Volume 29, Issue 2
May/June 2020

ASMFC
FISHERIES focus
Vision: Sustainable and Cooperative Management of Atlantic Coastal Fisheries

INSIDE THIS ISSUE

ASMFC Releases Aquaculture: Effects on Fish Habitat along the Atlantic Coast

The Atlantic States Marine Fisheries Commission announces the release of the 16th publication in its Habitat Management Series, entitled *Aquaculture: Effects on Fish Habitat along the Atlantic Coast*. The document provides a broad description of current and common marine aquaculture (mariculture) practices, siting considerations, and some potential effects on fish habitats. It's intended to serve as an introduction to the topic and facilitate a discussion on the intersection between aquaculture planning and fishery habitat conservation.

Floating oyster bags and suspended systems are popular oyster culture techniques in Florida. Photo (c) Florida Department of Agriculture and Consumer Services.

Mariculture is an important source of sustainable seafood production and a growing industry that creates jobs, supports communities, and promotes international trade. The U.S. aquaculture and mariculture industry was valued at $1.4 billion and produced 627 million pounds of meat and 1.2 million jobs in 2015. As the human population continues to grow, there will be an ever-increasing demand for seafood. Aquaculture and mariculture can help meet that demand.

From a fish habitat perspective, it is important to carefully consider spatial planning before establishing an aquaculture operation. Habitats such as submerged aquatic vegetation, coral reefs, or mangroves should be avoided as they are sensitive to nutrient fluxes, sedimentation, and disturbance, as well as being important habitats for a variety of organisms, including many Commission-managed species. Additionally, it's important to consider if a particular location will have spatial conflicts with other

AQUACULTURE, continued on page 12

Upcoming Meetings

The Atlantic States Marine Fisheries Commission was formed by the 15 Atlantic coastal states in 1942 for the promotion and protection of coastal fishery resources. The Commission serves as the deliberative body of the Atlantic coastal states, coordinating the conservation and management of nearshore fishery resources, including marine, shell and diadromous species. The fifteen member states of the Commission are: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

June 29 (1 - 4 PM)
Summer Flounder, Scup and Black Sea Bass Advisory Panel Webinar; visit http://www.asmfc.org/calendar/6/2020/summer-flounder,-scup-and-black-sea-bass-advisory-panel-webinar/1564 for more information

July 1 (1 - 4 PM)
Tautog Technical Committee and Stock Assessment Subcommittee; visit http://www.asmfc.org/calendar/7/2020/tautog-technical-committee-and-stock-assessment-subcommittee/1569 for more information

July 7 (9 - 11 AM)
Atlantic Menhaden Technical Committee Webinar; visit http://www.asmfc.org/calendar/7/2020/atlantic-menhaden-techncial-committee-webinar/1573 for more information

July 9 (1:30 - 4 PM)
Atlantic Striped Bass Work Group Webinar; visit http://www.asmfc.org/calendar/7/2020/striped-bass-work-group-webinar/1566 for more information

July 16 (9 AM - 4 PM)
Mid-Atlantic Fishery Management Council Webinar; visit https://www.mafmc.org/council-events/2020/july16-council-meeting-webinar for more information

July 21 (1:30 - 4 PM)
Atlantic Striped Bass Work Group Webinar; visit http://www.asmfc.org/calendar/7/2020/striped-bass-work-group-webinar/1567 for more information

August 3 - 6
ASMFC Summer Meeting Webinar; visit http://www.asmfc.org/home/2020-summer-meeting-webinar for more information

August 10 - 13
Mid-Atlantic Fishery Management Council, Location The Notary Hotel, 21 N. Juniper St., Philadelphia, PA

August 30 - September 3
AFS 150th Annual Meeting (virtual); visit https://afsannualmeeting.fisheries.org/ for more information

September 14 - 18
South Atlantic Fishery Management Council, Town & Country Inn, 2008 Savannah Highway, Charleston SC

September 29 - October 1
New England Fishery Management Council, Beauport Hotel, Gloucester, MA

October 6 - 8
Mid-Atlantic Fishery Management Council, Hyatt Place Long Island East End, 451 East Main St., Riverhead, NY

October 18 - 22
ASMFC 79th Annual Meeting, Ocean Place Resort and Spa, 1 Ocean Blvd, Long Branch, NJ

2020: A Year of Change and Adaptation

It's hard to believe the changes that have occurred since I last wrote in February. A global pandemic virtually stopped all normal activity, bringing unemployment to millions of Americans, forcing many of us to work from home, and turning healthcare and essential workers into new heroes. In Washington, DC and throughout the nation, protests occurring in the aftermath of the George Floyd tragedy are a stark reminder of our country's ongoing struggle to live up to its promise of equality and justice for all. No doubt these are difficult times that require us to find new ways of doing business, face new challenges, and seek long overdue changes. I try to find the silver lining during difficult times and I am optimistic that recent events will lead to real change and real solutions to be more compassionate, supportive, and fully inclusive in each of our actions.

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Over these past few months, I have worked closely with the Commission's leadership to ensure the Commission remains fully operational while protecting the health and safety of the staff. I am proud to say the entire staff has been "succeeding from a distance" through full-time telecommuting since March 16th. While it was certainly a significant departure for much of the staff, I have been impressed by their work ethic and commitment to the success of the Commission. Benchmark stock assessments for shad and American lobster remain on track and progress continues to be made on plan amendments for bluefish, summer flounder/scup/black sea bass and Atlantic striped bass, as well as on the development of ecological reference points for Atlantic menhaden. Progress is being maintained on countless other projects as well.

Due to prohibitions on travel and large gatherings, the Commission successfully conducted its Spring Meeting via webinar in May. This success is largely due to a great deal of planning, the willingness of our Commissioners and proxies to participate in test webinars and become comfortable with the new platform, and the effort of a dedicated team of staff members who all chipped in to ensure the two-day webinar ran smoothly. Combined, these actions allowed our Boards to effectively conduct the business at hand while maintaining the transparency of the interstate process.

Given the uncertainties of the pace of states reopening and potential continued prohibitions on large meetings in Arlington, Virginia in early August, the Summer Meeting will also be held as a virtual meeting. Board meetings with significant decisions (e.g. Atlantic Menhaden and Atlantic Striped Bass) will recess following staff/technical presentations and a question and answer session. These Boards will reconvene the following day to allow time for Commissioners to consider the information from the previous day, fully vet the issues with their state delegates, and prepare for board discussion and action.

While, through these actions, we have been able to bring our Commissioners together to deliberate and take necessary fishery management actions, in no way do I want to portray that the pandemic has not had a profound impact on commercial fishermen, for-hire businesses, recreational anglers, marine aquaculture industries, and seafood dealers/processors along the Atlantic coast. Passage of the Coronavirus Aid, Relief, and Economic Security (CARES) Act offers some relief in the form of $300 million for "Assistance to Fishery Participants" and a number of loan, grant, paycheck protection, and unemployment provisions that can also assist fishery-related businesses. The $300 million has been divided among all the states along the Atlantic, Gulf and Pacific coasts; $119 million is allocated to the Atlantic coastal states. Eligible entities include tribes, persons, fishing communities, certain aquaculture businesses, processors, or other fishery-related businesses, who have incurred economic revenue losses greater than 35% as compared to the prior five-year average revenue. Subsistence, cultural, or ceremonial fisheries are also eligible. The CARES Act includes a fishery disaster declaration directly within the legislation and allows payments to be made mid-season, a departure from the established disaster assistance procedure. Congress left the process and criteria for distributing the funds largely up to the Department of Commerce and NOAA Fisheries. The Commission has been working closely with its member states and NOAA Fisheries to coordinate development of state spend plans and, based on a state's preference, assist in the disbursement of funds to affected stakeholders. The Commission has a dedicated webpage, which provides information on the CARES Act, including a detailed description of the process, current status, state resources and contacts, and frequently asked questions as provided by NOAA Fisheries. The webpage can be found at http://www.asmfc.org/home/cares-act-resources.

While aid to fishermen through the CARES Act is a step in the right direction, available funds are not sufficient to meet all of the needs of our coastal fishing communities as they struggle to maintain their livelihoods and businesses. Congress continues to deliberate on additional assistance to help reduce the financial impacts of COVID-19. I am hopeful that the impacts to fisheries and fishing communities will be considered as part of any pending legislation.

I hope you and your families stay healthy and find ways to thrive during these challenging times.

New Addendum Updates Spot Management Through Improvements to the Traffic Light Approach

Introduction

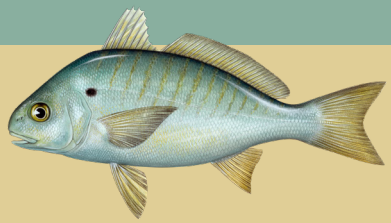
Spot directly support recreational and commercial fisheries in the U.S. Mid- and South Atlantic and function as an important forage species in the region. The range of this short-lived species includes brackish and saltwater habitats predominately between Chesapeake Bay and South Carolina. Annual variation in landings, typically composed of fish belonging to a single year class, is due in part to the prevailing environmental conditions at spawning and nursery sites. Small-sized spot remain a major component of the bycatch (or inadvertent catch of undersized or unwanted fish) associated with seine, trawl, and pound net fisheries in Chesapeake Bay and North Carolina, as well as the South Atlantic shrimp trawl fishery. The Traffic Light Approach (TLA) has been used since 2014 to monitor the spot population. The lack of an assessment approved for management use makes this approach the primary source of management advice. In February 2020, the Board approved Addendum III, which updates the TLA to more accurately reflect trends in the population.

Life History

Spot (*Leiostomus xanthurus*) is one of the 275 sciaenid species worldwide, six of which are managed by the Commission. Sciaenids are commonly called drums, croakers, or hardheads for the repetitive throbbing or drumming sounds they produce. Spot occur along the U.S. Atlantic coast in estuarine and coastal waters from the Gulf of Maine to Florida, although they are most abundant from Chesapeake Bay to South Carolina. Spot migrate seasonally, entering bays and estuaries in the spring where they remain until late summer or fall when they move offshore to spawn. Spot mature by age two, at lengths of 5.5 to 8.5 inches. Their maximum life span is about six years, although fish older than three years are uncommon.

Spawning takes place in the ocean from fall to early spring and the post-larvae move into estuaries, utilizing low-salinity tidal creeks where they develop into juveniles. As spot grow, they move toward higher salinity areas during the summer and early fall and offshore in the fall as water temperatures decrease. Those that summered in the northern portion of their range also move south in the fall. Spot are opportunistic bottom feeders, eating mainly worms, small crustaceans and mollusks, and organic material. The post-larvae prey on plankton but become bottom feeders as juveniles or adults. Spot are prey for several important fisheries including striped bass, weakfish, summer flounder, bluefish, and sharks.

Species Snapshot



Spot
Leiostomus xanthurus

Management Unit
Delaware to Florida

Common Names
Norfolk spot, flat croaker, golden croaker, spot croaker, silver gudgeon, goody, chub, roach, jimmy

Interesting Facts

- Spot travel in large (>100 fish), slow moving schools over sand-mud bottom.
- Spot are the only member of the drum family, which includes weakfish, red and black drum, and Atlantic croaker, with a forked tail.
- Spot tend to live longer and attain greater size in the northern extent of their range.

Largest Landed
2 pounds, 6 ounces (Poquoson, VA, 1980)

Maximum Age: 6 years

Stock Status
Unknown

Commercial & Recreational Fisheries

Pursued by recreational anglers and commercial fishermen alike, total spot landings in 2018 were 4.21 million pounds, a 60% decrease from 2017 levels. Of the 4.21 million pounds, 22% was harvested by commercial fishermen and 78% by recreational anglers.

Commercial spot fisheries occur along the Atlantic coast primarily from the Chesapeake Bay southward. Between 1950 and the early 1980s, commercial landings fluctuated widely, ranging from 3.9 to 14.5 million pounds. Such variability is expected because spot are a short-lived species and catch in most years consists of a single year class, the strength of which is variable due in part to environmental conditions prevalent in the spawning and nursery areas. Overall, commercial landings have decreased from historic levels, with the five lowest years since 1950 (the first year that commercial landings were recorded) occurring between 2010 and 2018. As in recent years, the majority of 2018 commercial harvest (921,617 pounds) came from Virginia (61%) and North Carolina (18%).

Spot is also a popular recreational species sought by anglers from Delaware Bay to northern Florida. Most of the Atlantic recreational harvest is taken within three miles of the coast, from shore or by private or rental boats. Recreational harvest has fluctuated from a high of 17.3 million pounds in 1981 to a low of 3.29 million pounds in 2018. From 2009-2018, recreational harvest has averaged 6.7

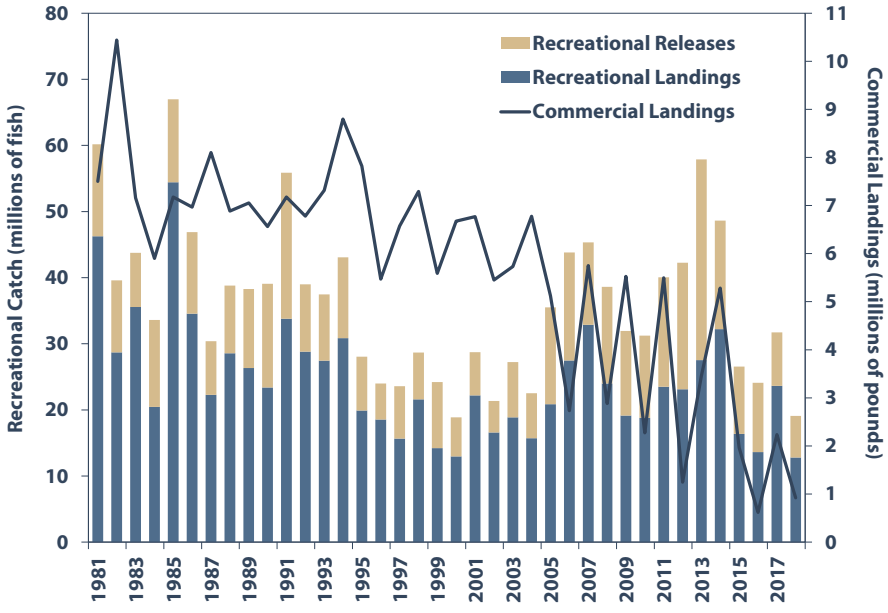
million pounds, and has exceeded commercial landings throughout this time frame. Recreational harvest in 2018 was 3.12 million pounds, a 57% decrease from 2016 levels. Virginia had the greatest share of the recreational harvest at 1.8 million pounds (53%).

Stock Status

In 2017, the first coastwide benchmark stock assessment was completed for spot. The assessment used a catch survey model to estimate population parameters (e.g., stock status, natural mortality, discard rates, and mortality) and biological reference points. However, due to conflicting trends in abundance and harvest, as well as other uncertainties, this assessment was not recommended to be used for management advice.

Spot collected for sampling as part of the SEAMAP Spring Survey. Photo © NC DMF.

Spot Recreational Catch & Commercial Landings
Source: ACCSP Data Warehouse, 2020



The TLA is used to annually evaluate fishery trends and develop management actions when harvest and abundance thresholds are exceeded for two of the three most recent years. The name comes from assigning a color (red, yellow or green) to categorize relative levels of indicators that reflect the condition of the fish population (abundance characteristic) or fishery (harvest characteristic) relative to a reference level. For example, as harvest increases relative to the reference period (2002-2012) average, the amount of green in a given year increases, and as harvest decreases, the amount of red in that year increases. The TLA illustrates long-term trends in the stock and triggers management action in response to declines in the stock or fishery.

The TLA was recently updated to incorporate additional fishery-independent surveys, age and length information, an updated reference period (2002-2012), regional characteristics (North: New Jersey – Virginia; South: North Carolina – Florida), and an updated management trigger mechanism. These updates will be implemented beginning with the 2020 TLA (conducted in August) and will better represent trends in adult abundance of spot than previous methods.

Atlantic Coastal Management

Spot is managed under the Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel (2011) and associated Addenda II (2014) and III (2020). The Omnibus Amendment updated all three species plans with requirements of the Commission's ISFMP Charter and the Atlantic Coastal Fisheries Cooperative Management Act.

Addendum II established use of the TLA to evaluate the status of the fisheries and potential coastwide or state-specified management actions (e.g. bag limits, size restrictions, time & area closures, and gear restrictions) based on the annual fisheries evaluation. The TLA has been used as a precautionary framework for fisheries with limited data to allow for a reasonable level of resource management.

continued, see SPOT on page 12

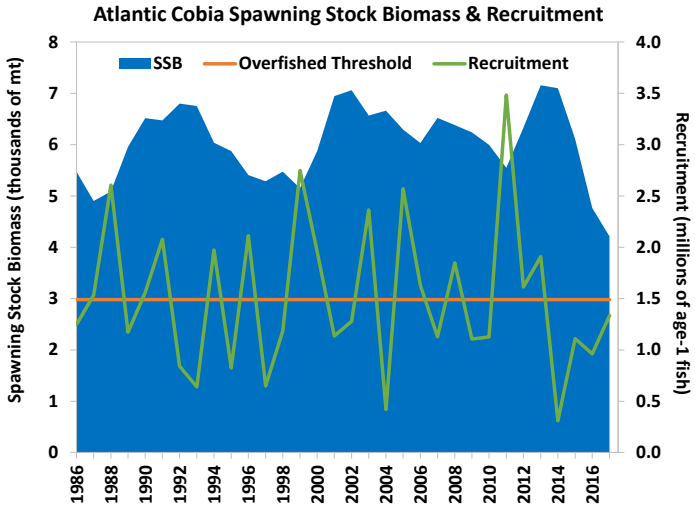
Atlantic Cobia

In February, the South Atlantic State/Federal Fisheries Management Board accepted the Atlantic Cobia Benchmark Stock Assessment and Peer Review Report, including new reference points, for management use. The assessment, which was conducted through the Southeast Data, Assessment, and Review (SEDAR) process, evaluated the Atlantic stock of cobia, which extends from the Georgia/Florida border north. Assessment results indicate the stock is not overfished and overfishing is not occurring.

Spawning stock biomass (SSB) has been above the overfished threshold throughout the timeframe (1986-2017), indicating the coastwide stock is not overfished. SSB has shown several large increases following years of high recruitment, the most recent following the 2011 recruitment peak, with the largest SSB in the time series occurring in 2013. These peaks in SSB have been followed by declines when recruitment moves back towards its average. While SSB has undergone a steep decline since the 2013 peak, SSB remains above the overfished threshold.

This assessment used re-calibrated recreational catch data from the Marine Recreational Information Program (MRIP). Landings of Atlantic cobia have generally increased since the 1980s, primarily driven by the recreational fishery, which accounts for about 96% of the total landings. Fishing mortality showed some increase in the most recent years, but did not approach the overfishing threshold, indicating the coastwide stock has not undergone overfishing during the assessment timeframe.

Several projections of the population under different harvest scenarios were conducted, describing predicted trends in biomass and the probability of the stock becoming overfished through 2024.



The TC recommended harvest quota levels to the Board based on projections that maintained a low probability of the stock becoming overfished and did not result in consistent declines in SSB. Based on the assessment results and harvest projections, the Board approved an annual total harvest quota of 80,112 fish for the 2020-2022 fishing seasons. The Board maintained current recreational measures for 2020 while the states consider potential regulatory changes for future years.

The Board also discussed recreational/commercial allocation as established by Amendment 1 to the Interstate Fishery Management Plan (FMP) for Atlantic Migratory Group Cobia, which currently allocates 92% of the total quota to the recreational fishery and 8% to the commercial fishery. These percentages were originally based on historical harvest from each sector within a period of reference

continued on page 10

ASMFC 2019 Annual Report Now Available

The Commission has released our 2019 Annual Report, which fulfills our obligation to inform Congress on the Commission's use of public funds, and provides stakeholders with an overview of activities and progress in carrying out our cooperative stewardship responsibilities for the marine, shell, and diadromous species under our care.

In the report, you will find a quick guide to stock status for the 27 species groups the Commission manages; a fisheries management section, which focuses on species which had the most significant management or stock assessment activities in 2019; and sections highlighting our major accomplishments in 2019 in the areas of fisheries science, habitat conservation, and fishery-dependent data collection and management. Please visit the Commission's website at www.asmfc.org for additional information on any of our programs or activities.

The report is available on the Commission website at www.asmfc.org, under Quick Links or directly at
http://www.asmfc.org/files/pub/2019AnnualReport_Web.pdf

Understanding Ecological Reference Points (ERPs)

Introduction: What are ERPs and Why are They Important?

In recent years, there has been an increasing push towards ecosystem approaches to fisheries management. Traditionally, fisheries have been assessed and managed on a species-by-species basis. However, species do not exist in a single-species vacuum in their natural environments. For example, a fish population is impacted by the availability of food, the level of predation, and the prevailing environmental conditions, among many other factors. In addition, that fish species, in turn, affects its predator and prey species, and the broader ecosystem. These interactions are essential to understand because management decisions for one species could have unforeseen impacts elsewhere, including on other fisheries, endangered species, and the ecosystem as a whole. Ecosystem-based approaches to fisheries management seek to account for these ecosystem interactions when managing fisheries.

Photo (c) Frank Marenghi, MD DNR

Ecological reference points (ERPs) are one potential step towards ecosystem-based approaches to fisheries management. While traditional single-species reference points, such as fishing mortality and biomass targets and thresholds, focus on the condition of one species in isolation, ERPs take into account a species' role in the ecosystem. ERPs allow managers to have a more holistic understanding of the condition of the stock, while also being able to understand the impacts that their fishery management decisions may have on other key species, fisheries, and the ecosystem as a whole.

Menhaden-specific ERPs

Purpose

Atlantic menhaden have supported one of the largest fisheries in the U.S. since colonial times, with landings going into fish meal, fish oil, and bait for other fisheries. However, Atlantic menhaden are also a food source for wide range of species including Atlantic striped bass, bluefish, sea birds, and marine mammals. Many of these predators support valuable commercial and recreational fisheries or ecotourism industries. The single species reference points that have been used to manage Atlantic menhaden do not take into account their role as a forage fish. ERPs are needed to ensure that there are enough menhaden not just for human use but also to sustain its predators.

The NWACS-MICE Model

The Commission's ERP Work Group was tasked with developing reference points that could account for Atlantic menhaden's role as a forage fish. The Workgroup explored a suite of models to develop ERPs, ranging from very simple to very complex. The performance of these models, their strengths and weaknesses, and their ability to address the Commission's ecosystem management objectives were evaluated to determine the best model for Atlantic menhaden ERPs.

The Work Group chose the Northwest Atlantic Coastal Shelf-Model of Intermediate Complexity for Ecosystems (NWACS-MICE) to develop Atlantic menhaden ERPs because it could explore both the impacts of predators on Atlantic menhaden biomass and the effects of Atlantic menhaden harvest on predator populations. In addition, it could be updated on a timeframe that works for managers. The NWACS-MICE is an intermediate complexity Ecopath with Ecosim (EwE) model that currently focuses on four key predator species (Atlantic striped bass, bluefish, weakfish, and spiny dogfish) and three key prey species (Atlantic menhaden, Atlantic herring, and bay anchovy). These species were chosen because diet data indicated they were top predators of Atlantic menhaden or key alternate prey species, and there were sufficient datasets to describe their population dynamics.

The NWACS-MICE model uses information from stock assessments, fishery-independent surveys, and studies of predator diets and feeding behavior to model how species interact in the ecosystem. The NWACS-MICE model can project how the focal species populations will respond to different levels of fishing mortality on predators and prey in the long-term. However, the current NWACS-MICE model is not as well-suited to estimating short-term changes in abundance and biomass of Atlantic menhaden because it doesn't capture how variable recruitment can be from year to year for this species. To achieve the best available management advice, the Workgroup recommended using a combination of the NWACS-MICE and the single-species Beaufort Assessment Model (BAM). The NWACS-MICE model will be used to examine the tradeoffs between Atlantic menhaden harvest and predator biomass in order to develop appropriate ERPs for menhaden, while the BAM will be used to determine Atlantic menhaden stock status relative to the ERPs and to recommend a total allowable catch (TAC).

continued, see SCIENCE HIGHLIGHT on page 8

SCIENCE HIGHLIGHT, continued from page 7

An important conclusion from the ERP assessment is that the final ERP definitions and values, including the appropriate harvest level for menhaden, depend on the management objectives for the ecosystem (i.e., management objectives for both Atlantic menhaden and its predators). The combination of modeling approaches recommended by the Workgroup provides a tool for managers to evaluate the tradeoffs between Atlantic menhaden harvest, predator harvest, and biomass of other key ecosystem species, in a quantitative and transparent way.

The Workgroup developed an example ERP fishing mortality target and threshold to show how this approach would work based on existing management objectives for Atlantic striped bass. Atlantic striped bass was chosen for this analysis because it was the most sensitive predator fish species to Atlantic menhaden harvest in the NWACS-MICE model, therefore, an ERP fishing mortality rate that sustains Atlantic striped bass biomass would likely not cause additional declines for other predators in the model. The example ERP fishing mortality target was defined as the maximum fishing mortality on Atlantic menhaden that would sustain Atlantic striped bass at its biomass (B) target when Atlantic striped bass are fished at its fishing mortality target. The example ERP fishing mortality threshold was defined as the maximum fishing mortality on Atlantic menhaden that would sustain Atlantic striped bass at its biomass threshold when Atlantic striped bass are fished at its fishing mortality target. In the example ERP scenarios that follow, all other species were fished at the same rate they experienced in 2017.

The rainbow surface plot from the NWACS-MICE (Figure 1) illustrates the example ERP scenario, and a set of tradeoffs that could be evaluated by managers. The colors indicate where Atlantic striped bass biomass would be in the long-term (relative to its target value) under different combinations of fishing mortality on Atlantic striped bass and Atlantic menhaden. Red and orange indicate low Atlantic striped bass biomass (i.e., below its biomass target), while yellow, green, and blue indicate high Atlantic striped bass biomass (i.e., above its biomass target). The solid black contour lines indicate combinations of Atlantic striped bass fishing mortality and Atlantic menhaden fishing mortality needed to maintain Atlantic striped bass at its biomass target and threshold, respectively. There are many possible combinations to achieve these goals, but there are trade-offs: if fishing mortality on Atlantic striped bass increases, then fishing mortality on Atlantic menhaden must decrease to maintain Atlantic striped bass at the same biomass level.

Figure 2 shows that if Atlantic striped bass continue to experience overfishing, as they were in 2017, then reducing Atlantic menhaden fishing mortality to zero would still not bring Atlantic striped bass back to their biomass target. However, if we reduce striped bass fishing mortality to its target fishing mortality target,

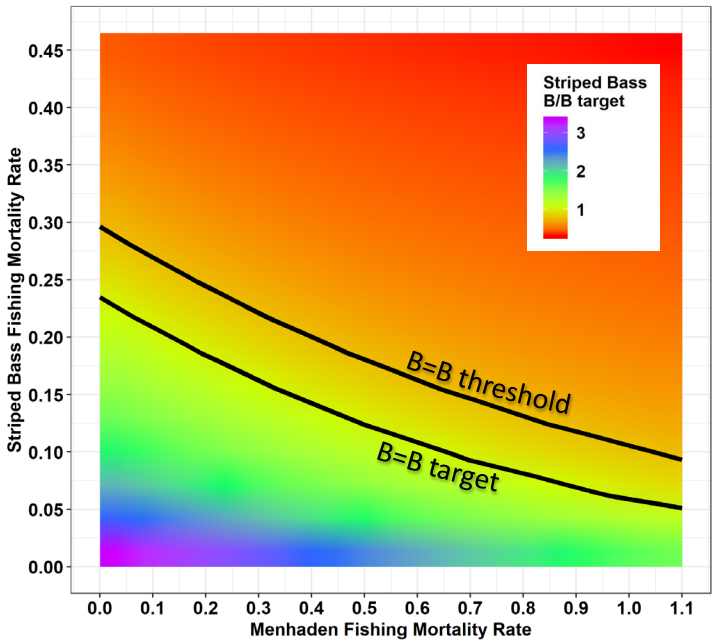


Figure 1. The colors on the plot indicate where striped bass biomass (B) will end up relative to its target under different levels of fishing mortality (F) on striped bass and menhaden. Reds and oranges indicate striped bass biomass will be less than its target and threshold (as you move towards the red area, stock is overfished). Whereas, greens, blues and purples indicate striped bass biomass will be greater than its target and threshold (as you move towards the blue area, the stock is in a healthy/sustainable condition). The solid black lines show combinations of fishing mortality which will result in striped bass biomass being at its threshold or its target.

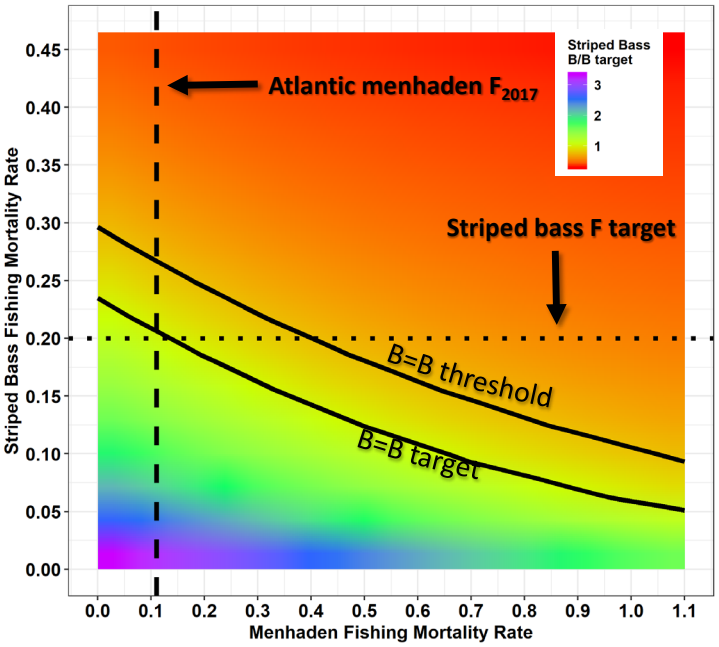


Figure 2. The dashed lines indicate the 2017 level of fishing mortality (F) on menhaden (vertical) and the striped bass fishing mortality target (horizontal). Striped bass biomass is slightly greater than the target where they intersect, indicating that if we fish striped bass at its target and keep fishing menhaden at its current levels, striped bass biomass in the long term will end up at or above its biomass target.

there are a range of Atlantic menhaden fishing mortality values that would keep Atlantic striped bass at or above their biomass target, as well as a range of values that would push Atlantic striped bass biomass below the biomass threshold. If Atlantic striped bass are fished at their fishing mortality target and Atlantic menhaden are fished at their 2017 fishing mortality level, then Atlantic striped bass biomass would stabilize at or slightly above its target biomass in the long-term.

In Figure 3, if we fish Atlantic striped bass at their fishing mortality target and fish Atlantic menhaden at their single-species fishing mortality target, then Atlantic striped bass biomass would stabilize between their biomass target and threshold in the long-term.

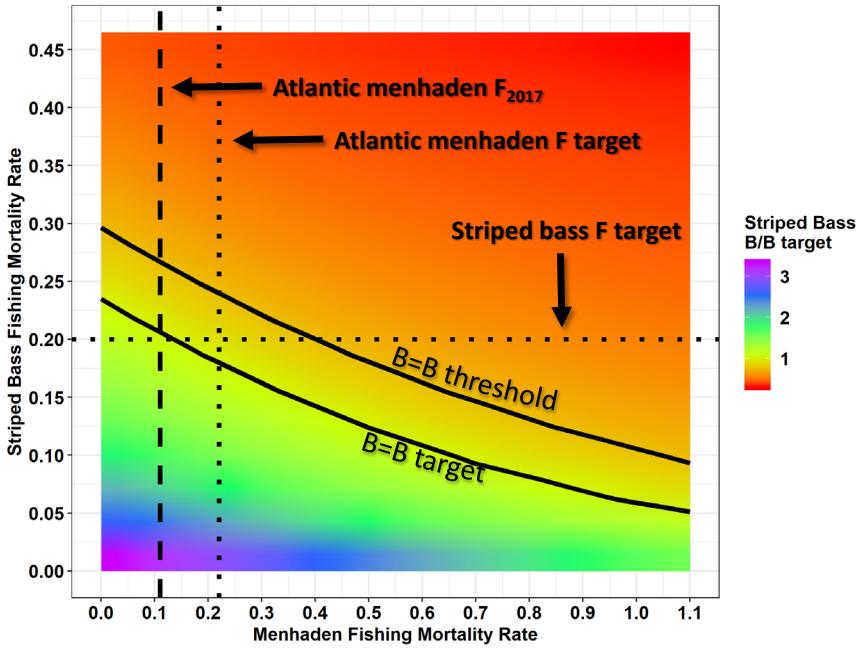


Figure 3. However, if we fish striped bass at its target and increase fishing on menhaden to its single-species target value, striped bass biomass in the long-term will end up between its biomass target and its biomass threshold.

In these example scenarios, all of the other key ecosystem species are assumed to be fished at their 2017 fishing mortality levels. For some species (e.g., bluefish), overfishing was occurring, and for others, the 2017 level was below their fishing mortality target (e.g., spiny dogfish). This tool could be used to explore the effects of fishing these species at their fishing mortality target or threshold. In addition, these plots can be produced for other species to explore where bluefish, weakfish, spiny dogfish, and Atlantic herring populations end up under different fishing mortality scenarios.

Next Steps

In May via webinar, the Atlantic Menhaden Management Board received an update on additional analyses conducted by the ERP Work Group, as requested by the Board in February. The additional analyses explored the sensitivity of the ERPs to different assumptions about ecosystem conditions (i.e., different biomass levels and F rates on the other focal species). The ERP Work Group presented the results of these analyses, including the values of the ERPs under the different scenarios and the probability of exceeding the respective ERPs under a TAC of 216,000 mt (status quo) for 2019-2021. The ERP Work Group also presented tradeoff curves and graphs to illustrate the tradeoffs between the management objectives for different species.

The ERP Workgroup and Atlantic Menhaden Technical Committee noted several sources of uncertainty in the analyses that need further exploration to better understand the sensitivity of the model and the uncertainty in the ERPs. These uncertainties included differences between the fishing rates in the Fishery Management Plans and in the ERP model for some species, a possible overestimation of the importance of Atlantic herring for striped bass diets, and the inability of weakfish to rebuild under any fishing rates explored in the analyses. The ERP Work Group therefore recommended additional analyses to explore (1) alternate Atlantic herring biomass scenarios given the uncertainty in future Atlantic herring recruitment; (2) sensitivity to model parameterization of the Atlantic herring/Atlantic striped bass relationship; and (3) scenarios where other ERP focal species are fished at their single-species F reference points. These analyses will help the Board to better understand the sensitivity of the ERPs to different ecosystem assumptions and sources of uncertainty, as well as provide context for Board discussions around risk and ecosystem management objectives.

The Board tasked the ERP Work Group with conducting the recommended analyses. The results will be reviewed at the August meeting when the Board is expected to consider a motion to adopt ERPs for Atlantic menhaden.

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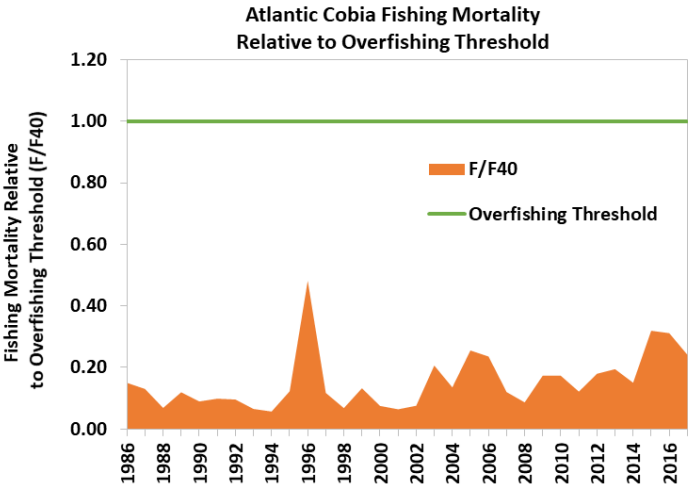
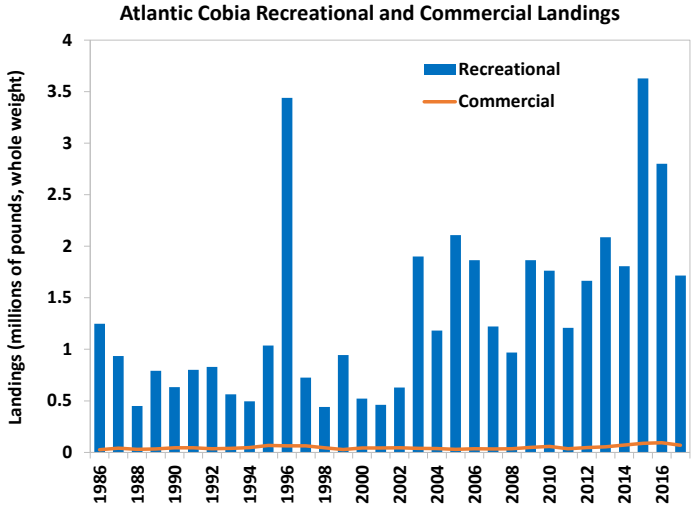




years, prior to the re-calibration of MRIP estimates. With the re-calibration of the recreational data, the percentages of harvest in the reference period changed, resulting in the current commercial allocation percentage being higher than its percentage of total harvest during the reference period. In response to this, the Board initiated an addendum to reevaluate allocation. The Board also noted potential regulatory inconsistencies among de minimis states and determined the de minimis measures should be reconsidered through the addendum.

The SEDAR 58 Report is available at http://www.asmfc.org/uploads/file/5e3d99a3SEDAR58_AtlCobiaAssessment_PeerReviewReport.pdf. An overview of the assessment is also available at on the Commission's website, www.asmfc.org, on the Cobia page under Stock Assessment Reports. For more information, please contact Dr. Mike Schmidtke, FMP Coordinator, at mschmidtke@asmfc.org.

Atlantic Croaker and Spot

The Commission's South Atlantic State/Federal Fisheries Management Board approved Addendum III to Amendment 1 to the Interstate Fishery Management Plan (FMP) for Atlantic Croaker and Addendum III to the Omnibus Amendment to the Interstate FMPs for Spanish Mackerel, Spot, and Spotted Seatrout. These Addenda adjust management of Atlantic croaker and spot through their respective Traffic Light Approaches (TLA).

Through the annual analysis of the TLA, which assigns a color (red, yellow, or green) to characterize relative levels of indicators that reflect the condition of the fish population (abundance characteristic) or fishery (harvest characteristic). If the amount of red, indicating low abundance or low harvest, in both characteristics exceeds threshold levels (30% and 60%) for too many years, management action is triggered. In 2018, the Atlantic Croaker Technical Committee and Spot Plan Review Team recommended updates to their respective TLAs that would incorporate additional fishery-independent indices, age information, use of regional characteristics, and changes to the management-triggering mechanism.

These Addenda change the management-triggering mechanisms to enact coastwide management if the amounts of red for both the harvest and abundance characteristics within a region (Mid-Atlantic and South Atlantic) exceed threshold levels for 3 of the 4 most recent years for Atlantic croaker and 2 of the 3 most recent years for spot. The Addenda also define commercial and recreational management responses to triggers at each threshold level (see table below). Finally, the Addenda define the processes for evaluating the fisheries while triggered measures are in place and determining when triggered measures may be removed.

Both Addenda were approved for immediate implementation by the states of New Jersey through Florida, and can be found on their species webpages at http://www.asmfc.org/species/atlantic-croaker and http://www.asmfc.org/species/spot under *Fishery Management Plans*. The next TLA analyses will be presented to the Board at the Commission's 2020 Summer Meeting.

For more information, please contact Dr. Mike Schmidtke, FMP Coordinator, at mschmidtke@asmfc.org.

Management Triggers & Reponses for Atlantic Croaker & Spot

Species	Recreational		Commercial	
	30% Threshold	60% Threshold	30% Threshold	60% Threshold
Atlantic Croaker	Bag Limit: up to 50 fish for non-*de minimis* states	Bag Limit: up to 40 fish for all states	Measures to achieve 1% harvest reduction from previous 10-year average for non-*de minimis* states with no regulations	Measures to achieve 5% harvest reduction from previous 10-year average for all states
Spot	Bag Limit: up to 50 fish for non-*de minimis* states	Bag Limit: up to 40 fish for all states	Measures to achieve 1% harvest reduction from previous 10-year average for non-*de minimis* states with no regulations	Measures to achieve 10% harvest reduction from previous 10-year average for all states

Note: Regulations will not go into effect unless management is triggered by the TLA Analysis.

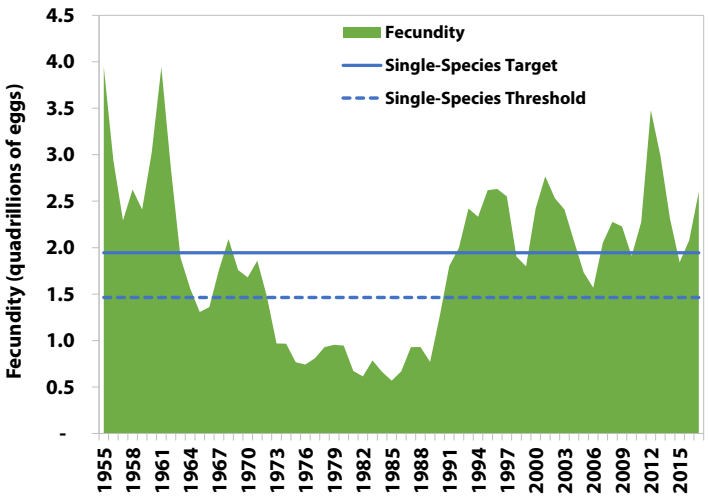
Atlantic Menhaden

In February, the Commission's Atlantic Menhaden Management Board accepted the results of the Single-Species and Ecological Reference Points (ERPs) Assessments and Peer Review Reports for management use. The single-species assessment indicates the stock is not overfished nor experiencing overfishing relative to the single-species reference points established in Amendment 3. However, the ERP assessment indicates that the fishing mortality reference points for menhaden should be lower to account for menhaden's role as a forage fish. In order to consider moving forward with the use of ERPs for management, the Board tasked the ERP Workgroup with producing several scenarios to explore how different fishing mortality assumptions for the other predator and prey species in the ERP model (i.e., bluefish, weakfish, spiny dogfish, and Atlantic herring) might affect the menhaden ERP fishing mortality target and threshold.

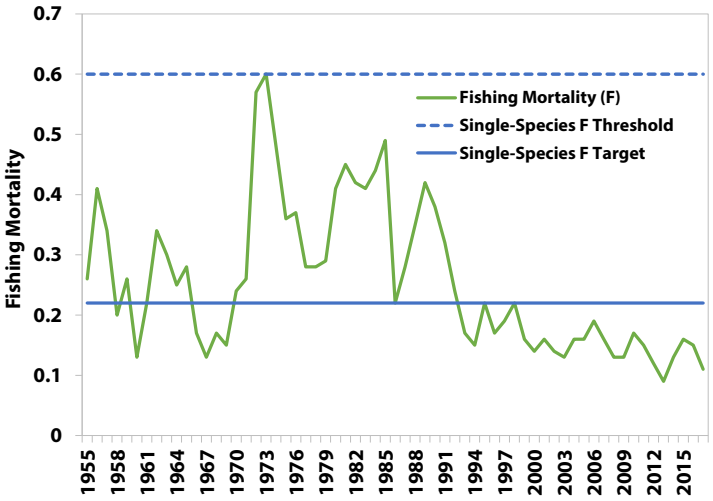
"On behalf of the Menhaden Board, I commend the ERP Workgroup and the dozens of state, federal, academic, and ASMFC scientists for their countless hours of dedication to this formidable task," stated Board Chair Nichola Meserve. "The Board has long recognized the importance of Atlantic menhaden as a forage fish for a variety of predators as reflected in its setting of conservative harvest limits for menhaden and its emphasis on the development of ERPs as one of its highest priorities for managing the species. The ERP assessment is an impressive body of work and a huge step towards fully realized ecosystem-based fishery management. Although there is still much more work to be done, the ERP assessment provides managers with a critical tool in setting harvest targets for menhaden in an ecosystem-context."

Under the traditional single-species reference points, Atlantic menhaden are neither overfished nor experiencing overfishing. Population fecundity, a measure of reproductive capacity (i.e., number of mature eggs in the population), has been above the single-species threshold since 1991 and above the single-species target in 20 of the 27 years since then, including 2017. Fishing mortality (F) has remained below the single-species overfishing threshold (0.6) since the mid-1970s, and below the single-species overfishing target (0.22) since the mid-1990s. Fishing mortality was estimated to be 0.11 in 2017. Although the ERP assessment indicates that the F reference points should be lower than the single-species reference points, it also showed that the conservative total allowable catch set for the 2018 to 2020 fishing seasons is consistent with the ERP F target in the example management scenario presented to the Board. A detailed overview of the ERP assessment can be found on page 7.

Atlantic Menhaden Fecundity
Source: ASMFC Atlantic Menhaden Single-Species Benchmark Stock Assessment, 2020



Atlantic Menhaden Fishing Mortality (Ages 2-4)
Source: ASMFC Atlantic Menhaden Single-Species Benchmark Stock Assessment, 2020



The Assessment and Peer Review Reports can be found on the Commission's website on the Atlantic menhaden webpage, http://www.asmfc.org/species/atlantic-menhaden, under stock status. A more detailed overview of the stock assessments is available at http://www.asmfc.org/uploads/file/5e3c4663AtlanticMenhadenAssessmentsOverview_Feb2020.pdf.

ASMFC Withdraws the Commonwealth of Virginia's Atlantic Menhaden Noncompliance Finding

On May 14th, the Atlantic States Marine Fisheries Commission notified the Secretary of Commerce that the Commonwealth of Virginia is in compliance with Amendment 3 to the Interstate Fishery Management Plan for Atlantic Menhaden. Specifically, the Commonwealth has promulgated regulations to implement the 51,000 metric ton (mt) Chesapeake Bay reduction fishery cap (cap). For the 2020 fishing season, the Commonwealth set the cap at approximately 36,000 mt, nearly 15,000 mt below Amendment 3's cap to reflect overages that occurred in 2019. The Virginia Marine Resources Commission, which now has regulatory authority for menhaden management in state waters, will set the cap at 51,000 mt in 2021 as long as catch is below the cap set in 2020.

"I would like to thank my fellow Virginia Commissioners, Governor Northam, Secretary Strickler, the Virginia General Assembly, and the Virginia Marine Resources Commission for their attention to this issue," stated Patrick Keliher, ASMFC Chair and Commissioner of the Maine Department of Marine Resources. "We are appreciative of their hard work to bring the Commonwealth back into compliance prior to the effective date of the moratorium."

Under the Atlantic Coastal Fisheries Cooperative Management Act, upon receiving notification that a state has come back into compliance with a mandatory management measure, the Secretary of Commerce determines whether the state is in compliance. If he concurs with the Commission's compliance finding, the moratorium is terminated immediately.

AQUACULTURE, continued from page 1

Clam seed is produced in Florida hatcheries for grow out on aquaculture leases. Photo (c) Florida Department of Agriculture and Consumer Services

individuals that use the area, namely fishermen, boaters, or landowners. Since there are many misconceptions about the impacts of aquaculture, it is important to raise awareness about both the potential benefits and adverse impacts to the public or any stakeholders that may be involved.

Aquaculture: Effects on Fish Habitat along the Atlantic Coast is available at http://www.asmfc.org/files/Habitat/HMS16_Aquaculture_May2020.pdf. For more information on aquaculture, visit the Commission website at http://www.asmfc.org/habitat/hot-topics or contact Dr. Lisa Havel, Habitat Committee Coordinator, at lhavel@asmfc.org.

SPOT, continued from page 5

Addendum III updates the TLA's management trigger mechanism, management responses to TLA triggers, and evaluation of the fishery's response to measures implemented if triggers occur. The TLA will continue to be conducted annually, although the updated analysis will be used, starting in 2020. Coastwide management actions are triggered if both characteristics (harvest and abundance) in either region exceed threshold levels of red for 2 of the 3 most recent years. If management action is triggered due to exceeding the 30% red threshold, states are required to implement a 50 fish per person recreational bag limit and commercial measures that would achieve a 1% reduction to average landings from the previous 10 years. If management action is triggered due to exceeding the 60% red threshold, states are required to implement a 40 fish per person recreational bag limit and commercial measures that would achieve a 10% reduction to average landings from the previous 10 years. Triggered measures may be removed after a minimum of 2 years if abundance has increased to the point that it no longer triggers management action.

In March 2017, a report on Sciaenid Fish Habitat was released including information on habitat for several species, including spot, during all stages of their lives, their associated Essential Fish Habitats and Habitat Areas of Particular Concern, threats and uncertainties to their habitats, and recommendations for habitat management and research. This report is meant to be a resource when amending FMPs in the future for these species.

For more information, please contact Dr. Mike Schmidtke, FMP Coordinator, at mschmidtke@asmfc.org.

ACCSP Holds Recreational Survey Regional Trainings

ACCSP staff conducted three regional trainings for the Access Point Angler Intercept Survey (APAIS), For-hire Telephone Survey (FHTS), and the Large Pelagics Telephone Survey (LPTS) add-on for their 13 Atlantic coast state partners (Maine – Georgia). APAIS, FHTS, and LPTS add-ons collect complementary sets of data that contribute to NOAA's Marine Recreational Information Program's (MRIP) catch and effort estimates.

APAIS interviewers practice collecting fish weights and measurements while recording survey responses with the Dockside Interceptor Application. Photo (c) Trevor Scheffel.

- APAIS is an in-person survey conducted at public marine fishing access points to collect catch data from anglers as they complete their fishing trips.
- FHTS is a telephone survey that collects information from for-hire vessel operators to estimate fishing effort for the for-hire sector.
- LPTS Add-on is an additional set of questions asked in conjunction with the FHTS that are required for fishing trips targeting large pelagic species.

ACCSP staff led a demonstration of the data collection process for APAIS. APAIS interviewers record survey responses with a tablet using a software program called the Dockside Interceptor Application (DIA). State staff gained hands-on experience using the DIA to collect survey data by simulating in-person angler interviews. Interviewers worked in pairs to practice interviewing techniques, collect weights and measurements for a sample of available caught fish, and record survey responses into the DIA.

The ability to properly identify fish species is an essential skill for APAIS interviewers to ensure that catch estimates are accurate for each species encountered during field sampling. At each regional training, the APAIS coordinator for each state was responsible for leading part of the fish identification section of the training. This section of the training involves a comprehensive review of the key identifying characteristics for observed fish species. APAIS interviewers are tested on both fish identification and survey procedures before being able to participate in field sampling.

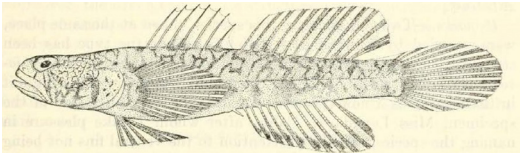
ACCSP staff also led a demonstration of the FHTS Computer Assisted Telephone Interviewing (CATI) system. The CATI system is an online application used to track phone call attempts made to vessel operators and record responses to the survey questionnaire. State staff used the CATI system to practice logging call attempts and conducting interviews of for-hire vessel captains.

The NOAA Communications and Education Team (CET) engaged with APAIS interviewers in a discussion on interviewer and angler perspectives as well as effectiveness of current MRIP outreach materials.

This tribute was created by the following USFWS staff to commemorate the life and accomplishments of Dr. Louella E. Cable, the first woman biologist to work for the predecessor agency of the USFWS: USFWS Stepping Up to Leadership Cohort 40, Team Sunshine -- Anthony Sowers, Cat Crawford, Michelle Moorman, Sarah Kulpa, Scott Ralston, Scott Rice, and coach Johnna Roy.

Dr. Louella E. Cable (1900-1986)

Dr. Louella E. Cable was a pioneer in fisheries conservation. She was described as a modest, poised and soft-spoken individual but tireless scientist. In 1927, she was the first person to study fisheries in pursuit of a master's degree from the University of South Dakota, then hired as the first female biologist at the U.S. Bureau of Fisheries, predecessor of the U.S. Fish and Wildlife Service (USFWS). At the Bureau's Beaufort, NC laboratory, she illustrated and described many aquatic species. She proved to be a tremendous scientific illustrator despite having no formal artistic training. Dr. Cable was among the first to rear larval marine fish successfully, which paved the way for enhanced study of early fish development. In 1937, Cable joined the Atlantic Coast Shad Investigation team and eventually became lead investigator. The team's work was pivotal in understanding the ecology of American shad and the impacts of pollution on its recovery. Dr. Cable began work at the Great Lakes Fishery Investigation Center in 1950 and earned her PhD at the University of Michigan in 1959. She worked for the USFWS for 43 years. Her legacy lives on through her numerous publications and illustrations and an annual scholarship fund established in her name at the University of South Dakota.



Cable's glory (Eleotrica cableae) - Named for and illustrated by Dr. Louella E. Cable

Employee of the Quarter: Joe Myers

Each quarter, the Commission honors an individual who has made notable contributions to the Commission's mission, vision, programs, and activities. For the first quarter of 2020 (January - March), Joe Myers, ACCSP Senior Fisheries Data Coordinator, was named the Employee of the Quarter for his dedicated and impressive pursuit of the values recognized by the award (teamwork, initiative, responsibility, quality of work, positive attitude and results)

In the more than six years Joe has been with ACCSP, he has proven to be a valuable contributor to not only the program as a whole, but also to program partners and his coworkers. Over the past several months, Joe has worked tirelessly on a number of tasks essential to meeting the deadlines on the Southeast For-Hire Integrated Electronic Reporting project and the South Atlantic commercial logbook project. He played an integral part in advancing both projects through his close collaboration with partners and the Software Team to implement the desired functionality, as well as creatively and efficiently developing alternative solutions to overcome potential roadblocks to implementation. In addition to his continued work on SAFIS redesign efforts, Joe also played a central role in coordinating with GARFO and SERO to develop the reporting "compromise" rules to be used for dual-permitted federal vessels. These projects are fundamental to reducing the reporting burden on industry while achieving the coastwide goal of a single report to meet the requirements of all partners.

In addition to effectively multi-tasking on these and other important items, Joe has a keen awareness of larger project and program objectives and the importance of these initiatives to ACCSP and the Commission. His ability to successfully balance the needs of multiple partners to achieve the larger goal has directly contributed to ACCSP's ability to meet the needs and deadlines of its partner agencies.

In appreciation of Joe's efforts, he received a cash award and a letter of appreciation to be placed in his personal record. In addition, his name is on the plaque displayed in the Commission's lobby. Congratulations, Joe!

In Memoriam

In May, the Commission and the larger marine fisheries management and scientific communities lost not only two notable contributors but two great men: Lewis Nelson Flagg and Carl N. Shuster, Jr. Below are edited excerpts from their respective obituaries.

Lewis Nelson Flagg

May 12, 1943 – May 17, 2020

On May 17th, Lewis Nelson Flagg, a retired State of Maine marine biologist and Army veteran, passed away peacefully with his daughter and wife at his side. He was 77 years old. Lewis graduated from Waldoboro High School in 1961 and earned a B.S. in Wildlife Management from the University of Maine in 1965. He joined the ROTC Program at UMaine and became a commissioned officer. In 1966, shortly after marrying Alice Lilienthal of South Thomaston, Lewis was called to serve at Fort Benning, Georgia, and from there, he went to Long Binh, Vietnam, for a year. After returning home, he stayed in the Army Reserves, and was promoted to Captain before separating from the service to spend more time with his family. The couple moved to Winthrop in 1968 where he joined the Maine Department of Marine Resources (ME DMR) as a biologist. He and his crew planned and built many of the fishways in the state. His distinguished career at ME DMR spanned 40 years. At one time, he served as acting Commissioner of the Department under then Governor Angus King. He worked with fishermen, law enforcement, and policy makers to improve Maine's fisheries and was highly respected for his extensive knowledge of Maine's wildlife, waterways, and vegetation.

Over his four decade career, Lewis was actively involved in the Atlantic States Marine Fisheries Commission. In 2005, Lewis

continued on page 16

COMMISSIONERS

ROBERT H. BOYLES, JR.

With his promotion to Director of the South Carolina Department of Natural Resources (SC DNR), Robert H. Boyles, Jr. has stepped down as ASMFC Administrative Commissioner for the State of South Carolina, bringing to a close his 16-year involvement with the Commission.

Over his time with the Commission, Robert served as the state's Legislative Commissioner (2004-2012) and its Administrative Commissioner (2012-2020). From 2006-2011, he was the Commission Chair and Vice-chair, providing thoughtful and deliberate leadership with the goal of facilitating the cooperative nature of our Compact and uniting the states and its federal partners in their shared stewardship responsibilities. He quickly became and will always be considered the "Senior Statesman" of the Commission (despite the youthful age at which he achieved this title). He could always be counted on to provide a poignant quote from one of our founding fathers to bring the group back to the fundamental question at hand. Through his words and deeds he helped to elevate the Commission and make it a better organization. We wish Robert the very best in his new job of overseeing the conservation and management of South Carolina's natural resources. They certainly could not be in better hands.

G. WARREN ELLIOTT

In late February, G. Warren Elliott became Pennsylvania's legislative appointee to the Commission. An avid recreational fisherman, Warren currently serves as the state's Citizen Representative to the Chesapeake Bay Commission and the Mid-Atlantic Fishery Management Council, where he serves as Vice Chair, as well as Chair of the Ecosystem and Planning Committee. In that capacity, he led efforts to create the protections for the Frank L. Lautenberg deep sea corals, advance protections for seventeen species of unmanaged Mid-Atlantic forage fish, and prepare the Ecosystem Approach to Fisheries Management guidance document. Warren is a past president of the Pennsylvania Fish and Boat Commission, where he served as a commissioner for eleven years. In his professional life, Warren served 12 years as Chair of the Franklin County, PA Board of Commissioners. He is one of the 100 Centennial Alumni from Penn State Mont Alto. He is also a distinguished alumnus of Shippensburg University, having earned honors for both his graduate and undergraduate degrees in Public Administration. He was also granted an honorary Doctorate for his devotion to public service. He is an author, and currently President of Cardinal Crossings, a consulting and real estate firm, and Chair of the Board of F&M Trust Bank. Warren lives in Chambersburg, PA with his wife of over 30 years, Donna. They have two sons, Logan and Brennan. Welcome aboard Warren!

PHIL MAIER

Philip Maier, new ASMFC Administrative Commissioner from South Carolina, serves as the sixth leader for Marine Resources Division (MRD), tasked with protecting and advocating for the state's marine resources. Phil grew up in coastal New Jersey, where he spent his formative years fishing with family and friends and working on recreational fishing boats. Upon obtaining a Master of Science in marine biology from the College of Charleston, he began his career with SC DNR. In the ensuing decades, he worked in various positions spanning the MRD, from environmental research to sea turtle monitoring to coastal land management. Most recently, he served as the Director of MRD's Coastal Reserves and Outreach section. In his free time, Phil enjoys spending time outdoors with his wife, Beth and their two children. Congratulations and welcome Phil!

CHERI PATTERSON

In March, Cheri Patterson was appointed Chief of the Marine Division of the New Hampshire Fish and Game Department (NH FGD), planning, coordinating, and supervising various fisheries-dependent and-independent programs, and fisheries policy. Having been with the NH FGD since 1977, Cheri is no stranger to the Commission, and has served on several Commission committees, plan review and plan development teams, and workgroups. From 2016-2019, she served as Doug Grout's proxy on several species management boards.

As Marine Division Chief, Cheri represents the Department on a variety of marine interstate and intrastate fisheries management boards, committees, and teams, including ASMFC, ACCSP, New England Fishery Management Council, National Marine Fisheries Service Atlantic Large Whale and Harbor Porpoise Take Reduction teams, the Portsmouth Oil Spill Response Workgroup, and the Seabrook Nuclear Plant Technical Advisory Committee. Congratulations, Cheri; we welcome your continued involvement in ASMFC and ACCSP.

STAFF

SARAH HYLTON

In April, Sarah Hylton joined the Commission staff as an ACCSP Recreational Data Coordinator. In her position, Sarah will be supporting the Marine Recreational Information Program surveys conducted through ACCSP, including the Access Point Angler Intercept Survey and the For-Hire Telephone Survey.

Sarah grew up near the DC area and most recently worked in Florida as a National Marine Fisheries Service observer. She completed her Master of Science from the University of New England, where she studied Atlantic shortnose sturgeon. Sarah earned her Bachelor's degree in Biological Oceanography from University of South Carolina. Welcome aboard, Sarah!

IN MEMORIAM, continued from page 14

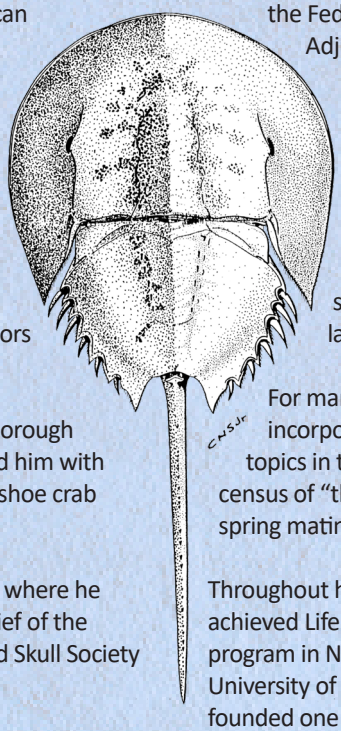
was awarded the Commission's Annual Award of Excellence for his enthusiastic approach to fisheries management as distinguished by his engagement with everyone he worked with, from new professionals to state and federal agency officials. He was instrumental in promoting and securing Maine's policy of restoring anadromous fish species throughout their historic range, providing the foundation for successful anadromous fish restoration activities to this day. He chaired several Commission management boards and represented Maine on all but one board in which Maine has declared an interest. He was a long-serving member of the Commission's Management and Science Committee and represented Maine on the New England Fishery Management Council. In all these capacities, Lewis embodied the true spirit of cooperative, interjurisdictional fisheries management by paying attention to the needs of his own state as well as those of other states.

A kind-hearted, trusted advisor, he served as both a mentor and friend to many. Lewis was known as a loyal friend, a gentle soul with a brilliant mind, and an educated outdoorsman. He was always up for a travel adventure and visited extended family and friends across the United States and the world, including the Azores, Portugal, Italy, Spain, and Switzerland. He loved a cup of black coffee while pouring over the day's copy of the Kennebec Journal in the morning and making blueberry muffins or pancakes for any family who came to visit. He was also an avid war historian, but, most of all, he was a man of honor, integrity and good humor who was mighty proud of his family. Memories and condolences may be shared with the family on the obituary page of the funeral home website at http://www.familyfirstfuneralhomes.com. In lieu of flowers, donations can be made to the Maine Masonic Charitable Foundation to support Maine Veterans' Homes.

Carl Nathaniel Shuster, Jr.

November 16, 1919 – May 28, 2020

Dr. Carl N. Shuster, Jr. passed away peacefully at home on May 28th, at the age of 100 years. Dr. Shuster was considered the world's greatest authority on *Limulus polyphemus,* the American horseshoe crab, which he fondly called "the Animal." In 2001, in response to the Commission's adoption of the first Interstate Fishery Management Plan for Horseshoe Crabs, NOAA Fisheries set aside hundreds of square miles in the Atlantic Ocean off the New Jersey and Delaware coast named the "Carl N. Shuster, Jr. Horseshoe Crab Reserve." When Dr. Shuster was over 80 years old, Harvard University a sked him to write a book dedicated solely to the horseshoe crab. He recruited colleagues to be co-authors and the book, *The American Horseshoe Crab*, was published in 2003. He also wrote and co-authored umerous articles on "the Animal." When David Attenborough produced his "Life on Earth" series, Dr. Shuster assisted him with his Delaware Bay mating season footage for the horseshoe crab segment.



Dr. Shuster was a 1942 graduate of Rutgers University, where he earned varsity letters in three sports, was Editor-in-Chief of the Scarlet Letter yearbook, and was a member of Cap and Skull Society and Chi Psi fraternity.

During World War II, Dr. Shuster flew 27 missions over Europe, many as lead plane navigator, and earned the Distinguished Flying Cross.

After returning from the War, he did graduate work at Rutgers with his much-beloved mentor, and oyster expert, Dr. Thurlow Nelson, and did research at the Woods Hole Marine Biological Laboratory. Dr. Shuster obtained his Ph.D. from New York University. Subsequently, Dr. Shuster was Director of the University of Delaware Marine Laboratories, Director of the U.S. Northeast Shellfish Sanitation Research Laboratory, worked for the Environmental Protection Agency, served as the Chief Environmental Advisor to the Federal Energy Regulatory Commission, and was an Adjunct Professor at the College of William & Mary.

His colleagues in marine biology conducted a symposium in Dr. Shuster's honor at Cape May, New Jersey, in 2016. All of the speakers commended him for being so collaborative in his approach to science, willingly sharing his data with others, suggesting ideas for further research, and sharing credit, all traits they said were sadly all too lacking in today's scientific circles.

For many years Dr. Shuster helped public school teachers incorporate horseshoe crabs and related environmental topics in their student education plans, and led an annual census of "the Animal" on Delaware Bay beaches during the spring mating season.

Throughout his life, Dr. Shuster was active in Boy Scouts. He achieved Life Scout. He organized the merit badge counselors program in Newark, Delaware, recruiting heavily from the University of Delaware faculty. In Rhode Island, in the 1960s, he founded one of the first co-ed explorer troops in the U.S., focused on marine biology, for which he received the Silver Beaver Award.

Memories and condolences may be shared with the family on the obituary page of the funeral home website at https://www.dignitymemorial.com/obituaries/arlington-va/carl-shuster-9201258.

Hand drawn illustration of the horseshoe crab by Dr. Carl Shuster, Jr.