Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201, Dover, DE 19901
Phone: 302-674-2331 | FAX: 302-674-5399 | www.mafmc.org
Michael P. Luisi, Chairman | P. Weston Townsend, Vice Chairman
Christopher M. Moore, Ph.D., Executive Director

MEMORANDUM

Date: May 27, 2022

To: Council

From: Julia Beaty, staff

Subject: 2023-2025 chub mackerel specifications setting

On June 8, 2022, the Mid-Atlantic Fishery Management Council (Council) will consider adopting 2023-2025 specifications for Atlantic chub mackerel. Council staff, the Scientific and Statistical Committee, the Monitoring Committee, and the Advisory Panel all recommend status quo specifications.

The following materials are provided behind this tab (unless otherwise noted) for the Council's consideration. Materials are listed in reverse chronological order.

1) Summary of the May 20, 2022 Monitoring Committee webinar
2) May 2022 Scientific and Statistical Committee report (*behind Tab 16*)
3) Staff memo on 2023-2025 specifications for Atlantic chub mackerel
4) April 2022 Advisory Panel Fishery Performance Report
5) 2022 Chub Mackerel Fishery Information Document

Mackerel, Squid, Butterfish Monitoring Committee
May 20, 2022
Webinar Meeting Summary

Monitoring Committee Attendees: Carly Bari (GARFO), Julia Beaty (MAFMC staff), Jason Didden (MAFMC staff), Lisa Hendrickson (NEFSC), Daniel Hocking (GARFO)

Additional Attendees: Katie Almeida, Greg DiDomenico, Jeff Kaelin, Meghan Lapp

Meeting Objectives: 1) Review recent longfin squid and chub mackerel fishery performance and management measure recommendations from the Advisory Panel, the Scientific and Statistical Committee (SSC), and Council staff; 2) Review, and if appropriate, recommend changes to the previously implemented 2023 longfin squid specifications; and 3) recommend 2023-2025 annual catch limits, annual catch targets, total allowable landings limits, and other management measures for chub mackerel.

Chub Mackerel 2023-2025 Specifications

The Monitoring Committee recommended that all chub mackerel specifications remain status quo in 2023-2025, with review and, if necessary, revision in interim years.

The Monitoring Committee agreed that expanded discard estimates based on the Standardized Bycatch Reporting Methodology would be beneficial for the purposes of chub mackerel catch accounting and specifications setting. To date, the Monitoring Committee has only considered a very simple analysis of the total proportion of chub mackerel reported in observer and vessel trip report (VTR) data that were discarded as opposed to retained. The Monitoring Committee agreed that they have much higher confidence in the observer data for discards compared to VTR data.

One Advisor who participated on the Monitoring Committee call recommended collection of biological samples from the recreational fishery, especially as recreational catches have been more consistent than commercial catches in recent years.

One Advisor who represents a commercial fish processing company said that although his company encouraged vessels to target chub mackerel in past years when *Illex* were not highly available, they have become more interested in exploring the potential for a thread herring fishery as an augment to the purse seine fishery. One Monitoring Committee member noted that an exploratory thread herring fishery would be the first case of considering an expanded fishery for an Unmanaged Forage Amendment Ecosystem Component species; therefore, thorough consideration would be needed regarding the most appropriate process.

Longfin Squid 2023 Specifications

After considering recent fishery performance, Advisory Panel input, and the SSC recommendation for status quo Acceptable Biological Catch (ABC), the Monitoring Committee found that modifications to the longfin squid specifications do not appear warranted at this time.

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Christopher M. Moore, Ph.D., Executive Director

MEMORANDUM

Date: May 3, 2022

To: Chris Moore, Executive Director

From: Julia Beaty, staff

Subject: 2023-2025 specifications for Atlantic chub mackerel

Executive Summary

This memorandum includes information to assist the Mid-Atlantic Fishery Management Council's (Council's) Scientific and Statistical Committee (SSC) and Mackerel, Squid, and Butterfish (MSB) Monitoring Committee in recommending 2022-2025 catch and landings limits for Atlantic chub mackerel (*Scomber colias*), as well as the other management measures which can be modified through the annual specifications process.

Additional information on fishery performance and past management measures can be found in the 2022 Chub Mackerel Fishery Information Document and the 2022 Chub Mackerel Fishery Performance Report developed by advisors.[1]

The Council approved 2020-2022 catch and landings limits for Atlantic chub mackerel in March 2019 based on the SSC's acceptable biological catch (ABC) recommendations (Table 1). These measures were implemented through Amendment 21 to the MSB Fishery Management Plan (FMP) and became effective in September 2020 (85 Federal Register 47103). The SSC, Monitoring Committee, and Council reviewed these measures in 2020 and 2021 and recommended no changes.

During their May 2022 meeting, the SSC will consider chub mackerel ABCs for 2023-2025. The Monitoring Committee will then meet to recommend annual catch limits (ACLs), annual catch targets (ACTs), and total allowable landings limits (TALs) for 2023-2025, and other management measures which can be modified through the annual specifications process.

The Council will meet in June 2022 to review the recommendations of the SSC and Monitoring Committee, as well as input from advisors. They will then recommend catch and landings limits and other management measures for 2023-2025.

Council staff recommend status quo chub mackerel specifications for 2023-2025. There is no new information to suggest that these measures should be modified. In addition, advisors did not recommend any changes for 2023-2025.

[1] Both documents will be posted to https://www.mafmc.org/fishery-performance-reports.

Table 1. 2020-2022 catch and landings limits for Atlantic chub mackerel.

Measure	mil lb	mt	Basis
ABC	5.07	2,300	SSC recommendation
Expected SC-FL catch	0.08	38	Highest annual SC-FL landings shown in commercial dealer and MRIP data, increased by about 10% to account for discards, which are not well quantified.
ACL	4.99	2,262	ABC minus expected SC-FL catch.
ACT	4.79	2,171	ACL reduced by a 4% management uncertainty buffer.
Expected dead discards	0.29	130	6% of ACT based on based on the commercial discard rate during 2003-2017 from northeast observer data.
TAL	4.50	2,041	ACT minus expected total dead discards.

Recent Catch and Landings

After remaining below 0.5 million pounds per year for many years, commercial chub mackerel landings spiked to 5.25 million pounds in 2013, but decreased to pre-2013 levels by 2016. In 2021, 37,371 pounds of chub mackerel were landed by commercial fishermen from Maine through North Carolina. Recreational chub mackerel landings are variable and averaged 122,132 pounds per year during 2017-2021. In 2021, recreational fishermen from Maine through North Carolina harvested an estimated 174,839 pounds of chub mackerel (Table 2).

Over the past 20 years, commercial and recreational landings were less than half the 2020-2022 TAL of 4.50 million pounds in every year except 2013. During 2017-2021, commercial and recreational landings did not exceed 5% of the 2020-2022 TAL in any year (Table 2).

Table 2. Commercial and recreational chub mackerel landings, in pounds, 2002-2021, from Maine through North Carolina. Landings in some years are combined to protect confidential data associated with fewer than three vessels and/or dealers.

Year	Commercial landings	Recreational landings	Total landings
2002	471	0	471
2003	488,316	0	488,316
2004	126	0	126
2005	0	0	0
2006	0	0	0
2007-2009	21,039	0	21,039
2010-2011	192,301	1,613	193,914
2012	164,867	0	164,867
2013	5,249,686	0	5,249,686
2014	1,230,411	49,813	1,280,224
2015	2,108,337	0	2,108,337
2016	610,783	2,087	612,870
2017	2,202	13,310	15,512
2018	22,357	104,830	127,187
2019	60,522	49,892	110,414
2020	56,925	125,757	182,707
2021	37,371	137,468	174,839

Stock Status and Biological Reference Points

The stock status of chub mackerel in the western Atlantic Ocean is unknown as there have been no quantitative assessments of this species in this region. Since July 2018, the SSC has assumed that biomass is currently at or above biomass at maximum sustainable yield, as described in more detail in the following section.

Review of Prior SSC Recommendations

The SSC recommended the first chub mackerel ABC during their July 2018 meeting. They concluded that insufficient information exists to assess the status and trends of chub mackerel in the northwest Atlantic. They concluded that an overfishing limit could not be specified and recommended an ABC of 2,300 mt (5.07 million pounds) based on expert judgement. Their ABC recommendation is based loosely on the historic high for commercial and recreational landings (around 5.25 million pounds in 2013) and assumptions about discards. This level of ABC will prevent the fishery from achieving its historic high, but will allow landings to exceed those in every other year over at least the past 20 years (Table 2). The SSC agreed that this level of catch is unlikely to result in overfishing given the general productivity of this species in fisheries throughout the world combined with the relatively low fishery capacity in U.S. Atlantic waters. Based on their recommendations, the ABC applies to total dead catch (i.e., commercial and recreational landings and dead discards) from Maine through the east coast of Florida.

The SSC determined the following to be the most significant sources of scientific uncertainty associated with the ABC:

- Stock size and productivity cannot be determined, there is no information to determine reference points for stock biomass levels, and little information exists to determine reference points for fishing mortality rates.
- There is no information on the source of recruits; it is unknown whether chub mackerel are episodic in the Mid-Atlantic, whether this is a range expansion with localized spawning, or neither.
- There is no information on predation mortality, or on the role of chub mackerel in predator diets.
- There is very high uncertainty in recreational landings and discards. Observer coverage on fisheries likely to catch chub mackerel may be low (*Illex* fleet, Mid-Atlantic small mesh bottom trawl).

The SSC reviewed their recommendations in September 2020 and September 2021 and recommended no changes.

Annual Catch Limit

The ACL for chub mackerel is derived by subtracting expected catch in the South Atlantic (in this case, referring to South Carolina through the east coast of Florida) from the ABC (Figure 1). An 84,500 pound buffer for expected South Atlantic catch was used when setting the chub mackerel ACL for 2020-2022. This represents about 2% of the ABC and was intended to be a conservatively high estimate based on the highest annual South Atlantic landings shown in commercial dealer and Marine Recreational Information Program (MRIP) data (i.e., 76,835 pounds of landings in 2011, the vast majority of which were recreational landings), increased by about 10% to account for dead discards. Chub mackerel discards in the South Atlantic are highly uncertain.

When the Council first set this buffer in 2019, they considered data through 2017. Commercial and recreational fishery data through 2021 suggest that 84,500 pounds remains higher than past annual South Atlantic catch. For example, MRIP data for 2018-2021 show no estimated recreational chub mackerel catch from South Carolina through the east coast of Florida. Atlantic Coastal Cooperative Statistics Program data show commercial landings amounts that are confidential, but less than 250 pounds in total across 2018-2021 combined.

If the Monitoring Committee and Council wish to maintain the previous rationale and methodology for setting this buffer, then no changes are needed for 2023-2025 specifications. Therefore, if the SSC recommends a status quo ABC, staff recommend a status quo ACL of 4.99 million pounds (2,262 mt) for 2023-2025.

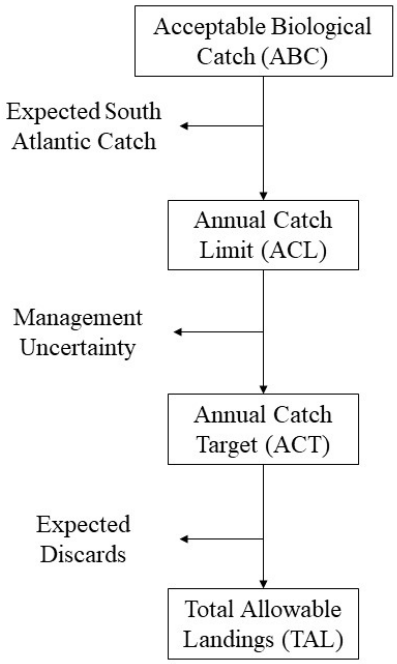

Figure 1. Flowchart summarizing chub mackerel catch and landings limits.

Annual Catch Target

As defined in the FMP, the ACT can be set less than or equal to the ACL to account for management uncertainty (Figure 1). The Council adopted a 4% management uncertainty buffer when they set the 2020-2022 specifications in March 2019. They did not recommend this buffer based on a quantitative methodology. This buffer was assumed to be sufficient to prevent ACL overages when used in combination with the in-season commercial fishery closure regulations described on the next page. Landings have remained well below the TAL. The 4% management uncertainty buffer has not proved to be constraining on the fishery as catch has been very low due to other factors (e.g., a focus on other commercial target species).

Council staff recommend a status quo management uncertainty buffer of 4%, resulting in a status quo ACT of 4.79 million pounds (2,171 mt) for 2023-2025, assuming the SSC recommends a status quo ABC.

Discards

Expected commercial and recreational discards in weight are subtracted from the ACT to derive the TAL (Figure 1). There are currently no expanded estimates of total chub mackerel commercial dead discards. MRIP provides estimates of recreational discards in numbers of fish.

When setting 2020-2022 specifications in March 2019, the Council agreed to reduce the ACT by 6% to account for expected discards. This was based on the commercial discard rate during 2003-2017 according to northeast observer data. The Council selected this as a preferred alternative because it was based on 15 years of data. It does not explicitly account for recreational data; however, based on information available at the time, the volume of recreational chub mackerel discards was assumed to be low compared to commercial discards, especially in years with targeted commercial fishing effort.

Observer data for 2021 are currently incomplete and preliminary; therefore, observer and vessel trip report (VTR) data through 2020 are shown in Table 3. The most recent 5 years of observer data show that 43% of total observed chub mackerel catch was discarded, considerably higher than the 6% assumed discard rate previously used to set specifications. As shown in Table 2, 2016-2020 were years with comparatively low commercial landings. As previously stated, the 2022 ABC is loosely based on the historic high for chub mackerel catch (2013). The average percentages over longer time periods are approximately 3% - 7%, depending on the time period and dataset (Table 3). After considering similar information in 2020 and 2021, the Monitoring Committee and Council did not recommend a change to the buffer between the ACT and the TAL to account for discards for 2021 or 2022 specifications.

Staff recommend a status quo TAL of 4.50 million pounds (2,041 mt) for 2023-2025.

Table 3. Percent of total commercial chub mackerel catch that was discarded, based on northeast fisheries observer and VTR data, 2007-2021, with associated number of trips.

Years	Observer Discard %	VTR Discard %
2006-2020 (15 years)	7% (337 trips)	3% (869 trips)
2011-2020 (10 years)	6% (301 trips)	3% (854 trips)
2016-2020 (5 years)	43% (193 trips)	4% (582 trips)
2013-2015 (top 3)	4% (95 trips)	3% (282 trips)
2013 (historic high)	3% (27 trips)	1% (63 trips)

Possession Limits

To date, the Council has not implemented a recreational chub mackerel possession limit. Specifications for 2020-2022 included no commercial possession limit until 90% of the TAL is projected to be landed. At that point, a 40,000 pound (18 mt) possession limit would be in effect. Once 100% of the TAL is projected to be landed, commercially permitted vessels would be limited to a 10,000 pound (4.5 mt) possession limit. When setting 2020-2022 specifications, the Council agreed that commercial fishery possession limits prior to in-season closure were unnecessary as the preferred in-season AMs were likely sufficient to constrain the fishery to prevent ACL overages. As previously stated, commercial and recreational landings, and presumably dead discards, have been well below the ACL, ACT, and TAL since they were first implemented in 2020.

According to stakeholder input provided during development of the Unmanaged Forage Omnibus Amendment, 40,000 pounds is approximately the amount of chub mackerel needed to fill a bait truck. Given the low value of chub mackerel (e.g., $0.53 per pound in 2021 dollars on

average during 2002-2021), fishermen may not target chub mackerel when restricted to a 40,000 pound possession limit; however, they would have an incentive to land chub mackerel caught incidentally. A 40,000 pound possession limit could, therefore, discourage discards. The number of trips which landed more than 40,000 pounds of chub mackerel over the past 20 years is confidential as it is associated with fewer than three vessels and/or dealers.

Ten thousand pounds was selected as the possession limit to be implemented in-season after the TAL is projected to be fully landed because it is approximately the average trip-level landings of chub mackerel based on northeast commercial fishery data for 1998-2017. Considering data for 2002-2021, about 90% of commercial trips which landed any amount of chub mackerel landed less than 10,000 pounds of chub mackerel.

As previously stated, if status quo specifications are implemented for 2023-2025, then the TAL would be 4.50 million pounds (2,041 mt). If the commercial possession limits remain unchanged, a commercial possession limit would be triggered once 4.05 million pounds (1,837 mt) of chub mackerel are projected to be landed by commercial and recreational fishermen. This level of landings has been reached only once over the past 20 years (i.e., in 2013, Table 2).

Council staff recommend no changes to the commercial or recreational chub mackerel possession limits.

Other Management Measures

There are no commercial or recreational minimum fish size limits for chub mackerel in federal waters. Minimum fish size limits are typically used to reduce fishing mortality on immature fish; however, a commercial minimum size limit for chub mackerel may provide little additional biological benefits considering current fishery selectivity. According to an analysis of observer data for Amendment 21, about 88% of the chub mackerel caught in bottom otter trawls are at least 20 cm in length. As suggested in Daley and Leaf (2019)[2] and supported by comments from fishermen, it is possible that chub mackerel's fast swimming speed reduces the potential for capture of larger individuals in the commercial fishery. Several scientific studies have documented the length at maturity for chub mackerel in various regions. The length at maturity varies by study. Daley (2018)[3] examined chub mackerel caught in commercial fisheries in the Mid-Atlantic and Southern New England and found that 50% of females reached maturity at about 27 cm. According to observer data, about 73% of the chub mackerel caught in bottom trawls are at least 27 cm.

Given that chub mackerel are predominantly caught with bottom otter trawls in commercial fisheries off the U.S. east coast, it can be assumed that most discarded chub mackerel would not survive. Therefore, a minimum fish size likely would increase mortality on this species without notable benefits of protecting immature fish.

Most chub mackerel landed on the U.S. east coast over the past 20 years were caught on bottom trawl vessels which also participate in the *Illex* squid fishery. Regulations for that fishery specify gear requirements (see 50 CFR 648.23), including gear restrictions for specific regulated mesh areas (50 CFR 648.80). The Council did not see a need to develop additional gear restrictions for

[2] Daley, T. T. and R. T. Leaf. 2019. Age and growth of Atlantic chub mackerel (*Scomber colias*) in the Northwest Atlantic. *Journal of Northwest Atlantic Fisheries Science.* 50: 1-12.

[3] Daley, T. 2018. Growth and reproduction of Atlantic chub mackerel (*Scomber colias*) in the Northwest Atlantic. Master's thesis. University of Southern Mississippi.

chub mackerel beyond what vessels are currently subject to in other fisheries. There are also no recreational gear restrictions for chub mackerel in federal waters.

Staff do not recommend that the Council implement new chub mackerel management measures such as minimum fish sizes, closed seasons, or gear restrictions for 2022-2025. These measures have not been used in the past and catch has remained well below the ABC.

Chub Mackerel Fishery Performance Report

April 2022

The Mid-Atlantic Fishery Management Council's (Council's) Mackerel, Squid, and Butterfish Advisory Panel met via webinar on April 26, 2022 to review the 2022 Chub Mackerel Fishery Information Document and develop the following Fishery Performance Report. The meeting also addressed longfin squid, but a separate report was generated for longfin squid.

The primary purpose of this Fishery Performance Report is to contextualize catch histories for the Scientific and Statistical Committee (SSC) by providing information about fishing effort, market trends, environmental changes, and other factors.

Eight advisors were in attendance. Two additional advisors with experience in the commercial chub mackerel fishery were not in attendance.

Advisor comments described below are not consensus or majority statements.

Advisory Panel members present: Katie Almeida, Greg DiDomenico, Daniel Farnham Jr., Emerson Hasbrouck, Jeff Kaelin, Pam Lyons Gromen, Samuel Martin, Gerry O'Neill

Others present: Carly Bari (GARFO), Julia Beaty (MAFMC staff), Alan Bianchi (NC DMF), Jason Didden (MAFMC staff), Michelle Duval (MAFMC member), Gavin Fay (SSC member), Damiana Hartley, Mark Holliday (SSC member), Peter Hughes (MAFMC MSB Committee Chair), Mary Beth Tooley

Discussion questions:

1. What factors have influenced recent catch (markets/economy, environment, regulations, other factors)?
2. Are the current fishery regulations appropriate? How could they be improved?
3. What would you recommend as research priorities?
4. What else is important for the Council to know?

Summary of Advisor Comments

Factors Influencing Catch

One advisor noted that the commercial fleet hasn't been targeting chub mackerel in recent years because they have been focusing on *Illex* squid.

One advisor suggested that the increasing recreational catch in recent years is due to increased prevalence in this region with warming waters. He added that south of the Gulf of Maine, recreational fishermen are more successful at catching chub mackerel than Atlantic mackerel.

Management Issues

Three advisors agreed that the concept of chub mackerel as an emerging fishery with climate change has been missing from Council management discussions. They agreed that the Council is being overly precautionary rather than prioritizing and supporting the development of sustainable

emerging fisheries which could bring economic benefits to the region. This mindset is preventing the Council from considering how fisheries can adapt to a changing environment.

Advisors did not recommend any changes to the catch and landings limits and other management measures for upcoming years. One advisor noted that the SSC will be asked to recommend acceptable biological catch levels for the upcoming three years. He said he hopes that three years from now we can have more information to make better informed decisions, especially in regards for the potential for the stock to support the fishery.

Research Recommendations

One advisor supported research on the range of the species, especially in regards to climate change, to help inform future management.

Chub Mackerel Fishery Information Document

April 2022

This document provides a brief overview of the biology, stock condition, management system, and fishery performance for Atlantic chub mackerel (*Scomber colias*) with an emphasis on the most recent few years. Data sources include commercial dealer reports, vessel trip reports (VTRs), and Marine Recreational Information Program (MRIP) data. All 2021 data should be considered preliminary. For more resources, including previous Fishery Information Documents, please visit https://www.mafmc.org/msb.

Key Facts

- The Mid-Atlantic Fishery Management Council developed the first management measures for Atlantic chub mackerel in U.S. waters. These measures became effective in 2017 and were modified in 2020.
- The stock status of chub mackerel in this region is unknown as there has been no quantitative stock assessment. The Scientific and Statistical Committee assumes that biomass is currently at a sustainable level.
- After spiking at 5.25 million pounds in 2013, commercial landings returned to low levels. In 2021, commercial fishermen landed 37,371 pounds of chub mackerel from Maine through North Carolina.
- It is estimated that recreational fishermen from Maine through North Carolina harvested 194,771 pounds of chub mackerel in 2021, the highest estimate in the MRIP time series (i.e., 1981 through present).

Basic Biology

Atlantic chub mackerel are a schooling pelagic species. They migrate seasonally and can be found throughout U.S. Atlantic waters in both inshore areas and to depths of about 250-300 meters.[1] Adults prefer temperatures of 15-20°C (about 60-70°F).[1,2] Some studies suggest that juveniles tend to be found closer inshore than adults.[3,4]

Atlantic chub mackerel grow rapidly during the first year of life.[2,3,5,6] They can reach at least age 13.[7] Daley and Leaf (2019) found that most fish sampled from commercial fishery catches off the northeast U.S. were age 3.[6]

Atlantic chub mackerel spawn in several batches. Spawning areas likely occur from North Carolina through the Gulf of Mexico.[8,9] Daley (2018) suggested that chub mackerel reach maturity around age two in the Northwest Atlantic, though other studies from various locations have published a range of ages at maturity.[3,9]

Chub mackerel are opportunistic predators with a seasonally variable diet of small crustaceans (especially copepods), small fish, and squid.[1,10] Adults tend to consume larger prey and more fish prey than juveniles.[4]

Very few quantitative estimates are available of the contribution of chub mackerel to the diets of predator species in the western North Atlantic. This is likely due in part to the difficulty of visually distinguishing partially-digested chub mackerel from related species such as Atlantic mackerel (*Scomber scomber*), bullet mackerel (*Auxis rochei*), and frigate mackerel (*Auxis thazard*).[11] The family Scombridae has been documented in the diets of some fish, marine mammals, sea birds, and sharks in the western North Atlantic.[12,13] However, few studies identify chub mackerel to the species level in the diets of any predators. A thorough literature review conducted by Council and NMFS staff in 2018 identified only one study with quantitative data on the role of chub mackerel in the diets of any predators off the U.S. east coast. [14] Manooch et al. (1984) found that chub mackerel made up 0.2% (by frequency of occurrence) of the diets of dolphinfish sampled off North Carolina through Texas.[15] Chub mackerel have been documented as prey for some predators in other parts of the world. For example, they are important prey for blue marlin at certain times of year off Portugal[16] and Cabo San Lucas.[17] They have also been documented as prey for Cory's shearwaters in the eastern North Atlantic, for long-beaked common dolphins off South Africa, and short-beaked common dolphins off the Iberian Peninsula.[18] It should be emphasized that diet composition of a predator species may vary by geography and can be flexible. Therefore, the importance of chub mackerel in the diets of predators in other parts of the world does not necessarily indicate its importance off the U.S. east coast. More diet information would be required to better establish this relationship.

To address this data gap, the Council funded a study with the goal of better delineating the role of chub mackerel in the diets of tunas and marlins, which were identified by stakeholders as predators of key interest. For this study, 758 non-empty stomachs from yellowfin and bigeye tunas were obtained from commercial and recreational fisheries, including recreational fishing tournaments, throughout the Mid-Atlantic and Southern New England, primarily in 2018 and 2019. Thirty-six white marlin and 17 blue marlin stomachs were also obtained. The marlin sample sizes were limited by regulations on landings. Chub mackerel were determined to be an exceptionally small component of the diets of tunas and marlins. Specifically, only two chub mackerel were identified in yellowfin tuna stomachs and seven chub mackerel were identified in two white marlin stomachs (Dr. Walt Golet, personal communication).

Status of the Stock

The stock status of chub mackerel in the western Atlantic Ocean is unknown as there have been no quantitative assessments of this species in this region. The SSC assumes that biomass is currently at or above biomass at maximum sustainable yield.[19]

Large fluctuations in abundance have been reported around the world, including in the mid-Atlantic and New England.[3, 20] These fluctuations may be partly the result of environmental influences such as temperature and upwelling strength on recruitment.[3] Given that chub mackerel are a fully pelagic species, ocean processes likely influence their availability in any given area, as well as their recruitment.

Management System and Fishery Performance

Management

The Mid-Atlantic Fishery Management Council manages Atlantic chub mackerel fisheries in federal waters from Maine through North Carolina. An increase in commercial landings during 2013-2015, as well as concerns about the potential role of chub mackerel as prey for tunas and

marlins, prompted the Council to adopt an annual commercial landings limit and a commercial possession limit for chub mackerel as part of the Unmanaged Forage Omnibus Amendment.[13] These measures were implemented in September 2017 and were the first regulations for chub mackerel fisheries off the U.S. east coast. They were intended to be temporary measures and were replaced by longer-term measures developed through Amendment 21 to the Mackerel, Squid, and Butterfish Fishery Management Plan, which became effective in September 2020.[21]

The Council's SSC recommends annual acceptable biological catch (ABC) limits for chub mackerel. The Council must either approve the ABC recommended by the SSC or approve a lower ABC. Total catch (i.e., commercial and recreational landings and dead discards) from Maine through the east coast of Florida count against the ABC. Expected South Carolina through Florida catch is subtracted from the ABC to derive the annual catch limit (ACL). An annual catch target (ACT) is set less than or equal to the ACL to account for management uncertainty. Expected dead discards are subtracted from the ACT to derive a total allowable landings limit (TAL). The commercial and recreational fisheries do not have separate annual catch or landings limits (Figure 1).

The catch and landings limits for 2020-2022 included an ABC of 5.07 million pounds, an ACL of 4.99 million pounds, an ACT of 4.79 million pounds, and a TAL of 4.50 million pounds. Catch and landings remained well below these limits in 2020-2021.

Although total catch from Maine through the east coast of Florida counts against the ABC, the ACL, ACT, and TAL apply to Maine through North Carolina. Based on past landings trends, the Council agreed that catch from South Carolina through Florida is immaterial to proper management. Therefore, commercial and recreational fisheries in South Carolina through Florida are not subject to the permit and possession limit requirements described below.

A commercial mackerel, squid, or butterfish fishing permit is required of vessels which retain chub mackerel for sale in federal waters from Maine through North Carolina. Ten permit types meet this requirement. The owner of any party or charter vessel that fishes for, possesses, or retains chub mackerel while carrying passengers for hire must have the federal mackerel/squid/butterfish for-hire permit. There is no federal permit type specific to Atlantic chub mackerel in either the commercial or recreational fisheries.

There is no commercial possession limit for chub mackerel until 90% of the TAL is projected to be landed. At that point, a 40,000 pound possession limit is in effect. Once 100% of the TAL is projected to be landed, commercially-permitted vessels are limited to a 10,000 pound possession limit. There are no federal waters recreational possession limits for chub mackerel.

There are no commercial or recreational gear restrictions, fish size requirements, or closed seasons for Atlantic chub mackerel in federal waters.

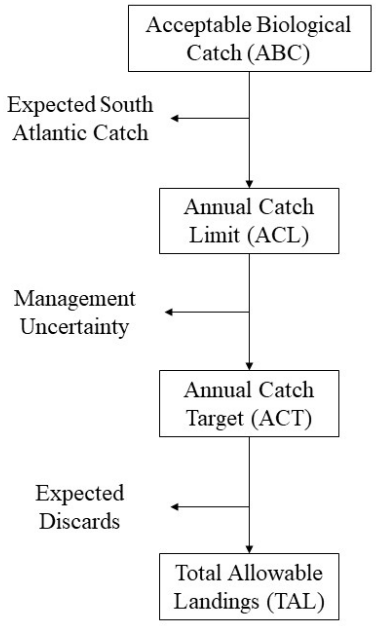

Figure 1. Flowchart summarizing chub mackerel catch and landings limits.

Commercial Fishery Trends

After remaining below 0.5 million pounds per year for several years, commercial chub mackerel landings spiked to 5.25 million pounds in 2013, but decreased to pre-2013 levels by 2016 (Table 1). [22] This temporary increase was the result of a small number of trawl vessels targeting chub mackerel. These vessels also participate in the *Illex* squid fishery. Some fishermen have described chub mackerel as a "bailout" species which they sometimes target when they are not able to harvest *Illex* squid. Chub mackerel tend to be harvested in the same areas and times of year when *Illex* squid are harvested; however, fishermen have said they typically will not harvest both species at the same time because the quality of both species suffers when they are stored together.

According to public comments, a small number of vessels on the east coast are capable of harvesting chub mackerel in profitable quantities because vessels need to be large, fast, and have refrigerated sea water or freezing capabilities in order to harvest this fast-swimming, low-value, warm water species. Landings data seem to support these statements.

Fewer than 5 vessels accounted for more than 95% of chub mackerel landings over the last 20 years (2002-2021). The chub mackerel landings from these vessels were sold to fewer than three dealers; therefore, much of the data associated with these vessels and dealers are confidential.[22]

At least 19 dealers across 6 states (MA, RI, CT, NY, NJ, VA) purchased at least 100 pounds of chub mackerel over the past 20 years combined (2002-2021), with only four dealers purchasing more than 10,000 pounds of chub mackerel. During this time period, an average of 10 vessels, with a maximum of 20 vessels, landed at least 100 pounds of chub mackerel per year from Maine through North Carolina.[22]

The annual average ex-vessel price per pound varied during 2002-2021, averaging $0.53 per pound (adjusted to 2021 dollars). There appears to be a relationship between price and volume

landed; however, this relationship is neither linear nor consistent across time. In general, years with higher landings had lower average annual prices per pound, and vice versa (Table 1).[22]

According to VTR data, about 91% of the chub mackerel landed by commercial fishermen from Maine through North Carolina from 2002 through 2021 were caught with bottom otter trawls. About 9% of landings were caught with midwater trawls. All other gear types collectively accounted for less than 1% of total landings.[23]

Nearly all commercial chub mackerel landings (about 97%) from Maine through North Carolina over the past 20 years occurred during June-October. The highest proportion of landings occurred in September (38%). June, July, August, and October contributed about equally to commercial landings (13-16%).[22]

According to VTR data, nearly all commercial chub mackerel landings from 2002-2021 originated from statistical areas south of New York. Much of these landings came from statistical areas which overlap with the shelf break (Figure 2).[23]

Public comments received during development of Amendment 21 suggest that most chub mackerel landed on the east coast are processed for use as human food, much of which is sent overseas, and lesser amounts are used as bait in other fisheries.

Table 1. Commercial chub mackerel landings, ex-vessel value, and average price per pound, Maine through North Carolina, 2002-2021. Value and price are adjusted to 2021 dollars using the Gross Domestic Product Price Deflator. Landings in some years are combined to protect confidential data representing fewer than 3 vessels and/or dealers.[22]

Year	Landings (pounds)	Ex-vessel value (2021 dollars)	Avg. price/pound (2021 dollars)
2002	471	$299	$0.64
2003	488,316	$34,988	$0.07
2004	126	$91	$0.72
2005	0	$0	--
2006	0	$0	--
2007-2009	21,039	$7,797	$0.37
2010-2011	192,301	$40,458	$0.21
2012	164,867	$74,391	$0.45
2013	5,249,686	$1,159,920	$0.22
2014	1,230,411	$381,446	$0.31
2015	2,108,337	$548,723	$0.26
2016	610,783	$113,672	$0.19
2017	2,202	$2,914	$1.32
2018	22,357	$12,214	$0.55
2019	60,522	$41,917	$0.69
2020	56,950	$30,829	$0.54
2021	37,371	$23,837	$0.64
2002-2021 avg.	512,287	$123,675	$0.53

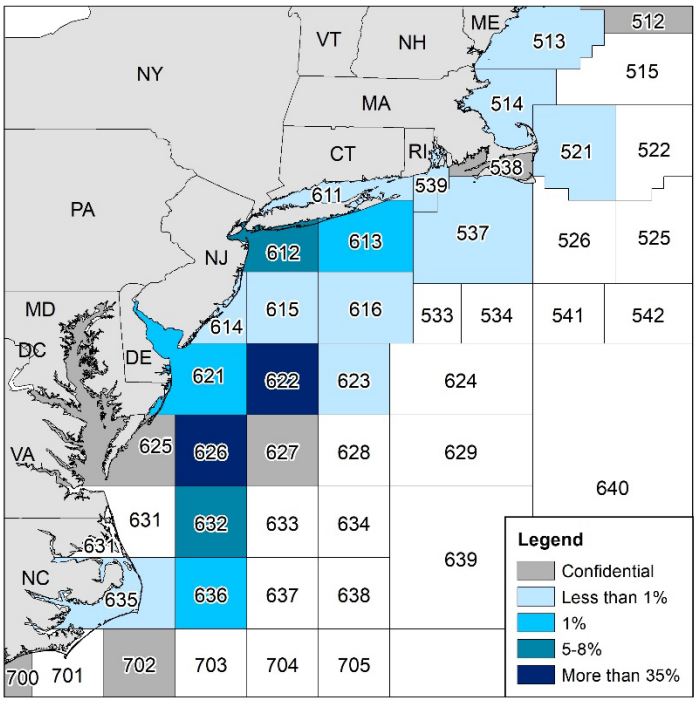

Figure 2. Percent of commercial chub mackerel landings by statistical area, 2002-2021 as shown in federal VTR data. Data associated with fewer than three vessels and/or dealers are confidential. Confidential landings collectively account for about 1% of the total.[23]

Recreational Fishery Trends

MRIP data from Maine through North Carolina show increasing recreational catch and harvest of chub mackerel nearly year from 2015 through 2021 (Table 2). In 2021, an estimated 215,631 chub mackerel were caught and 137,468 chub mackerel were harvested, corresponding to 194,771 pounds of harvested chub mackerel.[24]

The increasing recreational catch and harvest estimates in recent years could be due, at least in part, to improved reporting and improved differentiation between chub mackerel and other species which are similar in appearance, such as Atlantic mackerel. For example, in 2017 chub mackerel were added to the core list of species for trainings of MRIP field samplers from Maine through Virginia. In addition, the Council and partners at NMFS developed a small scombrid species identification guide and distributed over 3,700 copies to commercial and recreational permit holders and other interested stakeholders in 2019.[25]

MRIP data collection in 2020 was impacted by the COVID-19 pandemic. Specifically, the Access Point Angler Intercept Survey (APAIS), which serves as the basis for catch estimates in the shore based and private angler fishing modes, was suspended in all New England and Mid-Atlantic states in late March or April 2020 and resumed between May and August 2020, depending on the state. MRIP headboat sampling was also suspended in 2020 and resumed in 2021. NMFS used imputation methods to fill gaps in 2020 catch data with data collected in 2018 and 2019. These proxy data match the time, place, and fishing mode combinations that would have been sampled had the APAIS continued uninterrupted. Proxy data were combined with observed data to produce catch estimates using the standard estimation methodology.

It is not likely that the increase in recreational chub mackerel catch and harvest in 2020 is due to the use of imputed data as the imputed data match the 2018 and 2019 data. Any change from 2018 and 2019 would be due to changes in effort data (which are collected through mail and telephone surveys that were largely unimpacted by the pandemic) or due to changes during the locations and times of year that did not require use of imputed data.

During 2017-2021, about 56% of the recreational chub mackerel harvest from Maine through North Carolina (in numbers of fish) was caught in state waters, with the remaining 44% caught in federal waters. The proportion of harvest by mode averaged 57% from private and rental boats, 38% from party and charter boats, and 5% from shore (Table 3). Most recreational catch and harvest occurred in New York, Rhode Island, New Jersey, and Connecticut (Table 4). Most catch and harvest occurred during July and August (Table 5).[24]

Through development of Amendment 21, the Council heard anecdotal descriptions of recreational chub mackerel harvest, including reports of catch on for-hire vessels out of New York and New Jersey. There have also been reports of chub mackerel harvest for use as live bait on recreational trips out of Maryland and Virginia targeting white marlin, blue marlin, sailfish, spearfish, yellowfin tuna, bigeye tuna, and/or wahoo. According to public comments, this live bait fishery occurs on the edges of certain offshore canyons, especially Norfolk Canyon, where chub mackerel and their predators are concentrated in the late summer and early fall.[26]

Table 2. MRIP-estimated recreational catch and harvest of chub mackerel from Maine through North Carolina, 2002-2021.[24]

Year	Recreational catch (# of fish)	Recreational harvest (# of fish)	Recreational harvest (pounds)	% retained
2002-2010	0	0	0	--
2011	1,613	1,613	355	100%
2012	15,569	0	0	0%
2013	0	0	0	--
2014	60,191	49,813	48,087	83%
2015	0	0	0	--
2016	2,575	2,087	2,093	81%
2017	26,061	13,310	14,831	51%
2018	157,471	104,830	128,949	67%
2019	139,282	49,892	74,462	36%
2020*	199,919	125,757	149,578	63%
2021	215,631	137,468	194,771	64%
2017-2021 Avg.	**147,673**	**86,251**	**112,518**	**56%**

* Contribution of imputed data to total values for 2020: 19% for catch, 28% for harvest in numbers of fish, and 25% for harvest in pounds. This imputation method was only needed in 2020 due to COVID-related disruptions to the Access Point Angler Intercept Survey and subsequent data gaps.

Table 3. Chub mackerel harvest by recreational fishing mode in numbers of fish, 2002-2021, Maine through North Carolina.[24]

Year	Party/charter	Private/rental boat	Shore
2002-2010	0	0	0
2011	0	0	1,613
2012-2013	0	0	0
2014	49,813	0	0
2015	0	0	0
2016	1,889	198	0
2017	2,422	10,888	0
2018	43,424	58,817	2,589
2019	17,149	32,743	0
2020	35,901	70,676	19,180
2021	65,413	72,055	0
2017-2021 Avg.	**32,862 (38%)**	**49,036 (57%)**	**4,354 (5%)**

Table 4. Proportion of total chub mackerel catch and harvest in numbers of fish by state, 2017-2021. [24]

State	Recreational catch	Recreational harvest
ME	0%	0%
NH	3%	4%
MA	1%	0%
RI	30%	28%
CT	10%	8%
NY	40%	42%
NJ	17%	18%
DE	0%	0%
MD	Less than 1%	Less than 1%
VA	0%	0%
NC	0%	0%
Total	100%	100%

Table 5. Proportion of total chub mackerel catch and harvest in numbers of fish by wave, Maine through North Carolina, 2017-2021. Note that only North Carolina conducts MRIP sampling during wave 1.[24]

Wave	Catch	Harvest
1 (Jan-Feb)	0%	0%
2 (Mar-Apr)	0%	0%
3 (May-Jun)	3%	3%
4 (Jul-Aug)	55%	57%
5 (Sep-Oct)	42%	40%
6 (Nov-Dec)	0%	0%
Total	100%	100%

References

[1] Collette, B. B. and C. E. Nauen. 1983. FAO species catalogue. Vol. 2 Scombrids of the word: An annotated and illustrated catalogue of tunas, mackerels, bonitos, and related species known to date. Available at: http://www.fao.org/docrep/009/ac478e/ac478e00.htm

[2] Perrotta, R. G., M. D. Viñas, D. R. Hernandez, and L. Tringali. 2001. Temperature conditions in the Argentine chub mackerel (*Scomber japonicus*) fishing ground: implications for fishery management. *Fisheries Oceanography*. 10(3):275-283.

[3] Hernández, J. J. C. and A. T. S. Ortega. 2000. Synopsis of biological data on the chub mackerel (*Scomber japonicus* Houttuyn, 1782). FAO Fisheries Synopsis No. 157.

[4] Castro, J. J. 1993. Feeding ecology of chub mackerel *Scomber japonicus* in the Canary Islands area. *South African Journal of Marine Science.* 13(1): 323-328.

[5] Velasco, E. M., J. D. Arbol, J. Baro, and I. Sobrino. 2011. Age and growth of the Spanish chub mackerel *Scomber colias* off southern Spain: a comparison between samples from the NE Atlantic and the SW Mediterranean. *Revista de Biolgía Marina y Oceanografía.* 46(1):27-34.

[6] Daley, T. T. and R. T. Leaf. 2019. Age and growth of Atlantic chub mackerel (*Scomber colias*) in the Northwest Atlantic. *Journal of Northwest Atlantic Fisheries Science.* 50: 1-12.

[7] Carvalho, N., R. G. Perrotta, and E. Isidro. 2002. Age, growth and maturity in the chub mackerel (*Scomber japonicus* Houttuyn, 1782) from the Azores. *Arquipélago Life and Marine Sciences.* 19A: 93-99.

[8] Houde, E. D., S. A. Berkeley, J. J. Klinovsky, and C.E. Dowd. 1976. Ichthyoplankton survey data report: summary of egg and larvae data used to determine abundance of clupeid fishes in the eastern Gulf of Mexico. University of Miami Sea Grant Technical Bulletin Number 32. Available at: https://repository.library.noaa.gov/view/noaa/10888

Houde, E. D., J. C. Leak, C. E. Dowd, S. A. Berkeley, and W. J. Richards. 1979. Ichthyoplankton abundance and diversity in the eastern Gulf of Mexico - a report to the Bureau of Land Management prepared under contract number AA550-CT7-28. Available at: https://www.boem.gov/ESPIS/3/4042.pdf

Berrien, P. L. 1978. Eggs and larvae of *Scomber scombrus* and *Scomber japonicus* in continental shelf waters between Massachusetts and Florida. *Fishery Bulletin.* 76(1):95-115.

Richardson, D. E., J. K. Llopiz, C. M. Guignard, and R. K. Cowen. 2010. Larval assemblages of large and medium-sized pelagic species in the Straits of Florida. *Progress in Oceanography*. 86(2010):8-20.

Southeast Area Monitoring and Assessment Program (SEAMAP) larval survey catches from 1983-2014.

[9] Daley, T. 2018. Growth and reproduction of Atlantic chub mackerel (*Scomber colias*) in the Northwest Atlantic. Master's thesis. University of Southern Mississippi.

[10] Castro, J. J. and A. S. Del Pino. 1995. Feeding preferences of *Scomber japonicus* in the Canary Islands area. *Scientia Marina*. 59(3-4):352-333.

Sever, T. M., B. Bayhan, M. Bilecenoglu, and S. Mavili. 2006. Diet composition of the juvenile chub mackerel (*Scomber japonicus*) in the Aegean Sea (Izmir Bay, Turkey). *Journal of Applied Ichthyology*. 22(2006):145-148.

[11] Paine, M. A., J. R. McDowell, and J. E. Graves. 2007. Specific identification of western Atlantic Ocean scombrids using mitochondrial DNA cytochrome C oxidase subunit I (COI) gene region sequences. *Bulletin of Marine Science.* 80(2):353-367.

Personal communication with John Graves, Virginia Institute of Marine Science; Steve Poland, N.C. Division of Marine Fisheries, and Michelle Staudinger, University of Massachusetts Amherst.

[12] Montevecchi, W. A. and Myers, R. A. 1997. Centurial and decadal oceanographic influences on changes in northern gannet populations and diets in the north-west Atlantic: implications for climate change. *ICES Journal of Marine Science*. 54: 608–614.

Smith, L. A., J. S. Link, S. X. Cadrin, and D. L. Palka. 2015. Consumption by marine mammals on the Northeast U.S. continental shelf. *Ecological Applications.* 25(5):373-389.

Staudinger, M.D., K. E. Mills, K. Stamieszkin, N. R. Record, C. A. Hudak, A. Allyn, A. Diamond, K. D. Friedland, W. Golet, Me. E. Henderson, C. M. Hernandez, T. G. Huntington, R. Ji, C. L. Johnson, D. S. Johnson, A. Jordaan, J. Kocik, Y. Li, M. Liebman, O. W. Nichols, D. Pendelton, R. A. Richards, T. Robben, A. C. Thomas, H. J. Walson, and K. Yakola. 2019. It's about time: a synthesis of changing phenology in the Gulf of Maine ecosystem. *Fisheries Oceanography*: 1-34. Available at: https://doi.org/10.1111/fog.12429

Personal communication, Nancy Kohler, NEFSC.

[13] Unmanaged Forage Omnibus Amendment. Available at: http://www.mafmc.org/actions/unmanaged-forage

[14] Chub mackerel literature review available at: http://www.mafmc.org/s/12_Chub_lit_review_July2018.pdf

[15] Manooch, C. S., D. L. Mason, and R. S. Nelson. 1984. Food and gastrointestinal parasites of dolphin *Coryphaena hippurus* collected along the southeastern and Gulf Coasts of the United States. *Bulletin of the Japanese Society of Scientific Fisheries.* 509(9):1151-1525.

[16] Veiga, P., J. C. Xavier, C. A. Assis, and K. Erzini. 2011. Diet of the blue marlin, *Makaira nigricans*, off the south coast of Portugal. *Marine Biology Research*. 7:820-825.

[17] Abitia-Cardenas, L. A., F. Galvan-Magaña, F. J. Gutierrez-Sanches, J. Rodriquez-Romero, B. Aguilar-Palomino, and A. Moehl-Hitz. 1999. Diet of blue marlin *Makaira mazara* off the coast of Cabo San Lucas, Baja California Sur, Mexico. *Fisheries Research.* 44(1999):95-100.

[18] Alonso, H, J. P. Granadeiro, V. H. Paiva, A. S. Dias, J. A. Ramos, and P. Catry. 2012. Parent-offspring dietary segregation of Cory's shearwaters breeding in contrasting environments. *Marine Biology*. 159 (2012): 1197-1207.

Alonso, H, J. P. Granadeiro, M. P. Dias, T. Catry, and P. Catry. 2018. Fine-scale tracking and diet information of a marine predator reveals the origin and contrasting spatial distribution of prey. *Progress in Oceanography*. 162 (2018): 1-12.

Ambrose, S. T, P. W. Froneman, M. J. Smale, G. Cliff, and S. Plön. 2013. Winter diet shift of long-beaked common dolphins (*Delphinus capensis*) feeding in the sardine run off KwaZulu-Natal, South Africa. *Marine Biology*. 160 (2013): 1543-1561.

Granaderio, J. P., L. R. Monterio, and R. W. Furness. 1998. Diet and feeding ecology of Cory's shearwater *Calonectris diomedea* in the Azores, north-east Atlantic. *Marine Ecology Progress Series.* 166 (1998): 267-276.

Marçalo, A., L. Nicolau, J. Giménez, M. Ferreira, J. Santos, H. Araújo, A. Silva, J. Vingada, and G. J. Pierce. 2018. Feeding ecology of the common dolphin (*Delphinus delphis*) in western Iberian waters: has the decline in sardine (*Sardina pilchardus*) affected dolphin diet? *Marine Biology*. 165 (2018): 44.

[19] Report of the July 2018 SSC meeting. Available at: http://www.mafmc.org/ssc

[20] Goode, G. B. 1884. The food fishes of the U.S. part 3: natural history of useful aquatic animals. In: *The Fisheries and Fishery Industries of the United States.* U.S. Government Printing Office. Washington, D.C. Available at: http://celebrating200years.noaa.gov/rarebooks/fisheries/welcome.html

[21] More information on the Chub Mackerel Amendment (Amendment 21 to the Mackerel, Squid, and Butterfish Fishery Management Plan) is available at: https://www.mafmc.org/actions/chub-mackerel-amendment.

[22] Unpublished NMFS commercial fish dealer data (i.e., "DERS"), which include both state and federal dealer data).

[23] Data from commercial vessel trip reports submitted to the NMFS Greater Atlantic Regional Fisheries Office.

[24] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Accessed April 2022. Available at: https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index

[25] Digital copies of the small scombrid ID guide are available at: https://www.mafmc.org/actions/chub-mackerel-amendment (scroll down to "Related Resources"). Waterproof hard copies may be obtained by contacting Council staff at 302-674-2331 or contact@mafmc.org.

[26] Summary of November 9, 2017 webinar on chub mackerel in HMS diets. Available at: http://www.mafmc.org/actions/chub-mackerel-amendment