Atlantic States Marine Fisheries Commission

Habitat Committee

October 29, 2025
1:00 – 5:00pm

Agenda

The times listed are approximate; the order in which these items will be taken is subject to change.

Webinar Link: https://v.ringcentral.com/join/462557844

Field Trip (*optional*) 8:30 a.m.
- DNREC Lewes SAV shed facility.
- *901 Pilottown Rd, Lewes, DE*

Return 11:00 a.m.

Captain David H. Hart Award Luncheon - Buffet (Fishing Tournament Prizes) 12:00 p.m.

1. **Welcome & Introductions *(K. Wilke)*** **1:00 p.m.**

2. Committee Consent *(K. Wilke)*
   - Approval of Agenda
   - Approval of Fall 2024 Proceedings

3. Habitat Management Series Updates *(S. Kaalstad)* 1:15 p.m.
   - Atlantic States Shell Recycling Report
   - Next Topic(s)

4. Habitat Hotline 2025 Development 2:15 p.m.
   - Topic, format, state updates, etc.

Break 3:00 p.m.

5. Review of ongoing and emerging Atlantic fish habitat issues 3:15 p.m.
   - Considerations for Fish Habitat of Concern (FHOC) Updates

6. Roundtable State Updates & Other Business 4:15 p.m.
   - Habitat and restoration activity highlights

7. Adjourn 5:00 p.m.

The meeting will be held at Hyatt Place Dewey Beach, 1301 Coastal Hwy, Dewey Beach, DE, 19971 and via webinar; click here for details

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ATLANTIC STATES SHELL RECYCLING

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

OCTOBER 2025
ATLANTIC STATES MARINE FISHERIES COMMISSION
1050 N Highland St, Arlington, VA

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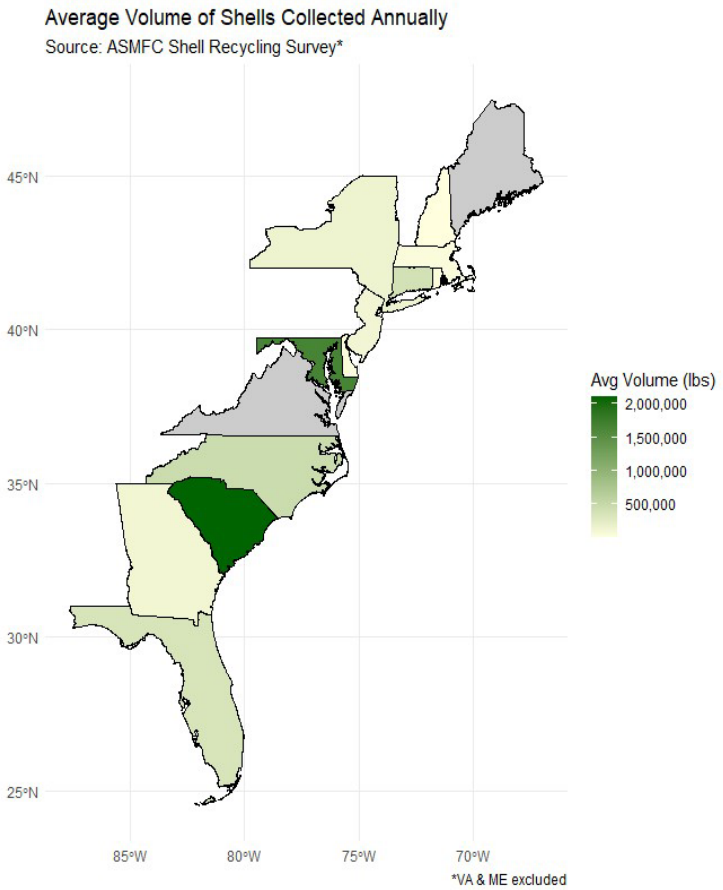
Executive Summary



Oysters are a keystone species in our coastal estuaries, and the reefs they form are critical ecosystems that 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 vital resource for reef restoration, have become increasingly scarce due to ecological 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. Recycling oyster shells serves several essential environmental, ecological, and economic purposes, with the overarching goal of sustaining marine restoration efforts, including oyster reef restoration and shoreline protection projects. 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 focus on shell recycling as a resource for states and practitioners along the Atlantic coast. It will highlight shell recycling programs across member states and offer recommendations for best management practices, including lessons learned, strategies to minimize the risk of disease introduction, and a variety of useful links and contacts. We hope this upcoming issue of the HMS will provide managers with the tools and guidance necessary to support the continued conservation of healthy coastal fish habitats.

Acknowledgements

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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Publication 2024

This publication of Habitat Management Series was made possible by the contributions of many, but the Habitat Committee would like to specifically acknowledge the efforts of the 2025 Editors: Tina Berger (ASMFC) Simen Kaalstad (ASMFC) Madeline Musante (ASMFC)

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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.

Introduction

Oyster shell recycling programs play a critical role in supporting coastal restoration by returning this valuable substrate to estuarine systems, where it provides settlement surface for oyster larvae, improves habitat complexity, and enhances ecosystem services such as water filtration and shoreline stabilization. For habitat managers, launching or expanding a shell recycling effort requires thoughtful planning that balances ecological goals with practical operations and community engagement.

Habitat and Ecological Concerns

The primary purpose of shell recycling is to create durable, clean substrate for oyster restoration and enhancement efforts. 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. Managers should also consider habitat placement, selecting sites that will support reef persistence, recruitment, and ecosystem function. The ideal bottom type for oyster substrate is sandy and firm as oysters cannot survive if submerged in the mud for too long.

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 Locations

Shells should be stored upland, away from tidal waters or flood prone areas, to reduce the risk of contamination and to allow natural weathering. Shell that is steamed may pose less of a concern for disease than freshly shucked shell obtained from restaurants. 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.

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 feedback to donors foster long-term participation. In many cases, partnerships with nonprofits, universities, and aquaculture operators help share costs, logistics, and storage capacity.

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)

Core vehicle & handling equipment

- Pickup trucks / flatbeds – flexible, low cost for small routes. Good for <10 locations/day.
- Box trucks / roll-off trucks – needed for medium/large routes and 30-cy dumpsters.
- Dump trailers / dump trucks – efficient for moving large, cured piles to staging or barge sites.
- Barges & cranes (deployment) for offshore/subtidal placement; match barge capacity to planting volume.
- Forklift / skid steer – handling pallets, barrels, and moving totes at curing sites.

Collection containers

- 5-gallon screw-top buckets – convenient for restaurants; ~25–30 lbs. when full (dry).
- 32- or 64-gallon wheeled totes – useful for larger restaurants and festivals.
- 30-cubic-yard roll-off dumpsters – standard for aggregation and transport to curing sites.
- Food-grade sealable barrels – reduce odor at donor sites and increase donor participation.

Curing & cleaning equipment

- Open-air curing pads / roll-offs – simplest/cheapest method (sun, wind).
- Shell tumblers / rotary washers – remove fines and some organics before/after curing (good for hatchery use).
- Airlift / pneumatic sorting units (e.g., Vermeer airlift) – separate shell from lightweight plastics / trash at scale.
- Tumbler screens & water jets – for centralized cleaning facilities.
- Pallets, tarps, drainage channels – keep shells off bare ground, speed drying, protect groundwater.

Personal protective equipment (PPE) & safety

- Gloves, eye protection, masks (dust), high-visibility vests for drivers/volunteers, first-aid kit, HAZMAT spill materials for fuel/grease, and safety training for heavy equipment.

Data & admin tools

- Weighing scales (truck scales or pallet scales), mobile data app/tablet for pickups, and a simple database (spreadsheet or cloud DB) to log donor, weight, date, curing site batch ID, contamination notes.

Siting curing locations

Top siting criteria

- Secure, non-flooding upland – out of the tidal zone, minimal storm surge risk.
- Accessible by collection vehicles – adequate load/unload space and legal access.
- Sufficient capacity – account for seasonal peaks and minimum curing retention time (see below).
- Drainage & containment – concrete or compacted base, berms or silt fences to prevent shell/soil runoff; avoid direct discharge to waterways.
- Distance & buffering from homes / restaurants – even well-managed piles can produce odor and attract pests. Typical practice: site at industrial/commercial zones, municipal properties, or partner organization lands; maintain buffer of hundreds of feet from residences where possible and site behind vegetation or structures.
- Community acceptance & permitting – early outreach to neighbors, zoning review, and local public health notification.

Odor / pest mitigation near people

- Use food-grade sealable barrels at donor sites to reduce on-site odor.
- Rotate or aerate piles, add drainage/cover during hot months.
- Use commercial deodorizers (evaluate with local regulators) and discourage indiscriminate bleach use.
- Strategic siting downwind of residential areas and outside school/recreation sightlines helps reduce complaints.
- Plan regular volunteer cleanups and prompt removal of contaminated loads.

Biosecurity / health considerations

- Provide site fencing and locked access to prevent illegal dumping and scavenging.
- Coordinate with local health departments – some jurisdictions have storage/food-waste rules.
- Prevent standing water and vector breeding; use drainage and rodent control as needed.

End-uses & deployment techniques

Primary end-uses

- Spat-on-shell production (hatchery setting): best when shell is clean and screened.
- Intertidal & subtidal reef construction (loose shell): classic use to create complex three-dimensional reefs.

- Bagged shell reefs: useful for shoreline stabilization and volunteer deployment; easier to handle but may require more labor.
- Living shoreline projects (bagged shell backed by coir or BESE mats, jute fiber): stabilize shorelines and trap sediment.
- Hatchery broodstock / aquaculture uses when shell is of suitable quality and cured properly.

Deployment techniques

- Loose broadcast with barge + water cannon – efficient for large subtidal plantings.
- Hand-bagging / volunteer bagging – good for intertidal and living shorelines; strong outreach benefit.
- Cast placement / conveyor systems / cranes – for precision in high-value restoration sites.
- Spat trays / racks / off-bottom systems – used in hatchery enhancement.

Curing & timing

- *Minimum curing time: 6 months* is a common standard (NSSP guidance and many states). In cool/wet climates or dense loads, 12 months is recommended.
- *Mechanism:* natural weathering (sun, wind) + pile aeration; washing/tumbling can reduce organics and time until safe use but follow state guidance.
- *Rotating vs. not rotating piles:* some programs do not turn piles (simpler), others do (speeds drying, reduces flies). Choose method consistent with space, staffing, and local rules.
- *Moisture control:* drainage holes in bags, elevated pallets, and sloped pads reduce anaerobic conditions and odors.
- *Record batch IDs:* every load, curing pad, and deployment must be traceable (date in / date out, source, contamination notes, etc.).

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

Program / operational metrics (i.e., logistics, participation) – continuously tracked.

- Total shell collected (lbs, bushels, or yd^3), monthly and annual totals.
- Number of donor partners (restaurants, markets, events).
- Collection frequency & pickup success (on-time pickups).
- Contamination rate (% loads with trash) and types of contamination.
- Curing inventory (batch IDs, volumes stored, curing start date).
- Volunteer hours & events (outreach ROI).
- Cost per bushel / cost per deployed yd^3 – for budgeting & grant reporting.

- Donor retention rate and monthly donor reports (helps restaurants see impact).

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), 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.

Practical checklist & troubleshooting

Start-up checklist

- Stakeholder map (regulators, donors, partners).
- 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 yd^3) 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.

Permitting Guidelines

Oyster reef restoration and shell recycling projects are regulated activities that require various permits and approvals to ensure they protect public health, water quality, navigation, and sensitive habitats. These projects generally fall under the jurisdiction of state environmental and marine resource agencies, as well as federal agencies, with some variation depending on the project's location, scope, and materials used. Whether you're curing shell in a parking lot or placing it in tidal waters, permitting is essential for legal and ecological success.

Core Permits and Regulatory Reviews

Federal Agencies Involved

- U.S. Army Corps of Engineers (USACE)

    - Under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, the USACE regulates the placement of materials in navigable waters and wetlands. See Section 404 and Section 10 Permitting Guide for more information.
    - Restoration projects using shell or alternative substrates (e.g., reef balls, limestone) typically require a Nationwide Permit (NWP) – most often NWP 27: Aquatic Habitat Restoration, Establishment, and Enhancement Activities.
    - Some projects require an Individual Permit if they fall outside the scope of nationwide permit conditions.
- U.S. Environmental Protection Agency (EPA)
    - Reviews and may comment on permits that have potential water quality or ecological impacts.
    - Provides oversight of Section 404 permitting under the Clean Water Act, especially for projects affecting wetlands or water quality. See Permit Program under CWA Section 404 | US EPA for more information.
- National Oceanic and Atmospheric Administration (NOAA)
    - Through the Essential Fish Habitat (EFH) consultation under the Magnuson-Stevens Act, NOAA Fisheries evaluates whether proposed reef sites may impact habitat used by federally managed species.
    - NOAA may also be involved through National Marine Sanctuaries or threatened/endangered species protections.
- U.S. Food and Drug Administration (FDA)
    - While the FDA does not directly issue permits, it governs the National Shellfish Sanitation Program (NSSP), which informs shell handling and curing practices to ensure recycled shell used for restoration doesn't pose public health risks.
    - Many states follow FDA NSSP guidelines requiring a minimum curing time of 6 months for recycled shell before deployment.

State Agencies and Typical Requirements

- Each coastal Atlantic state has its own permitting framework. Key responsibilities often fall under:
    - State Departments of Environmental Protection/Natural Resources
    - State Fisheries Commissions or Marine Resources Divisions
    - State Shellfish Sanitation Authorities (often housed within health or agriculture departments)
- These agencies may issue:

- Water Quality Certifications (Section 401) – ensuring compliance with state water quality standards
- State Aquaculture Permits – if shell is used in mariculture
- Coastal Zone Management Act (CZMA) Consistency Determinations – reviewed by the state's designated CZM agency

Requirement	Description	Issued By
401 Water Quality Certification	Ensures state water quality standards are met	State environmental agency
Shellfish Sanitation Approval	Verifies shell is clean, cured, and pathogen-free	Health or agriculture department
Coastal/Marine Habitat Permit	Approves restoration site and construction method	State marine/fisheries agency
Public Bottom Lease (if needed)	Authorizes use of state-owned submerged lands	State lands or marine agency

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, 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, 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.

Summary of Common Requirements Across States

Requirement	Common Across States?	Notes
USACE Nationwide Permit	✅ Yes	NWP 27 used widely for restoration activities
NSSP 6-Month Curing Requirement	✅ Yes (strongly recommended)	Adopted under FDA guidance to prevent pathogen risk
State Water Quality Certification	✅ Yes	Required under Section 401 of the Clean Water Act
Shellfish Sanitation Approval	✅ Yes	Overseen by state health/agriculture departments
Essential Fish Habitat Consultation	✅ Yes (via NOAA)	Required if project may impact federally managed species
State-specific Coastal Permits	✅ Yes	Varies widely: CAMA (NC), CAFRA (NJ), CZM review (all coastal states)

What to Prepare Before Applying

- Restoration site coordinates (GPS)
- Shell source, storage, and curing method
- Deployment technique and substrate type
- Monitoring plan (e.g., live oyster density, reef stability)
- Stakeholder/community support letters
- Proof of compliance with NSSP standards

Common Challenges

- Curing and storage space often warrants local zoning/permitting.
- Sanitation rules vary slightly by state; always check with your shellfish authority.
- Permit timelines range from weeks (for NWP) to months (for individual or state-specific reviews)
- Monitoring requirements increasingly standard – plan for long-term site tracking.

Key Takeaways for Practitioners

- Early coordination with state and federal agencies is essential, especially to determine if a project qualifies for a general or individual permit.

- Public health regulations (curing and contamination prevention) are just as critical as ecological compliance.
- Restoration practitioners should also budget for monitoring commitments, which are increasingly required as part of long-term permit compliance.
- Variability between states means that even similar projects may face very different timelines and requirements.

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 in^3; 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, planned for 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.

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.

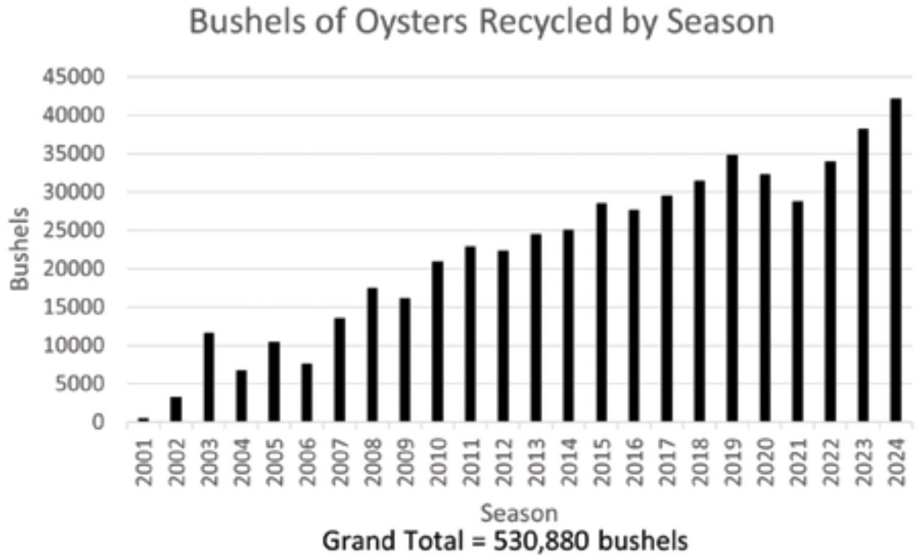
The South Carolina Oyster Recycling and Enhancement (SCORE) Program

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 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.

Trash picked from shell by volunteers. About 85% of collections from venues contain trash (plastics, utensils, etc.). Credit: SCDNR

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

Globally, oyster populations have declined to historically low levels. 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.

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.

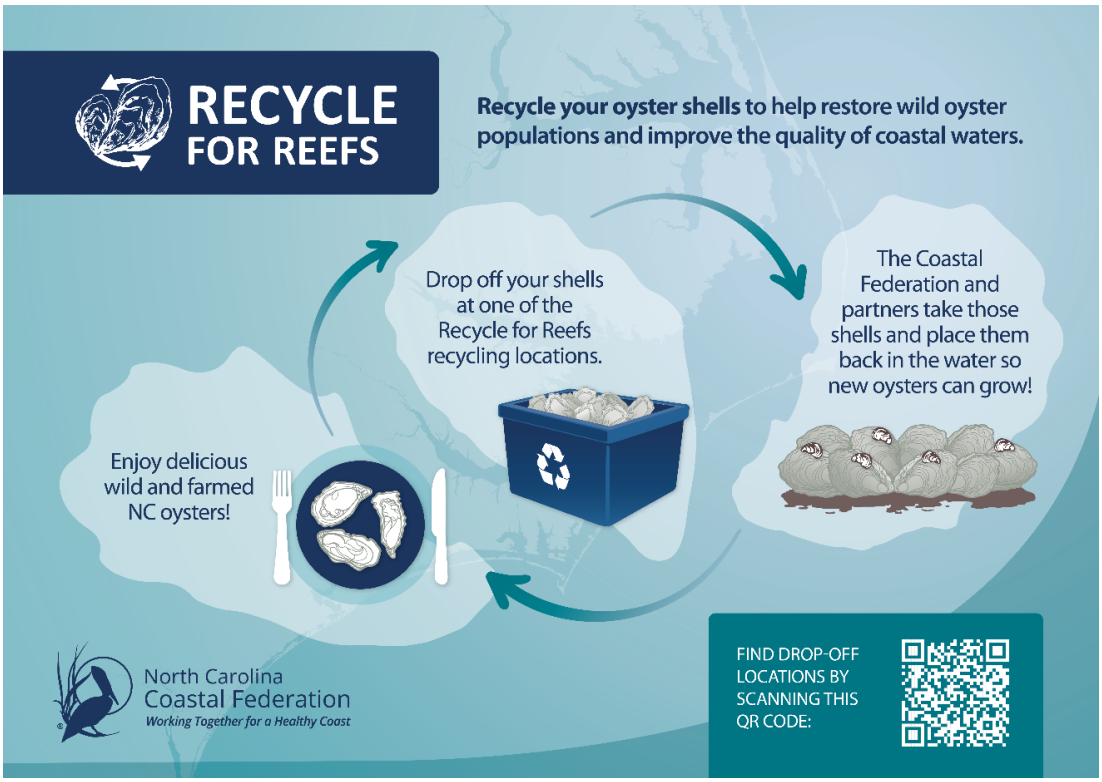
Restoration

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.



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

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 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.

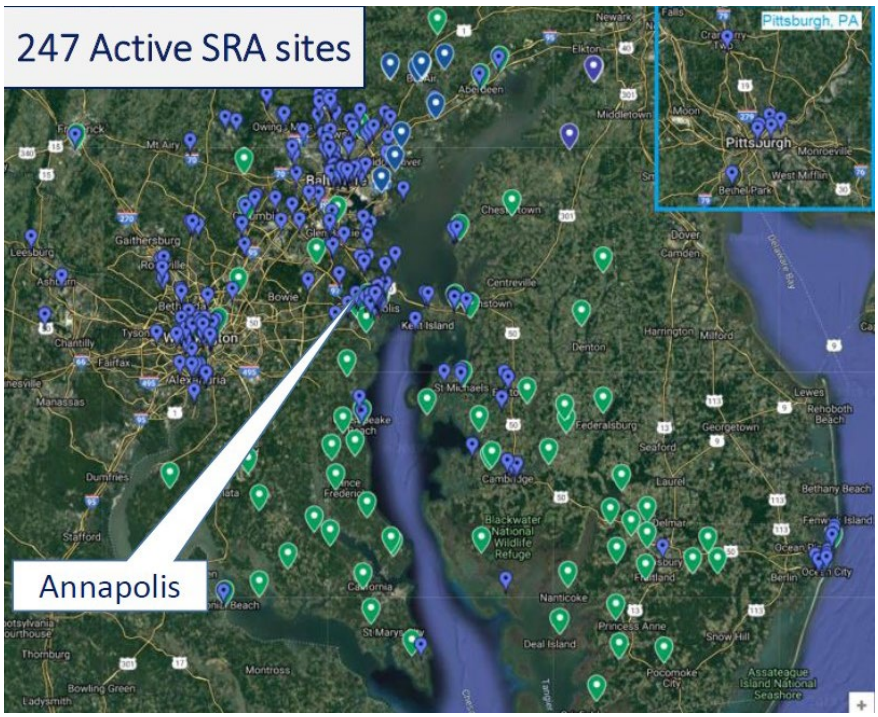
Maryland

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.

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.

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

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:** Shell is tracked by weight (in pounds) throughout the collection, curing, and deployment process.
- **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) and other agencies to document reef locations and track spatial restoration targets.

Restoration sites are monitored for more than 5 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.

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.

Oyster cage building event. Credit: Oyster Recovery Partnership

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 125,000 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 ≈ 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 enhancement. 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).

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.

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* (***S**trengthening **H**abitats through **E**nvironmental **L**earning and **L**eadership*), 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

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

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, 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-hous2113ewe 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

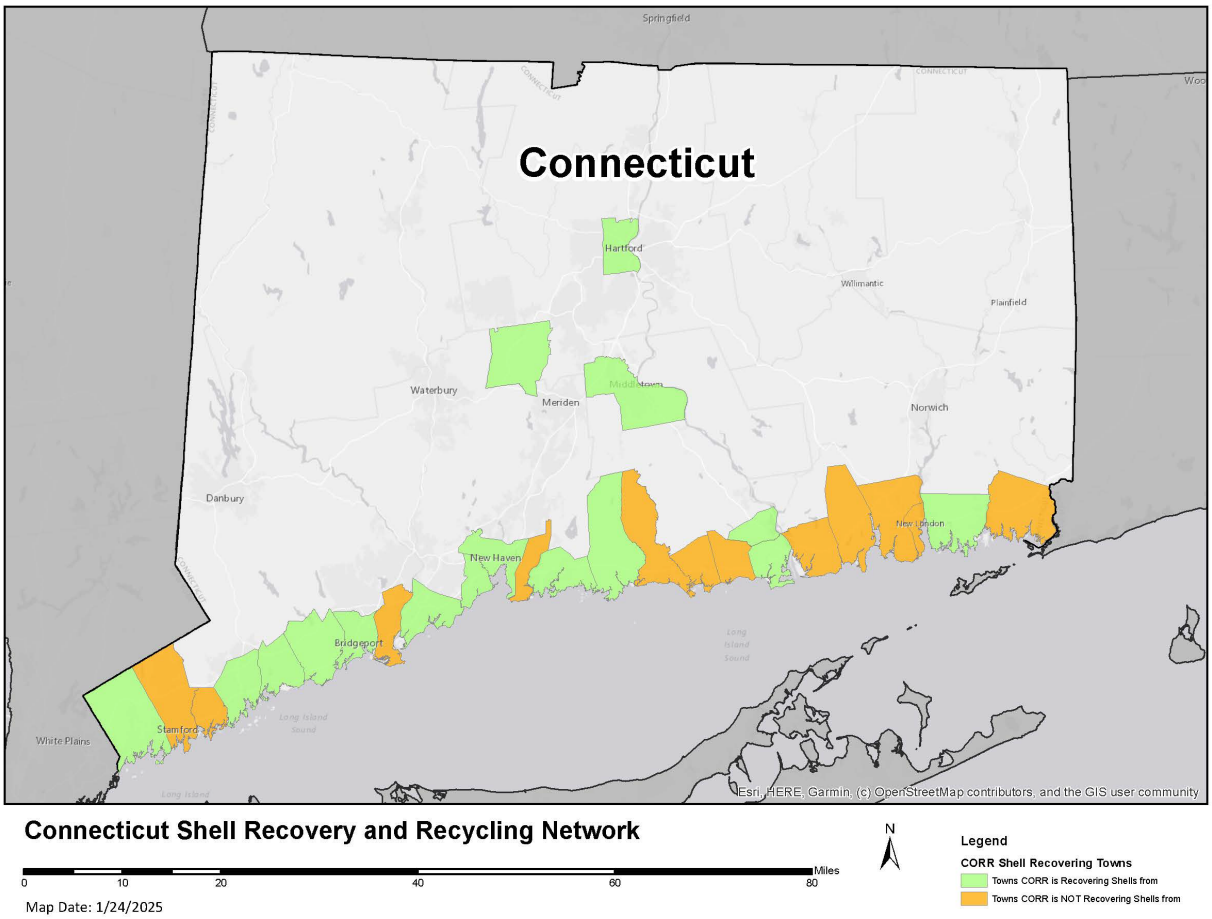
CORR collects approximately **7,500 bushels** (1 bushel = 50 lbs.) of shell annually (35% oysters, 65% other shellfish). Shell is sourced primarily from **restaurants**, but also from seafood markets, wholesale distributors, community drop-off sites, and events/festivals. Participating restaurants partners 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.

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.**



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

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.

CORR's Public Outreach and Educational Tent

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.

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 toters** 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.

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

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.

For additional information about the Massachusetts Oyster Project, please contact Mark Rousseau, mark.rousseau@mass.gov.

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.

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

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 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

- Incorporating Oysters into Living Shorelines Guide (Chesapeake Bay Foundation)
- (ADDITIONAL LINKS TO BE INCLUDED AT A LATER TIME)