FISHERY MANAGEMENT PLAN UPDATE
EASTERN OYSTER
AUGUST 2026

STATUS OF THE FISHERY MANAGEMENT PLAN

Fishery Management Plan History

Original FMP Adoption:	August 2001	
Amendments:	Amendment 1	January 2003
	Amendment 2	June 2008
	Amendment 3	April 2014
	Amendment 4	February 2017
	Amendment 5	May 2025
Revisions:	None	
Supplements:	Supplement A to Amendment 2	November 2010
Information Updates:	None	
Schedule Changes:	None	
Comprehensive Review:	2030	

The original Oyster Fishery Management Plan (FMP) was adopted by the North Carolina Marine Fisheries Commission (MFC) in 2001. This FMP set up a process for designation of additional areas limited to hand harvest methods around Pamlico Sound and recommended several statutory changes to the shellfish lease program including higher fees, training requirements, and modified lease production requirements (NCDMF 2001).

The Oyster FMP Amendment 1 changed one of the criteria for designation of hand harvest areas from waters generally less than 10 ft deep to waters less than 6 ft deep (NCDMF 2003). Highlights of the management measures developed in the Oyster FMP Amendment 2 included adopting a 15-bushel harvest limit in the Pamlico Sound and a 10-bushel harvest limit for all gears (hand and mechanical) in designated areas around the sound, reducing the available harvest season, changing the way lease production averages were calculated, limited lease applications to 5 acres and had a recommendation to expand oyster sanctuary construction efforts (NCDMF 2008). Supplement A raised the potential harvest limit in the Pamlico Sound to 20 bushels and created a monitoring system for determining when to close mechanical harvest in that area (NCDMF 2010). The Oyster FMP Amendment 3 created two seed oyster management areas in Onslow County (NCDMF 2014).

Amendment 4 was adopted in February 2017 with selected management measures that included: the continuation of the monitoring system for when to close mechanical harvest off public bottom in an area, a reduction of the culling tolerance from 10% to 5% in the commercial fisheries off public bottom, a reduction of the daily harvest limit for holders of the Shellfish License off public bottom to two bushels per person per day maximums 4 bushels per vessel, the continuation of the 6-week open season to mechanical harvest off public bottom in the bays with changes in the timing of the 6-week opening, modifications to shellfish lease provisions, and adding convictions of theft on shellfish leases and franchises to the types of violations that could result in license suspension or revocation (NCDMF 2017).

The Eastern Oyster FMP Amendment 5 adopted in May 2025 only focused on managing wild oyster stocks (NCDMF 2025). The ending of the relay program and the transition into the use of farming cages and hatchery sourced seed, have nearly eliminated the private industry's reliance on wild oysters. These changes to private culture practices reduce the need to consider aquaculture in the management of wild oyster stocks.

Management strategies from Amendment 5 were implemented at the start of the 2025–2026 oyster harvest season. To balance the value of oysters as both a fishery resource and essential habitat for oysters and other estuarine species, a three-tiered management strategy was adopted in Amendment 5 for oyster mechanical harvest management in Pamlico Sound. The first tier prioritizes the ecological value of oysters with the designation of Deep-water Oyster Recovery Areas (DORAs) at the mouth of the Pamlico and Neuse rivers closed to mechanical harvest. The closures protect 81% of the previously identified deep-water oyster habitat (Winslow 1889; Ballance 2004; and DMF sonar surveys), preventing further height loss and damage to recovering oyster reefs. Monitoring efforts will be used to evaluate the effectiveness of the closure within the next FMP amendment. The second tier is a Cultch Supported Harvest strategy that incorporates industry input to guide DMF pre-season sampling locations to assess the percentage of legal-sized oysters. This approach uses data to set fixed season lengths by proclamation, which may only be extended after further in-season sampling, balancing habitat and fishery value, and providing harvesters with greater certainty on the season length. An adaptive management framework is included to evaluate fixed season lengths if participation in the mechanical harvest fishery changes by 25%. The third tier is the Rotational Cultch Site strategy, which uses rotational openings available to harvest for the full extent of the mechanical season, at 10-acre planting sites across four management areas in Pamlico Sound. This tier further strengthens the integration of the DMF's Cultch Planting Program into management of the oyster fishery, prioritizing the fishery value of these sites.

Amendment 5 maintains the daily harvest limit of two bushels of oysters per person with a maximum of four bushels of oysters per vessel off public bottom for Shellfish License holders, the 6-week opening timeframe for mechanical harvest in the bays in Pamlico Sound, and 15-bushel hand/mechanical harvest limit in Pamlico Sound outside the bays and 10-bushel hand/mechanical harvest limits in the bays, and the 10-bushel hand harvest limit in the Mechanical Methods Prohibited Areas along the Outer Banks of Pamlico Sound as specified in MFC Rule 15A NCAC 03R .0108(1) and (2)(a), (b), (c), and (d).

Management Unit

The management unit of this FMP includes the Eastern Oyster (*Crassostrea virginica*) and its fisheries in all public coastal fishing waters of North Carolina. This FMP pertains only to oysters from wild stocks and does not address managing farmed oysters originating from private aquaculture leases and franchises.

Goal and Objectives

The goal of the N.C. Eastern Oyster FMP Amendment 5 is to manage the oyster resource to maintain oyster populations that provide long-term harvest and continue to offer protection and ecological benefits to North Carolina's estuaries. To achieve this goal, it is recommended that the following objectives be met:

- Use the best available biological, environmental, habitat, fishery, social, and economic data to effectively monitor and manage the oyster fishery and its environmental role.
- Support and implement the restoration and protection of oyster populations as both a fishery resource and an important estuarine habitat through the actions of the Cultch Planting and Oyster Sanctuary programs.
- Coordinate with DEQ and stakeholders to implement actions that protect habitat and environmental quality consistent with the Coastal Habitat Protection Plan (CHPP) recommendations.
- Manage oyster harvesting gear use to minimize damage to habitat.
- Promote stewardship of the resource through public outreach to increase public awareness regarding the ecological value of oysters and encourage stakeholder involvement in fishery management and habitat enhancement activities.

DESCRIPTION OF THE STOCK

Biological Profile

The Eastern Oyster (*Crassostrea virginica*) is an immobile filter feeding bivalve mollusk occurring naturally along the western Atlantic Ocean from the Gulf of St. Lawrence to the Gulf of Mexico (Bahr and Lanier 1981; Carlton and Mann 1996; Jenkins et al. 1997; MacKenzie et al. 1997). Recent research suggests several related oyster species are distributed throughout the Caribbean and coastal South America; however, the Eastern Oyster's southern range extends only to the northern Yucatan Peninsula (Gaffney 2005; Amaral and Simone 2014).

Initial molecular analysis indicates North Carolina's stock is part of the Atlantic coast stock, which extends from Maine to Key Biscayne, Florida (ASMFC 1988). Additional genetic analyses suggest a population division occurs in the Mid-Atlantic region, subdividing the Atlantic coast stock into northern and southern groups (Wakefield and Gaffney 1996; Hoover and Gaffney 2005; Varney and Gaffney 2008). North Carolina represents a transition zone within the Atlantic stock of Eastern Oyster, with a shift between northern and southern types occurring approximately at the southern boundary of the Pamlico Sound (Sackett 2002).

Eastern Oysters (hereafter, "oysters") inhabit waters across a wide range of temperatures (0°C to 32°C; Butler 1954). Though oysters can also tolerate extreme salinities (as low as 5 ppt and as high as 40 ppt) depending on temperature, their optimum salinity range is 14 and 28 ppt (Galtsoff 1964; Loosanoff 1965; Wallace 1966; Shumway 1996; Rybovich 2014). The distribution and survival of oysters is further influenced by abiotic factors such as oxygenation, flow, and tide (Stanley and Sellers 1986; Roegner and Mann 1995; Kennedy et al. 1996; Lenihan 1999), as well as biotic factors such as disease, bioeroders, and predation (Barnes et al. 2010; Johnson and Smee 2012; Pollack et al. 2012; Dunn et al. 2014).

North Carolina's oysters are composed of both subtidal populations (below the mean low tide water level, up to 26 ft deep) and intertidal populations (between the mean high and low tide levels; MacKenzie et al. 1997). Throughout the Croatan, Roanoke, and Pamlico sounds, oyster resources are almost exclusively subtidal. This region is primarily influenced by wind-driven tides, with intertidal oysters found occasionally near the inlets. Scattered subtidal populations may be found in larger systems farther south (Newport, White Oak, and New rivers systems). Conversely, intertidal populations are predominantly observed south of Cape Lookout and throughout estuaries extending to the state's southern border. The horse or Crested Oyster (*Ostrea equestris*) may be confused with small Eastern Oysters and can be locally abundant in both intertidal and subtidal habitats in southeastern North Carolina (Markwith et al. 2009).

Oyster bodies (meats) have a small foot, a relatively small adductor muscle, fillibranch gills with interlamellar junctions, and lack a siphon (Galtsoff 1964). The interior of the Eastern Oyster shell contains a purple-pigmented adductor muscle scar that does differentiate Eastern Oysters from other similar species within its range. The left valve is generally more cupped than the right that is normally found on top, and there is no gap between the shells when the valves are completely closed (Yonge 1960; Galtsoff 1964). Shell morphology can vary greatly depending on substrate and habitat conditions. For instance, oysters grown in subtidal and lower salinity environments tend to have thick, rounded shells with visible radial ridges (Stanley and Sellers 1986). In the presence of predators, oysters may allocate more energy to shell growth, resulting in thicker and heavier shells (Johnson and Smee 2012; Lord and Whitlatch 2012). Shell thickness has also been found to correlate with latitude and water temperature along the Atlantic coast, with warmer southern locations having oysters with thicker shells than colder northern locations (Lord and Whitlatch 2014).

Oysters are typically hermaphroditic, as they first develop and spawn as males in the first few years and may ultimately develop as females as individuals get larger and older (Galtsoff 1964; Kennedy 1983). Oysters may change sexes once each year when the gonad is undifferentiated (Thompson et al. 1996). Research suggests natural oyster populations maintain balanced sex ratios (Kennedy 1983). However,

certain environmental conditions, such as limited food availability and extreme salinity gradients, have been attributed to skewing sex ratios to high abundances of males (Bahr and Hillman 1967; Davis and Hillman 1971; Powell et al. 2013). The sex of nearby oysters may also influence individual oyster sex determination (Smith 1949; Menzel 1951). Age or size selective mortality (e.g., from disease or harvest pressure) can alter oyster population demographics and result in a local shift from male to female majority (Harding et al. 2012).

The formation of eggs and sperm is initially stimulated by increasing water temperatures during the spring (Galtsoff 1964; Kennedy et al. 1996). In North Carolina, oyster broadcast spawning peaks twice, once in June at 20°C, with a second spawning event in August at 25°C (Chestnut 1954). Salinities greater than 10 ppt are also typically required for mass spawning (Breuer 1962). Gonads may be developed in oysters at 2 to 3 months old, but most of these sub-adult oysters will not be sexually mature (Galtsoff 1964; Kennedy 1983). Fecundity estimates range from 2 million eggs for a 4-cm (1.5 in) oyster to 45 million for an oyster 7 cm (2.8 in) in length (Kennedy et al. 1996). These estimates range widely as oysters can spawn several times per season and gonads may expand into other tissues (Kennedy et al. 1996). However, it's accepted that larger oysters allocate greater energy towards egg production and therefore have increased fecundity (Kennedy et al. 1996). For instance, oysters collected from North Carolina's no-take sanctuaries have demonstrated that fecundity increases exponentially with size, reaching the highest levels in May (Mroch et al. 2012).

Under normal conditions, male oysters spawn first in response to various physical stimuli and environmental conditions. Female oysters are stimulated to spawn specifically by the presence of oyster sperm. Fertilization must take place shortly thereafter in the surrounding waters, or the unfertilized eggs lose their viability. Fertilized eggs develop into a free-swimming larva, which can migrate vertically in the water column in response to temperature and salinity changes (Hopkins 1931; Galtsoff 1964). Oyster larvae have also been documented to travel up to 30 mi, with dispersion strongly dependent on prevailing winds (Bahr and Lanier 1981; Andrews 1983). Patterns of larval distribution in North Carolina estuaries remain relatively unstudied; however, predictive models of Pamlico Sound larval dispersal from oyster sanctuaries have been developed (Haase et al. 2012).

An oyster larva may visit several sites before it cements itself to the substrate (Kennedy et al. 1996). Several environmental factors, including light, salinity, temperature, acoustic signature, and current velocity may influence the setting of larvae (Hidu and Haskins 1971; Lillis et al. 2013). Oyster larvae also respond positively to a protein on the surface of oyster shells as well as other recently set spat (Kennedy et al. 1996). Larval oysters tend to settle in the intertidal zone where salinities are above 20 ppt whereas in subtidal areas they settle when salinities are below 20 ppt (Mackin 1946; Loosanoff 1952; Menzel 1955). Generally, spatfall is higher in intertidal areas and in areas boasting salinities in the upper range of tolerance (Bahr and Lanier 1981).

Chestnut (1954) reported recruitment peaks generally occurring in June, the latter part of August, and possibly another peak in October. Ortega et al. (1990) found recruitment in western Pamlico Sound to be continuous, concentrated in one or two peaks depending on the year and location. Generally, peaks occurred in June (lesser) and September–October (greater). Munden (1975) reported that spat monitors located in Morehead City and Wilmington did not show a decline in availability of spat during the summer of 1972 until September.

Oyster growth is highest during the first 6 months after settling and gradually declines throughout the life of the oyster (Galtsoff 1964). Seasonally, adult oysters grow most rapidly during spring and fall in North Carolina. Shell growth was found to cease when water temperatures reached 28°C and slowed when temperatures decreased to 5°C (Chestnut 1954). Ortega et al. (1990) examined data from 1979–1989 and found that spat from western Pamlico Sound sites attained lengths of 10–40 mm during the first year and reached marketable size (76 mm) by the end of 3 years. Varying growth rates have been observed between

and within different regions of North Carolina and under different environmental conditions (Godwin 1981; Kennedy and Breisch 1981; Roegner and Mann 1995; Puckett and Eggleston 2012).

Stock Status

Data limitations prevent the DMF from conducting an Eastern Oyster stock assessment and calculating sustainable harvest metrics. Data available for the stock include commercial landings and fishing effort (i.e., trips) reported to the Trip Ticket Program, biological data collected from the commercial catch, and voluntary responses to an annual recreational survey. For information on the methodology used in previous stock assessment attempts, see Amendment 4 of the Oyster FMP (NCDMF 2017).

Stock Assessment

An oyster stock assessment was attempted in 1999, but the necessary data were lacking to determine levels of sustainable harvest (NCDMF 2001). Since there were no significant changes in the types and quantity of data collected, an oyster stock assessment could not be achieved in 2006, 2014, and again in 2022 (NCDMF 2008, 2017, 2025). The DMF partnered with researchers at North Carolina State University and The Nature Conservancy to design statistically robust fishery-independent population survey methodologies for oysters in North Carolina to inform a potential future stock assessment. While methods have been developed, DMF does not currently have the staff or equipment resources to implement the recommended sampling programs (NCDMF 2025).

While the oyster is managed by 18 other states along the Atlantic Coast and Gulf of Mexico, it is worth noting that only Louisiana, Maryland, and Virginia have extensive long term sampling programs and data sets needed to complete stock assessments. Louisiana's most recent stock assessment in 2023 utilized 1,700 dredge samples and 1,000 diver quadrat samples collected during summer months. Maryland conducts a stock assessment within the northern region of Chesapeake Bay and its tributaries (north of Smith Island, following the state-boundary); while Virginia's stock assessment of oysters includes the southern portion of the Chesapeake and its tributaries, including the James River. In addition to a stock assessment, Virginia employs a rotational harvest management system for oysters.

In the absence of a formal stock assessment, Delaware and New Jersey use other metrics to inform their management strategies. Delaware conducts a population survey to set quotas; New Jersey does an annual assessment of Delaware Bay. In North Carolina, management is focused on habitat protection measures and extensive restoration and enhancement measures that have maintained harvestable oyster populations.

DESCRIPTION OF THE FISHERY

Current Regulations

Oysters cannot be taken from any public bottom in areas designated as polluted by proclamation except for special instances for: Shellfish Management Areas (MFC Rule 15A NCAC 03K .0103), and for the depuration of shellfish (MFC Rule 15A NCAC 03K .0107). Beginning in April 2014, time and temperature control measures were initiated for oysters to prevent post-harvest growth of naturally occurring Vibrio spp. bacteria that can cause serious illness in humans between April 1 and September 30 of each year. Oysters cannot be taken between the hours of sunset and sunrise of any day. Beginning in the 2017–2018 season, the culling tolerance was reduced from 10% to 5% off public bottom based on management measures adopted in 2017 as a part Amendment 4 of the Oyster FMP and formalized in MFC Rule 15A NCAC 03K .0202 (NCDMF 2017).

<u>Wild Harvest</u>

The minimum size limit for oysters from public bottom is 3-in shell length. Both the hand and mechanical oyster harvest season from public bottom are opened annually by proclamation. It shall be unlawful to sell oysters taken on Saturday and Sunday from public bottom. The hand-harvest season for commercial and recreational harvest begins on October 15 each year with commercial harvest limited to Monday through

Friday each week and recreational harvest is allowed 7 days per week. Hand-harvest methods to take oysters are allowed in all areas found suitable for shellfish harvest by the Shellfish Sanitation and Recreational Water Quality Section of the DMF during the open season. Beginning in 2013 through statutory changes, the Shellfish License was restricted to hand harvest only, and harvest by mechanical methods was prohibited. Recreational harvest is only allowed by hand methods. The hand harvest season typically continues until it is closed by rule on March 31.

The daily hand harvest limit for oysters in the Pamlico Sound outside the bays is 15 bushels per day per commercial fishing operation and 10 bushels per day per commercial fishing operation in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound. Areas from Core Sound south have a daily hand harvest limit of 5 bushels per person, not to exceed 10 bushels in any combined fishing operation regardless of the number of persons, license holders, or boats involved. Recreational daily harvest limits in 2024 were one bushel per person per day, not to exceed two bushels per vessel per day.

Beginning in October of the 2017–2018 season, hand harvest for Shellfish License holders was limited to 2 bushels per person per day, not to exceed 4 bushels per vessel per day if two or more Shellfish License holders are onboard the vessel (NCDMF 2017). Hand harvesters with the Standard Commercial Fishing License (SCFL) could continue landing the higher daily harvest limits in all areas.

The mechanical harvest season for oysters opens on Monday the week before Thanksgiving (mid-November), and is restricted to deeper portions of the sounds, rivers, and bays north of the Pamlico Sound. These mechanical harvest areas are designated by rule (MFC Rule 15A NCAC 03R .0108). Mechanical methods for oysters are only allowed to operate from sunrise to 2 p.m. Beginning in the 2017–2018 harvest season, the 6-week open period for the bays was split into two potential open periods. The first opening in the bays could begin on the Monday of the week prior to the Thanksgiving holiday and runs through the Friday after Thanksgiving. The second opening of the bays could begin 2 weeks before Christmas and remain open for the remaining 4 weeks.

Areas outside the bays open to mechanical harvest are limited to a daily harvest limit of 15 bushels of oysters per operation and limited to 10 bushels of oysters per operation within the bays.

The mechanical harvest season can potentially run through March 31; however, the total number of weeks which mechanical harvest is allowed for each management area is determined by the condition of the oyster resource as evaluated by DMF sampling previous to and during the open season.

There are also further restrictions for mechanical oyster harvesters to make sure that cultch material and culled oysters are either put back into the water where they were taken or remain on the existing rocks. North Carolina has a rule in place (MFC Rule 15A NCAC 03K .0202) requiring culling on site. The following restrictions were put in place beginning with the 2012–2013 oyster season to discourage harvesters from not culling and removing extra cultch material.

- It shall be unlawful to possess more than 5 bushels of unculled catch onboard a vessel. Only material on the culling tray is exempt from culling restrictions.
- It shall be unlawful to possess accumulated dead shell or accumulated oyster cultch material while underway and not engaged in mechanical harvesting.

Some harvesters did not have vessels or dredges rigged for circular dredging patterns which work best with towing points over the side of the vessel or for short tows to allow for culling between pickups. The following restrictions were put in place to encourage circular dredging patterns and shorter tows to keep the cultch and culled oysters on the existing rocks.

- It shall be unlawful for the catch container (bag, cage) attached to a dredge to extend more than 2 ft in any direction from the tooth bar.
- It shall be unlawful to tow a dredge unless the point where the tow line or cable exits the vessel and goes directly into the water is on the port or starboard side of the vessel forward of the transom.

Private Culture (Shellfish Farms and Aquaculture)

There is a specific application process and public comment period required for an individual to obtain a franchise or lease for the culture of oysters. Owners of shellfish leases and franchises must provide annual production reports to the division. Failure to furnish production reports can constitute grounds for termination, and cancellation proceedings will begin for failure to meet production requirements and interfering with public trust rights. Public bottom must meet certain criteria to be deemed suitable for leasing for shellfish cultivation and there are specific planting, production, and marketing standards for compliance to maintain a shellfish lease or franchise. There are also management practices that must be adhered to while the lease is in operation, such as: marking poles and signs, spacing or markers, and removal of markers when the lease is discontinued.

The minimum size limit for oysters from private bottom is a 3-in shell length with a 5% culling tolerance, which is only required during the open public harvest season. During the rest of the year there is no minimum size or culling requirement for oysters taken from private bottom. There is no daily maximum harvest limit applied to the taking of oysters from private bottom. Permits are required to use mechanical methods for oysters on a lease or franchise.

Possession and sale of oysters by a hatchery or aquaculture operation and purchase and possession of oysters from a hatchery or aquaculture operation are exempt from the daily harvest limit and minimum size restrictions. The possession, sale, purchase, and transport of such oysters must be in compliance with the Aquaculture Operation Permit. Leases that use the water column must also meet certain standards as outlined in G.S. 113-202.1 to be deemed suitable for leasing and aquaculture purposes.

Commercial Fishery

Landings in the North Carolina oyster fishery are impacted by both biotic and abiotic factors that influence oyster survival and growth.

Data on landings from public bottom by gear indicates that, prior to 1960, most of the oysters were taken by dredge when compared to all hand methods. Chestnut (1955) reported that 90% of the oysters landed in North Carolina came from Pamlico Sound. The Pamlico Sound area is largely dependent on dredging. The resurgence of the dredge landings in 1987 was due, in part, to increased oyster populations and in part to increased effort, as displaced mechanical clam harvesters turned to oyster dredging due to closure of southern clam areas by a red tide. The red tide was a neurotoxic dinoflagellate bloom (*Karenia brevis*) that caused closure of over 361,000 acres of public bottom to shellfish harvest from November 1987 to May 1988. Hand harvest landings of oysters failed to reach their potential that same year since many of the hand-harvest-only areas were also closed because of the red tide. Hand harvest landings are the most consistent contributor to the state's oyster fishery. Hand harvest landings have exceeded dredge landings for significant periods between 1961 and 1970 and between 1989 and 2008 (NCDMF 2017).

The oyster parasite *Perkinsus marinus*, also known as Dermo disease, has been responsible for major oyster mortalities in North Carolina during the late 1980s to mid-1990s. Once infected with this protist, oysters suffer reduced growth, poor condition, diminished reproductive capacity and ultimately mortality (Ray and Chandler 1955; Haskin et al. 1966; Ford and Figueras 1988; Ford and Tripp 1996). Chestnut (1955) may have been the first to report its occurrence in North Carolina. Large-scale oyster mortalities during the fall of 1988 prompted investigations by the Virginia Institute of Marine Science (VIMS) and the Cooperative Oxford Laboratory (NCDMF 2008), which revealed Dermo as the causative agent.

Throughout the 1990s, DMF sampling indicated that Dermo infections were on the rise in southern estuaries. However, moderate and high Dermo infection levels during late summer did not reduce oyster populations. Hand harvest landings in the south from 1991 through 2002 did not decline in the same manner as landings from the Pamlico Sound during the same time. It is suspected that the small, high salinity estuaries may inhibit mortality by flushing out parasites at a higher rate or by exceeding the salinity tolerance of the Dermo parasite, allowing for a higher survival rate compared to the Pamlico Sound. The

link between low dissolved oxygen, increased availability of iron, and increased parasite activity may also be a factor in the different mortality rates; as the smaller, high salinity estuaries are less prone to low dissolved oxygen events than the Pamlico Sound (Leffler et al. 1998). Dermo infection intensity has remained low and mechanical harvest landings in the Pamlico Sound continued to recover from the extremely high Dermo mortality levels and hurricane impacts of the mid-1990s until additional environmental impacts (i.e., low dissolved oxygen and hurricanes) began affecting the fishery in 2011 (NCDMF unpublished data; Colosimo 2007).

Bioeroders (organisms that tunnel into oyster shell), in particular boring sponge (*Cliona* spp.), are also of concern for their impacts to oyster reefs in North Carolina. Boring sponges can weaken the shell, which may increase risk of susceptibility to predation by drilling predators (Thomas 1979, Pomponi & Meritt 1990, Stefaniak et al. 2005, Buschbaum et al. 2007). An oyster reef with significant bioerosion can experience shell loss, eventually cascading into a reduction in a loss of structural integrity (Rutzler 1975). Previous studies seeking to understand the impact of boring sponge on oyster reefs have been varied. Dunn et al. (2014) found prolific *Cliona* sp. assemblages on oyster reefs in high salinity habitats (>20 ppt) in North Carolina waters but did not observe a significant difference between sites with sponge and sites without sponge regarding spat on shell density, shell height, or mortality. Conversely, older studies suggest increased mortality and reduced larval settlement (Guida 1977; Barnes et al. 2010). These differences may point to broader community dynamics (presence of predators, salinity regimes, etc.) that can ultimately influence the dynamics between boring sponge and oysters (Guida 1977).

Current Commercial Fishery

Commercial oyster landings from private bottom (oyster farms) have generally been increasing annually while landings off public bottom (wild harvest) have historically been more variable (Figure 1). Over the last 8 years an increasing trend in landings from production on private bottom coupled with decreased landings from public bottom has led to landed bushels from farmed private culture exceeding public wild harvest landings every year since 2017 (Figure 1). Given the expansion of the private culture industry beyond the scope of FMPs, and changes in oyster farming practices which have reduced the reliance on wild oyster seed, private oyster culture will not be managed in the Eastern Oyster FMP. Private culture of oyster is managed by the DMF Shellfish Lease and Franchise Program, for more information visit: https://www.deq.nc.gov/about/divisions/marine-fisheries/licenses-permits-and-leases/shellfish-lease-and-franchise.

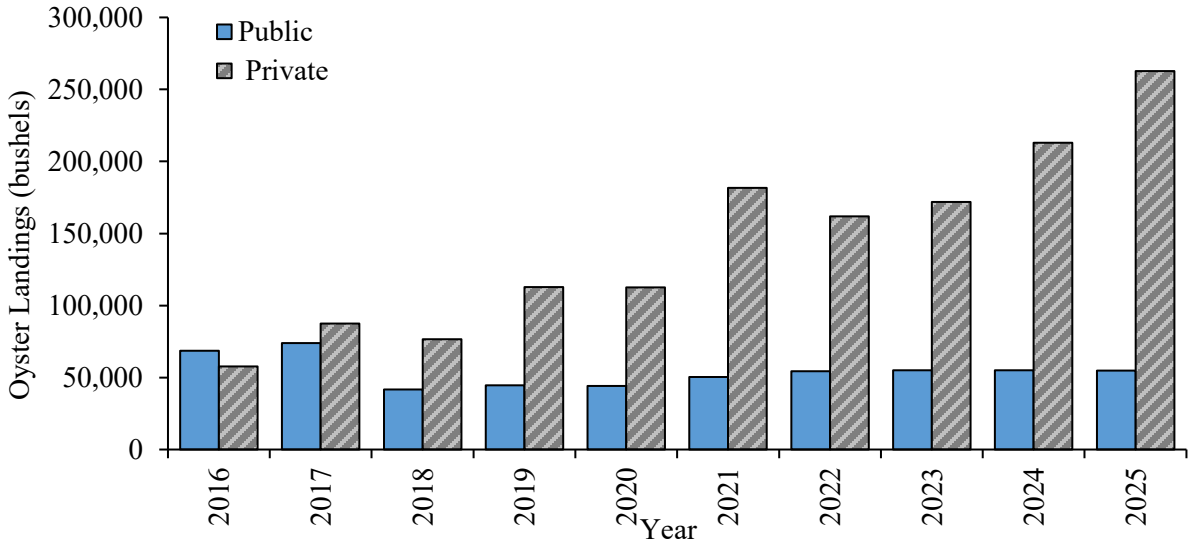

Figure 1. Annual commercial Eastern Oyster landings separated by private (farmed) and public (wild) bottom in North Carolina, 2016–2025 (Source: DMF Trip Ticket Program).

Hand harvest landings exceeded the mechanical landings from wild harvest public bottom in the past 10 years (Figure 2). In 2013, General Statute 113-169.2 limited the use of the Shellfish License to hand harvest methods only, this license is available to all residents of North Carolina for a lower fee than the SCFL. Hand harvest landings are relatively stable across years when compared to the fluctuations in landings from the mechanical fishery and are an important component of the public bottom oyster fishery. In 2019, due to hurricane impacts to subtidal oyster populations in the mechanical harvest area, commercial landings by hand harvest were over three times higher than mechanical harvest landings off public bottom. While overall harvest has remained stable since 2019, mechanical harvest has increased (Figure 2). This is likely due to better growing conditions and oyster availability in deep-water areas in the absence of hurricane events.

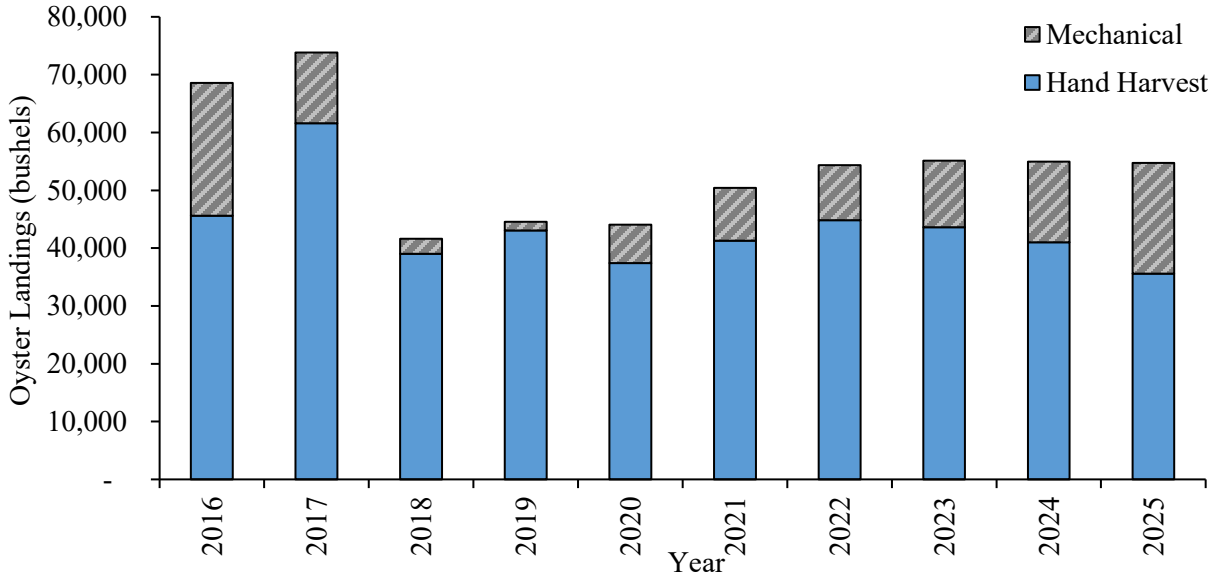

Figure 2. Annual commercial Eastern Oyster landings from public bottom separated by mechanical and hand harvest methods 2016–2025 (Source: DMF Trip Ticket Program).

Mechanical Harvest Fishery Off Public Bottom

Water temperatures were quite warm throughout the 2015–2016 season and not a lot of new growth was observed until January. Some areas in northern Hyde County were covered in tunicates the previous year and little spat was seen in these locations during this season. The Neuse River area was limited in locations to harvest oysters and closed early during this season. Effort was highest in the Pamlico River at the beginning of the season and then after Christmas, effort shifted to areas outside of Northern Hyde Area.

Like the previous season, water temperatures were relatively warm and little growth was observed in the oysters until January in the 2016–2017 season. In the Neuse River, live oysters were present in only a few locations. A confirmed low dissolved oxygen event occurred earlier that summer over a prolonged period near the mouth of the Neuse River which may have had an impact on oysters in this area. Within a few weeks of the season opening, only a few oyster harvesters were working in the Neuse River area, and most live oysters were found in shallow water (<20 ft deep). By late December the few oyster harvesters seen on the water were having to move around a lot to find oysters. Mechanical harvest was closed for the remainder of the season in mid-January for the Neuse River and Northern Dare Areas. The Pamlico River and Northern Hyde Areas remained open for the entire 2016–2017 season, but only a few fishermen remained harvesting oysters in early February and by mid-February no effort was seen in the open areas while sampling.

Pre-season sampling in October-November 2017 showed a lot of spat and small oysters in all areas, and two areas (Neuse River and Northern Dare) were below the threshold (<26%) of legal-sized oysters in the

samples. The 2017–2018 mechanical harvest season began Monday, November 13, 2017, and the 6-week open period in the bays was split into two. The culling tolerance was also reduced from 10% to 5% following the adoption of Amendment 4. Oysters were small according to the dealers at the beginning of the season and showed little growth. The Neuse River only had a few areas with live oysters available and closed on December 7, 2017, after reaching the legal-sized threshold for closure. Small oysters that would not grow into legal-size this season were also pre-dominant in the Pamlico River and Northern Dare Areas sampled early in the season. Both Pamlico River and Northern Dare Areas were closed to mechanical oyster harvest on December 25, 2017. Only the Northern Hyde Area remained open into 2018 but closed to mechanical harvest by late January. All mechanical harvest areas for oysters remained closed for the rest of the season. In addition, starting the first week of January 2018 and for the next 2 weeks, coastal North Carolina experienced record low temperatures, with at least one consecutive 72-hour period where air temperatures were below freezing. Most inshore areas and some of the deeper water areas had ice and some areas retained ice for 2 weeks. In mid-January, reports were coming in that some of the subtidal oysters in Pamlico Sound had been impacted by the freezing, particularly in shallow water areas where oysters are exposed to the air for a period caused by wind-driven tides.

In September 2018, Hurricane Florence made landfall in North Carolina and caused significant impacts on the oyster resource. Extended periods of hypoxic (dissolved oxygen < 2–3 mg/L) or anoxic (dissolved oxygen = 0 mg/L) conditions occurred in many of the deep-water areas of Pamlico Sound during the following weeks. Dive surveys of reefs on the Middle Grounds were conducted by NC State University researchers and they observed large-scale oyster mortality due to Hurricane Florence. Observations by their team did not suggest that oyster reefs in the shallow bays were as impacted. During initial sampling, the Neuse River, Pamlico River, and Northern Dare Areas all showed low numbers of living oysters and were all below the 26% legal size threshold. The initial sampling at Northern Hyde Area showed a legal percentage of 27%, just above the threshold. Mechanical fishing effort was relatively low due to poor catch, and the mechanical season was closed in all management areas on December 13, 2018. This closure prevented the second opening period of the bays to mechanical harvest. Impacts from Hurricane Florence are reflected in both reduced mechanical and overall oyster landings for the 2018–2019 season (Figures 1 and 2).

In September 2019, a decline in water quality from Hurricane Dorian negatively impacted the already reduced subtidal oyster populations in Pamlico Sound. All mechanical harvest management areas were below the 26% legal management trigger during pre-season sampling in 2019. The percentage of legal oysters in both Neuse River and Dare County management areas was lower in the 2019–2020 pre-season sampling than it was at the close of the 2018–2019 mechanical season, showing the deep-water oyster mortality that occurred in these areas from the storm event. Following the protocol established in Amendment 4 of the Oyster FMP (NCDMF 2017), the mechanical harvest season was opened on November 18, 2019, and closed on November 29, 2019, for all areas except Northern Hyde, which closed January 6, 2020. While open to mechanical harvest, the small amount of effort and landings occurred in the shallow water bays where oyster populations were not as significantly reduced by the storm events of 2018–2019 season. Mechanical landings for 2019 were the lowest reported during the last 25 years (Figure 2).

Pre-season sampling in the deep-water areas in both the Neuse and Pamlico management areas showed very low percentages of legal oyster prior to the start of the 2020–2021 mechanical harvest season, and these areas both tripped the management trigger twice and closed to mechanical harvest on December 14, 2020. The bays in the Pamlico management area maintained relatively high legal percentages for the entire possible 6-week season, and harvesters reported harvesting a full limit before noon, even up to the last few days of the possible season. The Northern Dare Management Area remained above the management trigger threshold for a relatively long time when compared to the previous three oyster seasons and remained open to mechanical harvest until February 14, 2021.

The Northern Hyde and Dare Management Areas started the 2021–2022 mechanical harvest season below the management trigger and were closed to mechanical harvest on December 13, 2021, after the

management trigger was tripped during first in-season trigger sampling event. Abundance and size of oysters in the deep-water areas of the Neuse and Pamlico River Management Areas continued to be very low. Mechanical harvest in these two management areas was supported by oysters found in the bays during the 6-week season.

The Neuse River, Pamlico River, Northern Hyde, and Northern Dare Management Areas were all below 26% legal management trigger during the 2022–2023 pre-season sampling. However, due to no fishery effort occurring at the time of data collection, pre-season sampling did not originally count towards the management trigger at the onset of this sampling program. In 2018, the Director made the decision to count the pre-season data towards the management trigger. This decision was made in response to the impacts to the sub-tidal oyster population from hurricane and storm events. For the 2022–2023 mechanical oyster season, after several years of recovery post major impact events, the Director made the decision to revert to the original management approach of not including the pre-season sampling data to better align the management trigger with fishery effort.

The Northern Hyde and Northern Dare Management Areas started the 2023–2024 mechanical harvest season below the management trigger and closed to mechanical harvest the first week of 2024. The abundance and size of oysters in the deep-water areas of the Neuse and Pamlico rivers have continued to be very low since 2017. Mechanical harvest in these two management areas was supported for the full 6-week possible season by high percentages of legal oysters found in the bays.

The season opened for all areas on November 18, 2024, for the 2024–2025 mechanical harvest season. The first in-season sampling in November showed the Northern Dare Management Area below the 26% legal size management trigger. Sampling conducted in December showed further growth in the oysters and all areas were above the 26% legal management trigger, except for the Neuse River Management Area having one sampling event below the 26% trigger. All deep-water mechanical harvest management areas remained open for the entire 2024–2025 season through March and the bays for their regular 6-week open season.

Prior to the opening of the 2025–2026 mechanical harvest season on November 17, 2025, Proclamation SR-2-2025 was issued which closed DORAs to mechanical harvest on August 21, 2025. SF-4-2025 issued November 10, 2025, identified the 18 existing rotational harvest cultch sites and the four sites open to mechanical harvest for the entirety of the possible 2025–2026 mechanical harvest season. Pre-season sampling (locations informed by the industry) was completed in late October 2025. Initial season lengths were based on the starting condition of live legal oysters calculated from pre-season sampling (see Fishery-Independent Monitoring for more detail). Proclamation SF-5-2025, issued November 10, 2025, established the initial mechanical season lengths at 10 weeks for the Northern Dare Area and Northern Hyde 15-bushel limit area, 6 weeks for the Northern Hyde 10-bushel limit area, 4 weeks for both the Neuse River 15-bushel area and the Pamlico River 10-bushel area, 5 weeks for the Pamlico River 15-bushel area, and 3 weeks for the Neuse River 10-bushel area. As prescribed in Amendment 5, the pooled numbers of legal oysters from mid-season sampling were used to determine the number of weeks the season should be extended. Mid-season sampling locations were informed by the industry and resulted in the mechanical harvest season being extended by 1 week in the Northern Hyde 15-bushel area, 3 weeks in the Neuse River 10-bushel area, 5 weeks in the Neuse River 15-bushel area, and 4 weeks in both the Pamlico River 10-bushel and 15-bushel areas via proclamation SF-7-2025. The Northern Hyde 10-bushel area was already at its maximum allowed season length of 6 weeks and was not extended. The results of mid-season sampling determined no season extension was warranted in the Northern Dare Area. Commercial fishermen reported that legal oyster abundance remained high through the end of the season in Long Shoal, Middleton, Wyesocking, and Great Narrows/Island areas.

Hand Harvest Fishery Off Public Bottom

Hand harvest gear accounts for most of the landings and has been the dominant harvest gear for oysters in North Carolina since the 1960s. Hand harvest oyster landings are also less variable than landings from mechanical gears (Figure 2). These higher, more consistent landings come from Core Sound south to the state line. The hand harvest areas in the northern region of the state are exclusively subtidal reefs with depths of 2 to 6 ft in which hand tongs are used. Hand harvest gear has not been extensively used in the northern area since oyster dredging was allowed in 1887. In Amendment 2 to the Eastern Oyster FMP, the MFC adopted the strategy to promote a more habitat friendly fishery by increasing the hand harvest limits to match dredging limits in the bay areas of the Pamlico Sound (NCDMF 2008). Amendment 2 put in place a 15-bushel per day hand/mechanical harvest limit per commercial fishing operation in the Pamlico Sound mechanical harvest areas outside the bays, a 10-bushel per day hand/mechanical harvest limit per commercial fishing operation in the bays and in the Mechanical Methods Prohibited area along the Outer Banks of the Pamlico Sound. This management option raised the limits of hand harvest to encourage less destructive harvest methods in those particular bays and open waters.

Hand harvest limits are 5 bushels per person, not exceeding 10 bushels per commercial fishing operation from Core Sound south to the North Carolina-South Carolina border for holders of the SCFL. As of October 2018, harvesters holding a Shellfish License statewide are limited to 2 bushels of oysters per person per day and no more than 4 bushels per vessel, following the selected management strategy adopted by the MFC in Amendment 4 of the Eastern Oyster FMP and continues through Amendment 5 (NCDMF 2017, 2025). Areas in the southern region from Core Sound south are closed to mechanical harvest of oysters.

Other factors affecting the hand harvest fishery are the loss of harvest area due to pollution closures. Many shellfish waters in North Carolina are permanently or conditionally closed due to bacterial contamination associated with urban development (Table 1). The greatest proportion of closed shellfish waters occur in the southern district (Onslow, Pender, New Hanover, and Brunswick counties) where over half of the waters are closed and can be attributed to small, narrow waterbodies and more developed watersheds. The area north of Core Sound with the higher hand harvest limits does not have the same problem with large percentages of the available harvest area closed by pollution so oyster harvest is not impacted.

Table 1. Classification of shellfish waters in acreage, 2015–2025 (Source: DMF Shellfish Sanitation and Recreational Water Quality Section).

Year	Open Area		Closed Area		
	Approved	Conditionally Approved Open	Conditionally Approved Closed	Restricted	Prohibited
2016	1,416,960	44,785	12,008		745,597
2017	1,414,709	44,425	12,209		747,759
2018*	1,414,525	44,122	11,859	18,933	729,761
2019	1,415,007	43,216	12,721	20,260	730,550
2020	1,416,683	43,085	9,919	18,117	736,128
2021	1,459,163	42,801	9,917	18,168	736,690
2022	1,415,971	43,309	5,914	6,683	752,266
2023	1,413,846	45,326	5,798	6,463	752,687
2024**	1,368,691	35,266	3,813	2,622	735,797
2025	1,368,851	35,367	3,789	2,546	735,636

* First year “Restricted” waters were differentiated from “Prohibited” waters.

** The GIS classification layer that is used to calculate water acreage was updated in early 2024 to reflect improved aerial imagery, improved digital mapping technology, and changes to the shoreline that have occurred since the layer was last updated. This led to notable changes in the calculated water acreage coast-wide that are not reflective of any changes in water quality in shellfish growing waters.

Hand-harvest oyster landings have generally been stable in recent years (Figure 2). Oyster hand harvest south of the Highway 58 Bridge generates a significant amount of the overall oyster landings even though the area only encompasses 5% of the total area open to harvest of shellfish in the state. During the 2017–2018 season, the intertidal oysters in the southern region of the state were impacted by record low temperatures that lasted over 2 weeks in early January. Reports were received that the cold temperatures and low tides during this period caused the oysters to die. In September 2018, Hurricane Florence caused oyster mortality in many of the hand harvest areas south of the Highway 58 Bridge. Market demand for local North Carolina oysters early in the 2018–2019 season in the southern region of the state was low due to public perception of water quality issues which may have been caused by the storm. In 2025, 54,715 bushels of oysters were harvested by hand off public bottom, slightly below the time series average of 54,217 bushels.

Permanent and Temporary Shellfish Closures

Microbial contamination from fecal matter is important to the DMF because it affects the opening and closing of waters to shellfish harvest. Fecal coliform bacteria occur in the digestive tract of, and are excreted in the solid waste from, warm-blooded animals including humans, wildlife, and domesticated livestock (Mallin 2009). Because consumption of shellfish containing high levels of fecal coliform bacteria and associated pathogens can cause serious illness in humans, shellfish growing waters must be closed to shellfish harvest when fecal coliform counts increase above the geometric mean standard of 14 MPN/100 mL [MFC Rules 15A NCAC 18A Section .0900 Classification of Shellfish Waters], where MPN denotes "most probable number." The DMF closes waters where a high potential for bacterial contamination exists, such as around marinas and point source discharges. Shellfish harvest closures have continued to occur over time, which has led to a reduction in available shellfish harvest areas. Long term shellfish closures due to bacterial contamination remove available harvest areas for shellfish and concentrate those activities on remaining resources compounding harvest related impacts on the oyster habitat in those areas.

Between 2011 and 2014, there were 1,427 acres of water permanently closed to shellfish harvesting in North Carolina, while between 2015 and early 2019, 6,876 additional acres were closed (Table 1). On February 4, 2015, approximately 314,710 acres were closed administratively in lower resource areas because of the inability to sample due to budget constraints. The areas closed to shellfish harvest because of the inability to meet federal sampling requirements caused by funding cuts were approximately 11,834 acres in the Neuse River, approximately 3,042 acres in the Pungo River, and approximately 299,107 acres in Albemarle Sound.

In addition to the areas that are permanently closed to the harvest of shellfish, other areas are temporarily closed during periods of high rainfall due to runoff. The rainfall closure threshold varies by growing area as detailed in each management plan and can vary from 1 to 2.5 in of rain in a 24-hour period. Closures last from several days to more than a month and reopen when bacteriological water sample results show the area has returned to normal conditions. Large storms, such as hurricanes, result in harvest closures covering much larger areas, sometimes including all of North Carolina's estuarine waters. The conditionally approved areas are concentrated in the Core-Bogue, New-White Oak, and Southern Estuaries management units. Within these watersheds, permanent closures are most common in the upper reaches of tidal creeks and rivers, with conditionally approved areas occurring downstream of those areas or in the upper portions of less degraded creeks. As temporary closures have increased in frequency and length, they have become an issue of great concern to the public, particularly in the southern area of the coast. For 2019, an additional classification of "restricted" was adopted for "areas that do not meet approved area criteria but is not grossly polluted" and can be used for limited shell fishing activities such as relay.

Throughout the North Carolina coast, 2018 was a record year for precipitation, with the landfall of Hurricane Florence contributing greatly to the total rainfall amounts. Temporary closures during the beginning of the oyster season were directly attributed to that event, with some area closures in the southern portion of the state lasting for over 30 days past the storm.

Private Culture

Authority to lease bottomland for private shellfish cultivation can be traced back to a state statute adopted in 1909. The DMF administers the shellfish lease program whereby state residents may apply to lease estuarine bottom and water columns for the commercial production of shellfish. The DMF does not differentiate between clam, oyster, Bay Scallop, and mussel leases; therefore, allowing shellfish growers to grow out multiple species simultaneously or as their efforts and individual management strategy allows. For the period of 2003–2013, roughly 40% of all private culture operations harvested only oysters (NCDMF 2017).

Since 1994, there has been an overall increase in oyster harvest from private culture operations. Oyster harvest from private culture operations in the period from 1994 to 2013 only accounted for 12% of all oyster landings (NCDMF 2017). However, due to increased interest in private culture of oysters and lower landings off public bottom, private culture harvest accounted for 83% of the total oyster landings in 2025 (Figure 2). In 2025, 262,731 bushels of oysters were harvested from private culture operations.

Recreational Fishery

Recreational landings for oysters in North Carolina are unavailable because there are no license requirements to take shellfish for personal consumption and therefore there is no way to fully determine the user group to collect their harvest information. Since 2011, the division has collected effort and catch data from the recreational oyster harvesters by surveying those individuals that indicate participation when purchasing a recreational fishing license. This survey does not include recreational oyster harvesters that do not purchase a recreational fishing license. As part of Amendment 5, adopted in May 2025, the MFC supported the DMF to further explore potential options and develop a solution to estimate recreational shellfish participation and landings with the intent to move towards a stock assessment and stock level management for oysters and to establish a mechanism to provide all recreational shellfish harvesters with Shellfish Sanitation and Recreational Water Quality Section health and safety information outside of the FMP process.

MONITORING PROGRAM DATA

Fishery-Dependent Monitoring

Currently, the only data available for the stock in all areas are the commercial landings and associated effort from the Trip Ticket Program. No fishery-dependent monitoring programs occur for oysters.

Fishery-Independent Monitoring

Public Bottom Mechanical Harvest Area Oyster Sampling

The cultch supported harvest strategy adopted within Amendment 5 to the Eastern Oyster FMP includes a revised framework for monitoring public oyster mechanical harvest areas, referred to as trigger sampling. This framework replaces the original protocol developed in Supplement A to Amendment 2 and continued through Amendment 4 of the Oyster FMP (NCDMF 2008, 2010, 2017). The previous trigger sampling protocol, implemented in 2010, was conducted to estimate the oyster condition across the four management areas in Pamlico Sound via dredge surveys, throughout the mechanical season. This sampling methodology became increasingly unreliable as participation in the mechanical oyster fishery declined, resulting in variable and uncertain season lengths. Sampling locations were often selected by NCDMF staff based on historical sites or professional judgment and were not always viewed by harvesters as representative of current fishing effort. In addition, the prior methodology relied on dredge sampling, which raised concerns among commercial harvesters regarding sampling accuracy.

The updated trigger sampling methodology utilizes hydraulic patent tongs, which provide a standardized and efficient means of collecting oyster samples that have been used in Virginia's long-term oyster monitoring surveys since 1993 (Schulte et al. 2018). The transition to patent tongs also supports a unified

sampling approach for both cultch and naturalized reefs, many of which have persisted for decades and now function similarly to natural oyster habitat. Standardizing sampling across these reef types improves consistency and may support future stock assessment efforts.

Under this framework, oyster samples are collected throughout Pamlico Sound in areas open to mechanical harvest. Patent tongs are used for pre-season sampling to determine initial season lengths and for a mid-season sampling event that may extend the season length for mechanical harvest. Cultch Supported Harvest Areas are subject to the previously established bushel limits (15 bushels per day open water, 10 bushels per day bays) and the bays will continue to be capped to a total 6-week possible season. This change eliminates the unpredictability in mechanical harvest season length experienced by harvesters and considers differences in oyster mortality experienced at varying depths of Pamlico Sound. The purpose of setting season lengths in these areas is to protect oyster habitat from excessive damage caused by harvest, and to maintain substrate for juvenile oyster recruitment.

For mechanical oyster harvest management Pamlico Sound is divided into four management areas: the Neuse River Area, Pamlico River Area, Northern Hyde Area, and Northern Dare Area (Figure 3). The 10-bushel per day bays and 15-bushel per day deep areas are considered separately for each management area as deep-water reefs and shallow reefs in the bays have been observed to be impacted differently from storm events and other environmental conditions (DMF unpublished data). With four management areas and two water-body types, there are a total of eight subregions to be sampled during pre-season and in-season trigger sampling efforts. Prior trigger sampling protocol gathered 10 samples per management area, this is now split evenly between the bays and deep-water sites within the updated framework. Therefore, each sampling effort equals 40 unique locations in Pamlico Sound.

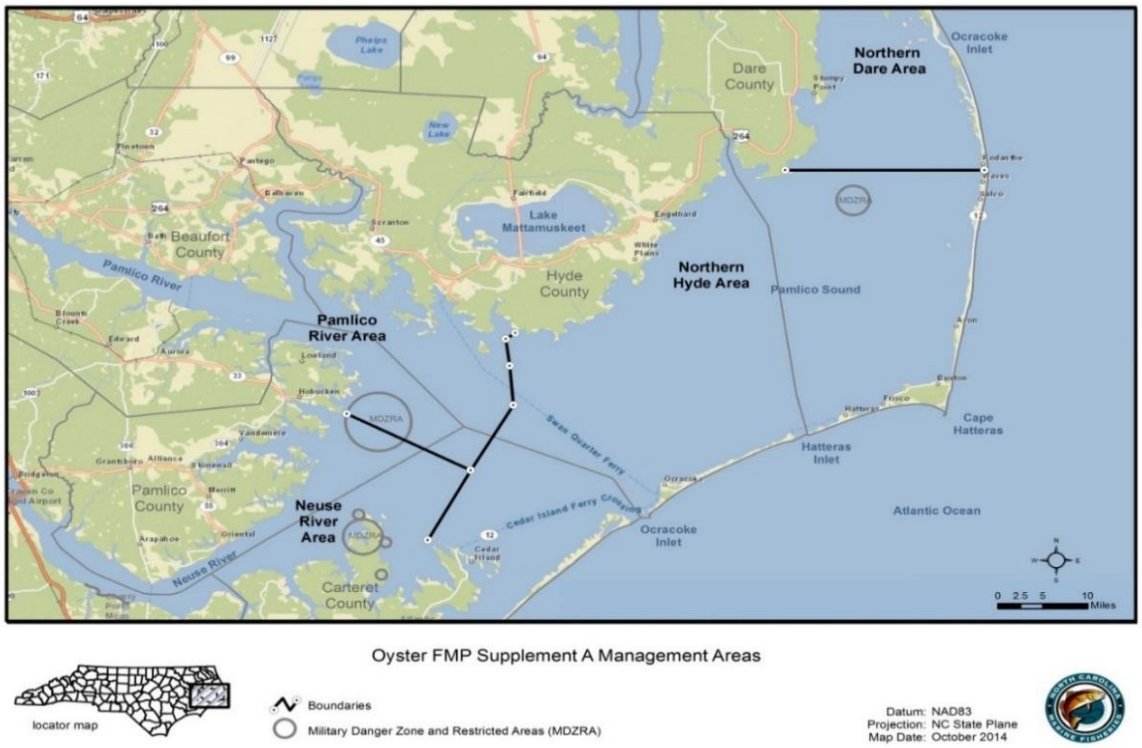

Figure 3. Mechanical harvest management areas from Amendment 4 of the Oyster Fishery Management Plan. These management areas will continue under Amendment 5 (NCDMF 2025).

Collaboration with commercial harvesters is a key component of the strategy. Information provided by harvesters on productive fishing locations helps guide mid-season sampling efforts and improve representation of active harvest areas. Pre-season trigger sampling occurs between late September and mid-

November prior to the mechanical harvest season, while mid-season sampling is conducted near the midpoint of the established season length. As prescribed in Amendment 5, pre-season sampling occurs prior to the mechanical harvest season in all four management areas, with at least 10 sites sampled per area. Samples from 10-bushel and 15-bushel harvest areas are evaluated separately, and the bottom 20% of sites with the lowest percentage of legal oysters are excluded to prevent unproductive and unutilized areas from influencing season length determinations. Season lengths are then established using the harvest criteria outlined in Table 2. One mid-season sampling event in each area is conducted prior to the midpoint of the proclaimed season to determine whether harvest may be extended. Using the same decision criteria as described for establishing initial season lengths, the number of weeks left in the season at the time mid-season sampling occurred is subtracted from the number of weeks identified based on condition in Table 2 to determine the number of weeks to extend the season.

The objectives of this strategy are to collect oyster metrics, including lengths, size-class densities, and population structure, to evaluate reef condition and inform season management decisions; standardize sampling on public bottom areas open to mechanical harvest for future analyses and stock assessment efforts; and improve communication and collaboration with commercial harvesters through shared sampling locations and incorporation of local knowledge, ultimately reducing uncertainty in mechanical harvest season length.

Table 2. Proposed weeks of Eastern Oyster mechanical harvest for 10-bushel (bay) and 15-bushel limit (open water) management areas based on the starting condition percentage of live legal oysters calculated from pre-season samples (included in Amendment 5 as Table 2.3).

	Weeks of Mechanical Harvest Season	
Starting Condition	10 bushel per day areas	15 bushel per day areas
<10%	0	0
10–14%	2	2
15–19%	3	3
20–24%	4	4
25–29%	5	5
30–34%	6	6
35–39%	6	8
40–44%	6	10
45–49%	6	13
50–54%	6	16
>55%	6	18

Spatfall Evaluation

DMF conducts annual spatfall sampling on cultch sites with Program 628. Prior to this program, a dredge survey (Program 610) was conducted between January and April to assess the settlement of recruits and growth of adult oysters. Additional samples were also collected using patent tongs and hand tongs in shallow or intertidal areas. Program 610 was discontinued in 2020. In 2021 a pilot study comparing sampling gears determined that hydraulic patent tongs offered greater reliability and efficiency for collecting oyster samples on cultch sites as opposed to dredging or SCUBA collected quadrats. Since 2022, cultch reefs have been sampled for the first 3 years using hydraulic patent tongs to gather size-class density data that align closely with DMF's oyster SCUBA surveys (P612) and resemble efforts conducted by Maryland and Virginia. The hydraulic tong survey methodology (P628) also converges with the aims of the trigger sampling survey for managing the mechanical oyster fishery. As such, DMF staff collect comparable oyster metrics across a variety of oyster habitats. Data collected from P628 encompasses both recently

constructed cultch sites and historical cultch sites (>3 years old) and may also include naturally occurring oyster beds. This methodology was adopted to better quantify recruitment and abundance of oysters on cultch planting sites.

Habitat and Enhancement Programs

To improve and preserve the diverse ecosystem functions provided by oyster reef habitat and support and maintain the oyster fishery, reef enhancement and restoration is an essential component of management in North Carolina. In recognition of this need, DMF's Habitat and Enhancement section coordinates ongoing habitat enhancement activities to improve statewide oyster populations and subsequently enhance the ecosystem services they provide. These efforts began with the Cultch Planting program in 1915 with the goal to rebuild oyster beds on public bottom by planting shells for substrate, thereby creating state-subsidizing harvest areas for the fishery. Over 21 million bushels of cultch material have been planted in the form of small-scale, low-relief, harvestable oyster reefs. Since the 1980s, over 2,000 cultch sites have been planted throughout North Carolina's coastline, with each area ranging in size from 0.5 to 10 acres. In 1996, the Oyster Sanctuary Program was established to construct large, no-take reserves that support oyster brood stock and supply both wild and cultch planting sites with oyster larvae. As of 2025, over 789 acres are protected across 17 no-take Oyster Sanctuaries.

RESEARCH NEEDS

The list below outlines five specific research needs from Amendment 4 and Amendment 5 to the North Carolina Oyster FMP (NCDMF 2017, 2025). Many environmental considerations are applied throughout the CHPP and are not part of this list but are still considered very important to oyster.

- Improve the reliability for estimating recreational shellfish harvest.
- Establish and monitor sentinel sites for shell bottom habitat conditions; develop shell bottom metrics to monitor.
- Explore the effects of water quality on oyster population dynamics.
- Develop regional juvenile and adult abundance indices (fisheries-independent).
- Quantify the impact of current fishing practices on oyster habitat suitability in North Carolina.

MANAGEMENT

There are no management triggers or methods to track stock abundance, fishing mortality, or recruitment between comprehensive reviews in the current FMP.

Amendment 5 was adopted in May 2025. The selected management strategies of the MFC in Amendment 5 of the Eastern Oyster FMP can be found in Table 3.

Table 3. Summary of the N.C. Marine Fisheries Commission management strategies and their implementation status for Amendment 5 of the Oyster Fishery Management Plan adopted May 2025 (NCDMF 2025).

Management Strategy	Implementation Status
RECREATIONAL HARVEST	
Support the DMF to further explore potential options and develop a solution to estimate recreational shellfish participation and landings, with the intent to move towards a stock assessment and stock level management for both hard clams and oysters; and to establish a mechanism to provide all recreational shellfish harvesters with Shellfish Sanitation and Recreational Water Quality health and safety information outside of the FMP process.	Ongoing

Management Strategy	Implementation Status
MECHANICAL HARVEST MANAGEMENT	
Deep-water Oyster Recovery Areas (DORAs) - Adopt the proposed Pamlico and Neuse River DORAs, which are bound by existing navigational aids as presented to the MFC Advisory Committees, to protect deep subtidal oyster reefs from continued physical disturbance by mechanical gear. These areas will be closed to mechanical oyster dredging and monitoring efforts will be used to evaluate the effectiveness of closure within the next FMP amendment. The DORAs cover 681 acres of potential oyster habitat (500 acres in Pamlico River and 180 acres in Neuse River), which represents approximately 81% of the vulnerable deep-water oyster habitat.	Existing proclamation authority; Began in 2025.
Cultch Supported Harvest - Adopt the Cultch Supported Harvest strategy outlined in Appendix 2 of Amendment 5, which would set the season length based on pre-season sampling aided by industry input on sampling locations with the 10 bushel per day and 15 bushel per day areas considered separately.	Existing proclamation authority; Began in 2025-2026 harvest season.
Rotational Cultch Site Strategy - Adopt the inclusion of Rotational Harvest Cultch Sites strategy outlined in Appendix 2. This strategy would create a rotating series of readily available cultch areas available to harvest for the full extent of the mechanical season length each year with the intent of reducing harvest pressure on natural reefs.	Existing proclamation authority; Began in 2025-2026 harvest season.
Adaptive Management - Adopt the proposed adaptive management framework to allow for modification of set season length based on changes to participation in the fishery.	Existing proclamation authority; Began in 2025-2026 harvest season.
MANAGEMENT FROM PREVIOUS PLANS CONTINUING THROUGH AMENDMENT 5	
A daily limit of 2 bushels of oysters per person with a maximum of 4 bushels of oysters per vessel off public bottom for Shellfish License holders statewide (NCDMF 2017).	Existing proclamation authority
A 6-week opening timeframe for mechanical harvest in deep bays to begin on the Mon of the week prior to Thanksgiving week through the Fri after Thanksgiving. Reopen 2 weeks before Christmas for the remainder of the 6-week season (NCDMF 2017).	Existing proclamation authority
A 15-bushel hand/mechanical harvest limit in Pamlico Sound mechanical harvest areas outside the bays, 10-bushel hand/mechanical harvest limit in the bays, and 10-bushel hand harvest limit in the Mechanical Methods Prohibited area along the Outer Banks of Pamlico Sound. Areas as defined and adopted in Amendment 2 of the Oyster FMP (NCDMF 2008).	Existing proclamation authority

MANAGEMENT PERFORMANCE AND FISHERY MANAGEMENT PLAN SCHEDULE RECOMMENDATIONS

Annual landings of farmed oysters from private bottom have surpassed wild harvest since 2017 due to increasing aquaculture production. Commercial landings of wild oysters from public bottom have remained

relatively unchanged since 2018 despite declining participation in the mechanical fishery, suggesting that extensive habitat enhancement and protection efforts have helped maintain resource availability. Amendment 5 to the Oyster Fishery Management Plan was adopted in May 2025 with a three-tiered management strategy for oyster mechanical harvest management which balances the value of oysters as a fishery resource and essential habitat for numerous estuarine species. Despite improvements, concerns remain, as oyster populations remain vulnerable to storms, hypoxia, pollution, disease, and habitat degradation. The recently designated DORAs are intended to protect deep-water reef habitat from gear disturbance and allow reef recovery; however, additional monitoring is needed to evaluate long-term biological responses to these management actions. In addition to continued monitoring, the collection of more robust recreational data, namely recreational shellfish participation and landings are needed to conduct a stock assessment for Eastern Oyster.

Pursuant to the adaptive management framework included in Amendment 5, participation in the mechanical oyster harvest fishery is monitored annually through the Annual FMP Review. Large changes in participation (±25% or more) triggers a review of the data to determine whether adjustments to fixed season lengths should be considered. Management measures adopted through Amendment 5 were first implemented during the Fall 2025 – Spring 2026 season. Changes to the fixed season lengths for the 2026 – 2027 mechanical harvest season were determined not to be necessary at the current level of participation in the mechanical oyster fishery.

The next comprehensive review is scheduled to occur in 2030 and the division recommends maintaining this schedule.

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