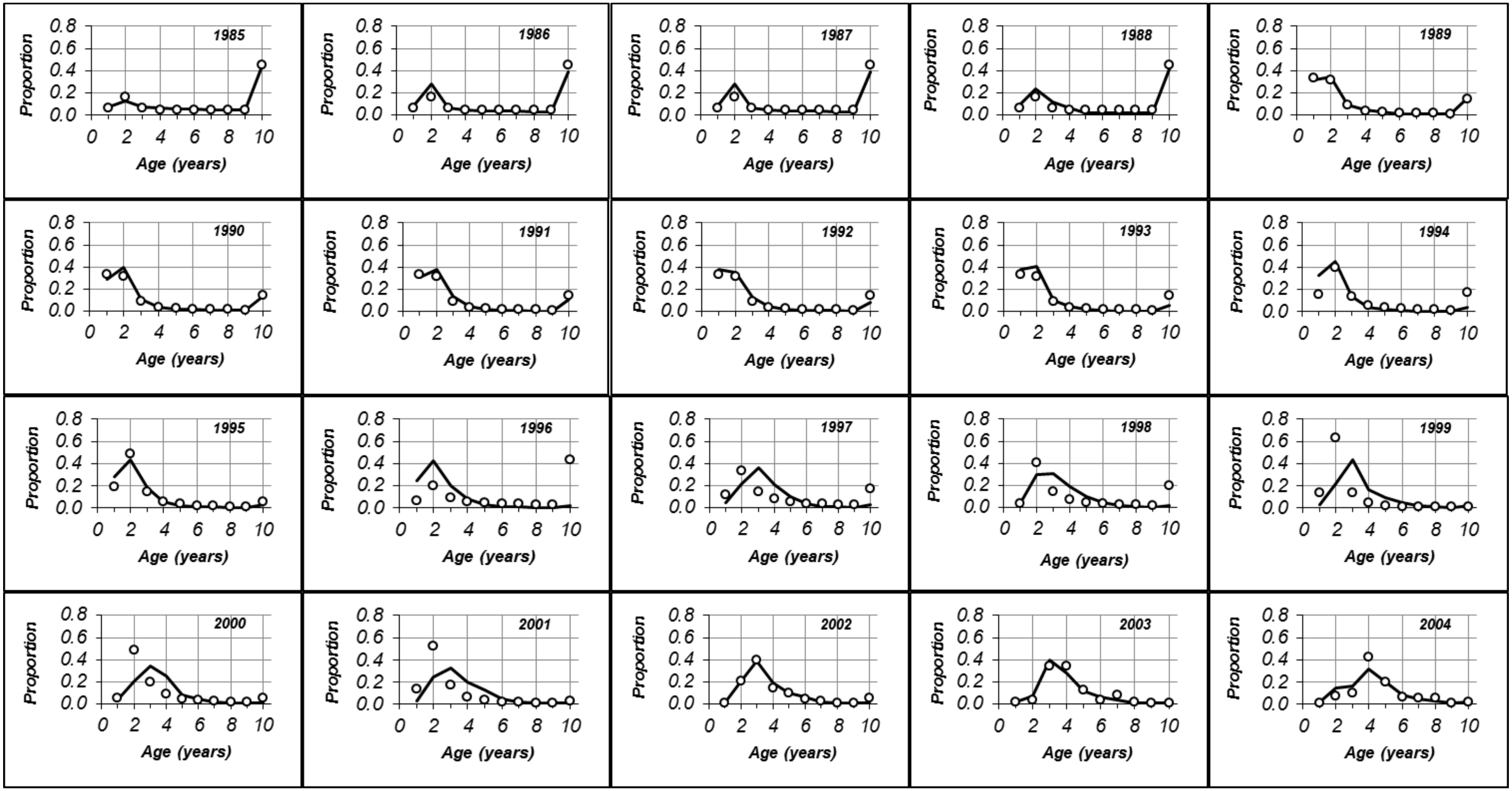

Figure 7 (continued):

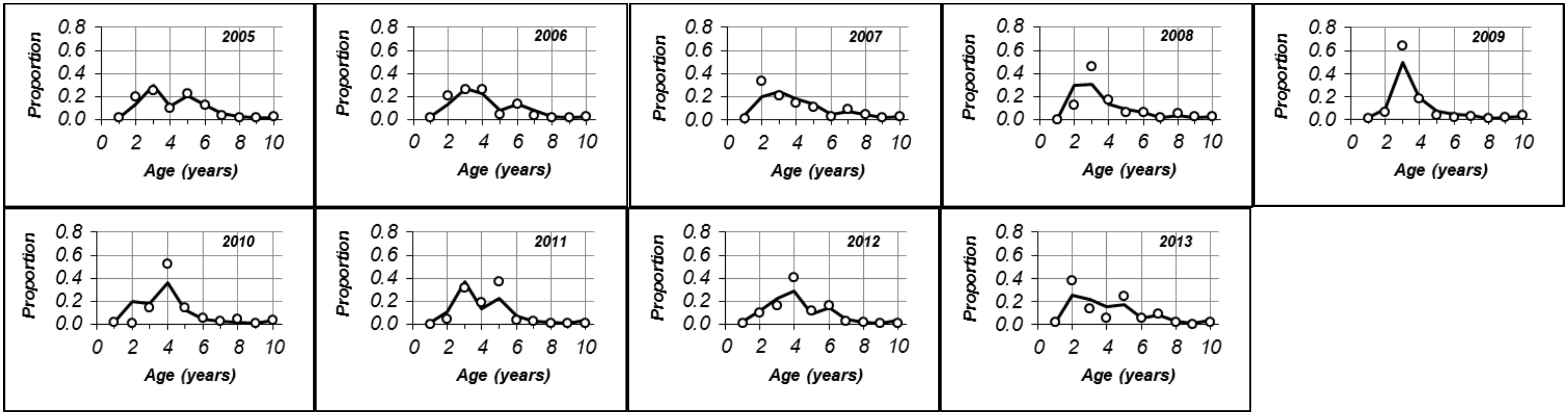

Figure 8: Annual observed (open circles) and ASAP estimated (bold lines) recreational black drum harvest age compositions.

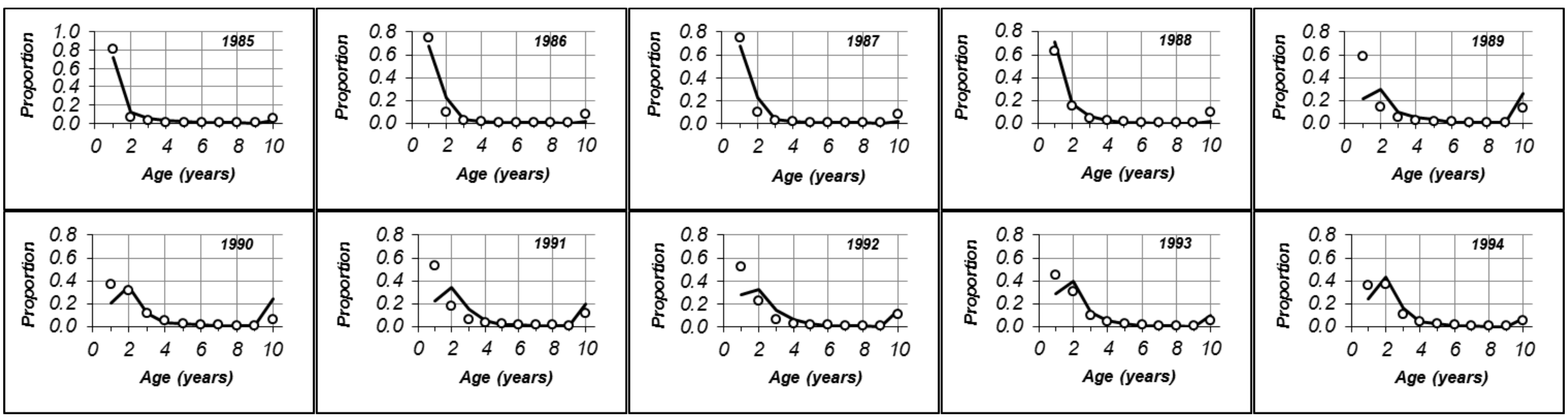

Figure 8 (continued):

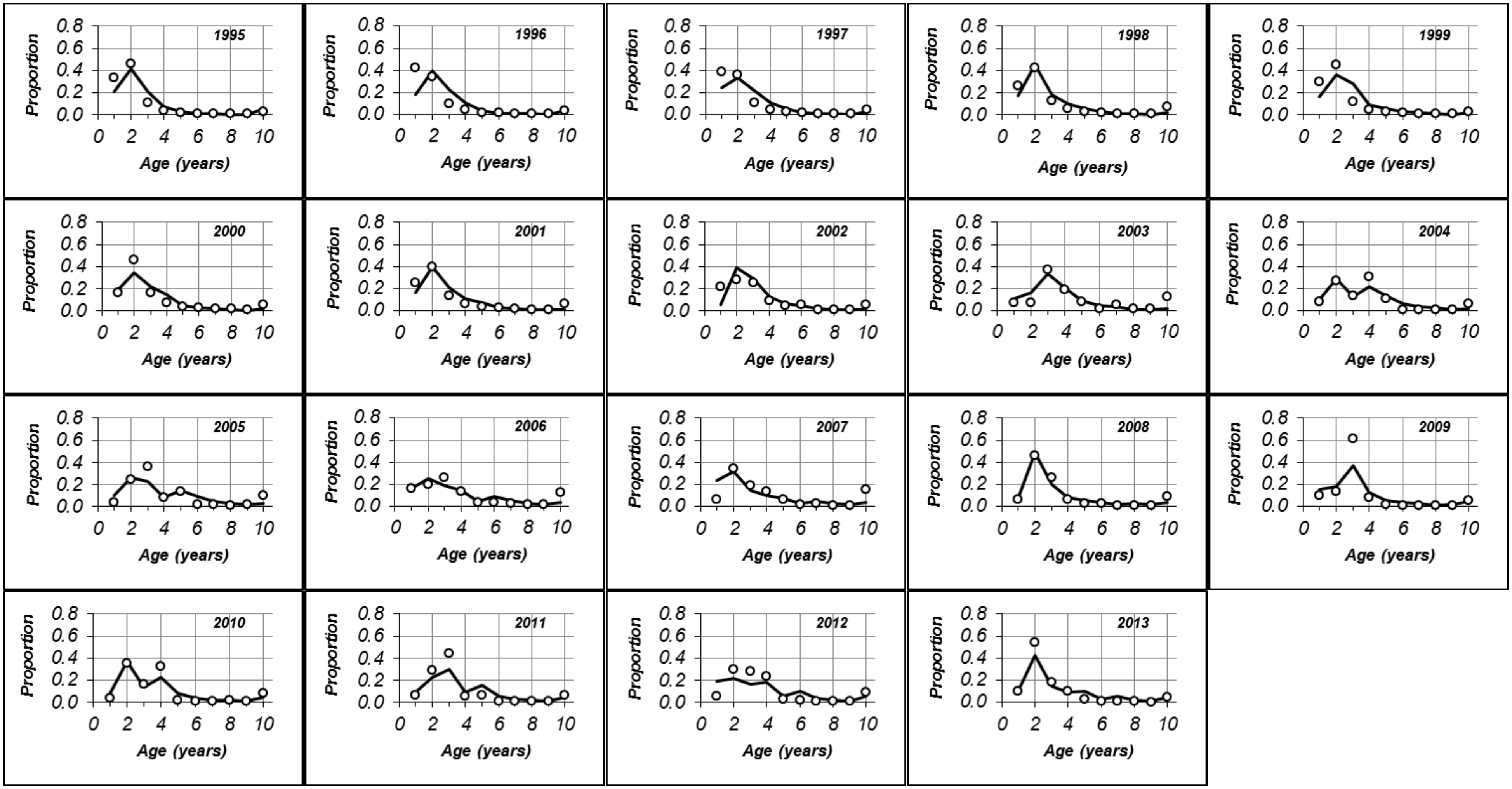

Figure 9: Annual observed (open circles) and ASAP estimated (bold lines) survey age compositions.

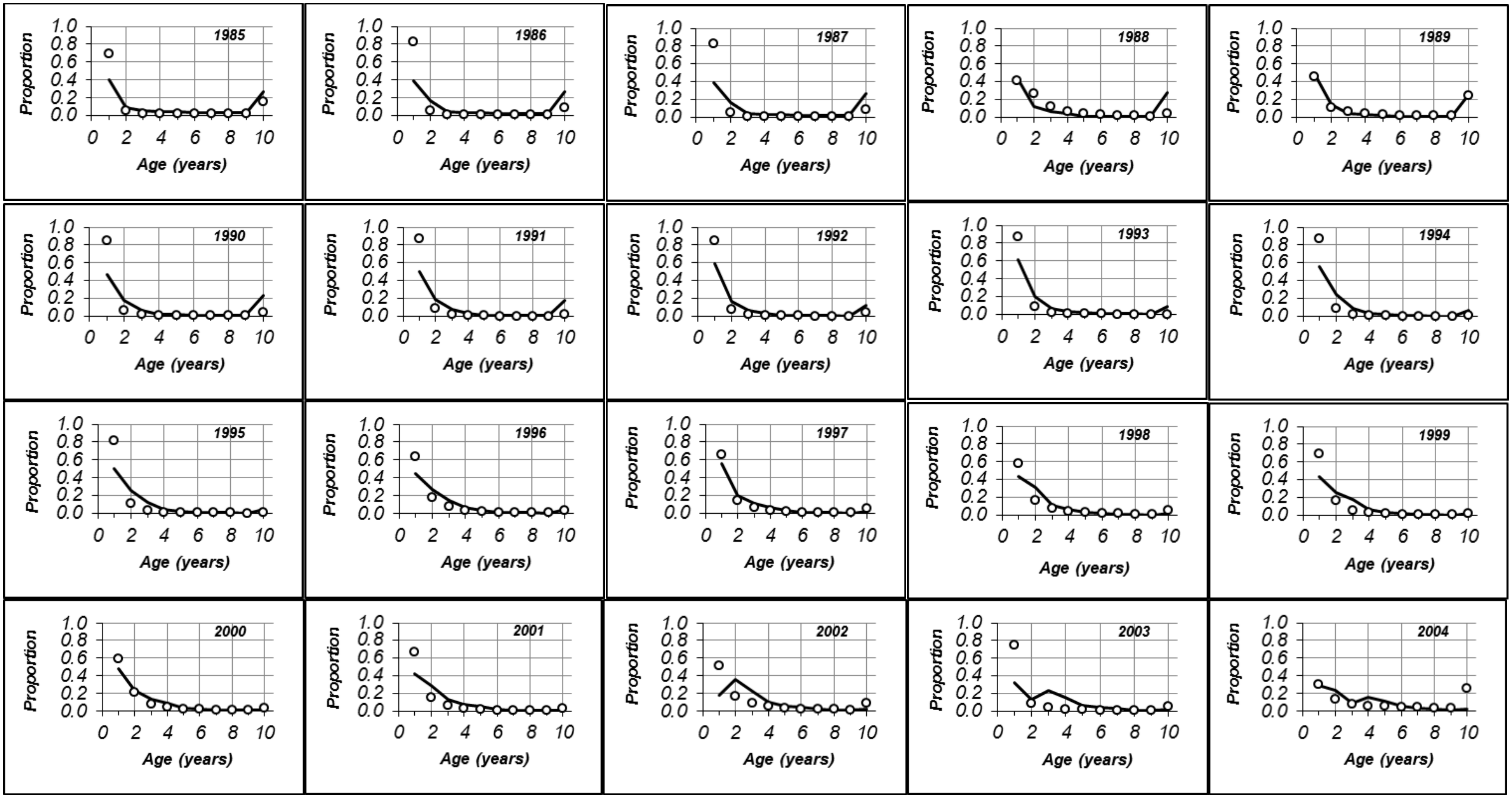

Figure 9 (continued):

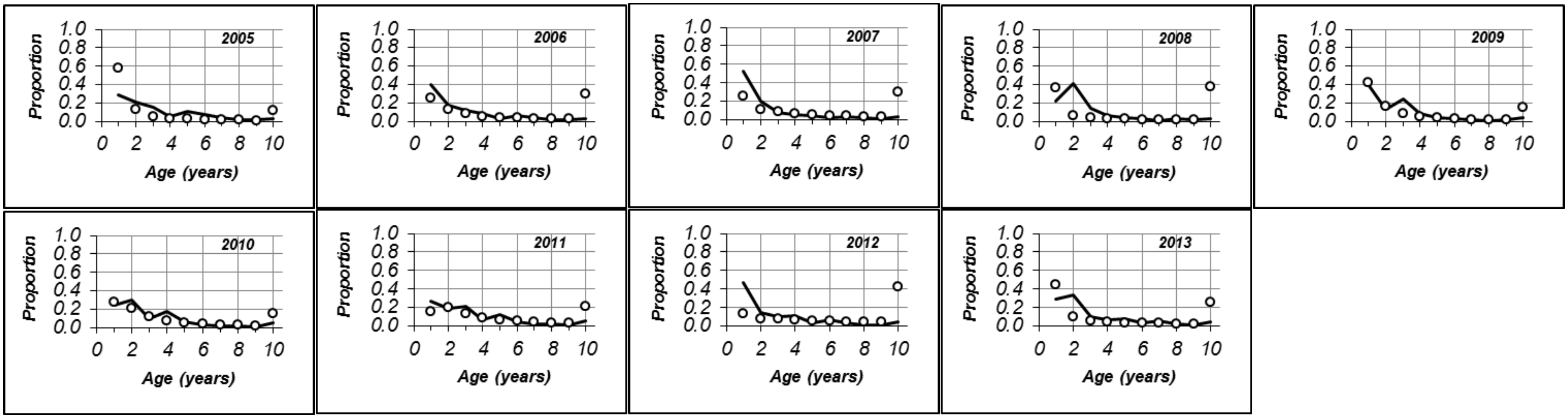

Figure 10: ASAP base model estimated commercial (top), recreational (middle), and survey (bottom) selectivities (ages 1-10+).

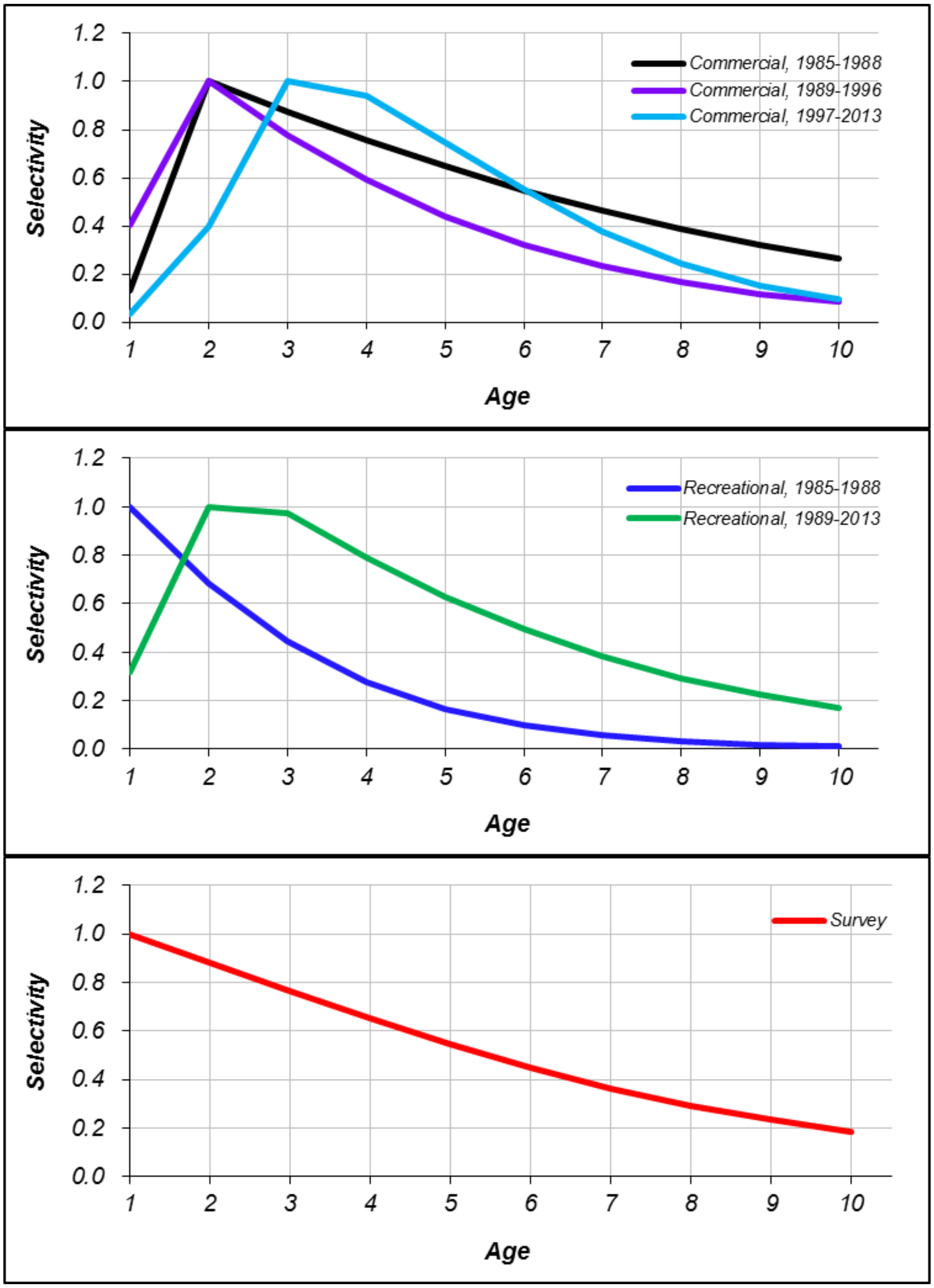

Figure 11: ASAP base model estimated recruitment. Dashed lines represent ±1 asymptotic standard errors.

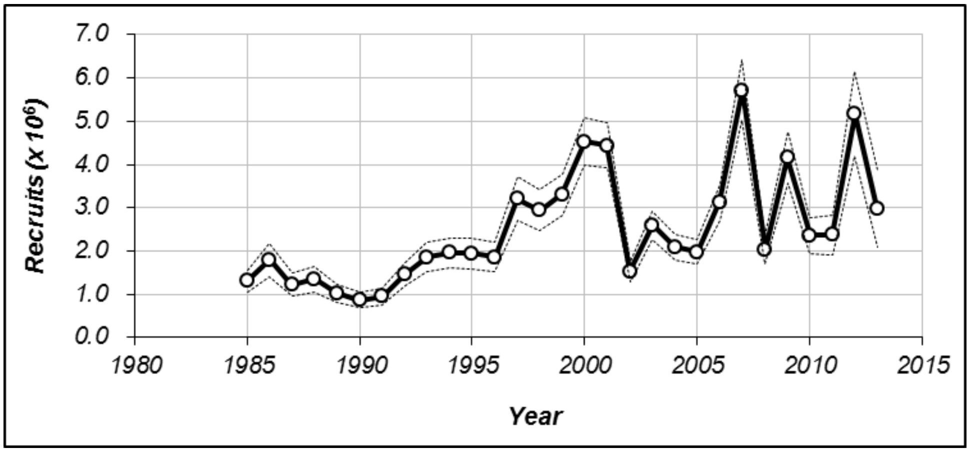

Figure 12: ASAP base model estimated spawning stock biomass (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

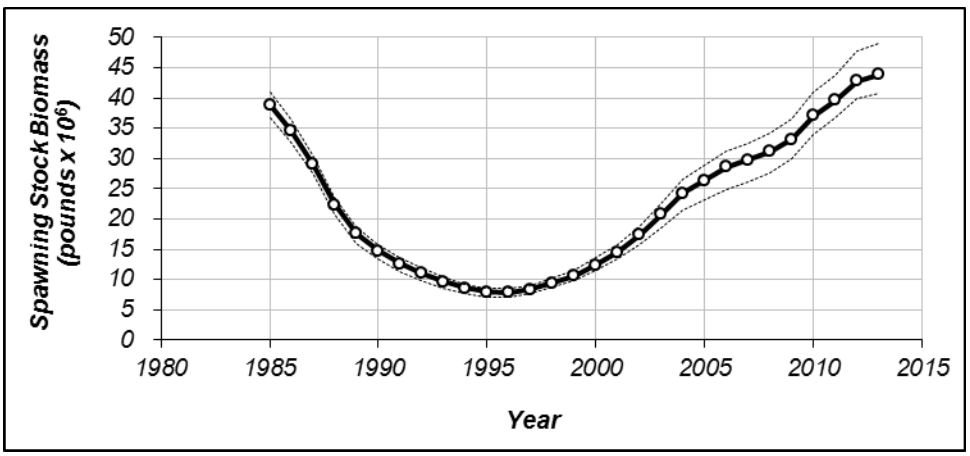

Figure 13: ASAP base model estimated average fishing mortality rates (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

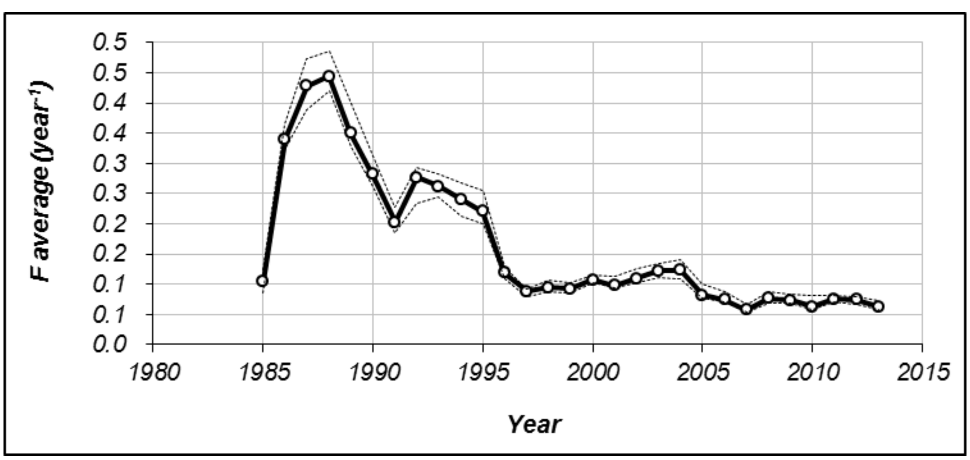

Figure 14: ASAP base model estimated age-1 recruits and spawning stock biomass. Arrows represent direction of the time-series. The yellow circle represents the most current data pair.

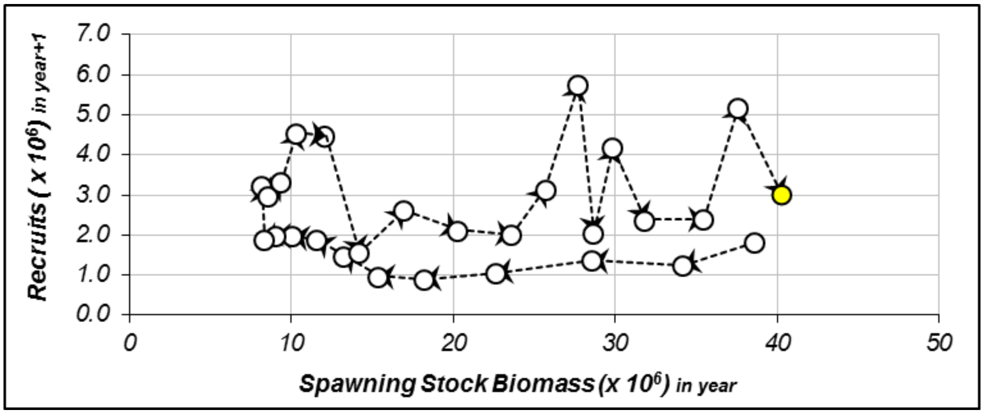

Figure 15: Time-series of black drum escapement rates (year^{-1}).

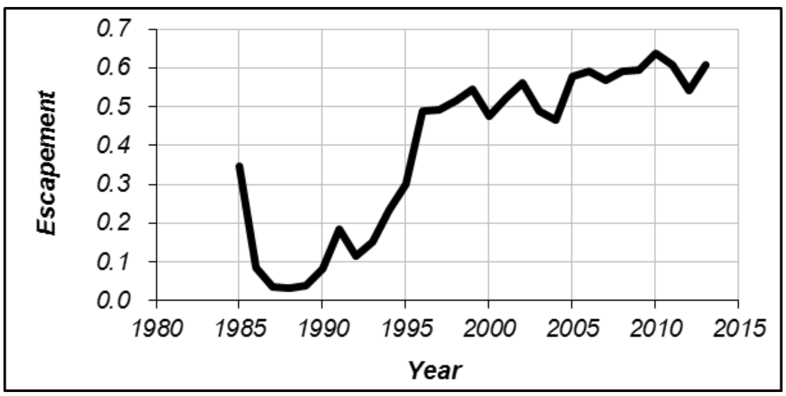

Figure 16: ASAP base model estimated age-1 recruits and spawning stock biomass (open circles). Equilibrium recruitment is represented by the bold line. Equilibrium recruitment per spawning stock biomass corresponding with the minimum and maximum spawning stock biomass estimates are represented by the slopes of the dashed diagonals (minimum spawning stock=14%SPR; maximum spawning stock=37%SPR). The yellow triangle represents the 2013 spawning stock biomass estimate.

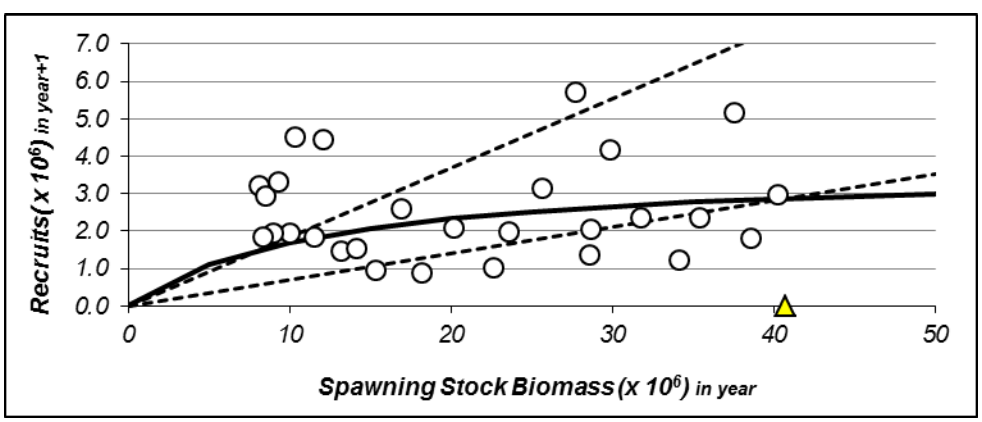

Figure 17: Retrospective analysis of ASAP base model. Top graphics depict estimated ratios of annual average fishing mortality to $F_{30\%}$ (dashed line) and spawning stock biomass to $SSB_{30\%}$ (dashed line). The two bottom graphics depict estimated age-1 recruits and age-10+ stock numbers.

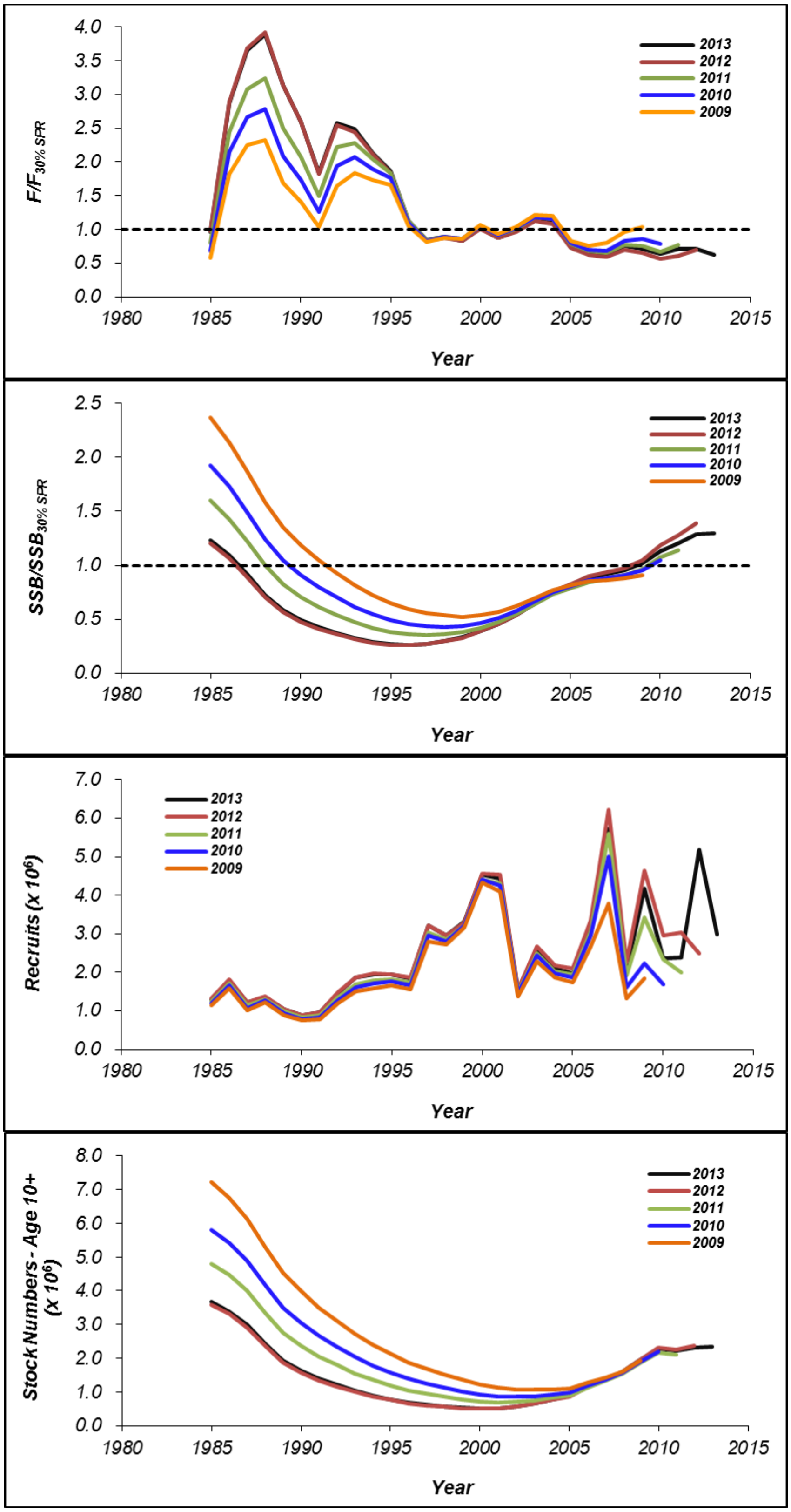

Figure 18: ASAP base model estimated ratios of annual average fishing mortality to $F_{30\%}$ and female spawning stock biomass to $SSB_{30\%}$. Arrows and dashed line represent direction of time-series. The yellow circle is the 2013 estimate; the red circle is current status (geometric mean of average F and SSB 2011-2013). Bottom graphic depicts current status and results of 2000 MCMC simulations relative to limit reference points.