



Mid-Atlantic Fishery Management Council
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Michael P. Luisi, Chairman | P. Weston Townsend, Vice Chairman
Christopher M. Moore, Ph.D., Executive Director

MEMORANDUM

Date: July 29, 2021
To: Council
From: J. Didden, Staff
Subject: Mackerel Agenda Items

Atlantic Mackerel

The purposes of this portion of the Council meeting are to consider requesting emergency action for mackerel and begin a framework to revise mackerel rebuilding.

Materials included to support the Council are listed below. Underlined page numbers in the bottom right hand corner represent a running total for this briefing tab.

- 1) Monitoring Committee Summary (July 26, 2021) (p3)
- 2) Staff Memo on Mackerel Rebuilding (July 29, 2021) (p7)
- 3) Report of the July 2021 SSC Meeting – See Committee Reports Tab
- 4) Staff Recommendations to SSC Memo (July 13, 2021) (p11)
- 5) MSB Advisory Panel Mackerel Fishery Performance Report (July 2021) (p15)
- 6) Mackerel Fishery Information Document (July 2021) (p19)
- 7) Northwest Atlantic Mackerel 2021 Management Track Assessment Report (June 2021) (p29)
- 8) Correspondence (p45)



MSB Monitoring Committee Meeting Summary

July 26, 2021

Webinar

The Mid-Atlantic Fishery Management Council's (Council) Mackerel, Squid, and Butterfish (MSB) Monitoring Committee met on July 26, 2021 at 10 am. The purpose of this meeting was to develop recommendations related to Atlantic mackerel management.

MSB Monitoring Committee Attendees: Jason Didden, Kiersten Curti, Daniel Hocking, and Chuck Adams.

Other Attendees: Jeff Kaelin, Alissa Wilson, Greg DiDomenico, Katie Almeida, Zach Greenberg, Zoe Goozner, Eric Reid, James Fletcher, Meghan Lapp, and Mary Sabo.

Atlantic Mackerel

Jason Didden described the Scientific and Statistical Committee's (SSC's) recommendations regarding mackerel. The Monitoring Committee discussion focused on the potential to take emergency action¹ for reducing and/or ending overfishing in 2021 and 2022 while a new rebuilding plan is developed – the SSC also provided initial input regarding rebuilding considerations, which is considered by staff in a separate memo. There appear to be two primary options for quick emergency action, each with some pros and cons discussed below. NMFS Greater Atlantic Regional Fisheries Office (GARFO) staff previously indicated that for an emergency action the Council is not necessarily limited to the SSC's catch recommendation, but the best scientific information available must support that the emergency action would reduce overfishing. Staff will be looking to confirm several procedural details with GARFO before the August 6, 2021 Mackerel, Squid, and Butterfish (MSB) Committee and Advisory Panel meeting. Since recreational measures have not been previously contemplated, their use would slow down any emergency action, but are likely needed for rebuilding options.

Emergency Action Option 1

Use the SSC's recommended catch of 8,760 MT, which was based on a catch of 23,184 Metric Tons (MT) in 2021 and application of a P* (tolerated risk of overfishing) of 0.4 (40%) in 2022. The SSC recommended minimizing additional catch in 2021, but made the assumption that the 2021 ABC will be caught so as to not underestimate 2021 catch and avoid setting rebuilding back further.

The primary pro with this option is that once implemented, this catch will have a 60% probability of ending overfishing even if 2021 catch was 23,184 MT, and is based on a recruitment assumption reflective of recruitment during the last ten years. These two

¹ Emergency actions are generally effective for six months and may be extended for an additional six months.

assumptions were recommended by the SSC and maximize that chance that the short-term projections are not overly optimistic in their projected rebuilding of SSB. After the Canadian quota (2021's 4,000 MT used) and recreational catch (3,503 MT is the 2015-2019 average) are accounted for, the Commercial Allocation would be 1,257 MT. With the current 3% management uncertainty buffer and a 98 MT discard set-aside (average MT 2015-2019), the commercial quota (DAH) would be 1,121 MT. Currently the directed fishery closes at 90% of the DAH so directed fishing would likely close after 1-2 weeks of fishing in 2022. Performance in terms of the discard assumption and incidental or smaller directed catches after a closure would be somewhat uncertain, but catch would likely be substantially reduced with this approach, thus reducing if not eliminating overfishing.

The primary con with this approach is uncertainty in timing. This approach would be outside the bounds of the existing Environmental Assessment (EA), and likely require the creation of an unplanned EA by GARFO staff, who are already fully occupied with existing priorities (including working with staff on the *Illex* permit EA). If even typical timing issues caused implementation to slide into the 2022 fishery (generally January 1-April 1) the existing quota of 17,312 MT would prevail until changed, potentially continuing substantial overfishing when combined with recreational and Canadian catch. If this option could be implemented before substantial fishing occurred in 2022, then this option would likely have the most beneficial impact on the mackerel stock because it would result in the lowest DAH for the 2022 winter U.S. fishery (late season catches from 2010-2019 October-December landings ranged from 28 MT - 4,520 MT so late 2021 landings might not be that high even if this option is not implemented until January 2022). Council staff plans to confirm the likely implementation timing of this option with GARFO before the August meeting.

Emergency Action Option 2

In the last EA for mackerel specifications, the lowest U.S. ABC considered was 9,456 MT (10,000 MT was deducted for Canada based on the Canadian quota at that time) and resulted in a U.S. commercial quota of 7,911 MT. If both this U.S. commercial quota (7,911 MT) and the current Canadian quota (4,000 MT) are fully caught in 2021 and the U.S. recreational catch equals the 5-year average of 3,503 MT, total 2021 removals would be 15,512 MT (also includes 98 MT of commercial discards). Compared to catch of 23,184 MT with the U.S. ABC and lower Canadian landings, a catch of 15,512 MT would substantially reduce fishing mortality by over a third to around 0.3, versus 0.48, assuming the recruitment scenario recommended by the SSC. The con with this option is that once implemented, overfishing would only be reduced, not eliminated or reduced as much as in Option 1. The pro is that if the existing EA can be utilized to streamline the NEPA process, the likelihood of achieving rapid implementation before substantial additional fishing occurs is higher (staff requesting additional GARFO input about the likely timeline). If catch was limited to 15,512 MT in 2021/2022, while overfishing would occur, stock biomass would still be predicted to slightly increase.

Public Comments:

Greg DiDomenico: What would happen if under these scenarios there was much higher than expected recreational catch? Staff: Post-season accounting is handled by GARFO, and it is not clear to staff how that accounting and paybacks would work if operating under an emergency

rule – staff will ask GARFO. How similar is mackerel situation to bluefish situation – we appear to be waiting for recruitment with both, that may never appear...? Staff reviewed bluefish assessment versus mackerel assessment, and noted that we are in different places in terms of process – bluefish is initiating rebuilding while mackerel is reacting to likely lack of progress over first several years of rebuilding.

Jeff Kaelin: Monitoring Committee and Council should consider that limited rebuilding occurs even with no catch (F_0). Staff reviewed that with no catch, and the recent/lower recruitment, the stock is projected to rebuild in eight years, i.e. in 2030. With some moderate background catch however (7,500 MT from Canada and recreational), the stock would not rebuild in 10 years with the recent/lower recruitment. The question of whether low recruitment is tied to environmental conditions or stock size or both is not known.

Staff Recommendation:

The Monitoring Committee did not have a particular recommendation between the two options other than highlighting the various pros and cons. Staff considered the two options discussed by the Monitoring Committee. If an abbreviated NEPA process can be utilized, then Option 2 may be the better option as it would have a higher chance of being implemented in time to avoid substantial overfishing in late 2021 or early 2022. If GARFO was completely sure that a new EA could be created and measures implemented by January 2022, then Option 1 would be better for the mackerel stock because it has a greater probability of eliminating overfishing in 2022 and results in a lower quota during the primary U.S. fishery that occurs in January-April. The impacts on fishing communities would also be higher with Option 1. **Given staff's understanding of current workload and timing issues, Option 2 is recommended at this time.** GARFO should have additional information on the NEPA process details by the August 6, 2021 MSB Committee Meeting.



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

MEMORANDUM

Date: July 29, 2021
To: Dr. Chris Moore, Executive Director
From: J. Didden, Staff
Subject: Mackerel Rebuilding, Framework Meeting 1

Atlantic Mackerel Rebuilding

Key Points

-The mackerel stock has not responded as predicted and recommendations from the SSC indicate changes are needed relative to rebuilding. The timeline for final action depends on resolving several key questions (see below) but could potentially be as early as October or December 2021.

-Recruitment has been low in recent years; projections indicate continued low recruitment will make it very challenging to rebuild to reference points that are based on higher recruitment, unless nearly zero catch occurs. Impacts on fishery participants could involve nearly a complete loss of mackerel revenues for the duration of the rebuilding period.

-Unless higher recruitment occurs, the fishery will not produce the Maximum Sustainable Yield (MSY) as estimated in the Management Track Assessment (which used a longer time series with a higher median recruitment). If low recruitment persists, the stock is projected to be able to make it to the biomass target, but sustained catches at or near MSY would cause the stock to decline since the MSY value is predicated on higher recruitment. Use of lower recruitment in calculating reference points would make it easier to rebuild on paper, but the MSY yields would be substantially less.

-The SSC noted that given the patterns in recruitment, a longer rebuilding timeline is likely needed.

The Magnuson-Stevens Act (MSA) states that rebuilding shall:

i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and

- (ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;
- (B) allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery...

Given the recent trends in catch, abundance, recruitment, and SSC input, staff suggests the following range options for a new rebuilding plan:

1. Confirm with GARFO staff that because mackerel would be predicted to rebuild in 8 years with no fishing, neither the low recruitment situation nor the inability to control Canadian catch could qualify mackerel for a *longer than 10-year* rebuilding plan. Assuming not, staff suggests basing a reset of the rebuilding plan on 10-years, starting in 2022.
2. Request that the range of alternatives be developed in collaboration with NMFS and the SSC such that the expected probability of rebuilding within 10-years be either 50%, 60%, or 75%. A quick survey by staff of recent rebuilding plans suggests this range would cover approaches previously used by the Mid-Atlantic Fishery Management Council and/or other Councils (though rebuilding probabilities greater than 50% appear in some cases to be weakly quantified).
3. Request that the SSC provide a recommendation on what the “Best Scientific Information Available” would be for assumed recruitment used in rebuilding projections in order to most closely achieve the targeted probabilities of rebuilding identified by the Council. Also request that the SSC provide a recommendation on how long a change in recruitment should persist before a regime change is apparent (and when reference points should be updated).
4. Include measures for all sectors to meet the rebuilding fairness requirements of the MSA.

As with the initial rebuilding plan, additional mid-course adjustments are likely. Given the high variability seen in mackerel recruitment, the probability of being precisely on any projected rebuilding trajectory is likely low – it is more likely that the stock will be substantially below or above the anticipated rebuilding trajectory after several years.

The river herring and shad cap for the mackerel fishery would be set when specifications stemming from the rebuilding plan are set. Unless directed otherwise, staff would add alternatives that take a similar approach as the current cap.

The SSC Report is
behind Tab 14.



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MEMORANDUM

Date: July 13, 2021
To: C. Moore
From: J. Didden
Subject: Mackerel Rebuilding Modification/Re-assessment and Potential Emergency Action; SSC Meeting

Atlantic Mackerel

The current mackerel Acceptable Biological Catch (ABC) of 29,184 metric tons (MT), is based on the projected catch in the first year (2019) of a rebuilding program designed to rebuild mackerel in 2023. Catches in 2020 and 2021 were originally slated to increase above 29,184 MT given the projected increases in biomass. These projections were predicated on a strong 2015 year class and typical year classes subsequently. At its May 2019 meeting, the SSC considered results from the 2019 Canadian Atlantic mackerel assessment, which indicated lower than expected recruitment in 2016-2018. The SSC determined that it would not be appropriate to recommend the planned higher ABCs with 2016-2018 recruitment levels likely lower than anticipated (i.e. lower than typical). Instead, in 2019 the SSC recommended maintaining the 29,184 MT ABC, and in 2020 endorsed the same ABC for 2021-2022 pending the 2021 mackerel management track assessment.

The 2018 stock assessment (2016 terminal year) and the 2021 assessment (2019 terminal year) both estimate that the mackerel stock reached a low point around 2012-2014 at around 8%-9% of the biomass target at that time¹. They both found that by their respective terminal years, the stock had increased to 22% and 24% of the biomass target. However, the 2018 assessment and associated projection methods estimated that more substantial stock rebuilding would have occurred by 2019 given the observed catches. The current estimates and trends indicate that rebuilding is very unlikely by the original target (2023) though staff notes that almost none of the data in the new assessment occurred while a rebuilding plan was in effect (since November 29, 2019). Potential causes of the apparent trends appear to be continued lower than typical recruitment, and changes in maturity and/or weight at age.

Several projections conducted for the current SSC meeting demonstrate the sensitivity of stock trajectory to recruitment. Using a lower recruitment draw for projections from 2009-on compared

¹ This would have led to a complete fishery closure based on the Council's risk policy that states the P* (probability of overfishing) should = 0 (i.e. catch = zero) when stock biomass is at or less than 10% the target.

to 1975-on reduces recruitment by almost a quarter. While 5-year average catch (18,419 MT) is predicted to rebuild in about 5 years (2022-2027) with the higher recruitment, at the lower recruitment with the same catch, the stock would be predicted to be only at 39% of the biomass target after 10 years (2022-2032). This creates a conundrum for setting future rebuilding catches, as assuming the higher recruitment may not be reflective of current conditions, but assuming lower recruitment makes it very difficult to achieve a target biomass that is itself based on the higher recruitment.

According to the most recent Canadian stock assessment conducted in 2021, Atlantic mackerel (in its 2020 terminal year of data) was “in the critical zone” (at about 58% of the limit reference point — the stock level below which productivity of the resource is sufficiently impaired to cause serious harm), with limited chance for rebuilding in the near future.²

Staff notes that stock-wide total mackerel catches have been relatively stable from 2011-2019, ranging from about 14,200 MT to 22,300 and that fishing mortality has decreased substantially over that time period as biomass has apparently more than doubled (a 148% increase). If A) Canada catches its 4,000 MT quota in 2021 (which seems likely), B) the U.S. commercial fishery performs similarly to last year from this point in time and ends around 6,000 MT for 2021, and C) the U.S. recreational fishery catches its recent five year average (about 3,500 MT), then the total 2021 catch would be about 13,500 MT³. This would be lower than any catch in the entire time series and would be closer to ending overfishing according to the assessment projections. The lowest catch in the time series occurred in 2015, 14,185 MT.

Given the observed apparent stock growth (at lower stock sizes) since 2011 with similar or higher catches, and pending the outcome of the SSC meeting, staff is considering recommending that as a rebuilding plan is modified or re-assessed, the Council request A) for NMFS to take emergency action to close the commercial mackerel fishery when landings are expected to reach 95% of 6,685 MT [14,185 MT (lowest time series catch) - 4,000 MT (Canadian quota) - 3,500 MT (expected U.S. Recreational catch) = 6,685 MT] and also B) close federal waters to harvest of mackerel by recreational fishermen. The 2018-2019 precision estimates of recreationally-harvested mackerel in federal waters were reasonable (Proportional Standard Error below 30%) and indicated federal waters (which the Council can affect) accounted for 10%-13% of harvest by weight. The Magnuson-Stevens Act requires that rebuilding harvest restrictions or recovery benefits be allocated fairly and equitably among sectors, so some impact on the recreational sector would appear warranted (U.S. recreational catch accounted for 28% of U.S. mackerel catch in 2019). These measures could likely be in effect until additional action regarding rebuilding is implemented, i.e. for part of the remainder of 2021 and initially for 2022.

Such an action, if catch was limited to around 14,185 MT, would further reduce fishing mortality to nearer to the overfishing reference point (regardless of the assumed recruitment scenario). Based

² <https://www.gazette.gc.ca/rp-pr/p2/2021/2021-05-26/html/sor-dors100-eng.html> When available, the Canadian assessment will be posted, and a draft may be available for the SSC members before the meeting.

³ It has also been estimated by Canadian DFO Science that there could be between 2,000 and 5,000 metric tons of unreported catches per year, which includes fishing mortality from various sources, notably recreational and some unreported commercial (including bait) harvests, discards and other mortalities. (see footnote 1 link above) These potential catches have not been included in any assessments.

on observations since 2011 and approximating from the available projections, some rebuilding would still be expected at this catch from 2020 to 2021 and again from 2021 to 2022 even if realized recruitment is the median of the more recent, lower time series. Under the lower recruitment scenario, catches of 23,184 MT in 2021 (current ABCs/quotas) and 18,419 MT (5-year average recent catch) in 2022 (41,603 MT combined) are projected to reduce biomass from 2020 to 2022 by 5% (but still be 34% above 2019), while Fmsy catches of 11,622 MT in 2021 and 12,762 in 2022 (24,384 MT combined) are projected to increase biomass from 2020 to 2022 by 18% (and be 66% above 2019). Catches of 28,370 MT (two times 14,185 MT) would be substantially closer to the lower (i.e. Fmsy) of the above-referenced projections, so some additional stock growth would be expected at annual catches of 14,185 MT (staff hopes that the NEFSC can run a projection for 14,185 MT to confirm). Staff notes that recruitment was estimated to actually have been above the lower assumed median amount in 4 out of the last 5 years.

Staff hopes that additional projections are available for the SSC meeting that can be considered and used to craft advice for the Council as further action on mackerel rebuilding is considered. These should include the standard P* calculations based on the Council's risk policy even though the risk policy to use P* is likely not binding for 2021-2022 given the Council's previous decision to base decisions on a rebuilding fishing mortality for 2019-2023. At the same time however, the recent assessment would appear to preclude continued implementation of the existing rebuilding fishing mortality (it would constitute overfishing). Accordingly, SSC recommendations for 2021 and initially 2022 may be better conceptualized as interim fishing level recommendations rather than traditional ABCs. A framework action (meeting #1) is scheduled for the August Council meeting (preceded by a joint MSB Committee and Advisory Panel meeting), and additional projections can be requested based on discussions/recommendations by the SSC, MSB Committee, MSB Advisory Panel, and Council for SSC review and rebuilding recommendations in September prior to Council action in October. For example, Council staff has asked NEFSC staff if assumed recruitment could be stepped from the lower to higher time series medians over 10 years, to build in some caution at the beginning, but acknowledge that to really get to a normal rebuilt stock you have to have normal recruitment (by definition, the current biomass and catch reference points could not be maintained without typical recruitment).

Given the divergence from P* was specific to the original rebuilding plan initiation, if the Council wants the next rebuilding time series to also have higher catches than P*, a similar risk policy modification would need to be included (the base risk policy dictates choosing the lower of a rebuilding F catch or a P*-derived catch). This was an intentional design of the rebuilding plan, so that divergence from P* would have to be directly considered in each instance. While not yet available when this document was written, it is anticipated that, P*-derived catches would likely be very low, possibly below just the combined anticipated Canadian and recreational catch, especially if the more recent, lower recruitment time series is used.

While the above-proposed course of action is a relatively rapid response, it is in line with the spirit of the Council's original rebuilding plan, which stated "...we also expect that a 2020 mackerel stock assessment update will be available to provide relatively quick feedback on initial rebuilding results."



Atlantic Mackerel Fishery Performance Report July 2021

The Mid-Atlantic Fishery Management Council's (Council) Mackerel-Squid-Butterfish (MSB) Advisory Panel (AP) met via webinar on July 7, 2021 to review an Atlantic mackerel Fishery Information Document and develop the following Fishery Performance Report. The primary purpose of the 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. The trigger questions below were posed to the AP to generate discussion. The AP was also asked about preliminary thoughts on potential rebuilding modifications given the recent mackerel assessment. Please note: The AP comments described below are not necessarily consensus or majority statements.

Advisory Panel members present: Jeff Kaelin, Sam Martin, Emerson Hasbrouck, Daniel J Farnham, G. Lovgren, Gerry O' Neill, Katie Almeida, Pam Lyons Gromen, Zack Greenberg, Greg DiDomenico, and Meghan Lapp.

Others present: Jason Didden, Doug Christel, Aly Pitts, Dave Secor, David Stormer, Alissa Wilson, Paul Rago, and Mark Holliday.

Trigger questions:

1. What factors have influenced recent catch (markets, environment, regulations, etc.)?
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?

1.1 General

Concern was voiced that shifting thermal habitat suitability is impacting the distribution and/or productivity of MSB species, and needs to be taken into account by assessments/management.

There is concern that assessments will be hurt if surveys are limited by wind development.

Concern was voiced about the potential effects of data gaps (surveys, observer, etc.) due to COVID-19.

Tariffs affect prices and profitability, and therefore trade. If a buyer is in China, that buyer may try to negotiate price based on what they know they will have to absorb in tariffs.

The costs of importing/exporting containers from/to overseas has increased (doubled in cases) and will likely be a factor going forward for quite some time.

1.2 Mackerel

Market/Economic Conditions

In 2020 spring fish disappeared before COVID-19 effects were substantially affecting fishing. 2021 landings would also have been impacted by uncertainty around Covid – all fisheries have been fragile and participants have worked to ensure the market is not flooded by multiple vessels landing at one time.

There are two very different markets – fresh and frozen. Export demand has been fairly steady. The fresh market has been more negatively impacted by Covid.

Given low herring quotas, prices may have been somewhat elevated just to keep boats going.

Environmental Conditions

See point above in general section about shifting thermal habitat. Mackerel availability continues to be highly variable and hard to predict year to year.

Management Issues

The RH/S cap had substantial negative impacts on the mackerel fishery in 2018/2019. There are discrepancies between New England and the Mid-Atlantic that can hamstring the mackerel fishery (especially given it's a high-volume fishery), while substantial RH/S cap remains in the Atlantic herring fishery.¹

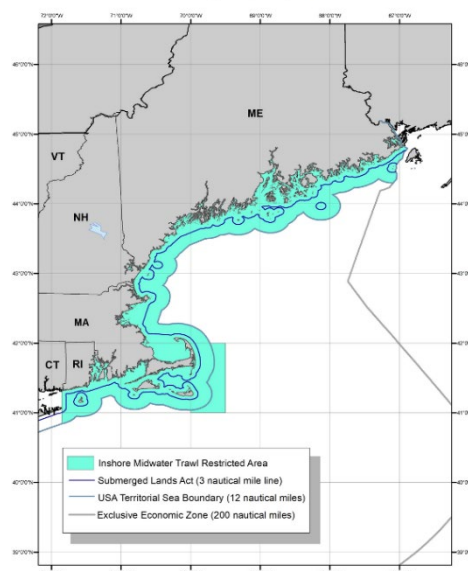
Fall 2020 – lack of Atlantic herring RSA restricts northern late-season mackerel landings in areas 3/1a.

New England's 12-mile line has been affecting landings since implementation – impacted 2021 and will impact future years. The effective limit is substantially more than 12 miles in some places.

¹ Recall Council discussion of this in February 2021

Inshore Midwater Trawl Restricted Area

This map includes the Inshore Midwater Trawl Restricted Area from Amendment 8 of the Herring Fishery Management Plan, 2/16/2021.



The Atlantic Herring fishery has become a choke-species for the Atlantic mackerel fishery.

In early 2020, the fishery collaborated to avoid RH/S and also luckily encountered mackerel further north early with observers onboard to benefit the cap estimates and give the fishery a chance (the previous year's ratio is used in a transition method until enough new trips are observed, so the fishery can potentially be shut down based on the previous year's data).

Cornell still has its real-time avoidance program through the squid-trawl network but has been slowed in last year due to Covid and switch away from BoatTracs.

Other Issues

AP members requested more info on trends in the relatively recent jig fishery.

More information on the Canadian fishery/assessment/quota decisions would be helpful.

We are under a current rebuilding plan that is not likely to succeed, if we are heading to a new rebuilding plan, the Council should be aware of current events such as Canadian assessment and quota cut (8,000 MT to 4,000 MT).

The current status of mackerel remains overfished. Focusing on biomass alone (and not age structure) may be short-sighted in terms of overall rebuilding and resiliency.

Paul Rago asked: Is there a preference for particular rebuilding time series – e.g. constant catch, lower then higher catch, etc.

There was some preference voiced for a constant-catch scenario. There was some preference voiced for rebuilding that starts with low F rates, especially considering ecosystem/food web interactions.

Performance at Fzero may be necessary to evaluate value in cutting quotas. It doesn't seem likely that much would improve with no catch, so need to consider extending rebuilding timeframe.

The lack of ability to control recreational catch needs to be considered in any rebuilding action.

Research Priorities

Related to RH/S – ASMFC partnered with USGS on RH/S genetic repository – see ASMFC webpage. Relates to trying to get to biological-based RH/S caps – they will need samples from the relevant fisheries (including mackerel) and the Council should encourage submission of relevant samples.

Council staff will re-distribute the MSB research priorities in case there are additional suggestions.



Atlantic Mackerel Fishery Information Document

July 2021

This Fishery Information Document provides a brief overview of the biology, stock condition, management system, and fishery performance for Atlantic mackerel (“mackerel” hereafter), with an emphasis on 2020. Data sources for Fishery Information Documents include unpublished National Marine Fisheries Service (NMFS) survey, dealer, vessel trip report (VTR), permit, and Marine Recreational Information Program (MRIP) databases and should be considered preliminary. For more resources, including previous Fishery Information Documents, please visit <http://www.mafmc.org/msb>.

Key Facts

- Mackerel began a rebuilding program on November 29, 2019, which was designed to rebuild the stock by 2023.
- Compared to the previous assessment, the Spawning Stock Biomass (SSB) in 2016 (the terminal year from that previous assessment), was revised downward by 29% in the new (still draft) 2021 Management Track Assessment (MTA).
- The new MTA indicated that SSB increased 39% from 2016 to 2019. The SSB in 2019 is estimated to be 24% of the updated biomass target. Overfishing was still occurring through 2019 and was 108% greater than the overfishing proxy. Rebuilding by 2023 appears very unlikely.
- SSB is estimated to have increased 180% from 2014 (the time series minimum) to 2019.
- The 2017 recruitment estimate was the lowest in the time series and recruitment has been below the long term median since 2008 except for one year (the 2015 year class).
- In the new MTA, the estimated proxy for Maximum Sustainable Yield declined by 17% (to 34,103 metric tons (MT) annually) compared to the previous assessment.
- The new MTA’s conclusions are consistent with the 2021 Canadian assessment.
- The SSB estimates from the range-wide egg survey, a key index in the assessment, reached a minimum in 2010 and have been below the median since 2005.
- The fishery was not constrained by the river herring and shad (RH/S) cap in 2020, and ended the year at about 46% of the commercial quota.
- 2019 and 2020 catches were below even the most conservative rebuilding option (with the lowest 2019-2020 catch limits), so regardless of which rebuilding plan the Council had selected, the current findings would have persisted.

Basic Biology

Mackerel is a semi-pelagic/semi-demersal (may be found near the bottom or higher in the water column) schooling species primarily distributed between Labrador (Newfoundland, Canada) and North Carolina. The stock is considered to comprise two spawning contingents: a northern contingent spawning primarily in the southern Gulf of St. Lawrence and a southern contingent spawning in the Mid-Atlantic Bight, Southern New England and the western Gulf of Maine. The two contingents mix during winter months on the Northeast U.S. shelf. The Canadian fishery likely primarily catches the northern contingent while the U.S. fishery likely catches both contingents.

Mackerel spawning occurs during spring and summer and progresses from south to north as surface waters warm. Atlantic mackerel are serial, or batch spawners. Eggs are pelagic. Post-larvae gradually transform from planktonic to swimming and schooling behavior at about 30-50 mm. Almost all fish are mature by age 3 in most years. Age 2 maturity appears to vary between around 50% to nearly 100%. Atlantic mackerel are opportunistic feeders that can ingest prey either by individual selection of prey organisms or by passive filter feeding. See <https://www.nefsc.noaa.gov/nefsc/habitat/efh/> for more life history information.

Status of the Stock

Based on the 2018 assessment (NEFSC 2018, available at <http://www.mafmc.org/ssc-meetings/2018/may-8-9>), the mackerel stock was declared overfished, with overfishing occurring in 2016 (the last year of data in the assessment). A 2021 management track assessment (MTA) indicates that while trends since 2014 are positive, the stock is only 24% of the biomass rebuilding target. The productivity of the stock appears to have declined. In the recent MTA, the estimated proxy for Maximum Sustainable Yield declined by 17% to 34,103 metric tons (MT) compared to the previous assessment. Past assessments (which used different methods and data) appear to have been overly optimistic about the stock's productivity.¹

Management System and Fishery Performance

Management

The Mid-Atlantic Fishery Management Council (the Council or MAFMC) established management of mackerel in 1978 and the management unit includes all federal East Coast waters. Expected Canadian landings are deducted from the total Acceptable Biological Catch (ABC) that is recommended by the Council's Scientific and Statistical Committee (SSC).

Access is limited with several tiers having different trip limits. Stricter trip limits are triggered when the quota is approached. Additional summary regulatory information is available at <https://www.fisheries.noaa.gov/region/new-england-mid-atlantic>.

¹ Referencing 1997 Federal Register publications, the 1997 mackerel allowable biological **catch** was specified about **ten times higher than** what we now think the **total SSB** was in that year.

At its May 2019 meeting, the SSC considered preliminary results from the 2019 Canadian Atlantic mackerel assessment, which indicated lower than expected recruitment in 2016-2018. The SSC determined that it would not be appropriate to recommend the original higher 2020 rebuilding ABC level based on recruitment levels in 2016-2018 that may be lower than those anticipated in the rebuilding plan. Instead, the SSC recommended maintaining the ABC for 2020 at the level established for 2019 (ABC = 29,184 mt). In 2020 the SSC endorsed maintenance of the existing ABC for 2021-2022 (2022 interim), pending the findings of the above-referenced MTA.

Fisheries

Figure 1 describes mackerel catches (all known sources) 1960-2019. Figures 2-3 describe domestic landings, ex-vessel revenues (nominal), and prices (inflation adjusted) since 1996. Figures 4-5 illustrate preliminary landings throughout the year for 2019-2021.

Table 1 describes 2020 Mackerel landings by state, and Table 2 describes 2020 Mackerel landings by gear type. Figures 6/7 describe the location of 2018/2019 mackerel landings.

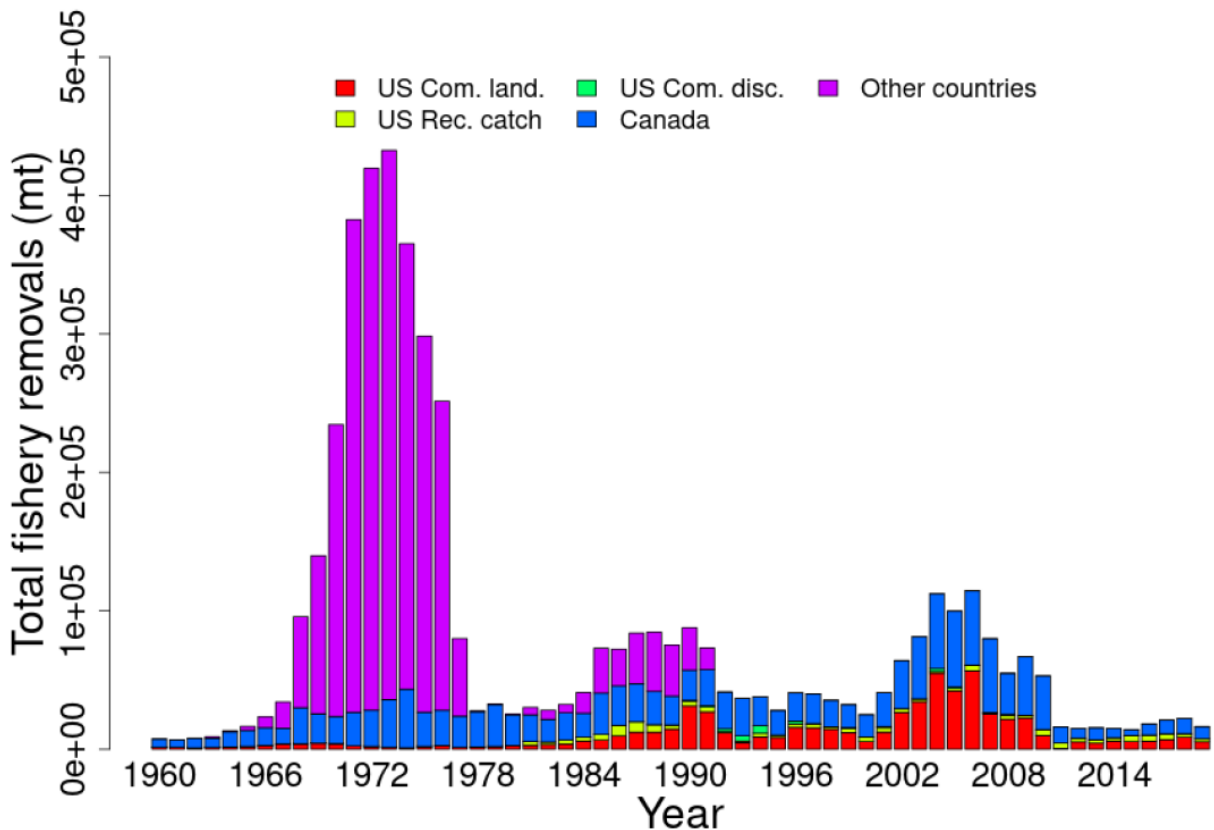


Figure 1. Total catch of northwest Atlantic mackerel between 1960 and 2019 by all known sources. U.S. recreational catch represents recreational landings plus discards, Canada represents Canadian landings (discards are not available), and other countries represents landings by all other countries.

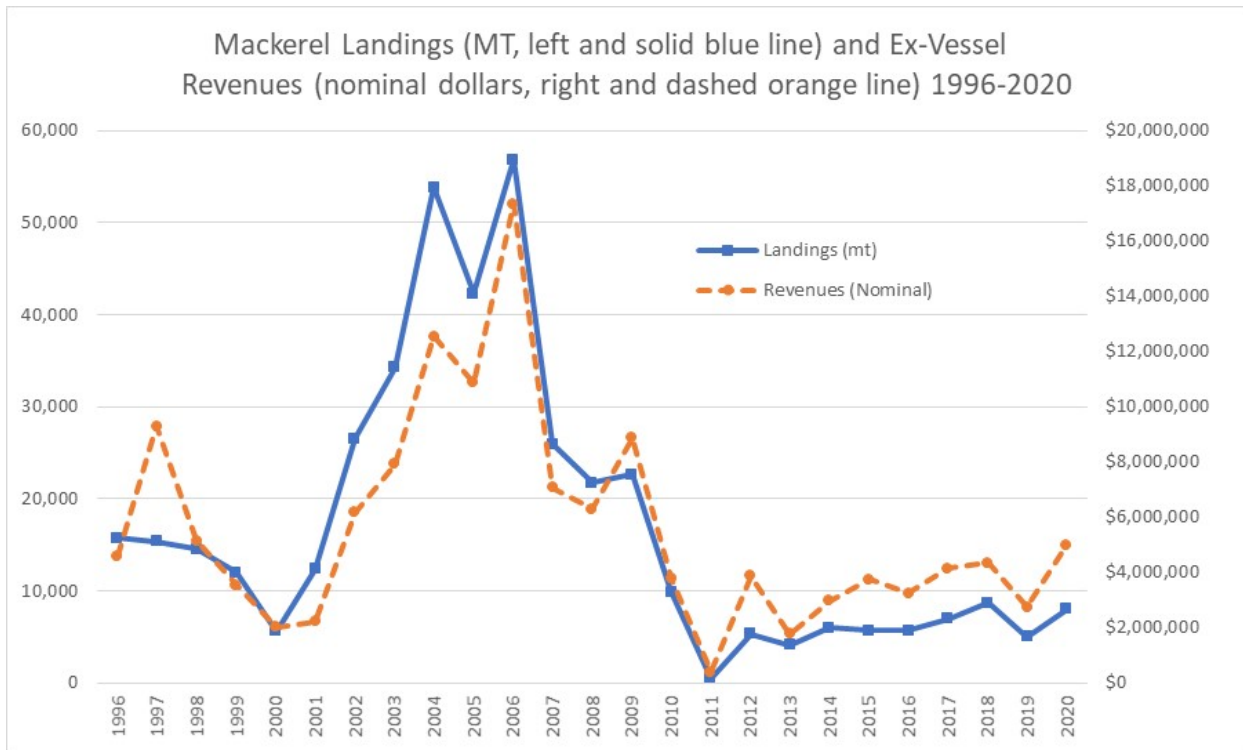


Figure 2. U.S. Mackerel Landings and Nominal Mackerel Ex-Vessel Values 1996-2020. Source: NMFS unpublished dealer data.

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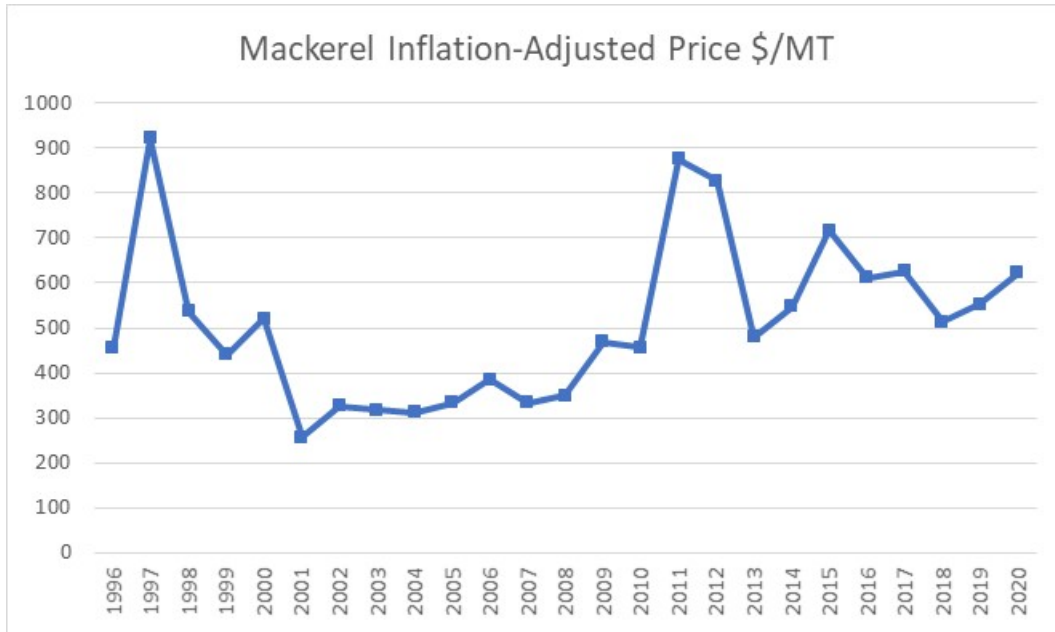


Figure 3. Ex-Vessel Mackerel Prices 1996-2020 Adjusted to 2020 Dollars Source: NMFS unpublished dealer data.

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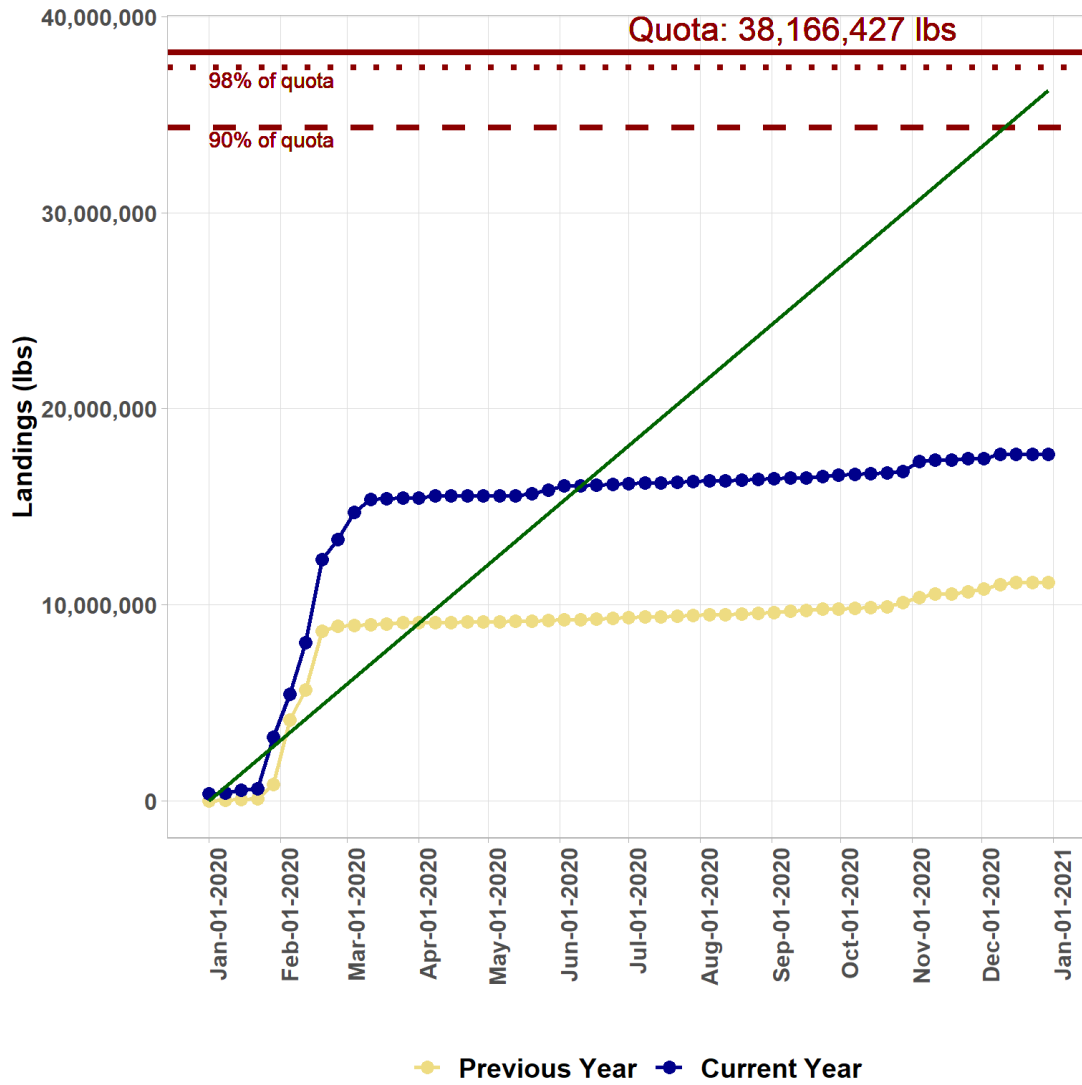


Figure 4. U.S. Preliminary Mackerel landings; 2020 in blue, 2019 in yellow-orange. Source: <https://www.fisheries.noaa.gov/new-england-mid-atlantic/commercial-fishing/quota-monitoring-greater-atlantic-region>.

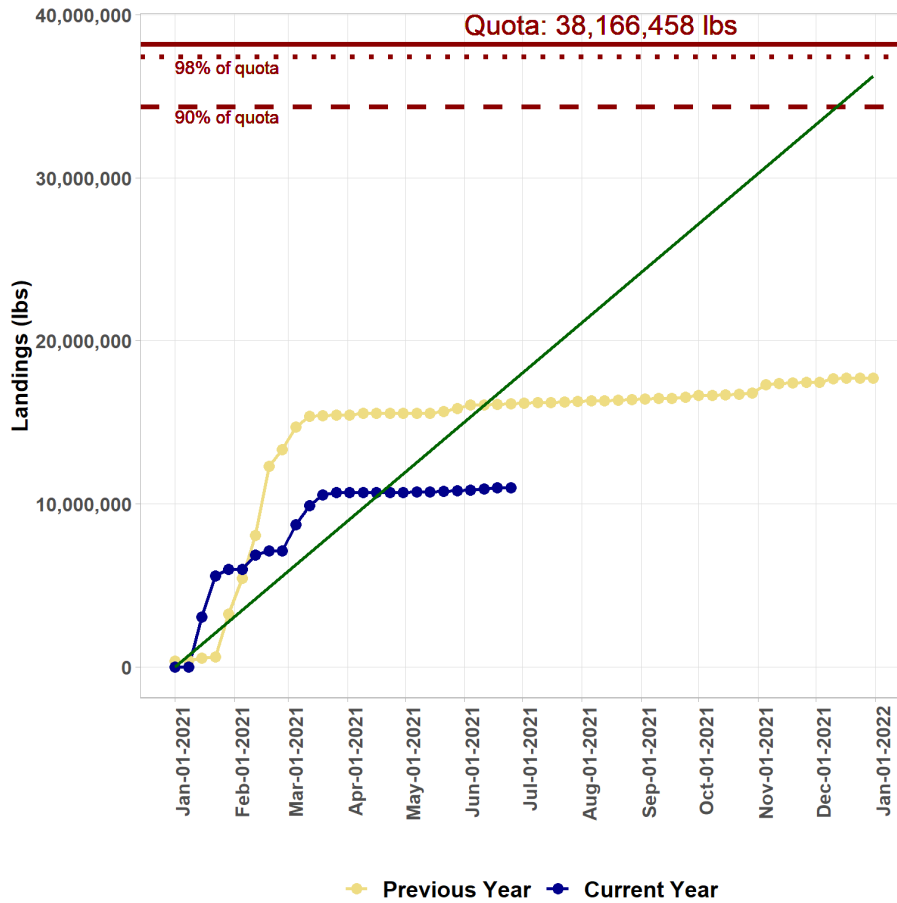


Figure 5. U.S. Preliminary Mackerel landings; 2021 in blue, 2020 in yellow-orange. Source: <https://www.fisheries.noaa.gov/new-england-mid-atlantic/commercial-fishing/quota-monitoring-greater-atlantic-region>.

Table 1. Commercial Mackerel landings (live weight) by state in 2020. Source: NMFS unpublished dealer data.

State	Metric_Tons
MA	3,991
NJ	2,412
RI	1,171
ME	436
Other	29
Total	8,039

Table 2. Commercial Mackerel landings (live weight) by gear in 2020. Source: NMFS unpublished dealer data.

GEAR	gmt
TRAWL, OTTER, BOTTOM, FISH	3,151
TRAWL, OTTER, MIDWATER	2,440
TRAWL, OTTER, MIDWATER PAIRED	1,369
PURSE SEINE, OTHER	408
LOONGLINE, BOTTOM	251
Other	420
Total	8,039

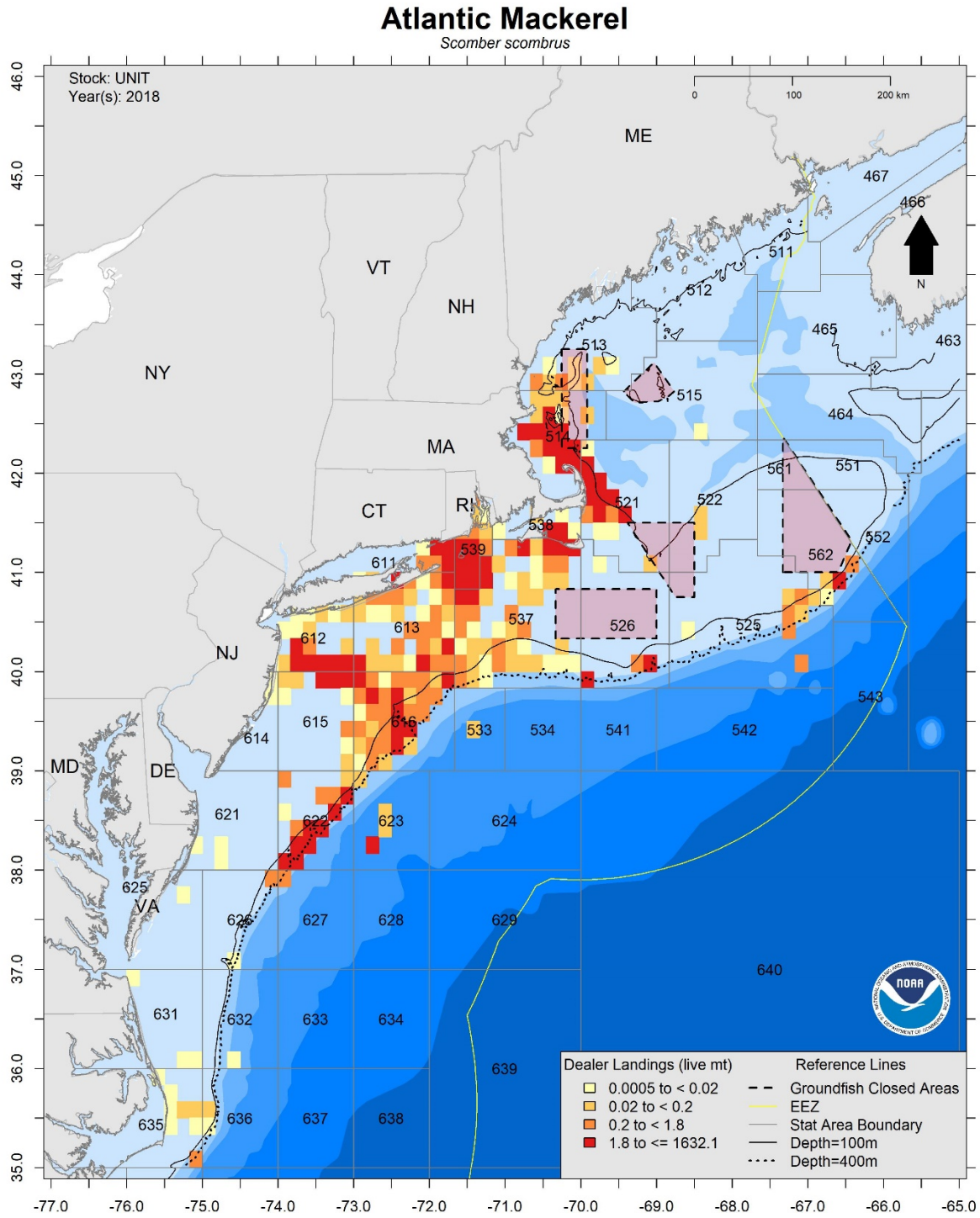


Figure 6. Approximate Primary 2018 Mackerel Catch Locations (from dealer and VTR data)

Atlantic Mackerel

Scomber scombrus

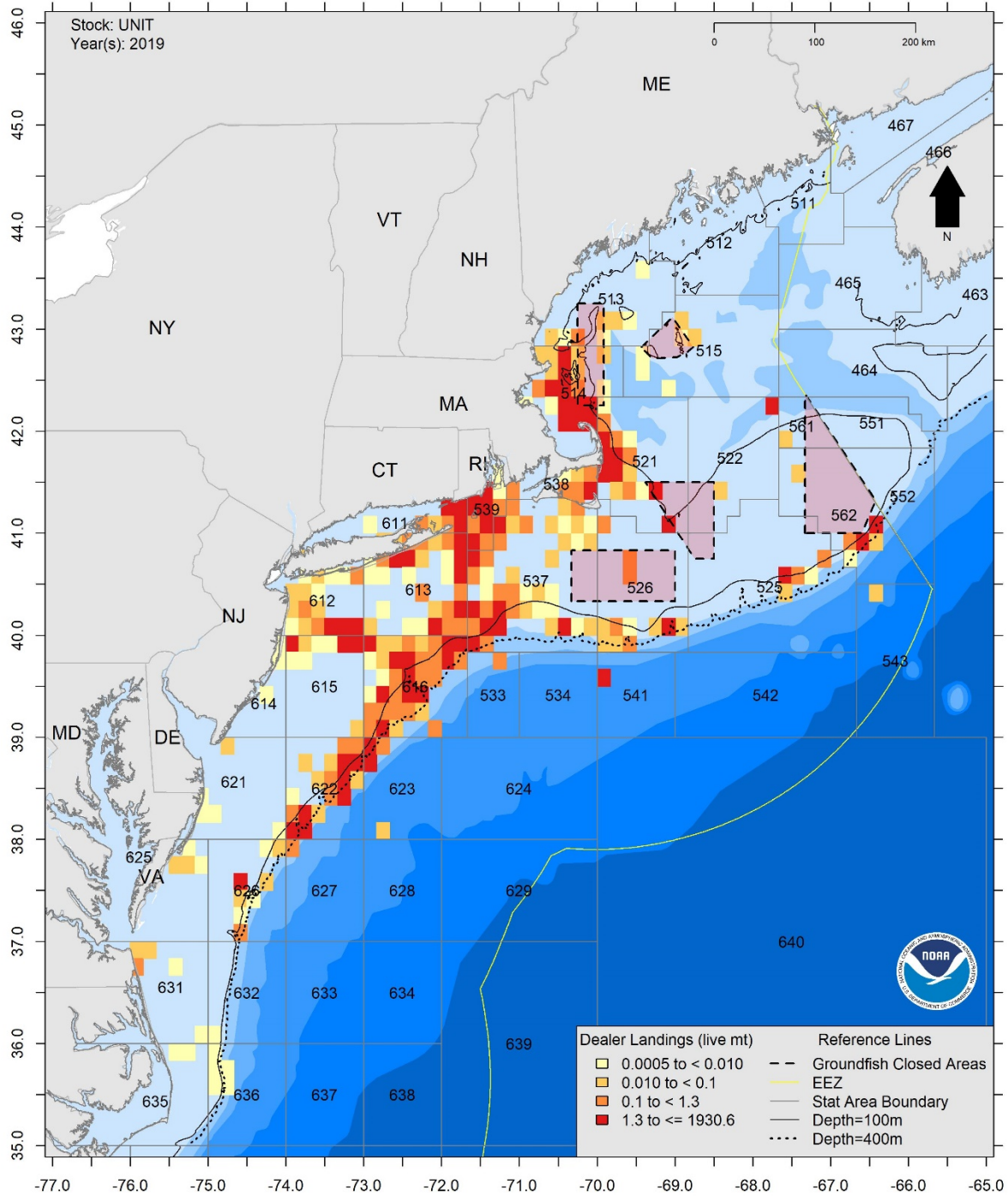
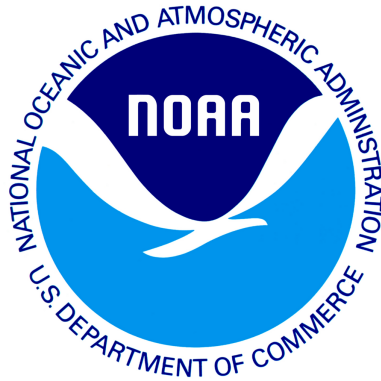


Figure 7. Approximate Primary 2019 Mackerel Catch Locations (from dealer and VTR data)

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draft working paper for peer review only



Northwest Atlantic mackerel

2021 Management Track Assessment Report

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

Compiled June 2021

This assessment of the northwest Atlantic mackerel (*Scomber scombrus*) stock is a level 2 management track assessment of the existing 2017 benchmark assessment (NEFSC 2018). Based on the previous assessment, the stock was overfished and overfishing was occurring. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, the analytical ASAP assessment model and reference points through 2019. Additionally, stock projections have been updated through 2023.

State of Stock: Based on this management track assessment, the northwest Atlantic mackerel (*Scomber scombrus*) stock is overfished and overfishing is occurring (Figures 1-2). Retrospective patterns were minor and retrospective adjustments for terminal year estimates were not needed. Spawning stock biomass (SSB) in 2019 was estimated to be 42,862 (mt), corresponding to 24% of the biomass target ($SSB_{MSY} proxy = 181,090$; Figure 1). The 2019 fully selected fishing mortality was estimated to be 0.458, corresponding to 208% of the overfishing threshold proxy ($F_{MSY} proxy = 0.22$; Figure 2).

Table 1: Catch and status table for northwest Atlantic mackerel. All weights are in (mt), recruitment is in (000s), and F represents the fishing mortality on fully selected ages (ages 6+). Model results are from the current ASAP assessment updated through 2019.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	<i>Data</i>									
US commercial landings	9,877	533	5,333	4,372	5,905	5,616	5,687	6,975	8,717	5,379
US recreational catch	4,288	4,040	2,670	2,406	2,296	4,274	4,569	4,161	2,394	2,117
US commercial discards	97	38	33	20	51	13	18	83	177	200
Canada	38,701	11,508	6,849	8,675	6,680	4,281	8,057	9,786	10,964	8,626
Other countries	0	0	0	0	0	0	0	0	0	0
Total catch	52,962	16,118	14,885	15,473	14,932	14,185	18,331	21,005	22,252	16,322
	<i>Model Results</i>									
Spawning Stock Biomass	24,412	17,317	17,018	17,877	15,319	20,266	30,870	40,190	47,554	42,862
F	2.151	1.248	1.424	1.27	1.194	1.081	0.82	0.638	0.576	0.458
Recruits (age1)	27,537	128,850	90,792	40,653	87,113	147,315	387,668	25,474	145,584	135,882

Table 2: Comparison of reference points estimated in the previous assessment (2017) and from the current management track assessment. An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections.

	2017	2021
$F_{40\%}$	0.26	0.22
$SSB_{MSY} proxy$ (mt)	196894	181090 (102292 - 386653)
MSY proxy (mt)	41334	34103 (19404 - 70927)
Median recruits (age 1) (000s)	180,572	178,743
<i>Overfishing</i>	Yes	Yes
<i>Overfished</i>	Yes	Yes

Projections: Short-term projections were derived by sampling from a cumulative distribution function of recruitment estimates from 1975 onward from the final ASAP model. Additional short-term projections were completed using recruitment estimates from 1999 and 2009 onward, and are presented in the supplementary material as sensitivity analyses. The annual fishery selectivity, maturity ogive, and mean weights-at-age used in the projections represent the most recent 5-year averages.

Table 3: Short-term projections of total fishery catch and spawning stock biomass for northwest Atlantic mackerel based on a harvest scenario of fishing at F_{MSY} proxy between 2022 and 2023. The primary U.S. commercial mackerel fishery in 2020 occurred before the COVID pandemic began and discards represent a small proportion of total catch; therefore, the preliminary 2020 total catch estimate of 18,038 (mt) was used in projections.. Catch in 2021 is assumed as the sum of the U.S. ABC and the Candian quota (23,184 (mt)).

Year	Catch (mt)	SSB (mt)	F
2020	18038	62039 (27791 - 120790)	0.366
Year	Catch (mt)	SSB (mt)	F
2021	23184	70137 (29523 - 140000)	0.412
2022	14881	84382 (38079 - 188330)	0.22
2023	18596	103970 (52807 - 261522)	0.22

Special Comments:

- Sources of uncertainty:

Natural mortality was assumed to be constant over both time and age. During the 2017 benchmark, the working group acknowledged that natural mortality likely varied over time, but concluded that the percent occurrence of mackerel in the diets of those predators well sampled by the NEFSC bottom trawl surveys was not sufficient to inform time-varying natural mortality rates. In addition, estimates of predation mortality were not available for the months the northern contingent was outside of the NEFSC trawl survey area. The working group also discussed the possibility of modeling natural mortality as age-varying, though time-invariant. However, recent work on the performance of assessment models across varying assumed natural mortality rates indicated that an assumed age-invariant natural mortality that approximates the average natural mortality across ages performed similarly to age-varying natural mortality values (Deroba and Schueller 2013). Accordingly, the working group moved forward with the assumption that natural mortality was constant across all ages and years. To consider evidence of different natural mortality rates, a likelihood profile for natural mortality was completed and is included in the supplementary material.

Canadian catch estimates represent a subset of total Canadian catch because bait fishery, recreational fishery and commercial discard estimates are not available.

To create a range-wide egg index, SSB estimates from Canada’s dedicated egg survey and the U.S.’s ecosystem surveys are used. However, GSI estimates are not available for the southern contingent because the primary U.S. fishery does not overlap with the spawning season and the seasonal bottom trawl surveys occur before or after the spawning season. Consequently, an average spawning seasonality function was used to calculate annual egg production. Similarly, due to a lack of fecundity estimates for the southern contingent, annual fecundity estimates from the Gulf of St. Lawrence were used to calculate spawning stock biomass from annual egg production. Efforts are currently underway to collect spawning mackerel from both contingents to provide updated fecundity estimates.

- Retrospective analysis (a major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}):

The 5-year Mohn’s ρ , relative to SSB, was 0.162 in the 2017 assessment and 0.326 in 2019. The 5-year Mohn’s ρ , relative to F, was 0.112 in the 2017 assessment and -0.093 in 2019. The retrospective pattern for this assessment was considered to be minor because the ρ -adjusted estimates of 2019 SSB ($SSB_{\rho}=32323$) and 2019 F ($F_{\rho}=0.505$) were within the approximate 90% confidence intervals around SSB (24,782 - 74,133) and F (0.25 - 0.84). Consequently, a retrospective adjustment of spawning stock biomass or fishing mortality in 2019 was not required.

- Population projections

The stochastic short-term projections completed for this management track assessment followed the

methodology accepted during the 2017 benchmark (NEFSC 2018) where recruitment is modeled by sampling from an empirical cumulative density function derived using recruitment estimates from 1975 onward. Due to recent low recruitment, additional short-term projections were completed using recruitment estimates from 1999 onward and 2009 onward. These projections are presented in the supplementary material as sensitivity analyses.

Northwest Atlantic mackerel is currently in a rebuilding plan and after the 2017 benchmark assessment, a target fishing mortality of 0.237 was selected as the F that would rebuild the stock in five years (by 2023). The short-term projections completed for the rebuilding plan were largely driven by a strong incoming (2015) year class. While this management track assessment indicates that 2016 recruitment is only 15% lower than that estimated during the 2017 assessment (and the only recruitment estimate since 2008 above the time-series median), the subsequent projected increase in SSB was not realized. As a result, even in the absence of fishing, the stock is not projected to be rebuilt by 2023. The absence of an increase in SSB is likely due to a combination of factors, including the increase in total removals in recent years due to the recalibrated MRIP estimates, a time-series low recruitment estimate for 2017, a minor retrospective pattern that resulted in an overestimation of spawning stock biomass, and a recent (2017-2019) decline in age-2 and age-3 maturity. Temporal trends in the proportion mature-at-age are included in the supplementary material.

- Changes made to the current assessment, beyond incorporating additional years of data:

U.S. catch was updated to include the recalibrated MRIP estimates. Updating the MRIP estimates did not impact the general temporal trend in recreational catch; however, from 2008-2016 the recalibrated catch estimates were approximately 213% higher than the original estimates used in the 2017 benchmark assessment (NEFSC 2018). A comparison of the original and realibrated MRIP estimates is included in the supplementary material. Additionally, updates to Canadian catch, catch-at-age and weight-at-age (WAA) were provided by Canada's Department of Fisheries and Oceans (DFO). The updated total catch and WAA estimates resulted in only minor changes to SSB and did not impact the temporal trend in fishing mortality, but the magnitude of F increased from 2010 onward by up to 20%. Minor updates were also provided for the U.S. egg index; these updates had a negligible impact on resulting model estimates. A comparison of the results from these bridge runs is provided in the supplementary material.

- Changes in stock status:

The stock status of northwest Atlantic mackerel has not changed since the previous assessment (NEFSC 2018).

- Qualitative description of stock condition:

Fishery composition data show a truncation in age structure, though age-9 fish were observed in the 2019 catch for the first time since 2012. After reaching a time-series minimum in 2010, range-wide SSB estimates developed from the egg surveys generally increased until 2017 but declined in 2018 and 2019. With the exception of 2017, these range-wide SSB estimates have been below the time-series median since 2005. However, egg production estimates for the southern contingent were approximately an order of magnitude greater in 2018 and 2019 compared to the previous ten years, and in 2018 and 2019 the southern contingent represented 54% and 18%, respectively, of the range-wide spawning stock biomass. With the exception of the 2015 year class (2016 recruitment), recruitment estimates have been below the corresponding time-series median since 2008 and the 2016 year class was the smallest of the time series.

- Research recommendations:

As mentioned in the above section on sources of uncertainty, fecundity estimates for the southern contingent are needed to improve spawning stock biomass estimates developed from the egg surveys. Additionally, further work on stock structure and the extent of contingent mixing is needed. Arai et al. (2021) demonstrated a shift in baseline otolith natal isotopic composition values of the two spawning contingents during the past two decades. Redding et al. (2020) found that for the 1998-2000 year classes, the majority of age-3+ fish collected from US waters in March represented the northern contingent. However, Arai et al. (2021) found that the southern contingent was dominant in age-3 and age-4 fish collected during the U.S. winter fishery in more recent years (2011-2016 year classes), and that contingent mixing levels varied among year classes. Consequently, in order to develop spatially-explicit assessment models that consider the dynamics

of each spawning contingent separately, year-class-specific baselines and annual estimates of contingent composition in fishery catches would be needed. Genetic work is also needed to distinguish the two spawning contingents and samples are currently being collected for a genetics study recently initiated by Canada's DFO.

- Additional issues:

DFO Canada is currently finalizing an assessment of the northern spawning contingent of northwest Atlantic mackerel, which indicates that the northern contingent has been in the Critical Zone, as defined by DFOs precautionary approach framework, since 2009. Estimated spawning stock biomass in 2020 was 29,109 mt and represented the second lowest estimate of the time series. Estimated 2020 fishing mortality for fully selected fish (age-5+) was 1.30 and above $F_{40\%}$. The 2015 year class was the only year class estimated to be greater than the time-series median since 2009, with this cohort now representing less than 8% of the harvested catch in 2020.

References:

Arai, K., M. Castonguay, and D. H. Secor. 2021. Multi-decadal trends in contingent mixing of Atlantic mackerel (*Scomber scombrus*) in the Northwest Atlantic from otolith stable isotopes. *Sci Rep* 11, 6667 (2021). <https://doi.org/10.1038/s41598-021-86116-2>

Deroba, J.J. and A.M. Schueller. 2013. Performance of stock assessments with misspecified age-and time-varying natural mortality. *Fisheries Research* 46: 27-40.

Northeast Fisheries Science Center (NEFSC). 2018. 64th Northeast Regional Stock Assessment Workshop (64th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 18-04; 529 p. Available from: <http://www.nefsc.noaa.gov/publications/>

Redding, S. G., L. W. Cooper, M. Castonguay, C. Wiernicki, and D. H. Secor. 2021. Northwest Atlantic mackerel population structure evaluated using otolith d18O composition. *ICES Journal of Marine Science*. doi:10.1093/icesjms/fsaa117.

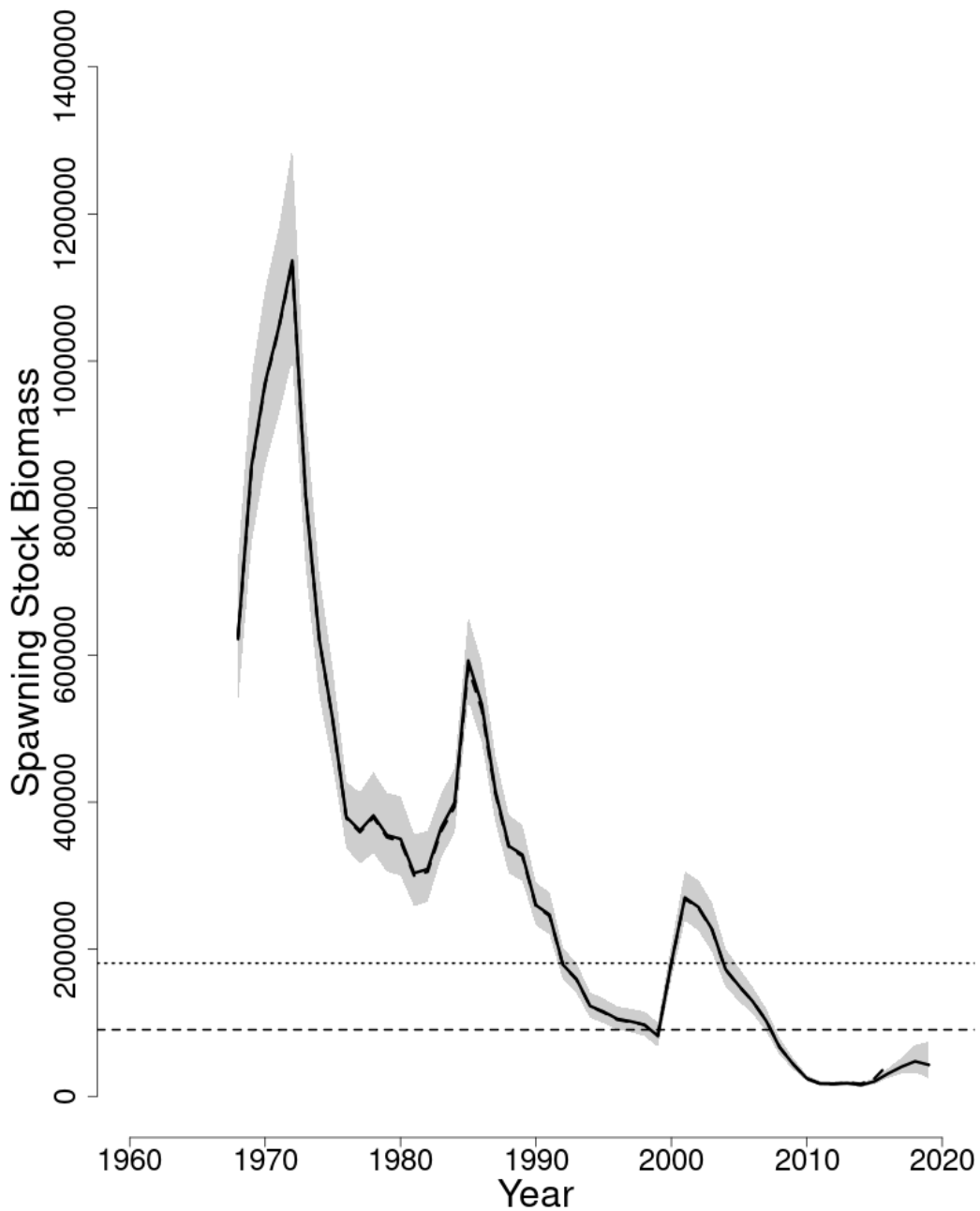


Figure 1: Trends in spawning stock biomass (mt) of northwest Atlantic mackerel between 1968 and 2019 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2} SSB_{MSY}$ proxy; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} proxy; horizontal dotted line) based on the 2021 assessment. The approximate 90% lognormal confidence intervals are shown.

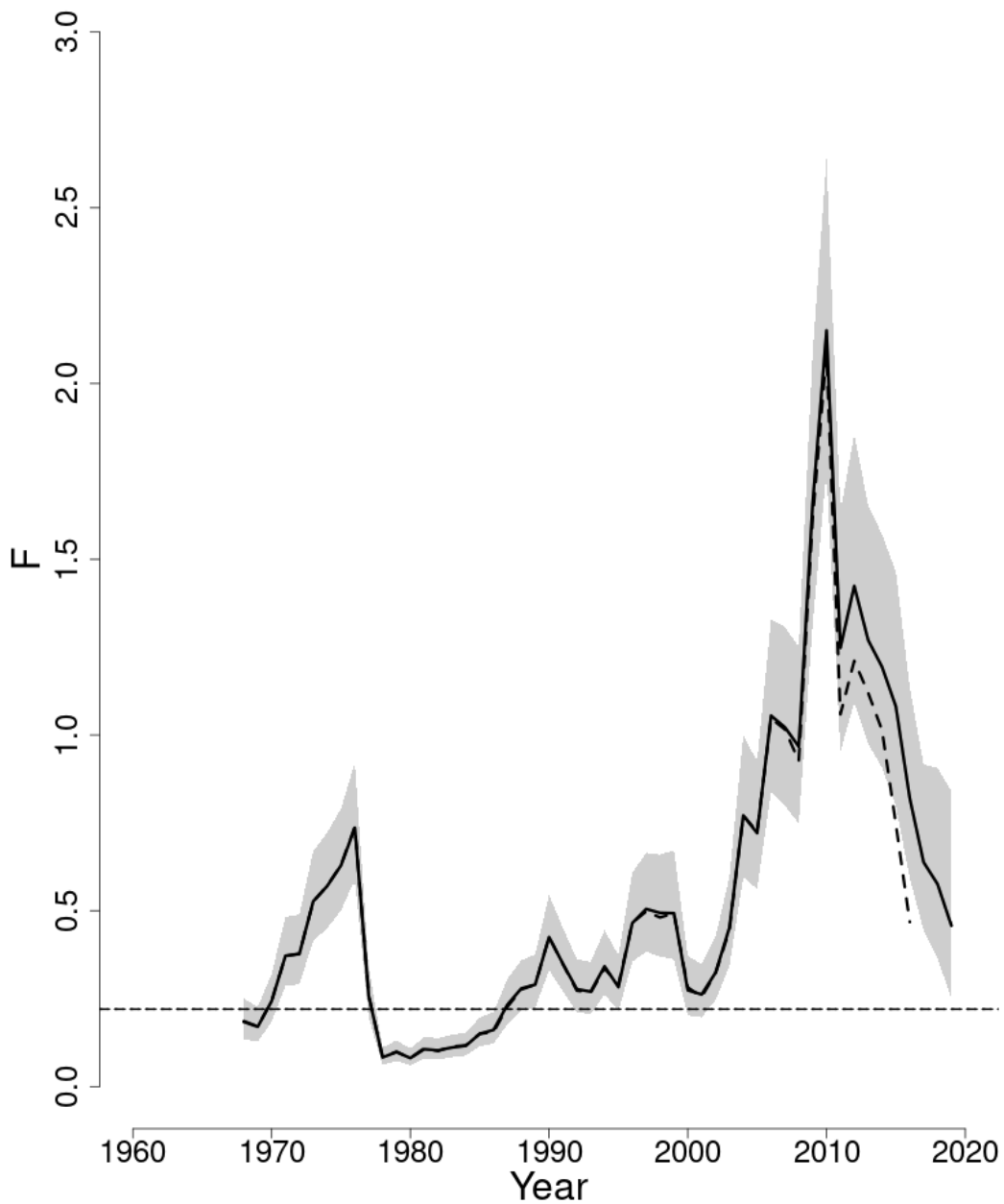


Figure 2: Trends in the fully selected fishing mortality (F) of northwest Atlantic mackerel between 1968 and 2019 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ ($F_{MSY proxy}=0.22$; horizontal dashed line). The approximate 90% lognormal confidence intervals are shown.

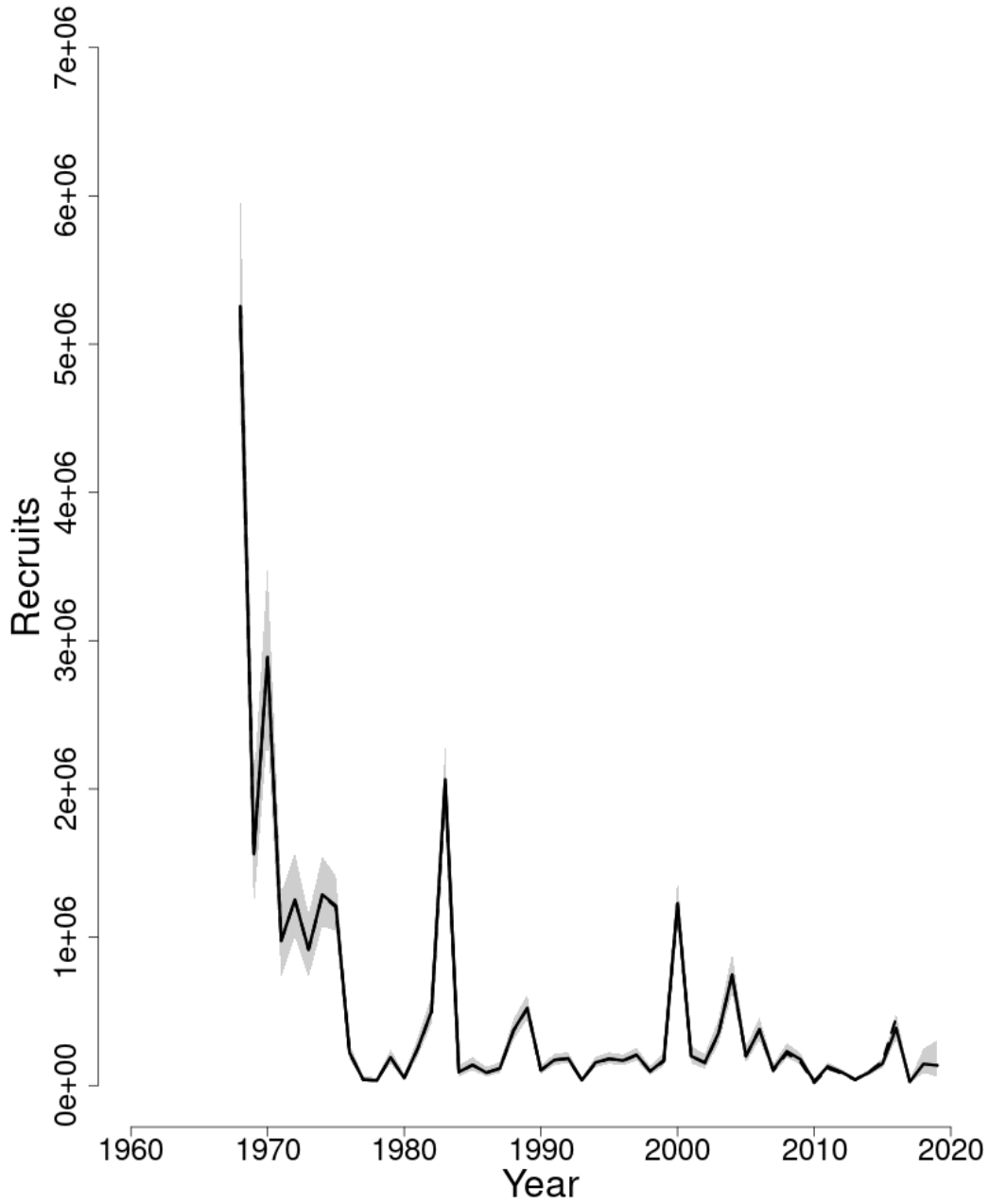


Figure 3: Trends in Recruits (age-1) (000s) of northwest Atlantic mackerel between 1968 and 2019 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

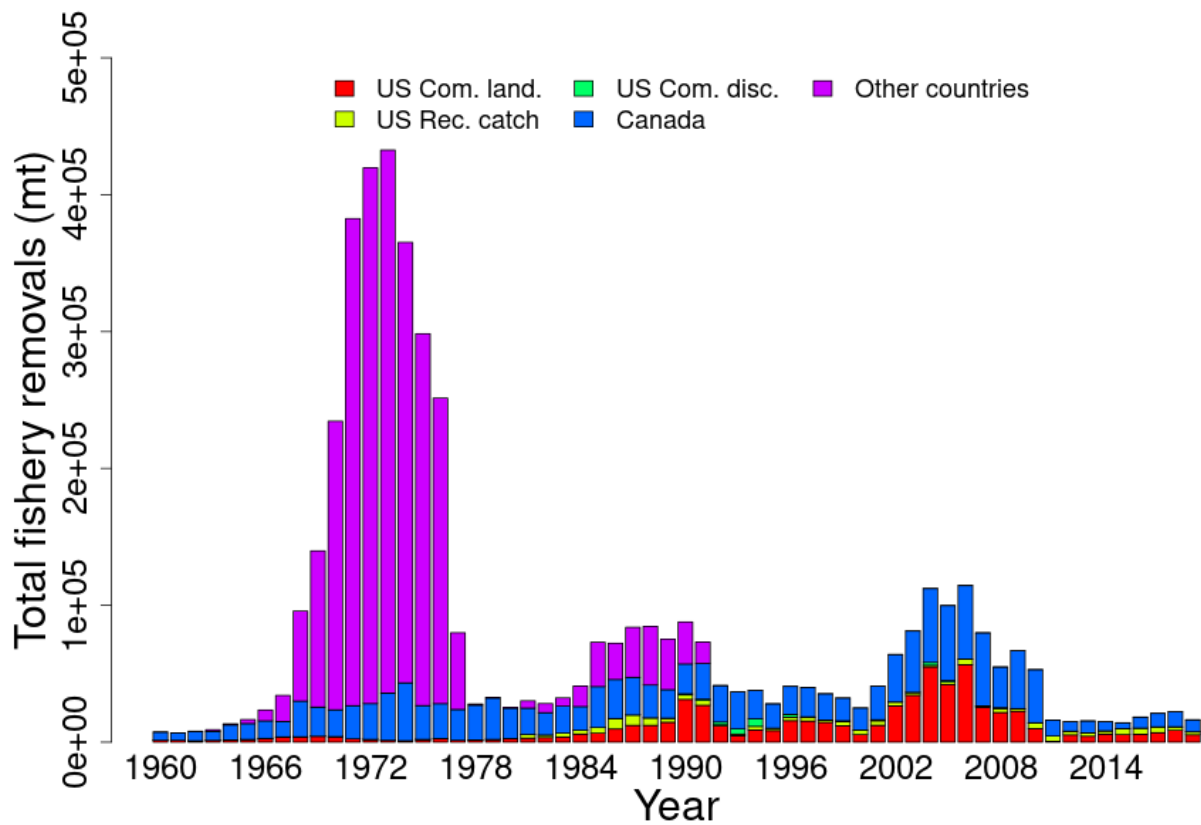


Figure 4: Total catch of northwest Atlantic mackerel between 1968 and 2019 by all sources. U.S. recreational catch represents recreational landings plus discards, Canada represents Canadian landings (discards are not available), and other countries represents landings by all other countries.

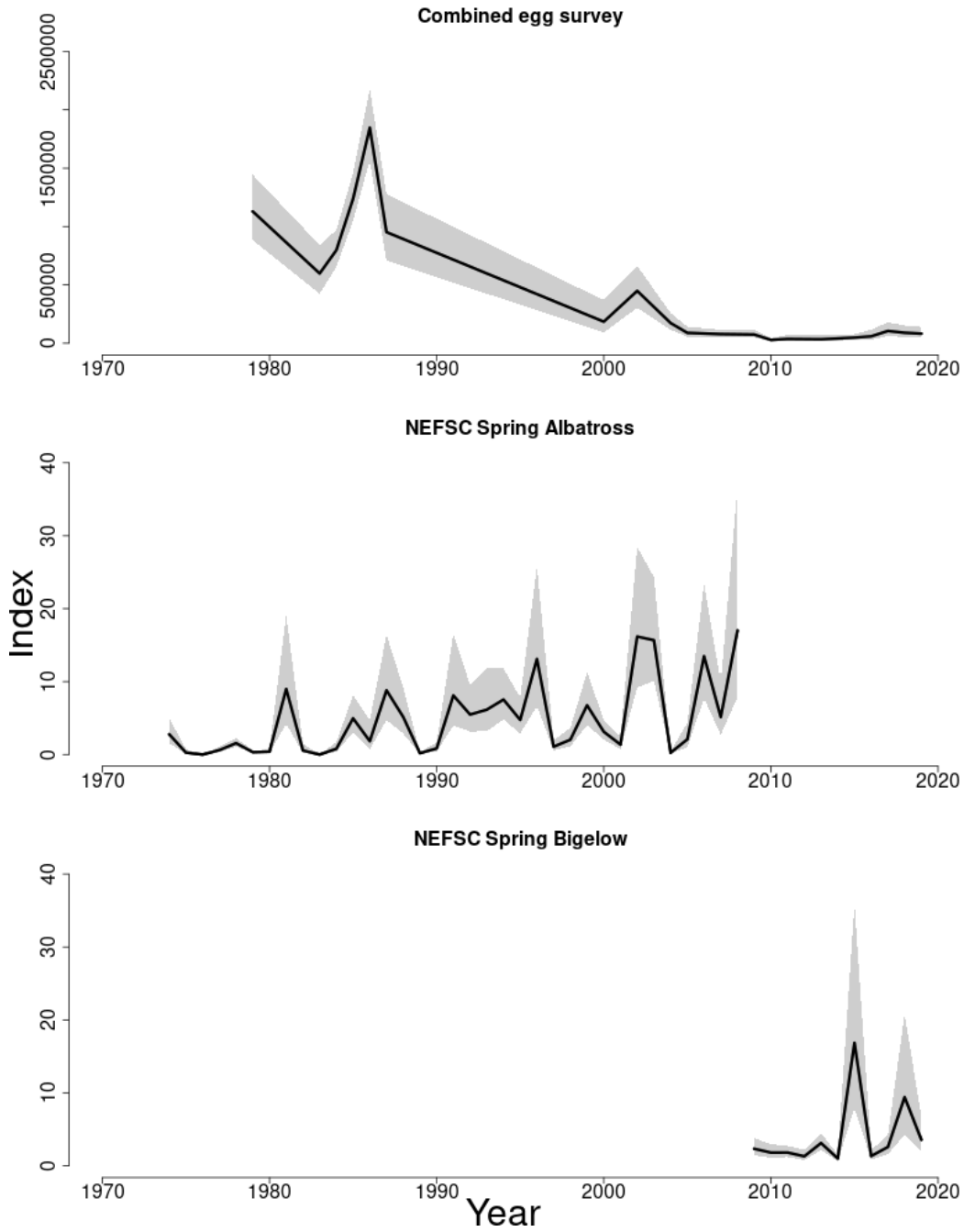


Figure 5: Indices of spawning stock biomass (mt) from the combined egg surveys and age-3+ fish/tow from the NEFSC spring bottom trawl survey for northwest Atlantic mackerel between 1974 and 2019.

Northwest Atlantic Mackerel Supplementary Material

Table S1: Northwest Atlantic mackerel short-term projections at $F_{MSY\ proxy}$ derived by sampling from an empirical cumulative distribution function based on recruitment estimates from 1999 onward

		2020	2021	2022	2023
SSB (mt)	Median	62,039	69,471	83,273	102,420
	5th Percentile	27,791	29,489	38,175	53,347
	95th Percentile	120,790	138,228	168,577	212,244
Recruitment (000s)	Median	155,704	155,515	155,323	155,708
	5th Percentile	27,511	27,684	27,526	27,570
	95th Percentile	743,849	746,511	746,913	746,040
January 1 biomass (mt)	Median	91,810	106,585	119,000	141,340
	5th Percentile	52,409	57,350	58,516	76,176
	95th Percentile	159,039	199,304	238,154	280,802
Catch (mt)	Median	18,038	23,184	14,673	18,276
	5th Percentile	18,038	23,184	6,508	9,281
	95th Percentile	18,038	23,184	29,171	37,018

Table S2: Northwest Atlantic mackerel short-term projections at $F_{MSY\ proxy}$ derived by sampling from an empirical cumulative distribution function based on recruitment estimates from 2009 onward

		2020	2021	2022	2023
SSB (mt)	Median	60,343	58,709	60,723	69,562
	5th Percentile	25,875	19,329	22,146	33,033
	95th Percentile	119,169	126,956	126,182	125,118
Recruitment (000s)	Median	128,885	128,784	128,338	128,886
	5th Percentile	26,493	26,517	26,500	26,508
	95th Percentile	280,899	281,681	281,799	281,542
January 1 biomass (mt)	Median	84,110	86,355	83,327	93,484
	5th Percentile	44,831	42,761	36,047	48,580
	95th Percentile	151,571	160,115	159,473	159,522
Catch (mt)	Median	18,038	23,184	10,808	12,571
	5th Percentile	18,038	23,184	3,712	5,683
	95th Percentile	18,038	23,184	23,175	23,335

Figure S1: Time series of northwest Atlantic mackerel catch (mt) with two-year projections at $F_{msy\ proxy}$ for 2005-2023. Short-term projections are shown for three recruitment scenarios, developed by sampling from an empirical cumulative distribution function based on recruitment estimates from 1975 onward, 1999 onward and 2009 onward. Catch in 2020 was assumed to equal preliminary estimates of total catch and 2021 catch was assumed to equal the sum of current US and Canadian quotas. The solid lines represent the reported catches and the median of the catch for each recruitment scenario. The dotted lines represent the 90% confidence intervals.

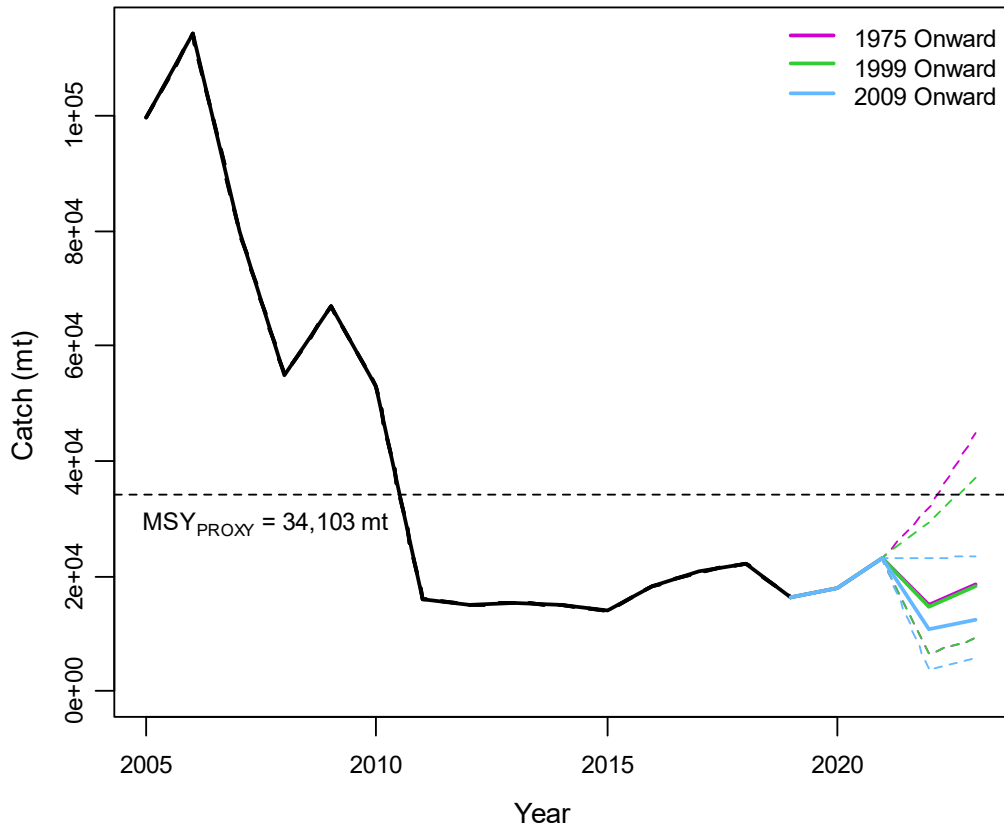


Figure S2: Time series of northwest Atlantic mackerel spawning stock biomass (mt) with two-year projections at $F_{msy\ proxy}$ for 2005-2023. Short-term projections are shown for three recruitment scenarios, developed by sampling from an empirical cumulative distribution function based on recruitment estimates from 1975 onward, 1999 onward and 2009 onward. Catch in 2020 was assumed to equal preliminary estimates of total catch and 2021 catch was assumed to equal the sum of current US and Canadian quotas. The solid lines represent the reported catches and the median of the catch for each recruitment scenario. The dotted lines represent the 90% confidence intervals.

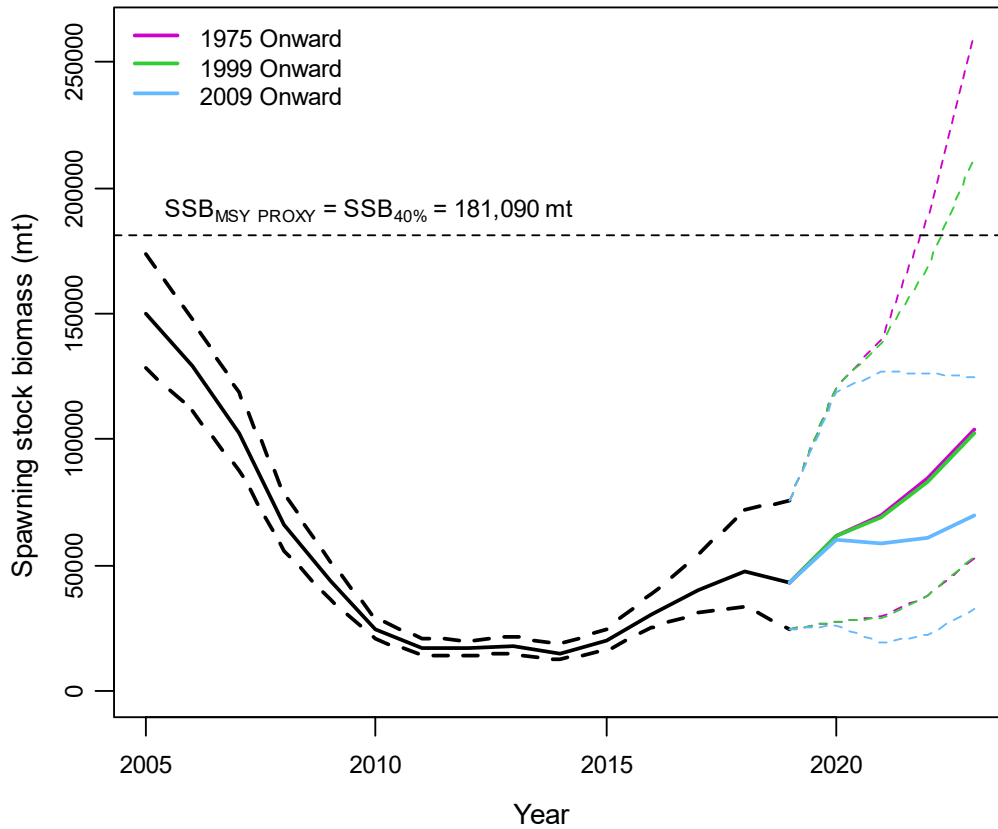


Figure S3: Likelihood profile of natural mortality for the final ASAP model. A constant natural mortality of 0.2 (blue circle) was used in the final ASAP model and the minimum value from the profile corresponded to a natural mortality of 0.26 (orange circle).

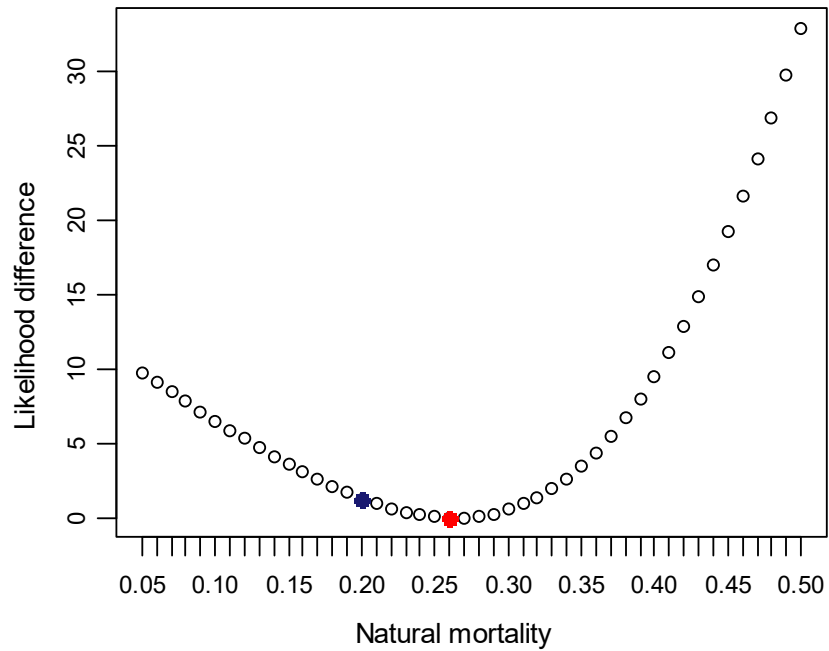


Figure S4: Northwest Atlantic mackerel maturity-at-age estimates derived from fishery-dependent Canadian samples.

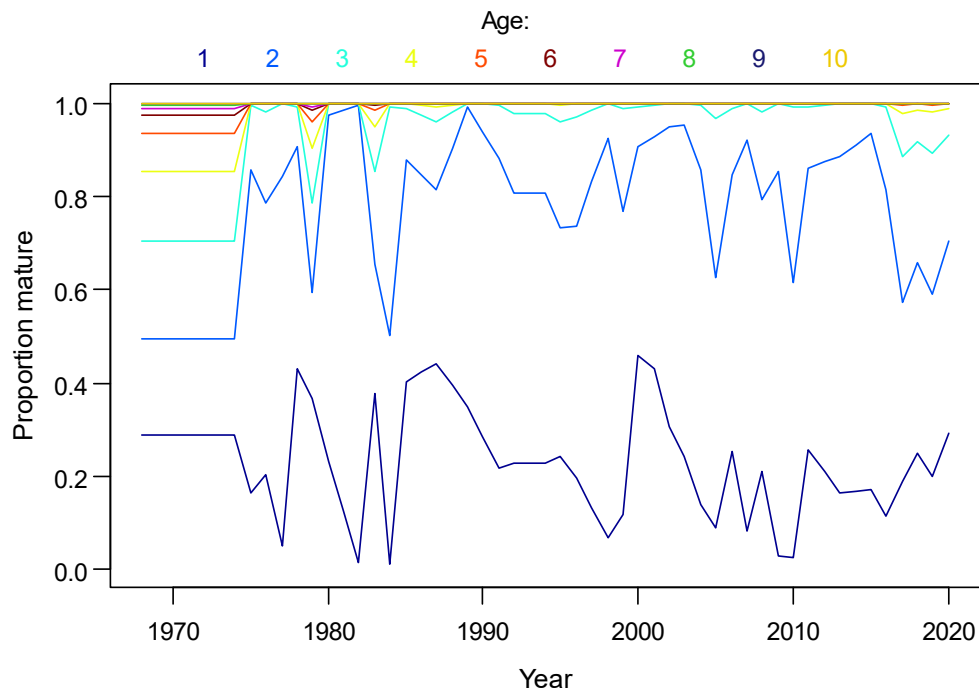
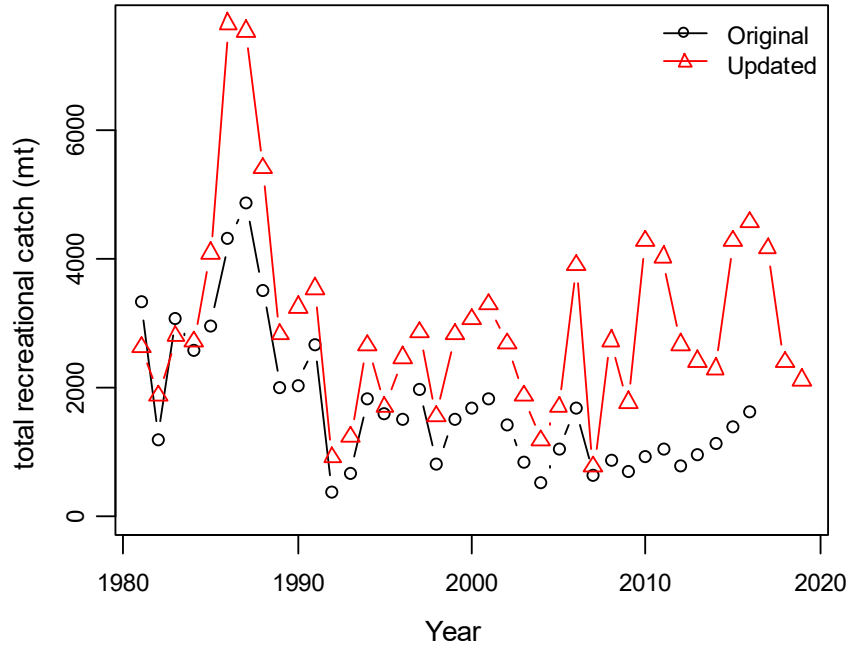


Figure S5: Comparison of northwest Atlantic mackerel (A) recreational fishery (B) and total fishery catch estimates (mt) from the original method and the updated estimates calibrated to the new effort survey.

A)



B)

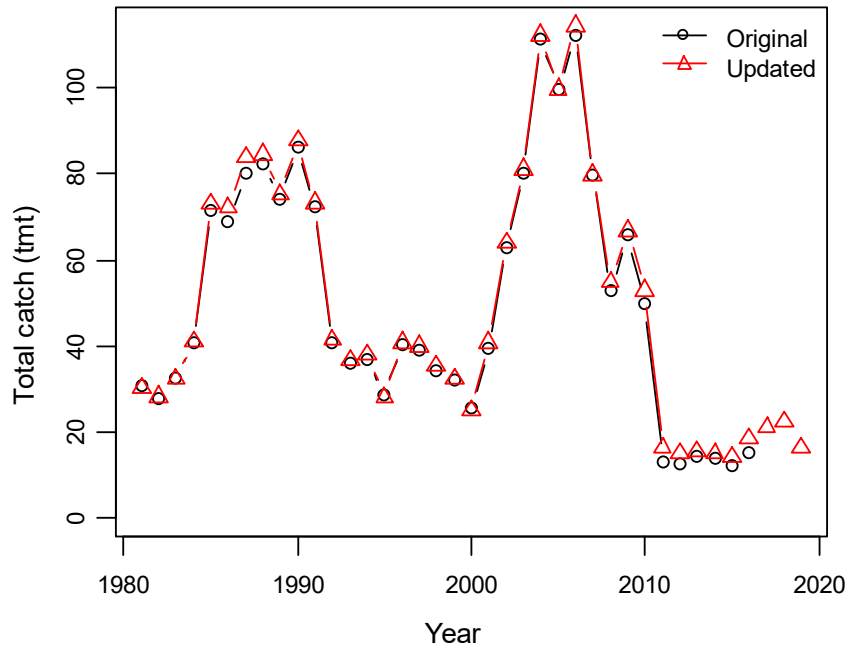
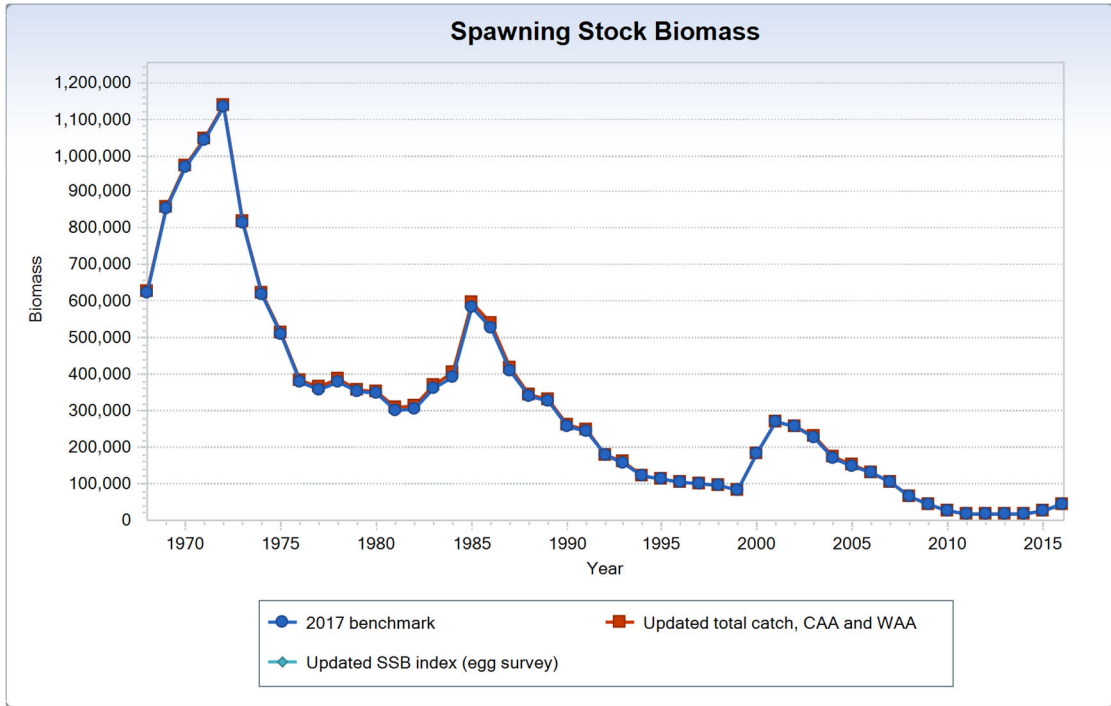
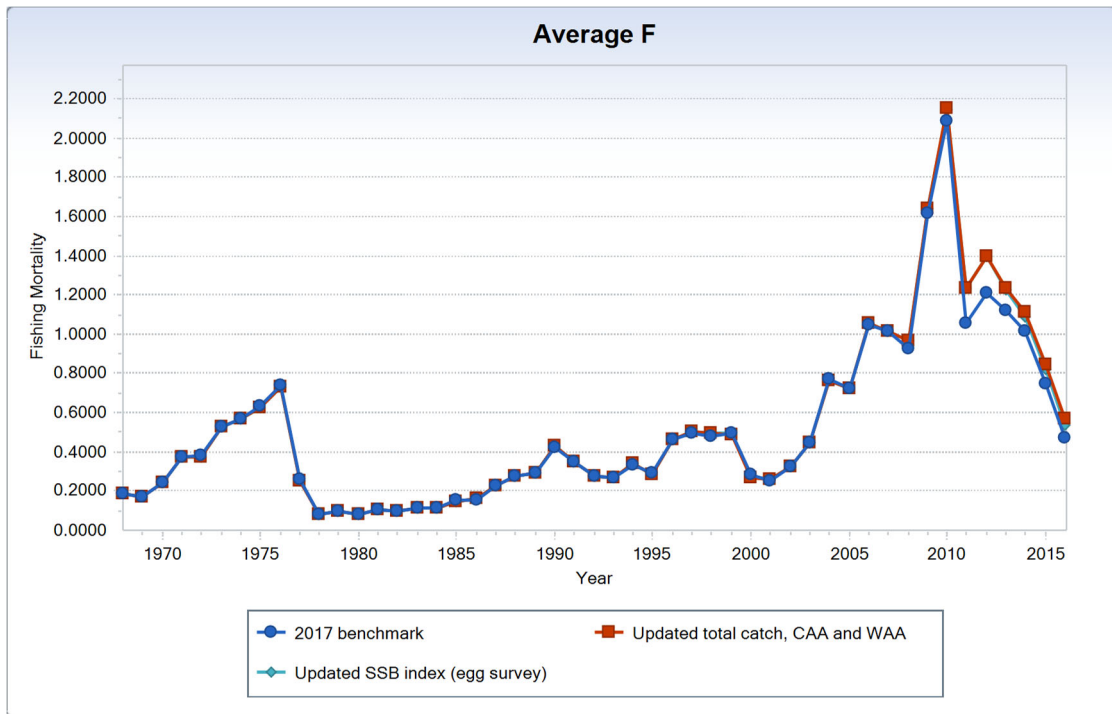


Figure S6: Comparison of (A) spawning stock biomass and (B) fishing mortality estimates from bridge runs updating the fishery catch time series and fishery-independent spawning biomass index in the 2017 benchmark model.

A)



B)



June 9, 2021

Samuel D. Rauch, III,
Deputy Assistant Administrator for Regulatory Programs
National Marine Fisheries Service, NOAA Fisheries
1315 East-West Highway Silver Spring, MD 20910

RE: Comments on the May 26, 2021, Proposed Rule for 2021-2022 Specifications for Atlantic Mackerel, Squid, and Butterfish Fisheries, NOAA-NMFS-2021-0048¹

The Pew Charitable Trusts (Pew) appreciates the opportunity to comment on NOAA Fisheries' proposed 2021-2022 Atlantic mackerel specifications. We urge NOAA Fisheries to reduce U.S. Atlantic mackerel catch for 2021-2022 in response to the species' declining populations² and the recent Fisheries and Oceans Canada (DFO) decision to reduce catch by 50%³.

As prey for a wide array of fish, seabird and marine mammal predators, mackerel are an important component of the forage base that supports the Northeast Shelf Large Marine Ecosystem (NES LME). A broader look at the NES LME forage base reveals other depleted forage species – in fact this very rule is recommending a 72% reduction in butterfish due to lower than expected recruitment. Scientists increasingly agree⁴ that catch levels for forage fish like mackerel should be set to maintain high abundance to ensure that the species' predators have plenty to eat. Healthy mackerel stocks would benefit the Atlantic ecosystems and the coastal communities that depend on them. In 2018, commercial landings of mackerel were valued at \$10.7 million in Canada and \$4.3 million in the United States,^{5,6} and these values do not consider the additional economic and ecological values that mackerel provide as forage.

In 2019 when the current rebuilding plan and specifications were established, we and others pointed out that the fishery has a retrospective pattern. Every time there is a sign of recovery, managers increased catch leading to its current overfished and overfishing designations.⁷ We argued that it was a mistake to increase catch on a stock that had just been declared overfished and subject to overfishing based on projections from the terminal year of a stock assessment and in such a way that required the Mid-Atlantic Fishery Management Council (MAFMC) to adjust its own risk policy⁸.

Unfortunately, those concerns have been realized as the best available science shows stronger conservation is necessary. The 2021 Canadian stock assessment indicates that “the number of spawning-age mackerel are at a historic low”⁹. In response to this latest science and to recover the fishery, DFO is taking a significant step of reducing catch by 50% as compared to 2020. In this decision, The Honourable Bernadette Jordan, Minister of Fisheries, Oceans and the Canadian Coast Guard, stated, “if the spawning biomass does not increase over the next two years, we are likely heading towards a commercial Atlantic mackerel fishery closure”¹⁰.

¹ Fisheries of the Northeastern United States; Atlantic Mackerel, Squid, and Butterfish Fisheries; Specifications, National Oceanic and Atmospheric Administration. Federal Register, Docket No. 210517-0107, May 26, 2021, [Link](#)

² Mid-Atlantic Fishery Management Council, Atlantic Mackerel Rebuilding Framework with Specifications (MSB Framework 13), Accessed June 8, 2021, [Link](#)

³ Fisheries and Oceans Canada, Minister Jordan announces Atlantic mackerel quota for 2021, Press Release, May 21, 2021, [Link](#)

⁴ Lenfest Ocean Program, Lenfest Forage Fish Task Force, May 1, 2008, [Link](#)

⁵ Fisheries and Oceans Canada, Minister Jordan announces Atlantic mackerel quota for 2021, Press Release, May 21, 2021, [Link](#)

⁶ NOAA Fisheries, Atlantic mackerel, Species Directory, accessed June 3, 2021, [Link](#)

⁷ “64th Northeast Regional Stock Assessment Workshop (64th Saw) Assessment Summary Report,” (2018), [Link](#)

⁸ Fisheries of the Northeastern United States; Framework Adjustment 13 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan, Docket No. 191022-0069, November 29, 2019, [Link](#)

⁹ Fisheries and Oceans Canada, Minister Jordan announces Atlantic mackerel quota for 2021, Press Release, May 21, 2021, [Link](#)

¹⁰ *Ibid.*

We strongly recommend that NOAA Fisheries, MAFMC and its Scientific and Statistical Committee, review this new Canadian science now and reduce the 2021 annual catch limit appropriately. Although the comment deadline for this Proposed Rule precedes the 2021 management track assessment peer review later this month, and the next mackerel stock assessment update does not take place until 2022, we recommend that NOAA Fisheries reduce 2021 and 2022 catch, and make additional necessary adjustments to the mackerel rebuilding plan moving forward.

The next few years will be critical for Atlantic mackerel. The Magnuson-Stevens Act calls for rebuilding mackerel as quickly as possible and applying the best available science. We encourage NOAA Fisheries to embrace this opportunity to effectively rebuild one of the most important forage fisheries on the east coast, taking into consideration the shared nature of the mackerel stock and the recent actions taken by DFO, and finalize U.S. catch limits for 2021-2022 that will have a high likelihood of success. Reducing U.S. catch now would be a wise investment in the longevity of the fishery to the benefit of fisheries, communities, predators and our shared ecosystem.

Sincerely,

A handwritten signature in blue ink, appearing to read 'J. Gordon', with a stylized flourish at the end.

Joseph Gordon
Project Director, Conserving Marine Life in the United States
The Pew Charitable Trusts



RE: Comments on the May 26, 2021 Proposed Rule for 2021-2022 Specifications for Atlantic Mackerel, Squid, and Butterfish Fisheries, NOAA- NMFS-2021-0048¹

June 10, 2021

Samuel D. Rauch III
Deputy Assistant Administrator for Regulatory Programs
National Marine Fisheries Service, NOAA Fisheries 1315 East-West Highway
Silver Spring, MD 20910

Dear Mr. Rauch,

Oceans North is a Canadian environmental non-governmental organization working on marine conservation in partnership with Indigenous and coastal communities. We appreciate the opportunity to comment on NOAA Fisheries' proposed 2021-2022 Atlantic mackerel specifications, as we have an interest in mackerel given the population is shared between Canada and the United States. We have been advocating for sustainable management of Atlantic mackerel for years through Fisheries and Oceans Canada (DFO)'s scientific and advisory processes. It is disappointing to witness the continued decline of this population to the lowest levels on record. In response to the latest scientific assessment from DFO and given Canada's decision to reduce its 2021 TAC by 50%,² we urge NOAA to follow suit and reduce allowable catches to a similar level.

The results of the most recent DFO mackerel stock assessment are incredibly concerning, but they are not surprising considering management decisions by Canada and the U.S. to date. The 2015-year class once offered a glimmer of hope for some recovery following decades-long decline. However, due largely to high exploitation rates, that year class was only 7% of the spawning stock biomass in 2020.³ The assessment also highlights that the spawning stock biomass is at the lowest ever observed (at 58% of the limit reference point) and has been in or near the Critical Zone, according to Canadian policy, for over 10 years. The stock assessment also revealed that there are almost no (<1 %) fish over 5 years, exploitation is focused on fish aged 2-5 years, and that there have been no notable recruitment events in recent years.⁴

As in the U.S., mackerel are important part of the economy in Atlantic Canada as a commercial, bait and recreational fishery. Additionally, mackerel support the broader ecosystem as a forage

¹ [Fisheries of the Northeastern United States: Atlantic Mackerel, Squid, and Butterfish Fisheries: Specifications, National Oceanic and Atmospheric Administration, Federal Register, Docket No. 210517-0107, May 26, 2021](#)

² [Minister Jordan announces Atlantic mackerel quota for 2021](#)

³ [Spawning-age mackerel at record lows in Atlantic Canada](#)

⁴ DFO science presentations from the Atlantic Mackerel Advisory Committee meeting, March 30, 2021

fish. However, past quotas have not allowed the stock to rebuild and have jeopardized future revenues. A 2020 cost-benefit analysis revealed that minimizing fishing could lead to benefits estimated at over \$54 million, with a 12.9% return on the “investment” in stock rebuilding.⁵

In light of the new Canadian assessment and catch reduction, we therefore urge NOAA Fisheries, MAFMC and its Scientific and Statistical Committee to reduce the 2021 annual catch for the benefit of our shared mackerel stocks, coastal livelihoods and ecosystem.

Sincerely,

Katie Schleit
Senior Fisheries Advisor
Oceans North

⁵ [The Jig is Up: Millions at stake in DFO’s failed actions to rebuild the Atlantic mackerel stock.](#)