ASMFC Stock Assessment Overview: Black Drum

Introduction

This document presents a summary of the 2015 benchmark stock assessment for black drum. The assessment was peer-reviewed by an independent panel of scientific experts through the ASMFC integrated external peer review process, which includes input from a member of the peer review panel throughout the assessment process. The assessment is the first coastwide assessment for black drum and contains the latest and best information available on the status of the stock for use in fisheries management.

Management Overview

The first Fishery Management Plan (FMP) for black drum was approved in 2013, providing managers with a suite of options for managing the fishery. Prior to the FMP, management was state-specific and varied from no regulations in North Carolina to a combination of size limits, possession limits, commercial trip limits, and/or annual commercial quotas in other states from New Jersey to Florida. The Maryland portion of the Chesapeake Bay was closed to commercial fishing in 1998.

The FMP requires all states to implement a maximum possession limit and minimum size limit (of at least 12 inches) by January 1, 2014, with an additional increase of the minimum size limit to at least 14 inches required by January 1, 2016. The FMP also includes a management framework to adaptively respond to future concerns or changes in the fishery or population.

What Data Were Used?

The black drum assessment used both fishery-dependent and fishery-independent data as well as information about black drum biology and life history. Fishery-dependent data come from recreational harvest and releases and commercial landings. Fishery-independent data are collected through scientific research and surveys.

Life History

Mature black drum undergo extensive south-north migrations every spring, spawning in estuaries and coastal bays along the Atlantic coast from Florida to New Jersey. Spawning occurs as early as January in Florida and occurs progressively later as fish move north, peaking in May in the Delaware Bay. Black drum are batch spawners and may spawn every 3-4 days throughout the spawning season. Young-of-year (YOY) fish in the Mid-Atlantic are believed to migrate south during their first fall and join other YOY fish in the South Atlantic. Juvenile fish use estuarine habitat and then migrate offshore to the mature stock around age 4 for males and age 5 for females. These migration patterns and genetic studies suggest that black drum along the Atlantic coast are a single stock unit.

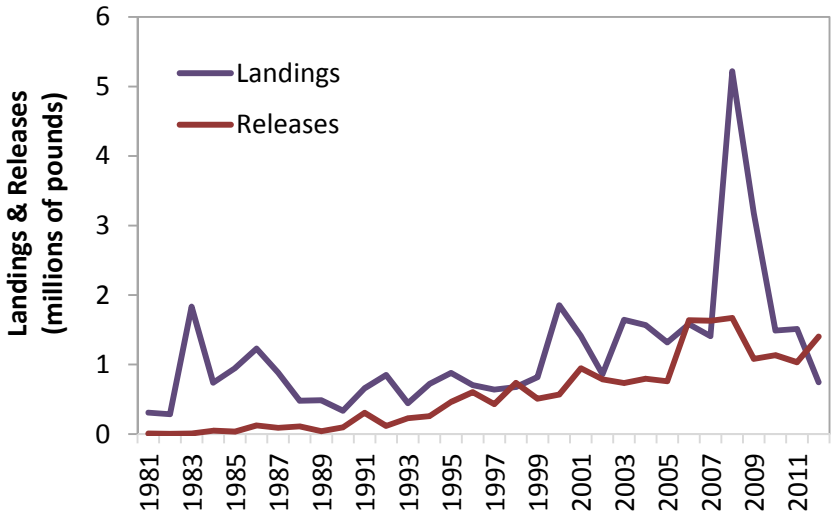
Black drum is a relatively fast growing, long-lived species experiencing rapid growth until approximately age 10. The oldest recorded fish was 67 years old and was captured in 2000. Natural mortality (M) of black drum is estimated to be 0.063 based on the observed maximum age.

Fishery-Dependent Data

Recreational Data

Recreational fisheries have accounted for the majority of coastwide black drum harvest, averaging just over 650,000 pounds from 1900-2012. Harvest increased gradually from 1900 through the 1970s and was variable in the 1980s, ranging from 285,000 pounds in 1982 to 1.83 million pounds in 1983. Harvest stabilized in the late 1980s through the 1990s, averaging 641,000 pounds from 1988-1999 (Figure 1). Harvest increased in the 2000s, averaging 1.87 million pounds from 2000-2008. Harvest peaked at 5.22 million pounds in 2008 before decreasing to just under 745,000 pounds in 2012. South Atlantic states harvested the majority of black drum, though harvest in Mid-Atlantic states increased significantly in recent years.

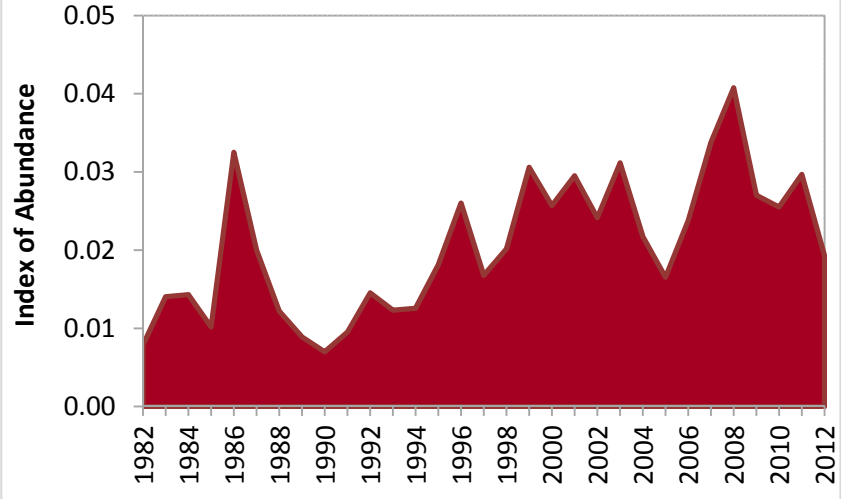
Figure 1 - Recreational Landings & Releases



The number and weight of fish released alive in recreational fisheries have increased steadily since the 1980s peaking at 892,610 fish (1.67 million pounds) in 2008. Black drum release mortality rate was assumed to be the same as red drum release mortality rate (0.08) based on the similarities in life histories and fisheries for both species. Estimates of harvest and releases were provided by the Marine Recreational Fisheries Statistics Survey (MRFSS) from 1981-2003 and the Marine Recreational Information Program (MRIP) from 2004-2012. Assessment methods used required complete catch histories so recreational harvest and releases were estimated from 1950-1980 using saltwater fishing license data recorded by the U.S. Fish and Wildlife Service (USFWS). Prior to 1950, recreational harvest estimates were extrapolated back to 1900 and releases were assumed to have been negligible.

Length sampling of the recreational harvest has been sparse, particularly in the Mid-Atlantic, and there is no size information available for fish released alive. Length data suggest that South Atlantic catches are mostly juvenile fish. Mid-Atlantic catches are primarily mature fish sought in trophy fisheries, though some YOY are captured during the summer and fall. No ageing structures (i.e., otoliths) are collected by MRFSS or MRIP and limited age sampling has been conducted by state sampling programs.

Figure 2 - Recreational Index of Abundance



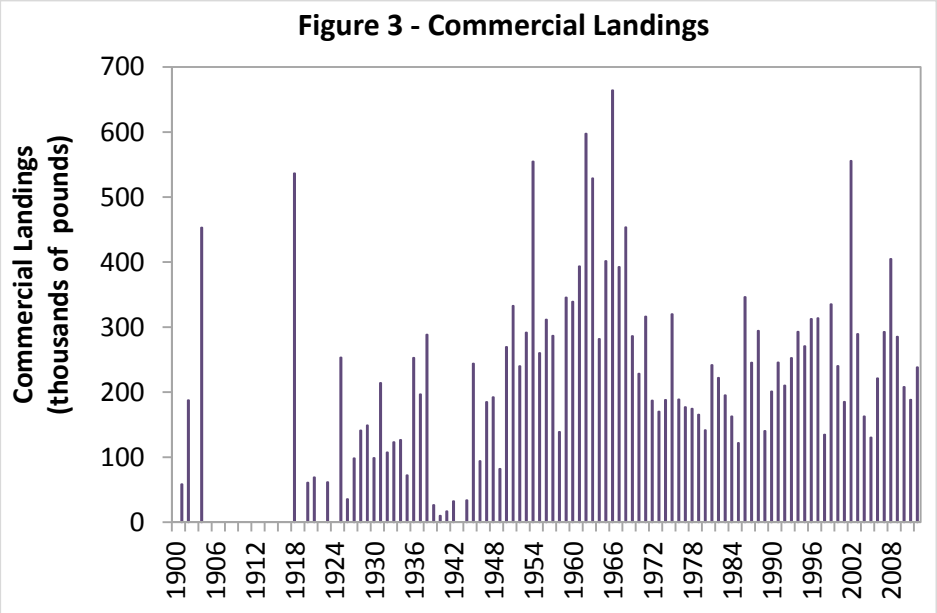
An index of abundance was developed from access-point intercepts of anglers conducted by MRFSS and MRIP (Figure 2). In addition to intercepted trips with black drum catches, fishing trips without black drum catches were subset to trips believed to be informative of black drum abundance. Subsetting was done with species associations to select trips that were likely fishing in black drum habitat and therefore could have caught black drum based on

other species caught during the trip. There is an increasing trend in the index of abundance over the time series from 1982-2012.

Commercial Data

Black drum are primarily landed as bycatch in commercial fisheries. There are some small-scale, targeted fisheries in the Mid-Atlantic supplying fish for consumption, primarily on Virginia's Eastern Shore. Black drum also served as a substitute for red drum as popularity of blackened redfish increased during the 1980s.

Figure 3 - Commercial Landings



Commercial landings have generally been a smaller portion of annual harvest, averaging 195,000 pounds from 1900-2012 (Figure 3). Prior to 1920, landings are sporadic and highly variable, including the fifth (1918; 536,332 pounds) and seventh (1904; 453,080 pounds) greatest annual landings. There are 16 of 20 years from 1900-1919 with no documented landings identified. Landings generally increased from 1920-1967, with the exception of the early 1940s during World War II. Landings then decreased from a maximum of 664,100 pounds in 1969 to 141,397 pounds in 1980. Landings were variable in the 1980s and then increased through the 1990s. Landings fluctuated around an average of 258,000 pounds from 1998-2012. Interannual variability has been high relative to total annual landings, reflective of bycatch fisheries and fluctuating recruitment events.

Landings were primarily in Florida and Virginia before Florida implemented regulations in the 1980s and a gillnet ban in the 1990s. Since the 1990s, the majority of black drum landings have been in North Carolina and Virginia. Landings in other states have been variable and relatively minimal. Most black drum are landed with gillnets and pound nets, while smaller percentages are landed with trawls, seines, and hook & line.

Commercial landings from 1900-1944 were obtained from archived U.S. Fish Commission reports, landings from 1945-1949 were provided by the National Marine Fisheries Service (NMFS), and landings from 1950-2012 were provided by the Atlantic Coastal Cooperative Statistics Program (ACCSP).

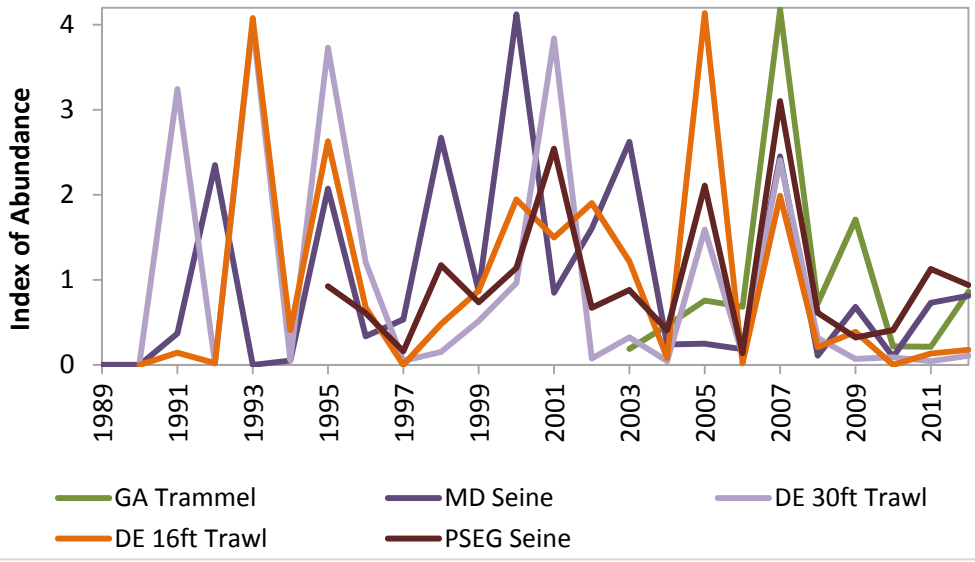
Length sampling of commercial fisheries has been limited outside of North Carolina, but indicates black drum landed in commercial fisheries are similar in size to fish harvested in recreational fisheries.

Fishery-Independent Data

Twenty eight fishery-independent surveys were evaluated during the assessment. Most surveys were not designed to target black drum and encounters were infrequent during many of the surveys. Eight surveys were used to develop indices of abundance. Five surveys tracked YOY abundance including the Public Service Enterprise Group (PSEG) Beach Seine survey, DE DFW 16ft and 30ft Trawl surveys, MD DNR Coastal Bays Seine survey, and GA DNR Marine Sportfish Population Health Trammel Net survey (Figure 4). Three surveys tracked

abundance of immature fish (< 600mm TL) including the NC DMF Program 915 Gill Net survey, SC DNR Trammel Net survey, and FL FWC Fisheries Independent Monitoring Seine survey (Figure 5). Three indices were developed from the FL FWC seine survey due to ecological differences in sampling areas. All indices are highly variable with no trends over time.

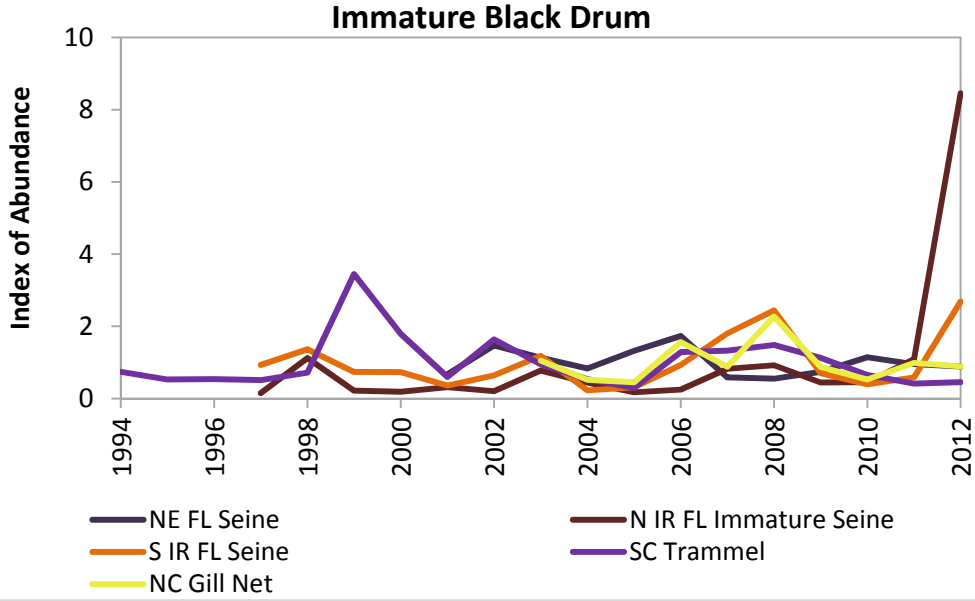
Figure 4 - Fishery Independent Abundance Indicies of Young-of-the-Year Black Drum



What Assessment Methods Were Used?

Several assessment methods were used depending on data availability. Trend analyses were conducted to evaluate associations between the indices and detect trends in abundance over time. Yield-per-recruit and spawning potential ratio analyses were completed, but not used to provide management advice due to limitations of information on how fish are selected by fishing gears at length or age. A Mann-Kendall analysis was used to detect increasing or decreasing trends over time. Some indices were positively associated, particularly YOY indices in the Mid-Atlantic, indicating that surveys are reliably tracking black drum abundance. The only trend detected in the complete indices was an increasing trend in the MRFSS and MRIP index. This trend proved to be unreliable because similar trends were not detected in other indices of abundance and it contradicted the exploitation pattern during these years.

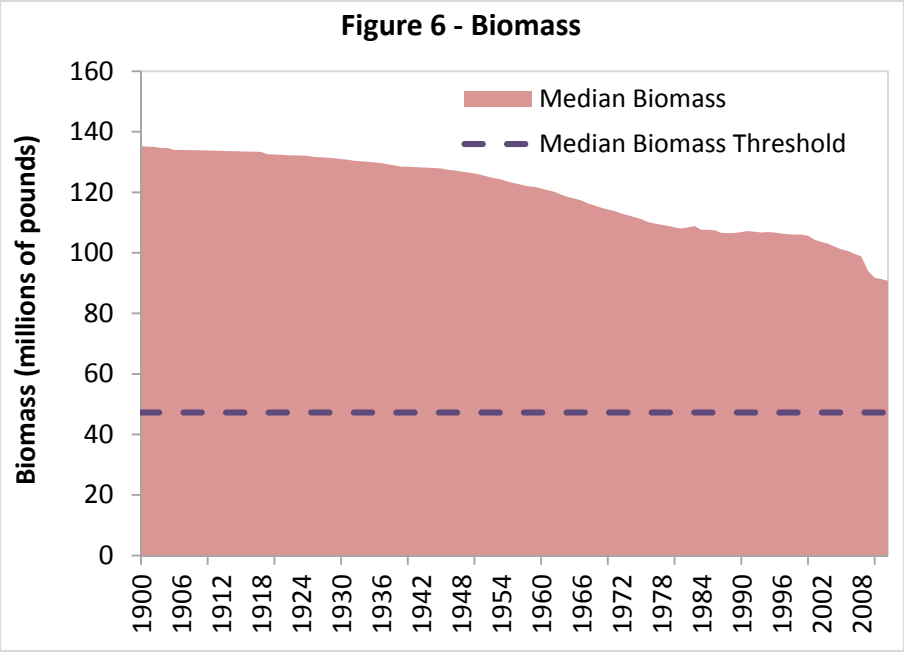
Figure 5 - Fishery-independent Abundance Indices of Immature Black Drum



Catch-based methods were used to estimate catch reference points such as maximum sustainable yield (MSY), the greatest potential yield that can be sustained by the stock, for data-poor stocks that lack information on abundance and size composition of the catch and population, but have data on the catch in weight and life history. Three methods were considered including Depletion-Corrected Average Catch (DCAC; MacCall 2009), Catch-MSY (Martell and Froese 2012), and Depletion-Based Stock Reduction analysis (DB-SRA; Dick and MacCall 2011). These methods have been evaluated against data-rich assessments and are considered robust given inputs and assumptions are correct.

DB-SRA was selected as the preferred method based on the underlying configuration of the methods, the required inputs, and performance of the methods evaluated through sensitivity analysis and simulated projections. DB-SRA requires several stock productivity and life history parameters and some assumptions about relative biomass. Biomass is assumed to be at carrying capacity at the beginning of the catch time series (i.e., an unfished stock), so a complete catch history is necessary. Annual changes in biomass are projected forward from the first year (1900) with a surplus production model based on productivity of the stock and observed catches. If the biomass estimates are realistic (i.e., do not exceed carrying capacity or go extinct) and match the assumed relative biomass in 2012, reference point estimates are considered plausible. Uncertainty can be incorporated in DB-SRA by selecting inputs from distributions and running many model iterations. The estimates from each plausible iteration are then use to develop probability distributions.

Figure 6 - Biomass



Depletion of the stock in 2012 was assumed to be between 50% and 90% of the stock size at carrying capacity. This broad distribution is based on the highly productive life history characteristics of black drum, relatively low harvest, and stable indices of abundance. Recreational harvest and dead releases were drawn from distributions based on point estimates and measures of precision. Commercial landings were drawn from uniform distributions with a lower bound equal to reported landings to account for some uncertainty in commercial landings (e.g., discarded fish, underreporting).

What is the Status of the Stock?

Based on the DB-SRA results, black drum life history, indices of abundance, and history of exploitation, the black drum stock is not overfished and not experiencing overfishing. Median biomass was estimated to decline slowly and steadily from 135.2 million pounds in 1900 to 90.78 million pounds in 2012 (Figure 6), though the median biomass estimate in 2012 is still well above the median biomass that produces maximum sustainable yield (B_{MSY}; 47.26 million pounds). The median maximum sustainable yield (MSY) estimate is 2.12 million pounds and provides an annual catch target that can be used to sustainably manage the fishery. The median overfishing limit (OFL) estimated with DB-SRA is 4.12 million pounds and provides a catch threshold that indicates overfishing when exceeded. The OFL is the maximum exploitation rate at the current biomass that does not lead to overfishing.

Data and Research Needs

The black drum stock assessment would be improved by applying a more complex, data-rich assessment method such as a statistical catch-at-age model. Data limitations that need to be addressed to successfully make this transition are biological sampling (length and age) of recreational and commercial fisheries and a fishery-independent survey tracking abundance and the age structure of the mature stock. Additionally,

information about fish discarded in commercial fisheries and movement of fish would improve the assessment.

Whom Do I Contact For More Information?

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Glossary

Carrying capacity: The maximum numbers or biomass of a given resource that an ecosystem can support.

Natural mortality (M): the instantaneous (not annual) rate at which fish die because of natural causes (predation, disease, starvation, etc.)

Otoliths: Inner 'ear bones' of fish that can be used to age fish.

Spawning potential ratio (SPR): Most commonly calculated as the ratio of spawning stock biomass per recruit (SSBR) of a fished stock divided by SSBR of an unfished stock, SPR represents the reproductive potential (SSB or egg production per recruit) of a fished stock compared to its unfished condition.

Statistical catch-at-age (SCAA) model: an age-structured stock assessment model that works forward in time to estimate population size and fishing mortality in each year. It assumes some the catch-at-age data have a known level of error.

Surplus production model: Also known as 'Biomass Dynamic Models', these models are among the simplest stock assessment techniques commonly employed by fisheries scientists to model population dynamics and track biomass. They are "simple" because they characterize the dynamics of a stock in terms of changes in total biomass without regard to age or size structure."

Yield per recruit (YPR): The expected yield in weight for a single fish or year class over the life of the fish or year class.

Young-of-the-year (YOY): An individual fish in its first year of life

References

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ASMFC. 2009. Guide to Fisheries Science and Stock Assessments. Washington, DC. http://www.asmfc.org/publications/GuideToFisheriesScienceAndStockAssessments.pdf

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