

**DRAFT MEETING SUMMARY OF THE
ATLANTIC STATES MARINE FISHERIES COMMISSION
EXECUTIVE COMMITTEE**

**The Hyatt Dewey Beach
Dewey Beach, DE
October 29, 2025**

INDEX OF MOTIONS

1. Approval of Agenda by Consent (Page 1)
2. Move to accept the FY25 Audit as presented. Motion by Dr. McNamee, second by Mr. Clark. Motion passed unanimously.

ATTENDANCE

Committee Members

Carl Wilson, ME
Renee Zobel, NH
Dennis Abbott, NH (LA Chair)
Dan McKiernan, MA, Vice Chair
Jason McNamee, RI
Bill Hyatt, CT
Marty Gary, NY
Joe Cimino, NJ, Chair
Kris Kuhn, PA

Roy Miller, DE (GA Chair)
John Clark, DE
Lynn Fegley, MD
Jamie Green, VA
Chris Batsavage, proxy for Kathy Rawls, NC
Ben Dyar, SC
Doug Haymans, GA
Erika Burgess, FL

Other Commissioners/Proxies

Mel Bell, SC LA proxy
David Borden, RI GA
Matt Gates, CT DEEP
Joe Grist, VA AA Proxy
Doug Grout, NH GA
Gary Jennings, FL GA
Jeff Kaelin, NJ GA

Ray Kane, MA GA
Carrie Kennedy, MD AA proxy
Malcolm Rhodes, SC GA
Brian Turner, NC LA
Megan Ware, ME AA proxy
Spud Woodward, GA GA

Staff

Bob Beal
Toni Kerns
Alexander Law

Laura Leach
Madeline Musante
Geoff White

Guests

Kenneth Boswell, MD CBA
Don Cocnavitch, MD CBA
Doug Collison, MD CBA
Dustin Delano, NEFSA
Ron Owens, PRFC

CALL TO ORDER

The Executive Committee of the Atlantic States Marine Fisheries Commission convened October 29, 2025 in the Ballroom at The Hyatt in Dewey Beach, Delaware. The meeting was called to order at 8:02 a.m. by Chair Joe Cimino.

APPROVAL OF AGENDA

The agenda was approved with a minor change in the order of agenda items.

APPROVAL OF SUMMARY MINUTES

The summary minutes from the August 6, 2025 meeting were approved as presented.

PUBLIC COMMENT

There was no public comment.

FY25 AUDIT OF THE COMMISSION

Mrs. Leach presented the FY25 financial audit of the Commission, noting it was a clean audit with no negative findings reported. Dr. McNamee made the following motion, which was seconded by Mr. Clark. *Move to accept the FY25 Audit as presented.* The motion passed unanimously.

REPORT OF THE DECLARED INTERESTS AND VOTING PRIVILEGES WORK GROUP

Mr. Beal reported a Declared Interests and Voting Privileges work group was formed to flesh out the discussion paper presented in August, to further frame the Executive Committee discussion. The work group will report back to the Executive Committee in February.

NOTIFYING ACTIONS ON MEETING AGENDAS

Mr. Beal discussed the issue of “notifying actions” on meeting agendas. After a thorough discussion staff was tasked with developing language for agendas (and possibly the ISFMP Charter), detailing the process and noting when public input was available.

LEGISLATIVE COMMITTEE UPDATE

Legislative Program Coordinator Alexander Law presented an update on the status of FY26 federal funding, the government shutdown, and the status of two recently introduced bills; the Fisheries Data Modernization Act, and the QUAHOGS Act.

CARES UPDATE

Mr. Beal provided an update on the status of the remaining issues with New Jersey and Florida CARES payments due to be repaid after audits found funds made some more than whole or they were ineligible to receive funds. The Commission has established repayment plans with some of the recipients in New Jersey and Florida. Also, New Jersey continues to work through the adjudicatory hearing process for several recipients.

FUTURE ANNUAL MEETING LOCATIONS

Mrs. Leach provided an update on future Annual Meeting locations. In 2026 (likely the second week of November) the Commission will meet in Newport, Rhode Island; 2027 South Carolina; 2028 Massachusetts; 2029 Pennsylvania; 2030 Georgia and 2031 Connecticut.

OTHER BUSINESS

Dustin Delano, New England Fisheries Stewardship Association expressed his concern with the public comment process used during the Menhaden Board meeting. He stated if you want buy-in you cannot discourage participation. Genuine collaboration starts with listening.

ADJOURN

The Executive Committee went into a closed session at 8:48 a.m. for a CARES and litigation update. The Executive Committee adjourned at 9:25 a.m.

Notifying “Actions” on Commission Agendas

During the Commission’s 2025 Annual Meeting, the Executive Committee discussed the process used to identify potential action items on Commission agendas. The Executive Committee tasked staff with developing a recommendation to ensure potential action items were properly noticed.

The Commission’s guiding documents include a definition of “final actions” that is considered in relation to meeting specific proxies for Legislative and Governor Appointee Commissioners and rescinding or amending board actions. Final actions are defined as: setting fishery specifications (including but limited to quotas, trip limits, possession limits, size limits, season, area closures, gear requirements), allocation, final approval of FMPs/amendments/addenda, emergency actions, conservation equivalency plans, and noncompliance recommendations.

Staff recommends adding language to the disclaimer included on the top of the meeting week agendas. This approach provides the public with general notification that action may be taken on any issues included on the agenda. This prevents the Commission from developing and adding a lengthy definition to the guiding documents.

The following bold/underlined language is recommended to be added to the agenda disclaimer.

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. **At these meetings, action may be taken on any agenda item, including, but not limited to, reports from staff, technical committees, stock assessment committees, peer reviews, Law Enforcement Committee, advisory panels, plan review teams, and plan development teams.**

Atlantic States Marine Fisheries Commission

Luncheon for Legislative and Governor Appointee Commissioners

February 4, 2026

11:45 – 1:15 PM

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

1. Welcome/Call to Order (R. Miller/D. Abbott)
2. Election of Chair/Vice Chairs (R. Miller/D. Abbott)
3. State(s) Report on Activities of Interest Related to Fisheries (New Chair/Vice Chair)
 - a. Discussion on Political Influence in the Commission Process (A. Law)
4. General Discussion (New Chair/Vice Chair)
5. Other Business (New Chair/Vice Chair)
6. 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.



Atlantic States Marine Fisheries Commission

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

MEMORANDUM

TO: Atlantic Menhaden Management Board
FROM: Atlantic Menhaden Plan Development Team
DATE: January 28, 2026
SUBJECT: Progress Report on Draft Addendum II to Amendment 3

At the 2025 Annual Meeting, the Atlantic Menhaden Management Board initiated draft Addendum II to Amendment 3 to consider options to reduce the Chesapeake Bay Reduction Fishery Cap by up to 50% and distribute the cap more evenly throughout the fishing season. Due to a delay in gaining access to confidential data, the Plan Development Team (PDT) was unable to complete the analyses necessary to draft options regarding quota periods for Board review at the Winter Meeting. This memo summarizes the PDT's work and seeks Board guidance to aid the PDT in continuing development of the Draft Addendum. Please note that a status quo option will be included in the addendum for each management issue per ASFMC policy, but these are not listed below for brevity.

Issue 1. Dividing the Chesapeake Bay Reduction Fishery Cap into Quota Periods

Statement of the Problem: As noted in the report of the Work Group on Precautionary Management in Chesapeake Bay, from 2015-2024, 49.5% of the reduction fishery effort and 46.09% of the reduction fishery landings in Chesapeake Bay occurred before July 15th. However, in 2023 and 2024, catch and effort have been well below the average until the end of June (Figure 1). The shift in harvest later in the season has corresponded with significant declines in harvest of pound net bait fisheries in Maryland, Virginia, and the Potomac River (Figure 2), which typically peak during the summer months.

Management Approaches

1) Divide Chesapeake Bay Cap into 3 to 5 periods:

Figure 1 shows an example of 3-5 quota periods based on equal harvest distribution from average landings between 2018-2024. Member(s) of the Board expressed interest in limiting harvest in any individual quota period to no more than one-third of the total Bay Cap to protect ingress into the Bay. However, the Board also requested options to delay harvest until later in the season. Delaying harvest until later in the season may require some quota periods to receive more than one-third of the Bay Cap and/or unequal period lengths. The PDT also notes the logistical difficulty in monitoring quota effectively over short periods due to the lag time in reporting/processing and recommends removing the 5-period option. The PDT is evaluating data from 2018-2024 to reflect the time period since the Bay Cap was implemented at its current level.

M26-12

Questions for the Board:

- i. Does the Board want to maintain a maximum of one-third of the Cap in each quota period?
- ii. Does the Board want to maintain equal season lengths or can unequal season lengths be considered?
- iii. Does the Board want to maintain a 5-period option?

2) Overages and Rollover Between Periods:

In the event that the reduction fishery does not harvest the full suballocation of the Bay Cap during a given quota period, the PDT is considering options for how the unused portion of the quota period sub-allocation is dealt with:

- i. No rollover: the remaining portion is unavailable for use later in the season
- ii. Proportional rollover: the remaining portion is divided proportionally across the remainder of the season and added to the remaining quota periods. For example: If the reduction fishery in the Bay was divided into three quota periods, and the first quota period was under harvested by 200,000 pounds, 100,000 pounds would be added to both the second and third quota period.
- iii. Delayed rollover: the remaining portion is added to the final quota period

The PDT is considering options for how overages should be paid back in the event that the reduction fishery exceeds the sub-allocation of the Bay Cap during a given quota period:

- i. Pay back in full during the subsequent period (i.e., subtract the overage from the next quota period's suballocation)
- ii. Pay back distributed throughout the remaining periods (i.e., divide the overage and subtract from each remaining quota period's suballocation).

Questions for the Board:

- i. If the Board maintains the limit of one-third of the Bay Cap per quota period, does the limit include rollover?
- ii. Are there options that the Board wants added or removed?

Table 1. Potential quota periods and average cumulative harvest from the Chesapeake Bay reduction fishery and the Maryland, PRFC, and Virginia pound net fisheries by week of the year, 2018-2024. Red bold type and black bold type indicate the first week in which 50% or 75% of harvest occurred or was exceeded, respectively.

Week of the Year	Date 1st Week of the	Quota Periods			Average Cumulative Harvest			
		Reduction			Reduction	MD PN	PRFC PN	VA PN
		Even 3	Even 4	Even 5				
8	2/19/2026					0.12%	0.00%	0.09%
9	2/26/2026					0.16%	0.16%	0.12%
10	3/5/2026					0.24%	0.37%	0.98%
11	3/12/2026					0.99%	2.52%	2.28%
12	3/19/2026					3.45%	5.29%	5.07%
13	3/26/2026					5.85%	8.21%	7.83%
14	4/2/2026					9.33%	12.38%	9.35%
15	4/9/2026					14.33%	15.97%	11.03%
16	4/16/2026					17.79%	20.24%	13.31%
17	4/23/2026					21.51%	23.77%	16.87%
18	4/30/2026					23.73%	26.35%	22.13%
19	5/7/2026	1	1	1	2.65%	25.33%	28.96%	27.64%
20	5/14/2026	1	1	1	5.45%	27.62%	31.47%	31.76%
21	5/21/2026	1	1	1	8.97%	29.89%	34.16%	35.31%
22	5/28/2026	1	1	1	13.48%	32.69%	36.82%	39.28%
23	6/4/2026	1	1	1	14.69%	36.53%	39.85%	42.78%
24	6/11/2026	1	1	1	19.60%	40.47%	43.03%	46.32%
25	6/18/2026	1	1	2	26.53%	44.17%	46.24%	49.29%
26	6/25/2026	1	2	2	30.29%	48.05%	49.15%	51.30%
27	7/2/2026	1	2	2	33.66%	51.17%	51.32%	52.85%
28	7/9/2026	2	2	2	37.52%	54.68%	53.22%	54.12%
29	7/16/2026	2	2	3	43.31%	57.77%	55.36%	55.44%
30	7/23/2026	2	2	3	48.80%	60.41%	58.01%	57.02%
31	7/30/2026	2	2	3	52.49%	63.19%	60.79%	59.73%
32	8/6/2026	2	3	3	56.98%	65.91%	63.20%	62.44%
33	8/13/2026	2	3	4	66.74%	68.93%	66.48%	65.40%
34	8/20/2026	3	3	4	73.81%	72.34%	69.28%	68.64%
35	8/27/2026	3	4	4	79.42%	75.99%	72.86%	71.27%
36	9/3/2026	3	4	5	84.12%	79.32%	76.02%	73.95%
37	9/10/2026	3	4	5	88.95%	83.03%	79.15%	77.00%
38	9/17/2026	3	4	5	93.14%	86.34%	81.52%	79.81%
39	9/24/2026	3	4	5	96.56%	89.15%	85.21%	82.00%
40	10/1/2026	3	4	5	97.22%	92.20%	88.05%	84.79%
41	10/8/2026	3	4	5	97.79%	95.01%	90.88%	86.61%
42	10/15/2026	3	4	5	98.17%	96.65%	93.39%	89.34%
43	10/22/2026	3	4	5	98.23%	97.47%	94.62%	92.20%
44	10/29/2026	3	4	5	98.77%	98.00%	95.86%	93.42%
45	11/5/2026	3	4	5	99.28%	98.69%	96.88%	94.71%
46	11/12/2026	3	4	5	99.88%	98.88%	97.54%	96.02%
47	11/19/2026	3	4	5	99.95%	98.97%	98.34%	96.81%
48	11/26/2026	3	4	5	99.95%	99.20%	98.95%	97.53%
49	12/3/2026	3	4	5	99.95%	99.38%	99.55%	98.01%
50	12/10/2026	3	4	5	100.00%	99.58%	100.00%	98.34%
51	12/17/2026					99.82%		99.50%
52	12/24/2026					99.99%		99.68%
53	12/31/2026					100.00%		100.00%

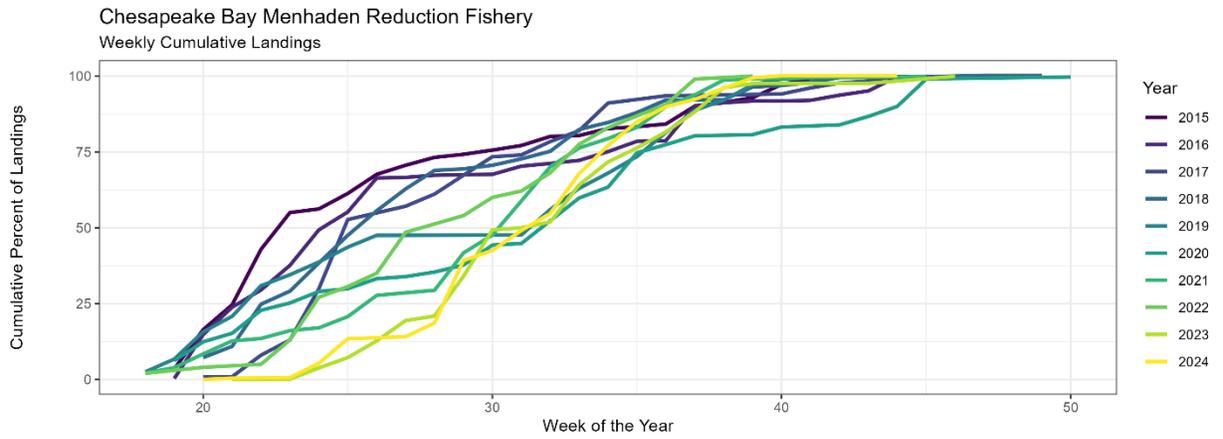


Figure 1. Cumulative percent of annual landings in the Chesapeake Bay menhaden reduction fishery 2015-2024.

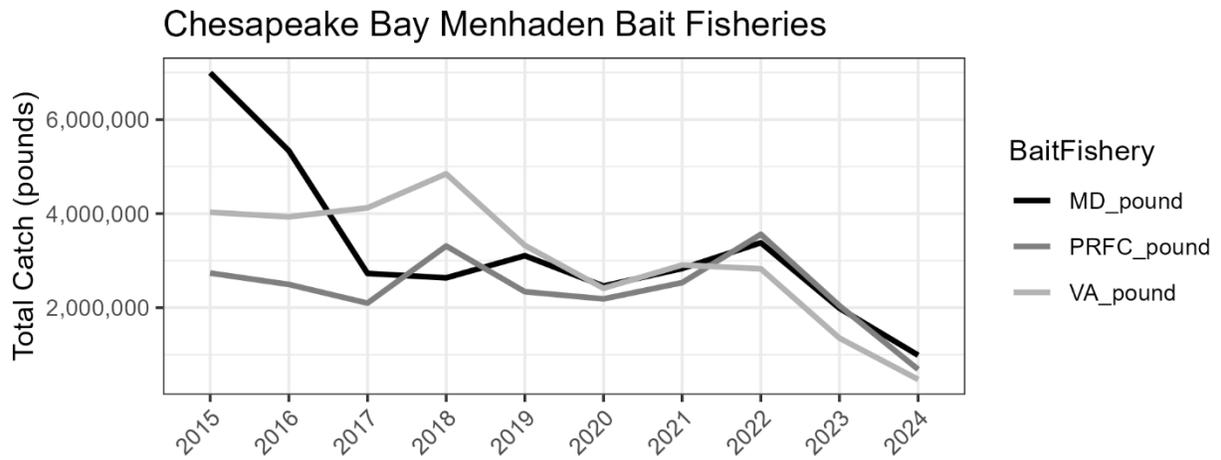


Figure 2. Total catch in MD, PRFC, and VA menhaden pound net fisheries 2015-2024.

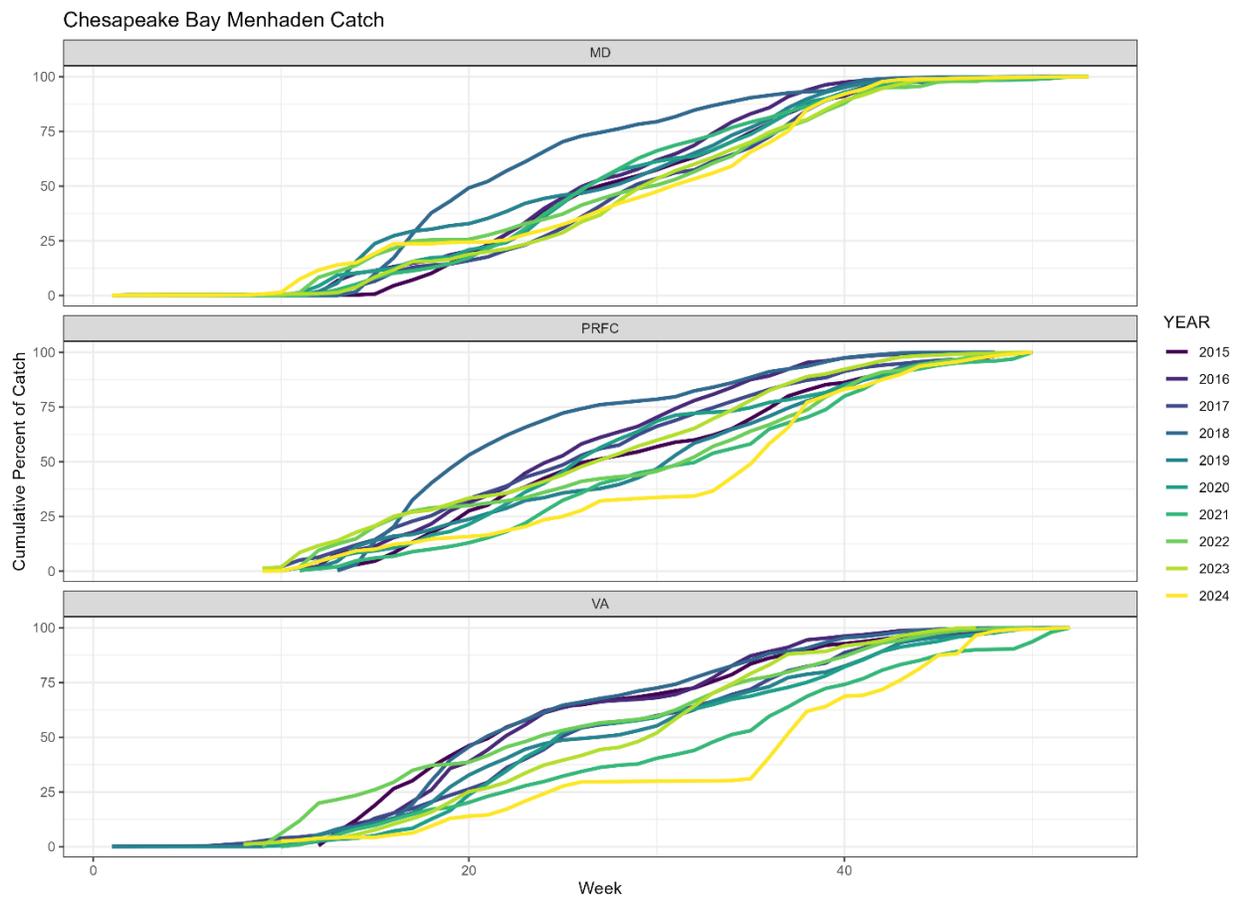


Figure 3. Cumulative percent of annual catch in MD, PRFC, and VA menhaden pound net fisheries in Chesapeake Bay 2015-2024.

Issue 2. Reducing the Chesapeake Bay Reduction Fishery Cap

Statement of the Problem: The Chesapeake Bay Reduction Fishery Cap was first implemented in 2006 as a precautionary measure due to the importance of menhaden’s role in the ecosystem and the uncertainty of its status in Chesapeake Bay. The cap was most recently updated in 2018 to 51,000 mt as an approximation of the average annual reduction landings in the Bay from 2012-2016. While the coastwide Total Allowable Catch (TAC) has fluctuated since 2018, the cap has remained constant. The Board initiated action to develop options to reduce the cap by up to 50% as a further precautionary action and reflect recent cuts to the TAC.

Draft Management Alternatives

Option B. Reduce the Chesapeake Bay Reduction Fishery Cap by 10% (value may change once we look at the data): The Bay Cap will be reduced to 45,900 mt. This reduction coupled with the in-year quota periods selected in Issue 1 may provide a similar reduction to the TAC cut adopted by the Atlantic Menhaden Management Board in October 2025 in an average year.

Option C. Reduce the Chesapeake Bay Reduction Fishery Cap by 20%: The Bay Cap will be reduced to 40,800 mt. This reduction in the Bay Cap approximates the same reduction in the

coastwide TAC adopted by the Atlantic Menhaden Board in October of 2025 for the 2026 fishing year.

Option D. Reduce the Chesapeake Bay Reduction Fishery Cap by 30%: The Bay Cap will be reduced to 35,700 mt. This reduction in the Bay Cap provides an additional buffer, compared to the coastwide TAC reduction of 20% adopted for the 2026 fishing year, to account for the uncertainty in how abundance in the Chesapeake Bay correlates to the abundance of the coastwide stock.

Option E. Reduce the Cap by 50%: The Chesapeake Bay Reduction Fishery Cap is reduced to 25,500 mt. This option provides the most conservative buffer to Atlantic menhaden migrating into Chesapeake Bay for ecological and socioeconomic benefit of the middle and upper portions of tidal rivers and main stem Chesapeake Bay.



Atlantic States Marine Fisheries Commission

1050 N. Highland Street • Suite 200A-N • Arlington, VA 22201
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Atlantic Menhaden Technical Committee Meeting Summary

January 7, 2026

Technical Committee Members: Caitlin Craig (NY, Chair), Claire Pelletier (NC), Keilin Gamboa-Salazar (SC), Nichole Ares (RI), Jeff Brust (NJ), Matt Cieri (ME), Ingrid Braun-Ricks (PRFC), Micah Dean (MA), Kelli Mosca (CT), Catherine Wilhelm (VA), Chris Swanson (FL), Sydney Alhale (NMFS), Alexei Sharov (MD), Garry Glanden (DE)

ASMFC Staff: James Boyle and Katie Drew

The TC met via webinar on January 7, 2026 to review the tasks set by the Board at the 2025 Annual Meeting and receive an update on the task to review the FMP's biological sampling requirement for the bait fishery.

Review of Board Task on Changing Environmental Conditions

The Board provided two tasks to the Technical Committee to evaluate the effects of changing environmental conditions on the Atlantic menhaden stock:

1. Evaluate information available from NOAA's Ecosystem Dynamics and Assessment Branch and Chesapeake Bay Office, and the Woods Hole Oceanographic Institution, to evaluate the possible effect of cold water on the Continental Shelf on menhaden migration and migratory patterns, particularly in relation to the timing of osprey arrival, nesting, and breeding.
2. Consider what role water temperature, dissolved oxygen levels, shoreline hardening, and other environmental factors play in the local abundance of menhaden and other forage species in the Chesapeake Bay.

The TC considered a range of options to proceed in responding to the Board task including performing a literature review, a correlation analysis, and developing a spatial distribution model, each of which represented significantly different workloads and timeframes. In the discussion, the TC considered the data limitations for more quantitative analyses, particularly the disconnect between targeted ages and sizes between osprey and the fishery, as well as the seasonal limitations of fishery-independent data. Additionally, they noted that the intended management goal could provide more information on what level of analysis is necessary and that a detailed analysis may be better incorporated into the assessment process. The TC decided to perform an initial literature review with the goal to present a report to the Board at the 2026 Spring Meeting.

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Update on Bait Sampling Task

The TC continued a discussion from the previous meeting evaluating whether the current biological sampling requirement for the bait fishery is sufficient. The TC discussed two paths forward: to continue analyses of the requirement with NOAA sampling data or to pause further analyses until there is an acceptable dataset of state bait ages as states are preparing to transition to processing samples. It was noted that the most recent ageing exchange continued to show inconsistencies between different readers, and there was concern with the applicability of the results if analyses are performed prior to the change from NOAA to state datasets. The TC decided to pause further analyses until there is a more consistent dataset from state processed samples and to maintain the current requirement size of 10-fish samples. They also noted that in the northern end of the range where there are larger menhaden, there is a greater variance of ages within a certain size. When analyses continue, the TC will review the sampling size requirement, including whether different sample sizes are necessary for different states to account for the greater variance in age and size.

James Boyle

To: Brian Collins
Subject: RE: [External] Menhaden Quota adjustment

From: Brian Collins <brian.c1@me.com>
Sent: Monday, January 5, 2026 10:32 PM
To: James Boyle <JBoyle@ASMFC.org>
Subject: Re: [External] Menhaden Quota adjustment

James, happy new year! I hope 2026 is a good one for you.

What makes the Bay Cap precautionary when we do not know whether or not the 51,000 MTs leaves any for the ecosystem? There is no data available about how many Menhaden enter the Chesapeake Bay or how many are needed for the fishery, birds and crabs.

What makes it a good idea to make averages from 2012-2016 for the years 2022-2025? What if the number of Menhaden entering the Bay decreases during the time from 2016 to 2025?

What I know you see and hear about is that the Chesapeake Bay is the nursery for Striped Bass, Menhaden, and the breeding center for Osprey and that blue crabs, rockfish and Osprey breeding success are at or heading towards all time lows for abundance and all of these species, with the exception of blue crabs, are crucial indicators used to measure whether there are enough Menhaden in the ecosystem. They are the pillars of the Atlantic Coast Ecological Reference Points (ERP) that is currently non-existent for the Bay.

How I see it we need to make sure there is a quota set for the fish birds and crabs before allowing industry to remove any Menhaden. How can we do that - Rhode Island does it for Narragansett Bay - we can do it for the Chesapeake Bay.

Thanks, Brian
Brian Collins
Alexandria, VA
703-795-8169



Atlantic Menhaden Management Board

Atlantic States Marine Fisheries Commission
1050 N. Highland St., Suite 200 A-N
Arlington, VA 22201

Dear Chairman Clark:

We submit this letter regarding the Board's Plan Development Team's preparation of an addendum to the Atlantic Menhaden Fishery Management Plan ("FMP") focusing on the purse seine fishery in the lower Chesapeake Bay. We respectfully request that this letter, and the exhibits included herein, be included in the supplementary materials in advance of the Board's meeting, and also distributed to Board members.

As it stands, the premise for the Board's proposed addendum is that the recent decline in Maryland menhaden pound net catches can be ascribed to Ocean Harvesters' purse seine fishery in the lower Bay creating a "gauntlet" that has prevented the fish from reaching pound nets in the mid and upper Bay. Significantly, neither the Board nor the PDT have examined this premise, but rather have just accepted it as fact. Ocean Harvesters respectfully submits that the Board should task the PDT to examine the premise because the information presented below demonstrates that other more plausible factors may be causing declining pound net catches.

Pound Net Effort in the Bay Has Declined Dramatically in Recent Years

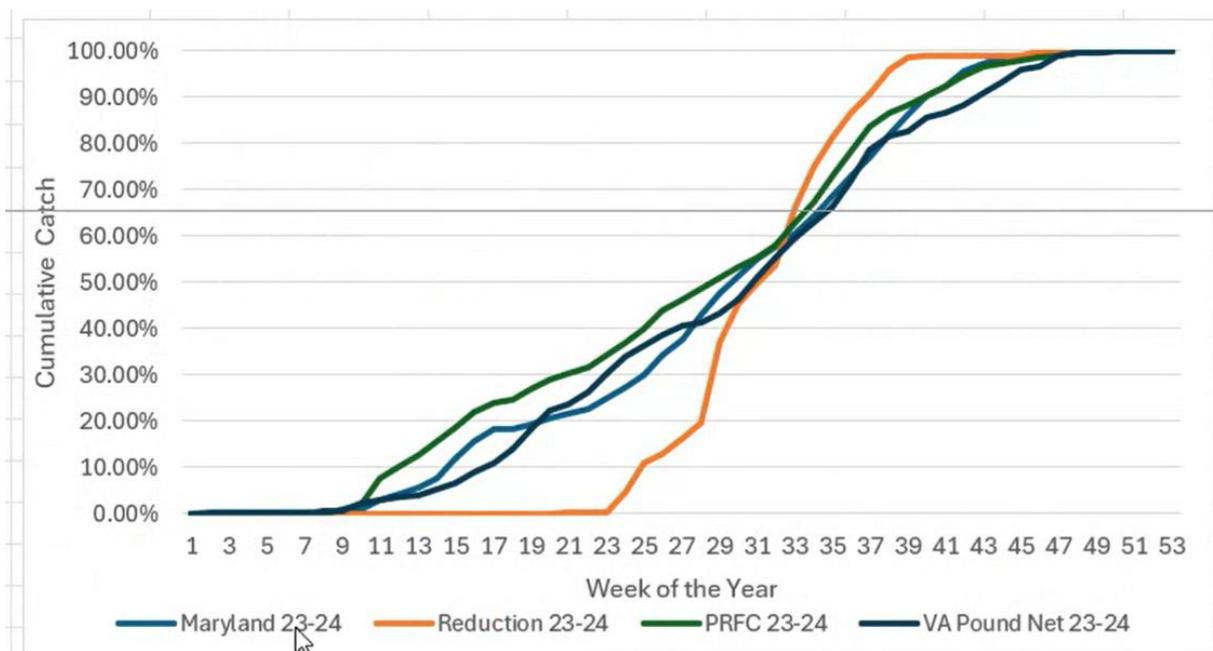
We recently received data from the Atlantic Coastal Cooperative Statistics Program ("ACCSP") Data Warehouse pursuant to an August data request of a month-by-month data pull of Maryland pound net effort and catches. Please refer to Exhibit A for a condensed version of the raw data.¹ That data highlighted a trend that can directly explain declining catches. Maryland's pound netting enterprise is in decline. From the years 2013 to 2024, the total number of trips reported by Maryland pound net fisherman decreased from 1,835 in 2013 to a mere 284 in 2024. A substantial drop-off occurred between 2016 and 2017, when Maryland pound net catches stair-stepped down. The maximum number of vessels operating in any month during these years also decreased, from a high of 25 in 2013, to 6 in 2024, with the total number of fishermen associated with these pound nets decreasing at the same level.

¹ The raw excel data files received pursuant to the ACCSP data pull are available upon request.

In years where catches for the purse seine fleet decreased, such as in 2017, when ASMFC lowered the catch cap for Atlantic menhaden by more than 40%, pound net landings in 2018 and 2019 did not proportionately skyrocket in response. Thus, to the extent a gauntlet exists (and it doesn't), the gauntlet should have been more of an impediment to pound net fishing when both pound net effort and catches were higher.

Catch Rates and Fishing Effort Do Not Show Negative Correlation or Causation

The graph below was presented to the PDT last week. As indicated, the graph lays out weekly catch rates for the reduction and pound net fisheries. In particular, we draw the Board's attention to weeks 21 through 40 of the year as indicated on the X-axis. If the purse seine fleet was indeed creating a gauntlet preventing Atlantic menhaden from traveling into the upper-Bay during those weeks, the Bay's pound net fishery numbers *should* indicate a corresponding steep decline in catch rate during these weeks. Instead, the catch rates remain on a relatively steady increase throughout the year; put differently, the slope of the lines depicting pound net catch rates from week 9 to week 45 is remarkably consistent.



The relationship, or lack thereof, demonstrated in this graph aligns with a preliminary analysis we asked Georgetown Economic Services of Washington, D.C. to conduct using public data presented to the Board in August 2025.² Based on records of reduction purse seine effort, which is indicative

² See Atlantic Menhaden Board Presentations, Slides as Presented by Lynn Fegley (MD DNR), at https://asmfc.org/wp-content/uploads/2025/08/AtlMenhadenBoardPresentations_August2025.pdf.

of menhaden's presence in the lower Bay, in the months during 2022-2024 when the number of reduction purse seine net sets exceeded its 10-year average, the Maryland pound net harvest size also tended to be above its 10-year average. The converse was also true. In fact, the direct relationship was statistically significant over these years. Attached hereto as Exhibit B is the more detailed memorandum of the statistical analysis prepared by Georgetown Economic Services. As with the chart included above, if the so-called gauntlet theory posed by Maryland were the reason behind the falling landings of Atlantic menhaden by Maryland pound-netters, the relationship between purse seine effort and pound net landings would instead be inversely related. However, the relationship does not bear out such a conclusion. The PDT should conduct its own examination using the biweekly purse seine set data that Director Fegley excerpted from the April Work Group Report and the ACCSP data pull providing monthly Maryland pound net menhaden landings.

In conclusion, our brief submission only scratches the surface of what appears to be a more complicated set of reasons for the decline in Maryland pound net menhaden catches. Before ascribing blame to Ocean Harvesters and implementing further restrictions in the Bay via a premature addendum, the Board should task the PDT to examine a range of considerations, including environmental and economic conditions, that may be a more direct cause of declining pound net catches.

Thank you for your consideration of this letter and the issues it presents. Our representatives will be available at the Board meeting to discuss these matters in more detail.

Respectfully submitted,

Ben Landry
Vice President of Public Affairs
Ocean Fleet Services

Exhibit A – Condensed Data Pull of Pound Net Catches and Effort from the Atlantic Coastal Cooperative Statistics Program

YEA R	MONTH	LIVE POUNDS	DOLLARS	TOTAL FISHERME N	TOTAL VESSELS	TRIP COUNT
2013	JANUARY	3153	378.36	3	3	7
2013	MARCH	29326	3225.86	4	4	33
2013	APRIL	811000	98827.31	21	23	239
2013	MAY	1543416	170094.95	25	23	328
2013	JUNE	1292318	184752.25	28	25	355
2013	JULY	833336	93911.32	17	16	228
2013	AUGUST	690168	89430.24	20	17	226
2013	SEPTEMBER	468509	60997.64	17	17	200
2013	OCTOBER	398620	51820.6	7	6	109
2013	NOVEMBER	194753	21422.83	10	9	65
2013	DECEMBER	119455	14334.6	5	5	34
2014	JANUARY	8730	785.7	5	4	11
2014	APRIL	543687	71968.17	17	16	129
2014	MAY	857710	112749.08	21	19	241
2014	JUNE	1031236	155653.72	22	22	289
2014	JULY	972667	167804.37	19	18	250
2014	AUGUST	919085.67	210418.66	17	15	210
2014	SEPTEMBER	1092636	282085.11	22	16	245
2014	OCTOBER	594188	154902.88	16	14	159
2014	NOVEMBER	179532	23219.16	14	11	82
2014	DECEMBER	51650	5681.5	5	5	22
2015	JANUARY	6650	864.5	3	3	5
2015	APRIL	545015	81752.25	10	11	104
2015	MAY	1148126	149373.42	19	20	272
2015	JUNE	1421704	227603.92	18	17	309
2015	JULY	784689	125619.68	16	14	225
2015	AUGUST	1025680	163558.8	15	16	211
2015	SEPTEMBER	1110189	177915.24	17	15	237
2015	OCTOBER	549020	87843.2	11	11	129
2015	NOVEMBER	115980	15193.4	9	8	47
2015	DECEMBER	86720	12975.2	8	7	33
2016	MARCH	339075	50861.25	9	7	51
2016	APRIL	433176	68888.16	13	11	105
2016	MAY	609640	90966	15	10	147
2016	JUNE	1253667	188410.05	17	13	224
2016	JULY	682170	115968.9	14	8	179

2016	AUGUST	1054217	284638.59	14	8	200
2016	SEPTEMBER	660337	79240.44	10	8	150
2016	OCTOBER	132150	21144	7	6	56
2016	NOVEMBER	16770	2683.2	4	3	19
2016	DECEMBER	45553	7288.48	4	4	18
2017	MARCH	37621	5643.15	4	3	14
2017	APRIL	314830	53521.1	6	4	75
2017	MAY	178413	28546.08	7	4	75
2017	JUNE	424190	68327.4	7	7	95
2017	JULY	530662	122052.26	10	6	129
2017	AUGUST	325802	74934.46	13	9	111
2017	SEPTEMBER	621406	99424.96	10	9	123
2017	OCTOBER	262240	86539.2	7	6	84
2017	NOVEMBER	26375	8703.75	9	6	27
2018	APRIL	794300	127344	13	9	121
2018	MAY	650790	104126.4	12	8	145
2018	JUNE	475682	80865.94	14	11	181
2018	JULY	191730	34511.4	11	7	105
2018	AUGUST	262990	36818.6	8	5	89
2018	SEPTEMBER	85900	15462	7	6	55
2018	OCTOBER	161740	27495.8	7	7	52
2019	MARCH	174740	24463.6	7	4	29
2019	APRIL	740970	103735.8	12	9	127
2019	MAY	230600	36896	6	4	70
2019	JUNE	295350	44302.5	10	6	78
2019	JULY	397570	59635.5	10	7	93
2019	AUGUST	518040	82886.4	11	6	104
2019	SEPTEMBER	519697.5	83151.6	9	6	92
2019	OCTOBER	176270	28203.2	6	6	58
2019	NOVEMBER	38980	5067.4	6	6	25
2019	DECEMBER	6570	1051.2	4	3	11
2020	MARCH	224280	35884.8	8	7	44
2020	APRIL	172430	27588.8	10	7	58
2020	MAY	169830	30569.4	7	5	70
2020	JUNE	626760	125352	10	9	112
2020	JULY	290350	232280	7	5	102
2020	AUGUST	264420	87258.6	7	5	75
2020	SEPTEMBER	407690	163076	7	5	81
2020	OCTOBER	190924	30547.84	6	5	61
2020	NOVEMBER	22210	3553.6	6	5	19
2020	DECEMBER	32890	5262.4	5	4	14
2021	MARCH	63750	9562.5	4	4	13
2021	APRIL	259134	41461.44	9	7	59

2021	MAY	320902	64180.4	10	8	63
2021	JUNE	698086	111693.76	11	10	132
2021	JULY	553935	88629.6	8	6	92
2021	AUGUST	325630	52100.8	7	5	75
2021	SEPTEMBER	298214	47714.24	9	7	72
2021	OCTOBER	254650	40744	8	7	64
2021	NOVEMBER	10820	1731.2	4	4	11
2021	DECEMBER	45120	7219.2	5	4	23
2022	MARCH	365270	65748.6	5	4	33
2022	APRIL	471150	89518.5	6	5	76
2022	MAY	125963	20154.08	6	5	43
2022	JUNE	395126	79025.2	12	9	125
2022	JULY	343940	61909.2	10	8	101
2022	AUGUST	565990	101878.2	11	8	121
2022	SEPTEMBER	571080	114216	11	8	101
2022	OCTOBER	369740	44368.8	8	6	71
2022	NOVEMBER	80600	13702	5	4	23
2022	DECEMBER	42030	7145.1	4	3	19
2023	APRIL	282120	64887.6	8	5	68
2023	MAY	102450	24588	7	5	42
2023	JUNE	238020	57124.8	9	7	75
2023	JULY	432930	86586	8	6	81
2023	AUGUST	286420	63012.4	6	6	69
2023	SEPTEMBER	318940	70166.8	6	5	66
2023	OCTOBER	253400	55748	6	5	63
2023	NOVEMBER	34320	7550.4	5	5	26
2023	DECEMBER	10160	2032	4	3	11
2024	MARCH	134510	29592.2	6	5	48
2024	APRIL	96020	20164.2	6	5	42
2024	MAY	8022	2165.94	5	4	13
2024	JUNE	10696	2353.12	7	6	39
2024	JULY	2965	1719.7	6	5	15
2024	AUGUST	55240	13257.6	7	6	37
2024	SEPTEMBER	156925	36092.75	5	5	45
2024	OCTOBER	64780	13603.8	4	3	33
2024	NOVEMBER	7540	1583.4	5	4	12

Exhibit B – Analysis of Maryland Harvest Sizes and the Number of Virginian Nets Set

I was provided the following data:

- 1) semi-monthly number of nets set by Virginian fisheries for the period 2015 to 2024, along with the ten-year average for each month (Table 2 in Atlantic Menhaden Board Presentation); and
- 2) monthly Maryland Pound Net Harvest for the period 2022 to 2024, along with the 10-year average harvest for each month (Figure 11 in Atlantic Menhaden Board Presentation).

I aggregated the number of nets set by year and month in order to transform it from a semi-monthly series to a monthly series. Further, both the nets set, and the Maryland harvest data, show monthly seasonality. I de-seasonalized the data by subtracting the 10-year average for each month from each series. This resulted in two series of deviations: (1) the monthly deviation of the number of nets set from the 10-year average number of nets set and (2) the monthly deviation of the Maryland harvest size from the 10-year average harvest size.

Next, I regressed the monthly Maryland harvest size deviation (the dependent variable) on the following independent variables: (1) the monthly number of nets set deviation and (2) the one-month lag of the Maryland harvest size deviation. I included the second independent variable because the monthly harvest size deviations show strong autocorrelation. That is, the size of the harvest deviation in one month affects the harvest deviation in the following month.

The table below shows the results of the regression:

	Estimate	Standard Error	t value	p value	
Intercept	-24.1612	23.0497	-1.048	0.30239	
Number of nets set deviation	0.6742	0.2165	3.115	0.00387	**
1-month lagged harvest size deviation	0.8164	0.1141	7.152	4.05E-08	***

The coefficient of the number of nets set deviation variable is 0.6742 and – with a p value of 0.00387 – is statistically significant at the 1 percent level. This result indicates a strong, positive relationship between the number of nets set deviation and the Maryland harvest deviation. Thus, when the number of Virginian nets set exceeds its 10-year average, the Maryland harvest size also tends to be above its 10-year average. Conversely, when the number of Virginian nets set is below its 10-year average, then the Maryland harvest size also tends to be below its 10-year average. Since it is highly unlikely that the number of Virginian nets set could be causing the size of the Maryland harvest (or vice versa), the most likely interpretation of this positive relationship is that both variables are responding to a common cause – namely, the extent of the fish presence in the bay.



Atlantic States Marine Fisheries Commission

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

MEMORANDUM

TO: Summer Flounder, Scup, and Black Sea Bass Management Board

FROM: Summer Flounder, Scup, and Black Sea Bass Technical Committee

DATE: January 27, 2026

SUBJECT: Recommendations for Distribution of 20% Liberalization for Black Sea Bass Recreational Management Measures

Background

In December 2025, the Summer Flounder, Scup, and Black Sea Bass Management Board (Board) and the Mid-Atlantic Fishery Management Council (Council) met jointly to set 2026 and 2027 recreational management measures for summer flounder, scup, and black sea bass. The Board and Council approved a 20% liberalization for black sea bass in 2026. In 2027, recreational management measures for black sea bass will remain status quo from 2026. Summer flounder and scup recreational management measures will remain status quo in 2026 and 2027. Status quo recreational management measures for summer flounder and scup may be found in Tables 6 and 7.

For black sea bass, the Board and Council opted to proceed with the regional conservation equivalency processes as outlined in [Addenda XXXI](#) and XXXII, as opposed to implementing uniform coastwide measures. [Addendum XXXII](#) established a three-region approach to setting recreational management measures for black sea bass where regions are defined as Massachusetts-New York, New Jersey, and Delaware-North Carolina (North of Cape Hatteras). Each time recreational management measures are set, the Board may specify how a liberalization or reduction in harvest is distributed among the regions (resulting in de facto regional harvest targets), based on factors including (but not limited to) resource distribution and expected availability, angler effort, prior year fishery performance, and Summer Flounder, Scup, and Black Sea Bass Technical Committee (TC) recommendations. The regions will then develop recreational measures that achieve the coastwide recreational harvest target. Additionally, states within a region will work together to develop recreational management measures that aim to achieve but not exceed the regional recreational harvest targets. However, states within a region do not need to propose or implement identical recreational management measures. In the event that a region is allowed to liberalize harvest, states will develop their measures in a manner that collectively reduces intraregional disparities (e.g. states with relatively restrictive measures, as determined by the TC based on performance, should be allowed a larger liberalization, while states with relatively liberal measures should take a smaller liberalization or remain at status quo). Addendum XXXII also states the Board should reduce interregional differences between measures when possible, taking into account regional differences in availability.

The TC met on January 6, 2026 and January 22, 2026 to review available data and develop recommendations for on how the 20% black sea bass liberalization could be distributed among regions. In addition, the TC reviewed a proposed method to estimate harvest in previously closed MRIP waves, which was developed with assistance from Northeast Fishery Science Center staff.

M26-14

Technical Committee Considerations and Recommendations

Due to a lack of consensus, the TC recommends the Board consider the following possible options for how to distribute the 20% liberalization among the regions:

- a) The liberalization is distributed equally between regions, i.e., each region will work separately to achieve but not exceed a 20% liberalization.
- b) The Board assigns a percent liberalization to a region or regions, and the other regions' percent liberalizations are adjusted accordingly to achieve the 20% coastwide liberalization.
- c) The Board assigns one or more management measures to a region or regions, resulting in de facto percent liberalization(s), and the other regions' percent liberalizations are adjusted accordingly to achieve the 20% coastwide liberalization.

When considering how a 20% liberalization could be distributed, it is important to note that the percent liberalizations are not equivalent between regions due to the different scale of harvest in each region. For example, if the southern region's proposed measures are only estimated to increase harvest within their region by 10%, that does not raise the other regions' allowed liberalizations by an equivalent 10%. If the Board is considering either options B or C, and starts with a focal region, it would be helpful to calculate the resulting percent change in the other two regions to understand the implications of that choice coastwide before making a final decision.

As a part of their discussion, the TC reviewed several analyses, which are included in this memo to be considered by the Board to assist in the determination of how the 20% liberalization will be distributed. These analyses include the following:

1. Estimated Liberalizations Achieved from Example Management Measures

The median¹ coastwide 2026 harvest estimated by the Recreation Demand Model (RDM) if management measures are held status quo is 5,860,833 pounds (Table 1). Coastwide harvest liberalized by 20%, calculated using the median coastwide value, is 7,033,000 pounds, an increase of 1,172,167 pounds. Tables 2 and 3 provide examples of the impacts of specific management measures on harvest, including the degree of liberalization in harvest, as estimated by the RDM. These are only examples that were preliminarily discussed by the TC for the sake of understanding the degree of the resulting liberalization and are not a list of the changes being considered by the states. Black sea bass management measures from 2025 (i.e., status quo management measures) can be found in Table 5.

Table 1. RDM-estimated harvest in pounds by state in 2026 under status quo management measures. The individual median harvest estimates calculated by state do not add up to the total coastwide median harvest because coastwide median harvest is calculated by summing the coastwide harvest by RDM draw and taking the median of all of those draws.

State	Status Quo Median Harvest (lbs)
MA	554,158
RI	529,332
CT	449,579
NY	628,441
NJ	2,453,967
DE	236,211

¹ All estimates of harvest in this memo are provided as the median of the range of values produced by the RDM.

State	Status Quo Median Harvest (lbs)
MD	258,229
VA	157,639
NC	237,562
Coastwide	5,860,833 ²

Table 2. The percent liberalizations and median harvest in pounds of black sea bass by state in the northern region (MA-NY) resulting from a **region-wide minimum size limit of 16 inches and a region-wide minimum size limit of 15.5 inches**, as estimated by the RDM. In addition, **the increased season included for CT is for the private and shore modes, for 5/18-11/28**. In 2025, the minimum size limit was 16.5 inches in Massachusetts, New York, and for the private/shore mode in Rhode Island; the minimum size limit was 16 inches in Connecticut and for the for-hire mode in Rhode Island. Connecticut’s status quo season for private and shore modes is 5/17-6/23 and 7/8-11/25. All other management measures in the northern region are held status quo.

State	Region-wide 16-inches minimum size and an increased season for CT		Region-wide 15.5-inches minimum size and an increased season for CT	
	Percent Liberalization	Median Harvest (lbs)	Percent Liberalization	Median Harvest (lbs)
MA	11.2%	618,423	23.6%	690,884
RI	12.4%	576,565	22.2%	627,123
CT	6.5%	468,493	11.7%	494,056
NY	25.4%	777,968	57.1%	991,949
Region-wide	13.9%	2,488,961 ²	29.1%	2,901,998 ²

Table 3. The percent liberalizations and median harvest in pounds of black sea bass by state in the southern region (DE-NC) resulting from a **region-wide minimum size limit of 12.5 inches and season from 5/1 through 12/31** and a **region-wide minimum size limit of 12.5 inches and season from 4/19 through 12/31**, as estimated by the RDM and adjusted by proposed methodology (Section “Additional Proposed Methodology” below). In 2025, the minimum size limit was 13 inches in the southern region; the season was 5/15 through 9/30 and 10/10 through 12/31. All other management measures in the southern region are held status quo.

State	Region-wide 12.5-inches minimum size and 5/1-12/31 season		Region-wide 12.5-inches minimum size and 4/19-12/31 season	
	Percent Liberalization	Median Harvest (lbs)	Percent Liberalization	Median Harvest (lbs)
DE	14.1%	271,224	15.4%	275,046
MD	11.2%	286,263	13.1%	292,464
VA	18.3%	190,303	20.8%	192,527
NC	21.8%	290,701	28.5%	306,706
Region-wide	16.5%	1,077,131 ²	19.9%	1,109,552 ²

² Individual state median harvest estimates do not add up to this value because the coastwide harvest is calculated by summing each state harvest estimate by draw from the RDM and taking the median of those values.

2. Angler Satisfaction

Angler satisfaction, as estimated by the RDM, is a measure of compensating variation, or the amount of money you would need to give to or take from a person after a change to keep them just as well off as they were before the change. This metric integrates changes in angler satisfaction due to regulations and changes in availability of fish in the system, and is based on changes in expected trip-level harvest and discards of all three species. For example, if fish are less available, compensating variation is how much money someone could be paid to offset the loss. If fish are more available, compensating variation is how much money could be taken away while leaving them no worse off. It measures the angler welfare impact of a change, not just how spending changes. If fish are no more or less available and management measures do not change, the compensating variation, or angler satisfaction, would be zero.

The TC reviewed angler satisfaction values for the status quo scenario by state, which looks at comparing the difference of the compensating variation between the 2024 and 2026 fishing years, if regulations were to remain the same (Figure 1). Angler satisfaction values from the RDM generally indicate anglers in NJ-NC will have improved satisfaction and anglers in MA-NY will have worse satisfaction in 2026 under status quo management measures for all three species.

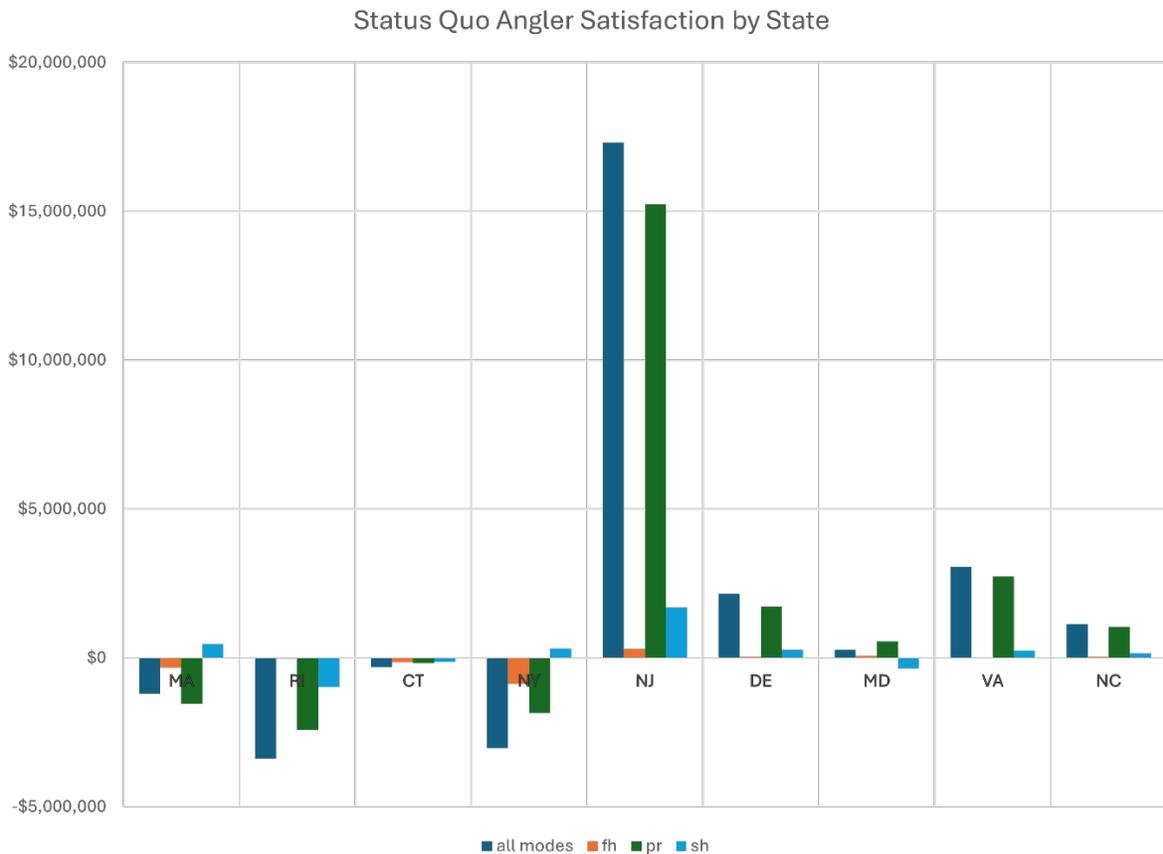


Figure 1. Angler satisfaction if 2024 regulations were to remain the same in 2026, as estimated by the RDM by state for all modes, the for-hire mode (fh), private mode (pr), and shore-based mode (sh). Negative values indicate that anglers would need to be paid to offset a loss, while positive values indicate that anglers could lose money and still be better off than they were in 2024.

3. Discard-to-Catch Ratios

Figures 2 and 3 provide information on black sea bass discards relative to overall catch by state and region, as calculated by the RDM for 2026 under status quo measures. New York, Rhode Island, Virginia, and Connecticut would have the highest black sea bass discard rates. For example, in New York, 93% of the black sea bass catch is estimated to be discarded. Delaware, Maryland, and New Jersey would have the lowest discard rates. When analyzing discards by region, the northern region would have the highest overall percentage of discards, followed by the southern region and New Jersey. Values from North Carolina include the entire state’s estimated landings and discards.

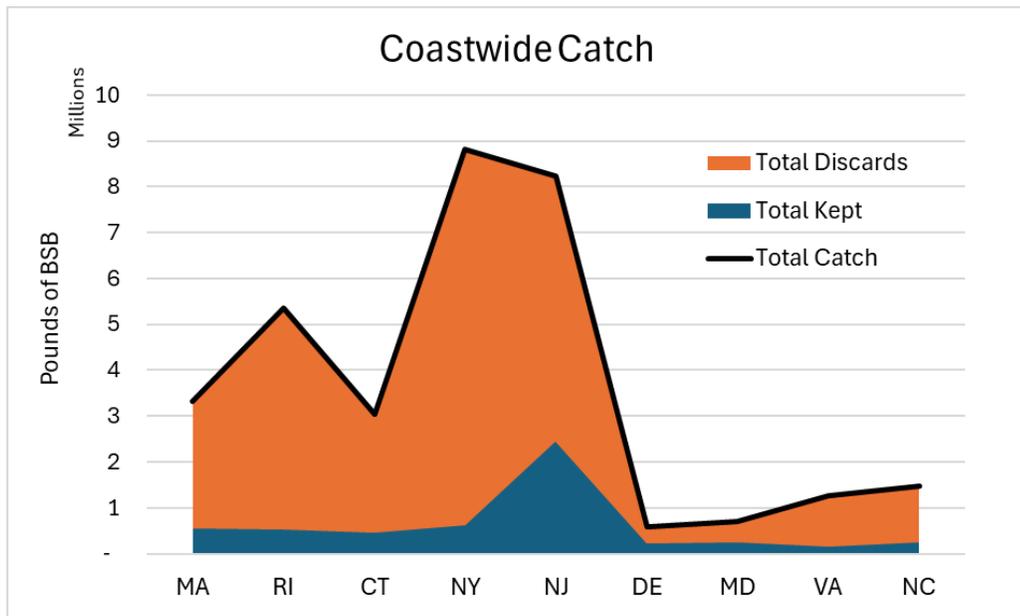


Figure 2. Total black sea bass recreational catch in millions of pounds by state (Massachusetts through North Carolina) as estimated by the RDM for 2026 under status quo management measures. Orange shows millions of pounds of black sea bass discarded recreationally and blue shows millions of pounds of black sea bass kept.

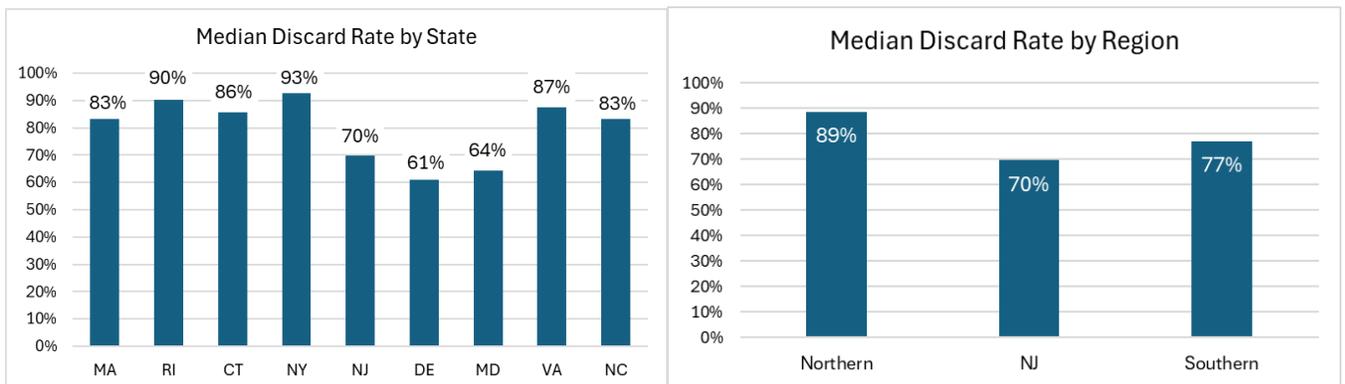


Figure 3. Median discard rate (percent of total black sea bass recreational catch that would be discarded under status quo measures) by state (Massachusetts through North Carolina) and by region (Northern=Massachusetts through New York, New Jersey, Southern=Delaware through North Carolina).

4. Coastal Distribution of Black Sea Bass Abundance

Figure 4, from the 2025 Black Sea Bass Management Track Assessment, shows trends in abundance of black sea bass for the North and South stock assessment sub-units. In the assessment, black sea bass abundance is separated out into these two spatial sub-units, with New Jersey split approximately at Hudson Canyon. The indices show black sea bass abundance in the northern assessment sub-unit, which has been increasing since the mid-2000's, is at a time series high. Comparatively, black sea bass abundance in the southern sub-unit has generally varied without trend, although abundance has increased in the last 5-10 years.

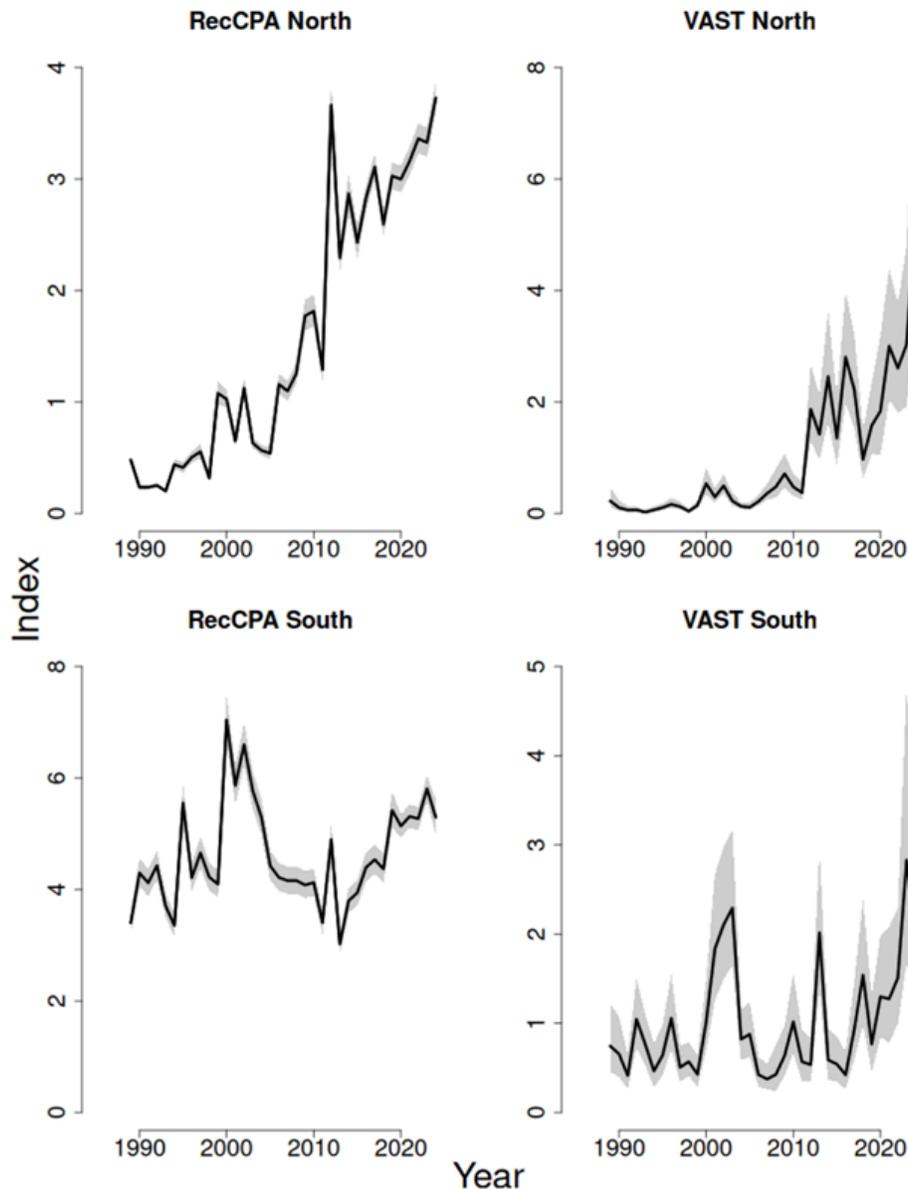


Figure 4. Indices of abundance for black sea bass between 1989-2024 for the recreational catch-per-angler (RecCPA) and the Vector Autoregressive Spatio-Temporal Model (VAST) models in the North and South regions. The approximate 95% lognormal confidence intervals are shown. Source: [2025 Black Sea Bass Management Track Assessment Report](#).

5. Catch-per-trip

Table 4 provides the average recreational catch (harvest and releases) of black sea bass by state.

Table 4. Average recreational catch-per-trip of black sea bass by state, as calculated from MRIP data from wave 4 of 2023 through wave 3 of 2025.

State	Average Catch-Per-Trip
MA	2.89
RI	3.19
CT	2.59
NY	1.59
NJ	2.00
DE	1.83
MD	1.78
VA	1.61
NC	3.69

Additional Proposed Methodology

The TC also reviewed a proposed methodology from the southern region to estimate harvest in MRIP waves that were not previously open to black sea bass recreational harvest.

Stakeholders from the southern region were interested in opening dates as early as April 15th, as the fish can move to the fishing grounds earlier than the current opening date of May 15th. However, since the fishery has previously been closed during that window in the region, the RDM estimate of harvest during that time will be an underestimate, since it depends on past MRIP catch data from that wave during which anglers were not targeting black sea bass. TC members from southern states and RDM developers calculated an adjustment meant to be a conservative estimate of harvest under April opening scenarios. The RDM predicts increases when opening is as early as May 1st since it is dependent on wave 3 data (May and June), and harvest is historically open during the majority of wave 3. Therefore, southern state TC members calculated the expected harvest increase when changing from May 15th to May 1st and divided by 14 to arrive at a daily rate. Southern state TC members then added 16 days of this harvest to the May 1st estimate to arrive at an adjusted estimate for an April 15th start date. That corresponds to a median 21.1% increase from the status quo for the southern region. In order to keep median percent increase under 20%, an April 19th or later opening would be necessary (a 19.9% increase). Southern state TC members believe this method uses catch data from wave 3 to better estimate the behavior of anglers during an April opening. However, this should be considered a conservative estimate, since the fish may not always move to the fishing grounds as early as proposed for opening. An important note is that until Federal conservation equivalency is approved through a Federal rulemaking, those with Federal permits and/or fishing in the EEZ will be under the Federal coastwide measures if they are more restrictive than state measures.

The TC expressed no concerns with this methodology.

Next Steps

Following the Board's decision on how the 20% liberalization will be distributed among the regions, the TC will use the RDM and associated decision support tool to recommend options for 2026 and 2027

recreational management measures for black sea bass which meet but do not exceed a 20% liberalization coastwide. Specific black sea bass measures and status quo summer flounder and scup measures (Tables 6 and 7) are associated with each option, as the model relies on inputs of measures from all three species to calculate estimates of 2026 harvest. Options will be organized by region (Massachusetts-New York, New Jersey, Delaware-North Carolina).

A template for submitting black sea bass recreational measure options has been distributed to the TC. All recreational management measure options should be submitted using this template to Tracey Bauer (tbauer@asmfc.org) no later than Monday, February 16, 2026.

Appendix 1.

Table 5. 2025 recreational management measures for black sea bass.

	STATE	Size Limit	Possession Limit	Open Season
Northern Region	MASSACHUSETTS	16.5"	4 fish	May 17-September 1
	RHODE ISLAND Private & Shore	16.5"	2 fish	May 22-August 26
			3 fish	August 27-December 31
	RI For-Hire	16"	2 fish	June 18-August 31
			6 fish	September 1-December 31
	CONNECTICUT Private & Shore	16"	5 fish	May 17-June 23; July 8-November 25
	CT (Authorized For-Hire Monitoring Program vessels)		5 fish	May 17-August 31
			7 fish	September 1-December 31
NEW YORK	16.5"	3 fish	June 23-August 31	
		6 fish	September 1-December 31	
	NEW JERSEY	12.5"	10 fish	May 17-June 19
			1 fish	July 1-August 31
			10 fish	October 1-October 31
			15 fish	November 1-December 31
Southern Region	DELAWARE	13"	15 fish	May 15-September 30; October 10-December 31
	MARYLAND			May 15-September 30; October 10-December 31
	VIRGINIA			May 15-July 15; August 5-December 31
	NORTH CAROLINA - North of Cape Hatteras (N of 35° 15'N)			May 15-September 30; October 10-December 31

Table 6. 2026 and 2027 recreational management measures for summer flounder (status quo from 2025).

STATE	Mode	Size Limit	Possession Limit	Open Season
MASSACHUSETTS	Private & For-Hire	17.5"	5 fish	May 24 – September 23
	Shore	16.5"		
RHODE ISLAND	All	19"	6 fish	April 1 – December 31
Rhode Island Shore Program (7 designated shore sites)	Shore	19"	4 fish ³	
		17"	2 fish ¹	
CONNECTICUT	All	19"	3 fish	May 4 – August 1
		19.5"		August 2 – October 15
Connecticut Enhanced Opportunity Shore Fishing Sites (45 designated shore sites)	Shore	17"	3 fish	May 4 – October 15
NEW YORK	All	19"	3 fish	May 4 – August 1
		19.5"		August 2 – October 15
NEW JERSEY	All	18"	3 fish	May 4 – September 25
New Jersey Shore Program Site (IBSP)	Shore	16"	2 fish	
New Jersey Delaware Bay and Tributaries	All	17"	3 fish	
DELAWARE, MARYLAND, & VIRGINIA	All	16"	4 fish	January 1 – May 31
		17.5"		June 1 – December 31
NORTH CAROLINA	All	15"	1 fish	August 16 – September 30 ⁴

³ Combined possession limit of 6 fish; no more than 2 fish at 17-inch minimum size limit.

⁴ Season subject to become more restrictive pending southern flounder management needs.

Table 7. 2026 and 2027 recreational management measures for scup (status quo from 2025).

STATE	Mode	Size Limit	Possession Limit	Open Season
MASSACHUSETTS	Shore	9.5"	30 fish	May 1 – December 31
	Private	11"		
	For-Hire	11"	40 fish	May 1 – June 30
			30 fish	July 1 – December 31
RHODE ISLAND	Shore	9.5"	30 fish	May 1 – December 31
	Private	11"		
	For-Hire	11"	30 fish	May 1 – August 31
			40 fish	September 1 – October 31
			30 fish	November 1 – October 31
CONNECTICUT	Shore	9.5"	30 fish	May 1 – December 31
	Private	11"		
	For-Hire	11"	30 fish	May 1 – August 31
			40 fish	September 1 – October 31
			30 fish	November 1 – December 31
NEW YORK	Shore	9.5"	30 fish	May 1 – December 31
	Private	11"		
	For-Hire	11"	30 fish	May 1 – August 31
			40 fish	September 1 – October 31
			30 fish	November 1 – December 31
NEW JERSEY	All	10"	30 fish	January 1 – June 30
				September 1 – December 31
DELAWARE, MARYLAND, VIRGINIA, & NORTH CAROLINA (North of Cape Hatteras, N of 35° 15'N)	All	9"	30 fish	January 1 – December 31



Atlantic States Marine Fisheries Commission

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

MEMORANDUM

TO: Atlantic Striped Bass Management Board

FROM: Atlantic Striped Bass Stock Assessment Committee

DATE: January 22, 2026

SUBJECT: Request for Board Guidance on Biological Reference Points and Spatial Management

Term of Reference #6 for the 2027 Atlantic striped bass benchmark stock assessment is:

Update or redefine biological reference points (BRPs; point estimates or proxies for BMSY, SSBMSY, FMSY, MSY). Define stock status based on BRPs by stock component where possible.

As the Stock Assessment Subcommittee (SAS) continues work on the assessment, they request guidance from the Board in order to develop biological reference points (BRPs) if the Board is looking for alternatives to the current BRPs.

This memo describes the history and rationale for the current BRPs and lays out the two areas that the SAS is looking for guidance on from the Board.

History of Current BRPs

The current spawning stock biomass (SSB) threshold for Atlantic striped bass is the estimate of female SSB in 1995, and the current SSB target is 125% of that value. The stock is declared overfished when SSB drops below the threshold. The current fishing mortality (F) target and threshold are the F rates that will maintain the population at the SSB target and threshold, respectively, in the long term. Overfishing occurs when F exceeds the F threshold. Because the Amendment 7 recruitment trigger was tripped prior to the most recent assessment update, the current values for the F target and F threshold are calculated using the current low recruitment regime (2008-2023) (Figure 1). This results in a lower F target and threshold than would be estimated from the longer time-series of recruitment used when the recruitment trigger has not been tripped.

The 1995 value of SSB was chosen as the threshold because the stock was declared rebuilt in 1995 based on 1) an increasing proportion of age-8+ (mature) female fish in the spawning population as a sign of an expanding age structure and a more productive, resilient spawning stock; and 2) a projection model that used life history information and F rates from tagging and catch curves to estimate SSB from the MD young-of-year (YOY) index over time. The MD YOY index extends back to the mid-1950s, so the estimates of SSB after the moratorium in the late 1980s were compared to estimates of SSB pre-collapse (1960-1972) to determine whether the

stock had recovered. The projection model indicated that in 1995, SSB was at the 1960-1972 reference level, so the stock was considered re-built to pre-collapse levels.

The threshold was set on the basis of empirical/historical metrics, including managers' and stakeholders' satisfaction with the stock condition in the 1960s. The target was a somewhat arbitrary level (25%) above the 1995 value. Since the stock is managed based on the target, it is important to have sufficient board input as to the values which should be reflected in the target level so that it is no longer based on a somewhat arbitrary decision.

From 2003 to 2013, the F threshold was defined as F_{MSY} , but during the 2013 assessment, projections indicated that the population would stabilize below the SSB threshold if it was fished at F_{MSY} . Therefore, the definition of the F target and threshold were changed to align with the definition of the SSB target and threshold. The decision to maintain the SSB target and threshold definitions and change the F target and threshold was based on the FMP objectives around SSB and population structure as well as concerns about the reliability of F_{MSY} estimates, given the uncertainty in the stock-recruitment relationship used to derive it. During the 2019 benchmark, SPR-based reference points were explored, but the estimates of $F_{40\%SPR}$ and $F_{30\%SPR}$ from the single-stock model were lower than the empirical F values and resulted in an SSB target and threshold that were much higher than the 1995-based target and threshold.

Although SSB exceeded the target in the early 2000s for four years and was close to the target (i.e., the confidence intervals on the estimates of SSB included the target) for 11 years (Figure 1), some Board members have voiced concerns that the SSB reference points are too high and are biologically unattainable, especially during the current period of very low recruitment.

Request for Board Guidance

The SAS is planning to explore both empirical BRPs and model-based BRPs (e.g., SPR-based reference points), including spatial BRPs through the 2027 benchmark. The SAS has identified two major questions that would benefit from Board guidance as the assessment progresses.

1. How does the Board want to balance preserving SSB and allowing fishing?
2. What does the Board want from a spatial management framework?

The SAS is not asking the Board to select a specific BRP definition or come to consensus on these questions at this time, but understanding the range of opinions and the factors the Board considers important will help the SAS develop BRP options that best address different management objectives.

Balancing SSB and F

There is a trade-off between preserving SSB and allowing fishing, and determining the best balance between these two parameters requires management input. If the Board wanted to establish a lower SSB target and threshold – for example, setting the target to the 1995 estimate of SSB and the threshold to some lower percentage of that value – then the F target and F threshold values could increase, depending on the assumptions about future recruitment. Or the Board could set higher F target and threshold values based on a stable period in the

fishery and calculate the SSB target and threshold values associated with those F rates in the long term, which would be lower than the current values.

A lower SSB would mean lower availability of larger fish. Even if the F target is increased, that may not translate into a higher harvest or yield, since that F rate is applied to a smaller population. In addition, lower availability of larger fish means lower encounter rates overall, particularly for the ocean region.

If the Board is interested in considering options for a set of BRPs with a higher F and lower SSB targets and thresholds, it would be helpful to receive input on things like:

- the preferred balance between SSB and F
- the relative importance of maximizing yield vs. maximizing catch rates or the availability of trophy size fish
- acceptable level of risk when it comes to preventing stock collapse
- alternative metrics for stock health such as total abundance or abundance of specific size or age classes instead of female SSB
- a preferred historical time-period for F reference points (i.e., when was the Board satisfied with fishery performance?)
- a preferred historical time-period for SSB reference points
- a lower limit on acceptable SSB levels, relative to 1995 levels or based on the preferred historical time-period

These items represent a range of possible management objectives and are not necessarily mutually exclusive of one another. The SAS could explore methods to evaluate tradeoffs between objectives and estimate optimal reference points to achieve multiple objectives. What is needed by the SAS is direction from the Board as to what is most valued from the fishery.

BRPs in a Spatial Management Framework

Currently, striped bass are assessed with a single set of BRPs for the entire stock-complex with region-specific management regimes to account for differences in availability of fish and other spatial dynamics. The SAS is exploring a new spatial, stock-specific model for this assessment and is seeking guidance on what the Board wants from a spatial management framework and how the Board would like to handle regions like Delaware Bay and the Hudson River.

Delaware Bay removals are part of the “ocean” fleet in the current single-stock model. The Delaware Bay stock was grouped with the Hudson River stock to form an “ocean” stock in the previous two-stock spatial model that did not pass peer review in 2019. If the Delaware Bay cannot be modeled as a separate region, due to data limitations, it could be grouped with either the Chesapeake Bay region/stock or with the “ocean” region again. Grouping Delaware Bay with the Chesapeake Bay would better align with recent research on the genetic similarity of fish from these areas and the frequent movement of both adult and juvenile fish between Bays through the C&D canal, but it would mean any stock- or region-specific BRPs would represent a joint Chesapeake Bay-Delaware Bay region/stock.

It would be helpful to receive input from the Board on their objectives for spatial management, such as:

- Is the Board interested in spatial BRPs – that is, having specific targets and thresholds by region to evaluate stock status against – or would the Board prefer to keep coastwide reference points and use spatial management regimes to attempt to achieve those targets?
- Would a Chesapeake/Delaware Bay region be acceptable to the Board, or would the Board prefer to keep Chesapeake Bay distinct from other regions?
- Is the Board interested in developing BRPs for the Hudson River as a distinct region if the data supported that, or would the Board prefer to keep the Hudson River with the “ocean” region?

The SAS notes that, similar to the current management framework, having coastwide or broader spatial BRPs would not prevent the use of finer scale regional management regimes.

The SAS noted that researchers at Virginia Tech have been working on a spatial management strategy evaluation for striped bass. The SAS will consider any available results from that project, as well as recent public comments on FMP objectives, that could inform potential biological reference point development and stakeholder priorities.

Timeline

If the Board is able to provide guidance to the SAS by the May 2026 Board Meeting, prior to the Assessment Workshop in August 2026, the SAS will be better able to develop options for BRPs that reflect the Board’s management direction. The SAS intends to have the BRPs or BRP methodologies peer reviewed along with the assessment models through the 2027 Northeast (NRCC) Research Track, making them available for management consideration as soon as the assessment and review process is complete.

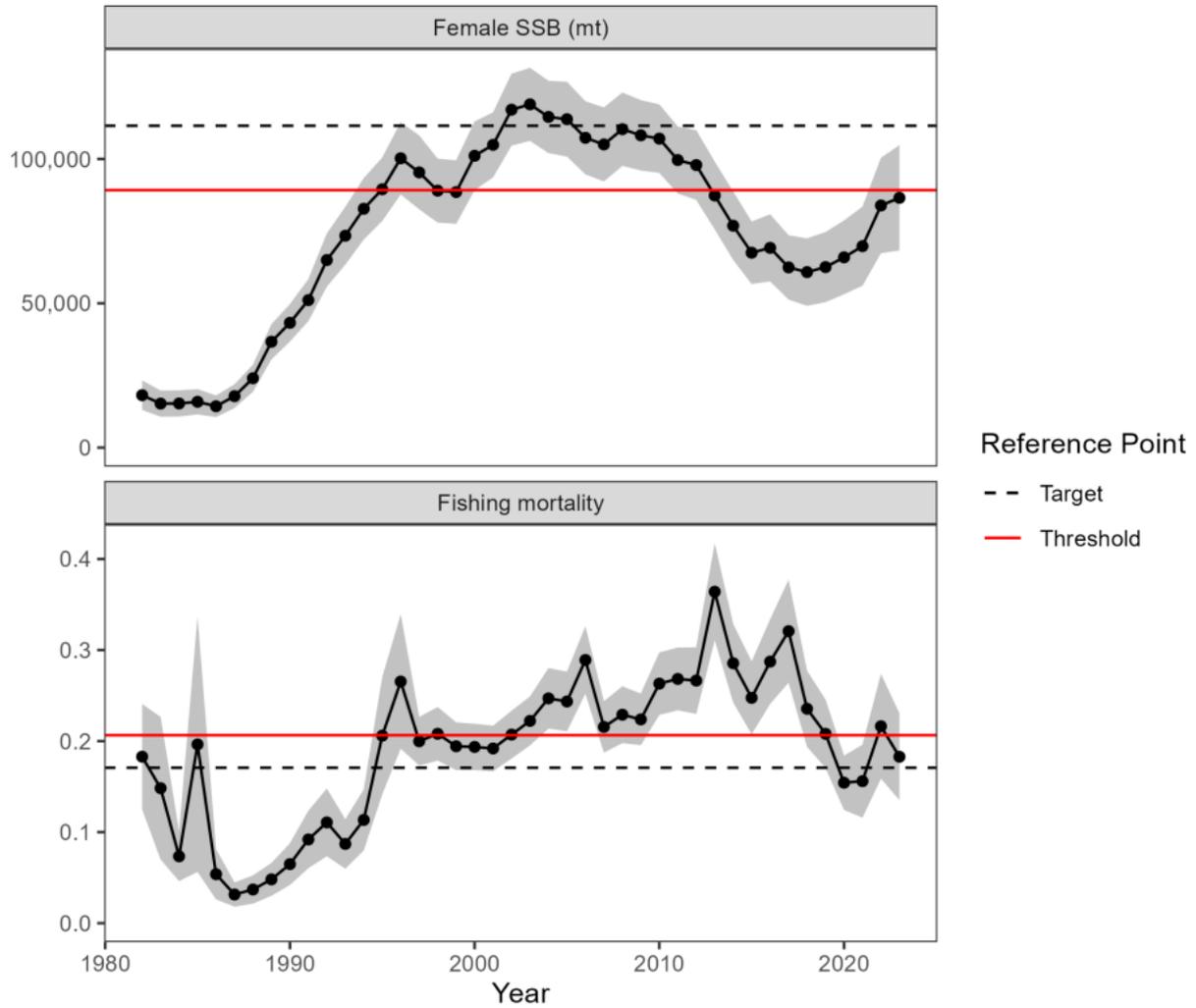


Figure 1. Female SSB (top) and total F estimates (bottom) plotted with their respective targets and thresholds. Shaded area indicates 95% confidence intervals of the estimates. Source: 2024 Stock Assessment Update.

Appendix 1: FMP Goal and Objectives in Amendment 7 Sections 2.3 and 2.4

The goal of Amendment 7 to the Interstate Fishery Management Plan for Atlantic Striped Bass is to perpetuate, through cooperative interstate fishery management, migratory stocks of striped bass; to allow commercial and recreational fisheries consistent with the long-term maintenance of a broad age structure, a self-sustaining spawning stock; and also to provide for the restoration and maintenance of their essential habitat.

In support of this goal, the following objectives are specified:

1. Manage striped bass fisheries under a control rule designed to maintain stock size at or above the target female spawning stock biomass level and a level of fishing mortality at or below the target exploitation rate.
2. Manage fishing mortality to maintain an age structure that provides adequate spawning potential to sustain long-term abundance of striped bass populations.
3. Provide a management plan that strives, to the extent practical, to maintain coastwide consistency of implemented measures, while allowing the states defined flexibility to implement alternative strategies that accomplish the objectives of the FMP.
4. Foster quality and economically-viable recreational, for-hire, and commercial fisheries.
5. Maximize cost effectiveness of current information gathering and prioritize state obligations in order to minimize costs of monitoring and management.
6. Adopt a long-term management regime that minimizes or eliminates the need to make annual changes or modifications to management measures.
7. Establish a fishing mortality target that will result in a net increase in the abundance (pounds) of age 15 and older striped bass in the population, relative to the 2000 estimate.



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Charting A Course for Striped Bass: Science and Regulatory Innovation for Offshore Aquaculture



U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-F/OAQ-001
FEBRUARY 2026

Charting A Course for Striped Bass: Science and Regulatory Innovation for Offshore Aquaculture

Kenneth L. Riley, Linnea Andersen, Noah C. Boldt, Russell Borski, Kristine Cherry, Jessica Couture, Brian Fredieu, Eric Herbst, Maylyn Hinson, Linas Kenter, James Morris, Mark Rath, Benjamin Reading, and Daniel Wieczorek

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U.S. Department of Commerce
Howard Lutnick, Secretary

National Oceanic and Atmospheric Administration
Neil Jacobs, NOAA Administrator

National Marine Fisheries Service
Eugenio Piñeiro Soler, Assistant Administrator for Fisheries

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For further information, direct inquiries to:

Kenneth Riley, PhD
Chief, Science Branch, Office of Aquaculture
NOAA Fisheries | U.S. Department of Commerce
1315 East-West Highway
Silver Spring, MD 20910
Ken.Riley@noaa.gov

Copies of this report are available online at:

<https://spo.nmfs.noaa.gov/tech-memos/>

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1 Executive Summary

Striped bass (*Morone saxatilis*) is one of the most valued fish species along the Atlantic coast of the United States (U.S.), noted for its ecological, cultural, and economic importance. Recreational and commercial fisheries have long depended on this species, but harvest in federal waters of the Exclusive Economic Zone (EEZ) along the East Coast has been prohibited since 1990. While the moratorium was vital for rebuilding wild stocks, it also blocks the potential to develop striped bass aquaculture offshore, despite major advances in science, technology, and management that now make such development both feasible and promising. Balancing aquaculture development with protection of wild striped bass populations and the fisheries they support is essential for ensuring the resilience of this iconic species. Over the past three decades, substantial progress has been made in aquaculture biology, offshore engineering, disease management, and regulatory oversight. Controlled breeding, biosecurity protocols, site selection tools, and environmental monitoring now allow offshore aquaculture systems to reduce risks of escapement, disease transmission, and ecosystem impacts. At the same time, governance frameworks have evolved to better integrate aquaculture with other ocean uses and conservation objectives. These advances suggest that offshore production of pure-strain striped bass could be feasible under a carefully designed regulatory structure that distinguishes aquaculture from wild harvest and ensures accountability, traceability, and environmental safeguards.

The purpose of this discussion paper is to identify the legal, policy, and scientific constraints on the production of cultured pure-strain striped bass in federal waters and outline the economic and environmental topics raised by the Atlantic States Marine Fisheries Commission (ASMFC). At the 2024 Winter Meeting of the ASMFC, Danielle Blacklock, Director of the NOAA Fisheries Office of Aquaculture, led the Interstate Fisheries Management Program (ISFMP) Policy Board in a discussion on the future of aquaculture and the potential role of Atlantic Striped Bass in U.S. seafood production. The Board raised longstanding concerns, describing issues on escapement, ecosystem impacts, enforcement related to the existing moratorium in the EEZ and illegal harvest, competition with wild-caught markets, economic feasibility, and the challenges of managing aquaculture alongside other ocean uses.

Building on this exchange, this Technical Memorandum provides historical context, summarizes the Commission's concerns, and identifies potential pathways forward. It examines the biological foundations, regulatory history, technological readiness, environmental considerations, market dynamics, and governance needs for striped bass aquaculture. The memo highlights how coordinated science, policy, and industry innovation could support sustainable offshore farming of this species in a way that complements wild stock conservation and contributes to U.S. seafood supply and coastal economies.

NOAA Fisheries, in coordination with ASMFC, could amend the relevant regulatory provisions to allow aquaculture as an explicit exception to the EEZ moratorium on the fishing, harvest, possession, and retention of striped bass. The sections that follow summarize the key regulatory and scientific issues and outline proposed next steps.

Summary of Key Regulatory and Science Issues

1.1 Enforcement Considerations

Fishery managers have expressed a need for strong, enforceable assurances that the development of an aquaculture market for pure-strain striped bass will not create incentives for illegal harvest or lead to negative impacts on wild stocks and the fisheries they support. The ASMFC (through its Law Enforcement Committee), state agencies, and NOAA Fisheries' Office of Law Enforcement (OLE) collaborate extensively on interjurisdictional fisheries enforcement. State precedents for labeling and tagging farmed product offer models for ensuring consumer confidence and preventing substitution of wild fish into aquaculture supply chains. Product differentiation and proper enforcement mitigate these challenges by providing better accountability on the water and enabling law enforcement to track a fish from its origin. Strategies could be developed for regulatory frameworks to ensure that aquaculture-raised striped bass are accurately labeled and traceable throughout the supply chain.

1.2 Economic Contributions

Market demand strongly supports the development of a domestic striped bass aquaculture sector. U.S. seafood consumption continues to outpace supply, with the majority of products imported. The development of a robust striped bass aquaculture industry has the potential to generate similar spillover benefits, particularly for coastal communities. Recent economic research suggests that striped bass aquaculture is most profitable in offshore net-pen systems, with breakeven prices comparable to those of commercially farmed red drum (*Sciaenops ocellatus*). Demand-side conditions are favorable, yet production cost challenges and regulatory inconsistencies, especially in states with gamefish designations, may be addressed. Interstate transport and sale of pure-strain farmed striped bass could present barriers for market development that will require synergies between state and federal regulations to avoid enforcement challenges and ensure transparency. A complete understanding of the impacts that a farmed striped bass industry will have on existing imports and wild-caught alternatives will require further analysis on potential production volumes and targeted markets. However, introducing farmed striped bass into non-traditional retail and food-service channels could expand

consumer exposure to the species, increasing overall demand for both farmed and wild-caught products.

1.3 Managing Ocean User Conflicts

The identification of suitable areas for aquaculture development, coupled with careful site selection and management, is fundamental to ensuring the long-term success and sustainability of offshore aquaculture. In the U.S., where competition for nearshore space is intense, expansion into the EEZ provides opportunities for larger sites with fewer nearshore user conflicts and greater social acceptance among commercial and recreational fishing communities. As part of NOAA's National Ocean Service, the National Centers for Coastal Ocean Science (NCCOS) plays a central role by developing science-based inclusive decision tools to inform precision siting for aquaculture and other sectors of the ocean economy.

1.4 Environmental Concerns

In the context of striped bass aquaculture, potential environmental effects can be grouped into several categories: (1) water quality, (2) benthic and sedimentary processes, (3) interactions with marine life and habitats, (4) cumulative and landscape-scale effects, and (5) mitigation strategies, including novel approaches such as integrated multi-trophic aquaculture (IMTA). Modern production technologies, standardized operating procedures, and best management practices reduce risks of degradation to water quality, benthic habitats, and marine life. All of these issues are managed by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE), in coordination with NOAA through consultations under existing federal law. EPA generally applies water quality models to characterize interactions between effluent and the receiving environment. Further, the NOAA NCCOS has ongoing collaborations with the EPA to provide depositional and water quality modeling products and science advice to support agency permitting and associated environmental reviews and consultations for finfish aquaculture projects proposed for federal waters.

1.5 Escapement and Genetic Concerns

Escape events are among the most widely recognized ecological risks associated with marine finfish aquaculture. Recent advances in genomic technologies now enable high-resolution monitoring of striped bass population structure. These tools have been applied to striped bass, where they have clarified stock composition and informed management across the species' range. Decades of hatchery experience, the success of the hybrid striped bass industry, and advances in selective breeding and fish health management have established a strong technical foundation for farming pure-strain striped bass. Offshore net-pen systems, which have been successfully demonstrated internationally,

provide suitable growing conditions while reducing many environmental pressures on coastal ecosystems. Emerging tools in genetics, automation, and biosecurity further strengthen the case for expansion into offshore environments. Additionally, NOAA and partners have developed models to evaluate genetic and ecological risks associated with aquaculture escape events. The intent of these tools are to support risk-based assessments of offshore aquaculture operations and to inform the development of management and engineering strategies that reduce the potential adverse effects of escape events on wild populations.

1.6 Disease

Equally important to environmental performance is maintenance of aquatic animal health. Disease represents one of the most significant operational risks in striped bass aquaculture and requires continuous, proactive management. Striped bass are susceptible to a range of pathogens and parasites, with recent research improving understanding of disease dynamics in both wild and farmed populations. Even well-managed farms may periodically require therapeutic intervention to control outbreaks, limit mortality, and protect animal welfare.

The Food and Drug Administration (FDA) provides centralized oversight of aquaculture therapeutants, ensuring that their use is scientifically justified and environmentally protective. At present, no antibiotics are approved for striped bass or most marine finfish species, reinforcing the importance of preventative health strategies. For striped bass aquaculture, disease prevention is therefore the primary line of defense, relying on vaccination where available, rigorous biosecurity protocols, water quality management, and structured health-monitoring programs to enable early detection and response. By integrating science-based biosecurity, judicious therapeutic use, and informed site selection, offshore aquaculture operations can reduce pathogen pressure, safeguard stock health, and minimize both economic losses and environmental risks. Comprehensive health-management frameworks that emphasize prevention, surveillance, and targeted intervention are thus essential for the sustainable development of offshore striped bass aquaculture.

1.7 Summary of Next Steps

Production of striped bass is already occurring abroad, with farmed product entering U.S. markets and competing with domestic seafood. The commercial appeal of cultivating pure-strain striped bass is therefore grounded in the existence of an established and recognized market opportunity. While demand in many regions remains seasonal, a key opportunity lies in expanding striped bass into a stable, year-round product that can complement and relieve pressure on wild fisheries while increasing total supply.

Realizing this opportunity will require coordinated progress across science, industry, and governance. Priority research needs include continued broodstock and selective-breeding programs, deployment of genetic safeguards, offshore production trials, fish health management, and development of sustainable feed strategies. At the same time, policy modernization will be essential, including reforms to regulatory frameworks in the EEZ, strengthened interagency coordination of federal permitting, expansion of marine spatial planning tools, and supporting workforce development and stakeholder engagement.

Striped bass aquaculture represents a strategic opportunity to expand domestic seafood production, strengthen coastal economies, and reinforce conservation of wild stocks. When science, governance, and markets are aligned, offshore farming of this species can move from technical feasibility to commercial reality, helping the United States advance national goals for seafood security, economic growth, and resilient coastal communities while coexisting with and supporting the long-term sustainability of commercial and recreational fisheries.

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2 Overview

2.1 Biology and Distribution of Striped Bass

The striped bass (*Morone saxatilis*) is one of the most important sport fish and commercial fisheries along the Atlantic coast of North America. It is an all-time favorite for anglers. It belongs to the family Moronidae, which comprises both freshwater and anadromous taxa. In North America, the genus *Morone* is represented by four species: striped bass, white perch (*M. americana*), white bass (*M. chrysops*), and yellow bass (*M. mississippiensis*). Striped bass is the largest and longest-lived member of the group, with individuals documented to live more than 30 years and reach weights exceeding 100 pounds, although fish over 75 pounds are rare (Bowers, 1900; Smith, 1907).

Striped bass populations display regionally distinct migratory behaviors along the U.S. Atlantic coast. North of Cape Hatteras, North Carolina, adults are anadromous, ascending freshwater or brackish rivers in spring to spawn before returning to the coastal ocean (Rulifson & Dadswell, 1995; Morris et al. 2003). Major spawning grounds on the U.S. Atlantic coast includes the Chesapeake Bay (Virginia and Maryland), the Hudson River, and the Delaware River, although smaller spawning populations exist in several other bays and rivers as well, including the Albemarle Sound-Roanoke River (North Carolina) and the Kennebec River (Maine). Larval and juvenile recruitment occurs in estuaries, where young fish typically reside for one to two years before dispersing offshore. Seasonal migrations extend northward to Nova Scotia during summer and southward to Virginia and North Carolina during winter, where spawning occurs in spring (Greene et al., 2009). In the Chesapeake Bay, migration patterns differ by age and sex, reflecting ontogenetic variation in maturity (Kohlenstein, 1981). The Hudson River stock shows similar dynamics, with both resident and ocean-migratory contingents (McLaren et al., 1981). In the Bay of Fundy, adults migrate downstream after spawning, while juveniles either remain in rivers or disperse along the coast (Rulifson & Dadswell, 1995).

In contrast, striped bass populations south of Cape Hatteras, extending to the St. John's River in northern Florida and into the Gulf of America, are primarily riverine and potamodromous, lacking consistent oceanic migrations (Setzler-Hamilton 1980; McIlwain, 1980). Historically, the Gulf range extended from the Suwannee River, Florida, westward to rivers of the Lake Pontchartrain basin in Louisiana (Pearson, 1938; Merriman, 1941; Barkuloo, 1961, 1967; GSMFC, 2006). Today, the only remnant population persists in the Apalachicola–Chattahoochee–Flint (ACF) river system spanning northwest Florida, Georgia, and Alabama. No records exist of Gulf specimens captured in open ocean habitats, although telemetry studies indicate that ACF striped bass occasionally enter the Gulf and migrate along the coastline (McIlwain, 1980; Fruge, 2006; Long et al., 2013).

Commercial landings of striped bass in the Gulf ended in the 1960s, however, coastal stock enhancement and contributions from reservoir escapement have created recreational fisheries in some areas. Although not native to Texas, striped bass are occasionally reported in estuaries and rivers as escapees from stocked reservoirs. These reports, documented by Texas Parks and Wildlife through gill net and creel surveys, occur mostly in Sabine, Galveston, and Matagorda Bays (Texas Parks and Wildlife, n.d.).

Beyond their native range along the Atlantic and Gulf coasts, striped bass were successfully introduced to the Pacific coast in the late nineteenth century (ca. 1879). Within a decade, they supported vibrant recreational and commercial fisheries from southern California to the Columbia River, Oregon (Nichols, 1966). An introduction to Kauai, Hawaii, in 1920 was unsuccessful, as the transplanted California fish failed to survive (Randall, 1987).

2.2 Striped Bass Fisheries Management

Management of Atlantic striped bass is coordinated through the Atlantic States Marine Fisheries Commission (ASMFC), which works in partnership with state and federal agencies to assess population status and implement regulatory measures across the species' range (ASMFC, 2022a). The management unit includes all coastal migratory striped bass stocks from Maine through North Carolina. ASMFC has primary authority for striped bass management within state waters, while NOAA Fisheries (NMFS) has management authority in federal waters. Federal waters under the Magnuson-Stevens Fishery Conservation and Management Act are defined as the Exclusive Economic Zone (EEZ), which extends from the seaward boundary of state waters out to 200 nautical miles offshore.

Stock assessments have consistently documented the species' natural population variability and periods of overexploitation. Severe overfishing during the late 1970s and early 1980s led to a coastwide collapse, prompting the adoption of a moratorium and strict harvest controls in the mid-1980s (Richards & Rago, 1999; ASMFC, 1990). These actions facilitated recovery, and by the mid-1990s the stock was declared rebuilt (ASMFC, 1997).

Since recovery, striped bass have remained among the most intensively managed fisheries along the Atlantic coast. Regulatory tools have included size and slot limits, seasonal closures, quotas, and gear restrictions, with measures adjusted adaptively in response to new scientific assessments (ASMFC, 2022a). Despite these efforts, the 2018 benchmark stock assessment concluded that the stock was overfished and that overfishing was occurring (NEFSC, 2019). In response, the ASMFC enacted harvest reductions in 2020 to curb fishing mortality and initiate rebuilding (ASMFC, 2020).

Total removals in 2021, including commercial harvest, commercial discards, and recreational harvest and release mortality, were estimated at 5.1 million fish, similar to

2020 levels (ASMFC, 2022b). Recreational removals accounted for approximately 86% of this total, reflecting the dominance of the recreational sector. The commercial fishery, managed under state-specific quotas, has maintained relatively stable landings since 2004, while the recreational fishery is managed through bag limits, size restrictions, and seasonal closures in some jurisdictions (ASMFC, 2022b).

Broader management reforms were codified in Amendment 7 to the Interstate Fishery Management Plan (FMP), approved in 2022. Amendment 7 introduced more precautionary recruitment triggers, clarified conservation equivalency standards, enhanced measures to reduce recreational release mortality, and reaffirmed the requirement to rebuild the stock by 2029 (ASMFC, 2022a). Addendum I, approved in May 2023, further allowed for voluntary transfers of commercial quota in the ocean region, contingent on stock status (ASMFC, 2023).

Following the 2024 Stock Assessment Update, which determined the stock remained overfished though not experiencing overfishing, the ASMFC initiated Draft Addendum III in December 2024. This addendum, currently under development, is intended to provide new recreational and commercial measures for implementation in 2026 to ensure rebuilding by 2029 (ASMFC, 2024a). The Board is expected to finalize the addendum following public comment in late 2025, with implementation planned for early 2026 (ASMFC, 2025).

This evolving management framework illustrates the dynamic and adaptive nature of striped bass governance. The challenge remains to balance sustainable harvest opportunities with long-term conservation goals for a species that holds ecological, cultural, and economic importance along the U.S. Atlantic seaboard.

2.3 Legal History of Striped Bass Management

2.3.1 Atlantic States Marine Fisheries Commission and the Striped Bass Conservation Act of 1984

The ASMFC, established in 1942 through an interstate compact, was created to coordinate management of interjurisdictional fisheries along the Atlantic seaboard, including striped bass (ASMFC, 2022a). The Commission is composed of representatives from 15 states, the District of Columbia, the Potomac River Fisheries Commission, and federal agencies including NMFS and the USFWS. Collectively, these entities hold primary management authority and adopt regulations consistent with the Interstate FMP (ASMFC, 1990).

By the mid-1970s, striped bass populations had declined to historic lows. In 1979, Congress directed NMFS and USFWS to conduct a comprehensive study of the causes of this decline, examining environmental change, predation, competition, and fishing mortality (U.S. Congress, 1979)¹. In response, ASMFC adopted the first Atlantic Striped Bass FMP in 1981 (ASMFC, 1981). To strengthen implementation, Congress enacted the Atlantic Striped Bass Conservation Act of 1984 (Pub. L. 98-613), which required states to implement ASMFC's striped bass regulations and established a federal enforcement backstop (U.S. Congress, 1984).

The Striped Bass Act empowered ASMFC to notify the Secretaries of Commerce and the Interior if a state failed to comply with the interstate FMP. Upon such notification, the Secretaries could jointly impose a moratorium on striped bass fishing in that state's waters (ASMFC, 1990). This enforcement authority, unique among the interstate marine fishery commissions, has proven effective in ensuring state compliance with ASMFC management actions (NMFS, 2020a).²

Congress strengthened the Striped Bass Act through amendments in 1988, authorizing the Secretary of Commerce acting through NMFS to regulate striped bass within the federal waters of the EEZ (U.S. Congress, 1988). Using this authority, the Secretary may develop offshore regulations, but any regulations are required to be consistent with the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. §1851 et seq.) and compatible with the ASMFC striped bass FMP. The 1988 and subsequent amendments also authorized NMFS and USFWS to carry out annual studies and population assessments of striped bass. The amendments also mandated biennial stock assessment and management reports from the Secretaries to ASMFC and Congress, expanded requirements for public participation in preparation of management plans, and provided dedicated annual funding for striped bass research and assessment (NMFS & USFWS, 1990).

In November 1990, NMFS implemented a moratorium on the harvest and possession of striped bass in the EEZ under the Striped Bass Act (55 Fed. Reg. 40184, 1990). This action was designed to reinforce ASMFC's rebuilding program, provide additional protection for striped bass thereby reducing fishing mortality, and ensure the effectiveness of state regulations. The moratorium remains in effect today (NMFS, 2020b). Amendment 4 to the Striped Bass Plan, adopted in 1989, allowed for limited increases in harvest. Amendment 4 relaxed the measures, and as states reopened fisheries, NMFS closed federal waters of the EEZ to ensure effectiveness of state

¹ "Reauthorization of the Atlantic Striped Bass Conservation Act", U.S. House of Representatives Report, 106-698.

² The Atlantic Coastal Fishery Cooperative Management Act (1993) generally mirrors the Striped Bass Act in giving the Secretary of Commerce the authority to impose moratoria in State waters, albeit for other Atlantic fisheries managed under ASMFC-approved fishery management plans. 1988 Amendments and the Federal Moratorium.

measures (ASMFC, 1989). Although reopening of the EEZ has been periodically evaluated, including under Amendment 6 in 2003, both managers and stakeholders have consistently supported its continued closure, citing the predominance of mature, spawning-capable females offshore and the risk of increased fishing mortality if federal waters of the EEZ were reopened (ASMFC, 2003).

2.3.2 Executive Order 13449

In 2007, Executive Order 13449 affirmed federal policy to conserve striped bass and red drum, while clarifying that aquaculture production of these species was not restricted (Bush, 2007). The order declared that it is “the policy of the U.S. to conserve striped bass and red drum for the recreational, economic, and environmental benefit of the present and future generations of Americans” (Bush, 2007). The E.O. notes, importantly, that the order must be implemented in a manner consistent with applicable law. The E.O. essentially directed NOAA to promulgate regulations that restrict the sale of EEZ striped bass if it could do so consistent with the law. NOAA already had regulations on the books (i.e., closure of federal waters of the EEZ) that achieved the policies of the E.O.

2.3.3 Federal Jurisdiction and Regulations (Current Legal Constraints)

Management authority for Atlantic striped bass within state waters resides with the coastal states, coordinated through the ASMFC’s Striped Bass FMP (ASMFC, 2022a). Federal authority in the EEZ is derived from the Magnuson Stevens Act, which predates the Atlantic Striped Bass Conservation Act and which requires NMFS to ensure that any regulations implemented for striped bass in the EEZ: (1) are consistent with the national standards under Section 301 of the MSA (16 U.S.C. §1851 et seq.); (2) are compatible with the ASMFC Striped Bass FMP and any federal moratoria authorized by statute; (3) ensure the effectiveness of state regulations within coastal waters; and (4) achieve long-term conservation and management objectives for the Atlantic striped bass resource (U.S. Congress, 1984; NMFS, 2020). In other words, NMFS or the Councils could develop a federal FMP for striped bass under the MSA if it so chooses. Alternatively, NMFS may implement regulations for striped bass under the ACA instead, which is the scheme we have today.

Federal regulations in the EEZ can be developed to complement ASMFC’s Striped Bass FMP. Currently, federal regulations prohibit fishing for, harvesting, possessing, or retaining Atlantic striped bass in the EEZ (50 C.F.R. §697.7). Limited exceptions exist in Block Island Sound, where possession is permitted during continuous transit provided no fishing occurs in EEZ waters (NMFS, 1990).

In 1995, following ASMFC’s declaration that striped bass stocks were rebuilt, NMFS considered lifting the EEZ ban or revising it to align with state size limits, as recommended by the Commission (ASMFC, 1997). After reviewing public comment and updated mortality estimates indicating fishing pressure was higher than previously believed, NMFS

elected to maintain the EEZ moratorium (NMFS, 1995). Further, Amendment 6 included a recommendation to NMFS to consider reopening the EEZ (ASMFC, 2003). Following public review and consideration of updated stock assessments, NMFS concluded in 2006 that reopening the EEZ posed unacceptable risks because effort levels and associated fishing mortality could not be reliably controlled (NMFS, 2006).

Currently, implementing regulations (50 CFR 697.7(b)) state that it is unlawful for any person to do any of the following:

- (1) Fish for Atlantic striped bass in the EEZ.
- (2) Harvest any Atlantic striped bass from the EEZ.
- (3) Possess any Atlantic striped bass in or from the EEZ, except in the following area: The EEZ within Block Island Sound, north of a line connecting Montauk Light, Montauk Point, NY, and Block Island Southeast Light, Block Island, RI; and west of a line connecting Point Judith Light, Point Judith, RI, and Block Island Southeast Light, Block Island, RI. Within this area, possession of Atlantic striped bass is permitted, provided no fishing takes place from the vessel while in the EEZ and the vessel is in continuous transit.
- (4) Retain any Atlantic striped bass taken in or from the EEZ.

2.4 Solutions and Recommendations

A regulatory pathway that allows for offshore aquaculture of striped bass in the U.S. EEZ could be achieved without undermining the conservation achievements of the Striped Bass Conservation Act or ASMFC's management program. The following solutions are recommended:

2.4.1 Regulatory Carve-Out for Aquaculture

NMFS could lead an effort to amend existing regulations to explicitly recognize aquaculture operations as an exception to the EEZ moratorium. Permitting criteria may be established specific to aquaculture while reaffirming the prohibition on wild harvest in the EEZ. The language would have to be specific about who, when, and where the exemption would apply. This amendment would be subject to public comment and could include commentary by the ASMFC. While straightforward textually, NMFS intent is to work with the ASMFC to address any possible concerns before such action is considered.

2.4.2 Enforcement and Monitoring Framework

Federal and state enforcement agencies may adopt a robust compliance and monitoring program for aquaculture operations. This may include reporting requirements, periodic

inspections, and integration of vessel monitoring systems or remote electronic monitoring to ensure no illegal harvest of wild striped bass occurs under the guise of aquaculture.

2.4.3 Traceability and Supply Chain Integrity

A comprehensive traceability system (“farm-to-market”) is essential to differentiate cultured striped bass from wild-caught products. Tools could include genetic certification, tagging, or electronic product tracking. Such measures would prevent substitution of illegally harvested wild fish into aquaculture supply chains, thereby preserving confidence among regulators, markets, and consumers. Importantly, this approach would align with existing wild striped bass tagging programs used by coastal states, creating a seamless framework for distinguishing wild and farmed fish in commerce.

2.4.4 Alignment with Fisheries Management Measures

Complimentary aquaculture regulations could be developed by the States in consideration of existing striped bass fisheries management tools such as bag limits, size limits, and possession limits. While these limits may not apply directly to aquaculture, aligning aquaculture rules with conservation objectives will minimize regulatory conflicts and reinforce stock protection.

2.4.5 Certification of Pure-Strain Cultured Striped Bass

To ensure that aquaculture production supports conservation, cultured fish could be certified as pure-strain and non-interbreeding with wild stocks. Hatchery protocols, broodstock management, and genetic testing would safeguard against introgression and maintain the integrity of wild striped bass populations. Non-interbreeding status can be achieved through strict physical containment measures, siting farms away from migratory stocks, or by applying genetic control approaches such as triploidy, sterility induction, or technologies to prevent successful interbreeding with wild fish.

2.4.6 Preventing Market Leakage of Wild Harvest

Clear rules, coupled with enforcement and traceability, must ensure that wild-caught striped bass do not enter markets under the label of cultured product. This will protect both the conservation gains achieved under ASMFC management and the credibility of aquaculture enterprises. Such safeguards are not new; they already exist within the current hybrid striped bass and pond-farmed striped bass industries, where farmed product is clearly distinguished from wild harvest through tagging, documentation, and distribution controls. Building on this established framework, similar approaches can be extended to offshore aquaculture operations to provide regulators, markets, and consumers with confidence that aquaculture production remains separate from wild harvest.

3 Striped Bass Aquaculture in the EEZ: Jurisdiction, Enforcement, and ASMFC's Potential Role

The governance landscape for striped bass in federal waters remains shaped by moratoria and ASMFC oversight, yet opportunities exist to adapt these frameworks for aquaculture without undermining wild stock protections. Traceability systems, tagging protocols, and strong enforcement provisions can close loopholes that otherwise risk illegal harvest. With proactive engagement, ASMFC and federal agencies can ensure that aquaculture complements conservation rather than conflicts with it.

3.1 Jurisdictional Context

As outlined in Section 2.3, harvest within the U.S. East Coast EEZ is prohibited. This section explores how the ASMFC could consider adapting existing authorities for oversight of striped bass aquaculture. These restrictions do not apply in the Gulf of America, where applications are actively being explored to farm Atlantic striped bass, not hybrid varieties, and commercial activity is already occurring, for the purpose of human consumption. Pond-based farms are operating in North Carolina, South Carolina, and Texas. North Carolina and Ohio are pursuing commercial-scale recirculating aquaculture following successful research trials. To have a meaningful role in the development of this industry, the ASMFC could consider using existing authority to establish monitoring and enforcement programs for striped bass aquaculture as the market expands and interest grows for production in the Atlantic.

Permitting for most aquaculture operations in the U.S. EEZ currently falls under the authority of federal agencies, specifically the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (ACE). Under the Magnuson-Stevens Act, the Regional Fishery Management Councils (RFMC) are consulted by NMFS in relation to impacts to Essential Fish Habitat (EFH) regarding the regulatory actions taken by either the EPA or the ACE. The ASMFC has representation on some regional fisheries management councils, but does not currently have a direct regulatory or enforcement role in EEZ aquaculture.

To clearly outline the current situation: permitting within the EEZ primarily falls under the jurisdiction of the EPA and the ACE. The RFMCs are typically not involved beyond Essential Fish Habitat (EFH) consultations, or to the extent a Council has taken actions on policies concerning aquaculture.

A complicating exception to the general rule above is that the management of Atlantic striped bass in state waters is primarily the responsibility of the coastal states, and is promulgated through the ASMFC's Striped Bass FMP. The management unit includes all coastal migratory striped bass stocks on the East Coast of the U.S., excluding the EEZ,

which is managed separately by NMFS. Under the Atlantic Striped Bass Act, Section 5158 requires NMFS to ensure that any regulations implemented in the EEZ for striped bass:

- 1) Are consistent with the national standards in Section 301 of the MSA (16 U.S.C. 1801 et seq.).
- 2) Are compatible with the Striped Bass FMP and each federal moratorium in effect, as authorized by statute.
- 3) Ensure the effectiveness of State regulations within the coastal waters of a state.
- 4) Achieve long term conservation and management goals for the Atlantic striped bass resource. Federal regulations in the EEZ can be developed to complement ASMFC's Striped Bass FMP.

In November 1990, NMFS implemented a moratorium on the harvest and possession of striped bass in the EEZ under the Striped Bass Act to support the ASMFC Striped Bass Plan, provide additional protection for striped bass, and ensure the effectiveness of state regulations. This moratorium remains in effect today and current federal regulations ban the fishing, harvesting, possession and retention of Atlantic striped bass in the EEZ. As interest grows in the commercial culture of pure-strain striped bass in federal waters both in the Gulf of America and along the Atlantic, it is essential to recognize the regulatory gap that exists and the opportunity for ASMFC to step into a more proactive and protective role.

If the ASMFC wishes to have a meaningful role in this process, it could implement enforcement provisions specific to striped bass aquaculture, an authority that it currently possesses. It is also important to note that the ASMFC may be compelled to act regardless, given the potential expansion of pure-strain striped bass aquaculture in the Gulf of America and the potential of that product entering markets along the Atlantic.

This represents a timely opportunity for the ASMFC to actively engage with its stakeholders and ensure its voice is heard in shaping policy.

3.2 Scenarios for ASMFC Involvement

The expansion of pure-strain striped bass aquaculture presents both economic opportunity and ecological risk. The ASMFC is uniquely positioned to provide oversight of this industry, in conjunction with their protection of the wild striped bass stock. While it does not control permitting in the EEZ, the Commission establishes fishery management provisions and compliance standards that apply to its member jurisdictions, and thus influence the actions taken by Federal agencies working in the EEZ. If the ASMFC wishes to ensure that aquaculture development walks in parallel with decades of conservation work, it can consider exercising its authority to define and enforce compliance expectations related to striped bass aquaculture. The emergence of pure-strain

production in regions like the Gulf of America underscores the urgency of this engagement.

Core Enforcement and Compliance Issues

Ultimately, fishery managers need strong, enforceable assurances that the development of an aquaculture market for pure-strain striped bass will not create incentives for illegal harvest, not undermine the commercial fishery or cause negative impacts on wild stocks. The primary enforcement concern appears to be illegal harvest, direct illegal sales of striped bass to consumers and restaurants. Strategies such as product differentiation and proper enforcement mitigate these challenges by improving accountability on the water and enabling law enforcement to track fish back to their origin. Effective regulation may include:

1. Traceability and Product Differentiation

Consistent labeling protocols across the supply chain, from production through market, are critical to preventing product misrepresentation. Effective approaches include physical identifiers, documentation procedures, and standardized processing requirements. Regulatory frameworks vary by jurisdiction, with some states tagging fish at the point of landing and others at the point of sale. The ASMFC has considered mandating dockside landing tags for all states, citing concerns that point-of-sale systems create greater opportunities for illegal harvest. A uniform dockside landing requirement could strengthen enforcement by reducing the risk of unrecorded landings, particularly in states with individual quotas where incentives for illegal sales are high. By ensuring traceability from the time fish are landed, tagging provides enforcement agencies with a critical tool to safeguard quota integrity and deter unlawful market activity.

Harvest of aquaculture striped bass from large offshore farms presents unique challenges for product tagging. Unlike small-scale operations, tagging at the point of capture, during loading to a well boat, or aboard a harvest vessel is impractical when tens of thousands of fish may be collected in a single event. Although gill- or tail-tagging systems can process up to approximately 200 fish per minute, they require individual handling, may adversely affect product quality, and can raise animal welfare concerns.

Dockside tagging reduces the risk of illegal mislabeling between aquaculture and wild-caught fish and is generally supported by enforcement agencies as a means of enhancing oversight, reducing opportunities for unlawful practices, and strengthening accountability across the seafood supply chain. Implementation considerations include enforcement logistics, operational safety, and consistency across fisheries with differing management structures. In particular, fisheries operating under individual quota systems are especially vulnerable to quota evasion, making rigorous dockside tagging a critical tool for compliance and traceability.

2. Monitoring and Market Controls

Reporting and tracking mechanisms must be adopted to monitor volumes of production, sales, and distribution of cultured striped bass. Rules concerning possession limits, vessel traffic, and size regulations may be considered, where appropriate, to ensure that aquaculture harvests are not masking illegal wild harvests.

3. Enforcement and Penalties

Penalty structures can deter violations, including fraudulent substitution between wild-caught and aquaculture products. Penalties should be calibrated to serve as effective deterrents and implemented through a clearly articulated enforcement framework that coordinates federal, state, and interstate authorities. Enforcement records show persistent convictions for the illegal possession or sale of fish by recreational fishers, underscoring the need for robust accountability measures (ASMFC, 2025). While the direct risk of recreational fish being misrepresented as aquaculture products may be relatively low, traceability systems and tagging requirements strengthen oversight and help address illicit market activity. There may also be value in exploring tagging protocols for recreational harvest, which could support traceability efforts and help deter unauthorized sales. In addition, consideration could be given to consistent size restrictions across recreational and commercial sectors.

4. Enforcement Burden and Legal Authorizations

The ASMFC and NOAA (specifically NMFS Office of Law Enforcement, OLE) collaborate extensively on fisheries enforcement. Their partnership blends federal oversight with regional/state-level enforcement, sharing burdens via multi-agency agreements and funding mechanisms tied to the Magnuson-Stevens Act and the Atlantic Coastal Fisheries Cooperative Management Act.

Under the Atlantic Coastal Fisheries Cooperative Management Act, NOAA provides funding to the states, in part, to support law enforcement capacity, including for Joint Enforcement Agreements (JEAs). NOAA's OLE maintains formal agreements with a wide list of states (e.g., MD, MA, FL, GA, etc.) to ensure nationwide coverage. ASMFC's Law Enforcement Committee (LEC) includes representatives from each member state plus NOAA, U.S. Coast Guard (USCG), and U.S. Fish and Wildlife Service (USFWS). Its tasks include reviewing enforcement plans, coordinating cross-jurisdictional efforts, and advising on regulation enforceability.

5. Law Enforcement Considerations

When reviewing investigation and criminal provisions, the following may be considered by the Law Enforcement Committee of the Atlantic States Marine Fisheries Commission:

- Consider a uniform regional traceability system for all seafood products harvested or produced for commercial sale, clearly distinguishing aquaculture from wild-caught sources.
- Standardize labels by year, type (aquaculture vs. wild-caught), color, and inscriptions for easy identification and traceability.
- Issue time-limited tags or labels (valid for a single calendar or fishing year) to ensure currency and prevent reuse or fraud.
- Include essential information on each tag, such as year, state or facility of origin, source type (aquaculture/wild), size limits (if applicable), and a unique identifier.
- Use tamper-evident and traceable tags that cannot be transferred between fish or altered without detection.
- Consider immediate tagging at the point of harvest or harvest-equivalent (e.g., at aquaculture facility dispatch or wild harvest landing).
- Require aquaculture operations to report production volumes and verify tag use based on certified harvest quantities.
- Enforce annual or seasonal return of all unused tags or labels, and prohibit federal permit renewal for non-compliance.
- Integrate tag tracking into dealer reports or electronic trip tickets, including identification of whether the product is farmed or wild-caught.
- Apply meaningful penalties, including license suspension or revocation, for mislabeling, misuse of tags, or other violations at the state or federal level.
- Ensure real-time, centralized access to tag issuance and use data for authorized enforcement personnel to facilitate on-the-ground inspections and audits.

Existing Models and Precedents

States have already taken action to regulate striped bass aquaculture in ways that promote transparency and accountability. Some states require a tagging program for commercially harvested striped bass. It is unlawful to sell or purchase commercially caught striped bass without a commercial tag. The intent is to prevent the sale or purchase of untagged striped bass in a state or jurisdiction where there is currently no commercial fishery program. Notably, Virginia had previously administered a detailed regulatory framework for culture of pure-strain striped bass. These efforts provide a valuable foundation for broader regional and federal collaboration.

A strong regulatory framework with effective enforcement and monitoring is essential to maintaining the integrity of the seafood supply chain. Clear differentiation between aquaculture-raised striped bass and wild-caught striped bass is critical to ensure consumer transparency and market fairness. To address these concerns, several Atlantic coastal states, including Massachusetts, Maine, New Hampshire, and Virginia (prior to repeal) have taken steps to regulate the labeling, handling, and marketing of aquaculture-

raised hybrid striped bass. These state efforts promote transparency and accountability and provide a valuable foundation for broader regional and federal collaboration.

1. Maine and New Hampshire

Maine and New Hampshire have adopted similar regulatory frameworks to ensure that aquaculture-raised striped bass are accurately labeled and traceable throughout the supply chain. This alignment reflects a broader regional effort to promote consistency in labeling and enforcement standards across jurisdictions.

The sale of wild striped bass caught for personal use or by commercial fisheries in other states or jurisdictions is prohibited in the State of Maine. Striped bass sold in Maine markets and restaurants is therefore a cultured product and is primarily hybrid striped bass. In Maine, regulations under 13 DMR § 188-42-02 require containers of aquaculture-raised hybrid striped bass, whether whole or filleted, to be labeled as “Hybrid Striped Bass” and include the state of origin; the names, permit numbers, and addresses of shipping and receiving dealers; the date of shipment; and the net weight of the container. Fillets must retain their skin, and like in Massachusetts, the use of the term “striped bass” for marketing hybrid products is prohibited. Possession exemptions already exist in Maine; chiefly the exemption applies to aquaculture products that do not meet the legal size or season requirements for wild-caught marine organisms of the same species.

New Hampshire enforces nearly identical standards through N.H Admin. Code § Fis 807.14. The regulation cites the potential for hybrid striped bass markets to be used as outlets for undersized striped bass and emphasizes the importance of regulatory consistency across states. Like Maine and Massachusetts, New Hampshire mandates clear product labeling, skin-on requirements for fillets, and restricts the use of the term “striped bass” in marketing or sales for hybrid striped bass.

2. Virginia

Regulations for the commercial striped bass fishery in Virginia include minimum sizes, possession limits, gear restrictions, seasons, and quotas. Virginia previously administered a detailed regulatory framework for the lawful propagation, sale, and transport of aquaculture-raised striped bass and hybrid striped bass under 4VAC20-252.

Under this system, anyone seeking to operate an aquaculture facility to raise striped bass or hybrid striped bass in Virginia was required to obtain a permit from the Virginia Marine Resources Commission. The permit authorized and defined the limits for the purchase,

possession, sale, transfer, and transport of striped bass and hybrid striped bass for aquaculture purposes. Permits were issued annually on a non-transferable basis, and were automatically renewed by the Commission provided the facility had been adequately maintained and remained structurally unchanged and in compliance with all permit conditions.

Permitted facilities were only allowed to acquire eggs, fry, and fingerlings from state-permitted, disease-free dealers. Each acquisition required documentation with receipts detailing the species, quantity, date, source, and destination. Harvesting striped bass from Virginia's tidal waters for the purpose of artificial spawning in aquaculture facilities remained subject to applicable state fishing laws, such as size limits and seasonal closures. Under the previous section, 4VAC20-252-210(C), striped bass or hybrid striped bass produced at a permitted aquaculture facility in another state may be imported for sale in Virginia, provided that all standards outlined in the regulation are met. Section 252-210 was repealed in April 2024 as an attempt to streamline regulations by the Commonwealth.

All market-ready fish had to be labeled with the name, address, and permit number of the producing facility. In addition, all sales and resales needed to be accompanied by a receipt documenting the species, seller, purchaser, date of sale, and production facility information. Copies of receipts were required to be kept by both parties and made available to enforcement authorities upon request. Permitted facilities were also required to maintain a chronological file of transactions for inspection by the Department of Wildlife Resources or agents of the Marine Resources Commission.

3. Massachusetts

Though Massachusetts does not have a legal framework addressing the aquaculture of pure strain striped bass, it does have an analogous legal framework for product differentiation of aquaculture vs wild caught product. Massachusetts enforces robust standards under 322 CMR 14.00 for the sale, transport, and distribution of aquaculture-raised finfish, with specific provisions for aquaculture-raised hybrid striped bass. Under Section 14.01, the state requires that all containers of aquaculture-raised striped bass, whether whole or filleted, are clearly labeled as "Hybrid Striped Bass". The labels must also include information on the state of origin, the names, and addresses of shipping and receiving dealers, the permit numbers of the shipping and receiving dealers, the date of shipment, and the net container weight. Aquaculture-raised hybrid striped bass fillets are also required to have the skin attached. Additionally, 322 CMR 14.01(5) makes it unlawful to promote, market, sell, or advertise hybrid striped bass products as "striped bass". Massachusetts extends these labeling requirements to all aquacultured finfish species that are wild caught and landed in the state. It also prohibits any sale, promotion, or

transport of aquaculture-raised finfish unless they are properly labeled and clearly identified as being an aquaculture product.

4. North Carolina

Finally, while not directed toward aquaculture, an analogous legal framework for product differentiation exists in North Carolina. The state governs the possession and sale of wild-caught striped bass through a permitting and tagging system under 15A NCAC 030. 0503. Fish dealers must obtain a Striped Bass Dealer Permit for a specific harvest area- the Atlantic Ocean, the Albemarle Sound Management Area, or the Joint and Coastal Fishing Waters of the Central/Southern Management Area. Sale, purchase, or possession of striped bass without a validated dealer permit is unlawful. Striped bass taken from open harvest proclamation areas must have a tag attached to the mouth and gill cover. Tags are issued by the North Carolina Division of Marine Fisheries and must not be bought, sold, or transferred. These regulations support accountability and traceability and are designed to separate legally harvested wild-caught fish from illegal or misrepresented products in the market. Farmed striped bass in North Carolina are not subject to tagging requirements for transport or retail sale but must be accompanied by documentation identifying their cultured origin throughout shipment and distribution. The production of farmed striped bass requires appropriate permits or licenses from the North Carolina Department of Agriculture and Consumer Services, with additional regulatory oversight by the North Carolina Division of Marine Fisheries.

Without clear and consistent standards for traceability, aquaculture markets could unintentionally become an outlet for illegally harvested or undersized wild-caught striped bass. This not only undermines fishery management goals, but also erodes consumer confidence. Together, these state-level regulations demonstrate a coordinated approach to strengthen transparency, traceability, and compliance in the seafood supply chain. Additionally, they provide a valuable foundation for coordinated regional strategies or future federal policies aimed at ensuring product integrity and building consumer trust in the growing domestic aquaculture sector.

4 Marine Spatial Planning and Siting

The identification of suitable areas for aquaculture development, coupled with careful site selection and management, is fundamental to ensuring the success and long-term sustainability of offshore aquaculture. Forecasting environmental interactions represents a critical first step, providing the foundation for coastal and ocean-use planning while helping to equitably address points of resistance to aquaculture expansion.

This section highlights the challenges associated with unplanned or poorly coordinated aquaculture development and emphasizes the benefits of structured marine spatial planning (MSP) approaches. Spatial planning tools ranging from geographic information systems (GIS) and remote sensing to coupled biophysical and socioeconomic models offer science-based frameworks to guide aquaculture expansion in both coastal and offshore environments (Froehlich et al., 2017; Lester et al., 2018). Integrated approaches, such as the ecosystem approach to aquaculture (EAA), explicitly account for ecological carrying capacity, stakeholder interests, and governance structures (Morris et al., 2025; Theuerkauf et al., 2019). Increasingly, these tools are being adopted by regulatory agencies and decision-makers to address environmental, economic, social, and governance considerations, including biosecurity, climate change, and competition among ocean users.

Recent advances in MSP have yielded a suite of decision-support tools that foster coordinated, participatory, and integrated approaches to aquaculture management (Kapetsky et al., 2013; Gentry et al., 2017). Such tools not only help protect natural resources but also provide mechanisms to balance multiple, and often conflicting, uses of marine space. Drawing on case studies, this section identifies both successful examples of MSP implementation and common pitfalls or barriers that may hinder practical application.

Planning for aquaculture operations in U.S. federal waters requires a particularly high level of spatial analysis, given the diversity of existing ocean uses and the complex siting criteria required for offshore fish farms. Suitable sites must balance biophysical parameters (e.g., water depth, current speed, wave exposure, distance to port) with regulatory requirements, ecological sustainability, and social acceptance. Effective planning also necessitates consideration of cumulative impacts across time and space, as well as harmonization of aquaculture siting with broader sustainability goals and regulatory frameworks.

Recent planning and permitting efforts in the Gulf of America and Southern California highlight the necessity of multi-agency collaboration in evaluating candidate farm areas (Riley et al., 2021; Morris et al., 2021; Wickliffe et al., 2024). These processes incorporated assessments of navigation corridors, military operations, industrial activities, commercial and recreational fisheries, protected species, and sensitive habitats to minimize conflicts across ocean sectors. In both cases, spatial analysis tools proved essential at different stages of decision-making. For example, automatic identification system (AIS) vessel-tracking data, which record ship position, course, and speed, were used to evaluate potential navigational conflicts during planning. These analyses highlighted when specific data layers (e.g., vessel traffic, habitat mapping, socioeconomic information) were most informative—some being critical during the early planning phase to guide siting alternatives, and others later in permitting phases to refine project footprints and mitigate conflicts.

Together, the Gulf of America and Southern California case studies represent the most significant federal step yet to support offshore aquaculture development and underscore the importance of structured spatial planning in advancing offshore aquaculture for species such as striped bass along the U.S. coastline. By integrating ecological, economic, and social dimensions, MSP provides a transparent and adaptive framework capable of facilitating industry growth while safeguarding ecosystem health and compatibility among multiple oceanic uses.

As part of NOAA's National Ocean Service, the National Centers for Coastal Ocean Science (NCCOS) plays a central role in advancing MSP by developing science-based inclusive decision tools to inform precision siting for aquaculture and other sectors of the ocean economy. NCCOS integrates GIS technologies with ecological and ocean-use data to support planning, scoping, authorizing, and mitigating activities. These robust quantitative tools are paired with community and stakeholder engagement methods to bring in social-cultural considerations into the analysis. This approach provides strategies for siting aquaculture operations that account for regulatory and management priorities as well as stakeholder concerns. By reducing user conflicts and enabling coordination among regulators, operators, and stakeholders, spatial planning supports responsible aquaculture development in U.S. federal waters.

4.1 Siting Considerations for Atlantic Striped Bass

NOAA's NCCOS conducted a preliminary spatial analysis to identify thermally suitable areas for striped bass aquaculture along the U.S. Atlantic coast. The analysis evaluated both state and federal waters from Maine through Florida by quantifying how often water temperatures fell within defined biological production thresholds.

The suitable temperature range is defined as the range of water temperatures over which striped bass can maintain normal physiological function, survive, feed, and grow at commercially viable rates. Recent work conducted with industry partners indicates that temperatures from 15 to 30 °C support commercial production of striped bass from approximately 50 g to 2.5 kg (Andersen et al., 2021). Within this broader suitable range, the optimal temperature range represents the narrower thermal window that maximizes growth, feed conversion, and production efficiency. Laboratory studies of juvenile striped bass have identified optimal temperatures ranging from 24 to 28 °C (Cox & Coutant, 1981; Secor et al., 2000), while grow-out performance in production settings is generally reported optimal between 22 and 26 °C (R. Borski, North Carolina State University, pers. comm.). This framework aligns with bioenergetic growth models developed for striped bass, where the suitable thermal range represents conditions that sustain survival and growth (Hartman & Brandt, 1995), while the optimal range for aquaculture identifies the temperatures that maximize growth, production efficiency, and profitability (Klinger et al., 2017; Mengual et al., 2021).

Temperatures below 15 °C or above 30 °C are expected to reduce physiological performance, slow growth, and lower economic returns. Because striped bass in offshore systems are fully submerged, the assessment used modeled temperatures between 6-10 m depth to represent cage conditions. The siting analysis also limited candidate areas to water depths of 50 to 150 m to support cage infrastructure and to locations within 30 nautical miles of shore, since greater distances are likely to reduce economic viability.

The Naval Research Laboratory Global Ocean Forecasting System 3.1: 41-layer HYCOM + NCODA Global 1/12° Analysis dataset was used to estimate temperatures at depth as it provided the high spatial and temporal range and resolution needed for this analysis. The dataset provides modeled temperatures at 40 depth levels throughout the global ocean, at eight times throughout the day to inform daily temperature ranges. For each grid cell, minimum and maximum daily temperatures were extracted, and a location was considered to fall within the thermal range only if both values were within the defined threshold range. The number of qualifying days was then tallied across the study period. Cage culture constraints, as outlined previously, were applied to further isolate areas with appropriate thermal conditions, sufficient depth for viable cage deployment, and distances from shore that are economically realistic. Depth estimates were sourced from the NOAA National Centers for Environmental Information Earth Topography (ETOPO) Global Relief Model (NOAA NCEI, 2022). Data from 2020–2023 were used to calculate the mean number of days within suitable and optimal ranges per year.

Large areas of thermal suitability were identified throughout the mid-Atlantic and southern Atlantic regions, with many locations remaining within the suitable range for nearly an entire year (Figure 1). When cage culture siting criteria were applied (i.e., depth and distance to shore) the extent of available areas decreased substantially; however, regions off Florida and North Carolina continued to provide broad areas of suitable conditions. Optimal temperatures were less common than the broader suitable range, as expected, but conditions exceeding 100 days per year at optimal temperatures were observed along the mid-Atlantic and southern coast. Despite the prevalence of wild striped bass populations in the northeast, areas north of Cape Hatteras, North Carolina, frequently experienced temperatures below the suitable range, often for weeks at a time and more than 100–200 days annually. Elevated temperatures were less problematic, as the Gulf Stream remains offshore of the 30 nm distance from shore constraint that was applied.

During our study period, an average of 68.2 million ha of state and federal waters along the Atlantic coast met the suitable temperature range for striped bass aquaculture \geq 250 days annually. Within this area, an average of 27.1 million ha was within the optimal temperature range for at least 150 days. When depth and distance from shore criteria were applied to the areas that experienced optimal temperatures

on average ≥ 180 days the area decreased to 429,000 ha, located off the coasts of North Carolina and Florida.

Although the physiological performance, growth, and bioenergetics of striped bass is comparatively well studied (e.g., Anweiler et al., 2019; Penny & Pavey, 2021; 2023), important uncertainties remain regarding the thermal tolerances of different populations and life history stages. Laboratory studies are required to clarify how thermal thresholds vary across developmental stages and genetics, thereby informing more precise bioenergetic modeling. Additional physiological thresholds should also be quantified and integrated into future analyses to better characterize the species' aquaculture potential.

Expanding this analysis to other regions of the U.S. EEZ would provide a broader perspective on feasibility. Moreover, as ocean conditions continue to shift, evaluating bioenergetic thresholds under forecasted climate and thermal regimes will be essential to assessing the opportunity and longevity of aquaculture potential. Such analyses should also consider the adaptive capacity of both the industry and the species itself when estimating long-term temperature changes. Finally, extending this framework to other candidate species would help identify opportunities for advancing offshore aquaculture in U.S. waters.

Climate Change and Ocean Warming

Projected warming of the northwest Atlantic is expected to alter thermal suitability for striped bass. Offshore sites in North Carolina and Florida already approach the upper tolerance threshold of 30°C during summer months, potentially increasing risks of thermal stress (Friedland et al., 2025). Conversely, northern sites may become more viable under warming scenarios.



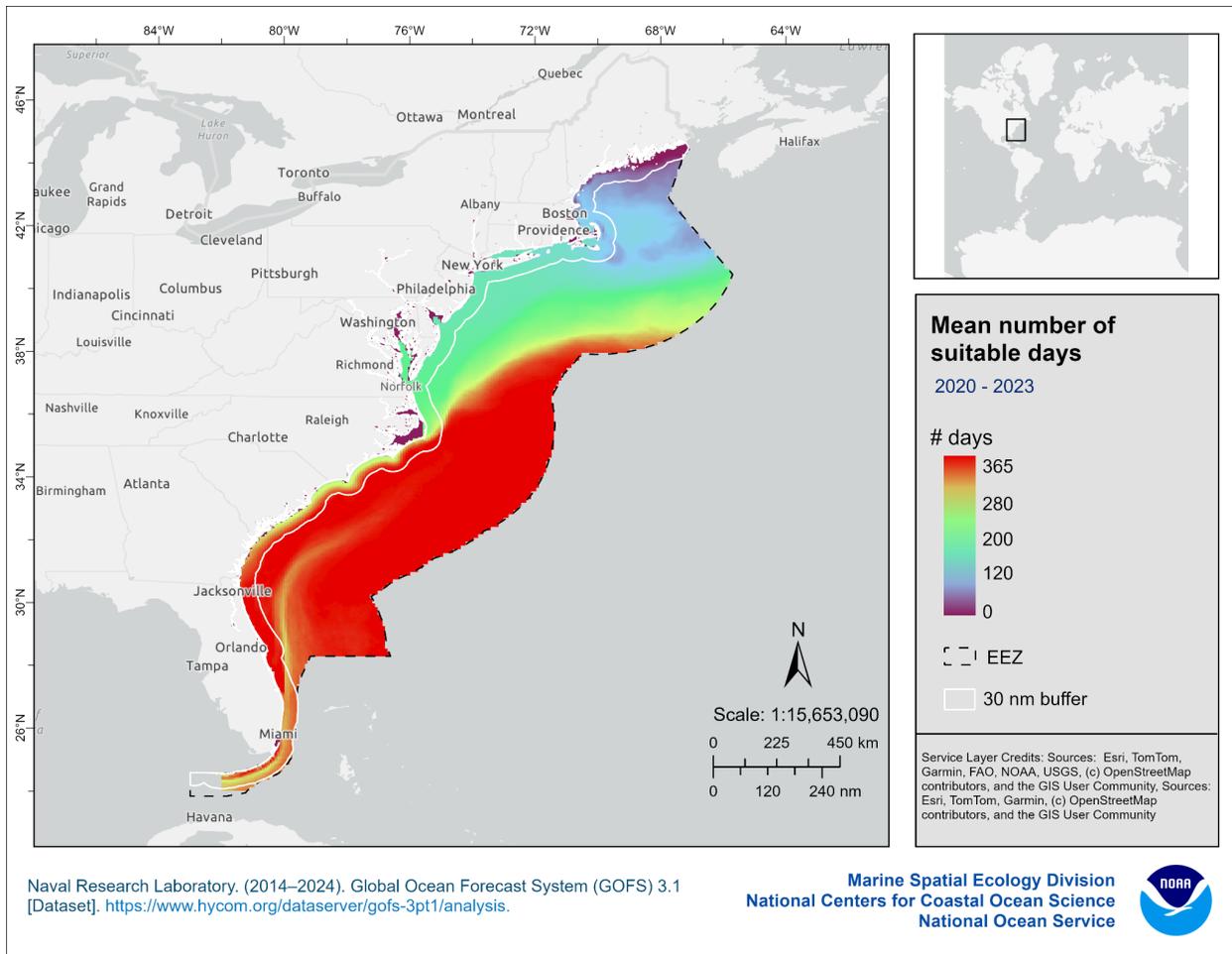


Figure 1. Number of days at suitable temperatures (15–30 °C) for striped bass, *Morone saxatilis*, in 2023. Water temperatures are presented for coastal and offshore waters through the extent of the Atlantic Coast U.S. EEZ (200 nm).

5 Consumer Awareness and Markets

Market conditions strongly favor the development of a domestic pure strain striped bass aquaculture sector (Andersen et al., 2021). Demand for sustainable, locally produced seafood is high, while wild harvests remain limited and imports of striped bass dominate supply. Pure-strain striped bass is well positioned to fill this gap, offering a recognizable and desirable product with strong consumer appeal and broad market potential.

When assessing the economic viability and sustainability of any new aquaculture industry, understanding market conditions, including supply and demand dynamics, is fundamental. These data inform pricing strategies, consumer behavior, and resource planning, while also guiding regulators and legislators on how to maximize economic benefits and minimize conflicts with existing enterprises.

Commercial hybrid striped bass aquaculture has been established in the U.S. since the late 1980s, complementing centuries of commercial capture fisheries. Despite these markets, interest from both producers and buyers is growing for pure-strain striped bass to meet rising demand for white-fleshed marine fish. Recent research and stakeholder engagement have also identified striped bass as a top candidate species for marine aquaculture expansion in the U.S. (Rexroad et al., 2021; Andersen et al., 2021; StriperHub, <https://ncseagrant.ncsu.edu/striperhub/>). These developments underscore the importance of evaluating the species' economic characteristics as commercialization advances.

5.1 Supply

A critical component of any economic analysis is the characterization of current market supply. For domestic aquaculture, evaluating the supply of wild-caught and imported alternatives provides insight into existing demand for a species and reveals trends in market strength over time. A comprehensive supply analysis for striped bass and other marine finfish species was previously conducted by Engle, van Senten, and Schwarz (2023); a similar methodology will be applied here using updated statistics to reflect current market conditions. This analysis will also incorporate the supply of farmed hybrid striped bass, given its relevance and similarity to the striped bass market.

According to the FAO (2025a), the only two regions where pure strain striped bass has been farmed since 1950 are Mexico and the Palestinian Territories. In 2023, Mexico had not reported any production (1,406 metric tons; 2022) and the Palestinian Territories had produced only 4 metric tons (FAO 2025a). Seven countries have produced farmed hybrid striped bass since 1950, however only four (Denmark, Israel, Italy, and the U.S.) reported production in 2024. The U.S. produced nearly 80% of the total supply of farmed hybrid striped bass in 2023 reaching 2,404 metric tons (FAO 2025a). Although the 2023 USDA Census of Aquaculture did not individually report statistics on food fish striped bass farms, 51 operations were identified as producing pure striped bass for “conservation, recreation, enhancement, or restoration purposes” in 2023 (USDA-NASS 2024).

Several states along the Atlantic coast allow for variable scales of commercial striped bass harvest, including Massachusetts, Rhode Island, New York, Delaware, Maryland, Virginia, and North Carolina. Commercial landings of striped bass reached 1,788 metric tons in 2023 while recreational landings were more than six times that (10,961 metric tons) in the same period (NOAA 2025b). While commercial landings remained relatively

flat from the prior year, recreational landings fell by 33% in 2023 compared to 2022 (NOAA 2025b). Overall, the current supply of striped bass products in the U.S. is limited, fragmented, and unable to keep pace with demand. Wild harvests are strictly regulated and hybrid aquaculture production, though established, has not scaled to meet broader seafood market needs. These constraints on supply highlight the opportunity for pure-strain striped bass aquaculture to expand domestic availability. With this supply gap established, the following section considers consumer demand and market drivers that make striped bass a compelling candidate for offshore aquaculture development.

5.2 Demand

The U.S. per capita consumption of seafood has remained relatively stable for the last 20 years, reaching 22.1 kg of consumption in 2022 similar to other “high-income countries” (FAO 2024). However, demand for imported seafood in the U.S. still remains the highest in the world, purchasing \$26.6 billion in 2024 which was \$4 billion more than the next country, China (FAO 2025b). In fact, 70-90% of the total seafood that is consumed in the U.S. is imported, with more than half of that volume coming from farmed sources (NMFS 2024). In recent years, the American consumer has shown an affinity for farmed products and is willing to pay more for locally produced seafood (Fonner & Sylvia 2015; Brayden et al., 2018; Quagraine 2019; Bouchard et al., 2021; Asche et al., 2022; Athnos et al., 2023). A domestic farmed striped bass industry has the potential to tap into these markets and take advantage of these US demand characteristics.

The primary market for striped bass extends across much of the U.S. eastern seaboard and Gulf States, where the species is well recognized and valued due to its long-standing fisheries. Additional, though smaller, markets exist in inland states. Wild-caught striped bass are harvested commercially under strict state-specific seasonal quotas and size limits and are typically landed at larger sizes (greater than 8–10 lbs.), making them well suited for fillet markets and high-end restaurants. In contrast, hybrid striped bass supply a different niche, commonly marketed at smaller sizes (1.5–2.0 lb.) and sold whole or live, particularly to urban ethnic markets. Farmed striped bass could enter channels similar to those of wild-caught fish while offering the advantage of year-round availability. As a highly recognizable product with versatile applications (e.g., whole fish, fillets, sushi), farmed striped bass would be positioned to complement, rather than replace, existing market segments.

Consumer preferences for several aquaculture species highlighted in the southeastern U.S. have been evaluated to better understand consumption habits (Agyeman et al. 2025; Rexroad et al. 2021). Respondents who rated the “source” of their striped bass as an important attribute, consumed it seasonally, and preferred to purchase it in restaurants or grocery stores were more likely to express strong demand (Agyeman et al. 2025). These findings suggest that future producers could successfully market striped bass through restaurants and grocery stores to seasonal consumers already familiar with the product.

Interestingly, price was not a statistically significant factor influencing the likelihood of purchase (Agyeman et al. 2025). Further work on consumer perceptions specific to striped bass is currently being conducted by StriperHub.

The extent to which farmed striped bass will substitute for imported or wild-caught striped bass in domestic markets remains uncertain and will require further study once production facilities are established. Market impacts will depend on factors such as relative price and availability of alternatives, product quality, production volumes, and the specific market channels targeted. Importantly, the introduction of a farmed product could also stimulate overall demand by increasing consumer exposure to striped bass in different seasons and product forms not traditionally available.

5.3 Harvest, Transport, and Processing

Hybrid striped bass are typically harvested at a size of 1.5-2.5 lbs., which is attained after 16-20 months of growout depending on the culture practices and environmental conditions. Fish are harvested using seines, lift nets, or pumping systems, and are either immediately placed in ice slurries to maintain product quality or live-hauled to urban ethnic markets which often provide the highest prices. Regardless of the sales channel, hybrid striped bass are sold almost exclusively as whole fish, with limited processing into fillets or other value-added products. At typical harvest sizes, hybrid striped bass yield only 30–35% fillet recovery, which is comparatively low and provides little incentive for processors to pursue fillet production.

Pure striped bass are produced in much smaller volumes, largely for regional markets. In the U.S., their proposed market size is 3–7 lbs., which can be attained in 24–36 months under favorable culture conditions. Unlike hybrids, pure striped bass are envisioned for harvest and processing into fillets and other value-added products, following a model more typical of marine finfish such as salmon. At these larger harvest sizes (≥ 3 lbs.), striped bass can achieve fillet yields closer to 40%, producing thicker cuts that resemble their wild-caught counterparts, a characteristic that enhances consumer familiarity and market appeal.

Efficient harvest and processing logistics are critical to resource use in offshore striped bass aquaculture. Variables such as harvest frequency, size uniformity, and stocking density directly influence costs and product quality (Engle et al., 2024). Uniform fish size simplifies grading and increases processing efficiency, though variability at scale can complicate operations. Optimizing stocking densities and harvest timing improves yields and reduces waste (Andersen et al., 2021).

Cold-chain management is important for striped bass, a high-value product requiring rapid chilling and continuous refrigeration to maintain freshness. Offshore distance complicates logistics, often necessitating insulated containers or onboard chilling systems (Srikanth et al., 2018). Efficient harvest and processing capacity will be critical for maintaining product quality, securing consistent supply, and enabling striped bass to penetrate broader domestic seafood markets.

5.4 Production Costs and Economic Contribution

Although no published studies have directly measured the cost of production for striped bass aquaculture in the U.S., several analyses have drawn on data from related species and production systems. Engle et al. (2024) estimated production costs for striped bass under three scenarios in the southern U.S.: coastal ponds modeled after red drum farms, offshore net pens modeled after greater amberjack (*Seriola dumerili*) and salmon farms, and recirculating aquaculture systems (RAS) modeled after salmon and rainbow trout facilities. Capital investments, production costs, and equipment requirements were adapted from these established industries, while biological performance assumptions for striped bass were derived from scientific literature and expert consultation. The analysis indicated that striped bass aquaculture was only profitable in offshore net pens, with breakeven prices comparable to those of commercially farmed red drum. Breakeven yields were similar to those of black drum, but higher than those required for species such as spotted seatrout and Florida pompano. Additional commercial research is needed to refine these estimates, and profitability in pond or RAS culture may be achievable with further technological and management improvements.

Economic contribution analyses provide broader insight into the linkages between aquaculture and other sectors of local, state, and national economies. A recent study by Kumar et al. (2024) found that U.S. aquaculture contributed \$3.8 billion to the national economy and supported more than 22,000 jobs. Foodfish farms exhibited an economic multiplier of 1.79, while marine aquaculture had a multiplier of 1.78, meaning that each dollar spent generated an additional \$0.79 and \$0.78, respectively, in related economic activity. The development of a robust striped bass aquaculture industry has the potential to generate similar spillover benefits, particularly for coastal communities. Such growth could stimulate investment in marine infrastructure and logistics networks, creating shared benefits across multiple industries.

5.5 Conclusion

While the true economic and marketing characteristics of striped bass aquaculture cannot be fully assessed until a commercial industry is established in the U.S., potential can be estimated from current science, existing literature, and comparable industry sectors. Hybrid striped bass has been cultured successfully at commercial scale since the 1980s.

There is momentum and a growing shift toward pure-strain striped bass culture, with several farms in North Carolina, Florida, and Texas already pursuing this transition. In contrast, the supply of wild striped bass in the U.S. remains limited relative to other fisheries, and the long-term sustainability of both commercial and recreational harvest is increasingly uncertain.

Demand for seafood in the U.S. remains strong with the majority of products being imported. While commercial-scale striped bass aquaculture is still in the early stages, economic indicators suggest the species has viable market potential, particularly in the context of growing consumer demand for domestic, sustainably produced seafood. Demand-side conditions are favorable, yet production cost challenges and regulatory inconsistencies—especially in states with gamefish designations—must be addressed. Interstate transport and sale of pure-strain farmed striped bass could present barriers for market development that will require synergies between state and federal regulations to avoid enforcement challenges and ensure transparency.

6 Striped Bass Aquaculture History

The history of striped bass aquaculture has been detailed extensively in the literature, with Andersen et al. (2021) offering the most current account. The culture of striped bass was first described in the late nineteenth century by managers with an interest in stock enhancement to improve production of fish for enhancing commercial and recreational fisheries for tributaries of Albemarle Sound, Chesapeake Bay, Delaware Bay, and New York Bay (Worth 1884a; Bowers 1900). The first published report of a successful hatch of striped bass eggs under artificial conditions was made in 1874 by Spencer Baird, the first commissioner of the U.S. Commission of Fish and Fisheries (Baird, 1874). In 1879, the U.S. Fish and Wildlife Service (USFWS) hatched striped bass fry at a site located along the Albemarle Sound in North Carolina that had been used as an American shad (*Alosa sapidissima*) hatchery (USFWS, 1882). The U.S. Fish Commission established the first dedicated hatchery for the propagation of striped bass in Weldon, NC (Worth 1884b). The Edenton National Fish Hatchery was then established in North Carolina in 1898 by the USFWS with a similar purpose to Weldon (Woodroffe, 2012).

In the early twentieth century, the USFWS published technical manuals detailing procedures for spawning, hatching, and fry release of various cultured fishes, including striped bass (Piper, 1982). By 1910, the foundational methods for striped bass propagation were already established; however, the U.S. Bureau of Fisheries, formerly U.S. Fish Commission, abandoned plans for marine stock enhancement (Worth, 1910). Interest in hatchery-based programs was revived in the 1950s, following the discovery of a naturally reproducing striped bass population in the Santee-Cooper Reservoir system of South Carolina (Scruggs Jr., 1957). This development stimulated a large-scale augmentation program aimed at creating self-sustaining populations in freshwater rivers

and reservoirs across the southeastern U.S., including Kentucky, Alabama, Georgia, and South Carolina (Geiger & Parker, 1985; Kinman, 1988; Stevens, 1975). By the 1980s, striped bass had been successfully stocked into hundreds of reservoirs across at least 36 states (Stevens, 1984; Kinman, 1988). Despite much success advancing culture and stocking practices, striped bass remained a challenging species.

A range of biological and operational constraints historically limited the development of striped bass culture. Key challenges included: (1) high sensitivity to handling and confinement stress; (2) inconsistent spawning success and unreliable hatchery production; (3) cannibalism during larval and juvenile stages, particularly under high stocking densities; (4) susceptibility to bacterial, parasitic, and viral diseases; and (5) elevated mortality during harvest, grading, and transport. Collectively, these constraints hindered large-scale adoption of striped bass aquaculture and shifted industry emphasis toward the culture of hybrid striped bass, which demonstrate improved tolerance to handling and environmental variability, more consistent performance on formulated feeds, and greater overall resilience to health management challenges. While history shows technical challenges, the hybrid industry demonstrates scalable solutions that inform pure-strain development.

6.1 Striped Bass Aquaculture: Lessons from the Hybrid Industry and Pathways for Expansion

Beginning in the 1960s, hybrid crosses between striped bass and other Moronids were produced because preliminary findings indicated that hybrids exhibited greater tolerance to extremes in temperature and dissolved oxygen than either parental species so were better suited in many aquaculture systems (Logan 1968). The most common cross made was between striped bass males and white bass (*M. chrysops*) females (i.e., sunshine bass) because many producers found that spawning smaller white bass females required less expertise than spawning striped bass females (Smith 1988). It was not until emergency fishing moratoriums were imposed (Maryland 1985–90; Virginia 1989–90) following the collapse of the striped bass fishery in the 1980s that the path for commercial hybrid striped bass aquaculture as a means of supplying a valuable seafood product emerged (Hodson & Hayes, 1990).

Today, the hybrid striped bass industry is fourth in value among finfish species in the U.S., behind only channel catfish, Atlantic salmon, and rainbow trout. Hybrid striped bass are currently cultured in about 19 different states, particularly in the South and Midwest, in constructed, inland freshwater ponds. The fish are usually grown for about 16 months, and are marketed whole at approximately 680 g (1.5 lbs.; D'Abramo et al., 2002). In coastal states, consumers are accustomed to, and often prefer, pure-strain wild striped bass harvested from marine environments. Pure strain striped bass, rather than hybrids, are also highly preferred in lucrative ethnic markets, seafood restaurants and sushi bars,

and unlike hybrids, these pure strain striped bass can be grown in “open” systems (e.g., coastal areas) with reduced risk of genetic contamination of wild stocks. Marine striped bass culture was even initiated to meet this demand, and for these purposes, fish are generally grown to larger sizes (2.2 kg) for whole, gutted, or filleted market forms.

Although hybrids have successfully established their niche in the US aquaculture landscape, they have struggled to penetrate mainstream markets where pure striped bass have an advantage. Nonetheless, they offer a close industry comparable in terms of production planning discussions and have helped lay the foundational research for pure striped bass aquaculture. The remaining sections of this chapter will provide an overview of the current understanding of production planning and intensive culture systems for striped bass by drawing upon strategies from the closely related and established U.S. hybrid industry.

6.2 Hatchery and Nursery Systems

Hatcheries typically maintain broodstock, which are induced to spawn using temperature and photoperiod manipulation, behavioral cues, and hormone induction when necessary (Hodson and Sullivan 1993; Clark et al., 2005; Andersen et al., 2021). Once spawned, fertilized eggs are incubated in McDonald-type hatching jars or tanks until they hatch, usually within 2-3 days at water temperatures of 18-22°C. After hatching, the larvae are either transferred directly into fertilized ponds or maintained in indoor nursery tanks where they are fed a diet of live zooplankton such as rotifers and brine shrimp nauplii (i.e., *Artemia*). As the larvae grow, they are weaned onto commercially prepared diets.

Once juvenile striped bass reach a size of approximately 1–2 g, they are typically transferred to outdoor nursery ponds or larger tanks for further grow-out. Earthen ponds, ranging from 0.1 to 1.0 ha, are fertilized to enhance natural productivity and supplemented with commercial feeds. Juveniles are commonly stocked at densities of 50,000–100,000 fish per hectare and grown to 10–50 g over a period of 3–4 months.

Indoor RAS systems represent an alternative nursery method, particularly in regions where temperatures are unsuitable for pond culture (e.g., colder latitudes). RAS facilities produce juveniles for transfer to larger land-based farms. Outdoor ponds and climate-controlled RAS present viable opportunities to produce large numbers of fingerlings required for offshore aquaculture operations. A parallel model exists in the Atlantic salmon industry in Norway, where smolt are reared in freshwater hatcheries and nursery systems before transfer to coastal and offshore marine cages. Over the past decade, conventional flow-through hatcheries have increasingly been replaced by RAS, which offer advantages in water use efficiency, environmental control, and siting flexibility (Brown et al., 2025).

6.3 Transport and Stocking

When juvenile striped bass reach the target size, they are harvested from nursery systems and transferred to grow-out facilities. Harvesting is commonly conducted using seines or by draining ponds, after which fish are loaded into transport tanks equipped with aeration or oxygenation systems to maintain water quality during transit. Upon arrival, fish are acclimated to the receiving water before being stocked into production units.

Stocking densities in grow-out systems vary with production intensity and facility design, typically ranging from 10 to 50 kg/m³. In pond or net-pen systems, densities are generally maintained at the lower end of this range due to limited environmental control, whereas RAS can support higher densities under carefully managed conditions with systems for management of water quality, dissolved gases, and disinfection. In these open-water and pond environments, densities are also moderated by the larger volume of production systems and the space afforded allowing individuals to swim more freely.

6.4 Growout Systems

Although most U.S. production of hybrid and pure striped bass occurs in ponds, tanks, and raceways, there is increasing interest in offshore culture systems to meet growing demand for marine foodfish. Offshore aquaculture involves rearing fish in marine cages or net pens located in coastal or offshore waters. These systems offer potential advantages over land-based production, including reduced land use, lower energy requirements, and in some cases, improved economic feasibility. At the same time, offshore operations face unique challenges such as exposure to severe weather, predation, and logistical constraints associated with remote locations.

Net pens used for culture are commonly constructed of high-density polyethylene (HDPE) or steel and range in volume from 100 to 1,000 m³. Stocking densities typically range from 10 to 25 kg/m³, with fish fed commercial diets through automated feeding systems. Offshore environments are generally characterized by high water exchange, stable temperatures, and elevated dissolved oxygen, conditions that support favorable growth. However, the open nature of these systems increases risks of escapement and disease transmission to wild stocks compared with land-based facilities.

Land-based indoor systems (i.e., RAS technology) provide an alternative grow-out strategy, offering controlled culture conditions, robust biosecurity and disease management, flexible siting to enhance market access, and reduced risks to marine ecosystems (Brown et al., 2025). Despite these advantages, widespread adoption of RAS for striped bass and other marine finfish has been limited by high capital and operating costs and the challenges of maintaining stable production. Continued research is needed

to address economic feasibility, product quality, feed formulation, and control of early maturation in culture systems.

7 Offshore Aquaculture Technology

Technological innovation has made it increasingly feasible to culture marine finfish in coastal and open-ocean environments, including the U.S. EEZ. Offshore aquaculture is generally defined as taking place in open ocean waters, in highly exposed environments subject to strong currents, waves, and storm events, requiring more robust and complex infrastructure than inshore or nearshore systems (Price & Morris, 2013; Drumm, 2010; Kapetsky et al., 2013). While offshore aquaculture represents only a small fraction of U.S. production today, demonstration projects and deployments in deep water have demonstrated that innovation in gear, materials, and monitoring systems can unlock substantial potential for growth (Froehlich et al., 2017; Buck et al., 2025). This sector currently consists of an offshore fish farm in Hawaii state waters and a small number of open ocean shellfish and seaweed farms around the nation.

7.1 NOAA's Role in Offshore Aquaculture Development

As one of the federal agencies responsible for stewardship of the nation's marine resources, NOAA is fostering the growth of a robust domestic aquaculture industry while ensuring that offshore development remains consistent with its environmental stewardship mandates. These efforts include developing tools to evaluate the ecological benefits and risks of marine aquaculture, implementing science-based regulations to safeguard ecosystems, and advancing production designs and operational practices that are compatible with sustainable fisheries and ocean use (Nicolls et al., 2020; NOAA OCM, 2023; BEA, 2021). Multi-agency work groups are also developing regionally tailored permitting frameworks to improve the efficiency and transparency of decision-making while maintaining compliance with environmental law. In support of these initiatives, Feldman et al. (2025) published a *Technical Guide to Marine Aquaculture Gear*, providing detailed guidance on cage and net-pen systems, mooring and anchoring technologies, and other essential components required for offshore aquaculture. These roles ensure that technological innovation is paired with regulatory oversight to support sustainable striped bass farming.

7.2 Marine Cages and Net-Pen Systems

Marine cage and net-pen aquaculture require large, durable enclosures designed to withstand offshore wave energy and the strong swimming behavior of cultured species. Striped bass, in particular, require high water flow for oxygenation, ample space to support growth, and robust containment systems to prevent escapes or structural

damage. Successful offshore operations also depend on high-quality formulated feeds, continuous monitoring of fish health, and strict biosecurity measures to minimize the risk of disease. Site selection is critical to avoid harmful algal blooms, ensure dispersal of organic waste, and maintain thermal regimes within the species' tolerance limits.

For striped bass, offshore production would likely use large-volume submersible or semi-submersible cages engineered for high-energy environments. Submersible cages can be lowered below the wave zone during storm events, while semi-submersible pens and large circular HDPE cages provide surface stability with reduced wave exposure (Langan & Horton, 2003; Price et al., 2017). Cage volumes on the scale of tens of thousands of cubic meters afford fish the ability to swim freely, which not only supports welfare but also reduces effective stocking densities allowing for optimal growth and production of striped bass.

7.3 Nets and Predator Exclusion

Net design is central to containment and welfare. Offshore nets are typically constructed from abrasion-resistant, high-strength materials such as knotless nylon or high-density polyethylene (HDPE), designed to withstand constant pressure from fish and environmental forces. Mesh sizes are selected to retain the smallest stocked fish while minimizing drag and maximizing water exchange. Predator exclusion is achieved through reinforced predator nets or double-net systems that deter sharks, seals, and other large marine animals. These barriers are tensioned with spacers or standoff frames to prevent collapse into stock nets, reducing the risk of escapes or entanglement. Overhead bird nets or canopy structures are commonly installed to prevent depredation by seabirds, reducing stock stress and feed loss. Routine inspection and net cleaning are essential to maintain mesh integrity, prevent fouling that diminishes water exchange, and ensure both containment and predator deterrence. Increasingly, copper-alloy mesh is being adopted despite its higher cost, as it provides superior resistance to biofouling, reduces the frequency of net cleaning, and offers enhanced durability and predator protection relative to traditional synthetic materials.

7.4 Innovation and Future Directions

Technological advances are rapidly enhancing the sustainability and profitability of offshore aquaculture. Innovations include co-location with existing offshore infrastructure, autonomous feeding barges, ship-based aquaculture, real-time environmental monitoring platforms, and novel antifouling materials. In the U.S., there is competition for nearshore space and expansion into federal waters provides opportunities for larger sites with fewer user conflicts and greater social acceptance among commercial and recreational fishing communities (Kapetsky et al., 2013; Buck et al., 2025). With one of the largest EEZs in the world, the U.S. has significant potential to expand striped bass production offshore,

provided that engineering, logistical, and environmental stewardship challenges are addressed through continued research, innovation, and regulatory collaboration.

8 Environmental and Ecosystems

Evidence from modern offshore systems shows that environmental impacts of net pen aquaculture can be limited and manageable when best practices are applied (Price & Morris, 2013). Strong currents, deeper waters, and advanced feeds reduce risks of nutrient buildup and habitat degradation, and with appropriate siting and monitoring, offshore striped bass farming can align with ecological sustainability goals while avoiding significant long-term ecosystem harm.

Despite these opportunities, public perception and regulatory concern remain among the largest barriers to starting new offshore aquaculture ventures in the U.S., particularly given the large ocean areas that could support development and the potential number of farms. The environmental effects of marine aquaculture vary widely depending on species selection, production methods, siting, and scale of operations (Belle & Nash, 2008; Price & Morris, 2013). Modern production technologies, standardized operating procedures, and best management practices (BMPs) reduce risks to water quality, benthic habitats, and marine life. Offshore farming, in particular, provides opportunities to minimize impacts due to deeper waters, stronger currents, and greater dilution potential compared to nearshore settings (Buck et al., 2025). At the same time, offshore development requires careful evaluation of ecological interactions, cumulative effects, and regulatory safeguards to ensure sustainable growth.

In the context of striped bass aquaculture, potential environmental effects can be grouped into several categories: (1) water quality, (2) benthic and sedimentary processes, (3) interactions with marine life and habitats, (4) cumulative and landscape-scale effects, and (5) mitigation strategies, including novel approaches such as integrated multi-trophic aquaculture (IMTA). This section synthesizes current knowledge, with a focus on offshore relevance, and highlights management and monitoring frameworks that can safeguard essential fish habitats (EFH) while supporting the expansion of a domestic striped bass aquaculture industry.

8.1 Water Quality and Nutrient Enrichment

Discharges such as solid wastes, nutrients, ammonia, fish waste, feed waste, pharmaceuticals, and chemicals from aquaculture operations are primarily governed by the implementing regulations of the Clean Water Act (CWA) Sections 402 and 403 (EPA, 2021). Section 402 requires that a National Pollution Discharge Elimination System (NPDES) permit for discharge into federal waters be issued in compliance with the U.S. Environmental Protection Agency's (EPA) ocean discharge criteria under Section 403,

which aim to prevent unreasonable degradation of receiving waters (NOAA, 2022; EPA, 2025). In preparation of an NPDES permit, EPA generally applies water quality models to characterize interactions between effluent and the receiving environment. These models can address effluent dispersion within the water column and particulate deposition in near- and far-field zones, thereby informing monitoring plans to ensure environmental compliance and performance (Cromey et al., 2002; Stucchi et al., 2005).

Three-dimensional (3D) modeling tools have been developed to refine these assessments by predicting the transport and fate of aquaculture-derived wastes under site-specific conditions. By incorporating hydrodynamics, bathymetry, stocking densities, and feed inputs, these models simulate the dispersion of dissolved nutrients and the deposition of solid wastes, enabling forecasts of benthic organic enrichment, nutrient concentrations, and dissolved oxygen dynamics (Cromey et al., 2002; OSPAR, 2005; Newell & Richardson, 2014). Their predictive capability provides a science-based framework to evaluate farm-scale and cumulative impacts, guide siting decisions, establish thresholds for sustainable production, and reduce ecological risks. When integrated into regulatory processes, such modeling approaches strengthen the environmental safeguards of aquaculture permitting while supporting industry growth in a precautionary and adaptive management framework.

Organic Loading

The primary water quality concerns from finfish cage culture are nutrient enrichment (nitrogen and phosphorus), suspended particulates, lipids, and fluctuations in dissolved oxygen (Belle & Nash, 2008; Holmer, 2010). Waste from feed and fish excretion contributes organic matter and nutrients to surrounding waters. In offshore environments, strong currents and high flushing rates typically enhance dispersal, reducing localized benthic accumulation compared to nearshore systems (Chamberlain & Stucchi, 2007). Nonetheless, large-scale striped bass production could elevate nitrogen and phosphorus inputs, particularly if stocking densities are not matched with site-specific hydrodynamics.

Studies across the U.S. and Europe indicate that when farms are sited in deep, well-circulated waters, measurable nutrient effects are typically limited to within 30 m of cages, and persistent long-term impacts are rare (Price & Morris, 2013). Improvements in feed formulation, feeding efficiency, and digestibility have also substantially reduced nutrient loading compared to historical operations (Naylor et al., 2009). Nutrient spikes and transient oxygen declines may occur during feeding events but generally recover quickly in offshore sites with strong flushing (Troell et al., 2009).

In contrast, farms located in shallow or semi-enclosed nearshore systems are at higher risk of causing localized eutrophication. Here, aquaculture impacts may be difficult to distinguish from terrestrial nutrient inputs or municipal discharges (Shumway, 2011). For striped bass offshore culture, siting in high-energy environments such as off the

continental shelf of North Carolina or Florida may reduce these risks. Maintaining high water exchange rates and adopting BMPs such as optimized feeding regimes, precision monitoring of feed delivery, and selection of formulated diets are critical for protecting water quality.

Dissolved Oxygen Dynamics

Respiration of fish and decomposition of organic waste can reduce dissolved oxygen (DO) levels, potentially affecting both cultured stocks and wild organisms. Offshore siting criteria, particularly depth (>50 m) and current speed (>5 cm s⁻¹), help mitigate these risks by ensuring sufficient oxygen replenishment. Seasonal stratification along the Atlantic coast, particularly in the mid- and south-Atlantic Bight, may constrain vertical mixing and should be carefully considered in site selection and hydrodynamic models (Friedland et al., 2025).

Hydrodynamics and Waste Dispersal

Modeling current velocities, flushing rates, and vertical mixing is central to evaluating carrying capacity. Offshore aquaculture has an advantage of greater dispersion compared to coastal farms, but cumulative impacts across multiple farms could overwhelm assimilative capacity if not spatially managed. Advanced models such as coupled hydrodynamic-biogeochemical frameworks (e.g., FVCOM, HYCOM, ROMS) can predict dispersal of nutrients and organic matter.

8.2 Benthic Habitats

Sedimentation Impacts

Deposition of waste feed and fecal matter can alter benthic community structure beneath cages. In coastal salmon farms, shifts toward opportunistic polychaetes and hypoxia-sensitive taxa have been observed (Hargrave, 2010). The extent of benthic impact offshore is expected to be more diffuse due to deeper water and higher energy conditions, though localized organic enrichment remains possible. For example, at well-managed offshore farms, these effects are typically confined to within 100 m of cages and benthic recovery between harvest and re-stocking is often rapid (Keeley et al., 2014). Anaerobic conditions may develop under heavily impacted sites, particularly in depositional environments with limited flushing or soft sediments (Kutti et al., 2007). To minimize risk, site selection should prioritize erosional seafloors, adequate depth, and high current velocity to disperse organic matter (Belle & Nash, 2008).

Emerging monitoring tools, including stable isotope tracers, acoustic imaging, and automated image analysis, provide cost-effective methods for assessing benthic impacts and far-field dispersal (Callier et al., 2018). Regulatory protocols often require sediment

monitoring of indicator parameters such as redox potential, total organic carbon, and sulfide concentrations. Adaptive management frameworks, wherein farm management practices are modified in response to monitoring outcomes, represent a best practice for ensuring benthic protection.

Essential Fish Habitat

Offshore aquaculture operations may occur within or adjacent to designated Essential Fish Habitat (EFH). To the extent practicable, siting should minimize interactions with sensitive benthic features, including deep-water corals and hard-bottom reef systems. Along the Atlantic coast, these habitats are frequently associated with shelf breaks and submarine canyon systems (NOAA, 2021). Early consultation with relevant management agencies, combined with baseline environmental surveys, can inform site selection and help reduce the risk of habitat disturbance or degradation.

In the South Atlantic region, proposed offshore aquaculture sites may also overlap with habitats that support diadromous fish species, coral reef systems, and estuarine waters that are hydrologically connected to EFH (SAFMC, 2014). Mandatory consultation processes and site-specific environmental review can help identify these sensitivities and guide placement decisions. While poorly sited operations have the potential to affect benthic communities and water quality, locating facilities in deeper, well-flushed offshore waters is generally associated with a lower likelihood of significant environmental impacts.

The NOAA NCCOS has ongoing collaborations with the EPA to provide depositional and water quality modeling products (see Figure 2) and science advice to support agency permitting and associated environmental reviews and consultations for finfish aquaculture projects proposed for U.S. federal waters.



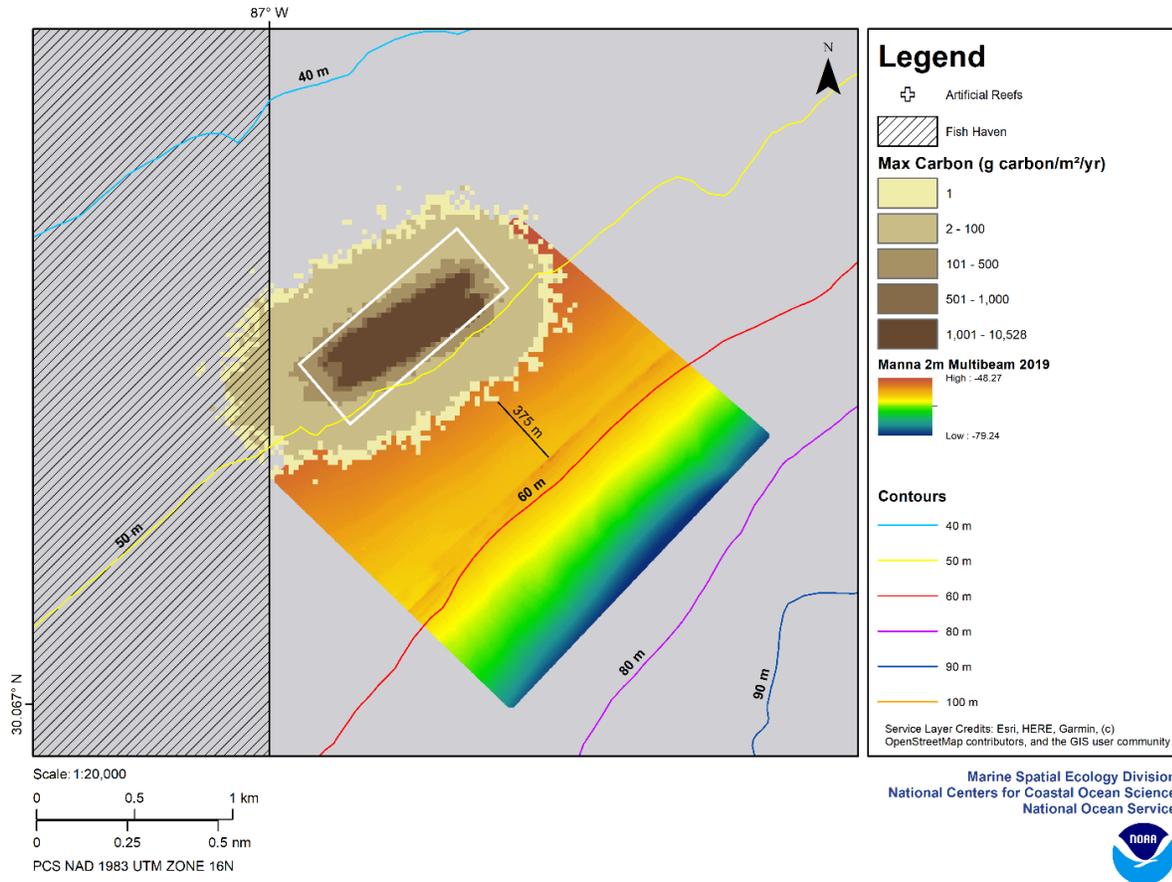


Figure 2. NOAA's National Centers for Coastal Ocean Science applied high-resolution depositional modeling to estimate maximum carbon deposition from a commercial-scale offshore finfish farm in the Gulf of America. Bathymetric data were collected during the baseline environmental survey and are represented at 2-m spatial resolution. The depositional model was run over a five-year period under maximum biomass conditions for an 18-cage configuration. Hydrodynamic forcing was derived from 2018 current fields produced by the Gulf of America HYCOM model. Model results demonstrate the importance of precision siting in identifying locations where solid waste and carbon deposition are sufficiently dispersed, thereby minimizing localized accumulation and supporting environmentally appropriate farm placement.

8.3 Protected Species and Habitat Interactions

The introduction of offshore aquaculture structures into Atlantic waters requires careful evaluation of potential interactions with protected resources, including marine mammals governed by the Marine Mammal Protection Act (MMPA) and species and habitats protected under the Endangered Species Act (ESA) (NOAA Fisheries, 2023a; NOAA

Fisheries, 2023b). Interactions between aquaculture gear and marine mammals, sea turtles, and seabirds remain an active concern but have been well documented both globally and domestically (Price & Morris 2013; NMFS 2015; Price et al. 2016; NMFS 2019; Bath et al. 2023). Recently, the NOAA Technical Guide to Offshore Aquaculture Gear and Protected Species Interactions indicates that entanglement risk is generally low for most offshore cage designs but not negligible, particularly for large whale species and protected turtles (Feldman et al., 2025). Gear modifications such as tensioned mooring lines, weak links, minimized slack, and the use of stiff or coated materials are essential to reduce entanglement hazards. In addition, strategic siting that avoids migratory corridors and ecologically sensitive habitats further lowers the likelihood of interactions.

Adequate risk assessment requires a baseline understanding of offshore aquaculture system design, mooring and net-pen configurations, feed inputs, and operational practices proposed for striped bass culture (Price & Morris, 2013). Potential pathways of interaction include entanglement with nets or mooring lines, attraction of predators such as seals and dolphins to farm sites, displacement or alteration of migratory routes, and changes in prey availability for ESA-listed fish, sea turtles, and marine mammals (Nelson et al., 2021; Read, 2008). The proximity of farms to designated critical habitats requires precautionary siting to avoid overlap (NOAA Fisheries, 2016; NMFS, 2021a; 2021b).

Emerging best management practices and technological innovations provide pathways to further reduce risks. These include predator-resistant and tensioned netting, siting analyses that explicitly exclude sensitive habitats and migratory routes, and adaptive monitoring programs that integrate acoustic, visual, and satellite data (Rust et al., 2014). Taken together, these measures highlight the importance of coupling aquaculture science with regulatory frameworks to ensure that striped bass offshore aquaculture develops in a manner consistent with the long-term protection and recovery goals of the MMPA and ESA.

NOAA's NCCOS is advancing a physics-based 3-D entanglement simulator in collaboration with partners (Bureau of Ocean Energy Management and BelleQuant Engineering) to support risk assessments for marine mammal entanglements with new and existing ocean industries including aquaculture. The simulator combines digital models of large whales and other protected species and underwater structures (moorings, rope, chain, and other structures) to mathematically and physically characterize the interactions between animal and gear. Potential entanglement scenarios, gear re-design can be tested to better understand risk and likelihood of adverse interactions between the gear and animal. This tool supports science-based risk assessments for regulators and industry, helping to inform engineering design, siting decisions, and mitigation strategies, thereby reducing one of the principal environmental concerns associated with offshore aquaculture expansion and facilitating efficient permitting and consultations for commercial-scale farms. By enabling proactive evaluation of entanglement risk and alternative design solutions, the entanglement simulator is intended to lower ecological

impact uncertainty around offshore farm operations, support environmental compliance, and ultimately de-risk farm deployment in federal waters as part of broader marine spatial planning and protected species interaction research.

8.4 Ecosystem-Level Considerations

Food Web Dynamics

Offshore striped bass aquaculture introduces an artificial biomass of piscivores into marine ecosystems. While contained, the farms may act as fish aggregating devices, altering local species distributions. Evidence from salmon and tuna net pens suggests farms attract pelagic species, including forage fish, invertebrates, and predators (Dempster et al., 2002). Such aggregations may increase predation pressure or alter trophic pathways, though they can also enhance foraging opportunities for wild species (Callier et al., 2018).

Harmful Algal Blooms

Naturally occurring harmful algal blooms (HABs) pose a direct risk to striped bass aquaculture through mechanisms including gill irritation and damage, toxin exposure, hypoxia, and acute mortality events. As a result, understanding whether offshore cage culture contributes to HAB dynamics is a critical consideration for siting and management in the EEZ. Synthesis of the global literature indicates that marine net pen aquaculture does not exhibit a consistent or causal relationship with HABs when farms are appropriately sited and managed (Price & Morris, 2013). While dissolved nutrient releases from cage culture can produce localized and transient increases in phytoplankton biomass, particularly within tens to hundreds of meters of net pens, these responses have not been linked to the initiation or persistence of toxic or nuisance algal blooms (Price et al., 2015). In offshore and well-flushed environments characteristic of the EEZ, hydrodynamic dispersion and biological assimilation rapidly dilute dissolved nutrients, rendering aquaculture-derived inputs minor relative to background nutrient variability and watershed-driven sources. Evidence suggests that HAB risk is primarily governed by site-specific factors such as flushing, stratification, and existing nutrient loads rather than cage culture itself. Consequently, precision siting in dispersive offshore waters, combined with modern feed formulations and efficient feeding practices, is expected to minimize eutrophication risk and decouple offshore striped bass aquaculture from HAB dynamics in the EEZ.

9 Escapement Risks and Genetic Considerations for Offshore Striped Bass Aquaculture

Escape events pose real risks for genetic introgression, but decades of selective breeding, coupled with new genomic tools, provide safeguards to manage those risks. Domesticated strains, sterility technologies, and rigorous monitoring can ensure that aquaculture operations do not compromise wild population integrity. When paired with robust containment systems, striped bass aquaculture can proceed without undermining the genetic resilience of wild stocks.

For offshore operations, it is useful to distinguish between chronic, low-level seepage of escapees and rare, high magnitude catastrophic releases, because these pathways differ in detectability, dispersal potential, and the timing of exposure that drives genetic risk. Seepage most often results from small holes, net abrasion, predator related tearing, and routine activities such as handling and lifting, creating a persistent trickle of escapees that can be difficult to detect directly yet still sustain contact with wild conspecifics (Jensen et al., 2010; Holmen et al., 2021). Catastrophic events are more commonly linked to structural failure or mooring failure, collisions, and extreme weather, and they can release large numbers of fish over short periods, overwhelming recapture capacity and increasing the likelihood that mature escapees enter migratory corridors or spawning habitats during sensitive windows (Jackson et al., 2015; Thorvaldsen et al., 2015).

Escape events are among the most widely recognized ecological risks associated with marine finfish aquaculture, with outcomes shaped by species behavior, farm design and durability, siting and hydrodynamic conditions, operational practices, and interactions with predators such as sharks, marine mammals, and seabirds. Ecological consequences have been well documented across freshwater, estuarine, and marine systems, including competition with wild conspecifics, habitat displacement, disease and parasite transmission, and genetic introgression (Naylor et al., 2005; Hutchings & Fraser, 2008). Although domesticated fish often show reduced individual fitness and survival compared to wild stocks (Glover et al., 2017), even limited interbreeding can erode local adaptation, homogenize genetic structure, and reduce the long-term resilience of wild populations (Bourret et al., 2011).

For offshore aquaculture of native striped bass, these risks warrant particular attention. Striped bass are highly mobile and migratory, with populations ranging from the Gulf of St. Lawrence (Canada) to the St. John's River (Florida) (Waldman et al., 2012). Resident populations occur in southern systems such as Albemarle Sound, North Carolina, while northern populations migrate extensively along the Atlantic coast (Boreman & Lewis, 1987; Overton et al., 2008). Escaped individuals could therefore disperse widely, interact with multiple genetically distinct subpopulations, and introduce risks of maladaptation or loss of genetic structure. Given the cultural, recreational, and commercial importance of

striped bass, and their complex genetic composition, safeguarding wild populations is a priority for both fisheries and aquaculture management (ASMFC, 2019).

9.1 Historical Stocking and Genetic Legacy

The striped bass has a long history of hatchery propagation and stock enhancement. Beginning in 1884, striped bass from the Roanoke River were widely distributed for research and restoration purposes (Geddings, 1971). By the mid-20th century, federal and state hatcheries were producing and transporting striped bass throughout the U.S. and abroad. These efforts expanded during the 1970s and 1980s, when more than 20 hatcheries collectively released millions of fish annually to support restoration following severe population declines caused by overfishing, habitat degradation, and recruitment failure (Boreman & Austin, 1985; Rulifson & Laney, 1999). Although stocking programs contributed to recovery, widespread “cross-stocking” introduced non-native genetic material into multiple watersheds, altering natural genetic structure and raising long-term conservation concerns (Waldman et al., 2012). For example, while remnant native Gulf populations persist in the Apalachicola–Chattahoochee–Flint (ACF) river system in Florida, genetic analyses reveal substantial introgression (52%) from Atlantic stocks used in enhancement programs across the Gulf (Wirgin et al., 1997; Wirgin et al., 2010; GSMFC, 2006). The legacy of these programs underscores the importance of preventing further anthropogenic genetic alteration through aquaculture escapes.

9.2 Advances in Genomic Tools

Modern genomic approaches now allow high-resolution monitoring of striped bass population structure. Methods such as RADseq and genome-wide SNP genotyping enable the detection of fine-scale differentiation, even among weakly structured marine populations (Vendrami et al., 2017; Drinan et al., 2018; Jenkins et al., 2019). Analytical advances, including identification of outlier loci, provide insights into adaptive divergence and improve assignment accuracy in mixed-stock analyses (Gagnaire et al., 2015). These tools have been applied to striped bass, where they have clarified stock composition and informed management (LeBlanc et al., 2020; Wojtusik et al., 2023, 2025). Applications extend to monitoring genetic introgression, detecting illegal harvest, and assessing risks associated with aquaculture escapes (Ackerman et al., 2011; Martinsohn & Ogden, 2009).

9.3 Domesticated Strains and Aquaculture Applications

In parallel with restoration programs, a domesticated striped bass broodstock line has been developed through more than 30 years of selective breeding for aquaculture performance. The National Program for Genetic Improvement and Selective Breeding, based at North Carolina State University’s Pamlico Aquaculture Field Laboratory, created

this line from multiple founder strains including the Roanoke River, Chesapeake Bay, Santee-Cooper Reservoir, Florida–Gulf of America, Canadian, and Pacific populations (Harrell et al., 1990; Kenter et al., 2018; 2023). Selection has emphasized growth, stress tolerance, and disease resistance, resulting in a strain phenotypically and genetically divergent from wild populations. This divergence may reduce the likelihood that escapees would survive or reproduce successfully in the wild, potentially lowering ecological risk compared to more recently domesticated or wild-derived stocks. However, if interbreeding occurs, maladaptive traits from the cultured line could still introgress into wild populations, compromising local adaptation and resilience (Ignatz et al., 2024; San Roman et al., 2025).

9.4 Risk Assessment and Mitigation

Effective escape risk management for offshore striped bass aquaculture requires a precautionary, multi-layered approach. Risk assessments incorporated into siting and permitting typically evaluate both the probability of escape and the ecological consequences of farm–wild interactions. Engineering strategies including robust mooring systems, regular inspection of nets and cages, predator deterrence, and contingency planning are critical for preventing escapes (Jackson et al., 2015). Genetic management measures such as broodstock traceability, use of sterile lines, and long-term genomic monitoring of both farmed and wild populations provide complementary safeguards (Glover et al., 2017; Karlsson et al., 2011).

Life-history traits of striped bass further inform risk analysis. For example, escaped males should reach maturity earlier and thus are more likely to contribute to wild spawning than females, which typically require two additional years to mature (Waldman et al., 2012). This suggests a moderate but non-negligible risk of introgression.

9.5 Reproductive Control and Genetic Containment

A practical operational safeguard is mandatory harvest before maturation, implemented through production schedules and, where appropriate, permit conditions that require complete cohort removal before fish are capable of spawning. This approach is widely treated in the aquaculture escape literature as a risk reduction measure because it limits the chance that escapees can contribute to reproduction, including scenarios where spawning can occur in or near net pens, or where mature escapees reach spawning habitats following an escape (Baskett et al., 2013).

One of the most effective strategies to minimize ecological and genetic risks from aquaculture escape events is the use of reproductively sterile fish. By eliminating or reducing the potential for interbreeding with wild populations, reproductive control technologies provide a biological safeguard that complements physical containment

measures. Several approaches are currently available or under development in finfish aquaculture and could be applied to striped bass (Xu et al., 2023).

NOAA has developed the Offshore Mariculture Escape Genetic Assessment (OMEGA) model to evaluate genetic and ecological risks associated with aquaculture escape events. OMEGA simulates the probability of fish escaping from offshore farm systems, their survival and dispersal in the marine environment, and the likelihood of encountering and interacting with wild conspecifics. The model is intended to support risk-based assessments of offshore aquaculture operations and to inform the development of management and engineering strategies that reduce the potential adverse effects of escape events on wild populations (Purcell et al., 2025).

Triploidy

Induction of triploidy, producing fish with three sets of chromosomes, has been successfully applied in numerous aquaculture species, including salmonids, carp, and catfish, to create sterile or functionally sterile individuals (Piferrer et al., 2009; Benfey, 2016). While triploid performance varies by species, triploid striped bass have been produced experimentally and show promise for use in commercial systems (Okomoda et al., 2020). Incorporation of triploid technology into offshore striped bass culture could provide a near-term strategy for genetic containment, though further research is required to ensure consistent induction rates, animal welfare, and commercial performance.

Genetic Knockdown Approaches

Emerging biotechnologies offer more targeted methods of inducing sterility through gene knockdown or knockout of key reproductive pathways (Houston & Macqueen, 2019; Gutasi et al., 2023; Xu et al., 2023). For example, suppression of genes involved in germ cell development or meiosis can yield sterile phenotypes without altering somatic growth. While these methods are not yet commercially applied in striped bass, they are commercially available technologies for other marine fish species and the technology represents a potential long-term avenue for highly reliable reproductive control.

Monosex or Sex-ratio Control

Manipulation of sex ratios, such as producing all-male or all-female populations, can reduce reproductive capacity if only one sex is cultured. For striped bass, male fish reach sexual maturity earlier and could present a higher risk of genetic introgression following escapes, whereas all-female populations may reduce this risk (Waldman et al., 2012). Sex control has been applied in other aquaculture species through hormonal or genetic methods (Beardmore et al., 2001; Luckenbach et al., 2017; Berlinsky et al., 2020), but further research is needed to assess its feasibility in striped bass.

Research and Development

Development of sterility induction methods for striped bass aquaculture remains a critical research need. While the domesticated broodstock line developed at North Carolina State University provides a stable genetic foundation for offshore farming, it has not yet been systematically adapted for sterility. Developing robust and commercially viable sterility methods, whether through triploidy, gene knockdown, or sex-ratio control, would likely require 4–5 years of focused research to optimize protocols compatible with domesticated strains and evaluate fish performance in a commercial setting. Investment in this research would provide regulators and producers with a powerful tool to minimize ecological risk and ensure the sustainability of offshore striped bass aquaculture.

10 Aquatic Animal Health Considerations for Offshore Aquaculture

Disease is a primary operational risk for striped bass aquaculture and a recurring constraint on economic performance. Offshore net pens can support healthy production, but only when farms prevent pathogen introduction, detect problems early, and respond quickly under a regulated framework (Rhodes et al., 2023).

Open water pens continuously exchange water with surrounding ecosystems. That exchange improves flushing, but it also allows microbes and parasites to move between cultured fish and wild fish. Stocking densities needed for commercial production can amplify outbreaks and increase losses if farms do not maintain strong health controls (Rhodes et al., 2023).

Offshore striped bass aquaculture can maintain high animal health standards when farms treat disease as an operational risk that must be managed continuously. The priority is prevention, early detection, and targeted response. Site selection, biosecurity, surveillance, and compliance with therapeutic regulations together reduce disease incidence and limit potential effects on nearby wild fish populations (Rhodes et al., 2023).

10.1 Main pathways for disease and parasite pressure

Several conditions elevate risk in offshore culture, and each point to a specific management response.

1. **Proximity to wild fish**

Pens located near migratory or resident striped bass can support two-way

movement of pathogens, which raises concerns for both farmed and wild fish (Rhodes et al., 2023).

2. High connectivity through water exchange

Pathogens and parasites can disperse beyond farm boundaries, so surveillance and response planning must account for the broader site area, not only the cage footprint (Rhodes et al., 2023).

3. Stress and suppressed immune function

Handling, fluctuating environmental conditions, and periods of suboptimal water quality can increase susceptibility to infection (Virginia Cooperative Extension, 2023).

4. Biofouling and infrastructure condition

Fouling can reduce water circulation and degrade local water quality inside and around cages. Farms can reduce this risk through routine cleaning and appropriate materials, including copper alloy mesh where feasible (Rhodes et al., 2023).

Once aquatic pathogens establish in natural systems, eradication becomes difficult. Experience and modeling show that farms can increase pathogen abundance in surrounding waters if controls fail, which can affect farm productivity and nearby wild populations (Rhodes et al., 2023).

10.2 Striped bass pathogens and treatment considerations

Striped bass culture faces a recognizable set of bacterial and parasitic hazards, with risk shaped by environment, husbandry, and baseline pathogen presence.

In the Chesapeake Bay, mycobacteriosis caused by *Mycobacterium shottsii* and *M. pseudoshottsii* is endemic among juvenile wild striped bass, particularly in nutrient enriched estuaries. Mycobacteria also occur in cultured striped bass and hybrid striped bass, most often in recirculating systems, broodstock settings, or facilities experiencing chronic stress and poor water quality. Relative to other bacterial diseases, mycobacteriosis is not typically a leading driver of commercial losses. Columnaris disease, caused by *Flavobacterium covae*, remains a concern for net pen production. Additional pathogens and parasites documented for striped bass include the following (Paperna and Zwerner, 1976; Rhodes et al., 2023; MD DNR, 2024).

- *Ichthyophthirius multifiliis*, a protozoan that causes ich, or white spot disease, in freshwater fish (Rhodes et al., 2023).

- *Edwardsiella tarda*, which can cause systemic infection and mortality (Lee Herman and Bullock, 1986).
- *Streptococcus iniae*, documented in hybrid striped bass with systemic impacts (Evans et al., 2006).

Parasites can cause meaningful health impacts when infestation intensity is high, increasing stress and weakening fish condition (Rhodes et al., 2023).

10.3 Prevention focused management

For striped bass aquaculture, prevention carries the most weight. Farms typically rely on vaccination where available, strict biosecurity, careful water quality management, and structured health monitoring to detect emerging problems before mortalities escalate (Evans et al., 2006).

Several actions consistently support better health outcomes:

Area of Focus	Key Practice/Goal
Optimal Water Quality	Maintaining stable, high-quality water conditions to reduce stress and disease susceptibility.
Nutrition	Proper nutrition is critical for supporting the immune system and overall health of cultured striped bass.
Robust Biosecurity	Preventing pathogen introduction through controlled stock movements, disinfection protocols, and equipment sanitation.
Appropriate Stocking Densities	Avoiding overcrowding to limit stress and disease transmission.
Regular Health Monitoring	Early detection of pathogens or parasites through systematic surveillance, diagnostics, and record keeping.
Strategic Site Selection	Well-sited net pens in areas with adequate current flow help disperse waste, excess nutrients, and potential pathogens. Good water exchange reduces the concentration of organic matter and microbial loads, limiting the accumulation of disease agents. Sites must also allow for practical access and regular monitoring.

10.4 Therapeutants, antibiotics, and U.S. regulatory oversight

Even well managed farms sometimes require therapeutic intervention to address mortalities, infestations, or infections (FDA, 2022). In U.S. marine aquaculture, the set of approved options remains limited compared to other animal production sectors (FDA, 2022). Therapeutant use is governed by a regulatory system designed to protect animal health, the environment, and food safety (FDA, 2020). Treatments, including extra label use where applicable, require veterinary supervision and must follow federal rules. Current constraints include the lack of therapeutants explicitly approved for offshore marine aquaculture systems in the United States, which increases the importance of prevention and careful case management (FDA, 2020).

FDA provides central oversight for aquaculture therapeutics, and this oversight helps limit ecological risk associated with medication use (Scott, 2004). Management approaches that reduce parasite pressure, such as adjusting stocking densities and timing stocking events, can reduce reliance on drugs. Antibiotic use has declined substantially in salmon aquaculture, including a reported drop of roughly 90 percent around the turn of the century with continued reductions thereafter (Tveterås 2002). In Maine, antimicrobial medicated feeds such as oxytetracycline were reported in 8 percent of salmon production cycles from 2003 to 2017, with no reported use from 2009 to 2017 (Love et al. 2020). Despite declining use, antibiotic persistence in sediments can range from days to years depending on light, oxygen, pH, temperature, and sediment characteristics (Adenaya et al. 2023; Coyne et al. 2001; Rigos and Troisi 2005). This persistence can contribute to selection for antibiotic resistant bacteria near aquaculture sites, so any use should remain limited and carefully controlled.

At present, no antibiotics are approved for striped bass and other marine aquatic species. Some broad-spectrum antibiotics and feed additives, including florfenicol and oxytetracycline, may be available under the National Investigational New Animal Drug Program as permitted by the U.S. Fish and Wildlife Service. Use should remain sparing, under veterinary oversight, and consistent with approved protocols to limit environmental accumulation and ecological disruption.

10.5 Vaccines and alternatives

Vaccines have been under development in aquaculture for more than 50 years and now represent a rapidly expanding disease prevention tool. Adoption varies because cultured species, production conditions, and delivery methods differ widely across aquaculture systems. Even so, vaccine development and use increasingly supports production practices that reduce antibiotic dependence while improving fish welfare.

11 Resource Use and Operational Efficiency in Offshore Striped Bass Aquaculture

Striped bass aquaculture is resource-intensive, but innovations in feed efficiency, automation, and renewable energy offer pathways to reduce costs and environmental impacts. Studies suggest offshore production can be profitable when efficiency is prioritized at scale. With continued improvements, striped bass farms could achieve both economic competitiveness and operational sustainability in U.S. waters.

11.1 Feeds and Feed Efficiency

Feed represents the single largest input cost in striped bass aquaculture and is the most significant driver of environmental performance. Research has focused on reducing reliance on fishmeal and fish oil while maintaining growth and health outcomes. Alternative ingredients such as soybean meal, corn gluten meal, and poultry by-product meal show promise, though digestibility and nutrient availability remain ongoing challenges (Fujita et al., 2023). Novel sources, including insect meals, bacterial biomass, fish silage, and single-cell proteins, are also being tested as viable replacements for traditional marine-derived proteins (Turchini et al., 2019; Glencross et al., 2007). Advances in formulation now allow diets to be tailored to species-specific needs, improving feed conversion ratios (FCR) and nutrient retention (Price & Beck-Stimpert, 2014; Hua et al., 2019).

Aquaculture has historically relied on forage fish (e.g., anchovy, sardine, menhaden) due to their high-quality protein and omega-3 fatty acids, with roughly 20 million metric tons ($\approx 20\%$ of the global marine harvest) processed annually for fishmeal and oil (FAO, 2018). However, supply has plateaued, and their proportional use in aquafeeds has declined for two decades (Naylor et al., 2021). Despite these trends, fishmeal and fish oil remain critical for some marine species requiring highly digestible proteins and long-chain polyunsaturated fatty acids (Hua et al., 2019). Studies have shown that alternative protein sources can replace much of the fishmeal in aquaculture diets without compromising performance (Rust et al., 2011; Gatlin et al., 2007). Plant proteins (soy, corn, algae, seaweed) and microbial or insect meals offer scalable solutions, with ongoing USDA and NOAA-supported research aimed at reducing environmental impacts and improving adoption (Rexroad et al., 2021).

Striped bass have demonstrated efficient feed conversion and can grow well on formulated diets with reduced reliance on fishmeal and fish oil (Rexroad et al., 2021; Andersen et al., 2021). This flexibility distinguishes them from other marine carnivorous species and helps limit pressure on forage fish resources. Continued refinement of striped bass-specific feeds will further strengthen the species' sustainability profile while supporting offshore aquaculture development.

11.2 Energy Use

Energy use is a major determinant of both cost and environmental footprint in offshore striped bass farming. Operations require energy for feeding, monitoring, cage maintenance, harvesting, and transport (Price & Beck-Stimpert, 2014). Lacking grid connectivity, farms rely on fossil fuels or renewable systems to power infrastructure (Fujita et al., 2023).

Harvesting is especially energy-intensive, with vessels consuming fuel for propulsion, refrigeration, and lifting equipment. Long-distance logistics amplify these demands, raising operational costs and carbon emissions (Sardar et al., 2025; Basurko et al. 2013). Optimizing vessel routing and adopting hybrid or alternative-fuel vessels can reduce energy use.

Renewable energy technologies such as floating solar, wave, and hybrid wind-solar systems are increasingly evaluated as alternatives for offshore aquaculture infrastructure (Rubino, 2008; Soto & Wurmman, 2019). Coupled with energy storage, these systems can provide reliable low-carbon power for feeding, sensors, and communications (Haider et al., 2024). Strategic siting also plays a role: proximity to shore reduces vessel fuel use and enables more efficient logistics (FAO, 2024).

As offshore aquaculture expands, energy management will become central to economic viability and environmental performance. Reducing fossil fuel dependence and integrating renewables will support both industry competitiveness and broader carbon-reduction goals. Integrating renewable energy and efficiency technologies can lower operating costs while reinforcing the sustainability profile of offshore striped bass aquaculture, strengthening its alignment with U.S. climate and seafood goals.

12 Historical Review of Research Initiatives and Commercial Projects

Past research and pilot projects in the U.S. and abroad show that striped bass aquaculture is biologically feasible but historically hampered by regulatory uncertainty, infrastructure challenges, and limited market development. Recent advances in genetics,

production systems, and consumer demand now address many of these barriers. These lessons confirm that the current moment offers the strongest opportunity yet for offshore striped bass aquaculture to succeed.

12.1 Research Initiatives

StriperHub, a coordinated NOAA Sea Grant initiative led by North Carolina Sea Grant and North Carolina State University, is advancing striped bass aquaculture in the U.S. by integrating genetics, production research, and industry outreach. Long-term selective breeding programs at NC State's Pamlico Aquaculture Field Laboratory have produced domesticated lines with improved growth, feed efficiency, stress tolerance, and disease resistance, now capable of reaching 1.8 kg within 18 months. By coupling these advances with seed production, grow-out demonstrations, and market development, StriperHub is positioning pure-line striped bass to compete directly in both premium and commodity markets, creating new opportunities for expansion of U.S. aquaculture.

The USDA has played a pivotal role in advancing striped bass and hybrid striped bass aquaculture through strategic research funding and breeding programs. Notably, USDA-supported initiatives, such as the National Research Support Project 8 (NRSP-8), NIFA projects, and Agricultural Research Service (ARS) collaborations, have fostered genetic improvement and selective breeding efforts, enabling enhanced growth, disease resistance, and performance in RAS and pond systems. These investments, combined with targeted SBIR grants focused on pedigree tracking, semen preservation, and broodstock development, have strengthened the industry's capacity for commercial diffusion of superior striped bass genetics

12.2 Marine Cage Culture

United States

Over the past five decades, several experimental and pilot-scale commercial attempts have been made to culture striped bass in marine net pens or cages, particularly in New York waters. These projects demonstrated the biological feasibility of cage culture but also underscored the environmental and operational challenges. The earliest documented trial occurred in 1974–1975, when researchers deployed floating cages in a seawater lagoon off Shelter Island, New York. Fingerlings stocked in the fall suffered from mortality events when water temperatures dropped to 1 °C, necessitating onshore overwintering. Restocked fish grew during the following summer, but survival and retention were poor due to escapes, and only 14% were harvestable by fall (Harrell et al., 1976). A second pilot project in 2011 stocked 15,000–20,000 striped bass into net pens in New York State waters (University of Vermont Sea Grant, 2022). This effort was short-lived after a vessel strike damaged infrastructure and Hurricane Sandy further disrupted

operations, ultimately forcing removal of the pens. Finally, in 2012, a private venture launched in Gardiners Bay at the northern end of Long Island. Striped bass raised in net pens exhibited strong growth and survived the impacts of Hurricane Sandy. Fish were later transferred to an onshore facility and marketed through restaurants and seafood retailers in Long Island and Manhattan, demonstrating small-scale biological and commercial feasibility. However, broader challenges related to permitting, scalability, and storm resilience remain unresolved (Multi Aquaculture Systems, 2012).

Collectively, these U.S. case studies highlight both the opportunities and risks of striped bass aquaculture in marine cages. While growth performance can be strong, success depends heavily on site selection, infrastructure resilience, and regulatory clarity. Despite these challenges, multiple offshore aquaculture initiatives have identified striped bass as a promising candidate for the U.S. EEZ in recent years. These include Pacific Ocean AquaFarms, with proposed sites off San Diego and Long Beach, California, and Manna Fish Farms, with proposed sites off Pensacola, Florida, and Long Island, New York.

International

Pacifico Aquaculture, founded in 2010 in Ensenada, Baja California, was the first and only commercial-scale offshore striped bass farm in North America. Situated 8 miles offshore near Isla Todos Santos, the operation utilized marine net pens supported by a hatchery and nursery RAS at Playa Tres Emes, where juveniles were reared to approximately 80 g before transfer offshore. The company achieved four-star Best Aquaculture Practices (BAP) certification, encompassing hatchery, grow-out, processing, and feed, and was recognized by Monterey Bay Aquarium's Seafood Watch with a "Good Alternative" rating. At its peak, Pacifico consistently produced up to 3,200 metric tons annually, with ambitions to scale toward 20,000 metric tons per year. Their product was marketed to "conscientious consumers" and premium channels across North America. Its striped bass entered retail and foodservice markets through distribution partnerships with Whole Foods, Amazon Fresh, Fresh Direct, Earth Fare, and through Santa Monica Seafood in California and the U.S. Southwest. Nationwide distribution extended through wholesalers such as Profish, Seattle Fish Company's Chef's Fresh Fish, Samuels Seafood, and Wulf's Fish, while restaurant chains including Pacific Catch prominently featured the product. Pacifico was also a regular exhibitor at the Seafood Expo North America, where it promoted its brand and product lines to domestic and international buyers.

For more than a decade, Pacifico represented the sole commercial example of offshore striped bass aquaculture in the region. In June 2025, the company ceased operations, marking the closure of North America's only offshore striped bass producer and concluding a pioneering commercial effort (Fiorillo, 2025; Mayer, 2025).

Several co-authors of this report conducted site visits to the Pacifico operation during commercial development, peak production, hatchery construction, and following its

closure, providing important lessons for future striped bass aquaculture development. Despite strong market demand, the operation experienced persistent production challenges, largely attributed to suboptimal siting relative to suitable thermal regimes. Temperature variability negatively affected growth rates and feed conversion efficiency, resulting in inconsistent production performance and difficulty in reliably supplying product to market. These observations underscore the critical importance of precision siting to ensure thermal suitability, production reliability, and long-term commercial viability for offshore striped bass aquaculture.

12.3 Recirculating Aquaculture Systems

Feasibility of land-based culture has been researched in depth for pure striped bass (Engle et al., 2024), but commercial scale comparables only exist for their hybrids in the U.S. and Asia. The U.S. companies included AquaFuture Inc., founded in 1990 (Turners Falls, Massachusetts) and Kent SeaTech founded in 1972 (Mecca, California). Both operations experienced years of technical successes with the species but economic challenges (e.g., feed cost, energy demand, stagnant fish prices) caused them to pivot to barramundi (*Lates calcarifer*) and biofuel respectively. Operations in China continue to demonstrate successful production in RAS for their domestic premium markets. Although the biological and technical potential exists to produce pure striped bass at scale in RAS, concerns about operating costs and market price remain when raising fish to marketable size.

12.4 Pond Aquaculture

Most commercial striped bass and hybrid striped bass production occurs in the southeastern and midwestern states (notably North Carolina, Arkansas, Mississippi, and Texas) where earthen ponds are used for fingerling and grow-out phases. Hybrid striped bass have historically been preferred due to superior hardiness and growth. The typical production system is a two-phase model: fry are first reared in hatcheries, then stocked into fertilized ponds to grow into fingerlings or market-size fish. Pond culture benefits from relatively low infrastructure costs and established feed-based management, though it requires substantial land, warm water, and aeration. The 2023 USDA Census of Aquaculture reports there were 57 farms producing hybrid striped bass in the U.S., with 32 of those marketing food-size fish.

13 Conclusions

Striped bass is among the most iconic and economically valuable fishes of the U.S. Atlantic coast. Decades of hatchery propagation, hybrid striped bass aquaculture development, and scientific advances have laid the foundation for farming pure striped

bass in offshore environments. This report demonstrates that offshore striped bass aquaculture is biologically feasible, economically competitive, and aligned with national goals of expanding domestic seafood production. Yet, current federal rulemaking prohibits possession of striped bass in the EEZ, creating a de facto ban on offshore striped bass farming along the eastern Atlantic. To advance sustainable aquaculture, this prohibition could be reconsidered. Updating federal and state regulations to explicitly allow striped bass aquaculture in the EEZ would unlock opportunities for economic growth, seafood security, and coastal community development while safeguarding wild stocks through modern genetic, ecological, and regulatory safeguards.

The pathway forward requires targeted investment in science and deliberate policy reform. Offshore striped bass aquaculture should proceed within a precautionary, adaptive management framework that emphasizes ecological compatibility, environmental responsibility, and stakeholder trust. With appropriate research, policy innovation, and regulatory clarity, the U.S. can establish a robust offshore striped bass aquaculture sector that complements conservation of wild fisheries and strengthens the resilience of the seafood supply chain.

13.1 Priority Research Needs

- Offshore production trials: Conduct large-scale demonstration farms to test performance under high-energy offshore conditions.
- Broodstock improvement: Expand selective breeding programs to enhance growth, feed efficiency, and disease resistance in domesticated lines.
- Feeds and nutrition: Optimize sustainable diets using alternative proteins, oils, and functional ingredients tailored to striped bass.
- Genetic containment tools: Develop and validate methods to ensure reproductive sterility of farmed striped bass.
- Fish health management: Advance vaccines and biosecurity protocols for aquatic animal health management in offshore settings.
- Farm economics: Model the production costs and business feasibility of striped bass aquaculture to determine profitability timelines and financial risk.
- Market research: Assess consumer preferences, willingness to pay, and branding strategies for farmed pure-strain striped bass.
- Reproductive control for striped bass aquaculture remains a critical research need.

13.2 Policy and Management Needs

- Regulatory reform: Amend 50 C.F.R. §697.7 to permit aquaculture of striped bass in the EEZ, while maintaining the ban on wild harvest.
- Permitting frameworks: Develop clear, streamlined, and science-based offshore aquaculture permitting pathways that integrate NOAA, EPA, and USACE authority.
- Traceability and labeling: Establish traceability standards to distinguish cultured striped bass from wild harvest, ensuring market integrity.
- Compliance and enforcement: Implement monitoring systems to verify containment, environmental compliance, and genetic safeguards.
- Biosecurity regulations: Update aquatic animal health frameworks to address offshore net-pen systems, including rapid response protocols for disease events.
- Stakeholder engagement: Facilitate public and industry input into striped bass aquaculture planning to build social license and reduce conflict.
- Workforce development: Support training programs to transition maritime workers into skilled aquaculture careers.

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DRAFT

From: [Info \(ASMFC\)](#)
To: [Comments](#); [Emilie Franke](#)
Subject: FW: [New] [External] Atlantic striped bass fishery
Date: Thursday, December 18, 2025 4:54:42 PM

-----Original Message-----

From: Eric Warner <eric.warner03@gmail.com>
Sent: Wednesday, December 17, 2025 11:00 AM
To: Info (ASMFC) <info@ASMFC.ORG>
Subject: [New] [External] Atlantic striped bass fishery

Recreational guys get blamed but commercial guys are raping the fishery. The fall run this year was awful for shore based anglers. Less fish year after year. Quit procrastinating! The commercial guys are just as responsible, and probably a hell of a lot more, for the downfall of this fishery. The fact that you guys continue to do nothing is absolutely disgusting and disgraceful. I am a catch and release recreational angler and would like to see this fishery thriving for future generations (my two sons).

E

Eric Warner

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.



Atlantic States Marine Fisheries Commission

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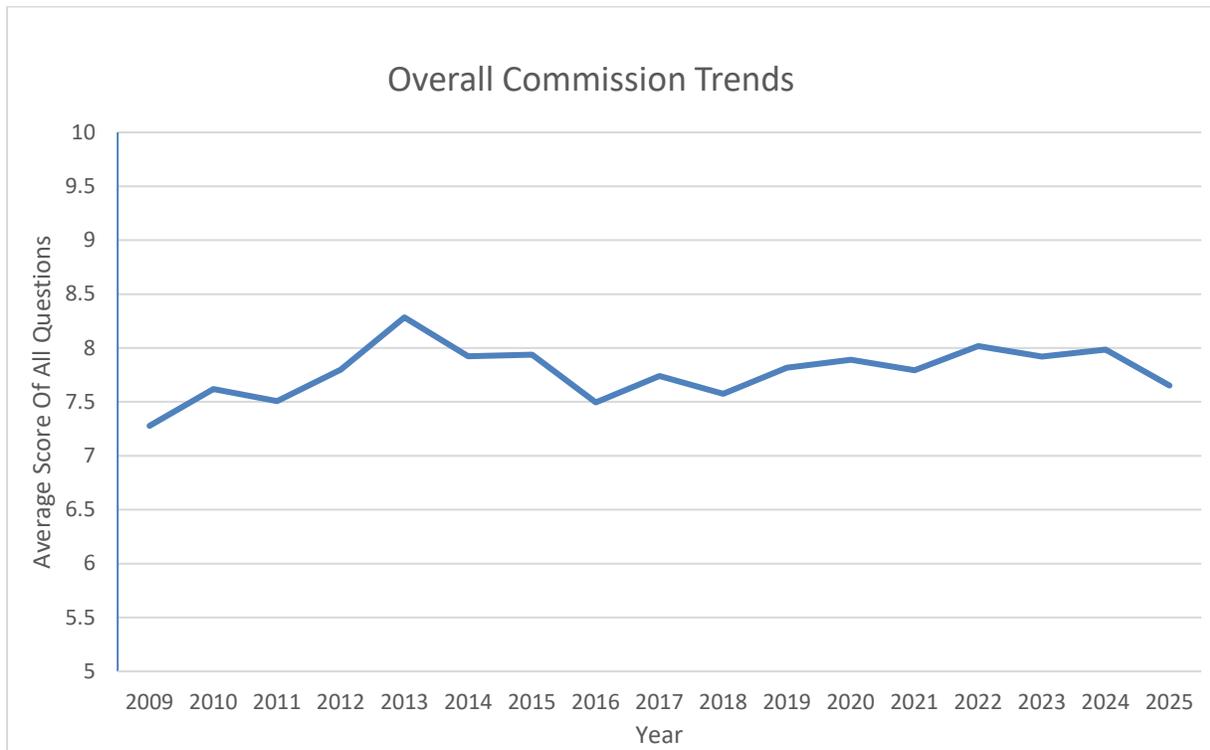
MEMORANDUM

SUBJECT: 2025 Commissioner Survey Results
TO: ISFMP Policy Board
FROM: Alexander Law
DATE: February 5, 2026

23 Commissioners and Proxies completed the 2025 ASMFC Commissioner Survey, which is based on the Commission’s 2024-2028 Strategic Plan. Questions 1-16 prompted respondents to rate their answers on a scale of 1 to 10 (ten-point Likert scale) and questions 17-21 prompted respondents to provide a written response. Questions 7, 8, 14, and 15 were new to the 2015 survey, and question 16 was added in 2020.

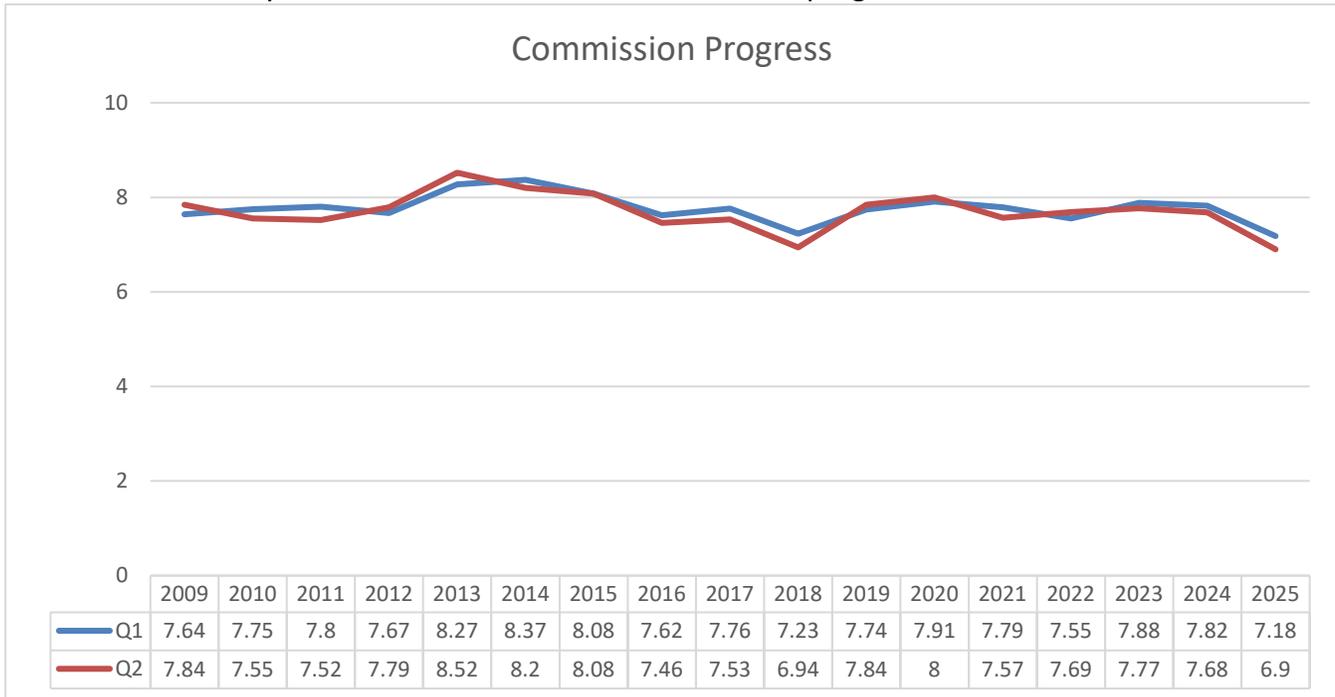
This memo includes graphs tracking responses for questions 1-16 throughout the time series (2009-2025), a summary of the five open-ended questions for 2025, and unabridged responses to the five open-ended questions.

Each question received 17-22 responses. This is significantly lower than the 28 from 2024’s survey and the 33 from 2023’s survey. The lower sample size from this year’s survey has exaggerated some of the trends.



Commission Progress

1. How comfortable are you that the Commission has a clear and achievable plan to reach the Vision (Sustainably managing Atlantic Coastal Fisheries)?
2. How confident are you that the Commission's actions reflect progress toward its Vision?



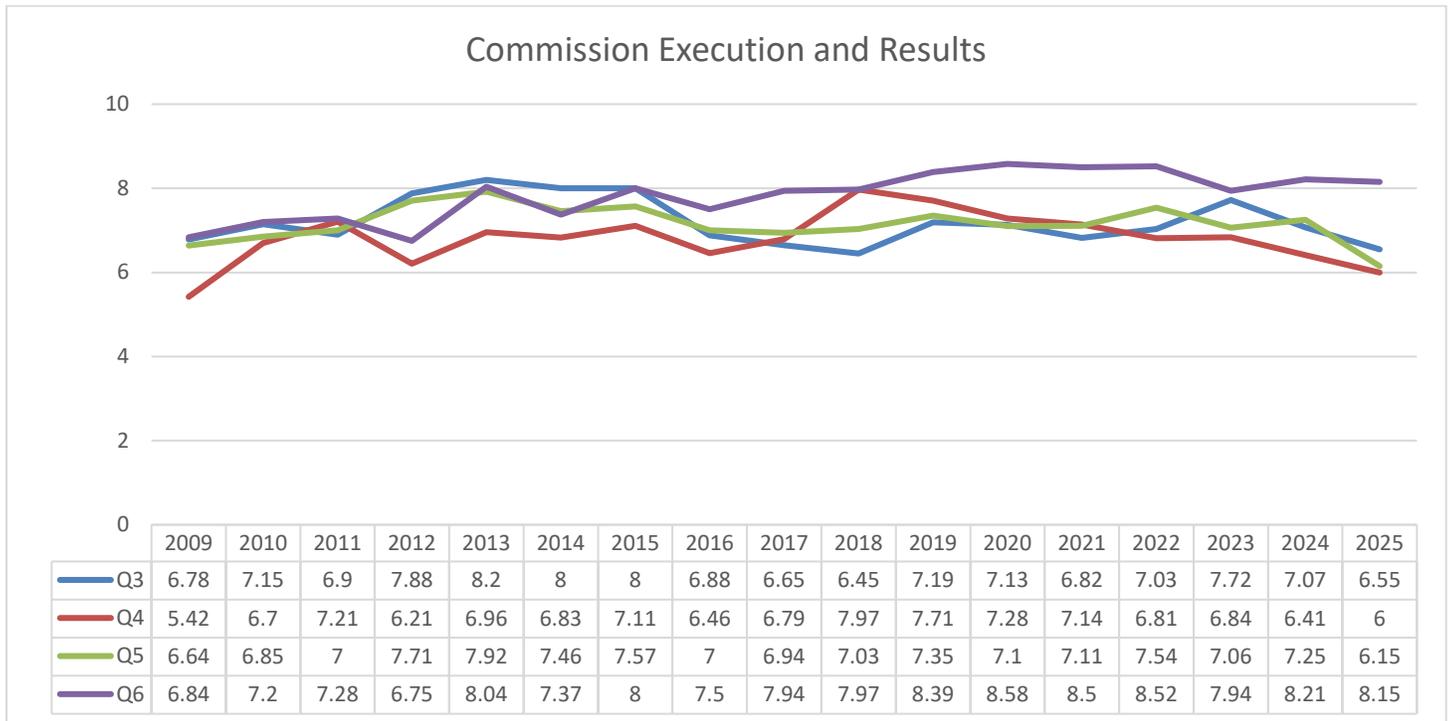
Commission Execution and Results

3. How satisfied are you with the cooperation between Commissioners to achieve the Commission's Vision?

4. How satisfied are you that the Commission has an appropriate level of cooperation with federal partners?

5. How satisfied are you with the Commission's working relationship with our constituent partners (commercial, recreational, and environmental)?

6. How satisfied are you with the Commission's effort and success in securing adequate fiscal resources to support management and science needs?



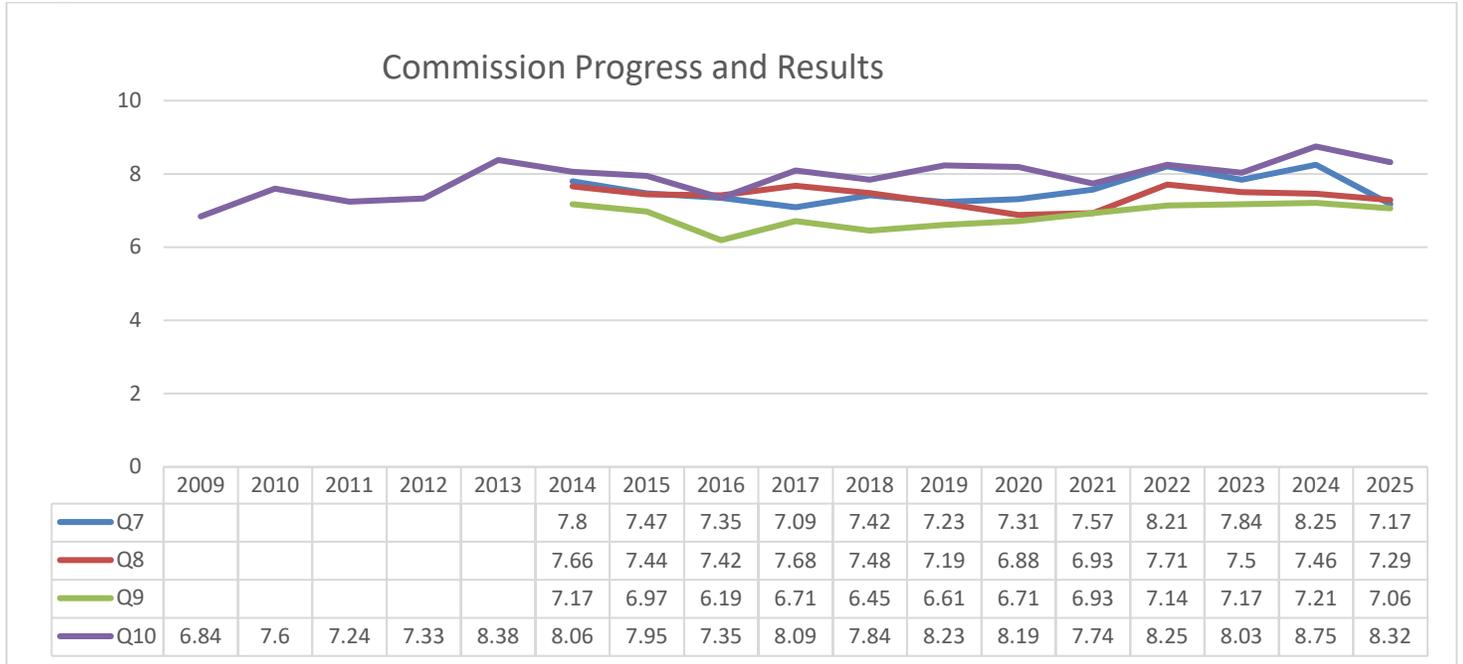
Commission Progress and Results

7. One of the metrics the Commission uses to measure progress is tracking the number of stocks where overfishing is no longer occurring. Is this a clear metric to measure progress?

8. How satisfied are you with the Commission's progress to end overfishing?

9. Are you satisfied with the Commission's ability to manage rebuilt stocks?

10. How satisfied are you with the Commission's efforts to engage with state legislators and members of Congress?

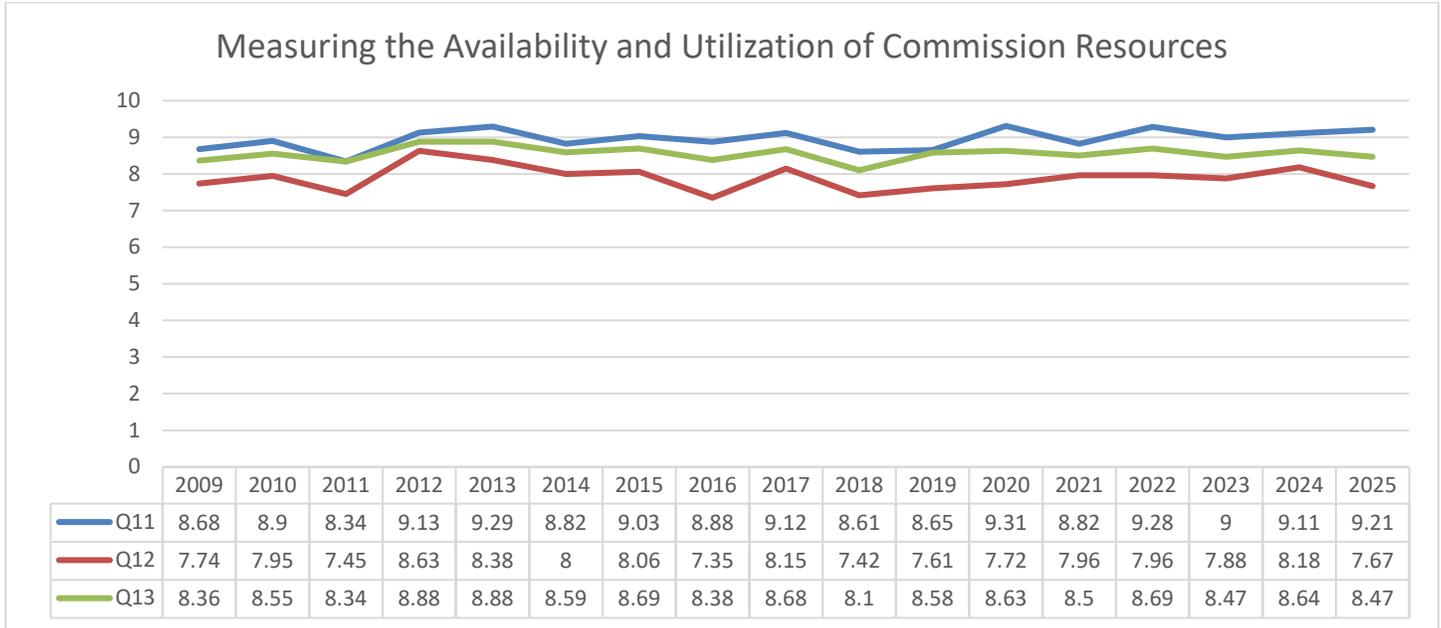


Measuring the Availability and Utilization of Commission Resources

11. How satisfied are you that the Commission efficiently and effectively utilizes available fiscal and human resources?

12. How comfortable are you with the Commission's performance in reacting to new information and adapting accordingly to achieve Commission Goals?

13. The Commission has a limited scope of authority. How comfortable are you that the Commission spends the appropriate amount of resources on issues within its control?

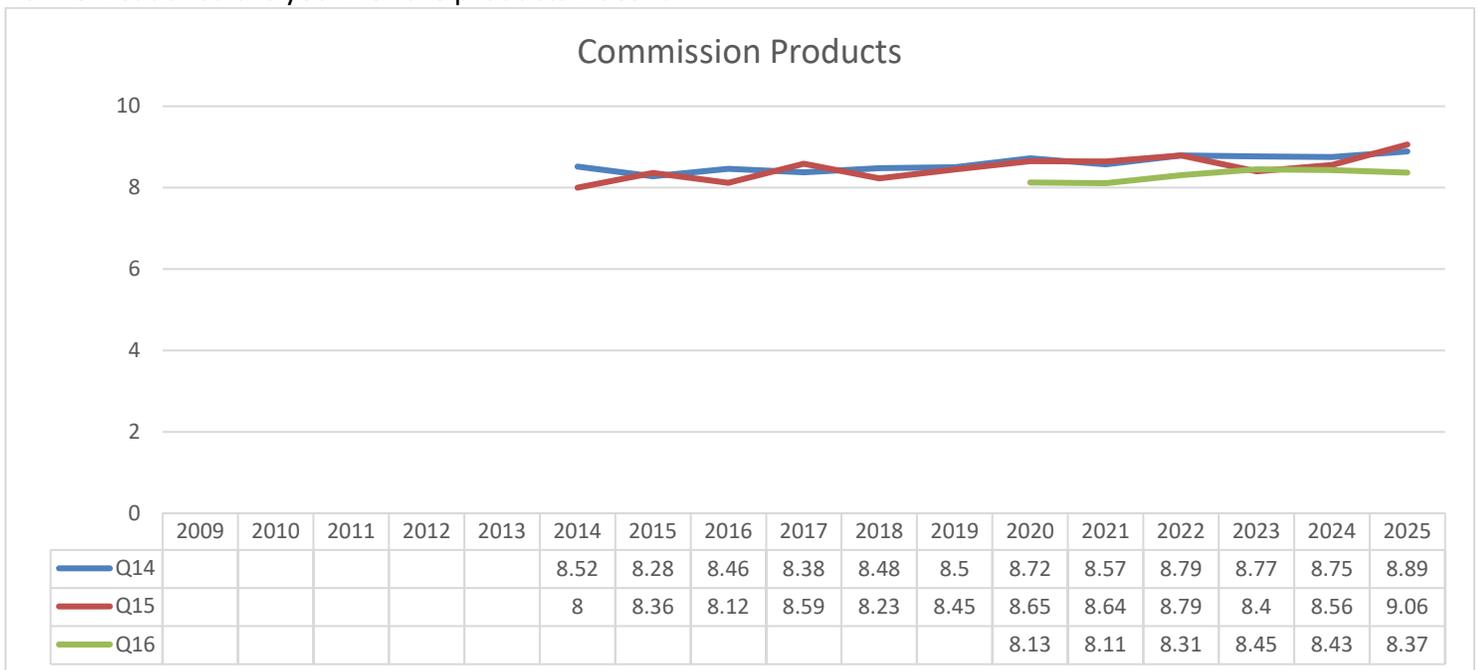


Commission Products

14. How satisfied are you with the products of the ISFMP Department?

15. How satisfied are you with the products of the Science Department?

16. How satisfied are you with the products ACCSP?



Highlights of the Ten-Point Scale Questions:

With fewer responses this year than in previous years, the average scores saw big swings if one or two respondents scored a question highly or extremely low.

While 13 of the 16 ten-point questions all saw a decrease in the average scores, (Q5) *“How satisfied are you with the Commission's working relationship with our constituent partners (commercial, recreational, and environmental)?”* and (Q7) *“One of the metrics the Commission uses to measure progress is tracking the number of stocks where overfishing is no longer occurring. Is this a clear metric to measure progress?”* saw the largest decreases. Both saw over a full point drop in their average scores from last year.

(Q4), Cooperation with Federal partners is consistently ranked as our lowest scoring question. Its average score this year, of six points, ranks as our second lowest average score across all years and all questions.

(Q11), (Q14), (Q15), the questions regarding the utilization of fiscal and human resources, products of the ISFMP department and the products of the Science department, were the only three to see an increase in average scores.

Discussion Question Summaries

Obstacles to the Commission's success in rebuilding stocks (Q17) Politics getting in the way of recommended management actions was the leading answer, far more than in previous years. This obstacle factors into responses in Qs 19&20. Other things mentioned more than once include climate change, MRIP and the need for accurate information.

The most **useful products produced by the Commission (Q18)** include; FMP reviews (the most common answer), stock assessments, summary documents, the new action tracker on the website, fishery dependent data, data tools, and staff support. Most ASMFC/ACCSP products were mentioned.

Additional products the Commission could provide (Q19) The most common answer was more socio-economic information/having an economist on staff. Plain language materials has been mentioned multiple years in a row. Other items mentioned include: A white paper on the authorities and scope of the Commission, earlier distribution of materials, performance reports for management objectives, decision documents similar to the Councils.

Issues the Commission should focus on more (Q20) The most common answer was industry and stakeholder outreach/education. A focus on the economics was carried over from Q19. All other answers varied wildly. Full unabridged responses are below.

Additional comments (Q21)

Many Commissioners declined to respond to this question. Those who did commented on how thankful they are for the staff.

Answers from Q17-21 that did not make it into the summary of each question but were mentioned multiple times across questions included; comment on the proliferation of lawsuits, cost of lawsuits, and the need to take proactive action to reduce conflicts. Also mentioned across questions is the inability for Commissioners to work together and/or work with the MAFMC on jointly managed species.

Unabridged Answers to Questions 17-20

Q17 What is the single biggest obstacle to the Commission's success in rebuilding stocks?

1. MRIP
2. Politics and habitat (which is outside of our control)
3. Funding
4. Not following the science due to political and/or commercial/recreational sector pressure.
5. Lack of will power to take action to restrict fishing mortality when stock status suggests action. Perfect recent examples striped bass and GM lobster.
6. climate change affecting stock productivity and resiliency
7. Climate change
8. Accurate! Information
9. Short-term stakeholder impacts prioritized over resource impacts
10. Legal fees and Declared Interests.
11. balancing stakeholder desires vs taking stronger conservation measures. I think we prolong the "pain" by not being conservative enough.
12. The inability to control the weather & Mother Nature, coupled with the difficulty in assessing a stock and projecting potential interaction with that stock in the future
13. Political impediments at both the state and Federal level are complicating efforts. Lobster, Menhaden, and Red Drum are examples
14. Various impacts from climate change
15. The rapidly changing ocean environment and political influences are equally impacting the success.
16. Controlling effort is the only tool the Commission has for rebuilding stocks but it becomes more apparent every year that several species are declining due to factors other than fishing that are out of the Commission's control.
17. How do you address declines in a stock when it is not yet overfished? Weighing actions now vs. later in this situation can be challenging
18. Many of my responses are lower than usual and that is because I have a few recent things on my mind, notably the menhaden/ERP action from the annual meeting, and Striped Bass. There has always been a measure of this in what we do of course, but I think there is an element of politics that is creeping in to levels that we have not seen before, which is having negative repercussions to our making sound, consistent decisions to promote sustainability for our important stocks.
19. Politics seems to play too big of a role. Need more SocioEconomic data to back up our decisions

Q18 What are the most useful products the Commission produces for you?

1. Summary documents of committee meetings and technical documents so that commissioners who don't have time to participate in all the meetings to get up to speed quickly.
2. The Action Tracker
3. Stock Assessments and updates are excellent
4. FMP Reviews, especially the compilations of state management measures within; stock assessments; quota transfer summary.
5. All are useful and constantly improving
6. Meeting materials & summaries, FMP Reviews, stock assessments, information on the website
7. FMPs
8. Fishery dependent data (ACCSP). This is part of the foundation of all of the other products produced.
9. Summaries of species status and a well thought out and thorough website.
10. Stock assessments and analyses related to trends of abundance and recruitment.

11. Meeting materials and products of the Communications Department
12. FMP documents, stock assessments, data tools and warehouses
13. Having used all the FMP and FMP Reviews, stock assessments, species profiles, etc., I find all the products useful.
14. Stock assessments - we are very lucky to have staff in-house at ASMFC who can conduct stock assessments, particularly with reduced capacity at the federal science centers
15. The Commission is an outstanding organization that produces many useful products, but the support you offer for local hearings in the states is extremely valuable. I may be out of touch on this aspect of things, but I feel like there are not as many training opportunities as there used to be from the Science department. I may be wrong about that, or if it is correct, there may be logical reasons for this, but it is my perception; I always found those trainings to be very well done and valuable, and I think could become super important as we lose resources from the federal government.
16. "Cliff note" version of meeting materials

Q19 What additional products could the Commission create to make your job easier?

1. Having an economist on staff who could provide analysis around decisions would be helpful
2. It is not a product idea but it would be extremely useful to distribute meeting materials well in advance of meeting so there is actually time to read and review 2000-3000 pages of materials, and then discuss with other Commissioners. If a stock assessment is available 10 weeks prior to a meeting, then distribute it to the Commissioners. This will require multiple emails with a status sheet, that notes when prior material was distributed, that links to the agenda.
3. White paper that delineates the scope of ASMFC authority, which is often misconstrued in court cases. Mechanism to support better sharing of lobster vessel tracker data between states and federal government (e.g., MOU, software development).
4. None
5. More independent surveys for species, Like sciaenids.
6. Periodic fishery performance reports. How well our management objectives are being met, how much economic activity each species produces, how satisfied are our partners with how we are managing etc.
7. None
8. Socio economic products would be desirable
9. More plain language outreach materials around important management actions for the wide variety stakeholders.
10. The Commission's products cover just about all the bases regarding biology, population dynamics and management, but more info on the economics of management could be useful.
11. The Councils produce decisions docs which are quick cheat sheets outlining the issues and corresponding options. It would be helpful to have this for some of our more complicated actions
12. I think you guys do a lot for us and its all great so no comments on this part.
13. See 17.

Q20 What issue(s) should the Commission focus more attention/time on?

1. Being more nimble with how we can adapt more timely management in response to stocks shifting due to changing environmental conditions (i.e how can we incorporate water quality in stock assessments).
2. We have lost the ability to work together and compromise in best interests of the resources that we manage. We need to figure out a different /better way to work together with the MAFMC. Joint meetings are generally a waste of time and money as most of the recommendations are for

status quo and it is impossible to get 60 individuals to do something different when one body or the other has veto power over the result.

3. More transparency and ownership of the RDM and decision support tool.
4. Outreach to create greater understanding of what we do and cannot do
5. Eel sampling in the Chesapeake Bay, accurate information about the total amount of striped bass in the Chesapeake, What to do about the Red Drum in the Chesapeake.
6. Proactive management measures to minimize future problems for the stocks, especially those with outdated stock assessments or with stock assessments with uncertain results
7. Lack of data sets to fit in models that are utilized for management. The models cannot work accurately with the limited data sets. This issue is going to get worse as federal funding dries up.
8. allocations and adjusting them. We have made great progress tackling this issue and I think we need to keep going./
9. Educating the public on how the commission is structured and that it is a state based compact not a federal body. Perhaps a series of PR pieces that are light hearted a speak to the realities of the job and complexity of it
10. Industry and stakeholder outreach
11. I'd like to see more emphasis on economic concerns. We've seen economic issues take on prominence for several species, for example, striped bass management hurting the for-hire sector in the Chesapeake and lowering the menhaden TAC affecting the reduction fishery workers, but we don't have economic analyses of these issues. Continuing with those issues, what are the factors affecting an angler's decision to go out on a for-hire boat - is the regulations, the cost per trip or a combination of those factors (e.g. I'll pay \$80 for a trip if I can keep X number of fish)? How much menhaden quota does the reduction fishery need to maintain employment - was the situation as dire as they claimed?
12. I was shocked and alarmed by some of the votes and comments made by our federal partners at the annual meeting. Very inconsistent with previous positions and counter to achieving sustainability goals. I don't envy these partners right now, so I think it will be very important for us to guard against putting them into positions where they will have to make comments/votes like this again to the extent that this is possible. This will require some strategic thinking on how best to bring things forward into the process for the foreseeable future. We are also going to have to bolster ourselves against loss of resources from the federal government (assessment support, objective advice, data collection) so that we can continue to serve our states as well as we can. The states can step up, we have expertise, so we should look for opportunities to do this.
13. Need to better anticipate public comment. But also need to better inform Stakeholders of when/where those comments can and should be made.

Q21 Additional comments.

1. Our dependence on MRIP's weak inability to secure time and space results accurately, results in huge swings of interpreted information that lacks confidence in it's usage. Yet, is labeled as best available science. When in actuality little science can be firmly attained.
2. Proliferation of lawsuits and misrepresentation of Board decisions reflects upon need to enhance relationship with external industry/enviro partners; take proactive action to reduce these conflicts.
3. The technical committee has set the bar so high for striped bass that we may never be able to reach that plateau.
4. Commission Employees are amazing. However; the decorum of the states representatives have eroded over the past 10 years and the ability to work with states to protect everyone's interests has declined as a result.
5. None

6. As with every year since I've been on the Commission, can't give enough praise to ASMFC leadership and staff. Keep up the great work! My experience with the new web site is mixed. The new web site looks great, much of it is an improvement, but there are a few items that I think were better on the old web site, most notably searching for older documents. It was easier to find them on the old web site when one could access the species page and just scroll down the list rather than use that filter and have the documents in tiles. I've used the Archive link to return to the old web page when I'm looking for a specific FMP or assessment. Finally, how do I save my responses to this survey so I can review for next year's survey?
7. I think I did enough proselytizing above :)
8. Staff performance is always top notch. It would be great if Commissioners would engage more with the Staff.



ATLANTIC STATES SHELL RECYCLING

A practitioner's guide to oyster shell recycling along the U.S. Atlantic coast

FEBRUARY 2026
ATLANTIC STATES MARINE FISHERIES COMMISSION
1050 N Highland St, Arlington, VA

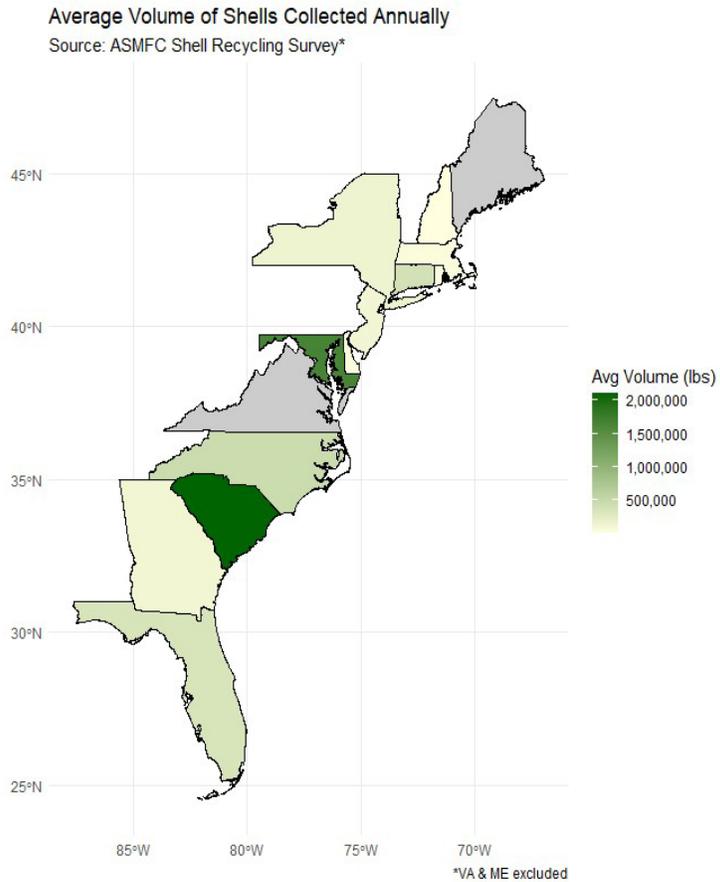
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Executive Summary

Oysters are a keystone species in our coastal estuaries, and the reefs they form enhance biodiversity, improve water quality, protect shorelines, and support important recreational and commercial fisheries. Along the Atlantic coast, many oyster reefs have been severely impacted by disease, pollution, overharvesting, and habitat loss, limiting the range of ecosystem services these reefs provide. Shells, a limiting factor for reef restoration, have become increasingly scarce due to ecological, economic, and logistical challenges associated with changes in oyster fisheries. As a result, the demand for shells in restoration projects often exceeds the available supply. To address this shortage, many states have implemented oyster shell recycling programs, partnering with local restaurants and eateries to reclaim shells. Effective and consistent management of shell recycling programs is crucial to maximize the use of recycled shells in restoration projects and ensure positive environmental outcomes.



This issue of the Habitat Management Series (HMS) will serve as a resource on shell recycling programs for states and practitioners along the Atlantic coast. It highlights shell recycling programs across member states and offers recommendations for best management practices, including permitting guidelines, lessons learned, strategies to minimize the risk of disease introduction, and a variety of useful links and contacts. We hope this HMS issue provides managers with the tools and guidance necessary to support the continued conservation of oyster reefs and healthy coastal fish habitat.

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Preface

For over 80 years, the [Atlantic States Marine Fisheries Commission](#) (herein after will be referred to as ASMFC or the Commission) has served as a deliberative body of the Atlantic coastal states, coordinating the conservation and management of 27 nearshore fish species. Each state is represented on the Commission by three Commissioners: the director of the state's marine fisheries management agency, a state legislator, and an individual appointed by the state's governor to represent stakeholder interests. These Commissioners participate in deliberations in the Commission's main policy arenas: interstate fisheries management, fisheries science, habitat conservation, and law enforcement. Through these activities, the states collectively ensure the sound conservation and management of their shared coastal fishery resources and the resulting benefits to the fishing and non-fishing public.

Habitat Program Mission

To work through the Commission, in cooperation with appropriate agencies and organizations, to enhance and cooperatively manage vital fish habitat for conservation, restoration, and protection, and support the cooperative management of Commission managed species.

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Introduction

Oyster shell recycling programs play a critical role in supporting coastal restoration by returning this valuable substrate to estuarine systems, where it provides a surface for oyster larvae settlement, increases habitat complexity, and enhances ecosystem services like water filtration and shoreline protection. For habitat managers, launching or expanding a shell recycling effort requires thoughtful planning that balances ecological objectives with operational logistics, economic efficiency, and community involvement. State agencies often define a "shell recycler" as a "nonprofit organization, community association, restaurant, seafood processor, or seafood dealer that donates shells to an authorized shell recycling collector and that has not received compensation for the shell donation from any source other than the Department or its agent" (Maryland Department of Natural Resources).

Shell recycling programs collect shells from where they are processed and consumed and utilize the discarded shells for enhancing shellfish habitats and improving coastal ecosystems. The practice also

helps restaurants reduce waste-disposal costs while contributing to cleaner water, greater marine biodiversity, and long-term recovery of shellfish habitats.

Habitat and Ecological Considerations

The primary purpose of shell recycling is to increase supply of durable, clean, and natural substrate for oyster restoration and enhancement efforts. Managers should also consider habitat placement, selecting sites that will support reef persistence, recruitment, and ecosystem function.

Permitting and Regulatory Awareness

While specific requirements vary by state, most shell recycling programs ultimately feed into restoration projects that require state and federal permits. These may involve agencies such as state departments of natural resources, departments of agriculture, and the U.S. Army Corps of Engineers. Practitioners should plan early for permit timelines and coordinate with regulatory partners to ensure compliance.

Storage and Curing

Shells should be stored upland, away from tidal waters or flood prone areas, to reduce the risk of contamination and to allow natural weathering. Storage areas should be secure and accessible to collection vehicles while large enough to handle seasonal surges in volume. Proximity to planned restoration sites can reduce transport costs.

Shells must be properly cured to eliminate pathogens, invasive species, and organic material. Curing times typically extend six months to a year, depending on site conditions, to ensure the shell is safe for use.

Odor, Neighbors, and Public Perception

Odor and pests (flies, maggots, rodents) are common concerns during shell curing. Programs can mitigate these impacts by using sealable containers, rotating shell piles, and siting curing locations away from residential areas. Building good relationships with neighbors and local officials is essential to prevent conflicts and build support.

Health, Safety, and Local Regulations

Local health departments may impose rules regarding shell handling, storage, and transport, particularly where shell is stored in populated areas. Programs should anticipate and address these requirements, ensuring staff and volunteers use safe handling practices and proper equipment.

Community Engagement and Partnerships

Shell recycling succeeds when it involves a wide network of partners, including restaurants, seafood markets, event organizers, volunteers, and local governments. Outreach, education, and regular feedback to donors help sustain long-term participation. Collaborations with nonprofits, universities, and aquaculture operators can also reduce costs and support collection and storage efforts. Engaging partners early in program planning is essential to ensure effective and lasting implementation.

Shell recycling programs provide multiple ecological and community benefits, but their success depends on anticipating logistical, ecological, and social challenges. By considering habitat requirements,

permitting needs, storage logistics, odor management, health and safety, and community partnerships, practitioners across Atlantic states can establish effective programs that contribute to sustainable oyster restoration and resilient coastal ecosystems.

Common Best Practices

Equipment considerations (collection, curing, deployment)

Effective shell recycling programs depend on selecting equipment that matches collection scale, hauling distances, storage capacity, and end-use of shell. Smaller programs often rely on pickup trucks and standardized containers for flexible, low-cost restaurant routes, while larger programs benefit from box trucks, roll-off dumpsters, and mechanized handling equipment to safely manage higher volumes. At curing and staging sites, infrastructure that promotes drainage, airflow, and easy material handling improves biosecurity, reduces odors, and increases operational efficiency. Programs deploying shell offshore or at subtidal sites may require barges, cranes, and coordinated staging logistics to align planting capacity with available shell. Across all scales, personal protective equipment (PPE), safety training, and clear volunteer identification are essential for risk management. Finally, basic data tools—such as scales, mobile data collection, and simple databases—support transparent tracking of volumes, contamination, and shell movement, strengthening accountability and program evaluation.

Table 1: Useful equipment

<i>Category</i>	<i>Equipment</i>	<i>Best Use / Application</i>	<i>Key Considerations</i>
Core Vehicle & Handling Equipment	Pickup trucks / flatbeds	Small collection routes (<10 locations/day); flexible and low cost	Limited payload; may require multiple trips
	Box trucks / roll-off trucks	Medium-large routes; hauling 30-cy dumpsters	Higher capital and maintenance costs; CDL requirements may apply
	Dump trailers / dump trucks	Moving large, cured piles to staging or barge sites	Requires adequate access and turning radius
	Barges & cranes (deployment)	Offshore or subtidal shell placement	Match barge capacity with planting volume and tidal access
	Forklift / skid steer	Moving pallets, barrels, totes at curing sites	Requires trained operators and stable surfaces

Collection Containers	5-gallon screw-top buckets	Restaurants; ~25–30 lbs when full (dry)	Easy handling; higher labor per volume	
	32–64-gallon wheeled totes	Large restaurants, festivals, high-volume sites	Requires storage space and wheeled access	
	30-cubic-yard roll-off dumpsters	Aggregation and bulk transport to curing sites	Requires site permits and truck access	
	Food-grade sealable barrels	Odor control at donor sites	Improves donor participation and cleanliness	
Curing & Cleaning Equipment	Open-air curing pads / roll-offs	Passive curing using sun and wind	Requires space, drainage, and pest management	
	Shell tumblers / rotary washers	Remove fines and organics; hatchery-grade shell	Higher capital and water use	
	Airlift / pneumatic sorting units	Large-scale removal of plastics and lightweight trash	Best for centralized facilities	
	Tumbler screens & water jets	High-volume centralized cleaning	Requires water management and maintenance	
	Pallets, tarps, drainage channels	Keep shells off ground; improve drying	Protects groundwater and reduces odor	
	PPE & Safety	Gloves, eye protection, masks, high-visibility vests, first-aid kits, spill kits	Worker and volunteer protection	Safety training recommended for heavy equipment
		Name badges / organization logos	Public-facing operations	Builds trust and visibility
Data & Admin. Tools	Truck or pallet scales	Accurate volume tracking	Calibrate regularly	

Mobile data apps / tablets	Field data collection	Reduces transcription errors
Spreadsheet or cloud database	Track donor, weight, date, batch ID, contamination	Enables reporting and quality control

Curing standards

Shell curing is a critical step in shell recycling programs to ensure that organic material has fully degraded, pathogens and invasive organisms are neutralized, and shells are safe for reuse in restoration or aquaculture applications. Most programs rely on open-air curing using sun and wind exposure, which is cost-effective, scalable, and operationally simple when supported by adequate space, airflow, and drainage. A minimum curing period of six months is commonly applied under National Shellfish Sanitation Program (NSSP) guidance and many state programs, while 12 months may be appropriate in cooler or wetter climates, dense stockpiles, or where airflow is limited.

Shells should be stored on prepared surfaces (e.g., pallets, tarps, compacted gravel, or concrete pads) to improve drying efficiency, minimize soil contamination, and protect groundwater. Drainage and moisture control – including sloped pads, vented containers, and runoff containment – reduce odors, pests, and anaerobic conditions. Some programs rotate piles to accelerate drying, while others maintain static piles for simplicity; the approach should align with available space, staffing, and local requirements. Programs with higher throughput or hatchery-quality needs may supplement curing with washing or sorting equipment to remove fines, organics, and lightweight debris.

All programs should maintain batch tracking and traceability, documenting source, dates in and out, contamination notes, and final deployment locations to support biosecurity, reporting, and quality assurance. The summary table below highlights common curing standards and operational considerations observed across Atlantic states programs.



IMPORTANT:



Odor, siting, and community considerations

Curing sites should be carefully selected and managed to minimize impacts to nearby residents, businesses, and sensitive environments. Odor and pest issues are most likely during warm months when organic material remains or drainage is inadequate. Programs can reduce risk by maintaining good drainage, rotating or aerating piles where feasible, scheduling routine cleanups, and promptly removing contaminated loads. Some programs evaluate commercial deodorizers in coordination with local regulators and discourage indiscriminate use of bleach or chemicals.

Siting should prioritize secure, non-flooding upland locations outside tidal and storm-surge zones, with sufficient access for collection vehicles and adequate space for curing retention. Runoff controls (e.g., lined pads, berms, silt fencing) should prevent shell fines or leachate from entering surface waters. Early coordination with local health departments and municipal authorities is recommended, as food-waste storage, vector control, and site operations may be regulated. Proactive siting and management help maintain community support and long-term program viability.

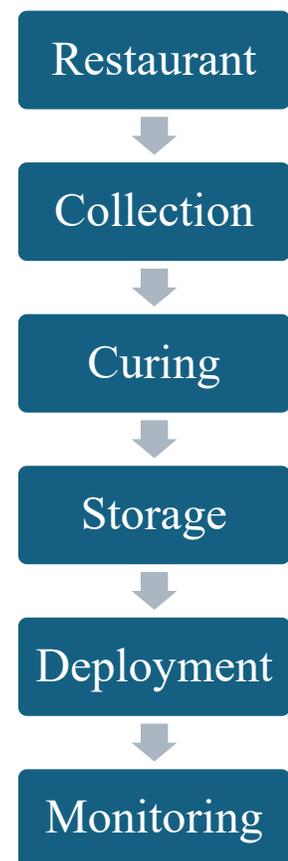
Table 2: Curing Standards

<i>Category</i>	<i>Standard recommendation</i>	<i>Benefit</i>
Minimum Curing Duration	≥ 6–12 months (program and state-specific)	Ensures organic material degrades, pathogens are neutralized, and shells are safe for deployment
Curing Method	Open-air sun and wind exposure	Passive, low-cost method for pathogen reduction and drying.
	Optional washing/tumbling	Reduces organics; follow state guidance
Surface Preparation	Pallets, tarps, concrete pads, or compacted gravel	Keeps shells off bare soil, improves drainage, accelerates drying, and protects groundwater.
Pile Management	Periodic turning, rotation, or aeration (as feasible)	Reduces odor, discourages pests, and improves uniform curing.
Moisture, Drainage & Runoff Control	Elevated pallets, drainage holes; sloped pads, drainage channels, berms, or silt fencing	Prevents leachate or shell fines from entering waterways.

Trash Removal	Manual sorting, screens, airlift systems, or tumblers	Reduces plastics and debris prior to curing or deployment.
Optional Cleaning Equipment	Shell tumblers, rotary washers, water jets	Removes fines and organics; beneficial for hatchery or centralized processing.
Biosecurity Controls	Secure site access, fencing, pest control; avoid flood-prone areas	Prevents illegal dumping, scavenging, and vector attraction.
Site Accessibility	Adequate access for trucks, trailers, and loaders	Supports safe and efficient collection and transfer operations.
Batch Tracking & Documentation	Unique batch IDs for each load and pad; Maintain curing logs and movement records	Tracks source, date in/out, contamination deployment; Supports audits, reporting, and QA/QC
Capacity Planning	Size site to accommodate seasonal peaks and full curing retention time	Prevents overflow, crowding, and operational bottlenecks.

End-uses & deployment techniques

Recycled shell supports a wide range of restoration end-uses and deployment techniques, depending on project goals, site conditions, and shell quality. Common applications include spat-on-shell production in hatchery settings, where clean and screened shell is essential; loose shell placement for intertidal and subtidal reef construction to create complex, three-dimensional habitat; and bagged shell reefs used for shoreline stabilization and volunteer-based projects. Recycled shell is also incorporated into living shoreline designs, often paired with coir logs, jute fiber, or biodegradable mats to enhance sediment capture and erosion control, and may be used for hatchery broodstock or aquaculture when properly cured and conditioned.



Deployment methods range from large-scale broadcast placement using barges and water cannons for subtidal reefs, to hand-bagging and volunteer installation for intertidal and shoreline projects, as well as precision placement using cranes, conveyors, or cast systems in high-value sites. Hatchery enhancement may utilize trays, racks, or off-bottom systems. While these practices fall within the restoration phase, which is not the primary focus of this document, they illustrate how recycled shell ultimately supports habitat recovery and coastal resilience.

Metrics and monitoring (what to measure, how often, and why)



Table 3: Program / Operational Metrics

<i>Metric</i>	<i>What It Measures</i>	<i>Why It Matters</i>	<i>Frequency</i>
Total shell collected (lbs, bushels, yd ³)	Volume of shell recovered from the waste stream	Demonstrates program scale, diversion from landfills, and restoration supply	Monthly and annually
Number of donor partners (restaurants, markets, events)	Participation level and geographic coverage	Tracks growth, outreach success, and network resilience	Monthly or quarterly

Collection frequency & pickup success	Scheduled vs. completed pickups and route efficiency	Supports route planning, staffing needs, and service reliability	Weekly or monthly
Contamination rate (% loads with trash)	Quality of incoming material and education effectiveness	Identifies training needs and operational inefficiencies	Ongoing / per load
Curing inventory (batch ID, volume, start date)	Shell currently in curing and readiness timeline	Supports biosecurity, traceability, and deployment planning	Continuous
Volunteer hours & events	Community engagement and labor contribution	Demonstrates outreach return on investment and grant match value	Monthly or event-based
Paid staff hours	Labor investment required to operate the program	Supports budgeting, staffing plans, and grant reporting	Monthly
Cost per bushel or per deployed yd³	Program efficiency and unit cost of operations	Informs budgeting, funding requests, and scalability analysis	Quarterly or annually
Donor retention rate & donor reporting	Consistency of restaurant participation and engagement	Supports long-term partnerships and program stability	Quarterly or annually

NOTE: ECOLOGICAL MONITORING AND PERFORMANCE

Although this document focuses on shell recycling best practices rather than restoration techniques, post-restoration monitoring is critical for demonstrating the ecological return on investment. Monitoring confirms whether recycled shell supports oyster recruitment, habitat complexity, and coastal resilience.

Practitioners should reference the *Oyster Habitat Restoration Monitoring and Assessment Handbook** (Baggett et al., 2014), which provides standardized national guidance on sampling design, performance metrics, monitoring frequency, and data management. Aligning monitoring approaches with these standardized methods improves data comparability across projects and supports adaptive management, program accountability, and long-term evaluation of restoration effectiveness.

Outreach, education, and engagement

Key audiences & messages

- *Restaurants / donors*: focus on simple benefits – landfill diversion, community good PR, monthly reports of pounds donated. Provide easy kits (tabletop pails, signage, instructions).
- *Volunteers & community groups*: “bagging days” and field installs are great engagement opportunities; emphasize hands-on restoration, measurable outcomes.
- *Local government & funders*: highlight coastal resilience, economic benefits (shoreline protection), and cost savings vs. engineered alternatives.
- *Schools & universities*: classroom modules, field days, and student research projects.

Recruitment strategies

- In-person visits for restaurants (most effective) and shell processing facilities, accompanied by a short one-page partnership agreement.
- Special events (Oyster Week, festivals) for mass recruitment and visibility.
- Social media campaigns and local press to highlight success stories and donor recognition.
- Monthly donor reports (lbs. collected, reef area supported) to sustain engagement.

Education materials

- One-page factsheets, bilingual signage (English/Spanish where applicable), short training videos for back-of-house staff, and a short checklist for acceptable vs. unacceptable contaminants.

*Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen, B. DeAngelis, J. Green, B. Hancock, and S. Morlock, 2014. Oyster habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA, USA, 96pp.

Practical checklist & troubleshooting

Start-up checklist

- Stakeholder map (regulators, donors, partners).
- Handling procedures for donors (e.g., restaurants) to ensure clean, recyclable shell material
- Site(s) identified for curing with landowner agreement.
- Vehicle and container plan (who collects what, when).
- Curing protocol documented (time, turning, drainage).
- Data template for pickups & curing batches.
- Outreach kit for restaurants & volunteers.
- Health department notification and basic insurance coverage.

Common problems & fixes

- *High contamination*: increase donor training, provide sealable buckets, schedule on-site training visits.
- *Odor complaints*: site further from homes, aerate piles more often, use sealed barrels at donors, employ commercial deodorizer when allowed.
- *Truck downtime / maintenance*: build redundancy into fleet and hire cross-trained drivers/volunteers.
- *Spikes in interest but limited capacity*: set minimum annual donation thresholds and prioritize large donors or clustered donors to maximize efficiency.
- *Insufficient cured shell*: plan mixed substrate projects and use alternative substrates for certain sites.

Final recommendations (practical priorities)

- *Start small, scale deliberately*. Pilot a few donor routes and one secure curing pad before expanding.
- *Standardize measurements*. Use consistent units (lbs. and yd³) and a simple database to track donors, contamination, and curing batches.
- *Engage regulators early*. Pre-application meetings speed permitting and reduce later obstacles.
- *Prioritize community fit*. Reduce neighbor friction through smart siting and proactive communication.
- *Measure both program and ecological outcomes*. Fund monitoring from project inception; it is key to adaptive management and fundraising (see [Baggett et al., 2014](#)).

Permitting Guidelines

Shell recycling and oyster reef restoration involve regulated activities that require permits and approvals to protect public health, water quality, navigation, and sensitive habitats. Oversight typically involves state environmental and marine resource agencies, and in many cases federal agencies, with requirements varying based on project location, scale, and how shell is ultimately used.

Core Permits and Regulatory Reviews

Programs that only collect, cure, and store shell generally face fewer regulatory requirements than projects that place shell or other materials into tidal waters. Once shell is deployed for reef construction, living shorelines, aquaculture, or research, additional permits and monitoring obligations usually apply. Because permitting frameworks differ across Atlantic states, early coordination with state shellfish authorities, coastal permitting offices, and restoration partners is essential to confirm applicable approvals, timelines, and compliance responsibilities.

State Agencies and Typical Requirements

Each coastal Atlantic state administers its own permitting framework for shell recycling and restoration activities, with primary oversight typically shared among state Departments of Environmental Protection or Natural Resources, state shellfish sanitation authorities (often housed within health or agriculture agencies), and fisheries or marine resources divisions. Depending on the nature and location of the project, these agencies may require approvals such as Section 401 Water Quality Certifications to ensure compliance with state water quality standards; shellfish sanitation authorization verifying that shell is properly cured and pathogen-free; Coastal Zone Management Act (CZMA) consistency determinations; coastal or marine habitat permits approving restoration methods and sites; state aquaculture permits when shell is used in mariculture; and, where applicable, public bottom leases authorizing the use of state-owned submerged lands. Early coordination with these agencies helps clarify requirements, timelines, and responsibilities before program implementation.

FEDERAL AGENCIES COMMONLY INVOLVED

U.S. Army Corps of Engineers (USACE)

- Regulates placement of materials in navigable waters and wetlands ([Section 10 / Section 404](#)).

U.S. Environmental Protection Agency (EPA)

- Oversees water quality protections and [Section 404 program review](#).

NOAA Fisheries

- Reviews impacts to [Essential Fish Habitat](#) and protected species

U.S. Food and Drug Administration (FDA)

- Provides [National Shellfish Sanitation Program](#) (NSSP) guidance informing shell curing standards.

Table 4: Typical Permitting Pathway by Program Activity

Program Activity	Enabling Authorities	Permits / Reviews	Notes
Shell Collection (restaurants, events)	Local / municipal	Business operations, waste handling rules (if applicable)	Generally low regulatory burden; contamination control and sanitation practices are important
Shell Storage & Curing	Local zoning, state shellfish sanitation authorities	Local land-use approvals; shell sanitation guidance (NSSP-based)	Storage location, odor control, drainage, and vector management may trigger local review.
Shell Transport	State DOT / local transportation rules	Vehicle weight limits, hauling requirements	Mostly operational compliance.
In-Water Shell Placement (e.g., reef restoration, living shorelines)	State coastal agencies + Federal agencies	Clean Water Act Section 404/10 (USACE) ; State Water Quality Certification (401); Coastal Zone approvals; habitat permits	Most restoration projects qualify for Nationwide Permits , but sensitive sites may require individual permits
Aquaculture or Hatchery Use	State aquaculture and shellfish agencies	Aquaculture permits; sanitation approvals	Shell quality and traceability are especially important.
Monitoring & Long-Term Compliance	State and federal permitting agencies	Monitoring plans required under permit conditions	Monitoring duration and intensity vary by project scale and habitat sensitivity.

Common Permitting Challenges

Practitioner Insights

- Upland curing and storage sites may require local zoning or operational approvals.
- Sanitation requirements vary slightly by state – always confirm guidance with your shellfish authority.
- Permit timelines can range from weeks (general permits) to months (individual permits).
- Monitoring requirements are increasingly standard and long-term site tracking should be planned and budgeted early.
- State frameworks differ substantially, even for similar project types.

Permitting Variability Across States

Although the federal framework is consistent, state-level differences significantly affect the permitting process:

Florida

[Florida Department of Environmental Protection \(FDEP\)](#) and [Florida Fish and Wildlife Conservation Commission \(FWC\)](#) are primary regulators. Projects often fall under [State Programmatic General Permits \(SPGPs\)](#) issued by USACE and administered jointly with FDEP. The [Florida Department of Agriculture and Consumer Services \(FDACS\)](#) manages shellfish sanitation and requires shell curing in accordance with NSSP standards.

Georgia

Shell recycling and reef restoration are permitted through the [Georgia Department of Natural Resources \(GADNR\)](#). GADNR coordinates closely with the Coastal Resources Division and the [Georgia Coastal Management Program](#), which oversees habitat and shoreline activities. Georgia's permitting is relatively centralized, with strong coordination between shellfish and coastal habitat programs.

South Carolina

The [South Carolina Department of Environmental Services \(SCDES\)](#) oversees shell curing and sanitation. The [South Carolina Department of Natural Resources \(SCDNR\)](#) issues restoration project authorizations and manages shell recycling. Permitting is streamlined through [General Shellfish Permits](#) for small-scale reef construction, but individual permits are still needed in sensitive areas.

North Carolina

Managed by the North Carolina Division of Marine Fisheries (DMF) and Division of Coastal Management. Requires [CAMA \(Coastal Area Management Act\)](#) permits for coastal projects. Shell handling follows NSSP guidance, with 6-month curing required.

Mid-Atlantic States (VA, MD, DE, NJ)

[Virginia Marine Resources Commission \(VMRC\)](#) leads oyster restoration permitting and leasing of state-owned bottomlands. The [Virginia Department of Environmental Quality \(VADEQ\)](#) manages Section 401 water quality certifications for certain activities impacting wetlands and streams.

In Maryland, the Department of Natural Resources (DNR) oversees restoration and [authorization of "shell recycling collectors"](#), with the [Maryland Department of the Environment \(MDE\)](#) issuing water quality certifications.

In Delaware, the [Department of Natural Resources and Environmental Control \(DNREC\)](#) manages restoration and waterway permits.

[New Jersey Department of Environmental Protection \(NJDEP\)](#) requires both [Tidelands](#) and [CAFRA \(Coastal Area Facility Review Act\)](#) permits for work below the mean high-water line.

New England (CT, RI, MA, NH, ME)

States like Connecticut and Rhode Island often require Shellfish Management Area permits and coordination with local shellfish commissions (see [RIDEM Permits & Licenses](#) and [CT DoAG Applications Forms and Licenses](#)). Permitting can involve town-level review (especially in Massachusetts), making the process highly site-specific.

Florida

Unlike some Atlantic states, Florida does not have a centralized, state-sponsored oyster shell recycling program. However, its history underscores the essential role of oyster shell in estuarine restoration. Historically, oyster shells from regional shucking houses were used to replenish commercially harvested reefs in places like Apalachicola Bay, where they served as critical substrate for oyster spat settlement and helped maintain reef height and structural complexity. With the rise of the half-shell market, shells are now distributed widely across restaurants and retail outlets, making collection and recovery for restoration more difficult.

Recognizing the value of oyster shells for spat settlement and growth, a network of local programs, led by Florida's NGOs, universities, and partnerships like the **Marine Discovery Center (MDC)** and the **Florida Chapter of the Coastal Conservation Association (CCA)**, has emerged to recover recycled shell for restoration. These programs collect shell from restaurants and waste partners, cure it outdoors for at least 90 days, and distribute it to restoration projects at minimal or no cost. Key contributors include MDC, Florida CCA, **Pensacola and Perdido Bay Estuary Program (PPBEP)**, and **Brevard Zoo**.

While historic relay efforts in areas like Apalachicola Bay focused on restoring subtidal reefs, much of the shell was lost to out-of-state markets. Today, most recycled shell supports smaller-scale intertidal reef construction. For larger projects, more durable substrates like limestone or oyster castles are often used to accommodate Florida's variable reef dynamics.

Florida's shell recycling efforts face several operational challenges, including equipment maintenance, staffing shortages, and long-distance hauling, especially during high-traffic summer months. Climate-related issues (e.g., maggots, odor, pests) have driven innovations in container design and the use of covered storage.

Permitting is overseen by the Florida Department of Environmental Protection (FDEP) and the U.S. Army Corps of Engineers, while restoration monitoring typically tracks metrics like live oyster density, reef footprint, sediment stabilization, and shoreline protection.

Community outreach and **volunteer engagement** are central to the programs' success, with volunteers supporting shell bagging, reef deployment, and public education. Although decentralized, Florida's network of shell recycling programs plays a huge role in restoring oyster reefs, supporting living shorelines, and enhancing coastal resilience across the state.

Marine Discovery Center “Shuck & Share” Shell Recycling Program

The [Marine Discovery Center’s Shuck & Share program](#), launched in 2014 in New Smyrna Beach, has become a cornerstone of oyster reef restoration in the Indian River Lagoon and beyond. Operating across nine Florida counties, the program has engaged more than **6,630 volunteers**, **recycled over 1 million pounds of oyster shell**, and **restored over 22,000 feet of shoreline and six acres of oyster reef**. Shuck & Share addresses two major challenges: reducing shell waste and creating a reliable, sustainable source of material for habitat restoration while building environmental stewardship through community engagement.



Branded “Shuck & Share” Bucket on oyster pile. Credit: Tess Sailor-Tynes (MDC)

The program collects approximately **1,000 bushels of shell annually** from 10 to 12 restaurants and various community events, with pickups occurring weekly to monthly depending on location and volume. Shell is stored in cubic yard dumpsters or lidded 5-gallon buckets, then cured for at least six months in accordance with NOAA and FDACS (Florida Department of Agriculture and Consumer Services) guidelines before being deployed in shoreline stabilization and reef enhancement projects. Around **80% of recycled shell is oyster**, with the remainder consisting of clams, scallops, and other species. Shell weight is tracked in pounds to monitor collection volumes.

Shuck & Share’s success relies on strong regional partnerships and consistent community involvement. More than **1,000 volunteers participate annually** in shell bagging, reef installation, and outreach events. Bagging is conducted on-site at MDC, with deployments carried out by students, civic groups, and other local collaborators. The program is supported by grants from the Indian River Lagoon National Estuary

Program, the Florida Fish and Wildlife Conservation Commission, and other funders, and operates in close collaboration with partners including FWC, CCA, Brevard Zoo, FDEP Parks and Recreation, St. Johns River Water Management District, WastePro, and the University of Central Florida, among others.

To minimize environmental impact, Shuck & Share has adopted innovative restoration materials such as biodegradable jute fiber and bio-starch-based BESE mats. Challenges like odor, shell contamination, and limited curing space are addressed through a combination of staff training, sealed containers, and site maintenance. While the program does not benefit from direct state recycling incentives, it has successfully leveraged local support and small grants to maintain and expand its impact. Through its science-based approach and strong public engagement, Shuck & Share continues to enhance Florida's estuarine health – proving the lasting power of community-driven conservation, one oyster at a time.

For more information and a full list of partners, visit: [Shuck & Share | Marine Discovery Center](#).

Coastal Conservation Association (CCA) Florida

[CCA Florida](#) has an oyster recycling program that started in 2017. They set up an agreement with Lake County to use a portion of their property near their landfill in Tavares, Florida for this program. More recently, CCA opened a second location at the Duke Mariculture Center in Crystal River and are working on opening other locations including in Okaloosa County. They have **deployed over 80 tons of recycled shell** back into the water in Florida estuaries and have well over 100 tons on hand currently. As with other oyster shell curing processes, CCA dries all shell out for a minimum of 6 months before donating it to partners in estuarine restoration. There is no charge for the shell and CCA delivers anywhere in the state free. Three-ton dump trailers are used for collection and transport, but 5-gallon buckets with lids and larger rolling trash cans with lids are used where dump-trailers are not feasible. CCA donations have also been part of several grant in-kind match efforts, including the upcoming Manatee River Oyster Restoration project in Manatee County with the Florida Fish and Wildlife Conservation Commission (FWC) and others. Further inquiry may be made at: [2020 Habitat Update - CCA Florida](#)

Pensacola and Perdido Bay Estuary Program (PPBEP)

PPBEP is focusing efforts to restore large-scale oyster reefs in Pensacola Bay, including **up to 1500 acres of subtidal oyster reefs**. In August 2024 they launched a full-scale oyster recycling program covering the Pensacola and Perdido Bay systems by engaging with area restaurants to collect shucked oyster shells and keep them out of area landfills. This effort was initially funded by a \$351,000 NOAA grant. The PPBEP partners with OysterCorps led by Franklin's Promise Coalition, which provides the person-power through engagement with local youth in coastal restoration workforce training efforts. Shucked shell is picked up regularly from area restaurants and transported to curing locations, where partners can obtain properly cured shell for restoration and resilience projects. In the short time this program has been in existence, **over 25 tons** (or about the same weight of a fully loaded semi-truck) of oyster shell has been recovered and is curing. For more information, please see: [Pensacola & Perdido Bays Estuary Program](#).

Brevard Zoo “Restore Our Shores” Shell Recycling Program

The Brevard Zoo's shell recycling program, launched in 2016 as part of its [Restore Our Shores](#) initiative, supports oyster reef restoration throughout Florida's Indian River Lagoon. It partners with the Shuck & Share initiative and collects approximately **1,500 to 2,000 bushels of oyster shell annually** from 17

active restaurants and **5 public drop-off sites**, with weekly collections handled by Zoo-operated vehicles. Shells are cured for a minimum of **6 months** at the Zoo's dedicated storage yard, which has the capacity to hold up to 1,000 bushels at a time, in compliance with Florida Department of Agriculture and Consumer Services (FDACS) sanitation guidelines.

Recycled shells are primarily used in bagged shell reef structures for shoreline stabilization and spat-on-shell projects in collaboration with local hatcheries. Data is tracked to measure shell volume, partner participation, and restoration outcomes. The program's restoration projects have contributed to the creation of several new oyster reef habitats across multiple sites within the lagoon.



Left side: Brevard Zoo shell collection pick-ups. Right side: “Restore Our Shores” informational kiosk at the Indian River Bar & Grill. Credit: Brevard Zoo

The program also places a strong emphasis on community engagement, involving hundreds of volunteers annually in shell bagging events, reef deployments, and public education. Partnerships with municipalities, FDACS, and the Indian River Lagoon National Estuary Program help expand the program's impact. While challenges such as **odor, limited curing space, and shell contamination exist**, Brevard Zoo addresses these through **restaurant staff education, use of lidded containers, and on-site sorting by staff and volunteers**. The Brevard Zoo's program demonstrates how regionally focused shell recycling efforts can meaningfully contribute to Florida's broader habitat restoration goals.

Looking Ahead

Florida's oyster recycling programs aim to expand their reach through additional partnerships, regional franchising, and innovative restoration techniques. Shuck & Share plans to continue introducing biodegradable materials and scaling restoration efforts statewide. PPBEP aspires to **restore up to 1,500 acres** of subtidal oyster reefs in Pensacola Bay. CCA Florida is working towards opening new recycling centers and supporting more large-scale projects like the Manatee River Oyster Restoration initiative. Florida's shell recycling initiatives demonstrate the power of community-driven conservation. By combining science, education, and collaboration, these programs not only restore vital oyster habitats but also foster resilience in Florida's coastal ecosystems for future generations.

Georgia

Georgia is home to approximately one-third of the remaining coastal salt marshes along the U.S. East Coast. Intertidal oyster reefs play a critical role in protecting these marshes from shoreline erosion by dissipating wave energy from boat wakes and tides. Oysters also serve as a valuable food source for humans and a wide variety of wildlife.

Georgia's oyster populations were once the most productive in the nation but have experienced a dramatic decline since their peak in the early 1900s when the state harvested nearly eight million pounds of oyster meat annually. By the 1930s, overharvesting and deteriorating environmental conditions had led to a widespread collapse of Georgia's reefs. Today, recovery is challenged not only by the ongoing threats of habitat degradation and disease, but also by a lack of suitable substrate for larval oyster settlement.

Georgia DNR "We Recycle Shell" Program

To address the decline in oyster populations, the [Georgia Department of Natural Resources \(GADNR\)](#) and University of Georgia Marine Extension and Georgia Sea Grant launched a statewide, community-based initiative called "[We Recycle Shell](#)". The program diverts oyster shells from landfills and returns them to coastal estuaries to serve as essential substrate for reef restoration and oyster recruitment. Originally established in 2004 under the name *Generating Enhanced Oyster Reefs in Georgia's Inshore Area (G.E.O.R.G.I.A.)*, the initiative has grown into a critical component of the state's oyster reef restoration strategy.

In collaboration with the nonprofit Shell to Shore, Inc., the program coordinates staff, volunteers, and equipment to manage collection and distribution of recycled shell across the state. Shell is gathered from 33 participating restaurants, six public recycling centers, and large-scale oyster roasts upon request. Collection frequency ranges from weekly to monthly, depending on volume and location. Approximately **2300 bushels (1 bushel = 2150.42 in³; dry weight = 76 lbs.)** are collected annually.

Restoration

Collected oyster shells are transported to centralized DNR sites for curing, then used in living shoreline projects, non-harvest restoration areas, recreational harvest zones, and academic research focused on reef restoration and sustainable shellfish management. The program uses digital databases to track shell volumes throughout the collection and storage process.

Monitoring includes both pre- and post-restoration assessments, with metrics such as live oyster density, sediment stabilization, and shoreline erosion reduction. While infrastructure constraints and labor costs remain ongoing challenges, *We Recycle Shell* continues to optimize its logistics to expand impact and promote public awareness of the ecological and economic importance of oyster reefs along Georgia’s coast.

One notable project, initiated in 2025, is the restoration of Teakettle Creek. This effort will use **594,000 lbs.** (appx. 360 cubic yards) of both recycled and purchased shell, making it Georgia’s largest oyster restoration project to date. The project site is located within a recreational shellfish harvest area in McIntosh County that primarily services underserved local communities.



Bagged oyster shells from shell recycling program being deployed via wooden pallets onto the bank of the North Newport River, Georgia as part of an oyster restoration project. Credit: Tyler Jones (GADNR)

Challenges and Solutions

“We Recycle Shell” faces three main challenges: funding, distance, and restaurant participation. The program relies heavily on federal grants, resulting in significant fluctuations in its operating budget. Adding to these financial constraints, many participating restaurants are located a great distance from the coast, making shell transportation both difficult and expensive. For example, the program collects shells from a restaurant on the northwest side of Atlanta, approximately 280 miles from the coast. Since participation in the program is voluntary many restaurants closer to the coast choose not to participate, further complicating collection efforts.

Success of the “We Recycle Shell” program is measured by tracking the pounds of shell collected, either estimated by volume or weighed on scales at truck stops. Like many states, Georgia experienced a decline in shell collection during and immediately after the COVID-19 pandemic due to widespread restaurant closures. However, collection rates have been steadily increasing. **In 2023, the program collected 143,190 lbs.** of shell, enough to restore approximately 780 feet of oyster reef along Georgia's shoreline.

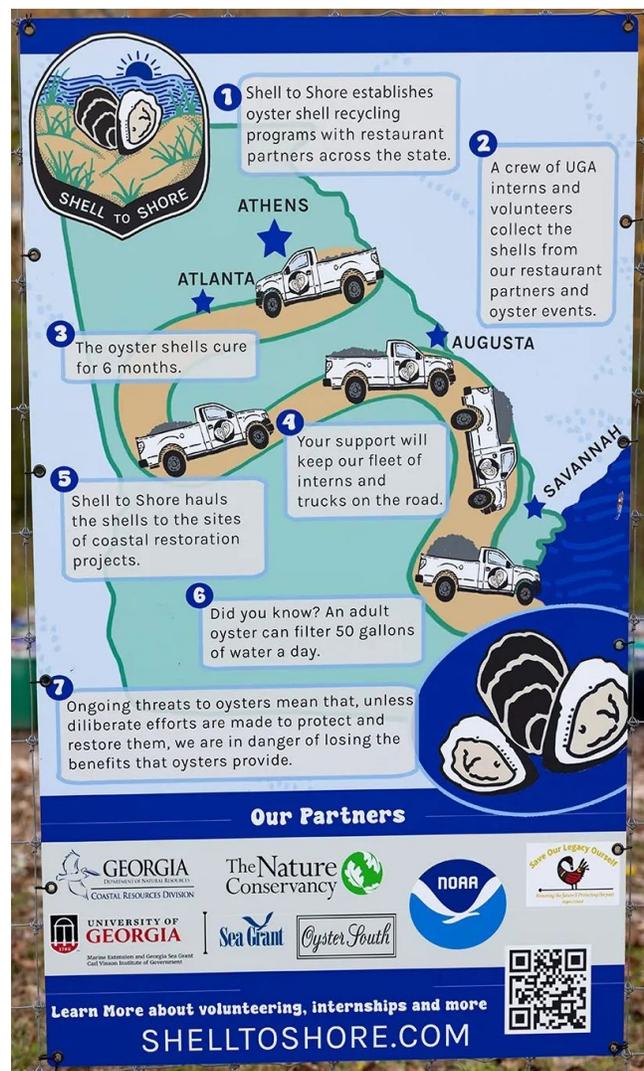
In 2024, “We Recycle Shell” experienced rapid growth, adding new restaurants and recycling centers with the support of a NOAA grant. This funding also enabled the hiring of an Oyster Shell Recycling Program Coordinator and the purchase of essential equipment and supplies. Over the next year, the program plans to launch an outreach campaign to build public support for shell recycling and encourage consumers to support participating restaurants. For more information please [We Recycle Shell](#), or contact the Georgia oyster shell recycling collective at werecycleshell@gmail.com.

Shell to Shore, Inc.

[Shell to Shore, Inc.](#), by contrast, is a community-based nonprofit shell recycling initiative focused on smaller coastal communities. It offers tailored pickup schedules for restaurants and emphasizes education and public engagement. Shell to Shore, Inc. is part of the larger “We Recycle Shell” collaborative and relies heavily on volunteers and community science (e.g., manual logs and spreadsheets) to track shell volume and assess restoration outcomes. While funding is a top concern, the program experiences additional challenges related to public awareness, outreach, and volunteer coordination. Its priority improvements include expanding education efforts and streamlining collection logistics.

Shell to Shore collaborates with local governments and coastal engineers to ensure permitting compliance and uses both cured shell and innovative substrates like crushed concrete in pilot projects. Education and outreach are central to its mission, and program evaluation incorporates ecological as well as community-based success metrics.

Together, these programs offer complementary strengths – pairing government-backed infrastructure with grassroots advocacy – to advance shell recycling and oyster reef restoration throughout coastal Georgia.



Shell to Shore infographic. Credit: Shell to Shore

South Carolina

Oysters are a cornerstone of South Carolina’s coastal identity, and the state has long recognized the ecological, economic, and cultural importance of its oyster populations. [The South Carolina Department of Natural Resources \(SCDNR\)](#), tasked with managing the state’s shellfish resources since 1986, oversees this invaluable resource. Approximately 95% of South Carolina’s oyster populations inhabit the intertidal zone, making them easily accessible to commercial and recreational harvesters. The state’s oyster industry is the fourth most economically important fishery, and the top three—shrimp, crab, and finfish—all depend on oyster reefs at some point during their life cycles. Each year, approximately 100,000 bushels of oysters are commercially harvested in South Carolina, while recreational harvests add another 35,000 bushels. With an additional 100,000 bushels imported annually, nearly 235,000 bushels of shell are available for potential recycling, yet only 12–13% historically have been reclaimed. To meet restoration needs, SCDNR often supplements its supply with shell sourced from out-of-state shucking houses.

The South Carolina Oyster Recycling and Enhancement (SCORE) Program

SCDNR launched its Shell Recycling Program in 1999, beginning with the collection of shells from community roasts and local restaurants in the Charleston area. In 2001, the program evolved into the [South Carolina Oyster Restoration and Enhancement \(SCORE\)](#) initiative, later rebranded in 2018 to reflect its broader focus on Recycling. Based at SCDNR’s Marine Resources Division in Charleston, SCORE engages communities statewide, educating the public about the critical role oysters play in coastal ecosystems and providing hands-on opportunities for participation in restoration activities.

Today, SCDNR SCORE and its partners provide free shell recycling services to 90 restaurants and maintain 34 public drop-off sites across eight counties. SCDNR works with various municipalities and entities to host the public drop-off sites on non-SCDNR properties. These locations are conveniently



Volunteers deploying oyster bags. Credit: SCDNR

located throughout the state and provide most of the shell recycled annually. Recycling bins and dump trailers are also delivered to catered events during the oyster roast season, which typically runs from October through May. These efforts are bolstered by annual outreach campaigns and marketing materials distributed at seafood markets and local businesses, ensuring widespread awareness and

participation. As a result, the program has steadily grown, recycling over **40,000 bushels of shell in 2024** alone, compared to just a few hundred in its first year.

Restoration

Recycled oyster shells are used to restore state-managed habitats, with **35,000–50,000 bushels deployed annually** to mitigate the impacts of harvesting. Shell is also deployed strictly for the ecosystem services they provide with the community restoration team using volunteers. Since 2001, more than 800,000 bushels have been used to create new reefs and enhance existing ones. These efforts have built approximately **7.2 acres** of oyster habitat, with community involvement playing a central role. **Over 48,000 volunteers** have contributed more than 109,000 hours to restoration activities, reflecting the strong conservation ethic fostered by the SCORE program.

The program tracks progress by documenting the volume of shell (in bushels) collected during each pickup from restaurants, roasts, and public drop-off bins. Under South Carolina law, bushels are defined as eight dry gallons, 2150.42 cubic inches, or 50 pounds. Oyster restoration areas created with recycled shells are continuously **monitored for recruitment, growth, and footprint changes over a three-year period**. South Carolina’s comprehensive and community-driven approach to shell recycling demonstrates the power of collaboration and innovation in achieving sustainable conservation outcomes.

Challenges and Solutions

Despite its success, the SCORE program faces logistical challenges, particularly in areas outside Charleston, where all SCDNR staff are based. Volunteer-staffed satellite programs have successfully recycled shells for years, yet managing these teams is difficult due to staff turnover and the distance from Charleston. A dedicated volunteer and restaurant coordinator in satellite locations is essential to sustaining these efforts.

Partnerships play a critical role in addressing these challenges. [The Outside Foundation](#), a nonprofit focused on environmental stewardship and outdoor education for children, collaborates annually with SCDNR to enhance shell recycling and restoration efforts in Hilton Head and Bluffton. With grant funding, the Foundation partners with I2 Recycling to manage local shell collection which has greatly improved the program’s efficiency and impact in the southern coastal region of the state.

Funding limitations remain a challenge, as the program primarily relies on sales of the Saltwater Recreational Fishing License, which can make acquiring equipment and hiring additional staff difficult.



Fortunately, the [Coastal Conservation Association – South Carolina \(CCA-SC\)](#) have been a longtime supporter of the SCORE Program by donating equipment, including dump trucks, hydraulic trailers, vessels, and materials for new public drop-off bins.

Public awareness and participation are also critical to the program’s success but remain a barrier. Surveys reveal that many people do not recycle shells because they are unaware of drop-off locations or the importance of recycling. To address this, SCDNR launched a targeted marketing campaign in 2019 and continues to update and distribute educational materials annually. These materials emphasize the value of recycling and provide clear information about drop-off locations to make participation more accessible.

Looking Ahead

Expanding shell recycling and oyster restoration to the northern coast of the state has been a long-term goal. The program is steadily working to raise awareness, engage with the restoration community, and develop grassroots initiatives to support expansion. Constructing new public drop-off locations to make recycling more convenient remains a priority. In 2025, the program will receive a new dump truck to improve the transport of large shell quantities from drop-off locations to holding facilities.

North Carolina

In North Carolina, despite some signs of recovery in recent years, oyster stocks are estimated to be just 15–20% of their historical harvest levels. Harvest data is currently the best indicator of oyster abundance in the state ([NC Eastern Oyster Fishery Management Plan](#)).

Oyster shell recycling in North Carolina is a partnership-driven initiative led by the [North Carolina Coastal Federation \(NCCF\)](#), a nonprofit organization that focuses on protecting and restoring the North Carolina coast. They work closely alongside the [North Carolina Department of Environmental Quality’s Division of Marine Fisheries \(NCDMF\)](#), [Albemarle Pamlico National Estuary Partnership \(APNEP\)](#), and many other partner organizations.

Shell recycling in North Carolina was originally run by NCDMF, from 2003 to 2013, using funds provided by the state legislature. From 2013 to 2018, NCDMF ran a scaled-down program with limited grant funding that provided drop-off locations for collecting the shell. While operating, the program provided 6-15 percent of the needed material for restoration activities. Unfortunately, due to funding cuts and staff reductions, the state program was ultimately discontinued in 2018, and all state-run oyster shell recycling centers were removed.

The North Carolina Coastal Federation

NCCF relaunched shell recycling efforts in 2020, aiming to provide 5% of the shell material needed to support oyster restoration. To get the material that is needed to build reefs, shells are often bought from shucking houses and delivered to project sites for a fee (in 2024 it typically costs \$3 per bushel plus transportation for shells in North Carolina). A recycling program thus provides a critical alternative for shells often discarded in landfills and gives both restaurants and consumers a chance to return their shells to the water and contribute to sustaining oyster populations. The program recycles about 8,900 bushels of shell for reef restoration annually. In 2023, the Federation recycled **9,434 bushels** of shell.

Restoration

Recycled shells are used to build reefs that serve as habitats for future oyster generations, with mature oysters becoming harvestable within a few years. These reefs also improve water quality, bolster coastal resilience, and support a variety of recreationally and commercially important fisheries. Primary destinations for recycled shell include estuarine reefs, with a goal of restoring 20 acres in the southern region and 5 acres in the north. Additional goals of the Federation-led program include collaborating with the Managed Areas Workgroup to prioritize growing areas for reef restoration; developing a list of sites, goals, and design recommendations for restoration projects in each area; and seeking grants and other funding sources to support project implementation and related monitoring efforts.

NCCF and NCDMF have built a strong partnership to restore oyster reefs across the state. In 2023, the two organizations constructed 23.22 acres of oyster sanctuary in Pamlico Sound using marl limestone rather than shell. Since 2016, this collaboration has expanded significantly, resulting in the creation of four large-scale sanctuaries (75–125 acres each) in addition to earlier efforts dating back to 1996. The sanctuary reefs represent only about 6 percent of the oyster reef footprint in the Pamlico Sound, but they produce about 25 percent of the Sound’s oyster larvae which are dispersed by currents and settle along North Carolina’s shore. These projects have been supported by a diverse set of funders, including NOAA, the NC General Assembly, USACE, the Albemarle-Pamlico National Estuary Partnership, The Nature Conservancy, NC DOT, and several state agencies.

In parallel, NCDMF operates a long-standing cultch planting program (initiated in 1915) that builds low-relief oyster habitat open to commercial harvest. In 2023, the program established 38.1 acres of cultch reefs using 24,150 bushels of shell and 317,923 bushels of limestone marl, funded primarily through state appropriations.

Monitoring is conducted by NCDMF through SCUBA surveys on sanctuaries and hydraulic tong grabs on cultch reefs to track oyster density and reef performance. Sanctuary reefs are estimated to support over 350 million oysters, based on extrapolated densities across reef materials and footprints, underscoring the large-scale ecological impact of these efforts.

Program success is measured by bushels of shell collected, acres of reef established, and the number of oysters monitored. The 2023 milestones demonstrate the program’s impact, but the Federation and its partners continue to seek innovative solutions to expand shell recycling and restore more oyster reefs across North Carolina’s estuarine waters. Through collaboration, education, and resourceful planning, the state’s oyster shell recycling program is laying the foundation for healthier marine ecosystems.

For more detailed information visit: [Oyster Restoration and Protection Plan for North Carolina: A Blueprint for Action 2021-2025 \(Full Report & Summary\)](#)

Community Engagement

Building community awareness is essential for the program’s sustainability and success. The Federation has created educational materials, including social media toolkits, videos, and infographics, to highlight the importance of shell recycling. Engaging restaurants and seafood markets by offering reliable and convenient collection services is essential and helps to simplify participation and build long-term partnerships.

North Carolina’s oyster shell recycling program is a collaborative solution to restore vital habitats and support coastal ecosystems. Despite logistical and funding challenges, the program’s progress in recycling shells, restoring reefs, and fostering community involvement underscores its potential for long-term impact. For more information about North Carolina visit: [Coastal Review | A Daily News Service of the North Carolina Coastal Federation](#).

Challenges and Solutions

North Carolina’s vast geography complicates shell collection and transport. While large metropolitan areas like Raleigh, Charlotte, and Durham generate significant shell volumes, logistics make transporting them to the coast challenging. Current recycling efforts are concentrated in three coastal regions: the Outer Banks, Morehead City, and Wilmington. The Federation works with contractors to stockpile shells near urban centers and transport them to coastal sites when volumes justify hiring tractor-trailers.

A key challenge for the NCCF program is not public awareness, but rather public participation, as awareness of oyster restoration is already strong in North Carolina. Another major issue is the competition for limited shell resources, both within the state and across state lines. Funding also ranks among the top challenges, while staffing and logistics – though present – are viewed as more general operational issues and less critical to shell recycling specifically. The state-run program (i.e., NCDMF), active from 2003 to 2018, was ultimately discontinued due to budget cuts and shifting priorities. Under the current Federation-run program, funding relies on grants and program fees, which can be inconsistent. Grants are



Recycle for Reefs infographic on 5x7" postcard. This promotional material is used at Seafood Markets and outreach/engagement events. It features a QR code to view public drop-off locations. Credit: NCCF

often unpredictable and focused on program initiation rather than maintenance. Currently, three part-time staff (0.25 FTE each) oversee coastal shell recycling. Expanding to urban areas will require additional personnel and financial resources, thus a cost-effective analysis is needed to balance participant fees with sustainable program management. While grant funding has been instrumental in launching efforts, securing long-term financial stability remains critical to expanding the program's reach.

Virginia

Virginia has multiple active shell recycling programs that collectively serve both urban and rural coastal areas, all with the shared goal of restoring oyster reefs in the Chesapeake Bay and its tributaries. These include initiatives coordinated by academic institutions, nonprofits, government agencies, and community groups. Most shell collected is from oysters and is gathered primarily from restaurants, seafood festivals, and community drop-off events.

Collection frequency varies by program and donor density, ranging from weekly in urban hubs to monthly or event-based in more rural areas. Collected shell is transported in large containers or dumpsters to centralized curing sites, where it is either deployed directly for reef construction or seeded with oyster larvae. Most programs rely on weight (pounds) or volume (cubic yards) to track performance.

Outreach and education programs are central to Virginia's efforts, engaging volunteers to help reduce contamination from food waste and trash, but also raise awareness about the ecological importance of oyster reefs. Permitting for shell use is generally managed at the state level through the Virginia Marine Resources Commission (VMRC), and post-restoration monitoring includes metrics such as live oyster density, spat recruitment, and reef persistence. Despite challenges related to shell contamination, curing space limitations, and long-term funding, Virginia remains a regional leader in community-driven shell recycling and oyster habitat restoration.

Active Shell Recycling Programs in Virginia

Virginia Oyster Shell Recycling Program (VOSRP)

- Operated by the Virginia Commonwealth University (VCU), VOSRP collects thousands of bushels of oyster shell annually from festivals, public drop-off sites, and their extensive restaurant collection routes for use in reef restoration and spat-on-shell aquaculture.

Lynnhaven River Now – Save Oyster Shell (S.O.S) Program

- A local initiative in the Virginia Beach area that engages restaurants and the public in shell recycling for use in the restoration of the Lynnhaven River oyster reefs.

Elizabeth River Project – Shell Collection

- Part of a broader environmental restoration effort in the Elizabeth River watershed, the project includes shell recycling for shoreline stabilization and reef-building efforts.

Chesapeake Bay Foundation – Oyster Restoration Center

- While primarily focused on restoration and spat production, this facility also participates in shell recycling efforts to support living shoreline and reef projects.

James River Association – Oyster Shell Recycling

- Conducts localized oyster shell drives and participates in community restoration activities throughout the James River watershed.

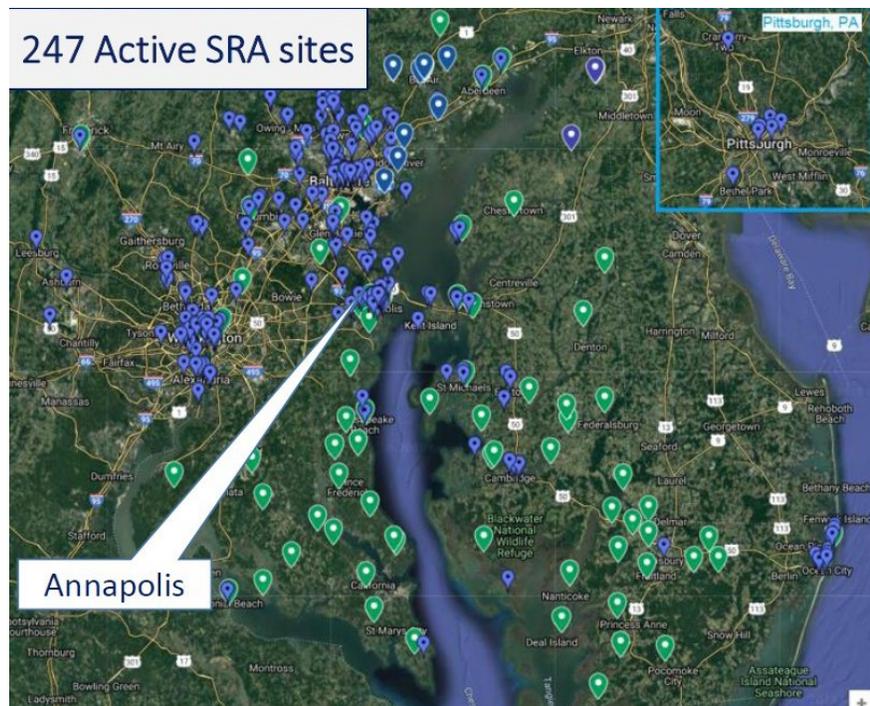
Maryland

Maryland has a robust shell recycling program coordinated primarily through the [Oyster Recovery Partnership \(ORP\)](#). The organization has been dedicated to restoring oyster habitats in Maryland's Chesapeake Bay for over 30 years. Central to this effort is the [Shell Recycling Alliance \(SRA\)](#), which ORP launched as a pilot program in 2010. The SRA addresses the critical shortage of oyster shells which are essential for oyster reef restoration, as shells provide the necessary surface for young oysters, or "spat," to grow. Since its inception, the program has successfully recycled over 330,000 bushels of shell that would have otherwise been discarded in landfills.

The Oyster Recovery Partnership Shell Recycling Alliance

The Shell Recycling Alliance (SRA) began as a pilot project serving the Baltimore, Annapolis, and Washington, D.C. areas, partnering with 32 restaurants and six public drop-off sites. Initially, shell was collected using a repurposed Ford F250 and 5-gallon buckets. As the program expanded, ORP adopted larger containers and dumpsters to improve efficiency. By 2024, the SRA had grown to include 166-member pickup sites, 81 drop-off locations, and 18 volunteer-run stations across Maryland, Pittsburgh, and Northern Virginia, collecting **27,000–36,000 bushels of shell annually**.

ORP's logistical operations are extensive, involving 8 different shell collection routes that service both high- and low-volume shell generators. These include 4 bi-weekly "day trips" and four longer routes requiring large-capacity vehicles for hook-and-go pickups. Partnerships with wholesale seafood distributors and contributions from seasonal events help the SRA provide approximately 30% of the shell needed for ORP's annual restoration projects. Other uses for recycled shell include aquaculture, water quality improvement, public education and outreach, and general waste reduction.



Shell Recycling Alliance (SRA) Shell collection routes. Credit: Oyster Recovery Partnership

Shell Collection and Transport Logistics

ORP operates one of the largest shell recycling networks on the U.S. East Coast, with **over 300 participating restaurants** and seafood businesses. **Eight shell collection routes** support the operation, including **four bi-weekly local routes** and four longer hauls using large-capacity vehicles. **High-volume sites in D.C.** are visited **up to two times a week**, while additional pickups cover Maryland suburbs and Northern Virginia. Route schedules are adjusted and optimized based on historical shell volumes and restaurant input to maintain efficiency and meet Department of Transportation standards.

Shells, mostly oysters (over 90%), are **collected weekly** and weighed in pounds to track donor performance and seasonal trends. Other collected shells include clams, scallops, mussels, and whelk. Shells are **stored in 30 cubic yard dumpsters** and remain wet, weighing around 1,000 lbs. per cubic yard. Once cured, they weigh approximately 730 lbs. per cubic yard.

Shells are **transported to a central curing site** across the Chesapeake Bay, a process challenged by summer beach traffic, long workdays, and vehicle maintenance demands.



*Dumping shell collected from restaurants at the main shell pile.
Credit: Oyster Recovery Partnership*

Trash Mitigation

About 80% of shell collections contain some level of trash or debris. ORP addresses this through a multi-stage strategy: educating restaurant staff to reduce contamination at the source, removing debris during transport and dumping, organizing community cleanup events that involve volunteers, schools, and scouts, filtering trash during the washing process at the Horn Point Hatchery, and conducting final cleanups before reef deployment. ORP is also exploring the use of a Vermeer airlift system to separate lightweight trash from shell.

Curing and Storage Practices

Shells are cured for at least 12 months, as required by Maryland regulations. They are not turned during this time, relying instead on sun exposure and weathering. After curing, shells are washed in an industrial shell tumbler. Curing sites include coastal restoration facilities, public lands, and nonprofit or municipal properties. The biggest factor in site selection is finding a secure space where shells can sit undisturbed for the full curing period.

Restoration and Monitoring

ORP tracks several ecological and operational indicators to evaluate the success of its shell recycling and restoration efforts:

- **Volume of Shell Recycled:** The total volume of recycled shell by participating SRA members or public drop-off site is tracked to the nearest bushel amount annually. The number of bushels is documented on datasheets and entered into the SRA relational database to track shell volume trends by location.
- **Spat-on-Shell Production:** The recycled shell is used as setting material in hatchery-based spat-on-shell operations. These hatchery-produced oysters are later deployed to restoration sites to increase reef density.
- **Acreage Restored:** One of ORP's key metrics is the total area of reef habitat restored using recycled shell and hatchery-produced oysters. ORP collaborates with the Maryland Department of Natural Resources (DNR), The National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers (USACE) Baltimore District to plan restoration activities and track spatial restoration targets.

Restoration sites are monitored for more than 6 years through collaborations with state and academic partners and include:

- **Live Oyster Density:** Regular field assessments are used to measure live oyster survival and density on restored reefs.
- **Spat Recruitment:** Natural and hatchery-enhanced spat settlement is tracked to evaluate reef productivity and long-term sustainability.
- **Reef Persistence & Habitat Function:** Physical stability and biological use of restored reefs are monitored to assess structural integrity and habitat value over time.
- **Water Quality & Sediment Stabilization (site-dependent):** In some locations, restoration projects supported by SRA shell are also evaluated for their impact on water clarity and shoreline erosion.

ORP also contributes data to statewide oyster restoration efforts to support adaptive management.

Outreach and Community Engagement

ORP engages the public and restaurant partners in its SRA program through a combination of print materials, social media, public events, and restaurant staff training. Recruiting new restaurant partners is largely driven by word-of-mouth or staff turnover, where individuals familiar with the program bring it to new establishments. While email, phone calls, and in-person visits were important during the program's initial rollout, organic growth through community networks now plays a more significant role.

To incentivize participation, Maryland previously offered a \$5 per bushel tax credit (up to \$1,500 annually) to restaurants between 2013 and 2022. Although this incentive was intended to retain large shell donors, relatively few restaurants actually claimed the credit, resulting in a minimal impact on overall shell volume. In 2022, a grant program replaced the tax credit, offering up to \$2,000 for businesses and

\$250 for nonprofits/community groups (see: [§ 4-1019.1. Annual grants for recycling oyster shells](#)). While the grant system provides broader access, it also requires an estimated \$100,000 in annual state funding. Expanding participation without parallel infrastructure growth could overextend current collection capacity.



Oyster cage building event. Credit: Oyster Recovery Partnership

ORP recommends that states considering similar incentives set minimum donation thresholds, increase grant caps, and consider broadening the eligibility to include individuals like shuckers and waste haulers. Smaller donors can still contribute value, particularly through public awareness or proximity to larger producers, but often aren't cost-effective from a collection standpoint.

Growth and Success of the Shell Recycling Alliance

Several strategies have supported the SRA program's growth and ongoing success:

- **Cost-Effectiveness Metrics:** ORP tracks the cost per bushel of collected shell, allowing for transparent evaluations of the program's financial sustainability.
- **Tailored Pickup Schedules:** Recognizing the unique needs of each restaurant or pickup location, high volume restaurants are prioritized with collection schedules optimized to maximize shell volume with each trip.
- **Relationship Building:** ORP engages with restaurant staff, conducts regular site visits, and recognizes top contributors to enhance retention and promote environmental conservation.
- **Technology and Data Tracking:** ORP uses an internal SRA database to track shell collection volumes and analyze program trends, which helps the team plan effective logistics and measure progress toward shell recycling goals.

- **Key Partnerships for Shell Storage:** Storing and aging shell before re-use is a vital step in the recycling process. Collaborations with state and county agencies have established aggregation sites where shell is deposited and allowed to age and cure naturally.

All recycled shell is ultimately delivered to ORP’s facility at the University of Maryland Center for Environmental Science (UMCES) Horn Point lab for use in Maryland’s large-scale restoration efforts.

Challenges and Solutions

The SRA program faces a few ongoing challenges – namely, managing odors, keeping restaurant partners engaged, and securing reliable long-term funding. Odor and pests are especially problematic during the summer, with issues like maggots, flies, and even rats chewing through plastic containers. To mitigate these problems, ORP uses sealable food-grade barrels, remote storage locations, and natural deodorizers like hydrated lime, vinegar, and lemons. The most effective odor solution is Epoleon N7C, a commercial-grade deodorizer. While the program discourages the use of bleach, some restaurants choose to use it on their own.

To support restaurants and maintain the SRA program’s momentum, ORP provides tailored support to restaurants and advocates for policies like Maryland’s grant program, which is set to expand in 2025.

Looking Ahead

Shell recycling is vital to Maryland’s oyster restoration strategy. The state will need 6.6–11.1 million bushels over the next decade to sustain commercial harvests, aquaculture, and restoration efforts. The SRA’s contribution of 330,000 bushels since 2010 demonstrates the scale of its impact, with each bushel contributing significantly to the health of the Chesapeake Bay’s oyster reefs.

Looking ahead, ORP plans to expand the SRA program, identify new collection sites, and deepen collaborations with public and private partners. ORP is also working with its partners to evaluate the feasibility of a national shell recycling strategy and explore alternative materials to supplement natural shell, hopefully serving as a model for other coastal states.

The Oyster Recovery Partnership’s Shell Recycling Alliance remains a leading example of environmental collaboration, blending grassroots support, strategic logistics, and policy advocacy to restore oyster habitats across the Chesapeake Bay.

For more information, please visit [Oyster Recovery Partnership | Chesapeake Bay Restoration | MD](#) or contact Ward Slacum, Executive Director (wslacum@oysterrecovery.org).

Delaware & Pennsylvania

Two organizations lead oyster shell recycling initiatives in Delaware & Pennsylvania: The Partnership for the Delaware Estuary (PDE) and the Delaware Center for the Inland Bays, each employing unique approaches to tackle the critical shortage of natural oyster shells for restoration projects.

Pennsylvania does not currently operate its own oyster shell recycling program due to its limited marine shoreline and lack of wild oyster habitat. However, it contributes to shell recycling through a cross-state

partnership coordinated by the Partnership for the Delaware Estuary, which facilitates shell recovery from Philadelphia-area restaurants. These shells are transported to curing sites in Delaware and used in habitat restoration and shoreline stabilization projects. Some restaurants and seafood vendors around Philadelphia have also been engaged informally by regional programs like the Chesapeake Bay Foundation and Oyster Recovery Partnership to divert shell southward into restoration efforts in Virginia and Maryland.

This type of inter-state collaboration highlights how regional coordination can expand access to restoration materials and engage inland communities in supporting estuarine health.

Partnership for the Delaware Estuary (PDE) Oyster Shell Recycling Program

The [Partnership for the Delaware Estuary \(PDE\)](#) leads collaborative, science-based efforts to improve the health of the Delaware River and Bay, which covers portions of Delaware, New Jersey, and Pennsylvania. As a part of this mission, PDE began its Oyster Shell Recycling Program in 2017 to reclaim post-consumer oyster shell to support ecological restoration. Initially focused on restaurant collections in New Castle County, Delaware, the program expanded in 2022 to include Philadelphia-based businesses. Participation is free, and partner establishments receive educational and promotional materials to inform staff and patrons about PDE's mission and the benefits of shell recycling. As of 2024, over a dozen restaurants and seafood markets across both states participate, contributing to the collection of an estimated average of **50,000 pounds of shell annually**. Approximately 55,000 pounds were collected in 2024 alone.

Collection Logistics

Shells are collected twice weekly using pick-up trucks from restaurants, seafood markets, local events, and community drop-off locations. **Trash contamination, present in roughly 15% of collections**, is addressed during the bagging process, with ongoing reminders to partners about proper disposal. Collected shells are **cured for at least six months** in open piles at partner organization properties (e.g., non-profits and municipalities). Curing sites are selected based on their proximity to collection routes, though limited participation from shell generators and a shortage of designated storage areas remains an ongoing challenge. Increasing the number and accessibility of curing sites are considered high priority improvements to help streamline operations.

PDE collects **approximately 940 bushels per year** (1 bushel \approx 53 lbs. or 13.25 gallons) and uses standardized internal conversion metrics:

- 1 bag recycled shell = 14 lbs.
- 1 bushel recycled shell = 53 lbs.
- 1 gallon recycled shell = 4 lbs.
- 1 cubic yard = 20 bushels
- 1 bushel = 13.25 gallons

Restoration Use

Recycled shells are primarily used for restoration projects and ecosystem service enhancement in the Delaware Estuary, where they create critical substrate for oyster reef development. These reefs provide habitat for marine life and help through sediment accretion. PDE has also piloted the use of oyster shell in

freshwater tidal zones to combat erosion, demonstrating the incredible versatility of this natural resource. Other types of shell collected by the program include clams and mussels (approximately 10%).

Restoration sites are **monitored for at least 5 years** post-deployment. Monitoring efforts include tracking oyster recruitment and growth, biodiversity surveys, physical reef stability, and elevation changes over time.

Outreach and Community Engagement

While participating businesses receive free collection services and educational materials, PDE primarily engages the public through volunteer events (e.g., Shell Bagging Days), public talks, and community outreach. Recruitment of new restaurant partners occurs mostly through word-of-mouth, social media, and in-person visits.

The program is managed by Leah Morgan, Assistant Manager of Estuary Science, and Jecy Klinkman, Assistant Restoration Coordinator. Ken Williamson, PDE’s Restoration Specialist, oversees shell pickup logistics across all program sites.

For more information, please visit: [Shell Recycling Program - Partnership for the Delaware Estuary](#)



Volunteers at a PDE Public Shell Bagging Event, on site at the shell management area in Wilmington, DE. Credit: PDE

Delaware Center for the Inland Bays “Don’t Chuck Your Shucks” Program

The [Delaware Center for the Inland Bays \(CIB\)](#) operates the “[Don’t Chuck Your Shucks](#)” (DCYS) program to address the ongoing shortage of natural oyster shell for habitat restoration. In partnership with local restaurants and businesses, DCYS reclaims post-consumer oyster shell that would otherwise end up

in landfills. Since its launch, the program has collected an average of **6,000 bushels annually**, totaling more than 37,500 bushels, or over 1,000 tons, by 2023.

Recycled shells from the program are used to support a variety of ecological enhancement efforts across Delaware's Inland Bays. These include the construction oyster reefs, living shoreline projects, and even contributions to the Partnership for the Delaware Estuary (PDE) for use in broader, science-based conservation initiatives throughout the region. By reclaiming shell for habitat restoration, DCYS strengthens both local estuarine health and regional collaboration to rebuild oyster populations.

Shells are collected weekly or semi-weekly by a part-time CEB staff member and transported to a curing facility at Delaware Seashore State Park's Fresh Pond Tract, where they are aged to eliminate harmful bacteria. Once cured, the shells are deployed in reef construction projects throughout the Inland Bays, including those led by the Delaware Department of Natural Resources and Environmental Control (DNREC).

The program is supported through a mix of private donations, DNREC funding, and EPA operating grants. Public education and engagement are central to DCYS's mission. Through its branded campaign and volunteer shell bagging events, the program raises awareness among restaurant staff, patrons, and community members about the ecological importance of oyster reef habitats.

For more information, please see the [DCYS Factsheet \(inlandbays.org\)](https://inlandbays.org).

New Jersey

New Jersey's coastal bays and estuaries once supported some of the most productive wild oyster (*Crassostrea virginica*) fisheries in the United States. By the mid-1800s, Delaware Bay oysters had become a major economic engine, with towns like Port Norris thriving as centers for harvesting, shucking, and shipping oysters to markets across the country. At its peak, New Jersey harvested millions of bushels annually. However, overharvesting, combined with sedimentation, habitat degradation, and especially the introduction of diseases such as MSX (*Haplosporidium nelsoni*) in the 1950s and Dermo (*Perkinsus marinus*) in the 1990s, led to dramatic population declines. By the late 20th century, wild oyster stocks were a fraction of their historic levels, prompting tighter harvest regulations and increased interest in restoration and aquaculture. Today, New Jersey's oyster population is maintained through a combination of rigorous quota management and habitat restoration initiatives centered on shell planting. Delaware Bay remains a stronghold for managed oyster production in the region and has a nationally recognized fishery management program associated with it.

Unlike the Delaware Bay, New Jersey's Atlantic coast oyster populations are primarily limited to the Mullica River-Great Bay Estuary. Located in the Pinelands National Reserve, and spanning three counties (Atlantic, Ocean and Burlington), this system has survived freshwater flooding events, disease outbreak, overharvesting, coastal development, and climate related impacts, making them the perfect candidate to enhance and expand upon. Despite their importance, these reefs did not have a consistent shell planting program until 2021. With most of the shell available to the state already committed to the Delaware Bay enhancement efforts, resources for Atlantic coast shell planting operations were extremely limited. Shell recycling programs were established to help bridge the gap of shell availability for Atlantic coast-based

oyster reef as well as shoreline enhancement efforts. More information can be found at [New Jersey Shell Recycling Guidelines for Restaurant-Based Shell Collection and Management](#).

NJ Fish and Wildlife’s Marine Resources Administration Shell Recycling Program

Along the Atlantic coast of New Jersey, the scarcity of shell available for oyster reef enhancement, coupled with the large number of local seafood establishments, prompted the development of a shell recycling program to make use of a resource that would otherwise be wasted. In 2019, New Jersey Fish & Wildlife's Marine Resources Administration (MRA) led the development of a Shell Recycling Program (SRP) aimed at enhancing natural oyster reefs. The MRA coordinated this initiative with support from the Jetty Rock Foundation, Rutgers University, and Stockton University to reduce landfill waste and promote environmental stewardship.

In 2024, the SRP was awarded a NOAA BIL grant (\$1.2+M) over three years, which has led to a rapid expansion of a program that now extends into Atlantic, Cape May, Cumberland, and Ocean Counties. Additionally, the MRA has partnered with ReClam the Bay and Randall’s Seafood, who aid in collection at additional venues. The MRA is also primed to announce a major partnership with Sysco (the largest food distributor in the world), which will expand collection to another 150-200 restaurants across the Mid-Atlantic region. During this NOAA expansion, the SRP has also developed a robust education program called *Project S.H.E.L.L (Strengthening Habitats through Environmental Learning and Leadership)*, which is centered in Atlantic City area schools (and expanding outward), which provides unique experiential learning opportunities to local schools. Lastly, the on-the-ground impacts of these enhancement efforts have already exceeded projections. In its first two years, the amplified shell planting has resulted in recruitment rates at approximately 3,000% greater than natural, unplanted control sites.



Trailer hauling collected shell. Credit: NJDEP

Collection and Curing Process

Shells are collected weekly from 32 participating restaurants on two separate collection routes, one in Cape May County and one in Atlantic County. To date, the program has collected over **500 tons** of recycled shell using specialized equipment operated by dedicated MRA staff, including custom dump trailers equipped with hydraulic lifts to empty shell containers into the trailer. These trailers reduce manual labor and increase efficiency of shell collection, allowing for significant program

expansion. Most collected shell comes from oysters, with small amounts of clam or other species. Once collected, the shell is transported to MRA’s Nacote Creek research station and cured for a minimum of six months via open-air sun drying, which eliminates harmful pathogens and ensures they are safe for shell planting.

In addition to MRA's shell routes, Randall's Seafood and ReClam the Bay distributed MRA supplied 5-gallon buckets to restaurants and use a bucket-swapping system to collect shell, replacing a full bucket with an empty one. Randall's Seafood dumps **their 5-gallon buckets into a 35-gallon toter**, and MRA picks up from Randall's weekly since it's along the current Atlantic County collection route. ReClam the Bay is located in Toms River, NJ, approximately 40 miles from MRA's facility where weekly collection is not feasible. ReClam the Bay collects the shell several times per week and stores it until MRA is able to pick up the shell.

Planting and Monitoring

MRA plants cured shell in subtidal oyster reefs in the Mullica River-Great Bay reef system, one of New Jersey's last self-sustaining wild oyster populations on its Atlantic Coast. Each summer, to coincide with the oyster spawning season, cured shell is loaded onto a barge, transported to the reefs, and dispersed using high-pressure water cannons to efficiently spread the shell across the plant site and maximize clean shell coverage for oyster larvae to settle upon. MRA has implemented two pre-plant monitoring methods,



Loose broadcasting of recycled shell using a barge and water cannon. Credit: NJDEP

including a spat bag and water quality assessment program, in which shell bags and water quality monitors are suspended in the water column over proposed plant sites to gather preliminary data to make informed decisions about shell plant timing. After shell planting, the reefs are then monitored monthly to evaluate recruitment success. In the summer of 2024, 10,000 bushels (~240 tons) were planted across a two-acre site, with results showing an average of over 2,000 spat per bushel, compared to fewer than 100 spat per bushel on non-enhanced control sites. Since 2021, the MRA has planted just under 1,300 tons of shell (recycled and purchased) on the MRGB oyster reefs.

Program Expansion and Education

With recent funding from NOAA's Coastal Zone Management Program, the MRA has expanded the shell recycling program using a three-pronged approach:

1. Increasing shell supply by partnering with more restaurants, adding public drop-off locations, and purchasing additional shell.
2. Enhancing reef restoration by expanding efforts within the Mullica River reef system and increasing annual planting capacity.

3. Coordinate education and outreach events to teach the public about Shell Recycling, including implementation of Project S.H.E.L.L. into an additional school in the 2025-2026 school year.

Project S.H.E.L.L. is designed to directly engage students from traditionally underserved communities and foster early interest in marine and environmental sciences. To support this, the MRA hired local graduates as Program Ambassadors, who receive training in lab work, field sampling, data collection, and community outreach while helping deliver educational programming to K–12 students.

Challenges and Solutions

Despite its growth, the MRA’s Shell Recycling Program still faces challenges, including limited statewide infrastructure, funding, odor and pest control, and a shortage of curing space. Public outreach remains minimal but is recognized as a key area for future development. Over the next three years, MRA expects to double shell collection volumes. As the program continues to grow, it is not only restoring critical oyster habitat along New Jersey’s coast but also fostering environmental stewardship by connecting scientists, educators, students, and the local restaurant community in support of a more sustainable and resilient coastal future. For more information, visit [NJDEP| Fish & Wildlife | Shell Recycling Program](#).

Long Beach Township’s Shell Recycling Program

The Long Beach Township (LBT) Shell Recycling Program in New Jersey began operating in 2017 and is managed by the local government. LBT collects approximately **80,000 pounds of shell annually**, consisting of about **80% oyster and 20% clam shells**, sourced from restaurants, community drop-off locations, and local events. Shell is collected on a **weekly basis** and is transported to a county-provided curing location off the island for **open-air curing**, where piles are exposed to the elements for a **minimum of six months**. LBT staff launched the program to supply shell for local oyster reef restoration and bay island stabilization projects in the Barnegat Bay/Little Egg Harbor Bay estuary. LBT relies on manual tracking systems and internal metrics logged in spreadsheets to monitor collection volume and shell condition, using a standard metric in which 1 bushel = 50 pounds.

Recycled shells are used by other organizations in restoration projects focused on oyster reef and shoreline enhancement, with **monitoring lasting over five years**. The program’s success is measured both by the volume of shell diverted from landfills and by partner engagement. Public outreach includes social media, school programs, printed materials, and local events, though participation remains modest due to limited infrastructure.

Currently, the township operates only one public drop-off site, with most collections coming from restaurant back-of-house operations. The program’s growth is constrained by staffing shortages, limited storage capacity, and transportation logistics. Future priorities include securing larger storage areas, improving site access, and obtaining permits for additional restoration projects.

For more information, visit [Oyster Shell Recycling Program – LBT Marine Field Station](#).

American Littoral Society’s “Shuck It, Don’t Chuck It” Program

In Monmouth County, NJ, the American Littoral Society (ALS) leads shell recycling efforts through its “Shuck It, Don’t Chuck It” program, collecting oyster shell from local restaurants to prevent it from

ending up in landfills. These shells are returned to New Jersey's bays to support oyster growth, help protect the coastline from erosion, and aid in shoreline restoration projects statewide, using volunteer-bagged shell from its Sandy Hook shell pile. ALS offers educational opportunities for students and community members through the *Operation Oyster* program and events like *Sip N' Shuck*, where participants learn to shuck oysters, explore oyster conservation, and shop locally from participating restaurants and farmers. In addition to restaurant collections, ALS maintains two community drop-off locations in Rumson. Since the program began, ALS has collected over 71,000 lbs. of shell. For more information on the "Shuck It, Don't Chuck It" shell recycling program, visit: [Shell Recycling - Littoral Society](#).

New York

Oysters have long played a crucial role in New York's coastal ecosystems, historically forming extensive reefs throughout estuaries such as New York Harbor, Long Island Sound, the Peconic Estuary, and South Shore lagoons. Once a major source of food and commerce, New York's oyster populations suffered severe declines due to overharvesting, habitat loss, pollution, and disease by the early 20th century. Today, a growing number of restoration initiatives aim to bring oysters back to these waters. In New York City, the Billion Oyster Project leads large-scale restoration and shell recycling efforts in New York Harbor. On Long Island, organizations like Cornell Cooperative Extension, Stony Brook University, and the Town of Hempstead have implemented reef restoration, aquaculture, and community science programs to enhance oyster populations and improve water quality. The Half Shells for Habitat program, a collaborative effort coordinated by the Seatuck Environmental Association, collects post-consumer oyster shells from restaurants and events across Long Island to supply vital material for these restoration projects. Collectively, these efforts reflect a statewide commitment to rebuilding oyster habitats, restoring ecosystem services, and engaging communities in coastal stewardship.

The Billion Oyster Project

The Billion Oyster Project's Shell Recycling Program, based in New York City, is one of the largest and longest-running oyster shell recycling efforts in the state. Part of the New York State Shell Collectors Alliance, the program supports habitat restoration, shoreline stabilization, water quality improvement, public education, and waste reduction by reclaiming oyster shells from restaurants and other sources for use in reef-building projects.

Operations and Logistics

The program collects approximately **300,000 pounds or 300 cubic yards of shell annually**, with roughly 90% consisting of oyster shell and the remainder from clams, scallops, and other shellfish. Shells are **collected weekly from over 50 participating restaurants**, as well as a few community drop-off locations, though the public use of these sites is limited. Shell is collected in 5-, 32-, or 64-gallon bins, stored in enclosed containers, and transported to curing locations. Curing takes place on approximately 0.66 acres of partner-owned land and lasts a **minimum of 6 months** but often extends to 12 months.

Even though state regulation is 6 months, shell must be cured between May-Sept, which means it must typically cure for a full 12 months if collected outside peak summer months. Wet, uncured shell weighs about 1,000 pounds per cubic yard, while cured shell averages 730 pounds per cubic yard.

Around 50% of collected shell contains some trash. To mitigate contamination, the program provides bilingual (English and Spanish) signage and offers staff training for restaurant partners. Volunteers also assist with trash removal at curing sites to ensure optimal shell quality before restoration use.



Branded truck collecting recycled shells from pick up sites around NYC. Credit: Billion Oyster Project

Restoration

The recycled shell is used in both loose and bagged form for oyster reef restoration throughout New York waters. Shell is deployed strategically to support oyster recruitment, enhance biodiversity, improve reef stability, and contribute to water quality improvements. Restoration sites are monitored for more than 5 years, with data collection focused on these key ecological indicators.

Outreach and Engagement

Outreach efforts include public talks, events, and social media campaigns, though word-of-mouth and restaurant staff turnover have proven to be the most effective recruitment tools for new partners. Participating restaurants receive signage and training materials to help educate staff and patrons about the ecological benefits of shell recycling.

Funding and Policy

The program is funded primarily through grants and donations. The [NY State Senate Bill 2023-S8436](#) has been proposed, but not yet passed, that would provide restaurants a \$0.10 per pound tax credit, up to \$1,000 annually, for donating shell to approved recycling programs.

Challenges and Future Needs

Despite its success, the program faces ongoing challenges including limited funding, storage space constraints, transportation logistics and costs, and permitting hurdles for reef deployment in NYC waters.

Nevertheless, the Billion Oyster Project continues to serve as a leading example of community-driven oyster restoration in the United States. For more information, please visit [Billion Oyster Project](#).

Town of Hempstead's Shell Recycling Program

The Town of Hempstead Shell Recycling Program is a municipally led initiative focused on oyster reef restoration, shoreline stabilization, and community engagement along Long Island's South Shore. Funded by the Town and supported through grants, the program is a member of the New York Shell Collectors Alliance, working in collaboration with regional partners such as the Billion Oyster Project, Half Shells for Habitat, and Cornell Cooperative Extension. In a region with strong cultural and economic ties to shell fishing, the program advances both environmental restoration and local economic resilience. Each year, more than 1,200 Town of Hempstead residents purchase recreational or commercial shellfish licenses, often spending their summers harvesting clams on nearby mudflats. According to the New York State Department of Environmental Conservation, Long Island's shellfish industry contributes over \$10 million annually to the local economy, underscoring the importance of sustainable resource management in the region.

Collection and Storage

The program collects approximately **1,972 U.S. bushels** of shell per year (or about **90.93 cubic yards**) with an estimated **90% oyster** and **10% clam shell** composition. Shell is primarily sourced from restaurants, but also from occasional public events and festivals. Collection occurs **three times per week** using 65-gallon rolling bins. Once gathered, shells are stored in **open-air curing piles** located on **public lands** and **coastal restoration facilities**. Curing lasts a **minimum of 12 months** and shell piles are rotated periodically. Odor is managed by siting curing areas away from populated spaces. While trash contamination is relatively low (~5%), common issues like discarded kitchen gloves are resolved by manually removing trash with pick sticks upon unloading.

Restoration and Monitoring

After curing, the shell is used for local restoration efforts, including intertidal oyster reef building and shoreline stabilization. Restoration sites are monitored for 1–3 years post-deployment, with success measured using indicators such as:

- Oyster recruitment and growth
- Water quality improvements
- Reef area restored or enhanced
- Volume of shell diverted from landfills

These metrics help evaluate the ecological benefits of shell recycling and the effectiveness of restoration activities.

Outreach and Engagement

Public engagement is supported through school programs, community workshops, public events, and print materials. Restaurant recruitment relies primarily on word of mouth, supplemented by occasional phone

and email outreach. While there is growing interest from the community, broader participation is constrained by staffing and infrastructure limitations.



Volunteers helping at the curing site. Credit: Town of Hempstead

Challenges and Next Steps

Key program challenges include limited funding and staffing capacity, transportation and logistics, competition for shell material from non-restoration uses (e.g., landscaping), and debris contamination from wind, soil, and equipment handling.

Program leaders have identified the need for a centralized shell cleaning facility equipped with tumbler screens and water jets as a top operational priority.

Looking ahead, the program aims to improve by developing more efficient curing techniques, expanding storage capacity, enhancing pest and odor control, and improving site accessibility. Despite operational hurdles, the Town of Hempstead Shell Recycling Program serves as a strong example of how local government can lead effective, community-based marine restoration. Through regional collaboration and public engagement, the program contributes meaningfully to coastal resilience, habitat enhancement, and the long-term sustainability of Long Island’s shellfish economy and ecosystems. For more information, please visit [Shellfish Restoration Program | Hempstead Town, NY](#).

Half Shells for Habitat

Half Shells for Habitat is a regionally coordinated oyster shell recycling program serving all of Long Island, New York. Led by the Seatuck Environmental Association, the program operates as a collaborative network supported by municipalities, restaurants, nonprofits, and local community partners. While it is centrally managed by a single nonprofit, the program functions as a shared platform: local partners can exchange shell, access common branding and outreach materials, apply for funding, and follow consistent operational guidance. This flexible structure is particularly effective in navigating the region’s patchwork of municipal jurisdictions governing coastal waters and waste management infrastructure.

Collection, Storage, and Use of Shell

The program collects approximately **50,000 pounds of shell annually**, primarily (95%) from oysters, with the remainder from clams. Shell is sourced from restaurants, seafood markets, and community events, and is **transported weekly** using pickup trucks or volunteers' personal vehicles. Due to infrastructure limits, the program is currently unable to onboard all interested restaurants. However, efforts are underway to expand capacity through grant support and proposed tax credit programs, especially targeting larger-volume donors, independent shuckers, and composting businesses that could help offset labor needs.

Shells are stored either bagged or loose, depending on project requirements, and are **cured at centralized locations for a minimum of 12 months**. Trash contamination is minimal (less than 1%) and is mitigated through clear instructions to restaurants and volunteer support at public events. Shell weights are tracked as the primary success metric, and monthly reports are shared with participating businesses to encourage continued involvement.

Shell is used **primarily for habitat restoration**, especially oyster reef enhancement, but also contributes to shoreline stabilization, water quality improvement, waste reduction, and environmental education. **Restoration success is measured by volume collected and area of habitat restored**, offering both environmental and public-facing outcomes.

Outreach and Community Engagement

Outreach is a key pillar of the program. New restaurant partners are recruited through in-person visits, while public engagement is driven by community events, public talks, social media campaigns, and printed materials. Signature events like Oyster Week invite restaurants from across Long Island to participate in shell recycling efforts. Educational inserts placed in customer check booklets help diners learn about the environmental benefits of oyster shell recycling.

Funding and Future Growth

The program is funded primarily through grants, with additional support from donations. Due to growing interest and limited workforce capacity, infrastructure expansion is a top priority. Proposed solutions include implementing state tax credits, expanding public drop-off locations, and building stronger partnerships with businesses capable of supplementing shell collection logistics.

Through a balance of local flexibility, regional coordination, and community engagement, Half Shells for Habitat has become a model for distributed shell recycling in New York. It supports ecological restoration while strengthening public awareness and participation in the stewardship of Long Island's coastal environments. For more information, please visit [Half Shells for Habitat](#).

Connecticut

Oysters have been a vital part of Connecticut's coastal ecology and economy for centuries, supporting both commercial and recreational fisheries in Long Island Sound and its tributaries. Historically, the state's extensive oyster beds provided abundant habitat and sustained large harvests, but overharvesting, pollution, disease, and habitat loss led to significant population declines by the mid-20th century.

Traditionally, shells from shucking houses were returned to the water to maintain reef structure and provide substrate for oyster larvae (spat) to settle. However, as the market shifted toward serving whole oysters for the half-shell trade, shell became more dispersed among restaurants, making recovery for restoration more challenging.

In recent decades, Connecticut has renewed its commitment to keeping shell in-state for habitat restoration. This includes the Connecticut Department of Agriculture's shell recycling initiative, launched in 2023 under Public Act No. 21-24, and the Collective Oyster Recycling & Restoration (CORR) program, which has been active for several years. Together, these efforts reclaim post-consumer shell from restaurants, seafood markets, events, and wholesalers, cure it to remove pathogens, and use it to restore oyster reefs, enhance shoreline resilience, improve water quality, and support biodiversity in the state's estuaries.

Connecticut Department of Agriculture

Public Act No. 21-24, signed into law on June 7, 2021, authorizes the Connecticut Department of Agriculture to acquire or purchase oyster shells for placement on state shellfish beds. Returning shells to the water increases available substrate for free-swimming oyster larvae, boosting population growth and enhancing the health of state-managed shellfish resources. Restored oyster reefs provide key environmental benefits, including storm surge protection, water filtration, habitat creation for marine life, and carbon sequestration.

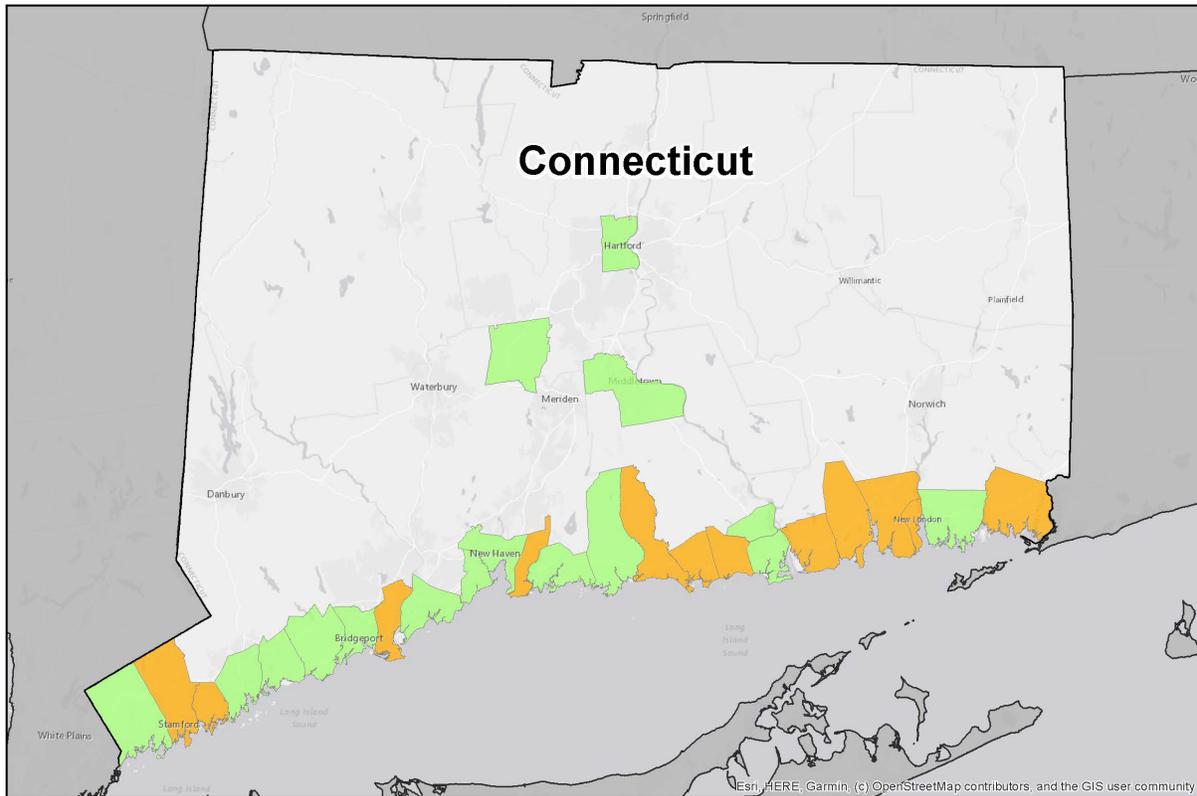
Since its inception, the program has recycled over **186,377 pounds** of oyster shells in Connecticut. Historically, most shells were discarded in landfills or sold for non-restoration purposes such as cosmetic products, chicken feed, or construction materials. Recent efforts, modeled after similar programs in South Carolina, Maryland, and Virginia, have shifted focus toward keeping shells in-state for reef restoration. The Department collaborates with nonprofit organizations, private businesses, and local shellfish commissions to collect, cure, and redeploy shells for ecological restoration. For more information, please visit [Connecticut Department of Agriculture](#).

Collective Oyster Recycling & Restoration (CORR) Program

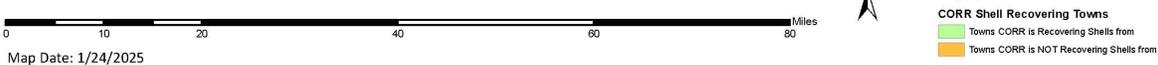
The Collective Oyster Recycling & Restoration (CORR) program, a nonprofit organization, has been active in Connecticut for several years and plays a central role in on-the-ground shell recycling efforts. CORR receives grant funding from the Connecticut Department of Agriculture and partners with wholesale oyster purchasers, event hosts, and organizations like the Connecticut Restaurant Association to expand recycling efforts across the state.

Operations and Logistics

CORR collects approximately **7,500 bushels** (1 bushel = 50 lbs.) of shell annually (35% oysters, 65% other shellfish). Shell is sourced primarily from **restaurants**, but also from seafood markets, wholesale distributors, community drop-off sites, and events/festivals. Participating restaurants partners place empty shells in labeled tabletop pails that educate diners about the program. Restaurant staff then transfers these into **5-gallon screw-top buckets** (~30 lbs. full, ~25 lbs. cured/dry), which CORR **collects weekly** using pickup trucks or dump trailers. Around **40%** of collections contain trash, which is removed before shells are placed in curing piles.



Connecticut Shell Recovery and Recycling Network



Map showing the towns that CORR is receiving shells from (green) and NOT receiving shells from (orange).

Credit: Connecticut Collective Oyster Recycling & Restoration (CORR) Program

Storage, Restoration, and Monitoring

Shells are cured in **open piles** on private property for a **minimum of six months** in compliance with state regulation. Curing relies on sun drying and natural weathering to eliminate pathogens and organic material. Piles are turned regularly to improve aeration, manage odor, and accelerate the curing process. Sites are chosen based on community and stakeholder acceptance. Odor is further mitigated by siting curing areas away from populated zones.

Once cured, 76–100% of shells are used for habitat restoration, particularly oyster reef enhancement. Restoration sites are monitored for over five years to track oyster recruitment, growth, and reef stability.

Outreach and Engagement

Public outreach is a major component of CORR’s work, with engagement driven by **community events, public talks, social media campaigns, print materials, school programs, and workshops**. New restaurant partners are recruited primarily through **in-person visits**, supplemented by email, phone calls, and word-of-mouth referrals. Tabletop pails and check inserts at restaurants help to raise awareness directly with customers, while participating at events like seafood festivals help connect the program to the broader public.

Partnerships

The Connecticut Department of Agriculture works with CORR, private businesses, local shellfish commissions, and wholesale seafood buyers to expand the program into towns including **Greenwich, Rowayton, Norwalk, Westport, Fairfield, Bridgeport, West Haven, New Haven, Hartford, Plantsville, and Bethel**. Connecticut Sea Grant serves as a research and evaluation partner, with Michael Gilman (Assistant Extension Educator) coordinating shell recycling efforts statewide and assisting municipalities that may be interested in joining.



CORR's Public Outreach and Educational Tent



Challenges and Priorities

Challenges for CORR include funding constraints, public awareness, staff shortages, transportation logistics, and competition for shell from non-restoration uses. Program priorities focus on expanding storage capacity, improving site accessibility, adopting more efficient curing methods, and increasing the number of participating towns and restaurant partners.

Learn more about the CORR Program at [Shell Recycling | Collective Oyster Recycling & Restoration - CORR](#).

Rhode Island

Rhode Island does not currently have an active oyster shell recycling program, but it has a history of small-scale initiatives. For the past two decades, the [Rhode Island Department of Environmental Management's Division of Marine Fisheries \(RI DEM DMF\)](#) collaborated with the [RI Chapter of The Nature Conservancy \(TNC\)](#) to operate localized shell recycling efforts. These programs supported habitat restoration but were discontinued in 2024 due to funding and staffing constraints. Despite this, the state retains valuable experience and infrastructure that could support future program relaunches.

Shell Collection and Use

At its peak, Rhode Island's program collected approximately 1,000 bushels of shell annually, with about 75% being oyster shell and the remaining 25% made up of clam and scallop shells. The vast majority (76–100%) of this recycled shell was used for **ecological restoration purposes**. Shells were deployed to

enhance oyster reefs, stabilize shorelines, support aquaculture, improve water quality, reduce waste, and promote public education. Most shells were **sourced from restaurants**, with additional contributions from festivals and public events.

Collection Logistics

Shells were collected **weekly or biweekly** using pickup trucks, dump trucks, and occasionally third-party transportation services. They were stored in **32-gallon totes** or open piles and cured for a minimum of **six months** to eliminate pathogens. Curing typically took place on public land in open-air sites, with exposure to sun and wind. While effective, this process was challenged by a lack of designated storage space and odor management issues. Approximately 15% of shell collections contained trash, which had to be removed manually during processing.

Restoration and Monitoring

Cured shell was used in both intertidal and subtidal restoration projects throughout Rhode Island where reef sites were chosen in collaboration with RIDEM and academic scientists. Sites were monitored for 4–5 years post-deployment, with data collected on **oyster recruitment and growth, reef stability, biodiversity, and water quality**. These metrics helped evaluate long-term ecological outcomes and informed future project designs. Program success was typically measured by the volume of shell diverted from landfills, the acreage of restored habitat, and the number of engaged partners.

Outreach and Participation

Public outreach was an integral part of the shell recycling initiative. Education and awareness efforts included brochures, printed materials, social media, and participation in local events and festivals. New restaurant partners were typically recruited through **in-person visits**, supported by email and phone follow-ups. Shell donations were **tracked primarily by weight**, and data were shared with participating restaurants on a monthly basis to maintain engagement.

Program Challenges

Despite its success, the program faced numerous barriers. These included inconsistent funding, limited staffing, logistical challenges related to transportation and storage, and competition for shell resources from neighboring states. Public awareness of the ecological value of shell recycling remained relatively low, which further hindered participation. As a result, the program's growth and sustainability were limited.

Rhode Island's past shell recycling initiatives demonstrate a strong potential for impactful restoration work. With renewed funding and strategic planning, the state is well-positioned to revive and scale up shell recycling in support of coastal resilience and marine ecosystem health.

Massachusetts

The Massachusetts oyster aquaculture industry generates \$30 million annually, making it the state's third highest-value seafood product, behind only lobster and sea scallop. Shell recycling has been practiced in Massachusetts for decades, with several Cape Cod municipalities (e.g., [Yarmouth](#), [Nantucket](#), [Tisbury](#),

and [others](#)) maintaining recycling centers where residents can dispose of shells and reduce landfill waste. Stockpiled shells are cured and then used in municipal oyster propagation efforts.

The Massachusetts Oyster Project

Since 2018, the [Massachusetts Oyster Project \(MOP\)](#), a volunteer nonprofit dedicated to restoring native shellfish populations in coastal estuaries, has coordinated a [shell recycling program](#) on Cape Cod. The program collects recycled shells from partner restaurants and provides designated locations for storing, cleaning and curing the shells. MOP also collaborates with community groups to maintain oyster upwellers at various sites across the state, supporting local restoration and propagation initiatives.

Operations and Logistics

The program collects an estimated **50,000 pounds of shell annually**, with **oysters making up 95%** of the collection and clams the remaining 5%. In 2023, MOP collected 55,000 pounds of oyster shells from restaurant partners, doubling its recycling volume over the past two years (see [Mass Oyster Annual Report 2023](#) for more information).

Shells are gathered primarily from **restaurants** in towns like Chatham, Wellfleet, Eastham, Orleans, and Provincetown, though additional sources include **community drop-off locations** and **local events or festivals (e.g., the ‘Give a Shuck’ Fundraiser)**. Collection occurs **seasonally**, typically **1–4 days per week**, depending on availability and need. Shells are stored in **5-gallon buckets**, and collection is handled using **pickup trucks**. Approximately **1% of collected material contains trash**, which is managed through signage, direct communication with restaurant staff, and manual sorting during shell handling.

Curing & Storage

Once collected, shells are taken to **open-air curing sites** located on **partner organization or municipal properties**, where they are **sun-dried for at least 12 months** to meet Massachusetts regulatory standards. Shell piles are turned or rotated periodically to ensure even curing. Current challenges include **limited storage space**, **pest and odor control**, and **accessibility of curing sites**, which are all prioritized areas for improvement. Although there is no formal tracking system in place, shell volume is monitored informally to assess program performance.

Restoration & Monitoring

While the MOP does not conduct post-restoration site monitoring, the recycled shell is used to support local oyster reef restoration efforts. The success of the program is measured primarily by the volume of shell diverted from the waste stream, as well as the number of participating restaurants and community partners.

Challenges & Future Needs

The MOP’s shell recycling program continues to expand through new restaurant partnerships, public shell disposal locations, and the development of guidance materials on oyster shell recycling for municipalities and the public. However, limited funding and capacity remain significant challenges, constraining the program’s ability to expand beyond Cape Cod. The program relies on grants and fundraising to sustain its efforts in the region.

A key goal of the MOP is to create and enhance oyster habitats using recycled oyster shells, thereby improving coastal water quality and resilience. In 2024, MOP hosted an [Oyster Restoration Symposium](#) at the New England Aquarium in Boston, bringing together practitioners, scientists, government agencies, and funders to identify best practices and next steps for advancing oyster restoration in Massachusetts.



Oyster bags being deployed for restoration. Credit: Mass. Oyster Project

For additional information about the Massachusetts Oyster Project, please contact Erika Smith, erika.smith@massoyster.org.

New Hampshire

Oysters have long played a vital role in New Hampshire's coastal ecosystems and human history. Indigenous communities relied on shellfish, including oysters, for sustenance for over 2,500 years, as evidenced by ancient shell middens. Later, European settlers harvested oysters for both food and trade. By the late 1800s, however, overharvesting, pollution, sedimentation, and disease had drastically reduced the state's wild oyster populations. Today, wild oyster harvesting is limited to regulated recreational activity, while commercial harvest is only allowed through licensed aquaculture using certified seed. See the [NH Oyster Industry Factsheet - April 2025](#) for more information.

Once home to more than 1,000 acres of oyster reef, New Hampshire's **Great Bay Estuary** has lost over 90% of its oyster habitat, with just over 100 acres remaining. This decline has significantly impacted the bay's ecological functions, including water filtration, habitat provisioning, and shoreline stabilization. In response, restoration efforts have been spearheaded since 2008 by a collaboration between the Coastal Conservation Association of New Hampshire (CCA-NH), The Nature Conservancy (TNC-NH), the University of New Hampshire (UNH), and New Hampshire Fish & Game.

CCA-New Hampshire Oyster Recycling Project

A cornerstone of New Hampshire shell recycling efforts is the [CCA-NH Oyster Shell Recycling Program](#), which reclaims oyster shells from local restaurants that would otherwise be discarded. With the help of dedicated volunteers, weekly shell collections are conducted using 20-gallon buckets, often transported by personal vehicles and small trailers. Shells are deposited into roll-off containers provided by supporters, then cured for at least six months to ensure they are safe for reuse. Once aged, the shells are deployed into the bay by partners such as TNC, UNH, and NH Fish & Game to support reef restoration and oyster recruitment. In addition to supplying critical restoration material, the program serves as a platform for public education, community engagement, and estuarine conservation advocacy.

While CCA-NH's recycling program focuses on recovery and deployment of shell, community engagement efforts are further supported by programs like TNC's Oyster Conservationist Program, in which volunteers raise spat-on-shell oysters and collect data on survival, growth, and wild recruitment. Together, these community-driven initiatives reflect a comprehensive and collaborative approach to restoring oyster populations and enhancing the ecological health of New Hampshire's Great Bay Estuary.

Challenges

The CCA-NH Shell Recycling program has encountered several challenges that continuously change and evolve over time, including:

- **Odor Issues:** The smell of “fresh” shells awaiting pick-up or during storage can deter participation by restaurants.
- **Restaurant Participation:** Improperly secured bucket covers exacerbate odor issues, prompting property owners to prohibit some high-volume restaurants from participating in the program.
- **Volunteer Retention:** Maintaining a consistent roster of volunteers to manage collections and operations can be difficult.

Measuring Success

CCA-NH evaluates the success of the Oyster Shell Recycling Program through the volume of shell collected and the level of public exposure. This fluctuates over time, but the program strives to maintain a core group of participating restaurants while also using it as an outreach tool to raise awareness and increase community involvement in Great Bay conservation efforts.

Looking Ahead

The CCA-NH Oyster Shell Recycling Program will have a new base of operations in 2025 at the New Hampshire Port Authority. This new location, with its multi-year arrangement and close proximity to local eateries, provides room for growth and opportunities to expand operations. Additionally, the Port Authority offers increased visibility, creating joint outreach opportunities that will enhance public awareness of the program's mission and impact.

The CCA-NH Oyster Shell Recycling Program continues to play a vital role in Great Bay restoration efforts. Through innovative partnerships, community involvement, and a commitment to environmental stewardship, the program is poised to grow and achieve even greater success in the years ahead.

More information on the program can be found at ccanh.org.

University of New Hampshire Oyster Shell Recycling

The University of New Hampshire's Jackson Estuarine Laboratory has operated the NH Oyster Shell Recycling Program for over 10 years, supporting oyster reef restoration efforts primarily in Great Bay, New Hampshire. The program is not part of a formal shell recycling alliance but operates in close collaboration with CCA-NH, The Nature Conservancy (TNC), and the NH Agricultural Experiment Station. Overall, UNH's Oyster Shell Recycling Program combines scientific rigor with community-based conservation to support sustainable oyster restoration in the Great Bay Estuary. While small in scale, the program plays an essential role in New Hampshire's broader oyster recovery efforts.

Operations and Logistics

The University of New Hampshire's Oyster Shell Recycling Program collects approximately **100 to 200 bushels of shell annually**, with about 95% consisting of oyster shell and the remaining 5% from clams and mussels. Shell is gathered using eight **32-gallon toters** and transported by trailer to the curing site.

Once collected, the **shell is sun-dried in open piles at Kingman Farm in Madbury, NH**, where it cures for a minimum of six months, though most shells are stored for over a year. **Roughly 45% of collected shell loads contain trash**, such as plastics and utensils, which are manually



Recycled shell is gathered using 32-gallon toters and transported by trailer to the curing site. Credit: University of New Hampshire

removed during unloading. The program does not rotate shell during curing, and the availability of secure space remains the primary factor in determining storage site selection.

Shell is delivered to the curing site by UNH researchers using a lab-owned trailer and pickup truck. Trash is manually removed during unloading. Storage site selection is primarily based on availability of secure space, and shell is not rotated during curing. Lack of designated storage capacity is a major challenge for the program. Once cured, shell is used in remote setting operations for spat-on-shell production, which is

funded in part by The Nature Conservancy and used in their Oyster Conservationist Project. Shell is also deployed directly onto restoration sites by UNH scientists.

Top program needs include larger or additional storage areas, enhanced site accessibility, improved pest and odor control, and more efficient curing techniques.

Outreach and Community Engagement

UNH engages the public primarily through events, festivals, and educational talks, and supports shell recycling awareness through outreach linked to the NH Shellfish Farmers Initiative, local articles, and online platforms. The program does not offer financial incentives for shell donors, and public awareness remains a key barrier to expansion. For more information, please visit [Jackson Estuarine Laboratory | School of Marine Science and Ocean Engineering](#).

Additional Resources

- [Oyster Habitat Restoration Monitoring and Assessment Handbook \(Baggett et al., 2014\)](#)
 - *Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen, B. DeAngelis, J. Green, B. Hancock, and S. Morlock, 2014. Oyster habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA, USA, 96pp.
- [Incorporating Oysters into Living Shorelines Guide \(Chesapeake Bay Foundation\)](#)
- [Georgia DNR \(Georgia Department of Natural Resources\). \(2025\) "Living Shorelines in Coastal Georgia: A Comprehensive Guide to Understanding and Designing Living Shorelines on the Georgia Coast"](#)
- [Shell Recycling Definitions – Maryland Code of Regulations. 08.02.26.01 – State Regulations | US Law | LII / Legal Information Institute](#)
- [Building Oyster Habitats \(South Carolina Oyster Recycling and Enhancement “SCORE” Program\)](#)
- [Shell Recycling | CORR](#)
- [New Jersey Shell Recycling Guidelines for Restaurant-Based Shell Collection and Management](#)
- [NWP 27: Aquatic Habitat Restoration, Establishment, and Enhancement Activities](#)
- [US Army Corps of Engineers: Section 404 and Section 10 Permitting Guide](#)