Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • www.asmfc.org

Spud Woodward (GA), Chair *Joe Cimino (NJ), Vice-Chair* *Robert E. Beal, Executive Director*

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

MEMORANDUM

Revised April 26, 2023

TO: Commissioners; Proxies; American Lobster Management Board; Atlantic Menhaden Management Board; Atlantic Coastal Cooperative Statistics Program Coordinating Council; Atlantic Striped Bass Management Board; Coastal Sharks Management Board; Executive Committee; Horseshoe Crab Management Board; ISFMP Policy Board; Law Enforcement Committee; Sciaenids Management Board

FROM: Robert E. Beal REB
Executive Director

RE: ASMFC Spring Meeting: May 1-3, 2023 (TA 23-036)

The Atlantic States Marine Fisheries Commission's Spring Meeting will be May 1-3, 2023 at **The Westin Crystal City**, located at 1800 Richmond Highway, Arlington, VA. The room block is now closed; if you need assistance reserving a room, please contact Cindy Robertson at crobertson@asmfc.org. This will be a hybrid meeting to allow for remote participation by Commissioners and interested stakeholders in all meetings.

The final agenda, main and supplemental meeting materials for the Spring Meeting are now available at http://www.asmfc.org/home/2023-spring-meeting; click on the relevant Board/Committee name to access the documents for that Board/Committee.

Webinar Information

Board meeting proceedings will be broadcast daily via webinar beginning Monday, May 1 at 12:45 p.m. and continuing daily until the conclusion of the meeting (expected to be 3:00 p.m.) on Wednesday, May 3. To register for the webinar, please go to: https://attendee.gotowebinar.com/register/8336694404906038107 (Webinar ID: 780-037-899).

If you are joining the webinar but will not be using voice over Internet protocol (VoIP), you can may also call in at 914.614.3221, access code 140-893-572. A PIN will be provided to you after joining the webinar; see webinar instructions for details on how to receive the PIN

Meeting Process

In terms of meeting process, Board chairs will ask both in-person and virtual Board members if they wish to speak. In-person members can simply raise their hands at the meeting without logging on to the webinar, while virtual members will raise their hands on the webinar. The Chair will work with staff to compile the list of speakers, balancing the flow of questions/comments between in-person and virtual attendees. The same process will be used for public comment. Depending upon the number of commenters, the Board Chair will decide how to allocate the available time on the agenda (typically 10 minutes) to the number of people who want to speak.

Each day, the webinar will begin 15 minutes prior to the start of the first meeting so that people can troubleshoot any connectivity or audio issues they may encounter. If you are having issues with the webinar (connecting to or audio-related issues), please contact Chris Jacobs at 703.842.0790.

We look forward to seeing you at the Spring Meeting. If the staff or I can provide any further assistance to you, please call us at 703.842.0740.

Enclosed: Final Agenda, Hotel Directions, TA 23-036, Travel Reimbursement Guidelines, and Webinar Instructions

Atlantic States Marine Fisheries Commission

Spring Meeting

May 1-3, 2023

The Westin Crystal City

Arlington, Virginia

Public Comment Guidelines

To provide a fair opportunity for public input, the ISFMP Policy Board has approved the following guidelines for use at management board meetings:

For issues that are not on the agenda, management boards will continue to provide opportunity to the public to bring matters of concern to the board's attention at the start of each board meeting. Board chairs will ask members of the public to raise their hands to let the chair know they would like to speak. Depending upon the number of commenters, the board chair will decide how to allocate the available time on the agenda (typically 10 minutes) to the number of people who want to speak.

For topics that are on the agenda, but have not gone out for public comment, board chairs will provide limited opportunity for comment, taking into account the time allotted on the agenda for the topic. Chairs will have flexibility in deciding how to allocate comment opportunities; this could include hearing one comment in favor and one in opposition until the chair is satisfied further comment will not provide additional insight to the board.

For agenda action items that have already gone out for public comment, it is the Policy Board's intent to end the occasional practice of allowing extensive and lengthy public comments. Currently, board chairs have the discretion to decide what public comment to allow in these circumstances.

In addition, the following timeline has been established for the submission of written comment for issues for which the Commission has *NOT* established a specific public comment period (i.e., in response to proposed management action).

1. Comments received three weeks prior to the start of a meeting week (April 10th) have been included in the briefing materials.
2. Comments received by 5:00 PM on Tuesday, April 25th will be included in supplemental materials.
3. Comments received by 10:00 AM on Friday, April 28th will be distributed electronically to Commissioners/Board members prior to the meeting.

The submitted comments must clearly indicate the commenter's expectation from the ASMFC staff regarding distribution. As with other public comment, it will be accepted via mail and email.

Final Agenda

The agenda is subject to change. The agenda reflects the current estimate of time required for scheduled Board meetings. The Commission may adjust this agenda in accordance with the actual duration of Board meetings. Interested parties should anticipate Boards starting earlier or later than indicated herein.

Monday May 1

12:45 – 2:30 p.m. **American Lobster Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia
Other Members: NMFS
Chair: McNamee
Other Participants: Perry, Reardon, Beal, Moore
Staff: Starks

1. Welcome/Call to Order *(J. McNamee)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from January 2023
3. Public Comment
4. Consider Addendum XXVII on Increasing Protection of Spawning Stock Biomass of the Gulf of Maine/Georges Bank Stock for Final Approval *(C. Starks)* **Final Action**
   - Review Options and Public Comment Summary *(C. Starks)*
   - Advisory Panel Report *(G. Moore)*
   - Consider Approval of Addendum XXVII
5. Update from Work Group on Implementation of Addendum XXIX: Tracker Devices in the Federal Lobster and Jonah Crab Fishery *(T. Kerns)*
6. Progress Update on 2023 Jonah Crab Benchmark Stock Assessment *(J. Kipp)*
7. Review Lobster Conservation Management Team Roles and Process *(C. Starks)*
8. Other Business/Adjourn

2:45 – 3:15 p.m. **Atlantic Menhaden Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: NMFS, PRFC, USFWS
Chair: Bell
Other Participants: Craig, Corbin
Staff: Boyle

1. Welcome/Call to Order *(M. Bell)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from February 2023
3. Public Comment
4. Review Report on the Atlantic Menhaden Fishery in Virginia *(P. Geer)*

5. Progress Update on Menhaden Single-species and Ecological Reference Point (ERP) Stock Assessments **Action**
   - Review and Consider Approval of ERP Terms of Reference *(K. Drew)*
6. Other Business/Adjourn

3:30 – 5:00 p.m. **Sciaenids Management Board**

Member States: New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: NMFS, PRFC
Chair: Batsavage
Other Participants: Simpson, Smott, Rickabaugh, Rogers, McDonough, Reichert
Staff: Bauer

1. Welcome/Call to Order *(C. Batsavage)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from August 2022
3. Public Comment
4. Consider 2023 Black Drum Benchmark Stock Assessment and Peer Review Report **Final Action**
   - Presentation of Stock Assessment *(C. McDonough)*
   - Presentation of Peer Review Panel Report *(M. Reichert)*
   - Consider Acceptance of Benchmark Stock Assessment and Peer Review Report for Management Use
   - Consider Adopting Annual Indicators
5. Consider Not Conducting 2023 Atlantic Croaker and Spot Traffic Light Analyses *(T. Bauer)*
6. Other Business/Adjourn

Tuesday, May 2

8:30 a.m. – Noon **Atlantic Striped Bass Management Board**

Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina
Other Members: DC, NMFS, PRFC, USFWS
Chair: Gary
Other Participants: Lengyel Costa, Mercer, Celestino, Newhard
Staff: Franke

1. Welcome/Call to Order *(M. Gary)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from January 2023
3. Public Comment
4. Update on Atlantic Striped Bass Cooperative Tagging Program *(J. Newhard)*
5. Technical Committee Report *(M. Celestino)* **Possible Action**
   - Projections Using 2022 Preliminary Data and Quota Utilization Scenarios
   - Consider Management Response to the Technical Committee Projections

6. Consider Approval of Addendum I on Ocean Commercial Quota Transfers **Final Action**
   - Review Options and Public Comment Summary *(E. Franke)*
   - Review Advisory Panel Report *(E. Franke)*
   - Consider Final Approval of Addendum I
7. Other Business/Adjourn

10:00 a.m. – 5:00 p.m. **Law Enforcement Committee**
(A portion of this meeting will be a closed session for LEC Coordinator and Committee members only)
Members: Baker, Beal, Blanchard, Brown, Cloyd, Corbin, Couch, Day, Gadomski, Henry, Hettenbach, Hodge, Hogan, Mercer, Moore, Noel, Pearce, Rogers, Sabo, Snellbaker, Thomas, Walker, Williams
Chair: *Snellbaker*
Staff: Blanchard

1. Welcome/Call to Order *(J. Snellbaker)*
2. Committee Consent
   - Approval of Agenda
3. Public Comment
4. Introductions
5. Review and Discuss Vessel Tracker Agency Interface *(J. Simpson)*
6. Discuss and Consider Changes to Enforceability Guidelines *(J. Snellbaker)*
7. Review and Discuss Commission Species (as needed)
   - Atlantic Striped Bass Plan Review Team Compliance Question
8. Review and Discuss Ongoing Enforcement Activities (**Closed Session**)
9. State Agency Reports
10. Other Business/Adjourn

Noon – 1:30 p.m. **Lunch Break** (provided)

Noon – 1:30 p.m. **Legislative and Governors Appointee Commissioners Luncheon**

1:45 – 3:45 p.m. **Atlantic Coastal Cooperative Statistics Program (ACCSP) Coordinating Council**
Partners: ASMFC, Connecticut, Delaware, District of Columbia, Florida, Georgia, MAFMC, Maine, Maryland, Massachusetts, NEFMC, New Hampshire, New Jersey, New York, NMFS, North Carolina, Pennsylvania, PRFC, Rhode Island, SAFMC, South Carolina, USFWS, Virginia
Chair: McNamee
Staff: White

1. Welcome/Call to Order *(J. McNamee)*
2. Council Consent
   - Approval of Agenda
   - Approval of Proceedings from November 2022
3. Public Comment
4. Consider Funding Decision Document and FY2024 Requests for Proposals *(J. Simpson)* **Action**
5. Update on Program and Committee Activities *(G. White, J. Simpson)*
6. Other Business/Adjourn

4:00 – 5:15 p.m. **Coastal Sharks Management Board**

Member States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: NMFS
Chair: Bell
Other Participants: Willey, Thomas, Brewster-Geisz
Staff: Starks

1. Welcome/Call to Order *(M. Bell)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from November 2022
3. Public Comment
4. Review NOAA Fisheries' Final Actions and Consider Comment on Proposed Actions for Coastal Sharks *(K. Brewster-Geisz)*
   - Proposed Rule to Prohibit the Harvest of Oceanic Whitetip Sharks
   - Final Amendment 14 to the 2006 Consolidated Atlantic Highly Migratory Species (HMS) Fishery Management Plan (FMP)
   - Final Atlantic Shark Fishery Review (SHARE)
   - Scoping for Amendment 16 to the 2006 Consolidated Atlantic HMS FMP
   - Scoping for Electronic Reporting
   - Proposed Rule for Amendment 15 to the 2006 Consolidated Atlantic HMS FMP
5. Consider Fishery Management Plan Review and State Compliance for 2021 Fishing Year *(C. Starks)* **Action**
6. Other Business/Adjourn

5:45 – 7: 15 p.m. **Annual Awards of Excellence Reception**

<u>Wednesday, May 3</u>

8:00 – 10:00 a.m. **Executive Committee**
Breakfast will be served at 7:45 a.m.

(A portion of this meeting will be closed for Committee members and Commissioners only)
Members: Abbott, Bell, Burgess, Cimino, Clark, Davis, Fegley, Geer, Gilmore, Keliher, Kuhn, McKiernan, McNamee, Miller, Patterson, Rawls, Woodward
Chair: Woodward
Staff: Leach

1. Welcome/Call to Order *(S. Woodward)*
2. Committee Consent
   - Approval of Agenda
   - Approval of Meeting Summary from February 2023
3. Public Comment
4. Report of the Administrative Oversight Committee *(J. Cimino)* **Action**
   - Presentation of the Fiscal Year 2024 Budget
5. Discuss Potential for Legislator and Governors Appointee Commissioner Stipends *(R. Beal)*
6. Review Potential Changes to the Conservation Equivalency Policy and Technical Guidance Document *(T. Kerns)*

7. Legislative Committee Update *(A. Law)*
8. Future Annual Meetings Update *(L. Leach)*
   - October 15-19, 2023 – Beaufort, North Carolina
   - 2024 – Maryland
   - 2025 – Delaware
   - 2026 – Rhode Island
   - 2027 – South Carolina
9. Executive Director Performance Review (**Closed Session**)
10. Other Business/Adjourn

10:15 a.m. – 12:15 p.m. **Interstate Fisheries Management Program Policy Board**
Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: DC, NMFS, PRFC, USFWS
Chair: Woodward
Staff: Kerns

1. Welcome/Call to Order *(S. Woodward)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from February 2023
3. Public Comment
4. Executive Committee Report *(S. Woodward)*
5. Discuss Possible Responses to Issues Identified in the Commissioner Survey *(T. Kerns)*
6. Consider Options Paper for Atlantic Bonito and False Albacore Management *(T. Kerns)* **Possible Action**
7. Update on Follow-up Addendum for the Harvest Control Rule **Action**
   - Overview of Timeline
   - Consider Approval of Plan Development Team Membership
8. Discuss Future of Mid-Atlantic Fishery Management Council's Research Set-aside Program *(R. Beal)* **Possible Action**
9. Assessment Science Committee Report *(K. Drew)* **Action**
10. Law Enforcement Committee Report *(K. Blanchard)*
11. Update on East Coast Climate Change Scenario Planning Initiative *(T. Kerns)*
12. Review Noncompliance Findings (if necessary) **Action**
13. Other Business/Adjourn

12:15 – 12:30 p.m. **Business Session**
Member States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Chair: Woodward
Staff: Beal

1. Welcome/Call to Order *(S. Woodward)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from November 2022
3. Public Comment
4. Consider Noncompliance Findings (if necessary) **Final Action**
5. Other Business/Adjourn

12:30 – 1:00 p.m. **Lunch Break** (provided)

1:00 – 3:00 p.m. **Horseshoe Crab Management Board**
Member States: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida
Other Members: NMFS, PRFC, USFWS
Chair: Clark
Other Participants: Ameral, Couch, Hoffmeister
Staff: Starks

1. Welcome/Call to Order *(J. Clark)*
2. Board Consent
   - Approval of Agenda
   - Approval of Proceedings from November 2022
3. Public Comment
4. Consider Work Group Report on Biomedical Best Management Practices *(C. Starks)* **Action**
5. Review Potential Processes and Resources Required for Evaluating Management Objectives for the Delaware Bay Bait Fishery *(C. Starks)* **Possible Action**
6. Other Business/Adjourn

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Atlantic Menhaden Stock Assessment Subcommittee (SAS) and Ecological Reference Point Workgroup (ERP) Call Summary

April 13, 2023

Committee Members in Attendance: Matt Cieri (ERP Chair), Sydney Alhale, Jeff Brust, Brooke Lowman, Jason McNamee, Alexei Sharov, Jason Boucher, Mike Celestino, David Chagaris, Micah Dean, Shanna Madsen, Howard Townsend
ASMFC Staff: James Boyle (ISFMP), Kristen Anstead (Science), Katie Drew (Science)
Public: Genny Nesslage, Margaret Conroy, Keilin Gamboa-Salazar, Max Appelman, Allison Colden, Jeff Kaelin, Tom Lilly, Shaun Gehan, Peter Himchak

Major Decisions

- The SAS approved the proposal to change the 2025 single-species assessment from a benchmark to an update

Next Steps

- Staff will circulate doodle polls for the May and October workshops and Terms of Reference for the single-species update and ERP benchmark

Discussion Summary

Assessment Schedule and Single-Species Update Proposal

Recently, ASMFC staff discussed the unusually busy stock assessment schedule for 2023-2025 and made suggestions for where work could be decreased. One of the suggestions was changing the 2025 single-species benchmark assessment to an update and Kristen presented this option to the SAS. The reasoning behind this suggestion was that the Beaufort Assessment Model (BAM) is a mature assessment tool that has been peer reviewed for menhaden several times (e.g., 2011, 2015, 2020). Since there are no planned changes to the model structure or inputs for 2025, changing the single-species assessment to an update would reduce the workload for Technical Committee (TC), SAS, and peer review (PR) panel members. Kristen outlined that within the update framework, the SAS can still investigate the MARECO index for inclusion in the BAM since it was included in the 2020 benchmark, discuss spatial considerations for BAM as potential paths forward for the 2031 benchmark assessment, further investigate the odd behavior of the terminal year of BAM observed in the last two assessments, and make research recommendations for 2031. Additionally, the SAS can still consider if the number of age and length samples collected from different commercial gears and regions is sufficient to characterize the fishery and discuss retrospective adjustments for projections.

SAS members expressed concern about how to proceed if the BAM update encounters problems that can only be addressed through a benchmark, incorporating any new data sources that address past research recommendations, and the optics of not doing a benchmark for such a high-profile species. Staff reiterated that the framework is already in place if a benchmark is needed part-way through (e.g., SAS and Terms of Reference have already been approved by the Board, peer review is already on the SEDAR schedule) and while it would not be ideal, flexibility is built into the schedule already since ERP is going through a benchmark. Additionally, research recommendations were recently reviewed during the 2022 stock assessment update and there were no significant projects noted that would fundamentally change BAM or its inputs. There are also advantages to having the PR focus on the ERP assessment, from an optics perspective, since there was a lot of public support for moving to multi-species management for this species.

The SAS ultimately supported moving from a benchmark to an update for the 2025 assessment given that there are no proposed changes for the model structure or inputs. If that change is accepted by the Assessment Science Committee and the Policy Board, the timeline for the update will be the same as what was proposed for the benchmark except the single-species assessment may need less time to meet during the proposed workshops (Table 1).

ERP Terms of Reference

The ERP WG reviewed the ERP TORs to evaluate whether they needed to be modified due to the proposed change from a benchmark to an update for the single-species assessment. The WG agreed that the TORs as modified on the previous call were still suitable, and only recommended removing the word “benchmark” when referring to the single-species assessment. The modified version will be circulated with the meeting summary and sent to the Board for approval at the May meeting.

ERP Methods and Data Workshop Planning

Katie reviewed the goals and major topics of the upcoming Methods Workshop I, which will be an ERP-only meeting. The workshop will be held via webinar, in order to maximize participation while keeping the assessment moving forward. The ERP WG will review the models explored during the previous benchmark assessment and discuss which ones to develop further moving forward, as well as discussing new analyses or models that could be developed for the 2025 benchmark. The WG will also identify the data needs to support the proposed models to best tailor the 2023 data submission request. Lead modelers for the suite of models explored in the previous benchmark will provide a brief overview of their respective models and comment on whether and/or how the model should be developed further for the 2025 benchmark. The workshop will need approximately 2 days of discussion, but that may be spread out over 2-4 days, depending on WG member availability and other scheduling considerations.

In addition, ASMFC will put out a call for data and models to external researchers and stakeholders via press release prior to the workshop, as is done for every benchmark assessment. People who are interested in submitting data or models can provide a “pre-proposal” type description of the dataset or model for the ERP WG to consider at the May workshop, and if the WG is interested in pursuing that submission further, the raw data or the detailed model description and code will be requested for the October meeting.

Some SAS members expressed concern that this meeting will be in webinar format instead of in-person, as they felt in-person workshops would better facilitate the kind of wide-ranging, conceptual discussion needed for these topics. Staff appreciated these concerns, but noted that there was not enough time to organize an in-person meeting in May and that pushing the meeting back further into the summer would reduce attendance of ERP WG members who had previous commitments. However, the October Data Workshop will be an in-person workshop, and because the single-species assessment will no longer need time at that workshop, there will be time to continue the discussion started at the May webinar-based workshop. Katie noted that the workshop structure was a little different from the usual ASMFC benchmark process because of the unique needs of the ERP assessment, and that the Methods Workshop I could be considered more of a Methods Scoping Workshop, where models will be initially considered for inclusion or exclusion, and final decisions on the scope of work for the benchmark will not be made until the in-person October meeting, which would be more of a Data and Methods Workshop.

Public Comment

Allison Colden (Chesapeake Bay Foundation) raised concerns about recent changes in the age composition of the catch and asked whether that would be considered during the 2025 assessment. Kristen noted that the bait and reduction catch-at-age data will be updated and examined for the single-species assessment, so observed changes will be incorporated into those results. Matt noted that the single-species update results with those data will be included in the ERP model, but the extent to which changes in the age-structure will be propagated through depends on the structure each ERP model.

Tom Lilly raised similar concerns about changes in the age structure of the reduction fishery and the implications for maturity and fecundity in the Bay and asked whether the data from the state bait samples sent to Beaufort for ageing were being sent back to the states. Kristen noted that age data were sent back to the states upon request and were fully provided to ASMFC for assessment updates. He also noted the poor reproductive condition of both striped bass and osprey in the Bay and connected that to the menhaden fishery. He urged the ERP WG to consider whether additional modeling or research was really needed to establish more conservative catch limits for the Chesapeake Bay.

In light of the public comment about age data, Matt reminded the group that there will be a menhaden ageing workshop in November. The objective of the workshop is to standardize ageing protocols between the states and the Beaufort lab to allow the states to take over the ageing of the bait samples instead of having Beaufort being responsible for all ages.

Table 1. Proposed timeline of the 2025 single-species and ERP assessments.

	Milestone	Date
✔	TC Call to review TORs and timeline	Oct. 4, 2022
✔	TC/ERP WG planning call	Feb. 24, 2023
	SAS/ERP WG planning call	April 13, 2023
	Methods Scoping Workshop (ERP)	**May 2023**
	New dataset submissions (ERPs)	**June 2023**
	Data and Methods Workshop (ERP)	**October 2023**
	2022-2023 Menhaden FI data submitted	February 2024
	2022-2023 Menhaden FD data submitted	April 2024
	2022-2023 Multispecies data submitted	July/Aug 2024
	Methods Workshop II	**October 2024**
	Assessment Workshop	**February 2025**
	Report Components to Staff	May 16, 2025
	Final report to SAS/ERP WG	June 2, 2025
	SAS/ERP WG call to approve report for TC review	Week of June 16, 2025
	Reports to TC/ERP WG for review	June 30, 2025
	TC call to approve reports	**Week of July 14, 2025**
	Reports to review panel	August 1, 2025
	Peer Review Workshop	**mid-late August 2025**
	Reports to Board (Meeting Materials)	Oct. 2, 2025
	Assessments presented at Annual Meeting	Oct. 16-20, 2025

From:	lee Ceperich
To:	Tina Berger; James Boyle; Katie Drew
Subject:	[External] ASMFC Menhaden Board May 1st comments
Date:	Tuesday, April 25, 2023 2:25:50 PM

Dear ASMFC board members,

Thank you for your continued work to manage and protect our marine resources. Please focus your efforts on behalf of VA, as the issue of overfishing of menhaden in the Chesapeake Bay is unsustainable. It appears that VA's own state government/ VMRC are unable or unwilling to address the issue effectively due to economic and political reasons. I would assume that MD is also being adversely affected by the overfishing of the Bay but I'm writing today on behalf of VA as a resident of the Northern Neck area who has witnessed the adverse effects of industrial fishing in the Bay on wildlife and residents directly.

As you know, VMRC has succeeded in getting an MOA with Omega Protein to limit fishing during holiday weekends and near the Chesapeake Bay Bridge Tunnel. This development is a step in the right direction and will limit the possibility of continued public relations problems brought on by fish spills on public beaches during peak tourist weekends, and will also reduce conflict in busy recreational fishing areas. However, the MOA will do little to address the larger problem which is continued LOCALIZED overfishing in a concentrated area. I understand that the data supports the fact that menhaden is not overfished on the East Coast in general. Have the ERPs used to measure the general population of menhaden been applied to the Chesapeake Bay region specifically?

Please explain how taking 80% of the East Coast quota of menhaden from one small area off of the Virginia coastline in the Chesapeake Bay is equitable or sustainable for the local wildlife populations -predator fish species (Striped bass, bluefish) birds (osprey) or for the other users of the bay-commercial fisherman, residents, small businesses, tourists, recreational fisherman. Why are all other stakeholders that rely on a healthy Bay ecosystem disregarded in favor of the interests of one foreign company's profit margin and employment of 250 individuals in

Reedville?

I sincerely don't understand how the commissions and individuals responsible for regulating the fishery (state government, VMRC, and ASMFC) can allow this imbalance of use in one area to take place. It is just common sense that if all the forage is taken from one area that the wildlife dependent on that forage species in that area will suffer.

ASMFC's own report to the Secretary of Commerce in 2019 from Bob Beal stated that "even with the stock of Atlantic menhaden not undergoing overfishing on a coastwide basis, localized depletion within the unique Bay ecosystem could have serious adverse effects on bay commission managed fisheries in poor condition, as well as other avian and aquatic species" Currently bay indicator species such as striped bass and ospreys are suffering chronic reproductive failure according to published sources, and local decreases in populations support these statements.

VA Code 28-203 that applies to menhaden allocations specifically states that the social and economic consequences must be considered in management of the fishery. Section 6 of ASMFC Charter and menhaden Amendment 3 also states that social and economic consequences must be considered. Instead, the VA quota was recently raised by 22,000 and Ocean Harvesters (for Omega) has added another ship to their fleet.

It is indisputable that the commercial fishing operation is important for the VA and local economy, but the small businesses that rely on recreational and commercial fishing, tourism and the overriding importance of protecting the Bay for future generations must be equally considered. Everyone must work together to identify a compromise solution that serves to protect the Bay ecosystem for future generations, and satisfy competing financial interests of the reduction fishery operation and other businesses/users that rely on a healthy Bay.

If Omega Protein is going to be allowed to continue operations, why can't the industrial fishing operation be restricted to the US Atlantic Zone? Why does VA allow factory fishing operations to occur so close to shore? No other state on the East Coast permits industrial fishing of this scale in their state waters.

As a Virginia resident I respectfully ask the board to consider the current state of affairs in the Bay and to take immediate and decisive action to manage this crucial issue.

Best regards,

Lee Ceperich
White Stone, VA

From:	Alan Kippy
To:	Tina Berger
Subject:	[External] FW: ASMFC Menhaden Board May 1st comments
Date:	Tuesday, April 25, 2023 11:50:37 AM

Subject: RE: ASMFC Menhaden Board May 1st comments

I have been in the Ches. Bay area since 1985. My first trip to the Bay allowed me to witness dozens of acres of full size adult bunker and 8 to 15 pound bluefish slaughtering them under the birds EVERYWHERE I looked. I also caught grey trout to 14 pounds every spring (early June) in Delaware Bay (Brandywine shoals)at night. Fish and bunker were plentiful then. Now….just ribbonfish. The big blues have been history for a long time in the bay. They follow the bunker….no bunker – no blues. I hear they are out 35 miles or more. I don't know. Grey trout are all but gone, but in the 90's you could catch hundreds of them under the lights at Kiptopeake. Not now! Herring? WTF happened to the herring? Mixed right along with the bunker I'd assume, turned into fish oil. No finger pointing there and I am surprised about that. People eat herring too!

You and your followers MUST totally shut down the bunker fleet here in the bay. Send them back to Canada and let em net yellow perch or something, before they deplete everything but ribbonfish here. I heard that OMEGA does not allow 'observers' from fed or state to be aboard their vessels. Is that correct? They have more power than our state and fed. Wildlife folks? That needs to change too. THEY must be shown that they are here by our graces and subject to our laws and limits. They gave us the bird finger when they intentionally overharvested bunker not long ago. Problem is……THEY'RE STILL HERE!!! Move em outta here please for our future's sake!!!

Alan Cochran

4122 Bruning Ct.

Fairfax, VA 22032

From: Tom Lilly <foragematters@aol.com>
Sent: Tuesday, April 25, 2023 8:53 AM
To: Tom Lilly <foragematters@aol.com>
Cc: jjbello@att.net; steveatkinson52@verizon.net; fayebailey28@gmail.com; bel44@verizon.net; debbiescampbell@icloud.com; lceperich@gmail.com; jcoker@co.northampton.va.us; daphnekcole8248@gmail.com; wdemmerle@outlook.com; cdollarchesapeake@gmail.com; hafbrau1@aol.com; info@puppydrum.net; jhiggins@trcp.org; jerrycole@gmail.com; mwrightjohnson@gmail.com; david_kabler@hotmail.com; sophieandfolly@yahoo.com; bkersta@aol.com; alankippy@gmail.com; mleonard@asafishing.org; almckegg@gmail.com; cmedice10@gmail.com; cmoore@cbf.org; savoystudio@gmail.com; chad@mraa.com; chris@bayflyfishing.com; RPaxton@dgparchitects.com; jbr1948@comcast.net; jerogers@aol.com; rogard@yahoo.com; branshew@gmail.com; davidsikorski@ccamd.org; l.lobosky@gmail.com; katturk1@gmail.com; blueyedmermaid@gmail.com; wvonohlen@gmail.com; kate.wilke@TNC.com; flypax@md.metrocast.net; dunnsville@gmail.com; llehowicz@gmail.com; eslaughter8890@gmail.com; grethelindemann@aol.com; cathlukas@gmail.com; cfoconsultllc@gmail.com
Subject: ASMFC Menhaden Board May 1st comments

To the above interested in VA menhaden conservation

Thank you for writing to the VMRC about the proposed buff/bycatch regulations. I secured copies by a FOIA request, I wanted to alert you to an ASMFC menhaden board meeting where Chair Mel Bell of SC has asked the VA delegates to report to the board on VA menhaden management. Certainly they will be telling the board about the MOA with the purse seine bait and reduction fishing and that menhaden are not overfished do everything is AOK in Virginia.

From out point of view VA menhaden management by the VMRC is not OK, quite the opposite. This begins when the MRC staff Shanna Masden and Pat Geer keep telling the MRC that the ASMFC says menhaden are not overfished, the stock is very healthy, This is the same thing Ben Landry of Omega keeps repeating. I hate to use the word "lie" but ASMFC Director Bob Beal addressed this in his letter to Commerce Secretary Ross in 2019, at page 3, "The Commissions action in setting the cap at 51,000mt .....reflects the reality that even with the stock of Atlantic menhaden not undergoing fishing on a coastwide basis, localizes depletion within the unique Bar ecosystem could have serious adverse effects on bay Commission managed fisheries in poor condition, as well as other avian and aquatic species" (scan) In fact , bay wildlife , particularly or two key menhaden overharvesting "indicator species" are suffering chronic reproductive failure. The striped bass spawning stock has four years of the lowest young of the year ever (scan) and ospreys are in a bay wide dye off from chick starvation due to menhaden harvesting (scan- Frontier's Journal- Academia.

The VMRC is aware the ASMFC finally adopted menhaden specific environmental reference points in 2020 but they are not being made aware of the conclusion that striped bass are the most "sensitive " fish species to menhaden harvests (scan Press Release) they are the "canary in the coal mine according to the ASMFC (scan) This is the science that connects the dots ....where there is overharvesting the indicator species will be harmed first and worst and the two species are having the worst harm a species can have,,,,reproductive failure. Ospreys are the second indicator species and they are in failure mode as well. One failure corroborates the other as to primary cause,

We now know the MRC has never gathered the information necessary to comply with VA Code 28-203 that applies to menhaden allocations (scan) That law requires the favor " the Commonwealth, the food and recreational fishermen " .We learned this in the VMRC response to our FOIA requests #23-24 (scan), In addition to Code section 28-203 the Commission Charter and menhaden Amendment 3 (which the US Department of Commerce forced Virginia to comply with) say allocations must consider not only the ecological consequences but also the social and economic consequences. The social and economic consequences of the decline in striped bass fishing in Virginia are grave indeed For example 600,000 fewer trips a year and $ 150,000 less spent at VA businesses a year by striped bass fiahermen. (scan VA data) Participation salt water fishing 15 million trips a year VA and MD (

scan NOAA- Lovell)

This has gone on too long but...We know why the MRC staff and the Commissioners refuse to listen to or apply available socio-economic information---its very obvious why they don't. Improving striped bass fishing by stopping the overharvestig as the ERP directs and the Frontier article confirm could save the ospreys creates benefits to the people, the fishermen and their children , to the charter captains and food fishermen in the ratios of a thousand to one . Marinas a ratio of one to eight hundred. Omega captains vs charter and food fish "captains" 10 to 1,800 in VA and MD, commercial crews , VA purse seiners (estimate 150) so 150 to 3,777 MD VA crews, 150 " purse seine fishermen vs 600,000 recreational fishermen MD and VA and about 50,000 of them children, charter clients benefited in VA and Md about 400,000 a year, about 90 fish wholesalers in the two states, one foreign owned business vs at least 10,000 small businesses in the two states affected by salt water fishing and boating, use of about 10 purse seine ships but decreased use and value of about 100,000 recreational fishing boats on the bay where these boats are often a families second most expensive investment and probably its most expensive one to own with insurance, fuel, repairs, trailer expense, replacement motors and electronics, slip fees, licensing fees and a hundred other expenses spent in MD and VA, THere is another thing here ..all the friendship and experiences that we have in those 15 million days fishing a year and all the proven mental and physical health benefits of nature based recreation specially for children (scan physical-health benefits)

It is not just at the VMRC that the managers refuse to consider any of the things I just mentioned. The menhaden delegates at the ASMFC totally refuse to comply with Section 6 of their Charter and menhaden Amendment 3 that says social and economic consequence MUST be considered. There was an important board meeting on November 22, 2022 there the delegates rained the Atlantic TAC (Commercial Quota) from

I

Tina Berger

From: Tom Lilly <foragematters@aol.com>
Sent: Friday, April 21, 2023 3:58 PM
To: James Boyle; Katie Drew; Robert Beal; Tina Berger
Subject: [External] Meeting May 1st menhaden possibilities
Attachments: NOAA Aging.pdf; YOY DNR.pdf; Canary story.pdf; Frontiers 2023.pdf; Frontiers 2019.pdf; ERP Press.pdf

To ASMFC Director Bob Beal , James Boyle,menhaden staff, scientists and Tina Berger (will send omitted scans later.....slo connection here)

Thought with the meeting on menhaden May 1st I should make you aware of some of the facts and opinions about Chesapeake Bay issues centering on overharvesting of menhaden causing reproductive failure of the bay's two iconic and menhaden "indicator" species, the striped bass spawning stock and ospreys. The ERP definitions and modeling bringing ospreys within the definion (see scans... ERP Press Release and Canary documents and "Path"article 2021 in "Frontiers" (scan) say plainly that severe problems such as reproductive failure (a species worst problem) in striped bass and ospreys is due to overharvesting of menhaden.The osprey article , also in Frontiers, (scan) corroborates what Dr Bryan Watts has been saying for years and in a real world sense both failures of these the two key avian and predator fish key species that represent the health of the Chesapeake Bay lays on a second layer of proof of cause. Both have failed.

With this proof of cause and effect and with the overwhelming evidence of negative social and economic consequences (scan Phil paper) compared to (scan George NY) these seem to be several relevant topics for discussion at the May 1st meeting. They are described below. There are also suggested motions.

Could you share this with your delegates so they can decide if it would be in the best interests of all the states and in particular Maryland that outlawed factory fishing 70 years ago but cannot prevent what you are allowing in Virginia. I will of course be available for any back up information, scans or discussion you want. The politics of this in Virginia are going to prevent any progress there ...the Governor has packed the MRC with Reedville - Omega advocates...any relief for Maryland will have to come from other states at the ASMFC for the benefit of everyone. Thanks again Tom Lilly 443 235 4465

Since menhaden board chair Mel Bell has scheduled VA menhaden as an item for discussion at the May 1st hybrid meeting I thought I would touch base with you. From what has gone on in VA the last two years it seems unlikely the VMRC will respond to anything or anyone interested in change in the menhaden harvest there.

That leaves the ASMFC to consider changes in Virginia such as reducing the current 51,000 mt cap, applying the cap to the VA coast or just zoning the reduction fishing into the US Atlantic. Since MD DNR in its statement on Resolution 02 questioned the authority of the ASMFC to do this I spoke to Bob Beal who was good enough to answer in the below mail . He reminded me that the only jurisdiction the states have through the Commission is to regulate in the states.(DNR 02 Statement-scan)

I join with millions of Marylanders and a bay full of precious wildlife that could benefit if you would ask the menhaden board to finally consider this proposal

" Determine the ecologic, social and economic consequences of leaving the factory fishing where it is or moving it out of the Bay or into the US Atlantic zone" (based on the best available information)

Since we know the Bay's two "indicator species" for menhaden overharvesting are suffering chronic reproductive failure (n.1) and that by the ERP definitions this failure of the striped bass spawning stock and nesting ospreys in due to overharvesting (n.2). The negative consequences of this to Marylanders (n.3) and Virginians (n.4) is all too well known. So another way to get this issue before the board could be a motion as follows:

"That the board determine the primary and contributing causes of the reproductive problems in the striped bass spawning stock and nesting ospreys in Chesapeake Bay based on the available scientific information and determine the likely social and economic consequences this has caused in Chesapeake Bay and determine the available management actions to correct the situation"

Another matter Allison mentioned at last weeks ASMFC ERP workshop was the percentage ot the year 0-2 menhaden harvested in the Bay. Allison said this size fish is most valuable for forage. Please look at the 2019-21 reduction fishing aging data finally coming out of the Beaufort lab. (scan). The Reduction catch of 0-2 year fish is in the Bay 99.1% . So in addition to the forage base and age diversity of the stock being destroyed there are many other bad consequences of this ...fish not allowed to spawn once, satisfying quota with large numbers of immature small fish etc. Another motion could be:

"That the board determine the cause and effect of the reduction industry harvesting large quantities of age 0-2 menhaden in Chesapeake Bay and the remedial measures that could be used to prevent or mitigate this in the future based on the best information now available

In conclusion and referring to the 15 million days Virginians and Marylanders, friends, families and children (and grandchildren) spend together salt water fishing a year (n.4) what is better to fill the holds of some multi millionaire's ships with thousands of tons of precious food that could be feeding our struggling wildlife or to leave it in the water to create more smiles on the faces of the kids and parents when they bring home some great memories of those adventures together and some fresh Chesapeake bay seafood to enjoy. That is the choice you make at every menhaden board meeting. Thanks for listening and I hope we can discuss this further before the meeting Tom Lilly 443 235 4465

SCANS:
(n.1) MD YOY
(n.2) ASMFC ERP Press Release
ASMFC "canary in coal mine"
as to the ERP definition and osprey
reproductive failure see article
scanned from Frontiers in Sci. journal
(n.3) PHIL's Charts MD data :
(n.4) Mail to VMRC re social and economics
10/24/22 at TLL mail VMRC

-----Original Message-----
From: Robert Beal <Rbeal@asmfc.org>
To: THOMAS LILLY <foragematters@aol.com>
Sent: Tue, Apr 18, 2023 4:16 pm
Subject: RE: [External] ASMFC Jurisdiction in state waters

Tom,

This is a follow-up to our conversation and your question regarding the Atlantic State Marine Fisheries Commission’s ability to establish and require implementation of fisheries regulations in state waters. The Commission’s role is to bring the states together to have them establish management programs for 27 species (or species groups) of marine fish or shellfish. Once the states approve these programs through the Commission process, they are obligated to implement the regulations consistent with the interstate fishery management plan. These regulations implemented by the states are binding in state waters.

The Commission is not a regulatory agency. It does not have the authority to implement regulations. However, as required by the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) the Commission's management plans must be implemented by the states.

Please let me know if you need more information on the Commission's process and authority,

Bob

From: Tom Lilly <foragematters@aol.com>
Sent: Tuesday, April 18, 2023 10:25 AM
To: Robert Beal <Rbeal@asmfc.org>
Subject: [External] ASMFC Jurisdiction in state waters

Hi Bob

Just a follow up on this. Could you write a response to this concern and address it to the menhaden board, to Mel Bell or to one of the staff concerned with menhaden or whomever is appropriate ?

Thanks Tom Lilly 443 235 4465

-----Original Message-----
From: Robert Beal <Rbeal@asmfc.org>
To: THOMAS LILLY <foragematters@aol.com>
Sent: Tue, Apr 11, 2023

Hi Tom,

I will give you a call at 2:30 tomorrow.

Bob

From: Tom Lilly <foragematters@aol.com>
Sent: Tuesday, April 11, 2023 12:23 PM
To: Robert Beal <Rbeal@asmfc.org>
Subject: Re: [External] Jurisdiction in state waters

From: Tom Lilly <foragematters@aol.com>
Sent: Tuesday, April 4, 2023 10:52 AM
To: Robert Beal <Rbeal@asmfc.org>
Subject: [External] Jurisdiction in state waters

Bob   I know you are busy with things other than menhaden. Over the years I have heard and see comments that question the authority of the Commission to regulate seasons, gear, quotas and zones of fishing in state waters. As to Chesapeake bay and Virginia the bay cap has been in effect for over 15 years and, of course, was upheld by the US Commerce Department after Virginia challenged it. This, I believe, is one of many examples of the Commission's authority to act in State waters.
    Could you possibly set aside a few minutes to discuss this ?   Thanks Tom Lilly   443 235 4465

they don't talk abt the two central species bec it reproductive fallacy

they don't agree to the term science is the real world EO definition see pag 12

ttds

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Challenges and Future Work
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REVIEW article

Front. Mar. Sci., 07 May 2021 | https://doi.org/10.3389/fmars.2021.607657 (https://doi.org/10.3389/fmars.2021.607657)

Check for updates

The Path to an Ecosystem Approach for Forage Fish Management: A Case Study of Atlantic Menhaden

not clear

Kristen A. Anstead (https://www.frontiersin.org/people/u/1089781)[1*], Katie Drew (https://www.frontiersin.org/people/u/990320)[1], David Chagaris (https://www.frontiersin.org/people/u/495125)[2], Amy McSchueller (https://www.frontiersin.org/people/u/1119106)[4], Jason E. McNamee (https://www.frontiersin.org/people/u/1124192)[5], Andre Buchheister (https://www.frontiersin.org/people/u/1120381)[6], Geneviève Nesslage (https://www.frontiersin.org/people/u/1126723)[7], Jim H. Uphoff Jr. (https://www.frontiersin.org/people/u/1171712)[8], Michael J. Wilberg (https://www.frontiersin.org/people/u/344791)[7], Alexei Sharov[9], Micah J. Dean[10], Jeffrey Brust[11], Michael Celestino[11], Shanna Madsen[12], Sarah Murray (https://www.frontiersin.org/people/u/1090785)[1], Max Appelman[1], Joseph C. Ballenger (https://www.frontiersin.org/people/u/1146004)[13], Joana Brito (https://www.frontiersin.org/people/u/359070)[2,14], Ellen Cosby[15], Caitlin Craig[16], Corrin Flora[17], Kurt Gottschall[18], Robert J. Latour (https://www.frontiersin.org/people/u/1146038)[19], Eddie Leonard[20], Ray Mroch[4], Josh Newhard (https://www.frontiersin.org/people/u/1111904)[21], Derek Orner[22], Chris Swanson[23], Jeff Tinsman[24], Edward D. Houde (https://www.frontiersin.org/people/u/615796)[7], Thomas J. Miller[7] and Howard Townsend (https://www.frontiersin.org/people/u/530527)[25]

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[12]Virginia Marine Resources Commission, Hampton, VA, United States
[13]South Carolina Department of Natural Resources, Charleston, SC, United States
[14]OKEANOS Research Center, University of the Azores, Horta, Portugal
[15]Potomac River Fisheries Commission, Colonial Beach, VA, United States
[16]New York Department of Environmental Conservation, East Setauket, NY, United States

They ignore and dont mention reality

the focus economic companies not defend as a whole

The 3 most imp factors are fed and ...

2021 JOURNAL FRONTIER

from BAM. All focal species had recently undergone single-species stock assessments, which provided life history, landings, and index data through 2017, as well as estimates of fishing mortality and population size. Newer data were not available for all of the groups included in the full NWACS EwE model; as a result, inputs for those groups were extrapolated from the terminal year of 2013.

The ERP WG evaluated the five ERP models based on their performance (i.e., residuals, sensitivities, and other diagnostics), their strengths and weaknesses, and their ability to inform the fundamental ecosystem management objectives (Buchheister et al., 2017a,b; McNamee, 2018; Uphoff and Sharov, 2018; Nesslage and Wilberg, 2019; Chagaris et al., 2020). The ERP WG ultimately recommended using the NWACS-MICE model rather than the other four for two reasons. First, the EwE framework used by the NWACS-MICE model was the only approach that could address both the top-down effects of predation on Atlantic menhaden and the bottom-up effects of Atlantic menhaden on predator populations, which were required to evaluate the key tradeoffs between Atlantic menhaden harvest and predator needs that were central to the identified ecosystem objectives. Second, the NWACS-MICE implementation was less data-intensive than the full NWACS model, which reduced some of the uncertainty associated with modeling the data-poor predators and prey in the full model. This meant the NWACS-MICE model could be updated more quickly and efficiently, on a timeframe that met manager's needs. Comparisons of the full and MICE versions of the NWACS model indicated that the NWACS-MICE model included the fish predators most sensitive to the menhaden population. Striped bass was the most sensitive fish predator to Atlantic menhaden harvest in both models. In the full NWACS model, nearshore piscivorous birds were also sensitive to Atlantic menhaden F, but their response was similar to striped bass over the range of scenarios explored by the full model (Southeast Data Assessment and Review [SEDAR], 2020b). This choice was consistent with a growing body of literature that has recommended models of intermediate complexity (i.e., MICE) for ecosystems as representing a compromise between complexity/realism and uncertainty for use in management (Plagányi et al., 2014; Collie et al., 2016; Punt et al., 2016). Specifically, the ERP WG recommended using the NWACS-MICE in conjunction with the single-species assessment model, BAM; the NWACS-MICE model would provide strategic advice about the trade-offs between Atlantic menhaden fishing mortality and predator biomass to set reference points, while the single-species model would be used to provide short-term tactical advice about harvest strategies to achieve the ERP F target (Chagaris et al., 2020; Southeast Data Assessment and Review [SEDAR], 2020b). The ERP report was peer-reviewed with the single-species assessment in 2019, and the ERP WG's recommended tool was deemed acceptable for management use by a panel of independent experts (Southeast Data Assessment and Review [SEDAR], 2020b). The peer-review panel also recommended the continued development of the alternative models going forward.

Birds

Current Management

The development and implementation of ERPs for Atlantic menhaden was a lengthy process (Figure 4 and Table 1), but in August 2020, ASMFC adopted the approach from the ERP WG for management use. The ERP target was defined as the maximum F on Atlantic menhaden that would sustain striped bass at their biomass target when striped bass were fished at their F target. The ERP threshold was defined as the maximum F on Atlantic menhaden that would keep striped bass at its biomass threshold when striped bass was fished at its F target. For both reference points, all other species in the model were fished at their *status quo* (i.e., 2017) F rates. Striped bass was the focal predator species for this analysis because it was the most sensitive to Atlantic menhaden F in both the NWACS-MICE and the full NWACS models. Thus, levels of Atlantic menhaden F that sustain striped bass should also sustain piscivorous birds and less sensitive predators, in the absence of significant disruptions to the ecosystem (Southeast Data Assessment and Review [SEDAR], 2020b). With these ERP targets and thresholds, the Atlantic Menhaden Management Board reviewed projections from the single-species model, BAM, and set a quota for 2021 and 2022 of 194,400 mt, a 10% decrease in the quota from 2020.

Birds

FIGURE 4

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Food supplementation increases reproductive performance of ospreys in the lower Chesapeake Bay

Michael H. Academia* and Bryan D. Watts

Center for Conservation Biology, College of William & Mary, Williamsburg, VA, United States

The Atlantic States Marine Fisheries Commission (ASMFC), the governing body responsible for managing fisheries on the U.S. East Coast, formally adopted the use of Ecological Reference Points (ERPs) for Atlantic menhaden, *Brevoortia tyrannus*. Scientists and stakeholders have long recognized the importance of menhaden and predators such as ospreys, *Pandion haliaetus*, that support the valuable ecotourism industry and hold cultural significance. Landings in the reduction fishery are at their lowest levels and menhaden is facing potential localized depletion. Mobjack Bay, located within the lower Chesapeake Bay, has been a focus of osprey research since 1970 and represents a barometer for the relationship between osprey breeding performance and the availability of their main prey, menhaden. Since local levels of menhaden abundance were not available, we conducted a supplemental menhaden feeding experiment on osprey pairs during the 2021 breeding season. Our main objective was to determine if the delivery rate of menhaden had an influence on nest success and productivity. Nest success ($\chi2 = 5.5$, df = 1, $P = 0.02$) and productivity ($\beta = 0.88$, SE = 0.45, CI = 0.049, 1.825, $P = 0.048$) were significantly higher within the treatment group. Reproductive rates within the control group were low and unsustainable suggesting that current menhaden availability is too low to support a demographically stable osprey population. Menhaden populations should be maintained at levels that will sustain a stable osprey population in which they are able to produce 1.15 young/active nest to offset mortality.

KEYWORDS
osprey, *Pandion haliaetus*, menhaden, *Brevoortia tyrannus*, localized depletion, ecological reference points, food supplementation

1 Introduction

World fisheries landings since the late 1980s have been steadily declining (Pauly and Zeller, 2016, FAO, 2020). With mounting concern over the state of our fisheries, management strategies have shifted focus from single-species to ecosystem-based objectives (Pauly et al., 2008). This style of management attempts to integrate ecological, economic, and social factors to secure and protect the sustainability of our fisheries and the ecosystems within which they reside (Einoder, 2009). Thus, United States federal policy firmly reinforces the implementation of Ecosystem-Based Fisheries Management (EBFM) which is an approach that considers trophic interactions and aims to promote the health and resilience of the ecosystem (McLeod and Leslie, 2009; Link, 2010, NMFS (National Marine Fisheries Service), 2016). Apex predators are essential indicators within this management approach and may provide more sensitive measures of changing fish populations because of their dietary dependencies (Furness, 1982; Diamond and Devlin, 2003). Monitoring fish-eating bird populations may be both more cost effective and better suited to the problem of understanding fish populations within an ecosystem (Cairns, 1988). Bird metrics may play an increasing role in the assessment of prey availability, especially in areas where conventional fisheries data are insufficient (Cairns, 1988). Bird populations may serve as an early warning system for changes in fish populations that have ecosystem implications (Kabuta and Laane, 2003; Cury et al., 2005).

The Atlantic States Marine Fisheries Commission (ASMFC), the governing body responsible for managing fisheries on the U.S. East Coast, formally adopted the use of Ecological Reference Points (ERPs) for Atlantic menhaden, *Brevoortia tyrannus*. Historical estimates of menhaden were limited and the harvest effects did not produce sufficient information on important predator species. Therefore, the ASMFC developed an interest in establishing ERPs to set quotas and evaluate menhaden's status and role as a forage species (Drew et al., 2021). Scientists and stakeholders have long recognized the importance of predators, such as bottlenose dolphins, *Tursiops truncates*, and humpback whales, *Megaptera novaeanglia*, that support a valuable ecotourism industry and hold cultural significance (Gannon and Waples, 2004; Glass and Watts, 2009; Butler et al., 2010; Smith et al., 2015; Drew et al., 2021).

Atlantic menhaden are a schooling fish that can be found along nearshore coasts along the Atlantic Ocean from Nova Scotia, CAN, to Florida, USA and go through large age- and size-dependent seasonal migrations (Dryfoos et al., 1973; Nicholson, 1978; Liljestrand et al., 2019). As indeterminate spawners, adults are capable of spawning multiple times in a season and inhabit estuarine and coastal areas such as Chesapeake Bay (Ahrenholz, 1991, Southeast Data Assessment and Review [SEDAR], 2020). As juveniles, they spend their first spring and summer in estuaries and by late fall, they join with other subadults and adults and migrate to nearshore coastal waters (Southeast Data Assessment and Review [SEDAR], 2020; Anstead et al., 2021).

Menhaden support the largest fishery in the U.S. East Coast by volume and is used for bait and reduced to fish oil and meal which are used for animal feed, fertilizer, and human health supplements (Anstead et al., 2021). The reduction fishery began in the mid-1800s with the use of purse seine gear and peaked in 1956 with over 20 menhaden reduction factories along the Atlantic Coast (Southeast Data Assessment and Review [SEDAR], 2020). Currently, landings in the reduction fishery are at their lowest levels (Southeast Data Assessment and Review [SEDAR], 2020) and at Chesapeake Bay, populations of menhaden are facing potential localized depletion. ASMFC defined localized depletion in Chesapeake Bay "as a reduction in menhaden population density below the level of abundance that is sufficient to maintain its basic ecological, economic, and social/cultural functions" (Annis et al., 2009). Localized depletion has not been officially defined or evaluated by managers because estimates of the standing stock within Chesapeake Bay have been unavailable and thresholds for exploitation cannot be resolved.

Known as the fish hawk, we selected the osprey as an appropriate non-finfish ERP to evaluate localized depletion of menhaden and food limitation within Chesapeake Bay. The ERP Work Group emphasized the research need for diet data collection and demographic responses of non-finfish predators (Atlantic States Marine Fisheries Commission [ASMFC], 2017). According to Buccheister et al. (2017), the nearshore piscivorous birds such as ospreys are sensitive to the overfishing of menhaden. Ecologically, ospreys are generalized specialists (Beirregaard et al., 2014). Specialized in that they are obligate piscivores and generalized in that they predate upon many species of fish. Ospreys surface plunge at a maximum depth of one meter and are more susceptible to a decrease in fish density than other birds such as pursuit divers that search for prey while swimming on the water surface and dive to deeper depths (Ashmole, 1971; Cramp and Simmons, 1979). Piscivory and plunge diving influences an ecological indicator's response to fish supply perturbations (Einoder, 2009). Reduced prey availability and fluctuations in environmental conditions are more evident in the foraging behavior and breeding success of a specialist (Furness and Ainley, 1984; Montevecchi, 1993). Moreover, shallow divers and surface feeders are more vulnerable, are considered more sensitive indicators than pursuit divers, and show greater variation in breeding performance (Montevecchi, 1993, Monaghan et al., 1994; Scott et al., 2006). As one of the more recognized raptors, ospreys have been used as an ecotoxicological sentinel species of environmental health due to their reproductive responses to natural and anthropogenic pressures and life history traits (Henny et al., 2008; Johnson et al., 2008; Grove et al., 2009). Ospreys exhibit strong nest fidelity and their reproductive status is observable by ground, boat, or aerial surveys which makes them a valuable and efficient sentinel of the ecosystem (Ogden et al., 2014) and an appropriate ERP for menhaden (Buccheister et al., 2017).

The Chesapeake Bay supports one of the largest osprey breeding populations in the world (Henny, 1983; Watts and Paxton, 2007). As with many similar populations, ospreys in the Chesapeake Bay experienced dramatic declines in the post-World War II era due to reproductive suppression (Truitt, 1969; Kennedy, 1971; Wiemeyer, 1971; Reese, 1977) induced by environmental contaminants (Via, 1975; Wiemeyer et al., 1975). The population sustained a low point by 1973 when Henny et al. (1974) estimated its size to be 1,450 breeding pairs. From 1973 to 1995, the population more than doubled in size to nearly 3,500 pairs (Watts et al., 2004) and believed to be between 8,000-10,000 pairs in 2020. However, the population has experienced spatial variation in recovery (Watts et al., 2004; Watts and Paxton, 2007). For example, average doubling time for the population on low-salinity, upper reaches of tributaries, was less than four years while doubling time on higher-salinity reaches of the lower Chesapeake Bay exceeded 40 years (Watts et al., 2004). This variation reflects the extent of the earlier decline, immigration from other regions of the Chesapeake Bay, and the local demography of pairs that may have been influenced by prey availability.

Mobjack Bay has been a focus of osprey research since 1970 and represents a barometer for the relationship between osprey breeding performance and menhaden availability (Glass, 2008). During the mid-1970s, there was little evidence of food limitation reflected in osprey reproductive performance and brood sizes within the higher salinity zones of the lower Chesapeake Bay (Stinson, 1976). However by the early 2000s, the proportion of menhaden in the diet had dropped by 40% and reproductive rates had dropped to precarious levels (Glass, 2008). We conducted a supplemental feeding experiment for osprey pairs nesting in Mobjack Bay during the 2021 breeding season. A clear barrier in resolving the relationship between osprey productivity and menhaden consumption is the lack of menhaden abundance data that can be scaled down to the local level. If such data were available, we could monitor osprey foraging, provisioning, and productivity, and assess the functional response to available menhaden. Since such data are not available, a food manipulative experiment in the wild was performed (Piatt et al., 2007). Our secondary objective was to determine prey composition and the dietary importance of menhaden.

2 Methods

2.1 Study species

Ospreys are large, long-winged raptors with a nearly global distribution that feed exclusively on fish (Poole, 2019). Most osprey populations across North America are migratory, spend the winter months in Central or South America and begin breeding at the age of three (Henny & Wight, 1969) Age-at-first-reproduction in Chesapeake Bay ospreys was recorded from 4 years (Kinkead, 1985) to 5.7 years (Poole, 1989; Poole et al., 2002). As the population reaches carrying capacity, age-at-first-reproduction increases (Spitzer, 1980; Poole, 1989). Poole (1989) estimated that pairs within the Chesapeake Bay must produce 1.15 young per year in order to offset adult mortality. On average, if the population consistently meets or exceeds this rate (demographic source) then the population would be expected to be stable to increasing (Pulliam, 1988). If the reproductive rate consistently falls below this threshold (demographic sink) the population would be expected to decline in the absence of compensatory immigration.

2.2 Food addition experiment

We established treatment (fish addition) and control (no fish addition) nests to assess the effect of increased provisioning on demography. We added 472 g ± 7.9 (SE) of menhaden every 3.5d ± 0.2 to treatment nests from the time of hatching to six weeks of age. We delivered menhaden to nests using a telescopic pole with a mounted delivery device. We sourced fresh or previously frozen menhaden from a local fishing supply company and the fish were counted, weighed, coded, and separated into packages for easy deployment. We selected study nests based on accessibility and randomly assigned accessible nests to treatments. We conducted an initial survey (late March to mid-April) of the study area for osprey nests (N = 114) and recorded location (latitude, longitude), accessibility by boat, nesting stage, nest substrate, height over water, and water depth. We screened nests for initial inclusion in the study based on accessibility, height over water (to allow for ready access to the nest) and water depth (to allow for boat access and maneuverability). We only included nests within the study that survived to hatching stage. We monitored all nests included within the initial draw until clutches hatched. Nests that hatched eggs were randomly assigned to two treatment groups (Figure 1) including a control group (N = 15) and a food addition group (N = 16). The nests in the East River were limited in boat accessibility and therefore assigned to the control group.

2.3 Demography

We monitored nests twice per week from clutch completion to fledging to quantify demographic parameters including clutch size, brood size, and the number of young fledged. From observations, we determined brood reduction (number of young lost between hatching and fledging). We noted the age that nestlings died and the stage when nests failed. We consider a nest to be successful if the pair produced at least one young to fledging age. We consider productivity to be the number of young that reached fledging age (7 wks) per active nest (Steenhof and Newton, 2007). We used a telescopic mirror pole to facilitate the examination of nest contents for nests that were >2 m above the water line.

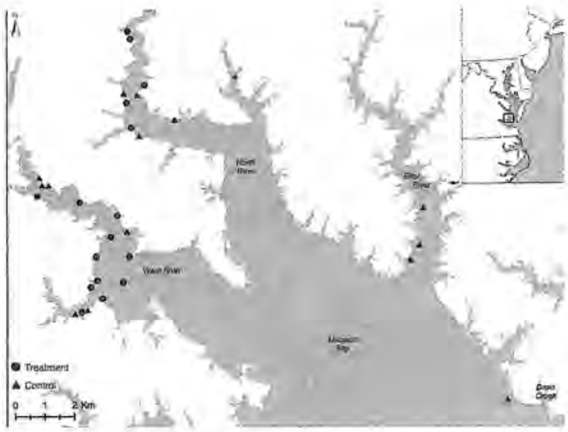

FIGURE 1
Map of the experimental area of Mobjack Bay on the lower eastern region of Chesapeake Bay, VA, USA. The locations of the control group (N = 15) represented by black triangles and the food addition group (N = 16) represented by black circles.

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2.4 Provisioning

We used trail cams (Browning Strike Force HD Pro X - BTC-5HDPX) to quantify nest provisioning rates including the average number of fish (n/day), biomass (g/day) and energy (kcal/day) for a subsample of treatment (N = 7) and control (N = 4) nests. We deployed cameras on nest structures that would accommodate them. We fastened trail cams to 1.91 cm (3/4 inch) diameter conduit and mounted conduit to the nesting structure such that cameras were positioned approximately 1 m above the nest. Cameras were programmed to record an image every 5 min during daylight hours (05:00 to 22:00). We extracted images from the photo set that depicted fish delivered to nests and identified all fish to the lowest taxonomic level possible. Most fish were identified to the species level but others could only be identified to the genus or family level. We estimated fish length from photos within an image processing program, ImageJ with Java (https://imagej.nih.gov/ij/index.html) and compared to known lengths from reference structures (Poole et al., 2002) including adult bill (male =32.5, female = 34.6 mm) and talon (male = 28.9, female = 30.0 mm). We estimated the biomass (g) of each fish using species-specific length-mass equations from published literature and FishBase (https://fishbase.in/, Appendix 2). We converted biomass to energy (kcal) using published species-specific energy density values (Appendix 3). For species that could not be identified to species, we used length-mass equations and energy density from a representative species of the taxonomic group. We consider the provisioning of control nests to include fish provided by adults and for treatment nests to include fish provided by adults and menhaden that we added to nests. It is important to note that treatment nests that did not have trail cameras were observed by boat and consumption of supplemented fish by the adults and young were verified.

2.5 Statistical analysis

Data were not independent, not normally distributed, and non-homogenous therefore, we used appropriate tests. We investigated the influence of treatment (control vs food addition) on demographic parameters including nest success, clutch size, the number of young hatched, brood reduction, and productivity. We constructed a two-by-two contingency table and used Pearson's Chi-squared analysis to compare the relationship between treatment type and nest success. We used Generalized Linear Models (GLMs) to determine if there were the average differences in clutch size, the number of young hatched, brood reduction, and productivity between the treatment types. For provisioning (fish/d, biomass/d, energy content/d), we analyzed data from trail cameras to evaluate the relationship between provisioning and demographic parameters. It is important to note that our models were based on totals and/or average provisioning rates including naturally provisioned and supplemental fish.

We used Generalized Linear Mixed Models (GLMMs) with a negative binomial distribution and log link, nest and treatment type as the random effects, and food addition and total provisioning (natural and supplemented) as the fixed effects. For the influence of provisioning on demographics, we used GLMs with a negative binomial distribution and log link and compared the effects of the mean fish/d, biomass/d, and energy content/d (natural and supplemented) on productivity (both treatment groups combined, N = 11). We calculated the supplemented average biomass/d/nest and energy content/d/nest threshold needed for the production of 1.15 fledglings per nest-season (estimated break-even rate). All analyses were performed in RStudio 4.02 and we used the MASS and glmmTMB packages for model development and validated by the DHARMa package for residual diagnostics on hierarchical regression models (Venables and Ripley, 2002; Brooks et al., 2017; R Core Team, 2020; Hartig, 2021).

3 Results

3.1 Food addition and demography

For the food addition group, 13 of the 16 nests (81%) succeeded with an average productivity rate of 1.13 + 0.18 (SE) young/active nest. The three nests that failed in this group failed on average during the first 1.38 + 0.5 wks. or when young were 10 d old. For the control group, five of the 15 nests (33%) succeeded with an average productivity rate of 0.47 young/active nest. The ten nests that failed in this group failed on average during the first 2.2 + 0.5 wks. The age at failure (d) between the food addition and control groups was not statistically significantly different (β = -0.47, SE = 0.41, P = 0.25). The age at failure for the control group ranged from 3 - 42 d with the highest mortality experienced during the first 15.5 d + 3.4 of the nestling period. Nest success and productivity were significantly different between the control and food addition groups (Table 1, Figure 2). Clutch size, the number of young hatched, and brood

TABLE 1 Two-way contingency table used for the Pearson's Chi-squared analysis that summarizes the relationship between treatment types and nest success during the 2021 osprey breeding season in the lower Chesapeake Bay, VA, USA ($\chi2$ = 5.5, df = 1, P = 0.02).

	NEST SUCCESS (NESTS)		
TREATMENT	SUCCESSFUL	FAILED	TOTAL
FISH ADDITION	13	3	16
CONTROL	5	10	15
TOTAL	18	13	31

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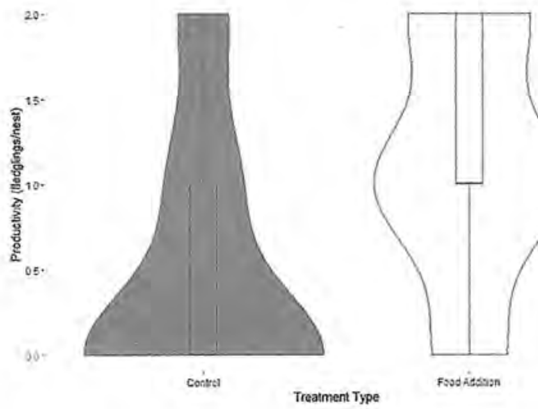

FIGURE 2
Productivity between the control group (N = 15) and the treatment group (N = 16) of ospreys during the 2021 breeding season in the lower Chesapeake Bay, VA, USA (β = 0.88, SE = 0.45, pseudo R^2 = 0.14, CI =0.049, 1.825, P= 0.048). Violin shapes represent the density of data distribution and the middle horizonal line of the box plots represent the median values.

reduction were not significantly different between the control and food addition groups (Table 2).

3.2 Provisioning and productivity

Food supplementation had a significant influence on the number of fish and amount of energy available to osprey broods (Table 3). A total of 241 Atlantic menhaden was supplemented to the food addition group and contributed 32,384 g that represented an estimated 61,206 kcal. This increased the average total prey biomass and energy content within the food addition group to 226.5 g/d/nest and 396.2 kcal/d/nest. The average biomass that was delivered to the control group was 166.8 g/d/nest and the average energy content was 242.2 kcal/d/nest (Appendix 1). For the control group, adult osprey delivered an average of 1.2 fish/d/nest compared to 1.1 fish/d/nest for the supplemented group.

Food supplementation had a significant influence on the likelihood that pairs reached the threshold reproductive rate of 1.15 young/nest (Figure 3). The estimated average fish biomass and energetic content needed for a pair to produce the threshold reproductive rate was 202.7 g/d and 338.6 kcal/d respectively. Within the study area, pairs required supplementation of 63.4 g/d of menhaden or 121 kcal/d in order to reach the productivity threshold.

Diet composition included a diverse list of fish species (Appendix 1). A total of 600 fish were documented as prey by ospreys in which 81% of taxa were identified to 21 species or to at least family. Atlantic menhaden (39%) dominated prey composition. Other known species included Atlantic herring (*Clupea harengus*) (10.3%), Atlantic croaker (*Micropogonias undulatus*) (5.8%), gizzard shad (*Dorosoma cepedianum*) (5.7%), and spot (*Leiostomus xanthurus*) (5%).

TABLE 2 Results for GLMs used to compare demographic parameters between treatment types during the 2021 osprey breeding season in the lower Chesapeake Bay, VA, USA.

DEMOGRAPHIC PARAMETERS	β	SE	PSEUDO r^2	CI	P
CLUTCH SIZE	0.07	0.21	0.75	-0.34, 0.48	0.75
No. of YOUNG HATCHED	0.12	0.24	0.04	-0.33, 0.62	0.57
BROOD REDUCTION	0.20	0.31	0.02	-0.81, 0.40	0.50

TABLE 3 Results of GLMMs with treatment effects on provisioning rates per d of nests under trail camera surveillance (N = 11) during the 2021 osprey breeding season in the lower Chesapeake Bay, VA, USA.

TREATMENT EFFECTS	β	SE	z VALUE	CI	P
FISH (number of fish/d)	0.25	0.02	13.4	0.21, 0.29	< 0.001
BIOMASS (g of fish/d)	0.002	0.0004	4.65	0.001, 0.003	< 0.001
ENERGY CONTENT (kcal of fish/d)	0.001	0.0002	5.22	0.008,0.002	< 0.001

4 Discussion

Supplementation of osprey nests with menhaden had a significant influence on the ability of nesting pairs to reach reproductive rates required for population maintenance. Our study shows that productivity was food limited as previous studies have substantiated (Simons and Martin, 1990; Richner, 1992; Wiehn and Korpimaki, 1997; Ferrer et al., 2018). Osprey pairs that did not receive supplementation had reproductive rates (0.47 young/nest) that were less than half of threshold levels. Within Mobjack Bay, productivity rates have shifted from reproductive surplus to reproductive deficit since the 1980s. For example, populations at various locations along the main stem of Chesapeake Bay were considered strongholds (McLean, 1986; Byrd, 1988). During 1983 and 1984, the average reproductive rate was 1.39 young/pair (Byrd, 1987). By 1988 and 1990, average productivity had dropped to 0.91 young/pair (Byrd, 1988, Byrd, 1990) and by 2005 and 2006 productivity had dropped further to 0.75 young/pair (Glass, 2008). If fishing pressure on menhaden within Chesapeake Bay persists, osprey productivity rates could decline precipitously, threaten population stability, and eventually lead to widespread population collapse. Menhaden populations should be maintained at levels that will sustain a stable osprey population in which they are able to produce 1.15 young/active nest to offset mortality.

Our research suggests that food addition significantly influenced osprey provisioning rates and these rates impacted reproductive performance. Specifically, daily average biomass and energy content of the prey composition significantly influenced productivity. Lind (1976) used a model developed by Wiens and Innis (1974) and calculated that each adult osprey required 286 kcal/d and each nestling at 11-16 d old needed at least 113 – 170 kcal/d. Based on calculations in which fish with an energy content of 1 kcal/g, a nest with two young plus the female would require 794 g of fish/d in order to successfully fledge and a nest with three young would require 1048 g of fish/d (Winberg, 1960). Along the U.S. Eastern Coast, Poole (1982) determined that male ospreys delivered 816 – 1426 g/d to nests that had young and nests that produced three – four young. In our study, menhaden consisted of 39% of the total diet composition and these fish have a high energy content of 1.89 kcal/g (June and Nicholson, 1964). Based on the calculations of Winberg (1960), if a nest fledged two young that was supplied with 39% or 309.7 g/d or 585.3 kcal/d of menhaden, the estimated additional biomass and energy content required would be 648.2 g/d or 1,225.1 kcal/d. Similarly if a nest fledged three young and was supplied with 39% or 408.7 g/d or 772.4 kcal/d of menhaden, the estimated additional biomass and energy content required would be 855.5 g/d or 1,616.9 kcal/d. For the nests in our study, the added average biomass and energetic threshold needed for a nest to reach the reproductive break-even point are 63.4 g/d and 121 kcal/d which would be a total average of 208.1 g/d and 347.6 kcal/d (Figure 3).

When we directly compared the provisioning rates in this study to historical studies in Mobjack Bay and the higher salinity areas of Chesapeake Bay, declines in daily fish deliveries were made evident. In 1975 and 1985, the fish delivery rate was 0.53 fish/hr/nest and 0.35 fish/hr/nest (McLean and Byrd, 1991). In 2006 and 2007, ospreys in the higher salinity areas delivered an average of 0.26 fish/h/nest (Glass, 2008). Our study revealed that in 2021, the fish delivery rate diminished to a mean of 0.11 fish/hr/nest. The average daily biomass delivered per nest fell from 237.1g and 172.3g in 1975 and 2007 to 144.7g in 2021 (Appendix 1, McLean and Byrd, 1991; Glass, 2008).

Brood reduction has been an effective parameter linking reproductive performance to food limitation in osprey (Glass, 2008). In a 5-yr study, Reese (1977) determined nestling loss rates in the upper Chesapeake Bay ranged from 8-23%. Nestling mortality rates were 47% and 78% for the supplementation and control groups respectively in this study. Poole (1984) conducted a

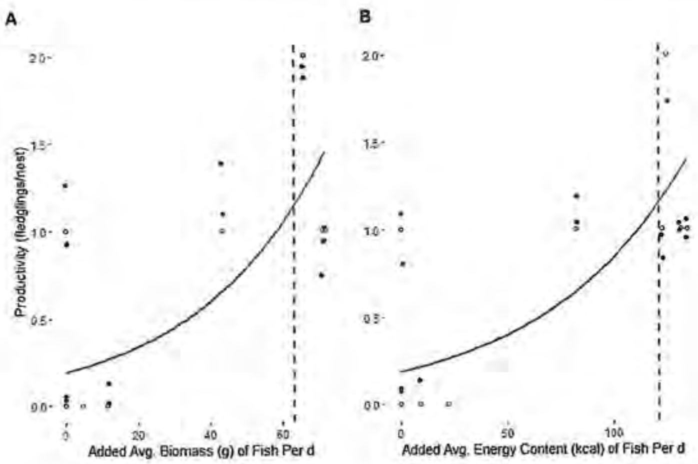

FIGURE 3
GLM's of the influence of the added (A) avg. biomass/d/nest (β = 0.03, SE = 0.01, Pseudo R^2 = 0.60, CI = 0.01, 0.05, P = 0.02) and (B) avg. energy content/d/nest (kcal) (β = 0.02, SE = 0.005, Pseudo R^2 = 0.64, CI = 0.006, 0.03, P = 0.02) for osprey pairs under trail camera surveillance after seven weeks post hatch of the first egg in 2021 breeding season in the lower Chesapeake Bay, VA, USA. The data points represented by white circles have been "jittered" along with random points represented in black circles for improved visibility of model fit. The dotted lines indicate the supplemented average biomass (63.4 g) and energy content (121 kcal) thresholds needed per d to produce 1.15 young per nest-season.

4-yr study in New England and determined that 75% of nestling mortality was caused by starvation. Glass and Watts (2009) determined that brood reduction was highly significant between nests in the lower estuarine sites compared to the higher estuarine sites and these data suggested that ospreys in the higher salinity areas were experiencing more food limitation than the lower salinity areas. Brood reduction has generally been linked with the lack of food availability in other study areas (Poole, 1982; Jamieson et al., 1983; Eriksson, 1986; Hagan, 1986; Forbes, 1991; Glass and Watts, 2009). Although brood reduction was higher in the control group, differences were not found to be significant in our study. This discrepancy could have been attributed to treatment effects in which the timing and intensity of the protocol was not strong enough to detect a significant signal. Perhaps if we supplemented more fish in greater frequency, we would have observed significant differences in the average brood reduction between the experimental groups.

The most compelling explanation for lower provisioning and productivity rates is localized depletion of the primary prey base. Although proximate causes of lower productivity may include storms, inter- and intraspecies competition, predation, as well as age-related care by parents, the ultimate cause of lower productivity may often be food shortage (Steenhof and Newton, 2007). Atlantic menhaden has a higher lipid content compared to other species with a nearly a 2:1 energy content/biomass ratio (June and Nicholson, 1964). Ospreys depend on menhaden and their reproductive performance is inextricably linked to the availability and abundance of this fish. In fact, previous studies have substantiated that menhaden are a vital prey item for ospreys during the breeding season particularly in the mid-Atlantic and northeastern United States (Spitzer and Poole, 1980; Poole, 1989; McLean and Byrd, 1991, Steidl et al., 1991, Glass and Watts, 2009). In 1985, this fish species consisted of 75% of the prey composition of ospreys in the lower Chesapeake Bay (McLean and Byrd, 1991). Then in 2006 and 2007, menhaden declined to 32% of the prey composition (Glass, 2008). In our study menhaden comprised of 39% of the total prey composition (Appendix 1). Assuming that the prey composition of ospreys reflects prey availability on a local level (Greene et al., 1983; Edwards, 1988; Glass, 2008), the current percentage of menhaden could indicate that this species has diminished in availability compared to the later portion of the 20th century.

Potential localized depletion of menhaden populations is one of the major sources of concern and conflict within Chesapeake Bay. According to the ASMFC, the coastwide stock assessment has determined that menhaden is not overfished and that no overfishing is occurring (Southeast Data Assessment and Review [SEDAR], 2020). However, a coastwide assessment does not capture spatial variation in menhaden availability for locations with persistent depletion such as Chesapeake Bay. Seine surveys of juvenile menhaden in Maryland and Virginia indicate that low levels of abundance and recruitment have been happening since the early 1990's and 2000's (Atlantic States Marine Fisheries Commission [ASMFC], 2004, Southeast Data Assessment and Review [SEDAR], 2020). Our data suggests that the reliable metric that links osprey population decline and food limitation is the osprey productivity rate. During the population decline in northern Florida, Bowman et al. (1989) determined that the productivity rate was 0.56 young/nest and this was due to insufficient food availability. When the Florida Bay population was healthy and food was abundant (Henny and Ogden, 1970), the productivity rate was 1.22 young/nest which is similar to the rate acquired by the food addition group of our study at 1.13 young/nest.

5 Conclusion

EBFM evolves when ERPs are consistently monitored (Pikitch et al., 2004). According to Amendment 3 of the Interstate Fishery Management Plan (FMP) for Atlantic menhaden (Southeast Data Assessment and Review [SEDAR], 2020; Anstead et al., 2021), ERPs are described as "a method to assess the status of menhaden not only with regard to the sustainability of human harvest, but also with the regard to their interaction with predators and the status of other prey species." The ERP working group is tasked with developing ERPs that are menhaden-specific that can account for the abundance of menhaden and their species role as a forage fish (Amendment 3 to the FMP, Anstead et al., 2021). Ospreys are non-finfish predators and can serve the ERP role which can allow management to practice informed decisions to develop harvest targets, assess menhaden's role as prey for upper trophic levels, and advance an ecosystem approach to fisheries management (EAFM) which considers multiple components of the ecosystem than just the target species (Patrick and Link, 2015). The menhaden population within Mobjack Bay is not currently adequate to sustain the osprey breeding population and we recommend that industrial purse seine fishing occur outside Chesapeake Bay.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Ethics statement

The animal study was reviewed and approved by Institutional Animal Care and Use Committee (IACUC-2021-05-03-14981-bjpaxt).

Author contributions

MA and BW designed and conducted the research. MA and BW performed the experiment, statistical analysis, and wrote the paper. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2023.1172787/full#supplementary-material

References

Ahrenholz, D. W. (1991). Population biology and life history of the north. *Mar. Fisheries Rev.* 53, 3.

Annis, E., Friedland, K., and Uphoff, J. (2009). Ecosystem-based fisheries management for Chesapeake bay: menhaden background and issue briefs. *Maryland Sea Grant* UMSGTS-2009-08, M/2–M/9.

Anstead, K. A., Drew, K., Chagaris, D., Schueller, A. M., McNamee, J. E., Buchheister, A., et al. (2021). The path to an ecosystem approach for forage fish management: a case study of Atlantic menhaden. *Front. Mar. Sci.* 8, 491. doi: 10.3389/fmars.2021.607657

Ashmole, P. (1971). "Sea Bird ecology and the marine environment," in *Avian biology*, vol. 1 . Eds. D. S. Farner and J. R. King (New York: Academic Press).

Atlantic States Marine Fisheries Commission (ASMFC) (2017). *Atlantic Menhaden stock assessment update* (Arlington, VA: ASMFC). Available at: http://www.asmfc.org/files/commissionerManual/ISFMP/MenhadenAssessmentOverview_Aug2017.pdf.

Atlantic States Marine Fisheries Commission (ASMFC) (2004). "Atlantic menhaden stock assessment report for peer review," in *Atlantic states marine fisheries commission, stock assessment report no. 04-01 (Supplement)* (Arlington, VA: Atlantic States Marine Fisheries Commission), 145.

Bierregaard, R. O., Poole, A. F., and Washburn, B. E. (2014). Ospreys (Pandion haliaetus) in the 21st century: populations, migration, management, and research priorities. *J. Raptor Res.* 48 (4), 301–308.

Bowman, R., Powell, G. V. N., Hovis, J. A., Kline, N. C., and Wimers, T. (1989). Variations in reproductive success between subpopulations of the osprey (Pandion haliaetus) in south Florida. *Bull. Mar. Sci.* 44 (1), 245–250.

Brooks, M. E., Kristensen, K., Van Benthem, K. J., Magnusson, A., Berg, C. W., Nielsen, A., et al. (2017). glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. *R J.* 9 (2), 378–400. doi: 10.32614/RJ-2017-066

Buchheister, A., Miller, T. J., and Houde, E. D. (2017). Evaluating ecosystem-based reference points for atlantic menhaden. *Mar. Coast. Fisheries* 9 (1), 457–478.

Butler, C. M., Rudershausen, P. J., and Buckel, J. A. (2010). Feeding ecology of Atlantic bluefin tuna (Thunnus thynnus) in north Carolina: diet, daily ration, and consumption of Atlantic menhaden (Brevoortia tyrannus). *Fishery Bull.* 108 (1), 56–59.

Byrd, M. A. (1987). "Osprey population studies," in *Virginia Nongame and endangered wildlife investigations* (Richmond, Virginia: Virginia Commission of Game and Inland Fisheries).

Byrd, M. A. (1988). "Osprey population studies," in *Virginia Nongame and endangered wildlife investigations* (Richmond, Virginia: Virginia Commission of Game and Inland Fisheries).

Byrd, M. A. (1990). "Osprey population studies," in *Virginia Nongame and endangered wildlife investigations* (Richmond, Virginia: Virginia Commission of Game and Inland Fisheries).

Cairns, D. K. (1988). Seabirds as indicators of marine food supplies. *Biol. Conserv.* 5, 261–271. doi: 10.1080/01965581.1987.10749517

S. Cramp and K. E. L. Simmons (Eds.) (1979). *The birds of the western palearctic* Vol. 11 (Oxford: Oxford University Press).

Cury, P., Shannon, L. J., Roux, J. P., Daskalov, G. M., Jarre, A., Moloney, C. L., et al. (2005). Trophodynamic indicators for an ecosystem approach to fisheries. *ICES J. Mar. Sci.* 62, 430–442. doi: 10.1016/j.icesjms.2004.12.006

Diamond, A. W., and Devlin, C. M. (2003). Seabirds as indicators of changes in marine ecosystems: ecological monitoring on machias seal island. *Environ. Monit. Assess.* 8, 153–175. doi: 10.1023/A:1025560805788

Drew, K., Cieri, M., Schueller, A. M., Buchheister, A., Chagaris, D., Nesslage, G., et al. (2021). Balancing model complexity, data requirements, and management objectives in developing ecological reference points for Atlantic menhaden. *Front. Mar. Sci.* 53. doi: 10.3389/fmars.2021.608059

Dryfoos, R. L., Cheek, R. P., and Kroger, R. L. (1973). Preliminary analysis of Atlantic menhaden, brevoortia tyrannus, migrations, population structure, survival and exploitation rates, and availability as indicated from tag returns. *Fish. Bull.* 71, 719–734.

Edwards, T. C. (1988). Temporal variation in prey preference patterns of adult ospreys. *Auk* 105, 244–251. doi: 10.2307/4087485

Einoder, L. D. (2009). A review of the use of seabirds as indicators in fisheries and ecosystem management. *Fisheries Res.* 95, 6–13. doi: 10.1016/j.fishres.2008.09.024

Eriksson, M. O. G. (1986). Fish delivery, production of young, and nest density of osprey (Pandion haliaetus) in southwest Sweden. *Can. J. Zoology* 64, 1961–1965. doi: 10.1139/z86-295

FAO (2020). "The state of world fisheries and aquaculture 2020," in *Brief. sustainability in action*(Rome: THE STATE OF THE WORLD series of the Food and Agriculture Organization of the United Nations). doi: 10.4060/ca9231en

Ferrer, M., Morandini, V., Baguena, G., and Newton, I. (2018). Reintroducing endangered raptors: a case study of supplementary feeding and removal of nestlings from wild populations. *J. Appl. Ecol.* 55, 1360–1367. doi: 10.1111/1365-2664.13014

Forbes, L. S. (1991). Hunger and food allocation among nestlings of facultatively siblicidal ospreys. *Behav. Ecol. Sociobiology* 29 (3), 189–195. doi: 10.1007/BF00166400

Furness, R. W. (1982). Competition between fisheries and seabird communities. *Adv. Mar. Biol.* 20, 225–309. doi: 10.1016/S0065-2881(08)60141-8

Furness, R. W., and Ainley, D. G. (1984). *Threat to seabird populations presented by commercial fisheries* (Cambridge, UK: ICBP).

Gannon, D. P., and Waples, D. M. (2004). Diets of coastal bottlenose dolphins from the US mid Atlantic coast differ by habitat. *Mar. Mammal Sci.* 20 (3), 527–545. doi: 10.1111/j.1748-7692.2004.tb01177.x

Glass, K. A. (2008). "Broad spatial trends in osprey provisioning, reproductive success, and population growth within lower Chesapeake bay," in *Dissertations, theses, and masters projects* (Virginia, USA: William & Mary. Paper). 1539626869. doi: 10.21220/s2-1n55-ph30

Glass, K. A., and Watts, B. D. (2009). Osprey diet composition and quality in high and low salinity areas of lower Chesapeake bay. *J. Raptor Res.* 43, 27–36. doi: 10.3356/JRR-08-22.1

Greene, E. P., Greene, A. E., and Freedman, B. (1983). *Foraging behavior and prey selection by ospreys in coastal habitats in Nova Scotia, Canada in biology and management of bald eagles and ospreys*. Ed. D. M. Bird (Ste. Anne de Bellevue, Quebec: Harpell Press), Pp. 257–267.

Grove, R. A., Henny, C. J., and Kaiser, J. L. (2009). Osprey: worldwide sentinel species for assessing and monitoring environmental contamination in rivers, lakes, reservoirs, and estuaries. *J. Toxicol. Environ. Health Part B* 12, 1,15–1,44. doi: 10.1080/10937400802545078

Hagan, J. M. (1986). Temporal patterns in pre-fledging survival and brood reduction in an osprey colony. *Condor* 88, 200–205. doi: 10.2307/1368916

Hartig, F. (2021). "DHARMa: residual diagnostics for hierarchical (Multi-level / mixed) regression models," in *R package version 0.4.4.* Available at: https://CRAN.Rproject.org/package=DHARMa.

Henny, C. J. (1983). "Distribution and abundance of nesting ospreys in the united states," in *Biology and management of bald eagles and ospreys* (Quebec, Canada: Harpell Press).

Henny, C. J., Grove, R. A., and Kaiser, J. L. (2008). Osprey distribution, reproductive success and contaminant burdens (OC pesticides, PCBs, PCDDs, PCDFs and mercury) along lower Columbia river 1997/1998 vs 2004. *Arch. Environ. Contam. Toxicol.* 54, 525–534. doi: 10.1007/s00244-007-9041-1

Henny, C. J., and Ogden, J. C. (1970). Estimated status of osprey populations in the united states. *J. Wildlife Manage.* 1, 214–217. doi: 10.2307/3799513

Henny, C. J., Smith, M. M., and Stotts, V. D. (1974). The 1973 distribution and abundance of breeding ospreys in the Chesapeake bay. *Chesapeake Sci.* 15 (3), 125-133. doi: 10.2307/1351027

Henny, C. J., and Wight, H. M. (1969). An endangered osprey population: estimates of mortality and production. *Auk* 86 (2), p.188–p.198. doi: 10.2307/4083495

Jamieson, I. G., Seymour, N. R., Bancroft, R. P., and Sullivan, R. (1983). Sibling aggression in nestling ospreys in Nova Scotia. *Can. J. Zoology* 61, 466–469. doi: 10.1139/z83-063

Johnson, B. L., Kaiser, J. L., Henny, C. J., and Grove, R. A. (2008). Prey of nesting ospreys on the Willamette and Columbia rivers, Oregon and Washington. *Northwest Sci.* 82 (3), 229–236. doi: 10.3955/0029-344X-82.3.229

June, F. C., and Nicholson, W. R. (1964). Age and size composition of the menhaden catch along the Atlantic coast of the united states 1958; with a brief review of the commercial fishery. *Special Scientific Report-Fisheries* 446, 1-26.

Kabuta, S. H., and Laane, R. W. P. M. (2003). Ecological performance indicators in the north Sea: development and application. *Ocean Coast. Manage.* 46, 277–297. doi: 10.1016/S0964-5691(03)00009-7

Kennedy, R. S. (1971). *Population dynamics of ospreys in tidewater, Virginia 1970 1971. M.A* (Williamsburg, VA: College of William and Mary), pp.83.

Kinkead, T. P. (1985). Age structure and dispersal of Chesapeake bay ospreys. *Dissertations, Theses, and Masters Projects* (William & Mary: Virginia, USA). Paper 1539625299. doi: :10.21220/s2-byss-qr76

Liljestrand, E. M., Wilberg, M. J., and Schueller, A. M. (2019). Estimation of movement and mortality of Atlantic menhaden during 1966–1969 using a Bayesian multi-state mark recovery model. *Fisheries Res.* 210, 204–213. doi: 10.1016/j.fishres.2018.10.015

Lind, G. S. (1976). *Production, nest site selection, and food habits of ospreys on deschutes national forest, oregon. M.S* (Corvallis, OR, USA: Oregon State University).

Link, J. (2010). *Ecosystem-based fisheries management: confronting tradeoffs* (Cambridge, UK: Cambridge University Press).

McLean, P. K. (1986). *The feeding ecology of the Chesapeake bay ospreys and the growth and behavior of their young* (Williamsburg, VA USA: The College of William and Mary).

McLean, P. K., and Byrd, M. A. (1991). Feeding ecology of Chesapeake bay ospreys and growth and behavior of their young. *Wilson Bull.* 103, 105–111.

McLeod, K. L., and Leslie, H. M. (2009). "Why ecosystem-based management" in *Ecosystem-based management for the oceans.* (Washington DC, USA: Island Press), pp. 3–12.

Monaghan, P., Walton, P., Wanless, S., Uttley, J. D., and Bljrns., M. D. (1994). Effects of prey abundance on the foraging behaviour, diving efficiency and time allocation of breeding guillemots uria aalge. *Ibis* 136 (2), 214–222.

Montevecchi, W. A. (1993). "Birds as indicators of change in marine prey stocks," in *Birds as monitors of environmental change.* Eds. R. W. Furness and J. J. D. Greenwood (London: Chapman and Hall), 217–265.

Nicholson, W. R. (1978). Movements and population structure of Atlantic menhaden indicated by tag returns. *Estuaries* 1 (3), 141–150. doi: 10.2307/1351455

NMFS (National Marine Fisheries Service) (2016). "Ecosystem-based fisheries management policy of the national marine fisheries service national oceanic and atmospheric administration," in *NMFS policy directive 01-120* (USA). Available at: www.nmfs.noaa.gov/op/pds/index.html.

Ogden, J. C., Baldwin, J. D., Bass, O. L., Browder, J. A., Cook, M. I., Frederick, P. C., et al. (2014). Waterbirds as indicators of ecosystem health in the coastal marine habitats of southern Florida: 1. selection and justification for a suite of indicator species. *Ecol. Indic.* 44, 148–163. doi: 10.1016/j.ecolind.2014.03.007

Patrick, W. S., and Link, J. S. (2015). Myths that continue to impede progress in ecosystem based fisheries management. *Fisheries* 40 (4), 155–160. doi: 10.1080/03632415.2015.1024308

Pauly, D., Alder, J., Booth, S., Cheung, W. W. L., Christensen, V., Close, C., et al. (2008). Fisheries in large marine ecosystems: descriptions and diagnoses. the UNEP large marine ecosystem report: a perspective on changing conditions in LMEs of the world's regional seas. *UNEP Regional Seas Rep. Stud.* 182), 23–40.

Pauly, D., and Zeller, D. (2016). Comments on FAOs state of world fisheries and aquacultur (SOFIA 2016) marine policy. *Marine Policy* 77, 2017, 176–181. doi: 10.1016/j.marpol.2017.01.006

Piatt, J. F., Harding, A. M., Shultz, M., Speckman, S. G., Van Pelt, T. I., Drew, G. S., et al. (2007). Seabirds as indicators of marine food supplies: cairns revisited. *Mar. Ecol. Prog. Ser.* 352, 221–234. doi: 10.3354/meps07078

Pikitch, E. K., Santora, C., Babcock, E. A., Bakun, A., Bonfil, R., Conover, D. O., et al. (2004). Ecosystem based fishery management. *Science* 305 (5682), 346–347. doi: 10.1126/science.1098222

Poole, A. F. (1982). Brood reduction in temperate and sub-tropical ospreys. *Oecologia* 53 (1), 111–119. doi: 10.1007/BF00377144

Poole, A. F. (1984). *Reproductive limitations in coastal ospreys: an ecological and evolutionary perspective* (Boston, MA: Unpubl. Ph.D. diss. Boston University).

Poole, A. F. (1989). *Ospreys: a natural and unnatural history (Vol. 246)* (Cambridge, UK: Cambridge University Press).

Poole, A. F. (2019). *Ospreys: the revival of a global raptor* (Baltimore, Maryland, USA: JHU Press).

Poole, A. F., Bierregaard, R. O., and Martell, M. S. (2002). *Osprey. birds of north America, no 683, ser.* Eds. A. F. Poole and F. Gill (Philadelphia, PA: Birds of North America, Inc).

Prevost, Y. A. (1983). "Osprey distribution and subspecies taxonomy," in *Biology and management of bald eagles and ospreys.* Ed. D. M. Bird (Montreal: Raptor Research Foundation), 157–174.

Pulliam, H. R. (1988). Sources, sinks, and population regulation. *Am. Nat.* 132 (5), 652–661. doi: 10.1086/284880

R Core Team (2020). *R: a language and environment for statistical computing* (Vienna, Austria: R Foundation for Statistical Computing). Available at: https://www.R-project.org/.

Reese, J. G. (1977). Reproductive success of ospreys in central Chesapeake bay. *Auk* 94 (2), 202–221. doi: 10.1093/auk/94.2.202

Richner, H. (1992). The effect of extra food on fitness in breeding carrion crows. *Ecology* 73, 330–335. doi: 10.2307/1938744

Scott, B. E., Sharples, J., Wanless, S., Ross, O. N., Frederiksen, M., and Daunt, F. (2006). "The use of biologically meaningful oceanographic indicies to separate the effects of climate and fisheries on seabird breeding success," in *Top predators in marine ecosystems.* Eds. I. L. Boyd, S. Wanless and C. J. Camphuysen (Cambridge: Cambridge University Press), 45–62.

Simons, L. S., and Martin, T. E. (1990). Food limitation of avian reproduction an experiment with the cactus wren. *Ecology* 71, 869–876. doi: 10.2307/1937358

Smith, C. R., Glover, A. G., Treude, T., Higgs, N. D., and Amon, D. J. (2015). Whale-fall ecosystems: recent insights into ecology, paleoecology, and evolution. *Annu. Rev. Mar. Sci.* 7, 571–596. doi: 10.1146/annurev-marine-010213-135144

Southeast Data Assessment and Review [SEDAR] (2020). *SEDAR 69 - Atlantic menhaden benchmark stock assessment report* (North Charleston SC: SEDAR).

Spitzer, P. R. (1980). *Dynamics of a discrete coastal breeding population of ospreys (Pandion haliaetus) in the northeastern united states during a period of decline and recovery 1969-1978* (New York: Cornell Univ.).

Spitzer, P. R., and Poole, A. F. (1980). Coastal ospreys between new York city and Boston: a decade of reproductive recovery 1969-1979. *Am. Birds.* 34, 233–242.

Steenhof, K., and Newton, I. (2007). *Assessing raptor nest success and productivity, in raptor research and management techniques.* Eds. D. M. Bird and K. L. Bildstein (Canada: Hancock House, Surrey, BC), 193–220.

Steidl, R. J., Griffin, C. R., and Niles, L. J. (1991). Contaminant levels of osprey eggs and prey reflect regional differences in reproductive success. *J. Wildlife Manage.* 601–608.

Stinson, C. H. (1976). *The evolutionary and ecological significance of the clutch size of the osprey* (Virginia: College of William and Mary, Williamsburg).

Truitt, R. V. (1969). The ospreys of great neck. *Atlantic Nat.* 24, 195–200.

Venables, W. N., and Ripley, B. D. (2002). "Random and mixed effects," in *Modern applied statistics with s* (New York, NY: Springer), 271–300.

Via, J. W. (1975). *Eggshell thinning and pesticide residues in ospreys from the lower Chesapeake bay* (Virginia: College of William and Mary, Williamsburg).

Watts, B. D., Byrd, M. A., and Watts, M. U. (2004). Status and distribution of breeding ospreys in breeding ospreys in Chesapeake bay: 1995-1996. *J. Raptor Res.* 38, 47–54.

Watts, B. D., and Paxton, B. J. (2007). Ospreys of the Chesapeake Bay: population recovery ecological requirements, and current threats. *Waterbirds*, 39–49. doi: 10.1675/1524-4695(2007)030[0039:OOTCBP]2.0.CO;2

Wiehn, J., and Korpimaki, E. (1997). Food limitation on brood size: experimental evidence in the Eurasian kestrel. *Ecology* 78, 2043–2050. doi: 10.1890/0012-9658(1997)078[2043:FLOBSE]2.0.CO;2

Wiemeyer, S. N. (1971). Reproductive success of potomac river ospreys–1970. *Chesapeake Sci.* 12 (4). 278–280. doi: 10.2307/1350918

Wiemeyer, S. N., Spitzer, P. R., Krantz, W. C., Lamont, T. G., and Cromartie, E. (1975). Effects of environmental pollutants on Connecticut and Maryland ospreys. *J. Wildlife Manage.* 1, 124–139. doi: 10.2307/3800475

Wiens, J. A., and Innis, G. S. (1974). Estimation of energy flow in bird communities: a population bioenergetics model. *Ecology* 55, 730–746. doi: 10.2307/1934410

Winberg, G. G. (1960). Rate of metabolism and food requirements of fishes. Fisheries research board of Canada translation series 194 ed.

FWD: Menhaden
From: George Scocca george@nyangler.com
To: Tom foragematters@aol.com
Date: Mon, March 8, 2021 7:15am

Hello Tom:

I am the person that spearheaded the bill that has kept reduction fishing out of NY waters. The changes here have been unbelievable. I can talk about it all day. My single greatest accomplishment in 35 years of fisheries management.

The availability of bunker throughout our season has seen an increase in both charter and party boats carrying anglers to get in on our great striped bass fishery. Bass stick with their food source and this has kept a healthy population of stripers in our waters. It's sparked a number of for hire boats to carry more anglers than ever before.

It has also had a profound effect on our bird population. We now have about 12 dozen nest pair eagles on long island and the osprey population is thriving. All due to the amount of forage for them to eat.

And lets not forget the importance of their filtering our waters.

Thank you.

George R. Scocca
nyangler.com

Check out my Linkedin profile

Atlantic Menhaden age estimations from the reduction fishery 2019-2021
NOTE that age estimates are expressed in number of fish aged
Data are from NMFS Beaufort Laboratory, Ray Mroch 1/20/2023

		Individuals			Percentage		
Area	Age	2019	2020*	2021*	2019	2020	2021
	0	0	0	0	0.0%	0.0%	0.0%
	1	280	0	7	45.1%	0.0%	9.2%
	2	275	0	65	44.3%	0.0%	85.5%
Mid-Atlantic Region	3+	66	0	4	10.6%	0.0%	5.3%
	0	4	0	0	0.3%	0.0%	0.0%
	1	1099	87	430	73.5%	20.4%	66.7%
	2	321	338	209	21.5%	79.3%	32.4%
Chespeake Bay	3+	71	1	6	4.7%	0.2%	0.9%
	0	0	0	0	0.0%	0.0%	0.0%
	1	46	0	0	47.9%	0.0%	0.0%
	2	36	0	0	37.5%	0.0%	0.0%
Fall Fishery	3+	14	0	0	14.6%	0.0%	0.0%

* Samples from 2020 and 2021 were limited due to the stay-at-home orders resulting from the COVID-19 pandemic

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Atlantic Striped Bass Management Board**

FROM: **Emilie Franke, FMP Coordinator**

DATE: **April 25, 2023**

SUBJECT: **Conservation Equivalency and Reduction Considerations for Management Actions under Amendment 7**

At the upcoming 2023 Spring Meeting, the Atlantic Striped Bass Management Board (Board) may consider potential management action in response to the Technical Committee (TC) projections incorporating preliminary 2022 removals. This memorandum reviews the conservation equivalency (CE) and reduction considerations if a management action is initiated by the Board.

Atlantic striped bass are managed under Amendment 7 to the Interstate Fishery Management Plan (FMP). Amendment 7 maintains the same commercial quotas (18% reduction from Add IV) and the same recreational size/bag limits (1 fish at 28-<35" for ocean; 1 fish at 18" min. for Bay) as Addendum VI, which were designed to achieve an 18% reduction from 2017 levels. As such, all approved Addendum VI conservation equivalency programs are maintained until such measures are changed. Approved Addendum VI CE programs are summarized in the enclosed table. Current CE programs include seasonal closures in some Chesapeake Bay jurisdictions, and some states took a less than 18% reduction in commercial quotas offset by a greater than 18% reduction by the recreational sector.

CE Stock Status Restriction

If the Board initiates a new action (e.g., addendum) to change management measures, that action will be subject to the Amendment 7 CE stock status restriction since the stock is currently overfished. When the stock is overfished, CE programs will not be approved for non-quota managed recreational fisheries, with the exception of the Hudson River, Delaware River, and Delaware Bay recreational fisheries.

This means that most recreational fisheries cannot deviate from the new FMP standards that would be specified in a new addendum. For example, if a new addendum specifies an FMP standard of specific season dates for the entire Chesapeake Bay, then all Chesapeake Bay states must implement those season dates. If a new addendum specifies an FMP standard of state-specific seasons, then state-specific seasons could be implemented.

Through a new addendum, the Board could choose to change some measures while maintaining other existing measures. For example, an addendum could specify a new FMP

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standard size/bag limit for the ocean and new size/bag limit for the Chesapeake Bay, while also specifying the FMP standard season as maintaining current state-specific seasons.

The only non-quota managed recreational fisheries that could deviate from new FMP standards through CE are Hudson River, Delaware River, and Delaware Bay recreational fisheries. Or, the Board could choose to specify FMP standards for those fisheries in the addendum.

As a reminder, the Chesapeake Bay spring trophy fishery is part of the ocean fishery for management purposes, and so will be subject to the same requirements as the ocean recreational fishery in any new action, unless that action establishes specific trophy fishery measures.

Board Guidance on Reduction Measures
If the Board initiates a management action to achieve a percent reduction, the TC would need guidance on what types of measures should be considered. In August 2022, the Board had a hypothetical discussion about what types of measures to consider in the event the 2022 Stock Assessment Update indicated a reduction was needed to rebuild the stock. Although a reduction was not indicated from the 2022 Assessment Update, the Board prepared for that possible outcome by addressing the following questions at the August 2022 Board meeting:

- How should the reduction be split between the commercial and recreational sectors? Should both sectors take the same percent reduction, or should one sector take a higher or lower percent reduction?
    - Board discussion from August 2022: requested options for both (1) an equal percent reduction for both sectors and (2) a different percent reduction for each sector weighted based on proportion of total removals.

- What recreational measures should be considered? If considering seasonal closures, would the Board prefer a consistent coastwide closure or flexibility for states to choose closure dates (e.g., within a particular wave)?
    - Board discussion from August 2022 for Ocean: requested options for the ocean that would either shrink or shift the current ocean slot limit. Seasonal closure options for the ocean could be considered if adjusting the slot limit does not achieve the reduction; any ocean seasonal closure options would be no-harvest closures with flexibility for states to select closure dates.
    - Board discussion from August 2022 for Chesapeake Bay: requested options for a Baywide slot limit or maximum size limit (e.g., 36” maximum), as well as options for seasonal closures, including Bay state-specific seasonal closure options.

Moving Forward from Current Measures
In August 2022, the Board also discussed the TC recommendation regarding how to move forward from current Addendum VI CE programs. The TC noted that while it would be possible to calculate a potential reduction under the assumption that all states implemented the Addendum VI FMP standard (instead of their CE programs), it would add additional uncertainty

by trying to predict what removals would have been under different regulations. Therefore, the TC recommended using the current set of management measures and resulting level of removals (now looking at 2022 removals) as the starting point for calculating the potential reduction. In other words, what new set of management measures would achieve the rebuilding reduction relative to the 2021/2022 commercial quotas and 2021/2022 recreational size limits/bag limits/seasons?

At the August 2022 meeting, the Board supported the TC's recommendation to use the current set of management measures and resulting level of removals as the starting point for calculating the potential reduction. The TC would develop a new set of management measures designed to achieve the reduction relative to the 2021/2022 commercial quotas and 2021/2022 recreational size limits/bag limits/seasons.

Again, through a new action, the Board could choose to change some measures while maintaining other existing measures (e.g., change the size/bag limits but maintain 2022 seasons).

The TC memo from August 2022 (Memo 22-77) is available here:
http://www.asmfc.org/uploads/file/63cb1abeSBTCreport_PotentialReductionMemo_07.2022.pdf

The full summary of August 2022 Board discussion is available here:
https://asmfc.org/files/Meetings/2022SummerMeeting/2022SummerMeetingSummary.pdf

Table. CE programs implemented for Addendum VI

State	Recreational Fisheries	Commercial Fisheries
MA	N/A	Changed size limit (35” minimum) with equivalent quota change
NY	Hudson River: Alternative size limit (18” to 28”) to achieve 18% removals reduction in combination with standard Ocean slot	Changed size limit (26” to 38”) with equivalent quota reduction
NJ	Alternative size limit (28 to < 38”) to achieve 25% removals reduction	Decreased commercial quota reduction (to 0%) with surplus recreational fishery reduction and transferred commercial quota to recreational bonus program fishery (24 to < 28”, 1 fish/day)
PA	DE River and Estuary downstream Calhoun St Bridge: Alternative size and bag limit on limited seasonal basis (2 fish/day at 21 to <24” during 4.1–5.31) to achieve 18% removals reduction	N/A
DE	DE River/Bay/tributaries: Alternative slot on limited seasonal basis (20" to <25" during 7.1–8.31) to achieve 20.4% removals reduction in combination with standard Ocean slot	Decreased commercial quota reduction (to -1.8%) with surplus recreational fishery reduction
MD	Chesapeake Bay: Alternative Summer/Fall for-hire bag limit with restrictions (2 fish, only 1 >28”, no captain retention) through increased minimum size (19”), April and two-week Wave 4 targeting closures, and shorter spring trophy season (May 1–15) to achieve 20.6% removals reduction; Ocean: FMP standard slot	Decreased Ocean and Chesapeake Bay commercial quota reduction (to -1.8%) with surplus Chesapeake Bay recreational fishery reduction
PRFC	Alternative Summer/Fall minimum size and bag limit (20” min, 2 fish/day) with a no targeting closure (7.7–8.20) and shorter spring trophy season (May 1–15) to achieve a 20.5% removals reduction	Decreased Chesapeake Bay commercial quota (to -1.8%) with surplus recreational fishery reduction
VA	Chesapeake Bay: Alternative slot limits during 5.16–6.15 (20” to 28”) and 10.4–12.31 (20” to 36”) and no spring trophy season to achieve a 23.4% removals reduction (reduction was the result of lowering prior bag limit from 2 to 1-fish per angler); Ocean: Alternative slot limit (28” to 36”)	Decreased Ocean commercial quota (to -7.7%) and Chesapeake Bay commercial quota (to -9.8%) with surplus recreational fishery reduction

R.I. Party and Charter Boat Association
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March 17, 2023

Mr. Marty Gary, Chair
Atlantic Striped Bass Management Board
Atlantic States Marine Fisheries Commission
1050 North Highland Street, Suite 200A-N
Arlington, Virginia 22201

RE: Possible Management response to March TC/SAS report

Mr. Gary,

The Rhode Island Party and Charter Boat Association (RIPCBA) is comprised of 58 charter/party boat owners that operate small businesses from ports in the State of Rhode Island. Without question, the harvest of Striped Bass is of significant importance to nearly all of our members. We would like to offer a few thoughts as the Striped Bass Management Board (Board) considers a management response to the recent Technical Committee and Stock Assessment Subcommittee's (TC/SAS) tasking report.

We are not surprised by the 40% increase in recreational removals in 2022. Reports from nearly every part of the coast were strong in 2022. It is worth noting that coastwide Charter/Party mode catch increased by less than 2% in 2022 compared to 2021 according to MRIP.

We consider the Striped Bass fishery to be conservatively managed with positive results over time. As the Board considers if it should wait for the next assessment or develop a management response for 2024, we ask that consideration be given to the importance of harvest of striped bass to the charter/party mode. Like other areas and charter/party associations, we have members that have built a business around catch and release, but the majority of our members support clients who desire harvesting Striped Bass for food. Nearly all of the recent management approaches to reducing mortality have impacted those charter/party clients who seek Striped Bass to eat. We consider this inequitable because management measures only impact those clients. If the Board does decide to respond to the higher 2022 catch, we encourage the Board to consider the very real economic impacts that will be assumed by the charter/party fleet. We recommend the board analyze catch by different recreational modes over time to see if there is a relationship between recent management measures and effects on different modes catch. Many fishery management plans and states partners recognize that recreational modes do not function with the same goals and objectives and have looked to mode specific measures to create equity within the recreational fishery, recognize the important economic contributions of the charter/party fleet, and achieve the FMP's goals and objectives. As example: Bluefish, Black Sea Bass, Scup, Tautog, GOM Haddock, and Bluefin Tuna all have mode specific measures. Maybe the Board could explore mode specific measures for this FMP.

We are also thinking about how we could observe such a strong Striped Bass fishery over time, given the less than stellar Chesapeake Bay/Maryland YOY results in several years. We believe the noticeably strong arrival of early season striped bass in Southern New England followed by weaker showings in late July and August could match up with average to below average Chesapeake Bay spawning success, but also indicate better performance from more northern spawning areas like the Hudson River. In our experience, the first Striped Bass to arrive in our areas are not Chesapeake Bay fish, but from more northern wintering locations. Chesapeake Bay fish show up in Southern New England later in the season. We think this could be considered as the Board considers how much risk to take until the next assessment is complete. Weakness in the Chesapeake, complemented by strength in other places, could explain our current healthy observations and provide rationale for a bit of risk tolerance by the Board until the next assessment.

The RIPCBA recognizes the importance of good Striped Bass management and we appreciate the opportunity to offer a few comments as the Board deliberates what to do in light of higher 2022 recreational catch. We ask that consideration be given to the impacts the Boards decisions will have on businesses like ours and our clients that like to eat Striped Bass.

Respectfully Submitted,

Capt. Rick Bellavance

Capt. Rick Bellavance, President
RI Party and Charter Boat Association

President Capt. Marc Berger, Vice-Pres. Seth Megarle, Treasurer Capt. TJ Karbowski, Secretary Capt. Mike Pirri

Mr. Marty Gary, Chair
Atlantic Striped Bass Management Board
Atlantic States Marine Fisheries Commission
1050 North Highland Street, Suite 200A-N
Arlington, Virginia 22201
RE: Possible Management response to March TC/SAS report

Mr. Gary,

The Connecticut Charter and Party Boat Association is comprised of 40 professional charter boats sailing from ten different Connecticut ports, covering the Western, Central and Eastern Long Island Sound. Our Professional Captains have verified credentials, are held to the highest ethics standards and are out on the water everyday often acting as the sheppard's of their areas.

We are not surprised by an increase in recreational removals in 2022. Reports from nearly every part of the coast were strong in 2022. It is worth noting that coastwide Charter/Party mode catch increased by less than 2% in 2022 compared to 2021 according to MRIP. If you predate the rebuild to the first emergency action: the cut from 2 fish to 1 per angler, we are 8 years into a rebuild effort. Why wouldn't you see an increase in (built back) harvest in year 8. Perhaps prior stock assessments mislead/ under reported the spawning stock biomass. It's very costly to bet on uncertainty, any added reductions on Striped Bass regulations will put nearly all for hire boats from Maine to the Carolinas out of business. The economic impact will crimple all recreational fishing opportunities and result in over a billion dollar loss every year.
Striped bass stock assessment narrows reproduction to just two locations Hudson river and the Chesapeake bay. Sexually mature Striped Bass winter over and reproduce in all Connecticut rivers and many northern rivers thru Massachusetts too. So the stock is supported by these rivers when poor Chesapeake reproductive years occur. Its very frustrating that Striped Bass spawning in the Chesapeake area must compete against omega protein for their food. And now this year Omega Protein is issued a 20% larger quota. Maybe the effort should be put on protecting forage for the Striped Bass instead of putting so many small businesses out of work.

Sincerely the Officers of the CCPBA
Capt. Marc Berger
Capt. Seth Megarle
Capt. TJ Karbowski
Capt. Michael Pirri

2023 Spring Meeting - Act Now!

Stripers Forever
57 Boston Rd
Newbury, MA 01951
stripers@stripersforever.org

April 25, 2023

Emilie Franke
FMP Coordinator
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, Virginia 22201

Ms. Franke & the ASMFC Striped Bass Management Board,

I am writing you today on behalf of thousands of our concerned members. The technical committee meeting on March 30, 2023 brought to light some very alarming data. With a significant rise in harvest during 2022, estimated to be more than double that of the previous year, the probability of rebuilding by 2029 has decreased by 83-86%. We are now looking at a 14.6% probability of rebuilding, even less if Addendum 1 (commercial quota transfers) is approved.

We have reached a defining moment in the recovery of the striped bass stock. The board can choose to either act now or delay action and derail the rebuilding timeline. Choosing the latter would clearly violate the requirements within Amendment 7. The board needs to stick to the 10-year rebuilding schedule with a minimum 50% chance of success.

Four straight years of poor recruitment in the Chesapeake combined with a massive increase in harvest has left us in a horrible position. We are removing more fish from the population than are entering it, many of whom are larger spawning fish, it is simply not sustainable. We suggested a harvest moratorium and seasonal closures during the public comment period leading up to Amendment 7. Neither was put in place and here we are again, trying to correct a management plan which to this point has failed.

Stripers Forever and our members ask that the board act swiftly in removing Addendum 1 from consideration on May 2nd. Instead, initiate an Addendum which would greatly reduce harvest and make certain that the stock successfully rebuilds by 2029.

Task the technical committee with developing options to adjust the current management plan. And hopefully, when the time comes, we urge the board to consider seasonal closures (specifically in and around spawning areas) as well as a coastwide commercial and recreational harvest moratorium. There is no time to waste, even the slightest delay will have a grave effect on rebuilding the stock.

Sincerely,

T. Van

Taylor Vavra
Vice President
taylor@stripersforever.org
(914) 522-9507

AMERICAN SALTWATER GUIDES ASSOCIATION
BETTER BUSINESS THROUGH CONSERVATION

Emilie Franke
FMP Coordinator
Atlantic States Marine Fisheries Commission
1050 N. Highland Street Suite 200
Arlington, Virginia 22201

4/17/23

RE: Initiating an Addendum to Ensure the Striped Bass Stock Successfully Rebuilds by 2029

Dear Ms. Franke,

The American Saltwater Guides Association (ASGA) is a coalition of fishing guides, fishing related businesses, and conservation minded private anglers. Our members on the Atlantic coast are reliant on a healthy population of striped bass. ASGA has engaged on every striped bass management issue in a meaningful and productive manner since our inception. Today, we believe that the striped bass fishery is at an inflection point: if action is not taken at the upcoming May meeting, the stock will not rebuild by 2029 and drastic measures may become warranted.

It is clear that some areas experienced excellent striped bass fishing last year. The good fishing translated into over 35 million pounds of striped bass harvested coastwide[1]. ASGA had deep concerns that the slot limit would fully exploit the robust 2015-year class. These concerns are now a reality. The 2015-year class is the last robust recruitment year. While the 2017 and 2018-year classes are average, there are four consecutive years of the lowest recruitment in recent history following. This leaves the stock and those that depend on a healthy striped bass population in a very dangerous place.

Amendment 7, which was just approved and implemented in May 2022, clearly states that the stock must be rebuilt within 10 years (Striped bass was declared overfished in 2019 thus the rebuilding deadline is 2029).[2]

2.7.2 Stock Rebuilding Schedules
If at any time the Atlantic striped bass population is declared overfished and rebuilding needs to occur (as specified in Section 4.1 Management Triggers), the Board will determine the rebuilding schedule at that time. The only limitation imposed under Amendment 7 is that the rebuilding schedule is not to exceed 10 years.

The current rebuilding plan has failed. The 2022 MRIP harvest numbers showed that harvest doubled and decreased the probability of rebuilding to 14%. The probability is considerably lower if commercial transfers are approved as per the Technical Committee meeting on March 30th. This is unacceptable to our community and clearly violates Amendment 7's rebuilding provisions. Taking a correction now is far better than draconian measures in a few years.

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[1] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division April 12, 2023.
[2] Atlantic States Marine Fisheries Commission. Amendment 7 to the Interstate Fisheries Management Plan for Atlantic Striped Bass. May 2022. https://asmfc.org/uploads/file/63cb1c52AtlStripedBassAm7_May2022.pdf

Delaying action in May would represent a complete failure of the Striped Bass Management Board to address known issues with the striped bass rebuilding plan.

We are asking only that the Striped Bass Management Board follow the rules it established. A new rebuilding plan that has a minimum of a 50% chance of success must be initiated, and those regulations need to be in place by the 2024 season.

ASGA and the undersigned anglers, fishing guides, and businesses are calling on the Striped Bass Management Board to initiate Addendum II to Amendment 7 to the Interstate Fishery Management Plan for Atlantic Striped Bass, ensuring the striped bass stock successfully rebuilds by 2029.

Sincerely,

Tony Friedrich
Vice President and Policy Director
tony@saltwaterguidesassociation.org
(202) 744-5013

CC: Bob Beal, ASMFC Executive Director
Martin Gary, Striped Bass Management Board Chair

SUPPORTING BUSINESSES & ORGANIZATIONS:

PATAGONIA	VAN STAAL	SIMMS FISHING	COSTA SUNGLASSES
HATCH OUTDOORS	CORTLAND LINE COMPANY	KISMET OUTFITTERS	OLD MAINE OUTFITTERS
SALTWATER EDGE	247 LURES	MARINE FISH CONSERVATION NETWORK	HARDY FLY FISHING
AMERICAN FLY FISHING TRADE ASSOCIATION	TEMPLE FORK OUTFITTERS	SIGHTLINES PROVISIONS	MARTHAS VINEYARD OUTFITTERS

SUPPORTING BUSINESSES & ORGANIZATIONS:

NORVISE

TITAN GUIDE SERVICE

GREAT LAKES FLY FISHING

MAINETAIN CHARTERS

SANDY HOOK OUTFITTERS

BADFISH

NANTUCKET TACKLE CENTER

CARTER FISHING COMPANY

CAPE COD ON THE FLY

BIG MOJO SPORTFISHING

DEAD DRIFT OUTFITTERS

NORTH ISLAND GUIDE SERVICE

FAR BANK

SAGE RODS

RIO FISHING PRODUCTS

REDINGTON

SUPPORTING BUSINESSES & ORGANIZATIONS:

PAMELA MAY CHARTERS	DIAMOND PASS OUTFITTERS	FLY WATER TRAVEL	REPYOURWATER
FLY FISHERMAN MAGAZINE	HOGY FISHING	ANYCREEK	CONFLUENCE FISHING
NORTH COAST ANGLER	ALTRICH ANGLERS CHARTERS	MONTAUK SURFCASTERS ALLIANCE	ORIGIN OUTFITTERS
BLOODLINE FISHING ADVENTURES	ROCK PEBBLE SAND FISHING	BADFISH FISHING CHARTERS	GET TIGHT SPORT FISHING

SUPPORTING BUSINESSES & ORGANIZATIONS:

RIPTIDE CHARTERS

JOE DIORIO GUIDE SERVICE

LIGHT LINES GUIDING

MOONDOG FISHING LLC

FLYWAY CHARTERS

BAREFOOT ADVENTURES

MOLDYCHUM

MARSH ON THE FLY

NO SLACK SPORTFISHNG

SIGLER GUIDE SERVICE

OUTCAST LURES

CHEEKY FISHING

BEN WHALLEY FISHING

REEL THERAPY FISHING CHARTERS

ROCK AND SAND CHARTERS

SCIENTIFIC ANGLERS

SUPPORTING BUSINESSES & ORGANIZATIONS:

RESOURCE RESTORATION GROUP	**HOLDING THE LINE GUIDE SERVICE**	**BRYNNIE-B INSHORE FISHING**	**CREEKSIDE ANGLING CO**
SUSTAINABLE FISHING CLUB	**SOLSTICE FLY FISHING**	**SLY FISHING OUTFITTERS**	**GUIDING FLOW TV**
SOUL FLY OUTFITTERS	**SUSQUEHANNA RIVER GUIDES**	**SYLVESTER OUTDOORS**	**SPRING TIDE MEDIA**
TAF SCHAEFER DESIGN	**ELDREDGE BROTHERS FLY SHOP**	**SALT OF THE EARTH**	**RISING TIDE ANGLERS**

SUPPORTING BUSINESSES & ORGANIZATIONS:

TNT FLY FISH

TRIDENT FLY FISHING

FORTE GUIDE SERVICES

UP-N-AT-EM GUIDE SERVICE

WESTPORT FLY

FIGHT LURE COMPANY

WILDSIDE ADVENTURE TRAVEL SERVICE

REGAL VISE

AHREX HOOKS

CRAFTY ONE CUSTOMS

CUBALAYA OUTFITTERS

OAKPOOL

JLS RODS

POOMBAH PLUGS

CURRENT CULTURE FLY SHOP

E-FISH360

SUPPORTING BUSINESSES & ORGANIZATIONS:

LUREWALKER FISHING

FIN & FEATHERS OUTFITTERS

SCHULTZ LURES

CROSS CURRENT INSURANCE

CATCHING SHADOWS CUSTOM FLIES

LARRY'S TACKLE SHOP

FISH THE SWING

FLORIDA FISHING PRODUCTS

SURFCASTER'S JOURNAL

MUSKY TOWN

SALTY CAPE

ISLAND X LURES

MY FISHING CAPEC COD

FLYLORDS

BIG WATER PIKES

MAKO REELS

SUPPORTING BUSINESSES & ORGANIZATIONS:

NORTHBAR TACKLE	BAJIO SUNGLASSES	DISTRICT ANGLING	CROSS CURRENT INSURANCE
OSPREY PERSPECTIVES	TIGHTLINED SLAM	REEL TALES MEDIA	STONEBRIDGE ROD CO
HIGH ROLLER GUIDE SERVICE	COASTAL FLY ANGLER	FISH GIRL ACK	THE LODGE AT 58 NORTH
RIVER BAY OUTFITTERS	OXBOW BREWING	HOG ISLAND BOATWORKS	ALL POINTS FLY SHOP

FISHING GUIDES:

ACK Surfcasting
Altrich Anglers Charters
Arnold’s Guide Service
Badfish Charters
Barefoot Adventures
Barnegat Bay Adventures
Bay Bound Guide Service
Ben Johnston fly fishing
Ben Whalley Fishing LLC
Benjie Halsell
Bent With Hog Guide Service
Big Fish Mojo Sportfishing
Bill Fisher Outfitters
Birds of Prey Charters LLC
Blane Chocklett Fishing
Blockhead Charters
Bloodline Fishing Adventures LLC
Blue Heron Fly Fishing
Blue runner charters
Boston Fishing Company and NE Fishing Academy
Brackish Outfitters
Breakwood Fishing Adventures
Brynnie-B Inshore Fishing, LLC
Buzzards Bay Fly Fishing Company
Cape Cod on the Fly
Carter Fishing Company
Cast90.com
Cga Outfitters
Champagne Charter Co.
Charter vessel HARLEY Block Island RI
Chesapeake on the Fly
Chubby's Charter
Coastal Fly Angler
Confluence Fishing
Connecticut Woods and Water
Cutting Edge Charter Services
Dead Drift Outfitters LLC
Diamond Pass Outfitters
Double haul anglers
Endorfin Fishing LLC
F/V Downeast Hope 3
Feather & Fin Leather Goods
Featherbay
Finns East Charters
Fish Girl Ack
Fish Insight Guide Service
Fishsticks Charters
Flyway Charters
ForeRiverSportfishing
Forte guide services
Get Tight Sport Fishing
Gillies & Fallon Guide Service, LLC
Gorilla tactics sportfishing
Great Lakes Flyfishing LLC
Guided Maine
Guiding Flow TV
Gulf Coast Fly, LLC
H&M Guides
Hepner Associates
High Roller Guide Service
HMH fly tying Vises
Holding the Line Guide Service
Howe Safety Services
Jenny E Charters
Joe Diorio Guide Service
JoeEvansFishing.com
Keeper Fishing Charters
Kikihnet Guide Services
Kismet Outfitters
Kismet Outfitters
Knot the Reel World Fly Fishing
Larrabee Outfitters LLC
Lateral lines charter service
Light Lines Guiding
Locofly
Maine Outdoors
Maine Sport Outfitters
Maine Striper Adventures
Mainetain Charters
Major League Surfcasting
Mark Kovach Fishing Services
MarshOnTheFly
Martha’s Vineyard Outfitters
Mazman charters

Mikes charters
Moondog fishing llc
Mudbone Charters
Muzzys Angling Adventures
MV Flyfishing Company
Nantasket Fly
Nervous Water Charters
Nev-r-enuf sportfishing LLC
Night Heron Charters
No Fluke Charter Fishing LLC
No Slack! Sportfishing Charters
North Coast Angler
North Island Fly LLC
Northeast Saltwater Flyfishing
Off Cost Outfitters
On the Rocks Charters
Origin Outfitters
Outcast Fishing Charters LLC
Pamela May Charters
Peak Dawn Anglers
Poudre River Outfitters
Reel Bros LLC
Reel Therapy Fly & Light Tackle fishing charters
Rhode Island Kayak Fishing Adventures
Rick Kustich Fly Fishing
Rising Tide Anglers
river through atlanta
Rock And Sand Charters
Salt of the earth Sportfishing inc.
Salt Tale Charters
Sandy Hook Outfitters
Seacoast Fly Fishing with American Saltwater Guides Association
Shadowcaster Charters
Sigler Guide Service
Skinny Water Charters
Solstice Fly Fishing
South Fork Salt
Striped Bass Hunt LLC
Superfly charters
Susquehanna River Guides
Sylvestre Outdoors, LLC
Terry Nugent
The Anglers Den
The Bamboo Doctor
The Coastal Sportsmen
The Delaware River Club
TideLines Fishing
Tidewater Charters
Tim Barr
Tim Moore Outdoors, LLC
Titan Guide Service LLC
TNT Fly Fish
Tom Gagnon Fly Fishing
Tombolo Charters
Tristan Raynes
Up-N-At-Em! Guide Service
Van Staal
Vineyard Boat Charters
Watch Hill Charters
Western hatch
Westport Fly

Chris Valaskatgis
James Gilbane
Russell Burgess
Andrew Ewing
Christopher Bell
Tom Roller
Owen Olson
Robert Salerno
Lynne Burchell Heyer
Joseph (J.R.) Hall
Tim Rider
Chris Wiley
John Hagan
Elton Bonneville
John Gizzo
Ron Hughed
Carter Simko
Kurt Huhner
James Ellis
Jeremy Ball
Stephen Tiffinger
Richard McCrory
Baer Denniston
Will Carr

Michael Holliday
Charles Pulver
James Boyle
Michael Powell
Capt. Henry Tomlinson
David LaPointe
Walker Italia
Parker Gerrish
Brian Lansing
Davin Topel
Brian Kelly
Capt. John Page Williams

OTHER SUPPORTING BUSINESSES & ORGANIZATIONS:

Tightline Construction
Elevate Youth
Northeast Saltwater Fly Fishing
Watch Hill Charters
Thirst Productions, LLC
Sunset Surfcasting
North Fork Anglers Fishing Club
SaltwaterFlies.com
JLS Light Tackle Guide Service
Current Culture Fly Shop
Endurance Charters
Cortes Outfitters, LLC
Walshe Associates
Fierston Fishing Team
Fishin' Physicians
Sweetgrass Rods
Fishing Guide University
Critter Catcher Fishing
AB Marine
Long Cast Plastics
Advanced Fishing USA
Sweetgrass Rods
Wally's Lures & Tackle
Belfer Lighting
JW Brooks International
Timber Flats Outfitters
Ragged Mountain Resort
Vacationland Bait & Tackle
Jay D. Gemma and Associates
BROOKLYN URBAN ANGLERS ASSOCIATION
North End Fishing Co.
Island Fly
VK Steelworks
HowardFilms
Lake Source LLC
The Barn

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Steven Bachiochi, Connecticut
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Richard Ferguson, New Jersey
Gregory Dubel, Rhode Island
Logan Landry, Maine
Chris Piatek, Maine
Davin Therriault , Connecticut
Michael Kandle , New Hampshire
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Anthony Kotoun , Rhode Island
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Shawn Ferguson , Connecticut
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Andy van Rooyen , Massachusetts
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Sam Betar , Rhode Island

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casey cayko , New York
Thom Winters , New Jersey
Parker James , New York
Gary Bogli , Connecticut
Zachary Pinerio , Massachusetts
Grace Romanowsky , Massachusetts
Douglas jones , Maryland
Sam Pierson , Maryland
Luke Schnitzler , New Jersey
Sigmund Holtz , New York
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Christopher Keeler , Maine
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peter farrell , Rhode Island
Devin Donahue , Rhode Island
Earl Evans , Rhode Island
Kirk Baker , Massachusetts
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Tyler Prather , Florida
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William Shine , Massachusetts
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Robert Galante , Massachusetts
Robert Pizzi , Massachusetts
Brett Malloy , Rhode Island
Sean Polcha , New York
Dan Mayberry , New York
Mark Stasiuk , New Jersey
Jack Howard , New York
George Varnum , New Hampshire
Kevin Bassett , Maine
Bradley Griffis , Florida
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Jonathan Brodie , Rhode Island
Michael Pecoraro , Maine
Jere W. Dunkelberger , Pennsylvania
Dillon Bersey , New Jersey
George Lechner , New Jersey
Joseph Gliottone , Massachusetts
Mark Holbrook Holbrook , Massachusetts
Jonathan Kelsey , Maine
R.E. Strzepek , New York
Patricia Strzepek , New York
Justin Baer , Pennsylvania
Justin Mangiante , Rhode Island
Steven McKenna , Rhode Island
Jonathan Drooks , Massachusetts
Michael Catalano , New York
Stephen Ehrens , Connecticut
Georgette Henrich , Massachusetts
Will Wiant , Massachusetts
Willard Ladd , Connecticut
Anthony Zan , New York
Rory Wagner , New Jersey
Ken Morris , Connecticut
NICHOLAS C CAVALIERI , Massachusetts
Mitch Battista , Rhode Island
William Dreyer , Massachusetts
Francis Convery , New Jersey
Richard Martel Jr , New Jersey
Ed Lambert , Pennsylvania
Bradley Berk , Connecticut
Ralph Romanelli , New York
Liam McGoldrick , New York
Paul Restuccia , Connecticut
Garrett Naimie , Maine
Adam Triano , New Jersey
Stephanie Ewen , Connecticut

John Hildenbrand , Connecticut
Richard Pimentel , Rhode Island
Gary Cole , Massachusetts
William Zbrozek , New Jersey
Mike Bruno , New Jersey
Wells Bates , Connecticut
Michael Mcguire , New York
Kenneth Lisagar , New York
Dave Whitney , New York
Michael Lynch , New Hampshire
Noah Mansoor , New York
Michael Jennings , Massachusetts
Caitlin Jones , Massachusetts
Larry Wietsna , New Jersey
Mike Jovanovic , New York
Michael Stevens , Massachusetts
William Labrador , New York
Pete Christy , Rhode Island
Robert H Hutchinson , New Jersey
John Petrino , New Hampshire
Dree Eklund , New York
Marc Fishman , Maine
Justin Gonzalez , Massachusetts
Anthony capozzi , New Jersey
Levi Opsatnic , New York
Megan Maher , Massachusetts
Emma Bernier , New York
Drew Stefaniak , Pennsylvania
Brian McCall , Massachusetts
Michael Kelley , Connecticut
Robert Hodge , Connecticut
Michael Vonfrolio , New Jersey
James Corbett , Massachusetts
Eric Loftus , Massachusetts
Andrew Manning , New York
John Bello , Virginia
Anthony Besaw , Massachusetts
Chris Varjan , New Jersey
Terrance Flynn , New Jersey
Daniel Marks , Virginia
Kevin Downing , Massachusetts
Samuel French , Massachusetts
Edward Roach , Maryland
Eric Carlson , Massachusetts
John Cole , Massachusetts
Bes Demiri , New York
Todd Lussier , Connecticut
Herbert Cloud , South Carolina
Neil Krauter , New Jersey
Frank Erwin , New York
Bruce Dew , New York
Daniel Chesmar , Connecticut
Stephen Wadsack , Ohio
Bruce Dew III , Massachusetts
Joan Naso Federman , New York
Dylan Taillie , Maryland
Frank Luciano , New York
joshua bloom , New York
Quintin Grandstaff , New Hampshire
Jesse Gordon , New York
Joshua Perry , New York
Richard Bertoli , New York
Thomas Dillon , New Jersey
Addison Minott , Massachusetts
Ben Molenaor , New Jersey
Paul Marzolla , New Jersey
Jeffrey Silver , Massachusetts
JASON FLECKENSTEIN , New Jersey
Jen Szelog , New Hampshire
Brian Conner , Maryland
Karen Parady , Massachusetts
John Tomici , New York
Charles Gregory , Rhode Island
Klark Goros , New York
Steven MacNally , Massachusetts
Peter Scharf , Pennsylvania
Ron Gaul , Connecticut
Rick Ramos , Massachusetts
Joseph Vairo , New York
David Gasiewski , Pennsylvania
Peter Parady , Massachusetts
Colleen Wilson , Massachusetts
Gretchen Sminkey , Maine
Richard Ramos , Massachusetts
Michael Chapman , Virginia
Matthew Abbott , Colorado
Alex Morin , Massachusetts
Raúl Hernandez JR. , Virginia

Charles Bowman , Pennsylvania
Braeden Cummings , Maine
Blayney Del Priore , Maryland
Michael Caggiano , Massachusetts
hugh halsell , Massachusetts
Richard Beverley , Maryland
Joseph Jachinowski , Rhode Island
Alan Maillet , Massachusetts
Jay Harrison , Massachusetts
Edward Merullo , Massachusetts
Larry Nefsey , New York
Bruce Bain , Rhode Island
CARL Heise , Rhode Island
Mike Baiata , New Jersey
Beth Zmijewski , Pennsylvania
Patrick Fitzgerald , Maryland
Shaun Ouellette , New Hampshire
David Byrd , Rhode Island
Michael Korn , New Jersey
Demetrios Daliapes , New York
Anthony Tracy , Massachusetts
Christian Adams , Massachusetts
Justin Rich , Massachusetts
Michael Jones , Massachusetts
Les Francis , New York
Kurt Schwarz , New York
Maxwell Wright , California
Sarah Doherty , New Hampshire
Kenneth Murray , Connecticut
James Hickey , New Jersey
Rebecca Mungiole , New Jersey
Robert Switzer , New Jersey
Brian Hines , Pennsylvania
Matthew Harnois , Rhode Island
Adalberto Gonzalez , Massachusetts
WAYNE F ZERVIS , Massachusetts
Rob Tartaglia , Massachusetts
Randy Rosenberger , Pennsylvania
August Lanzotti , New York
Peter Bassi , Massachusetts
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Lev Shatsman , New York
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Big C Bassin , New Jersey
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Rob Hess , New York
Ben gist , North Carolina
Ken Kern , Massachusetts
Dylan King , Maine
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Michael Beland , Rhode Island
John Ziogas , Connecticut
Logan Brunton , Massachusetts

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Mark Elias , New Hampshire
Mike Tardella , Connecticut
Dennis Michaud , Massachusetts
Michael Jaeger , New Hampshire
Ian Bell , Maine
Hansen Cummins , Connecticut
Germain Cloutier , Maine
Malcolm Gilbert , Massachusetts
Harlan Kroff , Massachusetts
David Price , New Jersey
John Taylor , Massachusetts
John Comitz , Pennsylvania
George Hetzel , Colorado

Ryan Kumicz , New York
Mark Haas , New York
Matt Murphy , New York
Ben Friedman , Connecticut
Elias Hood , Maine
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Gregory Nye , New Hampshire
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Paul Sowney , New Jersey
Keith Fitzpatrick , New York
Ryan Hines , Massachusetts
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Joe Rice , New York
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Cory Wood , New York
Kyle Nawrocki , New Hampshire
sophia cuccia , New York
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Mala Iqbal , New York
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Dennis Portalatin , New Jersey
Tyler Wick , Massachusetts
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Connor Watson , Massachusetts
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John Scola , Massachusetts

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Jan Machnik , Massachusetts
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Gregg McNally , Maine
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Matthew Scarfi , New Jersey
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Glenn Silverman , Connecticut
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Paul Liberty , Connecticut
John Wachter , New Jersey
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Robert Iwaskiewicz , Massachusetts
Lukas Rahlson , New Jersey
Glen Urban , Massachusetts
Ryan Gallagher , South Carolina
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Jeff Doerr , New Jersey
Tim Benson , Massachusetts
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Hugh Macdougall , Maine
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Anthony Rotondo , Rhode Island
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John Higgins , Maryland
Chris Brown , Connecticut
Benjamin Brewer , Connecticut
Hee Seung Oh , Massachusetts
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Thom Peters , Washington
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Steve Kalkowski , Connecticut
Aaron Kalkowski , Connecticut
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Ted Mackenzie , Massachusetts
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Roger Clark , Maine

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Collin Francoeur , New Hampshire
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Mitch Cord , Maryland
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WS Bollman , New York
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Bo Norris , Maine
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Michael Judd , New Hampshire
Alexander Earley , Connecticut
Max Flansburg , New York
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Douglas Cooke , Massachusetts
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John O'Shaughnessy , New York
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Richard Grein , New York
Travis Nguyen , Texas
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Will Clark , Massachusetts
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Aaron Ares , Maine
Joseph Macaluso , New York
Lyndsa Woods , Maine
Cody Whipple , Pennsylvania
Sam Usilton , Massachusetts
Zachary Horen , New Jersey
Thomas Wynne , Connecticut
Kevin Grainger , Florida
Spencer Beakey , Massachusetts
Javier Reza , California
Ned Cole , Virginia
Charles Machek , Virginia
Chase Gordon , New York
Ray West , Massachusetts
Drew Schankweiler , New Jersey
Kane Haffey , Massachusetts
Michael Porco , Rhode Island
Carolyn Tyson , New York

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Mike Tayloe , District of Columbia
Bert Rosa , Connecticut
Dave Shoaf , Virginia
Erin Volante , Massachusetts
Alexander Plant , Connecticut
John Gilchrist , New Jersey
Jack Barton , Massachusetts
Brent Flack-Davison , New York
Shawn Osborne , Massachusetts
Peter Knight , Massachusetts
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Corinne Green , Virginia
James Callahan , New York
Kurt Stuckwisch , Virginia
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Michael Kronfeld , New Jersey
daniel mccarthy , Massachusetts
Ian Albert , Massachusetts
Christopher Henrickson , New Jersey
scott larson , Massachusetts
Daniel Tukey , Massachusetts
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Seamus Geehan , Massachusetts
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Robert Herbst , Massachusetts
Paul Miller , Massachusetts
Beyan Begley , Massachusetts
Jorge Rodriguez , Connecticut
Sean Ballou , Massachusetts
James Slater , Connecticut
Bill DeLizio , Connecticut
abram pearson , Maine
Ronald Gallaway , Massachusetts
JOHN IOIA , New York
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Zachary Edwards , Pennsylvania
Brian Snowman , New Jersey
Anthony Thompson , Massachusetts
Anthony Thompson , Massachusetts
Kenneth Weinberger , New York
Todd Kunst , North Carolina
Ben Scott , Massachusetts
Ryan Gorman , Maine
Aram Berberian , Connecticut
Philip Desfosses , Maine
John McMahon , Virginia
Kenneth Katovitz , New York
Joseph O'Leary , Massachusetts
christopher gonyer , Massachusetts
Molly Brigham , Massachusetts
Bob Olsen , Vermont
Hunter Priebe , Connecticut
woodrow albin , Rhode Island
Dennis Lahiff , Delaware
Reece Masters , New Hampshire
Eddie Gonnella , Florida
Kendall Keer , New Jersey
LeeAnne Conway , Maine
Dustin Fehr , Rhode Island
Gaelen Kilburn , Vermont
Phil Kirkland , Oregon
Miles Hagedorn , Maine
jason currier , Maine
Chad Bruce , Massachusetts
JOSEPH DART , Massachusetts
Jared Wood , New Hampshire
Riverhorse Nakadate , Texas
Kieran Alessi , New Jersey
Richard Taylor , Connecticut
Harrison Buck , New Hampshire
Rui Coelho , Massachusetts
Max Mueffelmann , Massachusetts
Enmanuel Santos , New York
Fred Hook , Missouri
Wyatt Bramhall , Massachusetts
Matt Srebnik , New Hampshire
James nicol , New York
Kitri Schaefer , Maine
Jeanne Kispert , New York
Erik Lantz , Massachusetts
Joseph Gaspar , Maryland
Bryce cadrain , Massachusetts
Francis Garvan , New Hampshire
Wesley Tower , Maryland
Brendan Flimlin , Maryland
Sydney Porelle , Massachusetts
Tim Porelle , Massachusetts

Scott Davis , New Jersey
Vincent Giurleo , Massachusetts
Brandon Demone , New Jersey
Michael Bonadies , New Jersey
Jonathan Cavallone , New Jersey
Scott Stewart , Connecticut
Chris Briguglio , New York
Jeffrey Horowitz , Massachusetts
Anthony Stefanski , Massachusetts
James White , Massachusetts
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Alek Gagnon , Connecticut
Johnathan Goulart , Connecticut
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Bernie Kosinski , New Jersey
Peter Benedict , Connecticut
Dan Searle , Tennessee
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Jerry Riley , Indiana
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Evan Donald , Maine
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Tony Sarcona , Maine
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Robert Lee , Connecticut
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Michael Bryand , Maine
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Tony Vitti , New York
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Joe Notarangelo , Pennsylvania
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Tom Kelly , Massachusetts
Winslow Dresser , Maine
Vincent Simko , Connecticut
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Chris Ruschaupt , Virginia
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Al Keller , Florida

Joey Solomon , Massachusetts
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Christopher Johndrow , Connecticut
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Butch Lumbert , Connecticut
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Benjamin Masse , Rhode Island
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Mike McDonald , Massachusetts
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Ryan Richer , Rhode Island
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Darr Forrester , Rhode Island
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Scott Steinback , Massachusetts
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Cory Sodikoff , Virginia
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Austin Babyak , Maine
Lucius Taylor , Massachusetts
Rodney Lane , Maine
Brian Mawdsley , Connecticut
Dylan Gaffney , New York
Mollie Boaz Boaz , Georgia
Brian Potvin , Massachusetts
Henry Little , Rhode Island
William Mendez , New York
Lucas Hilker , Massachusetts
David Simpson , Texas
Julia LeMense , New York
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Deborah Leckonby , Massachusetts
John Yuschak , New Jersey
Seán Earnest , Pennsylvania
Janine Hoffer , Maine
Blaise Jenner , Maine
Matt Donaghey , Georgia
Antonio Centrella , Massachusetts
Drew Prowse , New Hampshire
Corey Rubin , New York
Scott Hoffer , Maine
Jarrett Matson , Maine
Alex Goniatis , Massachusetts
Marcus Quenzer , Pennsylvania
Leslie Doherty , Massachusetts
Michael Poulopoulos , New York
Gryphon Richardson , South Carolina
Brian Kendall , Connecticut
blake macleod , Massachusetts
Frederic Schaefer , Massachusetts
Matthew Kuhlmeier , Vermont
Gregg DiNardo , Massachusetts
Cathryn Valancius , Georgia
Blaine Farrell , Maine
Nathan Jandl , Wisconsin
Joe Wichnick , New Jersey
Mason Goodrich , Virginia
Alex Germond , Arizona
Don Russell , Maine
Andrew Uhr , North Carolina
Jeffrey Verrill , Maine
Doug Alichwer , Pennsylvania
Tyler Milam , New Hampshire
Robert Mamys , New York
Casey Wassick , Maine
John Yavorsky , New Jersey
John Harrington , Pennsylvania
Durbin Wells , Rhode Island
David Slater , Massachusetts
Mark Wilde , Vermont
Ryan Brule , Massachusetts
Jack Neal , Maine

Morgan Zazworsky , Pennsylvania
Daniel Zazworsky , Pennsylvania
Justin Wogen , Ohio
Nick Mayer , Vermont
Chris August , Tennessee
Emily Drezek , Connecticut
Lauren O'Connor , Massachusetts
Drew Whalen , New Hampshire
David Capen , Vermont
Kyle Casagrande , Connecticut
Albert Hartman , Maine
Adam Leon , New York
Peder Hagberg , New Jersey
Devon Scovill , Maine
Kelly Wolin , Massachusetts
John Bartolo , New Hampshire
Arthur Viens , New Hampshire
Julia Sargent , New Hampshire
Kyle Ferreira , Massachusetts
William Thomas , Massachusetts
Robert Fitzgerald , Massachusetts
Thomas Fuda , Connecticut
Emily Rice , Maine
Seth Shafer , Pennsylvania
Jason Kenyon , Massachusetts
steven baker , New Hampshire
Andy Lilienthal , Maine
Standish Bradford , Massachusetts
Norm Staunton , Vermont
Steve Volante , Massachusetts
William Coffey , North Carolina
Michae Green , Maine
Scott Brassard , New Hampshire
Stephen DeFilippo , New Hampshire
James K. Budelman , Montana
Griffin Dunn , Massachusetts
Rick Wittenbraker , Texas
Thomas Kokalas , New Jersey
Ken Hawkins , New York
Mike Murray , Utah
Costikyan Jarvis , New Hampshire
Al Heath , Maine
lucas st.clair , Maine
Lance Dutson , Maine
Kerry Alvino , Massachusetts
Michael Hoar , Massachusetts
Steve Bogdanowicz , New York
Christopher Barrette , Michigan
Brendan Curley , Massachusetts
Guillermo Nunez , Massachusetts
Robert Young , New Hampshire
Ben Nickol , Rhode Island
Mark Seymour , Massachusetts
james ingram , New Hampshire
Craig Masterman , Massachusetts
Adam Ureneck , Rhode Island
Ronald Florence , Rhode Island
Matthew Purnell , Connecticut
Andrew Mayer , Maine
Harry Woodhull , Connecticut
Kyle Dancause , Maine
DAVID BEATTIE , New Hampshire
Jeff Youmell , New York
Riley Sylvia , Massachusetts
Jake Gresh , Rhode Island
John Rogers , Massachusetts
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Henry Marchetti , Maine
Michael Presti , New York
Andrew Garnitz , Massachusetts
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Cole Callowhill , New Jersey
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Flynn Willsea , Maine
Alec Plotnikiewicz , Massachusetts
Greg Stohrer , New Hampshire
Ryan Doran , Massachusetts
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Nick Kelley , Massachusetts
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Michael Dooley , Maine
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Tim Anikis , Virginia
Brendan Holden , Massachusetts
Sam Herzig , New York
Matt Sedgwick , Connecticut
Aaron Gruler , Texas
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Cody Perry , Massachusetts
Benjamin Burns , Maine
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Derrik Holladay , Virginia
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Bryon Detwiler , New York
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Jacob Giles , Pennsylvania
Matthew Roach , Maryland
Timothy Reichheld , Massachusetts
Timothy Mugherini , Massachusetts
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Rosemary Burkhalter-Castro , Florida
CARLOS BAZ , New York
Owen Roberge , Florida
Tyler Doherty , Massachusetts
Devon Macko , Florida
James Shanley , New Hampshire
Mike Querfeld , Connecticut
Kevin Sinausky , Massachusetts
Rory Regan , Massachusetts
Dave Sherwood , Maine
Sean Burke , Massachusetts
Matthew Robertson , Connecticut
Alan Koop , New Jersey
Skyler Davis , Pennsylvania
Colby Smith , Massachusetts
Theo Caplan , Massachusetts
Joel Stoehr , New York
William Sistad , New Jersey
Marc Annese , Massachusetts
Chase Kokojan , Oklahoma
Dana Green , Maine
Matt Rooney , New Jersey
Anthony Poirier , Massachusetts
Stephen Richter , New Jersey
Pat Myers , Maryland
marc bouvier , New Hampshire
Derek Cummings , New Hampshire
Jarrett Miller , Oklahoma
Steve Doherty , New Hampshire
Sydney Howard , Massachusetts
Harry Erickson , New York

Taylor Feuti , Maine
Nick Ruggiero , New York
Erica Nectow , Massachusetts
Stephen Huebner , New Hampshire
Sean Oconnell , Connecticut
Gary Speed , Maine
William Crotty , Massachusetts
Pete Mohlin , Maine
Robert Stanton , Massachusetts
John Abplanalp , Connecticut
Mark Saliture , New York
Brad Curtin , Massachusetts
Mike Dean , New York
Eric Spicer , Rhode Island
Alex Doherty , Maine
Eric Cronin , Massachusetts
Tyler Potts , Pennsylvania
Currie Wagner , New Jersey
Lauren Warner , New Jersey
Andrew McCabe , Massachusetts
Ben Tayloe , Pennsylvania
Jim Nash , New York
john Bohuniek , New York
Marc Guy , Massachusetts
Alexander Bagdonas , Massachusetts
Jon Ritter , Massachusetts
Owen McKenna , Massachusetts
Mike Gribbin , Maryland
Connor Quigley , Massachusetts
Al Wood , Colorado
Doug Capla , Massachusetts
Seth Fiola , Rhode Island
Jacob Nichols , Maine
David Strand , Maryland
Eric Warner , New Jersey
Daniel Drabkin , Massachusetts
Jack McClurg , Connecticut
William Hallett , Connecticut
John Fay , Massachusetts
Samuel Rice , Maine
Christopher Fay , Massachusetts
Matt Boutet , Maine
Andrew Kettle , Maryland
Andrew St. Jean , Connecticut

Atlantic States Marine Fisheries Commission

Executive Committee

May 3, 2023
8:00 – 10:00 a.m.
Hybrid Meeting

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.
A portion of this meeting will be closed for Committee Members and Commissioners only.

1. Welcome/Introductions *(S. Woodward)*

2. Committee Consent
   - Approval of Agenda
   - Approval of Meeting Summary from February 1, 2023

3. Public Comment

4. Report of the Administrative Oversight Committee *(J. Cimino)* **Action**
   - Presentation of the Fiscal Year 2024 Budget

5. Discuss Potential for Legislator and Governors Appointee Commissioner Stipends *(R. Beal)*

6. Review Potential Changes to the Conservation Equivalency Policy and Technical Guidance Document (*T. Kerns)*

7. Legislative Committee Update (*A. Law)*

8. Future Annual Meetings Update *(L. Leach)*
   - October 15-19, 2023 – Beaufort, North Carolina
   - 2024 – Maryland
   - 2025 – Delaware
   - 2026 – Rhode Island
   - 2027 – South Carolina

9. Other Business

10. Executive Director Performance Review (**Closed Session**)

11. Adjourn

The meeting will be held at The Westin Crystal City (1800 Richmond Highway, Arlington, VA; 703.486.1111) and via webinar; click here for details

Commissioner Stipend Discussion Paper

Atlantic States Marine Fisheries Commission

April 18, 2023

Background

The Commission has discussed the potential to provide stipends to Legislative and Governors' Appointee (LGA) Commissioners for their participation in Commission activities. To date, the Commission has not provided a stipend or other financial compensation to Commissioners for participation. In contrast, the Magnuson-Stevens Act establishes a daily compensation rate (GS 15, Step 7, currently ~$540/day) for Federal Fishery Management Council members when engaged in Council activities. This paper presents different options that have been discussed.

Potential Tax Benefit for Commissioners

At the Winter Meeting, the idea of a potential tax benefit for Commissioners was suggested. Given that LGA Commissioners volunteer their time, staff was asked explore potential tax benefit options for the Commissioner's donated time.

Staff talked with tax professionals including a CPA. The tax professionals generally did not commit to a potential tax benefit for Commissioners volunteering time to the Commission. They noted a benefit was unlikely but each Commissioner would need to consult with their own tax advisor.

Stipends Paid by Member States to Their Commissioners

It was suggested that each state could voluntarily provide stipends to their LGA Commissioners if they choose to do so. These stipends would be outside of the Commission process and would be handled entirely by the individual states. Staff did not research this approach since it would be addressed by the individual states.

Options for Providing a Stipend to Legislative and Governors' Appointee (LGA) Commissioners

The following options are similar to those presented at the 2023 Winter Meeting.

Option 1 – Status Quo

The LGA Commissioners will continue to serve on a volunteer basis and not receive a stipend from the Commission.

Option 2 – A Stipend will be provided only for extraordinary meetings

The LGA Commissioners will receive a stipend for meetings that are outside of the four quarterly Commission meetings and outside of the joint meetings with one of the three Federal Fishery Management Councils. Examples of these meetings include NEFMC Atlantic Herring Committee meetings, Recreational Fisheries Summit, Scenario Planning Summit, etc.

Approximate Financial Impact: 13 Person days X $540 Stipend = $ 7,020

Option 3 – A Stipend will be provided for meetings outside of the Commission Quarterly Meetings

The LGA Commissioners will receive a stipend for meetings that are outside of the four quarterly Commission meetings including joint meetings with one of the three Federal Fishery Management Councils and other extraordinary meetings.

Approximate Financial Impact: 82 Person days X $540 Stipend = $44,280

Other Considerations

If a stipend is provided to LGA Commissioners, consideration should be given to the following items:

- Stipend for Proxies
- Virtual Participation
- LGA Eligibility to Receive Stipend
- Travel Days
- Partial Days
- Administrative Burden
- Other

Atlantic States Marine Fisheries Commission

DRAFT CONSERVATION EQUIVALENCY:

Policy and Technical Guidance Document

First Edition Approved May 2004
Revised and Approved October 2016
Draft Revisions for Review May 2023

Introduction

The purpose of this document is to provide policy and technical guidance on the application of conservation equivalency in interstate fisheries management programs developed by the Atlantic States Marine Fisheries Commission. The document provides specific guidance on development, submission, review and approval of conservation equivalency proposals.

Background

The Atlantic States Marine Fisheries Commission (Commission) employs the concept of conservation equivalency in a number of interstate fishery management programs. Conservation equivalency allows states/jurisdictions (hereafter states) flexibility to develop alternative regulations that address specific state or regional differences while still achieving the goals and objectives of Interstate Fishery Management Plans (FMPs). Allowing states to tailor their management programs in this way avoids the difficult task of developing one-size-fits-all management measures while still achieving equivalent conservation benefits to the resource.

Conservation equivalency is currently defined in the Interstate Fisheries Management Program (ISFMP) Charter as:

> *"Actions taken by a state which differ from the specific requirements of the FMP, but which achieve the same quantified level of conservation for the resource under management. One example can be, various combinations of size limits, gear restrictions, and season length can be demonstrated to achieve the same targeted level of fishing mortality. The appropriate Management Board/Section will determine conservation equivalency." The application of conservation equivalency is described in the document Conservation Equivalency Policy and Technical Guidance Document*

In practice, the Commission frequently uses the term "conservation equivalency" in different ways depending on the language included in the plan. Due to concerns over the lack of guidance on the use of conservation equivalency and the lack of consistency between fishery management programs, the ISFMP Policy Board approved a policy guidance document on conservation equivalency in 2004. In 2016, the Policy Board recognized some of the practices of the Commission regarding conservation equivalency had changed and revised the guidance. The Policy Board is again considering revision to the guidance to include requirements in how conservation equivalency is used.

General Policy Guidance

The use of conservation equivalency is an integral part of the Commission management process. Conservation equivalency is used in 2 ways: (1) in the development of the FMP

Commented [TK1]: While this path was used in the past it is not something that has been used in the last 10 years or more because of the additional time it adds to the process (needs time for states to develop measures that would be equivalent to the coastwide options in the document) (including implementation plans) and (2) as alternative management programs outside of the FMP process.

During the development of a management document the Plan Development Team (PDT) should recommend if conservation equivalency should be permitted for that species. The board ~~should~~ will provide a specific determination if conservation equivalency is an approved option for the ~~fishery management plan~~FMP, since conservation equivalency may not be appropriate or necessary for all management programs. The PDT should consider stock status, stock structure, data availability, range of the species, socio-economic information, and the potential for more conservative management when stocks are overfished or overfishing is occurring when making a recommendation on conservation equivalency. During the approval of a management document the Board will make the final decision on the inclusion of conservation equivalency.

Commented [TK2]: If this is a requirement will need to change

If conservation equivalency is determined to be appropriate, the conservation equivalency process ~~should~~ will be clearly defined and specific guidance ~~should~~ will be supplied in the fishery management documents. Each of the new fishery management plans, amendments, or addenda ~~should~~ will include the details of the conservation equivalency program, if applicable. The guidance ~~should~~ will include, at a minimum, a list of management measures that can be modified through conservation equivalency, evaluation criteria, review process, and monitoring requirements. If possible, tables including the alternative management measures should be developed and included in the management documents. The development of the specific guidance is critical to the public understanding and the consistency of conservation equivalency implementation.

Commented [TK3]: If we modify #1 above, I recommend this section is deleted.

Conservation equivalency proposals and Board approval are not required when states adopt a single more restrictive measures than those required in the FMP (e.g., higher minimum size, lower bag limit, lower quota, lower trip limit, closed or shorter seasons). These changes to the management program ~~should~~ will be included in a state's annual compliance report or state implementation plan. If states intend to change more than one regulation where one is more restrictive but the other is less restrictive, even if the combined impact is more restrictive, states must submit a conservation equivalency proposal for Board approval due to unexpected consequences that may arise (e.g., larger minimum size limit could increase discards).

Commented [TK4]: Should this change? What if a state does something .5% more conservative to get around CE rules?

~~The S~~States have the responsibility of developing conservation equivalency proposals for submission to the Plan Review Team (see standards detailed below). Upon receiving a conservation equivalency proposal, the PRT will initiate a formal review process as detailed in this guidance document. The state submitting the ~~conservation equivalency~~ proposal has the obligation to ensure proposed measures are enforceable. If the PRT has a concern regarding the enforceability of a proposed measure it can task the Law Enforcement Committee with reviewing the proposal. Upon approval of a conservation equivalency proposal, the implementation of the program becomes a compliance requirement for the state. Each of the approved programs ~~should~~ will be described and evaluated in the annual compliance review and included in annual FMP Reviews, unless different timing is approved by the board.

The management program~~s~~ ~~should~~ will place a limit on the length of time that a conservation equivalency program can remain in place without re-approval by the Board. Some approved management programs may require additional data to evaluate effects of the management measures. The burden of collecting the data falls on the state that has implemented such a conservation equivalency program. Approval of a conservation equivalency program may be terminated if the state is not completing the necessary monitoring to evaluate the effects of the program.

The Plan Review Team (PRT) will serve as the "clearing house" for ~~approval~~ review of conservation equivalency proposals. All proposals will be submitted to the PRT for review. The PRT will collect all necessary input from the appropriate committee (e.g. the technical committee, Law Enforcement Committee, Committee on Economics and Social Sciences and the Advisory Panel). The PRT will compile input ~~from all of the groups~~ and forward a recommendation to the management board.

When Conservation Equivalency will not be Permitted

Stock Status Conditions

Option 1. Conservation Equivalency is not permitted if the stock is overfished

Option 2. Conservation Equivalency is not permitted if overfishing is occurring

Option 3. Conservation Equivalency is not permitted if overfishing is occurring and the stock is overfished

Measures that cannot be Quantified

Measures that cannot be quantified are not be permitted under CE if their sole purpose is for credit in the reduction. The state submitting a proposed measure for credit must be able to demonstrate, to the satisfaction of the TC, a measurable reduction in harvest. Measures that are non-quantifiable can be encouraged and considered as a buffer but not used as direct credit for a reduction in harvest. The TC will determine if a measure is quantifiable or non-quantifiable. Non-quantifiable measures could include circle hooks, non-targeting zones/period, no gaffing, outreach promoting best practices for release, and other measures expected to reduce release mortality or overall discards.

Combining Coastwide and Conservation Equivalency

If there is a target coastwide reduction needed it cannot be achieved through a combination of some states implementing the coastwide measure and some states implementing the coastwide percent reduction at the state level. If a state proposes CE, that CE proposal must demonstrate equivalency the state-specific reduction that would have been achieved if the coastwide measure were implemented. For example, a

Commented [TK5]: Depending on the level of prescription these are options Boards could consider or one of the options could be the policy standard.

If it for the Boards then I suggest we add the following text:

Each species Board should/will consider which, if any, of the stock status CE options below are appropriate. If a species Board implements a stock status restriction for CE, it may choose to apply that restriction to the entire fishery or to some parts of the fishery (e.g., specific sector). If a species Board decides not to implement a stock status restriction for CE, the Board will provide rationale (via meeting proceedings) as to why such a CE restriction is not needed for that species.

coastwide measure may be projected to achieve a 10% coastwide reduction. In a particular state, that coastwide measure may be projected to achieve a 15% reduction in that state alone. If that state wants to propose a CE program, that CE program must demonstrate a 15% reduction, not a 10% reduction.

Standards for state conservation equivalency proposals

Each state seeking to implement a conservation equivalency program must submit a proposal for review and approval. Proposals will keep the number of options to a reasonable limit, those proposals that include an excessive number of options may delay timely review by the PRT and other groups and may ultimately delay the report to the Board. ~~The states should limit the number of options included in a proposal or prioritize the options for review.~~ Boards may set a cap on the number of options submitted.

State conservation equivalency proposals ~~should~~ will contain the following information:

1. Rationale: Why or how an alternate management program is needed in the state. Rationale may include, but are not limited to, socio-economic grounds, fish distribution considerations, size of fish in state waters, interactions with other fisheries, protected resource issues and enforcement efficiency.

2. Description of how the alternative management program meets all relevant FMP objectives and management measures (FMP standards, targets, and reference points). States are responsible for supplying adequate detail and analysis to confirm conservation equivalency based on the most recent stock assessment.

3. A description of:
   - Available datasets used in the analysis and data collection method, including sample size and coefficient of variation, explicitly state any assumptions used for each data set.
   - Limitations of data and any data aggregation or pooling.
     - The TC should establish minimum standards for the types and quality of data that can be used in a proposal. Examples include, but should not be limited to: minimum sample size, amount of imputed/borrowed data points, limit on PSE, types of data allowed and minimum number of years, survey design, data caveats and analytical assumptions, and consider previous CE proposals and build on their strengths (e.g., length of closed season). Some states may not be able to participate in CE because their data will not meet the standards established by the TC. The TC could consider alternative criteria, or states could consider alternatives, such as submitting a joint proposal with neighboring states.

- When evaluating closed periods, availability will be considered. Even within a month, availability can be very different, particularly when comparing the beginning and end. Any closed period must come from a period of high availability and include at least two consecutive weekend periods (Friday, Saturday and Sunday). Pooling of several years' worth of data should be encouraged for evaluation.

- The length of time the state is requesting conservation equivalency and a review schedule for the length of the program. Proposals ~~should~~ will identify the length of time measures are intended to be in place and the timing of the review of the specific measures which is required annually, it is encouraged to review the measures in conjunction with the FMP Review.~~.~~ If an approved CE program consistently meets program objectives, achieves the proposed measures with the management actions implemented, and if stock conditions remain favorable, a request for an extension should be made to the species management board at the end of the project period. Extensions for successful conservation equivalency programs should not exceed the next scheduled benchmark stock assessment.

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4. Each proposal must justify any deviations from the conservation equivalency procedures detailed in the FMP of this document. The state should conduct analyses to compare new procedures to procedures included in the plan, as appropriate, including corroborative information where available.

5. Include a plan describing the monitoring schedule, reporting requirements and documentation process of evaluating the impacts of the conservation equivalency measures.

Review Process

Implementation of new amendments/FMPs ~~should~~ will include timelines and a review process for conservation equivalency proposals. However, the review process and timeline needs to be established for all conservation equivalency proposals that are submitted outside of the implementation of a new management document.

The following is a list of the steps and timelines for review and approval of conservation equivalency proposals. Any deviations from the following process ~~should~~ must be included in the FMP.

1. Conservation equivalency ~~should~~ will be approved by the Management Board and where possible implemented at the beginning of the fishing year.

2. If a state is submitting a proposal outside of an implementation plan process, it ~~must~~ will provide the proposal at least two months in advance of the next board meeting to allow committees sufficient time to review the proposal and to allow states to respond to any requests for additional data or analyses. States may submit conservation equivalency proposals less than two months in advance of the next board meeting, but the review and approval at the upcoming board meeting is at the discretion of the Species Management Board Chair. Proposals submitted less than two weeks before a meeting will not be considered for approval at that meeting. The board chair will submit proposal to the Plan Review Team (PRT) for review.

3. The PRT should notify the state that the proposal is complete.

4. Upon receipt of the proposal, the PRT will determine what additional input will be needed from: the Technical Committee (TC), Law Enforcement Committee (LEC), ~~and~~ or Committee on Economic and Social Sciences (CESS). The PRT will distribute the proposal to all necessary committees for comment. The review should include a description of the impacts on or from adjoining jurisdictions or other management entities (Councils and/or NMFS). If possible, this description should include qualitative descriptions addressing enforcement, socio-economic issues and expectations from other states perspective (shifts in effort). The review should highlight efforts to make regulations consistent across waterbodies.

5. The PRT will compile all of the input and forward the proposal and comments to the Advisory Panel when possible. However, when there are time limitations, the AP may be asked for comments on a proposal prior to completion of other committee reviews. The Chair of the Advisory Panel (AP) will compile the AP Comments and provide a report to the Management Board.

6. The PRT will forward to the Board the proposal and all committee reviews, including any minority reports. The PRT will provide comment on whether the proposal is or is not equivalent to the standards within the FMP. If possible, the PRT ~~should~~ will identify potential cumulative effects of all conservation equivalency plans under individual FMPs (e.g. impacts on stock parameters).

7. The PRT reviews ~~should~~ will address whether a state's proposal followed the CE standards outlined in this policy, and any additional specifications included in the FMP.

8. The Board will decide whether to approve the conservation equivalency proposal and will set an implementation date, taking into account the requested implementation date in the proposal. Board action should be based on the PRT recommendation as well as other factors such as impacts to adjoining states and

Commented [TK6]: I am concerned 2 months would not be enough time with some of the additional data requirements federal management programs. When a board cannot meet in a timely manner and at the discretion of the board and Commission Chair, the boards have the option to have the ISFMP Policy Board approve the conservation equivalency plan.

Plan Review Following Approval and Implementation

1. Annually thereafter, states ~~should~~ will describe and evaluate the approved conservation equivalency programs in their compliance reports submitted for annual FMP Reviews, unless otherwise specified.

2. The PRT is responsible for evaluating all conservation equivalency programs during annual FMP reviews to determine if the conditions and goals of the FMP are maintained, unless a different timeline was established through board approval. If the state is not completing the necessary monitoring to evaluate their approved conservation equivalency program, this may be grounds for termination of the plan. The PRT will report to the Board on the performance of the conservation equivalency program, and can make recommendations to the Board if changes are deemed necessary.

3. Review Criteria: Fisheries data are confounded by uncertainty, which make evaluating actual performance difficult and impossible to develop a one size fits all analysis to evaluate performance. Criteria to consider when establishing guidelines for CE program analysis include:
    - Use multiple years' worth of data with consistent regulations to smooth variability
    - Use rates, rather than totals (e.g., CPUE vs catch) to account for changes in effort
    - Explicitly state and discuss assumptions and caveats of data and how they might affect the analysis
    - Account for any extra buffer required in the state's CE proposal

4. The Board may stablish appropriate actions for any state that does not achieve the target. It is recommended, action be established before performance is evaluated, perhaps as early as when criteria for developing CE proposals are established to alert states to the consequences of failing to meet the target before plans are implemented. Proposed action should be fair and equitable to all states, with the overall goal of achieving management objectives of the FMP.

5. The TC should also establish guidelines for what determines success. Considerations include:

Commented [TK7]: Evaluating success of any management measure is extremely difficult and some may say impossible.

Commented [TK8]: I am concerned this task could be unachievable for the TC

- Recognizing the various sources of uncertainty, how many years of data are needed to evaluate performance?
- Is the target based on harvest or total removals (harvest + dead discards)?
- If a state approaches, but does not achieve, the target, how close is close enough?
- For a state that requires a buffer, is it sufficient if they achieve the target, but not the target + buffer requirement?
- Is any action required if not all states achieve the target, but the coast as a whole does achieve the target?
- Do the answers to these questions differ depending on if the state is a major contributor to the fishery vs a fringe state?
- Would the Board allow a state to adjust their regulations if it is determined their proposal was overly conservative?

Coordination Guidance

The Commission's interstate management program has a number of joint or complementary management programs with NOAA Fisheries, US Fish and Wildlife Service and the Fishery Management Councils. Conservation equivalency creates additional burden on the Commission to coordinate with our federal fishery management partners. To facilitate cooperation among partners, the Commission should observe the following considerations.

- The Commission's FMPs may include recommendations to NOAA Fisheries for complementary EEZ regulations. Conservation equivalency measures may alter some of the recommendations contained in the FMPs, which would require the Commission notify NOAA Fisheries of any changes. The Commission needs to consider the length of time that it will take for regulations to be implemented in the EEZ and try to minimize the frequency of requests to the federal government.

- The protocol for NOAA fisheries implementing changes varies for the different species managed by the Commission. The varying protocols need to be considered as conservation equivalency proposals are being developed and reviewed.

- When necessary for complementary management of the stock, the Commission Chair will request federal partners to consider changes to federal regulations.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

From: Conservation Equivalency Work Group

To: Executive Committee

Re: Conservation Equivalency Task Responses

Objective 1: Determine what constitutes Conservation Equivalency success, policy wise

Objective 2: Define before and after technical analyses of CE proposals

Product 1: Revise the current Conservation Equivalency Guidance, based on Work Group recommendations and Policy Board decision points. Focus on Guidance elements to change from "recommended" to "required", in order to tighten up CE implementation.

Product 2: Create a Conservation Equivalency proposal template outlining all required proposal information, including content standards and criteria for evaluating CE

Work Group members: Collen Bouffard (CT), Jeff Brust (NJ), Lewis Gillingham (VA), Kevin Sullivan (NH), Dennis Abbott (NH), Joe Cimino (NJ), Jason McNamee (RI)

1. Develop a way to better characterize and address uncertainty of CE proposals:

Uncertainty in fisheries data can arise from numerous sources, including but not limited to, small sample size, reporting bias, gear selectivity, environmental variability, or non-representative sampling. Uncertainty in the data sources in turn carries through to analytical results of past performance, current status, or future predictions, in addition to compounding of uncertainty when combining multiple data sets with their own uncertainties. This is important for conservation equivalency proposals because uncertainty in proposal results affect the probability of success of achieving equivalency, and ultimately, management objectives. Proposals based on data with low uncertainty will be more likely to achieve the target than proposals based on data with high uncertainty.

The primary concern when highly uncertain data are used is that a proposal will not be conservative enough. For example, an insufficient harvest reduction. It is equally likely a proposal based on uncertain data could be overly conservative. While this might sound beneficial, it has the potential to result in lost opportunity for fishery participants, and erodes management equality among the states. It is in the best interest of ASMFC and its partners to achieve equivalency with as much precision as possible.

MEMORANDUM

To ensure proposals have a high probability of achieving the management target, the TC should establish minimum standards for the types and quality of data that can be used in a proposal. Examples include, but should not be limited to:

- Minimum sample size
- Amount of imputed/borrowed data points
- Limit on PSE
- Types of data allowed; minimum number of years
- Survey design
- Data caveats and analytical assumptions
- Consider previous CE proposals and build on their strengths (e.g., length of closed season)

The appropriate TC should establish a comprehensive list of standards. The Assessment Science Committee could outline the standards and provide examples, for TCs to build on for individual species and fishery implementation. To assist with development of the list, TCs should consider previous CE proposals and build on the strengths of those. Each proposal should include explicit discussion of how each data set meets the standards, as well as any other known or assumed biases that might affect its utility. Further, proposals should explicitly state any assumptions used for each data set when they are used in the analysis.

In many cases, the uncertainty of a dataset is unknown, such as with volunteer reported data. For these data sources, the TC could decide not to allow their use, or require states to provide evidence (or at least written justification) that the uncertainty falls within an acceptable range. Examples include comparing length frequency from volunteer data to MRIP data, or comparing volunteer reported catch rates with survey abundance.

If a state proposal does not meet all the criteria established by the TC – for example, if uncertainty in a dataset exceeds the allowable range, a proposal fails to fully explain assumptions and biases, or a dataset with unknown uncertainty can't be fully justified – it may result in a proposal being denied. Alternatively, the TC could impose additional/alternative criteria, such as requiring a 'penalty' term or buffer on achieving the target. These additional criteria should be established relative to each state's proposal, and not applied as a one size fits all solution.

It should be noted that any criteria established by the TC may affect the "structure" of each state's proposal differently. For example, a state with low MRIP PSEs might be able to provide a wave-specific proposal, while other states with higher PSEs might need to combine data across waves. There will undoubtedly be situations where some states will not be able to participate in CE at all because their data do not meet the standards. In these situations, alternative criteria could be considered, or states could consider alternatives, such as submitting a joint proposal with neighboring states.

2. Develop a buffer to account for uncertainty

a. Should stock status be accounted for when establishing buffers (stock status steps/tiers, control rule)

The Work Group agrees stock status should determine whether CE is allowable. The Conservation Equivalency guidance currently states "The PDT should consider stock status, stock structure, data availability, range of the species, socio-economic information, and the potential for more conservative management when stocks are overfished or overfishing is occurring when making a recommendation."

b. A buffer should not be overly burdensome on "fringe states". Should the buffer apply differently to the fringe states?

A buffer should apply differently or perhaps not be used at all for states with very small harvest. However, CE should be reevaluated to see if it was effective, just like any other state. A change is needed to avoid choose your own adventure by individual states. It's either coastwide measures or everyone does CEs. Every state should take the same reduction. A blanket 'fringe' state rule should not pertain to CE buffers.

Also, there is no current definition of 'fringe states'. One option would be a state with less than 1% of total removals (not <1% harvest).

3. Develop a hindsight analysis to see how well CE performed, including the coast wide measure for comparison

a. To inform the above buffer

b. Consider harvest vs total removals consistent with FMP

To achieve the Commission's long-term vision of "sustainable and cooperative management of Atlantic Coast fisheries," it is imperative that all Commission partners be held accountable for successful implementation of Commission management plans. Without accountability, it will be difficult for cooperative management to succeed. With respect to conservation equivalency, it is important to evaluate the effectiveness of each proposal after the fact to determine if the equivalency target was achieved. If equivalency was not achieved, appropriate repercussions should be established and implemented.

MEMORANDUM

As noted before, however, fisheries data are confounded by uncertainty, which make evaluating actual performance difficult. Factors that may affect catch include:

- Recruitment
- Environmental variability (availability)
- Sample size and sampling design (data variability)
- Effort (e.g., market conditions, weather)
- Angler behavior
- Frequently changing regulations (moving baseline)

These factors, taken in conjunction with the wide range of proposals, makes it impossible to develop a one size fits all analysis to evaluate performance. Regardless, Boards and TCs should still strongly consider developing a method of evaluation. Criteria to consider when establishing guidelines for CE proposal analysis include:

- Use multiple years' worth of data with consistent regulations to smooth variability
- Use rates, rather than totals (e.g., CPUE vs catch) to account for changes in effort
- Explicitly state and discuss assumptions and caveats of data and how they might affect the analysis
- Account for any extra buffer required in the state's CE proposal

The TC should also establish guidelines for what determines success. Considerations include:

- Recognizing the various sources of uncertainty, how many years of data are needed to evaluate performance?
- Is the target based on harvest or total removals (harvest + dead discards)?
- If a state approaches, but does not achieve, the target, how close is close enough?
- For a state that requires a buffer, is it sufficient if they achieve the target, but not the target + buffer requirement?
- Is any action required if not all states achieve the target, but the coast as a whole does achieve the target?
- Do the answers to these questions differ depending on if the state is a major contributor to the fishery vs a fringe state?
- Would the Board allow a state to adjust their regulations if it is determined their proposal was overly conservative?

Finally, the Board should also establish appropriate actions for any state that does not achieve the target. Ideally, actions should be established before performance is evaluated, perhaps as early as when criteria for developing CE proposals are established. This would alert states to the consequences of failing to meet the target before plans are implemented, and might sway a state's decision to implement if the risk outweighs the reward. Further, any proposed action should be fair and equitable to all states, with the overall goal of achieving management objectives of the FMP.

Although it is not possible to develop a single method to evaluate performance of CE proposals, development of explicit review criteria and guidelines by the relevant TC and Management Board prior to implementation, in addition to appropriate management responses for states that do not achieve equivalency, will promote accountability among the participating states.

4. **Some measures are non-quantifiable. For species and measures that are harder to evaluate equivalency, should CE be allowed?**
    a. **Should there be bounds on CE or is anything allowed unless specifically excluded by the FMP?**

The state submitting a proposed measure for credit must be able to demonstrate, to the satisfaction of the TC, a measurable reduction in harvest. Any measures meeting that criterion, and not specifically excluded in the FMP, should be allowed for consideration but could be rejected upon review. Measures that are non-quantifiable can be encouraged and considered as a buffer but not used as direct credit for a reduction in harvest. Non-quantifiable measures include circle hooks, non-targeting zones/period, no gaffing, outreach promoting best practices for release, and other measures expected to reduce release mortality or overall discards.

    b. **Should FMPs allow the mix of coast wide measures and CE measures within the same management process? E.g. last round of Striped Bass measures**

Stock status (over-fished vs not over-fished and their trend) should be the first consideration. If a stock is both over-fished and overfishing is occurring plus the stock abundance is in decline then the most conservative coast wide measures should be required by all states. If the stock is not over-fished then the CE criteria adopted by the Striped Bass Management Board "the PSE range not to exceed 40%" should apply. Consider additional latitude above the 40% PSE threshold, up to 50% PSE, if the stock is neither over-fished nor over fishing is occurring.

For recreational fisheries, we acknowledge there are not many FMPs that would be evaluating CE because there are not many species that use CW measures. We also note some species have annual catch targets (like RHLs). And there are species that have state/regional specific catch targets. Others simply manage to F targets which can only be evaluated after assessment updates - although there are management actions that seek a reduction value from a base year to an upcoming year.

There is consensus from the Work Group that if there is a target reduction needed it cannot be through a combination of a coastwide measure that is optional with some states opting to use an alternative method. It is possible that a state's harvest or expected harvest is so small that it may not impact the Coast Wide reduction projection if they didn't implement the measures. In other sections we refer to these as fringe states. There should not be a fringe exemption to this idea that there cannot be a mix of CE and Coast Wide targets. However, if a fringe state is de minimis then it they will likely be exempt from putting in Coast Wide measures.

For commercial fisheries, the application of CE is rare. Harvest reductions are often employed by straight forward quota reductions. However, in some circumstances a state may wish to employ CE over mandated trip limits or seasons to avoid issues of dead discards. Such proposals should be allowed to be submitted for TC and Board review. The only recent example of commercial CE is when NC used a bycatch percentage of the catch instead of a 100-pound trip limit for weakfish. The reason for the CE was to avoid massive discards. It would be important to keep such options on the table and allow the specific Board/PRT/TC to review such proposals.

5. Should measures that cannot be quantified be permitted under CE?

Measures that cannot be quantified should not be permitted under CE if their sole purpose is for credit in the reduction.

The submitting state must present quantifiable evidence that CE is necessary, not just use manipulation of models to make their case. The standards for state conservation equivalency proposals in the guidance document should be rigidly adhered to. For proposed CE measures where data provided are presented correctly, the Board must carefully consider whether the presented data sets are being applied correctly and with their intent in mind based on survey/study design. Board and TC review should not be solely on sound survey design, appropriate time series, and accuracy of data analysis, but should pass judgment on if the proposed data application is appropriate or rather it is being 'stretched' beyond its intent (e.g., reducing APAIS estimates beyond the survey design of 2-month Wave estimates to monthly, weekly, or daily catch rates). A PSE threshold (e.g., 40%) would address this for APAIS data to prevent data being used for 'rare event' species that are beyond the scope of a coastwide or regional survey designed to produce statistically reliable annual estimates. A similar threshold of data precision needs to be applied to smaller, state conducted programs.

MEMORANDUM

As an example, the implementation of 'No Targeting Seasons' used in the Chesapeake Bay fishery in response to Addendum VI for Striped Bass included many assumptions on how angler behavior would change with the regulations. Many measures, assessments, or analyses approved by the Board are caveated with some admission that we cannot predict changes in angler behavior, but measures such as 'No Targeting Seasons' rely heavily on the prediction of assumed changes in angler behavior. The effect of a No Targeting Season is nearly impossible to measure, thus their contribution to a resulting reduction or increase is immeasurable. In a case such as this, the CE should have been required to provide the required reduction at the 18% level with equivalent uncertainty, and the 'No Targeting Season' could have been added as a buffer to make the proposal more conservative. Furthermore, the CE guidance document states: "The state submitting the conservation equivalency proposal has the obligation to ensure proposed measures are enforceable." Proposed CE measures that may be considered 'non-traditional' forms of management should have strict review and agreement in a clear enforceability by the LE committee.

6a. Are there minimum data standards for CE?

A goal of 20% PSE was established by the ACCSP Recreational Technical Committee for sampling recreationally important species. NOAA Fisheries' advice is anything over 50% PSE should not be used for management. The Striped Bass Fishery Management Board set an acceptable maximum of PSE 40% for consideration of CE.

More flexibility may be appropriate when a stock is not over-fished nor over fishing is occurring, and stock abundance is stable or increasing.

States not meeting minimum data standards (PSE threshold) should consider a regional approach, as used for black sea bass and summer flounder, and by pooling their data (increasing sample size) to lower their cumulative PSE.

Any proposal must demonstrate a quantifiable reduction in harvest to be considered for CE.

The work group expressed concern regarding the use of citizen science in CE. Generally, the data gathered tends to be from a very select group with no means of validation. However, a program that has been on-going for a number of years with consistent sampling could provide useful insight as an index.

6b. Is there a required level of review of the data sets used if not within the bounds of the minimum data standards?

MEMORANDUM

A set of the most appropriate models and level of analytical review for data sets should be identified prior to the TC review. This should provide guidance for the TC and lead to more open discussion. A cap on the maximum number of proposals, plus an earlier timeline for submittal for state proposals, should be established to facilitate a more extensive review.

Any analyses that do not meet approved precision standards but are included for consideration should undergo sensitivity analyses to determine the effects on the stock due to modest proposed state changes from coast wide measures.

When evaluating closed periods, availability should be considered. Even within a month, availability can be very different, particularly when comparing the beginning and end. Any closed period should come from a period of high availability and include at least two weekend periods (Friday, Saturday and Sunday). Pooling of several years' worth of data should be encouraged for evaluation.

6. Should there be a time limit on CE programs (set number of years, assessment cycle, etc.)?

While a conservation equivalency program can be proposed to a species management board at any time, an approved program timeline should align with the next scheduled benchmark stock assessment. If an approved CE program consistently meets program objectives, achieves the proposed measures with the management actions implemented, and if stock conditions remain favorable, a request for an extension should be made to the species management board at the end of the project period. Extensions for successful conservation equivalency programs should not exceed the next scheduled benchmark stock assessment.

Though the timing of compliance reports may not coincide with CE program timelines and data collection, the work group feels annual updates for future approved conservation equivalency programs should be provided in species compliance reports. The updates should provide an overview of the program and approved measures, as well as a narrative describing the success or limitations of achieving the effects of the management measures. The updates should be reviewed by the species Plan Review Team and, if deemed necessary, sent to the species Technical Committee for further evaluation to determine the efficacy of the measures implemented and to provide comment back to the Board.

7. Should stock status impact CE? If so, how? Example, if a stock is declared OF/OFO then CE be re-evaluated?

MEMORANDUM

CE should be re-evaluated after any benchmark stock assessment. If a stock is declared overfished, CE should not be allowed. CE could not be reinstated until stock status returned to not overfished. The work group considered different categories of overfishing. If overfishing only occurred in the terminal year or was slightly above the threshold for two recent years, use of CE is not limited.

The work group devised additional questions. If a stock is determined overfished and CE is no longer allowed, do new coast wide measures automatically kick in? Or, if states had CE and for some reason there are no recommended changes for the upcoming year, are the current CE measures grandfathered in? It is possible F is trending down and the stock hasn't had time to rebound yet but status quo measures would be recommended.

The states always have the option to be more conservative. If a state wants to introduce more conservative measures, would they have to use the CE process, have an analysis done, and reviewed by a TC? If CE is prohibited while overfished, how would the more conservative measures be evaluated?

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: ISFMP Policy Board

FROM: Assessment and Science Committee

DATE: April 24, 2023

SUBJECT: Revisions to the Stock Assessment Schedule

The Assessment Science Committee (ASC) met on April 17th, 2023 to address several agenda items, including assessment data and code sharing needs, the upcoming changes to the MRIP data standards and queries, and revising the ASMFC stock assessment schedule.

ASMFC Staff reviewed the current stock assessment schedule for 2023 to 2025 and raised concerns to ASC about the workload for Technical Committee (TC) and Stock Assessment Subcommittee (SAS) members and Staff. In addition to the benchmark assessments scheduled for completion over that time period, there are a number of assessment updates and similar tasks on the schedule that will increase the workload for assessment teams, many of which overlap. See the supplemental file "Full Assessment Timeline 2023-2025.xlsx" for a more detailed overview which highlights when work will occur, not just when assessments are scheduled for completion.

Proposed Changes

ASC recommends the following changes to reduce overall workload without postponing the completion of critical benchmark and update assessments.

- **Change the sturgeon assessment in 2024 from a benchmark to an update.** The Sturgeon TC recommended conducting an update due to a lack of significant progress on research recommendations since the last benchmark.

- **Change the menhaden single-species assessment in 2025 from a benchmark to an update.** The single-species assessment has a mature model that has been peer reviewed multiple times. There are no planned changes to model structure or inputs for the 2025 assessment. Conducting an update instead of a benchmark would reduce work on the TC (which overlaps with the Ecological Reference Point WG), Staff, and ERP Review Panel, while still allowing the most up-to-date information to be provided to the ERP models. The ERP assessment would continue as a benchmark in 2025 and both the single-species and ERP assessments would undergo benchmarks as planned in 2031 to develop spatial components for the models.

M23-039

Long-Term Stock Assessment Schedule (Draft April 2023)

Species	2018	2019	2020	2021		2022	2023	2024	2025	2026
American Eel						Benchmark				
American Shad			Benchmark							
American Lobster			Benchmark						Benchmark	
Atlantic Croaker								Benchmark		
Atlantic Menhaden		Benchmark				Update			Update	
Atl. Menhaden ERPs		Benchmark							Benchmark	
Atlantic Sea Herring	Benchmark		Update			Update		Update	Benchmark	Update
Atlantic Striped Bass	Benchmark					Update		Update		**Update*
Atlantic Sturgeon								Update		
Black Drum						Benchmark				
Black Sea Bass	Update	Update		Update			Benchmark		Update	
Bluefish	Update	Update		Update		Benchmark	Update		Update	
Coastal Sharks			Benchmark				Benchmark			
Cobia		Benchmark							Update	
Horseshoe Crab		Benchmark						Update		
Horseshoe Crab ARM				Benchmark			Update	Update	Update	Update
Jonah Crab							Benchmark			
Northern Shrimp	Benchmark			Update				Update		
Red Drum						Benchmark		Benchmark		
River Herring								Benchmark		
Scup	Update	Update		Update			Update			
Spanish Mackerel						Update				
Spiny Dogfish	Update					Benchmark				Update
Spot								Benchmark		
Spotted Seatrout										
Summer Flounder	Benchmark			Update			Update		Update	
Tautog				Update				**Update*		
Weakfish		Update							Update	
Winter Flounder			Update			Update		Update		Benchmark

Notes:

Coastal Sharks	Hammerhead benchmark assessment 2023
Spotted Seatrout	States conduct individual assessments
Striped Bass	2027 Benchmark Assessment
Sturgeon	2027 Benchmark Assessment
River Herring	Peer Review in 2023, Board presentation in 2024

ASMFC Peer Review

SARC Review (Research Track)

SEDAR Peer Review (Research Track)

Completed

**Italics = under consideration, not officially scheduled*

Year	Month *Science Staff (Policy Staff)->*	**American Eel Benchmark 2022** *K. Anstead (C. Starks)*	**Intermediate Stock Assessment Training Course 2023** *K. Drew, J. Kipp, K. Anstead*	**Jonah Crab Benchmark 2023** *J. Kipp (C. Starks)*	**River Herring Benchmark 2023** *K. Drew (J. Boyle)*	**Lobster Data Updates (Annually)** *J. Kipp (C. Starks)*	**Northern Shrimp Data Update 2023** *K. Drew (C. Tuohy)*	**HSC ARM Annual** *K. Anstead (C. Starks)*	**Horseshoe Crab Update 2024** *K. Anstead (C. Starks)*	**Northern Shrimp Update 2024** *K. Drew (C. Tuohy)*	**Spot and Croaker Benchmarks 2024 (and TLAs Annually)** *J. Kipp & K. Anstead (T. Bauer)*	**Red Drum Benchmark 2024** *J. Kipp (T. Bauer)*	**Atlantic Sturgeon Update 2024** *K. Drew & K. Anstead (J. Boyle)*	**Striped Bass Update 2024** *K. Drew (E. Franke)*	**Weakfish Update 2024** *K. Drew (T. Bauer)*	**Menhaden Single-Species 2025** *K. Drew & K. Anstead (J. Boyle)*	**Menhaden ERP 2025** *K. Drew & K. Anstead (J. Boyle)*	**Lobster Benchmark 2025 (*Tentative dates to be confirmed during planning in later 2023)** *J. Kipp (C. Starks)*
	January	SAS Calls to Address Post-Assessment Board Task Work									Circulate Data Requests	Circulate Data Requests						
	February												TC Planning Call			TC/ERP Planning Call		
	March		Intermediate Training Weekly Classes: Mock DW								Mid-March Data Due		SAS Planning Call			Circulate Data Requests		
	April			Assessment Workshop							Validated Landings		Circulate Data Requests					
	May	Write Supplemental Report				Circulate Data Requests					Data Workshop (Virtual)	May 30: Data deadline					Methods Workshop I (ERP)	
	June	Report to Meeting Materials		Draft Assessment Report and review with TC				Request Data for ARM	TC & SAS Planning Calls			Data Workshop	Data Due through 2022		TC/SAS Planning Call	New Data Submissions Due		
2023	July			Peer Review Workshop					Circulate Data Requests		Data Requests for TLA							
	August	Present Supplemental Report to Board			Assessment Workshop	Data Due							Index Sub-group Work & Calls					
	September				Report drafted	Process Data; Draft Memo and review with TC	Data available	ARM/DBETC Call to Review ARM Results	Data Due through 2022		Assessment Workshop I; Run TLA and TC Call to Review							Assessment Planning
	October			Present Assessment and Review Reports to Board	Report approved by TC/SAS	Present Data Update to Board	Traffic light approach completed	Present ARM to Board	Index Sub-group Work & Calls		Present TLA to Board	Assessment Workshop I				Data Workshop		
	November		Mock AW 1: in-person		Peer Review		Memo drafted											
	December						Memo to Section						Update Models & Methods					
	January				Reports to Meeting Materials				Update Models & Methods		Assessment Workshop II			TC/SAS Planning Call				Circulate Data Requests
	February				Present Assessment to Board								Report Writing			FI Data through 2022 Due		
	March		Mock AW 2: in-person									Assessment Workshop II	Report Finalized by SAS			FD Data through 2022 Due		Stock Structure Workshop
	April												Report to TC					
	May					Circulate Data Requests			Report Writing			Report Finalized by SAS	TC Call to Approve Assessment	Data through 2023 submitted	Data through 2023 submitted			Data through 2023 due
	June							Request Data for ARM	Report Finalized by SAS		"Summer" Peer Review Workshop	Early June: TC Review	Report to Meeting Materials					Data/Researcher Workshop
2024	July								Report to TC			July 1: Report to SEDAR		Model runs	Model runs			
	August					Data Due			TC Call to Approve Assessment		July/August: Data Requests for TLA	Aug 12: Peer Review Workshop	Present update to Board at Summer Meeting	Runs finalized for ERPs	Runs finalized for ERPs		Multi-species Data Due	
	September					Process Data; Draft Memo and review with TC		ARM/DBETC Call to Review ARM Results	Report to Meeting Materials	Data available	Run TLA & TC Call							
	October					Present Data Update to Board		Present ARM to Board	Present update to Board at Summer Meeting w/Annual ARM	UME model runs completed	Present Assessment & TLA to Board	Present Assessment to Board		Report finalized for Meeting Materials	Report finalized for Meeting Materials	Methods Workshop II		Assessment Workshop I
	November									Report drafted				Present Assessment to Board	Present Assessment to Board			
	December									Present Assessment & TLA to Board								
	January																	
	February															Assessment Workshop		Assessment Workshop II (if needed)
	March																	
	April																	
	May					Circulate Data Requests										May 16: Report Sections Due to Staff		Draft Assessment Report
	June							Request Data for ARM								June 2: Report Draft to SAS & ERP for Review June 16: SAS/ERP Call to Finalize Reports June 30: Reports to TC		Review Assessment with TC
2025	July										Request TLA Data					July 14: TC Call to Approve Report for Peer Review		
	August					Data Due										Aug 1: Reports to Peer Review Panel Mid/Late August: Peer Review Workshop		Peer Review Workshop
	September					Process Data; Draft Memo and review with TC		ARM/DBETC Call to Review ARM Results			Run TLA & TC Call							
	October					Present Data Update to Board		Present ARM to Board			Present TLA to Board					Present Assessments to Board		Present Assessment and Review Reports to Board
	November																	
	December																	

American Ee	Jonah Crab S	River Herring	Lobster SAS	Northern Sh	HSC ARM	HSC SAS	Spot and Croak	Red Drum S	Atlantic Sturgeo	Striped Bas S	Weakfish SA	Menhaden	Menhaden ERI
Kristen Anste	Joshua Carlor	Jason Bouche	Joshua Carlor	Robert Atwo	Kristen Anstea	Kristen Anste	Kristen Anstead	Joey Balleng	Kristen Anstead	Michael Celes	Linda Barry	Sydney Alha	Kristen Anstea
Jason Bouche	Jeremy Collie	James Boyle	Jeff Kipp	Lulu Bates	Linda Barry	Linda Barry	Linda Barry	Tracey Bau	Jason Boucher	Margaret Con	Tracey Bauer	Kristen Ans	Jason Boucher
Matt Cieri	Jeff Kipp	Michael Brov	Conor McMa	Katie Drew	Henrietta Belln	Margaret Cor	Tracey Bauer	Jared Flowe	James Boyle	Katie Drew	Margaret Co	James Boyle	Michael Celesti
Margaret Co	Derek Perry	Margaret Co	Tracy Pugh	Alicia Miller	Jason Boucher	Jeffrey Dobbs	Margaret Finch	Angela Giul	Michael Celestin	Brooke Lowm	Katie Drew	Jeff Brust	David Chagaris
Sheila Eyler	Kathleen Rea	Katie Drew	Kathleen Rea	Tracy Pugh	Margaret Conr	Michael Kenc	Jeff Kipp	Jeff Kipp	Margaret Conroy	Gary Nelson	Angela Giulia	Matt Cieri	Matt Cieri
Laura Lee	Burton Shank	William Eakir	Burton Shank		Steve Doctor	Dave Smith	Laura Lee	CJ Schlick	Katie Drew	Alexei Sharov	Yan Jiao	Caitlin Craig	Micah Dean
Caitlin Starks	Caitlin Starks	Ben Gahagan	Caitlin Starks		Jim Lyons	Caitlin Starks	Brooke Lowmar	Ethan Simp	Jared Flowers	John Sweka	Laura Lee	Katie Drew	Katie Drew
John Sweka	Corinne Trues	Kyle Hoffman			Conor McGowa	John Sweka	Harry Rickabaug	Chris Swans	Dewayne Fox		Eric Levesqu	Brooke Low	Shanna Madse
Troy Tuckey		Trey Mace			Bryan Nuse		Somers Smott		Nathaniel Hancock		Shanna Mad	Jason McNa	Jason McName
Keith Whiteford		John Sweka			Samantha Robinson				Amanda Higgs			Amy Schuel	Amy Schueller
John Young		Joe Zydlewski			Dave Smith				Dave Kazyak			Alexei Sharo	Alexei Sharov
					Caitlin Starks				Laura Lee			Chris Swans	Howard Towns
					John Sweka				Bill Post				Jim Uphoff
					Wendy Walsh				Eric Schneider				
									David Secor				

Commissioner Stipend Discussion Paper

Atlantic States Marine Fisheries Commission

April 18, 2023

Background

The Commission has discussed the potential to provide stipends to Legislative and Governors' Appointee (LGA) Commissioners for their participation in Commission activities. To date, the Commission has not provided a stipend or other financial compensation to Commissioners for participation. In contrast, the Magnuson-Stevens Act establishes a daily compensation rate (GS 15, Step 7, currently ~$540/day) for Federal Fishery Management Council members when engaged in Council activities. This paper presents different options that have been discussed.

Potential Tax Benefit for Commissioners

At the Winter Meeting, the idea of a potential tax benefit for Commissioners was suggested. Given that LGA Commissioners volunteer their time, staff was asked explore potential tax benefit options for the Commissioner's donated time.

Staff talked with tax professionals including a CPA. The tax professionals generally did not commit to a potential tax benefit for Commissioners volunteering time to the Commission. They noted a benefit was unlikely but each Commissioner would need to consult with their own tax advisor.

Stipends Paid by Member States to Their Commissioners

It was suggested that each state could voluntarily provide stipends to their LGA Commissioners if they choose to do so. These stipends would be outside of the Commission process and would be handled entirely by the individual states. Staff did not research this approach since it would be addressed by the individual states.

Options for Providing a Stipend to Legislative and Governors' Appointee (LGA) Commissioners

The following options are similar to those presented at the 2023 Winter Meeting.

Option 1 – Status Quo

The LGA Commissioners will continue to serve on a volunteer basis and not receive a stipend from the Commission.

Option 2 – A Stipend will be provided only for extraordinary meetings

The LGA Commissioners will receive a stipend for meetings that are outside of the four quarterly Commission meetings and outside of the joint meetings with one of the three Federal Fishery Management Councils. Examples of these meetings include NEFMC Atlantic Herring Committee meetings, Recreational Fisheries Summit, Scenario Planning Summit, etc.

Approximate Financial Impact: 13 Person days X $540 Stipend = $ 7,020

Option 3 – A Stipend will be provided for meetings outside of the Commission Quarterly Meetings

The LGA Commissioners will receive a stipend for meetings that are outside of the four quarterly Commission meetings including joint meetings with one of the three Federal Fishery Management Councils and other extraordinary meetings.

Approximate Financial Impact: 82 Person days X $540 Stipend = $44,280

Other Considerations

If a stipend is provided to LGA Commissioners, consideration should be given to the following items:

- Stipend for Proxies
- Virtual Participation
- LGA Eligibility to Receive Stipend
- Travel Days
- Partial Days
- Administrative Burden
- Other

Bob Beal April 24, 2023
Executive Director
Atlantic States Marine Fisheries Commission
1050 N. Highland Street Suite 200
Arlington, Virginia 22201

RE: Support for Precautionary False Albacore and Atlantic Bonito Management and Transmittal of Literature Reviews

Dear Mr. Beal and members of the ASMFC Interstate Fisheries Management Program Policy Board (ISFMP):

Thank you for your consideration of false albacore and Atlantic bonito management at the upcoming Spring ASMFC Meeting. The American Saltwater Guides Association is a coalition of conservation minded private anglers, fishing guides, and small fishing related businesses. There are few species that unite the entire Atlantic coast like false albacore. There are cult-like followings of dedicated anglers for both of these inshore speedsters, and entire coastal economies depend upon them. Unfortunately, no formal management plans or conservation measures exist for either of these species, jeopardizing the long-term sustainability and abundance of false albacore and Atlantic bonito throughout the Atlantic coast. The ISFMP has a tremendous opportunity to proactively develop precautionary management for false albacore and Atlantic bonito. To jumpstart this process, ASGA has taken the initiative to provide the Commission with literature reviews of both species--in addition to the other scientific efforts referenced in more detail below. **ASGA strongly supports the ASMFC developing proactive management and precautionary guardrails for false albacore and Atlantic bonito.**

False albacore and Atlantic bonito provide extensive opportunity for inshore and near-shore anglers along the Atlantic coast. The light tackle and fly-fishing communities are especially dependent on these seasonal inshore species. So much so, that anglers and fishing guides in the Northeast will extend their seasons by traveling south to North Carolina to continue targeting false albacore. In 2022, preliminary estimates from the Marine Recreational Information Program identified 816,388 directed trips (primary and secondary target) for false albacore (aka, little tunny) and 203,409 Atlantic bonito trips.[1] These trips generate tremendous economic value for many within our membership up and down the Atlantic coast. Commercially, there are directed fisheries and relatively stable landings; however, ASGA is concerned about directed, large-scale fisheries potentially expanding with no management frameworks in place. These species are extremely valuable throughout the Atlantic coast, and, while there is currently no management, they would only benefit in the long-term by proactively developing management now.

The false albacore and Atlantic bonito fisheries, much like several other ASMFC managed species, are predominantly recreational. As a resource first, science-based organization, we want what is best for the health of the fishery, which is ultimately best for all stakeholders. This is the

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[1] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division April 4, 2023.

time for the ASMFC to be proactive and ensure these fisheries remain healthy and available to all stakeholders for the long-term. ASGA is advocating for proactive guardrails for both the recreational and commercial sectors targeting these species. While we understand that there are no stock assessments for false albacore or Atlantic bonito, and extensive data gaps exist, ASGA firmly believes that in the absence of perfect science, fishery management must be precautionary. ASGA has gone so far as to raise hundreds of thousands of dollars to provide the science needed to better understand these species.

To support our members dependent on these species and to catalyze proactive, precautionary management, ASGA initiated several scientific research efforts in 2022 with plans to continue and expand them in 2023:

- Acoustic Tagging: in the Fall of 2022, ASGA, the New England Aquarium, and partners deployed acoustic tags into false albacore in Nantucket Sound (near Cape Cod, MA). Data from other acoustic receiver arrays are still coming in, but we know that 90% of the released fish pinged, indicating a high rate of survivability. Now that we know acoustic tagging works for false albacore, we will deploy more tags in 2023 and utilize new technology to learn more about post-release mortality and movements.
- Conventional Tagging: ASGA worked with partners from Florida, North Carolina, New York, and Massachusetts to deploy conventional tags into false albacore. These tags are high volume, low return data collection tools. We are excited to increase these efforts in 2023 and learn more about coastal dynamics.
- Genetics Work: Over the course of three days in October 2022, ASGA leveraged some of the best Captains on the East coast to collect false albacore fin clips in Massachusetts, New York, and North Carolina. These fin clips went to our partners at Cornell University's Center for Sustainability; they analyzed the samples and concluded—based on the available sample size/region—this is clearly one stock of false albacore. ASGA is excited to continue this work in 2023 and include more sampling regions.

All of these scientific efforts were privately funded by ASGA and our partners because false albacore are an incredibly important species for our businesses and deserve proper management and conservation. ASGA fully intends to share this research and scientific information with managers and other scientific entities, and we have an exciting new tool to assist in filling recreational fishing data gaps.

Furthermore, we have attached two literary reviews[2] in draft form, which collate all known information on false albacore and Atlantic Bonito. ASGA commissioned these papers from Nicholas M. Calabrese, a Senior Fisheries Research Technician and PhD Candidate at the University of Massachusetts at Dartmouth's School of Marine Science and Technology in hopes that they would speed up the process at the ASMFC and lessen the potential workload for staff.

In addition, please see ASGA's September 2022 letter to the South Atlantic Fishery Management Council signed by more than 1,000 private anglers, fishing guides, and fishing-related brands and

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[2] A Review of the Fishery, Biology, and Life History of the Little Tunny (*Euthynnus alletteratus*) in the Northwest Atlantic and A Review of the Fishery, Biology, and Life History of the Atlantic Bonito (*Sarda sarda*) in the Northwest Atlantic.

companies from all over the Atlantic coast that supported developing precautionary management for False Albacore.[3]

Thank you for your consideration of these comments and efforts to develop management for false albacore and Atlantic bonito. This is a tremendous opportunity for the ASMFC to show passionate, conservation-minded anglers that it listens to the community and can manage fisheries proactively rather than reactively. **To that end, ASGA strongly supports the ISFMP Policy Board initiating an action at the Spring ASMFC Meeting to develop management plan(s) to ensure the long-term sustainability of false albacore and Atlantic bonito.**

Sincerely,

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CC: Members of the ASMFC's Interstate Fishery Management Program Policy Board

[3] American Saltwater Guides Association. ASGA Albie FMP Request. September 2022. https://saltwaterguidesassociation.com/wp-content/uploads/2022/09/ASGA_Albie_CMP_FMP_Request_Final.LOGOs_.pdf

American Saltwater Guides Association

A Review of the Fishery, Biology, and Life History of the Little Tunny (*Euthynnus alletteratus*) in the Northwest Atlantic

Nicholas M. Calabrese and Stephanie L. Merhoff

DRAFT

Final to be submitted within 15 days of the ASMFC Meeting

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EXECUTIVE SUMMARY

In recent years, Little Tunny has become a popular target of recreational fisheries along the Atlantic coast of the United States. There is currently no management plan for this species in United States waters or internationally (ICCAT 2021; NCMF 2023). There is limited research on stock structure or status. However, in the Eastern Atlantic several studies have shown genetic differences amongst Little Tunny from different locations (Gaykov and Bokhanov 2020; Olle et al. 2020). Commercial landings over the past decade have been dominated by Florida and North Carolina. Commercial discards occur almost exclusively in gill net fisheries. Florida has been responsible for 77% of recreational landings in the past decade. Approximately 73% of all recreationally caught Little Tunny since 1981 were released, and survival of these fish varies from 35% to 95% depending on fish condition. Recreational catch lengths and weights varied from 17 to 116 cm (Mean = 59.7 cm) and from 0.1 to 11.4 kg (Mean = 1.67 kg). There were no significant differences in length-frequencies amongst years or regions. Length weight equations were calculated by wave (two-month periods) and no significant differences were found.

The only growth study in United States waters (Adams and Kerstetter 2014) found males grow slower and reach larger sizes than females, and combined they reach a maximum size of 77.9 cm at a maximum age of five years. The only maturity study from the United States waters (de Sylva and Rathjen 1981) did not sample enough small fish to estimate length of first maturity, but all males over 40 cm and all females over 36 cm were mature. Little Tunny exhibit asynchronous oocyte development and multiple spawning events throughout the spring and summer (Schaefer 2001), with eggs being shed in several batches when water is the warmest (Collette and Nauen 1983). Spawning occurs near shore, and fecundity can vary from 70,000 to 2,200,000 eggs in females from 38 to 70 cm (Diouf 1980). Little is known about the natural

mortality of Little Tunny but estimates of larval instantaneous daily mortality ranges from 0.72 to 0.95 and estimates of adult natural mortality range from 0.167 to 0.396 (Allman and Grimes 1998; El-Haweet et al. 2013).

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BACKGROUND

Internationally, small tunas support fisheries that are important both economically and as a food source (Majkowski 2007; Isaac et al. 2012; Lucena-Fredou et al. 2021). In the United States, Little Tunny has become a popular target of recreational fisheries (NCMF 2023). Members of the Mackerel and Cobia Advisory Panel have indicated that the recreational fishery for them has become economically important (MCC 2022). Little Tunny is a popular target of the For-Hire industry, as they can be easily caught and provide a fun fight for clients (MCC 2022). The majority of recreationally caught Little Tunny are released, and little is known about the survival of these fish. There is also a small commercial fishery for Little Tunny, where they are usually utilized as bait for larger pelagic species and food (NCMF 2023). In 2022 the American Saltwater Guides Association (ASGA) wrote the South Atlantic Fishery Management Council to request that Little Tunny be included in a fisheries management plan based on a desire to be proactive and precautionary for a species that is important to recreational fisheries, and anecdotal evidence of increasing unreported landings (Poston, W. Personal Communication; 4/19/2023).

The assessment and management of tunas in the Atlantic and Mediterranean is the responsibility of the International Commission for Conservation of Atlantic Tunas (ICCAT). There is no ICCAT assessment or management plan for Little Tunny, however the species was identified priority for increased data collection (ICCAT 2019). In the United States, Little Tunny were previously grouped under the Coastal Migratory Pelagics Fishery Management Plan (CMP FMP) (Federal Register 1982), but no management regulations were proposed. In 2011 they were removed from this management plan and remain unassessed and unmanaged in United States waters (Federal Register 2011). The species included in the CMP FMP are managed jointly by the South Atlantic and Gulf of Mexico Fishery Management Councils. In federal waters, highly migratory species are managed by the National Oceanic and Atmospheric Administration Highly Migratory Species (NOAA HMS) Program. This program manages species that overlap multiple management council's jurisdictions. In addition, each state has its own marine fisheries management system for the fisheries occurring in their respective state waters (Appendix 1).

FISHERIES

Stock Structure and Status

There is little information available to determine the stock structure of many small tuna species, including Little Tunny (ICCAT 2019). There is currently no management structure in place for Little Tunny, but independent attempts to define stock structure and complete data-poor assessments are underway internationally (ICCAT 2021). Currently Little Tunny in the Atlantic are divided into five stock regions, based on traditional ICCAT management areas (ICCAT 2021). These areas are as follows: Northwest Atlantic, Northeast Atlantic, Mediterranean, Southeast Atlantic, and Southwest Atlantic (Figure 1).

There are no available genetic or morphological stock structure studies from the Northwest Atlantic, but there is a limited amount of information from other ICCAT management areas. Olle et al. (2020) found major genetic differences in Little Tunny within the Northeast management area. The two groups sampled were from the Ivory Coast and Senegal as well as Portugal and Spain (Olle et al. 2020). These genetic differences were of the same magnitude as the differences between Atlantic and Pacific Little Tunny (Olle et al. 2020). Gaykov and Bokhanov (2007) found morphological similarities between fish from Nigeria and Angola, countries in different ICCAT management units. Gaykov and Bokhanov (2020) also found significant morphological differences between those fish, and fish captured from Liberia and Morocco. Allaya et al. (2017) found significant differences in morphology of fish captured within Tunisian waters. Despite being separate management units, Little Tunny have been shown to migrate between the Mediterranean and Atlantic via the strait of Gibraltar (Rey and Cort 1981). There is clearly a lack of knowledge on the true stock structure of Little Tunny in the Atlantic and based on the results of studies in the Eastern Atlantic, it's possible there are different stocks within United States waters.

There is no official stock assessment for Little Tunny in any of the ICCAT management areas, but they have been identified as priority to be evaluated by ICCAT in 2017 (ICCAT 2017). There have been several examinations of stock status and stock risk recently, but much of it was focused outside of the Northwest Atlantic. Lucena-Fredou et al. (2017) developed a productivity susceptibility analysis for the longline fishery and found Little Tunny in the South Atlantic to be considered highly vulnerable. Pons et al. (2019A) used length-based data-limited assessment methods to determine that Little Tunny in the Southeast Atlantic are being overfished. Pons et al. (2019B) used catch-based assessment methods to come to the same conclusion. When the datasets were combined in an integrated assessment, no Little Tunny stocks were overfished (Pons et al 2019B; Lucena-Fredou et al. 2021). There was a high level of uncertainty in the results of these studies (Pons et al 2019B; Lucena-Fredou et al. 2021).

Data Sources

For this review, only non-confidential fisheries data was used. The commercial landings, recreational landings, and recreational discards data were provided by the Atlantic Coastal Cooperative Statistics Program (ACCSP). Commercial landings data dates back to 1951 and were limited to annual landings by state. Commercial discard data was provided by the Northeast (ME-NC) and Southeast Fisheries Science Centers (NC-TX) (NEFSC and SEFSC) and dates back to 1991. The observed discard data was aggregated by state, stat area, and gear type. Estimating total discards was beyond the scope of this review, but the observed values were used to characterize the gear types and states responsible for discarded Little Tunny. The non-confidential portion of this data represented 72% of all observed Little Tunny discards by weight in the Northeast. Southeast observer data was limited to numbers of fish observed and coverage was minimal.

All recreational data came from the Marine Recreational Information Program (MRIP) and there were few problems with confidentiality. As data was aggregated at more specific levels (i.e., state and fishing mode) estimation error became more significant. When examining the mode of fishing and location of catch, we presented the data as percentages of the total rather than specific values, allowing for the characterization of the fishery. Recreational discards are only reported in numbers of fish.

Commercial Landings

Historic commercial landings of Little Tunny were peaked in 1952 (744,000 lbs.) through but declined and remained low through the early 1980s (Mean = 8,6319 lbs.) (Figure 2). Landings increased through the 1980s, 1990s, and early 2000s (Figure 2). Over the past decade, landings have become stable between 435,197 and 613,112 lbs. (Mean = 509,812 lbs.).

Over the time-series, the South Atlantic averaged the highest landings (126,074.5 lbs.) (Table 1). Almost all (~90%) of the landings prior to the 1980s were from the Mid-Atlantic and North Atlantic (Figure 3). This changed in the 1980s South Atlantic began landing the majority of Little Tunny (Figure 3). Over the past decade, the South Atlantic has been responsible for 90% of the landings (Table A2.1).

Much of the early landings from the Mid-Atlantic and North Atlantic came from a combination of New Jersey, New York, and Massachusetts (Figure 4). From the 1990s through today, the landings have predominantly occurred in Florida and North Carolina (Table 2). Over the past decade these two states have been responsible for 51% and 39% of the all Little Tunny landings, respectively (Table A2.3). Individual state and region data can be seen in Appendix 2.

Commercial Discards

Almost 99% of observed Little Tunny discards in the Northeast Fisheries Observer Program were caught by gill nets. There are three types of gillnets observed by the program: fixed (34%), drift floating (20%), and drift sinking (45%). The annual breakdown of discards by gear can be seen in Figure 5. Only five states in the Northeast Fisheries Observer Program have recorded Little Tunny discards for the time series, and the majority of these discards come from North Carolina (80%) (Figure 6). There is very little data on discarded Little Tunny from the Southeast Fisheries Observer Program.

Recreational Landings

Since 1981 recreational landings have varied from 712,206 lbs. in 1982 to 5,513,399 lbs. in 2015 (Mean = 2,531,574.4 lbs.) (Table 3) (Figure 7). Landings over the past decade have been high relative to the rest of the time-series (Mean 3,456,398 lbs.). Like the commercial fishery, the South Atlantic accounts for the majority of recreational landings (Figure 8), with 84% of the landings since 1981 and 85% within the past decade (Table A2.4). Much of those landings are from Florida (76%) (Figure 9) (Table 4). Individual state and region data can be seen in Appendix 2.

The mode of fishing responsible for the landings varied by region, state, and year. Across all regions there was a decrease in landings from for-hire vessels in recent years (Figure 10). Private boats represent the majority of landings in all regions (Figure 11) (Table 5). Shore fishing is most common in the North-Atlantic (Figure 11) (Table 5). The North Atlantic has the smallest percentage of for-hire landings (3%) (Figure 11) (Table 5). Rhode Island (63%) and Massachusetts (45%) have the highest percentage of shore caught Little Tunny (Figure 12) (Table 6). Individual region and state catch by mode can be seen in Appendix 2.

The percentage of landings in state and federal waters also varied by region, state, and year. There did not seem to be an overall pattern in location of landings across the time-series (Figure 13). The North Atlantic (91%) has the highest percentage of landings in state waters (Figure 14) (Table 7). The Mid-Atlantic catches were predominantly in federal waters (76%), while the South Atlantic was split almost evenly (Figure 14) (Table 7). Of the South Atlantic states, Florida and North Carolina are the only ones with a high percentage of catch in state waters (Figure 15) (Table 8).

Recreational Discards

With the popularity of catch and release recreational fishing, discards represent an important component of the fishery. Over the entire time-series, 73% of little tunny catch was released (Figure 16) (Table 9). Since 1981 recreational discards have ranged from 78,347 fish in 1985 to 2,606,690 fish in 2014 (Mean = 1,210,849 fish) (Table 10) (Figure 18). There has been an overall increase in discards across the time series (Figure 18). Similar to commercial and recreational landings over the same time-period, recreational discards have occurred predominantly in the South Atlantic (Figure 19). This region has accounted for 77% of the discards since 1981 and 64% within the past decade (Table A2.10). Florida has the most discards of any state, accounting for 72% overall and 54% within the past decade (Figure 20) (Table 11). Individual state plots, and data can be seen in Appendix 2.

The mode of fishing responsible for the discards was dominated by private boats almost everywhere. Across all regions there appeared to be a decrease in the percentage of discards from for-hire vessels in the 2000s (Figure 21). Like landings, shore discards are more common in the North Atlantic (Figure 22) (Table 12). Rhode Island and Massachusetts have the highest percentage of shore released Little Tunny (Figure 23) (Table 13). Individual region and state catch by mode can be seen in Appendix 2.

The percentage of discards in state and federal waters also varied by region, state, and year. There did not seem to be an overall pattern in location of discards across the time-series (Figure 24). The majority of discards in the North Atlantic (95%) came from state waters (Figure 25) (Table 14). The Mid-Atlantic and South Atlantic discards were split almost evenly between state and federal waters (Figure 25) (Table 14).). Of the South Atlantic states, Florida and North Carolina are the only ones with a high percentage of discards in state waters (Figure 25) (Table 15).

Recreational Effort

The number of directed trips, trips where Little Tunny were the primary or secondary target, has varied from 4,071 trips in 1982 to 816,388 trips in 2022 (Mean = 22,571.2 trip). There has been an increasing trend over the time-series (R^2=0.86) specifically starting in 1993 (Figure 27).

Release Mortality

Since more than half of all recreationally caught Little Tunny are released, post-release mortality plays an important role in determining the total removals of the fishery. There is only one study on post-release mortality from the recreational fishery and analysis is ongoing (Kim et al. 2023). Preliminary results indicate survival of fish in good condition is approximately 95%, and declines to 35% for fish in poor condition (Kim et al. 2023). Of the 63 fish tagged in this experiment, 54 were in good condition, 6 were in fair conditions, and 3 were in poor condition (Kim et al. 2023).

LENGTH AND WEIGHT

Data Sources

All length and weight data utilized in this section came from the MRIP survey data, and dates back to 1981. Since this is a recreational fishery survey, all data is affected by the selectivity of hook and line gear, with the possibility that smaller size classes may be underrepresented. The data was downloaded from the online MRIP query system (NMFS FSD 2023), and analysis was completed in R Studio (RStudio Team 2020).

Comparisons of length frequency data were made using a series of Kolmogorov & Smirnov (K-S) tests with a modified version of the clus.lf function in the fishmethods package. The data did not have a sampling unit (i.e., interview or shift) variable to use, so a generic haul variable was assigned to each group, eliminating the among sampling unit variance and simplifying the comparison.

Length-weight observations were transformed using logarithms. Estimated weights were calculated from the relationships and compared to the observed weights to calculate 95% confidence intervals (Wigley et al. 2003). Length-weight relationships were compared across MRIP sample waves (two-month sampling bins starting as January and February). The predicted weights from each wave's length-weight relationship were compared using an analysis of covariance (ANCOVA).

Recreational Size Structure

There were 45,451 length samples collected by MRIP from 1981 to 2022 ranging from 17 to 116 cm (Mean = 59.7 cm; SD = 10.41 cm) (Figure 25). Annual mean length ranged from 53.4 cm in 2013 to 63.8 cm in 1989 (Table 16) with non-insignificant decreasing trend across the time-series (Figure 26). There were no significant differences in length distributions amongst years (K-S Tests; p>0.05), and all annual distributions can be seen in Figure A3.1.

The majority of samples came from the Gulf of Mexico and South Atlantic (95%). Mean length across the regions ranged from 57.1 cm in the Gulf of Mexico to 60.0 cm in the South Atlantic (Table 17). There were no significant differences in length distributions amongst regions (K-S Tests; p>0.05) (Figure 30), and all annual distributions for each region can be seen in Appendix 3. There was also no significant difference in length frequency distributions when grouped by month. (K-S Tests; p>0.05) (Figure 31).

There were 44,663 weight samples collected by MRIP from 1981 to 2022 ranging from 0.1 to 11.4 kg (Mean = 1.67 kg; SD = 0.908 kg) (Table 16). Annual mean weight ranged from 1.21 kg in 2013 to 3.17 kg in 2018 (Table 16) with non-significant decreasing trend across the time-series (Figure 29). Mean weight across the sub-regions ranged from 1.45 kg in the Gulf of Mexico, to 1.75 kg in the Mid-Atlantic (Table 17).

Length-Weight Relationships

The overall log-transformed length-weight relationship (Equation 1) showed a good fit (R^2 = 0.88) (Figure 32). When separated by wave, the R^2 values ranged from 0.83 for wave five to 0.94 for wave six (Table 18), and logarithmic length-weight relationships can be seen in Figure 33. When predicted weights were plotted with their 95% confidence intervals, there was good agreement amongst waves (Figure 34). The ANCOVA showed no significant difference in predicted weights amongst waves (p>0.05).

Equation 1.

$$log\,(W) = log\,(9.5E^{-6}) + 2.92\,log\,(L)$$

LIFE HISTORY

Growth and Maturity

Little Tunny can reach sizes over 100 cm (39.4 in), with the largest MRIP recorded fish measuring 116 cm (45.7 in) and 8 kg (17.7 lbs). There is only one published growth study on Little Tunny in United States waters. Adams and Kerstetter (2014) aged the otoliths of 213 Little Tunny collected from recreational fishermen in the Florida straits. Their estimated von Bertalanffy growth equation can be seen in Equation 2. When separated by sex, males grew slower and reached larger sizes, while females grew faster to smaller sizes (Table 19) (Adams and Kerstetter 2014). The estimated maximum size for the combined sexes was 77.9 cm (30.7 in) at a maximum age of five years (Adams and Kerstetter 2014). Due to the small spatial and temporal scale of the study relative to the distribution of Little Tunny across the entire Atlantic coast, this growth equation may not be representative of the population. There were 852 MRIP measurements greater than the estimated maximum size in Adams and Kerstetter (2014).

Equation 2

$$L(a) = 77.93(1 - e^{(-0.69(a+0.69))})$$

It may be beneficial to examine growth studies outside of the United States waters. A summary of the von Bertalanffy growth parameters from growth studies completed across the Atlantic can be seen in Table 19. The study completed closest to United States waters was from Campeche bank in the Gulf of Mexico (Cabrera et al. 2005). The Little Tunny from Campeche Bank were determined to exhibit a slower growth rate than in Adams and Kerstetter (2014) and reach larger sizes (Cabrera et al. 2005) (Table 19). The study with the largest sample size (n = 1454) took place in the Mediterranean and Aegean seas, where the Little Tunny were estimated to reach a maximum age of nine, grow slower, and reach a larger maximum size (123 cm/48.4 in) (Kahraman and Oray 2001) (Table VB Growth).

There has been one maturity study done on Little Tunny in United States Atlantic waters. De Sylva and Rathjen (1981) examined the maturity of recreationally caught Little Tunny from North Carolina to Florida. They did not have enough juvenile fish to estimate length at first maturity (L_{50}), but they did find that at 40 cm (15.7 in) for males and 36 cm (14.2 in) for females 100% of samples were mature (de Sylva and Rathjen 1981) (Table 20). Cruz-Castan et al. (2019) examined the reproductive biology of Little Tunny in the Southwest Gulf of Mexico and estimated a L_{50} of 34.35 cm (34.52 in) in males and 34.60 cm (13.62 in) in females. Maturity estimates for all areas of the Atlantic can be seen in Table 20.

Distribution, Habitat, and Diet

Little Tunny are distributed throughout coastal waters of the Eastern Atlantic, Mediterranean, and in Western Atlantic from the Gulf of Maine to Brazil (de Sylva and Rathjen 1961). Larvae have been found in large numbers near shore (Calkins and Klawe 1963; Marchal 1963; Gorbunova 1965; de Sylva et al. 1987), including in the Mississippi River delta (Allman and Grimes 1988). These larvae ranged from 2.5 mm at two days to 14 mm at 13 days old (Allman and Grimes 1988). In Florida waters larvae feed almost exclusively on appendicularians (Llopiz et al. 2010). Larvae were limited to the top 50 m of the water column (Llopiz et al. 2010).

Adult Little Tunny remain within the waters of the continental shelf (de Sylva et al. 1987). They school by size with other *Scombrids* but can scatter during certain times of the year (Collette and Nauen 1983). Their diet in United States waters is dominated by herring, and Little Tunny can be seen darting through schools and breaking the surface of the water while feeding (de Sylva and Rathjen 1961). Manooch et al. (1985) ranked the prevalence of different food sources found in Little Tunny from United States waters. From highest to lowest they were clupeids, engraulids, unidentifiable fish, carangids, squid, stomatopods, penaeids, diogenids, stromateids, and synodontids (Manooch et al. 1985). Season and time of day have been shown to affect the feeding habits of adults (Garcia and Posada 2013). Along the East Coast of the United States, adults move as far North as Massachusetts through the summer and early fall, before migrating back to the South for the winter (de Sylva and Rathjen 1961).

Spawning

Little Tunny exhibit asynchronous oocyte development and multiple spawning events throughout the spring and summer (Schaefer 2001), with eggs being shed in several batches when water is the warmest (Collette and Nauen 1983). Temperatures between 24˚ and 28˚ C were found to be the optimal thermal window for reproduction in the Gulf of Mexico (Cruz-Castan et al. 2019). Spawning has also been shown to be affected by the North Atlantic Oscillation (Baez et al. 2019) and prey availability (Llopiz et al. 2010). Due to the presence of larvae, it is believed that spawning occurs near the coast (Calkins and Klawe 1963; Marchal 1963; Gorbunova 1965; de Sylva et al. 1987). Spawning in the Northwest Atlantic is believed to occur in the waters of the Gulf of Mexico, Florida, the Bahamas, and the Carolinas (Yoshida 1979).

In the Southeast United States, the percentage of ripe males goes from 11.8% in March to 88.9% in May, with a peak in June (de Sylva and Rathjen 1961). The percentage of ripe females increased from 5% in March to 65% in May, with a peak in July (de Sylva and Rathjen 1961). In the Gulf of Mexico, Cruz-Castan et al. (2019) found two defined peaks in spawning activity in July and September. A similar spawning season is seen in the Mediterranean and Eastern

Atlantic (Collette and Nauen 1983; Mohamed et al. 2014; Saber et al. 2019). There is limited information on the fecundity of Little Tunny. Diouf (1980) found that fecundity ranged from 70,000 to 2,200,000 eggs in females ranging from 38 cm (14.9 in) to 70 cm (27.6 in).

Natural Mortality

There is little published information about Little Tunny natural mortality. Various methods of estimation using life history traits have been published, some of which are summarized by Vetter (1988). Allman and Grimes (1998) estimated the instantaneous daily mortality of Little Tunny larvae in the Mississippi River delta region, finding that in the Mississippi River plume it was 0.95 and in Panama City, Florida, it was 0.72. The natural mortality of Little Tunny adults along the Eastern Coast of Alexandria, Egypt was calculated using two methods, with the estimates ranging from 0.167 to 0.396 (El-Haweet et al. 2013).

Potential sources of Little Tunny natural mortality include predation, disease, and environmental stress. The most common predators of Little Tunny are sharks, yellowfin tuna and billfishes, as well as some observed cannibalism (Valerias and Abad 2006; Garcia and Posada 2013). In Egypt, wild-caught Little Tunny were found to be infected with trypanorhyncha metacestodes at an infection rate of 38.7% (Abdelsalam et al. 2016). This infection can lead to inflammation, necrosis, and fibrosis within the affected organs (Abdelsalam et al. 2016).

RESEARCH RECOMMENDATIONS

Fisheries Data

A more exhaustive review of fisheries catch data should be undertaken in order to estimate the total removals of the fishery and examine the uncertainty in these estimates. If possible, length data from commercial landings should be applied to the total landings to estimate catch at length. Fleet wide commercial discards need to be estimated from the appropriate method. With the majority of commercial discards occurring in gill net fisheries, survival of these fish is most likely low. For recreational landings, there is length data that could be applied to get catch at length. However, research will need to examine the effects of location and season on the groupings when applying length frequencies to landings. A more thorough investigation into recreational discards, including an examination of the uncertainty surrounding the estimate will better describe the number of fish discarded every year.

Biosampling

There have been minimal studies on the life history of Little Tunny in United States waters. Life history parameters such as growth, maturity, and fecundity play a large role in stock assessment modeling. Effort should be put forth to take biological samples from harvested Little Tunny along the Atlantic coast. The samples could include otoliths to estimate growth, gonads to estimate length at first maturity and fecundity, and tissue samples for genetic testing to evaluate stock structure.

Tagging

With more than half of the recreationally caught Little Tunny being released, post-release mortality and the factors effecting it will be crucial in determining total removals by the fishery. Tagging projects such as Kim et al. (2023) can help refine the estimate of mortality and provide advice to minimize mortality. Tagging studies can also estimate natural mortality and population size, both of which are important components of any future assessment.

Fishery CPUE

Fisheries independent surveys are used to track population trends for many species. Since Little Tunny do not show up in any fisheries independent surveys, some measure of recreational catch per unit effort (CPUE) could be used to standardize catch through the years and track fluctuations in the population. This should be done by isolating trips that targeted Little Tunny. For-hire vessels would most likely have the best catch rates and consistent methods, making them best suited for a CPUE study.

Economics

An analysis that examines the economic impact of the recreational Little Tunny fishery will help to justify precautionary approaches to management of the stock. Since the majority of this fishery is recreational catch and release, the economic value is harder to elucidate than just putting a dollar value on landings. In recreational fisheries revenue is generated through charters, tackle shops, marinas, and general tourism to areas where the fishery is occurring. Including these factors in an analysis that can estimate the impact Little Tunny has on local economies may help justify the need for management.

REFERENCES

Abdelsalam, M., Abdel-Gaber, R., Mahmoud, M.A., Mahdy, O.A., Khafaga, N.I.M., Warda, M. 2016. Morphological, molecular and pathological appraisal of *Callitetrarhynchus gracilis* plerocerci (Lacistorhynchidae) infecting Atlantic little tunny (*Euthynnus alletteratus*) in Southeastern Mediterranean. J. Adv. Res. 7(2): 317-326.

Adams, J.L., and Kerstetter, D.W. 2014. Age and Growth of Three Coastal Pelagic Tunas (*Actinopterygii: Perciformes: Scombridae*) in the Florida Straits USA: Blackfin Tuna, *Thunnus Atlanticus*, Little Tunny, *Euthynnus Alleteratus*, and Skipjack Tuna, *Katsuwonus Pelamis*. Acta Ichthyol. Piscat. 44 (3): 201-211.

Allaya, H., Abderraouf, B.F., Rebaya, M., Zrelli, S., Hattour, A., Quignard, J.P., Trabelsi, M. 2017. Morphological Differences Between two Populations of the Little Tunny, *Euthynnus alletteratus* (Rafinesque, 1810) in Tunisian Waters (Central Mediterranean Sea). Pakistan J. Zool., 49(5): 1621-1629.

Allman, R.J., Grimes, C.B. 1998. Growth and Mortality of Little Tunny (*Euthynnus Alletteratus*) Larvae off the Mississippi River Plume and Panama City, Florida. Bull. Mar. Sci. 62(1): 189-197.

Baez, J.C., Munoz-Exposito, P., Gomez-Vives, M.J., Fodoy-Garrido, D. 2019. The NAO affects the reproductive potential of small tuna migrating from the Mediterranean Sea. Fish. Res. 216: 41-46.

Cayre, P.M., Diouf, T. 1983. Estimating Age and Growth of Little Tunny, *Euthynnus alletteratus*, off the Coast of Senegal, Using Dorsal Fin Spine Sections. Proceedings of the international workshop on age determination of oceanic pelagic fishes: Tunas, billfishes, and sharks, p, 105-110. NOAA Tech. Rep. NMFS 8.

Cabrera, M.A. Defeo, O., Aguilar, J.D.D.M 2005. The Bonito Fishery (Euthynnus alletteratus) from the Northeast of the Bank of Campeche Mexico. Proceedings of the 47th Gulf and Caribbean Fisheries Institute: 744-757.

Calkins, T.P., Klawe W.L. 1963. Synopsis of biological data on black skipjack, *Euthynnus lineatus* Kishinouye 1920. FAO Fish. Rep. (6): 130-146.

Chur, V.N. 1973. Some biological characteristics of little tuna (*Euthynnus alletteratus* Rafinesque, 1810) in the eastern part of the tropical Atlantic. ICCAT Collective Volume of Scientific Papers. 1:489–500.

Collette, B., Nauen, C.E. 1983. FAO Species Catalogue, Vol. 2: Scombrids of the World. An Annotated and Illustrated Catalogue of Tunas, Mackerels, Bonitos and Related Species Known to Date. FAO Fisheries Synopsis 125(2): 129 pp.

Cruz-Castán, R., Meiners-Mandujano, C., Macías, D., Jiménez-Badillo, L. & Curiel-Ramírez, S. 2019. Reproductive biology of little tunny *Euthynnus alletteratus* (Rafinesque 1810) in the southwest Gulf of Mexico. PeerJ, 7: e6558.

De Sylva, D.P., Rathjen, W.F. 1961. Life History Notes on Little Tuna, *Euthynnus Alletteratus*, From the Southeastern United States. Bulletin of the Marine Science of The Gulf and Caribbean 2(2): 161-190.

De Sylva, D.P., Rathjen, W.F., Higman, J.B., Suarez-Caabro, J.A., Ramirez-Flores, A. 1987. Fisheries Development for Underutilized Atlantic Tunas: Blackfin and Little Tunny. NOAA Technical Memorandum, NMFS-SEFC-191.

Diouf, T. 1980. Pêche et biologie de trois Scombridae exploités au Sénégal: *Euthynnus alletteratus*, *Sarda sarda* et *Scomberomorus tritor*. Ph.D. Thesis, Université de Bretagne Occidentale, Brest.

Diouf, T. 1981. Premieres donnees relatives a l'exploitation et a la biologie de quelques "petits thonidés et especes voisines": *Euthynnus, Sarda, Scomberomorus* au Senegal. ICCAT Collective Volume of Scientific Papers.15(2):327–336.

El-Haweet, A.E., Sabry, E., Mohamed, H. 2013. Fishery Population Characteristics of *Euthynnus alletteratus* (Rafinesque 1810) in the Eastern Coast of Alexandria, Egypt. Turk. J. Fish. Aq. Sci. 13: 629-638.

Federal Register. 1982. Gulf of Mexico and South Atlantic coastal migratory pelagic resources. 48(25): 5270.

Federal Register. 2011. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Coastal Migratory Pelagic Resources in the Gulf of Mexico and Atlantic Region; Amendment 18. 76(250): 82058.

Garcia, C.B., Posada, C. 2013. Diet and feeding ecology of the little tunny, *Euthynnus alletteratus* (Pisces: Scombridae) in the central Colombian Caribbean: changes in 18 years. Lat. Am. J. Aquat. Res. 41(3): 588-594.

Gaykov, V.Z., Bokhanov, D.V. 2008. The biological characteristics of Atlantic black skipjack (*Euthynnus alletteratus*) of the Eastern Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT., 62(5): 1610–1628.

Gorbunova, N.N. 1965. Seasons and conditions of spawning of the scombroid fishes (Pisces, Scombroidei). Trudy Inst. Okeanol. Akad. Nauk, SSSR., 80:36-51. (Engl. transt. Available, U.S. Dep. Commer., Off. Tech. Serv., Wash., D.C.)

Hajjej, G., Hattour, A., Allaya, H., Jarboui, O., Bouain, A. 2010. Biology of little tunny *Euthynnus alletteratus* in the Gulf of Gabes, Southern Tunisia (Central Mediterranean Sea). Revista de Biología Marina y Oceanografía, 45: 399-406.

Hattour, A. 2009. Tunisian Minor Tunas: Biological Study and Fisheries. Collective Volume of Scientific Papers, ICCAT, 64:2230-2271.

ICCAT. 2017. Report of the 2017 Small tunas species group intersessional meeting, Miami, United States, 24–28 April 2017. Collect. Vol. Sci. Pap. ICCAT., 74: 1–75.

ICCAT. 2016. Geographical Definitions. Version 2016.02 EN.

ICCAT. 2019. Report for biennial period, 2018-2019 English version SCRS. Section 9.12 SMT – Small Tunas, pp 194-214. Madrid, Spain.

ICCAT. 2021. Report of the 2021 ICCAT Small Tunas Species Group Intersessional Meeting. Online. May 17-20 2021. 34 pp.

Isaac, V., Santo, R.E., Bentes, B., Mourao, K.R.M., Lucena-Fredou, F. 2012. The *Scomberomorus brasiliensis* gill-net production system in Northern Brazil; an Invisible and Mismanaged Small-scale Fishery. In: Moksness, E., Dahl, E., Stottrup, J. (eds) Global challenges in integrated coastal zone management. Wiley, Oxford, pp 49–60

Kahraman, A.E., Oray, I.K. 2001. The determination of age and growth parameters of Atlantic little tunny *Euthynnus alleteratus* (Rafinesque, 1810) in Turkish waters. Collective Volume of Scientific Papers, ICCAT, 52: 719-732.

Kim, E., Collatos, C., Kneebone, J. 2023. Monitoring Little Tunny (*Euthynnus alletteratus*) Movements and Post-Release Survival in Nantucket Sound, Massachusetts. Poster, Southern New England Chapter of the American Fisheries Society Meeting, January 2023.

Llopiz, J.K., Richardson, D.E., Shiroza, A., Smith, S.L., Cowen, R.K. 2010. Distinctions in the diets and distributions of larval tunas and the important role of appendicularians. Limnol. Oceanogr. 55(3): 983-996.

Lucena-Fredou, F., Mourato, B., Fredou, T., Lino, P.G., Munoz-Lechuga, R., Palma, C., Soares, A., Pons, M. 2021. Review of the life history, fisheries, and stock assessment for small tunas in the Atlantic Ocean. Rev. Fish. Biol. Fisheries., 31: 709–736.

Manooch III, C.S., Mason, D.L., Nelson, R.S. 1985. Foods of Little Tunny *Euthynnus alletteratus* Collected along the Southeastern and Gulf Coasts of the United States. Bul. Jap. Soc. Sci. Fish. 51(8): 1207-1218.

Marchal, E. 1963. Expose synoptique des donnees biologiques sur la thonine *Euthynnus alletteratus* (Rafinesque) 1810 (ouest Atlantique et Mediterranee). FAO Fish. Rep., 6:647-662.

MCC. 2023. Little Tunny White Paper. Mackerel and Cobia Committee, Attachment 3: Little Tunny.

Majkowski, J. 2007 Global fishery resources of tuna and tuna-like species. FAO Fisheries Technical Paper, vol 483, 54p

Mohamed, H., El-Haweet, A.E. & Sabry, E. 2014. Reproductive biology of little tunny, *Euthynnus alletteratus* (Rafinesque 1810) in the eastern coast of Alexandria, Egypt. Egyptian Journal of Aquatic Biology and Fisheries, 18: 139-150.

NMFS FSD, 2023.Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division

North Carolina Division of Marine Fisheries (NCMF). 2023. False Albacore Information Paper Update. February 2, 2023.

Olle, J., Hajjej, G., Macias, D., Saber, S., Lino, P.G., Munoz-Lechuga, R., Alayon, P.J.P., Angueko, D., Sow, F.N., Diaha, N.C., Fredou, F.L., Vinas, J. 2020. Deep genetic differentiation in the Little Tunny from the Mediterranean and East Atlantic. Collect. Vol. Sci. Pap. ICCAT., 77(9): 13–19.

Pons, M., Kell, L., Rudd, M.B., Cope, J.M., Lucena-Fre´dou, F. 2019A. Performance of length-based data-limited methods in a multifleet context: application to small tunas, mackerels, and bonitos in the Atlantic Ocean. ICES. J. Mar. Sci., 76(4): 960–973.

Pons, M., Lucena-Fredou, F., Fredou, T., Mourato, B. 2019B. Implementation of length-based and catch-based data limited methods for small tunas. SCRS/2019/063

Ramírez-Arredondo, I. 1993. Aspectos reproductivos de la carachana pintada, *Euthynnus alletteratus* (Pisces: *Scombridae*) de los alrededores de la Isla de Picua, Estado Sucre, Venezuela. Boletin del Instituto Oceanografico de Venezuela, 32: 69-78.

Rey, J.C., Cort, J.L. 1981. Migration de bonitos (*Sarda sarda*) y bacoreta (*Euthynnus alletteratus*) entre el Mediterraneo y el Atlantico. Collect. Vol. Sci. Pap. ICCAT, 15(2): 346-347.

Rodriguez-Roda, J. 1966. Estudio de la bacoreta, *Euthynnus alleteratus* (Raf.), bonito, *Sarda sarda* (Bloch) y melva, *Auxis thazard* (Lac.), capturados por las almadrabas españolas. Investigación Pesquera, 30:247-292.

Rodriguez-Roda, J., 1979. Edad y crecimiento de la bacoreta, *Euthynnus alletteratus* (Raf.) de la costa sudatlántica de España. Investigación Pesquera, 47: 397-402.

RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/.

Saber, S., Ortiz De Urbina, J., Lino, P., Gómez-Vives, M., Godoy, L., Coelho, R., Ciércoles, C., Muñoz-Lechuga, R. Macías, D. (2019). Analyses of the sex ratio for bullet tuna, Atlantic bonito and little tunny from Portuguese and Spanish waters. Front. Mar. Sci. Conference Abstract: Iberian Symposium on Marine Biology Studies (SIEBM XX).

Schaefer, K.M. 2001. Reproductive biology of tunas. Fish. Phys. 19: 225-270.

Valeiras, J., Abad, E. 2006. Manual de ICCAT, Descripción de la bacoreta. Publicaciones ICCAT; Comisión Internacional para la Conservación del Atún Atlántico. 243–250.

Valeiras, X., Macías, D., Gómez, M.J., Lema, L., Godoy, D., De Urbina, J.O., De la Serna, J.M., 2008. Age and growth of Atlantic little tuna (*Euthynnus alletteratus*) in the western Mediterranean Sea. Collective Volume of Scientific Papers, ICCAT, 62: 1638-1648.

Vetter, E.F. 1988. Estimation of natural mortality in fish stocks: a review. Fishery Bulletin. 86(1): 25-43.

Vieira, J.M.S., et al. 2021. Age, growth, and maturity of little tunny, *Euthynnus alletteratus* (Rafinesque, 1810) in southeastern Brazil." Latin American Journal of Aquatic Research, 49(5): 773-787.

Wigley S.E., H.M. McBride, N.J. McHugh. 2003. Length-weight relationships for 74 fish species collected during NEFSC research vessel bottom trawl surveys, 1992-9. NOAA Tech Memo NMFS NE 171; 26 p.

Yoshida, H.O., 1979. Synopsis of biological data on tunas of the genus *Euthynnus*. NOAA Tech. Rep., NMFS Circular, (429):1-57; FAO Fish Synop., 122, 57 pp.

TABLES

Table 1. A summary of commercial landings (lbs) from 1950-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	9	6	129	3000
Max	722000	247400	370816	744700
Mean	22672.1	35190.9	126074.5	241936.9
SD	64899.02	45735.45	99319.38	208374.87

Table 2. A summary of commercial landings (lbs) from 1950-2021 by state.

State	Min	Max	Mean	SD
MASSACHUSETTS	1200	247400	26128.2	70040.70
RHODE ISLAND	775	130487	46571.3	34166.36
CONNECTICUT	6	2000	327.7	739.54
NEW YORK	9	104500	20441.4	24024.63
NEW JERSEY	100	722000	41112.0	106915.88
DELAWARE	300	3000	1650.0	1909.19
MARYLAND	100	6800	1763.0	2381.95
VIRGINIA	25	13700	4157.8	4497.45
NORTH CAROLINA	129	370816	121616.4	76279.16
SOUTH CAROLINA	259	20262.11	5491.9	5910.45
GEORGIA	685	900	776.3	111.09
FLORIDA-EAST	8935	360139.4	207086.9	87266.08

Table 3. A summary of recreational landings (lbs) from 1981-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	20	33	320	712206
Max	998580	366801	4891017	5513399
Mean	90002.3	47221.6	810912.7	2531174.4
SD	163842.28	64480.39	1047721.78	969630.82

Table 4. A summary of recreational landings (lbs) from 1981-2021 by state.

State	Min	Max	Mean	SD
MASSACHUSETTS	1221	366801	65310.2	90259.29
RHODE ISLAND	163	134727	41733.2	39040.70
CONNECTICUT	33	187464	31509.1	49894.07
NEW YORK	624	249899	66649.1	65952.08
NEW JERSEY	388	998580	196933.9	243264.41
DELAWARE	20	30633	8333.7	10077.72
MARYLAND	234	808764	76229.8	166323.76
VIRGINIA	481	449289	54366.4	92314.04
NORTH CAROLINA	8627	1117723	198845.4	202893.66
SOUTH CAROLINA	320	95251	16587.8	24895.84
GEORGIA	20	87345	14781.3	21079.96
FLORIDA	435901	4891017	1931143.5	899474.75

Table 5. Percentage of recreational landings from each mode of fishing from 1981-2021 by region.

Region	Shore	For Hire	Private
Mid-Atlantic	10%	25%	65%
North Atlantic	48%	3%	49%
South Atlantic	15%	25%	60%
Total	16%	24%	60%

Table 6. Percentage of recreational landings from each mode of fishing from 1981-2021 by state.

State	Shore	For Hire	Private
MASSACHUSETTS	45%	3%	52%
RHODE ISLAND	63%	3%	35%
CONNECTICUT	4%	2%	94%
NEW YORK	15%	23%	62%
NEW JERSEY	13%	25%	62%
DELAWARE	0%	45%	55%
MARYLAND	0%	25%	75%
VIRGINIA	0%	25%	75%
NORTH CAROLINA	29%	31%	40%
SOUTH CAROLINA	0%	42%	58%
GEORGIA	0%	14%	86%
FLORIDA	14%	25%	62%

Table 7. Percentage of recreational landings in Federal and State waters from 1981-2021 by region.

Region	Federal	State
Mid-Atlantic	76%	24%
North Atlantic	9%	91%
South Atlantic	48%	52%
Total	50%	50%

Table 8. Percentage of recreational landings in Federal and State waters from 1981-2021 by state.

State	Federal	State
MASSACHUSETTS	4%	96%
RHODE ISLAND	15%	85%
CONNECTICUT	0%	100%
NEW YORK	50%	50%
NEW JERSEY	73%	27%
DELAWARE	90%	10%
MARYLAND	100%	0%
VIRGINIA	85%	15%
NORTH CAROLINA	49%	51%
SOUTH CAROLINA	95%	5%
GEORGIA	97%	3%
FLORIDA	47%	53%

Table 9. The percentage of catch landed vs discarded from 1981-2021 by region.

Region	Landings	Discards
Mid-Atlantic	24%	76%
North Atlantic	10%	90%
South Atlantic	31%	69%
Total	27%	73%

Table 10. A summary of recreational discards (individuals) from 1981-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	7	123	10	78347
Max	1952676	981784	273165	2606690
Mean	248568.3	72239.8	32233.7	1210849.4
SD	422905.25	142249.88	48146.93	620313.34

Table 11. A summary of recreational discards (individuals) from 1981-2021 by state.

State	Min	Max	Mean	SD
MASSACHUSETTS	188	981784	117905.1	216773.68
RHODE ISLAND	123	315534	45207.1	61422.70
CONNECTICUT	936	334830	49544.6	72920.41
NEW YORK	80	297313	77553.7	91020.45
NEW JERSEY	1522	390112	74303.2	93370.24
DELAWARE	7	7497	2417.0	2509.29
MARYLAND	140	98522	10182.8	22250.11
VIRGINIA	16	164594	11206.9	32426.39
NORTH CAROLINA	2533	273165	65662.9	54471.83
SOUTH CAROLINA	10	32277	6003.3	8922.09
GEORGIA	142	9050	4100.4	3031.26
FLORIDA	75595	1952676	874480.5	431864.95

Table 12. Percentage of recreational discards from each mode of fishing from 1981-2021 by region.

Region	Shore	For Hire	Private
Mid-Atlantic	15%	10%	76%
North Atlantic	52%	1%	47%
South Atlantic	4%	5%	91%
Total	13%	5%	82%

Table 13. Percentage of recreational discards from each mode of fishing from 1981-2021 by state.

State	Shore	For Hire	Private
MASSACHUSETTS	45%	3%	52%
RHODE ISLAND	63%	3%	35%
CONNECTICUT	4%	2%	94%
NEW YORK	15%	23%	62%
NEW JERSEY	13%	25%	62%
DELAWARE	0%	45%	55%
MARYLAND	0%	25%	75%
VIRGINIA	0%	25%	75%
NORTH CAROLINA	29%	31%	40%
SOUTH CAROLINA	0%	42%	58%
GEORGIA	0%	14%	86%
FLORIDA	4%	5%	91%

Table 14. Percentage of recreational discards in Federal and State waters from 1981-2021 by region.

Region	Federal	State
Mid-Atlantic	47%	53%
North Atlantic	5%	95%
South Atlantic	58%	42%
Total	48%	52%

Table 15. Percentage of recreational discards in Federal and State waters from 1981-2021 by state.

State	Federal	State
MASSACHUSETTS	2%	98%
RHODE ISLAND	7%	93%
CONNECTICUT	11%	89%
NEW YORK	25%	75%
NEW JERSEY	60%	40%
DELAWARE	100%	0%
MARYLAND	97%	3%
VIRGINIA	93%	7%
NORTH CAROLINA	48%	52%
SOUTH CAROLINA	96%	4%
GEORGIA	89%	11%
FLORIDA	59%	41%

Table 16. Annual MRIP survey of length and weight data from 1981-2022.

Year	Count	Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	234	33	78	58.6	7.92	0.4	6.0	1.87	1.220
1982	166	27	116	60.8	12.92	0.2	11.4	1.82	1.209
1983	392	25	98	60.2	12.07	0.2	7.3	1.70	0.919
1984	275	29	82	57.5	14.47	0.1	3.9	1.60	0.936
1985	205	21	89	63.0	9.30	0.2	5.9	2.37	1.296
1986	672	28	87	61.2	9.51	0.1	4.6	1.85	0.772
1987	1001	23	102	60.6	10.58	0.1	4.8	1.80	0.829
1988	818	24	90	61.4	10.53	0.2	4.6	1.82	0.866
1989	735	23	87	63.8	10.94	0.1	7.0	2.08	0.944
1990	898	23	87	61.7	10.74	0.1	5.9	1.88	0.923
1991	1028	22	82	59.8	10.49	0.1	9.0	1.75	0.826
1992	1327	24	89	59.0	10.17	0.1	4.4	1.65	0.758
1993	756	17	95	58.7	13.15	0.1	7.6	1.74	1.012
1994	763	24	91	60.3	9.20	0.1	4.9	1.67	0.729
1995	574	21	83	59.4	11.82	0.1	4.0	1.64	0.744
1996	825	21	91	59.9	10.79	0.1	4.7	1.71	0.785
1997	1089	26	91	59.8	13.62	0.1	6.3	2.05	1.229
1998	1531	24	93	57.8	12.90	0.1	5.5	1.72	0.930
1999	2101	24	93	59.0	10.46	0.1	7.5	1.95	1.007
2000	1889	27	88	57.3	10.00	0.1	5.6	1.61	0.779
2001	1460	26	80	59.6	8.85	0.2	4.3	1.72	0.762
2002	1847	20	102	59.7	9.58	0.1	6.7	1.66	0.782
2003	1241	27	91	59.1	9.45	0.1	5.8	1.66	0.746
2004	1371	31	78	61.1	8.42	0.2	3.9	1.70	0.666
2005	807	31	103	60.9	7.62	0.2	8.3	1.67	0.717
2006	1304	29	82	61.3	7.35	0.2	4.2	1.68	0.588
2007	1108	17	110	60.4	9.27	0.2	7.4	1.64	0.703
2008	954	28	83	57.4	10.42	0.1	4.6	1.46	0.737
2009	997	30	86	58.2	10.05	0.2	5.1	1.52	0.819
2010	979	17	90	58.6	10.74	0.2	4.8	1.54	0.798
2011	1289	17	87	57.5	11.36	0.1	4.4	1.51	0.780
2012	1687	17	88	58.5	9.57	0.1	4.9	1.49	0.700
2013	91	29	74	53.4	11.49	0.1	2.9	1.21	0.648
2014	1546	26	92	57.8	10.61	0.1	6.1	1.51	0.835
2015	1571	20	87	58.3	9.69	0.1	4.6	1.51	0.733
2016	1654	30	85	57.6	9.72	0.2	4.5	1.47	0.812
2017	1286	27	91	56.3	10.18	0.1	5.2	1.39	0.763
2018	1206	22	89	57.9	10.79	0.1	9.7	3.17	1.701
2019	1295	23	100	56.0	10.43	0.1	7.1	1.37	0.793
2020	1610	28	100	57.3	9.38	0.2	7.1	1.44	0.791
2021	1440	27	88	55.2	9.37	0.1	4.8	1.27	0.685
2022	1429	22	91	55.0	9.83	0.1	5.2	1.28	0.704
Total	**45451**	**17**	**116**	**58.7**	**10.41**	**0.1**	**11.4**	**1.67**	**0.908**

Table 17. A summary of length and weight data for each region of the MRIP survey.

Values	Carribean	Gulf of Mexico	Mid-Atlantic	North Atlantic	South Atlantic	Total
Count	4	19330	1431	617	24069	45451
Min of Length	34	17	24	33	17	17
Max of Length	54	116	103	110	102	116
Average of Length	40.8	57.1	58.9	59.6	60.0	58.7
StdDev of Length	9.00	9.34	9.71	7.62	11.13	10.41
Min of Weight		0.1	0.1	0.3	0.1	0.1
Max of Weight		9.0	10.5	7.4	11.4	11.4
Average of Weight		1.45	1.75	1.51	1.68	1.58
StdDev of Weight		0.773	1.076	0.802	0.995	0.915

Table 18. A summary of length-weight relationship parameters for waves 1-6.

Wave	a	b	log(a)	SE	R^2
1	9.5E-06	2.92	-11.56	0.004	0.91
2	8.8E-06	2.95	-11.64	0.005	0.85
3	7.7E-06	2.99	-11.78	0.002	0.87
4	1.1E-05	2.88	-11.39	0.003	0.86
5	1.0E-05	2.91	-11.49	0.006	0.83
6	1.1E-05	2.90	-11.45	0.003	0.94
Total	**9.5E-06**	**2.9283**	**-11.56**	**0.002**	**0.88**

Table 19. A summary of von Bertalanffy growth parameters from all available studies on Little Tunny around the world.

Citation	Area/Region	Sex	n	Method	L_{inf} (cm)	L_{inf} (in)	k	t_0	Max Age	Min L_{obs} (cm)	Min L_{obs} (in)	Max L_{obs} (cm)	Max L_{obs} (in)
Adams and Kerstetter (2014)	Florida Straits	Combined	213	Otoliths	77.93	30.7	0.69	-0.69	5	25	9.8	83.2	32.8
		Male	121	Otoliths	87.91	34.6	0.37	-1.65	-	-	-	-	-
		Female	63	Otoliths	77.49	30.5	0.64	-0.76	-	-	-	-	-
Hajjej et al. (2012)	Tunisian coast	Combined	413	Spines	127.2	50.1	0.139	-2.14	7	19.2	7.6	97.8	38.5
		Male	164	Spines	128.9	50.7	0.1375	-2.15	-	37.3	14.7	97.8	38.5
		Female	211	Spines	130.8	51.5	0.1312	-2.22	-	35.7	14.1	95.5	37.6
Cayre and Diouf (1983)	Senegal coasts	Combined	491	Spines	112	44.1	0.126	-	-	29.4	11.6	80.2	31.6
Rodriguez-Roda (1979)	East Atlantic Spain	Combined	-	Vertebrae	115	45.3	0.19	-1.71	5				
Hattour (2009)	Tunisian coasts	Combined	107	Spines	117	46.1	0.192	-1.12	7	36	14.2	110	43.3
		Combined		Vertebrae	106	41.7	0.255	-0.76	7				
		Combined		Otoliths	105	41.3	0.322	-0.51	7				
Kahraman and Oray (2001)	Aegean Sea	Combined	145	Spines	127.5	50.2	0.106	-4.18	5+	55	21.7	85	33.5
Kahraman and Oray (2001)	Mediterranean Sea	Combined	1454	Spines	123.229	48.5	0.127	-3.839	8+	52	20.5	97.5	38.4
Cabrera et al. (2005)	Gulf of Mexico	Combined	-	-	86	33.9	0.26	-0.32	-	-	-	-	-
Valeiras et al. (2008)	Western Mediterranean	Combined	130	Spines	91.5	36.0	0.39	-0.4	5	48	18.9	84	33.1
Vieira et al. (2021)	Southern Brazil	Combined	345	Spines	79.19	31.2	0.42	-0.97	5	33	13.0	78	30.7

Table 20. A summary of maturity estimates from all available studies on Little Tunny around the world.

Original Citation	Area/Region	Sex	n	Length (cm)	Length (in)	Estimate Type
Cruz-Castan et al. (2019)	Southwest Gulf of Mexico	Combined	951	34.4	13.5	L_{50}
		Male	455	34.35	13.5	L_{50}
		Female	480	34.6	13.6	L_{50}
Valeiras and Abad (2006)	Mediterranean Sea	Combined	-	56	22.0	L_{50}
Rodriguez-Roda (1966)	Gulf of Cadiz	Combined	425	57	22.4	L_{50}
Chur (1973)	Gulf of Guinea	Combined	-	43	16.9	L_{50}
Diouf (1981)	Senegal	Combined	-	40	15.7	L_{50}
de Sylva and Rathjen (1961)	North Carolina to Florida	Male	1340	40	15.7	100% Mature
		Female		36	14.2	100% Mature
Hajjej et al. (2010a)	Southern Tunisia	Male	153	42.8	16.9	L_{50}
		Female	244	44.8	17.6	L_{50}
Mahamed et al. (2014)	Egypt	Combined	628	42	16.5	L_{50}
		Male	44	33	13.0	L_{50}
		Female	102	38	15.0	L_{50}
Diouf (1980)	Northeast and Southeast Atlantic	Combined	-	42	16.5	L_{50}
Ramirez-Arredondo et al. (1996)	Venezuela	Combined	-	39.7	15.6	L_{50}
Saber et al. (2018)	Spanish Mediterranean	Combined	1266	51.13	20.1	L_{50}
		Male	414	43.44	17.1	L_{50}
		Female	461	50.07	19.7	L_{50}
Viera et al. (2021)	Brazil	Male	169	49.28	19.4	L_{50}
		Female	174	42.37	16.7	L_{50}

FIGURES

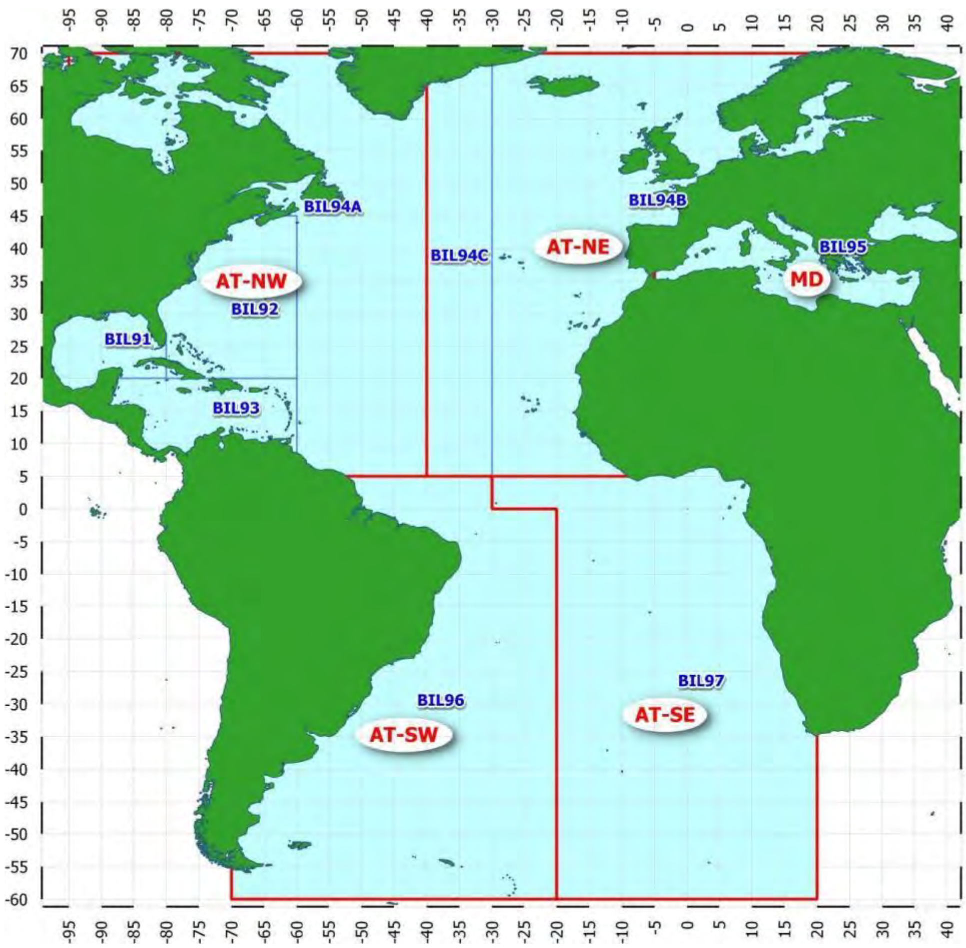

Figure 1. The five management units used by ICCAT for small tunas (ICCAT 2016).

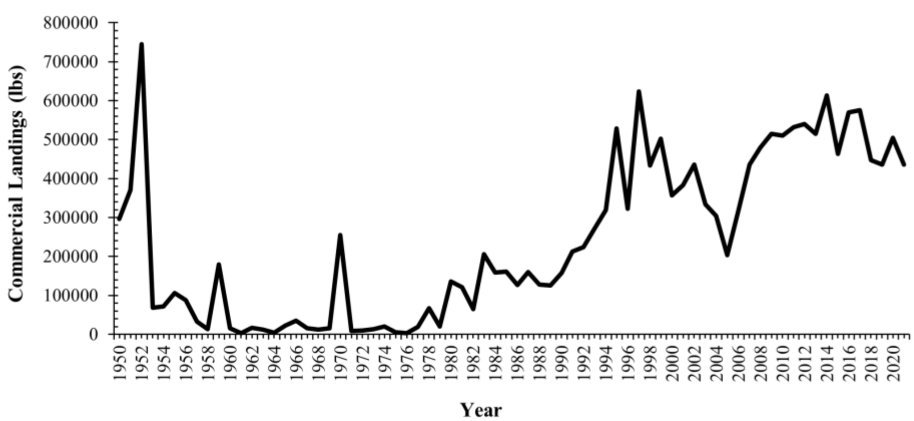

Figure 2. Total commercial landings (lbs) from 1950 to 2021.

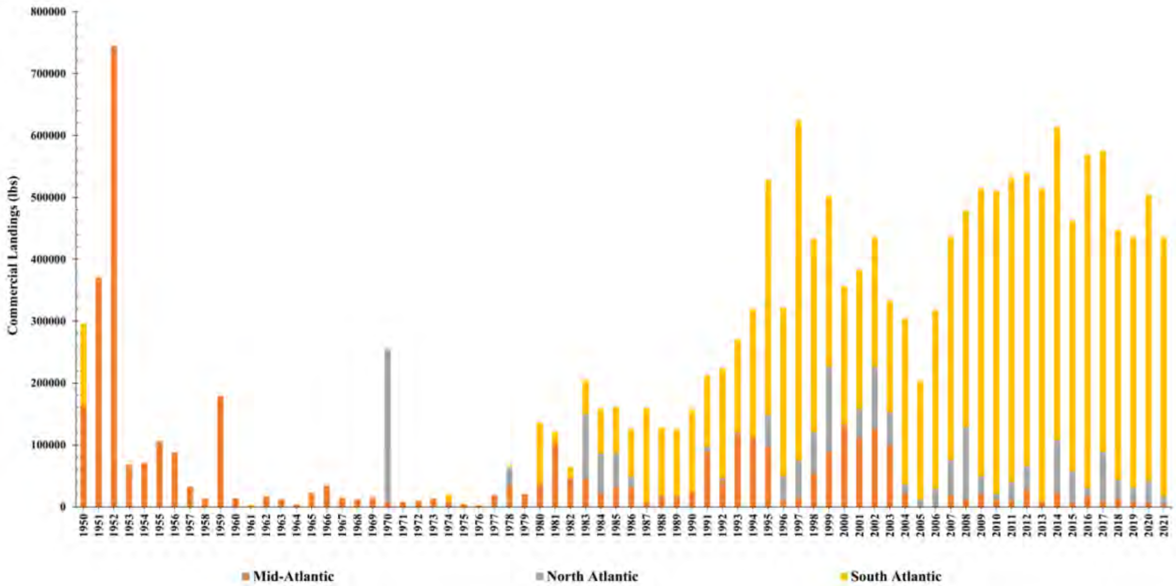

Figure 3. Total commercial landings (lbs) from 1950 to 2021 by region.

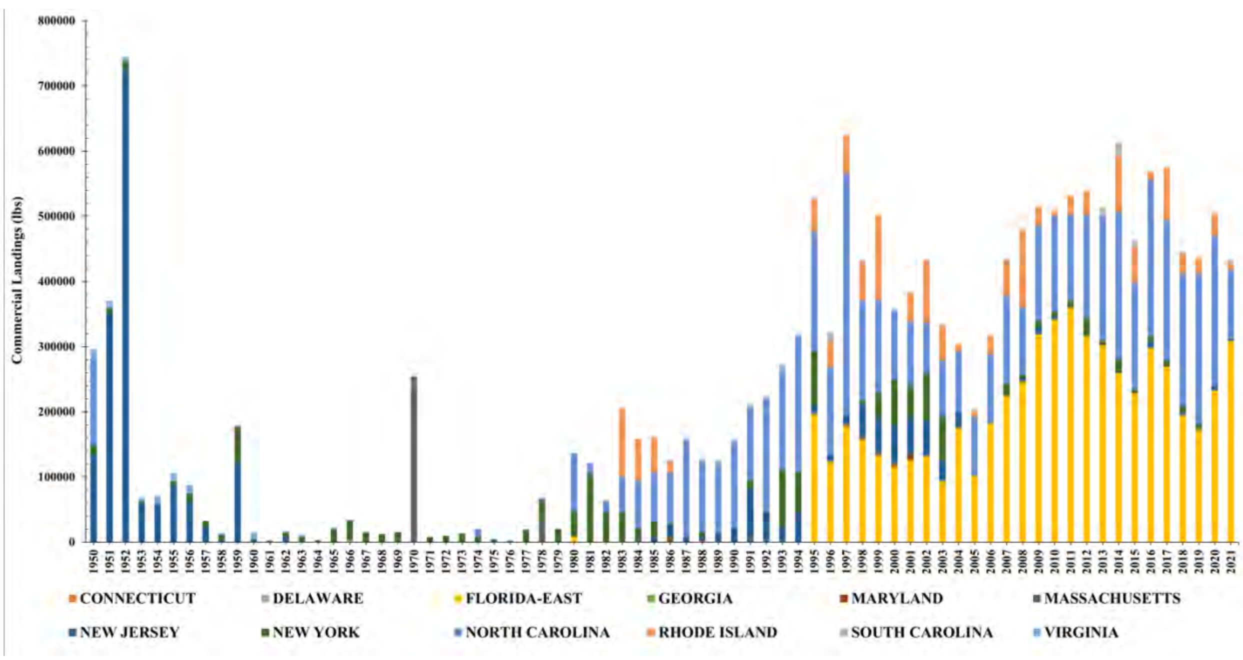

Figure 4. Total commercial landings (lbs) from 1950 to 2021 by state.

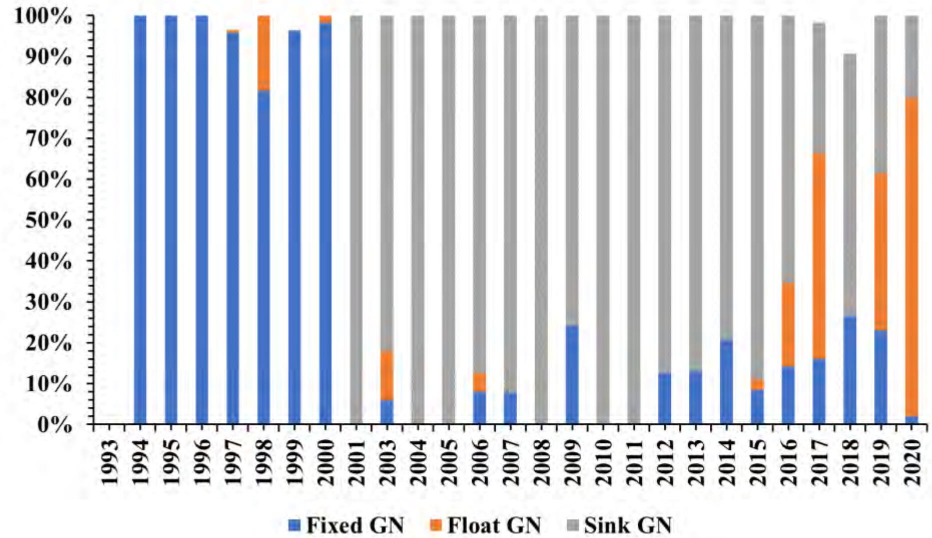

Figure 5. Percentage of commercial discards by type of gill net from 1993-2020

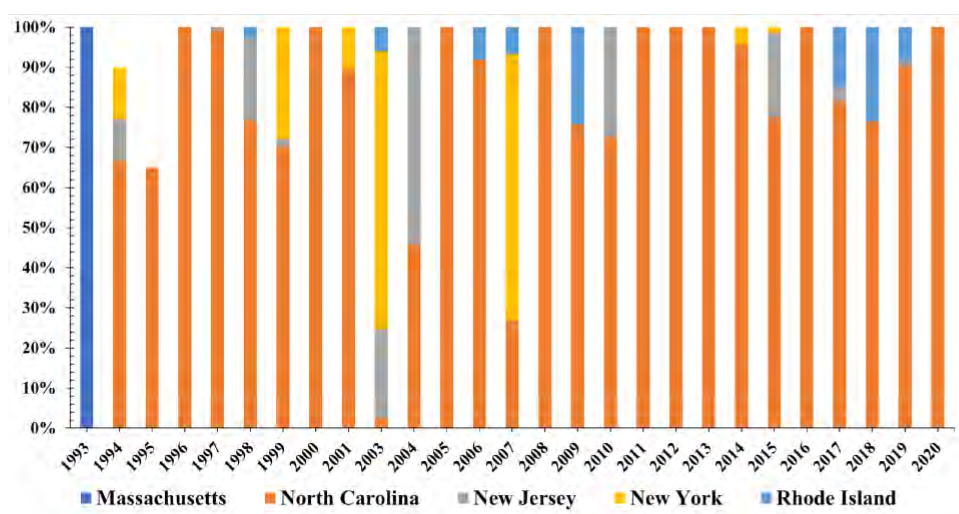

Figure 6. Percentage of commercial discards by state from 1993-2020

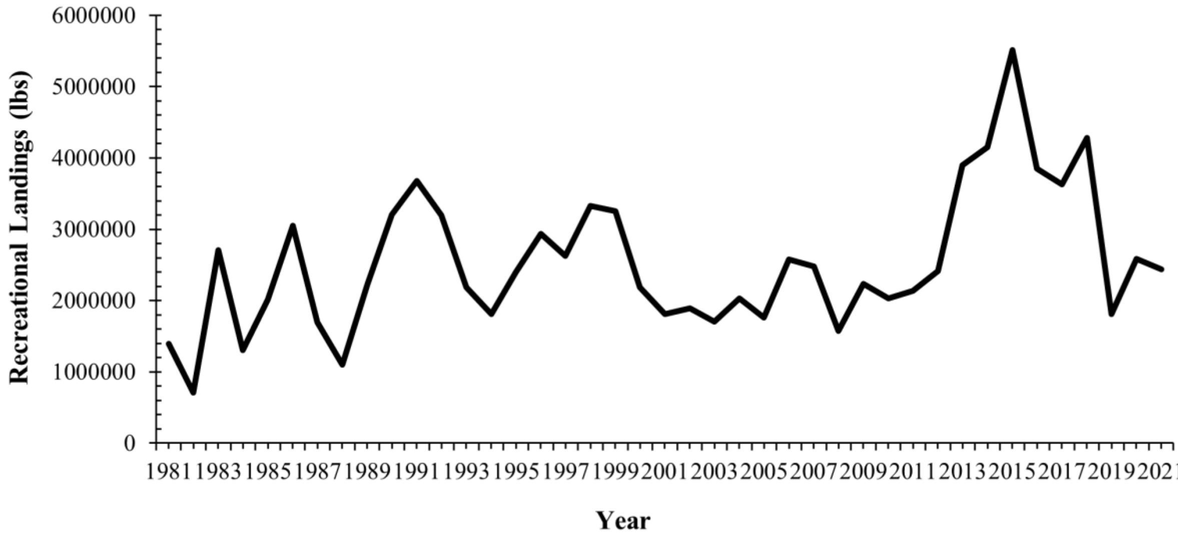

Figure 7. Total recreational landings (lbs) from 1981 to 2021.

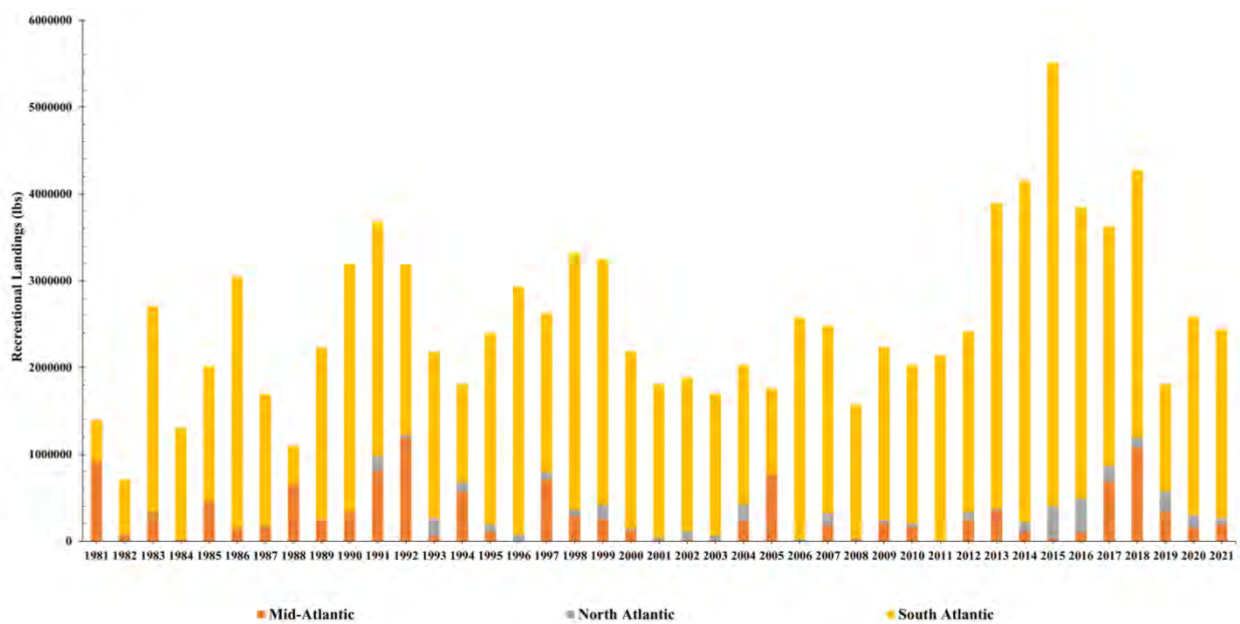

Figure 8. Total recreational landings (lbs) from 1950 to 2021 by region.

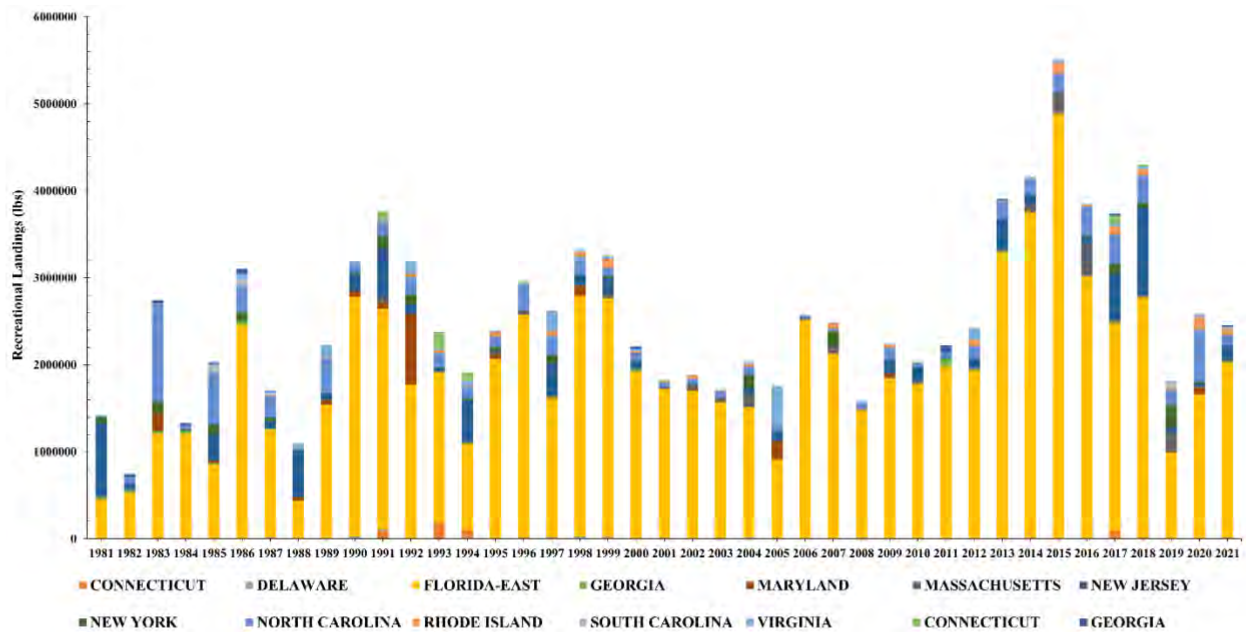

Figure 9. Total recreational landings (lbs) from 1950 to 2021 by state.

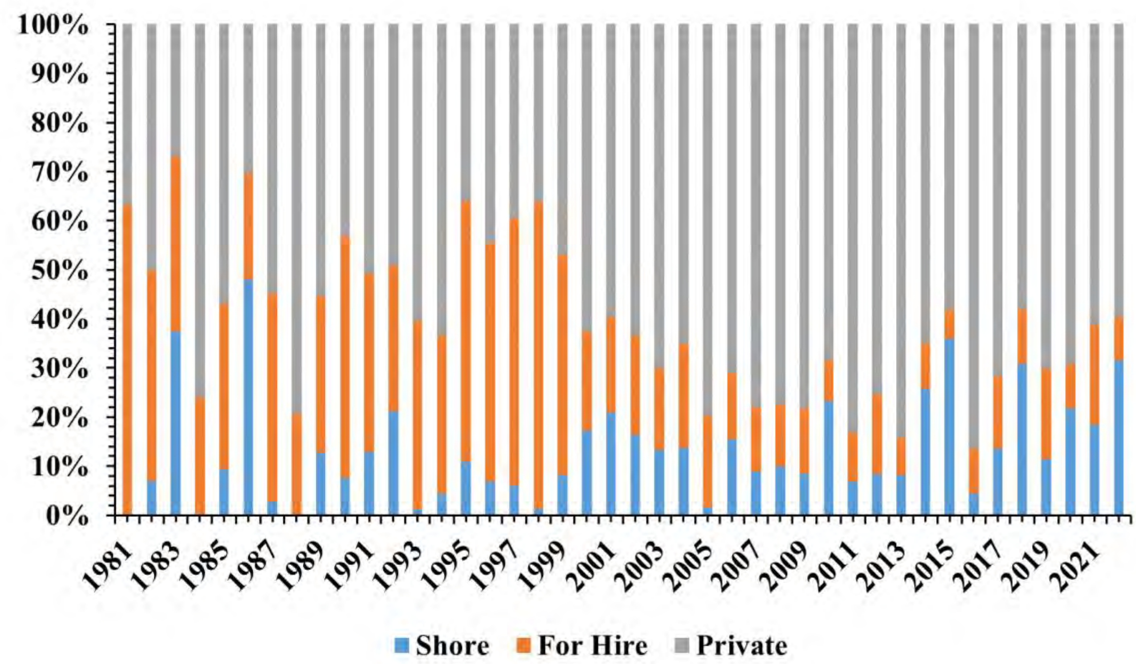

Figure 10. Percentage of recreational landings by mode of fishing from 1981-2022.

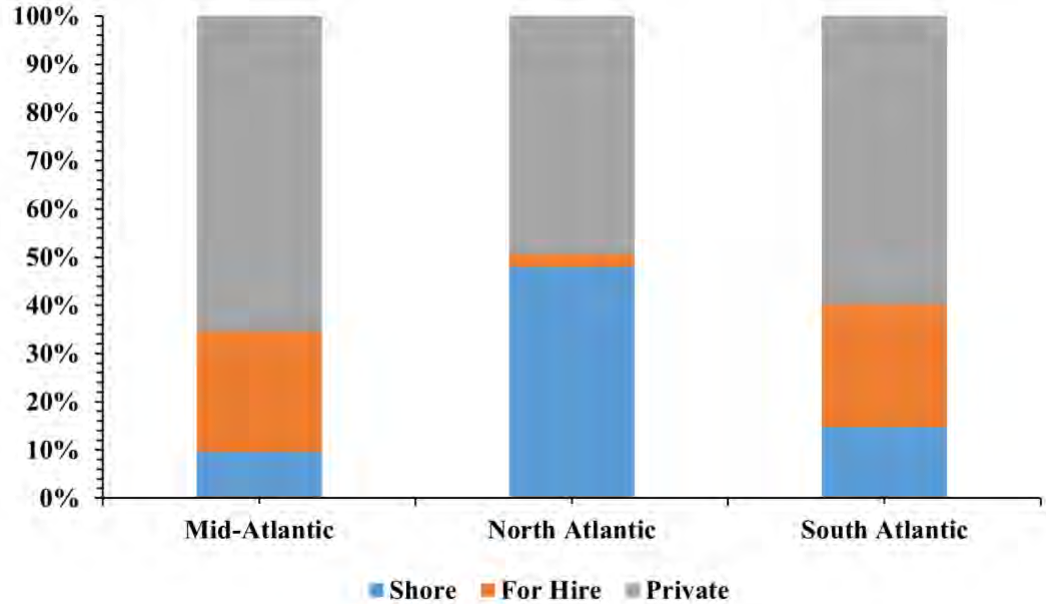

Figure 11. Percentage of recreational landings by mode of fishing for each region.

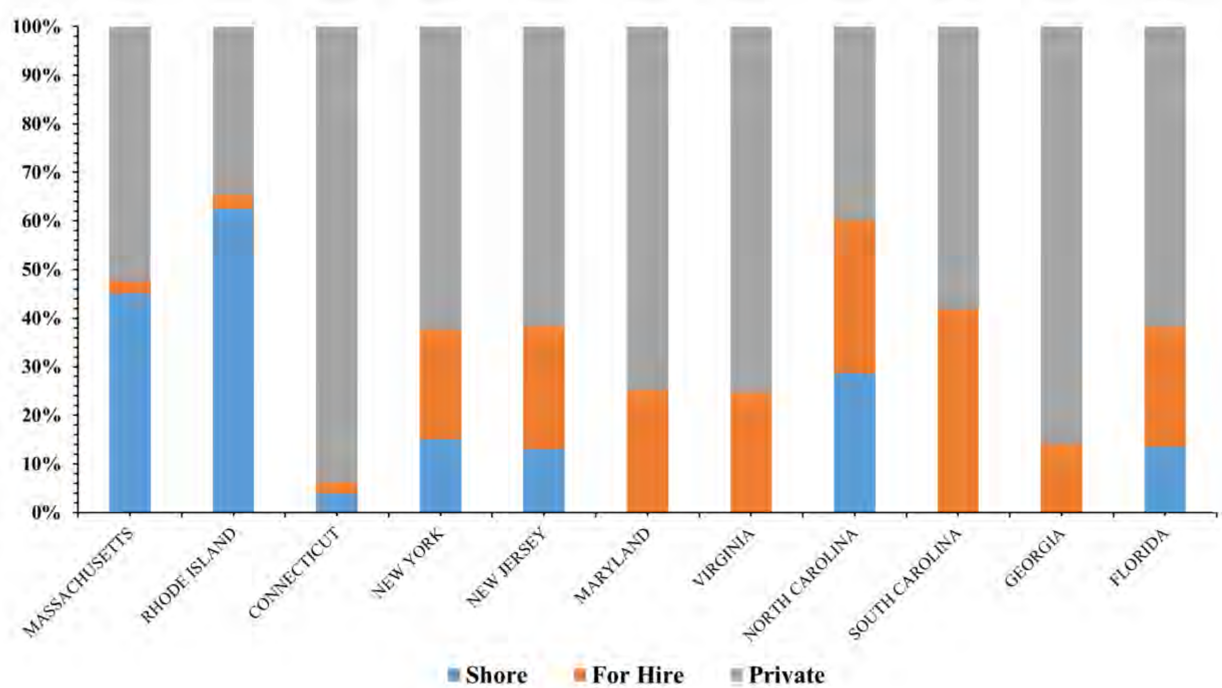

Figure 12. Percentage of recreational landings by mode of fishing for each state.

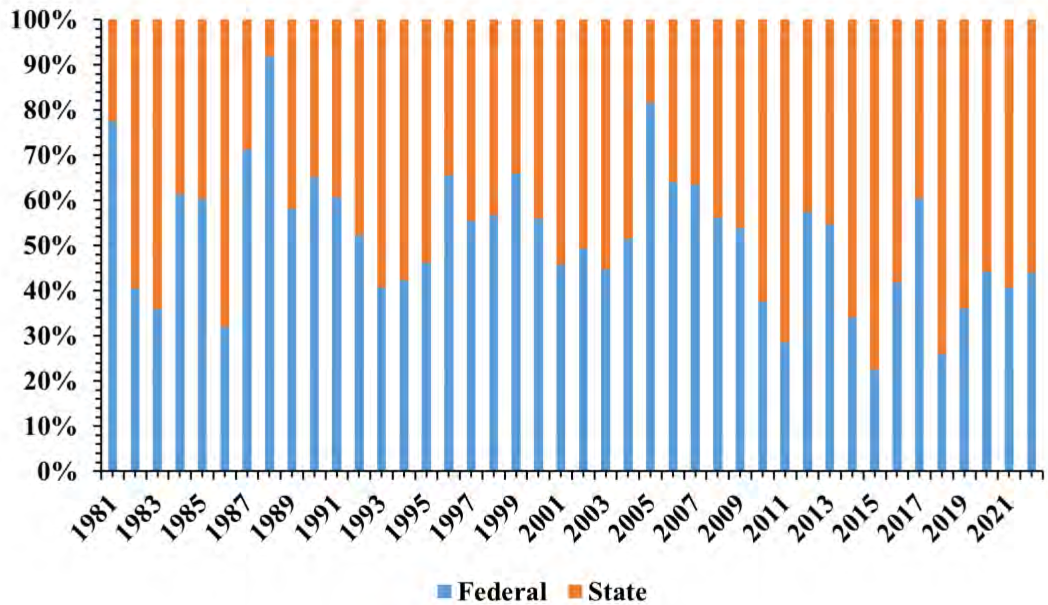

Figure 13. Percentage of recreational landings in federal and state waters from 1981-2022.

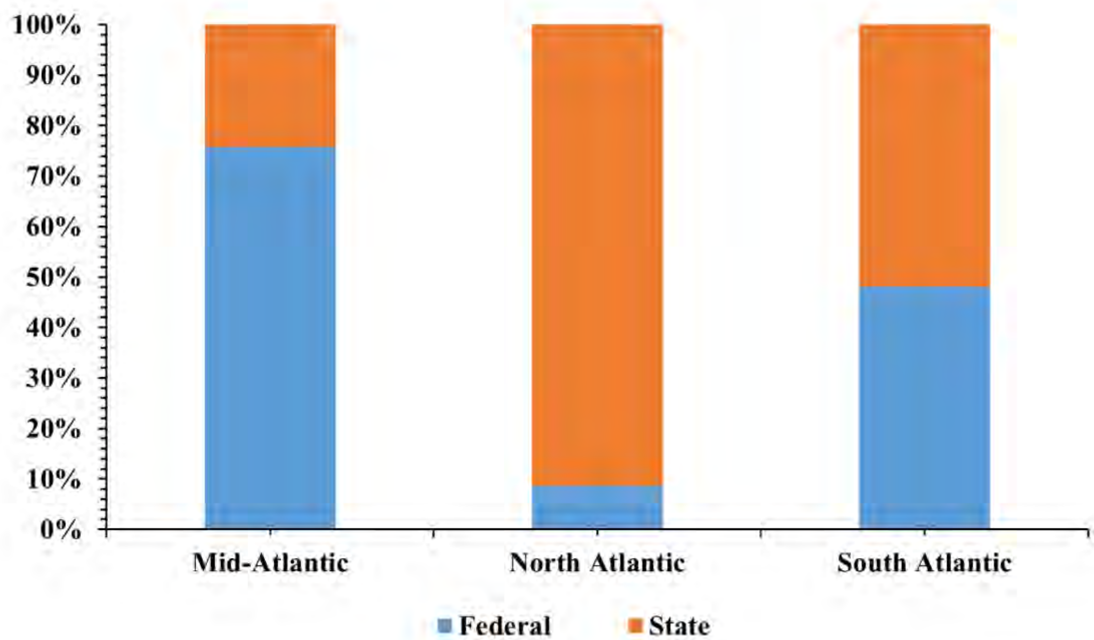

Figure 14. Percentage of recreational landings in federal and state waters for each region.

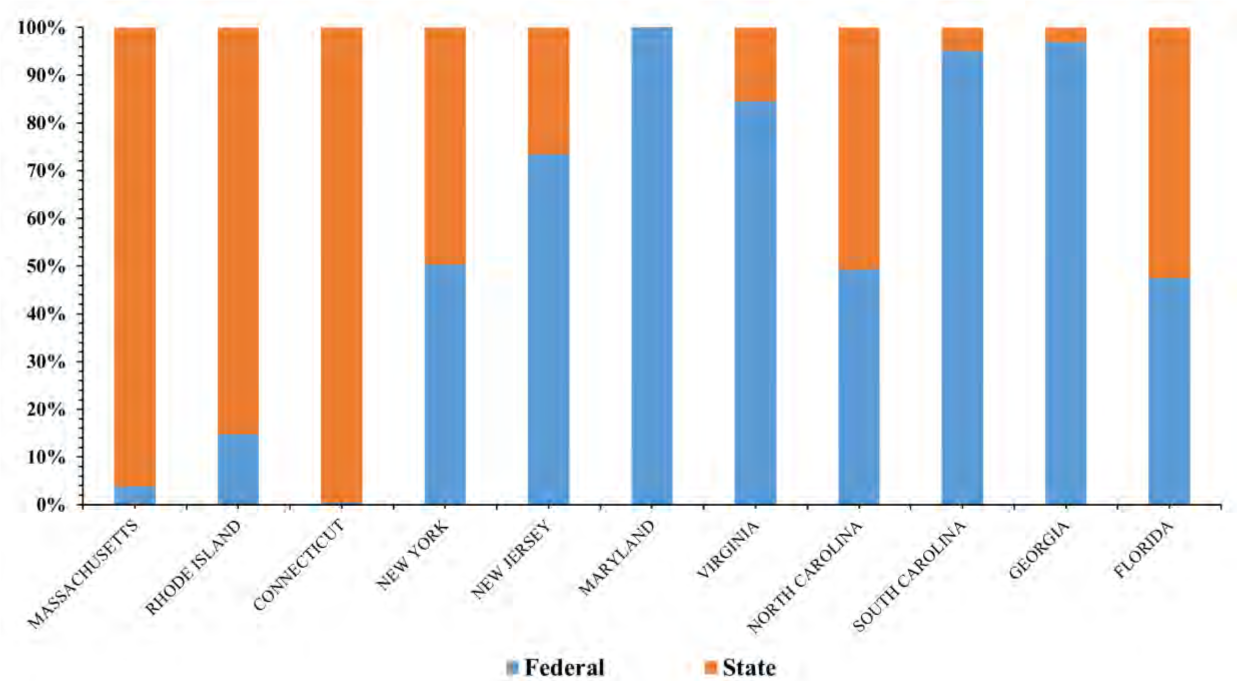

Figure 15. Percentage of recreational landings in federal and state waters for each state.

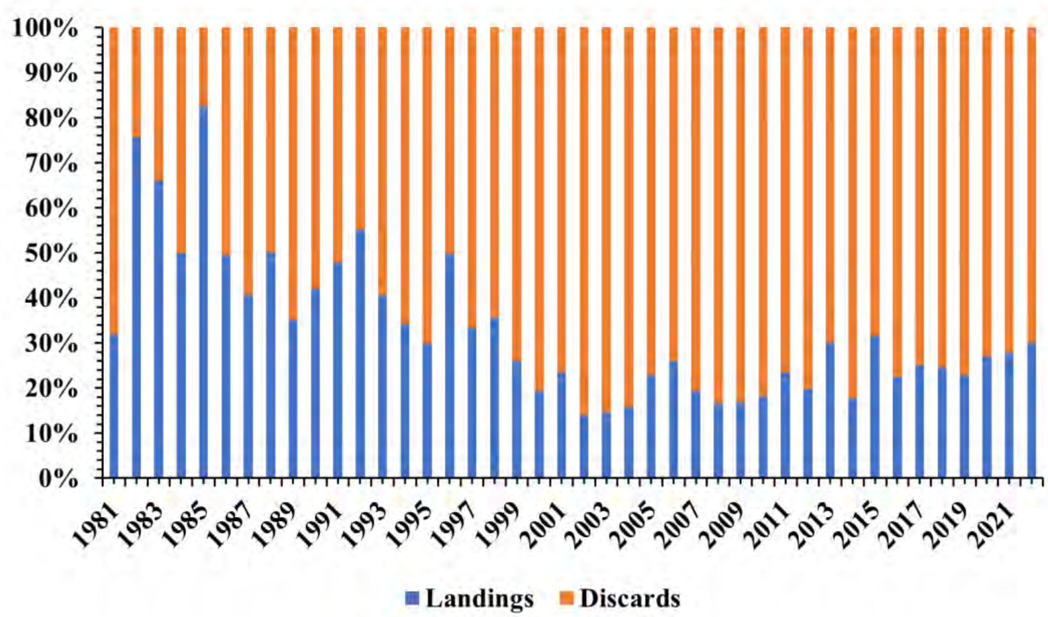

Figure 16. Percentage of fish landed vs discarded from 1981 to 2022.

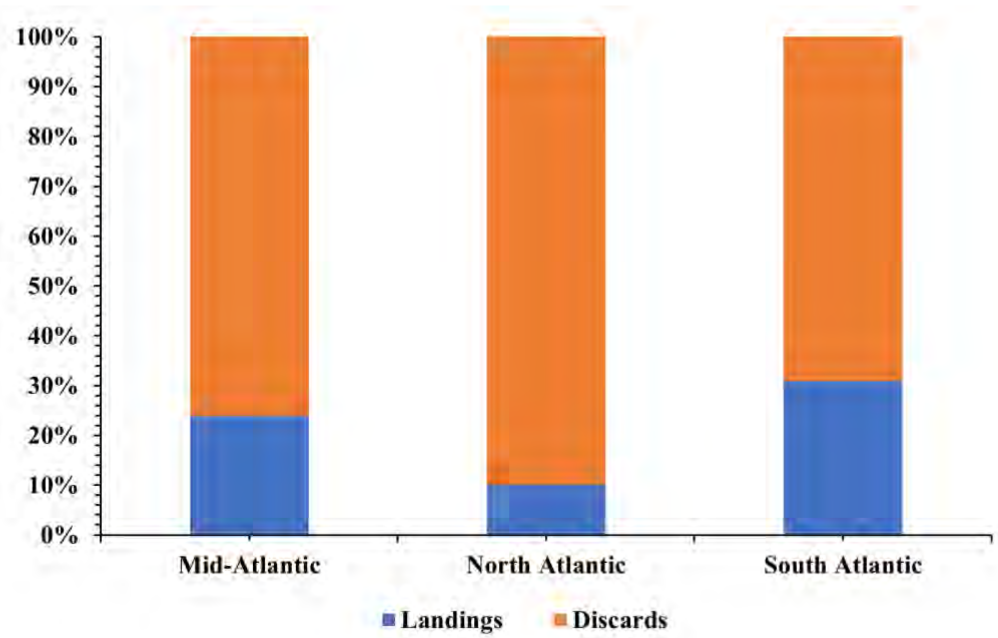

Figure 17. Percentage of fish landed and discarded by region from 1981 to 2022.

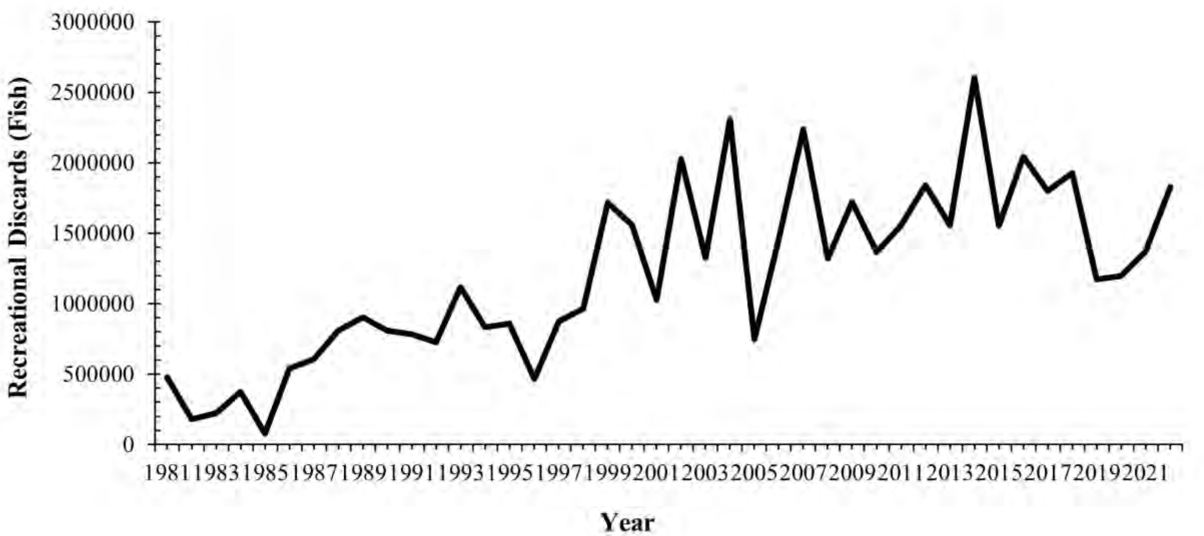

Figure 18. Total recreational discards (individuals) from 1981 to 2021.

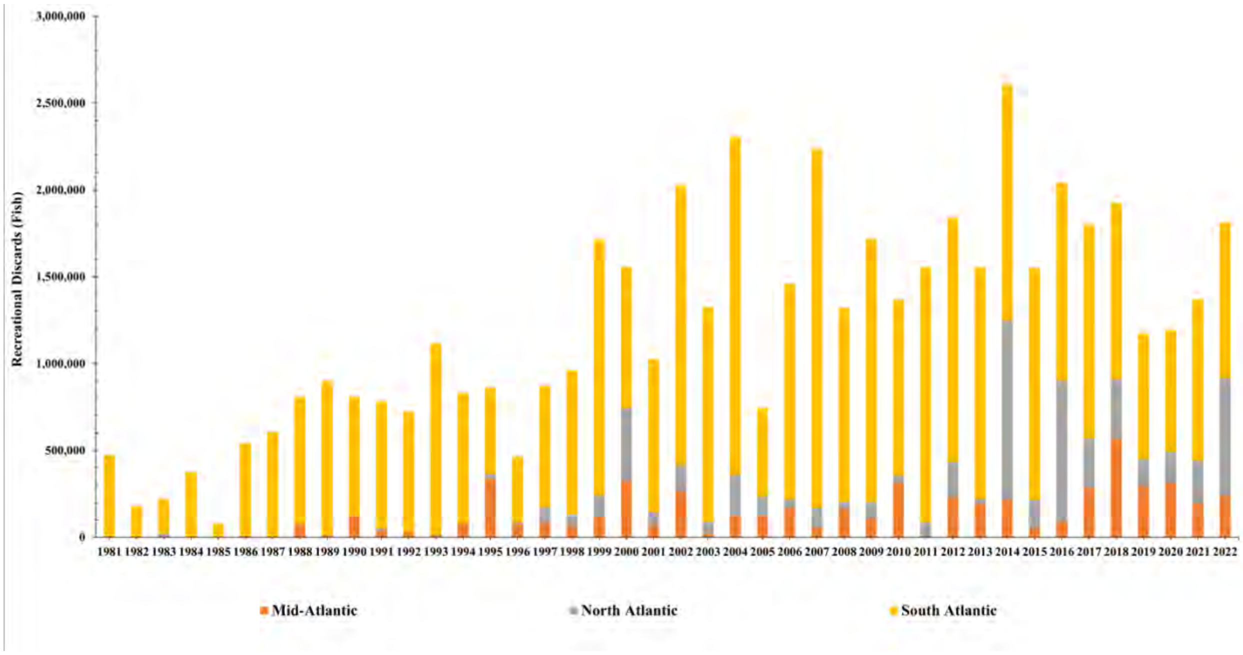

Figure 19. Total recreational discards (individuals) from 1981 to 2021 by region.

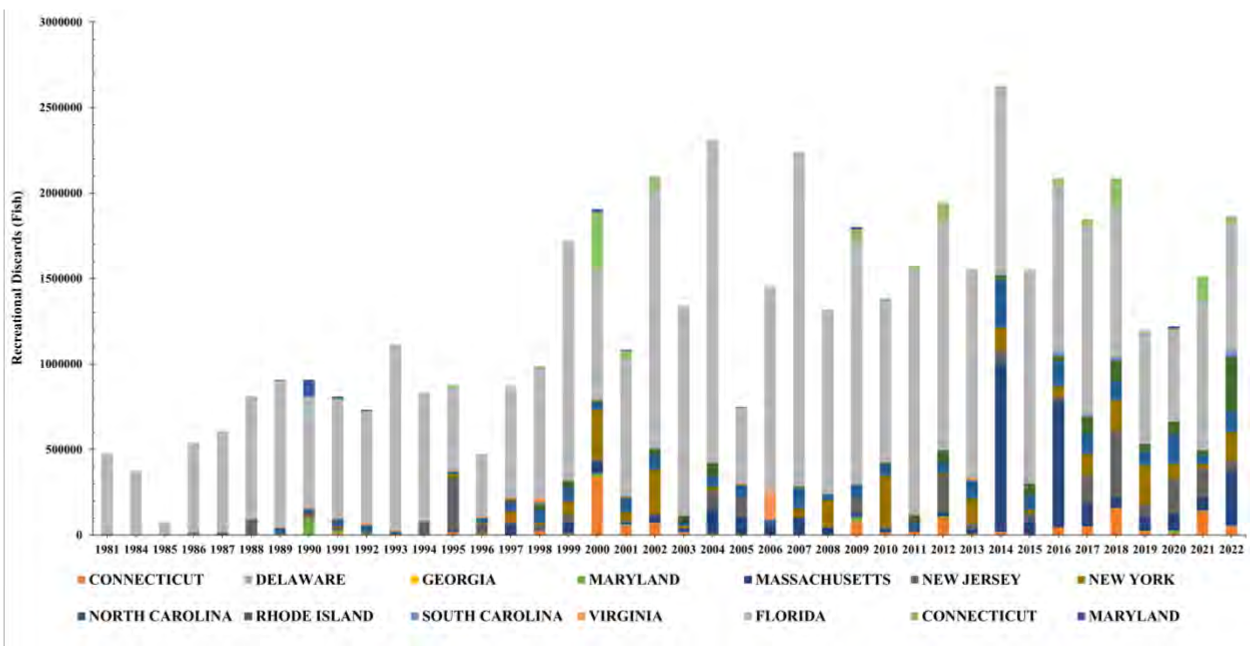

Figure 20. Total recreational discards (individuals) from 1981 to 2021 by state.

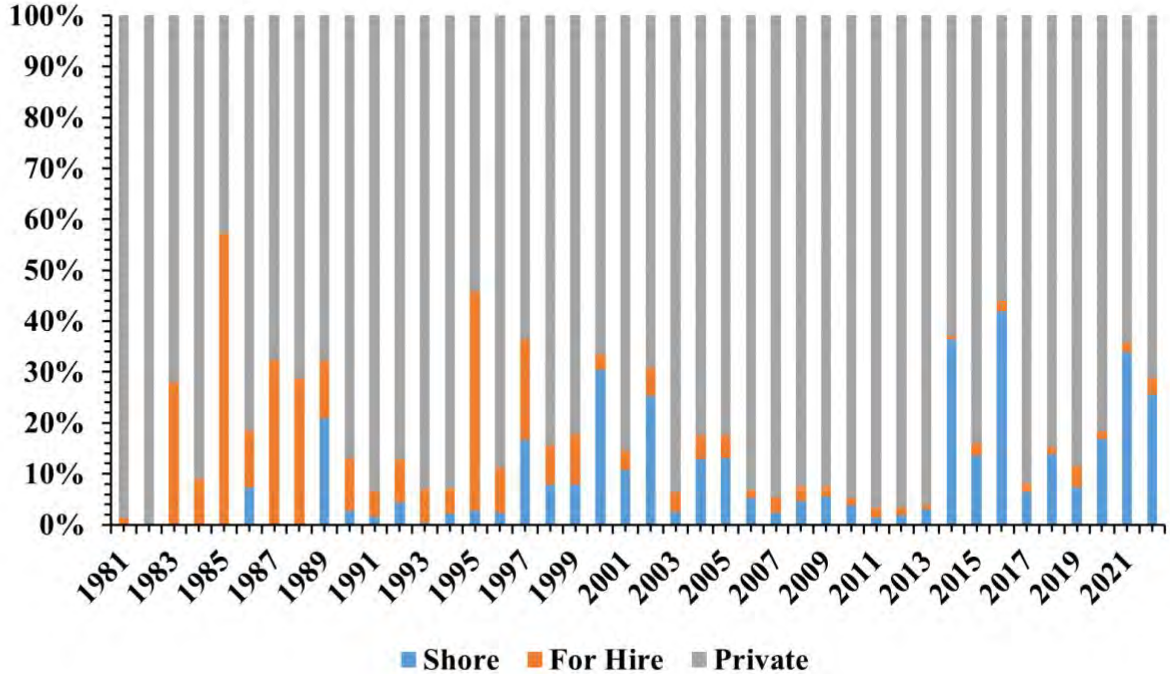

Figure 21. Percentage of recreational discards from each mode of fishing from 1981-2022.

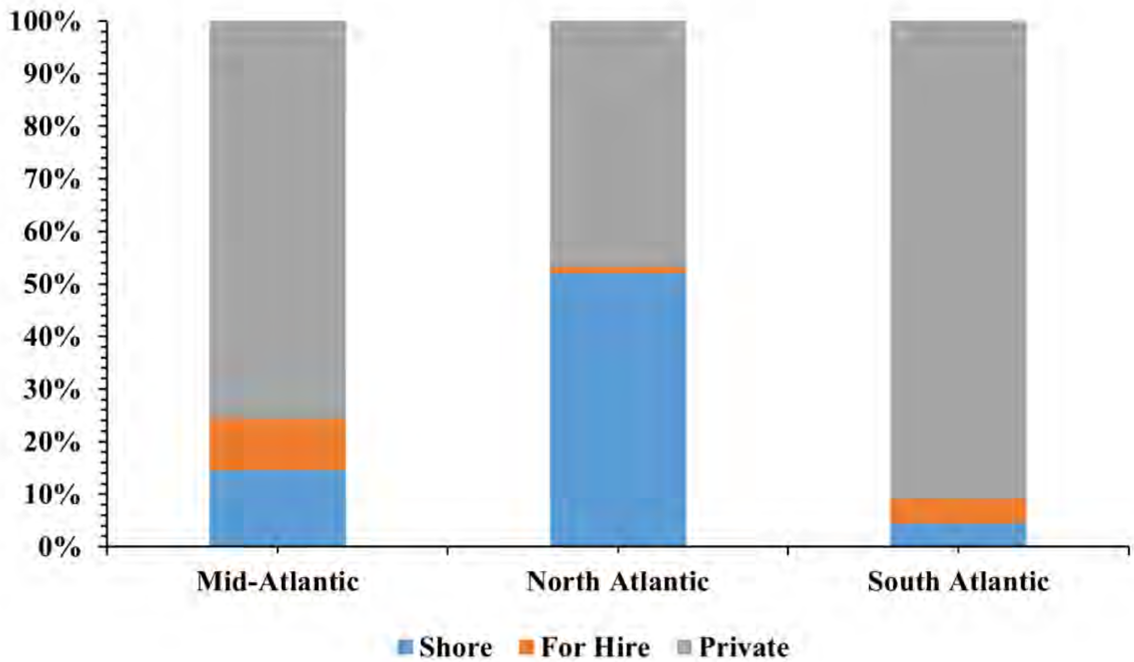

Figure 22. Percentage of recreational discards from each mode of fishing by region.

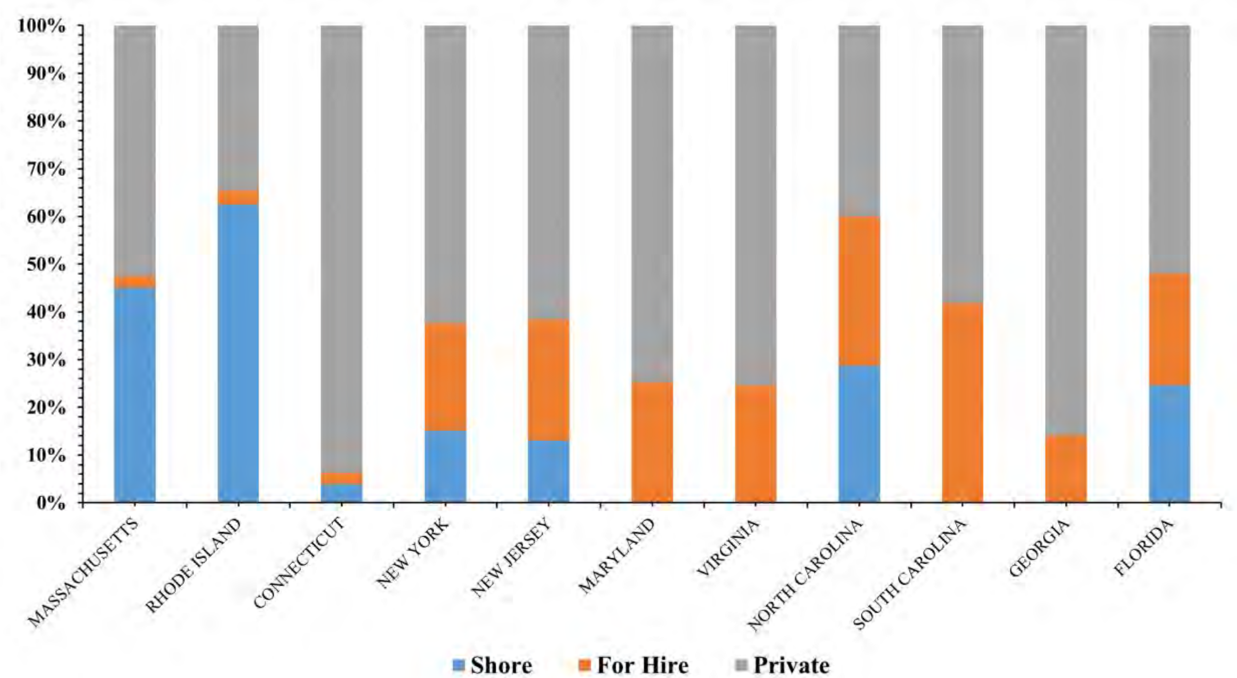

Figure 23. Percentage of recreational discards by mode of fishing for each state.

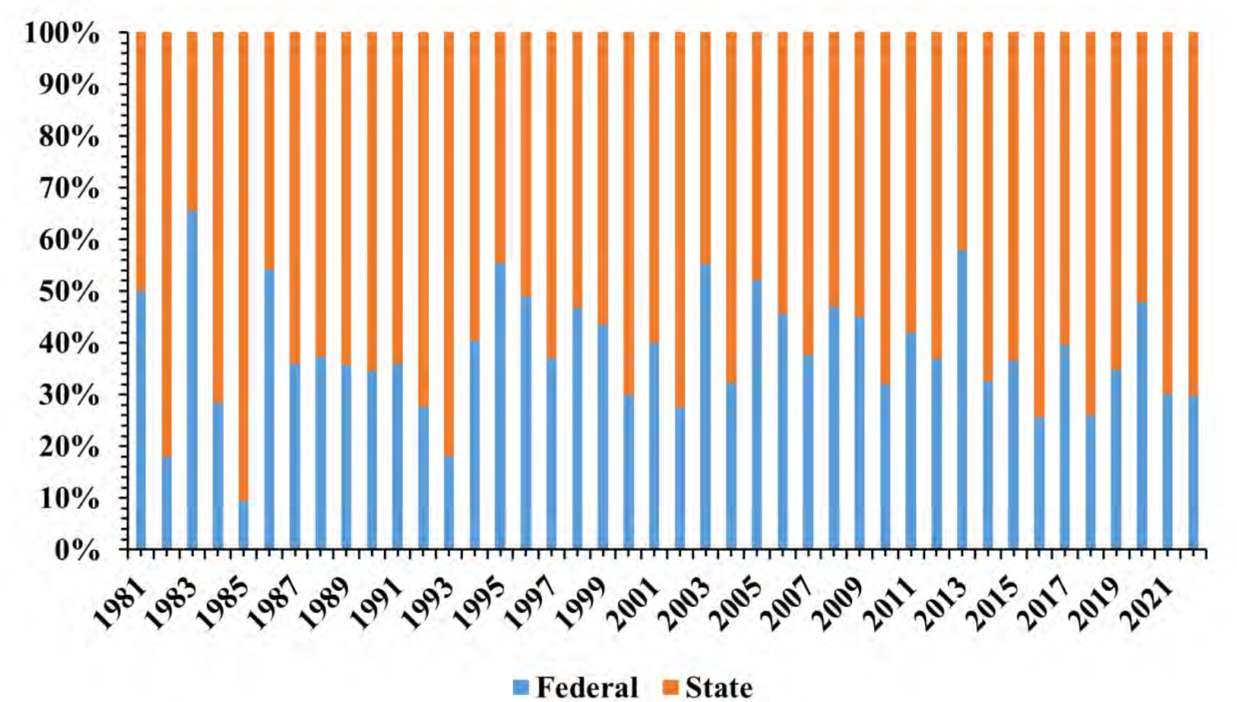

Figure 24. Percentage of recreational discards in federal and state waters from 1981-2022.

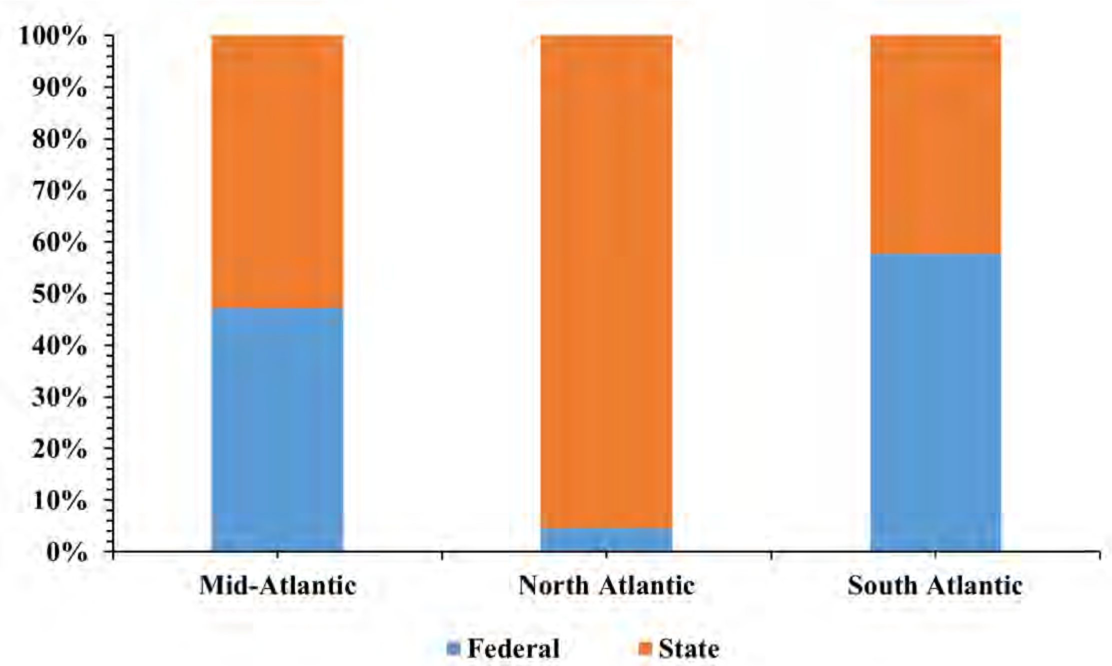

Figure 25. Percentage of recreational discards in federal and state waters for each region.

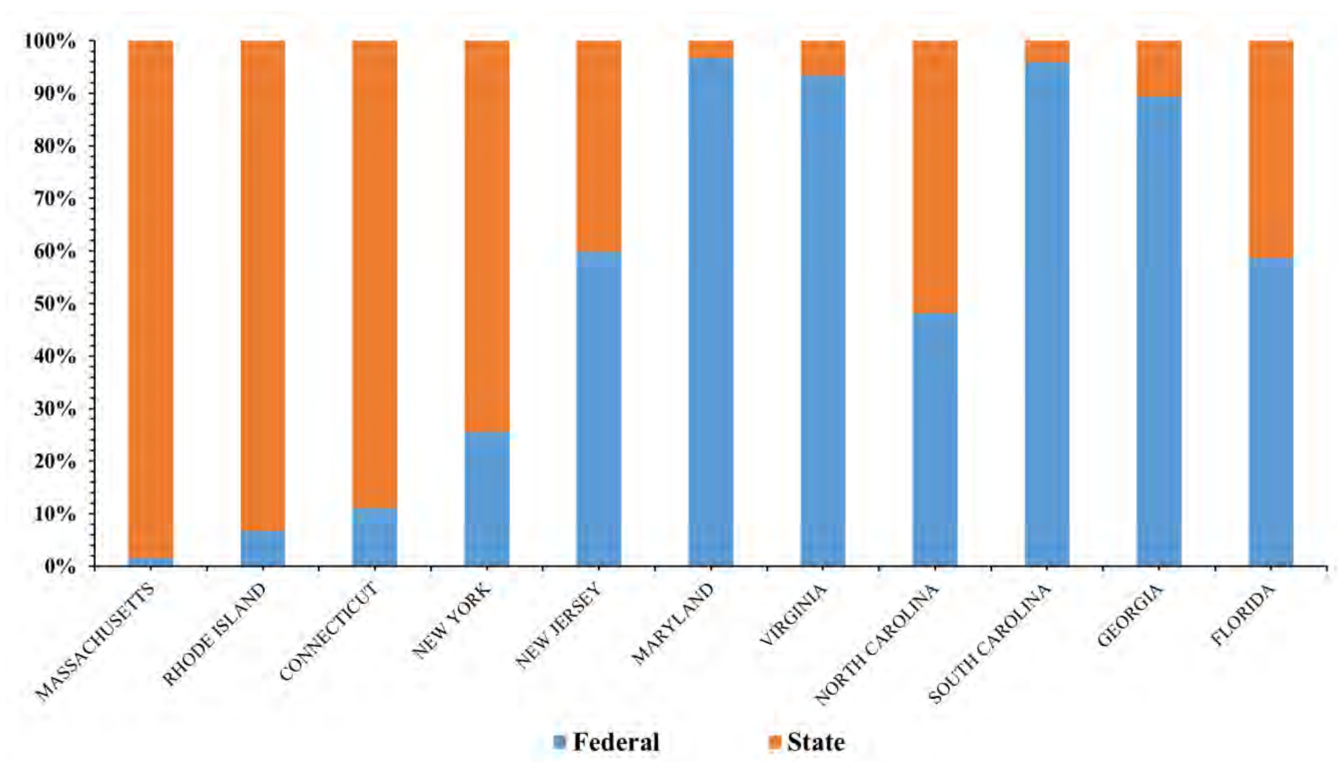

Figure 26. Percentage of recreational discards in federal and state waters for each state.

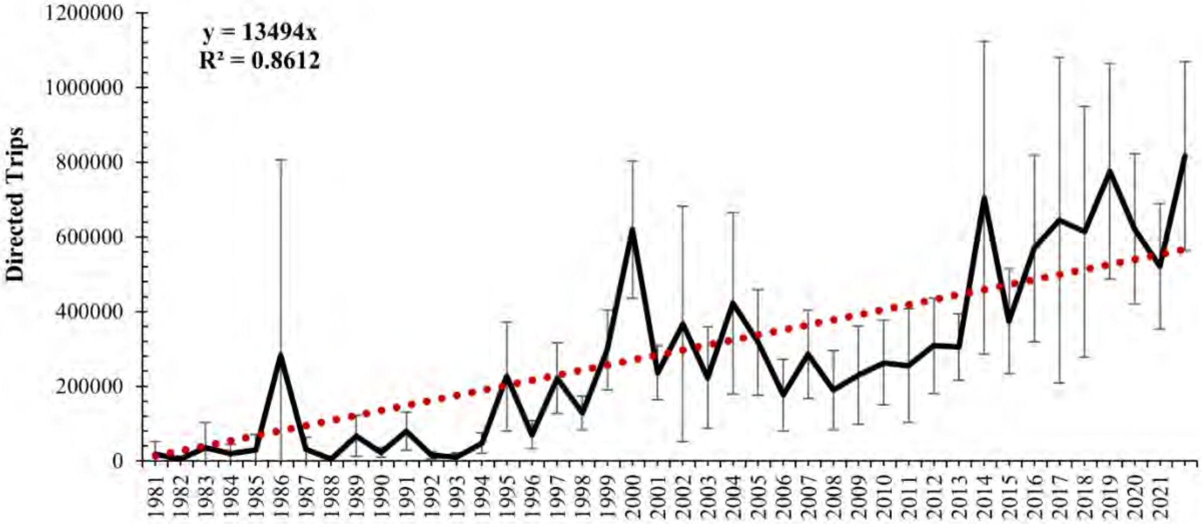

Figure 27. Directed trips for Little Tunny with 95% confidence intervals from 1981-2022.

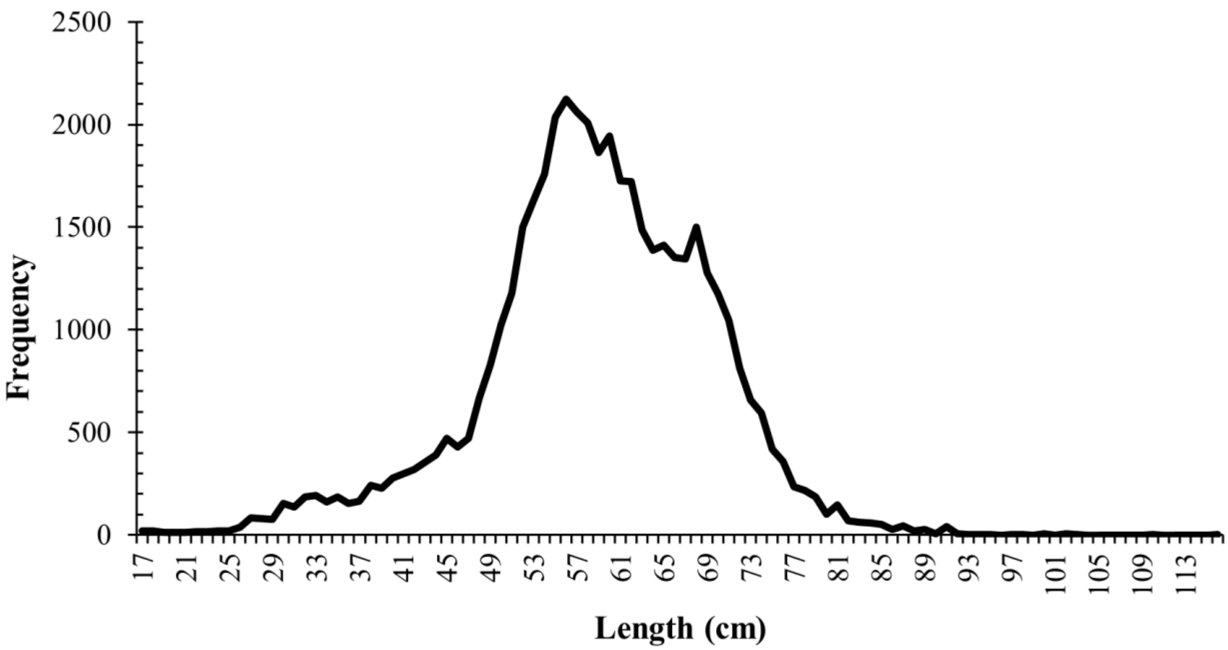

Figure 28. The aggregated length-frequency of the entire MRIP data set.

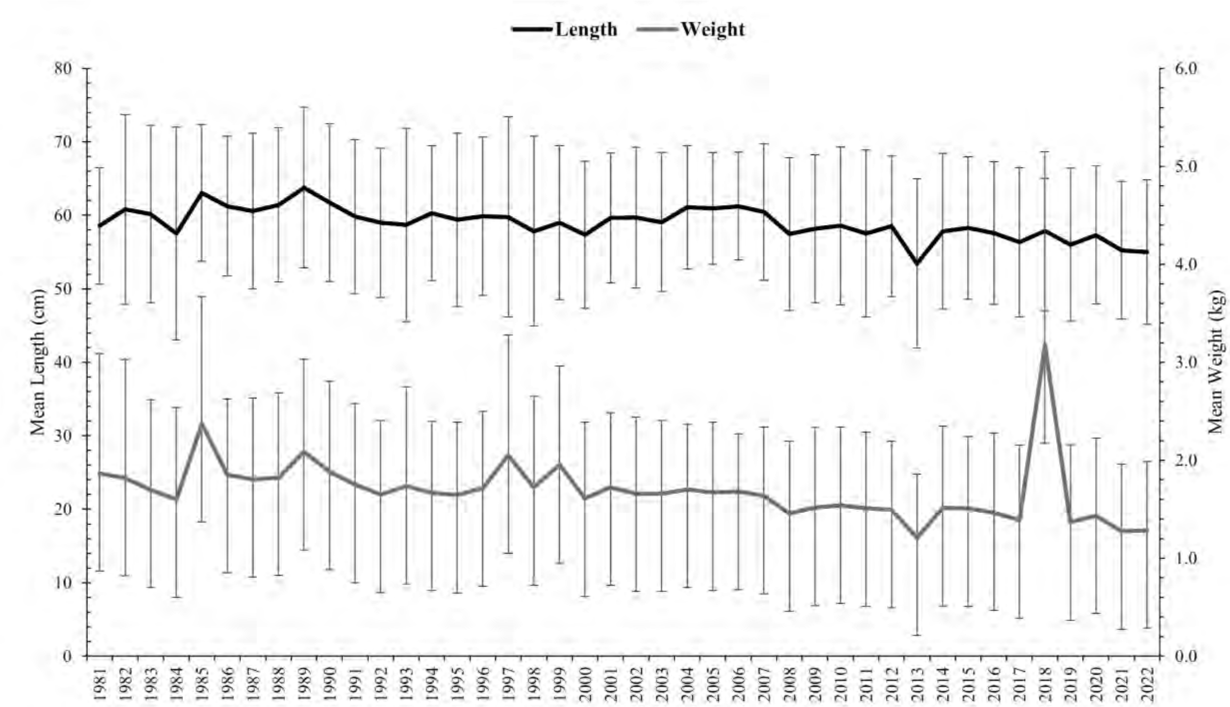

Figure 29. The mean length (Black) and mean weight (Gray) of MRIP sampled fish from 1981 to 2022, error bars based on standard deviation.

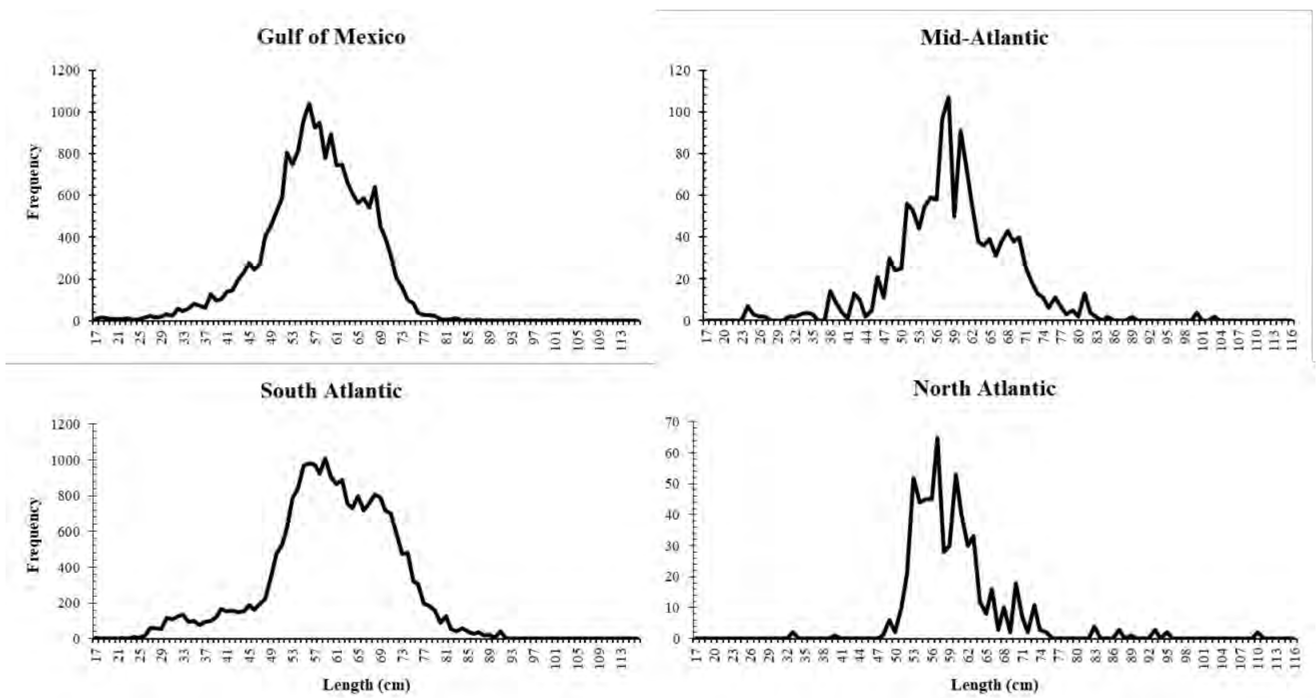

Figure 30. The length frequency distributions for the four sub-regions with data from 1981-2022.

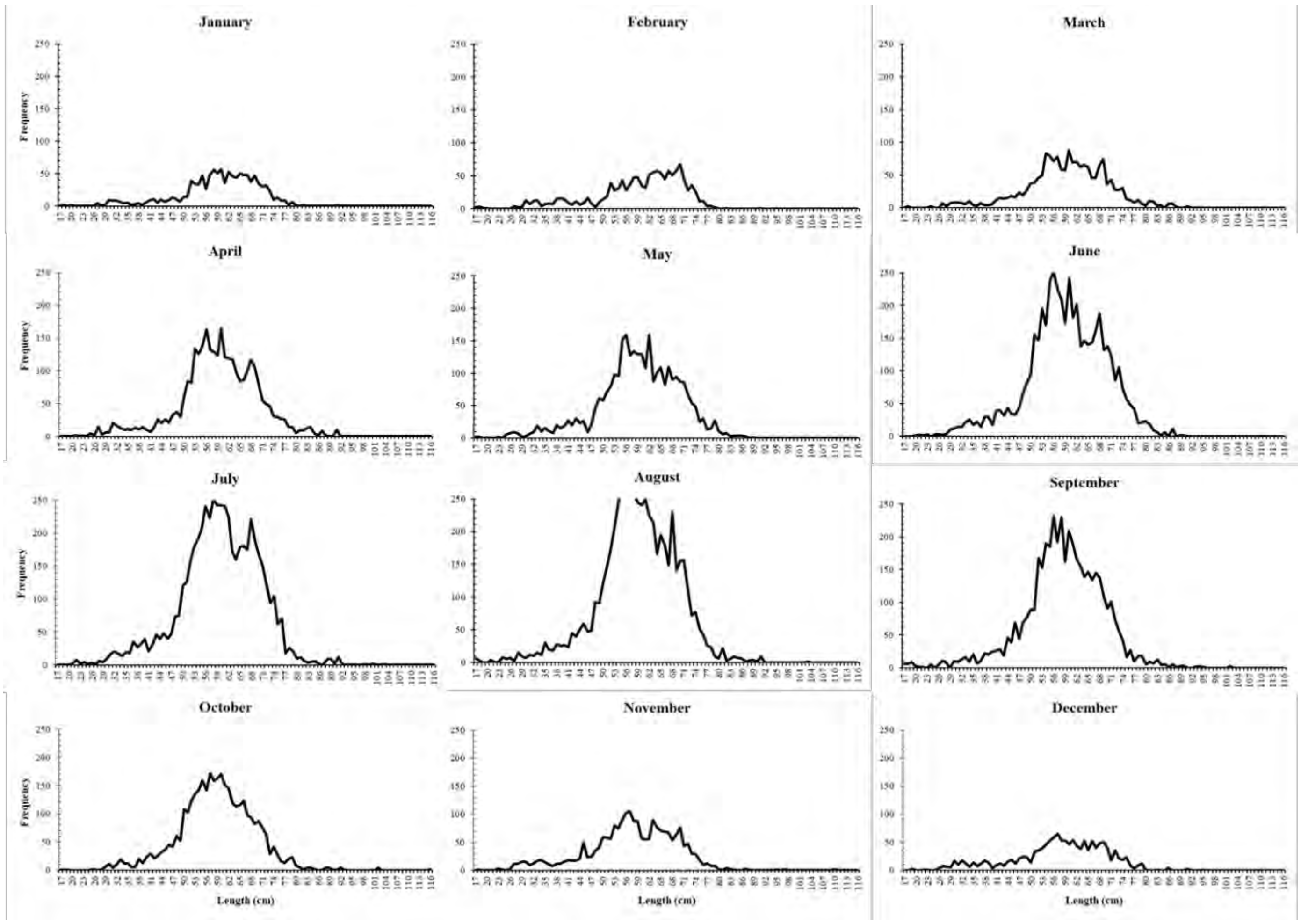

Figure 31. The length frequency distributions for by month with data from 1981-2022.

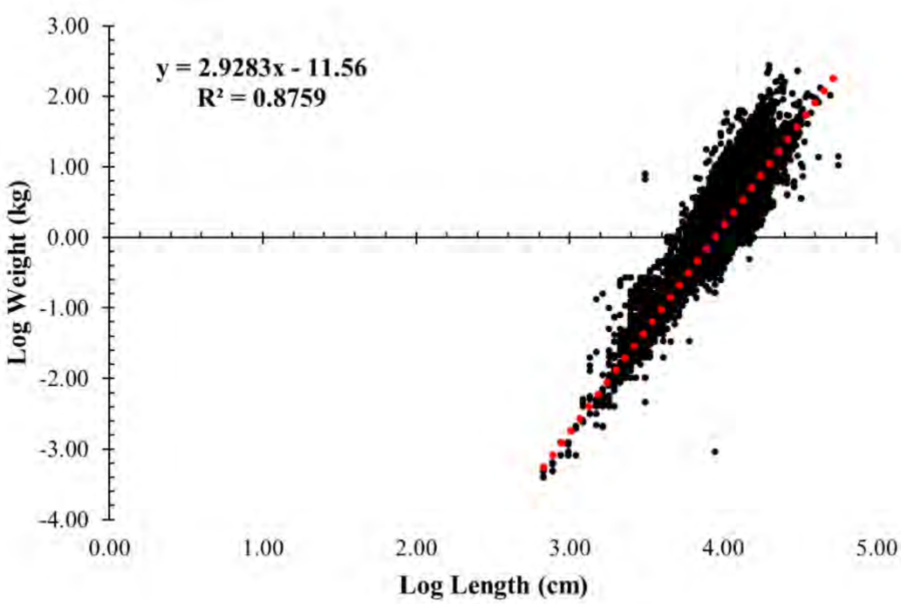

Figure 32. The logarithmic length-weight relationship on all data from 1981-2022.

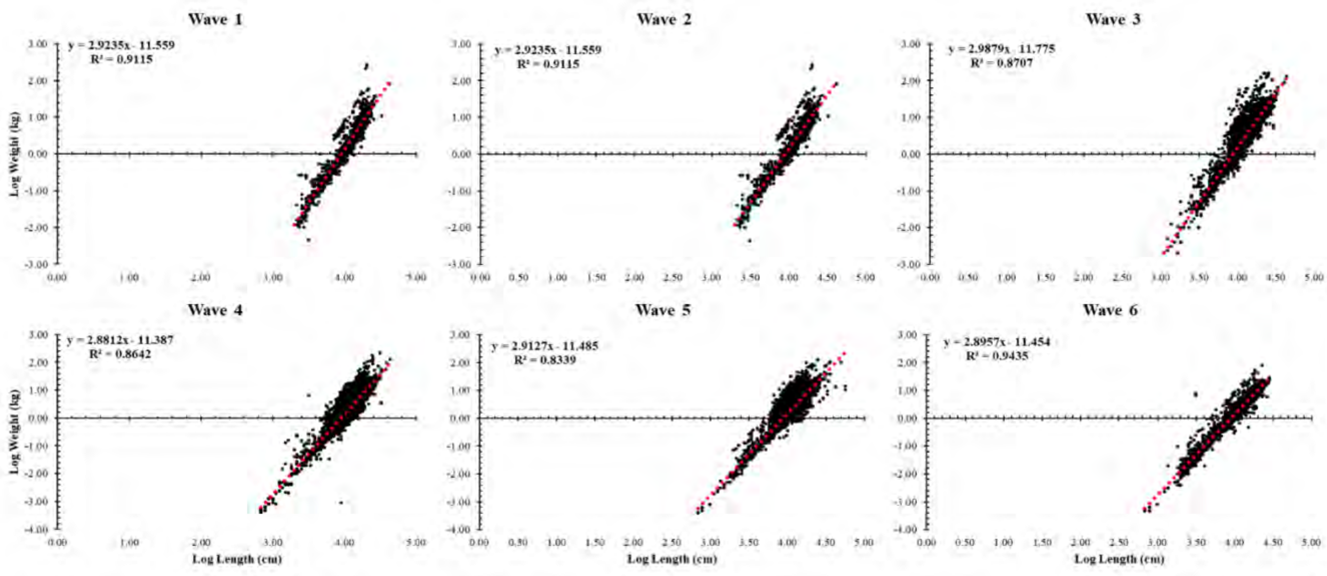

Figure 33. The logarithmic length-weight relationship for waves 1-6 using all data from 1981-2022.

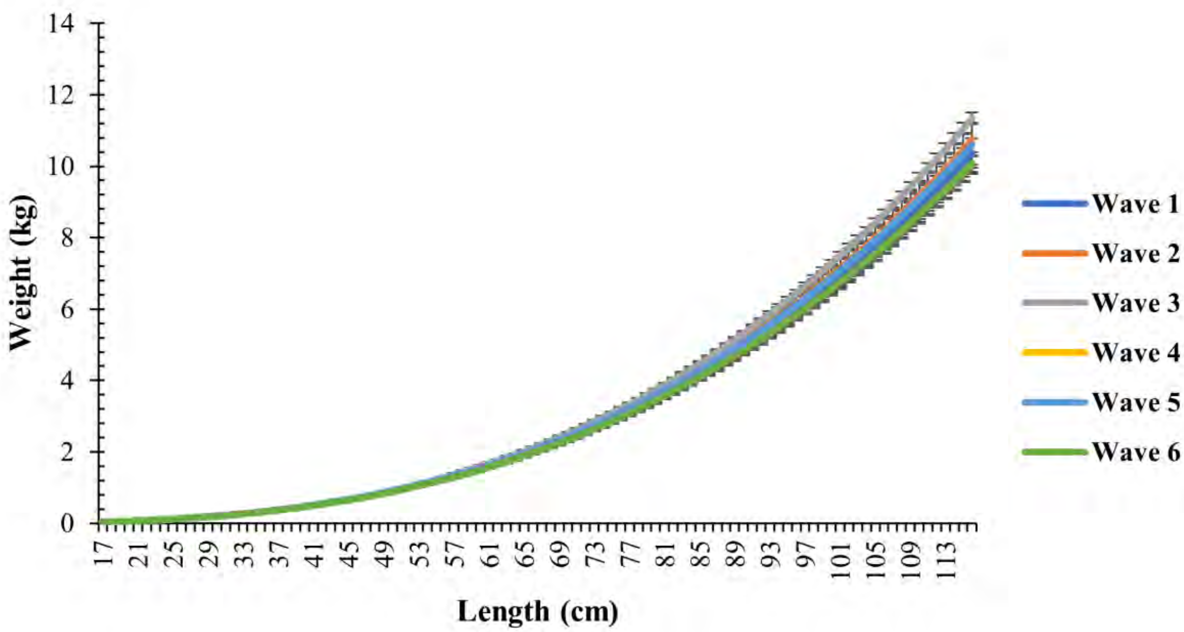

Figure 34. The predicted weights at length for waves 1-6 with 95% confidence intervals.

APPENDIX 1. MANAGEMENT AUTHORITY

Table 1. The marine fisheries management authority for each state along the Atlantic and Gulf coasts.

State	Management Authority
Maine	Department of Marine Resources
New Hampshire	Fish and Game
Massachusetts	Division of Marine Fisheries
Rhode Island	Department of Environmental Management
Connecticut	Department of Energy & Environmental Protection
New York	Department of Environmental Conservation
New Jersey	Department of Environmental Protection
Delaware	Fish and Wildlife
Maryland	Department of Natural Resources
Virginia	Marine Resources Commision
North Carolina	Division of Marine Fisheries
South Carolina	Department of Natural Resources
Georgia	Department of Natural Resources
Florida	Fish and Wildlife Conservation Commission

APPENDIX 2. FISHERIES DATA

Table A2.1. Commercial landings (lbs) 1950-2021 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total
1950	162700	0	133200	295900
1951	370300	0	0	370300
1952	744700	0	0	744700
1953	68300	0	0	68300
1954	71100	0	0	71100
1955	106200	0	0	106200
1956	88000	0	0	88000
1957	32500	0	0	32500
1958	13500	0	0	13500
1959	179200	0	0	179200
1960	14000	0	0	14000
1961	2200	0	900	3100
1962	16700	0	0	16700
1963	11900	0	0	11900
1964	3800	0	0	3800
1965	22400	0	0	22400
1966	34500	0	0	34500
1967	15000	0	0	15000
1968	12500	0	0	12500
1969	15200	0	0	15200
1970	7000	247400	0	254400
1971	8000	0	0	8000
1972	9900	0	0	9900
1973	13500	0	0	13500
1974	8000	0	12100	20100
1975	3600	0	1400	5000
1976	1700	0	1300	3000
1977	19100	0	0	19100
1978	37100	27500	2880	67480
1979	20300	0	129	20429
1980	39000	0	97185	136185
1981	104500	0	16380	120880
1982	45300	1700	17533	64533
1983	44700	105000	55464	205164
1984	21400	64500	72825	158725
1985	32200	54500	74689	161389
1986	31500	16900	77676	126076
1987	8200	0	150953	159153

Table A2.2. Commercial landings (lbs) 1950-2021 by region (Cont.).

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total
1988	16900	2000	109234	128134
1989	16300	1200	107938	125438
1990	23936	0	133102	157038
1991	89785	7500	115057	212342
1992	41095	5006	177495	223596
1993	117271	2419	150978	270668
1994	112397	0	206446	318843
1995	97609	50517	380262	528388
1996	10226	39380	272336	321942
1997	15129	59578	549193	623900
1998	53737	67006	311824	432567
1999	89252	137023	276315	502590
2000	132068	1274	223012	356354
2001	109533	48880	224202	382615
2002	127259	98275	209698	435232
2003	99180	54054	180119	333353
2004	22077	14284	267664	304025
2005	819	10746	191869	203434
2006	0	29071	288544	317615
2007	18577	57641	359224	435442
2008	10936	117973	350051	478959
2009	20633	29044	465202	514879
2010	11656	9297	488998	509952
2011	10832	29685	491689	532206
2012	28176	37876	473460	539512
2013	8161	775	505620	514556
2014	21896	85900	505316	613112
2015	5816	51806	405092	462714
2016	17168	12624	539667	569460
2017	8951	80119	485835	574905
2018	13414	30373	403897	447684
2019	7643	23344	405124	436111
2020	6920	34515	463443	504878
2021	3860	12859	418479	435198
Overall	22%	10%	68%	
10-Year	2%	7%	90%	

Table A2.3. Commercial landings (lbs) 1950-2021 by state.

Year	CT	DE	FL	GA	MD	MA	NJ	NY	NC	RI	SC	VA
1950	0	0	0	0	100	0	134800	14100	133200	0	0	13700
1951	0	0	0	0	600	0	349600	8600	0	0	0	11500
1952	0	0	0	0	0	0	722000	15700	0	0	0	7000
1953	0	0	0	0	0	0	60200	2700	0	0	0	5400
1954	0	0	0	0	0	0	58600	0	0	0	0	12500
1955	0	0	0	0	0	0	87500	5900	0	0	0	12800
1956	0	0	0	0	0	0	62800	12100	0	0	0	13100
1957	0	0	0	0	0	0	22800	9700	0	0	0	0
1958	0	0	0	0	0	0	2300	8900	0	0	0	2300
1959	0	0	0	0	0	0	123300	53500	0	0	0	2400
1960	0	0	0	900	200	0	1900	1800	0	0	0	10100
1961	0	0	0	0	0	0	1000	1200	900	0	0	0
1962	0	0	0	0	0	0	9300	5700	0	0	0	1700
1963	0	0	0	0	0	0	0	7800	0	0	0	4100
1964	0	0	0	0	0	0	0	2700	0	0	0	1100
1965	0	0	0	0	0	0	300	19100	0	0	0	3000
1966	0	3000	0	0	0	0	900	30200	0	0	0	400
1967	0	0	0	0	0	0	800	14200	0	0	0	0
1968	0	0	0	0	0	0	700	11800	0	0	0	0
1969	0	0	0	0	0	0	600	14600	0	0	0	0
1970	0	0	0	0	0	247400	100	6900	0	0	0	0
1971	0	0	0	0	0	0	0	8000	0	0	0	0
1972	0	0	0	0	0	0	400	9500	0	0	0	0
1973	0	0	0	0	0	0	600	12300	0	0	0	600
1974	0	0	0	0	0	0	1400	6600	12100	0	0	0
1975	0	0	0	0	0	0	3600	0	1400	0	0	0
1976	0	0	0	0	0	0	400	1300	1300	0	0	0
1977	0	0	0	0	0	0	1300	17700	0	0	0	100
1978	0	0	0	0	0	27500	2900	34200	2880	0	0	0
1979	0	0	0	0	0	0	1400	18900	129	0	0	0
1980	0	0	8935	0	0	0	0	38900	88250	0	0	100
1981	0	0	0	0	0	0	0	104500	16380	0	0	0
1982	0	0	0	0	0	0	0	45300	17533	1700	0	0
1983	0	0	0	0	0	0	500	44200	55464	105000	0	0
1984	0	0	0	0	0	0	2300	19100	72825	64500	0	0
1985	0	300	0	0	0	0	8200	23700	74689	54500	0	0
1986	0	0	0	0	6800	0	19200	2700	77676	16900	0	2800
1987	0	0	0	0	0	0	6400	1800	148730	0	2223	0

Table A2.3. Commercial landings (lbs) 1950-2021 by state (Cont.)

Year	CT	DE	FL	GA	MD	MA	NJ	NY	NC	RI	SC	VA
1988	2000	0	0	0	0	0	4900	9000	106732	0	2502	3000
1989	0	0	0	0	600	1200	11600	0	104839	0	3099	4100
1990	0	0	0	0	0	0	21900	0	131278	0	1824	2036
1991	0	0	0	0	0	7500	74103	13465	110419	0	4638	2217
1992	0	0	0	0	0	5006	40725	125	174481	0	3014	245
1993	0	0	0	744	0	2419	20017	88437	146836	0	4142	8817
1994	0	0	0	0	113	0	44993	62525	206150	0	296	4766
1995	0	0	196817	0	0	0	13100	82852	183445	50517	0	1657
1996	0	0	123878	0	0	0	10186	40	133980	39380	14478	0
1997	0	0	178118	0	1111	2353	14018	0	370816	57225	259	0
1998	0	0	157363	685	620	4869	49184	3933	153798	62137	663	0
1999	0	0	132955	0	924	6536	50759	37569	143360	130487	0	0
2000	0	0	116234	0	3360	1274	57940	70768	106778	0	0	0
2001	0	0	125849	0	6218	4659	54207	49108	98353	44221	0	0
2002	0	0	131900	0	0	0	54661	72598	77798	98275	0	0
2003	0	0	93551	0	0	0	31496	66767	86568	54054	0	917
2004	6	0	175344	0	510	2822	21368	9	92320	11456	0	190
2005	0	0	102059	0	0	0	0	576	88741	10746	1069	243
2006	0	0	181927	0	0	0	0	0	106617	29071	0	0
2007	12	0	224558	0	0	0	0	18577	134666	57629	0	0
2008	0	0	246308	0	0	0	5368	5543	103743	117973	0	25
2009	0	0	319114	0	0	0	10681	9952	146088	29044	0	0
2010	0	0	341661	0	0	0	3220	8436	147337	9297	0	0
2011	0	0	360139	0	0	0	0	10832	131549	29685	0	0
2012	0	0	315610	0	0	0	0	28176	157849	37876	0	0
2013	0	0	301773	0	0	0	0	8161	189746	775	14102	0
2014	0	0	259257	0	0	0	0	21896	225797	85900	20262	0
2015	0	0	228489	0	0	0	0	5816	164853	51806	11750	0
2016	0	0	298460	0	0	0	8689	8342	241208	12624	0	137
2017	168	0	269278	0	0	0	0	8951	216557	79951	0	0
2018	16	0	194990	0	0	0	2441	10973	204177	30357	4730	0
2019	32	0	172246	0	0	0	0	7643	232879	23312	0	0
2020	0	0	232758	0	0	0	6227	693	230685	34515	0	0
2021	60	0	308862	0	0	0	2390	1470	105306	12799	4311	0
Overall	0%	0%	33%	0%	0%	2%	13%	8%	34%	8%	1%	1%
10-Year	0%	0%	51%	0%	0%	0%	0%	2%	39%	7%	1%	0%

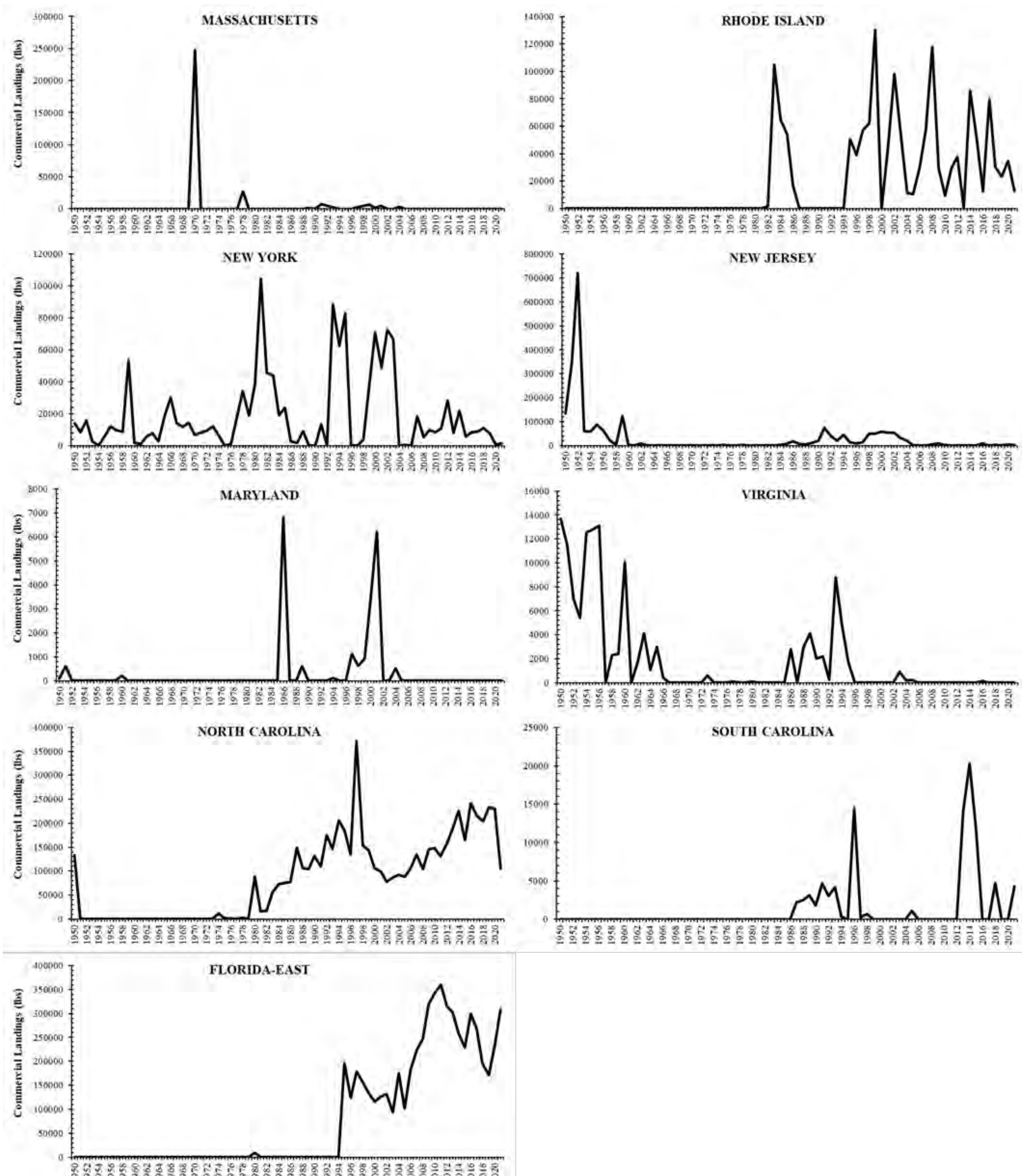

Figure A2.1. Commercial landings (lbs) 1950-2021 by state.

Table A2.4. Recreational landings (lbs) 1981-2021 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total Landings
1981	920993	0	457781	1397518
1982	71630	6215	600394	712206
1983	336438	0	2335621	2707381
1984	17990	0	1262139	1304684
1985	455637	0	1542895	2014304
1986	145653	0	2846040	3047545
1987	170312	8342	1511246	1697345
1988	653148	0	445410	1098558
1989	268504	0	1960705	2229209
1990	337799	198	2863545	3201542
1991	809101	171579	2697944	3678624
1992	1187473	39171	1967694	3194338
1993	54133	218900	1907937	2181334
1994	566903	111378	1131436	1811538
1995	111012	81137	2204575	2396724
1996	2297	70439	2861819	2934555
1997	712337	79113	1833886	2625336
1998	288578	73486	2966177	3328241
1999	255994	162555	2832336	3250885
2000	124975	18545	2016914	2185496
2001	11683	31182	1764449	1807314
2002	14420	100877	1772812	1888109
2003	14249	51253	1637416	1702973
2004	235601	185982	1604370	2026149
2005	771802	163	986982	1758947
2006	977	22675	2550607	2574312
2007	184506	136239	2155128	2482374
2008	24767	7022	1542132	1573994
2009	210140	38801	1987864	2236893
2010	166811	39692	1819802	2026305
2011	7326	0	2044772	2139443
2012	242793	94541	2079518	2416975
2013	354243	16821	3513499	3898408
2014	113522	105143	3928173	4147012
2015	34510	371067	5107822	5513399
2016	105315	388171	3353006	3846492
2017	685938	182955	2731168	3624896
2018	1078026	116497	3084753	4281179
2019	336800	241650	1231389	1810011
2020	154532	145519	2284562	2584633
2021	181443	82649	2151850	2440971
Overall	12%	4%	84%	-
10-Year	10%	5%	85%	-

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Table A2.5. Recreational landings (lbs) 1981-2021 by state.

Year	CT	DE	FL	GA	MD	MA	NJ	NY	NC	RI	SC	VA	Total
1981	0	0	457274	18744	0	0	855103	65890	0	0	507	0	1397518
1982	0	0	525340	33967	0	6215	71630	0	75054	0	0	0	712206
1983	0	0	1208083	35322	196361	0	0	140077	1117723	0	9815	0	2707381
1984	0	0	1214830	24555	0	0	0	17990	45356	0	1953	0	1304684
1985	0	0	855414	15772	31165	0	300940	110000	592230	0	95251	13532	2014304
1986	0	0	2459237	55852	0	0	0	90692	299670	0	87133	54961	3047545
1987	0	16711	1241671	7445	0	0	91591	38588	245567	8342	24008	23422	1697345
1988	0	0	435901	0	41581	0	534147	6982	8627	0	882	70438	1098558
1989	0	12258	1534553	0	50208	0	79594	0	403625	0	22527	126444	2229209
1990	0	30633	2756561	0	61139	0	193892	19820	101446	198	5538	32315	3201542
1991	92455	14833	2534524	0	78449	68599	549813	145510	163420	10525	0	20496	3678624
1992	3785	4967	1768164	0	808764	0	113618	111832	199210	35386	320	148292	3194338
1993	187464	0	1731845	364	0	0	34569	13781	167719	31436	8373	5783	2181334
1994	101197	0	1001257	1821	0	0	488115	25463	130179	10181	0	53325	1811538
1995	0	666	2068787	0	46524	35329	18656	37033	122540	45808	13248	8133	2396724
1996	20999	0	2559170	0	0	45395	0	0	301132	4045	1517	2297	2934555
1997	0	18918	1605156	0	0	16621	380124	89107	222312	62492	6418	224188	2625336
1998	161	28371	2765331	0	121091	1276	119151	0	200846	72049	0	19965	3328241
1999	13666	9932	2742328	0	6208	45488	179472	26270	90008	103401	0	34112	3250885
2000	0	0	1926266	25062	0	0	100310	0	85780	18545	4868	24665	2185496
2001	13865	556	1710493	0	0	11519	6281	0	53956	5798	0	4846	1807314
2002	0	370	1707138	0	10249	55473	3801	0	61386	45404	4288	0	1888109
2003	11766	201	1558345	55	14048	37071	0	0	79071	2416	0	0	1702973
2004	2299	20946	1487994	196	0	158279	64730	148995	95090	25404	21286	930	2026149
2005	0	0	916158	0	204887	0	117626	0	69869	163	955	449289	1758947
2006	0	0	2518832	53	589	22675	388	0	29943	0	1832	0	2574312
2007	0	86	2125635	6501	6094	73619	606	177239	29493	62620	0	481	2482374
2008	0	20505	1465903	73	0	7022	2756	1506	76229	0	0	0	1573994
2009	0	95	1848430	88	55896	1221	153360	0	139434	37580	0	789	2236893
2010	11296	500	1770130	0	234	28396	166077	0	49291	0	381	0	2026305
2011	0	20	1989482	87345	0	0	7306	0	55290	0	0	0	2139443
2012	5223	57	1937946	123	661	15959	116173	0	140027	73359	1545	125902	2416975
2013	0	0	3295027	13845	0	16821	354243	0	218472	0	0	0	3898408
2014	13695	0	3738902	174	3415	90875	103769	6338	189271	573	0	0	4147012
2015	0	0	4891017	0	0	242544	717	1409	207892	128523	8913	32384	5513399
2016	2271	0	3015161	0	278	366801	88633	11920	337845	19099	0	4484	3846492
2017	89111	0	2386230	24835	8005	0	540210	113981	334367	93844	10571	23742	3624896
2018	20276	68	2757650	1903	386	31229	998580	57953	315762	64992	11341	21039	4281179
2019	1190	1010	986790	172	9218	227636	57036	249899	185096	12824	59503	19637	1810011
2020	33	163	1665907	20	74064	10759	33155	23977	594801	134727	23854	23173	2584633
2021	7921	9808	2012022	15245	0	15933	163449	624	118785	58795	21043	7562	2440971
Overall	1%	0%	76%	0%	2%	2%	7%	2%	8%	1%	0%	2%	-
10-Year	0%	0%	77%	0%	0%	3%	7%	1%	8%	2%	0%	1%	-

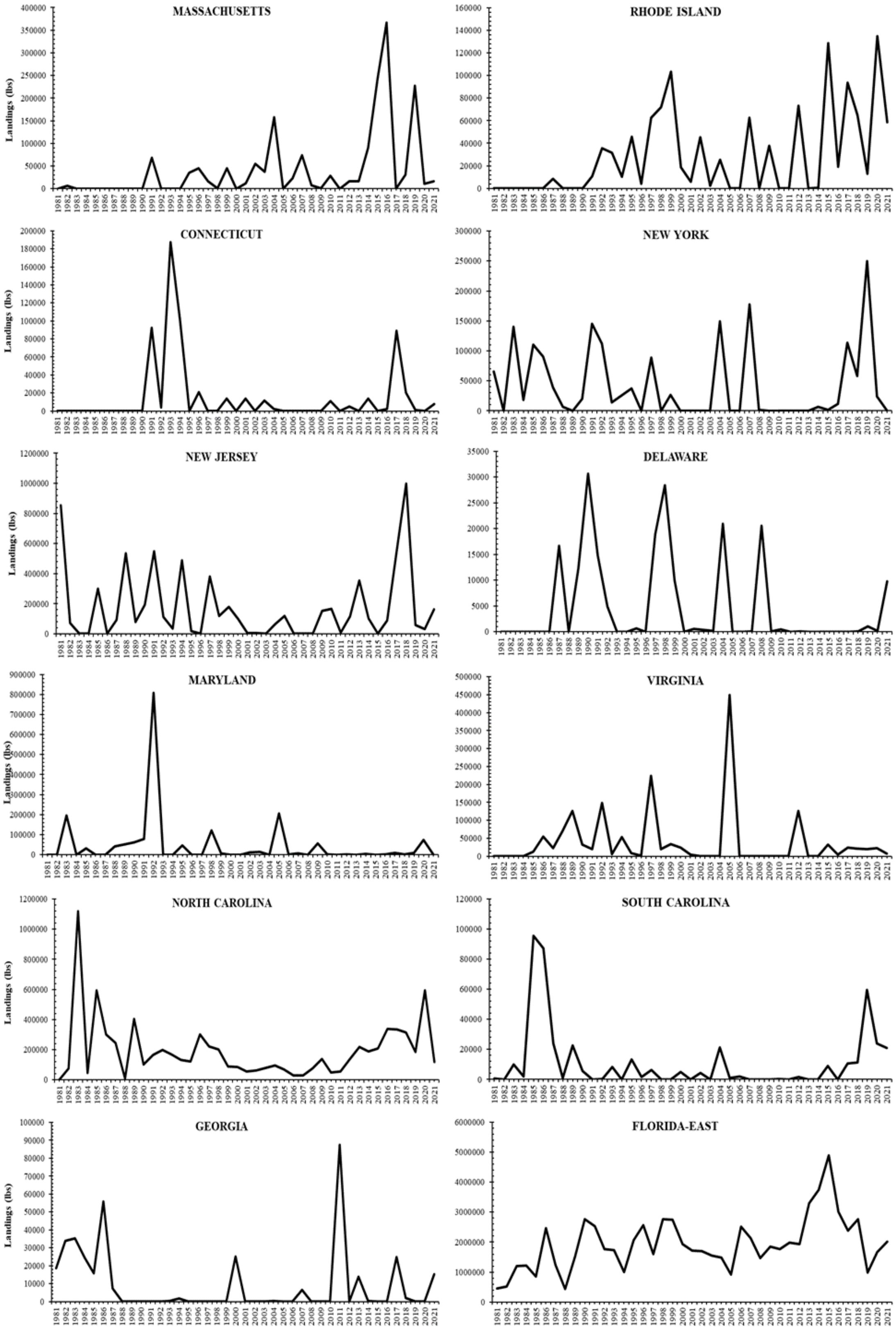

Figure A2.2. Recreational landings (lbs) 1981-2021 by state.

Table A2.6. Percentage of recreational landing 1981-2021 by fishing mode for each region.

Year	Mid-Atlantic			North Atlantic			South Atlantic		
	Shore	For Hire	Private	Shore	For Hire	Private	Shore	For Hire	Private
1981	0%	91%	9%	0%	0%	0%	0%	10%	90%
1982	0%	0%	100%	0%	0%	100%	8%	48%	44%
1983	0%	62%	38%	0%	0%	0%	43%	32%	25%
1984	0%	0%	100%	0%	0%	0%	0%	24%	76%
1985	0%	12%	88%	0%	0%	0%	12%	40%	48%
1986	0%	34%	66%	0%	0%	0%	51%	21%	29%
1987	0%	10%	90%	0%	3%	97%	3%	46%	51%
1988	0%	5%	95%	0%	0%	0%	0%	44%	56%
1989	0%	35%	65%	0%	0%	0%	14%	32%	54%
1990	0%	38%	62%	0%	100%	0%	9%	51%	41%
1991	0%	61%	39%	49%	3%	49%	14%	31%	54%
1992	0%	30%	70%	27%	1%	72%	34%	30%	36%
1993	0%	12%	88%	0%	2%	98%	1%	43%	55%
1994	12%	9%	79%	0%	4%	96%	1%	47%	52%
1995	17%	3%	80%	77%	10%	13%	8%	57%	35%
1996	0%	100%	0%	19%	0%	81%	7%	50%	43%
1997	0%	11%	89%	53%	13%	34%	6%	73%	21%
1998	0%	46%	54%	0%	2%	98%	2%	66%	33%
1999	0%	34%	66%	48%	0%	52%	7%	49%	45%
2000	0%	69%	31%	0%	0%	100%	18%	17%	64%
2001	0%	59%	41%	37%	22%	41%	21%	19%	60%
2002	0%	0%	100%	13%	10%	77%	17%	21%	62%
2003	0%	7%	93%	60%	5%	35%	12%	17%	71%
2004	38%	21%	41%	92%	2%	7%	1%	24%	75%
2005	0%	13%	87%	0%	100%	0%	3%	23%	74%
2006	0%	100%	0%	100%	0%	0%	15%	14%	72%
2007	96%	4%	0%	33%	1%	66%	0%	15%	85%
2008	0%	52%	48%	100%	0%	0%	10%	12%	78%
2009	0%	3%	97%	0%	4%	96%	10%	15%	76%
2010	0%	18%	82%	72%	0%	28%	24%	8%	68%
2011	0%	22%	78%	0%	0%	0%	7%	10%	83%
2012	0%	48%	52%	0%	37%	63%	10%	12%	79%
2013	0%	0%	100%	0%	0%	100%	9%	8%	83%
2014	0%	38%	62%	0%	5%	95%	27%	9%	64%
2015	0%	9%	91%	0%	0%	100%	39%	6%	55%
2016	0%	2%	98%	17%	0%	82%	3%	10%	87%
2017	0%	1%	99%	15%	1%	83%	17%	19%	64%
2018	78%	2%	20%	15%	13%	72%	15%	14%	71%
2019	0%	3%	97%	77%	1%	22%	2%	27%	72%
2020	0%	11%	89%	84%	0%	15%	19%	9%	71%
2021	0%	2%	98%	57%	1%	42%	19%	23%	59%
2022	0%	11%	89%	96%	0%	4%	8%	12%	80%

Table A2.7. Percentage of recreational landing 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state.

Year	CT			DE			FL			GA			MD			MA		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	0%	0%	0%	0%	0%	0%	11%	89%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	0%	57%	43%	0%	20%	80%	0%	0%	0%	0%	0%	100%
1983	0%	0%	0%	0%	0%	0%	0%	44%	56%	0%	7%	93%	0%	47%	53%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	16%	84%	0%	2%	98%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	0%	0%	0%	18%	82%	0%	0%	100%	0%	18%	82%	0%	0%	0%
1986	0%	0%	0%	0%	0%	0%	36%	27%	37%	0%	68%	32%	0%	0%	0%	0%	0%	0%
1987	0%	0%	0%	0%	100%	0%	22%	26%	52%	0%	6%	94%	0%	0%	0%	0%	0%	0%
1988	0%	0%	0%	0%	0%	0%	0%	52%	48%	0%	0%	0%	0%	14%	86%	0%	0%	0%
1989	0%	0%	0%	0%	5%	95%	43%	28%	29%	0%	0%	0%	0%	0%	100%	0%	0%	0%
1990	0%	0%	0%	0%	94%	6%	47%	24%	29%	0%	0%	0%	0%	100%	0%	0%	0%	0%
1991	25%	0%	75%	0%	86%	14%	35%	27%	38%	0%	0%	0%	0%	0%	100%	79%	0%	21%
1992	0%	0%	100%	0%	70%	30%	59%	18%	23%	0%	0%	0%	0%	17%	83%	0%	0%	0%
1993	0%	1%	99%	0%	0%	0%	30%	36%	33%	0%	100%	0%	0%	0%	0%	0%	0%	0%
1994	0%	3%	97%	0%	0%	0%	29%	35%	36%	0%	100%	0%	0%	0%	0%	0%	0%	0%
1995	0%	0%	0%	0%	100%	0%	29%	47%	24%	0%	0%	0%	0%	0%	100%	77%	23%	0%
1996	0%	0%	100%	0%	0%	0%	15%	50%	34%	0%	0%	0%	0%	0%	0%	29%	0%	71%
1997	0%	0%	0%	0%	54%	46%	6%	73%	21%	0%	0%	0%	0%	0%	0%	0%	43%	57%
1998	0%	100%	0%	0%	5%	95%	0%	66%	34%	0%	0%	0%	0%	100%	0%	0%	100%	0%
1999	0%	0%	100%	0%	0%	100%	6%	47%	47%	0%	0%	0%	0%	100%	0%	69%	0%	31%
2000	0%	0%	0%	0%	0%	0%	20%	18%	62%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2001	0%	46%	54%	0%	100%	0%	30%	17%	53%	0%	0%	0%	0%	0%	0%	100%	0%	0%
2002	0%	0%	0%	0%	0%	100%	35%	16%	49%	0%	0%	0%	0%	0%	100%	24%	0%	76%
2003	0%	0%	100%	0%	100%	0%	19%	14%	67%	0%	100%	0%	0%	6%	94%	83%	0%	17%
2004	0%	100%	0%	0%	3%	97%	44%	11%	46%	0%	100%	0%	0%	0%	0%	100%	0%	0%
2005	0%	0%	0%	0%	0%	0%	5%	18%	77%	0%	0%	0%	0%	0%	100%	0%	0%	0%
2006	0%	0%	0%	0%	0%	0%	16%	18%	66%	0%	100%	0%	0%	100%	0%	100%	0%	0%
2007	0%	0%	0%	0%	100%	0%	14%	14%	72%	0%	100%	0%	0%	100%	0%	62%	0%	38%
2008	0%	0%	0%	0%	41%	59%	19%	15%	66%	0%	100%	0%	0%	0%	0%	100%	0%	0%
2009	0%	0%	0%	0%	100%	0%	20%	14%	66%	0%	100%	0%	0%	7%	93%	0%	100%	0%
2010	0%	0%	100%	0%	100%	0%	25%	12%	63%	0%	0%	0%	0%	100%	0%	100%	0%	0%
2011	0%	0%	0%	0%	100%	0%	11%	14%	75%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2012	0%	0%	100%	0%	100%	0%	31%	14%	54%	0%	100%	0%	0%	100%	0%	0%	18%	82%
2013	0%	0%	0%	0%	0%	0%	20%	12%	68%	0%	0%	100%	0%	0%	0%	0%	0%	100%
2014	0%	0%	100%	0%	0%	0%	28%	13%	59%	0%	100%	0%	0%	100%	0%	0%	6%	94%
2015	0%	0%	0%	0%	0%	0%	46%	9%	45%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2016	0%	0%	100%	0%	0%	0%	6%	12%	82%	0%	0%	0%	0%	100%	0%	18%	0%	82%
2017	0%	0%	100%	0%	0%	0%	11%	25%	64%	0%	0%	100%	0%	0%	100%	0%	0%	0%
2018	0%	0%	100%	0%	100%	0%	10%	17%	73%	0%	6%	94%	0%	100%	0%	0%	50%	50%
2019	0%	0%	100%	0%	100%	0%	53%	15%	33%	0%	100%	0%	0%	0%	100%	79%	1%	21%
2020	0%	100%	0%	0%	100%	0%	17%	16%	67%	0%	100%	0%	0%	1%	99%	0%	0%	100%
2021	0%	0%	100%	0%	0%	100%	17%	25%	58%	0%	2%	98%	0%	20%	80%	0%	4%	96%
2022	0%	0%	0%	0%	100%	0%	22%	13%	65%	0%	0%	100%	0%	77%	23%	84%	0%	16%

Table A2.7. Percentage of recreational landing 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state (Cont.).

Year	NJ			NY			NC			RI			SC			VA		
	SH	**FH**	**PR**	**SH**	**FH**	**PR**	**SH**	**FH**	**PR**	**SH**	**FH**	**PR**	**SH**	**FH**	**PR**	**SH**	**FH**	**PR**
1981	0%	95%	5%	0%	37%	63%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
1982	0%	0%	100%	0%	0%	0%	67%	10%	23%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	82%	18%	91%	3%	6%	0%	0%	0%	0%	7%	93%	0%	0%	0%
1984	0%	0%	0%	0%	0%	100%	0%	67%	33%	0%	0%	0%	0%	100%	0%	0%	0%	0%
1985	0%	8%	92%	0%	12%	88%	32%	56%	12%	0%	0%	0%	0%	46%	54%	0%	77%	23%
1986	0%	0%	0%	0%	1%	99%	49%	13%	38%	0%	0%	0%	0%	14%	86%	0%	88%	12%
1987	0%	0%	100%	0%	0%	100%	20%	36%	45%	0%	3%	97%	0%	80%	20%	0%	2%	98%
1988	0%	0%	100%	0%	100%	0%	0%	18%	82%	0%	0%	0%	0%	100%	0%	0%	26%	74%
1989	0%	23%	77%	0%	0%	0%	35%	13%	52%	0%	0%	0%	0%	22%	78%	0%	60%	40%
1990	0%	13%	87%	0%	73%	27%	0%	43%	57%	0%	100%	0%	0%	100%	0%	0%	0%	100%
1991	0%	67%	33%	0%	75%	25%	12%	27%	61%	58%	42%	0%	0%	0%	0%	0%	0%	100%
1992	5%	51%	44%	0%	35%	65%	9%	48%	43%	30%	1%	69%	0%	100%	0%	0%	76%	24%
1993	0%	0%	100%	0%	45%	55%	3%	43%	54%	0%	7%	93%	0%	100%	0%	0%	0%	100%
1994	14%	0%	86%	0%	100%	0%	9%	57%	33%	0%	10%	90%	0%	0%	0%	0%	47%	53%
1995	100%	0%	0%	0%	7%	93%	0%	33%	67%	77%	0%	23%	0%	100%	0%	0%	0%	100%
1996	0%	0%	0%	0%	0%	0%	8%	38%	54%	0%	0%	100%	0%	100%	0%	0%	100%	0%
1997	0%	0%	100%	0%	0%	100%	8%	57%	35%	67%	5%	28%	0%	44%	56%	0%	30%	70%
1998	0%	0%	100%	0%	0%	0%	22%	72%	5%	0%	0%	100%	0%	0%	0%	0%	45%	55%
1999	0%	41%	59%	0%	0%	100%	0%	57%	43%	45%	1%	54%	0%	0%	0%	0%	20%	80%
2000	0%	86%	14%	0%	0%	0%	14%	63%	23%	0%	0%	100%	0%	100%	0%	0%	0%	100%
2001	0%	100%	0%	0%	0%	0%	0%	55%	45%	0%	7%	93%	0%	0%	0%	0%	0%	100%
2002	0%	0%	100%	0%	0%	0%	4%	69%	27%	0%	23%	77%	0%	0%	100%	0%	0%	0%
2003	0%	0%	0%	0%	0%	0%	0%	71%	29%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2004	0%	23%	77%	60%	23%	18%	0%	64%	36%	48%	2%	49%	0%	100%	0%	0%	100%	0%
2005	0%	85%	15%	0%	0%	0%	0%	19%	81%	0%	100%	0%	0%	100%	0%	0%	0%	100%
2006	0%	100%	0%	0%	0%	0%	0%	72%	28%	0%	0%	0%	0%	100%	0%	0%	0%	0%
2007	0%	100%	0%	100%	0%	0%	0%	47%	53%	0%	1%	99%	0%	0%	0%	0%	100%	0%
2008	0%	100%	0%	0%	100%	0%	0%	40%	60%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009	0%	1%	99%	0%	0%	0%	0%	33%	67%	0%	1%	99%	0%	0%	0%	0%	100%	0%
2010	0%	17%	83%	0%	0%	0%	0%	69%	31%	0%	0%	0%	0%	100%	0%	0%	0%	0%
2011	0%	22%	78%	0%	0%	0%	15%	65%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012	0%	100%	0%	0%	0%	0%	18%	40%	42%	0%	44%	56%	0%	100%	0%	0%	0%	100%
2013	0%	0%	100%	0%	0%	0%	0%	20%	80%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2014	0%	38%	62%	0%	0%	100%	0%	28%	72%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2015	0%	100%	0%	0%	100%	0%	48%	25%	27%	0%	0%	100%	0%	92%	8%	0%	3%	97%
2016	0%	0%	100%	0%	2%	98%	16%	26%	58%	0%	10%	90%	0%	0%	0%	0%	45%	55%
2017	0%	0%	100%	0%	0%	100%	45%	12%	43%	29%	3%	68%	0%	62%	38%	0%	21%	79%
2018	85%	2%	14%	0%	4%	96%	30%	19%	51%	26%	0%	74%	0%	26%	74%	0%	3%	97%
2019	0%	11%	89%	0%	0%	100%	10%	30%	59%	61%	0%	39%	0%	30%	70%	0%	9%	91%
2020	0%	47%	53%	0%	0%	100%	24%	21%	55%	91%	0%	9%	0%	26%	74%	0%	3%	97%
2021	0%	1%	99%	0%	100%	0%	0%	45%	55%	81%	0%	19%	0%	3%	97%	0%	0%	100%
2022	0%	0%	100%	0%	0%	100%	8%	45%	47%	98%	0%	2%	0%	27%	73%	0%	0%	100%

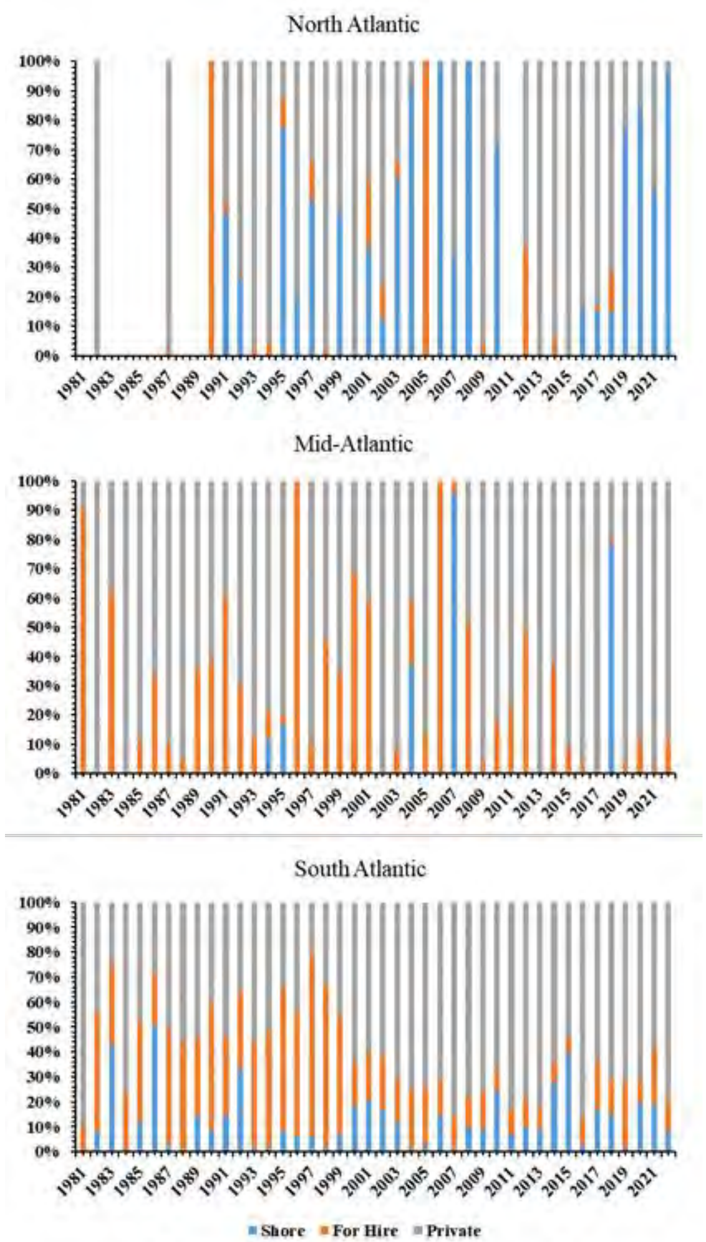

Figure A2.3. Percentage of recreational landing 1981-2021 by fishing mode for each region.

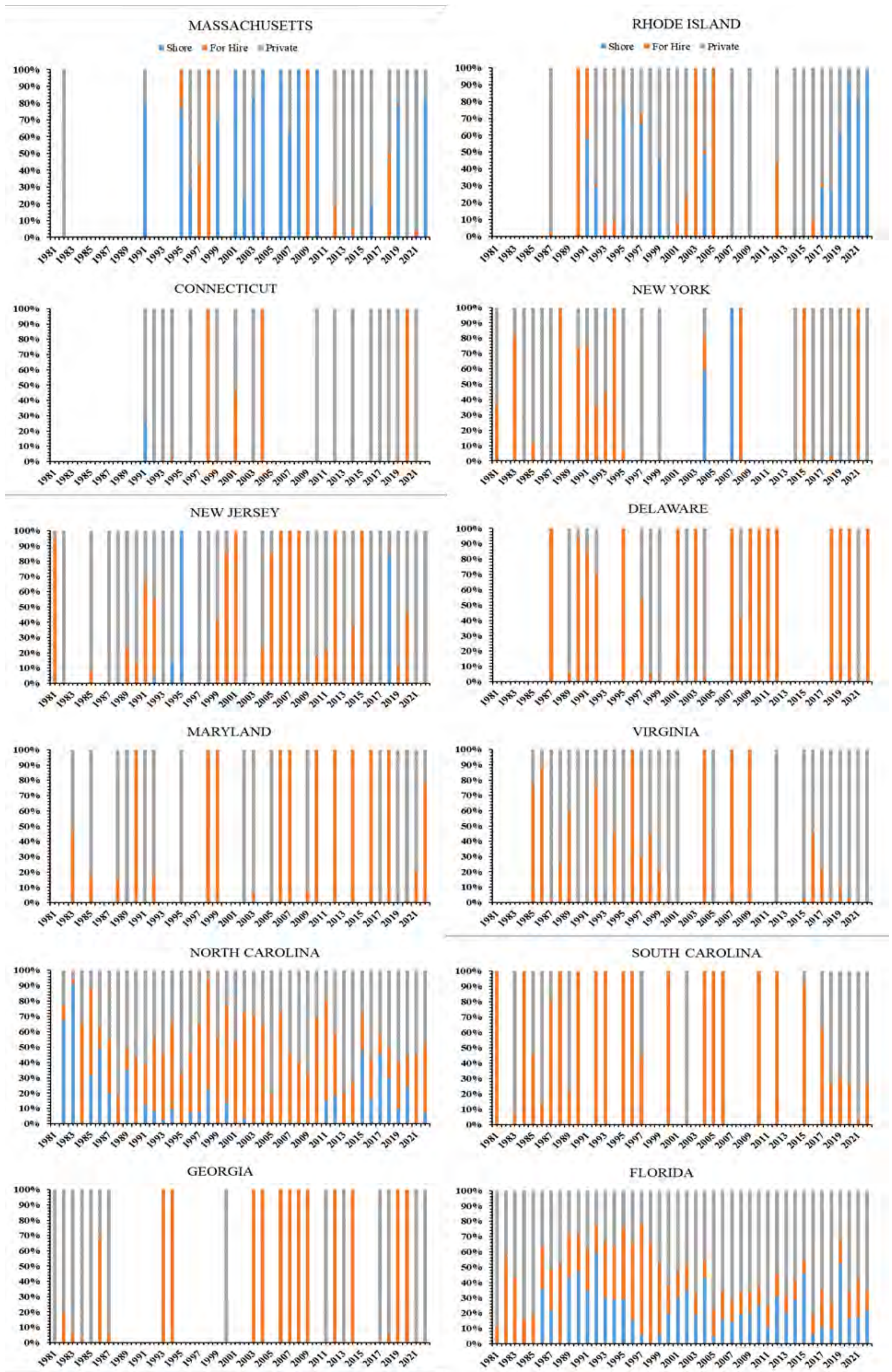

Figure A2.4. Percentage of recreational landing 1981-2021 by fishing mode for each state.

Table A2.8. Percentage of recreational landing 1981-2021 in state and federal waters for each region.

Year	Mid-Atlantic		North Atlantic		South Atlantic	
	Federal	State	Federal	State	Federal	State
1981	95%	5%	0%	0%	44%	56%
1982	100%	0%	100%	0%	33%	67%
1983	93%	7%	0%	0%	28%	72%
1984	0%	100%	0%	0%	62%	38%
1985	79%	21%	0%	0%	55%	45%
1986	100%	0%	0%	0%	28%	72%
1987	100%	0%	100%	0%	68%	32%
1988	97%	3%	0%	0%	84%	16%
1989	88%	12%	0%	0%	54%	46%
1990	96%	4%	100%	0%	62%	38%
1991	81%	19%	3%	97%	58%	42%
1992	86%	14%	5%	95%	33%	67%
1993	17%	83%	11%	89%	45%	55%
1994	11%	89%	9%	91%	61%	39%
1995	76%	24%	10%	90%	46%	54%
1996	100%	0%	0%	100%	67%	33%
1997	77%	23%	25%	75%	48%	52%
1998	98%	2%	73%	27%	52%	48%
1999	96%	4%	6%	94%	67%	33%
2000	90%	10%	60%	40%	54%	46%
2001	95%	5%	11%	89%	46%	54%
2002	100%	0%	10%	90%	51%	49%
2003	100%	0%	17%	83%	45%	55%
2004	44%	56%	0%	100%	58%	42%
2005	98%	2%	100%	0%	69%	31%
2006	100%	0%	0%	100%	65%	35%
2007	4%	96%	39%	61%	70%	30%
2008	94%	6%	0%	100%	56%	44%
2009	56%	44%	0%	100%	55%	45%
2010	98%	2%	0%	100%	33%	67%
2011	22%	78%	0%	0%	29%	71%
2012	100%	0%	76%	24%	52%	48%
2013	100%	0%	0%	100%	50%	50%
2014	94%	6%	0%	100%	33%	67%
2015	100%	0%	4%	96%	23%	77%
2016	14%	86%	3%	97%	47%	53%
2017	89%	11%	1%	99%	57%	43%
2018	13%	87%	4%	96%	31%	69%
2019	58%	42%	10%	90%	35%	65%
2020	88%	12%	5%	95%	44%	56%
2021	94%	6%	15%	85%	37%	63%
2022	97%	3%	1%	99%	58%	42%

Table A2.9. Percentage of recreational landing 1981-2021 in state and federal waters for each state.

Year	CT		DE		FL		GA		MD		MA	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	0%	0%	0%	0%	41%	59%	100%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	29%	71%	100%	0%	0%	0%	100%	0%
1983	0%	0%	0%	0%	46%	54%	100%	0%	100%	0%	0%	0%
1984	0%	0%	0%	0%	60%	40%	100%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	41%	59%	100%	0%	100%	0%	0%	0%
1986	0%	0%	0%	0%	24%	76%	78%	22%	0%	0%	0%	0%
1987	0%	0%	100%	0%	69%	31%	100%	0%	0%	0%	0%	0%
1988	0%	0%	0%	0%	84%	16%	0%	0%	100%	0%	0%	0%
1989	0%	0%	5%	95%	62%	38%	0%	0%	100%	0%	0%	0%
1990	0%	0%	100%	0%	61%	39%	0%	0%	100%	0%	0%	0%
1991	0%	100%	100%	0%	58%	42%	0%	0%	99%	1%	0%	100%
1992	0%	100%	70%	30%	29%	71%	0%	0%	100%	0%	0%	0%
1993	0%	100%	0%	0%	43%	57%	100%	0%	0%	0%	0%	0%
1994	0%	100%	0%	0%	63%	37%	100%	0%	0%	0%	0%	0%
1995	0%	0%	100%	0%	46%	54%	0%	0%	100%	0%	23%	77%
1996	0%	100%	0%	0%	67%	33%	0%	0%	0%	0%	0%	100%
1997	0%	0%	64%	36%	47%	53%	0%	0%	0%	0%	57%	43%
1998	0%	100%	100%	0%	52%	48%	0%	0%	100%	0%	100%	0%
1999	0%	100%	100%	0%	66%	34%	0%	0%	100%	0%	0%	100%
2000	0%	0%	0%	0%	54%	46%	100%	0%	0%	0%	0%	0%
2001	0%	100%	100%	0%	45%	55%	0%	0%	0%	0%	0%	100%
2002	0%	0%	100%	0%	50%	50%	0%	0%	100%	0%	0%	100%
2003	0%	100%	100%	0%	44%	56%	100%	0%	100%	0%	17%	83%
2004	0%	100%	100%	0%	56%	44%	100%	0%	0%	0%	0%	100%
2005	0%	0%	0%	0%	67%	33%	0%	0%	100%	0%	0%	0%
2006	0%	0%	0%	0%	64%	36%	0%	100%	100%	0%	0%	100%
2007	0%	0%	100%	0%	70%	30%	100%	0%	100%	0%	0%	100%
2008	0%	0%	100%	0%	54%	46%	100%	0%	0%	0%	0%	100%
2009	0%	0%	100%	0%	53%	47%	100%	0%	100%	0%	0%	100%
2010	0%	100%	100%	0%	32%	68%	0%	0%	100%	0%	0%	100%
2011	0%	0%	100%	0%	24%	76%	100%	0%	0%	0%	0%	0%
2012	0%	100%	100%	0%	50%	50%	100%	0%	100%	0%	0%	100%
2013	0%	0%	0%	0%	48%	52%	100%	0%	0%	0%	0%	100%
2014	0%	100%	0%	0%	32%	68%	100%	0%	100%	0%	0%	100%
2015	0%	0%	0%	0%	23%	77%	0%	0%	0%	0%	0%	100%
2016	0%	100%	0%	0%	46%	54%	0%	0%	100%	0%	0%	100%
2017	0%	100%	0%	0%	59%	41%	100%	0%	100%	0%	0%	0%
2018	0%	100%	100%	0%	28%	72%	100%	0%	100%	0%	0%	100%
2019	0%	100%	100%	0%	30%	70%	100%	0%	100%	0%	10%	90%
2020	0%	100%	100%	0%	46%	54%	100%	0%	100%	0%	70%	30%
2021	34%	66%	100%	0%	35%	65%	100%	0%	100%	0%	0%	100%
2022	0%	0%	100%	0%	58%	42%	100%	0%	100%	0%	4%	96%

Table A2.9. Percentage of recreational landing 1981-2021 in state and federal waters for each state (Cont.).

Year	NJ		NY		NC		RI		SC		VA	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	99%	1%	37%	63%	0%	0%	0%	0%	100%	0%	0%	0%
1982	100%	0%	0%	0%	29%	71%	0%	0%	0%	0%	0%	0%
1983	0%	0%	82%	18%	6%	94%	0%	0%	100%	0%	0%	0%
1984	0%	0%	0%	100%	100%	0%	0%	0%	100%	0%	0%	0%
1985	100%	0%	12%	88%	66%	34%	0%	0%	100%	0%	100%	0%
1986	0%	0%	100%	0%	31%	69%	0%	0%	100%	0%	100%	0%
1987	100%	0%	100%	0%	60%	40%	100%	0%	76%	24%	100%	0%
1988	100%	0%	83%	17%	64%	36%	0%	0%	100%	0%	77%	23%
1989	100%	0%	0%	0%	20%	80%	0%	0%	100%	0%	84%	16%
1990	100%	0%	24%	76%	72%	28%	100%	0%	100%	0%	100%	0%
1991	79%	21%	73%	27%	68%	32%	42%	58%	0%	0%	100%	0%
1992	61%	39%	15%	85%	68%	32%	6%	94%	100%	0%	85%	15%
1993	0%	100%	65%	35%	63%	37%	74%	26%	58%	42%	0%	100%
1994	0%	100%	100%	0%	47%	53%	100%	0%	0%	0%	74%	26%
1995	0%	100%	78%	22%	39%	61%	0%	100%	100%	0%	100%	0%
1996	0%	0%	0%	0%	72%	28%	0%	100%	100%	0%	100%	0%
1997	95%	5%	67%	33%	56%	44%	17%	83%	100%	0%	53%	47%
1998	94%	6%	0%	0%	49%	51%	72%	28%	0%	0%	100%	0%
1999	100%	0%	65%	35%	87%	13%	9%	91%	0%	0%	100%	0%
2000	94%	6%	0%	0%	40%	60%	60%	40%	100%	0%	73%	27%
2001	91%	9%	0%	0%	69%	31%	61%	39%	0%	0%	100%	0%
2002	100%	0%	0%	0%	81%	19%	23%	77%	100%	0%	0%	0%
2003	0%	0%	0%	0%	69%	31%	100%	0%	0%	0%	0%	0%
2004	76%	24%	23%	77%	86%	14%	2%	98%	100%	0%	100%	0%
2005	85%	15%	0%	0%	100%	0%	100%	0%	100%	0%	100%	0%
2006	100%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%
2007	100%	0%	0%	100%	97%	3%	85%	15%	0%	0%	100%	0%
2008	100%	0%	0%	100%	98%	2%	0%	0%	0%	0%	0%	0%
2009	40%	60%	0%	0%	80%	20%	0%	100%	0%	0%	100%	0%
2010	98%	2%	0%	0%	58%	42%	0%	0%	100%	0%	0%	0%
2011	22%	78%	0%	0%	81%	19%	0%	0%	0%	0%	0%	0%
2012	100%	0%	0%	0%	75%	25%	98%	2%	100%	0%	100%	0%
2013	100%	0%	0%	0%	88%	12%	0%	0%	0%	0%	0%	0%
2014	100%	0%	0%	100%	61%	39%	0%	100%	0%	0%	0%	0%
2015	100%	0%	100%	0%	32%	68%	11%	89%	100%	0%	100%	0%
2016	0%	100%	99%	1%	59%	41%	58%	42%	0%	0%	70%	30%
2017	93%	7%	72%	28%	41%	59%	3%	97%	62%	38%	74%	26%
2018	13%	87%	3%	97%	60%	40%	7%	93%	97%	3%	25%	75%
2019	36%	64%	59%	41%	41%	59%	10%	90%	95%	5%	100%	0%
2020	100%	0%	100%	0%	36%	64%	0%	100%	100%	0%	17%	83%
2021	98%	2%	0%	100%	57%	43%	17%	83%	100%	0%	0%	100%
2022	100%	0%	100%	0%	56%	44%	0%	100%	27%	73%	0%	100%

Figure A2.5. Percentage of recreational landing 1981-2021 in state and federal waters for each region.

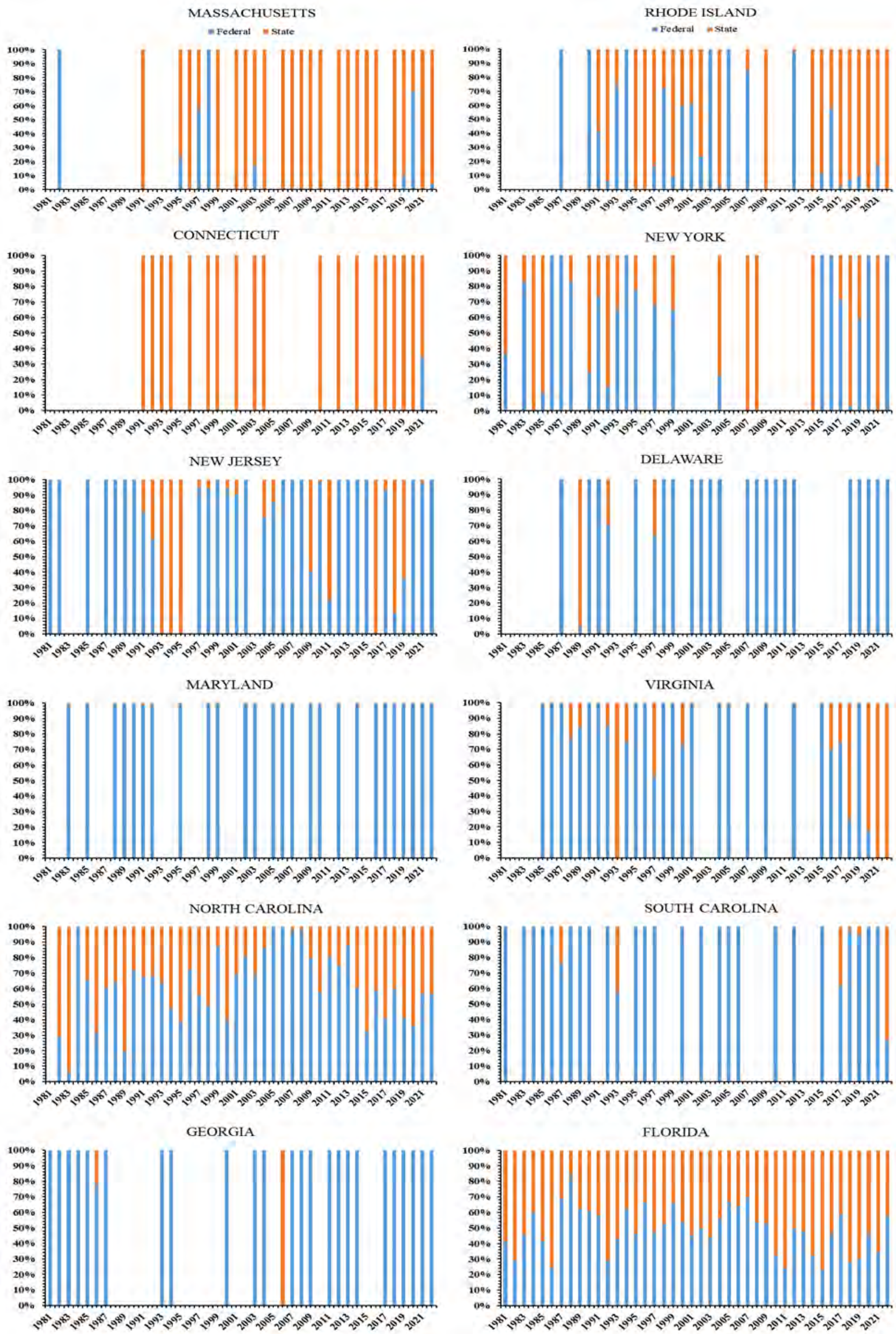

Figure A2.6. Percentage of recreational landing 1981-2021 in state and federal waters for each state.

Table A2.10. Recreational discards (individuals) 1981-2022 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total Discards
1981	5634	0	470343	475977
1982	0	0	179237	179237
1983	0	21426	201042	222468
1984	0	0	376302	376302
1985	219	0	78128	78347
1986	5547	0	534910	540457
1987	2980	0	603786	606766
1988	77823	0	731042	808865
1989	12858	0	890632	903490
1990	128607	0	681414	810021
1991	35360	13902	733931	783193
1992	28652	123	695081	723856
1993	11155	4762	1100091	1116008
1994	80854	0	751402	832256
1995	338723	26018	494035	858776
1996	75525	8915	380599	465039
1997	83683	87721	700747	872151
1998	66702	67674	828759	963135
1999	124293	115730	1477454	1717477
2000	325082	418189	813483	1556754
2001	72212	73905	882374	1028491
2002	268463	146637	1611236	2026336
2003	22203	66549	1236227	1324979
2004	129395	229080	1949311	2307786
2005	131807	103384	509493	744684
2006	167364	50155	1242543	1460062
2007	58668	110039	2068067	2236774
2008	163333	41844	1115807	1320984
2009	108817	94685	1515860	1719362
2010	313655	42203	1011187	1367045
2011	1522	84637	1468291	1554450
2012	231080	202197	1407275	1840552
2013	194144	26143	1333910	1554197
2014	214350	1034190	1358150	2606690
2015	55838	158564	1336191	1550593
2016	92145	810829	1138813	2041787
2017	285938	284995	1229748	1800681
2018	570765	340511	1015580	1926856
2019	297065	152844	723334	1173243
2020	310111	181568	702774	1194453
2021	196941	245869	928238	1371048
2022	238916	678375	896755	1814046
Overall	**11%**	**12%**	**77%**	-
10-Year	**14%**	**22%**	**64%**	-

Table A2.11. Recreational discards (individuals) 1981-2022 by state.

Year	CT	DE	GA	MD	MA	NJ	NY	NC	RI	SC	VA	FL
1981	0	0	0	0	0	5634	0	0	0	0	0	470343
1982	0	0	0	0	0	0	0	0	0	0	0	179237
1983	0	0	0	0	0	0	0	0	21426	4177	0	196865
1984	0	0	0	0	0	0	0	0	0	0	0	376302
1985	0	0	0	0	0	0	219	2533	0	0	0	75595
1986	0	0	0	0	0	0	5547	3857	0	9364	0	521689
1987	0	0	1387	0	0	0	0	8162	0	8702	2980	585535
1988	0	0	0	1423	0	75093	0	15332	0	2123	1307	713587
1989	0	25	0	4830	0	1895	0	32514	0	466	6108	857652
1990	0	1951	0	98522	0	23250	4286	24132	0	0	598	657282
1991	13435	247	0	12790	188	13906	8417	43851	279	257	0	689823
1992	0	0	0	8651	0	8734	724	39215	123	186	10543	655680
1993	0	0	0	0	824	0	4839	12841	3938	0	6316	1087250
1994	0	0	0	0	0	72639	0	8751	0	0	8215	742651
1995	15960	0	0	0	7289	307944	27777	10469	2769	0	3002	483566
1996	6723	0	0	0	0	57883	9180	23050	2192	2144	8462	355405
1997	936	0	0	0	62980	7491	67673	48107	23805	0	8519	652640
1998	23896	0	0	0	4810	33332	9513	75618	38968	4310	23857	748831
1999	5611	3712	0	0	67135	42293	78288	77884	42984	0	0	1399570
2000	334830	0	5558	18307	68786	17594	287854	41590	14573	10	1327	762105
2001	50072	6260	0	6591	15316	4070	51909	78517	8517	0	3382	803838
2002	67821	2768	0	1422	45085	2752	261521	89706	33731	3562	0	1517628
2003	12674	5558	0	631	19173	1720	13763	24662	34702	119	531	1210783
2004	5428	912	0	0	148347	104881	22965	62965	75305	58	637	1886190
2005	0	0	0	5719	96068	116892	80	68636	7316	0	9116	438314
2006	0	0	142	0	50155	0	2770	39901	0	0	164594	1197722
2007	1650	897	0	472	95010	3898	53377	115324	13379	0	24	1952676
2008	0	2465	0	0	41844	0	160868	33205	0	0	0	1079626
2009	67679	7497	9050	17269	27006	79626	4155	83453	0	130	270	1422384
2010	15130	93	0	462	18227	15787	297313	66459	8846	25	0	944189
2011	20083	0	0	0	17591	1522	0	30347	46963	0	0	1437168
2012	104921	7	3061	0	24074	221554	9519	59160	73202	0	0	1345034
2013	0	164	6084	0	26143	32630	147757	108149	0	0	13593	1219614
2014	16845	1933	0	821	981784	77169	134427	273165	35561	0	0	1084777
2015	2709	0	0	0	88853	32487	23351	87239	67002	0	0	1248952
2016	44515	0	0	524	733492	30453	61152	145700	32822	25161	16	966648
2017	49874	0	0	0	137285	164268	121670	119648	97836	13557	0	1096543
2018	157862	499	0	140	61491	390112	177470	110716	121158	19157	2544	885707
2019	20331	0	3421	185	89111	64988	230128	80205	43402	3720	1764	635988
2020	12018	0	0	14040	97230	205650	88742	171564	72320	986	1679	530224
2021	140874	1750	0	0	77848	169576	24826	52788	27147	1582	789	873868
2022	46737	6768	0	674	316104	64281	167193	125777	315534	32277	0	738701
Overall	**2%**	**0%**	**0%**	**0%**	**7%**	**5%**	**5%**	**5%**	**2%**	**0%**	**1%**	**72%**
10-Year	**3%**	**0%**	**0%**	**0%**	**15%**	**7%**	**7%**	**7%**	**5%**	**1%**	**0%**	**54%**

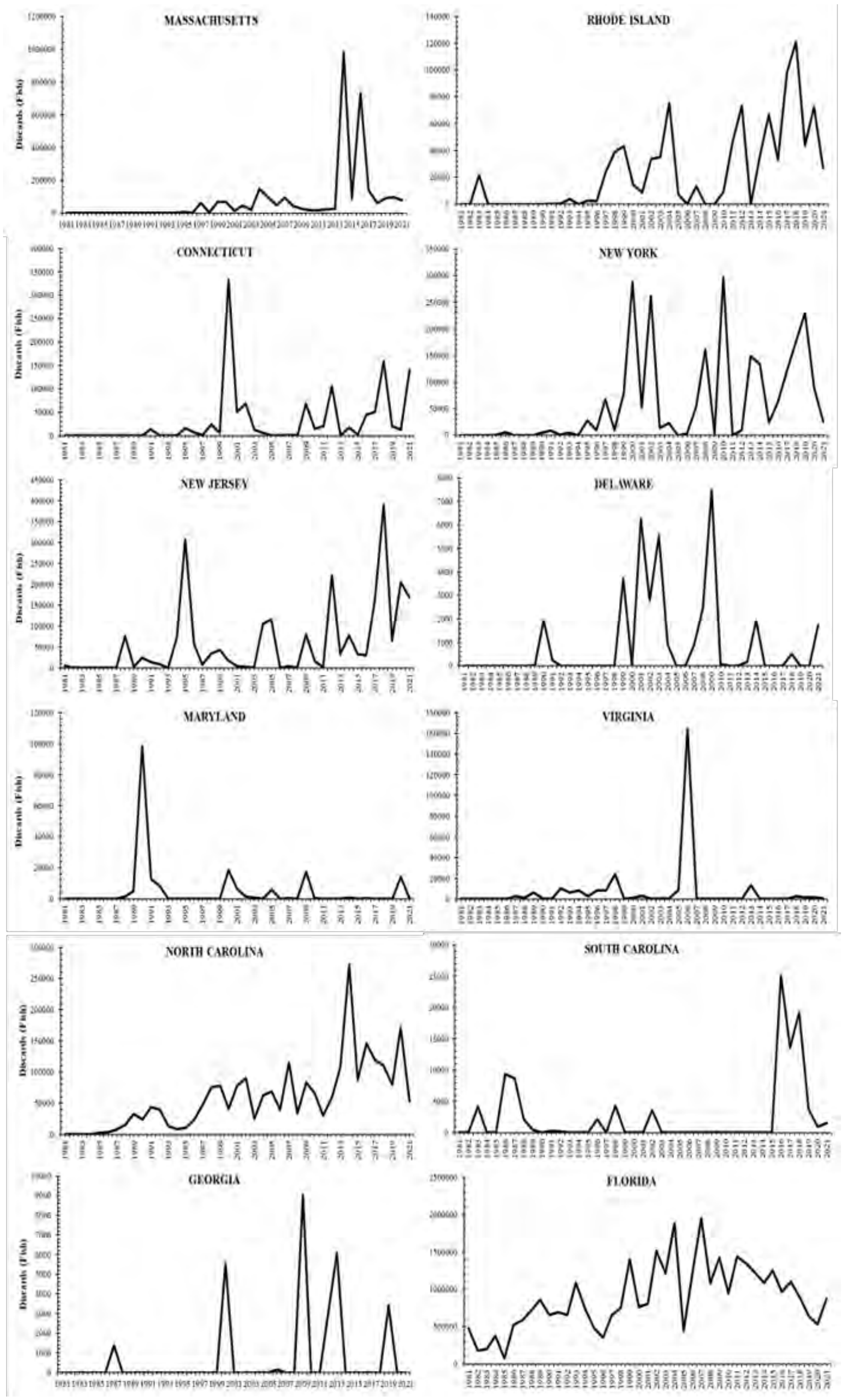

Figure A2.7. Recreational discards (individuals) 1981-2021 by state.

Table A2.12. Percentage of recreational discards 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each region.

Year	CT			DE			FL			GA			MD		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	17%	83%	0%	0%	0%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	9%	91%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	0%	0%	0%	60%	40%	0%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	0%	0%	8%	11%	82%	0%	0%	0%	0%	0%	0%
1987	0%	0%	0%	0%	0%	0%	0%	34%	66%	0%	1%	99%	0%	0%	0%
1988	0%	0%	0%	0%	0%	0%	0%	29%	71%	0%	0%	0%	0%	0%	100%
1989	0%	0%	0%	0%	0%	100%	21%	12%	67%	0%	0%	0%	0%	0%	100%
1990	0%	0%	0%	0%	78%	22%	0%	11%	89%	0%	0%	0%	0%	10%	90%
1991	34%	0%	66%	0%	41%	59%	0%	2%	98%	0%	0%	0%	0%	0%	100%
1992	0%	0%	0%	0%	0%	0%	4%	5%	91%	0%	0%	0%	0%	73%	27%
1993	0%	0%	0%	0%	0%	0%	0%	6%	94%	0%	0%	0%	0%	0%	0%
1994	0%	0%	0%	0%	0%	0%	0%	5%	95%	0%	0%	0%	0%	0%	0%
1995	0%	10%	90%	0%	0%	0%	2%	6%	91%	0%	0%	0%	0%	0%	0%
1996	0%	0%	100%	0%	0%	0%	2%	5%	93%	0%	0%	0%	0%	0%	0%
1997	0%	0%	100%	0%	0%	0%	6%	14%	81%	0%	0%	0%	0%	0%	0%
1998	0%	0%	100%	0%	0%	0%	1%	6%	93%	0%	0%	0%	0%	0%	0%
1999	44%	6%	50%	0%	0%	100%	2%	10%	88%	0%	0%	0%	0%	0%	0%
2000	74%	1%	25%	0%	0%	0%	4%	2%	94%	0%	0%	100%	0%	26%	74%
2001	28%	0%	72%	0%	26%	74%	10%	2%	88%	0%	0%	0%	0%	100%	0%
2002	2%	0%	98%	0%	0%	100%	6%	8%	85%	0%	0%	0%	0%	0%	100%
2003	0%	8%	92%	0%	1%	99%	1%	3%	95%	0%	0%	0%	0%	100%	0%
2004	50%	0%	50%	0%	18%	82%	0%	6%	94%	0%	0%	0%	0%	0%	0%
2005	0%	0%	0%	0%	0%	0%	6%	6%	89%	0%	0%	0%	0%	1%	99%
2006	0%	0%	0%	0%	0%	0%	2%	2%	96%	0%	100%	0%	0%	0%	0%
2007	0%	0%	100%	0%	0%	100%	0%	3%	97%	0%	0%	0%	0%	100%	0%
2008	0%	0%	0%	0%	31%	69%	1%	3%	95%	0%	0%	0%	0%	0%	0%
2009	0%	0%	100%	0%	0%	100%	0%	2%	98%	0%	0%	100%	0%	23%	77%
2010	0%	0%	100%	0%	100%	0%	6%	2%	93%	0%	0%	0%	0%	100%	0%
2011	0%	29%	71%	0%	0%	0%	0%	1%	99%	0%	0%	0%	0%	0%	0%
2012	0%	0%	100%	0%	100%	0%	0%	2%	98%	0%	0%	100%	0%	0%	0%
2013	0%	0%	0%	0%	100%	0%	1%	1%	98%	0%	0%	100%	0%	0%	0%
2014	3%	0%	97%	0%	0%	100%	0%	2%	98%	0%	0%	0%	0%	100%	0%
2015	0%	0%	100%	0%	0%	0%	14%	2%	84%	0%	0%	0%	0%	0%	0%
2016	10%	11%	80%	0%	0%	0%	7%	3%	91%	0%	0%	0%	0%	100%	0%
2017	0%	1%	99%	0%	0%	0%	1%	1%	98%	0%	0%	0%	0%	0%	0%
2018	0%	1%	99%	0%	1%	99%	1%	1%	98%	0%	0%	0%	0%	0%	100%
2019	0%	0%	100%	0%	0%	0%	0%	2%	98%	0%	0%	100%	0%	0%	100%
2020	20%	0%	80%	0%	0%	0%	0%	3%	97%	0%	0%	0%	0%	1%	99%
2021	0%	0%	100%	0%	0%	100%	48%	2%	50%	0%	0%	0%	0%	0%	0%
2022	0%	0%	100%	0%	0%	100%	0%	2%	97%	0%	0%	0%	0%	0%	100%

Table A2.12. Percentage of recreational landing 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state (Cont.).

Year	MA			NJ			NY			NC			RI			SC			VA		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	1%	99%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	0%	0%	0%	55%	45%	0%	7%	93%	0%	0%	0%	0%	6%	94%	0%	0%	0%
1987	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	35%	65%	0%	0%	0%	0%	6%	94%	0%	0%	100%
1988	0%	0%	0%	0%	32%	68%	0%	0%	0%	0%	5%	95%	0%	0%	0%	0%	37%	63%	0%	0%	100%
1989	0%	0%	0%	0%	0%	100%	0%	0%	0%	31%	2%	68%	0%	0%	0%	0%	7%	93%	0%	0%	100%
1990	0%	0%	0%	0%	0%	100%	0%	0%	100%	55%	2%	42%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1991	0%	0%	100%	3%	27%	70%	0%	100%	0%	5%	6%	89%	0%	0%	100%	0%	100%	0%	0%	0%	0%
1992	0%	0%	0%	0%	15%	85%	0%	51%	49%	11%	2%	87%	0%	0%	100%	0%	100%	0%	0%	43%	57%
1993	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	25%	75%	48%	0%	52%	0%	0%	0%	0%	0%	100%
1994	0%	0%	0%	12%	0%	88%	0%	0%	0%	0%	38%	62%	0%	0%	0%	0%	0%	0%	0%	17%	83%
1995	100%	0%	0%	0%	90%	10%	17%	6%	77%	0%	4%	96%	0%	12%	88%	0%	0%	0%	0%	0%	100%
1996	0%	0%	0%	0%	0%	100%	0%	0%	100%	11%	54%	35%	0%	0%	100%	0%	53%	47%	0%	73%	27%
1997	80%	0%	20%	0%	0%	100%	19%	74%	7%	15%	32%	53%	37%	5%	58%	0%	0%	0%	0%	0%	100%
1998	100%	0%	0%	99%	1%	0%	0%	67%	33%	11%	24%	66%	26%	0%	74%	0%	100%	0%	0%	0%	100%
1999	70%	0%	29%	0%	0%	100%	23%	1%	76%	9%	31%	60%	15%	0%	85%	0%	0%	0%	0%	0%	0%
2000	69%	2%	28%	0%	64%	36%	21%	2%	78%	4%	13%	83%	47%	0%	53%	0%	100%	0%	0%	0%	100%
2001	60%	0%	40%	0%	0%	100%	0%	0%	100%	8%	7%	85%	0%	9%	91%	0%	0%	0%	0%	0%	100%
2002	66%	1%	33%	0%	0%	100%	82%	0%	18%	12%	4%	84%	91%	4%	5%	0%	0%	100%	0%	0%	0%
2003	71%	0%	29%	0%	100%	0%	0%	0%	100%	15%	23%	62%	0%	1%	99%	0%	100%	0%	0%	0%	100%
2004	75%	1%	24%	0%	2%	98%	0%	23%	77%	1%	9%	89%	58%	0%	42%	0%	100%	0%	0%	17%	83%
2005	67%	0%	32%	0%	1%	99%	0%	100%	0%	0%	11%	89%	0%	0%	100%	0%	0%	0%	0%	4%	96%
2006	66%	0%	34%	0%	0%	0%	0%	0%	100%	0%	7%	93%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2007	24%	0%	76%	0%	9%	91%	0%	1%	99%	2%	6%	92%	34%	0%	66%	0%	0%	0%	0%	100%	0%
2008	86%	0%	14%	0%	0%	0%	0%	0%	100%	0%	17%	83%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009	86%	2%	11%	75%	2%	23%	0%	0%	100%	0%	2%	98%	0%	0%	0%	0%	100%	0%	0%	100%	0%
2010	0%	0%	100%	0%	0%	100%	0%	0%	100%	1%	8%	90%	0%	0%	100%	0%	100%	0%	0%	0%	0%
2011	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	14%	86%	36%	0%	64%	0%	0%	0%	0%	0%	0%
2012	0%	8%	92%	0%	0%	100%	100%	0%	0%	7%	4%	89%	14%	0%	86%	0%	0%	0%	0%	0%	0%
2013	0%	0%	100%	0%	0%	100%	19%	0%	81%	2%	3%	95%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2014	87%	0%	13%	0%	0%	100%	0%	0%	100%	0%	1%	99%	6%	1%	94%	0%	0%	0%	0%	0%	0%
2015	19%	1%	80%	0%	0%	100%	0%	51%	49%	0%	1%	99%	30%	1%	69%	0%	0%	0%	0%	0%	0%
2016	89%	0%	11%	0%	0%	100%	41%	2%	57%	15%	7%	78%	0%	1%	99%	0%	0%	100%	0%	100%	0%
2017	25%	3%	72%	0%	2%	98%	0%	1%	99%	14%	5%	80%	37%	0%	63%	0%	1%	99%	0%	0%	0%
2018	0%	8%	92%	53%	1%	46%	0%	1%	99%	18%	3%	79%	16%	0%	84%	0%	5%	95%	0%	0%	100%
2019	0%	4%	96%	0%	36%	64%	15%	0%	85%	9%	4%	87%	65%	0%	35%	0%	57%	43%	100%	0%	0%
2020	38%	1%	61%	0%	0%	100%	59%	0%	41%	19%	3%	78%	60%	0%	39%	0%	0%	100%	0%	0%	100%
2021	28%	2%	70%	19%	0%	81%	0%	1%	99%	0%	6%	94%	64%	1%	35%	0%	0%	100%	0%	0%	100%
2022	27%	1%	72%	2%	27%	71%	2%	7%	91%	0%	4%	96%	93%	0%	6%	0%	0%	100%	0%	0%	0%

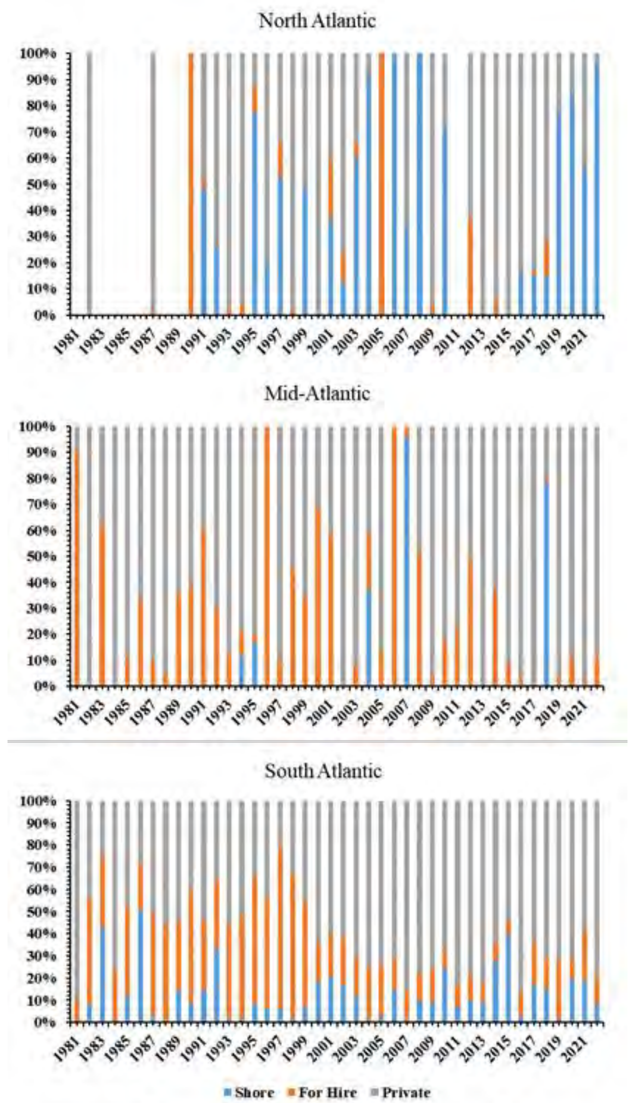

Figure A2.8. Percentage of recreational landing 1981-2021 by fishing mode for each region.

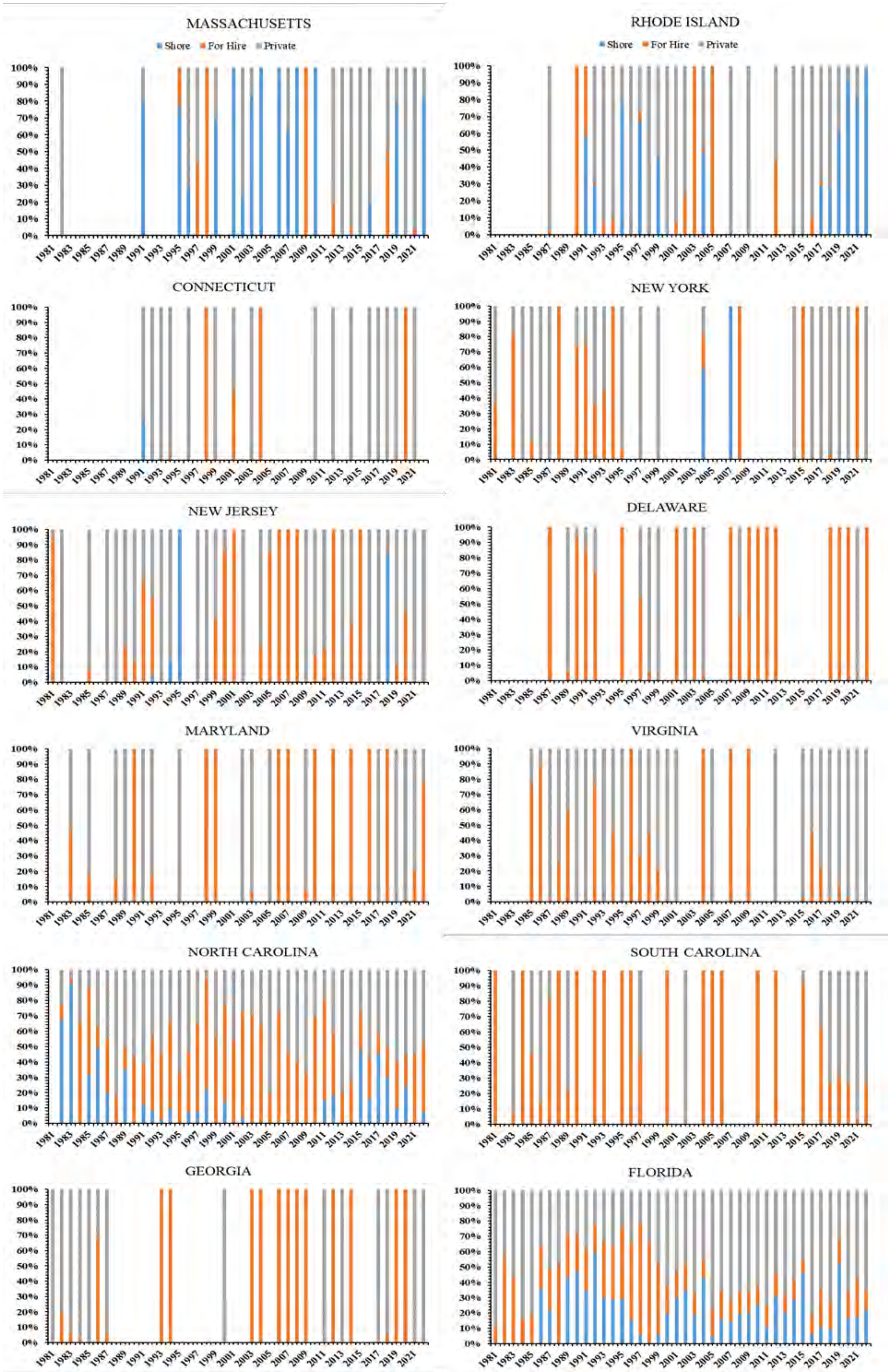

Figure A2.9. Percentage of recreational landing 1981-2021 by fishing mode for each state.

Table A2.13. Percentage of recreational discards 1981-2021 in state and federal waters for each region.

Year	Mid-Atlantic		North Atlantic		South Atlantic	
	Federal	State	Federal	State	Federal	State
1981	100%	0%	0%	0%	57%	43%
1982	0%	0%	0%	0%	94%	6%
1983	0%	0%	100%	0%	81%	19%
1984	0%	0%	0%	0%	68%	32%
1985	100%	0%	0%	0%	16%	84%
1986	100%	0%	0%	0%	67%	33%
1987	100%	0%	0%	0%	81%	19%
1988	99%	1%	0%	0%	61%	39%
1989	79%	21%	0%	0%	64%	36%
1990	99%	1%	0%	0%	44%	56%
1991	86%	14%	0%	100%	56%	44%
1992	80%	20%	100%	0%	43%	57%
1993	38%	62%	17%	83%	39%	61%
1994	17%	83%	0%	0%	64%	36%
1995	90%	10%	0%	100%	50%	50%
1996	88%	12%	0%	100%	60%	40%
1997	73%	27%	5%	95%	45%	55%
1998	49%	51%	29%	71%	59%	41%
1999	26%	74%	3%	97%	65%	35%
2000	9%	91%	1%	99%	67%	33%
2001	38%	62%	4%	96%	56%	44%
2002	3%	97%	1%	99%	47%	53%
2003	38%	62%	7%	93%	62%	38%
2004	79%	21%	11%	89%	68%	32%
2005	90%	10%	7%	93%	55%	45%
2006	98%	2%	0%	100%	70%	30%
2007	87%	13%	0%	100%	69%	31%
2008	65%	35%	0%	100%	66%	34%
2009	35%	65%	1%	99%	57%	43%
2010	5%	95%	0%	100%	53%	47%
2011	0%	100%	13%	87%	57%	43%
2012	0%	100%	0%	100%	67%	33%
2013	84%	16%	0%	100%	64%	36%
2014	37%	63%	0%	100%	67%	33%
2015	0%	100%	3%	97%	52%	48%
2016	4%	96%	2%	98%	48%	52%
2017	46%	54%	6%	94%	59%	41%
2018	28%	72%	0%	100%	37%	63%
2019	19%	81%	11%	89%	60%	40%
2020	79%	21%	1%	99%	60%	40%
2021	61%	39%	44%	56%	24%	76%
2022	78%	22%	0%	100%	59%	41%

Table A2.14. Percentage of recreational discards 1981-2021 in state and federal waters for each state.

Year	CT		DE		FL		GA		MD	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	0%	0%	0%	0%	57%	43%	0%	0%	0%	0%
1982	0%	0%	0%	0%	94%	6%	0%	0%	0%	0%
1983	0%	0%	0%	0%	80%	20%	0%	0%	0%	0%
1984	0%	0%	0%	0%	68%	32%	0%	0%	0%	0%
1985	0%	0%	0%	0%	11%	89%	0%	0%	0%	0%
1986	0%	0%	0%	0%	66%	34%	0%	0%	0%	0%
1987	0%	0%	0%	0%	81%	19%	100%	0%	0%	0%
1988	0%	0%	0%	0%	64%	36%	0%	0%	100%	0%
1989	0%	0%	100%	0%	65%	35%	0%	0%	100%	0%
1990	0%	0%	100%	0%	45%	55%	0%	0%	100%	0%
1991	0%	100%	100%	0%	55%	45%	0%	0%	64%	36%
1992	0%	0%	0%	0%	40%	60%	0%	0%	100%	0%
1993	0%	0%	0%	0%	38%	62%	0%	0%	0%	0%
1994	0%	0%	0%	0%	65%	35%	0%	0%	0%	0%
1995	0%	100%	0%	0%	49%	51%	0%	0%	0%	0%
1996	0%	100%	0%	0%	57%	43%	0%	0%	0%	0%
1997	0%	100%	0%	0%	46%	54%	0%	0%	0%	0%
1998	69%	31%	0%	0%	61%	39%	0%	0%	0%	0%
1999	0%	100%	100%	0%	67%	33%	0%	0%	0%	0%
2000	0%	100%	0%	0%	67%	33%	100%	0%	100%	0%
2001	0%	100%	100%	0%	55%	45%	0%	0%	100%	0%
2002	0%	100%	100%	0%	43%	57%	0%	0%	100%	0%
2003	0%	100%	100%	0%	62%	38%	0%	0%	100%	0%
2004	0%	100%	100%	0%	69%	31%	0%	0%	0%	0%
2005	0%	0%	0%	0%	55%	45%	0%	0%	100%	0%
2006	0%	0%	0%	0%	70%	30%	100%	0%	0%	0%
2007	0%	100%	100%	0%	70%	30%	0%	0%	100%	0%
2008	0%	0%	100%	0%	65%	35%	0%	0%	0%	0%
2009	0%	100%	100%	0%	57%	43%	100%	0%	100%	0%
2010	0%	100%	100%	0%	55%	45%	0%	0%	100%	0%
2011	0%	100%	0%	0%	57%	43%	0%	0%	0%	0%
2012	0%	100%	100%	0%	68%	32%	0%	100%	0%	0%
2013	0%	0%	100%	0%	66%	34%	100%	0%	0%	0%
2014	0%	100%	100%	0%	70%	30%	0%	0%	100%	0%
2015	0%	100%	0%	0%	52%	48%	0%	0%	0%	0%
2016	0%	100%	0%	0%	51%	49%	0%	0%	100%	0%
2017	26%	74%	0%	0%	62%	38%	0%	0%	0%	0%
2018	0%	100%	100%	0%	39%	61%	0%	0%	100%	0%
2019	0%	100%	0%	0%	63%	37%	100%	0%	100%	0%
2020	0%	100%	0%	0%	69%	31%	0%	0%	87%	13%
2021	76%	24%	100%	0%	23%	77%	0%	0%	0%	0%
2022	0%	100%	100%	0%	64%	36%	0%	0%	100%	0%

Table A2.14. Percentage of recreational discards 1981-2021 in state and federal waters for each state (Cont.).

Year	MA		NJ		NY		NC		RI		SC		VA	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	100%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	100%	0%	58%	42%	0%	0%	100%	0%	0%	0%
1987	0%	0%	0%	0%	0%	0%	66%	34%	0%	0%	100%	0%	100%	0%
1988	0%	0%	100%	0%	0%	0%	14%	86%	0%	0%	100%	0%	51%	49%
1989	0%	0%	100%	0%	0%	0%	49%	51%	0%	0%	100%	0%	56%	44%
1990	0%	0%	96%	4%	78%	22%	29%	71%	0%	0%	0%	0%	100%	0%
1991	0%	100%	97%	3%	100%	0%	64%	36%	0%	100%	100%	0%	0%	0%
1992	0%	0%	90%	10%	49%	51%	67%	33%	100%	0%	100%	0%	57%	43%
1993	0%	100%	0%	0%	45%	55%	77%	23%	20%	80%	0%	0%	33%	67%
1994	0%	0%	8%	92%	0%	0%	55%	45%	0%	0%	0%	0%	100%	0%
1995	0%	100%	92%	8%	65%	35%	73%	27%	0%	100%	0%	0%	100%	0%
1996	0%	0%	100%	0%	0%	100%	77%	23%	0%	100%	100%	0%	100%	0%
1997	0%	100%	62%	38%	75%	25%	41%	59%	20%	80%	0%	0%	67%	33%
1998	0%	100%	0%	100%	95%	5%	42%	58%	7%	93%	100%	0%	100%	0%
1999	4%	96%	30%	70%	20%	80%	40%	60%	3%	97%	0%	0%	0%	0%
2000	2%	98%	64%	36%	0%	100%	67%	33%	21%	79%	100%	0%	34%	66%
2001	16%	84%	100%	0%	14%	86%	62%	38%	9%	91%	0%	0%	100%	0%
2002	0%	100%	100%	0%	0%	100%	81%	19%	4%	96%	100%	0%	0%	0%
2003	16%	84%	100%	0%	0%	100%	69%	31%	5%	95%	100%	0%	100%	0%
2004	0%	100%	97%	3%	0%	100%	45%	55%	33%	67%	100%	0%	17%	83%
2005	0%	100%	88%	12%	0%	100%	53%	47%	94%	6%	0%	0%	100%	0%
2006	0%	100%	0%	0%	0%	100%	81%	19%	0%	0%	0%	0%	100%	0%
2007	0%	100%	99%	1%	85%	15%	64%	36%	0%	100%	0%	0%	100%	0%
2008	0%	100%	0%	0%	65%	35%	87%	13%	0%	0%	0%	0%	0%	0%
2009	3%	97%	16%	84%	0%	100%	54%	46%	0%	0%	100%	0%	100%	0%
2010	0%	100%	100%	0%	0%	100%	30%	70%	0%	100%	100%	0%	0%	0%
2011	61%	39%	0%	100%	0%	0%	41%	59%	0%	100%	0%	0%	0%	0%
2012	0%	100%	0%	100%	0%	100%	59%	41%	0%	100%	0%	0%	0%	0%
2013	0%	100%	100%	0%	80%	20%	42%	58%	0%	0%	0%	0%	100%	0%
2014	0%	100%	100%	0%	0%	100%	59%	41%	1%	99%	0%	0%	0%	0%
2015	0%	100%	0%	100%	0%	100%	52%	48%	7%	93%	0%	0%	0%	0%
2016	1%	99%	9%	91%	0%	100%	27%	73%	16%	84%	90%	10%	100%	0%
2017	3%	97%	40%	60%	53%	47%	35%	65%	1%	99%	100%	0%	0%	0%
2018	2%	98%	33%	67%	15%	85%	16%	84%	0%	100%	100%	0%	100%	0%
2019	18%	82%	49%	51%	10%	90%	43%	57%	3%	97%	71%	29%	0%	100%
2020	2%	98%	100%	0%	29%	71%	42%	58%	0%	100%	16%	84%	100%	0%
2021	1%	99%	65%	35%	38%	62%	33%	67%	1%	99%	100%	0%	58%	42%
2022	0%	100%	98%	2%	69%	31%	31%	69%	1%	99%	97%	3%	0%	0%

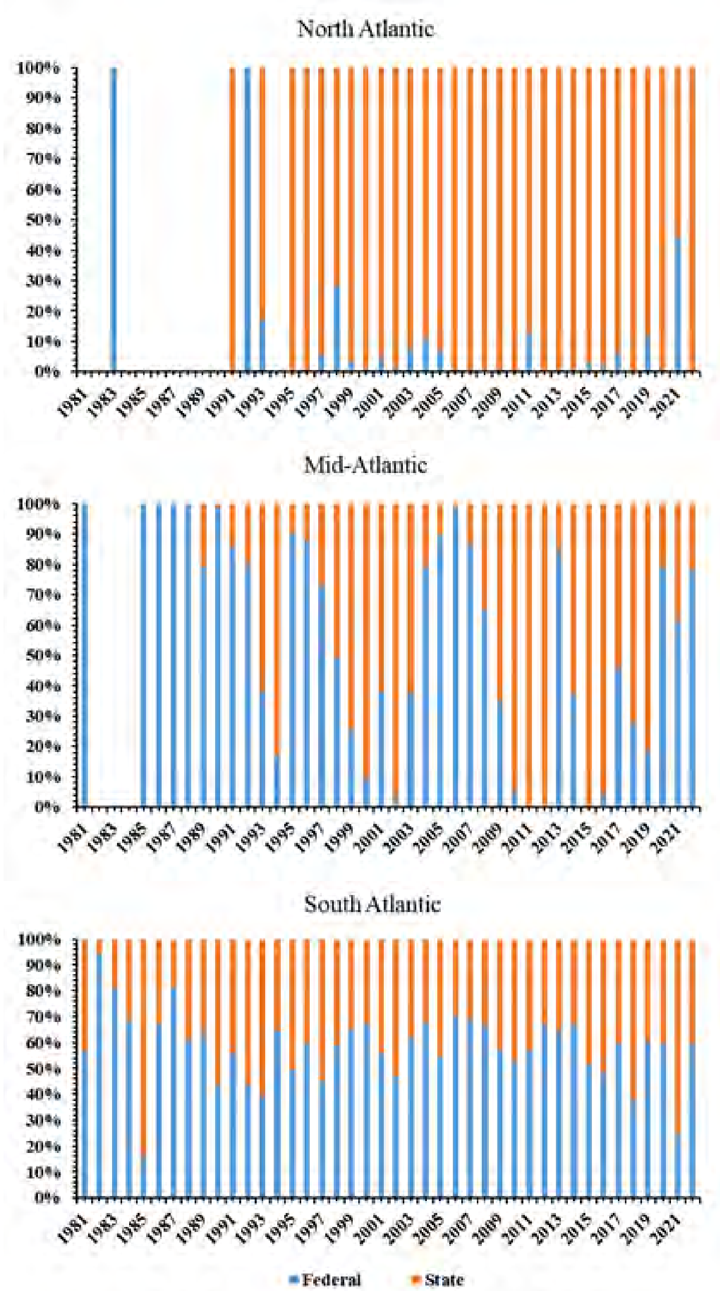

Figure A2.10. Percentage of recreational Discards 1981-2021 in state and federal waters for each region.

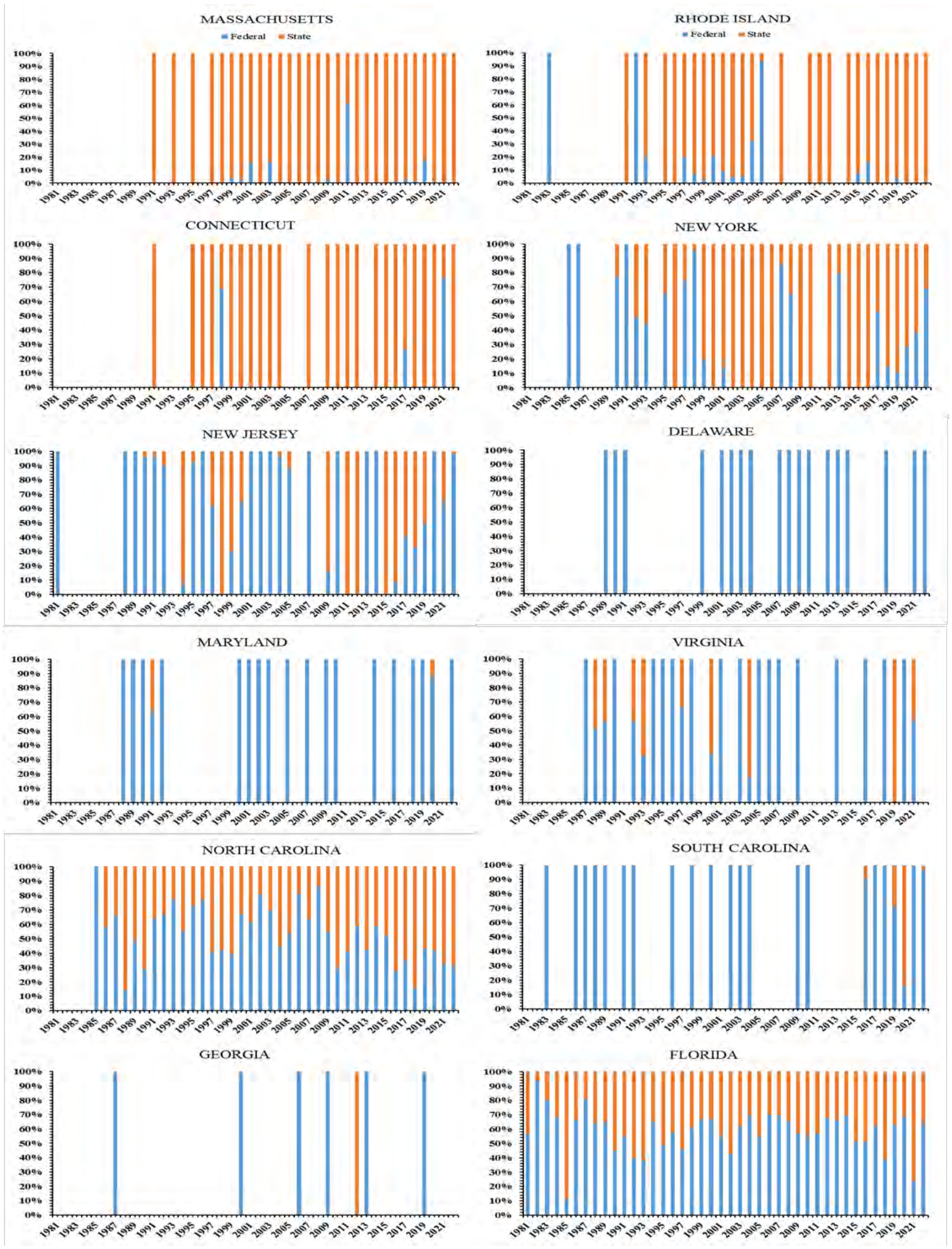

Figure A2.11 Percentage of recreational Discards 1981-2021 in state and federal waters for each state.

APPENDIX 3. LENGTH AND WEIGHT

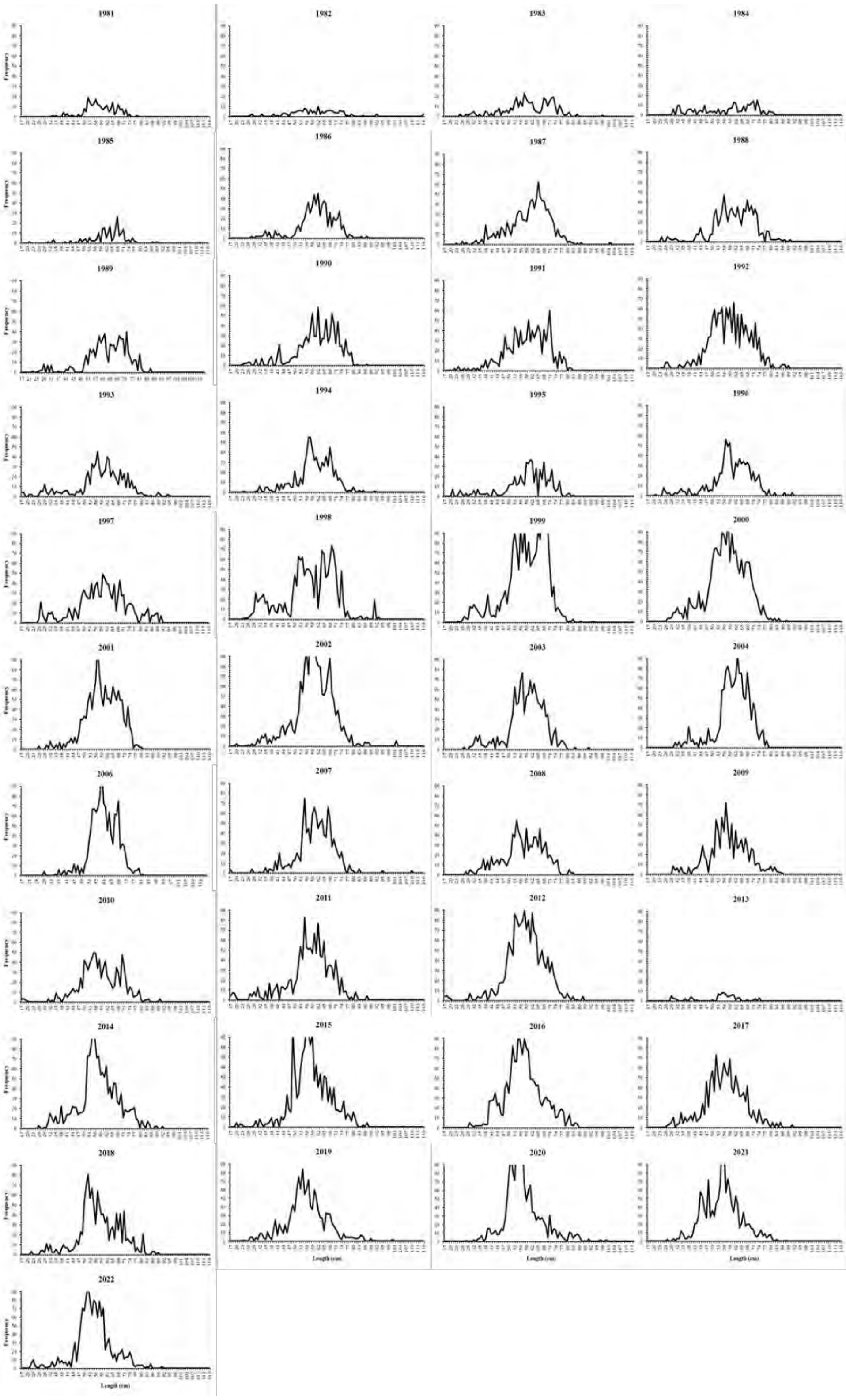

Table A3.1 The length frequencies from all regions by year.

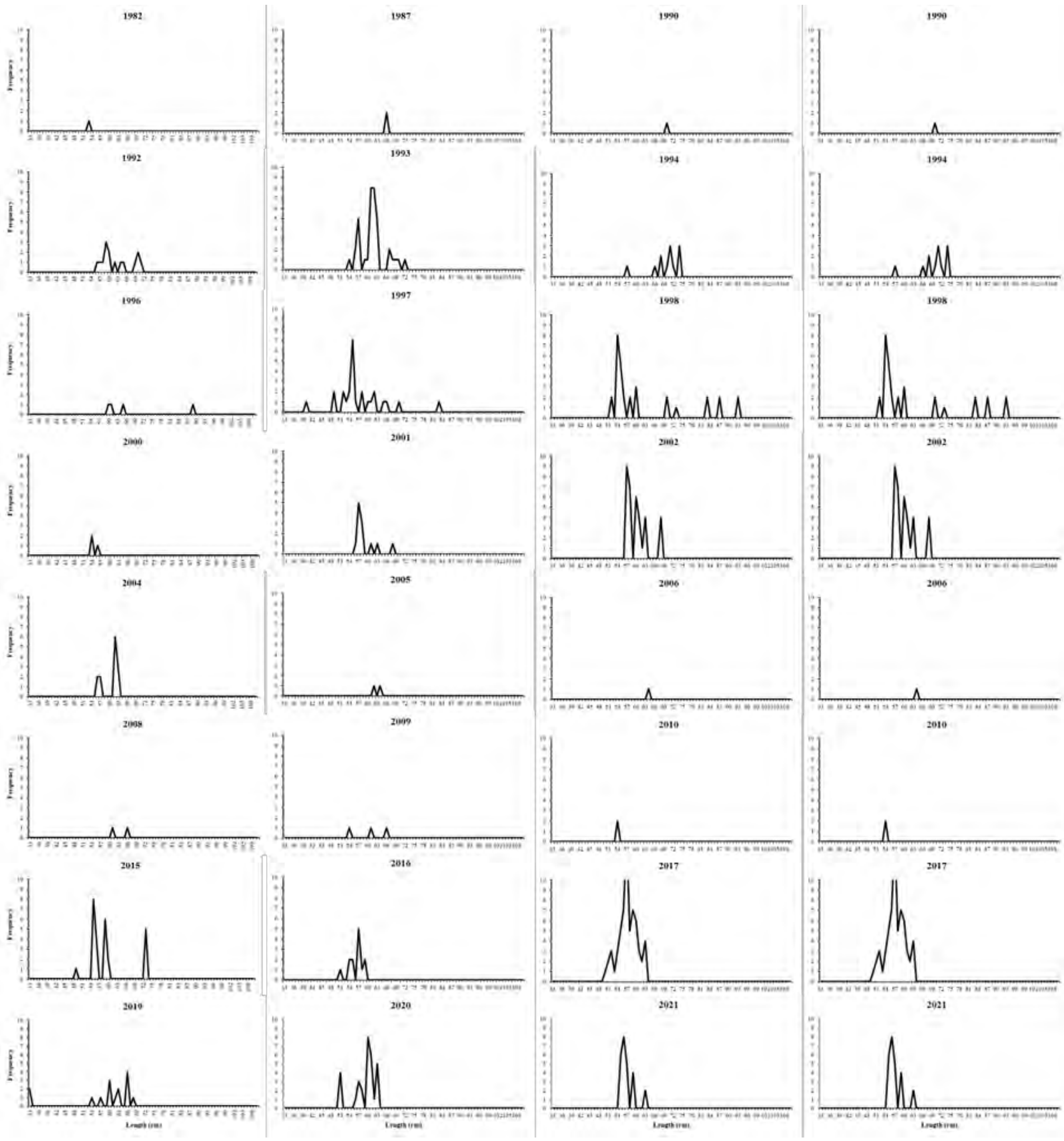

Figure A3.2. The length frequencies from the North Atlantic region by year.

Table A3.1. The summary of length and weight data from the North Atlantic region by year.

Year	Count	North Atlantic							
		Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	-	-	-	-	-	-	-	-	-
1982	1	53	53	53.0	-	1.2	1.2	1.25	-
1983	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-
1987	2	66	66	66.0	0.00	2.2	2.3	2.25	0.043
1988	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-
1990	1	70	70	70.0	-	3.8	3.8	3.84	-
1991	40	50	73	65.2	5.57	1.3	2.9	2.01	0.538
1992	15	56	71	62.6	5.19	1.2	2.7	1.69	0.497
1993	37	54	72	61.7	4.02	1.2	3.1	1.83	0.405
1994	12	57	74	69.7	4.74	1.6	3.2	2.34	0.388
1995	8	60	66	62.8	2.31	1.3	2.2	1.79	0.322
1996	4	60	89	68.8	13.67	1.3	4.7	2.54	1.520
1997	26	40	83	57.3	7.99	0.4	2.2	1.38	0.403
1998	31	52	93	63.2	13.33	1.0	3.8	1.84	0.850
1999	32	48	93	58.3	10.60	0.7	3.8	1.58	0.563
2000	3	54	56	54.7	1.15	1.1	1.7	1.53	0.339
2001	12	56	68	58.9	3.48	1.2	1.7	1.42	0.153
2002	35	57	68	60.3	3.46	1.2	1.9	1.56	0.194
2003	5	57	62	60.0	2.74	1.2	1.8	1.34	0.263
2004	13	56	63	60.5	2.85	1.2	1.8	1.70	0.159
2005	2	62	64	63.0	1.41	1.7	2.0	1.84	0.163
2006	1	64	64	64.0	-	2.0	2.0	1.95	-
2007	10	64	110	82.2	18.55	1.3	7.4	3.73	2.304
2008	2	61	66	63.5	3.54	1.3	2.0	1.62	0.483
2009	3	54	66	60.3	6.03	1.3	2.0	1.50	0.394
2010	2	54	54	54.0	0.00	1.3	1.3	1.28	0.000
2011	-	-	-	-	-	-	-	-	-
2012	46	53	53	53.0	0.00	1.4	1.9	1.58	0.215
2013	-	-	-	-	-	-	-	-	-
2014	13	49	73	57.4	7.83	0.8	1.6	1.22	0.284
2015	26	49	73	59.7	7.02	0.8	1.6	1.34	0.202
2016	13	51	59	56.2	2.27	1.0	2.4	1.57	0.536
2017	63	50	63	57.3	3.08	0.9	2.4	1.48	0.323
2018	31	52	68	56.7	3.38	2.5	4.7	3.22	0.662
2019	15	33	68	58.5	11.01	0.3	2.9	1.80	0.855
2020	30	51	63	59.0	3.71	0.8	2.0	1.42	0.283
2021	25	55	63	57.0	2.24	1.2	1.8	1.40	0.206
2022	58	52	63	57.5	3.37	1.0	1.8	1.28	0.231

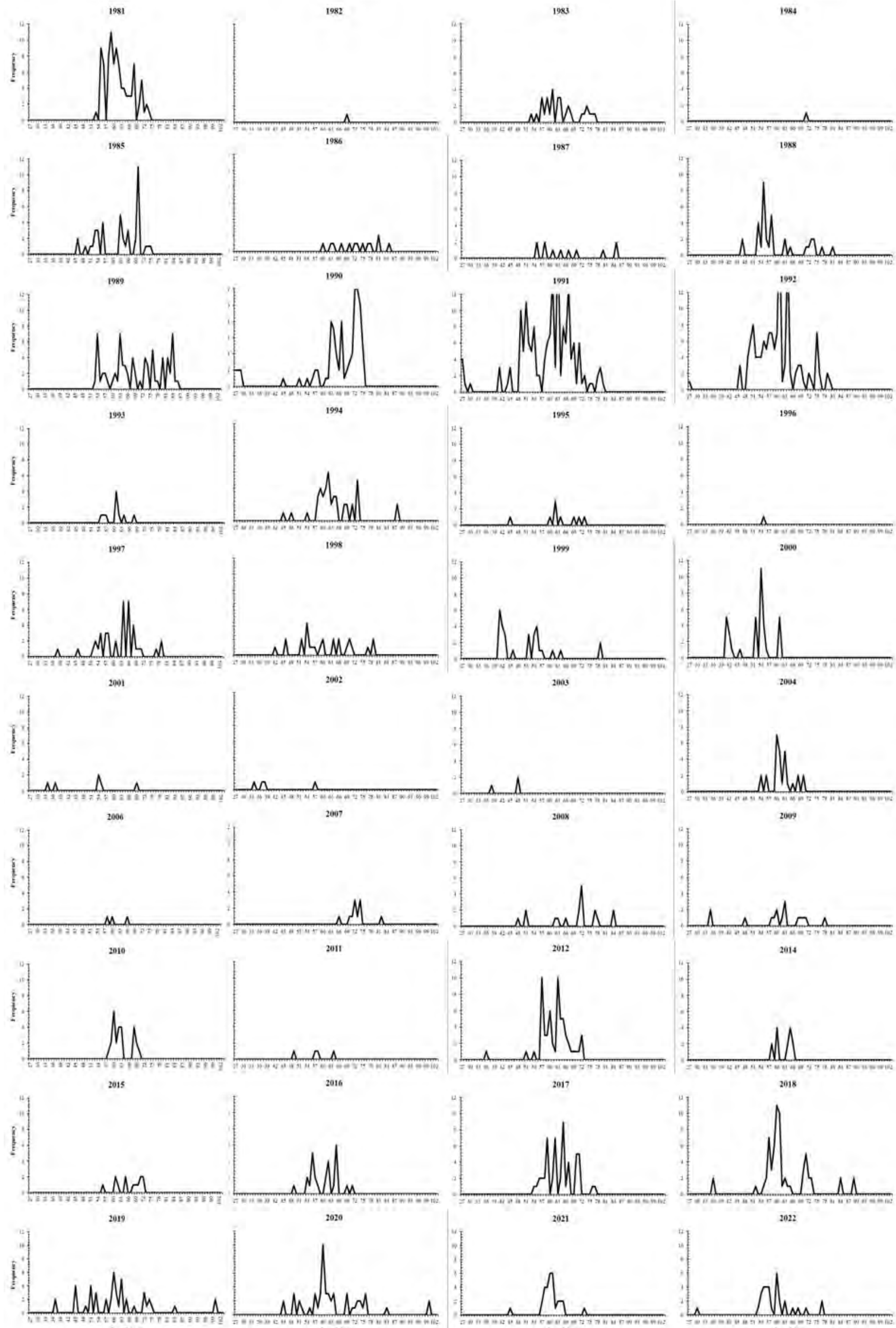

Figure A3.3. The length frequencies from the Mid-Atlantic region by year.

Table A3.2. The summary of length and weight data from the Mid-Atlantic region by year.

Year	Count	Mid-Atlantic Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	94	50	71	58.9	5.16	0.7	2.9	1.45	0.457
1982	1	66	66	66.0	-	1.7	1.7	1.72	-
1983	31	50	74	61.1	6.66	1.2	3.8	2.03	0.816
1984	1	68	68	68.0	-	2.9	2.9	2.87	-
1985	42	43	72	59.5	8.23	0.5	3.6	1.60	0.762
1986	13	57	82	69.8	7.70	1.2	4.6	2.72	1.008
1987	11	52	82	64.1	11.49	1.2	4.8	2.24	1.150
1988	35	44	78	57.0	8.79	0.6	4.6	1.79	0.788
1989	73	50	83	66.5	10.28	1.1	4.7	2.47	1.133
1990	94	24	72	62.6	11.47	0.6	4.9	2.58	1.073
1991	172	24	77	56.2	10.19	0.1	4.2	1.77	0.789
1992	138	24	77	56.9	8.11	0.6	4.4	1.56	0.663
1993	10	52	65	57.6	3.86	1.2	1.7	1.40	0.166
1994	44	42	85	61.2	8.03	0.6	4.1	1.74	0.709
1995	9	42	70	60.1	8.19	0.6	2.3	1.61	0.512
1996	1	52	52	52.0	-	0.7	0.7	0.73	-
1997	41	35	76	59.3	8.23	0.3	3.9	1.68	0.868
1998	26	39	76	57.6	10.09	0.5	5.2	1.77	1.201
1999	30	38	76	47.8	10.39	0.4	4.0	1.01	0.876
2000	36	38	58	48.5	6.58	0.4	2.0	0.91	0.396
2001	6	31	66	47.5	12.97	0.3	2.4	1.02	0.787
2002	4	31	54	38.5	10.47	0.3	1.0	0.46	0.359
2003	3	35	45	41.7	5.77	0.3	0.9	0.62	0.268
2004	28	51	67	58.7	4.11	1.0	2.0	1.48	0.235
2005	17	51	103	66.2	15.93	1.0	8.3	2.71	2.517
2006	3	55	63	58.3	4.16	1.4	2.5	1.82	0.622
2007	11	63	79	69.7	3.85	2.2	2.9	2.47	0.231
2008	18	45	81	66.1	10.56	0.9	3.9	2.21	0.863
2009	16	32	75	57.1	11.89	0.2	2.4	1.41	0.622
2010	26	55	67	60.0	3.71	1.1	2.4	1.56	0.393
2011	4	46	61	54.0	6.16	0.8	1.9	1.52	0.526
2012	60	33	69	58.8	5.69	0.2	2.8	1.47	0.386
2013	-	-	-	-	-	-	-	-	-
2014	14	55	63	59.6	3.03	1.3	2.2	1.69	0.328
2015	13	53	69	63.4	5.14	1.0	3.0	1.96	0.550
2016	27	46	68	57.3	5.20	0.7	2.4	1.50	0.478
2017	52	51	74	60.9	5.40	1.0	3.2	1.78	0.572
2018	64	33	89	59.7	9.51	0.6	8.3	3.46	1.550
2019	46	34	100	58.3	13.46	0.3	7.1	1.74	1.417
2020	53	42	100	60.7	11.57	0.5	7.1	1.83	1.288
2021	31	42	70	57.4	4.23	0.5	2.5	1.35	0.312
2022	33	27	74	55.8	7.98	0.1	2.6	1.36	0.512

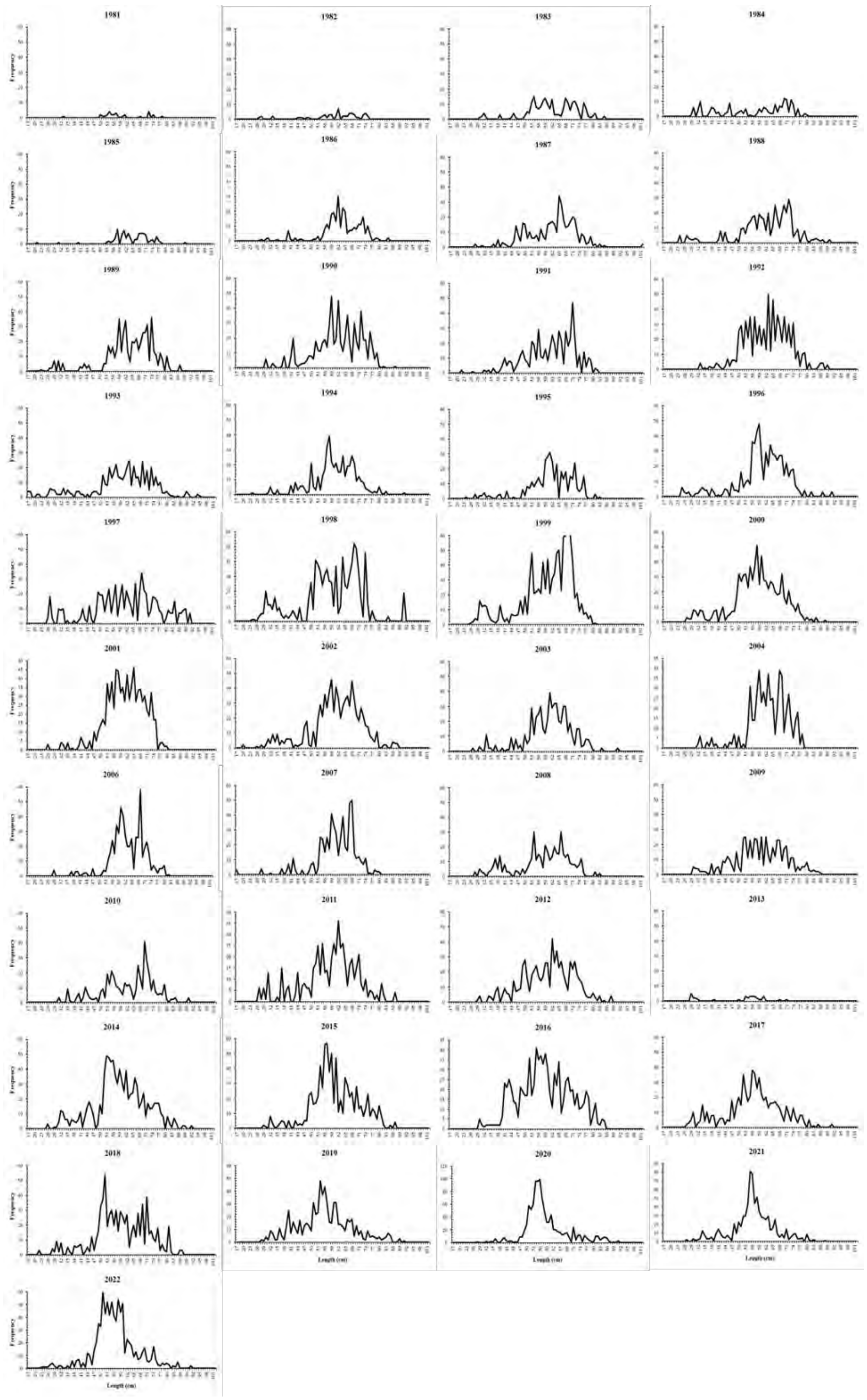

Figure A3.4. The length frequencies from the South Atlantic region by year.

Table A3.3. The summary of length and weight data from the South Atlantic region by year.

Year	Count	South Atlantic							
		Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	30	33	78	59.1	9.76	0.9	3.8	1.69	0.681
1982	60	27	75	60.3	12.02	0.2	11.4	1.94	1.577
1983	247	30	85	62.4	10.70	0.2	4.0	1.76	0.855
1984	176	29	80	57.4	14.87	0.1	3.6	1.56	0.922
1985	102	21	89	64.4	9.00	0.2	3.9	2.00	0.670
1986	283	28	84	63.4	8.86	0.1	3.9	1.82	0.750
1987	428	28	102	62.0	10.48	0.1	4.3	1.84	0.795
1988	450	24	90	62.5	12.00	0.2	3.4	1.46	0.976
1989	532	23	87	64.0	11.13	0.2	7.0	2.03	0.917
1990	636	30	87	62.0	10.36	0.2	4.5	1.76	0.806
1991	556	22	82	61.3	10.80	0.1	3.9	1.74	0.786
1992	746	33	89	62.4	9.59	0.2	4.4	1.81	0.767
1993	491	17	95	59.5	14.57	0.1	7.6	1.75	1.119
1994	465	24	91	60.4	9.35	0.1	4.9	1.62	0.735
1995	403	24	83	61.5	10.03	0.1	4.0	1.73	0.721
1996	653	25	91	60.6	10.80	0.1	4.6	1.74	0.776
1997	654	26	91	61.5	15.30	0.1	5.7	2.00	1.264
1998	901	24	91	59.0	13.27	0.1	5.5	1.65	0.803
1999	1034	26	81	59.9	11.46	0.2	7.5	2.17	1.165
2000	815	27	88	58.2	10.77	0.1	5.6	1.72	0.877
2001	835	26	80	61.1	8.71	0.2	4.3	1.89	0.814
2002	815	20	88	60.9	11.08	0.1	4.9	1.82	0.867
2003	583	27	91	60.9	9.91	0.1	5.8	1.86	0.823
2004	550	32	78	62.9	8.65	0.2	3.9	1.90	0.760
2005	398	31	85	61.0	8.69	0.2	4.2	1.73	0.758
2006	559	29	82	63.3	8.00	0.2	4.2	1.84	0.665
2007	549	17	80	61.0	8.89	0.2	4.2	1.70	0.646
2008	436	28	83	57.8	11.82	0.1	4.6	1.53	0.841
2009	521	30	86	59.4	11.51	0.2	5.1	1.69	0.967
2010	436	31	90	62.6	11.42	0.2	4.8	1.87	0.943
2011	541	27	87	58.5	11.89	0.1	4.4	1.60	0.936
2012	691	29	88	60.2	10.92	0.2	4.9	1.64	0.889
2013	35	29	71	49.0	13.25	0.1	2.3	0.97	0.626
2014	935	26	92	59.0	11.68	0.1	6.1	1.63	0.949
2015	817	29	87	60.7	10.18	0.1	4.6	1.70	0.831
2016	874	30	85	58.9	11.53	0.2	4.5	1.61	0.987
2017	648	27	91	56.4	11.80	0.1	5.2	1.44	0.886
2018	760	22	87	59.1	11.79	0.1	9.7	3.37	1.891
2019	719	28	91	55.9	11.85	0.1	5.0	1.40	0.885
2020	1045	28	91	58.5	9.37	0.2	4.9	1.53	0.803
2021	802	27	88	56.5	9.35	0.1	4.8	1.37	0.720
2022	858	23	91	56.5	9.55	0.1	5.2	1.38	0.767

American Saltwater Guides Association

A Review of the Fishery, Biology, and Life History of the Atlantic Bonito (*Sarda sarda*) in the Northwest Atlantic

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DRAFT

Final to be submitted within 15 days of the ASMFC Meeting

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EXECUTIVE SUMMARY

In recent years, Atlantic bonito has become a popular target of recreational fisheries along the Atlantic coast of the United States. There is currently no management plan for this species in United States waters or internationally (ICCAT 2021). There is limited research on stock structure or status. However, in the Eastern Atlantic several studies have shown genetic differences amongst bonito from different locations (Vines et al. 2004; Turan 2015). Commercial landings over the past decade have been dominated by Rhode Island (43%). Commercial discards occur almost exclusively in gill net fisheries. Much of the recreational landings in the past decade are from Massachusetts, Rhode Island, New Jersey, and North Carolina. Approximately 30% of all recreationally caught bonito since 1981 were discarded, and survival of these fish is unknown. Recreational catch lengths and weights varied from 15 to 113 cm (Mean = 50.6 cm) and from <0.1 to 10.2 kg (Mean = 0.99 kg). There were no significant differences in length-frequencies amongst years or regions. Length weight equations were calculated by wave (two-month periods) and no significant differences were found.

There were no growth or maturity studies in United States waters, but growth and maturity parameters from the Mediterranean and East Atlantic are summarized in Tables 19 and 20. Atlantic bonito exhibit asynchronous oocyte development and multiple spawning events throughout the spring and summer with eggs being shed in several batches when water is the warmest (Majorova and Tkacheva 1959; Rey et al., 1984; Kahraman 2014). Spawning occurs near shore, and fecundity can vary from 304,000 and 1,150,000 oocytes (Macias et al 2005; Valerias and Abad 2006). Little is known about the natural mortality of Atlantic bonito but estimates in other areas of the Atlantic range from 0.46 to 0.869 (Baibbat et al. 2019; Petukhova 2020).

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BACKGROUND

Internationally, small tunas, including Atlantic bonito, support fisheries that are important both economically and as a source of food (Majkowski 2007; Isaac et al. 2012; Lucena-Fredou et al. 2021). The Atlantic bonito has become a popular target and welcomed bycatch in the United States recreational fisheries. Many are kept for food or utilized as bait for larger pelagic species and sharks. In recent years, there has been an abundance of juvenile bonito available to recreational anglers. This has resulted in many immature bonito being harvested, and there is concern as to what impact this will have on their population (McManus, C. Personal Communication).

The assessment and management of tunas in the Atlantic and Mediterranean is the responsibility of the International Commission for Conservation of Atlantic Tunas (ICCAT). There is no ICCAT assessment or management plan for Atlantic bonito, however the species was identified as a species for which more data should be collected in order to assess the stock (ICCAT 2019). In the United States, Atlantic bonito are not managed and, unlike other small tunas and mackerels, were not included under the Coastal Migratory Pelagics Fishery Management Plan (CMP FMP) (Federal Register 1982). The species included in the CMP FMP are managed jointly by the South Atlantic and Gulf of Mexico Fishery Management Councils. In federal waters, highly migratory species are managed by the National Oceanic and Atmospheric Administration Highly Migratory Species (NOAA HMS) Program. This program manages species that overlap multiple management council's jurisdictions. In addition, each state has its own marine fisheries management system for the fisheries occurring in their respective state waters (Appendix 1).

FISHERIES

Stock Structure and Status

There is little information available to determine the stock structure of many small tuna species, including Atlantic bonito (ICCAT 2019). There is currently no management structure in place for bonito but attempts to define stock structure and complete data-poor assessments are underway (ICCAT 2021). Currently, bonito in the Atlantic are divided into five stock regions, based on traditional ICCAT management areas (ICCAT 2021). These areas are as follows: Northwest Atlantic, Northeast Atlantic, Mediterranean, Southeast Atlantic, and Southwest Atlantic (Figure 1).

There are no available genetic or morphological stock structure studies from the Northwest Atlantic, and there are only a handful from the other stock areas. Vines et al. (2004) found genetic isolation between bonito in the Western and Eastern Mediterranean. Turan (2015) found genetic differences between fish from the Black, Mediterranean, and Aegean seas. There were also significant genetic differences found in Mediterranean and West African caught bonito (Vines et al. 2020). Despite being separate management units, bonito have been shown to migrate between the Mediterranean and Atlantic via the Strait of Gibraltar (Rey and Cort 1981). There is clearly a lack of knowledge on the true stock structure of bonito in the Atlantic and based on the results of studies in the Eastern Atlantic, it's possible there are different stocks within United States waters.

There is no official stock assessment for Atlantic bonito in any of the ICCAT management areas, but in 2017 they were identified by ICCAT as a priority to be evaluated (ICCAT, 2017). There have been several examinations of stock status and stock risk done recently, but much of it was focused outside of the Northwest Atlantic. Pons et al. (2019A) used length based spawning potential ratio (LBSPR) and length based integrated mixed effects (LIME) models to assess the stock status of Northeast Atlantic and Mediterranean bonito. The other stock areas were excluded due to a lack of data (Pons et al. 2019A). There were conflicting results between the two models for both stock areas (Pons et al. 2019A). Catch based assessment models however, showed that biomass of bonito in the Northeast Atlantic was above B_{MSY}. Petukhova (2020) use LBSPR to assess bonito in the Northeast Atlantic and concluded that overfishing is occurring. There was a high level of uncertainty in the results of these studies (Pons et al 2019B; Lucena-Fredou et al. 2021).

Data Sources

For this review only non-confidential data was used. The commercial landings, recreational landings, and recreational discards data were provided by the Atlantic Coastal Cooperative Statistics Program (ACCSP). Commercial landings data dates back to 1951 and was limited to annual landings by state. Commercial discard data was provided by the Northeast (ME-NC) and Southeast Fisheries Science Centers (NC-TX) (NEFSC and SEFSC) and dates back to 1991. The observed discard data was aggregated by state, statistical area, and gear type. Estimating total discards was beyond the scope of this review, but the observed values were used to characterize the gear types used and states responsible for discarded bonito. The non-confidential portion of this data represented 81% of all observed Atlantic bonito discards by weight in the Northeast. Southeast observer data was limited to numbers of fish observed and coverage was minimal.

All recreational data came from the Marine Recreational Information Program (MRIP) and there were few problems with confidentiality. As data was aggregated by at more specific levels (i.e., state and fishing mode) estimation error became more significant. When examining the mode of fishing and location of catch, we presented the data as percentages of the total rather than specific values, allowing for the characterization of the fishery. Recreational discards are only reported in numbers of fish.

Commercial Landings

Up until 1977, commercial bonito landings were highly variable, ranging from 35,000 and 288,200 lbs. (Mean = 123,640.7 lbs.). From 1976 until 2000, commercial landings were higher and more variable (Mean = 272,314.3 lbs.) (Figure 2). Landings in the early 2000s dropped dramatically and have remained relatively stable over the past decade, between 25,378 and 81,565 lbs. (Mean = 49,905.7 lbs.).

Prior to the 1970s the Mid-Atlantic was responsible for most of the landings (Figure 3). Over the entirety of the time-series the North Atlantic averaged the highest landings (26,738.3 lbs.), with the majority occurring from the 1970s to the 1990s (Table 2). Over the past decade the North Atlantic has been responsible for 46% of the landings (Figure 3).

Much of the early landings in the Mid-Atlantic came from a combination of New Jersey and New York (Figure 4). Over the past decade Rhode Island has been responsible for 43% of all commercial landings of bonito (Table 2). The rest of the landings occurred in predominantly in New York, New Jersey, and North Carolina (Figure 4). Individual state and region data can be seen in Appendix 2.

Commercial Discards

Over 99% of observed Atlantic bonito discards from the Northeast Fisheries Observer Program were caught by gill nets. There are three types of gillnets that make-up this 99%: fixed (38%), drift floating (44%), and drift sinking (17%). The annual breakdown of discards by gear can be seen in Figure 5. Only five states in the Northeast Fisheries Observer Program have recorded bonito discards for the time series, and the majority of these discards come from New Jersey (53%) and Rhode Island (25%) (Figure 6). There is very little data on discarded Atlantic bonito from the Southeast Fisheries Observer Program.

Recreational Landings

Since 1981 recreational landings have ranged from 69,609 lbs. in 2016 to 11,527,512 lbs. in 1982 (Mean = 1,192,108.0 lbs.) (Table 3) (Figure 7). Landings have declined from the highs of the early 1980s and remained relatively stable since the 1990s. The Mid-Atlantic has been responsible for the majority of the landings (61%) over the entirety of the time series (Figure 8). Over the past decade, landings have been more evenly distributed between the North, South, and Mid-Atlantic (Table A2.3). Much of the landings in the past decade are from Massachusetts, Rhode Island, New Jersey, and North Carolina (Figure 9) (Table 4). Individual state plots and data can be seen in Appendix 2.

The mode of fishing responsible for the landings varied by region, state, and year. Across all regions there was a decrease in landings from for-hire vessels, with the exception of a spike in 2017 (Figure 10). Shore landings appear to vary by year, perhaps as a result of fish movement and availability to shore fishermen. Private boats represent the majority of landings in all regions, except the Mid-Atlantic where for-hire vessels are the most common mode (Figure 11) (Table 5). Shore fishing is most common in the North Atlantic (Figure 11) (Table 5). Individual region and state catch by mode can be seen in Figure 12, Table 6, Appendix 2.

The percentage of landings in state and federal waters also varied by region, state, and year. There did not seem to be an overall pattern in location of landings across the time-series, but more landings occurred in federal (78%) than state (22%) waters (Figure 13) (Table 7). The majority of the landings in the North Atlantic (55%) came from state waters (Figure 14) (Table

7). The Mid-Atlantic (93%) and South Atlantic (65%) catches were predominantly in federal waters (Figure 14) (Table 7). Individual state catch in state and federal waters can be seen in Figure 15, Table 8 Appendix 2.

Recreational Discards

With the popularity of catch and release recreational fishing, discards represent an important component of the fishery. Over the entire time-series 30% of bonito caught were discarded (Table 9) (Figure 16). Almost half the bonito caught in the North Atlantic (46%) and South Atlantic (46%) were discarded (Figure 17) (Table 9). Since 1981 recreational discards have ranged from 5,691 fish in 2009 to 826,667 fish in 1988 (Mean = 148,082 fish) (Table 10) (Figure 18). There is no obvious trend across the time-series, but there does appear to be periodic spikes in discards. The discards follow a similar pattern to landings across regions (Figure 19). The Mid-Atlantic was responsible for 68% of discards overall, but the North Atlantic was responsible for 47% over the past decade (Table A2.9). Florida has the most discards of any state, with much of that occurring early in the time series and very little in the past decade (Figure 20) (Table 11). Massachusetts and New Jersey have the most discards in the past decade (Figure 20) (Table 11). Individual state plots, and data can be seen in Appendix 2.

The mode of fishing responsible for the discards was dominated by private boats everywhere. Across all regions there appears to be a decrease in discards from for-hire vessels in recent years (Figure 21). Shore discards appear to vary by year and are more common in the North Atlantic (Figure 22) (Table 12). Rhode Island and Massachusetts have the highest percentage of shore released Bonito (Figure 23) (Table 13). Individual region and state catch by mode can be seen in Appendix 2.

The percentage of discards in state and federal waters also varied by region, state, and year. There did not seem to be an overall pattern in location of discards across the time-series (Figure 24). The majority of the discards in the North Atlantic (84%) came from state waters (Figure 25) (Table 14). The majority of Mid-Atlantic (68%) and South Atlantic (63%) discards occurred in federal waters (Figure 25) (Table 14). In the South Atlantic, Florida and North Carolina are the only states with a high percentage of discards in state waters (Figure 26) (Table 15).

Recreational Effort

The number of directed trips, trips where bonito were the primary or secondary target, has varied from 27,454 trips in 1983 to 335,900 trips in 2014 (Mean = 174,653.4 trip). There has been an increasing trend over the time-series (R^2=0.7), specifically starting in 1993 (Figure 27).

Release Mortality

Since 30% of all recreationally caught Atlantic bonito are released, post-release mortality plays an important role in determining the total removals of the fishery. There are currently no estimates of post-release mortality of Atlantic bonito, but a physiological response to the catch process has been recorded (Skomal 2006).

LENGTH AND WEIGHT

Data Sources

All length and weight data utilized in this section comes from MRIP survey dating back to 1981. Because this is a recreational fishery survey, all data is affected by the selectivity of hook and line gear, with the possibility that smaller size classes may be underrepresented. The data was downloaded from the online MRIP query system (NMFS FSD 2023), and analysis was completed in R Studio (RStudio Team 2020).

Comparisons of length frequency data were made using a series of Kolmogorov & Smirnov (K-S) tests with a modified version of the clus.lf function in the fishmethods package. The data did not have a sampling unit (i.e., interview or shift) variable to use, so a generic haul variable was assigned to each group, eliminating the among sampling unit variance and simplifying the comparison.

Length-weight observations were transformed using logarithms. Estimated weights were calculated from the relationships and compared to the observed weights to calculate 95% confidence intervals (Wigley et al. 2003). Length-weight relationships were compared across MRIP sample waves (two-month sampling bins starting as January and February). The predicted weights across all observed lengths from each wave's length-weight relationship were compared using an analysis of covariance (ANCOVA).

Recreational Size Structure

There were 6,874 length samples collected by MRIP from 1981 to 2022 ranging from 15 to 113 cm (Mean = 50.6 cm; SD = 12.11 cm) (Figure 28). Annual mean length ranged from 35.5 cm in 2006 to 69.4 cm in 2010 (Table 16) with no significant trend across the time-series (Figure

29). There were no significant differences in length distributions amongst years (K-S Tests; $p>0.05$), and all annual distributions can be seen in Figure A3.1.

The Caribbean sub-region was excluded from the spatial comparisons due to a lack of samples (n=43 across all years). Of the remaining sub-regions, the samples were relatively evenly distributed. Mean length across the sub-regions ranged from 47.1 cm in the Mid-Atlantic, to 53.0 cm in the North Atlantic (Table 17). There were no significant differences in length distributions amongst sub-regions (K-S Tests; $p>0.05$) (Figure 30), and all annual distributions for each sub-regions can be seen in Figures A3.2-9. There was also no significant difference in length frequency distributions when grouped by month. (K-S Tests; $p>0.05$) (Figure 31),

There were 6,864 weight samples collected by MRIP from 1981 to 2022 ranging from <0.1 to 10.2 kg (Mean = 0.99 kg; SD = 0.844 kg) (Table 16). Annual mean weight ranged from 0.34 kg in 2006 to 3.30 kg in 2007 (Table 16), with no significant trend across the time-series (Figure 29). Mean weight across the sub-regions ranged from 0.87 kg in the Mid-Atlantic, to 1.07 in the North Atlantic (Table 17).

Length-Weight Relationships

The overall log-transformed length-weight relationship (Equation 1) showed a good fit ($R^2 = 0.94$) (Figure 32). When separated by wave, the R^2 values ranged from 0.86 for wave six to 0.96 for waves two and five (Table 18). Individual logarithmic length-weight relationships can be seen in Figure 33. When predicted weights were plotted with their 95% confidence intervals there was good agreement amongst waves except for some deviation in the larger sizes of wave one (Figure 34). The ANCOVA showed no significant difference in predicted weights amongst waves ($p>0.05$).

Equation 1.

$$log\,(W) = log\,(3.7E^{-6}) + 3.15log\,(L)$$

LIFE HISTORY

Growth and Maturity

We were unable to find any growth studies on Atlantic Bonito from the United States Atlantic coast or Gulf of Mexico. There has been a significant amount of work done on this species in the Eastern Atlantic, Mediterranean, and Black Sea Franicevic et al. 2015; Pons et al. 2019). Combined sex maximum size (L_∞) ranged from 62.5 cm (24.6 in) in Western Mediterranean (Valeiras et al. 2008) to 103 cm (40.6 in) in the Black Sea (Zusser 1954) (Mean = 77.51 cm or 30.35 in) (Table 19). Growth rates estimates (k) varied from 0.13 (Zusser 1954) to 0.86 (Demire 1963; Turgan 1958) (Table 19). Age at length zero (t_0) varied from -2.74 (Hansen 1989) to -0.44 (Cengiz 2013) (Mean = -1.55) (Table 19). The two studies that separated sex both found that males grow slower and to larger sizes than females (Cengiz 2013; Kahraman et al. 2018).

Similar to growth, there were no available papers from the United States Atlantic coast or Gulf of Mexico that examined maturity of bonito. There were maturity studies located in the Eastern Atlantic, Mediterranean, and Black Sea (Table 20). Male length at first maturity (L_{50}) ranged from 35.8 cm (14.1 in) in the Mediterranean (Cengiz 2013) to 41 cm (16.1 in) off the coast of Morocco (Baibbat et al. 2016) (Table 20). Female L_{50} ranged from 37 cm (14.6 in) (Postel 1954) to 45 cm (17.7 in) off the coast of Morocco (Dardignac 1962) (Table 20).

Distribution and Movements

Atlantic bonito are distributed throughout coastal waters of the Eastern Atlantic, Mediterranean, and in Western Atlantic, from the Nova Scotia to Uruguay (Valerias and Abad 2006). Larvae are pelagic and limited to the warmest part of the water column, above the thermocline (Reglero et al. 2018). These larvae range from 4 mm at hatching to 2 cm when they are considered juveniles (Valerias and Abad 2006). Other small tuna larvae off Florida have been shown to feed almost exclusively on appendicularians (Llopiz et al. 2010), but there has been no work specific to Atlantic bonito larvae.

Adult Atlantic bonito remain within the waters of the continental shelf and may move into estuaries (Valerias and Abad 2006). They school by size with other Scombrids but can scatter during certain times of the year (Collette and Nauen 1983). In the Western Atlantic, bonito feed mainly on *clupeids*, *Peprilus paru*, *Leiosomus xanthurus*, *Anchoa sp*, *Scomberomorus sp*., *Prionotus sp*., *Loligo sp*., *Penaeus sp*., and squid (Bigelow and Schroeder 1953; Boschung 1966). Along the East Coast of the United States, adults most likely move as far North as Canada during the summer and early fall, before migrating back to the South for the winter, but there is a lack of official documentation of these migrations. Bonito can tolerate temperatures from 12° to 27°C and salinities 14 to 39 (Bianchi et al. 1999).

Spawning

Atlantic bonito exhibit asynchronous oocyte development and multiple spawning events throughout the spring and summer, with eggs being shed in several batches (Majorova and Tkacheva 1959; Rey et al., 1984; Kahraman 2014). Spawning has also been shown to be affected by the North Atlantic Oscillation (Baez et al. 2019). Spawning typically occurs near the coast (Valerias and Abad 2006). In the Northwest Atlantic, spawning occurs in three to four batches during the summer, with a peak in June and July. A similar spawning season is seen in the Mediterranean and Eastern Atlantic (Valerias and Abad 2006; Kahraman et al. 2014). There is limited information on the fecundity of bonito. Bonito exhibit indeterminate fecundity with estimates ranging from 304,000 and 1,150,000 oocytes (Macias et al 2005; Valerias and Abad 2006).

Natural Mortality

There is little published information about Atlantic bonito natural mortality. Various methods of estimation using life history traits have been published, some of which have been summarized by Vetter (1988). Along the southern Atlantic coast of Morocco, natural mortality was estimated to be 0.46, using a method based on fish longevity (Baibbat et al. 2019). In the northeastern region of the Atlantic Ocean, four methods were used to calculate Atlantic bonito natural mortality, with estimates ranging from 0.509 to 0.869 and a mean value of 0.695 (Petukhova 2020). Potential sources of Atlantic Bonito natural mortality include predation, disease, and environmental stress. Primary predators of Atlantic Bonito are wahoo, mahi mahi, and both adult and juvenile Atlantic bonito (Collette and Nauen 1983; Valerias and Abad 2006).

RESEARCH RECOMMENDATIONS

Fisheries Data

A more exhaustive review of fisheries catch data should be undertaken in order to estimate the total removals of the fishery and examine the uncertainty in these estimates. If possible, length data from commercial landings should be applied to the total landings to estimate catch at length. Fleet wide commercial discards need to be estimated using the appropriate methodology. With the majority of commercial discards occurring in gill net fisheries, survival of these fish is most likely low. For recreational landings, there is length data that could be applied to get catch at length. However, research will need to examine the effects of location and season on the groupings when applying length frequencies to landings. A more thorough investigation into recreational discards, including an examination of the uncertainty surrounding the estimate will better describe the number of fish discarded annually. Due to the harvest of immature bonito occurring recently, efforts should be made to estimate these removals specifically.

Biosampling

There have been minimal studies on the life history of Atlantic bonito in United States waters. Life history parameters such as growth, maturity, and fecundity play a large role in stock assessment modeling. Effort should be put forth to take biological samples from harvested bonito along the Atlantic coast. These samples could include otoliths to estimate growth, gonads to estimate length at first maturity and fecundity, and tissue samples for genetic testing to evaluate stock structure.

Tagging

With more than 34% of recreationally caught Atlantic bonito being released, post-release mortality and the factors effecting it will be crucial in determining total removals by the fishery. Tagging projects can help refine the estimate of mortality and provide advice as to minimizing mortality. Tagging studies can also estimate natural mortality and population size, important components of any future assessment.

Fishery CPUE

Fisheries independent surveys are used to track population trends for many species. Since Atlantic bonito do not show up in any fisheries independent surveys, some measure of recreational catch per unit effort (CPUE) could be used to standardize catch through the years and track fluctuations in the population. This should be done by isolating trips that targeted bonito. For-hire vessels would most likely have the best catch rates and consistent methods, making them best suited for a CPUE study.

Economics

An analysis that examines the economic impact of the recreational bonito fishery will help to justify precautionary approaches to management of the stock. Since the majority of this fishery is recreational and 30% is released, the economic value is harder to elucidate than just putting a dollar value on landings. In recreational fisheries revenue is generated through charters, tackle shops, marinas, and general tourism to areas where the fishery is occurring. Including these factors in an analysis that can estimate the impact bonito has on local economies may help justify the need for management.

REFERENCES

Ateş, C., Deval, C.M., Bök, T. 2008. Age and growth of Atlantic bonito (*Sarda sarda* Bloch, 1793) in the Sea of Marmara and Black Sea, Turkey. J. Appl. Ichthyol. 24: 546–550.

Baez, J.C., Munoz-Exposito, P., Gomez-Vives, M.J., Fodoy-Garrido, D. 2019. The NAO affects the reproductive potential of small tuna migrating from the Mediterranean Sea. Fish. Res. 216: 41-46.

Baibbat, S., Malouli, I., Abid, N. and Benazzouz, B. 2016. Study of the reproduction of Atlantic bonito (*Sarda sarda*) in South Atlantic Ocean of Morocco. Aquaculture, Aquarium, Conservation & Legislation – Int. J. Bioflux Soc. 9:954–964.

Bianchi, G., Carpenter, K.E., Roux, J.P., Mollow, F.J., Boyer, D., Boyer, H.J. 1999. Field Guide to the Living Marine Resources of Namibia. FAO species identification guide for fishery purposes. Rome, FAO. 265 pp.

Bigelow, H.B., Schroeder, W.C. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildl. Serv. 53: 577 pp.

Boschung, H.T. 1966. The occurrence of common bonito, *Sarda sarda,* in the Northern Gulf of Mexico. Trans. Am. Fish. Soc. 95: 227-228.

Cayré, P., Amon Kothias, J.B., Diouf, T., Stretta, J.M. 1993. Biology of tuna. In: Resources, fishing and biology of the tropical tunas of the Eastern Central Atlantic. FAO Fisheries Technical Paper. A. Fonteneau and J. Marcille (eds.) FAO, Rome, Italy, p 354.

Cengiz, 0. 2013. Some biological characteristics of Atlantic bonito (*Sarda sarda* Bloch, 1793) from Gallipoli Peninsula and Dardanelles (northeastern Mediterranean, Turkey). Turk. J. Zool., 37(1): 78-83.

Collette, B., Nauen, C.E. 1983. FAO Species Catalogue, Vol. 2: Scombrids of the World. An Annotated and Illustrated Catalogue of Tunas, Mackerels, Bonitos and Related Species Known to Date. FAO Fisheries Synopsis 125(2): 129 pp.

Dardignac, J. 1962. La bonite du Maroc Atlantique (*Sarda sarda*, Bloch). Rev. Trav. Inst. Pêches Marit., 26(4): 399-406.

Demir, M. 1963. Synopsis of biological data on bonito *Sarda sarda* (Bloch) 1793. FAO Fish. Rep. 6(2):101-129.

Federal Register. 1982. Gulf of Mexico and South Atlantic coastal migratory pelagic resources. 48(25): 5270.

Franicevic, M., Sinovcic, G., Cikes Kec, V., Zorica, B. 2005. Biometry analysis of the Atlantic bonito, *Sarda sarda* (Bloch, 1793), in the Adriatic Sea. Acta. Adriat. 46(2):213-222.

Hansen, J.E. 1987. Aspectos biológicos y pesqueros del bonito del Mar Argentino (Pisces, Scombridae, *Sarda sarda*). Collective Volume of Scientific Papers, ICCAT 26, 441–442.

ICCAT. 2016. Geographical Definitions. Version 2016.02 EN.

ICCAT. 2017. Report of the 2017 Small tunas species group intersessional meeting, Miami, United States, 24–28 April 2017. Collect. Vol. Sci. Pap. ICCAT., 74: 1–75.

ICCAT. 2019. Report for biennial period, 2018-2019 English version SCRS. Section 9.12 SMT – Small Tunas, pp 194-214. Madrid, Spain.

ICCAT. 2021. Report of the 2021 ICCAT Small Tunas Species Group Intersessional Meeting. Online. May 17-20 2021. 34 pp.

Isaac, V., Santo, R.E., Bentes, B., Mourao, K.R.M., Lucena-Fredou, F. 2012. The *Scomberomorus brasiliensis* gill-net production system in Northern Brazil; an Invisible and Mismanaged Small-scale Fishery. In: Moksness, E., Dahl, E., Stottrup, J. (eds) Global challenges in integrated coastal zone management. Wiley, Oxford, pp 49–60

Kahraman, A.E., Göktürk, D., Yildiz, T., Uzer, U. 2014. Age, growth, and reproductive biology of Atlantic bonito (*Sarda sarda* Bloch, 1793) from the Turkish coasts of the Black Sea and the Sea of Marmara. Tur. J. of Zoo. 38:614–621.

Kotsiri, M., Batjakas, I.E., Megalofonou, P. 2018. Age, growth and otolith morphometry of Atlantic bonito (Sarda sarda Block, 1793) from the eastern Mediterranean Sea. Acta. Adriat., 59(1): 97-110.

Kutaygil, N. 1967. Preliminary age analysis of *Mullus barbatus L.* and *Merlucius merlucius L.* in the Sea of Marmara and some pelagic fish of Turkey. FAO Proc. Tech. Pap. Gen. Fish. Counc. Medit. 8: 361–383.

Llopiz, J.K., Richardson, D.E., Shiroza, A., Smith, S.L., Cowen, R.K. 2010. Distinctions in the diets and distributions of larval tunas and the important role of appendicularians. Limnol. Oceanogr. 55(3): 983-996

Lucena-Fredou, F., Mourato, B., Fredou, T., Lino, P.G., Munoz-Lechuga, R., Palma, C., Soares, A., Pons, M. 2021. Review of the life history, fisheries, and stock assessment for small tunas in the Atlantic Ocean. Rev. Fish. Biol. Fisheries., 31: 709–736.

Macias, D., Lema, L., Gómez-Vives, M. J., Ortiz de Urbina, J. M. de la Serna, J. M., 2006. Some biological aspects of small tunas (*Euthynnus alletteratus*, *Sarda sarda* & *Auxis rochei*) from the Southwestern Spanish Mediterranean traps. Collect. Vol. Sci. Pap. ICCAT. 59(2): 579-589.

Majkowski, J. 2007 Global fishery resources of tuna and tuna-like species. FAO Fisheries Technical Paper, vol 483, 54p

Majorova, A., Tkacheva, K.S. (959. Distribution and conditions of reproduction of pelamid, *Sarda sarda* (Bloch), in the Black Sea according to data for the period 1956–1957. Proc. Tech. Pap. GFCM. 5: 509–514.

Mayorova, A., Tkacheva K.S. 1959. Distribution and conditions of reproduction of pelamid, *Sarda sarda* (Bloch), in the Black Sea according to data for the period 1956-1957. Proc. Tech. Pap. GFCM, 5: 509-514.

Nikolov, D.K. 1960. Biology of the bonito *Sarda sarda* (Bloch) from the Black Sea. Trud. Nauch.-issled. Inst. Rib. Prom. Varna. 3: 91–115 (in Bulgarian).

Nikolsky, G.W. 1957. Spezielle Fischkunde, VEB Deutscher Verlag der Wissenschaften, Berlin.

NMFS FSD, 2023.Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division

Numann, W., 1954. Growth and migration of short-finned tuna (Sarda sarda) in Turkish waters. Document technique, 42: 377-379.

Petukhova, N.G. 2020. Preliminary Assessment of the Stock Status of Atlantic Bonito (*Sarda sarda*) in the Northeastern Part of the Atlantic Ocean. J. Ich., 60(5): 732–741.

Postel, E. 1954. Contribution à l'étude des thonidés de l'Atlantique tropical. J. Cons. CIEM 19: 356–362.

Pons, M. 2018. Stock Status and Management in Tuna Fisheries: from data-rich to data-poor. PhD Dissertation. University of Washington, School of Aquatics and Fishery Science.

Pons, M., Kell, L., Rudd, M.B., Cope, J.M., Lucena-Fre´dou, F. 2019A. Performance of length-based data-limited methods in a multifleet context: application to small tunas, mackerels, and bonitos in the Atlantic Ocean. ICES. J. Mar. Sci., 76(4): 960–973.

Pons, M., Lucena-Fredou, F., Fredou, T., Mourato, B. 2019B. Implementation of length-based and catch-based data limited methods for small tunas. SCRS/2019/063

Reglero, P., Blanco1, E., Alemany1, F., Ferrá1, C., Alvarez-Berastegui, D., Ortega, A., de la Gándara, F., Aparicio-González1, A., Folkvord, A. 2018. Vertical distribution of Atlantic bluefin tuna *Thunnus thynnus* and bonito *Sarda sarda* larvae is related to temperature preference. Mar. Ecol. Prog. Ser. 594: 231-243.

Rey, J.C., Cort, J.L. 1981. Migration de bonitos (*Sarda sarda*) y bacoreta (*Euthynnus alletteratus*) entre el Mediterraneo y el Atlantico. Collect. Vol. Sci. Pap. ICCAT, 15(2): 346-347.

Rey, J.C., Alot, E., Ramos, A. 1984. Sinopsis biológica del bonito, *Sarda sarda* (Bloch), del Mediterráneo y Atlántico Este (Biology Synopsis of bonito, *Sarda sarda* (Bloch) from Mediterranean and eastern Atlantic). ICCAT, Coll. Sci. Pap., 20 (2): 469-502.

RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/.

Saber, S., Ortiz de Urbina, J., Lino, P.G., Gómez-Vives, M.J., Coelho, R., Lechuga, R., Macias, D. 2017. Biological samples collection for growth and maturity studies EU Portugal and Spain: Northeastern Atlantic and Western Mediterranean. 41 pp. ICCAT, Madrid.

Santamaria, N., Deflorio, M., De Metrio, G. 2005. Preliminary study on age and growth of juveniles of *Sarda sarda*, Bloch and *Euthynnus alletteratus*, Rafinesque, caught by clupeoids purse seine in the Southern Italian Seas. Collect. Vol. Sci. Pap. ICCAT, 58(2): 630-643.

Skomal, G.B. 2006. The Physiological Effects of Capture Stress on Post-Release Survivorship of Sharks, Tuna, and Marlin. PhD Dissertation. Boston University Graduate School of Arts and Sciences.

Tkacheva, K.C. 1958. Conditions of pelamids stocks in the Blacksea and fishery prospectives. Rybn. Khoz., 34: 10-13.

Turan, C. 2015. Microsatellite DNA reveals genetically different populations of Atlantic bonito *Sarda sarda* in the Mediterranean Basin. Biochem. Syst. Ecol. 63: 174–182.

Türgan, G. 1958. The age determination of bonitos and pelamids. Balık ve Balıkçılık 6(3): 18–20.

Valeiras, J., Abad, E. 2006. Manual de ICCAT, Descripción de la bacoreta. Publicaciones ICCAT; Comisión Internacional para la Conservación del Atún Atlántico. 199-207.

Valeiras, X., Macías, D., Gómez, M.J., Lema, L., Alot, E., Ortiz de Urbina, J.M., De la Serna, J.M. 2008. Age and growth of Atlantic bonito (*Sarda sarda*) in western Mediteranean Sea. Collect. Vol. Sci. Pap. ICCAT 62(5): 1649–1658.

Vetter, E.F. 1988. Estimation of natural mortality in fish stocks: a review. Fishery Bulletin. 86(1): 25-43.

Vinas, J., Alvarado Bremer, J.R., Pla, C. 2004. Phylogeography of the Atlantic bonito (*Sarda sarda*) in the Northern Mediterranean: the combined effects of historical vicariance, population expansion, secondary invasion, and isolation by distance. Mol. Phylogen. Evol. 33(1): 32–42.

Vinas, J. et al. 2020. Population genetic of Atlantic Bonito in The Northeast Atlantic and Mediterranean. Collect. Vol. Sci. Pap. ICCAT, 77(9): 6–12.

Wigley S.E., H.M. McBride, N.J. McHugh. 2003. Length-weight relationships for 74 fish species collected during NEFSC research vessel bottom trawl surveys, 1992-9. NOAA Tech Memo NMFS NE 171; 26 p.

Zaboukas, N., Megalofonou, P. 2007. Age estimation of the Atlantic bonito in the eastern Mediterranean Sea using dorsal spines and validation of the method. Sci. Mar. 71(4): 691–698.

Zusser, S.G. 1954. Biology and fishery for bonito in the Black Sea. Tr. VNIRO 28:160-174.

TABLES

Table 1. A summary of commercial landings (lbs.) from 1950-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	3	5	100	25378
Max	205472	275500	148442	562005
Mean	21749.9	26739.3	16476.4	155040.6
SD	32527.27	41182.33	23235.10	119493.61

Table 2. A summary of commercial landings (lbs.) from 1950-2021 by state.

State	Min	Max	Mean	SD
MAINE	-	-	-	-
NEW HAMPSHIRE	25	25	25.0	0.00
MASSACHUSETTS	100	138900	20459.4	30500.70
RHODE ISLAND	100	275500	44965.2	50513.08
CONNECTICUT	5	5000	480.0	944.34
NEW YORK	500	93274	21426.8	22618.07
NEW JERSEY	200	205472	39226.7	44758.86
DELAWARE	500	500	500.0	#DIV/0!
MARYLAND	13	105020	5907.1	19798.48
VIRGINIA	3	43700	6656.0	9831.85
NORTH CAROLINA	224	42372	13695.1	9554.28
SOUTH CAROLINA	473	5673	2656.5	1617.40
GEORGIA	-	-	-	-
FLORIDA	100	148442	23802.4	32342.04

Table 3. A summary of recreational landings (lbs.) from 1981-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	4	4	86	69609
Max	10119563	1707819	1911323	11527512
Mean	210507.4	80673.9	88941.8	960365.7
SD	1007861.60	190887.91	258164.69	1880829.84

Table 4. A summary of recreational landings (lbs.) from 1981-2021 by state.

State	Min	Max	Mean	SD
MAINE	0	27	27.0	0.00
NEW HAMPSHIRE	0	4	1.2	1.64
MASSACHUSETTS	1	219	42.3	46.84
RHODE ISLAND	0	775	50.0	131.27
CONNECTICUT	0	93	12.5	20.45
NEW YORK	0	352	42.4	71.64
NEW JERSEY	3	4590	240.1	784.94
DELAWARE	0	10	2.5	3.30
MARYLAND	0	368	28.5	79.77
VIRGINIA	0	95	12.7	24.41
NORTH CAROLINA	2	130	27.8	27.62
SOUTH CAROLINA	0	14	3.3	3.61
GEORGIA	0	6	1.8	1.93
FLORIDA	0	867	123.1	235.50

Table 5. Percentage of recreational landings by each mode of fishing from 1981-2021 by region.

Region	Shore	For Hire	Private
Mid-Atlantic	1%	71%	28%
North Atlantic	22%	35%	42%
South Atlantic	7%	12%	81%
Total	5%	42%	33%

Table 6. Percentage of recreational landings by each mode of fishing from 1981-2021 by state.

State	Shore	For Hire	Private
MAINE	0%	0%	100%
NEW HAMPSHIRE	70%	4%	26%
MASSACHUSETTS	40%	4%	56%
RHODE ISLAND	11%	65%	24%
CONNECTICUT	2%	9%	89%
NEW YORK	5%	23%	72%
NEW JERSEY	1%	77%	22%
DELAWARE	7%	76%	17%
MARYLAND	0%	76%	24%
VIRGINIA	0%	57%	43%
NORTH CAROLINA	6%	16%	78%
SOUTH CAROLINA	0%	63%	37%
GEORGIA	0%	44%	56%
FLORIDA	8%	7%	85%

Table 7. Percentage of recreational landings in federal and state waters from 1981-2021 by region.

Region	Federal	State
Mid-Atlantic	93%	7%
North Atlantic	45%	55%
South Atlantic	65%	35%
Total	78%	22%

Table 8. Percentage of recreational landings in federal and state waters from 1981-2021 by state.

State	Federal	State
MAINE	100%	0%
NEW HAMPSHIRE	13%	87%
MASSACHUSETTS	12%	88%
RHODE ISLAND	76%	24%
CONNECTICUT	7%	93%
NEW YORK	57%	43%
NEW JERSEY	97%	3%
DELAWARE	93%	7%
MARYLAND	100%	0%
VIRGINIA	94%	6%
NORTH CAROLINA	49%	51%
SOUTH CAROLINA	95%	5%
GEORGIA	92%	8%
FLORIDA	72%	28%

Table 9. The percentage of catch landed vs discarded from 1981-2021 by region.

Region	Landings	Discards
Mid-Atlantic	80%	20%
North Atlantic	54%	46%
South Atlantic	54%	46%
Total	70%	30%

Table 10. A summary of recreational discards (individuals) from 1981-2021 by region.

	Mid-Atlantic	North Atlantic	South Atlantic	Total
Min	2	12	0.9	5691
Max	499606	378413	59925	826667
Mean	38691.5	15599.7	8646.3	148082.2
SD	82182.82	43601.01	12091.12	164562.46

Table 11. A summary of recreational discards (individuals) from 1981-2021 by state.

State	Min	Max	Mean	SD
MAINE	97	97	97.0	0.00
NEW HAMPSHIRE	408	8933	3686.75	3902.149
MASSACHUSETTS	223	378413	27835.3	67226.93
RHODE ISLAND	12	43964	8397.1	10505.91
CONNECTICUT	25	36055	7681.8	10453.02
NEW YORK	109	68779	9084.5	14581.08
NEW JERSEY	66	289811	60140.0	90331.35
DELAWARE	2	3375	900.4	1183.18
MARYLAND	139	10700	3821.4	3444.39
VIRGINIA	59	9361	2736.9	2824.90
NORTH CAROLINA	368	59925	14277.4	13964.09
SOUTH CAROLINA	34	45664	5006.2	9132.64
GEORGIA	0.9	15362	2247.6	3983.87
FLORIDA	22	499606	94555.5	122963.48

Table 12. Percentage of recreational discards by each mode of fishing from 1981-2021 by region.

Region	Shore	For Hire	Private
Mid-Atlantic	23%	16%	61%
North Atlantic	25%	1%	74%
South Atlantic	6%	7%	87%
Total	19%	9%	72%

Table 13. Percentage of recreational discards by each mode of fishing from 1981-2021 by state.

State	Shore	For Hire	Private
MAINE	0%	100%	0%
NEW HAMPSHIRE	0%	0%	100%
MASSACHUSETTS	28%	1%	70%
RHODE ISLAND	25%	2%	73%
CONNECTICUT	0%	0%	100%
NEW YORK	11%	2%	87%
NEW JERSEY	26%	18%	56%
DELAWARE	20%	6%	74%
MARYLAND	0%	20%	80%
VIRGINIA	0%	27%	73%
NORTH CAROLINA	11%	5%	84%
SOUTH CAROLINA	0%	24%	76%
GEORGIA	0%	2%	98%
FLORIDA	3%	6%	92%

Table 14. Percentage of recreational discards in federal and state waters from 1981-2021 by region.

Region	Federal	State
Mid-Atlantic	68%	32%
North Atlantic	16%	84%
South Atlantic	63%	37%
Total	51%	49%

Table 15. Percentage of recreational discards in federal and state waters from 1981-2021 by state.

State	Federal	State
MAINE	0%	100%
NEW HAMPSHIRE	3%	97%
MASSACHUSETTS	10%	90%
RHODE ISLAND	40%	60%
CONNECTICUT	9%	91%
NEW YORK	49%	51%
NEW JERSEY	70%	30%
DELAWARE	38%	62%
MARYLAND	99%	1%
VIRGINIA	61%	39%
NORTH CAROLINA	50%	50%
SOUTH CAROLINA	63%	37%
GEORGIA	95%	5%
FLORIDA	73%	27%

Table 16. A summary of length and weight data for each year of the MRIP survey from 1981-2022.

Year	Count	Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	154	21	85	50.6	10.93	0.1	3.1	0.87	0.597
1982	155	15	77	53.3	12.11	0.0	4.0	1.18	0.766
1983	53	26	78	57.1	12.04	0.3	2.6	1.41	0.575
1984	81	23	78	55.7	11.10	0.2	2.6	1.34	0.640
1985	98	33	88	52.9	8.68	0.3	5.6	1.14	0.665
1986	285	26	88	54.7	7.23	0.1	3.4	1.21	0.475
1987	259	27	75	53.4	10.07	0.1	3.2	1.15	0.625
1988	596	23	79	47.4	14.25	0.0	2.2	1.01	0.553
1989	515	25	80	51.6	8.46	0.0	3.7	1.10	0.534
1990	244	20	74	52.4	9.25	0.0	2.5	1.04	0.434
1991	345	24	88	54.2	7.88	0.1	5.0	1.16	0.642
1992	234	30	74	54.6	7.29	0.2	3.1	1.24	0.411
1993	192	17	71	51.0	10.61	0.0	2.8	1.08	0.535
1994	214	23	81	41.1	13.71	0.1	3.6	0.64	0.664
1995	104	28	77	47.6	10.65	0.2	2.3	0.83	0.545
1996	72	22	77	46.3	12.64	0.1	3.0	0.88	0.660
1997	221	19	75	54.0	7.44	0.0	3.6	1.22	0.549
1998	165	17	77	53.3	8.63	0.0	3.3	1.16	0.745
1999	103	17	75	48.8	14.40	0.0	2.6	0.99	0.623
2000	162	17	73	48.2	13.60	0.0	3.2	1.03	0.760
2001	197	29	74	54.6	10.49	0.1	3.1	1.21	0.599
2002	265	33	77	54.9	7.85	0.2	3.5	1.21	0.448
2003	85	31	86	51.8	12.10	0.2	3.5	1.15	0.743
2004	103	36	72	55.1	7.08	0.2	3.0	1.20	0.454
2005	32	30	72	53.8	9.94	0.2	3.0	1.19	0.615
2006	72	30	58	35.5	8.45	0.2	1.5	0.34	0.327
2007	69	32	113	67.1	27.84	0.2	10.2	3.30	4.005
2008	30	51	72	61.0	6.55	0.9	3.0	1.87	0.693
2009	22	38	84	53.2	10.58	0.4	4.8	1.22	1.047
2010	29	31	84	69.4	12.84	0.3	4.8	2.84	1.326
2011	65	30	83	65.1	13.56	0.2	4.6	2.28	1.184
2012	89	19	83	62.2	12.25	0.0	4.6	1.91	1.085
2013	43	40	61	53.1	5.53	0.4	1.2	0.88	0.222
2014	140	28	79	43.5	8.50	0.2	4.0	0.61	0.450
2015	59	20	73	51.9	9.87	0.0	3.2	1.11	0.746
2016	52	29	76	50.6	10.18	0.2	3.6	1.01	0.699
2017	91	25	79	46.0	12.41	0.1	3.6	0.81	0.790
2018	204	19	72	43.7	12.31	0.0	3.0	0.70	0.554
2019	362	20	73	43.4	10.08	0.0	3.2	0.63	0.535
2020	352	22	80	46.1	10.41	0.0	3.4	0.76	0.580
2021	111	24	64	50.6	7.74	0.1	1.8	0.95	0.405
2022	140	15	87	41.7	15.91	0.0	4.5	0.75	0.897
Total	**6864**	**15**	**113**	**50.6**	**12.11**	**0.0**	**10.2**	**1.06**	**0.828**

Table 17. A summary of length and weight data for each region of the MRIP survey.

Values	Carribean	Gulf of Mexico	Mid-Atlantic	North Atlantic	South Atlantic	Grand Total
Count of Length	43	1025	1598	2054	2144	6864
Min of Length	40	21	20	15	15	15
Max of Length	61	88	85	113	88	113
Average of Length	53.1	50.9	47.1	53.0	50.7	50.6
StdDev of Length	5.53	12.61	10.05	11.14	13.58	12.11
Min of Weight	0.4	0.1	0.0	0.0	0.0	0.0
Max of Weight	1.2	3.5	5.6	10.2	5.0	10.2
Average of Weight	0.88	0.89	0.87	1.07	1.05	0.99
StdDev of Weight	0.222	0.708	0.572	0.975	0.927	0.844

Table 18. A summary of length-weight parameters for waves 1-6.

Wave	a	b	log(a)	SE	R^2
1	1.6E-05	2.79	-11.07	0.021	0.93
2	1.8E-06	3.34	-13.25	0.005	0.96
3	4.9E-06	3.08	-12.24	0.006	0.93
4	5.7E-06	3.05	-12.08	0.003	0.91
5	2.7E-06	3.24	-12.84	0.003	0.96
6	2.6E-06	3.23	-12.84	0.007	0.86
Total	**3.7E-06**	**3.1543**	**-12.508**	**0.003**	**0.94**

Table 19. A summary of von Bertalanffy growth parameters from various studies on Atlantic bonito around the world.

Original Citation	Area/Region	Sex	n	Method	L_{inf} (cm)	L_{inf} (in)	k	t_0	Max Age	Min L_{obs} (cm)	Min L_{obs} (in)	Max L_{obs} (cm)	Max L_{obs} (in)
Baibbat et al. (2016)	Morocco	Combined	2688		73.0	28.7	0.31	-2.45	5	31	12.2	74	29.1
Cengiz (2013)	Medditeranean	Combined	238	Otoliths	69.8	27.5	0.76	-0.44	-	23.8	9.4	72	28.3
		Male	82	Otoliths	72.2	28.4	0.69	-0.52	-	26.6	10.5	69.5	27.4
		Female	100	Otoliths	68.5	27.0	0.78	-0.34	-	28	11.0	72	28.3
Dardignac (1962)	Morocco	Combined	878	Spiues	64.0	25.2	0.69	-1.42	-	19	7.5	72	28.3
Rey et al. (1984)	Gibraltar, Spain	Combined	878	-	80.8	31.8	0.35	-1.7	-	19	7.5	71.5	28.1
Zusser (1954)	Black Sea, Russia	Combined	-	-	103.0	40.6	0.13	-1.8	-	-	-	-	-
Numann (1955)	Black Sea, Turkey	Combined	-	-	67.8	26.7	0.79	-	-	-	-	-	-
Nikolsky (1957)	Black Sea, Turkey	Combined	-	-	81.5	32.1	0.52	-	-	-	-	-	-
Turgan (1958)	Black Sea, Turkey	Combined	-	-	64.0	25.2	0.86	-	-	-	-	-	-
Niklov (1960)	Black Sea, Bulgaria	Combined	-	-	95.6	37.6	0.24	-1.24	-	-	-	-	-
Hansen (1989)	Argentina	Combined	-	-	74.6	29.4	0.22	-2.74	-	-	-	-	-
Cayre et al. (1993)	NE Atlantic	Combined	-	-	80.8	31.8	0.35	-1.7	5	-	-	-	-
Santamaria et al. (1998)	Ionian Sea, Italy	Combined	-	-	80.6	31.7	0.36	-1.37	-	-	-	-	-
Kahraman et al. (2014)	Black Sea and Sea of Maramara	Combined	212	Spine and Otolith	67.9	26.7	0.463	-1.22	-	17.7	7.0	63	24.8
		Male	89		74.6	29.4	0.364	-1.518	-	23	9.1	56.5	22.2
		Female	100		69.6	27.4	0.439	-1.327	-	25.5	10.0	63	24.8
Kotsiri et al. (2018)	Eastern Mediterranean Sea	Combined	502	Otolith	79.9	31.5	0.261	-1.23	7	7.2	2.8	70.4	27.7
Petukhova (2020)	Russia, Northeastern Atlantic Ocean	Combined	5634	-	75.6	29.8	0.41	-	-	22.3	8.8	72.5	28.5
Valeiras et al. (2008)	Western Mediterranean	Combined	136	Spines	62.5	24.6	0.719	-1.21	3	40	15.7	61	24.0
Tkacheva (1958)	Black Sea and Eastern Mediterranean	Combined	-	-	67.8	26.7	0.795	-	-	-	-	-	-
Mayorova and Tkacheva (1959)	Black Sea and Eastern Mediterranean	Combined	-	-	81.5	32.1	0.525	-	-	-	-	-	-
Demir (1963)	Black Sea and Eastern Mediterranean	Combined	-	-	64.0	25.2	0.86	-	-	-	-	-	-
Kutaygil (1967)	Black Sea and Eastern Mediterranean	Combined	-	-	95.6	37.6	0.237	-1.24	-	-	-	-	-
Zaboukas and Megalofonou (2007)	Eastern Mediterranean	Combined	397	Spines	83.0	32.7	0.24	-0.77	7	2.2	0.9	72.5	28.5

Table 20. A summary of maturity estimates from various studies on Atlantic bonito around the world.

Original Citation	Area/Region	Sex	n	L_{50} (cm)	L_{50} (in)
Baibbat et al. (2016)	Morocco	Combined	2688	42.6	16.8
		Male	83	41	16.1
		Female	75	40	15.7
Cenzig (2013)	Mediterranean	Male	82	35.8	14.1
		Female	100	41.9	16.5
Dardignac (1962)	Morocco	Male	-	40	15.7
		Female	-	45	17.7
Rey et al. (1984)	Gibraltar Spain	Male	242	38	15.0
		Female	229	39	15.4
Ates et al. (2008)	Black Sea and Marmara Sea, Turkey	Combined	694	36.9	14.5
Postel (1954)	East Atlantic	Male	-	39.2	15.4
		Female	-	37	14.6
Kahraman et al. (2014)	Black Sea and Marmara Sea, Turkey	Male	89	36.8	14.5
		Female	100	42.5	16.7
Petukhova (2020)	Russia, Northeastern Atlantic Ocean	Combined	5634	44.7	17.6
Saber et al. (2017)	Mediterranean	Combined		39.9	15.7

FIGURES

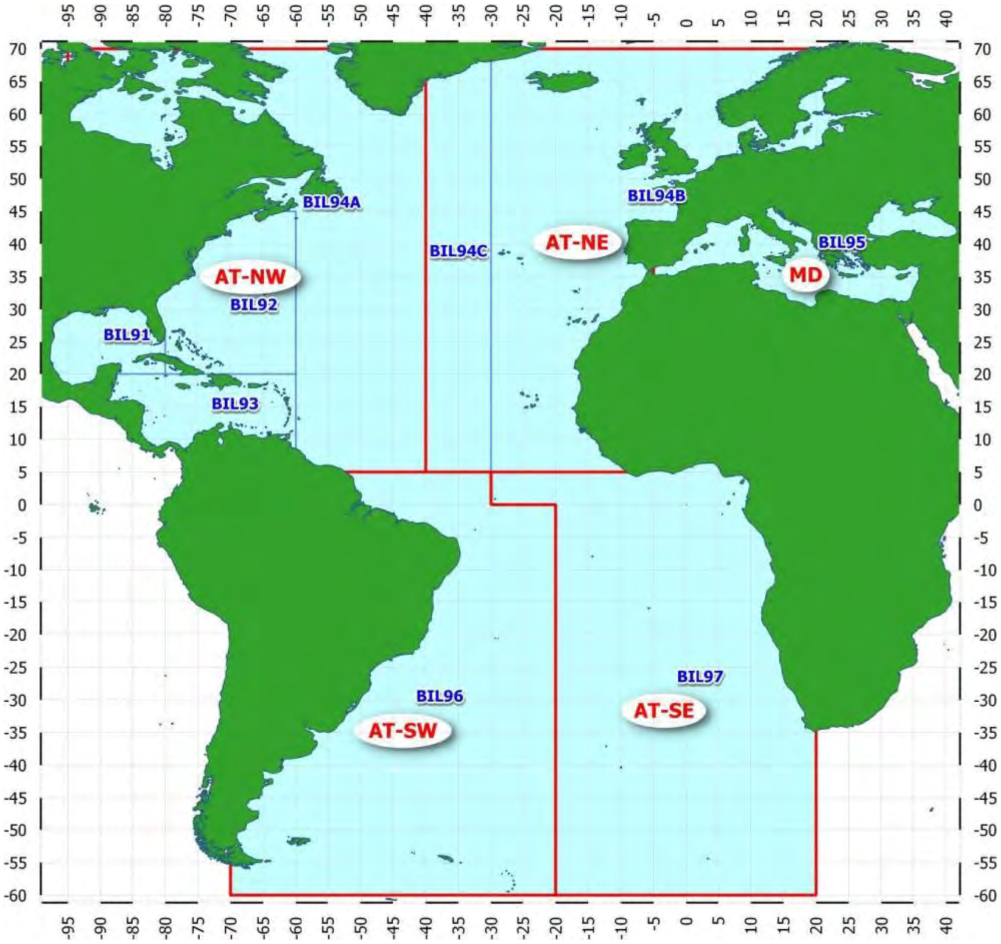

Figure 1. The five management units used by ICCAT for small tunas (ICCAT 2016).

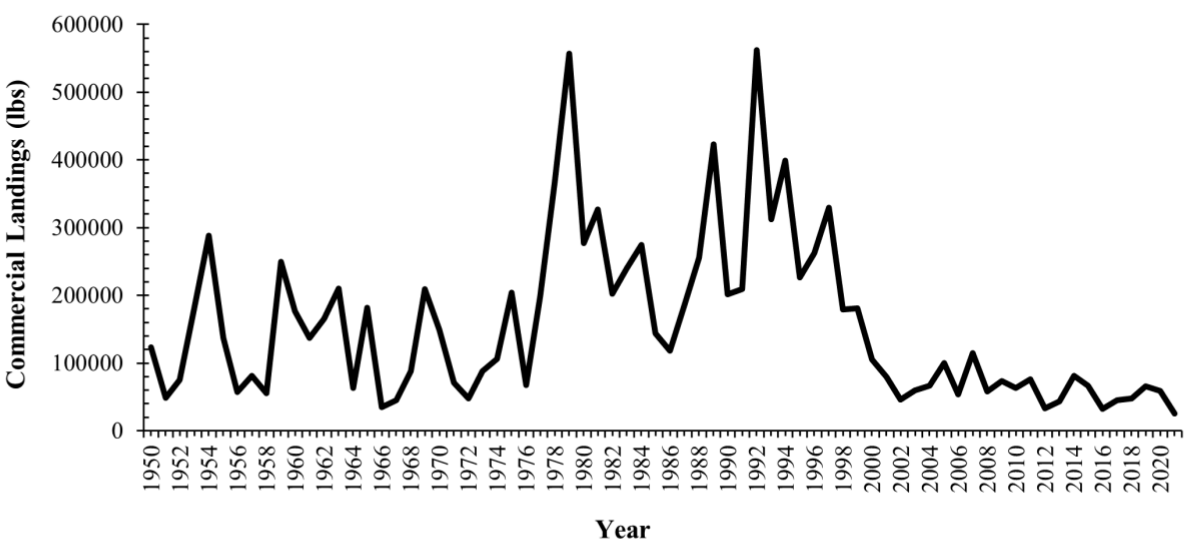

Figure 2. Total commercial landings (lbs.) from 1950 to 2021.

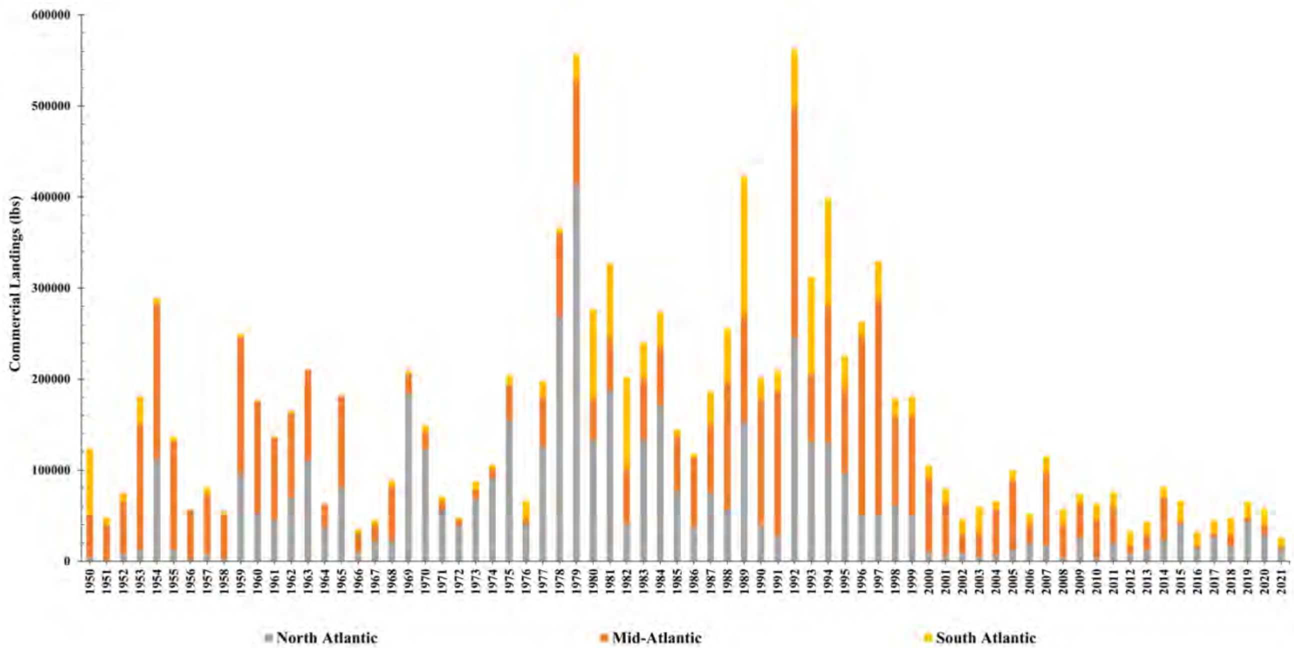

Figure 3. Total commercial landings (lbs.) from 1950 to 2021 by region.

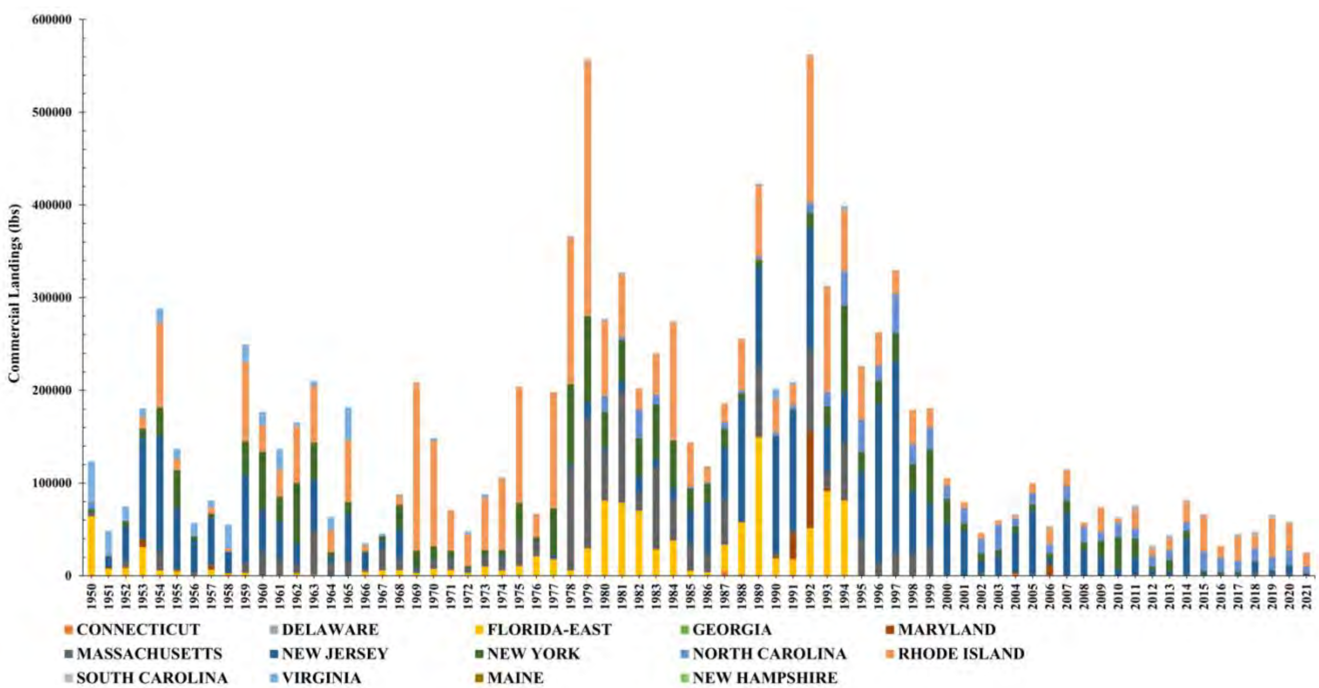

Figure 4. Total commercial landings (lbs.) from 1950 to 2021 by state.

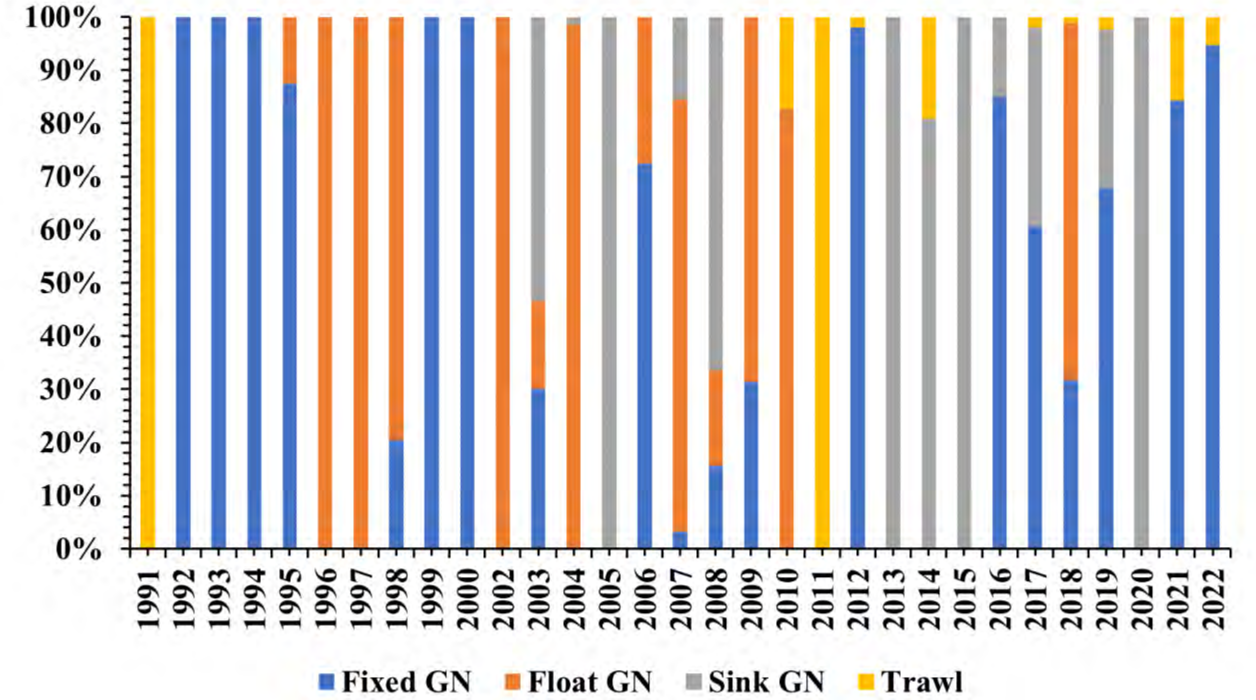

Figure 5. Percentage of commercial discards by type of gill net from 1993-2020

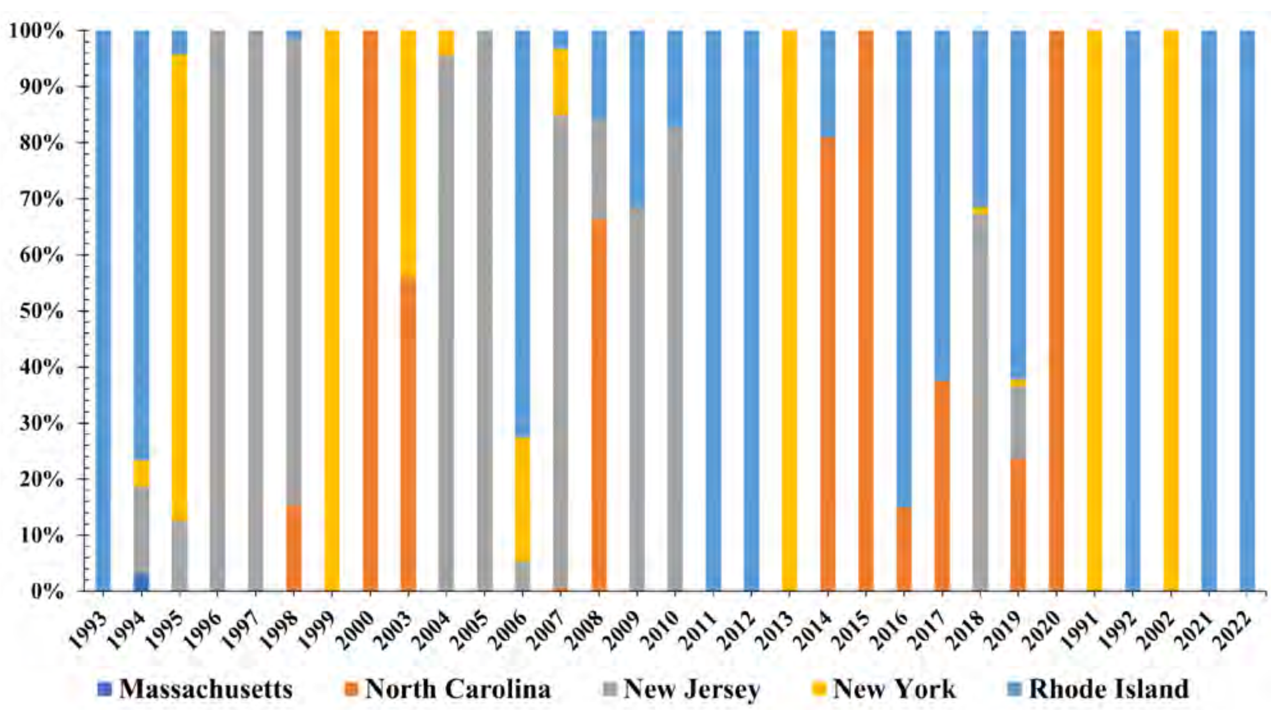

Figure 6. Percentage of commercial discards by state from 1993-2020

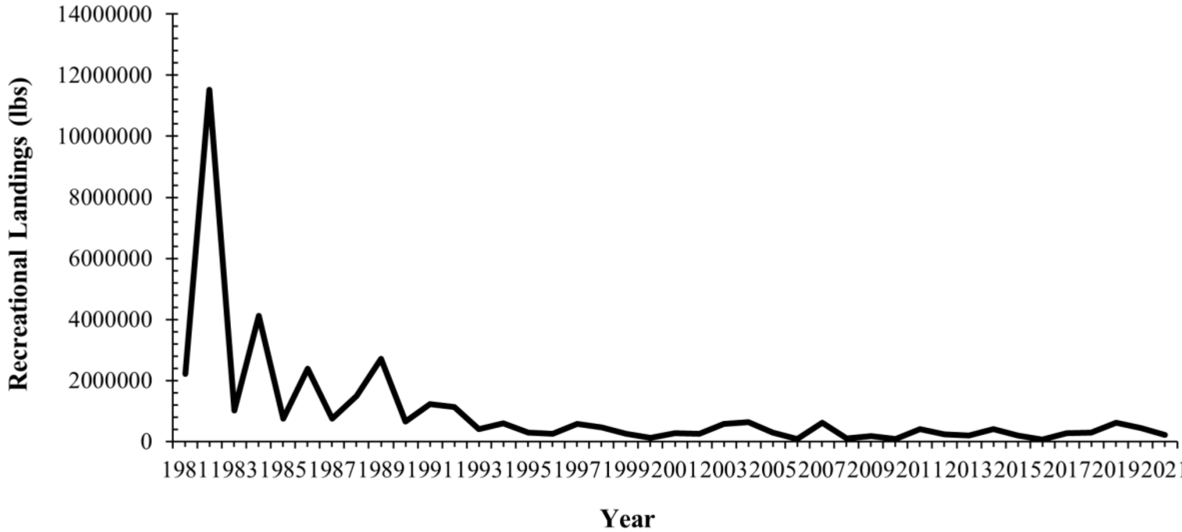

Figure 7. Total recreational landings (lbs.) from 1981 to 2021.

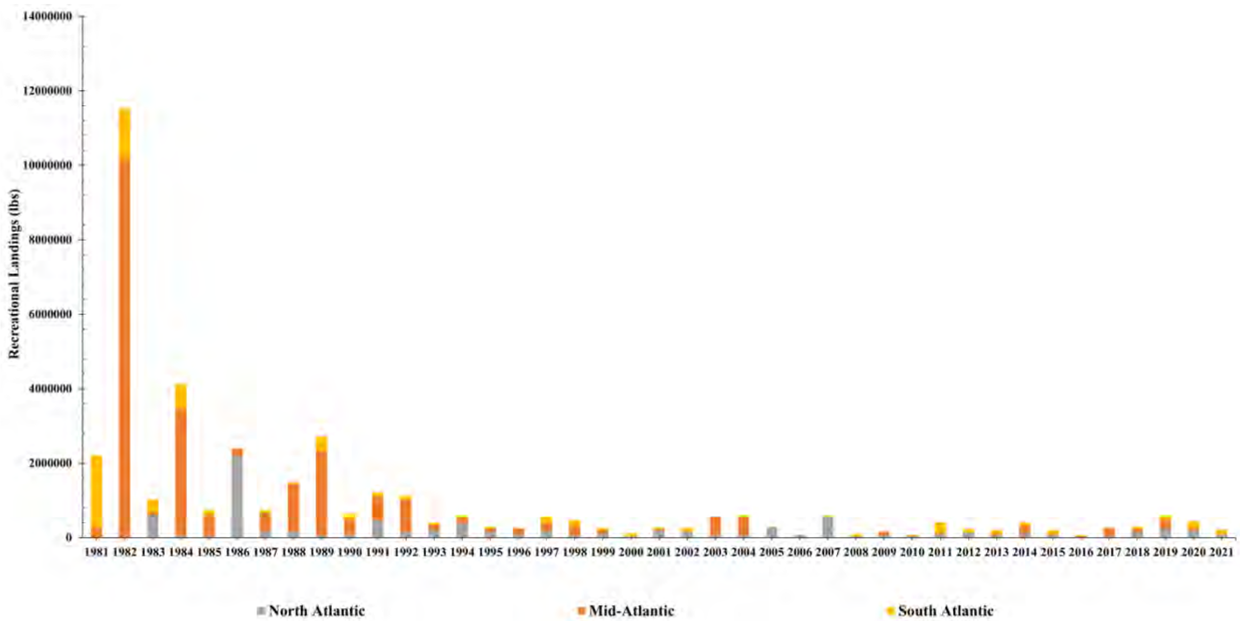

Figure 8. Total recreational landings (lbs.) from 1981 to 2021 by region.

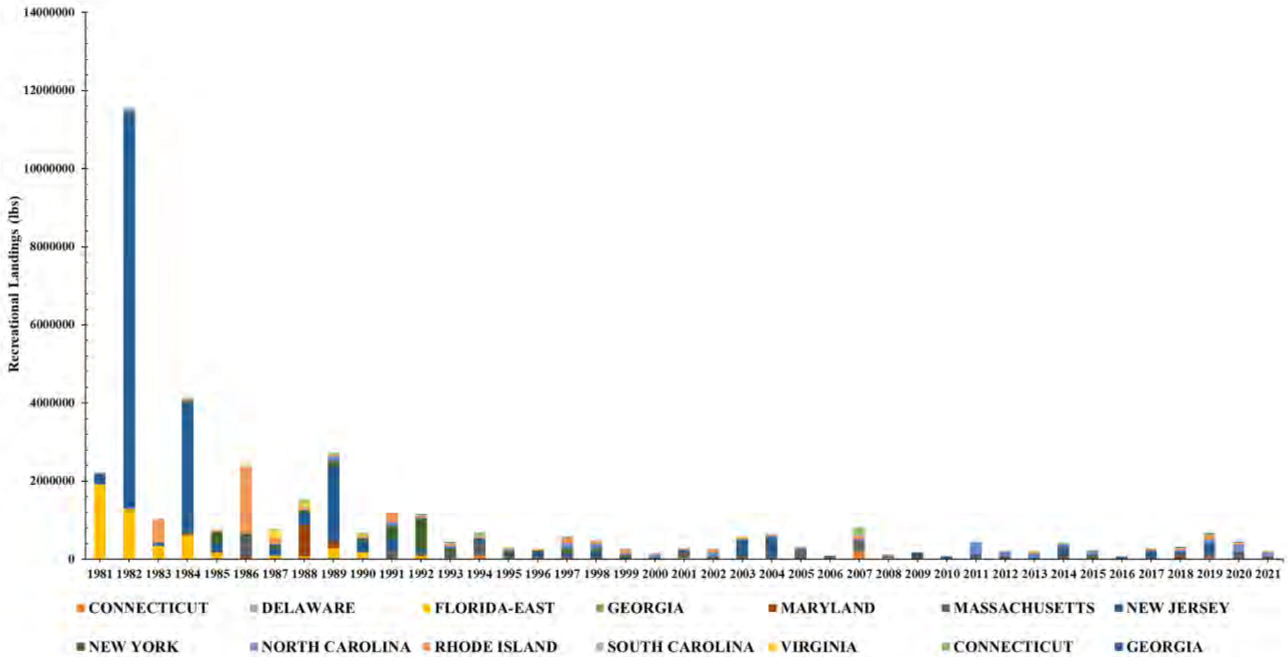

Figure 9. Total recreational landings (lbs.) from 1981 to 2021 by state.

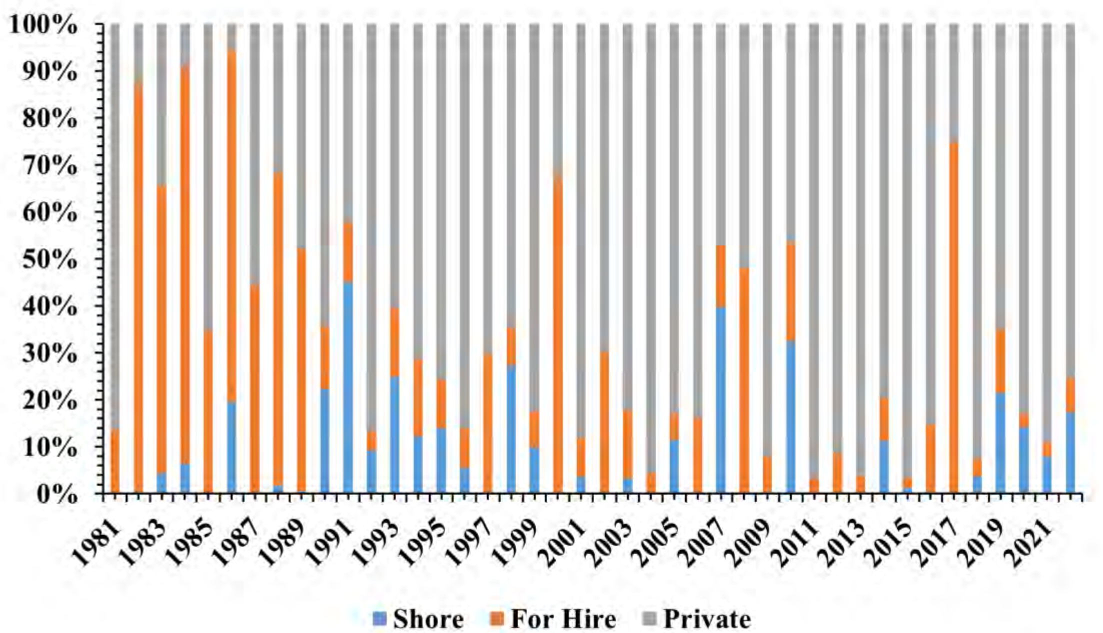

Figure 10. Percentage of recreational landings by mode of fishing from 1981-2022.

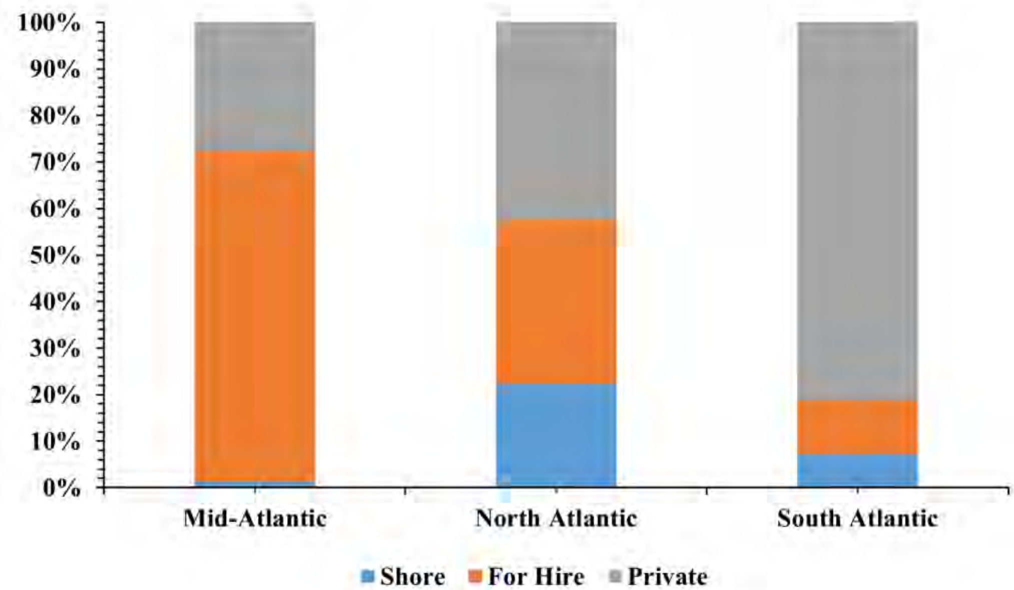

Figure 11. Percentage of recreational landings by mode of fishing for each region.

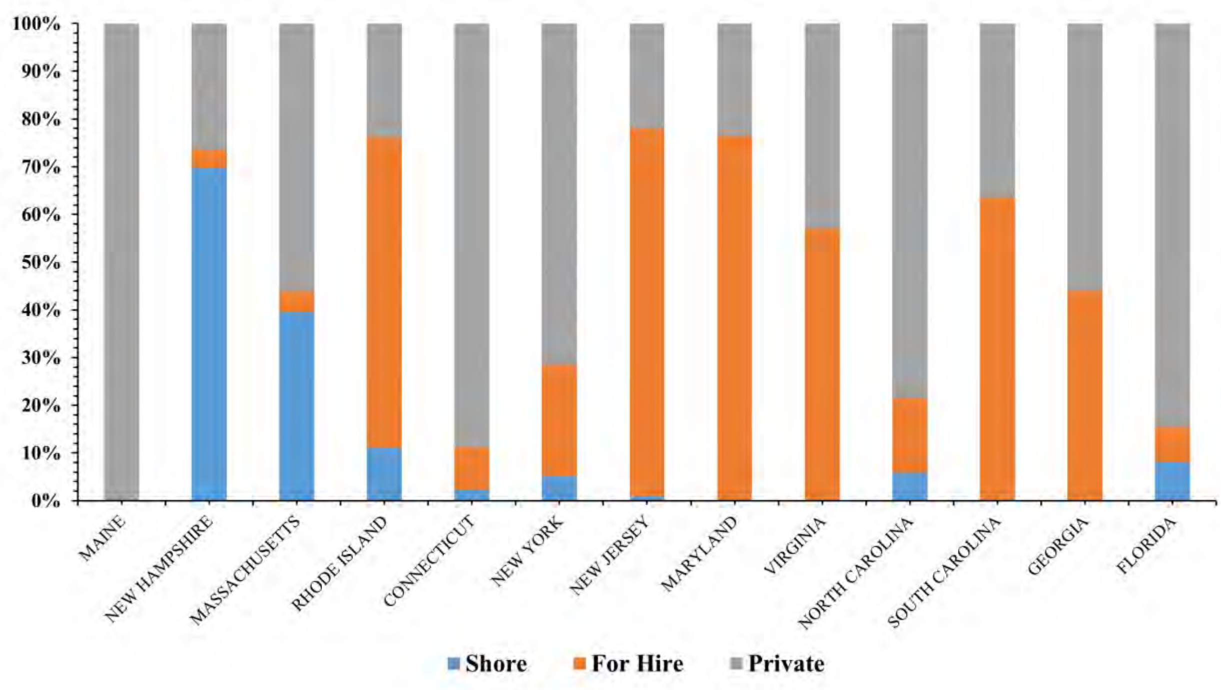

Figure 12. Percentage of recreational landings by mode of fishing for each state.

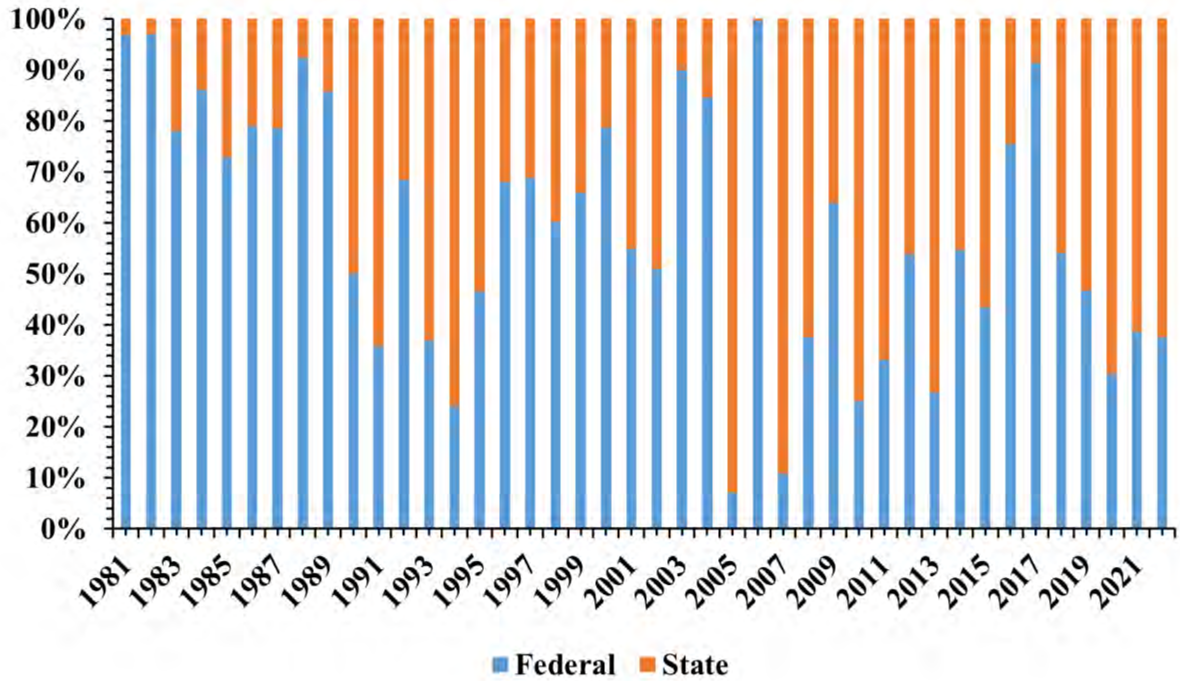

Figure 13. Percentage of recreational landings in federal and state waters from 1981-2022.

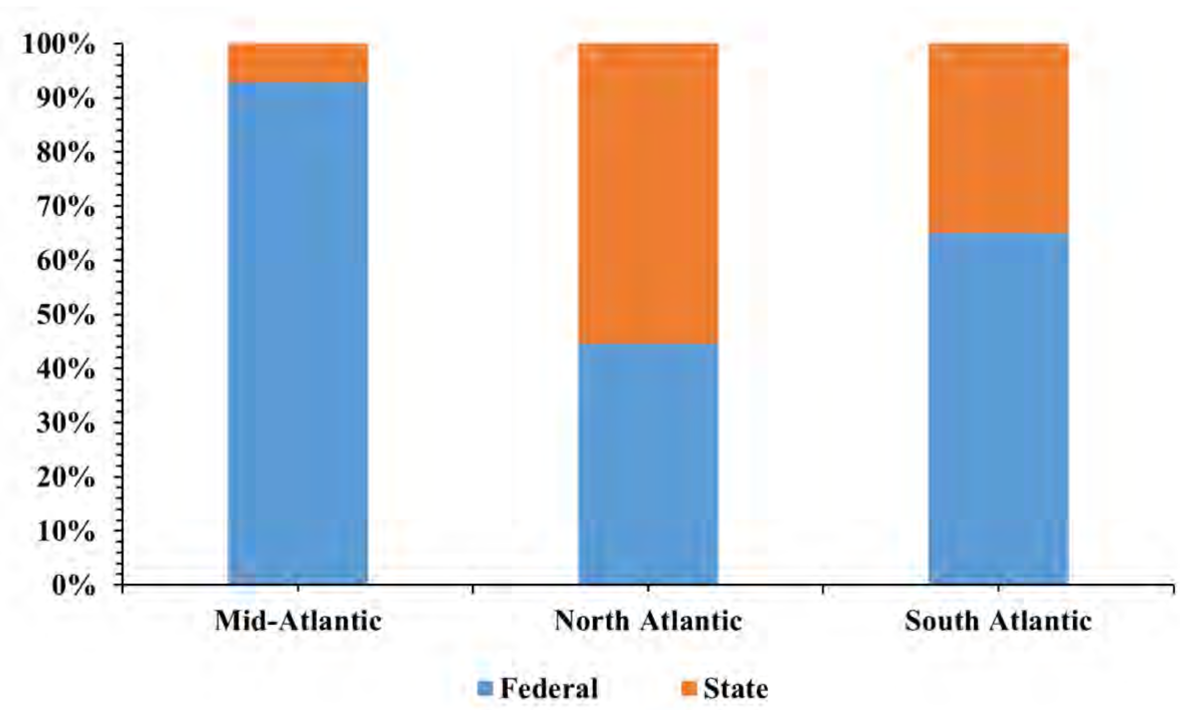

Figure 14. Percentage of recreational landings in federal and state waters for each region.

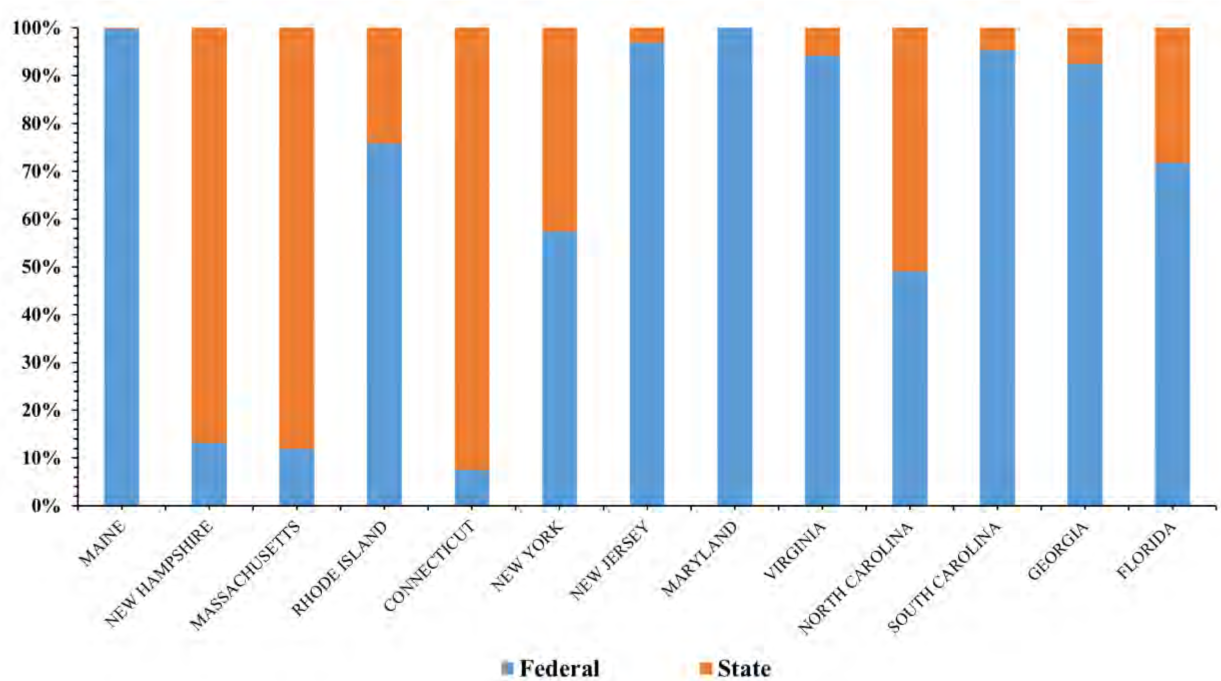

Figure 15. Percentage of recreational landings in federal and state waters for each state.

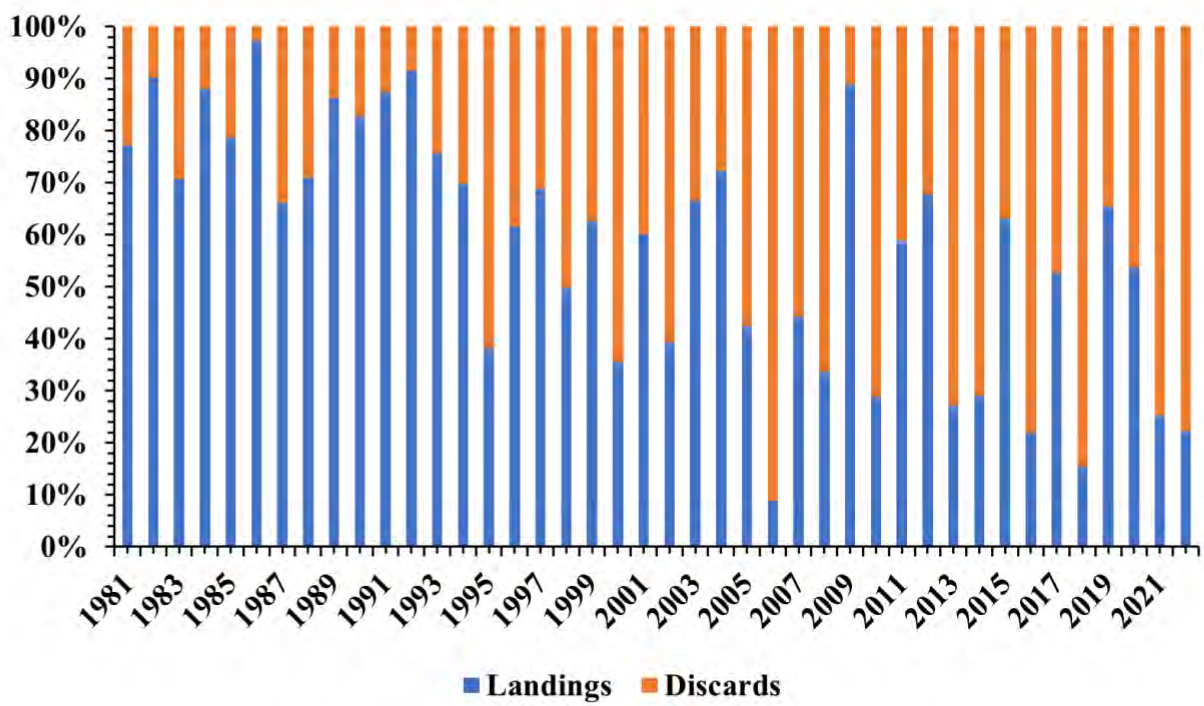

Figure 16. Percentage of fish landed vs discarded from 1981 to 2022.

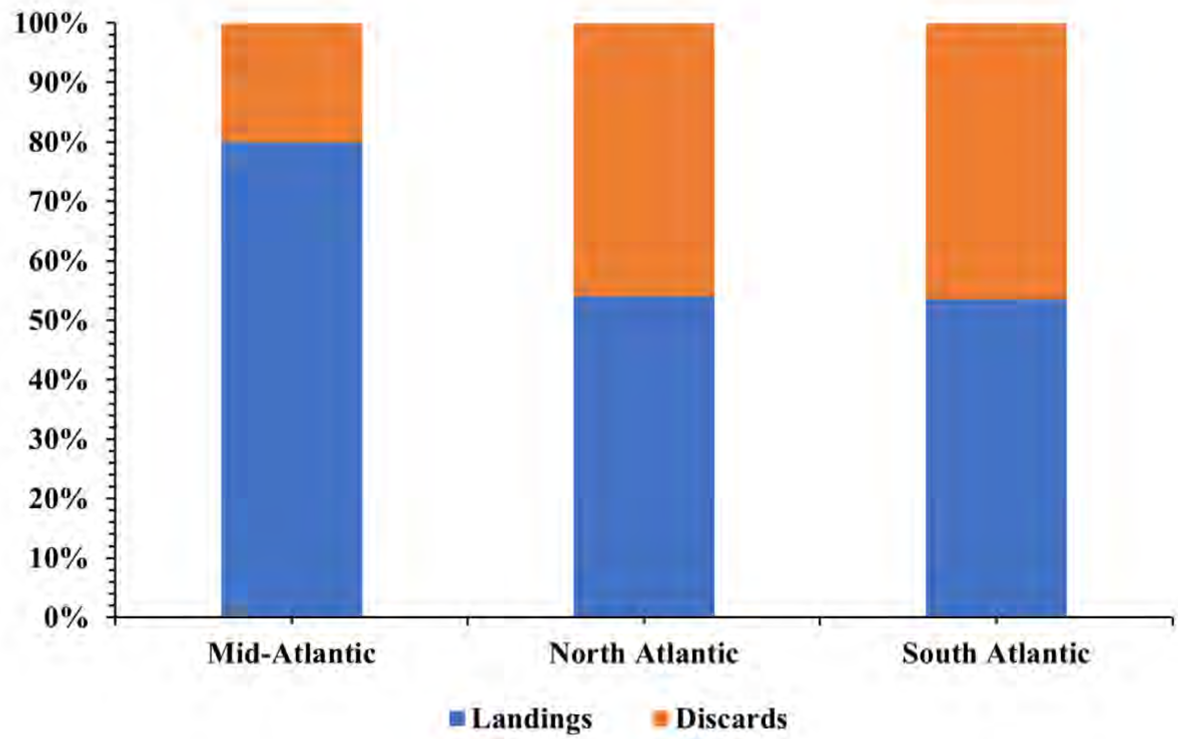

Figure 17. Percentage of fish landed vs discarded by region from 1981 to 2022.

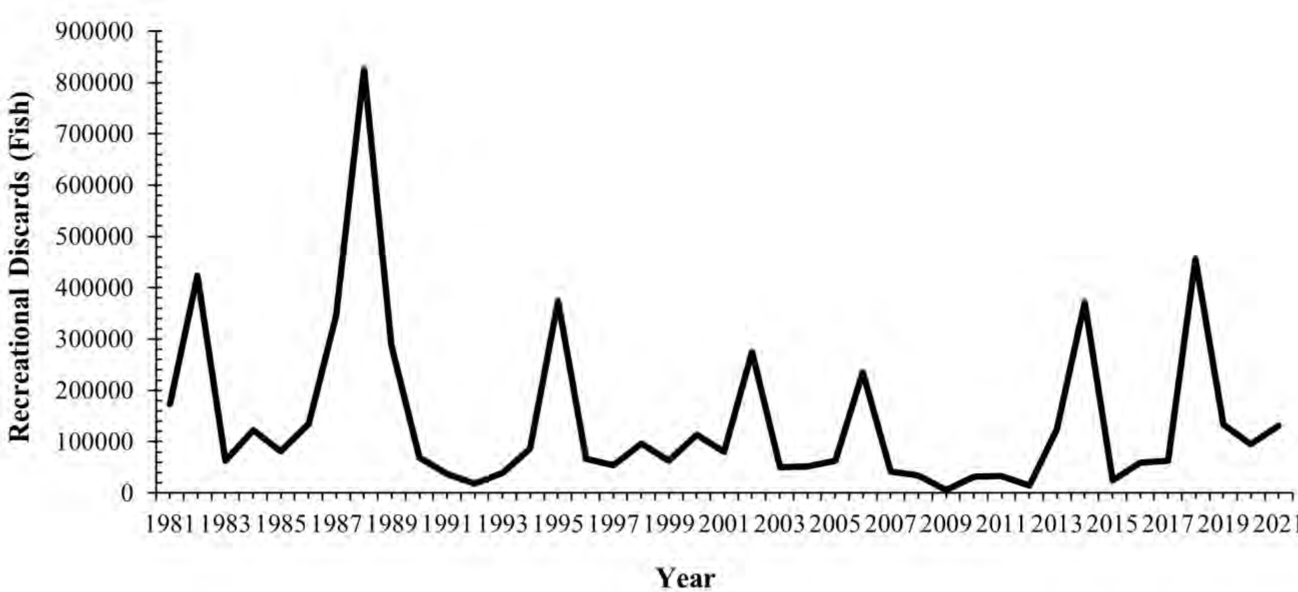

Figure 18. Total recreational discards (individuals) from 1981 to 2021.

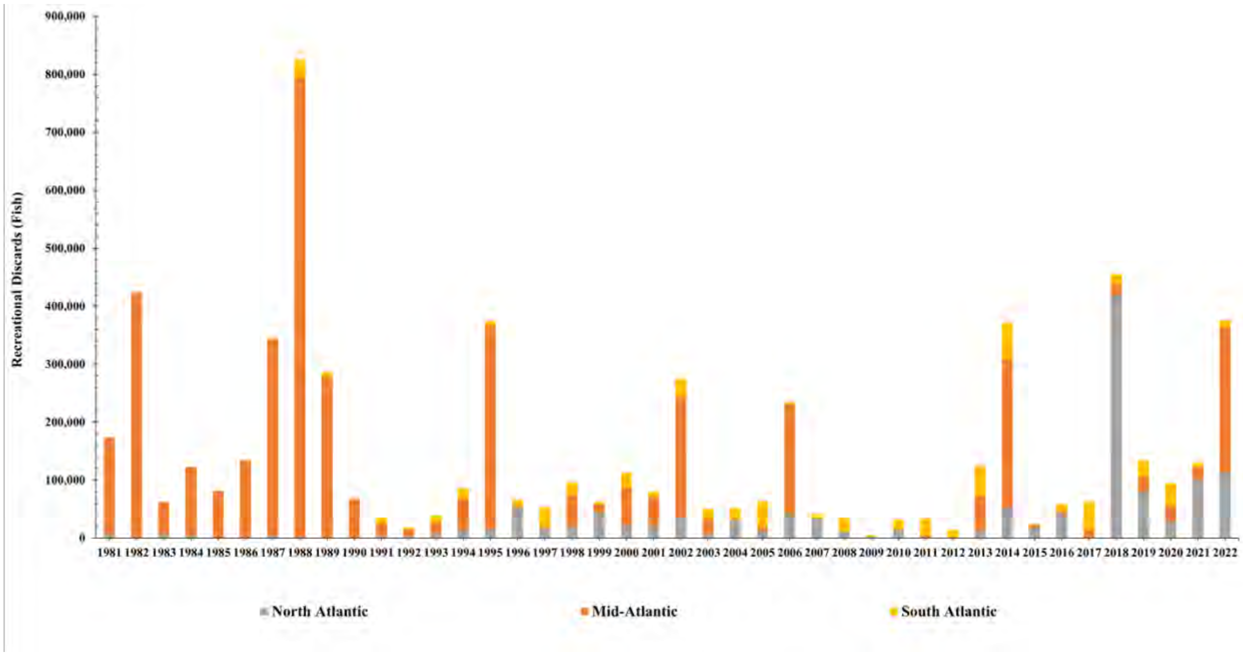

Figure 19. Total recreational discards (individuals) from 1981 to 2021 by region.

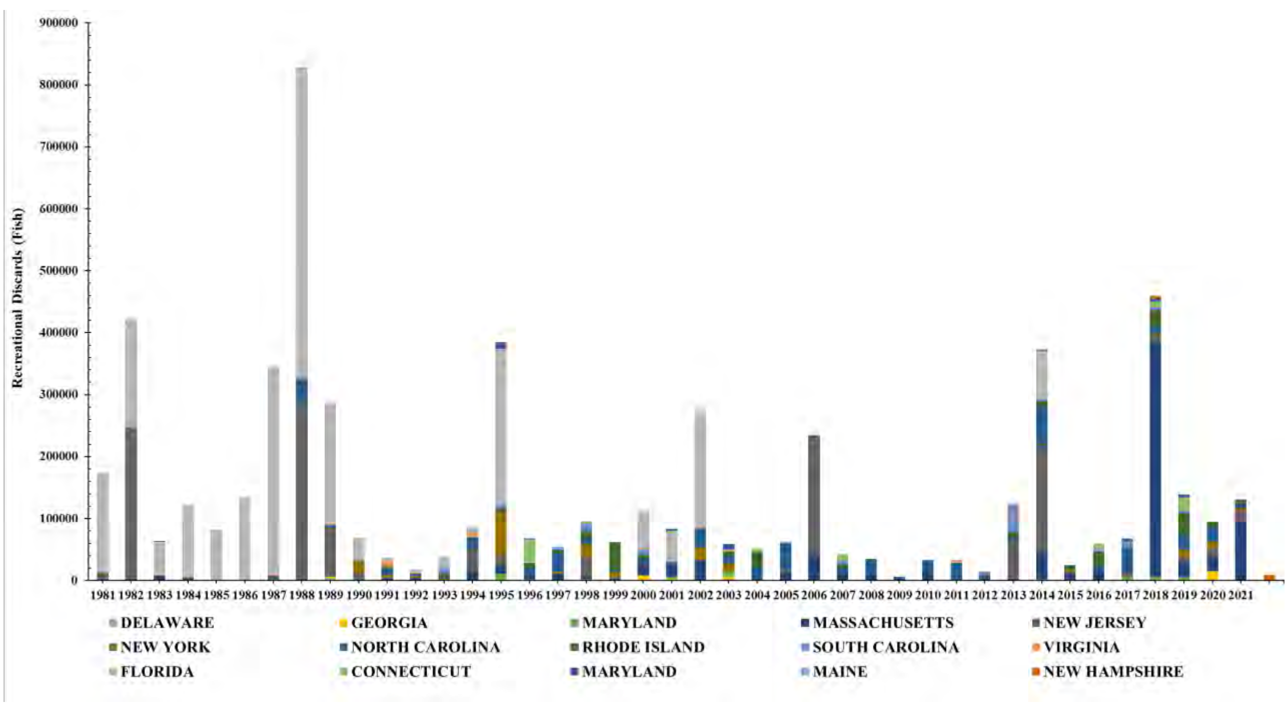

Figure 20. Total recreational discards (individuals) from 1981 to 2021 by state.

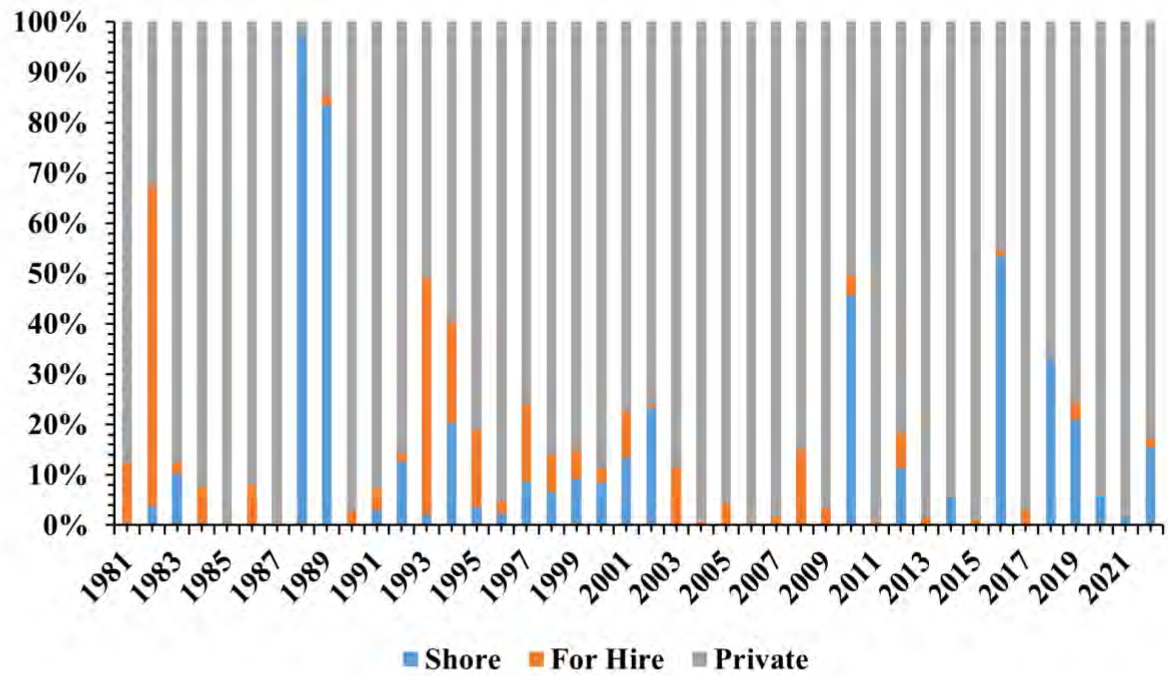

Figure 21. Percentage of recreational discards by mode of fishing from 1981-2022.

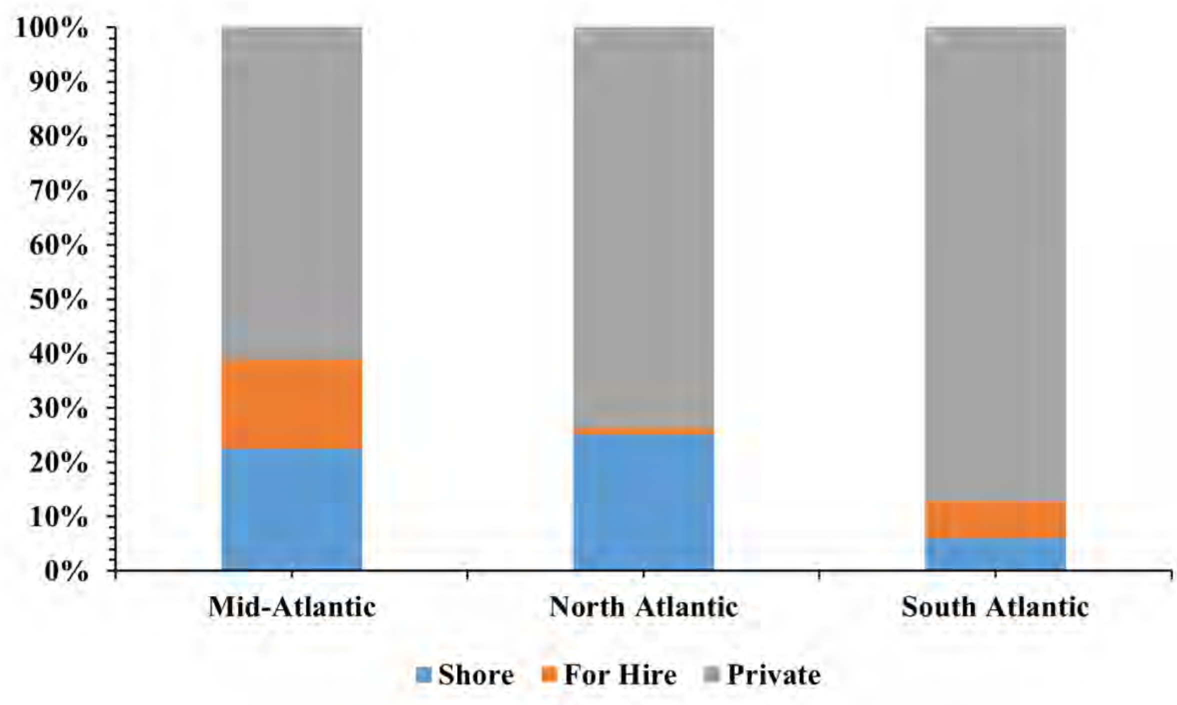

Figure 22. Percentage of recreational discards by mode of fishing for each region.

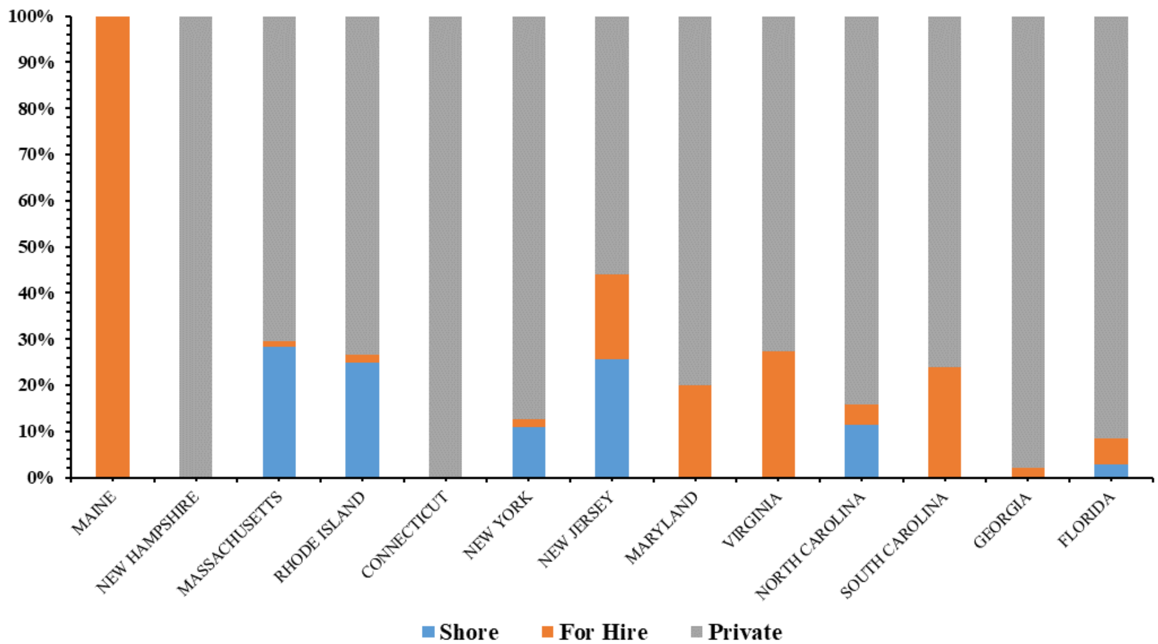

Figure 23. Percentage of recreational discards by mode of fishing for each state.

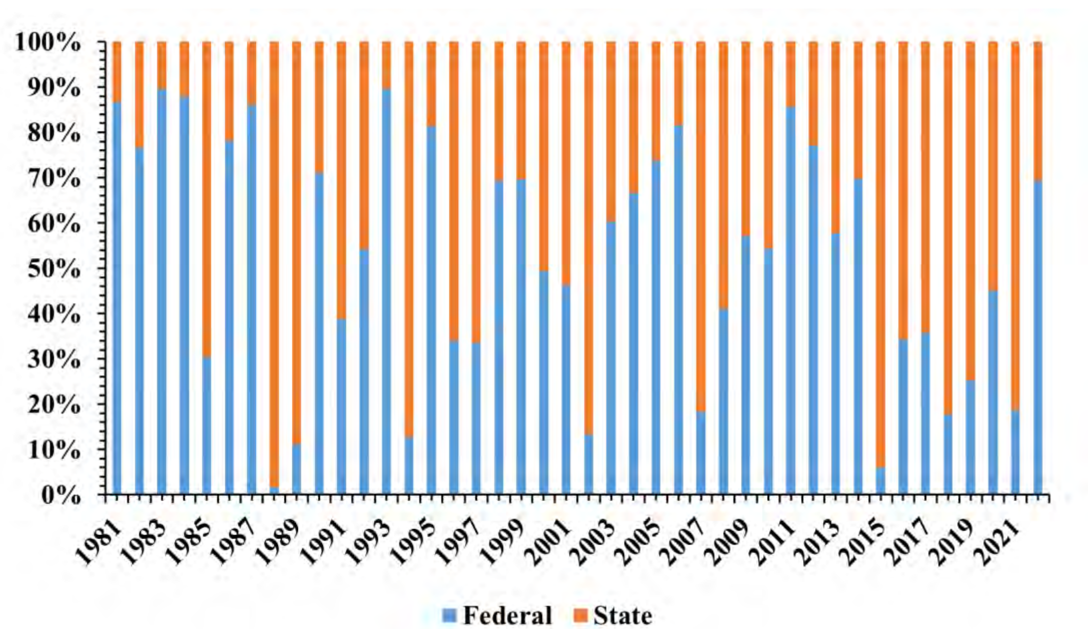

Figure 24. Percentage of recreational discards in federal and state waters from 1981-2022.

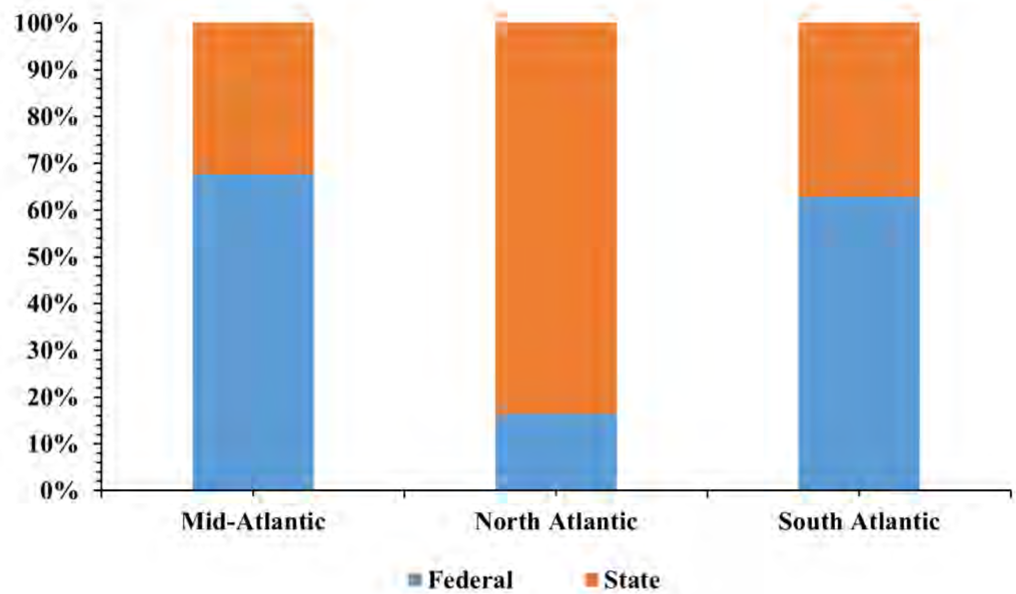

Figure 25. Percentage of recreational discards in federal and state waters for each region.

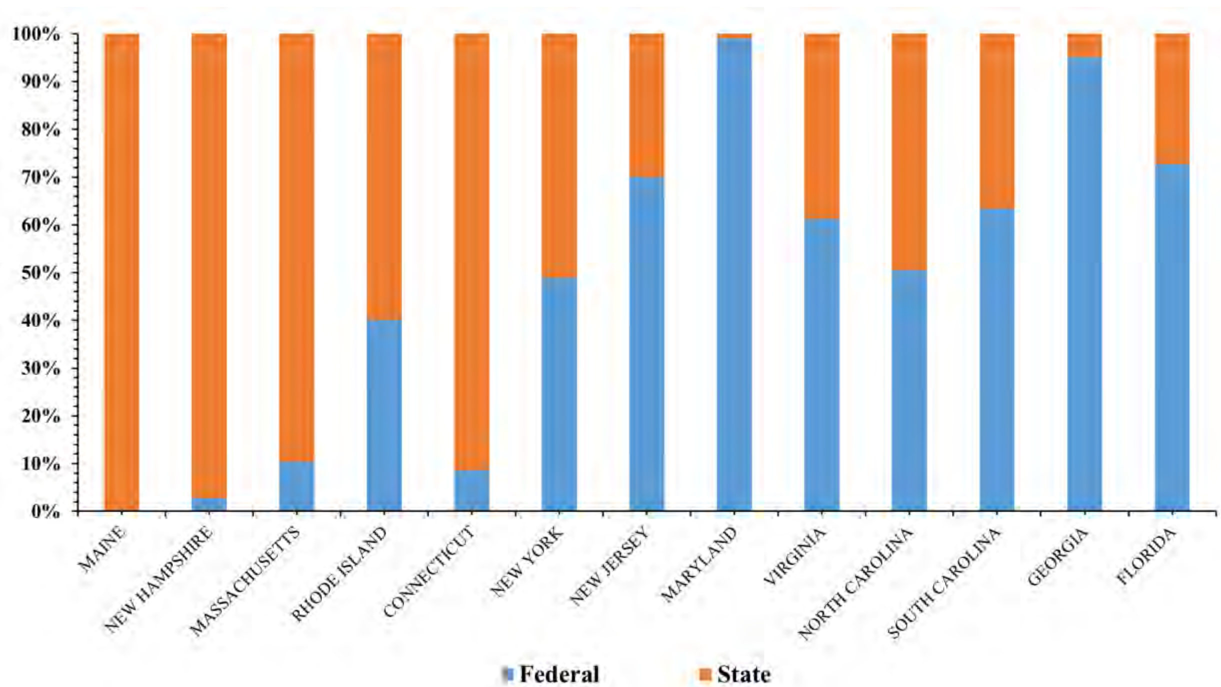

Figure 26. Percentage of recreational discards in federal and state waters for each state.

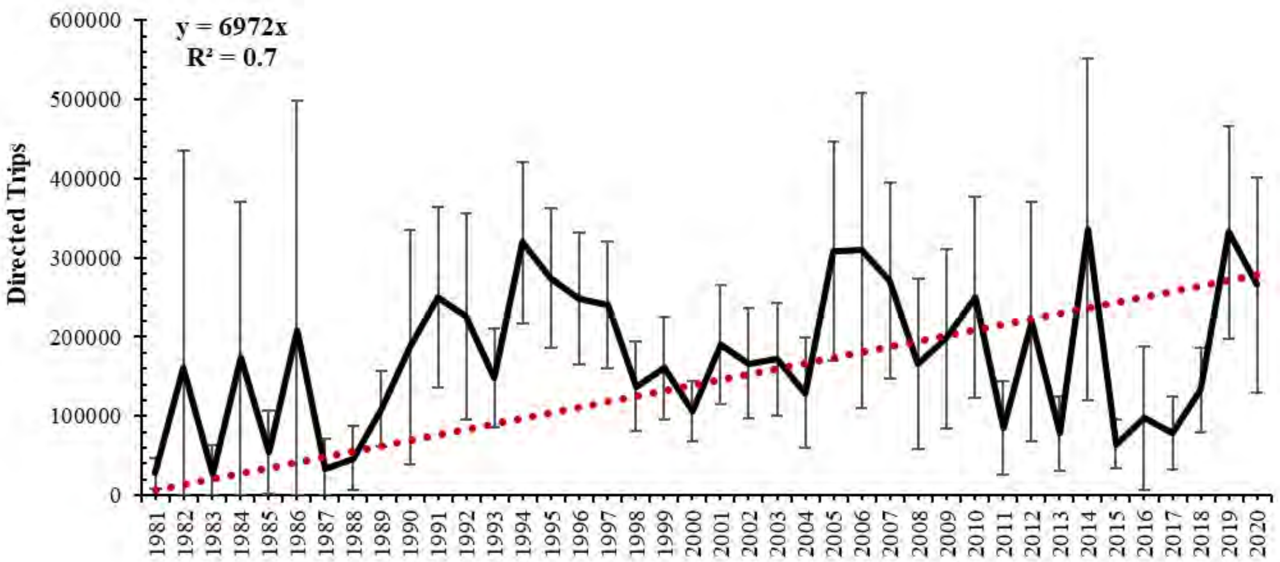

Figure 27. Directed trips for bonito with 95% confidence intervals from 1981-2022.

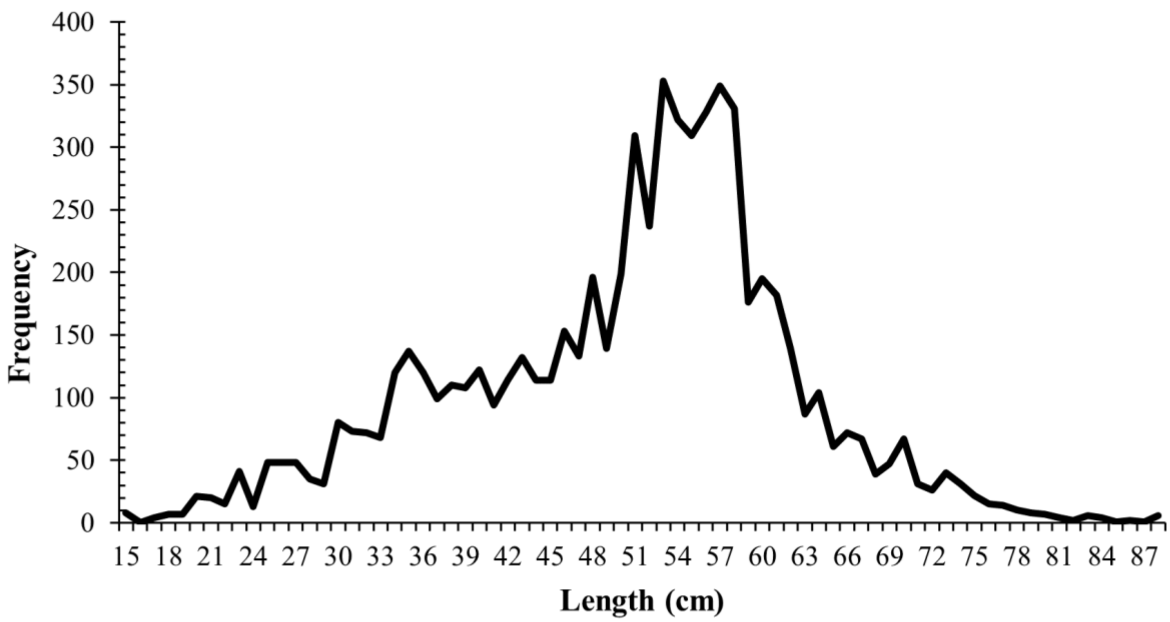

Figure 28. The aggregated length-frequency of the entire MRIP data set.

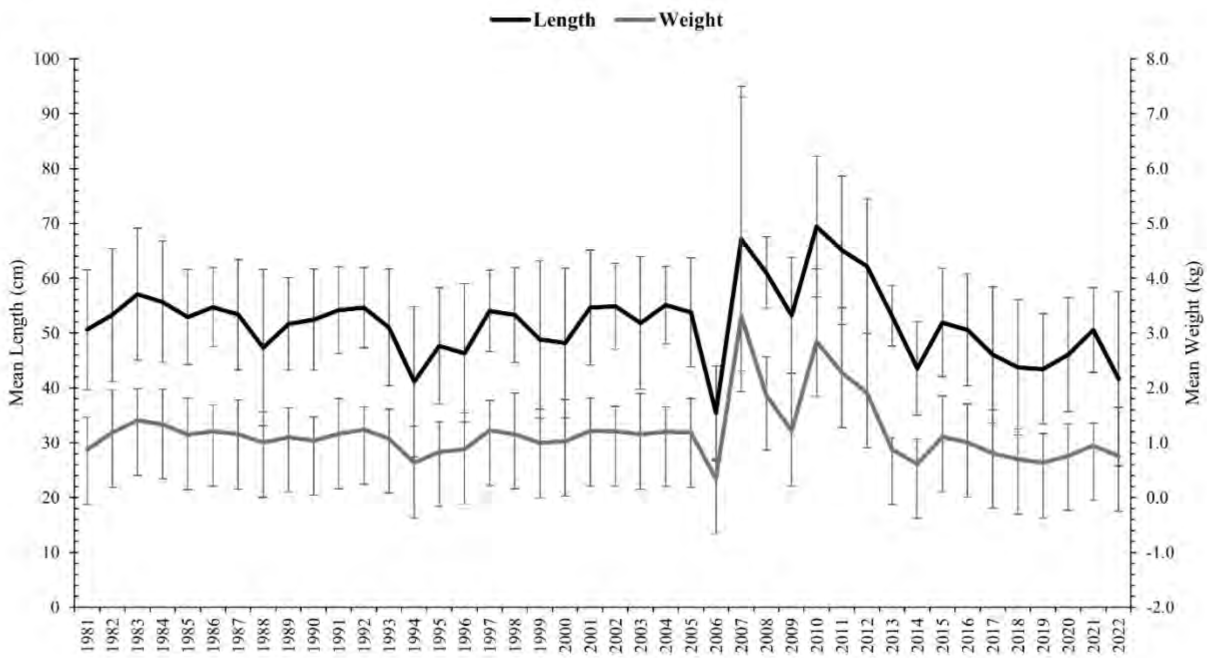

Figure 29. The mean length (Black) and mean weight (Gray) of MRIP sampled fish from 1981 to 2022, error bars based on standard deviation.

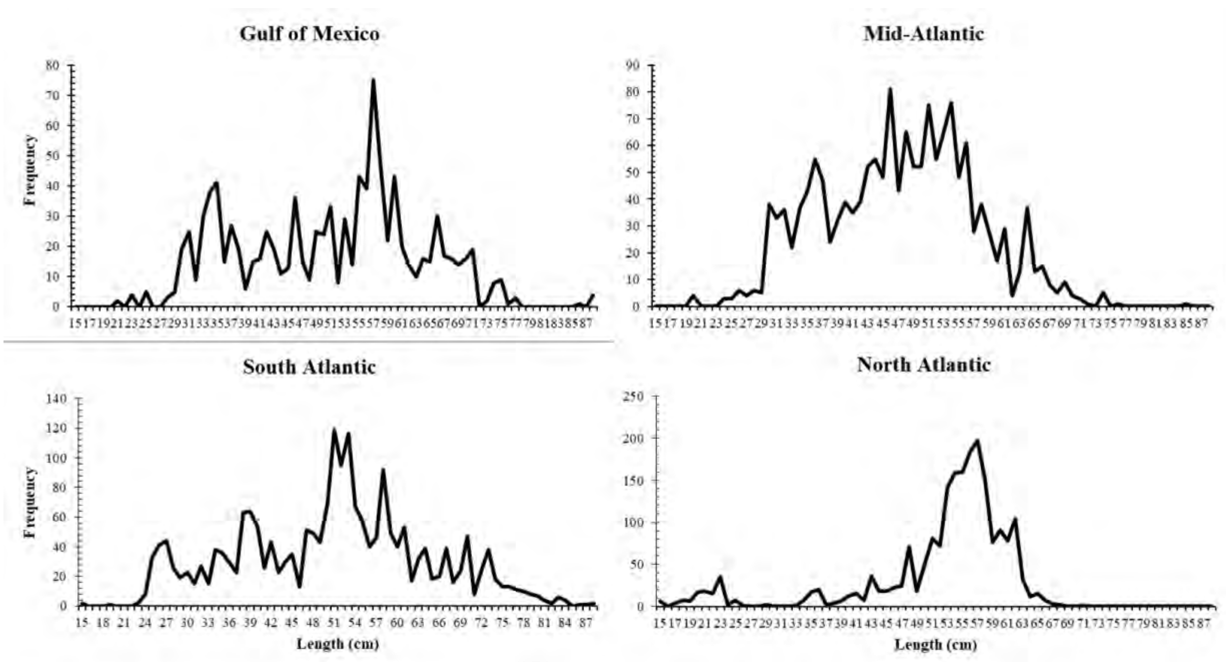

Figure 30. The length frequency distributions for the four regions with data from 1981-2022.

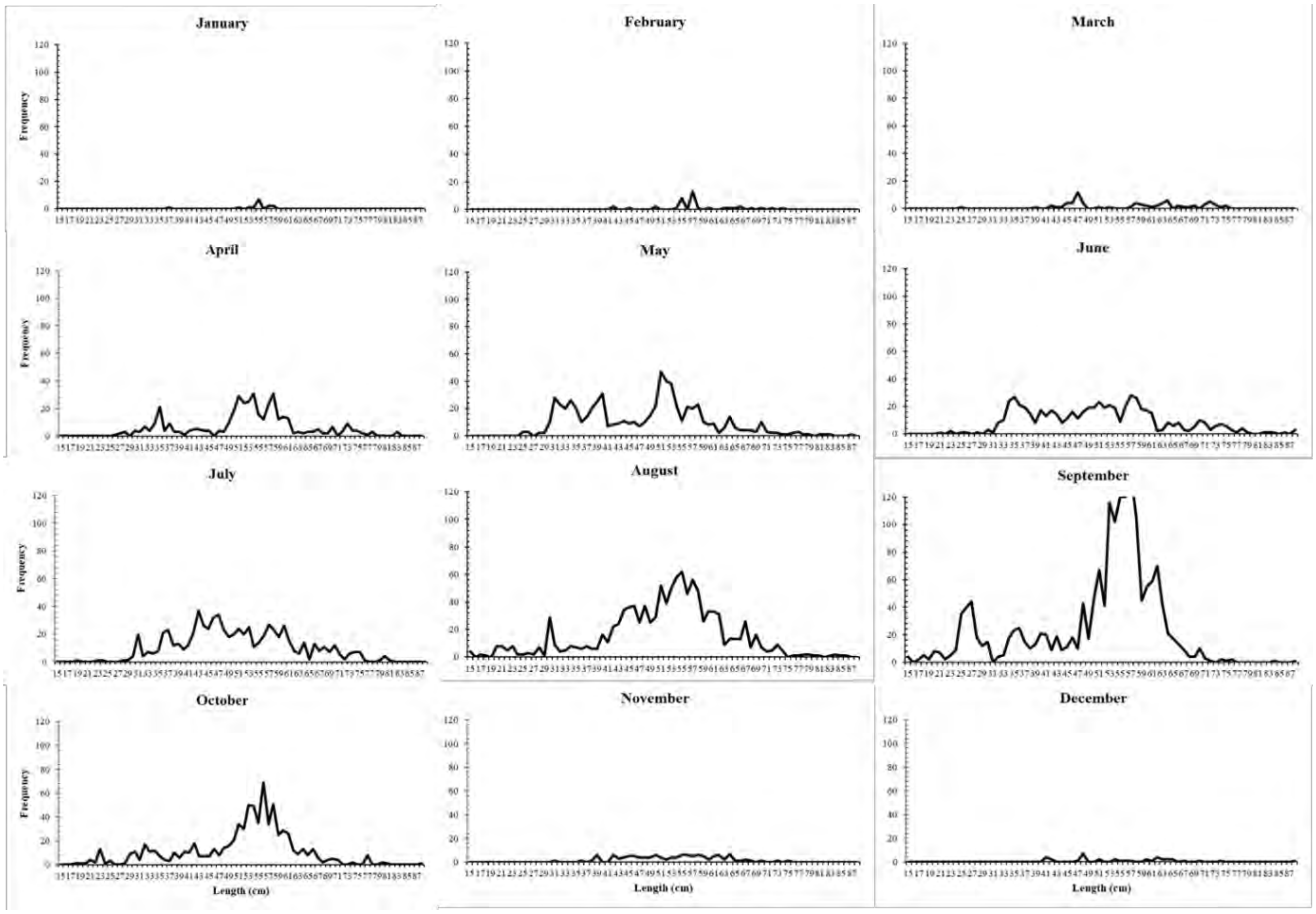

Figure 31. The length frequency distributions for by month from 1981-2022.

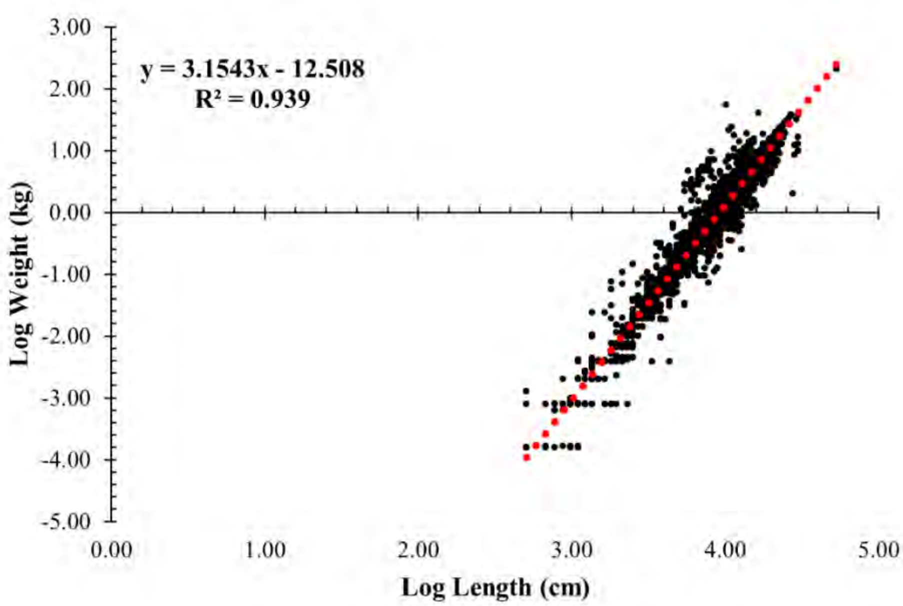

Figure 32. The logarithmic length-weight relationship on all data from 1981-2022.

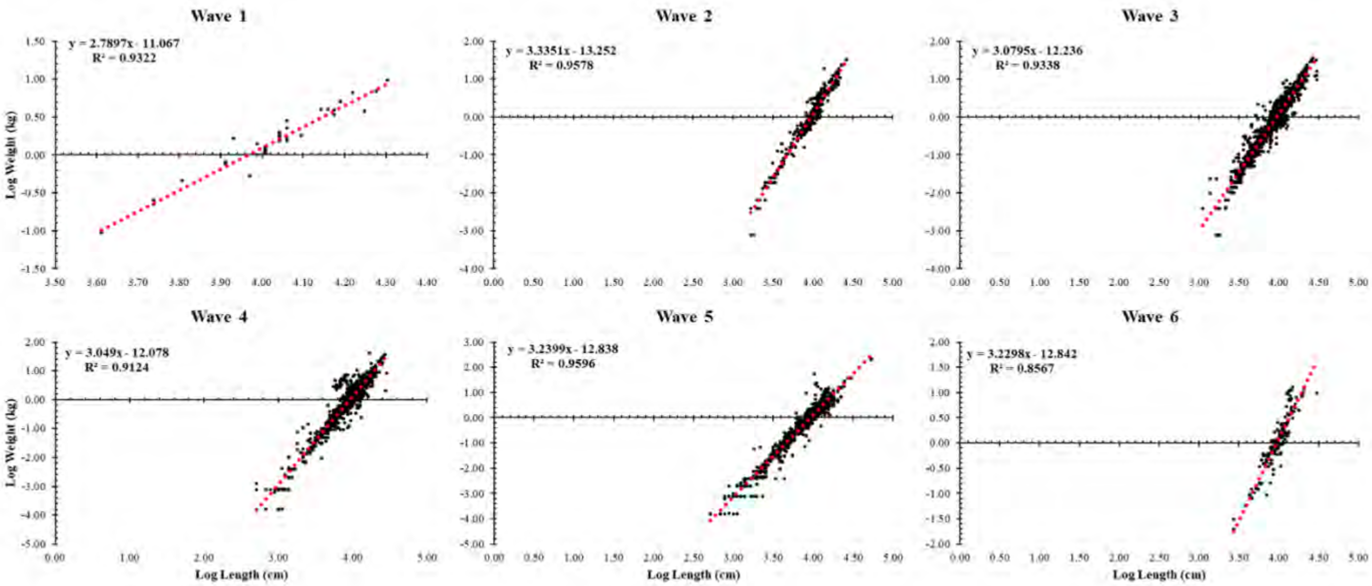

Figure 33. The logarithmic length-weight relationship for waves 1-6 using all data from 1981-2022.

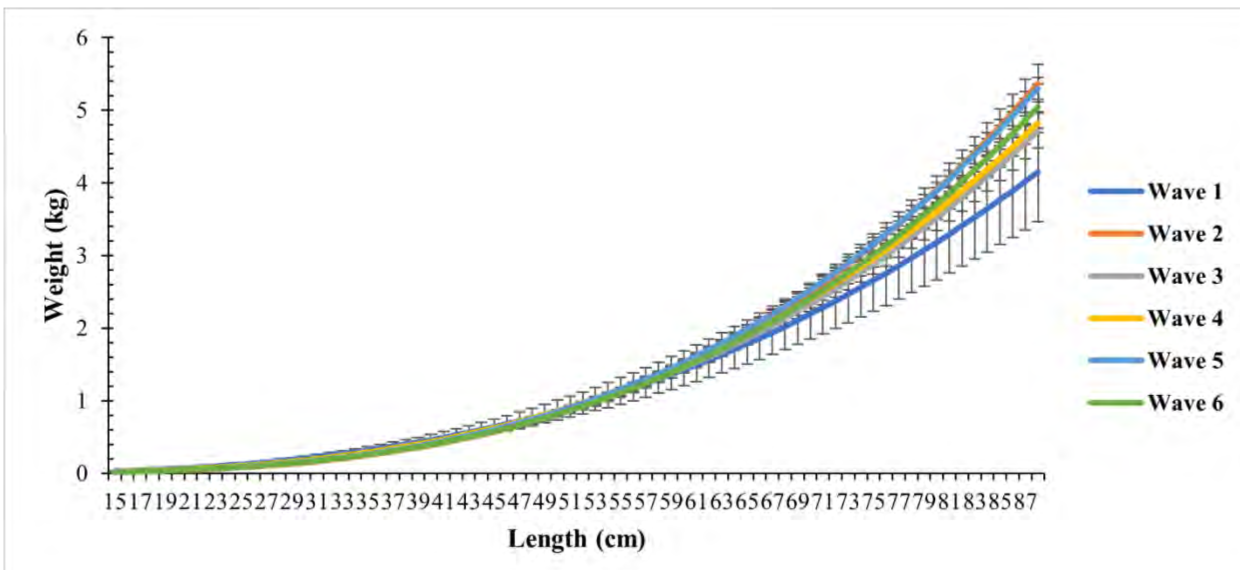

Figure 34. The predicted weights at length for waves 1-6 with 95% confidence intervals.

APPENDIX 1. MANAGEMENT AUTHORITY

Table 1. The marine fisheries management authority for each state along the Atlantic and Gulf coasts.

State	Management Authority
Maine	Department of Marine Resources
New Hampshire	Fish and Game
Massachusetts	Division of Marine Fisheries
Rhode Island	Department of Environmental Management
Connecticut	Department of Energy & Environmental Protection
New York	Department of Environmental Conservation
New Jersey	Department of Environmental Protection
Delaware	Fish and Wildlife
Maryland	Department of Natural Resources
Virginia	Marine Resources Commision
North Carolina	Division of Marine Fisheries
South Carolina	Department of Natural Resources
Georgia	Department of Natural Resources
Florida	Fish and Wildlife Conservation Commission

APPENDIX 2. FISHERIES DATA

Table A2.1. Commercial landings (lbs.) 1950-2021 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total
1950	47000	4700	71800	123500
1951	40000	600	7700	48300
1952	58400	7800	8600	74800
1953	137500	12800	30500	180800
1954	170300	112000	5900	288200
1955	119300	12900	4800	137000
1956	54000	2300	700	57000
1957	66900	7400	6500	80800
1958	49400	3300	2300	55000
1959	149900	96100	3300	249300
1960	121800	54200	600	176600
1961	90900	45500	600	137000
1962	93400	69400	2300	165100
1963	99900	109900	500	210300
1964	25400	37700	100	63200
1965	100000	81700	100	181800
1966	21300	9600	4100	35000
1967	17000	22600	5700	45300
1968	60500	21800	6000	88300
1969	21700	184100	2900	208700
1970	18600	122800	7200	148600
1971	8000	56500	6300	70800
1972	6500	38600	2900	48000
1973	9700	68000	10000	87700
1974	9700	91000	5400	106100
1975	38400	155000	10700	204100
1976	5500	40400	21100	67000
1977	53900	126300	17800	198000
1978	91000	269100	5777	365877
1979	112600	414400	29930	556930
1980	45200	133600	98227	277027
1981	57300	187100	82645	327045
1982	60500	41100	100723	202323
1983	67800	132800	39533	240133

Table A2.2. Commercial landings (lbs.) 1950-2021 by region (Cont.).

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total
1984	64000	171400	38725	274125
1985	60500	77300	6440	144240
1986	75600	38000	4664	118264
1987	76700	74200	35291	186191
1988	139600	57000	59086	255686
1989	116400	153600	152864	422864
1990	138558	40551	22438	201547
1991	159659	27248	21875	208782
1992	253286	245658	63061	562005
1993	74803	131025	106720	312548
1994	149876	130015	118854	398745
1995	94619	96606	34718	225943
1996	196957	49356	16268	262581
1997	236290	50901	42372	329563
1998	96332	61337	21353	179022
1999	106185	51388	23291	180864
2000	81956	9938	13343	105237
2001	56564	6501	16531	79596
2002	21617	9136	15456	46209
2003	27293	5027	27379	59699
2004	50456	6552	9303	66311
2005	75574	12684	11672	99930
2006	21873	19243	12137	53253
2007	80073	17395	17404	114872
2008	35555	4493	17515	57563
2009	37559	25821	10454	73834
2010	41823	4646	16454	62923
2011	38901	20224	16712	75837
2012	8635	8166	15896	32697
2013	17328	11910	14457	43695
2014	47004	23100	11461	81565
2015	3578	40740	22278	66596
2016	2634	14457	15183	32274
2017	3660	26764	14619	45043
2018	12090	16811	18691	47592
2019	4939	42989	17848	65776
2020	10055	30165	18221	58441
2021	2400	13706	9272	25378
Overall	44%	41%	15%	
10-Year	23%	46%	32%	

Table A2.2. Commercial landings (lbs.) 1950-2021 by state.

Year	CT	DE	FL EAST	GA	ME	MD	MA	NH	NJ	NY	NC	RI	SC	VA
1950	0	0	64000	0	0	0	4300	0	200	3100	7800	400	0	43700
1951	0	0	7700	0	0	1100	200	0	12400	500	0	400	0	26000
1952	0	0	8600	0	0	700	7800	0	36000	5900	0	0	0	15800
1953	0	500	30500	0	0	8000	100	0	109600	9900	0	12700	0	9500
1954	0	0	5900	0	0	0	20400	0	123700	31400	0	91600	0	15200
1955	0	0	4800	0	0	1700	700	0	65400	41300	0	12200	0	10900
1956	0	0	700	0	0	500	2200	0	34500	4700	0	100	0	14300
1957	0	0	6500	0	0	4400	1000	0	51200	3900	0	6400	0	7400
1958	0	0	2300	0	0	800	0	0	23000	0	0	3300	0	25600
1959	0	0	3300	0	0	0	10600	0	95500	35800	0	85500	0	18600
1960	0	0	600	0	0	100	25300	0	45000	62700	0	28900	0	14000
1961	0	0	600	0	0	300	16800	0	40600	27100	0	28700	0	22900
1962	0	0	2300	0	0	1100	8700	0	22600	65500	0	60700	0	4200
1963	500	0	500	0	0	0	48100	0	54800	39500	0	61300	0	5600
1964	0	0	100	0	0	0	13800	0	5900	5600	0	23900	0	13900
1965	0	0	100	0	0	100	14800	0	51400	13000	0	66900	0	35500
1966	0	0	4100	0	0	0	3200	0	17100	1800	0	6400	0	2400
1967	0	0	5700	0	0	300	22400	0	8500	5700	0	200	0	2500
1968	0	0	6000	0	0	0	11800	0	32900	25900	0	10000	0	1700
1969	0	0	2900	0	0	0	3300	0	2200	18500	0	180800	0	1000
1970	200	0	7200	0	0	0	8700	0	1100	14600	0	113900	0	2900
1971	0	0	6300	0	0	0	12700	0	1100	6900	0	43800	0	0
1972	0	0	2900	0	0	0	4500	0	800	2300	0	34100	0	3400
1973	0	0	10000	0	0	0	11500	0	800	5200	0	56500	0	3700
1974	0	0	5400	0	0	0	13800	0	2100	6400	0	77200	0	1200
1975	0	0	10700	0	0	0	29300	0	1400	37000	0	125700	0	0
1976	0	0	21100	0	0	0	15000	0	1200	4300	0	25400	0	0
1977	0	0	17800	0	0	0	900	0	3000	50900	0	125400	0	0
1978	0	0	5777	0	0	100	110600	0	3400	86600	0	158500	0	900
1979	0	0	29706	0	0	0	138900	0	18500	92900	224	275500	0	1200
1980	0	0	80941	0	0	0	52000	0	4500	39100	17286	81600	0	1600
1981	0	0	78706	0	0	0	119600	0	11300	44600	3939	67500	0	1400
1982	0	0	69974	0	0	0	18200	0	18700	41500	30749	22900	0	300
1983	0	0	28492	0	0	0	88600	0	8100	59300	11041	44200	0	400

Table A2.2. Commercial landings (lbs.) 1950-2021 by state (Cont.).

Year	CT	DE	FL EAST	GA	ME	MD	MA	NH	NJ	NY	NC	RI	SC	VA
1984	0	0	37832	0	0	400	43900	0	13100	50400	893	127500	0	100
1985	200	0	4991	0	0	0	29100	0	36100	24000	1449	48000	0	400
1986	0	0	3738	0	0	0	20700	0	54400	20500	926	17300	0	700
1987	5000	0	28568	0	0	0	48600	0	55800	20700	6723	20600	0	200
1988	1700	0	55973	0	0	600	300	0	131500	6700	3113	55000	0	800
1989	900	0	148442	0	0	0	77400	0	105800	8600	4422	75300	0	2000
1990	400	0	18376	0	0	1969	3734	0	125555	645	4062	36417	0	10389
1991	800	0	16972	0	0	27142	4285	0	129080	1247	4903	22163	0	2190
1992	300	0	51403	0	0	105020	87063	0	130370	17035	11658	158295	0	861
1993	185	0	91137	0	0	3750	17263	0	49168	20889	15583	113577	0	996
1994	0	0	81481	0	0	13	63547	0	52917	93274	37373	66468	0	3672
1995	146	0	0	0	0	875	39487	25	71433	21637	34718	56948	0	674
1996	0	0	0	0	0	0	13750	0	170963	25701	16268	35606	0	293
1997	0	0	0	0	0	0	25642	0	205472	30367	42372	25259	0	451
1998	0	0	0	0	0	0	24161	0	66764	29568	21353	37176	0	0
1999	413	0	0	0	0	0	29724	0	47360	58825	23291	21251	0	0
2000	235	0	0	0	0	0	996	0	55683	26273	13343	8707	0	0
2001	56	0	0	0	0	0	0	0	48151	8413	16531	6445	0	0
2002	0	0	0	0	0	0	2817	0	12794	8823	15456	6319	0	0
2003	0	0	0	0	0	121	522	0	20320	6852	27379	4505	0	0
2004	1943	0	0	0	0	1302	806	0	42194	6892	9303	3803	0	68
2005	96	0	0	0	0	0	1561	0	68716	6855	11672	11027	0	3
2006	724	0	0	0	0	10500	1328	0	5771	5579	9771	17191	2366	23
2007	97	0	0	0	0	0	493	0	67098	12975	16085	16805	1319	0
2008	5	0	0	0	0	0	247	0	27159	8396	16576	4241	939	0
2009	5	0	0	0	0	0	0	0	20084	17475	9981	25816	473	0
2010	20	0	0	0	0	0	0	0	7223	34292	15686	4626	768	308
2011	622	0	0	0	0	118	494	0	18730	20053	11039	19108	5673	0
2012	6	0	0	0	0	68	1201	0	4402	4165	11343	6959	4553	0
2013	151	0	0	0	0	0	530	0	3901	12585	10506	11229	3951	842
2014	46	0	0	0	0	0	1578	0	38823	8049	9081	21476	2380	132
2015	20	0	0	0	0	84	1761	0	1742	1752	20989	38959	1289	0
2016	32	0	0	0	0	104	1547	0	747	1783	15183	12878	0	0
2017	55	0	0	0	0	41	1038	0	1231	2388	11345	25671	3274	0
2018	99	0	0	0	0	0	3498	0	11037	1053	13848	13214	4843	0
2019	147	0	0	0	0	0	999	0	3095	1844	14045	41843	3803	0
2020	210	0	0	0	0	0	1198	0	9473	582	15926	28757	2295	0
2021	46	0	0	0	0	0	171	0	1664	736	7351	13489	1921	0
Overall	0%	0%	10%	0%	0%	2%	12%	0%	25%	14%	5%	29%	0%	3%
10-Year	0%	0%	0%	0%	0%	0%	3%	0%	15%	7%	26%	43%	6%	0%

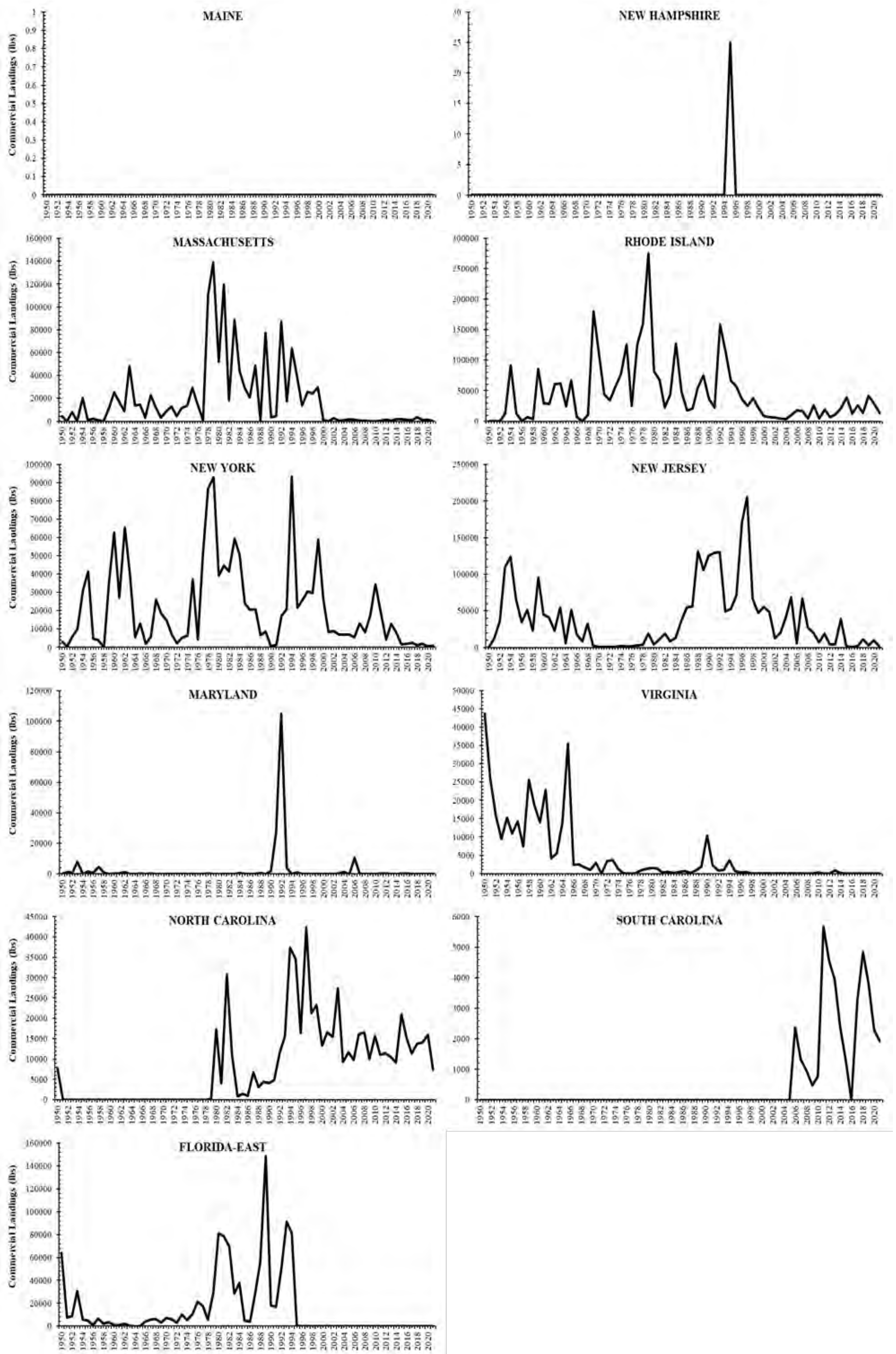

Figure A2.1. Commercial landings (lbs.) 1950-2021 by state.

Table A2.3. Recreational landings (lbs.) 1981-2021 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total Landings
1981	274941	0	1938204	2213145
1982	10146854	5062	1375596	11527512
1983	79947	599581	343470	1022998
1984	3417905	62922	638573	4119400
1985	564986	38685	143248	746919
1986	194353	2199329	0	2393682
1987	488097	176015	81437	745549
1988	1291161	164711	34337	1490209
1989	2273506	62019	371569	2707094
1990	409385	79954	156947	646286
1991	641291	468851	105260	1215402
1992	885716	146126	101063	1132905
1993	140060	207281	60980	408321
1994	145355	389903	68461	603719
1995	104330	147020	45611	296961
1996	166987	85191	5395	257573
1997	211247	184146	184053	579446
1998	250598	65720	154317	470635
1999	96900	111305	44469	252674
2000	11096	29758	74702	115556
2001	46615	186485	41181	274281
2002	19556	145031	97116	261703
2003	489345	76968	6684	572997
2004	496395	81789	48476	626660
2005	8803	269866	10758	289427
2006	12686	62512	4458	79656
2007	6356	555329	52726	614411
2008	933	36883	65984	103800
2009	98082	60446	13799	172327
2010	38319	26983	17712	83014
2011	35420	89852	287461	412733
2012	0	137943	96059	234002
2013	44705	61165	99252	205122
2014	198443	113832	91230	403505
2015	47369	53927	102409	203705
2016	37463	6704	25442	69609
2017	201751	52898	9579	264228
2018	94509	146748	55059	296316
2019	247845	243009	125031	615885
2020	60177	195039	179891	435107
2021	18351	79058	113110	210519
Overall	61%	20%	19%	
10-Year	32%	37%	31%	

Table A2.4. Recreational landings (lbs.) 1981-2021 by state.

Year	CT	DE	FL EAST	GA	MD	MA	NJ	NY	NC	RI	SC	VA	NH	ME
1981	0	0	1911323	0	0	0	256539	18402	26515	0	366	0	0	0
1982	0	0	1291789	0	0	0	10119563	27291	83807	5062	0	0	0	0
1983	0	0	341955	0	6557	0	73390	0	0	599581	1515	0	0	0
1984	19178	0	601192	0	52210	0	3323401	42294	15540	43744	21841	0	0	0
1985	0	21652	134337	0	32404	0	234371	275510	8911	38685	0	1049	0	0
1986	8098	0	0	0	70667	483412	28541	71844	0	1707819	0	23301	0	0
1987	28620	0	66165	0	0	2390	174787	103031	14910	145005	362	210279	0	0
1988	40532	0	26392	0	810508	3377	288019	69197	6016	120802	1929	123437	0	0
1989	26952	14573	244001	0	171987	1971	1923087	145514	116393	33096	11175	18345	0	0
1990	26129	9469	130434	0	7859	9098	263177	82565	22547	44727	3966	46315	0	0
1991	12491	410	5642	0	8677	202248	302915	329289	94896	254112	4722	0	0	0
1992	10655	377	67883	952	27672	83083	75043	774917	23078	52388	10102	7707	0	0
1993	30175	0	0	686	0	126175	0	138153	49289	50931	11691	1907	0	0
1994	83035	0	14068	0	0	298462	92482	41493	23713	8406	30680	11380	0	0
1995	0	0	0	0	5858	122341	47567	39844	41312	24679	4299	11061	0	0
1996	0	0	0	0	0	62300	134711	22750	5395	22891	0	9526	0	0
1997	172	0	0	0	0	50876	93068	118179	162981	133098	21072	0	0	0
1998	4753	7564	0	0	19701	0	175400	45197	145838	60967	8479	2736	0	0
1999	0	2480	0	0	0	6074	26308	68112	38658	105231	5811	0	0	0
2000	0	0	1711	13375	0	18468	11096	0	69580	11290	3411	0	0	0
2001	16257	0	15503	0	0	146012	46615	0	23603	24216	2075	0	0	0
2002	0	2945	0	0	4841	52117	11770	0	97116	92914	0	0	0	0
2003	0	0	0	0	47384	36771	411244	6572	6684	40197	0	24145	0	0
2004	0	0	0	0	0	50241	496395	0	48253	31548	223	0	0	0
2005	0	0	0	3477	26	258162	8777	0	9387	11704	1371	0	0	0
2006	0	0	0	0	0	62512	12344	342	4458	0	0	0	0	0
2007	204867	0	0	0	0	267251	6356	0	34694	83211	18032	0	0	0
2008	0	0	26892	0	0	36577	0	933	39092	306	0	0	0	0
2009	0	0	0	0	0	60133	98082	0	13799	313	0	0	0	0
2010	0	0	223	0	0	26932	38319	0	8018	51	9471	0	0	0
2011	0	0	0	3408	16275	89852	19141	0	287461	0	0	4	0	0
2012	0	0	0	8616	0	76917	0	0	95947	68	112	0	1457	59501
2013	0	0	0	0	174	0	44531	0	99252	61165	0	0	0	0
2014	8067	355	0	0	13	98646	181485	16590	91230	7119	0	0	0	0
2015	0	0	0	1960	0	48295	0	46716	102409	5628	0	653	4	0
2016	1400	0	2562	0	0	5304	37463	0	22128	0	752	0	0	0
2017	622	0	0	0	37	8325	200907	35	9579	43951	0	772	0	0
2018	13415	4427	168	1770	28049	93679	51343	0	42880	36722	12011	10690	2932	0
2019	39273	1074	0	3585	2183	101523	228776	15812	122932	102213	2099	0	0	0
2020	18	0	0	146	1171	133210	41213	14407	179805	61134	86	3386	677	0
2021	1393	0	0	0	0	53098	8779	9572	104790	16319	8320	0	8248	0
Overall	1%	0%	12%	0%	3%	8%	50%	6%	6%	10%	0%	1%	0%	0%
10-Year	2%	0%	0%	1%	1%	21%	27%	3%	29%	11%	1%	1%	0%	2%

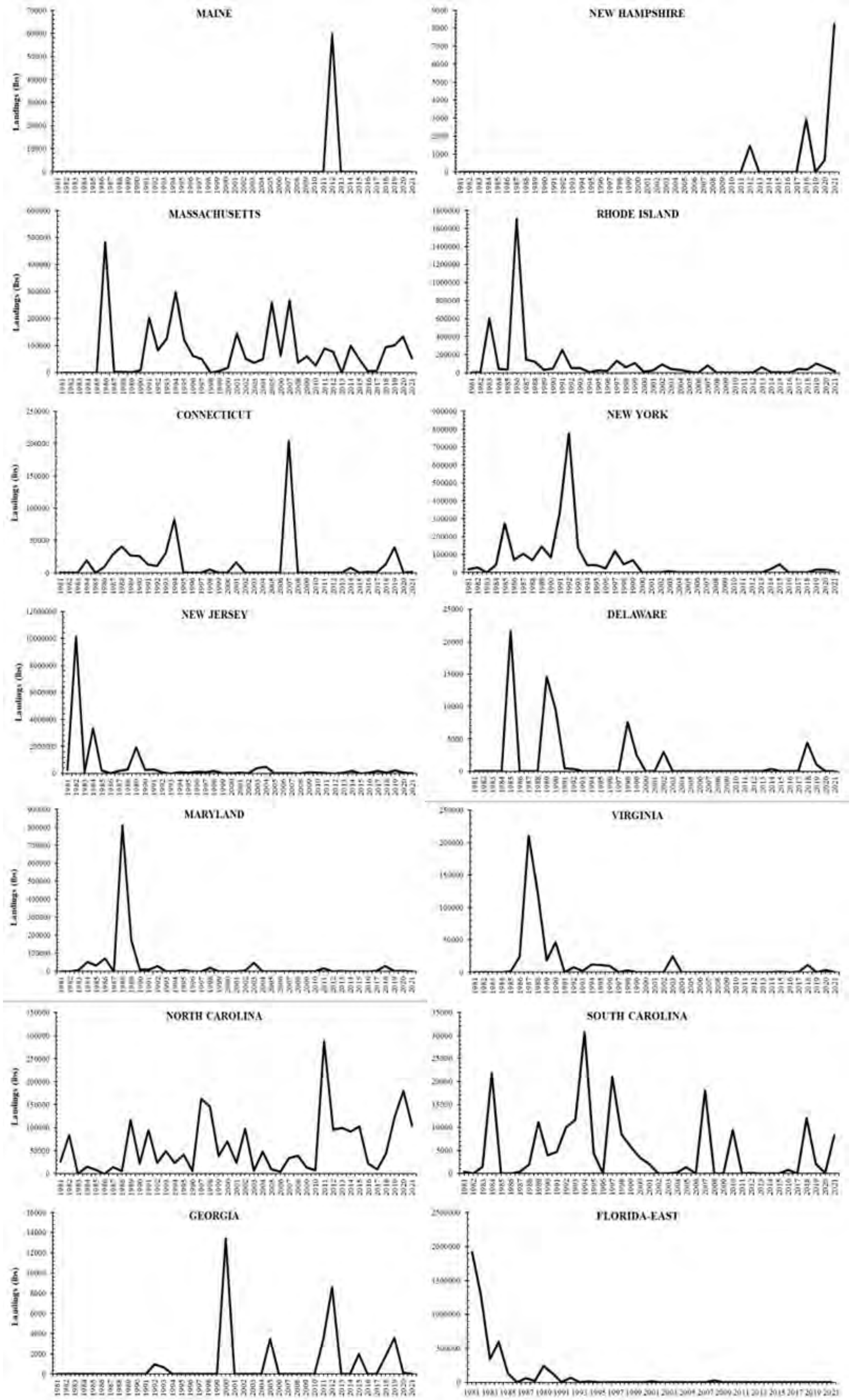

Figure A2.2. Recreational landings (lbs.) 1981-2021 by state.

Table A2.5. Percentage of recreational landing 1981-2021 by fishing mode for each region.

Year	Mid-Atlantic			North Atlantic			South Atlantic		
	Shore	For Hire	Private	Shore	For Hire	Private	Shore	For Hire	Private
1981	0%	94%	6%	0%	0%	0%	0%	2%	98%
1982	0%	98%	2%	0%	100%	0%	0%	4%	96%
1983	57%	7%	36%	0%	89%	11%	0%	26%	74%
1984	0%	99%	1%	0%	31%	69%	41%	12%	47%
1985	0%	39%	61%	0%	100%	0%	0%	0%	100%
1986	0%	38%	62%	21%	78%	1%	0%	0%	0%
1987	0%	65%	35%	0%	6%	94%	0%	3%	97%
1988	2%	72%	26%	0%	35%	65%	0%	5%	95%
1989	0%	54%	46%	15%	39%	45%	1%	42%	57%
1990	2%	12%	86%	9%	23%	68%	83%	11%	6%
1991	20%	14%	66%	89%	3%	9%	0%	50%	50%
1992	7%	3%	90%	30%	4%	66%	0%	13%	87%
1993	0%	19%	81%	49%	6%	44%	0%	30%	70%
1994	0%	12%	88%	19%	12%	69%	1%	53%	47%
1995	0%	0%	100%	28%	14%	58%	0%	24%	76%
1996	0%	6%	94%	17%	8%	76%	0%	89%	11%
1997	0%	39%	61%	0%	34%	66%	0%	15%	85%
1998	0%	9%	91%	1%	5%	94%	83%	8%	9%
1999	0%	2%	98%	23%	2%	75%	0%	33%	67%
2000	0%	0%	100%	0%	44%	56%	0%	83%	17%
2001	0%	0%	100%	0%	5%	95%	24%	33%	43%
2002	0%	0%	100%	0%	54%	46%	0%	0%	100%
2003	0%	12%	88%	23%	30%	47%	0%	56%	44%
2004	0%	3%	97%	0%	14%	86%	0%	2%	98%
2005	0%	10%	90%	13%	5%	82%	0%	8%	92%
2006	0%	100%	0%	0%	0%	100%	0%	0%	100%
2007	0%	100%	0%	44%	13%	43%	0%	6%	94%
2008	0%	100%	0%	0%	1%	99%	0%	74%	26%
2009	0%	0%	100%	0%	2%	98%	0%	88%	12%
2010	0%	0%	100%	100%	0%	0%	0%	100%	0%
2011	0%	14%	86%	0%	0%	100%	0%	3%	97%
2012	0%	0%	0%	0%	1%	99%	0%	19%	81%
2013	0%	0%	100%	0%	1%	99%	0%	7%	93%
2014	0%	9%	91%	40%	14%	46%	0%	4%	96%
2015	0%	1%	99%	5%	1%	93%	0%	3%	97%
2016	0%	0%	100%	0%	46%	54%	0%	29%	71%
2017	0%	96%	4%	0%	1%	99%	0%	35%	65%
2018	5%	4%	91%	5%	0%	95%	0%	11%	89%
2019	8%	27%	65%	47%	4%	50%	0%	6%	94%
2020	32%	8%	60%	22%	1%	77%	0%	3%	97%
2021	0%	1%	99%	21%	1%	78%	0%	5%	95%
2022	0%	19%	81%	29%	3%	69%	0%	13%	87%

Table A2.6. Percentage of recreational landing 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state.

Year	CT			DE			FL			GA			MD			MA		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	0%	0%	0%	0%	0%	0%	2%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	0%	1%	99%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	26%	74%	0%	0%	0%	0%	84%	16%	0%	0%	0%
1984	0%	100%	0%	0%	0%	0%	44%	6%	50%	0%	0%	0%	0%	100%	0%	0%	0%	0%
1985	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	63%	37%	0%	0%	0%
1986	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	52%	48%	96%	0%	4%
1987	0%	9%	91%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1988	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	99%	1%	0%	0%	100%
1989	0%	42%	58%	0%	100%	0%	0%	56%	44%	0%	0%	0%	0%	15%	85%	0%	0%	100%
1990	0%	0%	100%	0%	99%	1%	100%	0%	0%	0%	0%	0%	0%	100%	0%	78%	6%	17%
1991	0%	0%	100%	0%	15%	85%	0%	0%	100%	0%	0%	0%	0%	34%	66%	99%	0%	1%
1992	0%	30%	70%	0%	100%	0%	0%	0%	100%	0%	100%	0%	0%	87%	13%	28%	0%	72%
1993	44%	4%	52%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	70%	4%	27%
1994	0%	7%	93%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	25%	13%	62%
1995	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	34%	6%	60%
1996	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%	5%	75%
1997	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	23%	77%
1998	0%	5%	95%	0%	33%	67%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%
1999	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	12%	0%	88%
2000	0%	0%	0%	0%	0%	0%	0%	1%	99%	0%	0%	100%	0%	0%	0%	0%	47%	53%
2001	0%	0%	100%	0%	0%	0%	0%	71%	29%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2002	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%
2003	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	21%	79%	0%	8%	92%
2004	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%	89%
2005	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	83%	0%	100%	0%	9%	5%	86%
2006	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2007	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	92%	4%	4%
2008	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	99%
2010	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
2011	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
2012	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	1%	99%
2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
2014	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	46%	15%	39%
2015	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	2%	98%
2016	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	58%	42%
2017	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%
2018	0%	0%	100%	100%	0%	0%	0%	100%	0%	0%	9%	91%	0%	0%	100%	0%	0%	100%
2019	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	6%	94%	0%	22%	78%	23%	9%	68%
2020	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	1%	99%
2021	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	99%
2022	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	29%	3%	69%

Table A2.6. Percentage of recreational landing 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state (Cont.).

Year	NJ			NY			NC			RI			SC			VA			ME			NH		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	99%	1%	0%	18%	82%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	99%	1%	0%	0%	100%	0%	47%	53%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	62%	0%	38%	0%	0%	0%	0%	0%	0%	0%	89%	11%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1984	0%	100%	0%	0%	0%	100%	0%	100%	0%	0%	1%	99%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	100%	0%	64%	36%	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1986	0%	0%	100%	0%	34%	66%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	54%	46%	0%	0%	0%	0%	0%	0%
1987	0%	18%	82%	0%	88%	12%	0%	16%	84%	0%	5%	95%	0%	100%	0%	0%	94%	6%	0%	0%	0%	0%	0%	0%
1988	9%	12%	79%	0%	100%	0%	0%	26%	74%	0%	48%	52%	0%	0%	100%	0%	26%	74%	0%	0%	0%	0%	0%	0%
1989	0%	59%	41%	0%	32%	68%	3%	11%	85%	28%	40%	32%	0%	67%	33%	0%	5%	95%	0%	0%	0%	0%	0%	0%
1990	3%	12%	85%	0%	3%	97%	0%	56%	44%	0%	40%	60%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1991	1%	16%	83%	39%	11%	49%	0%	50%	50%	85%	5%	10%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1992	81%	0%	18%	0%	0%	100%	0%	26%	74%	38%	5%	57%	0%	66%	34%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1993	0%	0%	0%	0%	19%	81%	0%	13%	87%	2%	14%	83%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1994	0%	5%	95%	0%	7%	93%	1%	23%	76%	0%	20%	80%	0%	100%	0%	0%	91%	9%	0%	0%	0%	0%	0%	0%
1995	0%	0%	100%	0%	0%	100%	0%	16%	84%	0%	53%	47%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1996	0%	0%	100%	0%	0%	100%	0%	89%	11%	7%	15%	77%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
1997	0%	2%	98%	0%	68%	32%	0%	16%	84%	0%	38%	62%	0%	13%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1998	0%	0%	100%	0%	0%	100%	88%	8%	5%	1%	5%	94%	0%	15%	85%	0%	2%	98%	0%	0%	0%	0%	0%	0%
1999	0%	0%	100%	0%	3%	97%	0%	29%	71%	23%	2%	75%	0%	62%	38%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2000	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	39%	61%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2001	0%	0%	100%	0%	0%	0%	42%	2%	56%	0%	37%	63%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2002	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	85%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2003	0%	4%	96%	0%	100%	0%	0%	56%	44%	45%	51%	5%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2004	0%	3%	97%	0%	0%	0%	0%	1%	99%	0%	19%	81%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2005	0%	9%	91%	0%	0%	0%	0%	6%	94%	98%	2%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2006	0%	100%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2007	0%	100%	0%	0%	0%	0%	0%	9%	91%	0%	72%	28%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2008	0%	0%	0%	0%	100%	0%	0%	56%	44%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009	0%	0%	100%	0%	0%	0%	0%	88%	12%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2010	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2011	0%	25%	75%	0%	0%	0%	0%	2%	98%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2012	0%	0%	0%	0%	0%	0%	0%	12%	88%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%
2013	0%	0%	100%	0%	0%	0%	0%	7%	93%	0%	1%	99%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2014	0%	2%	98%	0%	78%	22%	0%	4%	96%	0%	13%	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2015	0%	0%	0%	0%	0%	100%	0%	1%	99%	48%	0%	52%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%
2016	0%	0%	100%	0%	0%	0%	0%	18%	82%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2017	0%	96%	4%	0%	100%	0%	0%	35%	65%	0%	1%	99%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2018	0%	8%	92%	0%	0%	0%	0%	14%	86%	12%	0%	88%	0%	0%	100%	0%	0%	100%	0%	0%	0%	80%	0%	20%
2019	9%	28%	63%	0%	11%	89%	0%	4%	96%	88%	0%	12%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2020	47%	2%	51%	0%	10%	90%	0%	2%	98%	70%	1%	29%	0%	100%	0%	0%	38%	62%	0%	0%	0%	0%	86%	14%
2021	0%	3%	97%	0%	0%	100%	0%	0%	100%	51%	2%	47%	0%	59%	41%	0%	0%	0%	0%	0%	0%	100%	0%	0%
2022	0%	18%	82%	0%	0%	0%	0%	11%	89%	34%	3%	63%	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%

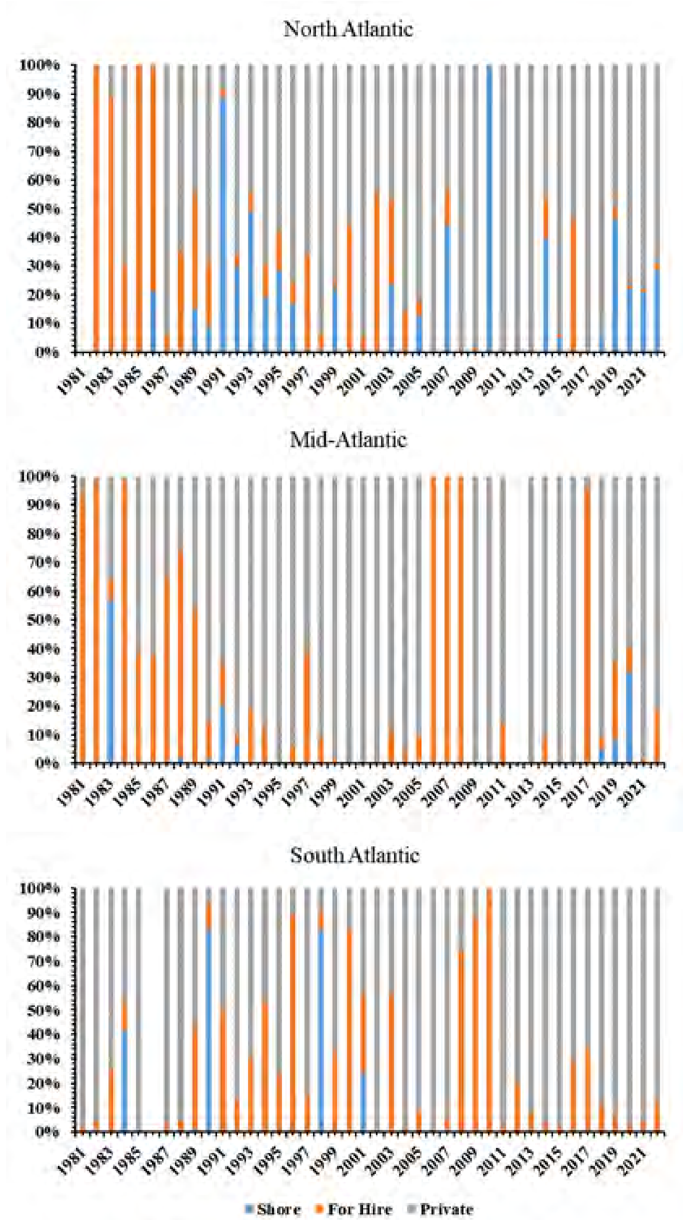

Figure A2.3. Percentage of recreational landing 1981-2021 by fishing mode for each region.

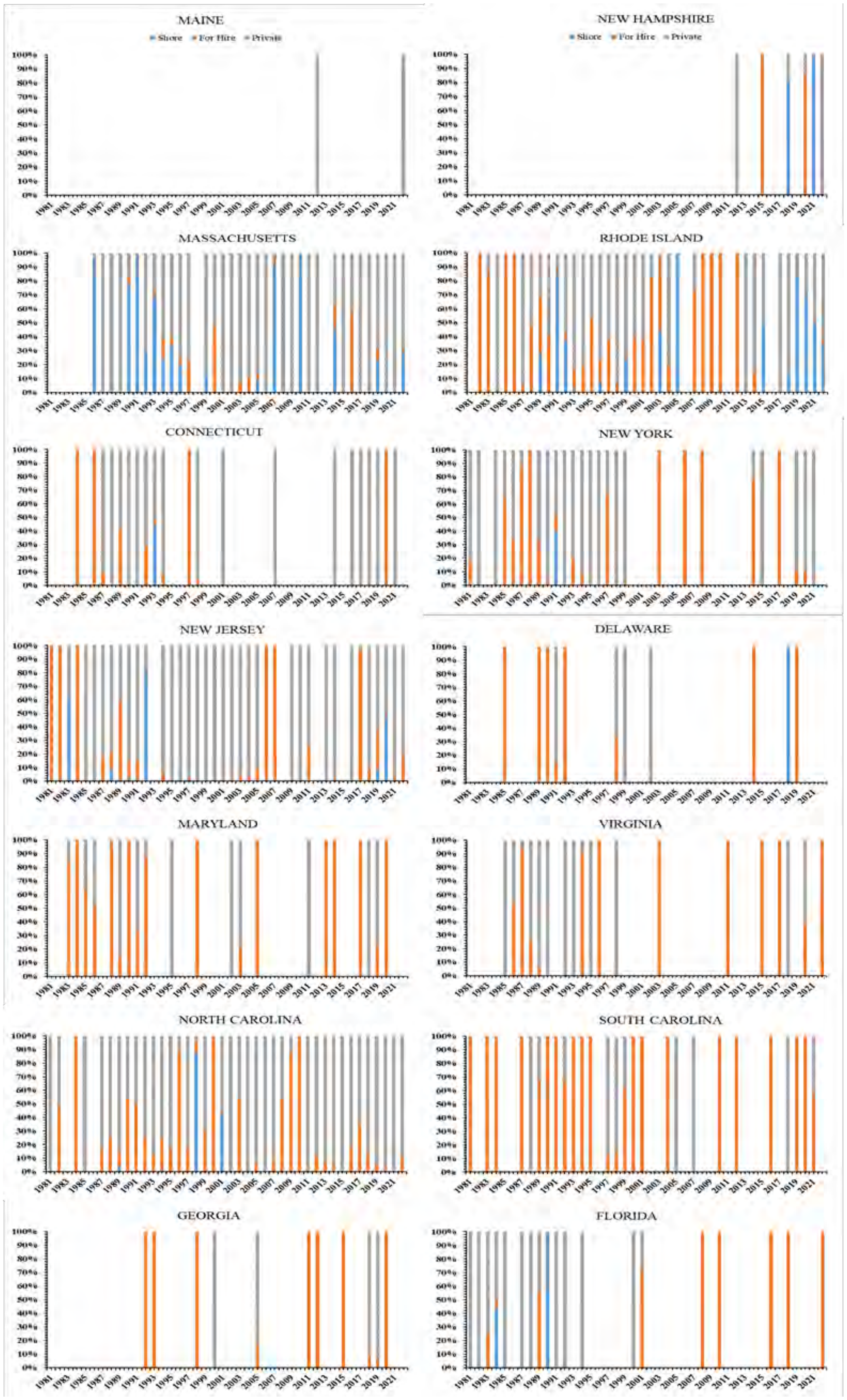

Figure A2.4 Percentage of recreational landing 1981-2021 by fishing mode for each state.

Table A2.7. Percentage of recreational landing 1981-2021 in state and federal waters for each region.

Year	Mid-Atlantic		North Atlantic		South Atlantic	
	Federal	State	Federal	State	Federal	State
1981	99%	1%	0%	0%	97%	3%
1982	100%	0%	100%	0%	75%	25%
1983	43%	57%	89%	11%	67%	33%
1984	98%	2%	31%	69%	28%	72%
1985	64%	36%	100%	0%	100%	0%
1986	84%	16%	79%	21%	0%	0%
1987	76%	24%	85%	15%	79%	21%
1988	96%	4%	71%	29%	77%	23%
1989	95%	5%	53%	47%	36%	64%
1990	66%	34%	41%	59%	14%	86%
1991	48%	52%	9%	91%	81%	19%
1992	83%	17%	10%	90%	24%	76%
1993	36%	64%	19%	81%	100%	0%
1994	60%	40%	1%	99%	79%	21%
1995	98%	2%	17%	83%	25%	75%
1996	100%	0%	4%	96%	100%	0%
1997	72%	28%	47%	53%	87%	13%
1998	97%	3%	48%	52%	6%	94%
1999	98%	2%	41%	59%	59%	41%
2000	0%	100%	46%	54%	100%	0%
2001	91%	9%	46%	54%	53%	47%
2002	40%	60%	64%	36%	34%	66%
2003	100%	0%	30%	70%	56%	44%
2004	100%	0%	14%	86%	48%	52%
2005	10%	90%	4%	96%	63%	37%
2006	97%	3%	100%	0%	100%	0%
2007	58%	42%	4%	96%	74%	26%
2008	0%	100%	0%	100%	59%	41%
2009	100%	0%	0%	100%	88%	12%
2010	8%	92%	0%	100%	100%	0%
2011	100%	0%	0%	100%	35%	65%
2012	0%	0%	44%	56%	67%	33%
2013	91%	9%	0%	100%	14%	86%
2014	91%	9%	24%	76%	14%	86%
2015	1%	99%	5%	95%	82%	18%
2016	100%	0%	41%	59%	48%	52%
2017	96%	4%	76%	24%	78%	22%
2018	94%	6%	20%	80%	75%	25%
2019	88%	12%	13%	87%	31%	69%
2020	50%	50%	36%	64%	18%	82%
2021	31%	69%	32%	68%	44%	56%
2022	100%	0%	21%	79%	36%	64%

Table A2.8. Percentage of recreational landing 1981-2021 in state and federal waters for each state.

Year	CT		DE		FL		GA		MD		MA	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	0%	0%	0%	0%	96%	4%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	74%	26%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	67%	33%	0%	0%	100%	0%	0%	0%
1984	100%	0%	0%	0%	24%	76%	0%	0%	100%	0%	0%	0%
1985	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%
1986	43%	57%	0%	0%	0%	0%	0%	0%	100%	0%	4%	96%
1987	9%	91%	0%	0%	85%	15%	0%	0%	0%	0%	100%	0%
1988	0%	100%	0%	0%	86%	14%	0%	0%	100%	0%	100%	0%
1989	42%	58%	100%	0%	38%	62%	0%	0%	100%	0%	0%	100%
1990	0%	100%	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%
1991	0%	100%	100%	0%	0%	100%	0%	0%	100%	0%	1%	99%
1992	0%	100%	100%	0%	0%	100%	100%	0%	100%	0%	4%	96%
1993	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	5%	95%
1994	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	1%	99%
1995	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	12%	88%
1996	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1997	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	20%	80%
1998	0%	100%	100%	0%	0%	0%	100%	0%	100%	0%	0%	0%
1999	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2000	0%	0%	0%	0%	99%	1%	100%	0%	0%	0%	12%	88%
2001	0%	100%	0%	0%	71%	29%	0%	0%	0%	0%	42%	58%
2002	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	100%
2003	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	8%	92%
2004	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%	89%
2005	0%	0%	0%	0%	0%	0%	17%	83%	100%	0%	4%	96%
2006	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%
2007	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2008	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%
2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2010	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
2011	0%	0%	0%	0%	0%	0%	100%	0%	100%	0%	0%	100%
2012	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2013	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
2014	0%	100%	100%	0%	0%	0%	0%	0%	100%	0%	24%	76%
2015	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2016	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	52%	48%
2017	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	9%	91%
2018	44%	56%	0%	100%	0%	100%	100%	0%	100%	0%	23%	77%
2019	0%	100%	100%	0%	0%	0%	100%	0%	100%	0%	21%	79%
2020	0%	100%	0%	0%	0%	0%	100%	0%	100%	0%	50%	50%
2021	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	33%	67%
2022	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	21%	79%

Table A2.8. Percentage of recreational landing 1981-2021 in state and federal waters for each state (Cont).

Year	NJ		NY		NC		RI		SC		VA		ME		NH	
	Federal	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**
1981	99%	1%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
1982	100%	0%	94%	6%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	38%	62%	0%	0%	0%	0%	89%	11%	100%	0%	0%	0%	0%	0%	0%	0%
1984	98%	2%	79%	21%	100%	0%	1%	99%	100%	0%	0%	0%	0%	0%	0%	0%
1985	100%	0%	26%	74%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%
1986	100%	0%	56%	44%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%
1987	92%	8%	0%	100%	56%	44%	100%	0%	100%	0%	100%	0%	0%	0%	0%	0%
1988	88%	12%	68%	32%	26%	74%	93%	7%	100%	0%	100%	0%	0%	0%	0%	0%
1989	98%	2%	42%	58%	26%	74%	66%	34%	84%	16%	90%	10%	0%	0%	0%	0%
1990	66%	34%	74%	26%	78%	22%	74%	26%	100%	0%	39%	61%	0%	0%	0%	0%
1991	94%	6%	5%	95%	85%	15%	15%	85%	100%	0%	0%	0%	0%	0%	0%	0%
1992	0%	100%	90%	10%	57%	43%	22%	78%	100%	0%	100%	0%	0%	0%	0%	0%
1993	0%	0%	35%	65%	100%	0%	64%	36%	100%	0%	100%	0%	0%	0%	0%	0%
1994	63%	37%	43%	57%	40%	60%	17%	83%	100%	0%	100%	0%	0%	0%	0%	0%
1995	100%	0%	95%	5%	17%	83%	41%	59%	100%	0%	100%	0%	0%	0%	0%	0%
1996	100%	0%	100%	0%	100%	0%	15%	85%	0%	0%	100%	0%	0%	0%	0%	0%
1997	45%	55%	93%	7%	86%	14%	57%	43%	100%	0%	0%	0%	0%	0%	0%	0%
1998	95%	5%	100%	0%	6%	94%	52%	48%	15%	85%	100%	0%	0%	0%	0%	0%
1999	100%	0%	97%	3%	53%	47%	43%	57%	100%	0%	0%	0%	0%	0%	0%	0%
2000	0%	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2001	91%	9%	0%	0%	38%	62%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2002	0%	100%	0%	0%	34%	66%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2003	100%	0%	100%	0%	56%	44%	51%	49%	0%	0%	100%	0%	0%	0%	0%	0%
2004	100%	0%	0%	0%	48%	52%	19%	81%	100%	0%	0%	0%	0%	0%	0%	0%
2005	9%	91%	0%	0%	75%	25%	2%	98%	100%	0%	0%	0%	0%	0%	0%	0%
2006	100%	0%	0%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2007	58%	42%	0%	0%	60%	40%	29%	71%	100%	0%	0%	0%	0%	0%	0%	0%
2008	0%	0%	0%	100%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
2009	100%	0%	0%	0%	88%	12%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
2010	8%	92%	0%	0%	100%	0%	0%	100%	100%	0%	0%	0%	0%	0%	0%	0%
2011	100%	0%	0%	0%	35%	65%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
2012	0%	0%	0%	0%	64%	36%	0%	100%	100%	0%	0%	0%	100%	0%	100%	0%
2013	91%	9%	0%	0%	14%	86%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
2014	98%	2%	11%	89%	14%	86%	45%	55%	0%	0%	0%	0%	0%	0%	0%	0%
2015	0%	0%	0%	100%	82%	18%	52%	48%	0%	0%	100%	0%	0%	0%	100%	0%
2016	100%	0%	0%	0%	52%	48%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2017	96%	4%	100%	0%	78%	22%	88%	12%	0%	0%	100%	0%	0%	0%	0%	0%
2018	98%	2%	0%	0%	67%	33%	6%	94%	100%	0%	100%	0%	0%	0%	0%	100%
2019	90%	10%	59%	41%	27%	73%	10%	90%	100%	0%	0%	0%	0%	0%	0%	0%
2020	53%	47%	26%	74%	18%	82%	5%	95%	100%	0%	100%	0%	0%	0%	77%	23%
2021	65%	35%	0%	100%	40%	60%	47%	53%	100%	0%	0%	0%	0%	0%	0%	100%
2022	100%	0%	0%	0%	35%	65%	66%	34%	0%	0%	100%	0%	0%	100%	1%	99%

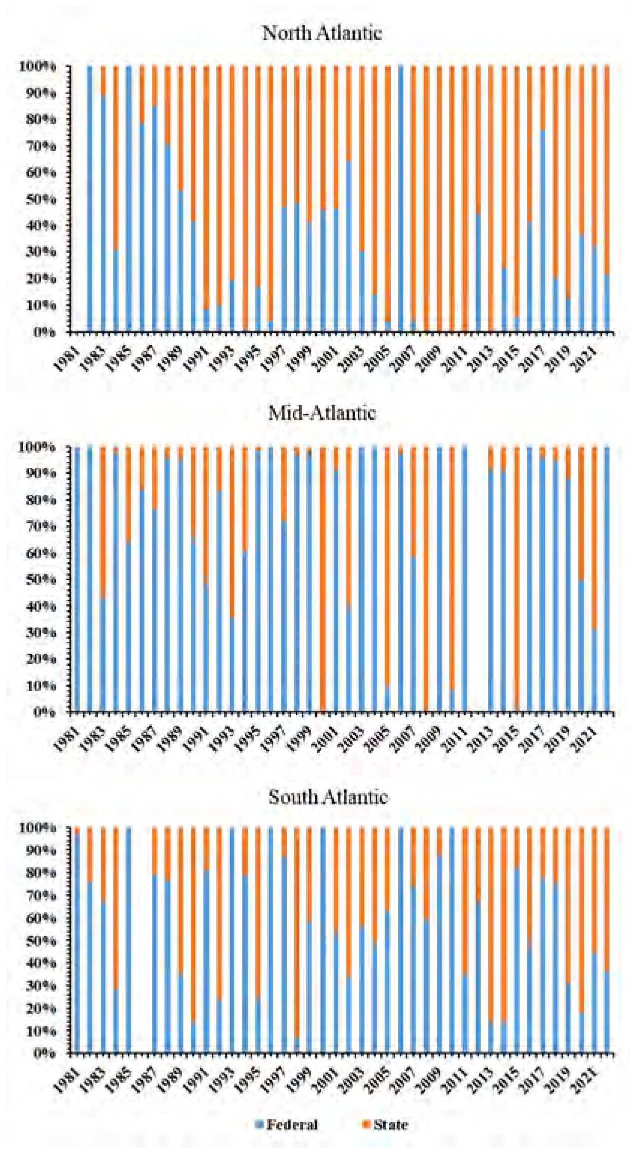

Figure A2.5. Percentage of recreational landing 1981-2021 in state and federal waters for each region.

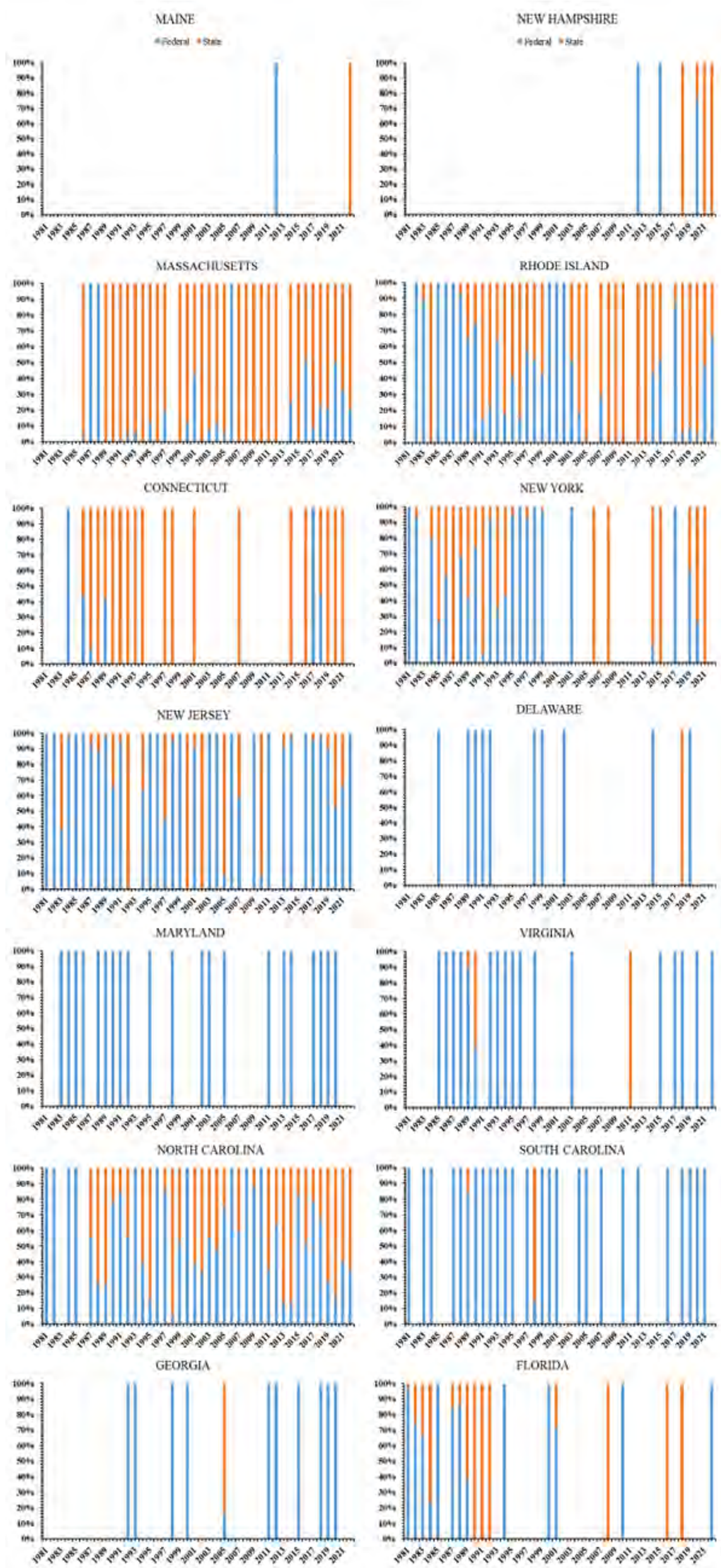

Figure A2.6. Percentage of recreational landing 1981-2021 in state and federal waters for each state.

Table A2.9. Recreational discards (individuals) 1981-2022 by region.

Year	Mid-Atlantic	North Atlantic	South Atlantic	Total Discards
1981	166496	6882	0	173378
1982	422974	0	0	422974
1983	55840	6365	0	62205
1984	117650	5000	0	122650
1985	81357	0	0	81614
1986	133696	0	368	134064
1987	339159	4513	1643	345315
1988	791460	1853	33354	826667
1989	278505	85	5647	286574
1990	66509	1008	1057	68574
1991	20114	4938	10413	36296
1992	11585	3202	3020	18656
1993	19547	7642	11733	38922
1994	52890	14752	18932	86574.9
1995	351181	15810	7163	374154
1996	2976	51932	11140	66048
1997	2946	16523	34367	53836
1998	54067	19873	20469	96099
1999	12647	45795	3759	62201
2000	64983	21908	17914	113016
2001	49204	21852	6489	80630
2002	209831	34670	30165	274666
2003	25949	6965	13049	50021
2004	289	31505	19082	51057
2005	8240	12313	42411	62964
2006	189336	42708	2755	234799
2007	0	33194	8810	42032
2008	0	11112	23411	34677
2009	0	2441	2561	5691
2010	139	14660	17279	32134
2011	4957	0	28618	33575
2012	0	251	14039	14290
2013	60946	12736	50273	123955
2014	257349	52277	62125	371751
2015	4561	18298	1783	24642
2016	4091	42615	12643	59349
2017	12914	745	49043	62873
2018	19901	419164	16222	455287
2019	25411	80319	27722	133701
2020	27011	28895	23817	95085
2021	20866	101587	8449	130902
2022	249793	113988	11773	375554
Mean	68%	21%	11%	-
10-Year	37%	47%	15%	-

Table A2.10. Recreational discards (individuals) 1981-2022 by state.

Year	CT	DE	GA	MD	MA	NJ	NY	NC	RI	SC	VA	FL	ME	NH
1981	0	0	0	0	0	5634	303	0	6882	0	0	160559	0	0
1982	0	0	0	0	0	247795	0	0	0	0	0	175179	0	0
1983	0	0	0	1358	6365	0	0	0	0	0	0	54482	0	0
1984	0	0	0	0	0	0	0	0	5000	0	0	117650	0	0
1985	0	0	257	0	0	0	109	0	0	0	0	81248	0	0
1986	0	0	0	0	0	0	614	368	0	0	1653	131429	0	0
1987	0	0	0	0	0	66	1687	1609	4513	34	1198	336208	0	0
1988	0	0	0	711	1155	289811	0	32981	698	373	1332	499606	0	0
1989	0	3375	2337	0	0	76196	2487	4214	85	1433	1058	195389	0	0
1990	0	379	0	0	223	12699	17285	1057	785	0	299	35847	0	0
1991	0	5	831	0	1520	2480	4252	9622	3418	791	9361	4016	0	0
1992	0	0	849	0	2483	1236	2695	2747	719	273	1693	5961	0	0
1993	0	0	0	0	993	0	1355	1690	6649	10043	0	18192	0	0
1994	0	0	0.9	0	14254	35581	517	18932	498	0	8158	8634	0	0
1995	0	0	0	10700	12409	18611	68779	2407	3401	4756	1198	251893	0	0
1996	36055	0	0	1600	7326	0	0	10845	8551	295	0	1376	0	0
1997	0	0	0	0	10988	0	2924	29817	5535	4550	0	22	0	0
1998	3119	0	1690	0	5036	32444	20506	8837	11718	11632	0	1117	0	0
1999	0	0	0	0	1831	3429	9218	2682	43964	1077	0	0	0	0
2000	829	98	8211	0	15466	2684	0	9257	5613	8657	2384	59817	0	0
2001	3170	0	3085	2692	17297	0	0	5001	1385	1488	0	46512	0	0
2002	0	0	0	0	33532	0	19490	30165	1138	0	2045	188296	0	0
2003	882	1963	4058	9155	0	203	11707	12968	6083	0	2921	0	0	0
2004	4119	0	181	0	1966	0	0	19082	25420	0	0	289	0	0
2005	0	0	0	0	12301	5898	0	42363	12	48	0	2342	0	0
2006	0	0	0	0	42708	189336	0	2755	0	0	0	0	0	0
2007	11379	0	28	0	15073	0	0	4523	6742	4287	0	0	0	0
2008	0	0	154	0	9474	0	0	23411	1638	0	0	0	0	0
2009	0	0	689	0	2441	0	0	2561	0	0	0	0	0	0
2010	0	0	56	139	14660	0	0	16583	0	696	0	0	0	0
2011	0	0	0	0	0	0	0	28618	0	0	4957	0	0	0
2012	0	0	0	0	251	0	0	7858	0	6181	0	0	0	0
2013	0	0	0	0	2192	60412	534	4609	10544	45664	0	0	0	0
2014	1389	619	0	1645	41634	175714	1429	59925	9254	2200	0	77942	0	0
2015	0	0	0	0	12983	0	4561	1325	5315	458	0	0	0	0
2016	6045	0	0	0	13377	0	0	10196	23193	2447	0	4091	0	0
2017	0	0	171	4873	242	5623	2012	40094	503	8949	59	347	0	0
2018	10086	1648	0	4153	378413	12572	1528	11745	26211	4477	0	0	97	4357
2019	21662	15	249	5009	23917	8388	11999	24033	34740	3689	0	0	0	0
2020	0	2	15362	0	20509	17561	9448	23817	7337	0	0	0	0	1049
2021	25	0	0	0	96060	17363	3503	7793	5094	656	0	0	0	408
2022	1103	0	0	0	99486	221623	28170	11773	4466	0	0	0	0	8933
Overall	2%	0%	1%	1%	15%	23%	4%	8%	4%	2%	1%	40%	0%	0%
10-Year	2%	0%	1%	1%	38%	28%	3%	11%	7%	4%	0%	4%	0%	1%

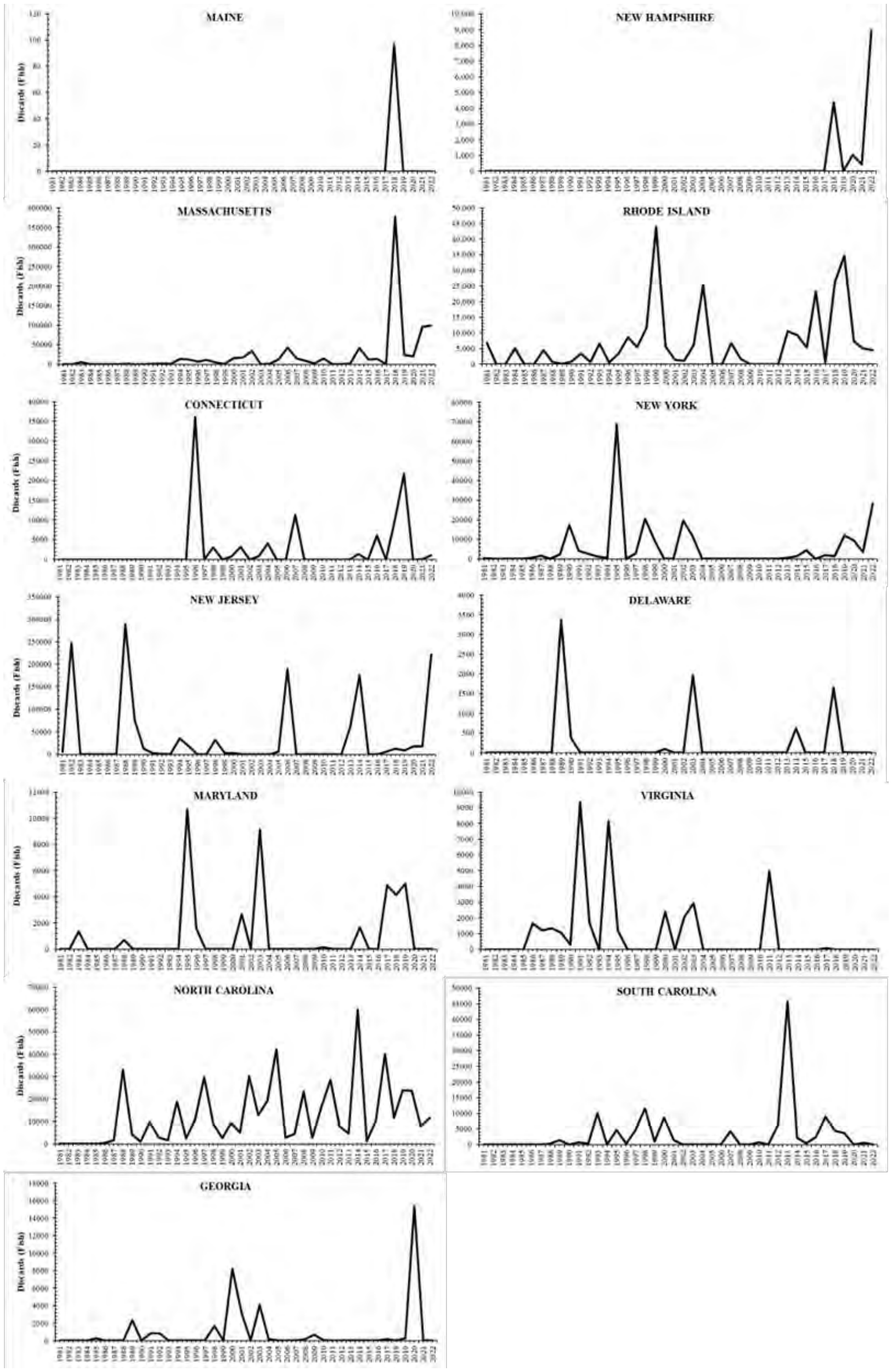

Figure A2.7. Recreational discards (individuals) from 1981-2021 by state.

Table A2.11. Percentage of recreational discards 1981-2021 by fishing mode for each region.

Year	Mid-Atlantic			North Atlantic			South Atlantic		
	Shore	For Hire	Private	Shore	For Hire	Private	Shore	For Hire	Private
1981	0%	94%	6%	0%	0%	0%	0%	2%	98%
1982	0%	98%	2%	0%	100%	0%	0%	4%	96%
1983	57%	7%	36%	0%	89%	11%	0%	26%	74%
1984	0%	99%	1%	0%	31%	69%	41%	12%	47%
1985	0%	39%	61%	0%	100%	0%	0%	0%	100%
1986	0%	38%	62%	21%	78%	1%	0%	0%	0%
1987	0%	65%	35%	0%	6%	94%	0%	3%	97%
1988	2%	72%	26%	0%	35%	65%	0%	5%	95%
1989	0%	54%	46%	15%	39%	45%	1%	42%	57%
1990	2%	12%	86%	9%	23%	68%	83%	11%	6%
1991	20%	14%	66%	89%	3%	9%	0%	50%	50%
1992	7%	3%	90%	30%	4%	66%	0%	13%	87%
1993	0%	19%	81%	49%	6%	44%	0%	30%	70%
1994	0%	12%	88%	19%	12%	69%	1%	53%	47%
1995	0%	0%	100%	28%	14%	58%	0%	24%	76%
1996	0%	6%	94%	17%	8%	76%	0%	89%	11%
1997	0%	39%	61%	0%	34%	66%	0%	15%	85%
1998	0%	9%	91%	1%	5%	94%	83%	8%	9%
1999	0%	2%	98%	23%	2%	75%	0%	33%	67%
2000	0%	0%	100%	0%	44%	56%	0%	83%	17%
2001	0%	0%	100%	0%	5%	95%	24%	33%	43%
2002	0%	0%	100%	0%	54%	46%	0%	0%	100%
2003	0%	12%	88%	23%	30%	47%	0%	56%	44%
2004	0%	3%	97%	0%	14%	86%	0%	2%	98%
2005	0%	10%	90%	13%	5%	82%	0%	8%	92%
2006	0%	100%	0%	0%	0%	100%	0%	0%	100%
2007	0%	100%	0%	44%	13%	43%	0%	6%	94%
2008	0%	100%	0%	0%	1%	99%	0%	74%	26%
2009	0%	0%	100%	0%	2%	98%	0%	88%	12%
2010	0%	0%	100%	100%	0%	0%	0%	100%	0%
2011	0%	14%	86%	0%	0%	100%	0%	3%	97%
2012	0%	0%	0%	0%	1%	99%	0%	19%	81%
2013	0%	0%	100%	0%	1%	99%	0%	7%	93%
2014	0%	9%	91%	40%	14%	46%	0%	4%	96%
2015	0%	1%	99%	5%	1%	93%	0%	3%	97%
2016	0%	0%	100%	0%	46%	54%	0%	29%	71%
2017	0%	96%	4%	0%	1%	99%	0%	35%	65%
2018	5%	4%	91%	5%	0%	95%	0%	11%	89%
2019	8%	27%	65%	47%	4%	50%	0%	6%	94%
2020	32%	8%	60%	22%	1%	77%	0%	3%	97%
2021	0%	1%	99%	21%	1%	78%	0%	5%	95%
2022	0%	19%	81%	29%	3%	69%	0%	13%	87%

Table A2.12. Percentage of recreational discards 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state.

Year	CT			DE			FL			GA			MD			MA		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	0%	0%	0%	0%	0%	0%	8%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	0%	0%	10%	1%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%	0%	100%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	8%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1987	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1988	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	100%
1989	0%	0%	0%	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1990	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1991	0%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	0%	73%	0%	27%
1992	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	0%	82%	0%	18%
1993	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1994	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	100%	0%	0%	0%	0%	8%	54%	38%
1995	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	18%	82%	40%	0%	60%
1996	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%	21%	0%	79%
1997	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	32%	15%	53%
1998	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%
1999	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2000	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%
2001	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	100%	0%	27%	0%	73%
2002	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2003	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	10%	90%	0%	0%	0%
2004	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	2%	98%
2005	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	5%	95%
2006	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2007	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
2008	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%
2010	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%
2011	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%
2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2014	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	41%	0%	59%
2015	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	99%
2016	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	58%	1%	41%
2017	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
2018	0%	0%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	36%	0%	64%
2019	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	27%	73%	0%	4%	96%
2020	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%
2021	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2022	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	58%	0%	42%

Table A2.12. Percentage of recreational discards 1981-2021 by fishing mode (SH = Shore; FH = For Hire; PR = Private) for each state (Cont.).

Year	NJ			NY			NC			RI			SC			VA			ME			NH		
	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR	SH	FH	PR
1981	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1982	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1987	0%	100%	0%	0%	0%	100%	0%	2%	98%	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1988	99%	0%	1%	0%	0%	0%	100%	0%	0%	0%	29%	71%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1989	100%	0%	0%	0%	33%	67%	0%	2%	98%	0%	0%	100%	0%	40%	60%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1990	0%	0%	100%	0%	0%	100%	0%	4%	96%	0%	74%	26%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1991	0%	0%	100%	0%	18%	82%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1992	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1993	0%	0%	0%	0%	41%	59%	30%	22%	48%	0%	2%	98%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1994	0%	0%	100%	0%	0%	100%	81%	5%	13%	0%	0%	100%	0%	0%	0%	0%	92%	8%	0%	0%	0%	0%	0%	0%
1995	0%	0%	100%	0%	0%	100%	0%	23%	77%	0%	8%	92%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1996	0%	0%	0%	0%	0%	0%	0%	12%	88%	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1997	0%	0%	0%	0%	0%	100%	0%	5%	95%	20%	20%	60%	0%	89%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1998	0%	0%	100%	0%	0%	100%	72%	15%	13%	0%	0%	100%	0%	49%	51%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1999	0%	0%	100%	0%	0%	100%	0%	93%	7%	13%	0%	87%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2000	0%	0%	100%	0%	0%	0%	0%	6%	94%	81%	2%	17%	0%	9%	91%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2001	0%	0%	0%	0%	0%	0%	0%	2%	98%	0%	11%	89%	0%	11%	89%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2002	0%	0%	0%	100%	0%	0%	2%	2%	96%	0%	4%	96%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2003	0%	100%	0%	0%	0%	100%	0%	14%	86%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2004	0%	0%	0%	0%	0%	0%	0%	1%	99%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2005	0%	30%	70%	0%	0%	0%	0%	1%	99%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2006	0%	0%	100%	0%	0%	0%	0%	8%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2007	0%	0%	0%	0%	0%	0%	0%	15%	85%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2008	0%	0%	0%	0%	0%	0%	0%	15%	85%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009	0%	0%	0%	0%	0%	0%	0%	8%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2010	0%	0%	0%	0%	0%	0%	0%	3%	97%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2011	0%	0%	0%	0%	0%	0%	0%	1%	99%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2012	0%	0%	0%	0%	0%	0%	21%	9%	70%	0%	0%	0%	0%	1%	99%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2013	0%	0%	100%	0%	100%	0%	0%	23%	77%	0%	0%	100%	0%	1%	99%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2014	0%	0%	100%	0%	0%	100%	0%	0%	100%	2%	3%	95%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2015	0%	0%	0%	0%	0%	100%	0%	14%	86%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2016	0%	0%	0%	0%	0%	0%	0%	5%	95%	94%	0%	6%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2017	0%	0%	100%	0%	0%	100%	0%	4%	96%	0%	2%	98%	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2018	14%	0%	86%	0%	5%	95%	0%	3%	97%	38%	0%	62%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	100%
2019	19%	15%	66%	36%	0%	64%	0%	3%	97%	64%	0%	36%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2020	9%	0%	91%	12%	0%	88%	0%	1%	99%	42%	2%	55%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2021	0%	2%	98%	0%	0%	100%	31%	1%	68%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2022	0%	3%	97%	0%	0%	100%	0%	3%	97%	4%	3%	93%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

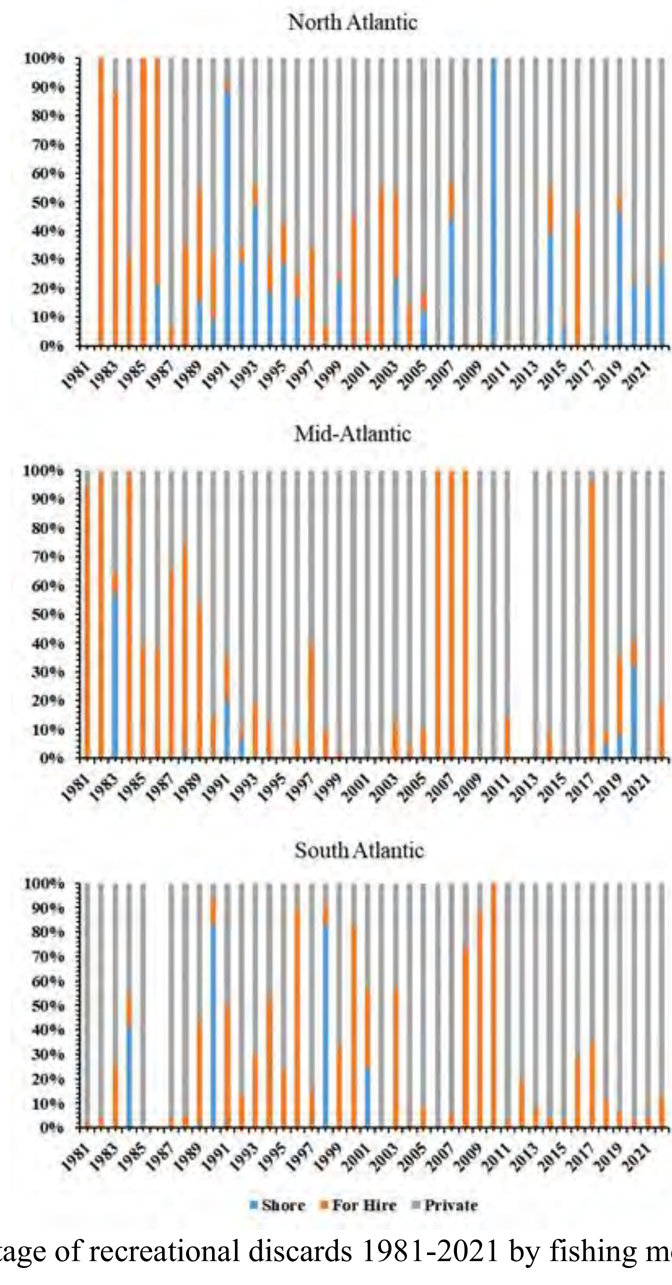

Figure A2.8. Percentage of recreational discards 1981-2021 by fishing mode for each region.

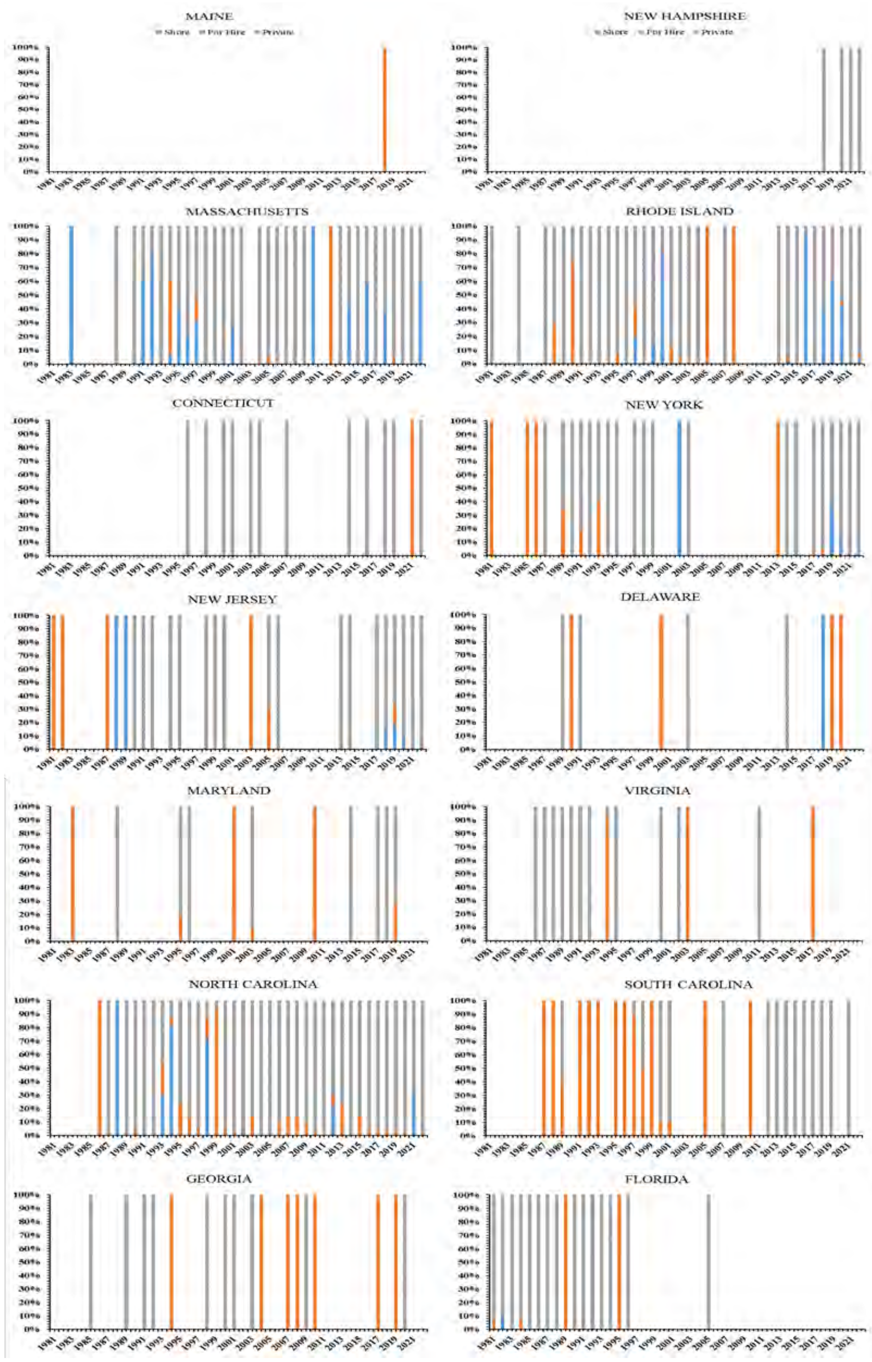

Figure A2.9. Percentage of recreational discards 1981-2021 by fishing mode for each state.

Table A2.13. Percentage of recreational discards 1981-2021 in state and federal waters for each region.

Year	Mid-Atlantic		North Atlantic		South Atlantic	
	Federal	State	Federal	State	Federal	State
1981	100%	0%	0%	100%	92%	8%
1982	100%	0%	0%	0%	36%	64%
1983	100%	0%	0%	100%	100%	0%
1984	0%	0%	100%	0%	87%	13%
1985	100%	0%	0%	0%	30%	70%
1986	61%	39%	0%	0%	82%	18%
1987	43%	57%	100%	0%	87%	13%
1988	1%	99%	38%	62%	8%	92%
1989	4%	96%	100%	0%	83%	17%
1990	69%	31%	100%	0%	83%	17%
1991	26%	74%	69%	31%	42%	58%
1992	46%	54%	0%	100%	84%	16%
1993	41%	59%	85%	15%	96%	4%
1994	14%	86%	4%	96%	17%	83%
1995	90%	10%	4%	96%	100%	0%
1996	100%	0%	16%	84%	100%	0%
1997	0%	100%	7%	93%	49%	51%
1998	97%	3%	37%	63%	31%	69%
1999	27%	73%	79%	21%	100%	0%
2000	2%	98%	0%	100%	100%	0%
2001	100%	0%	23%	77%	85%	15%
2002	9%	91%	3%	97%	28%	72%
2003	55%	45%	87%	13%	58%	42%
2004	0%	0%	74%	26%	54%	46%
2005	30%	70%	0%	100%	100%	0%
2006	100%	0%	0%	100%	81%	19%
2007	0%	0%	0%	100%	87%	13%
2008	0%	0%	15%	85%	54%	46%
2009	0%	0%	0%	100%	100%	0%
2010	100%	0%	0%	100%	100%	0%
2011	100%	0%	0%	0%	83%	17%
2012	0%	0%	0%	100%	79%	21%
2013	99%	1%	14%	86%	19%	81%
2014	98%	2%	1%	99%	45%	55%
2015	0%	100%	0%	100%	82%	18%
2016	0%	0%	25%	75%	68%	32%
2017	52%	48%	32%	68%	32%	68%
2018	66%	34%	13%	87%	86%	14%
2019	77%	23%	5%	95%	37%	63%
2020	52%	48%	6%	94%	69%	31%
2021	93%	7%	3%	97%	31%	69%
2022	89%	11%	25%	75%	87%	13%

Table A2.14. Percentage of recreational discards 1981-2021 in state and federal waters for each state.

Year	CT		DE		FL		GA		MD		MA	
	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State
1981	0%	0%	0%	0%	92%	8%	0%	0%	0%	0%	0%	0%
1982	0%	0%	0%	0%	36%	64%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
1984	0%	0%	0%	0%	87%	13%	0%	0%	0%	0%	0%	0%
1985	0%	0%	0%	0%	30%	70%	100%	0%	0%	0%	0%	0%
1986	0%	0%	0%	0%	81%	19%	0%	0%	0%	0%	0%	0%
1987	0%	0%	0%	0%	88%	12%	0%	0%	0%	0%	0%	0%
1988	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
1989	0%	0%	0%	100%	100%	0%	100%	0%	0%	0%	0%	0%
1990	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	100%	0%
1991	0%	0%	100%	0%	100%	0%	100%	0%	0%	0%	0%	100%
1992	0%	0%	0%	0%	100%	0%	100%	0%	0%	0%	0%	100%
1993	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
1994	0%	0%	0%	0%	100%	0%	0%	100%	0%	0%	2%	98%
1995	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
1996	0%	100%	0%	0%	100%	0%	0%	0%	100%	0%	0%	100%
1997	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1998	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	0%	100%
1999	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2000	0%	100%	100%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2001	0%	100%	0%	0%	0%	0%	100%	0%	100%	0%	28%	72%
2002	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2003	0%	100%	100%	0%	0%	0%	100%	0%	100%	0%	0%	0%
2004	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	2%	98%
2005	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%
2006	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2007	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2008	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2009	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	100%
2010	0%	0%	0%	0%	0%	0%	100%	0%	100%	0%	0%	100%
2011	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	80%	20%
2014	0%	100%	100%	0%	0%	0%	0%	0%	100%	0%	0%	100%
2015	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2016	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	67%
2017	0%	0%	0%	0%	0%	0%	0%	100%	92%	8%	100%	0%
2018	26%	74%	0%	100%	0%	0%	0%	0%	100%	0%	13%	87%
2019	0%	100%	100%	0%	0%	0%	100%	0%	100%	0%	4%	96%
2020	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	6%	94%
2021	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	2%	98%
2022	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	28%	72%

Table A2.14. Percentage of recreational discards 1981-2021 in state and federal waters for each state (Cont.).

Year	NJ		NY		NC		RI		SC		VA		ME		NH	
	Federal	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**
1981	100%	0%	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
1982	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1983	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1984	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1985	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1986	0%	0%	100%	0%	100%	0%	0%	0%	0%	0%	47%	53%	0%	0%	0%	0%
1987	100%	0%	0%	100%	52%	48%	100%	0%	100%	0%	100%	0%	0%	0%	0%	0%
1988	0%	100%	0%	0%	0%	100%	100%	0%	100%	0%	100%	0%	0%	0%	0%	0%
1989	0%	100%	88%	12%	67%	33%	100%	0%	100%	0%	100%	0%	0%	0%	0%	0%
1990	100%	0%	44%	56%	42%	58%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%
1991	0%	100%	100%	0%	8%	92%	100%	0%	100%	0%	0%	100%	0%	0%	0%	0%
1992	0%	100%	33%	67%	58%	42%	0%	100%	100%	0%	100%	0%	0%	0%	0%	0%
1993	0%	0%	41%	59%	70%	30%	98%	2%	100%	0%	0%	0%	0%	0%	0%	0%
1994	0%	100%	0%	100%	3%	97%	38%	62%	0%	0%	73%	27%	0%	0%	0%	0%
1995	92%	8%	88%	12%	100%	0%	17%	83%	100%	0%	100%	0%	0%	0%	0%	0%
1996	0%	0%	0%	0%	100%	0%	98%	2%	100%	0%	0%	0%	0%	0%	0%	0%
1997	0%	0%	0%	100%	42%	58%	20%	80%	100%	0%	0%	0%	0%	0%	0%	0%
1998	95%	5%	100%	0%	15%	85%	63%	37%	49%	51%	0%	0%	0%	0%	0%	0%
1999	100%	0%	0%	100%	100%	0%	82%	18%	100%	0%	0%	0%	0%	0%	0%	0%
2000	0%	100%	0%	0%	100%	0%	0%	100%	100%	0%	0%	100%	0%	0%	0%	0%
2001	0%	0%	0%	0%	71%	29%	11%	89%	100%	0%	0%	0%	0%	0%	0%	0%
2002	0%	0%	0%	100%	28%	72%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%
2003	100%	0%	0%	100%	45%	55%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%
2004	0%	0%	0%	0%	53%	47%	92%	8%	0%	0%	0%	0%	0%	0%	0%	0%
2005	30%	70%	0%	0%	100%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%	0%
2006	100%	0%	0%	0%	81%	19%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2007	0%	0%	0%	0%	75%	25%	0%	100%	100%	0%	0%	0%	0%	0%	0%	0%
2008	0%	0%	0%	0%	53%	47%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2010	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2011	0%	0%	0%	0%	83%	17%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%
2012	0%	0%	0%	0%	62%	38%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
2013	100%	0%	0%	100%	51%	49%	0%	100%	15%	85%	0%	0%	0%	0%	0%	0%
2014	99%	1%	0%	100%	43%	57%	3%	97%	100%	0%	0%	0%	0%	0%	0%	0%
2015	0%	0%	0%	100%	92%	8%	0%	100%	53%	47%	0%	0%	0%	0%	0%	0%
2016	0%	0%	0%	0%	68%	32%	0%	100%	65%	35%	0%	0%	0%	0%	0%	0%
2017	0%	100%	100%	0%	17%	83%	0%	100%	100%	0%	0%	100%	0%	0%	0%	0%
2018	67%	33%	42%	58%	81%	19%	0%	100%	100%	0%	0%	0%	0%	100%	0%	100%
2019	81%	19%	64%	36%	27%	73%	8%	92%	100%	0%	0%	0%	0%	0%	0%	0%
2020	80%	20%	0%	100%	48%	52%	8%	92%	0%	0%	0%	0%	0%	0%	0%	100%
2021	94%	6%	89%	11%	25%	75%	0%	100%	100%	0%	0%	0%	0%	0%	100%	0%
2022	100%	0%	0%	100%	87%	13%	1%	99%	0%	0%	0%	0%	0%	0%	0%	100%

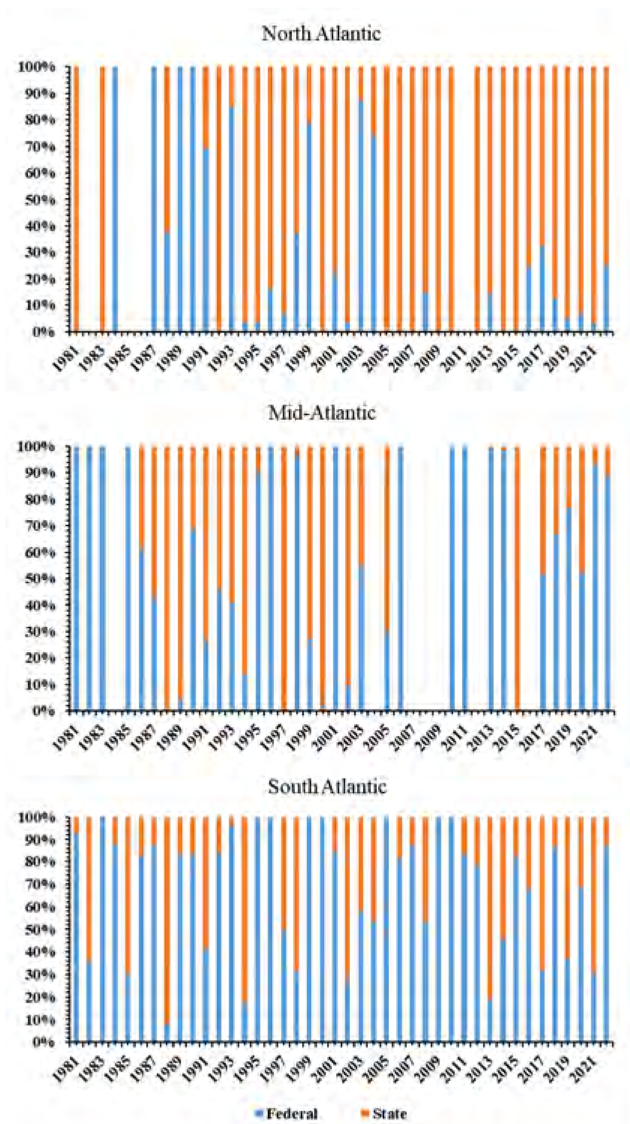

Figure A2.10. Percentage of recreational discards 1981-2021 in state and federal waters for each region.

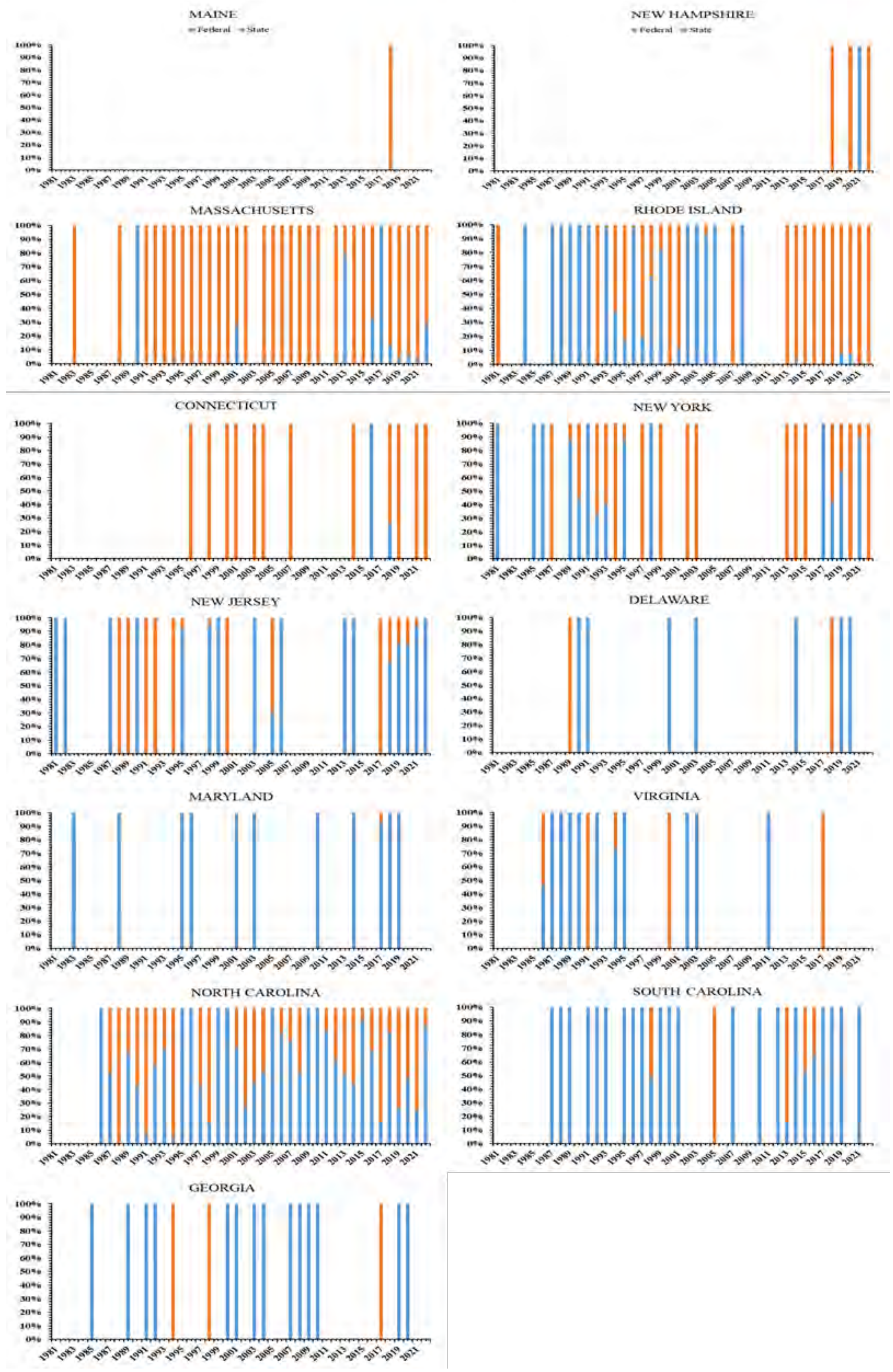

Figure A2.10. Percentage of recreational discards 1981-2021 in state and federal waters for each state.

APPENDIX 2 LENGTH AND WEIGHT

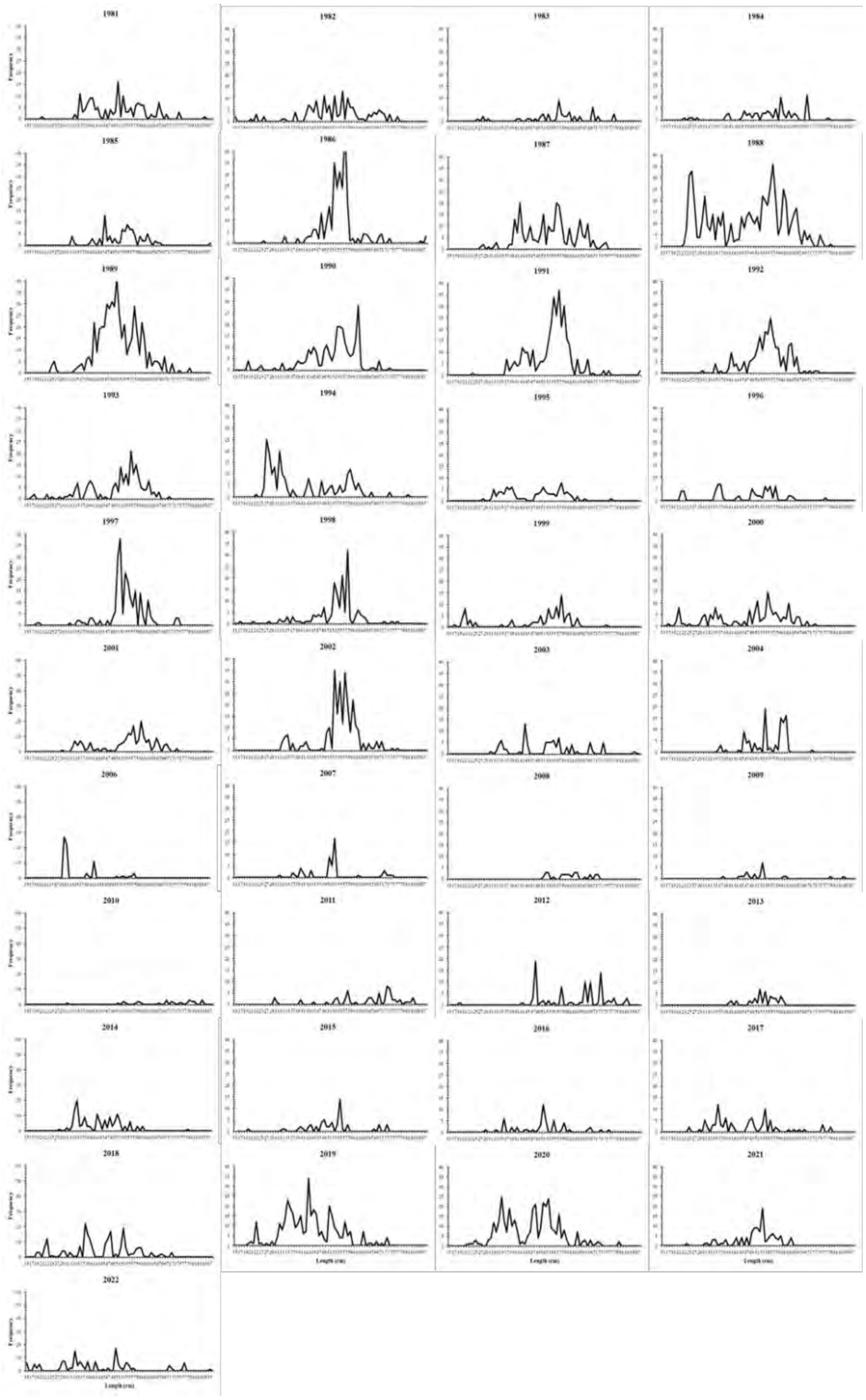

Figure A3.1. The length frequencies from all regions by year.

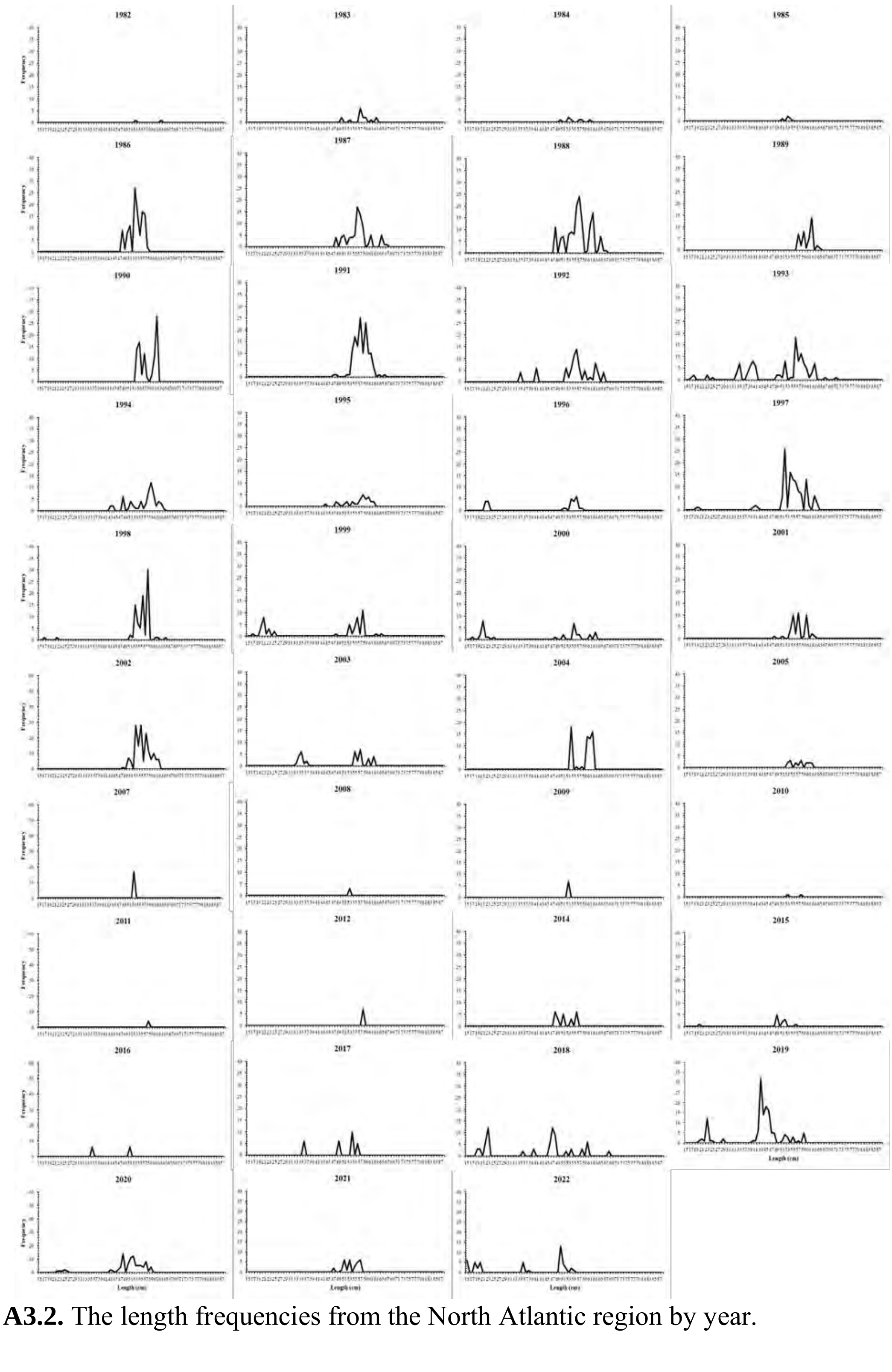

Figure A3.2. The length frequencies from the North Atlantic region by year.

Table A3.1. The summary of length and weight data from the North Atlantic region by year.

Year	North Atlantic								
	Count	Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	-	-	-	-	-	-	-	-	-
1982	2	53	63	58.0	7.07	1.0	1.4	1.21	0.316
1983	16	50	63	57.3	3.75	0.8	1.6	1.31	0.236
1984	7	50	61	55.1	3.72	0.8	1.3	1.10	0.176
1985	4	51	54	52.8	1.26	1.1	1.4	1.18	0.169
1986	115	48	58	53.5	2.70	0.8	1.9	1.12	0.211
1987	80	48	67	56.2	4.23	0.8	1.9	1.23	0.255
1988	146	48	67	56.7	4.55	0.7	1.8	1.24	0.255
1989	40	57	65	60.3	2.22	1.2	1.8	1.39	0.168
1990	90	54	62	58.3	3.27	1.0	1.9	1.28	0.231
1991	129	47	66	57.4	2.74	0.7	2.1	1.34	0.266
1992	81	35	66	55.3	7.44	0.5	1.8	1.38	0.235
1993	116	17	71	50.0	11.56	0.0	2.2	1.01	0.509
1994	64	43	64	56.1	5.43	0.5	2.0	1.29	0.426
1995	30	44	62	56.2	4.63	0.6	1.6	1.22	0.316
1996	27	22	58	45.3	15.16	0.1	1.5	0.87	0.547
1997	118	19	64	54.6	6.38	0.0	2.0	1.26	0.380
1998	86	17	65	55.2	6.06	0.0	1.8	1.15	0.367
1999	52	17	65	43.5	17.19	0.0	1.8	0.84	0.632
2000	33	17	63	41.4	18.05	0.0	1.7	0.76	0.644
2001	43	48	63	57.0	2.99	0.8	1.7	1.31	0.173
2002	152	48	62	55.7	3.06	0.8	1.8	1.22	0.226
2003	36	33	62	48.8	11.45	0.2	1.7	0.95	0.558
2004	63	54	62	58.9	3.29	1.0	1.7	1.45	0.245
2005	17	53	62	57.5	3.16	1.0	1.7	1.36	0.241
2006	4	57	58	57.8	0.50	1.1	1.5	1.38	0.179
2007	34	53	113	83.0	30.45	1.0	10.2	5.59	4.662
2008	3	53	53	53.0	0.00	1.0	1.0	0.98	0.000
2009	7	53	53	53.0	0.00	1.0	1.0	0.98	0.000
2010	2	53	58	55.5	3.54	1.0	1.3	1.12	0.189
2011	4	58	58	58.0	0.00	1.3	1.3	1.25	0.000
2012	7	58	58	58.0	0.00	1.3	1.3	1.25	0.000
2013	-	-	-	-	-	-	-	-	-
2014	23	48	56	51.7	3.26	0.5	1.5	0.90	0.309
2015	12	20	56	48.3	9.14	0.0	1.1	0.81	0.260
2016	12	36	51	43.5	7.83	0.3	0.9	0.61	0.291
2017	27	36	56	49.3	7.61	0.3	1.2	0.86	0.320
2018	71	19	68	40.5	14.69	0.0	2.2	0.62	0.529
2019	135	20	59	42.6	8.99	0.0	1.4	0.54	0.262
2020	90	22	59	50.0	7.87	0.0	1.6	0.92	0.338
2021	30	47	57	53.6	2.93	0.7	1.6	1.15	0.268
2022	46	15	55	36.0	15.70	0.0	1.2	0.52	0.444

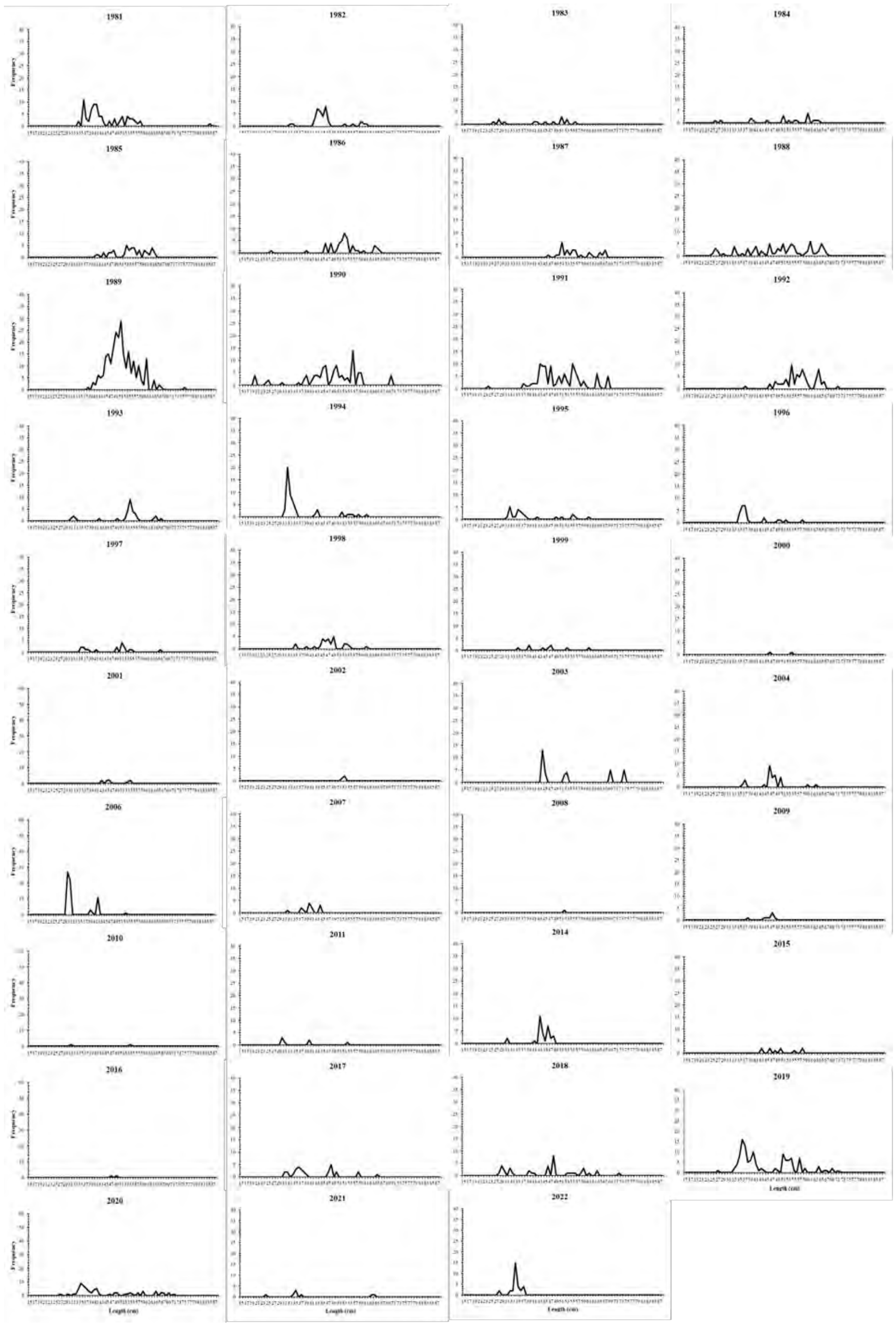

Figure A3.3. The length frequencies from the Mid-Atlantic region by year.

Table A3.2. The summary of length and weight data from the Mid-Atlantic region by year.

Year	Count	Mid-Atlantic							
		Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	79	34	85	44.1	8.31	0.1	1.4	0.55	0.346
1982	38	33	61	46.0	6.07	0.3	1.7	0.73	0.365
1983	14	26	56	43.1	10.75	0.3	1.5	0.89	0.400
1984	19	26	64	50.7	11.55	0.3	1.9	1.10	0.509
1985	44	41	64	54.5	6.32	0.4	5.6	1.31	0.793
1986	46	26	66	52.9	6.98	0.1	3.3	1.30	0.671
1987	30	46	67	56.3	6.15	0.5	2.5	1.46	0.518
1988	79	25	67	49.4	11.78	0.0	2.2	1.04	0.687
1989	257	38	76	51.2	5.65	0.4	2.3	1.16	0.450
1990	100	20	70	48.1	10.31	0.0	1.7	0.88	0.448
1991	108	24	68	50.4	8.15	0.1	2.1	0.97	0.490
1992	73	37	71	56.8	5.95	0.5	2.4	1.31	0.334
1993	32	31	66	52.2	8.91	0.2	1.7	1.08	0.411
1994	52	31	61	36.5	8.14	0.2	1.7	0.38	0.387
1995	25	31	61	39.5	9.13	0.2	1.7	0.52	0.470
1996	25	35	58	39.4	6.30	0.3	1.3	0.45	0.273
1997	18	35	66	46.6	8.88	0.2	2.3	0.84	0.519
1998	29	35	61	47.3	5.52	0.3	2.0	0.87	0.432
1999	9	35	61	45.7	7.89	0.3	2.0	0.90	0.597
2000	2	46	54	50.0	5.66	0.6	1.0	0.84	0.268
2001	9	43	54	47.7	4.64	0.6	1.2	0.77	0.243
2002	3	52	53	52.7	0.58	1.0	1.4	1.19	0.207
2003	34	44	74	54.0	12.02	0.5	2.8	1.34	0.804
2004	29	36	63	46.8	5.68	0.2	1.4	0.69	0.232
2005	5	30	46	35.6	7.80	0.2	0.7	0.30	0.246
2006	65	30	53	33.3	5.26	0.2	1.1	0.25	0.160
2007	13	32	44	39.8	3.36	0.2	0.6	0.43	0.108
2008	1	52	52	52.0	-	0.9	0.9	0.87	-
2009	8	38	48	45.3	3.20	0.4	0.7	0.60	0.103
2010	2	31	54	42.5	16.26	0.3	1.3	0.80	0.694
2011	7	30	54	36.4	9.02	0.2	1.3	0.53	0.390
2012	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-
2014	31	31	48	43.8	3.88	0.2	0.7	0.56	0.121
2015	10	43	58	49.7	5.64	0.5	1.3	0.85	0.310
2016	2	47	49	48.0	1.41	0.8	0.8	0.80	0.006
2017	30	31	65	41.7	8.92	0.2	1.8	0.54	0.389
2018	39	28	72	45.5	11.95	0.1	2.5	0.76	0.544
2019	122	27	71	44.6	9.85	0.2	2.6	0.68	0.511
2020	70	27	71	44.4	11.86	0.2	2.6	0.71	0.653
2021	8	24	64	40.9	14.52	0.1	1.8	0.63	0.711
2022	31	28	37	34.1	2.08	0.1	0.4	0.27	0.049

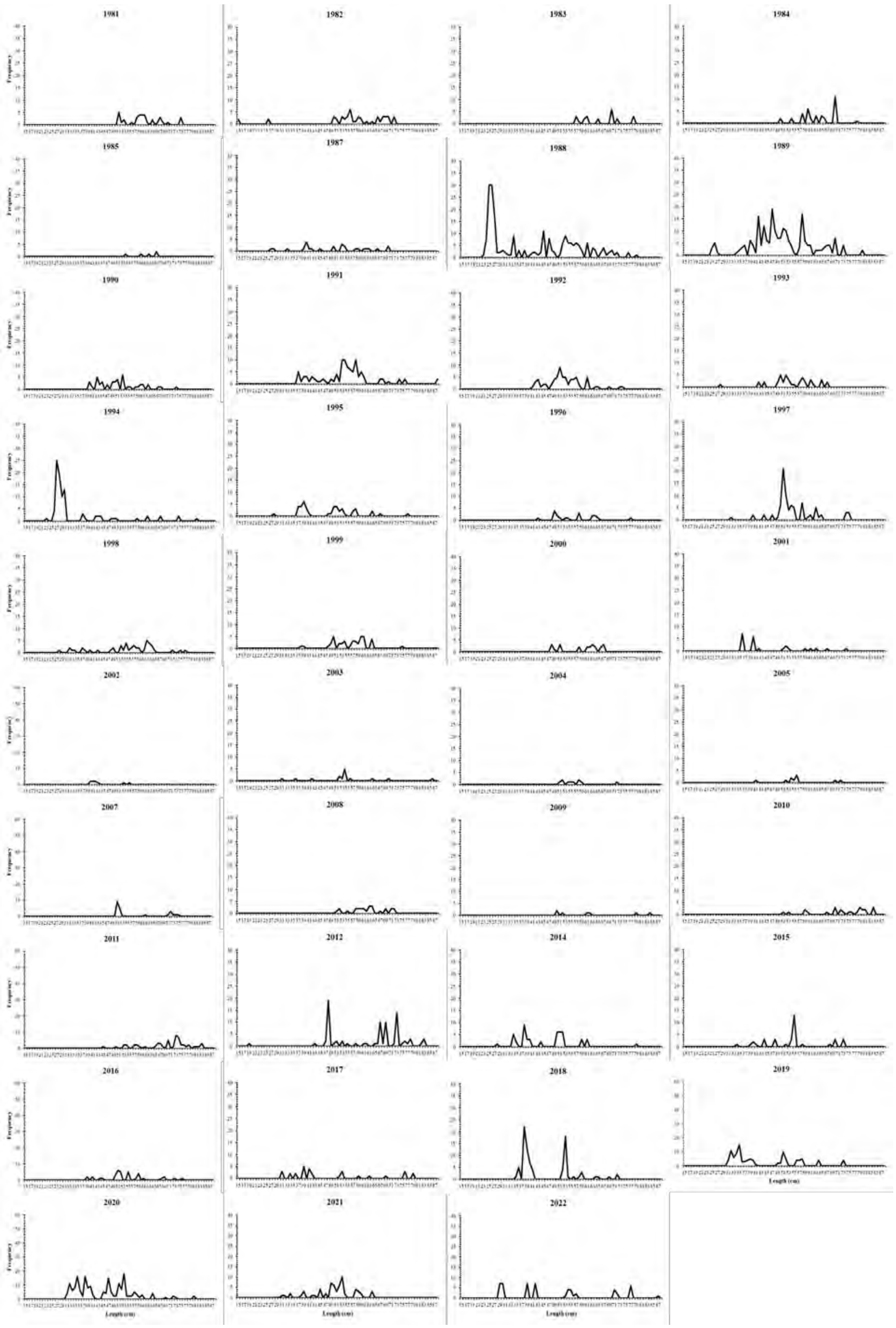

Figure A3.4. The length frequencies from the South Atlantic region by year.

Table A3.3. The summary of length and weight data from the South Atlantic region by year.

Year	South Atlantic								
	Count	Length				Weight			
		Min	Max	Mean	SD	Min	Max	Mean	SD
1981	36	51	75	60.6	6.86	0.5	3.1	1.46	0.593
1982	48	15	72	57.1	13.19	0.0	4.0	1.66	0.895
1983	22	57	78	66.4	7.08	1.2	2.6	1.85	0.508
1984	36	50	78	63.5	6.43	1.1	2.6	1.80	0.535
1985	5	54	66	61.8	5.02	1.2	2.4	1.63	0.476
1986	-	-	-	-	-	-	-	-	-
1987	26	27	70	49.7	12.14	0.1	2.2	0.94	0.636
1988	222	23	79	41.3	15.61	0.4	2.2	1.04	0.455
1989	213	25	80	50.5	10.81	0.0	3.7	0.97	0.631
1990	45	40	74	51.5	8.16	0.3	2.5	0.97	0.482
1991	101	37	88	54.2	9.99	0.3	5.0	1.27	0.852
1992	70	41	74	52.8	6.89	0.4	3.1	1.13	0.506
1993	41	28	67	54.0	7.71	0.1	2.8	1.33	0.608
1994	93	23	81	33.5	12.18	0.1	3.6	0.35	0.622
1995	44	28	77	47.8	10.09	0.2	2.3	0.82	0.563
1996	19	43	77	56.2	8.28	0.4	3.0	1.44	0.763
1997	84	32	75	54.6	7.77	0.2	3.6	1.23	0.667
1998	48	28	77	54.2	11.54	0.1	3.3	1.37	0.968
1999	41	38	75	56.1	6.84	0.4	2.6	1.21	0.575
2000	23	48	67	59.0	6.98	0.6	3.2	1.92	0.902
2001	23	36	74	46.3	11.64	0.3	2.7	0.79	0.669
2002	9	40	55	44.1	5.71	0.4	1.5	0.58	0.360
2003	15	31	86	54.1	13.07	0.2	3.5	1.22	0.901
2004	10	51	72	56.7	6.06	0.8	3.0	1.18	0.654
2005	10	41	72	56.6	8.81	0.6	3.0	1.25	0.856
2006	2	51	56	53.5	3.54	0.8	0.9	0.87	0.095
2007	22	51	75	58.6	10.13	0.8	3.1	1.47	0.849
2008	26	51	72	62.3	6.09	1.0	3.0	2.01	0.634
2009	7	50	84	62.6	13.90	0.8	4.8	2.15	1.499
2010	25	51	84	72.6	9.66	0.8	4.8	3.14	1.157
2011	54	45	83	69.3	9.09	0.8	4.6	2.58	1.048
2012	81	19	83	62.8	12.66	0.0	4.6	1.98	1.110
2013	-	-	-	-	-	-	-	-	-
2014	50	28	79	45.8	9.96	0.2	4.0	0.77	0.600
2015	36	34	73	54.3	10.24	0.3	3.2	1.30	0.874
2016	36	39	76	54.2	8.87	0.3	3.6	1.20	0.744
2017	30	31	79	48.8	15.92	0.2	3.6	1.05	1.207
2018	85	35	72	45.3	9.38	0.2	3.0	0.72	0.575
2019	105	31	73	43.1	11.53	0.2	3.2	0.71	0.763
2020	186	31	80	44.9	10.27	0.2	3.4	0.71	0.628
2021	62	31	64	50.2	7.44	0.2	1.8	0.89	0.385
2022	53	29	87	49.4	17.51	0.1	4.5	1.19	1.224

Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

MEMORANDUM

TO: **Horseshoe Crab Management Board**

FROM: **Caitlin Starks, Senior Fishery Management Plan Coordinator**

DATE: **April 26, 2023**

SUBJECT: **Work Group Recommendations and Report on Biomedical Best Management Practices**

Background

In 2022, the Horseshoe Crab Management Board (Board) appointed a work group to review and update the best management practices (BMPs) for handling biomedical catch. The original BMP document was developed by a similar work group in 2011 and included BMPs for the various steps throughout the biomedical process, from collection to release. Many of these practices were already in use by the biomedical companies in order to sustain the horseshoe crab population and ensure a steady and reliable supply of product to the pharmaceutical market.

Formation of the 2023 work group was prompted by the Board's recent discussions about biomedical mortality and follows the recommendation to periodically review the BMPs for the continued successful management of the horseshoe crab resource. The work group includes technical committee and advisory panel members with expertise in horseshoe crab biology, ecology, and biomedical processing. The BMP document that was included with the Board's meeting materials includes a modified list of BMPs, as recommended by the 2023 work group. It also provides background on the horseshoe crab biomedical fishery, information on current regulations in the Commission's Horseshoe Crab Fishery Management Plan (FMP) related to biomedical collections, as well as descriptions of general processes used to collect and transport horseshoe crabs for biomedical purposes. Finally, it includes a set of research recommendations that could inform future improvements to the BMPs.

Additional Work Group Recommendations

Over the course of several meetings between January and April, 2023, the work group reviewed the BMPs and proposed modifications to more accurately characterize the practices that are expected to minimize the mortality and injury of horseshoe crabs collected for biomedical purposes. Through these discussions the work group identified several additional recommendations for the Board's consideration.

First, the work group recommends the Management Board task the Technical Committee (TC) with reevaluating the calculation of the coastwide biomedical mortality estimates presented in Commission documents. It came to the attention of the work group that the current calculation process, which applies a 15% estimated mortality rate to bled crabs and adds that number to the number of observed mortalities, may result in double counting of some horseshoe crab mortalities. The TC should review the data and recommend a method for calculating the overall estimated mortality of crabs collected for biomedical use on an annual basis.

M23-41

The work group also recommends that where it describes biomedical processes, the Commission's FMP be modified to use language that accurately reflects the practices used by the industry. For example, the FMP refers to collections of biomedical horseshoe crabs as "harvest." However, given the requirement to release these crabs back to the water, the work group believes such take would be more accurately described as "collection." Other misleading terminology in the FMP (e.g., shipping versus transport) continues to create public confusion about biomedical handling processes.

The work group also discussed that, in addition to the five biomedical operations along the Atlantic coast that are licensed by the US Food and Drug Administration (FDA), there are other operations along the coast that are not licensed by the FDA but are still permitted to collect blood from horseshoe crabs for other purposes such as health or medical research. The work group recommends each state provide a report to the Board on any such operations in their state, including the permitting and reporting requirements for these operations.

From: doris lake
To: info
Subject: [External] horseshoe crabs
Date: Wednesday, April 19, 2023 5:31:25 PM

Moritoriam on harvesting /killing horseshoe crabs,Bring the ecosystem back to life .Migrating birds depend on the eggs of the crabs to continue their journey.There is no need for Bio labs to use HS crab blood.There is a synthetic substance available.Stop the harvesting for money and let nature return the balance to our shores for all the living creatures that depend on them and I don't mean us.

Thank you   Doris Lake

EARTHJUSTICE

April 21, 2023

Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
comments@asmfc.org

VIA ELECTRONIC MAIL

Re: Safeguarding public participation in decisions about the horseshoe crab bait fishery in Delaware Bay

Dear Members of the Horseshoe Crab Management Board:

I write on behalf of New Jersey Audubon and Defenders of Wildlife to request that the Board institute a process for providing advance notice to the public before considering the authorization of any bait harvest of female Delaware Bay-origin horseshoe crabs. Under the current management regime, the public is unable to anticipate whether the Board is actively considering the authorization of a female harvest for a given year. As a result, concerned members of the public are unable to make informed decisions about whether and how to engage in the Board's decision-making process.

In November 2022, when the Board maintained a female bait harvest quota of zero horseshoe crabs in Delaware Bay, it described its decision as "[a]cknowledging public concern about the status of the red knot population in the Delaware Bay."[1] However, the Board also approved a new adaptive resource management ("ARM") model that is nearly certain to recommend authorizing a female bait harvest every year. While the Board opted not to implement the model's recommendation for 2023, the public cannot foresee whether the Board will implement the model's recommendations in future years or maintain a harvest quota of zero.

With the vital question of a female bait harvest perpetually at issue, every year the stakes for the public will remain as high as they were in 2022. The status quo presents the public with two unreasonable options: (1) mobilize annually to oppose a female bait harvest that the Board might not actually be considering, which would waste the time and resources of the Board, Commission staff, and public; or (2) sit on the sidelines and risk that the Board will implement the ARM model's recommendation for a female harvest without any advance public notice.

The Board can resolve this uncertainty by committing to provide advance notice to the public if it is considering the authorization of a female bait harvest in Delaware Bay. For example, the Board could commit to indicating no later than its Summer Meeting if it may take action at its

[1] Atlantic States Marine Fisheries Commission, News Release, "Horseshoe Crab Board Sets 2023 Specifications for Horseshoe Crabs of Delaware Bay-Origin & Adopts ARM Framework Revision via Addendum VIII" (Nov. 10, 2022), https://asmfc.org/uploads/file/636d41cepr33_HSC2023DEBaySpecs_AddendumVIII_Approval.pdf.

Annual Meeting to authorize a female bait harvest for the following fishing year. If the Board makes such an indication, then the public can decide how to engage and submit comments. If the Board does not indicate the possible authorization of a female bait harvest, then the public will know that it is not necessary to engage on this issue for a given year.

We appreciate the Board's acknowledgment of public concern about the status of the red knot population. By giving the public advance notice about a possible female horseshoe crab bait harvest, the Board would enable the public to make more informed decisions about future engagement.

Respectfully submitted,

Benjamin Levitan
Senior Attorney
Earthjustice Biodiversity Defense Program
(202) 797-4317
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