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# North Carolina Hard Clam Fishery Management Plan Amendment 3

North Carolina Division of Marine Fisheries

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**Disclaimer**: Data in this Fishery Management Plan may have changed since publication based on updates to source documents.

## ACKNOWLEDGMENTS

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## EXECUTIVE SUMMARY

The Hard Clam is a commercially and recreationally important molluscan shellfish species harvested in North Carolina's estuarine waters. The commercial Hard Clam fishery has been in decline since its peak in the 1980's. The mechanical harvest portion of the commercial fishery has seen the most pronounced decline, landing less than 2% of the fishery's peak harvest (1995) each year from 2017 to 2022. Harvest from the recreational fishery cannot be quantified because the number of recreational shellfish harvesters in North Carolina is currently unknown.

The status of the Hard Clam stock in North Carolina is unknown due to data limitations preventing the NCDMF from conducting a Hard Clam stock assessment and calculating sustainable harvest metrics. Data available for the stock are commercial landings, data collected from fish houses, and an annual recreational survey. Landing trends will reflect population abundance to an extent, but other factors like market demand, regulations, changes in effort, and gear technology also affect trends (NCDMF 2017).

The goal of the N.C. Hard Clam FMP is to manage the Hard Clam resource to provide long-term harvest and continue to offer protection and ecological benefits to North Carolina's estuaries. The following objectives will be used to achieve this goal: to use the best available biological, environmental, habitat, fishery, social, and economic data to effectively monitor and manage the Hard Clam fishery and its environmental role; to manage Hard Clam harvesting gear use to minimize damage to the habitat; to coordinate with DEQ and stakeholders to implement actions that protect habitat and environmental quality consistent with the Coastal Habitat Protection Plan (CHPP) recommendations; and to promote stewardship of the resource through public outreach to increase public awareness regarding the ecological value of Hard Clams and encourage stakeholder involvement in fishery management and habitat enhancement activities.

To meet the goal and objectives of Amendment 3, two issues within the North Carolina Hard Clam fishery are addressed: 1) phase out of the mechanical harvest fishery; and 2) quantifying recreational shellfish harvest.

The observed declines in harvest and participation in the mechanical clam harvest fishery, along with habitat concerns associated with bottom disturbing gears, as well as significant cost to the state for management of this fishery prompted a re-examination of whether this fishery should still be allowed to operate. Additionally, the allowance of mechanical clam harvest in conjunction with maintenance dredging was also explored. To address this issue, the N.C. Marine Fisheries Commission (NCMFC) selected the following management at its March 2025 business meeting:

1. Mechanical Clam Harvest
    - Phase out mechanical clam harvest in three years (May 2028) to be consistent with G.S. 113 221 (d)

2. Mechanical Clam Harvest in Conjunction with Maintenance Dredging
   - Discontinue allowance for mechanical clam harvest in conjunction with maintenance dredging upon adoption of this plan

The number of recreational shellfish harvesters in North Carolina is currently unknown, which prevents reliable estimates of total recreational harvest of shellfish. Because there is no license or permit required for recreational shellfish harvest, there is currently no mechanism for reaching and educating recreational harvesters regarding human health and safety information on shellfish harvest like there is for commercial harvesters when they acquire their license. This issue is shared for the Eastern Oyster FMP Amendment 5. To address this issue for both FMPs, the NCMFC selected the following management at its March 2025 business meeting:

1. 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.

Additionally, the following management measures from Amendment 2 are carried forward into Amendment 3:

- Daily harvest limit for recreational purposes is 100 clams per person per day not to exceed 200 per clams per vessel per day.

- Maintain shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110.

- Maintain management of the Ward Creek Shellfish Management Area as described in the Hard Clam FMP Amendment 1.

- Maintain current daily mechanical Hard Clam harvest limits by waterbody (Table 1).

- Institute a resting period within the mechanical clam harvest area in the northern part of Core Sound.

- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats.

- Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and submerged aquatic vegetation (SAV) habitat exist based on all available information.

# INTRODUCTION

This is Amendment 3 to the Hard Clam Fishery Management Plan (FMP). FMPs are the ultimate product that brings all information and management considerations into one document. The N.C. Division of Marine Fisheries (NCDMF) prepares FMPs for adoption by the N.C. Marine Fisheries Commission (NCMFC) for all commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources. The goal of these plans is to ensure long-term viability of these fisheries. By law, each FMP must be reviewed at least once every five years (G.S. 113-182.1). The NCDMF reviews each FMP annually and a comprehensive review is undertaken approximately every five years. The last comprehensive review of the plan (Amendment 2) was approved by the NCMFC) in 2017. All management authority for the North Carolina Hard Clam fishery is vested in the State of North Carolina. The NCMFC adopts rules and policies and implements management measures for the Hard Clam fishery in Coastal and Joint Fishing Waters in accordance with G.S. 113-182.1. Until Amendment 3 is approved for management, Hard Clams are managed under Amendment 2 (NCDMF 2017).

The status of the Hard Clam stock in North Carolina is unknown due to data limitations preventing the NCDMF from conducting a Hard Clam stock assessment and calculating sustainable harvest metrics. Data available for the stock are commercial landings, data collected from fish houses, and an annual recreational survey. Data is obtained from the North Carolina Trip Ticket Program, where catch rates are estimated for both hand and mechanical harvest. Landing trends will reflect population abundance to an extent, but other factors like market demand, regulations, changes in effort and gear technology also affect trends (NCDMF 2017).

For more information about previous and current management, see the original Hard Clam FMP (NCDMF 2001) and previous amendments, all of which are available on the North Carolina Division of Marine Fisheries Fishery Management website.

## Fishery Management Plan History

| | |
|---|---|
| Original FMP Adoption: | 2001 |
| Amendments: | Amendment 1 (2008) |
| | Amendment 2 (2017) |
| Revisions: | None |
| Supplements: | None |
| Information Updates: | None |
| Schedule Changes: | None |
| Next Comprehensive Review: | Five years after adoption of Amendment 3 |

Past versions or revisions of the Hard Clam FMP (NCDMF 2001, 2008, 2017) are available on the NCDMF website: Fishery Management Plans | NC DEQ

### Management Unit

Includes the Hard Clam, *Mercenaria mercenaria*, and its fisheries in all Coastal and Joint Fishing Waters of coastal North Carolina. G.S. 113-221.

### Goal and Objectives

The goal of the N.C. Hard Clam FMP is to manage the Hard Clam resource to 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 Hard Clam fishery and its environmental role.
- Manage Hard Clam harvesting gear use to minimize damage to the habitat.
- Coordinate with DEQ and stakeholders to implement actions that protect habitat and environmental quality consistent with the Coastal Habitat Protection Plan (CHPP) recommendations.
- Promote stewardship of the resource through public outreach to increase public awareness regarding the ecological value of Hard Clams and encourage stakeholder involvement in fishery management and habitat enhancement activities.

## DESCRIPTION OF THE STOCK

### Biological profile

#### DISTRIBUTION

The Hard Clam, *Mercenaria mercenaria*, is a large bivalve distributed along the east coast of North America from the Gulf of St. Lawrence, Canada to the central coast of eastern Florida (Harte 2001, Abbott 1986, Mackenzie et al. 2002). This species has been transplanted in the northwest Pacific (Crane et al. 1975, Carlton 1992, Chew 2001), Puerto Rico, Europe (Heppell 1961, Chew 2001), China (Chavanich et al. 2010), and Japan (Hiwatari et al. 2006). Another species, *M. campechiensis*, also known as the Southern Quahog, inhabits ocean waters off North Carolina and occurs mainly from North Carolina to Florida (Hadley and Coen 2006). The Hard Clam is not native to the Gulf of Mexico (Abbott 1986); however, a subspecies, *M. mercenaria texana*, and *M. campechiensis* inhabit the Gulf Coast and have been mistaken for *M. mercenaria* (Dillon and Manzi 1989a,b).

Common names for *M. mercenaria* include Hard Clam, Quahog, Quahaug, Northern Quahog, Littleneck Clam, and Cherrystone Clam. Hard Clams occur throughout the south Atlantic region in estuaries from the intertidal zone to depths exceeding 18 m (Abbott

1974; Eversole et al. 1987). In North Carolina, Hard Clams are most abundant in higher salinity waters inside the barrier islands from Ocracoke southward to the South Carolina border (NCDMF shellfish bottom mapping data, unpublished). Hard Clams are found near Oregon and Hatteras inlets and the western side of Pamlico Sound but are much less abundant compared to clams that inhabit waters inside and south of Ocracoke Island.

### HABITAT PREFERENCES AND TOLERANCES

Hard Clams occupy mostly shallow, estuarine environments and can inhabit a variety of sediment types, including sand or muddy sediments, bare, course substrates, as well as seagrass and near oyster beds (Wells 1957, Roegner and Mann 1991, Harte 2001). Localized adult population densities can vary considerably, ranging from small patches to extensive beds, and density is dependent on many environmental factors, including organic content and composition of sediment and localized flow (Fegley 2001). Experimental and field studies have shown that areas with heterogeneous substrate mixtures of sand or mud with shell or gravel often support more clams than homogeneous substrates as the larger substrate can act as a spatial predator refuge (Anderson et al. 1978, Arnold et al. 1984). Increased densities and survivorship have also been observed for Hard Clams that inhabit seagrass beds (Peterson et al. 1984; Peterson 1986b).

Hard Clams have a wide temperature and salinity tolerance which likely contributes to their extensive species range and successful transplantations worldwide. Adult Hard Clams can tolerate temperatures between -6 and 35°C (21.2 and 95°F; Stanley and Dewitt 1983); below freezing temperatures, subtidal clams have a higher survival rate than those exposed in the intertidal areas (Eversole et al. 1987). Growth rates of Hard Clams are most favorable at water temperatures around 20°C (68°F) and growth ceases at 9°C (48.2°F) and 31°C (87.8°F; Ansell 1968; Eversole et al. 1986). Hard Clams have been found in waters with salinity ranging from 4 to over 35 parts per thousand (ppt) but cannot survive extended periods in salinities less than about 12 ppt. Growth is optimal at salinities from 24 to 28 ppt for adults (Chestnut 1951a) and 26 to 27 ppt for larval growth and survival to settlement (Davis 1958, Davis and Calabrese 1964). Hard Clams cease siphoning water below 15 and above 40 ppt (Hamwi 1968), or below about 4°C (39.2°F; Loosanoff 1937) and above 34°C (93.2°F; Roegner and Mann 1991), and will close their valves tightly during periods of stress and respire anaerobically to reduce mortality (Eversole et al. 1987).

Adequate water circulation is essential for successful growth and recruitment of Hard Clams. Water currents move food, maintain water quality, remove waste, and transport eggs and larvae in the water column (Eversole et al. 1986). Hard Clams obtain food by filtering suspended particulate matter and absorbing dissolved organics directly from the water. Larvae and adult Hard Clams can select their food and regulate the quality and quantity of food they consume. Hard Clams adapt well to a changing food supply, but are sensitive to the presence or absence of particular algal species that can affect growth (Eversole et al. 1986; Eversole et al. 1987). More detailed habitat and water quality information is available in the Environmental Factors section.

### REPRODUCTIVE BIOLOGY

The gametogenic and spawning cycle of the Hard Clam varies with latitude (Eversole et al. 1984; Eversole et al. 1987). Spawning occurs in North Carolina from spring through fall, when water temperatures reach 20°C (68°F; Loosanoff and Davis 1950; Porter 1964). Spawning clams release eggs and sperm through the exhalent siphon into the water where fertilization occurs and rapid development begins. The first larval stage is the trochophore stage that lasts about a day, followed by several veliger/pediveliger stages that last approximately 20 days. Juvenile clams (spat) settle along edges of sandbars and channels where varying water currents occur (Carriker 1959). Hard Clams will also settle in substrates with shell and subtidal vegetation. These substrates appear to have better conditions for spat survival than unstructured substrates because they offer protection from predators (Kerswill 1941; Wells 1957; MacKenzie 1977; Peterson 1982).

Precursors to both male and female sex cells are found in the gonads of juveniles (Eversole 2001). During the juvenile stage, gonadal cells differentiate and clams develop predominately as males. As adults, many clams transform into females. The sex ratio of adult clams is approximately 1:1 across its geographical range (Eversole 2001).

Sexual maturity in Hard Clams tends to be a function of size not age, therefore maturity is dependent on growth. Sexual maturity is usually reached during the second to third year at a shell length of 1.3 inches (33 mm), but faster growing clams may mature at an earlier age (Eversole et al. 1987). The legally harvestable size of one-inch thick (25.4 mm) is typically reached by age two to five with three as a reasonable average expectation in North Carolina (C. Peterson, UNC Institute of Marine Science, personal communication).

Although estimates vary, fecundity depends on size and condition (Ansell and Loosmore 1963). Several studies have found that fecundity increased with shell length (Bricelj and Malouf 1980; Peterson 1983; Eversole et al. 1984; Peterson 1986a). Reproductive senescence is often common in long-lived species but there is no evidence that reproductive production declines with age in Hard Clams (Peterson 1983; Peterson 1986a). Hard Clams occur in aggregations over a wide area, and close proximity of adults is important for successful reproduction to occur in organisms that spawn in the water column (Peterson 2002). Because Hard Clams have limited mobility, spawning efficiency could be reduced in areas where harvest has caused a significant decrease in number and size of Hard Clams within these aggregations. Reduced spawning efficiency could affect future recruitment in Hard Clam populations (Fegley 2001; Peterson 2002).

### SIZE STRUCTURE, AGE, AND GROWTH

Hard Clam populations exhibit a wide size range of individuals (Fegley 2001). Growth rates of Hard Clams are highly variable and depend on water temperature, habitat, food availability, and genetics (Ansell 1968; Pratt and Campbell 1956; Chanley 1958; Peterson et al. 1983; Peterson et al. 1985; Arnold et al. 1991). Shell growth is greatest during the first year after which growth decreases as age increases (Eversole et al. 1986; Eversole et al. 1987).

Age can be determined by direct examination of annual growth lines within the shell. Age frequency distributions differ widely among sites within and between regions (Fegley 2001). There is also variation in the age of similar-sized clams even within the same habitat (Peterson et al. 1984; Rice et al. 1989; Fegley 2001). The maximum age seen in North Carolina is 46 years old (Peterson 1986a); however, the maximum life span of this species can exceed 100 years (Ridgway et al. 2011).

Shell growth patterns vary by latitude. North Carolina shell growth follows a southern growth pattern where light bands form during the winter months when animals are growing the fastest and dark band form during the late summer to fall months when growth is slowest, resulting in annual banding patterns (Peterson et al. 1983; Jones et al. 1990; Arnold et al. 1991, Goodwin et al. 2021). The opposite shell pattern growth is observed in northern latitudes (i.e., Connecticut to Massachusetts and England) where a dark band forms during the colder winter months, and a light band forms during the warmer months. At the middle part of the geographical range (i.e., New Jersey) shell pattern banding follows the "northern" banding pattern during the first several years of growth and then takes on a more "southern" banding pattern as they age (Fritz 2001). Unlike in other areas of their geographic range where growth ceases during certain times of the year, mature Hard Clams in North Carolina are capable of depositing shell material throughout the entire year, suggesting the species may serve as an important sclerochronological archive, documenting some of the most complete records of intra-annual environment conditions in their shells (Goodwin et al. 2021).

**BIOLOGICAL STRESSORS**

Few data are available on direct predation rates on larval Hard Clams (Kraeuter 2001), but high natural mortality in the larval stages suggest predation is probably high during this life stage. Newly set or juvenile Hard Clams (<1 mm shell length) are vulnerable to many predators. Primary predators of juvenile Hard Clams include Snapping Shrimp (*Alpheus heterochaelis*), Mud Crab (*Dyspanopeus sayi*), and Blue Crab (*Callinectes sapidus*; Beal 1983; Kraeuter 2001). Stone Crabs (*Menippe mercenaria*) are effective predators of both juvenile and adult Hard Clams, capable of opening large Hard Clams (30–60 mm shell length) that typically cannot be preyed on by Blue Crabs, and the abundance of Stone Crabs in North Carolina has been increasing since 2000 (Wong et al. 2010). Several types of snails (*Urosalpinx* sp*., Polinices* sp.), whelks (*Busycon* sp.), Cownose Rays (*Rhinoptera bonasus*), and various birds feed on adult Hard Clams (Kraeuter and Castagna 1980; Kraeuter 2001). As Hard Clams grow the number of potential predators is reduced (Kraeuter 2001). Hard Clam survival from predation is affected by sediment characteristics such as presence of shell fragments and seagrasses, and presence of other prey species (Peterson 1982; Peterson 1986b; Kraeuter 2001).

Infectious diseases can result in devastating losses of wild populations of some mollusks but Hard Clams appear to be relatively disease free and studies of captive populations show that non-predation losses are typically only 5% to 10% per year (Eldridge and Eversole 1982; Eversole et al. 1987; Bower et al. 1994). QPX (Quahog Parasite X = Unknown) is a parasite found in Hard Clams along the eastern coast of North American from Atlantic Canada to Virginia (Smolowitz et al. 1998; Dahl et al. 2011). QPX disease has not been identified in Hard Clams south of Virginia (Dahl et al. 2011) and a 2011 study confirmed QPX disease is a cold-water infection and not likely to occur in North Carolina because of warmer waters that impedes development of this disease in Hard Clams (Dahl et al. 2011).

Many large-scale Hard Clam mortalities along the northeastern United States and Canada are related to air exposure during extreme cold events and negative impacts from stress associated with parasites (Smolowitz et al. 1998). Diseases in larval and juvenile Hard Clams held in culture conditions are often caused by bacteria, fungi, and viruses that are common in the cultured bivalves and are associated with opportunistic invaders of animals under stress in high-density culture situations (Ford 2001).

Anthropogenic activities can also affect Hard Clam populations. Physical disturbances including bulkhead and dock construction, boat scarring, and dredging, can disrupt the sediment and increase turbidity (Bricelj et al. 2017), which can negatively impact Hard Clam feeding and growth. Additionally, extensive dredging can change bottom topography and flow patterns (Bricelj et al. 2017), which can alter food availability and larval distribution. Propeller wash from boat traffic may also displace sediment that can expose clams and increase their vulnerability to predators, and clam larvae that go through the propeller and engine cooling system are at risk of damage. Furthermore, toxic compounds from pressure-treated wood used to construct new docks, piers, and bulkheads leach into the water and accumulate in the sediment (Weis and Weis 1996). New construction often occurs in the spring, coinciding with Hard Clam spawning ,which can expose Hard Clam larvae to toxic leachates (Bricelj et al. 2017).

### Stock Unit

The unit stock is considered all Hard Clams occurring within North Carolina coastal waters.

### Assessment Methodology

Data are not available to perform a traditional assessment, so it was not possible to estimate population size or fishing mortality rates.

### Stock Status

Data limitations prevent the NCDMF from conducting a Hard Clam 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. Amendment 2 of the FMP recommends the status continue to be defined as unknown due to the continued lack of data needed to conduct a reliable assessment of the stock.

## DESCRIPTION OF THE FISHERY

Additional analyses and discussion of North Carolina's commercial and recreational Hard Clam fisheries can be found in earlier versions of the Hard Clam FMP (NCDMF 2001, 2008, and 2017); all FMP documents are available on the NCDMF Fishery Management Plans website. Commercial and recreational landings can be found in the License and Statistics Annual Report (NCDMF 2022) on the NCDMF Fisheries Statistics website.

Discussion of socio-economic information (NCDMF 2022) describes the fishery as of 2021 and is not intended to be used to predict potential impacts from management changes. This and other information pertaining to FMPs are included to help inform decision-making regarding the long-term viability of the state's commercially and recreationally significant species and fisheries. For a detailed explanation of the methodology used to estimate economic impacts, please refer to the NCDMF License and Statistics Section Annual Report (NCDMF 2022).

### Commercial Fishery

Since the inception of the Trip Ticket Program (TTP) in 1994, Hard Clam data collection has continuously improved. Hard Clam landings come from both public harvest and private production, which are managed under different regulations, therefore trip numbers, landings, and effort cannot be compared between public harvest and private production. Since 2003, approximately 1% of the annual landings cannot be identified as either public harvest or private production. Much of the improvement has been from better recording and editing requirements, and from the new licensing system. In the following sections the different gear types in the fishery are separated into either public harvest or private production. Because there are some trips that could not be differentiated in the database, they were excluded from analyses.

The Hard Clam industry has provided a way to make a living and food for coastal communities along the entire Atlantic East Coast from the Canadian maritime region to Florida. Fluctuations in commercial landings are common along the Atlantic East Coast with a general trend of decline through time (Figure 1). A large part of the decline in Atlantic Coast landings occurred in the 1970's as a result of overfishing in New York and closure of shellfish beds due to bacterial pollution (MacKenzie et al. 2002). For more information on environmental pathogens, see Environmental Factors, Threats, and Alterations section.

#### GEAR TYPES

*Hand Harvest*

The hand harvest fishery for Hard Clams is year-round in North Carolina. Hand harvesting methods include signing (spotting siphon holes), treading, hand raking, hand tonging, and bull raking. Clams are taken by hand and rake in shallow water, up to 4 feet deep ($\leq$1.2 m) while hand tongs and bull rakes are used in deeper water up to 20 feet deep (1.2 to 12.2 m; Cunningham et al. 1992). Bull rakes have been used to exploit clam populations in New River, White Oak River, Bogue Sound, Newport River, North River, and the

Intracoastal Waterway channel of Brunswick, New Hanover, Pender, and Onslow counties. Many subsistence fishermen use bull rakes in the southern area of the state.

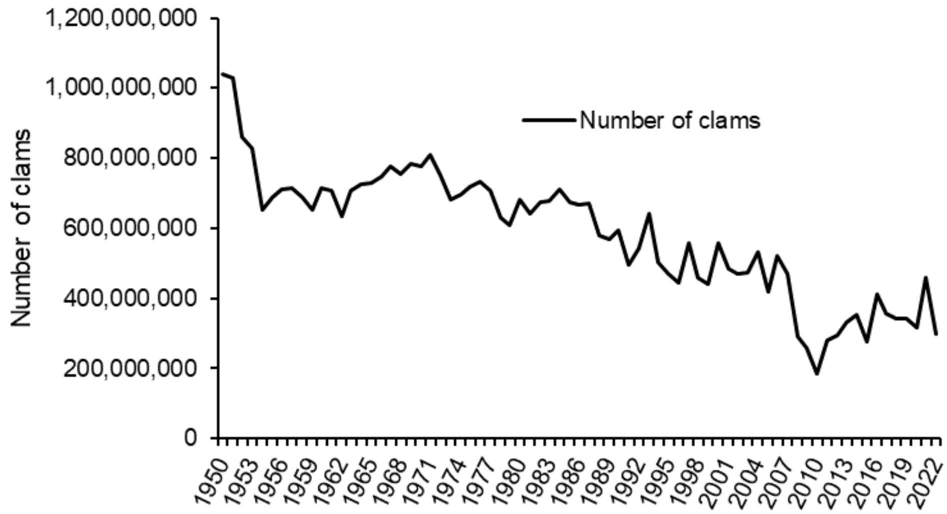



Figure 1. Commercial Hard Clam landings (number of clams, using a conversion factor of 0.32 oz per individual; ASFMC 1992) along the Atlantic East Coast (Maine south to Florida east coast), 1950–2022. Source: NMFS commercial fisheries landings database, except for NC landings from 1994 to 2022 using TTP.

*Mechanical Harvest*

The two types of mechanical harvest gear currently used in North Carolina are the hydraulic escalator dredge and the clam trawl or “clam kicking” vessel. The hydraulic escalator dredge has an escalator or conveyor located on the side of the vessel. A sled is connected to the front end of the escalator. When the front end of the escalator is lowered to the bottom, the sled glides over the bottom. A blade on the sled penetrates the bottom to a depth of about four inches (10 cm) and collects the clams as they are forced from the bottom by water pressure (Cunningham et al. 1992). In clam trawling or “kicking”, clams are dislodged from the bottom with propeller backwash and a heavily chained trawl with a cage attached at the cod end towed behind the boat gathers the clams. Kick boats are generally 20 to 30 ft long and can operate in depths from 3 to 10 feet (1.0 m to 3.05 m). The propeller is usually positioned 12 to 15 inches above the bottom and extra weight can be added to the stern to improve the angle and height above the bottom. For better efficiency in varying water depths, boats include a winged rudder, which has two iron plates welded on either side of the rudder to deflect water downward (Cunningham et al. 1992). One person operates smaller kick boats, while larger boats may have a crew of two or three (Guthrie and Lewis 1982).

### HISTORICAL PUBLIC HARVEST FISHERY

North Carolina Hard Clam harvest has fluctuated historically, often in response to changes in demand, improved harvesting techniques, and increases in polluted shellfish area closures. Hand harvest accounted for all recorded landings prior to the mid-1940s, when early forms of mechanical harvest were developed. Hand harvest is currently allowed year-round with daily harvest limits. A daily harvest limit of 6,250 clams per fishing operation from public waters was established in 1986 by proclamation and has remained in effect since (NCMFC Rule 15A NCAC 03K .0301 (a)).

The first mechanical method for harvesting Hard Clams was known as dredging. This gear allowed fishermen to remain on board and enabled them to work in poor weather (Guthrie and Lewis 1982). Trawls were first used to harvest clams in 1968 and remain in use today in a technique known as "kicking" (Guthrie and Lewis 1982). Increased market demand and more efficient gear soon led to increased landings around the 1970s (Figure 2). Another major development in the fishery occurred in 1968 with the advent of hydraulic dredges. This gear used jets of water from a high-pressure pump to displace bottom sediments covering the clams and a conveyor carried the catch up to the vessel. Hard Clam landings remained stable through the 1960s and 1970s. Since the late 1980s, Hard Clam landings have declined. This decline may be the result of decreased abundance, increasing closures of shellfish waters from pollution, changing market demand, and storm events.

Allocation conflicts did not occur in the Hard Clam fishery until the late 1980's as more management measures were put in place to reduce habitat impacts causing harvesters to compete more for the limited resource. Mechanical harvest methods can negatively impact submerged aquatic vegetation (SAV) and oyster rocks (Peterson et al. 1987). Regulations to protect habitats from mechanical harvest methods have been in place since 1977 and mechanical harvest has largely been confined to deeper waters of the sounds and rivers. A rotation scheme for White Oak River and New River, including a portion of the Intracoastal Waterway (IWW), has been implemented annually by proclamation since the early 1980s. The intent was to prevent overharvesting of the clam stocks, discourage violations by mechanical harvesters who cross the lines in search of more lucrative clam quantities, and prevent the taking of undersized clams, or "buttons". The NCDMF also allows harvest of clams by mechanical means in some navigational channels before maintenance dredging activities performed by the U.S. Army Corps of Engineers (USACE). For a thorough history of the Hard Clam fishery including overall history, historic landings and trends, management changes for mechanical commercial gear, length of seasons, and openings and closures of bays, please refer to Amendment 2 of the Clam FMP.

### PRESENT PUBLIC HARVEST FISHERIES

The current minimum size limit for clams is 1-inch thickness (width). The current daily hand harvest limit is 6,250 clams and the fishery is open year-round. Current public mechanical harvest limits vary by waterbody. In some instances, mechanical harvest areas are rotated (alternately open and closed) with other areas (Table 1). Since 2008, upon adoption of Amendment 1 to the Hard Clam FMP, Core Sound has been divided into two areas and the northern area is open every other year while the southern area is opened annually. In 2015 adjustments were made to the Newport River area due to oyster encroachment. Then in 2017 there were modifications to the areas in Core Sound and North River, and use of mechanical methods was prohibited in Bogue Sound due to SAV encroachment.

Table 1. Current daily mechanical Hard Clam harvest limits by waterbody.

| Waterbody | Daily harvest limit (Number of clams) | Additional information |
|---|---|---|
| Northern Core Sound | 5,000 | Rotates one year open and one year closed opposite the open/close rotation of the New River |
| Southern Core Sound | 5,000 | Open annually |
| North River | 3,750 | Open annually |
| Newport River | 3,750 | Open annually |
| White Oak River | 6,250 | Rotates one year open and one year closed opposite the open/close rotation of the New River |
| New River | 6,250 | Rotates one year open and one year closed opposite the open/close rotation of Northern Core Sound, the White Oak River, and the IWW in the Onslow/Pender counties area |
| New River Inlet | 6,250 | Open annually from Marker 72A to the New River Inlet |
| IWW Onslow/Pender counties area | 6,250 | Intracoastal Waterway (maintained marked channel only) from Marker #65, south of Sallier's Bay, to Marker #49 at Morris Landing. All public bottoms within and 100 feet on either side of the Intracoastal Waterway from Marker #49 at Morris Landing to the "BC" Marker at Banks Channel. Open every other year when the New River is closed. |

## ANNUAL LANDINGS, TRIPS, PARTICIPATION, AND MARKET GRADES

Separating Hard Clam landings data into public harvest and private production is inexact prior to 1994 because landings information was collected on a voluntary basis. Since 1994, about 88% (1994–2013 combined estimates) of the total commercial Hard Clam harvest came from public harvest areas in North Carolina. The annual number of Hard Clams from public bottom averaged 19.6 million from 1994 to 2022, but landings have steadily declined through time. Annual landings averaged 11.7 million from 2012–2022 (Figure 2).

There are year-to-year fluctuations in the number of trips harvesting Hard Clams. The annual number of trips has declined during the time series (1994–2022), with the highest number of trips in 1994 (Figure 3). Adverse weather conditions (e.g., hurricanes, and heavy rain events) can impact the annual landings. Freshwater runoff after storm events often causes shellfish harvest area closures and therefore reduces Hard Clam harvest effort for short time periods.

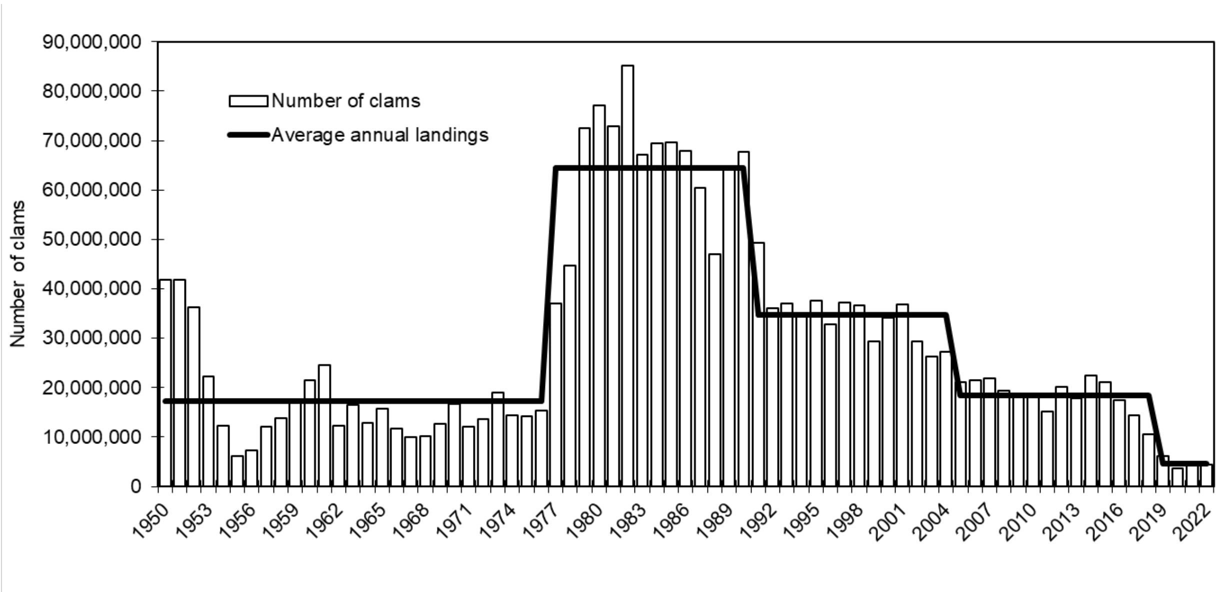



Figure 2. Hard Clam landings (number of clams) from public harvest and private production showing the average annual landing trends (solid line) for specific time periods,1950–1976, 1977–1990, 1991–2004, 2005–2018, 2019–2022. TTP.

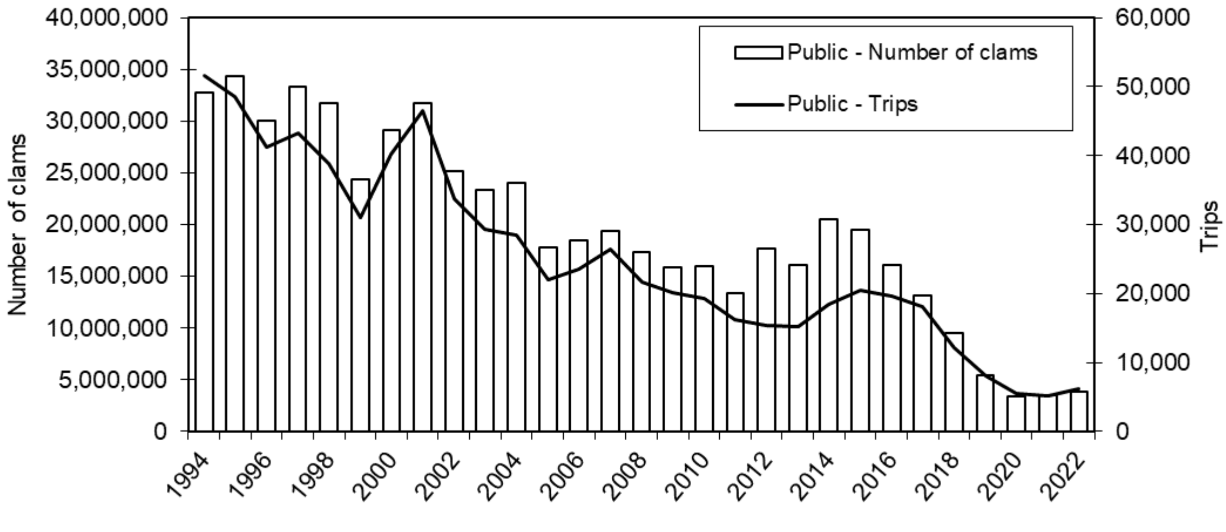



Figure 3. North Carolina annual commercial Hard Clam landings (number of clams) and trips from public harvest, 1994–2022. TTP.

New River and Core Sound are the top two waterbodies where Hard Clams are harvested from public harvest areas, accounting for 50% of the landings from 1994 to 2022 (Figure 4). Landings in the southern part of the state, including the areas of Stump Sound, Lockwood Folly, Topsail Sound, Masonboro Sound, Cape Fear River, Shallotte River and the Inland Waterway, accounted for an additional 25% of the public Hard Clam landings from 1994 to 2022.

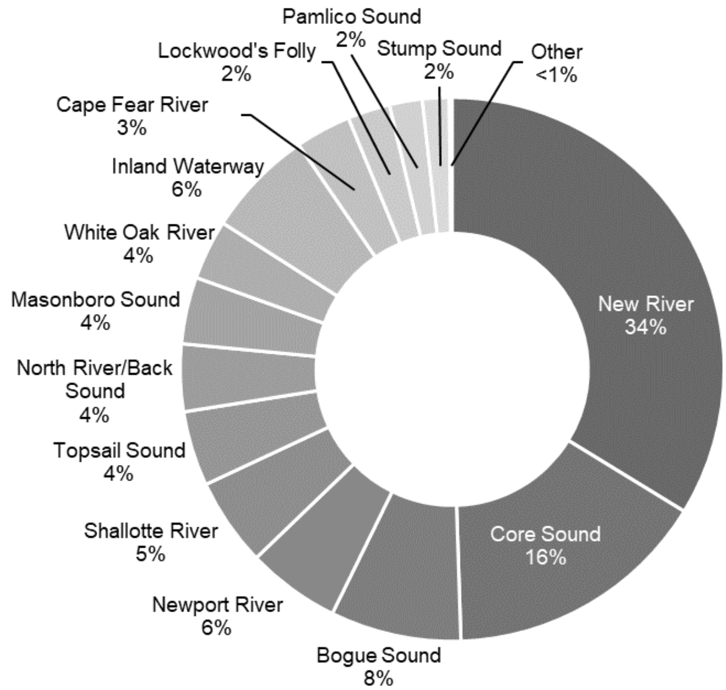



Figure 4. Commercial Hard Clam landings (percent of total landings) by waterbody from public harvest 1994 to 2022 combined. TTP.

Clam fishery participation has declined by about 82% over the last twenty years (Figure 5). There was an increase in participation in the hand harvest fishery from 2013–2015, then a decline from over 600 participants in 2015 to less than 280 participants in 2022 (Figure 5). Hand gears have had an order of magnitude more participants across the entire time series (Figure 5).

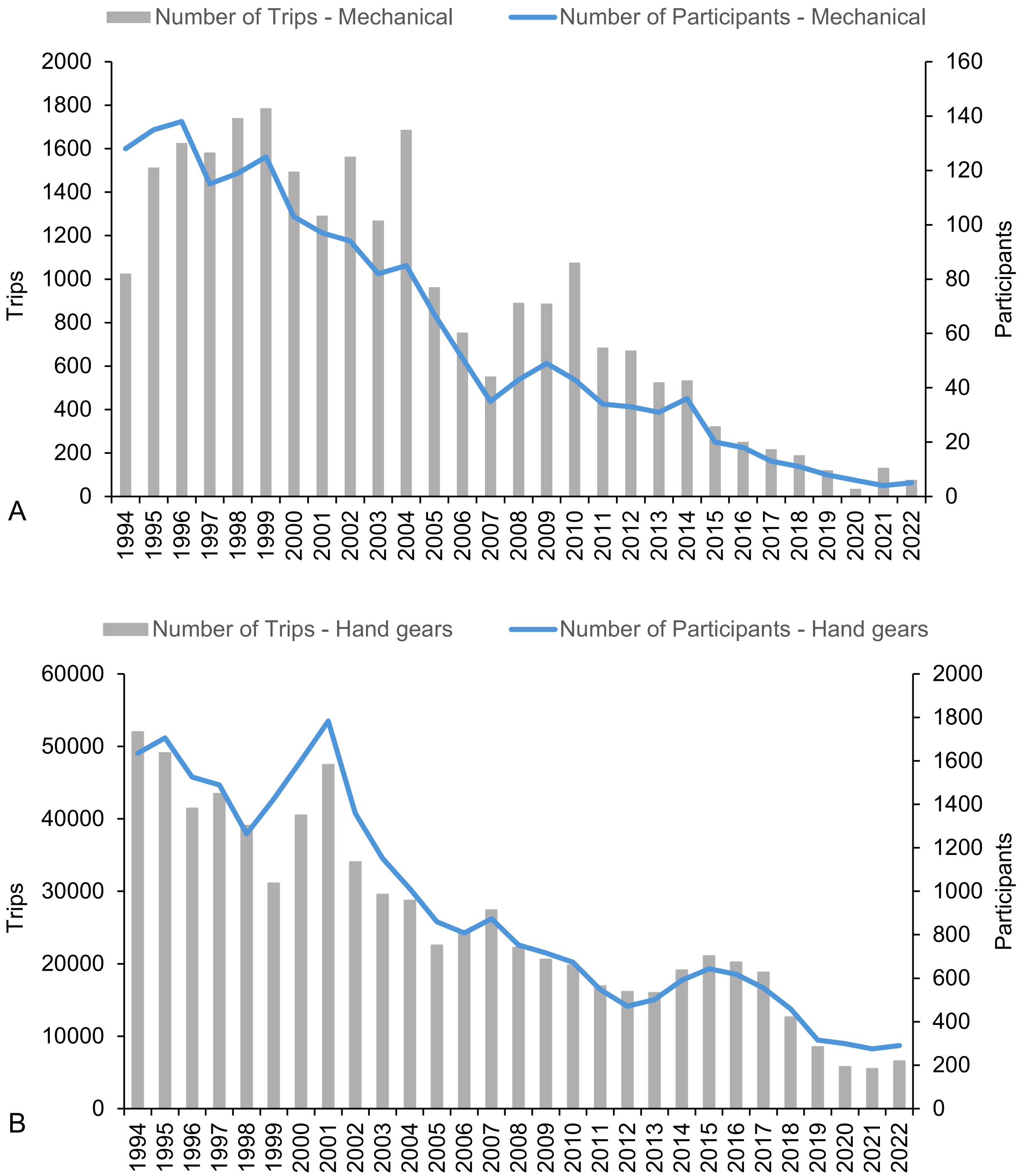
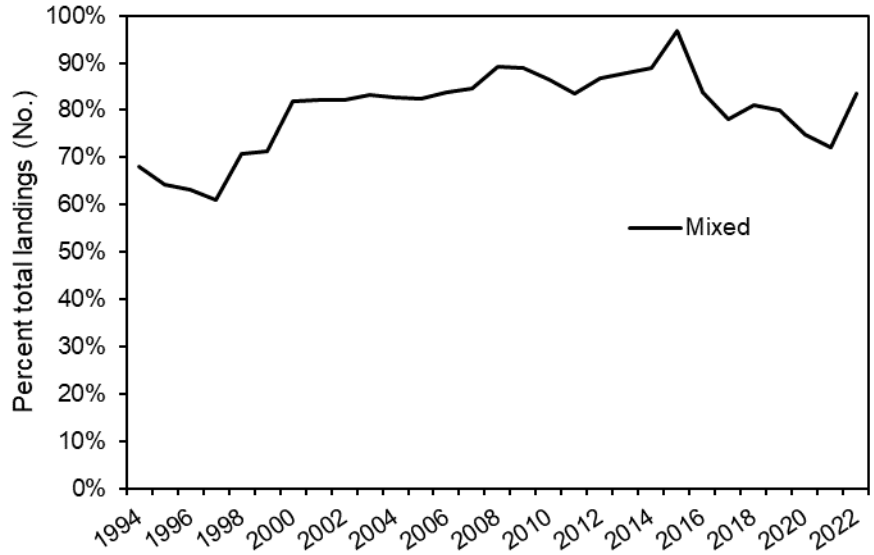



Figure 5. Participant and trip count by gear category for Hard Clam harvest, 1994–2022. (A) mechanical gear and (B) hand gears. Data provided by the NCDMF TTP.

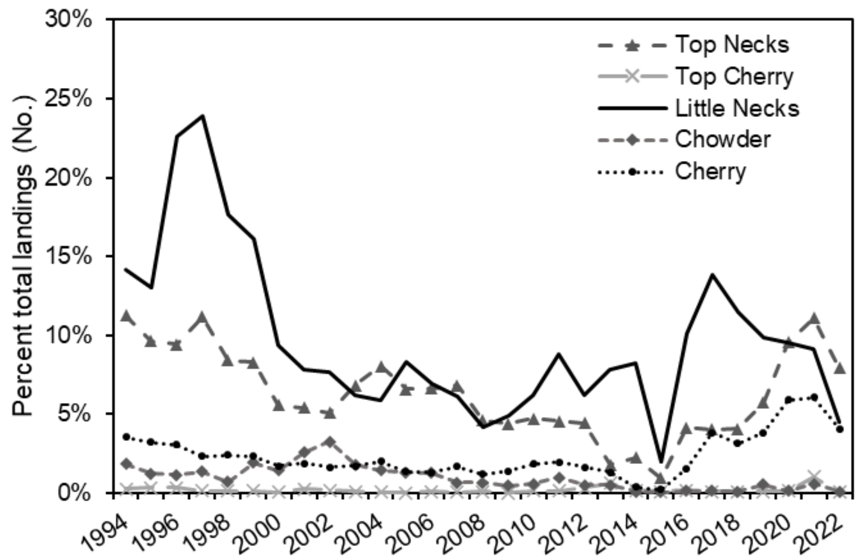
Hard Clam harvest is sorted by thickness (shell width) into various market grades when purchased by the seafood dealer. A mixed or unclassified market grade is the most common Hard Clam size category from public harvest and comprised 79% of the total landings from 1994 to 2022 (Figure 6a). Little neck, which consists of the smallest clams typically measuring between 1-inch (25 mm) to 1 ¼-inch (32 mm) in thickness, is the second most dominant market category of Hard Clam from public harvest (Figure 6b). Top neck is the next largest market category in size with individuals ranging from 1 ¼-inch (32 mm) to 1 ⅝-inch in thickness (41 mm). The proportion of Hard Clams graded as top necks from public harvest has remained about the same throughout the time series (6% on average; Figure 6b). Hard Clams in the cherry and top cherry market grades have a shell thickness that ranges between 1 ⅝-inch (41 mm) to 2 ¼-inches (57 mm). These two market categories have not shown much change in proportion to the total Hard Clam public harvest from 1994 to 2022, although the cherry market grade began to see a slight increase in 2017 (Figure 6b). Chowder Hard Clams are the largest market category by size and are any Hard Clams greater than 2 ¼-inch shell thickness (Figure 6b).

*Hand Harvest*

Hand harvest from public areas is a year-round fishery and has average landings of 16,274,336 clams per year (1994–2022). Most hand harvest occurs in the spring and summer when warm water is conducive to wading (Figure 7). Annual public harvest and the number of hand harvest trips per year for Hard Clams has declined overall from 1994 to 2022, except for a moderate increase from 2012 to 2014 (Figure 8). The annual catch per unit effort (CPUE; number of clams per trip) from public area hand harvest also reflects this increase from 2012 to 2014 but has subsequently dropped back down to around 600 clams per trip (Figure 9).




A.




B.

Figure 6. Annual landings (percent of total annual landings) of Hard Clams from public harvest by market grade, 1994–2022 combined. A. Mixed grade only; B. All other market grades. TTP.

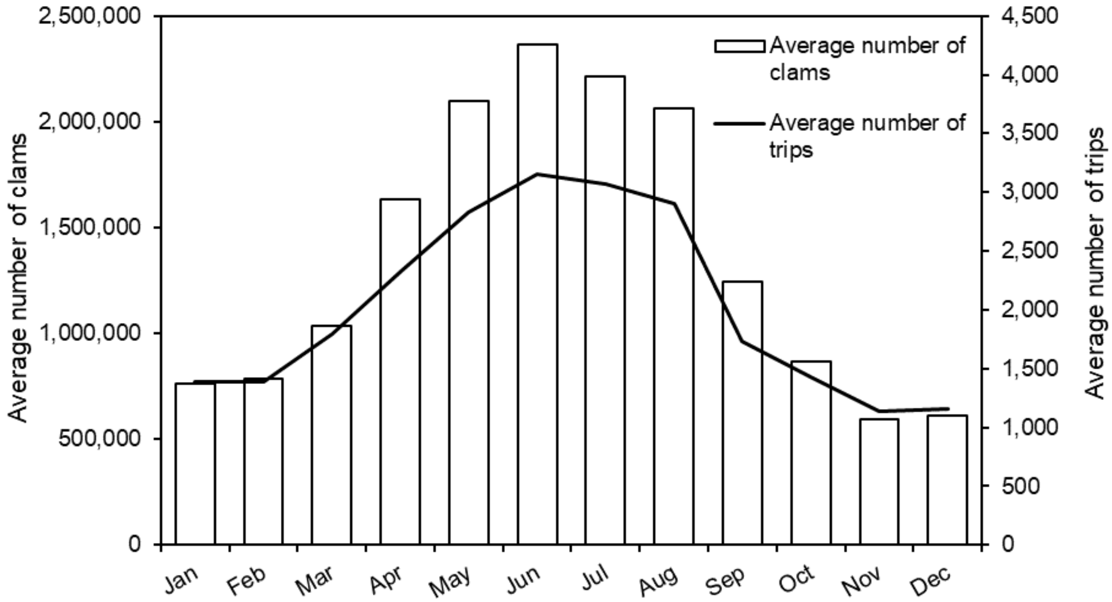



Figure 7. Average Hard Clam landings (number of clams) and average number of trips by month from public harvest using hand gears, 1994–2022. TTP.

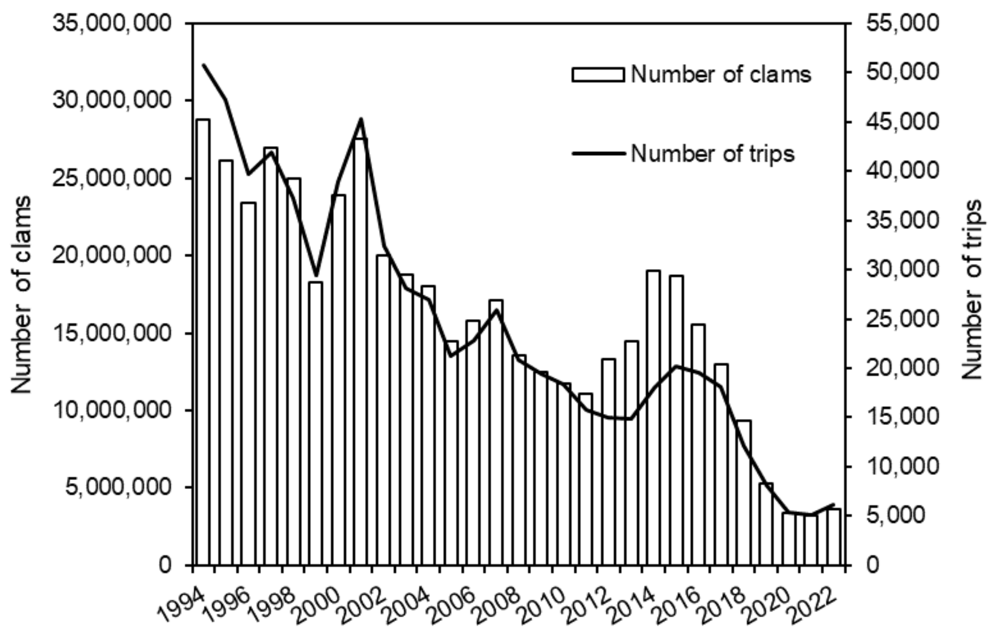



Figure 8. Annual Hard Clam landings (number of clams) and trips from public harvest using hand gears, 1994–2022. TTP.

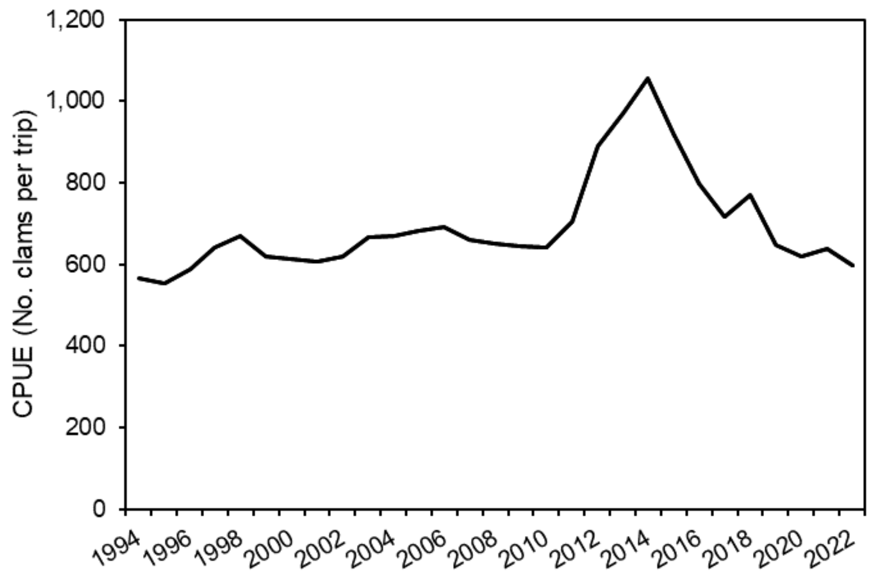



Figure 9. Annual catch per unit effort (CPUE; number of clams per trip) of hand harvest from public areas, 1994–2022. TTP.

*Mechanical Harvest*

Mechanical harvest season usually begins the second Monday in December and extends through the week of March 31. Harvest is allowed only from 7:30 a.m. to 4:00 p.m. on Monday through Friday until before the Christmas holiday and then Monday through Wednesday after December 25 for the remainder of the open harvest season.

Hard Clam landings from public harvest, using mechanical methods, has average landings of 3,319,605 clams each fishing year (1994/95 to 2021/2022). The mechanical clam harvest season usually has the highest landings at the beginning of the fishing season in December and declines as the season progresses (Figure 10). Landings outside of the usual mechanical clam harvest season are from temporary openings for the maintenance of channels and temporary openings in Core Creek when bacteriological levels are at acceptable levels to harvest clams. Hard Clam landings and trips fluctuate from fishing year to fishing year and appear to be greatly influenced by harvest from the New River mechanical harvest area (Figure 11). Mechanical clam landings have remained below 1,000,000 clams per season since 2016/2017.

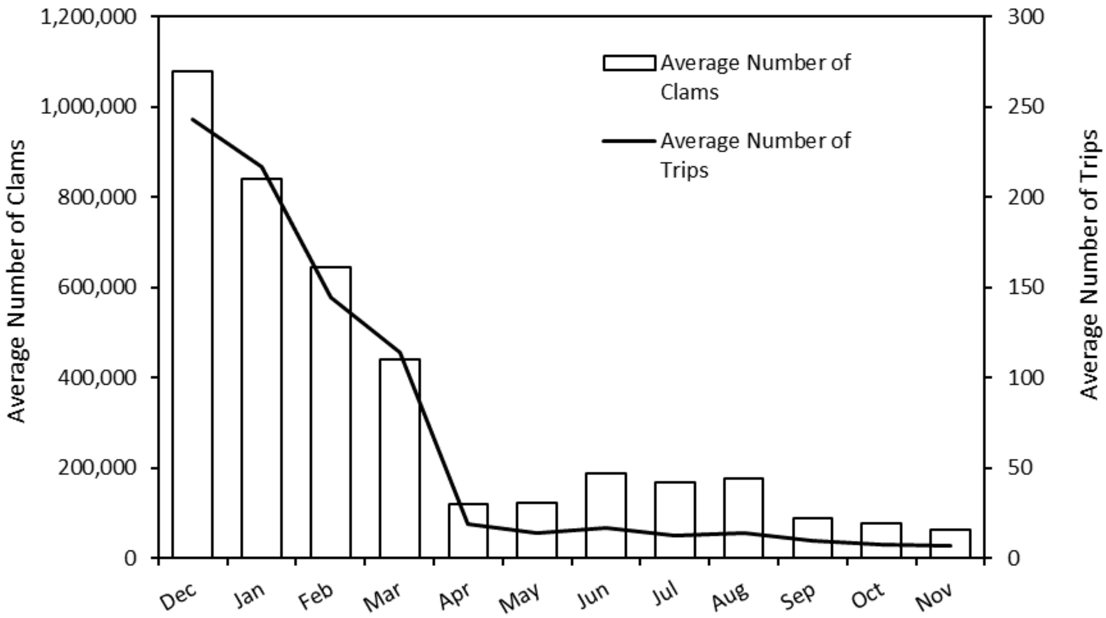



Figure 10. Average Hard Clam landings (number of clams) and average number of trips by month from public harvest using mechanical gears, 1994/95–2022/March 2023. TTP.

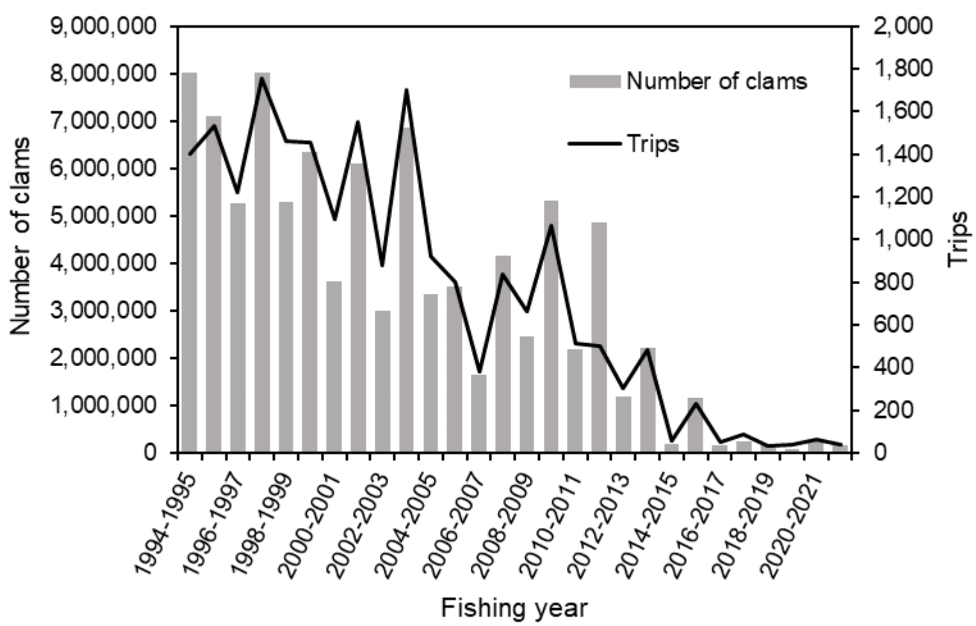



Figure 11. Hard Clam landings (number of clams) and trips from public harvest using mechanical gears by fishing year (Dec-Nov), 1994/95–2021/2022. TTP.

**PRIVATE SHELLFISH CULTURE: SHELLFISH LEASES AND FRANCHISES**

This plan does not focus on management of private shellfish culture through shellfish leases and franchises; however, detailed information on the history and management of private shellfish culture can be found in Amendment 2 of the Hard Clam FMP. It should also be noted that there is only one seed distributer in North Carolina, which hinders the growth of private shellfish culture for clams in the state.

## Recreational Fishery

Hard Clams are commonly harvested recreationally year-round in North Carolina by hand and rakes. The recreational bag limit is currently 100 clams per person per day with no more than 200 clams per vessel at a minimum size of 1-inch thick. The NCDMF has limited data on recreational clam fishing, including the number of participants and the extent of their economic activity. Efforts to accurately quantify the impact of recreational fishing on shellfish (mollusks and crustaceans) have been met with limited success in North Carolina. The NCDMF collects data on recreational fishing in conjunction with the Marine Recreational Information Program (MRIP). However, MRIP collects information on finfish only. In addition, because any North Carolina resident can purchase a low cost commercial shellfish license to take shellfish in commercial quantities for recreational purposes, harvest from a commercial shellfish license used for recreational purposes does not get recorded because it is not sold to a seafood dealer.

Based on recommendations by the original Oyster and Hard Clam FMPs, House Bill 1427 was introduced before the general assembly in 2004 to establish a recreational shellfish license on a three-year trial basis (NCDMF 2001b). However, House Bill 1427 was not passed. In the same year, House Bill 831 sought to create a saltwater fishing license requiring individuals recreationally fishing for finfish and shellfish to obtain a license, but this bill did not pass. The state legislature revisited the issue in 2005 and passed a bill to create the Coastal Recreational Fishing License (CRFL). When CRFL was implemented in 2007, it was only required when harvesting finfish and did not include shellfish.

Recreational harvest of Hard Clams in North Carolina does not require a fishing license, thus, the total amount of recreational landings cannot be estimated and remains unknown. However, a mail survey has been used since 2010 to estimate harvest from Coastal Recreational Fishing License (CRFL) holders. This population of recreational harvesters makes up an unknown proportion of total recreational harvest, but still provides insight into catch rates, harvest trends, and scale of harvest by CRFL holders. In 2010, surveys were only mailed out in November and December, so harvest and effort estimates are very low (Table 2). Estimates of harvest and catch rate have declined since 2013 (Figure 12). In 2022, recreational harvest was roughly one half of that in 2020 and only 30% of the time series average.

Recreational clam harvest was reported from 60 waterbodies throughout coastal North Carolina. Overall survey results demonstrate a distinct seasonality for the recreational harvest of clams, with peak activity observed during summer months. This, coupled with the highest concentrations of clamming activity being observed in Pamlico, Bogue, and Masonboro sounds and during summer months, suggests coastal tourism may significantly impact recreational clam harvest. More background and history on recreational shellfish harvest can be found in Appendix 2 (the Recreational Harvest Issue Paper).

Table 2. Estimated number of trips, number of Hard Clams harvested, and catch rate (clams per trip) per year of Coastal Recreational Fishing License holders, 2010–2022. An asterisk (*) for 2010 indicates a partial year of sampling.

| Year | Number of trips | Number of clams | Catch rate |
|---|---|---|---|
| 2010* | 528 | 8,731 | 18.4 |
| 2011 | 6,350 | 127,597 | 22.9 |
| 2012 | 6,726 | 146,151 | 27.3 |
| 2013 | 8,644 | 191,842 | 26.2 |
| 2014 | 6,325 | 162,656 | 28.8 |
| 2015 | 7,637 | 166,419 | 27.4 |
| 2016 | 8,456 | 84,199 | 12.3 |
| 2017 | 3,435 | 75,171 | 21.8 |
| 2018 | 2,362 | 26,769 | 11.3 |
| 2019 | 5,088 | 114,042 | 22.4 |
| 2020 | 6,557 | 62,164 | 9.5 |
| 2021 | 1,765 | 15,471 | 8.8 |
| 2022 | 6,628 | 28,241 | 4.3 |

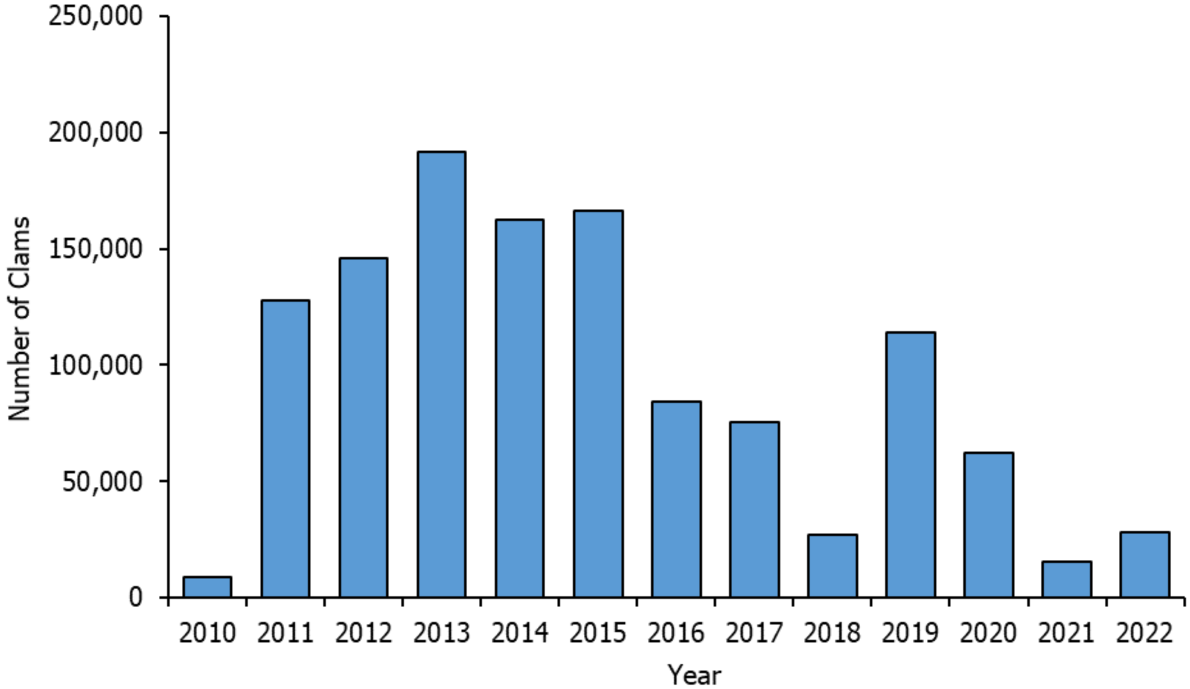



Figure 12. Annual recreational Hard Clam landings (number of clams) in North Carolina, 2010–2022. Data from 2010 represent a partial year of sampling.

## Summary of Economic Impact

### ECONOMIC ASPECTS OF THE FISHERY

*Ex-Vessel Value and Price*

The value of Hard Clams to the North Carolina seafood industry has fluctuated over time. Before the mid-1970s, their economic contribution was relatively small, representing no more than 1–2% of the total value of landed seafood in the state. In 2013, clams were the sixth most economically important commercial seafood species in North Carolina. Landings of clams accounted for 4.7% of the total value of commercial non-finfish landings and 2.9% of the total value of all commercial seafood landings in the state.

The real value (the value that is adjusted for inflation) of North Carolina Hard Clam landings on public bottom has generally declined over the last twenty years peaking at just under $9 million in 1995 and declining until 2011 where ex-vessel value increased yearly until it peaked in 2015 at about $6 million before declining again in the last 7 years. When adjusted for the effects of inflation, 2021 saw the lowest landings value in the time series since 1994, then landings started increasing in 2014 and 2015, which then continued declining year over year to 2022 (Figure 13). The decline in total value is largely driven by a decrease in catch described in the previous section (Figure 11).

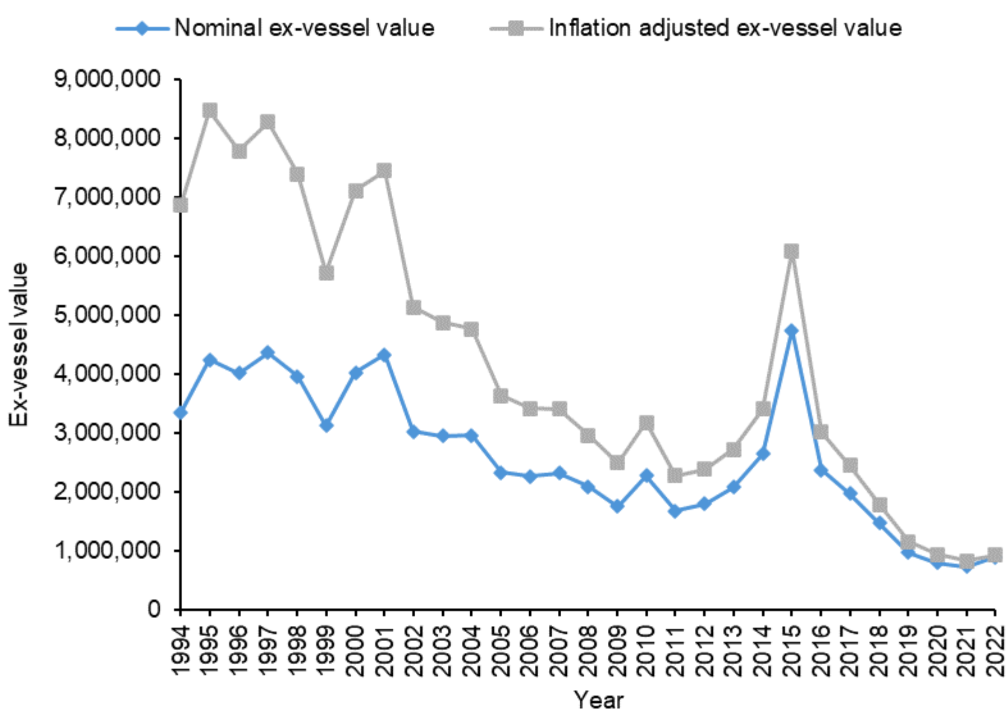



Figure 13. Annual ex-vessel value of Hard Clams in North Carolina, 1994–2022. Inflation adjusted values are in 2022 dollars. NCDMF TTP.

The average price per clam stayed constant from 1994–2014 before increasing dramatically in 2015, followed by a drop in 2016, and then a consistent increase from 2017–2022 (Figure 14). When adjusted for 2022 dollars, the average price per clam from 1994 to 2022 peaked in 2015 at $0.31 and had the lowest average value in 2012 at $0.14 In the last five years clam values have increased from $0.19 in 2018 to $0.21 in 2021 and $0.27 in 2022.

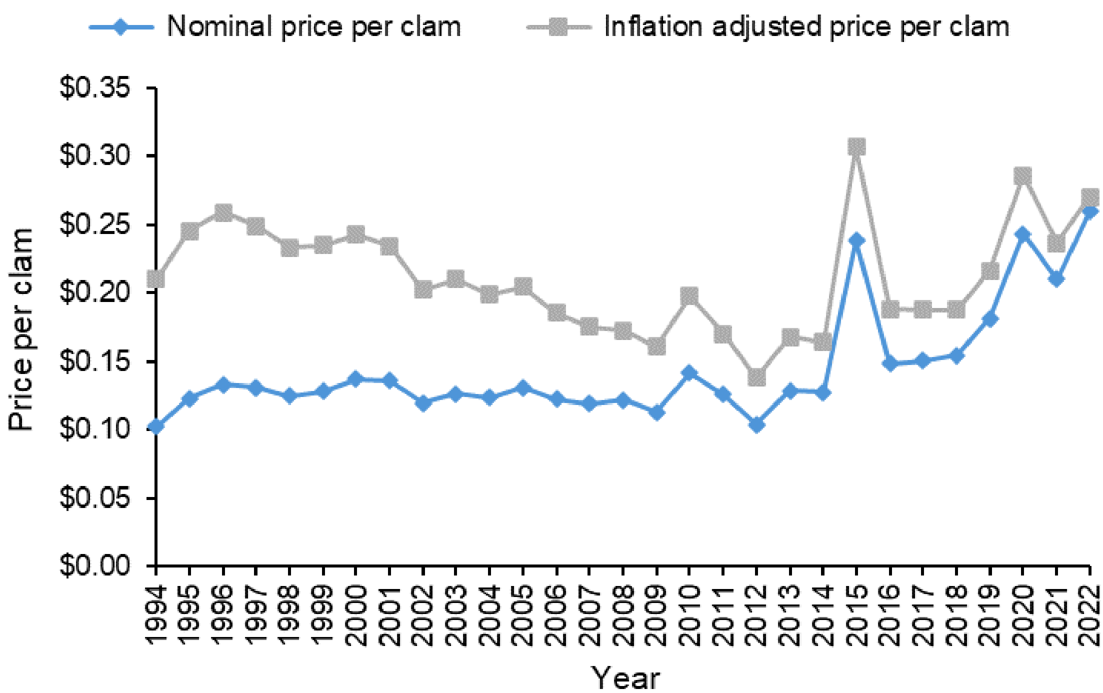



Figure 14. Annual average nominal and inflation adjusted price per clam harvested on public bottom in North Carolina 1994–2022. Data provided by the NCDMF TTP.

From 2004 to 2019 the value of all clam grades was stable and did not have much variation across grades. In 2020, there was a large spike in little neck prices and then a sharp decrease in 2021 before coming back up to $0.52 in 2022. This market volatility could have been influenced by outside market drivers such as the COVID-19 pandemic.

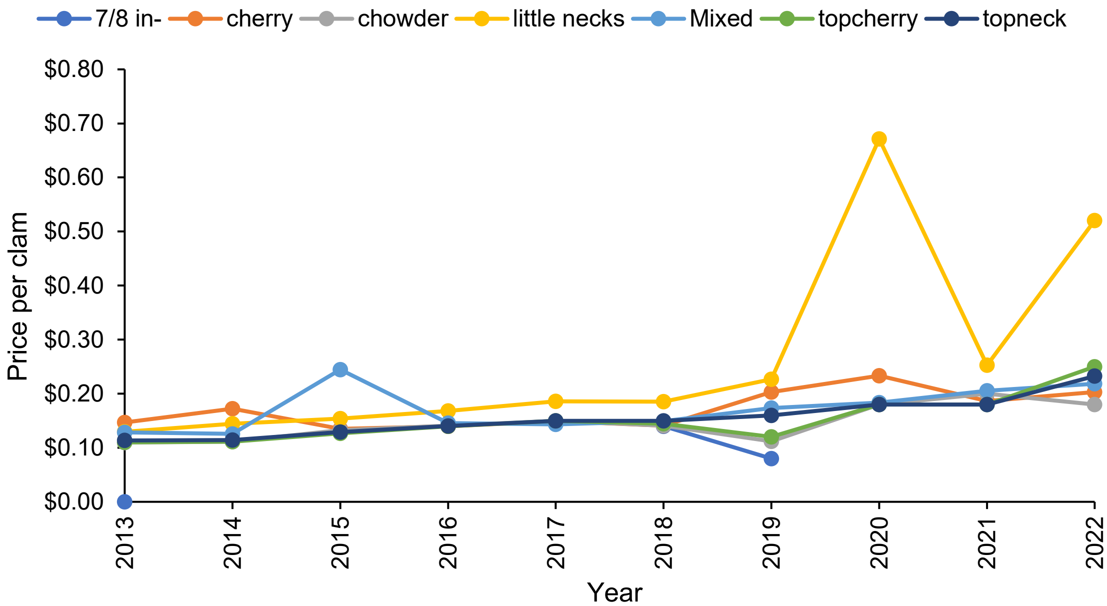



Figure 15. Annual average ex-vessel grade prices of Hard Clams in North Carolina, 2013–2022. Data provided by the NCDMF TTP.

Most water bodies account for a constant amount of the clam harvest value over time (Figure 16). Notably, the New River has seen a decrease in the market share of landed clams in the last two years. Clam landings from public bottom in New River fell from 65% of the market share in 2014 to 9% in 2022. Core Sound and Bogue Sound have made up more of the landed clams in the last 5 years making up a combined 43% of clams landed from public bottom in 2022.

*Gear*

From 2004 to 2022, hand harvest dominated the percent of total ex-vessel value of clam landings. The percentage of mechanical harvest value saw a decrease over that period from a peak of 24% in 2003 to a low of 13% in 2015. As a proportion of clam harvest on public bottom, mechanical harvest has oscillated around 20% of market share for most of the time series with high yearly fluctuations from 2011–2016. From 2018 to 2022 hand harvest made up at least 86% of the harvest (Figure 17). Since 2016 mechanical harvest has accounted for between 20% and 24% of landings (Figure 17).

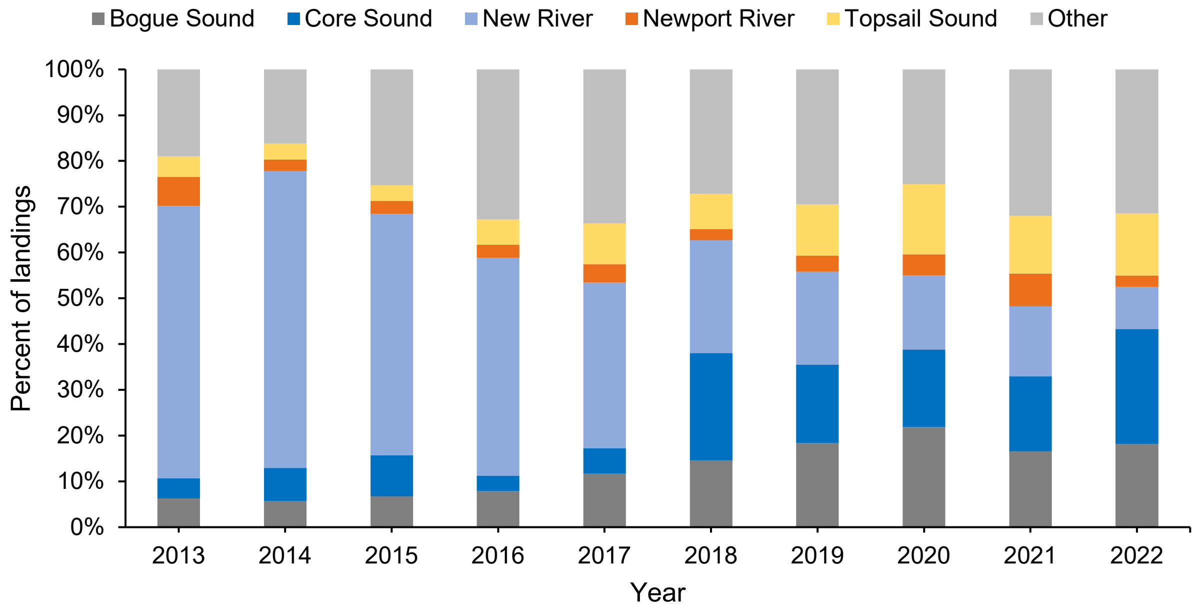



Figure 16. Percent of total annual commercial Hard Clam harvest value by waterbody, 2013–2022. Data provided by the NCDMF TTP.

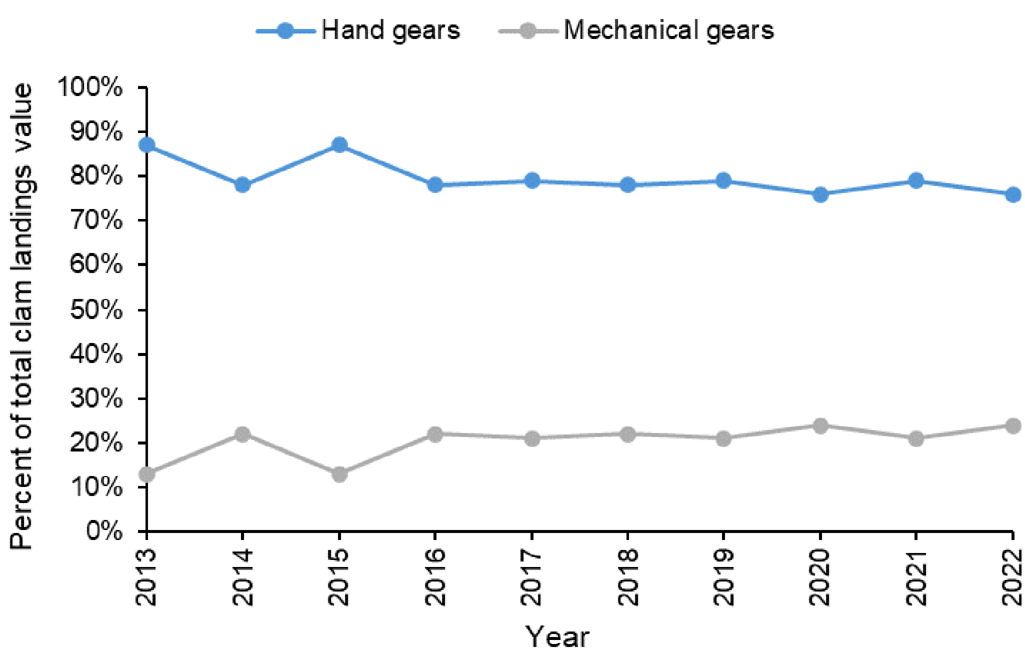



Figure 17. Annual percent of total landings value by gear type used to harvest Hard Clams,2013–2022. Data provided by the NCDMF TTP.

*Participation And Trips*

The NCDMF tracks commercial landings of shellfish in the state through the Trip Ticket Program. Among the variables collected, number of participants, number of trips, gear types, location of landings and harvest, and number of dealers are categorized and summarized in this section.

In the last 20 years, 97% of clammers have recorded landings worth under $25,000 with 43% of clammers landing clams worth $500 or less a year. This indicates most participants use clamming as a supplement to their income.

Those participating in hand harvest were primarily in the 50–59 year old age group, with participation of individuals < 49 years old declining over time (Figure 18).

As is the case in all commercial fisheries in North Carolina, clam fishers may only sell their catch to licensed seafood dealers. The number of dealers reporting landings of clams has declined since a high of 94 in 2013. The number of dealers purchasing clams fell to 47 in 2019. Since 2019 the annual number of dealers participating in the purchase of clams has been stable with 26 in 2022.

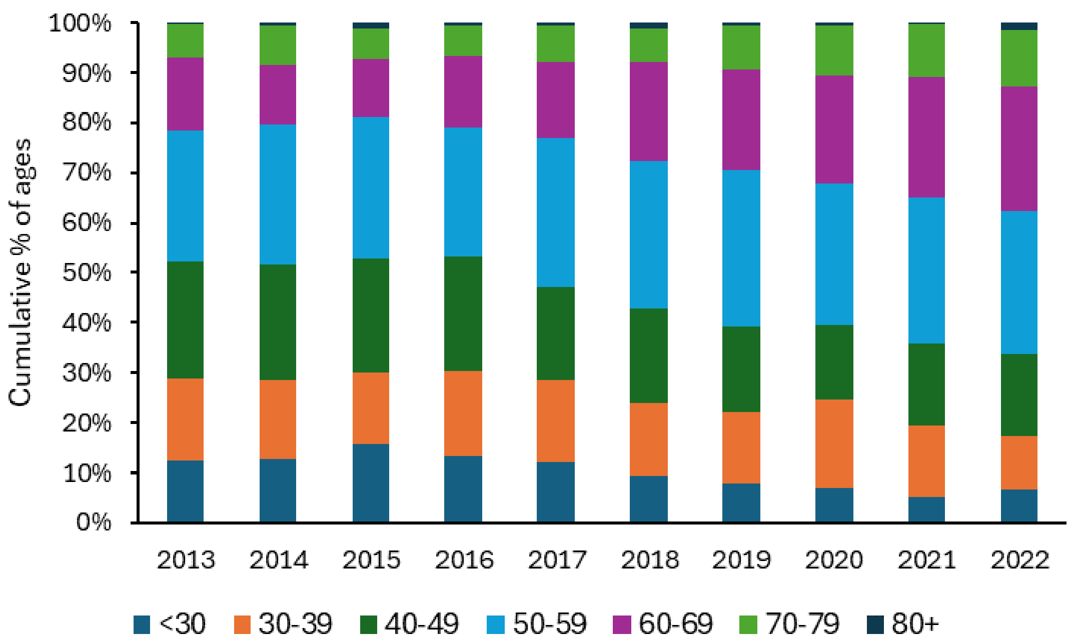



Figure 18. Age group demographics for Hard Clam hand harvest, 2013 – 2022 Data provided by the NCDMF TTP.

*Economic Impact of the Commercial Fishery*

The expenditures and income within the commercial fishing industry, as well as those by consumers of seafood produce ripple effects as the money is spent and re-spent in the state economy. Each dollar earned and spent generates additional economic impacts by stimulating further activity in other industries which fosters jobs, income, and business sales. These impacts are estimated using the NCDMF commercial fishing economic impact model which utilizes information from socioeconomic surveys of commercial fishermen and seafood dealers in North Carolina, economic multipliers found in *Fisheries Economics of the United States, 2020,* and IMPLAN economic impact modeling software. In 2022, the commercial clam fishery in North Carolina supported an estimated 326 full-time and part-time jobs, approximately $1.37 million in income, and approximately $3 million in sales impacts (Table 3). In the last ten years the industry has contracted in landings, participants, and economic impacts.

*Recreational Fishery Economics*

The NCDMF has limited data on recreational clamming, including the number of participants and the effect of their effort on the economy. For more information on the Recreational Fishery, see Appendix 2 (the Recreational Harvest Issue Paper).

Table 3. Economic impact of the commercial Hard Clam fishery in North Carolina, 2013–2022 reported in 2022 dollars. NCDMF Fisheries Economics Program.

| | | | | Estimated Economic Impacts | | | |
|---|---|---|---|---|---|---|---|
| Year | Participants[1] | Trips[1] | Clams landed (in thousands)[1] | Ex-vessel value (in thousands)[1] | Jobs[2,3] | Income impacts (in thousands)[3] | Sales impacts (in thousands)[3] |
| 2022 | 276 | 6,194 | 3,828 | $890 | 326 | $1,370 | $2,988 |
| 2021 | 268 | 5,140 | 3,557 | $789 | 313 | $1,399 | $2,996 |
| 2020 | 292 | 5,438 | 3,430 | $903 | 338 | $1,389 | $2,997 |
| 2019 | 311 | 8,151 | 5,428 | $1,110 | 365 | $1,793 | $4,119 |
| 2018 | 452 | 12,211 | 9,492 | $1,710 | 537 | $2,667 | $5,843 |
| 2017 | 544 | 18,189 | 13,156 | $2,349 | 647 | $3,490 | $7,920 |
| 2016 | 599 | 19,612 | 16,047 | $2,891 | 722 | $4,247 | $9,252 |
| 2015 | 627 | 20,413 | 19,529 | $5,850 | 885 | $8,400 | $18,830 |
| 2014 | 581 | 18,372 | 20,538 | $3,267 | 728 | $4,883 | $11,222 |
| 2013 | 491 | 15,241 | 16,061 | $2,611 | 606 | $4,124 | $8,767 |

[1]As reported by the NCDMF trip ticket program.
[2]Represents both full-time and part-time jobs.
[3]Economic impacts calculated using the NCDMF commercial fishing economic impact model and reported in 2022 dollars.

#### SOCIAL IMPORTANCE OF THE FISHERY

*Commercial Fishermen*

The NCDMF Fisheries Economics Program has been conducting a series of in-depth interview-style surveys with commercial fishermen along the coast since 1999. Data from these interviews are added to a growing database and used for fishery management plans, among other uses. The description of the clam fishery from these surveys can be found in Amendment 2.

## ECOSYSTEM PROTECTION AND IMPACT

### Coastal Habitat Protection Plan

In the 1990s, addressing habitat and water quality degradation was recognized by resource managers, fishermen, the public, and the legislature as a critical component for improving and sustaining fish stocks, as well as the coastal ecosystem. When the Fisheries Reform Act of 1997 (FRA; G.S. 143B-279.8) was passed, it required developing Coastal Habitat Protection Plans (CHPPs). The legislative goal of the CHPP is "…the long-term enhancement of coastal fisheries associated with coastal habitats." The FRA specifies that the CHPP will identify threats and recommend management actions to protect and restore coastal habitats critical to North Carolina's coastal fishery resources. The plans are updated every five years and must be adopted by the NC Coastal Resources Commission (CRC), the NC Environmental Management Commission (EMC), and the NC Marine Fisheries Commission (MFC) to ensure consistency among commissions as well as their supporting NC Department of Environmental Quality (DEQ) agencies. The 2021 CHPP Amendment is the most recent update to the CHPP, building upon the 2016 CHPP source document.

The North Carolina DEQ CHPP includes four overarching goals for the protection of coastal habitat: 1) improve effectiveness of existing rules and programs protecting coastal fish habitats; 2) identify and delineate strategic coastal habitats; 3) enhance habitat and protect it from physical impacts; and 4) enhance and protect water quality. The CHPP is an interagency plan with its goals and actions carried out by several state agencies. For instance, while the NCDMF has the capacity to recommend management decisions towards meeting the goals described above pertaining to coastal habitat, the North Carolina Division of Water Resources (NCDWR) has the ability to enforce policies concerning water quality issues described in the CHPP. Overall, achieving the goals set by the CHPP to protect North Carolina's coastal resources involves managers and policy makers from several state agencies to make recommendations and ultimately enforce them as regulations.

Hard Clams occur extensively in estuarine systems. Habitats for juvenile and adult Hard Clams include both intertidal and subtidal soft bottom (defined by Street et al. (2005) as "unconsolidated, unvegetated sediment that occurs in freshwater, estuarine, and marine systems" to include both deeper subtidal bottom and shallow intertidal flats), shell bottom (which can be commonly referred to as oyster beds, rocks, reefs, bars, and shell hash), and SAV. NCDMF's Estuarine Bottom Habitat Mapping (EBHM) Program mapped North Carolina's shellfish-growing bottom habitats between 1990 and 2021 and identified the top clam-producing bottom types across the state, as listed in Table 4.

By region, *Subtidal Hard Vegetated without Shell* (SAV on sandy bottom) was the most productive clam habitat in the Pamlico Sound region, but in regions south of Pamlico Sound, unvegetated intertidal and subtidal shelly bottom types both produced more clams than vegetated bottom (Table 4). Other unvegetated, non-shelly bottom types (identified in the CHPP as "soft bottom habitat") also provide habitat for clams, but the EBHM program generally found clams at lower densities in those habitats than in shell bottom and SAV habitat. The EBHM program data support findings in the scientific literature that SAV (Peterson et al. 1984; Irlandi 1994; Carroll et al. 2008) and shell bottom (Peterson et al. 1995) provide superior habitat to unstructured soft bottom habitat. In addition to hosting lower densities of clams, soft bottom habitat is by far the most extensive estuarine habitat in North Carolina, and faces fewer threats than structured habitats. Therefore, the protection of SAV and shell bottom habitats from both physical impacts and water quality degradation are important when considering protecting clam habitats.

Table 4. Average clam densities for the top five clam-producing bottom types as identified by the EBHM program.

| EBHM bottom habitat category | Avg. clams per square meter | Habitat description |
|---|---|---|
| Intertidal Firm Non-vegetated Shell | 2.03±0.03 | Intertidal oyster reef/reef fringe on sandy or muddy sand bottom |
| Intertidal Hard Non-vegetated Shell | 1.50±0.04 | Intertidal oyster reef/reef fringe on sandy or shelly bottom |
| Subtidal Firm Non-vegetated Shell | 0.86±0.03 | Subtidal oyster reef/reef fringe on sandy or muddy sand bottom |
| Subtidal Hard Non-vegetated Shell | 0.87±0.04 | Subtidal oyster reef/reef fringe on sandy or shelly bottom |
| Subtidal Hard Vegetated w/o Shell | 0.71±0.01 | SAV beds on sandy bottom |

## Habitat and Enhancement Program

The NCDMF has not identified a need to target restoration efforts towards increasing Hard Clam populations; however, NCDMF supports enhancement programs which benefit native shellfish species through a variety of initiatives. In recognition of the eastern oyster as a keystone species in estuarine habitat, these initiatives focus on oyster restoration, while indirectly and simultaneously providing enhancement to Hard Clam habitat.

### CULTCH PLANTING

The objective of the NCDMF cultch planting program is to provide shellfish habitat on public bottom grounds open to commercial harvest. While cultch planting is traditionally viewed as an oyster restoration measure, it may also serve as a restoration tool for other shellfish species, including Hard Clams. A comprehensive overview of the cultch planting program is available in the Eastern Oyster FMP Amendment 5, Appendix 4.

### OYSTER SANCTUARIES

Oyster Sanctuaries in North Carolina are designed in such a way that enhanced habitat complexity may provide habitat for both oysters and other species typically found on or near oyster reefs. At many of these sites, soft bottom habitat between hard substrate patches may provide ideal habitat for clam colonization and also offer refuge from predation (Castagna 1970).

Hard Clams, as with oysters, in harvest-protected sanctuaries can serve as broodstock populations, providing subsidies to harvestable areas (Gobler et al. 2022). While a monitoring protocol is in place for oyster sanctuaries, there is currently no provision for addressing Hard Clam ecology associated with these protected areas.

A comprehensive overview of the Oyster Sanctuary Program is available in the Eastern Oyster FMP Amendment 5, Appendix 4.

### SHELLFISH AQUACULTURE

Aquaculture of Hard Clams has ecosystem service value similar to wild stocks. Hard Clams maintain the capacity to filter large volumes of water. Depending on the ploidy of Hard Clams in culture, environmental conditions, and the duration of grow out, shellfish aquaculture may provide an additional source of larvae for habitat enhancement. However, currently there are limited seed producers in North Carolina, potentially hindering the growth of clam aquaculture.

### CLAM RESTORATION EFFORTS IN OTHER STATES

Although a majority of shellfish restoration efforts have focused on oysters, a few recent projects have looked at effective strategies for enhancing depleted clam populations along the east coast. The cost-effectiveness of various methods has been investigated, including the use of spawner sanctuaries, planting seeded shell, and larval release in shallow lagoons of New York and Florida (Arnold et al. 2002; Doall et al. 2009; Gobler et al. 2022). Among these strategies, spawner sanctuaries appear to have had the most success. This strategy, as suggested by Peterson (2002), takes advantage of the long lifespan and sustained reproductive output of *M. mercenaria*.

A study conducted in Shinnecock Bay, along Long Island, New York observed the 9-year impact of transplanting 3.2 million adult Hard Clams and placing them in high-density no-take spawner sanctuaries (Gobler et al. 2022). Compared to neighboring lagoons during the same time period, Shinnecock Bay saw a 16-fold increase in landings of clams, in addition to significant decreases in harmful algae density and chlorophyll A concentration and a significant net gain in seagrass habitat (Gobler et al. 2022). While other projects testing the spawner sanctuary strategy had mixed results, their takeaways highlighted the importance of suitable environmental conditions using healthy adult clams. For instance, shallow water (< 2 m), higher DO, higher temperatures, and higher salinity (> 20 psu) likely all play a significant role in both the ability of adult clams to recondition between spawning years, as well as survivability and recruitment of larvae (Castagna & Chanley 1973; Doall et al. 2009; Arnold et al. 2002; Gobler et al. 2022).

Therefore, careful consideration of environmental variables must occur during site selection for any possible clam restoration projects. While both oysters and clams have similar ecological roles as filter feeders in shallow water estuaries, each has specific physiological tolerances and environmental needs. Oysters can survive a wide range of environmental conditions, while clams have a narrower tolerance of environmental variables and are not constrained to the tidal column upper limits (Galimany et al., 2017). Furthermore, researchers have placed considerable emphasis on the necessity of long-term monitoring surveys (similar to protocols used for NC's Oyster Sanctuary Program) following any restoration efforts involving *M. mercenaria* (Simpson et al. 2022).

## Environmental Factors, Threats, and Alterations

### PHYSICAL THREATS

*Mobile Bottom Disturbing Fishing Gear*

Goal 3 of the 2016 CHPP is to "enhance and protect habitats from adverse physical impacts," which includes reducing the impacts of mobile bottom disturbing fishing gear, the negative effects of which are described in detail in Section 8.1.1 of the 2016 CHPP. Soft bottom habitat, because of its low structure and dynamic nature, has historically been considered the most appropriate location to use bottom disturbing gear. NCMFC rules restrict bottom disturbing gears in designated soft bottom habitat. Fishing gears with the greatest potential to damage soft bottom include dredges and trawls. Of the threats to structured clam habitat, physical disturbance from mechanical harvest of clams and oysters is the most obvious. Impacts of mechanical harvest on unstructured, soft bottom sediments are less studied, and the 2021 CHPP (NCDEQ 2021) highlights the need for increased monitoring of the condition of North Carolina's estuarine soft bottom habitat with regards to chemical and microbial contaminants and benthic macroinvertebrate communities. Recommended Action (RA) 8.6 in the 2021 CHPP (expansion of DWR's benthic macroinvertebrate sampling to estuaries) could directly contribute to a better understanding of the impacts of bottom disturbing gear on soft bottom habitats, and RA 8.1 (convene an expert workgroup to document data gaps and monitoring needs) and RA 8.2 (develop an ecosystem condition report) will provide a roadmap to better understanding impacts to Hard Clam habitats. For more in depth information on mobile bottom disturbing fishing gear, see the Mechanical Harvest Issue Paper.

*Hand Harvest Methods*

Intensive hand harvest methods can be destructive to oyster rocks. The harvest of clams or oysters by tonging or raking on intertidal oyster beds causes damage not only to living oysters but also to the cohesive shell structure of the reef (Lenihan and Peterson 1998). This destruction has been an issue where oysters and Hard Clams co-exist, primarily around the inlets in the northern part of the state and on intertidal oyster beds in the south (NCDMF 2001a). For more history on hand harvest methods, see Amendment 2 of the Hard Clam FMP.

**WATER QUALITY THREATS**

Marine bivalves, including oysters, have been shown to accumulate chemical contaminates, such as hydrocarbons and heavy metals, in high concentrations. Reductions in growth and increased mortality have been observed in soft-shelled clams (*M. arenaria*) following oil spill pollution events (Appeldoorn 1981). Impaired larval development, increased respiration, reduction in shell thickness, inhibition of shell growth, and general emaciation of tissues have been attributed to adult bivalve exposure to heavy metal contamination (Roesijadi 1996).

High concentrations of organic contaminates also result in impairment of physiological mechanisms, histopathological disorders, and loss of reproductive potential in bivalves (Capuzzo 1996). As shellfish can easily accumulate chemical pollutants in their tissues, consumption of impaired shellfish can create a health risk. Subsequently, shellfish closures occur due to chemical contamination, commonly associated with industry, marinas, and runoff.

Delivery of inorganic pollutants, organic contaminants, and harmful microbes to waterways occurs via both point and non-point sources. The accumulation of such harmful agents in the water column subjects oyster populations to the adverse effects listed above. Point sources have identifiable origins and include National Pollution Discharge Elimination System (NPDES) wastewater discharges. Although wastewater discharges are treated, mechanical failure can allow contaminated sewage to reach shellfish growing waters, thereby triggering an area to be closed to harvest.

Non-point sources of microbial contamination include runoff from animal agriculture operations and urban development. Animal agriculture produces waste with fecal bacteria, runoff from pastures, concentrated animal feeding operations (CAFOs), and land where CAFO waste has been applied as manure, all of which can be transported to surface waters and subsequently lead to shellfish restrictions (Wolfson and Harrigan 2010; Burkholder et al. 2007; Hribar 2010). Impervious surfaces (e.g., roads, roofs, parking lots) facilitate runoff and microbe transportation, facilitating significant water quality degradation in neighboring watersheds (Holland et al. 2004). For instance, in New Hanover County, an analysis of the impact of urban development showed that just 10–20% impervious cover in an area impairs water quality (Malin et al. 2000). In North Carolina, most CAFOs primarily house swine and poultry with a majority located in the coastal plain portions of the Cape Fear and Neuse River basins; however, both occur in all basins across the coastal plain (NCDWR 2024; Off 2022).

*Hypoxia*

Point and non-point sources (developed and agricultural lands) are also sources of increased nutrient loads, which fuel phytoplankton growth and increase the strength and frequency of algal blooms. The eventual bacterial decomposition of these blooms results in a depletion of dissolved oxygen levels that can be dangerous to shellfish, particularly in warm, deep waters. Increased eutrophication leads to decreased oxygen levels (hypoxia and anoxia), which North Carolina's estuaries can already be prone to because of salinity stratification and high summertime water temperatures (Buzzelli et al. 2002). These low-oxygen events degrade the usability of subtidal oyster reef habitats for fish (Eby and Crowder 2002) and cause high rates of oyster mortality in the deeper (4–6 m) waters of the estuaries (Lenihan and Peterson 1998; Powers et al. 2009; Johnson et al. 2009). Increased state action to limit nutrient loading from urban and agricultural lands is critical for reducing hypoxia impacts to estuarine habitat and resources, including oysters and the reefs they create (NCDWR 2024).

**CLIMATE CHANGE**

According to North Carolina's 2020 Climate Science Report (Kunkel et al. 2020), the intensity of hurricanes is likely to increase with warming temperatures, which will result in increased heavy precipitation from hurricanes. Additionally, it is likely the frequency of severe thunderstorms and the annual total precipitation in NC will increase. The expected increase in heavy precipitation events will lead to increased runoff, which will result in an increase in chemical and microbial pollutants transferred to clam habitats. Recent research has provided evidence that negative impacts from increased precipitation and pollutant delivery to estuaries have already begun in North Carolina (Kunkel et al. 2020; Paerl et al. 2019).

For instance, Paerl et al. (2020) investigated the impact of tropical cyclones on nutrient delivery and algal bloom occurrences in the Neuse River Estuary and Pamlico Sound. They found high-discharge storm events, such as high-rainfall tropical cyclones, can double annual nutrient loadings to the estuary, leading to increased nutrients and dissolved organic carbon. Phytoplankton response to moderate storm events is immediate, while during high-rainfall events like Floyd (1999), Matthew (2016), Florence (2018), and Dorian (2019) phytoplankton growth is diverted downstream to Pamlico Sound, where it can persist for weeks. Additionally, increased organic matter and phytoplankton biomass from heavy rainfall events contribute to oxygen depletion, exacerbating hypoxic and anoxic conditions in the Neuse River and Pamlico Sound.

Additionally, warming water temperatures caused by climate change may benefit growth rates for pathogens that can negatively impact resources. For instance, increased water temperatures have been linked to increasing abundance of the bacterium, *Vibrio*, over the past 60 years (Vezzulli et al. 2016). This is a significant public health issue and can disrupt shellfish markets, as *Vibrio* species get taken up by filter-feeding shellfish and can cause life-threatening illness when consumed. Common wisdom in North Carolina has advised against consuming raw shellfish in the warm-water months for this reason, and rising water temperatures threaten to increase this risk, potentially through longer periods of the year.

In addition to causing hypoxia, the enhanced phytoplankton growth resulting from increased rainfall and nutrient delivery to estuaries will also result in negative impacts to SAV habitat. The majority of SAV loss in North Carolina has been attributed to decreases in light availability due to increased eutrophication (nutrient enrichment) and suspended sediments, and those losses are expected to increase as eutrophication increases due to climate change (NCDEQ 2021). Further, North Carolina's dominant high-salinity SAV species, Eelgrass (*Zostera marina*), is already growing at the warmest edge of its thermal tolerance in NC, regularly experiencing stressful temperatures that affect growth and reproduction. While the response of eelgrass to increased water temperatures is complex, and the species may be more resilient in North Carolina than other states (Bartenfelder et al. 2022), projections of shifts in the range of eelgrass due to warming waters indicate that the species' southern limit is likely to move northward and potentially out of North Carolina altogether by 2100 (Wilson and Lotze, 2019).

To reduce the negative impacts of climate change on the Hard Clam fishery, it will be important for state agencies to implement policies that encourage the use of agriculture, forestry, and urban stormwater best management practices (BMPs) to reduce the amount of runoff reaching North Carolina's estuaries. This need, among others, has been emphasized in the CHPP as recommended actions to improve water quality. While the MFC has little direct control over such actions to mitigate the impacts of increased runoff, it can continue to support them through its role in developing and approving the CHPP, coordinating the efforts of the Environmental Management Commission, the Coastal Resources Commissions, and their respective state agencies to continue trying to improve water quality for fish habitats.

### WATER QUALITY MANAGEMENT THROUGH THE CHPP

Improved water quality has been a component of all editions of the CHPP, and the 2021 CHPP included a specific focus on improving water quality to protect SAV habitat, which will directly benefit the clam fishery. The 2021 CHPP proposed to follow the successful examples of management in Chesapeake Bay and Tampa Bay with a five-element strategy that includes 1) supporting efforts to improve water quality; 2) protecting and restoring SAV; 3) enhancing SAV research and monitoring; 4) improving collaboration through citizen involvement, education and outreach; and 5) addressing other contributing factors such as physical disturbance and climate change.

The 2021 CHPP's SAV protection recommendations heavily emphasize the first element, and NCDWR staff have led the Nutrient Criteria Development Process (NCDP), with collaboration from other DEQ divisions, including NCDMF habitat and enhancement staff. Because the EMC's current chlorophyll and turbidity standards are not enough to protect SAV from light limitation, the 2021 CHPP placed increased emphasis on developing new standards and updating current but deficient standards to improve water quality to protect and restore SAV. To address that, the NCDP team has developed a water clarity standard, as poor clarity is what prevents light from reaching SAV beds, and DWR staff are beginning the process of bringing the proposed standard to the EMC within the next year. There are many potential pitfalls along the way, but if the approval process is successful, it will take approximately a year.

From there, it will take until the 2030 biennial update to the North Carolina Integrated Report (303d list), which identifies which water quality parameters are exceeded in which of the state's waterbodies, to have enough data to assess waterbodies as impaired for clarity. An impairment listing on the 303d list triggers the need to develop a Total Maximum Daily Load, or TMDL, (or another approved alternative). TMDL development also identified sources and causes of water quality degradation so that restoration efforts can target the appropriate issues (common causes are detailed in the 2021 CHPP, but include increased freshwater input and nutrient delivery from impervious surfaces, agriculture, and wastewater, among others).

Following TMDL development, then on-the-ground restoration work would begin to start improving water clarity, so the earliest potential improvements from this effort may occur in the early 2030s. The timeline of this effort is not short, but it represents the best opportunity for statewide restoration of SAV habitat through improving water quality, which will also reduce the frequency of shellfish harvest closures and provide benefits to other habitats like oyster reefs by reducing nutrient pollution and the severity of hypoxic events.

The 2026 update to the CHPP will consider progress made in this process and provide further recommendations to advance this process and other avenues for improving water quality in North Carolina's estuaries through collaboration with DWR, DCM, and other state agencies with direct jurisdiction over issues driving water quality degradation.

**ENVIRONMENTAL PATHOGENS**

There are various environmental pathogens that can impact shellfish and those that consume shellfish. These pathogens include Neurotoxic Shellfish Poisoning (NSP), *Vibrio*, and Green Gill.

Neurotoxic Shellfish Poisoning (NSP) is a disease caused by consumption of molluscan shellfish contaminated with brevetoxins primarily produced by the dinoflagellate, *Karenia brevis*. Blooms of *K. brevis*, called Florida red tide, occur frequently along the Gulf of Mexico. Ocean currents have transported *K. brevis* blooms up the Atlantic coast and has been carried to North Carolina, which accounted for the red tide event and NSP outbreak in 1987 (Watkins et al. 2008).

*Vibrio* spp are salt loving bacteria that inhabit coastal waters throughout the world, and with the exception of toxigenic *Vibrio cholera* 01, are not usually associated with pollution that triggers shellfish closures and can be ubiquitous in open shellfish growing areas. Vibrios are more common during the warmer summer months and are found throughout the coastal waters of North Carolina (Blackwell and Oliver 2008; Pfeffer et al. 2003).

Green gill in clams comes from the single-celled alga called *Haslea ostrearia.* This is a blue-green diatom found in the coastal waters of North Carolina. For more detailed information on these environmental pathogens, see Amendment 2 of the Hard Clam FMP.

#### SHELLFISH SANITATION

The NCDMF has a contingency plan in place as required by the FDA, including a monitoring program (National Shellfish Sanitation Program, NSSP) and management plan. The purpose is to ensure quick response of any harmful algal species within State waters that may threaten the health and safety of shellfish consumers. The plan also details the system to provide early warning of any potential issues, actions to be taken to protect public health and steps to reopen areas to harvest. (Shellfish Sanitation and Recreational Water Quality Section Marine Biotoxin Contingency Plan 2022). Shellfish Sanitation and Marine Patrol are the primary Sections of NCDMF responsible for North Carolina's compliance with the NSSP.

The Shellfish Sanitation Section classifies shellfish growing areas and recommends closures and re-openings to the Director that are implemented by proclamation. The entire North Carolina coast is divided into a series of management units that are referred to as Growing Areas. Each of these Growing Areas is individually managed to determine which portions of the area are suitable for shellfish harvest, and which need to be closed to harvest. Data collected and used in classifying Growing Areas include actual and potential pollution sources, rainfall and runoff impacts, physical hydrodynamic patterns, and bacteriological water quality.

Shellfish growing waters can be classified as "Approved", "Conditionally Approved", "Restricted", or "Prohibited". Approved areas are consistently open to harvest, while Prohibited areas are off limits for shellfish harvest. Conditionally Approved areas can be open to harvest under certain conditions, such as dry weather when stormwater runoff is not having an impact on surrounding water quality, and Restricted waters can be used for harvest at certain times as long as the shellfish are subjected to further cleansing before they are made available for consumption. For a map of both temporary and permanent closures, please visit the Interactive Shellfish Closure Map on NCDMF's Shellfish Sanitation website. Additional information can be found under Current Polluted Area Proclamations.

### Protected Species

A "protected species" is defined as any organism whose population is protected by federal or state statute due to the risk of extinction. In North Carolina, these species are primarily protected by the following federal statues: the Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and the Migratory Bird Treaty Act (MBTA). The primary marine mammal that occurs in North Carolina estuaries is the common Bottlenose Dolphin (*Tursiops truncatus*; Hayes 2018) though the West Indian Manatee (*Trichechus manatus*) seasonally occurs during warm water months (Cummings et al. 2014). The NMFS splits this fishery into two distinct Category III fisheries: the Atlantic Shellfish Bottom Trawl fishery and the Atlantic Ocean, Gulf of Mexico, Caribbean shellfish dive, hand/mechanical collection fishery. The Category III designations indicate there are no known gear interactions with marine mammals. More information on the MMPA List of Fisheries and fisheries categorizations can be found on the National Oceanic and Atmospheric Administration (NOAA) MMPA website.

North Carolina estuaries are also home to multiple ESA-listed species including the Green Sea Turtle (*Chelonia mydas*), Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Loggerhead Sea Turtle (*Caretta caretta*), Leatherback Sea Turtle (*Dermochelys coriacea*), Hawksbill Sea Turtle (*Eretmochelys imbricata)*, Atlantic Sturgeon (*Acipenser oxyrinchus*), and Shortnose Sturgeon (*Acipenser brevirostrum*). These species are unlikely to be impacted as harvest methods employed largely exclude any potential for direct interactions. Due to the lack of recorded interactions and the unlikelihood of any interactions between these ESA-listed species and the clam industry, it can be assumed that any potential impacts of Hard Clam harvest on protected species populations would be primarily indirect and at the ecosystem-level.

North Carolina is home to a diverse array of migratory bird species (Potter et al. 2006). Overall, there is little evidence to suggest that any Hard Clam harvest method impacts MBTA-protected species. Some research suggests that hand and rake harvest of clams has a negligible effect on certain species of shorebirds (Navedo and Masero 2008).

## FINAL AMENDMENT THREE MANAGEMENT STRATEGY

The NCMFC selected management measures

### APPENDIX 1: CLAM MECHANICAL HARVEST ISSUE PAPER

Option 1: Mechanical Clam Harvest

d. Phase out mechanical clam harvest in three years (May 2028) to be consistent with G.S. 113-221 (d).

Option 2: Mechanical Clam Harvest in Conjunction with Maintenance Dredging

b. Discontinue allowance for mechanical clam harvest in conjunction with maintenance dredging upon adoption of this plan

### APPENDIX 2: RECREATIONAL SHELLFISH HARVEST ISSUE PAPER

Option 1: Recreational Harvest

b. 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.

## MANAGEMENT FROM PREVIOUS PLANS

There are management measures from the original FMP to carry forward into Amendment 3 unless otherwise changed in Amendment 3. Management measures from the Hard Clam FMP Amendment 2 that will be carried forward into Amendment 3 are listed below:

- Daily harvest limit for recreational purposes is 100 clams per person per day not to exceed 200 per clams per vessel per day.
- Maintain shading requirements for clams on a vessel, during transport to a dealer, or storage on a dock during June through September. These requirements would be implemented as a public health protection measure under 15A NCAC 03K .0110.
- Maintain management of the Ward Creek Shellfish Management Area as described in the Hard Clam FMP Amendment 1.
- Maintain current daily mechanical Hard Clam harvest limits by waterbody (Table 1).
- Institute a resting period within the mechanical clam harvest area in the northern part of Core Sound.
- Take latitude/longitude coordinates of the poles marking the open mechanical clam harvest area boundary in the New River, still with the flexibility to move a line to avoid critical habitats.
- Maintain management of the mechanical clam harvest in existing areas from Core Sound south to Topsail Sound, including modifications to the mechanical clam harvest lines to exclude areas where oyster habitat and SAV habitat exist based on all available information.

## RESEARCH NEEDS

The research recommendations listed below are offered by the NCDMF to improve future management strategies of the Hard Clam fishery. They are considered high priority as they will help to better understand the Hard Clam fishery and meet the goal and objectives of the FMP. This list of research recommendations is also provided in the Annual FMP Review and NCDMF Research Priorities documents.

- Develop Hard Clam sampling methodology to monitor regional adult abundance
- Map and characterize Hard Clam habitat use by bottom type
- Develop a survey to better quantify recreational harvest
- Determine natural morality estimates
- Investigate causes of recent clam-kills and overall decline in Hard Clam abundance in the New River

# APPENDICES

## Appendix 1: Clam Mechanical Harvest Issue

### ISSUE

The number of participants and trips in the mechanical clam fishery on public bottom have steadily declined since the 1990s to the lowest levels on record. This, along with habitat concerns associated with bottom disturbing gears, as well as significant cost to the state for management of this fishery, has led the North Carolina Division of Marine Fisheries (NCDMF) to re-examine if this fishery should still be allowed to operate.

### ORIGINATION

The NCDMF

### BACKGROUND

*Historical Importance*

Historically, harvest of Hard Clams by mechanical methods from public bottom made up a significant portion of the commercial Hard Clam landing on public bottom from its advent in the mid-1940s all the way through the early-2010's. As detailed in the Status of the Fishery section, mechanical harvest of Hard Clams began as a rudimentary version of dredging where boat propellers were used to blow sediment away and expose Hard Clams for hand harvest. This evolved through time into the modern methods of escalator dredging and clam trawling we see today (see Mechanical Harvest subsection of the Status of the Fishery section).

Historical mechanical harvest data are sparse until 1950 when commercial reporting became more regular. The mechanical harvest in the early 1950s was massive compared to recent decades, exceeding 35 million Hard Clams in 1951 (Figure 1.1). This period of high landings was followed by a steep decline in landings that lasted until the late 1960s. An increase in demand for North Carolina Hard Clams was created during the 1976–1977 season, when Hard Clam beds in the northeastern states became inaccessible due to abnormally thick ice. This period marked another large increase in mechanical harvest that would last into the mid-1980s. Since the late 1980s, Hard Clam landings have declined. This decline is likely the result of a decrease in abundance, increased closures of shellfish waters from pollution, changing market demand, several major storms, and a red tide event in 1987.

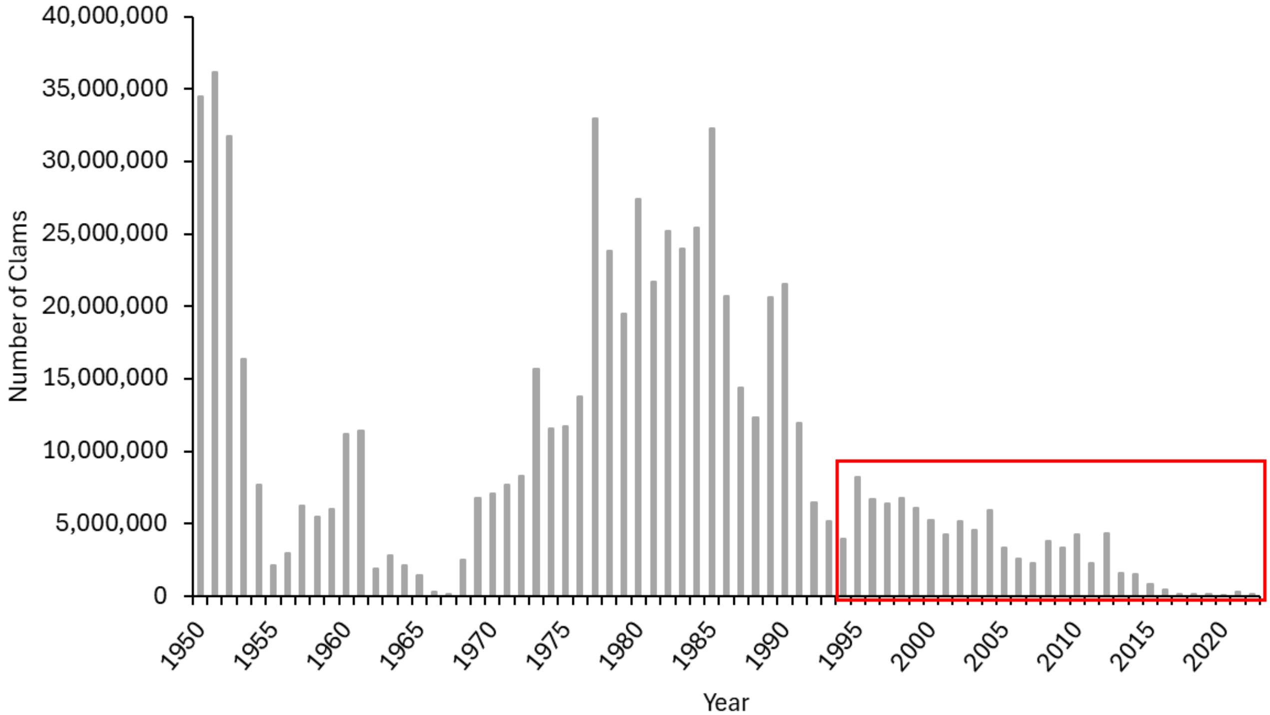



Figure 1.1. Hard Clam landings (number of clams) using mechanical gears on public bottom by year, 1950–2022. TTP data are presented in the red box.

Since 1994, the mechanical Hard Clam fishery has seen a steady decline in landings and participation to its lowest levels since clam trawls were first used in the late 1960s (Figure 1.1). Landings from this fishery have declined from a maximum harvest of over 8.7 million Hard Clams in 1995, to a level that has remained below 100,000 Hard Clams per year from 2017 to 2022. The precipitous decline in landings is mirrored by a similar decline in participation over the same period. In 1996, the fishery maxed out at 138 participants. Over the next two and a half decades, participation quickly waned with less than 10 participants per year active in the fishery from 2019 to 2022 (Figure 1.2).

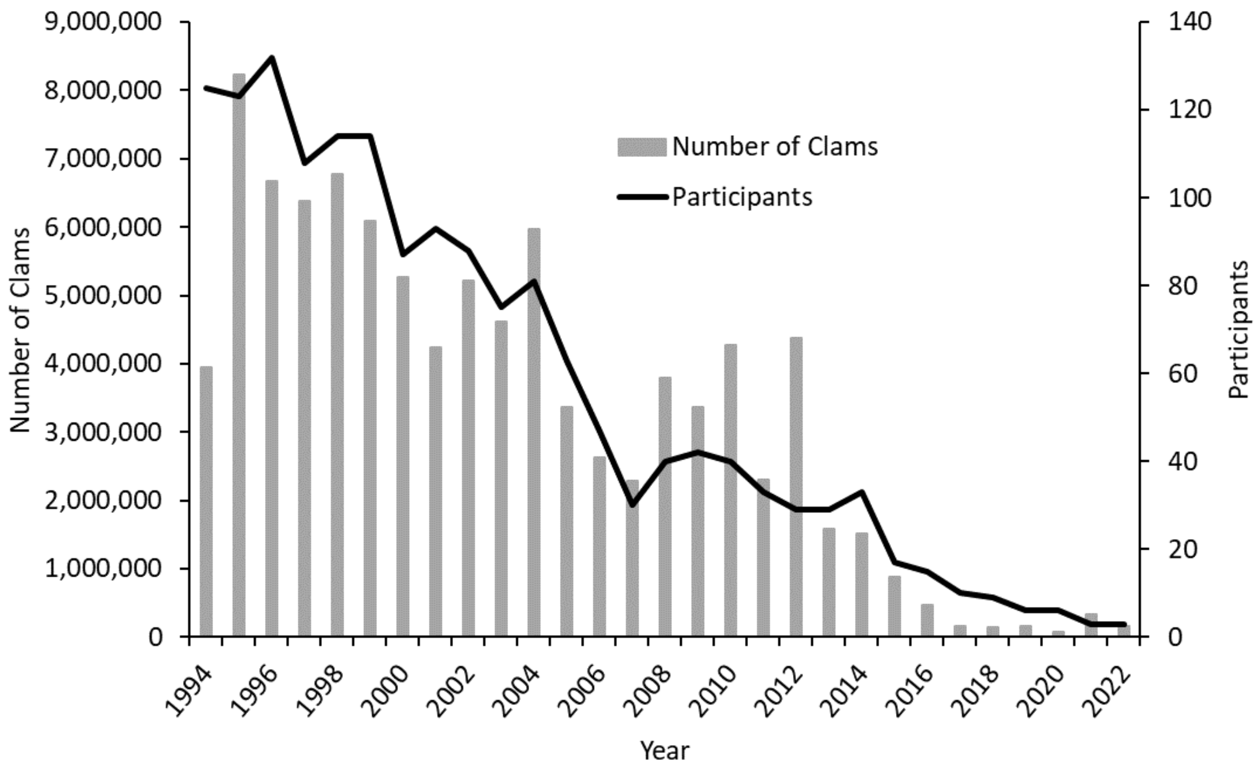



Figure 1.2. Hard Clam landings (number of clams) and number of participants using mechanical gears on public bottom by year, 1994–2022.

As detailed in the Status of the Fishery section, the mechanical Hard Clam harvest season can occur from December 1 through March 31 and is opened by proclamation in specific areas. These areas are limited to what is defined in Amendment 2. These areas include portions of Core Sound, North River, Newport River, Bogue Sound, White Oak River, New River, New River inlet, and the IWW in Onslow and Pender Counties. These areas can be reduced but cannot be expanded beyond what is outlined in Amendment 2. Since 1994, the New River and Core Sound have accounted for over 80% of the total mechanical Hard Clam harvest from 1994–2022 (Figure 1. 3). The New River was the most important waterbody for mechanical harvest from 2000 to 2016, before being overtaken by Core Sound. The New River has seen a consistent decline in overall contribution to the landings since 2012, except for 2020 which had extremely low landings overall because of the COVID-19 pandemic. The consistent decline is primarily due to a series of clam kill events that occurred in the 2010s, which decimated the population within New River, and caused fishermen to move to new waterbodies or transition to other fisheries.

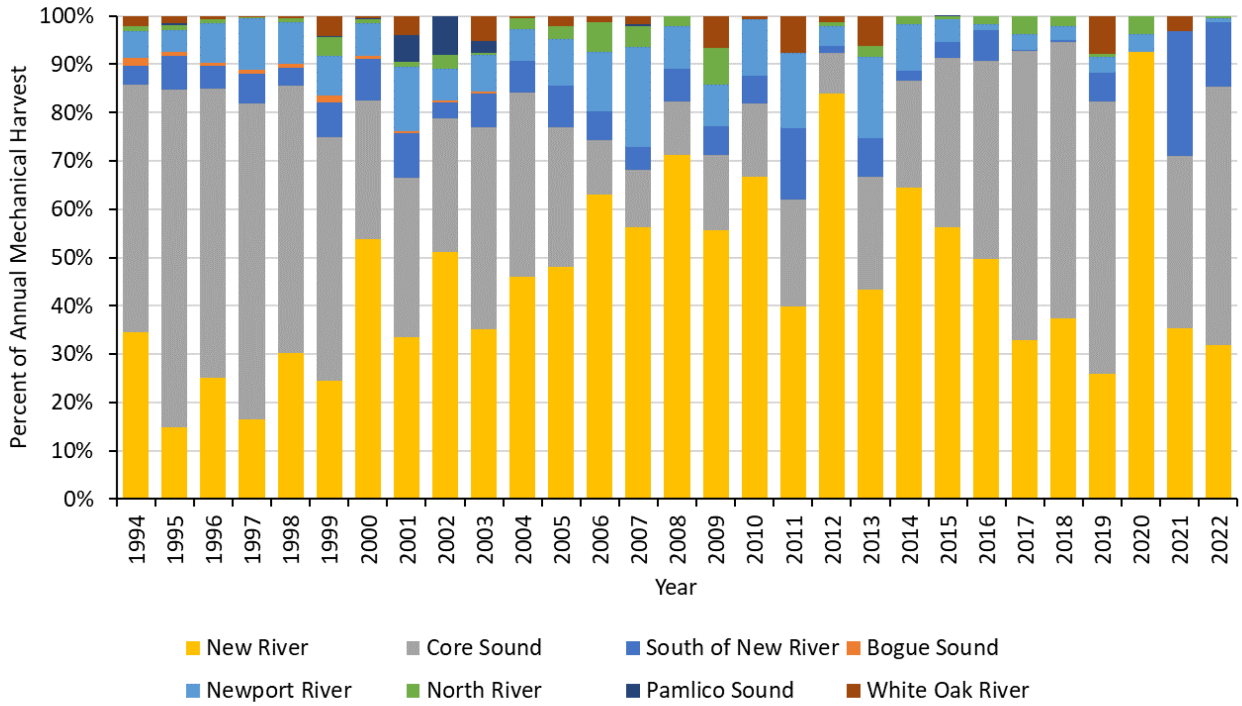



Figure 1.3. Percentage of annual mechanical Hard Clam harvest on public bottom by waterbody and year, 1994–2022.

*Enforcement*

Each year the NCDMF marks all the mechanical clam harvest area boundaries with posts and signs (except for the New River) to ensure enforceability of these boundaries. The staff must replace all missing or damaged posts and signs affected by weather or vandalism. The loss of posts and signs can be significant in years with major weather events such as hurricanes.

In addition to the significant cost and staff time associated with marking the mechanical harvest areas, a large force of Marine Patrol officers is required to monitor and enforce these areas. Normally, each harvest area will have several officers watching the lines with a couple on standby with vessels in case there is a violation. Then when the vessels start returning to the docks, it takes several officers to complete an inspection (i.e., count the Hard Clams, check licenses, and maintain security while counting the Hard Clams). The large volume of Hard Clams caught from these operations requires a good deal of Marine Patrol manpower, especially when several vessels return to the docks at the same time. In Core Sound, the vast area encompassed by the mechanical clam harvest area, along with its zig-zagging boundary makes enforcement difficult and resource intensive.

*Maintenance Dredging*

The NCDMF also allows the harvest of Hard Clams by mechanical means before maintenance dredging occurs in some navigational channels through NCMFC Rule 15A NCAC 03K .0301 (b). The purpose of this is to allow commercial fishermen access to a resource that would otherwise be destroyed during the maintenance dredging process. The execution of opening an area prior to maintenance dredging requires communication and collaboration between the NCDMF, Army Corps of Engineers (ACE), and the fishermen requesting access to mechanically harvest within the proposed dredge area. Late notice by fishermen, difficulty in communication with ACE, and the time to prepare and process proclamations to open areas have been major obstacles to this program since its inception in 1991. Due to the complicated process and limited interest from mechanical harvesters, no openings for mechanical harvest in proposed maintenance dredging areas have occurred since 2007.

### AUTHORITY

N.C. General Statutes

| | |
|---|---|
| 113-134 | Rules. |
| 113-182 | Regulation of fishing and fisheries. |
| 113-182.1 | Fishery Management Plans. |
| 113-201 | Legislative findings and declaration of policy; authority of Marine Fisheries Commission. |
| 113-221.1 | Proclamation; emergency review. |
| 143B-289.52 | Marine Fisheries Commission – powers and duties. |

N.C. Marine Fisheries Commission Rules (15A NCAC)

| | |
|---|---|
| 03K .0302 | Mechanical Harvest of Clams from Public Bottom |

### DISCUSSION

The NCDMF recommends consideration of options to further reduce, phase out, or eliminate the mechanical clam harvest fishery due to habitat concerns with mechanical gears, declining participation in a fishery that lands just 0.1% of its historical catch, and significant cost to the state for monitoring and enforcement.

*Habitat Concerns*

Goal 3 of the 2016 CHPP is to “enhance and protect habitats from adverse physical impacts,” which includes reducing the impacts of mobile bottom disturbing fishing gear, the negative effects of which are described in detail in Section 8.1.1 of the 2016 CHPP. Under Goal 3, the primary relevant recommended actions are 3.3 “Protect habitat from adverse fishing gear effects through improved compliance” and 3.8 “Develop coordinated policies including management adaptations and guidelines to increase resiliency of fish habitat to ecosystem changes." The management options presented in this issue paper support those recommended actions by simplifying compliance and contributing to the

CHPP's comprehensive management strategy of managing both physical and water quality impacts to improve habitat resilience.

Summarizing information compiled in the 2016 CHPP, impacts from mobile bottom-disturbing fishing gear range from changes in community composition from removal of species to physical disruption of the habitat (Barnette 2001). Corbett et al (2004), found an increase in total suspended sediment 1.5 – 3 times above background concentrations for less than a day, and minor impacts on nutrient and chlorophyll a concentrations. Wind played a greater role in mixing the water column and altering its nutrient and sediment characteristics. Bottom trawls, dredges, and other mobile gears can cause rapid and extensive physical damage to hard bottom habitat (e.g. Auster and Langton 1999; SAFMC 1998). Habitat complexity is reduced through flattening of mounds, filling of depressions, dispersing shell hash, and removing small biotic cover such as hydrozoans and sponges (Auster et al. 1996; Løkkenborg 2005). Auster and Langton (1999), ASMFC (2000), and Collie et al. (2000) discussed impacts of fishing gears on SAV. Belowground effects, such as those from toothed dredges, heavy trawls, and boat propellers, may cause total loss of SAV, requiring months to years to recover. Excessive sedimentation from bottom disturbing fishing gear and propeller wash can bury SAV. Because of the severe bottom impacts, the MFC restricts use of this gear to open sand and mud bottoms, including areas frequently dredged for navigation, such as the AIWW, disallowing it in SAV and oyster habitats. Clam trawling, or kicking, began in Core Sound as a method involving the scouring of bottom sediment with a prop wash while towing a trawl. Anecdotal accounts indicate significant negative impacts occurred to oyster rocks prior to marking and closing areas to mechanical harvest of clams. As part of CHPP implementation, the area allowed for clam kicking was modified by proclamation to clearly avoid all SAV and oyster beds and to establish a buffer of 50–100 feet between the gear and structured habitats.

Fishing related impacts to habitat have been reviewed and compiled in fishery management plans and have been summarized in documents produced by the South Atlantic Fisheries Management Council (SAFMC), Mid-Atlantic Fisheries Management Council (MAFMC), N.C. Moratorium Steering Committee (MSC 1996), Auster and Langton (1999), NCDMF (1999), and Collie et al. (2000). Gears with the greatest potential for damage to soft bottom include dredges and trawls. However, research suggests that neither activity has a significant effect on clam recruitment (Auster and Langton 1999; NCDMF 1999; Collie et al. 2000). Dredges and trawls have a greater impact on structured habitat where clams are more abundant. Oyster rocks and cultch plantings provide excellent habitat for Hard Clam settlement and growth in areas where salinity regimes and water flow are suitable for survival. Hard Clam harvesting in oyster rocks involves overturning or sifting through shells and oysters overlying clams, possibly damaging the oysters. For this reason, oyster rocks are protected from mechanical harvest of clams and bull rakes by rule (Marine Fisheries Commission Rules 15A NCAC 03K .0304 and 03K .0102). Most harvesting of clams in relation to oysters occurs around the base of the beds where they are most abundant (Noble 1996). Clams are also harvested by mechanical methods using either hydraulic escalator dredge or clam trawl. Current fisheries regulations prohibit the use of mechanical gear in SAV beds and live oyster beds because of the destructive capacity of the gear. Mechanical harvest of clams is now only allowed in designated harvest areas that do not contain significant SAV or oyster resources. In the 20-year period analyzed in the 2016 CHPP, trips for mechanical harvest of clams made up 18% of all trips using mobile bottom-disturbing fishing gears; however, that percentage had decreased to 6% of all trips by the terminal year of the analysis (2013), largely attributed to changes in regulations regarding gear restriction areas for mechanical harvesting of clams.

In accordance with the CHPP (e.g. 2016 CHPP action 3.3: protect habitat from adverse fishing gear effects through improved compliance), the NCDMF has already reduced the allowable mechanical clam harvest areas in the state due to concerns over encroachment with oysters and overlap with SAV beds. Beginning in 2008, the NCDMF discontinued the Pamlico Sound area in rotation with the northern Core Sound area and instituted an annual resting period between northern Core Sound and the southern Core Sound areas due to limited harvest and concerns over impacts to the crab fishery in the area (NCDMF 2017). From 2019–2020 (north of Bogue Inlet; APNEP 2022) and 2021 (south of Bogue Inlet; NCDMF 2022), a comprehensive study was conducted to map SAV beds across the state. The SAV maps generated from this study were overlayed onto the mechanical clam harvest area maps to look for areas of overlap. Significant overlap was identified in four of the harvest areas including Core Sound, North River, Bogue Sound, and New River. The mechanical clam harvest areas were then adjusted to eliminate overlap and provide a suitable buffer. An example of this overlap and subsequent area modification in 2020 for North River can be seen in Figure 1. 4. Due to the large extent of overlap with SAV, the entire mechanical clam harvest area in Bogue Sound was eliminated in 2020 (Figure 1. 5).

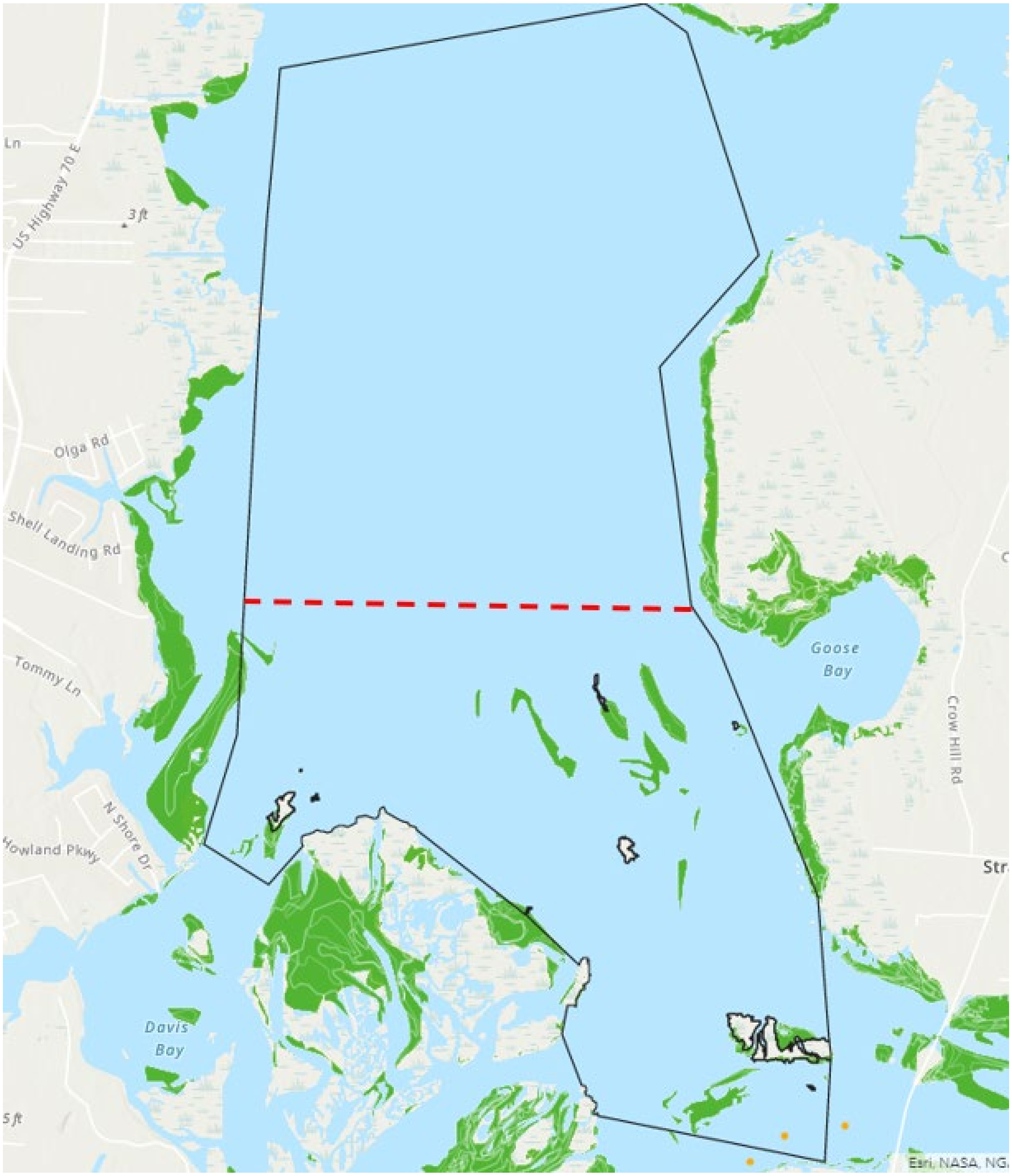



Figure 1.4. Map of the original North River mechanical clam harvest area (black line) overlaid with SAV mosaic (in green; APNEP 2022) to show SAV overlap. The dotted red line is where the new southern area boundary was established in 2020.


Figure 1.5. Map of the original Bogue Sound mechanical clam harvest area (black line) overlaid with SAV mosaic (in green; APNEP 2022) to show SAV overlap. This area was closed to mechanical clam harvest in 2020 due to the large extent of SAV overlap.

Organisms in soft bottom habitat are adapted to shifting and changing sediments. However, when sedimentation is excessive, there can be negative impacts. In addition to direct physical damage to the shell mound structure, bottom disturbing fishing gear, including hydraulic clam dredges, clam trawls (kickers), and shrimp and crab trawls can impact clam beds and oyster reefs indirectly by re-suspending sediment. High levels of suspended sediment in an estuarine or marine habitat can reduce successful settlement of larval clams and oysters and can smother other benthic invertebrates (Coen et al. 1999; AFS 2003). Excessive sedimentation can also harm shellfish by clogging gills, increasing survival time of pathogenic bacteria, or increasing ingestion of non-food particles (SAFMC 1998). Water column sediments can increase survival of fecal coliform bacteria in waterways (Schueler 1999), and while fecal coliform bacteria do not affect the viability of clams or oysters, pathogenic bacteria can make shellfish unfit for human consumption.

*Socioeconomic Analysis*

Commercial landings and effort data collected through the DMF trip ticket program are used to estimate the economic impact of the commercial fishing industry. For commercial fishing output, total impacts are estimated by incorporating modifiers from NOAA's Fisheries Economics of the United States reports from 2012–2020 (National Marine Fisheries Service 2023), which account for proportional expenditures and spillover impacts from related industries. By assuming the mechanical clam harvest commercial fishery's economic contribution is a proportion equal to its contribution to total commercial ex-vessel values, we can generate an estimate of the economic contribution of the clam mechanical harvest fishery statewide.

From 2012 to 2022, clam mechanical harvest on public bottom economic sales contributions have varied from a high of $960,000 in 2012 to a low of approximately $62,000 in 2020 and supported between 41 and 4 jobs annually. Annual sales impacts and number of trips have consistently declined over the past decade, notably dropping sharply in 2017 and again in 2020 (Table 1.1.). The industry expanded in 2021, and to a lesser extent in 2022, but has not returned to pre-2016 landings or participation which has steadily declined over the period (Table 1.1.).

Table 1.1. Annual economic contributions from the clam mechanical harvest commercial fishery to the state of North Carolina from 2012–2022 reported in 2022 dollars. * Indicates confidential data

| Year | Trips | Participants | Ex-Vessel Value | Job Impacts | Income Impacts | Value Added Impacts | Sales Impacts |
|---|---|---|---|---|---|---|---|
| 2022 | 41 | 3 | < $75,000* | 4 | $44,522 | $92,392 | $105,235 |
| 2021 | 72 | 3 | < $75,000* | 5 | $32,630 | $149,882 | $175,563 |
| 2020 | 32 | 6 | $18,891 | 7 | $29,053 | $53,201 | $62,685 |
| 2019 | 40 | 6 | $32,992 | 8 | $53,273 | $83,219 | $122,346 |
| 2018 | 56 | 9 | $24,752 | 10 | $38,595 | $69,255 | $84,564 |
| 2017 | 59 | 10 | $27,570 | 11 | $40,962 | $67,218 | $92,955 |
| 2016 | 106 | 15 | $83,951 | 19 | $123,316 | $214,598 | $268,630 |
| 2015 | 178 | 17 | $257,687 | 28 | $369,966 | $649,341 | $829,340 |
| 2014 | 360 | 33 | $226,378 | 43 | $338,399 | $554,643 | $777,574 |
| 2013 | 348 | 29 | $252,269 | 40 | $365,723 | $636,974 | $826,304 |
| 2012 | 414 | 29 | $284,867 | 41 | $423,831 | $701,532 | $960,031 |

Each year the NCDMF uses a large number of staff, primarily marine patrol officers, and financial resources to monitor, manage, and enforce this fishery. These costs are difficult to justify for a fishery with low participation and diminished value. The cost to the state to facilitate the execution of this fishery may be better used to fund projects more beneficial to the clam fishery as a whole, or at least one that benefits more users.

*Maintenance Dredging*

If the mechanical clam harvest fishery on public bottom were to be discontinued, it may be necessary to end the exception for mechanical harvest prior to maintenance dredging described in rule 15A NCAC 03K .0301 (b). If the primary mechanical clam fishery is closed, fishermen that currently participate in the fishery would likely get rid of their gear, leaving no one to participate in pre-maintenance dredging openings. This would further benefit the habitat by reducing the extent of turbidity issues associated with mechanical gears. This program has not been utilized since 2007, and with declines in the mechanical clam harvest fishery as whole, it is unlikely to be used much in the future.

*Management options*

Due to concerns about physical disturbance of SAV and oyster habitat by the gear, concerns about turbidity and sedimentation, dwindling participation and landings, and significant cost to demarcate, maintain, and enforce the fishery, the NCDMF re-examined the fishery in terms of whether the habitat value may outweigh the value of the fishery.

Due to the requirements of G.S. 113 221 (d), it is unlikely that mechanical clam harvest fishery could be ended immediately upon adoption of this amendment. An immediate closure of this fishery could “result in severe curtailment of the usefulness or value of equipment in which fishermen have any substantial investment” as outlined in statute. This would require “a future effective date so as to minimize undue potential economic loss to fishermen”. Possible management options include, but are not limited to; status quo, ending the allowance for mechanical clam harvest in conjunction with maintenance dredging activities, further limiting mechanical clam harvest areas, phasing out the fishery, and ending the fishery immediately. These management options would only affect mechanical clam harvest from public bottom and would not affect their use on private bottom.

Status quo would allow the fishery to continue to operate as it currently does. The fishermen currently operating in the fishery could continue, and new harvesters could join. The cost to the state for demarcation and enforcement would remain the same, making up a significant cost compared to the total value of the fishery. Concerns about effects of bottom disturbing gears on structured habitats would not be addressed.

Discontinuing the allowance for mechanical clam harvest in conjunction with maintenance dredging could also be considered. This would end a program that has not been utilized since 2007. This option could be pursued on its own, or in conjunction with a closure or phase out of the whole fishery. This would require a change to rule 15A NCAC 03K .0301 (b).

Mechanical clam harvest areas could be further limited to create boundaries that are more easily enforceable that also create buffers around critical habitat to protect them from sedimentation associated with bottom disturbing gears, as was done in the North River (Figure 1. 4). To improve enforceability the boundaries would be based on permanent structures or known geographic features, be rectangular or rhomboid in shape without zig-zagging lines and have complete line of sight visibility. The exact boundaries for these reduced areas would be developed after adoption of Amendment 3 based on habitat protection, enforceability, and fishermen input on specific locations the industry would like to maintain. This option would be implemented through proclamation after the new, smaller areas boundaries are developed. As with status quo, fishermen currently operating in the fishery could continue, and new harvesters could join. The cost to the state for demarcation would be reduced, but the resources required for enforcement would likely remain the same, making up a significant cost compared to the total value of the fishery. This would help address habitat concerns, but sedimentation would still occur from mechanical harvesting operations.

The mechanical clam harvest fishery could be phased out over a set timeframe, as was done with the shellfish relay program. This option would allow fishermen currently operating in the fishery to continue during the phase out period, but would discourage new participants. The phase out period would allow current mechanical harvesters time to get rid of gear and transition to other clam harvesting methods or fisheries. This option would address habitat concerns from the use of the gear as well as cost concerns associated with demarcation and enforcement. This option is consistent with G.S.

113-221 (d), as it gives “a future effective date so as to minimize undue potential economic loss to fishermen”.

After hearing concerns from the FMP Advisory Committee about participants wanting the ability to re-enter the fishery, the DMF developed an option for a phase out timeframe of three years from adoption of this amendment unless minimum participation and landings increases occur in the fishery in any year prior to 2027. This increase in participation and landings would show the fishery is no longer diminishing. Historical fisheries data were examined to develop potential thresholds for the minimum participation and landings that would signal renewed participation in the fishery. A reasonable threshold for participants in the mechanical clam harvest fishery on public bottom is ten participants. Ten participants have not been active in a single year in the fishery since 2017 and is over three times the number of active participants in 2022 (three participants), but still less than a tenth of the peak participation in 1996 (132 participants). A reasonable threshold for landings in the mechanical clam harvest fishery on public bottom is one-million clams. The fishery last landed at least one-million clams in 2014 (1.5 million clams) and one-million clams is over six times the number caught in 2022 (less than 200,000 clams), but still less than an eighth of the peak landings in 1995 (8.2 million clams). In this option, if both thresholds are met in any single year prior to January 2027, the issue would be brought back to the MFC for consideration at their May 2027 business meeting, or the next meeting that participation and harvest estimates are available from 2026, where they would decide whether to move forward with phase out of the fishery. This timing ensures that if following May 2027 the phase out continues as planned, fishermen would still have had three years to sell their gear and exit the fishery before the phase out is complete and the fishery closes in 2028, which would be consistent with G.S. 113-221 (d) (Figure 1. 6).

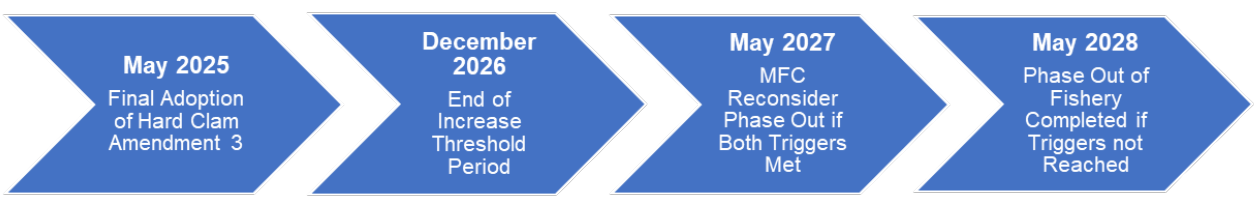



Figure 1.6. Proposed timeline for the phase out of the Mechanical Clam Harvest Fishery on public bottom if number of participants and landings triggers in this management option are met.

There is a potential that setting participation and landing thresholds that trigger reconsideration by the MFC for phasing out the fishery may have an unintended consequence. Fishermen may re-enter this fishery in the near term in an effort to maintain it as an option in the long term. Based on the habitat degradation effects of mechanical clam harvest, along with the aforementioned DMF resources needed for demarcation and enforcement of management areas, the DMF recommends the phasing out of this gear within three years without triggers for reconsideration of the phase out.

### MANAGEMENT OPTIONS

Option 1: Mechanical Clam Harvest

a. Status quo
b. Further limit mechanical clam harvest areas to improve enforceability and protect habitat
    - Make mechanical areas rectangular with straight lines for enforcement like was done in North River.
    - Focus on specific areas the industry would like to maintain
    - There are only a small number of overlaps with current SAV mosaics. Most of which is on the western banks of Core Sound
    - Could look into overlap with oysters or other SHAs and critical habitat
c. Phase out mechanical clam harvest in three years (May 2028) to be consistent with G.S. 113 221 (d) unless two metrics are met that signify increased participation in the fishery
    - Phase out needed to comply with G.S. 113-221 (d)
    - Would allow fishermen to plan ahead and sell gear, transition to other fisheries
d. Phase out mechanical clam harvest in three years (May 2028) to be consistent with G.S. 113 221 (d) without participation and landing triggers

Option 2: Mechanical Clam Harvest in Conjunction with Maintenance Dredging

a. Status quo
b. Discontinue allowance for mechanical clam harvest in conjunction with maintenance dredging upon adoption of this plan

### RECOMMENDATIONS

The NCDMF recommends Option 1.d, a phase out of the mechanical clam harvest fishery to be completed three years from the adoption of this plan. The DMF also recommends Option 2.b, the immediate end to the allowance for mechanical clam harvest in conjunction with maintenance dredging.

*Advisory Committee Recommendations and Public Comment: see Appendix 5*

*NCMFC Selected Management Options*

Option 1: Mechanical Clam Harvest

d. Phase out mechanical clam harvest in three years (May 2028) to be consistent with G.S. 113 221 (d).

Option 2: Mechanical Clam Harvest in Conjunction with Maintenance Dredging

b. Discontinue allowance for mechanical clam harvest in conjunction with maintenance dredging upon adoption of this plan

## Appendix 2: Recreational Shellfish Harvest Issue Paper

### ISSUE

The number of recreational shellfish harvesters in North Carolina is currently unknown, which prevents reliable estimates of total recreational harvest of shellfish. Additionally, commercial harvesters are provided with human health and safety information regarding shellfish harvest when acquiring their license; however, there is currently no mechanism for reaching and educating recreational harvesters.

### ORIGINATION

The North Carolina Division of Marine Fisheries (NCDMF) Oyster/Clam Plan Development Team (PDT).

### BACKGROUND

Despite the importance of the commercial shellfish fisheries (molluscan and crustacean) to the state, limited data exist on recreational shellfish harvest. Currently, the NCDMF has limited data on recreational shellfish harvesting, including the number of participants and the extent of their economic activity. Collection of recreational shellfish harvest data, in addition to existing commercial landings data available through the North Carolina Trip Ticket Program (NCTTP) would provide a better estimate of total fishing mortality, relative abundance, and improve knowledge of variation in abundance caused by a combination of fishing effort and environmental changes. A more accurate account of landings allows managers to examine the proportional harvest of recreational and commercial fisheries to make better decisions on management strategies for both harvest sectors. It is imperative to collect high quality recreational harvest data to address potential management issues such as harvest limits, size limits, and gear restrictions Collection of this data is crucial to completing a stock assessment and moving to stock level management of Oyster and Hard Clam.

Efforts to accurately quantify the impact of recreational fishing on shellfish have had limited success in North Carolina. The NCDMF collects data on recreational fishing in conjunction with the federal government's Marine Recreational Information Program (MRIP). However, MRIP collects information on finfish only.

Participation in recreational shellfishing in North Carolina has not been assessed for over 30 years. In 1991, a phone survey was conducted by the Marine Recreational Fisheries Statistics Survey (MRFSS), precursor to the MRIP, and it indicated that 3% of households in coastal North Carolina participated in recreational shellfishing, compared to an average of approximately 7% for finfish at that time (D. Mumford, NCDMF, personal communication). In 1991, MRFSS reported that in the state more than one million recreational fishing trips targeted shellfish. However, data on actual shellfish harvest estimates were not reported. The current extent of coastal households in North Carolina that recreationally harvest shellfish is unknown at this time.

The Marine Fisheries Commission in the original Bay Scallop, Hard Clam, and Oyster FMPs recommended developing a mechanism to obtain data on recreational harvest of shellfish (DMF 2007). The need for a mechanism to be able to accurately quantify recreational effort and harvest has been a consistent area of concern in all subsequent North Carolina shellfish and crustacean FMPs. The Hard Clam Fisheries Management Plan FMP (NCDMF 2001a) and Eastern Oyster FMP (NCDMF 2001b) supported adoption of a mechanism to provide data on recreational shellfish harvest. As a result, House Bill 1427 was introduced before the General Assembly in 2003 to establish a recreational shellfish license. This license would have been for shellfish only and would have been instituted on a trial basis for three years. However, the bill was never passed. In 2004, House Bill 831 did pass a saltwater fishing license mandating those individuals recreationally fishing for both finfish and shellfish to obtain a license. However, the state legislature revisited the issue in 2005 and replaced the saltwater fishing license with the Coastal Recreational Fishing License (CRFL).

The CRFL, which was implemented January 1, 2007, is only required when targeting finfish. When the CRFL legislation was originally drafted in 2007, it also included shellfish. However, the inclusion of shellfish was removed from the draft bill was removed before it was finally legislated. To fill this data gap, a survey of shellfish harvesting participation was added to the CRFL in November 2010 to collect monthly data on the harvest of crabs, oysters, clams, and scallops from the CRFL pool. The survey sample is made up of approximately 650 randomly selected CRFL holders that hold a valid license for at least one day during the survey period and answer “yes” to the harvest of at least one of the following species: crabs, oysters, clams, or scallops. In September 2014, the sample size was doubled to approximately 1,300 CRFL holders to increase the number of responses and precision of estimates. The selected CRFL holders are sent a letter explaining the survey along with the survey itself. Those that have not responded by the end of the month are sent a second copy of the survey. This survey obtains information on the number of trips taken during the survey period, average length of the trip, average party size, number of species kept and discarded, gear used, location information (water access), waterbody, and county of harvest. The mail survey estimates are a useful representation of shellfish harvest by CRFL holders but are limited in that they do not cover the entire population of potential recreational shellfish harvesters and probably represent a minimum estimate of effort and harvest. Despite good response rates, few responses contain oyster and clam activity.

The Fisheries Reform Act of 1997 (FRA) created a Recreational Commercial Gear License (RCGL) to allow recreational fisherman to use limited amounts of commercial gear to harvest recreational limits of seafood for personal consumption; however, shellfish gear (including hand, rakes, and tongs) was not authorized under this license. Since these gears are not covered by RCGL, recreational shellfishers can use these gears to harvest recreational bag limits of oysters and clams without a license. Therefore, recreational harvest data are not captured by past RCGL surveys.

Some recreational fishers may purchase a commercial shellfish license rather than a CRFL because the license is easy to obtain (available to any NC resident), is relatively inexpensive ($50.00), and allows fishers to harvest more shellfish than allowed under recreational limits. The Trip Ticket Program only captures landings from fishers who sell their catch to certified seafood dealers. Identifying and surveying individuals who purchase a commercial shellfish license but do not have any record of landings within the North Carolina Trip Ticket Program could be used to determine if the license is indeed being used for recreational purposes. This is also true for fishers who buy a Standard Commercial Fishing License (SCFL) with a shellfish endorsement but do not have any reported landings of shellfish. Even though this approach limits the sampling universe to only recreational fishers who bought a commercial license, it would provide some information on recreational shellfish harvest occurring that is not constrained by recreational limits. The shellfish harvest survey provides the ability to characterize recreational shellfish harvest but still has limitations for estimating the total recreational harvest of shellfish.

With the limited data collected from the optional CRFL survey, some pieces of information about recreational effort have been captured. For instance, recreational oyster harvest was reported from 92 waterbodies throughout coastal North Carolina, with Topsail, Pamlico, Bogue, and Masonboro sounds all including more than 100 reported trips. The same survey revealed 70% of recreational oyster harvest effort originated from private residences, private boat ramps, or from shore. Given only 28% of reported effort originated at public access locations, intercept-oriented surveys are less than ideal. Recreational oyster harvest effort and catch were concentrated between October and March, accounting for over 84% of reported trips. Conversely, some individuals reported recreational harvest of oysters during summer months despite state-imposed restrictions on harvest during this time. This suggests unfamiliarity with state regulations such as season and area closures.

Another concern of not having a license requirement for recreational shellfish harvest is the inability to easily communicate health and safety concerns of this harvest to recreational participants. The Shellfish Sanitation and Recreational Water Quality Section (SSRWQ) within the NCDMF is responsible for ensuring all shellfish (oysters, clams, mussels) harvested or processed within North Carolina are safe for human consumption. To ensure shellfish are being harvested from areas free of contaminants, the SSRWQ conducts pollution source assessments around shellfish growing areas, direct water quality sampling, hydrographic studies at point source discharges of pollution, and studies of the impacts of stormwater runoff on water quality. The SSRWQ also conducts inspections and certifications of shellfish dealer facilities, as well as providing training for commercial harvesters and dealers, to ensure that shellfish are handled, stored, processed, and transported in a manner that keeps them safe for consumption.

To help keep the public informed of safe harvest areas and safe harvesting and handling practices, the SSRWQ produces several publicly available informational resources, including the following:

- Prohibited Shellfish Harvest Boundaries – SSRWQ establishes permanent closure boundaries that prohibit the harvest of shellfish in areas where there may be consistent contamination exceeding the standards for safe human consumption. These permanently closed areas are described and established via proclamation.

- Polluted Area Proclamations and Temporary Closure Maps – In addition to the permanently closed areas described above, studies have found that water quality in certain areas can be negatively impacted by stormwater runoff, and shellfish can become temporarily unsafe for harvest under certain conditions. SSRWQ has developed management plans describing rainfall thresholds that can generate negative impacts and require temporary closures of these impacted areas. Temporary closures are put in place via proclamation and shown visually on the NCDMF website through a web map updated as closed areas change.

- Articles and Fact Sheets on Safe Handling Practices – Temperature abuse or improper handling practices can render shellfish unsafe to eat. To provide the public with information on how to safely store and handle shellfish, SSRWQ has prepared articles, fact sheets, and pamphlets available through the NCDMF website.

- Information on *Vibrio* Bacteria – *Vibrio* bacteria are naturally occurring bacteria that can be found in North Carolina waters and can cause severe illness in certain susceptible populations if consumed or through exposure to open wounds. Notably, these bacteria can proliferate within harvested shellfish even after they've been removed from the water, if the shellfish are held in warm/hot temperatures for extended periods of time. Proper handling/cooling of harvested shellfish is a critical step towards avoiding illness. SSRWQ has made available pamphlets and articles describing risks associated with these types of bacteria, and best practices for shellfish handling.

Although commercial harvesters, dealers, and shellfish lease/franchise holders are provided with all this information when acquiring their license, getting their dealer certification, or acquiring/renewing their lease, there is no mechanism for reaching and educating recreational harvesters unless they actively seek out information.

## AUTHORITY

N.C. General Statute

| | |
|---|---|
| 113-134 | Rules. |
| 113-169.2 | Shellfish license for NC residents without a SCFL, |
| 113-174.2 | Coastal Recreational Fishing License. |
| 113-182 | Regulation of fishing and fisheries. |
| 113-182.1 | Fishery Management Plans. |
| 113-201 | Legislative findings and declaration of policy; authority of Marine Fisheries Commission. |
| 113-221.1 | Proclamation; emergency review. |
| 143B-289.52 | Marine Fisheries Commission – powers and duties. |

Session Law 2023-137

N.C. Marine Fisheries Commission Rule (15A NCAC)

| | |
|---|---|
| 03O.0101 | PROCEDURES AND REQUIREMENTS TO OBTAIN LICENSES, ENDORSEMENTS AND COMMERCIAL FISHING VESSEL REGISTRATION |
| 03O.0107 | LISENCE REPLACEMENT AND FEES |
| 03O.0501 | PROCEDURES AND REQUIREMENTS TO OBTAIN PERMITS |
| 03O.0502 | PERMIT CONDITIONS; GENERAL |
| 03O.0506 | SPECIAL PERMIT REQUIRED FOR SPECIFIC MANAGEMENT PURPOSES |

**DISCUSSION**

Given North Carolina's shellfish fisheries are exclusively under state jurisdiction, lack of recreational shellfish harvest data makes conducting stock assessments and addressing potential management issues such as harvest limits, size limits, and gear restrictions difficult. There are no data on demographics, perceptions, or expenditures of recreational shellfish harvesters in the state. Consequently, there is no data available to conduct an economic impact assessment of recreational oyster harvesting. Due to widespread accessibility of intertidal oysters and clams along North Carolina's coast, the potential impact of recreational harvest could be significant.

Table 2.1. Recreational shellfish harvest license requirements for east coast states.

| State | License Requirements |
|---|---|
| Maine | No state license, towns have local restrictions and permits |
| New Hampshire | State license |
| Massachusetts | No state license, towns have local restrictions and permits |
| Rhode Island | Required for non-residents |
| Connecticut | No state license, towns have local restrictions and permits |
| New York | No state license, towns have local restrictions and permits, also has residency requirements |
| New Jersey | State license |
| Delaware | State license |
| Maryland | None, must be state resident |
| Virginia | None |
| North Carolina | None |
| South Carolina | State license |
| Georgia | State license and free permit |
| Florida | State license |

License requirements for recreational shellfish harvesting varies by state along the United States east coast (Given North Carolina's shellfish fisheries are exclusively under state jurisdiction, lack of recreational shellfish harvest data makes conducting stock assessments and addressing potential management issues such as harvest limits, size limits, and gear restrictions difficult. There are no data on demographics, perceptions, or expenditures of recreational shellfish harvesters in the state. Consequently, there is no data available to conduct an economic impact assessment of recreational oyster harvesting. Due to widespread accessibility of intertidal oysters and clams along North Carolina's coast, the potential impact of recreational harvest could be significant.

Table 2.1). Most states require some type of license while in Maine, Massachusetts, New York, and Connecticut individual towns and cities require a license to recreationally harvest shellfish. North Carolina and Virginia are the only states without some form of license, local permitting, or residency requirements.

There are multiple avenues the NCDMF and MFC could pursue to better assess the population of recreational shellfish harvesters. One solution is to include shellfish as part of the CRFL. This can be accomplished by three different methods. The first is to require the existing CRFL to recreationally harvest both finfish and shellfish. The second would be to create a separate shellfish only CRFL. This license would only give a recreational angler access to the allowed shellfish species and would exclude finfish harvest. This would allow fishery access to recreational anglers who are only interested in harvesting shellfish, and the cost could be set at a lower price than a standard CRFL. The third option would be to require the existing CRFL and create an additional recreational shellfish endorsement. The endorsement would be applied to the CRFL and would indicate the angler is licensed to recreationally harvest both finfish and shellfish. One drawback to these three options is it would require legislation to change the CRFL.

Another solution is to develop a recreational shellfish permit. The MFC has the authority to implement a permit to help manage estuarine and coastal resources and can set a maximum fee of up to $100 (although most permits are free of charge). A permit could function similar to a license. Recreational anglers would be required to have the permit to participate in the recreational shellfish fishery. A nominal fee for the permit would discourage participants from only obtaining the permit because it was free, helping to constrain the sampling universe.

Creating a specific CRFL, as outlined above, or a recreational shellfish permit would provide NCDMF with a complete pool of recreational shellfish harvesters. That list could then be used as a survey frame to help estimate effort and harvest in the fishery. Having a list of the population of recreational shellfish harvesters is useful for distributing shellfish area closure proclamations and maps. If shellfish species are added to the existing CRFL, the activity survey conducted during CRFL sale would still be needed to identify fishers who are involved in recreational shellfishing. These fishers would then receive additional surveys to estimate effort and harvest in the recreational shellfish fishery.

Although creating a specific type of CRFL, adding shellfish under the existing CRFL, or developing a recreational shellfish permit would be the most efficient mechanisms to determine effort in the fishery, another way to obtain these data would be to capture this activity in MRIP. The MRIP does capture some non-finfish activity, but those data are broad and not available to shellfish at the species level and MRIP agents rarely encounter those types of recreational fishing trips. Most recreational shellfishing effort is by coastal residents using private docks and access points as opposed to public access points. Because MRIP is a nationwide program, any changes to methodology designed to intercept more recreational shellfishing activity would need to undergo extensive review process and if implemented could take away from intercepts in other target fisheries.

Personal consumption by participants holding commercial fishing licenses (either a SCFL with a shellfish endorsement or a Shellfish license without a SCFL) would not be covered under any type of recreational shellfish license or permit. In the fall of 2023, the North Carolina General Assembly passed Session Law 2023-137. Section 6 of this legislation requires anyone holding a commercial fishing license who is engaged in a commercial fishing operation to report all fish (including shellfish) harvested to NCDMF, regardless of if the fish are sold or kept for personal consumption. Currently, this legislation is effective December 1, 2025. The NCDMF is working on draft rules to implement this law and to develop the reporting mechanism for these participants. Implementation of this law should fill this data gap.

Implementing a licensing or permitting requirement for recreational shellfish harvesters would give the NCDMF the opportunity to inform participants of where to find information on harvest closure boundaries, where to sign up to receive polluted area proclamations or to access temporary closure maps, and where to find information on safe handling practices, particularly as it relates to *Vibrio* bacteria.

To pursue any of these solutions, significant time and effort will be needed to assess internal program and resource capabilities and limitations. Any legislative changes require a specific process and are ultimately out of NCDMF or MFC control. Given these constraints, the NCDMF recommends exploring potential options and solutions outside of the FMP process.

### MANAGEMENT OPTIONS

Option 1: Recreational Harvest

a. Status Quo
    - Does not provide reliable estimates of recreational shellfish harvest or effort.
    - Does not provide a mechanism to ensure recreational shellfish harvesters are provided with SSRWQ health and safety information and links to harvest area closures.

b. Support the NCDMF 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 SSRWQ health and safety information outside of the FMP process.

## RECOMMENDATIONS

The DMF recommends that the NCMFC support the NCDMF to further explore potential options and develop a solution to quantify 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 SSRWQ health and safety information outside of the FMP process.

*Advisory Committee Recommendations and Public Comment: see* *Appendix 5*

*NCMFC Selected Management Options*

Option 1: Recreational Harvest

b. Support the DMF to further explore potential options and develop a solution to estimate recreational shellfish participation and landings, 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.

## Appendix 3: Hard Clam Management in Other States

Hard Clam management in other states. Bushels abbreviated as 'bu.'

| State | Fishery | License Requirements | Trip Limit | Size Limit | Gear Limit | Open Season Area |
|---|---|---|---|---|---|---|
| **Maine** | Recreational | No state license. License by town. | 1 peck per person/day (peck is 1/4 of a bushel) | 1 inch hinge width | Limited to hand rakes and tongs | - |
| | Commercial | State license | - | - | - | |
| **New Hampshire** | Recreational | State license | No open season for *Mercenaria mercenaria*. Regs for other clam species | No limit | - | No open season |
| | Commercial | - | - | - | | - |
| **Massachusetts** | Recreational | No state license, towns have local restrictions & permits | Consult town regs | 1 inch shell thickness | - | - |
| | Commercial | Town permit and shellfish ID card issued by Mass DMF | 40 Bu/Day | 1 inch thickness (wild) | | |
| **Rhode Island** | Recreational | Required only for non-residents | (Shellfish management areas)Resident limit: 1 peck/person. Non resident: 1/2 peck/person. (Non-management areas) Resident: 1/2 BU/person. Non resident: 1 peck/person | 1 inch hinge width | - | - |
| | Commercial | - | Bay Quahog: Shellfish management areas: 3 BU/person/day with exceptions. Non management areas: 12 BU/person/day | - | Bay Quahog: No person shall dig and/or take any bay quahogs from the waters of this State by dredge(s), rakes, or other apparatus operated by mechanical power or hauled by power boats, unless otherwise provided for in these regulations. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Connecticut** | Recreational | No State, towns have local restrictions and permits | 1/4 - 1/2 BU variable by town | 1.5–2 inches variable by town | - | - |
| | Commercial | State license | - | - | | |
| **New York** | Recreational | No State, towns have local restrictions on permits, and residency requirements | 100 clams/day | 1 inch thickness | Only rakes and tongs allowed | Open areas - year round |
| | Commercial | Shellfish digger permit required | No limit | - | No mechanical | - |
| **New Jersey** | Recreational | State license | 150 clams | 1.5 inches length | Hand implements only | No harvest on Sundays |
| | Commercial | State license + training course | - | 1- 1.5 inches length | No mechanical or motive power | - |
| **Delaware** | Recreational | State license. For >100 but <500 clams need a non-commercial clamming permit. | Residents: 100 clams/day. Non Residents: 50 clams/day | 1.5 inches or larger | Hand held rake only | Clamming prohibited 30 min before sunrise and after sunset. |
| | Commercial | Commercial clam tong/rake license | 2,500 clams/day | - | - | - |
| | | Commercial dredge clam license | no limit | | | |
| **Maryland** | Recreational | None, must be state resident. | 250 clams/day | 1 inch transverse measurement | Hand operated gear only. No mechanical harvesting. | - |
| | Commercial | State license | No limit | 1 inch transverse measurement | Hydraulic Dredge: sunrise to 4pm. Other gear: sunrise to sunset | Harvest only in Pocomoke and Tangier Sound. 1/1 - 5/31 & 9/15 - 12/31 |
| **Virginia** | Recreational | None | 250 clams/day by hand or tongs from open areas | - | Hand or ordinary tongs | - |
| | Commercial | State license | - | | - | |
| **North Carolina** | Recreational | None | 100 clams/person/day | 1 inch thick | Hand or rake | Year round |
| | Commercial | State license | Hand harvest 6,250 clams/ trip. Mechanical harvest limits vary by open water body | 1 inch thick | Hand or mechanical implements | Hand harvest open year-round. Mechanical harvest is second Monday in Dec – March 31 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **South Carolina** | Recreational | State license | 1/2 BU clams/person/day | 1 inch thick | Hand operated gear | No harvest from 5/15 - 9/1 |
| | Commercial | State license | No limit | - | - | - |
| **Georgia** | Recreational | State license and free permit | 1 BU clams/person/day | 3/4-inch depth (perpendicular to hinge) | Hand or handheld implements | Clamming prohibited 30 min before sunrise and after sunset. Approved locations |
| | Commercial | State license | No limit | | | |
| **Florida** | Recreational | State license | One 5-gallon bucket/person/day | 1 inch thick across the hinge | - | Year round |
| | Commercial | Aquaculture license | - | - | | - |

## Appendix 4: Hard Clam Fishery Management Plan Advisory Committee Workshop Summary

### ISSUE

Summarize stakeholder input received during the Oyster & Clam Fishery Management Plans Advisory Committee Workshop.

### ORIGINATION

The North Carolina Division of Marine Fisheries (DMF).

### BACKGROUND

The Oyster-Clam Fishery Management Plans (FMPs) Advisory Committee (AC) met for a three-day workshop July 15, 16, and 27 at Craven Community College in New Bern. As these two fisheries share considerable overlap in their ecology and management, these FMPs are revised simultaneously though written separately. The purpose of the workshop was for the AC to assist DMF staff in evaluating management issues and options included in the draft documents of Amendment 5 for the Eastern Oyster FMP and Amendment 3 for the Hard Clam FMP. Specifically, DMF sought to solicit feedback and input on the impacts of management options on the oyster and clam resources and user groups. It is important to note the aim of the AC workshop was to receive input from committee members based on their experiences, expertise, and sector relationships, not to build a consensus among AC members or to recommend specific management strategies.

For the Hard Clam FMP, DMF staff presented overviews of the base plan (life history, stock status, description of the fisheries, habitat impacts, and environmental threats), mechanical clam harvest issue paper, and the recreational shellfish harvest issue paper. Each presentation was followed by an opportunity for the AC to ask clarifying questions and discuss the content and management options included in each paper or section of the draft. Below is a summary of the input and subsequent discussions for the base plan and issue papers of Amendment 3. These ideas represent options the AC suggested the NCDMF explore. NCDMF staff explored these options and discussed where they could be incorporated into the base plan and issue papers.

### DISCUSSION

*Base Plan*

Members of the AC suggested adding more demographic information in the mechanical and hand harvest fishery. The AC also suggested more graphs comparing private harvest and commercial harvest. They noted clam aquaculture has been slow to grow due to limited seed supply in NC.

Similar to oyster, the AC emphasized the importance of water quality and its importance to SAV. Since water quality issues are explored extensively in the Coastal Habitat Protection Plan and enforced by the Division of Water Resources, the AC suggested strengthening ties to the CHPP in the base plans.

*Mechanical Clam Harvest*

The NCDMF brought forward several options to AC members to address the mechanical clam harvest issue. Options included phase out of the fishery and further reducing the mechanical clam harvest areas to make enforcement easier. The NCDMF also presented an option to end the allowance for mechanical clam harvest in conjunction with maintenance dredging operations.

Members of the AC expressed concerns with discontinuing the mechanical clam harvest fishery. They noted this fishery is an important source of supplemental income for a small group of mostly retired people. Members also stated the fishery has an important historical significance to the state and to their heritage and should, therefore, be preserved. They also stated many of the participants in this fishery are aging out and hope to pass the tradition and equipment on to their children to continue the practice.

Members of the AC expressed support for changing the boundaries of the mechanical clam harvest areas to be more easily enforced. They were open to areas being reduced in size if input from fishermen was considered when defining the new boundaries.

AC members did not believe the mechanical clam harvest fishery was a major source of turbidity, SAV degradation, or any other water quality concerns. They felt protecting these habitats should not come at the cost of the clam fishery. There was broad support for further protections and research on SAV, but the focus should be on large-scale threats, such as prop scarring from recreational vessels.

*Recreational Shellfish Harvest*

AC members recognized the potential widespread impact of recreational shellfish harvest, particularly with high tourism occurring along the coast and harvest effort being largely undocumented. The AC workshop further highlighted the importance of understanding this impact as estimating recreational harvest would be necessary for a future stock assessment. Members of the AC recognized the potential scale of recreational harvest and the importance of filling the current data gap. As such, the AC voiced support for taking steps to collect this data, either through survey or temporary permit, until a recreational license could be put in place. Additionally, the AC identified the importance of a system in place to improve public education for safe harvest practices and reduce consumption during warm months. Listing public health as a concern furthered the discussion to the potential economic impact Vibrio cases might have on North Carolina’s shellfish fisheries. Ultimately, the AC agreed that a nominal permit would be a great step before a license to promote education and to collect recreational data.

## Appendix 5: Summary Of Management Recommendations and Comment

Table 5.1. Summary of management recommendations from Division of Marine Fisheries (DMF), the Northern, Southern, Shellfish Crustacean, and Habitat & Water Quality Advisory Committees (AC).

| | DMF | Northern AC | Southern AC | Shellfish & Crustacean AC | Habitat & Water Quality AC |
|---|---|---|---|---|---|
| Appendix 1: Clam Mechanical Harvest | | | | | |
| *MCH* | Initial Recommendation: Option 1.c. The Division recommends a phase out to be completed three years from the adoption of this plan unless fishery participation increases to 10 participants and landings increase to 1 million clams in any year prior to 2027. If these increases are met, the issue would be reconsidered by the MFC at their May 2027 business meeting, or the next meeting that participation and harvest estimates are available from 2026.<br><br>Final Recommendation: Option 1.d. The Division recommends a phase out to be completed three years from the adoption of this plan, without participation and landings triggers. | Option 1.a. Mechanical clam harvest to stay at status quo. | Option 1.a. Maintain status quo in the mechanical clam fishery. | Option 1.c. Recommend the Division's initial recommendation regarding phasing out the mechanical clam harvest as described in the mechanical clam harvest issue paper | Option 1.c. Endorse the Division's initial recommendation in the Mechanical Clam Harvest Issue Paper |
| *MCH with Maintenance Dredging* | Option 2.b. The Division recommends the immediate end to the allowance for mechanical clam harvest in conjunction with maintenance dredging. | Option 2.a. Mechanical clam harvest to stay at status quo. | Option 2.a. Maintain status quo in the mechanical clam fishery. | Option 2.b. Recommend to discontinue the allowance of mechanical clam harvest in conjunction with maintenance dredging | Option 2.b. Endorse the Division's recommendation in the Mechanical Clam Harvest Issue Paper |

| Appendix 2: Recreational Shellfish Harvest | | | | | |
|---|---|---|---|---|---|
| | Option 1.b. Support the NCDMF to further explore potential options and develop a solution to quantify recreational shellfish participation and landings, and to establish a mechanism to provide all recreational shellfish harvesters with SSRWQ health and safety information outside of the FMP process. | Option 1.b. Endorse the MFC tasking the DMF with exploring options for a recreational shellfish license/permit outside of the FMP process. | Option 1.b. Recommend that the MFC task the DMF to further explore potential options and develop a solution to quantify recreational shellfish participation and landings, as all of Option 1. b. is written. | Option 1.b. Recommend that the MFC task the DMF to further explore potential options and develop a solution to quantify recreational shellfish participation and landings, as all of Option 1. b. is written. | Option 1.b. Recommend that the MFC task the DMF to further explore potential options and develop a solution to quantify recreational shellfish participation and landings, as all of Option 1. b. is written.<br><br>In addition: the AC supports the expansion of monitoring efforts and the establishment of sentinel sites as a critical step in validating the success of FMPs, and to prioritize the proper funding and partnerships with research institutions. |

*Online Clam and Oyster Public Questionnaire*

The online Spotted Seatrout Public Questionnaire opened on December 11, 2024, and closed January 15, 2025. In total, the questionnaire had 8 participants, 3 comments for both clam and oyster, 2 comments for clam, and 3 comments for oyster.

Of the open response comments received, the 2 comments specifically for clam were advocating for status quo of the mechanical clam fishery. Comments received for both clam and oyster were advocating to promote the stocking of shellfish to help rebuild natural populations, promoting sustainable methods like aquaculture, and protecting habitat from bottom disturbing gear.

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